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Analysis of Aggregate Fish and Shellfish Expenditure

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The Virginia Agricultural and Mechanical College came into being in 1972 upon acceptance by the Commonwealth of the provisions of the Morrill Act of 1862 "to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." Research and investigations were first authorized at Virginia's land-grant college when the Virginia Agricultural Experiment Station was established by the Virginia General Assembly in 1886.

The Virginia Agricultural Experiment Station received its first allotment upon passage of the Hatch Act by the United States Congress in 1887. Other related Acts followed, and all were consolidated in 1955 under the Amended Hatch Act which states "It shall be the object and duty of the State agricultural experiment stations . . . to conduct original and other researches, investigations and experiments bearing directly on and contributing to the establishment and maintenance of a permanent and effective agricultural industry of the United States, including the researches basic to the problems of agriculture and its broadest aspects and such investigations as have for their purpose the development and improvement of the rural home and rural life and the maximum contributions by agriculture to the welfare of the consumer . . . ."

In 1962, Congress passed the McIntire-Stennis Cooperative Forestry Research Act to encourage and assist the states in carrying on a program of forestry research, including reforestation, land management, watershed management, rangeland management, wildlife habitat improvement, outdoor recreation, harvesting and marketing of forest products, and "such other studies as may be necessary to obtain the fullest and most effective use of forest resources."

In 1966, the Virginia General Assembly "established within the Virginia Polytechnic Institute a division to be known as the Research Division . . . which shall encompass the now existing Virginia Agricultural Experiment Station . . . ."

ANALYSIS OF AGGREGATE FISH AND SHELLFISH EXPENDITURE

by

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ABSTRACT

To enhance the understanding of fish and shellfish buying patterns in the United States, this study investigated the nature and magnitude of the influence of price, household income, and socioeconomic and demographic variates on aggregate seafood expenditure. The source of data was the 1972-1974 U.S. Bureau of Labor Statistics Consumer Expenditure Diary Survey. The empirical analysis of aggregate fish and shellfish expenditure was based on information from 9,066 households. The list of socioeconomic and demographic characteristics hypothesized to affect fish and shellfish expenditure included: (1) geographic region, (2) population density (urbanization), (3) household size, (4) race of household head, (5) marital status of household head, (6) education of household head, (7) occupation of household head, (8) tenure class (homeownership) of household head , (9) seasonality, and (10) employment status of the female household head. Geographic region, population density, race, marital status, the price of fish and shellfish, household size, and household income were statistically significant factors of household expenditure on fish and shellfish. However, education, occupation, and tenure class of the household head as well as seasonality and employment status of the female household head were not statistically significant factors of household expenditure on fish and shellfish. Given information on price, household income, household size, and socioeconomic and demographic variates, profiles were constructed to examine household expenditure behavior.

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CHAPTER I

INTRODUCTION

Background

Operations, investment planning, and market research programs in the seafood industry necessitate information on reliable measures of consumer expenditure patterns for fish and shellfish. Price and quantity changes at the retail level of the seafood marketing chain provide signals to processors at the wholesale level and to watermen at the dockside level. Information on consumer expenditure for fishery products may lead to the development of processing and storage activities and facilities to increase market outlets. Market research programs are seriously restricted without information on factors affecting consumer expenditure of fishery products. Consumer expenditure information can also contribute to public decisions which will insure a more uniform flow of raw products to the processing sector.

The share of fish and shellfish expenditure relative to total red meat, poultry, and seafood expenditure has ranged from 5.3 percent to 8.2 percent over the past thirty years (Table 1). Over the same period, the annual per capita consumption of fish and shellfish has trended gradually upward from 10.2 pounds to 13.6 pounds. Generally, consumer expenditure patterns depend upon prices, income, and socioeconomic and demographic characteristics. However, a paucity of information exists as to how such factors affect consumer expenditure for fish and shellfish.

Table 1. Price, Per Capita Consumption, and Share of Fish and Shellfish Expenditure Relative to Total Red Meat, Poultry, and Seafood Expenditure.

Year	Per Capita Fish/Shellfish Consumption	Consumer Price Index for Fish/Shellfish	Per Capita Total Red Meat/Poultry/Seafood Consumption	Consumer Price Index for Total Red Meat/Poultry/Seafood	Fish/Shellfish Expenditure Share
	(Pounds)	(1967 = 100)	(Pounds)	(1967 = 100)	(%)
1950	11.8	73.1	162.3	85.5	6.2
1951	11.2	83.4	157.8	95.6	6.2
1952	11.2	81.3	165.2	94.7	5.8
1953	11.4	78.3	171.7	89.5	5.8
1954	11.2	78.7	171.5	88.0	5.8
1955	10.5	77.1	175.1	82.8	5.6
1956	10.4	77.0	180.7	79.1	5.6
1957	10.2	78.0	174.7	85.8	5.3
1958	10.6	83.4	171.6	93.9	5.5
1959	10.9	84.9	179.8	90.3	5.7
1960	10.3	85.0	178.4	89.1	5.5
1961	10.7	86.9	180.6	89.3	5.8
1962	10.6	90.5	181.9	91.5	5.8
1963	10.7	90.3	187.8	90.1	5.7
1964	10.5	88.2	191.8	88.7	5.4
1965	10.8	90.8	187.4	94.5	5.5
1966	10.9	96.7	193.1	102.6	5.3
1967	10.6	100.0	200.8	100.0	5.3
1968	11.0	101.6	204.5	102.2	5.3
1969	11.2	107.2	206.1	110.8	5.3
1970	11.8	117.8	211.7	116.5	5.6
1971	11.5	130.2	217.0	116.9	5.9
1972	12.5	141.9	216.9	128.0	6.4
1973	12.9	162.8	204.7	160.4	6.4
1974	12.2	187.7	214.7	163.9	6.5
1975	12.3	203.3	207.0	178.1	6.8
1976	13.1	227.3	221.0	179.4	7.5
1977	12.9	251.6	221.7	178.4	8.2
1978	13.6	275.4	219.7	208.3	8.2
1979	13.3	302.3	222.0	239.3	7.6
1980	13.5	328.6	226.7	247.9	7.9

Source: Food Consumption, Prices, and Expenditures, U.S. Department of Agriculture, Economics and Statistics Service, Statistical Bulletin No. 656, February 1981.

Socioeconomic and demographic forces - particularly household size, place of residence (region), and population density (urbanization) - may exert notable influences on fish and shellfish expenditure. These hypotheses are primarily attributable to shifts in the response of consumption to the life cycle, differences in accessibility of the products, differences in climate, and the development of consumer buying habits. In addition, a number of studies of specific household expenditures present evidence to indicate that race, education, occupation, tenure class (homeownership), marital status, seasonality, and employment status of the female head are statistically important factors [Brown and Deaton (1972), Ferber (1973), Buse and Salathe (1979)]. The impact of the various socioeconomic and demographic characteristics is likely to reflect, in part, differences in tastes and preferences, culture, and infrastructure of households.

Objective and Scope

To enhance the understanding of fish and shellfish buying patterns in the United States, this study investigates the nature and magnitude of the influence of price, household income, and socioeconomic and demographic variates on aggregate seafood expenditure. The components of this broad category are tuna, salmon, other finfish, shellfish, and other seafood. The source of data is the 1972-1974 U.S. Bureau of Labor Statistics Consumer Expenditure Diary Survey. The Survey provides a comprehensive source of expenditure

and income information in relation to socioeconomic and demographic characteristics of U.S. households [Capps, Spittle, and Finn (1981)]. The list of socioeconomic and demographic characteristics hypothesized to affect fish and shellfish expenditure includes: (1) geographic region, (2) population density, (3) household size, (4) race of household head, (5) marital status of household head, (6) education of household head, (7) occupation of household head, (8) tenure class of household head, (9) seasonality, and (10) employment status of the female household head. The aggregate fish and shellfish analysis is limited to this set of characteristics due to the unavailability of additional information.

Organization

Chapter II presents a literature review to identify strengths and weaknesses of similar research and to place this research study into proper perspective. Chapter III concerns the data base and the statistical model. Chapter IV deals with the empirical results. Chapter V offers a summary of the major conclusions of the research study.

CHAPTER II

LITERATURE REVIEW

This literature review covers exclusively research studies that employ household survey data to investigate consumer expenditure patterns for fish and shellfish. By identifying strengths and weaknesses of similar studies, a foundation is built on which to conduct analyses of fish and shellfish expenditure.

Purcell and Raunikar (1968) analyzed the demand for fish and shellfish using data compiled by a panel of 160 households in Atlanta, Georgia, during the period 1958 to 1962. The general procedure of the analysis was to summarize fish and shellfish expenditure by several socioeconomic and demographic variates and to develop statistical models to estimate the effect of race, age composition, season, income, trend, gifts, and price on expenditure by households for particular categories of fish and shellfish (fresh fish; fish sticks; other fish; tuna; salmon; lobster and lobster tails; fresh, frozen, and canned oysters; oyster stew; fresh, frozen, and canned scallops; fresh, breaded frozen, and other frozen shrimp; canned or other shrimp; tuna pie or casserole; tuna salad; sardines in oil; sardines in sauce; and total fish and shellfish).

The five-year average annual expenditures for fish and shellfish was $17.46. Annual per capita expenditure for fishery products was $5.24. The five-year average annual household and per capita expenditures for fish and shellfish by income group, by household

size, and by race for the Atlanta Consumer Panel are exhibited in Table 2. Household expenditure for fish and shellfish increased as household income and household size increased. In addition, fish and shellfish expenditure for non-white households was, on average, about 36 percent greater than fish and shellfish expenditure for white households.

The statistical model used in the analysis was given by the linear relationship:

$$(1) \qquad Y_i = \beta_0 + \sum_{k=1}^{14} \beta_i X_{ki} + e_i ,$$

where:

Y_i represents fish and shellfish expenditure,

X_{1i} represents race (white = 1, nonwhite = 0),

X_{2i} represents number of persons under 2 years old,

X_{3i} represents number of persons 2-5 years old,

X_{4i} represents number of persons 6-10 years old,

X_{5i} represents number of persons 11-18 years old,

X_{6i} represents number of persons over 18 years old (adults),

X_{7i} represents annual household income in dollars,

X_{8i} represents winter quarter,

X_{9i} represents spring quarter,

X_{10i} represents summer quarter,

X_{11i} represents fall quarter,

X_{12i} represents trend over time in quarters,

X_{13i} represents quantity of gifts, and

X_{14i} represents price in dollars/pound.

Table 2. Five-Year Average Annual Household and Per Capita Expenditure for Fish and Shellfish, Atlanta Consumer Panel, Atlanta, Georgia, 1958 to 1962.

Income Group	Household Expenditure	Per Capita Expenditure
<$ 2,000	$11.02	$4.73
$ 2,000 - $ 3,999	16.95	4.74
$ 4,000 - $ 5,999	18.14	4.70
$ 6,000 - $ 7,999	20.52	6.10
$ 8,000 - $ 9,999	24.02	6.41
$10,000 - $11,999	21.48	6.70
>$12,000	30.05	8.91

Household Size	Household Expenditure	Per Capita Expenditure
1	$ 6.08	$6.08
2	14.00	7.00
3	18.18	6.06
4	21.01	5.25
5	23.12	4.62
6	26.10	4.39
>6	28.34	3.50

Race	Household Expenditure	Per Capita Expenditure
White	$15.22	$5.07
Non-White	20.73	5.43

Source: Purcell, J. C. and R. Raunikar, "Analysis of Demand Fish and Shellfish," Research Bulletin 51, Department of Agricultural Economics, Univeristy of Georgia, December 1968.

The estimated coefficients for this linear expenditure function were as follows:

$$(2)\ \hat{Y}_i = \underset{}{-.38} - \underset{(.16)}{1.71X^{*}_{1i}} - \underset{(.26)}{.24X_{2i}} + \underset{(.13)}{.46X^{*}_{3i}} + \underset{(.11)}{.60X^{*}_{4i}} + \underset{(.081)}{.75X^{*}_{5i}} + \underset{(.11)}{1.02X^{*}_{6i}}$$

$$+ \underset{(.000024)}{.00031X^{*}_{7i}} + \underset{(.24)}{.59X^{*}_{8i}} - \underset{(.20)}{.039X_{9i}} + \underset{(.20)}{.21X_{11i}} - \underset{(.025)}{.047X_{12i}} + \underset{(.011)}{.027X^{*}_{13i}}$$

$$+ \underset{(4.61)}{3.36X_{14i}}$$

$$R^2 = .199 \qquad n = 160$$

The estimated standard errors of the estimated coefficients are in parentheses. Asterisks indicate that the coefficients are statistically different from zero.

Statistically significant racial differences and seasonal differences for fish and shellfish expenditure were found. The number of persons in the five age classifications as well as household income were statistically important in accounting for the variation in fish and shellfish expenditure. However, the effect of the price of fish and shellfish on fish and shellfish expenditure was not significantly different from zero.

Although this research study provided a sufficient analysis of the demand for fish and shellfish, the work had salient limitations. First, the analysis was region specific. Households located in different geographic regions may exhibit different fish and shellfish demand patterns. Second, the analysis was conducted using data from the years 1958 to 1962. Dramatic changes in prices, income, and socioeconomic and demographic characteristics have occurred over

the past twenty years. Third, with regard to the demand for fish and shellfish, the analysis omitted potentially important household characteristics such as population density, education, occupation, and tenure class.

Nash (1971) summarized responses of 1586 U.S. households (4,864 persons) surveyed by the National Marine Fisheries Service. The purpose of the statistical survey was to investigate the patterns of fish and shellfish product purchases according to socioeconomic and demographic characteristics of households. The household diary responses were classified by major fish and shellfish products, measurement of consumption and expenditure, socioeconomic and demographic characteristics (household income, household size, geographic region, age of household head, education of household head, occupation of household head, age and sex of children, race, and religion), and month and quarter. The list of major fishery products included: (1) specialty items (tuna pie, clam chowder, oyster stew, TV dinners, smoked fish, other specialties), (2) canned fish (pink salmon, red salmon, other salmon, white tuna, light tuna, other tuna, domestic sardines, imported sardines, shrimp, oysters, other canned products), (3) fresh and frozen shellfish (shrimp, oysters, crabs, lobster, lobster tails, clams, scallops, other shellfish), and (4) fresh and frozen finfish (haddock, flounder, sole, halibut, ocean perch, cod, salmon, red snapper, catfish, whiting, swordfish, pollock, and other finfish). Information was also reported on the following: (1) the frequency of item purchase, (2)

the total number of pounds purchased, (3) the total dollars spent on the item, (4) the price per pound of the item, (5) the pounds purchased per household, and (6) the pounds purchased per capita.

Average annual per capita fish and shellfish consumption and expenditure information by particular socioeconomic and demographic characteristics from the Nash report are presented in Table 3. Levels of fish and shellfish consumption and expenditure varied substantially among different groups of consumers. For instance, although the consumption and expenditure patterns for Catholics and Protestants were reasonably similar, they differed appreciably from the consumption and expenditure pattern for Jews. The per capita fish and shellfish consumption and expenditure for blacks were almost double the per capita fish and shellfish consumption and expenditure for whites. On a per capita basis, households located in the New England region, East South Central region, and West South Central region spent more on fish and shellfish than households located in the Middle Atlantic region, East North Central region, West North Central region, South Atlantic region, Mountain region, and Pacific region.

Although this work provided a definitive summary of per capita fish and shellfish consumption and expenditure patterns for various classifications of U.S. households, the research suffered from the lack of statistical support. Without statistical analyses - for example, analysis of variance or regression analysis - the investigation of statistical reliability through formal tests of signifi-

Table 3. Average Annual Per Capita Fish and Shellfish Consumption and Expenditure by Socioeconomic and Demographic Characteristics; February 1969 to January 1970.

Socioeconomic and Demographic Characteristic[a]	Per Capita Consumption (Pounds)	Per Capita Expenditure (Dollars)
RACE:		
Negro	23.054	19.80
White	12.264	10.53
Other	16.100	13.83
Not Specified	7.369	6.33
RELIGION:		
Catholic	13.061	11.22
Jewish	27.254	23.41
Protestant	12.322	10.58
Other	14.451	12.41
Not Specified	3.160	2.71
INCOME PER CAPITA:		
$1,000	10.970	9.42
$1,000 to $1,999	12.568	10.79
$2,000 to $2,499	9.229	7.92
$2,500 to $2,999	14.023	12.04
$3,000 to $3,499	13.022	11.18
$3,500 to over	12.658	10.87
OCCUPATION OF HOUSEHOLD HEAD:		
Professional and Semiprofessional	9.437	8.10
Proprietors, Managerial	11.429	9.81
Clerical and Sales	14.059	12.07
Craftsmen, Foremen	12.282	10.55
Head Operative	10.154	8.72
All Others	18.429	15.83
EDUCATION OF HOUSEHOLD HEAD:		
<4 years of high school	15.958	13.70
<4 years of college	15.595	13.39
College graduate	10.318	8.86

Table 3. Continued.

Socioeconomic and Demographic Characteristic[a]	Per Capita Consumption (Pounds)	Per Capita Expenditure (Dollars)
GEOGRAPHIC REGION:		
New England	17.609	15.12
Middle Atlantic	14.294	12.27
E. North Central	10.044	8.62
W. North Central	7.882	6.77
South Atlantic	14.220	12.21
E. South Central	17.237	14.80
W. South Central	16.555	14.22
Mountain	14.239	12.23
Pacific	13.958	11.99

[a]Other characteristics such as age of household head (under 25, 25-34, 35-44, 45-54, 55 and over), household size (1 person, 2-3 persons, 4-5 persons, over 5 persons), household income (under $4,000, $4,000 to $4,999, $5,000 to $5,999, $6,000 to $6,999, $7,000 to $7,999, $8,000 to $8,999, $9,000 to $9,999, $10,000 to $14,999, and $15,000 and over), age and sex of children in household, month of purchase, and season of purchase were not included in this table, although available.

Source: Nash, Darrel A., "A Survey of Fish Purchases of Socio-Economic Characteristics," U.S. Department of Commerce, National Marine Fisheries Service, Data Report 62, April 1971.

cance is precluded. The lack of statistical support can only be alleviated by the consistency of results among related and additional studies.

Salathe (1979) and Smallwood and Blaylock (1981) investigated the impact of household size and income on purchases of numerous food items. The former analysis was based on data from the 1972-74 BLS Consumer Expenditure Survey, while the latter analysis was based on data from the 1977-78 Nationwide Food Consumption Survey.

The statistical model used in the respective studies was given by the quadratic relationship:

$$(3) \qquad Y_i = \beta_0 + \beta_1 I + \beta_2 I^2 + \beta_3 HS + \beta_4 (HS)^2 + \beta_5 (I)(HS) + e_i,$$

where:

Y_i represents household expenditure,

I represents household income,

I^2 represents the square of household income,

HS represents household size,

$(HS)^2$ represents the square of household size, and

$(I)(HS)$ represents the interaction of household income and household size.

The estimated coefficients for the quadratic fish and shellfish expenditure functions were:

Salathe[1]

JUNE 1972 to JUNE 1973

$$(4) \qquad \hat{Y}_i = \underset{(1.75)}{.08855467} + \underset{(5.97)}{.00152651\ I^*} - \underset{(-0.11)}{.00000073\ I^2} + \underset{(4.86)}{.13678494\ HS^*}$$

$$- \underset{(-2.08)}{.00633757\ (HS)^{2*}} - \underset{(-0.42)}{.00002025\ (I)(HS)}$$

$$R^2 = .030.$$

JULY 1973 to JUNE 1974

$$(5)\quad \hat{Y}_i = \underset{(1.71)}{.08742908} + \underset{(2.22)}{.00060052\ I^{*}} + \underset{(0.16)}{.00000005\ I^{2}} + \underset{(7.82)}{.22222309\ HS^{*}} - \underset{(-5.07)}{.01596364\ (HS)^{2*}} + \underset{(1.06)}{.00005318\ (I)(HS)}$$

$$R^2 = .030.$$

Smallwood and Blaylock[2]

APRIL 1977 to MARCH 1978

$$(6)\quad \hat{Y}_i = \underset{(3.48)}{.294153^{*}} + \underset{(5.96)}{.030264\ I^{*}} - \underset{(2.17)}{.000092\ I^{2*}} + \underset{(3.35)}{.151123\ HS^{*}} + \underset{(0.64)}{.003470\ (HS)^{2}} - \underset{(0.18)}{.00026\ (I)\ (HS)}$$

$$R^2 = .034.$$

The numbers in parentheses denote t-values. Asterisks indicate the coefficients are statistically different from zero. Household purchases of fish and shellfish were quite responsive to household income and household size. In the Salathe study, a thousand dollar increase in household income led to a 67-cent to 70-cent increase in bi-weekly household fish and shellfish expenditure. A unit increase in household size generated a 13-cent to 20-cent increase in bi-weekly household fish and shellfish expenditure. In the Smallwood and Blaylock study, a thousand dollar increase in household income led to only a 3-cent increase in weekly household fish and shellfish expenditure, whereas a unit increase in household size generated a 15-cent increase in weekly household fish and shellfish expenditure.

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[1] Fish and shellfish expenditure was two-week expenditure by households measured in dollars, and income was measured in annual dollars.

[2] Fish and shellfish expenditure was one-week expenditure by households measured in dollars, and income was measured in thousands of dollars.

The respective research studies employed data from more recent time periods than the Purcell and Raunikar study and the Nash study; however, neither the Salathe study nor the Smallwood and Blaylock study examined the influence of additional socioeconomic and demographic factors on fish and shellfish expenditure.

CHAPTER III

DATA AND EMPIRICAL MODEL

Data

Household survey data provide a rich source of data on a variety of socioeconomic and demographic characteristics. As evident from Chapter II, it is necessary to take account of the effects of socioeconomic and demographic characteristics on consumption patterns to unravel the complexities of household consumption behavior.

The data source, the Consumer Expenditure Diary Survey, covers the non-institutional population of the United States in two samples of twelve month periods from June 1972 to June 1973 and July 1973 to June 1974. The time period is short enough to insure stable consumer preferences, yet long enough to accommodate the diversity of consumer choices. The sample for each survey year was partitioned into 52 weekly subsamples so as to cover the entire calendar year and to expose seasonal variations in expenditure patterns. The first survey year included 11,065 households, while the second survey year included 12,121 consumer units. Participants listed all expenditures during two consecutive seven-day periods, except for those expenditures incurred while away from home overnight on trips or vacations.

All data were collected through the voluntary cooperation of households. Two separate collection vehicles served to obtain the data: (1) an interviewer-administered household characteristics

questionnaire, and (2) a separate diary to record daily expenses. The first recorded socioeconomic and demographic information pertaining to the household, and the second provided a self-reporting, product-oriented daily expense record. The diary questionnaire was divided by day of purchase and by broad classification of goods and services to aid the respondent when recording daily purchases and to facilitate the coding of individual purchases.

The sample used for this analysis includes 10,294 households reporting income and fish and shellfish expenditure information. The source of price information in the sample is the Consumer Price Index for fish and shellfish (Table 4). In short, the sample provides expenditure, price, and income information in relation to socioeconomic and demographic characteristics of U.S. households.

Fish and shellfish expenditure patterns by income and socioeconomic and demographic classification are exhibited in Tables 5-16. [3] For comparative purposes, total food expenditure patterns by income and socioeconomic and demographic classification are presented in Appendix Tables A.1-A.12. For the sample, the mean and median two-week expenditures for fish and shellfish are $2.81 and $1.72, respectively. The minimum expenditure is $0.03, and the maximum expenditure is $100.65. The mean and median percentages of total food expenditure for fish and shellfish are 4.04 and 2.61 percent respectively. In contrast, the mean and median two-week expenditures for total food are $81.28 and $72.47, respectively. The minimum

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[3] Note: Text after this page continues on page 30 following these tables.

Table 4. Consumer Price Index for Fish/Shellfish (1967=1.00), June 1972 to June 1974.

Date	Consumer Price Index for Fish*
June 1972	1.413
July 1972	1.420
August 1972	1.428
September 1972	1.444
October 1972	1.458
November 1972	1.480
December 1972	1.486
January 1973	1.494
February 1973	1.513
March 1973	1.528
April 1973	1.561
May 1973	1.602
June 1973	1.637
July 1973	1.638
August 1973	1.652
September 1973	1.671
October 1973	1.708
November 1973	1.758
December 1973	1.783
January 1974	1.804
February 1974	1.826
March 1974	1.852
April 1974	1.869
May 1974	1.871
June 1974	1.871

*32.41 percent increase from June 1972 to June 1974. Compound monthly growth rate 1.12 percent.

Source: Food Consumption, Prices, and Expenditures, U.S. Department of Agriculture, Economic and Statistics Service, Statistical Bulletin No. 656, February 1981.

Table 5. Fish and Shellfish Expenditure by Household Income.

	Number of Households*	Mean	Median	Standard Deviation	Minimum	Maximum	Percentage of Total Food Expenditure	
							Mean	Median
Less than $0	6 (0.06)	$1.59	$1.29	$1.24	$.44	$ 3.62	3.98	1.72
Equal to $0	52 (0.51)	$3.84	$1.88	$5.55	$.31	$ 29.40	6.39	4.01
>$0-$1,999	411 (3.99)	$2.14	$1.31	$2.44	$.25	$ 18.73	6.34	4.30
$2,000-$2,999	456 (4.43)	$2.22	$1.42	$2.86	$.19	$ 37.50	5.90	3.92
$3,000-$3,999	443 (4.30)	$2.61	$1.64	$3.27	$.27	$ 43.60	5.20	3.70
$4,000-$4,999	498 (4.84)	$2.28	$1.58	$2.63	$.15	$ 27.10	4.67	3.25
$5,000-$5,999	443 (4.30)	$2.53	$1.64	$3.15	$.26	$ 39.41	4.62	3.24
$6,000-$6,999	502 (4.88)	$2.58	$1.57	$3.34	$.29	$ 45.07	4.10	2.82
$7,000-$7,999	469 (4.56)	$2.48	$1.58	$3.20	$.19	$ 36.93	3.81	2.78
$8,000-$9,999	968 (9.40)	$2.62	$1.59	$3.21	$.23	$ 37.50	3.92	2.61
$10,000-$11,999	1060 (10.30)	$2.48	$1.56	$3.89	$.10	$ 89.96	3.24	2.16
$12,000-$14,999	1335 (12.97)	$2.71	$1.76	$2.99	$.03	$ 27.77	3.51	2.28
$15,000-$19,999	1360 (13.21)	$2.87	$1.86	$3.49	$.21	$ 50.22	3.14	2.13
$20,000-$24,999	682 (6.63)	$3.54	$2.26	$4.00	$.22	$ 32.48	3.42	2.24
$25,000-$34,999	451 (4.38)	$4.24	$2.43	$7.20	$.19	$100.65	3.60	2.20
$35,000-$49,999	139 (1.35)	$3.62	$2.64	$4.13	$.35	$ 34.00	3.37	2.15
$50,000 +	69 (0.67)	$4.70	$2.20	$7.20	$.37	$ 47.10	3.39	2.00
Incomplete Income Reporting	950 (9.23)	$3.31	$1.97	$4.15	$.28	$ 52.22	4.81	2.99

*Figures in parentheses give percentage of households in the socioeconomic and demographic category.

Source: Computations by the author.

Table 6. Fish and Shellfish Expenditure by Geographic Region.

	Number of Households*	Mean	Median	Standard Deviation	Minimum	Maximum	Percentage of Total Food Expenditure	
							Mean	Median
U.S.	10294	$2.81	$1.72	$3.75	$.03	$100.65	4.04	2.61
Northeast	2749 (26.70)	$3.32	$2.04	$4.08	$.03	$ 66.28	4.28	2.82
North Central	2571 (24.97)	$2.31	$1.54	$2.75	$.23	$ 46.80	3.48	2.38
South	2950 (28.65)	$2.72	$1.68	$3.69	$.10	$ 89.96	4.21	2.71
West	2024 (19.66)	$2.91	$1.69	$4.31	$.15	$100.65	4.18	2.66

*Figures in parentheses give percentage of households in the socioeconomic and demographic category.
Source: Computations by the author.

Table 7. Fish and Shellfish Expenditure by Population Density.

	Number of Households*	Mean	Median	Standard Deviation	Minimum	Maximum	Percentage of Total Food Expenditure	
							Mean	Median
SMSAs 1,000,00 + Population**	4959 (48.17)	$3.04	$1.89	$3.83	$.03	$ 89.96	4.18	2.67
Central Cities[a]	2102 (20.41)	$3.39	$2.04	$4.21	$.03	$ 47.10	4.78	3.28
Other than Central Cities[b]	2857 (27.75)	$2.79	$1.77	$3.49	$.18	$ 89.96	3.74	2.37
SMSAs 400,000 to 999,999 Population**	1235 (12.00)	$2.80	$1.76	$3.48	$.15	$ 40.61	3.95	2.60
Central Cities[a]	597 (5.80)	$2.81	$1.79	$3.24	$.26	$ 27.77	4.26	2.83
Other than Central Cities[b]	638 (6.20)	$2.78	$1.73	$3.70	$.15	$ 40.61	3.66	2.42
SMSAs 50,000 to 399,999 Population**	1433 (13.92)	$2.50	$1.61	$2.97	$.21	$ 39.41	3.84	2.50
Central Cities[a]	714 (6.94)	$2.35	$1.57	$2.84	$.21	$ 28.00	3.84	2.48
Other than Central Cities[b]	719 (6.98)	$2.64	$1.69	$3.08	$.22	$ 39.41	3.85	2.54
Outside SMSAs**	2667 (25.91)	$2.56	$1.56	$4.05	$.19	$100.65	3.93	2.57
Urban	1183 (11.49)	$2.60	$1.59	$4.23	$.19	$100.65	4.03	2.67
Rural	1484 (14.42)	$2.53	$1.51	$3.90	$.21	$ 66.28	3.85	2.53

[a]Urban.
[b]Including rural.
*Figures in parentheses give percentage of households in the socioeconomic and demographic category.
Source: Computations by the author.
**SMSA refers to Standard Metropolitan Statistical Area.

Table 8. Fish and Shellfish Expenditure by Household Size.

	Number of Households*	Mean	Median	Standard Deviation	Minimum	Maximum	Percentage of Total Food Expenditure		Mean Per Household Member
							Mean	Median	
1	1396 (13.56)	$1.98	$1.29	$2.37	$.19	$ 37.50	5.99	4.00	$1.98
2	2851 (27.70)	$2.64	$1.67	$3.43	$.10	$100.65	4.45	2.95	$1.32
3	1848 (17.95)	$2.93	$1.69	$4.51	$.19	$ 89.96	3.82	2.48	$ .97
4	1872 (18.19)	$2.86	$1.79	$3.51	$.25	$ 52.22	3.20	2.21	$ .71
5	1182 (11.48)	$3.17	$1.96	$3.75	$.03	$ 36.93	3.21	2.15	$ .63
6	597 (5.80)	$3.75	$2.16	$5.44	$.26	$ 66.28	3.26	2.07	$ .62
7	281 (2.73)	$3.36	$2.29	$3.44	$.35	$ 22.08	3.26	1.97	$ .48
8	142 (1.38)	$3.57	$2.72	$3.42	$.28	$ 26.37	2.89	1.92	$ .44
9	73 (0.71)	$3.47	$2.50	$2.85	$.35	$ 12.21	3.21	1.88	$ .38
10	31 (0.30)	$4.40	$2.75	$4.31	$.50	$ 15.37	3.84	2.58	$ .44
11	13 (0.13)	$4.64	$4.60	$2.13	$1.84	$ 10.00	4.50	3.75	$ .42
12	3 (0.03)	$1.22	$ .93	$ .68	$ .73	$ 2.01	1.77	1.86	$ .10
13	4 (0.04)	$3.64	$3.27	$2.29	$1.26	$ 6.75	3.60	4.39	$ .28
14	0	---	---	---	---	---	---	---	---
15	1 (0.01)	$1.70	$1.70	---	$1.70	$ 1.70	1.05	1.05	$ .11

*Figures in parentheses give percentage of households in the socioeconomic and demographic category.
Source: Computations by the author.

Table 9. Fish and Shellfish Expenditure by Race of Household Head.

	Number of Households*	Mean	Median	Standard Deviation	Minimum	Maximum	Percentage of Total Food Expenditure	
							Mean	Median
White and other than Black	9224 (89.61)	$2.73	$1.65	$3.73	$.03	$100.65	3.81	2.49
Black	1070 (10.39)	$3.52	$2.34	$3.78	$.19	$ 46.80	6.03	4.23

*Figures in parentheses give percentage of households in the socioeconomic and demographic category.
Source: Computations by the author.

Table 10. Fish and Shellfish Expenditure by Marital Status of Household Head.

	Number of Households*	Mean	Median	Standard Deviation	Minimum	Maximum	Percentage of Total Food Expenditure	
							Mean	Median
Married	7803 (75.80)	$2.96	$1.80	$3.96	$.03	$100.65	3.66	2.39
Other[a]	2491 (24.20)	$2.35	$1.50	$2.92	$.19	$ 45.07	5.24	3.55

[a]Widowed, divorced, separated, never married.
*Figures in parentheses give percentage of households in the socioeconomic and demographic category.
Source: Computations by the author.

Table 11. Fish and Shellfish Expenditure by Education of Household Head.

	Number of Households*	Mean	Median	Standard Deviation	Minimum	Maximum	Percentage of Total Food Expenditure	
							Mean	Median
None	114 (1.11)	$3.17	$1.64	$5.54	$.26	$ 43.60	5.72	4.05
Some Grade School Completed	2021 (19.63)	$2.73	$1.74	$2.97	$.22	$ 37.50	4.69	3.22
Some High School Completed	1657 (16.10)	$2.74	$1.77	$3.21	$.10	$ 36.93	3.97	2.65
High School Graduates	3217 (31.25)	$2.74	$1.65	$3.67	$.15	$ 66.28	3.85	2.42
Some College Completed	1486 (14.44)	$2.68	$1.62	$4.35	$.03	$100.65	3.52	2.39
College Graduate, Graduate Work	1799 (17.48)	$3.20	$1.96	$4.36	$.19	$ 89.96	4.03	2.59

*Figures in parentheses give percentage of households in the socioeconomic and demographic catagory.
Source: Computations by the author.

Table 12. Fish and Shellfish Expenditure by Occupation of Household Head.

	Number of Households*	Mean	Median	Standard Deviation	Minimum	Maximum	Percentage of Total Food Expenditure	
							Mean	Median
Self Employed	760 (7.38)	$2.96	$1.68	$4.18	$.21	$ 50.22	3.78	2.37
Salaried Professional, Technical Workers	1220 (11.85)	$2.98	$1.89	$3.51	$.25	$ 40.14	3.61	2.54
Salaried Managers and Administrators	1050 (10.20)	$3.30	$1.85	$5.94	$.31	$100.65	3.56	2.23
Clerical	713 (6.93)	$2.62	$1.60	$3.18	$.19	$ 40.61	4.07	2.66
Sales	410 (3.98)	$2.80	$1.73	$3.83	$.27	$ 45.07	3.36	2.17
Craftsmen	1402 (13.62)	$2.76	$1.72	$3.48	$.18	$ 52.22	3.43	2.17
Operatives	1261 (12.25)	$2.56	$1.61	$2.84	$.10	$ 25.00	3.44	2.49
Unskilled Laborers and Service Workers	1207 (11.73)	$2.86	$1.79	$3.37	$.03	$ 28.67	4.51	2.85
Retired	1312 (12.75)	$2.56	$1.58	$3.17	$.15	$ 43.60	5.11	3.58
Other	959 (9.32)	$2.83	$1.78	$3.46	$.25	$ 39.41	5.21	3.27

*Figures in parentheses give percentage of households in the socioeconomic and demographic category.
Source: Computations by the author.

Table 13. Fish and Shellfish Expenditure by Tenure Class of Household Head.

	Number of Households*	Mean	Median	Standard Deviation	Minimum	Maximum	Percentage of Total Food Expenditure	
							Mean	Median
Homeowner	6723 (65.31)	$2.89	$1.77	$3.76	$.03	$ 89.96	3.74	2.41
Renter	3461 (33.62)	$2.70	$1.65	$3.76	$.19	$100.65	4.59	3.05
Not Reported	110 (1.07)	$2.08	$1.45	$2.16	$.25	$ 14.36	4.88	3.89

*Figures in parentheses give percentage of households in the socioeconomic and demographic category.
Source: Computations by the author.

Table 14. Fish and Shellfish Expenditure by Employment Status of Female Head Outside the Home.

	Number of Households*	Mean	Median	Standard Deviation	Minimum	Maximum	Percentage of Total Food Expenditure	
							Mean	Median
Employed	3256 (31.63)	$2.85	$1.78	$3.89	$.10	$100.65	3.44	2.27
Unemployed	7038 (68.37)	$2.80	$1.70	$3.68	$.03	$ 89.96	4.32	2.82

*Figures in parentheses give percentage of households in the socioeconomic and demographic category.
Source: Computations by the author.

Table 15. Fish and Shellfish Expenditure by Month and Year.

	Number of Households*	Mean	Median	Standard Deviation	Minimum	Maximum	Percentage of Total Food Expenditure Mean	Median
				1972				
June-July	82 (0.79)	$2.85	$1.24	$9.87	$.25	$ 89.96	3.96	1.96
July-Aug.	366 (3.55)	$2.33	$1.35	$2.67	$.10	$ 23.77	3.49	2.36
Aug.-Sept.	390 (3.78)	$2.47	$1.47	$3.30	$.25	$ 37.50	3.88	2.49
Sept.-Oct.	333 (3.23)	$2.37	$1.44	$2.71	$.26	$ 20.15	3.82	2.25
Oct.-Nov.	399 (3.87)	$2.29	$1.55	$2.57	$.26	$ 25.14	3.76	2.57
Nov.-Dec.	377 (3.66)	$2.44	$1.50	$3.24	$.27	$ 40.61	3.52	2.55
Dec.-Jan.	576 (5.59)	$2.65	$1.49	$3.69	$.18	$ 43.60	4.08	2.57
				1973				
Jan.-Feb.	407 (3.95)	$2.58	$1.57	$3.72	$.34	$ 45.07	4.06	2.61
Feb.-Mar.	409 (3.97)	$2.65	$1.84	$2.72	$.29	$ 22.22	4.14	2.82
Mar.-Apr.	433 (4.20)	$3.04	$1.90	$5.56	$.27	$100.65	4.35	2.86
Apr.-May	427 (4.14)	$2.82	$1.84	$3.65	$.26	$ 50.22	4.57	3.11
May-June	396 (3.84)	$2.85	$1.67	$3.57	$.25	$ 33.73	4.26	2.84
June-July	399 (3.87)	$2.92	$1.55	$4.20	$.26	$ 34.00	3.89	2.38
July-Aug.	460 (4.46)	$2.80	$1.76	$3.90	$.27	$ 46.80	4.24	2.54
Aug.-Sept.	434 (4.21)	$2.91	$1.85	$3.43	$.29	$ 32.48	4.17	2.60
Sept.-Oct.	427 (4.14)	$3.06	$1.92	$3.88	$.29	$ 47.10	3.96	2.78
Oct.-Nov.	399 (3.87)	$2.85	$1.77	$3.66	$.19	$ 36.27	3.92	2.47
Nov.-Dec.	502 (4.87)	$2.68	$1.67	$3.42	$.28	$ 36.93	3.99	2.45
Dec.-Jan.	624 (6.06)	$3.19	$1.99	$4.18	$.19	$ 66.28	4.20	2.86
				1974				
Jan.-Feb.	446 (4.33)	$2.81	$1.69	$3.29	$.22	$ 22.08	3.89	2.59
Feb.-Mar.	399 (3.87)	$3.31	$2.00	$4.29	$.15	$ 52.22	4.19	2.70
Mar.-Apr.	469 (4.55)	$2.92	$1.78	$3.50	$.29	$ 40.14	3.84	2.61
Apr.-May	416 (4.04)	$3.26	$2.02	$3.70	$.34	$ 33.16	4.13	2.82
May-June	381 (3.70)	$3.07	$1.81	$3.52	$.03	$ 26.37	4.23	2.69
June-July	274 (2.66)	$3.01	$2.07	$3.35	$.35	$ 29.98	4.19	2.82
Incomplete Start Date Information	9 (0.08)	$3.14	$3.58	$2.15	$.50	$ 6.91	5.25	4.44
Start Date Errors Outside Survey Period	48 (0.46)	$2.55	$2.05	$2.24	$.39	$ 10.92	3.69	2.32
Nonconsecutive Start Date Errors	12 (0.11)	$3.68	$2.63	$3.79	$.70	$ 14.38	4.46	2.16

*Figures in parentheses give percentage of households in the socioeconomic and demographic category.
Source: Computations by the author.

Table 16. Fish and Shellfish Expenditure by Season.

	Number of Households *	Mean	Median	Standard Deviation	Minimum	Maximum	Percentage of Total Food Expenditure	
							Mean	Median
Winter[a]	2563 (25.06)	$2.88	$1.80	$3.95	$.15	$100.65	4.07	2.68
Spring[b]	2375 (23.22)	$2.98	$1.78	$4.06	$.03	$ 89.96	4.21	2.71
Summer[c]	2410 (23.56)	$2.68	$1.63	$3.41	$.10	$ 47.10	3.95	2.51
Fall[d]	2877 (28.13)	$2.72	$1.67	$3.57	$.18	$ 66.28	3.95	2.57

[a]Jan.-Feb., Feb.-Mar., Mar.-Apr.

[b]Apr.-May, May-June, June-July.

[c]July-Aug., Aug.-Sept., Sept.-Oct.

[d]Oct.-Nov., Nov.-Dec., Dec.-Jan.

*Figures in parentheses give percentage of households in the socioeconomic and demographic category.

Source: Computations by the author.

expenditure for total food is $1.17, and the maximum expenditure is $697.76.

The average two-week fish and shellfish expenditure for households located in the Northeast is $3.32, whereas the average two-week expenditures for households located in the West, South, and North Central are $2.91, $2.72, and $2.31, respectively (Table 6). With regard to population density, the average two-week expenditure for fish and shellfish ranges from $2.35 for households located in central cities of Standard Metropolitan Statistical Areas (SMSAs) 50,000 to 399,999 population to $3.39 for households located in central cities of SMSAs 1,000,000 and over population (Table 7).

On average, college graduates and uneducated persons spend more on fish and shellfish than do persons with some college completed, high school graduates, persons with some high school completed, and persons with some grade school completed (Table 11). Salaried managers and administrators expend more on fish and shellfish than do professional and technical workers, self-employed persons, unskilled laborers, sales personnel, craftsmen, clerical workers, operatives, and retired people (Table 12). Average two-week expenditure for fish and shellfish tends to vary seasonally from $2.68 in the summer to $2.98 in the spring (Table 16). On average, blacks, married persons, homeowners, and employed female household heads expend more on fish and shellfish than do non-blacks, non-married persons, renters, and unemployed female household heads (Tables 9, 10, 13, 14). Average two-week fish and shellfish expenditure tends to trend upward

with increases in household size and income (Tables 5 and 8). Fish and shellfish expenditure by household size is depicted pictorially in Figure 1.

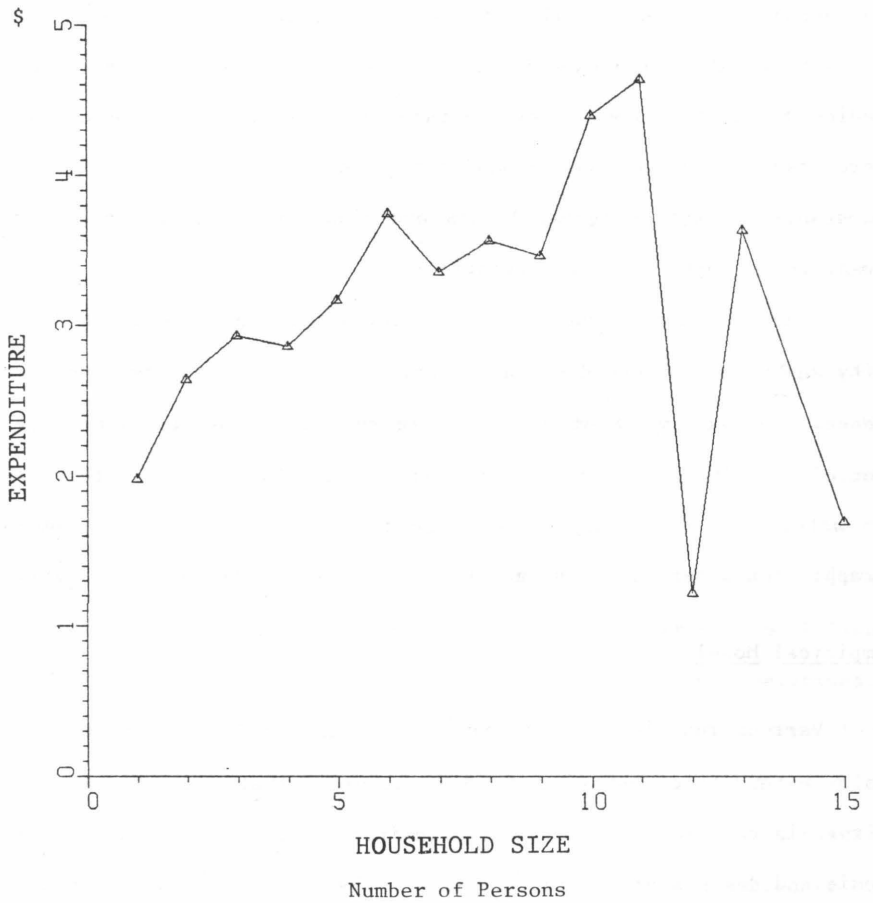
With the exception of race, total food expenditure patterns by socioeconomic and demographic classification are reasonably similar to fish and shellfish expenditure patterns. To summarize, mean and median two-week household expenditures as well as mean and median percentages of total food expenditures for fish and shellfish vary substantially across income levels and classifications of socioeconomic and demographic characteristics.

Indeed, income, education, occupation, region, population density and other household characteristics are related to some degree. Hence, the net impact of each on fish and shellfish expenditure is not clear. The objective of the remainder of this research study is to attempt to disentangle the effects of socioeconomic and demographic characteristics on aggregate fish and shellfish expenditure.

Empirical Model

Various functional forms have been suggested to represent household expenditure behavior. All hypothesize that household expenditure is related to price, household income, and numerous socioeconomic and demographic characteristics. The most widely used include the (1) linear, (2) quadratic, (3) double logarithmic, (4) semi-logarithmic, (5) inverse, and (6) logarithmic-inverse functional forms [Brown and Deaton (1972), Leser (1963), Goreaux (1960), Prais and

Figure 1. Fish/Shellfish Expenditure by Household Size.



Houthakker (1955), Hassan and Johnson (1977)]. In light of the literature review in Chapter II, this study hypothesizes the quadratic function [Salathe (1979) and Smallwood and Blaylock (1981)] to be the form of the aggregate fish and shellfish expenditure function.

The quadratic form possesses properties set forth by demand theory and may be thought of as a second order Taylor series expansion in household income and household size to a general expenditure function [Howe (1977)]. Salathe (1978) found that the quadratic form more accurately describes expenditure behavior when comparing empirically alternative functional forms.

The mathematical form of the quadratic function used is:

$$
\begin{aligned}
(7)\quad FISH = {} & A_0 + A_1GR_2 + A_2GR_3 + A_3GR_4 + A_4L2 + A_5L3 + A_6L4 + A_7L5 + \\
& A_8L6 + A_9L7 + A_{10}L8 + A_{11}R1 + A_{12}M1 + A_{13}E1 + A_{14}E2 + \\
& A_{15}E3 + A_{16}E4 + A_{17}E5 + A_{18}OC1 + A_{19}OC2 + A_{20}OC3 + \\
& A_{21}OC4 + A_{22}OC5 + A_{23}OC6 + A_{24}OC7 + A_{25}OC8 + A_{26}OC9 + \\
& A_{27}H1 + A_{28}FH1 + A_{29}S1 + A_{30}S2 + A_{31}S3 + A_{32}PR + \\
& A_{33}FAMSIZE + A_{34}FSQ + A_{35}TOTLINC + A_{36}INSQ + A_{37}FSINC + \\
& e.
\end{aligned}
$$

The parameters A_0, $A_1,\ldots,A_{37}$ are the coefficients that measure the response of fish and shellfish expenditure to changes in price, household income, household size, and socioeconomic and demographic variates. The random variable e represents the stochastic disturbance term of the quadratic expenditure function. The independent variables GR2, GR3, GR4, L2, L3, L4, L5, L6, L7, L8, R1, M1, E1, E2, E3, E4, E5, OC1, OC2, OC3, OC4, OC5, OC6, OC7, OC8, OC9, H1, FH1,

S1, S2, and S3 are binary or zero-one variables. Zero-one variables in this study take on the value of unity with the occurrence of a particular attribute and take on the value of zero with the non-occurrence of a particular attribute. For example, when the variable GR2 is equal to one, this representation implies that the household is located in the North Central region of the United States. When the variable GR2 is equal to zero, this representation indicates that the household is located either in the Northeast, the South, or the West. The list of variable names is exhibited in Table 17.

Most of the independent variables in the statistical model are zero-one variables. The key purpose of the use of zero-one variables is to achieve a greater degree of generalization in model formulation. The binary variables are intercept shifters, not slope shifters, of the quadratic expenditure function. The coefficients of the binary variables reflect the impact of region, population density, race of the household head, marital status of the household head, education of the household head, occupation of the household head, tenure class of the household head, employment status of the female head, and seasonality on fish and shellfish expenditure.

When zero-one variables are used, classifications of the socioeconomic and demographic variates have to be established so that they are mutually exclusive and exhaustive. The number of ones in each classification represents the number of replications. To handle the singularity problem (the sum of all zero-one variables of a particular socioeconomic and demographic variate forms a perfect

Table 17. List of Variable Names

Variate	Variable Name	Description
FISH, SHELLFISH EXPENDITURE	FISH	Fish and shellfish expenditure
REGION	GR1	Northeast region (omitted category)
	GR2	North Central region
	GR3	South region
	GR4	West region
POPULATION DENSITY	L1	SMSAs 1,000,000 and over population, central cities (omitted category)
	L2	SMSAs 1,000,000 and over population, other than central cities
	L3	SMSAs 400,000 to 999,999 population, central cities
	L4	SMSAs 400,000 to 999,999 population, other than central cities
	L5	SMSAs 50,000 to 399,999 population, central cities
	L6	SMSAs 50,000 to 399,999 population, other than central cities
	L7	Outside SMSAs, urban areas
	L8	Outside SMSAs, rural areas
RACE	R1	White and other than black
	R2	Black (omitted category)
MARITAL STATUS	M1	Married
	M2	Widowed, divorced, separated, never married (omitted category)
EDUCATION	E1	Some grade school completed
	E2	Some high school completed
	E3	High school graduate
	E4	Some college completed
	E5	College graduate, graduate work
	E6	None (omitted category)

Table 17. List of Variable Names (continued)

Variate	Variable Name	Description
OCCUPATION	OC1	Self-employed
	OC2	Salaried professional, technical worker
	OC3	Salaried managers, administrators
	OC4	Clerical
	OC5	Sales
	OC6	Craftsmen
	OC7	Operatives
	OC8	Unskilled laborers
	OC9	Retired
	OC10	Other (omitted category)
TENURE CLASS	H1	Homeowner
	H2	Renter (omitted category)
EMPLOYMENT STATUS OF FEMALE HOUSEHOLD HEAD	FH1	Employed female household head
	FH2	Unemployed female household head (omitted category)
SEASON	S1	Winter quarter
	S2	Spring quarter
	S3	Summer quarter
	S4	Fall quarter (omitted category)
HOUSEHOLD SIZE	FAMSIZE	Household size
HOUSEHOLD INCOME	TOTLINC	Household income
PRICE OF FISH, SHELLFISH	PR	Consumer price index of fish, shellfish
	FSQ	Family size squared
	INSQ	Total money income squared
	FSINC	Interaction of household size and income

linear association with the intercept of the statistical model), one of the zero-one variables of each set of classifications is arbitrarily deleted. Hence A_0, the intercept of the quadratic function, represents confounded components--some general intercept for the statistical model and the effects of omitted zero-one variables from each set of classifications of socioeconomic and demographic variates. Technically, A_0 is the base intercept of the expenditure function. The coefficients of the binary variables indicate the numerical amount by which the intercept of the included classifications of the set of discrete variables differs from the base intercept.

Elasticities can be computed from (7) to summarize the influence of price, household size, and income on household fish and shellfish expenditure. The income elasticity measures the percentage change in fish and shellfish expenditure due to a one-percent change in income. The income elasticity implied by (7) is given by:

$$(8) \qquad \eta = (\partial FISH/\partial TOTLINC)(TOTLINC/FISH)$$

$$\eta = (A_{35} + 2A_{36}TOTLINC + A_{37}FAMSIZE)(TOTLINC/FISH),$$

where $(\partial FISH/\partial TOTLINC)$ is the partial derivative of FISH with respect to TOTLINC; (8) implies that the value of the income elasticity depends upon the expenditure level, income, and household size. A negative income elasticity indicates that expenditures on fish and shellfish decline (rise) as income increases (decreases). A positive income elasticity indicates that expenditures on fish and shellfish rise (decline) as income increases (decreases). The

larger the magnitude of the income elasticity, the more responsive fish and shellfish expenditures are to changes in household income.

The household-size elasticity measures the percentage change in fish and shellfish expenditure due to a one-percent change in household size. The household-size elasticity associated with (7) is given by:

$$(9) \qquad \eta = (\partial FISH/\partial FAMSIZE)(FAMSIZE/FISH)$$

$$\eta = (A_{33} + 2A_{34}FAMSIZE + A_{37}TOTLINC)(FAMSIZE/FISH),$$

where (∂FISH/∂FAMSIZE) is the partial derivative of FISH with respect to FAMSIZE; (9) implies that the value of the household size elasticity depends upon the expenditure level, income, and household size. A positive (negative) household size elasticity indicates that expenditures on fish and shellfish rise (decline) as household size increases. The larger the magnitude of the household size elasticity, the more responsive fish and shellfish expenditures are to changes in household size.

The price elasticity of demand measures the percentage change in fish and shellfish consumption due to a one-percent change in price. The price elasticity of demand associated with (7) is given by:

$$(10) \qquad \varepsilon = [(\partial FISH/\partial PR)(PR/FISH)] - 1$$

$$\varepsilon = [(A_{32})(PR/FISH)] - 1,$$

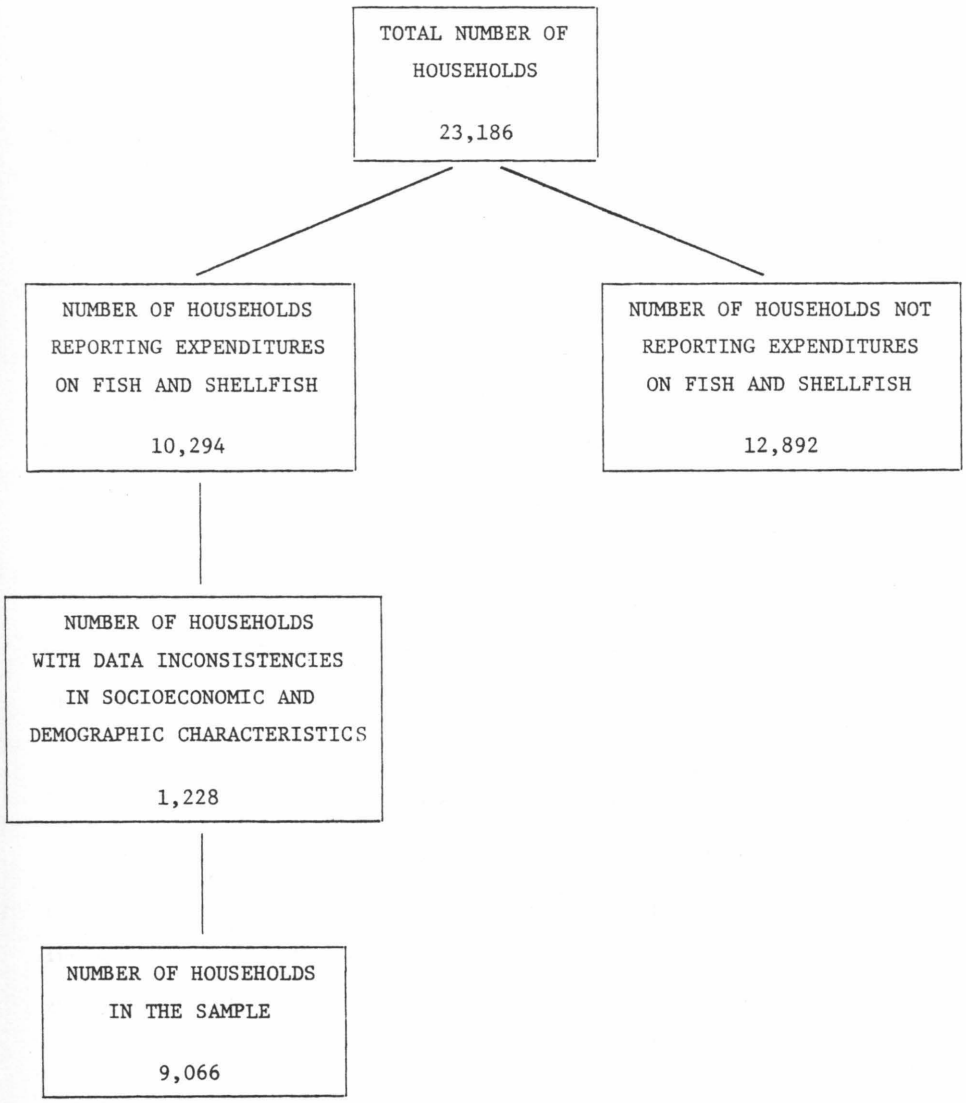
where (∂FISH/∂PR) is the partial derivative of FISH with respect to PR; (10) implies that the value of the price elasticity of demand

depends upon the expenditure level and the price level. A positive value of A_{32} indicates that the demand for fish and shellfish is inelastic. Increases (decreases) in fish and shellfish price lead to concomitant increases (decreases) in fish and shellfish expenditure. A negative value of A_{32} indicates that the demand for fish and shellfish is elastic. Increases (decreases) in fish and shellfish price lead to concomitant decreases (increases) in fish and shellfish expenditure. The larger the magnitude of the price elasticity, the more responsive fish and shellfish expenditures are to changes in price. The sample means of FISH, TOTLINC, FAMSIZE, and PR are used in this study for calculating the price, income, and household-size elasticities.

Since both zero-one and continuous quantitative variables are components of the respective model, the model is, technically speaking, a multiple covariance model. Analysis of covariance is the combination or the blending of multiple regression and analysis of variance. The covariates in this study are price, household size, and household income. In order to conduct the analysis for the statistical model, a number of households (1,228) with data inconsistencies in socioeconomic and demographic variates were eliminated from the set of 10,294 households. The data inconsistencies were the following: (1) incomplete income reporting, (2) negative household income, (3) tenure class of household head not reported, and (4) incomplete or erroneous information pertaining to seasonal expenditure. A schematic diagram of the selection of the sample

used in the research study is depicted in Figure 2. The empirical analysis of aggregate fish and shellfish expenditure is based on information from the remaining 9,066 households.

Figure 2. Schematic Diagram of the Selection of the Sample.



CHAPTER IV

RESULTS

The estimation of the coefficients of the quadratic expenditure function was accomplished through the use of ordinary least squares. The regression analysis for the quadratic functional form is exhibited in Table 18. The Durbin-Watson D statistic indicates the absence of autocorrelation in the disturbance term of the statistical model. Slightly more than five percent of the variation in household expenditure on fish and shellfish is accounted for by the set of regressors in the quadratic expenditure model. The unadjusted coefficient of determination for the statistical models is in line with the coefficients of determination for the statistical models in both the Salathe study and the Smallwood and Blaylock study. The matrix of correlation coefficients for regressors in the quadratic expenditure function indicates the absence of multicollinearity problems.

The estimated coefficients of the zero-one variables represent incremental differences relative to the base intercept. Tests of hypotheses about the individual parameters of the zero-one variables provide information about whether the intercepts for each of the included classifications of discrete variables are different from the omitted classifications.

The t-test is used to perform tests of significance about the estimated coefficients of binary variables and about the estimated

Table 18. Regression Analysis for the Quadratic Expenditure Function

Variable	Parameter Estimate	Standard Error	T Ratio	P-Value
INTERCEPT	1.735957	0.637809	2.7218	0.0065
GR2	-0.925695	0.108628	-8.5217	0.0001
GR3	-0.511838	0.107462	-4.7630	0.0001
GR4	-0.354774	0.115277	-3.0776	0.0021
L2	-0.715699	0.117082	-6.1128	0.0001
L3	-0.532041	0.181263	-2.9352	0.0033
L4	-0.642257	0.178131	-3.6055	0.0003
L5	-0.944423	0.171119	-5.5191	0.0001
L6	-0.768446	0.172485	-4.4551	0.0001
L7	-0.609822	0.142889	-4.2678	0.0001
L8	-0.818751	0.140310	-5.8353	0.0001
FAMSIZE	0.320673	0.085064	3.7698	0.0002
R1	-0.787605	0.136953	-5.7509	0.0001
M1	-0.270649	0.123257	2.1958	0.0281
E1	-0.233591	0.402349	-0.5806	0.5615
E2	-0.234763	0.406640	-0.5773	0.5637
E3	-0.258510	0.402725	-0.6419	0.5210
E4	-0.352284	0.410740	-0.8577	0.3911
E5	-0.219734	0.414338	-0.5303	0.5959
OC1	-0.043051	0.218343	-0.1972	0.8437
OC2	-0.068508	0.195591	-0.3503	0.7262
OC3	0.050911	0.198687	0.2562	0.7978
OC4	-0.042254	0.201816	-0.2094	0.8342
OC5	-0.185795	0.242276	-0.7669	0.4432
OC6	-0.240408	0.180802	-1.3297	0.1837
OC7	-0.325365	0.179636	-1.8112	0.0701
OC8	0.001987026	0.177189	0.0112	0.9910
OC9	0.143165	0.183565	0.7799	0.4355
TOTLINC	0.00004860425	0.00001180944	4.1157	0.0001
H1	0.065234	0.089557	0.7284	0.4664
FH1	-0.128521	0.091548	-1.4039	0.1604
S1	0.108730	0.105585	1.0298	0.3031
S2	0.131055	0.109395	1.1980	0.2309
S3	0.040345	0.108229	0.3728	0.7093
PR	0.905674	0.263859	3.4324	0.0006
FSQ	-0.00906743	0.008729477	-1.0387	0.2990
INSQ	2.96780E-10	8.59976E-11	3.4510	0.0006
FSINC	-0.0000055646	0.00000256488	-2.1695	0.0301

Durbin-Watson D Statistic = 1.9534

R^2 = 0.0514, F = 13.21 (p-value = 0.0001)

Source: Computations by author

coefficients of continuous quantitative variables. To test hypotheses about all possible pairs of differences among the parameters of the zero-one variables within particular socioeconomic and demographic classifications, the Newman-Keuls procedure is used. The Newman-Keuls test, a sequential range test, is designed to overcome the problem of the changing level of significance when conventional statistical tests for ascertaining differences among pairs of parameters are applied to sets of non-orthogonal differences.[4] The basic notion underlying this test is that the ranges of differences specified as significant at a chosen level of significance are systematically adjusted according to the number of coefficients in the particular classifications so as to offset the loss of the level of significance. Pairwise comparisons for estimated coefficients of the statistical models by socioeconomic and demographic variates based on the Newman-Keuls test are presented in Appendix Table A.13.

The p-value (probability value) summarizes what the data say about the credibility of the null hypothesis H_0: $A_i = 0$, i=1,2,...,37 for the quadratic expenditure model. The null hypothesis is rejected if the p-value is less than the specified level of significance. The significance level chosen for this research study is 0.05.

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[4] The basic problem with testing all possible pairs is that the level of significance decreases as the number of non-orthogonal comparisons increases. One may be performing tests of hypotheses at some chosen level of significance when in fact the true level of significance may be considerably less. The outcome is that too many differences are judged to be statistically significant at a chosen significance level.

Households located in the Northeast purchase significantly more fish and shellfish than households located in the North Central, the South, and the West. In addition, households located in the South and the West spend significantly more on fish and shellfish than households located in the North Central. No statistically significant differences exist in fish and shellfish expenditure patterns between households in the South and in the West. Further, households located in SMSAs with 1,000,000 and over population spend significantly more on fish and shellfish than households located in less densely populated areas. Fish and shellfish expenditure for households located in SMSAs with 400,000 to 999,999 population, SMSAs with 50,000 to 399,999 population, and urban and rural areas outside SMSAs is statistically the same.

Education of the household head, occupation of the household head, tenure class of the household head, seasonality, and employment status of the female household head are not statistically important factors in explaining the variation in household expenditure on fish and shellfish. Blacks and married persons, however, expend significantly more on fishery products than non-blacks and non-married persons.

The price of fish and shellfish, household size, and household income are statistically significant factors of household expenditure on fish and shellfish. In the quadratic expenditure model, increases (decreases) in price, household size, and household income lead to concomitant increases (decreases) in household expenditure

on fish and shellfish. The household income, household size, and price elasticities for fish and shellfish are exhibited in Table 19.

Table 19. Household Income, Household Size, and Price Elasticities[a]

Elasticity	Quadratic Expenditure Function	Salathe Study	Smallwood and Blaylock Study
Household Income	0.1651	0.3568[b] 0.2407[c]	0.3278
Household Size	0.2296	0.4275[b] 0.5668[c]	0.4251
Price	-0.4654	N/A[d]	N/A[d]

[a]Evaluated at the sample means: (1) TOTLINC - $12254.523, (2) FISH - $2.777, (3) FAMSIZE - 3.315, and (4) PR - 1.639
[b]Data from June 1972 to June 1973.
[c]Data from July 1973 to July 1974.
[d]Not applicable.

A ten-percent change in household income is positively associated with a 1.65 percent change in aggregate fish and shellfish expenditure. This measure indicates that fish and shellfish is a normal good. Similarly, a ten-percent change in household size is positively associated with a 2.29 percent change in aggregate fish and shellfish expenditure. In this study, the magnitudes of the household-income elasticity and the household-size elasticity are less than the corresponding magnitudes in the studies by Salathe and Smallwood and Blaylock. The effect of price on demand for fish and

shellfish is inelastic. A ten-percent change in price leads to a 4.69 percent change in fish and shellfish consumption in the opposite direction. On the basis of the estimated price coefficient in the statistical model, a ten-percent increase (decrease) in the price of fish and shellfish leads to a 4.88 percent increase (decrease) in fish and shellfish expenditure. Contrary to the Purcell and Raunikar study, price plays a statistically significant role in household expenditure on fish and shellfish. In agreement with the works of Purcell and Raunikar, Salathe, and Smallwood and Blaylock, household size and household income influence household expenditure on fish and shellfish.

The estimated quadratic expenditure model may be used to make predictions of two-week household expenditure on fish and shellfish given information on price, household income, household size, and socioeconomic and demographic characteristics. Various socioeconomic and demographic profiles can be constructed to examine household expenditure behavior. To illustrate, two profiles of two-week household expenditure on fish and shellfish by household income and household size are presented in Tables 20 and 21.

The first profile incorporates the following socioeconomic and demographic characteristics: (1) the household is located in the Northeast, (2) the household is located in a central city within a SMSA of 1,000,000 and over population, (3) the household head is black, (4) the household head is separated, (5) the household head is a high school graduate, (6) the household head is self-employed,

Table 20. PROFILE 1: Predictions of Two-Week Household Expenditure by Household Income and by Household Size.

Household Income	Number of Persons in Household				
	1	2	3	4	5
$ 2,000	$4.80	$5.09	$5.35	$5.60	$5.82
$ 5,000	$4.94	$5.21	$5.45	$5.68	$5.89
$10,000	$5.18	$5.41	$5.63	$5.84	$6.02
$15,000	$5.43	$5.64	$5.83	$6.01	$6.16
$20,000	$5.70	$5.88	$6.04	$6.19	$6.32
$25,000	$5.98	$6.13	$6.27	$6.39	$6.49
$35,000	$6.59	$6.69	$6.77	$6.83	$6.87
$50,000	$7.61	$7.63	$7.62	$7.60	$7.56

Table 21. PROFILE 2: Predictions of Two-Week Household Expenditure by Household Income and by Household Size.

Household Income	Number of Persons in Household				
	1	2	3	4	5
$ 2,000	$3.00	$3.29	$3.55	$3.80	$4.02
$ 5,000	$3.14	$3.41	$3.65	$3.88	$4.09
$10,000	$3.30	$3.61	$3.83	$4.04	$4.22
$15,000	$3.63	$3.84	$4.03	$4.21	$4.36
$20,000	$3.90	$4.08	$4.24	$4.39	$4.52
$25,000	$4.18	$4.33	$4.47	$4.59	$4.69
$35,000	$4.79	$4.89	$4.97	$5.03	$5.07
$50,000	$5.81	$5.83	$5.82	$5.80	$5.76

(7) the household head is a renter, (8) the female household head is unemployed, and (9) the season is the fall quarter. The second profile embodies the following socioeconomic and demographic characteristics: (1) the household is located in the South, (2) the household is located in a rural area outside a SMSA, (3) the household head is white, (4) the household head is married, (5) the household head has completed some high school, (6) the household head is an unskilled laborer, (7) the household head is a homeowner, (8) the female household head is employed, and (9) the season is the summer quarter. The price used for the arrangement of these profiles is the annual average Consumer Price Index for fish and shellfish for 1980 (3.286).

For example, a household with an annual income of $20,000 and five family members that fits the specification of the first profile would spend $6.32 bi-weekly for fish and shellfish. Similarly, a household with the same annual income and family size that fits the specification of the second profile would spend $4.52 bi-weekly for fish and shellfish. In general, for any socioeconomic and demographic profile, as household size increases (decreases) ceteris paribus, or as household income increases (decreases) ceteris paribus, the expenditure on fish and shellfish also increases (decreases). The tremendous wealth of detail in the classifications of the socioeconomic and demographic variates permits the construction of many unique profiles of the types in Tables 20 and 21. The reader is left to pursue those which are of most interest to him.

Such profiles are useful for market research programs by the seafood industry.

CHAPTER V

SUMMARY AND CONCLUSIONS

To enhance the understanding of fish and shellfish buying patterns in the United States, this study investigated the nature and magnitude of the influence of price, household income, household size, and particular socioeconomic and demographic variates on aggregate seafood expenditure. The source of data was the 1972-1974 U.S. Bureau of Labor Statistics Consumer Expenditure Diary Survey. The empirical analysis of aggregate fish and shellfish expenditure was based on information from 9,066 households.

This study hypothesized the quadratic form to represent household expenditure behavior. It was assumed that household expenditure on fish and shellfish was related to price, household income, and numerous socioeconomic and demographic characteristics. Most of the independent variables in the statistical models were zero-one variables. The binary variables were intercept shifters, not slope shifters, of the quadratic expenditure function. The coefficients of the binary variables reflected the impact of region, population density, race, marital status, education, occupation, and tenure class of the household head, as well as employment status of the female head and seasonality on fish and shellfish expenditure. Since both zero-one and continuous quantitative variables were components of the statistical model, the model represents, technically speaking, a multiple covariance model.

The estimation of the coefficients of the quadratic expenditure function was accomplished through the use of ordinary least squares. The t-test was used to perform tests of significance about the estimated coefficients of binary variables and about the estimated coefficients of continuous quantitative variables. Tests of significance about all possible pairs of estimated coefficients for socioeconomic and demographic variates were accomplished through the use of the Newman-Keuls procedure.

The respective statistical tests indicated that geographic region, population density, race, and marital status statistically influence household expenditure on fish and shellfish. On the other hand, education, occupation, and tenure class of the household head, as well as seasonality and employment status of the female household head, were not statistically significant factors of household expenditure on fish and shellfish.

The price of fish and shellfish, household size, and household income were statistically significant factors of household expenditure on fish and shellfish. Increases (decreases) in price, household size, and household income led to concomitant increases (decreases) in household expenditure on fish and shellfish. The income elasticity derived from the statistical model was 0.1651, indicating that fish and shellfish was a normal good. The price elasticity was -0.4654, indicating that the demand for fish and shellfish was inelastic. The household-size elasticity was 0.229, indicating the responsiveness of household fish and shellfish expenditure to a one-percent change in household size.

The estimated quadratic expenditure model was used to make predictions of two-week household expenditure on fish and shellfish given information on price, household income, household size, and socioeconomic and demographic characteristics. Two socioeconomic and demographic profiles were constructed to examine household expenditure behavior.

A logical generalization is to extend the analysis to focus on individual fish and shellfish species such as hard blue crabs, oysters, clams, and food finfish. A second generalization involves the examination of the impact of additional socioeconomic and demographic characteristics such as religion and age-sex composition of the household on fish and shellfish expenditure. A third generalization encompasses the use of the 1977-1978 Nationwide Food Consumption Survey. A comparison of household expenditure patterns on fish and shellfish from the 1972-1974 Consumer Expenditure Diary Survey and from the 1977-1978 Nationwide Food Consumption Survey provides indications of stability or instability of consumer behavior in the seafood market. The last decade was characterized by dramatic changes in price, household income, and socioeconomic and demographic characteristics. Additional studies of household expenditure behavior are likely to pay dividends to the seafood industry.

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APPENDIX

Table A.1. Total Food Expenditure by Household Income.

	Number of Households	Mean	Median	Standard Deviation	Minimum	Maximum
Less than $0	6	$ 60.40	$ 54.43	$39.20	$15.95	$124.89
Equal to $0	52	$ 59.80	$ 49.31	$41.83	$ 9.42	$223.69
>$0-$1,999	411	$ 43.11	$ 34.12	$33.63	$ 1.17	$256.62
$2,000-$2,999	456	$ 46.61	$ 37.48	$32.65	$ 1.50	$264.07
$3,000-$3,999	443	$ 57.03	$ 47.88	$48.96	$ 4.72	$697.76
$4,000-$4,999	498	$ 57.55	$ 50.47	$36.51	$ 1.92	$314.43
$5,000-$5,999	443	$ 61.72	$ 50.99	$43.85	$ 4.63	$544.67
$6,000-$6,999	502	$ 66.66	$ 59.00	$38.73	$10.76	$325.00
$7,000-$7,999	469	$ 70.51	$ 59.52	$43.48	$10.66	$352.48
$8,000-$9,999	968	$ 72.80	$ 66.71	$38.60	$ 4.38	$375.49
$10,000-$11,999	1060	$ 82.95	$ 75.10	$43.44	$ 9.96	$589.88
$12,000-$14,999	1335	$ 85.83	$ 80.84	$39.34	$11.28	$339.26
$15,000-$19,999	1360	$ 98.96	$ 92.83	$47.75	$ 9.37	$660.61
$20,000-$24,999	682	$112.12	$103.23	$55.22	$15.63	$483.67
$25,000-$34,999	451	$122.55	$114.98	$58.71	$24.00	$408.69
$35,000-$49,999	139	$131.09	$121.48	$68.45	$15.28	$437.49
$50,000 +	69	$137.62	$117.40	$87.83	$30.65	$630.66
Incomplete Income Reporting	950	$ 83.59	$ 73.90	$50.85	$ 1.24	$374.05

Source: Computations by the author.

Table A.2. Total Food Expenditure by Geographic Region.

	Number of Households	Mean	Median	Standard Deviation	Minimum	Maximum
U.S.	10294	$81.28	$72.47	$49.94	$1.17	$697.76
Northeast	2749	$88.86	$79.74	$52.50	$1.92	$660.61
North Central	2571	$80.65	$71.15	$49.02	$1.17	$408.69
South	2950	$74.83	$66.93	$45.23	$1.24	$630.66
West	2024	$81.17	$72.12	$52.62	$1.50	$697.76

Source: Computations by the author.

Table A.3. Total Food Expenditure by Population Density.

	Number of Households	Mean	Median	Standard Deviation	Minimum	Maximum
SMSAs 1,000,000 + Population	4959	$85.36	$75.49	$52.26	$1.17	$660.61
Central Cities[a]	2102	$80.47	$69.96	$51.54	$2.73	$630.66
Other than Central Cities[b]	2857	$88.97	$79.52	$52.50	$1.17	$660.61
SMSAs 400,000 to 999,999 Population	1235	$81.20	$73.63	$46.46	$1.24	$437.49
Central Cities[a]	597	$76.74	$68.46	$43.87	$1.24	$314.43
Other than Central Cities[b]	638	$85.37	$77.95	$48.43	$4.38	$437.49
SMSAs 50,000 to 399,999 Population	1433	$79.23	$71.52	$46.96	$1.92	$483.67
Central Cities[c]	714	$74.57	$67.33	$46.38	$1.92	$483.67
Other than Central Cities[b]	719	$83.86	$76.75	$47.11	$2.10	$374.05
Outside SMSAs	2667	$74.81	$66.04	$47.85	$2.44	$697.76
Urban	1183	$76.05	$65.99	$49.97	$3.17	$467.01
Rural	1484	$73.81	$66.10	$46.10	$2.44	$697.76

[a]Urban.

[b]Including rural.

Source: Computations by the author.

Table A.4. Total Food Expenditure by Household Size.

	Number of Households	Mean	Median	Standard Deviation	Minimum	Maximum	Mean Per Household Member
1	1396	$ 40.88	$ 34.43	$ 27.66	$ 1.17	$287.58	$40.88
2	2851	$ 65.80	$ 58.79	$ 35.84	$ 1.92	$437.49	$32.90
3	1848	$ 80.58	$ 73.52	$ 43.77	$ 5.57	$697.76	$26.86
4	1872	$ 94.85	$ 86.34	$ 49.24	$ 6.73	$630.66	$23.71
5	1182	$105.37	$ 97.48	$ 51.07	$ 9.34	$589.88	$21.07
6	597	$117.29	$107.64	$ 54.25	$ 9.33	$660.61	$19.54
7	281	$122.97	$117.38	$ 57.79	$ 3.17	$408.69	$17.56
8	142	$139.48	$136.06	$ 60.72	$ 39.76	$467.01	$17.43
9	73	$127.26	$112.62	$ 58.72	$ 10.36	$299.75	$14.14
10	31	$148.43	$148.34	$ 70.58	$ 21.38	$374.05	$14.84
11	13	$128.62	$130.28	$ 69.37	$ 32.72	$264.07	$11.69
12	3	$132.24	$107.97	$116.94	$ 29.33	$259.42	$11.02
13	4	$120.92	$106.40	$ 59.33	$ 71.62	$199.28	$ 9.30
14	0	----	----	----	----	----	---
15	1	$161.50	$161.50	----	$161.50	$161.50	$10.76

Source: Computations by the author.

Table A.5. Total Food Expenditure by Race of Household Head.

	Number of Households	Mean	Median	Standard Deviation	Minimum	Maximum
White and Other Than Black	9224	$82.65	$73.70	$50.45	$1.17	$697.76
Black	1070	$69.44	$60.83	$43.49	$2.10	$356.26

Source: Computations by the author.

Table A.6. Total Food Expenditure by Marital Status of Household Head.

	Number of Households	Mean	Median	Standard Deviation	Minimum	Maximum
Married	7803	$89.77	$80.65	$50.42	$2.44	$697.76
Other[a]	2491	$54.68	$44.91	$37.55	$1.17	$354.52

[a]Widowed, divorced, separated, never married.

Source: Computations by the author.

Table A.7. Total Food Expenditure by Education of Household Head.

	Number of Households	Mean	Median	Standard Deviation	Minimum	Maximum
None	114	$63.77	$47.46	$72.75	$4.72	$697.76
Some Grade School Completed	2021	$69.83	$69.65	$45.43	$1.17	$366.01
Some High School Completed	1657	$80.39	$72.44	$50.25	$3.17	$660.61
High School Graduates	3217	$82.39	$74.89	$46.02	$1.50	$467.01
Some College Completed	1486	$83.68	$73.85	$50.11	$7.48	$483.67
College Graduate, Graduate Work	1799	$92.08	$82.77	$56.07	$1.24	$630.66

Source: Computations by the author.

Table A.8. Total Food Expenditure by Occupation of Household Head.

	Number of Households	Mean	Median	Standard Deviation	Minimum	Maximum
Self Employed	760	$88.85	$76.81	$59.06	$ 2.44	$630.66
Salaried Professional, Technical Workers	1220	$91.26	$83.56	$49.08	$ 8.15	$437.49
Salaried Managers and Administrators	1050	$99.07	$87.56	$55.48	$10.88	$660.61
Clerical	713	$74.57	$65.39	$44.36	$ 3.37	$284.94
Sales	410	$92.04	$83.41	$55.91	$ 6.91	$483.67
Craftsmen	1402	$89.82	$82.10	$46.94	$ 5.98	$408.69
Operatives	1261	$82.10	$74.06	$45.73	$ 4.81	$589.88
Unskilled Laborers and Service Workers	1207	$75.33	$67.76	$43.63	$ 3.54	$289.50
Retired	1312	$57.53	$49.54	$42.34	$ 1.50	$697.76
Other	959	$69.87	$60.08	$48.12	$ 1.17	$467.01

Source: Computations by the author.

Table A.9. Total Food Expenditure by Tenure Class of Household Head.

	Number of Households	Mean	Median	Standard Deviation	Minimum	Maximum
Homeowner	6723	$88.42	$80.03	$51.83	$1.17	$697.76
Renter	3461	$68.40	$60.08	$43.26	$1.24	$630.66
Not Reported	110	$49.45	$40.26	$31.39	$4.63	$133.18

Source: Computations by the author.

Table A.10. Total Food Expenditure by Employment Status of Female Head Outside the Home.

	Number of Households	Mean	Median	Standard Deviation	Minimum	Maximum
Employed	3256	$90.49	$81.67	$49.83	$3.17	$660.61
Unemployed	7038	$77.02	$67.54	$49.41	$1.17	$697.76

Source: Computations by the author.

Table A. 11. Total Food Expenditure by Month and Year.

	Number of Households	Mean	Median	Standard Deviation	Minimum	Maximum
			1972			
June-July	82	$77.51	$72.58	$42.72	$ 4.63	$174.02
July-Aug.	366	$74.44	$67.41	$41.50	$ 9.47	$287.58
Aug.-Sept.	390	$72.25	$64.03	$44.36	$ 3.67	$466.56
Sept.-Oct.	333	$72.09	$64.17	$44.15	$ 8.82	$400.01
Oct.-Nov.	399	$73.49	$66.62	$44.44	$ 1.24	$339.26
Nov.-Dec.	377	$75.50	$64.16	$41.73	$ 9.33	$279.30
Dec.-Jan.	576	$76.38	$67.95	$51.46	$ 1.92	$697.76
			1973			
Jan.-Feb.	407	$78.13	$70.47	$46.56	$ 1.17	$325.00
Feb.-Mar.	409	$76.52	$65.12	$45.75	$ 5.83	$300.15
Mar.-Apr.	433	$77.63	$70.34	$46.13	$ 7.35	$428.33
Apr.-May	427	$76.86	$68.01	$53.31	$ 1.50	$483.67
May-June	396	$75.77	$67.83	$42.41	$ 4.38	$253.54
June-July	399	$82.40	$72.77	$52.73	$ 3.17	$544.67
July-Aug.	460	$81.34	$71.51	$56.35	$ 5.62	$660.61
Aug.-Sept.	434	$83.82	$77.17	$48.18	$ 2.73	$361.12
Sept.-Oct.	427	$86.60	$75.44	$56.37	$ 8.21	$630.66
Oct.-Nov.	399	$85.39	$76.50	$51.29	$ 5.57	$388.59
Nov.-Dec.	502	$83.63	$75.94	$47.87	$ 6.77	$329.06
Dec.-Jan.	624	$88.99	$80.78	$53.54	$ 8.96	$404.04
			1974			
Jan.-Feb.	446	$83.93	$75.68	$48.64	$ 4.81	$334.62
Feb.-Mar.	399	$87.85	$76.58	$48.38	$ 4.81	$314.43
Mar.-Apr.	469	$88.50	$76.71	$58.07	$11.07	$589.88
Apr.-May	416	$90.66	$83.25	$53.21	$ 8.87	$366.01
May-June	381	$86.10	$73.61	$56.83	$ 4.72	$467.01
June-July	274	$88.51	$83.90	$47.42	$ 2.10	$322.99
Incomplete Start Date Information	9	$61.54	$52.63	$32.50	$ 9.96	$116.03
Start Date Errors Outside Survey Period	48	$81.56	$77.12	$42.87	$14.40	$189.77
Nonconsecutive Start Date Errors	12	$91.70	$72.18	$44.84	$41.02	$191.06

Source: Computations by the author.

Table A.12. Total Food Expenditure by Season.

	Number of Households	Mean	Median	Standard Deviation	Minimum	Maximum
Winter[a]	2563	$82.21	$73.05	$49.50	$1.17	$589.88
Spring[b]	2375	$82.87	$74.24	$51.38	$1.50	$544.67
Summer[c]	2410	$78.92	$70.19	$49.64	$2.73	$660.61
Fall[d]	2877	$81.11	$72.46	$49.48	$1.24	$697.76

[a]Jan.-Feb., Feb.-Mar., Mar.-Apr.

[b]Apr.-May, May-June, June-July.

[c]July-Aug., Aug.-Sept., Sept.-Oct.

[d]Oct.-Nov., Nov.-Dec., Dec.-Jan.

Source: Computations by the author.

Table A.13. Pairwise Comparisons: Newman-Keuls Test; Geographic Region, Population Density, Education of Household Head, Occupation of Household Head, and Season

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Geographic Region

	GR2	GR3	GR4
Coefficient Estimate	-.925695	-.511838	-.354774

$$R_3(GR4, GR2) = q_{.05}(3,9028)\frac{S_{(GR4-GR2)}}{\sqrt{2}} = 0.270699 < 0.570921^a$$

$$R_2(GR4, GR3) = q_{.05}(2,9028)\frac{S_{(GR4-GR3)}}{\sqrt{2}} = 0.225305 > 0.157064^a$$

$$R_2(GR3, GR2) = q_{.05}(2,9028)\frac{S_{(GR3-GR2)}}{\sqrt{2}} = 0.207627 < 0.413857^a$$

Population Density

	L5	L8	L6	L2
Coefficient Estimate	-.944423	-.818751	-.768446	-.715699

L4	L7	L3
-.642257	-.609822	-.532041

$$R_7(L3, L5) = q_{.05}(7,0928)\frac{S_{(L3-L5)}}{\sqrt{2}} = 0.637290 > 0.412382^a$$

Education of Household Head

	E4	E3	E2
Coefficient Estimate	-.352284	-.258510	-.234763

E1	E5
-.233591	-.219734

$$R_5(E5, E4) = q_{.05}(5,9028)\frac{S_{(E5-E4)}}{\sqrt{2}} = 0.394311 > 0.132550^a$$

Occupation of Household Head

	OC7	OC6	OC5	OC2
Coefficient Estimate	-.325365	-.240408	-.185795	-.068508

OC1	OC4	OC8	OC3	OC9
-.043451	-.042254	.001987926	.050911	.143165

Table A.13. Pairwise Comparisons (continued)

Occupation of Household Head (continued)

$$R_9(OC9, OC7) = q_{.05}(9,9028)\ \frac{S_{(OC9-OC7)}}{\sqrt{2}} = 0.5101667 > 0.468530^a$$

Season

	S3	S1	S2
Coefficient Estimate	.040345	.108730	.131055

$$R_3(S2, S3) = q_{.05}(3,9028)\ \frac{S_{(S2-S3)}}{\sqrt{2}} = 0.278506 > 0.090710^a$$

[a]Difference of coefficient estimates

$q_{.05}(3,9028) = 3.31$

$q_{.05}(5,9028) = 3.86$

$q_{.05}(7,9028) = 4.17$

$q_{.05}(9,9028) = 4.39$

Source: Computations by the author.

Note: For Table A.13, lines under the coefficient estimates indicate nonsignificant differences. $R_h(J, K)$ is the least significant range for the comparison involving h coefficients specifically for the difference between the coefficient of variable J and the coefficients of variable K. $q_\alpha(h, n-k-1)$ is the tabulated value of the studentized range at the α level of significance for h coefficients and n-k-1 degrees of freedom. S_{J-K} is the standard error of the difference between the coefficient of variable J and the coefficient of variable K. If the difference between the coefficient of variable J and the coefficient of variable K exceeds $R_h(J, K)$, then this difference is statistically different from zero at the α level of significance.

Virginia's Agricultural Experiment Stations

1—Blacksburg
Virginia Tech

2—Steeles Tavern
Shenandoah Valley Research Station

3—Orange
Piedmont Research Station

4—Winchester
Winchester Fruit Research Laboratory

5—Middleburg
Virginia Forage Research Station

6—Warsaw
Eastern Virginia Research Station

7—Suffolk
Tidewater Research and Continuing Education Center

8—Blackstone
Southern Piedmont Research and Continuing Education Center

9—Critz
Reynolds Homestead Research Center

10—Glade Spring
Southwest Virginia Research Station

11—Hampton
Seafood Processing Research and Extension Unit