A PILOT INVESTIGATION OF CONSUMER PREFERENCES FOR BEEF

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PREFERENCES FOR BEEF

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CHAPTER I

INTRODUCTION

General

One of the more important economic decisions in any society concerns the kinds of products and the amounts of each that are to be produced with scarce resources. The manner in which this decision is made differs greatly between different types of economic systems. In one type of system all economic decisions are made by a board of planners and consumers have little, if any, influence on resource allocation. However, in our capitalistic society, consumers play a very different role, the nature of this role being well exemplified by the adage "The customer is king".

Consumer sovereignty in our society is based upon the relationship that exists between the interdependent forces of the household and firm. The theory of the household portrays individual consumers as having ordinal preference scales or utility functions which they wish to maximize under the restraint of their budget or income, and product prices as given in the market. Consequently, consumers register more dollar votes for those products that are higher up on their preference scales than for those commodities which occupy a lower position on their preference surface. The collection of goods finally chosen therefore depends on, (1) the individual's set of values or preferences, (2) the size of his income and (3) product prices as given in the market.

The theory of the firm portrays producers as attempting to maximize profits. With due consideration being given to the restraints imposed by transformation functions and resource costs, producers will reach their objective by producing those commodities that command the highest prices in the market. Hence, producers guided by the profit motive will respond to consumer desires.

In order for an optimum allocation of resources to come about it is necessary for the marketing force, which brings households and firms together, to perform its pricing function efficiently. Most definitions of marketing are restricted to the physical tasks performed by middlemen. Such a narrow definition does not take into account the function of marketing in price formation or determination and the directive role it exercises in guiding the flow of factors into their optimum use in production and goods and services into consumption.[1] Viewed in this light, marketing should start with determination of consumers' desires rather than with the bundle of goods that just happens to be produced.[2] Therefore, one of the major objectives of our marketing system should be that of measuring consumers' preferences for various kinds and quantities of products and then accurately reflecting these preferences back to producers.

The general problem area of this study is concerned with the efficiency with which the marketing system performs its economic or pricing function.

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[1] G. S. Shepherd, "The Field of Agricultural Marketing Research: Objectives, Definition, Content and Criteria," Journal of Farm Economics, XXXI, No. 3 August, 1948, pp. 444-445.

[2] G. G. Judge, S. K. Seaver, and W. F. Henry, "Competitive Position of the Connecticut Poultry Industry: Economic Interpretations of Interregional Competition," University of Connecticut, Bulletin 309, 1954. p. 7.

For example under the present system do consumers get the types and quantities of commodities desired or could producers reap a greater return by changing the production ratio of products? In order to answer this question we need to have information relative to the following:

1. Consumer basic preferences[3]
2. The monetary values that consumers place on their basic preferences
3. How can we merchandize so as to better meet consumers desires
4. How can labeling, grading etc. be orientated toward consumer basic preferences

This study is primarily concerned with questions (1) and (2) above, that is, what are consumers basic preferences and what monetary values do they place on these preferences. In an attempt to investigate these questions, this study is concerned with the commodity beef. However, since this is a pilot investigation and limited in personnel and funds, only the T-Bone cut of steak is utilized. This choice was made since T-Bone steak is one of the major primal cuts of beef for which price is affected by the grade.

The major objective of this study can be stated thus: to measure the various aspects of consumer basic preferences for T-Bone steak and to ascertain the monetary values consumers place on their basic preferences.

In the course of following through on the major objective several methods of research will be investigated as to their applicability to this type of study and suggestions will be made for future work. Also price response relationships for different grades of T-Bone steak will be estimated from empirical results and an economic analysis will be made for each relationship.

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[3]Basic preferences, as used in this study are defined as those preferences which are independent of prices and income.

The Problem Area Restated

The problem area of this study has been stated in terms of the efficiency with which the marketing system performs its pricing function. Before we examine the problem area in more detail it may be well to define marketing efficiency as it is used here.

The following definition of marketing efficiency follows the logic presented in a preference study by Goldman concerning the commodity eggs.

> The total efficiency with which eggs are marketed in a given community may be expressed symbolically as a vector:
>
> $$u = (u^{(1)}, u^{(2)}, \ldots, u^{(\theta)}) \qquad (1)$$
>
> Where: u = total efficiency (utility)
>
> $u^{(1)}$ = the utility of the i^{th} individual from the consumption of eggs
>
> θ = the number of consumers in a given community
>
> The vector, (1), is defined as greater than any other vector when at least one of its components is greater than the corresponding component of any other vector, and no other component is less. According to this definition, maximum marketing efficiency exists when no other change in conditions increases the vector, (1) - - i.e., it must be impossible to increase the utility of any persons without decreasing that of others.[4]

In a similar manner, by this definition a given society will be maximizing satisfaction from resources going into the production of T-Bone steaks only when function (1) is at maximum. Such a definition finds a basis in welfare economics and a measure of welfare is defined relative to the degree that the utility function is maximized. Maximum welfare exists when the utility function is maximized under a given transformation function for society and under a given income distribution.[5]

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[4] Alan Stewart Goldman, "Efficiency of Marketing Eggs in Des Moines," unpublished Ph.D. Dissertation, Iowa State College, 1956, pp. 1-3.

[5] O. Lange, "The Foundation of Welfare Economics," Econometrica, X, 1942, pp. 215-228.

As has been pointed out previously, consumers cast dollar votes for those kinds of products that are higher on their preference scale. Therefore, whenever a consumer buys a particular quality (grade) of beef he is casting a dollar vote for that particular grade. Retailers, in turn, compile such dollar votes and then inform their suppliers of preferred grades by buying more quantity of those particular grades for which more votes have been cast. This process is carried back to the primary producer who then has knowledge of consumer preferences as indicated by price ratios of the various grades.

With reference to beef, consumer satisfaction can be at a maximum only when producers have an incentive by the means of price differentials to produce those grades and quantities of each that are desired. Therefore, in order to be efficient, a marketing system must not only determine consumers' basic preferences, but must also accurately reflect the true monetary values placed on these preferences back to producers.

The measurement of consumer preferences and related variables is a relatively new type of research, hence, the methodology upon which these studies are based is still in an exploratory stage. Therefore, a companion problem area is that of screening available methods as to their admissibility for generating empirical data by which to investigate the major problem area. Each of the available methods has certain advantages and disadvantages depending on the particular problem to be investigated. In particular the methods evaluated will be consumer and market surveys versus controlled experiments.

CHAPTER II

THEORETICAL FRAMEWORK

Since the measurement of consumer preferences is a relatively new area, there is a lack of systematic theory pertaining specifically to this type of work. However, a general framework can be developed from conventional economic analysis of the forces of the household, firm, and market. Only a brief statement of the relevant theory will be given in this section.

As pointed out earlier, the force of the household consists of individual consumers who attempt to maximize utility functions under the restraints of limited money incomes and product prices as given in the market place. In order to examine consumer behavior it is necessary to consider all three factors simultaneously. Economic theory provides a convenient tool in indifference curve analysis, which combines all three factors into a single analysis.

The theory of the firm portrays individual producers as combining a bundle of resources in the manner which will enable them to realize the greatest net return for their productive effort. The restraints under which firms attempt to reach their goal are product prices, physical transformation possibilities and resource cost. The theory of the firm provides a tool in terms of iso-resource curves for analyzing producer behavior toward resource allocation between products. Iso-resource or iso-cost curves depicts possible combinations of two products that can be produced with a given resource or cost outlay.

It is not sufficient to present a theory that includes only the theory of producer and consumer behavior. Each of these units arranges its behavior pattern in terms of a market variable, which is price. To formulate a complete theory, it is necessary to present a theory of the determination of this market variable. The interaction of consumers and producers in the market place serves to determine the observed levels of prices.

In order to illustrate the role of the marketing system in resource allocation, a given community's indifference map for Choice and Good grades of beef will be transposed on the community's iso-cost or production possibility function. As a means of simplification it will be assumed that producers can produce either or both Good and Choice grade animals and the combinations of the two grades are as given in Figure 1.

In Figure 1, YX represents the community's production possibility curve for a given amount of resources available for the production of Good and Choice grade beef. The goal of society is to obtain the greatest amount of satisfaction as possible from the given resources. Two levels of satisfaction are represented by indifference curves I_1 and I_2. Similarly two pricing schemes are represented by the price lines $Y_1 X_1$ and $Y_2 X_2$. These two pricing schemes bring about two different resource allocations, one is efficient, whereas the other is inefficient.

Assume that the marketing system reflects pricing scheme $Y_1 X_1$. When this is the case, firms will produce at point R which yields Oa_1 of Choice and Ob_1 of Good. At point R consumers are on curve I_1, but this is not the optimum production combination since curve I_2, a higher level of satisfaction, is accessible with the given resource or cost outlay. In order to bring about the allocation that is consistent with society's goal, the marketing system must reflect pricing scheme $Y_2 X_2$. The point of equilibrium

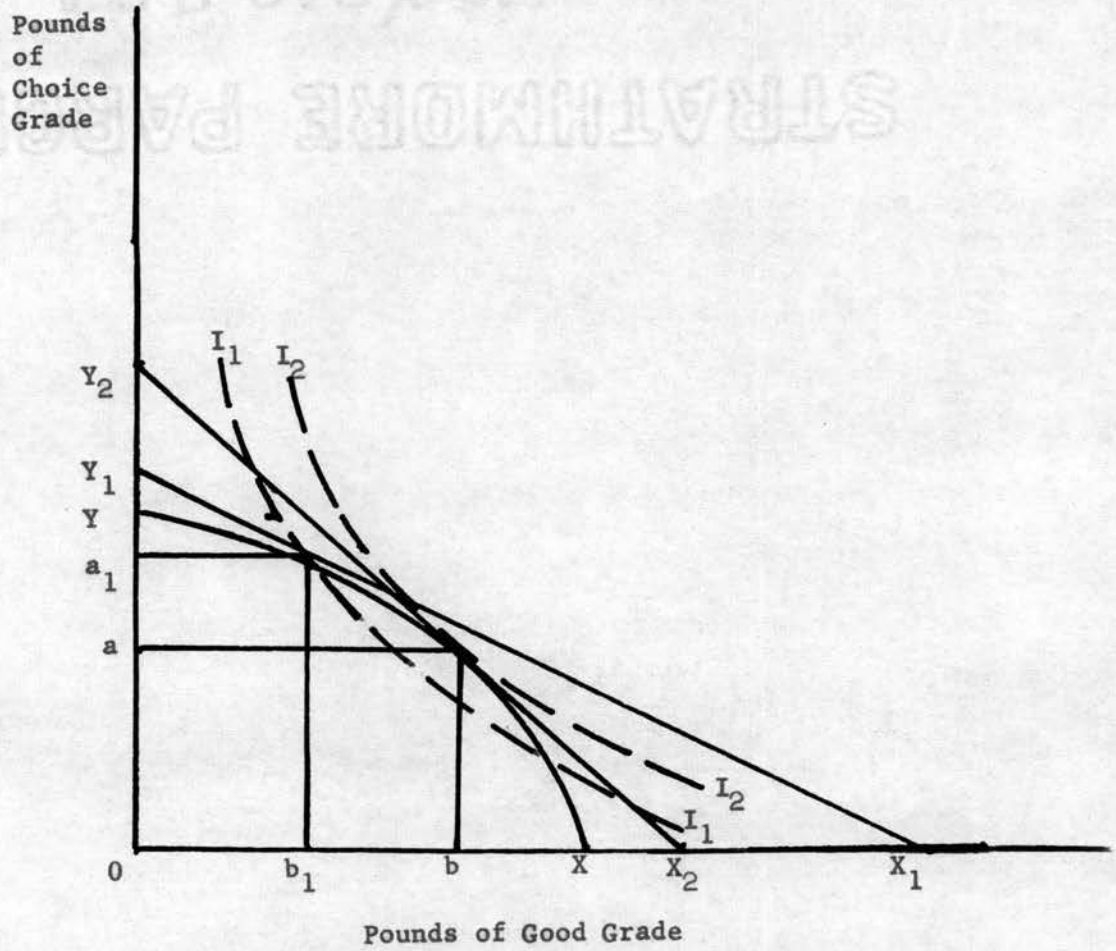

Figure 1. Relationship Between Price Reflection and Resource Allocation

is at point S which yields Oa of Choice and Ob of Good.

The value of society's utility function cannot be at a maximum if the pricing mechanism fails to reflect consumer preferences. That is, under a condition of imperfect reflection of consumer preferences to producers, resources are allocated in the community according to prices that imperfectly designate the desires of consumers. Under these conditions welfare cannot be at a maximum by definition.[1]

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[1] O. Lange, pp. 215-228.

CHAPTER III

METHODOLOGY

General

The major objective of this study has been stated thus: to measure the various aspects of consumer preferences for T-Bone steak and to ascertain the monetary values consumers place upon their preference. In order to investigate this objective it is now in order to consider the methodology underlying the generation of data for preference studies. Two important problem areas involved are:

1. What is the nature of the data necessary to test the postulated hypotheses?
2. What is the best research method for generating the type of data specified in (1)?

The general purpose of generating data is to test the empirical validity of postulated hypotheses; therefore, hypotheses themselves specify the type of data to be generated. Hence, the initial step in fruitful research is the formulation of meaningful, testable hypotheses.

Many hypotheses in research dealing with economic problems originate from functional relationships that economists postulate to describe the real world. The variables included in these relationships come from two major sources, economic theory and the researcher's own and others' experience in the field that initiated the problem.

In order to postulate functions that describe consumer basic and monetary preferences for different grades of beef, it is necessary to combine information from economic theory, the field of grading, and other factors that may condition consumer preferences. Since a brief statement of the theoretical framework has been presented, the discussion will proceed to grading and other factors.

> "The specific grade of a slaughter animal is determined by an evaluation in terms of factors which influence carcass excellence - conformation, finish, quality and maturity."[1]

These factors are discussed by Dowell and Bjorka in their book Livestock Marketing.

Conformation is the build, shape, or proportion of the various parts of the animal or carcass. Animals or carcasses that possess superior conformation yield a high proportion of the most desirable cuts and a low proportion of the less desirable cuts.

Finish refers to the degree of fat. It includes the fat on the outside of the body or carcass, on the inside of the body cavity, and between the muscles and tissues. Thus, finish refers not only to the quantity but also to the quality and distribution of fat.

Quality refers to the character of the flesh and fat. In the carcass it is associated with the tenderness and palatability of the meat and hence refers to the strength of the muscle fiber, the amount and strength of the connective tissue and the character of the intercellular fat. Quality also refers to the relationship between edible meat and fat and the size and character of the bones.

In all grading work, it is necessary that due consideration be given to each factor. The same animal or carcass may possess prime confirmation, choice finish, and good quality. Hence, it is a matter of balancing one factor against the other in determining the final grade.[2]

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[1] Official United Standards for Grades of Slaughter Cattle", PMA Service and Regulatory Announcement No. 11, Washington: Government Printing Office, 1950, p. 2.

[2] Austin Allyn Dowell and Knute Bjorka, Livestock Marketing (New York and London, 1941) pp. 302-303.

Shepherd discusses the usefulness of grades for wholesaling and retail purposes.

> In 1923 the Federal Government began official grading of carcasses, not merely for market reporting services, but as the basis for purchases of beef. Since that time a number of institutional buyers have come to specify that the beef they buy must be graded and stamped by an official government grader. This stamp that is placed on carcasses by official government graders remain visible on the retail cuts, therefore consumers can ascertain what grade they are buying when they buy federally inspected beef.[3]

Not all meat that consumers buy is stamped with official government grades. Packers also market meat that carry packers private brands as well as meat that is not labeled to grade in any manner. Hence, consumers have three alternatives in determining the grade they buy:

1. Official government grades,
2. Packers brands,
3. Their own ability to judge grade quality from physical characteristics. Factors such as fat to lean ratio, tenderness, etc. that are used by the trade to distinguish between grades will be referred to as grade factors.

Factors other than grade factors that may condition consumers basic preferences are:

1. The practice of shopping at a retail outlet that markets only one grade of beef,
2. The practice of consulting a butcher concerning the quality of beef that is purchased,[4]
3. Health restrictions such as a no-fat diet.

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[3]Goeffrey S. Shepherd, "Marketing Farm Products - Economic Analysis", The Iowa State College Press, Ames Iowa, 1955, pp. 204-207.

[4]When consumers ask butchers for advice with regard to quality they indirectly use grading factors since recommendations will probably be based on grade factors.

This list is not exhaustive, but is sufficient to indicate that factors other than grade factors may condition consumers basic preferences. Even though these other variables do exist, this study assumes they play a minor role. Therefore hypotheses to be formulated will stress those factors that are used in grade determination.

A general model depicting the variables that condition consumers basic preference may be postulated as:

$$g = f(x_1, x_2, x_3, x_4, x_5, x_6, x_7, \ldots, x_n) \qquad \text{Model 3.1}$$

Where g = preferred grade[5]

x_1 = amount of marbling (flakes of fat intermingled with lean)

x_2 = amount of outside fat

x_3 = color of the lean

x_4 = color of the outside fat

x_5 = flavor

x_6 = juiciness

x_7 = tenderness

$x_8 \ldots x_n$ = other physical factors

Since Model 3.1 is for basic preferences, (price and income are not selection factors) it has economic meaning only when consumers are able and willing to attach monetary values to the characteristics they prefer.

A general model depicting preferences when price and income are the only factors may be given by the following relationship:

$$g = f(x_1, x_2, x_3, x_4, x_5) \qquad \text{Model 3.2}$$

Where g = preferred grade[6]

x_1 = price of Prime

---

[5] Prime, Choice, Good and Commercial are the only grades considered in this study.

[6] Ibid.

x_2 = price of Choice

x_3 = price of Good

x_4 = price of Commercial

x_5 = family income

Hypotheses formed solely from Model 3.2 would also fall short of describing the real world unless consumers only consider price and income when making decisions as to what grade to purchase.

In order to formulate a model that describes the actual relationship existing for consumers' purchases, it would be necessary to include variables from both models. The number of hypotheses that could be tested from such a relationship would necessitate more time and resources than were available in this study, therefore hypotheses presented for consideration will be limited to those the author deems the most relevant. These are enumerated as follows:

1. In general consumers prefer lean to fat. Since the fat to lean ratio is less in lower grades, consumers will purchase the lower grades when prices of lower and higher grades are equal.[7]

2. When the price ratio of a preferred grade to other grades increases, consumers will shift from preferred grades to others.

3. Consumers are not familiar with grade labeling.

4. Consumers do not have sufficient knowledge concerning grade factors to distinguish between grades.

Since the next step involves testing the validity of these hypotheses with empirical data, different methods of research will be examined with respect to their ability to generate the required data.

Available Methods

Certain hypotheses regarding consumer preferences for different grades

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[7] Higher and lower grades as used in this study are relative terms, grade Good is a higher grade when compared with grade Commercial, but is a lower grade when compared with Choice.

of beef were set forth in the preceeding section. Hence, the next step is to evaluate different research methods as to their ability to generate the kind of data specified by the hypotheses. The methods that will be considered are:

1. Consumer surveys
2. Market surveys (time-series data)
3. Controlled experiments
4. Combinations of the above methods

Before proceeding further it is advisable to discuss the more important elements of each method as they are defined in this study. Consumer surveys involve "interviewing"; whereas, market surveys and controlled experiments are based on actual purchases. Rhodes makes the following distinction:

> In general, this discussion will class as "sales research" all those methods which base a decision about the effect of a given variable upon the volume of actual sales of the product concerned. In contrast, "interviewing research" includes those methods of determining consumers attitudes and preferences by some sort of direct communication with consumers themselves, not necessarily involving their purchasing the product or products concerned.[8]

Consumer surveys as used in this study will be synonymous with Rhodes' "interviewing technique".

Since market surveys and controlled experiments both involve actual purchases of the product concerned, they will be distinguished on some other basis. Jessen makes a distinction which is appropriate for our purpose.

> The essential difference between the survey and experiment for determining "cause and effect" relationship is that in the experiment the investigator exercises "control" over when and which investigative units of a given factor (or treatment) whose effect

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[8] V. James Rhodes, "A Theoretical and Empirical Investigation of Consumer Preferences for Beef by Grades in Metropolitan St. Louis, 1954", Unpublished Thesis, Harvard University, 1955, pp. 122

> is under measurement will be put. It is the exercising of this "control" that we may call experimenting. When we don't exercise this control in our investigation (either because we can't or we don't choose to) we are surveying rather than experimenting.[9]

Both market surveys and controlled experiments as used in this study will refer to methods which involve actual purchases, but they will differ in that market surveys will refer to data which have been generated by the market under normal conditions, and controlled experiments will refer to data that have been generated under conditions controlled by the investigator.

With these distinctions in mind, the discussion will proceed to the advantages and disadvantages of each of the three methods. After weighing the advantages against the disadvantages an investigator should be able to formulate expectations regarding the accuracy of results he can obtain from each method. Hence, he can then make a decision as to the method or combination of methods that is best suited to his objective.

Consumer Surveys

The advantages of consumers surveys as given by Morse are:

> a. Merits of the Better Types of Consumer Survey. Since a consumer survey circumvents the market and goes directly to the consumer it permits a more complete picture of consumers preferences than is revealed by sales data alone. It is restricted, if well conducted, only to the extent of the consumer's ability or willingness to express her preferences.
>
> Insomuch as the survey is conducted among consuming units, certain basic facts with which the preferences may be associated can be secured. In this way individuals whose preferences are studied may be classified according to such factors as: income, race, age groups, family size, geographic region, and size of communities. Measures of covariability of factors and preferences may be received.
>
> It is by means of the consumer survey that one is able to go farthest in discovering the forces determining, affecting, and associated with consumer preferences.[10]

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[9] Raymond J. Jessen, (unpub. sampling class notes) Iowa State College, 1951.

[10] R. L. D. Morse, "Rationale for Studies of Consumer Food Preference" Advances in Food Research, III, p. 410.

The advantages that have been listed are dependent upon a satisfactory solution of many problems that are inherent in the survey method. Some of these problems are brought out by Brown.

> The survey method is used in the three following general forms: factual surveys, opinion surveys, and interpretive surveys. The distinction among these three types is important because there is a difference in the scientific accuracy of information obtained by these forms of the questionnaire method. - - -
>
> When the survey method is employed in this form, its results are subject to many errors. These include the errors of memory; the inability to generalize, the desire to make a good impression, and various human tendencies which bias the report. Since a human being is reporting an action of himself or his family, many errors are bound to be injected into the data obtained.[11]

This list is not exhaustive of the problems that are encountered with survey techniques, but enough are listed to give an indication of the many sources of errors that the investigator should take into account when he designs a questionnaire and conducts the interview. Another major problem which may be mentioned is that of sampling. The results of a survey, if they are to be useful, must be extrapolated to that population from which the sample was drawn. Therefore, care must be taken that the sample represents, as much as possible, the total population from which it is taken.

Assuming that sources of errors mentioned (and others not listed) have been minimized to a satisfactory level, an investigator can expect to obtain fairly accurate results in measuring consumer basic preferences for different grades of beef. He can also expect to obtain satisfactory measurements of those factors associated with basic preferences such as knowledge of grade characteristics, etc.

Basic preferences and associated factors are incorporated in the overall objective of this study, but since the major objective also pertains to measuring monetary values that consumers place on basic preferences, it is necessary

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[11] Lydon O. Brown, Marketing and Distribution Research, (New York, 1949 pp. 296-297.

to formulate some expectation of the accuracy of the data the investigator could expect to obtain if he injected hypothetical prices into the interview.

The manner in which the interviewer can present such a situation is by using photographs or actual cuts of the grades in which he is interested. Since it is assumed that he is interested in getting responses concerning grade it is necessary that factors such as kind of cut, amount of bone, size of cut, outside fat, etc. be at the same level for all grades. His original question could be "which of these cuts would you choose if all were priced at ___¢ per lb?" Since price is not a selection factor the respondent should be able to give his basic preference as based on physical characteristics. After the respondent selects a certain cut the interviewer can then raise the price of that cut to some desired level while holding the price of the other cuts at the original level. He then presents this new situation to the respondent, who may stay with the higher priced cut or switch to one of the other grades. If the consumer shifts to a lower priced grade it may be that he is not willing to pay any differential, or some smaller differential than that set by the interviewer. In order to determine if the respondent will pay a smaller differential than originally set, the interviewer would progressively lower the price spread. Similarly to get a maximum differential it may be necessary for the interviewer to continue raising the price of the original selection.

It is obvious that this scheme is versatile in the measuring of price differentials between first and second choices, second and third, first and third, and other combinations. This method would give an investigator unlimited power in getting at consumer monetary preferences, if it is assumed that consumers will give the same responses (or reasonably close) under

actual shopping conditions. The validity of such an assumption must be seriously questioned. Respondents are placed under a hypothetical shopping condition that is entirely foreign to that met in real life and it is very probable they cannot predict their future actions because many factors other than price change from one shopping period to another.

Based on the limitations which have been presented, it may be difficult for an investigator to measure monetary preferences by using data obtained from consumer surveys.

Market Surveys

Market surveys includes those methods of getting at consumer preferences by analyzing prices, quantities, and qualities of the product concerned. Morse lists the following limitations to measuring consumer preferences by using data obtained in market surveys.

> A major limitation of the market survey method lies in the over-simplified relationship which is commonly assumed between price and consumers' preference. Actually what is secured by the market data survey method is a picture of consumers' choices in terms of prices, and quantities and qualities taken. Such choices may reflect only roughly their preferences. The market may be so organized that is difficult, if not impossible, for the consumers to express adequately their likes and dislikes in their market selections. Several conditions may interfere: (1) The range of products offered consumers may limit the extent of their choices. (2) The products may be labeled inaccurately as to their quality. Hence, the consumers in part are unable to compare satisfactorily the qualities offered in the market and intelligently to express their preferences in their choices, and in part are actually misled in their market selections so that their market choices reflect only a limited and perhaps a false picture of consumers' preferences. (3) Consumers' market selections of particular items are not solely a function of the price and the quality of the particular product; the selection is confounded by such other considerations as: store personnel, types of display, proximity of the store, store services, volume of other goods purchased at the store etc.[12]

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[12] Ibid, pp. 93-95.

Even though market surveys yield data which is generated under actual marketing conditions, the limitations as given above would lead an investigator to expect such data to give inaccurate measurements of either basic or monetary preferences.

Controlled Experiments

A possible alternative to market and consumer surveys is controlled experimentation which is a basic method of research in the physical and biological sciences. Controlled experiments are those methods in which the investigator attempts to eliminate the effect of "non-test" variables in order to measure the response of experimental material to varying levels of a given "test" variable.

Perhaps one of the best methods of eliminating non-test factors is to hold them constant while subjecting the experimental material to different levels of the test variable. This procedure is relatively easy for physical scientists who work with such variables as temperatures, volume, pressure, chemical reaction etc., but it is much more difficult for social scientists who deal with subject matter that is affected by a multitude of variables, many of which are impractical, if not impossible, to physically control. Hence, if a social scientist employs a controlled experiment, he must use some alternative procedure to physical control for eliminating non-test variables.

An alternative to physical control is statistical control. Statistical control is used in both experiments and surveys, but a major difference of its use in these two methods of research is pointed out by Brunk.

> Using the experimental method the researcher must describe and control the conditions under which the effects are produced. Variables not kept constant must be measured and eliminated statistically. The

> data gathered with the survey method are the everyday experiences of the population under study. Elimination of the effect of non-test variables is attempted by stratification in sampling and by statistical analysis after the data are gathered. Assuming that this can be done the latter approach is restricted in that innovation cannot be tested. This is a serious restriction for market development per se implies innovation.[13]

A frequently used statistical tool in co-variance which allows an experimenter to adjust results for one source of uncontrolled variation. Other means of elimination is by designing the experiment so that variability of non-test factors can be eliminated in the analysis. There are several designs that are available and the design which a given researcher employs will depend upon the amount and kind of non-test variables, amount of co-operation he can obtain in acquiring experimental test units, available resources, etc.

An over-all appraisal of controlled experimentation in any study must be based on how much variation due to non-test factors can be eliminated by a combination of physical and statistical control. With reference to preference studies, what expectations can an investigator formulate as to the accuracy of the results obtained from a controlled experiment carried out under actual shopping conditions? Since sales or disappearance figures are the type of data to be analyzed to fulfill the major objective of preference studies, a general model that relates disappearance and a few of the many possible sources of variation is presented in Model 3.3.

$$y_{ijklm} = u + p_i + s_j + t_k + r_l + d_m + e_{ijklm} \qquad \text{Model 3.3}$$

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[13]Max E. Brunk and Walter T. Federer, "Experimental Designs and Probability Sampling in Marketing Research," American Statistical Association Journal, Vol. 48, September, 1953, pp. 440-441.

Where y_{ijklm} = quantity disappearance of T-Bone steak for i^{th} price, j^{th} store, k^{th} time period, l^{th} position, and m^{th} day.

u = over-all mean effect

p_i = price effect (for the i^{th} price)

s_j = store type effect (for the j^{th} store)

t_k = time period effect (for the k^{th} period)

r_l = location position (for the l^{th} location)

d_m = day effect (for the m^{th} day)

e = random error

Model 3.3 states that the disappearance of T-Bone steaks is associated with the over-all mean effect, price of T-Bone, store type, time period, position of T-Bone display within the store proper, day effect, and residual error. It is realized that these are only a few of many variables that can logically affect sales volumes of T-Bone steak. Other factors are bone content, size of cut, amount of outside fat, etc.

Different experimental designs can be employed to eliminate those factors that are not physically controlled. In Model 3.3 a randomized blocks design can be employed to eliminate the variation due to one non-test factor. If the investigator was limited in resources, etc. and randomized blocks was the most efficient design available under given restrictions, he would then block experimental treatments into that non-test factor that would decrease error sum of squares by the greatest amount. Glen L. Burrows in a paper given to the Southwestern Social Science Meeting, April 1955 states:

> And in retail store experimentation the greatest single source of variability has been demonstrated over and over again to be that among stores. Even among stores that have been purposively selected so as to agree in volume of sales, management practices, physical layout, geographical location and hours of operation, the between-

store component in an analysis of variation still dominates everything else.[14]

In those cases that present two sources of large amounts of variation, the investigator can eliminate both by the use of latin square. The latin square design, however, is restrictive in that the number of stores must equal the number of treatments. Other statistical tools are different treatment arrangements within a given experimental design, such as factorial arrangements of treatments, incomplete blocks, split plots, etc. Use of the more complex designs are, however, dependent upon the objectives, knowledge of sources of variations, etc. The use of an appropriate design is essential to a study of this type because of the many factors that are impossible to hold constant by physical means. However, in order to return to the basic problem involved, it will be assumed that an investigator can control non-test factors by combining statistical and physical controls.

If the investigator is concerned with over-all preference for different grades, he can employ different pricing schemes as treatments, and the disappearance of various grades will be measurements of the monetary value that consumers place on preferred grades. If the investigator is interested in determining consumers basic preferences for individual physical characteristics by employing Model 3.3 it is necessary to hold price equal for all grades while varying the physical characteristics being tested. For example if the experimenter is interested in testing preference for amount of outside fat, all other physical factors, as well as price, must be held constant while the amount of outside fat varies. Variation in disappearance figures would then be the result of the one factor, outside fat.

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[14]Glen L. Burrows, "The Adaptation and Use of Experimental Designs in Merchandising Research" (unpubl. paper presented at Southwestern Social Science Meeting, April 1955) p. 5.

Combinations of Different Methods

A major criticism of consumer surveys concerns the accuracy of data obtained from questions dealing with the price differentials respondents are willing to pay. Since a knowledge of price differentials is essential if the marketing system is to perform its pricing function efficiently, a study of this type would have little economic significance if based solely on this research method.

Controlled experiments, if well conducted, appears to be an accurate method of obtaining monetary preferences, but they are weak in that factors such as income, knowledge of grades, etc. can not be obtained from "sales data" alone. Therefore, in order to attain the major objective of this study, a combination of controlled experimentation and consumer surveys will be employed in the empirical investigation.

CHAPTER IV

MODELS AND EMPIRICAL RESULTS

General

The specific objectives of the empirical investigation have been stated as follows:

1. To determine consumer basic preferences for different physical characteristics of beef as they are related to the grades Prime, Choice, Good and Commercial,
2. To measure the monetary values that consumers place on their basic preferences (preferred grades),
3. To compare consumers responses to questions concerning price differentials they are willing to pay as obtained by surveying versus responses under actual shopping conditions.

It may be advisable at this time to point out that this investigation was restricted to visual preferences, which includes those preferences that are based on the consumer's own ability to judge quality from physical characteristics, grade labels, or butchers recommendations. No attempt was made to relate visual preferences to eating preferences.[1] Another point that should be clarified concerns objective (2). This

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[1]It is not too unrealistic to assume that consumers associate eating preferences with physical characteristics.

objective refers to measuring consumers monetary values placed on different grades rather than individual physical characteristics. Cases may arise in which a consumer prefers individual characteristics that are not incorporated within a single grade, for example he may prefer bright red lean and little if any marbling; in this case the chosen grade will not represent the sum total of individual preferences for physical characteristics, but will represent an over-all preference.

Selection of Cut. It would probably be desirable to study consumer preferences for all fresh cuts of beef. However, this would be a task of large proportions, and limited funds and personnel made this approach infeasible. Therefore, this study was limited to the center cut of the short loin (T-Bone steak). This cut was chosen for the following reasons:

1. T-Bone is a popular cut, therefore it enters into the purchases of many of those consumers purchasing meat,
2. Grade differences are more important in the loin section than any other section of the carcass, as determined by differences in wholesale prices,
3. T-Bones are amenable to controlled experiments; that is, non-test variables such as size of cut, amount of bone, outside trim, shape of cut, etc. can be held constant.

Selection of Stores. The retail outlets employed in this study were selected on the following criteria:

1. Self-service
2. Large volume
3. Clientele representative of different income levels.

Stillwater Store Experiment

The first phase of the study was carried out during the late winter of 1956 in Stillwater, Oklahoma. This phase was set up as a pilot study and included a controlled experiment in one large self-service store, a home survey of a sample of consumers who actually purchased T-Bone steak during the test period, and a store survey of a sample of all shoppers within the test store. Since the controlled experiment was the first to be performed, its administration and results will be discussed before taking up the survey phases.

Procedure. The controlled experiment was designed to give consumers an opportunity to select different grades of T-Bone steak at different prices. A necessary feature was to administer the experiment in such a manner that consumers would be unaware that an experiment was being performed, hence store personnel who took part in the study were cautioned as to this point.

The test store normally offers two grades of T-Bone, Choice and Good mature. It was desired to experiment with more than two grades, and management was questioned as to the possibility of adding both Prime and Commercial. Commercial was rejected on the basis of store policy. Therefore, the experiment included Prime, Choice and Good mature beef. Good and Choice grades were supplied by the store through its regular channel, but since its suppliers did not merchandize Prime, this grade had to be ordered from another source.

It was anticipated that loins would vary from the top to the bottom of grade classes, therefore that person who was responsible for cutting and displaying was requested to match top Good with top Choice and top Prime, low Good with low Choice and low Prime, etc.[2] The person responsible for cutting

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[2]Able assistance on matters concerning grade control was freely given by L. E. Walters of the Animal Husbandry Department of Oklahoma A. & M. College.

was also requested to match steaks of the same size and bone content. This was a fairly easy task since only the short loin was used for experimental purposes.

All steaks were trimmed to a uniform fat cover of 1/2 inch and cellophane wrapped in packages of 1, 2 and 3 steaks for each grade. Each package contained labeling as to type of cut, price per pound, weight in pounds and ounces, and total purchase price. Grade labeling was omitted on the first five treatments.

The steaks were displayed in three adjacent bins as illustrated in the following diagram.

Other Meats	Prime T-Bone Steak	Choice T-Bone Steak	Good T-Bone Steak	Other Meats

Figure 2. Position of Grades Within Display

A question arose as to position within the meat counter, and on the basis of traffic flow it was decided to use the center position. To eliminate position effects, the grades were rotated daily among the bins. Since a source of variation may stem from different levels within bins, the person in charge of keeping the bins stocked was cautioned to keep all three at approximately the same level. This request not only referred to the absolute level, but also to packages containing different number of steaks. In keeping with normal shopping conditions, the stockers were also advised to keep bins at normal levels. Frequent visits were made to the store to insure that an adequate supply and grade differences were being maintained.

Pricing Schemes. Several price structures were considered, but the one which appeared to offer the most information is presented in Table I. The time period that was proposed for each treatment in Table I was 7 days since it was felt that a majority of consumers shop at least once a week. Treatments 1 through 5 used packages unlabeled as to grade; whereas, treatments 6 and 7 used packages with grade labeling.

TABLE I

PRICE DIFFERENTIALS USED IN STILLWATER STORE EXPERIMENT

Treatment	Prime	Choice	Good
1	0	0	0
2	-14	0	0
3	+14	0	0
4	0	0	+14
5	0	0	-14
6	0	0	0
7	0	0	0

The absolute prices were set at a level that did not vary too greatly from the retail prices which prevailed at that time. A spread of 14 cents was considered great enough to obtain a shift in purchases among grades.[3] The price of Choice was set at 89 cents for all treatments and the price of Prime and Good varied as indicated in Table I.

The reader may question the advisability of keeping the price of Choice constant throughout the experiment. With the given number of treatments it was felt that the amount and kind of information obtained on grades

[3] It was also felt that when price is 14 cents below the normal price some shoppers would come into the T-Bone market, likewise 14 cents above the normal price would drive some shoppers away.

Prime and Choice would outweigh the information lost on Choice. By using this pricing scheme it is possible to derive price consumption (demand) curves for Prime and Good.[4]

Treatments 1, 2 and 3 were designed to generate a price consumption response relationship for Prime. In line with this objective it will be noticed that prices of Choice and Good were held constant during these treatments. Likewise, a price consumption response relationship for Good can be derived from Treatments 1, 4 and 5, in which the prices of Prime and Choice were held constant.

Treatments 1, 6 and 7 were designed to provide information on basic preferences, therefore prices of all grades were equal during these treatments. Treatments 1 through 5 differ from 6 and 7 in that no identification by means of labels or federal stamps were available to purchasers; whereas, in Treatments 6 and 7 packages were labeled as to grade, the objective being to attempt to estimate the impact of grade labeling on selection.

Model. A logical relationship between disappearance of Prime, Choice and Good T-Bone and associated variables for the Stillwater experiment may be represented by Model 4.1.

$$y_{ij} = u + p_i + c_j + e_{ij} \qquad \text{Model 4.1}$$

Where y_{ij} = disappearance of Prime, Choice and Good T-Bone steak for the i^{th} price and j^{th} customer count

u = over all mean effect

p_i = price effect (for the i^{th} price)

c_j = customer count (for the j^{th} count)

e = residual error

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[4]Consumption curves derived in this study do not meet all the requirements of a theoretical demand curve, but the time period for the entire experiment was short enough that incomes, tastes and preferences, range of available goods, prices of all other goods (excluding prices of T-Bone steaks), and the number of consumers probably did not undergo drastic change.

In this model store physical factors such as bone, shape, etc. are physically controlled, and grades are rotated among bins. The effect due to number of shoppers can be eliminated since the analysis is to be based on pounds per 1000 customers. Uncontrolled sources of variation entering into the error term are time effects, income effects, prices of substitute goods (especially other meats), and many others. However, it was felt that the time period of experimentation would be short enough that uncontrolled sources of variation would remain fairly stable.

Results. Before presenting the results it may be well to point out that difficulty was encountered in obtaining adequate supplies. Due to insufficient stock, one, two or all three grades were not available on certain days. Fortunately an adequate supply of all three grades was available on Thursday, Friday and Saturday of Treatments 1 through 5. Treatments 6 and 7 did not yield data that could be analyzed due to short supplies. Therefore, the following analysis will pertain to Thursday, Friday and Saturday of Treatments 1 through 5.

Results are presented in two types of tables, one type is based on percentage figures, while the other is based on pounds per 1000 customers.[5] Table II is presented for the purpose of placing pricing treatments close to the results.

TABLE II

PRICING TREATMENTS EMPLOYED IN STILLWATER STORE EXPERIMENT

Treatment	Prime	Choice	Good	Ave. Price
1	$ .89	$ .89	$.89	$ .8900
2	.75	.89	.89	.8433
3	1.03	.89	.89	.9366
4	.89	.89	1.03	.9366
5	.89	.89	.75	.8433

[5]Figures based on pounds per 1000 customers were obtainable from daily customer count, which is a normal practice of store management.

Tables III and IV give the same results, but Table IV presents the information in a form that is necessary in much of the following analysis.

TABLE III

PERCENTAGE DISTRIBUTION OF GRADES PURCHASED IN STILLWATER STORE EXPERIMENT

Treatment	Prime %	Choice %	Good %	Total %
1	20.1	42.7	37.2	100
2	29.9	39.3	30.8	100
3	21.8	35.6	42.6	100
4	12.9	45.5	41.6	100
5	19.1	25.8	55.1	100

TABLE IV

POUNDS PER 1000 CUSTOMERS PURCHASED IN STILLWATER STORE EXPERIMENT

Treatment	Prime lbs.	Choice lbs.	Good lbs.	Total lbs.
1	5.648	12.022	10.456	28.126
2	13.304	17.495	13.746	44.545
3	9.002	14.702	17.578	41.282
4	3.875	13.618	12.441	29.934
5	8.074	10.902	23.320	42.296

Test of Models and Hypotheses with Results from the Stillwater Store Experiment

Basic Preferences. In Treatment 1 price was not a selection factor since all grades were priced at 89 cents. Distinguishing physical characteristics among grades were amount of marbling and color of the lean. The lean to fat ratio was the highest in Good, followed by Choice, then Prime. During Treatment 1 Prime accounted for 20.1 percent of the total T-Bone sales;

whereas, Choice and Good accounted for 42.7 and 37.2 percent respectively. In testing the hypothesis that consumers prefer lean to fat it appears from this evidence that consumers are not adverse to a moderate amount of marbling but do not wish to purchase those steaks that are more heavily marbled.

Treatment 1 is the only treatment that gives information as to basic preferences since the other four involve price differentials. However, an analysis of variance was run on the data presented in Table IV. The design employed was that of randomized blocks in which the various grades were blocks and the five pricing schemes were treatments. A summary of the results is presented in Table V.

TABLE V

ANALYSIS OF VARIANCE SUMMARY FOR PURCHASES OF T-BONE STEAK IN STILLWATER STORE EXPERIMENT

Source	D.F.	S.S.	M.S.	Fobs.
Total	14	336.12	--	--
Treatments	4	77.24	19.31	1.49
Grades	2	155.04	77.52	5.97*
Error	8	103.84	12.98	--

*Significant at .05 level

Grade mean	Prime	Choice	Good
	7.980 lbs	13.747 lbs.	15.508 lbs.

Standard error of a grade mean = 1.611.

A multiple range test computed for grade means resulted in Prime being significantly different from Good and Choice at the .05 level of significance. Pricing treatments were not significantly different from each other at the .05 level of probability. These results lend credence to the evidence that consumers prefer lean to fat.

Demand for Prime. In order to obtain a point estimate of the price response for Prime in the Stillwater test store, the disappearance of Prime per 1000 customers (y) was fitted as a linear function of the price of Prime (x). This relationship is based upon Treatments 1, 2 and 3 and appears as Equation 4.1 in the text.

$$y = 22.992 - \underset{(.227)}{.154x} \qquad \text{Equation 4.1}$$

In Equation 4.1 the sign of the price coefficient is negative and therefore agrees with economic theory. The price elasticity of demand at the means is -1.468, and it is estimated that a 1 percent increase in the price of Prime would result in approximately a 1.5 decrease in its sales. Although this equation does appear logical, the fact that it is based on only three points and the standard error of the price coefficient is relatively large (.227), only limited statistical and economic inferences should be drawn.

Demand for Good. A point estimate of demand for Good can be approximated by Equation 4.2 in which y is the disappearance of Good per 1000 customers and x is the price of Good. This equation is based upon Treatments 1, 4 and 5 in which Prime and Choice were held constant at 89 cents, while Good varied from 75 cents to $1.03.

$$y = 49.985 - \underset{(.306)}{.389x} \qquad \text{Equation 4.2}$$

Equation 4.2 gives a negative sign for the price coefficient. Price elasticity at the means is -2.245. However, this equation is similar to that estimated for Prime in that it is based on only three points and gives a large standard error (.306) for the price coefficient. Hence, inference from Equation 4.2 is also limited to a point estimation.

Consumer Response to Price Change. One of the hypotheses which was desired to test was that consumers shift from their preferred grade into a second choice when the price of their preferred grade increases. The results presented in Table III can be employed to get at consumers response to price changes. By using the results from Treatment 1 as a measure of basic preference, shifts among grades are shown in Table VI.

TABLE VI

PERCENTAGE SHIFT AMONG GRADES DUE TO PRICE CHANGES IN STILLWATER STORE EXPERIMENT*

Treatment	Prime %	(% Change)	Choice %	(% Change)	Good %	(% Change)
1	20.1	0	42.7	0	37.2	0
2	29.9	+9.8	39.3	-3.4	30.8	-6.4
3	21.8	+1.7	35.6	-7.1	42.6	+5.4
4	12.9	-7.2	45.5	+2.8	41.6	+4.4
5	19.1	-1.0	25.8	-16.9	55.1	+17.9

*All percent changes computed from Treatment 1.

The (% change) columns in Table VI do not refer to absolute quantities. For example, the absolute amount of Prime sold in Treatment 2 may remain the same or decrease from the absolute amount sold in Treatment 1, even though the percentage change is + 9.8. The figure + 9.8 refers to percentage increase in Prime sales in Treatment 2 as compared to its percentage sales in Treatment 1, similarly all (% change) figures compare a given treatment to Treatment 1.

In Treatment 2 Prime decreased from 89 to 75 cents and Choice and Good were held constant at 89 cents. Even though the absolute prices of grades Choice and Good remained unchanged their prices increased relative to the

price of Prime. The net result was an increase of 9.8 percent for Prime and 3.4 and 6.4 percent decrease in Choice and Good respectively.[6]

In Treatment 3 Prime increased to $1.03 while Good and Choice remained at 89 cents. Hence, there was a relative decrease in the prices of Good and Choice. By comparing Treatment 3 with Treatment 1 it is found that Prime increased 1.7 percent even in face of the 14 cent price increase. Choice decreased 7.1 percent and Good increased by 5.4 percent.

In Treatment 4 Good was priced at $1.03 while Prime and Choice were priced at 89 cents. By comparing Treatment 4 with Treatment 1 the 14 cent increase in Good resulted in a 4.4 percent increase in Good while Prime decreased 7.2 percent and Choice increased by 2.8 percent.

In Treatment 5 Good decreased 14 cents as compared to Treatment 1. Prime and Choice were held constant at 89 cents. The decrease in the price of Good resulted in 17.9 percent increase in Good while Prime and Choice decreased by 1.0 and 16.9 percent respectively.

Treatments 2 and 5 yielded expected results in that a lowering of the price of Prime in Treatment 2 resulted in a percentage increase in Prime, and similarly for Good in Treatment 5. However, Treatments 3 and 4 also showed a small percentage increase in Prime and Good respectively, when the price of each was increased. Therefore, Treatments 2 and 5 tend to support the hypothesis that consumers will shift to lower priced grades when the price of their preferred grade increases, however, Treatments 3 and 4 give evidence contrary to the hypothesis.

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[6]It is impossible to measure the exact nature of grade shifts, but measurement of the net result and direction affords a good estimate of the general relationship of shifting due to price change.

Before leaving this particular analysis it may be well to point out Table V indicates that in Treatment 5 sales per 1000 customers was the largest of all treatments, therefore the 17.9 percent increase in Good may be due to consumers entering the market rather than shifting from Prime and Choice.

One of the disadvantages of controlled experiments is that an investigator cannot obtain measurements of income, consumer knowledge of grade factors, cooking methods, etc. Hence, in order to measure such variables, surveys were conducted after the store experiment was completed.

Home Survey

Procedure. The home surveys included a sample of consumers who actually purchased T-Bone steak during the experiment. Since the experiment was to simulate normal shopping conditions, it was necessary that the sample be drawn in a manner that would not permit shoppers to know that an experiment was being performed. Therefore, cashiers were instructed to keep a list of those T-Bone steak purchasers whom they knew by name and those who cashed checks.[7] Along with names they also listed addresses if they were known, date, grade, amount, and purchase price.[8] Sheets were made up that facilitated a quick listing of this information. Cashiers were cautioned to fill in sheets in such a manner that purchasers would not be suspicious. The consumers drawn in this manner were later interviewed at their homes.

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[7] A sample drawn in this manner is necessarily biased, however, it was the only sampling technique that met with management approval.

[8] It was later found that restricting the sample in this manner led to a smaller sample than was desired.

One of the major purposes of the home survey was to obtain consumer response to questions concerning monetary preferences. Since consumer response to given pricing treatments were already determined under actual shopping conditions, it was felt that if a purchaser was presented the same situation in a survey, sales and survey results could be compared. The schedule employed in the home survey is presented in Appendix A.

The results presented in this section will, to the large part, deal with questions pertaining to the question "Can consumer surveys be employed to measure the monetary values that consumers place on their basic preferences?"

Two interviewers were used in the home survey in which a display of actual cuts of Prime, Choice and Good T-Bone steaks was presented to each respondent. The display device consisted of a porcelain tray that was placed on the top side of a cardboard box that contained dry ice. Each steak was individually wrapped in cellophane. The same precautions were taken as in the store experiment in eliminating non-test factors such as size, shape, outside trim, thickness, etc. by selective matching. Official government stamps were removed in order to present the respondent the same situation as that encountered in the store experiment. Position of steaks were rotated frequently in order to eliminate that source of variation.

As the interviewer presented the display the respondent was requested to choose between the three cuts, assuming that all cuts were priced at 89 cents per pound. After the respondent selected a given cut, he was then asked his reasons for choosing that particular cut. Reasons such as marbling, color of lean, texture etc. were the type of answers that were expected. Many respondents however, based their choice on size, bone content and other non-test variables. An attempt was made to physically control

non-test factors but nevertheless it was difficult to match shape, bone content, etc., hence, some differences in non-test factors were probably real; but even so, one respondent would list one steak as the largest while another would list a different steak as the largest. Therefore, it was necessary to control non-test factors by making different assumptions to fit individual cases after a respondent gave non-grade factors as reasons for their selection. This was satisfactory in some cases, but in others the best answer that could be obtained was "This steak just looks better than the others."

Test of Models and Hypotheses with Results from Stillwater Home Survey

Response to Price Increase of Preferred Grade. When the respondent selected a cut and gave reasons for his selection, the price of the selected cut was increased from 89 cents to $1.03 while the price of the other two cuts remained at 89 cents. He was then asked which steak he would purchase. After the respondent made a selection under the new pricing scheme, the preferred cut was increased by 14 cents while the price of the other two cuts were held constant. In those cases in which respondents chose the same cut as before, the price of that cut was increased to $1.17 while the other two cuts remained at 89 cents. In those cases in which respondents selected one of the other two cuts the new pricing scheme presented would be two cuts at $1.03 and the remaining cut at 89 cents.

These steps were carried out until the respondent selected all three grades, or until it was evident that he would not purchase the third, and in some cases the second choice at a price of 89 cents. Results of this question are presented in Table VII.

TABLE VII

RESPONSE TO PRICE INCREASES IN PREFERRED GRADES IN STILLWATER HOME SURVEY

Grade	85¢/lb.	$1.03/lb.	$1.17/lb.	$1.31/lb.	$1.45/lb.
Prime*	11	3	1	1	0
Choice*	12	4	2	0	0
Good*	14	4	2	0	0

*The prices of the other two grades remained constant at 89 cents.

Of the eleven consumers who chose Prime when all three grades were priced at 89 cents only three said they would purchase it at $1.03 when the other grades remained at 89 cents. Of those three who stayed with Prime only one remained when it increased to $1.17; but this one stayed through $1.31. Responses of those preferring Choice and Good are very similar to those preferring Prime.

Table VII indicates very little difference between monetary preferences of those preferring different grades, that is, respondents preferring one grade placed approximately the same monetary value on their preference as those respondents preferring other grades.

Relationship Between Preferred Grade and Second Choice. An important aspect of respondent shift in grades concerns the grade that is chosen when the price of the preferred grade is increased. Table VIII presents this information for the home survey.

TABLE VIII

RELATIONSHIP BETWEEN FIRST AND SECOND PREFERENCE IN STILLWATER HOME SURVEY

First Preference	Number of Respondents	Second Preference			
		Prime	Choice	Good	Wouldn't buy*
Prime	11	--	7	4	0
Choice	12	4	--	6	2
Good	14	3	8	--	3

*Consumers who stated they would only purchase first choice.

The second preference of the eleven listing Prime as their first preference was divided into 7 for Choice and 4 for Good. The second preference of the 12 who listed Choice as their first preference was divided into 4 for Prime, 6 for Good and 2 who would not consider purchasing neither Good nor Prime. The second preference of the 14 who listed Good as their first preference was divided into 3 for Prime, 8 for Choice and 3 who would not consider purchasing neither Prime nor Choice.

It appears from Table VIII that consumers preferring Prime have a tendency to switch to Choice, which is reasonable since Choice has physical characteristics more closely associated to those inherent in Prime than does grade Good. Similarly, consumers preferring Good have a tendency to choose Choice rather than Prime. Since Choice is the grade between Prime and Good, the consumers in this group are expected to be split fairly even between those preferring characteristics tending toward Prime and those who prefer characteristics tending toward Good, hence, the 4 and 6 split between Prime and Good respectively is consistent with the other results.

Accuracy of Survey Results in Measuring Monetary Preferences. A specific objective of this study is to compare consumer surveys and controlled experiments in obtaining measurements of the true monetary values that consumers place on their preferences for different grades of T-Bone steak. In order to get at this question, persons actually purchasing T-Bone steak under experimental prices were to be presented the same situation in an interview after the controlled experiment was completed.

It was desired to conduct the controlled experiment under conditions that simulated actual shopping conditions. Therefore, the survey sample was restricted to those purchasers whom cashiers knew by name and those who cashed checks. Such a scheme worked satisfactorily for the first two treatments, but only a few names were obtained during the remainder of the experiment. Since the majority of consumers surveyed purchased T-Bone steak during Treatment 1, in which a price differential was not a factor, this study fails to generate sufficient data upon which to evaluate the survey method for measuring consumer monetary preferences. However, in a future study that employs a greater number of outlets, the method attempted here should yield data that can be used to measure the accuracy of monetary preferences as obtained from consumer surveys. Since the home survey was based on such a small sample, it was decided to employ the same type of interview within the store proper.

Stillwater Store Survey

Procedure. The store survey was conducted similar to the home survey in most respects but differed in the following ways:

1. Four grades were used in the store survey, whereas only three were

employed in the home survey. As was pointed out earlier, it was desired to experiment with Commercial grade, but store policy would not permit its sale. However, since surveying did not involve actual sales, it was possible to include commercial in the store survey.

2. A larger sample was drawn in the store survey than was possible in the home survey. The sample used in store interviews was not restricted to purchasers of T-Bone steak as was the sample used in the home survey, but rather included shoppers drawn at random from the entire store population.

The display was similar to that which was taken to consumers homes. Consumers were selected at random as they passed by the display stand. Two interviewers alternated with each other so as to have an interviewer present from opening to closing time. The same precautions concerning control of non-test physical characteristics that were taken in the controlled experiment and home survey were also taken here. The position of grades within the display were rotated as frequently as steaks were replaced with fresher cuts, which was approximately every two hours.

The store survey was conducted on Thursday, Friday and Saturday, March 29, through March 31, 1956. 140 usable schedules were obtained.

Test of Models and Hypotheses with Results from Stillwater Store Survey

Response to Price Increase. Consumer response to questions concerning monetary values are given in Table IX.

TABLE IX

RESPONSE TO PRICE INCREASE IN PREFERRED GRADES IN STILLWATER STORE SURVEY

Grade Selected	89¢/lb.	1.03/lb - %		1.17/lb. - %		1.31/lb - %		1.45/lb.
Prime*	28	6	21.43%	2	7.1%	1	3.6%	0
Choice*	30	7	23.3 %	2	6.7%	0	0	0
Good*	38	2	5.3 %	0	0	0	0	0
Commercial*	44	11	25.0 %	3	6.8%	1	2.3%	0

*The price of the other three grades remained constant at 89¢.

In Table IX, 6 of the 28 consumers preferring Prime indicated they would pay 1.03 per pound for their preferred grade rather than select one of the other three grades at 89 cents per pound. Percentage wise this is 21.43 percent. When the price of Prime was increased to $1.17, other grades remaining at 89 cents, only 2 of the 6 who stayed with Prime the first increase were willing to pay this second price increase. These two consumers made up 7.1% of the original 28. The other grades are interpreted in the same manner.

Table IX indicates that consumer response to price increase is approximately the same for those who selected Prime, Choice, or Commercial as their first preference. Those preferring Good appear to react differently as indicated by a smaller percentage staying with their preference on the first price increase.

Relationship Between First and Second Preferences. As in the home survey, relevant information can be obtained by relating first and second preferences. Table X presents this information for the store survey.

TABLE X

RELATIONSHIP BETWEEN FIRST AND SECOND PREFERENCES IN STILLWATER STORE SURVEY

First Pref.	Resps.	Second Preference					Second Preference (in percent)				
		Prime	Choice	Good	Comm.	None	Prime	Choice	Good	Comm.	None*
Prime	28	-	14	3	5	6	-	50.0%	10.7%	17.9%	21.4%
Choice	30	8	-	16	3	3	26.7%	-	53.3%	10.0%	10.0%
Good	38	7	12	-	18	1	18.4%	31.6%	-	47.4%	2.6%
Comm.	44	13	16	9	-	6	29.6%	36.4%	20.5%	-	13.5%

*Number of consumers who refused to indicate a second preference.

Fifty percent of those consumers listing Prime as their first preference selected Choice as their second. This is expected since Choice is more nearly like Prime than the other two grades. Of those consumers listing Choice as their first preference 26.7 percent selected Prime and 53.3% selected Good. This result is logical since Choice is the intermediate grade between Prime and Good. The percentage split for those preferring Good was 18.4 percent for Prime, 31.6% for Choice and 47.4 percent for Commercial. This is also a logical division since the larger percentages went to the two grades that Good comes between. Those consumers who selected Commercial as their first preference chose second preferences that are inconsistent with their first choice. Good, the grade that would be expected to receive the highest percentage actually received 20.5 percent which is lower than the 29.6 percent and 36.4 percent received by Prime and Choice respectively.

Consumer Knowledge of Grade Standards. It will be recalled that respondents were dependent upon their own ability to judge quality by physical

characteristics when selecting preferences. The relationship between ability to name grades in order from Prime to Commercial is presented in Table XI.

TABLE XI

RELATIONSHIP BETWEEN FIRST SELECTION AND ABILITY TO NAME GRADES IN ORDER IN STILLWATER STORE SURVEY*

Ability to Name:	First Selection			
	Prime %	Choice %	Good %	Commercial %
4 or more grades correctly	42.9	16.7	5.3	22.7
3 grades correctly	17.9	6.7	5.3	9.2
2 grades correctly	10.6	13.3	7.9	15.9
1 grade correctly	3.6	0	7.9	4.5
No grades correctly	25.0	63 3	73.6	47.7

*This is not necessarily a test of judging ability. Consumers were just asked to name the grades, not to identify the grades on display.

The purpose of Table XI is to test the hypothesis that consumers who are familiar with the grading system tend to select the higher grades when prices of all grades are equal. Of those selecting Prime 42.9 percent could name four or more grades in order, whereas, of those selecting grade Good only 5.3 percent could name 4 or more grades in order. Twenty-five percent of those choosing Prime could not name any grades in order, whereas, the percentage of grade Good was 73.6.

It appears from Table XI that respondents selecting Prime were more familiar with grades than any other group, however, those respondents selecting commercial were more familiar with grades than either the Choice or Good groups. Hence, there is evidence both for and against the hypothesis.

Preferences for Individual Physical Characteristics. Respondents' preferences for individual physical characteristics, both grading and non-grading factors, are presented in Table XII.

Table XII indicates little difference between respondents in different grade classes as to their preference for outside fat. The largest percentage of all grade classes preferred one-quarter inch or less; and the next smallest amount, one-half inch, accounted for almost all other respondents.

The Prime group indicated a stronger preference for moderate amount of marbling than did the other groups. Choice ranked second with 50 percent preferring a moderate amount, 36.7 percent preferring a little and 13.3 percent desiring none. The Good and Commercial groups were similar in that respondents in both groups were divided about equally among the three amounts of marbling. The relationship between grade selected and amount of marbling as shown by Table XII is logical since degree of marbling is one of the more important grade factors.

Responses given on preferred color of lean are not as grouped as those concerning amount of marbling. Medium color was preferred by the largest percentage in all grade groups, whereas dark was the least preferred except in the Good class where dark was preferred over light.

White fat was preferred over yellow fat by the largest percentage in all grade classes; however, approximately one-third of the respondents in all grade classes indicated no preference.

The largest percentage of respondents in all grade classes selected three-quarter inch as the most desired thickness. The second most preferred thickness of those selecting Prime was one inch or over, whereas the second preferred thickness for other grades was one-half inch.

TABLE XII

PERCENTAGE DISTRIBUTION OF PREFERRED PHYSICAL CHARACTERISTICS BY GRADE IN STILLWATER STORE SURVEY

Physical Characteristics:	Grade selected			
	Prime %	Choice %	Good %	Commercial %
Outside Fat Cover				
1/4" (or less)	53.6	60.0	57.9	65.9
1/2"	39.2	36.7	39.5	29.6
3/4"	3.6	-	2.6	-
1" (or more)	-	-	-	-
No Preference	3.6	3.3	-	4.5
Total	100.0	100.0	100.0	100.0
Marbling				
Moderate	82.1	50.0	31.6	31.8
Little	10.7	36.7	34.2	38.7
None	3.6	13.3	28.9	25.0
No Preference	3.6	-	5.3	4.5
Total	100.0	100.0	100.0	100.0
Color of Lean				
Light	32.1	30.0	13.2	34.1
Medium	60.8	43.3	60.5	43.2
Dark	7.1	16.7	21.0	18.2
No Preference	-	10.0	5.3	4.5
Total	100.0	100.0	100.0	100.0
Color of Fat				
White	64.3	46.7	47.4	45.4
Yellow	3.6	10.0	15.8	11.4
No Preference	32.1	43.3	36.8	43.2
Total	100.0	100.0	100.0	100.0
Thickness				
1/4" (or less)	-	3.3	-	2.3
1/2"	25.0	30.0	28.9	34.1
3/4"	42.9	46.7	57.9	43.2
1" (or more)	32.1	16.7	10.6	18.1
No Preference	-	3.3	2.6	2.3
Total	100.0	100.0	100.0	100.0

The over-all indication of Table XII is that amount of marbling is the only physical characteristic of those tested that differed to any degree between grade classes.

Relationship Between Income Level and Preferred Grade. Before leaving the store survey it may be appropriate to obtain the relationships between grade selection and income level; and income level versus price increases of selected grade. Table XIII presents the results of income level versus grade selection.

TABLE XIII

PERCENTAGE DISTRIBUTION OF ANNUAL INCOME LEVEL BY GRADE SELECTIONS IN STILLWATER STORE SURVEY

Income Level	No. of Resps.	Prime %	Choice %	Good %	Comm. %	Total %
Below 2,000	19	10.5	21.1	26.3	42.1	100.0
2,000- 4,000	49	18.4	20.4	20.4	40.8	100.0
4,000- 6,000	42	19.0	26.3	35.7	19.0	100.0
6,000- 8,000	17	23.5	23.5	29.5	23.5	100.0
8,000-10,000	10	50.0	-	30.0	20.0	100.0
Over 10,000	2	-	50.0	-	50.0	100.0

Of those respondents reporting annual income of two thousand dollars or below, 10.5 percent selected Prime, 21.1 percent selected Choice, 26.3 percent chose Good and 42.1 percent selected Commercial. Percentages were similar in the two to four thousand dollar income bracket. Grade selections in the four to six and six to eight thousand dollar income brackets were split fairly equal among all the grades.

It is very difficult to detect a possible relationship between income and grade selection because of the small number of respondents in each income bracket, especially the last two.

Relationships Between Income Level and Price Increases. Another relationship that is meaningful is that of income level and willingness to stay with a selection through price increases. Table XIV is presented for this purpose.

TABLE XIV

PERCENTAGE DISTRIBUTION OF RESPONDENTS BY INCOME LEVELS STAYING WITH SELECTED GRADES THROUGH SUCCESSIVE PRICE INCREASES IN STILLWATER STORE SURVEY

Income	No. of Respondents	+14¢ %	+28¢ %	+42¢ %
Below 2,000	19	42.1	15.8	5.3
2,000- 4,000	49	16.3	2.0	-
4,000- 6,000	42	11.9	2.4	-
6,000- 8,000	10	17.6	5.9	5.9
8,000-10,000	2	50.0	50.0	-

Of those respondents reporting annual income of two thousand dollars or less 42.1 percent stayed with their selected grades as the price of their preferred grade increased 14 cents (prices of other grades remained constant). Similarly, only 16.3 percent of those in the income bracket of two to four thousand stayed with the 14 cent increase.

Table IV indicates a reverse relationship to what would be expected. An explanation may be that respondents were not making actual purchases and such human characteristics as pride could very easily enter into this type of question.

Oklahoma City Experiment

Procedure. Experience gained in the Stillwater study provided the basis for controlled experiments conducted in five large super-markets of

another chain. Four were located at Oklahoma City and the other at Shawnee. These experiments were similar in many respects to that conducted in Stillwater, but were quite different in others. Since the procedure for the Stillwater experiment has been presented in some detail, perhaps these latter experiments can be best presented by pointing out major differences.

Consumer surveys were taken in conjunction with the Stillwater experiment, whereas these experiments were restricted to sales data. The Stillwater experiment was conducted with mature beef only. These experiments were conducted with both mature and calf beef, the specific grades being Choice mature, and Good and Commercial calf. It will be recalled that packages were not labeled as to grade at Stillwater, whereas in the Oklahoma City stores, packages of T-Bone steak were clearly labeled as to grade. However, the Shawnee experiment differed from the Oklahoma City study in that packages were not labeled as to grade.

Pricing schemes used in the Oklahoma City and the Shawnee studies not only differed from that employed at Stillwater, but also differed between each other. Management had been stressing grade labels and felt that pricing Choice mature below calf grades or Good calf below Commercial calf would be harmful to customer-store relationship. Therefore, the pricing scheme used in the Oklahoma City stores was placed under this restriction. However, since the Shawnee experiment was to be conducted without grade labels, management agreed to a more flexible pricing scheme in that one store.[9]

Another important difference is that of the treatment period. Due to short supplies that were encountered in the Stillwater experiment it was decided to run each pricing treatment one day only. Fridays and Saturdays were selected because of their being large volume days; and it was also felt that week-end shoppers constitute a fairly homogeneous population.

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[9] Pricing schemes that were used will be presented later.

Ten treatments were involved in these latter studies and it was hoped that the experiment could be concluded after five consecutive week-ends. However, during some week-ends, test stores advertised T-bone steak in order to meet competition and it was not possible to conduct the experiments on those week-ends. Hence, the study ran from August 17 through October 13, 1956.

Store management was concerned about the possibility of slow sales during those days in which higher prices were to be in effect and in order to minimize this possibility high and low pricing treatments were paired together in each week-end. Management also included a safety factor by requesting meat market managers to return to normal pricing when they could not move large supplies under experimental prices. This restriction was most undesirable from the investigator's point of view, however in order to retain observations, meat market managers were requested to take a reading of the day's customer count and gross sales at the time of return to normal pricing. Since sales were to be analyzed as pounds per 1000 customers, such an arrangement appeared to be the best available alternative.[10] There was also a possibility that supplies would be exhausted before the end of the day's operations, therefore, meat market managers were requested to take readings at the time of sell out of any grade.

All steaks used in these studies were supplied by test stores, who obtained them through regular channels. Just as in the Stillwater study, those responsible were cautioned to maintain physical controls such as grade differences, bone content, etc. Other administrative procedures were similar to those taken at Stillwater and will not be re-discussed here.

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[10]This arrangement was made with realization that evening shoppers may constitute a different population than morning and mid-day shoppers, but this risk had to be taken if observations were to be usable.

Since the Oklahoma City study involved labeling, and a different pricing scheme than that used in Shawnee, results will be analyzed separately. The remainder of this section will be devoted to the Oklahoma City phase, and the Shawnee phase will be presented in the next section.

Pricing Scheme. The pricing scheme employed in the Oklahoma City stores is presented in Table XV.

TABLE XV

PRICING TREATMENTS EMPLOYED IN OKLAHOMA CITY STUDY

Treatment	Price per pound			Average Price
	Choice mature	Good calf	Commercial calf	
1	$ .99	$ .99	$ .99	$ .990
2	1.05	.89	.75	.897
3	1.19	1.05	.89	1.043
4	.89	.75	.59	.743
5	1.05	.89	.89	.943
6	1.05	.89	.59	.843
7	1.05	1.05	.75	.950
8	1.05	.75	.75	.850
9	1.05	.59	.59	.743
10	.99	.99	.99	.990

This pricing scheme is similar to that used at Stillwater in that information on one grade was sacrificed in order to gain information on the other two. In this case it was desired to gain information on the calf grades, therefore, Choice mature was held at $1.05 per pound in all Treatments except 1, 3, 4 and 5.

Models. There are many different models that could be postulated for the relationship existing between T-Bone sales and associated variables. Possible models differ not only to the kind and number of independent variables, but also to type of mathematical form. In choosing models to be tested by

empirical data generated in the Oklahoma City stores, it would have been desirable to include many independent variables. However, since this study was limited in personnel and resources, only those variables that were considered to be the most important were measured.

One of the simplest models that could be postulated utilizes the linear form with a single variable. Such a model is Model 4.2 which depicts the disappearance of a given grade of T-Bone as a function of its own price.

$$y = bx + e \qquad \text{Model 4.2}$$

Where y = disappearance of a given grade in pounds per 1000 customers

x = price of the given grade

e = random error

This model can be used to obtain an approximation of demand for a chosen grade if the prices of the other two grades are held constant as the grade under consideration is varied in price.[11] The results obtained from Treatments 2, 5 and 6 can be used to approximate demand for Commercial calf, since during these treatments Choice mature was held constant at $1.05 and Good calf was held constant at 89 cents while the price of Commercial calf was varied from 59 to 89 cents. Similarly, data generated by Treatments 2, 7 and 8 can be used to estimate the demand for Good calf since Choice mature was held at $1.05 and Commercial calf held at 75 cents while the price of Good calf was varied from 75 to 89 cents.

The demand for Choice mature cannot be estimated from Model 4.2 since its price changes are not associated with constant prices for Good and Commercial calf grades.

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[11] Tastes and preferences, prices of other goods (other than competing grades of T-Bone) incomes, etc. are assumed to remain fairly stable during the short time period of experimentation.

Model 4.2 can also be employed to obtain an approximation of demand for any two or all three grades as a single product rather than individual grades. y would represent disappearance of two or all three grades and x would represent different levels of prices; that is, the prices of the grades under consideration would be increased or decreased by the same amount.

Treatments 2, 3 and 4 can be used to measure the demand of T-Bone steak as a single product rather than for individual grades. In Treatment 2 all grades were 14 cents higher than in Treatment 4, similarly all grades were 14 cents higher in Treatment 3 than in Treatment 2.[12]

Model 4.2 can also be used to estimate the demand for calf grades as one product. In Treatment 5, 8 and 9, Good and Commercial calf were both priced the same, Choice mature was held constant at $1.05 and the price of calf grades varied from 59 cents to 89 cents. Hence, the demand for calf grades can be approximated from the results of these treatments.

The disappearance of a given grade may be associated with prices of other grades as well as its own price. Model 4.3 postulates such a relationship.

$$y_{ij} = b_1 x_i + b_2 x_j + e_{ij} \qquad \text{Model 4.3}$$

Where y_{ij} = disappearance of a given grade in pounds per 1000 customers

x_i = price of the given grade in cents per pound

x_j = price of a competing grade in cents per pound

e = random error

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[12] It will be noticed that Choice mature and Commercial calf were actually 16 cents rather than 14 cents higher in Treatment 2 than in Treatment 4, which is 2 cents over what was planned, but this 2 cents difference does not invalidate the principle of Model (4.2).

In Treatments 2, 5, 6, 7, 8, and 9 the price of Choice mature is held constant, therefore these treatments can be employed in Model 4.3 when obtaining disappearance figures for Good and Commercial calf grades. If y_{ij} represents disappearance of Good calf then x_i is the price of Good calf and x_j is the price of Commercial calf. Likewise, when y_{ij} represents the disappearance of Commercial calf then x_i is the price of Commercial calf and x_j is the price of Good calf.

Results of Oklahoma City Experiment. The results of the Oklahoma City experiment are first presented on a percentage basis in Table XVI and then as pounds per 1000 customers in Table XVII.

In Table XVI sales of T-Bone of the three grades are listed as percentages of total sales for individual stores and also for all stores combined. For example, during Treatment 1 Choice mature accounted for 46.50 percent of T-Bone sales in Store 1; whereas, it accounted for 43.67 percent of the all stores total.

The same information that is presented in Table XVI is listed as pounds per 1000 customers in Table XVII.

In Table XVII, Store 1 sold 14.664 pounds per 1000 customers of Choice mature during Treatment 1; whereas, 9.778 pounds per 1000 customers were sold when all stores were aggregated. All store totals were computed by summing original pounds and customer count across all stores and then dividing total pounds by total customer count. In this manner all four stores are treated as one.

It is not to be implied that all stores form a homogenous group, which in fact they do not, but since most chain organizations follow the practice of maintaining identical prices in all their stores in a given city or vicinity, it is felt that "all stores" analysis has more meaning than individual store analysis. Therefore, the following analysis is restricted to "all stores" data.

TABLE XVI

PERCENTAGE DISTRIBUTION OF T-BONE SALES BY GRADES AND TREATMENTS IN OKLAHOMA CITY STUDY

		Choice Mature %	Good Calf %	Comm. Calf %	Total %
Treatment No. 1					
	Store No. 1	46.50	42.13	11.37	100
C.M.-$ .99	Store No. 2	43.69	17.93	38.38	100
G.C.-$ .99	Store No. 3	55.75	15.47	28.78	100
C.C.-$ .99	Store No. 4	27.44	59.37	13.19	100
	All Stores	43.67	37.00	19.33	100
Treatment No. 2					
	Store No. 1	14.20	28.91	56.89	100
C.M.-$1.05	Store No. 2	11.10	54.19	34.71	100
G.C.-$ .89	Store No. 3	21.05	30.38	48.57	100
C.C.-$ .75	Store No. 4	5.84	22.73	71.43	100
	All Stores	13.93	36.40	49.67	100
Treatment No. 3					
	Store No. 1	18.60	44.31	37.09	100
C.M.-$1.19	Store No. 2	11.66	47.08	41.26	100
G.C.-$1.05	Store No. 3	27.00	37.53	35.47	100
C.C.-$ .89	Store No. 4	7.08	21.23	71.69	100
	All Stores	15.46	39.58	44.96	100
Treatment No. 4					
	Store No. 1	13.30	32.99	53.71	100
C.M.-$ .89	Store No. 2	12.79	64.10	23.11	100
G.C.-$ .75	Store No. 3	10.25	10.25	79.50	100
C.C.-$ .59	Store No. 4	2.86	36.43	60.71	100
	All Stores	11.25	40.28	48.47	100
Treatment No. 5					
	Store No. 1	27.27	37.49	35.24	100
C.M.-$1.05	Store No. 2	18.99	50.25	30.76	100
G.C.-$ .89	Store No. 3	9.04	38.28	52.68	100
C.C.-$ .89	Store No. 4	21.31	35.36	43.33	100
	All Stores	20.21	39.87	39.92	100
Treatment No. 6					
	Store No. 1	11.36	41.55	47.09	100
C.M.-$1.05	Store No. 2	11.32	31.05	57.63	100
G.C.-$ .89	Store No. 3	0.82	25.00	74.18	100
C.C.-$ .59	Store No. 4	9.18	17.97	72.85	100
	All Stores	8.56	33.86	57.58	100

TABLE XVI (Continued)

		Choice Mature %	Good Calf %	Comm. Calf %	Total %
Treatment No. 7					
	Store No. 1	19.42	31.58	49.00	100
C.M.-$1.05	Store No. 2	30.78	39.32	29.90	100
G.C.-$1.05	Store No. 3	8.13	32.82	59.05	100
C.C.-$ .75	Store No. 4	15.83	30.96	53.21	100
	All Stores	18.50	33.45	48.05	100
Treatment No. 8					
	Store No. 1	12.33	53.98	33.69	100
C.M.-$1.05	Store No. 2	11.08	66.69	22.23	100
G.C.-$ .75	Store No. 3	12.36	39.95	47.69	100
C.C.-$ .75	Store No. 4	14.63	45.45	39.92	100
	All Stores	12.09	54.95	32.96	100
Treatment No. 9					
	Store No. 1	11.75	50.37	37.88	100
C.M.-$1.05	Store No. 2	10.66	59.78	29.56	100
G.C.-$ .59	Store No. 3	10.50	44.03	45.47	100
C.C.-$ .59	Store No. 4	11.78	41.32	46.90	100
	All Stores	11.31	50.42	38.27	100
Treatment No. 10					
	Store No. 1	24.42	43.48	32.10	100
C.M.-$ .99	Store No. 2	27.77	58.89	13.34	100
G.C.-$ .99	Store No. 3	13.53	31.58	54.89	100
C.C.-$ .99	Store No. 4	35.88	53.82	10.30	100
	All Stores	24.92	47.23	27.85	100

TABLE XVII

POUNDS PER 1000 CUSTOMERS BY TREATMENTS AND GRADES
IN OKLAHOMA CITY STUDY

		Choice Mature	Good Calf	Comm. Calf	Total
Treatment No. 1					
	Store No. 1	14.664	13.288	3.586	
C.M.-$ .99	Store No. 2	7.416	3.044	6.516	
G.C.-$ .99	Store No. 3	18.141	5.033	9.363	
C.C.-$ .99	Store No. 4	3.725	8.059	1.791	
	All Stores*	9.778	8.284	4.329	22.391
Treatment No. 2					
	Store No. 1	9.937	20.237	39.825	
C.M.-$1.05	Store No. 2	5.607	27.386	17.540	
G.C.-$ .89	Store No. 3	13.389	20.040	32.044	
C.C.-$ .75	Store No. 4**	1.132	4.401	13.833	
	All Stores	8.110	21.183	28.908	58.201
Treatment No. 3					
	Store No. 1	5.732	13.653	11.430	
C.M.-$1.19	Store No. 2	3.925	15.856	13.893	
G.C.-$1.05	Store No. 3**	13.811	19.195	18.141	
C.C.-$ .89	Store No. 4	1.377	4.131	13.949	
	All Stores	4.653	11.913	13.530	30.096
Treatment No. 4					
	Store No. 1	7.035	17.445	28.404	
C.M.-$ .89	Store No. 2	5.721	28.674	10.339	
G.C.-$ .75	Store No. 3**	2.266	2.266	17.582	
C.C.-$ .59	Store No. 4**	1.050	13.393	22.321	
	All Stores	4.928	17.634	21.223	43.785
Treatment No. 5					
	Store No. 1	16.254	22.342	21.003	
C.M.-$1.05	Store No. 2	6.813	18.032	11.037	
G.C.-$ .89	Store No. 3	4.877	20.644	28.409	
C.C.-$ .89	Store No. 4	3.597	5.969	7.313	
	All Stores	8.556	16.882	16.902	42.340
Treatment No. 6					
	Store No. 1	7.822	28.613	32.435	
C.M.-$1.05	Store No. 2	3.263	8.950	16.614	
G.C.-$ .89	Store No. 3	0.286	8.745	25.949	
C.C.-$ .59	Store No. 4	3.501	6.855	27.786	
	All Stores	3.984	15.752	26.790	46.526

TABLE XVII (Continued)

		Choice Mature	Good Calf	Comm. Calf	Total
Treatment No. 7					
	Store No. 1	9.731	15.821	24.548	
C.M.-$1.05	Store No. 2	9.186	11.735	8.923	
G.C.-$1.05	Store No. 3	3.863	15.601	28.071	
C.C.-$ .75	Store No. 4	2.669	5.221	8.973	
	All Stores	6.706	12.124	17.418	36.248
Treatment No. 8					
	Store No. 1	7.841	34.323	21.424	
C.M.-$1.05	Store No. 2	5.065	30.485	10.162	
G.C.-$ .75	Store No. 3	3.929	12.698	15.159	
C.C.-$ .75	Store No. 4	2.756	8.567	7.524	
	All Stores	5.522	25.093	15.052	45.667
Treatment No. 9					
	Store No. 1	10.278	44.057	33.139	
C.M.-$1.05	Store No. 2	6.611	37.070	18.332	
G.C.-$ .59	Store No. 3	4.379	18.362	18.959	
C.C.-$ .59	Store No. 4	4.363	15.309	17.376	
	All Stores	6.718	29.957	22.740	59.415
Treatment No. 10					
	Store No. 1	8.718	15.522	11.460	
C.M.-$ .99	Store No. 2	13.556	28.756	6.514	
G.C.-$ .99	Store No. 3	2.091	4.879	3.480	
C.C.-$ .99	Store No. 4	4.024	6.036	1.156	
	All Stores	6.827	12.939	7.628	27.394

*All store totals were computed by summing original pounds across all stores and dividing by all stores customer count.

**Customer count was not available, hence figures are based on customer count estimated from regression analysis.

Test of Models and Hypotheses with Results from Oklahoma City Experiment

The empirical data used in testing postulated models consists of the "all stores" figures as they are given in Table XVII, and exception being those data obtained from Treatment 2. In reference to Table XVII, the reader will notice that disappearance figures for Treatment 2 appear to be extremely high in relation to all other treatments, other than Treatment 9. The large disappearance figures in Treatment 9 can logically be accounted for by the fact that both calf grades were at their lowest experimental price, 59 cents, but the same logic cannot be applied to Treatment 2 where Good calf was priced at 89 cents and Commercial calf at 75 cents. Explanations such as pay periods, gross sales per customer, etc. were examined, but the only one that appeared to be of value was the possibility of advertising effects.

As has been previously pointed out, interruptions were made in the experimental period due to test stores advertising T-Bone steaks on given week-ends. T-Bones were advertised on the week-end falling between Treatments 2 and 3, and two week-ends between Treatments 8 and 9. Treatments 3 through 8 were conducted without advertising breaks.

An examination of Treatment results on the basis of prices and advertising periods indicates that advertising tends to deflate the following week-end disappearance figures. However, results obtained in Treatment 2 appears to be the only data that is completely inconsistent with all other results. Not all equations that are to be tested require Treatment 2, hence, Treatment 2 will be omitted from those equations in which its results are not essential, but in those equations in which it is necessary to use Treatment 2, its results will enter the analysis as estimated values rather than

those given in Table XVII. The adjustment in each case will be based on regression analysis that contains observations from Treatments 3 through 8 since these treatments were not interupted by advertising breaks.[13]

Demand for T-Bone Steaks (all grades combined). The demand for all grades as a single product can be approximated by either Equation 4.3 or 4.4. Both equations involve Model 4.2 in which y is the disappearance of all grades per 1000 customers and x is the average price of all grades; but these equations differ in that Equation 4.3 includes data obtained in Treatments 3 through 9; whereas, Equation 4.4 includes only the three level Treatments 2, 3 and 4. As a matter of arbitrary selection Equation 4.3 is presented first.

$$y = 111.022 - .783x^{**} \qquad \text{Equation 4.3}$$

$$(.193)$$

$$(4.059)$$

$$R^2 = .733$$

In this equation and others that follow, the standard error of a coefficient appears directly below in the first set of parenthesis, and the t-value appears in the lower set. The symbol (*) will appear with each coefficient that is statistically different from zero at the 5 percent level. Similarly, the symbol (**) will appear when the coefficient is significantly different from zero at the 1 percent level. Correlation coefficients are represented by the symbol R^2.

The results of Equation 4.3 are in agreement with existing theory in that the price coefficient is negative. The size of the price coefficient

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[13] It is realized that adjustments for advertising effects can only be rough approximations, but nevertheless it appeared to be a better alternative than no adjustment.

is relatively large when compared with its standard error and is statistically different from zero at the 1 percent level.

Price elasticity of demand, a very important concept to both firms and policy makers, will be computed for all equations. Elasticities will be computed at the means in each instance. The price elasticity of demand for all grades as estimated by Equation 4.3 is -1.679. At the mean price (88.9 cents), Equation 4.3 predicts that a 1.7 percent increase in sales in T-Bones (all grades) will be associated with a 1 percent decrease in price.

Equation 4.4 can also be used in approximating the demand for all grades. This equation is based on data obtained in Treatments 2, 3 and 4.[14] In these three level treatments all grades changed by the same absolute amount, that is, each grade was 14 cents higher in Treatment 2 than in Treatment 4, likewise, each grade was 28 cents higher in Treatment 3 than in Treatment 4.[15]

$$y = 78.834 - .454x \qquad \text{Equation 4.4}$$

$$(.151)$$

$$(3.003)$$

$$R^2 = .900$$

The negative sign of the price coefficient in Equation 4.4 is expected; also the standard error is small in relation to the magnitude of the coefficient connecting consumption and price.

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[14] An estimated figure of 40.720 pounds per 1000 customers was used in treatment 2, the actual figure being 58.201. Estimation was made from the equation $y = a + bx$ where y is the disappearance of all grades per 1000 customers and x is the average price of all grades. This equation is based on results of those treatments that were not interrupted by advertising, the Treatments being 4, 5, 6, 7 and 8.

[15] As has been mentioned earlier, store management changed prices by 16 cents rather than 14 cents for given grades in all level treatments, but 14 cents is the average change and is more uniform than any other figure.

The t-value is not large enough to meet the 5 percent level of probability, but this statistical test may not be too meaningful in this instant since it is based on only one degree of freedom. The large value of R^2 lends support to the use of Equation 4.4 as a basis for predicting the sales of T-Bone from average price of all grades. The price elasticity of demand as given by Equation 4.4 is -1.064, whereas, equation 4.3 gave price elasticity as -1.679.

The three level treatments used in Equation 4.4 may also be employed in testing the hypothesis that consumers will shift to higher grades as the price level increases. Table XVIII presents the percentage shift between grades in the three level treatments.

TABLE XVIII

PERCENTAGE SHIFTS BETWEEN GRADES AS THE PRICES OF ALL GRADES CHANGED BY THE SAME ABSOLUTE AMOUNT IN OKLAHOMA CITY STUDY

		Choice Mature %	Good Calf %	Commercial Calf %	Total %
Treatment No. 4					
C.M.-$ .89 G.C.-$ .75 C.C.-$ .59	All Stores	11.25	40.28	48.47	100
Treatment No. 2					
C.M.-$1.05 G.C.-$ .89 C.C.-$ .75	All Stores	13.93	36.40	49.67	100
Treatment No. 3					
C.M.-$1.19 G.C.-$1.05 C.C.-$ .89	All Stores	15.46	39.58	44.96	100

The results of table XVIII indicate very little shifting between grades during level treatments and thus a stability of choices on a relative basis.

Comparison of Equations 4.3 and 4.4. Equations 4.3 and 4.4 are both approximations of demand for all grades and as such should be compared. The price coefficients of both equations are negative, but the magnitude of the price coefficient in 4.3 is approximately twice as large as that in 4.4. The coefficient in 4.4 is not statistically significant from zero at the 5 percent level, which may not be meaningful since 4.4 is based on only three points; whereas, 4.3 is significant at the 1 percent level. The R^2 value of 4.3 is .733; whereas, R^2 of 4.4 is .900. In view of these criteria it would be difficult to choose one over the other, but 4.3 may receive additional support in that it is based on more observations than in 4.4.

Perhaps the demand of all grades as one product is not very meaningful when based on results of this study since the disappearance of Choice mature is relatively less than either of the calf grades in all Treatments except 1 and 10. Hence, it may be well to estimate demand for calf grades as individual products.

Demand for Good Calf. The estimation of the parameters of Model 4.2 where y is the disappearance of Good calf in pounds per 1000 customers and x the price of Good calf is presented in Equation 4.5. Data used in this equation were generated by Treatments 2, 7 and 8.[16] In these treatments Choice mature was held at $1.05 per pound and Commercial calf was held constant at 75 cents per pound.

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[16] Data in treatment 2 is estimated from the equation $y = a + bx$ where y is disappearance of Good calf and x is the price of Good calf. This equation is based on those treatments that were not interrupted by advertising breaks.

$$y = 56.560 - .429x \qquad \text{Equation 4.5}$$
$$(.079)$$
$$(5.446)$$
$$R^2 = .967$$

The results of Equation 4.5 gives the price coefficient a negative sign. The standard error of the regression coefficient is relatively small when compared to its magnitude. The t-value is not significant at the .05 level, but again this test was based on only one degree of freedom. In view of the large value of R^2, and small standard error associated with the estimated price coefficient, Equation 4.5 appears to be a fairly accurate method for predicting the sales of Good calf from its own price. The estimated price elasticity of demand at the mean was -2.130.

Disappearance of Good Calf as Associated with the Price of Good Calf and the Price of Commercial Calf. The disappearance of Good calf is probably associated with the price of Commercial calf, a logical substitute, as well as its own price. An estimation of the parameters of Model 4.3 where y_{ij} is the disappearance of Good calf in pounds per 1000 customers, x_1 is the price of Good calf, and x_j is the price of Commercial calf is given in Equation 4.6. Data used in this equation were generated by Treatments 5, 6, 7, 8 and 9, in which Choice mature was held constant at $1.05 per pound.

$$y_{ij} = 52.756 - .429x_1** + .042x_j \qquad \text{Equation 4.6}$$
$$(.061) \quad (.083)$$
$$(7.057) \quad (.508)$$
$$R^2 = .967$$
$$F = 28.88*$$

The signs of price coefficients of both Good and Commercial calf grades are what may be expected; however, the magnitude of the coefficient associated

with Commercial calf is only .042; whereas, that associated with Good calf is .429.

Since five observations were used in estimating Equation 4.6 the t-value probably has more meaning than in those equations based on three observations. If this is true then the price coefficient of Commercial calf is not significantly different from zero. Hence, it appears that within the price range tested, the price of Commercial calf has little effect on the sales of Good calf. The cross elasticity of demand at the mean quantity of Good calf disappearance and the mean price of Commercial calf was computed as .151.

Demand for Commercial Calf. The demand for Commercial calf can be approximated from results obtained in Treatments 2, 5 and 6.[17] In these treatments Choice mature was held constant at $1.05 per pound and Good calf was held constant at 89 cents.

The estimation of Model 4.2 where y is the disappearance of Commercial calf per 1000 pounds and x is the price of Commercial calf is given in Equation 4.7.

$$y = 45.636 - .334x \qquad \text{Equation 4.7}$$

$$(.103)$$

$$(3.231)$$

$$R^2 = .913$$

Equation 4.7 is consistent with theory in that the price coefficient is negative; however the standard error the coefficient is fairly large relative to the magnitude of the coefficient and the t-value is not

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[17] Data in Treatment 2 is estimated from the equation $y = a + b_x$ where y is the disappearance of Commercial calf in pounds per 1000 customers and x is the price of Commercial calf. This equation is based on those treatments that were not interrupted by advertising breaks.

statistically significant at as much as the .05 level. Elasticity of price demand was computed as -1.190. In view of this evidence, estimation of the disappearance of Commercial calf from its own price would probably involve a sizable amount of error.

Since Good calf is a logical substitute for Commercial calf it may be well to associate the sales of Commercial calf with the prices of both calf grades.

Disappearance of Commercial Calf as Associated with the Price of Commercial Calf and Price of Good Calf. The estimation of Model 4.3 in which y_{ij} is the disappearance of Commercial calf in pounds per 1000 customers, x_i is the price of Commercial calf, and x_j is the price of Good calf, is given in Equation 4.8. The data used in this equation were generated by Treatments 5, 6, 7, 8 and 9; in which Choice mature was held constant at $1.05 per pound.

$$y_{ij} = 39.520 - .346x_i + .059x_j \qquad \text{Equation 4.8}$$

$$(.166) \quad (.121)$$

$$(2.088) \quad (.487)$$

$$R^2 = .696$$

$$F = 2.306$$

The signs of price coefficients of both Good and Commercial calf grades agree with theory in that a decrease in sales of Commercial calf is associated with an increase in the price of Commercial calf; whereas, an increase in sales of Commercial calf is associated with a price increase of Good calf. However, even though the signs of both price coefficients agree with expectations, the magnitude of the coefficient of either grade is not statistically different from zero. Cross elasticity of demand from Equation 4.8 was computed as .249.

Demand for Calf Grades. The demand for calf grades as a single product can be approximated in the same manner as was the demand for individual calf grades. The data that are used in this instance were obtained from Treatments 5, 8 and 9. In these treatments Choice mature was held constant at $1.05 per pound and the price of calf grades (price of Good calf = price of Commercial calf) was varied from 59 through 89 cents.

The estimation of the parameters of Model 4.2 where y is the disappearance of calf grades in pounds per 1000 customers and x is the price of calf grades is given in Equation 4.9.

$$y = 89.339 - .634x \qquad \text{Equation 4.9}$$
$$(.095)$$
$$(6.682)$$
$$R^2 = .978$$

The results of Equation 4.9 gives a negative price coefficient which is large in comparison with its standard error. The price coefficient is not statistically different from zero at as much as the 5 percent level, but in view of the one degree of freedom that the t-value is based on, this statistical test may not have much meaning in this instance. The large R^2 value lends support to equation 4.9 as a means of predicting the disappearance of calf grades from its price. The price elasticity of demand using the means of each variable is estimated to be -0.634.

Treatments 5, 8 and 9 can also be used to measure basic preferences for Good and Commercial calf grades since price was not a factor (price of Good calf = price of Commercial calf) in these treatments.

Table XIX indicates that purchases of calf grades were split approximately even in Treatments 5 and 9, whereas, in Treatment 8 sales of Good calf was almost twice as great as sales of Commercial calf.

TABLE XIX

PERCENTAGE SHIFTS BETWEEN GOOD AND COMMERCIAL CALF GRADES WHEN GOOD AND COMMERCIAL CALF WERE PRICED THE SAME IN OKLAHOMA CITY STUDY

		Good Calf %	Commercial Calf %	Total %
Treatment No. 9				
G.C.-$ .59	All Stores	56.85	43.15	100
C.C.-$ .59				
Treatment No. 8				
G.C.-$ .75	All Stores	62.51	37.49	100
C.C.-$ .75				
Treatment No. 5				
G.C.-$ .89	All Stores	49.97	50.03	100
C.C.-$ .89				

Another method of estimating demand for calf grades as a single product is to determine the association existing between the disappearance of calf grades and the average price of Good and Commercial calf grades. The estimation of Model 4.2 where y is the sales of calf grades per 1000 customers and x is the average price of Good and Commercial calf grades is given in Equation 4.10. Data used in this equation were obtained from Treatments 3 through 10.

$$y = 86.224 - .640x^{**} \qquad \text{Equation 4.10}$$

$$(.136)$$

$$(4.703)$$

$$R^2 = .787$$

Equation 4.10 is graphed in Figure 3.

The results of Equation 4.10 is consistent with economic theory in that the price coefficient has a negative sign. The price coefficient is

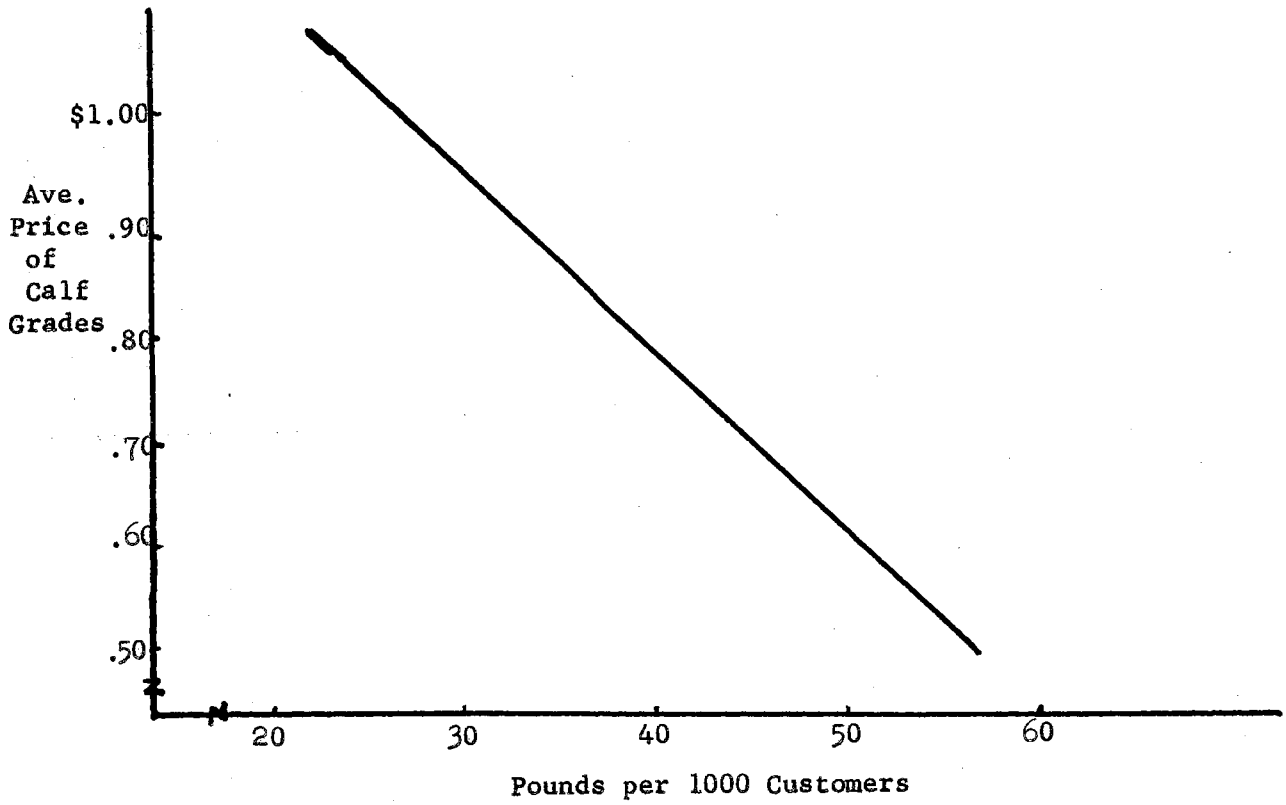

Figure 3. Demand for Calf Grades in Oklahoma City

also significant at the one percent level of probability. In view of these criteria and the fairly large R^2 value, average calf price appears to be a fairly accurate basis upon which to predict calf grade sales. Price elasticity of demand was computed as -1.432.

An analysis of variance was run on the data presented in Table XVII. The design employed was that of randomized blocks in which the grades were blocks and the pricing schemes were treatments. A summary of the results is presented in Table XX.

TABLE XX

ANALYSIS OF VARIANCE SUMMARY OF PURCHASES OF T-BONE STEAK IN OKLAHOMA CITY STUDY

Source	D. F.	S.S.	M.S.	Fobs.
Total	107	10,940.97	--	--
Treatments	9	1,198.10	133.12	2.01*
Grades	2	2,613.40	1,306.70	19.71**
Grades and Treatm.	18	1,957.78	108.77	1.64
Error	71	5,171.69	66.30	--

Grade means	Choice Mature	Good Calf	Commercial Calf
	6.52	16.02	16.78

Standard error of a grade mean = 1.288

Treatment means	T_1	T_{10}	T_3	T_7	T_4	T_8	T_5	T_6	T_2	T_9
	7.89	9.27	11.26	12.03	13.04	13.33	13.86	14.24	17.16	19.02

Standard error of a treatment mean = 2.3505

*Significant at .05 level.
**Significant at .01 level.

A multiple range test computed for grade means resulted in Choice mature being significantly different from Good and Commercial calf grades at the .05

level of probability. A similar test was run for pricing treatments and Treatments 7, 4, 8, 5, 6, 2, and 9 were different from Treatments 1 and 10 at the .01 level.

Shawnee Study

Pricing Scheme. The Shawnee phase was conducted in one store only. This experiment also differed from that ran in Oklahoma City in that packages were not labeled as to grade and a different pricing scheme was employed. The pricing scheme is presented in Table XXI.

TABLE XXI

PRICING SCHEME EMPLOYED IN THE SHAWNEE STUDY

Treatment	Choice Mature	Good Calf	Commercial Calf	Average Price
1	$ .99	$ .99	$ .99	$ .990
2	1.09	.59	.59	.757
3	1.09	.89	.89	.957
4	1.09	.75	.75	.863
5	1.09	.89	.75	.910
6	1.09	.75	.89	.910
7	1.09	.59	.89	.857
8	1.09	.89	.59	.857
9	1.09	.99	.99	1.023
10	.85	.99	.99	.943

This pricing scheme is similar to that used in Oklahoma City in that information on Choice mature was sacrificed in order to increase information on the calf grades. It will be noticed that Good calf is priced below Commercial calf in Treatments 6 and 7, and Choice mature is priced below both calf grades in Treatment 10. Hence, this pricing scheme is more flexible than that used in Oklahoma City.

Models to be tested with data generated in the Shawnee study are identical to those tested in the Oklahoma City section. Hence, Model 4.2 will be employed when using one independent variable and Model 4.3 will be used with two independent variables.

Results. The results of the Shawnee experiment are first presented on a percentage basis in Table XXII and then as pounds per 1000 customers in Table XXIII.

Test of Models and Hypotheses with Results from Shawnee Experiment

Demand for T-Bone Steaks as a Single Product. The estimation of the parameters of Model 4.2 where y is the disappearance of all grades per 1000 customers and x is the average price per pound of all grades is given in Equation 4.11. Equation 4.11 is based upon all Treatments except 6 and 10.[18]

$$y = 58.625 - .374x^{*} \qquad \text{Equation 4.11}$$

$$(.144)$$

$$(2.597)$$

$$R^2 = .529$$

The relationship between the sales in pounds per 1000 customers of all grades and average price of all grades is consistent with economic theory in that the price coefficient is negative. The standard error of the price coefficient does not include positive signs and the t-value is statistically different from zero at the .05 level of probability. Price elasticity of demand at the mean price was computed as -1.352.

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[18] Treatment 6 and 10 were not used since customer counts were not available for those days.

TABLE XXII

SALES STATED AS PERCENTAGES IN SHANNEE STUDY

	Choice Mature %	Good Calf %	Commercial Calf %	Total %
Treatment No. 1 C.M.-$ .99 G.C.-$ .99 C.C.-$ .99	23.91	37.03	39.06	100
Treatment No. 2 C.M.-$1.09 G.C.-$ .59 C.C.-$ .59	14.78	34.06	51.16	100
Treatment No. 3 C.M.$1.09 G.C.-$ .89 C.C.-$ .89	11.64	35.32	53.04	100
Treatment No. 4 C.M.-$1.09 G.C.-$ .75 C.C.-$ .75	27.11	41.82	31.07	100
Treatment No. 5 C.M.-$1.09 G.C.-$ .89 C.C.-$ .75	14.58	29.82	55.60	100
Treatment No. 6 C.M.-$1.09 G.C.-$ .75 C.C.-$ .89	20.03	35.53	44.44	100
Treatment No. 7 C.M.-$1.09 G.C.-$ .59 C.C.-$ .89	18.70	56.45	24.85	100
Treatment No. 8 C.M.-$1.09 G.C.-$ .89 C.C.-$ .59	29.73	23.52	46.75	100

TABLE XXII (Continued)

	Choice Mature %	Good Calf %	Commercial Calf %	Total %
Treatment No. 9 C.M.-$1.09 G.C.-$ .99 C.C.-$ .99	9.32	36.02	54.66	100
Treatment No. 10 C.M.-$ .85 G.C.-$ .99 C.C.-$ .99	14.19	35.90	49.91	100

TABLE XXIII

POUNDS PER 1000 CUSTOMERS PURCHASED IN SHAWNEE STUDY

	Choice Mature lbs.	Good Calf lbs.	Commercial Calf lbs.	Total lbs.
Treatment No. 1 C.M.-$ .99 G.C.-$ .99 C.C.-$ .99	4.480	6.938	7.321	18.739
Treatment No. 2 C.M.-$1.09 G.C.-$ .59 C.C.-$ .59	4.441	10.238	15.378	30.057
Treatment No. 3 C.M.-$1.09 G.C.-$ .89 C.C.-$ .89	2.802	8.505	12.773	24.080
Treatment No. 4 C.M.-$1.09 G.C.-$ .75 C.C.-$ .75	5.806	8.956	6.655	21.417
Treatment No. 5 C.M.-$1.09 G.C.-$ .89 C.C.-$ .75	4.346	8.887	16.574	29.807
Treatment No. 6* C.M.-$1.09 G.C.-$ .75 C.C.-$ .89	4.174	7.405	9.263	20.842
Treatment No. 7 C.M.-$1.09 G.C.-$ .59 C.C.-$ .89	5.333	16.097	7.088	28.518
Treatment No. 8 C.M.-$1.09 G.C.-$ .89 C.C.-$ .59	7.865	6.224	12.368	26.457

TABLE XXIII (Continued)

	Choice Mature lbs.	Good Calf lbs.	Commercial Calf lbs.	Total lbs.
Treatment No. 9	1.895	7.318	11.108	20.321
C.M.-$1.09				
G.C.-$ .99				
C.C.-$ .99				
Treatment No. 10*	2.235	5.655	7.863	15.753
C.M.-$ .85				
G.C.-$ .99				
C.C.-$ .99				

*Customer counts were not available for Treatments 6 and 10. Customer counts for these two treatments were estimated as the average customer count for the other Saturdays.

The R^2 indicates that 53 percent of the variation in T-Bone sales was accounted for by average price of all grades, therefore, in view of this available criterion, average price of all grades appears to be a fairly good indicator of total T-Bone steak sales in this one test store.[19]

Demand for Good Calf. The demand for Good calf can be approximated from the results obtained in Treatments 3, 6, and 7.[20] In these three treatments Choice mature was held constant at $1.09, Commercial calf was held constant at 89 cents and the price of Good calf was varied from 59 to 89 cents. Model 4.2 was employed where y represents the disappearance of Good calf in pounds per 1000 customers and x is the price of Good calf. The estimation of the parameters is given in Equation 4.12.

$$y = 29.990 - .260x \qquad \text{Equation 4.12}$$

$$(.178)$$

$$(1.457)$$

$$R^2 = .680$$

Equation 4.12 is consistent with theory in that the price coefficient is negative; however, the standard error of the coefficient is fairly large relative to the magnitude of the coefficient and the t-value is statistically significant at only the 40 percent level. Elasticity of demand was computed as -1.811. In view of this evidence, estimation of sales of Good calf from its own price would probably involve a sizable amount of error.

Demand for Commercial Calf. Demand for Commercial calf can be approximated from Treatments 3, 5 and 8. In these treatments Choice mature was

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[19] All implications made in this section will necessarily apply only to the one test store employed in the experiment.

[20] Customer count was not available for Treatment 6, therefore, it was estimated as the average of other Saturdays' customer counts.

held constant at $1.09 and Good calf was held constant at 89 cents while the price of Commercial calf was varied from 59 to 89 cents. Model 4.2 was employed where y is the sales of Commercial calf in pounds per 1000 customers and x is the price of Commercial calf. The parameters are estimated in Equation 4.13.

$$y = 13.761 + .002x \qquad \text{Equation 4.13}$$
$$(.154)$$
$$(.013)$$
$$R^2 = .002$$

Equation 4.13 gives the price coefficient a positive sign, but the magnitude of the coefficient is very small. The standard error is approximately 7.5 times as large as the coefficient, and R^2 indicates very little relationship exists between the price of Commercial calf and its volume of sales. Elasticity as given by Equation 4.13 is + .003.

These results are inconsistent with theory and perhaps one explanation rests upon the small number of observations taken, three in this case. A sizable amount of error in any one of the three observations could very easily yield results that do not depict the true character of the relationship that actually exists between the price of Commercial calf and its disappearance.

Demand for Calf Grades as One Product. Demand for Good and Commercial calf grades as one product can be approximated from Treatments 2, 3, 4 and 7. In these treatments Choice mature was held constant at $1.09 while calf price (price of Good calf = price of Commercial calf), was varied from 59 to 89 cents.

The estimation of the parameters of Model 4.2 where y is the disappearance of calf grades in pounds per 1000 customers, and x is the price of

calf grades (price of Good calf = price of Commercial calf) is given by Equation 4.14.

$$y = 30.427 - .127x \qquad \text{Equation 4.14}$$
$$(.149)$$
$$(.852)$$
$$R^2 = .266$$

Equation 4.14 gives a price coefficient that is in accord with economic theory, but its standard error is large enough to permit a positive sign. The t-value is statistically significant at only the 50 percent level and the R^2 value indicates that only 26.6 percent of the variation of sales of calf grades (when they are priced the same) is explained by calf prices. Price elasticity was computed as -.504.

Disappearance of Calf grades as a Function of Average Calf Price. In order to examine the possibility of predicting the volume of sales of calf grades by a single independent variable, Model 4.2 was once again employed where y represents the disappearance of calf grades in pounds per 1000 customers and x is the average price of calf grades. The parameters in this instance are given by Equation 4.15. The treatments used to generate the empirical data were Treatments 2 through 9.[21] The price of Choice mature was held constant at $1.09 during these treatments.

$$y = 29.644 - .108x \qquad \text{Equation 4.15}$$
$$(.125)$$
$$(.861)$$
$$R^2 = .129$$

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[21]Treatment 6 was omitted since customer count was not available on that day.

Equation 4.15 gives practically the same results as did Equation 4.14, therefore the same economic and statistical inference applies. The relationship existing between individual calf grades and two independent variables can be estimated from Model 4.3.

Disappearance of Commercial Calf as Associated with the Variables, Price of Good Calf and Price of Commercial Calf. The estimation of the parameters of Model 4.3 where y_{ij} is the disappearance of Commercial calf in pounds per 1000 customers, x_i is the price of Commercial calf, and x_j is the price of Good calf is given in Equation 4.16. The data for this equation were generated by Treatments 2 through 9.[22] The price of Choice mature was held constant at 89 cents during these treatments.

$$y_{ij} = 1.797 - .055x_i + .174x_j \qquad \text{Equation 4.16}$$

$$(.097) \quad (.094)$$

$$(.563) \quad (1.844)$$

$$R^2 = .594$$

$$F = 3.66$$

The signs of the x_i and x_j coefficients both agree with economic theory. Equation 4.16 states that an increase in sales of Commercial calf grade is associated with a decrease in the price of Commercial calf. Likewise, an increase in the volume of sales of Commercial grade is associated with an increase in the price of Good grade. The magnitude of the Good calf price coefficient is larger than the price coefficient of Commercial calf. This indicates that a substitution of Commercial calf for Good calf, when the price of Good increases, has a stronger effect on the volume of Commercial sales than the price of Commercial.

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[22]Treatment 6 was omitted.

The standard error of the x_i coefficient is large enough to allow a positive sign, but the standard error of the x_j coefficient does not include negative signs. Neither coefficient is statistically different from zero at the .05 level of probability. Cross elasticity of demand was computed as 1.157.

Disappearance of Good Calf as Associated with the Variables, Price of Good Calf and Price of Commercial Calf. The estimation of the parameters of Model 4.3 where y_{ij} represents the disappearance of Good calf in pounds per 1000 customers, x_i is the price of Good calf and x_j is the price of Commercial calf is given in Equation 4.17. The treatments used were the same as those used in Equation 4.16.

$$y_{ij} = 16.338 - .194x_i ** + .111x_j \qquad \text{Equation 4.17}$$

$$(.039) \qquad (.040)$$

$$(4.960) \qquad (2.741)$$

$R^2 = .867$

$F = 12.99*$

Equation 4.17 is similar to Equation 4.16 in that the signs of both price coefficients agree with economic theory. Both standard errors are small and the t-value of x_i is significant at the .01 probability level and x_j is significant at the .05 level. From the magnitude of the signs the price of Good calf has more effect on the sales of Good calf than the substitution effect due to price changes in Commercial calf. Cross elasticity was computed as .913.

CHAPTER V

SUMMARY AND RECOMMENDATIONS FOR FUTURE WORK

Summary

A major responsibility of the marketing system in a capitalistic society is to measure the strength of consumers' desires for different kinds and amounts of products, and then accurately reflect these desires back to producers in the form of price differentials. In order to gauge the efficiency with which the marketing system is performing its pricing function, consumer preferences studies can be conducted in which consumer monetary preferences are measured at their source.

This type of research is still in the exploratory stage, hence, there are many problems concerning applicable theory, research methodology, and administration or procedure. This study is an attempt toward setting up operational methods for measuring the various aspects of consumers' basic preferences and the monetary values they place upon their desires.

The commodity beef was the desired vehicle, but due to limited personnel and funds only the T-Bone cut was utilized. The major objectives may be listed thus:

1. To determine consumers' basic preferences for different grades of T-Bone Steak,
2. To ascertain monetary values consumers place on their preferences.

In obtaining measurements, several methods of research were evaluated as to their ability to generate the required data. From this evaluation it was decided that the consumer survey method can be employed in getting at basic preferences, but offers little value as a means of ascertaining monetary values placed on those preferences. Therefore, in order to measure monetary preferences it was decided to employ a controlled experiment in which measurements could be obtained as price responses.

The first phase of the over-all study was conducted in Stillwater and consisted of a controlled experiment in one large self-service store, home surveys, and consumer surveys within the store proper. The primary purpose of the controlled experiment was to test administrative procedure.

The home survey was to get at basic preferences and also to obtain information regarding the question "Can consumer surveys be employed in obtaining price differentials that respondents are willing to pay under actual shopping conditions?" Since each individual in the home survey had actually purchased T-Bone steak during the store experiment, it was possible to present the same situation. However, there was limited name listing after the first two treatments; and since in the first treatment all grades were priced equally, it was not feasible to attempt to answer this question with the very small sample obtained in Treatment 2.

In order to work with a larger sample, it was necessary to conduct a survey within the store proper. The questions asked respondents were very similar to those asked in the home survey, the major differences being that all shoppers had an equal chance of being chosen and Commercial grade was edded.

The more important results obtained from the initial phase (Stillwater Study) are as follows:

Stillwater Controlled Experiment

1. In the same price range, the estimated demand for grade Good was greater than the estimated demand for grade Prime. Consumption of both grades was inversely related to its price,

2. Lends credence to the feasibility of using controlled experiments for estimating price-consumption response relationships,

Stillwater Home Survey

1. Results gave evidence that consumers will shift to lower priced grades when the price of their preferred grade increases,

2. As respondents shifted from their preferred grade when the price of that grade was increased, there was a tendency for the second choice to be that grade most closely associated to the first selection,

Stillwater Store Survey

1. On the average, 75 percent of the respondents shifted to a lower priced grade when the price of their selected grade increased 14 cents,

2. When asked to name Federal grades, a larger percentage of those preferring Prime were able to respond than those preferring other grades. However, those selecting Commercial (the lowest grade) ranked second,

3. Marbling was the only individual physical characteristic of those tested that differed to any degree between grade classes. 82.1 percent of those selecting Prime chose a moderate amount of marbling, 50 percent of those in the Choice group desired a moderate amount, and only 31.6 and 31.8 percent respectively of the Good and Commercial groups chose the moderate amount,

4. 42.1 percent of those respondents in the lowest income bracket ($2000 annually) stayed with their preferred grade through the first 14 cents price increase; whereas, the other income brackets averaged approximately 15 percent.

Oklahoma City Study

The Oklahoma City phase was conducted in four large self-service markets. No surveys were taken in this study, hence, results are restricted to "sales data".

This phase was similar in many respects to that conducted in Stillwater, but was quite different in others. One of the major differences is that Choice mature and Good and Commercial calf T-Bones were utilized here; whereas, in Stillwater only mature beef was employed.

Since this phase was restricted to "sales data" the information is necessarily limited to price responses. Store management would not consent to lowering the price of Choice mature below calf grade prices, hence results are largely limited to calf grades. Some of the more important results are as listed:

Oklahoma City Study

1. Little shifting among grades was indicated as the price of all grades were increased by the same absolute amount, however consumption per 1000 customers was inversely related to price. The price elasticity of demand was computed as -1.064,

2. The sales of Good and Commercial calf were both inversely related to its own price. Elasticity of demand for Good calf was computed as -2.130 and elasticity for Commercial was computed as -1.190,

3. The sales of either calf grades were not associated to a significant degree with the other's price,

4. The sales of Good and Commercial calf grades were split approximately even in two out of three treatments in which they were equally priced,

5. The disappearance of calf grades was inversely related to their average price. The price elasticity of demand was computed as -1.432.

A companion study to the Oklahoma City study was conducted in Shawnee. This experiment differed from the Oklahoma City study in three major points. Only one store was used in Shawnee, packages of T-Bone steak were unlabeled as to grade, and the pricing scheme was more flexible. The more important results may be summarized as:

1. The sales of Good calf were not very closely associated with its own price. Similar results were obtained for Commercial calf,

2. When an attempt was made to explain the disappearance of Commercial calf as a function of the price of Good calf as well as its own price, results indicated that the price of Good calf had a greater effect on sales of Commercial calf than the price of Commercial calf,

3. An analysis similar to (2) was run on the disappearance of Good calf and results in this instance indicated that the price of Good calf had a greater effect on its own sales than did the price of Commercial calf.

Recommendations for Future Work

Any contributions that this study may make toward future controlled experiments in the area of consumer preference studies will probably come from avoiding or solving the many problems encountered in this work. Recommendations are as listed:

1. In experimenting with products that are graded it is essential to keep experimental material away from border-line cases,

2. Before conducting an experiment in a store that does not ordinarily handle products that are to be included in the experiment, it may be well to initiate the new product or products sometime prior to the actual experiment,

3. Due to errors that are associated with estimating missing plots it is imperative that adequate supplies be maintained,

4. One of the major problems met in this study was that of deliberate cut-off when products were not moving at experimental prices. When this happened a customer count was taken at cut-off time. Since this study used data based on pounds sold per 1000 customers it first appeared that effects of such a cut-off would not be too great, but this is true only if early and late day shoppers constitute a fairly homogeneous group,

5. If definite differences in disappearance figures are desired then an investigator should inject a range of experimental prices that is wide enough to accomplish this purpose.

6. This study failed to generate sufficient data to get at the question "Can consumer surveys be employed to obtain the true price

differentials that respondents are willing to pay under actual shopping conditions"? However, the procedure employed in this study appeared to be a sound method and is recommended for future work that includes more stores,

7. Whenever possible it is recommended that an experimental design be employed that will allow store differences to be eliminated in the statistical analysis,

8. The effects of advertising between experimental treatments has already been fully discussed. Therefore, a strong recommendation is to avoid this pitfall if at all possible.

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APPENDIX A

APPENDIX A

Department of Agricultural Economics
Oklahoma A. & M. College

Consumer Survey (Beef)

Date_____

Enumerator_____

1. Name_____
2. Address_____
3. Occupation of Wage Earner(s)_____
4. Age of Persons Eating at Home:

_____	_____	_____
_____	_____	_____

5. Who normally makes purchases of meat for the family?_____
6. On what days do you normally purchase meat?

S M T W Th. F S

7. Let's suppose you are purchasing T-Bone steaks for your family; which one of these cuts would you purchase? After each selection, ask respondent why the particular cut was chosen.

89	89	89
103	89	89
117	89 - 103	89
131	89-103-117	89-103
145	89-103-117-131	89-103-117
	103-117-131-145	89-103-117-131
		103-117-131-145

8. In general, what do you look for in buying T-Bone steak?

   a. Fat (outside): 1/4"____1/2"____3/4"____1"____No pref.____

   b. Fat (inside): moderate____little____none____no pref.____

   c. Color of fat: white____yellow____no pref.____

   d. Color of lean: light____med.____dark____no pref.____

   e. Thickness: 1/4"____1/2"____3/4"____1"____ no pref.____

   f. Size of steak: large____medium____small____no pref.____

   g. No. of pieces per package: 1____2____3____no pref.____

9. What do you desire in a piece of steak ready for the table?

   a. Tenderness d.____

   b. Flavor e.____

   c. Juiciness

10. How would you rank the above characteristics in order of importance?

    a.____ b.____ c.____

11. Does your family eat steak fairly regularly or do you serve it more as a special meal?

    a. Regular____

    b. Special____

12. What cooking methods do you use to prepare steak?

    a. Broil____

    b. Fry____

13. How often do you use meat tenderizers? (Mechanical, commercial enzymes, home techniques etc.) Frequently____ Occasionally____ Never____.

14. Are you familiar with government grades for meat? yes____ no____. If yes, ask question 15; if no, go to question 16.

15. Would you identify these steaks as to grade?

    1.____ 2.____ 3.____

16. If the price of the grade you are accustomed to buying increased, would you:

    a. Buy the same amount_____

    b. Buy less_____

    c. Switch to another grade_____

17. May I ask you how often you are paid?

    a. Weekly_____

    b. Twice monthly_____

    c. Monthly_____

    d. Other_____

18. Would you tell me your approximate income?

Below 1000_____	6000-7000_____
1000-2000_____	7000-8000_____
2000-3000_____	8000-9000_____
3000-4000_____	9000-10,000_____
4000-5000_____	Over 10,000_____
5000-6000_____	

19. Approximately what % of your income is spent on meat each week? _____%

VITA

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