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Leo Joseph Guedry, Jr. for the Ph. D.
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The demand models which have been estimated for outdoor recreation facilities have suffered from a lack of generality. That is, the estimates derived from one set of recreation resources have rarely been applicable to another, although similar, set of resources. An effort has been made in this study to relieve the demand estimates of this limitation by incorporating site and population characteristics into the demand model.

This was accomplished first by incorporating conceptually site and population characteristics into neoclassical theory of consumer behavior. Using the Hotelling-Clawson demand model for outdoor recreation, the model was estimated using personal

interview data collected in the Bend Ranger District of the Deschutes National Forest in Oregon.

The site characteristics considered in the study were: (1) Remoteness of the site; (2) level of site development; (3) potential density of use at the site; and (4) the level of fishing success at the site. These variables were incorporated into the demand model in two ways. The remoteness of the site was used to increase the specification of the quantity variable, days of recreation. The remaining three site characteristics were incorporated in the empirical model as explanatory variables.

Population characteristics considered in the model are: (1) Children in the recreation unit; (2) place of residence; (3) education; (4) occupation; (5) years of camping experience; and (6) the investment in outdoor recreation equipment. These variables were all included in the empirical model as explanatory variables.

Demand equations were estimated for the total facility and for each group of sites defined by a remoteness level. The coefficients estimated for each variable in the final equations obtained for each remoteness level are statistically compared in an effort to determine whether the demands for remoteness levels differ. In addition, value estimates for each level of remoteness were estimated and compared.

The results from the analyses indicated that a difference did exist between the demands for the remoteness levels defined. In addition, the results suggested that there was evidence to indicate that each of the site and population characteristics exhibited significance in one or more of the demand models estimated.

The Role of Selected Population and Site Characteristics in the Demand for Forest Recreation

by

Leo Joseph Guedry, Jr.

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Dean of Graduate School

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CHAPTER I

INTRODUCTION

The relevance of traditional consumer behavior theory has generally been accepted in analyzing the demand for outdoor recreation. Albeit, the "extra-market"[1/] character of outdoor recreation has given rise to controversial demand estimates. In a recent article, Stoevener and Brown (1967) group the major arguments challenging the quantification of the demand for outdoor recreation into the following three classes:

1. Arguments implying the impossibility of attaching economic values to recreation services because of the aesthetic and other characteristics of recreation services.

2. Arguments implying that the individual consumer's willingness to pay does not reflect the social value of these services.

3. Arguments arising from the confusion between the methodology of economic analysis and the policy conclusions which can be drawn from such analysis.

1/ An "extra-market" good is a good for which a market does not exist, but for which a market conceivably could exist.

Each of these arguments are discussed by Stoevener and Brown individually; they conclude in essence that, as such, these arguments do not constitute evidence to dismiss the empirical estimation of demand for outdoor recreation. These arguments do, however, indicate the complexity of the "outdoor recreation" commodity and the need for further research. Most studies in this area have concentrated on a small area of this broad problem. The effort undertaken in this study is an additional attempt to provide meaningful insights into this complex commodity.

The Problem

The problem of this study is two fold. One is the conceptualization of a demand model to evaluate the benefits accruing from a given outdoor recreation resource and the other is including in this model variables which are significant from a facility[2/] management viewpoint. Consumer demand theory will form the conceptual basis of this model. Although previous research efforts in the demand for outdoor recreation have given rise to a useful framework of analysis, it appears that some further expansion of the framework can increase the usefulness of the estimates to policy

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2/ "Facility" is used throughout this study to refer to a collection of recreation sites. "Site" will be used in a more specific sense to refer to campground and the like, within a facility.

makers and facility managers. In general, the value estimates derived from one set of recreational resources have rarely been applicable to another, though similar, set of resources. Consequently, from an operational standpoint, these estimates have been of limited usefulness in many decision-making contexts. It is suggested that this limitation has its roots in two areas. First, the use of recreation or visitor days as the quantity variable for the total facility is too broadly defined. Defined in this way the quantity variable refers to a specific combination of characteristics which are unique to that recreation facility. Second, previous models have failed to consider the characteristics of the user population. It is the purpose of this study to relieve the estimates of the facility specificity by focusing on the two areas just mentioned. How the results obtained in this study can be generalized will be discussed in the last chapter.

The Objectives

In attempting to relieve the estimates of facility specificity, the particular objectives of the study are:

1. Improve the specification of the quantity variable by grouping the sites of the facility into classes on the basis of defined levels of remoteness.

2. Specify and incorporate into the demand model population and site characteristics which appear *a priori* significant as determinants of the demand for forest recreation.

3. Hypothesize and estimate demand models for each level of remoteness with specific attention to the population and site characteristics as explanatory variables.

4. Test the hypothesis that certain unique facility characteristics impart different economic values to the recreational services derived from them by comparing the estimated demand equations for each level of remoteness to each other and comparing the economic value derived from each.

The accomplishment of these objectives required the selection of a study area which provided variability among site and user population characteristics. A resource-based facility as defined by Clawson and Knetsch (1966) provides the desired variability. Therefore, a resource-based facility in Oregon, the Bend Ranger District of the Deschutes National Forest, was selected as the study area. The Bend District possesses a broad range of man-made and natural physical characteristics which draws users from a large geographical area.

Outline of Thesis

The body of the thesis is contained in Chapters II, III, IV, V and VI. Chapter II presents the conceptual economic model which arises from traditional consumer demand theory. An attempt is made in this chapter to incorporate site and user population characteristics into the traditional consumer demand model. A description of the study area and the sampling procedure followed is given in Chapter III. Chapter IV presents a discussion of the way in which the variables to be used in the analysis are measured. Tables presenting the data used in the estimation procedures are also given. This chapter also contains a description of the zones and how they were determined for this study. Chapter V contains a presentation of the general statistical model to be applied in estimating the demand equations. Each demand equation hypothesized is estimated and test of statistical significance run on the variables. Using the sample data, experiments are conducted on each variable in an effort to determine its significance empirically in the models hypothesized. Then for each analysis a model for further testing is presented and estimated. The models constructed for each level of remoteness will then be compared by statistically testing the differences between the parameter estimates of the equations and also comparing the value estimates from each remoteness level to each other. The results from the statistical analyses will be summarized in Chapter VI. An effort will be made in this chapter to examine the relevant methodological conclusions, both economic and statistical, which have arisen from the analyses conducted in the study. Pragmatic conclusions which have relevance to the policy maker and resource manager will be incorporated into the final section of the chapter.

CHAPTER II

THE DEMAND FOR RESOURCE-BASED OUTDOOR RECREATION: METHODOLOGICAL CONSIDERATIONS

The development of the economic model will form the focus of this chapter. Neoclassical theory of consumer behavior and specifically, the adaptation proposed by Hotelling (1947) as expanded by Clawson (1959) form the basis of the conceptual model. An attempt is made to increase the specificity of the theoretical model by incorporating site and population characteristics into the consumer's decision-framework. Further attention is given to the definition of the quantity variable and its dimensions. The quantity variable will be discussed, followed by a discussion of the explanatory variables.

The Economic Model

The extra-market[3/] nature of the recreation product has prompted modification of the neoclassical demand model. In this analysis, the Hotelling-Clawson formulation of the demand for outdoor recreation will be used. Clawson (1959), in applying Hotelling's (1947) suggestion, divided the area from which the recreation facility draws its users into distance zones and used

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3/ Op. cit. 1.

the average travel cost from each zone as the price variable for the zone. Using this information, he hypothesized his demand model; the quantity of visits from a zone is a function of its average travel cost. Expanding upon this framework Brown, Singh and Castle (1964) incorporated income as an explanatory variable in the model. They further specified the price variable by substituting "transfer cost"[4/] in the place of travel cost as the price variable. Clawson, in his pioneering effort, used cost per visit as the price variable and used travel cost as an estimate of the cost per visit in his empirical work. Brown, Singh and Castle point out that travel cost is a special case of the more general phenomenon of transfer costs. That is, although travel cost is a substantial part of the cost associated with outdoor recreation, it is not the only cost item and therefore, it is more appropriate to include all pertinent costs; hence an attempt to obtain transfer costs seems warranted.[5/]

[4/] Brown, Singh and Castle credit Clifford Hildreth with first suggesting this terminology. Transfer costs are those costs incurred by the buyer or seller of goods, but which are not normally included in prices.

[5/] In the case of publicly owned recreation facilities the majority of the costs associated with participation in outdoor recreation activities are of a transfer nature. (Brown, Singh and Castle, 1964)

As indicated in Chapter I, the models formulated thus far have generated estimates which suffer from incomplete specification, therefore, limiting their usefulness as policy and management tools. This limitation arises partially from two sources--such as visitor days, recreation days or visits and the failure to incorporate the characteristics of the user population. The former is particularly acute when the demand for a given outdoor recreation facility is under consideration. In those analyses where the demand for a given outdoor recreation activity, such as fishing, boating, etc., has been studied, this problem with the quantity variable does not exist. However, in the case where a facility as a whole is under consideration, the estimates which result from such broadly defined quantity variables refer to a recreation product which is uniquely defined for the facility under study. Obviously, when attempting to apply the results generated for one facility to another, which also has associated with it a uniquely defined product, the inferences are highly tenuous. This problem is further magnified when little or no information relating to the characteristics of the user population is considered. Failure to include information on the user population restricts severely the predictive character of the models.

In an attempt to provide some relief from these two shortcomings, a classification scheme will be set up on the quantity variable, and population characteristics will be incorporated into the model as explanatory variables. The discussion will now turn to these two adaptations in the Hotelling-Clawson model.

Classification of the Quantity Variable

The quantity variable, as it has been used in previous models, related to either the quantity of recreation days at a given facility, or the quantity of recreation days of a given activity at a given facility or area. In this analysis, the focus is on the former. The estimates resulting from models designed to explain a given activity focus only on a segment of the management program of a facility. In order to accomplish the objectives outlined in Chapter I, it is necessary to concentrate on the total facility and its characteristics rather than the activities undertaken in the facility. The use of a model which has the quantity of recreation days at a specific facility as a function of certain explanatory variables is limiting. Because as such, this quantity variable is tied to a specific facility and relates to all the natural and man-made characteristics of that facility. The usefulness of this quantity variable becomes suspect when the possibility of another facility possessing a dissimilar physical composition is considered. In addition, little information is available in these estimates to suggest how sites within the facility affect the quantity demanded, implying limited usefulness to facility managers.

A "resource-based" facility[6/] contains numerous physical characteristics, some unique to it and some general to other similar types of facilities. These characteristics influence the demand for a facility and they may enter the demand function as explanatory variables. Or alternatively, they may be reflected in the definition of the dependent or quantity variable. It is suggested that greater specificity may be given the quantity variable if the latter approach is used. Therefore, a classification of the quantity variable will be attempted and the criterion for such a scheme will be developed.

The construction of a classification scheme requires first the establishment of a complete "category" of classes (Conklin, 1960). The category refers to a set of classes defined in terms of a common criterion. Specifically, the criterion chosen should possess the following attributes:

1. Relevance--the characteristic or characteristics chosen should be relevant to the universe of interest, resource-based outdoor recreation facilities.

2. Exhaustiveness--the chosen characteristic or characteristics should include all elements of the universe of interest.

6/ A resource-based facility's dominant characteristic is its outstanding physical resources. A fuller description is given in Clawson and Knetsch, 1966, p. 37, Table 2.

3. Exclusion--all of the elements in the universe belong to one and only one of the classes established for the category.

The first of these attributes relates to the nature of the recreation product and its commonality among resource-based outdoor recreation facilities. If it is possible to relate the demand model to facility characteristics common to the type of facility under consideration, some relief from the facility specificity of previous estimates may be obtained. The latter two attributes are necessary if one is to obtain a meaningful application of the conceptual model to an empirical problem.

Implicit in the preceding discussion is that, by grouping the sites within the facility on the basis of some characteristic or characteristics possessing the above attributes, a more homogenous product is obtained. This conclusion arises from the following assumption: that a relationship exists between the need(s) (e.g., escape, exercise, social status, etc. [Wagar, 1965]) an individual seeks to satisfy and the activities in which he participates. From this assumption, it can be implied that the activities which are undertaken at an outdoor recreation facility are possible because the characteristics of the facility permit their taking place. Therefore, it follows that a functional relationship exists between needs and the characteristics of the facility. It is suggested that needs, whether they are psychological, sociological, or physical in origin, provide content to the definition of a recreation day for the individual. The above reasoning provides the basis for the following assumption: recreation days derived from sites possessing a similar characteristic(s) are more homogenous than those arising from sites possessing dissimilar characteristics.

As inferred previously, resource-based recreation facilities embody numerous natural and man-made characteristics which could form the basis for a classification scheme. Possibilities are, however, restricted by the attributes sought in such a basis. Following Conklin's (1960) suggested properties of a classification scheme, the characteristic or characteristics used as the criterion or basis for establishing a category of classes should be relevant, exhaustive and exclusive. In addition, each class should have a tendency for similar activities to be undertaken within the sites possessing a given characteristic or characteristics. Therefore, some inference can be made about similarity of needs satisfied within a given class and the homogeneity of the recreation or visitor days taken at these sites. Three general characteristics of a resource-based facility suggest themselves as appropriate for our purposes: (1) remoteness of the sites within the facility, (2) the potential density of use at the sites within the facility and (3) development of the sites within the facility.

For the purposes of this study, remoteness of the sites within the facility will serve as the basis for the classification scheme. The selection of remoteness over the other two suggested general facility characteristics is basically its relationship with the natural environment and the potential usefulness of the estimates derived. The remoteness of a site or group of sites relative to the other sites in the facility is the context in which remoteness will be used in this study. Remoteness, as it is defined, is not independent of the other two general facility site characteristics and some reflection of the other two will be embodied in the suggested classification scheme. An attempt will now be made to demonstrate that remoteness of the site possesses the desired properties for a common criterion and that the estimates which result will provide useful policy and management insights.

The tendency for increased homogeneity of the recreation day within a given level of remoteness may become clearer if the idea of needs, as described previously, is discussed in relation to this facility characteristic. As suggested in the foregoing discussion, needs and facility characteristics are related via the activities an individual undertakes. Certain activities require extreme levels of remoteness, and it seems reasonable to expect at these extreme levels that the kind of needs which are satisfied by individuals are similar. It is further argued that although the diversity between activities and needs is not as great between closer levels of remoteness, a difference does exist among these levels. Given the assumption that needs give content to the meaning of a recreation day, the quantity variable defined in terms of a recreation day at a given level of remoteness is more meaningful than one defined as a recreation day at a given facility. Knowledge of the facility's geographical composition should permit the measure of remoteness in some definitive way; e.g., accessibility in terms of road types, miles to the site, or time necessary to reach the site once in the facility.

A model designed to explain the demand for recreation days at a given level of remoteness will allow the comparison of sites within the facility. An indication will be given as to how the explanatory variables may operate differently at given levels of remoteness within the facility; thereby providing facility managers with information to suggest, for example, the direction development or lack of development should take within the facility. Managers of similar resource-based facilities should be able to take the results generated and, with some interpolation, make use of the resulting estimates across their respective facilities. Policy makers should gain some insights on the level of development desirable in resource-based facilities. Values generated from the estimates at remote sites can be compared to those at more easily accessible sites to give an indication whether the value generated to society is significantly different from these sites. Such information will provide policy makers with evidence, not presently available, to be incorporated into their decision framework.

Transfer Cost [7/]

Neoclassical economic theory of consumer behavior assumes that the individual maximizes his utility subject to some budget constraint. In this section we are concerned with one of the elements of budget constraint, the price per unit of recreation. [8/] Price for a market good is given to the individual via the market mechanism; however, in the case of publicly provided recreation a market in the conventional sense is not in operation. The price per unit of recreation in these publicly provided facilities are generally zero or close to zero. It is, therefore, necessary to examine the framework of the individual consumer to determine what variable or variables influence the quantity of recreation taken. In addressing this problem, Hotelling (1947) suggested that even if the price for entrance is zero, there is a price to the individual for use of the facility. This price he suggested was the cost of getting to the facility. Clawson (1959), utilizing Hotelling's suggestion,

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7/ Op. cit. 5.

8/ As used here a unit of recreation reflects time and in its general usage refers to a recreation day or a day at a recreation facility spent in some form of recreation activity.

classified the user population into distance zones, using the average travel cost from each zone as the price. Clawson estimated a demand equation for outdoor recreation for the average zone. It is suggested here that what the Hotelling-Clawson approach has assumed is that for outdoor recreation the relevant price variable is the "effective price"[9/] per unit of recreation.

Ideally, the transfer cost should include all expenditures to and from the site and all on-site expenditures. As used here, transfer cost includes only variable cost; fixed cost will be considered in a later section. This cost is then put on the per unit basis assumed for the quantity variable. In general, this has been the transfer cost per day per person. The use of the constructed price variable per day per person or group has certain inherent peculiarities which should be pointed out. The inclusion of the travel cost to and from the site which incorporates all cost associated with travel such as automobile operation, meals on trip, motel rental, etc., as part of the price variable, gives rise to the first problem associated with the use of transfer cost as the price variable.

9/ As used here the effective price is defined to be the price of the product plus the transfer cost of obtaining that product.

Let

P = Transfer cost

O = On-site cost

T = Travel cost

q = Number of days at the site

Then

$$P = O + T \tag{2-1}$$

The on-site cost is a function of the length of stay at the site. As the number of days stayed increases, the on-site cost increases. However, travel cost is independent of the number of days at the site. Once at the site the total travel cost is invested and unaffected by the number of days spent at the site. This raises a question about the form of the budget constraint when the transfer cost is put on a per day basis, since the variable put on a per day basis should be a function of days. It is observed that the travel cost portion of the transfer cost is not a function of days at the site. Consequently, when the transfer cost is placed on a per day basis in the following manner, the significance of this discussion in terms of the budget constraint can be observed.

$$\frac{P}{q} = \frac{(O + T)}{q} = \frac{O}{q} + \frac{T}{q} \tag{2-2}$$

Conceptually, what results is that the larger q gets, the less $\frac{T}{q}$

becomes and therefore the budget constraint is curvilinear rather than the usually assumed linear form.[10/] The larger the travel cost portion is of the transfer cost, the more relevant this observation is to the conceptual framework of the decision maker.

The incorporation of transportation cost as part of the price variable also gives rise to another problem. If a price per person per day is used as the price variable, then it can be seen that the transportation cost portion of the travel cost is an inverse function of the number of persons traveling to the site together. An example may serve to clarify this: Consider two groups of recreationists traveling to park X from city Y. Both groups travel in one automobile each; there are four persons in group 1 and two persons in group 2. The cost of transportation is $5.00. Therefore, the per person transportation cost in group 1 is $1.25 and in group 2 is $2.50. If two of the four persons in group 1 were children they would be given equal weighting with the adults. This would not be a problem if each person paid separately for the transportation. But, as will be argued later, outdoor recreation is a group activity; one in which participation by family units is significant. At first glance, it would appear that this problem could be solved by concentrating

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[10/] This point was brought to the author's attention by Dr. John Edwards of the Department of Agricultural Economics, Oregon State University.

on a recreation group rather than the individual recreationist. However, it can be observed that on-site cost and travel cost other than cost of transportation is a function of the size of the group. It would be reasonable, for example, to expect that the total cost for meals per day would be higher for the group with four than the group with two people. Therefore, in either basis used, per person or per group, there will be a measurement problem in the transfer cost which cannot be accounted for in the construct of the price variable itself. As will be discussed later, the group will be used in the study as the relevant unit of observation.

Income and Distance

Little attention needs to be given to income as a determinant of demand. Any elementary text discussing consumer demand theory covers the role played by income as a shifter of the demand schedule. For a discussion of income as a determinant of demand, see Henderson and Quandt (1958).

The distance variable cannot be disposed of as easily; the logic for including it in the demand model has been discussed by Clawson (1959) and Brown, Singh and Castle (1964). A reiteration of their argument deserves some comment here. The results of their discussions indicate that distance is a reflector of several variables, and as a result its role in the demand function is somewhat ambiguous. Clawson (1959) points out that, as a reflector of the cost in time, distance may act as a shifter of demand. How this enters the model depends upon how the recreationist views his time in travel. If he views travel time as undesirable, it will shift the demand schedule to the left and if he views travel time as desirable, it will shift the demand schedule to the right. Brown, Singh and Castle (1964) point out that distance as a measure of travel time may act as a shifter for another reason. As the distance from the recreation facility increases, one can expect the number of substitutes to increase; in which case, distance will shift the demand schedule to the left. However, distance is not unique in this respect, since an increase in the level of income may also increase the number of substitutes available to the individual.

Besides the correlation between the transfer cost and distance variable which has been experienced by most researchers, a further observation may be entered here. It seems reasonable to expect that distance may also be correlated with income, since one would expect the greater the distance from the facility, a higher percentage of the visitors would arise out of the higher income groups.

<u>Site Characteristics</u>

A recent article by Kelvin J. Lancaster (1966) presents an approach to consumer theory which represents a break from traditional theory. "The chief technical novelty lies in breaking away from the traditional approach that goods are direct objects of utility and, instead, supposing that it is the properties or characteristics of the goods from which utility is derived" (Lancaster, 1966, p. 133). In summarizing the essence of his approach, Lancaster makes the following three points:

> "1. The good, per se, does not give utility to the consumer; it possesses characteristics, and these characteristics give rise to utility.
>
> "2. In general, a good will possess more than one characteristic, many characteristics will be shared by more than one good.
>
> "3. Goods in combination may possess characteristics different from those pertaining to the goods separately." (Lancaster, 1966, p. 134)

Lancaster's emphasis on product characteristics as the object of utility rather than the product itself would appear to have particular significance in explaining the consumption of outdoor recreation. Several researchers have indicated that the Hotelling-Clawson model will have only limited usefulness until it comes to grips with the "quality" of recreation experience (Castle and Brown, 1964). Stevens, in attacking this problem of relating the quality in outdoor recreation to recreation values, suggests that an appropriate theory would have to meet the following requirements:

> "First, the theory must define a 'quality' variable which will reflect the quality of the recreational experience. Second, it must relate the variable to a decision-making framework for an individual. Third, it must relate individual decisions to aggregate behavior." (Stevens, 1965, p. 23)

In his discussion, Stevens suggested a close examination of a given outdoor recreation activity might reveal a characteristic of this activity which would index the quality of the recreation experience realized from participation in the given activity. Applying this suggestion to a specific activity, fishing, Stevens used fishing success as a reflection of quality. Other characteristics were mentioned as possible measures of quality, but were dismissed because of measurement problems. These were condition of the road, innate attractiveness of the site, the degree of crowding, and the level of management.

It was suggested that the attempt by Stevens to incorporate a variable which reflects the quality of the recreation experience into a demand model is essentially the application of a theoretical model similar in construction to that proposed by Lancaster. That is, implicit in Stevens' effort, is the assumption that the individual's utility function is a function of his hypothesized "quality" variable and the other appropriate variables. If one is willing to accept the argument that site characteristics are important variables in the individual's utility function, then it is necessary that these be included as explanatory variables in the demand for outdoor recreation.

Drawing on the ideas expressed by Lancaster and the empirical research effort by Stevens, it is suggested that some effort is in order to incorporate site characteristics within a given recreation facility into the demand model. The definition given to the quantity variable and its discussion suggests some general characteristics which *a priori* appear to be significant. Due to the aggregative nature of the model to be estimated, the characteristics to be considered are general in character. It is proposed that the following site variables be incorporated into the demand model: (1) the level of site development,[11/] (2) the potential density of use and (3) the level of fishing success. Another general site characteristic, the level of remoteness of the site, has already been included in the model through the quantity variable. The remaining portion of this section will be a discussion of the conceptualized role of these three site characteristics in the decision-framework of the individual recreationist.

11/ Development as it is used in this study reflects the extent to which man-made changes have taken place to make the natural recreational attributes of a site available for recreationists' consumption.

Development of a site is, of course, related to the definition of the quantity variable, discussed in a previous section. However, even within a given site classification the level of development tends to limit or promote participation in specific recreation activities, thereby influencing the extent to which an individual can satisfy his desire to participate in certain activities. Consequently, it is suggested that the level of site development is reflected in his demand function via the individual's utility function.

The second suggested site characteristic, potential density of use, reflects the possibility of interaction with other recreationists. How this variable will react upon the individual's demand function will depend upon the satisfaction or dissatisfaction the recreationist received from association with other recreationists. It is argued that in the individual's decision process, it is not the actual level of use which is important, but it is the knowledge he possesses about the possible density of use which enters his decision framework. Each individual recreationist has some idea about amount of association with other recreationists which is desirable to him. This conception about association arises partly from experience and partly from a preconceived idea relating to the needs he seeks to satisfy by his participation in outdoor recreation activities. Consequently, one of the factors influencing his demand for a given site will depend upon the number and location of the camping units within the site or campground. The degree of association is a function of the number and spacing of camping units, if the site is used at full capacity. However, in cases where the site is not being used at full capacity, the situation is not as clear. Consider the following example: Recreationist X desires to recreate in an area in which he is as far removed from other recreationists as possible. Recreationist Y desires an area where he can have frequent contact with other recreationists. Assume that X enters a site which is completely empty, therefore, the actual crowding is zero, selects a campsite. However, the camping sites are only ten feet apart within this campground. Then enters Y, who in attempting to satisfy his needs will select the site immediately adjacent to X. It is argued that X, if at all possible, would select a campground in which the above situation would not occur, and that Y would have selected that campground because of the possibility of interaction with other recreationists. It is on this basis that the potential density use is a more appropriate variable for consideration than actual use.

The final suggested site characteristic, fishing success at the site, relates more directly to a specific recreation activity than do the other two. But in the case of resource-based facilities, it does appear to be an important quality variable to a large group of recreationists. Following the initial work of Stevens (1965), it is considered that, at sites where fishing is an activity undertaken by the recreationists, the success of fishing is an important site characteristic in his decision model. As in the case of the other characteristics, it is assumed that the level of fishing success will enter the demand model via the utility function of the individual.

Population Characteristics

It was previously hypothesized that the lack of specificity in prior models arose partially from the failure of those models to embody characteristics of the user population. The significance of such characteristics, in explaining the demand for outdoor recreation, has been alluded to by numerous researchers. Marion Clawson (1959), in his initial work, explains that the estimates derived from his model are only an approximation of the demand curve for the total recreation experience for several reasons. One reason is -- "the population in various distance zones may differ considerably in terms of average income or of income distribution, as well as perhaps in other socio-economic characteristics" (Clawson, 1959, p. 19). In a more recent work, Clawson and Knetsch (1966) offer a more elaborate discussion as to the role and significance of these variables. A part of their suggestions arise out of the work conducted by the Outdoor Recreation Resource Review Commission (ORRRC). ORRRC

Report No. 20 (1962) contains one of the most extensive efforts to collect information pertinent to the user population and its demand for given outdoor recreation facilities to date. This report has given impetus to the numerous suggestions that the inclusion of socio-economic variables would increase the specification of the Hotelling-Clawson demand model. Even so, little attention has been given to the theoretical considerations of including such variables in a demand model for outdoor recreation. Stoevener and this writer (1968) suggested in a recent paper that if the substitutes are clearly defined for the product, then the assumption of a given utility is appropriate. This follows from the derivation of a demand function for a product from the individual's utility function and budget constraint. If the substitutes of a product are defined, they will appear in the utility function and their prices in the budget constraint. The demand function derived from the utility maximization process will contain the prices of these substitutes. Therefore, in hypothesizing a demand model, one will usually include the prices of substitute products. However, in cases where these substitutes cannot be clearly defined, some factors underlying the utility function must be considered if the demand function is to be appropriately specified. The difficulty of specifying substitutes between leisure time pursuits is well known. Leisure time activities are more highly individualistic in character than the normal commodity case. Realization of this character amplifies the significance of including population characteristics in the demand models for outdoor recreation.

It is hypothesized in this study that consumer preferences for outdoor recreation are affected by "sociological variables".[12/] There are three ways in which the analysis of this problem can proceed.

First, a behavioral science model may be incorporated into the economic model. A review of literature (Chapters II and III, Clawson and Knetsch, 1966, provide a bibliography) in search of a behavioral theory of outdoor recreationists suggests nothing sufficiently general and formal for the needs of this study. This is not to imply, however, that theorizing about leisure time behavior has not been undertaken by behavioral scientists (Neumeyer and Neumeyer, 1958). A more rigorous framework would be necessary, however, to serve the needs of the analysis.

Second, recent efforts in the area of marketing suggest the analysis of the individual's entire decision process (Nicosia, 1966).

[12/] These variables have been referred to as socio-economic, demographic, or population variables depending upon the discipline by which they are used. The term sociological variables is used in this study to make explicit the distinction between these variables and what are considered traditional economic variables in demand analysis.

Such an approach would allow the consideration of product characteristics, the individual's environment and his perceptiveness, and the stimuli which he may receive to be reflected in the analysis. Although promising, adaptation of this approach to outdoor recreation will be more productive once its usefulness has been demonstrated in the conventional market situation.

The final approach follows along the lines suggested by Katona (1960). He indicates that for the study of economic behavior, it is more appropriate to focus upon clearly defined variables and differentiate among groups on the basis of these, rather than try to develop social-psychological models to reflect consumer behavior. Such a recommendation probably arises from two sources: a) At this point psychological models are specific to a given individual or group and do not carry the general content exhibited by economic models. b) From a practical point of view, even if such a conceptual model could be worked in with an economic model, the measurement problems at present may be prohibitive.

Given the objectives of the study, the available behavioral theory in this area, and the results of previous studies, it is proposed that Katona's suggestion be followed. It is hypothesized that sociological variables such as education, occupation, place of residence, past camping experience and age are important determinants underlying tastes and preferences of outdoor recreationists.

The discussion will now turn to how specific variables affect the preference structure of recreationists, which are eventually reflected in the demand for outdoor recreation.

It has been suggested, at various times, that participation in outdoor recreation may be the resultant of a desire for social status in American society (ORRRC, 1962). Sociologists have attempted to divide society into socioeconomic classes as part of their attempt to determine social status. Research in this area has established occupation as one of the primary indicators of general social prestige or status (Hatt, 1950). The question we are attempting to draw inferences about is one raised by the Outdoor Recreation Resource Review Commission studies (1962). Is participation in outdoor recreation a class phenomenon or is it strictly associated with income? It is suggested that a person's existence in a given occupation and the interrelationship with other members of the group influence his leisure time activity. Such group interaction will influence his preference function. The influence of such an occupational group may even be stronger where the demand for a particular product, such as outdoor recreation, is considered. Marguerite C. Burk makes the following observation related to the latter point: "Among other socioeconomic factors related to consumer behavior, which have been studied by economists in the postwar period, have been occupation and education.

These phenomena apparently influence preferences differently for different types of goods. They have less effect on food and more on clothing, recreation, and outlays on further education." (Burk, 1968, p. 101)

Education is another sociological variable which may be significant in explaining influence on the demand for outdoor recreation via the preference structure of the individual. It is implied that as an individual moves from one education stratum to another, his perspective and attitude toward leisure time activity changes. Also, his association is generally with persons of a similar educational background and this interrelationship results in a desire for given outdoor recreation activities. The desired activities will require his participation to take place at a site of particular characteristics within the facility. In the case of education, and also occupation, some relation will exist with income. Part of the influence which may arise across education and occupation strata may be due to a higher level of income security, rather than totally due to the interrelationship between individuals in a given group. However, for purposes of this study, it is hypothesized that education and occupation are important variables in explaining the demand for forest recreation.

The Outdoor Recreation Resource Review Commission (1962) indicated that the results of their statistical analysis show age to have the strongest relation to outdoor recreation of all the sociological variables considered in their study. Age enters the individual's demand for outdoor recreation in the following two ways: (1) It may act as a constraint resulting from physical limitations; e. g., those resulting from aging; (2) Age may also be reflected in the individual's utility function as a result of changes in tastes and preferences. These two effects of age are not necessarily independent; that is, a change in tastes may be the result of a change in physical capabilities.

The relationship of age to the spectrum of outdoor recreation activities does not appear to be consistent. It seems reasonable to expect that as an individual increases in age, his participation in the most strenuous outdoor recreation activities would decrease. But one would not expect participation in activities such as sightseeing, picnicking, etc., to decrease as rapidly with advancing age. If, as suggested, this relationship between age and activities does exist, then the age distribution of the population utilizing a given recreation facility would be of particular importance in the management of that facility. That is, if there is a difference in the demand among age groups for outdoor recreation activities, then the present and future age distribution of the user population will have to be considered in facility development.

One of the reasons for the increase in the demand for outdoor recreation has been attributed to its suitability for family group recreation. If attention is to be focused on the family recreation units, then not only the age of parents is important, but also the age of the children becomes an important factor. The age of the youngest child may act as a constraint on the activities of the family in much the same way as the physical limitations resulting from aging have been hypothesized to do. Much of this constraint may result from psychological inhibition rather than actual physical limitation.

An alternative to age might be the "Family Life Cycle" variable, which is a reflection of age, marital status, and children's ages (Lansing and Kish, 1957). This would be particularly of use in a case where the demand under consideration is that of family group activities. There is a disadvantage here in that the life cycle variable cannot be used as a continuous variable. The Outdoor Recreation Resource Review Commission (1962) suggested that age was the more appropriate of the two variables to use in the study of demand for outdoor recreation.

The place of residence, at first glance, appears to show some promise as an explanatory variable in predicting the demand for outdoor recreation. The role of outdoor activity in the daily environment of the rural and urban resident can be expected to differ considerably. Hence, it would seem reasonable to hypothesize that the demand for outdoor recreation activities would be different between the two groups. However, it must be kept in mind that while the opportunity for outdoor activity is greater in the case of rural areas, sociologists have indicated that the social differences between rural and urban areas are declining as a result of the technological innovations in machinery, transportation, and mass communication (Berelson and Steiner, 1964). This suggests there is increased homogeneity in our national culture, and as indicated by the Outdoor Recreation Resources Review Commission (1962), similarities in outdoor leisure patterns may be part of this trend. Therefore, the suggestion that place of residence, across the broad categories of urban and rural, might be significant in analyzing the demand for outdoor recreation, does not appear quite as fruitful as originally thought. This does not, however, rule out the possibility of intra-residence differences arising not only from physical factors, but also from possible group influences in preference structures arising from the impact of residence. If differences can be implied to exist within residence groupings from an estimated demand equation, then the distribution of future and present residences of the user population can be of value to facility managers and policy makers in planning. In an effort to determine if these intra-residence differences between urban and rural categories exist, the following residence categories are used in this study:

(1) inside city limits; (2) suburb; (3) rural, nonfarm; and (4) rural, farm.

It may be true today that the similarity between urban and rural society is great, and that the outdoor leisure patterns may be quite similar. However, it is a reasonable assumption that this was not the case in the past; implying that past residence may be important as a determinant of the demand for outdoor recreation. Former rural residents may have developed different outdoor recreation use patterns, e.g., during childhood, and though they are now urban residents, they may utilize their leisure time differently than do lifetime urban residents. Consequently, though the two cultures are becoming more similar with respect to the demand for outdoor recreation, some differences may occur today.

The remaining variable which we are attempting to incorporate into the model, experience in outdoor recreation, deviates from the general population characteristics. Outdoor recreation, as any other activity, requires a certain amount of skill in its performance. However, outdoor recreation activities differ in the requirements for obtaining the necessary skills (Stone and Taves, 1958). It is suggested that there is a progression in these skill requirements and that it is possible to group recreational activities accordingly. If this is correct, it should be possible to observe the extent to which the mastering of skills required for certain activities leads to successively "more difficult" activities.

It must be pointed out that technological improvement and investment in outdoor recreation equipment and facilities by the public and the recreationists have, to some extent, substituted for personal inputs required by the recreationists. This observation should provide some useful insights to planners for future recreational activities.

Fixed Investment in Outdoor Recreation Equipment

Fixed investment in outdoor recreation equipment could be considered with the other user population characteristics, but given the speculation surrounding this variable, it was decided to treat it separately. Some researchers have maintained that fixed investment in equipment enters the decision framework of the recreationists via the price variable (Gray and Anderson, 1964; MacNeely and Badger, 1968). Such an hypothesis indicates that changes in the level of fixed investment will have the same influence on the demand for outdoor recreation as a change in variable cost. This hypothesis does not appear strong when one considers that the funds are committed in the fixed items and, at any point in time, do not enter the short-run decision framework of the recreationist. The decision to recreate and how long to recreate is determined on the basis of those factors over which the recreationists has some control. The decision to purchase the fixed items of equipment was made some point in the past and the cost of such equipment has no influence on his decision to recreate today. However, ownership of the equipment does affect the variable cost of such a trip to the owner. Variable cost per day is lower to the owner than to the renter of the same equipment. By incorporating a depreciated cost per day for equipment, the effect is to raise the per day price to the owner of recreation equipment, removing a portion of the difference in the price between renter and owner, and implying more similarity in the length of stay and number of trips of the two. To summarize the above ideas, the price variable is affected by the level of fixed investment, but this influence arises from ownership and its effect on the price variable, and not by the cost of the equipment in the short run.

Beyond the indirect effect on the price of outdoor recreation, the ownership of outdoor recreation equipment suggests something about the character of the recreationist's decision framework. The factors motivating the initial decision to purchase the outdoor recreation equipment reflects information about the preference function of the recreationist. A high level of investment in certain types of recreation equipment suggests that at the time of purchase the recreationist's preference for outdoor recreation activity of a given type was such that the recreationist was motivated to make the purchase. This assumes that utility is derived from use of the equipment as well as, possibly, ownership itself. That is, the factors influencing the individual's preference function which motivates the purchase of certain levels and types of recreation equipment are embodied indirectly in the amount and kind of equipment the recreationist owns.

Formal Presentation of the Economic Model

The discussion of the variables and the role they play in the demand for outdoor recreation facilities forms the basis for the economic model to be estimated and tested statistically. In general, the economic model hypothesized in this study is the following:

$$Q = f(P, I, D, E, S, C)$$

where

Q is the quantity of recreation days taken at a given facility or remoteness level within the facility.

P is the price per day for a recreation day at the facility.

I is the level of income of recreationists using the facility.

D is the distance traveled to the facility by recreationists.

E is the amount of investment in outdoor recreation equipment by recreationists using the facility.

S is the sociological characteristics of the user population.

C is the site characteristics of the sites making up the facility.

A Basic Assumption

Before proceeding to the empirical estimation of the hypothesized conceptual model, a fundamental assumption underlying the application of neoclassical demand theory to the empirical problem should be pointed out. Thus far, very little has been said to indicate the unit of recreationists to which the recreation day is to refer. Several alternatives are available: the recreation day could refer to the individual recreationist, the family recreation unit, or to a recreation group of related or unrelated individuals. It is suggested that outdoor recreation at resource-based facilities is primarily a group activity. Therefore, the decisions which recreationists make, with respect to outdoor recreation, are made with the group activity in mind. Hence, the appropriate unit to which the quantity of recreation days should relate is the recreation group, which we shall define as a recreation unit.

The neoclassical demand model focuses on the individual consumer as the decision maker. To correspond directly to the neoclassical model, it would be necessary to consider the individual recreationist as the decision maker. However, as just discussed, it is assumed that the recreation unit and not the individual recreationist is the appropriate decision unit. The traditional neoclassical demand model does not allow the consideration of interdependencies of utilities within its theoretical framework. A model to take these interdependencies into account would involve the development of framework to reflect group decision-making. Since it is not the purpose of this study to attempt the development of such a model, it will be assumed that the decision model developed for the individual is the same as that which exists for the recreation unit.

Economic Value

The economic value estimates derived from an aggregate demand function, as derived by the Clawson framework, is the final methodological consideration to be discussed. The contribution to society arising from a given facility devoted to recreation compared to other uses of this facility is of primary concern to public policy agencies. Alfred Marshall (1920) was the first to point out that the demand curve for an individual contains information additional to the price-quantity relationship. He argued that a measure of surplus satisfaction to the individual could be obtained if the consumer's surplus as he defined it was examined. Marshall defined consumer's surplus as: "The excess of the price which he [the consumer] would be willing to pay rather than go without the thing, over that which he actually does pay, is the economic measure of this surplus satisfaction" (Marshall, 1920, p. 103). This definition has given rise to the use of the willingness to pay interpretation to the area under the aggregate demand curve as argued by Hotelling (1939). This approach has been used in outdoor recreation research as a means of estimating the economic value to society accruing from a recreation facility or activity. The estimates which arise from the Hotelling-Clawson model yield a demand equation for the average zone. Generally this equation has been used to construct a demand schedule by holding all of the variables in the equation, other than price, constant. Then, making the assumption that users from each zone will react to a change in price in the same way; i.e., the slope of the demand schedule is assumed the same for each zone, cost to the users for each zone is allowed to increase, yielding a relationship between added costs and days taken at a given recreation facility. It is the area under this schedule which has been taken as a measure of economic value to society. A bothersome question in this procedure is, what is embodied in this schedule of added costs and days? The following is an attempt to clarify the meaning of this derived schedule.

Assume that the following graph presents a demand equation which has been derived via the Hotelling-Clawson model. (Straight line demand schedules will be used for the sake of simplicity.)

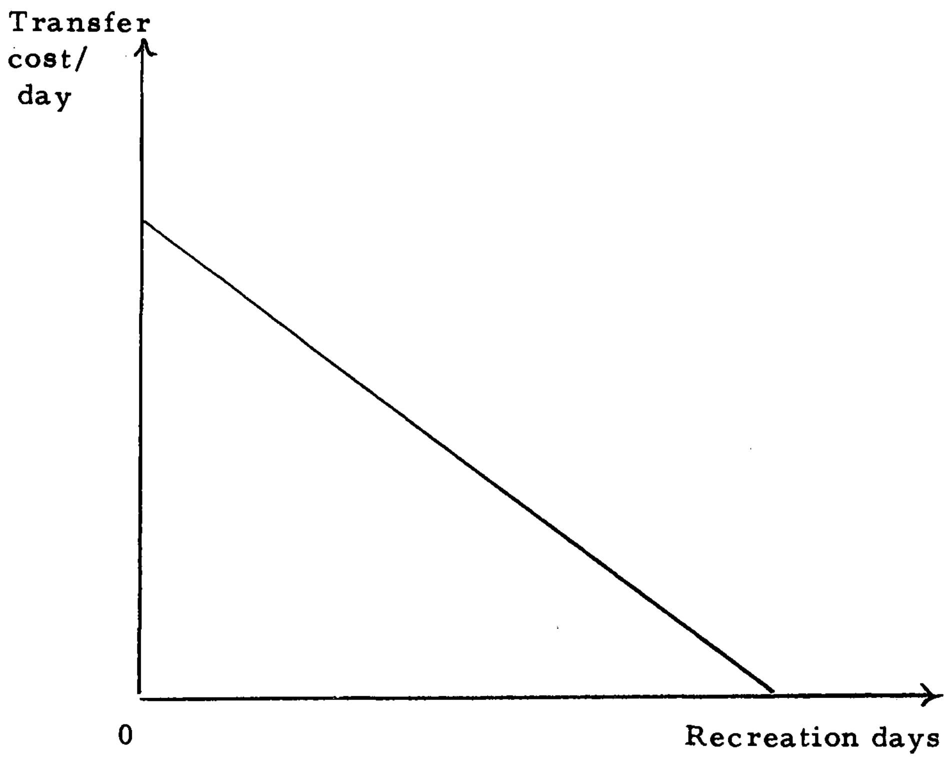

Figure 1. Demand schedule for the average zone.

Usually the equation from which the schedule is estimated is given in recreation days per capita. This is an empirical necessity and does not need to be included in this discussion. Assume further that there are two zones from which the above equation was estimated. Each of these zones has a demand schedule for the facility given as follows:

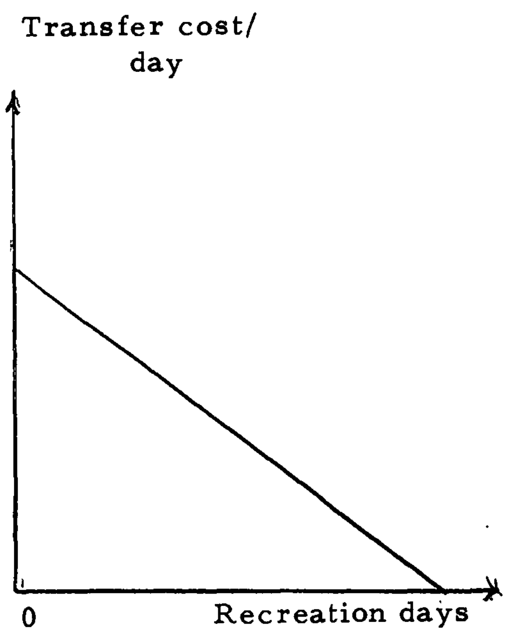

Figure 2. Demand schedule for zone 1.

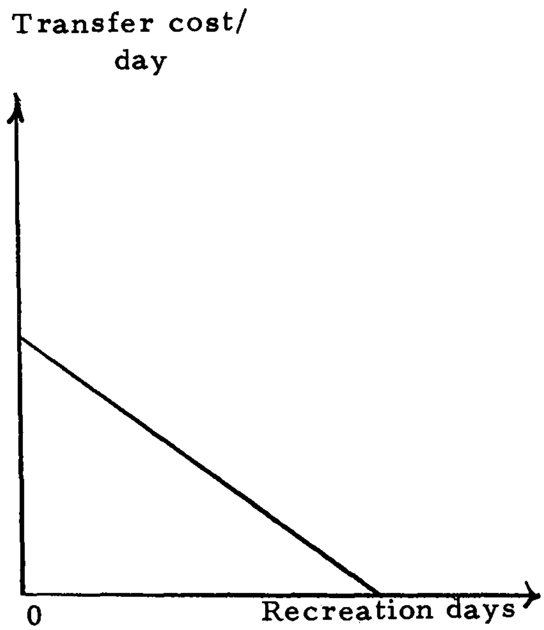

Figure 3. Demand schedule for zone 2.

Reflected in the demand equation for the average zone is one price (average transfer cost per day) and one quantity (the number of days from that zone) which represent one point on the average zone demand schedule. For purposes of illustration, let the following represent these two points.

$\bar{P}_{10}$ = average transfer cost/day for zone 1.

$\bar{P}_{20}$ = average transfer cost/day for zone 2.

A_{10} = the number of recreation days taken at $\bar{P}_{10}$ from zone 1.

A_{20} = the number of recreation days taken at $\bar{P}_{20}$ from zone 2.

The initial average prices and quantities are given for zone 1 and zone 2 in Figures 4 and 5, respectively.

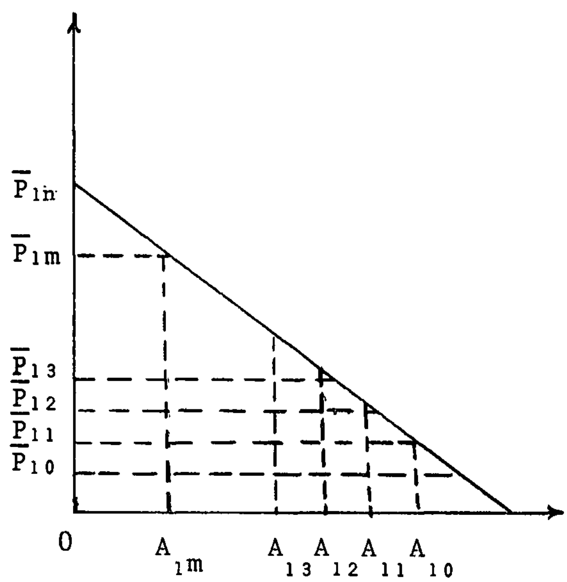

Figure 4. Demand schedule for zone 1 (with average transfer cost from zone).

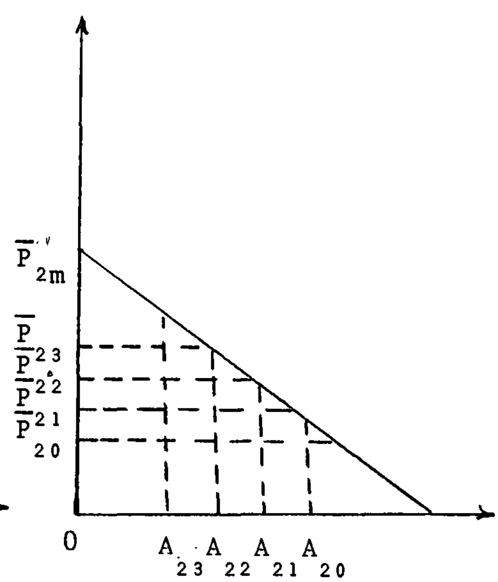

Figure 5. Demand schedule for zone 2 (with average transfer cost from zone).

The sum of A_{10} and A_{20} represents the initial point on the added cost schedule for the facility's demand, Figure 6, generally associated with zero added cost.

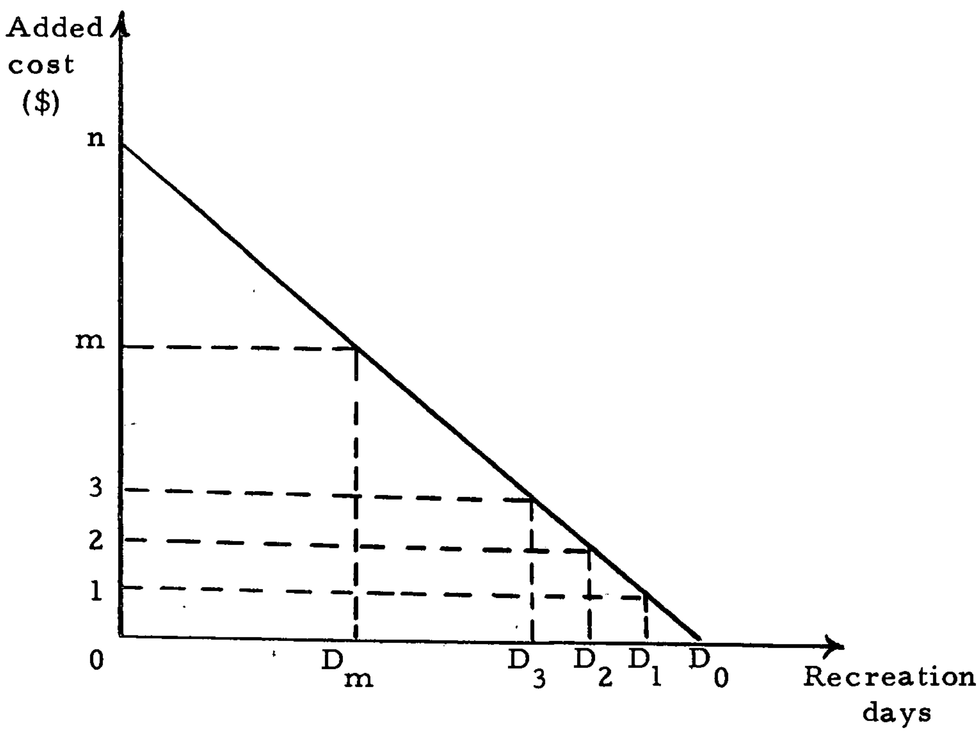

Figure 6. Net willingness to pay schedule.

where

$$D_0 = A_{10} + A_{20}.$$

If one dollar is added to the average transfer cost in zones 1 and 2, we see from Figures 4 and 5 that quantities A_{11} and A_{21} are taken respectively where $\overline{P}_{11} = \overline{P}_{10} + \$1$ and $\overline{P}_{21} = \overline{P}_{20} + \$1$. Adding to the average transfer cost from zone 1, Figure 4, and zone 2, Figure 5 in one dollar increments the added cost-total number of recreation days at the facility schedule is obtained, Table 1.

Table 1. The Net Willingness to Pay Schedule.

Average transfer cost zone 1 ($)	Average transfer cost zone 2 ($)	Added cost ($)	Total recreation days taken at the facility
$\bar{P}_{10}$	$\bar{P}_{20}$	0	$D_0 = A_{10} + A_{20}$
$\bar{P}_{11} = \bar{P}_{10} + \$1$	$\bar{P}_{21} = \bar{P}_{20} + \$1$	1	$D_1 = A_{11} + A_{21}$
$\bar{P}_{12} = \bar{P}_{10} + \$2$	$\bar{P}_{22} = \bar{P}_{20} + \$2$	2	$D_2 = A_{12} + A_{22}$
$\bar{P}_{13} = \bar{P}_{10} + \$3$	$\bar{P}_{23} = \bar{P}_{20} + \$3$	3	$D_3 = A_{13} + A_{33}$
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
$\bar{P}_{1m} = \bar{P}_{10} + \$m$	$\bar{P}_{2m} = \bar{P}_{10} + \$m$	m	$D_m = A_{1m}$
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
$\bar{P}_{1n} = \bar{P}_{10} + \$n$	-	n	$D_n = 0$

If the process of adding in one dollar increments is continued, we finally reach in zone 2, Figure 5, $\overline{P}_{2m}$ where no days will be taken from zone 2 and at some added cost n where the average transfer cost in zone 1 reaches $\overline{P}_{1n}$, Figure 4, where no days will be taken from zone 1. When the average transfer cost in zone 1 reaches $\overline{P}_{1n}$ no days are taken at the facility and at that price the net willingness to pay schedule intersects the vertical axis, Figure 6.

Examined in this way, it can be seen that what is contained in the area under the added cost schedule is the sum of the willingness to pay as reflected by the demand schedule for each zone over and above what is actually paid on the average from each zone. It is, therefore, suggested that what is captured in this oft-used diagram is the net willingness to pay of the users of the facility. This value will be used in the study as the economic value of the facility.

CHAPTER III

STUDY AREA AND SAMPLING PROCEDURE

The problem and objectives outlined in Chapter I suggested that an outdoor recreation facility possessing variability among site and user population characteristics was desirable for the study area. A resource-based facility as defined by Clawson and Knetsch (1966), it was decided, would provide the desired variability. The physiographic character of the State of Oregon is such that numerous resource-based facilities exist within its boundaries. In Oregon, the majority of these facilities provide forest-based recreation. Selecting from these forest lands, the Bend Ranger District of the Deschutes National Forest was chosen as the study area for this thesis.

The Study Area

Located on the east side of the Cascade Mountain Range, the Bend Ranger District lies approximately southwest of the town of Bend, Oregon, and borders on the Three Sisters Wilderness area. A portion of the wilderness area lies within the boundaries of the district. A map locating the Bend Ranger District in the State of Oregon is given in Figure 7. The district covers a land area of

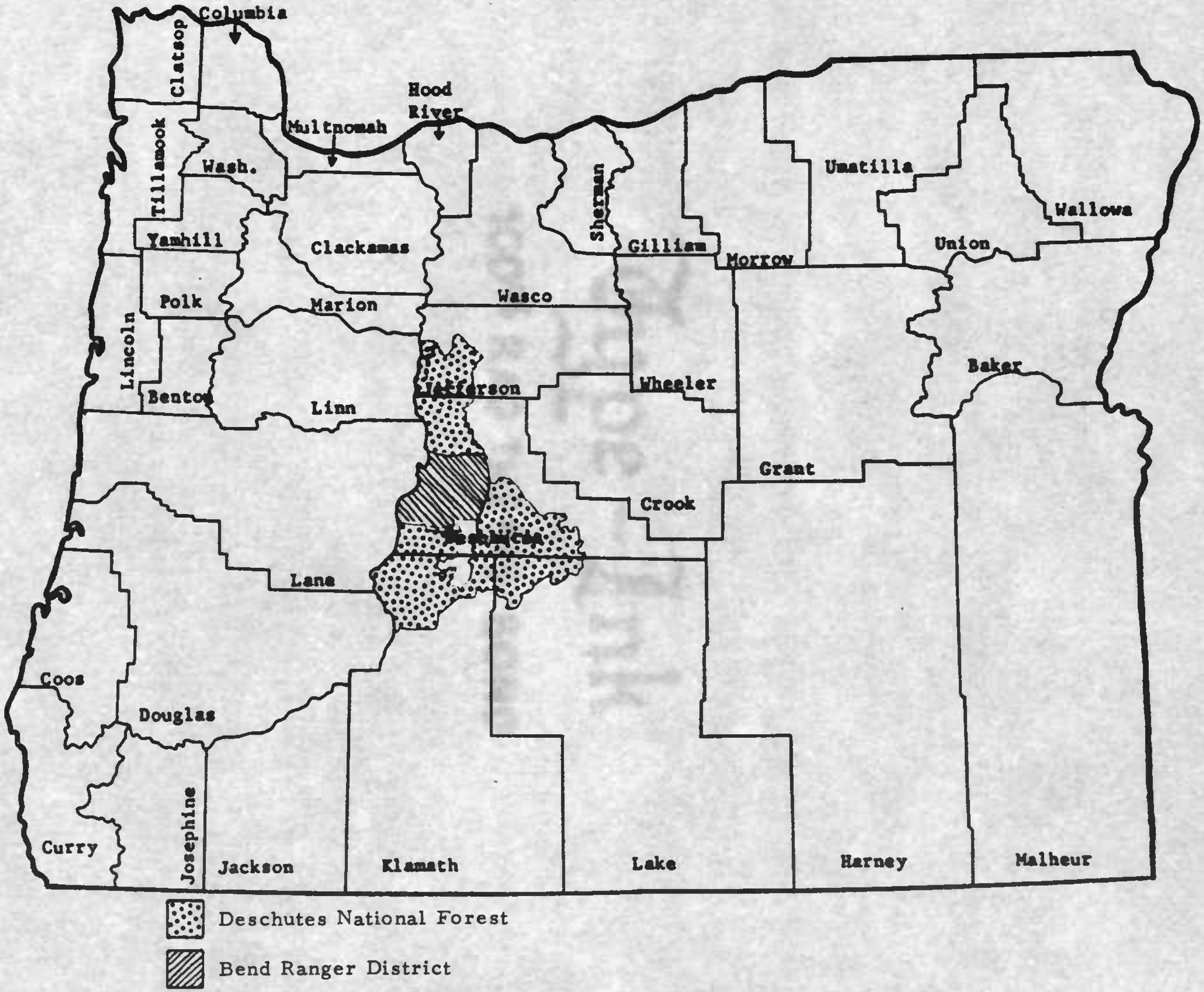

Figure 7. The study area in Oregon (Bend Ranger District of the Deschutes National Forest).

approximately 540,000 acres of the one and one-half million acres contained in the Deschutes National Forest. Of the estimated three and a quarter million visitor days [13/] taken in the Deschutes National Forest in 1966, 1,174,100 were taken within the Bend District. The district is located a substantial distance from population centers, therefore these visits are generally related to overnight or weekend trips. Recreation activities undertaken by these visitors within the district range from back-packing into wilderness areas to relaxing on the patio of a resort. Visitors to the district are primarily from Oregon, California, and Washington.

This study will focus on summer forest recreation and therefore, those sites within the Bend District designated primarily for winter sports, such as skiing, will not be included in the study area. There are 59 designated summer recreation sites and trails, with man-made development ranging from a garbage can and toilet facilities to resorts, which include cabins, restaurants, and concessions. Therefore the level of development across these sites varies considerably, offering a broad range of diverse recreation activities.

In order not to be misleading on the range of site development which exists within the Bend Ranger District, some further description is warranted. The sites within the district can be broken

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[13/] A visitor day as defined by the U.S. Forest Service is one visitor staying 12 hours or two visitors staying six hours, etc.

into three groups: 1) trails and shelters; 2) campgrounds; and 3) resorts. The trails and shelters are the most primitive from the standpoint of facility development. Among the campgrounds a range of development exists. However, if compared to highly developed campgrounds elsewhere, the most highly developed campground within the district would not be considered as well developed. There are no campgrounds with hookups for campers, showers, etc., for example. The resorts are the most intensively developed areas and are reasonably comparable to these types of facilities elsewhere.

Sampling

The problem and specific objectives outlined in Chapter I specify not only the choice of a study area, but also other facets associated with the sample survey. The primary factors to be considered are: 1) the population to be sampled, 2) the data to be collected, 3) the choice of the sampling unit, and 4) the size of the sample to be collected. The first portion of this section will be devoted to a discussion of these four factors in relation to the study conducted in this thesis.

As indicated in Chapter II, an attempt has been made to specify more completely the demand model for outdoor recreation, so that inferences projected from a given empirical estimation will be more meaningful when applied to similar recreation facilities. Therefore, the target population 14/ of interest in this study is the user population of summer-oriented forest recreation facilities of the resource-based type. In attempting to focus the analysis on this target population, a sample was taken from the summer recreationists at a given resource-based facility, the Bend Ranger District of the Deschutes National Forest. The sampled population 15/ is identified as that population of users in the Bend Ranger District of the Deschutes National Forest during the summer recreation season 16/ of 1967. The questionnaire used in the personal interviews conducted within the district is given in Appendix I.

Limited discussion can be given to the choice of the sampling unit, since in Chapter II the discussion of the quantity variable indicated the sampling unit to be considered in this study. In that

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14/ "The totality of elements which are under discussion and about which information is desired will be called the target population" (Mood and Graybill, 1963, p. 141).

15/ "Let x_1, x_2, ..., x_n be a random sample from a population with density f(x); then this population is called the sampled population" (Ibid., p. 142).

16/ Discussions with U.S. Forest Service officials in the Bend District indicated that the major portion of the summer recreation activity takes place between July 4th and Labor Day.

discussion, a recreation unit was defined as a group of recreationists [17/] encountered participating in outdoor recreation activities at the site. Therefore, in this study the sampling unit refers to the recreation unit and not to individual recreationists.

The final aspect of sampling to be considered is the determination of the size of the sample. Two pieces of information are necessary to arrive at the appropriate sample size. First, the tolerable limits of error which can be accepted in the sample estimates and the purpose of the study accomplished must be specified. Secondly, a probability statement relating the sample size and the limits of error must be constructed. The construction of the latter is dependent upon the type of sampling used in this study. For purposes of this analysis, the Bend Ranger District was stratified into two strata on the basis of accessibility of the sites. There are 59 designated summer sites in the Bend Ranger District. Because annual use data were not available or the sites were similar to other sites and adjacent to them, five of the 59 were deleted from the sample area. The remaining 54 sites were stratified into two strata; 13 sites were grouped into one stratum and 41 into the other. These two strata were further stratified by site; 13 substrata in one and

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17/ Recreationists in this case may refer to one or more individuals participating in outdoor activities together.

41 substrata in the other. Then a systematic sample of recreation units with a random start was taken within each substratum.

The development of a probability statement requires that an estimate of the variance of the variable under consideration be ascertained. In the present study, the variable of initial interest would be the quantity variable for each substratum (site). Therefore, the appropriate first approximation to the sample size would require an estimate of the variance of the quantity variable for each substratum (site) considered. Such information was not available for the facility under consideration and consequently, a probability statement could not be constructed. It should be pointed out that this would give only a first approximation to the sample size, since other variables besides the quantity variable are relevant to the analysis. Other problems associated with the determination of sample size in the demand for outdoor recreation studies, using the zoning approach have been discussed by Gray (1968).

The lack of adequate information on the variances made it necessary to arrive at a sample size by means other than conventional statistical procedures. Consequently, the sample size of 600 recreation units was arrived at by considering several factors. The number of interviews which can be conducted is constrained by availability of funds. Therefore, when funds are limited, the amount of error which will be accepted in the parameter estimates is partially determined. In addition, the use to be made of the data collected in the sample is also known. It was desirable that the sample taken be large enough so that an adequate representation of the origin of the user population could be identified for purposes of establishing distance zones. Within each stratum, it seemed desirable that the sample be large enough and distributed across the substrata (sites) in such a way that, if appropriate, further stratification of the sites could be accomplished and adequate sample data would be available to yield meaningful parameter estimates. Combining this information with the number of sites contained in the study area, the sample size of 600 recreation units was decided upon.

Sampling Procedure

The actual collection of the sample by personal interview in each substratum (site) and the size of that sample was determined in the following manner. Estimates of recreation visits [18/] by "area kind" [19/] at each designated site were obtained from the

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18/ A recreation visit is a visit to the recreation site. No length of time is associated with its measurement. In total, it is a measure of the total number of visits to a given "area kind" within a designated recreation site.

19/ "Area kind" is a designation of a code which identifies within a

U.S. Forest Service for the Bend Ranger District. Since the summation across each "area kind" to get the total recreation visits for each site would involve double counting, some other method had to be used if the available use data were to be useful in distributing the sample across the sites considered in the study. It was expected that most of the recreation units interviewed would be involved in the camping activity, so the recreation visits, at sites where more than one "area kind" was indicated, estimates for the campground-family type [20/] were used to represent the recreation visits for those sites. It seemed reasonable to expect that more recreation visits would be observed at the easily accessible sites. If the sample was distributed to each site on the basis of the proportion of visits taken at the site to the total recreation visits for all sites, the easily accessible sites would be sampled intensely and the more difficult to reach sites sparsely. An objective of the study is to estimate

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recreation site different areas, either by the type of recreation activity(s) they are designed for, or on the basis of some site characteristic associated with that given area of the recreation site. Examples of area kinds are: campground family-type; lakes or ponds; picnic ground-family type and trails-recreation.

[20/] U. S. Forest Service officials from the Bend District indicated that the estimates of visits relating to campground use were their most accurate.

demand equations for different levels of remoteness within the district, therefore, the sample taken must reflect the user population at all sites sufficiently well to provide enough observations so that meaningful estimates can be arrived at from the sample data. Therefore, it was decided that sites within the district be stratified into two strata on the basis of accessibility. One stratum was defined to include all the sites with difficult accessibility. A site was considered to have difficult accessibility if travel on a trail or primitive road [21/] was necessary to reach the site. Thirteen of the 54 sites were included within this stratum. The remaining 41 sites were considered easily accessible and were placed in the other stratum. Each site was given equal weighting for purposes of distributing the 600 recreation units to each of the two strata. Therefore, 13/54 of the 600, 144 recreation units were allocated to be sampled from the stratum including those sites with difficult accessibility and the remaining 456 were to be sampled from within the other stratum (for convenience, these numbers were rounded to 150 and 450).

Using the estimated recreation visits obtained for 1966 from the U.S. Forest Service, the number of recreation units to be

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21/ A primitive road can generally be defined as an unmaintained dirt road.

sampled within each stratum was distributed to each site in the stratum on the following basis. The ratio of recreation visits to each site in 1966 to the total number of recreation visits in the stratum was calculated. The number of recreation units to be sampled at each site was allocated to the sites on the basis of this ratio in each of the stratum.

Unofficial data available over a four-year period, 1963-1966, indicated that use in the district was not equally distributed throughout a week during the summer recreation season. The average, over this four-year period, indicated that 52.5% of the visits occurred during the five week days and 47.5% occurred on the two-day weekend. To account for this unequal use pattern within a week, the total number of recreation units to be sampled at each site were distributed to the week days and weekends on the basis of these two percentages. In addition, during the 1967 camping season there were two holiday weekends, the Fourth of July and the Labor Day weekend. Therefore, in attempting to account for all types of use in the facility, some consideration had to be given to the holiday users. There were ten weekends in the general camping season, two of which were holiday weekends. Of the number of recreation units to be sampled on the weekend, 2/10 were allocated to be collected on the Labor Day weekend. The remainder of the recreation units to be sampled on the weekends were collected during the two and one-half weeks period in August 1967 when the sampling, other than the Labor Day weekend, was conducted. The amount of recreation units at each site to be sampled on the regular weekends were distributed equally to each of the three weekends. A total of 13 week days were available during the sampling period, three in the first week and five in each of the remaining two weeks. The number of recreation units to be sampled at a site on the week days were distributed to be collected as closely as possible on the basis of the distribution of the number of week days available during the sampling period.

Sampling at each site was conducted in the following way: The interviewer entered the site, selecting the first recreation unit to be interviewed in such a way that each unit at the site had an equal opportunity to be selected. Subsequently, every nth recreation unit was interviewed, until the number of recreation units to be interviewed on that day was collected. How many units were skipped between each interview depended on the number of units at the site at that time. This procedure was adhered to as closely as possible at each site; however, at the more remote sites where difficulty was encountered in finding recreation units, generally whatever recreation units were available were interviewed.

The preceding is a description of the planned sampling procedure which was to be followed in the study. However, due to forest fires in the region, the sampling had to be less than the intended total of 600 recreation units. The existence of fire hazard in the forests of Oregon necessitated the closing of all forests to recreationists near the end of the sampling period. Twenty-one of the recreation units to be collected during the two and one-half weeks period were missed and were to be collected the last week in August, prior to the Labor Day weekend. These, along with the 54 recreation units to be interviewed on the Labor Day weekend, had to be cancelled. Therefore, a total of 525 recreation units were interviewed, 113 at the more remote sites and 412 at the more accessible sites.

Of the 525 total questionnaires collected, 45 were discarded because of irregularities. Sixteen of those discarded were related to recreation units stopping at the Bend Ranger District as a side trip to some other primary destination. Hindsight suggests that the construction of Question 19, which was designed to encounter this problem, was not extensive enough to allow satisfactory handling in these 16 cases. Some question should have been included to determine the miles involved in the side trip, as well as the days related to travel on this side trip. Twenty-one were discarded because of obvious misinterpretation of the questions by the respondents. The remaining eight questionnaires were excluded from the analysis because the respondents refused to give their family incomes, which made it impossible to place the recreation unit in the appropriate income group for its distance zone. Therefore the total number of usable observations was 480.

CHAPTER IV

EMPIRICAL CONTENT OF THE VARIABLES TO BE USED IN THE STATISTICAL MODELS

The variables discussed in Chapter II are now given empirical content. How these variables are estimated and whether these measurements are the most appropriate representation of the conceptualized variables will be the focus of this chapter. The construction of the population and income zones will be considered first in the discussion, then each variable used in the analysis will be considered.

Construction of Population and Income Zones

Application of the Hotelling-Clawson model employs the use of the concentric zone concept as a means of identifying the user population and defining the quantity variable. The cross-sectional differences in use which arise from differences in the population size of the zones is accounted for by placing the quantity variable, usually visits or recreation days, on a per capita basis. The distance zones are established by placing the geographical area from which the user population arises into population zones corresponding to the centers of population within the geographical region. Such population zones are constructed with the population center at the center of a given distance zone and includes all of the population which lies within the distance boundaries of the distance zone. All population lying within the boundaries of a given distance zone must be included, even though the user population does not normally arise out of every section of the zone. All of the zone population is relevant because the quantity variable is defined as the number of recreation days per capita from each zone. 22/ It can be expected that the users will not arise from the zone uniformally for two reasons: (1) the population is not expected to be homogenously distributed within the zone and (2) the availability of substitute recreation facilities may vary for recreationists residing in different parts of the zone.

The characteristics of the zone population can be used to further identify the user population. Identification of the distance zone population on the basis of characteristics such as occupation, education, income, or place of residence increases the specification of the distance zone population relevant to the use of the

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22/ Others have used somewhat different zoning constructions, Stevens (1965) and Brown, Singh and Castle (1964) used basically the concentric zone but restricted the population of relevance to only that lying within the State of Oregon. Pankey and Johnson (1968) and Gibbs (1969) used the county as the zone construct. Boyet and Tolley (1966) used state boundaries as the zone construct.

recreation facility. The better specified the population from which the facility users arise, the more meaningful the inferences are which can be drawn from the estimates desired.

Brown, Singh, and Castle (1964) and subsequently Stevens (1965) grouped the distance zone populations according to income. Several reasons exist for identifying the distance zone populations on the basis of income rather than some other population characteristic. First, and the main reason, is that income group data by state and county are readily available. Secondly, income is generally considered highly related to other population characteristics. Finally, the influence of income as a determinant of demand has long been established, and its reaction from a group standpoint can be expected to be significant. This is particularly true as the distance zones become further removed from the recreation facility under consideration. Consequently, for these reasons the distance zone populations will be further delineated by income groups.

Implementation of the above ideas in this study was conducted in the following manner: The relevant geographical area was determined by examining the residences of the recreation units observed in the sample. [23/] This examination revealed the following six towns and cities which are considered population centers from which users arise: Bend, Eugene, and Portland, Oregon; Seattle, Washington; San Francisco and Los Angeles, California. Each of these cities were located as close as possible to the center of a distance zone. These distance zones were determined by constructing concentric circles around the center of the Bend Ranger District. Counties were placed within each distance zone by using the distance from the major population center in each county. If no concentration of population existed within the county, the distance from the county seat was used to determine the appropriate distance zone. Table 2 and Figure 8 contain the counties and states by distance zones. Examination of Table 2 will reveal that all of the States of Oregon, California, Washington, Idaho, Nevada, and Utah, and parts of Wyoming, Montana, Arizona, Colorado, along with parts of the Canadian Provinces of British Columbia and Alberta combine to make up the relevant geographic region. Table 1 of Appendix 2 shows the number of recreation units and the number of recreation days observed in the sample by zone,

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[23/] This is based on the assumption that the sample was representative of the place of origin of the recreation units as well as the type of recreation units using the Bend Ranger District of the Deschutes National Forest.

Table 2. Distance Zones by Population Center, States and Counties.

Distance zone	Population center	State and counties[a]
1	Bend, Oregon	Oregon: Deschutes, Crook, Jefferson
2	Eugene, Oregon	Oregon: Benton, Lane, Linn, Marion, Hood River, Harney, Klamath, Wasco, Sherman, Gilliam, Wheeler
3	Portland, Oregon	Oregon: Douglas, Jackson, Lake, Grant, Morrow, Lincoln, Polk, Yamhill, Washington, Multnomah, Clackamas
		Washington: Clark, Skamania, Klictitat
4	Seattle, Washington	Oregon: Clatsop, Columbia, Tillamook, Coos, Curry, Josephine, Umatilla, Union, Wallowa, Baker, Malheur
		California: Del Norte, Siskiyou, Modoc, Humboldt, Trinity, Shasta, Lassen, Tehama, Mendocino, Glenn, Butte, Plumas, Sierra, Lake, Colusa, Sutter, Yuba, Nevada, Placer, Yolo
		Washington: Adams, Asotin, Benton, Chelan, Clallam, Columbia, Cowlitz, Douglas, Franklin, Garfield, Grant, Grays Harbor, Island, Jefferson, King, Kitsap, Kittitas, Lewis, Lincoln, Mason, Pacific, Pierce, San Juan, Skagit, Snohomish, Spokane, Thurston, Wahkiakum, Walla Walla, Whatcom, Whitman, Yakima
		Idaho: Latah, Nez Perce, Lewis, Adams, Valley, Washington, Payette, Gem, Boise, Canyon, Ada, Elmore, Gooding Owyhee

Table 2--Continued.

		Nevada: Douglas, Humboldt, Ormsby, Storey, Washoe Canada: British Columbia: Victoria
5	San Francisco, California	California: Sonoma, Napa, Solano, Sacramento, El Dorado, Alpine, Mono, Tuolumne, Mariposa, Madera, Amador, Calaveras, San Joaquin, Stanislaus, Merced, Marin, Contra Costa, San Francisco, Alameda, San Mateo, Santa Clara, Santa Cruz, San Benito, Monterey, Fresno Washington: Okanogan, Ferry, Stevens, Pend Orielle Idaho: Boundary, Bonner, Kootenai, Benewah, Shoshone, Clearwater, Idaho, Custer, Camas, Blaine, Butte, Lincoln, Jerome, Twin Falls, Minidoka, Cassia, Power, Bannock, Bingham, Oneida Nevada: Churchill, Elko, Lander, Lyon, Mineral, Pershing Utah: Box Elder, Cache Montana: Lincoln, Sanders Canada, British Columbia: Greater Vancouver, Comox-Alberni, Kootenay East, Okanogan Boundary
6	Los Angeles, California	California: All remaining counties in California not included in zones 4 and 5. Idaho: All remaining counties in Idaho not included in zones 4 and 5. Nevada: remaining counties in Nevada not included in zones 4 and 5.

Table 2--Continued.

	Utah: All remaining counties in Utah not included in zone 5.
	Wyoming: All counties except Crook, Weston, Converse, Niobrara, Platte, Goshen, Laramie
	Montana: All remaining counties not included in zone 5 except Phillips, Valley, Daniels, Sheridan, Roosevelt, Garfield, McCone, Richland, Dawson, Prairie, Wilbaux, Custer, Powder River, Fallon, Carter
	Colorado: Moffat, Routt, Jackson, Rio Blanco, Garfield, Mesa, Delta, Montrose
	Arizona: Mohave
	Canada:
	British Columbia: Cariboo, Kamloops, Kootney West, Nanaimo b/, Cowichan, The Islands, Okanogan Revelstoke
	Alberta: Battle River, Camerose, Bow River, Calgary, Edmonton, Lethbridge, Maclead, Medicine Hat, Red Deer, Wetaskiwin

a/ In the case of Canada, names within the two provinces correspond to electoral districts since county demarcations are not used in Canada.

b/ The electoral district of Nanaimo was inadvertently included in Distance zone 6 when it should have been included in zone 5. The size of the population of Nanaimo is so small relative to the total population that little influence, if any, can be expected on the quantity variables from these zones.

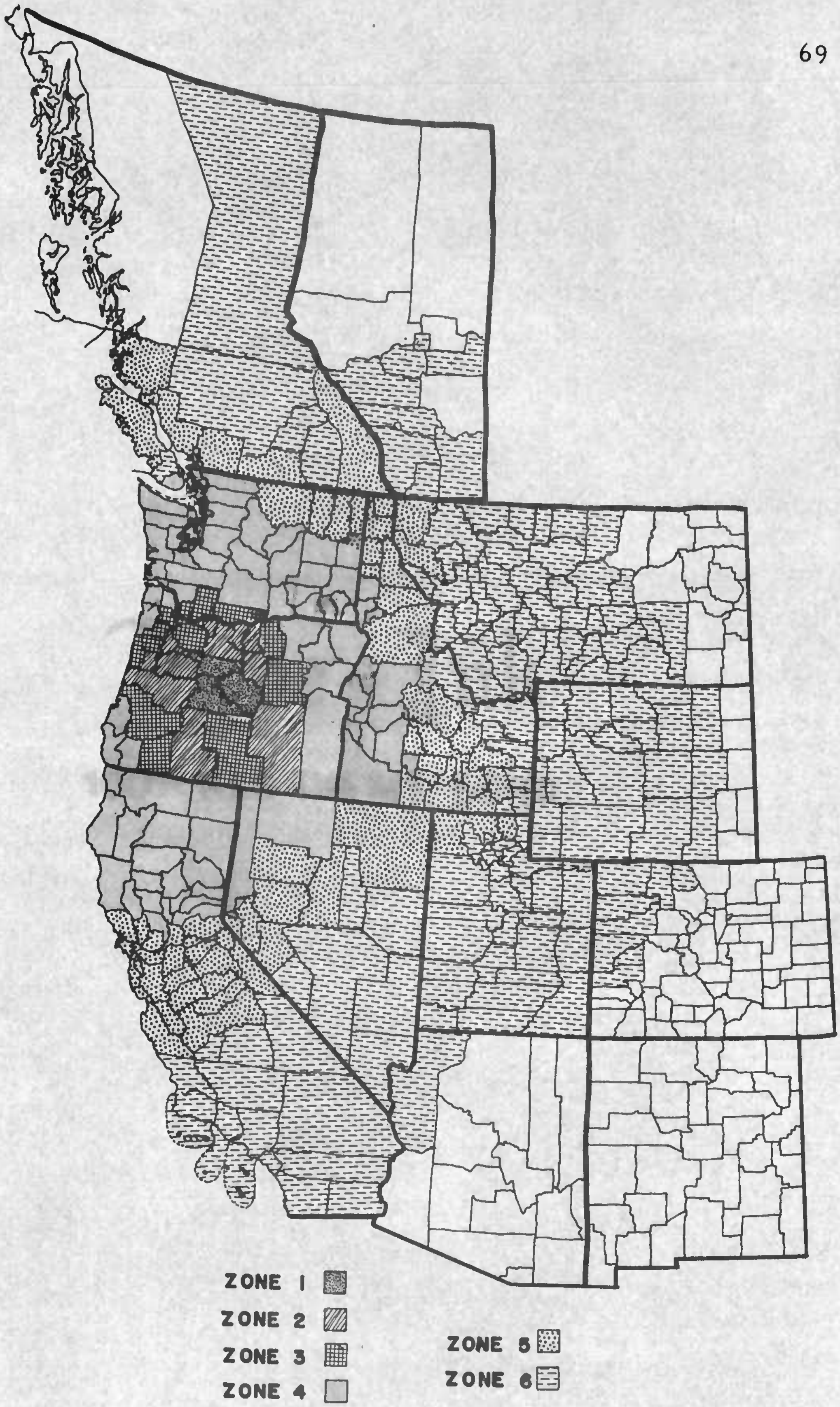

Figure 8. Geographic location of the six distance zones.

state, and counties from which they arise.

The establishment of the population distance zones along county lines allows the further identification of population by income groups within each distance zone. Using July 1, 1966, population estimates by county (U.S. Bureau of the Census, 1968) the population within each county was grouped into six income groups. Then by income group, the populations were summed for those counties comprising the distance zone. Table 3 presents the distribution of population by income group within each distance zone along with the observed number of recreation units and recreation days. The distribution of income for each county was arrived at in the following way: For Oregon, unpublished data for the income distribution by county of total number of tax returns for 1966 was obtained from the Oregon State Tax Commission and the percent of population in each income group by county was estimated from this data. 1966 total tax return data from California (California, 1966, p. 41-51) was used in the same way to estimate the distribution of income by county in that state. All other states were given the distribution of income as indicated by the 1960 Census of Population (U.S. Bureau of the Census, 1963). Population estimates for the two Canadian Provinces were based on the 1961 distribution of population by electoral districts (Dominion Bureau of Statistics, 1967a) which were inflated by the estimated percent increase for

Table 3. The Distribution of Population, Sampled Recreation Units, and Total Recreation Days by Income Group within Each Distance Zone.

Distance zone and income group	Population	Number of recreation units observed	Total number of recreation days observed
1			
Under $2, 000	6, 499	2	68
2, 000- 3, 999	5, 569	2	68
4, 000- 5, 999	7, 550	6	38
6, 000- 9, 999	16, 718	28	82
10, 000-14, 999	7, 542	10	49
15, 000 & over	2, 922	8	17
2			
Under $2, 000	68, 273	0	0
2, 000- 3, 999	59, 861	8	120
4, 000- 5, 999	77, 901	7	27
6, 000- 9, 999	213, 669	48	464
10, 000-14, 999	101, 002	40	200
15, 000 & over	37, 194	12	36
3			
Under $2, 000	134, 165	1	4
2, 000- 3, 999	127, 625	5	119
4, 000- 5, 999	165, 904	5	133
6, 000- 9, 999	439, 138	81	796
10, 000-14, 999	248, 442	60	385
15, 000 & over	96, 326	18	128
4			
Under $2, 000	398, 359	3	28
2, 000- 3, 999	685, 311	3	15
4, 000- 5, 999	1, 056, 170	4	85
6, 000- 9, 999	1, 593, 047	16	216
10, 000-14, 999	588, 358	14	93
15, 000 & over	218, 761	5	19

Table 3--Continued.

5			
Under $2, 000	522, 538	0	0
2, 000- 3, 999	1, 297, 550	1	7
4, 000- 5, 999	1, 713, 790	5	109
6, 000- 9, 999	2, 447, 142	16	237
10, 000-14, 999	1, 452, 328	18	120
15, 000 and over	707, 030	9	90
6			
Under $2, 000	991, 093	0	0
2, 000- 3, 999	2, 481, 098	1	4
4, 000- 5, 999	3, 148, 827	4	130
6, 000- 9, 999	4, 744, 088	15	183
10, 000-14, 999	2, 616, 000	11	88
15, 000 and over	1, 291, 258	14	74

each province given in the 1967 Canada Yearbook (Dominion Bureau of Statistics, 1967a). The population was then distributed for each electoral district on the basis of the 1961 Census of Canada for each province. The income groups for the Canadian provinces (Dominion Bureau of Statistics, 1967b, p. 53) only went to $10, 000 or more. In order to distribute the population through the last two income groups used, that portion of the population in the $10, 000 or more group from the Canadian census data was allocated between the $10, 000-$14,999 and $15, 000 and over categories in the following way. Using the rest of the zone population in these two income groups, the percentage of this population in each of the two income groups was determined. These two percentages were then used to allocate the population in the $10, 000 or more category from the Canadian census to the final two income groups to be used in the study. Two and four tenths percent of the population of each electoral district included in the study from British Columbia, and 2.7% from Alberta, had to be distributed to the last two income groups in this manner. The income groups used to distribute zone populations were based on U.S. dollars. Therefore, it was assumed that the Canadian income groups corresponded directly. This assumption would not have been necessary if the exchange rate between U.S. and Canadian dollars at the time of the study had been used to adjust the Canadian income groups. However, since two different year distributions were being used such an attempt seemed unwarranted.

As indicated in Table 3, the sample data were placed into income groups according to the response given in Question 30, Appendix 1. Using the midpoints of the income groups on the questionnaire, each recreation unit was placed into its distance zone income population group. The \$14, 000-\$15, 999 income category on the questionnaire does not fall within the \$10, 000-\$14, 999 or the \$15, 000 and over categories, although its midpoint of \$15, 000 would place those recreation units indicating family incomes in this range into the \$15, 000 and over income population group. It was decided to place these recreation units into the \$10, 000-\$14, 999 because it seemed reasonable to expect a greater similarity in consumption patterns to this population group as opposed to that population having incomes of \$20, 000 and greater, which are included in the \$15, 000 and over population group.

Construction of Variables

The empirical measurement of the variables to be used in the statistical analysis will be discussed next. The data used was obtained from personal interviews taken at the facility and secondary sources from which information on the site characteristics were taken. The source of the data and their use in the zoning framework will form the remaining content of this chapter.

Before proceeding to a discussion of the variables, a deviation from the usual independent variable construction should be pointed out. It has generally been the practice to use as the independent variables for each zone income population group the simple average of the variable as obtained from the sample units of each zone income group. For purposes of this study, this procedure will be deviated from and a weighted average of each of the independent variables will be used. The number of days each recreation unit stays at the site will be used as the weight in the construction of this weighted average. Because the dependent variable is expressed as days from a zone income group per capita, each observation (recreation unit) contributes differently to the total number of days taken from a zone income group, depending on how many days the observation stays at the facility. Therefore, this difference between the contribution made to the dependent variable by recreation units should also be reflected in the independent variables. This is done by weighting each recreation unit's independent variables by the number of days it contributes to the total number of recreation days observed from its zone income group.

Quantity Variable

The quantity variable to be used in the statistical analyses is defined as the number of recreation days per 1, 000, 000 population observed in the sample for each zone income population group. Table 4 presents the total number of recreation days per 1, 000, 000 population by zone income group for the Bend Ranger District and each level of remoteness to be considered in the analyses. Remoteness, as it will be used in this study, is based on the type of road access to the site. On this basis, the sites have been grouped in the following way: (1) All those sites with direct access from a paved road; (2) all those sites with access via paved road and all-weather road [24/]; (3) all those sites with access via paved road and dirt road; (4) all those sites with access via paved, all-weather, dirt and/or primitive roads; and (5) all those sites with access via trails. Several trails which did not lead to a particular designated site were included in the analysis; these were included as sites in remoteness grouping (5). A list of sites and the number of days sampled at each, by remoteness category, is given in Table 2 of Appendix 2.

The above measure is a first approximation to a reflection of remoteness. It was initially thought that some combination of time, upon entrance of the Bend District, to reach the site and type of access would provide a more appropriate measure of remoteness.

24/ An all-weather road is one which has a gravel or crushed rock surface.

Table 4. Total Number of Recreation Days Per Capita by Distance Zone, Income Population Group and Remoteness Levels.

Distance zone	Income population group	Total Bend ranger district	Remoteness a/ I	Remoteness b/ II	Remoteness c/ III	Remoteness d/ IV	Remoteness e/ V
		Recreation days per capita X10^{-6}					
1							
	Under $2,000	10,463.15	---	10,309.27	---	153.86	---
	2,000- 3,999	12,210.45	359.13	---	---	11,851.31	---
	4,000- 5,999	5,033.11	264.90	3,841.05	264.90	662.25	---
	6,000- 9,999	4,904.89	1,435.57	837.42	1,435.57	538.34	657.90
	10,000-14,999	6,496.95	4,905.86	---	---	530.36	1,060.72
	15,000 & over	5,817.93	---	1,026.69	2,395.61	342.23	2,053.38
2							
	Under $2,000	---	---	---	---	---	---
	2,000- 3,999	2,004.64	935.50	33.41	835.26	---	200.46
	4,000- 5,999	346.59	154.04	---	179.71	---	12.83
	6,000- 9,999	2,171.58	234.00	252.72	1,450.84	182.52	51.48
	10,000-14,999	1,980.16	742.55	217.81	247.51	277.22	495.03
	15,000 & over	967.90	295.74	---	134.43	107.54	430.17
3							
	Under $2,000	29.81	---	---	29.81	---	---
	2,000- 3,999	932.42	23.50	101.86	713.02	94.02	---
	4,000- 5,999	801.67	747.42	30.13	24.11	---	---
	6,000- 9,999	1,812.64	853.94	111.58	601.17	102.47	143.46
	10,000-14,999	1,549.66	635.96	257.60	446.78	128.80	80.50
	15,000 & over	1,328.82	674.79	166.10	145.33	72.66	269.91

Continued

Table 4--Continued.

4						
Under $2,000	70.29	7.53	47.69	15.06	---	---
2,000- 3,999	21.89	---	7.29	14.59	---	---
4,000- 5,999	80.48	1.89	72.90	5.68	---	---
6,000- 9,999	135.59	18.83	3.13	104.83	3.76	5.02
10,000-14,999	158.07	54.38	50.98	23.79	---	28.89
15,000 & over	86.85	82.28	---	---	---	4.57
5						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	5.39	---	---	---	5.39	---
4,000- 5,999	63.60	1.16	12.25	50.18	---	---
6,000- 9,999	96.85	76.00	5.72	15.11	---	---
10,000-14,999	82.62	16.52	19.96	20.65	25.47	---
15,000 & over	127.29	29.70	19.80	49.50	28.28	---
6						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	1.61	---	1.61	---	---	---
4,000- 5,999	41.28	20.64	8.25	---	12.38	---
6,000- 9,999	38.57	14.33	22.34	1.26	.64	---
10,000-14,999	33.64	2.67	13.76	8.79	8.40	---
15,000 & over	57.31	25.55	10.84	10.06	8.51	2.32

a/ Remoteness I will be used to refer to sites accessible by paved roads.
b/ Remoteness II will be used to refer to sites accessible by paved and all-weather roads.
c/ Remoteness III will be used to refer to sites accessible by paved and dirt roads.
d/ Remoteness IV will be used to refer to sites accessible by paved, all-weather and dirt roads.
e/ Remoteness V will be used to refer to sites accessible by trails only (all recreation units interviewed on a designated trail were included in this remoteness level).

However, no question in the personal interview was asked about point of entrance into the district or how long it took to reach the site once the district had been entered. Therefore, the data available would have been inadequate to identify remoteness in this way. A more sophisticated approach, utilizing a technique similar to that employed by Lucas (1965) in his study of wilderness areas, may have been employed. However, in this case, some sites would be included in different levels of remoteness depending upon the perception of remoteness of the recreation units interviewed.

Price Variable

Transfer cost per day, it was argued, is the effective price to the recreation unit for a day of outdoor recreation. Defined in this way, the transfer cost variable represents all variable expenditures by the recreation unit incurred on the trip to and from the site, and all variable costs incurred while at the site. A complete list of items used to construct the transfer cost is given in Question 27 of the questionnaire, Appendix 1. Several of the expenditure items obtained in Question 27 require additional manipulation before incorporation into the transfer cost variable. A discussion of these manipulations will be beneficial in understanding the character of the transfer cost variable.

An attempt is made to remove the at home food expenditures from those occurring while at the site and in travel. If the transfer cost is to reflect the variable cost associated with the recreation experience, then whenever possible, it is necessary that the normal at home expenditures be removed. For purposes of this discussion, food expenditures will be broken into two groups: (1) Food expenditures at the site, and (2) food expenditures while traveling. In each, the average at home cost per day per person for food, beverages and tobacco by six "before tax" family income categories was calculated for 1967 using averages based on 1961-1962 data (Linden, 1965, p. 26) inflated by the 1967 consumer price index for food (Commodity prices, 1968). For the on site food expenditures, the difference between these expenditures for food at the site by each recreation unit and the average at home expenditures for the income group to which the recreation unit belonged was obtained. This difference is used as food expenditures in the construction of the transfer cost variable.

The number of days in travel to the site was not obtained during the personal interview. Therefore, some additional assumptions had to be made to obtain the difference between food cost while traveling and at home average food expenditures. It was assumed that the average miles traveled in a day was 400 miles, and that anyone traveling less than 200 miles to the site would do so without necessarily incurring food expenditures on the trip. Any recreation unit traveling 200 miles or further, therefore, would be assumed to have incurred food expenditures on the trip. To determine the food while traveling on the trip over and above the normal at home food expenditures to be included in the transfer cost, the following procedure was adopted. All the recreation units traveling less than 200 miles to the site and indicating no food expenditures while traveling were assumed to have zero food expenditures while traveling. Recreation units traveling less than 200 miles to the site and indicating food expenditures while traveling were handled as follows: The average at home food costs were multiplied by the ratio of miles the recreation unit traveled to 400 miles. The difference between the indicated food expenditures for the recreation unit and the above obtained product was applied to the recreation unit's transfer cost. For recreation units traveling 200 miles or more, the same manipulation was used and the difference applied to the transfer cost, whether or not expenditures for food while traveling were indicated in the interview.

Gas and oil expenditures in previous studies have generally been calculated in the following way: Obtain the total distance traveled and multiply this mileage figure by an average cost per mile. In general, this average cost per mile was that for automobiles. In the original construction of the questionnaire, it seemed reasonable to expect not only automobiles, but also truck campers, trailer campers, automobiles pulling boats and trailers, etc. Therefore, in an attempt to differentiate between the transportation cost incurred in the operation of these various vehicles, a question designed to obtain gas and oil expenditures associated with the trip was included on the questionnaire. Examination of the questionnaires revealed that some of the responses given to this question were suspect. This was particularly true with respect to the recreation units traveling the greater distances. The questionable responses from this group were in the form of unexplainable low gas and oil cost figures. In order to avoid nonuse of the data obtained, an average for each group of vehicles observed in the personal interviews was derived and multiplied by the miles traveled for each recreation unit, depending on the vehicle type. This reduced the variability within each vehicle group, but allowed for differences between groups of vehicles. Expenditures relating to vehicle maintenance while on the trip were also collected on the questionnaire. This cost item was added to the gas and oil expenditures, in those cases where it was indicated on the questionnaire, for purposes of computing the averages referred to above for each group of vehicles. Therefore, the average cost figure for each vehicle group includes not only gas and oil expenditures, but also a representation of the average maintenance incurred by those recreation units in the sample. Table 3, Appendix 2, presents the different types of vehicles for which averages were calculated, the average cost per mile by vehicle group and the number observed in the sample of each vehicle or vehicle combination. There were 11 recreation units with vehicle combinations which occurred only once; the questionnaire expenditures were used in these cases. The total one-way gas, oil and maintenance was doubled, i.e., it was assumed that the recreation unit came to the site by the shortest distance and returned by the same route.

The two other costs incurred while traveling, lodging while traveling and food while traveling, with at home normal food cost removed, were also doubled. This is because one-way costs were obtained on the questionnaire. Therefore, it was assumed that food and lodging while traveling would be the same for the recreation unit to and from the site. All other variable expenditure items were entered into the transfer cost directly. The total transfer cost was then divided by the number of days the recreation unit stayed at the site to get the transfer cost per day for each recreation unit observed in the sample. The average transfer cost per day for each income population group is calculated by using the transfer cost per day for each recreation unit from the income population group in the sample, Table 5.

It seems reasonable to expect that the transfer cost per day will be a function of the number of individuals in the recreation

Table 5. Average Transfer Cost Per Day by Zone Income Population Group for the Bend Ranger District and Each Level of Remoteness.

Distance zone	Income population group	Total Bend ranger district	Remoteness I	Remoteness II	Remoteness III	Remoteness IV	Remoteness V
		($)	($)	($)	($)	($)	($)
1							
	Under $2, 000	-11.12	---	-11.38	---	6.03	---
	2,000- 3,999	.49	9.26	---	---	.22	---
	4,000- 5,999	.96	1.61	-.27	2.44	7.24	---
	6,000- 9,999	4.42	5.83	1.04	-.38	5.18	15.52
	10,000-14,999	1.75	2.40	---	---	-2.93	1.08
	15,000 & over	3.85	---	2.85	7.61	5.02	-.23
2							
	Under $2, 000	---	---	---	---	---	---
	2,000- 3,999	.90	-.36	10.56	.83	---	5.53
	4,000- 5,999	6.20	5.05	---	6.11	---	21.14
	6,000- 9,999	2.39	4.97	6.64	.64	5.97	6.19
	10,000-14,999	8.52	7.26	13.41	10.58	12.00	5.26
	15,000 & over	6.91	16.81	---	22.06	4.66	-4.08
3							
	Under $2, 000	5.03	---	---	5.03	---	---
	2,000- 3,999	2.39	8.07	8.66	1.24	2.92	---
	4,000- 5,999	1.55	.92	12.48	7.47	---	---
	6,000- 9,999	3.97	3.50	11.32	2.85	7.56	3.22
	10,000-14,999	6.64	8.17	7.91	4.10	5.34	6.70
	15,000 & over	7.28	6.10	-.87	19.56	3.89	9.57

Continued

Table 5--Continued.

4						
Under $2,000	10.83	20.48	11.03	5.37	---	---
2,000- 3,999	11.03	---	9.36	11.87	---	---
4,000- 5,999	3.31	69.73	1.49	4.59	---	---
6,000- 9,999	-.38	10.71	29.83	-4.03	17.29	2.06
10,000-14,999	9.36	14.61	1.60	12.33	---	10.73
15,000 & over	18.66	19.09	---	---	---	10.79
5						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	7.88	---	---	---	7.88	---
4,000- 5,999	4.91	50.26	4.90	3.85	---	---
6,000- 9,999	4.70	1.58	42.56	6.09	---	---
10,000-14,999	15.92	30.24	20.91	4.80	11.73	---
15,000 & over	10.07	23.11	5.28	12.05	-3.72	---
6						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	22.89	---	22.89	---	---	---
4,000- 5,999	2.01	1.07	2.82	---	3.05	---
6,000- 9,999	8.64	14.68	.66	58.37	54.25	---
10,000-14,999	22.43	25.98	19.75	26.39	21.56	---
15,000 & over	40.37	21.88	48.72	66.84	36.73	103.43

unit. Therefore, part of the difference in the average transfer per day between income groups may arise because the average size of the recreation unit differs between income groups. In an effort to account for this difference, the average number of individuals in the recreation unit will be incorporated as an independent variable in the analysis. Table 6 presents the average number of individuals in the recreation unit by income population group for each analysis.

Income and Distance

Distance: Geographically, the location of the Bend Ranger District is such that recreation units must pass through either Bend or Lapine, Oregon, to reach access roads to the district, if major highways are traveled. Once Bend or Lapine is reached, there are five major access routes into the district, one of which leads only to two sites. The access route into the district depends upon whether the recreation unit approaches the district from Lapine or Bend, and the location of the site within the district at which the recreation unit was observed. In determining the overall distance traveled by the recreation unit, it was assumed that the recreation unit proceeded from its place of residence to Bend or Lapine, whichever was the shortest distance from the recreation unit's residence. Then, from one of these two locations, it was assumed that the recreation unit proceeded to the site by the most direct route.

Table 6. Average Number of Individuals in a Recreation Unit by Zone Income Population Group for the Bend Ranger District and Each Level of Remoteness.

Distance zone	Income population group	Total Bend ranger district	Remoteness I	Remoteness II	Remoteness III	Remoteness IV	Remoteness V
1							
	Under $2,000	15.8	---	16.0	---	2.0	---
	2,000- 3,999	2.0	3.0	---	---	2.0	---
	4,000- 5,999	3.2	3.0	2.9	4.0	4.2	---
	6,000- 9,999	4.5	3.3	3.1	6.6	1.9	6.5
	10,000-14,999	4.2	3.4	---	---	11.0	4.4
	15,000 & over	3.5	---	3.0	4.0	2.0	3.5
2							
	Under $2,000	---	---	---	---	---	---
	2,000- 3,999	2.5	2.0	3.0	2.6	---	3.3
	4,000- 5,999	4.1	4.5	---	4.0	---	2.0
	6,000- 9,999	3.1	4.1	3.5	2.4	5.8	7.1
	10,000-14,999	4.4	5.0	4.7	2.6	3.6	4.8
	15,000 & over	6.5	2.8	---	4.0	3.0	10.8
3							
	Under $2,000	4.0	---	---	4.0	---	---
	2,000- 3,999	1.3	2.0	2.5	1.0	2.0	---
	4,000- 5,999	2.0	2.0	2.6	2.0	---	---
	6,000- 9,999	3.2	3.1	3.5	2.8	4.1	5.3
	10,000-14,999	4.6	4.6	5.6	3.9	4.5	5.2
	15,000 & over	4.5	4.0	5.0	4.4	3.0	5.9

Continued

Table 6--Continued.

4						
Under $2,000	2.0	2.0	2.0	2.0	---	---
2,000- 3,999	3.3	---	1.0	4.4	---	---
4,000- 5,999	2.0	4.0	2.0	2.0	---	---
6,000- 9,999	6.0	3.5	3.2	6.6	3.3	7.0
10,000-14,999	5.4	4.4	5.5	2.7	---	9.2
15,000 & over	4.7	4.7	---	---	---	5.0
5						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	4.0	---	---	---	4.0	---
4,000- 5,999	2.4	3.0	2.0	2.4	---	---
6,000- 9,999	3.6	3.4	3.4	4.8	---	---
10,000-14,999	4.2	4.1	5.0	4.0	3.7	---
15,000 & over	4.3	4.5	2.0	4.0	6.0	---
6						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	1.0	---	1.0	---	---	---
4,000- 5,999	2.8	3.2	3.0	---	2.0	---
6,000- 9,999	2.9	3.9	2.0	4.8	6.0	---
10,000-14,999	3.7	6.0	4.0	3.9	2.2	---
15,000 & over	4.3	4.4	4.2	3.6	5.0	3.3

Highway maps were used to determine the distance traveled from place of residence to Bend or Lapine. The mileage from these points to the site was estimated by the use of a fireman's map of the district and a mileage wheel. In 29 of the 108 different routes established to sites in the district, it was not entirely obvious which was the logical route to follow. In such cases it was assumed, as above, that the recreation unit would select the route which requires the shortest time to travel. In order to decide which route required the shortest time the following miles per hour were assumed on the different types of roads within the district:

Paved roads - 60 miles per hour.

All-weather roads - 40 miles per hour.

Dirt roads - 25 miles per hour.

Primitive roads - 10 miles per hour.

The selection of this criteria is somewhat arbitrary, but gives some basis for being consistent in making the decision when it had to be made. In order to be able to approach the solution to this problem in a more accurate way, it would be necessary to know how much further an individual would be willing to travel on a paved road rather than travel on a dirt road or similar road combinations.

As previously stated, there are five paved routes into the district, but there are also 11 access routes to the district other than paved. In all cases, that route which the recreation unit is assumed to follow is the one requiring the shortest time to reach the site. Hence, the distance used in the analyses is the sum of the shortest distance to Bend or Lapine via major highways and the shortest in time to the site from these two towns. Distance is not used directly in the analyses as a variable because of the prior evidence of the high interrelationship with transfer cost. However, it is used in the computation of the gas, oil and maintenance portion of the transfer cost.

Income: Total family income was obtained through the questionnaire via personal interviews. Appendix 1, Question 30. An examination of Question 30 will reveal that the wording was not as precise as it should have been. No specific identification was attached to the total family income to indicate whether "before" or "after taxes" income was desired. It is assumed that the income given was the "before taxes" family income. However, "after taxes" income appears to be the most relevant because it corresponds more closely to disposable income and is more directly related to consumption.

Family income was collected in the form of a \$2, 000 range with two open intervals, under \$2, 000 and \$20, 000 or more. In the analyses, the midpoints of the closed intervals are used as the income of the recreation units. An unpublished summary of the distribution of personal income for Oregon for 1966 obtained from the Oregon Tax Commission is used to estimate the average incomes of recreation units with incomes under $2, 000 and $20, 000 or more. A weighted average income was calculated based on the number of returns and on the number of exemptions. As expected the weighted average incomes calculated on these two sets of data were similar. For incomes under $2, 000, the weighted average income calculated using all returns indicating positive incomes, was $998. 11 and that calculated from exemptions was $1, 043. 96. It was decided, based on this information, to use $1, 000 as the family income of the recreation units indicating an income under $2, 000.

For incomes of $20, 000 and more, the unpublished personal tax data went up to $500, 000 or more. The $500, 000 or more open interval had only nine returns and 25 exemptions reported in this interval, therefore this interval was left out in the calculations of the average income over $20, 000. Using the intervals in the range from $20, 000 to $500, 000 the weighted average income based on all returns was $35, 593. 80 and that based on exemptions was $35, 478. 48. Based on these results, an average income of $35, 550 was used as an estimate of the family incomes for recreation units indicating $20, 000 or more. The weighted averages by zone income population groups for each analysis are presented in Table 7.

Site Characteristics

In addition to the accessibility variable which is used in the classification of the quantity variable, three physical characteristics of the site are considered in the analysis. These characteristics will be considered in the following order: (1) The level of site development, (2) potential density of use, and (3) the level of fishing success.

Level of Site Development: The level of site development, as hypothesized in the conceptual model, is assumed to enter the demand function via the preference function of the recreation unit. The suggestion is that the recreation unit is sensitive to the extent to which the site is developed within a given level of remoteness. In order to supply empirical content to this variable, it is necessary that a definition be given to development in the recreation context. As it is used in this study, development will represent only the development at the site related to recreation activity, exclusive of access road development to the site. Development, then, reflects the man-made changes at the site which make it more usable and available to the user population for outdoor

Table 7. Average Total Family Income by Zone Income Population Group for the Bend Ranger District and Each Level of Remoteness.

Distance zone	Income population group	Total Bend ranger district	Remoteness I	Remoteness II	Remoteness III	Remoteness IV	Remoteness V
		($)	($)	($)	($)	($)	($)
1							
	Under $2,000	1,000	---	1,000	---	1,000	---
	2,000- 3,999	3,000	3,000	---	---	3,000	---
	4,000- 5,999	5,000	5,000	5,000	5,000	5,000	---
	6,000- 9,999	8,122	8,167	7,714	8,667	7,000	8,273
	10,000-14,999	11,531	11,432	---	---	13,000	11,250
	15,000 & over	21,953	---	19,000	17,000	17,000	30,033
2							
	Under $2,000	---	---	---	---	---	---
	2,000- 3,999	3,000	3,000	3,000	3,000	---	3,000
	4,000- 5,999	5,000	5,000	---	5,000	---	5,000
	6,000- 9,999	8,509	8,040	7,481	8,787	8,231	8,818
	10,000-14,999	11,810	11,453	13,727	12,520	11,143	11,520
	15,000 & over	28,725	24,836	---	28,130	17,000	34,516
3							
	Under $2,000	1,000	---	---	1,000	---	---
	2,000- 3,999	3,000	3,000	3,000	3,000	3,000	---
	4,000- 5,999	5,000	5,000	5,000	5,000	---	---
	6,000- 9,999	8,226	7,677	8,755	8,765	8,200	8,841
	10,000-14,999	11,821	11,797	11,719	11,595	12,188	13,000
	15,000 & over	24,884	27,458	17,000	20,975	19,000	26,988

Continued

Table 7--Continued.

4						
Under $2,000	1,000	1,000	1,000	1,000	---	---
2,000- 3,999	3,000	---	3,000	3,000	---	---
4,000- 5,999	5,000	5,000	5,000	5,000	---	---
6,000- 9,999	7,417	8,400	9,000	7,132	7,000	9,000
10,000-14,999	12,677	11,625	13,000	13,857	---	13,118
15,000 & over	24,916	25,244	---	---	---	19,000
5						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	3,000	---	---	---	3,000	---
4,000- 5,999	5,000	5,000	5,000	5,000	---	---
6,000- 9,999	8,772	8,914	9,000	7,973	---	---
10,000-14,999	12,850	12,667	13,138	13,000	12,622	---
15,000 & over	26,386	31,610	17,000	21,770	35,550	---
6						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	3,000	---	3,000	---	---	---
4,000- 5,999	5,000	5,000	5,000	---	5,000	---
6,000- 9,999	8,366	7,441	9,000	8,333	7,000	---
10,000-14,999	12,227	15,000	12,778	11,696	11,000	---
15,000 & over	26,727	32,359	18,286	26,638	18,273	35,550

recreation activities. The selection of an empirical variable to represent the level of development must reflect the degree to which sites have been developed relative to each other. Initially, it was thought that investment in recreation facilities at the site would give such a measure. Investigation of available records revealed that the information was not complete enough for the present study. Therefore, some other measure of development had to be ascertained. It was decided that the per unit [25/] replacement cost for each site would provide an adequate substitute.

The replacement cost for each site, excluding the resorts, is constructed in the following way: Costs for most of the items were ascertained from an average cost list provided by the Northwest Regional Office of the Forest Service (U. S. Forest Service, 1968a). For those items for which costs were not available, estimates were provided by the District Forest Service officials. The list of estimated cost was then combined with an inventory of facilities (U. S. Forest Service, 1968c) at the site to obtain the total replacment cost for the site. A per unit replacement cost was then obtained by dividing the total estimated replacement cost by the number of units at each site.

25/ A unit as it is referred to here represents an overnight facility at a site such as tent pads, trailer spurs, and resort units.

Development at the three resorts in the district was handled differently. Records on property assessments from the Deschutes County Assessor's office were used to provide the per unit level of investment. The weighted averages used in the analyses are given in Table 8 and the estimates of total replacement cost, number of units at the site, along with the per unit replacement cost by site is given in Table 4, Appendix 2.

An examination of Table 8 reveals that the average level of development for those sites visited by recreation units from each income group observed in Remoteness Level V is higher than might be expected. The reason for this unexpectedly high value is due to a developed water system which exists at one of the sites, West Cultus Lake campground and the inclusion into this remoteness level trails which did not lead to a particular site. In the cases where designated trails were included as the site, the development level, which is determined by dividing total replacement cost by the number of units, is unduly high. This is because there is generally along these trails toilet facilities and waste disposal containers and for consistency, i.e., to place the replacement cost on a per unit basis, the replacement cost of these facilities were divided by one. This procedure therefore, distorts the per unit replacement cost constructed to be used in the calculation of the income group averages.

Table 8. Average Per Unit Development of Sites Visited by Recreation Units from Each Zone Income Population Group for the Bend Ranger District and Each Level of Remoteness.

Distance zone	Income population group	Total Bend ranger district	Remoteness I	Remoteness II	Remoteness III	Remoteness IV	Remoteness V
		($)	($)	($)	($)	($)	($)
1							
	Under $2, 000	570	---	567	---	736	---
	2, 000- 3, 999	395	405	---	---	395	---
	4, 000- 5, 999	626	3, 227	500	411	406	---
	6, 000- 9, 999	1, 699	3, 156	567	570	402	3, 484
	10, 000-14, 999	2, 468	2, 972	---	---	423	1, 160
	15, 000 & over	1, 048	---	567	411	423	2, 135
2							
	Under $2, 000	---	---	---	---	---	---
	2, 000- 3, 999	2, 124	3, 227	474	604	---	3, 579
	4, 000- 5, 999	653	1, 074	---	296	---	602
	6, 000- 9, 999	549	1, 592	512	269	444	4, 310
	10, 000-14, 999	2, 466	3, 202	554	326	505	4, 371
	15, 000 & over	2, 924	2, 667	---	417	395	4, 517
3							
	Under $2, 000	240	---	---	240	---	---
	2, 000- 3, 999	296	405	567	240	395	---
	4, 000- 5, 999	418	405	567	634	---	---
	6, 000- 9, 999	989	1, 322	554	383	451	2, 266
	10, 000-14, 999	1, 756	3, 269	515	299	427	3, 978
	15, 000 & over	2, 628	3, 048	567	220	423	4, 734

Continued

Table 8--Continued.

4						
Under $2, 000	603	1, 242	567	398	---	---
2, 000- 3, 999	344	---	498	267	---	---
4, 000- 5, 999	582	4, 449	508	240	---	---
6, 000- 9, 999	793	1, 836	488	418	561	5, 067
10, 000-14, 999	2, 162	3, 089	320	458	---	5, 067
15, 000 & over	3, 145	3, 286	---	---	---	602
5						
Under $2, 000	---	---	---	---	---	---
2, 000- 3, 999	390	---	---	---	390	---
4, 000- 5, 999	394	356	498	370	---	---
6, 000- 9, 999	453	480	544	280	---	---
10, 000-14, 999	1, 018	3, 116	534	240	669	---
15, 000 & over	403	390	567	261	551	---
6						
Under $2, 000	---	---	---	---	---	---
2, 000- 3, 999	498	---	498	---	---	---
4, 000- 5, 999	2, 148	3, 932	567	---	395	---
6, 000- 9, 999	1, 207	2, 437	498	277	220	---
10, 000-14, 999	628	2, 114	682	327	384	---
15, 000 & over	1, 487	2, 462	566	313	1, 242	1, 033

Potential Density of Use: The second site characteristic, the potential density of use, as described in Chapter II, reflects the possibility of interaction with other recreationists at the site. The appropriate measure for the variable depends upon the design of the site, how the units are located, and the full capacity in numbers of people at the site at any one time. For each site, "the people at one time" capacity 26/ is given for each area kind 27/. (U.S. Forest Service, 1968b). The possible area kinds at each site are given in the following list:

Observation sites.

Boating sites.

Swimming sites.

Campground--family type.

Picnic ground--family type.

Hotel, lodge, resort, privately owned.

Other commercial public service sites.

26/ The people at one time capacity at developed sites is defined by the Forest Service Rim Handbook as the number of persons which the site can safely and reasonably accommodate at any one time, as presently developed.

27/ An area kind is the designation for the general type of recreation activity or activities the area of the site is designed to provide through its development.

For the sites considered in the study, 37 were given a people at one time capacity (PAOT) for the campground--family type only, 8 for campground--family type and boating sites, 3 for hotel, lodge, resort, privately owned, and 5 for which PAOT estimates are given for a combination of area kinds.

The PAOT provides an estimate of the maximum use at the site; however, no account has been taken of the space involved. The acres encompassed by the site are classified into two types, developed acres and peripheral acres. Peripheral acres form a buffer zone around the site and are maintained as nearly as possible in their natural state. Developed acres are that portion of the site in which development has taken place or is designated for development. In general, the developed acres are as large or larger than the peripheral acres.

The potential density of use at a site is determined by dividing the people at one time capacity by the number of developed acres (U.S. Forest Service, 1968b). Table 5, Appendix 2, contains the PAOT, number of developed acres, and the estimated potential density of use by site which are used in constructing the averages presented in Table 9.

Fishing Success: The third and final site characteristic considered in this study is that of fishing success. No attempt

Table 9. Average Potential Density of Use of Sites Visited by Recreation Units from Each Zone Income Population Group for the Bend Ranger District and Each Level of Remoteness.

Distance zone	Income population group	Total Bend ranger district	Remoteness I	Remoteness II	Remoteness III	Remoteness IV	Remoteness V
1							
	Under $2,000	22.80	---	23.10	---	3.00	---
	2,000- 3,999	14.34	32.00	---	---	13.80	---
	4,000- 5,999	21.14	11.70	24.32	11.00	10.52	---
	6,000- 9,999	17.44	15.98	23.10	20.97	10.84	10.91
	10,000-14,999	14.03	17.00	---	---	5.60	4.50
	15,000 & over	16.94	---	23.10	11.00	5.60	22.67
2							
	Under $2,000	---	---	---	---	---	---
	2,000- 3,999	11.06	11.70	10.90	10.35	---	11.00
	4,000- 5,999	9.95	11.32	---	9.26	---	3.00
	6,000- 9,999	12.67	13.57	22.71	11.31	8.34	12.82
	10,000-14,999	15.28	15.47	23.45	9.66	5.56	19.66
	15,000 & over	15.19	13.16	---	16.74	13.80	16.44
3							
	Under $2,000	12.30	---	---	12.30	---	---
	2,000- 3,999	14.13	32.00	23.10	12.30	13.80	---
	4,999- 5,999	30.79	32.00	23.10	3.00	---	---
	6,000- 9,999	18.18	24.04	23.45	10.19	8.90	19.32
	10,000-14,999	16.26	16.76	22.42	12.89	10.00	21.40
	15,000 & over	14.93	13.36	23.10	12.40	5.60	17.69

Continued

Table 9--Continued.

4						
Under $2,000	17.02	5.00	23.10	3.80	---	---
2,000- 3,999	15.79	---	25.00	11.18	---	---
4,000- 5,999	23.43	6.70	24.73	12.30	---	---
6,000- 9,999	6.01	11.07	19.36	4.06	11.70	15.00
10,000-14,999	12.93	17.25	7.91	11.31	---	15.00
15,000 & over	18.47	19.33	---	---	---	3.00
5						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	5.50	---	---	---	5.50	---
4,000- 5,999	8.82	11.20	25.00	4.80	---	---
6,000- 9,999	21.75	23.45	20.31	13.80	---	---
10,000-14,999	14.76	12.62	24.02	12.30	10.90	---
15,000 & over	15.10	24.67	23.10	11.53	5.70	---
6						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	25.00	---	25.00	---	---	---
4,000- 5,999	15.09	12.66	23.10	---	13.80	---
6,000- 9,999	23.59	22.84	25.00	11.53	15.00	---
10,000-14,999	13.23	12.50	15.88	8.55	14.00	---
15,000 & over	15.50	18.22	21.84	9.46	5.00	20.67

was made in this study to collect from recreationists information related to fishing success. Instead, creel census data obtained from the Oregon State Game Commission regional office in Bend was used to supply the information used in this study. Using the Oregon State Game Commission annual report (1958-1967) the total number of fish caught and the total number of hours fished for the ten-year period was obtained for the bodies of water immediately adjacent to each site. The total number of fish caught was then divided by the total number of hours fished to obtain the average fish/hour catch at each of the lakes and streams. In cases where there was more than one lake and/or stream adjacent to the site, the total number of fish caught and the total number of hours fished were obtained across all bodies of water adjacent to the site. These totals were used to calculate the average fish/hour caught at the site. For several sites or trails, there was more than one adjacent body of water, but the creel census data was available for only one of these. In such cases, the data for that body of water were used to represent the fish/hour at the site. This procedure had to be followed for four sites in the study. In addition, there were seven sites for which no bodies of water were adjacent, or the adjacent body of water was closed to fishing. In such cases, these sites were assumed to have zero fish caught per hour.

Table 6, Appendix 2, contains the average fish/hour caught by site which is used in the study to reflect fishing success or fishing effort. Table 10 contains the averages used in the analyses.

A diversion is in order concerning the validity of the creel census data used in the analyses. The collection of this data at the lakes and streams in the study area is based primarily on a voluntary response by anglers. Consequently, there is a somewhat sporadic response which arises in the numbers obtained for the lakes or streams in different years. It is partially for this reason an average over a ten-year period was taken, rather than the creel census for the 1967 season alone. The nature of this data should be considered, and the results from the analyses should be considered, with this character of the data on the fishing success variable in mind.

Population Characteristics

The construction of variables related to the characteristics of the user population will now be discussed. The discussion will center on their acquisition and measurement for use in the models to be estimated. All of the population variables to be considered in the analyses were collected via personal interviews. The following population characteristics will be discussed: (1) Education, (2) occupation, (3) age, (4) place of residence, and (5) years of camping experience.

Table 10. Average Number of Fish Caught Per Hour at Sites Visited by Recreation Units from Each Zone Income Population Group for the Bend Ranger District and Each Level of Remoteness

Distance zone	Income population group	Total Bend ranger district	Remoteness I	Remoteness II	Remoteness III	Remoteness IV	Remoteness V
1							
	Under $2,000	.9097	---	.9132	---	.6721	---
	2,000- 3,999	.3000	.5465	---	---	.2925	---
	4,000- 5,999	.3775	.8618	.3056	.2498	.6518	---
	6,000- 9,999	.5171	.6313	.9132	.3048	.3262	.3829
	10,000-14,999	.7241	.7114	---	---	1.1907	.5491
	15,000 & over	.5102	---	.9132	.2498	1.1907	.4991
2							
	Under $2,000	---	---	---	---	---	---
	2,000- 3,999	73.99	.8618	.2771	.7120	---	.3638
	4,000- 5,999	.8231	1.0400	---	.6537	---	.5918
	6,000- 9,999	.5843	.8521	.4399	.5452	.8283	.3120
	10,000-14,999	.6713	.8064	.8003	.6952	.8257	.3135
	15,000 & over	.5642	1.1020	---	.4551	.2925	.2965
3							
	Under $2,000	.5465	---	---	.5465	---	---
	2,000- 3,999	.5609	.5465	.9132	.5465	.2925	---
	4,000- 5,999	.5656	.5465	.9132	.7248	---	---
	6,000- 9,999	.6906	.7255	.7992	.6682	.7032	.4831
	10,000-14,999	.6626	.9253	.4475	.4755	.6418	.3481
	15,000 & over	.8333	1.0587	.9132	.5427	1.1907	.2810

Continued

Table 10--Continued.

4						
Under $2,000	.8743	.6827	.9132	.8467	---	---
2,000- 3,999	.4800	---	.2925	.5737	---	---
4,000- 5,999	.4042	.8618	.3812	.5465	---	---
6,000- 9,999	.1851	.7775	.2863	.0483	.8590	.2498
10,000-14,999	.8281	1.0575	.9977	.6428	---	.2498
15,000 & over	.6975	.7036	---	---	---	.5918
5						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	.7895	---	---	---	.7895	---
4,000- 5,999	.7080	1.0994	.2925	.8003	---	---
6,000- 9,999	.5479	.5266	.9203	.5144	---	---
10,000-14,999	.6144	.8489	.6136	.5465	.5181	---
15,000 & over	.5723	.5465	.9132	.6201	.2771	---
6						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	.2925	---	.2925	---	---	---
4,000- 5,999	.7586	.9765	.9132	---	.2925	---
6,000- 9,999	.4885	.7734	.2925	.4939	.9472	---
10,000-14,999	.5726	1.2541	.6951	.4922	.2393	---
15,000 & over	.8352	.7572	.8960	.7266	.6827	2.4407

Education: The years of formal education was obtained from the respondent of each recreation unit interviewed. Because most of the units interviewed were family groups, the most appropriate variable probably would be the years of education of the head of household. However, this was not obtained unless the respondent and the head of the household were the same. A survey of the questionnaires indicates that in a large percentage of the family units interviewed, the head of household was the respondent, although it is not possible to make a precise determination at this point. The years of education for each respondent was averaged for each recreation unit in a given population and income group and entered into the analysis as an explanatory variable. Table 11 contains averages used in each of these analyses.

Occupation: Occupation, as it is used in the study is hypothesized to reflect in some meaningful way a measure of social prestige into the demand for outdoor recreation. As pointed out in Chapter II, sociological research has identified occupation as one meaningful measure of social prestige. Operationally, the rating of occupations according to their prestige rankings was conducted in the following way. Each recreation unit was asked the occupation of the head of household or chief bread-winner. The occupations, as given on the questionnaire, were

Table 11. Average Years of Formal Education of Respondents from Each Zone Income Population Group for the Bend Ranger District and Each Level of Remoteness.

Distance zone	Income population group	Total Bend ranger district	Remoteness I	Remoteness II	Remoteness III	Remoteness IV	Remoteness V
1							
	Under $2,000	8.12	---	8.00	---	16.00	---
	2,000- 3,999	12.00	12.00	---	---	12.00	---
	4,000- 5,999	10.26	14.00	10.00	12.00	9.60	---
	6,000- 9,999	12.80	11.50	12.00	14.04	14.44	12.64
	10,000-14,999	13.53	13.22	---	---	12.00	15.75
	15,000 & over	15.71	---	12.00	16.00	18.00	16.83
2							
	Under $2,000	---	---	---	---	---	---
	2,000- 3,999	11.52	11.52[a/]	12.00	10.58	---	15.33
	4,000- 5,999	13.22	15.25	---	11.29	---	16.00
	6,000- 9,999	12.43	12.18	12.24	12.32	12.82	16.00
	10,000-14,999	12.92	12.41	12.68	13.56	13.57	13.12
	15,000 & over	15.92	15.73	---	12.20	16.00	17.19
3							
	Under $2,000	10.00	---	---	10.00	---	---
	2,000- 3,999	6.79	8.00	10.92	6.00	8.00	---
	4,000- 5,999	10.26	10.00	14.40	13.00	---	---
	6,000- 9,999	13.29	12.44	12.35	14.81	12.07	13.49
	10,000-14,999	12.12	12.53	12.27	11.03	13.12	12.95
	15,000 & over	16.66	17.23	16.00	16.00	8.00	18.31

Continued

Table 11--Continued.

4						
Under $2, 000	10.54	11.00	10.00	12.00	---	---
2, 000- 3, 999	10.53	---	12.00	9.80	---	---
4, 000- 5, 999	12.54	14.00	12.86	8.00	---	---
6, 000- 9, 999	9.41	12.47	10.20	8.47	10.67	16.00
10, 000-14, 999	13.73	12.38	14.93	12.64	---	15.06
15, 000 & over	15.53	15.78	---	---	---	11.00
5						
Under $2, 000	---	---	---	---	---	---
2, 000- 3, 999	8.00	---	---	---	8.00	---
4, 000- 5, 999	14.39	12.00	12.00	15.02	---	---
6, 000- 9, 999	11.38	10.38	13.21	15.68	---	---
10, 000-14, 999	13.96	15.58	14.86	14.80	11.51	---
15, 000 & over	14.36	13.33	18.00	14.86	12.00	---
6						
Under $2, 000	---	---	---	---	---	---
2, 000- 3, 999	10.00	---	10.00	---	---	---
4, 000- 5, 999	10.89	10.58	10.00	---	12.00	---
6, 000- 9, 999	9.91	12.35	8.00	15.00	12.00	---
10, 000-14, 999	14.60	13.00	14.83	16.61	12.64	---
15, 000 & over	13.50	10.58	18.57	14.85	14.55	12.33

a/ There was only one recreation unit sampled in this income group and the years of formal education were not collected, therefore, the average for the corresponding total district income group was used.

then given a numerical value taken from the 1963 replication of the National Opinion Research Center's 1947 study of the prestige positions accorded to 90 occupations by a national sample of the American adult population (Hodge, Siegel and Rossi, 1966, p. 324-325). This scale is also known as the North-Hatt occupation prestige scale. The occupations obtained by the interview procedure were given a rating according to the North-Hatt scale by three individuals, separately. [28/] The results were compared from the three separate rankings and ranking disagreements were reconciled by discussion of the three. An advantage of using the prestige rating scale is that a continuous measure of occupation is obtained, thus making it possible to treat occupation as a continuous variable in the analyses rather than using dummy variables, which have traditionally been used to incorporate occupation as a variable into regression analysis.

Several problems occurred in the classification of occupations obtained from the sample data which should be mentioned, as well as their subsequent resolution. Initially, the occupations on the scale were established in 1947 and the same occupations were used in the 1963 replication. The structure of occupations has changed since 1947 and some of the occupations in existence today had very

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[28/] The author wishes to acknowledge the assistance of Kenneth Gibbs and John Jaksch in completing these rankings.

little correspondence to any of those given on the scale; therefore, some judgment on the part of the three individuals ranking the occupation was required. A problem, also, arose with those recreation units indicating that the chief breadwinner was retired. In those cases where the previous occupation was identified, this occupation was used to establish a ranking on the assumption that the influence of occupation on the type of outdoor recreation remains after retirement. When only "retired" was given, no rating was given to that observation. The same procedure was followed for those indicating they were students or unemployed. These observations were then deleted from the average occupation level calculated for the zone income group to be used in the statistical analysis. In the case of students, if they indicated their parent's occupation, this occupation was rated and used for that observation. The averages resulting from this procedure are given in Table 12 by zone and income group.

Age: The age of each member of the recreation unit was obtained and the following three age groups established: (1) The average age of adults, (2) the average age of children, and (3) the age of the youngest child. A problem arises in the case of the first two age groups with the zoning techniques, because it will be necessary to use the average of the average from which

Table 12. Average Occupation Prestige Rating of the Head of Household of Recreation Units from Each Zone Income Population Group for the Bend Ranger District and Each Level of Remoteness.

Distance zone	Income population group	Total Bend ranger district	Remoteness I	Remoteness II	Remoteness III	Remoteness IV	Remoteness V
1							
	Under $2,000	68.0	---	68.0	---	69.0	---
	2,000- 3,999	50.0	50.0	---	---	50.0	---
	4,000- 5,999	52.7	82.0	50.6	66.0	48.0	---
	6,000- 9,999	67.5	64.8	63.0	68.3	75.6	70.7
	10,000-14,999	67.5	64.9	---	---	67.0	79.6
	15,000 & over	75.1	---	67.0	74.0	84.0	78.8
2							
	Under $2,000	---	---	---	---	---	---
	2,000- 3,999	62.9	62.0	57.0	68.0	---	62.9[a]
	4,000- 5,999	70.4	76.2	---	62.6	---	70.4[a]
	6,000- 9,999	64.7	66.5	64.6	63.5	67.0	80.3
	10,000-14,999	70.8	66.6	77.7	71.9	73.8	71.4
	15,000 & over	81.9	87.3	---	73.0	76.0	82.6
3							
	Under $2,000	70.0	---	---	70.0	---	---
	2,000- 3,999	59.8	74.0	50.0	59.8[a]	62.0	---
	4,000- 5,999	64.0	64.0	74.8	50.0	---	---
	6,000- 9,999	65.2	59.1	61.7	72.5	69.3	69.2
	10,000-14,999	68.8	70.1	64.4	72.8	56.3	70.4
	15,000 & over	81.9	82.8	89.0	75.9	53.0	83.8

Continued

Table 12--Continued.

4						
Under $2,000	60.3	45.0	66.0	50.0	---	---
2,000- 3,999	62.8	---	58.0	65.2	---	---
4,000- 5,999	74.0	71.0	74.1	73.0	---	---
6,000- 9,999	66.4	69.8	62.6	65.3	65.0	81.0
10,000-14,999	73.8	67.6	77.3	71.7	---	80.9
15,000 & over	81.8	81.8	---	---	---	81.8[a/]
5						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	74.0	---	---	---	74.0	---
4,000- 5,999	77.4	66.0	68.0	80.0	---	---
6,000- 9,999	75.9	75.7	71.1	79.2	---	---
10,000-14,999	74.4	73.8	75.9	75.8	72.6	---
15,000 & over	79.6	74.8	82.0	81.2	80.0	---
6						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	68.0	---	68.0	---	---	---
4,000- 5,999	64.8	62.0	50.0	---	76.0	---
6,000- 9,999	66.9	64.9	68.0	71.0	64.0	---
10,000-14,999	74.9	73.0	76.6	82.2	65.2	---
15,000 & over	77.3	73.5	86.0	80.9	73.2	77.3

[a/] There was only one recreation unit sampled in this income group and the occupation of the head of household was not collected, therefore, the average for the corresponding total district income group was used.

interpretation becomes difficult. An additional problem is the age at which children and adults are separated. For this study, this is done purely on an arbitrary basis and the dividing age is set at 15 years. Any person in the group more than 15 years old is considered as an adult and less than or equal to 15 years old is considered a child.

For purposes of the analyses, it was decided to use the number of persons in the recreation unit which are greater than 15 years and those equal to or less than 15 years, rather than considering age directly. For use in the zone income group construct, the ratio of recreation days taken by recreation units in each age group to the total number of recreation days taken by each income group is used. Because the total of the two will equal one, it was expected that the two ratios would be highly interrelated, so only the ratio of the units of age less than or equal to 15 years old was included in the analyses. For purposes of comparison between levels of remoteness, this variable can also be viewed as a restriction to participation. Table 13 contains the ratios used in each of the analyses.

Place of Residence: The present place of residence and the place of residence of the respondent as a child was obtained from each of the recreation units interviewed. In these analyses, only

Table 13. The Ratio of Recreation Days Taken by Recreation Units with Children Less than or Equal to 15 Years Old to the Total Number of Recreation Days Taken from Each Zone Income Population Group for the Bend Ranger District and Each Level of Remoteness.

Distance zone	Income population group	Total Bend ranger district	Remoteness I	Remoteness II	Remoteness III	Remoteness IV	Remoteness V
1							
	Under $2,000	.9853	---	1.0000	---	.0000	---
	2,000- 3,999	.0294	1.0000	---	---	.0000	---
	4,000- 5,999	.2368	1.0000	.0000	1.0000	1.0000	---
	6,000- 9,999	.6341	.6250	.5000	.8333	.2222	.7273
	10,000-14,999	.6939	.7568	---	---	1.0000	.2500
	15,000 & over	.8235	---	1.0000	1.0000	.0000	.6667
2							
	Under $2,000	---	---	---	---	---	---
	2,000- 3,999	.1167	.0000	1.0000	.0800	---	.6667
	4,000- 5,999	.6296	1.0000	---	.3571	---	.0000
	6,000- 9,999	.2780	.5400	.4259	.0968	1.0000	.9091
	10,000-14,999	.7700	.9467	.6818	.2800	.4286	.9800
	15,000 & over	.7500	.4545	---	.6000	1.0000	.9375
3							
	Under $2,000	.0000	---	---	.0000	---	---
	2,000- 3,999	.0000	.0000	.0000	.0000	.0000	---
	4,000- 5,999	.0000	.0000	.0000	.0000	---	---
	6,000- 9,999	.3756	.3360	.4082	.2727	.7556	.7460
	10,000-14,999	.6805	.8418	.6406	.4955	.4375	.9500
	15,000 & over	.8828	.9077	1.0000	1.0000	.0000	.9231

Continued

Table 13--Continued.

4						
Under $2,000	.0000	.0000	.0000	.0000	---	---
2,000- 3,999	.5333	---	.0000	.8000	---	---
4,000- 5,999	.0235	1.0000	.0000	.0000	---	---
6,000- 9,999	.1713	.5000	.6000	.0539	.3333	1.0000
10,000-14,999	.7527	.5625	1.0000	.3571	---	1.0000
15,000 & over	.4211	.4444	---	---	---	.0000
5						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	1.0000	---	---	---	1.0000	---
4,000- 5,999	.0367	1.0000	.0000	.0233	---	---
6,000- 9,999	.4810	.3710	.5714	1.0000	---	---
10,000-14,999	.6333	.6667	.7586	1.0000	.2162	---
15,000 & over	.6000	.5714	.0000	.6286	1.0000	---
6						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	.0000	---	.0000	---	---	---
4,000- 5,999	.1462	.2923	.0000	---	.0000	---
6,000- 9,999	.3169	.7500	.0000	.6667	1.0000	---
10,000-14,999	.5909	1.0000	.5833	.8696	.1818	---
15,000 & over	.9324	1.0000	.9286	.7692	1.0000	.6667

the present place of residence of the recreation unit will be considered as a variable. The decision to consider only the present place of residence was made primarily for two reasons: (1) Conceptually, the present place of residence is the most germane of the two, and (2) from a statistical point of view the number of variables to be included in the model is already large relative to the number of observations. The respondents were given a choice of five possible places of residence types: (1) Inside city limits, (2) suburb of the city, (3) rural--not on a farm, (4) rural on farm, and (5) other. For purposes of this analyses, the ratio of recreation days taken by recreation units from each of the first four residence categories to the total number of days taken by that income population group (Table 14) will be included as explanatory variables in the statistical analyses.

Years of Camping Experience: The number of years of camping experience for each recreation unit observed were taken to be the number of years the respondent indicated he had been camping. As in the case of other variables, the average of the years of camping (Table 15) will be obtained by using all of the observations of those units arising from the population zone and income group.

Table 14. The Ratio of Recreation Days Taken by Recreation Units from Each Residence Category to the Total Number of Recreation Days Taken from Each Zone Income Population Group for the Bend Ranger District and Each Level of Remoteness.

Distance zone	Income population group	Total Bend ranger district: Inside city limits	Suburb	Rural nonfarm	Rural farm	Remoteness Level I: Inside city limits	Suburb	Rural nonfarm	Rural farm
1									
	Under $2,000	1.0000	.0000	.0000	.0000	---	---	---	---
	2,000- 3,999	.0294	.9706	.0000	.0000	1.0000	.0000	.0000	.0000
	4,000- 5,999	.8158	.1316	.0526	.0000	1.0000	.0000	.0000	.0000
	6,000- 9,999	.6585	.0854	.1098	.1463	.7083	.0000	.1667	.1250
	10,000-14,999	.3877	.4694	.1429	.0000	.3513	.4395	.1892	.0000
	15,000 & over	.5882	.0000	.0000	.4118	---	---	---	---
2									
	Under $2,000	---	---	---	---	---	---	---	---
	2,000- 3,999	.8833	.1167	.0000	.0000	1.0000	.0000	.0000	.0000
	4,000- 5,999	1.0000	.0000	.0000	.0000	1.0000	.0000	.0000	.0000
	6,000- 9,999	.8641	.0496	.0711	.0152	.6600	.1000	.2000	.0400
	10,000-14,999	.5650	.1850	.1700	.0800	.5867	.4133	.0000	.0000
	15,000 & over	.9167	.0833	.0000	.0000	1.0000	.0000	.0000	.0000
3									
	Under $2,000	.0000	.0000	.0000	1.0000	---	---	---	---
	2,000- 3,999	.0000	.0588	.1513	.0252	.0000	.0000	.0000	1.0000
	4,000- 5,999	.9624	.0301	.0000	.0075	1.0000	.0000	.0000	.0000
	6,000- 9,999	.4724	.2249	.2713	.0276	.2453	.1627	.5493	.0427
	10,000-14,999	.5870	.2078	.0286	.0415	.6139	.3038	.0317	.0506
	15,000 & over	.5156	.4297	.0547	.0000	.4615	.5385	.0000	.0000

Continued

Table 14--Continued.

4								
Under $2, 000	.3214	.6786	.0000	.0000	1.0000	.0000	.0000	.0000
2, 000- 3, 999	.8667	.0000	.1333	.0000	---	---	---	---
4, 000- 5, 999	.1529	.7765	.0706	.0000	1.0000	.0000	.0000	.0000
6, 000- 9, 999	.2546	.7361	.0093	.0000	.9333	.0000	.0667	.0000
10, 000-14, 999	.4839	.3656	.0000	.1505	.9688	.0312	.0000	.0000
15, 000 & over	.2632	.2105	.4210	.1053	.2222	.2222	.4445	.1111
5								
Under $2, 000	---	---	---	---	---	---	---	---
2, 000- 3, 999	1.0000	.0000	.0000	.0000	---	---	---	---
4, 000- 5, 999	.0184	.8349	.0183	.1284	1.0000	.0000	.0000	.0000
6, 000- 9, 999	.9240	.0633	.0000	.0127	.9032	.0807	.0000	.0161
10, 000-14, 999	.8000	.1667	.0333	.0000	.4167	.4167	.1666	.0000
15, 000 & over	.7667	.1555	.0778	.0000	.2381	.4286	.3333	.0000
6								
Under $2, 000	---	---	---	---	---	---	---	---
2, 000- 3, 999	.0000	1.0000	.0000	.0000	---	---	---	---
4, 000- 5, 999	.5000	.5000	.0000	.0000	1.0000	.0000	.0000	.0000
6, 000- 9, 999	.3934	.0109	.0164	.0000	.9559	.0000	.0441	.0000
10, 000-14, 999	.9205	.0795	.0000	.0000	1.0000	.0000	.0000	.0000
15, 000 & over	.9865	.0000	.0000	.0000	1.0000	.0000	.0000	.0000

Table 14--Continued.

Distance zone	Income population group	Remoteness level II: Inside city limits	Suburb	Rural nonfarm	Rural farm	Remoteness level III: Inside city limits	Suburb	Rural nonfarm	Rural farm
1									
	Under $2,000	1.0000	.0000	.0000	.0000	---	---	---	---
	2,000- 3,999	---	---	---	---	---	---	---	---
	4,000- 5,999	1.0000	.0000	.0000	.0000	.0000	.0000	1.0000	.0000
	6,000- 9,999	.7143	.0000	.2857	.0000	.6667	.2083	.0000	.1250
	10,000-14,999	---	---	---	---	---	---	---	---
	15,000 & over	1.0000	.0000	.0000	.0000	.0000	.0000	.0000	1.0000
2									
	Under $2,000	---	---	---	---	---	---	---	---
	2,000- 3,999	.0000	1.000	.0000	.0000	---	---	---	---
	4,000- 5,999	---	---	---	---	---	---	---	---
	6,000- 9,999	.7222	.1852	.0000	.0926	.9487	.0513	.0000	.0000
	10,000-14,999	.5909	.0909	.2273	.0909	.4286	.0714	.5000	.0000
	15,000 & over	---	---	---	---	1.0000	.0000	.0000	.0000
3									
	Under $2,000	---	---	---	---	---	---	---	---
	2,000- 3,999	.0000	.5385	.4615	.0000	.0000	.0000	1.0000	.0000
	4,000- 5,999	.8000	.0000	.0000	.2000	---	---	---	---
	6,000- 9,999	.5714	.3878	.0408	.0000	.3778	.4889	.0000	.1333
	10,000-14,999	.8125	.1875	.0000	.0000	.7500	.0000	.0000	.2500
	15,000 & over	1.0000	.0000	.0000	.0000	.0000	.0000	1.0000	.0000

Continued

Table 14--Continued

4								
Under $2,000	.0000	1.0000	.0000	.0000	1.0000	.0000	.0000	.0000
2,000- 3,999	1.0000	.0000	.0000	.0000	.8000	.0000	.2000	.0000
4,000- 5,999	.1429	.8571	.0000	.0000	.0000	.0000	1.0000	.0000
6,000- 9,999	.4000	.6000	.0000	.0000	.0659	.9341	.0000	.0000
10,000-14,999	.0000	1.0000	.0000	.0000	.3571	.2143	.0000	.4286
15,000 & over	---	---	---	---	---	---	---	---
5								
Under $2,000	---	---	---	---	---	---	---	---
2,000- 3,999	---	---	---	---	---	---	---	---
4,000- 5,999	.0000	1.0000	.0000	.0000	.0000	.8140	.0232	.1628
6,000- 9,999	1.0000	.0000	.0000	.0000	1.0000	.0000	.0000	.0000
10,000-14,999	.7586	.2414	.0000	.0000	1.0000	.0000	.0000	.0000
15,000 & over	1.0000	.0000	.0000	.0000	.8571	.1429	.0000	.0000
6								
Under $2,000	---	---	---	---	---	---	---	---
2,000- 3,999	.0000	1.0000	.0000	.0000	---	---	---	---
4,000- 5,999	.0000	1.0000	.0000	.0000	---	---	---	---
6,000- 9,999	.0000	.0000	.0000	.0000	.6667	.3333	.0000	.0000
10,000-14,999	1.0000	.0000	.0000	.0000	.6957	.3043	.0000	.0000
15,000 & over	.9286	.0000	.0000	.0000	1.0000	.0000	.0000	.0000

Continued

Table 14--Continued.

Distance zone	Income population group	Remoteness level IV				Remoteness level V			
		Inside city limits	Suburb	Rural nonfarm	Rural farm	Inside city limits	Suburb	Rural nonfarm	Rural farm
1									
	Under $2,000	1.0000	.0000	.0000	.0000	---	---	---	---
	2,000- 3,999	.0000	1.0000	.0000	.0000	---	---	---	---
	4,000- 5,999	.0000	1.0000	.0000	.0000	---	---	---	---
	6,000- 9,999	.7778	.2222	.0000	.0000	.3636	.0000	.0909	.5455
	10,000-14,999	1.0000	.0000	.0000	.0000	.2500	.7500	.0000	.0000
	15,000 & over	1.0000	.0000	.0000	.0000	1.0000	.0000	.0000	.0000
2									
	Under $2,000	---	---	---	---	---	---	---	---
	2,000- 3,999	---	---	---	---	.6667	.3333	.0000	.0000
	4,000- 5,999	---	---	---	---	1.0000	.0000	.0000	.0000
	6,000- 9,999	.9487	.0513	.0000	.0000	1.0000	.0000	.0000	.0000
	10,000-14,999	.4286	.0714	.5000	.0000	.4200	.0000	.3000	.2800
	15,000 & over	1.0000	.0000	.0000	.0000	1.0000	.0000	.0000	.0000
3									
	Under $2,000	---	---	---	---	---	---	---	---
	2,000- 3,999	.0000	.0000	1.0000	.0000	---	---	---	---
	4,000- 5,999	---	---	---	---	---	---	---	---
	6,000- 9,999	.3778	.4889	.0000	.1333	.5397	.4127	.0000	.0000
	10,000-14,999	.7500	.0000	.0000	.2500	.5500	.4500	.0000	.0000
	15,000 & over	.0000	.0000	1.0000	.0000	.4615	.5385	.0000	.0000

Continued

Table 14--Continued

4								
Under $2,000	---	---	---	---	---	---	---	---
2,000- 3,999	---	---	---	---	---	---	---	---
4,000- 5,999	---	---	---	---	---	---	---	---
6,000- 9,999	1.000	.0000	.0000	.0000	1.0000	.0000	.0000	.0000
10,000-14,999	---	---	---	---	.5294	.0000	.0000	.4706
15,000 & over	---	---	---	---	1.0000	.0000	.0000	.0000
5								
Under $2,000	---	---	---	---	---	---	---	---
2,000- 3,999	1.000	.0000	.0000	.0000	---	---	---	---
4,000- 5,999	---	---	---	---	---	---	---	---
6,000- 9,999	---	---	---	---	---	---	---	---
10,000-14,999	.9189	.0811	.0000	.0000	---	---	---	---
15,000 & over	1.0000	.0000	.0000	.0000	---	---	---	---
6								
Under $2,000	---	---	---	---	---	---	---	---
2,000- 3,999	---	---	---	---	---	---	---	---
4,000- 5,999	.0000	1.0000	.0000	.0000	---	---	---	---
6,000- 9,999	1.0000	.0000	.0000	.0000	---	---	---	---
10,000-14,999	1.0000	.0000	.0000	.0000	---	---	---	---
15,000 & over	1.0000	.0000	.0000	.0000	1.0000	.0000	.0000	.0000

Table 15. Average Years of Camping Experience of Recreation Unit Respondents for Each Zone Income Population Group for the Bend Ranger District and Each Level of Remoteness.

Distance zone	Income population group	Total Bend ranger district	Remoteness I	Remoteness II	Remoteness III	Remoteness IV	Remoteness V
1							
	Under $2,000	4.2	---	4.0	---	15.0	---
	2,000- 3,999	48.9	12.0	---	---	50.0	---
	4,000- 5,999	18.2	8.0	16.2	7.0	38.0	---
	6,000- 9,999	20.0	24.9	7.8	23.9	27.8	14.3
	10,000-14,999	22.3	18.8	---	---	48.0	35.0
	15,000 & over	18.9	---	2.0	30.0	30.0	12.7
2							
	Under $2,000	---	---	---	---	---	---
	2,000- 3,999	13.4	15.0	10.0	13.4	---	6.3
	4,000- 5,999	33.4	6.8	---	44.3	---	15.0
	6,000- 9,999	11.7	15.7	30.7	7.5	13.2	16.0
	10,000-14,999	17.2	15.7	16.1	29.3	13.7	15.7
	15,000 & over	23.0	29.5	---	27.0	20.0	17.9
3							
	Under $2,000	20.0	---	---	20.0	---	---
	2,000- 3,999	47.7	35.0	55.4	50.0	25.0	---
	4,000- 5,999	10.0	10.4	4.2	6.0	---	---
	6,000- 9,999	24.1	26.5	21.9	21.1	27.1	21.7
	10,000-14,999	27.0	24.9	40.2	22.6	14.9	27.0
	15,000 & over	24.6	23.2	30.0	33.5	50.0	13.0

Continued

Table 15--Continued.

4						
Under $2,000	47.3	15.0	62.0	17.0	---	---
2,000- 3,999	38.7	---	60.0	28.0	---	---
4,000- 5,999	36.4	25.0	36.4	40.0	---	---
6,000- 9,999	41.8	23.6	35.2	47.2	30.0	10.0
10,000-14,999	22.4	20.1	28.1	18.9	---	19.6
15,000 & over	28.8	30.1	---	---	---	6.0
5						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	1.0	---	---	---	1.0	---
4,000- 5,999	54.9	25.0	55.0	55.6	---	---
6,000- 9,999	10.4	8.3	30.9	13.3	---	---
10,000-14,999	24.7	13.2	23.0	22.9	34.9	---
15,000 & over	20.3	28.2	35.0	12.7	15.0	---
6						
Under $2,000	---	---	---	---	---	---
2,000- 3,999	20.0	---	20.0	---	---	---
4,000- 5,999	19.5	7.0	20.0	---	40.0	---
6,000- 9,999	45.9	18.2	66.0	26.7	4.0	---
10,000-14,999	31.8	20.0	39.4	18.3	34.6	---
15,000 & over	19.7	21.6	8.9	18.8	32.7	6.0

Investment in Outdoor Recreation Equipment

Cost information on the recreation equipment used by the recreation unit at the time of the interview was obtained (Appendix 1, Question 29). In addition, two items were included in the questionnaire to obtain part of the fixed investment, the amount of boating equipment and the price of the Golden Eagle permit. 29/ Although no particular question was specified to obtain the information of whether a recreation unit possessed a Golden Eagle permit, interviewers were instructed to obtain information about the amount of the campground fee. When $7.00 was given as an answer, the interviewers asked whether the recreation unit had a Golden Eagle permit; if they did, the interviewer noted it on the questionnaire. In addition, for each piece of equipment, the number of that type of equipment, whether it was owned, borrowed, or rented, and the date of purchase for each item was obtained. No attempt was made in the study to establish the present value of the equipment by using some form of depreciation schedule, for several reasons.

29/ The Golden Eagle permit is the annual user fee which was authorized under the Land and Water Conservation Fund Act of 1965. This annual fee of $7.00 permits entrance to National forests, parks, refuges and other designated Federal recreation areas where entrance fees are charged, unless otherwise specified. This permit was considered to be a fixed cost for the recreation season under consideration and was included as a fixed investment item.

First, the nature of certain pieces of equipment, such as fishing tackle, would require more detailed information than was obtained. Secondly, it could be questioned whether an appropriate depreciation schedule for the different pieces of equipment could be identified. Therefore, the sum of the purchase prices for each piece of equipment was used as the total investment in equipment for each recreation unit. The average of these for each income population group (Table 16) was used in the analyses. In a limited number of cases, the purchase price of the item was not known. In these cases, the item was entered into that recreation unit's total investment as a zero cost.

Table 16. Average Total Investment in Recreation Equipment at the Site of Recreation Units in Each Zone Income Population Group for the Bend Ranger District and Each Level of Remoteness.

Distance zone	Income population group	Total Bend ranger district	Remoteness I	Remoteness II	Remoteness III	Remoteness IV	Remoteness V
		($)	($)	($)	($)	($)	($)
1							
	Under $2, 000	602	---	610	---	33	---
	2, 000- 3, 999	2, 709	302	---	---	2, 132	---
	4, 000- 5, 999	355	---	312	30	880	---
	6, 000- 9, 999	1, 012	1, 358	1, 643	293	838	1, 160
	10, 000-14, 999	2, 069	2, 431	---	---	1, 100	877
	15, 000 & over	858	---	60	1, 123	975	927
2							
	Under $2, 000	---	---	---	---	---	---
	2, 000- 3, 999	1, 997	1, 850	0	2, 714	---	33
	4, 000- 5, 999	774	70	---	1, 433	---	7
	6, 000- 9, 999	784	1, 025	2, 040	461	1, 239	1, 028
	10, 000-14, 999	1, 181	1, 277	1, 034	714	1, 144	1, 358
	15, 000 & over	1, 825	2, 084	---	3, 270	1, 474	1, 284
3							
	Under $2, 000	22	---	---	22	---	---
	2, 000- 3, 999	2, 195	884	1, 634	2, 305	2, 298	---
	4, 000- 5, 999	4, 931	5, 252	832	111	---	---
	6, 000- 9, 999	3, 220	2, 342	1, 932	5, 584	1, 369	860
	10, 000-14, 999	1, 285	888	2, 515	1, 294	1, 230	519
	15, 000 & over	1, 644	1, 032	881	1, 089	6, 800	2, 553

Continued

Table 16--Continued.

4						
Under $2, 000	5, 553	1, 800	7, 403	1, 571	---	---
2, 000- 3, 999	1, 754	---	4, 207	528	---	---
4, 000- 5, 999	2, 284	250	2, 502	160	---	---
6, 000- 9, 999	2, 275	737	2, 331	2, 658	1, 129	863
10, 000-14, 999	2, 419	2, 751	2, 158	1, 004	---	3, 437
15, 000 & over	2, 424	2, 555	---	---	---	62
5						
Under $2, 000	---	---	---	---	---	---
2, 000- 3, 999	1, 955	---	---	---	1, 955	---
4, 000- 5, 999	2, 830	1, 823	896	3, 326	---	---
6, 000- 9, 999	2, 018	2, 218	3, 670	390	---	---
10, 000-14, 999	1, 111	486	1, 570	187	1, 478	---
15, 000 & over	3, 585	5, 699	4, 007	2, 751	2, 530	---
6						
Under $2, 000	---	---	---	---	---	---
2, 000- 3, 999	174	---	174	---	---	---
4, 000- 5, 999	2, 528	1, 514	1, 745	---	4, 741	---
6, 000- 9, 999	2, 810	1, 426	3, 817	1, 565	1, 057	---
10, 000-14, 999	1, 138	88	1, 008	1, 206	1, 614	---
15, 000 & over	540	281	1, 352	635	282	130

CHAPTER V

STATISTICAL DEMAND MODELS

In this chapter a demand equation is estimated for the Bend Ranger District and each level of remoteness, using the data in Chapter IV. Each hypothesized equation is discussed and analyzed leading to the presentation of a model for further empirical testing. The final estimated equation for each level of remoteness will be statistically compared and the differences across levels will be evaluated, in an attempt to test the hypothesis that the demands for recreational resources, yielding different recreational services, are different. The differences analyzed will relate to the remoteness of sites.

General Statistical Model

Least squares estimation procedures will be used to estimate the statistical demand models. These techniques have been employed in previous studies dealing with the demand for outdoor recreation (for example, see Brown, Singh and Castle, 1964; Stevens, 1966; and Wennergren, 1967). However, the employment of the zoning framework with the zone income group as the observation unit in the analyses raises some question about the direct application of ordinary least squares analysis. In ordinary least squares, it is assumed that the variance of the error term is constant for each observation and independent of the explanatory variables.

In the zoning framework the number of sampled recreation units comprising the observation for each zone income group differs. Therefore, it is assumed that the variance of the error term for each income group observation is inversely proportional to the number of recreation units sampled from each zone income group, instead of constant as usually assumed. If this assumption is realistic, a direct application of ordinary least squares in a use such as this would yield estimates that are unbiased, but lack the property of minimum variance. [30/] Draper and Smith (1966) recommend weighted least squares analysis as a means of obtaining parameter estimates that are minimum variance unbiased estimates from an application of least squares when the variance of the error term is not constant. The primary difficulty encountered in the employment of weighted least squares is the determination of the proper weights to use. An examination of the assumption concerning the variance of the error term which

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[30/] The application would not yield a set of estimates which are efficient or in Johnston's (1963) terminology, best linear unbiased estimates.

precipitated this discussion provides insight on the appropriate weight to use in this analysis. Assuming that

$$\text{var } \varepsilon_{ij} = \frac{\sigma^2}{n_{ij}} \tag{5-1}$$

where

n_{ij} , is the number of recreation units sampled from the i^{th} income population group of the j^{th} distance zone.

σ^2 , is the variance of the error term which is assumed constant for each ij observation.

Ordinary least squares assumes that the var $\varepsilon_{ij} = \sigma^2$ for all observations. That is, the variance of the error term is assumed equal for each observation. Therefore, an application of the ordinary least squares estimating techniques requires that equation (5-1) yield a variance (σ^2) which is not a function of the number of recreation units from each zone income group. This can be obtained by multiplying both sides of equation (5-1) by n_{ij}. That is,

$$n_{ij} \text{ var } \varepsilon_{ij} = \frac{n_{ij} \sigma^2}{n_{ij}} \tag{5-1a}$$

Since

$$n_{ij} \text{ var } \varepsilon_{ij} = \text{var } (\sqrt{n_{ij}} \, \varepsilon_{ij})$$

Equation (5-1a) becomes

$$\text{var } (\sqrt{n_{ij}} \, \varepsilon_{ij}) = \sigma^2 \tag{5-2}$$

Equation (5-2) satisfies the assumptions of ordinary least squares and will allow the application of usual techniques to a model possessing an error term of $\sqrt{n_{ij}}\ \varepsilon_{ij}$. Therefore, since the $\sqrt{n_{ij}}$ yields a model with a constant variance term, given the assumption presented, it is the appropriate weight to be used in the remaining sections of this chapter. Since the appropriateness of this weight depends upon the realism of the assumption, some effort to establish how realistic this assumption may be is warranted. This is undertaken by utilizing the data given in Table 17. The number of recreation days per capita X 10^6 taken by recreation units sampled from each zone income group are placed in three groups. These three groups are defined by the number of recreation units sampled from each zone income group. The variance of each group is calculated by using the following formula:

$$\hat{\sigma}_j^2 = \frac{\sum_{i=1}^{n} (Q_i - \bar{Q}_i)^2}{n_j} \qquad (5\text{-}3)$$

where

j ; represents the size group.

i ; represents the number of observations in the j^{th} size group.

The results are as follows: 1) small; $\hat{\sigma}_s^2$ = 13, 726, 193; 2) medium; $\hat{\sigma}_m^2$ = 2, 073, 537; and 3) large; $\hat{\sigma}_L^2$ = 52, 176. This evidence suggests that the assumption of nonhomogenous variance is justifiable.

In each analysis, an exponential model will be used. For

Table 17. Total Number of Recreation Days Per Capita X 10^6 in the Sample From Each Zone Income Population Group Stratified by the Number of Recreation Units Observed in Each Income Population Group.

Distance zone	Income population group	Small $0<n_{ij} \leq 10$[a/]	Medium $10<n_{ij} \leq 39$	Large $39<n_{ij} \leq 81$
I				
	Under $2,000	10,463.15		
	2,000- 3,999	12,210.45		
	4,000- 5,999	5,033.11		
	6,000- 9,999		4,904.89	
	10,000-14,999	6,496.95		
	15,000 & over	5,817.93		
II				
	Under $2,000			
	2,000- 3,999	2,004.64		
	4,000- 5,999	346.59		
	6,000- 9,999			2,171.58
	10,000-14,999			1,980.16
	15,000 & over		967.90	
III				
	Under $2,000	29.81		
	2,000- 3,999	932.42		
	4,000- 5,999	801.67		
	6,000- 9,999			1,812.64
	10,000-14,999			1,549.66
	15,000 & over		1,328.82	
IV				
	Under $2,000	70.29		
	2,000- 3,999	21.89		
	4,000- 5,999	80.48		
	6,000- 9,999		135.59	
	10,000-14,999		158.07	
	15,000 & over	86.85		
V				
	Under $2,000			
	2,000- 3,999	5.39		
	4,000- 5,999	63.60		

Continued

Table 17--Continued.

	6,000- 9,999		96.85
	10,000-14,999		82.62
	15,000 & over	127.29	
VI			
	Under $2,000		
	2,000- 3,999	1.61	
	4,000- 5,999	41.28	
	6,000- 9,999		38.57
	10,000-14,999		33.64
	15,000 & over		57.31

a/ n_{ij} is the number of recreation units observed from the j^{th} distance zone's i^{th} income population group.

purpose of clarity, the weighting procedure applied to a generalized form of this model will now be presented. Consider the following exponential model:

$$Y_{ij} = e^{\beta_o + \beta_1 X_{1ij} + \beta_2 X_{2ij} + \beta_3 X_{3ij} + \ldots + \beta_m X_{mij}} + \varepsilon_{ij} \qquad (5\text{-}4)$$

where

i ; represents the i^{th} income population group.

j ; represents the j^{th} distance zone.

Y_{ij} ; represents the dependent variable.

X_{nij} ; represents the independent variables.

$(n = 1, 2, \ldots, m)$

The evidence obtained from Table 17 suggests that there is some validity to the assumption that the variance of the error term is inversely proportional to the number of recreation units sampled from each income population group. Therefore, drawing upon the results presented in equation (5-2), the $\sqrt{n_{ij}}$ is the appropriate weight to use, given the evidence available. To obtain the necessary weighted error term ($\sqrt{n_{ij}}\,\varepsilon_{ij}$), both sides of (5-4) must be raised to the $\sqrt{n_{ij}}$ th power.

$$(Y_{ij})^{\sqrt{n_{ij}}} = e^{\sqrt{n_{ij}}\,(\beta_o + \beta_1 X_{1ij} + \beta_2 X_{2ij} + \beta_3 X_{3ij} + \ldots + \beta_m X_{mij} + \varepsilon_{ij})} \tag{5-5}$$

or alternatively,

$$Y_{ij}^{\sqrt{n_{ij}}} = e^{\sqrt{n_{ij}}\,\beta_o + \beta_1 \sqrt{n_{ij}}\, X_{1ij} + \beta_2 \sqrt{n_{ij}}\, X_{2ij} + \beta_3 \sqrt{n_{ij}}\, X_{3ij} + \ldots + \beta_m \sqrt{n_{ij}}\, X_{mij} + \sqrt{n_{ij}}\,\varepsilon_{ij}} \tag{5-5a}$$

Transforming equation (5-5a) in the usual way to the logarithmic form so that the equation is linear in the parameters, equation (5-6) is obtained.

$$\sqrt{n_{ij}}\ln Y_{ij} = \sqrt{n_{ij}}\,\beta_o + \beta_1 \sqrt{n_{ij}}\, X_{1ij} + \beta_2 \sqrt{n_{ij}}\, X_{2ij} + \ldots + \beta_m \sqrt{n_{ij}}\, X_{mij} + \sqrt{n_{ij}}\,\varepsilon_{ij} \tag{5-6}$$

The resulting estimating equation is

$$\sqrt{n_{ij}}\ln y_{ij} = \sqrt{n_{ij}}\,b_0 + b_1\sqrt{n_{ij}}\,x_{1ij} + b_2\sqrt{n_{ij}}\,x_{2ij} + \ldots + b_m\sqrt{n_{ij}}\,x_{mij} \qquad (5\text{-}7)$$

The weights have been incorporated into the model for the purpose of obtaining minimum variance unbiased estimates of the parameters. Therefore, once equation (5-7) has been estimated, the weights are removed from the model and it is transformed back to the exponential form, yielding equation (5-8).

$$\hat{y}_{ij} = e^{\hat{b}_0' + \hat{b}_1 x_{1ij} + \hat{b}_2 x_{2ij} + \ldots + \hat{b}_m x_{mij}} \qquad (5\text{-}8)$$

where

$$\hat{b}_0' = \overline{\ln y_{ij}} - \hat{b}_1\overline{x_{1ij}} - \hat{b}_2\overline{x_{2ij}} - \ldots - \hat{b}_m\overline{x_{mij}}$$

The constant term has to be adjusted when the weights are removed and the model transformed back to the original exponential model. This is because the weights were included in the means of the independent and dependent variables used to calculate the constant term in the estimated weighted logarithmic model .

Procedure for Examining the Estimated Statistical Demand Equations

Each of the hypothesized models will be examined on the basis of the distribution of the residuals, the statistical significance of the partial regression coefficients,[31/] the sign of the partial regression coefficients and a consideration of the amount of the variation explained by the model as expressed by its coefficient of multiple correlation (R^2). All independent variables will then be examined for high interrelationships with other independent variables in the model. This will be accomplished by examining the simple correlation coefficients between independent variables. A simple correlation coefficient of .7 or greater[32/] between two independent variables will be considered as a high interrelationship between the two.

When an independent variable has a simple correlation coefficient of .7 or greater with one or more of the other independent variables, the role of the variable will be reappraised by estimating a model with all independent variables which exhibit a high interrelationship with the variable removed. The variable will then be

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[31/] A two tail t-test is conducted on each of the partial regression coefficients and if the coefficient is statistically different from zero at a probability level of .10 or less, the partial regression coefficient is considered significant.

[32/] The selection of $r \geq .7$ as an indication of a high interrelationship between two variables is admittedly arbitrary and incomplete. It is incomplete because the simple correlation coefficient only measures the linear relationship between two variables. It is arbitrary because there is no way to determine whether a simple correlation coefficient is high or not, in terms of one variable's effect on another in the model.

reexamined as to the sign of the partial regression coefficient and its significance level. If the variable's partial regression coefficient was significant and was unaffected by the above procedure, the variable will be considered as significant in the demand model. If the variable was not significant and was unaffected by removing all other independent variables with a simple correlation coefficient of .7 or greater, a new model will be estimated with all variables with a simple correlation coefficient of .6 or greater with the independent variable under consideration removed. A variable whose partial regression coefficient still exhibits insignificance will then be removed from the model. The above procedure will be used in examining the results from all models hypothesized in the study. On the basis of this examination, a model in each of the analyses will be presented for further testing or research.

Variables and Notation

This section presents a list of variables [33/] and notation which will be followed throughout the thesis. Let:

j ; represent the j^{th} distance zone. (j = 1, 2, 3, 4, 5, 6)

i ; represent the i^{th} income population group within

[33/] As pointed out in Chapter IV, all variables used in the analyses are measured on the basis of the sample data.

the j^{th} distance zone. $(i = 1, 2, 3, 4, 5, 6)$

Q_{ij} ; represent the total number of recreation days per capita taken by the i^{th} income population group of the j^{th} distance zone. (Quantity variable)

P_{ij} ; represent the average transfer cost per recreation unit per day observed from the i^{th} income population group of the j^{th} distance zone. (Price variable)

I_{ij} ; represent the average total family income of the recreation units observed from the i^{th} income population group of the j^{th} distance zone. (Income variable)

B_{ij} ; represent the average number of people per recreation unit observed from the i^{th} income population group of the j^{th} distance zone. (Number in the recreation unit variable)

C_{ij} ; represent the ratio of the number of recreation days taken by recreation units with children less than or equal to 15 years of age to the total number of recreation days taken by recreation units observed from the i^{th} income population group of the j^{th}

distance zone. (Proportion of days taken by recreation units with children)

L_{ij}^{1} ; represent the ratio of recreation days taken by recreation units with present residences inside city limits to the total number of recreation days taken by recreation units observed from the i^{th} income population group of the j^{th} distance zone. (Proportion of days taken by recreation units residing inside city limits)

L_{ij}^{2} ; represent the ratio of recreation days taken by recreation units with present residences in suburbs to the total number of recreation days taken by recreation units observed from the i^{th} income population group of the j^{th} distance zone. (Proportion of days taken by recreation units residing in suburbs)

L_{ij}^{3} ; represent the ratio of recreation days taken by recreation units with present residences in rural nonfarm areas to the total number of recreation days taken by recreation units observed from the i^{th} income population group of the j^{th} distance zone.

(Proportion of days taken by recreation units residing in rural nonfarm areas)

L^4_{ij} ; represent the ratio of recreation days taken by recreation units with present residences on farms to the total number of recreation days taken by recreation units observed from the i^{th} income population group of the j^{th} distance zone. (Proportion of days taken by recreation units residing in rural farm residences)

S_{ij} ; represent average years of formal education of the individual responding to the personal interview for each recreation unit observed from the i^{th} income population group of the j^{th} distance zone. (Years of education variable)

O_{ij} ; represent the average occupation rating of the head of household of the recreation units observed from the i^{th} income population group of the j^{th} distance zone. (Occupation rating variable)

Y_{ij} ; represent the average number of years camping of the individual responding to the personal interview for each recreation unit observed from the i^{th} income population group of the j^{th} distance zone. (Years of camping experience variable)

E_{ij} ; represent the average investment in recreation equipment being used on the trip observed by recreation units from the i^{th} income population group of the j^{th} distance zone. (Investment in recreation equipment variable)

D_{ij} ; represent the average level of development of sites used by recreation units observed from the i^{th} income population group of the j^{th} distance zone. (Level of site development variable)

U_{ij} ; represent the average potential density of use of sites used by recreation units observed from the i^{th} income population group of the j^{th} distance zone. (Potential density of use at the site variable)

F_{ij} ; represent the average fishing success at the sites used by recreation units observed from the i^{th} income population group of the j^{th} distance zone. (Fishing success variable)

Estimated Demand Equation for the Bend Ranger District

On the basis of the economic model presented in Chapter II, the following demand model was hypothesized for the Bend Ranger District.

$$Q_{ij} = e^{\beta_0 + \beta_1 P_{ij} + \beta_2 I_{ij} + \beta_3 B_{ij} + \beta_4 C_{ij} + \beta_5 L^1_{ij} + \beta_6 L^2_{ij} + \beta_7 L^3_{ij} + \beta_8 L^4_{ij} + \beta_9 S_{ij} + \beta_{10} O_{ij} + \beta_{11} Y_{ij} + \beta_{12} E_{ij} + \beta_{13} D_{ij} + \beta_{14} U_{ij} + \beta_{15} F_{ij} + \varepsilon_{ij}} \qquad (5\text{-}9)$$

Equation (5-9) is estimated by weighting the equation by $\sqrt{n_{ij}}$ and transforming the exponential model to its logarithmic form, then applying the multiple regression estimating procedure. Equation (5-10) is the resulting estimated equation.

$$\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = -2.610529 - \underset{(.049807)}{.207085} \sqrt{n_{ij}}\, P_{ij}^{****}$$

$$+ \underset{(.000091)}{.000134} \sqrt{n_{ij}}\, I_{ij} - \underset{(.290820)}{.084641} \sqrt{n_{ij}}\, B_{ij}$$

$$- \underset{(2.009128)}{.493552} \sqrt{n_{ij}}\, C_{ij} + \underset{(3.575077)}{8.429542} \sqrt{n_{ij}}\, L^{1**}_{ij}$$

$$+ \underset{(3.060466)}{6.059774} \sqrt{n_{ij}}\, L^{2*}_{ij} + \underset{(4.478386)}{11.947277} \sqrt{n_{ij}}\, L^{3***}_{ij}$$

$$+ \underset{(4.742272)}{8.638212} \sqrt{n_{ij}}\, L_{ij}^{4*} - \underset{(.333932)}{.149581} \sqrt{n_{ij}}\, S_{ij}$$

$$- \underset{(.057782)}{.077653} \sqrt{n_{ij}}\, O_{ij} + \underset{(.049336)}{.110032} \sqrt{n_{ij}}\, Y_{ij}^{**}$$

$$- \underset{(.000360)}{.001008} \sqrt{n_{ij}}\, E_{ij}^{**} + \underset{(.000431)}{.000365} \sqrt{n_{ij}}\, D_{ij} \qquad (5\text{-}10)$$

$$+ \underset{(.069639)}{.153340} \sqrt{n_{ij}}\, U_{ij}^{**} + \underset{(2.544034)}{5.388727} \sqrt{n_{ij}}\, F_{ij}^{**}$$

$R^2 = .958$ d.f. = 17

The stars in equation (5-10) are used to reflect the significance level of the partial regression coefficients; ****, ***, ** and * represent .01, .02, .05 and .10 significance levels, respectively. A coefficient without a star is statistically different from zero at a significance level greater than ten percent. The standard error of the coefficients are given in the parentheses under each partial regression coefficient. Transforming (5-10) to the original hypothesized model and removing the weight, equation (5-11) is obtained.

$$\hat{Q}_{ij} = e^{-1.078939 - .207085 P_{ij} + .000134 I_{ij} - .084641 B_{ij} - .493552 C_{ij} + 8.429542 L_{ij}^{1} + 6.059774 L_{ij}^{2} + 11.947277 L_{ij}^{3} + 8.638212 L_{ij}^{4} - .149581 S_{ij}}$$

$$-.077653\ O_{ij} + .110032\ Y_{ij} - .001008\ E_{ij} \quad (5\text{-}11)$$
$$+ .000365\ D_{ij} + .153340\ U_{ij} + 5.388727\ F_{ij}$$

All assumptions of least squares analysis are made on the form of the model actually estimated (5-10). Consequently, all test of significance used in the analyses will have to be made on the results obtained from the estimated log model.

Draper and Smith (1966) suggest that one way of determining the appropriateness of the form of the model used is to compare a plot of residuals against the predicted values of the dependent variable and against the independent variables themselves. Of particular interest in this study is the assumption made about the variance of the error term. If the constancy assumption of the variance of the error term is correct, a plot of residuals ($Q_{ij} - \hat{Q}_{ij}$) against the predicted values of the dependent variable should be random (the residuals should form a horizontal band around the axis of predicted values). Figure 9 gives a plot of the residuals arising from equation (5-10) against the predicted values arising from the equation. It appears from Figure 9 that the logarithmic form used in estimating the parameters of the exponential model does generate a set of residuals which appear to be (approximately) randomly distributed. This indicates that the weighting procedure used does not violate the constant variance assumption of the error

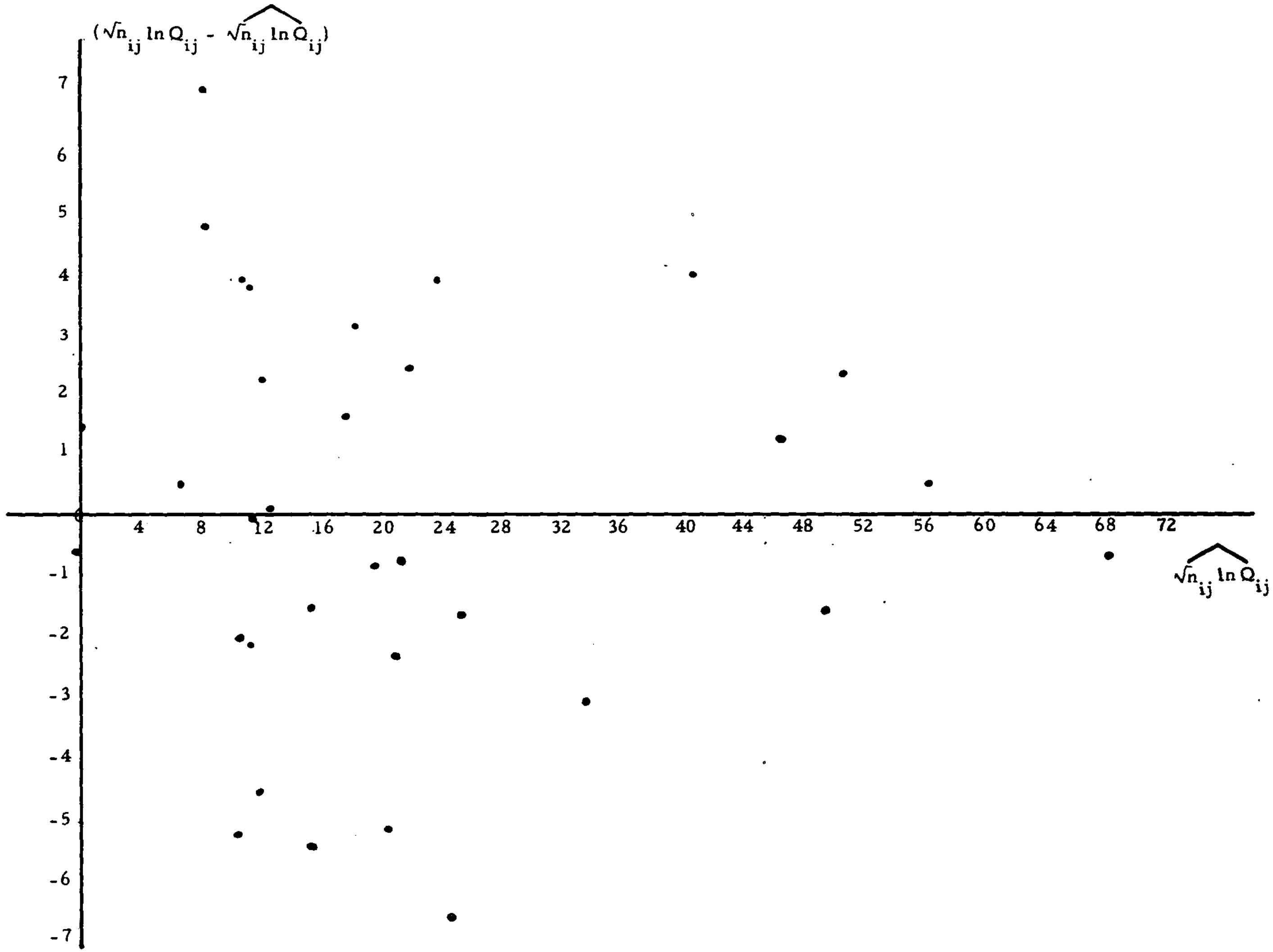

Figure 9. Residuals against the predicted dependent variable from the weighted logarithmic equation estimated for the Bend Ranger District (Eq. 5-10).

term. Therefore, the form of the model used appears appropriate in this analysis.

Although equation (5-10) is the model estimated, equation (5-11) is the original form of the model hypothesized and will be used for purposes of prediction. Edwards (1961) indicated that when a logarithmic transformation is made on a model with a multiplicative error term, the predictive properties of the original model, when the estimated log equation is transformed back to the original model, may not be as good as exhibited by the logarithmic form. "These differences arise because the logarithm of a variable increases at a decreasing rate, so that the mean of the logs of any pair of numbers lies below the log of the mean of the numbers" (Edwards, 1961, p. 106). One way to determine if the predictability is different between the two models is to generate a new set of residuals, using the originally hypothesized model as estimated by the log model, plot these residuals against the predicted dependent variable, and calculate a new multiple correlation coefficient. Figure 10 contains the plot of the residuals generated from equation (5-11). Using this set of residuals and the following formula, a new multiple correlation coefficient (R^2) is calculated.

$$R^2 = 1 - \frac{\sum e_{ij}^2}{\sum q_{ij}^2} \qquad (5\text{-}12)$$

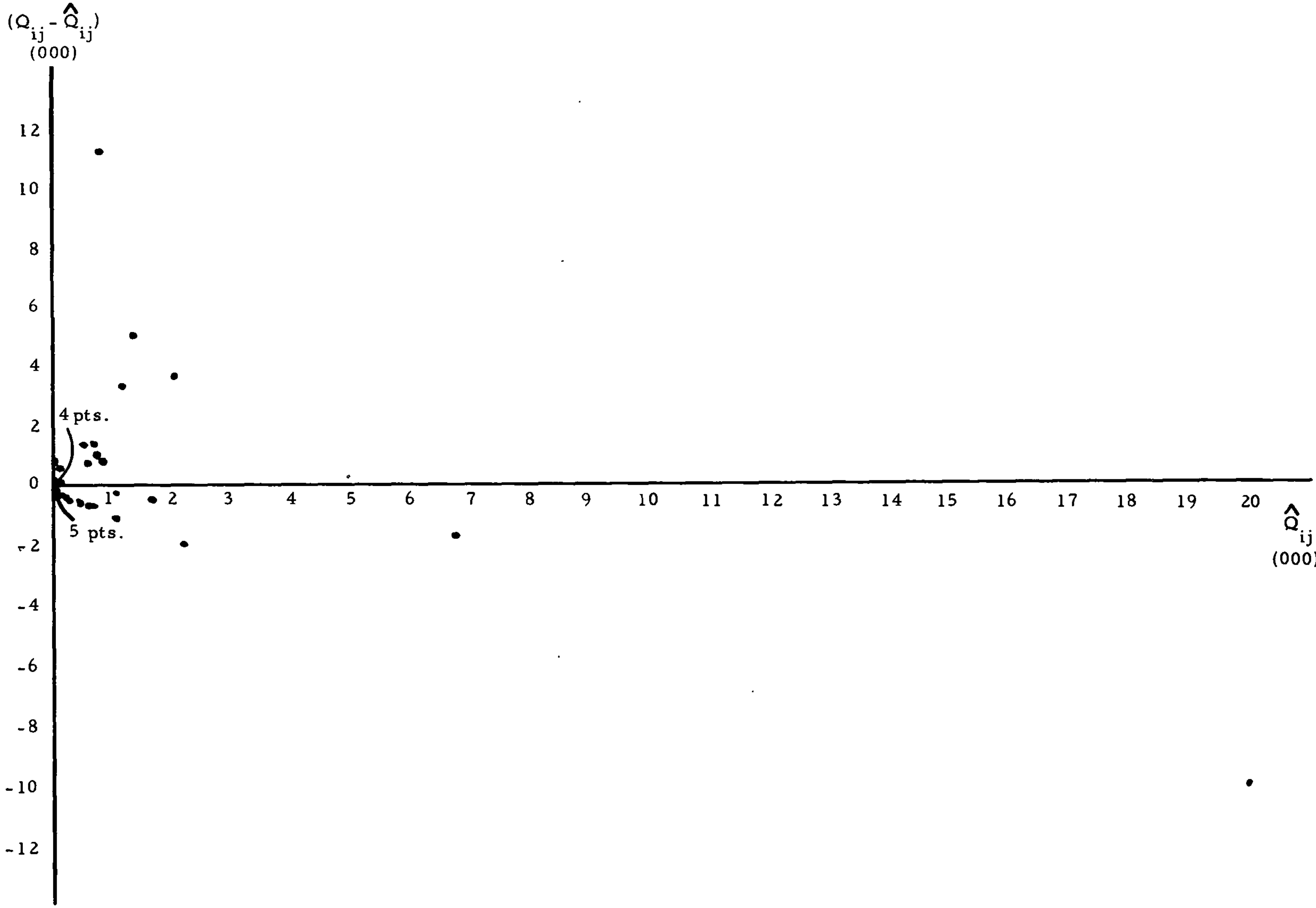

Figure 10. Residuals against the predicted dependent variable from the exponential form of the equation estimated for the Bend Ranger District (Eq. 5-11).

where

$$e_{ij} = Q_{ij} - \hat{Q}_{ij}$$

$$q_{ij} = Q_{ij} - \bar{Q}_{ij}$$

The adjusted R^2 cannot be given its usual interpretation because the sums of error squared arise from a model other than the model to which the least squares analysis was actually applied. It does, however, indicate what has happened to the error term as a result of the transformation. The resulting $R^2 = -.011$ indicates that the error terms have been greatly affected by the transformation. An examination of Figure 10 indicates that the large increase in the error sums of squares is due primarily to three predicted values. Equation (5-11) greatly over predicts the number of recreation days per capita from distance zone one, income population groups one and three. The equation also greatly under predicts the number of recreation days per capita from distance zone one income population group two. Each of these income population groups is in the distance zone closest to the Bend Ranger District and represent populations with total family incomes of less than $6, 000 annually. Since the observations were weighted by the number of recreation units observed in each income population group, the importance of these three observations in deriving the estimated equation can be reflected partially by checking the number of recreation units observed in each of the three income population groups. Income population groups one and two had two recreation units observed from each. Income population group three had six recreation units observed from it in the sample. Therefore, in each case, the weight given to the observation for the income population group was small relative to some of the other income groups.

In an attempt to obtain an estimated demand equation which was free of the above problem, a first order polynomial of the following form was estimated.

$$\begin{aligned} Q_{ij} = {} & \beta_0 + \beta_1 P_{ij} + \beta_2 I_{ij} + \beta_3 B_{ij} + \beta_4 C_{ij} + \beta_5 L^1_{ij} \\ & + \beta_6 L^2_{ij} + \beta_7 L^3_{ij} + \beta_8 L^4_{ij} + \beta_9 S_{ij} + \beta_{10} O_{ij} \\ & + \beta_{11} Y_{ij} + \beta_{12} E_{ij} + \beta_{13} D_{ij} + \beta_{14} U_{ij} \\ & + \beta_{15} F_{ij} + \varepsilon_{ij} \end{aligned} \tag{5-13}$$

Applying the weight of $\sqrt{n_{ij}}$ for the same reasons given in the case of the exponential model, equation (5-14) was estimated.

$$\begin{aligned} \widehat{\sqrt{n_{ij}}\, Q_{ij}} = {} & 4142.4220 \underset{(61.5044)}{-128.6814} \sqrt{n_{ij}}\, P^*_{ij} + \underset{(.1119)}{.0254} \sqrt{n_{ij}}\, I_{ij} \\ & + \underset{(359.1216)}{236.2643} \sqrt{n_{ij}}\, B_{ij} + \underset{(2480.9917)}{1975.0717} \sqrt{n_{ij}}\, C_{ij} \end{aligned}$$

$$+ \underset{(4414.7192)}{3759.7975} \sqrt{n_{ij}}\, L^1_{ij} + \underset{(3779.2468)}{3610.1426} \sqrt{n_{ij}}\, L^2_{ij}$$

$$+ \underset{(5530.1792)}{6737.3878} \sqrt{n_{ij}}\, L^3_{ij} + \underset{(5856.0405)}{5035.5661} \sqrt{n_{ij}}\, L^4_{ij}$$

$$+ \underset{(412.3586)}{424.5772} \sqrt{n_{ij}}\, S_{ij} \underset{(71.3529)}{-185.2747} \sqrt{n_{ij}}\, O^{***}_{ij}$$

$$+ \underset{(60.9234)}{53.4729} \sqrt{n_{ij}}\, Y_{ij} \underset{(.4442)}{-.8844} \sqrt{n_{ij}}\, E^{*}_{ij} \qquad (5\text{-}14)$$

$$\underset{(.5319)}{-.0562} \sqrt{n_{ij}}\, D_{ij} + \underset{(85.9942)}{188.2470} \sqrt{n_{ij}}\, U^{**}_{ij}$$

$$\underset{(3141.5251)}{+586.5907} \sqrt{n_{ij}}\, F_{ij}$$

$R^2 = .710$ d.f. = 17

Removing the weights from (5-14) and adjusting the constant term, (5-15) gives the estimated demand equation.

$$\begin{aligned}\hat{Q}_{ij} = {} & 1601.6173-128.6814\, P_{ij} + .0254\, I_{ij} + 236.2643\, B_{ij} \\ & + 1975.0717\, C_{ij} + 3759.7975\, L^1_{ij} + 3610.1426\, L^2_{ij} \\ & +6737.3878\, L^3_{ij} + 5035.5661\, L^4_{ij} + 424.5772\, S_{ij} \\ & -185.2747\, O_{ij} + 53.4729\, Y_{ij} -.8844\, E_{ij} \qquad (5\text{-}15) \\ & -0562\, D_{ij} + 188.2470\, U_{ij} + 586.5907\, F_{ij}\end{aligned}$$

The residuals arising from equations (5-14) and 5-15) are plotted against the predicted number of recreation days per capita in Figures 11 and 12, respectively. The adjusted multiple correlation coefficient of .579 is calculated, using the new residuals obtained from equation (5-15) and the formula given by (5-12). The removal of the weights from (5-14) and adjusting the constant term does not appear to have great effect on the error terms, which is also indicated by the adjusted multiple correlation coefficient. An examination, however, of the two figures indicates an error in the analysis, or possibly an inadequate model (Draper and Smith, 1966). There is an indication of an error in the analysis, because between 2,000 and 10,000 recreation days per capita (Figure 11) the model consistently over predicts, and between -6,000 and 0 recreation days per capita the model consistently under predicts. The same pattern can be seen to arise out of the residual plots from equation (5-15) in Figure 12.

It also appears from the two figures that there may be need for a higher order equation or cross-product terms, indicating the form of the model is inadequate. To examine the need for a higher order equation, each of the independent variables were plotted against the residuals from equation (5-15). None exhibited a need for a higher-order equation. It was, therefore, concluded that a systematic error which was not random existed in the first order polynomial equation.

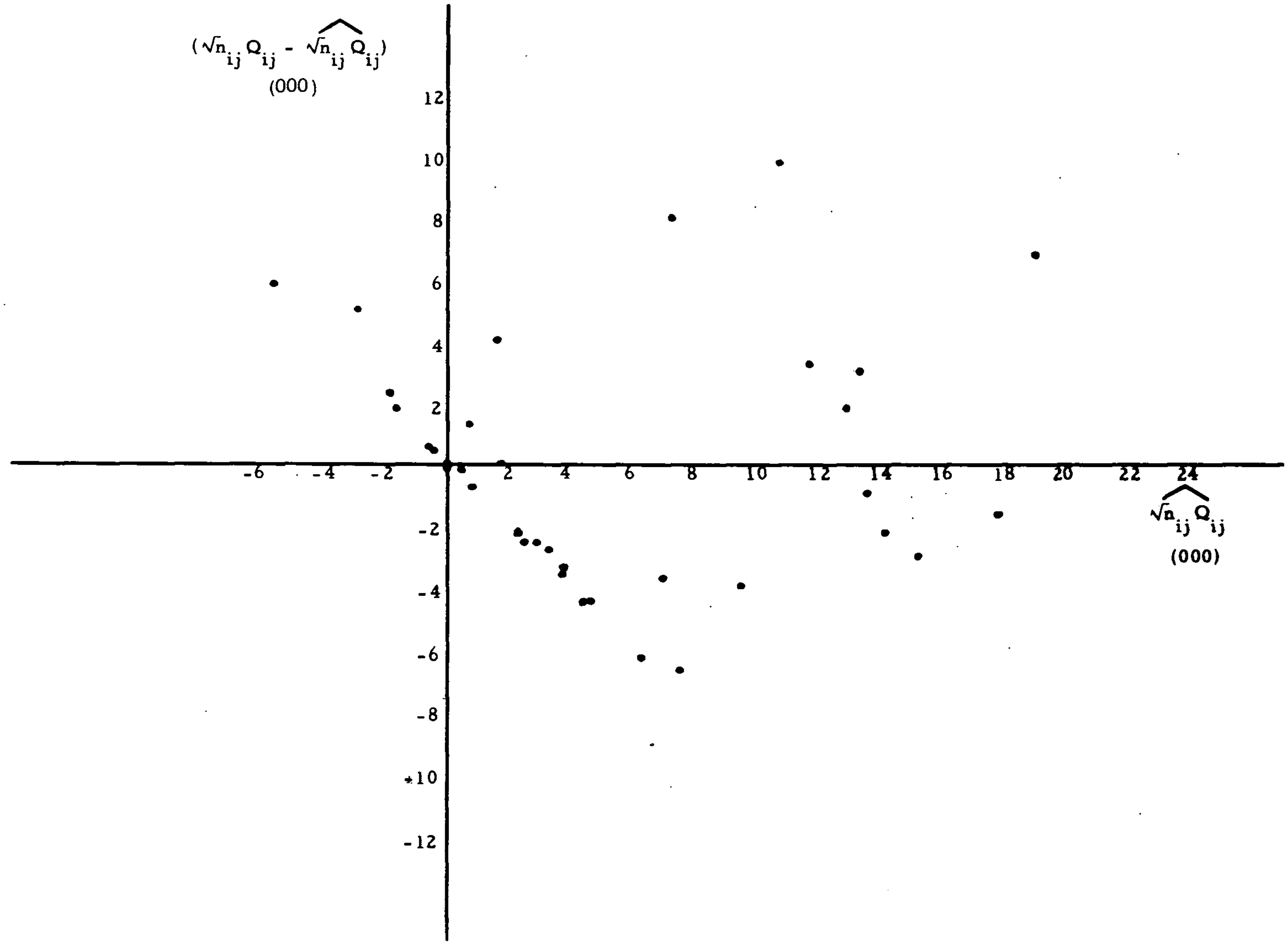

Figure 11. Residuals against the predicted dependent variable from the weighted first order polynomial equation estimated for the Bend Ranger District (Eq. 5-14).

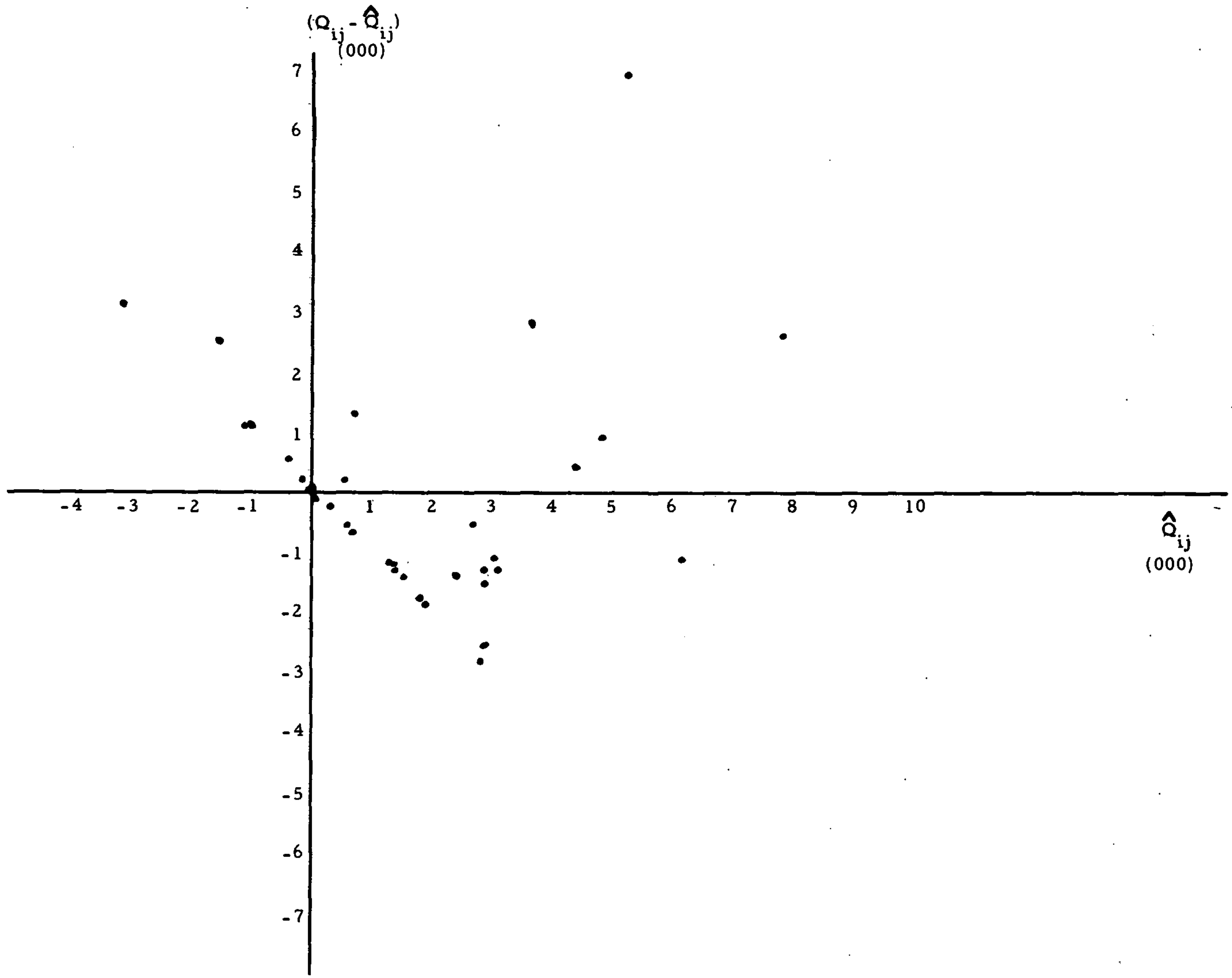

Figure 12. Residuals against the predicted dependent variable from the unweighted form of the first order polynomial equation estimated for the Bend Ranger District (Eq. 5-15).

On the basis of the above investigation as to the mathematical form of the model to be used in the remainder of the analysis of the demand for the Bend Ranger District, it was decided that the exponential model be used. Although the exponential model presented a problem with prediction, it yielded a larger number of significant variables and in its estimating form (the logarithmic form) did not violate greatly the assumptions associated with the error term. It is possible that the exponential model could be improved if nonlinear estimation techniques were used instead of the linear least squares procedures applied in the analysis. As Draper and Smith state:

> "In general when a linearized form of a nonlinear model is used, all the usual formulae and analyses of linear regression theory can be applied. Any results obtained are, however, only valid to the extent that the linearized form provides a good approximation to the true model." (Draper and Smith, 1966, p. 274)

Therefore, results obtained here have to be interpreted in light of the above statement. No attempt will be made to improve upon the estimates derived in this study by the use of nonlinear estimating procedures, because of the speculation surrounding the appropriate procedure to be used and the difficulties encountered in their use. 34/ Therefore, equation (5-11) is taken as the

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34/ Draper and Smith (1966, Chapter 10) give a discussion of three nonlinear estimating procedures and the difficulties encountered in the use of each.

estimated demand equation for the Bend Ranger District. It must be cautioned that the test of significance used in the examination of each independent variable and the model suggested for further study can only be viewed as hypotheses arising from the sample data. This is because the sample data is used to provide information in the construction of these additional models.

Examination of Variables in the Demand Equation for the Bend Ranger District

An examination of equation (5-10) reveals that only nine of the hypothesized variables have partial regression coefficients which are significantly different from zero at conventional levels of probability. As discussed in the beginning of this chapter, each independent variable will be examined separately to determine whether the role of the variable statistically has been influenced by high interrelationships with other independent variables in the model. This examination will be initiated by an investigation of Table 18 which presents the simple correlation coefficients between the 15 independent variables in the analysis. These are the simple correlation coefficients between the weighted form of the variables. The weighted variables are used because these are the forms of the variables used in estimating the parameters in the model.

It can first be observed from Table 18 that there are only

Table 18. Simple Correlation Coefficients Between Weighted Independent Variables, Total Bend Ranger District.

	$\sqrt{n_{ij}}P_{ij}$	$\sqrt{n_{ij}}I_{ij}$	$\sqrt{n_{ij}}B_{ij}$	$\sqrt{n_{ij}}C_{ij}$	$\sqrt{n_{ij}}L^1_{ij}$	$\sqrt{n_{ij}}L^2_{ij}$	$\sqrt{n_{ij}}L^3_{ij}$	$\sqrt{n_{ij}}L^4_{ij}$	$\sqrt{n_{ij}}S_{ij}$	$\sqrt{n_{ij}}O_{ij}$	$\sqrt{n_{ij}}Y_{ij}$	$\sqrt{n_{ij}}E_{ij}$	$\sqrt{n_{ij}}D_{ij}$	$\sqrt{n_{ij}}U_{ij}$	$\sqrt{n_{ij}}F_{ij}$
$\sqrt{n_{ij}}P_{ij}$	1.0000	.6244	.3249	.5680	.4560	-.0868	.1325	-.0323	.4280	.4371	.2956	.0719	.3682	.3313	.4517
$\sqrt{n_{ij}}I_{ij}$		1.0000	.7138	.8341	.6466	.1594	.3428	.1360	.7833	.7704	.4494	.3549	.7364	.5939	.7014
$\sqrt{n_{ij}}B_{ij}$			1.0000	.8547	.7287	.3209	.4474	.1773	.8338	.8680	.5957	.4456	.7634	.7107	.7889
$\sqrt{n_{ij}}C_{ij}$				1.0000	.7325	.1436	.3906	.2670	.8306	.8352	.4841	.3071	.8283	.6905	.8218
$\sqrt{n_{ij}}L^1_{ij}$					1.0000	-.1054	.3409	.0689	.8118	.8228	.3481	.3428	.5268	.7388	.7822
$\sqrt{n_{ij}}L^2_{ij}$						1.0000	.2928	-.0984	.3363	.3304	.5454	.4558	.3326	.1769	.2696
$\sqrt{n_{ij}}L^3_{ij}$							1.0000	.1280	.6525	.6108	.4842	.7052	.4661	.6679	.6492
$\sqrt{n_{ij}}L^4_{ij}$								1.0000	.2051	.1959	-.0020	-.0189	.1932	.1895	.1474
$\sqrt{n_{ij}}S_{ij}$									1.0000	.9842	.6868	.6309	.7620	.8673	.9405
$\sqrt{n_{ij}}O_{ij}$										1.0000	.7192	.6328	.7570	.8847	.9326
$\sqrt{n_{ij}}Y_{ij}$											1.0000	.6517	.5039	.6340	.6269
$\sqrt{n_{ij}}E_{ij}$												1.0000	.3807	.7077	.6362
$\sqrt{n_{ij}}D_{ij}$													1.0000	.6299	.7607
$\sqrt{n_{ij}}U_{ij}$														1.0000	.8471
$\sqrt{n_{ij}}F_{ij}$															1.0000

two variables which have simple correlation coefficients of .6 or less with all other independent variables. These two variables are $\sqrt{n_{ij}}\, L_{ij}^2$ and $\sqrt{n_{ij}}\, L_{ij}^4$; their examination will be conducted in conjunction with the other two residence variables in the analysis and, therefore, all variables will be considered in this portion of the analysis.

Number in the Recreation Unit (B_{ij}): It can be seen that the inclusion of B_{ij}, number in the recreation unit, is unwarranted. B_{ij} was included in the model on purely empirical grounds. Since the recreation unit was taken as the unit of observation rather than the individual, it appeared that some means had to be taken to account for price differences which may occur simply because the average size of the recreation unit was different in one income population group versus another. This is tantamount to hypothesizing that P_{ij} and B_{ij} are highly interrelated. The empirical evidence arising from the sample refutes the hypothesis, since the simple correlation coefficient between $\sqrt{n_{ij}}\, P_{ij}$ and $\sqrt{n_{ij}}\, B_{ij}$ is .3249. Therefore, B_{ij} was removed from the model and was not considered in the models used in investigating the other independent variables.

Price (P_{ij}): The price variable ($\sqrt{n_{ij}}\, P_{ij}$) has a partial regression coefficient which is statistically different from zero at the one percent level. Its sign is negative, agreeing with the expected sign suggested by the theoretical model. An examination of Table 18 shows that the $\sqrt{n_{ij}}\, P_{ij}$ does not have a simple correlation coefficient greater than or equal to .7 with any of the other independent variables. The price variable is therefore considered significant as a determinant of the demand for the Bend Ranger District, and will be kept in the model.

<u>Income</u> (I_{ij}): The income variable ($\sqrt{n_{ij}}\, I_{ij}$) has a partial regression coefficient which is significant at the .20 probability level in equation (5-10). The sign of the partial regression coefficient is positive, which corresponds to the expected sign. In addition to $\sqrt{n_{ij}}\, B_{ij}$, which has already been removed from further inclusion in the model, $\sqrt{n_{ij}}\, I_{ij}$ has a simple correlation coefficient greater than or equal to .7 with the following five variables: $\sqrt{n_{ij}}\, C_{ij}$, $\sqrt{n_{ij}}\, S_{ij}$, $\sqrt{n_{ij}}\, O_{ij}$, $\sqrt{n_{ij}}\, D_{ij}$ and $\sqrt{n_{ij}}\, F_{ij}$. Removing these variables along with the $\sqrt{n_{ij}}\, B_{ij}$ from equation (5-10), the following results are obtained:

$$\widehat{\sqrt{n_{ij}}\ln Q_{ij}} = -2.537279 - \underset{(.039533)}{.172248}\sqrt{n_{ij}}\, P_{ij} + \underset{(.000042)}{.000072}\sqrt{n_{ij}}\, I_{ij}$$

$$+ \underset{(1.055825)}{5.594742}\sqrt{n_{ij}}\, L^{1}_{ij} + \underset{(1.570538)}{4.149027}\sqrt{n_{ij}}\, L^{2}_{ij}$$

$$+ \underset{(2.730283)}{11.259294} \sqrt{n_{ij}} L^3_{ij} + \underset{(3,039315)}{4.864968} \sqrt{n_{ij}} L^4_{ij}$$

$$+ \underset{(.027169)}{.058499} \sqrt{n_{ij}} Y_{ij} - \underset{(.000309)}{.000854} \sqrt{n_{ij}} E_{ij} \qquad (5\text{-}16)$$

$$+ \underset{(.063386)}{.137206} \sqrt{n_{ij}} U_{ij}$$

$R^2 = .937$ d.f. = 23

The partial regression coefficient in equation (5-16) of $\sqrt{n_{ij}}\, I_{ij}$ is again only significant at the .20 probability level. Therefore, an additional attempt was made to determine if the income variable exhibits greater empirical importance in the demand for the Bend Ranger District than appears in equations (5-10) and (5-16); this was done by removing all independent variables with a simple correlation coefficient .6 or greater with $\sqrt{n_{ij}}\, I_{ij}$. Along with $\sqrt{n_{ij}}\, B_{ij}$, the following variables were removed from equation (5-10): $\sqrt{n_{ij}}\, C_{ij}$, $\sqrt{n_{ij}}\, L^1_{ij}$, $\sqrt{n_{ij}}\, S_{ij}$, $\sqrt{n_{ij}}\, O_{ij}$, $\sqrt{n_{ij}}\, D_{ij}$ and $\sqrt{n_{ij}}\, F_{ij}$. After these variables were removed from equation (5-10), equation (5-17) was estimated.

$$\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = -.204587 - \underset{(.057668)}{.169437} \sqrt{n_{ij}} P_{ij} + \underset{(.000058)}{.000152} \sqrt{n_{ij}} I_{ij}$$

$$+ \underset{(2.233981)}{2.300802} \sqrt{n_{ij}} L^2_{ij} + \underset{(3.944370)}{9.246520} \sqrt{n_{ij}} L^3_{ij}$$

$$+ \underset{(4.307491)}{1.046186} \sqrt{n_{ij}}\, L_{ij}^{4} + \underset{(.039464)}{.045095} \sqrt{n_{ij}}\, Y_{ij}$$

$$- \underset{(.000445)}{.001119} \sqrt{n_{ij}}\, E_{ij} + \underset{(.071893)}{.348448} \sqrt{n_{ij}}\, U_{ij} \tag{5-17}$$

$$R^2 = .861 \qquad \text{d.f.} = 24$$

The partial regression coefficient of $\sqrt{n_{ij}}\, I_{ij}$ is significantly different from zero at the .02 level of probability in equation (5-17). The results from equation (5-17) indicate the influence of the variables with a simple correlation coefficient greater than or equal to .6 does affect the empirical importance of the total family income arising from the sample data. It is therefore concluded, based on the empirical evidence arising out of equation (5-17), that the hypothesis that total family income is a significant determinant of the demand for the Bend Ranger District cannot be rejected.

<u>Proportion of Days Taken by Recreation Units with Children</u> (C_{ij}): Influence of children on the demand for the Bend Ranger District, as reflected by C_{ij}, the ratio of the number of days taken by recreation units with children less than or equal to 15 years old to the total number of days taken by recreation units for a zone income population group, does not appear as a significant determinant of demand in equation (5-10). The partial regression

coefficient is statistically significant at a .90 level and has a negative sign. The results from equation (5-10) not only raise a question about the statistical significance of C_{ij} in the demand model, but also the directional influence of C_{ij} on the demand for the Bend Ranger District. Since the argument has been made that outdoor recreation is a group activity, and in particular, a family activity, it might be expected when the Bend Ranger District as a whole is considered, that the partial regression coefficient of $\sqrt{n_{ij}}\, C_{ij}$ would be positive rather than negative, as is indicated in equation (5-10). Examining Table 18, it is seen that six variables, $\sqrt{n_{ij}}\, I_{ij}$, $\sqrt{n_{ij}}\, L^1_{ij}$, $\sqrt{n_{ij}}\, S_{ij}$, $\sqrt{n_{ij}}\, O_{ij}$, $\sqrt{n_{ij}}\, D_{ij}$ and $\sqrt{n_{ij}}\, F_{ij}$, have simple correlation coefficients with $\sqrt{n_{ij}}\, C_{ij}$ which are .7 or greater. Equation (5-18) is obtained by removing these variables and $\sqrt{n_{ij}}\, B_{ij}$ from equation (5-10), and reestimating the model.

$$\begin{aligned}
\widehat{\sqrt{n_{ij}}\ln Q_{ij}} = {} & .841474 - \underset{(.051212)}{.165466}\sqrt{n_{ij}}\, P_{ij} + \underset{(1.421041)}{4.689292}\sqrt{n_{ij}}\, C_{ij} \\
& + \underset{(2.132145)}{1.708077}\sqrt{n_{ij}}\, L^2_{ij} + \underset{(3.709181)}{8.402174}\sqrt{n_{ij}}\, L^3_{ij} \\
& - \underset{(4.154132)}{.841448}\sqrt{n_{ij}}\, L^4_{ij} + \underset{(.037147)}{.035615}\sqrt{n_{ij}}\, Y_{ij} \\
& - \underset{(.000442)}{.000658}\sqrt{n_{ij}}\, E_{ij} + \underset{(.077511)}{.268740}\sqrt{n_{ij}}\, U_{ij}
\end{aligned} \tag{5-18}$$

$R^2 = .876$ d.f. = 24

Statistically, the partial regression coefficient of $\sqrt{n_{ij}}\, C_{ij}$ is significantly different from zero at the .01 level, indicating that the significance of the variable as a determinant of the demand for recreation days in the Bend Ranger District is affected by the variables removed from equation (5-10). The results from equation (5-18) also indicate a positive sign on the partial regression coefficient of $\sqrt{n_{ij}}\, C_{ij}$, which was expected. These results indicate that the hypothesized significance of C_{ij} in the theoretical model does have an empirical counterpart, as exhibited by the sample data in equation (5-18), and therefore, on the basis of these results cannot be rejected.

The aggregative measure used for C_{ij} in this study raises some question about what kind of interpretation can be given to this variable in the statistical model. A strict interpretation of the coefficient on this variable would indicate that as the ratio of days taken by recreation units with children in them to the total number of recreation days taken from a given income group increased, the total number of days taken by the income group would be affected positively. This implies that within the sample, as the ratio of the total number of days taken by recreation units with children increased, so did the total number of days per capita taken by the income population group. Such evidence would indicate that in the Bend Ranger District, the existence of children in the recreation units affects the number of days per capita demanded positively.

Place of Residence (L_{ij}^1, L_{ij}^2, L_{ij}^3, L_{ij}^4): These four variables will be considered together. If the analysis was conducted on the data from each recreation unit rather than aggregating it to be included in the zoning framework, these residence variables would be included as dummy or zero-one variables. These would be interpreted as shifters of the demand schedule. However, because the zoning procedure was used in the study, some adaptation of the zero-one approach had to be made. Adjustment to the zoning framework was made by using the ratio of the number of days taken by a given residence category to the total number of days taken from a given income population group, as the unit of observation for each residence category.

An attempt will be made to determine whether or not recreation units from the different residence areas influence the demand for outdoor recreation differently. The question which is being asked is: Is there a difference in the response which is due to the residence variables that is not explained by the other variables? If there is no difference in the place of residence from which income group users arise on the demand for recreation day, then no account of place of residence is necessary in the model. Therefore our concern is with a test of the null hypothesis (H_o: $\beta_i - \beta_j = 0$) vs. the alternative hypothesis (H_a: $\beta_i - \beta_j \neq 0$), when β_i and β_j

are the partial regression coefficients associated with two of the residence variables. Snedecor (1956) suggests the following procedure for statistically testing the difference between partial regression coefficients in the same equation.

$$t = \frac{b_i - b_j}{s_{\beta_i - \beta_j}} \qquad (5\text{-}19)$$

d. f. = n-m

where,

b_i is the estimated partial regression coefficient for variable i.

b_j is the estimated partial regression coefficient for variable j.

$s_{\beta_i - \beta_j}$ is the estimated standard error of the difference between β_i and β_j.

n is the number of observations.

m is the total number of variables in the model.

$s_{\beta_i - \beta_j}$ is estimated in the following way:

$$s^2_{\beta_i - \beta_j} = s^2_{y.123 \ldots n} (c_{ii} + c_{jj} - 2c_{ij}) \qquad (5\text{-}20)$$

where,

s^2_{y} .123 ... n is the variance of the dependent variable from regression.

c is an element of the inverse matrix of the corrected or residual sums of squares and cross-products. [35/]

Taking the square root of equation (5-20), the standard error of the difference between β_i and β_j is obtained. Table 19 contains the results of this sequence of hypotheses tests performed on equations (5-10) and (5-21).

In equation (5-10), the partial regression coefficients from each of the residence levels are significantly different from zero at some level of significance equal to or less than ten percent. The sign on the partial regression coefficient for each of the residence variables is positive. The test of differences between the partial regression coefficients of the residence variables estimated in equation (5-10), presented in Table 19, shows that only the partial regression coefficients of $\sqrt{n_{ij}}\, L^2_{ij}$ and $\sqrt{n_{ij}}\, L^3_{ij}$ are statistically different from each other, at the ten percent level. From this result, it can be inferred that the proportion of recreation units residing in suburbs observed, contributes differently to the number

35/ The elements of the inverse matrix are often referred to in the literature as Gauss multipliers.

Table 19. Calculated t-values for the Difference Between Partial Regression Coefficients of the Residence Variables in the Demand Equation for the Bend Ranger District.

Hypothesis	t-values	
	Equation (5-10)[a/]	Equation (5-21)[b/]
$H_o: \beta_{L^1_{ij}} - \beta_{L^2_{ij}} = 0$ $H_a: \beta_{L^1_{ij}} - \beta_{L^2_{ij}} \neq 0$	1.2479	2.7352***
$H_o: \beta_{L^1_{ij}} - \beta_{L^3_{ij}} = 0$ $H_a: \beta_{L^1_{ij}} - \beta_{L^3_{ij}} \neq 0$	1.1817	-1.0038
$H_o: \beta_{L^1_{ij}} - \beta_{L^4_{ij}} = 0$ $H_a: \beta_{L^1_{ij}} - \beta_{L^4_{ij}} \neq 0$	-.0691	-.0064
$H_o: \beta_{L^2_{ij}} - \beta_{L^3_{ij}} = 0$ $H_a: \beta_{L^2_{ij}} - \beta_{L^3_{ij}} \neq 0$	-1.7512*	2.3242**
$H_o: \beta_{L^2_{ij}} - \beta_{L^4_{ij}} = 0$ $H_a: \beta_{L^2_{ij}} - \beta_{L^4_{ij}} \neq 0$	-.7518	-1.3287

Continued

Table 19--Continued.

H_o: $\beta_{L^3_{ij}} - \beta_{L^4_{ij}} = 0$ H_a: $\beta_{L^3_{ij}} - \beta_{L^4_{ij}} \neq 0$	.7478	.6409

a/ d.f. = 17.

b/ d.f. = 24.

c/ The stars refer to the significance levels; ****, ***, **, and * refer to .01, .02, .05 and .10, respectively.

of recreation days per capita from the average zone income population group than does the proportion of recreation units observed residing in rural nonfarm areas. As in the case of the other variables discussed, the removing of highly interrelated variables may allow some further inferences to be drawn about the difference place of residence may have on the quantity of recreation days per capita arising from a zone. In this case, four variables instead of one are being considered simultaneously and the removal of variables are handled somewhat differently. Each independent variable having a simple correlation coefficient of .7 or greater with each of the residence variables is removed. Therefore, from equation (5-10), the following variables along with $\sqrt{n_{ij}}\,B_{ij}$ are removed: $\sqrt{n_{ij}}\,C_{ij}$, $\sqrt{n_{ij}}\,S_{ij}$, $\sqrt{n_{ij}}\,O_{ij}$, $\sqrt{n_{ij}}\,E_{ij}$, $\sqrt{n_{ij}}\,U_{ij}$ and

$\sqrt{n_{ij}}\, F_{ij}$. The new model estimated is given in equation (5-21).

$$
\begin{aligned}
\widehat{\sqrt{n_{ij}}\ \ln Q_{ij}} = {} & -2.404054 - \underset{(.040045)}{.147709}\sqrt{n_{ij}}\, P_{ij} + \underset{(.000051)}{.000007}\sqrt{n_{ij}}\, I_{ij} \\
& + \underset{(.854024)}{6.501387}\sqrt{n_{ij}}\, L^1_{ij} + \underset{(1.644461)}{2.376871}\sqrt{n_{ij}}\, L^2_{ij} \\
& + \underset{(2.251837)}{9.039641}\sqrt{n_{ij}}\, L^3_{ij} = \underset{(3.020273)}{6.520708}\sqrt{n_{ij}}\, L^4_{ij} \qquad (5\text{-}21) \\
& + \underset{(.024674)}{.055042}\sqrt{n_{ij}}\, Y_{ij} + \underset{(.000355)}{.000846}\sqrt{n_{ij}}\, D_{ij}
\end{aligned}
$$

$R^2 = .930$ d.f. = 24

The results from equation (5-21) are different than those in equation (5-10); the partial regression coefficient of $\sqrt{n_{ij}}\, L^2_{ij}$ is no longer significant at the ten percent level or less. The partial regression coefficients of the $\sqrt{n_{ij}}\, L^1_{ij}$ and $\sqrt{n_{ij}}\, L^3_{ij}$ are both significant at the one percent level in equation (5-21), and that for $\sqrt{n_{ij}}\, L^4_{ij}$ is now significant at the five percent level. There has, however, been no change in the signs of the partial regression coefficient on these four variables. Pairwise tests of differences between the partial regression coefficients are given in Table 19. Results from these tests indicate a difference between the partial regression coefficients of $\sqrt{n_{ij}}\, L^2_{ij}$ and

$\sqrt{n_{ij}}\, L_{ij}^{3}$, implying that the effect of suburban residence and rural nonfarm residence on the number of recreation days per capita from an income population group is different. Equation (5-21) however, also reveals a difference between the partial regression coefficients of $\sqrt{n_{ij}}\, L_{ij}^{2}$, which are statistically different at the two percent level. This indicates that there is also a difference between the influence of recreation units observed residing inside city limits and those residing in suburbs on the number of recreation days per capita taken from an income population group.

The pairwise test presented in Table 19 only provides information indicating which residence areas should not be combined. The results from equation (5-21) suggest that there is evidence to indicate that $\sqrt{n_{ij}}\, L_{ij}^{1}$ and $\sqrt{n_{ij}}\, L_{ij}^{2}$ should not be combined, and that $\sqrt{n_{ij}}\, L_{ij}^{2}$ and $\sqrt{n_{ij}}\, L_{ij}^{3}$ should not be combined. Knowing what residence areas not to combine does, however, suggest alternative groupings from which a logical grouping can be made, using these results and the discussion in Chapter II. It can be seen in Table 19 that partial regression coefficients of the following residence variables are statistically different at a probability level of greater than ten percent in equation (5-21):

$\sqrt{n_{ij}}\, L^1_{ij}$ and $\sqrt{n_{ij}}\, L^3_{ij}$

$\sqrt{n_{ij}}\, L^1_{ij}$ and $\sqrt{n_{ij}}\, L^4_{ij}$

$\sqrt{n_{ij}}\, L^2_{ij}$ and $\sqrt{n_{ij}}\, L^4_{ij}$

$\sqrt{n_{ij}}\, L^3_{ij}$ and $\sqrt{n_{ij}}\, L^4_{ij}$

Combining on the basis of the statistical results, as completely as possible, the following three combinations suggest themselves: (1) Combine L^1_{ij}, L^3_{ij} and L^4_{ij}; (2) combine L^2_{ij} and L^4_{ij}; and (3) combine L^3_{ij} and L^4_{ij}. Of the three combinations suggested, the third combination of L^3_{ij} and L^4_{ij} appears to be the most suitable. In the discussion of these variables in Chapter II, it was initially suggested that some differences may exist between urban and rural residents in outdoor recreation use patterns. At that point in the discussion, however, a finer division of residence areas was suggested for use, based on evidence of increasing similarity between urban and rural society. There is evidence in the pairwise test that indicates that within the urban population differences in the model do exist, since the partial regression coefficient of $\sqrt{n_{ij}}\, L^1_{ij}$ and $\sqrt{n_{ij}}\, L^2_{ij}$ are significantly different. Therefore, based on the sample data, L^1_{ij} and L^2_{ij} should not be combined in models for future testing. Evidence from the sample, however, tend to suggest in the model for the Bend Ranger District that differences do not exist between L_{ij}^{3} and L_{ij}^{4}, the rural categories. Therefore, in the model suggested for further testing, these two rural categories will be combined into one residence category.

A further note on the residence variables is in order. It was observed in equation (5-10) that each of the residence variables had a coefficient which was statistically significant. In equation (5-21) three of the four variables had coefficients which were significant. The signs on the coefficients in both equations were positive. Therefore, it can be suggested that the directional effect of the days taken by residence groups on the demand for the Bend district is invariant. The results in Table 19, however, indicate that although the directional effect on the quantity variable is not different, the size of the effect is different between these residence groupings. Equation (5-21) indicates that the coefficients of the ratio of days taken by recreation units residing within city limits and the ratio of days taken by recreation units residing in the suburbs are statistically different at the two percent level. From this result, then, it is inferred that size effect on the number of days taken per capita is greater in the case of L_{ij}^{1} than L_{ij}^{2}. A similar conclusion can be reached in the comparison between L_{ij}^{2} and L_{ij}^{3}. In this case, the proportion of days taken by recreation units residing in rural nonfarm areas has the greatest effect. These results suggest that place of residence influences the demand for outdoor recreation positively, but the size of this influence can be expected to differ across residence groups.

Education (S_{ij}): Years of education has a partial regression coefficient which is not significantly different from zero at the ten percent level or less. The sign of the partial regression coefficient is negative, which is contrary to what would be expected. It seems reasonable to expect that the role of education would be similar to that exhibited by income, which would lead to an expected positive sign. Examining the role of years of education further, the $\sqrt{n_{ij}}\, B_{ij}$ is removed from equation (5-10) along with all other independent variables which have a simple correlation coefficient of .7 or greater with $\sqrt{n_{ij}}\, S_{ij}$. Table 18 shows that the following variables are removed from equation (5-10): $\sqrt{n_{ij}}\, I_{ij}$, $\sqrt{n_{ij}}\, C_{ij}$, $\sqrt{n_{ij}}\, L^1_{ij}$, $\sqrt{n_{ij}}\, O_{ij}$, $\sqrt{n_{ij}}\, D_{ij}$, $\sqrt{n_{ij}}\, U_{ij}$ and $\sqrt{n_{ij}}\, F_{ij}$. Upon removal of these variables from the original model, equation (5-22) was estimated.

$$\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = -.333088 \underset{(.037558)}{-.169468} \sqrt{n_{ij}}\, P_{ij} \underset{(1.537194)}{- 1.603721} \sqrt{n_{ij}}\, L^2_{ij} \underset{(2.990179)}{+ 4.972653} \sqrt{n_{ij}}\, L^3_{ij} \underset{(3.219413)}{-.597559} \sqrt{n_{ij}}\, L^4_{ij} \underset{(.063452)}{+ .638005} \sqrt{n_{ij}}\, S_{ij} \underset{(.029252)}{+ .021524} \sqrt{n_{ij}}\, Y_{ij} \tag{5-22}$$

$$-.000521 \sqrt{n_{ij}}\, E_{ij}$$
$$(.000304)$$

$R^2 = .920$ d.f. = 25

The statistical significance of $\sqrt{n_{ij}}\, S_{ij}$'s partial regression coefficient has been greatly affected by the removal of highly related variables. It is now significantly different from zero at the one percent level. Also, it can be observed that the sign on the partial regression coefficient is now positive, which would correspond to expectation. Evidence resulting from equation (5-22) will not allow rejection of the hypothesis that the years of education is a significant variable in the demand model for the Bend Ranger Distrist, on the basis of the sample data.

Occupation (O_{ij}): The partial regression coefficient on the occupation rating variable is significantly different from zero at the 20 percent level in equation (5-10). As in the case of S_{ij}, the sign is also contrary to expectation. A negative partial regression coefficient would have the following interpretation: that as the social status of users from an income population group increased, there would be a reduction in the number of recreation days per capita taken by that income population group. This might be expected to be the case within a given remoteness level, or when the occupation group under consideration is a group of the more prestigious occupations. But when the total Bend Ranger District is considered, and the total sphere of occupations included, as it is here, an inverse relationship to occupation prestige is unexpected. Removing all highly related variables, as suggested by Table 18, in addition to $\sqrt{n_{ij}}\,B_{ij}$ from equation (5-10), some additional information about the role of the O_{ij} variable from the sample data may be obtained. In addition to $\sqrt{n_{ij}}\,B_{ij}$, the following variables are removed: $\sqrt{n_{ij}}\,I_{ij}$, $\sqrt{n_{ij}}\,C_{ij}$, $\sqrt{n_{ij}}\,L^1_{ij}$, $\sqrt{n_{ij}}\,S_{ij}$, $\sqrt{n_{ij}}\,Y_{ij}$, $\sqrt{n_{ij}}\,D_{ij}$, $\sqrt{n_{ij}}\,U_{ij}$ and $\sqrt{n_{ij}}\,F_{ij}$. Equation (5-23) presents the results of this manipulation.

$$
\begin{aligned}
\widehat{\sqrt{n_{ij}}\ln Q_{ij}} = {} & -1.918318 \underset{(.037206)}{-.166188}\sqrt{n_{ij}}\,P_{ij} \underset{(1.413209)}{-.850964}\sqrt{n_{ij}}\,L^2_{ij} \\
& \underset{(2.896877)}{+8.202905}\sqrt{n_{ij}}\,L^3_{ij} \underset{(3.233937)}{-.542059}\sqrt{n_{ij}}\,L^4_{ij} \\
& \underset{(.011581)}{+.126503}\sqrt{n_{ij}}\,O_{ij} \underset{(.000296)}{-.000638}\sqrt{n_{ij}}\,E_{ij}
\end{aligned}
\tag{5-23}
$$

$R^2 = .916$ d.f. $= 26$

The significance level of the partial regression coefficient of $\sqrt{n_{ij}}\,O_{ij}$ in equation (5-23) is at the one percent level. Its sign is now positive, which appears to be more appropriate. A considerable difference, therefore, is observed in the performance of the occupation rating variable over its indicated role in the originally hypothesized model. It appears that when the occupation rating variable is allowed to operate in the model free of highly related variables, that the sample data reflects that it is a highly significant variable in the demand equation for the Bend Ranger District. These results, then, do not recommend the rejection of the hypothesized significance of social occupation prestige in the conceptual model.

<u>Years of Camping Experience</u> (Y_{ij}): In the original model, Y_{ij} has a partial regression coefficient which is significantly different from zero at the five percent level. It also has a positive sign, which would be expected.

An examination of Table 18 indicates that $\sqrt{n_{ij}}\, Y_{ij}$ has a simple correlation coefficient of .7 or greater with only $\sqrt{n_{ij}}\, O_{ij}$. Therefore, the role of Y_{ij} is examined further by removing $\sqrt{n_{ij}}\, O_{ij}$ along with $\sqrt{n_{ij}}\, B_{ij}$ from equation (5-10), and estimating equation (5-24). The results from equation (5-24) will indicate whether the role of Y_{ij} is influenced to any significant degree by the highly interrelated variable.

$$
\begin{aligned}
\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = -2.846199 &- \underset{(.042513)}{.188600} \sqrt{n_{ij}}\, P_{ij} + \underset{(.000079)}{.000075} \sqrt{n_{ij}}\, I_{ij} \\
&- \underset{(1.725323)}{.768714} \sqrt{n_{ij}}\, C_{ij} + \underset{(2.429196)}{5.010490} \sqrt{n_{ij}}\, L^{1}_{ij} \\
&+ \underset{(2.346225)}{3.551309} \sqrt{n_{ij}}\, L^{2}_{ij} + \underset{(3.934398)}{9.784351} \sqrt{n_{ij}}\, L^{3}_{ij}
\end{aligned}
$$

$$+ \underset{(4.006446)}{5.022357} \sqrt{n_{ij}} L_{ij}^{4} - \underset{(.287340)}{.116378} \sqrt{n_{ij}} S_{ij} \qquad (5\text{-}24)$$

$$+ \underset{(.034912)}{.061638} \sqrt{n_{ij}} Y_{ij} - \underset{(.000358)}{.000946} \sqrt{n_{ij}} E_{ij}$$

$$+ \underset{(.000426)}{.000278} \sqrt{n_{ij}} D_{ij} + \underset{(.063777)}{.116307} \sqrt{n_{ij}} U_{ij}$$

$$+ \underset{(2.441311)}{4.308055} \sqrt{n_{ij}} F_{ij}$$

$R^2 = .953$ d.f. = 19

The partial regression coefficient of $\sqrt{n_{ij}}\, Y_{ij}$ is significant at the ten percent level. Comparing this result with equation (5-10) suggests that the significance level of the partial regression coefficient has dropped, which would indicate that the role of Y_{ij} may have been overemphasized in the original model. The decline in statistical importance, however, is not sufficient enough to indicate a rejection of Y_{ij}'s hypothesized role in the demand for the Bend Ranger District based on the sample data. The above results indicate further examination of this variable may be warranted. Therefore, a new model was estimated with all variables with a simple correlation coefficient of .6 or greater with $\sqrt{n_{ij}}\, Y_{ij}$ removed from equation (5-10). The additional variables removed are: $\sqrt{n_{ij}}\, S_{ij}$, $\sqrt{n_{ij}}\, E_{ij}$, $\sqrt{n_{ij}}\, U_{ij}$ and $\sqrt{n_{ij}}\, F_{ij}$. The model estimated is given by equation (5-25).

$$\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = \underset{}{-1.986890} \underset{(.042143)}{-.156320} \sqrt{n_{ij}}\, P_{ij} \underset{(.000053)}{-.000004} \sqrt{n_{ij}}\, I_{ij}$$

$$+ \underset{(1.704401)}{1.239105} \sqrt{n_{ij}}\, C_{ij} + \underset{(.993473)}{6.142999} \sqrt{n_{ij}}\, L^1_{ij}$$

$$+ \underset{(1.661723)}{2.337845} \sqrt{n_{ij}}\, L^2_{ij} + \underset{(2.287126)}{9.215578} \sqrt{n_{ij}}\, L^3_{ij} \qquad (5\text{-}25)$$

$$+ \underset{(3.274463)}{5.655218} \sqrt{n_{ij}}\, L^4_{ij} + \underset{(.024994)}{.053646} \sqrt{n_{ij}}\, Y_{ij}$$

$$+ \underset{(.000443)}{.000656} \sqrt{n_{ij}}\, D_{ij}$$

$$R^2 = .931 \qquad\qquad d.f. = 23$$

The partial regression coefficient on $\sqrt{n_{ij}}\, Y_{ij}$ is again significant at the five percent level. These results, therefore, are consistent with the results obtained above, and the conclusion reached appears to be justified.

<u>Investment in Recreation Equipment</u> (E_{ij}): In equation (5-10) E_{ij} has a coefficient which is significantly different from zero at the two percent level. The sign on the coefficient is negative. A negative sign in this case is somewhat confusing. Considering the individual recreation unit, it seems reasonable to expect that the average length of stay among owners of recreation equipment would be longer than that of renters, since the price to owners would be lower than to renters. If one were to argue from a number of

trips basis, it might be suggested that recreation units owning a small amount of equipment have more disposable income for trip-taking. However, using the aggregated income group averages, as is done in the study, it may be that the recreation units with the highest investment in recreation equipment come from the more distant zones, which have fewer days per capita in each income population group than do closer zones. Proceeding as before, all variables with a simple correlation coefficient greater than or equal to .7, along with $\sqrt{n_{ij}}\, B_{ij}$ are removed from equation (5-10). Table 18 indicates that $\sqrt{n_{ij}}\, L^3_{ij}$ and $\sqrt{n_{ij}}\, U_{ij}$ will be removed from the original model. The new equation estimated is given in equation (5-26).

$$
\begin{aligned}
\widehat{\sqrt{n_{ij}}\ln Q_{ij}} = {} & -2.347955 \underset{(.049581)}{-.156844} \sqrt{n_{ij}}\, P_{ij} \underset{(.000078)}{-.000071} \sqrt{n_{ij}}\, I_{ij} \\
& \underset{(2.047158)}{+.092478} \sqrt{n_{ij}}\, C_{ij} \underset{(2.711073)}{+.854093} \sqrt{n_{ij}}\, L^1_{ij} \\
& \underset{(2.388223)}{-1.037982} \sqrt{n_{ij}}\, L^2_{ij} \underset{(4.763918)}{+.705831} \sqrt{n_{ij}}\, L^4_{ij} \\
& \underset{(.256992)}{+.486762} \sqrt{n_{ij}}\, S_{ij} \underset{(.060349)}{+.007039} \sqrt{n_{ij}}\, O_{ij} \\
& \underset{(.044841)}{+.016763} \sqrt{n_{ij}}\, Y_{ij} \underset{(.000350)}{-.000286} \sqrt{n_{ij}}\, E_{ij}
\end{aligned}
\qquad (5\text{-}26)
$$

$$+ .000434 \sqrt{n_{ij}}\, D_{ij} \quad + 2.309767 \sqrt{n_{ij}}\, F_{ij}$$
$$(.000514) \qquad\qquad (2.877057)$$

$R^2 = .929$ $\qquad\qquad$ d.f. = 20

In equation (5-26) the partial regression coefficient is significant at only the 50 percent level. This might indicate that one or more of the variables may have carried the $\sqrt{n_{ij}}\, E_{ij}$ into a significant role in equation (5-10). It could also indicate that the particular combination of variables in equation (5-26) is such that the true statistical significance of the variable is distorted. In attempting to clarify the role of this variable, all variables with a simple correlation coefficient greater than or equal to .6 with $\sqrt{n_{ij}}\, E_{ij}$ are removed from equation (5-10). In addition to the variables removed in estimating equation (5-26), the following variables are removed from the original model: $\sqrt{n_{ij}}\, S_{ij}$, $\sqrt{n_{ij}}\, O_{ij}$, $\sqrt{n_{ij}}\, Y_{ij}$ and $\sqrt{n_{ij}}\, F_{ij}$. The results obtained from the newly estimated model are given in equation (5-27).

$$\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = \underset{}{-2.925174} \underset{(.055544)}{-.129823} \sqrt{n_{ij}}\, P_{ij} \underset{(.000072)}{-.000036} \sqrt{n_{ij}}\, I_{ij}$$

$$\underset{(2.300861)}{+ 1.658222} \sqrt{n_{ij}}\, C_{ij} \underset{(1.370906)}{+ 6.536435} \sqrt{n_{ij}}\, L^1_{ij} \tag{5.27}$$

$$\underset{(2.077890)}{+ 3.864544} \sqrt{n_{ij}}\, L^2_{ij} \underset{(4.346464)}{+ 6.979007} \sqrt{n_{ij}}\, L^4_{ij}$$

$$+ \underset{(.000295)}{.000600} \sqrt{n_{ij}}\, E_{ij} + \underset{(.000580)}{.001011} \sqrt{n_{ij}}\, D_{ij}$$

$$R^2 = .872 \qquad\qquad \text{d.f.} = 24$$

In equation (5-27) the partial regression coefficient of $\sqrt{n_{ij}}\, E_{ij}$ again becomes significant, this time at the ten percent level. Now, however, the sign of the coefficient has changed from negative to positive. The erratic performance of the variables on the investment in recreation equipment variable makes it difficult to reach a conclusion about its role in the demand equation for the Bend Ranger District.

The final variables to be examined are the three site characteristics: level of site development, potential density of use, and fishing success. Attention will first be turned to a discussion of the empirical role of the level of site development (D_{ij}), as evidenced by the sample data.

Level of Site Development (D_{ij}): The partial regression coefficient of $\sqrt{n_{ij}}\, D_{ij}$ in equation (5-10) is significantly different from zero at the fifty percent level. Its sign is positive, agreeing with the expectation that as development increased at a resource-based facility, more recreation days would be taken. Little inference can be drawn about this variable, because it does not appear as a very important variable statistically in the demand model. Investigating the role of this variable further, all variables with a simple correlation coefficient greater than or equal to .7 with $\sqrt{n_{ij}}\,D_{ij}$, along with $\sqrt{n_{ij}}\,B_{ij}$, are removed from equation (5-10). The variables removed are: $\sqrt{n_{ij}}\,I_{ij}$, $\sqrt{n_{ij}}\,C_{ij}$, $\sqrt{n_{ij}}\,S_{ij}$, $\sqrt{n_{ij}}\,O_{ij}$, and $\sqrt{n_{ij}}\,F_{ij}$. The new estimated model is given in equation (5-28).

$$
\begin{aligned}
\widehat{\sqrt{n_{ij}}\ln Q_{ij}} = {} & -2.426167 \underset{(.032638)}{-.151611}\sqrt{n_{ij}}\,P_{ij} \underset{(.957430)}{+5.822676}\sqrt{n_{ij}}\,L^1_{ij} \\
& \underset{(1.567609)}{+3.447235}\sqrt{n_{ij}}\,L^2_{ij} \underset{(2.643909)}{+10.162085}\sqrt{n_{ij}}\,L^3_{ij} \\
& \underset{(2.874321)}{+4.875280}\sqrt{n_{ij}}\,L^4_{ij} \underset{(.025937)}{+.055924}\sqrt{n_{ij}}\,Y_{ij} \\
& \underset{(.000303)}{-.000654}\sqrt{n_{ij}}\,E_{ij} \underset{(.000294)}{+.000683}\sqrt{n_{ij}}\,D_{ij} \\
& \underset{(.062214)}{+.106838}\sqrt{n_{ij}}\,U_{ij}
\end{aligned} \qquad (5\text{-}28)
$$

The results from equation (5-28) indicate that the empirical significance of $\sqrt{n_{ij}}\,D_{ij}$ is affected by the variables removed from the model. Its partial regression coefficient is now significantly different from zero at the five percent level. The sign of the coefficient has not been affected by the manipulation. Therefore, the evidence resulting from the sample data does not allow the rejection of the hypothesized significance of site development in the conceptual model.

<u>Potential Density of Use at the Site</u> (U_{ij}): The second site characteristic included in the hypothesized model was potential density of use at the site. Its partial regression coefficient is significantly different from zero at the five percent level in equation (5-10). A positive relationship is estimated with the dependent variable, as evidenced by the positive sign on the coefficient. Removing all variables with a simple correlation coefficient greater than or equal to .7 ($\sqrt{n_{ij}}\, L^1_{ij}$, $\sqrt{n_{ij}}\, S_{ij}$, $\sqrt{n_{ij}}\, O_{ij}$, $\sqrt{n_{ij}}\, E_{ij}$, and $\sqrt{n_{ij}}\, F_{ij}$ along with $\sqrt{n_{ij}}\, B_{ij}$) from equation (5-10) provides additional information about its empirical significance. With these variables removed from the model, a new equation (5-29) was estimated.

$$\begin{aligned}
\widehat{\sqrt{n_{ij}}\,\ln Q_{ij}} = {} & .617684 \underset{(.058804)}{-.167150}\sqrt{n_{ij}}\, P_{ij} + \underset{(.000074)}{.000030}\sqrt{n_{ij}}\, I_{ij} \\
& + \underset{(2.166451)}{4.497427}\sqrt{n_{ij}}\, C_{ij} + \underset{(2.253731)}{.523004}\sqrt{n_{ij}}\, L^2_{ij} \\
& + \underset{(3.688615)}{6.107332}\sqrt{n_{ij}}\, L^3_{ij} + \underset{(4.383469)}{.141404}\sqrt{n_{ij}}\, L^4_{ij} \\
& + \underset{(.038577)}{.025118}\sqrt{n_{ij}}\, Y_{ij} + \underset{(.000606)}{.000176}\sqrt{n_{ij}}\, D_{ij}
\end{aligned} \tag{5.29}$$

$$+ .207736 \sqrt{n_{ij}}\, U_{ij}$$
$$(.070805)$$

$$R^2 = .867 \qquad\qquad d.f. = 23$$

The significance of $\sqrt{n_{ij}}\, U_{ij}$ is relatively unaffected by the removal of the highly interrelated variables. Its partial regression coefficient is significantly different from zero at the one percent level in equation (5-29). A positive sign on the partial regression coefficient indicates that its directional effect on the quantity variable has been unaffected by the variable removal procedure. Consequestly, the evidence presented from the sample information does not imply a rejection of the hypothesized significance of U_{ij} as a determinant of the demand for the Bend Ranger District.

<u>Fishing Success</u> (F_{ij}): Fishing success, as measured by the fish caught per hour, is the final variable included in the model to be examined. Its partial regression coefficient in equation (5-10) is significantly different from zero at the five percent level. The positive sign on the partial regression coefficient corresponds to what would be expected from the fishing success variable, since fishing is a major activity in the Bend Ranger District. Removing all independent variables ($\sqrt{n_{ij}}\, I_{ij}$, $\sqrt{n_{ij}}\, C_{ij}$, $\sqrt{n_{ij}}\, L^1_{ij}$, $\sqrt{n_{ij}}\, S_{ij}$, $\sqrt{n_{ij}}\, O_{ij}$, $\sqrt{n_{ij}}\, D_{ij}$ and $\sqrt{n_{ij}}\, U_{ij}$) with a simple correlation coefficient greater than or equal to .7 with $\sqrt{n_{ij}}\, F_{ij}$ along with $\sqrt{n_{ij}}\, B_{ij}$

from equation (5-10), the following model is estimated.

$$\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = \underset{}{-.256011} \underset{(.046991)}{-.170333} \sqrt{n_{ij}}\, P_{ij} \underset{(1.893902)}{-.418885} \sqrt{n_{ij}}\, L_{ij}^2$$

$$\underset{(3.659641)}{+ 6.298603} \sqrt{n_{ij}}\, L_{ij}^3 \underset{(3.855030)}{+ 3.481933} \sqrt{n_{ij}}\, L_{ij}^4 \tag{5-30}$$

$$\underset{(.034728)}{+ .063007} \sqrt{n_{ij}}\, Y_{ij} \underset{(.000382)}{-.000726} \sqrt{n_{ij}}\, E_{ij}$$

$$\underset{(1.436915)}{+ 10.935317} \sqrt{n_{ij}}\, F_{ij}$$

$R^2 = .878$ d.f. = 25

In equation (5-30) the partial regression coefficient on $\sqrt{n_{ij}}\, F_{ij}$ is significantly different from zero at the one percent level, and maintains its positive sign. Although the significance of the partial regression coefficient has increased, indicating that the parameter is affected by the variables removed, no different conclusion about F_{ij}'s role in the model can be reached. Based on the sample evidence, the hypothesized significance of F_{ij} in the demand for the Bend Ranger District is not rejected.

Model for Further Testing (Bend Ranger District)

In the preceding section a demand model was hypothesized, subjected to test, some of its properties examined, and each variable in the model examined with highly interrelated variables removed. It is the purpose of this section to summarize these results and suggest, on the basis of the above investigation, a model which appears fruitful for future research efforts. In addition, this model will be estimated, the variables examined, and the net willingness to pay schedule derived.

The statistical results of the preceding section suggest the removal of the number in the recreation unit variable (B_{ij}), since its relationship with the average transfer cost (P_{ij}) does not appear high. Some question about the significance of the total family income variable is raised, since its role in the model does not appear as significant until all variables that have a simple correlation coefficient of .6 or greater are removed from the model. However, the theoretical basis for the inclusion of income as an explanatory variable in a demand model is well grounded. Stronger empirical evidence than is suggested here would be needed to remove it from a model for future testing. As the results from the pairwise test of the partial regression coefficients suggested, the two rural residence categories, rural nonfarm (L_{ij}^3) and rural farm (L_{ij}^4), will be combined in the new model. The inside city limits (L_{ij}^1) and suburb (L_{ij}^2) categories will be kept separate, as in the originally hypothesized model.

Both years of education (S_{ij}) and the occupation prestige rating variable (O_{ij}) exhibit significance when the independent variables with simple correlation coefficients of .7 or greater are removed from the model. An examination of the simple correlation coefficient between S_{ij} and O_{ij} reveals that it is .9842, which indicates that they are statistically approximately the same variable. It would, therefore, seem reasonable to drop one or combine them in some way. The occupation prestige rating is only a first approximation of a variable to reflect social status. An index in which income, education and occupation were incorporated would be more meaningful in drawing inferences about the influence of social status on the demand for recreation days at the facility. Therefore, since O_{ij} has limited meaning, as it is used, it is suggested that this variable be removed from the model. This leaves S_{ij} to explain whatever influence social prestige may have on the demand for outdoor recreation, until some more appropriate measure of social status can be obtained.

The performance of the investment in recreation equipment variable (E_{ij}) in the estimated models indicates that it is sensitive in both sign and significance level to other variables in the equation.

The results are such that it was difficult to draw definite inferences about the role this variable performs in the demand for outdoor recreation. For this reason, it is suggested that E_{ij}, as it was used in this study, be removed from the model. Part of the difficulty with this variable may be in the measurement used in the study, i.e., total investment in equipment undepreciated. A more relevant measure, such as the present value of the equipment, might yield more definite results than were obtained.

All variables not considered in the above discussion will be left in the model to be suggested for further testing. It is obvious that in the formulation of this model no attempt is made to remove all highly interrelated variables, but only those variables in which their significance does not appear relevant or definable in explaining the demand for the Bend Ranger District. The argument of high interrelationship with another variable as reason for removal was made, in the case of the occupation rating; but this had theoretical justification, as well as empirical evidence, to support its removal. The problem of highly interrelated variables is considered to be a statistical problem. The inclusion of variables within an economic model is based on theoretical argument. To remove a variable from a model because of the statistical relationship it has with some other variable model without theoretical economic support may be questionable.

Based on the analysis of the sample data for the Bend Ranger District, it is suggested that the following model be subjected to further empirical testing and investigation. 36/

General Model

$$Q_{ij} = e^{\beta_o + \beta_1 P_{ij} + \beta_2 I_{ij} + \beta_3 C_{ij} + \beta_4 L^1_{ij} + \beta_5 L^2_{ij} + \beta_6 (L^3_{ij} + L^4_{ij}) + \beta_7 S_{ij} + \beta_8 Y_{ij} + \beta_9 D_{ij} + \beta_{10} U_{ij} + \beta_{11} F_{ij} + \varepsilon_{ij}} \tag{5-31}$$

Logarithmic Model

$$\begin{aligned}\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = \; & -2.816187 \underset{(.044901)}{- .152087} \sqrt{n_{ij}} P_{ij} \\ & \underset{(.000079)}{-.000016} \sqrt{n_{ij}} I_{ij} \underset{(1.654279)}{+ .647822} \sqrt{n_{ij}} C_{ij} \\ & \underset{(2.685411)}{+ 4.135908} \sqrt{n_{ij}} L^1_{ij} \underset{(2.444084)}{+ 1.544873} \sqrt{n_{ij}} L^2_{ij} \\ & \underset{(3.593705)}{+ 5.101409} \sqrt{n_{ij}} (L^3_{ij} + L^4_{ij}) \\ & \underset{(.305236)}{+ .110782} \sqrt{n_{ij}} S_{ij} \underset{(.036807)}{+ .031866} \sqrt{n_{ij}} Y_{ij}\end{aligned} \tag{5-32}$$

36/ This form of model presentation will be used throughout the remainder of the thesis.

$$+ .000526 \underset{(.000464)}{} \sqrt{n_{ij}}\, D_{ij} + .040746 \underset{(.062362)}{} \sqrt{n_{ij}}\, U_{ij}$$

$$+ 1.657633 \underset{(2.346044)}{} \sqrt{n_{ij}}\, F_{ij}$$

$R^2 = .9354$ d.f. = 21

Exponential Model

$$\hat{Q}_{ij} = e^{-1.117075 - .152087 P_{ij} - .000016 I_{ij} + .647822 C_{ij} + 4.135908 L^1_{ij} + 1.544873 L^2_{ij} + 5.101409 (L^3_{ij} + L^4_{ij}) + .110782 S_{ij} + .031866 Y_{ij} + .000526 D_{ij} + .040746 U_{ij} + 1.657633 F_{ij}} \quad (5\text{-}33)$$

Equation (5-32) is a model suggested for further testing or research. It was generated on the basis of the sample data; consequently, statistical test of hypothesis have no meaning. However, some observations about the equation can be made, if the idea that the results are hypotheses, and not tests, is kept in mind. If this model was the one originally hypothesized with 21 degrees of freedom, only one variable, P_{ij}, would have a partial regression coefficient which is statistically different from zero. Therefore, only meaningful inferences statistically concerning the price variable could have been drawn from these results. The reason for this result is the evidence of multicollinearity which exists in the equation. As was suggested, no attempt was made to remove these interrelated variables. The basis for this approach arises out of an unpublished paper by Brown (1968), in which he discusses the importance of not removing relevant variables from a model. Brown's argument centers on the specification error arising from the omission of relevant variables from a model. The focus of his argument is on the bias which results in the parameter estimates when relevant variables are omitted from the model. The conclusion arising from Brown's luminous statement of the problem is that if the objective of the estimated equation is to predict the dependent variable, then the use of an incomplete model is adequate, as long as the relationship between excluded and included variables remain the same. These results suggest that if there is concern over the magnitude of the estimated parameters, the removal of a variable from an equation should be done only on the basis that its importance in the model is not relevant. An attempt has been made in this study to avoid the specification error suggested by Brown, through experiments on the independent variables. Therefore, although the problem of multicollinearity does seem prevalent in the final model suggested for further study, no attempt will be made to remove further variables from the equation.

An observation concerning the use of the empirical estimate of the demand equation (5-33) may be appropriate. When the above model suggested for further study is reestimated with another set of data, a test of the hypothesis that the partial regression coefficients in the newly estimated model are different from those obtained in equation (5-33) may be informative. This would be particularly interesting when the facility under consideration is some resource-based facility other than the Bend Ranger District. Such a test would provide evidence to the applicability of the model estimated, and those estimated in the remainder of this chapter, to other resource-based facilities of a similar nature.

A test of the type described above would also be informative if new data were collected from the Bend Ranger District. Conducted on new information, this sort of test would provide evidence to indicate the validity of the estimates obtained in this study.

Figure 13 contains a plot of the estimated demand schedule through the scatter of points between average transfer cost and days per capita for the total Bend Ranger District. The demand schedule is plotted from equation (5-33) by holding all independent variables constant at their means and letting the average transfer cost variable vary. In examining the extent to which the estimated equation fits the scatter, it must be kept in mind that in estimating equation (5-33), the observations were weighted by the number of

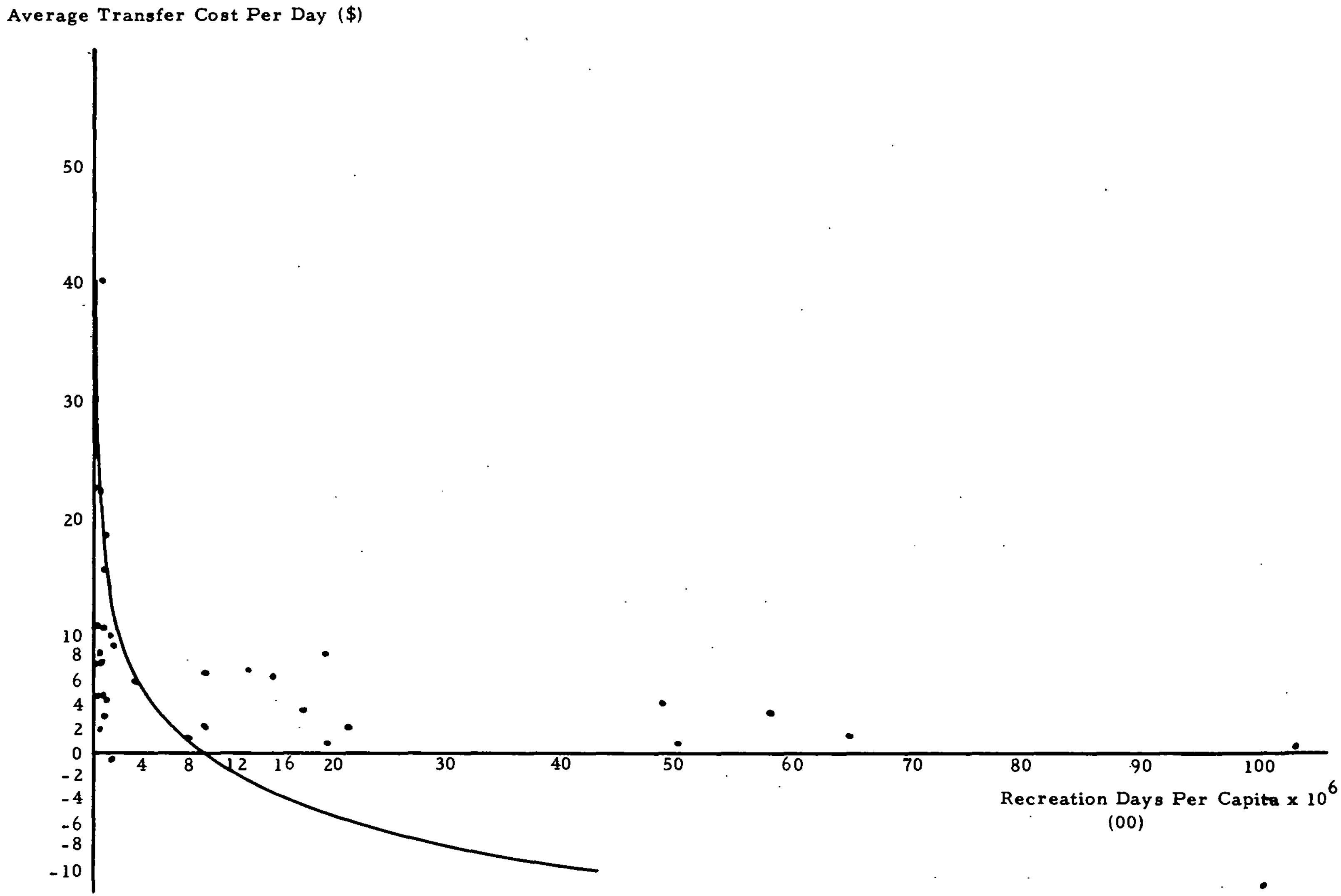

Figure 13. Estimated demand schedule for the Bend Ranger District plotted through the average transfer cost--recreation days per capita scatter (Eq. 5-33).

recreation units observed from each income population group. Therefore, those observations with the larger number of recreation units in them were given more weight in the estimated equation. Consequently, the equation can be expected to provide a better fit to those zone income group observations containing the larger number of recreation units observed.

Equation (5-33) is also used to construct the net willingness to pay schedule in an attempt to estimate the economic value of the Bend Ranger District, as evidenced by the sample data. Following the procedure suggested in Chapter II, the average transfer cost for each income population group is increased in one dollar increments. At each dollar added to the transfer cost, equation (5-33) is used to predict the number of recreation days per capita from each income population group. Inflating the predicted number of recreation days per capita by the population from each income population group and summing across the income group, a total number of recreation days from the population of the geographical region defined by the distance zones is obtained for each added cost. A plot of the corresponding added cost and total number of recreation days give the net willingness to pay schedule for the defined geographical region. This schedule estimated using equation (5-33), is given in Figure 14. Table 20 contains the added cost and predicted total number of recreation days used to

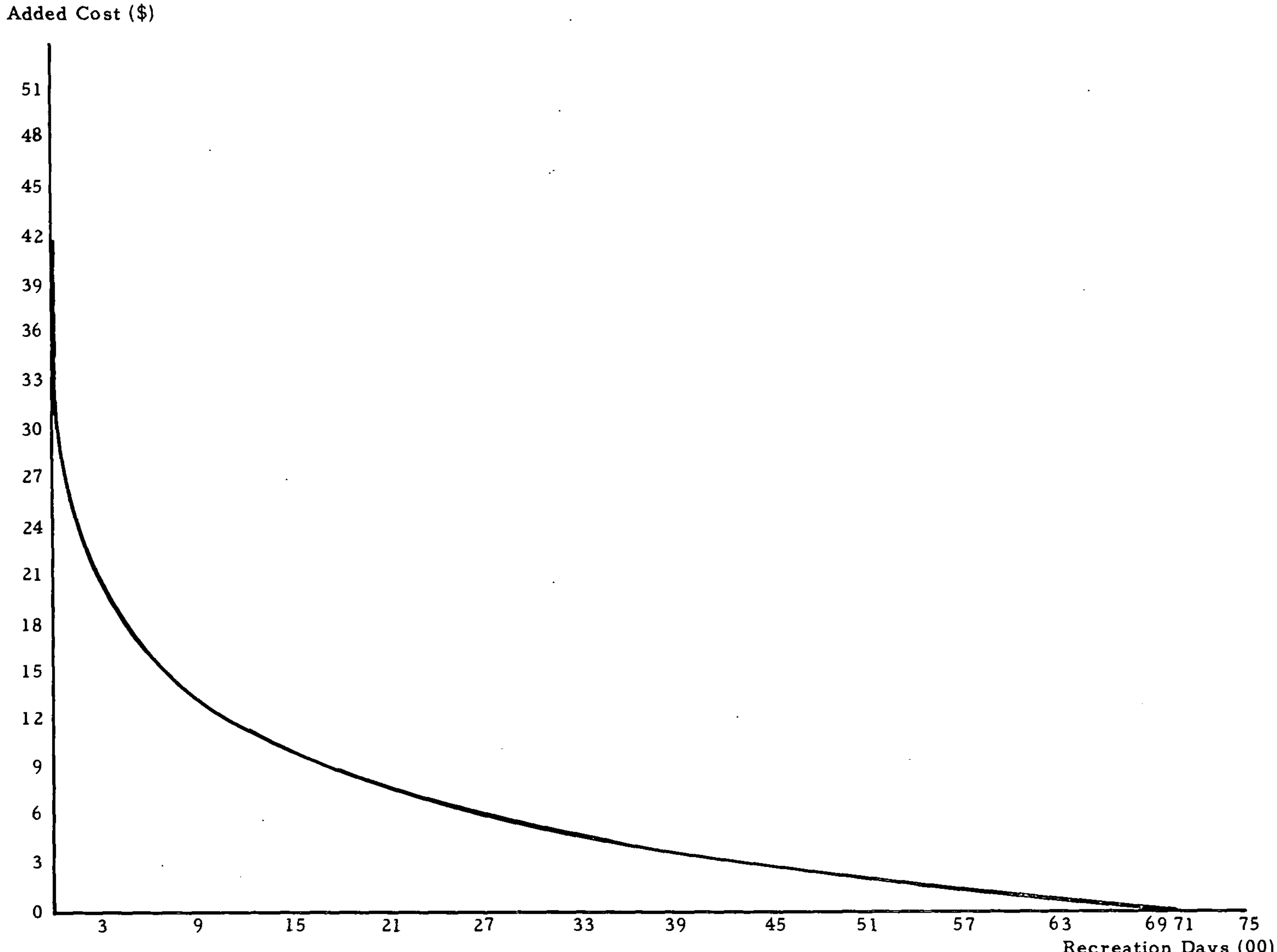

Figure 14. Net willingness to pay schedule for the Bend Ranger District (Eq. 5-34).

Table 20. Predicted Total Number of Recreation Days Taken in the Bend Ranger District at Various Levels of Increased Average Transfer Cost Per Recreation Day by the Sample of Users.

Increased average transfer cost/day	Total number of recreation days a/ (all income groups)	Total number of recreation days (In-groups removed) b/
($)		
0	7,068	3,740
1	6,066	3,210
2	5,206	2,755
3	4,468	2,364
4	3,835	2,029
5	3,291	1,741
6	2,824	1,495
7	2,424	1,283
8	2,080	1,101
9	1,786	945
10	1,532	811
11	1,315	696
12	1,129	597
13	969	513
14	831	440
15	714	378
16	612	324
17	526	278
18	451	239
19	387	205
20	332	176
21	285	151
22	245	129
23	210	111
24	180	95
25	155	82
26	133	70
27	114	60
28	98	52
29	84	44
30	72	38
31	62	33
32	53	28
33	46	24
34	39	21

Continued

Table 20--Continued

35	34	18
36	29	15
37	25	13
38	21	11
39	18	10
40	16	8
41	13	7
42	12	6
43	10	5
44	8	4
45	7	4
46	6	3
47	5	3
48	5	2
49	4	2

a/ Rounded to the nearest day.

b/ Zone 5 income group 4 and zone 6 income group 3 were removed.

obtain Figure 14. The economic value of the Bend Ranger District derived from the sample is obtained by determining the area under the net willingness to pay schedule. In order to estimate the area under the schedule, the data from Table 20 was used to estimate the equation of the schedule (5-34).

$$\hat{Q} = e^{8.86 - .15 P} \tag{5-34}$$

Integrating equation (5-34), an estimate of the net economic value is obtained for the sample.

$$\int_{0}^{\infty} e^{8.86 - .15 P} dp = \frac{1}{.15} e^{8.86}$$

$$= \$46,963.22$$

Therefore, the economic value of the Bend Ranger District, derived from the sample is equal to $46.963.22. This value is derived from the sample of recreation units and therefore, relates to only those recreation units observed at the facility in the sample. No attempt has been made to project from the value derived from the sample to the total population of recreation units which used the facility. In addition, the derived value refers to only the 1967 summer recreation season.

In each of the remaining analyses the computed value estimates will relate to the sample of recreation units in the 1967 summer recreation season observed at the various remoteness levels.

A check as to the accuracy of this value estimate can be obtained by summing the number of recreation days observed from each income population group in Table 3. The total number of recreation days observed was 4, 232 in the sample. At zero increase in the average transfer cost, the predicted number of days should correspond closely to the total number of days actually observed. An examination of Table 20 shows that the total number of days predicted by equation (5-33) is 7, 068. This indicates that there has been a considerable over-estimation using equation (5-33); therefore, the value estimate derived is questionable. In an effort to arrive at a more meaningful estimate of economic value, the predicted number of recreation days for each income group was compared to the actual number of days observed in the sample, Table 21. As can be seen in Table 21, the income group 4 in zone 5 and income group 3 in zone 6 have been predicted to yield substantial number of days over that actually observed. Part of the over predictions in the two income groups is due to the low average transfer cost obtained in the sample, Table 5. Removing these two observations from the analysis may provide a more meaningful measure of the economic value generated by the sample for the Bend Ranger District. Using equation (5-33) with the two observations removed, the adjusted net willingness to pay schedule is given in Figure 15. The data used in constructing this schedule is also given in Table 20. Equation (5-35) is estimated, using the price-quantity relationships generated from equation (5-33) with the two income groups removed.

$$\hat{Q} = e^{8.23 - .15 P} \tag{5-35}$$

Integrating equation (5-35), the adjusted economic value derived from the sample is obtained.

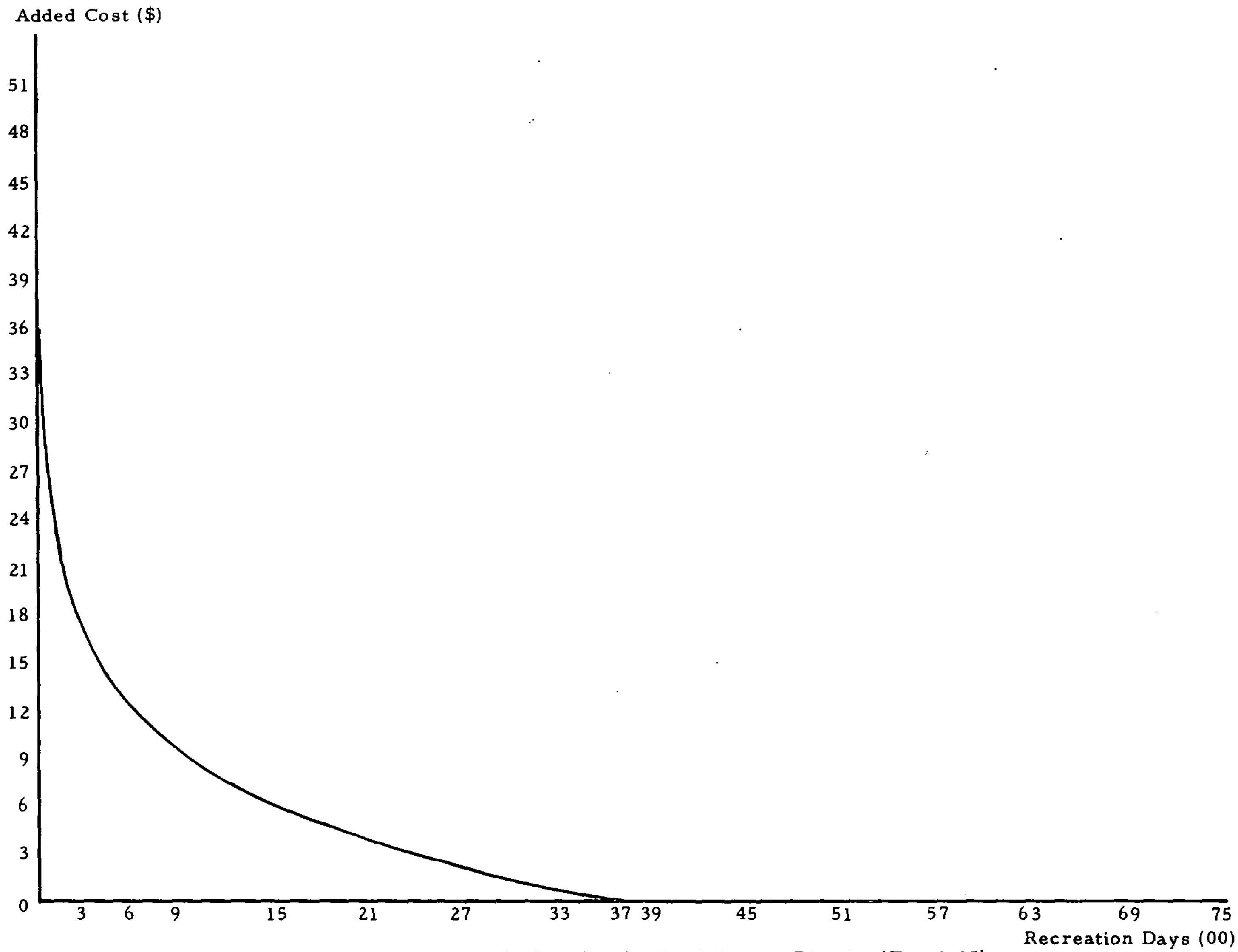

Figure 15. Adjusted net willingness to pay schedule for the Bend Ranger District (Eq. 5-35).

Table 21. Comparison of the Number of Days Observed in the Sample and the Number of Days Predicted by Equation (5-33) for Each Income Population Group.

Distance zone	Income population group	Days observed in the sample	Days predicted by equation (5-33)
1	Under $2,000	68	58.88
	2,000- 3,999	68	.54
	4,000- 5,999	38	3.68
	6,000- 9,999	82	21.70
	10,000-14,999	49	10.31
	15,000 & over	17	5.00
2	Under $2,000	0	---
	2,000- 3,999	120	72.92
	4,000- 5,999	27	89.11
	6,000- 9,999	464	102.95
	10,000-14,999	200	90.97
	15,000 & over	36	58.95
3	Under $2,000	4	87.31
	2,000- 3,999	119	3.80
	4,000- 5,999	133	133.00
	6,000- 9,999	796	419.37
	10,000-14,999	385	112.60
	15,000 & over	128	108.45
4	Under $2,000	28	44.87
	2,000- 3,999	15	221.71
	4,000- 5,999	85	154.48
	6,000- 9,999	216	145.70
	10,000-14,999	93	335.29
	15,000 & over	19	108.90
5	Under $2,000	0	
	2,000- 3,999	7	206.70
	4,000- 5,999	109	334.97
	6,000- 9,999	237	1,676.71
	10,000-14,999	120	191.52
	15,000 & over	90	120.38

Continued

Table 21--Continued.

6	Under $2, 000	0	
	2, 000- 3, 999	4	3.67
	4, 000- 5, 999	130	1,651.21
	6, 000- 9, 999	183	360.09
	10, 000-14, 999	88	146.16
	15, 000 & over	74	8.59

$$\int_0^{\infty} e^{8.23 - .15} dp = \frac{1}{.15} e^{8.23}$$

$$= \$25,012.23$$

Examining the difference between the number of actually observed days, 3, 865, and that estimated by equation (5-33) at zero added cost, 3, 740, a difference of 125 recreation days is observed. This result suggests that the removal of the two income groups does improve the predictability of the estimated equation. However, little about the estimated economic value can be said, other than it probably lies somewhere between the two estimates obtained.

Estimated Demand Equation for Remoteness Level I

A demand equation will now be estimated using the data obtained from recreation units observed in the sample, at sites within the Bend Ranger District which are accessible by paved roads. All data on the site variables will relate to those sites which are defined by this level of remoteness. Variable notations are the same as used in the analysis of the total Bend Ranger District. The procedure of analysis will follow the same pattern used in the preceding analysis for each equation estimated for the remoteness levels.

Based on the conceptual model presented in Chapter II, the following general model was hypothesized and estimated for Remoteness Level I:

General Model

$$Q_{ij} = e^{\beta_o + \beta_1 P_{ij} + \beta_2 I_{ij} + \beta_3 B_{ij} + \beta_4 C_{ij} + \beta_5 L^1_{ij} + \beta_6 L^2_{ij} + \beta_7 L^3_{ij} + \beta_8 L^4_{ij} + \beta_9 S_{ij} + \beta_{10} O_{ij} + \beta_{11} Y_{ij} + \beta_{12} E_{ij} + \beta_{13} D_{ij} + \beta_{14} U_{ij} + \beta_{15} F_{ij} + \varepsilon_{ij}} \qquad (5\text{-}35)$$

Logarithmic Model

$$\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = -.435268 \underset{(.033579)}{-.133957} \sqrt{n_{ij}}\, P_{ij}^{****}$$

$$\underset{(.000061)}{-.000038} \sqrt{n_{ij}}\, I_{ij} \quad \underset{(.572287)}{-.923232} \sqrt{n_{ij}}\, B_{ij}$$

$$\underset{(2.076284)}{+ 4.022137} \sqrt{n_{ij}}\, C_{ij}^{*} \underset{(4.996930)}{+ 5.769295} \sqrt{n_{ij}}\, L^1_{ij}$$

(5-36)

$$+ \underset{(5.311400)}{8.743171} \sqrt{n_{ij}}\, L^2_{ij} + \underset{(4.930736)}{8.964861} \sqrt{n_{ij}}\, L^3_{ij}{}^{*}$$

$$+ \underset{(7.787377)}{6.417365} \sqrt{n_{ij}}\, L^4_{ij} - \underset{(.313628)}{.194677} \sqrt{n_{ij}}\, S_{ij}$$

$$+ \underset{(.071004)}{.034865} \sqrt{n_{ij}}\, O_{ij} + \underset{(.069485)}{.050850} \sqrt{n_{ij}}\, Y_{ij}$$

$$+ \underset{(.000408)}{.000488} \sqrt{n_{ij}}\, E_{ij} + \underset{(.000337)}{.000429} \sqrt{n_{ij}}\, D_{ij}$$

$$- \underset{(.077485)}{.070956} \sqrt{n_{ij}}\, U_{ij} + \underset{(2.428337)}{.084187} \sqrt{n_{ij}}\, F_{ij}$$

$R^2 = .9699$ d.f. = 11

<u>Exponential Model</u>

$$\hat{Q}_{ij} = e^{-.230122 - .133957 P_{ij} - .000038 I_{ij}}$$

$$-.923232\, B_{ij} + 4.022137\, C_{ij} + 5.769295\, L^1_{ij}$$

$$+ 8.743171\, L^2_{ij} + 8.964861\, L^3_{ij} + 6.417365\, L^4_{ij}$$

(5-37)

$$-.194677\, S_{ij} + .034865\, O_{ij} + .050850\, Y_{ij}$$

$$+ .000488\, E_{ij} + .000429\, D_{ij} - .070956\, U_{ij}$$

$$+ .084187\, F_{ij}$$

Figure 16 gives a plot of the residuals against the predicted dependent variables derived using equation (5-36). The residuals appear to have an approximate random distribution, although a slight pattern of conversion from low predicted values to high predicted values does exist. This indicates that possible the weights used are only a first approximation, and some other weight might improve the efficiency of the estimated parameters. However, the plot does not appear to indicate discernible error in the analysis. Therefore, it is concluded that the form of the model estimated is adequate. How well the linear estimation technique has approximated the exponential model can be examined, at least partially, by examining Figure 17. Figure 17 contains the plot of the residuals and predicted dependent variable estimated by equation (5-37). The plot of the transformed results indicates that the distribution of the error term is not as random as that exhibited by those arising from the logarithmic equation. However, the multiple correlation coefficient calculated for equation (5-36) indicates that error term may not be affected as greatly as suggested by Figure 17. Using equation (5-12), the adjusted multiple correlation coefficient (R^2) for equation (5-36) is equal to .8093. This would give some indication that the predictive character of equation (5-36) has not been affected substantially, although the equation does over predict the results from zone one income population group three by

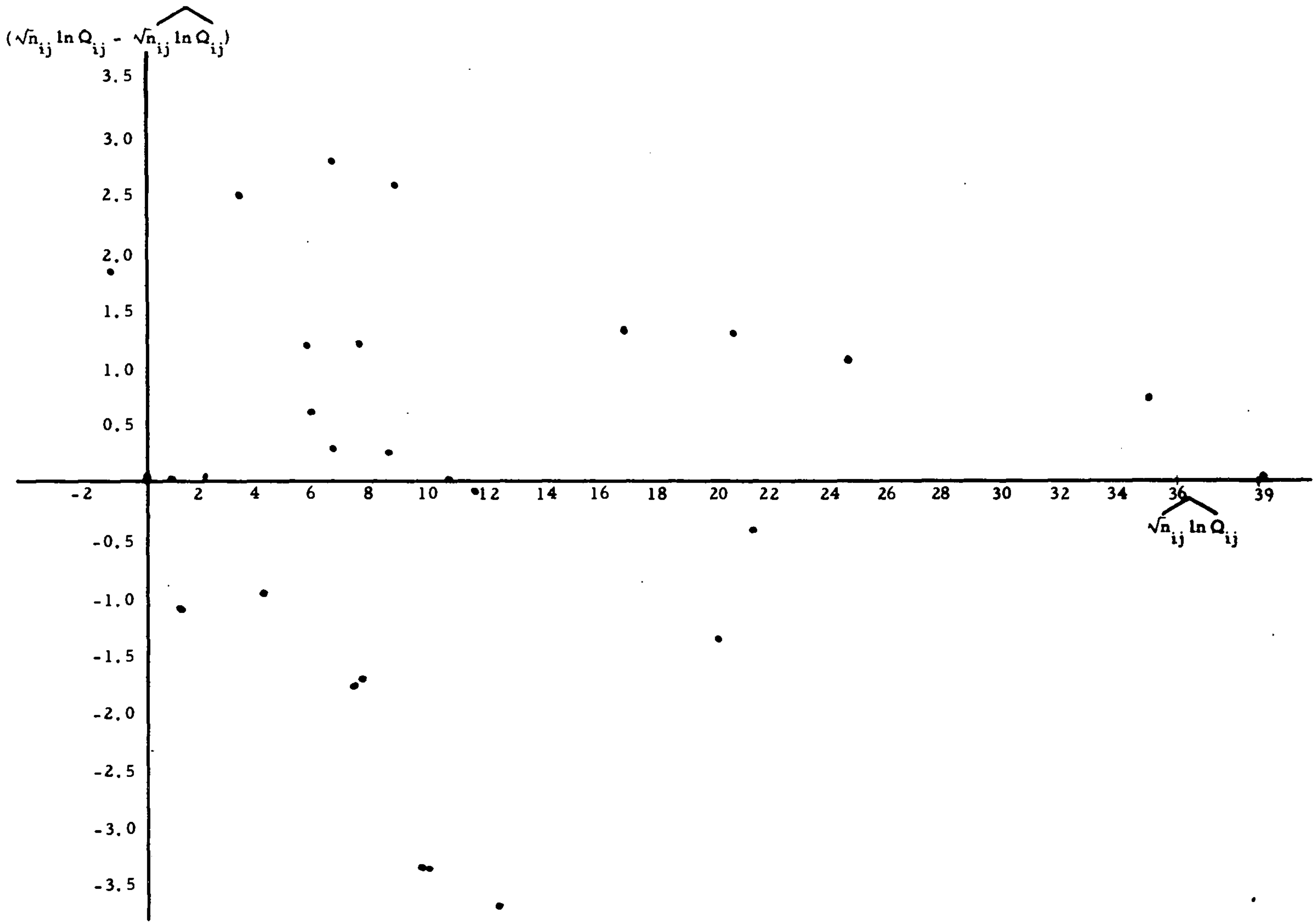

Figure 16. Residuals against the predicted dependent variable from the weighted logarithmic equation estimated for Remoteness Level I (Eq. 5-36).

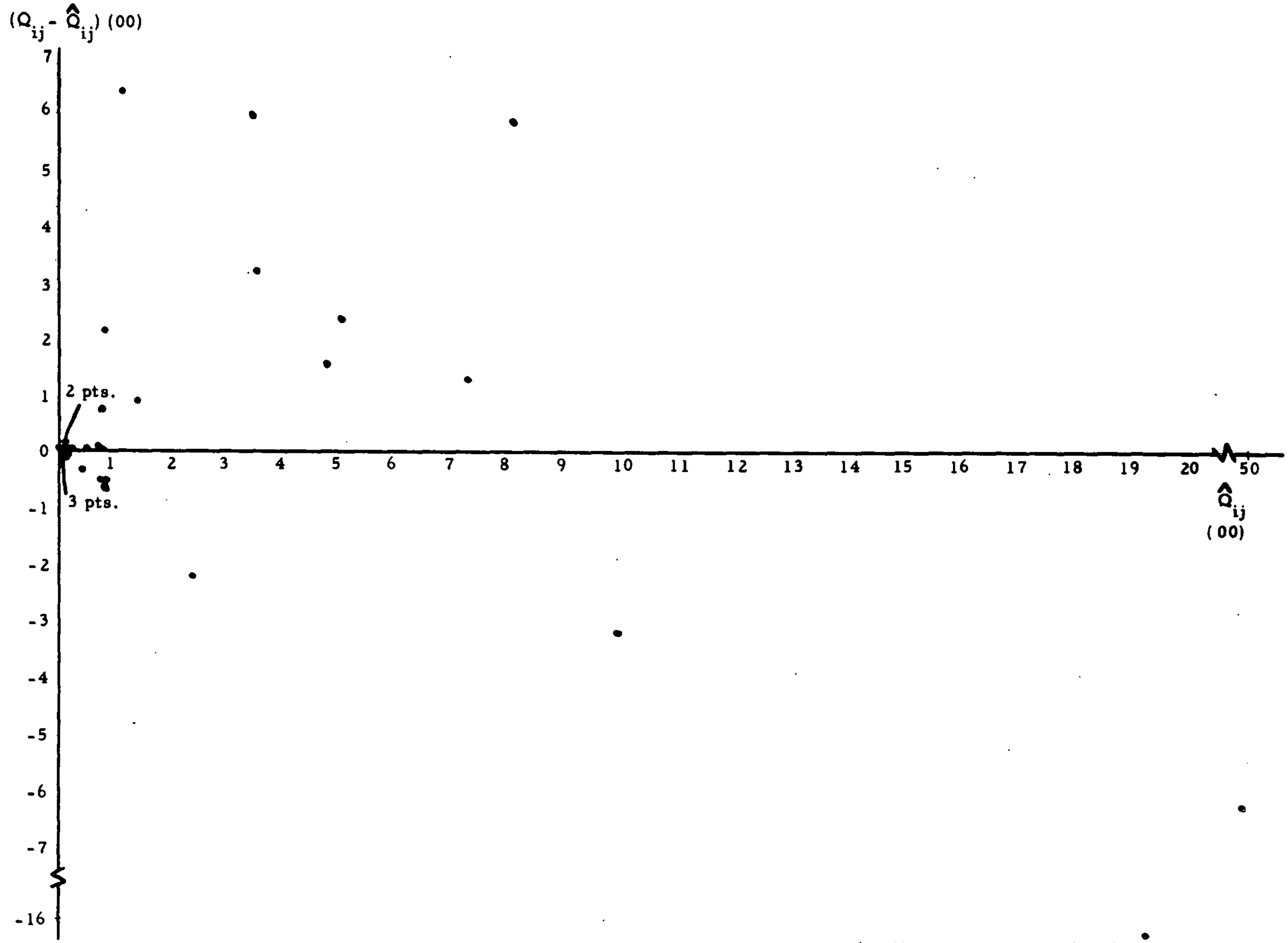

Figure 17. Residuals against the predicted dependent variable from the exponential form of the equation estimated for Remoteness Level I (Eq. 5-37).

1, 641 recreation days per capita. The small number, one, of recreation units observed in that income group could explain part of the problem here, since the weight used is small.

The preceding examination does not indicate that the predictive character of the equation has been greatly affected by the transformation. Therefore, equation (5-37) was accepted as the demand equation for Remoteness I, to be subjected to further investigation. Table 22 contains the simple correlation coefficients between the weighted variables used in this analysis. Following the procedures previously discussed, each variable in the model will now be examined for its relevance in the model. However, in this and the remaining equations to be estimated, the results from models estimated in examining the role of each independent variable will be summarized in a table to avoid repetition. The table presented for each analysis will contain information pertinent to the examination of the independent variable being investigated. From the originally hypothesized equation, the t-value and significance level of the partial regression coefficient of the variable will be presented. Then the variables removed from the hypothesized model and the simple correlation coefficient of these variables removed will be given. The partial regression coefficient, the standard error of the coefficient, the calculated t-value, the degrees of freedom associated with the estimated equation, and the significance

Table 22. Simple Correlation Coefficients Between Weighted Independent Variables, Remoteness Level I.

	$\sqrt{n_{ij}}P_{ij}$	$\sqrt{n_{ij}}I_{ij}$	$\sqrt{n_{ij}}B_{ij}$	$\sqrt{n_{ij}}C_{ij}$	$\sqrt{n_{ij}}L^1_{ij}$	$\sqrt{n_{ij}}L^2_{ij}$	$\sqrt{n_{ij}}L^3_{ij}$	$\sqrt{n_{ij}}L^4_{ij}$	$\sqrt{n_{ij}}S_{ij}$	$\sqrt{n_{ij}}O_{ij}$	$\sqrt{n_{ij}}Y_{ij}$	$\sqrt{n_{ij}}E_{ij}$	$\sqrt{n_{ij}}D_{ij}$	$\sqrt{n_{ij}}U_{ij}$	$\sqrt{n_{ij}}F_{ij}$
$\sqrt{n_{ij}}P_{ij}$	1.0000	.3271	.2792	.3261	.1343	.1919	.0291	-.1356	.2227	.2004	.2483	-.2738	.3090	.0421	.2323
$\sqrt{n_{ij}}I_{ij}$		1.0000	.6838	.6587	.3208	.6917	.2656	-.0301	.7089	.7277	.6715	.4224	.6190	.5049	.6587
$\sqrt{n_{ij}}B_{ij}$			1.0000	.9039	.6592	.7471	.4098	.0737	.9323	.9530	.8288	.4827	.8564	.7834	.9380
$\sqrt{n_{ij}}C_{ij}$				1.0000	.6529	.7445	.1419	-.3724	.8120	.8269	.6731	.2018	.8532	.5763	.8426
$\sqrt{n_{ij}}L^1_{ij}$					1.0000	-.1738	-.0722	-.1966	.5582	.6394	.4288	.1735	.6097	.4617	.6696
$\sqrt{n_{ij}}L^2_{ij}$						1.0000	.2862	.0136	.7597	.7261	.6103	.3977	.7058	.5284	.6974
$\sqrt{n_{ij}}L^3_{ij}$							1.0000	.2048	.5809	.5034	.6779	.6885	.1961	.7158	.4398
$\sqrt{n_{ij}}L^4_{ij}$								1.0000	.0733	.1315	.3008	.0472	.0635	.2460	.0554
$\sqrt{n_{ij}}S_{ij}$									1.0000	.9785	.8990	.5773	.8128	.8337	.9557
$\sqrt{n_{ij}}O_{ij}$										1.0000	.8907	.5692	.8174	.8463	.9502
$\sqrt{n_{ij}}Y_{ij}$											1.0000	.6358	.7281	.8502	.8624
$\sqrt{n_{ij}}E_{ij}$												1.0000	.2646	.7740	.4679
$\sqrt{n_{ij}}D_{ij}$													1.0000	.5467	.8519
$\sqrt{n_{ij}}U_{ij}$														1.0000	.7566
$\sqrt{n_{ij}}F_{ij}$															1.0000

level at which the partial regression coefficient is significantly different from zero will be given, which result from the equation estimated to isolate the influence of the variable. In addition, the R^2 of the estimated equation is given. The results contained in the table will then be used in determining which variables can be appropriately removed from the originally hypothesized model.

Table 23 contains the results arising from the investigation of variables in equation (5-36). The partial regression coefficient of the price variable ($\sqrt{n_{ij}}\, P_{ij}$) is significantly different from zero at the one percent level in equation (5-36). The sign of the coefficient is negative, which agrees with theoretical expectations. An examination of Table 22 shows that the highest simple correlation coefficient $\sqrt{n_{ij}}\, P_{ij}$ has with any other independent variable is .3271 with $\sqrt{n_{ij}}\, I_{ij}$. Showing no high interrelationship with the other variables in the model, the results from equation (5-36) are accepted as indicating that $\sqrt{n_{ij}}\, P_{ij}$ is significant in the demand for sites within Remoteness I. The results from Table 22 also show that the hypothesis that average transfer cost (P_{ij}) and the average number in the income population group would be highly related must again be rejected in this model, since the simple correlation coefficient between $\sqrt{n_{ij}}\, P_{ij}$ and $\sqrt{n_{ij}}\, B_{ij}$ is only .2792. Therefore, the B_{ij} is removed from further consideration in the model, and will not be included in the models estimated in subsequent

Table 23. Analysis of Independent Variables in the Demand Model for Remoteness Level I.

Originally hypothesized equation Eq. (5-36)					Results of statistical analysis of the independent variables					
Variable	Calculated t-value	Significance level	Simple correlation coefficient of variables removed	Variables removed	Partial regression coefficient	Standard error of the co-efficient	Calculated t-value	Degrees of freedom	Significance level	R^2
$\sqrt{n_{ij}}P_{ij}$	-3.9893	.01	$r \geq .7$	None						
$\sqrt{n_{ij}}I_{ij}$	-.6282	.60	$r \geq .7$	S_{ij}, O_{ij}	-.000043	.000041	-1.0492	14	.40	.963
			$r \geq .6$	$C_{ij}, L^2_{ij}, Y_{ij}, D_{ij}, F_{ij}$	.000136	.000057	2.3698	19	.05	.808
$\sqrt{n_{ij}}C_{ij}$	1.9372	.10	$r \geq .7$	$L^2_{ij}, S_{ij}, O_{ij}, D_{ij}, F_{ij}$	5.395227	1.373083	3.9293	17	.01	.938
$\sqrt{n_{ij}}L^1_{ij}$	1.1546	.30	$r \geq .7$	$C_{ij}, S_{ij}, O_{ij},$	4.530447	1.735697	2.6102	17	.02	.953
$\sqrt{n_{ij}}L^2_{ij}$	1.6461	.20		D_{ij}, U_{ij}	8.885016	2.066944	4.2986	17	.01	.953
$\sqrt{n_{ij}}L^3_{ij}$	1.8182	.10			4.258232	2.062531	2.0646	17	.10	.953
$\sqrt{n_{ij}}L^4_{ij}$	.8241	.50			1.162314	3.787943	.3068	17	.80	.953
$\sqrt{n_{ij}}S_{ij}$	-.6207	.60	$r \geq .7$	$I_{ij}, C_{ij}, L^2_{ij}, O_{ij}, Y_{ij}, D_{ij}, U_{ij}, F_{ij}$	.519971	.074313	6.9970	20	.01	.913
$\sqrt{n_{ij}}O_{ij}$	.4910	.70	$r \geq .7$	$I_{ij}, C_{ij}, L^2_{ij}, S_{ij}, Y_{ij}, D_{ij}, U_{ij}, F_{ij}$	.107432	.016880	6.3646	20	.01	.901

Continued on next page

Table 23 Continued.

Originally hypothesized equation Eq. (5-36)					Results of statistical analysis of the independent variables					
Variable	Calculated t-value	Significance level	Simple correlation coefficient of variables removed	Variables removed	Partial regression coefficient	Standard error of the co-efficient	Calculated t-value	Degrees of freedom	Significance level	R^2
$\sqrt{n_{ij}}Y_{ij}$	.7318	.50	$r \geq .7$	$S_{ij}, O_{ij}, D_{ij}, U_{ij}, F_{ij}$	.110631	.052153	2.1213	17	.05	.956
$\sqrt{n_{ij}}E_{ij}$	1.1985	.30	$r \geq .7$	U_{ij}	.000178	.000353	.5050	13	.70	.962
			$r \geq .6$	L^3_{ij}, Y_{ij}	.000686	.000301	2.2772	15	.05	.946
$\sqrt{n_{ij}}D_{ij}$	1.2742	.30	$r \geq .7$	$C_{ij}, L^2_{ij}, S_{ij}, O_{ij}, Y_{ij}, F_{ij}$	.001321	.000269	4.9154	18	.01	.918
$\sqrt{n_{ij}}U_{ij}$	-.9157	.40	$r \geq .7$	$L^3_{ij}, S_{ij}, O_{ij}, Y_{ij}, E_{ij}, F_{ij}$	.191770	.035777	5.3601	18	.02	.915
$\sqrt{n_{ij}}F_{ij}$	.0347	$\sim$	$r \geq .7$	$C_{ij}, S_{ij}, O_{ij}, Y_{ij}, D_{ij}, U_{ij}$	.800992	1.899999	.4216	18	.70	.940
			$r \geq .6$	$I_{ij}, L^1_{ij}, L^2_{ij}$	6.957082	.785780	8.8537	21	.01	.885

variable examinations.

Total family income ($\sqrt{n_{ij}}\, I_{ij}$) has a partial regression coefficient which is not significantly different from zero at ten percent or less in equation (5-36). The sign of the coefficient is negative, which runs counter to theoretical expectation. An examination of the results in Table 23 indicates that the removal of variables with a simple correlation coefficient of .7 or greater has little influence on the significance level or sign of the partial regression coefficient. However, when the variables with a simple correlation coefficient equal to .6 or greater with $\sqrt{n_{ij}}\, I_{ij}$ are removed, the partial regression coefficient exhibits significance. The sign of the coefficient has changed from negative to positive. The income variable's role in the demand for sites within Remoteness Level I is, therefore, expected to be important in future analysis.

The importance of the ratio of the number of days taken by recreation units with children is evidenced by its significant partial regression coefficient. The removal of interrelated variables yields a partial regression coefficient which is more significant than in the original model, and the sign of the variable's coefficient has remained unchanged. Therefore, further consideration should be given this variable.

The four residence variables are again considered together.

Only the $\sqrt{n_{ij}}\, L^3_{ij}$ has a partial regression coefficient which is significantly different from zero at ten percent or less. A removal of all variables having a simple correlation coefficient of .7 or greater yields three of the four significantly different from zero. The partial regression coefficient on $\sqrt{n_{ij}}\, L^4_{ij}$, the rural farm recreation units, is significant at only the 80 percent level. An examination of Table 22 reveals that the $\sqrt{n_{ij}}\, L^4 ij$ has no variable in which it has a simple correlation coefficient greater than or equal to .6. Therefore, it was decided that the results obtained by removing variables with simple correlation coefficients of .7 or greater would be used to test whether these variables contributed differently to the average income group demand for outdoor recreation in Remoteness I. Table 24 contains the test of differences between the partial regression coefficients of the residence variables in the originally hypothesized model, and the model with the interrelated variables removed.

The results of the pairwise test between the partial regression coefficients in equation (5-36) indicate that no difference, statistically, at a ten percent or less level of significance, exists between any of the pairs of partial regression coefficients. Results from Table 24 indicate that with independent variables having simple correlation coefficients of .7 or greater removed, a test of differences between certain partial regression coefficients

Table 24. Calculated t-values for the Difference Between Partial Regression Coefficients of the Residence Variables in the Demand Equation for Remoteness Level I

Hypothesis	t-values: Equation (5-36)[a]	t-values: Equation ($r \geq .7$)[b]
$H_o: \beta_{L^1_{ij}} - \beta_{L^2_{ij}} = 0$	-1.4189	-2.9188****
$H_a: \beta_{L^1_{ij}} - \beta_{L^2_{ij}} \neq 0$		
$H_o: \beta_{L^1_{ij}} - \beta_{L^3_{ij}} = 0$	-1.2171	.1827
$H_a: \beta_{L^1_{ij}} - \beta_{L^3_{ij}} \neq 0$		
$H_o: \beta_{L^1_{ij}} - \beta_{L^4_{ij}} = 0$	-.1438	-.9685
$H_a: \beta_{L^1_{ij}} - \beta_{L^4_{ij}} \neq 0$		
$H_o: \beta_{L^2_{ij}} - \beta_{L^3_{ij}} = 0$	-.0702	2.1764**
$H_a: \beta_{L^2_{ij}} - \beta_{L^3_{ij}} \neq 0$		
$H_o: \beta_{L^2_{ij}} - \beta_{L^4_{ij}} = 0$	.4111	1.9667*
$H_a: \beta_{L^2_{ij}} - \beta_{L^4_{ij}} \neq 0$		

Continued

Table 24--Continued.

H_o: $\beta_{L^3_{ij}} - \beta_{L^4_{ij}} = 0$	.4918	.8902
H_a: $\beta_{L^3_{ij}} - \beta_{L^4_{ij}} \neq 0$		

a/ d.f. = 11.

b/ d.f. = 17.

reveals some statistical differences. These results indicated that the partial regression coefficients between $\sqrt{n_{ij}}\ L^1_{ij}$ and $\sqrt{n_{ij}}\ L^2_{ij}$ are statistically different from one another at the one percent level. This indicates that the recreation units residing inside city limits and those residing in suburbs influence the number of recreation days per capita from the average income group differently. A significant test of difference between the partial regression coefficients of $\sqrt{n_{ij}}\ L^2_{ij}$ and $\sqrt{n_{ij}}\ L^3_{ij}$, at the five percent level, and between those of the coefficients of $\sqrt{n_{ij}}\ L^2_{ij}$ and $\sqrt{n_{ij}}\ L^4_{ij}$, at the ten percent level, infer that the influence of recreation units from suburban residences is different from each of the other residence categories. The results from the pairwise test do not provide evidence to suggest that there is a significant difference between any of the other pairs of residence variables. In Chapter II, it was suggested that a difference existed between urban and rural residences on the outdoor recreation demand function. These two categories were further subdivided because of the increased similarities in rural and urban societies. Since a difference does appear to exist between the two urban classifications and does not between the two rural classifications, it is suggested, based on the empirical evidence and these theoretical observations, that the $\sqrt{n_{ij}}\ L^3_{ij}$ and $\sqrt{n_{ij}}\ L^4_{ij}$ should be combined. The model for future study would then contain inside city limits, suburb and rural residence categories to be tested.

The results in Table 23 show that the partial regression coefficients for $\sqrt{n_{ij}}\, S_{ij}$ and $\sqrt{n_{ij}}\, O_{ij}$ are significantly different from zero at the one percent level, when independent variables with a simple correlation coefficient of .7 or greater are removed from the original hypothesized model. Further examination shows that the variables removed from the model are exactly the same when the variables are considered in separate models. The only difference is that O_{ij} is removed when S_{ij} is considered and vice versa. The simple correlation coefficient between $\sqrt{n_{ij}}\, S_{ij}$ and $\sqrt{n_{ij}}\, O_{ij}$ is .9785. This high simple correlation coefficient and their relationship with the other variables suggest statistical equivalence of the two variables. Conceptually, these statistical results can be justified; therefore, for future testing only one of the variables will be maintained in the model. The measurement of the education variable (S_{ij}) is more straightforward than that of the occupation rating variable (O_{ij}). It can be inferred that inferences concerning social prestige from the use of O_{ij} can also be drawn from S_{ij}. Therefore, O_{ij} will be removed from the model suggested for further study.

The information given in Table 23 indicates that under the procedures defined for variable removal from the original model, there is little indication that any of the remaining variables should be removed. Therefore, the general and estimated forms of the following model are suggested for further research.

General Model

$$Q_{ij} = e^{\beta_o + \beta_1 P_{ij} + \beta_2 I_{ij} + \beta_3 C_{ij} + \beta_4 L^1_{ij} + \beta_5 L^2_{ij} + \beta_6 (L^3_{ij} + L^4_{ij}) + \beta_7 S_{ij} + \beta_8 Y_{ij} + \beta_9 E_{ij} + \beta_{10} D_{ij} + \beta_{11} U_{ij} + \beta_{12} F_{ij}} + \varepsilon_{ij} \tag{5-38}$$

Logarithmic Model

$$\begin{aligned}
\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = \; & .211215 \underset{(.030524)}{-.150331} \sqrt{n_{ij}}\, P_{ij} \underset{(.000045)}{-.000047} \sqrt{n_{ij}}\, I_{ij} \\
& \underset{(1.642247)}{+ 2.187552} \sqrt{n_{ij}}\, C_{ij} \underset{(3.226056)}{+ 3.552013} \sqrt{n_{ij}}\, L^1_{ij} \\
& \underset{(4.053872)}{+ 5.689490} \sqrt{n_{ij}}\, L^2_{ij} \underset{(3.723644)}{+ 4.929806} \sqrt{n_{ij}}\, (L^3_{ij} + L^4_{ij}) \\
& \underset{(.210663)}{+ .077162} \sqrt{n_{ij}}\, S_{ij} \underset{(.058632)}{+ .082515} \sqrt{n_{ij}}\, Y_{ij} \\
& \underset{(.000348)}{+ .000417} \sqrt{n_{ij}}\, E_{ij} \underset{(.000321)}{+ .000299} \sqrt{n_{ij}}\, D_{ij} \\
& \underset{(.073391)}{-.062347} \sqrt{n_{ij}}\, U_{ij} \underset{(2.240447)}{-1.445283} \sqrt{n_{ij}}\, F_{ij}
\end{aligned} \tag{5-39}$$

$R^2 = .9617$ d.f. $= 14$

<u>Exponential Model</u>

$$\hat{Q}_{ij} = e^{\begin{aligned}&.166514 -.150311\, P_{ij} -.000047\, I_{ij} + 2.187552\, C_{ij} \\ &+ 3.552013\, L^1_{ij} + 5.689490\, L^2_{ij} \\ &+ 4.929806\, (L^3_{ij} + L^4_{ij}) \\ &+ .077162\, S_{ij} + .082515\, Y_{ij} \\ &+ .000417\, E_{ij} + .000299\, D_{ij} -.062347\, U_{ij} \\ &- 1.445283\, F_{ij}\end{aligned}} \qquad (5\text{-}40)$$

A plot of equation (5-40), holding all variables other than price constant at their means, through the average transfer cost per day and days per capita scatter is contained in Figure 18. Equation (5-40) is used to construct the net willingness to pay schedule for Remoteness Level I. A plot of this schedule is contained in Figure 19. Using the data (Table 25) generated from equation (5-40) to construct the net willingness to pay schedule, an equation for the schedule in Figure 19 was estimated.

$$\hat{Q} = e^{7.72 - .15\, P} \qquad (5\text{-}41)$$

Integrating equation (5-41), an estimate of the economic value of sites within Remoteness Level I is obtained from the sample.

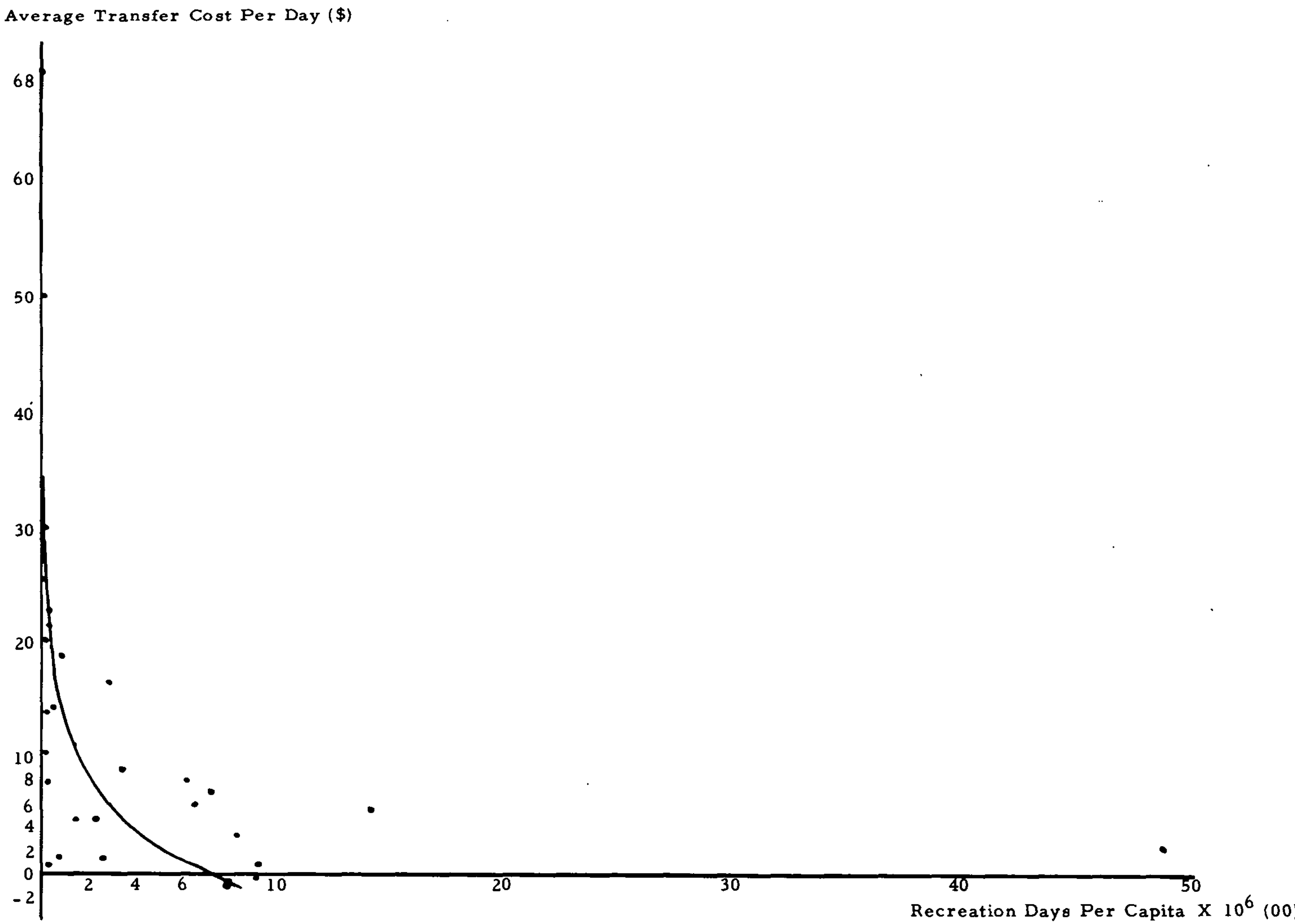

Figure 18. Estimated demand schedule for Remoteness Level I plotted through the average transfer cost--recreation days per capita scatter (Eq. 5-40).

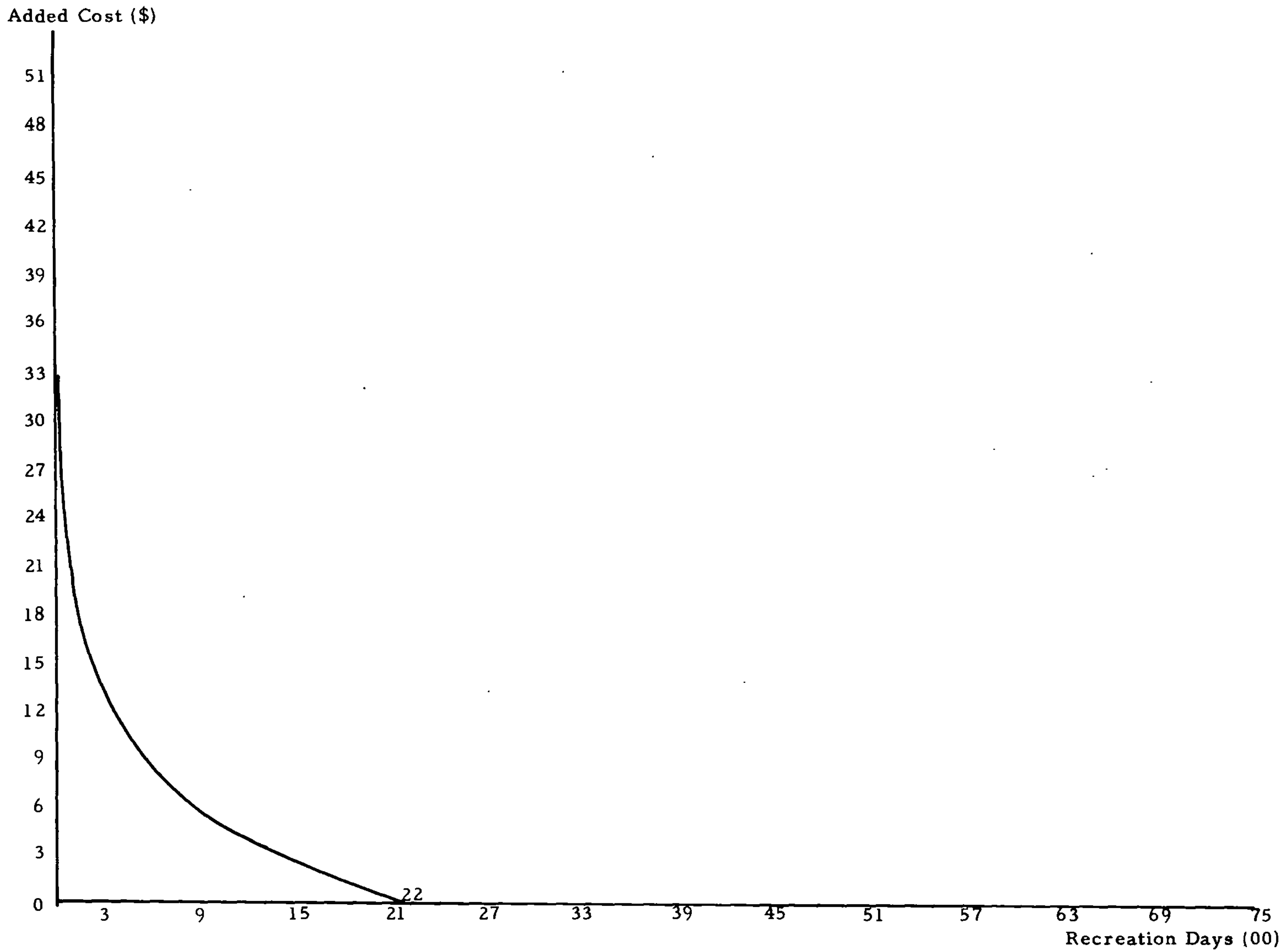

Figure 19. Net willingness to pay schedule for Remoteness Level I (Eq. 5-41).

Table 25. Predicted Total Number of Recreation Days Taken in the Bend Ranger District at Sites Within Remoteness Level I at Various Levels of Increased Average Transfer Cost per Recreation Day by the Sample of Uses.

Increased average transfer cost/day ($)	Total number of recreation days [a/]
0	2, 246
1	1, 932
2	1, 663
3	1, 431
4	1, 231
5	1, 059
6	911
7	784
8	675
9	581
10	500
11	430
12	370
13	318
14	274
15	236
16	203
17	174
18	150
19	129
20	111
21	96
22	82
23	71
24	61
25	52
26	45
27	39
28	33
29	29
30	25
31	21
32	18
33	16
34	14

Continued

Table 25--Continued.

35	12
36	10
37	9
38	7
39	6
40	5
41	5
42	4
43	4
44	3
45	3
46	2
47	2
48	2
49	1

a/ Rounded to the nearest day.

$$\int_0^\infty e^{7.72 - .15 P} dp = \frac{1}{.15} e^{7.72}$$
$$= \$15,019.73$$

The usefulness of this value estimate can be checked by comparing the actual sample days taken at the site within Remoteness Level I (1,485) and those predicted at zero added cost from equation (5-40) (2,246). As in the case of the analysis of the total Bend Ranger District, the initial total number of days on the net willingness to pay schedule is over predicted by equation (5-40).

Estimated Demand Equation for Remoteness Level II

Data pertaining to all sites accessible by paved and all-weather roads will now be used to estimate a demand equation for these sites within the Bend Ranger District, using the techniques employed in the previous sections. Table 26 contains the simple correlation coefficients between the weighted independent variables in the model. The results of the models estimated to examine each explanatory variable separately for evidence of its role in the model are presented in Table 27. Using the basic model suggested in Chapter II, each of the 15 variables were included in the originally hypothesized model and estimated. The relevant model forms as hypothesized and estimated are given in the following equations.

General Model

$$Q_{ij} = e^{\beta_o + \beta_1 P_{ij} + \beta_2 I_{ij} + \beta_3 B_{ij} + \beta_4 C_{ij} + \beta_5 L_{ij}^1 + \beta_6 L_{ij}^2 + \beta_7 L_{ij}^3 + \beta_8 L_{ij}^4 + \beta_9 S_{ij} + \beta_{10} O_{ij} + \beta_{11} Y_{ij} + \beta_{12} E_{ij} + \beta_{13} D_{ij} + \beta_{14} U_{ij} + \beta_{15} F_{ij} + \varepsilon_{ij}} \quad (5\text{-}42)$$

Logarithmic Model

$$\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = -.432090 \underset{(.026064)}{-.105864} \sqrt{n_{ij}}\, P_{ij}{}^{****} \underset{(.000139)}{-.000025} \sqrt{n_{ij}}\, I_{ij}$$

$$+ \underset{(.257915)}{.108701} \sqrt{n_{ij}}\, B_{ij} + \underset{(2.087006)}{1.836130} \sqrt{n_{ij}}\, C_{ij}$$

$$+ \underset{(2.686247)}{2.627842} \sqrt{n_{ij}}\, L^1_{ij} + \underset{(2.385416)}{1.349262} \sqrt{n_{ij}}\, L^2_{ij} \tag{5-43}$$

$$+ \underset{(4.094837)}{5.025188} \sqrt{n_{ij}}\, L^3_{ij} + \underset{(7.432131)}{3.443457} \sqrt{n_{ij}}\, L^4_{ij}$$

$$+ \underset{(.279380)}{.032569} \sqrt{n_{ij}}\, S_{ij} - \underset{(.066083)}{.020020} \sqrt{n_{ij}}\, O_{ij}$$

$$\underset{(.035730)}{-.019101} \sqrt{n_{ij}}\, Y_{ij} + \underset{(.000428)}{.000224} \sqrt{n_{ij}}\, E_{ij}$$

$$+ \underset{(.006258)}{.001762} \sqrt{n_{ij}}\, D_{ij} + \underset{(.100160)}{.129979} \sqrt{n_{ij}}\, U_{ij}$$

$$\underset{(2.088084)}{-.442705} \sqrt{n_{ij}}\, F_{ij}$$

$R^2 = .9215$ d. f. = 10

Exponential Model

$$\hat{Q}_{ij} = e^{-.355391 - .105864\, P_{ij} - .000025\, I_{ij} + .108701\, B_{ij} + 1.836130\, C_{ij} + 2.627842\, L^1_{ij} + 1.349262\, L^2_{ij}} \tag{5-44}$$

$$+ 5.025188\, L_{ij}^{3} + 3.443457\, L_{ij}^{4} + .032569\, S_{ij}$$

$$- .020020\, O_{ij} - .019101\, Y_{ij} + .000224\, E_{ij}$$

$$+ .001762\, D_{ij} + .129979\, U_{ij} - .442705\, F_{ij}$$

A plot of the residuals against the predicted dependent variable for equations (5-43) and (5-44) are contained in Figures 20 and 21, respectively. The plot of the residuals arising from equation (5-43) do not appear to be completely random. However, no particular pattern which might suggest a systematic error in the analysis, or what might be done to relieve this lack of randomness, reveals itself from the plot. One attempt, which is not shown, was made to determine if some improvement in the form of the model could be made using least squares procedures. A first order polynomial was fitted by the data, but the same systematic error pattern which was exhibited using this estimating form in the first analysis appeared, suggesting an error in the analysis. Upon examining Figure 21, presenting the plots from equation (5-44), a similar occurrence of a couple of grossly overestimated and underestimated points reveal themselves. How greatly this has affected the predictive ability of equation (5-44) can be seen partially by examining the adjusted R^2. This adjusted multiple correlation coefficient for equation (5-44) is .7188. The error terms, consequently, do

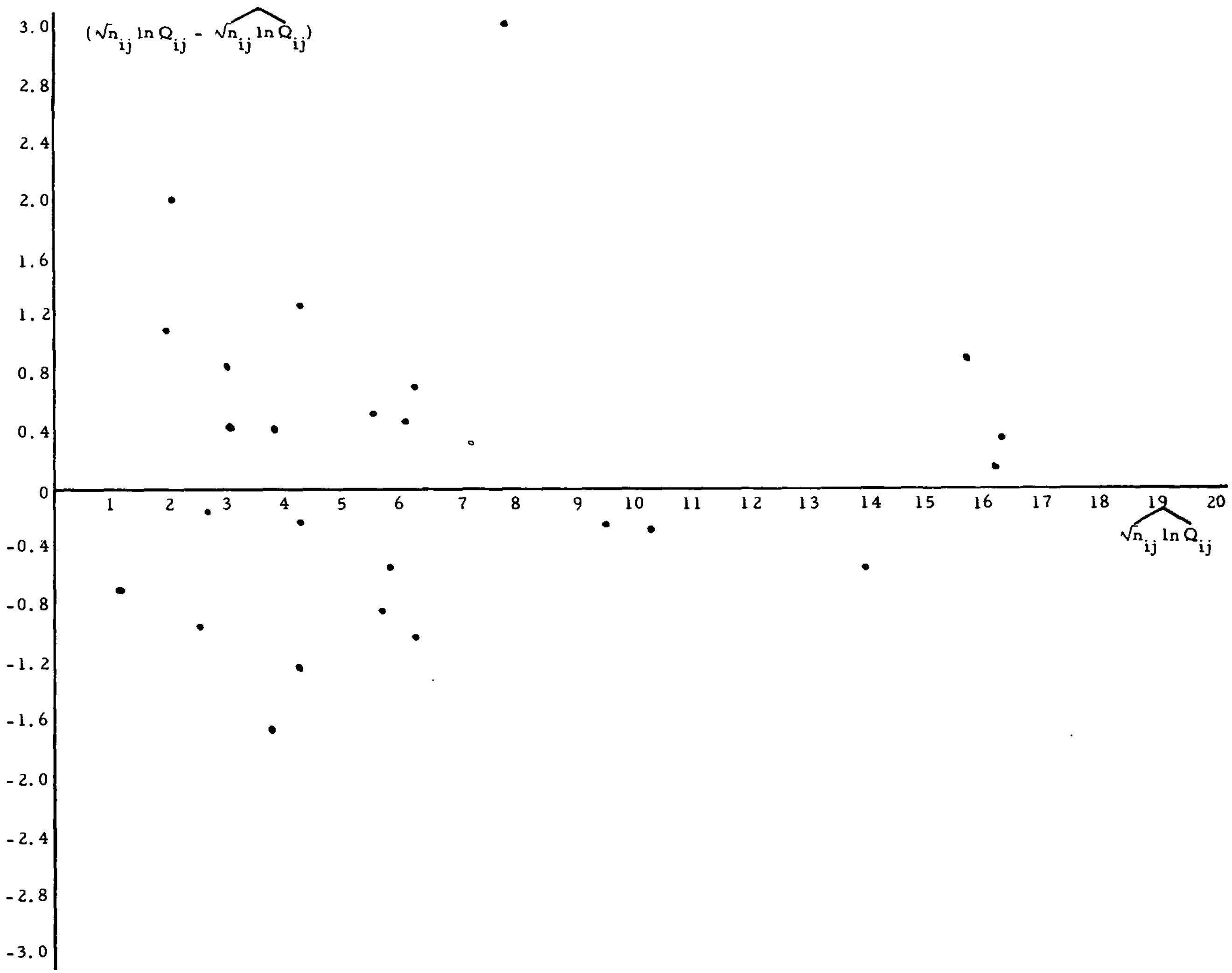

Figure 20. Residuals against the predicted dependent variable from the weighted logarithmic equation estimated for Remoteness Level II (Eq. 5-43).

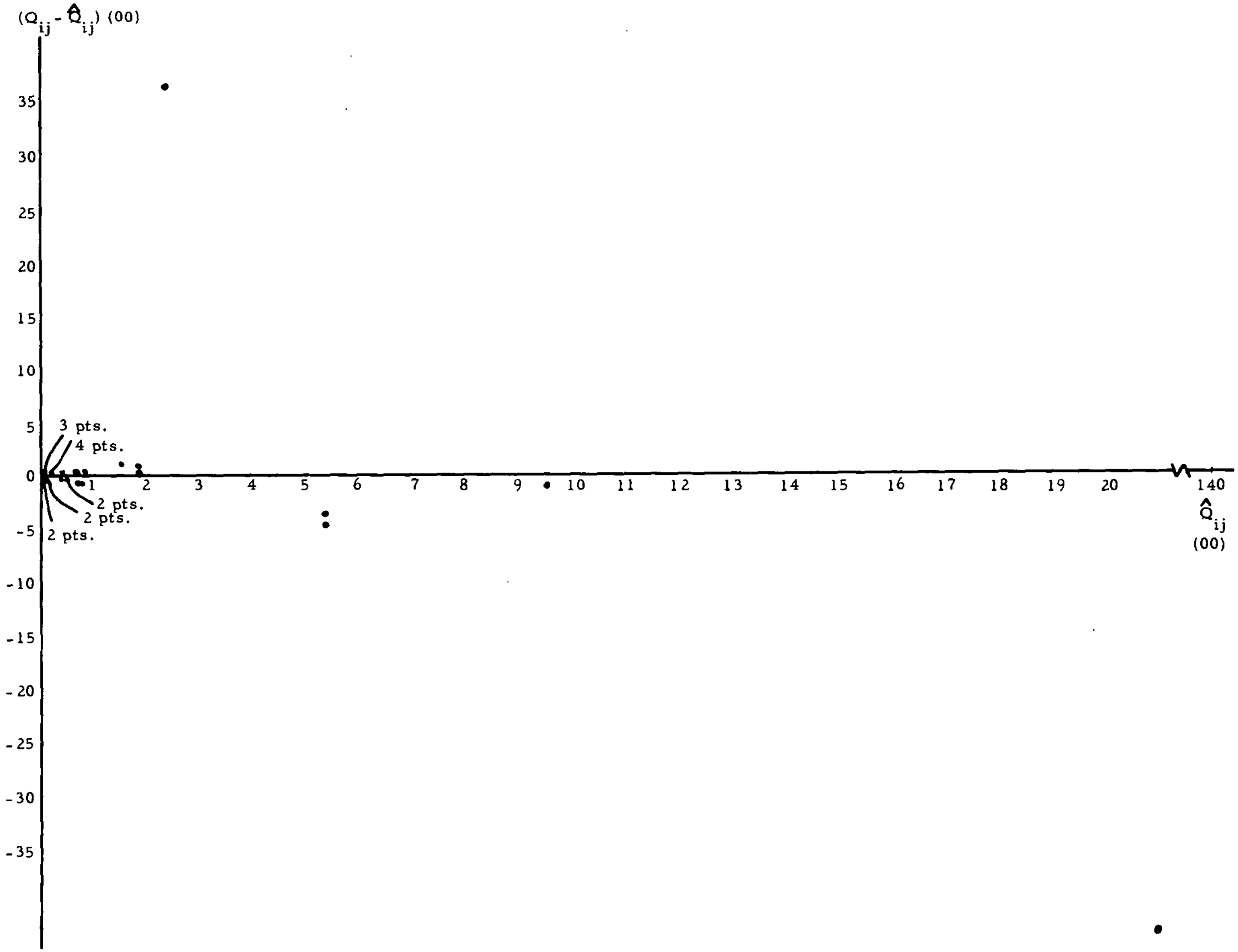

Figure 21. Residuals against the predicted dependent variable from the exponential form of the equation estimated for Remoteness Level II (Eq. 5-44).

not appear to have been affected greatly as a result of transforming the equation for estimation purposes. Therefore, equation (5-44) will be taken as the demand equation for sites, accessible by paved and all-weather roads, within the Bend Ranger District.

Each of the independent variables of equation (5-44) will now be examined to determine whether their role in the model has been affected by highly interrelated variables. The simple correlation coefficients between the weighted variables are contained in Table 26. Resulting parameter estimates from equations free of high interrelationships for each independent variable are given in Table 27.

There are no independent variables in the model having a simple correlation coefficient of .7 or greater with the price variable ($\sqrt{n_{ij}}\,P_{ij}$). Therefore, since the variable was significantly different from zero at the one percent level in equation (5-43), it is left in the model. Evidence obtained in Table 26 indicates that again it is appropriate to remove B_{ij}, because the simple correlation coefficient between $\sqrt{n_{ij}}\,P_{ij}$ and $\sqrt{n_{ij}}\,B_{ij}$ is only .7910. The average number of individuals in the recreation unit is, therefore, removed from further consideration in the model.

Total family income, ($\sqrt{n_{ij}}\,I_{ij}$), has a partial regression coefficient which is significantly different from zero at the 90 percent level and a sign which is negative. All independent

Table 26. Simple Correlation Coefficients Between Weighted Independent Variables, Remoteness Level II.

	$\sqrt{n_{ij}}P_{ij}$	$\sqrt{n_{ij}}I_{ij}$	$\sqrt{n_{ij}}B_{ij}$	$\sqrt{n_{ij}}C_{ij}$	$\sqrt{n_{ij}}L^1_{ij}$	$\sqrt{n_{ij}}L^2_{ij}$	$\sqrt{n_{ij}}L^3_{ij}$	$\sqrt{n_{ij}}L^4_{ij}$	$\sqrt{n_{ij}}S_{ij}$	$\sqrt{n_{ij}}O_{ij}$	$\sqrt{n_{ij}}Y_{ij}$	$\sqrt{n_{ij}}E_{ij}$	$\sqrt{n_{ij}}D_{ij}$	$\sqrt{n_{ij}}U_{ij}$	$\sqrt{n_{ij}}F_{ij}$
$\sqrt{n_{ij}}P_{ij}$	1.0000	.5751	.2910	.5177	.5566	-.1096	-.0479	.0318	.6277	.6080	.2751	.4512	.5475	.4467	.5380
$\sqrt{n_{ij}}I_{ij}$		1.0000	.6584	.8376	.7572	-.1494	.1080	.1670	.8817	.8799	.3738	.3929	.7787	.7034	.7031
$\sqrt{n_{ij}}B_{ij}$			1.0000	.8087	.6845	-.0575	.0982	.1748	.6877	.7451	.3347	.3455	.7077	.6644	.6187
$\sqrt{n_{ij}}C_{ij}$				1.0000	.6705	-.0598	.0741	.0907	.7540	.7761	.2217	.2900	.6623	.5509	.6418
$\sqrt{n_{ij}}L^1_{ij}$					1.0000	-.4580	.0007	.2591	.8190	.8118	.3637	.4611	.8272	.7672	.6536
$\sqrt{n_{ij}}L^2_{ij}$						1.0000	-.0459	-.1576	.0009	-.0092	.2079	.1207	-.0272	.0108	-.0450
$\sqrt{n_{ij}}L^3_{ij}$							1.0000	.1592	.1489	.1647	.0359	-.0202	.2595	.2633	.4019
$\sqrt{n_{ij}}L^4_{ij}$								1.0000	.2987	.3517	.0066	.0293	.3056	.3413	.2259
$\sqrt{n_{ij}}S_{ij}$									1.0000	.9775	.5032	.5537	.9326	.8656	.8092
$\sqrt{n_{ij}}O_{ij}$										1.0000	.5196	.5714	.9423	.8884	.8002
$\sqrt{n_{ij}}Y_{ij}$											1.0000	.7441	.5628	.5517	.2565
$\sqrt{n_{ij}}E_{ij}$												1.0000	.5706	.5883	.5000
$\sqrt{n_{ij}}D_{ij}$													1.0000	.9394	.8025
$\sqrt{n_{ij}}U_{ij}$														1.0000	.7045
$\sqrt{n_{ij}}F_{ij}$															1.0000

Table 27. Analysis of Independent Variables in the Demand Model for Remoteness Level II.

Originally hypothesized equation Eq. (5-43)					Results of statistical analysis of the independent variables					
Variable	Calculated t-value	Significance level	Simple correlation coefficient of variables removed	Variables removed	Partial regression coefficient	Standard error of the co-efficient	Calculated t-value	Degrees of freedom	Significance level	R^2
$\sqrt{n_{ij}}P_{ij}$	-4.0617	.01	$r \geq .7$	None						
$\sqrt{n_{ij}}I_{ij}$	- .1779	.90	$r \geq .7$	$C_{ij}, L^1_{ij}, S_{ij}, O_{ij}, D_{ij}, U_{ij}, F_{ij}$	.000291	.000082	3.5333	18	.01	.631
$\sqrt{n_{ij}}C_{ij}$	.8798	.40	$r \geq .7$	S_{ij}, O_{ij}, I_{ij}	1.719537	.889971	1.9321	14	.10	.916
$\sqrt{n_{ij}}L^1_{ij}$	.9783	.40	$r \geq .7$	$I_{ij}, S_{ij}, O_{ij}, D_{ij},$	6.006751	1.227861	4.8920	16	.01	.886
$\sqrt{n_{ij}}L^2_{ij}$	.5656	.60		U_{ij}	3.900906	1.286464	3.0323	16	.01	.886
$\sqrt{n_{ij}}L^3_{ij}$	1.2272	.30			9.153977	3.018338	3.0328	16	.01	.886
$\sqrt{n_{ij}}L^4_{ij}$	.4633	.70			5.822674	5.222214	1.1150	16	.30	.886
$\sqrt{n_{ij}}S_{ij}$	.1166	$\sim$	$r \geq .7$	$I_{ij}, C_{ij}, L^1_{ij}, O_{ij}, D_{ij}, U_{ij}, F_{ij}$	.465219	.083691	5.5588	18	.01	.770
$\sqrt{n_{ij}}O_{ij}$	- .3029	.80	$r \geq .7$	$I_{ij}, C_{ij}, L^1_{ij}, S_{ij}, D_{ij}, U_{ij}, F_{ij}$	.101064	.016443	6.1465	18	.01	.798
$\sqrt{n_{ij}}Y_{ij}$	- .5346	.70	$r \geq .7$	E_{ij}	- .003566	.020158	- .1769	12	.90	.919
			$r \geq .6$	None						

Continued on next page

Table 27 Continued.

Originally hypothesized equation Eq. (5-43)					Results of statistical analysis of the independent variables					
Variable	Calculated t-value	Significance level	Simple correlation coefficient of variables removed	Variables removed	Partial regression coefficient	Standard error of the co-efficient	Calculated t-value	Degrees of freedom	Significance level	R^2
$\sqrt{n}_{ij}E_{ij}$	.5231	.70	$r \geq .7$	Y_{ij}	.000035	.000242	.1461	12	.90	.919
			$r \geq .6$	None						
$\sqrt{n}_{ij}D_{ij}$	.2816	.80	$r \geq .7$	$I_{ij}, L^1_{ij}, S_{ij}, O_{ij}, U_{ij}, F_{ij}$	.010332	.002013	5.1335	17	.01	.872
$\sqrt{n}_{ij}U_{ij}$	1.2977	.30	$r \geq .7$	$I_{ij}, L^1_{ij}, S_{ij}, O_{ij}, D_{ij}, F_{ij}$	.217760	.036681	5.9366	17	.01	.894
$\sqrt{n}_{ij}F_{ij}$	-.2120	.90	$r \geq .7$	$I_{ij}, S_{ij}, O_{ij}, D_{ij}, U_{ij}$	-.622687	1.411039	-.4413	16	.70	.886
			$r \geq .6$	C_{ij}, L^1_{ij}	5.635281	1.756733	3.2078	18	.01	.602

variables with a simple correlation coefficient of .7 or greater with $\sqrt{n_{ij}}\, I_{ij}$ were removed from equation (5-43). The partial regression coefficient in the new model is significantly different from zero at the one percent level. A positive sign is estimated for the coefficient, which corresponds to theoretical expectation. It would therefore be hypothesized, based on the sample evidence, that the income variable is significant in explaining the demand for sites within Remoteness Level II.

The ratio of days taken by units with children to the total number of days from an income group, $\sqrt{n_{ij}}\, C_{ij}$, exhibits a coefficient which is significant when independent variables having a simple correlation coefficient of .7 or greater are removed from equation (5-43). This indicates that its role in the demand model for Remoteness Level II may have been distorted. Table 27 indicates that when these variables are removed from the model, the partial regression coefficient of $\sqrt{n_{ij}}\, C_{ij}$ is significantly different from zero at the ten percent level. Such evidence suggests that children in the recreation unit do affect positively the number of days taken at sites within Remoteness Level II.

None of the four residence variables test significantly different from zero at ten percent or less in the original equation. However, upon removing all variables which have a simple correlation coefficient of .7 or greater with any of the four residence variables from equation (5-43), $\sqrt{n_{ij}}\, L^1_{ij}$, $\sqrt{n_{ij}}\, L^2_{ij}$ and $\sqrt{n_{ij}}\, L^3_{ij}$ exhibit partial regression coefficients which are significantly different from zero at the one percent level. The partial regression coefficient of $\sqrt{n_{ij}}\, L^4_{ij}$ is only significantly different from zero at the 30 percent level. An examination of the simple correlation coefficients of other independent variables and $\sqrt{n_{ij}}\, L^4_{ij}$ indicates there are none which are as great as .6. Therefore, the results given in Table 27 are taken to conduct the pairwise test of difference between the partial regression coefficients. The results of these pairwise tests are given in Table 28.

Taking the results from the originally hypothesized equation (5-43), the pairwise test between partial regression coefficients indicates that no two are statistically different from zero at the prescribed ten percent level or less. These results would indicate that there is no difference in the influence of the place of residence on the demand for sites within Remoteness Level II. However, when the variables which are highly interrelated with the residence variables are removed from equation (5-43), some differences do occur. The partial regression coefficients of inside city limits $\sqrt{n_{ij}}\, L^1_{ij}$) and suburb ($\sqrt{n_{ij}}\, L^2_{ij}$) are statistically different from zero at the five percent level. There is also a difference between the partial regression coefficient of $\sqrt{n_{ij}}\, L^2_{ij}$ and that

Table 28. Calculated t-values for the Difference Between Partial Regression Coefficients of the Residence Variables in the Demand Equation for Remoteness Level II.

Hypothesis	t-values Equation (5-43)[a]	Equation ($r \geq .7$)[b]
H_o: $\beta_{L^1_{ij}} - \beta_{L^2_{ij}} = 0$	1.0360	2.3556**
H_a: $\beta_{L^1_{ij}} - \beta_{L^2_{ij}} \neq 0$		
H_o: $\beta_{L^1_{ij}} - \beta_{L^3_{ij}} = 0$	-.7008	-1.1643
H_a: $\beta_{L^1_{ij}} - \beta_{L^3_{ij}} \neq 0$		
H_o: $\beta_{L^1_{ij}} - \beta_{L^4_{ij}} = 0$	-.1076	.3275
H_a: $\beta_{L^1_{ij}} - \beta_{L^4_{ij}} \neq 0$		
H_o: $\beta_{L^2_{ij}} - \beta_{L^3_{ij}} = 0$	-1.0864	-1.18749*
H_a: $\beta_{L^2_{ij}} - \beta_{L^3_{ij}} \neq 0$		
H_o: $\beta_{L^2_{ij}} - \beta_{L^4_{ij}} = 0$	-.2911	-.3524
H_a: $\beta_{L^2_{ij}} - \beta_{L^4_{ij}} \neq 0$		

Continued

Table 28--Continued.

$H_o: \beta_{L^3_{ij}} - \beta_{L^4_{ij}} = 0$	.1906	.5312
$H_a: \beta_{L^3_{ij}} - \beta_{L^4_{ij}} \neq 0$		

a/ d.f. = 10.

b/ d.f. = 16.

associated with the rural nonfarm residence ($\sqrt{n_{ij}}\ L^3_{ij}$) at the ten percent level. No statistical difference appears to exist between any other pairwise combination given in Table 28. Following the same line of argument presented in the two previous sections, it is maintained that under further testing of the residence areas is accomplished, the rural and urban categories should not be combined. Therefore, the model for further study will contain $\sqrt{n_{ij}}\ L^1_{ij}$, $\sqrt{n_{ij}}\ L^2_{ij}$, and $\sqrt{n_{ij}}\ (L^3_{ij} + L^4_{ij})$.

The results from equation (5-43) indicate that neither the partial regression coefficient for $\sqrt{n_{ij}}\ S_{ij}$ nor $\sqrt{n_{ij}}\ O_{ij}$ is significantly different from zero at the ten percent level or less. However, upon removing the variables which have a simple correlation coefficient of .7 or greater with each, both partial regression coefficients test significantly different from zero at the one percent level. An examination of the variables removed in each case shows that the same variables were removed. Also, an examination of Table 26 indicates that there is a simple correlation coefficient of .9775 between $\sqrt{n_{ij}}\, S_{ij}$ and $\sqrt{n_{ij}}\, O_{ij}$. These observations suggest that these two variables are, in fact, explaining the same variation in the model. Further observation indicates that similar variables removed from the model in the case of $\sqrt{n_{ij}}\, S_{ij}$ and $\sqrt{n_{ij}}\, O_{ij}$, were also removed when $\sqrt{n_{ij}}\, I_{ij}$ and $\sqrt{n_{ij}}\, F_{ij}$ were considered. Conceptually, an argument can be made relating I_{ij}, S_{ij}, and O_{ij}, which are all population characteristics. However, the relationship between these three variables and F_{ij} would not necessarily be related from a theoretical view. It is suggested, therefore, that $\sqrt{n_{ij}}\, F_{ij}$ be allowed to remain in the model. However, an examination of Table 26 indicates that the simple correlation coefficients between $\sqrt{n_{ij}}\, I_{ij}$ and $\sqrt{n_{ij}}\, S_{ij}$ and $\sqrt{n_{ij}}\, O_{ij}$ are .8817 and .8799, respectively. This would imply a high degree of interrelationship between these variables. For future study of sties within Remoteness Level II, only one of these variables should be included in the model. For purposes of this study, the $\sqrt{n_{ij}}\, I_{ij}$ will be maintained in the model.

The partial regression coefficients of $\sqrt{n_{ij}}\, Y_{ij}$ and $\sqrt{n_{ij}}\, E_{ij}$ do not exhibit statistical significance at the prescribed levels in equation (5-43). The results in Table 26 indicate that they are highly related only with each other. Upon removal of each to determine the significance of the other, little is accomplished to suggest they perform a statistically significant role in the model. Based on the evidence presented in Table 27, it is suggested that these two variables be removed from the model for further testing.

Results arising from equation (5-43) yield partial regression coefficients for the level of site development ($\sqrt{n_{ij}}\ D_{ij}$) and potential density of use at the site ($\sqrt{n_{ij}}\ U_{ij}$) which are not significantly different from zero at the ten percent level or less. Upon removing, in the case of each, the other independent variables which have a simple correlation coefficient of .7 or greater, they both have partial regression coefficients which are statistically different from zero at the one percent level. Further investigation shows that exactly the same variables have to be removed when variables with $r \geq .7$ are removed from the original model. The simple correlation coefficient between $\sqrt{n_{ij}}\ D_{ij}$ and $\sqrt{n_{ij}}\ U_{ij}$ is .9394. As indicated in Chapter II, the site characteristics are not independent of each other and in this particular grouping of sites, it appears that these two variables may, in fact, be explaining the same variation in the dependent variable. If this is the case, only one should be kept in the model for further testing. The question then becomes which one should be removed. It would appear that, though in this set of data the two variables are in fact similar in this model, potential density of use is a function of the site development. In this sense, site development is the more general of the two. For this reason, it is suggested that for purposes of further study, potential density of use be removed from the model.

The final site characteristic, fish caught per hour ($\sqrt{n_{ij}}\, F_{ij}$), does appear to have some similar characteristics with the other two site characteristics. However, the similarity is not as great as in the case of the other two, and is, therefore, kept in the model as a separate variable. The results given in Table 27 indicate that its significance as a determinant of demand for sites within Remoteness Level II warrants further investigation on the basis of the sample data collected for this study.

On the basis of the evidence presented in this section, the following general and estimated forms of the model were suggested for further testing for sites which are accessible by paved and all-weather roads.

General Model

$$Q_{ij} = e^{\beta_0 + \beta_1 P_{ij} + \beta_2 I_{ij} + \beta_3 C_{ij} + \beta_4 L^1_{ij} + \beta_5 L^2_{ij} + \beta_6 (L^3_{ij} + L^4_{ij}) + \beta_7 D_{ij} + \beta_8 F_{ij}} \qquad (5\text{-}45)$$

Logarithmic Model

$$\sqrt{n_{ij}}\ \widehat{\ln Q_{ij}} = -.727047 \underset{(.019749)}{-.114503} \sqrt{n_{ij}}\ P_{ij} \underset{(.000081)}{-.000045} \sqrt{n_{ij}}\ I_{ij}$$

$$+ \underset{(1.130453)}{1.665500} \sqrt{n_{ij}}\ C_{ij} + \underset{(1.936518)}{3.815755} \sqrt{n_{ij}}\ L^{1}_{ij}$$

$$+ \underset{(1.684243)}{2.170526} \sqrt{n_{ij}}\ L^{2}_{ij} + \underset{(2.840176)}{5.444515} \sqrt{n_{ij}}\ (L^{3}_{ij} + L^{4}_{ij}) \tag{5-46}$$

$$+ \underset{(.003731)}{.004548} \sqrt{n_{ij}}\ D_{ij} \underset{(1.159844)}{-.088081} \sqrt{n_{ij}}\ F_{ij}$$

$R^2 = .8875$ d.f. = 17

Exponential Model

$$\hat{Q}_{ij} = e^{-.561749 - .114503\, P_{ij} - .000045\, I_{ij} + 1.665500\, C_{ij} + 3.815755\, L^{1}_{ij} + 2.170526\, L^{2}_{ij} + 5.444515\, (L^{3}_{ij} + L^{4}_{ij}) + .004548\, D_{ij} - .088081\, F_{ij}} \tag{5-47}$$

Equation (5-47) is plotted through the scatter of points defined by the observed recreation day per capita and average transfer cost (Figure 22). Figure 23 contains the net willingness to pay schedule derived from equation (5-47). The price quantity relationship used to plot the net willingness to pay schedule is contained in Table 29. An estimate of the economic value of the sites within Remoteness II, obtained from the sample, is arrived at by estimating the following

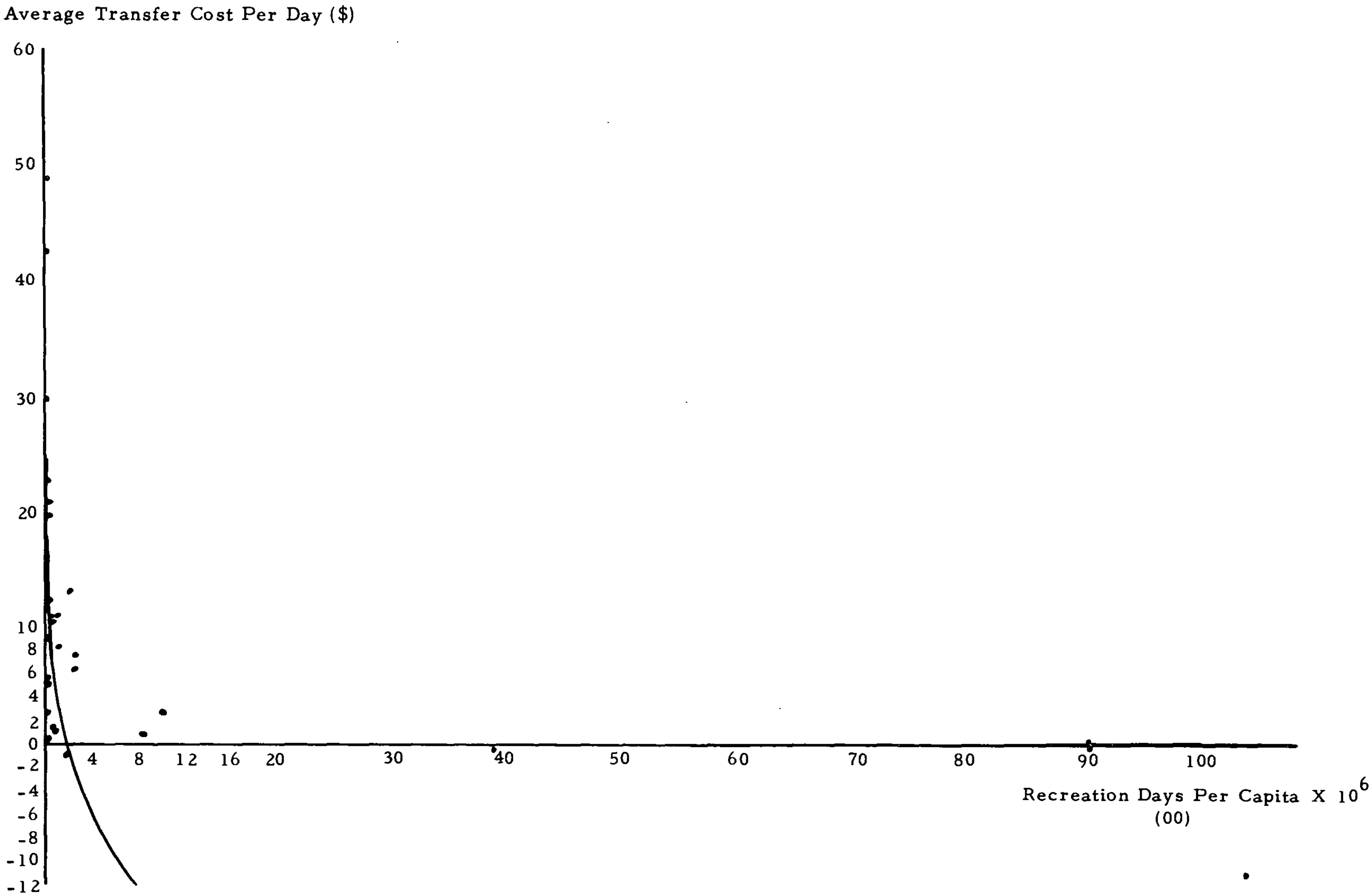

Figure 22. Estimated demand schedule for Remoteness Level II plotted through the average transfer cost--recreation days per capita scatter (Eq. 5-47).

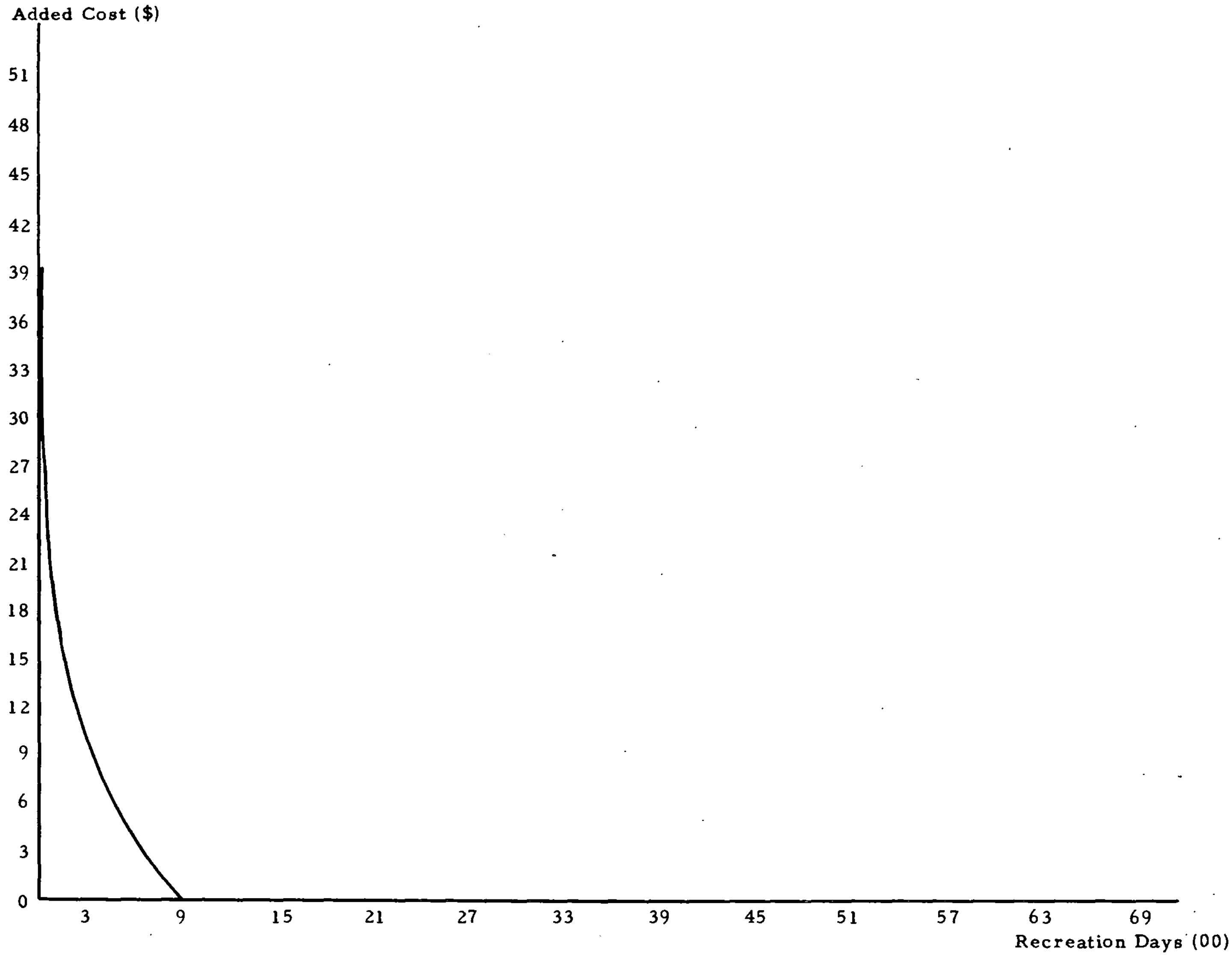

Figure 23. Net willingness to pay schedule for Remoteness Level II (Eq. 5-48).

Table 29. Predicted Total Number of Recreation Days Taken in the Bend Ranger District at Sites Within Remoteness Level II at Various Levels of Increased Average Transfer Cost Per Recreation Day by the Sample of Users.

Increased average transfer cost/day ($)	Total number of recreation days [a/]
0	917
1	817
2	729
3	650
4	580
5	517
6	461
7	411
8	367
9	327
10	292
11	260
12	232
13	207
14	185
15	165
16	147
17	131
18	117
19	104
20	93
21	83
22	74
23	66
24	59
25	52
26	47
27	42
28	37
29	33
30	30
31	26
32	23
33	21
34	19
35	17

Continued

Table 29--Continued.

36	15
37	13
38	12
39	11
40	9
41	8
42	7
43	7
44	6
45	5
46	5
47	4
48	4
49	3

a/ Rounded to the nearest day.

equation, using the data in Table 29.

$$\hat{Q} = e^{6.82 - .11P} \qquad (5\text{-}48)$$

Integrating equation (5-48), the economic value derived from the sample at sites within Remoteness Level II is obtained.

$$\int_0^\infty e^{6.82 - .11\,P}\, dp = \frac{1}{.11}\, e^{6.82}$$

$$= \$8,327.14$$

An examination of the initial point on the willingness to pay schedule (917) indicates an overprediction of 179 recreation days. The original number of recreation days observed at the sites was 738.

Estimated Demand Equation for Remoteness Level III

All sites accessible by paved and dirt roads define Remoteness Level III. The data collected within the sample of the Bend Ranger District pertaining to this group of sites will be used to estimate a demand function for Remoteness Level III. Drawing on the conceptual discussion of demand for outdoor recreation in Chapter II, the general model hypothesized in the previous analyses is again hypothesized in this analysis. The relevant general and estimated forms of the model are given in the following equations:

General Model

$$Q_{ij} = e^{\beta_0 + \beta_1 P_{ij} + \beta_2 I_{ij} + \beta_3 B_{ij} + \beta_4 C_{ij} + \beta_5 L^1_{ij} + \beta_6 L^2_{ij} + \beta_7 L^3_{ij} + \beta_8 L^4_{ij} + \beta_9 S_{ij} + \beta_{10} O_{ij} + \beta_{11} Y_{ij} + \beta_{12} E_{ij} + \beta_{13} D_{ij} + \beta_{14} U_{ij} + \beta_{15} F_{ij} + \varepsilon_{ij}} \qquad (5\text{-}49)$$

Logarithmic Model

$$\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = -.711966 \underset{(.027147)}{-.071236} \sqrt{n_{ij}} P_{ij}^{**} + \underset{(.000079)}{.000122} \sqrt{n_{ij}}\, I_{ij}$$

$$+ \underset{(.676282)}{.056070} \sqrt{n_{ij}}\, B_{ij} \underset{(2.221914)}{-4.841493} \sqrt{n_{ij}}\, C_{ij}^{*}$$

$$-1.312552 \underset{(2.763099)}{} \sqrt{n_{ij}}\, L^1_{ij} \quad -5.479651 \underset{(3.771645)}{} \sqrt{n_{ij}}\, L^2_{ij}$$

$$-.956582 \underset{(3.134376)}{} \sqrt{n_{ij}}\, L^3_{ij} \quad -2.964338 \underset{(3.498393)}{} \sqrt{n_{ij}}\, L^4_{ij} \qquad (5\text{-}50)$$

$$+.464479 \underset{(.317987)}{} \sqrt{n_{ij}}\, S_{ij} + .003263 \underset{(.061169)}{} \sqrt{n_{ij}}\, O_{ij}$$

$$+.035628 \underset{(.038172)}{} \sqrt{n_{ij}}\, Y_{ij} \quad -.000072 \underset{(.000214)}{} \sqrt{n_{ij}}\, E_{ij}$$

$$+.006758 \underset{(.004122)}{} \sqrt{n_{ij}}\, D_{ij} + .135285 \underset{(.133712)}{} \sqrt{n_{ij}}\, U_{ij}$$

$$-3.697722 \underset{(4.860910)}{} \sqrt{n_{ij}}\, F_{ij}$$

$R^2 = .9365$ d.f. $= 10$

Exponential Model

$$\hat{Q}_{ij} = e^{-.437848 - .071236\, P_{ij} + .000122\, I_{ij}}$$

$$+ .056070\, B_{ij} - 4.841493\, C_{ij} - 1.312552\, L^1_{ij}$$

$$-5.479651\, L^2_{ij} - .956582\, L^3_{ij} - 2.964338\, L^4_{ij}$$

$$+ .464479\, S_{ij} + .003263\, O_{ij} + .035628\, Y_{ij}$$

$$-.000072\, E_{ij} + .006758\, D_{ij} + .135285\, U_{ij}$$

$$-3.697722\, F_{ij}$$

A plot of the residuals against the predicted dependent variable for equations (5-50) and (5-51) are contained in Figures 24 and 25, respectively. The distribution of the predicted error terms from equation (5-50) appears to be (approximately) randomly distributed, indicating that the form of the model is adequate. However, those arising from the exponential form of the estimated equation indicate three points are greatly affected by the transformation. Two of the income groups are greatly under predicted, and one is greatly over predicted by the exponential form of the equation. The equation greatly over predicts the results in zone one income group four. There is a negative transfer cost associated with this observation and is probably the reason for the over prediction. The reasonably high per day transfer cost of \$7.61 is probably the reason for the under prediction from zone one income group six. The reason for the under prediction of the number of days from zone two income population group four is not as readily ascertainable, since the transfer cost is low and the weight given to the observation was four, the square root of 16. It is, therefore, suggested that this under estimation is a result of the combination of all variables in the equation. The influence these three points have on the sums of squares of error in the transformed model is evidenced in the adjusted R^2, which is .2239 for equation (5-51).

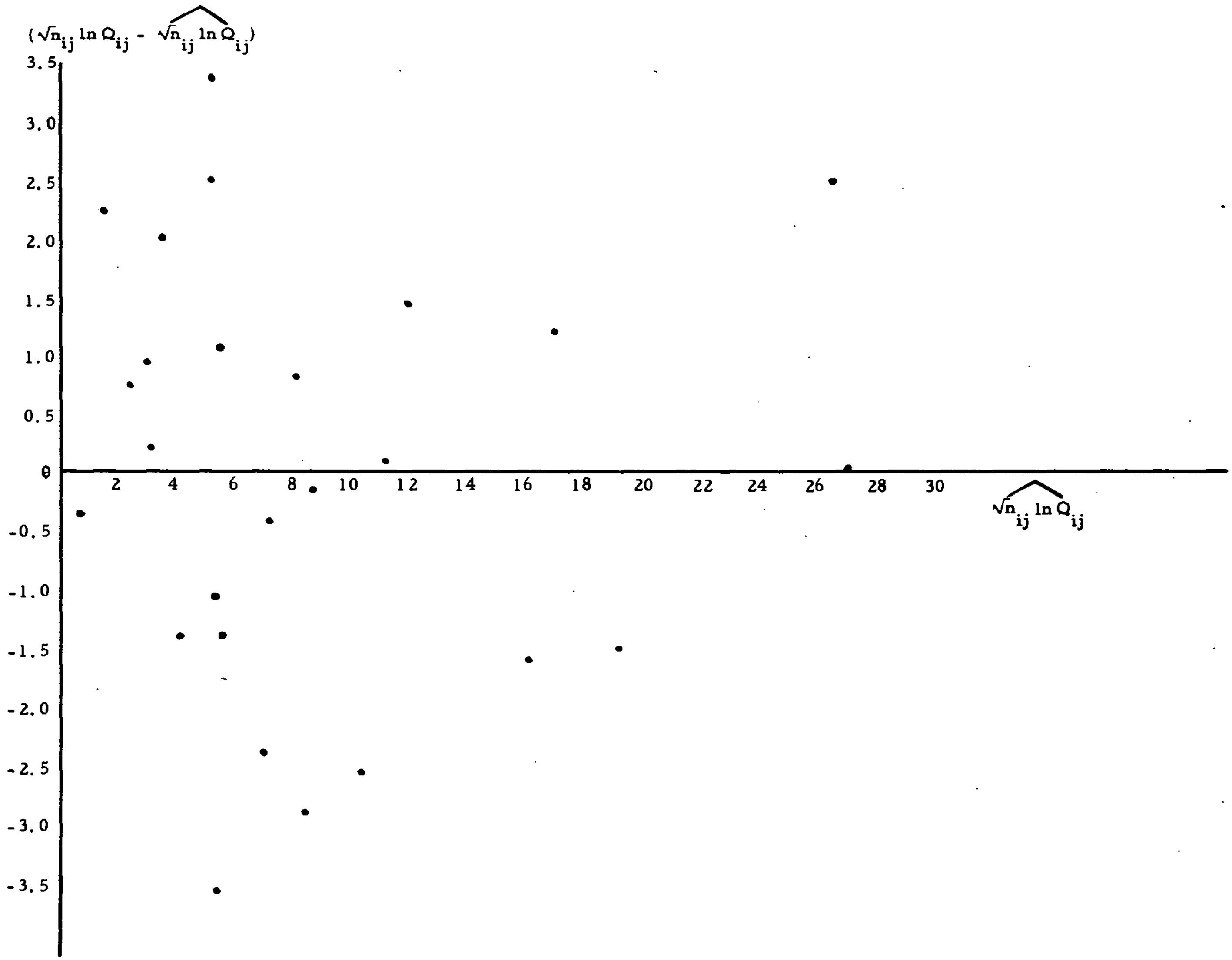

Figure 24. Residuals against the predicted dependent variable from the weighted logarithmic equation estimated for Remoteness Level III (Eq. 5-50).

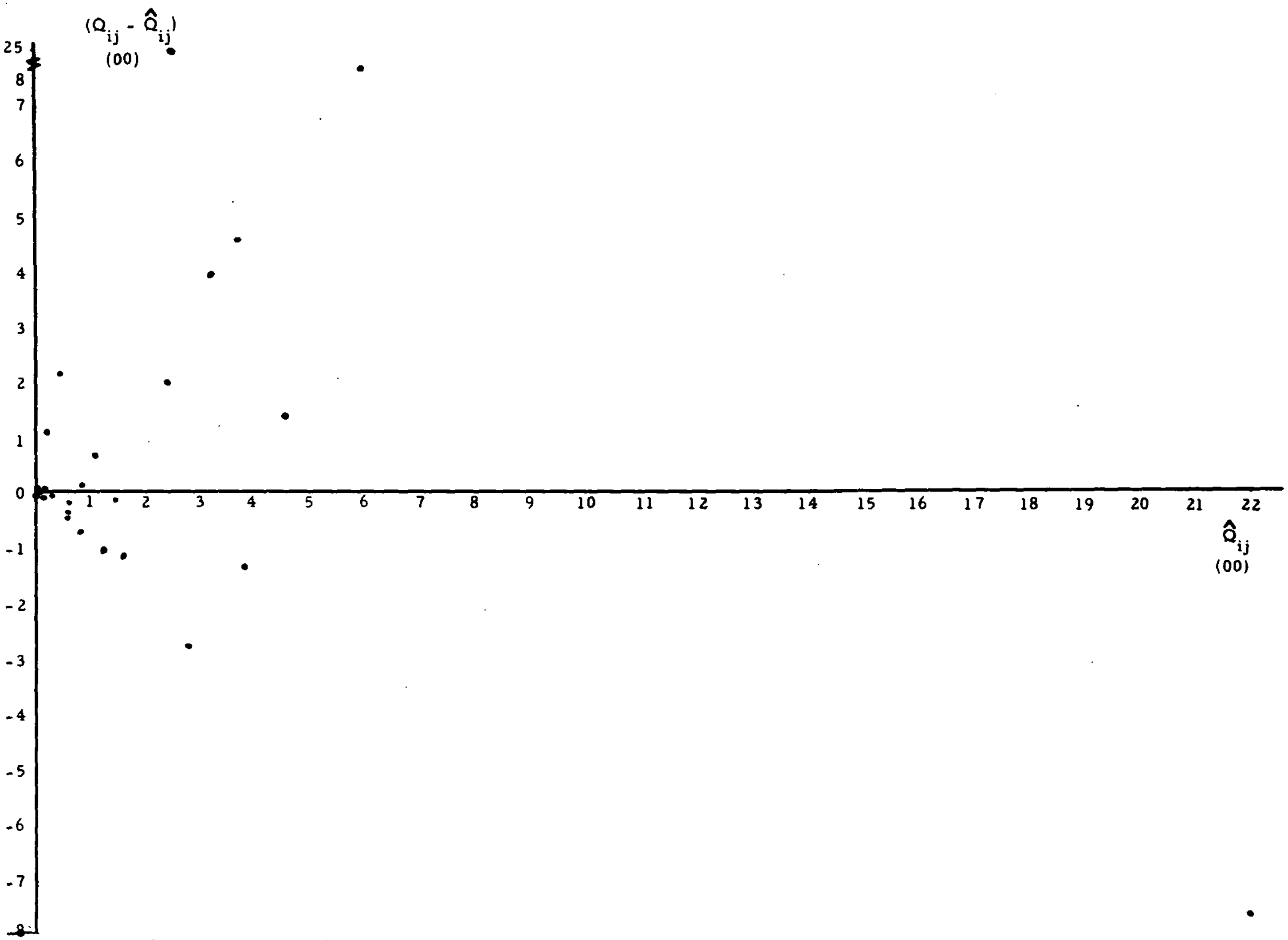

Figure 25. Residuals against the predicted dependent variable from the exponential form of the equation estimated for Remoteness Level III (Eq. 5-51).

An attempt, not shown, was made to relieve the above results of the prediction problems by trying a first order polynomial. But, as in previous cases, a systematic error in the analysis was indicated from a plot of the residuals. It was therefore, decided to accept the results associated with the exponential model; the predictive properties of the equation should be considered in terms of the results discussed above.

Each of the independent variables will now be examined separately, in an attempt to assess their role in the demand model as indicated by the results from equation (5-50). Tables 30 and 31 contain the simple correlation coefficients between the weighted independent variables and the results of the variable examinations, respectively. The price variable has a partial regression coefficient which is significantly different from zero at the five percent level in equation (5-50). An examination of Table 30 indicates that $\sqrt{n_{ij}}\, P_{ij}$ is not highly related with any of the independent variables in the equation. The simple correlation coefficient between $\sqrt{n_{ij}}\, P_{ij}$ and $\sqrt{n_{ij}}\, B_{ij}$ is only .0070; therefore, $\sqrt{n_{ij}}\, B_{ij}$ will again be removed from further consideration in the model.

Total family income ($\sqrt{n_{ij}}\, I_{ij}$) has a partial regression coefficient which is significantly different from zero at the 20 percent level in the original hypothesized model. There are no independent variables with which it has a simple correlation coefficient of .7

Table 30. Simple Correlation Coefficients Between Weighted Independent Variables, Remoteness Level III.

	$\sqrt{n_{ij}}P_{ij}$	$\sqrt{n_{ij}}I_{ij}$	$\sqrt{n_{ij}}B_{ij}$	$\sqrt{n_{ij}}C_{ij}$	$\sqrt{n_{ij}}L^1_{ij}$	$\sqrt{n_{ij}}L^2_{ij}$	$\sqrt{n_{ij}}L^3_{ij}$	$\sqrt{n_{ij}}L^4_{ij}$	$\sqrt{n_{ij}}S_{ij}$	$\sqrt{n_{ij}}O_{ij}$	$\sqrt{n_{ij}}Y_{ij}$	$\sqrt{n_{ij}}E_{ij}$	$\sqrt{n_{ij}}D_{ij}$	$\sqrt{n_{ij}}U_{ij}$	$\sqrt{n_{ij}}F_{ij}$
$\sqrt{n_{ij}}P_{ij}$	1.0000	.4388	.0070	.3770	.1672	-.0643	-.2058	-.1624	.1422	.0780	-.0880	-.0515	-.1493	-.0041	.1130
$\sqrt{n_{ij}}I_{ij}$		1.0000	.4705	.5297	.5266	.1620	-.2396	-.1815	.6543	.6673	.2179	.3484	.3848	.5915	.4898
$\sqrt{n_{ij}}B_{ij}$			1.0000	.5135	.4650	.4530	-.2107	-.1731	.6469	.7143	.5598	.3793	.6889	.6925	.2487
$\sqrt{n_{ij}}C_{ij}$				1.0000	.3667	-.1308	-.1387	-.1427	.4375	.3628	-.0075	.0276	.1518	.5262	.0973
$\sqrt{n_{ij}}L^1_{ij}$					1.0000	-.1891	-.1849	-.3673	.8318	.7849	.1335	.4094	.5805	.7142	.8249
$\sqrt{n_{ij}}L^2_{ij}$						1.0000	-.2495	-.1247	.1923	.2502	.6183	.4086	.4070	-.0383	-.0329
$\sqrt{n_{ij}}L^3_{ij}$							1.0000	-.1736	-.1968	-.1474	-.2044	-.1292	-.1838	-.0682	-.1548
$\sqrt{n_{ij}}L^4_{ij}$								1.0000	-.2099	-.2392	-.1527	-.1701	-.1249	-.1255	-.2525
$\sqrt{n_{ij}}S_{ij}$									1.0000	.9582	.3899	.6449	.7537	.7832	.8376
$\sqrt{n_{ij}}O_{ij}$										1.0000	.5020	.6625	.7819	.7990	.8113
$\sqrt{n_{ij}}Y_{ij}$											1.0000	.5220	.4337	.2379	.2730
$\sqrt{n_{ij}}E_{ij}$												1.0000	.6387	.3737	.6306
$\sqrt{n_{ij}}D_{ij}$													1.0000	.7061	.6158
$\sqrt{n_{ij}}U_{ij}$														1.0000	.5982
$\sqrt{n_{ij}}F_{ij}$															1.0000

Table 31. Analysis of Independent Variables in the Demand Model for Remoteness Level III.

Originally hypothesized equation Eq. (5-50)					Results of statistical analysis of the independent variables					
Variable	Calculated t-value	Significance level	Simple correlation coefficient of variables removed	Variables removed	Partial regression coefficient	Standard error of the co-efficient	Calculated t-value	Degrees of freedom	Significance level	R^2
$\sqrt{n_{ij}}P_{ij}$	-2.6241	.05	$r \geq .7$	None						
$\sqrt{n_{ij}}I_{ij}$	1.5420	.20	$r \geq .7$	None						
			$r \geq .6$	S_{ij}, O_{ij}	.000112	.000068	1.6465	13	.20	.914
$\sqrt{n_{ij}}C_{ij}$	-2.1790	.10	$r \geq .7$	None						
$\sqrt{n_{ij}}L^1_{ij}$	- .4750	.70	$r \geq .7$	$S_{ij}, O_{ij}, U_{ij}, F_{ij}$	2.470860	1.370112	1.8034	15	.10	.894
$\sqrt{n_{ij}}L^2_{ij}$	-1.4529	.20			-2.039078	2.219985	- .9185	15	.40	.894
$\sqrt{n_{ij}}L^3_{ij}$	- .3059	.80			3.060838	2.726596	1.1226	15	.30	.894
$\sqrt{n_{ij}}L^4_{ij}$	- .8473	.50			1.781867	2.682544	.6642	15	.60	.894
			$r \geq .6$	Y_{ij}	2.804908	1.418951	1.9767	16	.10	.876
					- .494868	2.095598	- .2361	16	.90	.876
					2.993156	2.856709	1.0478	16	.40	.876
					1.892571	2.809960	.6735	16	.60	.876

Continued on next page

Table 31 Continued.

Originally hypothesized equation Eq. (5-50)					Results of statistical analysis of the independent variables					
Variable	Calculated t-value	Significance level	Simple correlation coefficient of variables removed	Variables removed	Partial regression coefficient	Standard error of the co-efficient	Calculated t-value	Degrees of freedom	Significance level	R^2
$\sqrt{n_{ij}}S_{ij}$	1.4607	.20	$r \geq .7$	$L^1_{ij}, O_{ij}, D_{ij}, U_{ij}, F_{ij}$	.467563	.096966	4.8219	16	.01	.857
$\sqrt{n_{ij}}O_{ij}$	.0534	~	$r \geq .7$	$L^1_{ij}, S_{ij}, D_{ij}, U_{ij}, F_{ij}$	.104152	.020912	4.9805	16	.01	.863
$\sqrt{n_{ij}}Y_{ij}$	-.9334	.40	$r \geq .7$	None						
			$r \geq .6$	L^2_{ij}	.016629	.033816	.4918	12	.70	.921
$\sqrt{n_{ij}}E_{ij}$	-.3345	.80	$r \geq .7$	None						
			$r \geq .6$	$S_{ij}, O_{ij}, D_{ij}, F_{ij}$	.000111	.000179	.6199	15	.60	.900
$\sqrt{n_{ij}}D_{ij}$	1.6397	.20	$r \geq .7$	S_{ij}, O_{ij}, U_{ij}	.009633	.003442	2.7987	14	.02	.895
$\sqrt{n_{ij}}U_{ij}$	1.0118	.40	$r \geq .7$	$L^1_{ij}, S_{ij}, O_{ij}, D_{ij}$	.360647	.095528	3.7753	15	.01	.883
$\sqrt{n_{ij}}F_{ij}$	-.7607	.50	$r \geq .7$	L^1_{ij}, S_{ij}, O_{ij}	2.219154	2.097191	1.0582	14	.40	.906
			$r \geq .6$	E_{ij}, D_{ij}	3.663852	1.658029	2.2098	16	.05	.883

or greater. The $\sqrt{n_{ij}}\, I_{ij}$ has a simple correlation coefficient of .6 or greater with only $\sqrt{n_{ij}}\, S_{ij}$ and $\sqrt{n_{ij}}\, O_{ij}$. Removing these two variables from equation (5-50) and reestimating the model gives the results indicated in Table 31. The partial regression coefficient is still only significantly different from zero at the 20 percent level. This result suggests that, based on the sample data, family income is not a significant determinant of the demand for sites within Remoteness Level III.

There are no independent variables which have simple correlation coefficients of .6 or greater with $\sqrt{n_{ij}}\, C_{ij}$, the ratio of the number of days taken by recreation units with children to the total number of days taken from a given income population group. Therefore, the results from equation (5-50) are taken to reflect the role of C_{ij} in the demand equation for Remoteness Level III. The $\sqrt{n_{ij}}\, C_{ij}$ in equation (5-50) has a partial regression coefficient which is statistically different from zero at the ten percent level. This result implies that the $\sqrt{n_{ij}}\, C_{ij}$ is a significant variable in the demand for Remoteness Level III. It is interesting to note that the sign on the coefficient is negative, indicating that the existence of children in the recreation unit in this remoteness level has a negative effect on the quantity of days taken per capita from the zone. This is not inconsistent with the hypothesis indicated in Chapter II, that children may act as a constraint on certain recreation activities. From these results, one might be led to infer that the existence of children in the recreation unit has a negative effect on the number of days taken at sites which are as remote as those in Remoteness Level III, or more remote. Further information on this point will be obtained from the following two analyses.

The partial regression coefficients of the four residence variables do not test significantly different from zero at the ten percent level or less in equation (5-50). The results from this equation indicate that very little inference can be drawn about the importance of these variables in the demand for Remoteness Level III. All variables having a simple correlation coefficient of .7 or greater were removed from the original model, and only one of the residence variables, $\sqrt{n_{ij}}\, L_{ij}^{1}$, had a partial regression coefficient which was significantly different from zero at the ten percent level or less. It can be observed from Table 31 that, although none of the residence variables other than $\sqrt{n_{ij}}\, L_{ij}^{1}$ have partial regression coefficients which are significantly different from zero at the prescribed levels, the signs on all but $\sqrt{n_{ij}}\, L_{ij}^{2}$ changes from negative to positive. These signs appear to be more realistic than those resulting from equation (5-50). It does not appear reasonable that all four places of residence would have a negative effect on the number of days taken per capita from a zone income population group. In an effort to determine if any of the three residence type variables are insignificant, or their influence is being distorted by other independent variables in the model, all independent variables with a simple correlation coefficient of .6 or greater are removed from the model. The results in Table 30 show that only $\sqrt{n_{ij}}\, Y_{ij}$, in addition to the variables previously removed, will be removed from the originally hypothesized model. As seen in Table 31, there is little difference in the results obtained; $\sqrt{n_{ij}}\, L^1_{ij}$ is still the only residence variable with a partial regression coefficient that is statistically significant from zero at the ten percent level or less. The signs remain unaffected by the removal of $\sqrt{n_{ij}}\, Y_{ij}$, although the significance levels of $\sqrt{n_{ij}}\, L^2_{ij}$ and $\sqrt{n_{ij}}\, L^3_{ij}$ are affected by the variable's removal. A test of pairwise differences between the partial regression coefficients will be conducted on the results from the original model and those with all independent variables with a single correlation coefficient of .6 or greater with the residence variables removed. The results are contained in Table 32.

In equation (5-50) there are no differences between the partial regression coefficients of any pair of residence variables. The results from the reestimated equation with all independent variables having $r \geq .6$, with the residence variables, removed from the model indicates a difference statistically between the partial regression coefficients of $\sqrt{n_{ij}}\, L^1_{ij}$ and $\sqrt{n_{ij}}\, L^2_{ij}$ at the five percent level. No

Table 32. Calculated t-values for the Difference Between Partial Regression Coefficients of the Residence Variables in the Demand Equation for Remoteness Level III.

Hypothesis	t-values	
	Equation (5-50) a/	Equation ($r \geq .6$) b/
$H_o: \beta_{L^1_{ij}} - \beta_{L^2_{ij}} = 0$	1.7430	2.3701**
$H_a: \beta_{L^1_{ij}} - \beta_{L^2_{ij}} \neq 0$		
$H_o: \beta_{L^1_{ij}} - \beta_{L^3_{ij}} = 0$	-.1147	-.0710
$H_a: \beta_{L^1_{ij}} - \beta_{L^3_{ij}} \neq 0$		
$H_o: \beta_{L^1_{ij}} - \beta_{L^4_{ij}} = 0$	.6718	.3946
$H_a: \beta_{L^1_{ij}} - \beta_{L^4_{ij}} \neq 0$		
$H_o: \beta_{L^2_{ij}} - \beta_{L^3_{ij}} = 0$	-1.2571	-1.2899
$H_a: \beta_{L^2_{ij}} - \beta_{L^3_{ij}} \neq 0$		
$H_o: \beta_{L^2_{ij}} - \beta_{L^4_{ij}} = 0$	-.8886	-.9497
$H_a: \beta_{L^2_{ij}} - \beta_{L^4_{ij}} \neq 0$		

Continued

Table 32--Continued.

H_o: $\beta_{L^3_{ij}} - \beta_{L^4_{ij}} = 0$	.6606	.3666
H_a: $\beta_{L^3_{ij}} - \beta_{L^4_{ij}} \neq 0$		

a/ d.f. = 10.

b/ d.f. = 16.

difference is exhibited between the other pairs of regression coefficients. These results suggest that L^1_{ij} and L^2_{ij} should not be combined; however, L^1_{ij} or L^2_{ij} could be combined with the other two residence variables. The argument against combining rural and urban areas has been made in the previous analysis. Also, in this analysis the combination of L^2_{ij} with the two rural categories might be ruled out, because the indicated directional effect of L^3_{ij} and L^4_{ij} is different from the negative of L^2_{ij}. Therefore, it is suggested that L^3_{ij} and L^4_{ij} be combined to form one residence variable, and let L^1_{ij} and L^2_{ij} remain as separate variables in the model for further study.

The partial regression coefficients of the years of formal schooling ($\sqrt{n_{ij}}\, S_{ij}$) and the occupation prestige rating ($\sqrt{n_{ij}}\, O_{ij}$) are not significantly different from zero at the ten percent level or less in equation (5-50). Upon removing, for each, those independent variables which have a simple correlation coefficient of .7 or greater with each of these two variables, their partial regression coefficients are significantly different from zero at the one percent level. The variables which are removed from the originally hypothesized model are exactly the same for $\sqrt{n_{ij}}\, S_{ij}$ and $\sqrt{n_{ij}}\, O_{ij}$, except $\sqrt{n_{ij}}\, O_{ij}$ is removed when $\sqrt{n_{ij}}\, S_{ij}$ is examined and vice versa. The simple correlation coefficient between $\sqrt{n_{ij}}\, S_{ij}$ is .9582. In addition, the signs in the originally hypothesized model and those with the independent variables with $r \geq .7$ removed are the same for both variables, positive. These results indicate that in the demand for Remoteness Level III, $\sqrt{n_{ij}}\, S_{ij}$ and $\sqrt{n_{ij}}\, O_{ij}$ operate in the model as identical variables. Therefore, as in the case of the previous analyses, only one of these two should be kept in the model. For the same reasons of measurement and appropriateness of the variable used in the other analyses, the $\sqrt{n_{ij}}\, S_{ij}$ will be kept in the model and $\sqrt{n_{ij}}\, O_{ij}$ removed.

The years of camping experience ($\sqrt{n_{ij}}\, Y_{ij}$) and investment in outdoor recreation equipment ($\sqrt{n_{ij}}\, E_{ij}$) in equation (5-50) have partial regression coefficients which are not significantly different from zero at the ten percent level or less. Neither variable has a simple correlation coefficient of .7 or greater with any independent variable, therefore, in the case of each variable all independent variables with simple correlation coefficients of .6 or greater were removed from equation (5-50). After the above manipulation was performed on each variable separately and a new model estimated, neither variable exhibited a partial regression coefficient which was statistically significant from zero at the prescribed levels. On the basis of these results from the sample data, it is suggested that these two variables are not important determinants of demand for sites within Remoteness Level III and are removed from the model.

The final three site characteristics exhibit statistically significant partial regression coefficients after highly interrelated variables are removed from the original equation (5-50). The only variable on which some discussion seems warranted is the fishing success variable ($\sqrt{n_{ij}}\,F_{ij}$). The partial regression coefficient on $\sqrt{n_{ij}}\,F_{ij}$ in the original model has a negative sign. Once the independent variables with simple correlation coefficients of .7 or greater were removed from equation (5-50), the sign on the coefficient became positive. Since the partial regression coefficient was still not exhibiting significance, all those independent variables with simple correlation coefficients of .6 or greater were removed from equation (5-50). Upon removal of these variables, the $\sqrt{n_{ij}}\,F_{ij}$ has a partial regression coefficient which is statistically significant from zero at the five percent level and is positive. A positive sign corresponds to theoretical expectation, that as fishing success increases, the number of days taken per capita from a given income population group increases.

Based on this analysis of the independent variables in the demand for sites accessible by only paved and dirt roads, the following model is estimated and suggested for further study.

General Model

$$Q_{ij} = e^{\beta_0 + \beta_1 P_{ij} + \beta_2 C_{ij} + \beta_3 L^1_{ij} + \beta_4 L^2_{ij} + \beta_5 (L^3_{ij} + L^4_{ij}) + \beta_6 S_{ij} + \beta_7 D_{ij} + \beta_8 U_{ij} + \beta_9 F_{ij} + \varepsilon_{ij}} \quad (5\text{-}52)$$

Logarithmic Model

$$\begin{aligned}\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = {} & -.340649 \underset{(.023201)}{-.057039} \sqrt{n_{ij}}\, P_{ij} \underset{(1.848394)}{-3.960983} \sqrt{n_{ij}}\, C_{ij} \\ & \underset{(2.026851)}{-.335456} \sqrt{n_{ij}}\, L^1_{ij} \underset{(2.783484)}{-1.886654} \sqrt{n_{ij}}\, L^2_{ij} \\ & \underset{(2.757239)}{-1.226582} \sqrt{n_{ij}}\, (L^3_{ij} + L^4_{ij}) \underset{(.234365)}{+.400392} \sqrt{n_{ij}}\, S_{ij} \\ & \underset{(.003372)}{+.003502} \sqrt{n_{ij}}\, D_{ij} \underset{(.099317)}{+.262215} \sqrt{n_{ij}}\, U_{ij} \\ & \underset{(3.085513)}{-2.138460} \sqrt{n_{ij}}\, F_{ij}\end{aligned} \quad (5\text{-}53)$$

$R^2 = .9074$ d.f. = 16

Exponential Model

$$\hat{Q}_{ij} = e^{\,-.238562 \,-.057039\, P_{ij} \,-\, 3.960983\, C_{ij} \,-.335456\, L^{1}_{ij} \,-1.886654\, L^{2}_{ij} \,-1.226582\, (L^{3}_{ij} + L^{4}_{ij}) \,+\, .400392\, S_{ij} \,+\, .003502\, D_{ij} \,+\, .262215\, U_{ij} \,-2.138460\, F_{ij}} \qquad (5\text{-}54)$$

A plot of equation (5-54), holding all variables other than price constant at their means through the scatter of observed price-quantity points, is given in Figure 26. Equation (5-54) is also used to estimate the net willingness to pay schedule for sites within Remoteness Level III. The total number of recreation days predicted from equation (5-54) at each level of added cost is given in Table 33. The net willingness to pay schedule obtained from Table 33 is exhibited in Figure 27. The number of recreation days observed in the sample at sites within Remoteness Level III was 1,358. Equation (5-54) predicts at zero added cost 1,619 recreation days; therefore, at the initial observation which should correspond closely to the number of recreation days in the sample, equation (5-54) over predicts by 261 recreation days. Consequently, the economic value estimated will necessarily be an over estimate

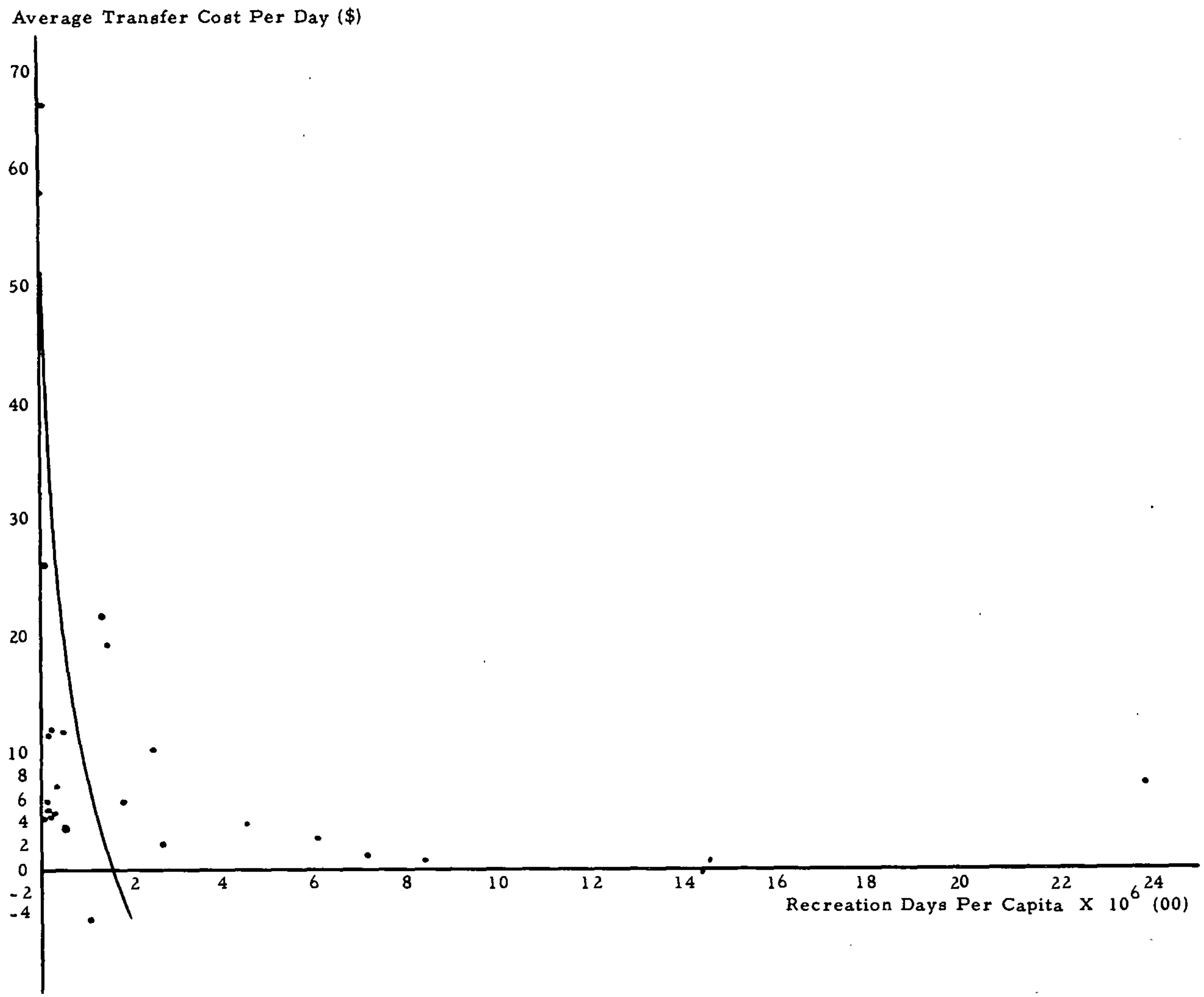

Figure 26. Estimated demand schedule for Remoteness Level III plotted through the average transfer cost--recreation days per capita scatter (Eq. 5-54).

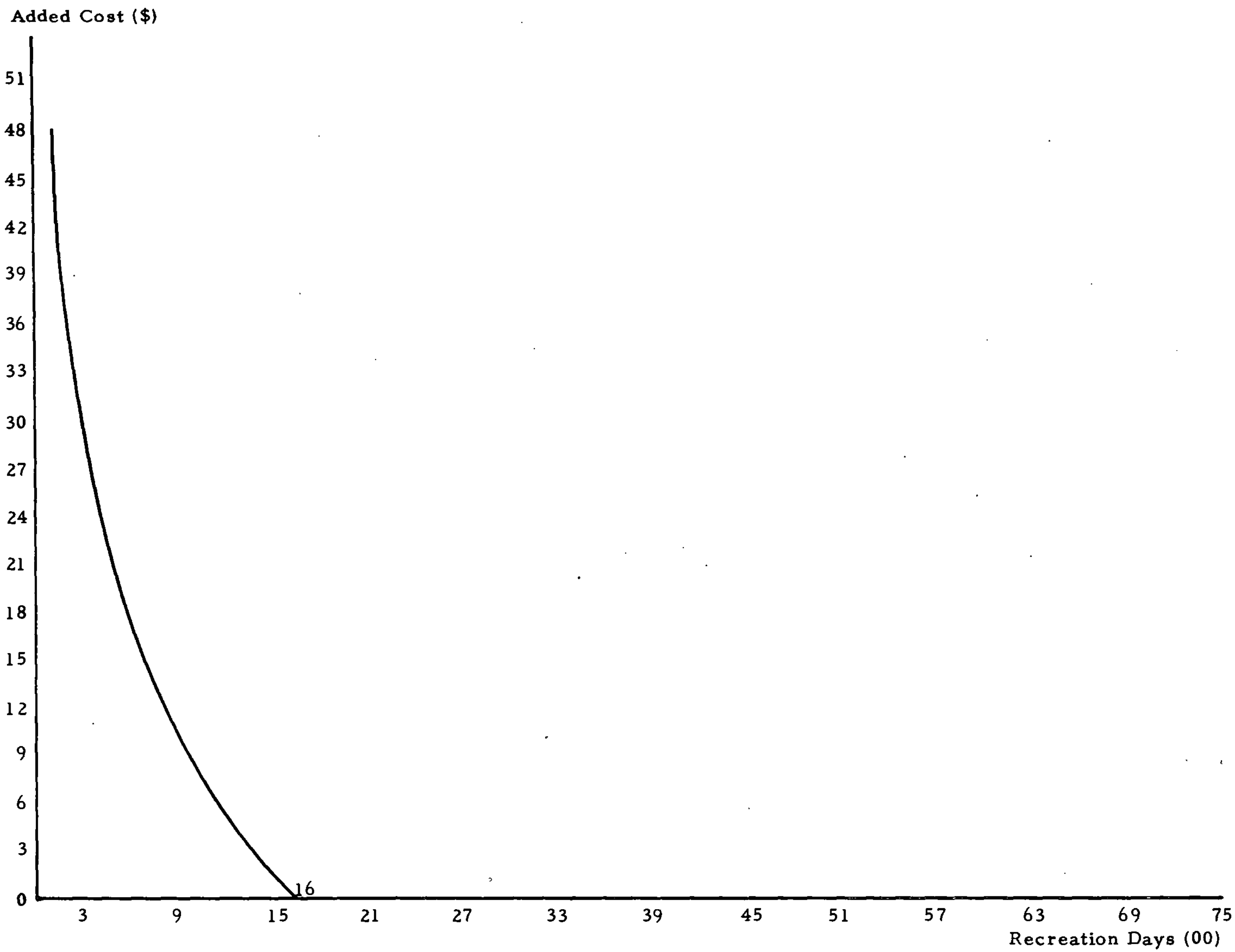

Figure 27. Net willingness to pay schedule for Remoteness Level III (Eq. 5-55).

Table 33. Predicted Total Number of Recreation Days Taken in the Bend Ranger District at Sites Within Remoteness Level III at Various Levels of Increased Average Transfer Cost Per Recreation Day by the Sample of Users.

Increased average transfer cost/day ($)	Total number of recreation days a/
0	1,619
1	1,530
2	1,445
3	1,365
4	1,289
5	1,218
6	1,150
7	1,086
8	1,026
9	969
10	915
11	865
12	817
13	771
14	729
15	688
16	650
17	614
18	580
19	548
20	517
21	489
22	462
23	436
24	412
25	389
26	368
27	347
28	328
29	310
30	293
31	276
32	261
33	247

Continued

Table 33--Continued.

34	233
35	220
36	208
37	196
38	185
39	175
40	165
41	156
42	148
43	139
44	132
45	124
46	117
47	111
48	105
49	99

[a] Rounded to the nearest day.

of the economic value obtained from the sample.

Using the data generated from equation (5-54) in Table 33, the following equation is an estimate of the net willingness to pay schedule for Remoteness Level III.

$$\hat{Q} = e^{7.390 - .057 P} \tag{5-55}$$

The economic value derived from the sample of users is given as follows:

$$\int_{0}^{\infty} e^{7.390 -.057 P} \, dp = \frac{1}{.057} \, e^{7.39}$$

$$= \$28.415.90.$$

Estimated Demand Equation for Remoteness Level IV

In the Bend Ranger District, there is a group of sites which are accessible only by travel over a combination of roads such as paved, all-weather, dirt and/or primitive road combinations. Those sites which are accessible only by this type of road combinations are defined to be in Remoteness Level IV. The data collected at these sites are now used to estimate a demand equation for this level of remoteness. The general and estimated forms of the hypothesized model are given in the following equations.

General Model

$$Q_{ij} = e^{\beta_0 + \beta_1 P_{ij} + \beta_2 I_{ij} + \beta_3 B_{ij} + \beta_4 C_{ij} + \beta_5 L^1_{ij} + \beta_6 L^2_{ij} + \beta_7 L^3_{ij} + \beta_8 L^4_{ij} + \beta_9 S_{ij} + \beta_{10} O_{ij} + \beta_{11} Y_{ij} + \beta_{12} E_{ij} + \beta_{13} D_{ij} + \beta_{14} U_{ij} + \beta_{15} F_{ij} + \varepsilon_{ij}} \qquad (5\text{-}56)$$

Logarithmic Model

$$\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = -1.107580 \underset{(.037434)}{-.094083} \sqrt{n_{ij}} P_{ij}^{*} \underset{(.000070)}{-.000007} \sqrt{n_{ij}} I_{ij}$$

$$+ \underset{(.299399)}{.104390} \sqrt{n_{ij}}\, B_{ij} + \underset{(1.379831)}{.214204} \sqrt{n_{ij}}\, C_{ij}$$

$$+ \underset{(5.788977)}{7.633779} \sqrt{n_{ij}}\, L^{1}_{ij} + \underset{(5.534012)}{9.231455} \sqrt{n_{ij}}\, L^{2}_{ij}$$

(5-57)

$$+ \underset{(5.210527)}{10.549282} \sqrt{n_{ij}}\, L^{3*}_{ij} + \underset{(5.759180)}{3.305684} \sqrt{n_{ij}}\, L^{4}_{ij}$$

$$+ \underset{(.188130)}{.518278} \sqrt{n_{ij}}\, S_{ij}^{**} - \underset{(.044833)}{.090897} \sqrt{n_{ij}}\, O_{ij}^{*}$$

$$+ \underset{(.039943)}{.030598} \sqrt{n_{ij}}\, Y_{ij} - \underset{(.000387)}{.000393} \sqrt{n_{ij}}\, E_{ij}$$

$$- \underset{(.002551)}{.002095} \sqrt{n_{ij}}\, D_{ij} - \underset{(.194706)}{.140932} \sqrt{n_{ij}}\, U_{ij}$$

$$- \underset{(1.903704)}{.883144} \sqrt{n_{ij}}\, F_{ij}$$

$R^2 = .9670$ d.f. = 5

Exponential Model

$$\hat{Q}_{ij} = e^{-.866530 - .094083 P_{ij} - .000007 I_{ij} + .104390 B_{ij} + .214204 C_{ij} + 7.633779 L^{1}_{ij} + 9.231455 L^{2}_{ij} + 10.549282 L^{3}_{ij} + 3.305684 L^{4}_{ij} + .518278 S_{ij}}$$

(5-58)

$$-.090897\ O_{ij} + .030598\ Y_{ij} - .000393\ E_{ij}$$

$$-.002095\ D_{ij} - .140932\ U_{ij} - .883144\ F_{ij}$$

The above equation is the estimated demand equation for Remoteness Level IV. How well the weighted logarithmic equation approximated the exponential model hypothesized is seen partially by examining the plot of the residuals against the predicted dependent variable. The residual plots derived from equations (5-57) and (5-58) are given in Figures 28 and 29, respectively. The plot in Figure 28 resulting from equation (5-57) exhibits a random distribution of the residual, indicating that the weighted logarithmic form is appropriate. However, the plot of the residuals arising from equation (5-58) exhibits several points which indicate the equation under predicts two of the observations and over predicts three others. The results to the predictability of the equation by these five income groups can be seen in the adjusted R^2. The adjusted R^2 for equation (5-58) is equal to .3439. The five observations the equation fails to predict reasonably well are the first five income groups in distance zone one. The two which are under predicted are income population groups defined by \$2,000-\$3,999 and \$6,000-\$9,999. Those which are over predicted are the under \$2,000, \$4,000-\$5,999, and \$10,000-\$14,999 income population groups. The number of recreation units observed from the

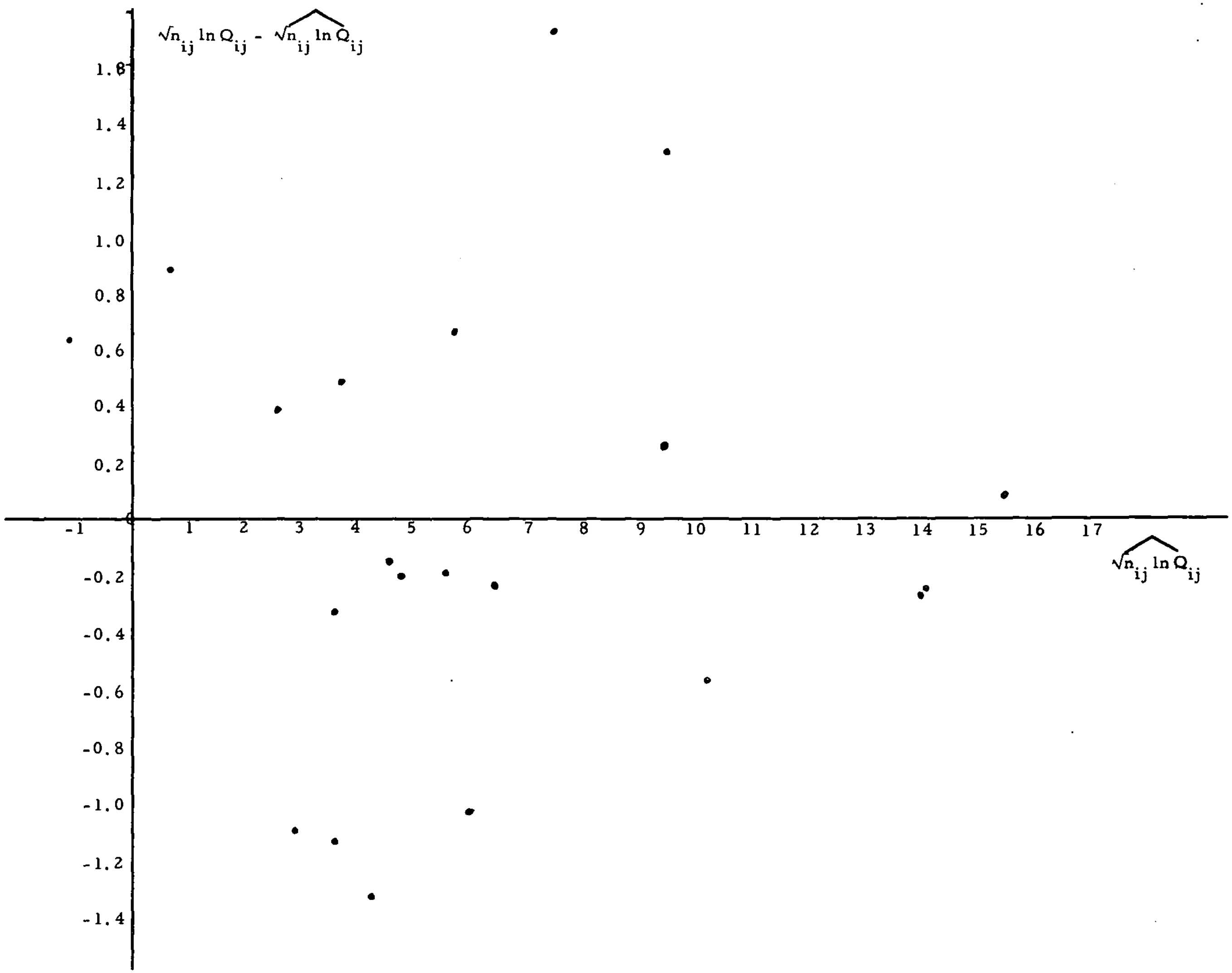

Figure 28. Residuals against the predicted dependent variable from the weighted logarithmic equation estimated for Remoteness Level IV (Eq. 5-57).

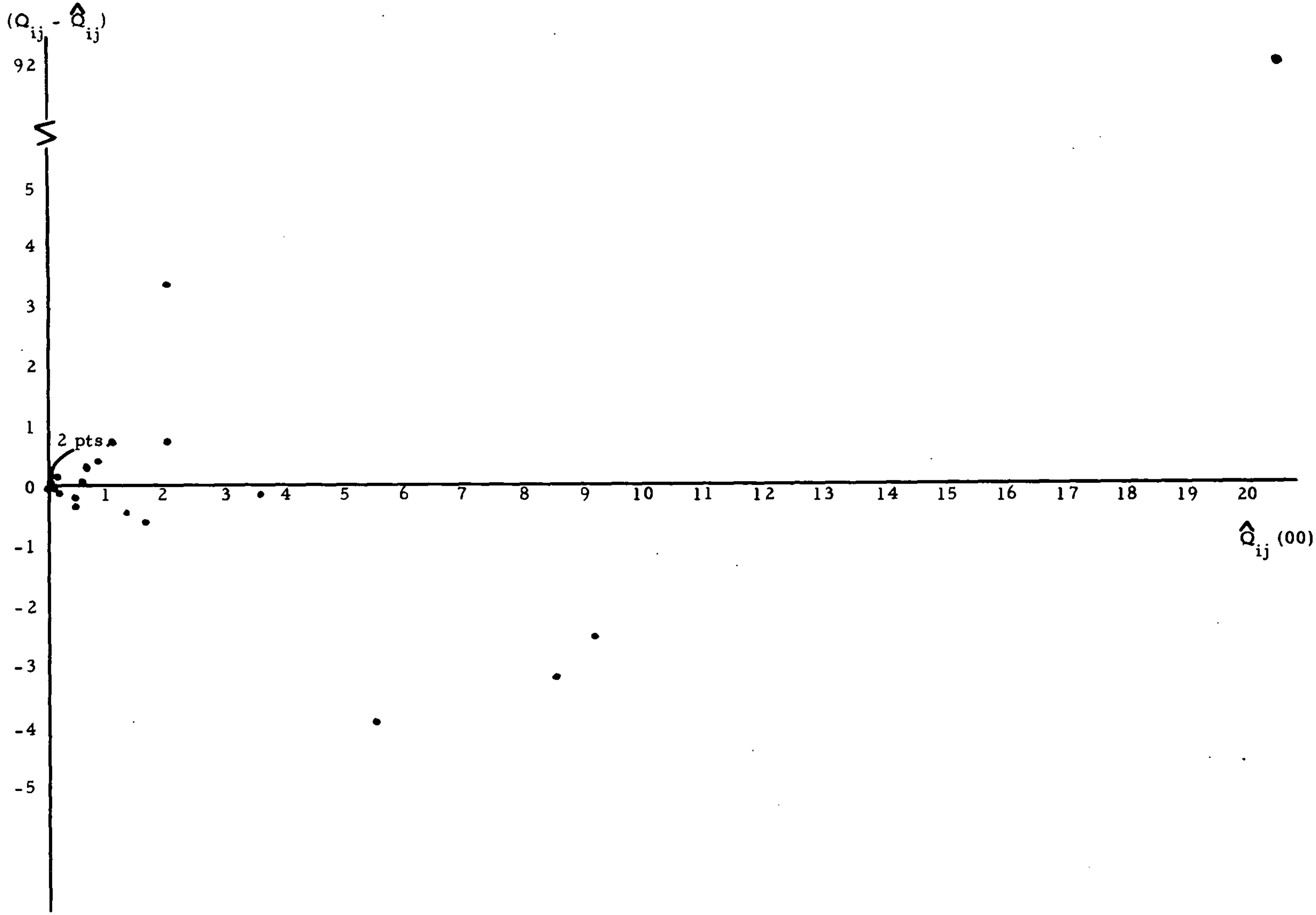

Figure 29. Residuals against the predicted dependent variable from the exponential form of the equation estimated for Remoteness Level IV (Eq. 5-58).

former two income population groups were one and three. Those observed in the latter group were one, two and one, respectively. Therefore, in none of the five income groups was the weight given to the observations very large, which may indicate part of the reason these under and over predictions occur. However, within this set of sites, the number of observations within any income population group is limited. The largest number of recreation units observed from a given income population group was nine. Therefore, it seems reasonable to infer that the linearized form of the exponential model estimated does not approximate the exponential model as well as desired. However, in the absence of trying to estimate the model by some method other than least squares regression, which has been ruled out in this study, equation (5-58) is accepted as the estimated demand equation for Remoteness Level IV.

The results from this equation will now be examined in the same manner in which those in the previous analyses were investigated. The simple correlation coefficients of the weighted independent variables are given in Table 34. Results from the analysis of each independent variable are given in Table 35.

The price variable ($\sqrt{n_{ij}}\, P_{ij}$) has a partial regression coefficient which is statistically different from zero at the ten percent level in equation (5-57). An examination of Table 34 shows

Table 34. Simple Correlation Coefficients Between Weighted Independent Variables, Remoteness Level IV.

	$\sqrt{n_{ij}}P_{ij}$	$\sqrt{n_{ij}}I_{ij}$	$\sqrt{n_{ij}}B_{ij}$	$\sqrt{n_{ij}}C_{ij}$	$\sqrt{n_{ij}}L^1_{ij}$	$\sqrt{n_{ij}}L^2_{ij}$	$\sqrt{n_{ij}}L^3_{ij}$	$\sqrt{n_{ij}}L^4_{ij}$	$\sqrt{n_{ij}}S_{ij}$	$\sqrt{n_{ij}}O_{ij}$	$\sqrt{n_{ij}}Y_{ij}$	$\sqrt{n_{ij}}E_{ij}$	$\sqrt{n_{ij}}D_{ij}$	$\sqrt{n_{ij}}U_{ij}$	$\sqrt{n_{ij}}F_{ij}$
$\sqrt{n_{ij}}P_{ij}$	1.0000	.1994	.2552	.3127	.3918	-.1205	-.0398	.0239	.3243	.3171	.0660	-.1977	.4972	.3007	.3071
$\sqrt{n_{ij}}I_{ij}$		1.0000	.5581	.4656	.5148	-.1677	.0809	.3057	.5742	.5987	.2697	-.2682	-.6036	.2220	.4512
$\sqrt{n_{ij}}B_{ij}$			1.0000	.8783	.6491	.0921	-.0927	.3766	.7208	.7378	.3062	.1612	.6126	.4802	.8187
$\sqrt{n_{ij}}C_{ij}$				1.0000	.5647	.2121	-.2048	.2936	.6436	.6609	.1592	.0492	.5516	.4403	.6883
$\sqrt{n_{ij}}L^1_{ij}$					1.0000	-.3813	-.3522	.1582	.6851	.6577	.0549	-.1620	.5989	.4267	.5325
$\sqrt{n_{ij}}L^2_{ij}$						1.0000	-.1763	.2545	.1836	.1919	.5594	.2329	.0763	.3905	.0839
$\sqrt{n_{ij}}L^3_{ij}$							1.0000	-.1308	-.0306	.0664	-.0350	.4242	-.0014	-.1440	.1696
$\sqrt{n_{ij}}L^4_{ij}$								1.0000	.4520	.3879	.2466	.1903	.2712	.4467	.3551
$\sqrt{n_{ij}}S_{ij}$									1.0000	.9516	.4161	.1212	.7599	.6635	.7562
$\sqrt{n_{ij}}O_{ij}$										1.0000	.4530	.2735	.7727	.6697	.7789
$\sqrt{n_{ij}}Y_{ij}$											1.0000	.3596	.4848	.5223	.3177
$\sqrt{n_{ij}}E_{ij}$												1.0000	.0342	.2697	.2593
$\sqrt{n_{ij}}D_{ij}$													1.0000	.3925	.6074
$\sqrt{n_{ij}}U_{ij}$														1.0000	.3836
$\sqrt{n_{ij}}F_{ij}$															1.0000

Table 35. Analysis of Independent Variables in the Demand Model for Remoteness Level IV.

Originally hypothesized equation Eq. (5-57)					Results of statistical analysis of the independent variables					
Variable	Calculated t-value	Significance level	Simple correlation coefficient of variables removed	Variables removed	Partial regression coefficient	Standard error of the co-efficient	Calculated t-value	Degrees of freedom	Significance level	R^2
$\sqrt{n_{ij}}P_{ij}$	-2.5133	.10	$r \geq .7$	None						
$\sqrt{n_{ij}}I_{ij}$	- .1035	~	$r \geq .7$	None						
			$r \geq .6$	D_{ij}	- .000003	.000063	- .0415	7	~	.962
$\sqrt{n_{ij}}C_{ij}$	.1552	.90	$r \geq .7$	None						
			$r \geq .6$	S_{ij}, O_{ij}, F_{ij}	- .123071	1.061314	- .1160	9	~	.904
$\sqrt{n_{ij}}L^1_{ij}$	1.3187	.30	$r \geq .7$	None						
$\sqrt{n_{ij}}L^2_{ij}$	1.6681	.20								
$\sqrt{n_{ij}}L^3_{ij}$	2.0246	.10	$r \geq .6$	S_{ij}, O_{ij}	7.815957	4.411897	1.7716	8	.20	.904
$\sqrt{n_{ij}}L^4_{ij}$	..5740	.60			9.735461	4.013882	2.4254	8	.05	.904
					10.256992	4.215580	2.4331	8	.05	.904
					5.836082	6.368736	.9164	8	.40	.904
$\sqrt{n_{ij}}S_{ij}$	2.7549	.05	$r \geq .7$	O_{ij}, D_{ij}, F_{ij}	.414314	.189436	2.1871	9	.10	.932

Continued on next page

Table 35 Continued.

Originally hypothesized equation Eq. (5-57)					Results of statistical analysis of the independent variables					
Variable	Calculated t-value	Significance level	Simple correlation coefficient of variables removed	Variables removed	Partial regression coefficient	Standard error of the co-efficient	Calculated t-value	Degrees of freedom	Significance level	R^2
			$r \geq .6$	C_{ij}, L^1_{ij}, U_{ij}	.453061	.059719	7.5866	12	.01	.917
$\sqrt{n}_{ij}O_{ij}$	-2.0275	.10	$r \geq .7$	S_{ij}, D_{ij}, F_{ij}	- .056650	.051396	-1.1022	9	.30	.908
			$r \geq .6$	C_{ij}, L^1_{ij}, U_{ij}	.077571	.016888	4.5932	12	.01	.825
$\sqrt{n}_{ij}Y_{ij}$	..7660	.50	$r \geq .7$	None						
			$r \geq .6$	None						
$\sqrt{n}_{ij}E_{ij}$	-1.0153	.40	$r \geq .7$	None						
			$r \geq .6$	None						
$\sqrt{n}_{ij}D_{ij}$	- .8212	.50	$r \geq .7$	S_{ij}, O_{ij}	- .002232	.003396	- .6573	8	.60	.904
			$r \geq .6$	I_{ij}, F_{ij}	- .002146	.002462	- .8718	10	.50	.902
$\sqrt{n}_{ij}U_{ij}$	- .7238	.60	$r \geq .7$	None						
			$r \geq .6$	S_{ij}, O_{ij}	- .090850	.247338	- .3673	8	.80	.904
$\sqrt{n}_{ij}F_{ij}$	- .4639	.70	$r \geq .7$	S_{ij}, O_{ij}	.186166	2.384338	.0781	8	~	.904
			$r \geq .6$	C_{ij}, D_{ij}	.884582	1.649864	.5362	10	.70	.898

that there are no independent variables which have a simple correlation coefficient of .7 or greater with $\sqrt{n_{ij}}\, P_{ij}$. Therefore, using the results from equation (5-57), the price variable is considered to have a significant role in the demand for Remoteness Level IV and will be maintained in the model. The results in Table 34 again indicate that the assumed relationship between the average number in the recreation unit ($\sqrt{n_{ij}}\, B_{ij}$) and the price variable was inappropriate. The simple correlation coefficient between these two variables in this analysis is .2552. Consequently, the $\sqrt{n_{ij}}\, B_{ij}$ will be removed from further consideration in the model and the analysis.

The total family income ($\sqrt{n_{ij}}\, I_{ij}$) variable has a partial regression coefficient which is significantly different from zero in equation (5-57) at a probability level higher than 90 percent. These results indicate that the $\sqrt{n_{ij}}\, I_{ij}$ variable is very insignificant as a determinant of the demand for Remoteness Level IV. The sign on the coefficient is negative, indicating that the directional effect of income, however insignificant in this model, is contrary to theoretical expectation. There are no independent variables with which $\sqrt{n_{ij}}\, I_{ij}$ has a simple correlation coefficient of .7 or greater. Therefore, all those with simple correlation coefficients of .6 or greater with $\sqrt{n_{ij}}\, I_{ij}$ were removed from equation (5-57) and the model was reestimated. The results from the new equation yield almost the identical conclusion about the $\sqrt{n_{ij}}\, I_{ij}$ as indicated in equation (5-57). From the evidence obtained from the sample data, the $\sqrt{n_{ij}}\, I_{ij}$ does not exhibit statistically a significant role in the demand for sites within Remoteness Level IV. Based on the information obtained here, the family income variable is removed from the model.

The partial regression coefficient of $\sqrt{n_{ij}}\, C_{ij}$, the ratio of the number of recreation days taken by recreation units with children to the total number of recreation days taken by recreation units from an income population group, is only significantly different from zero at the 90 percent level. The sign of the coefficient is positive. A positive sign on $\sqrt{n_{ij}}\, C_{ij}$ raises some question about the tentative hypothesis suggested in the previous analysis that children in the recreation unit have a negative effect on the number of days taken per capita at the more remote sites. The results in Table 35 indicate that when the independent variables which have simple correlation coefficients of .6 or greater with $\sqrt{n_{ij}}\, C_{ij}$ are removed from the original model, the coefficient was still not significant at the prescribed levels of significance. However, the partial regression coefficient has a sign which is negative. Therefore, although $\sqrt{n_{ij}}\, C_{ij}$ appears to have very little significance in the demand for sites within this level of remoteness, the negative sign on the coefficient does not refute the tentative hypothesis between children in the recreation unit and increasing degrees of remoteness. Using the sample evidence presented here, $\sqrt{n_{ij}}\ C_{ij}$ is removed from the model.

Only the partial regression coefficient of $\sqrt{n_{ij}}\ L^3_{ij}$, the ratio of the number of days taken by recreation units residing in rural nonfarm areas to the total number of recreation days taken from an income population group, of the residence variables is statistically significant from zero at the ten percent level or less in equation (5-57). There are no independent variables which have a simple correlation coefficient of .7 or greater with any of the four residence variables. Therefore, all independent variables with simple correlation coefficients of .6 or greater with any of the four residence variables were removed from equation (5-57). The partial regression coefficients of both $\sqrt{n_{ij}}\ L^2_{ij}$ and $\sqrt{n_{ij}}\ L^3_{ij}$ are statistically significant from zero at the five percent level in the new equation. A pairwise test of significance between the partial regression coefficients of the four residence variables from equation (5-57) and the equation estimated with those independent variables with $r \geq .6$ removed are given in Table 36.

The results from the pairwise test suggest that no pair of partial regression coefficients estimated for the residence variables in each of the equations are statistically different from each other at a level of ten percent or less. Therefore, no evidence is

Table 36. Calculated t-values for the Difference Between Partial Regression Coefficients of the Residence Variables in the Demand Equation for Remoteness Level IV

Hypothesis	t-values: Equation (5-52)[a/]	t-values: Equation ($r \geq .6$)[b/]
$H_o: \beta_{L^1_{ij}} - \beta_{L^2_{ij}} = 0$	-1.1023	-1.0778
$H_a: \beta_{L^1_{ij}} - \beta_{L^2_{ij}} \neq 0$		
$H_o: \beta_{L^1_{ij}} - \beta_{L^3_{ij}} = 0$	-2.0102	-1.3877
$H_a: \beta_{L^1_{ij}} - \beta_{L^3_{ij}} \neq 0$		
$H_o: \beta_{L^1_{ij}} - \beta_{L^4_{ij}} = 0$	1.1349	.4369
$H_a: \beta_{L^1_{ij}} - \beta_{L^4_{ij}} \neq 0$		
$H_o: \beta_{L^2_{ij}} - \beta_{L^3_{ij}} = 0$	-.6915	-.0921
$H_a: \beta_{L^2_{ij}} - \beta_{L^3_{ij}} \neq 0$		
$H_o: \beta_{L^2_{ij}} - \beta_{L^4_{ij}} = 0$	1.3712	.7383
$H_a: \beta_{L^2_{ij}} - \beta_{L^4_{ij}} \neq 0$		

Table 36--Continued.

H_o: $\beta_{L^3_{ij}} - \beta_{L^4_{ij}} = 0$	1.9368	.9749
H_a: $\beta_{L^3_{ij}} - \beta_{L^4_{ij}} \neq 0$		

a/ d.f. = 5.

b/ d.f. = 8.

obtained from the pairwise test to indicate which residence variables should not be combined. The results in Table 35 do indicate that when those independent variables with $r \geq .6$ with the residence variables are removed, the partial regression coefficient of $\sqrt{n_{ij}}\, L^2_{ij}$ and $\sqrt{n_{ij}}\, L^3_{ij}$ are statistically different from zero at the five percent level. Therefore, it appears from these results that a statistically significant influence is being exerted by one of the urban and one of the rural residence categories. Based on this observation, it is suggested that in the model for further study $\sqrt{n_{ij}}\, L^1_{ij}$ and $\sqrt{n_{ij}}\, L^2_{ij}$ be combined to represent the urban category, and the $\sqrt{n_{ij}}\, L^3_{ij}$ and $\sqrt{n_{ij}}\, L^4_{ij}$ be combined to represent the rural category.

Years of formal education $(\sqrt{n_{ij}}\, S_{ij})$ has a partial regression coefficient which is significantly different from zero at the five percent level with a positive sign in the equation (5-57). Removing those independent variables which have a simple correlation coefficient of .7 or greater with $\sqrt{n_{ij}}\, S_{ij}$, the coefficient is still significantly different from zero at the ten percent level. However, since the significance level of the coefficient decreased when these variables were removed from the model, an additional model with the independent variables having $r \geq .6$ with $\sqrt{n_{ij}}\, S_{ij}$ removed from equation (5-57). The coefficient was again significantly different from zero, this time at the one percent level. No change in the sign of the partial regression coefficient was observed in the three equations. Therefore, the sample data indicates that $\sqrt{n_{ij}}\, S_{ij}$ is statistically significant in the demand for sites within Remoteness Level IV.

In the previous analyses, the occupation prestige rating ($\sqrt{n_{ij}}\, O_{ij}$) and $\sqrt{n_{ij}}\, S_{ij}$ were concluded on both statistical and theoretical grounds to be the same variable in the models. However, in equation (5-57), the partial regression coefficient on $\sqrt{n_{ij}}\, O_{ij}$ is significantly different from zero at the ten percent level and possesses a negative sign. This result implies that the role of the $\sqrt{n_{ij}}\, S_{ij}$ and $\sqrt{n_{ij}}\, O_{ij}$ are different in this model. However, an examination of Table 34 indicates that the simple correlation coefficient between these two variables is .9516. A removal of these independent variables, one of which is $\sqrt{n_{ij}}\, S_{ij}$, with simple correlation coefficients of .7 or greater with $\sqrt{n_{ij}}\, O_{ij}$ from equation (5-57) gives a new estimated model in which the partial regression coefficient of $\sqrt{n_{ij}}\, O_{ij}$ is only statistically significant from zero at the 30 percent level. The sign on the coefficient remains negative. A comparison of the partial regression coefficient of $\sqrt{n_{ij}}\, O_{ij}$ in equation (5-57) and the coefficient estimated in the equation with those variables having $r \geq .7$ with $\sqrt{n_{ij}}\, O_{ij}$ removed indicates that the size of the coefficient has decreased. This suggests that the negative effect $\sqrt{n_{ij}}\, O_{ij}$ has on the dependent variable has decreased. This probably reflects that $\sqrt{n_{ij}}\, O_{ij}$ is picking up the role of the $\sqrt{n_{ij}}\, S_{ij}$ variable.

Since the coefficient of the variable was not statistically significant from zero at the ten percent level or less, those variables with $r \geq .6$ with the $\sqrt{n_{ij}}\, O_{ij}$ were removed from equation (5-57) and the model reestimated. The coefficient on $\sqrt{n_{ij}}\, O_{ij}$ is positive and statistically different from zero at the one percent level. It now appears that the role between $\sqrt{n_{ij}}\, S_{ij}$ is similar; however, the variability of the sign on the partial regression coefficient of $\sqrt{n_{ij}}\, O_{ij}$ confuses the issue. Since the simple correlation coefficient and the experimentation with the two variables indicate a high degree of relationship between the two variables, one will be removed from the model. The stability of $\sqrt{n_{ij}}\, S_{ij}$ in the results and the accuracy in its measurement, compared to that of $\sqrt{n_{ij}}\, O_{ij}$, leads to its inclusion in the model and the removal of $\sqrt{n_{ij}}\, O_{ij}$.

The remaining five variables presented in the original model after examination, the results of which are presented in Table 35, do not, on the basis of the sample data, exhibit statistical significance in this demand model. It is, therefore, concluded that these variables are not important determinants in the demand for sites within Remoteness Level IV, and will be removed from the model for further testing.

The general and estimated forms of the model indicated for further study at sites within Remoteness Level IV, based on the examinations conducted, are given in the following equations.

General Model

$$Q_{ij} = e^{\beta_0 + \beta_1 P_{ij} + \beta_2 (L^1_{ij} + L^2_{ij}) + \beta_3 (L^3_{ij} + L^4_{ij}) + \beta_4 S_{ij} + \varepsilon_{ij}} \qquad (5\text{-}59)$$

Logarithmic Model

$$\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = -.889955 \underset{(.028603)}{-.114460} \sqrt{n_{ij}}\, P_{ij} \underset{(2.163228)}{+ 2.240942} \sqrt{n_{ij}}\, (L^1_{ij} + L^2_{ij}) \underset{(2.114858)}{+ 3.521087} \sqrt{n_{ij}}\, (L^3_{ij} + L^4_{ij}) \underset{(.155009)}{+ .298858} \sqrt{n_{ij}}\, S_{ij} \qquad (5\text{-}60)$$

$R^2 = .8434$ d.f. $= 16$

Exponential Model

$$\hat{Q}_{ij} = e^{-.706545 - .114460\, P_{ij} + 2.240942\, (L^1_{ij} + L^2_{ij}) + 3.521087\, (L^3_{ij} + L^4_{ij}) + .298858\, S_{ij}} \tag{5-61}$$

Figure 30 contains a plot of equation (5-61) through the price quantity scatter observed for sites within Remoteness Level IV.

The net willingness to pay schedule obtained from equation (5-61) is given in Table 37 and Figure 31. The number of days observed in the sample at sites within Remoteness Level IV was 398. Equation (5-61) at zero added cost predicts a total of 880 recreation days, which is an over prediction of 482 recreation days. Consequently, the value estimate derived from equation (5-62) will be an over estimate of the value derived from the sample of users.

$$\hat{Q} = e^{6.78 - .11\, P} \tag{5-62}$$

Integrating equation (5-62), the estimate of economic value from the sample is obtained.

$$\int_0^{\infty} e^{6.78 - .11\, P}\, dp = \frac{1}{.11} \quad e^{6.78}$$

$$= \$8,000.62.$$

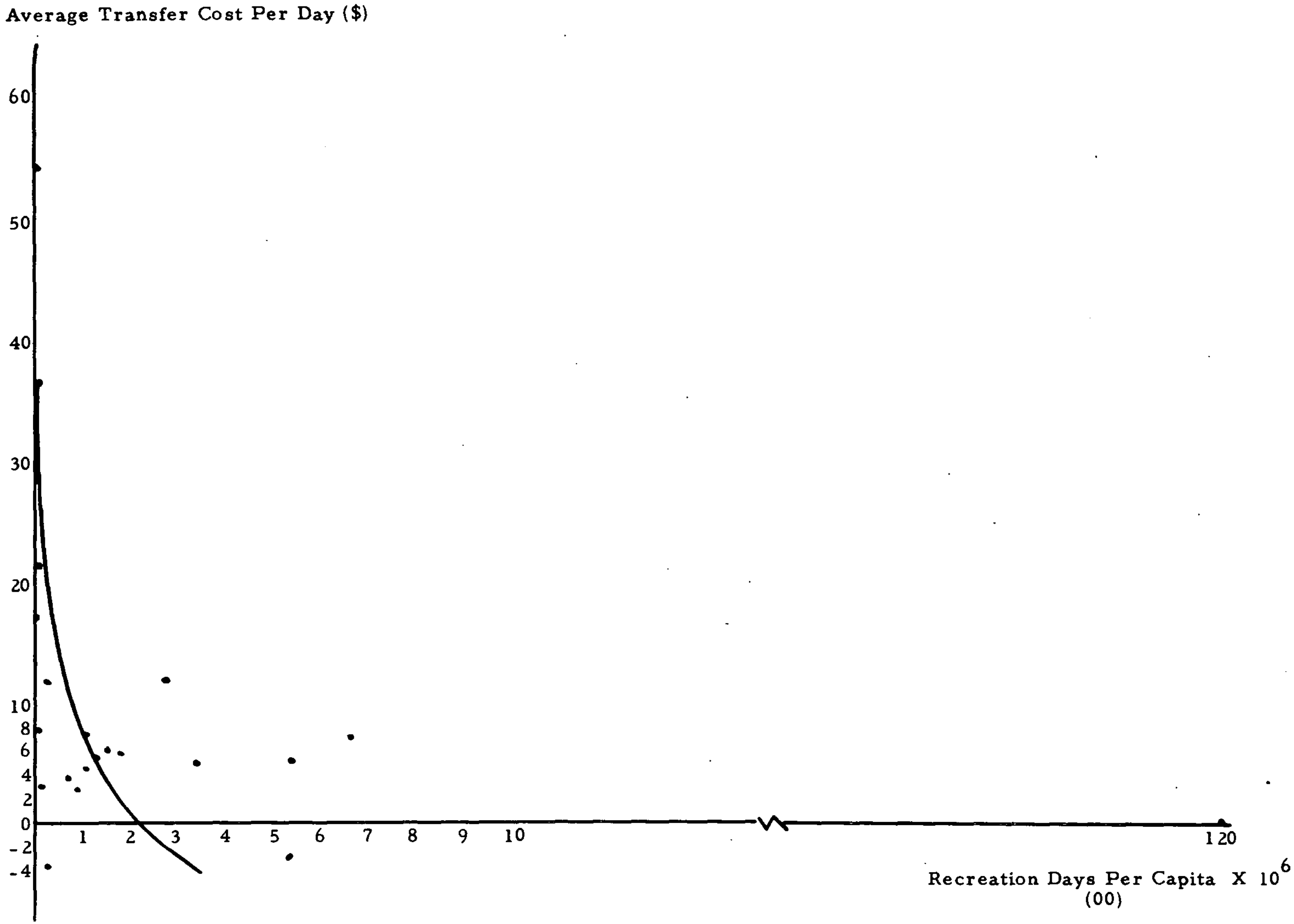

Figure 30. Estimated demand schedule for Remoteness Level IV plotted through the average transfer cost--recreation days per capita scatter (Eq. 5-61).

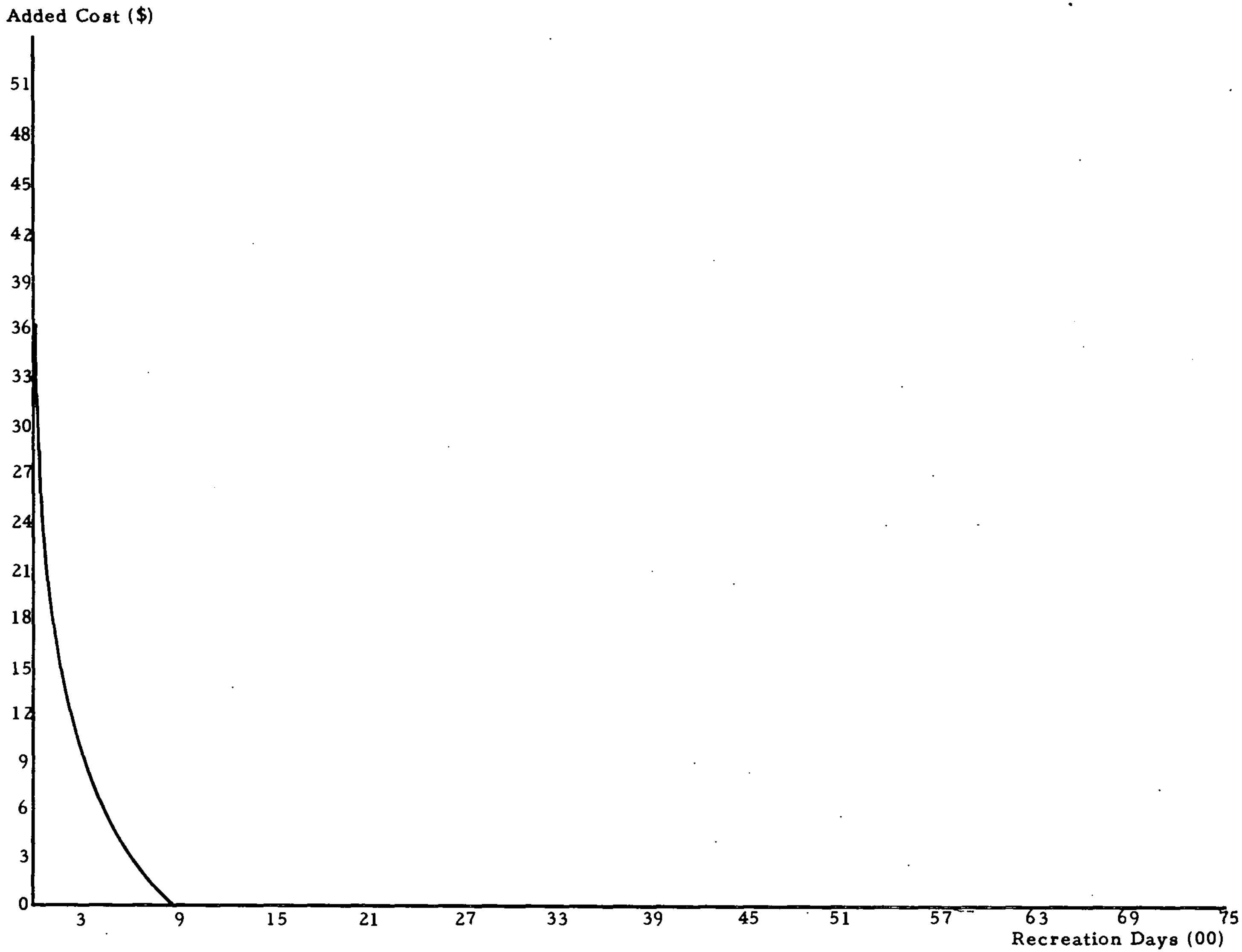

Figure 31. Net willingness to pay schedule for Remoteness Level IV (Eq. 5-62).

Table 37. Predicted Total Number of Recreation Days Taken in the Bend Ranger District at Sites Within Remoteness Level IV at Various Levels of Increased Average Transfer Cost Per Recreation Day by the Sample of Users.

Increased average transfer cost/day ($)	Total number of recreation days [a/]
0	880
1	784
2	700
3	624
4	556
5	496
6	443
7	395
8	352
9	314
10	280
11	250
12	223
13	199
14	177
15	158
16	141
17	126
18	112
19	100
20	89
21	79
22	71
23	63
24	56
25	50
26	45
27	40
28	36
29	32
30	28
31	25
32	23
33	20
34	18

Continued

Table 37--Continued.

35	16
36	14
37	13
38	11
39	10
40	9
41	8
42	7
43	6
44	6
45	5
46	5
47	4
48	4
49	3

a/ Rounded to the nearest day.

Estimated Demand Equation for Remoteness Level V

Remoteness Level V is defined to include those sites accessible by trail only; that is, although once in the Bend Ranger District a recreation unit may travel on several different types of roads, access to these sites after such travel still requires hiking on a trail to reach them. This group of sites, then, make up the most remote sites considered in this study. Due to location, the use at these sites is lower than at the other groupings of sites previously considered. The sites were stratified to account for this observation. Even so, only 15 income population groups were observed at this set of sites. The following statistical problem would be encountered if the general model arising from Chapter II, used in the other analyses, is applied to this set of sample data. There are 15 independent variables in that model and only 15 observations in this set of data. Therefore, if the hypothesized model is to provide any meaningful test, the number of variables considered in the model will have to be reduced.

It would seem appropriate to examine the relevance of the site characteristics in this model, since the location of the sites dictates certain characteristics. Some of the sites included in this remoteness level are designated trails on which minimum development exists at some point on the trail. Others are shelters with (very) minimal development. Therefore, the level of development variable and the potential density of use variable could be removed from this model, on the basis that the remoteness level itself predetermines these two variables. This observation is not necessarily true when the fishing success variable is considered, since there may be substantial variation in this variable at lakes and streams along the trails or at these sites. This type of reasoning on conceptual grounds is not as decisive when the population characteristics are considered, since the user characteristics are not directly related to the characteristics of the site. Some appeal, therefore, is made to the results obtained in the previous analyses to provide insights as to the most appropriate variables to be removed from the model.

In none of the previous analyses has the hypothesized relationship between the price variable (P_{ij}) and the number of persons in the recreation unit (B_{ij}) not been rejected. Therefore, B_{ij} will not be incorporated into this model. In each of these analyses, evidence has been presented which indicated that the two rural residence categories should be combined; therefore, in this model L_{ij}^3 and L_{ij}^4 will be combined into a single variable representing rural residences.

The statistical performance of the variables, years of formal schooling (S_{ij}) and occupation prestige rating (O_{ij}), in the previous models has been such that it was argued that they were in fact the same variable in the estimated equations. Therefore, only one of the two, S_{ij}, was maintained in the models for future study because of confidence in the variable's measurement. Based on this result in the previous models, it is suggested that only S_{ij} be included as a variable in the hypothesized model for sites within Remoteness Level V.

Consequently, based on the theoretical discussion in Chapter II and the modification of the full model suggested by the preceding analyses, the following general model as hypothesized and the empirical forms of the model tested are relevant.

General Model

$$Q_{ij} = e^{\beta_0 + \beta_1 P_{ij} + \beta_2 I_{ij} + \beta_3 C_{ij} + \beta_4 L^1_{ij} + \beta_5 L^2_{ij} + \beta_6 (L^3_{ij} + L^4_{ij}) + \beta_7 S_{ij} + \beta_8 Y_{ij} + \beta_9 E_{ij} + \beta_{10} F_{ij} + \varepsilon_{ij}} \quad (5\text{-}63)$$

Logarithmic Model

$$\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = \underset{}{-5.907342} \underset{(.029125)}{-.070970} \sqrt{n_{ij}}\, P_{ij}^* \underset{(.000024)}{+.000032} \sqrt{n_{ij}}\, I_{ij}$$

$$\underset{(.919419)}{-1.713524} \sqrt{n_{ij}}\, C_{ij} \underset{(3.011024)}{+.449125} \sqrt{n_{ij}}\, L^1_{ij} \quad (5\text{-}64)$$

$$\underset{(2.794977)}{+2.215438} \sqrt{n_{ij}}\, L^2_{ij} \underset{(2.088584)}{+6.244816} \sqrt{n_{ij}}\, (L^3_{ij} + L^4_{ij})^{**}$$

$$\underset{(.141302)}{+.574633} \sqrt{n_{ij}}\, S_{ij}^{***} \underset{(.029731)}{-.025257} \sqrt{n_{ij}}\, Y_{ij}$$

$$\underset{(.000363)}{-.000800} \sqrt{n_{ij}}\, E_{ij}^* \underset{(1.443549)}{+2.078327} \sqrt{n_{ij}}\, F_{ij}$$

$R^2 = .9920$ d.f. = 4

Exponential Model

$$\hat{Q}_{ij} = e^{-3.684571 - .070970 P_{ij} + .000032 I_{ij} - 1.713524 C_{ij} + .449125 L^1_{ij} + 2.215438 L^2_{ij}} \quad (5\text{-}65)$$

$$+ 6.244816 (L^3_{ij} + L^4_{ij}) + .574633 S_{ij}$$

$$-.025257 Y_{ij} -.000800 E_{ij} + 2.078327 F_{ij}$$

A plot of the residuals against the predicted dependent variable for equations (5-64) and (5-65) is given in Figures 32 and 33, respectively. As in the previous models estimated, the plot of the residuals from the exponential model does not appear as random as those which result from the logarithmic equation. The effect of the transformation can also be seen in the adjusted multiple correlation coefficient associated with equation (5-65). The adjusted $R^2 = .3201$ which indicates that the predictive properties of equation (5-65) are not as good as might be desirable. However, from the residual plot on the logarithmic equation, it appears that the appropriate form of the equation was estimated. Consequently, except for attempting some estimation procedures other than ordinary regression techniques, the results obtained here appear as adequate as possible. Therefore, equation (5-65) is accepted as the estimated demand equation for sites within Remoteness Level V.

Table 38 contains the simple correlation coefficients between the weighted independent variables which will be used to examine each of the independent variables separately. The results of

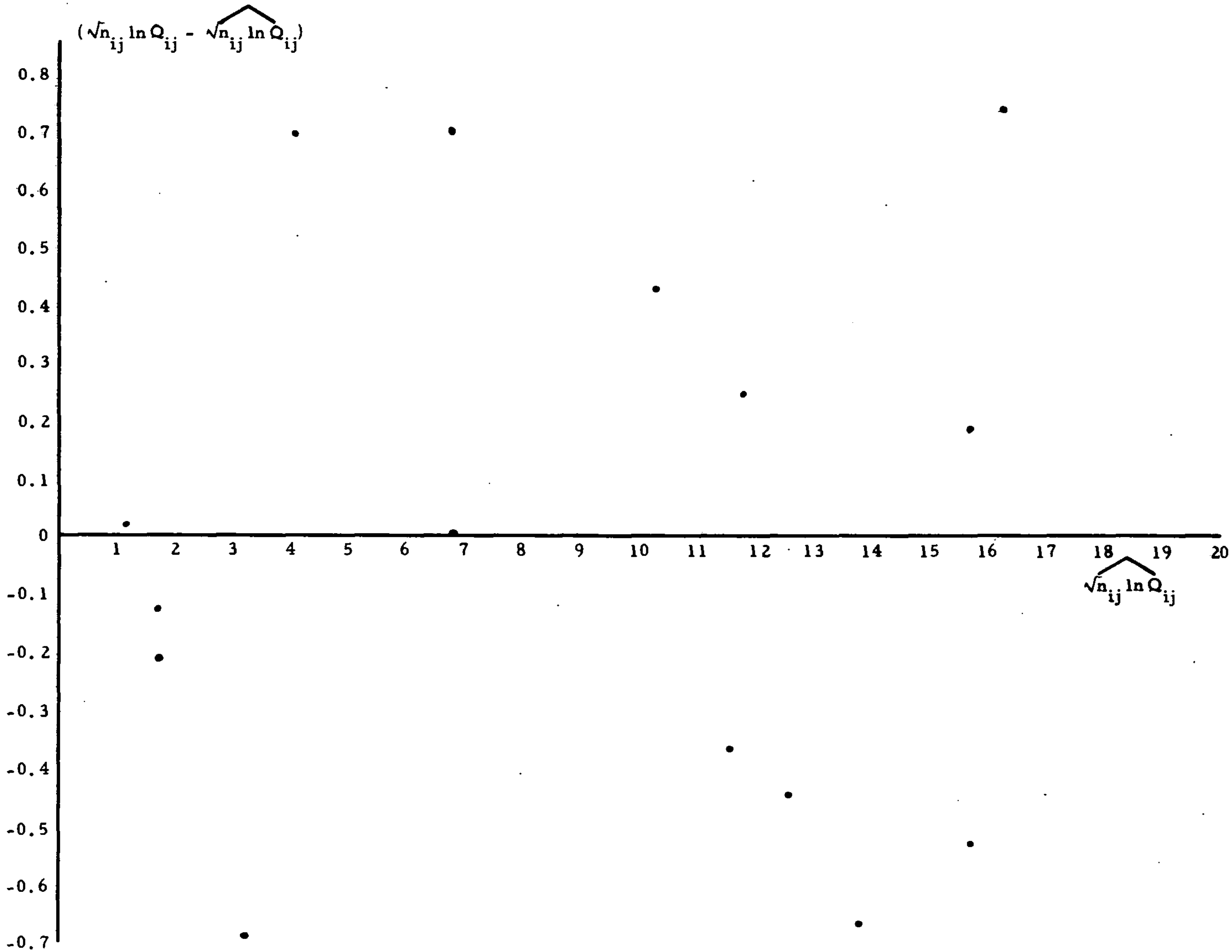

Figure 32. Residuals against the predicted dependent variable from the weighted logarithmic equation estimated for Remoteness Level V (Eq. 5-64).

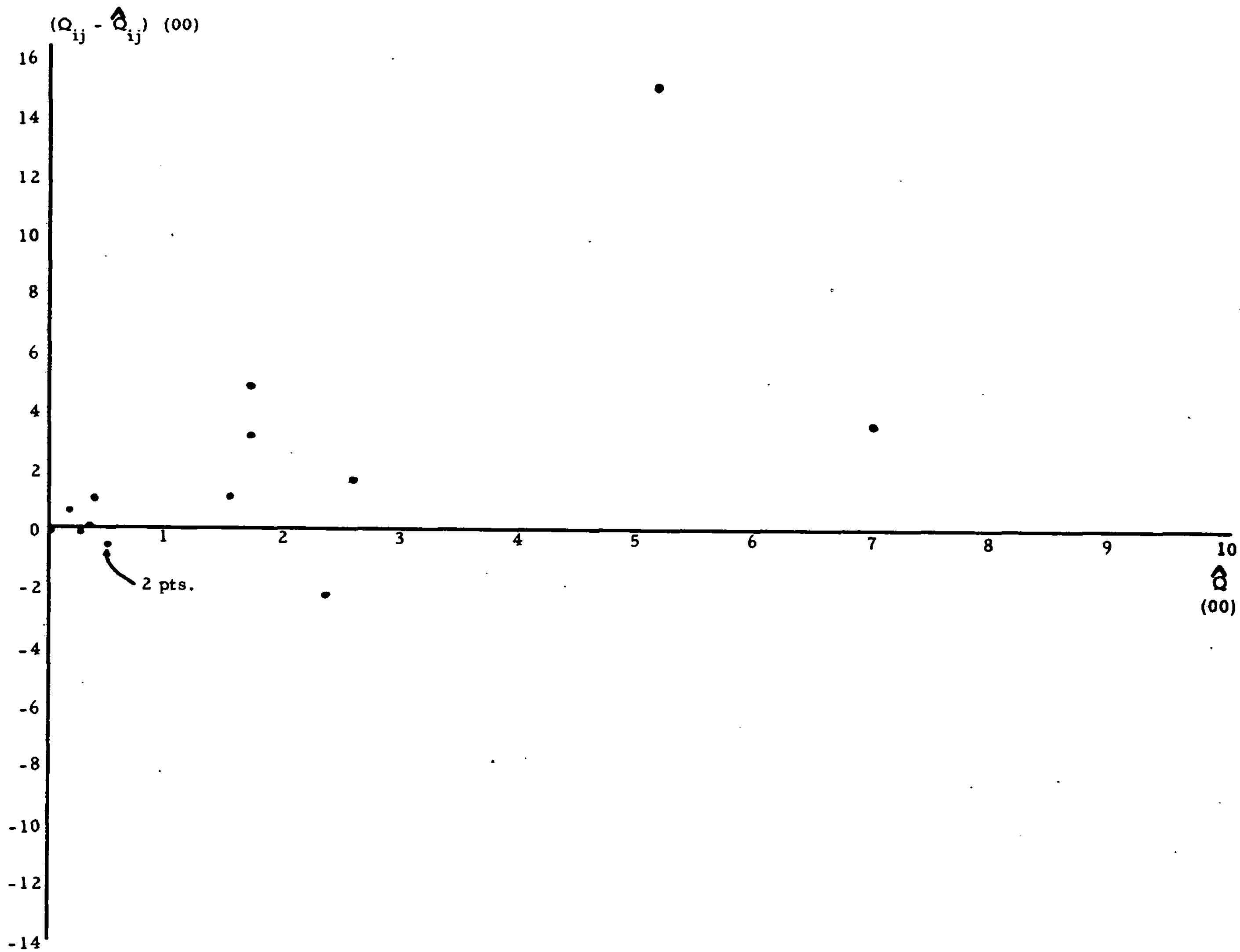

Figure 33. Residuals against the predicted dependent variable from the exponential form of the equation estimated for Remoteness Level V (Eq. 5-65).

Table 38. Simple Correlation Coefficients Between Weighted Independent Variables, Remoteness Level V.

	$\sqrt{n_{ij}}P_{ij}$	$\sqrt{n_{ij}}I_{ij}$	$\sqrt{n_{ij}}C_{ij}$	$\sqrt{n_{ij}}L^1_{ij}$	$\sqrt{n_{ij}}L^2_{ij}$	$\sqrt{n_{ij}}(L^3_{ij}+L^4_{ij})$	$\sqrt{n_{ij}}S_{ij}$	$\sqrt{n_{ij}}Y_{ij}$	$\sqrt{n_{ij}}E_{ij}$	$\sqrt{n_{ij}}F_{ij}$
$\sqrt{n_{ij}}P_{ij}$	1.0000	.1594	-.1113	-.0183	-.1785	.0521	-.2962	-.2987	-.2238	.8942
$\sqrt{n_{ij}}I_{ij}$		1.0000	.4080	.6444	-.0001	-.1357	.5775	.1383	.3455	.3624
$\sqrt{n_{ij}}C_{ij}$			1.0000	.3517	.1786	.3966	.7901	.5431	.6203	-.0274
$\sqrt{n_{ij}}L^1_{ij}$				1.0000	-.2965	-.2907	.4179	.0120	-.0687	.2072
$\sqrt{n_{ij}}L^2_{ij}$					1.0000	-.3148	.4038	.6714	.1431	-.0119
$\sqrt{n_{ij}}(L^3_{ij}+L^4_{ij})$						1.0000	.1774	.1235	.4399	-.0797
$\sqrt{n_{ij}}S_{ij}$							1.0000	.6676	.6049	-.0523
$\sqrt{n_{ij}}Y_{ij}$								1.0000	.3289	-.0541
$\sqrt{n_{ji}}E_{ij}$									1.0000	-.2674
$\sqrt{n_{ji}}F_{ij}$										1.0000

these separate analyses are contained in Table 39. An examination of equation (5-64) indicates that there are four variables which have partial regression coefficients which are significantly different from zero at the ten percent level or less. Further examination of the independent variables will indicate whether their statistical role, as exhibited by equation (5-64), is representative of their true role in the empirical model.

The partial regression coefficient of the price variable ($\sqrt{n_{ij}}\ P_{ij}$) is significantly different from zero in equation (5-64) at the ten percent level. Its sign is negative, which corresponds to theoretical expectation. As indicated in Table 39, the removal of those independent variables with simple correlation coefficients of .7 or greater with $\sqrt{n_{ij}}\ P_{ij}$ increase the significance level of $\sqrt{n_{ij}}\ P_{ij}$'s coefficient in the demand model for sites within Remoteness Level V. It is, therefore, suggested that the price variable be maintained in the model for further study.

The total family income variable ($\sqrt{n_{ij}}\ I_{ij}$) has a partial regression coefficient which is statistically different from zero at the 30 percent level. There are no independent variables which have a simple correlation coefficient of .7 or greater; therefore, all variables with a simple correlation coefficient of .6 or greater were removed from equation (5-64). The results in Table 39 indicate that after the above manipulation, the partial regression

Table 39. Analysis of Independent Variables in the Demand Model for Remoteness Level V.

Originally hypothesized equation Eq. (5-64)					Results of statistical analysis of the independent variables					
Variable	Calculated t-value	Significance level	Simple correlation coefficient of variables removed	Variables removed	Partial regression coefficient	Standard error of the coefficient	Calculated t-value	Degrees of freedom	Significance level	R^2
$\sqrt{n_{ij}}P_{ij}$	-2.4368	.10	$r \geq .7$	F_{ij}	-.031566	.010978	-2.8756	5	.05	.988
$\sqrt{n_{ij}}I_{ij}$	1.3480	.30	$r \geq .7$	None						
			$r \geq .6$	L^1_{ij}	.000032	.000021	1.5285	5	.20	.992
$\sqrt{n_{ij}}C_{ij}$	-1.8637	.20	$r \geq .7$	S_{ij}	-2.667759	1.801701	-1.4807	5	.20	.959
			$r \geq .6$	E_{ij}	-2.575885	1.516943	-1.6981	6	.20	.956
$\sqrt{n_{ij}}L^1_{ij}$	.1492	.90	$r \geq .7$	None						
$\sqrt{n_{ij}}L^2_{ij}$	.7926	.50								
$\sqrt{n_{ij}}(L^3_{ij}+L^4_{ij})$	2.9900	.05	$r \geq .6$	I_{ij}, Y_{ij}	-.288593	2.952436	-.0977	6	$\sim$	.986
					.404092	2.446285	.1652	6	.90	.986
					4.860144	1.907604	2.5478	6	.05	.986
$\sqrt{n_{ij}}S_{ij}$	4.0667	.02	$r \geq .7$	C_{ij}	.641842	.167031	3.8426	5	.02	.985
$\sqrt{n_{ij}}Y_{ij}$	-.8495	.50	$r \geq .7$	None						
			$r \geq .6$	L^2_{ij}, S_{ij}	.043614	.083398	.5230	6	.70	.852

Continued on next page

Table 39 Continued.

Originally hypothesized equation Eq. (5-64)					Results of statistical analysis of the independent variables					
Variable	Calculated t-value	Significance level	Simple correlation coefficient of variables removed	Variables removed	Partial regression coefficient	Standard error of the co-efficient	Calculated t-value	Degrees of freedom	Significance level	R^2
$\sqrt{n_{ij}}E_{ij}$	-2.2021	.10	$r \geq .7$	None						
$\sqrt{n_{ij}}F_{ij}$	1.4397	.30	$r \geq .7$	P_{ij}	-1.227129	.696020	-1.7631	5	.20	.980
			$r \geq .6$	None						

coefficient of $\sqrt{n_{ij}}\, I_{ij}$ is still statistically different from zero only at some level greater than ten percent. This indicates that the hypothesized role of $\sqrt{n_{ij}}\, I_{ij}$ in the demand for Remoteness Level V is not significant statistically. Consequently, the total family income variable will not be included in the final model.

The ratio of the number of days taken by recreation units with children to the total number of days ($\sqrt{n_{ij}}\, C_{ij}$) does not exhibit a partial regression coefficient which is statistically significant from zero at the ten percent level or less. This result is true in each equation estimated in the $\sqrt{n_{ij}}\, C_{ij}$ analysis as reflected by Table 39. It is interesting to note that the sign on each of the partial regression coefficients for $\sqrt{n_{ij}}\, C_{ij}$ in the three equations estimated was negative. This gives further evidence to indicate that children may act as a constraint to participation in outdoor activities in the more remote sites. However, little can be concluded about this variable at sites within Remoteness Level V, since the variable does not exhibit statistical significance. Therefore, the $\sqrt{n_{ij}}\, C_{ij}$ will not be kept in the final model.

Only the partial regression coefficient of the rural residence category ($\sqrt{n_{ij}}\, [L^3_{ij} + L^4_{ij}]$) is statistically different from zero at some level less than the ten percent level in equation (5-64). Since there were no independent variables with simple correlation coefficients of .7 or greater with any of the residence variables, those with $r \geq .6$ were removed from equation (5-64). Upon re-estimation of the model with these independent variables removed, the partial regression coefficient of ($\sqrt{n_{ij}}\,[L_{ij}^{3} + L_{ij}^{4}]$) is still the only coefficient which exhibits significance at the prescribed level. One change did occur; the sign on the partial regression coefficient for inside city limits went from a positive in equation (5-64) to a negative in the reestimated equation. Table 40 contains the pair-wise test of differences between the residence variables from the two equations.

The results from the pairwise test, conducted in Table 40, indicate that in both equations the influence of the two urban residence categories ($\sqrt{n_{ij}}\,L_{ij}^{1}$ and $\sqrt{n_{ij}}\,L_{ij}^{2}$) are not statistically different. But both urban categories have coefficients which are significantly different from the coefficient estimated for the rural residence category. Therefore, in the final model $\sqrt{n_{ij}}\,L_{ij}^{1}$ and $\sqrt{n_{ij}}\,L_{ij}^{2}$ will be combined to represent the urban category, and $\sqrt{n_{ij}}\,(L_{ij}^{3} + L_{ij}^{4})$ will be maintained in its present form.

Table 39 indicates that the statistical significance of the coefficients on $\sqrt{n_{ij}}\,S_{ij}$, $\sqrt{n_{ij}}\,Y_{ij}$ and $\sqrt{n_{ij}}\,F_{ij}$ has been only minutely affected by the removal of interrelated variables from the results indicated in equation (5-64). The signs of the coefficients on $\sqrt{n_{ij}}\,Y_{ij}$ and $\sqrt{n_{ij}}\,F_{ij}$ are the reverse of what they were in equation (5-64). This is probably the result of the variables which were

Table 40. Calculated t-values for the Difference Between Partial Regression Coefficients of the Residence Variables in the Demand Equation for Remoteness Level V.

Hypothesis	t-values Equation (5-64)[a]	Equation ($r \geq .6$)[b]
H_o: $\beta_{L^1_{ij}} - \beta_{L^2_{ij}} = 0$	-1.7223	-.8116
H_a: $\beta_{L^1_{ij}} - \beta_{L^2_{ij}} \neq 0$		
H_o: $\beta_{L^1_{ij}} - \beta_{(L^3_{ij} + L^4_{ij})} = 0$	-4.2560***	-3.8827****
H_a: $\beta_{L^1_{ij}} - \beta_{(L^3_{ij} + L^4_{ij})} \neq 0$		
H_o: $\beta_{L^2_{ij}} - \beta_{(L^3_{ij} + L^4_{ij})} = 0$	-3.9639***	-4.8654****
H_a: $\beta_{L^2_{ij}} - \beta_{(L^3_{ij} + L^4_{ij})} \neq 0$		

[a] d.f. = 4.

[b] d.f. = 6.

removed in each case when the model was reestimated. However, neither of these variables exhibit statistical significance and, therefore, will be removed from the model. The $\sqrt{n_{ij}}\, S_{ij}$ will be maintained in the model, based on the evidence presented in this table.

The investment in outdoor recreation equipment variable ($\sqrt{n_{ij}}\, E_{ij}$) has a partial regression coefficient which is statistically significant from zero at the ten percent level in equation (5-64). Its partial regression coefficient has a negative sign which indicates that, within Remoteness Level V, investment in outdoor recreation equipment has a negative effect on the number of recreation days taken by the average income population group. There are no independent variables with a simple correlation coefficient of .7 or greater; therefore, the results from equation (5-64) were accepted to indicate that $\sqrt{n_{ij}}\, E_{ij}$ was a significant determinant of the demand within Remoteness Level V.

Based on the above discussion, the equation (5-66) is hypothesized. The general and empirical forms of the model which are relevant are given in the following equations.

<u>General Model</u>

$$Q_{ij} = e^{\beta_0 + \beta_1 P_{ij} + \beta_2 (L^1_{ij} + L^2_{ij}) + \beta_3 (L^3_{ij} + L^4_{ij}) + \beta_4 S_{ij} + \beta_5 E_{ij} + \varepsilon_{ij}} \tag{5-66}$$

Logarithmic Model

$$\widehat{\sqrt{n_{ij}} \ln Q_{ij}} = -6.169393 \underset{(.012910)}{-.022180} \sqrt{n_{ij}}\, P_{ij}$$

$$\underset{(2.734211)}{-1.020320} \sqrt{n_{ij}}\, (L_{ij}^1 + L_{ij}^2) + \underset{(1.985987)}{3.267634} \sqrt{n_{ij}}\, (L_{ij}^3 + L_{ij}^4) \qquad (5\text{-}67)$$

$$\underset{(.192913)}{+.694583} \sqrt{n_{ij}}\, S_{ij} \underset{(.000431)}{-.001104} \sqrt{n_{ij}}\, E_{ij}$$

$R^2 = .9484$ d.f. = 9

Exponential Model

$$\hat{Q}_{ij} = e^{-3.846700 - .022180 P_{ij} - 1.020320 (L_{ij}^1 + L_{ij}^2) + 3.267634 (L_{ij}^3 + L_{ij}^4) + .694583 S_{ij} - .001104 E_{ij}} \qquad (5\text{-}68)$$

A plot of equation (5-68) through the scatter of observed price-quantity points is given in Figure 34. The net willingness to pay schedule which is obtained from this equation is given in Table 41 and Figure 35. Equation (5-69) is the estimated net willingness to pay schedule obtained from the data generated in Table 41 from equation (5-68).

$$\hat{Q} = e^{6.155 - .022 P} \qquad (5\text{-}69)$$

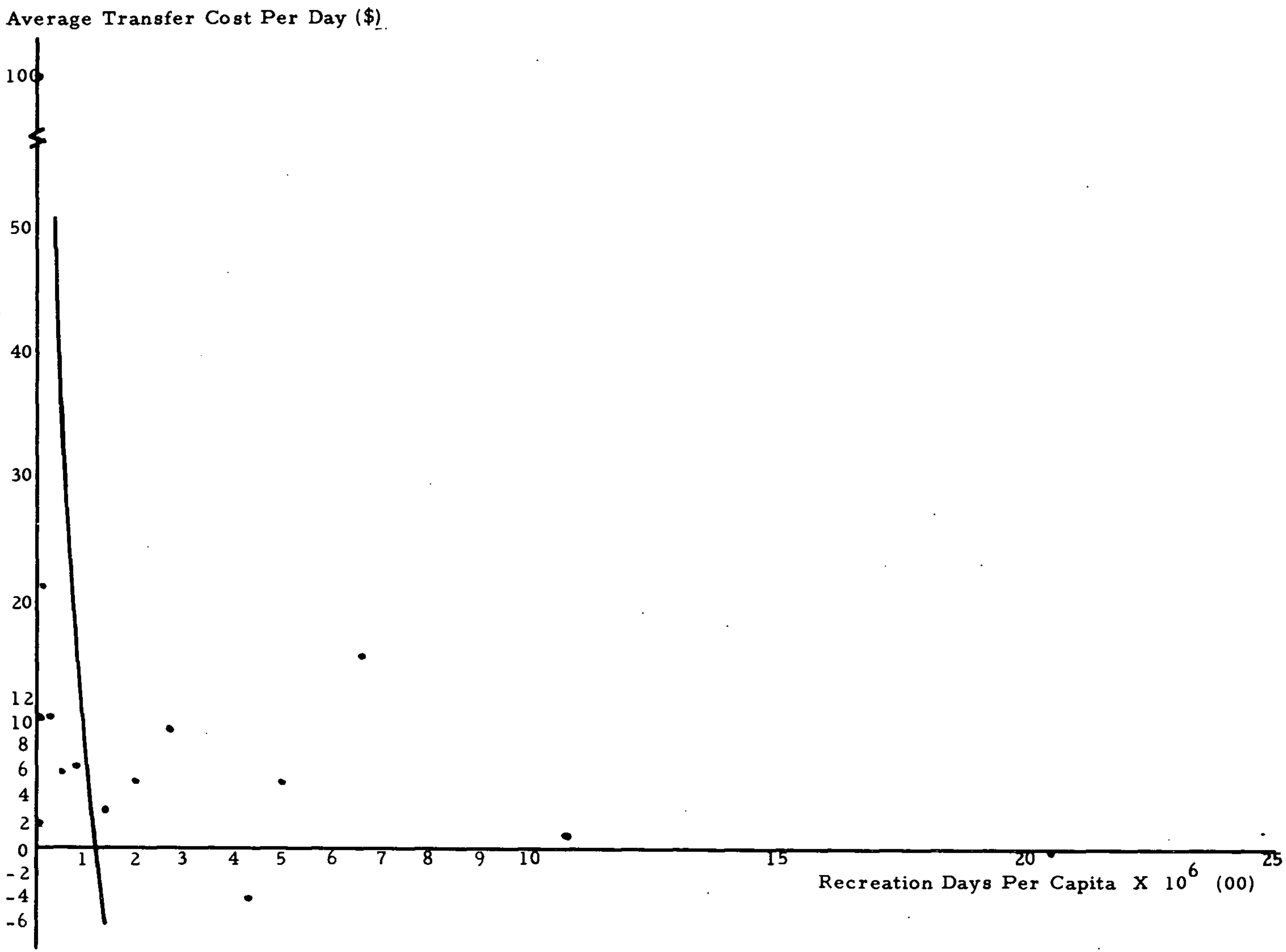

Figure 34. Estimated demand schedule for Remoteness Level V plotted through the average transfer cost--recreation days per capita scatter (Eq. 5-68).

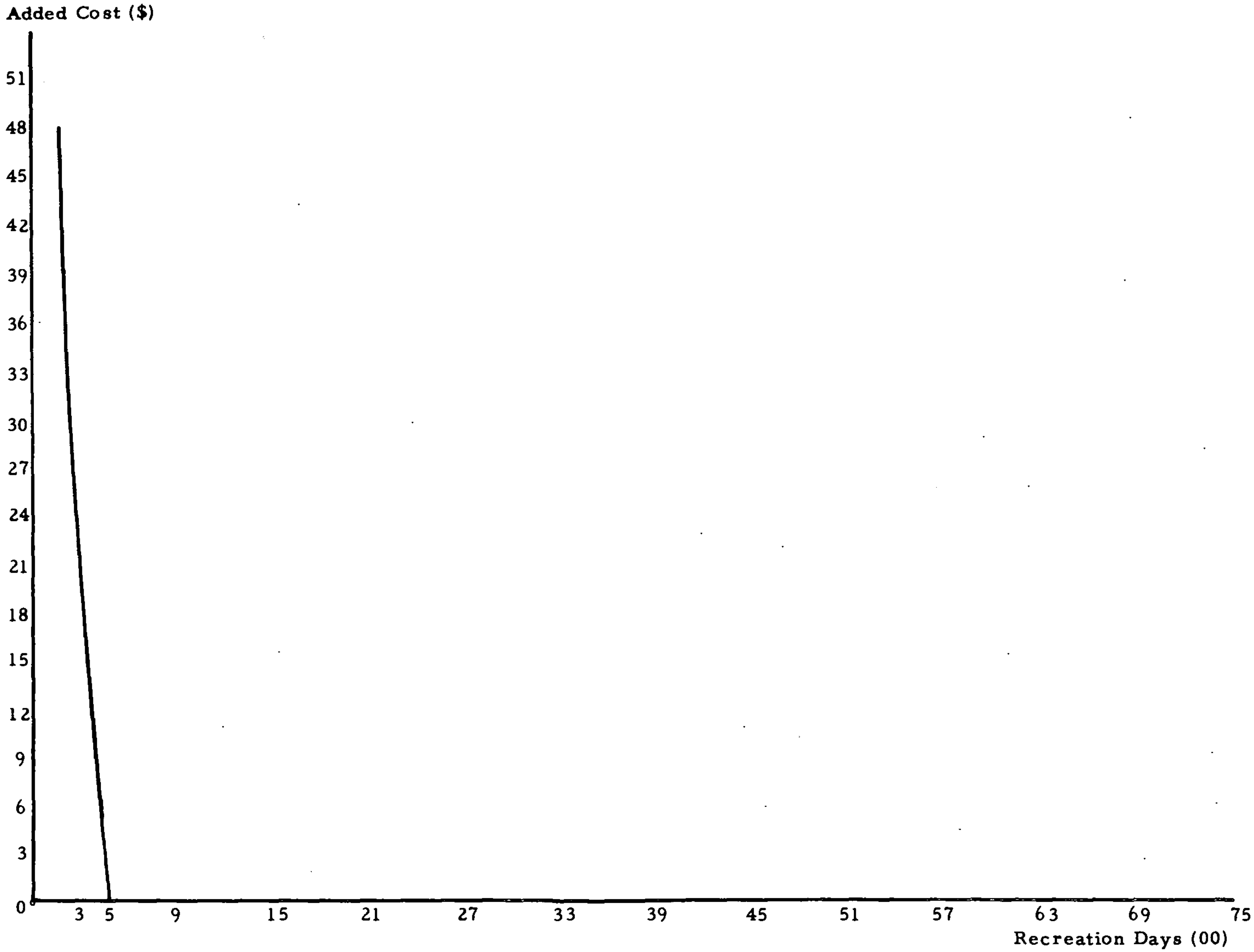

Figure 35. Net willingness to pay schedule for Remoteness Level V (Eq. 5-69).

Table 41. Predicted Total Number of Recreation Days Taken in the Bend Ranger District at Sites Within Remoteness Level V at Various Levels of Increased Average Transfer Cost Per Recreation Day by the Sample of Users.

Increased average transfer cost/day ($)	Total number of recreation days [a/]
0	471
1	461
2	451
3	441
4	431
5	422
6	412
7	403
8	394
9	386
10	377
11	369
12	361
13	353
14	345
15	338
16	330
17	323
18	316
19	309
20	302
21	296
22	289
23	283
24	277
25	271
26	265
27	259
28	253
29	248
30	242
31	237
32	232
33	227
34	222

Continued

Table 41--Continued.

35	217
36	212
37	207
38	203
39	198
40	194
41	190
42	186
43	182
44	178
45	174
46	170
47	166
48	162
49	159

[a/] Rounded to the nearest day.

Integrating equation (5-69), the economic value of the sites within Remoteness Level V derived from the sample is estimated as follows:

$$\int_0^{\infty} e^{6.155 - .022\,P}\, dp = \frac{1}{.022}\; e^{6.155}$$

$$= \$21,519.$$

A comparison of the observed number of recreation days (253) and that predicted by equation (5-68) at zero added cost (471) indicates that the value estimated for the sample is an over estimate.

Statistical Comparison of the Final Demand Equations Estimated for the Five Remoteness Levels

One of the objectives of the study is to compare statistically the final models estimated for the different levels of remoteness. This comparison was suggested as a means to provide evidence that the demands for different levels of remoteness are empirically, as well as conceptually, different.

Without conducting statistical tests, it can be seen that the evidence presented in the preceding sections suggest that a difference exists between the demand equations for each level of remoteness. In none of the equations estimated and examined was the same combination of variables found to be statistically significant. Therefore, none of the equations suggested for further study contain the same variables, which alone suggests that the demand between remoteness levels is different. There are variables common to each of the demand equations estimated and suggested for further study. Comparison between those variables common to each pair of equations would provide further evidence to indicate where the differences between equations exist.

A pairwise comparison between each pair of estimated final demand equations was made by statistically testing the difference between the partial regression coefficients of the variables common to each pair of remoteness levels. The statistical test which was used to make the comparison was a test of the null hypothesis that the partial regression coefficient for a given variable in one remoteness level equation was equal to that estimated for another (H_o: $\beta_i - \beta_j = 0$), against the alternative hypothesis that they were not equal (H_a: $\beta_i - \beta_j \neq 0$). The test statistic used is an F-test given by the following formula. 37/

$$F = \frac{(b_i - b_j)^2}{V\ (b_i - b_j)} \qquad (5\text{-}70)$$

where,

b_i is the estimated partial regression coefficient of the variable of interest in equation i. (i = 1, 2, 3, 4, 5)

b_j is the estimated partial regression coefficient of the variable of interest in equation j. (j = 1, 2, 3, 4, 5)

$V\ (b_i - b_j) = V\ (b_i) + V\ (b_j) - 2\ \mathrm{Cov}\ (b_i,\ b_j)$

$V\ (b_i)$ is the variance of b_i

$V\ (b_j)$ is the variance of b_j

$\mathrm{Cov}\ (b_i,\ b_j)$ is the covariance of $b_i\ b_j$.

For the purposes of this analysis, it was assumed that the

37/ This statistical test was suggested to the author by Dr. Roger Peterson, Department of Statistics, Oregon State University.

covariance between the estimated coefficients was zero. This assumes that the estimated parameters within a given equation are independent of those from some other estimated equation. Since the estimated coefficients arise from different samples, there is a problem in determining the degrees of freedom associated with the F-test given in equation (5-70). Steel and Torrie (1960) give a formula for calculating an approximate t value, to which a calculated t value can be compared when the estimates of the parameters arise from equations with different degrees of freedom. Since the F statistic is the square of the t statistic, the square root of the results obtained from equation (5-70) can be compared to the adjusted t value obtained from the following formula, to determine whether not the partial regression coefficients of the variables compared are statistically different from one another.

$$t' = \frac{W_i t_i + W_j t_j}{W_i + W_j} \qquad (5\text{-}71)^{38/}$$

38/ This test is used when the variances of two populations from which parameters are compared are not equal. In this case, the variance of the error terms between equations range from a high 7.75 in Remoteness Level III's equation to a low of 2.48 in Remoteness Level V's equation. Therefore, for this analysis, the variances were assumed not to be equal. Another characteristic of this test is pointed out by Steel and Torrie (1960, p. 81). "This approximation errs slightly on the conservative side in that the value of t' required for significance may be slightly too large." (Steel and Torrie, 1960, p. 81) where,

> t' is the adjusted t value accounting for both degrees of freedom.
>
> t_i is the table t value at a specified level of significance associated with the degrees of freedom from equation i. (i = 1, 2, 3, 4, 5)
>
> t_j is the table t value at a specified level of significance associated with the degrees of freedom from equation j (j = 1, 2, 3, 4, 5)
>
> $W_i = \frac{s_i^2}{d.f.}$ s_i^2 is the standard error of the parameter under consideration in equation i.
>
> $W_j = \frac{s_j^2}{d.f.}$ s_j^2 is the standard error of the parameter under consideration in equation j.

The results of the pairwise test between equations from the five remoteness levels are given in Table 42. The numbers given in Table 42 are the calculated F-values using the test statistic given by equation (5-70). A star by the figure indicates that there is a statistical difference at the ten percent level or less between the estimated partial regression coefficients of the variable for the two equations considered.

Table 42. Calculated F Values Between the Partial Regression Coefficients of Variables Which are the Same Between the Equations Estimated for the Five Remoteness Levels.

Hypothesis	Remoteness Level I Equation			
	Remoteness II	Remoteness III	Remoteness IV	Remoteness V
H_o: $\beta_{ip} - \beta_{jp} = 0$ H_a: $\beta_{ip} - \beta_{jp} \neq 0$	.969743	5.916988*	.734286	14.939035*
H_o: $\beta_{iI} - \beta_{jI} = 0$ H_a: $\beta_{iI} - \beta_{jI} \neq 0$	.000465	---	---	---
H_o: $\beta_{ic} - \beta_{jc} = 0$ H_a: $\beta_{ic} - \beta_{jc} \neq 0$	.068565	6.183735*	---	---
H_o: $\beta_{iL^1} - \beta_{jL^1} = 0$ H_a: $\beta_{iL^1} - \beta_{jL^1} \neq 0$	.004772	1.041118	---	---

Continued

Table 42--Continued

H_o: $\beta_{iL^2} - \beta_{jL^2} = 0$	.642592	.2.373615	---	---
H_a: $\beta_{iL^2} - \beta_{jL^2} \neq 0$				
H_o: $\beta_{i(L^1 + L^4)} - \beta_{j(L^1 + L^2)} = 0$	---	---	---	---
H_a: $\beta_{i(L^1 + L^2} - \beta_{j\,(L^1 + L^2)} \neq 0$				
H_o: $\beta_{i(L^3 + L^4)} - \beta_{j\,(L^3 + L^4)} = 0$	.012079	1.765438	.108216	.155130
H_a: $\beta_{i(L^3 + L^4)} - \beta_{j(L^3 + L^4)} \neq 0$				
H_o: $\beta_{iS} - \beta_{jS} = 0$	---	1.052081	.718479	4.672022*
H_a: $\beta_{iS} - \beta_{jS} \neq 0$				

Continued

Table 42--Continued

H_o: $\beta_{iY} - \beta_{jY} = 0$ H_a: $\beta_{iY} - \beta_{iY} \neq 0$	---	---	---	---
H_o: $\beta_{iE} - \beta_{jE} = 0$ H_a: $\beta_{iE} - \beta_{jE} \neq 0$	---	---	---	7.537960*
H_o: $\beta_{iD} - \beta_{jD} = 0$ H_a: $\beta_{iD} - \beta_{jD} \neq 0$	1.274120	.894173	---	---
H_o: $\beta_{iU} - \beta_{jU} = 0$ H_a: $\beta_{iU} - \beta_{jU} \neq 0$	---	6.907525*	---	---
H_o: $\beta_{iF} - \beta_{jF} = 0$ H_a: $\beta_{iF} - \beta_{jF} \neq 0$	.289402	.033046	---	---

Continued

Table 42--Continued

Hypothesis	Remoteness level II			Remoteness level III		Remoteness level IV
	III	IV	V	IV	V	V
$H_o: \beta_{iP} - \beta_{jP} = 0$ $H_a: \beta_{iP} - \beta_{jP} \neq 0$	3.558190*	.000002	15.303411*	2.431416	1.723404	8.645685*
$H_o: \beta_{iI} - \beta_{jI} = 0$ $H_a: \beta_{iI} - \beta_{jI} \neq 0$	---	---	---	---	---	---
$H_o: \beta_{iC} - \beta_{jC} = 0$ $H_a: \beta_{iC} - \beta_{jC} \neq 0$	6.743512*	---	---	---	---	---
$H_o: \beta_{iL^1} - \beta_{jL^1} = 0$ $H_a: \beta_{iL^1} - \beta_{jL^1} \neq 0$	2.192931	---	---	---	---	---

Continued

Table 42--Continued.

$H_o: \beta_{iL^2} - \beta_{jL^2} = 0$	1.555176	---	---	---	---	---
$H_a: \beta_{iL^2} - \beta_{jL^2} \neq 0$						
$H_o: \beta_{i(L^1+L^2)} - \beta_{j(L^1+L^2)} = 0$	---	---	---	---	---	.874952
$H_a: \beta_{i(L^1+L^2)} - \beta_{j(L^1+L^2)} \neq 0$						
$H_o: \beta_{i(L^3+L^4)} - \beta_{j(L^3+L^4)} = 0$	2.80144	.295040	.394548	1.866621	1.749196	.007632
$H_a: \beta_{i(L^3+L^4)} - \beta_{j(L^3+L^4)} \neq 0$						
$H_o: \beta_{iS} - \beta_{jS} = 0$	---	---	---	.130568	.939289	2.556994
$H_a: \beta_{iS} - \beta_{jS} \neq 0$						

Continued

Table 42--Continued.

H_o: $\beta_{iY} - \beta_{jY} = 0$	---	---	---	---	---	---
H_a: $\beta_{iY} - \beta_{jY} \neq 0$						
H_o: $\beta_{iE} - \beta_{jE} = 0$	---	---	---	---	---	---
H_a: $\beta_{iE} - \beta_{jE} \neq 0$	---	---	---	---	---	---
H_o: $\beta_{iD} - \beta_{jD} = 0$	.043478	---	---	---	---	---
H_a: $\beta_{iD} - \beta_{jD} \neq 0$						
H_o: $\beta_{iU} - \beta_{jU} = 0$	---	---	---	---	---	---
H_a: $\beta_{iU} - \beta_{jU} \neq 0$						
H_o: $\beta_{iF} - \beta_{jF} = 0$	.386913	---	---	---	---	---
H_a: $\beta_{iF} - \beta_{jF} \neq 0$						

An examination of Table 42 indicates significant statistical differences between the estimated demand equations for the five remoteness levels suggested for further study. The coefficient of the price variable (P_{ij}) was observed to be statistically significant in each of the estimated demand equations. A significant difference was observed between the price coefficients estimated for Remoteness Level V and each of the other remoteness levels, with the exception of Remoteness Level III. The coefficient on the price variable in the demand equation estimated for Remoteness Level III can be found to be statistically different from the coefficients on price estimated in Remoteness Level II and Remoteness Level I.

No statistically significant difference was observed between the price coefficients estimated for Remoteness Levels I and II. A pairwise difference was observed to exist between the price coefficient estimated for Remoteness Levels IV and V. The coefficient estimated for Remoteness Level IV was not observed to be significantly different statistically with any of the other four estimated price coefficients.

An indication of the above results can be seen in the price elasticities which were calculated for each remoteness level. [39/]

Remoteness Level I	η	$= -2.132$
Remoteness Level II	η	$= -1.251$
Remoteness Level III	η	$= -.655$
Remoteness Level IV	η	$= -1.155$
Remoteness Level V	η	$= -.291$

Another significant result contained in the table concerns C_{ij}, the proportion of days taken by recreation units with children. C_{ij} was found to be a significant variable in Remoteness Levels I, II and III. These pairwise tests of difference indicate that there is no statistically significant difference between C_{ij}'s coefficient in Remoteness Levels I and II. However, the evidence indicates that the coefficient of C_{ij} estimated in Remoteness Level III is statistically different from those estimated in Remoteness Levels I and II. This suggests that the role of C_{ij} in the demand for sites within Remoteness Level III is different from the role estimated for this variable within Remoteness Levels I and II. It will be recalled that in the estimated equation for Remoteness Level III,

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39/ The price elasticity formula used is

$$\eta = \frac{\delta Q}{\delta P} \cdot \frac{P}{Q}$$

when

$$Q = e^{b_0 + b_1 P}$$

The elasticity estimate becomes (footnote continued on next page)

the sign on the partial regression coefficient estimated for C_{ij} was negative, which is the reverse of the results obtained in the other two equations.

The partial regression coefficients estimated on the years of formal education variable (S_{ij}) in Remoteness Levels I and V are shown to be statistically different at the ten percent level or less on the basis of the test conducted. No pairwise difference between the estimated coefficients from the other possible pairwise comparisons were observed.

Investment in outdoor recreation equipment (E_{ij}) and potential density of use (U_{ij}) were included in the final models of only two of the equations estimated for the remoteness levels. E_{ij} was included in the final models estimated for Remoteness Levels I and V. The pairwise tests of difference given in Table 42 indicate that the coefficients estimated for these two equations are significantly different at the ten percent level or less. This implies that the influence of E_{ij} within these two models is different. A similar result is observed between the coefficients of the potential density

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39/ cont.

$$\eta = \frac{\left(e^{b_0 + b_1 P}\right) b_1 P}{Q} = b_1 P$$

of use (U_{ij}) variable in the equations estimated for Remoteness Levels I and III.

The remaining comparisons between the coefficients of variables within the models show no difference statistically.

CHAPTER VI

IMPLICATIONS AND CONCLUSIONS

This chapter is divided into two sections. In the first section, methodological implications arising from the thesis are considered. These will focus on both economic and statistical considerations. In the second section, the resulting policy implications will be treated. This discussion will focus on the practical problems faced by the natural resource administrators.

Methodological Conclusions

Economic Interpretation

This study was initiated by drawing on previous research efforts undertaken in the study of the demand for outdoor recreation. An effort was made to expand on the existing knowledge in this area by examining in detail the determinants of the demand for outdoor recreation in a forest environment. It was believed at the outset of the research that this approach would be methodologically interesting and, if successful, would provide some needed practical information. Using as a basis the prior information available from other studies and the methodological considerations discussed in Chapter II, the variables contained in Column 1 of Table 43 were

Table 43. Variables Hypothesized Prior to and Resulting from the Study, with Expected Signs, to be Significant in Explaining the Demand for a Resource-based Facility.

(1) Variables hypothesized prior to the study	(2) Variables hypothesized resulting from the study	(3) Hypothesized signs resulting from the study
Price	Price	Negative
Income	Income	Positive
Children in the recreation unit	Children in the recreation unit	Positive
Place of residence	Place of residence	
a. Inside city limits	a. Inside city limits	Positive
b. Suburbs	b. Suburbs	Positive
c. Rural nonfarm	c. Rural	Positive
d. Rural farm		
Education	Education	Positive
Occupation	Occupation	Positive
Camping experience	Camping experience	Positive
Investment in outdoor recreation equipment		
Level of site development	Level of site development	Positive
Potential density of use at the site	Potential density of use at the site	Positive
Fishing success	Fishing success	Positive

hypothesized as important determinants of the demand for forest recreation.

The results obtained in this study, it is hoped, are an addition to the understanding of the demand for outdoor recreation. Evidence obtained in the study should provide some basis for the more complete development of the theory in this subject area. In an effort to be helpful to subsequent research efforts, the variables and the expected signs which this research suggests deserve further testing are given in Columns 2 and 3, respectively, of Table 43. Each of these will in turn be discussed. It is recognized that, in some instances, the statistical results upon which the hypotheses are based are somewhat ambiguous. An investigation of these can be made by reviewing Chapter V.

The results arising from this study about the significance of price and income in the demand for outdoor recreation vary little from previous studies. The only inferences that might be of importance concern income. Statistically, the income variable does not appear to be as significant an explanatory variable in the model as previous research efforts may have suggested. These results could have arisen because the income levels of families observed in this study were high. The mean income level of the recreation units observed was \$9, 907. Such a high mean income for recreation units participating in outdoor recreation activities at resource-based facilities located at a distance from population centers, such that travel is involved, suggests that participation is primarily an activity of the medium and high income groups.

Price and income in the traditional theory of consumer behavior generally enter the demand model via the budget constraint. Other of the variables which have been considered in this study were visualized to enter the decision framework of the consumer via the utility function. How these variables influence the demand for outdoor recreation can be suggested from the results obtained.

Although not significant statistically in the initially hypothesized model, the existence of children within the recreation unit does appear to have a positive effect upon the demand for resource-based facilities. This indicates that the suggestion made in Chapter II about family group participation in outdoor recreation has some validity. This conclusion, however, was not consistent when the resource-based facility was stratified on the basis of remoteness. The inference which could be drawn about the influence of children in the recreation unit upon the recreation unit's decision framework, given the measurement used in this analysis, suggests that the effect of children on the demand for outdoor recreation moves from positive to negative. That is, as one moves from less remote to more remote sites, the influence of children upon the recreation unit's decision framework changes.

The evidence indicates that at the more accessible sites within a resource-based facility, the existence of children within the recreation unit influences the demand for outdoor recreation positively. However, at more remote levels within a resource-based facility, the existence of children may act as a constraint upon outdoor recreation activities. It may be that the level of development at the more easily accessible sites is more conducive to total family group participation, or that the members of the recreation unit which participate in the more remote areas can reach such areas from the more accessible sites within a resource-based facility. Therefore, the children within the unit participate in the activities available at these sites and the other members of the unit operate from these sites as a base of activities. These results can best be explained by considering the utilities of all members of the decision unit.

It was mentioned previously that because of mass communication and improved transportation facilities, a greater similarity exists between urban and rural society than in the past. An effort was made in this study to reflect the relationship of this observation to participation in outdoor recreation by incorporating in the model the place of residence of the recreation units from each income population group. The measurement problems associated with these variables have been discussed. Albeit, some relevant observations may be helpful to future research efforts.

A general conclusion which may be stated from the results obtained in the study is that a difference between the effect of urban and rural residences on the demand for outdoor recreation in the equations estimated was observed. Little evidence was available to suggest that the role of the place of residence was variable across remoteness levels. Although the effect of residence appears to be positive on the demand models, the size of this effect is different between residence categories.

No difference was observed within the models estimated between the effects exhibited by the two rural categories, rural nonfarm and rural farm, on the demand for outdoor recreation at resource-based facilities. Although evidence was available to suggest that one of the two rural residence categories was significant in the demand models estimated, no statistical difference between these estimated parameters was observed. This result was true except in the models estimated for Remoteness Level III, where neither of the two rural residence categories indicated significance in the model. These analyses suggest that participation in outdoor recreation by those recreation units which reside in rural areas is affected little by whether these recreation units reside on a farm or in a rural community.

The results were not as consistent between the two urban categories. A statistical difference was observed between the two urban categories, inside city limits and suburbs, in the model for the total facility. The results indicated that those recreation units residing inside city limits had a greater effect on the demand for outdoor recreation at the resource-based facility than those recreation units having residences within suburbs. Similar results were indicated by the analysis conducted in Remoteness Levels II and III. Although in Remoteness Level I a difference was indicated between the two urban categories, the influence by those units arising from suburban residences appears to be greater than those which resided inside city limits.

No statistical difference was observed between the two urban categories in the demand equations estimated for Remoteness Levels IV and V. No difference here indicates that at the more remote levels, the influence of urban residences is invariant on the demand for outdoor recreation at resource-based facilities.

In the demand model estimated for the total facility, a statistical difference was observed between the influence of residences in suburbs and rural nonfarm areas. These results suggest that recreation units residing in rural nonfarm residences have a greater influence on the demand for outdoor recreation at a resource-based facility than do recreation units residing in suburban areas. A similar result was observed in Remoteness

Level II. No difference between these two residence areas was observed in Remoteness Levels III and IV. In Remoteness Level I, the evidence indicates that the influence of recreation units residing in suburban areas are greater than those residing in rural nonfarm areas. The rural residence categories were combined in Remoteness Level V and the results suggested that the influence from the rural categories were different from the two urban categories. A difference between the effect of inside city limits residence and rural residence was not observed in any of the other models estimated.

To summarize the results concerning the effect of residence on the demand for outdoor recreation at a resource-based facility:

(1) No difference was observed between the influence of the two rural residence categories in the demand models estimated.

(2) Differences were observed between the urban residence categories in the demands estimated for the total facility and Remoteness Levels I, II and III with no differences observed in Remoteness Levels IV and V.

(3) Variability was observed in the differences between the two urban categories and the two rural categories within each of the models estimated.

(4) Across remoteness levels, no difference was observed in the influence residence has between the remoteness levels.

A positive relationship was observed between the years of formal education and the number of recreation days taken per capita from an income population group. This positive relationship was exhibited in each of the experimental models estimated for the separate analyses conducted. Education was a statistically significant variable in the originally hypothesized models for Remoteness Levels IV and V.

The positive role of education in the demand models, undoubtedly, reflects partially the increase in income which generally is associated with higher levels of education. This can be evidenced by the fact that a positive relationship was observed between income and the years of formal education in the study. A change in perspective as to what are desirable leisure time pursuits may also be reflected in the observation that as years of education increase, so does participation in outdoor recreation. Additional evidence to this point may be indicated by the strong statistical results observed between recreation days per capita and the years of formal education in the last two remoteness categories. The role of education within these two categories is much stronger in the demand model than was exhibited in the other three remoteness categories. The affect education has on the demand for outdoor recreation at these two remoteness levels was not statistically different.

Across other remoteness levels, a difference in the influence of education was observed between Remoteness Levels I and V. The coefficients between other pairs of remoteness level equations were not statistically different. In the case of Remoteness Levels I and V, the size of the influence of education on the quantity variable is larger in the model for Remoteness Level V.

An indication of a positive relationship between the demand for outdoor recreation and the years of formal education may have substantial relevance in the projection of outdoor recreation demand in the future at resource-based facilities. If the trend toward an increased percentage of the population having a greater degree of formal education continues, the incorporation of this variable in future demand models may be of increasing importance. In addition, speculating on the basis of the observed difference between the influence of education in the demands for Remoteness Levels I and V and the strength of the education variable in demand models for Remoteness Levels IV and V, some inference may be drawn indicating the character of the type of facility which may become the most desirable as levels of education increase within society.

Within the statistical analyses presented in Chapter V, the role of education and occupation was assumed, on the basis of the evidence, to be causally the same variable within the demand models. However, results from the experimental models constructed do indicate, in general, a positive relationship between the dependent variable and occupation. It was suggested that the limited inferences about social status reflected by occupation might also be drawn from education, since the two variables appear to be analogous in the models. To this extent, it is theorized that a positive relationship exists between social status and the days of recreation taken at resource-based facilities. Although this observation is very speculative, additional attempts to incorporate the influence a desire for social status has on the demand for outdoor recreation would appear justifiable. Such information would possibly reflect the influence the group within which a person or family associates has upon the decision-framework of the family. How great is "keeping up with the Jones" effect in terms of the demand for outdoor recreation facilities?

The years of camping experience is suggested for future research because within the model for the total resource-based facility, this was an important variable. However, the results of the analyses of the levels of remoteness did not suggest that the years of experience was important, except in the model for

Remoteness Level I. The reason why years of experience camping may not have appeared to be an important influence on the demand in the more remote levels may be due to the fact that age may act as a physical constraint upon participation in recreation activities at the more remote levels. Although the desire for participation in outdoor activities is still substantial, the age constraint may only allow participation in the less strenuous activities. Some further attention to this possibility needs to be given to this influence within demand models, if the tendency toward long life and earlier retirement continues.

Investment in outdoor recreation equipment was originally included in the model on the argument that the amount of equipment owned reflected the individual's preference for certain types of outdoor recreation at the time the equipment was purchased. It was suggested that the ownership of outdoor recreation equipment entered the demand function of the recreation unit in some way other than through its effect on the variable cost. The statistical results obtained in the analysis for the total Bend Ranger District were confusing. It was difficult to determine whether the effect in the demand model was positive or negative. The results obtained from the different remoteness level analyses were somewhat more conclusive.

Investment in outdoor recreation equipment was maintained in the final models for Remoteness Levels I and V. The pairwise test of difference between the coefficients estimated in each of the two equations indicates they are significantly statistically different from one another. These results indicate that the role of investment in outdoor recreation equipment at the least and most remote sites are different. In Remoteness Level I the sign on the partial regression coefficient is positive, which indicates a positive influence on the demand for days at these sites. The coefficient is negative in the equation estimated for Remoteness Level V. This result suggests that as the investment in outdoor recreation equipment increases, the number of days taken per capita decreases; or, restated, the demand schedule shifts to the left.

The results obtained in Remoteness Level I correspond to the hypothesis set forth in Chapter II. As the recreation units increase their investment in equipment, it can be expected that more recreation days will be taken. However, for those recreation units observed within Remoteness Level V, the opposite results occurred. Such a result could infer that users of sites within the most remote areas in resource-based facilities are primarily over-night or short-stay users, and require only a minimum amount of equipment. Those recreation units that use the more sophisticated equipment and stay longer in the remote areas, such as considered in this study, are small in number compared to the short-stay users.

The results obtained in this study make it difficult to draw any substantive conclusions about the role of the investment in outdoor recreation equipment in the demand model for outdoor recreation. The only suggestion which can be made on the basis of this study, is that future attempts to identify the role of capital investment in equipment, with respect to recreation activities, could possibly provide insights into its role in the demand for outdoor recreation facilities.

Evidence presented in the analysis suggests that the level of site development is positively associated with the number of recreation days taken per capita. Such a conclusion would indicate that as development increased within the total facility, the participation would increase. The same positive effect on the demand model was observed in the equations estimated for Remoteness Levels I, II and III. The conclusion reached in the case of development in this study has to be considered cautiously, because in none of the equations was development observed to be significant in the originally hypothesized equation. A test of difference between the pairs of coefficients estimated in the final equations for the three remoteness levels reveals no significant statistical difference between the coefficients. This indicates that the influence of site development is invariant in its effect on the demand for these three remoteness levels.

No evidence was obtained which indicated that the level of site development was a significant determinant of the demand for sites within Remoteness Level IV. Development was deleted from inclusion in the demand model estimated for Remoteness Level V. Consequently, no inference is possible on its influence within the demand model estimated.

It was argued in Chapter II that the utility from a commodity may be a function of the characteristics of that commodity rather than the commodity itself. Therefore, a good's characteristic(s) imparts satisfaction to the consumer and, in this way, is a reflection of the quality the consumer sees in the good. Generalizing from this argument, the positive influence of site development in the demand for the total resource-based facility and the three remoteness levels may infer that site development is an indication of quality within these groupings of sites. That is, in these four site groupings, recreation units find site development an appealing characteristic. Little can be said about the kinds of development these results suggest indicate quality, since only a gross measurement of development per unit was employed.

The second site characteristic considered in the study which may provide an indication of quality is potential density of use at the site. This site characteristic reflects the possibility of interaction with other recreation units at a site. Within the model estimated for the total resource-based facility, the coefficient on the density of use variable was statistically significant and possessed a positive sign. Drawing on this result, it can be indicated that when the total facility was considered, an increase in the density of use at sites would increase the number of days taken per capita from an income population group. These results imply that the possibility of interaction with other recreation units appears to be a desirable characteristic at a site.

Within the analyses conducted on remoteness levels, the potential density of use variable was found to exhibit possible significance in only the demand models estimated for Remoteness Levels I, II and III. In each of these models, the results indicate this variable exhibits a positive relationship with the number of days taken per capita. In the model for Remoteness Level I, the sign on the coefficient was negative in the final model; however, in the experimental model with interrelated variables removed, the coefficient was positive. A tentative hypothesis which arises from these results is that in the less remote sites, the interaction with other recreation units is a desirable characteristic of a site.

The potential density of use variable was deleted from the demand model estimated for Remoteness Level V. In the model estimated for Remoteness Level IV, the results do not suggest potential density of use as an important variable in the model.

Another quality indicator of a site incorporated into the model was the degree of fishing success at the site. In the model estimated for the total facility, this variable's coefficient was statistically significant with a positive sign. This result suggests that within a resource-based facility, the fishing success at sites is positively related to days taken per capita from an income population group. Therefore, it might be inferred that within these types of outdoor recreation facilities, the higher the fishing success, the greater the quality of the site to the recreation units observed.

The results obtained from the final models estimated across the remoteness levels do not appear to agree with the results obtained in the model for the total facility. The coefficients estimated in these final models exhibit a negative sign; this would indicate the opposite of the conclusion reached above in the discussion of the total facility. However, in none of the models is the statistical evidence as strong as obtained in the demand model for the total facility. An examination of the analysis of the independent variables in the case of each of the remoteness levels indicates that when the interrelated variables are removed, the fishing success variable has a positive sign. This result gives greater validity to the argument that the greater the degree of fishing success at sites, the greater the quantity of days taken at these sites.

A final site characteristic which has been discussed indirectly throughout the preceding discussion of the variables, but has not been directly discussed is accessibility or remoteness of the site. Used as a basis for identifying the quantity variable more specifically, the evidence obtained in the study suggests that a difference exists between the demands for the remoteness levels as defined. This difference is reflected by the fact that in none of the equations estimated do the same combinations of variables appear significant in the model. In addition, a significant statistical difference was observed between the influence of the variables common to the equations in certain cases.

It can be inferred from these results that since evidence exists to indicate a difference between the demands defined across a resource-based facility, further efforts to specify the quantity variable are warranted. Such attempts may provide increased meaning to the character of the outdoor recreation commodity.

In general, it can be inferred that there is some validity to the hypothesis that certain unique facility characteristics impart different economic values to the recreational services derived from them. This can be seen by examining the value estimates obtained from each level of remoteness on a per unit basis.

	Value/visit
Remoteness Level I ------	$ 82.53
Remoteness Level II ------	$ 101.55
Remoteness Level III -----	$ 260.70
Remoteness Level IV -----	$ 148.16
Remoteness Level V -----	$ 406.02

These results may also be inferred from the price elasticities of demand estimated for each level of remoteness. The results obtained from the study suggest that as the sites become more remote, users are less responsive to changes in price. These results are not completely consistent, since the price elasticity of demand at the means for Remoteness Level III is more inelastic than the elasticity estimate obtained for Remoteness Level IV.

An attempt has been made in this study to observe the economic behavior of the recreation unit at a resource-based facility. The behavior observed was associated with characteristics relative to the recreation unit and the characteristics of the sites at which these recreation units were observed. An effort was made to theoretically suggest how these characteristics entered the make-up of the utility function. From the utility function is derived the demand function, which was estimated in this study and can be used to predict behavior of the observed recreation units.

Statistical Implications

During the course of this inquiry, a consistent problem was observed with estimated demand equations used to predict the net willingness to pay schedule from which the value estimates are derived. The estimated equations appeared to consistently over predict the net willingness to pay schedule. In the discussions for each of the models, it was observed that a good portion of the over prediction was due to large error in only a few of the income population group predictions. However, due to the aggregative nature of the model used to obtain the net willingness to pay, the error which exists in the prediction of any income group's participation will be in existence at every point on the net willingness to pay schedule. Similarly, it appears that any bias (Edwards, 1962) which may arise from the transformation will also be carried over to each point defining the net willingness to pay schedule.

It is realized that the use of some form of estimating procedure other than ordinary least squares analysis may, in part, be the answer to the problems encountered in this study. However, it also appears that the way in which the net willingness to pay schedule is obtained in the model compounds whatever error may exist in the estimated model. One solution to this problem is the development of a model which allows the estimation of the value estimates directly from the estimated equation.

Policy Implications

In this section, attention will be given to those results arising from the study which may be of interest to the natural resource administrator.

1. The evidence collected in this study suggests that heterogeneity exists in the demands for sites within different remoteness levels of a resource-based facility. Consequently, when decisions designed to affect use are made concerning the facility these differences should be considered. Policy decisions such as user fees, etc., may have a different effect on the users of sites within one remoteness level compared to the users of another remoteness level.
2. The evidence of this thesis indicates that the value generated from a resource-based facility does not arise evenly throughout the facility. The value generated by sites at the different levels of remoteness are different.
3. Knowledge of characteristics of the user population at a resource-based facility may provide additional information on the level of use and the use patterns within the facility. Of particular interest here is

the observed influence of children on the demand for the facility by recreation units. As the remoteness of sites increase within the facility, it appears that the existence of children within the recreation units has an inverse relationship with the number of days taken.

The place of residence may affect the level of use and the use patterns within a facility. Within the total facility, it appears that users from inside city limits have a greater affect on the total demand than those from suburbs. However, the indications are that users from rural nonfarm areas affect the demand for the total facility the greatest.

The inference drawn that education appears to have a greater influence on the users' demand in the more remote areas of a resource-based facility suggests that if higher levels of education are anticipated, the establishment and development of new sites may be considered accordingly.

4. Site characteristics do appear to have an influence on the participants' demand for a resource-based facility. The evidence appears to suggest that the three site characteristics, development, potential density of use

and fishing success, have a positive influence on use in a resource-based facility. It is also a tentative conclusion from the study that these three characteristics are quality indicators in the less remote areas. Little evidence about their role in the more remote areas was ascertained.

Consideration of the above four implications for natural resource administrators may provide some insights into management problems they encounter.

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APPENDICES

APPENDIX 1

D-3 OREGON STATE UNIVERSITY 8/11/67

Hello, I'm ______________________. I'm working on a recreation survey for Oregon State University and would like to ask you a few interesting questions if you don't mind.

1 - ____________Number — Including yourself, how many persons are there in your party which is camping or stopping at this particular place?

2 - Is your party mainly a family group, or is it a group of unrelated individuals, such as friends or neighbors?
- 1 Family group (ask 2a, 2b, 2c)
- 2 Unrelated indiv. (ask 2d, 2e)
- 3 Other (Explain) (ask 2d, 2e)

2a - What members of your family make up your present party?

2b - What is the approximate age of each member of the family who is with you?

Members	Approximate age of each
1 Husband	__________
2 Wife	__________
3 Children	____________(Age of each one)
4 Other (Who?) __________	__________
Other (Who?) __________	__________

2c - ________ Age — What is the age of your oldest son or daughter?

2d - How many men or women are there in your group? Any children with your group?

2e - What is the approximate age of each member of your group?

Number		Approximate age of each
________	Men	__________
________	Women	__________
________	Child(ren)	__________

ASK OF EVERYONE

3 - ____________________________ May I ask where you presently live--the city or town and state?
(City or Town) (State)

3a - ____________________(Pop.) What is the approximate population of your city or town?

4	- 1 Inside city limits - 2 Suburb of city - 3 Rural - not on farm - 4 Rural - on a farm - 5 Other (Describe below)		(HAND RESPONDENT CARD A) Which one of the statements on this card best describes the area where you presently live?
5	- 1 Own 2 Rent 3 Other (What?) __________		Do you own or rent the place in which you are now living?
6	- 1 Single DU 2 Duplex 3 Triplex 4 Apartment (4 units or more) 5 Other (Describe) ______________		Is the place where you presently live a single dwelling unit, a duplex, a triplex, a multiple unit, such as an apartment house, or is it some other type, such as a trailer house?
7	- ________________________ (City or Town) (State)		What was your hometown when you were growing up as a small child? (Between 1 and 8 yrs. of age)
	____________________(Pop.) O D.K.		What was the approximate population of your hometown at that time? Just your best estimate.
8	- 1 Inside city limits 2 Suburb of city 3 Rural - not on farm 4 Rural - on a farm 5 Other (Explain)		(HAND RESPONDENT CARD A) Which one of these statements best describes the area where you lived when you were growing up as a child?
9	- _____________ (Last Grade)		Would you mind telling me the last grade you completed in school?
10	- _____________(Type) _____________Industry		What type of work does the chief breadwinner in the family do? (INT: If not family group, obtain occupation of respondent)
10a	- ______________Years		About how many years have you (has that person) been doing that type of work?
10b	- _____________Occupa. 2 No other occupation		Did you (the chief breadwinner) have any other type of occupation before your (his) present one? (If YES) What?

11	- 1 Overnight here (Skip to 12) 2 Lodge or motel (Ask 11a) 3 Other (Where?) (Ask 11a)	Are you staying overnight at this campsite, or are you staying elsewhere, such as at a lodge or motel?
11a	- 1 Yes 2 No 3 D. K.	Do you plan to come back to this campsite tomorrow?

12 - Usually there are two sides to almost everything. First, what do you like MOST about this particular site, or your camping location? (PROBE!)

Anything else?

13 - Turning to the other side, what do you like LEAST about this particular site, or your camping location? (PROBE!)

Anything else?

14 -

(Name) | (INTERVIEWER: Write in name of campsite)

15 - What types of outdoor recreation or activities do you, personally, enjoy doing the most? (INT: Obtain specific types)

16 - What types of outdoor recreation or activities does your family enjoy doing the most as a group?

17 -

Most	Next	Third	
1	1	1	-- Fishing
2	2	2	-- Boating
3	3	3	-- Water skiing
4	4	4	-- Swimming
5	5	5	-- Camping
6	6	6	-- Hunting
7	7	7	-- Sightseeing
8	8	8	-- Photography
9	9	9	-- Hiking
0	0	0	-- Riding
X	X	X	-- Other (Name)
	Y	Y	-- No other

(HAND RESPONDENT CARD B)

Which one of these would you say is your main type of activity while you are stopping or staying in this particular area?

Which comes next?
Which is third?

18 - ______________ Days		How many days have you been staying at this particular site or location?
______________ More days		How many more days, if any, do you plan to stay at this location or site?

19 - 1 Visit particular area 2 Visit Deschutes Forest 3 Stopped off (Ask 19a) 4 Other (Explain)	(HAND RESPONDENT CARD C) Which one of these statements best describes your travel plans so far as this area is concerned?

(ASK ONLY OF THOSE WHO STOPPED OFF ENROUTE -- Code 3 in #19)

19a - ______________ (City or town) (State)	What is the main destination of your trip -- the city or town and state?

(ASK OF EVERYONE)

20 - 1 A lot 2 Quite a bit 3 A little 4 Not at all 5 Cannot remember	How often would you say you went camping as a child--a lot, quite a bit, a little or not at all?

21 - ______________ Years	All in all, how many years have you, yourself, been camping? Just your best estimate.

22 - 1 Van camper 2 Truck camper 3 Trailer camper 4 Tent trailer 5 Outside frame tent 6 Tube tent 7 Umbrella tent 8 Ordinary tent	9 Sleeping bag 0 Stove 1 Lantern 2 Cooler 3 Back pack 4 Other	(HAND RESPONDENT CARD D) Which of the following types of camping equipment are you using on this trip? If there are any other major items not listed, please give us those, too.

ASK ONLY OF THOSE USING A STOVE IN #22 (Code 0)

23 - 1 Yes - open fire 2 Always used stove 3 Did not cook before	You mentioned that you are using a stove on this trip. Before you used a stove, did you cook over the open fire when camping?

ASK ONLY OF THOSE WHO ARE USING A BACK PACK IN #22

24 - 1 Army surplus (Rucksack) 2 Board frame 3 Contour frame 4 Other (Explain)	You mentioned a minute ago that you are using a back pack on this trip. Which of these types of back packs are you using? (HAND RESPONDENT CARD E)
24a - ____________ Before present ______________ ______________ 0 No previous use	What type, or types, of back packs, if any, have you used previously. Please list in order of use--the type you used just before your present one, the one before that, and so on.

ASK OF EVERYONE

25 - 1 Van camper 2 Truck camper 3 Trailer camper 4 Tent trailer 5 Outside frame tent 6 Tube tent 7 Umbrella tent 8 Ordinary tent 9 Sleeping bag 0 Stove 1 Lantern 2 Cooler 3 Back pack 4 Other (Name) 5 No other type	(HAND RESPONDENT CARD D) Thinking of your adult life, are there any of these types of equipment which you have used in the past which you are no longer using?
26 - 1 Van camper 2 Truck camper 3 Trailer camper 4 Tent trailer 5 Outside frame tent 6 Tube tent 7 Umbrella tent 8 Ordinary tent 9 Sleeping bag 0 Stove 1 Lantern 2 Cooler 3 Back pack 4 Other (Name) 5 No plans to buy	Looking at the card again (CARD D), do you happen to have any plans to buy any of these types of equipment within the next year or so? (IF YES) Which one, or ones?

(INTERVIEWER: Refer to #19. If either code 1 or code 2 is circled, use the first (a) wording below. If either code 3 or 4 is circled, use second (b) wording.)

27 - (a) To help the University figure out how valuable camping is to the state, I'd like to ask you about your expenditures from your home to this area. To help you remember, let me ask separately for the items on my list. Please include the costs of your entire group as best possible.

(b) To help the University figure out how valuable camping is to the state, I'd like to ask you about your expenditures involved in stopping off here--that is, how much extra it cost to stop off here. To help you remember, let me ask separately for the items on my list. Please include the costs for your entire group as best possible.

Item:	How Much (Extra) to site
Food while traveling, including restaurants	$__________
Food and liquor while camping	$__________
Lodging while traveling..................	$__________
Campground fee, if any	$__________
Lodge or motel rental while in this area ..	$__________
Boat rental	$__________
Boat launching	$__________
Gasoline and oil for boat	$__________
Boat equipment, such as life preservers, fire extinguishers, etc.	$__________
Motor or boat maintenance and repairs for trip	$__________
Fishing tackle rental	$__________
Bait for fishing	$__________
Trailer or camper rental	$__________
Tent rental	$__________
Stove rental	$__________
Clothing for trip	$__________
Souvenirs or similar items	$__________
Film and supplies for camera	$__________
Car maintenance and repairs for trip	$__________
Gasoline and oil for car	$__________

Any other items not mentioned thus far?
(If YES, list each one on back of questionnaire and give amount to site.

28 - All in all, about how much do you expect to spend on this entire trip (for stopping off at this point on your trip)? $________

29 - Again, let me ask you about some of the equipment you are using. Are you using a boat on this trip?

(If YES) Do you own the boat? (INTERVIEWER: follow the same procedure for each item on list. This is, ask first if the item is being used on this trip and, if yes, if the item is owned. Then, <u>for each item owned</u>, ask questions 29a and 29b.

29a - What year did you purchase ____________________?

29b - Would you please tell me the approximate purchase price of __________________?

<u>Item:</u>	29a - Own? (X - if YES)	29b - Year purchased	29b - Approximate cost
Boat	________	________	$________
Boat trailer	________	________	$________
Fishing tackle	________	________	$________
Van camper	________	________	$________
Truck camper	________	________	$________
Trailer camper	________	________	$________
Tent trailer	________	________	$________
Outside frame tent (pop-up tent)	________	________	$________
Umbrella tent	________	________	$________
Tube tent	________	________	$________
Ordinary tent, such as pup tent........	________	________	$________
Back pack	________	________	$________
Sleeping bag (if more than one, list)	________	________	$________
Stove	________	________	$________
Lantern	________	________	$________
Cooler	________	________	$________

Any other types of camping equipment I haven't mentioned? (If YES, list and obtain necessary information.)

30 -	1	(a)	Under $2, 000	
	2	(b)	$2, 000 - $3, 999	(HAND RESPONDENT CARD F)
	3	(c)	$4, 000 - $5, 999	
	4	(d)	$6, 000 - $7, 999	Would you please look at this card and tell me which one of these groups best fits your total family income for last year?
	5	(e)	$8, 000 - $9, 999	
	6	(f)	$10, 000- $11, 999	
	7	(g)	$12, 000- $13, 999	
	8	(h)	$14, 000- $15, 999	
	9	(i)	$16, 000- $17, 999	Just call your answer by letter, please.
	0	(j)	$18, 000- $19, 999	
	X	(k)	$20, 000 or over	

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31 - 1 Male	1	Under 21 years of age	
2 Female	2	21 - 29 years	
	3	30 - 39	Age and sex of respondent
	4	40 - 49	
	5	50 - 59	
	6	60 or over	

______________ ______________ Phone number of respondent
(Area code) (Number) (for verification purposes)

X I hereby certify this interview was actually taken with the person described above, and represents a true and accurate account of the interview.

______________________ ______________, 1967
(Interviewer's Signature) (Date)

COMMENTS ON INTERVIEW (if any)

(a) -	1 High 2 Medium 3 Low 4 D. K.	How would you rate the recreation value of this particular location -- high or low? (INT: Do not include "medium" in questioning, but circle if given)
(b) -	1 Very noisy 2 Quite noisy 3 Not too noisy 4 Not at all noisy 5 D. K.	How noisy is this particular site--not at all noisy, not too noisy, quite noisy, or very noisy?
(c) -	1 Very convenient 2 Quite convenient 3 Not too convenient 4 Not at all convenient 5 D. K.	How much, if any, is this particular location convenient to water sports, such as fishing, swimming, or boating--very convenient, quite convenient, not too convenient, or not at all convenient?
(d) -	1 A lot 2 Quite a bit 3 A little 4 None at all 5 D. K.	How much privacy, if any, do you feel you have at this particular site--a lot, quite a bit, a little, or none at all?
(e) -	1 Very friendly 2 Quite friendly 3 Not too friendly 4 Not at all friendly 5 D. K.	How friendly are the campers at this particular location--not at all friendly, not too friendly, quite friendly, or very friendly?
(f) -	1 Very beautiful 2 Quite beautiful 3 Not too beautiful 4 Not at all beautiful 5 D. K.	How beautiful is this particular site--not at all beautiful, not too beautiful, quite beautiful, or very beautiful?
(g) -	1 Very convenient 2 Quite convenient 3 Not too convenient 4 Not at all convenient 5 D. K.	How convenient is this particular location to your present home--very convenient, quite convenient, not too convenient, not at all convenient?
(h) -	1 Very interested 2 Quite interested 3 Not too interested 4 Not at all interested 5 D. K.	How interested are you in returning to this particular site next year--not at all interested, not too interested, quite interested, or very interested?

(i) -	1 Very safe 2 Quite safe 3 Not too safe 4 Not at all safe 5 D. K.	How much, if any, do you feel this location is safe for children--very safe, quite safe, not too safe, or not at all safe?
(j) -	1 Very clean 2 Quite clean 3 Not too clean 4 Not at all clean 5 D. K.	How clean is this particular location--not at all clean, not too clean, quite clean, or very clean?
(k) -	1 Better developed 2 All right as it is 3 Not as well developed 4 D. K.	Some people like a camp site that is well developed with quite a few conveniences, while others like a camp site that is more primitive. Do you personally, think this camp site should be better developed or not as well developed?

APPENDIX 2

Table 1. Number of Recreation Days and Units Observed in the Sample by Distance Zone, State and County.

Distance zone	State	County	Recreation days	Recreation units
1	Oregon			
		Deschutes	283	49
		Crook	21	3
		Jefferson	18	4
2	Oregon			
		Benton	84	10
		Lane	544	61
		Linn	67	11
		Marion	72	23
		Hood River	3	1
		Harney	2	1
		Klamath	11	5
		Wasco	64	3
3	Oregon			
		Clackamas	104	18
		Douglas	32	9
		Jackson	49	8
		Lincoln	26	4
		Multnomah	875	98
		Polk	16	2
		Washington	84	17
		Yamhill	355	9
	Washington			
		Clark	24	5
4	Oregon			
		Clatsop	2	1
		Columbia	5	2
		Tillamook	14	2
		Coos	207	13
		Curry	19	1

Table 1--Continued.

		Josephine	67	2
		Umatilla	31	4
		Union	2	1
	California			
		Humboldt	32	3
		Shasta	6	2
		Mendocino	5	1
		Butte	11	2
		Placer	8	1
	Washington			
		Benton	9	1
		Cowlitz	8	1
		Grays Harbor	4	1
		King	11	3
		Pierce	2	1
		Snohomish	4	1
	Idaho			
		Nez Perce	3	1
	Nevada			
		Washoe	6	1
5	California			
		Alameda	72	10
		Contra Costa	8	2
		Marin	32	4
		Napa	31	2
		Sacramento	199	5
		San Francisco	6	2
		San Joaquin	21	2
		San Mateo	58	5
		Santa Clara	85	10
		Santa Cruz	4	1
		Sonoma	21	1
		Stanislaus	23	4

Table 1--Continued.

	Idaho			
		Custer	3	1
6	California			
		Kern	6	1
		Los Angeles	274	22
		Orange	57	8
		Riverside	33	4
		San Bernardino	42	2
		San Diego	4	2
		Santa Barbara	29	2
		Tulare	26	1
		Ventura	5	2
	Montana			
		Cascade	3	1

Table 2. Sites and the Number of Days Taken at Each by Remoteness Levels.

Site (campground, resort, shelter or trail)	Remoteness Level I	Remoteness Level II	Remoteness Level III	Remoteness Level IV	Remoteness Level V
Cultus Lake North Unit			36		
Browns Creek				26	
West Cultus					170
Little Cultus			31	81	
Meadow		8			
Charlton Lake Shelter					
Southfork Shelter					2
Swampy Lakes Shelter					1
Swede Ridge Shelter					
Green Lakes Trail				47	
Muskrat Lake Shelter					
Six Lakes Trail					33
Irish and Taylor Lakes			4	3	
Tumalo Falls			2		
Cultus Lake			47		
Cultus Lake Resort	94				
Little Fawn		23			
South		14			
Elk Lake	80				
Point	43				
Mallard Marsh				35	
Beach	26				
Elk Lake Lodge	170				
Crane Prairie	530				
Cow Camp			45		

Continued

Table 2--Continued.

Lava Lake		319		
Little Lava Lake				17
North Wickiup		360		
Gull Point				185
North Twin Lake			104	
South Twin Lake	260			
Sheep Bridge			190	
Twin Lakes Resort	31			
Quinn River	104			
Rock Creek			635	
Benham Falls				
Big River	45			33
Bull Bend			5	
Pringle Falls			14	
River			17	
Deschutes Bridge				17
Mile			160	
Devil's Garden	26			
Devil's Lake	67			
Soda Creek			43	
Satan Creek	9			
Todd Lake			25	
Upper Campground				
Lava Island				
Aspen MDF				1
Slough				
Fall River		14		
Island Meadow Trail-3				
Mirror Lakes Trail-20				

Table 3. Types and Number of Vehicles in the Sample Used to Calculate the Average Gas, Oil and Maintenance Cost Per Mile.

Vehicle type or combination	Number observed in sample a/	Average gas, oil and maintenance cost per mile
		($)
Van camper	9	.0493
Truck camper and trailer camper	9	.1081
Truck camper and boat and trailer	21	.0524
Truck camper	47	.0564
Trailer camper and boat and trailer (2 cars)	20	.1154
Trailer camper	128	.0695
Tent trailer	18	.0616
Car or truck and boat and trailer	54	.0606
Car or truck	158	.0521

a/ The total of this column will not sum to 480 because 15 of the observations did not fit into any of the defined vehicle categories.

Table 4. Total Replacement Cost, Number of Units and Per Unit Replacement Cost by Site in the Bend Ranger District.

Site (Campground, resort, shelter or trail)	Total replacement cost a/ ($)	Number of units b/	Per unit replacement cost ($)
Cultus Lake North Unit	17,654	43	410.56
Browns Creek	2,004	6	334.00
West Cultus	60,803	12	5,066.92
Little Cultus	4,226	10	422.60
Meadow	7,164	13	551.08
Charlton Lake Shelter	1,052	1	1,052.00
Southfork Shelter	1,182	1	1,182.00
Swampy Lakes Shelter	1,052	1	1,052.00
Swede Ridge Shelter	1,052	1	1,052.00
Green Lakes Trail	602	1	602.00
Muskrat Lakes Shelter	676	1	676.00
Six Lakes Trail	736	1	736.00
Irish and Taylor Lakes	634	1	634.00
Tumalo Falls	4,636	4	1,159.00
Cultus Lake	11,044	18	613.56
Cultus Lake Resort c/	106,610	23	4,635.22
Little Fawn	8,952	35	255.77
South	11,380	24	474.17
Elk Lake	148,276	28	5,295.57
Point	42,614	11	3,874.00
Mallard Marsh	9,371	17	551.24
Beach	39,050	5	7,810.00
Elk Lake Lodge c/	44,390	21	2,113.81
Crane Prairie	12,975	32	405.47
Cow Camp	6,274	37	169.57
Lava Lake	21,561	38	567.39
Little Lava Lake	1,984	9	220.44
North Wickiup	18,925	38	498.03
Gull Point	22,114	56	394.89
North Twin Lake	2,390	6	398.33
South Twin Lake	180,713	56	3,227.02
Sheep Bridge	6,308	15	420.53
Twin Lakes Resort c/	53,390	12	4,449.17
Quinn River	14,403	40	360.08
Rock Creek	7,686	32	240.19

Continued

Table 4--Continued.

Benham Falls	1,602	5	320.40
Big River	6,210	5	1,242.00
Bull Bend	1,520	3	506.67
Pringle Falls	1,498	4	374.50
River	887	4	221.75
Deschutes Bridge	4,680	12	390.00
Mile	2,090	5	418.00
Devil's Garden	2,496	8	312.00
Devil's Lake	3,202	9	355.78
Soda Creek	1,498	2	749.00
Satan Creek	746	4	186.50
Todd Lake	7,015	20	350.75
Upper Campground	2,288	5	457.60
Lava Island	934	1	934.00
Aspen MDF	736	1	736.00
Slough	882	1	882.00
Fall River	1,872	2	936.00
Island Meadow Trail-3	618	1	618.00
Mirror Lakes Trail-20	744	1	744.00

a/ Source: (U.S. Forest Service, 1968a)

b/ Source: (U.S. Forest Service, 1968c)

c/ The data for the resorts were obtained from public assessment records of the Deschutes County Assessor's office.

Table 5. People at One Time Capacity, Number of Developed Acres and Potential Density of Use at Sites Within the Bend Ranger District.

Site Campground, resort, shelter or trail	People at one time capacity a/ (PAOT)	Number of developed acres	Potential density of use
Cultus Lake North Unit	165	15	11.0
Browns Creek	30	2	15.0
West Cultus	60	4	15.0
Little Cultus	50	9	5.6
Meadow	65	12	5.4
Charlton Lake Shelter	6	1	6.0
Southfork Shelter	6	1	6.0
Swampy Lakes Shelter	6	1	6.0
Swede Ridge Shelter	6	1	6.0
Green Lakes Trail	3	1	3.0
Muskrat Lakes Shelter	6	1	6.0
Six Lakes Trail	50	1	50.0
Irish-Taylor Lakes b/	3	1	3.0
Tumalo Falls	40	3	13.3
Cultus Lake	105	4	26.2
Cultus Lake Resort	200	7	28.6
Little Fawn	20	12	1.7
South	120	11	10.9
Elk Lake	165	11	15.0
Point	75	3	25.0
Mallard Marsh	85	15	5.7
Beach	45	3	15.0
Elk Lake Lodge	200	16	12.5
Crane Prairie	160	5	32.0
Cow Camp	185	13	14.2
Lava Lake	254	11	23.1
Little Lava Lake	45	3	15.0
North Wickiup	300	12	25.0
Gull Point	290	21	13.8
North Twin Lake	30	8	3.8
South Twin Lake	280	24	11.7
Sheep Bridge	75	20	3.8
Twin Lakes Resort	40	6	6.7
Quinn River	200	20	10.0

Continued

Table 5--Continued.

Rock Creek	160	13	12.3
Benham Falls	25	5	5.0
Big River	25	5	5.0
Bull Bend	15	8	1.9
Pringle Falls	20	3	6.7
River	20	2	10.0
Deschutes Bridge	60	11	5.5
Mile	25	3	8.3
Devil's Garden	40	9	4.4
Devil's Lake	45	4	11.2
Soda Creek	10	1	10.0
Satan Creek	20	1	20.0
Todd Lake	100	10	10.0
Upper Campground	25	3	8.3
Lava Island	5	2	2.5
Aspen MDF	6	2	3.0
Slough	25	3	8.3
Fall River	10	4	2.5
Island Meadow Trail-8	3	1	3.0
Mirror Lakes Trail-20	3	1	3.0

a/ Source: (U.S. Forest Service, 1968b)

b/ This is an estimate of the PAOT and number of developed acres.

Table 6. Average Fish Caught Per Hour by Site in the Bend Ranger District.

Site (Campground, resort, shelter or trail)	Average fish caught/ hour a/
Cultus Lake North Unit	.2498
Browns Creek d/	0
West Cultus	.2498
Little Cultus b/	1.1907
Meadow	.6721
Charlton Lake Shelter	.4076
Southfork Shelter c/	3.3333
Swampy Lakes Shelter c/	.6875
Swede Ridge Shelter d/	0
Green Lakes Trail e/	.5918
Muskrat Lake Shelter	2.4688
Six Lakes Trail b/	.6556
Irish-Taylor Lakes b/	.7248
Tumalo Falls	.6875
Cultus Lake	.2498
Cultus Lake Resort	.2498
Little Fawn	1.2541
South	.2771
Elk Lake	1.2541
Point	1.2541
Mallard Marsh	.2771
Beach	1.2541
Elk Lake	1.2541
Crane Prairie	.5465
Cow Camp b/	.5480
Lava Lake	.9132
Little Lava Lake b/	.9472
North Wickiup	.2925
Gull Point	.2925
North Twin Lake	.8467
South Twin Lake	.8618
Sheep Bridge d/	0
Twin Lakes Resort	.8618
Quinn River c/	.5465
Rock Creek	.5465
Benham Falls	.6721

Continued

Table 6--Continued.

Big River	.6827
Bull Bend	.6827
Pringle Falls	.6827
River	.6827
Deschutes Bridge	.7895
Mile	.7895
Devil's Garden d/	0
Devil's Lake	1.0994
Soda Creek e/	.7713
Satan Creek	.7713
Todd Lake	.3886
Upper Campground d/	0
Lava Island	.6721
Aspen MDF	.6721
Slough	.6721
Fall River	1.0173
Island Meadow Trail-3 d/	0
Mirrow Lakes Trail-20 d/	0

a/ Source: Oregon State Game Commission annual report (1958-1967)

b/ Several lakes, rivers or streams were adjacent to the site, therefore, the average fish caught per hour for all adjacent bodies of water was used.

c/ Several lakes, rivers or streams were adjacent to the site but data was available for only one, therefore, its creel census data was used in constructing the average.

d/ No adjacent bodies of water or if the site was adjacent to a body of water it was not open to fishing during 1967.

e/ No creel census data was available for the body of water adjacent to the site. However, data for a body of water with similar characteristics was available and the data from this body of water was used as an estimate.

Table 7. Number of Recreation Days and Units Observed in the Sample at Each Remoteness Level by Distance Zone and Income Population Group.

Distance zone	Income population group	Remoteness Level I Recreation days	Remoteness Level I Recreation units	Remoteness Level II Recreation days	Remoteness Level II Recreation units	Remoteness Level III Recreation days	Remoteness Level III Recreation units
1							
	Under $2,000	0	0	67	1	0	0
	2,000- 3,999	2	1	0	0	0	0
	4,000- 5,999	2	1	29	2	2	1
	6,000- 9,999	24	9	14	4	24	6
	10,000-14,999	37	6	0	0	0	0
	15,000 & over	0	0	3	1	7	1
2							
	Under $2,000	--	--	--	--	--	--
	2,000- 3,999	56	1	2	1	50	4
	4,000- 5,999	12	3	0	0	14	3
	6,000- 9,999	50	11	54	9	310	16
	10,000-14,999	75	15	22	6	25	7
	15,000 & over	11	4	0	0	5	3
3							
	Under $2,000	0	0	0	0	4	1
	2,000- 3,999	3	1	13	2	91	1
	4,000- 5,999	124	2	5	2	4	1
	6,000- 9,999	375	35	49	12	264	18
	10,000-14,999	158	32	64	9	111	9
	15,000 & over	65	9	16	1	14	3

Continued

Table 7--Continued.

4						
Under $2,000	3	1	19	1	6	1
2,000- 3,999	0	0	5	1	10	2
4,000- 5,999	2	1	77	2	6	1
6,000- 9,999	30	5	5	2	167	6
10,000-14,999	32	7	30	2	14	3
15,000 & over	18	4	0	0	0	0
5						
Under $2,000	--	--	--	--	--	--
2,000- 3,999	0	0	0	0	0	0
4,000- 5,999	2	1	21	1	86	3
6,000- 9,999	186	7	14	6	37	3
10,000-14,999	24	6	29	6	30	2
15,000 & over	21	3	14	1	35	4
6						
Under $2,000	--	--	--	--	--	--
2,000- 3,999	0	0	4	1	0	0
4,000- 5,999	65	2	26	1	0	0
6,000- 9,999	68	10	106	1	6	3
10,000-14,999	7	1	36	4	23	4
15,000 & over	33	4	14	3	13	3
Totals	1,485	182	738	82	1,358	109

Table 7--Continued.

Distance zone	Income population group	Remoteness Level IV		Remoteness Level V	
		Recreation days	Recreation units	Recreation days	Recreation units
1					
	Under $2, 000	1	1	0	0
	2, 000- 3, 999	66	1	0	0
	4, 000- 5, 999	5	2	0	0
	6, 000- 9, 999	9	3	11	6
	10, 000-14, 999	4	1	8	3
	15, 000 & over	1	1	6	5
2					
	Under $2, 000	--	--	--	--
	2, 000- 3, 999	0	0	12	2
	4, 999- 5, 999	0	0	1	1
	6, 000- 9, 999	39	9	11	3
	10, 000-14, 999	28	6	50	6
	15, 000 & over	4	1	16	4
3					
	Under $2, 000	0	0	0	0
	2, 000- 3, 999	12	1	0	0
	4, 000- 5, 999	0	0	0	0
	6, 000- 9, 999	45	9	63	7
	10, 000-14, 999	32	4	20	6
	15, 000 & over	7	1	26	4

Continued

Table 7--Continued.

4				
Under $2,000	0	0	0	0
2,000- 3,999	0	0	0	0
4,000- 5,999	0	0	0	0
6,000- 9,999	6	2	8	1
10,000-14,999	0	0	17	2
15,000 & over	0	0	1	1
5				
Under $2,000	--	--	--	--
2,000- 3,999	7	1	0	0
4,000- 5,999	0	0	0	0
6,000- 9,999	0	0	0	0
10,000-14,999	37	4	0	0
15,000 & over	20	1	0	0
6				
Under $2,000	--	--	--	--
2,000- 3,999	0	0	0	0
4,000- 5,999	39	1	0	0
6,000- 9,999	3	1	0	0
10,000-14,999	22	2	0	0
15,000 & over	11	2	3	2
Totals	398	54	253	53