PREDICTING AGGREGATE FOOD CONSUMPTION FOR A SPECIFIC GEOGRAPHIC AREA: AN APPLICATION TO SOUTHEAST MINNESOTA

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Abstract

This thesis develops a framework for estimating food expenditures for a variety of U.S. communities, including regions, states counties and metropolitan areas. The framework is then illustrated by providing estimates of household expenditures for 19 food categories at the national level, in the Twin Cities metropolitan area and in the Southeastern Minnesota area. First household characteristics are related to food expenditures using Consumer Expenditure Survey Data (CEX); then expenditures are aggregated at the community level by applying household demographic profiles from American Community Survey data to the estimations from Consumer Expenditure Survey data. This research is distinctive because (1) it suggests a general and universal model for forecasting food expenditure patterns at almost any regional level; and (2) it provides a good estimation of food expenditure to match with current foodshed analysis. The regression results present a comprehensive relationship between demographic factors and consumer expenditures on 19 food categories. Findings also show that household purchasing patterns are significantly different across regions and that it is not accurate to use average CEX results for the nation to estimate aggregate expenditure by households in a particular locale.

Key words: CEX ACS foodshed

JEL codes: D12 Q18 R12 R22

Table of Contents

1. INTRODUCTION

Local foodshed studies, which compare food consumption and production patterns within a region, are being used with increasing frequency in studies of local food systems. The concept of foodshed was first introduced by permaculturist Arthur Cetz (Urban foodsheds, 1991), as an analogue to the watershed, to explain critical thought about where food is coming from and how it is getting to people. This concept serves both global (e.g., Kloppenburg, Hendrickson and Stevenson) and local food analysis (e.g., Peters et al., 2009) from perspectives of economics, ecology and other disciplines. Several regional foodshed projects have yielded useful results. For example, an analysis for New York State (Peters, 2007), using two models to identify the local production capacity to satisfy points of consumption, suggests that a large share of food need can be supplied "within distances one to two orders of magnitude shorter than the thousands of kilometers traveled in the modern food system".

For the purpose of comparing food consumption and production patterns, it is critical to have good estimates of food expenditures. However, researchers often use national estimates of food consumption or idealized diets as the basis for estimates of food consumed by the local population. For example, in the Alameda County Foodshed Report (Cozad et al., 2002), researchers estimate total food expenditures by "taking gross food retailer and server sales from the Economic Census as measures of food expenditures at home and away from home, and multiplying county population data by national averages for food expenditures reported by the USDA" (page 50). Similar procedures are used in many other foodshed analyses. This procedure oversimplifies the estimation by assuming

that national food expenditure patterns are exactly the same as regional food expenditure patterns; and this is likely not true for many U.S. communities.

Only one study thus far has somewhat accounted for the fact that local populations may have preferences for food consumption that differ from national averages. The University of Wisconsin-Milwaukee (UWM) Employment and Training Institute has developed location-specific Purchasing Power Profiles for broad consumption bundles (including overall food expenditures), using 2002-2003 Consumer Expenditure Survey (CEX) and 2000 US Census data. (http://www4.uwm.edu/eti/PurchasingPower/ETImethodology.htm) In this project, ten household-level attributes, including five household income levels and five family/household types are considered in estimating expenditures for each retail category. Then 25 expenditure estimates (5 household types X 5 income levels) are calculated separately for each category of expenditures. With the number of households for each of the 25 cells (5 household types X 5 income levels) obtained from 2000 Census data, CEX expenditure patterns for each retail area are applied against the population in each of the 25 cells for each neighborhood. Compared with the Alameda County Foodshed Report, this analysis captures some differences between national level and regional level expenditures; but only accounts for household income and family composition. These two attributes, while expected to be associated with food consumption preferences, are chosen arbitrarily and may be far from enough to truly capture a heterogeneous expenditure patterns across localities. However, computational complexity makes it difficult to increase number of variables for this analysis. Moreover, because Census data

are only updated every ten years, there can be significant changes to numbers of households in certain regions, which lessens the reliability of forecasts based on Census data. Also, they do this research only for overall food expenditures (food at home and food away from home).

This paper introduces a new, more effective procedure for matching Consumer Expenditure Diary Survey data (CEX) and American Community Survey data (ACS) to estimate regional food expenditures. The ultimate goal of this research is to create a general model for estimating total household expenditures on different food products in a given area. Specifically there are three objectives for this paper: (1) Specify and estimate expenditure functions. (2) Use CEX, U.S. Census and ACS data to project consumption levels. (3) Compare the estimated national level consumption to the regional level consumption, which include Southeast Minnesota area (SEMN) and Twin Cities Metropolitan area (TC) for this project.

To achieve the objectives, a three-step method is taken: (1) For expenditure functions, data from the Bureau of Labor Statistics (BLS) CEX survey, which is specifically designed to characterize the spending patterns of U.S. households, are used to estimate models of household expenditures on 19 disaggregated food product categories. The censoring problem of zero expenditures by some households in the CEX is addressed by using Tobit regression to estimate the expenditure models. (2) To enable projection of consumption levels in a particular locale, the explanatory variables in the expenditure models are chosen and specified to be present in the CEX data and to be consistent with community-level data available in Census and ACS. This makes it possible to generate

estimates of food expenditure patterns that are consistent with the demographic characteristics of a locale for areas as large as a state or a region and for many smaller areas such as a county or a single community. (3) As for the comparison between SEMN and TC, it is assumed that households in SEMN and TC have different food expenditure patterns from the nation, and that there are differences between patterns in these two areas as well. This demonstrates the importance of capturing regional differences when estimating regional food expenditures.

The current study differs from previous work in that it focuses explicitly on food expenditures, it allows for annual updating of community profiles with ACS data, and it deals with methodological issues associated with censored expenditure patterns for a disaggregated list of food products. Overall, the study improves upon current methods of estimating location-specific aggregate food expenditures, and it provides tools for accurately estimating location-specific expenditures for a disaggregated list of food products. These estimates can, in turn, be used in modeling food product flows into, within, and out of the region.

The remainder of this thesis is organized as follows. The next section introduces the CEX and ACS data used in this research. In section 3, demand function and estimation procedures are specified. Section 4 discusses estimation results and expenditure projection from the analysis. Finally, section 5 closes the food expenditure analysis with conclusion.

2. DATA

2.1 Consumer Expenditure Survey

As noted, household expenditure patterns are estimated with data from the Consumer Expenditure Survey (CEX). CEX is a nationally representative survey conducted by Bureau of Labor Statistics; it is intended to capture US consumers' annual purchasing behavior. The survey collects expenditure data on 16 general retail products categories (food as a whole is one of them) and a large number of subgroups under each major category. CEX is the leading public source of expenditure data and is widely used in food buying behavior research (e.g. Nayga, 1995; Yen, 2002). However, this information has rarely been used in foodshed analysis.

CEX is composed of two independent but parallel components—the quarterly interview survey and the diary survey. The two surveys represent the same population but are designed to collect different types of expenditures with separate survey instruments. Each survey has around 80% respondent rates each year, which is reasonably representative.

The interview survey is designed on a rotating panel. It obtains data on large expenditures over five quarters. At the end of each quarter, 20% of households are dropped and replaced by new households by design. This feature makes the interview survey less ideal when dealing with certain economic methods that are on an annual basis.

The diary survey is a rolling panel survey, which is designed to provide a continuous flow of detailed information on household expenditures and household characteristics.

The diary survey collects data over two consecutive 1-week period on frequently purchased smaller items, including food and beverages, housekeeping supplies and so on. To match the features of American Community Survey data (introduced below), the diary survey from year 2008 is chosen to capture the most recent food purchasing patterns.[1] It contains a sample of over 7000 households.

2.2 American Community Survey

In this research, CEX is used in the first step of the calculation procedure to estimate household expenditure patterns, which are then projected into geographic locations using community-level data from the American Community Survey (ACS) data.

ACS is updated annually by the Census Bureau's reengineered decennial census program to provide community profiles in terms of the socio-economic characteristics of their populations. Community level information on the age profiles, gender composition, education, and employment status of households and individuals is reported annually. Compared with the decennial census data, the ACS data are more up-to-date and reflect the most recent demographic patterns. However, ACS has some disadvantages as well. With a smaller sample size, ACS is unable to capture household characteristics in geographic areas with populations less than 20,000.[2] This issue can, however, be addressed by using Census data. In this theses I use ACS data when possible, but supplement the community level datasets with the most recent Census data available when necessary.

[1] In the following analysis, CEX is abbreviated for Consumer Expenditure Diary Survey
[2] This population limitation is for 2006-2008 three- year estimates. For a separate 2006-2008 single year estimate, the geographic area population limitation is 65,000, which excludes too many counties.

2.3 Matching CEX with ACS

One challenge of this project is to match the variables from CEX with those from ACS. There are numerous variables in both datasets. However, since the CEX estimation will be projected into geographic locations using ACS data, the sets of variables chosen from CEX must have exactly the same definitions as those in ACS. This is not an easy procedure because a number of household attributes are elicited via different instruments and cannot be directly matched. .

After searching and comparing all variables in the two datasets, seven sets of variables describing household attributes are selected as the best matches in the analysis. Additionally, to capture seasonality in food purchasing patterns, dummy variables that indicate the month of the interview are also included in the analysis as an additional set of variables.

Of the eight sets of variables, age of householder[3], household income, family size (number of members in a family) and number of earners are the easiest to match because they are numeric in CEX data and can be grouped into the same segmentations as in the ACS.

For ethnicity, there are more types in CEX than in ACS; therefore individuals of multiple-ethnicities, along with those of an ethnicity that is not listed in ACS, are grouped into a category labeled 'other ethnicities'. This corresponds well with the categories in the ACS.

Family type is a complicated variable since there are many criteria in ACS. The five-

[3] There is only one respondent from a family to answer the survey by CEX, and this reference is assumed as the householder. Personal records for age and race are householders' age and race because it's impossible to project other family members age and race from ACS,

group segmentation used in the Power Purchasing Project is borrowed here. It divides all families into: family with children under age 18 with married parents, family with children under age 18 with a single parent, family with no children under age 18 with married parents, family no children under 18 with a single parent, and non-family households.

CEX groups regions into Northeast, Midwest, South and West. Relating these regions to locations in the ACS data is straightforward. For urban/rural, metropolitan/micropolitan, USDA provides a Rural-Urban Continuum Codes that code each county into one of the 9 categories. The criteria for the codes are consistent with Census/ACS. A complete list of variables is shown in Table 1.

As is noted earlier, the ACS does not report information for all geographic areas. In particular, data are not available in areas that have a population less than 20,000. In addition, data on ethnicity are sometimes not available in ACS, even for some larger counties. For these counties, it is necessary to infer data using updated household numbers and the percentage of households in each variable group from 2000 Census data. The 2006-2008 three-year ACS data estimates match well with the 2008 CEX data.

It should be noted that this modeling procedure is not perfect; there are two main concerns related to choice of variables. First, the accuracy of the model may be reduced because there are variables in the CEX that are important for understanding consumers' purchasing behavior but cannot be included in the model. For example, householder's gender, employment status and education level are commonly used demographic variables in other studies, and they have been found to explain some important aspects of

Table 1: Explanatory Variables

Variable category	Binary Variables	Description
Age	age1	15-24
	age2	25-34
	age3	35-44
	age4	45-54
	age5	55-64
	age6	65-74
	age7	75-84
	age8	85+
Income	income1	Less than $10,000
	income2	$10,000 to $14,999
	income3	$15,000 to $24,999
	income4	$25,000 to $34,999
	income5	$35,000 to $49,999
	income6	$50,000 to $74,999
	income7	$75,000 to $99,999
	income8	$100,000 to $149,999
	income9	$150,000 to $199,999
	income10	$200,000 or more
Region	region_n	Northeast
	region_m	Midwest
	region_s	South
	region_w	West
	urban	
	rural	
	metropolitan	
	micropolitan	
Family_size	family_size1	1 person
	family_size2	2 person
	family_size3	3 person
	family_size4	4 person
	family_size5	5+ person

Table 1 continued

Variable category	Binary Variables	Description
Ethnicity	race1	1 White
	race2	2 African American, or Black
	race3	3 American Indian, or Alaskan Native
	race4	4 Asian
	race5	5 Native Hawaiian or Other Pacific Islander
	race6	6 Multi-race and one race other than listed in 1-5
Family Type	FAM_TYPE1	Family with children under age 18, with married parents
	FAM_TYPE2	Family with children under age 18, with a single parent
	FAM_TYPE3	Family with no children under age 18, with married parents
	FAM_TYPE4	Family with no children under age 18, with a single parent
	FAM_TYPE5	Non-family households
Number of Earner	earner0	0 earner
	earner1	1 earner
	earner2	2 earners
	earner3	3 or more earners
Month	jan	
	feb	
	mar	
	apr	
	may	
	jun	
	jul	
	aug	
	sep	
	oct	
	nov	
	dec	

a householder's purchasing decision. However, because such variables are not found or not in the same format as in ACS, they are not included in the model. Ignoring useful information like this makes the CEX model less accurate. Second, changing some continuous variables into dummy variables format may also reduce the accuracy of the model. In CEX, age of householder and family income are continuous variables. However, to match the formats with those in ACS, they are transformed into dummy variables that indicate intervals of the original continuous variables. This change causes some loss of accuracy in capturing age and household effects. However, it should also be noted that the use of sets of binary variables for key demographic characteristics allows for greater flexibility in representing their relationship with expenditure levels than do many algebraic functional forms that have continuous variables.

3. MODEL SPECIFICATION AND ESTIMATION

3.1 Literature Review

CEX is a major data source for analyzing consumer purchasing patterns, specifying demand functions and measuring estimation procedures. One usage of the CEX data is to analyze the relationship between some particular variable (s) and the expenditure for one or more products. For example, Harrison (1986) estimates the difference of demographic factors, household income and total household expenditures between two age groups: 65-74 and 75 and over. Seung-Hyun Hong (2004) uses CEX to estimate that U.S. household music expenditure has declined as a result of Napster.

Researchers have also used CEX to analyze household food purchasing patterns, mostly for particular types of food. Nayga (1992) uses the 1992 CEX to examine the determinants of household expenditure on fresh and processed fruits and vegetables and suggests that households with higher income, better education, larger size and older age tend to spend more on fresh and processed fruit and vegetables. Yen (1996, 2002) examines determinants of expenditures on alcohol and fats and oils. These mainly discuss different methods for solving the zero-expenditure problem, but they also estimate effects that income, region, education and other factors have on expenditure patterns.

I use CEX data in a manner consistent with recent literature to estabilish associations between household attributes and expenditure patterns. This is the first of a two-step procedure to estimate area-specific food expenditure patterns. Specifically, a demand function is specified to estimate relationships between household size and composition, demographics, income, seasonality and observed expenditures in 19 food product

categories within the CEX data set. The second step involves estimating community level expenditures in a manner consistent with the estimated household-level consumption patterns and the characteristics of each community's population. To accomplish this, the regression parameter estimates from the first step that are found to significantly affect expenditure patterns as well as the number of households in each relevant variable group from the ACS are used to calculate aggregate community-level expenditures. A unique feature here is that the first step of regression is inspired by the second step of projecting number of households in each variable group to the regression results. ACS reports socio-economic characteristics as binary variables, so only the number of units (individuals or households) in each variable group is reported. For example, in ACS there are 8 age groups (see Table 1.), so we can only know how many households are in each of the 8 age ranges. As a result, in the demand function of the first step, all variables are captured by binary variables that match the ACS format.

3.2 Model Specification

Choice of demand function specification is important when analyzing expenditure patterns. There are many forms of demand functions, including classical demand systems with quantity dependent equations, Linear Expenditure Systems (LES), Double-Log system, Translog System, Rotterdam model, Almost Ideal Demand System (AIDS), and Qudratic Expenditure System (QES) etc.

Introduced by Deaton and Muellbauer, AIDS is by far the most popular demand function. It is 'of comparable generality to the Rotterdam and translog models but has considerable advantages' and 'gives and arbitrary first-order approximation to any

demand system' (Deaton and Muellbauer, 1980). This model satisfies all the four properties of demand functions: adding-up, homogeneity, symmetry and negativity.

However, AIDS is not suitable with analysis based on CEX because of the lack of price information in CEX. Some studies have addressed this non-price problem by adding regional price indexes to each category for households, however there is high risk of linear relationship between region dummies and regional price variables (Heien and Durham, 1991). Some other studies have tried adding monthly price indexes. However, since variables of 12 months have already been included in the demand function for this research to track seasonality effects, adding monthly price indexes is not only unnecessary but would also generate multicollinearity problems. As a reasonable alternative, adjusted demand models can be formed to address this problem by considering price as constant across consumers. Introduced by Heien and Durham (1991), a modified Quadratic Expenditure System (QES) is one popular function to apply to CEX analysis. Instead of the quadratic income term, Zhen (2008) uses binary income variable to capture income effects. This modified model is borrowed here. The modified QES functionis thus specified as:

$$y_{ih} = \beta_{i0} + \sum_k \beta_{ik} x_{kh} + \sum_q \alpha_{ih} Y_{qh}$$

where y_{ih} is the expenditure on the $i_h$food by the h_h household. Y_{qh} is the household income for the h_h household with q income levels, x_{kh} represents a combination of k demographic variables for the h_h household. Since all the demographic and income variables are dummy variables, the base level variable of each variable group is dropped in the model. The base for each group is in Appendix table 1.

This function is well suited for aggregation. This can be illustrated by simplifying the function to have only two mutually exclusive binary independent variables x_{h1} and x_{h2}. The simplified function looks like this:

$$y_{ih} = \beta_{i0} + \beta_{i1} x_{h1} + \beta_{i2} x_{h2}$$

By aggregating n households in a particular region together, we get

$$\sum_h y_{ih=} \; n\,\beta_{i0} + \beta_{i1} \sum_{h1} h1 + \beta_{i2} \sum_{h2} h2$$

Suppose there are p households in variable x_{h1} and t households in variable $x_{h2,}$, the function can be transformed as:

$$\sum_m y_{i=} \; n\,\beta_{i0} + p\beta_{i1} + t\beta_{i2}$$

This function is the foundation of the estimation and aggregation procedure.

3.3 Estimation Procedure

3.3.1. Model estimation

The specified demand function is used in this step. However, this function cannot be estimated by simple linear regression (SLR) because a substantial number of households report zero expenditure on some food product categories. This can be the result of the household having sufficient inventory for consumption during the survey period, preference for other food products, or other reasons. Including these zero expenditures while using SLR would generate negative predictions of household expenditures for some households. For products with very few zero expenditure, it might be possible to ignore the non-positive values, but for some products a large proportion of households have zero expenditures and merely examining positive observations would lead to selection bias. Other studies address this problem by two methods: the two-step Probit

model or the Tobit model.

In the first step of the two-step Probit procedure, a probit regression model is estimated to predict a household's probability of purchase, conditional on household characteristics. In the second step of the procedure, purchase levels for households that did make a purchase are regressed on a different set of explanatory variables.

The Tobit model is a one-step procedure and is a much simpler to estimate with censored data like that in CEX. Compared with the two-step Probit, Tobit model assumes that a consumer's choice of whether or not to buy and how much to buy is determined by the same sets of variables. Although this assumption makes it impossible to separate effects of variables on the decision to purchase and the level of purchase, the Tobit model is still a reasonably good choice for at least two reasons. First, there is no well-accepted evidence indicating which variables should appear in each step as in the two-step Probit procedure, and it is found that most researchers who used the two-step procedure simplify the estimation by choosing only one or two sets of variables in the second step. For example, Yen (2002) used eight sets of variables, including income, education and race in the first step but only age groups in the second step. This is quite common for other two-step procedure users. Second, use of the two-step Probit poses difficult theoretical and computational problems for the aggregation section of this study. As a result, the Tobit model was chosen as the estimation procedure for this research.

The Tobit model considers zero expenditure for a certain food product as censored. Specifically, I assume the following relationship exists.

$y^{*}=\beta_0+x\beta+u,\ u|x\sim \text{Normal}\ (0,\sigma^2)$

Where y* is a latent variable that admits all real values and represents the household expenditure of each food category. Instead we are only able to observe $y=\max(0, y^*)$

The conditional expectation of y is then expressed as.

$$E(y|x)=P(y>0|x)*E(y|y>0,x)=\Phi(x\beta/\sigma)*E(y|y>0,x) \quad (1)$$

$$E(y|y>0,x)=x\beta+\sigma\lambda(x\beta/\sigma) \quad (2)$$

Where λ is the inverse Mills ratio, which is the ratio of the probability density function (φ) to the cumulative distribution function (Φ) of a distribution

Substituting (1) into (2) yields

$$E(y|x)=\Phi(x\beta/\sigma)x\beta+\sigma\varphi(x\beta/\sigma)$$

In CEX, the approximately 7,000 Consumer Units (CU, in level of household) are used to represent all the households in the nation. However, some consumer units represent more of the population than others and hence carry more weight. In order to capture the representativeness of each household in CEX sample, this weight should be taken into account. Ignoring weights can severely affect the results. In CEX, there is a particular weight variable 'FINLWT21', which has been 'adjusted so that the sum of all CU weights for one month approximates one third of the U.S. population (2008 CEX Public Use Microdata User's Documentation). It should be explained here that each CU is recorded in two consecutive weeks, with two separate weekly expenditure records. For purpose of the research, the CU in two weeks are considered as two different CUs, which is because 1) the two weeks for each CU may be recorded in different months, so to better capture the seasonality effect; 2) the weight variable has also taken month into account, so assuming on CU's purchasing behavior in two weeks as different accounts

would match better with the weighting scheme. With this procedure, there around 14,000 accounts in each year's model.

There are two drawbacks associated with this estimation procedure. First, $E(y \mid x)$ is a nonlinear function of x and β, but for purpose of the aggregation with regional household numbers, this function is considered as linear. This simplified approximation might reduce the estimation accuracy. Second, it is assumed that the scale σ, Φ and φ are the same for this national sample as for each particular region. This means that instead of modeling particular Tobit regression for each region, which is impossible to do with CEX, the general Φ, φ and σ from the Tobit regression for national sample are considered constant when estimating the expenditures for each particular region. The most detailed regional variable in CEX is at the state level and these state variables are not complete. Even if they were complete, there would be limited records in each state out of 14,000 records. For the purpose of analyzing county level food expenditures, it is not possible to model a particular Tobit regression for every county to get the specific Φ, φ and σ. This assumption might also affect the model's accuracy. Results with these assumptions will be compared with the real national level results to indicate the accuracy, which will be discussed in section 4.

3.3.2. Aggregation

With estimated parameters from Tobit regression result for each food category and the numbers of households (n_k) in each variable group from ACS, the aggregated model function is :

$$\sum_m e_n = n\beta_0 + \sum_q n_k \Phi_k \beta_k + n\sigma\varphi$$

Because 12 month variables are included in the model for seasonality, the former calculation is done for each month separately. Merely by doing so, we can get weekly expenditure for each month because the dependent variable is weekly expenditure of each food category. But for this research, we are more interested in average annual food expenditures, so 12 months results should be summed up. This is done by specifying how many weeks in each month and then adding up all weekly expenditures; and hence the estimation result is total annual household expenditure for each food category in the particular region, which is very useful and informational. Here the results are dollar value expenditures, not quantity.

When it comes to comparing results between different regions, average household expenditure is a more appropriate unit for comparison, which is equal to total household expenditures divided by total number of households in the region. In the rest of the paper, all analysis and comparison are for average household expenditures.

4. RESULTS

4.1 Regression Results

This subsection shows results from the CEX estimation as introduced in the third section. First, I present joint significance tests for each of the demographic variable groups. Then I discuss regression results for each of the 19 food categories, in some cases grouping several similar food categories together.

Table 2 summarizes results from joint significance tests for each demographic variable group. These tests reveal the patterns of these variable groups as a whole for each of the food category. Several general patterns stand out from the results.

- **Age** and **Family Size** are jointly significant for every food category.
- **Income**, **Region** and **Ethnicity** are jointly significant for most of the food categories. Among these, **Income** is not jointly significant for pork; **Region** is not jointly significant for beef or processed vegetables; **Ethnicity** is not jointly significant for eggs.
- **Family Type**, **Number of Earners** and **Month** are jointly significant for only a few of the food categories. **Family Type** is not jointly significant for most of the meat products or processed fruits; Also, **Number of Earners** is not jointly significant for most of the meat products or processed vegetable; **Month** is not jointly significant for cereal and bakery products, dairy products, fresh vegetables, fats and oils or nonalcoholic beverage. Although these variable groups do not have statistically significant explanatory power for many food categories, they have been found to be important factors in other studies. Table 2 also proves that the previous UWM research fails to include enough important variables by arbitrarily choosing income and family composition variables.

Table 2: Joint significance tests by checking log likelihood scale

	age	income	fam_type	fam_size	region	Ethnicity	no of earner	month
Cereal & Cereal Prod	***	***	*	***	***	***	*	N
Bake Product	***	***	***	***	***	***	***	N
Beef	***	***	N	***	N	***	N	***
Pork	***	N	**	***	*	**	N	***
Other Meat	***	***	N	***	***	***	*	**
Poultry	***	**	N	***	***	***	N	***
Seafood	***	***	N	***	***	***	***	*
Eggs	***	*	N	***	***	N	N	***
Milk Product	***	***	**	***	**	***	***	N
Other Dairy	***	***	***	***	***	***	***	N
Fresh Fruit	***	***	***	***	***	***	***	***
Processed Fruit	***	***	N	***	***	***	***	***
Fresh Vegetable	***	***	***	***	***	***	N	N
Processed Vegetable	***	***	**	***	N	***	*	***
Sweets	***	***	***	***	***	***	*	***
Fats and Oils	***	***	*	***	*	***	**	N
Miscellaneous Food	***	***	N	***	***	***	***	***
Nonalchoholic Beverage	***	***	N	***	*	***	*	N
Food away from home	***	***	N	*	***	***	***	***

Note: *** Statistically significant at the 0.01 level; ** Statistically significant at the 0.05 level; * Statistically significant at the 0.1 level; N not statistically significant.

The individual analyses list the joint significance indicators below each demographic variable group. There are also some general patterns standing out from regression results of each food category.

The scales of parameters are different for food categories, which can be explained by the scale of total expenditure. For high expenditure food products, the parameters are larger while for lower expenditure food products, the parameters are relatively smaller.

Age, income level and number of earners have the strongest relationship with purchasing patterns. For some food categories, purchases increase with age; for others, households in the middle age groups purchase the most. Income does not have a consistent effect, but for some food categories there tends to be a positive relationship between income level and expenditure when households reach a certain level of income. Most food categories show some income-sensitive purchasing patterns, though not necessarily the same. Generally speaking, family size has a positive relationship with expenditure, which is reasonable. Purchases show regional differences for some food categories, and this effect is especially important when analyzing the difference between Southeastern Minnesota, Twin Cities and National expenditures. Ethnicity shows some interesting differences. African American households purchase less for nearly all the food categories compared with other ethnicities. Asian households, because of their special diet habit, show some significant difference toward expenditures on certain food categories like fresh vegetables and other dairy products. The following subsections describe regression results for each of the food categories.

(1)Cereal and bakery products

Table 3: Cereal					
Parameter	**Estimate**	**Standard Error**	**Parameter**	**Estimate**	**Standard Error**
Intercept	-5.6734***	0.8122	**Midwest**	-0.7139**	0.2859
age 25-34	1.5867***	0.4521	**South**	-1.396***	0.2603
age 35-44	1.8355***	0.4539	**West**	-1.1794***	0.2871
age 45-54	2.7043***	0.444	**Region**	***	
age 55-64	2.0345***	0.4625	**rural**	0.3461	0.4277
age 65-74	2.4581***	0.5138	**micropolitan**	-0.3763	0.3434
age 75-84	2.466***	0.5959	**African American, or Black**	-0.5717*	0.2982
age 85+	2.426***	0.6916	**American Indian, or Alaskan Native**	-3.0796*	1.7474
Age	***		**Asian**	1.6174***	0.4858
$10,000 to $14,999	0.7149	0.5255	**Native Hawaiian or Other Pacific Islander**	3.3339**	1.5749
$15,000 to $24,999	-0.522	0.4684	**Other ethnicities**	0.5197	1.0015
$25,000 to $34,999	-0.2968	0.4813	**Ethnicity**	***	
$35,000 to $49,999	0.223	0.4741	**1 earner**	-0.0748	0.3256
$50,000 to $74,999	0.5567	0.4745	**2 earners**	-0.7321*	0.3905
$75,000 to $99,999	1.6496***	0.5117	**3+ earners**	-0.8775*	0.5227
$100,000 to $149,999	1.8665***	0.5327	**Number of earner**	*	
$150,000 to $199,999	1.1568	0.7127	**feb**	0.1708	0.4425
$200,000 or more	1.753***	0.6012	**mar**	-0.0275	0.4446
Family income	**		**apr**	-0.0084	0.4378
Family with no children under age 18, with married parents	-0.0583	0.4091	**may**	0.0927	0.4306
Family with children under age 18, with a single parent	-0.543	0.4933	**jun**	-0.1651	0.4464
Family with no children under age 18, with a single parent	-0.6693	0.4658	**jul**	0.2676	0.4408
Non-family households	-0.9692**	0.4534	**aug**	0.6753	0.4353
Family type	*		**sep**	0.2593	0.439
2 people family	2.8222***	0.5739	**oct**	0.9284**	0.4288
3 people family	5.1726***	0.5161	**nov**	0.8255*	0.4391
4 people family	6.1665***	0.525	**dec**	0.2923	0.4412
5+ people family	7.9467***	0.5178	**Seasonality**	N	
Family size	***		**Scale**	9.4532	0.0908

Table 4: Bakery Products					
Parameter	**Estimate**	**Standard Error**	**Parameter**	**Estimate**	**Standard Error**
Intercept	-2.6042***	0.9383	**Midwest**	-1.0288***	0.3353
age 25-34	1.4719***	0.5223	**South**	-1.1577***	0.3047
age 35-44	2.8462***	0.524	**West**	-1.1319***	0.3355
age 45-54	3.7617***	0.5121	**Region**	***	
age 55-64	3.9534***	0.5299	**rural**	-0.3472	0.4933
age 65-74	4.9593***	0.5889	**micropolitan**	-0.1309	0.3964
age 75-84	4.6069***	0.6818	**African American, or Black**	-2.6412***	0.3497
age 85+	3.0512***	0.7966	**American Indian, or Alaskan Native**	-2.0172	1.9804
Age	***		**Asian**	-2.4747***	0.5869
$10,000 to $14,999	-0.3272	0.6049	**Native Hawaiian or Other Pacific Islander**	-0.8636	1.8753
$15,000 to $24,999	-0.4159	0.5342	**Other ethnicities**	0.0774	1.1783
$25,000 to $34,999	0.1432	0.5508	**Ethnicity**	***	
$35,000 to $49,999	0.864	0.5439	**1 earner**	-0.8132**	0.3752
$50,000 to $74,999	2.0105***	0.5442	**2 earners**	-1.8201***	0.4548
$75,000 to $99,999	3.9682***	0.5911	**3+ earners**	-1.7449***	0.6158
$100,000 to $149,999	4.6411***	0.6175	**Number of earner**	***	
$150,000 to $199,999	4.1262***	0.8342	**feb**	0.5251	0.5138
$200,000 or more	4.3902***	0.6988	**mar**	-0.0235	0.5171
Family income	***		**apr**	0.3681	0.5081
Family with no children under age 18, with married parents	-0.4831	0.4864	**may**	1.0683**	0.4988
Family with children under age 18, with a single parent	-1.5214***	0.5861	**jun**	0.0989	0.5171
Family with no children under age 18, with a single parent	-1.7879***	0.5521	**jul**	0.1118	0.5132
Non-family households	-1.1116**	0.5375	**aug**	0.3243	0.5077
Family type	***		**sep**	-0.2949	0.512
2 people family	3.5801***	0.6759	**oct**	0.8144	0.4999
3 people family	5.9052***	0.6059	**nov**	0.9576*	0.5134
4 people family	8.0997***	0.6165	**dec**	0.716	0.5146
5+ people family	9.0435***	0.6094	**Seasonality**	N	
Family size	***		**Scale**	11.7571	0.0915

Tables 3 and 4 present regression results for cereal and bakery products. For both products, there is a positive, though not strictly monotonic relationship between age and household spending level. Household expenditures also have a significant relationship with household income for both product categories. For cereal, household expenditure is significantly higher than the base level (less than $10,000) when household income exceeds $75,000. For bakery products, the difference starts when household income exceeds $50,000.

Expenditures for bakery products are significantly different across family types. Single parent households with or without children under age 18 and non-family households spend significantly less on bakery products than the base level (married parents with children under 18).

There are significant differences in expenditure levels across regions for both products; expenditures in the Midwest, South and West are significantly lower than the base level, which is the East region. Tables 3 and 4 also show differences across ethnic groups. For cereal, Asian and native Hawaiian or other Pacific Islander households spend significantly more than the base level (White). For bakery products, African American or Black and Asian households spend significantly less than the base level.

(2)Meats

Tables 5, 6 and 7 present regression results for beef, pork and other meats. There are some significant, though minor, differences associated with most of the demographic

Table 5: Beef					
Parameter	**Estimate**	**Standard Error**	**Parameter**	**Estimate**	**Standard Error**
Intercept	-21.3675***	2.1631	**Midwest**	-0.1739	0.7656
age 25-34	1.6958	1.2063	**South**	0.4858	0.6935
age 35-44	3.5999***	1.2049	**West**	-0.1887	0.7661
age 45-54	4.7941***	1.1799	**Region**	N	
age 55-64	4.9988***	1.2246	**rural**	-0.2871	1.1318
age 65-74	4.2638***	1.365	**micropolitan**	0.4928	0.9074
age 75-84	2.4594	1.6037	**African American, or Black**	-1.4992*	0.7874
age 85+	3.7292**	1.8675	**American Indian, or Alaskan Native**	0.899	4.3321
Age	***		**Asian**	-3.7477***	1.3425
$10,000 to $14,999	-0.361	1.4287	**Native Hawaiian or Other Pacific Islander**	4.7285	4.0439
$15,000 to $24,999	-1.543	1.2627	**Other ethnicities**	-4.7175*	2.8126
$25,000 to $34,999	2.0391	1.2775	**Ethnicity**	***	
$35,000 to $49,999	1.4113	1.267	**1 earner**	-0.5706	0.8667
$50,000 to $74,999	1.0211	1.2708	**2 earners**	-1.3087	1.0347
$75,000 to $99,999	2.9698**	1.3654	**3+ earners**	-0.8577	1.3705
$100,000 to $149,999	4.1314***	1.4184	**Number of earner**	N	
$150,000 to $199,999	4.7309**	1.8693	**feb**	-1.0294	1.1552
$200,000 or more	3.4094**	1.6027	**mar**	-3.8384***	1.1783
Family income	***		**apr**	-0.6254	1.1372
Family with no children under age 18, with married parents	1.1106	1.071	**may**	-1.2622	1.122
Family with children under age 18, with a single parent	-1.2243	1.3033	**jun**	-2.0872*	1.1653
Family with no children under age 18, with a single parent	0.4089	1.2175	**jul**	-1.5999	1.1562
Non-family households	-0.8702	1.1848	**aug**	-1.1288	1.1386
Family type	N		**sep**	-1.1753	1.1446
2 people family	6.8419***	1.515	**oct**	0.3199	1.1151
3 people family	12.0497***	1.3625	**nov**	-3.2574***	1.1667
4 people family	12.8572***	1.3806	**dec**	-3.3656***	1.1719
5+ people family	17.0983***	1.36	**Seasonality**	***	
Family size	***		**Scale**	23.2422	0.2648
Table 6: Pork					

Parameter	Estimate	Standard Error	Parameter	Estimate	Standard Error
Intercept	-16.9347***	1.439	**Midwest**	0.044	0.5109
age 25-34	1.3692*	0.8134	**South**	0.711	0.4622
age 35-44	3.2124***	0.8106	**West**	-0.3378	0.5122
age 45-54	4.1441***	0.7933	**Region**	*	
age 55-64	4.2232***	0.8233	**rural**	0.4383	0.7427
age 65-74	4.7652***	0.9101	**micropolitan**	0.0435	0.5987
age 75-84	3.1687***	1.0657	**African American, or Black**	0.7671	0.5148
age 85+	2.8282**	1.245	**American Indian, or Alaskan Native**	1.4687	2.8821
Age	***		**Asian**	0.3796	0.8729
$10,000 to $14,999	0.3233	0.9388	**Native Hawaiian or Other Pacific Islander**	8.992***	2.6129
$15,000 to $24,999	-0.3481	0.8295	**Other ethnicities**	1.1949	1.7467
$25,000 to $34,999	0.1905	0.8484	**Ethnicity**	**	
$35,000 to $49,999	0.4441	0.8394	**1 earner**	-0.591	0.5739
$50,000 to $74,999	0.5748	0.8408	**2 earners**	-1.4138**	0.6839
$75,000 to $99,999	1.3817	0.9056	**3+ earners**	-0.5097	0.9102
$100,000 to $149,999	0.7967	0.9452	**Number of earner**	N	
$150,000 to $199,999	-0.1093	1.2622	**feb**	-0.426	0.7708
$200,000 or more	1.3234	1.065	**mar**	-0.8223	0.7754
Family income	N		**apr**	-1.3083*	0.7658
Family with no children under age 18, with married parents	1.1106	0.715	**may**	-0.7887	0.7498
Family with children under age 18, with a single parent	-1.5321*	0.8728	**jun**	-1.5408**	0.7801
Family with no children under age 18, with a single parent	0.9542	0.8126	**jul**	-2.5183***	0.7817
Non-family households	0.9046	0.7788	**aug**	-0.9532	0.7628
Family type	**		**sep**	-1.5732**	0.7702
2 people family	6.3027***	0.9969	**oct**	0.8614	0.744
3 people family	8.9874***	0.8978	**nov**	-0.7471	0.773
4 people family	11.0118***	0.9092	**dec**	-0.1238	0.7675
5+ people family	12.4633***	0.8985	**Seasonality**	***	
Family size	***		**Scale**	15.3754	0.1821

Table 7: Other Meats

Parameter	Estimate	Standard Error	Parameter	Estimate	Standard Error
Intercept	-10.4321***	1.0713	**Midwest**	-0.8252**	0.375
age 25-34	0.198	0.5992	**South**	-1.278***	0.3423
age 35-44	1.5373***	0.5971	**West**	-1.5938***	0.3781
age 45-54	2.2825***	0.5835	**Region**	***	
age 55-64	1.516**	0.6081	**rural**	0.6068	0.5574
age 65-74	2.1108***	0.6738	**micropolitan**	-0.3649	0.4509
age 75-84	0.7554	0.7932	**African American, or Black**	-1.6983***	0.402
age 85+	1.3111	0.9204	**American Indian, or Alaskan Native**	-0.07	2.1802
Age	***		**Asian**	-3.238***	0.6966
$10,000 to $14,999	-1.1328	0.7164	**Native Hawaiian or Other Pacific Islander**	1.6738	2.0686
$15,000 to $24,999	-0.4942	0.6235	**Other ethnicities**	-1.3146	1.3638
$25,000 to $34,999	0.2389	0.6372	**Ethnicity**	***	
$35,000 to $49,999	0.8216	0.6278	**1 earner**	-0.6434	0.4293
$50,000 to $74,999	0.6541	0.6307	**2 earners**	-1.1812**	0.5117
$75,000 to $99,999	1.5019**	0.6766	**3+ earners**	-0.5372	0.6798
$100,000 to $149,999	1.5945**	0.7051	**Number of earner**	*	
$150,000 to $199,999	0.79	0.9463	**feb**	0.3745	0.5856
$200,000 or more	1.4746*	0.7944	**mar**	0.912	0.5853
Family income	***		**apr**	1.0765*	0.574
Family with no children under age 18, with married parents	-0.2338	0.5354	**may**	1.3188**	0.5629
Family with children under age 18, with a single parent	-0.912	0.6491	**jun**	0.4701	0.586
Family with no children under age 18, with a single parent	-1.0262*	0.6122	**jul**	0.9673*	0.5787
Non-family households	-0.1478	0.5861	**aug**	0.8208	0.5744
Family type	N		**sep**	0.2259	0.5829
2 people family	4.3093***	0.7507	**oct**	1.2556**	0.564
3 people family	5.474***	0.6739	**nov**	-0.3765	0.592
4 people family	6.7057***	0.6846	**dec**	-0.1707	0.5913
5+ people family	7.6486***	0.6745	**Seasonality**	**	
Family size	***		**Scale**	11.3263	0.1369

variables for household expenditure levels of other meats. There are not many significant

relationships between demographic variables and household expenditure levels.

For all three products, age has a significant relationship with household expenditure levels. Household expenditure is significantly higher in all age groups compared with base level (younger than 25), and households with householder's age between 35 and 74 have the highest expenditure levels.

There is a significant relationship between household income and household expenditure levels for beef and other meats. For both, household expenditure is significantly higher than the base level (less than $10,000) when household income exceeds $75,000. In contrast, There is not a significant relationship between household pork expenditure level and household income level.

There is no significant difference in household expenditures for beef and pork across regions. For other meats, there is significantly higher household expenditure in the West compared with the base level.

There is a significant relationship between ethnicity and meat expenditure levels. Asian households spend significantly less on beef, relative to the base level, which can be explained by the fact that beef is not a major ingredient in traditional Asian cuisine. Table 6 shows that Native Hawaiian or Other Pacific Islander households spend significantly more on pork than other ethnicities. Again, this reflects the traditional cuisine. Table 7 also shows that Asian households spend significantly less on other meats compared with base level.

(3)Poultry

Table 8: Poultry					
Parameter	**Estimate**	**Standard Error**	**Parameter**	**Estimate**	**Standard Error**
Intercept	-13.2287***	1.3632	**Midwest**	-2.4383***	0.4885
age 25-34	1.0149	0.7589	**South**	-1.682***	0.4381
age 35-44	2.1131***	0.7576	**West**	-1.4195***	0.4819
age 45-54	3.078***	0.7427	**Region**	***	
age 55-64	2.4201***	0.7743	**rural**	-1.4577*	0.7574
age 65-74	2.1186**	0.8671	**micropolitan**	-1.4291**	0.5965
age 75-84	1.3199	1.0286	**African American, or Black**	2.3734	0.4846
age 85+	-0.5105	1.2352	**American Indian, or Alaskan Native**	-0.0956***	2.8059
Age	***		**Asian**	0.613	0.82
$10,000 to $14,999	-1.3912	0.9049	**Native Hawaiian or Other Pacific Islander**	3.8892	2.6115
$15,000 to $24,999	-1.8825**	0.7951	**Other ethnicities**	-1.7176	1.7641
$25,000 to $34,999	-1.6005**	0.8138	**Ethnicity**	***	
$35,000 to $49,999	-0.8636	0.7999	**1 earner**	0.7979	0.5612
$50,000 to $74,999	-0.7233	0.802	**2 earners**	0.1412	0.6669
$75,000 to $99,999	0.2453	0.8632	**3+ earners**	0.3657	0.8805
$100,000 to $149,999	0.2825	0.8992	**Number of earner**	N	
$150,000 to $199,999	-0.3644	1.1946	**feb**	-0.2949	0.7478
$200,000 or more	0.4358	1.0121	**mar**	-1.9045**	0.7615
Family income	**		**apr**	-0.6324	0.7406
Family with no children under age 18, with married parents	-0.0382	0.6829	**may**	-0.4919	0.727
Family with children under age 18, with a single parent	-1.7995**	0.832	**jun**	-0.5029	0.7509
Family with no children under age 18, with a single parent	-0.6292	0.7769	**jul**	-0.2096	0.7438
Non-family households	0.6108	0.7409	**aug**	-0.0262	0.7343
Family type	N		**sep**	-0.1051	0.7385
2 people family	6.0084***	0.9522	**oct**	1.0737	0.7207
3 people family	9.1173***	0.8525	**nov**	1.3805*	0.7392
4 people family	9.1955***	0.8677	**dec**	-0.16	0.7471
5+ people family	11.0422***	0.855	**Seasonality**	***	
Family size	***		**Scale**	14.6569	0.1802

Table 8 presents the regression result for poultry. Household expenditure differs significantly from base level (age less than 25) when age of householder exceeds 35. Household expenditure is significantly less than base level (less than $10,000) when household income is between $15,000 and $34,999. There is a significant relationship between region and household expenditure levels. Households in the Midwest, South and West spend significantly less than households in the East, which is the base region.

(4)Fish and seafood

Table 9 presents the regression result for Fish and seafood. Age has a significant relationship with household expenditure levels. Households with age of householder between 35 and 84 purchase significantly more fish and seafood than base level (age less than 25). Of all these age groups, households with householder's age ranging 45-54 and 75-84 purchase the most fish and seafood.

There is a significant relationship between household income level and expenditure level, though the pattern is not monotonically increasing. Household expenditure level is higher than the base level when income level exceeds $25,000. Households with income $75,000-$149,999 and over $200,000 spend most on fish and seafood.

Household expenditure levels also differ significantly between different regions. Households in the Midwest, South and West spend significantly less on fish and seafood than the base region, and households in Midwest spend the least. Among ethnic groups, Asian households spend significantly more on fish and seafood compared with base level, which can be explained by their eating habits. Finally, two-earner and three-plus-earner

Table 9: Fish and Seafood

Parameter	Estimate	Standard Error	Parameter	Estimate	Standard Error
Intercept	-28.0986***	2.2843	**Midwest**	-4.1507***	0.7777
age 25-34	0.7465	1.2879	**South**	-3.5486***	0.6981
age 35-44	2.5617**	1.2809	**West**	-2.1946***	0.7608
age 45-54	5.4238***	1.2515	**Region**	***	
age 55-64	4.4542***	1.3011	**rural**	-0.6668	1.2153
age 65-74	4.6751***	1.4368	**micropolitan**	-1.6897*	0.9729
age 75-84	5.8692***	1.6428	**African American, or Black**	1.8006**	0.8036
age 85+	2.8705	1.9444	**American Indian, or Alaskan Native**	-2.3715	4.7469
Age	***		**Asian**	9.0875***	1.2078
$10,000 to $14,999	0.1868	1.511	**Native Hawaiian or Other Pacific Islander**	2.9099	4.2074
$15,000 to $24,999	0.7235	1.3255	**Other ethnicities**	0.4911	2.7659
$25,000 to $34,999	3.7408***	1.3456	**Ethnicity**	***	
$35,000 to $49,999	2.6021*	1.3386	**1 earner**	-1.2539	0.8912
$50,000 to $74,999	3.2643**	1.3364	**2 earners**	-2.4227**	1.0575
$75,000 to $99,999	7.0102***	1.4214	**3+ earners**	-4.8621***	1.4183
$100,000 to $149,999	6.8187***	1.4802	**Number of earner**	***	
$150,000 to $199,999	4.7022**	1.9563	**feb**	3.0754***	1.1892
$200,000 or more	8.4954***	1.6276	**mar**	0.8666	1.2094
Family income	***		**apr**	2.0802*	1.1837
Family with no children under age 18, with married parents	0.7705	1.1083	**may**	1.8303	1.1621
Family with children under age 18, with a single parent	-1.9405	1.3775	**jun**	0.3034	1.218
Family with no children under age 18, with a single parent	-0.6538	1.2723	**jul**	1.1922	1.1963
Non-family households	1.3019	1.2126	**aug**	2.381**	1.1763
Family type	N		**sep**	-0.9422	1.2164
2 people family	6.0489***	1.5575	**oct**	0.8649	1.1776
3 people family	8.5112***	1.3997	**nov**	0.5222	1.2099
4 people family	10.6324***	1.4172	**dec**	0.5082	1.2098
5+ people family	12.987***	1.3889	**Seasonality**	*	
Family size	***		**Scale**	21.4643	0.3119

households spend significantly less on fish and seafood than base level (no earner). This might be due to the time required and difficulty for preparing and cooking fish and seafood.

(5)Eggs

Table 10 presents the regression result for Eggs. This is a relatively low expenditure product category, so the parameters are small. Age has a significantly positive relationship with household expenditure level. Household expenditure levels differ from base level when household's age is older than 35. In contrast, income does not have much effect on egg expenditure, though households with income $35,000-$49,999 and $100,000-$149,999 spend significantly more than the base level.

(6)Dairy products

Tables 11 and 12 present regression results for fresh milk and cream and other dairy products. The results show that there are similar purchasing patterns for these two products, so the following discussion identifies common patterns and refers to both products as dairy products.

Age has significant relationship with households' expenditure level for dairy products. Household expenditure differs from base level for every age group. Households with age of householder 45-84 spend the most on dairy products, while those with the youngest and oldest householders purchase less than middle-age groups.

There is a significant relationship between household expenditure level and household income. Household expenditure is higher than base level when household income exceeds a certain income level ($75,000 for fresh milk and cream and $35,000 for

Table 10: Eggs					
Parameter	**Estimate**	**Standard Error**	**Parameter**	**Estimate**	**Standard Error**
Intercept	-4.4773***	0.4045	**Midwest**	-0.1833	0.1436
age 25-34	0.2768	0.2263	**South**	-0.0015	0.1297
age 35-44	0.7721***	0.2254	**West**	0.2996**	0.142
age 45-54	0.9388***	0.2212	**Region**	***	
age 55-64	1.1627***	0.2292	**rural**	0.1135	0.212
age 65-74	1.1085***	0.2545	**micropolitan**	-0.0806	0.1708
age 75-84	1.3501***	0.2926	**African American, or Black**	-0.1393	0.1467
age 85+	0.7264**	0.3476	**American Indian, or Alaskan Native**	-1.3003	0.8845
Age	***		**Asian**	-0.3646	0.2476
$10,000 to $14,999	0.2364	0.2652	**Native Hawaiian or Other Pacific Islander**	1.2894*	0.7499
$15,000 to $24,999	0.3203	0.2336	**Other ethnicities**	0.3813	0.4882
$25,000 to $34,999	0.1619	0.2408	**Ethnicity**	***	
$35,000 to $49,999	0.4779**	0.2372	**1 earner**	0.0133	0.1605
$50,000 to $74,999	0.3396	0.2381	**2 earners**	-0.2646	0.1922
$75,000 to $99,999	0.4766*	0.2561	**3+ earners**	-0.3479	0.2561
$100,000 to $149,999	0.8006***	0.2656	**Number of earner**	N	
$150,000 to $199,999	0.1852	0.3563	**feb**	0.3409	0.215
$200,000 or more	0.5649*	0.2994	**mar**	-0.3969*	0.2208
Family income	*		**apr**	-0.1825	0.2159
Family with no children under age 18, with married parents	0.3304*	0.2006	**may**	-0.1017	0.2108
Family with children under age 18, with a single parent	-0.2561	0.2435	**jun**	-0.4527**	0.221
Family with no children under age 18, with a single parent	0.1084	0.2282	**jul**	-0.1657	0.2166
Non-family households	0.0138	0.2196	**aug**	-0.2707	0.2153
Family type	N		**sep**	-0.3164	0.2169
2 people family	1.0928***	0.2798	**oct**	-0.1189	0.2119
3 people family	2.2542***	0.2517	**nov**	0.3078	0.2146
4 people family	2.5856***	0.2562	**dec**	0.2474	0.2147
5+ people family	3.2924***	0.2527	**Seasonality**	**	
Family size	***		**Scale**	4.3133	0.0532

Table 11: Fresh Milk and Cream					
Parameter	**Estimate**	**Standard Error**	**Parameter**	**Estimate**	**Standard Error**
Intercept	-1.9976***	0.524	**Midwest**	-0.2872	0.1862
age 25-34	0.9732***	0.2908	**South**	-0.4933***	0.1695
age 35-44	1.5563***	0.2918	**West**	-0.2965	0.1863
age 45-54	1.8197***	0.2855	**Region**	**	
age 55-64	1.6491***	0.2962	**rural**	0.752***	0.2757
age 65-74	1.8643***	0.3296	**micropolitan**	-0.4859**	0.2231
age 75-84	1.9926***	0.3816	**African American, or Black**	-1.9814***	0.1985
age 85+	1.169***	0.4472	**American Indian, or Alaskan Native**	-1.1792	1.1039
Age	***		**Asian**	-0.869***	0.3258
$10,000 to $14,999	0.16	0.341	**Native Hawaiian or Other Pacific Islander**	0.9228	1.0256
$15,000 to $24,999	0.0438	0.3009	**Other ethnicities**	0.3346	0.6498
$25,000 to $34,999	0.1979	0.3092	**Ethnicity**	***	
$35,000 to $49,999	0.2396	0.306	**1 earner**	0.06	0.2104
$50,000 to $74,999	0.3876	0.3064	**2 earners**	-0.2387	0.254
$75,000 to $99,999	1.3664***	0.3314	**3+ earners**	-1.0225***	0.3429
$100,000 to $149,999	1.6214***	0.3457	**Number of earner**	***	
$150,000 to $199,999	1.0118**	0.4649	**feb**	-0.0454	0.2851
$200,000 or more	1.4654***	0.3904	**mar**	-0.3706	0.2875
Family income	***		**apr**	-0.1707	0.2823
Family with no children under age 18, with married parents	-0.2067	0.2698	**may**	0.1274	0.2772
Family with children under age 18, with a single parent	-0.533*	0.3233	**jun**	-0.1989	0.2875
Family with no children under age 18, with a single parent	-0.833***	0.3073	**jul**	-0.242	0.285
Non-family households	-0.4942*	0.298	**aug**	-0.1606	0.2822
Family type	**		**sep**	-0.65**	0.2854
2 people family	1.8322***	0.3754	**oct**	-0.1772	0.2781
3 people family	3.4663***	0.3363	**nov**	-0.2738	0.2862
4 people family	4.4767***	0.3429	**dec**	-0.2335	0.2854
5+ people family	'5.4568***	0.3385	**Seasonality**	N	
Family size	***		**Scale**	6.4055	0.055

Table 12: Other Dairy Products					
Parameter	**Estimate**	**Standard Error**	**Parameter**	**Estimate**	**Standard Error**
Intercept	-4.5641	0.9511	**Midwest**	-0.2742	0.3347
age 25-34	1.7652	0.5315	**South**	-1.3801	0.3056
age 35-44	2.4917	0.5335	**West**	0.186	0.3335
age 45-54	3.5987	0.5206	**Region**	N	
age 55-64	3.1978	0.5386	**rural**	0.1545	0.4998
age 65-74	3.7311	0.5985	**micropolitan**	-0.2831	0.4013
age 75-84	2.572	0.6932	**African American, or Black**	-3.8562	0.3608
age 85+	2.1453	0.8055	**American Indian, or Alaskan Native**	-0.7635	1.9602
Age	***		**Asian**	-6.1568	0.6176
$10,000 to $14,999	-0.9034	0.6219	**Native Hawaiian or Other Pacific Islander**	-5.4925	2.022
$15,000 to $24,999	-0.5419	0.5449	**Other ethnicities**	0.0254	1.1809
$25,000 to $34,999	0.332	0.559	**Ethnicity**	***	
$35,000 to $49,999	1.0564	0.5513	**1 earner**	-0.3965	0.271
$50,000 to $74,999	2.0984	0.5507	**2 earners**	-0.845	0.3247***
$75,000 to $99,999	4.1746	0.5952	**3+ earners**	-0.6436	0.434
$100,000 to $149,999	5.3994	0.62	**Number of earner**	*	
$150,000 to $199,999	5.0198	0.829	**feb**	0.4238	0.3626
$200,000 or more	5.5149	0.6979	**mar**	-0.4605	0.3677
Family income	***		**apr**	-0.0441	0.3603
Family with no children under age 18, with married parents	0.2149	0.486	**may**	0.1162	0.3542
Family with children under age 18, with a single parent	-1.2884	0.5921	**jun**	-0.5203	0.3693
Family with no children under age 18, with a single parent	-1.5412	0.5544	**jul**	-0.7999**	0.3674
Non-family households	-0.9757	0.5405	**aug**	-0.3568	0.3624
Family type	**		**sep**	-0.3912	0.3648
2 people family	2.8692	0.6813	**oct**	0.4799	0.353
3 people family	4.8854	0.6099	**nov**	0.5796	0.3629
4 people family	5.9952	0.6203	**dec**	-0.0883	0.3653
5+ people family	6.726	0.6142	**Seasonality**	***	
Family size	***		**Scale**	7.6031	0.0799

other dairy products). Households with income $100,000-$149,999 and over $200,000 spend the most on dairy products.

Households living in South spend significantly less on dairy products than households in the base region. Some ethnicities also have significantly different household expenditure levels. African American households spend significantly less on dairy products than the base ethnic group, which is consistent with other food categories expenditure patterns. Asian households also spend significantly less on dairy products than the base group. This difference is more significant in other dairy products than in fresh milk and cream. This can be explained by unique eating and cooking habits that generally do not include dairy products other than milk.

(7)Fruits and Vegetables

Tables 13, 14, 15 and 16 present regression results for fresh fruits, fresh vegetables, processed fruits and processed vegetables. These four products categories show some general patterns as well as some specific patterns.

Age has a significantly positive, though not strictly monotonic relationship with household expenditure on fruits and vegetables. Fruits and vegetables expenditure have a significantly positive, though not strictly increasing, relationship with household income when it exceeds a certain level ($35,000 for fresh fruits, $50,000 for processed fruits and vegetables, $75,000 for fresh vegetables).

There is a significant relationship between family type and household expenditure level on fresh fruits. Families with married couple and children under 18 spend the most on fresh fruits and families with married couple and no children under 18 spend the least.

Table 13: Fresh Fruits					
Parameter	**Estimate**	**Standard Error**	**Parameter**	**Estimate**	**Standard Error**
Intercept	-5.7015***	0.9592	**Midwest**	-0.6279*	0.3339
age 25-34	1.817***	0.5364	**South**	-1.4089***	0.3044
age 35-44	2.9379***	0.5373	**West**	1.1045***	0.3298
age 45-54	4.0089***	0.5242	**Region**	***	
age 55-64	4.0405***	0.5416	**rural**	-0.2312	0.5056
age 65-74	4.6859***	0.5983	**micropolitan**	-1.3352***	0.4065
age 75-84	5.0628***	0.6874	**African American, or Black**	-2.9645	0.3594
age 85+	3.7999***	0.7981	**American Indian, or Alaskan Native**	0.0816	1.9553
Age	***		**Asian**	0.6304	0.5657
$10,000 to $14,999	-0.0163	0.618	**Native Hawaiian or Other Pacific Islander**	-2.7623	1.9255
$15,000 to $24,999	-0.2848	0.5431	**Other ethnicities**	2.243*	1.1522
$25,000 to $34,999	0.5058	0.5581	**Ethnicity**	***	
$35,000 to $49,999	0.5452***	0.5516	**1 earner**	-0.5038	0.3754
$50,000 to $74,999	1.8004***	0.5495	**2 earners**	-1.8365***	0.4521
$75,000 to $99,999	2.9474***	0.5929	**3+ earners**	-2.0134***	0.6107
$100,000 to $149,999	3.833***	0.6189	**Number of earner**	***	
$150,000 to $199,999	4.7479***	0.8216	**feb**	0.2345	0.5149
$200,000 or more	5.4325***	0.6915	**mar**	-0.079	0.5189
Family income	***		**apr**	1.3966***	0.5057
Family with no children under age 18, with married parents	-0.8365*	0.4837	**may**	1.6356***	0.4964
Family with children under age 18, with a single parent	-3.7413***	0.5976	**jun**	1.9732***	0.5108
Family with no children under age 18, with a single parent	-2.1026***	0.5511	**jul**	1.2789**	0.5119
Non-family households	-1.9238***	0.543	**aug**	1.4356***	0.5057
Family type	***		**sep**	0.3911	0.511
2 people family	3.2001***	0.6827	**oct**	0.188	0.5023
3 people family	4.9935***	0.6128	**nov**	-0.2776	0.5178
4 people family	5.0994***	0.6234	**dec**	-0.5646	0.5187
5+ people family	6.1946***	0.6151	**Seasonality**	***	
Family size	***		**Scale**	11.222	0.0995

Table 14: Fresh Vegetables					
Parameter	**Estimate**	**Standard Error**	**Parameter**	**Estimate**	**Standard Error**
Intercept	-5.3243***	0.899	**Midwest**	-1.2836***	0.3159
age 25-34	2.1907***	0.5052	**South**	-1.4341***	0.2871
age 35-44	3.1793***	0.506	**West**	0.9068***	0.3115
age 45-54	4.0077***	0.4948	**Region**	***	
age 55-64	4.1685***	0.5112	**rural**	0.4095	0.4757
age 65-74	4.0547***	0.5671	**micropolitan**	-1.2485***	0.3848
age 75-84	4.6794***	0.6525	**African American, or Black**	-2.3452***	0.3369
age 85+	3.8327***	0.7581	**American Indian, or Alaskan Native**	-2.2327	1.8962
Age	***		**Asian**	3.0225***	0.5244
$10,000 to $14,999	-1.0729*	0.5857	**Native Hawaiian or Other Pacific Islander**	0.4125	1.7165
$15,000 to $24,999	-0.9137*	0.5123	**Other ethnicities**	0.0054	1.1016
$25,000 to $34,999	0.189	0.5246	**Ethnicity**	***	
$35,000 to $49,999	-0.2244	0.5193	**1 earner**	0.0219	0.3569
$50,000 to $74,999	0.716	0.5182	**2 earners**	-0.5677	0.4288
$75,000 to $99,999	2.0839***	0.5596	**3+ earners**	-0.7066	0.5784
$100,000 to $149,999	2.3787***	0.5836	**Number of earner**	N	
$150,000 to $199,999	2.4266***	0.7783	**feb**	-0.2174	0.484
$200,000 or more	4.1092***	0.6544	**mar**	-0.428	0.4863
Family income	***		**apr**	-0.0617	0.4764
Family with no children under age 18, with married parents	1.0397**	0.4543	**may**	-0.0847	0.4687
Family with children under age 18, with a single parent	-1.9497***	0.5588	**jun**	-0.8331*	0.4865
Family with no children under age 18, with a single parent	-0.5415	0.5172	**jul**	0.0079	0.4798
Non-family households	-0.8646*	0.5095	**aug**	0.2834	0.4748
Family type	***		**sep**	-1.0133**	0.482
2 people family	2.6031***	0.6406	**oct**	0.1455	0.4701
3 people family	4.1502***	0.5759	**nov**	-0.0426	0.4821
4 people family	4.7678***	0.5854	**dec**	-0.4653	0.4836
5+ people family	5.8193***	0.578	**Seasonality**	N	
Family size	***		**Scale**	10.6311	0.0934

Table 15: Processed Fruits					
Parameter	**Estimate**	**Standard Error**	**Parameter**	**Estimate**	**Standard Error**
Intercept	-4.4516***	0.7201	**Midwest**	-0.8612***	0.254
age 25-34	-0.0166	0.4008	**South**	-1.4588***	0.2312
age 35-44	0.1469	0.402	**West**	-0.7171***	0.2533
age 45-54	1.1165***	0.3923	**Region**	***	
age 55-64	0.8136**	0.4084	**rural**	-0.3619	0.3868
age 65-74	1.6746***	0.4535	**micropolitan**	-0.2421	0.3081
age 75-84	2.0416***	0.5226	**African American, or Black**	-0.2437	0.266
age 85+	2.2972***	0.603	**American Indian, or Alaskan Native**	-2.6018	1.5933
Age	***		**Asian**	-1.9536***	0.4575
$10,000 to $14,999	-1.0471**	0.4779	**Native Hawaiian or Other Pacific Islander**	1.4768	1.4048
$15,000 to $24,999	-0.1315	0.4146	**Other ethnicities**	0.5728	0.891
$25,000 to $34,999	0.0193	0.428	**Ethnicity**	***	
$35,000 to $49,999	0.5964	0.4215	**1 earner**	-0.4767*	0.2899
$50,000 to $74,999	1.4186***	0.4214	**2 earners**	-1.159***	0.3485
$75,000 to $99,999	2.3428***	0.454	**3+ earners**	-1.407	0.4657
$100,000 to $149,999	2.9385***	0.4729	**Number of earner**	888	
$150,000 to $199,999	3.2886***	0.6279	**feb**	0.4602	0.3924
$200,000 or more	2.3739***	0.5334	**mar**	-0.5595	0.3997
Family income	***		**apr**	0.4792	0.3877
Family with no children under age 18, with married parents	-0.3424	0.3654	**may**	0.0884	0.3828
Family with children under age 18, with a single parent	-0.3712	0.443	**jun**	-0.0514	0.3968
Family with no children under age 18, with a single parent	-0.5894	0.4171	**jul**	-0.288	0.3951
Non-family households	-0.6481	0.4053	**aug**	0.2638	0.3879
Family type	N		**sep**	-0.2034	0.3926
2 people family	1.6613***	0.5129	**oct**	0.1978	0.3838
3 people family	3.4977***	0.461	**nov**	1.0769***	0.3894
4 people family	4.3618***	0.468	**dec**	0.4228	0.3922
5+ people family	4.8964***	0.463	**Seasonality**	***	
Family size	***		**Scale**	8.1425	0.0868

Table 16: Processed Vegetables					
Parameter	**Estimate**	**Standard Error**	**Parameter**	**Estimate**	**Standard Error**
Intercept	-6.3941***	0.6781	**Midwest**	-0.012	0.2383
age 25-34	1.1969***	0.3781	**South**	-0.265	0.2175
age 35-44	1.4483***	0.3794	**West**	-0.2628	0.2395
age 45-54	2.0979***	0.3714	**Region**	N	
age 55-64	1.9788***	0.3856	**rural**	0.5906*	0.349
age 65-74	1.7864***	0.4296	**micropolitan**	0.2202	0.2823
age 75-84	2.0077***	0.4961	**African American, or Black**	-0.7188***	0.2494
age 85+	1.4422**	0.5791	**American Indian, or Alaskan Native**	0.3902	1.3609
Age	***		**Asian**	-1.6579***	0.4268
$10,000 to $14,999	-0.1494	0.4447	**Native Hawaiian or Other Pacific Islander**	0.1277	1.3499
$15,000 to $24,999	0.2294	0.3902	**Other ethnicities**	-1.2594	0.8695
$25,000 to $34,999	0.4131	0.4009	**Ethnicity**	***	
$35,000 to $49,999	0.3682	0.3968	**1 earner**	-0.3965	0.271
$50,000 to $74,999	0.893**	0.3963	**2 earners**	-0.845	0.3247***
$75,000 to $99,999	1.5342***	0.4272	**3+ earners**	-0.6436	0.434
$100,000 to $149,999	1.7682***	0.4443	**Number of earner**	*	
$150,000 to $199,999	0.5632	0.597	**feb**	0.4238	0.3626
$200,000 or more	1.4226***	0.5024	**mar**	-0.4605	0.3677
Family income	***		**apr**	-0.0441	0.3603
Family with no children under age 18, with married parents	0.3141	0.3403	**may**	0.1162	0.3542
Family with children under age 18, with a single parent	-0.866**	0.4137	**jun**	-0.5203	0.3693
Family with no children under age 18, with a single parent	-0.276	0.3876	**jul**	-0.7999**	0.3674
Non-family households	-0.0056	0.3745	**aug**	-0.3568	0.3624
Family type	**		**sep**	-0.3912	0.3648
2 people family	2.3975	0.4758	**oct**	0.4799	0.353
3 people family	4.1034***	0.4266	**nov**	0.5796	0.3629
4 people family	4.5332***	0.4343	**dec**	-0.0883	0.3653
5+ people family	5.4751***	0.4285	**Seasonality**	***	
Family size	***		**Scale**	7.6031	0.0799

There are no such patterns for processed fruits, fresh or processed vegetables.

Region has some significant relationships with household expenditure levels on fruits and vegetables. Households in the West spend significantly more on fresh fruits and vegetables than base level, while those in the South spend significantly less. Households in Midwest, South and West spend significantly less on processed fruits than base level. There is no significant regional pattern for expenditures on processed vegetables. In addition, households in micropolitan areas spend significantly less on fresh fruits and vegetables compared with base level (metropolitan area).

Household expenditure levels for some of these products are also significantly associated with some ethnicities. African or black households spend significantly less on fresh fruits and vegetables and processed vegetables than the base ethnic group. Asian households spend significantly less on processed fruits and vegetables and more on fresh vegetables, compared with the base group.

There is also a significant relationship between number of household and household expenditures on some fruits and vegetables products. Households of two or more earners spend less on fruits than base level. Finally, household expenditures on some fruits and vegetables differ by month. Households spend significantly more on fresh fruits from April to August than in the base month (January).

(8)Sugar and other sweets

Table 17 presents the regression result for sugar and other sweets. There is a significant relationship between household expenditure level and both age and household income. The relationship is increasing at the beginning and then decreasing. Family type

Table 17: Sugar and Other Sweets					
Parameter	**Estimate**	**Standard Error**	**Parameter**	**Estimate**	**Standard Error**
Intercept	-9.0834***	0.8629	**Midwest**	0.5262*	0.3027
age 25-34	0.6609	0.4803	**South**	-0.6436**	0.2778
age 35-44	1.7464***	0.4801	**West**	0.2265	0.303
age 45-54	2.2175***	0.47	**Region**	***	
age 55-64	2.5291***	0.4874	**rural**	0.3243	0.4471
age 65-74	3.307***	0.5394	**micropolitan**	-0.3178	0.3601
age 75-84	3.1626***	0.6258	**African American, or Black**	-1.6966***	0.3206
age 85+	0.8799	0.7526	**American Indian, or Alaskan Native**	0.1715	1.7114
Age	***		**Asian**	-1.7027***	0.539
$10,000 to $14,999	0.3649	0.5636	**Native Hawaiian or Other Pacific Islander**	-0.6119	1.7104
$15,000 to $24,999	0.2864	0.4978	**Other ethnicities**	-0.9868	1.081
$25,000 to $34,999	0.3098	0.5105	**Ethnicity**	***	
$35,000 to $49,999	0.7956	0.5046	**1 earner**	-0.4142	0.3426
$50,000 to $74,999	0.939*	0.5052	**2 earners**	-0.4232	0.4112
$75,000 to $99,999	1.825***	0.5443	**3+ earners**	0.5779	0.5487
$100,000 to $149,999	2.682***	0.5651	**Number of earner**	*	
$150,000 to $199,999	1.8638**	0.7544	**feb**	2.0722***	0.4669
$200,000 or more	1.8581***	0.6391	**mar**	1.4313***	0.4708
Family income	***		**apr**	0.3434	0.469
Family with no children under age 18, with married parents	-1.425***	0.4332	**may**	1.4734***	0.4552
Family with children under age 18, with a single parent	-1.1192**	0.5238	**jun**	0.2211	0.4786
Family with no children under age 18, with a single parent	-1.7173***	0.4943	**jul**	0.2738	0.4717
Non-family households	-0.3824	0.4732	**aug**	0.7613	0.4648
Family type	***		**sep**	0.5889	0.469
2 people family	4.2118***	0.6038	**oct**	1.9693***	0.4553
3 people family	4.8269***	0.5418	**nov**	1.7001***	0.4683
4 people family	5.4928***	0.55	**dec**	2.6704***	0.465
5+ people family	6.4029***	0.5442	**Seasonality**	***	
Family size	***		**Scale**	9.6877	0.0985

is also associated with household expenditure level. Households with children under 18 spend more on sugar and other sweets than other family types. African American and Asian households spend significantly less on sugar and other sweets than base ethnic groups.

(9)Fats and oils

Table 18 presents the regression result for fats and oils. There is a positive, though not strictly monotonic relationship between age and household expenditure level. Income is not strongly associated with fats and oils expenditures, but household expenditure does differ from base level when household income is between $75,000 and $149,000. Finally, African American and Asian households spend more on fats and oils than the base ethnic group.

(10)Miscellaneous foods

Table 19 presents the regression result for miscellaneous foods. There is a positive, though not strictly monotonic relationship between household expenditure level and household income. Number of earners has a negative relationship with household expenditure level. Finally, African American and Asian households spend less on miscellaneous foods than the base group.

(11)Nonalcoholic beverages

Table 20 presents the regression result for nonalcoholic beverages. There is a negative, though not strictly monotonic relationship between age and household expenditure level. Once again, African American and Asian households spend less on nonalcoholic beverages than the base ethnic group.

Table 18: Fats and Oils					
Parameter	**Estimate**	**Standard Error**	**Parameter**	**Estimate**	**Standard Error**
Intercept	-8.7794***	0.8356	**Midwest**	-0.4962*	0.2901
age 25-34	1.2048***	0.4683	**South**	-0.705***	0.2637
age 35-44	1.7496***	0.4682	**West**	-0.5572*	0.2906
age 45-54	2.5293***	0.4576	**Region**	*	
age 55-64	2.3373***	0.4745	**rural**	0.7379*	0.426
age 65-74	2.7198***	0.5233	**micropolitan**	-0.2218	0.3458
age 75-84	2.6164***	0.604	**African American, or Black**	-1.4003***	0.3088
age 85+	0.3484	0.7307	**American Indian, or Alaskan Native**	1.019	1.6205
Age	***		**Asian**	-1.5985***	0.5241
$10,000 to $14,999	0.4074	0.5453	**Native Hawaiian or Other Pacific Islander**	2.2065	1.5629
$15,000 to $24,999	0.6383	0.4789	**Other ethnicities**	-0.6902	1.0325
$25,000 to $34,999	0.1342	0.4951	**Ethnicity**	***	
$35,000 to $49,999	0.6846	0.4873	**1 earner**	-0.7371**	0.3286
$50,000 to $74,999	0.9437*	0.4881	**2 earners**	-1.2084***	0.3934
$75,000 to $99,999	1.8545***	0.5231	**3+ earners**	-0.6766	0.5241
$100,000 to $149,999	1.7483***	0.5455	**Number of earner**	**	
$150,000 to $199,999	0.9579	0.7278	**feb**	-0.323	0.453
$200,000 or more	0.8967	0.6202	**mar**	-0.0435	0.4532
Family income	***		**apr**	0.4114	0.4425
Family with no children under age 18, with married parents	0.7074*	0.411	**may**	0.3912	0.4366
Family with children under age 18, with a single parent	-0.1446	0.4987	**jun**	0.4261	0.4492
Family with no children under age 18, with a single parent	-0.1964	0.4714	**jul**	0.3662	0.4466
Non-family households	0.0251	0.4574	**aug**	0.7265*	0.439
Family type	*		**sep**	0.1642	0.4461
2 people family	2.8489***	0.5807	**oct**	0.719*	0.4345
3 people family	4.5502***	0.5227	**nov**	0.8558*	0.4466
4 people family	5.1541***	0.5308	**dec**	0.7052	0.4467
5+ people family	6.2077***	0.5231	**Seasonality**	N	
Family size	***		**Scale**	8.9572	0.1034

Table 19: Miscellaneous Foods					
Parameter	**Estimate**	**Standard Error**	**Parameter**	**Estimate**	**Standard Error**
Intercept	-6.8968***	1.802	**Midwest**	1.2101*	0.6468
age 25-34	2.968***	0.9912	**South**	-0.6287	0.5898
age 35-44	4.1839***	0.9962	**West**	1.5353**	0.6456
age 45-54	5.3707***	0.9732	**Region**	***	
age 55-64	4.2529***	1.0096	**rural**	0.2214	0.9525
age 65-74	4.7859***	1.1275	**micropolitan**	-1.241	0.7643
age 75-84	4.912***	1.3073	**African American, or Black**	-6.5054***	0.6765
age 85+	-0.0415	1.5416	**American Indian, or Alaskan Native**	-6.6833*	3.8209
Age	***		**Asian**	-5.4744***	1.1228
$10,000 to $14,999	-0.0883	1.1721	**Native Hawaiian or Other Pacific Islander**	2.9066	3.574
$15,000 to $24,999	0.6494	1.0317	**Other ethnicities**	3.6665*	2.2256
$25,000 to $34,999	1.6707	1.0613	**Ethnicity**	***	
$35,000 to $49,999	3.2982***	1.0481	**1 earner**	-1.5637**	0.7236
$50,000 to $74,999	5.7013***	1.0493	**2 earners**	-2.3443***	0.8763
$75,000 to $99,999	9.3177***	1.14	**3+ earners**	-2.833**	1.1879
$100,000 to $149,999	11.5223***	1.1893	**Number of earner**	***	
$150,000 to $199,999	9.0338***	1.6103	**feb**	0.2182	0.9905
$200,000 or more	10.5609***	1.3483	**mar**	-2.435**	0.9972
Family income	***		**apr**	0.1742	0.9758
Family with no children under age 18, with married parents	-1.951**	0.9395	**may**	0.608	0.9608
Family with children under age 18, with a single parent	-0.7195	1.1246	**jun**	-0.1156	0.9959
Family with no children under age 18, with a single parent	-2.3681**	1.0624	**jul**	0.6599	0.9848
Non-family households	0.712	1.0357	**aug**	0.4675	0.9779
Family type	N		**sep**	-0.0904	0.9818
2 people family	8.8103***	1.3012	**oct**	2.4729**	0.9616
3 people family	12.4493***	1.1635	**nov**	1.4561	0.9877
4 people family	15.1843***	1.1876	**dec**	-0.1551	0.9904
5+ people family	17.0249***	1.1752	**Seasonality**	***	
Family size	***		**Scale**	22.7619	0.1732

Table 20: Nonalcoholic Beverages					
Parameter	**Estimate**	**Standard Error**	**Parameter**	**Estimate**	**Standard Error**
Intercept	-6.261***	1.1626	**Midwest**	-0.7005*	0.4223
age 25-34	0.6519	0.6423	**South**	-0.2141	0.3829
age 35-44	2.6771***	0.6438	**West**	0.3842	0.4201
age 45-54	3.3864***	0.6293	**Region**	*	
age 55-64	1.5594**	0.6557	**rural**	-0.1669	0.6226
age 65-74	1.4719**	0.7345	**micropolitan**	-0.2993	0.4987
age 75-84	0.7113	0.8576	**African American, or Black**	-2.6082***	0.435
age 85+	-2.765***	1.0329	**American Indian, or Alaskan Native**	2.0194	2.4279
Age	***		**Asian**	-2.8896***	0.7335
$10,000 to $14,999	-0.2464	0.7649	**Native Hawaiian or Other Pacific Islander**	2.717	2.2885
$15,000 to $24,999	-0.2525	0.6719	**Other ethnicities**	0.5726	1.4541
$25,000 to $34,999	0.1157	0.6909	**Ethnicity**	***	
$35,000 to $49,999	0.616	0.6814	**1 earner**	-0.629	0.4727
$50,000 to $74,999	1.7266**	0.6818	**2 earners**	-1.0175*	0.5699
$75,000 to $99,999	2.6889***	0.7409	**3+ earners**	0.1159	0.7674
$100,000 to $149,999	3.8376***	0.7731	**Number of earner**	*	
$150,000 to $199,999	3.1684***	1.0375	**feb**	0.5837	0.6455
$200,000 or more	2.6204***	0.8774	**mar**	0.2193	0.6478
Family income	***		**apr**	1.039	0.6362
Family with no children under age 18, with married parents	-0.2642	0.6041	**may**	1.3044**	0.6253
Family with children under age 18, with a single parent	-0.3892	0.7231	**jun**	1.3161**	0.6467
Family with no children under age 18, with a single parent	-0.2844	0.6836	**jul**	1.4221**	0.641
Non-family households	0.67	0.6619	**aug**	0.9455	0.6366
Family type	N		**sep**	0.1929	0.6415
2 people family	5.6785***	0.8356	**oct**	0.7053	0.6287
3 people family	8.1332***	0.7476	**nov**	0.6559	0.6463
4 people family	9.4621***	0.7638	**dec**	-0.3905	0.6484
5+ people family	10.4365***	0.7541	**Seasonality**	N	
Family size	***		**Scale**	14.3979	0.1218

(12)Food away from home

Table 21 presents the regression result for food away from home. There is a positive, though not strictly monotonic relationship between age and household expenditure level. As expected, household income has a significantly positive relationship with household expenditure level in contrast with most other food categories, however, there is not a strong relationship between family size and household expenditures. Only four and five-people households spend significantly more on food away from home than base level (one person household).

Households in micropolitan areas spend significantly less on food away from home than those in metropolitan areas. African American households also spend significantly less on food away from home than base level. Finally, as expected, there is a positive relationship between number of earners and household expenditure on food away from home.

4.2 Household Demographic Patterns

This section presents data on the number of households associated with each demographic variable for the three geographic areas considered in this analysis: nation, Twin Cities Metro area (TC) and Southeast Minnesota area (SEMN). Using the regression results for each food category and multiplying parameters by the number of households for each variable yields estimates of household expenditures in a specific area. It's estimated that the distribution of each demographic variable group is significantly different between the three geographic areas.

Table 21: Food away from Home					
Parameter	**Estimate**	**Standard Error**	**Parameter**	**Estimate**	**Standard Error**
Intercept	-4.609	5.6244	**Midwest**	-3.1333	2.0419
age 25-34	-5.662*	3.0138	**South**	3.3147*	1.8551
age 35-44	-10.0434***	3.049	**West**	-1.4799	2.0362
age 45-54	-12.8856***	2.9748	**Region**	***	
age 55-64	-15.8553***	3.0886	**rural**	0.3728	3.0084
age 65-74	-12.6823***	3.493	**micropolitan**	-7.4039***	2.4011
age 75-84	-21.4961***	4.1357	**African American, or Black**	-13.8316***	2.108
age 85+	-18.1053***	4.8577	**American Indian, or Alaskan Native**	0.7841	11.7735
Age	***		**Asian**	-0.2142	3.4741
$10,000 to $14,999	0.4085	3.7562	**Native Hawaiian or Other Pacific Islander**	6.5571	11.3246
$15,000 to $24,999	3.6392	3.3014	**Other ethnicities**	11.4136	7.0218
$25,000 to $34,999	14.9058***	3.3703	**Ethnicity**	***	
$35,000 to $49,999	22.7702***	3.3231	**1 earner**	12.1305***	2.3192
$50,000 to $74,999	34.2403***	3.3274	**2 earners**	15.6464***	2.7993
$75,000 to $99,999	48.25***	3.6163	**3+ earners**	19.8297***	3.7783
$100,000 to $149,999	66.1344***	3.7713	**Number of earner**	***	
$150,000 to $199,999	88.2608***	5.0396	**feb**	5.9039*	3.1068
$200,000 or more	86.8968***	4.2392	**mar**	3.5557	3.1184
Family income	***		**apr**	6.315**	3.0688
Family with no children under age 18, with married parents	-3.4823	2.9728	**may**	5.2835*	3.0292
Family with children under age 18, with a single parent	-0.0289	3.5646	**jun**	4.1582	3.1296
Family with no children under age 18, with a single parent	-7.0228**	3.3597	**jul**	-2.9739	3.1265
Non-family households	-0.1478	3.2791	**aug**	5.5897*	3.0748
Family type	N		**sep**	-1.489	3.0927
2 people family	5.2957	4.1105	**oct**	3.1545	3.0365
3 people family	4.8718	3.6622	**nov**	-2.0677	3.1294
4 people family	9.6447**	3.7551	**dec**	-0.9463	3.119
5+ people family	8.4309**	3.7117	**Seasonality**	***	
Family size	*		**Scale**	72.1568	0.5245

Table 22 presents the household demographic pattern results. The distribution of household numbers for each demographic variable group differs across these three areas, Table 23 presents the Chi-squared test results of these distributions and they are significantly different. While absolute numbers of households are not directly comparable across these three areas, relative shares of households can be compared.

Table23: Distributions of household numbers across variables in each variable group

	Nation vs TC	Nation vs SEMN	TC vs SEMN
Age	***	***	***
Income	***	***	***
Fam_type	***	***	***
Fam_size	***	***	***
Ethnicity	***	***	***
No. of earner	***	***	***

Note: *** Statistically significant at the 0.01 level

There are noteworthy differences in the distribution of households across householder age groups. Compared with figures for the nation, percentages of households in TC with householder's age 35-44 are higher and those for age over 65 are lower; for SEMN, percentages of households with householder's age over 75 are higher. Therefore, the age composition in TC is younger than national level while that in SEMN is older. The share of higher-income households in TC is higher than that in SEMN and nationwide. Compared with national level, there are lower percentages of households with income $10,000-$34,999 and a higher percentage of households with income over $75,000 in TC; there are higher percentages of households with income $35,000-$74,999 and lower percentage with income over $100,000 in SEMN.

Table 22: Number of households in each variable

	National		TC Metro		SEMN	
	Total	Percent	Total	Percent	Total	Percent
Intercept	112,386,298	100.00%	1,255,120	100.00%	308785	100.00%
age 25-34	18037058	16.05%	217831	17.36%	48704	15.77%
age 35-44	22634635	20.14%	279910	22.30%	57966	18.77%
age 45-54	24348213	21.66%	295313	23.53%	64037	20.74%
age 55-64	18890339	16.81%	202421	16.13%	46973	15.21%
age 65-74	11789769	10.49%	103968	8.28%	32940	10.67%
age 75-84	8440959	7.51%	69092	5.50%	26392	8.55%
age 85+	2977530	2.65%	27438	2.19%	11266	3.65%
$10,000 to $14,999	6139558	5.46%	44,948	3.58%	16742	5.42%
$15,000 to $24,999	11921076	10.61%	90,918	7.24%	34609	11.21%
$25,000 to $34,999	11899350	10.59%	101,909	8.12%	33331	10.79%
$35,000 to $49,999	15951147	14.19%	160,830	12.81%	49586	16.06%
$50,000 to $74,999	21109871	18.78%	247,897	19.75%	66857	21.65%
$75,000 to $99,999	13992314	12.45%	194,201	15.47%	41405	13.41%
$100,000 to $149,999	13758104	12.24%	210,723	16.79%	31711	10.27%
$150,000 to $199,999	4858631	4.32%	74,712	5.95%	8185	2.65%
$200,000 or more	4710621	4.19%	68,819	5.48%	7609	2.46%
Family with no children under age 18, with married parents	31660934	28.17%	336979	26.85%	98438	31.88%
Family with children under age 18, with a single parent	10839688	9.65%	108430	8.64%	22977	7.44%
Family with no children under age 18, with a single parent	8324775	7.41%	65946	5.25%	12117	3.92%
Non-family households	37515773	33.38%	443,841	35.36%	103589	33.55%
2 people family	37335641	33.22%	412636	32.88%	112423	36.41%
3 people family	17861625	15.89%	188847	15.05%	43352	14.04%
4 people family	15267746	13.59%	180782	14.40%	40840	13.23%
5+ people family	11027068	9.81%	117655	9.37%	27718	8.98%
Midwest	25786905	22.94%	1,255,120	100.00%	308785	100.00%
South	41378050	36.82%	0	0.00%	0	0.00%
West	24596861	21.89%	0	0.00%	0	0.00%
rural	23405242	20.83%	0	0.00%	32302	10.46%
micropolitan	22561641	20.08%	0	0.00%	169283	54.82%
African American, or Black	13183271	11.73%	72,581	5.78%	2569	0.83%
American Indian, or Alaskan Native	792477	0.71%	6,144	0.49%	818	0.26%
Asian	4160264	3.70%	44,470	3.54%	3913	1.27%
Native Hawaiian or Other Pacific Islander	125451	0.11%	343	0.03%	67	0.02%
Other ethnicities	6203903	5.52%	27666	2.20%	2772	0.90%
1 earner	43949449	39.11%	479,816	38.23%	98412	31.87%
2 earners	32729572	29.12%	435,555	34.70%	118342	38.33%
3+ earners	7201318	6.41%	96,710	7.71%	25575	8.28%

The distribution of households by composition shows similar patterns in both TC and SEMN area. Relative to the nation, both have a higher percentage of households with married parents and children under 18 and a lower percentage of households with a single parent. There is higher percentage of households with married parents without children under 18 in SEMN.

The share of number of household members (family size) does not differ much in the three areas. And it is not surprising that there is a higher percentage of rural households in SEMN.

Compared with national level, there is a much higher percentage of White American households and a lower percentage of all other ethnicities households in TC, and this percentage is even lower in SEMN. Also different from the national level, there is higher percentage of households with more than two earners (including two earners) in TC and SEMN.

The percentage of households in each variable is useful for understanding regional differences. The differences can be explained by scale of contribution from each variable, which will be explained in the next section.

4.3 Performance Check

After discussing the specification and estimation of the model, it's important to check the accuracy of the food expenditure estimates. This performance check is only done at national level. Accuracy is measured by comparing the estimated average household expenditures on 19 food categories with the real expenditures directly provided by CEX at national level. Table 24 presents this comparison result.

Table 24: Average National Household Expenditure of Real CEX and Model Estimated results

Food Category	Real CEX ($/year)	Model Estimation ($/year)	CEX/Estimate
Cereals and cereal products	170	160	1.06
Bakery products	337	349	0.97
Beef	239	240	1.00
Pork	163	148	1.10
Other meats	106	101	1.05
Poultry	159	136	1.17
Fish and seafood	128	115	1.11
Eggs	51	45	1.13
Fresh milk and cream	168	163	1.03
Other dairy products	261	246	1.06
Fresh fruits	222	218	1.02
Fresh vegetables	212	212	1.00
Processed fruits	116	113	1.03
Processed vegetables	107	107	1.00
Sugar and other sweets	129	132	0.98
Fats and oils	104	98	1.06
Miscellaneous foods	680	697	0.98
Nonalcoholic beverages	342	328	1.04
Food away from home	2,698	2494	1.08
Total	6,392	6,101	1.05

In this table, the second column shows the public use expenditures directly published by CEX and the third column shows the estimated expenditures from the model. The last column presents a comparison scale, which is the ratio of the published CEX expenditures to estimated expenditures. The comparison here is to see how close the estimated expenditure is to the officially provided CEX expenditure. The ideal pattern is the estimated expenditure is equal to the provided CEX expenditure, when the estimation over CEX scale is equal to 1. Table 24 shows that most of the scales are around 0.95 to

1.05, which is close to 1. The scales for Poultry and Eggs are over 1.1, so the expenditures for Poultry and Eggs are underestimated. The scales for Pork, Fish and Seafood and Food away from home are over 1.05, so these expenditures are also underestimated. Generally speaking, the estimated results are close enough to the published results, which means the model has well captured the real expenditure patterns.

4.4 Comparison between Regions

The estimation of food expenditures is very important in understanding the household purchasing patterns. It also provides information that can be helpful for guiding food production and food and nutrition related policy making. It is reasonable that there are different food purchasing patterns in different regions. Table 25 presents average annual household expenditure levels and average budget shares for the 19 food categories for each of the three geographic areas considered in this study. The differences can be explained by CEX regression results and household demographic patterns from ACS.

Compared with national level, average household expenditure differs for pork and other meat in TC and SEMN. Expenditure for pork is lower for both, which could be explained by higher percentage of two and more-earner households who purchase less pork and by lower percentage of Native Hawaiian or Other Pacific Islander households who buy significantly more pork. Expenditure for other meats is higher in both areas. For TC, possible explanations include higher percentage of households with the householder's age between 35 and 54, who purchase more other meats and higher percentage of households with income between $75,000 and $149,999. For both, another possible explanation is the lower percentage of African American and Asian households

who purchase less other meats.

Table 25: Regionl Food Expenditure Comparison

	National Average		SEMN Average		TC Average	
Food Category	Household Expenditure ($/year)	Budget Share	Household Expenditure ($/year)	Budget Share	Household Expenditure ($/year)	Budget Share
Cereals and cereal products	160	2.62%	165	2.77%	167	2.59%
Bakery products	349	5.72%	356	5.98%	358	5.55%
Beef	240	3.94%	247	4.15%	249	3.85%
Pork	148	2.42%	142	2.38%	140	2.17%
Other meats	101	1.65%	109	1.83%	107	1.65%
Poultry	136	2.23%	111	1.86%	130	2.01%
Fish and seafood	115	1.88%	83	1.40%	104	1.62%
Eggs	45	0.74%	44	0.74%	44	0.67%
Fresh milk and cream	163	2.68%	164	2.76%	169	2.62%
Other dairy products	246	4.03%	273	4.58%	277	4.29%
Fresh fruits	218	3.57%	203	3.42%	228	3.53%
Fresh vegetables	212	3.47%	188	3.16%	210	3.25%
Processed fruits	113	1.85%	114	1.91%	116	1.80%
Processed vegetables	107	1.75%	108	1.81%	107	1.65%
Sugar and other sweets	132	2.17%	152	2.56%	151	2.34%
Fats and oils	98	1.60%	100	1.67%	97	1.50%
Miscellaneous foods	697	11.42%	724	12.17%	763	11.82%
Nonalcoholic beverages	328	5.38%	322	5.41%	327	5.07%
Food away from home	2,494	40.88%	2,346	39.44%	2,712	42.02%
Total	6,101	100.00%	5,949	100.00%	6,454	100.00%

Expenditure for poultry is less in SEMN than national level. This could be due to the fact that SEMN is in Midwest and households in Midwest tend to purchase less poultry. Also, the higher rate of households in micropolitan area could be a reason because households in micropolitan area purchase significantly less poultry.

Both TC and SEMN households purchase less fish and seafood than national level and SEMN households spend much less on fish and seafood than TC households. The

regional factor is a leading contributor to this pattern since households in Midwest purchase much less fish and seafood and these two areas are both within Midwest. Another explanation is the ethnicity. African American and Asian households purchase more seafood while these households are of lower percentage in TC and SEMN areas.

Expenditure of other dairy products in both SEMN and TC is much higher than that of national level. Household income might be a strong factor that leads to this difference. The higher percentage of households in the high income rank in TC contributes a lot to the higher expenditure. The contribution of income to SEMN is not as clear as in TC, but the higher percentage of households in middle income rank in SEMN could also lead to a higher expenditure. Another explanation for higher other dairy products is the lower percentage of households with a single parent and African American or Asian households in TC and SEMN areas than national level, which family types have negative effect on expenditures.

Expenditures for fresh fruits and fresh vegetables are less in SEMN, compared with national level and TC area. For both products, this difference is most likely due to the different patterns of household income level. There is a positive relationship between household expenditure and income level, so expenditure in SEMN, with a composition of more lower-income households but less higher-income households, is less than other geographic areas. The 54.82% of households in micropolian areas is also a strong factor that leads to less expenditure on fresh fruits in SEMN, this rate is 20.08% nationally and 0% in TC area. For fresh vegetables, another reason that might result in less fresh vegetable expenditure is that Asian households are loyal fresh vegetable buyers but the

percentage of Asian households is much lower in SEMN compared with the other two geographic areas.

Households in TC and SEMN spend much more on sugar and other sweets than that of national level. For both, this pattern might be due to lower percentage of households with single parent, being in Midwest and lower proportion of African American and Asian households. Higher high-rank income household percentage in TC might contribute to the higher expenditure; and higher percentage of households with older householder in SEMN might be the contribution.

Households in TC spend more on miscellaneous foods than that of national level. This pattern could be explained by higher high-income household proportion, lower percentage of household with married or single parent with no children under 18, being in Midwest and lower percentage of African American and Asian households.

Compared with national level, household expenditure for food away from home is higher in TC and lower in SEMN. For TC, the higher proportion of high-income households is a leading factor for this pattern. TC also has the highest proportion of 4 member households, who spend the most outside home. Lower percentage of African American and Asian households is another reason. The lower expenditure in SEMN is most likely due to a smaller high-rank household proportion and being in micropolitan areas, which is a major contributor for expenditure on food away from home.

These differences also indicate that it is important to take the unique demographic profile of a region into account. Table 26 presents the comparison of aggregate household food expenditures in SEMN calculated by simply multiplying average CEX results for

the nation by the number of households in SEMN (column 2 and 4 "CEX ($ in Thousand)") with the CEX/ACS projection procedure for SEMN developed for this study ("CEX/ACS ($ in Thousand)"). The "Ratio" column is the ratio of CEX to CEX/ACS. Table 26 shows that use of national average CEX expenditures, as is commonly done in foodshed studies, results in large overestimates of pork, poultry, fish and seafood, eggs, fresh fruits, fresh vegetables, and food away from home expenditures and large underestimates of sugar and sweet expenditures in SEMN. There is a similar pattern for TC expenditures, but fewer categories have large over- or underestimations.

Table 26: Comparison for aggregate food expenditure in SEMN

	SEMN			TC		
Food Category	CEX ($ in Thousand) [A]	CEX/ACS($ in Thousand) [B]	Ratio A/B	CEX ($ in Thousand) [A]	CEX/ACS($ in Thousand) [B]	Ratio A/B
Cereals and cereal products	52,493	50,817	1.03	213,370	209,990	1.02
Bakery products	104,061	109,873	0.95	422,975	449,557	0.94
Beef	73,800	76,228	0.97	299,974	311,951	0.96
Pork	50,332	43,793	1.15	204,585	175,683	1.16
Other meats	32,731	33,527	0.98	133,043	133,771	0.99
Poultry	49,097	34,147	1.44	199,564	162,762	1.23
Fish and seafood	39,524	25,636	1.54	160,655	131,035	1.23
Eggs	15,748	13,605	1.16	64,011	54,639	1.17
Fresh milk and cream	51,876	50,764	1.02	210,860	212,308	0.99
Other dairy products	80,593	84,147	0.96	327,586	347,170	0.94
Fresh fruits	68,550	62,803	1.09	278,637	285,827	0.97
Fresh vegetables	65,462	58,067	1.13	266,085	263,198	1.01
Processed fruits	35,819	35,106	1.02	145,594	146,113	1.00
Processed vegetables	33,040	33,214	0.99	134,298	134,048	1.00
Sugar and other sweets	39,833	46,939	0.85	161,910	189,771	0.85
Fats and oils	32,114	30,762	1.04	130,532	121,235	1.08
Miscellaneous foods	209,974	223,498	0.94	853,482	957,355	0.89
Nonalcoholic beverages	105,604	99,384	1.06	429,251	410,554	1.05
Food away from home	833,102	724,511	1.15	3,386,314	3,403,508	0.99
Total	1,973,754	1,836,822	1.07	8,022,727	8,100,475	0.99

The difference of the expenditures estimated from the two procedures can be very large when considering the scale of the expenditures. For example, the national average procedure overestimates pork expenditures by $6.54 million in SEMN and $28.9 million in TC. These expenditure levels can be converted to quantities using the average retail pork price for 2008, which USDA/ERS reported, to be $2.94/lb. The resulting overestimates of quantities are 2.22 million pounds of pork in SEMN and 9.83 million pounds of pork in TC. Assuming an average meat yield of 90 pounds for a market hog, this implies overestimates of 24,667 and 109,222 animals, respectively.

This demonstrates the inaccuracies that can be introduced by using national average CEX results to estimate local consumption patterns. Local food researchers should take this pattern into consideration.

5. CONCLUSION

The purpose of this research is to build a general model to estimate total household expenditures for each of 19 food categories for any geographic area for which data are reported in the Census or American Community Survey. This objective was addressed by regressing each food expenditure with several groups of demographic, income and seasonality variables, in form of dummy variables. These variables were chosen to match the variable form from both Consumer Expenditure Survey and American Community Survey data. To deal with the zero-expenditure problem, the models were estimated using Tobit regression, which takes into consideration consumer's decision of both whether or not to buy a product and how much to buy. The Tobit regression results reveal some interesting results about what factors affect consumers' expenditure patterns for each food product.

The regression results were combined with regional household demographic data from Census and ACS by multiplying the parameter of each variable with the number of households in that variable level from the particular region. This makes it possible to estimate aggregate expenditures for a region. It also allows for cross-regional comparisons in average expenditure patterns, as reflected by budget shares. As expected, expenditure patterns in Twin-Cities and Southeastern Minnesota were found to be different from the National level. These differences in expenditure patters can be explained by differences in the demographic composition of households in each region in combination with regression parameters associated with those demographic variables. A performance check is done following all the analysis to show how well the model and

results are, which support the effect and efficiency of the research.

This model is generally applicable and can be used to estimate household food expenditures at any geographic area level.

APPENDIX

Table 1 List of Base Level Variables

Variable Category	Base Level Variable	Description
Age	age1	15-24
Income	income1	Less than $10,000
Region	region_n	Northeast
	urban	
	metropolitan	
Family_size	family_size1	1 person
Ethnicity	race1	White
Family Type	fam_type1	Family with children under age 18, with married parents
Number of Earner	earner0	0 earner
Month	Jan	

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