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ANALYSES OF THE 1985 CONTINUING SURVEY OF FOOD INTAKES BY INDIVIDUALS

Volume I
Estimating Usual Dietary Intake, Assessing Dietary Adequacy, and Estimating Program Effects: Applications of Three Advanced Methodologies Using FNS's Four-Day Analysis File

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EXECUTIVE SUMMARY

This report presents findings from a study of the feasibility of using three advanced statistical methodologies to analyze data from food consumption surveys. The first methodology generates improved estimates of usual dietary intake by individuals on the basis of a small number of days of survey data. The second methodology makes use of data on nutritional requirements, as well as data on dietary intake, to estimate the incidence of dietary inadequacy in a population. The third methodology generates improved estimates of the effects of any two assistance programs on dietary quality and household food expenditures when decisions to participate in the programs are made jointly.

The primary findings from this study pertain to the feasibility of [redacted] the previous two months, and (3) participation in FNS programs by the subjects and their households.

We used the subsample of CSFII respondents who participated in at least four waves of the survey to conduct our analyses. After merging records from the core and low-income samples of the survey, that subsample consisted of 1,947 women and 760 children who were residing in 1,858 households. Our effective sample sizes were actually smaller than these numbers because we restricted our analyses to cases whose household incomes did not exceed 200 percent of the poverty guidelines. Sample sizes for the analyses of program effects on dietary quality and food expenditures were further reduced by the requirement that the cases meet certain WIC eligibility criteria. Actual sample sizes for the various analyses are given below.

ESTIMATION OF USUAL DIETARY INTAKE

Using data for 638 children ages 1-5 years in low-income households, we tested the feasibility and efficacy of an advanced methodology for estimating the distribution of usual dietary intake in a population. This methodology, which is recommended by the Subcommittee on Criteria for Dietary Evaluation of the National Research Council (National Research Council, 1986), can be implemented only when two or more days of data on food intake by individuals are available. It entails computing the average daily intake of a nutrient by each member of a sample. Due to day-to-day fluctuations in an individual's reported intake of a nutrient (i.e., "intraindividual variation in intake"), the distribution of the average daily intake values among the sample members exaggerates the dispersion of usual daily intake in the population. The NRC Subcommittee advocates using a relatively simple statistical procedure to adjust the average daily intake values so as to reduce the influence of intraindividual variation. The sample distribution of the adjusted average daily intake values represents an unbiased estimate of the distribution of usual daily intake in the population.

Limitations of the Methodology

1. The intake-adjustment procedure can be implemented only when two or more days of intake data are available for at least a subsample of the survey respondents.

2. The adjustment of average daily intake values is appropriate only for those nutrients for which the unadjusted average daily intake distributions are relatively symmetric. For this reason, we did not apply the adjustment procedure for vitamins A, C, and E.[1]

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[1]We applied the adjustment procedure for calcium, iron, protein, zinc, and food energy. The relatively assymmetric distribution of iron intake among children calls into question the reliability of our results for iron.

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3. The intake-adjustment procedure may not be appropriate when the distribution of average daily intakes is not normal. Unfortunately, existing research provides little guidance as to when the intake-adjustment procedure provides an adequate approximation to usual intake and when more complex procedures are required.

Findings from the Analysis

1. The adjusted four-day average daily intake values for the five nutrients for which they could be computed are, as anticipated, distributed more tightly around the sample mean values than are the unadjusted four-day average daily intake values.

2. The adjusted four-day average daily intake values yield estimates of the percentage of children with usual intakes below the Recommended Dietary Allowances (RDA) which differ in some cases by up to nine percentage points (plus or minus) from estimates obtained using unadjusted four-day average daily intakes. We would expect these differences to be greater for data sets that provide fewer than four days of intake data, since the relative improvement from the adjustment procedure is greater the fewer days of intake data that are available.

Recommendations for Future Research

1. For those nutrients for which its use is clearly appropriate (i.e., nutrients for which the average daily intake is normally distributed), we encourage FNS to adopt the NRC Subcommittee's recommended methodology for adjusting individual dietary intake data when multiple days of intake data are available for at least a subsample of the survey respondents. This procedure can be easily implemented and it yields estimates of usual intake with statistical properties that are superior to those based on unadjusted intake data.

2. In order to obtain the benefits from the removal of intraindividual variation in intake for the remaining nutrients, we recommend that FNS monitor ongoing evaluations of the applicability of the NRC intake-adjustment procedure to symmetric but non-normal intake distribution and the development of procedures that could be used to adjust the intake values of nutrients with asymmetric intake distributions.

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3. The intake-adjustment procedure has the potential to permit statistically valid assessments of dietary adequacy to be conducted on the basis of fewer days of data than has heretofore been considered possible. For example, it may be possible to conduct such an assessment on the basis of a single day of data for an 80 percent subsample and multiple days of data for a 20 percent subsample. Because of the large cost savings that could be realized by collecting fewer days of intake data, we recommend that FNS use an existing data set to assess the statistical implications of applying this procedure to fewer than four days of data.

ASSESSMENT OF DIETARY ADEQUACY

The Recommended Dietary Allowances, in conjunction with estimated distributions of the usual intake of nutrients, have traditionally been used to make relative assessments of dietary adequacy among population groups (e.g., Food Stamp participants and eligible nonparticipants). This is done by estimating the percentage of individuals in each group whose usual daily intake of a selected nutrient falls short of the RDA. Groups with smaller estimated percentages of persons whose intakes are below the RDA can be said to be at less risk of having inadequate intakes of the nutrient than groups with larger estimated percentages. It is important to note that valid inferences regarding the absolute percentage of group members with diets that fail to satisfy their individual-specific nutritional requirements cannot be drawn from the estimated percentage of group members who fail to meet the RDA.

The NRC Subcommittee on Criteria for Dietary Evaluation recommends the use of an alternative dietary assessment methodology that, in principle, permits valid inferences to be drawn regarding the relative quality of diets of population groups as well as the absolute percentage of persons in a group having inadequate diets. The Subcommittee's recommended methodology, known as the "probability approach," entails the comparison of the estimated distribution of usual daily intake of a nutrient (e.g., the adjusted average daily intake of the nutrient, as derived from dietary survey data) with the distribution of requirements for that nutrient among persons in a selected population group. That comparison yields an estimate of the absolute prevalence of inadequate intake of that nutrient among members of the group.

On the basis of data on 638 children ages 1-5 years, we used an approximation to the probability approach to evaluate the adequacy of intake of vitamin C and we used the full probability approach to evaluate the adequacy of intake of protein.

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Limitations of the Methodology

1. For most nutrients and most demographic groups, the available information on the distribution of requirements is inadequate for implementing the probability approach. For children, sufficient information exists to permit the probability approach to be implemented fully only for protein and partially for vitamin C.

2. To correctly apply the probability approach, the intake and requirements distributions for a nutrient must be independent. The NRC Subcommittee believed that the two distributions are, in general, independent; however, recent research has raised questions about this. Unfortunately, there is little information available at present that can be used to determine whether the intake and requirements distributions are independent.

3. A dissenting member of the NRC Subcommittee argued that the quality of the survey data that underlie estimates of usual intake provide a weak foundation for estimating the absolute prevalence of dietary inadequacy based on the probability approach.

Findings from the Analysis

1. Protein is available in such abundance in diets in the United States that the probability approach to the assessment of adequacy indicates a virtual absence of protein deficiency among low-income children.

2. Under the assumption of independence of the intake and requirements distributions, our partial implementation of the probability approach for vitamin C revealed that 13 percent of low-income children exhibit an inadequate intake of vitamin C.

Recommendations for Future Research

1. At this time, the probability approach to dietary assessment can be conveniently implemented for only a very limited set of nutrients and population groups. Broader application of the procedure is contingent upon advances in three areas of research: (1) basic research on the distributions of individual requirements for specific nutrients, (2) broader dissemination of findings from completed research on nutritional requirements, and (3) continued research on the appropriate application of the procedure in the presence of correlated intake and requirements distributions.

ESTIMATION OF THE EFFECTS OF NUTRITION-ASSISTANCE PROGRAMS ON DIETARY INTAKE AND FOOD EXPENDITURES

In a program evaluation in which a subset of eligible applicants is not randomly selected to receive benefits, the eligible individuals or households who apply for and receive program benefits may differ in unobserved ways from the eligible individuals or households who do not receive assistance.[2] If those unobserved differences between program participants and eligible nonparticipants influence the evaluation's outcome measure, then ordinary least-squares (OLS) regression (which controls only for observed differences) will generate biased estimates of the effects of the program. This is the "selection bias" problem.

A two-stage econometric procedure has been developed to potentially eliminate selection bias in nonexperimental program evaluations. In the first stage of the procedure, an equation that explains participation in the program is estimated, and the results are used to create a synthetic variable known as "lambda." For any given individual, the value of lambda is a function of the difference between actual participation behavior and the behavior that is predicted on the basis of observable characteristics. Thus, lambda is a reflection of unobservable factors that influence the program participation decision and may also influence the evaluation's outcome measure. In the second stage of the procedure, lambda is inserted in the equation that explains the outcome measure of the evaluation. With the outcome equation so modified to control for unobservable factors that influence program participation, it can be used to obtain consistent estimates of the program's effects.[3]

In an evaluation of two assistance programs, a simple extension of the existing software for the two-stage procedure so as to include a second program participation equation may fail to control properly for selection bias if the decisions to participate in the programs are made jointly. Only recently has reasonably convenient econometric software become available to permit generating consistent estimates of the effects of two programs for which the participation decisions are related. We used that software to estimate the effects of the WIC and Food Stamp programs on the dietary intake of "WIC-eligible" women and children and on the food expenditures of households that contain one or more "WIC-eligible" members.[4]

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[2]For example, eligible households who apply for food stamps may be more aware of nutritional requirements than eligible nonapplicants.

[3]A consistent estimator is one whose estimates become (a) closer to the true value of the parameter being estimated and (b) more symmetrically distributed around that value as the sample size increases.

[4]The term "WIC-eligible" refers to women and children in this study's CSFII analysis file who are categorically eligible to participate in WIC and who meet an approximation to the program's income screen. The CSFII does not provide sufficient data to determine if an individual is at nutritional risk, which is the final criterion in the full test of WIC eligibility.

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Limitations of the Methodology

1. The primary limitation of the procedure used to control for selection bias due to joint decisions to participate in two assistance programs is that at least one "identifying variable" must be included in each of the participation equations. In this context, an identifying variable is a significant predictor of the program participation decision, but is not a significant predictor of the outcome measure (i.e., dietary intake or food expenditures). However, finding an identifying variable for analyses that attempt to correct for selection bias has frequently been problematic; indeed, in our analysis of nutrient intake we had only limited success in finding an identifying variable in the equation that explains WIC participation by children and we were unable to find one in the equation that explains WIC participation by women.

2. A related limitation of the methodology is that relatively large sample sizes may be necessary. With sample sizes ranging from 236 to 515 cases, we found relatively few statistically significant explanatory variables in some of the program participation equations. This shortcoming exacerbated the problem of finding identifying variables.

3. A final limitation of the methodology is that the commercially-available software for estimating the effects of two related assistance programs is a module within an econometric-software package that is not well documented and is not user-friendly.

Findings from the Analysis: Dietary Intake

1. We implemented the two-program selection bias correction procedure successfully on a sample of 445 "WIC-eligible" children. Our results show consistently positive, but statistically insignificant, estimates of WIC participation on a child's intake of eight nutrients.[5] For six of those nutrients, the estimated effects of Food Stamps are positive (three are statistically significant). One of the two negative estimates of the effects of Food Stamps is statistically significant.

2. The changes in nutrient intake attributable to WIC and Food Stamps, either separately or in combination, that are implied by our results for children range from -18 percent to +28 percent.

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[5]The eight nutrients that we examined for children are food energy, protein, calcium, iron, zinc, and vitamins A, C, and E.

3. Our inability to find an identifying variable in the WIC participation equation prevented us from implementing the two-program selection bias correction procedure fully on our sample of 236 "WIC-eligible" women.

4. The OLS estimation (uncorrected for selection bias) of intake equations for eleven nutrients generated positive estimates of the effects of a woman's participation in WIC on her intake of all of the nutrients; however, only two of those estimates are significant.[6] The estimated effects of Food Stamps are mixed in sign, and only one is statistically significant.

5. The changes in nutrient intake attributable to WIC and Food Stamps, either separately or in combination, that are implied by the OLS results for women are frequently large in size, ranging from -42 percent to +90 percent. We interpret the extreme estimates not as evidence of large actual program effects, but rather as further evidence that our results for women are not reliable. The small number of cases in our sample of women is an important factor in explaining these extreme results.

6. For both women and children, we estimate that WIC participation by another household member has positive effects on the intake of most of the nutrients considered in this analysis, suggesting the existence of WIC "spillover effects;" however, few of those estimates differ significantly from zero.

Findings from the Analysis: Food Expenditures

1. On a sample of 515 households that contained one or more "WIC-eligible" members, we successfully used the two-program selection bias correction procedure to estimate the effects of Food Stamps and WIC on household expenditures on food used at home and on all food.

2. An additional dollar of Food Stamp benefits increases household expenditures by $.29 and $.05 on, respectively, food at home and all food. Both of these estimates are within the range of corresponding estimates from previous studies, but only the estimated effect on food at home is statistically significant. Together, the estimates imply that Food Stamps induce a substitution of expenditures on food at home for expenditures on food away from home.

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[6]The eleven nutrients that we examined for women are food energy, protein, folacin, calcium, magnesium, iron, zinc, and vitamins A, B6, C, and E.

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3. Both the sign and the magnitude of our estimates of the effects of WIC on total food expenditures and on expenditures on food at home are highly sensitive to alternative methods of modeling the extent of a household's participation in WIC (i.e., the number and type of household members who participate in WIC). The small number of cases in our sample of households prevented our exploring this issue fully.

Recommendations for Future Research

1. The small size of our samples of "WIC-eligible" women, children, and households greatly reduced the reliability of our estimates of the effects of WIC and Food Stamps on dietary intake and food expenditures. Thus, we recommend that models like those used in this study be estimated on samples of at least 500 cases and, preferably, 1,000 or more cases. The 1987-88 Nationwide Food Consumption Survey may provide sufficient "WIC-eligible" cases for estimating these models reliably.

2. The state of the art in modeling the effects of WIC on household food expenditures is far behind that for Food Stamps. FNS should consider providing support for basic research on the relationship between WIC benefits and household food expenditures.

3. The difficulties that we experienced in finding variables to identify the program participation equations cannot be attributed to the unique features of the CSFII. In designing food consumption surveys, FNS should be mindful that information on a range of factors that may influence program participation decisions would greatly facilitate the use of those data in program evaluations. An example of the kind of information that might be useful is data on the costs of participation in FNS programs, such as distance to the nearest program office, availability of a private automobile or access to public transportation, and the type of issuance of Food Stamps (mail or over-the-counter).

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PREFACE

This two-volume report presents findings from an analysis of data on women and children from the 1985 panel of the Continuing Survey of Food Intakes by Individuals (CSFII). This research was conducted by Mathematica Policy Research for the Food and Nutrition Service of the U.S. Department of Agriculture under contracts 53-3198-6-41 (TO 7), 53-3198-7-31, and 53-3198-8-95 (TO 4).

The research described in the two volumes of this report was conducted in two distinct phases. In Phase 1, we used data from the first of six waves of interviews conducted with respondents to the 1985 CSFII to estimate the effects of the WIC and Food Stamp programs on dietary intake by women and young children. Each wave of the survey obtained data on dietary intake over a 24-hour period. In Phase 2, we used four days of CSFII data on the same two demographic groups to estimate usual dietary intake, to assess the adequacy of diets, and to estimate the effects of the WIC and Food Stamp programs on dietary intake and household food expenditures.

We used essentially the same models in both phases of our analysis to estimate WIC and Food Stamp effects on dietary intake. Because they are based upon data for four days rather than one day, the Phase-2 estimates supercede the Phase-1 estimates. Volume I of this report presents findings from all components of the Phase-2 analysis, as well as a summary of findings from the Phase-1 analysis and a comparison of those findings with the corresponding findings from the Phase-2 analysis. That summary and comparison should provide sufficient information on the Phase-1 analysis for most readers; those who require additional information should refer to Volume II of this report, which is devoted exclusively to a detailed presentation of findings from the Phase-1 analysis.

I. OBJECTIVES AND OVERVIEW OF THE REPORT

For several years, the Food and Nutrition Service (FNS) of the U.S. Department of Agriculture (USDA) has been supporting the development and application of new data files and advanced analytic methodologies for assessing the effects of nutrition assistance programs on household food expenditures and dietary intake. In addition, the National Research Council (NRC) recently recommended the use of two advanced statistical procedures for estimating usual dietary intake and assessing the quality of diets (National Research Council, 1986). The main purpose of this report is methodological in nature--to assess the feasibility of using the new data and advanced analytic methodologies to analyze (1) the distribution of usual dietary intake, (2) the prevalence of nutritionally inadequate diets, and (3) the effectiveness of nutrition assistance programs at increasing household food expenditures and improving the nutritional quality of diets. Because the data and analytic methodologies have not been widely used or tested, the findings reported herein should be regarded as preliminary in nature. We recommend that they not be used to inform current policy decisions, but rather to illustrate how in the future FNS might generate information on the dietary status of the populations served by its programs and the effectiveness of its programs at improving the diets of those populations.

This, the first chapter of the report, discusses the information requirements that led FNS to (a) support the collection of data and construction of data files, and (b) contribute to the development of the analytic methodologies that form the basis for the research findings presented herein.

Chapter II presents the results of applying two advanced methodologies intended to improve survey-based assessments of dietary intake and dietary adequacy within a population. It reports first on the use of an NRC-recommended procedure for estimating the distribution of usual daily nutrient intake by individuals on the basis of multiple days of dietary data. This procedure is designed to reduce the error in such estimates that may result from day-to-day fluctuations in an individual's dietary intake. The chapter then reports on the use of a second NRC-recommended procedure--a procedure for estimating the percentage of a population group with inadequate intake of a nutrient. As input, the procedure requires an estimate of the distribution of usual intake of the selected nutrient among the members of the population group, as well as existing research findings on the distribution of individual requirements for that nutrient. It is currently feasible to apply the first procedure to a wide range of nutrients. In contrast, implementation of the second procedure is hampered by a scarcity of published information on dietary requirements and by a need for further methodological development.

Setting the stage for the estimates of program effects on food expenditures and diet quality that are presented in Chapter IV, Chapter III explains how the self-selection of eligible persons or households into or out of an assistance program can greatly complicate evaluating the effectiveness of that program at achieving its mandated objectives. The chapter shows that sophisticated econometric modeling may be required in order to obtain consistent estimates of the effects of a program in the presence of

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such self-selection.[1] Chapter IV then provides the program-effect estimates and the various procedures necessary to obtain them. It begins by describing the econometric software developed by FNS to obtain consistent estimates of the joint effects of any two of its programs on an outcome measure of interest. The next two sections of the chapter present the software-generated estimates of the effects of the Food Stamp Program and the Special Supplemental Food Program for Women, Infants, and Children (WIC) on nutrient intake by individuals and on the food expenditures of households. In each of these sections, we also assess the reliability of the estimates obtained along several dimensions and compare them with findings from previous studies. The final section of the chapter offers recommendations for future applications of the software and for the development of related software.

A. DEVELOPING A NEW DIETARY INTAKE DATA BASE

The 1985 and 1986 Panels of the Continuing Survey of Food Intakes by Individuals (CSFII) were the USDA's major dietary intake data collection initiative in the period between the Nationwide Food Consumption Surveys (NFCS) of 1977-78 and 1987-88. Whereas the NFCS obtains dietary intake data from an individual respondent for three consecutive days and only once during the survey period, the 1985 and 1986 Panels of the CSFII obtained dietary data for six days distributed over seasons of the year and days of the week within a one-year survey period. Underlying this survey design is the belief that these additional and more inclusive observations on dietary

[1]A consistent estimator is one whose estimates become (a) closer to the true value of the parameter being estimated and (b) more symmetrically distributed around that value as the sample size increases.

intake will enable researchers to obtain better estimates of usual dietary intake than can be obtained from the NFCS.[2]

The 1985 and 1986 Panels of the CSFII surveyed women ages 19-50 years in the contiguous 48 states and their children ages 1-5 years. In the spring of 1985, the first of six waves of data for the 1985 CSFII was collected. For this target population of women and children, the in-person baseline interview obtained information on self-reported health status (including the pregnancy/lactation status of women), self-reported height and weight, special diets, and the kinds and quantities of all foods eaten the previous day. It also obtained information on the households in which the women and children resided: the age, sex, educational level, and employment of all household members; household income and food expenditures; and participation by the household or its members in nutrition assistance programs. A total of 2,781 women and 1,203 children in 2,560 households in separate core and low-income samples participated in the baseline interview.[3]

Via telephone, the five bimonthly follow-up interviews obtained one-day dietary intake data, as well as updated information on household composition, food expenditures, program participation, and pregnancy/lactation status. Because other information was not updated, the full survey provides longitudinal data on dietary intake, but only a baseline "snapshot" of most

[2]After a hiatus for the 1987-88 NFCS, the CSFII resumed in 1989 with a revised format. Under the revised format, the target population is broader and dietary intake data is collected from each responding individual for three consecutive days.

[3]These counts of respondents to the baseline survey do not include cases which, for budgetary reasons, were intentionally dropped from the low-income sample prior to the second wave of data collection.

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other variables. Due to sample attrition, only 73 percent of the households, 70 percent of the women, and 63 percent of the children on whom information was provided in the baseline interview of the 1985 CSFII were represented in three or more of the follow-up interviews.

The focus of the follow-up interviews on dietary intake is consistent with the objective of obtaining data that are well-suited for estimating usual dietary intake. Chapter II demonstrates the power of the CSFII data in that particular application. However, a negative aspect of this focus on dietary intake in the follow-up interviews is that models of dietary intake based on the CSFII must be specified in light of the fact that only the baseline values of many independent variables are available to explain both the baseline and follow-up values of dietary intake. The dietary intake models that are presented in Chapter IV are specified in this way.

To enhance the capacity of the CSFII data to support analyses of women and children in low-income households, FNS contracted with Mathematica Policy Research, Inc. (MPR) to construct data files that contain merged data for cases in the survey's core and low-income samples. Because low-income households and individuals are included in the core sample, a file of merged data from the two samples provides more observations on low-income cases than are available in the low-income sample alone. With more cases, a merged file permits computing descriptive statistics with smaller standard deviations and estimating model parameters with smaller standard errors than would be possible otherwise.

The first of two files constructed for FNS by MPR and containing merged and reweighted data for the core and low-income samples of the 1985 CSFII provides baseline data for all cases on whom information was provided in the baseline interview. Fraker and Post (1987) provide a comprehensive description of the contents of that file and the procedures that were used to construct it. That file formed the basis for MPR's initial application of the CSFII data to model the effects of nutrition-assistance programs on dietary intake by women and young children.[4]

The second file provides baseline data plus three additional days of data for the 1,858 households, 1,947 women, and 760 children who participated in at least four of the six waves of the 1985 CSFII. FNS and MPR jointly determined that a file which contains four waves of data represents the best trade-off between the competing objectives of retaining the maximum number of repeated observation on dietary intake and of avoiding excessive sample attrition. As described by Fraker and Post (1988), MPR recomputed the sample weights for the cases in this file to adjust both for the effect of combining data from the core and low-income samples and for attrition from the two samples. In this volume of our report on our CSFII-based research, we obtain estimates of usual dietary intake, of the prevalence of inadequate intake, and of the effects of a program on household food expenditures and individual dietary intake by analyzing data for a low-income subset of the cases in the merged four-day file.

B. ESTIMATING USUAL DIETARY INTAKE

In assessing the adequacy of the dietary intake of a population group, information is needed on the normal or usual intakes of the members of that group. The distribution of observed dietary intakes in a randomly selected sample of individuals on a single day, or the distribution of average daily

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[4]The findings from MPR's analysis of baseline data from the 1985 CSFII appear in Volume II of this report.

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intakes when a limited number of multiple days of dietary data are available, are, in general, biased estimators of the distribution of usual dietary intake in the population group from which the sample is drawn. The biases arise because each person's actual intake varies considerably from day to day, resulting in a dispersion of average daily intake values within the sample which exceeds the dispersion of usual daily intake values within the population.

This bias has important implications for the evaluation of dietary adequacy within a population group and the comparison of dietary intake across population groups. If the measure of average daily intake obtained from a limited number of days of intake data is not adjusted so as to eliminate the influence of the variation in daily intake for each individual (referred to as "intraindividual variation"), then estimates of the prevalence of inadequate intake based on the intake distribution will be biased.

The research findings reported in Chapter II show that the distribution of average daily intake of a nutrient in a sample improves as an estimator of the distribution of usual daily intake in the population group as the number of days of data increases. The chapter also shows that additional improvement can be obtained by using a statistical adjustment procedure to reduce the influence of intraindividual variation in dietary intake on the sample distribution of average daily intake. Although not shown in the chapter, it is important to note that the improvement in the estimate of the distribution of usual intake obtained from the removal of intraindividual variation is greatest when relatively few days of intake data are available.

In addition, Chapter II discusses the assumptions that underlie the particular method that we used to remove intraindividual variation from the estimates of usual intake (a method recommended by the National Research Council (1986)), particularly the assumption that the intake distribution is normal or, at least, roughly symmetrical. A recent study (Johnson et al., 1988) questions the extent to which most nutrients satisfy the normality assumption. Since little is known about the impact of the violation of the normality assumption on the estimates of usual intake obtained from the intake-adjustment procedure, and since the procedure _is_ known to be inappropriate when the intake distribution is asymmetrical, Chapter II calls for additional research on methods of estimating usual dietary intake.

C. ASSESSING DIETARY ADEQUACY

Estimates of the distribution of usual dietary intake for a population group are compared to requirement standards or to intake norms to obtain measures of the prevalence of inadequate intake within a population group. Under the "probability approach" to the assessment of dietary adequacy, the variation in nutrient requirements across individuals is recognized by using the distribution of individual requirements as the standard against which the estimated distribution of usual intake is evaluated. An estimate of the proportion of the population group with inadequate intake is obtained as the average probability of inadequate intake for the individuals in the sample.

Chapter II illustrates the probability approach by using it to estimate the prevalence of inadequate protein intake among children in low-income households. It also examines an approximation to the probability approach for both protein and vitamin C. The approximation is of interest because its application requires less information on the distribution of nutrient requirements than does the full probability approach. Because of the limited amount of published information on nutrient requirements, we were unable to estimate the proportions of low-income children having inadequate intakes of the other nutrients included in this study.

As is true for the intake-adjustment procedure, questions have been raised about the assumptions underlying the use of the probability approach. If, as has been suggested by some researchers (e.g., Johnson et al., 1988), the assumption of the independence of the intake and requirements distributions is not satisfied for most nutrients, the simple application of the probability approach that we illustrate in Chapter II is inappropriate. Chapter II concludes that it will not be possible to have full confidence in estimates generated by the probability approach until additional research on the potential correlation of the intake and requirements distributions has been completed. In addition, the routine application of the probability approach will require further research on nutrient requirements and wider dissemination of existing research findings on nutrient requirements.

D. ESTIMATING PROGRAM EFFECTS ON DIETARY INTAKE AND FOOD EXPENDITURES

In order to assess the effectiveness of its programs at improving the diets of persons in low-income households, FNS requires consistent estimates of the effects of those programs on the intake of nutrients by individuals and on the food expenditures of households. Chapter III discusses two factors that may necessitate using sophisticated econometric models to obtain those estimates: first, program participants may differ from eligible nonparticipants along unobservable dimensions that influence dietary intake and food expenditures; second, it may be inappropriate to estimate the effects of a program under the assumption that decisions to participate in that program are unrelated to decisions to participate in other, similarly oriented programs. The chapter provides FNS with guidance about the circumstances under which these problems are likely to be encountered in program evaluations.

At the time this study began, FNS was preparing to engage in three different analyses of the effects of pairs of nutrition assistance programs on diet quality and/or food expenditures.[5] FNS recognized that the econometric software for obtaining consistent estimates of the effects of two programs for which participation decisions are often jointly made did not exist in a reasonably accessible form. Thus, as part of its Food Stamp Microsimulation contract, FNS funded a task to enhance the existing LIMDEP[tm] econometric software package so that it could be used both in the impending studies and in future studies to estimate the effects of its programs.

The results of our application of the new econometric software to estimate models of the effects of the Food Stamp and WIC programs on nutrient intake and food expenditures are presented in Chapter IV. Those results should be viewed as preliminary in nature, rather than as highly reliable estimates of effects of these programs. The objectives of the chapter are to demonstrate the research potential of the new software, identify problems associated with its use, assess the reasonableness of the estimates that it generates, provide FNS with guidance about the circumstances under which the

[5]The three analyses were (1) an analysis of the effects of the School Breakfast Program and the National School Lunch Program on the food expenditures of the households of participating students (conducted under the first Child Nutrition Analysis and Modeling contract); (2) an analysis of the effects of the Food Stamp and WIC programs on dietary intake, based on data from the first wave of the 1985 CSFII (conducted under the Food Stamp Microsimulation contract--see Volume II of this report for the research findings from this analysis); and (3) the current study (under the first Quick Response Studies contract).

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software is likely to generate reliable estimates, and advise FNS on the potential utility of further related software development.

II. ESTIMATING USUAL DIETARY INTAKE AND ASSESSING DIETARY ADEQUACY

Information on the adequacy of dietary intake is used by FNS to identify population subgroups that may be at nutritional risk, as well as to monitor the effectiveness of FNS programs in meeting the dietary needs of the populations served by those programs. Estimates of the proportion of the population that may be at risk of inadequate dietary intake are frequently based on data from food consumption surveys. Those survey data are used to obtain estimates of the distribution of long-run average or "usual" daily intakes of nutrients for the population. These estimates are then compared to average daily requirements standards or intake norms to obtain measures of the prevalence of inadequate or excessive intake for specific nutrients for specific components of the population.

In this chapter, we estimate of the distribution of usual dietary intake for a population (Section A) and then use requirements standards to assess the adequacy of those intakes (Section B).[6] The final section (Section C) summarizes our recommendations as to the estimation of usual dietary intakes and the assessment of dietary adequacy, and outlines several suggestions for future research.

A. USUAL DIETARY INTAKE

The measure of dietary intake that is required in an assessment of dietary adequacy for a population is the normal or usual daily intake of

[6]Sections A and B draw on National Research Council (1986), Life Sciences Research Office (1986), Johnson et al. (1988), and Ritenbaugh et al. (1988).

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individuals that would persist over time.[7] As has been documented in a number of studies, the actual daily intake of individuals varies substantially, with intake generally varying more within each person over time (intraindividual variation) than it does among persons (interindividual variation). (See National Research Council, 1986, Chapter 4; and Ritenbaugh et al., 1988, Chapter III, for reviews of this literature.) Due to the presence of this intraindividual variation, the distribution of one-day observations on dietary intake for a sample of individuals is a biased estimator of the distribution of usual dietary intake for the population from which the sample was drawn.[8] Thus, the percentage of sample members whose one-day intake of a nutrient satisfies a particular dietary criterion (e.g., intake above a fixed level) is a biased estimator of the percentage of the population whose usual intake of the nutrient fulfills that dietary criterion. Accurate estimates of the distribution of usual intakes are critical to the evaluation of dietary adequacy within a population, as well as to comparisons of dietary intake across subgroups of the population.

In this section, we describe one of several proposed methods of estimating the distribution of usual dietary intake and apply that method to data for children from the 1985 CSFII.

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[7]The appropriate time period for measures of usual intake is subject to some debate since physiological factors--the ability of the body to store some nutrients in body tissue for long periods--suggest that the appropriate time period (e.g., day, month, quarter) for measuring usual intake may vary for different nutrients (Johnson et al., 1988).

[8]One-day dietary intake data provides an unbiased estimate of the mean of the usual intake distribution, but a biased estimate of the variance. Furthermore, the presence of intraindividual variation will substantially increase the width of the confidence intervals around the estimate of the mean, which may be a serious problem if the sample size is small (Life Sciences Research Office, 1986).

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1. <u>The NRC Intake-Adjustment Procedure</u>

The distribution of usual dietary intake for the population can be approximated more reliably when multiple days of intake observations are available for each person in the sample. The Subcommittee on Criteria for Dietary Evaluation of the National Research Council (National Research Council, 1986) recommends a methodology for approximating usual dietary intake on the basis of multiple days of intake data. We refer to this procedure as the "NRC intake-adjustment procedure."[9] This procedure produces an estimate of the distribution of usual intake for the population on the basis of the observed sample mean intake (i.e., the mean across all individuals and all days of data) and information obtained by separating the sample distribution of individual mean intake values into two sources:

1. <u>Interindividual variation in intake</u>--variation in usual dietary intake among sample members (the variation of interest for estimating the usual intake of the population)

2. <u>Intraindividual variation in intake</u>--day-to-day fluctuations in a sample member's reported intake

The procedure recommended by the NRC Subcommittee relies on analysis of variance (ANOVA) to obtain estimates of intraindividual and interindividual variation in sample distributions of individual mean dietary intake values.[10] Those estimates are used to approximate the intake distributions

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[9]More recently, Ritenbaugh et al. (1988) and Battese et al. (1988) have developed alternative methods for estimating the distribution of usual intakes. These methods are discussed in a later section.

[10]Although not incorporated in the procedure recommended by the NRC Subcommittee, it is also possible to adjust for any variation in measured intake due to sample design and survey methodology. Such adjustment would include controlling for any variation in observed daily intake values among sample members and across replicates of intake for a given member due to: (1) differences in the season of the year or day of the week when the data

that would hold if the intraindividual variation were reduced to zero (as would be the case if a large number of intake observations were present for each individual). When the observed intake data are thus adjusted to control for intraindividual variation, the intake distributions are unbiased estimators of both the mean and variance of the distribution of usual intake across the population.

As noted by the NRC Subcommittee, nonrandom errors, such as the systematic under- or over-reporting of daily intake or systematic errors in the food composition tables used to convert food data into nutrients, are not captured by the intake-adjustment procedure. That is, the estimates of usual intake that are based on survey data will encompass any errors that are present in either the reported daily food intake data or the conversion of the food items to nutrient intake data. Since accurate estimates of the distribution of usual intakes are critical to survey-based dietary assessments, concern about the overall quality of the survey data has lead to a call for expanded research efforts to improve food consumption survey methods (and thus data on dietary intakes) and food composition data. (See National Research Council, 1986; Life Science Research Office, 1988; and Johnson et al. 1988 for discussions of this issue.)

The NRC intake-adjustment procedure is feasible when two or more replicates of one-day intake are available for a sample or for a subset of a

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were collected, and (2) differences in the survey methodology (e.g., in-person versus telephone interview, or 24-hour dietary recall versus a dietary intake diary.) As is discussed further in Appendix A, we found no evidence of such differences for the children in our sample. This finding should not be taken as evidence that the sample design and survey methodology effects do no exist for other samples since Ritenbaugh et al. (1988) found evidence of a wave-1 effect and Battese et al. (1988) found evidence of month and weekday effects for the women in their samples.

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sample. As it is not necessary to have the same number of observations of daily intake for each sample member for this procedure, significant savings in data collection costs could be obtained by using sample designs that collect multiple days of data for only selected subsamples of the population. It is this type of design that is to be used in the next NHANES survey.

In a recent study that applied the NRC intake-adjustment procedure to the 1985 CSFII (Ritenbaugh et al., 1988), the presence of intraindividual variation led to significant biases in the estimates of the prevalence of inadequate intake in the absence of the intake adjustment; equally important, the study discovered a significant limitation of the adjustment procedure: it was found to be inappropriate for nutrients characterized by asymmetrical intake distributions.[11] As part of the Ritenbaugh et al. study, an alternative nonparametric method was developed to adjust for intraindividual variation when the intake distribution is asymmetrical; however, because the procedure has not been tested fully, we have not applied it in this study. Consequently, as is discussed further below, we limit our use of the NRC intake-adjustment procedure to nutrients that exhibit relatively symmetrical intake distributions.[12]

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[11]The NRC Subcommittee recommended that skewed distributions be normalized through transformations, such as the logarithmic transformation. Ritenbaugh et al. reported that the adjusted distribution for logarithmically transformed data would provide a distribution of median intakes rather than mean intakes, which would differ substantially in such cases.

[12]Recent work by Battese et al. (1988) raises questions regarding the assumption of normally distributed intake data that underlies the NRC intake-adjustment procedure. This issue is discussed further in a later section.

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2. The Estimation of Usual Dietary Intake

Before describing the application of the NRC intake-adjustment procedure, we describe the selection of the sample of children and the nutrients to be analyzed. We then outline the analytical approach and present our examination of the estimates of usual intake.

a. Selecting the Sample and the Nutrients To Be Analyzed

This analysis focuses on children ages 1-5 years in low-income households. Although five year-old children are categorically ineligible to participate in WIC, we included them in the analysis sample because participation in FNS programs is not an explicit component of this analysis. Contributing to this decision was a desire to maintain a large sample size for the analysis. From among the 760 children represented in FNS's four-day file, we selected into our analysis sample 638 who were residing in households with incomes not in excess of 200 percent of the poverty level (an approximation of the WIC income eligibility criterion).

To maintain consistency across major components of this study, we focused our analysis of dietary adequacy on the same set of nutrients that we analyze in our estimation of WIC and Food Stamp effects on dietary intake by children. As is explained in Chapter IV, those include the five nutrients that were originally targeted by WIC: protein, vitamin A, vitamin C, calcium, and iron. To those we added food energy, vitamin E, and zinc. The addition of the latter three nutrients was based on an analysis of CSFII data which showed that the mean four-day average intake of each of those nutrients among children in low-income households that participated in

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neither WIC nor Food Stamps was less than 100 percent of the RDA.[13] Thus, the full set of nutrients examined was as follows:

- o Vitamin A
- o Vitamin C
- o Calcium
- o Vitamin E
- o Iron
- o Food Energy
- o Protein
- o Zinc

b. Analytical Approach

The analysis of the effects of the intake-adjustment procedure on estimates of usual intake involved the comparison of estimates of usual intake based on (1) the distribution of one day of intake data,[14] (2) the distribution of the average of four days of intake data (hereafter referred to as the "four-day average distribution," and (3) the adjusted distribution of four days of intake data (hereafter referred to as the "adjusted four-day distribution." This comparison illustrates the improvements in the reliability of the estimates of usual dietary intake that are possible with multiple observations on individual intake. A detailed description of the application of the intake-adjustment procedure is provided in Appendix A.

Since the intake-adjustment procedure that is recommended by the NRC Subcommittee is appropriately applied only when the intake distribution (i.e., the distribution of average daily intake across sample members) is

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[13]We conducted this preliminary analysis on the basis of four days of dietary data for children from households with incomes not in excess of 200 percent of poverty. All nutrients for which RDA have been established were considered.

[14]We used baseline data from the CSFII to compute the one-day estimates of usual intake. We then compared those with the estimates obtained on the basis of multiple days of data.

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symmetrical, we did not apply the procedure for three nutrients with highly asymmetrical distributions: vitamins A, C, and E. Although the distribution of iron intake is asymmetrical, we applied the procedure for that nutrient because of the concern about inadequate intake of iron by young children.[15] As a consequence of its asymmetrical intake distribution, our results for iron must be regarded as less reliable than those for the other four nutrients.

At present, there is little guidance as to the degree of divergence from a symmetrical distribution that can be tolerated by the intake-adjustment procedure. However, recent work by Battese et al. (1988) suggests that the intake distributions for all of the nutrients included in their study--calcium, energy, iron, protein, and vitamin C--are skewed and that "a narrow class of distributions [e.g., normal, Weibull, gamma] is unlikely to be satisfactory for a large number of different . . . [nutrients]." Battese et al. conclude that additional work is needed on alternative parametric and semiparametric procedures to estimate the distributions of usual intakes, while Ritenbaugh et al. (1988) present a first-cut at a completely nonparametric approach to the estimation of the distribution of usual intake when the intake distribution is asymmetrical. As neither the Battese et al. nor Ritenbaugh et al. procedures are fully developed, it is clear that further research is needed on appropriate methods to estimate the distribution of usual intake, including research to

[15]The Joint Nutrition Monitoring Evaluation Committee (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 1986) lists iron as a nutrient that warrants priority in public health monitoring for children ages 1-5 years because of high prevalences of abnormal clinical and biochemical indicators of iron status for that group.

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determine the conditions under which the relatively simple NRC intake-adjustment procedure provides an adequate approximation to usual intake.

c. <u>Estimates of Usual Intake</u>

As summarized in Table II.1, the full comparison of the three alternative estimates of usual intake considers five nutrients: calcium, iron, food energy, protein, and zinc. As the findings from the comparison are very similar for all of the nutrients, we focus our discussion on a single nutrient--calcium.

The three estimates of the distribution of usual daily intake of calcium--the distribution of one-day intakes, the distribution of four-day average intakes, and the adjusted distribution of four-day average intakes--are displayed in Figure II.1 for low-income children ages 1-5.[16] The RDA for those children is superimposed on the figure as a reference point. (Comparable figures for the remaining nutrients are presented in Appendix L.) Table II.2 provides the mean, median, minimum, and maximum values of the three intake distributions for calcium. Appendix Table L.1 reports those values for the intake distributions of the remaining nutrients.[17]

It is clear from Figure II.1 and Table II.2 that the apparent distribution of usual intake is considerably different under the three alternative measures. As expected, the distribution of one-day intakes has the greatest dispersion, reflecting the presence of significant intraindividual varia-

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[16]In preparing the displays of the estimates of the usual intake distributions, we used a smoothing technique to produce the final figures.

[17]Table L.1 provides descriptive data on the one-day and four-day intake distributions for all eight of the nutrients that we examined. It also provides data on the adjusted four-day intake distributions for the five nutrients in that group to which we applied the adjustment procedure.

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TABLE II.1

SUMMARY OF THE ESTIMATES OF THE DISTRIBUTION OF USUAL INTAKE FOR SELECTED NUTRIENTS: LOW-INCOME CHILDREN

Nutrient	Estimates of the Distribution of Usual Intake		
	One-day	Four-Day Average	Adjusted Four-day
Vitamin A	YES	YES	NO
Vitamin C	YES	YES	NO
Calcium	YES	YES	YES
Vitamin E	YES	YES	NO
Iron	YES	YES	YES
Food Energy	YES	YES	YES
Protein	YES	YES	YES
Zinc	YES	YES	YES

FIGURE II.1

CALCIUM

Intake vs. RDA
CHILDREN 1-5

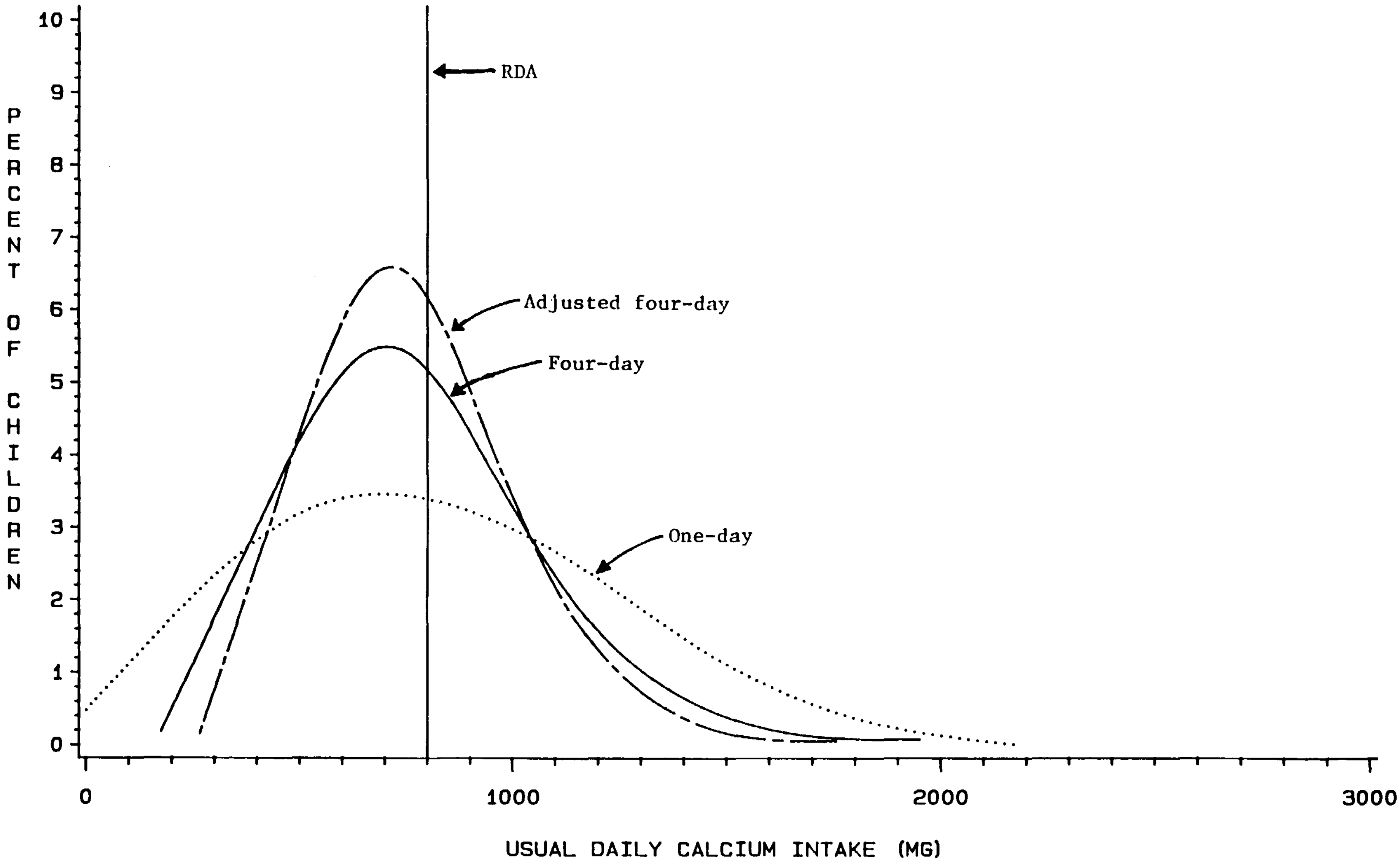

TABLE II.2

CHARACTERISTICS OF THE ALTERNATIVE INTAKE DISTRIBUTIONS FOR CALCIUM (MG): LOW-INCOME CHILDREN

(weighted data, N=638)

	Mean Value	Median Value	Minimum Value	Maximum Value
One-Day Distribution	806	721	8	2,319
Four-Day Average Distribution	766	729	137	1,969
Adjusted Four-Day Average Distribution	766	715	246	1,761

SOURCE: FNS's 4-day analysis file for the 1985 CSFII.

tion. By averaging intakes over multiple days, as in the four-day average distribution, intraindividual variation is reduced, and, consequently, the intake distribution is more tightly packed. The reduction in the variation that is not of interest--intraindividual variation--generates a better estimate of the variation that is of interest--variation in intake across the population.

The adjusted four-day average distribution improves on the four-day average distribution by using statistical relationships to obtain an estimate of intraindividual variation, which is then used to remove the intraindividual variation from the estimate of usual intake. By purging the estimate of usual intake of intraindividual variation, the adjusted four-day distribution provides the best available estimate of the variation in intake across the population, and is packed even more tightly than the four-day average distribution.

It should be noted that a substantial component of the improvement in the estimate of usual intake that is obtained using the NRC intake-adjustment procedure can be achieved with fewer than four days of data. According to the NRC Subcommittee, three days of intake data may be more than is required for the estimation of the distribution of usual intake. Furthermore, much of the gain from the NRC intake-adjustment procedure could be obtained with multiple days of data for only a subset of the sample.

3. Implications of the Alternative Estimates of Usual Intake

To better understand the implications of the alternative estimates of usual intake for dietary assessments, we examined the impact of the intake distributions on the estimate of the proportion of low-income children that

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fail to attain the RDA.[18] We did this for the five nutrients for which we implemented the NRC intake-adjustment procedure. These comparisons of the estimated intake distributions with the RDA are for illustrative purposes only; the next section provides a full discussion of the findings from the intake analysis as they relate to the estimation of the prevalence of inadequate dietary intake.

The choice of estimators for the distribution of usual intake can have a significant effect on the estimate of the proportion of a population group that fails to attain the RDA for a nutrient, as shown in Table II.3. Based on the one-day intake distribution, about 53 percent of the low-income children ages 1-5 fail to attain the RDA for calcium. Using the four-day average distribution and the adjusted four-day average distribution, the estimates of the proportion of the children with usual intakes below the RDA are much higher, about 64 percent for both distributions. Clearly, the use of the one-day intake distribution as an estimate of usual intake can introduce error into the estimate of the proportion of a population group that fails to attain the RDA.

Although the estimate of the proportion of children with usual intake of calcium below the RDA is the same regardless of whether the four-day average distribution or the adjusted four-day distribution is used, it is

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[18]We used 100 percent of the RDA as the fixed cutoff point in our comparisons of the estimated intake distributions with the RDA. There are two RDA age categories within the age range of the children in our sample: children ages 1-3 and ages 4-5. For most of the nutrients in our study, the RDAs differ for these two groups. In order to capture the aging of the children in our sample over the CSFII time period, we constructed weighted RDAs for the children who turned 4 years-old during the survey period. In presenting the data, children who were age 3 for two survey days and age 4 for two survey days were assigned to the age category which had the higher RDA for the particular nutrient being examined.

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TABLE II.3

THE PERCENT OF LOW-INCOME CHILDREN FAILING TO ACHIEVE THE RDA FOR SELECTED NUTRIENTS: ALTERNATIVE ESTIMATES BASED ON THREE DIFFERENT NUTRIENT INTAKE DISTRIBUTIONS

(weighted data, N=638)

Nutrient	Estimated Percent with Usual Intake Less than RDA		
	One-day Distribution	Four-day Average Distribution	Adjusted Four-day Average Distribution
Calcium	52.5	63.5	63.8
Iron			
Ages 1-3	88.1	88.4	92.7
Ages 4-5	56.1	61.2	61.8
Food Energy			
Ages 1-3	56.0	49.5	48.4
Ages 4-5	60.0	74.9	84.0
Protein			
Ages 1-3	5.9	3.5	0.0
Ages 4-5	6.6	2.5	0.0
Zinc	77.2	88.6	94.1

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important to note that this relationship does not hold for all nutrients. Table II.3 shows that the choice between these two distributions can have important implications for the estimates of the proportion of a population group that fails to attain the RDA. The adjusted four-day average intake distributions yield estimates of the proportion of children who fail to attain the RDAs for iron, food energy, protein, and zinc that differ in some cases by as much as nine percentage points (plus or minus) from estimates obtained using the unadjusted four-day average distributions. Furthermore, the gains from the use of the adjusted-intake distribution relative to the distribution of average daily intake would be even greater if fewer days of data were available. In other words, the marginal improvement in the estimate of usual intake from the NRC intake-adjustment procedure over a simple daily average is greater when fewer days of intake data are available.

The impact of moving from the one-day to the adjusted four-day distribution on the estimates of the proportion of a population group that fails to attain the RDA is determined by the location of the median of the distribution of usual daily intake relative to the RDA.[19] As shown in Table II.3, the estimate of the proportion of the children ages 1-3 who fail to attain the RDA for food energy using the one-day distribution is higher than that obtained using the adjusted four-day distribution, while the pattern is reversed for children ages 4-5. This occurs because the median of the distribution of usual intake is (we infer) <u>equal to or slightly above</u> the

[19]We cannot observe the distribution of usual daily intake; however, we can infer the approximate location of the median of that distribution from the location of the median of the adjusted four-day intake distribution, which is the best available estimator of the distribution of usual daily intake.

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RDA for the younger children, so the compression toward that median which occurs when moving from the one-day to the adjusted four-day distribution pulls more intakes above the RDA. In contrast, for the older children, the median of the adjusted intake distribution is (we infer) below the RDA, so the compression resulting from the application of the intake-adjustment procedure pulls more intakes below the RDA. Because the one-day distribution is "flattened," the proportion of the sample with intakes above a cutoff to the right of the median of the distribution of usual daily intake, or below a cutoff to the left of the median of that distribution, is inflated relative to the proportion based on the adjusted four-day distribution.

B. DIETARY ADEQUACY

The estimation of the distribution of usual dietary intake is the first step in assessing the prevalence of inadequate intake of a nutrient within a population group or in making cross-group comparisons of dietary adequacy. The second step entails the use of nutrient requirements or intake norms as a standard against which to assess the adequacy of usual nutrient intake. In this section, we discuss alternative standards for assessing dietary adequacy. We then apply several of those standards to the estimates of usual intakes that were derived in the previous section.

1. Nutrient Intake Requirements

The RDAs are often used as a standard for assessing the quality of diets within a population group or in making cross-group comparisons of diet

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quality.[20] The RDAs reflect the presumed average requirement of a population group for a nutrient as well as the presumed variability among the group members in their requirements. They are established well above the presumed mean requirements so as to accommodate that variability. Thus, if a population group's mean intake of a nutrient equals or exceeds the relatively high standards of the RDA, the probability of inadequate intake (i.e., intake less than requirement) is quite low for members of that group.

There are two basic approaches to the use of the RDAs in dietary assessments. The first approach is essentially the procedure outlined above. It entails the comparison of a group's mean daily intake of a nutrient (i.e., an estimate of the mean of the distribution of usual daily intake) with the group's RDA for that nutrient. A mean intake that equals or exceeds the RDA implies a low probability of inadequate intake of that nutrient among the group members. This approach can also be used to make relative evaluations of the adequacy of intake of a given nutrient across population groups. A group whose mean intake of a nutrient is well below the RDA is at greater risk of deficient intake than a group whose mean intake is closer to the RDA.

The second approach, the "RDA-based fixed cutoff approach," entails the use of the RDA or some proportion of the RDA (e.g., 75 percent) as the standard against which to compare estimates of the distribution of usual daily intake. Unlike the first approach, the RDA-based fixed cutoff approach requires an estimate of the full distribution of usual intake, not just an estimate of the mean of the distribution. The previous section

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[20]The NRC (1980) notes that the RDAs are designed "to exceed the requirements of most individuals and thereby to ensure that the needs of nearly all in the population are met."

described an advanced procedure for estimating this distribution. Given an estimate of the distribution of usual daily intake of a nutrient, it is a straightforward matter to compute the estimated percentage of a population group whose usual daily intake of a nutrient is below the RDA or some proportion of the RDA. Unfortunately, this estimate is difficult to interpret and, consequently, the procedure is often inappropriately applied.

Because the RDAs are established well above the presumed mean requirements so as to allow for variation among individuals in dietary requirements, the estimated percentage of a population group with usual intake below the RDA cannot properly be interpreted as an estimate of the percentage of the group with inadequate diets. Furthermore, there is no basis in biological research for the selection of any particular proportion of the RDA for use as an alternative fixed cutoff in such an evaluation. Indeed, because nutritional needs vary across individuals, the accurate estimation of the proportion of a population group with inadequate intake of a nutrient requires estimates of the distribution of nutritional requirements in addition to estimates of the distribution of usual daily intake.

The fact that the estimated percentage of a population group whose usual daily intake of a nutrient is less than the RDA (or some proportion of the RDA) is not a valid estimate of the percentage of that group with inadequate dietary intake does not mean that there are no valid applications of the RDA-based measure. Brownie and Habicht (1984) note that <u>relative</u> comparisons across population groups of the proportion of group members with intakes below fixed cutoff points may provide valid and relevant information for some types of dietary assessments. In such an application, the

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appropriate interpretation of the estimates is that the probability of deficient intake is greater for a group having a higher estimated proportion of its members with intakes below the RDA than it is for a group having a lower estimated value of that proportion. If an estimate of the absolute proportion of group members with deficient intake of a nutrient is required, then the estimation procedure must incorporate information on the distribution of requirements for that nutrient.

The "problems and misinterpretations occasioned by the use of the RDA as a standard for dietary adequacy" led the Expert Panel on National Nutrition Monitoring (EPONNM) that was responsible for the update on Nutrition Monitoring in the United States (Life Science Research Office, 1989) to chose "not to express dietary intake data . . . as a percent of the RDA or to apply the RDA or any proportion of the RDA as a sole criterion for assessing whether a nutrient constitutes a public health problem because of inadequacy." However, EPONNM notes that the RDA may be used appropriately as a basis for assessing the relative adequacy of dietary intake across population groups, and it recommends the use of mean intakes of population groups that fall well below the RDAs (i.e., the first approach described above) as rough indicators of the need for further examination of the nutritional status of those groups.

2. The Probability Approach

A theoretically correct procedure for estimating the prevalence of inadequate intake outlined by the NRC Subcommittee takes explicit account of the variability in nutrient requirements across individuals. It relies on an estimate of the distribution of individual nutrient requirements, in conjunction with an estimate of the distribution of usual intake. Under the

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"probability approach," the likelihood that an individual's observed level of intake is inadequate is derived from the requirement distribution, where the requirement distribution is explicitly related to a specific level of nutriture (e.g., adequate for the prevention of clinical deficiency symptoms). Individuals whose intake is relatively high will have a lower probability of inadequate intake, while those whose intake is relatively low will have a higher probability of inadequate intake. Although it is not possible to determine whether the intake of a particular individual is adequate or inadequate using the probability approach, an estimate of the prevalence of inadequate intake for a population group can be derived as the average probability of inadequate intake for the individuals in the sample.

Although in theory the probability approach yields estimates of the prevalence of inadequate intake that are grounded in biological principles, in practice there are several factors that raise questions about the reliability of the estimates that are obtained. First, a critical assumption underlying the probability approach is that the nutrient intake and nutrient requirement distributions are independent (i.e., there is no reason to believe that individuals with low (or high) usual intake will necessarily exhibit a low (or high) requirement). According to the NRC Subcommittee, this assumption is believed to be met for most nutrients by separating the population group of interest into reasonably homogeneous age and sex subgroups. However, for some nutrients, other factors (such as body weight, pregnancy and lactation status, energy intake, and protein intake) should also be controlled in the prevalence estimates. Because little is known about the independence of the distributions, the NRC Subcommittee

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calls for research to determine the magnitude of any correlation between dietary intake and nutrient requirements (National Research Council, 1986).

A recent report by Johnson et al. (1988) is less optimistic about the independence of the intake and requirement distributions, stating that "[t]here is good reason to believe that requirements and intake are not independent." Since the violation of the independence assumption significantly complicates the application of the probability method, Johnson et al. question the use of the probability approach until additional research on the association of intake and requirements has been completed.

Assuming that the intake and requirement distributions are independent, a second limitation of the probability approach is the lack of necessary information on the distribution of nutrient requirements. That information--the mean and shape of the distribution for the population group of interest--is presently available in published reports only for a few nutrients and only for selected population groups.[21] However, it is possible to approximate the probability-approach prevalence estimates for some nutrients if only the mean of the requirement distribution is available for the population group of interest. Since the estimate of the prevalence of inadequate intake is sensitive to the mean of the requirement distribution but not particularly sensitive to the variance when the distribution is relatively symmetrical, a fixed cutoff point at the mean can

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[21]The lack of published reports on nutrient requirements should not necessarily be taken as an indication that the information is not available from unpublished sources. To date there has not been a need for the wide dissemination of estimates of distributions of nutrient requirements. One suggestion that has been made to facilitate the production and dissemination of such estimates is to place the responsibility for obtaining estimates of requirement distributions within the purview of the NRC Subcommittee that produces the RDAs.

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be used to approximate the probability-approach estimates for nutrients with symmetrical requirement distributions. Unfortunately, the availability of mean values of requirement distributions is also limited.

Finally, the quality of the dietary intake data and food composition data that underlie the estimates of usual intakes has important implications for assessing dietary adequacy. Estimates of the prevalence of inadequate intake within a population group will incorporate any biases that exist in the estimates of the distribution of the usual intake of the population group. This limitation is noted in general terms in the body of the NRC Subcommittee's report and addressed quite strongly in a dissenting view by D.M. Hegsted (National Research Council, 1986). Dr. Hegsted concludes that:

> . . . the probability approach rests upon a weak foundation both with respect to the data on nutrient requirements and, especially, the survey methodology. Most of the errors, biases, and variability in the data collected are likely to result in substantial overestimates of the extent of undernutrition. . . .
>
> . . . The most appropriate recommendation of the [NRC] [S]ubcommittee should be that the probability approach deserves further study but, at this time, the extent of under- or malnutrition can not be determined from dietary survey data.

Concerns about the availability of the data needed for the probability approach led the EPONNM to chose not to include estimates of nutrient inadequacy derived by the probability approach in the update on <u>Nutrition Monitoring in the United States</u> (Life Science Research Office, 1989) and to conclude that "[w]hen the necessary supporting information is generated, the probability approach can be used more extensively and its utility established. . . ." and, furthermore, "[t]here is a continuing need to explore other approaches to [the] assessment [of dietary adequacy]."

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3. The Assessment of Inadequate Intake

In this section, we explore the use of probability approach in the assessment of the prevalence of inadequate intake for children ages 1-5, under the assumption that the intake and requirement distributions are independent. Specifically, we estimate the prevalence of inadequate intake obtained under the probability approach and from the use of the mean-requirement as a fixed cutoff point. The mean-requirement cutoff point serves as an approximation for the probability approach when information on the variance of the requirement distribution is not available. The mean-requirement appears to be an adequate approximation to the probability approach under the following conditions: (1) the requirement distribution is relatively symmetrical, (2) the mean requirement does not fall in the tail of the intake distribution, and (3) the variance of dietary intake is greater than the variance of the requirement distribution for the nutrient (National Research Council, 1986).

Unfortunately, for the majority of the nutrients that are considered in our analysis, information is not available on either the mean or the variance of the requirement distribution. Thus, for our sample of children ages 1-5 and for the nutrients selected for this study, information on the mean and variance of the requirement distribution is available in published reports only for protein, while information on the mean (but not the variance) of the distribution of vitamin C is available. Consequently, our estimation of the prevalence of inadequate intake using the probability approach is limited to one nutrient (protein). And our estimation of the prevalence of inadequate intake based on the mean-requirement is limited to two nutrients (protein and vitamin C). For the remaining nutrients considered in this component of our study--vitamin A, calcium, vitamin E, iron, zinc, and food energy, we were unable to obtain estimates of the prevalence of inadequate intake for children.

Since the distribution of adjusted four-day average intakes provides the best estimate of usual daily intake, the estimates of the prevalence of inadequate intake for protein are based on that distribution. For vitamin C, for which the NRC intake-adjustment procedure could not be applied because of the asymmetrical shape of its distribution, the assessment of dietary adequacy is based on the four-day average intake distribution. A detailed description of the assumptions underlying our analysis of the prevalence of inadequate intake is provided in Appendix A.

As shown in Table II.4, the estimates of the prevalence of inadequate intake of protein are zero. Since the protein intakes of virtually all of the children in our sample exceed the RDA, as shown in Figures II.2 and II.3, there is nothing to be gained from the application of the probability approach for this nutrient. By definition, the RDA for a particular nutrient is established at a level which exceeds the requirements of most individuals within the population group.

It is unfortunate that we were able to apply the full probability approach only to protein, since the use of the requirement distribution in assessing dietary adequacy is more critical for nutrients for which at least some members of the population group fail to attain the RDA. However, as the use of the mean-requirement as a fixed cutoff point provides an approximation to the probability approach (under the assumptions outlined above), the analysis for vitamin C furnishes some evidence on the prevalence

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TABLE II.4

ESTIMATES OF THE PERCENTAGES OF LOW-INCOME CHILDREN HAVING INADEQUATE INTAKES OF PROTEIN AND VITAMIN C, USING THE PROBABILITY APPROACH AND THE MEAN REQUIREMENT AS A FIXED CUTOFF

(weighted data, N=638)

	Protein	Vitamin C
Probability Approach		
Ages 1-3	0.0	----
Ages 4-5	0.0	----
Mean Requirement		
Ages 1-3	0.0	----
Ages 4-5	0.0	----
Ages 1-5	----	13.3
RDA		
Ages 1-3	0.0	----
Ages 4-5	0.0	----
Ages 1-5	----	23.1

SOURCE: FNS's 4-day analysis file for the 1985 CSFII.

NOTE 1: Values reported for protein are based on adjusted 4-day intake distributions; values reported for vitamin C are based on the unadjusted 4-day intake distributions.

NOTE 2: Percentages of children having intakes less than the RDAs are shown for reference purposes. They should not be interpreted as estimates of the percentages of children having inadequate nutrient intakes.

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FIGURE II

PROTEIN

Intake vs. RDA & Need
CHILDREN 1-3

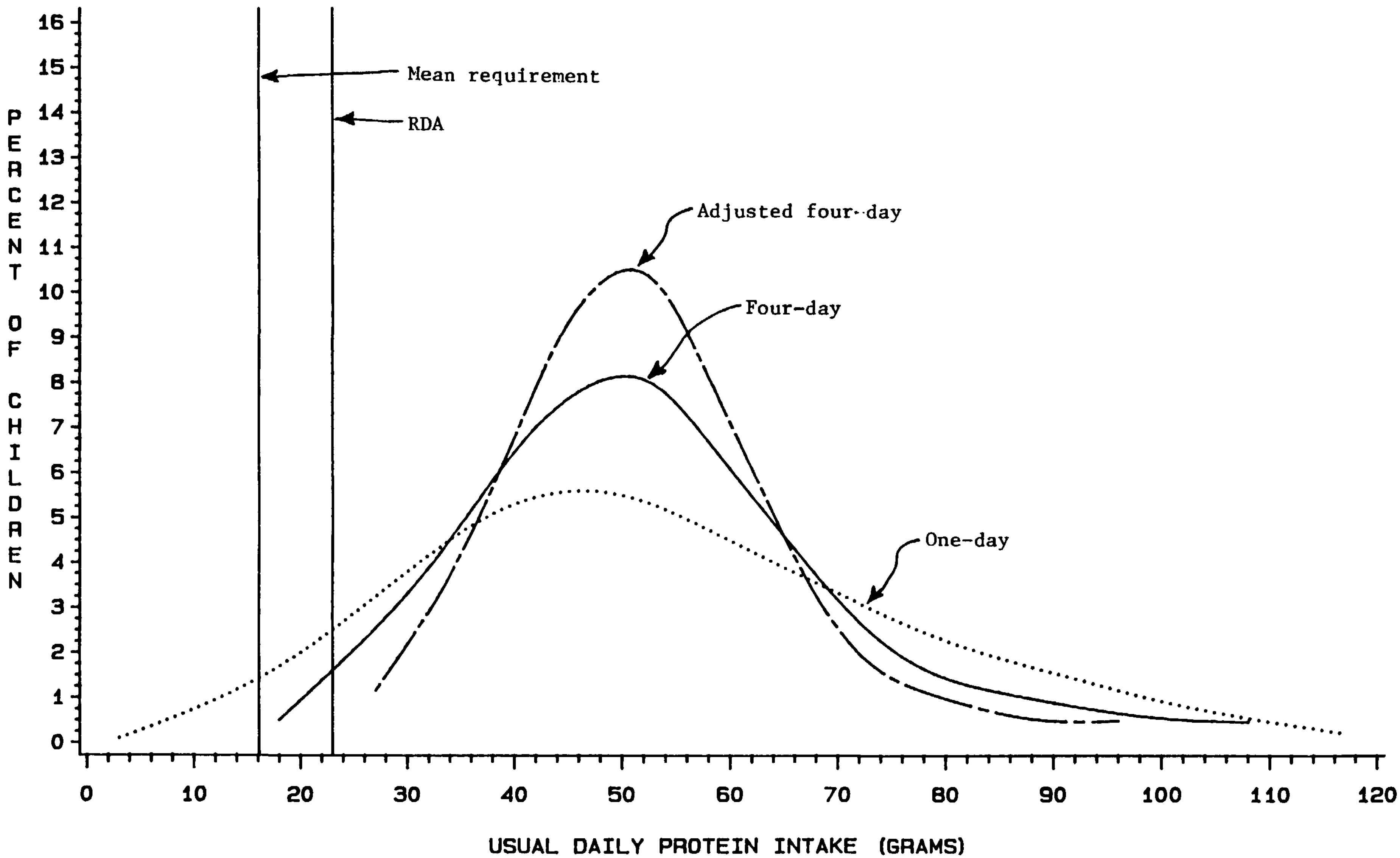
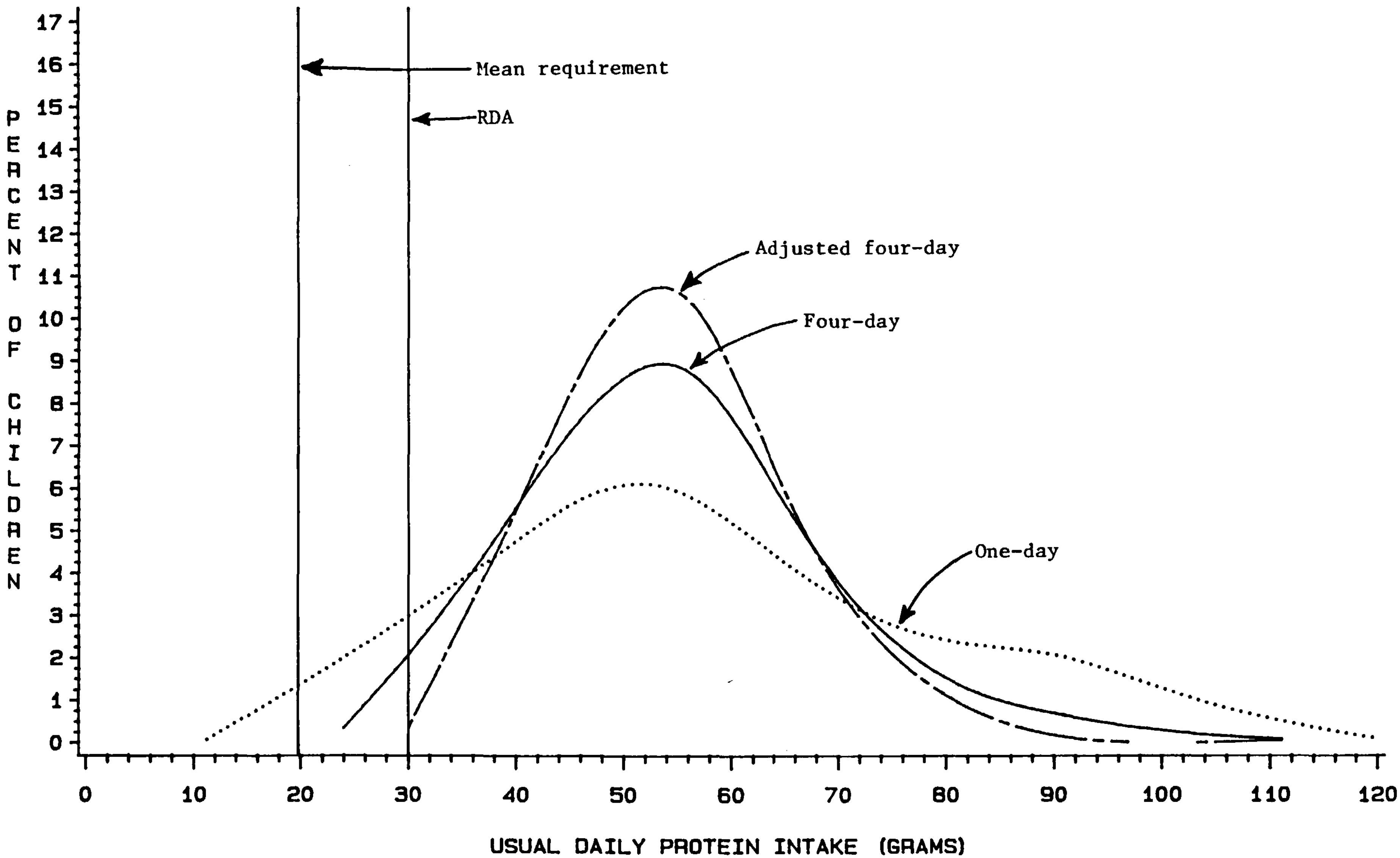


FIGURE Table of Contents

PROTEIN

Intake vs. RDA & Need

CHILDREN 4-5



of inadequate intake when the RDA is not attained by a significant share of the population group.

Table II.4 provides estimates for protein and vitamin C of the prevalence of inadequate intake using the mean-requirement as a fixed cutoff point. Because there is nothing to be learned from protein concerning the merit of the probability approach, we focus our discussion on vitamin C.

Using the four-day average intake distribution, the estimated prevalence of inadequate intake of vitamin C among children is 13 percent, as reported in Table II.4 and illustrated in Figure II.4. Thus, although 23 percent of the children fail to attain the RDA for vitamin C, only 13 percent of the children are estimated to have inadequate intakes of vitamin C. Because the RDAs are defined so as to ensure that the needs of almost the entire population are met, the proportion of the population that fails to attain the RDA will exceed the proportion of the population with an inadequate intake of a particular nutrient.

C. SUGGESTIONS FOR FUTURE RESEARCH

The findings presented in the previous section show that the methodology recommended by the NRC Subcommittee (National Research Council, 1986) to reduce the bias in estimates of the usual intake of the population group generates estimates of distributions of usual intake which differ substantially from those obtained using a single day of intake and, to a lesser extent, from those based on a simple average of multiple days of intake. Under the assumption of the normality of the intake distribution, the NRC intake-adjustment procedure mitigates an important source of bias in the estimate of the usual intake of the population group. The procedure can be easily applied with two or more replicates of daily intake data for a

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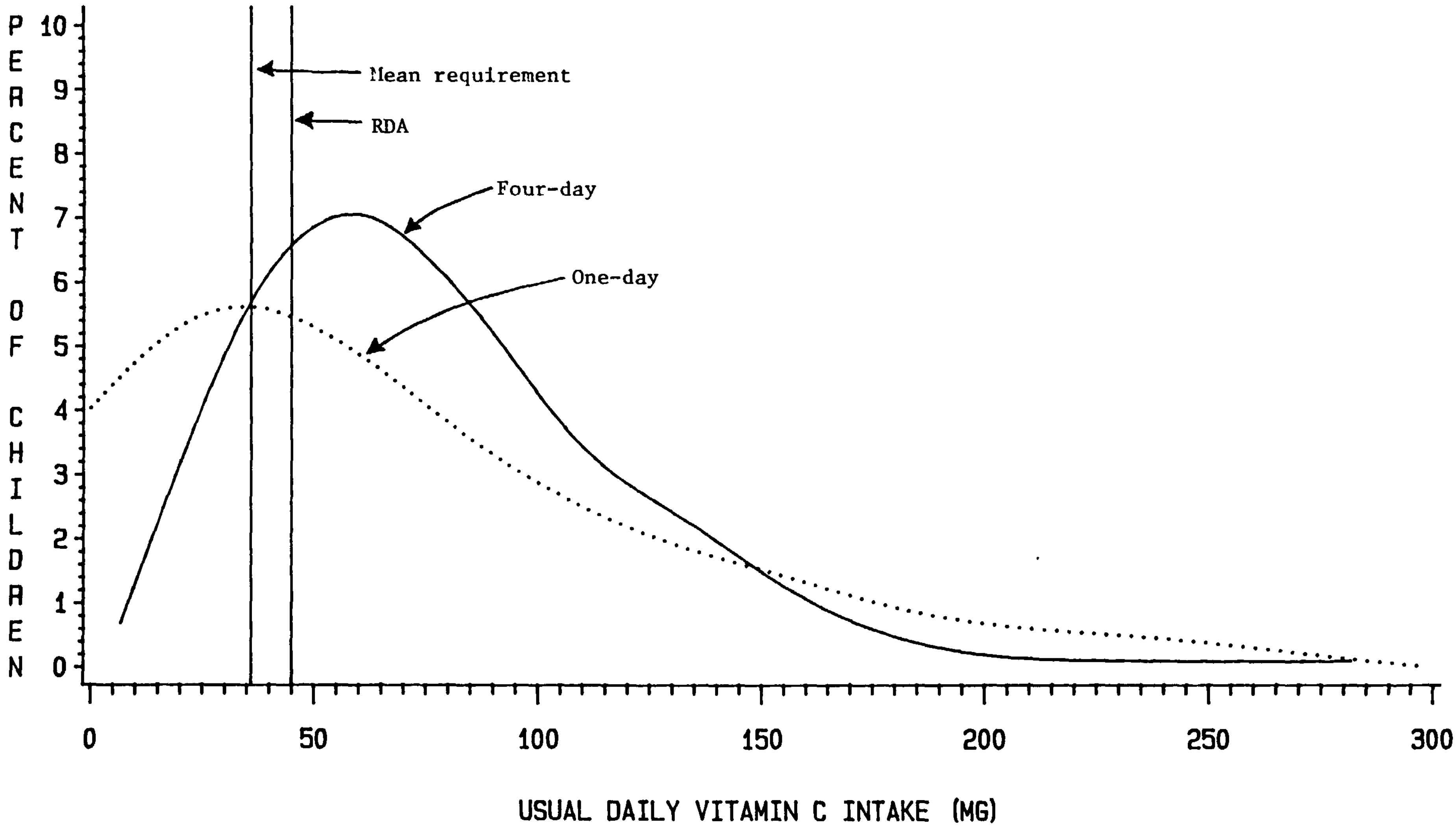
FIGURE 11.4

VITAMIN C

Intake vs. RDA & Need

CHILDREN 1-5



sample (or multiple days of intake data for a subsample and a single day of data for the full sample). Unfortunately, the NRC intake-adjustment procedure may not be appropriate when the intake distribution is not normal and is not appropriate when the intake distribution is asymmetrical. Additional research is needed to determine the general applicability of the NRC intake-adjustment procedure, as well as to develop procedures that are appropriate when the intake distribution is asymmetrical. Such research is important since accurate estimation of the distribution of usual intake is critical to any method of dietary assessment (whether the assessment of interest involves a comparison of intake across population groups or the estimate of the prevalence of inadequate intake within a particular population group).

Our application of the probability approach to estimate the prevalence of inadequate intake within a population group was severely constrained by the lack of published information on the requirement distributions. Furthermore, questions have been raised about a key assumption underlying the use of the probability approach: the assumption of the independence of the intake and requirement distributions. While the NRC Subcommittee believed that this assumption could be met by separating the population group into relatively homogeneous subgroups and controlling for related factors (e.g., energy intake or protein intake), other researchers are less optimistic about the reasonableness of the assumption of independence (e.g., Johnson et al., 1988). At present there is little information on the correlation between intake and requirement distributions. Thus, although the probability approach provides a theoretically valid means of estimating the prevalence of inadequate intake, it is not practical until additional research on the correlation of the intake and requirement distributions has been conducted and the information needed to support the probability approach is made more readily available.

Finally, there are those who believe that the existing food intake survey data are not of sufficient quality to support any accurate estimation of the prevalence of inadequate intake within a population group (e.g., Hegsted's dissenting statement in National Research Council, 1986). Since the basic purpose of food consumption surveys is to provide the information needed to determine the adequacy of dietary intake in the U.S. population, continued review and assessment of the methods used to collect and analyze food intake data are needed. A recent compendium of methodological research on dietary intake surveys (Pao et al., 1989) summarizes much of the recent work which examines new approaches for obtaining information on dietary intakes and outlines areas in which additional research is needed to improve the quality of estimated daily intake data. Included in the latter is research on the factors affecting the quality of reported intake (e.g., the design of the survey instrument and the survey methodology), and alternative methods of converting the food items into food composition data.

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III. THE PROBLEM OF SELECTION BIAS IN PROGRAM EVALUATIONS

If an assistance program has the option of withholding services from eligible applicants, then elementary statistics can be used to assess its effectiveness at achieving its mandated objectives within the framework of an experimental evaluation design in which eligible applicants are selected randomly to receive or be denied program services. Absent the waiver of program regulations, the requirement that federal entitlement programs, including the Food Stamp Program, provide services to all eligible applicants precludes adopting an experimental evaluation design. For nonentitlement programs, such as WIC, the cost of implementing an experimental evaluation design may be prohibitive. When an experimental evaluation design is not feasible for whatever reason, sophisticated econometric methodologies may be required to obtain reliable estimates of the effectiveness of a program.

This chapter examines three specific analytic complexities that must be addressed to use a nonexperimental research design to evaluate assistance programs: (1) controlling for observed differences between program participants and eligible nonparticipants; (2) controlling for unobserved differences between program participants and eligible nonparticipants; and (3) controlling for the influence of decisions about joint participation in several programs. This discussion of the statistical complexity of nonexperimental program evaluations will provide the foundation for Chapter IV, which presents the findings of our application of recently developed econometric software to assess the effectiveness of the Food Stamp and WIC programs at augmenting household food expenditures and improving the quality of diets.

A. PROGRAM EVALUATIONS BASED ON A CLASSICAL EXPERIMENTAL DESIGN

As a starting point for our examination of the analytic complexities associated with a nonexperimental program evaluation, it is useful to consider how one might evaluate a hypothetical program which has the option of withholding services from eligible applicants. Given that flexibility, along with an adequate budget for the evaluation, it would be feasible to adopt a classical experimental evaluation design that has a high probability of producing reliable results. Under this experimental design, a random sample of program applicants who are eligible to receive program services is selected. The usual program services are then provided to a random subsample of the applicants, while services are withheld from the other subsample of applicants.

The key feature of a classical experimental design for program evaluation is that the characteristics of sample cases receiving services (both observed characteristics, such as education, and unobserved characteristics, such as attitudes regarding the program's objectives) would not differ on average from those of the sample members who are denied services. The random assignment of services ensures this outcome. Consequently, the simplest of statistical measures of the effect of a program--the difference between the sample mean value of an outcome measure for program participants and the sample mean value for eligible applicants who had been denied services--would be an unbiased, fully reliable estimate of the program's true mean impact on the population of all program participants. No econometric modeling would be required to obtain this estimate.

B. ANALYTIC COMPLICATIONS INTRODUCED BY A NONEXPERIMENTAL EVALUATION DESIGN

Let us now consider how a program might be evaluated if withholding services to eligible applicants was not an option, thus precluding an experimental evaluation design, or if the implementation of an experimental design was prohibitively expensive. A "first-cut" approach to the evaluation might entail comparing the mean value of the outcome measure for a random sample of program participants with the mean value of the same measure for a random sample of eligible nonparticipants. The samples could be drawn from the cases in a general-purpose survey data base, such as the Current Population Survey (CPS) or the Survey of Income and Program Participation (SIPP), or from a more specialized data base, such as the NFCS or the CSFII.

There are two problems with the first-cut approach. First, the selection of a random sample of eligible nonparticipants would require replicating the program eligibility rules. Few data sets provide the detailed information necessary to do so with accuracy. For example, few data sets permit reliable replications of the asset eligibility requirements for participation in the Food Stamp Program or the "nutritional risk" component of the WIC eligibility requirements. The second problem with the "first-cut" approach to the evaluation is that the characteristics of the sample of program participants may differ on average from those of the sample of eligible nonparticipants for reasons unrelated to the procedure that is used to select the two samples from a survey data base.

The solution to the first problem--the replication of program eligibility rules--is to collect more accurate and more detailed data on the factors that enter into the process of determining program eligibility.

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This undertaking can be expensive, as evidenced by the cost of the SIPP data collection program. SIPP was designed in part to provide better data on program eligibility than are available in the CPS. The standard solution to the second problem--differences (on average) in the characteristics of program participants and eligible nonparticipants--is to specify regression models of the outcome measure. These models permit the analyst to compute the difference in the mean value of the outcome measure between the two groups while controlling for observed differences in their characteristics.

C. LIMITATIONS OF REGRESSION ANALYSIS AND THE PROBLEM OF SAMPLE SELECTION BIAS

In the past decade, researchers have become aware of a potentially important deficiency in the regression-based approach to nonexperimental program evaluations. That deficiency is fundamentally a problem with inadequate data. Specifically, the evaluation data base may not provide information on all of the important respects in which program participants differ from eligible nonparticipants. If some of the unobserved factors influence the outcome measure, then differences in those factors between the two groups will bias regression estimates of the effects of a program. This is referred to as "sample selection bias," or simply "selection bias."

To illustrate the problem of selection bias in nonexperimental program evaluations, let us assume that Food Stamp recipients are more aware of the nutritional requirements of the human body than are eligible nonparticipants. Let us further assume that (1) no measure of nutritional knowledge exists in the evaluation data base, but that (2) such knowledge does have a positive influence on the actual quality of diets. Under these assumptions, the difference between participants and eligible nonparticipants in the regression-adjusted mean value of the measure of dietary quality would be a positively biased estimate of the program's true effect on dietary intake. Such bias arises because all of that difference would be attributed to the influence of the program, when in fact some would be due to the higher level of nutritional knowledge by Food Stamp recipients and would exist even in the absence of the program.

While the source of selection bias is inadequate data, the practical solution to the problem usually entails econometric modeling rather than the collection of more or better data (for instance, it would be very difficult to collect some of the critical data on individual attitudes). The econometric solution to the problem is to estimate a model of the program participation decision and then compare the actual program participation of program eligibles with the model's prediction of their probabilities of participating. Actual participation is an outcome of the influence of both observed and unobserved variables, whereas the predicted probability of participation is a function of observed variables only, so the difference between the two is a reflection of (and a measure of) the influence of unobserved variables.

In his pathbreaking articles on selection bias, Heckman develops a methodology for incorporating the information on unobservable factors from the participation analysis into a synthetic variable known as "lambda."[22] For any given individual, the value of lambda is a function of the difference between actual participation behavior and the behavior that is predicted on the basis of observable characteristics. Thus, lambda is a reflection of unobservable factors that influence the program participation

[22]See Heckman (1978, 1979) and Heckman and Robb (1985).

decision and may also influence the evaluation's outcome measure. This constructed variable can be included in the equation that explains the outcome measure. By controlling for the influence of the unobservable factors on the outcome measure, lambda may eliminate the problem of sample selection bias in the regression estimate of the effect of a program.

To be fully effective at eliminating selection bias, the model of program participation must include one or more explanatory variables that do not also appear in the model that explains the program outcome measure. These included variables are referred to as "identifying variables." Many researchers have found that the necessity for including identifying variables in the participation model greatly reduces the practical value of Heckman's selection bias correction procedure. Indeed, some of the more skeptical researchers argue that it is almost never possible to satisfy this requirement. In the absence of identifying variables, it may technically still be possible to implement Heckman's procedure, but in that case one cannot be confident that it solves the selection bias problem.

To illustrate why the necessity of identifying variables can be so restrictive, it is useful to return to our earlier example of a nonexperimental evaluation of the effectiveness of the Food Stamp Program at improving dietary quality. Implementing Heckman's sample selection bias correction procedure as part of such an evaluation would require estimating a model of Food Stamp participation and subsequently estimating a regression model of dietary quality. The model of participation should include one or more variables that do not influence dietary quality. Unfortunately, it may be difficult to find variables in the evaluation's data base that influence Food Stamp participation but not dietary quality.

MPR's experience has been that it is usually, but not always, possible to find one or more identifying variables; however, doing so often entails the time consuming task of estimating many alternative models of both program participation and the outcome measure. The risk of failing to find an identifying variable is intensified when the number of cases in the analysis sample is small.

D. SELECTION BIAS IN A MULTIPLE PROGRAM CONTEXT

For the past several years, FNS has funded research on the interactions of its own nutrition assistance programs both with each other and with cash and in-kind programs administered by other federal agencies and by the states. For example, under the first Food Stamp Analytic Studies contract, four reports on various aspects of program interactions were produced. These were two empirical analyses of patterns of multiple program participation among Food Stamp participants (Long, 1988, and Long and Doyle, 1989), a study of the interaction and sequencing of benefits under 18 state and federal tax and transfer programs (Fraker, 1987), and a handbook of 29 programs (providing cash assistance, nutrition assistance, and other in-kind assistance) whose unifying theme is interactions of those programs with the Food Stamp Program (MPR, 1986). This body of research both reflects and documents the importance of analyzing individual nutrition assistance programs within the context of other related nutrition assistance programs and within the broader context of other in-kind and cash assistance programs.

When evaluating the effect of a program on an outcome of interest, it is important that the researcher consider whether other programs may also have important effects on the outcome measure. The answer to this question is often determined by the characteristics of the population being studied. For example, if a study seeks to determine the effect of Food Stamps on the food expenditures of <u>all</u> low-income households, it may be appropriate to neglect the WIC Program in the analysis because it provides benefits only to a small proportion of the study's target households. Conversely, a study of the effects of Food Stamps on the food expenditures of low-income households that contain young children, or pregnant, lactating, or postpartum women, could seriously be flawed by the exclusion of the WIC Program, since it is an important source of assistance for that population.

If it is believed that a study's outcome measure for the population of interest is substantially influenced by, say, two assistance programs, then it is essential that measures of participation in both programs be included among the explanatory variables in a model of the outcome measure. Failure to do so might generate a misspecified model, which in turn would generate biased estimates of the effects of the specific program that is being

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possibility that some of the same unobserved factors that influence participation in one program also influence participation in the other).

It is not possible to provide firm rules about the importance of estimating the participation models for two programs simultaneously. If it is possible to submit a single application for benefits from both programs, if the programs provide benefits that address similar needs, if a large proportion of the study's target population participates in both programs, or if there is some other reason to believe that the participation decisions are related, then it would be prudent to estimate the participation models simultaneously.

The quality of the estimates of the effects of two programs cannot be compromised by estimating the participation models simultaneously. At worst, that estimation would show that the participation decisions are unrelated. Under those conditions, the simultaneous estimates of the participation models (and the associated lambda variables) would essentially be the same as those that would be obtained by estimating the models independently. On the other hand, if the participation decisions are in fact made jointly, then any lambda variables formed on the basis of independent estimates of the program participation models would be misspecified. The inclusion of the misspecified lambdas in the outcome model would generate biased estimates of the effects of the programs.

In addition to an MPR study of the effects of Food Stamps and WIC on dietary intake, based on wave-1 data from the 1985 CSFII,[23] we are aware of three studies that have used the results of estimating models of

[23]The findings from the wave-1 study are summarized in Chapter IV of Volume I of this report and are described in detail in Volume II of this report.

participation in two or more programs simultaneously to control for selection bias in the estimates of the effects of those programs on outcome variables. Fraker and Moffitt (1988) estimated a model of the effects of the Food Stamp and AFDC programs on the work effort of female heads of household with dependent children. In controlling for selection bias, they assumed that decisions to participate in the Food Stamp and AFDC programs are made jointly. Long (1988) treated the participation of school children in the School Breakfast Program and the National School Lunch Program as joint decisions to control for selection bias in estimates of the effects of those programs on food expenditures by households with school-age children. Finally, in an ongoing study of the effects of cash and in-kind transfers on the work effort of female heads of household with dependent children, Steinberg (1988) is treating participation in public housing, Food Stamps, and AFDC as outcomes of a joint decision-making process. Each of these studies used a different estimation procedure to deal with the jointness of decisions about participating in multiple assistance programs.[24] Those procedures are briefly discussed in Section D of Chapter IV.

[24]Long (1988) used the same estimation procedure that we have used in this study.

IV. ESTIMATING PROGRAM EFFECTS ON DIETARY INTAKE AND FOOD EXPENDITURES

The Food Stamp Program is designed to increase the food purchasing power of eligible households who apply for participation, thus enabling them to obtain more nutritious diets through normal channels of trade. For infants, young children, and pregnant, postpartum, and breastfeeding women whose physical and mental health is at risk by reason of inadequate nutrition or health care, the WIC Program provides nutrition education and vouchers that can be used to purchase specific supplemental foods.

This chapter reports findings from our application of recently developed econometric software to estimate the effectiveness of the Food Stamp and WIC programs at (1) improving the quality of the diets of women and children from low-income households and (2) enhancing food purchases by those households. Because the software is relatively untested and is cumbersome to use, because the estimation results are based on relatively small samples, and because the issues associated with specifying the model are challenging, we recommend that the estimates of the program effects that are presented in this chapter be regarded as preliminary, rather than as definitive, in nature.

A. THE ECONOMETRIC SOFTWARE

Under the Food Stamp Microsimulation Contract, FNS funded the development of a new module within the LIMDEP^tm econometric software package. This module permits researchers to estimate two program participation equations simultaneously, form the associated lambda variables, and then use the lambda variables to control for selection bias in estimating the effects of

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a program on a selected outcome variable.[25] This estimation methodology is referred to within LIMDEP[tm] as a bivariate selection model.

The econometric specification of the bivariate selection model is provided in Appendices B and C. Here, we simply note that the model consists of three equations: an equation that explains participation in Program A by persons (or households) eligible for that program, an equation that explains participation by eligibles in Program B, and an equation that explains the value of some measure of the effectiveness of the two programs at achieving their mandated objectives. In the particular applications of the model that are reported in this chapter, the two programs are the Food Stamp Program and the WIC Program and the outcome measure is, in the first application, the nutrient intake of individuals, and, in the second application, household food expenditures.

LIMDEP[tm] is not an easy software package to use. Its documentation is generally cryptic and in some instances incomplete; further, some of its more complex modules operate like "black boxes" and do not enable the researcher to diagnose anomalous estimation results,[26] and the researcher must be alert to subtle changes in the input data file that are generated by some LIMDEP[tm] modules. These and other issues associated with using LIMDEP[tm] are documented more fully in Appendix D.

As discussed in the next two sections of this chapter, certain components of our analysis encountered problems that cannot be attributed to

[25]Bivariate probit analysis is used to estimate the program participation equations simultaneously on the subsample of cases who are eligible to participate in both of the programs under consideration.

[26]For example, it is not possible to save the case-by-case values of the lambda variables generated by the bivariate selection model to generate descriptive statistics with them or analyze them in any other way.

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LIMDEP^{tm}. These include a small sample size and the absence of identifying variables in the WIC participation equation in the analysis of dietary intake by women, and the lack of robustness exhibited by the estimates of the effects of WIC to alternative model specifications in the analysis of household food expenditures. For these reasons, as well as because we need more experience in using LIMDEP^{tm}, we recommend that the program-effect estimates presented in this chapter not be used to inform policy decisions.

The analytical results presented in the following two sections were generated on the basis of a complex econometric procedure that was used to estimate models of the effects of nutrition assistance programs on nutrient intake by individuals and on food expenditures by households. To ensure that these results are accessible to a broader, less technical audience, we describe the models and the estimation procedure only in very general and non-technical terms in those sections. Appendices B and C provide detailed information on the technical aspects of the analysis.

B. PRELIMINARY ESTIMATES OF THE EFFECTS OF THE PROGRAMS ON DIETARY INTAKE

This section presents preliminary estimates of the effectiveness of the Food Stamp and WIC programs at improving the diets of women and children in low-income households. More specifically, it presents estimates of the effects on the nutrient intake of women and children of: (1) their own receipt of WIC benefits, (2) the receipt of WIC benefits by other members of their households, and (3) the participation of their households in the FSP. We obtained the estimates by analyzing the four days of 24-hour dietary recall data that are available in FNS's four-day analysis file for the 1985 CSFII.

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In the remainder of Section B, we describe the samples of women and children that we extracted from FNS's four-day CSFII data file. We also introduce the nutrients to be analyzed and document their presence in the diets of the sample women and children. The models of dietary intake that we used to obtain estimates of program effects on dietary intake are then briefly described. Finally, estimates of the effects of the programs are presented and their reliability is assessed.

1. Selecting the Samples and the Nutrients To Be Analyzed

a. Sample Selection

From among the cases of women and children in the four-day CSFII file, we selected those that satisfied the categorical eligibility criteria for participation in the WIC Program on at least one of the four survey days. Specifically, we selected children who had not attained their fifth birthday prior to the first day of data collection, and women who were pregnant, breastfeeding and less than one year postpartum, or not breastfeeding and less than six months postpartum on any of the four days represented in the data file. In addition, we required that the baseline household incomes of the selected cases not exceed 200 percent of the poverty level. This screen restricted the analysis samples to those cases that were likely to have met the income-eligibility criteria for Food Stamps or WIC at some point during the year-long CSFII survey period.[27] The absence of reliable post-baseline

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[27]To allow for the possibility that a household or individual that was income ineligible for WIC or Food Stamps as of the baseline might subsequently have become eligible due either to an increase in household size or to a reduction in income, we adopted a baseline income screen that was somewhat larger than either the WIC income screen (185 percent of poverty) or the Food Stamp gross income screen (130 percent of poverty).

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income data in the CSFII precluded applying a screen on income eligibility for the two programs on the post-baseline survey days.

To be certified as eligible to receive WIC benefits, infants, children under the age of five years, and pregnant, postpartum, and breastfeeding women must be members of households that satisfy the program's income screen. In addition, they must be determined to be at nutritional risk. At a minimum, an assessment of nutritional risk must include the measurement of height and weight and a hematological test for anemia. Federal regulations governing the WIC Program specify numerous nutritional risk conditions which state and local agencies may, at their discretion, use as a basis for the certification of nutritional risk.

In selecting the sample of women and children to be analyzed in this component of our study, we screened CSFII cases on the basis of the WIC categorical and income-eligibility criteria. We did not attempt to select cases on the basis of the program's nutritional risk criteria because such a screening would require information that is not available in the CSFII. For convenience, we refer to our analysis samples as consisting of "WIC-eligible" women and children, in full knowledge that the sample selection process did not include an assessment of nutritional risk.

Of the 760 children in the four-day CSFII file, 445 satisfied the age and income criteria for inclusion in the analysis sample for children and also had good data on all of the variables in the analysis. Of these, 123 participated in both Food Stamps and WIC on one or more of the four survey days. An additional 33 of the sample children participated in WIC only, while 110 received no WIC benefits but did belong to households that received Food Stamps.

Among the 1,947 women in the four-day CSFII file, 236 satisfied the categorical and income criteria for inclusion in this study's analysis sample and also had good data on all of the analytic variables. Of these, 49 received WIC benefits and belonged to households that received Food Stamps, while 15 received only WIC benefits, and 77 received only Food Stamps. As explained later, the relatively small number of women in our analysis sample adversely affected the reliability of our analysis findings for women.

b. Selection of the Nutrients To Be Analyzed

The WIC Program was originally designed to provide foods rich in protein, iron, calcium, vitamin A, and vitamin C (Public Law 94-105, November 7, 1975). We therefore included these five nutrients in our analysis of the effects of WIC on dietary intake. Subsequent legislation (Public Law 95-627, November 10, 1978) established more general nutritional objectives for the program, stating that the supplemental foods provided by WIC should contain "nutrients determined to be lacking in the diets of the targeted population."

We used data from FNS's four-day CSFII file to determine the nutrients other than the five nutrients originally targeted by WIC for which the mean intake relative to the RDA (i.e., the "nutrient adequacy ratio") is less than 1 among low-income women and children who are not participants in either Food Stamps or WIC. For children, we found food energy, vitamin E, and zinc to be problematic; for women, we found food energy, vitamin B6, vitamin E, folacin, magnesium, and zinc to be problematic. These three additional nutrients for children and six for women round out the nutrients analyzed in this study. For the analysis samples of women and children,

Table IV.1 shows the sample means and standard deviations of the nutrient adequacy ratios for the selected nutrients.

2. <u>The Analytic Models</u>

To estimate the effects of the WIC and Food Stamp programs on nutrient intake, we used both the ordinary least-squares (OLS) regression model and the bivariate selection model. As explained in the previous chapter, the latter model addresses the problem of sample selection bias, which is often present in program evaluations; the former model does not. Both models include an equation that explains variation across sample cases in the intake of each of the selected nutrients; in addition, the bivariate selection model includes a Food Stamp participation equation and a WIC participation equation.

a. <u>Dependent Variables</u>

The dependent variables in the nutrient intake equations are either the nutrient adequacy ratios (NARs) or the log-transformed NARs for eight selected nutrients for children and eleven for women. A comparison between the distributions of the error terms from one set of preliminary OLS estimates of the nutrient intake equations in which untransformed NARs were the dependent variables and those from another set in which log-transformed NARs were the dependent variables was the basis for our final specification of the nutrient intake measures. For each nutrient, we selected the specification of the dependent variable that produced the regression error terms whose distribution was more nearly normal. Our objective in doing so was to ensure the validity of the t-statistics in hypothesis testing. Applying this process to women, we selected log-transformed NARs as the dependent

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TABLE IV.1

SAMPLE MEANS AND STANDARD DEVIATIONS OF THE NUTRIENT INTAKE VARIABLES
(weighted data)

	WIC-Eligible Children (N=445)		WIC-Eligible Women (N=236)	
	Mean	Standard Deviation	Mean	Standard Deviation
Food Energy	0.946	0.248	0.824	0.282
Protein	2.026	0.610	1.339	0.462
Vitamin A	1.821	1.324	0.997	0.983
Vitamin B6	-----	-----	0.627	0.271
Vitamin C	1.702	0.987	1.416	1.048
Vitamin E	1.158	1.312	0.900	0.846
Folacin	-----	-----	0.480	0.255
Calcium	0.944	0.356	0.785	0.353
Magnesium	-----	-----	0.641	0.251
Iron	0.752	0.340	0.655	0.277
Zinc	0.708	0.215	0.585	0.214

SOURCE: FNS's 4-day analysis file for the 1985 CSFII.

NOTE: The measure of intake is the "nutrient adequacy ratio"--the intake of a nutrient divided by the RDA for that nutrient.

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variables in the analyses of iron, folacin, and vitamins A and E. For children, we selected as dependent variables the log-transformed NARs for iron and vitamins A, C, and E. All of the NARs, whether transformed or untransformed, were computed on the basis of four days of intake data.

b. Independent Variables

One set of independent variables explains the intake of all of the selected nutrients for women; another set serves that purpose for children. Both sets consist of four different measures of program participation, socioeconomic control variables, and variables that control for the stratification of the samples of women and children.

Program Participation Variables. The fact that the data in our analysis files were gathered on four different days over the course of a year complicates specifying the program participation variables in the models. For example, a person may have received WIC benefits for just two of the four survey days. The program participation variables account for such variation by measuring the proportion of the four days on which participation occurred. The variables that are defined in this way are:

1. The individual's own participation in the WIC Program
2. Participation in the Food Stamp Program by the individual's household
3. Concurrent participation in both WIC and Food Stamps
4. Participation in WIC by one or more other members of the individual's household

The inclusion of the third participation variable in the nutrient intake equations allows for an "interaction effect" between WIC and Food Stamp participation. That is, it allows for the possibility that the effect of participation in both programs differs from the sum of the effect of participation in WIC only and the effect of participation in Food Stamps only. One reason for hypothesizing the existence of a positive interaction effect is that WIC participants who also receive Food Stamps may spend their Food Stamps more effectively because the nutrition education component of the WIC Program makes them better consumers.

WIC supplemental foods are intended for the exclusive use of the women/children who receive them; however, some of those foods may in fact be consumed by other persons in a recipient's household. Thus, a person's participation in WIC may have "spillover effects" on the dietary intake of other persons in the household.[28] The fourth participation variable is designed to capture such effects.

Socioeconomic Control Variables. Among the independent variables in the nutrient intake equations are the socioeconomic characteristics of the subjects, their mothers (for children only), and their households. Variables measuring the following socioeconomic characteristics are included in the nutrient intake equations for women:

- Age
- Education
- Height (self-reported)
- Pregnancy/lactation status
- Race and ethnicity
- Employment status
- An indicator of special diets
- Household size
- Per capita household income
- Geographic region

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[28]Spillover effects would also arise if the availability of WIC supplemental foods permitted some of a household's normal food supply that would otherwise be allocated to the WIC recipient to be allocated to other persons in the household.

The socioeconomic control variables in the nutrient intake equations for children measure the following characteristics:

- Age
- Mother's education
- Sex
- Height (reported by child's mother)
- Race and ethnicity
- Mother's employment status
- Household size
- Per capita household income
- Geographic region

Analogous to the program participation variables, several of the socioeconomic control variables measure the proportion of survey days that a characteristic was in effect. For example, there are variables that measure the proportion of survey days that a woman or child was in a particular age group. Appendix B provides detailed definitions of all of the socioeconomic control variables in the nutrient intake equations for women and children.

Sample Stratification Variables. Also included among the independent variables in the nutrient intake equations are variables that formed the basis for stratifying the samples in both the CSFII design and in the subsequent creation of FNS's merged four-day analysis file containing cases from both the core and low-income samples of the CSFII.[29] Among these are variables that indicate whether a woman or child is from the core sample or from the low-income sample of the CSFII and, if the latter is the case, whether the individual resided at baseline in an area segment with a high, medium, or low poverty rate.

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[29]See Fraker and Post (1989) for descriptions of the design of the CSFII and for details on MPR's merging of data from the core and low-income samples.

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Detailed definitions of the sample stratification variables, as well as the other independent variables and the dependent variables in the nutrient intake equations for women and children, are provided in Appendix B, along with descriptive statistics on those variables. The appendix also provides similar information on the variables in the WIC and Food Stamp participation equations that are part of the bivariate selection model.

c. Estimation Approach

We estimated the nutrient intake equations within the context of two different econometric models. First, we used the ordinary least-squares regression model to estimate the intake equations. OLS can generate estimates of the dietary effects of program participation while also controlling for the influence of the socioeconomic characteristics and sample stratifiers in the intake equations. As explained in Chapter III, a potential weakness with OLS is that it cannot control for unobserved differences between program eligibles who elect to participate in WIC and/or Food Stamps and those who choose not to participate. For example, those who choose to participate may be more aware of dietary requirements and thus might have better diets than eligible nonparticipants even in the absence of the programs. If this enhanced awareness (or other analogous factors) does indeed influence program participation and dietary quality but is unobserved, then estimates of the effects of programs on dietary intake based on OLS methods are subject to selection bias.

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The bivariate selection model is capable of generating estimates of program effects on dietary intake that are free of selection bias.[30] In this application, the model consists of an equation that explains an individual's decision to participate in the WIC Program, a second equation that explains the decision of the individual's household to participate in the Food Stamp Program, and a nutrient intake equation. Estimating the model successfully requires that one or more "identifying variables" be included in each participation equation (i.e., variables that are significant predictors of the participation decisions but are not significant predictors of dietary intake). This requirement is more likely to have been satisfied for children than for women. Therefore, the bivariate selection model appears to provide more reliable estimates of program effects on dietary intake by children than does the OLS model, whereas OLS appears to provide more reliable estimates for women. Of course, the latter estimates are uncorrected for potential selection bias.

3. The Results of the Estimation Process

This section summarizes the OLS and the bivariate selection model estimates of the effects of the WIC and Food Stamp programs on the nutrient intake of women and children who are categorically eligible to receive WIC benefits and who are from low-income households. Only the estimates of program effects are presented here; complete analytical results, including estimates of the effects of the socioeconomic control variables and the sample stratification variables in the nutrient intake equations, as well as

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[30]Formally, when applied under appropriate conditions, the bivariate selection model is a consistent estimator of program effects (i.e., it is biased for small samples, but the bias disappears as the sample size increases).

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bivariate selection model estimates of the WIC and Food Stamp participation equations, are presented in Appendices E-G for children and H-J for women.

a. Results for Children

Table IV.2 summarizes the qualitative findings from using the OLS model and the bivariate selection model to estimate the effects of the programs on the nutrient intake of children. As explained in the preceding section, we prefer the estimates generated by the bivariate selection model because they are potentially free of sample selection bias. However, few qualitative differences exist between the two sets of estimates.

With one exception, the bivariate selection model estimates of the effects of WIC participation on nutrient intake by children are positive in sign; however, none is significantly different from zero. The quantitative estimates of the effects of WIC, expressed as percentage changes in nutrient adequacy ratios, are presented in the first column of Table IV.3. Those estimates range from -7 percent for vitamin A to +28 percent for vitamin C. Despite the positive percentage changes shown for seven of the eight nutrients, the lack of statistical significance of the estimates means that we cannot conclude with confidence that participation in WIC has other than a zero effect on the intake of those nutrients by children.

Our findings for Food Stamps are more conclusive than those for WIC. The second column of Table IV.2 shows that the bivariate selection model estimates of the effects of Food Stamps on the dietary intake of children are positive and statistically significant for food energy, protein, and zinc. For those three nutrients, we estimate that the receipt of Food Stamps increases intake relative to the RDA by 15 to 20 percent (see Table IV.3, Column 2). We also estimate that Food Stamp participation generates a

TABLE IV.2

QUALITATIVE ESTIMATES OF PROGRAM EFFECTS ON DIETARY INTAKE:
WIC-ELIGIBLE CHILDREN
(weighted data, N=445)

	Bivariate Selection Model				Ordinary Least Squares Regression			
	WIC	Food Stamps	WIC and Food Stamp Interaction	Participation in WIC by Other Family Members	WIC	Food Stamps	WIC and Food Stamp Interaction	Participation in WIC by Other Family Members
Food Energy	+	+**	-**	+	+	+*	-**	+
Protein	+	+**	-**	-	+*	+**	-**	-
Vitamin A	-	-	-	+	-	-	-	+
Vitamin C	+	+	-	+	+*	+	-	+
Vitamin E	+	-*	+	+**	+	-	+	+**
Calcium	+	+	-	-	+	+	-	-
Iron	+	+	+	+**	+	+	+	+**
Zinc	+	+**	-*	-	+	+*	-*	+

SOURCE: FNS's 4-day analysis file for the 1985 CSFII.
NOTE: Complete estimation results are provided in Appendix B.
* (**): Estimate of program effect is significant at the .05 (.01) level.

TABLE IV.3

ESTIMATES OF PERCENTAGE CHANGES IN DIETARY INTAKE ATTRIBUTABLE TO PROGRAM PARTICIPATION: WIC-ELIGIBLE CHILDREN

(weighted data, N=445)

	WIC Only	Food Stamps Only	WIC and Food Stamps	Participation in WIC by Other Family Members
Food Energy	3.2%	14.7%	-4.7%	0.0%
Protein	8.2%	20.0%	0.0%	-3.0%
Vitamin A	-7.0%	-9.7%	-18.0%	20.3%
Vitamin C	28.4%	10.3%	25.6%	13.4%
Vitamin E	14.6%	-25.6%	11.8%	35.9%
Calcium	4.0%	13.4%	8.2%	-4.7%
Iron	5.0%	9.4%	20.1%	20.6%
Zinc	6.2%	18.4%	3.1%	-0.2%

SOURCE: FNS's 4-day analysis file for the 1985 CSFII.

NOTE: The percentage changes shown in this table are derived from the bivariate selection model estimates of program effects.

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25 percent reduction in the intake of vitamin E by children. The bivariate selection model estimates of the effects of Food Stamps on the intake of calcium, iron, and vitamins A and C do not differ significantly from zero.

We find no significant evidence of positive interaction effects of WIC and Food Stamps on dietary intake by children. Indeed, the third column of Table IV.2 shows significant negative interaction effects for food energy, protein, and zinc. A negative interaction effect does not mean that the two programs in combination reduce the intake of a nutrient. Rather, it means that the estimated effect of the two programs together is smaller than the sum of the estimates of the separate effects of the programs. This can be seen in the third column of Table IV.3, which shows that our estimates of the combined effects of WIC and Food Stamps on the intake of food energy, protein, and zinc are smaller than the sum of the estimates of the separate program effects in Columns 1 and 2.[31]

The evidence produced by the bivariate selection model on the spillover effects of WIC is weak; however, it does indicate that participation by mothers and/or siblings in WIC has a positive effect on the intake of two nutrients by children. Table IV.3 shows that the presence in the household of a WIC recipient other than the subject increases a child's intake of vitamin E and iron by an average of 36 and 21 percent, respectively.

The Identification Problem. In Chapter III, we stressed that a major difficulty in eliminating sample selection bias in program evaluations that

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[31]We computed the percentage changes shown in Column 3 of Table IV.3 by summing the bivariate selection model estimates of WIC-only effects, Food-Stamp-only effects, and the interaction effects. Thus, the numbers shown in Column 3 are not estimates of the interaction effects as such, but rather are estimates of the combined effects of the two programs that incorporate the interaction effects.

are based on nonexperimental data is finding identifying variables--variables that affect the probability of participating in a program but do not affect the outcome measures. In the context of the analysis of program effects on dietary intake, this problem can be restated in the following way. The selection bias problem arises because we do not know whether WIC or Food Stamp participants would differ from nonparticipants in their dietary intake even in the absence of the programs. If such differences would exist, then a comparison of dietary intake between participants and nonparticipants may yield incorrect estimates of the true program effects, even if other variables are controlled for through regression analysis. However, if some identifying variable can be found that affects the probability of participating in a program but does not affect dietary intake, then a correct estimate of that program's effect can be obtained by examining individuals who have different values of the identifying variable.

In our analysis of dietary intake by children, the key identifying variable in the food stamp participation equation is the potential food stamp benefit--the benefit that a child's FSP-eligible household could receive if it chose to participate in the program. There is no conceptual basis for believing that the potential food stamp benefit of an eligible household affects dietary intake by children in that household;[32] however, there is a strong basis for believing that it influences the household's FSP participation decision. Consistent with this conceptual framework, our

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[32]Eligible nonparticipants in the FSP have positive potential food stamp benefits but there is no reason to believe that those potential benefits influence their intake of nutrients. In any reasonable conceptual model of nutrient intake, it must be actual FSP participation or actual food stamp benefits that affect nutrient intake.

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empirical analysis shows that the potential food stamp benefit is a significant predictor of the FSP participation decision (see Appendix E).

There is no available counterpart to the potential Food Stamp benefit that can serve as an identifying variable in the WIC participation equation for children. Within the federal guidelines for WIC supplemental foods for children ages one to five years, local agencies have discretion over the specific types and quantities of foods to provide; however, the CSFII does not identify WIC foods. Consequently, there is no observable variation among the children in our analysis file in the dollar value of the foods that they actually receive or potentially could receive through the WIC Program.

As an alternative to the potential WIC benefit, we used a measure of a child's weight relative to his or her height as the primary identifying variable in the WIC participation equation. The conceptual basis for this choice is twofold. First, we regard this variable as a proxy for the nutritional risk criteria which must be satisfied by an income-eligible child before he or she can be certified as eligible to receive WIC benefits. The argument is that children whose weight is low relative to their height are more likely to be identified by social workers or other authorities as being at nutritional risk and, consequently, are more likely to be brought into the WIC Program.[33] Second (and more controversially), we believe that current weight-relative-to-height is independent of current food intake, thus permitting weight relative to height to serve as an identifying variable in the WIC participation equation.

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[33] As reported in Appendix E, low weight relative to height is a highly significant predictor of WIC participation by children.

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A secondary identifying variable in the WIC participation equation is a dummy (0,1) variable that takes on a value of 1 for children who are members of households that rent the homes in which they are living as opposed to owning them or occupying them without a required cash payment. Appendix E shows that the "rent home" variable is a statistically significant predictor of WIC participation by children at the .04 level, whereas weight-relative-to-height is significant at the .01 level.

Expert reviewers of an earlier draft of this report expressed reservations about "weight relative to height" as an identifying variable in the WIC participation equation. They noted the existence of substantial measurement error in the numerator of that variable and, more importantly, they questioned our assumption of independence between that variable and dietary intake.[34] In response to the latter concern, we reestimated the nutrient intake equations with "weight relative to height" included as an explanatory variable. For seven of the eight nutrients considered, the results confirm the reviewers' concern that this variable is a significant predictor of children's dietary intake. Findings from a similar investigation of the "rent home" variable show that it is a significant predictor of children's intake of only vitamin E and iron. Thus, although both "weight relative to height" and "rent home" are significant predictors of WIC participation, for analyses of most nutrients only the latter can serve as an identifying variable in the WIC participation equation of the bivariate

[34]The measurement error in the weight relative to height variable derives from the fact that the weight and height of children were not measured directly during the CSFII interviews, but rather were reported by their mothers. This survey methodology is known to result in large errors in the reported weight of children.

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selection model because it is not a significant predictor of dietary intake.[35]

As noted in Chapter III, the absence of specific identifying variables in a model that attempts to correct for selection bias does not necessarily mean that the correction procedure has no beneficial effect; the nonlinear functional form of the program participation equation(s) may serve to identify the model. However, the absence of identifying variables does substantially increase the likelihood that some selection bias remains in the "corrected" estimates. The bivariate selection model estimates of program effects on the intake of vitamin E and iron by young children should be interpreted in this context, because, as noted above, the "rent home" variable cannot serve as an identifier in the WIC participation equation.

The controversy surrounding the "weight relative to height" variable is symptomatic of a more general problem, which is the scarcity in data sets such as the CSFII and NFCS of variables that can serve as identifiers in models that are designed to estimate program effects on dietary outcomes while controlling for selection bias. This nature of this problem varies somewhat from program to program, but two key factors are the absence of

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[35]The finding that "weight relative to height" is a significant predictor of children's intake of most of the nutrients considered implies that the estimates of WIC and Food Stamp effects that are summarized in Tables IV.2 and IV.3 may be biased by the omission from the nutrient intake equations of this significant explanatory variable. However, our revised estimates of program effects, obtained with "weight relative to height" included among the explanatory variables in the intake equations, do not differ substantially from the earlier estimates in their signs, magnitudes, or statistical significance. Consequently, this chapter continues to present results for children that are based on intake equations that do not include the "weight relative to height" variable. Appendix M presents the detailed results of the OLS and bivariate selection model estimation of the revised nutrient intake equations, along with a table (analogous to Table IV.2) summarizing the qualitative findings.

cross-sectional variation in program benefits (as explained above, this is the case for WIC but not the FSP) and the absence of measures of the cost of participation (e.g., travel costs, waiting time, and time spent filling out forms). Absent this type of information, the identification problem is likely to be severe in any program evaluation based on nonexperimental data.

Assessment of the Results for Children. On the whole, both the sign and magnitude of the bivariate selection model estimates of the program effects on nutrient intake by children are reasonable. Our most strongly held a priori expectation was that participation in WIC and/or Food Stamps would increase the intake of at least some nutrients by children. With respect to WIC, the bivariate selection model estimates do not refute this hypothesis; with respect to Food Stamps, they support it for three nutrients, and (for unknown reasons) they refute it for vitamin E.

We are disappointed by the low statistical significance of our estimates of the effects of WIC; however, we are heartened by the fact that those estimates are not so large in absolute value that they undermine our confidence in the estimation methodology.[36] It would be premature to conclude on the basis of these estimates that WIC has no beneficial effects on the diets of participating children. The absence of statistically significant estimates of the effects of WIC may be due to a small sample size (445 cases) rather than the ineffectiveness of the WIC Program at improving the diets of children. We recommend further analysis of the

[36] In contrast, our analysis of the wave-1 CSFII data (see Volume II of this report) yielded estimates which implied that participation in WIC increases the intake of iron and vitamin E by children by more than 100 percent and reduces their intake of vitamin A by 72 percent.

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effects of the program using a data base that provides more observations on WIC-eligible children than does the CSFII, such as the 1987-88 NFCS.

At least two possible reasons explain why these estimates of the effect of WIC are more moderate in magnitude than our estimates based on wave-1 data from the 1985 CSFII.[37] First, they are based on average daily dietary intake over four days. That measure of intake displays far less variation and fewer extreme values than does the one-day measure. As evidence to support this point, we note that the standard deviations of the one-day NARs are approximately 50 percent larger than their four-day counterparts in Table IV.1. Second, the logarithmic transformation of selected NARs appears to be a factor in the absence of extreme values in the current set of estimates of the effects of WIC. In fact, we used the log transformation for the three nutrients for which the one-day WIC estimates were most extreme. The resultant four-day estimates of percentage changes in the NARs attributable to WIC have the same signs as the one-day estimates but are far smaller in magnitude, ranging from -7 percent to +15 percent.

Because of their higher levels of statistical significance, their generally positive signs, and their moderate absolute values, the bivariate selection model estimates of the effects of Food Stamps on nutrient intake by children appear to be both reasonable and more reliable than the corresponding estimates of the effects of WIC.

It is possible to present arguments on both sides of the question about whether we should expect the WIC and Food Stamp programs to have positive

[37]Section B.4 of this chapter further summarizes the findings from our analysis of wave-1 data from the 1985 CSFII and compares those findings with the findings from our analysis of four days of CSFII data. Volume II of this report provides a complete discussion of those findings.

interaction effects on nutrient intake. Consequently, it is difficult to pass judgment on the reasonableness of the estimates of those effects on nutrient intake by children that are derived from the bivariate selection model. We recommend that future testing for interaction effects be limited to analyses based on larger samples than those that were available for this study and/or on those nutrients for which a strong a priori argument can be made about why an interaction effect should be expected.

The bivariate selection model estimates of the spillover effects of WIC should be regarded as the most preliminary of the estimates of the four different types of WIC and Food Stamp dietary effects that we have presented. This is the first study of which we are aware that has attempted to estimate such effects. The finding of generally positive and occasionally significant estimates of spillover effects is in accordance with our a priori expectation that those effects are positive but small in magnitude. Based on these findings, further research on the spillover effects of WIC is warranted.

b. Results for Women

The sample of women who are categorically eligible to receive WIC benefits and who are from low-income households is much smaller than the corresponding sample of children--236 cases versus 445 cases--thus reducing the statistical reliability of our estimates for women. The small sample size was also a serious handicap in using the bivariate selection model to estimate program effects. For that reason, we prefer the OLS regression estimates, despite their probable contamination by selection bias.

We have explained that using the bivariate selection model successfully to obtain estimates of the effects of WIC and Food Stamps on nutrient intake requires the presence of one or more identifying variables in the participation equation for each program. We were unable to find such a variable for the equation that explains WIC participation by women.[38] Indeed, we found very few statistically significant predictors of WIC participation by women, and those that we did find were also significant predictors of nutrient intake. A larger sample would likely yield more statistically significant predictors of WIC participation, some of which might serve as identifying variables.

In theory, the WIC participation equation can be identified merely by the nonlinearity of the bivariate probit procedure that we used to estimate this equation jointly with the Food Stamp participation equation; however, in practice, nonlinearity is a weak basis for identification. Thus, due to the absence of identifying variables, we conclude that the bivariate selection model estimates of the nutrient intake equations for women have not been corrected properly for the presence of bias associated with the selection of eligible women into the WIC Program. We thus prefer the OLS estimates. However, those estimates are also subject to selection bias, and the small size of the sample of women reduces their statistical significance. Consequently, we caution that neither set of estimates of the effects of the programs on nutrient intake by women is reliable.

The OLS estimates of the effects of WIC on dietary intake by women are positive in sign for all 11 of the nutrients that we considered; however, Table IV.4 shows that only the estimates for vitamin C and magnesium are

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[38]Body weight relative to height and a variable that distinguishes children in households that rent their homes from other children are the identifying variables in the WIC participation equation for children. Unfortunately, these variables are not significant predictors of WIC participation by women.

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TABLE IV.4

QUALITATIVE ESTIMATES OF PROGRAM EFFECTS ON DIETARY INTAKE:
WIC-ELIGIBLE WOMEN
(weighted data, N=236)

	Bivariate Selection Model				Ordinary Least Squares Regression			
	WIC	Food Stamps	WIC and Food Stamp Interaction	Participation in WIC by Other Family Members	WIC	Food Stamps	WIC and Food Stamp Interaction	Participation in WIC by Other Family Members
Food Energy	+	-	-	+	+	-	-	+
Protein	+	+	-	+	+	+	-	+
Vitamin A	+	-	+	+	+	-*	+	+
Vitamin B6	+	+	+	+	+	+	+	+
Vitamin C	+	-	+	+	+*	-	-	+
Vitamin E	+	+	+	+*	+	+	+	+*
Folacin	+	-	+	+*	+	-	+	+*
Calcium	+	+	-	+	+	-	-	+
Magnesium	+	-	-	+	+*	-	-	+
Iron	+	-	+	+*	+	-	+	+*
Zinc	+	+	-	+	+	+	-	-

SOURCE: FNS's 4-day analysis file for the 1985 CSFII.
NOTE: Complete estimation results are provided in Appendix B.
* (**): Estimate of program effect is significant at the .05 (.01) level.

significantly different from zero. We estimate that WIC increases the intake (relative to the RDA) of vitamin C and magnesium by 90 percent and 42 percent, respectively (see Table IV.5). Many of the estimated effects of WIC on other nutrients are also relatively large, as shown in Column 1 of Table IV.5, but the standard errors for these estimates are so large that we cannot say with confidence that the true effects differ from zero.

The OLS estimates of the effects of Food Stamps on nutrient intake by women are mixed in sign and, with one exception, are statistically insignificant. Table IV.5 shows that these estimates are much smaller in absolute value than the corresponding estimates of the effects of WIC.

The last two columns of Table IV.4 show that the OLS estimates of the interaction effects of WIC and Food Stamps are mixed in sign and statistically insignificant, while the estimates of the spillover effects of WIC are almost all positive in sign and are significant for three nutrients.

<u>Assessment of the Results for Women</u>. The small size of the sample of WIC-eligible women compromised our ability to obtain estimates of program effects on nutrient intake that are corrected for selection bias. In addition, the small sample generated large standard errors and reduced the statistical significance of most of our estimates of the effects of the programs on women. For these reasons, we recommend that these estimates not be used to guide policy decisions about the WIC and Food Stamp programs.

An important aspect of the small sample of WIC-eligible women is the small number of sample participants in both WIC and Food Stamps (49 cases) and the even smaller number of sample participants in WIC alone (15 cases). With such small numbers of WIC participants, estimating interaction effects for WIC and Food Stamps is inadvisable. It would be better to use the 64

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TABLE IV.5

ESTIMATES OF PERCENTAGE CHANGES IN DIETARY INTAKE ATTRIBUTABLE TO PROGRAM PARTICIPATION: WIC-ELIGIBLE WOMEN

(weighted data, N=236)

	WIC Only	Food Stamps Only	WIC and Food Stamps	Participation in WIC by Other Family Members
Food Energy	9.3%	-5.2%	-1.5%	6.3%
Protein	26.8%	3.5%	21.0%	2.4%
Vitamin A	9.6%	-42.3%	25.6%	35.6%
Vitamin B6	38.7%	1.7%	62.0%	9.7%
Vitamin C	90.1%	-5.0%	68.5%	3.6%
Vitamin E	7.3%	3.1%	57.2%	38.9%
Folacin	32.4%	-17.2%	43.0%	31.5%
Calcium	30.1%	-10.5%	11.2%	1.9%
Magnesium	42.4%	-10.0%	18.8%	12.9%
Iron	18.0%	-6.7%	14.5%	20.7%
Zinc	18.2%	4.7%	13.4%	0.0%

SOURCE: FNS's 4-day analysis file for the 1985 CSFII.

NOTE: The percentage changes shown in this table are derived from the ordinary least-squares regression estimates of program effects.

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observations on WIC participants to obtain the best possible estimates of the effects of WIC without recognizing their interaction with Food Stamps. This example provides support for our earlier recommendation that the search for program interaction effects should be restricted to analyses based on large samples, which are more likely to provide adequate numbers of observations on program participants and thus more accurate estimates of the interaction effects.

A final observation on these results is that, although the estimates of the spillover effects of WIC on women are rendered suspect by the small sample size and the inability to correct for selection bias, it is nevertheless true that the strong pattern of positive estimates of those effects, combined with several statistically significant estimates, suggests that further study of these spillover effects is warranted. In this regard, the results for women are consistent with the results for children.

4. <u>Comparison with Results from Previous Studies</u>

Previous studies of the effects of nutrition assistance programs on

dietary intake are quite heterogeneous in terms of the populations studied, the programs considered, and the manner in which potential sample selection bias was handled. In this section, we review four previous studies, including an earlier MPR study based upon baseline data from the 1985 CSFII, and compare the reported estimates of program effects with the estimates that we presented in the previous section.

a. MPR's Study Based Upon One Day of CSFII Data

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on dietary intake by WIC-eligible women and children. The analysis file for that study contains merged and reweighted data from both the core and the low-income samples of the 1985 CSFII panel. Relative to the four-day CSFII analysis file, the wave-1 file provides more usable observations on WIC-eligible women (381 versus 236) and children (818 versus 445), but fewer days of data per observation (one day versus four). Those differences have partially offsetting implications for the statistical reliability of estimates of program effects; however the estimates based upon the four-day file are more reliable (i.e., have smaller standard errors) than those based upon the wave-1 file. For that reason, we have chosen to present the four-day estimates in this volume, the first in a two-volume report, while briefly summarizing the baseline estimates and comparing them with the four-day estimates in this section. The second volume of this report provides a detailed discussion of the baseline estimates.

Analytic Models and Dietary Outcome Measures. As in the analysis of the four-day data, we used both the OLS regression model and the bivariate selection model to analyze the effects of the WIC and Food Stamp programs on dietary intake over a single 24-hour period. We used the bivariate selection model to jointly estimate WIC and Food Stamp participation equations and to incorporate the results in the estimation of the dietary intake equations so as to control for potential sample selection bias. The independent variables in both the program participation equations and the dietary intake equations were, for the most part, the one-day counterparts to the independent variables in the four-day analysis. An exception to that rule is that we did not include in the dietary intake equations a measure of WIC participation by household members other than the individuals whose

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intake was being analyzed. The set of one-day dietary intake measures that we analyzed was broader than the set of four-day measures, consisting of 16 nutrients (food energy, protein, and 14 micronutrients), cholesterol, and the percentage of food energy provided by protein, fat, and carbohydrate.

Summary of Results. For WIC-eligible children, OLS and the bivariate selection model produced generally similar qualitative estimates of the effects of WIC participation on dietary intake. Both analytic methodologies produced estimates of WIC effects that are positive and statistically significant for six of the fourteen micronutrients considered and negative and significant for only one. The two methodologies also both produced estimates of the effects of WIC that are positive and significant for cholesterol and statistically insignificant for protein. They differ with respect to their findings for food energy and its component sources. The OLS results show that WIC has a positive and significant effect on the intake of food energy but no significant effects on the proportions of food energy derived from protein, fat, and carbohydrate. The bivariate selection model results show that WIC has no significant effect on the intake of food energy but a positive and significant effect on the proportion of food energy derived from carbohydrate and negative and significant effects on the proportions derived from protein and fat.[39]

The two analytic methodologies produced estimates of Food Stamp effects on dietary intake by children that are less consistent with each other than are the WIC estimates. The OLS estimates of Food Stamp effects on dietary

[39]Although they differ in statistical significance, the OLS and bivariate selection model estimates of WIC effects on food energy intake and on the contributions of the three macronutrients to that intake have the same signs.

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intake are positive and significant for food energy and seven of the fourteen micronutrients and are statistically insignificant for the remaining micronutrients as well as the other dietary outcome measures considered. In contrast, the bivariate selection model estimates are statistically insignificant for all outcome measures with the exception of one micronutrient. In general, the bivariate selection model estimates have the same signs as the OLS estimates, but the former have larger standard errors (roughly twice as large as the OLS standard errors), implying a lack of statistical reliability.[40]

For WIC-eligible women, the OLS and bivariate selection models generated estimates of WIC and Food Stamp effects on dietary intake that, while generally positive in sign, are with only a few exceptions statistically insignificant.[41] The small size of the sample of women and the measurement of dietary intake on the basis of only one day of data contributed to the imprecision of the estimates. In addition, difficulty in modeling the WIC eligibility of women adversely affected the estimation of the WIC participation equation, which in turn had negative implications for the capacity of the bivariate selection model to control for selection bias associated with the decisions of WIC-eligible women to participate in the program.

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[40]The bivariate selection model estimates of WIC effects on children also have standard errors that are large relative to those of the OLS estimates; nevertheless, they achieve conventional levels of statistical precision for many of the dietary outcome measures considered.

[41]For the full set of dietary outcome measures, OLS generated just one statistically significant estimate of WIC and Food Stamp effects, while the bivariate selection model generated only two significant estimates.

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Comparison of the One- and Four-Day Estimates. The analysis of four days of CSFII intake data focused on subsets of the dietary outcome measures that were examined in the earlier one-day analysis. Table IV.6 summarizes the qualitative findings from those two studies regarding the effects of WIC and Food Stamps on the eight outcome measures for children and eleven outcome measures for women that were common to both studies. In this table, the findings for children were generated by the bivariate selection model, while those for women were generated by OLS. Our decision to base the comparison of one-day and four-day results for women on the OLS estimates reflects our previously-discussed reservations concerning the reliability of the bivariate selection model estimates for women. Those reservations derive from the small sizes of the baseline and four-day samples of WIC-eligible women, the problem of modeling WIC eligibility, and the identification problem in estimating the WIC participation equation for women.

For children, the signs of the estimates of WIC and Food Stamp effects on the eight measures of dietary intake are generally positive and invariant with respect to whether they were obtained on the basis of one day or four days of intake data. The one-day and four-day estimates differ most notably with respect to their statistical significance. The one-day estimates of WIC effects are significant for three of the eight outcome measures, versus none for the four-day estimates. In contrast, none of the one-day estimates of Food Stamp effects are significant, versus four of the four-day estimates.[42] When considered together, the one-day and four-day estimates

[42]The standard errors of the four-day estimates are consistently smaller than those of the one-day estimates but, especially for WIC, the four-day estimates of program effects are often smaller than the one-day estimates.

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TABLE IV.6

COMPARISON OF ESTIMATES OF PROGRAM EFFECTS ON DIETARY INTAKE, BASED ON ONE DAY AND FOUR DAYS OF DATA

Nutrient	WIC 1 Day	WIC 4 Days	Food Stamps 1 Day	Food Stamps 4 Days
Panel 1: WIC-Eligible Children				
Food Energy	+	+	+	+**
Protein	-	+	+	+**
Vitamin A	-**	-	+	-
Vitamin C	+	+	-	+
Vitamin E	+*	+	-	-*
Calcium	+	+	+	+
Iron	+**	+	+	+
Zinc	-	+	+	+**
Panel 2: WIC-Eligible Women				
Food Energy	+	+	-	-
Protein	+	+	+	+
Vitamin A	-	+	+	-*
Vitamin B6	+*	+	+	+
Vitamin C	+	+*	+	-
Vitamin E	+	+	+	+
Folacin	+	+	+	-
Calcium	-	+	-	-
Magnesium	+	+*	+	-
Iron	+	+	+	-
Zinc	+	+	+	+

SOURCE: FNS's wave-1 and 4-day analysis files for the 1985 CSFII. Results for children generated by bivariate selection model. Results for women generated by OLS.

* (**): Estimate of program effect is significant at the .05 (.01) level.

provide weak evidence of positive effects of both WIC and Food Stamps on the intake of a broad range of dietary outcomes. The small proportion of statistically significant estimates and instability in the statistical significance of estimates across measurement periods suggest that those results are far from being definitive estimates of the dietary effects of WIC and Food Stamps on young children.

A comparison of the one-day and four-day estimates of WIC and Food Stamp effects on dietary intake by women suggests that those results are even less definitive than the ones for children. The second panel of Table IV.6 shows that the proportion of outcome measures for which the estimates of WIC and Food Stamp effects are statistically significant is smaller than the corresponding proportion for children. While almost all of the WIC estimates are positive in sign, no such consistency is apparent in the Food Stamp estimates. Thus, the one-day and four-day estimates together rather weakly suggest that WIC may have positive effects on dietary intake by WIC-eligible women, but they provide no basis for drawing even preliminary conclusions regarding the dietary effects of Food Stamps.

b. Other Studies of Program Effects on Dietary Intake

The National WIC Evaluation (Rush et al., 1986) is the previous study that is most similar to the current study. It produced separate sets of estimates of the effects of WIC on dietary intake by pregnant women, infants younger than 1 year of age, and children younger than 5 years of age. The effects of Food Stamp were also estimated, as were the interaction effects of WIC and Food Stamps. For pregnant women only, data on pre-WIC dietary intake were used to control for the selection bias associated with WIC enrollment. Six of the nutrients considered in our study were also examined

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in the National WIC Evaluation: food energy, protein, vitamins A and C, calcium, and iron. The following summary of findings is restricted to those nutrients.

Using a model without a WIC-Food Stamp interaction term, Rush et al. found that WIC participation significantly increased the intake of vitamin C and iron by children. All other estimates of the effects of WIC generated by that model are statistically insignificant; however, the signs of those estimates are positive for three of the remaining four nutrients (protein being the exception).[43] These results are broadly consistent with our own qualitative results for children, as presented earlier in Table IV.2.[44] The primary differences are the sign reversals for the estimated effects of WIC on the intake of protein and vitamin A.

On the basis of merged data for infants and children, Rush et al. estimated a model of program effects on nutrient intake that includes a WIC-Food Stamp interaction term. Caution must be exercised in comparing those estimates with our own because the data set that we used, the CSFII, provides no data on the dietary intake of infants. In particular, it should be noted that the WIC food package for infants provides formula rather than whole milk, and the concentration of calcium is lower in formula than in whole milk. The two sets of qualitative estimates of program effects are displayed in Panel 1 of Table IV.7.

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[43]This summary of results for children is based upon estimates presented in Table VI-2 of Rush et al. (1986).

[44]Our own results for children are not strictly comparable with those of Rush et al. because our model includes a WIC-Food Stamp interaction term but their model does not. They did include the interaction term in a model that they estimated on merged data for infants and children.

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TABLE IV.7

COMPARISON OF MPR'S ESTIMATES OF PROGRAM EFFECTS ON DIETARY INTAKE WITH ESTIMATES OBTAINED BY RUSH ET AL.

Nutrient	WIC		Food Stamps		WIC and Food Stamp Interaction	
	MPR	Rush et al.	MPR	Rush et al.	MPR	Rush et al.
Panel 1: Children (MPR); Infants and Children (Rush et al.)						
Food Energy	+	-	+**	+	-**	-
Protein	+	-	+**	+	-**	-
Vitamin A	-	+	-	-	-	+
Vitamin C	+	+*	+	+	-	+
Calcium	+	-*	+	+	-	-
Iron	+	+**	+	+	+	+**
Panel 2: WIC-Eligible Women (MPR); Pregnant WIC-Eligible Women (Rush et al.)						
Food Energy	+	+*	-	-	-	+
Protein	+	+*	+	-	-	+
Vitamin A	+	+**	-*	+	+	+
Vitamin C	+*	+**	-	+	-	+
Calcium	+	+**	-	-	-	+**
Iron	+	+**	-	-	+	+

SOURCE: MPR's estimates were obtained from FNS's 4-day analysis file for the 1985 CSFII using the bivariate selection model for children and the OLS regression model for women. The estimates of Rush et al. (1986) are from Tables V-B-13 and VI-B-5.10 of the final report for the National WIC Evaluation.

* (**): Estimate of program effect is significant at the .05 (.01) level.

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Rush et al. also estimated models of nutrient intake by pregnant women with and without a WIC-Food Stamp interaction term. The estimates of the effects of WIC generated by the model without the interaction term are positive for all six of the selected nutrients and are significant for all of those except vitamin A.[45] Their report provides less detail on the Food Stamp estimates; however, the only statistically significant result is a positive estimated effect on the intake of food energy.

Using a model with a WIC-Food Stamp interaction term, Rush et al. obtained positive and significant estimates of the effects of WIC on the intake of all six of the selected nutrients by pregnant women. Our own estimates of those effects for all WIC-eligible women are also positive but, with the exception of vitamin C, are not statistically significant. Much of the difference in statistical significance between the two sets of estimates can be attributed to the fact that the Rush et al. sample of women contained more than 3,400 cases, whereas our own sample of women contains only 236 cases. Panel 2 of Table IV.7 provides a complete comparison of our own qualitative estimates of program effects on nutrient intake by women with those of Rush et al.

Dietary intake data on 1,542 elderly persons from the SSI/Elderly Food Stamp Cashout Project (1980-81) and on 1,054 households from the Rural Income Maintenance Experiment (1969-1973) formed the basis for analyses of the effects of Food Stamps on nutrient intake undertaken by Butler and

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[45]This summary of results for women generated by the model without a WIC-Food Stamp interaction term is based on estimates presented in Table V-7 of Rush et al. (1986).

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Raymond (1986).[46] Neither of these data sets provides a nationally representative sample of the target demographic groups, thus severely limiting the conclusions that can be drawn from the empirical results of Butler and Raymond.

Butler and Raymond used a model that controlled for selection bias to obtain estimates from the Food Stamp Cashout data base of the effects of Food Stamps on the intake of 9 nutrients by elderly individuals. The estimated Food Stamp effect had a negative sign for each of those nutrients, but only for thiamin did it differ from zero at the 5 percent level of significance. In their analysis of the data from the Rural Income Maintenance Experiment, Butler and Raymond were unable to find an identifying variable for the Food Stamp participation equation. Consequently, they used OLS regression, uncorrected for potential selection bias, to estimate the effects of Food Stamps on the intake of 10 nutrients by the household. For 8 of the 10 nutrients considered, the estimated Food Stamp effect was negative, but only for protein did it differ significantly from zero. For thiamin and niacin, the estimated Food Stamp effect was positive but insignificant.

Because Butler and Raymond's finding of consistently negative but generally insignificant Food Stamp effects on nutrient intake is at odds with a priori expectations, their study has generated critical reviews within the academic research community. Our own finding of generally

[46]In their analyses of both data sets, Butler and Raymond used nutrient adequacy ratios as the measure of dietary intake. For an individual in the Food Stamp Cashout data base, they computed the NARs in a straightforward fashion. For a household in the Rural Income Maintenance Experiment data base, Butler and Raymond computed the NAR for a nutrient as the sum of the intake of that nutrient over all household members, divided by the sum of the RDAs for that nutrient.

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positive and often significant Food Stamp effects on nutrient intake by children and our mixed results for women provide some empirical support for those who question the robustness and generalizability of Butler and Raymond's results.

On the basis of data for approximately 3,000 households from the Low Income Supplement to the 1977-78 NFCS, Basiotis et al. (1987) estimated a model of the effects of Food Stamps and WIC on the nutrient intake of households. The measure of nutrient intake in this study was a composite index of the intake of 11 micronutrients by all household members. Without addressing the potential problem of selection bias, the authors used a three-equation structural model to obtain positive and statistically significant estimates of the effects of Food Stamp benefits and WIC participation on the composite measure of nutrient intake.

Given their disparate samples and analytic designs, it may be inadvisable to search for consistent patterns in the results of our own study and the three studies reviewed in this section; however, we will venture two observations. First, the preponderance of evidence from these studies suggests that the WIC Program has beneficial effects on the quality of diets of the individuals who participate in it. The empirical evidence that supports this observation is stronger for women than for children. Second, the results of these studies vis-a-vis the effectiveness of the Food Stamp Program at improving the quality of diets are inconclusive. For the various nutrients examined, few of the estimates of the effects of Food Stamps are statistically significant, and their signs show no clear patterns.

C. PRELIMINARY ESTIMATES OF PROGRAM EFFECTS ON FOOD EXPENDITURES

In addition to considering the effects of the WIC and Food Stamp programs on the dietary quality of "WIC-eligible" women and children, we consider the effectiveness of the programs at supplementing the food purchases of the households of those individuals. Food purchases are supplemented when the benefits received from the WIC and Food Stamp programs increase the household's expenditures on food. However, since the additional food expenditures may be used to provide food to other household members, the supplementation of food expenditures does not necessarily increase the nutrient intake of the women and young children in the household.

The preliminary estimates of the effects of the WIC and Food Stamp programs on the food purchases of low-income households are presented in this section. The first part of the section describes the selection of the waves of data that were to be used for the food expenditure analysis and the selection of the sample of households that was extracted from FNS's four-day CSFII data file. The household food expenditure model that forms the basis of our estimates of program effects is then described. The program-effect estimates and an assessment of their reliability are presented in the final part of this section.

1. Selecting the Waves of Data and the Sample To Be Analyzed

In this section, we discuss two issues associated with estimating the food expenditure model:

- Deciding whether to base the food expenditure analysis on data from wave 1 or on data from all four waves of FNS's four-day data file
- Selecting the sample of households

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a. Choosing Between Data from Wave 1 and from All Four Waves

In each wave of the CSFII, respondents were asked how much money their household usually spent per week (or per month) on food over the preceding two months. Unlike the data on nutrient intake, we have no reason to believe that the responses to the food-purchase questions were influenced systematically by the day of the week on which the interview occurred. This expectation was supported by our preliminary analyses of the data from all four survey waves, which revealed that food expenditures did not vary systematically by the day of the week of the interview. Furthermore, we found no significant evidence that food expenditures vary over seasons of the year. Given that we have no indication that mean food expenditures over four survey waves would provide a more reliable estimator of usual food expenditures than would the food expenditure amount reported in a single wave, we use the baseline (wave 1) data to analyze the effect of the WIC and Food Stamp programs on household food expenditures.

In addition to providing a good measure of usual food expenditures, the baseline data have the advantage of providing information on important explanatory variables (e.g., household income) that is either not available in the later waves or is not available in reliable form.

b. Sample Selection

The sample used in the food expenditure analysis includes all households that contained at least one member who satisfied the WIC income and categorical eligibility requirements in wave 1. That is, we selected all households which had incomes not in excess of 185 percent of poverty and which included a member who was categorically eligible for WIC.[47] Individuals who are categorically eligible for WIC include (1) children younger than age 5 and (2) women who are pregnant, breastfeeding and less than one year postpartum, or not breastfeeding and less than six months postpartum. Of the 1,858 households in FNS's four-day analysis file for the 1985 CSFII, 515 satisfied the criteria for inclusion in the analysis sample for household food expenditures and also had complete data for the variables used in the analysis. Those 515 households included 173 households in which one or more members were WIC participants (hereafter referred to as WIC participant households) and 250 Food Stamp participant households. Of the program-participant households, 123 households were participating in both the WIC and Food Stamp programs.

2. <u>The Analytic Model</u>

The analytic framework for the household food expenditure analysis parallels the analytic framework for nutrient intake. We estimated the effects of the WIC and Food Stamp programs on household food expenditures by using both the OLS model and the bivariate selection model, with the latter model correcting for the presence of any selection bias. As was true with

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[47]Because the nutrient intake analysis is based on all four waves of data and because of the lack of reliable income data in the post-baseline survey waves, a higher income screen was used in defining the sample for that analysis than was used for the food expenditure analysis. Since the food expenditure analysis is based on wave 1 only, for which their is reliable income data, the sample for the food expenditure analysis was limited to those households that satisfy the actual program income eligibility criteria in wave 1--household income not in excess of 185 percent of the poverty level. (Although each state sets its own income limits for WIC, federal regulations require that those limits not exceed 185 percent of the poverty level.) As was true for the nutrient intake analysis, we did not attempt to model the nutritional risk criteria for WIC eligibility for the food expenditure analysis.

the nutrient intake analysis, the bivariate selection model captures such selection bias by controlling for unmeasured differences between the WIC and Food Stamp program participant and nonparticipant households that may influence the household's food expenditure behavior (e.g., knowledge of nutritional needs).

a. Dependent Variables

The dependent variables in the food expenditure analysis are two measures of household food expenditures: food expenditures on food eaten at home and total food expenditures (which includes expenditures on food eaten at home, as well as expenditures on food bought and eaten away from home). Expenditures on food eaten at home include purchases that are made with Food Stamp coupons and WIC vouchers. Table IV.8 presents means and standard deviations for the food expenditures of "WIC-eligible" households.

Since previous work has shown that the size and composition of the household have important effects on food expenditures (e.g., see Pollack and

Wales, 1980 and 1981; and Barnes and Gillingham, 1984), Table IV.8 presents descriptive statistics on total food expenditures, food expenditures per household member, and food expenditures per "equivalent person." The latter measure adjusts for the age and sex composition of the household through the use of weights for each household member that reflect his or her dietary requirements relative to those of an arbitrary household member, generally an adult male. The sum of the weights over all household members is the number of adult-male-equivalent (AME) persons in the household. For this analysis, we have used the relative cost of a nutritionally adequate diet

TABLE IV.8

SAMPLE MEANS AND STANDARD DEVIATIONS FOR THE HOUSEHOLD FOOD EXPENDITURE VARIABLES: WIC-ELIGIBLE HOUSEHOLDS

(weighted data, N=515)

	Mean	Standard Deviation
Household Total Food Expenditures (Dollars per Month)	275.40	139.98
Per Household Member	68.20	34.58
Per Adult-Male-Equivalent Household Member	90.92	46.55
Household Expenditures on Food at Home (Dollars per Month)	225.27	118.29
Per Household Member	55.06	26.64
Per Adult-Male-Equivalent Household Member	73.45	35.76

SOURCE: Wave 1 of FNS's 4-day analysis file for the 1985 CSFII.

for each household member to obtain an AME-adjusted measure of household food expenditures.[48]

As shown in Table IV.8, total food expenditures per month averaged $275 for the households in the sample, with $225 of that amount spent on food at home. After household size and composition were controlled for, the comparable figures were $91 per month per AME for total food expenditures and $73 per month per AME for food expenditures at home.

b. Independent Variables

The independent variables that are included in the household food expenditure equations consist of measures of program participation, socioeconomic control variables, and variables that control for the stratification of the CSFII samples.

Program Participation Variables. In defining the program participation variables, we initially considered two alternative measures of participation: (1) variables that indicated whether the household had received any benefits from the program, and (2) variables that measured the dollar value of all program benefits received by the household and/or its members. We measured the value of a household's WIC benefits as the sum of the dollar value of the WIC vouchers or checks received by the participating individ-

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[48]The basis for our AME adjustment is the moderate-cost food plan developed by the Human Nutrition Information Service of USDA. This food plan, which is one of four plans (thrifty, low-cost, moderate-cost, and liberal-cost), suggests the amount of foods that could be consumed by individuals of different sexes and ages to meet dietary standards at a moderate cost. Although little consensus has been reached about the appropriate AME scale, an earlier analysis of household food expenditures by Long (1988) found that program-effect estimates for models using AME adjustments based on the moderate-cost food plan, the low-cost food plan, and relative food energy needs were not sensitive to the particular scale that was used.

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uals within the household.[49] We measured the value of the Food Stamp benefits received by a household as the face value of the coupons.[50]

The first of the two alternative measures of program participation assumes that participation in a program has a fixed effect on the household's food expenditure behavior, while the second measure assumes that the program effect varies with the value of the benefits that the household receives from the program. The latter measure of participation permits the estimation of the effect of each additional dollar of program benefits on the household's food expenditures--referred to as the household's marginal propensity to consume (MPC) food from the program benefits.

With respect to Food Stamps, the estimates of the effect of the program were consistent across the two model specifications, with the "value of the benefits" measure displaying the stronger relationship with household food expenditures. Consequently, we have used that variable as the measure of Food Stamp participation in our final model specification.

A comparison of the estimates of the effect of the program based on the alternative measures yielded quite different results for WIC. Using the first measure, participation in WIC was estimated to have a large, statis-

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[49]In Fiscal Year 1985, the value of an individual's WIC food package ranged from $26.67 per month for postpartum women to $35.80 for infants, with an estimated average value of $31.69 for all individuals. Because there is relatively little variation in the value of WIC benefits across individuals, the variation in the value of the household's WIC benefits is due primarily to differences in the number of WIC participants in the households. For the WIC participant households in our sample, the average value of the WIC benefits received by the households was $45.46. (The lack of variation in the value of the WIC benefits received by women and children prevent our using a measure of the value of WIC benefits in the nutrient intake analysis.)

[50]For the Food Stamp participants within our sample of WIC-eligible households, the average value of the Food Stamp benefit was $114.17 per month.

tically significant effect on household food expenditures, while the estimate of the effect based on the measure of the "value of the benefits" did not differ significantly from zero in a statistical sense.

In an effort to understand these apparently contradictory results, we estimated a number of exploratory models of the relationship between the household's participation in WIC and its food expenditures, including models based on the number and "types" of WIC participants within the household (e.g., pregnant women, postpartum or pregnant women, children, or infants). Although the small number of WIC participant households in our sample limited our ability to control for all types of WIC households, a model based on types of WIC participants within the household proved to have the greatest explanatory power and is the version of the model reported here. However, it is important to note that our estimates of the effect of WIC participation on household food expenditures were sensitive to the choice of participation measures, and, consequently, the estimates reported here should be viewed as quite preliminary. A larger sample of WIC participant households is needed to explore the WIC participation-food expenditures relationship fully.

To summarize, the program participation variables that are included in the food expenditure equations are defined as follows:

- Indicators of the presence in the household of a WIC participant who was:
  - a pregnant woman
  - a breastfeeding or postpartum woman[51]
  - a child
  - an infant

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[51]The small number of household that contained a WIC participant who was breastfeeding prevented us from considering breastfeeding and postpartum women separately.

- o An indicator of whether the household contained WIC participants from two or more of the program categories listed above

- o The dollar value of the Food Stamps received by the household

Socioeconomic Control Variables. In defining many of the socioeconomic control variables that are included in the food expenditure equations, we used the characteristics of the respondent to the household survey to serve as proxies for the characteristics of her household.[52] The socioeconomic control variables include the following:

- o The respondent's position within the household (e.g., female head of household, main meal planner/preparer)

- o The respondent's age

- o The respondent's education

- o The respondent's race and ethnicity

- o The respondent's employment status

- o An indicator of the presence of a male head in the household

- o Household size[53]

- o An indicator of the presence of a pregnant woman in the household

- o An indicator of the presence of a woman who is breastfeeding in the household

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[52]In selecting the respondent to the household survey, priority was placed on identifying the woman between the ages of 19 and 50 who was the female head of the household or the main meal planner and preparer in the household. If none of the 19-50 year-old women in the household satisfied those criteria, the 19-50 year-old woman who was most knowledgeable about the household was selected as a survey respondent.

[53]Because the food expenditure model is scaled by adult-male-equivalent units, the household size variable provides a measure of economies of scale in food purchases and preparation.

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- o Household income
- o Geographic region

Sample Stratification Variables. The final set of independent variables, the sample stratification variables, include the variables that were used in stratifying the samples in both the CSFII design and in the creation of FNS's four-day analysis file. Those variables are described in Appendix C. That appendix provides detailed definitions of and descriptive statistics for all of the dependent and independent variables in the food expenditure equations, as well as for the variables in the WIC and Food Stamp participation equations of the bivariate selection model.

c. Estimation Approach

The estimation approach used in the analysis of household food expenditures, like the nutrient intake analysis, obtained estimates of the WIC and Food Stamp program effects within the context of two different econometric models: the OLS model, which produces biased estimates of program effects in the presence of selection bias, and the bivariate selection model, which is used to purge the estimates of program effects of such bias.

As discussed in Section B, the bivariate selection model is sensitive to our ability to identify factors that affect the program participation decisions, but which do not affect the outcome behavior of interest (in this case, household food expenditures). Because this requirement was satisfied for the food expenditure analysis, the bivariate selection model provides more reliable estimates of the effects of WIC and Food Stamps on household food expenditures than does the OLS model.

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3. Estimation Results

The program effect estimates obtained from our analysis of household food expenditures are presented in this section. The complete analytical results, including the estimates of the WIC and Food Stamp participation equations, are presented in Appendix K.

a. Expenditures on Food at Home

As reported in Table IV.9, participation in WIC by household members within each of the participation categories had positive effects on the household's expenditures on food at home, although the effects were statistically significant only for breastfeeding or postpartum women (hereafter referred to as "mothers") and for infants. After controlling for the types of WIC participants within the household, the presence of WIC participants in more than one of the participant categories was estimated to have a negative and statistically significant effect on food expenditures at home. To calculate the full effect of WIC participation for a household in which there were WIC participants from multiple categories, one needs to sum the coefficient estimates of the effect of participation by each individual and the estimate of the effect of multiple types of participants. (Estimates of the full effect on households of participation in WIC are presented later in this section.)

The estimates of the magnitudes of the increases in food expenditures due to participation in the WIC and Food Stamp programs are summarized in Table IV.10. Ignoring the impact of multiple types of WIC participants for the moment, the greatest increases in food expenditures due to WIC participation are observed for households in which the WIC participants include mothers and infants. In contrast, households in which the WIC participants

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TABLE IV.9

QUALITATIVE ESTIMATES OF PROGRAM EFFECTS ON HOUSEHOLD FOOD EXPENDITURES PER AME: WIC-ELIGIBLE HOUSEHOLDS

(weighted data, N=515)

	Expenditures on Food at Home		Total Food Expenditures	
	Bivariate Selection Model	*Ordinary* Least Squares	*Bivariate* Selection Model	*Ordinary* Least Squares
Household's WIC Participants Include:				
Pregnant Woman	+	-	+	-
Breastfeeding or Postpartum Woman	+ **	+ **	+ **	+ **
Child	+	-	+	-
Infant	+ **	+ **	+ **	+ **
Multiple Types of Participants	- **	- **	- **	- **
Food Stamp Benefit Amount	+ *	+	+	-

SOURCE: Wave 1 of FNS's 4-day analysis file for the 1985 CSFII.

NOTE: Complete estimation results are provided in Appendix C.

* (**) Estimate of program effect is significant at the .05 (.01) level.

TABLE IV.10

ESTIMATES OF THE
DOLLAR CHANGE IN HOUSEHOLD FOOD EXPENDITURES PER AME
ATTRIBUTABLE TO PROGRAM PARTICIPATION: WIC-ELIGIBLE HOUSEHOLDS
(weighted data, N=515)

	Expenditures on Food at Home (Dollars per Month)	Total Food Expenditures (Dollars per Month)
Household's WIC Participants Include:		
Pregnant Woman	9.13	6.66
Breastfeeding or Postpartum Woman	37.18	44.44
Child	8.16	17.74
Infant	30.14	34.10
Multiple Types of Participants	-36.90	-50.53
Additional Dollar of Food Stamp Benefits	.29	.05

SOURCE: Wave 1 of FNS's 4-day analysis file for the 1985 CSFII.

NOTE: The estimates shown in this table are derived from the bivariate selection model estimates of program effects.

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include either pregnant women or young children make little, if any, changes in their expenditures on food at home as a result of WIC participation. It would appear that WIC benefits are treated differently when they are received by different members of the household.

The full effect of WIC participation on the household's food expenditures depends on both the particular type of WIC participants in the household and the presence of participants within multiple participation categories. Thus, the estimated full effect of WIC on expenditures on food at home for a household with WIC participants that include a mother and an infant would be the sum of the effects of participation by each individual and the effect of multiple types of participants: $37.18 + $30.14 - $36.90, or $30.42.

The magnitudes of the estimated increases in food expenditures due to WIC participation should be interpreted with caution, since these estimates indicate that the WIC-induced increase in expenditures on food at home per AME exceeds the average value per AME of the WIC benefit packages received by certain types of households. Table IV.11 presents the predicted full effect of WIC participation on household expenditures for the WIC participant households in our sample and the actual value of the WIC benefits received by those households. As shown in the table, the average dollar value per AME of the household's WIC benefits for households that include a mother who is a WIC participant is $19.29, while the average estimated increase in food expenditures at home for those households is $32.64 per AME. Given the sensitivity of the analysis to the particular measures of WIC participation that were used and the small sample sizes upon which the parameter estimates were based, these estimates should be viewed as evidence

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TABLE IV.11

COMPARISON OF THE AVERAGE VALUE OF HOUSEHOLD WIC BENEFITS WITH THE PREDICTED INCREASE IN HOUSEHOLD EXPENDITURES ON FOOD AT HOME DUE TO WIC PARTICIPATION

(weighted data, N=515)

	Average Value of Household's WIC Benefits per AME (Dollars per Month)	Predicted Increase in Expenditures on Food at Home per AME Due to WIC Participation by All WIC Participants in the Household (Dollars per Month)
Household's WIC Participants Include:		
Pregnant Woman	19.57	1.92
Breastfeeding or Postpartum Woman	19.29	32.64
Child	17.52	8.05
Infant	18.21	25.09
All WIC Participant Households	15.73	16.49

SOURCE: Wave 1 of FNS's 4-day analysis file for the 1985 CSFII.

NOTE: The estimates shown in this table are derived from the bivariate selection model estimates of program effects.

* (**) Estimate of program effect is significant at the .05 (.01) level.

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that additional exploratory work must be undertaken on the appropriate specification of the WIC participation-food expenditure relationship. As noted earlier, our ability to explore this relationship was constrained by the relatively small sample of WIC participant households.

Our findings on the effect of WIC on household expenditures for food at home are roughly consistent with those of the only other WIC participation-food expenditure study of which we are aware--the National WIC Evaluation (Rush et al., 1986). That study found no significant impact on expenditures for food at home of participation in the WIC program by pregnant women. Unfortunately, because the sample for the food expenditure analysis was limited to pregnant women and their households, the National WIC Evaluation can provide little insight into the apparent complexity of the full WIC participation--food expenditure relationship for all WIC households.

Unlike the WIC estimates, the estimate of the effect of Food Stamps on household expenditures on food at home is not sensitive to the specification of the model. Each additional dollar of Food Stamp benefits increases expenditures on food at home by 29 cents for the "WIC-eligible" households. This estimate of the MPC for food at home out of Food Stamp benefits compares with an MPC for food at home from cash income of .09.[54] Both estimates are statistically significant and are well within the range of estimates obtained from previous studies of expenditures on food at home. In general, the estimates from previous studies of the MPC for food at home

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[54]The estimate of the MPC for food at home for cash income is from the bivariate selection model estimates of the food expenditure equation, as reported in Appendix K. The estimates of the effect of the Food Stamp benefits and cash income on expenditures on food at home differ from zero in a statistical sense, implying that coupons are treated differently than cash for purchases of food at home.

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from cash income range from .05 to .11, while most of the estimates of the MPC from Food Stamp benefits range from .20 to .45.[55]

b. Total Food Expenditures

The estimates of the effects of WIC participation by the household members on total food purchases exactly parallel the findings of the effects of WIC on expenditures on food at home, as shown in Tables IV.9 and IV.10; thus, they will not be discussed further. In contrast, the estimate of the MPC for total food expenditures from Food Stamps is .05 and does not differ from zero in a statistical sense.[56] Thus, Food Stamp benefits have no effect on the total food expenditures of the household. This finding, in conjunction with the estimated increase in food expenditures at home due to Food Stamp participation, suggests that households reduce their expenditures on food away from home due to their participation in Food Stamps. Thus, while total food expenditures have not increased with participation in Food Stamps, the allocation of those expenditures between food at home and food away from home has changed significantly. Support for this result is found in a recent study of food expenditures at home and away from home which found that households participating in the Food Stamp Program were significantly less likely than nonparticipating households to purchase food away from home (Lee and Brown, 1986).

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[55]Appendix Table C.4 summarizes the findings from previous studies of the impact of Food Stamps on the expenditures of low-income households for food at home.

[56]Because previous work has focused on analyzing expenditures on food at home, there is no existing literature with which to compare this finding. One exception to the tendency of previous studies to focus on food at home is the work by Beebout et al. (1985), in which total food expenditures were examined. However, because that study examined food expenditures in Puerto Rico, it is not an appropriate comparison for this analysis.

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c. Assessment of the Results

The bivariate selection model estimates of the effects of Food Stamps on household expenditures on food at home and on total food expenditures are reasonable and, where estimates from previous studies were available, consistent with such studies. The estimates of the effect of WIC on household food expenditures are much more problematic. The findings reported here, as well as the exploratory work that was conducted to arrive at the final model specification, suggest that the relationship between WIC participation and household food expenditures is quite complicated. There is evidence that the effects of the WIC program vary for different types of participating households, although the small sample of WIC participant households that was available prevented our exploring the relationship as fully as we would have liked. Due to the sensitivity of our estimates to alternative model specifications and due to our inability to fully consider the effect of different types of participant households within the sample sizes available in the 1985 CSFII, the estimates that are reported herein should be viewed as very preliminary.

D. LIMITATIONS OF OUR RESULTS AND RECOMMENDATIONS FOR FUTURE RESEARCH

There are three principal weaknesses in the results of our application of the bivariate selection model to estimate the effects of WIC and Food Stamps on dietary intake and food expenditures:

1. The signs of our estimates of the effects of WIC and Food Stamps on dietary intake are positive for most nutrients, but the standard errors of those estimates are so large that we cannot say with 95 percent confidence that the true effects are different from zero. Larger samples would be likely to result in smaller standard errors and, hence, in enhanced statistical significance of the program-effect estimates.

2. The absence of identifying variables in the WIC participation equation prevented us from satisfactorily estimating the bivariate selection model of dietary intake on the sample of women. The small size of the sample of women contributed to this problem, as did the limited number of potential predictors of WIC participation in the CSFII data base.

3. Our estimates of the effect of WIC on household food expenditures are highly sensitive to alternative model specifications. This sensitivity reflects the primitive state of our knowledge of the relationships between household composition and (a) food requirements and (b) the value of WIC benefits received by all members of the household.

These weaknesses in our results motivate several recommendations for future research on the effects of nutrition assistance programs on dietary intake and food expenditures. Those recommendations are as follows:

- If FNS requires information on the relative effectiveness of the WIC and Food Stamp programs at improving dietary quality, then it should consider the estimation of models similar to those developed in this report on data from the 1987-88 NFCS. As a first step, the number of observations provided by the NFCS on "WIC-eligible" women and children should be ascertained and compared with the sizes of the corresponding samples that were the basis for this report.

- Due to the paucity of prior research, the state of the art in modeling the effect of WIC on household food expenditures is far behind that for Food Stamps.[57] If this relationship is potentially of policy importance, then FNS should undertake the basic research that will be required to develop and estimate well-specified models of the relationship.

- The scarcity in most data sets of variables that can identify program participation equations severely limits the feasibility of using models that correct for selection bias

[57]The National WIC Evaluation (Rush et al., 1986) is the one study of which we are aware that has estimated models of the effects of WIC on household food expenditures.

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> to estimate the effects of those programs.[58] In designing both general-purpose data bases, such as the NFCS and CSFII, and data bases that are designed specifically for the evaluation of a specific program or programs, FNS should be mindful of the need to obtain information on a range of factors that influence program participation decisions.[59]

FNS should also be aware of alternative econometric software for estimating the effects of multiple assistance programs while controlling for selection bias associated with the joint decisions of eligibles to participate in those programs. Full information maximum likelihood (FIML) is an alternative to LIMDEP's two-stage procedure for estimating the bivariate selection model.[60] Both the FIML estimates and the two-stage estimates are unbiased, but the FIML estimates are more efficient (i.e., the standard errors of the FIML estimates tend to be smaller than those of the two-stage estimates). A serious drawback of FIML is that it is often necessary to custom develop the complex code for the software.

Neither the two-stage approach of LIMDEP[tm] nor the FIML approach are practical options for estimating the trivariate selection model--a model of the joint decision of eligibles to participate in three assistance programs and of the effects of those programs on some outcome measure. McFadden (1986) has developed a statistical procedure known as the "method of

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simulated moments," which permits researchers to estimate the trivariate selection model as well as more complex models. Steinberg (1988) has used this procedure to estimate a model of the effects of Food Stamps, AFDC, and public housing on hours of work by female heads of household with dependent children. Her model controls for selection bias arising from the joint decision of eligibles to participate in any or all of the three programs.

REFERENCES

Barnes, R. and R. Gillingham. "Demographic Effects in Demand Analysis: Estimation of the Quadratic Expenditure System Using Microdata." Review of Economics and Statistics, Vol. 66. November 1984, pp. 591-601.

Basiotis, P. Peter, et al. "Food Stamps, Food Costs, Nutrient Availability, and Nutrient Intake." Journal of Policy Modeling, Vol. 9, No. 3, pp. 383-404.

Battese, G.E., S.M. Nusser, and W.A. Fuller. "Estimation of the Distribution of Usual Intakes for Selected DIetary Components Using Data from the 1985-86 CSFII." Ames, IA: Center for Agricultural and Rural Development and Department of Statistics, Iowa State University, 1988.

Beebout, Harold, et al. Evaluation of the Nutrition Assistance Program in Puerto Rico, Volume II: Effects on Food Expenditures and Diet Quality. A report to the U.S. Congress. Washington, DC: Mathematica Policy Research, June 1985.

Benus, J., J. Kmenta, and H. Shapiro. "The Dynamics of Household Budget Allocation to Food Expenditures." Review of Economics and Statistics, Vol. 58, No. 2, 1976, pp. 129-138.

Brown, C. and J.P. Habicht. "Selecting a Screening Cut-off Point or Diagnostic Criterion for Comparing Prevalences of Disease." Biometrics, Vol. 40, 1984, pp. 675-684.

Brown, M., S.R. Johnson, and R.L. Rizek. "Food Stamps and Expenditure Patterns: A Statistical Analysis." University of Missouri-Columbia. Report prepared under U.S. Department of Agriculture Grant No. 53-3244-9-188, 1982.

Butler, J. S., and Jennie Raymond. "The Effect of the Food Stamp Program on Nutrient Intake." Paper presented at the NBER conference on the economics of government expenditure programs. Cambridge, MA: National Bureau of Economic Research, November 1986.

Chen, J.A. "Simultaneous Equations Models with Qualitative Dependent Variables: A Food Stamp Program Participation and Food Cost Analysis." Ph.D. dissertation. University of Missouri, 1983.

Devaney, B. and T. Fraker. "Estimation of MPR's Food Expenditure Model on Mainland U.S. Data." Memorandum to the Food and Nutrition Service, U.S. Department of Agriculture, October 15, 1985.

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Food and Agriculture Organization, World Health Organization, and United Nations University. Energy and Protein Requirements. Report of a Joint FAO/WHO/UNU Expert Consultation, Technical Report Series 724. Geneva, Switzerland: World Health Organization, 1985.

Fraker, Thomas M. "The Effects of Food Stamps on Food Consumption: A Review of the Literature." Washington, DC: Mathematica Policy Research, October 1990 (revised draft).

Fraker, Thomas and Charlie Post. "Documentation for a SAS Analysis File Containing Merged 4-Day Data for the Core and Low-Income Samples of the 1985 CSFII." Washington, DC: Mathematica Policy Research, March 1989.

Fraker, Thomas and Robert Moffitt. "The Effect of Food Stamps on Labor Supply: A Bivariate Selection Model." Journal of Public Economics, Vol. 35, February 1986, pp. 25-56.

Fraker, Thomas and Rana Tarazi. "Descriptive Tables Based Upon Merged Wave 1 Data for the Core and Low-Income Samples of the 1985 CSFII." Washington, DC: Mathematica Policy Research, July 1987.

Heckman, James J. "Dummy Endogenous Variables in a Simultaneous Equations System." Econometrica, Vol. 46, July 1978, pp. 931-961.

________. "Sample Selection Bias as a Specification Error." Econometrica, Vol. 47, January 1979, pp. 153-161.

________ and R. Robb. "Alternative Methods for Evaluating the Impact of Interventions," in Longitudinal Analysis of Labor Market Data, ed. by J. Heckman and B. Singer. Cambridge University Press, 1985.

Hymans, S.H. and H.T. Shapiro. "The Allocation of Household Income to Food Consumption." Journal of Econometrics, Vol. 4, No. 2, 1976, pp. 167-188.

Irwin, M.I., and B.K. Hutchins. "A Conspectus of Research on Vitamin C Requirements of Man." Journal of Nutrition, Vol. 106, 1976, pp. 823-879.

Johnson, S.R. et al. "Methodological Factors Affecting the Measurement of Dietary Status." Ames, IA: Center for Agricultural and Rural Development and Department of Statistics, Iowa State University, 1988.

Lee, J.Y. and M.G. and Brown. "Food Expenditures At Home and Away From Home in the United States--A Switching Regression Analysis." Review of Economics and Statistics, Vol. 68, No. 1, February 1986, pp. 142-147.

Life Sciences Research Office. "Guidelines for Use of Dietary Intake Data." Bethesda, MD: Federation of American Societies for Experimental Biology, 1986.

Life Sciences Research Office. "Estimation of Exposure to Substances in the Food Supply." Bethesda, MD: Federation of American Societies for Experimental Biology, 1988.

Life Sciences Research Office. Nutrition Monitoring in the United States--An Update Report on Nutrition Monitoring. Prepared for the U.S. Department of Agriculture and the U.S. Department of Health and Human Services. Washington, DC: U.S. Government Printing Office, 1989.

Long, Sharon K. "The Impact of the School Nutrition Programs on Household Food Expenditures." Washington, DC: Mathematica Policy Research, October 1988.

Mathematica Policy Research. "Handbook of Assistance Programs." Washington, DC: Mathematica Policy Research, June 1986.

McFadden, Daniel. "A Method of Simulated Moments for Estimation of Multinomial Probits Without Numerical Integration." Mimeograph. Massachusetts Institute of Technology, 1986.

National Research Council, Subcommittee on Criteria for Dietary Evaluation. Nutrient Adequacy: Assessment Using Food Consumption Surveys. Washington, DC: National Academy Press, 1986.

National Research Council. Recommended Dietary Allowances. Washington, DC: National Academy Press, 1980.

Pao, E.M., K.S. Sykes, and Y.S. Cypel. USDA Methodological Research for Large-Scale Dietary Intake Surveys, 1975-99. Alexandria, VA: Human Nutrition Information Service, U.S. Department of Agriculture, 1989.

Pollack, R.A. and T.J. Wales. "Comparison of the Quadratic Expenditure System and Translog Demand Systems with Alternative Specifications of Demographic Effects." Econometrica, Vol. 48, April 1980, pp. 595-612.

________. "Demographic Variables in Demand Analysis." Econometrica, Vol. 49, November 1981, pp. 1,533-1,551.

Ritenbaugh, Cheryl, et al. "Methodological Issues in Food Consumption Surveys." Final report under USDA cooperative agreement #58-3198-6-62, July 1988.

Rush, David, et al. The National WIC Evaluation. Research Triangle Park, NC: Research Triangle Institute, 1986.

Salathe, L.E. "The Food Stamp Program and Low-Income Households' Food Purchases." Agricultural Economics Research, Vol. 32, No. 4, 1980a.

Salathe, L.E. "Impact of Elimination of the Food Stamp Program's Purchase Requirement on Participants' Food Purchases." Southern Journal of Agricultural Economics, December 1980b, pp. 87-92.

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Senauer, B. and N. Young. "The Impact of Food Stamps on Food Expenditures: Rejection of the Traditional Model." American Journal of Agricultural Economics, February 1986, pp. 37-43.

Smallwood, D.M. and J.R. Blaylock. "Analysis of Food Stamp Program Participation and Food Expenditures." Economics Research Service staff report, U.S. Department of Agriculture, 1983.

Steinberg, Barbara. "The Labor Supply Effects of Government Transfers in Cash and In Kind." Discussion paper, Department of Economics, University of Virginia, October 1988.

U.S. Department of Health and Human Services and U.S. Department of Agriculture. "Nutrition Monitoring in the United States--A Report from the Joint Nutrition Monitoring Evaluation Committee." DHHS Publication No. (PHS) 86-1255. Public Health Service. Washington, DC: U.S. Government Printing Office, 1986.

West, D.A. "Effects of the Food Stamp Program on Food Expenditures." Office of Economic Analysis and Program Evaluation staff report, U.S. Department of Agriculture, 1979.

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APPENDIX A

TECHNICAL DETAILS FOR CHAPTER II: ESTIMATING USUAL DIETARY INTAKE AND ASSESSING DIETARY ADEQUACY

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This appendix describes the steps involved in estimating usual dietary intake using the NRC Subcommittee's intake-adjustment procedure and those required to apply the probability approach (and its approximation--the mean of the requirement distribution) as the criterion for assessing dietary adequacy. We also describe our procedure for determining the proportion of the population that fails to attain the RDA. We apply these procedures for a sample of low-income children. We examine eight nutrients: vitamin A, vitamin C, calcium, vitamin E, iron, food energy, protein, and zinc.

In addition to providing the technical documentation for the findings presented in the body of the report, it is hoped that this appendix will assist other analysts in their application of the two methodologies. Because of the latter objective, we present very detailed information on the computer code used in generating our findings.

A. SELECTION OF THE SAMPLE

During an earlier stage of this project, MPR developed a SAS analysis file which includes 4 days of intake data, as well as selected other information from the 1985 CSFII six-wave core and low-income files (see Fraker and Post, 1988). The analysis file includes all women ages 19-50 and their children ages 1-5 (as of the first interview) in the 1985 CSFII who reported at least four days of dietary intake. In this analysis of nutriture, we limited our sample to the children residing in low-income households, defined as households in which the income as of wave 1 was less than or equal to 200 percent of the poverty level.[1] Of the 760 children on

[1]We used the following SAS code to extract the sample of children from FNS's four-day SAS analysis file: IF HINCLMS LE 2*($415+(D1HPERS-1)*$145) AND D1AGE LE 5, where $415 is the poverty level for a single-person household; $145 is the amount by which the poverty line increases with each

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FNS's four-day, 638 passed the household income screen and were included in our analysis sample.

The data for each child were downloaded to a personal computer so that we could use PC SAS for the analyses and to generate the figures included in the body of the report.

B. ESTIMATING USUAL DIETARY INTAKE

A sample distribution of nutrient intakes includes multiple sources of variation: (1) interindividual variation--the variation in intake between individuals in the sample, (2) intraindividual variation--day-to-day fluctuations in a person's food intake which are not the result of sample design or temporal influences, and (3) sample design and/or temporal variation--variation caused by differences in survey methods (e.g., telephone versus in-person interviews) or differences in the seasonal or day-of-the-week timing of the data collection. Estimates of the distribution of usual intake of a population which are based on sample distributions which include sources of variation other than interindividual variation. In order to obtain unbiased estimates of usual intake, such extra-interindividual variation must be removed. This section describes our efforts to remove the sample design variation, temporal variation, and

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additional household member; HINCLMS = [total household income last month, computed by summing across the following household measures: HINCAFDC (income last month from AFDC); HINCBUS/12 (household income last year from business or farm, converted to average income per month); HINCINT/12 (income last year from interest, dividends, or annuities, converted to average income per month); HINCOTH (income last month from rent, child support, alimony, or other sources); HINCPENS (income last month from pensions or retirement funds); HINCSSI (income last month from social security or SSI); HINCWAGE (income last month from wages/salary); HINCWC (income last month from unemployment or workers' compensation); some missing values were imputed (see Fraker and Post, 1988)], D1HPERS = [number of persons in the household as of day 1], and D1AGE = [age at the time of the first interview].

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intraindividual variation from the sample distributions of average daily intake.

1. Sample Design and Temporal Variation

To investigate the influence of sample design and temporal variation on reported intake, we regressed nutrient intake for each day on a series of nine binary variables indicating whether that day of intake was: (1) from wave 2, 3, 4, 5, or 6 (wave 1 was the omitted category), (2) collected during the summer, fall, or winter (spring was the omitted category), and (3) for a weekend day (weekday was the omitted category). Each day of intake for each child was treated as a separate, independent observation.[2]

The R^2 (a measure of the extent to which the independent variables capture the variation in the dependent variable) for each of the nutrient equations was less than .015, indicating no systematic variation in intake due to sample design or temporal issues.[3] Given the results of the regression analysis, we did not adjust the intake distributions for sample design variation or temporal variation.

2. Intraindividual Variation

As the intake-adjustment procedure proposed by the NRC Subcommittee is appropriately applied only to relatively symmetrical intake distributions, we limited the application of the procedure to five nutrients: calcium, iron, food energy, protein, and zinc. In this section, we describe how we

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[2]Thus, for each nutrient, there were 2552 observations (638 children X 4 days of intake per child).

[3]In the equation for one nutrient there was a single binary dummy variable which was statistically significant--the coefficient on the binary variable indicating that the intake data were for a weekend day was negative and statistically significant in the equation for calcium.

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selected the set of nutrients for which the adjustment procedure was applied and describe the steps involved in implementing the procedure.

a. Selection of Nutrients with Symmetrical Intake Distributions

At present, there is no standard as to the degree of symmetry that is required in the intake distribution in order to apply the intake-adjustment procedure. In selecting the nutrients for which we applied the procedure, we have tried to be relatively conservative in our use of the procedure. We assessed the symmetry of the four-day average nutrient intake distributions using both a visual assessment of histograms based on four-day average intakes and a comparison of the estimates of the measures of statistical skewness across nutrients. We first visually analyzed the symmetry of the histograms based on the weighted four-day average intakes of each nutrient. The four-day average distributions for five nutrients appeared to be fairly symmetrical (calcium, food energy, iron, protein, and zinc), while the distributions for three nutrients appeared to be fairly asymmetrical (vitamins A, C, and E).

The second step in our analysis of symmetry involved the use of the PROC MEANS procedure in SAS to produce weighted estimates of the skewness for each distribution, reported in Table A.1. The estimates of skewness for vitamins A and E are substantially higher than the median estimate of statistical skewness for the nutrients included in this analysis (the median

TABLE A.1

STATISTICAL SKEWNESS OF SAMPLE DISTRIBUTIONS OF FOUR-DAY AVERAGE INTAKE: LOW-INCOME CHILDREN

(weighted data, N=638)

Nutrient	Skewness
Vitamin A	3.70
Vitamin C	1.26
Calcium	0.88
Vitamin E	6.10
Iron	2.12
Food Energy	0.39
Protein	0.60
Zinc	0.78

estimate is a little above 1), while the estimate of skewness for iron is somewhat higher than the median value.[4]

Based on the histograms and the estimates of statistical skewness, we decided not to apply the adjustment procedure to the intake distributions for vitamins A, C, and E. We decided to apply the adjustment procedure to the intake distribution for iron, despite the estimate of statistical skewness, because of particular concern about inadequate intake of among young children (U.S. Department of Health and Human Services and U.S. department of Agriculture, 1986). The results for iron should be regarded as less reliable than those for the other nutrients for which we applied the adjustment procedure.

b. Application of the Intake-Adjustment Procedure

In adjusting the intake distribution of the five nutrients, we used a three-step process which is based on the procedure outlined by the NRC Subcommittee and more clearly specified in Ritenbaugh et al. (1988, Appendices 3 and 8). First, we disaggregated the total sum of squared deviations of one-day observations on dietary intake by individual sample members from the sample grand mean daily intake into two components: (1) deviations of daily intake values for an individual from his or her mean daily intake (i.e., the error sum of squares) and (2) deviations of individual mean daily intake values from the sample grand mean daily intake (i.e., the model sum of squares). Next, we calculated attenuation factors.

[4]Similar findings with respect to the symmetry of the distributions for these nutrients are reported in Ritenbaugh et al.(1988). They also studied food energy, protein, vitamin A(IU), vitamin C, calcium, and iron in their analysis of nonpregnant, nonlactating young women, using the 1985 CSFII, and they reported that the intake distributions for vitamin A and vitamin C were skewed, and that the intake distribution for iron was slightly skewed.

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Finally, we used the attenuation factors to adjust the four-day nutrient intake distributions.

Step 1: Disaggregation of the Total Sum of Squares. We obtained estimates of the total model, and error sums of squares through a three-part process.[5] Before describing that process, it is useful to note that:

$$\text{(A.1)} \quad \sum_{i=1}^{4}\sum_{j=1}^{n} W_j(Y_{ij} - \bar{\bar{Y}})^2 = 4\sum_{j=1}^{n} W_j(\bar{Y}_j - \bar{\bar{Y}})^2 + \sum_{i=1}^{4}\sum_{j=1}^{n} W_j(Y_{ij} - \bar{Y}_j)^2$$

(Total Sum of Squares = Model Sum of Squares + Error Sum of Squares)

where, W_j is the sample weight for the j-th child in the sample, 4 is the number of days of intake data, n (= 638) is the number of children in the sample, Y_{ij} is the i-th day of intake data for the j-th child, $\bar{Y}_j$ is the four-day mean intake for the j-th child, and $\bar{\bar{Y}}$ is the four-day mean intake over all of the children in the sample (i.e., the grand mean daily intake).

We used PROC REG with the WEIGHT option to obtain the error sum of squares. Specifically, we regressed the dependent variable in deviations form--that is, $(Y_{ij} - \bar{Y}_j)$--on a vector of 1s. The mean value of this variable is zero, so the total sum of squares from the regression analysis is $\sum_{i=1}^{4}\sum_{j=1}^{n} W_j(Y_{ij} - \bar{Y}_j)^2$, which is the error sum of squares in equation (A.1).

We computed the model sum of squares directly from the data by summing $W_j(\bar{Y}_j - \bar{\bar{Y}})^2$ over all sample children and multiplying by 4.

[5]Ritenbaugh et al. (1989) use analysis of variance (ANOVA) to disaggregate the total sum of squares using unweighted data. Unfortunately, PROC ANOVA in SAS is not structured to produce appropriate estimates for the intake-adjustment procedure using weighted data. An alternative SAS procedure, PROC GLM, is, in principle, capable of producing appropriate estimates based on weighted data. However, we found the procedure is (1) prohibitively expensive to run on a mainframe computer and (2) accepts no more than approximately 150 cases when run on an IBM 386 AT personal computer.

As an internal check on the calculation of the error and model sums of squares, we used PROC REG with the WEIGHT option to compute the total sum of squares. We did this by regressing the dependent variable, Y_{ij}, on a vector of 1s. The error sum of squares from that analysis is the total sum of squares in equation (A.1). For each nutrient considered, we found that the sum of the computed values of the error and model sums of squares was equal to the computed value of the total sum of squares.

This somewhat convoluted approach to computing the error and model sums of squares would have been unnecessary had we been able to use a personal computer to run PROC GLM with the WEIGHT option on more than approximately 150 cases. As a one-time check on the validity of the approach, we used PROC GLM with the WEIGHT option to conduct the disaggregation shown in equation (A.1) for 100 cases for the nutrients iron and protein. The PROC GLM results for the total, model, and error sums of squares were identical to those obtained using the alternative approach just described.

Step 2: Calculation of the Attenuation Factors. We used the computed values of the model and error sums of squares, along with the degrees of freedom for the model (DFMODEL) and for the error (DFERROR), to compute the mean square for the model (MSMODEL) and the mean square for the erroor (MSERROR).

We based our calculation of the attenuation factors on the SAS program listing found in Appendix 3 of Ritenbaugh et al. (1988) That listing provides sample SAS code for computing attenuation factors based on one, three, six, and fourteen days of nutrient intake data. We modified the code to calculate an attenuation factor for four days of nutrient intake. Our modified code was as follows:

```
MEANREPL = (DFMODEL+DFERROR+1)/(DFMODEL+1);
ERRORDIF = MSMODEL - MSERROR;
IF ERRORDIF LT 0 THEN ERRORDIF = 0;
SDINTRA = MSERROR**0.5;
SDINTER = (ERRORDIF / MEANREPL)**0.5;
VRATIO = (SDINTRA**2)/(SDINTER**2);
ATTFACT4 = (1/(1 + (VRATIO * 0.25)))**.5;
```

Using the LOTUS 1-2-3 spreadsheet package, we computed the respective values of ATTFACT4 (the attenuation factor for four days of nutrient intake) for each nutrient, using the values of DFMODEL, DFERROR, MSMODEL, and MSERROR derived in Step 1, and the equations found in the modified code listing. The values for all of the variables are displayed in Table A.2.

Step 3: The Adjustment of the Four-Day Intake Distributions. We adjusted the four-day average intake for each child in our sample, using the following algorithm:

Adjusted nutrient intake =

[(Unadjusted four-day average intake - Grand mean intake)

* Attenuation Factor]

+ Grand mean intake,

where the grand mean intake is the weighted average of the unadjusted four-day average intakes across all of the children in the sample.

Because the value of the attenuation factor is by construction bounded by 0 and 1, the value of the adjusted nutrient intake will always be no farther from the grand mean than is the corresponding value for the unadjusted intake. In fact, for our sample, the values of the attenuation factors all lie between 0.70 and 0.83, implying that the adjusted nutrient intake distribution is between 17 and 30 percent more closely-centered around the grand mean than is the unadjusted four-day distribution. This

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TABLE A.2

VALUES OF THE ATTENUATION FACTORS (ATTFACT4)
AND FACTORS USED TO CALCULATE THE ATTENUATION FACTORS
BY NUTRIENT: LOW-INCOME CHILDREN
(weighted data, N=638)

Nutrient	DFMODEL	MSMODEL	DFERROR	MSERROR	MEANREPL	ERRORDIF	SDINTRA	SDINTER	VRATIO	ATTFACT4
Calcium	637	314,709.3	1,914	99,295.5	4.0	215,413.8	315.11	232.06	1.84	0.827
Iron	637	57.1	1,914	27.8	4.0	29.4	5.27	2.71	3.78	0.717
Food Energy	637	502,883.8	1,914	182,929.0	4.0	319,954.8	427.70	282.82	2.29	0.798
Protein	637	911.3	1,914	371.6	4.0	539.7	19.28	11.62	2.75	0.770
Zinc	637	20.2	1,914	10.3	4.0	9.9	3.21	1.57	4.15	0.701

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can be seen by comparing the statistics for the two distributions displayed in Appendix Table L.1.[6] For all nutrient intake distributions for which the adjustment was done, the maximum value of the adjusted four-day distribution is lower than the maximum value of the unadjusted four-day distribution, and the minimum value of the adjusted four-day distribution is higher than the minimum value for the unadjusted four-day distribution.

C. ASSESSING DIETARY ADEQUACY

In this section, we describe several calculations needed in order to apply the probability approach and then discuss the estimation of the prevalence of inadequate intake using the probability approach and the mean-requirement as a fixed cutoff point.

1. Calculations Needed for Applying the Probability Approach

Four calculations were necessary before we could apply the probability method to the analysis of protein intake. First, we converted the children's ages from years to months to conform to the age group breakdowns listed by the World Health Organization/Food and Agricultural Organization of the United Nations/United Nations University (WHO/FAO/UNU, 1976) for protein requirements. Second, we imputed body weights, in kilograms, for

---

[6]The attenuation factors were computed based on the full sample of children ages 1-5, and the four-day intake distributions were also adjusted using the full sample. In Appendix Table L.1, the statistics for some of the nutrients are shown both for children ages 1-3 and for children ages 4-6. Because the sample was divided into these two age groups, each of which may have a different mean intake value, the means for some of the adjusted four-day distributions are not the same as the corresponding means for the unadjusted four-day distributions. This is solely a function of the age-group split--note that for the three nutrients for which there is only one RDA age category (vitamin C, calcium, and zinc), the means of the adjusted four-day distributions are the same as the means of the unadjusted four-day

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children whose body weights were not reported, and we converted all reported body weights from pounds to kilograms, because protein requirements are expressed in terms of grams (g) of intake per kilogram (kg) of body weight per day. Third, we modified the WHO/FAO/UNU table of protein requirements to incorporate an assumption of mixed diets. Finally, we calculated the means and standard deviations of the intake requirements for each age group.

a. Computation of Age in Months

The algorithm for computing children's ages in months is listed in Figure A.1 (see lines 14-45). The variable BIRTHDAY stores the child's date of birth, in MM-DD-YY format. The variables D1PQDATE, D2PQDATE, D3PQDATE, and D4PQDATE stores the dates of the interviews for day 1, day 2, day 3, and day 4, respectively; all are in MM-DD-YY format.

b. Imputation of Body Weights and Conversion to Kilograms

The algorithm for imputing body weights for children for whom body weights were not reported is also shown in Figure A.1 (see lines 47-68). The body weights which were assigned to the children for whom weights were missing were provided by the NRC (see National Research Council, 1980, Table 1, pp. 20-21); the imputed body weights correspond to the 50th percentile for each age bracket used by the NRC. All nonmissing values for body weight were converted from pounds to kilograms by dividing the body weight by 2.2.

c. Modification of the Protein Requirements Table

The WHO/FAO/UNU report breaks protein requirements into requirements for maintenance and requirements for growth, each expressed in milligrams of nitrogen per kilogram per day (see WHO/FAO/UNU, 1985, Table 33, p. 105). The sum of the requirements for maintenance and growth equals the mean

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```
****************************************************************;
*                                                              ;
*                   APPENDIX FIGURE A.1                        ;
*                                                              ;
*          CONVERSION OF AGE FROM YEARS TO MONTHS              ;
*                                                              ;
*       IMPUTATION OF BODY WEIGHTS FOR MISSING VALUES          ;
*                                                              ;
****************************************************************;
LIBNAME OUT 'F:\';
DATA OUT.KIDFINAL TEMP(KEEP=
  WT KG D1AGE M1AGE D2AGE M2AGE D3AGE M3AGE D4AGE M4AGE
  BIRTHDAY D1PQDATE);
 SET OUT.KIDSWTH;

IF HHID=21095 & GRIDID=5 THEN DO; * FIX BAD-AGE KID;
  D2AGE=2; D3AGE=2;
END;
IF HHID=21753 & GRIDID=3 THEN DO; * FIX BAD-AGE KID;
  D3AGE=5; D4AGE=5;
END;

* COMPUTE AGES, IN MONTHS;
 BYR=BIRTHDAY-INT(BIRTHDAY/100)*100;
 BMO=INT(BIRTHDAY/10000);
 BDA=INT(BIRTHDAY/100) - (INT(BIRTHDAY/10000)*100);

 YR=D1PQDATE-INT(D1PQDATE/100)*100;
 MO=INT(D1PQDATE/10000);
 DA=INT(D1PQDATE/100) - (INT(D1PQDATE/10000)*100);

 M1AGE=(YR-1)*12 + (MO-1) - (BYR-1)*12 - (BMO-1);
 IF BDA-DA > 0 THEN M1AGE=M1AGE - 1;

 YR=D2PQDATE-INT(D2PQDATE/100)*100;
 MO=INT(D2PQDATE/10000);
 DA=INT(D2PQDATE/100) - (INT(D2PQDATE/10000)*100);

 M2AGE=(YR-1)*12 + (MO-1) - (BYR-1)*12 - (BMO-1);
 IF BDA-DA > 0 THEN M2AGE=M2AGE - 1;

 YR=D3PQDATE-INT(D3PQDATE/100)*100;
 MO=INT(D3PQDATE/10000);
 DA=INT(D3PQDATE/100) - (INT(D3PQDATE/10000)*100);

 M3AGE=(YR-1)*12 + (MO-1) - (BYR-1)*12 - (BMO-1);
 IF BDA-DA > 0 THEN M3AGE=M3AGE - 1;

 YR=D4PQDATE-INT(D4PQDATE/100)*100;
 MO=INT(D4PQDATE/10000);
 DA=INT(D4PQDATE/100) - (INT(D4PQDATE/10000)*100);

 M4AGE=(YR-1)*12 + (MO-1) - (BYR-1)*12 - (BMO-1);
 IF BDA-DA > 0 THEN M4AGE=M4AGE - 1;

* FIX PHYSICAL WEIGHTS, CONVERT TO KGS;
 IF WT=. THEN DO;
   IF SEX=1 THEN DO; * MALES;
     IF M1AGE LE 17 THEN KG=10.15; * 1-1.5;
     ELSE IF M1AGE LE 23 THEN KG=11.47; * 1.5-2;
     ELSE IF M1AGE LE 35 THEN KG=12.34; * 2-3;
     ELSE IF M1AGE LE 47 THEN KG=14.62; * 3-4;
```

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```
          ELSE IF M1AGE LE 59 THEN KG=16.69; * 4-5;
          ELSE IF M1AGE LE 71 THEN KG=18.67; * 5-6;
        END;
        ELSE DO; * FEMALES;
          IF M1AGE LE 17 THEN KG=9.53; * 1-1.5;
          ELSE IF M1AGE LE 23 THEN KG=10.82; * 1.5-2;
          ELSE IF M1AGE LE 35 THEN KG=11.80; * 2-3;
          ELSE IF M1AGE LE 47 THEN KG=14.10; * 3-4;
          ELSE IF M1AGE LE 59 THEN KG=15.96; * 4-5;
          ELSE IF M1AGE LE 71 THEN KG=17.66; * 5-6;
        END;
      END;
      ELSE DO;
         KG=WT/2.2;
      END;
    OUTPUT OUT.KIDFINAL;
      IF _N_ < 30 OR HHID=21095 OR HHID=21753 THEN OUTPUT TEMP;

PROC MEANS DATA=OUT.KIDFINAL;
 VAR WT KG D1AGE M1AGE D2AGE M2AGE D3AGE M3AGE D4AGE M4AGE;

PROC PRINT DATA=TEMP;
```

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requirement. Safe levels of protein intake are estimated at 2 standard deviations above the mean requirement; these are expressed in grams of protein per kilogram per day. The conversion from mg nitrogen/kg/day to g protein/kg/day uses the implied equivalence 1 g protein = 160 mg nitrogen. All estimates in the WHO/FAO/UNU table are based on the assumption that proteins are ingested in the form of eggs or milk (hereafter referred to as an "egg and milk protein diet"). We multiplied all of the WHO/FAO/UNU estimates by the factor 1.33 to adjust for NRC's assumption that, in the mixed diets that most individuals ingest, the proteins are used only about 75 percent as effectively as in egg and milk protein diets.[7] Coefficients of variation (CV) are also supplied by WHO/FAO/UNU. Standard deviations (SD) in the protein requirement for each age group were derived from the coefficients of variation in the following way: SD = CV * mean requirement.

d. Calculation of Means and Standard Deviations

The mean requirements and standard deviations for protein are listed in Table A.3. These statistics include the multiplication by the factor 1.33 to adjust for the assumption of mixed diets of protein.

2. Estimation of the Prevalence of Inadequate Intake and the Proportion of the Population Failing to Attain the RDA

We estimated the prevalence of the inadequate intake of protein using all three intake distributions (the one-day, the four-day average, and the adjusted four-day average intake distributions) and both criteria for adequacy (the probability method and the mean requirement cutoff). Because

---

[7]This adjustment was necessary to make the "safe levels" reported in the WHO/FAO/UNU table approximately equal to the RDA.

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TABLE A.3

ESTIMATES OF MEAN REQUIREMENTS AND CORRESPONDING STANDARD DEVIATIONS FOR PROTEIN, BY AGE

Age (Months)	Mean Requirement (g Protein/kg/day)	Standard Deviation
12-17	1.3333	0.1729
18-23	1.2469	0.1559
24-35	1.2136	0.1456
36-47	1.1721	0.1406
48-59	1.1388	0.1366
60-71	1.0972	0.1317
72-83	1.0889	0.1307

the analysis of protein was the most comprehensive analysis among all of the nutrients, we describe only the procedure for protein.

We used a two-step procedure in our analysis of protein. In Step 1, we derived (a) estimates of the prevalence of inadequate intake and (b) estimates of the proportion of the population failing to attain the RDA. In Step 2, we generated the graphic displays of the estimates generated in Step 1.

Step 1a: Estimates of the Prevalence of Inadequate Intake. Figure A.2 provides a listing of the code we used for deriving the estimates of the prevalence of inadequate intake. We declared arrays (see lines 29-34) to hold (1) the values of the mean protein requirements in g/protein/kg/day (STKNEED), (2) the standard deviations of protein requirements (STKSD), and (3) the RDAs. We needed 7 array slots because there are 7 age groups in the requirements table for protein (see Table A.3). These 7 age groups are listed in lines 36-37. We initialized the values for each of these arrays in lines 41-46. It should be noted that the values for STKNEED and STKSD do not include the multiplication by 1.33 to adjust for the assumption of a mixed diet of proteins. The adjustment is made later in the program.

In lines 48-71, we looped over the 4 days of information to calculate average values over the 4 days for (1) protein requirements in g/protein/kg/day (KNEEDAVG), (2) the standard deviation for the protein requirements (KSDAVG), (3) the RDA (RDAAVG), (4) age (AGEAVG), and (5) protein requirements in g/protein/day (GNEEDAVG).

We applied the probability method to all three intake distributions, using both the assumption of a 100 percent egg/milk protein diet and the assumption of a mixed diet of proteins. In Chapter II, we reported only the

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```
*******************************************************;
*                                                     ;
*              APPENDIX FIGURE A.2                    ;
*                                                     ;
*  CALCULATION OF ESTIMATES OF PREVALENCE: PROTEIN    ;
*                                                     ;
*******************************************************;


OPTIONS PS=60 LS=120;
*** this is for protein ****;

DATA ALLKIDS CSFII.PROT1T3 (KEEP= SCALWGT
    SCALWGT HHID GRIDID E1DTPRO APRO NPRO RAPRO3 RNPRO3 KNEED1
    GNEED1 RDA1 KNEEDAVG RDAAVG GNEEDAVG AGEAVG R1PRO3
    RISK1DAY RISK4UN RISK4AD RISK1DM RISK4UNM RISK4ADM
    RDA1DAY RDA4UN RDA4AD
    PROB1 PROBUN PROBAD PROB1M PROBUNM PROBADM)
             CSFII.PROT4T6 (KEEP= SCALWGT
    SCALWGT HHID GRIDID E1DTPRO APRO NPRO RAPRO3 RNPRO3 KNEED1
    GNEED1 RDA1 KNEEDAVG RDAAVG GNEEDAVG AGEAVG R1PRO3
    RISK1DAY RISK4UN RISK4AD RISK1DM RISK4UNM RISK4ADM
    RDA1DAY RDA4UN RDA4AD
    PROB1 PROBUN PROBAD PROB1M PROBUNM PROBADM);
 SET CSFII.FOUR5;

* compute needs for each age bracket, in months;
* first set up storage arrays;
 ARRAY STKNEED(7) STKNEED1-STKNEED7;
 ARRAY STKSD(7) STKSD1-STKSD7;
 ARRAY STRDA(7) STRDA1-STRDA7;
 ARRAY MAGE(4) M1AGE M2AGE M3AGE M4AGE;
 ARRAY DAGE(4) D1AGE D2AGE D3AGE D4AGE;

* 7-slot arrays refer to age brackets 1-7: (1=1-1.5),(2=1.5-2),  ;
* (3=2-3),(4=3-4),(5=4-5),(6=5-6),(7=6-7);
* 4-slot arrays refer to days of intake: 1-4;


* assign values to storage arrays, based on tables;
 STKNEED1=1;STKNEED2=.9375;STKNEED3=.9125;STKNEED4=.88125;
   STKNEED5=.85625;STKNEED6=.825;STKNEED7=.81875;
 STKSD1=.13;STKSD2=.11719;STKSD3=.1095;STKSD4=.10575;
   STKSD5=.10275;STKSD6=.099;STKSD7=.09825;
 STRDA1=23;STRDA2=23;STRDA3=23;STRDA4=23;STRDA5=30;STRDA6=30;STRDA7=30;

* compute needed variable values;
 KNEEDSUM=0;KSDSUM=0;RDASUM=0;AGESUM=0;GNEEDSUM=0;
 J=1;   * j keeps track of the days: do process for each of 4 days;
  DO UNTIL (J>4);
    IF MAGE(J) LE 17 THEN I=1;        * looks at age in months;
    ELSE IF MAGE(J) LE 23 THEN I=2;  * finds which month age bracket;
    ELSE IF MAGE(J) LE 35 THEN I=3;  * kid is in;
    ELSE IF MAGE(J) LE 47 THEN I=4;
    ELSE IF MAGE(J) LE 59 THEN I=5;
    ELSE IF MAGE(J) LE 71 THEN I=6;
    ELSE I=7;
   KNEEDSUM=KNEEDSUM+STKNEED(I); * needs in g prot/kg/day;
   KSDSUM=KSDSUM+STKSD(I);       * sd in g prot/kg/day;
   RDASUM=RDASUM+STRDA(I);
```

```
      AGESUM=AGESUM+DAGE(J);
      GNEEDSUM=GNEEDSUM+STKNEED(I)*KG; * need in g prot/day;
        IF J=1 THEN DO;
          KNEED1=STKNEED(I);  * for day 1 analyses;
          KSD1=STKSD(I);
          GNEED1=STKNEED(I)*KG;
          RDA1=STRDA(I);
        END;
      J=J+1;
     END;

   * compute averages;
    KNEEDAVG=KNEEDSUM/4;
    KSDAVG=KSDSUM/4;
    RDAAVG=RDASUM/4;
    AGEAVG=AGESUM/4;
    GNEEDAVG=GNEEDSUM/4;

   * compute risk probs using milk/egg diet assumption;
   RISK1DAY=(1 - PROBNORM((E1DTPRO/KG - KNEED1)/KSD1))*100;
   RISK4UN =(1 - PROBNORM((APRO/KG  - KNEEDAVG)/KSDAVG))*100;
   RISK4AD =(1 - PROBNORM((NPRO/KG  - KNEEDAVG)/KSDAVG))*100;
   label RISK1DAY='% AT RISK/DAY 1 DATA/100% MILK-EGG DIET';
   label RISK4UN ='% AT RISK/4-DAY UNADJ/100% MLK-EGG DIET';
   label RISK4AD ='% AT RISK/4-DAY ADJ/100% MILK-EGG DIET';

   * compute risk probs using mixed diet assumpt.(75% of milk/egg diet);
   RISK1DM =(1 - PROBNORM((E1DTPRO/KG - 1.33*KNEED1)/(1.33*KSD1)))*100;
   RISK4UNM=(1 - PROBNORM((APRO/KG - 1.33*KNEEDAVG)/(1.33*KSDAVG)))*100;
   RISK4ADM=(1 - PROBNORM((NPRO/KG - 1.33*KNEEDAVG)/(1.33*KSDAVG)))*100;
   label RISK1DM='% AT RISK/1 DAY DATA/75% MILK-EGG DIET';
   label RISK4UNM='% AT RISK/4-DAY UNADJ/75% MILK-EGG DIET';
   label RISK4ADM='% AT RISK/4-DAY ADJ/75% MILK-EGG DIET';

   * compute % less than RDA ;
   IF E1DTPRO<RDA1 THEN RDA1DAY=100;ELSE RDA1DAY=0;
   IF APRO<RDAAVG THEN RDA4UN=100;ELSE RDA4UN=0;
   IF NPRO<RDAAVG THEN RDA4AD=100;ELSE RDA4AD=0;
   label RDA1DAY='% UNDER RDA/DAY 1 DATA';
   label RDA4UN ='% UNDER RDA/4-DAY UNADJ DATA';
   label RDA4AD ='% UNDER RDA/4-DAY ADJUSTED DATA';

   * compute % < mean req. using 100% egg/milk assumption;
    IF E1DTPRO < GNEED1 THEN PROB1=100;ELSE PROB1=0;
    IF APRO < GNEEDAVG THEN PROBUN=100;ELSE PROBUN=0;
    IF NPRO < GNEEDAVG THEN PROBAD=100;ELSE PROBAD=0;
   label PROB1='% UNDER 100% EG/MLK DIET/1-DAY DATA';
   label PROBUN='% UNDER 100% EG/MLK DIET/4-DAY UNADJ';
   label PROBAD='% UNDER 100% EG/MLK DIET/4-DAY ADJ';

   * compute % < mean req. using 75% egg/milk diet assumption;
    IF E1DTPRO < GNEED1*1.33 THEN PROB1M=100;ELSE PROB1M=0;
    IF APRO < GNEEDAVG*1.33 THEN PROBUNM=100;ELSE PROBUNM=0;
    IF NPRO < GNEEDAVG*1.33 THEN PROBADM=100;ELSE PROBADM=0;
   label PROB1M='% UNDER 75% EG/MLK DIET/1-DAY DATA';
   label PROBUNM='% UNDER 75% EG/MLK DIET/4-DAY UNADJ';
   label PROBADM='% UNDER 75% EG/MLK DIET/4-DAY ADJ';

   * round variables for later use in graphics;
   RAPRO3=ROUND(APRO,3);
```

```
RNPRO3=ROUND(NPRO,3);
R1PRO3=ROUND(E1DTPRO,3);

* output data sets for later use: 1 for kids 1-3, 1 for kids 4-6;
*  & 1 for the full group for the probability analysis;

IF AGEAVG < 3.5 THEN OUTPUT CSFII.PROT1T3;
ELSE OUTPUT CSFII.PROT4T6;
OUTPUT ALLKIDS;
RUN;
PROC MEANS DATA=ALLKIDS;
 VAR RISK1DAY RISK4UN RISK4AD RISK1DM RISK4UNM RISK4ADM
     RDA1DAY RDA4UN RDA4AD PROB1 PROBUN PROBAD PROB1M PROBUNM PROBADM;
  WEIGHT SCALWGT;
RUN;
DATA X;
 SET ALLKIDS;
  IF _N_ > 10 THEN STOP;
PROC PRINT DATA=X;
RUN;

PROC MEANS DATA=CSFII.PROT1T3;
 VAR KNEEDAVG GNEEDAVG APRO NPRO E1DTPRO RDAAVG AGEAVG
     RISK1DAY RISK4UN RISK4AD RISK1DM RISK4UNM RISK4ADM RDA1DAY RDA4UN
     RDA4AD PROB1 PROBUN PROBAD PROB1M PROBUNM PROBADM;
  WEIGHT SCALWGT;

PROC MEANS DATA=CSFII.PROT4T6;
 VAR KNEEDAVG GNEEDAVG APRO NPRO E1DTPRO RDAAVG AGEAVG
     RISK1DAY RISK4UN RISK4AD RISK1DM RISK4UNM RISK4ADM RDA1DAY RDA4UN
     RDA4AD PROB1 PROBUN PROBAD PROB1M PROBUNM PROBADM;
  WEIGHT SCALWGT;

```

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value which was derived by the execution of line 91; for this calculation, we assumed the mixed diet (both KNEEDAVG and KSDAVG are multiplied by 1.33) and we used the adjusted four-day intake distribution. The PROBNORM function calculates the area under a standard normal curve which lies to the left of a given standardized value. We applied the conventional standardization to each adjusted intake value--we subtracted the mean requirement for a mixed diet (1.33*KNEEDAVG) from the adjusted actual intake per kilogram (NPRO/KG); we then divided the result by the standard deviation of the requirements for a mixed diet (1.33*KSDAVG). Subtracting the value of the PROBNORM() from 1 generates an estimate of the probability that an individual's protein requirement lies above his/her intake; i.e., it generates an estimate of the probability that the person's intake is inadequate for his/her needs. We multiplied this result by 100 to convert the estimate to a percentage. In turn, calculating the mean of RISK4ADM across all children provides an estimate of the percentage of the sample for which protein intake falls below need.

We also applied the mean requirement criterion to an analysis of the adequacy of protein intake, using each of the three intake distributions; each of the diet assumptions was also applied (see lines 104-118). In the text of Chapter II, we reported results only for the mixed diet assumption. Depending on the intake distribution under study, if the child's intake was below the mean requirement, we assigned a value of 100 to PROB1M, PROBUNM, or PROBADM; otherwise we assigned a value of 0. Thus, the means of PROB1M, PROBUNM, and PROBADM across all children provide estimates of the percentage of the sample whose protein intake falls below the mean requirement, using the one-day, four-day, and adjusted four-day distributions, respectively.

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We also computed the values of protein intake, rounded to the nearest 3 grams (see lines 120-123). This allowed SAS to draw smoother graphs (see Step 2 below). We output the information for each child to one of two files (one for each age group), based on the child's average age; to be conservative, we output the children who were age 3 for 2 days and age 4 for 2 days with the age group 4-6 (to which, for protein, is associated the higher RDA). We computed means for selected variables for the full sample (see lines 132-135), for the subgroup of children ages 1-3 (see lines 143-147), and for the subgroup of children ages 4-6 (see lines 149-153).

Step 1b: Estimating the Proportion of the Population Failing to Achieve the RDA. We also estimated the percent of the population failing to attain the RDA, using each of the three intake distributions (see lines 96-102). Depending on the intake distribution under study, if the child's intake was below the RDA, we assigned a value of 100 to RDA1DAY, RDA4UN, or RDA4AD; otherwise we assigned a value of 0. Thus, the means of RDA1DAY, RDA4UN, and RDA4AD across all children provide estimates of the percentage of the sample whose protein intake falls below the RDA, using the one-day, four-day, and adjusted four-day distributions, respectively.

Step 2: Generating the Graphical Display. Figure A.3 provides a listing of the code for applying Step 2 of the process for estimating the prevalence of inadequate intake. We ran frequencies on the rounded values of intake for each of the three intake distributions to provide grouped frequencies (see lines 6-11). We then merged the frequencies based on the three intake distributions into one file (see 12-15). Lines 16-32 are a listing of the code necessary to plot the frequencies. The graphs were smoothed using the I=SM57 command (lines 47-49). Each distribution must be

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```
*****************************************************;
*                                                   ;
*               APPENDIX FIGURE A.3                 ;
*                                                   ;
*    GRAPHIC PRESENTATION OF RESULTS FOR PROTEIN    ;
*                                                   ;
*****************************************************;
LIBNAME CSFII 'E:\';
* for the following names, second letter: A refers to 4-day avg.,    ;
*  unadj., N to new 4-day avg., adj./ # on end refers to rounding;
*  level.;

PROC FREQ DATA=CSFII.PROT1T3;
 TABLES RAPRO3 / OUT=ANEW3;
 TABLES RNPRO3 / OUT=NNEW3;
 TABLES R1PRO3 / OUT= NEW3;
  WEIGHT SCALWGT;
RUN;
DATA NEWFIN;
 MERGE ANEW3(RENAME=(PERCENT=APCT3)) NNEW3(RENAME=(PERCENT=NPCT3))
       NEW3(RENAME=(PERCENT=PCT3));
RUN;
GOPTIONS RESET=ALL;
FILENAME GRAFOUT 'PRO1T3.GSF';
GOPTIONS GSFNAME=GRAFOUT GSFMODE=REPLACE DEV=HP7475A;
GOPTIONS NOPROMPT;
  SYMBOL1 I=SM57 c=white l=1;
  SYMBOL2 I=SM57 c=white L=9;
  SYMBOL3 I=SM57 c=white L=33;
TITLE1 'PROTEIN';
TITLE2 'Intake vs. RDA & Need';
TITLE3 'CHILDREN 1-3';
AXIS1 LABEL=("USUAL DAILY PROTEIN INTAKE (GRAMS)")
      ORDER=0 TO 120 BY 10;
AXIS2 LABEL =("PERCENT OF CHILDREN");
PROC GPLOT DATA=NEWFIN GOUT=CSFII.PROT4T6;
 PLOT APCT3*RAPRO3=1 NPCT3*RNPRO3=2 PCT3*R1PRO3=3/OVERLAY
             HREF=16.1 23 HAXIS=AXIS1 VAXIS=AXIS2;
RUN;
PROC FREQ DATA=CSFII.PROT4T6;
 TABLES RAPRO3 / OUT=ANEW3;
 TABLES RNPRO3 / OUT=NNEW3;
 TABLES R1PRO3 / OUT= NEW3;
  WEIGHT SCALWGT;
RUN;
DATA NEWFIN;
 MERGE ANEW3(RENAME=(PERCENT=APCT3)) NNEW3(RENAME=(PERCENT=NPCT3))
       NEW3(RENAME=(PERCENT=PCT3));
RUN;
GOPTIONS RESET=ALL;
FILENAME GRAFOUT 'PRO4T6.GSF';
GOPTIONS GSFNAME=GRAFOUT GSFMODE=REPLACE DEV=HP7475A;
GOPTIONS NOPROMPT;
  SYMBOL1 I=SM57 c=white l=1;
  SYMBOL2 I=SM57 c=white L=9;
  SYMBOL3 I=SM57 c=white L=33;
TITLE1 'PROTEIN';
TITLE2 'Intake vs. RDA & Need';
TITLE3 'CHILDREN 4-5';
AXIS1 LABEL=("USUAL DAILY PROTEIN INTAKE (GRAMS)")
```

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```
          ORDER=0 TO 120 BY 10;
    AXIS2 LABEL =("PERCENT OF CHILDREN");
    PROC GPLOT DATA=NEWFIN GOUT=CSFII.PROT4T6;
     PLOT APCT3*RAPRO3=1 NPCT3*RNPRO3=2 PCT3*R1PRO3=3/OVERLAY
                  HREF=19.8 30 HAXIS=AXIS1 VAXIS=AXIS2;
    RUN;
```

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assigned a color (e.g., c=white); otherwise the different types of lines specified (e.g., L=1 and L=9) will not be distinguished and all lines will be drawn using the same line type. It should be noted that, originally, three cutoff values were overlaid on top of the intake distributions (see lines 30-31). The lowest value was dropped from the presentation in Chapter II (the lowest value corresponds to the 100 percent egg and milk protein diet). The value for the mixed diet assumption was taken from the output of the PROC MEANS for children ages 1-3 and 4-5 (see the Step 1 listing, lines 143-147 and 149-153).

APPENDIX B

TECHNICAL DETAILS FOR SECTION IV.B: DIETARY INTAKE ANALYSIS

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This appendix provides technical details on the econometric analysis underlying the estimates of WIC and Food Stamp effects on dietary intake that are presented in Chapter IV. Section A provides the econometric specifications of the bivariate selection model and the ordinary least-squares regression model that we used to estimate the effects of WIC and Food Stamps on dietary intake. The estimation procedures are explained in Section B. Section C provides definitions and descriptive statistics for the dependent and independent variables in the models.

A. THE ECONOMETRIC MODELS

The bivariate selection model of WIC and Food Stamp effects on dietary intake consists of a nutrient intake equation, an equation that explains participation in the WIC program, and an analogous equation that explains participation in the Food Stamp Program. The OLS model consists of the nutrient intake equation only. For both models, the unit of analysis is the individual--a woman or child in a low-income household.

The complete econometric specification of the bivariate selection model is as follows:

$$\text{(B.1)} \quad N_{ki} = X_i a_k + b_{k1} WIC_i + b_{k2} FS_i + b_{k3}(WIC_i * FS_i) + b_{k4} OTHWIC_i + e_{ki}$$

$$\text{(B.2)} \quad WIC_i = 1 \text{ if } Z_{wi} c_w + u_{wi} > 0$$

$$= 0 \text{ if } Z_{wi} c_w + u_{wi} \leq 0$$

$$\text{(B.3)} \quad FS_i = 1 \text{ if } Z_{fi} c_f + u_{fi} > 0$$

$$= 0 \text{ if } Z_{fi} c_f + u_{fi} \leq 0$$

where N_{ki} is the intake of nutrient k by individual i; X is a vector of variables influencing dietary intake; WIC is a binary variable denoting

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participation in the WIC Program (1=participant, 0=nonparticipant); FS is a binary variable denoting participation in the Food Stamp Program (1=participant, 0=nonparticipant); WIC*FS is an interaction term that identifies participants in both programs; OTHWIC is a binary variable denoting WIC participation by other members of the household (1=other participants, 0=no other participants); Z_w and Z_f are vectors of variables that influence decisions to participate in the WIC and food stamp programs, respectively; and e_k, u_w, and u_f are random disturbance terms. The other terms are individual parameters or vectors of parameters to be estimated.

The disturbance terms in the three equations are assumed to be normally distributed with homoskedastic variances. Thus, for the dietary intake equation we assume:

$$e_{ki} \sim N(0, s_k^2)$$

For the WIC and Food Stamp participation equations we assume:

$$u_{wi} \sim N(0, 1)$$

$$u_{fi} \sim N(0, 1)$$

In addition, we assume the following regarding the covariances of the disturbance terms in the WIC and Food Stamp participation equations with those in the nutrient intake equation: $cov(e_{ki}, u_{wi}) = s_{kw}$ and $cov(e_{ki}, u_{fi}) = s_{kf}$. If either or both pairs of disturbances are correlated, that is, if $s_{kw} \neq 0$ and/or $s_{kf} \neq 0$, then the procedure used to estimate the nutrient intake equation should be one that controls for selection bias arising from the program participation decisions. Because the OLS model assumes that the disturbance term in the nutrient intake equation is uncorrelated with those in the program participation equations, its estimates are subject to sample selection bias. The bivariate selection model allows for the possible nonzero correlation of those disturbances, so its estimates are not subject to selection bias.

Finally, we assume the following regarding the disturbance terms in the program participation equations: $cov(u_{wi}, u_{fi}) = s_{wf}$. A nonzero value of this covariance implies that some of the same unobserved factors that influence the WIC participation decision also influence the Food Stamp participation decision. Under these conditions, the efficient estimation of the participation equations requires that they be estimated jointly.[1]

B. THE ESTIMATION PROCEDURE

An extension of a Heckman's two-stage procedure can be used to control for selection bias and thereby obtain consistent estimates of the program effect parameters (b_{k1}, b_{k2}, b_{k3}, and b_{k4}) in the nutrient intake equation.[2] The first stage of this procedure entails the computation of two so-called "lambda" variables--LAMBDA-W and LAMBDA-F--which, in effect, are the components of e_k in the nutrient intake equation that are correlated with u_w in the WIC participation equation and u_f in the food stamp partici-pation equation. These variables are then inserted in the dietary intake equation as additional explanatory variables to control for selection bias. The disturbance term in the modified intake equation is uncorrelated with those in the participation equations.

---

[1]An efficient estimation procedure makes optimal use of the sample information on the behavior in question. It has a smaller variance than inefficient procedures and, therefore, is more likely to produce statistically significant estimates.

[2]See Heckman (1978, 1979) and Heckman and Robb (1985).

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In the second stage of the estimation procedure, generalized least-

[redacted]

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Appendices E through J provide complete sets of results for women and children from our use of the bivariate selection model to estimate equations (B.1) - (B.3), as well as our use of the OLS model to estimate equation (B.1).

C. DEFINITION AND DESCRIPTION OF THE ANALYTIC VARIABLES

This section begins by reviewing the criteria that we used to select the analysis samples of women and children. The implications of those criteria for the estimation of the WIC and Food Stamp participation equations are discussed. It then explains how the availability of multiple days of data influenced our specification of certain key analytic variables. The section concludes with a tabular presentation of the definitions of the analytic variables and their mean values and standard deviations.

The absence of reliable data on household income in the post-baseline waves of the CSFII influenced the criteria that we used to select cases into the analysis samples of women and children. If good income data had been available for all waves of the survey, we would have selected into the analysis samples all individuals who met the WIC categorical and income eligibility criteria on any one of the days represented in FNS' four-day analysis file.[5] As it was, we selected all individuals who met the WIC categorical eligibility criteria on any of the four days and who resided in households with baseline gross incomes not in excess of 200 percent of the poverty level. Underlying this selection criterion was the realization that small fluctuations in income could make the baseline-ineligible members of

[5]The WIC income eligibility screen is 185 percent of poverty, whereas the Food Stamp gross income screen is 130 percent of poverty; hence, all persons in households that are income eligible for Food Stamps are also income eligible for WIC.

this group eligible for WIC and/or Food Stamps on one or more of the post-baseline survey days.

The dependent variables in the WIC and Food Stamp participation equations are indicators of participation on **any** of the days represented in FNS' four-day analysis file. We estimated the "ever participated in WIC" and "ever participated in Food Stamps" equations on cases satisfying the baseline income screen as well as the screen for categorical WIC eligibility on any of the four survey days. Thus, some individuals who were not eligible for WIC or Food Stamps at baseline were included in the samples on which we estimated the participation equations. In the participation equations are explanatory variables that influence an eligible person or household's participation decision, as well as variables that might precipitate a change in income-eligibility from baseline (e.g., a change in household size).

The availability of four days of data also influenced the specification of variables in the nutrient intake equation. We defined those variables to be the four-day average values of the underlying variables. Thus, for example, the dependent variable in equation (B.1) is an individual's average daily intake of a nutrient (relative to the RDA), computed over the four available days of data. Among the independent variables in that equation are the average household size and the individual's average age over the four days. Binary variables for which four days of data are available (e.g., WIC and Food Stamp participation and an indicator of pregnancy) also appear in the nutrient intake equation as average values over four days. These may be interpreted as the proportion of the four days during which the behavior or characteristic in question was in effect.

The CSFII provides no post-baseline data on many variables (e.g., height, education, and employment status). The baseline values of such variables are used in the nutrient intake equation.

Tables B.1 through B.3 define all of the dependent and independent variables in the equations for Food Stamp participation, WIC participation, and nutrient intake. Those variables may be defined for women only, for children only, or for both women and children. The tables also provide descriptive statistics on those variables, computed on the appropriate sample(s) of women and/or children.

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TABLE B.1

VARIABLES IN THE MODEL OF HOUSEHOLD FOOD STAMP PARTICIPATION, WITH DESCRIPTIVE STATISTICS COMPUTED ON THE SAMPLES OF WIC-ELIGIBLE WOMEN AND CHILDREN

(weighted data)

Variable Name	Variable Definition	Sample of Women (N=236)		Sample of Children (N=445)	
		Mean	Standard Deviation	Mean	Standard Deviation
Dependent Variable					
EFSPART	Household participated in FSP on any of the 4 survey days (yes=1, no=0)	0.349	0.478	0.394	0.489
Independent Variables					
RESEMP	Household respondent worked for pay last week (yes=1, no=0)	0.315	0.465	0.332	0.471
RESFHEAD	Household respondent is female head (yes=1, no=0)	0.947	0.224	0.961	0.193
SARESAGE	Household respondent's average age (scaled by dividing by 10)	2.740	0.608	2.900	0.558
SARESAGS	Household respondent's average squared age (scaled by dividing by 100)	7.877	3.755	8.727	3.515
RESNONWH	Household respondent's race (nonwhite=1, white=0)	0.297	0.458	0.272	0.445
RESHISP	Household respondent's ethnicity (Hispanic=1, other=0)	0.107	0.310	0.088	0.284
SRESEDUC	Household respondent's education in years (scaled by dividing by 10)	1.216	0.256	1.216	0.199
MALEHEAD	Male head present in household (yes=1, no=0)	0.753	0.432	0.764	0.425
MALEEMP	Male head worked for pay last week (yes=1, no=0)	0.656	0.476	0.656	0.475
ESIZDECR	Household size decreased between any consecutive survey days (yes=1, no=0)	0.107	0.310	0.091	0.287
ESIZINCR	Household size increased between any consecutive survey days (yes=1, no=0)	0.367	0.483	0.173	0.379

(continued)

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TABLE B.1 (continued)

Variable Name	Variable Definition	Sample of Women (N=236) Mean	Sample of Women (N=236) Standard Deviation	Sample of Children (N=445) Mean	Sample of Children (N=445) Standard Deviation
Independent Variables (continued)					
OWNHOME	Household owns its own home (yes=1, rents or occupies with no payment=0)	0.418	0.494	0.409	0.492
RENTHOME	Household rents its home (yes=1, owns or occupies with no payment=0)	0.570	0.496	0.559	0.497
SGUARAMT	Household monthly Food Stamp guarantee amount (scaled by dividing by 100)	2.586	0.775	2.957	0.789
SINC	Household monthly income (scaled by dividing by 1,000)	1.007	0.511	1.069	0.628
SINCSQ	Household monthly income squared (scaled by dividing by 1,000,000)	1.273	1.162	1.536	1.614
NEAST	Household resides in Northeast (yes=1, no=0)	0.214	0.411	0.216	0.412
SOUTH	Household resides in South (yes=1, no=0)	0.291	0.455	0.270	0.445
WEST	Household resides in West (yes=1, no=0)	0.276	0.448	0.233	0.423
LOPOV	Low income sample, low poverty area segment (yes=1, no=0)	-----	-----	0.051	0.221
MIDPOV	Low income sample, medium poverty area segment (yes=1, no=0)	-----	-----	0.180	0.384
LOMIDPOV	Low income sample, low or medium poverty area segment (yes=1, no=0)	0.171	0.377	-----	-----
HIPOV	Low income sample, high poverty area segment (yes=1, no=0)	0.180	0.385	0.204	0.404
SUBCORE	Core sample, suburban area segment (yes=1, no=0)	0.237	0.426	0.260	0.439
NMCORE	Core sample, nonmetropolitan area segment (yes=1, no=0)	0.120	0.325	0.117	0.322
SUBLOW	Low income sample, suburban area segment (yes=1, no=0)	0.111	0.314	0.161	0.368
NMLOW	Low income sample, nonmetropolitan area segment (yes=1, no=0)	0.122	0.329	0.138	0.345

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TABLE B.2

VARIABLES IN THE MODEL OF WIC PARTICIPATION BY INDIVIDUALS, WITH DESCRIPTIVE STATISTICS COMPUTED ON THE SAMPLES OF WIC-ELIGIBLE WOMEN AND CHILDREN

(weighted data)

Variable Name	Variable Definition	Sample of Women (N=236) Mean	Sample of Women (N=236) Standard Deviation	Sample of Children (N=445) Mean	Sample of Children (N=445) Standard Deviation
	Dependent Variable				
EOWNWIC	Individual participated in WIC on any of the 4 survey days (yes=1, no=0)	0.251	0.434	0.261	0.440
	Independent Variables				
CEAGE2	Child was age 2 on any of the 4 survey days (yes=1, no=0)	-----	-----	0.404	0.491
CEAGE3	Child was age 3 on any of the 4 survey days (yes=1, no=0)	-----	-----	0.455	0.499
CEAGE4	Child was age 4 on any of the 4 survey days (yes=1, no=0)	-----	-----	0.491	0.500
CEAGE5	Child was age 5 on any of the 4 survey days (yes=1, no=0)	-----	-----	0.204	0.403
SAVAGE	Woman's average age (scaled by dividing by 10)	2.712	0.571	-----	-----
SAVAGSQ	Woman's average squared age (scaled by dividing by 100)	7.680	3.411	-----	-----
NONWHITE	Subject's race (nonwhite=1, white=0)	0.297	0.458	0.272	0.445
HISPANIC	Subject's ethnicity (Hispanic=1, other=0)	0.107	0.310	0.089	0.286
GOODHLTH	Subject's health is excellent or good (yes=1, no=0)	0.933	0.251	0.962	0.191
WTHT	Subject's weight in pounds divided by height in inches	2.202	0.439	0.921	0.215
EPREG	Woman was pregnant on any of the 4 survey days (yes=1, no=0)	0.503	0.501	-----	-----
ELACT	Woman was lactating on any of the 4 survey days (yes=1, no=0)	0.286	0.453	-----	-----
SMOMEDUC	Mother's education in years (scaled by dividing by 10)	-----	-----	1.216	0.198
SOMEHS	Woman has some high school education (yes=1, no=0)	0.208	0.407	-----	-----
HSGRAD	Woman is high school graduate (yes=1, no=0)	0.423	0.495	-----	-----
SOMECOL	Woman has some college education (yes=1, no=0)	0.178	0.383	-----	-----
COLGRAD	Woman is college grad. (yes=1, no=0)	0.134	0.341	-----	-----

(continued)

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TABLE B.2 (continued)

Variable Name	Variable Definition	Sample of Women (N=236) Mean	Standard Deviation	Sample of Children (N=445) Mean	Standard Deviation
Independent Variables (continued)					
MOMEMP	Mother worked for pay last week (yes=1, no=0)	-----	-----	0.331	0.471
EMPLOYED	Woman worked for pay last week (yes=1, no=0)	0.318	0.467	-----	-----
MALEHEAD	Male head present in household (yes=1, no=0)	0.753	0.432	0.764	0.425
MALEEMP	Male head worked for pay last week (yes=1, no=0)	0.656	0.476	0.656	0.475
AVHHSIZE	Average household size	4.136	1.395	4.645	1.373
ESIZDECR	Household size decreased between any consecutive survey days (yes=1, no=0)	0.107	0.310	0.091	0.287
ESIZINCR	Household size increased between any consecutive survey days (yes-1, no=0)	0.367	0.483	0.173	0.379
OWNHOME	Household owns its home (yes=1, rents or occupies with no payment=0)	0.418	0.494	0.409	0.492
RENTHOME	Household rents its home (yes=1, owns or occupies with no payment=0)	0.570	0.496	0.559	0.497
SPCINC	Household monthly income per capita (scaled by dividing by 100)	2.706	1.262	2.338	1.178
SPCINCSQ	Household squared monthly income per capita (scaled by dividing by 100,000)	0.891	0.672	0.685	0.565
NEAST	Household resides in Northeast (yes=1, no=0)	0.214	0.411	0.216	0.412
SOUTH	Household resides in South (yes=1, no=0)	0.291	0.455	0.270	0.445
WEST	Household resides in West (yes=1, no=0)	0.276	0.448	0.233	0.423
LOPOV	Low income sample, low poverty area segment (yes=1, no=0)	-----	-----	0.051	0.221
MIDPOV	Low income sample, medium poverty area segment (yes=1, no=0)	-----	-----	0.180	0.384
LOMIDPOV	Low income sample, low or medium poverty area segment (yes=1, no=0)	0.171	0.377	-----	-----
HIPOV	Low income sample, high poverty area segment (yes=1, no=0)	0.180	0.385	0.204	0.404
SUBCORE	Core sample, suburban area segment (yes=1, no=0)	0.237	0.426	0.260	0.439
NMCORE	Core sample, nonmetropolitan area segment (yes=1, no=0)	0.120	0.325	0.117	0.322
SUBLOW	Low income sample, suburban area segment (yes=1, no=0)	0.111	0.314	0.161	0.368
NMLOW	Low income sample, nonmetropolitan area segment (yes=1, no=0)	0.122	0.329	0.138	0.345

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TABLE B.3

VARIABLES IN THE NUTRIENT INTAKE MODEL, WITH DESCRIPTIVE STATISTICS COMPUTED ON THE SAMPLES OF WIC-ELIGIBLE WOMEN AND CHILDREN

(weighted data)

Variable Name	Variable Definition	Sample of Women (N=236) Mean	Sample of Women (N=236) Standard Deviation	Sample of Children (N=445) Mean	Sample of Children (N=445) Standard Deviation
Dependent Variables					
AVKCAL	NAR for food energy	0.824	0.282	0.946	0.248
AVPRO	NAR for protein	1.339	0.462	2.026	0.610
LOGAVGVA	Log of NAR for vitamin A	-.315	0.882	0.435	0.544
AVB6	NAR for vitamin B6	0.627	0.271	-----	-----
AVGVC	NAR for vitamin C	1.416	1.048	-----	-----
LOGAVGVC	Log of NAR for vitamin C	-----	-----	0.368	0.589
LOGAVGVE	Log of NAR for vitamin E	-.340	0.660	-.092	0.592
LOGAVFOL	Log of NAR for folacin	-.881	0.568	-----	-----
AVCALC	NAR for calcium	0.785	0.353	0.944	0.356
AVMG	NAR for magnesium	0.641	0.251	-----	-----
LOGAVGFE	Log of NAR for iron	-.516	0.450	-.374	0.417
AVZINC	NAR for zinc	0.585	0.214	0.708	0.215
Independent Variables					
AVOWNWIC	Average value of dummy variable for subject's own WIC participation	0.127	0.266	0.178	0.338
AVFSPART	Average value of dummy variable for household's Food Stamp participation	0.298	0.429	0.331	0.443
AVFSWIC	Average value of interaction of dummy variables for WIC and Food Stamp part.	0.095	0.247	0.130	0.292
AVOTHWIC	Average value of dummy variable for WIC participation by other household member	0.252	0.356	0.141	0.306
AVCAGE2	Average value of dummy variable for child's age=2 years	-----	-----	0.227	0.316
AVCAGE3	Average value of dummy variable for child's age=3 years	-----	-----	0.275	0.345
AVCAGE4	Average value of dummy variable for child's age=4 years	-----	-----	0.255	0.323

(continued)

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TABLE B.3 (continued)

Variable Name	Variable Definition	Sample of Women (N=236) Mean	Sample of Women (N=236) Standard Deviation	Sample of Children (N=445) Mean	Sample of Children (N=445) Standard Deviation
	Independent Variables (continued)				
AVCAGE5	Average value of dummy variable for child's age=5 years	-----	-----	0.109	0.236
SAVAGE	Woman's average age (scaled by dividing by 10)	2.712	0.571	-----	-----
SAVAGSQ	Woman's average squared age (scaled by dividing by 100)	7.680	3.411	-----	-----
AVAG1922	Average value of dummy variable for woman's age=19 to 22 years	0.236	0.407	-----	-----
AVAG51	Average value of dummy variable for woman's age>50 years	0.001	0.027	-----	-----
FEMALE	Child's sex (female=1, male=0)	-----	-----	0.516	0.500
HEIGHT	Subject's height in inches	63.826	2.420	35.537	6.055
AVPREG	Average value of dummy variable for pregnant woman	0.184	0.222	-----	-----
AVLACT	Average value of dummy variable for lactating woman	0.155	0.292	-----	-----
NONWHITE	Subject's race (nonwhite=1, white=0)	0.297	0.458	0.272	0.445
HISPANIC	Subject's ethnicity (Hispanic=1, other=0)	0.107	0.310	0.089	0.286
DIETFLAG	Woman is on special diet (yes=1, no=0)	0.090	0.287	-----	-----
MOMEMP	Mother worked for pay last week (yes=1, no=0)	-----	-----	0.331	0.471
EMPLOYED	Woman worked for pay last week (yes=1, no=0)	0.318	0.467	-----	-----
MSOMEHS	Mother has some high school education (yes=1, no=0)	-----	-----	0.226	0.418
SOMEHS	Woman has some high school education (yes=1, no=0)	0.208	0.407	-----	-----
MHSGRAD	Mother is high school graduate (yes=1, no=0)	-----	-----	0.414	0.493
HSGRAD	Woman is high school graduate (yes=1, no=0)	0.423	0.495	-----	-----
MSOMECOL	Mother has some college education (yes=1, no=0)	-----	-----	0.264	0.441

(continued)

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TABLE B.3 (continued)

Variable Name	Variable Definition	Sample of Women (N=236) Mean	Sample of Women (N=236) Standard Deviation	Sample of Children (N=445) Mean	Sample of Children (N=445) Standard Deviation
	Independent Variables (continued)				
SOMECOL	Woman has some college education (yes=1, no=0)	0.178	0.383	-----	-----
MCOLGRAD	Mother is college graduate (yes=1, no=0)	-----	-----	0.058	0.233
COLGRAD	Woman is college graduate (yes=1, no=0)	0.134	0.341	-----	-----
AVHHSIZE	Average household size	4.136	1.395	4.645	1.373
SPCINC	Household monthly income per capita (scaled by dividing by 100)	2.706	1.262	2.338	1.178
SPCINCSQ	Household squared monthly income per capita (scaled by dividing by 100,000)	0.891	0.672	0.685	0.565
NEAST	Household resides in Northeast (yes=1, no=0)	0.214	0.411	0.216	0.412
SOUTH	Household resides in South (yes=1, no=0)	0.291	0.455	0.270	0.445
WEST	Household resides in West (yes=1, no=0)	0.276	0.448	0.233	0.423
LOPOV	Low income sample, low poverty area segment (yes=1, no=0)	-----	-----	0.051	0.221
MIDPOV	Low income sample, medium poverty area segment (yes=1, no=0)	-----	-----	0.180	0.384
LOMIDPOV	Low income sample, low or medium poverty area segment (yes=1, no=0)	0.171	0.377	-----	-----
HIPOV	Low income sample, high poverty area segment (yes=1, no=0)	0.180	0.385	0.204	0.404
SUBCORE	Core sample, suburban area segment (yes=1, no=0)	0.237	0.426	0.260	0.439
NMCORE	Core sample, nonmetropolitan area segment (yes=1, no=0)	0.120	0.325	0.117	0.322
SUBLOW	Low income sample, suburban area segment (yes=1, no=0)	0.111	0.314	0.161	0.368
NMLOW	Low income sample, nonmetropolitan area segment (yes=1, no=0)	0.122	0.329	0.138	0.345
LAMBDA-F	The Food Stamp sample selection bias correction term	0.0000034	NA	0.0000014	NA
LAMBDA-W	The WIC sample selection bias correction term	-.0000022	NA	0.0000012	NA

APPENDIX C

TECHNICAL DETAILS FOR SECTION IV.C:
FOOD EXPENDITURE ANALYSIS

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This appendix provides technical details on the econometric analysis underlying the estimates of WIC and Food Stamp program effects on household food expenditures that are presented in Chapter IV. As this econometric analysis is very similar to that conducted for the nutrient intake analysis, this discussion is less detailed than that of Appendix B and assumes that the reader is familiar with that appendix.

A. THE ECONOMETRIC MODEL

Like the nutrient intake analysis, the bivariate selection model of the effects of WIC and Food Stamps on household food expenditures consists of three equations: an equation for household participation in the WIC program, an equation for household participation in the Food Stamp Program, and a household food expenditure equation. The OLS model involves the estimation of the food expenditure equation only.

The formal specification of the bivariate selection model is as follows:

(C.1) $$EXP_i = X_i a + b_1 WIC_i + b_2 FSBEN_i + e_i \qquad i=1,2,\ldots,N$$

(C.2) $$\begin{aligned} WIC_i &= 1 \text{ if } Z_{wi}c_1 + u_{wi} > 0 \qquad i=1,2,\ldots,N \\ &= 0 \text{ if } Z_{wi}c_1 + u_{wi} \leq 0 \end{aligned}$$

(C.3) $$\begin{aligned} FS_j &= 1 \text{ if } Z_{fj}c_2 + u_{fj} > 0 \qquad j=1,2,\ldots,F \\ &= 0 \text{ if } Z_{fj}c_2 + u_{fj} \leq 0 \end{aligned}$$

where EXP_i is the food expenditure of the ith household; X_i is a vector of household characteristics that affect food expenditures; WIC_i is a binary variable indicating the household's participation in WIC (1 = participant, 0

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= nonparticipant)[1]; $FSBEN_i$ is the dollar value of the household's benefits from the Food Stamp Program; FS_j is a binary variable indicating the household's participation in Food Stamps (1 = participant, 0 = nonparticipant); Z_{wi} and Z_{fj} are vectors of household characteristics that affect the WIC and Food Stamp participation decisions, respectively; and e, u_w, and u_f are random disturbance terms. The remaining terms are individual parameters or vectors of parameters to be estimated.

It is important to note that the relevant samples for the program participation equations are the populations of households which were eligible to participate in the program of interest. Thus, the WIC participation equation (equation (C.2)) is estimated over the sample of WIC-eligible households, the same sample as is the basis of the food expenditure equation (equation (C.1)). The Food Stamp participation equation (equation (C.3)) is estimated over the sample of Food Stamp-eligible households. The latter is defined as all households with income that did not exceed 130 percent of the poverty level.[2]

The disturbance terms from the three equations are assumed to have the following distributions:

$e \sim N(0, s^2)$

$u_w \sim N(0, 1)$

---

[1]As is discussed in the text of this report, we explored a number of different measures of the household's participation in WIC.

[2]Our ability to differentiate between the WIC-eligible and Food Stamp-eligible households in the food expenditure analysis, but not in the nutrient intake analysis, reflects our reliance on wave-1 data for the food expenditure analysis and on all four days of data for the nutrient intake analysis. As there are not good measures of household income in the post-baseline waves, income-eligibility for the programs for the full CSFII period had to be approximated using the wave-1 household income.

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$u_f \sim N(0, 1)$

and the following covariances:

$$\mathrm{cov}(e_i, u_{wi}) = s_{ew}$$

$$\mathrm{cov}(e_j, u_{fj}) = s_{ef}$$

$$\mathrm{cov}(u_{fj}, u_{wj}) = s_{fw}$$

The presence of selection bias in the food expenditure equation is indicated by $s_{ew} \neq 0$ and/or $s_{ef} \neq 0$, denoting the need to control for such bias in the estimation procedure. The correlation between the disturbance terms in the program participation equations, as indicated by $s_{wf} \neq 0$, implies that the program participation equations should be estimated jointly.

B. THE ESTIMATION PROCEDURE

The estimation procedure for the food expenditure analysis is based on the two-stage procedure outlined in Appendix B. In the first stage of the estimation procedure, the "lambda" variables--LAMBDA-W and LAMBDA-F--are derived from the parameter estimates obtained from the estimation of the WIC and Food Stamp participation equations. In order to capture the correlation between the disturbance terms of the two participation equations, the equations are estimated jointly using bivariate probit for those households that are eligible for both programs. The lambda terms for these households are derived from the bivariate probit estimation results.

In order to obtain LAMBDA-W for those households that are eligible for WIC but not Food Stamps, a univariate probit model of WIC participation is estimated for all WIC-eligible households. LAMBDA-W for these households is derived from the parameter estimates for that model, while LAMBDA-F is set equal to zero since participation in that program is not a decision for these households.[3]

In the second stage of the procedure, the food expenditure equation is estimated using generalized least squares, with the WIC and Food Stamp lambda included to account for the selection bias. The program effect estimates obtained using this procedure are consistent.

Appendix K provides the complete results for the use of the bivariate selection model to estimate equations (C.1) - (C.3), as well as the results for the estimation of (C.1) using OLS.

C. DEFINITION AND DESCRIPTION OF ANALYTIC VARIABLES

Tables C.1 through C.3 define all the dependent and independent variables in the equations for WIC participation, Food Stamp participation, and household food expenditures. The tables also provide descriptive statistics on those variables.

Table C.4 provides a summary of the estimates of the effect of the Food Stamp Program on expenditure on food at home obtained from selected studies, while Table C.5 provides documentation for the Table C.4 estimates.

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[3]Since the food expenditure equation is estimated for the WIC-eligible population, we do not need to consider the households that are eligible for Food Stamps, but ineligible for WIC.

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TABLE C.1

VARIABLES IN THE MODEL OF HOUSEHOLD WIC PARTICIPATION, WITH DESCRIPTIVE STATISTICS COMPUTED ON THE SAMPLE OF WIC-ELIGIBLE HOUSEHOLDS
(weighted data, N=515)

Variable Name	Variable Definition	Mean	Standard Deviation
Dependent Variable			
HHWIC1	One or more members of household participated in WIC in wave 1 (yes=1, no=0)	0.287	0.453
Independent Variables			
RESEMP	Household respondent worked for pay last week (yes=1, no=0)	0.310	0.453
RESFHEAD	Household respondent is female head (yes=1, no=0)	0.971	0.167
SRESAGE	Household respondent's age (scaled by dividing by 10)	2.853	0.638
RESNONWH	Household respondent's race (nonwhite=1, white=0)	0.349	0.477
RESHISP	Household respondent's ethnicity (Hispanic=1, other=0)	0.158	0.365
SRESEDUC	Household respondent's education in years (scaled by dividing by 10)	1.169	0.218
RESGHLTH	Household respondent's health is good or excellent (yes=1, no=0)	0.850	0.357
MALEHEAD	Male head present in household (yes=1, no=0)	0.698	0.459
MALEEMP	Male head worked for pay last week (yes-1, no=0)	0.577	0.495
TOTSIZE	Household size	4.257	1.430
OWNHOME	Household owns its home (yes=1, rents or occupies with no payment=0)	0.302	0.460

(continued)

TABLE C.1 (continued)

Variable Name	Variable Definition	Mean	Standard Deviation
Independent Variables (continued)			
RENTHOME	Household rents its home (yes=1, owns or occupies with no payment=0)	0.668	0.471
WICPOTPC	Household potential WIC benefit amount per household member	13.202	6.878
SPCINC	Household monthly income per household member (scaled by dividing by 100)	2.241	1.022
SPCINCSQ	Household monthly income per household member squared (scaled by dividing by 1,000)	6.064	4.838
NEAST	Household resides in Northeast (yes=1, no=0)	0.199	0.399
SOUTH	Household resides in South (yes=1, no=0)	0.337	0.473
WEST	Household resides in West (yes=1, no=0)	0.222	0.416
LOPOV	Low income sample, low poverty area segment (yes=1, no=0)	0.039	0.194
MIDPOV	Low income sample, medium poverty area segment (yes=1, no=0)	0.224	0.417
HIPOV	Low income sample, high poverty area segment (yes=1, no=0)	0.268	0.443
SUBCORE	Core sample, suburban area segment (yes=1, no=0)	0.168	0.374
NMCORE	Core sample, nonmetropolitan area segment (yes=1, no=0)	0.128	0.334
SUBLOW	Low income sample, suburban area segment (yes=1, no=0)	0.166	0.373
NMLOW	Low income sample, nonmetropolitan area segment (yes=1, no=0)	0.135	0.343

TABLE C.2

VARIABLES IN THE MODEL OF HOUSEHOLD FOOD STAMP PARTICIPATION, WITH DESCRIPTIVE STATISTICS COMPUTED ON THE SAMPLE OF FSP-ELIGIBLE HOUSEHOLDS

(weighted data, N=981)

Variable Name	Variable Definition	Mean	Standard Deviation
	Dependent Variable		
FSPART1	Household participated in FSP in wave 1 (yes=1, no=0)	0.502	0.500
	Independent Variables		
RESEMP	Household respondent worked for pay last week (yes=1, no=0)	0.340	0.474
RESFHEAD	Household respondent is female head (yes=1, no=0)	0.945	0.229
SRESAGE	Household respondent's age (scaled by dividing by 10)	3.217	0.797
RESNONWH	Household respondent's race (nonwhite=1, white=0)	0.486	0.500
RESHISP	Household respondent's ethnicity (Hispanic=1, other=0)	0.128	0.335
SRESEDUC	Household respondent's education in years (scaled by dividing by 10)	1.120	0.247
MALEHEAD	Male head present in household (yes=1, no=0)	0.578	0.494
MALEEMP	Male head worked for pay last week (yes-1, no=0)	0.377	0.485
IFKIDLT6	Presence of child less than age 6 in household (yes=1, no=0)	0.530	0.499
OWNHOME	Household owns its home (yes=1, rents or occupies with no payment=0)	0.302	0.460

(continued)

TABLE C.2 (continued)

Variable Name	Variable Definition	Mean	Standard Deviation
	Independent Variables (continued)		
RENTHOME	Household rents its home (yes=1, owns or occupies with no payment=0)	0.673	0.469
SGUARAMT	Household monthly Food Stamp guarantee amount (scaled by dividing by 10)	25.928	8.593
SINC	Household monthly income (scaled by dividing by 100)	6.793	3.308
SINCSQ	Household monthly income squared (scaled by dividing by 100,000)	0.571	0.526
NEAST	Household resides in Northeast (yes=1, no=0)	0.242	0.429
SOUTH	Household resides in South (yes=1, no=0)	0.354	0.478
WEST	Household resides in West (yes=1, no=0)	0.165	0.372
LOPOV	Low income sample, low poverty area segment (yes=1, no=0)	0.051	0.221
MIDPOV	Low income sample, medium poverty area segment (yes=1, no=0)	0.295	0.456
HIPOV	Low income sample, high poverty area segment (yes=1, no=0)	0.371	0.483
SUBCORE	Core sample, suburban area segment (yes=1, no=0)	0.080	0.271
NMCORE	Core sample, nonmetropolitan area segment (yes=1, no=0)	0.098	0.297
SUBLOW	Low income sample, suburban area segment (yes=1, no=0)	0.209	0.407
NMLOW	Low income sample, nonmetropolitan area segment (yes=1, no=0)	0.193	0.395

TABLE C.3

VARIABLES IN THE MODEL OF HOUSEHOLD EXPENDITURES ON FOOD AT HOME AND TOTAL FOOD EXPENDITURES, WITH DESCRIPTIVE STATISTICS COMPUTED ON THE SAMPLE OF WIC-ELIGIBLE HOUSEHOLDS
(weighted data, N=515)

Variable Name	Variable Definition	Mean	Standard Deviation
	Dependent Variables		
FDINAME	Household expenditures on food at home per AME	73.460	35.760
FDTOTAME	Household total food expenditures per AME	90.919	46.552
	Independent Variables		
RESPTEMP	Household respondent worked full-time for pay last week (yes=1, no=0)	0.117	0.322
RESFTEMP	Household respondent worked part-time for pay last week (yes=1, no=0)	0.193	0.395
RESFHEAD	Household respondent is female head (yes=1, no=0)	0.972	0.167
RESMLPLN	Household respondent is meal planner (yes=1, no=0)	0.967	0.180
SRESAGE	Household respondent's age (scaled by dividing by 10)	2.853	0.638
RESNONWH	Household respondent's race (nonwhite=1, white=0)	0.349	0.477
RESHISP	Household respondent's ethnicity (Hispanic=1, other=0)	0.158	0.365
SRESEDUC	Household respondent's education in years (scaled by dividing by 10)	1.169	0.218
MALEHEAD	Male head present in household (yes=1, no=0)	0.698	0.459
HHSIZMCP	Household size per AME	3.227	1.175
PREG	Household member is pregnant (yes=1, no=0)	0.087	0.282
ACT	Household member is lactating (yes=1, no=0)	0.068	0.253

(continued)

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TABLE C.3 (continued)

Variable Name	Variable Definition	Mean	Standard Deviation
Independent Variables (continued)			
AMEFSBEN	Household monthly Food Stamp amount per AME	21.786	30.467
AMEINC	Household monthly income per AME	302.420	144.870
AWICPREG	Household WIC participant is pregnant (yes=1, no=0)	0.031	0.173
AWICMOM	Household WIC participant is breastfeeding or postpartum (yes=1, no=0)	0.064	0.244
AWICKID	Household WIC participant is child (yes=1, no=0)	0.166	0.372
AWICINF	Household WIC participant is infant (yes=1, no=0)	0.098	0.297
MULTCAT	Household WIC participants in multiple categories (yes=1, no=0)	0.060	0.237
NEAST	Household resides in Northeast (yes=1, no=0)	0.199	0.399
SOUTH	Household resides in South (yes=1, no=0)	0.337	0.473
WEST	Household resides in West (yes=1, no=0)	0.222	0.416
LOPOV	Low income sample, low poverty area segment (yes=1, no=0)	0.039	0.194
MIDPOV	Low income sample, medium poverty area segment (yes=1, no=0)	0.224	0.417
HIPOV	Low income sample, high poverty area segment (yes=1, no=0)	0.268	0.443
SUBCORE	Core sample, suburban area segment (yes=1, no=0)	0.168	0.374
NMCORE	Core sample, nonmetropolitan area segment (yes=1, no=0)	0.128	0.334
SUBLOW	Low income sample, suburban area segment (yes=1, no=0)	0.166	0.373
NMLOW	Low income sample, nonmetropolitan area segment (yes=1, no=0)	0.136	0.343

TABLE C.4

ESTIMATES OF THE MARGINAL PROPENSITY TO CONSUME FOOD (MPC_f) AT HOME, FROM SELECTED STUDIES

Study	Data Set	Target Group; Sample Size		MPC_f Out of: Food Stamps	MPC_f Out of: Money Income
STUDIES BASED ON PRE-EPR DATA					
Benus, Kmenta, and Shapiro (1976)	1968-72 Michigan PSID data	All households; n = 3,300		.86	.05
Hymans and Shapiro (1976)	1968-72 Michigan PSID data	All households;			
		1st half sample,	linear	.35	.14
		n = 1,659	logarithmic	.29	.24
		2nd half sample,	linear	.64	.17
		n = 1,659	logarithmic	.30	.23
		Full sample	logarithmic	.29	.23
West and Price (1976)	1972-73 sample of Washington State households with children ages 8-12 years	All households; n = 992		.37	.05
Neenan and Davis (1977)	1976 sample of households in Polk Co., Florida	FSP participants; n = 123		.45	.06
West, Price, and Price (1978)	1972-73 sample of Washington State households with children ages 8-12 years	FSP eligibles; n = 331		.31	.03
Salathe (1980)	1973-74 Consumer Expenditure Diary Survey	FSP eligibles; n = 2,254		.36	.06
Johnson, Burt, and Morgan (1981)	1977-78 LI supplement to the NFCS	FSP eligibles; n = 3,800		.17	.06
Brown, Johnson, and Rizek (1982)	1977-78 LI supplement to the NFCS	FSP participants; n = 911		.45	.05
Chavas and Yeung (1982)	1972-73 Consumer Expenditure Diary Survey	FSP eligibles in South; n = 659		.37	.13
Allen and Gadson (1983)	1977-78 LI supplement to the NFCS	FSP eligibles; n = 3,850		.30	.08
Chen (1983)	1977-78 LI supplement to the NFCS	FSP participants; n = 1,809		.20	.09
West (1984)	1973-74 Consumer Expenditure Diary Survey	FSP participants; n = 587		.17	NA
		FSP eligibles; n = 2,407		.47	NA
Smallwood and Blaylock (1985)	1977-78 LI supplement to the NFCS	FSP eligibles; n = 2,852		.23	.10
Senauer and Young (1986)	1977 and 78 Michigan PSID data	FSP participants; n = 573		.33	.05
Basiotis, Johnson, Morgan, and Chen (1987)	1977-78 LI supplement to the NFCS	FSP eligibles; n = 2,950		.17	.10
Devaney and Fraker (1989)	1977-78 LI supplement to the NFCS	FSP eligibles; n = 4,473			
		Weighted data		.42	.08
		Unweighted data		.21	.07

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TABLE C.4 (continued)

Study	Data Set	Target Group; Sample Size	MPC, Out of: Food Stamps	Money Income
		STUDIES BASED ON POST-EPR DATA		
Chen (1983)	1979-80 LI supplement to the NFCS	FSP participants; n = 1,630	.23	.11
Senauer and Young (1986)	1978 and 79 Michigan PSID data	FSP participants; n = 574	.26	.07
Fraker, Long, and Post (1990)	1985 Continuing Survey of Food Intake by Individuals	FSP & WIC eligibles; n = 515	.29	.05

NOTE 1: Table C.5 provides additional information on the estimates shown in this table.
NOTE 2: Fraker (1990) provides full bibliographic citations for the studies referenced in this table.

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TABLE C.5

NOTES IN SUPPORT OF TABLE C.4--MPC_f ESTIMATES

Study	Page Reference for Estimates	Notes
		STUDIES BASED ON PRE-EPR DATA
Benus, Kmenta, and Shapiro (1976)	137	None.
Hymans and Shapiro (1976)		MPC_f out of food stamps is for urban households in lowest quintile of per capita income. For log model, MPC_f out of food stamps computed on assumption that food stamps is only income; MPC_f out of money income computed on assumption that wages/salaries is only income. Mean values of income and food consumption for first half sample used in all MPC_f computations.
Linear Model	178 & 184	
Logarithmic Model	185 & 186	
West and Price (1976)	729	Income enters model in log form. MPC_f out of income computed at sample mean income.
Neenan and Davis (1977)	95	Model includes interactions of food stamp benefit with income and household size. MPC_f out of benefit and income computed at sample mean values of income, benefit, and household size.
West, Price, and Price (1978)	137-38	Model includes food stamp participation dummy and log of income. MPC_f out of benefit and income computed at sample mean values of income and benefit.
Salathe (1980)	40	MPC_f out of income obtained from equation estimated on eligible nonparticipants. Those coefficients were used to predict what the food expenditures of participants would be if they were not participating. The MPC_f out of food stamp benefits was derived by comparing those predicted values with the actual expenditures of participants.
Johnson, Burt, and Morgan (1981)	62-63	MPC_f estimates are from Equation 3.
Brown, Johnson, and Rizek (1982)	Table 4	MPC_f estimates are from the unrestricted model (Model 3).
Chavas and Yeung (1982)	Table 5	MPC_f estimates are for metropolitan households with nonblack, noncollege-educated heads.
Allen and Gadson (1983)	42	None.
Chen (1983)	91-92	Based on 1977-78 data. Model includes square of income. MPC_f out of income computed at sample mean value of income for food stamp participants.
West (1984)	31-34	Model includes log of income and interaction of food stamp benefit with log of income. MPC_f out of benefit computed at sample mean value of income for food stamp participants. Insufficient descriptive data on income and benefits to compute MPC_f out of income. Estimates are from Model 3.
Smallwood and Blaylock (1985)	49	None.
Senauer and Young (1986)	40-41	Based on 1978 data. Model is nonlinear in income and food stamp benefit. MPC_f out of benefit and income are the median values for the sample households.

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TABLE C.5 (continued)

Study	Page Reference for Estimates	Notes
		STUDIES BASED ON PRE-EPR DATA (continued)
Basiotis, Johnson, Morgan, and Chen (1987)	393	Model includes squared values of benefit and income. MPC_f out of benefit and income computed at sample mean values of benefit and income for food stamp participants.
Devaney and Fraker (1989)	101	None.
		STUDIES BASED ON POST-EPR DATA
Chen (1983)	91-92	Based on 1979-80 data. Model includes square of income. MPC_f out of income computed at sample mean value of income for food stamp participants.
Senauer and Young (1986)	40-41	Based on 1979 data. Model is nonlinear in income and food stamp benefit. MPC_f out of benefit and income are the median values for the sample households.
Fraker, Long, and Post (1990)	107	None.

APPENDIX D

SOME TECHNICAL GUIDANCE FOR FIRST-TIME USERS OF THE LIMDEP[tm] ECONOMETRIC SOFTWARE PACKAGE

MPR has now used LIMDEP to estimate bivariate selection models for three studies for FNS. In the process of that work, we have identified several "quirks" in the software which can be frustrating for the first-time user. In this appendix, we briefly describe those quirks and offer some suggestions on how to deal with them.

A. THE "DUMP" COMMAND

LIMDEP provides a very useful procedure, called DUMP, whereby the analyst can save ("dump" to an output file) a data set that has been converted to binary format (the format from which LIMDEP operates). Using this procedure can provide a significant time savings when analyzing large data sets, as it eliminates the need to read in the data set anew for each LIMDEP session.

The DUMP command is also useful when the analysis that is being conducted involves multiple steps. The command can be used to save the results obtained at an intermediate step, permitting the analyst to resume work at that step without re-estimating the earlier work. In the context of the bivariate selection model, one uses the DUMP command to "save" the results of the bivariate probit estimation, so that it is not necessary to continually re-run what is a time-consuming estimation procedure.

The product of the DUMP process is two files: a binary file that contains the data and a LIMDEP-reference file, which provides the information needed by the LIMDEP software to read the data file. The data set is re-created within LIMDEP by accessing the latter file through the LOAD command.

There are two factors to be aware of in using the DUMP command. First, although it is technically possible to use the DUMP command at the end of

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each run, we have found that such use invariably introduces errors into the data set. Therefore, we recommend that one be conservative in the use of the DUMP command and, when it is used, check the data (e.g., examine basic descriptive statistics) to ensure that no unexpected changes have occurred. Second, even if one does not use the DUMP command, the binary file that is created as part of the DUMP process is modified following each subsequent run, while the LIMDEP-reference file is not modified. Our experience has been that this eventually results in errors in the data file that is being re-created, presumably because the binary file no longer corresponds to the structure expected by the reference file. This problem can be avoided by maintaining a back-up copy of the binary file and, when needed, replacing the modified binary file with the initial version that was created as part of the DUMP command.

Because of the ease with which these errors can be inadvertently introduced into the data, it is important in using LIMDEP to (1) monitor the output that is generated from the package very carefully to ensure the integrity of the data is maintained and (2) take care to keep back-up copies of the binary files that are created at different stages of the analysis.

B. WEIGHTED ANALYSIS

The second stage of the bivariate selection model estimation procedure is very sensitive to the nature of the weights that are used for weighted analysis. Although the LIMDEP documentation states that the sample weights are scaled to make the sum of the weights equal to the sample size, this does not occur for all of the LIMDEP modules. It is very important that the analyst make this adjustment prior to estimating each stage of the bivariate selection model.

C. SCALING THE DATA

The first stage of the bivariate selection model involves the estimation of a bivariate probit model. The estimation of the bivariate probit is a complex nonlinear optimization problem that can be quite difficult to solve. We have found that scaling the variables included in the model so that the variables are of approximately the same magnitude (between 0 and 1) greatly facilitates the operation of the estimation procedure. Failing to adjust the data in this manner can result in a variety of error messages that provide little guidance as to the true problem.

D. OTHER ISSUES

There are several other relatively simple factors to be aware of in using LIMDEP:

- For data sets that contain more than 40 variable, the variable names must be read in with the data, rather than named as part of the data creation job (as the documentation suggests).

- The output file that contains the results of the analysis conducted during a LIMDEP session is created as part of exiting from LIMDEP. As a result, it is not possible to examine the results before deciding on whether to use the DUMP command.

- LIMDEP documentation is cryptic and, in some cases, incomplete or incorrect. In general, LIMDEP is not a user-friendly software package; although LIMDEP's author is usually willing to answer questions.

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APPENDIX E

DETAILED ESTIMATION RESULTS FOR CHILDREN: BIVARIATE PROBIT ESTIMATES OF THE WIC AND FOOD STAMP PARTICIPATION EQUATIONS

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MODEL COMMAND: PROBIT ;LHS=EFSPART ;RHS=Z1 ;WTS=SCALEDWT ;MATRIX (B=DELTA1)

Ordinary Least Squares Estimates

Dependent Variable..........	EFSPART
Number of Observations......	445.
Mean of Dependent Variable..	.39439
Std. Dev. of Dep. Variable..	.48927
Std. Error of Regression....	.28792
Sum of Squared Residuals....	34.652
R - Squared.................	.67398
Adjusted R - Squared........	.65370
F-Statistic (26, 418).....	33.23580
Significance of F-Test......	.00000
Log-Likelihood..............	-63.445
Restricted (Slopes=0) Log-L.	-312.80
Chi-Squared (26)...........	498.71
Significance Level..........	.32173E-13

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.921396	.322965	2.853 (.00433)	1.0000	.00000
RESEMP	-.282382E-02	.326878E-01	-.086 (.93116)	.33187	.47141
RESFHEAD	.225986	.946599E-01	2.387 (.01697)	.96128	.19315
SARESAGE	-.205300	.199587	-1.029 (.30366)	2.9003	.55758
SARESAGS	.287611E-01	.309530E-01	.929 (.35279)	8.7273	3.5151
RESNONWH	.106690	.400788E-01	2.662 (.00777)	.27168	.44533
RESHISP	-.167855	.529159E-01	-3.172 (.00151)	.88325E-01	.28409
SRESEDUC	-.310421	.896522E-01	-3.462 (.00054)	1.2155	.19890
MALEHEAD	-.411274E-01	.574181E-01	-.716 (.47382)	.76442	.42484
MALEEMP	-.266000	.529394E-01	-5.025 (.00000)	.65627	.47549
ESIZDECR	.213540	.572018E-01	3.733 (.00019)	.90537E-01	.28727
ESIZINCR	-.590649E-01	.415336E-01	-1.422 (.15500)	.17288	.37857
OWNHOME	.685413E-02	.847770E-01	.081 (.93556)	.40851	.49211
RENTHOME	.269854	.846651E-01	3.187 (.00144)	.55933	.49703
SGUARAMT	.903772E-01	.262327E-01	3.445 (.00057)	2.9570	.78898
SINC	-.421468	.925708E-01	-4.553 (.00001)	1.0686	.62837
SINCSQ	.993570E-01	.365120E-01	2.721 (.00650)	1.5359	1.6142
NEAST	-.115107	.456663E-01	-2.521 (.01172)	.21643	.41228
SOUTH	-.569523E-01	.406222E-01	-1.402 (.16092)	.27012	.44452
WEST	.397617E-02	.449359E-01	.088 (.92949)	.23330	.42341
LOPOV	-.221199	.847917E-01	-2.609 (.00909)	.51395E-01	.22105
MIDPOV	.203805	.634927E-01	3.210 (.00133)	.17966	.38434
HIPOV	.145055	.608452E-01	2.384 (.01713)	.20431	.40365
SUBCORE	-.134560E-01	.469062E-01	-.287 (.77421)	.25964	.43893
NMCORE	.143956	.574322E-01	2.507 (.01219)	.11676	.32150
SUBLOW	.390939E-01	.545802E-01	.716 (.47383)	.16153	.36843
NMLOW	.203750E-01	.585939E-01	.348 (.72804)	.13768	.34495

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Probit Estimates

Log-Likelihood.............	-85.986
Restricted (Slopes=0) Log-L.	-307.95
Chi-Squared (26)...........	443.94
Significance Level..........	.32173E-13

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	2.34947	2.37509	.989 (.32256)	1.0000	.00000
RESEMP	-.946079E-01	.263818	-.359 (.71989)	.33187	.47141
RESFHEAD	2.15356	.765348	2.814 (.00490)	.96128	.19315
SARESAGE	-2.04824	1.47871	-1.385 (.16601)	2.9003	.55758
SARESAGS	.282485	.227259	1.243 (.21386)	8.7273	3.5151
RESNONWH	.731117	.277066	2.639 (.00832)	.27168	.44533
RESHISP	-.933265	.384425	-2.428 (.01520)	.88325E-01	.28409
SRESEDUC	-2.21739	.692738	-3.201 (.00137)	1.2155	.19890
MALEHEAD	-.502155	.465805	-1.078 (.28102)	.76442	.42484
MALEEMP	-1.05321	.399395	-2.637 (.00836)	.65627	.47549
ESIZDECR	1.63157	.490198	3.328 (.00087)	.90537E-01	.28727
ESIZINCR	-.289092	.312995	-.924 (.35568)	.17288	.37857
OWNHOME	-.363700	.604663	-.601 (.54751)	.40851	.49211
RENTHOME	1.14889	.594655	1.932 (.05336)	.55933	.49703
SGUARAMT	.889880	.216168	4.117 (.00004)	2.9570	.78898
SINC	-.194206	1.13907	-.170 (.86462)	1.0686	.62837
SINCSQ	-.895875	.612353	-1.463 (.14347)	1.5359	1.6142
NEAST	-.879497	.390878	-2.250 (.02445)	.21643	.41228
SOUTH	-.746187	.354312	-2.106 (.03520)	.27012	.44452
WEST	-.902059E-01	.444880	-.203 (.83932)	.23330	.42341
LOPOV	-1.25250	.713843	-1.755 (.07933)	.51395E-01	.22105
MIDPOV	.744948	.505272	1.474 (.14039)	.17966	.38434
HIPOV	.604724	.485949	1.244 (.21335)	.20431	.40365
SUBCORE	.263474E-01	.503504	.052 (.95827)	.25964	.43893
NMCORE	1.33341	.551030	2.420 (.01553)	.11676	.32150
SUBLOW	.454307	.374677	1.213 (.22531)	.16153	.36843
NMLOW	.189086	.383195	.493 (.62170)	.13768	.34495

Frequencies of actual vs. predicted outcomes
Predicted outcome has the highest probability.

		Predicted	
Actual	TOTAL	0	1
TOTAL	445	204	241
0	212	182	30
1	233	22	211

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MODEL COMMAND: PROBIT ;LHS=EOWNWIC ;RHS=Z2 ;WTS=SCALEDWT ;MATRIX (B=DELTA2)

Ordinary Least Squares Estimates

Dependent Variable..........	EOWNWIC
Number of Observations......	445.
Mean of Dependent Variable..	.26113
Std. Dev. of Dep. Variable..	.43974
Std. Error of Regression....	.35838
Sum of Squared Residuals....	53.300
R - Squared.................	.37920
Adjusted R - Squared........	.33582
F-Statistic (29, 415).....	8.74123
Significance of F-Test......	.00000
Log-Likelihood.............	-159.25
Restricted (Slopes=0) Log-L.	-265.31
Chi-Squared (29)...........	212.11
Significance Level.........	.32173E-13

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.953429	.256410	3.718	(.00020)	1.0000	.00000
CEAGE2	.371112E-01	.632335E-01	.587	(.55728)	.40380	.49121
CEAGE3	.101667E-01	.444435E-01	.229	(.81906)	.45502	.49853
CEAGE4	-.838941E-01	.641944E-01	-1.307	(.19125)	.49070	.50048
CEAGE5	.322552E-01	.631561E-01	.511	(.60955)	.20350	.40306
NONWHITE	.958937E-01	.526619E-01	1.821	(.06862)	.27168	.44533
HISPANIC	-.156078	.657183E-01	-2.375	(.01755)	.89415E-01	.28566
GOODHLTH	-.187947	.967335E-01	-1.943	(.05202)	.96208	.19122
WTHT	-.384485	.932364E-01	-4.124	(.00004)	.92054	.21525
SMOMEDUC	-.186992	.107536	-1.739	(.08206)	1.2160	.19779
MOMEMP	.846445E-01	.411648E-01	2.056	(.03976)	.33136	.47123
MALEHEAD	.586474E-02	.693684E-01	.085	(.93262)	.76442	.42484
MALEEMP	-.159713	.661679E-01	-2.414	(.01579)	.65627	.47549
AVHHSIZE	-.180210E-01	.157108E-01	-1.147	(.25137)	4.6452	1.3733
ESIZDECR	-.459605E-01	.640009E-01	-.718	(.47268)	.90537E-01	.28727
ESIZINCR	.106732	.495124E-01	2.156	(.03111)	.17288	.37857
OWNHOME	.260743	.107843	2.418	(.01561)	.40851	.49211
RENTHOME	.382613	.107009	3.576	(.00035)	.55933	.49703
SPCINC	.875821E-01	.713020E-01	1.228	(.21932)	2.3375	1.1782
SPCINCSQ	-.359134	.147359	-2.437	(.01480)	.68489	.56532
NEAST	-.106587	.562877E-01	-1.894	(.05828)	.21643	.41228
SOUTH	-.113854	.508232E-01	-2.240	(.02508)	.27012	.44452
WEST	-.118019	.573059E-01	-2.059	(.03945)	.23330	.42341
LOPOV	-.464359E-01	.108206	-.429	(.66782)	.51395E-01	.22105
MIDPOV	.973565E-01	.813951E-01	1.196	(.23166)	.17966	.38434
HIPOV	.212487E-01	.777998E-01	.273	(.78476)	.20431	.40365
SUBCORE	-.182174E-01	.578780E-01	-.315	(.75295)	.25964	.43893
NMCORE	.480683E-01	.728582E-01	.660	(.50941)	.11676	.32150
SUBLOW	-.720064E-01	.683783E-01	-1.053	(.29231)	.16153	.36843
NMLOW	.568265E-01	.732371E-01	.776	(.43779)	.13768	.34495

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Probit Estimates

Log-Likelihood.............	-151.64
Restricted (Slopes=0) Log-L.	-288.27
Chi-Squared (29)...........	273.26
Significance Level..........	.32173E-13

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	2.47942	1.29696	1.912 (.05591)	1.0000	.00000
CEAGE2	.112225	.289949	.387 (.69872)	.40380	.49121
CEAGE3	.101026E-01	.207523	.049 (.96117)	.45502	.49853
CEAGE4	-.464637	.302248	-1.537 (.12423)	.49070	.50048
CEAGE5	.301728E-01	.319407	.094 (.92474)	.20350	.40306
NONWHITE	.367677	.230750	1.593 (.11107)	.27168	.44533
HISPANIC	-.485073	.321203	-1.510 (.13100)	.89415E-01	.28566
GOODHLTH	-.607564	.461121	-1.318 (.18764)	.96208	.19122
WTHT	-2.22849	.552761	-4.032 (.00006)	.92054	.21525
SMOMEDUC	-.881573	.494738	-1.782 (.07477)	1.2160	.19779
MOMEMP	.525194	.206667	2.541 (.01105)	.33136	.47123
MALEHEAD	.109069	.297394	.367 (.71381)	.76442	.42484
MALEEMP	-.464436	.291265	-1.595 (.11081)	.65627	.47549
AVHHSIZE	-.110170	.724613E-01	-1.520 (.12841)	4.6452	1.3733
ESIZDECR	-.205317	.299395	-.686 (.49286)	.90537E-01	.28727
ESIZINCR	.474819	.229864	2.066 (.03886)	.17288	.37857
OWNHOME	1.25759	.637571	1.972 (.04856)	.40851	.49211
RENTHOME	1.92763	.622687	3.096 (.00196)	.55933	.49703
SPCINC	.278260	.347176	.801 (.42285)	2.3375	1.1782
SPCINCSQ	-1.78712	.782910	-2.283 (.02245)	.68489	.56532
NEAST	-.652139	.281969	-2.313 (.02073)	.21643	.41228
SOUTH	-.527709	.245261	-2.152 (.03143)	.27012	.44452
WEST	-.726867	.303106	-2.398 (.01648)	.23330	.42341
LOPOV	-.701604E-01	.535900	-.131 (.89584)	.51395E-01	.22105
MIDPOV	.411074	.386779	1.063 (.28787)	.17966	.38434
HIPOV	.339419	.376328	.902 (.36710)	.20431	.40365
SUBCORE	-.835303E-01	.355061	-.235 (.81401)	.25964	.43893
NMCORE	.404364	.393135	1.029 (.30369)	.11676	.32150
SUBLOW	-.189533	.279746	-.678 (.49808)	.16153	.36843
NMLOW	.159609	.306589	.521 (.60265)	.13768	.34495

Frequencies of actual vs. predicted outcomes
Predicted outcome has the highest probability.

		Predicted	
Actual	TOTAL	0	1
TOTAL	445	315	130
0	289	240	49
1	156	75	81

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MODEL COMMAND: BIVARIATE ;LHS=EFSPART,EOWNWIC ;RH1=Z1 ;RH2=Z2 ;STA

FIML ESTIMATES OF BIVARIATE PROBIT MODEL

Log-Likelihood............. -236.37

DESCRIPTIVE STATISTICS FOR REGRESSORS APPEAR
WITH SINGLE EQUATION ESTIMATES

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	2.02049	2.91973	.692 (.48893)	.00000	.00000
RESEMP	-.644167E-01	.333148	-.193 (.84668)	.00000	.00000
RESFHEAD	2.08814	.634747	3.290 (.00100)	.00000	.00000
SARESAGE	-1.71000	1.75168	-.976 (.32896)	.00000	.00000
SARESAGS	.237200	.270106	.878 (.37985)	.00000	.00000
RESNONWH	.739284	.380251	1.944 (.05187)	.00000	.00000
RESHISP	-.962474	.475471	-2.024 (.04294)	.00000	.00000
SRESEDUC	-2.31607	.813096	-2.848 (.00439)	.00000	.00000
MALEHEAD	-.468622	.675555	-.694 (.48788)	.00000	.00000
MALEEMP	-1.04456	.569529	-1.834 (.06664)	.00000	.00000
ESIZDECR	1.61453	.712760	2.265 (.02350)	.00000	.00000
ESIZINCR	-.310398	.406467	-.764 (.44508)	.00000	.00000
OWNHOME	-.345455	.967495	-.357 (.72105)	.00000	.00000
RENTHOME	1.16616	.903072	1.291 (.19659)	.00000	.00000
SGUARAMT	.865742	.304243	2.846 (.00443)	.00000	.00000
SINC	-.254416	1.86950	-.136 (.89175)	.00000	.00000
SINCSQ	-.882935	.980963	-.900 (.36808)	.00000	.00000
NEAST	-.912009	.596923	-1.528 (.12655)	.00000	.00000
SOUTH	-.770335	.528477	-1.458 (.14494)	.00000	.00000
WEST	-.100774	.676401	-.149 (.88157)	.00000	.00000
LOPOV	-1.24182	1.11763	-1.111 (.26652)	.00000	.00000
MIDPOV	.731817	.770542	.950 (.34224)	.00000	.00000
HIPOV	.587462	.605367	.970 (.33184)	.00000	.00000
SUBCORE	.225120E-01	.752377	.030 (.97613)	.00000	.00000
NMCORE	1.31080	.799270	1.640 (.10101)	.00000	.00000
SUBLOW	.432157	.531193	.814 (.41590)	.00000	.00000
NMLOW	.222099	.496147	.448 (.65441)	.00000	.00000
ONE	2.19943	1.64466	1.337 (.18112)	.00000	.00000
CEAGE2	.149355	.364220	.410 (.68176)	.00000	.00000
CEAGE3	-.490855E-01	.233257	-.210 (.83333)	.00000	.00000
CEAGE4	-.420638	.379881	-1.107 (.26817)	.00000	.00000
CEAGE5	.279959E-01	.363788	.077 (.93866)	.00000	.00000

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AVHHSIZE	-.112130	.795932E-01	-1.409	(.15890)	.00000	.00000
ESIZDECR	-.206671	.342533	-.603	(.54627)	.00000	.00000
ESIZINCR	.472957	.256946	1.841	(.06567)	.00000	.00000
OWNHOME	1.30686	.958295	1.364	(.17265)	.00000	.00000
RENTHOME	1.98116	.942558	2.102	(.03556)	.00000	.00000
SPCINC	.258542	.471952	.548	(.58382)	.00000	.00000
SPCINCSQ	-1.69545	1.11866	-1.516	(.12962)	.00000	.00000
NEAST	-.633982	.313358	-2.023	(.04305)	.00000	.00000
SOUTH	-.502489	.295966	-1.698	(.08955)	.00000	.00000
WEST	-.718377	.346981	-2.070	(.03842)	.00000	.00000
LOPOV	-.546811E-01	.854701	-.064	(.94899)	.00000	.00000
MIDPOV	.432899	.595168	.727	(.46701)	.00000	.00000
HIPOV	.351809	.579463	.607	(.54377)	.00000	.00000
SUBCORE	-.758092E-01	.587716	-.129	(.89737)	.00000	.00000
NMCORE	.437943	.639963	.684	(.49377)	.00000	.00000
SUBLOW	-.163384	.310501	-.526	(.59875)	.00000	.00000
NMLOW	.182331	.367005	.497	(.61932)	.00000	.00000
RHO(1,2)	.247478	.192400	1.286	(.19835)		

Joint Frequency Table: Columns=EOWNWIC
Rows=EFSPART
(N) = Count of Fitted Values

	0	1	TOTAL
0	179	33	212
	(187)	(16)	(203)
1	110	123	233
	(129)	(113)	(242)
TOTAL	289	156	445
	(316)	(129)	(445)

APPENDIX F

DETAILED ESTIMATION RESULTS FOR CHILDREN: BIVARIATE SELECTION MODEL ESTIMATES OF THE NUTRIENT INTAKE EQUATIONS

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```
Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART   = *
Selection Criterion B: EOWNWIC   = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG    = 0         WICELIG   = 0
EFSPART  miscoded =      0         EOWNWIC  miscoded =       0
 FSELIG    = 0         WICELIG   = 1
EFSPART  miscoded =      0         EOWNWIC  miscoded =       0
 FSELIG    = 1         WICELIG   = 0
EFSPART  miscoded =      0         EOWNWIC  miscoded =       0
 FSELIG    = 1         WICELIG   = 1
EFSPART  miscoded =      0         EOWNWIC  miscoded =       0

                  EFSPART   = 0     EFSPART   = 1
 EOWNWIC   = 0            0                 0


 EOWNWIC   = 0            0                 0


Number of incorrectly coded eligibilities:
FSELIG   =    0     WICELIG =     0

Full sample contains       445.0 observations.
Selected sample contains   445.0 observations.


    Ordinary    Least Squares Estimates

    Dependent Variable..........     AVKCAL
    Number of Observations......          445.
    Mean of Dependent Variable..        .94625
    Std. Dev. of Dep. Variable..        .24842
    Std. Error of Regression....        .21981
    Sum of Squared Residuals....    19.906
    R - Squared.................        .21535
    Adjusted R - Squared........        .15441
    F-Statistic ( 32,  412).....       3.53366
    Significance of F-Test......        .00000
    Log-Likelihood..............    59.895
    Restricted (Slopes=0) Log-L.   -11.190
    Chi-Squared (32)............    142.17
    Significance Level..........    .32173E-13

Estimated disturbance standard deviation =  .223039
Estimated correlation with selection equation A = -.234342
Estimated correlation with selection equation B =   .243396
```

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.661111	.125399	5.272 (.00000)	.99999	.12737
AVOWNWIC	.306312E-01	.840118E-01	.365 (.71541)	.17826	.87865E-01
AVFSPART	.139364	.512443E-01	2.720 (.00654)	.33115	.51765E-01
AVFSWIC	-.214159	.827346E-01	-2.589 (.00964)	.13025	.85534E-01
AVOTHWIC	.247589E-03	.475207E-01	.005 (.99584)	.14097	.49472E-01
AVCAGE2	.606374E-01	.597579E-01	1.015 (.31024)	.22655	.61475E-01
AVCAGE3	.176942	.485112E-01	3.647 (.00026)	.27507	.49567E-01
AVCAGE4	-.137540	.572200E-01	-2.404 (.01623)	.25488	.58593E-01
AVCAGE5	-.187371E-01	.689763E-01	-.272 (.78590)	.10862	.70626E-01
FEMALE	-.673744E-01	.224767E-01	-2.998 (.00272)	.51588	.23230E-01
AVHHSIZE	.567400E-02	.941368E-02	.603 (.54668)	4.6452	.94441E-02
SPCINC	.370207E-02	.447451E-01	.083 (.93406)	2.3374	.45026E-01
SPCINCSQ	.350496E-01	.932352E-01	.376 (.70697)	.68488	.94032E-01
NONWHITE	-.555690E-01	.337610E-01	-1.646 (.09977)	.27168	.33864E-01
HISPANIC	-.491777E-01	.422119E-01	-1.165 (.24401)	.89414E-01	.42045E-01
MSOMEHS	.988425E-01	.604310E-01	1.636 (.10192)	.22557	.62740E-01
MHSGRAD	.609956E-01	.606388E-01	1.006 (.31447)	.41382	.62642E-01
MSOMECOL	.533520E-01	.634351E-01	.841 (.40032)	.26435	.65278E-01
MCOLGRAD	-.143288E-01	.790776E-01	-.181 (.85621)	.57519E-01	.80845E-01
MOMEMP	.259441E-01	.260883E-01	.994 (.31999)	.33136	.26128E-01
HEIGHT	.555682E-02	.232196E-02	2.393 (.01670)	35.537	.24046E-02
NEAST	.372990E-01	.365412E-01	1.021 (.30738)	.21643	.36751E-01
SOUTH	.227425E-01	.336207E-01	.676 (.49876)	.27012	.33834E-01
WEST	-.699739E-03	.366651E-01	-.019 (.98477)	.23330	.37021E-01
LOPOV	-.555033E-01	.713471E-01	-.778 (.43661)	.51395E-01	.70722E-01
MIDPOV	-.859140E-01	.529130E-01	-1.624 (.10444)	.17966	.53501E-01
HIPOV	-.903629E-01	.504741E-01	-1.790 (.07341)	.20431	.51145E-01
SUBCORE	-.205282E-01	.372598E-01	-.551 (.58167)	.25963	.37631E-01
NMCORE	-.728664E-01	.457274E-01	-1.593 (.11105)	.11676	.46251E-01
SUBLOW	-.318083E-01	.436398E-01	-.729 (.46607)	.16153	.43903E-01
NMLOW	.443293E-01	.459826E-01	.964 (.33502)	.13767	.46541E-01
Lambda-F	-.413660E-01	.340205E-01	-1.216 (.22402)	.14180E-05	.31086E-01
Lambda-W	.440495E-01	.290824E-01	1.515 (.12986)	.12209E-05	.29620E-01

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Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART = *
Selection Criterion B: EOWNWIC = *

Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

```
 FSELIG   = 0          WICELIG  = 0
EFSPART  miscoded =     0          EOWNWIC  miscoded =      0
 FSELIG   = 0          WICELIG  = 1
EFSPART  miscoded =     0          EOWNWIC  miscoded =      0
 FSELIG   = 1          WICELIG  = 0
EFSPART  miscoded =     0          EOWNWIC  miscoded =      0
 FSELIG   = 1          WICELIG  = 1
EFSPART  miscoded =     0          EOWNWIC  miscoded =      0
```

	EFSPART = 0	EFSPART = 1
EOWNWIC = 0	0	0
EOWNWIC = 0	0	0

Number of incorrectly coded eligibilities:
FSELIG = 0 WICELIG = 0

Full sample contains 445.0 observations.
Selected sample contains 445.0 observations.

Ordinary Least Squares Estimates

Dependent Variable..........	AVGPRO
Number of Observations......	445.
Mean of Dependent Variable..	2.02582
Std. Dev. of Dep. Variable..	.60969
Std. Error of Regression....	.54248
Sum of Squared Residuals....	121.25
R - Squared.................	.20652
Adjusted R - Squared........	.14489
F-Statistic (32, 412).....	3.35099
Significance of F-Test......	.00000
Log-Likelihood..............	-342.12
Restricted (Slopes=0) Log-L.	-410.72
Chi-Squared (32)............	137.19
Significance Level..........	.32173E-13

Estimated disturbance standard deviation = .549366
Estimated correlation with selection equation A = -.233056
Estimated correlation with selection equation B = .211997

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The column labelled std.dev.of X below is the
uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	1.28626	.308391	4.171 (.00003)	.99999	.31435
AVOWNWIC	.165220	.207026	.798 (.42483)	.17826	.21685
AVFSPART	.404656	.126434	3.201 (.00137)	.33115	.12776
AVFSWIC	-.569855	.203335	-2.803 (.00507)	.13025	.21110
AVOTHWIC	-.616789E-01	.117403	-.525 (.59933)	.14097	.12210
AVCAGE2	.828184E-01	.147190	.563 (.57366)	.22655	.15172
AVCAGE3	.355571	.119437	2.977 (.00291)	.27507	.12233
AVCAGE4	-.458712	.140782	-3.258 (.00112)	.25488	.14461
AVCAGE5	-.447110E-01	.169710	-.263 (.79220)	.10862	.17431
FEMALE	-.115528	.554134E-01	-2.085 (.03708)	.51588	.57333E-01
AVHHSIZE	.131801E-01	.230988E-01	.571 (.56827)	4.6452	.23308E-01
SPCINC	.289844E-01	.109724	.264 (.79166)	2.3374	.11113
SPCINCSQ	.214408E-01	.228632	.094 (.92528)	.68488	.23207
NONWHITE	.180850E-01	.828174E-01	.218 (.82714)	.27168	.83577E-01
HISPANIC	.223668E-04	.103435	.000 (.99983)	.89414E-01	.10377
MSOMEHS	.186634	.149139	1.251 (.21079)	.22557	.15484
MHSGRAD	.139617	.149405	.934 (.35005)	.41382	.15460
MSOMECOL	.975433E-01	.156178	.625 (.53226)	.26435	.16111
MCOLGRAD	-.108345	.194522	-.557 (.57754)	.57519E-01	.19953
MOMEMP	.152486	.641288E-01	2.378 (.01742)	.33136	.64484E-01
HEIGHT	.125566E-01	.573032E-02	2.191 (.02843)	35.537	.59347E-02
NEAST	-.337246E-01	.898263E-01	-.375 (.70733)	.21643	.90701E-01
SOUTH	.540321E-01	.826028E-01	.654 (.51303)	.27012	.83502E-01
WEST	-.214384E-02	.901186E-01	-.024 (.98102)	.23330	.91368E-01
LOPOV	-.295422	.174701	-1.691 (.09083)	.51395E-01	.17454
MIDPOV	-.989637E-01	.129923	-.762 (.44623)	.17966	.13204
HIPOV	-.141665	.123932	-1.143 (.25300)	.20431	.12623
SUBCORE	.950855E-01	.915425E-01	1.039 (.29894)	.25963	.92874E-01
NMCORE	-.259977	.112376	-2.313 (.02070)	.11676	.11415
SUBLOW	.141093E-01	.106952	.132 (.89505)	.16153	.10835
NMLOW	.127716	.112774	1.132 (.25743)	.13767	.11486
Lambda-F	-.105683	.846162E-01	-1.249 (.21168)	.14180E-05	.76721E-01
Lambda-W	.903096E-01	.714886E-01	1.263 (.20649)	.12209E-05	.73102E-01

```
Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART   = *
Selection Criterion B: EOWNWIC   = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG    = 0          WICELIG   = 0
EFSPART  miscoded =      0          EOWNWIC  miscoded =      0
 FSELIG    = 0          WICELIG   = 1
EFSPART  miscoded =      0          EOWNWIC  miscoded =      0
 FSELIG    = 1          WICELIG   = 0
EFSPART  miscoded =      0          EOWNWIC  miscoded =      0
 FSELIG    = 1          WICELIG   = 1
EFSPART  miscoded =      0          EOWNWIC  miscoded =      0

                   EFSPART  = 0     EFSPART  = 1
 EOWNWIC   = 0             0                0


 EOWNWIC   = 0             0                0


Number of incorrectly coded eligibilities:
FSELIG   =    0     WICELIG =    0

Full sample contains       445.0 observations.
Selected sample contains   445.0 observations.


    Ordinary    Least Squares Estimates

    Dependent Variable..........     LOGAVGVA
    Number of Observations......          445.
    Mean of Dependent Variable..        .43484
    Std. Dev. of Dep. Variable..        .54417
    Std. Error of Regression....        .49970
    Sum of Squared Residuals....    102.88
    R - Squared.................        .15487
    Adjusted R - Squared........        .08923
    F-Statistic ( 32,  412).....       2.35937
    Significance of F-Test......        .00007
    Log-Likelihood..............   -305.56
    Restricted (Slopes=0) Log-L.   -360.13
    Chi-Squared (32)............    109.13
    Significance Level..........     .40927E-11

Estimated disturbance standard deviation =  .500003
Estimated correlation with selection equation A =  .816241E-01
Estimated correlation with selection equation B =  .280508E-01
```

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.499236	.279541	1.786	(.07411)	.99999	.28956
AVOWNWIC	-.700032E-01	.193111	-.363	(.71698)	.17826	.19975
AVFSPART	-.969701E-01	.113964	-.851	(.39483)	.33115	.11768
AVFSWIC	-.126257E-01	.188280	-.067	(.94654)	.13025	.19445
AVOTHWIC	.202795	.108389	1.871	(.06135)	.14097	.11247
AVCAGE2	.133465	.134634	.991	(.32153)	.22655	.13976
AVCAGE3	.918798E-01	.108743	.845	(.39815)	.27507	.11268
AVCAGE4	-.130765	.128366	-1.019	(.30835)	.25488	.13320
AVCAGE5	.280206	.154694	1.811	(.07009)	.10862	.16056
FEMALE	.209721E-01	.508647E-01	.412	(.68011)	.51588	.52811E-01
AVHHSIZE	-.125355E-01	.207713E-01	-.604	(.54617)	4.6452	.21470E-01
SPCINC	-.110300	.988150E-01	-1.116	(.26432)	2.3374	.10236
SPCINCSQ	.217933	.206256	1.057	(.29069)	.68488	.21377
NONWHITE	.973996E-02	.744029E-01	.131	(.89585)	.27168	.76985E-01
HISPANIC	-.229626	.924927E-01	-2.483	(.01304)	.89414E-01	.95584E-01
MSOMEHS	.134078	.137382	.976	(.32909)	.22557	.14263
MHSGRAD	.296126E-01	.137226	.216	(.82915)	.41382	.14241
MSOMECOL	.222189	.143063	1.553	(.12040)	.26435	.14840
MCOLGRAD	.361406E-01	.177253	.204	(.83844)	.57519E-01	.18379
MOMEMP	.934217E-01	.575370E-01	1.624	(.10444)	.33136	.59398E-01
HEIGHT	.278046E-02	.526527E-02	.528	(.59745)	35.537	.54666E-02
NEAST	-.981721E-01	.808066E-01	-1.215	(.22440)	.21643	.83547E-01
SOUTH	-.235193	.744146E-01	-3.161	(.00157)	.27012	.76916E-01
WEST	-.239881	.812867E-01	-2.951	(.00317)	.23330	.84162E-01
LOPOV	-.157712	.155618	-1.013	(.31084)	.51395E-01	.16078
MIDPOV	.167211E-01	.117389	.142	(.88673)	.17966	.12163
HIPOV	.118814	.112222	1.059	(.28972)	.20431	.11627
SUBCORE	-.115292E-01	.825771E-01	-.140	(.88896)	.25963	.85549E-01
NMCORE	-.245991	.101517	-2.423	(.01539)	.11676	.10515
SUBLOW	.378678E-01	.964424E-01	.393	(.69458)	.16153	.99807E-01
NMLOW	-.828677E-01	.102148	-.811	(.41722)	.13767	.10580
Lambda-F	.471724E-01	.708846E-01	.665	(.50574)	.14180E-05	.70670E-01
Lambda-W	.256996E-01	.652070E-01	.394	(.69349)	.12209E-05	.67337E-01

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```
 Bivariate Probit Sample Selection Model

 Selection Criterion A: EFSPART  = *
 Selection Criterion B: EOWNWIC  = *


 Modified selection model for Mathematica - 2/11/88
 (WHG) Two level selection on eligibility and choice.

 Bivariate frequencies for eligibility and participation:

 FSELIG   = 0          WICELIG  = 0
EFSPART  miscoded =      0        EOWNWIC  miscoded =      0
 FSELIG   = 0          WICELIG  = 1
EFSPART  miscoded =      0        EOWNWIC  miscoded =      0
 FSELIG   = 1          WICELIG  = 0
EFSPART  miscoded =      0        EOWNWIC  miscoded =      0
 FSELIG   = 1          WICELIG  = 1
EFSPART  miscoded =      0        EOWNWIC  miscoded =      0

                   EFSPART  = 0     EFSPART  = 1
 EOWNWIC  = 0             0                0


 EOWNWIC  = 0             0                0


 Number of incorrectly coded eligibilities:
 FSELIG  =    0     WICELIG =    0

 Full sample contains       445.0 observations.
 Selected sample contains   445.0 observations.


     Ordinary    Least Squares Estimates

     Dependent Variable..........     LOGAVGVC
     Number of Observations......          445.
     Mean of Dependent Variable..        .36842
     Std. Dev. of Dep. Variable..        .58876
     Std. Error of Regression....        .49990
     Sum of Squared Residuals....    102.96
     R - Squared.................        .27743
     Adjusted R - Squared........        .22131
     F-Statistic ( 32,  412).....       4.94340
     Significance of F-Test......        .00000
     Log-Likelihood..............   -305.75
     Restricted (Slopes=0) Log-L.   -395.17
     Chi-Squared (32)............    178.85
     Significance Level..........    .32173E-13

 Estimated disturbance standard deviation =  .500700
 Estimated correlation with selection equation A =  .120547
 Estimated correlation with selection equation B =  .803472E-01
```

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The column labelled std.dev.of X below is the
uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.325111	.281762	-1.154 (.24856)	.99999	.28968
AVOWNWIC	.283993	.195793	1.450 (.14693)	.17826	.19983
AVFSPART	.103187	.115264	.895 (.37067)	.33115	.11773
AVFSWIC	-.131344	.191689	-.685 (.49322)	.13025	.19453
AVOTHWIC	.134343	.108776	1.235 (.21681)	.14097	.11251
AVCAGE2	-.275455	.135101	-2.039 (.04146)	.22655	.13981
AVCAGE3	-.215877	.109495	-1.972 (.04866)	.27507	.11273
AVCAGE4	-.373499	.128954	-2.896 (.00378)	.25488	.13326
AVCAGE5	.110501	.155318	.711 (.47680)	.10862	.16062
FEMALE	-.460269E-01	.510094E-01	-.902 (.36689)	.51588	.52833E-01
AVHHSIZE	-.201769E-01	.210438E-01	-.959 (.33766)	4.6452	.21479E-01
SPCINC	-.985545E-01	.997094E-01	-.988 (.32295)	2.3374	.10240
SPCINCSQ	.335440	.207939	1.613 (.10671)	.68488	.21386
NONWHITE	.964262E-01	.752156E-01	1.282 (.19984)	.27168	.77017E-01
HISPANIC	.111758	.937673E-01	1.192 (.23332)	.89414E-01	.95623E-01
MSOMEHS	.157297	.137758	1.142 (.25352)	.22557	.14269
MHSGRAD	.224294	.137839	1.627 (.10369)	.41382	.14247
MSOMECOL	.450362	.143862	3.131 (.00175)	.26435	.14846
MCOLGRAD	.433323	.178375	2.429 (.01513)	.57519E-01	.18387
MOMEMP	.310780E-01	.583481E-01	.533 (.59429)	.33136	.59423E-01
HEIGHT	.177644E-01	.527734E-02	3.366 (.00076)	35.537	.54689E-02
NEAST	.102769	.817093E-01	1.258 (.20848)	.21643	.83582E-01
SOUTH	-.105177	.753401E-01	-1.396 (.16270)	.27012	.76948E-01
WEST	-.267365	.819858E-01	-3.261 (.00111)	.23330	.84197E-01
LOPOV	-.495934	.157849	-3.142 (.00168)	.51395E-01	.16084
MIDPOV	-.153165E-01	.118339	-.129 (.89702)	.17966	.12168
HIPOV	.261234E-01	.113170	.231 (.81745)	.20431	.11632
SUBCORE	.189487	.832065E-01	2.277 (.02277)	.25963	.85584E-01
NMCORE	-.713330E-01	.102347	-.697 (.48582)	.11676	.10519
SUBLOW	.832995E-01	.975802E-01	.854 (.39330)	.16153	.99849E-01
NMLOW	.123937	.103170	1.201 (.22964)	.13767	.10585
Lambda-F	.749013E-01	.754517E-01	.993 (.32085)	.14180E-05	.70699E-01
Lambda-W	.587662E-01	.662475E-01	.887 (.37504)	.12209E-05	.67365E-01

```
Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART  = *
Selection Criterion B: EOWNWIC  = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG  = 0        WICELIG  = 0
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG  = 0        WICELIG  = 1
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG  = 1        WICELIG  = 0
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG  = 1        WICELIG  = 1
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0

                   EFSPART  = 0     EFSPART  = 1
 EOWNWIC  = 0              0                0


 EOWNWIC  = 0              0                0


Number of incorrectly coded eligibilities:
FSELIG  =    0     WICELIG =    0

Full sample contains       445.0 observations.
Selected sample contains   445.0 observations.


    Ordinary    Least Squares Estimates

    Dependent Variable..........     LOGAVGVE
    Number of Observations......          445.
    Mean of Dependent Variable..       -.09180
    Std. Dev. of Dep. Variable..        .59201
    Std. Error of Regression....        .52467
    Sum of Squared Residuals....    113.41
    R - Squared.................        .21279
    Adjusted R - Squared........        .15165
    F-Statistic ( 32,  412).....       3.48029
    Significance of F-Test......        .00000
    Log-Likelihood..............   -327.26
    Restricted (Slopes=0) Log-L.   -397.62
    Chi-Squared (32)............    140.72
    Significance Level..........    .32173E-13

Estimated disturbance standard deviation =  .526892
Estimated correlation with selection equation A =  .154089
Estimated correlation with selection equation B = -.103116
```

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.166616	.294494	-.566 (.57155)	.99999	.30403
AVOWNWIC	.146135	.201150	.727 (.46753)	.17826	.20973
AVFSPART	-.256155	.120434	-2.127 (.03343)	.33115	.12356
AVFSWIC	.228401	.196285	1.164 (.24458)	.13025	.20417
AVOTHWIC	.358589	.113693	3.154 (.00161)	.14097	.11809
AVCAGE2	.367384	.141545	2.596 (.00944)	.22655	.14674
AVCAGE3	.231197	.114441	2.020 (.04336)	.27507	.11831
AVCAGE4	.462336E-01	.135027	.342 (.73205)	.25488	.13986
AVCAGE5	.367785	.162759	2.260 (.02384)	.10862	.16858
FEMALE	.196275E-01	.534304E-01	.367 (.71336)	.51588	.55450E-01
AVHHSIZE	-.625097E-02	.219086E-01	-.285 (.77540)	4.6452	.22543E-01
SPCINC	-.894447E-01	.104209	-.858 (.39072)	2.3374	.10748
SPCINCSQ	-.118566E-02	.217400	-.005 (.99565)	.68488	.22445
NONWHITE	.125311	.785263E-01	1.596 (.11054)	.27168	.80832E-01
HISPANIC	-.233799	.977010E-01	-2.393 (.01671)	.89414E-01	.10036
MSOMEHS	.219709	.144183	1.524 (.12755)	.22557	.14976
MHSGRAD	.741060E-01	.144031	.515 (.60689)	.41382	.14952
MSOMECOL	.142809	.150234	.951 (.34182)	.26435	.15582
MCOLGRAD	-.101084	.186423	-.542 (.58766)	.57519E-01	.19297
MOMEMP	.123372	.607825E-01	2.030 (.04238)	.33136	.62366E-01
HEIGHT	.463727E-02	.553175E-02	.838 (.40186)	35.537	.57398E-02
NEAST	-.203722	.853202E-01	-2.388 (.01695)	.21643	.87722E-01
SOUTH	-.151840	.784891E-01	-1.935 (.05305)	.27012	.80760E-01
WEST	.310263E-01	.857696E-01	.362 (.71755)	.23330	.88368E-01
LOPOV	-.232803	.164563	-1.415 (.15716)	.51395E-01	.16881
MIDPOV	-.152247	.123733	-1.230 (.21853)	.17966	.12770
HIPOV	-.245163	.118175	-2.075 (.03803)	.20431	.12208
SUBCORE	-.134744	.871270E-01	-1.547 (.12198)	.25963	.89824E-01
NMCORE	-.216448	.107051	-2.022 (.04319)	.11676	.11040
SUBLOW	-.322139E-01	.101577	-.317 (.75114)	.16153	.10479
NMLOW	-.106853	.107467	-.994 (.32008)	.13767	.11109
Lambda-F	.721619E-01	.768433E-01	.939 (.34769)	.14180E-05	.74201E-01
Lambda-W	-.364726E-01	.684123E-01	-.533 (.59394)	.12209E-05	.70702E-01

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```
Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART  = *
Selection Criterion B: EOWNWIC  = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG   = 0          WICELIG  = 0
EFSPART  miscoded =      0          EOWNWIC  miscoded =      0
 FSELIG   = 0          WICELIG  = 1
EFSPART  miscoded =      0          EOWNWIC  miscoded =      0
 FSELIG   = 1          WICELIG  = 0
EFSPART  miscoded =      0          EOWNWIC  miscoded =      0
 FSELIG   = 1          WICELIG  = 1
EFSPART  miscoded =      0          EOWNWIC  miscoded =      0

                     EFSPART  = 0     EFSPART  = 1
 EOWNWIC  = 0               0                0


 EOWNWIC  = 0               0                0


 Number of incorrectly coded eligibilities:
 FSELIG  =    0     WICELIG =    0

 Full sample contains       445.0 observations.
 Selected sample contains   445.0 observations.


     Ordinary    Least Squares Estimates

     Dependent Variable..........     AVCALC
     Number of Observations......         445.
     Mean of Dependent Variable..       .94349
     Std. Dev. of Dep. Variable..       .35623
     Std. Error of Regression....       .31199
     Sum of Squared Residuals....    40.104
     R - Squared.................       .23123
     Adjusted R - Squared........       .17152
     F-Statistic ( 32,  412).....      3.87254
     Significance of F-Test......       .00000
     Log-Likelihood..............   -95.958
     Restricted (Slopes=0) Log-L.   -171.59
     Chi-Squared (32)............    151.27
     Significance Level..........    .32173E-13

 Estimated disturbance standard deviation =  .314776
 Estimated correlation with selection equation A = -.155915
 Estimated correlation with selection equation B =  .213666
```

```
Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART   = *
Selection Criterion B: EOWNWIC   = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG    = 0        WICELIG   = 0
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG    = 0        WICELIG   = 1
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG    = 1        WICELIG   = 0
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG    = 1        WICELIG   = 1
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0

                   EFSPART   = 0     EFSPART   = 1
 EOWNWIC   = 0              0                 0


 EOWNWIC   = 0              0                 0


Number of incorrectly coded eligibilities:
FSELIG   =     0      WICELIG =     0

Full sample contains       445.0 observations.
Selected sample contains   445.0 observations.


    Ordinary    Least Squares Estimates

    Dependent Variable..........     LOGAVGFE
    Number of Observations......          445.
    Mean of Dependent Variable..       -.37375
    Std. Dev. of Dep. Variable..        .41724
    Std. Error of Regression....        .30991
    Sum of Squared Residuals....    39.571
    R - Squared.................        .44705
    Adjusted R - Squared........        .40410
    F-Statistic ( 32,  412).....      10.40903
    Significance of F-Test......        .00000
    Log-Likelihood..............   -92.982
    Restricted (Slopes=0) Log-L.   -241.93
    Chi-Squared (32)............    297.90
    Significance Level..........    .32173E-13

Estimated disturbance standard deviation =  .310850
Estimated correlation with selection equation A = -.173642
Estimated correlation with selection equation B =  .975971E-02
```

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.969271	.174413	-5.557	(.00000)	.99999	.17958
AVOWNWIC	.501583E-01	.119989	.418	(.67593)	.17826	.12388
AVFSPART	.936898E-01	.717893E-01	1.305	(.19187)	.33115	.72986E-01
AVFSWIC	.574773E-01	.117183	.490	(.62379)	.13025	.12060
AVOTHWIC	.206336	.674094E-01	3.061	(.00221)	.14097	.69752E-01
AVCAGE2	.258661E-02	.836512E-01	.031	(.97533)	.22655	.86676E-01
AVCAGE3	.992668E-01	.678005E-01	1.464	(.14317)	.27507	.69887E-01
AVCAGE4	.469962	.797787E-01	5.891	(.00000)	.25488	.82612E-01
AVCAGE5	.677678	.961209E-01	7.050	(.00000)	.10862	.99578E-01
FEMALE	-.914795E-02	.315904E-01	-.290	(.77214)	.51588	.32753E-01
AVHHSIZE	.632102E-02	.129997E-01	.486	(.62679)	4.6452	.13316E-01
SPCINC	.248278E-01	.615778E-01	.403	(.68681)	2.3374	.63484E-01
SPCINCSQ	-.245301E-01	.128367	-.191	(.84845)	.68488	.13258
NONWHITE	-.314282E-01	.464928E-01	-.676	(.49905)	.27168	.47746E-01
HISPANIC	-.148334	.579131E-01	-2.561	(.01043)	.89414E-01	.59281E-01
MSOMEHS	.167313	.853316E-01	1.961	(.04991)	.22557	.88459E-01
MHSGRAD	.137188	.852186E-01	1.610	(.10743)	.41382	.88321E-01
MSOMECOL	.100345	.889026E-01	1.129	(.25902)	.26435	.92038E-01
MCOLGRAD	-.265914E-01	.110286	-.241	(.80947)	.57519E-01	.11399
MOMEMP	.108866	.361669E-01	3.010	(.00261)	.33136	.36839E-01
HEIGHT	.374992E-02	.327264E-02	1.146	(.25186)	35.537	.33904E-02
NEAST	.845218E-02	.506446E-01	.167	(.86745)	.21643	.51816E-01
SOUTH	-.452751E-01	.466119E-01	-.971	(.33139)	.27012	.47703E-01
WEST	-.163943E-01	.507936E-01	-.323	(.74687)	.23330	.52197E-01
LOPOV	-.120300	.975086E-01	-1.234	(.21730)	.51395E-01	.99714E-01
MIDPOV	-.647551E-01	.731619E-01	-.885	(.37611)	.17966	.75433E-01
HIPOV	-.904363E-01	.698957E-01	-1.294	(.19571)	.20431	.72112E-01
SUBCORE	.901986E-01	.515312E-01	1.750	(.08005)	.25963	.53057E-01
NMCORE	-.983186E-01	.633631E-01	-1.552	(.12074)	.11676	.65211E-01
SUBLOW	.248189E-02	.601239E-01	.041	(.96707)	.16153	.61901E-01
NMLOW	.214500E-01	.635647E-01	.337	(.73578)	.13767	.65620E-01
Lambda-F	-.566983E-01	.481690E-01	-1.177	(.23917)	.14180E-05	.43829E-01
Lambda-W	-.109978E-01	.407729E-01	-.270	(.78737)	.12209E-05	.41762E-01

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Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART = *
Selection Criterion B: EOWNWIC = *

Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

```
 FSELIG   = 0         WICELIG  = 0
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG   = 0         WICELIG  = 1
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG   = 1         WICELIG  = 0
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG   = 1         WICELIG  = 1
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
```

	EFSPART = 0	EFSPART = 1
EOWNWIC = 0	0	0
EOWNWIC = 0	0	0

Number of incorrectly coded eligibilities:
FSELIG = 0 WICELIG = 0

Full sample contains 445.0 observations.
Selected sample contains 445.0 observations.

Ordinary Least Squares Estimates

Dependent Variable..........	AVZINC
Number of Observations......	445.
Mean of Dependent Variable..	.70793
Std. Dev. of Dep. Variable..	.21510
Std. Error of Regression....	.19582
Sum of Squared Residuals....	15.798
R - Squared.................	.16935
Adjusted R - Squared........	.10484
F-Statistic (32, 412).....	2.62499
Significance of F-Test......	.00001
Log-Likelihood..............	111.32
Restricted (Slopes=0) Log-L.	52.909
Chi-Squared (32)............	116.82
Significance Level..........	.10143E-12

Estimated disturbance standard deviation = .197401
Estimated correlation with selection equation A = -.254344
Estimated correlation with selection equation B = .809127E-01

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The column labelled std.dev.of X below is the
uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.305794	.111021	2.754 (.00588)	.99999	.11347
AVOWNWIC	.441260E-01	.753541E-01	.586 (.55816)	.17826	.78276E-01
AVFSPART	.130555	.461876E-01	2.827 (.00470)	.33115	.46116E-01
AVFSWIC	-.152567	.737254E-01	-2.069 (.03851)	.13025	.76199E-01
AVOTHWIC	-.140400E-02	.426566E-01	-.033 (.97374)	.14097	.44073E-01
AVCAGE2	-.587306E-01	.529814E-01	-1.109 (.26764)	.22655	.54766E-01
AVCAGE3	.943998E-01	.431003E-01	2.190 (.02851)	.27507	.44158E-01
AVCAGE4	-.223091E-01	.505569E-01	-.441 (.65902)	.25488	.52199E-01
AVCAGE5	.970656E-01	.609157E-01	1.593 (.11106)	.10862	.62919E-01
FEMALE	-.471446E-01	.199885E-01	-2.359 (.01834)	.51588	.20695E-01
AVHHSIZE	.975006E-02	.830122E-02	1.175 (.24018)	4.6452	.84134E-02
SPCINC	.835278E-02	.391794E-01	.213 (.83118)	2.3374	.40113E-01
SPCINCSQ	.441162E-01	.815513E-01	.541 (.58853)	.68488	.83770E-01
NONWHITE	-.220881E-01	.296685E-01	-.744 (.45658)	.27168	.30168E-01
HISPANIC	-.355513E-02	.370363E-01	-.096 (.92353)	.89414E-01	.37457E-01
MSOMEHS	.615138E-01	.539604E-01	1.140 (.25429)	.22557	.55893E-01
MHSGRAD	.535863E-01	.538719E-01	.995 (.31988)	.41382	.55806E-01
MSOMECOL	.307052E-01	.562515E-01	.546 (.58517)	.26435	.58154E-01
MCOLGRAD	-.659622E-01	.699424E-01	-.943 (.34563)	.57519E-01	.72022E-01
MOMEMP	.339372E-01	.232117E-01	1.462 (.14372)	.33136	.23277E-01
HEIGHT	.622672E-02	.207266E-02	3.004 (.00266)	35.537	.21422E-02
NEAST	.437117E-04	.324150E-01	.001 (.99892)	.21643	.32740E-01
SOUTH	.767494E-02	.297904E-01	.258 (.79669)	.27012	.30141E-01
WEST	-.395838E-02	.324146E-01	-.122 (.90281)	.23330	.32981E-01
LOPOV	-.447280E-01	.624479E-01	-.716 (.47384)	.51395E-01	.63004E-01
MIDPOV	.111122E-01	.465415E-01	.239 (.81129)	.17966	.47662E-01
HIPOV	.733034E-02	.444023E-01	.165 (.86887)	.20431	.45564E-01
SUBCORE	.687965E-01	.328475E-01	2.094 (.03622)	.25963	.33524E-01
NMCORE	-.452290E-01	.403771E-01	-1.120 (.26264)	.11676	.41204E-01
SUBLOW	-.112231E-01	.382188E-01	-.294 (.76902)	.16153	.39112E-01
NMLOW	.231082E-01	.403100E-01	.573 (.56647)	.13767	.41462E-01
Lambda-F	-.492727E-01	.332086E-01	-1.484 (.13788)	.14180E-05	.27694E-01
Lambda-W	.377834E-02	.258998E-01	.146 (.88401)	.12209E-05	.26388E-01

APPENDIX G

DETAILED ESTIMATION RESULTS FOR CHILDREN: OLS ESTIMATES OF THE NUTRIENT INTAKE EQUATIONS

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Ordinary Least Squares Estimates

Dependent Variable..........	AVKCAL
Number of Observations......	445.
Mean of Dependent Variable..	.94626
Std. Dev. of Dep. Variable..	.24841
Std. Error of Regression....	.22897
Sum of Squared Residuals....	21.706
R - Squared.................	.20777
Adjusted R - Squared........	.15037
F-Statistic (30, 414).....	3.61929
Significance of F-Test......	.00000
Log-Likelihood..............	40.635
Restricted (Slopes=0) Log-L.	-11.167
Chi-Squared (30)............	103.60
Significance Level..........	.95451E-11
Durbin - Watson Statistic...........	1.6869
Estimated Autocorrelation (Rho).....	.15655

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.673822	.119463	5.640 (.00000)	1.0000	.00000
AVOWNWIC	.121433	.707617E-01	1.716 (.08293)	.17826	.33792
AVFSPART	.967369E-01	.440394E-01	2.197 (.02704)	.33116	.44251
AVFSWIC	-.250670	.836276E-01	-2.997 (.00304)	.13025	.29153
AVOTHWIC	.208485E-01	.483915E-01	.431 (.67015)	.14097	.30617
AVCAGE2	.545968E-01	.615184E-01	.887 (.37913)	.22655	.31647
AVCAGE3	.174414	.493132E-01	3.537 (.00058)	.27507	.34472
AVCAGE4	-.130393	.584915E-01	-2.229 (.02492)	.25489	.32313
AVCAGE5	-.134788E-01	.706218E-01	-.191 (.82817)	.10862	.23570
FEMALE	-.670323E-01	.232798E-01	-2.879 (.00429)	.51588	.50031
AVHHSIZE	.456023E-02	.925545E-02	.493 (.62822)	4.6452	1.3733
SPCINC	-.743206E-02	.445913E-01	-.167 (.84320)	2.3375	1.1782
SPCINCSQ	.589437E-01	.934177E-01	.631 (.53591)	.68489	.56532
NONWHITE	-.496147E-01	.334809E-01	-1.482 (.13487)	.27168	.44533
HISPANIC	-.474876E-01	.419789E-01	-1.131 (.25753)	.89415E-01	.28566
MSOMEHS	.937421E-01	.619409E-01	1.513 (.12663)	.22557	.41843
MHSGRAD	.512825E-01	.614987E-01	.834 (.40974)	.41382	.49307
MSOMECOL	.482326E-01	.645182E-01	.748 (.46160)	.26435	.44148
MCOLGRAD	-.237396E-01	.797682E-01	-.298 (.75949)	.57519E-01	.23309
MOMEMP	.187089E-01	.257602E-01	.726 (.47485)	.33136	.47123
HEIGHT	.562036E-02	.240967E-02	2.332 (.01917)	35.537	6.0547
NEAST	.405245E-01	.363168E-01	1.116 (.26430)	.21643	.41228
SOUTH	.254388E-01	.332709E-01	.765 (.45114)	.27012	.44452
WEST	.122941E-01	.364050E-01	.338 (.73289)	.23330	.42341
LOPOV	-.460860E-01	.702832E-01	-.656 (.51980)	.51395E-01	.22105
MIDPOV	-.752423E-01	.533504E-01	-1.410 (.15516)	.17966	.38434
HIPOV	-.848442E-01	.511559E-01	-1.659 (.09381)	.20431	.40365
SUBCORE	-.198568E-01	.375904E-01	-.528 (.60423)	.25964	.43893
NMCORE	-.679744E-01	.462906E-01	-1.468 (.13852)	.11676	.32150
SUBLOW	-.362395E-01	.439157E-01	-.825 (.41481)	.16153	.36843
NMLOW	.357462E-01	.464476E-01	.770 (.44808)	.13768	.34495
Sigma	.228974	.767521E-02	29.833 (.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	AVGPRO
Number of Observations......	445.
Mean of Dependent Variable..	2.02583
Std. Dev. of Dep. Variable..	.60966
Std. Error of Regression....	.56473
Sum of Squared Residuals....	132.03
R - Squared.................	.19994
Adjusted R - Squared........	.14196
F-Statistic (30, 414).....	3.44871
Significance of F-Test......	.00000
Log-Likelihood..............	-361.09
Restricted (Slopes=0) Log-L.	-410.70
Chi-Squared (30)............	99.226
Significance Level..........	.74982E-10
Durbin - Watson Statistic..........	1.6815
Estimated Autocorrelation (Rho).....	.15927

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	1.33756	.294639	4.540 (.00002)	1.0000	.00000
AVOWNWIC	.358983	.174524	2.057 (.03806)	.17826	.33792
AVFSPART	.299178	.108617	2.754 (.00613)	.33116	.44251
AVFSWIC	-.650871	.206256	-3.156 (.00189)	.13025	.29153
AVOTHWIC	-.163120E-01	.119351	-.137 (.86154)	.14097	.30617
AVCAGE2	.699551E-01	.151727	.461 (.64966)	.22655	.31647
AVCAGE3	.346850	.121624	2.852 (.00465)	.27507	.34472
AVCAGE4	-.444394	.144262	-3.080 (.00238)	.25489	.32313
AVCAGE5	-.348144E-01	.174179	-.200 (.82251)	.10862	.23570
FEMALE	-.114531	.574165E-01	-1.995 (.04414)	.51588	.50031
AVHHSIZE	.969030E-02	.228273E-01	.425 (.67443)	4.6452	1.3733
SPCINC	.160453E-02	.109979	.015 (.93616)	2.3375	1.1782
SPCINCSQ	.741394E-01	.230402	.322 (.74349)	.68489	.56532
NONWHITE	.339885E-01	.825761E-01	.412 (.68317)	.27168	.44533
HISPANIC	.204807E-02	.103535	.020 (.93252)	.89415E-01	.28566
MSOMEHS	.169732	.152769	1.111 (.26645)	.22557	.41843
MHSGRAD	.111666	.151678	.736 (.46865)	.41382	.49307
MSOMECOL	.805876E-01	.159125	.506 (.61894)	.26435	.44148
MCOLGRAD	-.136505	.196737	-.694 (.49531)	.57519E-01	.23309
MOMEMP	.137530	.635341E-01	2.165 (.02927)	.33136	.47123
HEIGHT	.127222E-01	.594314E-02	2.141 (.03106)	35.537	6.0547
NEAST	-.293762E-01	.895705E-01	-.328 (.73938)	.21643	.41228
SOUTH	.569371E-01	.820583E-01	.694 (.49530)	.27012	.44452
WEST	.259416E-01	.897879E-01	.289 (.76521)	.23330	.42341
LOPOV	-.277981	.173344	-1.604 (.10528)	.51395E-01	.22105
MIDPOV	-.743879E-01	.131581	-.565 (.57934)	.17966	.38434
HIPOV	-.128193	.126169	-1.016 (.31127)	.20431	.40365
SUBCORE	.950595E-01	.927117E-01	1.025 (.30668)	.25964	.43893
NMCORE	-.248617	.114170	-2.178 (.02835)	.11676	.32150
SUBLOW	.488438E-02	.108312	.045 (.91640)	.16153	.36843
NMLOW	.108252	.114557	.945 (.34779)	.13768	.34495
Sigma	.564733	.189299E-01	29.833 (.00000)		

Ordinary Least Squares Estimates

Dependent Variable..........	LOGAVGVA
Number of Observations......	445.
Mean of Dependent Variable..	.43485
Std. Dev. of Dep. Variable..	.54417
Std. Error of Regression....	.51845
Sum of Squared Residuals....	111.28
R - Squared................	.15364
Adjusted R - Squared........	.09231
F-Statistic (30, 414).....	2.50514
Significance of F-Test......	.00003
Log-Likelihood.............	-323.03
Restricted (Slopes=0) Log-L.	-360.13
Chi-Squared (30)...........	74.191
Significance Level..........	.13045E-04
Durbin - Watson Statistic..........	1.6518
Estimated Autocorrelation (Rho).....	.17408

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.420437	.270490	1.554 (.11655)	1.0000	.00000
AVOWNWIC	-.429951E-01	.160220	-.268 (.77866)	.17826	.33792
AVFSPART	-.600644E-01	.997148E-01	-.602 (.55473)	.33116	.44251
AVFSWIC	-.128778E-01	.189351	-.068 (.90262)	.13025	.29153
AVOTHWIC	.204118	.109569	1.863 (.05988)	.14097	.30617
AVCAGE2	.131577	.139291	.945 (.34797)	.22655	.31647
AVCAGE3	.102488	.111656	.918 (.36235)	.27507	.34472
AVCAGE4	-.125450	.132438	-.947 (.34658)	.25489	.32313
AVCAGE5	.286293	.159903	1.790 (.07046)	.10862	.23570
FEMALE	.201605E-01	.527106E-01	.382 (.70284)	.51588	.50031
AVHHSIZE	-.906461E-02	.209564E-01	-.433 (.66899)	4.6452	1.3733
SPCINC	-.101244	.100965	-1.003 (.31789)	2.3375	1.1782
SPCINCSQ	.219197	.211518	1.036 (.30132)	.68489	.56532
NONWHITE	.588943E-03	.758081E-01	.008 (.94141)	.27168	.44533
HISPANIC	-.223723	.950494E-01	-2.354 (.01814)	.89415E-01	.28566
MSOMEHS	.153119	.140248	1.092 (.27517)	.22557	.41843
MHSGRAD	.514022E-01	.139246	.369 (.71182)	.41382	.49307
MSOMECOL	.241269	.146083	1.652 (.09520)	.26435	.44148
MCOLGRAD	.609333E-01	.180613	.337 (.73311)	.57519E-01	.23309
MOMEMP	.896174E-01	.583267E-01	1.536 (.12087)	.33136	.47123
HEIGHT	.269712E-02	.545603E-02	.494 (.62712)	35.537	6.0547
NEAST	-.885552E-01	.822292E-01	-1.077 (.28201)	.21643	.41228
SOUTH	-.224660	.753327E-01	-2.982 (.00318)	.27012	.44452
WEST	-.237238	.824288E-01	-2.878 (.00431)	.23330	.42341
LOPOV	-.145844	.159137	-.916 (.36313)	.51395E-01	.22105
MIDPOV	.137353E-01	.120797	.114 (.87539)	.17966	.38434
HIPOV	.114663	.115828	.990 (.32438)	.20431	.40365
SUBCORE	-.634684E-02	.851129E-01	-.075 (.89871)	.25964	.43893
NMCORE	-.247683	.104812	-2.363 (.01771)	.11676	.32150
SUBLOW	.357610E-01	.994349E-01	.360 (.71820)	.16153	.36843
NMLOW	-.814975E-01	.105167	-.775 (.44484)	.13768	.34495
Sigma	.518446	.173784E-01	29.833 (.00000)		

Ordinary Least Squares Estimates

Dependent Variable..........	LOGAVGVC
Number of Observations......	445.
Mean of Dependent Variable..	.36843
Std. Dev. of Dep. Variable..	.58876
Std. Error of Regression....	.51948
Sum of Squared Residuals....	111.72
R - Squared.................	.27409
Adjusted R - Squared........	.22148
F-Statistic (30, 414).....	5.21052
Significance of F-Test......	.00000
Log-Likelihood..............	-323.92
Restricted (Slopes=0) Log-L.	-395.17
Chi-Squared (30)............	142.50
Significance Level..........	.32173E-13
Durbin - Watson Statistic...........	1.6197
Estimated Autocorrelation (Rho).....	.19014

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.465440	.271031	-1.717 (.08271)	1.0000	.00000
AVOWNWIC	.357756	.160540	2.228 (.02497)	.17826	.33792
AVFSPART	.159018	.999141E-01	1.592 (.10796)	.33116	.44251
AVFSWIC	-.141652	.189730	-.747 (.46220)	.13025	.29153
AVOTHWIC	.142314	.109788	1.296 (.19237)	.14097	.30617
AVCAGE2	-.280529	.139570	-2.010 (.04257)	.22655	.31647
AVCAGE3	-.197206	.111879	-1.763 (.07491)	.27507	.34472
AVCAGE4	-.361875	.132702	-2.727 (.00662)	.25489	.32313
AVCAGE5	.123024	.160223	.768 (.44916)	.10862	.23570
FEMALE	-.474152E-01	.528160E-01	-.898 (.37342)	.51588	.50031
AVHHSIZE	-.141451E-01	.209983E-01	-.674 (.50824)	4.6452	1.3733
SPCINC	-.850366E-01	.101166	-.841 (.40585)	2.3375	1.1782
SPCINCSQ	.344190	.211941	1.624 (.10090)	.68489	.56532
NONWHITE	.813376E-01	.759596E-01	1.071 (.28487)	.27168	.44533
HISPANIC	.122983	.952394E-01	1.291 (.19413)	.89415E-01	.28566
MSOMEHS	.190658	.140528	1.357 (.17189)	.22557	.41843
MHSGRAD	.261426	.139525	1.874 (.05843)	.41382	.49307
MSOMECOL	.483788	.146375	3.305 (.00120)	.26435	.44148
MCOLGRAD	.476015	.180974	2.630 (.00867)	.57519E-01	.23309
MOMEMP	.221862E-01	.584433E-01	.380 (.70477)	.33136	.47123
HEIGHT	.176295E-01	.546694E-02	3.225 (.00153)	35.537	6.0547
NEAST	.121184	.823936E-01	1.471 (.13787)	.21643	.41228
SOUTH	-.852345E-01	.754833E-01	-1.129 (.25842)	.27012	.44452
WEST	-.259037	.825936E-01	-3.136 (.00201)	.23330	.42341
LOPOV	-.471741	.159455	-2.958 (.00341)	.51395E-01	.22105
MIDPOV	-.178853E-01	.121038	-.148 (.85480)	.17966	.38434
HIPOV	.200388E-01	.116060	.173 (.83950)	.20431	.40365
SUBCORE	.199122	.852830E-01	2.335 (.01905)	.25964	.43893
NMCORE	-.730991E-01	.105022	-.696 (.49391)	.11676	.32150
SUBLOW	.782606E-01	.996336E-01	.785 (.43845)	.16153	.36843
NMLOW	.124121	.105378	1.178 (.23771)	.13768	.34495
Sigma	.519483	.174131E-01	29.833 (.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	LOGAVGVE
Number of Observations......	445.
Mean of Dependent Variable..	-.09180
Std. Dev. of Dep. Variable..	.59201
Std. Error of Regression....	.54475
Sum of Squared Residuals....	122.86
R - Squared.................	.21050
Adjusted R - Squared........	.15329
F-Statistic (30, 414).....	3.67944
Significance of F-Test......	.00000
Log-Likelihood..............	-345.06
Restricted (Slopes=0) Log-L.	-397.63
Chi-Squared (30)............	105.14
Significance Level..........	.45852E-11
Durbin - Watson Statistic...........	1.6536
Estimated Autocorrelation (Rho).....	.17322

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.222978	.284214	-.785 (.43902)	1.0000	.00000
AVOWNWIC	.571461E-01	.168349	.339 (.73172)	.17826	.33792
AVFSPART	-.188016	.104774	-1.794 (.06983)	.33116	.44251
AVFSWIC	.269823	.198958	1.356 (.17206)	.13025	.29153
AVOTHWIC	.335845	.115128	2.917 (.00385)	.14097	.30617
AVCAGE2	.373256	.146358	2.550 (.01078)	.22655	.31647
AVCAGE3	.239714	.117321	2.043 (.03933)	.27507	.34472
AVCAGE4	.409247E-01	.139157	.294 (.76181)	.25489	.32313
AVCAGE5	.365037	.168016	2.173 (.02870)	.10862	.23570
FEMALE	.188067E-01	.553849E-01	.340 (.73165)	.51588	.50031
AVHHSIZE	-.313792E-02	.220196E-01	-.143 (.85800)	4.6452	1.3733
SPCINC	-.719574E-01	.106087	-.678 (.50525)	2.3375	1.1782
SPCINCSQ	-.277097E-01	.222250	-.125 (.86879)	.68489	.56532
NONWHITE	.113668	.796543E-01	1.427 (.15023)	.27168	.44533
HISPANIC	-.232585	.998719E-01	-2.329 (.01935)	.89415E-01	.28566
MSOMEHS	.235637	.147363	1.599 (.10630)	.22557	.41843
MHSGRAD	.967460E-01	.146311	.661 (.51623)	.41382	.49307
MSOMECOL	.158780	.153495	1.034 (.30223)	.26435	.44148
MCOLGRAD	-.771908E-01	.189776	-.407 (.68645)	.57519E-01	.23309
MOMEMP	.129585	.612860E-01	2.114 (.03312)	.33136	.47123
HEIGHT	.452064E-02	.573285E-02	.789 (.43660)	35.537	6.0547
NEAST	-.202280	.864012E-01	-2.341 (.01874)	.21643	.41228
SOUTH	-.149309	.791549E-01	-1.886 (.05678)	.27012	.44452
WEST	.176423E-01	.866110E-01	.204 (.82011)	.23330	.42341
LOPOV	-.237211	.167211	-1.419 (.15269)	.51395E-01	.22105
MIDPOV	-.165981	.126926	-1.308 (.18836)	.17966	.38434
HIPOV	-.253651	.121705	-2.084 (.03564)	.20431	.40365
SUBCORE	-.132753	.894313E-01	-1.484 (.13420)	.25964	.43893
NMCORE	-.222915	.110130	-2.024 (.04117)	.11676	.32150
SUBLOW	-.282904E-01	.104480	-.271 (.77708)	.16153	.36843
NMLOW	-.963558E-01	.110503	-.872 (.38785)	.13768	.34495
Sigma	.544750	.182601E-01	29.833 (.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	AVCALC
Number of Observations......	445.
Mean of Dependent Variable..	.94350
Std. Dev. of Dep. Variable..	.35622
Std. Error of Regression....	.32446
Sum of Squared Residuals....	43.583
R - Squared.................	.22646
Adjusted R - Squared........	.17040
F-Statistic (30, 414).....	4.04000
Significance of F-Test......	.00000
Log-Likelihood..............	-114.47
Restricted (Slopes=0) Log-L.	-171.58
Chi-Squared (30)............	114.22
Significance Level..........	.53352E-13
Durbin - Watson Statistic...........	1.8706
Estimated Autocorrelation (Rho).....	.64711E-01

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.639287	.169280	3.777 (.00026)	1.0000	.00000
AVOWNWIC	.151592	.100270	1.512 (.12703)	.17826	.33792
AVFSPART	.871184E-01	.624041E-01	1.396 (.15950)	.33116	.44251
AVFSWIC	-.129609	.118501	-1.094 (.27427)	.13025	.29153
AVOTHWIC	-.201236E-01	.685711E-01	-.293 (.76222)	.14097	.30617
AVCAGE2	-.285854E-02	.871721E-01	-.033 (.92403)	.22655	.31647
AVCAGE3	.876838E-02	.698771E-01	.125 (.86831)	.27507	.34472
AVCAGE4	-.104660	.828829E-01	-1.263 (.20449)	.25489	.32313
AVCAGE5	.198244	.100072	1.981 (.04558)	.10862	.23570
FEMALE	-.508958E-02	.329877E-01	-.154 (.85081)	.51588	.50031
AVHHSIZE	-.101529E-02	.131150E-01	-.077 (.89702)	4.6452	1.3733
SPCINC	-.148888	.631862E-01	-2.356 (.01802)	2.3375	1.1782
SPCINCSQ	.398150	.132374	3.008 (.00295)	.68489	.56532
NONWHITE	-.159627	.474427E-01	-3.365 (.00099)	.27168	.44533
HISPANIC	-.206496E-01	.594844E-01	-.347 (.72658)	.89415E-01	.28566
MSOMEHS	.954719E-01	.877707E-01	1.088 (.27701)	.22557	.41843
MHSGRAD	.108080	.871440E-01	1.240 (.21294)	.41382	.49307
MSOMECOL	.193977	.914227E-01	2.122 (.03253)	.26435	.44148
MCOLGRAD	.777015E-01	.113032	.687 (.49940)	.57519E-01	.23309
MOMEMP	.113764	.365024E-01	3.117 (.00213)	.33136	.47123
HEIGHT	.671044E-02	.341453E-02	1.965 (.04730)	35.537	6.0547
NEAST	-.886515E-02	.514612E-01	-.172 (.83974)	.21643	.41228
SOUTH	-.708970E-01	.471452E-01	-1.504 (.12910)	.27012	.44452
WEST	-.250103E-01	.515861E-01	-.485 (.63356)	.23330	.42341
LOPOV	.518234E-01	.995918E-01	.520 (.60954)	.51395E-01	.22105
MIDPOV	.128079	.755978E-01	1.694 (.08693)	.17966	.38434
HIPOV	.560483E-01	.724883E-01	.773 (.44589)	.20431	.40365
SUBCORE	.785520E-01	.532659E-01	1.475 (.13681)	.25964	.43893
NMCORE	-.330353E-01	.655941E-01	-.504 (.62084)	.11676	.32150
SUBLOW	-.109007	.622289E-01	-1.752 (.07674)	.16153	.36843
NMLOW	-.581055E-01	.658165E-01	-.883 (.38173)	.13768	.34495
Sigma	.324457	.108758E-01	29.833 (.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	LOGAVGFE
Number of Observations......	445.
Mean of Dependent Variable..	-.37375
Std. Dev. of Dep. Variable..	.41724
Std. Error of Regression....	.32199
Sum of Squared Residuals....	42.922
R - Squared.................	.44469
Adjusted R - Squared........	.40445
F-Statistic (30, 414).....	11.05106
Significance of F-Test......	.00000
Log-Likelihood..............	-111.07
Restricted (Slopes=0) Log-L.	-241.93
Chi-Squared (30)............	261.72
Significance Level..........	.32173E-13
Durbin - Watson Statistic...........	1.4978
Estimated Autocorrelation (Rho).....	.25112

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.891404	.167992	-5.306 (.00000)	1.0000	.00000
AVOWNWIC	.518971E-01	.995074E-01	.522 (.60875)	.17826	.33792
AVFSPART	.462653E-01	.619295E-01	.747 (.46192)	.33116	.44251
AVFSWIC	.468072E-01	.117600	.398 (.69235)	.13025	.29153
AVOTHWIC	.211246	.680497E-01	3.104 (.00221)	.14097	.30617
AVCAGE2	.255694E-02	.865092E-01	.030 (.92608)	.22655	.31647
AVCAGE3	.885401E-01	.693458E-01	1.277 (.19935)	.27507	.34472
AVCAGE4	.467102	.822526E-01	5.679 (.00000)	.25489	.32313
AVCAGE5	.673528	.993106E-01	6.782 (.00000)	.10862	.23570
FEMALE	-.828289E-02	.327368E-01	-.253 (.78861)	.51588	.50031
AVHHSIZE	.272572E-02	.130153E-01	.209 (.81649)	4.6452	1.3733
SPCINC	.129894E-01	.627057E-01	.207 (.81793)	2.3375	1.1782
SPCINCSQ	-.185797E-01	.131367	-.141 (.85865)	.68489	.56532
NONWHITE	-.210477E-01	.470819E-01	-.447 (.65916)	.27168	.44533
HISPANIC	-.153378	.590320E-01	-2.598 (.00946)	.89415E-01	.28566
MSOMEHS	.147891	.871032E-01	1.698 (.08625)	.22557	.41843
MHSGRAD	.113805	.864813E-01	1.316 (.18551)	.41382	.49307
MSOMECOL	.808820E-01	.907275E-01	.891 (.37690)	.26435	.44148
MCOLGRAD	-.527073E-01	.112172	-.470 (.64368)	.57519E-01	.23309
MOMEMP	.110280	.362248E-01	3.044 (.00265)	.33136	.47123
HEIGHT	.384724E-02	.338856E-02	1.135 (.25573)	35.537	6.0547
NEAST	.376077E-03	.510698E-01	.007 (.94175)	.21643	.41228
SOUTH	-.543702E-01	.467867E-01	-1.162 (.24429)	.27012	.44452
WEST	-.149972E-01	.511938E-01	-.293 (.76256)	.23330	.42341
LOPOV	-.128643	.988345E-01	-1.302 (.19049)	.51395E-01	.22105
MIDPOV	-.587604E-01	.750229E-01	-.783 (.43981)	.17966	.38434
HIPOV	-.848858E-01	.719370E-01	-1.180 (.23683)	.20431	.40365
SUBCORE	.855278E-01	.528608E-01	1.618 (.10218)	.25964	.43893
NMCORE	-.952673E-01	.650953E-01	-1.464 (.13987)	.11676	.32150
SUBLOW	.313851E-02	.617557E-01	.051 (.91292)	.16153	.36843
NMLOW	.175980E-01	.653160E-01	.269 (.77796)	.13768	.34495
Sigma	.321990	.107931E-01	29.833 (.00000)		

Ordinary Least Squares Estimates

Dependent Variable..........	AVZINC
Number of Observations......	445.
Mean of Dependent Variable..	.70793
Std. Dev. of Dep. Variable..	.21509
Std. Error of Regression....	.20380
Sum of Squared Residuals....	17.195
R - Squared.................	.16287
Adjusted R - Squared........	.10221
F-Statistic (30, 414).....	2.68497
Significance of F-Test......	.00001
Log-Likelihood..............	92.462
Restricted (Slopes=0) Log-L.	52.926
Chi-Squared (30)............	79.072
Significance Level..........	.26829E-05
Durbin - Watson Statistic...........	1.6662
Estimated Autocorrelation (Rho).....	.16690

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.362169	.106329	3.406 (.00087)	1.0000	.00000
AVOWNWIC	.685663E-01	.629823E-01	1.089 (.27659)	.17826	.33792
AVFSPART	.872859E-01	.391977E-01	2.227 (.02508)	.33116	.44251
AVFSWIC	-.169196	.744337E-01	-2.273 (.02231)	.13025	.29153
AVOTHWIC	.722152E-02	.430714E-01	.168 (.84259)	.14097	.30617
AVCAGE2	-.602979E-01	.547552E-01	-1.101 (.27087)	.22655	.31647
AVCAGE3	.864347E-01	.438917E-01	1.969 (.04686)	.27507	.34472
AVCAGE4	-.224303E-01	.520610E-01	-.431 (.67014)	.25489	.32313
AVCAGE5	.955805E-01	.628577E-01	1.521 (.12482)	.10862	.23570
FEMALE	-.464669E-01	.207204E-01	-2.243 (.02410)	.51588	.50031
AVHHSIZE	.701215E-02	.823792E-02	.851 (.39971)	4.6452	1.3733
SPCINC	-.257468E-02	.396890E-01	-.065 (.90449)	2.3375	1.1782
SPCINCSQ	.542947E-01	.831475E-01	.653 (.52156)	.68489	.56532
NONWHITE	-.134817E-01	.298000E-01	-.452 (.65552)	.27168	.44533
HISPANIC	-.656306E-02	.373638E-01	-.176 (.83764)	.89415E-01	.28566
MSOMEHS	.469587E-01	.551312E-01	.852 (.39938)	.22557	.41843
MHSGRAD	.351470E-01	.547376E-01	.642 (.52865)	.41382	.49307
MSOMECOL	.161164E-01	.574251E-01	.281 (.77063)	.26435	.44148
MCOLGRAD	-.861883E-01	.709985E-01	-1.214 (.22315)	.57519E-01	.23309
MOMEMP	.330492E-01	.229281E-01	1.441 (.14607)	.33136	.47123
HEIGHT	.630939E-02	.214476E-02	2.942 (.00358)	35.537	6.0547
NEAST	-.463968E-02	.323242E-01	-.144 (.85737)	.21643	.41228
SOUTH	.216086E-02	.296132E-01	.073 (.89966)	.27012	.44452
WEST	.322391E-03	.324026E-01	.010 (.93965)	.23330	.42341
LOPOV	-.480079E-01	.625563E-01	-.767 (.44940)	.51395E-01	.22105
MIDPOV	.179347E-01	.474851E-01	.378 (.70607)	.17966	.38434
HIPOV	.125302E-01	.455319E-01	.275 (.77420)	.20431	.40365
SUBCORE	.657822E-01	.334578E-01	1.966 (.04720)	.25964	.43893
NMCORE	-.418947E-01	.412015E-01	-1.017 (.31087)	.11676	.32150
SUBLOW	-.119100E-01	.390877E-01	-.305 (.75481)	.16153	.36843
NMLOW	.182823E-01	.413412E-01	.442 (.66242)	.13768	.34495
Sigma	.203800	.683141E-02	29.833 (.00000)		

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APPENDIX H

DETAILED ESTIMATION RESULTS FOR WOMEN: BIVARIATE PROBIT ESTIMATES OF THE WIC AND FOOD STAMP PARTICIPATION EQUATIONS

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MODEL COMMAND: PROBIT ;LHS=EFSPART ;RHS=Z1 ;WTS=SCALEDWT ;MATRIX (B=DELTA1)

Ordinary Least Squares Estimates

Dependent Variable..........	EFSPART
Number of Observations......	236.
Mean of Dependent Variable..	.34885
Std. Dev. of Dep. Variable..	.47762
Std. Error of Regression....	.36357
Sum of Squared Residuals....	27.758
R - Squared.................	.48221
Adjusted R - Squared........	.42057
F-Statistic (25, 210).....	7.82279
Significance of F-Test......	.00000
Log-Likelihood..............	-82.312
Restricted (Slopes=0) Log-L.	-159.97
Chi-Squared (25)............	155.31
Significance Level..........	.32173E-13

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	2.61496	.549840	4.756 (.00000)	1.0000	.00000
RESEMP	.235637E-01	.595358E-01	.396 (.69226)	.31488	.46545
RESFHEAD	-.542615	.155623	-3.487 (.00049)	.94705	.22440
SARESAGE	-1.05635	.352949	-2.993 (.00276)	2.7400	.60816
SARESAGS	.181195	.552257E-01	3.281 (.00103)	7.8774	3.7553
RESNONWH	.126649	.678408E-01	1.867 (.06192)	.29722	.45801
RESHISP	.921774E-01	.875286E-01	1.053 (.29229)	.10749	.31039
SRESEDUC	-.469909E-01	.123614	-.380 (.70384)	1.2155	.25642
MALEHEAD	-.572584E-01	.101863	-.562 (.57404)	.75294	.43222
MALEEMP	-.109103	.929983E-01	-1.173 (.24072)	.65567	.47616
ESIZDECR	.503786E-01	.909840E-01	.554 (.57978)	.10707	.30985
ESIZINCR	-.366372E-01	.571434E-01	-.641 (.52143)	.36675	.48294
OWNHOME	-.575335E-01	.228404	-.252 (.80112)	.41758	.49421
RENTHOME	.161211	.222302	.725 (.46834)	.57001	.49613
SGUARAMT	.266949E-01	.480736E-01	.555 (.57870)	2.5861	.77461
SINC	-.514177	.193497	-2.657 (.00788)	1.0067	.51084
SINCSQ	.158791	.862310E-01	1.841 (.06555)	1.2733	1.1620
NEAST	-.626319E-01	.865151E-01	-.724 (.46910)	.21380	.41086
SOUTH	-.943680E-01	.813916E-01	-1.159 (.24628)	.29143	.45539
WEST	-.578674E-01	.794513E-01	-.728 (.46641)	.27628	.44811
LOMIDPOV	.218761	.107363	2.038 (.04159)	.17105	.37735
HIPOV	.254505	.102952	2.472 (.01343)	.18037	.38531
SUBCORE	.909060E-01	.819965E-01	1.109 (.26758)	.23735	.42636
NMCORE	-.157186	.939397E-01	-1.673 (.09428)	.11974	.32535
SUBLOW	-.344723E-02	.107135	-.032 (.97433)	.11057	.31426
NMLOW	-.865333E-01	.105954	-.817 (.41410)	.12247	.32853

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Probit Estimates

Log-Likelihood.............	-78.706
Restricted (Slopes=0) Log-L.	-163.04
Chi-Squared (25)...........	168.67
Significance Level.........	.32173E-13

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	9.30141	2.61909	3.551 (.00038)	1.0000	.00000
RESEMP	.110770	.302891	.366 (.71458)	.31488	.46545
RESFHEAD	-2.43046	.721793	-3.367 (.00076)	.94705	.22440
SARESAGE	-4.78219	1.63962	-2.917 (.00354)	2.7400	.60816
SARESAGS	.830922	.257509	3.227 (.00125)	7.8774	3.7553
RESNONWH	.722399	.327049	2.209 (.02719)	.29722	.45801
RESHISP	.422093	.443345	.952 (.34106)	.10749	.31039
SRESEDUC	-.180104	.644337	-.280 (.77985)	1.2155	.25642
MALEHEAD	-.296330	.428732	-.691 (.48945)	.75294	.43222
MALEEMP	-.437138	.364591	-1.199 (.23053)	.65567	.47616
ESIZDECR	.371442	.374617	.992 (.32143)	.10707	.30985
ESIZINCR	-.194653	.291822	-.667 (.50476)	.36675	.48294
OWNHOME	-.783642	1.01747	-.770 (.44119)	.41758	.49421
RENTHOME	.583320	.973598	.599 (.54908)	.57001	.49613
SGUARAMT	.431043E-01	.225333	.191 (.84830)	2.5861	.77461
SINC	-2.01805	1.14742	-1.759 (.07862)	1.0067	.51084
SINCSQ	.566765	.591913	.958 (.33831)	1.2733	1.1620
NEAST	-.272664	.431238	-.632 (.52720)	.21380	.41086
SOUTH	-.320649	.433020	-.740 (.45900)	.29143	.45539
WEST	-.913394E-03	.440137	-.002 (.99834)	.27628	.44811
LOMIDPOV	1.25337	.517039	2.424 (.01535)	.17105	.37735
HIPOV	1.18102	.468749	2.520 (.01175)	.18037	.38531
SUBCORE	.895262	.490730	1.824 (.06810)	.23735	.42636
NMCORE	-.698290	.557521	-1.252 (.21039)	.11974	.32535
SUBLOW	.141848	.445424	.318 (.75014)	.11057	.31426
NMLOW	-.296092	.452893	-.654 (.51325)	.12247	.32853

Frequencies of actual vs. predicted outcomes
Predicted outcome has the highest probability.

		Predicted	
Actual	TOTAL	0	1
TOTAL	236	117	119
0	110	89	21
1	126	28	98

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MODEL COMMAND: PROBIT ;LHS=EOWNWIC ;RHS=Z2 ;WTS=SCALEDWT ;MATRIX (B=DELTA2)

Ordinary Least Squares Estimates

Dependent Variable..........	EOWNWIC
Number of Observations......	236.
Mean of Dependent Variable..	.25063
Std. Dev. of Dep. Variable..	.43429
Std. Error of Regression....	.38001
Sum of Squared Residuals....	29.460
R - Squared.................	.33535
Adjusted R - Squared........	.23435
F-Statistic (31, 204).....	3.32025
Significance of F-Test......	.00000
Log-Likelihood..............	-89.335
Restricted (Slopes=0) Log-L.	-137.53
Chi-Squared (31)............	96.383
Significance Level..........	.62707E-09

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	1.07854	.677134	1.593	(.11120)	1.0000	.00000
SAVAGE	-.873406	.398928	-2.189	(.02857)	2.7118	.57130
SAVAGSQ	.158270	.649466E-01	2.437	(.01481)	7.6804	3.4108
NONWHITE	-.104191E-01	.736984E-01	-.141	(.88757)	.29722	.45801
HISPANIC	-.391163E-01	.978109E-01	-.400	(.68922)	.10749	.31039
SOMEHS	.259682	.138134	1.880	(.06012)	.20810	.40681
HSGRAD	.596111E-01	.137745	.433	(.66519)	.42281	.49506
SOMECOL	-.115875	.146226	-.792	(.42810)	.17753	.38292
COLGRAD	-.787940E-01	.163068	-.483	(.62895)	.13354	.34089
EMPLOYED	.219394	.640049E-01	3.428	(.00061)	.31768	.46657
GOODHLTH	.748591E-01	.112053	.668	(.50409)	.93295	.25065
WTHT	-.764728E-01	.711334E-01	-1.075	(.28235)	2.2024	.43890
EPREG	.727833E-01	.681530E-01	1.068	(.28555)	.50341	.50105
ELACT	.181859	.716930E-01	2.537	(.01119)	.28599	.45285
MALEHEAD	.193079E-01	.110589	.175	(.86140)	.75294	.43222
MALEEMP	-.971054E-01	.982116E-01	-.989	(.32279)	.65567	.47616
AVHHSIZE	-.919521E-02	.275322E-01	-.334	(.73839)	4.1363	1.3951
ESIZDECR	-.596693E-01	.101820	-.586	(.55786)	.10707	.30985
ESIZINCR	.110595	.717442E-01	1.542	(.12319)	.36675	.48294
OWNHOME	.363202	.240087	1.513	(.13033)	.41758	.49421
RENTHOME	.426885	.235290	1.814	(.06963)	.57001	.49613
SPCINC	-.773080E-01	.103559	-.747	(.45536)	2.7055	1.2619
SPCINCSQ	.122367	.197697	.619	(.53594)	.89055	.67208
NEAST	.186084	.873740E-01	2.130	(.03319)	.21380	.41086
SOUTH	.844393E-01	.901586E-01	.937	(.34898)	.29143	.45539
WEST	-.160892	.928907E-01	-1.732	(.08326)	.27628	.44811
LOMIDPOV	-.143950	.117585	-1.224	(.22087)	.17105	.37735
HIPOV	-.237637E-03	.112497	-.002	(.99831)	.18037	.38531
SUBCORE	-.139915	.932149E-01	-1.501	(.13336)	.23735	.42636
NMCORE	-.746801E-01	.103586	-.721	(.47094)	.11974	.32535
SUBLOW	.150970	.111782	1.351	(.17683)	.11057	.31426
NMLOW	.104376	.112412	.929	(.35314)	.12247	.32853

****

Probit Estimates

Log-Likelihood.............. -85.491
Restricted (Slopes=0) Log-L. -137.93
Chi-Squared (31)............ 104.87
Significance Level.......... .12658E-10

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.459440	2.86900	.160 (.87277)	1.0000	.00000
SAVAGE	-2.45218	1.48969	-1.646 (.09974)	2.7118	.57130
SAVAGSQ	.447292	.242315	1.846 (.06491)	7.6804	3.4108
NONWHITE	-.116477	.316732	-.368 (.71306)	.29722	.45801
HISPANIC	.101577	.421869	.241 (.80973)	.10749	.31039
SOMEHS	1.15073	.627779	1.833 (.06680)	.20810	.40681
HSGRAD	.478111	.630664	.758 (.44839)	.42281	.49506
SOMECOL	-.245739	.733153	-.335 (.73749)	.17753	.38292
COLGRAD	-.758812	.853885	-.889 (.37419)	.13354	.34089
EMPLOYED	1.17207	.323942	3.618 (.00030)	.31768	.46657
GOODHLTH	.177588	.436027	.407 (.68380)	.93295	.25065
WTHT	-.254975	.319203	-.799 (.42441)	2.2024	.43890
EPREG	.246336	.295892	.833 (.40512)	.50341	.50105
ELACT	1.01269	.356391	2.842 (.00449)	.28599	.45285
MALEHEAD	.168673	.444241	.380 (.70418)	.75294	.43222
MALEEMP	-.587817	.397590	-1.478 (.13929)	.65567	.47616
AVHHSIZE	-.388176E-01	.120895	-.321 (.74814)	4.1363	1.3951
ESIZDECR	-.225568	.438482	-.514 (.60695)	.10707	.30985
ESIZINCR	.438680	.320716	1.368 (.17137)	.36675	.48294
OWNHOME	2.01886	1.47458	1.369 (.17096)	.41758	.49421
RENTHOME	2.25537	1.46624	1.538 (.12400)	.57001	.49613
SPCINC	-.320775	.502177	-.639 (.52297)	2.7055	1.2619
SPCINCSQ	.239506	1.01881	.235 (.81414)	.89055	.67208
NEAST	.737612	.381939	1.931 (.05345)	.21380	.41086
SOUTH	.440322	.375361	1.173 (.24077)	.29143	.45539
WEST	-1.03032	.501995	-2.052 (.04013)	.27628	.44811
LOMIDPOV	-1.07079	.598606	-1.789 (.07365)	.17105	.37735
HIPOV	-.245944	.493089	-.499 (.61793)	.18037	.38531
SUBCORE	-.721228	.470833	-1.532 (.12557)	.23735	.42636
NMCORE	-.193115	.501335	-.385 (.70009)	.11974	.32535
SUBLOW	.861382	.488550	1.763 (.07788)	.11057	.31426
NMLOW	.735802	.463934	1.586 (.11274)	.12247	.32853

Frequencies of actual vs. predicted outcomes
Predicted outcome has the highest probability.

		Predicted	
Actual	TOTAL	0	1
TOTAL	236	180	56
0	172	144	28
1	64	36	28

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MODEL COMMAND: BIVARIATE ;LHS=EFSPART,EOWNWIC ;RH1=Z1 ;RH2=Z2 ;STA
RT=DELTA1,DELTA2 ;WTS=SCALEDWT ;HOLD ;MAXIT=99 $

FIML ESTIMATES OF BIVARIATE PROBIT MODEL

Log-Likelihood............. -161.25

DESCRIPTIVE STATISTICS FOR REGRESSORS APPEAR
WITH SINGLE EQUATION ESTIMATES

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	9.53495	3.31586	2.876 (.00403)	.00000	.00000
RESEMP	.175776	.405967	.433 (.66503)	.00000	.00000
RESFHEAD	-1.89313	.912152	-2.075 (.03794)	.00000	.00000
SARESAGE	-5.12050	1.95647	-2.617 (.00887)	.00000	.00000
SARESAGS	.872056	.293612	2.970 (.00298)	.00000	.00000
RESNONWH	.684585	.436889	1.567 (.11713)	.00000	.00000
RESHISP	.377601	.619817	.609 (.54238)	.00000	.00000
SRESEDUC	-.274426	.785865	-.349 (.72694)	.00000	.00000
MALEHEAD	-.229750	.577117	-.398 (.69056)	.00000	.00000
MALEEMP	-.447523	.403847	-1.108 (.26780)	.00000	.00000
ESIZDECR	.335408	.478127	.702 (.48299)	.00000	.00000
ESIZINCR	-.211123	.408867	-.516 (.60560)	.00000	.00000
OWNHOME	-.654561	1.52530	-.429 (.66782)	.00000	.00000
RENTHOME	.498466	1.44931	.344 (.73090)	.00000	.00000
SGUARAMT	.255464E-01	.301226	.085 (.93241)	.00000	.00000
SINC	-1.97190	2.16884	-.909 (.36325)	.00000	.00000
SINCSQ	.551596	1.25368	.440 (.65995)	.00000	.00000
NEAST	-.173111	.601147	-.288 (.77337)	.00000	.00000
SOUTH	-.287978	.622857	-.462 (.64383)	.00000	.00000
WEST	-.199677E-01	.639895	-.031 (.97511)	.00000	.00000
LOMIDPOV	1.20695	.776959	1.553 (.12032)	.00000	.00000
HIPOV	1.15410	.710857	1.624 (.10448)	.00000	.00000
SUBCORE	.791196	.772804	1.024 (.30593)	.00000	.00000
NMCORE	-.481512	.811795	-.593 (.55308)	.00000	.00000
SUBLOW	.100699	.520703	.193 (.84665)	.00000	.00000
NMLOW	-.353868	.613259	-.577 (.56392)	.00000	.00000
ONE	1.39104	3.73553	.372 (.70961)	.00000	.00000
SAVAGE	-2.89034	2.03030	-1.424 (.15456)	.00000	.00000
SAVAGSQ	.510036	.340065	1.500 (.13366)	.00000	.00000
NONWHITE	-.350051E-02	.464853	-.008 (.99399)	.00000	.00000
HISPANIC	.704832E-01	.559993	.126 (.89984)	.00000	.00000
SOMEHS	.880407	.803444	1.096 (.27317)	.00000	.00000
HSGRAD	.374839	.760106	.493 (.62191)	.00000	.00000
SOMECOL	-.154328	1.01491	-.152 (.87914)	.00000	.00000
COLGRAD	-.485304	1.12800	-.430 (.66702)	.00000	.00000
EMPLOYED	1.12727	.434444	2.595 (.00947)	.00000	.00000
GOODHLTH	-.507546E-01	.505379	-.100 (.92000)	.00000	.00000
WTHT	-.207823	.417936	-.497 (.61900)	.00000	.00000
EPREG	.248797	.348846	.713 (.47572)	.00000	.00000
ELACT	.910948	.416969	2.185 (.02891)	.00000	.00000

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MALEHEAD	.188382	.520307	.362 (.71731)	.00000	.00000
MALEEMP	-.605163	.484823	-1.248 (.21195)	.00000	.00000
AVHHSIZE	-.397579E-01	.130065	-.306 (.75985)	.00000	.00000
ESIZDECR	-.120926	.537860	-.225 (.82211)	.00000	.00000
ESIZINCR	.426833	.376323	1.134 (.25670)	.00000	.00000
OWNHOME	1.89701	1.85023	1.025 (.30523)	.00000	.00000
RENTHOME	2.09080	1.78426	1.172 (.24128)	.00000	.00000
SPCINC	-.181252	.693148	-.261 (.79371)	.00000	.00000
SPCINCSQ	-.512125E-01	1.58494	-.032 (.97422)	.00000	.00000
NEAST	.723966	.461266	1.570 (.11653)	.00000	.00000
SOUTH	.455159	.454292	1.002 (.31639)	.00000	.00000
WEST	-1.10228	.661078	-1.667 (.09543)	.00000	.00000
LOMIDPOV	-1.05610	.778203	-1.357 (.17475)	.00000	.00000
HIPOV	-.256859	.642675	-.400 (.68940)	.00000	.00000
SUBCORE	-.609379	.775205	-.786 (.43182)	.00000	.00000
NMCORE	-.189381	.676015	-.280 (.77937)	.00000	.00000
SUBLOW	.853633	.544420	1.568 (.11689)	.00000	.00000
NMLOW	.711893	.483400	1.473 (.14084)	.00000	.00000
RHO(1,2)	.431936	.254896	1.695 (.09016)		

Joint Frequency Table: Columns=EOWNWIC
Rows=EFSPART
(N) = Count of Fitted Values

	0	1	TOTAL
0	95 (100)	15 (17)	110 (117)
1	77 (79)	49 (40)	126 (119)
TOTAL	172 (179)	64 (57)	236 (236)

APPENDIX I

DETAILED ESTIMATION RESULTS FOR WOMEN: BIVARIATE SELECTION MODEL ESTIMATES OF THE NUTRIENT INTAKE EQUATIONS

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Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART = *
Selection Criterion B: EOWNWIC = *

Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

```
 FSELIG   = 0          WICELIG  = 0
EFSPART  miscoded =     0          EOWNWIC  miscoded =      0
 FSELIG   = 0          WICELIG  = 1
EFSPART  miscoded =     0          EOWNWIC  miscoded =      0
 FSELIG   = 1          WICELIG  = 0
EFSPART  miscoded =     0          EOWNWIC  miscoded =      0
 FSELIG   = 1          WICELIG  = 1
EFSPART  miscoded =     0          EOWNWIC  miscoded =      0
```

	EFSPART = 0	EFSPART = 1
EOWNWIC = 0	0	0
EOWNWIC = 0	0	0

Number of incorrectly coded eligibilities:
FSELIG = 0 WICELIG = 0

Full sample contains 236.0 observations.
Selected sample contains 236.0 observations.

Ordinary Least Squares Estimates

Dependent Variable..........	AVKCAL
Number of Observations......	236.
Mean of Dependent Variable..	.82426
Std. Dev. of Dep. Variable..	.28206
Std. Error of Regression....	.21412
Sum of Squared Residuals....	9.2615
R - Squared.................	.42126
Adjusted R - Squared........	.32672
F-Statistic (33, 202).....	4.45563
Significance of F-Test......	.00000
Log-Likelihood..............	47.211
Restricted (Slopes=0) Log-L.	-35.670
Chi-Squared (33)............	165.76
Significance Level..........	.32173E-13

Estimated disturbance standard deviation = .214397
Estimated correlation with selection equation A = -.262053E-01
Estimated correlation with selection equation B = -.999124E-01

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.930089	.861199	-1.080 (.28015)	1.0000	.89866
AVOWNWIC	.155797	.191667	.813 (.41630)	.12652	.19738
AVFSPART	-.246717E-01	.103819	-.238 (.81216)	.29835	.89522E-01
AVFSWIC	-.855757E-01	.194197	-.441 (.65946)	.94659E-01	.19041
AVOTHWIC	.656578E-01	.637590E-01	1.030 (.30311)	.25181	.66488E-01
SAVAGE	.864594	.453097	1.908 (.05637)	2.7119	.46092
SAVAGSQ	-.151156	.713425E-01	-2.119 (.03411)	7.6807	.73122E-01
AVAG1922	.580338E-02	.833682E-01	.070 (.94450)	.23582	.80156E-01
AVAG51	1.18915	.799316	1.488 (.13683)	.14938E-02	.80031
HEIGHT	.107863E-01	.728039E-02	1.482 (.13846)	63.827	.76393E-02
AVPREG	-.110924	.878569E-01	-1.263 (.20675)	.18437	.89669E-01
AVLACT	-.117480	.653965E-01	-1.796 (.07243)	.15545	.68261E-01
NONWHITE	-.526049E-01	.440449E-01	-1.194 (.23234)	.29723	.45956E-01
HISPANIC	.949244E-01	.552923E-01	1.717 (.08602)	.10749	.58177E-01
DIETFLAG	-.685663E-01	.599154E-01	-1.144 (.25246)	.90119E-01	.62876E-01
EMPLOYED	-.347126E-01	.402916E-01	-.862 (.38894)	.31769	.41965E-01
SOMEHS	.599987E-01	.805314E-01	.745 (.45625)	.20810	.85298E-01
HSGRAD	.217894	.772386E-01	2.821 (.00479)	.42282	.81817E-01
SOMECOL	.129509	.883363E-01	1.466 (.14262)	.17753	.88765E-01
COLGRAD	.206504	.905122E-01	2.282 (.02252)	.13355	.95982E-01
AVHHSIZE	.181759E-02	.159084E-01	.114 (.90904)	4.1364	.15314E-01
SPCINC	-.551757E-01	.659016E-01	-.837 (.40246)	2.7056	.64954E-01
SPCINCSQ	.111632	.123684	.903 (.36676)	.89058	.12253
NEAST	-.112205	.591500E-01	-1.897 (.05783)	.21380	.60777E-01
SOUTH	-.193015E-01	.559690E-01	-.345 (.73020)	.29144	.57894E-01
WEST	.440725E-01	.524784E-01	.840 (.40101)	.27628	.55638E-01
LOMIDPOV	-.200698	.704700E-01	-2.848 (.00440)	.17105	.71818E-01
HIPOV	-.222643	.718739E-01	-3.098 (.00195)	.18037	.68627E-01
SUBCORE	-.226861	.541542E-01	-4.189 (.00003)	.23736	.56347E-01
NMCORE	-.387773	.613739E-01	-6.318 (.00000)	.11974	.65104E-01
SUBLOW	-.516894E-01	.639235E-01	-.809 (.41874)	.11057	.67471E-01
NMLOW	.383477E-01	.659449E-01	.582 (.56090)	.12247	.68564E-01
Lambda-F	-.182816E-01	.663495E-01	-.276 (.78291)	.34345E-05	.43962E-01
Lambda-W	-.293174E-01	.387375E-01	-.757 (.44916)	-.22238E-05	.38997E-01

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Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART = *
Selection Criterion B: EOWNWIC = *

Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

```
 FSELIG   = 0         WICELIG  = 0
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG   = 0         WICELIG  = 1
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG   = 1         WICELIG  = 0
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG   = 1         WICELIG  = 1
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0

                   EFSPART  = 0     EFSPART  = 1
 EOWNWIC  = 0              0                0


 EOWNWIC  = 0              0                0
```

Number of incorrectly coded eligibilities:
FSELIG = 0 WICELIG = 0

Full sample contains 236.0 observations.
Selected sample contains 236.0 observations.

Ordinary Least Squares Estimates

Dependent Variable..........	AVPRO
Number of Observations......	236.
Mean of Dependent Variable..	1.33880
Std. Dev. of Dep. Variable..	.46222
Std. Error of Regression....	.36444
Sum of Squared Residuals....	26.829
R - Squared.................	.37568
Adjusted R - Squared........	.27369
F-Statistic (33, 202).....	3.68342
Significance of F-Test......	.00000
Log-Likelihood..............	-78.297
Restricted (Slopes=0) Log-L.	-152.23
Chi-Squared (33)............	147.87
Significance Level..........	.32173E-13

Estimated disturbance standard deviation = .365955
Estimated correlation with selection equation A = -.130403
Estimated correlation with selection equation B = -.909867E-01

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-1.56517	1.57160	-.996	(.31929)	1.0000	1.5295
AVOWNWIC	.514974	.358761	1.435	(.15117)	.12652	.33594
AVFSPART	.139217	.248686	.560	(.57561)	.29835	.15237
AVFSWIC	-.199434	.395246	-.505	(.61385)	.94659E-01	.32408
AVOTHWIC	.315677E-01	.116817	.270	(.78698)	.25181	.11316
SAVAGE	1.43773	.868926	1.655	(.09800)	2.7119	.78448
SAVAGSQ	-.238518	.135290	-1.763	(.07790)	7.6807	.12445
AVAG1922	.147555	.173530	.850	(.39515)	.23582	.13643
AVAG51	1.27907	1.54761	.826	(.40853)	.14938E-02	1.3621
HEIGHT	.196136E-01	.131050E-01	1.497	(.13449)	63.827	.13002E-01
AVPREG	-.711925	.163967	-4.342	(.00001)	.18437	.15262
AVLACT	-.340091	.118054	-2.881	(.00397)	.15545	.11618
NONWHITE	-.406782E-01	.803792E-01	-.506	(.61280)	.29723	.78217E-01
HISPANIC	.227404	.999334E-01	2.276	(.02287)	.10749	.99018E-01
DIETFLAG	-.103581	.107379	-.965	(.33473)	.90119E-01	.10701
EMPLOYED	-.899319E-01	.742793E-01	-1.211	(.22600)	.31769	.71426E-01
SOMEHS	.170924E-01	.141597	.121	(.90392)	.20810	.14518
HSGRAD	.252338	.136257	1.852	(.06404)	.42282	.13925
SOMECOL	.200335	.170829	1.173	(.24091)	.17753	.15108
COLGRAD	.363416E-01	.159101	.228	(.81932)	.13355	.16336
AVHHSIZE	-.255762E-01	.326833E-01	-.783	(.43389)	4.1364	.26065E-01
SPCINC	-.200369	.131831	-1.520	(.12854)	2.7056	.11055
SPCINCSQ	.374974	.244478	1.534	(.12509)	.89058	.20855
NEAST	-.803533E-01	.111996	-.717	(.47308)	.21380	.10344
SOUTH	-.956106E-01	.103709	-.922	(.35658)	.29144	.98537E-01
WEST	.181329	.927645E-01	1.955	(.05062)	.27628	.94696E-01
LOMIDPOV	-.185206	.134194	-1.380	(.16754)	.17105	.12224
HIPOV	-.274453	.150989	-1.818	(.06911)	.18037	.11680
SUBCORE	-.214239	.993840E-01	-2.156	(.03111)	.23736	.95904E-01
NMCORE	-.447445	.108322	-4.131	(.00004)	.11974	.11081
SUBLOW	-.856968E-01	.113120	-.758	(.44870)	.11057	.11484
NMLOW	.127713	.119727	1.067	(.28611)	.12247	.11670
Lambda-F	-.763481E-01	.186525	-.409	(.68231)	.34345E-05	.74823E-01
Lambda-W	-.662746E-01	.745963E-01	-.888	(.37430)	-.22238E-05	.66374E-01

```
Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART  = *
Selection Criterion B: EOWNWIC  = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG   = 0          WICELIG  = 0
EFSPART  miscoded =      0        EOWNWIC  miscoded =       0
 FSELIG   = 0          WICELIG  = 1
EFSPART  miscoded =      0        EOWNWIC  miscoded =       0
 FSELIG   = 1          WICELIG  = 0
EFSPART  miscoded =      0        EOWNWIC  miscoded =       0
 FSELIG   = 1          WICELIG  = 1
EFSPART  miscoded =      0        EOWNWIC  miscoded =       0

                  EFSPART  = 0     EFSPART  = 1
 EOWNWIC  = 0             0                0


 EOWNWIC  = 0             0                0


 Number of incorrectly coded eligibilities:
 FSELIG  =    0     WICELIG =    0

 Full sample contains       236.0 observations.
 Selected sample contains   236.0 observations.


     Ordinary    Least Squares Estimates

     Dependent Variable..........     LOGAVGVA
     Number of Observations......          236.
     Mean of Dependent Variable..       -.31464
     Std. Dev. of Dep. Variable..        .88177
     Std. Error of Regression....        .62290
     Sum of Squared Residuals....    78.378
     R - Squared.................        .49885
     Adjusted R - Squared........        .41697
     F-Statistic ( 33,  202).....       6.09302
     Significance of F-Test......        .00000
     Log-Likelihood..............   -204.80
     Restricted (Slopes=0) Log-L.   -304.66
     Chi-Squared (33)............    199.73
     Significance Level.........     .32173E-13

 Estimated disturbance standard deviation =  .630286
 Estimated correlation with selection equation A = -.146755
 Estimated correlation with selection equation B = -.263185
```

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-6.75438	3.23095	-2.091 (.03657)	1.0000	2.6143
AVOWNWIC	.748196	.770684	.971 (.33164)	.12652	.57420
AVFSPART	-.201670	.661389	-.305 (.76043)	.29835	.26043
AVFSWIC	.281313	.943213	.298 (.76551)	.94659E-01	.55393
AVOTHWIC	.371171	.240827	1.541 (.12326)	.25181	.19342
SAVAGE	3.41743	1.92879	1.772 (.07643)	2.7119	1.3408
SAVAGSQ	-.650735	.294350	-2.211 (.02705)	7.6807	.21272
AVAG1922	-.153537	.426170	-.360 (.71864)	.23582	.23318
AVAG51	5.36277	3.57731	1.499 (.13385)	.14938E-02	2.3282
HEIGHT	.240723E-01	.263809E-01	.912 (.36151)	63.827	.22223E-01
AVPREG	.158905	.362137	.439 (.66081)	.18437	.26085
AVLACT	-.188816	.242479	-.779 (.43616)	.15545	.19858
NONWHITE	-.252881	.165180	-1.531 (.12578)	.29723	.13369
HISPANIC	.315940	.198746	1.590 (.11191)	.10749	.16924
DIETFLAG	-.267911E-01	.216004	-.124 (.90129)	.90119E-01	.18291
EMPLOYED	-.178625	.153651	-1.163 (.24502)	.31769	.12208
SOMEHS	-.138664	.273041	-.508 (.61156)	.20810	.24814
HSGRAD	.354813	.262683	1.351 (.17678)	.42282	.23801
SOMECOL	.246543	.390767	.631 (.52809)	.17753	.25823
COLGRAD	.447168	.305148	1.465 (.14281)	.13355	.27922
AVHHSIZE	.730203E-01	.804242E-01	.908 (.36391)	4.1364	.44551E-01
SPCINC	-.523277E-01	.312560	-.167 (.86704)	2.7056	.18896
SPCINCSQ	.150803	.575120	.262 (.79316)	.89058	.35646
NEAST	.372004E-01	.241756	.154 (.87771)	.21380	.17681
SOUTH	.411077E-01	.219744	.187 (.85161)	.29144	.16842
WEST	.722593	.178080	4.058 (.00005)	.27628	.16186
LOMIDPOV	.164131	.296369	.554 (.57971)	.17105	.20892
HIPOV	.306217E-01	.373737	.082 (.93470)	.18037	.19964
SUBCORE	-.194480	.206237	-.943 (.34568)	.23736	.16392
NMCORE	-.428765	.207322	-2.068 (.03863)	.11974	.18939
SUBLOW	-.188634	.221816	-.850 (.39510)	.11057	.19628
NMLOW	-.379281	.249583	-1.520 (.12860)	.12247	.19946
Lambda-F	-.201797	.531133	-.380 (.70399)	.34345E-05	.12789
Lambda-W	-.253046	.170371	-1.485 (.13748)	-.22238E-05	.11345

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Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART  = *
Selection Criterion B: EOWNWIC  = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG   = 0        WICELIG  = 0
EFSPART  miscoded =     0       EOWNWIC  miscoded =      0
 FSELIG   = 0        WICELIG  = 1
EFSPART  miscoded =     0       EOWNWIC  miscoded =      0
 FSELIG   = 1        WICELIG  = 0
EFSPART  miscoded =     0       EOWNWIC  miscoded =      0
 FSELIG   = 1        WICELIG  = 1
EFSPART  miscoded =     0       EOWNWIC  miscoded =      0

                  EFSPART  = 0     EFSPART  = 1
 EOWNWIC  = 0             0                0


 EOWNWIC  = 0             0                0


Number of incorrectly coded eligibilities:
FSELIG  =    0    WICELIG =    0

Full sample contains       236.0 observations.
Selected sample contains   236.0 observations.


    Ordinary    Least Squares Estimates

    Dependent Variable..........     AVB6
    Number of Observations......         236.
    Mean of Dependent Variable..       .62719
    Std. Dev. of Dep. Variable..       .27132
    Std. Error of Regression....       .20599
    Sum of Squared Residuals....    8.5712
    R - Squared.................       .42113
    Adjusted R - Squared........       .32657
    F-Statistic ( 33,  202).....      4.45329
    Significance of F-Test......       .00000
    Log-Likelihood..............    56.351
    Restricted (Slopes=0) Log-L.   -26.504
    Chi-Squared (33)............    165.71
    Significance Level..........    .32173E-13

Estimated disturbance standard deviation =  .207352
Estimated correlation with selection equation A = -.155756
Estimated correlation with selection equation B =  .948779E-01
```

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-1.76764	.822559	-2.149 (.03164)	1.0000	.86452
AVOWNWIC	.202355	.182434	1.109 (.26735)	.12652	.18988
AVFSPART	.547764E-01	.100100	.547 (.58423)	.29835	.86121E-01
AVFSWIC	.151898	.183786	.826 (.40853)	.94659E-01	.18318
AVOTHWIC	.892666E-01	.608270E-01	1.468 (.14223)	.25181	.63962E-01
SAVAGE	1.33878	.431361	3.104 (.00191)	2.7119	.44341
SAVAGSQ	-.224891	.681004E-01	-3.302 (.00096)	7.6807	.70344E-01
AVAG1922	.849443E-02	.789064E-01	.108 (.91427)	.23582	.77111E-01
AVAG51	2.29802	.745703	3.082 (.00206)	.14938E-02	.76990
HEIGHT	.684382E-02	.693792E-02	.986 (.32392)	63.827	.73491E-02
AVPREG	-.172685	.828370E-01	-2.085 (.03710)	.18437	.86263E-01
AVLACT	.518382E-01	.622288E-01	.833 (.40483)	.15545	.65667E-01
NONWHITE	-.440666E-01	.422339E-01	-1.043 (.29677)	.29723	.44210E-01
HISPANIC	.791541E-01	.531681E-01	1.489 (.13655)	.10749	.55967E-01
DIETFLAG	-.517892E-01	.570572E-01	-.908 (.36405)	.90119E-01	.60487E-01
EMPLOYED	-.237421E-01	.386515E-01	-.614 (.53904)	.31769	.40371E-01
SOMEHS	.617574E-01	.769578E-01	.802 (.42227)	.20810	.82058E-01
HSGRAD	.175840	.739741E-01	2.377 (.01745)	.42282	.78709E-01
SOMECOL	.111647	.837482E-01	1.333 (.18249)	.17753	.85393E-01
COLGRAD	.133830	.865172E-01	1.547 (.12190)	.13355	.92335E-01
AVHHSIZE	-.124493E-01	.149723E-01	-.831 (.40570)	4.1364	.14733E-01
SPCINC	-.735765E-01	.624465E-01	-1.178 (.23870)	2.7056	.62486E-01
SPCINCSQ	.196291	.117007	1.678 (.09343)	.89058	.11788
NEAST	-.421916E-01	.567365E-01	-.744 (.45709)	.21380	.58468E-01
SOUTH	-.106002E-01	.533344E-01	-.199 (.84246)	.29144	.55695E-01
WEST	.127472	.504095E-01	2.529 (.01145)	.27628	.53524E-01
LOMIDPOV	-.981529E-01	.674295E-01	-1.456 (.14549)	.17105	.69090E-01
HIPOV	-.809512E-01	.684573E-01	-1.183 (.23701)	.18037	.66020E-01
SUBCORE	-.651746E-01	.519617E-01	-1.254 (.20974)	.23736	.54207E-01
NMCORE	-.238863	.590201E-01	-4.047 (.00005)	.11974	.62630E-01
SUBLOW	.643443E-01	.609872E-01	1.055 (.29140)	.11057	.64908E-01
NMLOW	.583956E-01	.625341E-01	.934 (.35040)	.12247	.65959E-01
Lambda-F	-.292574E-01	.652449E-01	-.448 (.65385)	.34345E-05	.42292E-01
Lambda-W	.703578E-02	.361600E-01	.195 (.84573)	-.22238E-05	.37516E-01

```
Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART  = *
Selection Criterion B: EOWNWIC  = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG   = 0          WICELIG  = 0
EFSPART  miscoded =      0          EOWNWIC  miscoded =       0
 FSELIG   = 0          WICELIG  = 1
EFSPART  miscoded =      0          EOWNWIC  miscoded =       0
 FSELIG   = 1          WICELIG  = 0
EFSPART  miscoded =      0          EOWNWIC  miscoded =       0
 FSELIG   = 1          WICELIG  = 1
EFSPART  miscoded =      0          EOWNWIC  miscoded =       0

                   EFSPART  = 0     EFSPART  = 1
 EOWNWIC  = 0              0                0


 EOWNWIC  = 0              0                0


Number of incorrectly coded eligibilities:
FSELIG  =    0     WICELIG =    0

Full sample contains       236.0 observations.
Selected sample contains   236.0 observations.


    Ordinary    Least Squares Estimates

    Dependent Variable..........     AVGVC
    Number of Observations......          236.
    Mean of Dependent Variable..       1.41637
    Std. Dev. of Dep. Variable..       1.04814
    Std. Error of Regression....        .69935
    Sum of Squared Residuals....    98.796
    R - Squared.................        .55291
    Adjusted R - Squared........        .47987
    F-Statistic ( 33,  202).....       7.57001
    Significance of F-Test......        .00000
    Log-Likelihood..............   -232.12
    Restricted (Slopes=0) Log-L.   -345.45
    Chi-Squared (33)............    226.67
    Significance Level..........    .32173E-13

Estimated disturbance standard deviation =  .708978
Estimated correlation with selection equation A =   .196060
Estimated correlation with selection equation B =   .241070
```

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	2.33341	3.74571	.623 (.53331)	1.0000	2.9351
AVOWNWIC	.566993	.900124	.630 (.52876)	.12652	.64466
AVFSPART	-.369389	.801744	-.461 (.64499)	.29835	.29239
AVFSWIC	.949863E-01	1.12050	.085 (.93244)	.94659E-01	.62191
AVOTHWIC	.404122E-01	.279821	.144 (.88517)	.25181	.21716
SAVAGE	-1.49882	2.26729	-.661 (.50857)	2.7119	1.5054
SAVAGSQ	.217991	.345397	.631 (.52795)	7.6807	.23882
AVAG1922	-.106052	.507044	-.209 (.83433)	.23582	.26180
AVAG51	6.53889	4.19082	1.560 (.11869)	.14938E-02	2.6139
HEIGHT	.220309E-01	.304107E-01	.724 (.46879)	63.827	.24951E-01
AVPREG	-.287879	.419983	-.685 (.49306)	.18437	.29287
AVLACT	-.363398	.279062	-1.302 (.19284)	.15545	.22295
NONWHITE	.744937	.191478	3.890 (.00010)	.29723	.15010
HISPANIC	.974794E-01	.230242	.423 (.67202)	.10749	.19001
DIETFLAG	-.155739	.248215	-.627 (.53037)	.90119E-01	.20536
EMPLOYED	-.209973	.179103	-1.172 (.24105)	.31769	.13706
SOMEHS	-.634123	.311166	-2.038 (.04156)	.20810	.27859
HSGRAD	-.224936	.300201	-.749 (.45368)	.42282	.26722
SOMECOL	-.547303	.458315	-1.194 (.23241)	.17753	.28992
COLGRAD	.677707	.347988	1.947 (.05147)	.13355	.31349
AVHHSIZE	-.667784E-02	.952057E-01	-.070 (.94408)	4.1364	.50018E-01
SPCINC	.177893	.369262	.482 (.62998)	2.7056	.21215
SPCINCSQ	.908406E-01	.677220	.134 (.89329)	.89058	.40020
NEAST	-.159908	.283869	-.563 (.57322)	.21380	.19850
SOUTH	-.491477	.255791	-1.921 (.05468)	.29144	.18909
WEST	-.153355	.203989	-.752 (.45218)	.27628	.18172
LOMIDPOV	.359195	.347394	1.034 (.30115)	.17105	.23456
HIPOV	.272648	.445176	.612 (.54024)	.18037	.22414
SUBCORE	-.615563E-02	.239512	-.026 (.97950)	.23736	.18404
NMCORE	-.733504	.237277	-3.091 (.00199)	.11974	.21263
SUBLOW	-.193503	.253467	-.763 (.44521)	.11057	.22037
NMLOW	-.171096	.287640	-.595 (.55196)	.12247	.22394
Lambda-F	.261639	.649636	.403 (.68713)	.34345E-05	.14358
Lambda-W	.283925	.199580	1.423 (.15485)	-.22238E-05	.12737

```
Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART  = *
Selection Criterion B: EOWNWIC  = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG   = 0          WICELIG  = 0
EFSPART  miscoded =      0          EOWNWIC  miscoded =      0
 FSELIG   = 0          WICELIG  = 1
EFSPART  miscoded =      0          EOWNWIC  miscoded =      0
 FSELIG   = 1          WICELIG  = 0
EFSPART  miscoded =      0          EOWNWIC  miscoded =      0
 FSELIG   = 1          WICELIG  = 1
EFSPART  miscoded =      0          EOWNWIC  miscoded =      0

                     EFSPART  = 0     EFSPART  = 1
 EOWNWIC  = 0                0                0


 EOWNWIC  = 0                0                0


Number of incorrectly coded eligibilities:
FSELIG  =     0     WICELIG =     0

Full sample contains       236.0 observations.
Selected sample contains   236.0 observations.


    Ordinary    Least Squares Estimates

    Dependent Variable..........     LOGAVGVE
    Number of Observations......          236.
    Mean of Dependent Variable..       -.34042
    Std. Dev. of Dep. Variable..        .66038
    Std. Error of Regression....        .50318
    Sum of Squared Residuals....    51.144
    R - Squared.................        .41694
    Adjusted R - Squared........        .32169
    F-Statistic ( 33,  202).....       4.37730
    Significance of F-Test......        .00000
    Log-Likelihood.............    -154.43
    Restricted (Slopes=0) Log-L.   -236.43
    Chi-Squared (33)...........     164.01
    Significance Level.........     .32173E-13

Estimated disturbance standard deviation =  .504343
Estimated correlation with selection equation A = -.105445
Estimated correlation with selection equation B = -.316374E-01
```

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The column labelled std.dev.of X below is the
uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-4.70467	2.04408	-2.302	(.02136)	1.0000	2.1118
AVOWNWIC	.172624	.457216	.378	(.70576)	.12652	.46384
AVFSPART	.124396	.268259	.464	(.64285)	.29835	.21037
AVFSWIC	.420076	.472857	.888	(.37434)	.94659E-01	.44746
AVOTHWIC	.384138	.151589	2.534	(.01127)	.25181	.15624
SAVAGE	1.93546	1.08768	1.779	(.07517)	2.7119	1.0831
SAVAGSQ	-.350693	.171014	-2.051	(.04030)	7.6807	.17183
AVAG1922	-.464774E-01	.203760	-.228	(.81957)	.23582	.18836
AVAG51	3.88183	1.90585	2.037	(.04167)	.14938E-02	1.8807
HEIGHT	.154180E-01	.172122E-01	.896	(.37038)	63.827	.17952E-01
AVPREG	.163629E-01	.207678	.079	(.93720)	.18437	.21072
AVLACT	.624612E-01	.154230	.405	(.68549)	.15545	.16041
NONWHITE	-.347473E-01	.104578	-.332	(.73969)	.29723	.10799
HISPANIC	.242530	.131415	1.846	(.06496)	.10749	.13671
DIETFLAG	.893762E-01	.141302	.633	(.52705)	.90119E-01	.14775
EMPLOYED	.262094	.961107E-01	2.727	(.00639)	.31769	.98617E-01
SOMEHS	.415606	.189331	2.195	(.02815)	.20810	.20045
HSGRAD	.734567	.181972	4.037	(.00005)	.42282	.19227
SOMECOL	.674259	.211319	3.191	(.00142)	.17753	.20859
COLGRAD	.682047	.212961	3.203	(.00136)	.13355	.22555
AVHHSIZE	.878806E-02	.385328E-01	.228	(.81959)	4.1364	.35988E-01
SPCINC	-.130932	.159142	-.823	(.41066)	2.7056	.15264
SPCINCSQ	.215485	.297243	.725	(.46849)	.89058	.28795
NEAST	.148177	.141972	1.044	(.29662)	.21380	.14282
SOUTH	.122538	.133149	.920	(.35741)	.29144	.13605
WEST	.521426	.123897	4.209	(.00003)	.27628	.13075
LOMIDPOV	-.214368	.168730	-1.270	(.20392)	.17105	.16877
HIPOV	-.327495	.176217	-1.858	(.06310)	.18037	.16127
SUBCORE	-.194133	.128747	-1.508	(.13159)	.23736	.13241
NMCORE	-.547798	.144854	-3.782	(.00016)	.11974	.15299
SUBLOW	.136567	.150383	.908	(.36381)	.11057	.15855
NMLOW	.113923	.155524	.733	(.46386)	.12247	.16112
Lambda-F	-.738507E-01	.183536	-.402	(.68741)	.34345E-05	.10331
Lambda-W	-.478549E-01	.923883E-01	-.518	(.60448)	-.22238E-05	.91642E-01

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```
Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART  = *
Selection Criterion B: EOWNWIC  = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG   = 0          WICELIG  = 0
EFSPART  miscoded =      0        EOWNWIC  miscoded =        0
 FSELIG   = 0          WICELIG  = 1
EFSPART  miscoded =      0        EOWNWIC  miscoded =        0
 FSELIG   = 1          WICELIG  = 0
EFSPART  miscoded =      0        EOWNWIC  miscoded =        0
 FSELIG   = 1          WICELIG  = 1
EFSPART  miscoded =      0        EOWNWIC  miscoded =        0

                   EFSPART  = 0     EFSPART  = 1
 EOWNWIC  = 0              0                0


 EOWNWIC  = 0              0                0


Number of incorrectly coded eligibilities:
FSELIG  =    0     WICELIG =    0

Full sample contains       236.0 observations.
Selected sample contains   236.0 observations.


    Ordinary    Least Squares Estimates

    Dependent Variable..........     LOGAVFOL
    Number of Observations......          236.
    Mean of Dependent Variable..        -.88067
    Std. Dev. of Dep. Variable..         .56777
    Std. Error of Regression....         .40864
    Sum of Squared Residuals....     33.731
    R - Squared.................         .47978
    Adjusted R - Squared........         .39480
    F-Statistic ( 33,  202).....        5.64546
    Significance of F-Test......         .00000
    Log-Likelihood..............    -105.31
    Restricted (Slopes=0) Log-L.    -200.77
    Chi-Squared (33)............     190.92
    Significance Level..........     .32173E-13

Estimated disturbance standard deviation =  .414403
Estimated correlation with selection equation A = -.228944
Estimated correlation with selection equation B =  .130961
```

The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-4.32172	1.68787	-2.560 (.01045)	1.0000	1.7150
AVOWNWIC	.216067	.378614	.571 (.56822)	.12652	.37669
AVFSPART	-.404599E-01	.241494	-.168 (.86695)	.29835	.17085
AVFSWIC	.323032	.398791	.810 (.41792)	.94659E-01	.36339
AVOTHWIC	.292955	.124812	2.347 (.01892)	.25181	.12689
SAVAGE	1.99411	.907387	2.198 (.02797)	2.7119	.87962
SAVAGSQ	-.352440	.142510	-2.473 (.01339)	7.6807	.13955
AVAG1922	.381863E-01	.174086	.219 (.82637)	.23582	.15297
AVAG51	3.99332	1.56228	2.556 (.01059)	.14938E-02	1.5273
HEIGHT	.636376E-02	.141094E-01	.451 (.65197)	63.827	.14579E-01
AVPREG	-.598805	.171593	-3.490 (.00048)	.18437	.17113
AVLACT	.507898E-01	.127001	.400 (.68922)	.15545	.13027
NONWHITE	-.554050E-01	.870007E-01	-.637 (.52423)	.29723	.87703E-01
HISPANIC	.358189	.108899	3.289 (.00100)	.10749	.11103
DIETFLAG	-.114115	.115873	-.985 (.32471)	.90119E-01	.11999
EMPLOYED	.829331E-02	.798813E-01	.104 (.91731)	.31769	.80088E-01
SOMEHS	.202699	.155146	1.307 (.19138)	.20810	.16278
HSGRAD	.498792	.149528	3.336 (.00085)	.42282	.15614
SOMECOL	.419284	.177411	2.363 (.01811)	.17753	.16940
COLGRAD	.387739	.174270	2.225 (.02609)	.13355	.18317
AVHHSIZE	-.275996E-02	.328048E-01	-.084 (.93295)	4.1364	.29226E-01
SPCINC	-.823898E-01	.134785	-.611 (.54102)	2.7056	.12396
SPCINCSQ	.256736	.250846	1.023 (.30608)	.89058	.23385
NEAST	-.645163E-01	.118984	-.542 (.58766)	.21380	.11599
SOUTH	.762979E-01	.110243	.692 (.48888)	.29144	.11049
WEST	.285668	.102152	2.796 (.00517)	.27628	.10618
LOMIDPOV	-.162456	.142123	-1.143 (.25301)	.17105	.13706
HIPOV	-.135272	.152571	-.887 (.37529)	.18037	.13097
SUBCORE	-.175279	.107437	-1.631 (.10279)	.23736	.10753
NMCORE	-.680818	.119657	-5.690 (.00000)	.11974	.12425
SUBLOW	.434073E-01	.123237	.352 (.72467)	.11057	.12876
NMLOW	-.228927E-01	.127723	-.179 (.85775)	.12247	.13085
Lambda-F	-.878175E-01	.175352	-.501 (.61651)	.34345E-05	.83898E-01
Lambda-W	.163391E-01	.754026E-01	.217 (.82845)	-.22238E-05	.74424E-01

```
Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART  = *
Selection Criterion B: EOWNWIC  = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG   = 0         WICELIG   = 0
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG   = 0         WICELIG   = 1
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG   = 1         WICELIG   = 0
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG   = 1         WICELIG   = 1
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0

                   EFSPART  = 0     EFSPART  = 1
 EOWNWIC  = 0              0                0


 EOWNWIC  = 0              0                0


Number of incorrectly coded eligibilities:
FSELIG  =    0     WICELIG =    0

Full sample contains       236.0 observations.
Selected sample contains   236.0 observations.


    Ordinary    Least Squares Estimates

    Dependent Variable..........     AVCALC
    Number of Observations......          236.
    Mean of Dependent Variable..        .78549
    Std. Dev. of Dep. Variable..        .35248
    Std. Error of Regression....        .25627
    Sum of Squared Residuals....    13.266
    R - Squared.................        .46916
    Adjusted R - Squared........        .38243
    F-Statistic ( 33,  202).....       5.40987
    Significance of F-Test......        .00000
    Log-Likelihood..............    4.8048
    Restricted (Slopes=0) Log-L.   -88.269
    Chi-Squared (33)............    186.15
    Significance Level..........    .32173E-13

Estimated disturbance standard deviation =  .258429
Estimated correlation with selection equation A = -.177345
Estimated correlation with selection equation B = -.148110
```

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-2.07223	1.22014	-1.698	(.08944)	1.0000	1.0756
AVOWNWIC	.407646	.286283	1.424	(.15447)	.12652	.23623
AVFSPART	.819888E-02	.232286	.035	(.97184)	.29835	.10714
AVFSWIC	-.145724	.338755	-.430	(.66707)	.94659E-01	.22789
AVOTHWIC	.154165E-01	.909828E-01	.169	(.86545)	.25181	.79576E-01
SAVAGE	1.36998	.709120	1.932	(.05337)	2.7119	.55164
SAVAGSQ	-.236076	.109118	-2.163	(.03050)	7.6807	.87516E-01
AVAG1922	.461606E-01	.151409	.305	(.76046)	.23582	.95934E-01
AVAG51	1.81957	1.28514	1.416	(.15682)	.14938E-02	.95784
HEIGHT	.134556E-01	.100277E-01	1.342	(.17965)	63.827	.91430E-02
AVPREG	-.220403	.131759	-1.673	(.09437)	.18437	.10732
AVLACT	-.130605	.910275E-01	-1.435	(.15135)	.15545	.81697E-01
NONWHITE	-.198445	.623964E-01	-3.180	(.00147)	.29723	.55002E-01
HISPANIC	.133135	.763958E-01	1.743	(.08139)	.10749	.69629E-01
DIETFLAG	-.107946	.819186E-01	-1.318	(.18760)	.90119E-01	.75252E-01
EMPLOYED	-.465471E-01	.581173E-01	-.801	(.42318)	.31769	.50226E-01
SOMEHS	.191924	.105370	1.821	(.06854)	.20810	.10209
HSGRAD	.344479	.101624	3.390	(.00070)	.42282	.97922E-01
SOMECOL	.269754	.141296	1.909	(.05624)	.17753	.10624
COLGRAD	.414047	.118196	3.503	(.00046)	.13355	.11488
AVHHSIZE	.185881E-01	.283980E-01	.655	(.51275)	4.1364	.18329E-01
SPCINC	-.600282E-01	.111964	-.536	(.59186)	2.7056	.77739E-01
SPCINCSQ	.115817	.206062	.562	(.57408)	.89058	.14665
NEAST	-.144092	.900420E-01	-1.600	(.10954)	.21380	.72741E-01
SOUTH	-.193790	.819603E-01	-2.364	(.01806)	.29144	.69290E-01
WEST	.130383	.692001E-01	1.884	(.05954)	.27628	.66590E-01
LOMIDPOV	.109585	.108958	1.006	(.31453)	.17105	.85955E-01
HIPOV	-.208511E-01	.132518	-.157	(.87497)	.18037	.82135E-01
SUBCORE	-.111064	.776268E-01	-1.431	(.15250)	.23736	.67439E-01
NMCORE	-.272916	.806523E-01	-3.384	(.00071)	.11974	.77919E-01
SUBLOW	-.235241	.849535E-01	-2.769	(.00562)	.11057	.80752E-01
NMLOW	-.128596	.930506E-01	-1.382	(.16697)	.12247	.82060E-01
Lambda-F	-.766676E-01	.183973	-.417	(.67687)	.34345E-05	.52615E-01
Lambda-W	-.713913E-01	.615500E-01	-1.160	(.24609)	-.22238E-05	.46674E-01

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Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART = *
Selection Criterion B: EOWNWIC = *

Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

```
 FSELIG   = 0           WICELIG  = 0
EFSPART  miscoded =      0         EOWNWIC  miscoded =       0
 FSELIG   = 0           WICELIG  = 1
EFSPART  miscoded =      0         EOWNWIC  miscoded =       0
 FSELIG   = 1           WICELIG  = 0
EFSPART  miscoded =      0         EOWNWIC  miscoded =       0
 FSELIG   = 1           WICELIG  = 1
EFSPART  miscoded =      0         EOWNWIC  miscoded =       0

                    EFSPART  = 0     EFSPART  = 1
 EOWNWIC  = 0              0                0


 EOWNWIC  = 0              0                0
```

Number of incorrectly coded eligibilities:
FSELIG = 0 WICELIG = 0

Full sample contains 236.0 observations.
Selected sample contains 236.0 observations.

Ordinary Least Squares Estimates

```
Dependent Variable..........     AVMG
Number of Observations......        236.
Mean of Dependent Variable..      .64126
Std. Dev. of Dep. Variable..      .25074
Std. Error of Regression....      .17534
Sum of Squared Residuals....   6.2104
R - Squared.................      .50890
Adjusted R - Squared........      .42867
F-Statistic ( 33,  202).....     6.34312
Significance of F-Test......      .00000
Log-Likelihood..............   94.368
Restricted (Slopes=0) Log-L.  -7.8891
Chi-Squared (33)............   204.51
Significance Level..........   .32173E-13
```

Estimated disturbance standard deviation = .176201
Estimated correlation with selection equation A = -.153380
Estimated correlation with selection equation B = -.449793E-01

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-1.76466	.745612	-2.367 (.01795)	1.0000	.73589
AVOWNWIC	.321875	.169512	1.899 (.05759)	.12652	.16163
AVFSPART	-.166688E-01	.115466	-.144 (.88522)	.29835	.73307E-01
AVFSWIC	-.111390	.184880	-.602 (.54684)	.94659E-01	.15593
AVOTHWIC	.804266E-01	.554144E-01	1.451 (.14668)	.25181	.54446E-01
SAVAGE	1.18202	.409555	2.886 (.00390)	2.7119	.37743
SAVAGSQ	-.191723	.639228E-01	-2.999 (.00271)	7.6807	.59878E-01
AVAG1922	.100788	.808861E-01	1.246 (.21275)	.23582	.65638E-01
AVAG51	1.85198	.722726	2.562 (.01039)	.14938E-02	.65536
HEIGHT	.121075E-01	.622241E-02	1.946 (.05168)	63.827	.62556E-02
AVPREG	-.343786	.769772E-01	-4.466 (.00001)	.18437	.73428E-01
AVLACT	-.246334	.559033E-01	-4.406 (.00001)	.15545	.55897E-01
NONWHITE	-.865918E-01	.381638E-01	-2.269 (.02327)	.29723	.37632E-01
HISPANIC	.114300	.476284E-01	2.400 (.01640)	.10749	.47640E-01
DIETFLAG	-.139682	.509553E-01	-2.741 (.00612)	.90119E-01	.51487E-01
EMPLOYED	-.809817E-01	.352795E-01	-2.295 (.02171)	.31769	.34365E-01
SOMEHS	.113609	.674400E-01	1.685 (.09207)	.20810	.69849E-01
HSGRAD	.189958	.649537E-01	2.925 (.00345)	.42282	.66998E-01
SOMECOL	.120378	.801229E-01	1.502 (.13299)	.17753	.72688E-01
COLGRAD	.208610	.758277E-01	2.751 (.00594)	.13355	.78598E-01
AVHHSIZE	-.332708E-02	.151959E-01	-.219 (.82669)	4.1364	.12541E-01
SPCINC	-.111610	.616441E-01	-1.811 (.07021)	2.7056	.53189E-01
SPCINCSQ	.282885	.114314	2.475 (.01334)	.89058	.10034
NEAST	-.686184E-01	.530164E-01	-1.294 (.19557)	.21380	.49769E-01
SOUTH	-.904973E-01	.490564E-01	-1.845 (.06507)	.29144	.47408E-01
WEST	.111903	.442800E-01	2.527 (.01150)	.27628	.45561E-01
LOMIDPOV	-.452026E-01	.633069E-01	-.714 (.47521)	.17105	.58810E-01
HIPOV	-.902642E-01	.703887E-01	-1.282 (.19971)	.18037	.56197E-01
SUBCORE	-.132418	.471589E-01	-2.808 (.00499)	.23736	.46142E-01
NMCORE	-.294506	.517262E-01	-5.694 (.00000)	.11974	.53312E-01
SUBLOW	-.598302E-01	.537913E-01	-1.112 (.26602)	.11057	.55250E-01
NMLOW	-.221828E-02	.565797E-01	-.039 (.96873)	.12247	.56145E-01
Lambda-F	-.374327E-01	.860273E-01	-.435 (.66347)	.34345E-05	.35999E-01
Lambda-W	-.240939E-01	.348925E-01	-.691 (.48987)	-.22238E-05	.31934E-01

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```
Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART  = *
Selection Criterion B: EOWNWIC  = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG   = 0         WICELIG  = 0
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG   = 0         WICELIG  = 1
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG   = 1         WICELIG  = 0
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0
 FSELIG   = 1         WICELIG  = 1
EFSPART  miscoded =     0        EOWNWIC  miscoded =      0

                   EFSPART  = 0     EFSPART  = 1
 EOWNWIC  = 0             0                 0


 EOWNWIC  = 0             0                 0


 Number of incorrectly coded eligibilities:
 FSELIG  =    0     WICELIG =    0

 Full sample contains       236.0 observations.
 Selected sample contains   236.0 observations.


     Ordinary    Least Squares Estimates

     Dependent Variable..........     LOGAVGFE
     Number of Observations......          236.
     Mean of Dependent Variable..       -.51650
     Std. Dev. of Dep. Variable..        .44970
     Std. Error of Regression....        .34591
     Sum of Squared Residuals....    24.171
     R - Squared.................        .40580
     Adjusted R - Squared........        .30873
     F-Statistic ( 33,  202).....      4.18037
     Significance of F-Test......        .00000
     Log-Likelihood..............   -65.984
     Restricted (Slopes=0) Log-L.   -145.75
     Chi-Squared (33)............    159.54
     Significance Level..........    .32173E-13

 Estimated disturbance standard deviation =  .346040
 Estimated correlation with selection equation A =  .161604E-03
 Estimated correlation with selection equation B = -.546438E-01
```

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-4.97899	1.35259	-3.681	(.00023)	1.0000	1.4518
AVOWNWIC	.245294	.297845	.824	(.41019)	.12652	.31887
AVFSPART	-.587181E-01	.140400	-.418	(.67579)	.29835	.14462
AVFSWIC	.197382E-02	.290185	.007	(.99457)	.94659E-01	.30761
AVOTHWIC	.209834	.100069	2.097	(.03600)	.25181	.10741
SAVAGE	2.39762	.697164	3.439	(.00058)	2.7119	.74460
SAVAGSQ	-.395745	.110425	-3.584	(.00034)	7.6807	.11813
AVAG1922	.149690	.122727	1.220	(.22258)	.23582	.12949
AVAG51	3.13490	1.21526	2.580	(.00989)	.14938E-02	1.2929
HEIGHT	.117743E-01	.114863E-01	1.025	(.30533)	63.827	.12341E-01
AVPREG	.100240	.135678	.739	(.46002)	.18437	.14486
AVLACT	.238770	.102781	2.323	(.02017)	.15545	.11027
NONWHITE	.174994E-01	.691769E-01	.253	(.80029)	.29723	.74241E-01
HISPANIC	.267162	.874014E-01	3.057	(.00224)	.10749	.93984E-01
DIETFLAG	-.898964E-01	.945553E-01	-.951	(.34174)	.90119E-01	.10157
EMPLOYED	-.646904E-01	.631709E-01	-1.024	(.30581)	.31769	.67795E-01
SOMEHS	.161292	.128047	1.260	(.20780)	.20810	.13780
HSGRAD	.409567	.122805	3.335	(.00085)	.42282	.13217
SOMECOL	.366865	.134696	2.724	(.00646)	.17753	.14340
COLGRAD	.315134	.144037	2.188	(.02868)	.13355	.15506
AVHHSIZE	-.222692E-01	.234586E-01	-.949	(.34247)	4.1364	.24740E-01
SPCINC	-.498516E-01	.989475E-01	-.504	(.61439)	2.7056	.10493
SPCINCSQ	.896349E-01	.186500	.481	(.63079)	.89058	.19795
NEAST	-.887753E-01	.917305E-01	-.968	(.33315)	.21380	.98185E-01
SOUTH	-.212808E-02	.872941E-01	-.024	(.98055)	.29144	.93527E-01
WEST	.188783	.834864E-01	2.261	(.02374)	.27628	.89883E-01
LOMIDPOV	-.203312	.108626	-1.872	(.06125)	.17105	.11602
HIPOV	-.144934	.105254	-1.377	(.16851)	.18037	.11087
SUBCORE	-.877289E-01	.848669E-01	-1.034	(.30127)	.23736	.91028E-01
NMCORE	-.441542	.976840E-01	-4.520	(.00001)	.11974	.10517
SUBLOW	.623695E-01	.101357	.615	(.53833)	.11057	.10900
NMLOW	.777962E-01	.103322	.753	(.45148)	.12247	.11076
Lambda-F	-.997201E-02	.746563E-01	-.134	(.89374)	.34345E-05	.71020E-01
Lambda-W	-.232162E-01	.591366E-01	-.393	(.69463)	-.22238E-05	.63000E-01

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```
Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART   = *
Selection Criterion B: EOWNWIC   = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG    = 0         WICELIG   = 0
EFSPART  miscoded =      0        EOWNWIC  miscoded =       0
 FSELIG    = 0         WICELIG   = 1
EFSPART  miscoded =      0        EOWNWIC  miscoded =       0
 FSELIG    = 1         WICELIG   = 0
EFSPART  miscoded =      0        EOWNWIC  miscoded =       0
 FSELIG    = 1         WICELIG   = 1
EFSPART  miscoded =      0        EOWNWIC  miscoded =       0

                   EFSPART  = 0     EFSPART  = 1
 EOWNWIC   = 0             0                0


 EOWNWIC   = 0             0                0


Number of incorrectly coded eligibilities:
FSELIG   =    0     WICELIG =    0

Full sample contains       236.0 observations.
Selected sample contains   236.0 observations.


    Ordinary    Least Squares Estimates

    Dependent Variable..........     AVZINC
    Number of Observations......          236.
    Mean of Dependent Variable..        .58498
    Std. Dev. of Dep. Variable..        .21386
    Std. Error of Regression....        .16421
    Sum of Squared Residuals....    5.4467
    R - Squared.................        .40795
    Adjusted R - Squared........        .31123
    F-Statistic ( 33,  202).....       4.21784
    Significance of F-Test......        .00000
    Log-Likelihood..............    109.85
    Restricted (Slopes=0) Log-L.    29.654
    Chi-Squared (33)............    160.40
    Significance Level..........    .32173E-13

Estimated disturbance standard deviation =  .165364
Estimated correlation with selection equation A =  .102300
Estimated correlation with selection equation B = -.186203
```

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uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.379407	.658879	-.576 (.56472)	1.0000	.68916
AVOWNWIC	.198879	.145889	1.363 (.17281)	.12652	.15137
AVFSPART	.132946E-01	.743860E-01	.179 (.85815)	.29835	.68652E-01
AVFSWIC	-.972944E-01	.145246	-.670 (.50295)	.94659E-01	.14602
AVOTHWIC	.714869E-02	.485600E-01	.147 (.88296)	.25181	.50988E-01
SAVAGE	.472426	.343414	1.376 (.16892)	2.7119	.35347
SAVAGSQ	-.752971E-01	.541278E-01	-1.391 (.16420)	7.6807	.56076E-01
AVAG1922	.714639E-01	.626529E-01	1.141 (.25402)	.23582	.61470E-01
AVAG51	.239358	.606050	.395 (.69288)	.14938E-02	.61374
HEIGHT	.736303E-02	.557618E-02	1.320 (.18669)	63.827	.58584E-02
AVPREG	-.167669	.677888E-01	-2.473 (.01338)	.18437	.68765E-01
AVLACT	-.285777	.504455E-01	-5.665 (.00000)	.15545	.52348E-01
NONWHITE	-.426473E-01	.338438E-01	-1.260 (.20763)	.29723	.35242E-01
HISPANIC	.112657	.422823E-01	2.664 (.00771)	.10749	.44615E-01
DIETFLAG	-.105568	.460780E-01	-2.291 (.02196)	.90119E-01	.48218E-01
EMPLOYED	-.103576	.307191E-01	-3.372 (.00075)	.31769	.32182E-01
SOMEHS	-.138102E-01	.621595E-01	-.222 (.82418)	.20810	.65413E-01
HSGRAD	.103731	.595264E-01	1.743 (.08140)	.42282	.62744E-01
SOMECOL	.110465	.676823E-01	1.632 (.10266)	.17753	.68072E-01
COLGRAD	.713202E-01	.697133E-01	1.023 (.30628)	.13355	.73606E-01
AVHHSIZE	-.657745E-02	.121022E-01	-.543 (.58679)	4.1364	.11744E-01
SPCINC	-.103694	.501122E-01	-2.069 (.03852)	2.7056	.49812E-01
SPCINCSQ	.230832	.945078E-01	2.442 (.01459)	.89058	.93968E-01
NEAST	-.116015	.449505E-01	-2.581 (.00985)	.21380	.46609E-01
SOUTH	-.294983E-01	.427687E-01	-.690 (.49037)	.29144	.44398E-01
WEST	.680665E-01	.403965E-01	1.685 (.09200)	.27628	.42668E-01
LOMIDPOV	-.786355E-01	.539833E-01	-1.457 (.14521)	.17105	.55076E-01
HIPOV	-.122224	.543156E-01	-2.250 (.02443)	.18037	.52628E-01
SUBCORE	-.971384E-01	.416210E-01	-2.334 (.01960)	.23736	.43212E-01
NMCORE	-.230137	.473214E-01	-4.863 (.00000)	.11974	.49927E-01
SUBLOW	-.163208E-01	.493058E-01	-.331 (.74064)	.11057	.51742E-01
NMLOW	.453651E-01	.507972E-01	.893 (.37182)	.12247	.52580E-01
Lambda-F	.444658E-02	.447979E-01	.099 (.92093)	.34345E-05	.33713E-01
Lambda-W	-.288707E-01	.292619E-01	-.987 (.32382)	-.22238E-05	.29906E-01

APPENDIX J

DETAILED ESTIMATION RESULTS FOR WOMEN: OLS ESTIMATES OF THE NUTRIENT INTAKE EQUATIONS

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Ordinary Least Squares Estimates

Dependent Variable..........	AVKCAL
Number of Observations......	236.
Mean of Dependent Variable..	.82424
Std. Dev. of Dep. Variable..	.28209
Std. Error of Regression....	.23064
Sum of Squared Residuals....	10.852
R - Squared.................	.41971
Adjusted R - Squared........	.33153
F-Statistic (31, 204).....	4.75964
Significance of F-Test......	.00000
Log-Likelihood..............	28.511
Restricted (Slopes=0) Log-L.	-35.697
Chi-Squared (31)............	128.42
Significance Level..........	.32173E-13
Durbin - Watson Statistic...........	1.9495
Estimated Autocorrelation (Rho).....	.25247E-01

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.855313	.888955	-.962 (.33932)	1.0000	.00000
AVOWNWIC	.768727E-01	.160370	.479 (.63748)	.12652	.26556
AVFSPART	-.429121E-01	.656318E-01	-.654 (.52136)	.29834	.42942
AVFSWIC	-.493329E-01	.182650	-.270 (.77762)	.94656E-01	.24726
AVOTHWIC	.628014E-01	.654713E-01	.959 (.34085)	.25180	.35615
SAVAGE	.803631	.449841	1.786 (.07185)	2.7118	.57130
SAVAGSQ	-.141540	.713123E-01	-1.985 (.04586)	7.6804	3.4108
AVAG1922	.787309E-02	.798277E-01	.099 (.88443)	.23581	.40722
AVAG51	1.22680	.793425	1.546 (.11933)	.14937E-02	.27346E-01
HEIGHT	.112077E-01	.751452E-02	1.491 (.13315)	63.826	2.4195
AVPREG	-.104391	.887569E-01	-1.176 (.23917)	.18437	.22180
AVLACT	-.109280	.671401E-01	-1.628 (.10095)	.15545	.29230
NONWHITE	-.472983E-01	.441469E-01	-1.071 (.28527)	.29722	.45801
HISPANIC	.988625E-01	.576685E-01	1.714 (.08404)	.10749	.31039
DIETFLAG	-.656001E-01	.625369E-01	-1.049 (.29586)	.90116E-01	.28696
EMPLOYED	-.280279E-01	.407925E-01	-.687 (.49998)	.31768	.46657
SOMEHS	.635918E-01	.842470E-01	.755 (.45755)	.20810	.40681
HSGRAD	.220552	.808725E-01	2.727 (.00688)	.42281	.49506
SOMECOL	.125636	.883091E-01	1.423 (.15233)	.17753	.38292
COLGRAD	.207971	.950951E-01	2.187 (.02825)	.13354	.34089
AVHHSIZE	.179777E-02	.149473E-01	.120 (.87148)	4.1363	1.3951
SPCINC	-.618868E-01	.636642E-01	-.972 (.33416)	2.7055	1.2619
SPCINCSQ	.122414	.121245	1.010 (.31508)	.89055	.67208
NEAST	-.992781E-01	.580069E-01	-1.711 (.08455)	.21380	.41086
SOUTH	-.136876E-01	.570161E-01	-.240 (.79704)	.29143	.45539
WEST	.431832E-01	.553975E-01	.780 (.44250)	.27628	.44811
LOMIDPOV	-.203639	.709874E-01	-2.869 (.00463)	.17105	.37735
HIPOV	-.219144	.673279E-01	-3.255 (.00149)	.18037	.38531
SUBCORE	-.234729	.550819E-01	-4.261 (.00006)	.23735	.42636
NMCORE	-.391263	.637512E-01	-6.137 (.00000)	.11974	.32535
SUBLOW	-.478635E-01	.667277E-01	-.717 (.48086)	.11057	.31426
NMLOW	.377721E-01	.675781E-01	.559 (.58388)	.12247	.32853
Sigma	.230641	.106161E-01	21.726 (.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	AVPRO
Number of Observations......	236.
Mean of Dependent Variable..	1.33876
Std. Dev. of Dep. Variable..	.46227
Std. Error of Regression....	.39345
Sum of Squared Residuals....	31.579
R - Squared................	.37115
Adjusted R - Squared........	.27559
F-Statistic (31, 204).....	3.88389
Significance of F-Test......	.00000
Log-Likelihood.............	-97.533
Restricted (Slopes=0) Log-L.	-152.26
Chi-Squared (31)...........	109.45
Significance Level..........	.14337E-11
Durbin - Watson Statistic..........	1.9526
Estimated Autocorrelation (Rho).....	.23706E-01

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-1.33727	1.51646	-.882	(.38282)	1.0000	.00000
AVOWNWIC	.359497	.273574	1.314	(.18695)	.12652	.26556
AVFSPART	.474026E-01	.111961	.423	(.67536)	.29834	.42942
AVFSWIC	-.126361	.311581	-.406	(.68743)	.94656E-01	.24726
AVOTHWIC	.323031E-01	.111687	.289	(.76511)	.25180	.35615
SAVAGE	1.24455	.767380	1.622	(.10218)	2.7118	.57130
SAVAGSQ	-.207526	.121651	-1.706	(.08556)	7.6804	3.4108
AVAG1922	.151879	.136177	1.115	(.26526)	.23581	.40722
AVAG51	1.42695	1.35350	1.054	(.29334)	.14937E-02	.27346E-01
HEIGHT	.215739E-01	.128189E-01	1.683	(.08986)	63.826	2.4195
AVPREG	-.700560	.151409	-4.627	(.00002)	.18437	.22180
AVLACT	-.321796	.114534	-2.810	(.00547)	.15545	.29230
NONWHITE	-.190488E-01	.753097E-01	-.253	(.78875)	.29722	.45801
HISPANIC	.234677	.983760E-01	2.386	(.01714)	.10749	.31039
DIETFLAG	-.967523E-01	.106681	-.907	(.36890)	.90116E-01	.28696
EMPLOYED	-.758591E-01	.695876E-01	-1.090	(.27661)	.31768	.46657
SOMEHS	.175132E-01	.143716	.122	(.87053)	.20810	.40681
HSGRAD	.250864	.137960	1.818	(.06696)	.42281	.49506
SOMECOL	.189671	.150646	1.259	(.20665)	.17753	.38292
COLGRAD	.316110E-01	.162222	.195	(.82573)	.13354	.34089
AVHHSIZE	-.281840E-01	.254984E-01	-1.105	(.26972)	4.1363	1.3951
SPCINC	-.223661	.108604	-2.059	(.03847)	2.7055	1.2619
SPCINCSQ	.405258	.206831	1.959	(.04864)	.89055	.67208
NEAST	-.520851E-01	.989533E-01	-.526	(.60574)	.21380	.41086
SOUTH	-.857259E-01	.972632E-01	-.881	(.38308)	.29143	.45539
WEST	.177437	.945021E-01	1.878	(.05864)	.27628	.44811
LOMIDPOV	-.185687	.121097	-1.533	(.12246)	.17105	.37735
HIPOV	-.256470	.114854	-2.233	(.02522)	.18037	.38531
SUBCORE	-.230642	.939636E-01	-2.455	(.01433)	.23735	.42636
NMCORE	-.465446	.108752	-4.280	(.00005)	.11974	.32535
SUBLOW	-.816255E-01	.113830	-.717	(.48100)	.11057	.31426
NMLOW	.117918	.115281	1.023	(.30853)	.12247	.32853
Sigma	.393448	.181099E-01	21.726	(.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	LOGAVGVA
Number of Observations......	236.
Mean of Dependent Variable..	-.31463
Std. Dev. of Dep. Variable..	.88176
Std. Error of Regression....	.67940
Sum of Squared Residuals....	94.162
R - Squared.................	.48464
Adjusted R - Squared........	.40633
F-Statistic (31, 204).....	6.18849
Significance of F-Test......	.00000
Log-Likelihood..............	-226.45
Restricted (Slopes=0) Log-L.	-304.66
Chi-Squared (31)............	156.42
Significance Level..........	.32173E-13
Durbin - Watson Statistic...........	1.9145
Estimated Autocorrelation (Rho).....	.42770E-01

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-6.03501	2.61859	-2.305	(.02107)	1.0000	.00000
AVOWNWIC	.958046E-01	.472401	.203	(.82074)	.12652	.26556
AVFSPART	-.422662	.193331	-2.186	(.02831)	.29834	.42942
AVFSWIC	.583004	.538031	1.084	(.27961)	.94656E-01	.24726
AVOTHWIC	.355554	.192858	1.844	(.06330)	.25180	.35615
SAVAGE	2.82168	1.32509	2.129	(.03252)	2.7118	.57130
SAVAGSQ	-.556109	.210064	-2.647	(.00856)	7.6804	3.4108
AVAG1922	-.136118	.235148	-.579	(.57060)	.23581	.40722
AVAG51	5.76662	2.33718	2.467	(.01386)	.14937E-02	.27346E-01
HEIGHT	.289758E-01	.221354E-01	1.309	(.18870)	63.826	2.4195
AVPREG	.211019	.261450	.807	(.42597)	.18437	.22180
AVLACT	-.118345	.197774	-.598	(.55765)	.15545	.29230
NONWHITE	-.194974	.130043	-1.499	(.13110)	.29722	.45801
HISPANIC	.347884	.169873	2.048	(.03953)	.10749	.31039
DIETFLAG	-.103448E-02	.184214	-.006	(.94329)	.90116E-01	.28696
EMPLOYED	-.122232	.120162	-1.017	(.31131)	.31768	.46657
SOMEHS	-.117328	.248166	-.473	(.64192)	.20810	.40681
HSGRAD	.368352	.238225	1.546	(.11932)	.42281	.49506
SOMECOL	.210712	.260131	.810	(.42424)	.17753	.38292
COLGRAD	.449719	.280121	1.605	(.10571)	.13354	.34089
AVHHSIZE	.696288E-01	.440301E-01	1.581	(.11108)	4.1363	1.3951
SPCINC	-.120458	.187535	-.642	(.52883)	2.7055	1.2619
SPCINCSQ	.251291	.357150	.704	(.48949)	.89055	.67208
NEAST	.147579	.170870	.864	(.39307)	.21380	.41086
SOUTH	.860370E-01	.167952	.512	(.61523)	.29143	.45539
WEST	.712552	.163184	4.367	(.00004)	.27628	.44811
LOMIDPOV	.146491	.209107	.701	(.49142)	.17105	.37735
HIPOV	.734789E-01	.198327	.370	(.71106)	.18037	.38531
SUBCORE	-.260650	.162254	-1.606	(.10549)	.23735	.42636
NMCORE	-.471594	.187791	-2.511	(.01234)	.11974	.32535
SUBLOW	-.161363	.196559	-.821	(.41780)	.11057	.31426
NMLOW	-.394921	.199064	-1.984	(.04595)	.12247	.32853
Sigma	.679396	.312718E-01	21.726	(.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	AVB6
Number of Observations......	236.
Mean of Dependent Variable..	.62717
Std. Dev. of Dep. Variable..	.27133
Std. Error of Regression....	.22193
Sum of Squared Residuals....	10.047
R - Squared.................	.41927
Adjusted R - Squared........	.33102
F-Statistic (31, 204).....	4.75104
Significance of F-Test......	.00000
Log-Likelihood..............	37.600
Restricted (Slopes=0) Log-L.	-26.519
Chi-Squared (31)............	128.24
Significance Level..........	.32173E-13
Durbin - Watson Statistic...........	2.1209
Estimated Autocorrelation (Rho).....	-.60448E-01

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-1.72904	.855372	-2.021 (.04209)	1.0000	.00000
AVOWNWIC	.243332	.154312	1.577 (.11211)	.12652	.26556
AVFSPART	.105615E-01	.631524E-01	.167 (.84291)	.29834	.42942
AVFSWIC	.134691	.175750	.766 (.45048)	.94656E-01	.24726
AVOTHWIC	.968619E-01	.629980E-01	1.538 (.12144)	.25180	.35615
SAVAGE	1.30022	.432847	3.004 (.00314)	2.7118	.57130
SAVAGSQ	-.218309	.686183E-01	-3.182 (.00186)	7.6804	3.4108
AVAG1922	.765739E-02	.768120E-01	.100 (.88380)	.23581	.40722
AVAG51	2.34928	.763451	3.077 (.00254)	.14937E-02	.27346E-01
HEIGHT	.771073E-02	.723063E-02	1.066 (.28761)	63.826	2.4195
AVPREG	-.177523	.854038E-01	-2.079 (.03674)	.18437	.22180
AVLACT	.496383E-01	.646036E-01	.768 (.44928)	.15545	.29230
NONWHITE	-.360851E-01	.424791E-01	-.849 (.40120)	.29722	.45801
HISPANIC	.766437E-01	.554899E-01	1.381 (.16490)	.10749	.31039
DIETFLAG	-.523825E-01	.601743E-01	-.871 (.38920)	.90116E-01	.28696
EMPLOYED	-.263442E-01	.392515E-01	-.671 (.51018)	.31768	.46657
SOMEHS	.534960E-01	.810643E-01	.660 (.51742)	.20810	.40681
HSGRAD	.168014	.778173E-01	2.159 (.03025)	.42281	.49506
SOMECOL	.110744	.849729E-01	1.303 (.19070)	.17753	.38292
COLGRAD	.125748	.915026E-01	1.374 (.16709)	.13354	.34089
AVHHSIZE	-.149069E-01	.143826E-01	-1.036 (.30190)	4.1363	1.3951
SPCINC	-.797686E-01	.612591E-01	-1.302 (.19110)	2.7055	1.2619
SPCINCSQ	.199382	.116665	1.709 (.08500)	.89055	.67208
NEAST	-.462117E-01	.558155E-01	-.828 (.41370)	.21380	.41086
SOUTH	-.146433E-01	.548622E-01	-.267 (.77969)	.29143	.45539
WEST	.125877	.533047E-01	2.361 (.01823)	.27628	.44811
LOMIDPOV	-.915200E-01	.683057E-01	-1.340 (.17823)	.17105	.37735
HIPOV	-.721122E-01	.647843E-01	-1.113 (.26623)	.18037	.38531
SUBCORE	-.619595E-01	.530010E-01	-1.169 (.24212)	.23735	.42636
NMCORE	-.247740	.613428E-01	-4.039 (.00012)	.11974	.32535
SUBLOW	.590285E-01	.642069E-01	.919 (.36212)	.11057	.31426
NMLOW	.503745E-01	.650252E-01	.775 (.44542)	.12247	.32853
Sigma	.221928	.102150E-01	21.726 (.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	AVGVC
Number of Observations......	236.
Mean of Dependent Variable..	1.41632
Std. Dev. of Dep. Variable..	1.04815
Std. Error of Regression....	.76372
Sum of Squared Residuals....	118.99
R - Squared.................	.53913
Adjusted R - Squared........	.46909
F-Statistic (31, 204).....	7.69806
Significance of F-Test......	.00000
Log-Likelihood..............	-254.06
Restricted (Slopes=0) Log-L.	-345.46
Chi-Squared (31)............	182.79
Significance Level..........	.32173E-13
Durbin - Watson Statistic...........	2.1389
Estimated Autocorrelation (Rho).....	-.69433E-01

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	1.46707	2.94358	.498 (.62459)	1.0000	.00000
AVOWNWIC	1.27593	.531030	2.403 (.01639)	.12652	.26556
AVFSPART	-.705672E-01	.217325	-.325 (.74167)	.29834	.42942
AVFSWIC	-.234614	.604806	-.388 (.69933)	.94656E-01	.24726
AVOTHWIC	.507017E-01	.216794	.234 (.80102)	.25180	.35615
SAVAGE	-.774692	1.48955	-.520 (.60996)	2.7118	.57130
SAVAGSQ	.102513	.236135	.434 (.66809)	7.6804	3.4108
AVAG1922	-.125240	.264332	-.474 (.64123)	.23581	.40722
AVAG51	6.02266	2.62725	2.292 (.02173)	.14937E-02	.27346E-01
HEIGHT	.155157E-01	.248827E-01	.624 (.54108)	63.826	2.4195
AVPREG	-.342930	.293899	-1.167 (.24304)	.18437	.22180
AVLACT	-.442226	.222319	-1.989 (.04539)	.15545	.29230
NONWHITE	.670277	.146183	4.585 (.00002)	.29722	.45801
HISPANIC	.632759E-01	.190956	.331 (.73724)	.10749	.31039
DIETFLAG	-.184763	.207077	-.892 (.37701)	.90116E-01	.28696
EMPLOYED	-.272202	.135075	-2.015 (.04271)	.31768	.46657
SOMEHS	-.650318	.278965	-2.331 (.01970)	.20810	.40681
HSGRAD	-.232603	.267791	-.869 (.39028)	.42281	.49506
SOMECOL	-.505182	.292416	-1.728 (.08167)	.17753	.38292
COLGRAD	.682937	.314886	2.169 (.02954)	.13354	.34089
AVHHSIZE	-.295071E-03	.494946E-01	-.006 (.94297)	4.1363	1.3951
SPCINC	.262505	.210810	1.245 (.21183)	2.7055	1.2619
SPCINCSQ	-.278537E-01	.401476	-.069 (.90183)	.89055	.67208
NEAST	-.282796	.192077	-1.472 (.13829)	.21380	.41086
SOUTH	-.539067	.188796	-2.855 (.00481)	.29143	.45539
WEST	-.140197	.183437	-.764 (.45176)	.27628	.44811
LOMIDPOV	.372784	.235059	1.586 (.11005)	.17105	.37735
HIPOV	.214430	.222941	.962 (.33949)	.18037	.38531
SUBCORE	.667002E-01	.182392	.366 (.71428)	.23735	.42636
NMCORE	-.675281	.211098	-3.199 (.00177)	.11974	.32535
SUBLOW	-.219498	.220954	-.993 (.32324)	.11057	.31426
NMLOW	-.145007	.223770	-.648 (.52512)	.12247	.32853
Sigma	.763716	.351529E-01	21.726 (.00000)		

Ordinary Least Squares Estimates

Dependent Variable..........	LOGAVGVE
Number of Observations......	236.
Mean of Dependent Variable..	-.34041
Std. Dev. of Dep. Variable..	.66037
Std. Error of Regression....	.54200
Sum of Squared Residuals....	59.928
R - Squared.................	.41522
Adjusted R - Squared........	.32636
F-Statistic (31, 204).....	4.67262
Significance of F-Test......	.00000
Log-Likelihood..............	-173.13
Restricted (Slopes=0) Log-L.	-236.43
Chi-Squared (31)............	126.60
Significance Level..........	.32173E-13
Durbin - Watson Statistic...........	2.0350
Estimated Autocorrelation (Rho).....	-.17524E-01

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-4.50865	2.08903	-2.158 (.03031)	1.0000	.00000
AVOWNWIC	.726213E-01	.376867	.193 (.82709)	.12652	.26556
AVFSPART	.310600E-01	.154233	.201 (.82164)	.29834	.42942
AVFSWIC	.468105	.429225	1.091 (.27640)	.94656E-01	.24726
AVOTHWIC	.388514	.153856	2.525 (.01189)	.25180	.35615
SAVAGE	1.76638	1.05712	1.671 (.09218)	2.7118	.57130
SAVAGSQ	-.323369	.167582	-1.930 (.05210)	7.6804	3.4108
AVAG1922	-.435442E-01	.187594	-.232 (.80214)	.23581	.40722
AVAG51	4.02216	1.86453	2.157 (.03039)	.14937E-02	.27346E-01
HEIGHT	.173722E-01	.176590E-01	.984 (.32815)	63.826	2.4195
AVPREG	.227494E-01	.208577	.109 (.87820)	.18437	.22180
AVLACT	.755421E-01	.157778	.479 (.63785)	.15545	.29230
NONWHITE	-.139793E-01	.103744	-.135 (.86276)	.29722	.45801
HISPANIC	.246911	.135520	1.822 (.06643)	.10749	.31039
DIETFLAG	.943729E-01	.146960	.642 (.52893)	.90116E-01	.28696
EMPLOYED	.271700	.958616E-01	2.834 (.00510)	.31768	.46657
SOMEHS	.411792	.197979	2.080 (.03662)	.20810	.40681
HSGRAD	.729502	.190049	3.839 (.00024)	.42281	.49506
SOMECOL	.665540	.207524	3.207 (.00172)	.17753	.38292
COLGRAD	.674330	.223471	3.018 (.00302)	.13354	.34089
AVHHSIZE	.553484E-02	.351258E-01	.158 (.84885)	4.1363	1.3951
SPCINC	-.152094	.149610	-1.017 (.31162)	2.7055	1.2619
SPCINCSQ	.240512	.284923	.844 (.40429)	.89055	.67208
NEAST	.168078	.136315	1.233 (.21649)	.21380	.41086
SOUTH	.128175	.133987	.957 (.34221)	.29143	.45539
WEST	.517609	.130183	3.976 (.00015)	.27628	.44811
LOMIDPOV	-.211417	.166819	-1.267 (.20358)	.17105	.37735
HIPOV	-.309124	.158219	-1.954 (.04928)	.18037	.38531
SUBCORE	-.205239	.129441	-1.586 (.11013)	.23735	.42636
NMCORE	-.566201	.149814	-3.779 (.00029)	.11974	.32535
SUBLOW	.137060	.156809	.874 (.38720)	.11057	.31426
NMLOW	.102310	.158807	.644 (.52758)	.12247	.32853
Sigma	.542001	.249476E-01	21.726 (.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	LOGAVFOL
Number of Observations......	236.
Mean of Dependent Variable..	-.88064
Std. Dev. of Dep. Variable..	.56778
Std. Error of Regression....	.44112
Sum of Squared Residuals....	39.695
R - Squared.................	.47602
Adjusted R - Squared........	.39640
F-Statistic (31, 204).....	5.97842
Significance of F-Test......	.00000
Log-Likelihood..............	-124.52
Restricted (Slopes=0) Log-L.	-200.78
Chi-Squared (31)............	152.51
Significance Level..........	.32173E-13
Durbin - Watson Statistic...........	1.9900
Estimated Autocorrelation (Rho).....	.50182E-02

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-4.19868	1.70019	-2.470 (.01378)	1.0000	.00000
AVOWNWIC	.324245	.306719	1.057 (.29198)	.12652	.26556
AVFSPART	-.171842	.125525	-1.369 (.16876)	.29834	.42942
AVFSWIC	.278047	.349332	.796 (.43262)	.94656E-01	.24726
AVOTHWIC	.314676	.125219	2.513 (.01228)	.25180	.35615
SAVAGE	1.87314	.860353	2.177 (.02894)	2.7118	.57130
SAVAGSQ	-.331906	.136390	-2.434 (.01514)	7.6804	3.4108
AVAG1922	.360414E-01	.152676	.236 (.79961)	.23581	.40722
AVAG51	4.14797	1.51748	2.733 (.00676)	.14937E-02	.27346E-01
HEIGHT	.894878E-02	.143720E-01	.623 (.54168)	63.826	2.4195
AVPREG	-.611973	.169754	-3.605 (.00050)	.18437	.22180
AVLACT	.455439E-01	.128410	.355 (.72167)	.15545	.29230
NONWHITE	-.314030E-01	.844340E-01	-.372 (.71009)	.29722	.45801
HISPANIC	.351434	.110295	3.186 (.00183)	.10749	.31039
DIETFLAG	-.115423	.119606	-.965 (.33782)	.90116E-01	.28696
EMPLOYED	.166125E-02	.780186E-01	.021 (.93151)	.31768	.46657
SOMEHS	.179143	.161128	1.112 (.26681)	.20810	.40681
HSGRAD	.476370	.154674	3.080 (.00252)	.42281	.49506
SOMECOL	.416107	.168897	2.464 (.01399)	.17753	.38292
COLGRAD	.364402	.181876	2.004 (.04389)	.13354	.34089
AVHHSIZE	-.992156E-02	.285878E-01	-.347 (.72677)	4.1363	1.3951
SPCINC	-.101379	.121762	-.833 (.41098)	2.7055	1.2619
SPCINCSQ	.267268	.231890	1.153 (.24905)	.89055	.67208
NEAST	-.743941E-01	.110942	-.671 (.51056)	.21380	.41086
SOUTH	.653163E-01	.109047	.599 (.55727)	.29143	.45539
WEST	.280897	.105952	2.651 (.00848)	.27628	.44811
LOMIDPOV	-.143551	.135769	-1.057 (.29189)	.17105	.37735
HIPOV	-.109028	.128769	-.847 (.40281)	.18037	.38531
SUBCORE	-.167028	.105348	-1.585 (.11015)	.23735	.42636
NMCORE	-.707170	.121929	-5.800 (.00000)	.11974	.32535
SUBLOW	.284648E-01	.127621	.223 (.80793)	.11057	.31426
NMLOW	-.463396E-01	.129248	-.359 (.71908)	.12247	.32853
Sigma	.441117	.203041E-01	21.726 (.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	AVCALC
Number of Observations......	236.
Mean of Dependent Variable..	.78547
Std. Dev. of Dep. Variable..	.35251
Std. Error of Regression....	.27790
Sum of Squared Residuals....	15.754
R - Squared.................	.46050
Adjusted R - Squared........	.37851
F-Statistic (31, 204).....	5.61694
Significance of F-Test......	.00000
Log-Likelihood..............	-15.475
Restricted (Slopes=0) Log-L.	-88.283
Chi-Squared (31)............	145.62
Significance Level..........	.32173E-13
Durbin - Watson Statistic...........	1.9821
Estimated Autocorrelation (Rho).....	.89298E-02

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-1.83611	1.07109	-1.714 (.08405)	1.0000	.00000
AVOWNWIC	.236514	.193228	1.224 (.21997)	.12652	.26556
AVFSPART	-.826518E-01	.790787E-01	-1.045 (.29768)	.29834	.42942
AVFSWIC	-.655989E-01	.220073	-.298 (.75929)	.94656E-01	.24726
AVOTHWIC	.150637E-01	.788854E-01	.191 (.82818)	.25180	.35615
SAVAGE	1.17070	.542007	2.160 (.03019)	2.7118	.57130
SAVAGSQ	-.204165	.859231E-01	-2.376 (.01756)	7.6804	3.4108
AVAG1922	.508754E-01	.961832E-01	.529 (.60400)	.23581	.40722
AVAG51	1.96887	.955985	2.060 (.03846)	.14937E-02	.27346E-01
HEIGHT	.154069E-01	.905413E-02	1.702 (.08635)	63.826	2.4195
AVPREG	-.207618	.106942	-1.941 (.05070)	.18437	.22180
AVLACT	-.110859	.808960E-01	-1.370 (.16831)	.15545	.29230
NONWHITE	-.176679	.531919E-01	-3.322 (.00122)	.29722	.45801
HISPANIC	.141229	.694838E-01	2.033 (.04099)	.10749	.31039
DIETFLAG	-.100610	.753497E-01	-1.335 (.17977)	.90116E-01	.28696
EMPLOYED	-.312226E-01	.491503E-01	-.635 (.53344)	.31768	.46657
SOMEHS	.193604	.101508	1.907 (.05482)	.20810	.40681
HSGRAD	.344082	.974420E-01	3.531 (.00064)	.42281	.49506
SOMECOL	.258571	.106402	2.430 (.01527)	.17753	.38292
COLGRAD	.410232	.114579	3.580 (.00055)	.13354	.34089
AVHHSIZE	.161870E-01	.180098E-01	.899 (.37338)	4.1363	1.3951
SPCINC	-.838266E-01	.767080E-01	-1.093 (.27539)	2.7055	1.2619
SPCINCSQ	.147498	.146086	1.010 (.31507)	.89055	.67208
NEAST	-.113490	.698916E-01	-1.624 (.10176)	.21380	.41086
SOUTH	-.182696	.686979E-01	-2.659 (.00829)	.29143	.45539
WEST	.126490	.667477E-01	1.895 (.05637)	.27628	.44811
LOMIDPOV	.108085	.855317E-01	1.264 (.20493)	.17105	.37735
HIPOV	-.308262E-02	.811223E-01	-.038 (.92078)	.18037	.38531
SUBCORE	-.128954	.663673E-01	-1.943 (.05051)	.23735	.42636
NMCORE	-.290697	.768128E-01	-3.784 (.00028)	.11974	.32535
SUBLOW	-.230126	.803992E-01	-2.862 (.00471)	.11057	.31426
NMLOW	-.137794	.814238E-01	-1.692 (.08809)	.12247	.32853
Sigma	.277896	.127912E-01	21.726 (.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	AVMG
Number of Observations......	236.
Mean of Dependent Variable..	.64124
Std. Dev. of Dep. Variable..	.25076
Std. Error of Regression....	.18918
Sum of Squared Residuals....	7.3008
R - Squared.................	.50593
Adjusted R - Squared........	.43085
F-Statistic (31, 204).....	6.73871
Significance of F-Test......	.00000
Log-Likelihood..............	75.281
Restricted (Slopes=0) Log-L.	-7.9087
Chi-Squared (31)............	166.38
Significance Level..........	.32173E-13
Durbin - Watson Statistic...........	2.0787
Estimated Autocorrelation (Rho).....	-.39338E-01

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-1.66555	.729144	-2.284 (.02218)	1.0000	.00000
AVOWNWIC	.271690	.131540	2.065 (.03792)	.12652	.26556
AVFSPART	-.640232E-01	.538329E-01	-1.189 (.23378)	.29834	.42942
AVFSWIC	-.872720E-01	.149815	-.583 (.56816)	.94656E-01	.24726
AVOTHWIC	.826813E-01	.537013E-01	1.540 (.12092)	.25180	.35615
SAVAGE	1.09649	.368972	2.972 (.00345)	2.7118	.57130
SAVAGSQ	-.177900	.584922E-01	-3.041 (.00282)	7.6804	3.4108
AVAG1922	.102263	.654768E-01	1.562 (.11561)	.23581	.40722
AVAG51	1.92308	.650788	2.955 (.00362)	.14937E-02	.27346E-01
HEIGHT	.130986E-01	.616360E-02	2.125 (.03285)	63.826	2.4195
AVPREG	-.340595	.728007E-01	-4.678 (.00001)	.18437	.22180
AVLACT	-.239750	.550700E-01	-4.354 (.00004)	.15545	.29230
NONWHITE	-.760667E-01	.362104E-01	-2.101 (.03485)	.29722	.45801
HISPANIC	.116494	.473012E-01	2.463 (.01402)	.10749	.31039
DIETFLAG	-.137166	.512944E-01	-2.674 (.00796)	.90116E-01	.28696
EMPLOYED	-.761526E-01	.334591E-01	-2.276 (.02265)	.31768	.46657
SOMEHS	.111634	.691016E-01	1.616 (.10353)	.20810	.40681
HSGRAD	.187354	.663337E-01	2.824 (.00525)	.42281	.49506
SOMECOL	.115974	.724334E-01	1.601 (.10666)	.17753	.38292
COLGRAD	.204666	.779995E-01	2.624 (.00913)	.13354	.34089
AVHHSIZE	-.498334E-02	.122602E-01	-.406 (.68681)	4.1363	1.3951
SPCINC	-.122322	.522190E-01	-2.342 (.01914)	2.7055	1.2619
SPCINCSQ	.295527	.994483E-01	2.972 (.00345)	.89055	.67208
NEAST	-.586055E-01	.475788E-01	-1.232 (.21697)	.21380	.41086
SOUTH	-.876791E-01	.467661E-01	-1.875 (.05901)	.29143	.45539
WEST	.109968	.454385E-01	2.420 (.01567)	.27628	.44811
LOMIDPOV	-.436729E-01	.582258E-01	-.750 (.46048)	.17105	.37735
HIPOV	-.809425E-01	.552241E-01	-1.466 (.14009)	.18037	.38531
SUBCORE	-.138000	.451796E-01	-3.054 (.00271)	.23735	.42636
NMCORE	-.303844	.522904E-01	-5.811 (.00000)	.11974	.32535
SUBLOW	-.596149E-01	.547318E-01	-1.089 (.27702)	.11057	.31426
NMLOW	-.812563E-02	.554293E-01	-.147 (.85556)	.12247	.32853
Sigma	.189178	.870761E-02	21.726 (.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	LOGAVGFE
Number of Observations......	236.
Mean of Dependent Variable..	-.51649
Std. Dev. of Dep. Variable..	.44970
Std. Error of Regression....	.37218
Sum of Squared Residuals....	28.257
R - Squared.................	.40542
Adjusted R - Squared........	.31507
F-Statistic (31, 204).....	4.48712
Significance of F-Test......	.00000
Log-Likelihood..............	-84.416
Restricted (Slopes=0) Log-L.	-145.75
Chi-Squared (31)............	122.68
Significance Level..........	.32173E-13
Durbin - Watson Statistic..........	1.9873
Estimated Autocorrelation (Rho).....	.63532E-02

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-4.92735	1.43447	-3.435 (.00086)	1.0000	.00000
AVOWNWIC	.179844	.258783	.695 (.49497)	.12652	.26556
AVFSPART	-.666559E-01	.105908	-.629 (.53727)	.29834	.42942
AVFSWIC	.318136E-01	.294736	.108 (.87888)	.94656E-01	.24726
AVOTHWIC	.206647	.105649	1.956 (.04903)	.25180	.35615
SAVAGE	2.35647	.725892	3.246 (.00153)	2.7118	.57130
SAVAGSQ	-.389320	.115074	-3.383 (.00101)	7.6804	3.4108
AVAG1922	.151374	.128815	1.175 (.23959)	.23581	.40722
AVAG51	3.15664	1.28032	2.466 (.01392)	.14937E-02	.27346E-01
HEIGHT	.119784E-01	.121259E-01	.988 (.32607)	63.826	2.4195
AVPREG	.105852	.143224	.739 (.46728)	.18437	.22180
AVLACT	.245295	.108341	2.264 (.02333)	.15545	.29230
NONWHITE	.204624E-01	.712382E-01	.287 (.76641)	.29722	.45801
HISPANIC	.270490	.930574E-01	2.907 (.00415)	.10749	.31039
DIETFLAG	-.875634E-01	.100913	-.868 (.39079)	.90116E-01	.28696
EMPLOYED	-.592632E-01	.658254E-01	-.900 (.37254)	.31768	.46657
SOMEHS	.165128	.135946	1.215 (.22363)	.20810	.40681
HSGRAD	.412635	.130501	3.162 (.00197)	.42281	.49506
SOMECOL	.364043	.142501	2.555 (.01100)	.17753	.38292
COLGRAD	.317331	.153451	2.068 (.03769)	.13354	.34089
AVHHSIZE	-.219551E-01	.241199E-01	-.910 (.36708)	4.1363	1.3951
SPCINC	-.541213E-01	.102733	-.527 (.60543)	2.7055	1.2619
SPCINCSQ	.974126E-01	.195649	.498 (.62493)	.89055	.67208
NEAST	-.784154E-01	.936035E-01	-.838 (.40799)	.21380	.41086
SOUTH	.267852E-02	.920048E-01	.029 (.92638)	.29143	.45539
WEST	.188321	.893930E-01	2.107 (.03435)	.27628	.44811
LOMIDPOV	-.206435	.114550	-1.802 (.06941)	.17105	.37735
HIPOV	-.143459	.108644	-1.320 (.18477)	.18037	.38531
SUBCORE	-.941368E-01	.888836E-01	-1.059 (.29105)	.23735	.42636
NMCORE	-.443005	.102873	-4.306 (.00005)	.11974	.32535
SUBLOW	.659880E-01	.107676	.613 (.54812)	.11057	.31426
NMLOW	.784329E-01	.109048	.719 (.47964)	.12247	.32853
Sigma	.372176	.171308E-01	21.726 (.00000)		

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Ordinary Least Squares Estimates

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Dependent Variable..........     AVZINC
Number of Observations......          236.
Mean of Dependent Variable..        .58496
Std. Dev. of Dep. Variable..        .21388
Std. Error of Regression....        .17713
Sum of Squared Residuals....    6.4003
R - Squared.................        .40464
Adjusted R - Squared........        .31417
F-Statistic ( 31,  204).....       4.47263
Significance of F-Test......        .00000
Log-Likelihood..............    90.814
Restricted (Slopes=0) Log-L.    29.631
Chi-Squared (31)............    122.37
Significance Level..........    .32173E-13
Durbin - Watson Statistic...........     1.9419
Estimated Autocorrelation (Rho).....     .29058E-01
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Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.343500	.682698	-.503 (.62138)	1.0000	.00000
AVOWNWIC	.106453	.123161	.864 (.39270)	.12652	.26556
AVFSPART	.277557E-01	.504038E-01	.551 (.58942)	.29834	.42942
AVFSWIC	-.559263E-01	.140271	-.399 (.69205)	.94656E-01	.24726
AVOTHWIC	-.274797E-03	.502805E-01	-.005 (.94342)	.25180	.35615
SAVAGE	.447883	.345468	1.296 (.19310)	2.7118	.57130
SAVAGSQ	-.717586E-01	.547663E-01	-1.310 (.18827)	7.6804	3.4108
AVAG1922	.737292E-01	.613059E-01	1.203 (.22839)	.23581	.40722
AVAG51	.236204	.609333	.388 (.69951)	.14937E-02	.27346E-01
HEIGHT	.713210E-02	.577098E-02	1.236 (.21540)	63.826	2.4195
AVPREG	-.159053	.681633E-01	-2.333 (.01959)	.18437	.22180
AVLACT	-.277547	.515621E-01	-5.383 (.00000)	.15545	.29230
NONWHITE	-.435971E-01	.339038E-01	-1.286 (.19685)	.29722	.45801
HISPANIC	.117580	.442881E-01	2.655 (.00839)	.10749	.31039
DIETFLAG	-.102726	.480269E-01	-2.139 (.03177)	.90116E-01	.28696
EMPLOYED	-.963269E-01	.313278E-01	-3.075 (.00255)	.31768	.46657
SOMEHS	-.533477E-02	.646998E-01	-.082 (.89405)	.20810	.40681
HSGRAD	.111146	.621083E-01	1.790 (.07136)	.42281	.49506
SOMECOL	.107873	.678194E-01	1.591 (.10900)	.17753	.38292
COLGRAD	.779232E-01	.730309E-01	1.067 (.28733)	.13354	.34089
AVHHSIZE	-.495397E-02	.114792E-01	-.432 (.66983)	4.1363	1.3951
SPCINC	-.105097	.488927E-01	-2.150 (.03096)	2.7055	1.2619
SPCINCSQ	.237661	.931135E-01	2.552 (.01106)	.89055	.67208
NEAST	-.102672	.445480E-01	-2.305 (.02106)	.21380	.41086
SOUTH	-.221711E-01	.437871E-01	-.506 (.61923)	.29143	.45539
WEST	.683972E-01	.425441E-01	1.608 (.10522)	.27628	.44811
LOMIDPOV	-.854873E-01	.545168E-01	-1.568 (.11414)	.17105	.37735
HIPOV	-.125236	.517063E-01	-2.422 (.01559)	.18037	.38531
SUBCORE	-.105771	.423017E-01	-2.500 (.01270)	.23735	.42636
NMCORE	-.227092	.489595E-01	-4.638 (.00002)	.11974	.32535
SUBLOW	-.961885E-02	.512454E-01	-.188 (.83021)	.11057	.31426
NMLOW	.502426E-01	.518985E-01	.968 (.33623)	.12247	.32853
Sigma	.177127	.815293E-02	21.726 (.00000)		

APPENDIX K

DETAILED ESTIMATION RESULTS FOR THE HOUSEHOLD FOOD EXPENDITURE ANALYSIS

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MODEL COMMAND: PROBIT ;LHS=FSPART1 ;RHS=FSTMP1 ;WTS=FSWTS ;MATRIX(B=DELTA1

Ordinary Least Squares Estimates

Dependent Variable..........	FSPART1
Number of Observations......	981.
Mean of Dependent Variable..	.50177
Std. Dev. of Dep. Variable..	.50025
Std. Error of Regression....	.40598
Sum of Squared Residuals....	157.57
R - Squared.................	.35752
Adjusted R - Squared........	.34139
F-Statistic (24, 956).....	22.16568
Significance of F-Test......	.00000
Log-Likelihood..............	-494.99
Restricted (Slopes=0) Log-L.	-711.95
Chi-Squared (24)............	433.92
Significance Level..........	.32173E-13

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.855057	.155388	5.503 (.00000)	1.0000	.00000
RESFHEAD	.228871	.602012E-01	3.802 (.00014)	.94467	.22874
SRESAGE	-.523456E-01	.196666E-01	-2.662 (.00778)	3.2170	.79740
RESHISP	.536271E-02	.420699E-01	.127 (.89857)	.12836	.33467
RESNONWH	.498487E-01	.316420E-01	1.575 (.11516)	.48623	.50007
SRESEDUC	-.148757	.575825E-01	-2.583 (.00978)	1.1201	.24680
RESEMP	-.106919	.305233E-01	-3.503 (.00046)	.33960	.47381
MALEHEAD	-.205043	.390907E-01	-5.245 (.00000)	.57756	.49420
MALEEMP	-.138284	.387819E-01	-3.566 (.00036)	.37657	.48477
IFKIDLT6	.624449E-01	.323177E-01	1.932 (.05333)	.52981	.49937
SGUARAMT	.100598E-01	.202893E-02	4.958 (.00000)	25.928	8.5927
SINC	-.696845E-01	.147428E-01	-4.727 (.00000)	6.7932	3.3076
SINCSQ	.235216	.906267E-01	2.595 (.00945)	.57076	.52649
OWNHOME	.693196E-01	.887210E-01	.781 (.43461)	.30242	.45954
RENTHOME	.199633	.875314E-01	2.281 (.02257)	.67343	.46920
LOPOV	-.219973	.787396E-01	-2.794 (.00521)	.51287E-01	.22069
MIDPOV	-.725929E-01	.534458E-01	-1.358 (.17438)	.29455	.45607
HIPOV	-.269084E-01	.490848E-01	-.548 (.58355)	.37064	.48322
SUBCORE	.710890E-01	.647703E-01	1.098 (.27240)	.80005E-01	.27144
NMCORE	.177499E-01	.619794E-01	.286 (.77458)	.97604E-01	.29693
SUBLOW	-.102818E-01	.406872E-01	-.253 (.80050)	.20939	.40708
NMLOW	-.180877E-01	.415089E-01	-.436 (.66301)	.19297	.39483
NEAST	-.102610	.389444E-01	-2.635 (.00842)	.24245	.42878
SOUTH	-.209404	.376658E-01	-5.560 (.00000)	.35374	.47837
WEST	-.139064	.449241E-01	-3.096 (.00196)	.16519	.37154

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Probit Estimates

Log-Likelihood.............	-472.06
Restricted (Slopes=0) Log-L.	-679.86
Chi-Squared (24)............	415.61
Significance Level..........	.32173E-13

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	1.10120	.551874	1.995	(.04600)	1.0000	.00000
RESFHEAD	.860242	.214908	4.003	(.00006)	.94467	.22874
SRESAGE	-.173675	.706967E-01	-2.457	(.01402)	3.2170	.79740
RESHISP	-.121852E-01	.146792	-.083	(.93384)	.12836	.33467
RESNONWH	.158135	.115869	1.365	(.17232)	.48623	.50007
SRESEDUC	-.554406	.201621	-2.750	(.00596)	1.1201	.24680
RESEMP	-.383606	.108066	-3.550	(.00039)	.33960	.47381
MALEHEAD	-.700603	.139492	-5.023	(.00000)	.57756	.49420
MALEEMP	-.450038	.136136	-3.306	(.00095)	.37657	.48477
IFKIDLT6	.240834	.117952	2.042	(.04117)	.52981	.49937
SGUARAMT	.360508E-01	.755394E-02	4.772	(.00000)	25.928	8.5927
SINC	-.225263	.509113E-01	-4.425	(.00001)	6.7932	3.3076
SINCSQ	.761938	.307264	2.480	(.01315)	.57076	.52649
OWNHOME	.231156	.321282	.719	(.47185)	.30242	.45954
RENTHOME	.690051	.317421	2.174	(.02971)	.67343	.46920
LOPOV	-.847349	.304985	-2.778	(.00546)	.51287E-01	.22069
MIDPOV	-.234028	.196081	-1.194	(.23266)	.29455	.45607
HIPOV	-.835930E-01	.184489	-.453	(.65047)	.37064	.48322
SUBCORE	.295711	.234203	1.263	(.20672)	.80005E-01	.27144
NMCORE	.611697E-01	.227427	.269	(.78796)	.97604E-01	.29693
SUBLOW	-.723081E-01	.145836	-.496	(.62002)	.20939	.40708
NMLOW	-.998941E-01	.150932	-.662	(.50807)	.19297	.39483
NEAST	-.366934	.147496	-2.488	(.01286)	.24245	.42878
SOUTH	-.728250	.140309	-5.190	(.00000)	.35374	.47837
WEST	-.501773	.165284	-3.036	(.00240)	.16519	.37154

Frequencies of actual vs. predicted outcomes
Predicted outcome has the highest probability.

		Predicted	
Actual	TOTAL	0	1
TOTAL	981	472	509
0	483	370	113
1	498	102	396

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MODEL COMMAND: PROBIT ;LHS=HHWIC1 ;RHS=WIC1  ;WTS=AWTMHH ;MATRIX(B=DELTA2)

    Ordinary    Least Squares Estimates

    Dependent Variable..........     HHWIC1
    Number of Observations......         515.
    Mean of Dependent Variable..       .28665
    Std. Dev. of Dep. Variable..       .45264
    Std. Error of Regression....       .37838
    Sum of Squared Residuals....   70.012
    R - Squared.................       .33517
    Adjusted R - Squared........       .30118
    F-Statistic ( 25,  489).....     9.86120
    Significance of F-Test......       .00000
    Log-Likelihood..............  -216.91
    Restricted (Slopes=0) Log-L.  -322.01
    Chi-Squared (25)............   210.19
    Significance Level..........   .32173E-13
```

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.155841	.260599	-.598 (.54983)	1.0000	.00000
RESFHEAD	-.561090	.112649	-4.981 (.00000)	.97149	.16660
SRESAGE	.107630	.325414E-01	3.307 (.00094)	2.8530	.63791
RESHISP	-.160007E-01	.507549E-01	-.315 (.75257)	.15775	.36486
RESNONWH	.583431E-01	.456959E-01	1.277 (.20168)	.34899	.47711
SRESEDUC	-.315976E-02	.908156E-01	-.035 (.97224)	1.1685	.21812
RESEMP	.148527	.408470E-01	3.636 (.00028)	.30999	.46294
RESGHLTH	-.892325E-01	.520635E-01	-1.714 (.08654)	.85018	.35724
MALEHEAD	.214219	.629148E-01	3.405 (.00066)	.69822	.45948
MALEEMP	-.183480	.598391E-01	-3.066 (.00217)	.57713	.49450
TOTSIZE	.380304E-01	.169818E-01	2.239 (.02512)	4.2571	1.4304
WICPOTPC	.284057E-01	.292514E-02	9.711 (.00000)	13.202	6.8780
SPCINC	-.124296	.817830E-01	-1.520 (.12855)	2.2409	1.0221
SPCINCSQ	.163261E-01	.173201E-01	.943 (.34588)	6.0641	4.8381
OWNHOME	.190658	.107626	1.771 (.07648)	.30220	.45966
RENTHOME	.420563	.106960	3.932 (.00008)	.66784	.47144
LOPOV	-.200482	.109658	-1.828 (.06751)	.39064E-01	.19394
MIDPOV	-.261775E-01	.705063E-01	-.371 (.71043)	.22373	.41715
HIPOV	.445415E-01	.651180E-01	.684 (.49397)	.26785	.44327
SUBCORE	-.394802E-02	.623533E-01	-.063 (.94951)	.16789	.37414
NMCORE	.164626	.720576E-01	2.285 (.02233)	.12779	.33418
SUBLOW	.101423	.583765E-01	1.737 (.08232)	.16625	.37266
NMLOW	.608956E-01	.639342E-01	.952 (.34086)	.13586	.34298
NEAST	.383489E-01	.563502E-01	.681 (.49616)	.19866	.39938
SOUTH	-.106949	.497952E-01	-2.148 (.03173)	.33727	.47324
WEST	-.264247	.551121E-01	-4.795 (.00000)	.22197	.41597

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Probit Estimates

Log-Likelihood..............	-208.42
Restricted (Slopes=0) Log-L.	-328.72
Chi-Squared (25)............	240.60
Significance Level..........	.32173E-13

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-3.34273	1.36123	-2.456 (.01406)	1.0000	.00000
RESFHEAD	-2.14089	.489737	-4.372 (.00001)	.97149	.16660
SRESAGE	.435743	.131954	3.302 (.00096)	2.8530	.63791
RESHISP	-.593888E-01	.229638	-.259 (.79593)	.15775	.36486
RESNONWH	.206028	.187649	1.098 (.27223)	.34899	.47711
SRESEDUC	.685740E-01	.385365	.178 (.85877)	1.1685	.21812
RESEMP	.578803	.175702	3.294 (.00099)	.30999	.46294
RESGHLTH	-.322465	.202877	-1.589 (.11196)	.85018	.35724
MALEHEAD	.776938	.248310	3.129 (.00175)	.69822	.45948
MALEEMP	-.690665	.241849	-2.856 (.00429)	.57713	.49450
TOTSIZE	.128503	.701120E-01	1.833 (.06683)	4.2571	1.4304
WICPOTPC	.106714	.130477E-01	8.179 (.00000)	13.202	6.8780
SPCINC	-.485491	.330887	-1.467 (.14231)	2.2409	1.0221
SPCINCSQ	.558072E-01	.720715E-01	.774 (.43874)	6.0641	4.8381
OWNHOME	1.56154	.950645	1.643 (.10046)	.30220	.45966
RENTHOME	2.49002	.950149	2.621 (.00878)	.66784	.47144
LOPOV	-1.35106	.670788	-2.014 (.04399)	.39064E-01	.19394
MIDPOV	-.115009	.290105	-.396 (.69178)	.22373	.41715
HIPOV	.201849	.256609	.787 (.43151)	.26785	.44327
SUBCORE	.867203E-01	.284373	.305 (.76040)	.16789	.37414
NMCORE	.674153	.305402	2.207 (.02728)	.12779	.33418
SUBLOW	.482076	.242414	1.989 (.04674)	.16625	.37266
NMLOW	.303782	.255329	1.190 (.23414)	.13586	.34298
NEAST	.103029	.221355	.465 (.64161)	.19866	.39938
SOUTH	-.472766	.208466	-2.268 (.02334)	.33727	.47324
WEST	-1.06740	.247045	-4.321 (.00002)	.22197	.41597

Frequencies of actual vs. predicted outcomes
Predicted outcome has the highest probability.

		Predicted	
Actual	TOTAL	0	1
TOTAL	515	366	149
0	342	288	54
1	173	78	95

FIML ESTIMATES OF BIVARIATE PROBIT MODEL

Log-Likelihood............. -409.34

DESCRIPTIVE STATISTICS FOR REGRESSORS APPEAR
WITH SINGLE EQUATION ESTIMATES

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.827035	.970087	.853 (.39392)	.00000	.00000
RESFHEAD	1.68579	.468397	3.599 (.00032)	.00000	.00000
SRESAGE	-.295963E-01	.143573	-.206 (.83668)	.00000	.00000
RESHISP	-.190193	.221783	-.858 (.39113)	.00000	.00000
RESNONWH	.392738	.214148	1.834 (.06666)	.00000	.00000
SRESEDUC	-.307554	.402060	-.765 (.44430)	.00000	.00000
RESEMP	-.288541	.205104	-1.407 (.15949)	.00000	.00000
MALEHEAD	-.785180	.299147	-2.625 (.00867)	.00000	.00000
MALEEMP	-.396656	.254496	-1.559 (.11909)	.00000	.00000
IFKIDLT6	-.574714	.470967	-1.220 (.22236)	.00000	.00000
SGUARAMT	.130708E-01	.140010E-01	.934 (.35053)	.00000	.00000
SINC	-.260615	.800783E-01	-3.254 (.00114)	.00000	.00000
SINCSQ	1.14412	.428824	2.668 (.00763)	.00000	.00000
OWNHOME	.197677	.524829	.377 (.70643)	.00000	.00000
RENTHOME	.857216	.519530	1.650 (.09895)	.00000	.00000
LOPOV	-.769334	.617486	-1.246 (.21280)	.00000	.00000
MIDPOV	-.170169E-01	.388651	-.044 (.96508)	.00000	.00000
HIPOV	.132384	.357788	.370 (.71138)	.00000	.00000
SUBCORE	.680380	.442844	1.536 (.12444)	.00000	.00000
NMCORE	.361832	.444169	.815 (.41529)	.00000	.00000
SUBLOW	-.372071	.254880	-1.460 (.14435)	.00000	.00000
NMLOW	-.339277	.264488	-1.283 (.19957)	.00000	.00000
NEAST	-.598842	.303526	-1.973 (.04850)	.00000	.00000
SOUTH	-.750901	.275467	-2.726 (.00641)	.00000	.00000
WEST	-.375827	.330601	-1.137 (.25562)	.00000	.00000
ONE	-3.39708	1.50607	-2.256 (.02410)	.00000	.00000
RESFHEAD	-1.53247	.539648	-2.840 (.00451)	.00000	.00000
SRESAGE	.327527	.143733	2.279 (.02268)	.00000	.00000
RESHISP	.427477E-01	.236483	.181 (.85655)	.00000	.00000
RESNONWH	.144138	.189153	.762 (.44605)	.00000	.00000
SRESEDUC	.414858	.386106	1.074 (.28261)	.00000	.00000
RESEMP	.404806	.202060	2.003 (.04513)	.00000	.00000
RESGHLTH	-.493375	.211504	-2.333 (.01966)	.00000	.00000
MALEHEAD	.562041	.238945	2.352 (.01866)	.00000	.00000
MALEEMP	-.664021	.242798	-2.735 (.00624)	.00000	.00000
TOTSIZE	.166467	.702675E-01	2.369 (.01783)	.00000	.00000
WICPOTPC	.961403E-01	.128149E-01	7.502 (.00000)	.00000	.00000
SPCINC	-.225300	.491829	-.458 (.64689)	.00000	.00000
SPCINCSQ	.388344E-01	.140429	.277 (.78213)	.00000	.00000
OWNHOME	1.23826	1.13796	1.088 (.27653)	.00000	.00000
RENTHOME	1.83133	1.13020	1.620 (.10516)	.00000	.00000

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LOPOV	-1.21856	.852934	-1.429 (.15310)	.00000	.00000
MIDPOV	-.376314	.286895	-1.312 (.18963)	.00000	.00000
HIPOV	-.716852E-01	.234531	-.306 (.75987)	.00000	.00000
SUBCORE	.291117	.385420	.755 (.45005)	.00000	.00000
NMCORE	.214126	.355322	.603 (.54676)	.00000	.00000
SUBLOW	.375921	.231678	1.623 (.10467)	.00000	.00000
NMLOW	.246915	.234194	1.054 (.29174)	.00000	.00000
NEAST	.266229	.221986	1.199 (.23041)	.00000	.00000
SOUTH	-.170160	.226575	-.751 (.45265)	.00000	.00000
WEST	-.739036	.245397	-3.012 (.00260)	.00000	.00000
RHO(1,2)	.550807	.940864E-01	5.854 (.00000)		

Joint Frequency Table: Columns=HHWIC1
Rows=FSPART1
(N) = Count of Fitted Values

	0	1	TOTAL
0	152	42	194
	(132)	(48)	(180)
1	127	123	250
	(167)	(97)	(264)
TOTAL	279	165	444
	(299)	(145)	(444)

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Bivariate Probit Sample Selection Model

Selection Criterion A: FSPART1  = *
Selection Criterion B: HHWIC1   = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 HHFSELG  = 0          HHWICELG = 0
FSPART1  miscoded =      0        HHWIC1   miscoded =       0
 HHFSELG  = 0          HHWICELG = 1
FSPART1  miscoded =      0        HHWIC1   miscoded =       0
 HHFSELG  = 1          HHWICELG = 0
FSPART1  miscoded =      0        HHWIC1   miscoded =       0
 HHFSELG  = 1          HHWICELG = 1
FSPART1  miscoded =      0        HHWIC1   miscoded =       0

                  FSPART1  = 0     FSPART1  = 1
HHWIC1   = 0             0                8


HHWIC1   = 0             0                0


Number of incorrectly coded eligibilities:
HHFSELG =    0     HHWICELG=    0

Full sample contains       515.0 observations.
Selected sample contains   515.0 observations.


    Ordinary    Least Squares Estimates

    Dependent Variable..........     FDINAME
    Number of Observations......          515.
    Mean of Dependent Variable..      73.45561
    Std. Dev. of Dep. Variable..      35.76293
    Std. Error of Regression....      29.50447
    Sum of Squared Residuals....     .42046E+06
    R - Squared.................        .31805
    Adjusted R - Squared........        .27428
    F-Statistic ( 31,  483).....       7.26649
    Significance of F-Test......        .00000
    Log-Likelihood.............    -2457.3
    Restricted (Slopes=0) Log-L.    -2572.3
    Chi-Squared (31)............     230.13
    Significance Level..........     .32173E-13

Estimated disturbance standard deviation =  30.2870
Estimated correlation with selection equation A = -.261118
Estimated correlation with selection equation B = -.809138E-01
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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	23.6993	21.6532	1.094 (.27374)	1.0000	18.860
RESFHEAD	-6.60688	11.7356	-.563 (.57345)	.97150	10.728
RESMLPLN	18.9785	9.68582	1.959 (.05006)	.96658	9.2049
SRESAGE	6.36319	3.01832	2.108 (.03501)	2.8531	2.7947
RESHISP	3.08129	4.61093	.668 (.50397)	.15775	4.0687
RESNONWH	-9.02160	4.30156	-2.097 (.03597)	.34899	3.7832
SRESEDUC	-1.55618	8.44985	-.184 (.85388)	1.1686	7.5273
RESFTEMP	1.72068	5.00070	.344 (.73078)	.11738	4.9533
RESPTEMP	-6.27033	3.93660	-1.593 (.11120)	.19262	3.8155
MALEHEAD	.709730	5.04937	.141 (.88822)	.69823	4.3676
HHSIZMCP	-5.61466	2.17620	-2.580 (.00988)	3.2271	1.8135
PREG	6.98452	5.78368	1.208 (.22719)	.87101E-01	5.7657
LACT	-14.6611	6.16681	-2.377 (.01743)	.68450E-01	6.1514
AMEINC	.880995E-01	.188793E-01	4.666 (.00000)	302.43	.17332E-01
AMEFSBEN	.291489	.114588	2.544 (.01097)	21.787	.10172
AWICPRG	9.12771	13.2796	.687 (.49186)	.30727E-01	11.953
AWICMOM	37.1827	9.02103	4.122 (.00004)	.63569E-01	7.8977
AWICKID	8.16215	8.89671	.917 (.35891)	.16553	8.0362
AWICINF	30.1358	9.69481	3.108 (.00188)	.97548E-01	7.9016
MULTCAT	-36.8962	13.1585	-2.804 (.00505)	.59813E-01	11.910
LOPOV	-8.03950	9.93117	-.810 (.41822)	.39065E-01	8.6709
MIDPOV	-8.11013	6.17362	-1.314 (.18896)	.22373	5.4943
HIPOV	-2.42021	5.74144	-.422 (.67336)	.26786	5.2303
SUBCORE	-7.34170	5.61695	-1.307 (.19119)	.16790	5.2645
NMCORE	-10.9500	6.26827	-1.747 (.08066)	.12779	5.6321
SUBLOW	6.76953	5.58225	1.213 (.22525)	.16625	4.7656
NMLOW	-1.80751	5.79340	-.312 (.75504)	.13587	5.1195
NEAST	19.8638	5.01766	3.959 (.00008)	.19866	4.5023
SOUTH	15.6801	4.55007	3.446 (.00057)	.33727	4.0479
WEST	3.14106	4.94964	.635 (.52569)	.22197	4.5767
Lambda-F	-13.2905	5.12742	-2.592 (.00954)	-.25324E-01	3.7552
Lambda-W	-9.77116	6.31170	-1.548 (.12160)	.28754E-01	4.4831

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Bivariate Probit Sample Selection Model

Selection Criterion A: FSPART1   = *
Selection Criterion B: HHWIC1    = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 HHFSELG  = 0          HHWICELG = 0
FSPART1  miscoded =      0          HHWIC1   miscoded =       0
 HHFSELG  = 0          HHWICELG = 1
FSPART1  miscoded =      0          HHWIC1   miscoded =       0
 HHFSELG  = 1          HHWICELG = 0
FSPART1  miscoded =      0          HHWIC1   miscoded =       0
 HHFSELG  = 1          HHWICELG = 1
FSPART1  miscoded =      0          HHWIC1   miscoded =       0

                    FSPART1  = 0     FSPART1  = 1
 HHWIC1   = 0              0                8


 HHWIC1   = 0              0                0


 Number of incorrectly coded eligibilities:
 HHFSELG =    0     HHWICELG=    0

 Full sample contains        515.0 observations.
 Selected sample contains    515.0 observations.


     Ordinary    Least Squares Estimates

     Dependent Variable..........     FDTOTAME
     Number of Observations......         515.
     Mean of Dependent Variable..     90.92017
     Std. Dev. of Dep. Variable..     46.55075
     Std. Error of Regression....     36.89664
     Sum of Squared Residuals....    .65754E+06
     R - Squared.................       .37055
     Adjusted R - Squared........       .33015
     F-Statistic ( 31,  483).....      9.17197
     Significance of F-Test......       .00000
     Log-Likelihood.............   -2572.4
     Restricted (Slopes=0) Log-L.   -2708.1
     Chi-Squared (31)...........    271.39
     Significance Level.........    .32173E-13

 Estimated disturbance standard deviation =  37.6443
 Estimated correlation with selection equation A = -.149169
 Estimated correlation with selection equation B = -.203371
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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	56.3127	27.2421	2.067 (.03872)	1.0000	23.585
RESFHEAD	-16.3520	14.4181	-1.134 (.25674)	.97150	13.416
RESMLPLN	18.2836	12.0849	1.513 (.13030)	.96658	11.511
SRESAGE	4.82236	3.83649	1.257 (.20876)	2.8531	3.4949
RESHISP	4.47417	5.87075	.762 (.44599)	.15775	5.0880
RESNONWH	-9.01461	5.44345	-1.656 (.09771)	.34899	4.7311
SRESEDUC	12.3980	10.8541	1.142 (.25335)	1.1686	9.4132
RESFTEMP	15.6020	6.31585	2.470 (.01350)	.11738	6.1943
RESPTEMP	-5.26325	4.96008	-1.061 (.28863)	.19262	4.7715
MALEHEAD	-11.2859	6.42009	-1.758 (.07876)	.69823	5.4619
HHSIZMCP	-8.77608	2.82897	-3.102 (.00192)	3.2271	2.2678
PREG	2.52872	7.29840	.346 (.72898)	.87101E-01	7.2102
LACT	-22.1297	7.70840	-2.871 (.00409)	.68450E-01	7.6927
AMEINC	.105334	.239965E-01	4.390 (.00001)	302.43	.21675E-01
AMEFSBEN	.461552E-01	.142374	.324 (.74580)	21.787	.12721
AWICPRG	6.65584	16.8009	.396 (.69199)	.30727E-01	14.947
AWICMOM	44.4441	11.2566	3.948 (.00008)	.63569E-01	9.8764
AWICKID	17.7405	11.1921	1.585 (.11295)	.16553	10.050
AWICINF	34.0981	12.4169	2.746 (.00603)	.97548E-01	9.8813
MULTCAT	-50.5342	16.6460	-3.036 (.00240)	.59813E-01	14.894
LOPOV	-10.5585	12.6775	-.833 (.40493)	.39065E-01	10.843
MIDPOV	-14.1415	7.87278	-1.796 (.07246)	.22373	6.8709
HIPOV	-6.93758	7.36156	-.942 (.34598)	.26786	6.5407
SUBCORE	-10.7192	7.15716	-1.498 (.13421)	.16790	6.5835
NMCORE	-10.2709	8.06067	-1.274 (.20259)	.12779	7.0432
SUBLOW	7.53291	7.05699	1.067 (.28577)	.16625	5.9596
NMLOW	-1.36553	7.40452	-.184 (.85368)	.13587	6.4021
NEAST	22.5022	6.42758	3.501 (.00046)	.19866	5.6304
SOUTH	19.8218	5.80997	3.412 (.00065)	.33727	5.0620
WEST	4.37405	6.30237	.694 (.48766)	.22197	5.7233
Lambda-F	-14.1144	6.35217	-2.222 (.02628)	-.25324E-01	4.6961
Lambda-W	-15.4301	8.12691	-1.899 (.05761)	.28754E-01	5.6063

Ordinary Least Squares Estimates

Dependent Variable..........	FDINAME
Number of Observations......	515.
Mean of Dependent Variable..	73.45430
Std. Dev. of Dep. Variable..	35.76396
Std. Error of Regression....	30.82946
Sum of Squared Residuals....	.46097E+06
R - Squared.................	.29884
Adjusted R - Squared........	.25691
F-Statistic (29, 485).....	7.12784
Significance of F-Test......	.00000
Log-Likelihood..............	-2481.0
Restricted (Slopes=0) Log-L.	-2572.4
Chi-Squared (29)............	182.79
Significance Level..........	.32173E-13
Durbin - Watson Statistic...........	2.0069
Estimated Autocorrelation (Rho).....	-.34428E-02

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	46.1078	17.9897	2.563 (.01037)	1.0000	.00000
RESFHEAD	-5.02653	10.4396	-.481 (.63579)	.97149	.16660
RESMLPLN	23.0753	9.16701	2.517 (.01173)	.96657	.17994
SRESAGE	6.62752	2.80989	2.359 (.01785)	2.8530	.63791
RESHISP	2.61891	4.10278	.638 (.53106)	.15775	.36486
RESNONWH	-6.89820	3.76596	-1.832 (.06415)	.34899	.47711
SRESEDUC	-3.78711	7.59212	-.499 (.62406)	1.1685	.21812
RESFTEMP	2.32873	5.00111	.466 (.64652)	.11738	.32218
RESPTEMP	-5.72081	3.85229	-1.485 (.13391)	.19261	.39474
MALEHEAD	-5.31881	4.02895	-1.320 (.18395)	.69822	.45948
HHSIZMCP	-7.04516	1.78762	-3.941 (.00015)	3.2270	1.1749
PREG	9.80877	5.73503	1.710 (.08385)	.87100E-01	.28225
LACT	-13.7463	6.20193	-2.216 (.02566)	.68449E-01	.25276
AMEINC	.576105E-01	.152152E-01	3.786 (.00025)	302.42	144.87
AMEFSBEN	.660337E-01	.684568E-01	.965 (.33736)	21.786	30.467
AWICPRG	-6.36217	9.66238	-.658 (.51798)	.30726E-01	.17274
AWICMOM	30.2299	7.36618	4.104 (.00009)	.63568E-01	.24422
AWICKID	-3.00380	4.50807	-.666 (.51290)	.16552	.37201
AWICINF	21.6634	5.94875	3.642 (.00040)	.97546E-01	.29699
MULTCAT	-25.8688	9.20034	-2.812 (.00518)	.59812E-01	.23737
LOPOV	-12.3880	8.65162	-1.432 (.14870)	.39064E-01	.19394
MIDPOV	-8.46557	5.54733	-1.526 (.12333)	.22373	.41715
HIPOV	-1.55436	5.27773	-.295 (.76151)	.26785	.44327
SUBCORE	-5.25233	5.27266	-.996 (.32114)	.16789	.37414
NMCORE	-11.0941	5.68616	-1.951 (.04880)	.12779	.33418
SUBLOW	6.51439	4.78215	1.362 (.16999)	.16625	.37266
NMLOW	-2.45023	5.15961	-.475 (.64026)	.13586	.34298
NEAST	18.9430	4.52213	4.189 (.00006)	.19866	.39938
SOUTH	13.8198	4.06040	3.404 (.00087)	.33727	.47324
WEST	.288866	4.53927	.064 (.90522)	.22197	.41597
Sigma	30.8295	.960610	32.094 (.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	FDTOTAME
Number of Observations......	515.
Mean of Dependent Variable..	90.91855
Std. Dev. of Dep. Variable..	46.55192
Std. Error of Regression....	38.50808
Sum of Squared Residuals....	.71919E+06
R - Squared.................	.35434
Adjusted R - Squared........	.31573
F-Statistic (29, 485).....	9.17806
Significance of F-Test......	.00000
Log-Likelihood..............	-2595.5
Restricted (Slopes=0) Log-L.	-2708.1
Chi-Squared (29)............	225.25
Significance Level..........	.32173E-13
Durbin - Watson Statistic..........	2.0129
Estimated Autocorrelation (Rho).....	-.64338E-02

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	84.1249	22.4704	3.744 (.00029)	1.0000	.00000
RESFHEAD	-17.8652	13.0397	-1.370 (.16749)	.97149	.16660
RESMLPLN	21.6406	11.4502	1.890 (.05620)	.96657	.17994
SRESAGE	5.48032	3.50975	1.561 (.11475)	2.8530	.63791
RESHISP	3.57760	5.12465	.698 (.49254)	.15775	.36486
RESNONWH	-6.14581	4.70394	-1.307 (.18866)	.34899	.47711
SRESEDUC	9.91257	9.48307	1.045 (.29688)	1.1685	.21812
RESFTEMP	15.9739	6.24672	2.557 (.01053)	.11738	.32218
RESPTEMP	-4.86877	4.81177	-1.012 (.31326)	.19261	.39474
MALEHEAD	-17.3893	5.03243	-3.455 (.00074)	.69822	.45948
HHSIZMCP	-10.2738	2.23285	-4.601 (.00001)	3.2270	1.1749
PREG	6.63090	7.16344	.926 (.35806)	.87100E-01	.28225
LACT	-20.5397	7.74662	-2.651 (.00813)	.68449E-01	.25276
AMEINC	.729840E-01	.190048E-01	3.840 (.00021)	302.42	144.87
AMEFSBEN	-.162344	.855072E-01	-1.899 (.05510)	21.786	30.467
AWICPRG	-17.9222	12.0690	-1.485 (.13393)	.30726E-01	.17274
AWICMOM	33.6462	9.20085	3.657 (.00038)	.63568E-01	.24422
AWICKID	-1.98929	5.63088	-.353 (.72245)	.16552	.37201
AWICINF	18.8657	7.43039	2.539 (.01106)	.97546E-01	.29699
MULTCAT	-29.6758	11.4918	-2.582 (.00983)	.59812E-01	.23737
LOPOV	-16.5400	10.8065	-1.531 (.12221)	.39064E-01	.19394
MIDPOV	-14.9598	6.92899	-2.159 (.02960)	.22373	.41715
HIPOV	-6.29950	6.59224	-.956 (.34208)	.26785	.44327
SUBCORE	-8.87453	6.58591	-1.348 (.17478)	.16789	.37414
NMCORE	-10.8737	7.10240	-1.531 (.12210)	.12779	.33418
SUBLOW	7.93833	5.97323	1.329 (.18095)	.16625	.37266
NMLOW	-1.61977	6.44470	-.251 (.78969)	.13586	.34298
NEAST	21.9986	5.64845	3.895 (.00017)	.19866	.39938
SOUTH	17.4711	5.07171	3.445 (.00076)	.33727	.47324
WEST	.533862	5.66986	.094 (.88706)	.22197	.41597
Sigma	38.5081	1.19987	32.094 (.00000)		

APPENDIX L

SUPPLEMENTAL TABLES FOR CHAPTER II

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TABLE L.1

RDA AND STATISTICS OF THE ALTERNATIVE INTAKE DISTRIBUTIONS
FOR EACH NUTRIENT: LOW-INCOME CHILDREN
(weighted data, N=638)

Nutrient	RDA	Intake Distribution: One-day Mean	One-day Median	One-day Minimum	One-day Maximum	Four-day Mean	Four-day Median	Four-day Minimum	Four-day Maximum	Adjusted Four-day Mean	Adjusted Four-day Median	Adjusted Four-day Minimum	Adjusted Four-day Maximum
Vitamin A (ug RE)													
Ages 1-3	400	754	566	2.5	13,532	754	604	83.7	5,580	N/A	N/A	N/A	N/A
Ages 4-5	500	780	596	47.7	6,384	849	685	147.4	8,868	N/A	N/A	N/A	N/A
Vitamin C (mg)	45	77.9	58.7	1.2	595.8	78.1	72.3	7.4	367.8	N/A	N/A	N/A	N/A
Calcium (mg)	800	808	715	8	2,319	766	721	137	1,969	766	729	248	1,761
Vitamin E (mg alpha-TE)													
Ages 1-3	5	7.1	4.0	0.1	213.9	8.2	4.3	0.9	83.3	N/A	N/A	N/A	N/A
Ages 4-5	6	5.9	4.7	0.8	90.0	5.8	5.0	1.6	52.6	N/A	N/A	N/A	N/A
Iron (mg)													
Ages 1-3	15	9.9	8.2	0.6	91.5	9.5	8.6	3.0	41.7	9.5	8.9	4.9	32.7
Ages 4-5	10	10.8	9.0	2.1	39.7	9.9	9.4	3.2	24.9	9.8	9.5	5.1	20.6
Food Energy (kcal)													
Ages 1-3	1,300	1,321	1,210	101	2,727	1,303	1,279	478	2,497	1,319	1,299	660	2,271
Ages 4-5	1,700	1,534	1,435	353	4,298	1,463	1,442	631	3,310	1,447	1,429	782	2,920
Protein (g)													
Ages 1-3	23	53.0	49.4	2.0	117.3	51.2	49.5	17.8	109.4	51.6	50.3	25.9	98.4
Ages 4-5	30	58.5	53.4	8.4	198.0	54.7	53.8	24.6	126.7	54.3	53.6	31.1	109.8
Zinc (mg)	10	7.8	6.8	0.3	28.4	7.4	7.0	2.6	17.2	7.4	7.1	4.0	14.3

TABLE L.2

THE PERCENT OF LOW-INCOME CHILDREN FAILING TO ACHIEVE THE RDA FOR SELECTED NUTRIENTS: ALTERNATIVE ESTIMATES BASED ON THREE DIFFERENT NUTRIENT INTAKE DISTRIBUTIONS

(weighted data, N=638)

Nutrient	Estimated Percent with Usual Intake Less than RDA		
	One-day Distribution	Four-day Average Distribution	Adjusted Four-day Average Distribution
Vitamin A			
Ages 1-3	31.4	16.6	N/A
Ages 4-5	28.7	27.9	N/A
Vitamin C	39.5	23.1	N/A
Calcium	52.5	63.5	63.8
Vitamin E			
Ages 1-3	62.1	67.7	N/A
Ages 4-5	50.8	66.0	N/A
Iron			
Ages 1-3	88.1	88.4	92.7
Ages 4-5	56.1	61.2	61.8
Food Energy			
Ages 1-3	56.0	49.5	48.4
Ages 4-5	60.0	74.9	84.0
Protein			
Ages 1-3	5.9	3.5	0.0
Ages 4-5	6.6	2.5	0.0
Zinc	77.2	88.6	94.1

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FIGURE L.1

VITAMIN A

Intake vs. RDA
CHILDREN 1-3

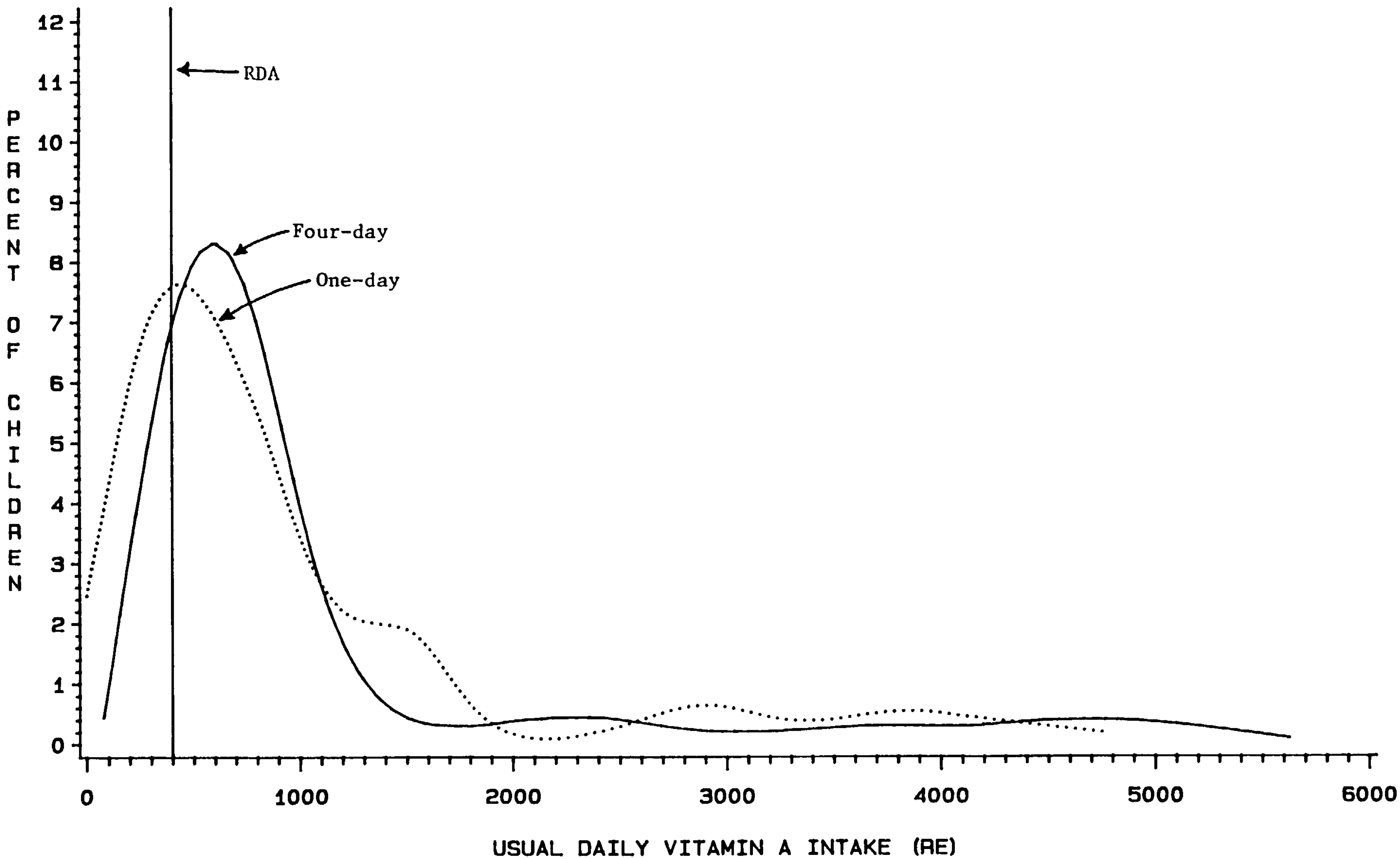

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FIGURE L.2

VITAMIN A

Intake vs. RDA
CHILDREN 4-5

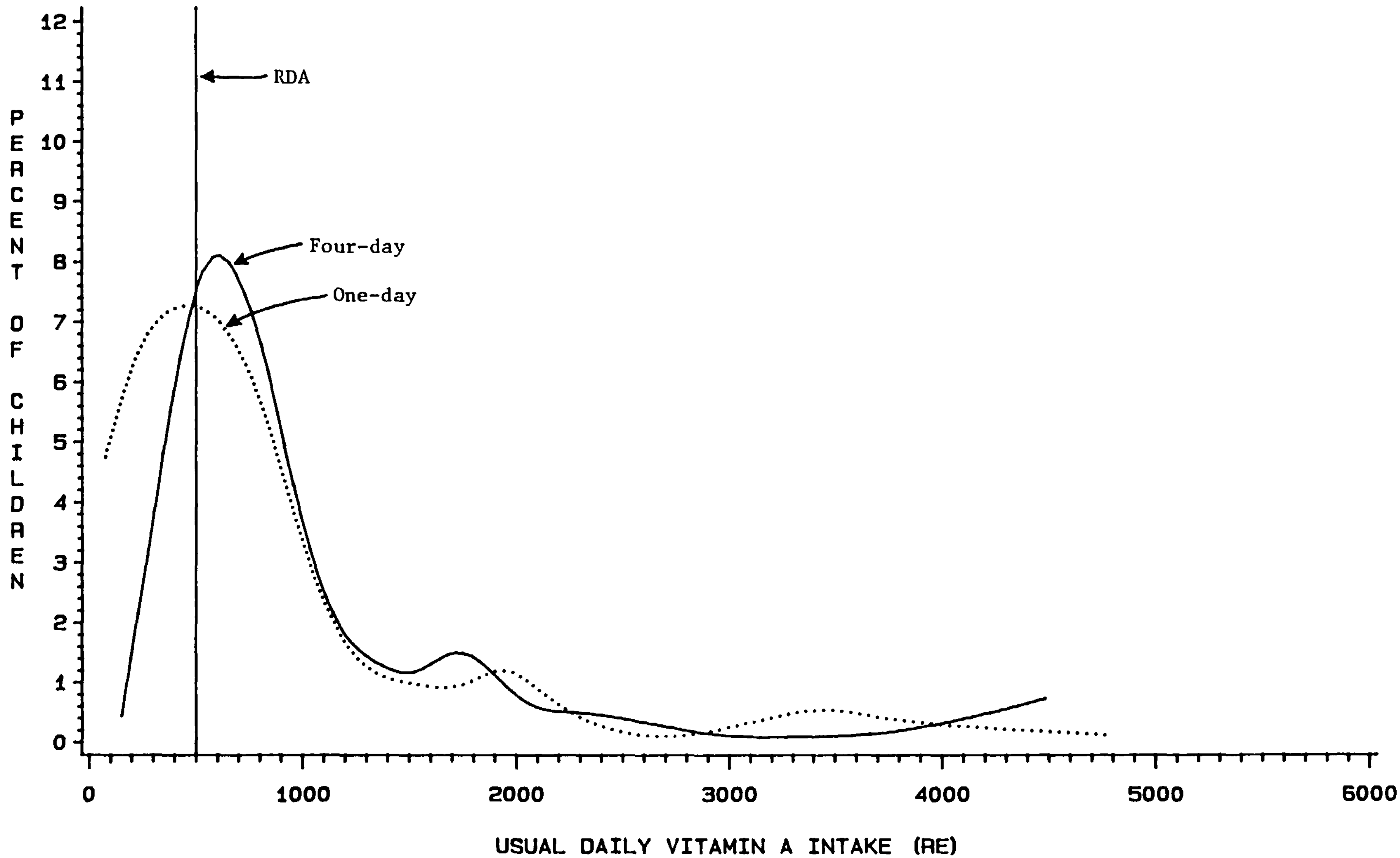

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FIGURE L.3

VITAMIN C

Intake vs. RDA & Need

CHILDREN 1-5

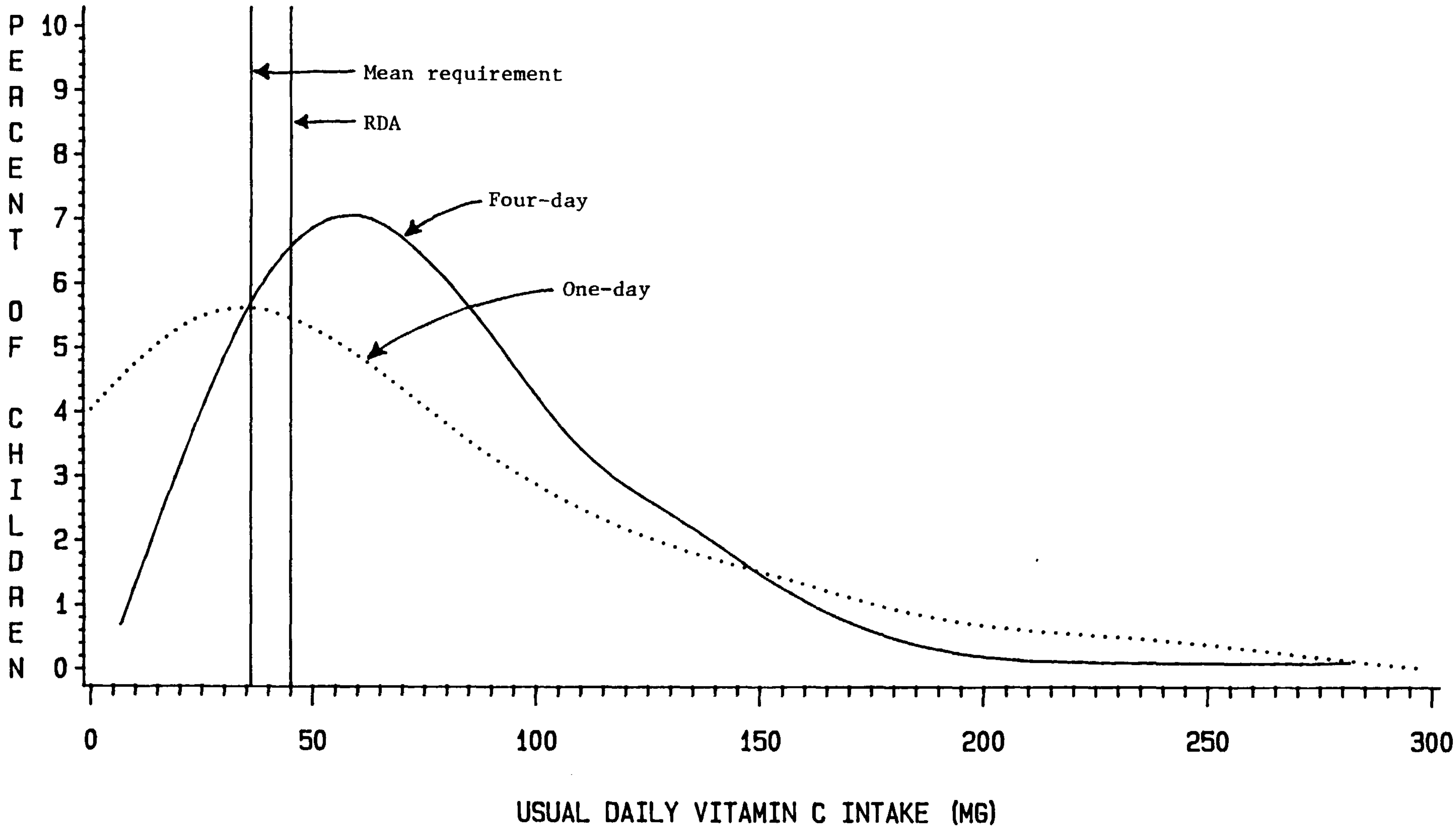

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FIGURE L.4

CALCIUM

Intake vs. RDA
CHILDREN 1-5

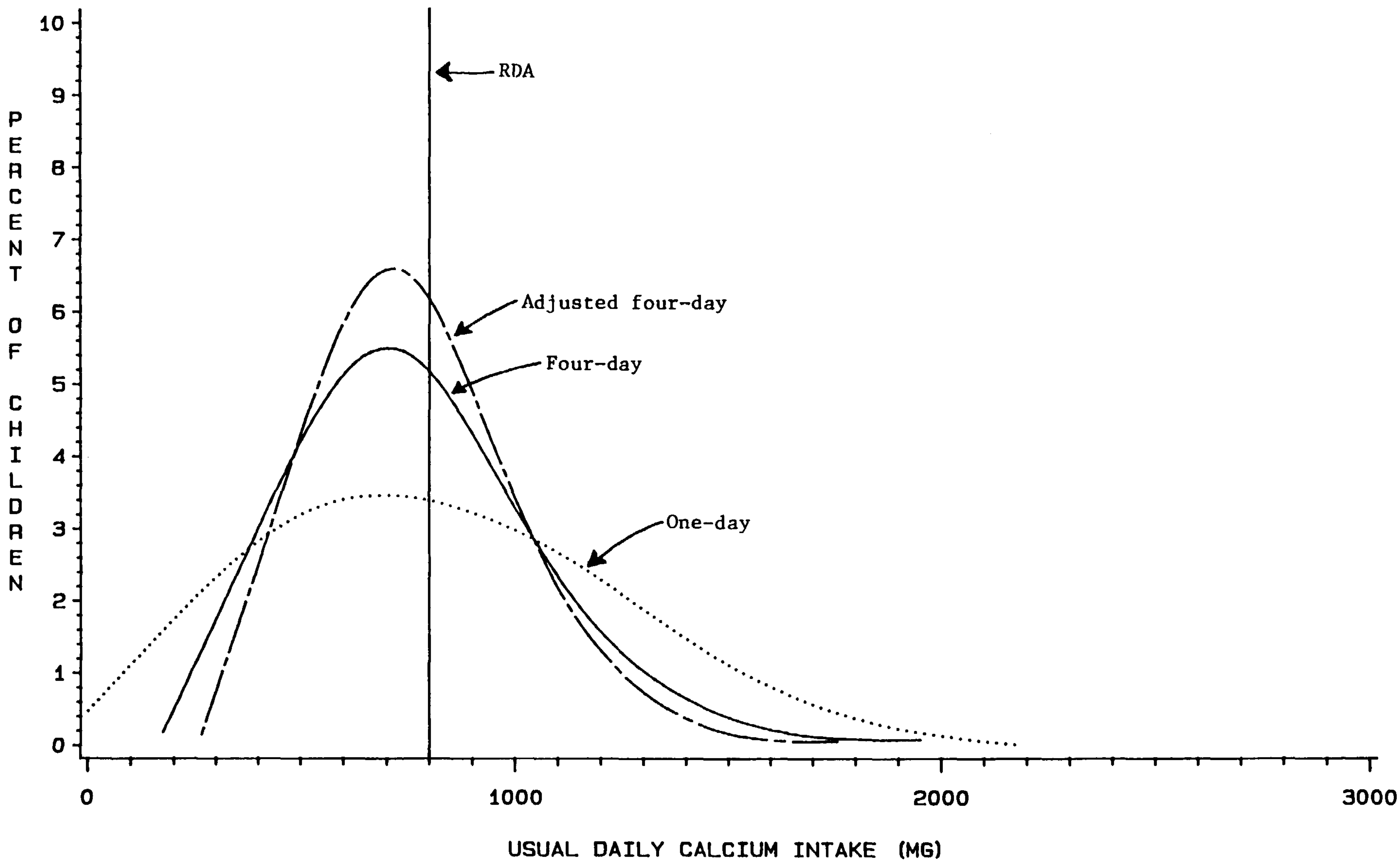

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FIGURE L.5

VITAMIN E

Intake vs. RDA
CHILDREN 1-3

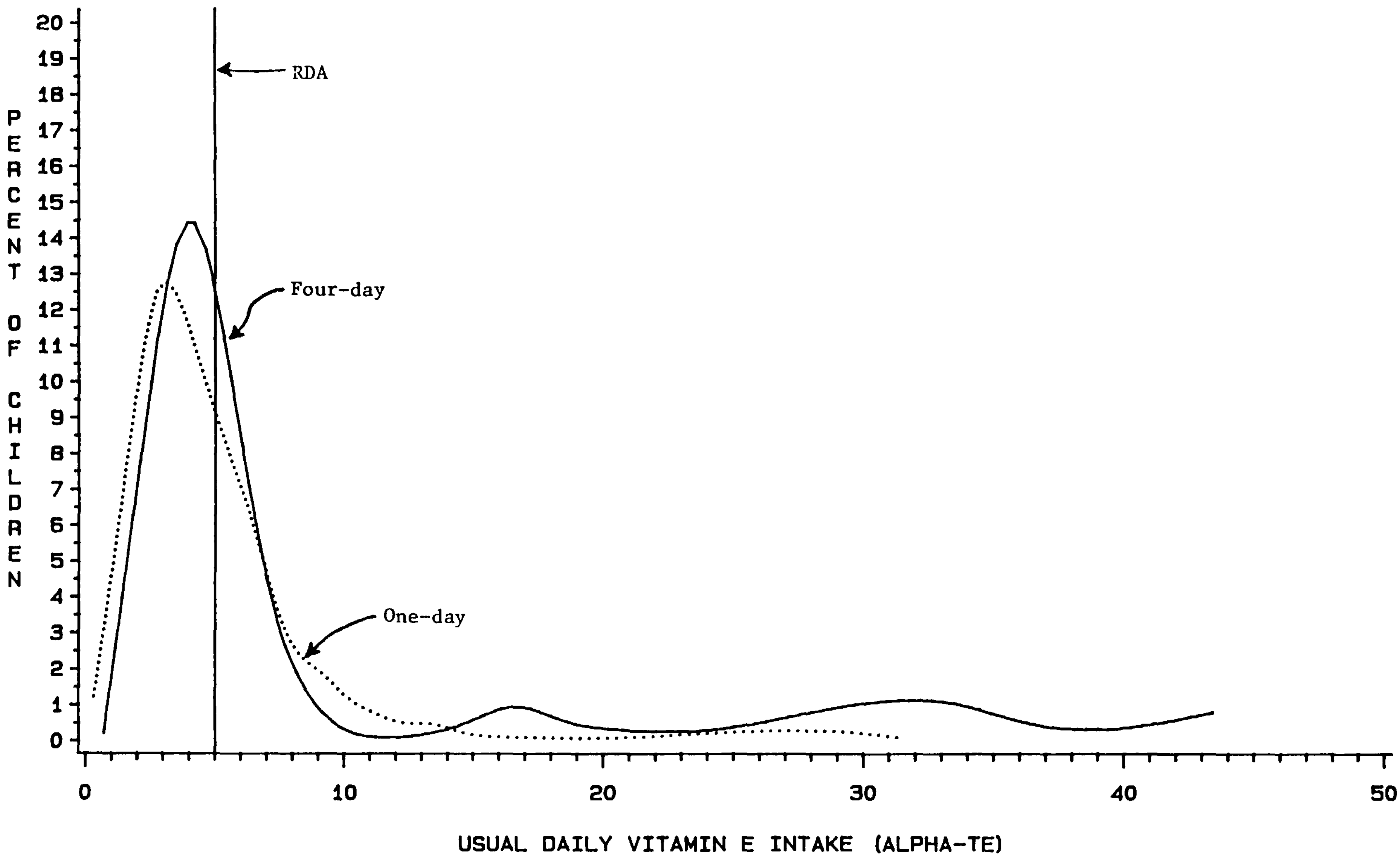

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FIGURE L.6

VITAMIN E

Intake vs. RDA
CHILDREN 4-5

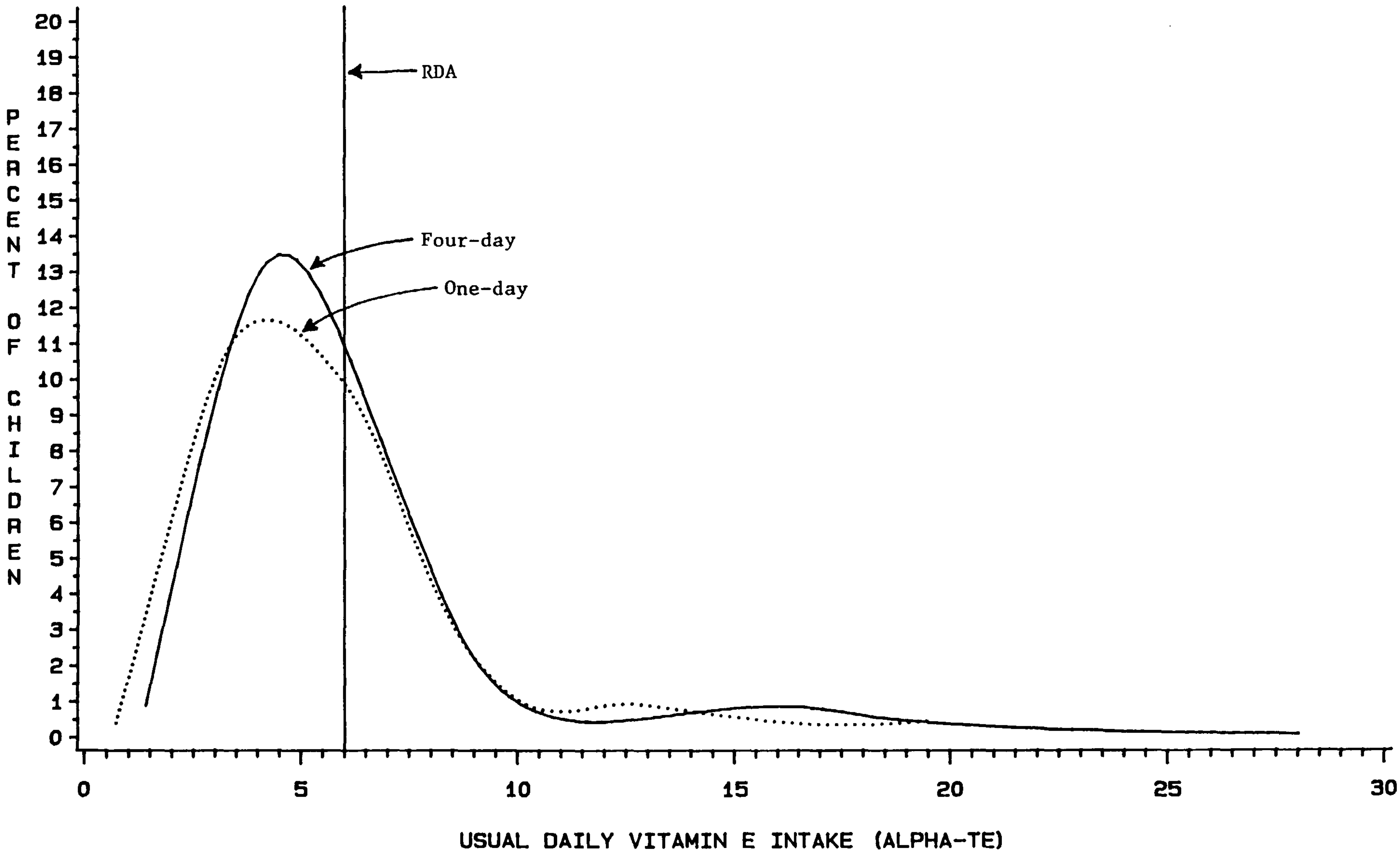

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FIGURE L.7

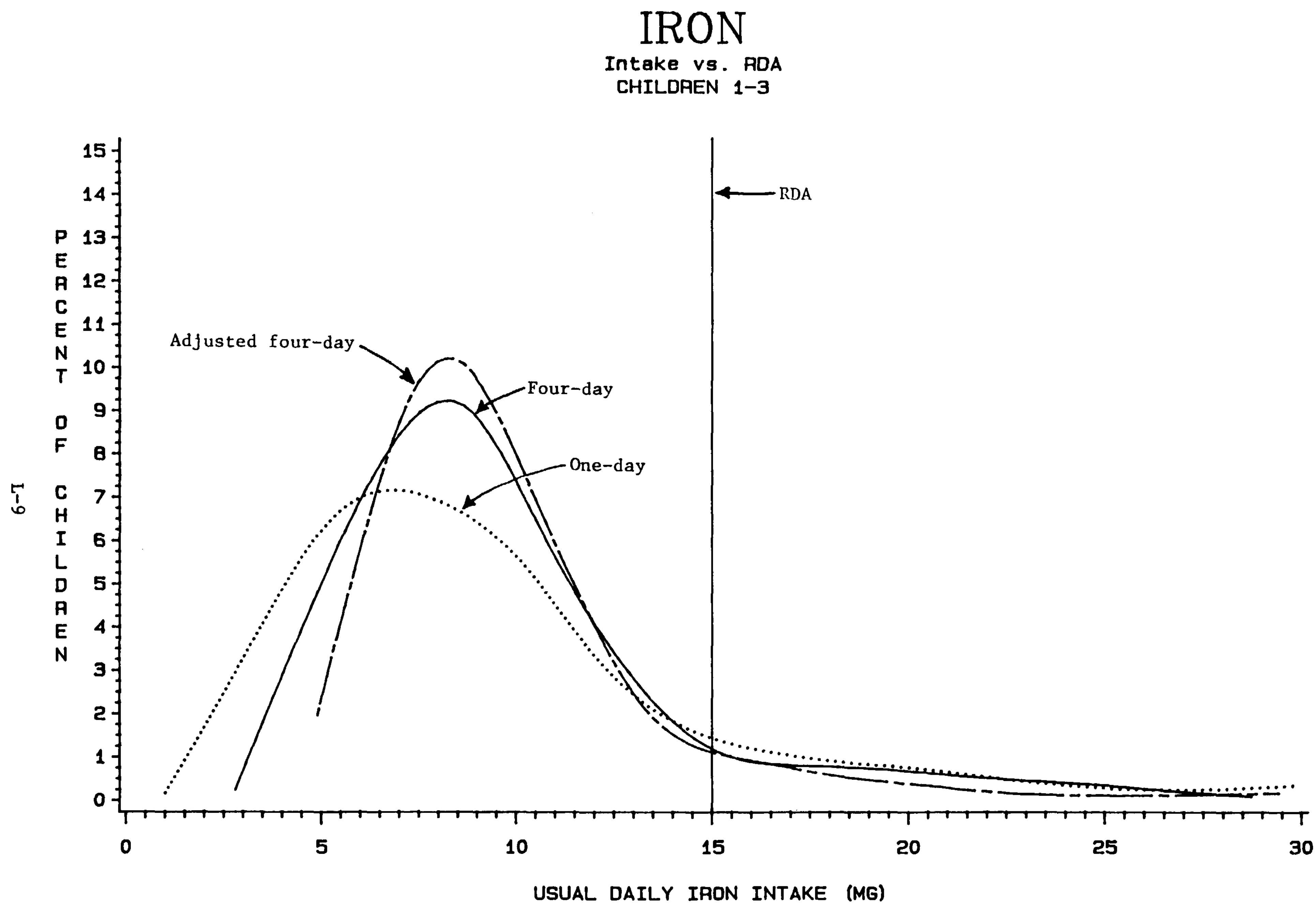

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FIGURE L.8

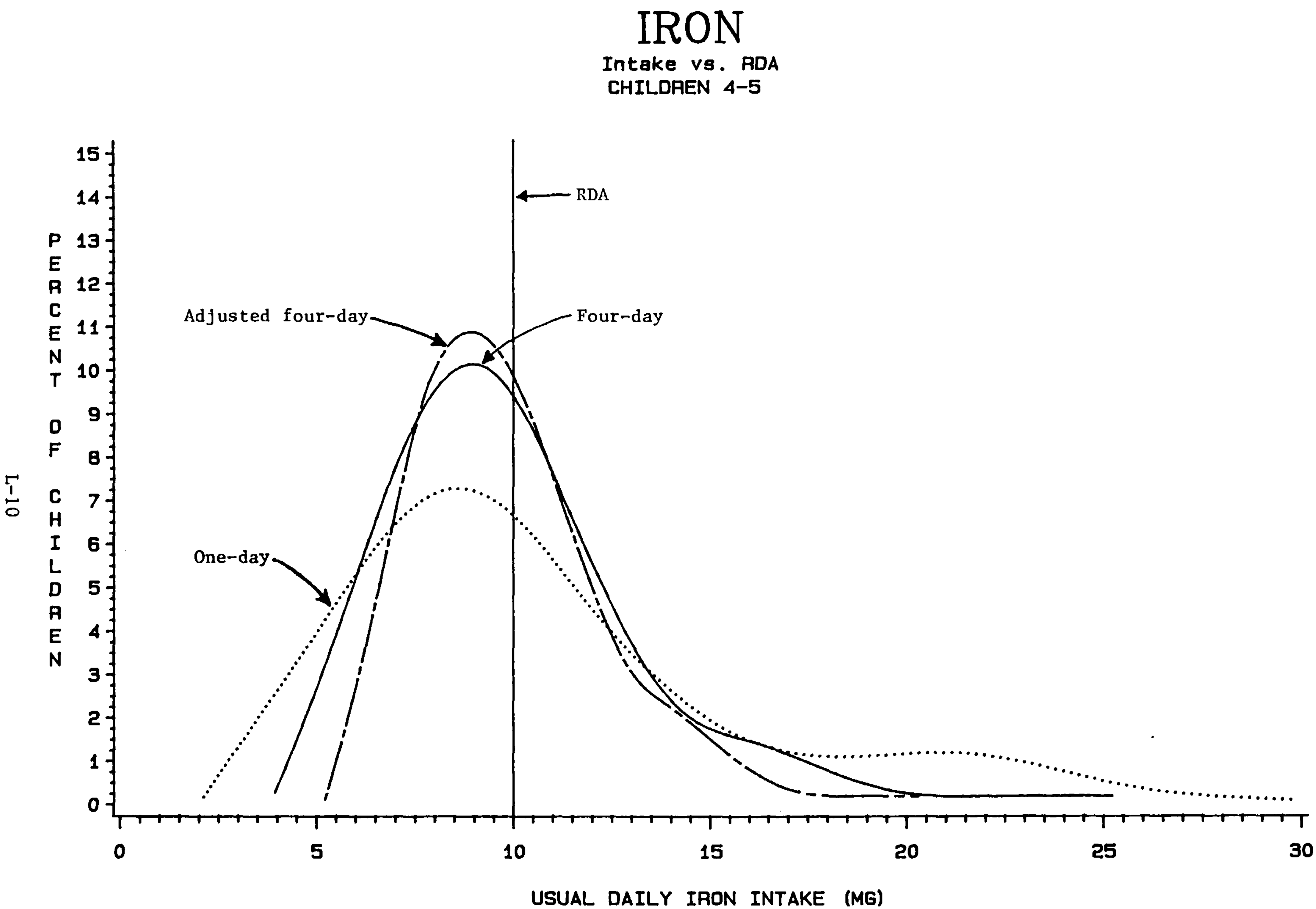

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FIGURE L.9

FOOD ENERGY

Intake vs. RDA
CHILDREN 1-3

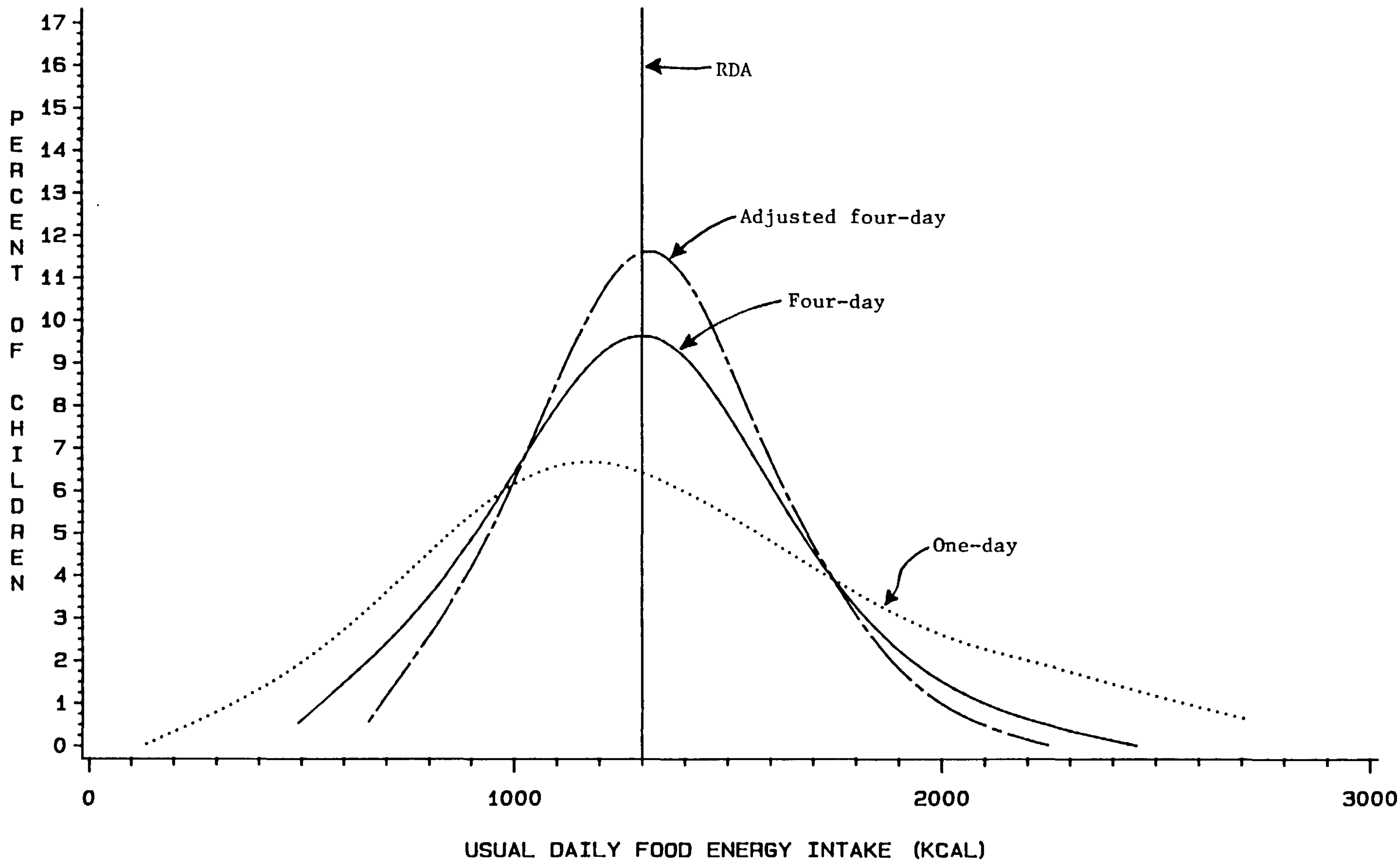

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FIGURE L.10

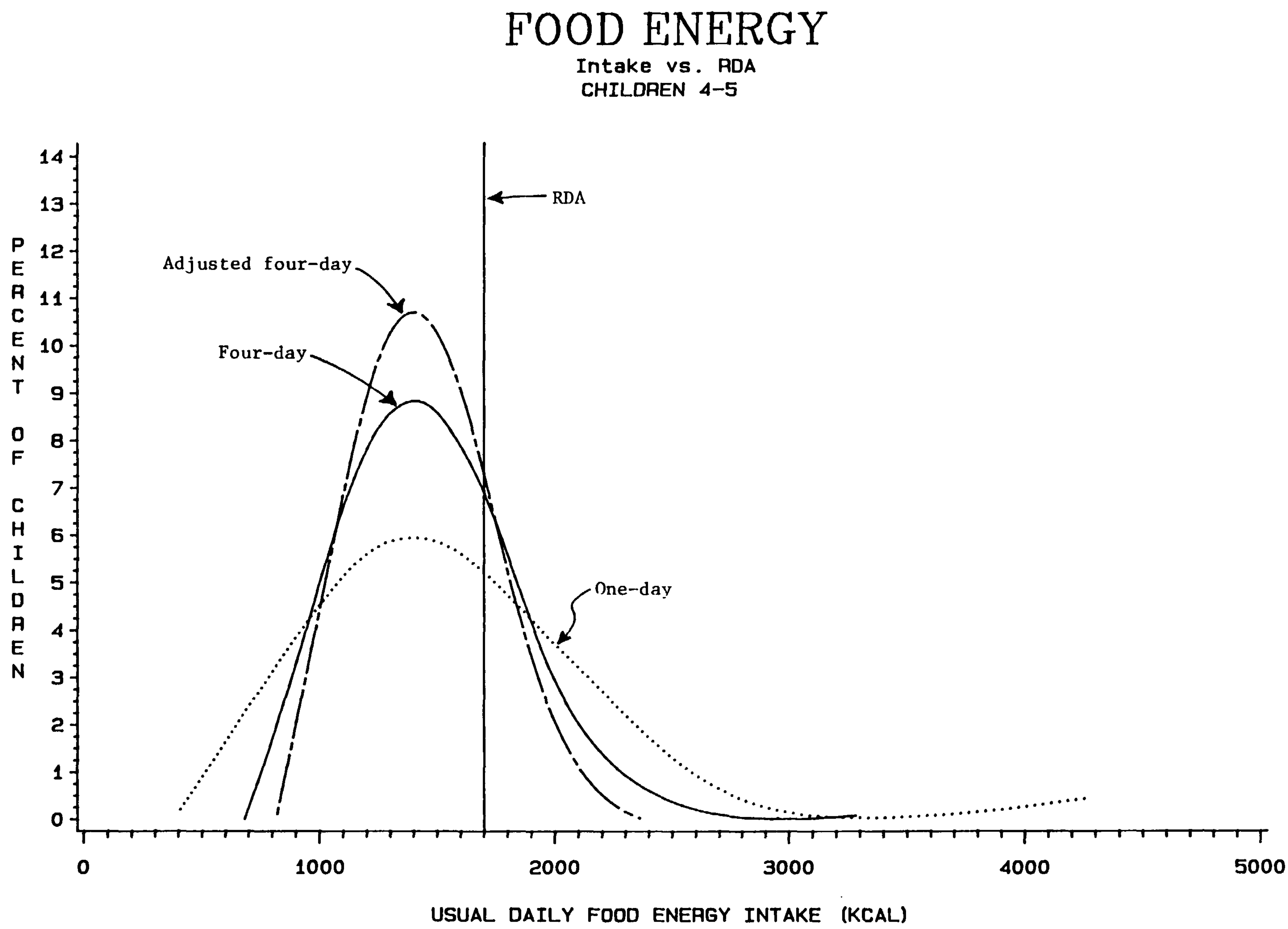

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FIGURE L.11

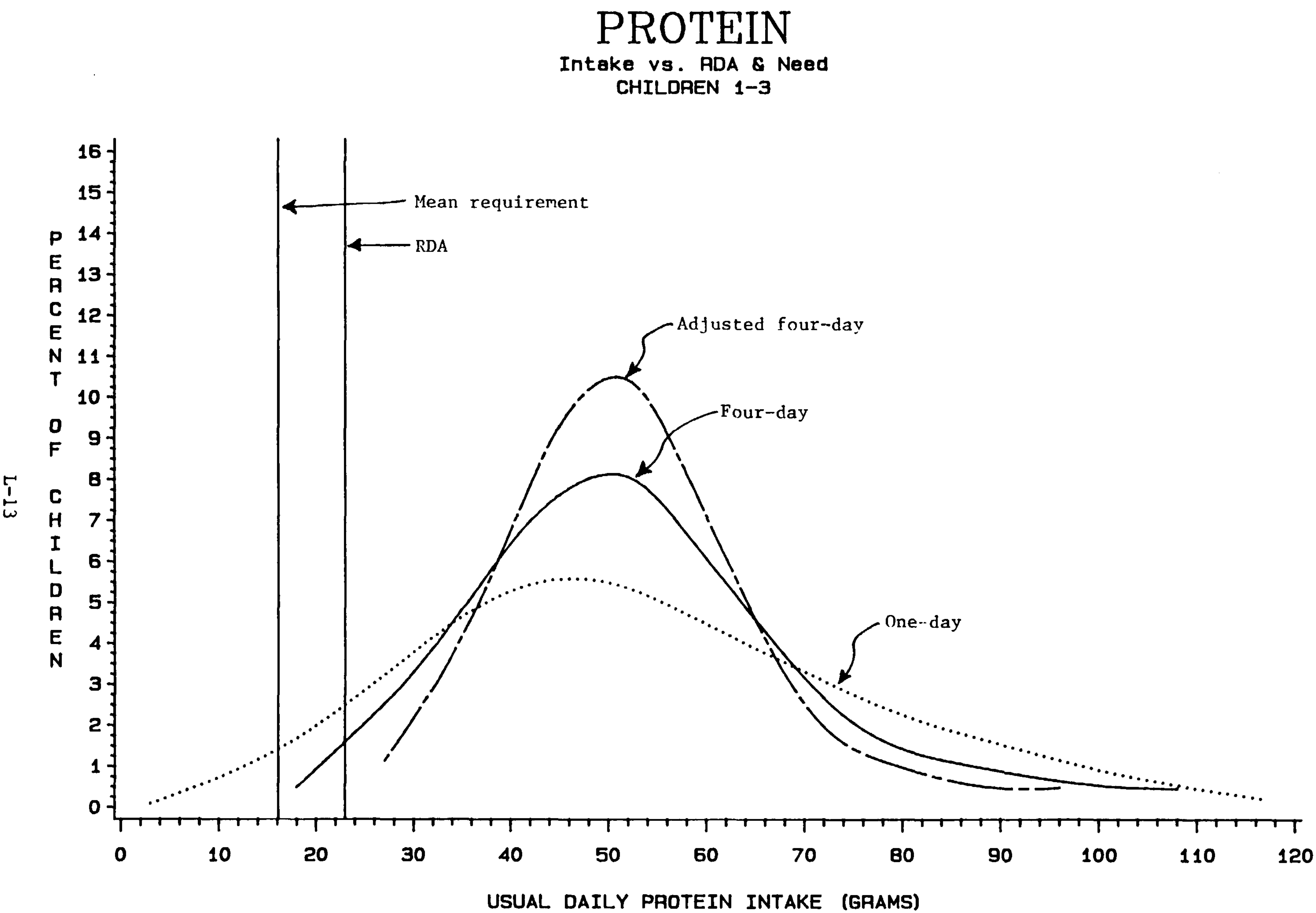

FIGURE L.12

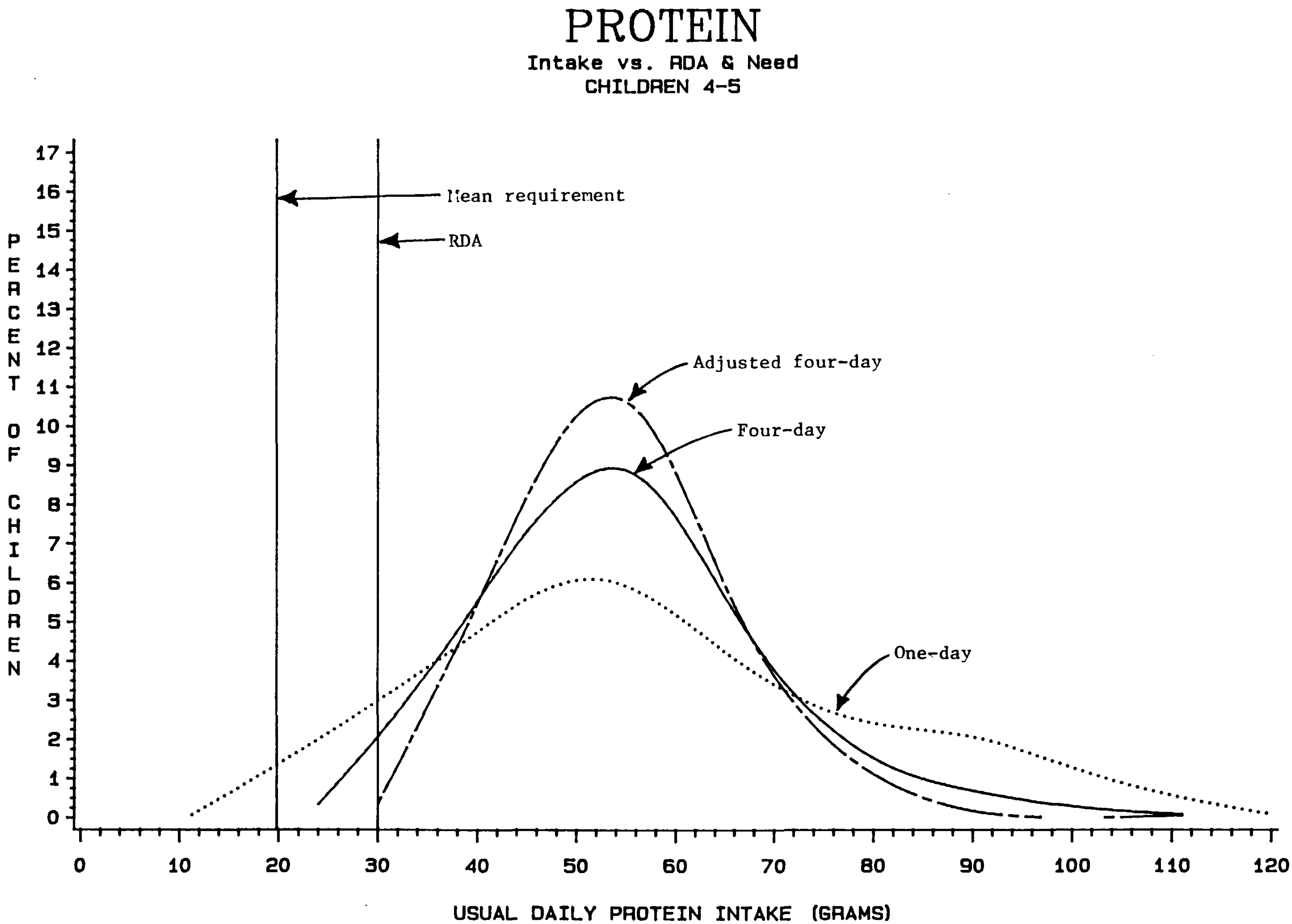
PROTEIN
Intake vs. RDA & Need
CHILDREN 4-5
Mean requirement
RDA
Adjusted four-day
Four-day
One-day
PERCENT OF CHILDREN
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
0
10
20
30
40
50
60
70
80
90
100
110
120
USUAL DAILY PROTEIN INTAKE (GRAMS)

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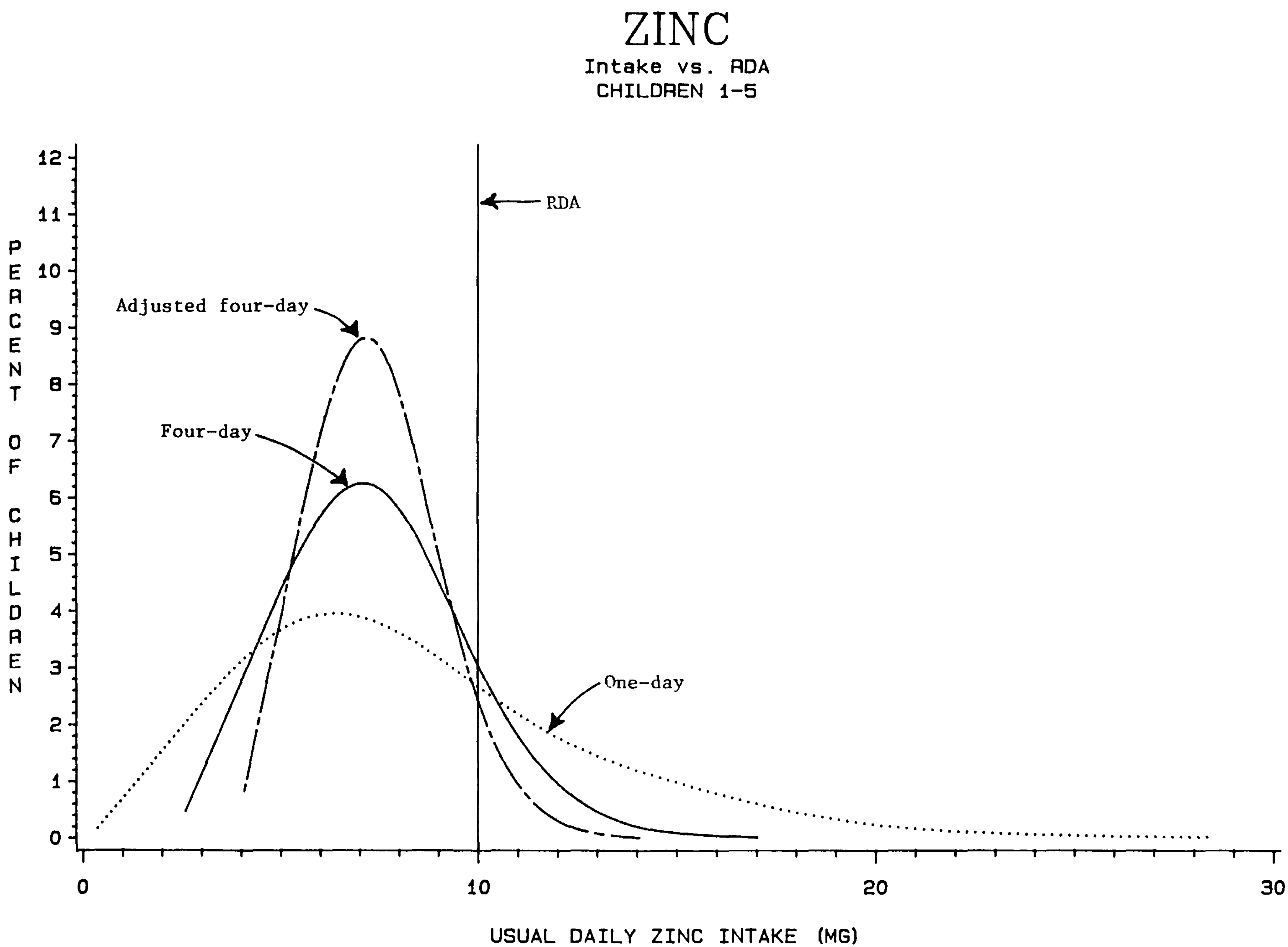
FIGURE L.13



APPENDIX M

OLS AND BIVARIATE SELECTION MODEL ESTIMATES OF THE NUTRIENT INTAKE EQUATIONS FOR CHILDREN, WITH "WEIGHT RELATIVE TO HEIGHT" INCLUDED AS AN EXPLANATORY VARIABLE

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TABLE M.1

ALTERNATIVE QUALITATIVE ESTIMATES OF PROGRAM EFFECTS ON DIETARY INTAKE:
WIC-ELIGIBLE CHILDREN
(weighted data, N=445)

	Bivariate Selection Model				Ordinary Least Squares Regression			
	WIC	Food Stamps	WIC and Food Stamp Interaction	Participation in WIC by Other Family Members	WIC	Food Stamps	WIC and Food Stamp Interaction	Participation in WIC by Other Family Members
Food Energy	+	+**	-*	+	+	+*	-**	+
Protein	+	+**	-**	-	+*	+**	-**	-
Vitamin A	+	-	+	+*	-	-	+	+*
Vitamin C	+	+	-	+	+*	+	-	+
Vitamin E	+	-*	+	+**	+	-	+	+**
Calcium	+	+	-	-	+	+	-	-
Iron	+	+	+	+**	+	+	+	+**
Zinc	+	+**	-*	+	+	+*	-*	+

SOURCE: FNS's 4-day analysis file for the 1985 CSFII.

NOTE: Complete estimation results are provided in the remainder of Appendix M. These results were generated by a model in which "weight relative to height" is an explanatroy variable in the dietary intake equation. These results should be compared with those presented in Table IV.2.

* (**): Estimate of program effect is significant at the .05 (.01) level.

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Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART = *
Selection Criterion B: EOWNWIC = *

Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

```
 FSELIG    = 0          WICELIG   = 0
EFSPART  miscoded =       0          EOWNWIC  miscoded =        0
 FSELIG    = 0          WICELIG   = 1
EFSPART  miscoded =       0          EOWNWIC  miscoded =        0
 FSELIG    = 1          WICELIG   = 0
EFSPART  miscoded =       0          EOWNWIC  miscoded =        0
 FSELIG    = 1          WICELIG   = 1
EFSPART  miscoded =       0          EOWNWIC  miscoded =        0
```

	EFSPART = 0	EFSPART = 1
EOWNWIC = 0	0	0
EOWNWIC = 0	0	0

Number of incorrectly coded eligibilities:
FSELIG = 0 WICELIG = 0

Full sample contains 445.0 observations.
Selected sample contains 445.0 observations.

Ordinary Least Squares Estimates

Dependent Variable..........	AVKCAL
Number of Observations......	445.
Mean of Dependent Variable..	.94625
Std. Dev. of Dep. Variable..	.24842
Std. Error of Regression....	.21794
Sum of Squared Residuals....	19.522
R - Squared.................	.22861
Adjusted R - Squared........	.16668
F-Statistic (33, 411).....	3.69109
Significance of F-Test......	.00000
Log-Likelihood..............	64.227
Restricted (Slopes=0) Log-L.	-11.190
Chi-Squared (33)............	150.84
Significance Level..........	.32173E-13

Estimated disturbance standard deviation = .220199
Estimated correlation with selection equation A = -.220600
Estimated correlation with selection equation B = .181968

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.377176	.161042	2.342 (.01918)	.99999	.16553
AVOWNWIC	.638781E-01	.839616E-01	.761 (.44678)	.17826	.88117E-01
AVFSPART	.141086	.506615E-01	2.785 (.00535)	.33115	.51393E-01
AVFSWIC	-.205607	.816462E-01	-2.518 (.01179)	.13025	.84972E-01
AVOTHWIC	.596584E-02	.472463E-01	.126 (.89952)	.14097	.49159E-01
AVCAGE2	.340498E-01	.597650E-01	.570 (.56886)	.22655	.61842E-01
AVCAGE3	.126959	.512396E-01	2.478 (.01322)	.27507	.52677E-01
AVCAGE4	-.190396	.594867E-01	-3.201 (.00137)	.25488	.61472E-01
AVCAGE5	-.993131E-01	.740997E-01	-1.340 (.18016)	.10862	.76385E-01
FEMALE	-.597724E-01	.224249E-01	-2.665 (.00769)	.51588	.23238E-01
AVHHSIZE	.733891E-02	.924780E-02	.794 (.42744)	4.6452	.93962E-02
SPCINC	.138851E-02	.438364E-01	.032 (.97473)	2.3374	.44707E-01
WTHT	.187097	.684908E-01	2.732 (.00630)	.92054	.70392E-01
SPCINCSQ	.374006E-01	.913503E-01	.409 (.68223)	.68488	.93352E-01
NONWHITE	-.677555E-01	.333668E-01	-2.031 (.04229)	.27168	.33929E-01
HISPANIC	-.521584E-01	.412856E-01	-1.263 (.20646)	.89414E-01	.41754E-01
MSOMEHS	.959047E-01	.599240E-01	1.600 (.10950)	.22557	.62293E-01
MHSGRAD	.737513E-01	.601227E-01	1.227 (.21994)	.41382	.62371E-01
MSOMECOL	.735585E-01	.630329E-01	1.167 (.24322)	.26435	.65247E-01
MCOLGRAD	.609379E-02	.782697E-01	.078 (.93794)	.57519E-01	.80624E-01
MOMEMP	.253302E-01	.256374E-01	.988 (.32315)	.33136	.25939E-01
HEIGHT	.922542E-02	.265375E-02	3.476 (.00051)	35.537	.27574E-02
NEAST	.483508E-01	.361697E-01	1.337 (.18130)	.21643	.36719E-01
SOUTH	.249706E-01	.330397E-01	.756 (.44978)	.27012	.33598E-01
WEST	.319724E-02	.360758E-01	.089 (.92938)	.23330	.36781E-01
LOPOV	-.477083E-01	.696942E-01	-.685 (.49364)	.51395E-01	.70269E-01
MIDPOV	-.992839E-01	.521954E-01	-1.902 (.05715)	.17966	.53349E-01
HIPOV	-.102156	.497680E-01	-2.053 (.04011)	.20431	.50967E-01
SUBCORE	-.228155E-01	.366216E-01	-.623 (.53328)	.25963	.37367E-01
NMCORE	-.652084E-01	.450311E-01	-1.448 (.14760)	.11676	.46005E-01
SUBLOW	-.397013E-01	.427987E-01	-.928 (.35360)	.16153	.43685E-01
NMLOW	.529538E-01	.451898E-01	1.172 (.24127)	.13767	.46316E-01
Lambda-A	-.411817E-01	.337606E-01	-1.220 (.22253)	.14180E-05	.30860E-01
Lambda-B	.298775E-01	.290737E-01	1.028 (.30412)	.12209E-05	.29884E-01

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Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART = *
Selection Criterion B: EOWNWIC = *

Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

```
 FSELIG    = 0          WICELIG   = 0
EFSPART  miscoded =      0        EOWNWIC  miscoded =       0
 FSELIG    = 0          WICELIG   = 1
EFSPART  miscoded =      0        EOWNWIC  miscoded =       0
 FSELIG    = 1          WICELIG   = 0
EFSPART  miscoded =      0        EOWNWIC  miscoded =       0
 FSELIG    = 1          WICELIG   = 1
EFSPART  miscoded =      0        EOWNWIC  miscoded =       0
```

	EFSPART = 0	EFSPART = 1
EOWNWIC = 0	0	0
EOWNWIC = 0	0	0

Number of incorrectly coded eligibilities:
FSELIG = 0 WICELIG = 0

Full sample contains 445.0 observations.
Selected sample contains 445.0 observations.

Ordinary Least Squares Estimates

Dependent Variable..........	AVGPRO
Number of Observations......	445.
Mean of Dependent Variable..	2.02582
Std. Dev. of Dep. Variable..	.60969
Std. Error of Regression....	.53592
Sum of Squared Residuals....	118.05
R - Squared.................	.22559
Adjusted R - Squared........	.16341
F-Statistic (33, 411).....	3.62814
Significance of F-Test......	.00000
Log-Likelihood..............	-336.17
Restricted (Slopes=0) Log-L.	-410.72
Chi-Squared (33)............	149.10
Significance Level..........	.32173E-13

Estimated disturbance standard deviation = .540295
Estimated correlation with selection equation A = -.216857
Estimated correlation with selection equation B = .138099

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.450489	.395289	1.140 (.25443)	.99999	.40704
AVOWNWIC	.263083	.206727	1.273 (.20316)	.17826	.21668
AVFSPART	.409725	.124608	3.288 (.00101)	.33115	.12638
AVFSWIC	-.544681	.200565	-2.716 (.00661)	.13025	.20895
AVOTHWIC	-.448471E-01	.116353	-.385 (.69991)	.14097	.12088
AVCAGE2	.455734E-02	.146758	.031 (.97523)	.22655	.15207
AVCAGE3	.208447	.125827	1.657 (.09760)	.27507	.12954
AVCAGE4	-.614296	.145962	-4.209 (.00003)	.25488	.15116
AVCAGE5	-.281888	.181746	-1.551 (.12090)	.10862	.18783
FEMALE	-.931515E-01	.550931E-01	-1.691 (.09087)	.51588	.57143E-01
AVHHSIZE	.180808E-01	.226358E-01	.799 (.42442)	4.6452	.23106E-01
SPCINC	.221744E-01	.107186	.207 (.83610)	2.3374	.10994
WTHT	.550722	.167807	3.282 (.00103)	.92054	.17310
SPCINCSQ	.283611E-01	.223357	.127 (.89896)	.68488	.22956
NONWHITE	-.177862E-01	.816035E-01	-.218 (.82746)	.27168	.83432E-01
HISPANIC	-.875129E-02	.100906	-.087 (.93089)	.89414E-01	.10267
MSOMEHS	.177986	.147396	1.208 (.22722)	.22557	.15318
MHSGRAD	.177164	.147705	1.199 (.23035)	.41382	.15337
MSOMECOL	.157021	.154770	1.015 (.31032)	.26435	.16044
MCOLGRAD	-.482312E-01	.191988	-.251 (.80164)	.57519E-01	.19826
MOMEMP	.150678	.628592E-01	2.397 (.01653)	.33136	.63784E-01
HEIGHT	.233552E-01	.652815E-02	3.578 (.00035)	35.537	.67806E-02
NEAST	-.119343E-02	.886623E-01	-.013 (.98926)	.21643	.90294E-01
SOUTH	.605906E-01	.809686E-01	.748 (.45427)	.27012	.82618E-01
WEST	.932698E-02	.884027E-01	.106 (.91597)	.23330	.90445E-01
LOPOV	-.272477	.170217	-1.601 (.10943)	.51395E-01	.17279
MIDPOV	-.138318	.127774	-1.083 (.27902)	.17966	.13119
HIPOV	-.176379	.121868	-1.447 (.14781)	.20431	.12533
SUBCORE	.883529E-01	.896897E-01	.985 (.32458)	.25963	.91886E-01
NMCORE	-.237436	.110331	-2.152 (.03139)	.11676	.11313
SUBLOW	-.912375E-02	.104633	-.087 (.93051)	.16153	.10742
NMLOW	.153102	.110570	1.385 (.16615)	.13767	.11389
Lambda-A	-.105141	.838881E-01	-1.253 (.21008)	.14180E-05	.75885E-01
Lambda-B	.485942E-01	.713555E-01	.681 (.49586)	.12209E-05	.73485E-01

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Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART   = *
Selection Criterion B: EOWNWIC   = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG    = 0          WICELIG   = 0
EFSPART  miscoded =       0          EOWNWIC  miscoded =       0
 FSELIG    = 0          WICELIG   = 1
EFSPART  miscoded =       0          EOWNWIC  miscoded =       0
 FSELIG    = 1          WICELIG   = 0
EFSPART  miscoded =       0          EOWNWIC  miscoded =       0
 FSELIG    = 1          WICELIG   = 1
EFSPART  miscoded =       0          EOWNWIC  miscoded =       0

                   EFSPART   = 0     EFSPART   = 1
 EOWNWIC   = 0              0                0


 EOWNWIC   = 0              0                0


Number of incorrectly coded eligibilities:
FSELIG   =     0     WICELIG =     0

Full sample contains        445.0 observations.
Selected sample contains    445.0 observations.


    Ordinary     Least Squares Estimates

    Dependent Variable..........     LOGAVGVA
    Number of Observations......          445.
    Mean of Dependent Variable..        .43484
    Std. Dev. of Dep. Variable..        .54417
    Std. Error of Regression....        .48610
    Sum of Squared Residuals....    97.116
    R - Squared.................        .20025
    Adjusted R - Squared........        .13603
    F-Statistic ( 33,  411).....       3.11845
    Significance of F-Test......        .00000
    Log-Likelihood..............   -292.74
    Restricted (Slopes=0) Log-L.   -360.13
    Chi-Squared (33)............    134.77
    Significance Level..........    .32173E-13

Estimated disturbance standard deviation =  .487377
Estimated correlation with selection equation A =   .114432
Estimated correlation with selection equation B = -.894332E-01
```

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.651343	.355937	-1.830	(.06726)	.99999	.36920
AVOWNWIC	.647216E-01	.188456	.343	(.73127)	.17826	.19654
AVFSPART	-.899912E-01	.110925	-.811	(.41721)	.33115	.11463
AVFSWIC	.220297E-01	.182103	.121	(.90371)	.13025	.18952
AVOTHWIC	.225967	.105383	2.144	(.03201)	.14097	.10964
AVCAGE2	.257255E-01	.132744	.194	(.84633)	.22655	.13793
AVCAGE3	-.110662	.113270	-.977	(.32858)	.27507	.11749
AVCAGE4	-.344952	.131989	-2.613	(.00896)	.25488	.13711
AVCAGE5	-.463089E-01	.164115	-.282	(.77781)	.10862	.17037
FEMALE	.517775E-01	.498623E-01	1.038	(.29908)	.51588	.51830E-01
AVHHSIZE	-.578887E-02	.202645E-01	-.286	(.77513)	4.6452	.20957E-01
SPCINC	-.119675	.963127E-01	-1.243	(.21403)	2.3374	.99715E-01
WTHT	.758164	.151349	5.009	(.00000)	.92054	.15700
SPCINCSQ	.227460	.200998	1.132	(.25778)	.68488	.20821
NONWHITE	-.396429E-01	.731535E-01	-.542	(.58788)	.27168	.75675E-01
HISPANIC	-.241705	.901561E-01	-2.681	(.00734)	.89414E-01	.93129E-01
MSOMEHS	.122173	.133562	.915	(.36033)	.22557	.13894
MHSGRAD	.813019E-01	.133790	.608	(.54340)	.41382	.13911
MSOMECOL	.304071	.140037	2.171	(.02990)	.26435	.14553
MCOLGRAD	.118898	.173256	.686	(.49255)	.57519E-01	.17982
MOMEMP	.909337E-01	.560139E-01	1.623	(.10450)	.33136	.57854E-01
HEIGHT	.176466E-01	.591296E-02	2.984	(.00284)	35.537	.61502E-02
NEAST	-.533874E-01	.792186E-01	-.674	(.50036)	.21643	.81899E-01
SOUTH	-.226164	.724492E-01	-3.122	(.00180)	.27012	.74937E-01
WEST	-.224090	.792563E-01	-2.827	(.00469)	.23330	.82036E-01
LOPOV	-.126125	.151848	-.831	(.40620)	.51395E-01	.15673
MIDPOV	-.374572E-01	.114871	-.326	(.74436)	.17966	.11899
HIPOV	.710232E-01	.109685	.648	(.51729)	.20431	.11368
SUBCORE	-.207979E-01	.804990E-01	-.258	(.79613)	.25963	.83344E-01
NMCORE	-.214959	.990759E-01	-2.170	(.03003)	.11676	.10261
SUBLOW	.588348E-02	.940867E-01	.063	(.95014)	.16153	.97434E-01
NMLOW	-.479191E-01	.996482E-01	-.481	(.63060)	.13767	.10330
Lambda-A	.479191E-01	.687654E-01	.697	(.48590)	.14180E-05	.68830E-01
Lambda-B	-.317287E-01	.642565E-01	-.494	(.62146)	.12209E-05	.66653E-01

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Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART = *
Selection Criterion B: EOWNWIC = *

Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

```
 FSELIG   = 0          WICELIG  = 0
EFSPART  miscoded =      0         EOWNWIC  miscoded =      0
 FSELIG   = 0          WICELIG  = 1
EFSPART  miscoded =      0         EOWNWIC  miscoded =      0
 FSELIG   = 1          WICELIG  = 0
EFSPART  miscoded =      0         EOWNWIC  miscoded =      0
 FSELIG   = 1          WICELIG  = 1
EFSPART  miscoded =      0         EOWNWIC  miscoded =      0
```

	EFSPART = 0	EFSPART = 1
EOWNWIC = 0	0	0
EOWNWIC = 0	0	0

Number of incorrectly coded eligibilities:
FSELIG = 0 WICELIG = 0

Full sample contains 445.0 observations.
Selected sample contains 445.0 observations.

Ordinary Least Squares Estimates

Dependent Variable..........	LOGAVGVC
Number of Observations......	445.
Mean of Dependent Variable..	.36842
Std. Dev. of Dep. Variable..	.58876
Std. Error of Regression....	.49889
Sum of Squared Residuals....	102.29
R - Squared.................	.28037
Adjusted R - Squared........	.22259
F-Statistic (33, 411).....	4.85239
Significance of F-Test......	.00000
Log-Likelihood..............	-304.30
Restricted (Slopes=0) Log-L.	-395.17
Chi-Squared (33)............	181.74
Significance Level..........	.32173E-13

Estimated disturbance standard deviation = .499656
Estimated correlation with selection equation A = .129044
Estimated correlation with selection equation B = .487603E-01

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The column labelled std.dev.of X below is the
uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.641977	.366750	-1.750 (.08004)	.99999	.37891
AVOWNWIC	.321095	.196223	1.636 (.10176)	.17826	.20171
AVFSPART	.105109	.114918	.915 (.36038)	.33115	.11764
AVFSWIC	-.121800	.190097	-.641 (.52170)	.13025	.19451
AVOTHWIC	.140724	.108603	1.296 (.19506)	.14097	.11253
AVCAGE2	-.305126	.136446	-2.236 (.02534)	.22655	.14156
AVCAGE3	-.271656	.116759	-2.327 (.01998)	.27507	.12058
AVCAGE4	-.432486	.135665	-3.188 (.00143)	.25488	.14071
AVCAGE5	.205800E-01	.168740	.122 (.90293)	.10862	.17485
FEMALE	-.375432E-01	.512665E-01	-.732 (.46398)	.51588	.53194E-01
AVHHSIZE	-.183189E-01	.209638E-01	-.874 (.38221)	4.6452	.21509E-01
SPCINC	-.101136	.992022E-01	-1.019 (.30797)	2.3374	.10234
WTHT	.208796	.155741	1.341 (.18003)	.92054	.16113
SPCINCSQ	.338064	.206871	1.634 (.10222)	.68488	.21369
NONWHITE	.828263E-01	.754631E-01	1.098 (.27239)	.27168	.77666E-01
HISPANIC	.108431	.932166E-01	1.163 (.24474)	.89414E-01	.95579E-01
MSOMEHS	.154019	.137414	1.121 (.26236)	.22557	.14259
MHSGRAD	.238529	.137732	1.732 (.08330)	.41382	.14277
MSOMECOL	.472912	.144241	3.279 (.00104)	.26435	.14936
MCOLGRAD	.456114	.178429	2.556 (.01058)	.57519E-01	.18455
MOMEMP	.303928E-01	.580549E-01	.524 (.60061)	.33136	.59376E-01
HEIGHT	.218585E-01	.608144E-02	3.594 (.00033)	35.537	.63120E-02
NEAST	.115103	.818874E-01	1.406 (.15984)	.21643	.84054E-01
SOUTH	-.102691	.749675E-01	-1.370 (.17075)	.27012	.76909E-01
WEST	-.263016	.817114E-01	-3.219 (.00129)	.23330	.84194E-01
LOPOV	-.487234	.156969	-3.104 (.00191)	.51395E-01	.16085
MIDPOV	-.302371E-01	.118312	-.256 (.79828)	.17966	.12212
HIPOV	.129620E-01	.113046	.115 (.90871)	.20431	.11667
SUBCORE	.186934	.828916E-01	2.255 (.02412)	.25963	.85536E-01
NMCORE	-.627868E-01	.102103	-.615 (.53860)	.11676	.10531
SUBLOW	.744911E-01	.971718E-01	.767 (.44332)	.16153	.99998E-01
NMLOW	.133561	.102807	1.299 (.19389)	.13767	.10602
Lambda-A	.751070E-01	.750357E-01	1.001 (.31685)	.14180E-05	.70641E-01
Lambda-B	.429507E-01	.668164E-01	.643 (.52034)	.12209E-05	.68407E-01

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```
Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART   = *
Selection Criterion B: EOWNWIC   = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG    = 0          WICELIG   = 0
EFSPART  miscoded =      0          EOWNWIC  miscoded =       0
 FSELIG    = 0          WICELIG   = 1
EFSPART  miscoded =      0          EOWNWIC  miscoded =       0
 FSELIG    = 1          WICELIG   = 0
EFSPART  miscoded =      0          EOWNWIC  miscoded =       0
 FSELIG    = 1          WICELIG   = 1
EFSPART  miscoded =      0          EOWNWIC  miscoded =       0

                    EFSPART   = 0      EFSPART   = 1
 EOWNWIC   = 0              0                 0


 EOWNWIC   = 0              0                 0


Number of incorrectly coded eligibilities:
FSELIG  =     0     WICELIG =     0

Full sample contains       445.0 observations.
Selected sample contains   445.0 observations.


    Ordinary    Least Squares Estimates

    Dependent Variable..........     LOGAVGVE
    Number of Observations......          445.
    Mean of Dependent Variable..       -.09180
    Std. Dev. of Dep. Variable..        .59201
    Std. Error of Regression....        .52061
    Sum of Squared Residuals....    111.40
    R - Squared.................        .22492
    Adjusted R - Squared........        .16268
    F-Statistic ( 33,  411).....       3.61412
    Significance of F-Test......        .00000
    Log-Likelihood..............   -323.27
    Restricted (Slopes=0) Log-L.   -397.62
    Chi-Squared (33)............    148.71
    Significance Level..........    .32173E-13

Estimated disturbance standard deviation =  .524355
Estimated correlation with selection equation A =  .170877
Estimated correlation with selection equation B = -.165403
```

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

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Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART = *
Selection Criterion B: EOWNWIC = *

Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

```
 FSELIG   = 0           WICELIG  = 0
EFSPART  miscoded =      0          EOWNWIC  miscoded =      0
 FSELIG   = 0           WICELIG  = 1
EFSPART  miscoded =      0          EOWNWIC  miscoded =      0
 FSELIG   = 1           WICELIG  = 0
EFSPART  miscoded =      0          EOWNWIC  miscoded =      0
 FSELIG   = 1           WICELIG  = 1
EFSPART  miscoded =      0          EOWNWIC  miscoded =      0
```

	EFSPART = 0	EFSPART = 1
EOWNWIC = 0	0	0
EOWNWIC = 0	0	0

Number of incorrectly coded eligibilities:
FSELIG = 0 WICELIG = 0

Full sample contains 445.0 observations.
Selected sample contains 445.0 observations.

Ordinary Least Squares Estimates

Dependent Variable..........	AVCALC
Number of Observations......	445.
Mean of Dependent Variable..	.94349
Std. Dev. of Dep. Variable..	.35623
Std. Error of Regression....	.30965
Sum of Squared Residuals....	39.409
R - Squared.................	.24272
Adjusted R - Squared........	.18191
F-Statistic (33, 411).....	3.99181
Significance of F-Test......	.00000
Log-Likelihood..............	-92.067
Restricted (Slopes=0) Log-L.	-171.59
Chi-Squared (33)............	159.05
Significance Level..........	.32173E-13

Estimated disturbance standard deviation = .311391
Estimated correlation with selection equation A = -.141787
Estimated correlation with selection equation B = .155049

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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.268263	.227523	1.179 (.23837)	.99999	.23518
AVOWNWIC	.824462E-01	.120026	.687 (.49214)	.17826	.12520
AVFSPART	.128398	.709096E-01	1.811 (.07018)	.33115	.73019E-01
AVFSWIC	-.756101E-01	.116364	-.650 (.51584)	.13025	.12073
AVOTHWIC	-.368602E-01	.670715E-01	-.550 (.58262)	.14097	.69845E-01
AVCAGE2	-.307665E-01	.847360E-01	-.363 (.71654)	.22655	.87866E-01
AVCAGE3	-.580610E-01	.723765E-01	-.802 (.42243)	.27507	.74844E-01
AVCAGE4	-.185063	.843271E-01	-2.195 (.02819)	.25488	.87340E-01
AVCAGE5	.828205E-01	.104921	.789 (.42990)	.10862	.10853
FEMALE	.489275E-02	.318110E-01	.154 (.87776)	.51588	.33017E-01
AVHHSIZE	.150190E-02	.130105E-01	.115 (.90810)	4.6452	.13350E-01
SPCINC	-.141626	.618390E-01	-2.290 (.02201)	2.3374	.63520E-01
WTHT	.249717	.968993E-01	2.577 (.00996)	.92054	.10001
SPCINCSQ	.373102	.129017	2.892 (.00383)	.68488	.13264
NONWHITE	-.180184	.469838E-01	-3.835 (.00013)	.27168	.48206E-01
HISPANIC	-.282995E-01	.579898E-01	-.488 (.62554)	.89414E-01	.59325E-01
MSOMEHS	.919939E-01	.850935E-01	1.081 (.27966)	.22557	.88507E-01
MHSGRAD	.130126	.853610E-01	1.524 (.12740)	.41382	.88617E-01
MSOMECOL	.221401	.894183E-01	2.476 (.01329)	.26435	.92704E-01
MCOLGRAD	.108761	.110789	.982 (.32625)	.57519E-01	.11455
MOMEMP	.122467	.359287E-01	3.409 (.00065)	.33136	.36854E-01
HEIGHT	.115570E-01	.376681E-02	3.068 (.00215)	35.537	.39178E-02
NEAST	-.645665E-03	.507889E-01	-.013 (.98986)	.21643	.52171E-01
SOUTH	-.741027E-01	.464586E-01	-1.595 (.11071)	.27012	.47736E-01
WEST	-.357014E-01	.507898E-01	-.703 (.48210)	.23330	.52258E-01
LOPOV	.478367E-01	.977678E-01	.489 (.62464)	.51395E-01	.99838E-01
MIDPOV	.986706E-01	.736551E-01	1.340 (.18037)	.17966	.75799E-01
HIPOV	.350799E-01	.703012E-01	.499 (.61778)	.20431	.72414E-01
SUBCORE	.732217E-01	.516015E-01	1.419 (.15590)	.25963	.53091E-01
NMCORE	-.280221E-01	.634831E-01	-.441 (.65892)	.11676	.65364E-01
SUBLOW	-.113774	.604335E-01	-1.883 (.05975)	.16153	.62067E-01
NMLOW	-.369961E-01	.639190E-01	-.579 (.56273)	.13767	.65806E-01
Lambda-A	-.343037E-01	.442364E-01	-.775 (.43807)	.14180E-05	.43846E-01
Lambda-B	.397913E-01	.411263E-01	.968 (.33327)	.12209E-05	.42459E-01

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Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART  = *
Selection Criterion B: EOWNWIC  = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG   = 0         WICELIG  = 0
EFSPART  miscoded =     0         EOWNWIC  miscoded =      0
 FSELIG   = 0         WICELIG  = 1
EFSPART  miscoded =     0         EOWNWIC  miscoded =      0
 FSELIG   = 1         WICELIG  = 0
EFSPART  miscoded =     0         EOWNWIC  miscoded =      0
 FSELIG   = 1         WICELIG  = 1
EFSPART  miscoded =     0         EOWNWIC  miscoded =      0

                   EFSPART  = 0     EFSPART  = 1
 EOWNWIC  = 0              0                0


 EOWNWIC  = 0              0                0


Number of incorrectly coded eligibilities:
FSELIG  =    0     WICELIG =    0

Full sample contains       445.0 observations.
Selected sample contains   445.0 observations.


    Ordinary    Least Squares Estimates

    Dependent Variable..........     LOGAVGFE
    Number of Observations......          445.
    Mean of Dependent Variable..       -.37375
    Std. Dev. of Dep. Variable..        .41724
    Std. Error of Regression....        .30620
    Sum of Squared Residuals....    38.535
    R - Squared.................        .46022
    Adjusted R - Squared........        .41688
    F-Statistic ( 33,  411).....     10.61874
    Significance of F-Test......        .00000
    Log-Likelihood.............    -87.077
    Restricted (Slopes=0) Log-L.   -241.93
    Chi-Squared (33)............    309.71
    Significance Level..........    .32173E-13

Estimated disturbance standard deviation =  .306902
Estimated correlation with selection equation A = -.155740
Estimated correlation with selection equation B = -.676652E-01
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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-1.44458	.225989	-6.392 (.00000)	.99999	.23256
AVOWNWIC	.105814	.121350	.872 (.38322)	.17826	.12380
AVFSPART	.965728E-01	.711155E-01	1.358 (.17447)	.33115	.72205E-01
AVFSWIC	.717937E-01	.117873	.609 (.54247)	.13025	.11938
AVOTHWIC	.215908	.668103E-01	3.232 (.00123)	.14097	.69066E-01
AVCAGE2	-.419215E-01	.838910E-01	-.500 (.61728)	.22655	.86886E-01
AVCAGE3	.155953E-01	.719573E-01	.217 (.82842)	.27507	.74010E-01
AVCAGE4	.381480	.834301E-01	4.572 (.00000)	.25488	.86366E-01
AVCAGE5	.542793	.103823	5.228 (.00000)	.10862	.10732
FEMALE	.357795E-02	.315180E-01	.114 (.90962)	.51588	.32648E-01
AVHHSIZE	.910812E-02	.129694E-01	.702 (.48251)	4.6452	.13201E-01
SPCINC	.209549E-01	.611994E-01	.342 (.73205)	2.3374	.62812E-01
WTHT	.313203	.959177E-01	3.265 (.00109)	.92054	.98898E-01
SPCINCSQ	-.205944E-01	.127538	-.161 (.87172)	.68488	.13116
NONWHITE	-.518286E-01	.466097E-01	-1.112 (.26615)	.27168	.47669E-01
HISPANIC	-.153324	.576914E-01	-2.658 (.00787)	.89414E-01	.58663E-01
MSOMEHS	.162395	.844714E-01	1.922 (.05455)	.22557	.87520E-01
MHSGRAD	.158542	.847316E-01	1.871 (.06133)	.41382	.87628E-01
MSOMECOL	.134171	.887912E-01	1.511 (.13077)	.26435	.91670E-01
MCOLGRAD	.759624E-02	.109899	.069 (.94489)	.57519E-01	.11327
MOMEMP	.107838	.359621E-01	2.999 (.00271)	.33136	.36443E-01
HEIGHT	.989122E-02	.373775E-02	2.646 (.00814)	35.537	.38741E-02
NEAST	.269531E-01	.506302E-01	.532 (.59448)	.21643	.51589E-01
SOUTH	-.415452E-01	.463735E-01	-.896 (.37032)	.27012	.47204E-01
WEST	-.987068E-02	.504229E-01	-.196 (.84480)	.23330	.51676E-01
LOPOV	-.107251	.971771E-01	-1.104 (.26974)	.51395E-01	.98725E-01
MIDPOV	-.871365E-01	.729573E-01	-1.194 (.23234)	.17966	.74953E-01
HIPOV	-.110179	.697201E-01	-1.580 (.11404)	.20431	.71606E-01
SUBCORE	.863696E-01	.511141E-01	1.690 (.09108)	.25963	.52499E-01
NMCORE	-.854990E-01	.629790E-01	-1.358 (.17460)	.11676	.64635E-01
SUBLOW	-.107311E-01	.600388E-01	-.179 (.85815)	.16153	.61375E-01
NMLOW	.358875E-01	.634452E-01	.566 (.57163)	.13767	.65073E-01
Lambda-A	-.563898E-01	.481397E-01	-1.171 (.24145)	.14180E-05	.43357E-01
Lambda-B	-.347218E-01	.413946E-01	-.839 (.40158)	.12209E-05	.41986E-01

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Bivariate Probit Sample Selection Model

Selection Criterion A: EFSPART   = *
Selection Criterion B: EOWNWIC   = *


Modified selection model for Mathematica - 2/11/88
(WHG) Two level selection on eligibility and choice.

Bivariate frequencies for eligibility and participation:

 FSELIG    = 0        WICELIG   = 0
EFSPART  miscoded =      0        EOWNWIC  miscoded =      0
 FSELIG    = 0        WICELIG   = 1
EFSPART  miscoded =      0        EOWNWIC  miscoded =      0
 FSELIG    = 1        WICELIG   = 0
EFSPART  miscoded =      0        EOWNWIC  miscoded =      0
 FSELIG    = 1        WICELIG   = 1
EFSPART  miscoded =      0        EOWNWIC  miscoded =      0

                  EFSPART  = 0     EFSPART  = 1
 EOWNWIC  = 0             0                0


 EOWNWIC  = 0             0                0


Number of incorrectly coded eligibilities:
FSELIG  =    0    WICELIG =    0

Full sample contains       445.0 observations.
Selected sample contains   445.0 observations.


    Ordinary    Least Squares Estimates

    Dependent Variable..........     AVZINC
    Number of Observations......          445.
    Mean of Dependent Variable..        .70793
    Std. Dev. of Dep. Variable..        .21510
    Std. Error of Regression....        .19420
    Sum of Squared Residuals....    15.501
    R - Squared.................        .18300
    Adjusted R - Squared........        .11740
    F-Statistic ( 33,  411).....       2.78964
    Significance of F-Test......        .00000
    Log-Likelihood..............    115.54
    Restricted (Slopes=0) Log-L.    52.909
    Chi-Squared (33)............    125.27
    Significance Level..........    .32173E-13

Estimated disturbance standard deviation =  .195348
Estimated correlation with selection equation A = -.240419
Estimated correlation with selection equation B =  .178414E-01
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The column labelled std.dev.of X below is the uncorrected OLS standard errors.

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.564196E-01	.143897	.392 (.69500)	.99999	.14750
AVOWNWIC	.733260E-01	.762424E-01	.962 (.33618)	.17826	.78520E-01
AVFSPART	.132068	.458579E-01	2.880 (.00398)	.33115	.45795E-01
AVFSWIC	-.145056	.740886E-01	-1.958 (.05025)	.13025	.75717E-01
AVOTHWIC	.361820E-02	.424526E-01	.085 (.93208)	.14097	.43804E-01
AVCAGE2	-.820819E-01	.532377E-01	-1.542 (.12312)	.22655	.55107E-01
AVCAGE3	.505013E-01	.458505E-01	1.101 (.27071)	.27507	.46940E-01
AVCAGE4	-.687317E-01	.529068E-01	-1.299 (.19391)	.25488	.54777E-01
AVCAGE5	.262975E-01	.658980E-01	.399 (.68985)	.10862	.68066E-01
FEMALE	-.404680E-01	.199990E-01	-2.024 (.04302)	.51588	.20707E-01
AVHHSIZE	.112123E-01	.826570E-02	1.356 (.17494)	4.6452	.83728E-02
SPCINC	.632083E-02	.388640E-01	.163 (.87080)	2.3374	.39838E-01
WTHT	.164323	.608516E-01	2.700 (.00693)	.92054	.62725E-01
SPCINCSQ	.461810E-01	.808831E-01	.571 (.56803)	.68488	.83184E-01
NONWHITE	-.327912E-01	.296642E-01	-1.105 (.26898)	.27168	.30233E-01
HISPANIC	-.617299E-02	.367827E-01	-.168 (.86672)	.89414E-01	.37206E-01
MSOMEHS	.589335E-01	.535985E-01	1.100 (.27153)	.22557	.55508E-01
MHSGRAD	.647893E-01	.536875E-01	1.207 (.22751)	.41382	.55577E-01
MSOMECOL	.484520E-01	.562744E-01	.861 (.38924)	.26435	.58141E-01
MCOLGRAD	-.480256E-01	.697631E-01	-.688 (.49120)	.57519E-01	.71842E-01
MOMEMP	.333979E-01	.230660E-01	1.448 (.14764)	.33136	.23114E-01
HEIGHT	.944877E-02	.237342E-02	3.981 (.00007)	35.537	.24571E-02
NEAST	.975026E-02	.324084E-01	.301 (.76352)	.21643	.32720E-01
SOUTH	.963184E-02	.296149E-01	.325 (.74500)	.27012	.29939E-01
WEST	-.535755E-03	.321790E-01	-.017 (.98672)	.23330	.32775E-01
LOPOV	-.378818E-01	.620072E-01	-.611 (.54125)	.51395E-01	.62615E-01
MIDPOV	-.630284E-03	.463781E-01	-.014 (.98916)	.17966	.47539E-01
HIPOV	-.302766E-02	.442721E-01	-.068 (.94548)	.20431	.45415E-01
SUBCORE	.667877E-01	.325736E-01	2.050 (.04033)	.25963	.33297E-01
NMCORE	-.385032E-01	.401207E-01	-.960 (.33721)	.11676	.40994E-01
SUBLOW	-.181553E-01	.380485E-01	-.477 (.63325)	.16153	.38927E-01
NMLOW	.306829E-01	.401711E-01	.764 (.44498)	.13767	.41272E-01
Lambda-A	-.491108E-01	.332194E-01	-1.478 (.13931)	.14180E-05	.27499E-01
Lambda-B	-.866856E-02	.262549E-01	-.330 (.74127)	.12209E-05	.26629E-01

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Ordinary Least Squares Estimates

Dependent Variable..........	AVKCAL
Number of Observations......	445.
Mean of Dependent Variable..	.94626
Std. Dev. of Dep. Variable..	.24841
Std. Error of Regression....	.22698
Sum of Squared Residuals....	21.278
R - Squared.................	.22337
Adjusted R - Squared........	.16508
F-Statistic (31, 413).....	3.83180
Significance of F-Test......	.00000
Log-Likelihood..............	45.059
Restricted (Slopes=0) Log-L.	-11.167
Chi-Squared (31)............	112.45
Significance Level..........	.33448E-12
Durbin - Watson Statistic...........	1.7094
Estimated Autocorrelation (Rho).....	.14530

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.383404	.155542	2.465	(.01355)	1.0000	.00000
AVOWNWIC	.130837	.702225E-01	1.863	(.05985)	.17826	.33792
AVFSPART	.101076	.436825E-01	2.314	(.02011)	.33116	.44251
AVFSWIC	-.233144	.831236E-01	-2.805	(.00532)	.13025	.29153
AVOTHWIC	.219785E-01	.479724E-01	.458	(.65163)	.14097	.30617
AVCAGE2	.279776E-01	.616801E-01	.454	(.65472)	.22655	.31647
AVCAGE3	.119572	.524625E-01	2.279	(.02197)	.27507	.34472
AVCAGE4	-.189475	.615052E-01	-3.081	(.00237)	.25489	.32313
AVCAGE5	-.101860	.764388E-01	-1.333	(.17986)	.10862	.23570
FEMALE	-.588390E-01	.232521E-01	-2.530	(.01137)	.51588	.50031
AVHHSIZE	.590990E-02	.918694E-02	.643	(.52787)	4.6452	1.3733
SPCINC	-.913279E-02	.442076E-01	-.207	(.81829)	2.3375	1.1782
WTHT	.199651	.693250E-01	2.880	(.00428)	.92054	.21525
SPCINCSQ	.557390E-01	.926122E-01	.602	(.55507)	.68489	.56532
NONWHITE	-.621835E-01	.334755E-01	-1.858	(.06061)	.27168	.44533
HISPANIC	-.522142E-01	.416462E-01	-1.254	(.20784)	.89415E-01	.28566
MSOMEHS	.880341E-01	.614343E-01	1.433	(.14850)	.22557	.41843
MHSGRAD	.628362E-01	.610958E-01	1.028	(.30513)	.41382	.49307
MSOMECOL	.672186E-01	.642961E-01	1.045	(.29690)	.26435	.44148
MCOLGRAD	-.466362E-02	.793516E-01	-.059	(.90814)	.57519E-01	.23309
MOMEMP	.204558E-01	.255434E-01	.801	(.42925)	.33136	.47123
HEIGHT	.953697E-02	.274873E-02	3.470	(.00071)	35.537	6.0547
NEAST	.496913E-01	.361415E-01	1.375	(.16607)	.21643	.41228
SOUTH	.251310E-01	.329818E-01	.762	(.45275)	.27012	.44452
WEST	.129614E-01	.360892E-01	.359	(.71853)	.23330	.42341
LOPOV	-.422530E-01	.696849E-01	-.606	(.55210)	.51395E-01	.22105
MIDPOV	-.913638E-01	.531819E-01	-1.718	(.08259)	.17966	.38434
HIPOV	-.978761E-01	.509126E-01	-1.922	(.05225)	.20431	.40365
SUBCORE	-.234690E-01	.372847E-01	-.629	(.53691)	.25964	.43893
NMCORE	-.605893E-01	.459597E-01	-1.318	(.18470)	.11676	.32150
SUBLOW	-.432348E-01	.436016E-01	-.992	(.32355)	.16153	.36843
NMLOW	.466435E-01	.461989E-01	1.010	(.31446)	.13768	.34495
Sigma	.226983	.760848E-02	29.833	(.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	AVGPRO
Number of Observations......	445.
Mean of Dependent Variable..	2.02583
Std. Dev. of Dep. Variable..	.60966
Std. Error of Regression....	.55788
Sum of Squared Residuals....	128.54
R - Squared.................	.22113
Adjusted R - Squared........	.16267
F-Statistic (31, 413).....	3.78243
Significance of F-Test......	.00000
Log-Likelihood..............	-355.11
Restricted (Slopes=0) Log-L.	-410.70
Chi-Squared (31)............	111.17
Significance Level..........	.62423E-12
Durbin - Watson Statistic...........	1.7207
Estimated Autocorrelation (Rho).....	.13964

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.506761	.382292	1.326	(.18222)	1.0000	.00000
AVOWNWIC	.385886	.172593	2.236	(.02452)	.17826	.33792
AVFSPART	.311591	.107363	2.902	(.00402)	.33116	.44251
AVFSWIC	-.600733	.204301	-2.940	(.00359)	.13025	.29153
AVOTHWIC	-.130794E-01	.117906	-.111	(.87705)	.14097	.30617
AVCAGE2	-.619396E-02	.151597	-.041	(.91900)	.22655	.31647
AVCAGE3	.189966	.128942	1.473	(.13720)	.27507	.34472
AVCAGE4	-.613408	.151167	-4.058	(.00010)	.25489	.32313
AVCAGE5	-.287645	.187871	-1.531	(.12220)	.10862	.23570
FEMALE	-.910924E-01	.571490E-01	-1.594	(.10743)	.51588	.50031
AVHHSIZE	.135513E-01	.225797E-01	.600	(.55619)	4.6452	1.3733
SPCINC	-.326072E-02	.108653	-.030	(.92579)	2.3375	1.1782
WTHT	.571139	.170387	3.352	(.00103)	.92054	.21525
SPCINCSQ	.649720E-01	.227622	.285	(.76749)	.68489	.56532
NONWHITE	-.196703E-02	.822761E-01	-.024	(.92975)	.27168	.44533
HISPANIC	-.114734E-01	.102358	-.112	(.87635)	.89415E-01	.28566
MSOMEHS	.153403	.150993	1.016	(.31131)	.22557	.41843
MHSGRAD	.144717	.150161	.964	(.33789)	.41382	.49307
MSOMECOL	.134901	.158027	.854	(.39830)	.26435	.44148
MCOLGRAD	-.819344E-01	.195030	-.420	(.67741)	.57519E-01	.23309
MOMEMP	.142527	.627806E-01	2.270	(.02247)	.33136	.47123
HEIGHT	.239263E-01	.675582E-02	3.542	(.00057)	35.537	6.0547
NEAST	-.315283E-02	.888285E-01	-.035	(.92233)	.21643	.41228
SOUTH	.560565E-01	.810628E-01	.692	(.49679)	.27012	.44452
WEST	.278503E-01	.886999E-01	.314	(.74867)	.23330	.42341
LOPOV	-.267016	.171271	-1.559	(.11544)	.51395E-01	.22105
MIDPOV	-.120507	.130711	-.922	(.36015)	.17966	.38434
HIPOV	-.165473	.125133	-1.322	(.18331)	.20431	.40365
SUBCORE	.847262E-01	.916382E-01	.925	(.35873)	.25964	.43893
NMCORE	-.227490	.112960	-2.014	(.04218)	.11676	.32150
SUBLOW	-.151268E-01	.107164	-.141	(.85882)	.16153	.36843
NMLOW	.139425	.113548	1.228	(.21769)	.13768	.34495
Sigma	.557878	.187001E-01	29.833	(.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	LOGAVGVA
Number of Observations......	445.
Mean of Dependent Variable..	.43485
Std. Dev. of Dep. Variable..	.54417
Std. Error of Regression....	.50501
Sum of Squared Residuals....	105.33
R - Squared.................	.19888
Adjusted R - Squared........	.13874
F-Statistic (31, 413)......	3.30727
Significance of F-Test......	.00000
Log-Likelihood..............	-310.81
Restricted (Slopes=0) Log-L.	-360.13
Chi-Squared (31)............	98.634
Significance Level..........	.22690E-09
Durbin - Watson Statistic...........	1.6594
Estimated Autocorrelation (Rho)......	.17032

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.663018	.346065	-1.916	(.05305)	1.0000	.00000
AVOWNWIC	-.791075E-02	.156237	-.051	(.91304)	.17826	.33792
AVFSPART	-.438761E-01	.971887E-01	-.451	(.65617)	.33116	.44251
AVFSWIC	.525079E-01	.184941	.284	(.76849)	.13025	.29153
AVOTHWIC	.208334	.106733	1.952	(.04880)	.14097	.30617
AVCAGE2	.322699E-01	.137231	.235	(.80012)	.22655	.31647
AVCAGE3	-.102108	.116723	-.875	(.38626)	.27507	.34472
AVCAGE4	-.345864	.136842	-2.527	(.01147)	.25489	.32313
AVCAGE5	-.434273E-01	.170068	-.255	(.78710)	.10862	.23570
FEMALE	.507270E-01	.517334E-01	.981	(.32919)	.51588	.50031
AVHHSIZE	-.402942E-02	.204399E-01	-.197	(.82424)	4.6452	1.3733
SPCINC	-.107589	.983571E-01	-1.094	(.27421)	2.3375	1.1782
WTHT	.744832	.154241	4.829	(.00001)	.92054	.21525
SPCINCSQ	.207241	.206052	1.006	(.31639)	.68489	.56532
NONWHITE	-.463012E-01	.744794E-01	-.622	(.54201)	.27168	.44533
HISPANIC	-.241357	.926584E-01	-2.605	(.00929)	.89415E-01	.28566
MSOMEHS	.131824	.136685	.964	(.33753)	.22557	.41843
MHSGRAD	.945051E-01	.135932	.695	(.49442)	.41382	.49307
MSOMECOL	.312099	.143052	2.182	(.02807)	.26435	.44148
MCOLGRAD	.132100	.176549	.748	(.46119)	.57519E-01	.23309
MOMEMP	.961346E-01	.568314E-01	1.692	(.08743)	.33136	.47123
HEIGHT	.173087E-01	.611562E-02	2.830	(.00494)	35.537	6.0547
NEAST	-.543569E-01	.804109E-01	-.676	(.50672)	.21643	.41228
SOUTH	-.225809	.733810E-01	-3.077	(.00240)	.27012	.44452
WEST	-.234749	.802945E-01	-2.924	(.00378)	.23330	.42341
LOPOV	-.131544	.155041	-.848	(.40130)	.51395E-01	.22105
MIDPOV	-.464088E-01	.118324	-.392	(.69627)	.17966	.38434
HIPOV	.660449E-01	.113275	.583	(.56754)	.20431	.40365
SUBCORE	-.198227E-01	.829544E-01	-.239	(.79767)	.25964	.43893
NMCORE	-.220131	.102255	-2.153	(.03015)	.11676	.32150
SUBLOW	.966403E-02	.970089E-01	.100	(.88381)	.16153	.36843
NMLOW	-.408434E-01	.102788	-.397	(.69280)	.13768	.34495
Sigma	.505012	.169280E-01	29.833	(.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	LOGAVGVC
Number of Observations......	445.
Mean of Dependent Variable..	.36843
Std. Dev. of Dep. Variable..	.58876
Std. Error of Regression....	.51883
Sum of Squared Residuals....	111.17
R - Squared.................	.27767
Adjusted R - Squared........	.22345
F-Statistic (31, 413).....	5.12133
Significance of F-Test......	.00000
Log-Likelihood..............	-322.82
Restricted (Slopes=0) Log-L.	-395.17
Chi-Squared (31)............	144.71
Significance Level..........	.32173E-13
Durbin - Watson Statistic..........	1.6315
Estimated Autocorrelation (Rho).....	.18427

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.795425	.355531	-2.237	(.02443)	1.0000	.00000
AVOWNWIC	.368442	.160511	2.295	(.02108)	.17826	.33792
AVFSPART	.163948	.998471E-01	1.642	(.09715)	.33116	.44251
AVFSWIC	-.121737	.190000	-.641	(.52954)	.13025	.29153
AVOTHWIC	.143598	.109653	1.310	(.18771)	.14097	.30617
AVCAGE2	-.310775	.140985	-2.204	(.02653)	.22655	.31647
AVCAGE3	-.259519	.119916	-2.164	(.02931)	.27507	.34472
AVCAGE4	-.429006	.140585	-3.052	(.00259)	.25489	.32313
AVCAGE5	.226023E-01	.174720	.129	(.86597)	.10862	.23570
FEMALE	-.381057E-01	.531485E-01	-.717	(.48068)	.51588	.50031
AVHHSIZE	-.126116E-01	.209990E-01	-.601	(.55591)	4.6452	1.3733
SPCINC	-.869691E-01	.101047	-.861	(.39428)	2.3375	1.1782
WTHT	.226851	.158459	1.432	(.14890)	.92054	.21525
SPCINCSQ	.340549	.211688	1.609	(.10417)	.68489	.56532
NONWHITE	.670564E-01	.765166E-01	.876	(.38537)	.27168	.44533
HISPANIC	.117612	.951928E-01	1.236	(.21476)	.89415E-01	.28566
MSOMEHS	.184172	.140423	1.312	(.18703)	.22557	.41843
MHSGRAD	.274553	.139650	1.966	(.04722)	.41382	.49307
MSOMECOL	.505361	.146965	3.439	(.00079)	.26435	.44148
MCOLGRAD	.497690	.181378	2.744	(.00632)	.57519E-01	.23309
MOMEMP	.241711E-01	.583859E-01	.414	(.68155)	.33136	.47123
HEIGHT	.220797E-01	.628290E-02	3.514	(.00062)	35.537	6.0547
NEAST	.131600	.826103E-01	1.593	(.10763)	.21643	.41228
SOUTH	-.855843E-01	.753882E-01	-1.135	(.25578)	.27012	.44452
WEST	-.258279	.824908E-01	-3.131	(.00204)	.23330	.42341
LOPOV	-.467385	.159282	-2.934	(.00366)	.51395E-01	.22105
MIDPOV	-.362032E-01	.121561	-.298	(.75935)	.17966	.38434
HIPOV	.523150E-02	.116373	.045	(.91649)	.20431	.40365
SUBCORE	.195018	.852234E-01	2.288	(.02146)	.25964	.43893
NMCORE	-.647079E-01	.105052	-.616	(.54576)	.11676	.32150
SUBLOW	.703124E-01	.996623E-01	.706	(.48791)	.16153	.36843
NMLOW	.136503	.105599	1.293	(.19365)	.13768	.34495
Sigma	.518825	.173911E-01	29.833	(.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	LOGAVGVE
Number of Observations......	445.
Mean of Dependent Variable..	-.09180
Std. Dev. of Dep. Variable..	.59201
Std. Error of Regression....	.54164
Sum of Squared Residuals....	121.16
R - Squared.................	.22138
Adjusted R - Squared........	.16294
F-Statistic (31, 413).....	3.78801
Significance of F-Test......	.00000
Log-Likelihood..............	-341.97
Restricted (Slopes=0) Log-L.	-397.63
Chi-Squared (31)............	111.32
Significance Level..........	.58175E-12
Durbin - Watson Statistic...........	1.6563
Estimated Autocorrelation (Rho).....	.17184

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-.801134	.371163	-2.158	(.02973)	1.0000	.00000
AVOWNWIC	.758678E-01	.167568	.453	(.65529)	.17826	.33792
AVFSPART	-.179378	.104237	-1.721	(.08207)	.33116	.44251
AVFSWIC	.304714	.198354	1.536	(.12093)	.13025	.29153
AVOTHWIC	.338094	.114474	2.953	(.00346)	.14097	.30617
AVCAGE2	.320263	.147184	2.176	(.02847)	.22655	.31647
AVCAGE3	.130538	.125189	1.043	(.29821)	.27507	.34472
AVCAGE4	-.766933E-01	.146767	-.523	(.60807)	.25489	.32313
AVCAGE5	.189091	.182402	1.037	(.30114)	.10862	.23570
FEMALE	.351176E-01	.554853E-01	.633	(.53464)	.51588	.50031
AVHHSIZE	-.451036E-03	.219223E-01	-.021	(.93198)	4.6452	1.3733
SPCINC	-.753431E-01	.105490	-.714	(.48241)	2.3375	1.1782
WTHT	.397459	.165427	2.403	(.01597)	.92054	.21525
SPCINCSQ	-.340894E-01	.220996	-.154	(.85083)	.68489	.56532
NONWHITE	.886467E-01	.798809E-01	1.110	(.26704)	.27168	.44533
HISPANIC	-.241994	.993783E-01	-2.435	(.01467)	.89415E-01	.28566
MSOMEHS	.224274	.146598	1.530	(.12250)	.22557	.41843
MHSGRAD	.119747	.145790	.821	(.41707)	.41382	.49307
MSOMECOL	.196577	.153427	1.281	(.19774)	.26435	.44148
MCOLGRAD	-.392149E-01	.189353	-.207	(.81796)	.57519E-01	.23309
MOMEMP	.133062	.609530E-01	2.183	(.02797)	.33136	.47123
HEIGHT	.123177E-01	.655915E-02	1.878	(.05787)	35.537	6.0547
NEAST	-.184031	.862426E-01	-2.134	(.03158)	.21643	.41228
SOUTH	-.149922	.787029E-01	-1.905	(.05441)	.27012	.44452
WEST	.189706E-01	.861178E-01	.220	(.80961)	.23330	.42341
LOPOV	-.229581	.166285	-1.381	(.16426)	.51395E-01	.22105
MIDPOV	-.198075	.126905	-1.561	(.11502)	.17966	.38434
HIPOV	-.279595	.121490	-2.301	(.02076)	.20431	.40365
SUBCORE	-.139944	.889705E-01	-1.573	(.11219)	.25964	.43893
NMCORE	-.208213	.109671	-1.899	(.05521)	.11676	.32150
SUBLOW	-.422164E-01	.104044	-.406	(.68712)	.16153	.36843
NMLOW	-.746618E-01	.110242	-.677	(.50591)	.13768	.34495
Sigma	.541637	.181557E-01	29.833	(.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	AVCALC
Number of Observations......	445.
Mean of Dependent Variable..	.94350
Std. Dev. of Dep. Variable..	.35622
Std. Error of Regression....	.32200
Sum of Squared Residuals....	42.822
R - Squared.................	.23996
Adjusted R - Squared........	.18292
F-Statistic (31, 413).....	4.20631
Significance of F-Test......	.00000
Log-Likelihood..............	-110.55
Restricted (Slopes=0) Log-L.	-171.58
Chi-Squared (31)............	122.06
Significance Level..........	.32173E-13
Durbin - Watson Statistic..........	1.8893
Estimated Autocorrelation (Rho).....	.55330E-01

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.251718	.220655	1.141 (.25338)	1.0000	.00000
AVOWNWIC	.164142	.996186E-01	1.648 (.09599)	.17826	.33792
AVFSPART	.929093E-01	.619686E-01	1.499 (.13027)	.33116	.44251
AVFSWIC	-.106219	.117920	-.901 (.37175)	.13025	.29153
AVOTHWIC	-.186156E-01	.680543E-01	-.274 (.77528)	.14097	.30617
AVCAGE2	-.383823E-01	.875002E-01	-.439 (.66485)	.22655	.31647
AVCAGE3	-.644188E-01	.744240E-01	-.866 (.39149)	.27507	.34472
AVCAGE4	-.183506	.872522E-01	-2.103 (.03404)	.25489	.32313
AVCAGE5	.802980E-01	.108437	.741 (.46598)	.10862	.23570
FEMALE	.584452E-02	.329858E-01	.177 (.83669)	.51588	.50031
AVHHSIZE	.785878E-03	.130327E-01	.060 (.90722)	4.6452	1.3733
SPCINC	-.151158	.627135E-01	-2.410 (.01566)	2.3375	1.1782
WTHT	.266438	.983454E-01	2.709 (.00696)	.92054	.21525
SPCINCSQ	.393873	.131381	2.998 (.00304)	.68489	.56532
NONWHITE	-.176400	.474888E-01	-3.715 (.00032)	.27168	.44533
HISPANIC	-.269574E-01	.590800E-01	-.456 (.65289)	.89415E-01	.28566
MSOMEHS	.878544E-01	.871516E-01	1.008 (.31524)	.22557	.41843
MHSGRAD	.123499	.866714E-01	1.425 (.15085)	.41382	.49307

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Ordinary Least Squares Estimates

Dependent Variable..........	LOGAVGFE
Number of Observations......	445.
Mean of Dependent Variable..	-.37375
Std. Dev. of Dep. Variable..	.41724
Std. Error of Regression....	.31877
Sum of Squared Residuals....	41.967
R - Squared.................	.45706
Adjusted R - Squared........	.41630
F-Statistic (31, 413).....	11.21520
Significance of F-Test......	.00000
Log-Likelihood..............	-106.06
Restricted (Slopes=0) Log-L.	-241.93
Chi-Squared (31)............	271.75
Significance Level..........	.32173E-13
Durbin - Watson Statistic...........	1.5138
Estimated Autocorrelation (Rho).....	.24309

Variable	Coefficient	Std. Error	T-ratio	(Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	-1.32577	.218440	-6.069	(.00000)	1.0000	.00000
AVOWNWIC	.659626E-01	.986189E-01	.669	(.51131)	.17826	.33792
AVFSPART	.527553E-01	.613467E-01	.860	(.39469)	.33116	.44251
AVFSWIC	.730207E-01	.116737	.626	(.53949)	.13025	.29153
AVOTHWIC	.212936	.673713E-01	3.161	(.00187)	.14097	.30617
AVCAGE2	-.372558E-01	.866221E-01	-.430	(.67065)	.22655	.31647
AVCAGE3	.651659E-02	.736771E-01	.088	(.89046)	.27507	.34472
AVCAGE4	.378736	.863765E-01	4.385	(.00003)	.25489	.32313
AVCAGE5	.541341	.107349	5.043	(.00000)	.10862	.23570
FEMALE	.397134E-02	.326547E-01	.122	(.87063)	.51588	.50031
AVHHSIZE	.474435E-02	.129019E-01	.368	(.71277)	4.6452	1.3733
SPCINC	.104457E-01	.620841E-01	.168	(.84222)	2.3375	1.1782
WTHT	.298607	.973584E-01	3.067	(.00247)	.92054	.21525
SPCINCSQ	-.233727E-01	.130062	-.180	(.83513)	.68489	.56532
NONWHITE	-.398462E-01	.470122E-01	-.848	(.40180)	.27168	.44533
HISPANIC	-.160447	.584870E-01	-2.743	(.00633)	.89415E-01	.28566
MSOMEHS	.139354	.862770E-01	1.615	(.10278)	.22557	.41843
MHSGRAD	.131085	.858016E-01	1.528	(.12302)	.41382	.49307
MSOMECOL	.109278	.902960E-01	1.210	(.22462)	.26435	.44148
MCOLGRAD	-.241764E-01	.111440	-.217	(.81173)	.57519E-01	.23309
MOMEMP	.112893	.358726E-01	3.147	(.00194)	.33136	.47123
HEIGHT	.970508E-02	.386025E-02	2.514	(.01188)	35.537	6.0547
NEAST	.140863E-01	.507563E-01	.278	(.77267)	.21643	.41228
SOUTH	-.548306E-01	.463190E-01	-1.184	(.23529)	.27012	.44452
WEST	-.139992E-01	.506828E-01	-.276	(.77353)	.23330	.42341
LOPOV	-.122910	.978638E-01	-1.256	(.20703)	.51395E-01	.22105
MIDPOV	-.828725E-01	.746875E-01	-1.110	(.26710)	.17966	.38434
HIPOV	-.104377	.715005E-01	-1.460	(.14090)	.20431	.40365
SUBCORE	.801253E-01	.523618E-01	1.530	(.12241)	.25964	.43893
NMCORE	-.842219E-01	.645448E-01	-1.305	(.18935)	.11676	.32150
SUBLOW	-.732388E-02	.612331E-01	-.120	(.87184)	.16153	.36843
NMLOW	.338964E-01	.648808E-01	.522	(.60814)	.13768	.34495
Sigma	.318769	.106852E-01	29.833	(.00000)		

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Ordinary Least Squares Estimates

Dependent Variable..........	AVZINC
Number of Observations......	445.
Mean of Dependent Variable..	.70793
Std. Dev. of Dep. Variable..	.21509
Std. Error of Regression....	.20240
Sum of Squared Residuals....	16.919
R - Squared.................	.17635
Adjusted R - Squared........	.11452
F-Statistic (31, 413).....	2.85243
Significance of F-Test......	.00000
Log-Likelihood..............	96.072
Restricted (Slopes=0) Log-L.	52.926
Chi-Squared (31)............	86.293
Significance Level..........	.50044E-07
Durbin - Watson Statistic..........	1.6932
Estimated Autocorrelation (Rho).....	.15339

Variable	Coefficient	Std. Error	T-ratio (Sig.Lvl)	Mean of X	Std.Dev.of X
ONE	.128443	.138696	.926 (.35791)	1.0000	.00000
AVOWNWIC	.761347E-01	.626167E-01	1.216 (.22238)	.17826	.33792
AVFSPART	.907781E-01	.389512E-01	2.331 (.01926)	.33116	.44251
AVFSWIC	-.155091	.741205E-01	-2.092 (.03494)	.13025	.29153
AVOTHWIC	.813093E-02	.427765E-01	.190 (.82866)	.14097	.30617
AVCAGE2	-.817206E-01	.549995E-01	-1.486 (.13382)	.22655	.31647
AVCAGE3	.422989E-01	.467803E-01	.904 (.36985)	.27507	.34472
AVCAGE4	-.699786E-01	.548436E-01	-1.276 (.19965)	.25489	.32313
AVCAGE5	.244526E-01	.681597E-01	.359 (.71880)	.10862	.23570
FEMALE	-.398731E-01	.207337E-01	-1.923 (.05217)	.51588	.50031
AVHHSIZE	.809835E-02	.819190E-02	.989 (.32508)	4.6452	1.3733
SPCINC	-.394340E-02	.394195E-01	-.100 (.88356)	2.3375	1.1782
WTHT	.160677	.618164E-01	2.599 (.00944)	.92054	.21525
SPCINCSQ	.517156E-01	.825814E-01	.626 (.53901)	.68489	.56532
NONWHITE	-.235970E-01	.298498E-01	-.791 (.43542)	.27168	.44533
HISPANIC	-.103670E-01	.371355E-01	-.279 (.77160)	.89415E-01	.28566
MSOMEHS	.423649E-01	.547804E-01	.773 (.44580)	.22557	.41843
MHSGRAD	.444452E-01	.544785E-01	.816 (.42033)	.41382	.49307
MSOMECOL	.313961E-01	.573322E-01	.548 (.59121)	.26435	.44148
MCOLGRAD	-.708361E-01	.707570E-01	-1.001 (.31872)	.57519E-01	.23309
MOMEMP	.344551E-01	.227768E-01	1.513 (.12681)	.33136	.47123
HEIGHT	.946142E-02	.245101E-02	3.860 (.00020)	35.537	6.0547
NEAST	.273765E-02	.322270E-01	.085 (.89254)	.21643	.41228
SOUTH	.191311E-02	.294096E-01	.065 (.90438)	.27012	.44452
WEST	.859381E-03	.321804E-01	.027 (.92792)	.23330	.42341
LOPOV	-.449231E-01	.621373E-01	-.723 (.47692)	.51395E-01	.22105
MIDPOV	.496026E-02	.474218E-01	.105 (.88083)	.17966	.38434
HIPOV	.204231E-02	.453983E-01	.045 (.91647)	.20431	.40365
SUBCORE	.628751E-01	.332464E-01	1.891 (.05615)	.25964	.43893
NMCORE	-.359512E-01	.409818E-01	-.877 (.38487)	.11676	.32150
SUBLOW	-.175397E-01	.388791E-01	-.451 (.65639)	.16153	.36843
NMLOW	.270523E-01	.411951E-01	.657 (.51917)	.13768	.34495
Sigma	.202398	.678440E-02	29.833 (.00000)		