8-1990

Scan Data : An alternative source of data for consumer demand research

Kent Lee Wolfe

To the Graduate Council:

I am submitting herewith a thesis written by Kent Lee Wolfe entitled "Scan Data : An alternative source of data for consumer demand research." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

David B. Eastwood, Major Professor

We have read this thesis and recommend its acceptance:

John R. Brooker, Greg G. Pompelli

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

To the Graduate Council:

I am submitting herewith a thesis written by Kent Lee Wolfe entitled "Scan Data: An Alternative Source of Data for Consumer Demand Research." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

David B. Eastwood

David B. Eastwood, Major Professor

66

We have read this thesis
and recommend its acceptance:

John R Brooker

Accepted for the council:

C W Minkel

Vice Provost
and Dean of The Graduate School

Scan Data: An Alternative Source of Data for Consumer Demand Research

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Kent Lee Wolfe

August 1990

ACKNOWLEDGEMENT

The author wishes to declare his gratitude to everyone involved in the completion of this thesis. I would like to extend special appreciation to Dr. David B. Eastwood, the committee chairman, for his help and guidance. I would also like to extend appreciation to Dr. John R. Brooker and Dr. Greg G. Pompelli, the graduate committee members, for their time and help. I would also like to thank the Kroger Company for supplying the scan and advertising data used in this thesis.

DEDICATION

I would like to dedicate this thesis to my wife and son, Heidi and Jacob Wolfe. The completion of this thesis would not be possible if it were not for the support and encouragement given to me by Heidi.

ABSTRACT

Scan data have recently become a more popular source of data for use in consumer demand research. Previous studies have used scan data to measure the effects of promotional actives and their effects on consumer demand. Before scan data were available, researhers most frequent sources of data were governmentsurvey publications. These data sets are creditable and usefull but they do not contain all the desirable characteristices needed in consumer demand research. There are also private corporations that collect and supply data, but there intrest lies with the needs of industry not academia. The government surveys are briefly describedand comments regarding their usefulness in consumer demand follows. The public data sets are also described and a word is said about their effectiveness in consumer demand research at the acedemic level.

The empirical analysis is centered around estimation the demand for beef hotdogs using scan data plus data that contain advertising information from television, radio, and newspaper. The null hypotheses that holidays, television, and radio advertising do not have an impact on demand can all be rejected, since the respective parameter estimates are significantly by different from zero. Newspaper advertising on the other hand has proven to be insignificant.

TABLE OF CONTENTS

LIST OF FIGURES

VITA

Kent Lee Wolfe was born in San Miguel County, New Mexico, on March 10, 1966. He attended Clarke County Public schools in Athens, Georgia and Graduated from Cedar Shoals High School in 1980. He received a Bachelor of Science degree in Agriculture from the University of Georgia in August, 1988. He was married to Heidi Lynn Hunt on August 20, 1988. Jacob Lee Wolfe was born on December 12, 1989.

He entered graduate school at The University of Tennessee at Knoxville in August, 1988, and received the Masters of Science degree with a major in Agricultural Economics in August, 1990. He entered the Doctoral program in July, 1990 at The University of Tennessee at Knoxville.

CHAPTER I

INTRODUCTION

There are a variety of survey based data sets available today collected by the federal government that contain information useful for food demand research. The surveys are generally cross-sectional or taken over a short time interval. These surveys have collected information on consumer nutrition, consumer expenditures, and socio-demographic characteristics. Until recently, however, researchers have had to rely on these various government surveys to obtain data.

One of the purposes of creating these data is to gather information about retail food market operations. Increased efficiency can be achieved by providing a more accurate portrayal of changing demand, giving managers the tools needed to make effective managerial decisions, and generating measures of the effectiveness of promotional and merchandising strategies. In order to approximate the exchange process, models and analyses that contain dynamic elements are involved. This makes it necessary for a data set to show adjustments over time. With two exceptions public data sets do not have this capability, and as noted below even in these two instances, there are limitations. The

private data sets contain some of this information, but they are proprietary, directed toward limited research objectives, and generally too costly for the independent, objective, and basic research conducted by the academic community.

All data sets, whether public or proprietary, are designed to collect specific information. For example, one survey might focus on a population's socioeconomic characteristics or how a public policy is being accepted by constituents. The public data sets that are gathered by the federal government have a long standing tradition of being carefully designed and implemented. Problems can arise when the data sets are used for research that strays from the original objectives behind collecting the survey. These pertain to sampling and/or measurement related limitations. The private, proprietary, data that are available are very expensive, and usually the designs and measurements are not as rigorous and or documented as in the government data sets. Nonetheless, these data may be quite useful for research on the effects of advertising and promotional strategies on food demand.

When consumers purchase food items they usually do it in a supermarket setting that offers many substitutes and compliments. Thus, data should include: a) detailed information on food commodities, food groups, and consumer units; b) price information on food items; c) advertising measurements; d) the impact of promotional changes over time; e) the changing socioeconomic composition of the population; and f) consistency in the definitions and measurements of the data.

CHAPTER II

REVIEW OF AVAILABLE DATA SETS

PUBLIC DATA SETS

1. PERSONAL CONSUMER EXPENDITURES SURVEY

The Personal Consumer Expenditures survey, PCE, measures consumer expenditures for the nation and is an indicator of economic activity at the national level. Estimates of broad aggregates begin with 1790, and accurate quarterly time series are available since 1928. The PCE measures consumer expenditures for current production and is a part of the National Income and Product Accounts. The PCE gathers information on goods and services that are purchased by consumers. Operating expenses of non-profit institutions and the value of food, fuel, clothing, rental of dwellings, and financial services that are received by individual consumers are included (Bureau of Economic Analysis). The Department of Commerce collects the data with the aim of representing the economy of the United States. The PCE is based on business and

governmental sources. Food expenditures include marketing, transportation, and packaging costs. Information pertaining to the consumption of food away from home is also included.

Unfortunately, since the PCE measures aggregate levels of economic activity, it is difficult to break down and look at specific regions, food categories, or even consumers (Smallwood and Blaylock). In addition, the PCE does not meet other criteria mentioned earlier. There is no information on advertising measurements. The survey is a time-series data set, but the effects of promotions and price changes cannot be estimated because it does not collect detailed food consumption data, price information or promotional measures. Furthermore, there is no information on the socioeconomic characteristics of the population.

2. U.S.D.A. FOOD CONSUMPTION

The Department of Agriculture consumption data are disappearance data that provide information on the flow of commodities from the farm to the consumers. The survey was started in 1909, and it has progressed into an annual publication. The survey uses an accounting method to follow the commodities, known as supply and utilization. The supply segment is concerned with the supply of the commodities. Beginning stocks, production, imports, and shipments from U.S. territories are all included. Utilization is concerned with the various uses of the commodities. Military purchases, food and nonfood uses, shipments to U.S. territories, and ending stocks are used to calculate the utilization of the commodities. Presently there are 200 commodities included in the

survey, but prior to 1982 the survey consisted of roughly 260 different commodities (Haidacher).

The USDA disappearance data also have a number of shortcomings. For example, the data do not contain detailed food consumption, price, or, advertising information. Thus, promotional and price change impacts cannot be observed. In addition, definitions among different years of the survey are different which cause problems in comparing data from different years. The changing socioeconomic characteristics of the population are not collected.

3. CONSUMER EXPENDITURE SURVEY

The Consumer Expenditure Survey, CES, is operated by the Bureau of Labor Statistics and is collected every ten years. The CES was started in 1888-91 and collected in 1901,1917-19, 1933-36, 1941-42, 1950, 1960-61 and in 1972-73. However, not until 1980-81 was it collected on a continuous basis. The CES defines the "Market Basket of Goods" that are frequently purchased by urban consumers. The CES is used to generate the Consumer Price Index, CPI, which estimates the change in cost of this fixed market basket.

The CES has two components. The first survey is called the Interview, CES/I, and is concerned with collecting data on large purchases (e.g., housing). The Interview survey collects detailed data on about sixty to seventy percent of the household expenditures. The second survey is called the Diary, CES/D. The diary is concerned with the consumer's recall of the previous two week's expenditures. The diary

collects data on about thirty to forty percent of the most frequently purchased household items (Buse).

The CES survey has been supplemented quarterly with additional information to keep the survey updated since 1981. The quarterly survey is called the Continuous Consumer Expenditure Survey, CCES. The CCES is a rotating survey which allows it to add and drop families from its survey in order to get a better representation of the population. It also helps to keep the changing market basket of goods, updated. The BLS's CES survey looks at consumers' expenditures whereas the U.S.D.A.'s Consumer Survey looks at the amount actually consumed.

One problem with the CES surveys is that they do not always keep up with the ever changing composition of food purchases, socioeconomic and demographic composition of the population, and economic environment. Also, the survey only looks at the aggregates. The CES is not very useful in research that intends to look at a certain segment of the population. The CES survey only studies the urban population as of 1981 due to budget cuts. The survey initially covered the urban wage earners. It was then expanded to include the urban consumer and later the rural population. CES definitions are not consistent across surveys. An example is the difference in the definition for "head of the family" (Buse). The categories for food groupings are also inconsistent across the surveys. The CES also has a somewhat limited coverage of foods. For example, a recent CES contained 290 food categories, whereas a U.S.D.A.'s survey described below has 4,700. This poses a problem when studying the demand for specific products. The CCES does not have price information or information on specific products.

This is a cross sectional data set so dynamic impacts on consumer demand cannot be seen. It does not collect price information. The CCES is a quarterly supplement to the CES and a time-series data set. The quarterly supplement is not desirable for managerial or consumer decision making time horizons with respect to food. The definitions are not consistent across surveys. There is no information on socioeconomic characteristics of the panelists. As a result, the CES and CCES do not meet the criteria specified.

4. NATIONWIDE FOOD CONSUMPTION SURVEY

The Nationwide Food Consumption Survey, NFCS, is conducted every ten years. The Department of Agriculture wanted detailed information concerning the diets and food expenditures of American consumers. The only way to obtain this information was to conduct surveys of representative samples of the population. Food consumption is based on a seven day recall. This survey is collected by the USDA. The survey was started in 1936-37 and was originally collected for the spring season only. Following surveys were collected roughly every ten years. The latest NFCS survey, 1987-1988 is expected to be published in the summer of 1990. It will have 27 nutrient categories and will be drawn from a smaller sample. The NFCS gathers detailed information on the quality of consumers' diets as well as their food expenditures. Since the data are collected for a twelve month period every ten years, it is considered a cross-sectional data set. Thus, it is difficult to use to test dynamic models of food consumption for managerial decision making on the part of

food retailers. The definitions in the NFCS are always changing which makes it difficult to compare or combine surveys of different years (Buse). This is a cross-sectional data set so it is not useful in showing the impact of promotions or price changes on consumer demand over time. The survey does not collect information on advertising measures. The socioeconomic characteristics of the respondents are not collected, and definitions are not consistent across surveys of different years.

5. CONTINUING SURVEY OF FOOD INTAKE BY INDIVIDUALS

The Continuing Survey of Food Intake by Individuals, CSFII, collects information on a target population: women ages 19 to 50 with children ages 1 to 5. This U.S.D.A. survey collects diet and nutrition information and was first collected at a national level in 1985. It is also a cross-sectional data set that is collected every ten years. This survey is used to update the NFCS. For the 1985 CSFII survey the respondents' food intakes were categorized into 27 dietary components plus energy, whereas the 1977-78 NFCS data were categorized into 14 nutrient groups plus food energy. Information is collected on whether food was consumed at home or away from home. Socioeconomic and demographic data are also provided by respondents. The survey uses a one day recall to see the food consumption of the people included in the survey. In 1989 the survey was expanded to include men, women and children of all ages to give a better representation of U.S. consumers (Buse).

The CSFII survey data source is concerned with measuring people's

nutritional patterns. Information is not collected on the quantity of food purchased or its price. This is a cross sectional data set so it is not useful in showing the impact of promotions or price changes on consumer demand over time. The survey does not collect information on advertising. Socioeconomic changes of the respondents are recorded, so this is the only criterion listed above that the CFSII meets. There is no detailed price information on food items. Another drawback is definitions are not consistent between surveys. The one day recall is really insufficient in giving an appropriate picture of the respondents' food intake patterns.

6. NATIONAL HEALTH AND NUTRITION EXAMINATIONS SURVEY

NHaNES, or the National Health and Nutrition Examinations Survey, is primarily concerned with the health of people and not consumer expenditures. NHaNES is collected by the National Center for Health Statistics of the Department of Health and Human Services. As a result, the NHaNES does not provide useful information on food consumption. The first survey was conducted in 1960-62, and following surveys were taken in 1971-74 as well as in 1976-80, so the surveys are cross-sectional. NHaNES records detailed information on socioeconomic and demographic characteristics. It does not record information concerning the quantity of food purchased. Detailed information regarding the location, type, and quantity of food that was consumed is collected in the survey. The survey has a list of 4,800 different food items but is concerned with the frequency of consumption of only 18 food groups (Buse).

NHaNES does show the socioeconomic changes that are taking place but only at ten-year intervals. The NHaNES survey does not record food consumption or food expenditures. This makes the data set inadequate for this study. There is no information regarding the prices of commodities or advertising measures. The NHaNES is a cross sectional data set so promotional and price impacts on consumer demand cannot be observed. The definitions are not constant across surveys of different years.

7. SURVEY OF INCOME AND PROGRAM PARTICIPATION

The Survey of Income and Program Participation, SIPP, has a nonfood focus. This survey is a joint development among the Department of Health and Human Resources, the Social Security Administration, and the Bureau of the Census. The SIPP is a continuous survey that was started in October of 1983. Data are collected on family members who are at least 15 years old and includes whether or not they are participating in various government social programs. Information on the size, composition, and educational level of each family member is gathered. The survey follows a family for two and a half years and records information on events that cause the individuals to change their economic activities (Buse).

The SIPP survey does not record food consumption or food expenditures. There is no information regarding the prices of commodities, or advertising measures. The SIPP is a time series data set, but since it has a nonfood focus, promotional and price impacts on consumer

demand cannot be observed.

8. SURVEY OF INCOME AND EDUCATION

The Survey of Income and Education, SIE, collects data on the socio-economic characteristics of family members as well as if individuals are currently in the labor force. The SIE was created by congress and collected by the Census Bureau to help update the 1970 census estimates. It was collected April-June of 1976. Information was recorded on whether or not the family was receiving any social program help. This was used to estimate the number of school aged children living below or at the poverty level.

As with most of the surveys mentioned, the SIE survey is also a cross-sectional data set. The SIE does not collect data on food expenditures or consumption. Even though the SIE is a cross-sectional data set, it has a nonfood focus, so promotional and price impacts on consumer demand cannot be observed. On the other hand, the SIE does provide very detailed information on the composition and characteristics of each family and its members. The members' sex, educational level, ethnic background, and ability to use languages are recorded in the survey. There is no information on advertising measures (Buse).

9.PANEL STUDY OF INCOME DYNAMICS

This panel is surveyed by the University of Michigan. It was started in 1967 with a representative sample of 5,000 U.S. households. If the family splits due to death, a divorce, or a child moving out,

surviving split offs become part of the survey. The sample has remained representative of the population. The survey records consumption, income, and other socioeconomic data on the households.

The survey does not meet the previously stated criteria. It does not gather detailed information about food consumption or prices of commodities. No advertising measures are available.

This brief review of public data sets indicates that the NFCS and the BLS surveys are noticeably different. The BLS uses a consumer unit in it's survey while the U.S.D.A.'s survey is based on a household unit. The U.S.D.A.'s household units are considered "housekeeping households" which means that ten or more meals are consumed by at least one member of that particular household.

The various surveys contain definitions that are not constant. Each is specifically implemented to collect certain information. These surveys are not suitable for analyzing many of the important retail food marketing issues. The inconsistencies in the surveys make it very difficult to combine surveys to obtain a superior data set. The PCE and CCES, for example, differ in the way they generate expenditure figures. For example, the purpose of the CESS is to collect data on the urban portion of the population whereas the PCE collects its data with regard to the total economy. The two surveys collect information concerning consumer expenditures for newly produced products. This could be misleading if one is not careful. The PCE arrives at a larger expenditure figure than the CCES in total food, at home food, and food away from home expenditures. This difference may be attributed to the fact that the CCES does not include food expenditures by individuals who

are away overnight or longer, whereas the PCE includes these expenditures (USDA ERS Handbook No. 71). The CCES is based on household surveys while the PCE relies on business and governmental sources. The PCE also collects information on food eaten away from home (the survey is sent to eating and drinking establishments), and the CCES does not. On the other hand, the PCE does not include information on public programs, business meals, and nonfarm home production. Income tends to be under-reported in household surveys. This helps to explain the difference in the expenditure figures of the two surveys.

The NFCS is different from the CCES in the fact that it measures food consumption, whereas the CCES measures food expenditures. The CCES includes individuals living in group dwellings, and the NFCS does not. In the NFCS food from restaurants' carry-out food and food carried home for consumption would fall under at-home consumption, whereas in the CCES each of the above groups would be listed in separate categories.

There is also a problem with inconsistencies between the same surveys conducted in different years. Differences in variable definitions, amount of detail, and target populations make comparisons very difficult. For example, the NFCS is not even consistent between different surveys. The above data sets, with the exceptions of the PCE, disappearance data, and CCES, are all cross-sectional data sets. There is a problem associated with cross-sectional data in that there is no variation in the population being observed. In order to make projections over time, assumptions would have to be made about the behavior of groups of people. That is people would have to act in the same manner over a long period of time as portrayed by the cross-section. This,

however, is not likely to be the case and is consequently a major limitation of the public surveys for dynamic analyses.

There are two other reasons why cross-sectional data are not ideal for measuring consumer response behavior. The first is that time-series data are better equipped to predict price elasticities of demand because prices vary over time. The second reason is that it is difficult to distinguish between a change in demand and a change in the demand structure. If the population is changing and a certain segment of that population gains a larger share, then the overall demand structure changes even though response parameters within groups remained the same. The change in the composition alone can cause changes in demand (Shrimper).

B. SCANNER DATA

Prior to the introduction of scanner systems, supermarkets had no way of monitoring what went out through the "front door." Supermarket managers had to rely on warehouse movements to gain information on movement of products and sales. The sheer number of products found in a supermarket made it very difficult for chains to track individual items. Manufacturers were responsible for all of the marketing and promotion of products as well as products' suggested sale prices. Except for cases of experimental research, it was difficult to obtain requisite sales and advertising data to be used in studying demand for detailed food products.

Since the introduction of scanner systems into supermarkets in the early 1970's, store managers have had access to a new data source. With

the scanner systems, daily product performance is available, but there are approximately 35 to 40 thousand products carried in retail stores (Capps, 1989). In 1988 roughly sixty percent of total supermarket sales were being processed by scanners. This is up from forty percent in 1984 (Capps, 1988). By aggregating daily data over a week, a manager is able to see the week's sales and product movement. The week is an excellent time frame for food demand for three primary reasons. First, consumers usually shop on a weekly basis. Second, promotions and advertising campaigns usually last one week. After a promotion or advertisement has been run for a week, the manager can use the scan data to see if the strategy was effective in increasing a product's movement. Third, managers of supermarkets use weekly projections to schedule labor, keep track of inventory, implement advertising and promotions, and to see the gross margins of each individual department (Thayer).

Scan data can provide a clear record of what is being purchased, so store managers can actually look at what is " going out the front door" as opposed to what is coming in " the back door." It is not unusual for a store to have overall sale variations of ten percent between the first and last week of the month, with much larger swings at the product level. Scanner data could help managers to avoid stockouts and to keep inventories at lower levels. Scanners allow management to identify the items that are selling and also to measure the performance of items at varying price levels (Thayer).

The scanner systems use lasers to read bar codes that are assigned to products. The UPC code is assigned by a national organization so that each product is assigned a individual code. The UPC code is

usually constructed of twelve numbers - the first six numbers identify the manufacturer of the product, and the last six numbers are used to identify the product (Eastwood). The laser beam reads the UPC code many times in a very short amount of time to make certain the UPC code is scanned properly. The UPC code is then matched with a master file of prices to identify the item's price. The price of the good is then printed on the sales receipt along with a brief description of the good. All the transactions of a day's sales can be recorded so they can be used in the future.

The benefits derived from implementing scanner systems can be grouped into two separate categories. One category is called "hard" benefits, which include tools for management to use in decision making by analyzing the scanner data. The second category is the "soft" benefits, which are less tangible. There is increased efficiency at the checkout terminals when scanner systems are used. Checkout time can be reduced, which reduces costs through increased employee productivity and increases customer satisfaction. The use of scanners could allow managers to estimate future demand by using past data. The scanners can be used to monitor stock levels, and if the level drops below a predetermined level, the system will reorder it. Scanners can record a product's sales performance which can allow managers to observe the effectiveness of displays, peak customer traffic which is useful in estimating labor requirements, and gives a better estimate of shrinkage since sales can be compared to inventory (Eastwood). Scan data now allow researchers to perform demand research that previously was not possible or very limited (Capps, 1987 Micro-Data Base).

Recent technological developments in scanner systems have occurred (DeSanta). One of the new scanner systems comes with two disk drives as a safeguard against the failure of the host. This scanner system is able to store transactions in memory and later down load them to the host computer. The system is able to keep track of coupon redemptions, inventory reductions, and product movement without being on-line with the host computer. "Insti-add" is a feature that allows the cashier to scan an item that is not currently on file. Cashiers can also look up price information on a product from any terminal in the store. Electronic flip charts provide information on produce as well as beer and wine. The system also offers a feature called "suspend and recall." This allows a cashier to suspend an order after the last item has been scanned and then go to another customer. The cashier can recall the suspended order and add to it or finish checking out the customer.

Scanner data can be a useful tool in conducting economic research. It can allow researchers to look at a specific item and see how it has moved over time. Scanner data are a primary data source, whereas surveys and interviews are secondary data. It has characteristics of both cross-sectional and time-series data. Scanner systems can transfer the data to computer storage media indefinitely so time-series can be generated. Also, information can be collected from a variety of sources around the country. Approximately sixty percent of the supermarkets nation wide are now using scanners (Eastwood).

There is software available today that can be used with the scanner system to show the productivity of an individual employee. The software package allows management to see how many hours a week an employee has

worked, how long he was on break, the department in which he works, job codes, and even if he is affiliated with a union.

A problem with using scanner data is that there is no information regarding the characteristics of the consumers purchasing products from the store. Scanners can collect the information on product movement but have no way to gather information on who is purchasing it. There is also a problem associated with the sheer volume of data that is generated. As stated earlier, a typical supermarket may carry roughly forty thousand items.

Another problem area involves variable weight items. Scanner systems have trouble reading these items' bar codes. This results in a lack of representation of variable weight items in the scan data. There is also a problem if the weight of the item is not known. How can the quantity moved be determined? The label will have the item's price, and the scanner will record the transaction, but how much of that product was sold may not be recorded.

Another limitation stems from the dumping of product level records into default codes. This occurs in two basic ways. When cashiers are rushed they may pass a bar code over the scanner only one or two extra times, and if the code still has not been recognized, manually use a catchall code to record the product. The other is that management level software may combine some bar codes into catchall codes. For example, individual deli department items may be combined into a single code when daily or weekly totals are generated. In either case, data on individual product sales are lost.

There are two other reasons that variable weight items have not been

recorded consistently by scanner systems. One is that bar codes must be assigned in many instances. Variable weight items such as meat do not have UPCs. Not all fixed weight products have UPC codes assigned to them, especially regional suppliers such as specialty foods. This makes it difficult for the data processor to incorporate these codes into the scanner data set (Eastwood). Second, special programming must be used to record the size of variable weight items. This makes it difficult to get data on exactly how much of the variable weight product was purchased.

The problem of variable weight items can be overcome by using scanners that work in conjunction with scales. The scale weighs the item and records its weight along with creating a bar code for the item. The scanner then reads the label which identifies the product and cost. Since meat, fish, and poultry account for roughly 17.5 percent of total grocery store sales it extremely important to be able to monitor their movements (Supermarket Business, Sept.1988). There is another way which is to have special software/hardware that can recognize the trailing package price and store this rather than item movement.

The use of scanners does not always ensure that the product will be scanned. This could cause actual movement to be masked. The UPC labels themselves can be a major source of problems. The labels may become wrinkled between the time they are applied and the time they reach the scanner. A UPC label on a cellophane package is very hard for the scanner to read. Cellophane when wrinkled creates shadows on the label that misleads the scanner. If a label cannot be read by the scanner, the product's price has to be manually keyed into the system. If a

label is not easily read, the productivity of the cashier suffers, which over time can cost the store a great deal in terms of labor. Power surges or outages can cause the scanner to lose its data.

There is a belief that the use of scanner equipment will stop employee theft, but there are numerous ways that cashiers can avoid scanning an item if they desire to do so. For example, an item may be passed over the laser window with the UPC code facing upward. Another way to avoid scanning a item is to tape a UPC code for a cheaper product to the wrist of the cashier and run that over the scanner window. So installing scanner equipment just to decrease theft may not produce the desired result. One of the biggest hurdles to cross is the large capital outlay required to purchase the scanning equipment.

"Only since 1979 have scanner data, through refinements by manufactures of electronic scanning checkout systems, combined with the improved understanding of the sophisticated systems by retail users, been generated with enough reliability and consistency for application in economic research." (Capps, 1989). Scan data have made the task of monitoring promotional strategies less expensive (McLaughlin and Lesser). Data that are being generated by supermarkets are now being manipulated for use in marketing research (Wittink et al.). The scanner data are time series data so researchers can measure dynamic effects. The scanner data also have the characteristics of a cross-sectional data set. Information can be gathered from a wide range of different stores at one point in time and over time. Capps 1989, Lesser and Smith, and Whittnik et al. have concluded scan data are suitable for demand analyses.

C. SCAN DATA SOURCES.[1]

Private firms collect scan data to use in research. Information Resources Incorporated, IRI, is a private information collecting firm that offers two services to clients. The first is called "Behavior-scan," and the second is "Infoscan". Behaviorscan contains information on household characteristics and purchases by store using scanners. Infoscan tracks consumers' weekly purchases by UPC codes. The panelists are issued I.D. cards so that their purchasing behavior can be monitored. The household's card number is read by the scanner to match purchases to individual households. Both of the services collect data in selected cities on individual items, prices of the items, and the bundles of goods a household purchases.

Burgoyne Incorporated provides a detailed account of a client's or a test product's performance at the retail level as well as the movement of a competitor's product. Burgoyne provides information describing store displays. For example, the number of facings, how they are allotted by store, and the point of purchase materials being used are recorded. They also monitor inventories and report items that are out of stock.

Mapes and Ross, M&R, tests and evaluates different advertising media. M&R is able to replace regular television ads with test advertisements in the households of their panelists. The same method of testing radio advertisements is also available. For testing radio ads

---

[1] Material Contained in this section is based on the work of the S-165 Food Demand Regional Committee.

the participants are asked to listen to a radio program that contains the test ad. Printed test advertising is also available in popular magazines. The test ad is tipped into the requested magazine. There is a follow up interview to measure the effectiveness of the test advertisement.

The Test Marketing Group provides information on advertising focus groups, coupon redemptions, and other services. Advertising is available for print and television. Monitors are installed in panelist's homes to observe what channel is being watched. The panelists are all cable subscribers so that the test advertisement can be inserted in place of a regular ad. The coupon redemption of panelists is also recorded and matched to the individual household. This allows clients to cross the gap between coupon redemption and demographic characteristics. The effectiveness of a particular coupon strategy can also be measured. Test marketing and forecasting is available.

Market Facts Incorporated provides a wide variety of services. Consumer mail panels are available for customers that include 220,000 U.S. households and 20,000 Canadian residences. There is a telephone service that can conduct interviews or administer surveys. The telephone service can use a client's directory, random dialing, or the panelists from the mail survey. There is an option of using a mall interview with six malls participating nationwide. The malls are equipped with kitchens for taste tests, interviewing areas, display areas, and conference rooms. Video equipment is used to record the actions of the interviewee. Focus groups are used to help provide information about advertising effectiveness, concept research, and product development. Test

markets across the country are geographically dispersed to allow a good representation of the population. There are television, radio, and print advertising options that can be used in testing market expectations.

Mail Diary Panel provides its customers with consumption and purchasing data on a wide range of products. Diaries are used to collect the information on the demographics of who uses a particular product, quantity purchased, frequency of purchase, timing of purchase, location of the purchase, and the purpose for which the product was purchased. A detailed description of what and when a product was purchased is collected from the panelists.

The A. C. Nielsen company is the largest information collecting firm in the world. It provides information on private and generic labels alike. There are 1,600 grocery chains working with Nielsen, and this represents about 70 percent of the market. Clients can download information to their P.C.'s and use software packages to manipulate the data. The effectiveness of manufacturers' and competitors' promotions can be observed by using a system called Scantrack plus. Television commercials can be monitored to understand how they impact the panelists. Custom test commercials can be inserted in place of regular commercials. Since the panelists have television monitors in their homes, even households without cable are included in the panel. This allows a better representation of the American public. Economic activities and weather are monitored, and research is carried out to estimate their effects. Panelists use I.D. cards so Nielsen can track their purchasing patterns.

The private firms that collect scan data do so in a manner that is

focused on industries' needs and not on the academic community's. Private firms are more likely to have vested interests and report biased findings as opposed to more impartial academic research. The data are only available to the academic community for impartial analyses and research at the regular cost to any business. There is also a question of how the data have been manipulated by the vendors. To date very little is known about the statistical procedures used.

CHAPTER III

NONSCANNER PROMOTIONAL EVALUATION

There have been studies carried out to estimate the effects of different promotional approaches. Wilkinson, Paksoy, and Mason analyzed the effects of different promotional methods. The methods of promotion were price changes, newspaper advertising, shelf space changes, and in-store promotions. The goods that were under observation were Camay soap (bath size), White House apple juice (32 ounce size), Manhattan rice (the one pound bag), and Piggly Wiggly frozen pie shells. Quantities of the goods sold were recorded as well as competitors' brands and alternative sizes of the good, advertising, and display space over 24 weeks. The researchers calculated 75 percent of the product's price, and this along with the retail price and the cost to the store were the pricing levels used. The method of display consisted of doubling the usual shelf space and using special displays. The advertising was carried out in the supermarket's weekly advertisements, and each advertisement had the same lettering, height, and mention of price and product name.

Price elasticities, substitution patterns, and the price-sales

relationship were estimated. Reducing the price of the pie shells resulted in an inelastic own-price elasticity while the juice, rice, and soap all experienced elastic own-price elasticities. The own-price elasticities, as might be expected, were most elastic for the soap and juice, since these products tend to have many perceived substitutes. With respect to the cross-price elasticities, substitution for the store brands of juice and rice decreased as the prices of the test products were lowered. Newspaper advertising was not very effective because demand did not increase significantly. The use of displays and increased shelf space seemed to be a very effective way to increase the sales of the test products. The analysis of the residuals and predicted variability of the model provided evidence in favor of the estimated promotional effects.

Funk, Meilke, and Huff conducted a study on the effects of retail pricing and advertising on the movement of beef (18 specific cuts). The data were collected over the period beginning January 1974 and ending May 1975. Advertising data were collected from an audit of five stores of a major food chain located in Toronto Canada. Price data were supplied by a pricing service. Data were also collected on the weekly sales levels of beef, price information, and weekly newspaper advertisements. Regression analysis was performed on a retail demand function to see what the effects price reductions and advertising had on beef sales. The price reductions were found to be price elastic so decreasing the price of beef led to increased revenues. Cross-price elasticities were not found to be important in this particular study. The own-advertising elasticities were significant and positive for individual products as

well for aggregate beef products, but less elastic than the own-price elasticities. The study found pork advertising had a negative effect on beef sales while advertising for other meats, in general, had positive effects on beef sales. The effects of competing products' advertising were found to be insignificant.

Marion and Walker conducted research pertaining to the response of specific meats to weekly prices at the retail level. Five meat categories were followed over a 52 week period in two major supermarkets in Ohio. This study was concerned with the relationships between prices and quantities on a weekly basis for meat products at the retail level. It tried to isolate the demand relationships, in the very short-run, that affect managerial decisions like pricing, advertising, and inventory control. The-own price coefficients were found to be negative, and a majority of the cross-price coefficients were positive. Ten linear regression equations were used, one for each product. The results indicate that newspaper advertising was not significant in any of the models. The variable representing payday was significant. The study found that there was a difference in the quantities sold depending on the week in the month.

Carman and Figueroa conducted a study to analyze the factors that are associated with weekly food sales variation. Data were collected over a 105 week period that started in July of 1978 and ended July 1980. Information was collected on sales by department, number of advertised specials by department, store coupons, advertising media used, and gross margin by department. The data were collected from ten stores in Ohio. The stores had variations in sales from 50,000 to 150,000 dollars a

week. The study employed ordinary least squares regression analysis.

The study demonstrated that retail food sales tended to decrease as the time period since the last pay-day increased. There is a significant relationship between the percentage decrease in sales and the income level of the consumers who frequent a particular store. The variability in sales, expressed as a percentage, differs by department with meat experiencing the greatest degree of variability, followed by groceries, while produce had the least amount of variability.

The weeks of the month variables, weeks two through four, had negative signs and were significant at the 95 percent significance level. The coefficients on the variables increased in size as the week variable increased. The holiday variables representing Easter, the Fourth of July, Labor Day, and Christmas were all positive and significant, while New Years and Memorial Day were insignificant. Seasonal variables had negative coefficients and were significant. Trend variables were found to be insignificant.

The advertising variables all had positive signs, but television advertising for produce was the only variable that was found to be significant at the 95 percent level. Only produce experienced a sales increase from the use of coupons. The purpose of grocery specials are to generate additional store traffic. The grocery special variable was significant and showed a positive relationship between store specials and store sales. The study revealed price was inelastic for all meats and that produce was a substitute for meat.

Cox and Wohlgenant conducted a study to estimate the effects of price and quality on cross-sectional demand. The data used in the study

were obtained from the 1977-1978 NFCS, the western region. The Houthaker-Theil (1951-52) model distinguishes between goods and commodities to offset the problem of heterogeneity by including a quality variable. For example, goods are considered homogeneous in the usual demand approach, and therefore, there is no distinction on the basis of the quality of goods. But commodities may be considered heterogenous, possessing different levels of quality giving way to differentiated products within the same commodity catagory. The Cox and Wohlgenant model adjusts for quality by separating income and expenditure. Vegetables were the product used in the study and were broken down into three groups: frozen, fresh, and canned.

Fresh vegetables are the only vegetable group that had a significant income effect on RDMP. RDMP stands for regional/quarterly mean prices for the consuming households and is used to indicate the effects of quality. Urbanization was found to be significant for fresh and canned vegetables while only canned vegetables had a significant shopping location effect. The significance of the age of the head of the household as well as the number of meals eaten at home had a negative relationship on RDMP.

The three vegetable groups show negative relationships between family size and RDMP. Income was found to have a positive impact on RDMP. The three groups also had negative own-price effects, whereas there was a positive relationship between canned and fresh vegetables. The positive relationship suggests that canned and fresh vegetables are substitutes.

Curhan's study (1972) was unsuccessful in rejecting the null

hypothesis that changing shelf space effects unit sales in supermarkets. Five hundred grocery products were studied, and shelf space was either increased or decreased for specific test items. Four regional stores, which were apart of a chain, were used as test stores, and 24 other area stores were used as controls. Unit sales were monitored for five to twelve weeks prior and after a change in a product's shelf space. The changes in shelf space were made on the recommendations of store managers and a computer management system called COSMOS. COSMOS based it's recommendations on the profitability of a product per unit of shelf space it occupied.

The variables to be tested were as follows: retail price, brand type, market share, rate of sales, shelf capacity, merchandise variety, availability of substitutes, repurchase frequency, and extent of unplanned purchasing. Considerable preparation, minimum preparation, and ready to use categories were also used to help account for impulse purchasing.

Stepwise multiple regression analysis was used to analyze the data. The results of the analysis did not allow for the explanation of shelf space elasticity. The adjusted R^2 was 0.12. The independent variables also had large standard errors as did the dependent variable. The impact of a change in the shelf space of a product on unit sales had very little impact in relation to other factors that affect unit sales. The research did lead to insights into the shelf space elasticities for subsets of products like rate of sales, extent of display area, test store, product category.

In another study by Curhan (1974), the effects of merchandising and

promotional activities on the unit sales of fresh fruits and vegetables were estimated. Data were obtained through inventory counting and delivery records of two stores. The fresh fruit and vegetables were broken down into four groups: hard fruit, soft fruit, cooking vegetables, and salad vegetables. These four groups accounted for nearly all the fresh fruit and vegetables sold in the two supermarkets.

Variables included in the study are display space, retail price, newspaper advertising, and display location quality. The following are requirements for inclusion as a variable. Promotion price must be at least a ten percent decrease from the retail price of a product. Display space is a 200 percent increase from original display space. Advertising is included if one of three produce products featured in the chain's weekly newspaper advertisements is a product under study. Prime locations are separate floor tables, ends of large tables, and high traffic locations on wall counters.

A 7^{-2} factorial experiment design using a quarter factorial was used to analyze the data. This analysis provides information on certain variables and combinations of variables. The results suggest that an increase in space increases average unit sales of that category. For example, doubling the shelf space of hard fruit increased the category's average unit sales by 44 percent. The effect on unit sales by increasing shelf space of high priced soft fruit was greater than the effect on low priced soft fruit. Price promotion, a decrease in price, was not statistically significant except for soft fruit. This is unusual because it is commonly taken that price reductions increase unit sales. Advertising was significant only for hard fruits and cooking vegetables.

The effects of advertising were extremely large for seasonal products. The location quality was significant for hard fruits and cooking vegetables.

CHAPTER IV

PROMOTIONAL STUDIES USING SCANNER DATA

Manufacturers set aside large amounts of capital in an attempt to estimate the profit maximizing prices for their products (McLaughlin and Lesser). They have been unable to get accurate estimates nevertheless. Retailers, in general, do not set aside a marketing budget and tend to price the goods they carry either by judgement calls or rules-of-thumb. These techniques are generally good, but in the long run they may not be accurate.

McLaughlin and Lesser used scanners to study the effects of price variations on potato demand. Round, white, ten pound bags of potatoes were used in the study which lasted four weeks. The last week of the study and the following week were used to collect an exit survey of the customers. Three major insights came out of analyzing the data: demand differs by store, price changes cause potato sales to change, and consumers did not reduce weekly purchases after a surge in purchases brought on by reduced prices. Thus, decreasing the price of potatoes caused an increase in consumption, not just a shift in weekly sales. This showed that potatoes are responsive to price changes even though

they are considered an inelastic good. This is especially present in individual stores.

The effects of promotional programs were analyzed by Whittnik et al. The promotional variables to be investigated were temporary price reductions, displays (end-of-aisle), and feature advertisements (the brand name of the product was in the ad). Ten different markets were used in the study, and data were collected over a 52 week period. Competitors' products were also monitored.

The objectives of the study and model were to show the short-term effects of specific marketing programs on branded products using time-series data that showed variation among stores. The product used was tuna fish. Data were collected on three major national brands: Starkist, Chicken of the Sea, and Bumble Bee. The regional, private, and smaller brands were excluded. A 6.5 ounce can of chunk light tuna, which accounts for nearly 80 percent of the tuna sales, was selected for use.

The results of the study show that the own-price elasticities are negative and that the cross-price elasticities are positive, as they should be. The use of displays as promotional activities increased sales and did not differ much between markets. The use of feature advertisements and displays together increased units sales by roughly 75 percent in one particular market. The increase of the combined effects was 75 times greater than adding the effects of each variable if it was used separately. Analysis showed that brand switching only accounted for 8 percent of the increase in the unit sales of Starkist.

The study also looked at toothpaste. When a display is used to

promote the 8.2 ounce size of the product, a portion of the sales increase, 14 percent, came from cannibalism of the product's other sizes. The use of feature ads caused a cannibalism rate of 16 percent. Displays generated the greatest increases in sales and caused the least damage regarding sales loss from cannibalism of other size products. Different effects were observed for different promotional activities. Combining displays and feature ads increased sales more than implementing these strategies separately. It was also observed that displays increased brand switching more than other types of promotional activities.

The retail demand for the following goods were analyzed using scan data: beef (steak, ground beef, roast beef), chicken, and pork (pork chops, ham, and pork loin) by Capps 1988. The own-price elasticities were generally significantly different from zero and negative as expected. Ground beef's own-price elasticity was negative but not statistically significant. Ham had a positive own-price elasticity that was significant. The cross-price elasticities were generally significant and positive. The variable payday was insignificant. Seasonality was significant. Advertisement fliers increased sales significantly and had positive own-advertisement elasticities except for pork. Only five cross-advertising effects were significant out of the possible eighteen.

In another study, conducted by Tellis, advertising expenditures and gross rating points were used to measure market structure. Research has shown that advertising has a stronger effect on a consumer if he or she is familiar with the particular product or with the message that is

being conveyed in the ad. Scan data were collected for toilet tissue over the period of one year. The number of rolls, dollar volume, coupon use, feature ad use, and display use data were also collected. Product movement was recorded in conjunction with monitoring television advertisements. Consumer response to an ad was stronger for brands for which they were loyal. The behavioral response to the effects of advertising is nonlinear. Thus advertising tends to be more effective at increasing unit sales through increasing the consumption of that product rather than attracting consumers from other products, or brand-switching. Price changes have the same results on sales. It is also noted that displays, coupons, and feature ads increase consumption from loyal consumers. Brand loyalty is a much stronger determinant of a consumer's purchasing decision than is advertising. The other promotional variables also have a greater effect on sales than advertising.

By breaking down scanner data, Culputa was able to observe the effectiveness of sales promotions and the origin of the sales increase. Scan data from IRI were used in the study. Data were collected on 2,000 households for a two year period between 1980-1982. The prices of products, promotional programs, household identification, and when the products were purchased were all recorded. Ground coffee was the product studied here. Brand-switching accounted for 84 percent of the increase in sales as a result of a promotional program. The increase in sales by consumers purchasing an item early accounted for roughly 14 percent. Stock piling on the other hand, resulted in two percent of the increased sales. Ninety-eight percent of the increase in sales that is seen following a price reduction is the result of brand-switching.

In a study conducted by Lattin and Bucklin, it was observed that if retailers and manufactures implement price changes too often, decreasing the price will no longer increase sales. This is because consumers no longer see the price reduction a bargain but expect it. It is believed that consumers establish a base reference price for a good and when a promotional price is enacted, they see the reduction in price as a deal. Promotions if used too often will also loose their effectiveness. Consumers are less likely to purchase an item being promoted if the last purchase of the item was during a promotion. Consumers respond to promotional activities, but there is a better response if the promotion is not used on a regular basis. The data were provided by IRI and included price, value, and promotional programs. They were collected over a 75 week period. Maximum likelihood regression techniques were used.

Lattin and Bucklin found that different promotional activities increased sales by different amounts. For example a price cut of 10 percent in the price of paper towels increased sales 22 percent, and when an ad and a price reduction were combined, sales increased by 177 percent. Promotional impacts varied by product categories, regions, and even neighborhoods within a region. The use of an individual promotional program can increase sales, but by combining different promotional activities, sales can be increased to a larger extent. A combination of price reductions and displays increased sales more than by an increases of each of these activities used alone. They noted it is important to follow sales for several weeks after a promotional activity when is discontinued to see if stock piling did occur which

would cause sales to drop.

The effects of advertising are rarely all seen in the present advertising period according to Kluyer and Brodie. There is a carry-over effect that can be seen in other periods. It is very difficult to account for the carry-over effect of advertising and promotional programs in other periods. The study found that other promotional variables (displays, price reductions, etc.) did not seem to carry over into other periods and that the results may be different for lesser developed or new products. Chocolate biscuits, liquid detergents, and toothpaste were the products used in this study. Fifteen data sets included 28 bimonthly observations over 1975-1980. The data included market share, relative price distribution intensity, and advertising share for chocolate biscuits, liquid detergents, and toothpaste. Market share and relative price were obtained from the Nielsen audits. Non-linear regression was used.

Walters and Rinne show that supermarkets use a variety of promotional programs to attract new customers and increase the supermarket's sales. Loss leader promotions (i.e., a retailer puts an item on sale at a price below retailers' cost) are thought to increase the store's profit by increasing traffic and attracting customers. Another method is to use double coupons. The belief behind these promotional programs is that increased traffic will result in increased sales of the non-promoted higher margin products. The data used in this study were supplied by a grocery chain. Multiple linear regression was used to analyze the data. The study found that the bulk of sales increases came not from the promoted low margin goods but instead from the

nonpromoted high margin goods. Therefore, the use of these promotional programs did not increase the profit of the stores as might be expected. The authors caution that the results may not apply because different regions respond in different ways to various marketing programs.

The effects of point of purchase, P-O-P, signs were used in a study by Archabal, McIntire, Bell, and Tucker to see if they had any effect on consumers' purchases. The signs, some of which related to nutritional values of foods, were under investigation to see if they increased a product's movement. Unbranded produce was used, so there was no brand switching induced by the P-O-P signs. Only six products out of the department's 50 items were issued signs for the study. Scan data from 373 stores over a 12 week period were collected. A 3-way analysis of covariance was used. Consumers seemed to be unaffected by the use of P-O-P signs. This indicates that shoppers avoid foods they do not want instead of shopping to increase their nutritional level. Hidden cameras were used to see if people looked up at the P-O-P signs. Only 4.5 percent of the shoppers glanced at the signs, and only 30 percent of the people that glanced at the signs looked at them for more than one second.

A study conducted by Moriarty (1985a) found that the use of displays increased sales in different stores, supermarkets, chain pharmacies, and independent pharmacies. The increase was reported to be approximately 38 percent in the supermarkets and an astonishing 107 percent in the pharmacies. More shelf movement of products was observed when displays were absent, but no significant differences were found. The study used multiple regression, and the data were gathered from scanners. Weekly

unit sales, retail price, and newspaper feature advertisements were recorded. Different views of a promotion's effectiveness are held by retailers and manufactures. Retailers are concerned with the impact the promotion has on other goods, whereas the manufacturer is only concerned with the performance of its goods

Moriarty (1985b) conducted another study to examine the effects of newspaper feature advertisements and price interactions. Data were supplied from 5 stores for 92-94 weeks. Only one product, unspecified, was used in the study. Regression analysis was employed. The product in stores 1 and 2 had a large share of that product's market. The price of the product rarely changed so the own-price elasticity was hard to estimate. The product in stores 3-5 was promoted more heavily. The data for stores 1 and 2 were pooled, and the data for stores 3-5 were pooled.

In stores 1 and 2 the price reduction and feature advertisement interaction were not significant. This was felt to be due to the large market share, over 50 percent of the unit sales in store 1 and 2, while stores 3-5 had market shares of under 30 percent. Stores 3-5 experienced a significant increase in sales by using feature advertisements and price reductions together. The interaction effect between price and feature advertizing was negative and significant. This gives rise to the conclusion that consumers respond more to price reductions in the presence of a feature ad than if no feature ad was present.

In a study conducted by Kumar and Leone, the significance of in store promotions and brand and store substitution were tested. Sixty

weeks of data were collected from ten stores using scanners. The product used in the study was disposable diapers. Three major brands accounted for 95 percent of the market. The data were gathered in a southwestern city. The data contained information on volume, promotional activities, feature advertisements, and in-store displays. Price promotions, feature advertising, and display activities were all found to increase the sales of the particular brand of diapers they were promoting. The study concluded that the increase in sales came from brand switching, consumers switching stores, and general increased store traffic.

In a study by Jensen and Schroeter, the effects of television advertising were evaluated. Data were collected over a 92 week period, late 1985-mid 1987. Scanners supplied price and quantity data on 2,500 panel households. The house holds were separated into three groups. The first group was subjected to heavy levels of television advertising for a particular product, beef. The second group, was subjected to "base" levels of television advertising. The third group of households was the control group and was not subject to any product adverting. In the last 28 weeks of the study, both the heavy and base groups were exposed to intermediate advertising levels. Linear regression was used to analyze the data. The regression analysis indicated a strong positive correlation between feature ad prices and expenditures on beef. The coefficients on heavy and base advertising levels were found to be insignificant. A Chow test was used to test if the entire vector of parameters were equal for the three levels of advertising. At the 25 percent level, the hypothesis that there is no difference cannot be

rejected. Thus, television advertising was found to be ineffective in stimulating the demand for beef. The study revealed hispanics consumed above-average amounts of beef while college-educated households that planned meals consumed below-average amounts of beef.

In a study by Gagnon and Osterhaus scanners were used to collect data on pharmaceutical products and demographics. The data were collected in grocery stores and chain and independent pharmacy. Generalized least squares was used to analyze the data. The study estimated the effect of floor displays on shelf unit sales, all other promotional activities were held constant. Displays were found to be significant in increasing product sales in all three of the retail outlets. In grocery stores the effect of floor displays increased sales 38 percent. In the pharmacy, both independent and chain, floor displays accounted for a increase in product sales of 107 percent. The effects of displays did not seem to have a negative impact on shelf unit sales.

CHAPTER V

ESTIMATION AND ANALYSIS

A. INTRODUCTION

This chapter illustrates the application of scan data to marketing and price analysis for a specific product, beef hotdogs. Because store management is concerned with the efficient operation of stores, it would be very beneficial to have a better way to estimate the demand for particular products in response to holidays and advertising. If managers could anticipate an increase in the demand for a particular good as a result of a holiday or an advertising campaign they might be able to avoid large inventories and stockouts and schedule deliveries and labor more efficiently.

B. DATA

The data used in this research were obtained through two independent sources. First the price and item movement for beef hotdogs as well as the price for hamburger were obtained from the scanner data of a chain supermarket having stores in the Knoxville area. The data were collected from five stores and covered 62 weeks starting the week of May

28, 1988 and ending August 11, 1989. The five stores were distributed all over the metropolitan area and represented a large share of the area's supermarket sales.

The data represent weekly totals of item movement for each bar code. They are accumulated at each of the five supermarkets and forwarded to the chain's corporate headquarters once a week. Computer tape copies are sent to the University, and the information is added to the historic record.

Missing data are the result of either a mechanical failure at the store level and the scan data are not recorded, or the headquarter computer facility is experiencing technical difficulty, and the weekly data cannot be transferred from the store accounts to the headquarters computer banks. When the problem is at the store level, the data are not collected, and they are lost. When the data cannot be transferred, new sales are added to the previous week's, and this continues until the problem at the headquarter's computer facility is corrected. This is called a "running total." To adjust for this problem the data for the combined weeks are divided by the number of weeks the running total was in effect. The results are then used only for the last week of the running total. Interim weeks are left missing. This procedure was used to reduce the risk of entering incorrect data into the data set more than once.

The week is a useful time period because advertising and promotional activities usually last for a week. The daily data are pooled and expressed as weekly item movements. This allows store managers to observe the relationships between unit sales and promotional campaigns.

The week is again appropriate because consumers tend to do their shopping on a weekly basis. Managers may also be able to identify the periods of high consumer traffic on a weekly basis and make labor schedules out to increase efficiency and thus reduce the supermarket's labor cost.

There are fifty five UPC codes each representing an individual hotdog product. The product description, which reveals the meat ingredient found in each hotdog, associated with each UPC is used to group individual hotdogs into categories. For example, hotdogs that have chicken in their ingredients are placed into the chicken hotdog category. The same method is used to place meat, cheese, turkey, and beef hotdogs into their respective categories.

There are fourteen beef hotdog bar codes, each representing a different product. The difference in products may be physical characteristics. For example, the length of the beef hotdog, it's ingredients, or the difference could be in the processor's name, (e.g. Oscar Meyer or Khan). The price of the beef hotdogs used in this study is a weighted average of all the individual beef hotdog UPC prices. The weighting mechanism is a ratio of the sum of all beef hotdog prices in week t to the total quantity of beef hotdogs sold in the same week, t. This produces an index that is calculated for each of the 62 weeks. The price that was used for the substitute product, hamburger, was determined by looking at all of the prices for hamburger over the same 62 week period. It was apparent from observing a plot of hamburger data that the price for all the hamburger products moved in the same general direction. Thus, the price of one particular hamburger product

was used to represent all hamburger prices (Capps, 88). (The hamburger products were ground chuck and ground beef in various packaging).

The second part of the advertising data were obtained from newspapers (primarily the supplemental advertising section in the Knoxville News Sentinel). The information was gathered from the chain's supplement in the Monday paper and occasional daily ads. The following information was recorded for each newspaper advertisement: the number of ads for a particular product, location in the supplement (front, middle, back), the color (color or black and white), and the size in square inches. Weekly television and radio advertising data were provided by the supermarket's regional marketing manager, and they were expressed in units of gross rating points. The five supermarkets are all located in the same metropolitan area, so consumers are exposed to identical advertisements in all three of the advertising medias.

Gross rating points for television were zero until the weeks before and of July 4, 1989, (week 58) Figure 1. The figure does not indicate any change in advertising associated with July 4 in 1988 (week 6). An increase in advertising occurred with increased unit sales and price reductions associated with July 4, 1989 (week). The increase in advertising prior and during the peak demand period for beef hotdogs is, obviously, an attempt to attract both loyal and other consumers to the chain's stores. This is logical because the increase in unit sales is drastic during the Fourth of July time period.

The gross rating points for radio advertising were zero, as with television advertising. Figure 2. shows the gross rating points per week during the 62 week observational period. The increase in radio

advertising prior and during the peak demand period was an attempt, as in the case of television adverting, to attract consumers to the chain's stores.

Beef hotdog advertising in the newspaper was present all year round, Figure 3. The newspaper advertising was relatively stable during the course of the year, with the exception of the period prior and during the Fourth of July. Here again, this seems to coincide with the item movement and price reductions.

Point of purchase, P-O-P, advertising data were collected but not included in this model even though it is an important promotional technique. This is because P-O-P advertising was present on different brands of beef hotdogs, and when the beef hotdog data were aggregated, the P-O-P advertising was present in each time period, t. It was collected in a manner as either being present or absent. Because there was no variation, there was no empirical logic behind the inclusion of this variable the model.

C. MODEL

The consumer's utility function is assumed to be weakly separable. Weak separability refers to the marginal rate of substitution between two goods contained in a subset. The condition is that the marginal rate of substitution, MRS, between the two goods be independent of the quantity demanded for other commodity subsets. Beef hotdogs and hamburger are considered to be in the same subgroup, under the assumption that hamburger is a substitute good for beef hotdogs. This study then assumes weak separability holds and that the MRS between beef

hotdogs and hamburger is independent of the demand for other commodity subgroups (Raunikar and Huang).

The demand curve can be estimated because of the assumption that supply of beef hotdogs is perfectly elastic to the individual consumer at any market price (Figure 4). The supply of beef hotdogs is assumed to be unlimited to the individual consumer, meaning that each shopper can purchase desired quantities at any given price level. This is because an individual consumers, logically, cannot consume all the beef hotdogs in a given supermarket. Stores on the other hand, are required to sell as much of a product as possible at a given price. Stores want to have an ample supply of a product on hand at any given time.

Previous research and economic theory provided the background for the specification of this demand model. The model is as follows:

$$Q_t = F(P1_t, P2_t, Ad1_t, Ad2_t, Ad3_t, H_t),$$

Q_t = the item movement in lbs. for beef hot dogs in each week t.

$P1_t$ = price of beef hotdogs in week t ($/lbs.).

$P2_t$ = price of hamburger in week t ($/lbs.).

$Ad1_t$ = television advertising gross rating points in week t.

$Ad2_t$ = radio advertising gross rating points in week t.

$Ad3_t$ = newspaper advertising in inches in week t.

H_t = a binary variable for holiday (H=1 if week contains a holiday, 0 otherwise).

D. COMMENTS ON VARIABLES

Maximizing utility subject to a budget constraint leads to a demand

equation in which quantity is a function of prices and income. Advertising is introduced into the demand equation to allow for its impact on preferences (utility). Holidays are also associated with changes in preferences. The movement of beef hotdogs during the week of the Fourth of July increased dramatically. Advertising variables are included in the model because of their effect on sales (Capps,1988, Moriarty, 85,p.81-98).

The unit sales for beef hotdogs, Figure 5, were fairly constant over the observational period with the exception of a few weeks in July. This occurrence is noticeable in both 1988 and 1990. The figure suggests that the peak demand for hotdogs is just prior to and the week of the Fourth of July. The weighted price per pound of beef hotdogs can be seen in Figure 6. The price of beef hotdogs seems to be somewhat volatile during the year in that the price rarely remains the same for more than a one week period. It is interesting to note that the price of beef hotdogs drops during the same time frame as the demand for hotdogs is increasing. This could be to attract potential consumers to beef hotdogs in particular or it could be the manufacturers decreasing prices to attract consumers to their products during this peak demand period. The week following the Fourth of July indicates a large increase in the price again. This may be due to managers and manufactures alike increasing prices due to a decrease in demand to reach a profit maximizing level. Closer inspection of Figure 6 shows a noticeable decrease in the price again in the month of February, and there is a slight corresponding increase in unit sales as depicted in Figure 5.

Groundbeef prices, Figure 7, seemed to not have the volatility associated with them as did beef hotdogs. The price of groundbeef tended to increase during the 1989 year and either increased or returned to this bench mark price of $ 1.79/lb.. There was no apparent explanation for the price fluctuations in the 1988 year.

The explicit form of the demand equation is

$$Q_t=B_0+B_1(P1)+B_2(P2)+B_3(Ad1)+B_4(Ad2)+B_5(Ad3)+B_6(H)+E$$

The parameter estimates (B_j) should all be positive with the exception of the price of beef hotdogs which should be negative. The own-price coefficient, B_1, should be negative indicating that as the price of beef hotdogs increases, quantity demanded will decrease. The price of hamburger should have a positive coefficient indicating a complementary relationship with beef hotdog demand. As the price of hamburger increases, consumers are going to substitute beef hotdogs for hamburger thus increasing beef hotdog demand. If advertising is effective, logically there should be an increase product movement.

Previous research, see chapter II, shows that advertising has a positive effect on the quantity demanded of that particular product. Therefore television, radio, and newspaper advertising should have positive coefficients. Intuitively, the major summer holiday, the Fourth of July, should have a positive coefficient. The null hypothesis is that holidays, television, radio, newspaper, own-price, and the price of substitutes do not effect the demand for beef hotdogs.

E. RESULTS

The estimated equation is shown in Table 1[2]. The R^2 statistic, or the coefficient of determination, was 0.866. The computed F= 59.4, is significant. The root mean square error is 139.08 which does appear to be large in comparison to the general weekly item movement (Table 1), which varied between 200-600 units a week (Table 2).

The model appeared to possess no significant amount of multicollinearity. A correlation matrix was obtained from SAS, and it indicated that there was no real pair wise problem. A further check for multicollinearity was conducted. Each variable was regressed on the other variables. The R^2's were low (Table 3), the highest being 0.515, and this attested that there was not a problem with multicollinearity.

The method for checking to see if heteroscedasticity was present was the Goldfeld-Quant test. This was a precautionary measure because heteroscedasticity is not usually found in time-series data for a single product. After performing the necessary steps, the calculated F value was less than the F critical value thus failing to reject the null hypothesis of constant error variance.

To check for autocorrelation the Durbin-Watson test, D.W. was used. The D.W. statistic that was generated, 1.49, fell in the indeterminate range, thus failing to reject the null hypothesis of no autocorrelation. The visual observation of the residuals plotted against time does not indicate the presence of autocorrelation between other time periods.

All of the variables were significant at the 95 percent sig-

---

[2] All Tables and Figures are in the Appendix.

nificance level with the exception of newspaper advertising (Ad3). The positive signs on the substitute price and television advertisement parameter estimates were as expected. The estimated coefficients of the price of beef hotdogs, P1, was negative as expected. There was a prominent holiday effect as indicated by the size of the estimated parameter. The positive sign associated with the holiday parameter, H, was consistent with the findings of previous research. The estimated coefficient of the price of hamburger, P2 was also positive. Again, economic theory suggests that if the price of a product increases, people are going to substitute a similar product in its place.

Newspaper advertising, surprisingly, was found to be statistically insignificant. The television parameter estimate was positive and significant. This indicated that television advertising has a positive effect on the demand for beef hotdogs. It also reflects advertising at a time when the demand is at a peak. Radio advertising was significant but had a negative coefficient estimate, this is opposite of what was expected. The negative parameter estimate indicates that radio advertising has a negative effect on the demand for beef hotdogs. The negative signs associated with the radio advertising parameter may be attributed to consumers being attracted to the supermarket after hearing the advertisement, but once in the store deciding to purchase a substitute good with a lower price. It may also reflect the three-peak promotional periods around July 1989, whereas television had only two peak promotional periods of slightly different duration.

F. CONCLUSIONS

The overall explanatory power of this model was encouraging. At the 95 percent significance level the parameter estimate for newspaper advertising was not significant while the rest of the parameter estimates were significant. The negative signs associated with newspaper advertising and radio advertising were also unexpected.

The implementation of promotional activities, such as price reductions and advertising, coincide with peak demand for beef hotdogs. The demand for beef hotdogs during the course of the year remains fairly stable. The need still exists to determine the effects of different promotional activities on individual products so managers and manufactures alike will be able to respond quickly or prepare for the effects of events that cause an increase in demand. For example, a manager would want to have some idea how many additional units of hotdogs to order from suppliers if a television advertisement were going to run next week. A manager could use the preceding week's values for beef hotdogs prices, ground beef prices, radio, and newspaper advertising levels along with the new level of television advertising and plug these values into the estimated demand equation to see the demand response.

The estimation of product demand at the store level needs to receive a lot more attention because it can be very useful to a variety of business personnel, like store managers for example, and the results could be used at every level in the food sector, including the farm level.

G. ELASTICITIES

I. non-peak elasticities[3]

Own-price	= -1.87
Cross-price	= 2.3151
Radio	= -0.021
Television	= 0.0495

II. Peak period elasticities[4]

Own-price	= - 0.2399
Cross-price	= 0.4932
Radio	= 0.00
Television	= 0.29

The elasticities calculated from averaging the weeks that did not include July 4 indicated that own-price and cross-price elasticities were elastic. The own price elasticity (-1.87) indicates that a one percent increase in the price of beef hotdogs causes a 1.87 unit decrease in beef hotdog demand. The cross-price elasticity (2.32) indicates that a one percent increase in the price of ground beef causes a 2.32 unit increase in the demand for beef hotdogs. The advertising elasticities were varied. The television elasticity was positive and

---

[3]Non-peak elasticities. Calculated by averaging observations for all weeks but those that include The 4 of July.

[4] These elasticities reflect peak period, July 4 weeks, elasticities. The elasticities were computed from averaging the observations of both July 4 weeks.

inelastic (0.050). The television elasticity was the largest of all the advertising elasticities indicating that it was the most effective advertising media associated with increasing consumer demand. The radio elasticity (-0.021) is negative and inelastic. Increasing expenditures on radio advertising would lead to a decrease in beef hotdog demand, and this is contrary to logical reasoning. This suggests that these promotions are used during weeks when sales are relatively low.

The elasticities calculated by averaging the weekly data for the July 4 weeks, week 6 and 58, revealed different results. The own-price elasticity is negative but inelastic (-0.24). The cross-price elasticity was positive and inelastic (0.49). The elasticities indicate that the price of beef hotdogs and groundbeef do not effect the demand for beef hotdogs as drastically as they did in non-peak periods. Consumers are much less price sensitive for hotdogs during the Fourth of July period, as expected. The television advertising elasticity is (0.29), this is a large increase compared to the same elasticity from the non-peak weeks. Television advertising has a larger impact on demand during the week of July 4 than it does any other week in the year. The elasticity for radio advertising was zero because there was no advertising during the week of July 4.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Prior to scan data, much of the economic research, and especially academic research, in the area of consumer demand had to rely on government survey publications for data. The government surveys are a valuable and creditable data sources, but they lack the desirable properties needed for many types of consumer demand research. The surveys are not a primary data source, and they tend to lack consistency in their definitions. The lack of consistency is found not only between different surveys, but between the same surveys in different years. The surveys are generally cross-sectional data sets so the effects of promotional activities cannot readily be observed.

There are private firms that supply data to be used in economic research, but they have their limitations as well. The cost of obtaining data from a private firm is usually too high to be practical in academic research. Private firms usually collect and prepare their data for use by private industry. There is also some wariness in regards to the statistical methods used by private firms to compile and prepare their data.

The scanner data used in this research meet all the previously stated properties important for research on dynamic consumer demand effects for well defined products (disaggregate groups). The scan data provide detailed information in regards to price and item movement on all goods sold through supermarkets. Each item sold and it's respective price can be recorded by the scanner. This is actual data not estimated numbers derived through the use of a survey. Scan data allows researchers the ability to observe price changes over time and the corresponding unit sales creating an historical record. Scan data have the potential to provide consistent measurement associated with each UPC code. This alleviates the problem of deriving a common unit of measurement to be used in empirical research. For example, a UPC code represents a specific good including it's size price and name. These characteristics make scan data a reliable source of data for consumer demand research.

The empirical parts of this study illustrate the potential of scan data as a decision making tool and as a new-data source for empirical research. This was accomplished by 1) the analysis of scan data for a specific product, 2) the creation of a matching advertising data set, and 3) the estimation of an empirical market demand relationship.

This paper provides estimates for the demand for beef hotdogs in the Knoxville metropolitan area with respect to the following variables: price of beef hotdogs and groundbeef, television, radio, and newspaper advertising. Scan data was used to supply quantity, price, and unit size information. Television and radio advertising data were supplied by the supermarket's regional marketing manager. Newspaper advertising

data were obtained from the Knoxville News Sentinel newspaper. Being able to estimate the demand response to the above variables is very important to store mangers. With better demand estimation, managers can define peak shopping periods and schedule labor more efficiently. The ability to estimate consumer demand better will allow managers to maintain a more efficient inventory level. In the case of hotdogs, the peak demand occurs during one point in the year, around the Fourth of July, and the supermarket manager wants to have an ample supply of hotdogs on hand to meet the demand. Managers are able to observe actual item movement as it goes out the "front door" instead of relying on what comes in the "back door"(deliveries to the store from warehouses) as they have had to do in the past. Scanners may allow managers to see how much merchandise is lost as a result of shrinkage.

Hamburger and beef hotdogs are assumed to be weakly separable, the marginal rate of substitution between these two commodities is independent of the demand for other commodity subgroups. Ordinary least squares was used to estimate the linear model. Television, radio, and newspaper advertising were also included to observe their effects on the demand for beef hotdogs. All of the variables were statistically significant at the 95 percent level with the exception of newspaper advertising. The sign of each parameter was positive or negative as anticipated except for radio advertising. Radio advertising had a negative sign. There were no problems of multicollinearity, heteroscedasticity, or autocorrelation. The estimated model has an R^2 and F of 0.866 and 59.4, respectively. These statistics suggest that the overall regression was significant and has good explanatory ability.

The elasticities calculated for the Peak periods, from the two weeks containing the Fourth of July, were quite different from the non-peak period elasticities. The own-price elasticity is inelastic and negative (-.239). The cross-price elasticity is positive and inelastic (0.49) but smaller than its counter part in the nonpeak period. Television advertising is inelastic and positive (0.49) while the elasticity for radio advertising is zero because there was no advertising during the Fourth of July weeks.

REFERENCES

REFERENCES

Archabal, Dale P., Shelby H. McIntyre, Cherryl H. Bell, and Nancy Tucker. "The Effect of Nutrition P-O-P Signs on Consumer Attitudes and Behavior." Journal of Marketing, 63(1987):373

Bureau of Economic Analysis, U.S. Department of Commerce. Biennial Supplement of the Survey of Current Consumer Business, GPO 1988.

Buse, Ruben C. "Survey of U.S. Households pertaining to Income, Expendituresor Consumption." Working Paper, University of Wisconsin, Madison. 1987

Capps, Oral C. Jr. "Utilizing Scanner Data to Estimate Retail Demand Functions for Meat Products." American Journal of Agricultural Economics, 71(1989):750-60.

Capps, Oral C. Jr. "The Ultimate Data Source for Demand Analysis?" Working Paper, Texas A & M University (1987).

Capps, Oral C. Jr. "Defining Management Responsibilities in the Retail Food Distribution Industry."Journal of Food Distribution Research, September, 1988:33-45.

Capps, Oral C. Jr. "MICRODATA BASES -- SCANNER DATA." Working Paper, Texas A & M University (1987).

Carman, H. F. and E. E. Figueroa. "An Analysis of Factors Associated with Weekly Food Store Sales Variation." Agribusiness, 2(1986):375-90.

Cox, T. and M. Wohlgenant. "Price and Quality Effects in Cross-Sectional Demand Analysis." American Journal of Agricultural Economics, 68(1986):908-19.

Culputa, Sunij. "Impact of Sales Promotions on When, What, and How Much to Buy." Journal of Marketing Research, 25(1988):342-55.

Curhan, Ronald C. "The Effects of Merchandising and Temporary Promotion Activities on Sales of Fresh Fruit and Vegetables in Supermarkets." Journal of Marketing Research, 11(1974):286-94.

Curhan, Ronald C. "The Relationship Between Shelf Space and Unit Sales in Supermarkets." Journal of Marketing Research, 9(1972):406-12.

DeSanta, Richard. "A Bold Experiment." Progressive Grocier No.2 67(1988):67-70.

Eastwood, David B.. "Potential Consumer Benefits of Scanner Data: The Case of Supermarkets." Proceedings of the 35th Annual Conference of the American Council on Consumer Interests (M. Carsky, ed.): Columbus, MO: American Council on Consumer Interests, 1989:14-17.

Funk, T. F., K. D. Meilke, and H. B. Huff. "Effects of Retail Pricing and Advertising on Fresh Beef sales." American Journal of Agricultural Economics, 59(1977):533-7.

Gagnon, Jean P., and Osterhaus, Jane T. "Research Note: Effectiveness of Floor Displays on the sales of Retail Products." Journal of Marketing, 61(1985):

Haidacher, Richard C., "USDA Commodity Disappearance Data and BLS Price Data." July 31, 1987.

Houthaker, H. "CompensatedChanges in Qualities and Qualities Consumed." Rev. of Economic Stud. 19(1951-52):155-164.

Jensen, Helen H., and John R. Schroeter."Estimating Retail Beef Demand Using Household Panel Scanner Data." Contract paper for Beef Industry Council of the National Live Stock and Meat Board. 1989.

Kluyver, Cornelis A., and Roderick J, Brodie. "Advertising-Versus-Marketing mix Carryover Effects."Journal of Business Research, 15(1987):269-87.

Kumar, V. and R. P. Leone. "Measuring the Effect of Retail Store Promotions on Brand and Store Substitution." Journal of Marketing Research, 25(1988):178-85.

Lattin, James A. and Randolph E. Bucklin. "Reference Effects of Price and Promotion on Brand Choice Behavior." Journal of Marketing Research, 26(1989):299-310.

Lesser, W. and J. Smith. "The Accuracy of Supermarket Scanning Data: An Initial Investigation." Journal of Food Distribution Research, 17(1986):69-74.

Marion, B. W. and F. E. Walker. "Short-Run Predictive Models for Retail Meat Sales." American Journal of Agriculture Economics, 60(1978):667-73.

McLaughlin, E. and W. Lesser. "Experimental Price Variability and Consumer Response: Tracking Potato Sales with Scanners." Working Paper, Cornell University 1986.

Moriarty, M. M. "Retail Promotional Effects on Intra- and Interbrand Sales Performance." Journal of Retailing, 61(1985):27-47.

Moriarty, M. M. "Feature Advertising-Price Interaction Effects in the Retail Environment." Journal of Retailing, 61(1985):81-98.

Pindyck, Robert S., and Daniel L. Rubienfeld. Econometric models and Economic Forecasts, New York:McGraw-Hill, 1981.

Raunikar, Robert, and Huang, Chung-Liang. Food Demand Analysis. Iowa State University Press, 1987:14-15.

Schrimper, Ronald A., "Cross-Sectional Data For Demand Analysis."The Economics of Meat Demand,.October 1986:74-92.

Smallwood, David M., and James R. Blaylock. "Food Spending in American Households, 1980-81." USDA ERS No. 71

Supermarket Business. Supermarket Business, (September 1988).

Tellis, Gerald. "Advertising Exposure, Loyalty, and Brand Purchase: A Two Stage Model of Choice." Journal of Marketing Research, 25(1988):134-44.

Thayer, Warren. "Measuring the Power of Promotion." Progressive Grocer, 68(1989):38-46.

Theil, H. "Qualities, Prices and Budget Enquiries." Rev. of Economic Stud. 19(1951-52):129-147.

U.S. Department of Agriculture, Eonomic Research Service."Consumption and Utilization of Agricultural Products." Handbook No.671. 5(1989)26-29.

Walters, Rockney G., and Heikke J. Rinne. "An Empirical Investigation into the Impact of Price Promotions on Retail Store Performance." 62(1986):

Wilkinson, J.B., J. B. Mason, and C. H. Paksoy. "Assessing the Impact of Short-Term Supermarket Strategy Variables, "Journal of Marketing research, 19(1982):72-86.

Wittink, D. R., M. J. Addona, W. J. Hawkes, and J. C. Porter. "The Estimation, Validation, and Use of Promotional Effects Based on Scanner Data." Working Paper, Cornell University (1988).

APPENDICES

APPENDIX A

ADDRESSES OF PRIVATE INFORMATION SOURCES

A.C Nielsen. (Contact Michael J. Spindler).
Nielsen Plaza
Northbrook, IL. 60062-6288
(312)498-6300

Burgoyne, Inc. (Contact Paul C. Lubin).
One North Broadway
White Plains, NY. 10601
(914)949-3214

Information Resources, Inc. (Contact Hugh Anderson).
30 Old Kings Highway South
Darien, CT 06820
(203)656-0770

Mail Dairy Panel. (Contact Edward R. Appel).
524 South Avenue, East
Cranford, NJ 07016

Mapes and Ross (Contact Peter C. Lenz).
Research Park
176 Wall Street
Princeton, NJ 08540
(609)924-8600

Market Facts, Inc. (Contact Robert Saladoff).
1730 Pennsylvania Ave., NW
Washington, DC 20006
(202)737-0890

The Test Marketing Group (Contact E. Katherine St. Cyr).
140 South Dearborn
Chicago, IL 60603
(312)782-9713

APPENDIX B

Table 1.

Estimated Model and Statistics

$$Q_t = 211.79 - 401.45(P1) + 566.93(P2) + 1.58(Ad1) - 0.90(Ad2) - 0.65(Ad3) + 1202.68(H)$$
$$(1.66) \quad (-6.21) \quad (6.02) \quad (4.53) \quad (-2.23) \quad (-0.93) \quad (8.95)^5$$

Goodness of Fit Measure	Numerical value
Adjusted R^2	0.711
Coefficient of determination R^2	0.866
F	59.4
Root Mean Square Error (RMSE)	139.08

[5] T-values

Table 2.

Weekly Item Movement.

Week	Item movement	Week	Item movement
1	445	32	Missing
2	459	33	384
3	485	34	278
4	347	35	257
5	387	36	298
6	1730	37	526
7	954	38	386
8	379	39	483
9	353	40	417
10	395	41	418
11	374	42	255
12	359	43	261
13	363	44	272
14	361	45	321
15	430	46	291
16	361	47	299
17	277	48	319
18	273	49	391
19	286	50	391
20	328	51	373
21	308	52	388
22	262	53	537
23	340	54	605
24	302	55	499
25	282	56	458
26	82	57	361
27	207	58	2270
28	312	59	1441
29	262	60	1212
30	261	61	287
31	336	62	293

Table 3.

Individual Regression Statistics

Dependent Variable	R^2
Price of Beef hotdogs (P1)	0.515
Price of Groundbeef (P2)	0.421
Television Advertising (AD1)	0.244
Radio Advertising (AD2)	0.091
Newspaper Advertising (AD3)	0.366
Holiday (H)	0.446

Table 4.

Averages of Variables

Variable	Average over 62 observations
Quantity	439.85 pounds
Price beef hotdogs	$ 1.94 pound
Price groundbeef	$ 1.71 pound
Television advertising	13.00 gross rating points
Radio advertising	10.00 gross rating points
Newspaper advertising	20.58 Sq. Inches

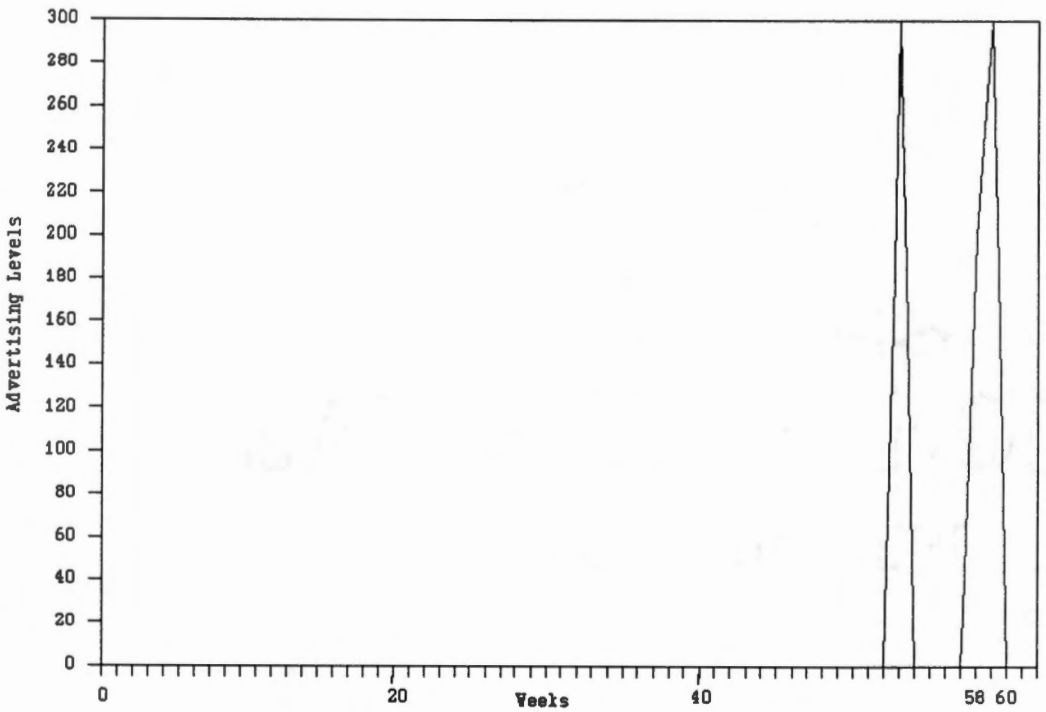

FIGURE 1. Television Advertising.
May 14, 1988 Through August 11, 1989
Weeks 6 and 58 are July 4 weeks

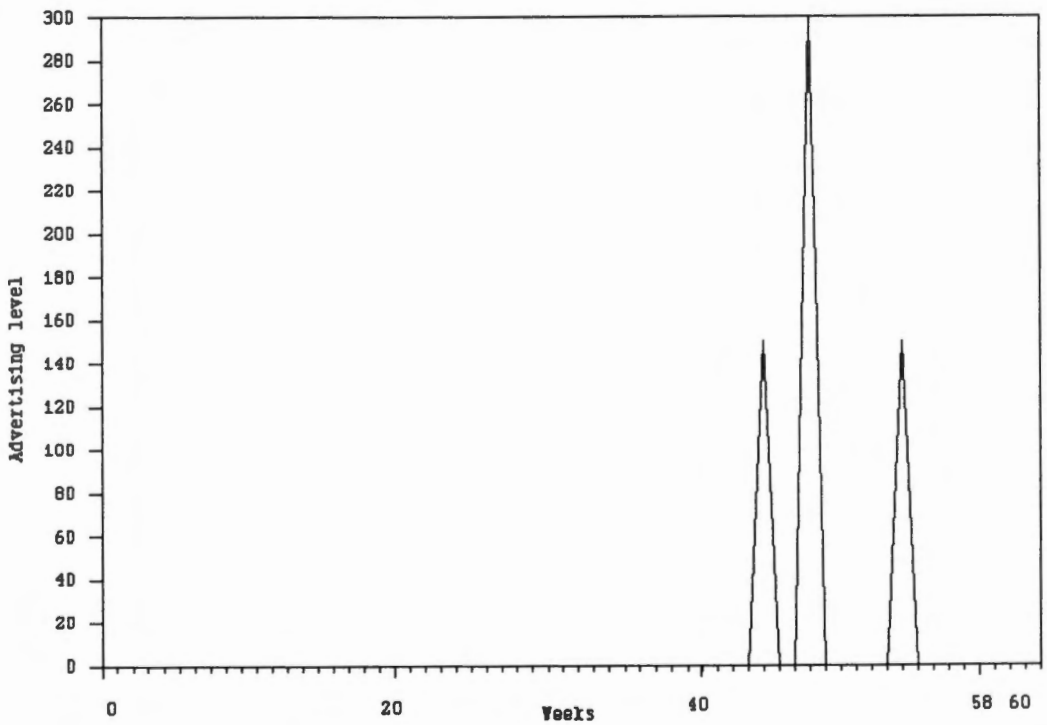

FIGURE 2. Radio Advertising.
May 14, 1988 Through August 11, 1989
Weeks 6 and 58 are July 4 weeks

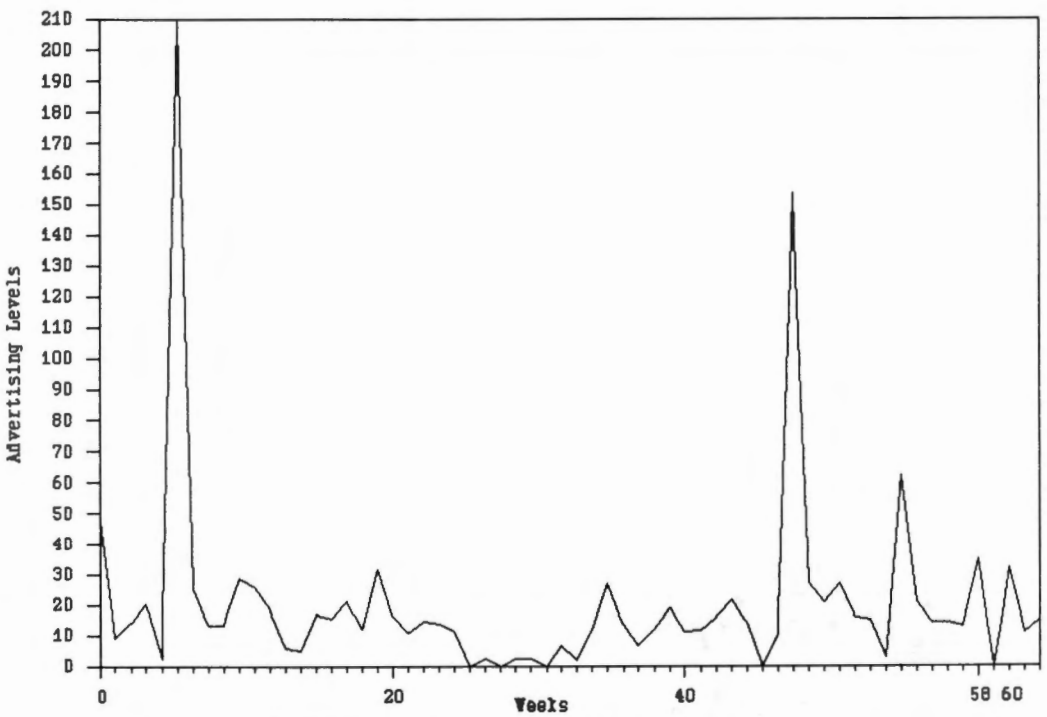

FIGURE 3. Newspaper Advertising.
May 14, 1988 Through August 11, 1989
Weeks 6 and 58 are July 4 weeks

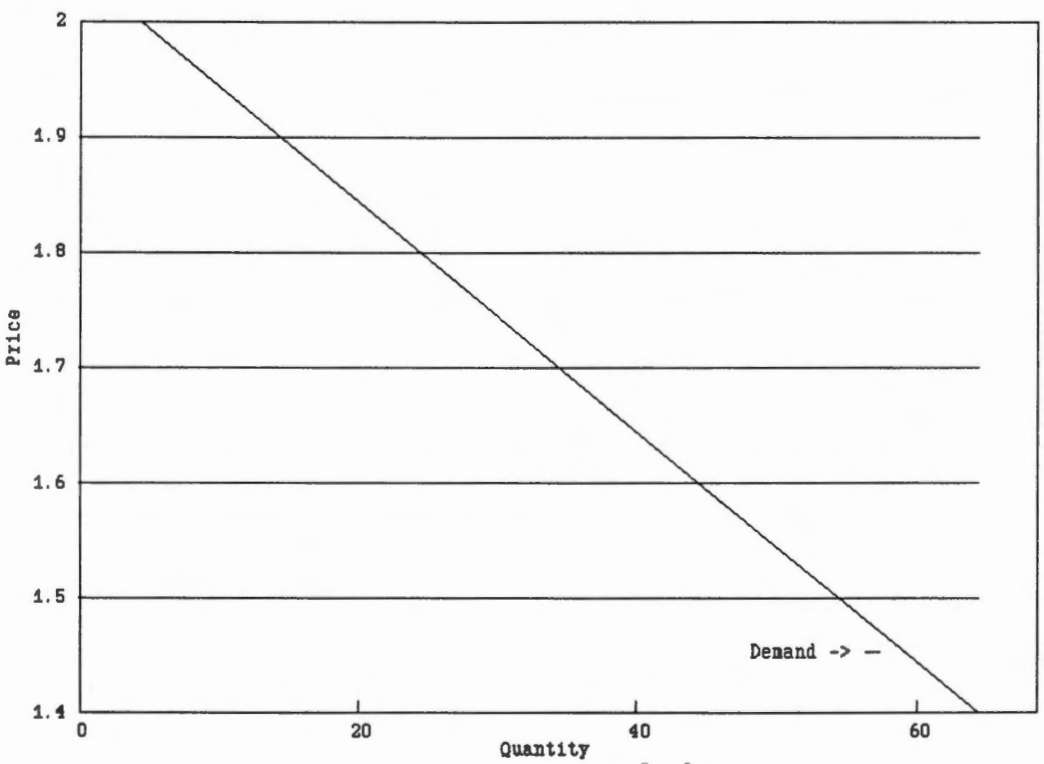

FIGURE 4. Constant Supply.

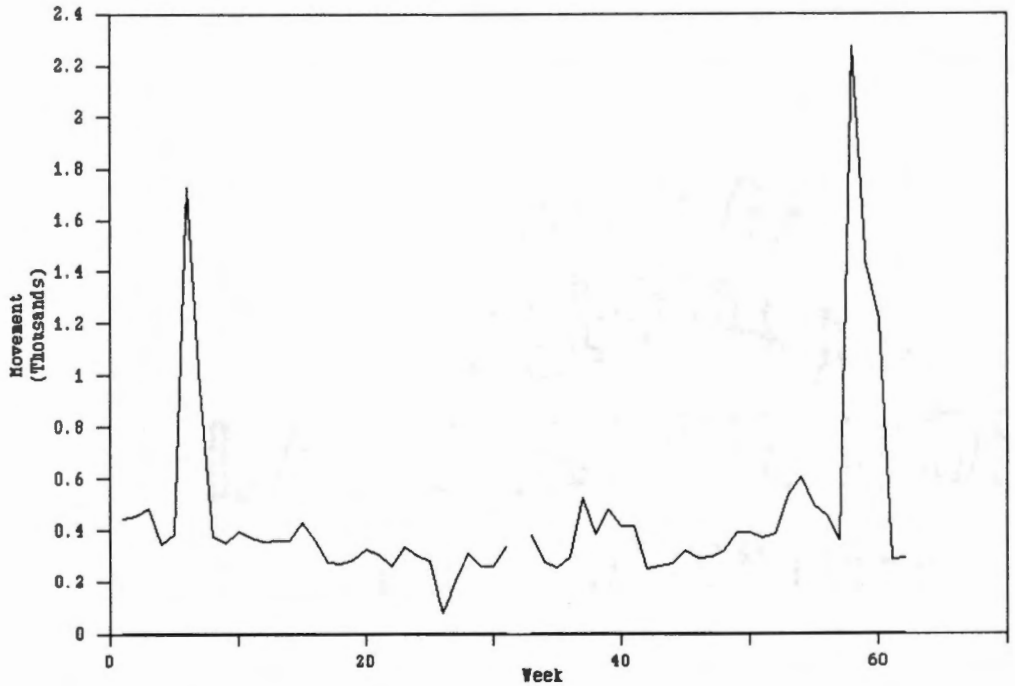

Figure 5. Beef Hotdog Movement.
May 14, 1988 Through August 11, 1989
Weeks 6 and 58 are July 4 weeks

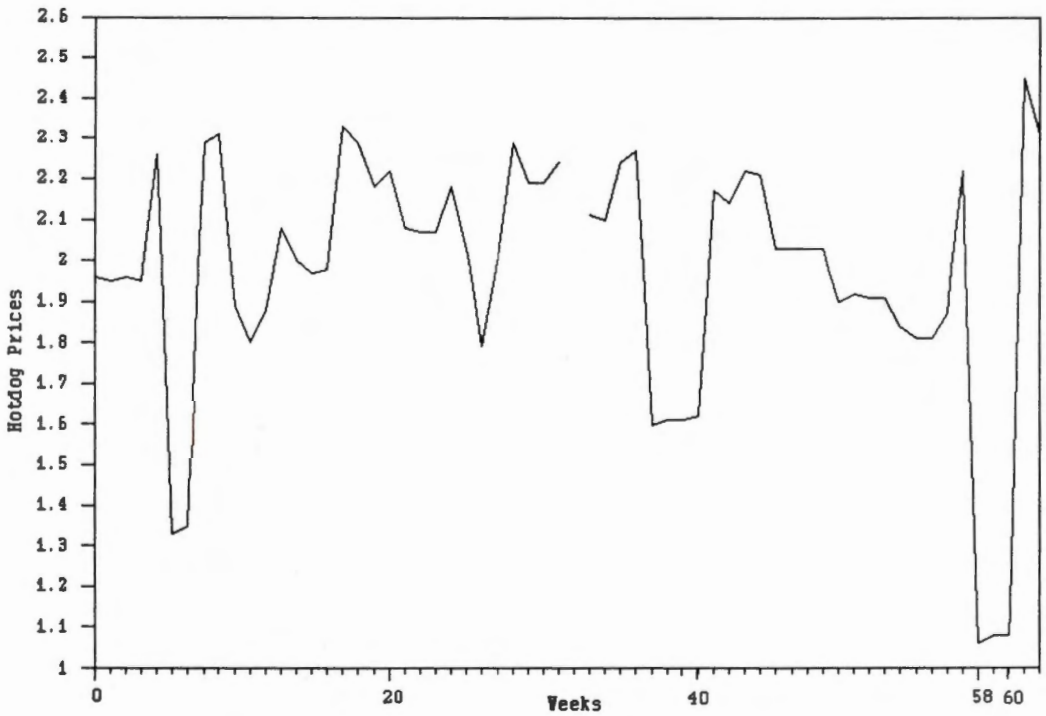

FIGURE 6. Beef Hotdog Prices.
May 14, 1988 Through August 11, 1989
Weeks 6 and 58 are July 4 weeks

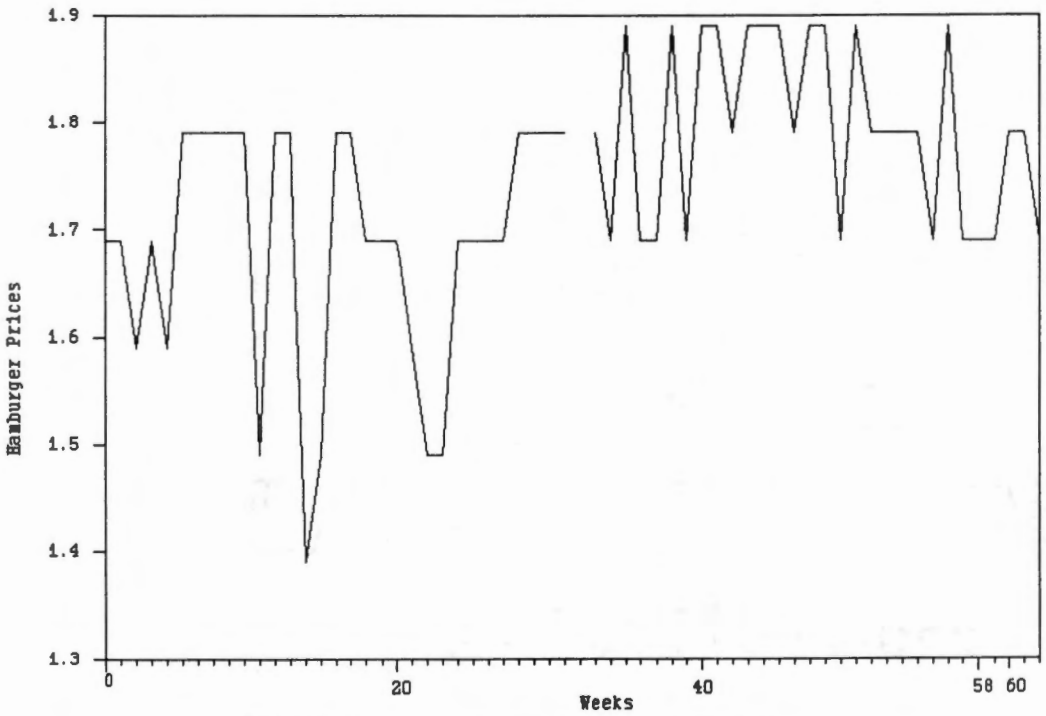

FIGURE 7. Hamburger Price Movement.
May 14, 1988 Through August 11, 1989
Weeks 6 and 58 are July 4 weeks

VITA

Kent Lee Wolfe was born in San Miguel County, New Mexico, on March 10, 1966. He attended Clarke County Public schools in Athens, Georgia and Graduated from Cedar Shoals High School in 1980. He received a Bachelor of Science degree in Agriculture from the University of Georgia in August, 1988. He was married to Heidi Lynn Hunt on August 20, 1988. Jacob Lee Wolfe was born on December 12, 1989.

He entered graduate school at The University of Tennessee at Knoxville in August, 1988, and received the Masters of Science degree with a major in Agricultural Economics in August, 1990. He entered the Doctoral program in July, 1990 at The University of Tennessee at Knoxville.