THE IDENTIFICATION AND COMPARISON OF PREFERENCES FOR RECREATION LOCATIONS: THE EXAMPLE OF ONTARIO PROVINCIAL PARK CAMPERS

Thesis for the Degree of Ph. D.

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DONALD EMERSON HALLMAN

1973

This is to certify that the

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THE EXAMPLE OF ONTARIO PROVINCIAL PARK CAMPERS

presented by

Donald Emerson Hallman

has been accepted towards fulfillment
of the requirements for

Ph.D degree in Geography

Michael Chubb
Major professor

Date May 9, 1973

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ABSTRACT

THE IDENTIFICATION AND COMPARISON OF PREFERENCES FOR RECREATION LOCATIONS: THE EXAMPLE OF ONTARIO PROVINCIAL PARK CAMPERS

By

Donald Emerson Hallman

In a number of studies examining the spatial characteristics of demand for recreation opportunities, there has been a tendency to adopt direct measures of spatial origin-destination movements of recreation resource users as indicators of recreation demand. This study is based on the assertion that such measures indicate only recreation consumption under the particular spatial pattern of origins and recreational destinations in which the movements occur, not recreation demand. A model is discussed and applied in which spatial movements of recreation resource users are regarded as the outcome of choices among available alternative destinations based on locational preferences independent of particular patterns of destinations. This approach appears capable of revealing a number of characteristics of locational preferences from knowledge of spatial flows within known origin-destination systems.

In the revealed preference approach adopted in this study, movements to recreation destinations were conceptualized as revealing pairwise choices between the destination alternative chosen and each other alternative available for choice. Destinations were grouped into locational types based on their distance-from-origin and site attractiveness attributes, and these locational types constituted the alternatives

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The analysis described above was applied to information on the movements of campers from 54 Ontario origins to 81 Ontario provincial parks. The data employed consisted of a one percent (approximately) sample of campers during the 1966 camping season and a 100 percent sample of 1968 campers. Information on characteristics of campers for the 1966 sample was utilized to formulate camper subgroups which were analyzed for preference differences. The three camper characteristics selected for this purpose included extent of camping experience, length of stay at park, and type of occupation.

Results of the application of the revealed preference model suggest that this approach has considerable utility in indicating preferences underlying patterns of recreation travel. A considerable degree of order was discerned in the preferences of Ontario campers among park destinations, a significant finding since it points to the existence of similarities in preferences, despite obvious variations in choice situations and observed destination choices.

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The scaling of locational preferences of Ontario campers indicated that the more preferred locational types definitely tended to involve shorter distances than less preferred types. Distance appeared to be more strongly related to locational preference than the site attractiveness measures employed. Despite the prominence of the distance-to-destination variable, there was evidence of some degree of substitution between distance and attractiveness, largely involving locational types having short to moderate distances. With respect to temporal aspects, few major differences in preference structure between the 1966 and 1968 camper data were found. This result supports the hypothesis that preferences have considerable stability over time.

The analysis of preference differences among camper subgroups indicated little relationship between observable differences in preference and the camper characteristics under consideration. Only with respect to length of stay did subgroup differences appear to be significantly greater than expected. These results point to the need to further define and measure user attributes having relevance to locational preferences held.

Finally, it was shown that potential exists for applying the revealed preference approach in a predictive campacity as an aid to planning for future development of recreation opportunities. The need for developing improved methods for measuring attractiveness of recreation destinations and for defining locational types was underlined. Once such problems are resolved, future research might well refine and extend the results of this study to other temporal and spatial situations as well as to other forms of recreation pursuits.

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By

Donald Emerson Hallman

A THESIS

Submitted to

Michigan State University

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

Department of Geography

1973

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CHAPTER 1

INTRODUCTION

The Problem

Setting and Objectives

The recent rapid growth in participation in various recreational opportunities has been amply documented by a variety of studies and statistics.[1] Accompanying such growth in participation has been a change in attitude toward recreation as a focus of research, reflected in the following statement:

> The traditional view that human activities in the pursuit of recreation are a form of indulgence having marginal status among the concerns of society is no longer tenable. Indeed the institution of recreation and the action systems that support it (should be) treated . . . as comparable in importance and priority with the social structures centered on production and consumption.[2]

Largely because of the obvious spatial and environmental components of recreational activities, geographers were among the first to demonstrate this change in attitude by embarking on research in recreation.[3]

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[1]Perhaps the best known evidence of such growth is found in reports of the U.S. Outdoor Recreation Resources Review Commission in the early 1960's and subsequent surveys by the Bureau of Outdoor Recreation.

[2]National Academy of Sciences, A Program for Outdoor Recreation Research (Washington: National Academy of Sciences, 1969), p. 1.

[3]Initial research by North American geographers is discussed in a review of recreational geography by McMurry and Davis (K.C. McMurry and C.M. Davis, "Recreational Geography", American Geography: Inventory and Prospect, eds. P.E. James and C.F. Jones (Syracuse: Association of American Geographers, 1954), pp. 251-5.

One evident focus which has developed in recreation research is that of recreational demand. As Knetsch has suggested, merely to know that demand is increasing is not enough. "What is needed is not a collection of miscellaneous facts, but an understanding of the relationships inherent in recreation behavior and the ability to forecast the effects of proposed alternative actions."[1] He goes on to identify a significant problem apparent in many demand studies:

> The trouble arises from a confusion over the difference between demand and consumption. Use or attendance figures are incorrectly called demand, instead of being interpreted as consumption or the interaction of both demand, which certainly exists, and the supply of opportunities, which also exists.[2]

> The single most serious and most fundamental deficiency in most demand surveys and studies is that they do not provide any means of determining how recreational use will respond to changes in supply -- and that, after all, is the portion on which guidance is needed.[3]

The problem is thus seen as one of determining demand characteristics which exist independent of the present supply of opportunities:

> Demand is one element of a system. Analysis of the preference of individuals and groups can indicate the directions and amount of total demand. These, together with the other elements of the system -- the location of recreation places and the way resources are used -- produce a pattern.[4]

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[1]J.L. Knetsch, A Design for Assessing Outdoor Recreation Demands in Canada, A Report to National and Historic Parks Branch, Canada Department of Indian Affairs and Northern Development (Ottawa: 1967), p. 5.

[2]Ibid.

[3]Ibid., p. 7.

[4]Outdoor Recreation Resources Review Commission, Outdoor Recreation for America (Washington: U.S. Government Printing Office, 1962), p. 10.

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It is readily apparent that both demand and supply in recreation have important spatial components. Since many recreation activities cannot be pursued in the immediate vicinity of places of residence, some degree of spatial separation between origins of recreation resource users (demand centers) and locations of recreation opportunities (supply centers) usually exists. Attempts to assess the adequacy of recreation opportunities in meeting demand, then, inevitably include measurement of the extent of spatial separation of demand and supply centers and the flows of the users from origins to recreation destinations.

This dissertation is concerned with certain spatial implications of the problem identified above by Knetsch. A fundamental tenet, providing much of the motivation behind this study, is that the spatial interaction patterns established by recreation resource users (i.e. flows from origins to destinations) are indicative of recreation consumption, not recreation demand. Accordingly, such interaction patterns are closely linked to the specific spatial pattern of origins and recreation opportunities within which they are observed. In order to better understand demand, an attempt must be made to view existing recreation use characteristics outside of the distorting influences of specific configurations of origin and opportunity locations.

Knetsch has suggested that the significance of demand statements lies in their function as "guides to what people actually want"[1] (as opposed to what people are observed to select). This dissertation, then, contributes to recreation demand research by vitue of its concern

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[1] Knetsch, A Design for Assessing Outdoor Recreation Demands in Canada, p. 5.

with the preferences of recreation resource users underlying their choice of recreation destination. The methodology adopted involves the analysis of observed origin-destination interaction patterns viewing these as the outcome of choices among the alternative locations available.[1] Most important to the approach, choices are conceptualized as the result of evaluating available destinations in the light of preferences which are independent of the actual pattern of destinations available to the chooser. The identification of preferences among destination locations (termed "locational preferences")[2] indicating some attributes of underlying demand, comprises the major contribution of the dissertation.

Specific objectives of the dissertation may be stated as follows:

(1) the description and discussion of an approach which appears to be capable of modelling preferences for recreation destinations from data on the spatial movement of recreation resource users.

(3) the application of this preference model to a specific example of recreation interaction employing available empirical data, and the evaluation of the results of this application.

(3) the examination of the contributions and potential uses of the preference model in recreation research.

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[1]"Interaction" here refers to movement of individuals from origins to destinations for recreational purposes.

[2]The term "space preferences" is also used to describe such preferences.

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A Note on the Research Approach

The dissertation concerns the analysis of the behavioral basis of spatial activity. This approach appears to embrace two viewpoints in geographic research, the spatial analytic and the behavioral. By virtue of its concern with spatial patterns and the processes associated with such patterns, the approach may be defined as that of spatial analysis.[1] In emphasizing the relationship between behavioral phenomena and spatial patterns, the approach falls under the heading of "behavioral geography."[2]

Some writers, however, distinguish between the spatial analytic and behavioral approaches on the basis of the types of explanations sought. Olsson, for example, has suggested that the two approaches might be differentiated by their inferences regarding form and process:

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[1]Spatial analysis frequently is defined to include study of the regularities of spatial patterns, identification and analysis of processes influencing and influenced by such patterns, and prediction of future spatial processes and patterns.

[2]As Gould has noted (P.R. Gould, "Methodological Developments Since the Fifties," Progress in Geography, Volume 1, eds. C. Board et al. [London: Edward Arnold, 1969]) the behavioral approach in geography appears to have two emphases -- one, the analysis of the behavioral bases of spatial patterns, and two, the impact of perception of environment on decision making. The first of these foci is exemplified by the papers edited by Cox and Golledge (K.R. Cox and R.G. Golledge, eds., Behavioral Problems in Geography: A Symposium [Evanston: Northwestern University, Department of Geography, Studies in Geography, XVII, 1969]). Research included in the second of these emphases is reviewed in articles by Brookfield (H.C. Brookfield, "On the Environment as Perceived," Progress in Geography, Volume 1, eds., C. Board et al.) and by Wood (L.J. Wood, "Perception Studies in Geography," Transactions, Institute of British Geographers, L (1970), pp. 129-42.)

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> . . . while the spatial analyst attempts to infer individual behavior from knowledge of a given spatial pattern, the behaviorist argues for reasoning the other way around.[1]

If, from the above, it is concluded that spatial analysts attempt to infer behavior solely from spatial pattern while behaviorists attempt inference of spatial pattern solely from behavior, then the dissertation is oriented toward some sort of middle ground between these two extremes. Individual behavior and the spatial patterns relevant to it are viewed as mutually dependent phenomena rather than one considered as dependent on the other. As Rushton has stated concerning the study of urban spatial structure:

> Although the spatial structure of activities in an urban area will reflect both current and past patterns of behavior, explanations of spatial structure based on such patterns of behavior often seem to be tautological since it would appear to be just as reasonable to explain behavior as a function of spatial structure as to explain structure as a function of behavior. The relationship is clearly one of mutual dependence.[2]

The dissertation focuses on what might be termed "spatial behavior", i.e. decision making by individuals about their use of and action in space. The movement of an individual from point A to point B is evidence that a spatial choice has been made, but the decision process, not the movement is spatial behavior.[3]

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[1] G. Olsson, "Inference Problems in Locational Analysis," Behavioral Problems in Geography, eds. Cox and Golledge, p. 14.

[2] G. Rushton, "Behavioral Correlates of Urban Spatial Structure," Economic Geography, XLVII (1971), p. 49.

[3] Rushton (G. Rushton, "Analysis of Spatial Behavior by Revealed Space Preference," Annals of the Association of American Geographers, LIX (1969), pp. 391-402.) suggests making a distinction between "spatial behavior" (procedure by which alternative locations are evaluated and choices made) and "behavior in space" (description of spatial choices made).

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Structure of the Dissertation

The structure of this study follows the general order of objectives already described. The remainder of the introductory chapter reviews relevant recreation research. Chapter II discusses the methodological developments and assumptions on which the preference model is based and outlines the form of the model. The third chapter is concerned with the data requirements of the approach and discusses how these requirements can be met in applying it to a specific case study, the movements of campers utilizing provincial parks in Ontario, Canada. In the fourth chapter, the model is applied to Ontario provincial park camper data and the resulting information on locational preferences is presented and discussed. The fifth chapter discusses the application of the approach to examine differences among groups with respect to locational preferences. Finally, Chapter VI draws conclusions about the preference model and its application, and discusses the implications and logical extensions of the approach.

Reasons for Selecting Provincial Park Campers for the Study

The previous section indicated that the spatial interaction data to be utilized in the application of the preference model concerns the movements of campers to Ontario provincial parks. In view of the many different types of spatial interaction which might have been considered, all

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considered, all under the general heading of recreation,[1] the reasons for selecting this type of interaction are discussed briefly.

Availability of Data. -- The primary reason for employing camper data in the study is that considerably more information has been compiled for this group than for other types of recreational groups. Reasonably detailed data on total numbers of campers, camper days, length of stay etc. have been gathered for a number of years for most publicly-operated campground facilities. Also, for many areas, sample surveys of camping parties provide information about origins of campers, their socio-economic characteristics, purpose of visit and so on. The fact that information is frequently available about the site characteristics of camping parks is also important, since the technique to be employed requires information on destination site characteristics.

For Ontario, a substantial amount of information has been compiled on camping in Ontario provincial parks. User surveys have been carried out periodically since 1964, providing origin-destination information for a sample of campers. While the reliability of some of the survey data has been questioned as will be discussed later, it appears suitable for the purposes of the preference approach. Information

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[1]Needless to say, considerable space could be devoted to defining the term "recreation" since it has been defined in a variety of ways. For the purposes of this study, recreation is identified through a group of recognizable outdoor activities under the assumption that individuals participating in such activities are experiencing recreation. The activity groups commonly included are: driving for pleasure, playing sports, swimming, sight-seeing, picnicking, walking and riding, fishing, boating, hunting, camping, winter sports, and spectator events. (after O.R.R.R.C., Study Report No. 19, National Recreation Survey (Washington: U.S. Government Printing Office, 1962), pp. 108-9.

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[2] M. Chubb,
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concerning the characteristics of Ontario provincial parks is readily available and has been compiled and analyzed to some extent (as noted later). Certain information is available on other recreation pursuits in the province (see Wolfe[1] for example), however it is much less detailed and there are major problems in obtaining data on destination site characteristics.

Neglect of Commercial and Other Public Camping Facilities. -- In discussing the availability of interaction data for Michigan recreation resource users, Chubb has suggested that the lack of information on camping in areas other than state or federal areas constitutes an important restriction on the analysis of camping on a statewide basis.[2] Such a criticism applies equally well to Ontario, where it is estimated that slightly over one-half of all campers in Ontario in 1966 used commercial or other campground facilities as opposed to provincial parks. However, there are several reasons which can be advanced for proceeding without the inclusion of non-provincial park users and opportunities.

It has been argued, for example, that in Ontario, camping facilities other than provincial parks offer a different type of camping opportunity not directly comparable to provincial park camping (e.g. more commercialized in the case of privately-operated facilities, or more

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[1] R.I. Wolfe, Parameters of Recreational Travel in Ontario: A Progress Report (Downsview, Ontario: Ontario Department of Highways Report No. RB111, 1966).

[2] M. Chubb, Outdoor Recreation Planning in Michigan by a Systems Analysis Approach: Part III - The Practical Application of "Program RECSYS" and "SYMAP" (Michigan State University, Department of Resource Development, Recreation Research and Planning Unit, Technical Report No. 2, 1968) p. 10.

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primitive in the case of non-developed wilderness areas).[1] The suggestion is that campers do not lump together all camping opportunities in deciding among alternatives, but rather make a distinction between provincial park opportunities and other facilities. If this hypothesis were verified it would lend support to analyzing provincial park opportunities separately from other opportunities.

The main problem in ignoring other camping opportunities is that in modelling the locational choice process, not all available alternatives and interactions are being considered. However, this would seem to be of importance only if campers frequenting non-provincial park destinations have significantly different locational preferences than do provincial park campers (i.e. that including these campers would affect the overall results considerably). There is little basis for making such an assertion. Even if such a situation was suspected, a good case might be made for keeping these two types of campers separate in the analysis simply because combining them would obscure the significant differences between them.

Aside from the above arguments, the magnitude of the problem of collecting the required information on origin-destination movements and destination site characteristics for the many and frequently smaller non-provincial park opportunities is such that the benefits to the analysis would have to be substantial to justify the additional effort involved.

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[1] R.G.R. Rogers, "An Analysis of Some Elements of Demand for Ontario Provincial Parks" (unpublished Master's thesis, Faculty of Graduate Studies, University of Guelph, 1966), p. 10.

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Thus while from certain standpoints it might be desirable to include in the analysis all camping opportunities in the province, it appears that employing provincial park data alone is justifiable, providing this limitation is recognized in interpreting the results.

Spatial Interaction of Recreation Resource Users - Review of Studies

A number of studies has focused on the interaction patterns of recreation resource users and the basis of choice of recreation destinations. It is pertinent at this point to assess the contribution of such research to the dissertation topic. Each study reviewed has attempted to model certain characteristics of the spatial interaction of users incorporating assumption (often implicit) about their choice behavior. They differ somewhat in their treatment of the locational factor. The first group examined devotes little attention to the influence of destination location on choice behavior of users. The second group refers much more explicitly to location of destination and includes this information in modelling procedures.

Modelling of Destination Selection -- Site Emphasis

Research efforts by Lucas, Lime, Shafer and Thompson, and Hodgson are representative of the first group of studies identified above.[1] All four

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above.[1] All four concern camper utilization of publicly-operated campground facilities (probably the best-documented type of recreation activity). Each has striven to relate use to various campground attributes through the development of mathematical models identifying those variables most closely associated with variations in use. Lucas has examined destination attributes including physical resources, resource quality indices, extent of development and relative location, and their relationship to percentage occupancy of campgrounds in two national forests in Michigan.[2] Lime[3] and Shafer[4] undertook essentially similar studies for campgrounds in Minnesota and New York respectively. Hodgson examined relationships of campground characteristics to average length of stay of camping parties.[5] While these studies will not be discussed in detail here, several observations are in order.

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[1]R.C. Lucas, User Evaluation of Campgrounds on Two Michigan National Forests (St. Paul, Minn.: North Central Forest Experiment Station, U.S.D.A. Forest Service Research Paper, NC-44, 1970).

D.W. Lime, "A Spatial Analysis of Auto-Camping in the Superior National Forest of Minnesota: Models of Campground Selection Behavior" (unpublished Ph.D. dissertation, Department of Geography, University of Pittsburgh, 1969).

E.L. Shafer and R.C. Thompson, "Models that Describe Use of Adirondack Campgrounds" Forest Science, XIV (1968), pp. 383-391.

R.W. Hodgson, "Campground Features Attractive to Michigan State Park Campers" (unpublished Master's thesis, Department of Resource Development, Michigan State University, 1971).

[2]Lucas, User Evaluation of Campgrounds.

[3]Lime, "A Spatial Analysis of Auto-Camping."

[4]Shafer and Thompson, "Models that Describe Use."

[5]Hodgson, "Campground Features."

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Differences in accessibility of camping destinations were either dismissed (as in Shafer's study) or considered only in terms of superficial generalizations (for example the studies by Lucas and Lime). No attempt was made to look at origins of campers frequenting particular campgrounds. Rather, accessibility was measured in general terms, for example the distance from one or two nearby urban concentrations, with the implicit assumption that this measure is representative of accessibility for campers. The validity of such an assumption is questionable.

Each of the studies mentioned above found that only a few campground attributes were useful in accounting for campground use. Some explanatory variables appear self-evident, (for example, that average annual total visitor days is affected markedly by size of campground). Viewed in the context of choice behavior, some variables contributing to "explaining" campground use are puzzling. They appear to suggest that all of the campers had knowledge of rather obscure campground characteristics (for instance, number of islands accessible by motorboat), and employed this knowledge in choosing a destination.

From the above, it is apparent that these studies are not related to the individual decision maker. Rather they have considered aggregates of decisions and have attempted to explain, not by looking at choice procedures, but by establishing associations between these aggregates and environmental characteristics with little regard to how such characteristics enter the decision process.

Shafer offers a clue to a major difficulty in such an approach in his observation about the mutual interdependence between campground size and use:

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> . . . campground size has an organic quality and grows over time in response to inherent physical opportunities and demand. Campground size is not an independent variable in the main, but a summation of many administrative judgements and responses over the course of years.[1]

Thus to attempt to account for use in terms of existing facilities and attributes is to miss the fundamental interdependence between use and many destination characteristics.

It seems illogical to consider destination attributes as being independent of use characteristics, when it is apparent that such independence frequently does not exist. Great care in dealing with interdependence among destination attributes is evident in some studies. Unfortunately similar attention is not given to the interrelationships between the so-called "dependent" variable (i.e. campground use) and the so-called "independent" variables.[2]

In summary, three main points have been made; first, that locational characteristics have been inadequately treated, second, that campground attributes identified as influencing use have not been linked to choice behavior, and third, that use is considered to be dependent on

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[1]Shafer and Thompson, "Models that Describe Use," p. 389.

[2]It might be argued that to clarify the nature of such a relationship is the purpose of such a study. However, the technique commonly employed, regression analysis, does not provide answers to the question of causality of association. Rather, it ascertains the degree of explanation achieved if one variable is assumed to be dependent on one or more variables independent to it. Thus (as in Shafer's study) a correlation coefficient of 0.97 between campground use and campground size can be obtained without considering the possibility of interdependence. Predictions of the use of new or expanded campgrounds on the basis of this size variable might then be made without an adequate understanding of the interrelationship between the two variables.

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campground attributes and consequently the existence of a certain amount of mutual interdependence is ignored.

Modelling of Destination Selections -- Site and Situation Emphasis

The Gravity Model. -- A number of researchers have employed a gravity function to model the spatial interaction of recreation resource users.[1] In this model, interaction ($V_{1,2}$) between two places is represented in terms of some characteristics of the places, frequently their population (P_1 and P_2), and the distance ($d_{1,2}$) between them. The general form of the gravity equation is:

$$V_{1,2} = \frac{k\ (P_1)^x\ (P_2)^x}{d_{1,2}^{\ z}}$$

where k is a constant, and x, y and z are exponents derived through fitting of the equation to available interaction data.

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[1]Cf., E. Ullman and D.J. Volk, "An Operational Model for Predicting Reservoir Attendance and Benefits," Papers, Michigan Academy of Science, Arts and Letters, XLVII (1961), pp. 473-84.

C.C. Crevo, "Characteristics of Summer Weekend Recreational Travel" Highway Research Record, XLIV (1963), pp. 51-60.

Wolfe, Parameters of Recreational Travel.

C.S. Van Doren, "An Interaction Travel Model for Projecting Attendance of Campers at Michigan State Parks: A Study in Recreational Geography" (unpublished Ph.D. dissertation, Department of Geography, Michigan State University, 1967).

H.K. Cheung, A Day-Use Park Visitation Model. Canadian Outdoor Recreation Demand Study, Technical Note No. 1, (Ottawa: National Parks Branch, undated).

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Wolfe, has modified the general form of the gravity function by letting P_1 represent origin population, P_2, the capacity of recreation destination, and d, the origin-destination distances.[1] Introduction of such a capacity measure, varying with type of recreation pursuit, represents an attempt to measure some characteristic of destinations, apart from distance, which might be expected to influence interaction. Employing interaction data for Ontario origins and destinations, Wolfe was able to derive values for the exponents and k in the gravity function for several recreation pursuits including patronage of cottages, provincial parks and commercial resorts. He found substantial variation in these values for the different recreation pursuits examined.

One of the most important restrictions of the gravity model is that it assumes spatial interaction among origins and destinations will not vary with differences in availability of alternative destinations. That is, interaction between a specified type of origin and destination for a given distance will be represented as invariant regardless of the pattern of alternatives which might exist. As Ellis and Van Doren have suggested,[2] interaction more logically might be expected to vary with different spatial systems. In terms of choice behavior, it seems more realistic to conceptualize interaction as a choice among available alternatives, rather than as a choice among the entire range of destination types included in the system, whether available or not (as in the gravity model).

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[1]Wolfe, Parameters of Recreational Travel.

[2]J.B. Ellis and C.S. Van Doren, "A Comparative Evaluation of Gravity and System Theory Models for Statewide Recreational Travel Flows," Journal of Regional Science, VI (1966), pp. 57-70.

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[4]Ellis and Van
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As noted by Rushton,[1] gravity models imply the existence of locational preferences, and the fitting of increasingly complex gravity functions to interaction data represents attempts to more accurately model existing locational preferences.[2] The inefficiencies of such a "trial and error" approach are apparent.

The Systems Model. -- Ellis has applied a systems approach to the modelling of spatial interaction of recreation resource users.[3] The method involves derivation of a set of simultaneous equations which describe all parts of the system including origins, destinations and their linkages. The movement of users in the system is analogous to the flow of water through a distribution network consisting of pumps (demand at origins), pipes (linkages), and cisterns (destinations) of various capacities.

One significant advantage of the systems approach over the gravity model, according to Ellis, is its consideration of the interdependence of alternative destinations.[4] A change in attractiveness of a destination for example, will be reflected in changes throughout the system not identifiable in the gravity model.

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[1]Rushton, "Analysis of Spatial Behavior," p. 396.

[2]R. Malm, G. Olsson and O. Warneryd, "Approaches to Simulations of Urban Growth," Geografiska Annaler, XLVIII B (1966), pp. 9-22.

[3]Michigan State University, Department of Resource Development, Michigan Outdoor Recreation Demand Study (Lansing, Michigan: State Resource Planning Program, Michigan Department of Commerce, Technical Report No. 6, Vol. 1, 1966).

[4]Ellis and Van Doren, "A Comparative Evaluation of Gravity and Systems Theory Models."

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[1] J.B. Ellis, A
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While the gravity model assumes the form of spatial interaction, the systems model assumes only the forms of the system components and computes the resulting interaction. The forms of these components are derived through initial estimates subsequently modified by "tuning" to increase the accuracy of the model's prediction of known interactions. The systems model, unlike the gravity approach, does not employ actual interactions to derive a function to predict interaction under any pattern of destination alternatives. Rather, the systems model considers alternatives available for each origin and derives interaction for each of these patterns. The result is a technique which achieves greater accuracy in modelling spatial interaction than the gravity model, but accomplishes this largely by adjusting the parameters of the model until satisfactory accuracy in representing known flows is achieved. As Ellis has noted subsequently, the ultimate result of adjusting parameters to obtain exact representation of interactions is a model "with absolutely no validity for prediction"[1] since the basis for measuring component influence has been destroyed in the tuning process.

Another characteristic of the systems model is its assumption that distance between origin and destination (measured in terms of time and cost) always has a deterring (frictional) effect. While this assumption appears to be useful in modelling many types of interaction patterns, there is some question as to its utility in modelling the interaction patterns of recreation participants (i.e. travelling to a

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[1] J.B. Ellis, A Systems Model for Recreational Travel in Ontario: Further Results (Downsview: Ontario Department of Highways, Report No. RR148, 1969), p. 15.

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The systems model, then, is tied to the specific spatial pattern of origins and destinations that exist. Relevant to the goal of representing locational preferences independent of particular origin-destination patterns, this model does not appear to make a significant contribution. No generalizations of preferences from interaction patterns are achieved.

Summary

The literature reviewed above, by and large, contributes relatively little to the type of approach adopted for this dissertation. While several studies have examined interaction patterns of recreation resource users, frequently they are subject to the criticism that they are simply describing interaction patterns in terms of the spatial structures in which the interactions occur.[1] As seen in the following chapter, this study adopts a more fundamental approach to the analysis of observed locational choices.

[1]Rushton, "Analysis of Spatial Behavior," p. 392.

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CHAPTER II

A REVEALED PREFERENCE APPROACH TO MODELLING LOCATIONAL CHOICE

The first part of this chapter reviews theory relevant to the purpose of modelling locational preferences. The methodological approach adopted in this dissertation is developed in detail in the remainder of the chapter.

Decision Theory: Relevance to Modelling Locational Choice

> Decision theory may be viewed as primarily an analysis of the environment; that is, an orderly summary of those features of the environment that control behaviour. Such a description of the environment, combined with simple assumptions about behaviour tendencies that the organism brings to that environment, may yield an effective description of behaviour.[1]

This comment on the focus of decision theory[2,3] reveals its relevance to this study. Locational decisions may be conceptualized as

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[1]W. Edwards and A. Tversky (eds.), Decision Making (Harmondsworth: Penguin Books Ltd., 1967), p. 8.

[2]This body of theory has been designated variously as utility, preference, decision-making, choice or consumer's choice theory. Basically these terms refer to the same theoretical concepts, although some are more restrictive than others (for example the theory of consumer's choice limits analysis to the choice of commodity bundles by consumers). The distinction between utility and preference appears to lie in the designation of utility as a measure of strength of preference (although measurement methods are subject to debate). For the most part the general term "decision theory" shall be adopted in this discussion.

[3]The term "theory" is widely employed in the literature and is thus retained in this discussion. However, in the writer's opinion, the term "model" would be a more appropriate designation (indicating a simplification or idealization of reality).

choices among alternative locations. Interest lies in summarizing certain factors hypothesized to influence locational choice and in using such a summary together with simple behavioral assumptions to describe spatial interaction.

Drawing from the literature in economics and psychology (the disciplines responsible for virtually all of the existing developments in decision theory), this section reviews characteristics of decision theory pertinent to the dissertation topic.

Pertinent Characteristics of Decision Theory

Typically, theory about decision making has been formulated by making assumptions about choice behavior and then deducing theorems from these assumptions. The nature of such assumptions provides a convenient basis for distinguishing among different types of decision theories.[1] It is sufficient to note here that the more realistic the assumptions made, the more complex is the theory formulation and the more demanding are its data requirements.

Employment of Decision Theory. -- Atkinson *et al.* differentiate among alternative approaches to the employment of decision theories.[2] One method uses choice theory as a measuring technique. Given a pattern of choice probabilities among alternatives, the theory provides a measure

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[1]Appendix I provides a classification scheme for theories on the basis of their major assumptions.

[2]R.C. Atkinson, G.H. Bower, E.J. Crothers, *An Introduction to Mathematical Learning Theory* (New York: J. Wiley, 1965), pp. 135-137.

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of the strengths of responses to the alternatives which are said to have led to the observed patterns of probabilities. The chief value of decision theory then is as a method of identifying the "attractiveness" of alternatives, and the degree to which these values can recreate the choice probabilities is an estimate of the accuracy of the attractiveness values.

Decision theory might also be employed to derive laws capable of summarizing data on choice behavior. The laws take the form of constraints on the pattern of choice probabilities. The term "transitivity", for example, summarizes a particular pattern of choice probabilities as will be discussed later.

Decision theory will be utilized chiefly as a measuring technique in this study, although certain laws shall be employed to summarize choice data. Accordingly, decision theory is designated as "the set of postulates relating the response strength variable to response probabilities."[1]

Revealed Preference Theory. -- This term is employed to designate one type of decision theory which relates preferences underlying decision behavior to observable choices among alternatives.[2]

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[1] Ibid., p. 136.

[2] P.A. Samuelson, "Consumption Theory in Terms of Revealed Preference," Economica, XV (1948), pp. 243-53.

A fundamental axiom of this theory is that choice reveals preference. Accordingly, if an individual has a choice among alternatives, by selecting one of these, he reveals a preference for it over others, and by observing these choices it is possible to draw conclusions about preferences among alternatives. Graphical representation of preferences can be achieved through the use of indifference curves, with each line (curve) linking combinations of alternatives to which the chooser is indifferent. A series of such curves constitutes an indifference (preference) surface.[1]

To assist in the application of revealed preference theory, it appears useful to simplify the analysis of the choice situation by considering choices among pairs of alternatives and consequently employing the method of paired comparisons.[2] Each response (choice) is viewed as a comparative judgment between the alternatives, indicating whether one of the pair is greater than the other in some respect. From such responses, a matrix can be derived, indicating the number and proportion of times each alternative is judged higher on the scale than every other alternative. From this information, attempts are made to scale the alternatives on the basis of the attribute being judged.

Luce's Choice Axiom. -- The paired comparisons approach applies

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[1]Further references to revealed preference theory include W. Edwards, "The Theory of Decision Making," Psychological Bulletin, LI (1954), pp. 380-417, and H.S. Houthakker, "The Present State of Consumption Theory: A Survey Article," Econometrica, XXIX (1961), pp. 704-40.

[2]J.P. Guilford, Psychometric Methods (2nd ed. New York: McGraw-Hill Book Co., 1954), Chapter 7.

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to presentations of two alternatives. A choice axiom formulated by Luce provides the means of expanding consideration to more than two alternatives.[1] This constant ratio rule states that the ratio of the probability of choosing one alternative to the probability of choosing another alternative is constant regardless of the number and type of other alternatives in the choice set.

This constant ratio assumption has a number of consequences. For one thing, it means that choices from larger sets (three or more alternatives) can be accounted for by observing choices between pairs of alternatives. Also by conceptualizing observed choices from larger sets as choices between pairs of alternatives, the set of alternatives can be scaled on a preference scale.

The Modelling of Locational Choice

Rushton, drawing on the methodology briefly referred to above, has developed a model of revealed space preference for analyzing choices involving alternative locations.[2] It is recognized that the preference structure so defined must provide a description of locational choice which is independent of the specific pattern of locational alternatives within which choices are made. A number of principles are applied toward achieving such an objective, as outlined below.

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[1] R.D. Luce, Individual Choice Behavior (New York: John Wiley & Sons, 1959). Atkinson, Bower and Crothers, An Introduction to Mathematical Learning Theory, pp. 146-50.

[2] Rushton, "The Scaling of Locational Preferences."

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> The first principle is that whenever a choice is made we regard this choice as revealing a small segment of a total preference structure possessed by the subject. That segment is a statement of preference between the combinations of location and site attributes of the choice selected and of the opportunities rejected. Since in any experimental situation the total set of conceivable situations will not be complete, an ordering of the relative frequency of choice combinations will not be identical with the ordering of the same combinations by preference. In other words, one consequence of this distinction between preference and choice is that the most commonly chosen locations will not necessarily be the most preferred.[1]

In the model, movements to destinations are conceptualized as revealing pairwise choices between the alternative chosen, and each other alternative available for choice (the alternatives here are destinations which have been generalized into locational types based on their location and site attributes). Employment of the paired comparisons approach in conjuction with the constant ratio assumption, enables the revealing of degree of similarity in preference between pairs of locational types. From such information, the establishment of a preference scaling of locational types and ultimately formulation of a locational preference surface are possible (as discussed in the following section).[2]

The model is a static one, considering preferences at one point in time. Individuals are assumed to act in a rational manner, achieving the maximizing of utility (satisfaction) through their choices. Hence the model is a riskless one and does not provide for errors in choice which might be expected to occur. In addition, this model is

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[1]G. Rushton, "Behavioral Correlates of Urban Spatial Structure," Economic Geography, XLVII (1971), p. 51.

[2]Rushton, "The Scaling of Locational Preferences."

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probabilistic in the sense that the probabilities which govern choices are unrestricted (i.e., they can range between 0 and 1). While the model, then, embodies certain unrealistic assumptions, these appear to be essential in order to use simple spatial interaction data in its application.

A Revealed Preference Approach to Analysis of Locational Choice Data

This section discusses the utilization of revealed preference theory in deriving information about locational preferences from empirical data. The procedure employed follows that described by Rushton.[1]

Assume that information is available concerning the home origins and numbers of individuals frequenting various recreation destinations. In effect then, there is knowledge of a system consisting of the origin points of recreation resource users, the destinations which they patronize and the flows between origins and destinations (Figure 1).[2] If each origin and destination as well as the flow between them is considered to be unique, little can be done toward establishing rules whereby movement occurs. Each individual presumably would act in a unique, unpredictable manner and no summarizing of such spatial behavior would be attainable.

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[1]Rushton, "The Scaling of Locational Preferences."

[2]The origins here are the cities from which the major recreation flows originate and the destinations (opportunities) are existing facilities for a type of recreation pursuit (in this case, camping in provincial parks).

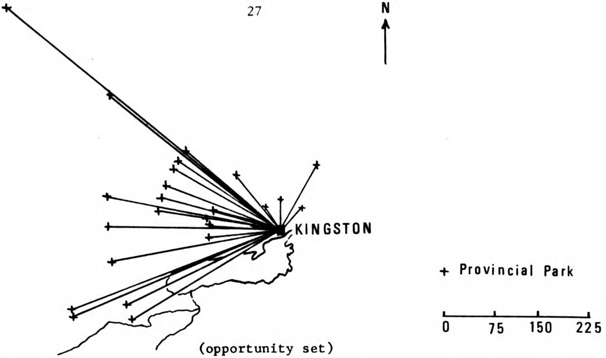

Fig. 1.--Provincial park destinations available to Kingston campers.

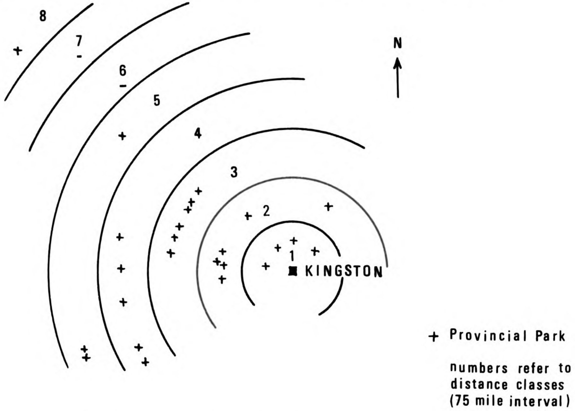

Fig. 2. -- Park destinations classified by distance from Kingston.

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It is obvious, however, that destinations frequently have certain characteristics in common, and it seems likely that individuals have some awareness of the similarities of various destinations. For example, in Figure 1, it is apparent that a number of destinations are located at similar distances from the origin center of Kingston. Thus, when examining movements of Kingston campers, it would seem useful to group destinations on the basis of the distance attribute. Figure 2 shows how such a grouping might be accomplished.[1] Obviously when more than one origin is considered, a destination often will be situated at varying distances from each of these origins.

Some degree of generalization of destinations in this system has now been achieved, based on one attribute of the destinations (distance from origins) which is hypothesized to have some influence on flows in the system. Site characteristics logically might be hypothesized as an additional attribute(s) of destinations relevant to flows in the system. It is evident, though, that the measurement and grouping of destinations on the basis of such an attribute is a much more difficult task than for the distance-from-origin attribute. Not only is there a wide variety of types and combinations of characteristics which might be included in such a category, but frequently there are problems in measuring and obtaining such information. The problem is compounded by the fact that it is not simply a classification of destinations by site characteristics that is desired, but rather a classification based on site characteristics considered relevant to the users' choice of destination.

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[1]Straight-line distances are used in this example, but it would be relatively easy to substitute actual road mileages in the calculations.

Thus, the fact that one camping destination may provide 400 campsites while another may provide only 33 campsites may have no bearing on choice between the two destinations, and accordingly would have little usefulness in the classification.[1] While the problems, then, are considerable, the knowledge that such classifications indeed have been attempted is an encouragement to efforts to consider relevant site characteristics.[2]

It would appear then, that recreational destinations can be generalized into "locational types" on the basis of common distance-from-origin and "attractiveness" characteristics. Figures 3 and 4 illustrate such a classification scheme. Left until later is the explicit definition and derivation of locational types used in this study. For each individual movement in the system, information is now held about locational type selected and locational types (opportunites) available from that origin. For example, in Figure 3, campers cannot choose a destination with attractiveness of 1 in the closest distance zone,

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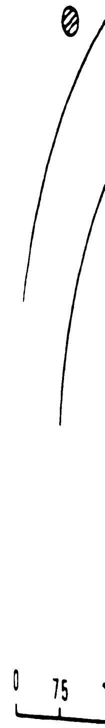
[1]The possibility exists, of course, that number of campsites may be closely related to other variables which are relevant to choice, and thus may serve as a useful index in such a classification.

[2]Rushton (Rushton, "Analysis of Spatial Behavior by Revealed Space Preference," p. 395.) has made use of a surrogate (town size) to represent those attributes presumed to be of importance in decisions about grocery purchases. Similarly, Wolfe (Wolfe, Parameters of Recreational Travel.) has employed capacity of a destination for a particular recreational pursuit as a surrogate for attractiveness of site. Ellis (J.B. Ellis,"Systems Analysis of Provincial Park Camping: 1966 Park Users Survey,"report prepared for Parks Branch, Ontario Department of Lands and Forests [Toronto: 1968]) has utilized factor analysis of many site characteristics to achieve measures of overall attractiveness for parks.



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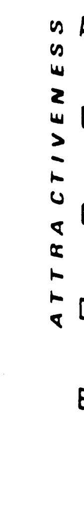

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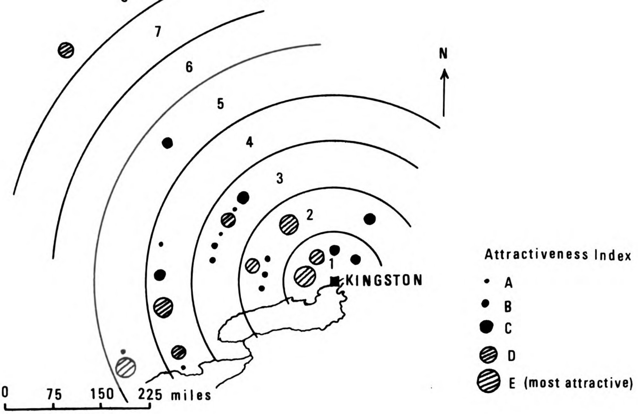

Fig. 3.--Park destinations classified by attractiveness and distance from Kingston.

DISTANCE

ATTRACTIVENESS	1	2	3	4	5	6	7	8
A			2	2	1			
B		3	2					
C		1	1	1	1			
D	1	1	1	1				1
E	1	1		1	1			

(figures indicate no. of parks)

Fig. 4.-- Locational types available to Kingston campers.

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consequently this locational type does not constitute an alternative here.[1]

Revealed preference theory states that given data on choices among pairs of alternatives, a unique preference scaling of such alternatives can be derived. Each movement to a particular locational type is regarded as indicative that a series of pairwise choices between that alternative and other alternatives has been made.[2] Figure 4 provides an illustration. There is a total of nineteen locational types available to Kingston campers. Therefore, if a camper chooses locational type 1E, he is regarded as having made pairwise choices between this type and each of the other eighteen available types.

Once information is possessed about locational choices and available locational types, a revealed preference data matrix can be formed. Table 1 represents a portion of such a matrix in which only two of the forty locational types are not available from any of the origin centers considered. This matrix of choice data is employed to achieve a representation of locational preferences (as described below).

Revealed preference data can be presented in terms of probabilities. For example, if 400 individuals choose locational type A over type B, while only 100 select B over A, then the probability that

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[1]Figure 4 shows that, in a number of cases, more than one destination is assigned to a locational type. Note that in the analysis, the choice alternatives are locational types, not specific destinations. Accordingly, choices among destinations represented by the same locational type are not dealt with.

[2]The question of whether this conceptualization of the decision process is a useful and/or realistic model has been discussed earlier.

TABLE 1

REVEALED PREFERENCE DATA MATRIX - COMPARISON OF LOCATIONAL TYPES[a]

CELLS SHOW NUMBER OF TIMES SAMPLE HOUSEHOLDS PREFERRED COLUMN LOCATIONAL TYPE TO ROW TYPE.(. 3426. HOUSEHOLDS)

b	1 b	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	44	172	158	27	34	13	27	12	252	104	111	39	20	38	1	0	434	358	224	59
2	308	220	245	69	66	25	33	18	286	218	162	105	35	54	1	0	661	540	403	132
3	390	398	350	106	41	29	64	36	405	343	261	93	40	96	6.	0	809	787	500	169
4	.311	266	330	91	49	34	35	20	524	279	184	93	31	58	9	0	593	483	348	199
5	94	126	101	51	13	10	3	12	249	186	57	34	11	9	4	0	257	146	134	66
6	114	89	72	35	22	5	4	6	157	111	54	25	10	11	3	0	254	154	80	53

TABLE 2

PROBABILITY THAT COLUMN LOCATIONAL TYPE IS PREFERRED TO ROW TYPE[a]

b	1 b	2	3	4	5	6	7	8	.9	10	11	12	13	14	15	16	17	18	19	20
1	0.00	0.36	0.29	0.08	0.27	0.10	0.09	0.09	0.60	0.35	0.24	0.16	0.07	0.13	0.02	0.00	0.66	0.40	0.34	0.17
2	0.64	0.00	0.43	0.21	0.34	0.22	0.14	0.15	0.71	0.49	0.32	0.33	0.15	0.16	0.01	0.00	0.76	0.53	0.47	0.35
3	0.71	0.57	0.00	0.24	0.29	0.29	0.23	0.19	0.78	0.64	0.37	0.35	0.21	0.22	0.05	0.00	0.83	0.58	0.51	0.37
4	0.92	0.79	0.76	0.00	0.49	0.49	0.40	0.38	0.96	0.79	0.65	0.60	0.47	0.40	0.17	0.00	0.95	0.92	0.69	0.61
5	0.73	0.66	0.71	0.51	0.00	0.31	0.08	0.52	0.87	0.84	0.59	0.41	0.22	0.36	0.29	0.00	0.88	0.60	0.64	0.64
6	0.90	0.78	0.71	0.51	0.69	0.00	0.15	0.40	0.91	0.85	0.74	0.47	0.34	0.37	0.25	0.00	0.93	0.90	0.66	0.52

TABLE 3

RANKING OF LOCATIONAL TYPES BY PERCENT OF TIMES PREFERRED TO OTHER TYPES[a]

RANK	LOC. TYPES	PERCENT .GT. 0.5	RELATIONSHIP TO NEAREST NEIGHBOR
1	33	100.00	0.00
2	17	97.44	0.57
3	25	94.87	0.58
4	9	92.31	0.63
5	34	89.74	0.57
6	1	87.18	0.53

[a]Data are from a sample of campers at Ontario provincial parks in 1966 (discussed in detail later). Only a portion of the table is reproduced here.

[b]Numbers represent locational types.

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A will be chosen over B is 0.80 while the probability for B over A is 0.20. Table 2 indicates the probabilities obtained from the revealed preference matrix in Table 1. The two locational types that are not available are then eliminated from the matrix (since no choices are present on which to assess preferences). Locational types may then be ordered on the basis of percentage of time they are revealed as preferred to other types (i.e. percentage of the pairwise choices in which they have a probability of choice greater than 0.5). Table 3 shows such a ranking, while Table 4 illustrates a portion of the re-ordered matrix.

When the probability of choosing locational type A over type B is 0.5, it follows that the probability of choosing B over A is also 0.5 (since the probabilities must sum to 1.0). In this situation, indifference is apparent between the two alternatives; both are equally preferred. Hence the absolute difference from 0.5 of the probability of choice between any pair of locational types may be regarded as an indicator of the similarity of preferences for the two types. If the difference is 0.0, preferences are similar, while a difference of 0.5 indicates maximum dissimilarity. Table 5 represents a portion of a matrix of differences from 0.5, referred to as a proximity matrix. Note that the upper half of the matrix is the same as the lower half, hence only half of the matrix is required.

The degree of transitivity (consistency) of the pairwise choices of the population is also of interest. For example, if A is preferred to B (A→B) and B→C, then A must be preferred to C in order for trans-

PROBABILITY THAT COLUMN EDUCATIONAL TYPE IS PREFERRED TO ROW TYPE

(EDUCATIONAL TYPES ORDERED BY THEIR RANK IN TABLE [illegible] WITH -1 FOR MISSING DATA)

TABLE 4

PROBABILITY THAT COLUMN LOCATIONAL TYPE IS PREFERRED TO ROW TYPE[a]

(LOCATIONAL TYPES ORDERED BY THEIR RANK IN TABLE WITH -1 FOR MISSING DATA)

	33	17	25	9	34	1	18	26	2	10	19	3	35	20	27	11	5	21	12	4
33	-1.00	0.43	0.32	0.36	0.27	0.31	0.16	0.17	0.16	0.11	0.12	0.12	0.10	0.08	0.07	0.10	0.13	0.05	0.07	0.03
17	0.57	-1.00	0.42	0.34	0.36	0.34	0.24	0.27	0.26	0.25	0.22	0.17	0.10	0.11	0.09	0.12	0.12	0.11	0.10	0.05
25	0.58	0.58	-1.00	0.37	0.49	0.44	0.36	0.30	0.31	0.26	0.27	0.26	0.23	0.19	0.22	0.20	0.09	0.16	0.12	0.09
9	0.64	0.56	0.63	-1.00	0.43	0.60	0.28	0.27	0.28	0.37	0.28	0.22	0.19	0.05	0.04	0.18	0.13	0.09	0.05	0.04
34	0.73	0.64	0.51	0.57	-1.00	0.47	0.39	0.33	0.38	0.35	0.37	0.29	0.24	0.21	0.24	0.21	0.26	0.20	0.21	0.06
1	0.69	0.66	0.56	0.60	0.53	-1.00	0.40	0.37	0.36	0.35	0.34	0.29	0.29	0.17	0.19	0.24	0.27	0.20	0.16	0.08

TABLE 5

PERCEIVED SIMILARITY BETWEEN LOCATIONAL TYPES - PROXIMITY MATRIX[a]

(ABSOLUTE DIFFERENCE OF PROBABILITIES FROM .5 WITH -1 FOR MISSING DATA)

	33	17	25	9	34	1	18	26	2	10	19	3	35	20	27	11	5	21	12	4
33	-1.00	0.07	0.18	0.14	0.23	0.19	0.34	0.33	0.34	0.39	0.38	0.38	0.40	0.42	0.43	0.40	0.37	0.45	0.43	0.47
17	0.07	-1.00	0.08	0.16	0.14	0.15	0.25	0.23	0.24	0.25	0.28	0.33	0.40	0.39	0.41	0.38	0.38	0.39	0.40	0.45
25	0.18	0.08	-1.00	0.13	0.01	0.06	0.14	0.20	0.19	0.24	0.23	0.24	0.27	0.31	0.28	0.30	0.41	0.34	0.35	0.41
9	0.14	0.16	0.13	-1.00	0.07	0.10	0.22	0.23	0.22	0.13	0.22	0.28	0.31	0.45	0.42	0.32	0.37	0.41	0.42	0.45
34	0.23	0.14	0.01	0.07	-1.00	0.03	0.11	0.17	0.12	0.15	0.13	0.21	0.22	0.29	0.26	0.29	0.24	0.30	0.29	0.41
1	0.19	0.16	0.06	0.10	0.03	-1.00	0.10	0.13	0.14	0.15	0.16	0.21	0.21	0.33	0.31	0.26	0.23	0.30	0.34	0.42

TABLE 6

TRANSITIVITY TEST FOR CONSISTENCY OF PREFERENCE SURFACE[a]

(CELL VALUE IS 1 IN J TH COLUMN AND I TH ROW WHEN PROBABILITY THAT J WILL BE CHOSEN OVER I (J P I) IS GREATER THAN 0.5)

	33	17	25	9	34	1	18	26	2	10	19	3	35	20	27	11	5	21	12	4	36	6	28	37	31	13	22	14	24	23	8	38	7	32	29	39	15	30
33	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
25	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
34	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TABLE 7

REVISED TRANSITIVITY MATRIX[a]

(INCOMPLETE TRIPLES ARE MADE TRANSITIVE)

	33	17	25	9	34	1	18	26	2	10	19	3	35	20	27	11	5	21	12	4	36	6	28	37	31	13	22	14	24	23	8	38	7	32	29	39	15	30
33	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
25	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
34	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TRANSITIVITY BY ROW= 0.98855

[a]Data are from a sample of campers at Ontario provincial parks in 1966 (discussed in detail later). Only a portion of the table is reproduced here.

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itivity to exist among this triple. Hence a test for weak transitivity[1] is employed to indicate strength of consistency of the revealed preferances.[2] Table 6 illustrates such a test. If complete transitivity existed, the locational type represented by each column would be preferred to each locational type of the columns to the right of it (i.e. 1's would occupy all the cells of the lower half of the matrix). In this test, incomplete triples are rendered transitive (Table 7). Transitivity is expressed as the proportion of the total number of triples which is transitive, and accordingly varies from 0 (maximum inconsistency) to 1.0 (complete transitivity).

At this point in the method of analysis, therefore, the degree of similarity of preferences for pairs of alternative destinations has been represented using data on destinations chosen and available for each origin center. Also, a coefficient has been employed to indicate degree of consistency of such preferences. The next step involves the identification, if possible, of the preference function on which the pairwise similarity data appear to be based.

The Scaling of Pairwise Locational Preferences

The revealed preference approach described in the previous

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[1]To elaborate, transitivity may be weak (if $A \rightarrow B \geq 0.5$ and $B \rightarrow C \geq 0.5$, then $A \rightarrow C \geq 0.5$), moderate (if $A \rightarrow B \geq 0.5$ and $B \rightarrow C \geq .05$, then $A \rightarrow C \geq$ minimum of $A \rightarrow B$ and $B \rightarrow C$) or strong (if $A \rightarrow B \geq 0.5$ and $B \rightarrow C \geq 0.5$ then $A \rightarrow C \geq$ maximum of $A \rightarrow B$ and $B \rightarrow C$).

[2]M.G. Kendall, Rank Correlation Methods (Third Ed. London: Charles Griffin and Co. Ltd., 1962), pp. 144-148.

section has produced a proximity matrix whose cell values are considered to express similarities between preferences for pairs of locational types. While such a matrix is of considerable value, much of its meaning is hidden and requires translation into a more easily understood form. A solution to this problem would appear to be the construction of a scale which would summarize and clarify preferences for locational types. Such a scaling of locational preferences involves the derivation of a preference function representing rules of choice among alternative destinations.

The simplest scale to construct and to comprehend is one which scales objects (locational types here) along one dimension according to preferences. However, frequently the benefits of simplicity of the unidimensional scale are accompanied by disadvantages stemming from the greater assumptions which must be made about the data. For instance, a unidimensional scale can be constructed by assuming that pairwise similarity measures from the proximity matrix should be additive. That is, if A is preferred to B and B is preferred to C, then the distance on the scale between A and C should equal AB plus BC. By averaging a number of estimates for such distances, we arrive at a scaling of preferences along one dimension.[1]

There is little basis for assuming that preferences can be adequately scaled along one dimension.[2] Thus, the situation appears

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[1]Rushton, "The Scaling of Locational Preferences."

[2]Employment of the previously mentioned test of weak transitivity can help ascertain the validity of unidimensional scaling of the preference data. It is suggested that the lesser the proportion of intransitivities (i.e. A→B, B→C, C→A) the more likely it is that individuals rank locational types along only one dimension in deciding among alternatives.

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amenable to a multidimensional scaling procedure, with a unidimensional scale considered simply a special case of the general approach. The underlying purposes of multidimensional scaling "of somehow getting hold of whatever pattern or structure may otherwise lie hidden in a matrix of empirical data and of representing that structure in a form that is much more accessible to the human eye,"[1] indicate its relevance to the problem.

Attention is focused on those multidimensional scaling procedures generally designated as "nonmetric", that is, they make use of only the ordinal properties of the empirical data. As noted by Shepard,[2] these nonmetric procedures have several advantages over the earlier metric approach.[3] For one thing, in observation of choices or judgments, researchers may be reluctant to attribute much importance to exact numerical measures because of the possibility of errors in judgment or measurement. Employing only the ordinal attributes of the data would seem to be one way of reducing the possible error. Nonmetric procedures also improve over earlier methods by the adoption of goodness-of-fit criteria enabling evaluation of the resulting scale in terms of how accurately it represents the original data. In addition, the newer approaches are more flexible than metric scaling, capable of

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[1]R.N. Shepard, "Introduction to Volume I," Multidimensional Scaling: Volume I, eds. R.N. Shepard, A.K. Romney and S.B. Nerlove (New York: Seminar Press, 1972), p. 1.

[2]Ibid., pp. 6-7.

[3]Much of the development of metric multidimensional scaling is associated with Torgerson (W.S. Torgerson, Theory and Methods of Scaling [New York: Wiley, 1958]).

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treating a wide variety of scaling problems -- for instance, situations where data are missing or are to be weighted.

Pioneering contributions to nonmetric multidimensional scaling were made by Shepard and Kruskal.[1,2,3] The essential features of these developments are briefly considered. Given some measure of similarity (proximity) between pairs of objects, the objective is to find the scaling configuration of these objects such that the resulting distances between object pairs correspond to the proximity measures. Correspondence here means obtaining a relationship between proximity measures and the distances of the scaling configuration which is monotonic (i.e. if AB represents the largest proximity measure, then the resulting distance AB should represent the smallest distance). The degree to which monotonicity is achieved serves as a measure of the adequacy of the scaling configuration. Since a trivial solution could be attained by adding one dimension for each object scaled, a further requirement is that the final configuration be of the smallest possible dimensionality.

The multidimensional scaling algorithm developed by Kruskal was adopted in the scaling of the locational preference data of the study. More recently, several additional multidimensional scaling algorithms

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[1] R.N. Shepard, "The Analysis of Proximities: Multidimensional Scaling with an Unknown Distance Function," Psychometrika, XXVII, (1962), pp. 125-39.

[2] J.B. Kruskal, "Multidimensional Scaling by Optimizing Goodness of Fit to an Nonmetric Hypothesis," Psychometrika, XXIX, (1964), pp. 1-27.

[3] J.B. Kruskal, "Nonmetric Multidimensional Scaling: A Numerical Method," Psychometrika, XXIX, (1964), pp. 115-29.

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have been developed.[1] However, as noted by Shepard, these approaches all undertake basically the same kind of analysis.[2] Important attributes held in common include assumption of a monotonic relationship between scaling distances and the proximity data, adoption of an iterative procedure adjusting scale points to approach the monotonic relation, and attainment of results which frequently are indistinguishable when the approaches are applied to the same data. Differences among the procedures relate to less significant aspects including speed, adaptability, data capacity, type of metric and susceptibility to local minima (degenerate) solutions.[3]

Since commencement of this dissertation research employing the Kruskal algorithm, a recent analysis by Roskam has concluded that the Kruskal approach has some tendency to favor degenerate solutions, particularly when ties occur in the data to be scaled.[4] Roskam suggests a new procedure incorporating what he considers to be the strong points

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[1]For example, the smallest space analysis of Guttman and Lingoes reviewed in J.C. Lingoes, "A General Survey of the Guttman-Lingoes Nonmetric Program Series," Multidimensional Scaling: Volume I, eds. R.N. Shepard, A.K. Romney and S.B. Nerlove (New York: Seminar Press, 1972), pp. 49-68, or the work of Young and Torgerson (F.W. Young and W.S. Torgerson, "TORSCA: A FORTRAN IV Program for Shepard-Kruskal Multidimensional Scaling Analysis," Behavioral Science, XII (1967), p. 498).

[2]R.N. Shepard, "A Taxonomy of Some Principal Types of Data and of Multidimensional Methods for their Analysis," Multidimensional Scaling: Volume I, eds. Shepard, Romney and Nerlove, pp. 21-47.

[3]Problems with local minima occur when the iterative approach finds a solution which, relative to other solutions attempted, minimizes departure from monotonicity but which does not comprise an absolute minimum for the scaling problem.

[4]E.E. Roskam, A Comparison of Principles for Algorithm Construction in Nonmetric Scaling, Michigan Mathematical Psychology Program Technical Report MMPP 69-2 (Ann Arbor, Michigan: 1969), p. 6.

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of both Kruskal and Guttman-Lingoes approaches.[1] Certainly future scaling efforts should be based on full consideration of these recent developments.

The multidimensional scaling technique adopted in this study can be better understood through an example in which it is possible to compare actual versus optimal scaling configurations. The proximity matrix here consisted of road mileages between pairs of urban centers in Southwestern Ontario (Table 8). The objective was to scale in two dimensions this half matrix of distances producing a two-dimensional "map" of these centers. Through comparison with the map of actual locations of these centers, the effectiveness of the scaling techniques can be ascertained. Successive analyses dealt with five, ten, fifteen and twenty urban centers and Figure 5 illustrates results of three of these.

Where five centers were scaled (Figure 5, part A), stress (a measure of the degree of attainment of a monotone relationship) was 0.0, indicating that the ranking of inter-city distances in the data input was maintained in the scaling results. Note that the correspondence between derived location and true location is not particularly good, primarily because of the relatively few restrictions the stress minimization requirement places on locating such a small number of points.

Analysis of the ten centers produced a stress of .030 (3%). The fit between real and derived locations again was not particularly good (Figure 5, part B).

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[1]E.E. Roskam and J.C. Lingoes, "MINISSA-1: A FORTRAN-IV Program for Smallest Space Analysis of Square Symmetric Matrices," Behavioral Science, XIV, (1969), p.

TABLE 8

ROAD MILEAGE BETWEEN PAIRS OF SELECTED CENTERS IN SOUTHERN ONTARIO[a]

	1 Barrie	2 Brampton	3 Brantford	4 Burlington	5 Chatham	6 Galt	7 Guelph	8 Hamilton	9 Kitchener	10 London	11 Niagara Falls	12 Oakville	13 Orillia	14 Owen Sound	15 Port Colborne	16 St. Catharines	17 Sarnia	18 Stratford	19 Toronto	20 Windsor
1 Barrie																				
2 Brampton	55																			
3 Brantford	112	62																		
4 Burlington	82	33	31																	
5 Chatham	220	169	121	149																
6 Galt	99	47	17	30	124															
7 Guelph	83	35	31	31	138	15														
8 Hamilton	90	38	26	10	142	24	29													
9 Kitchener	100	50	26	41	129	12	16	36												
10 London	154	105	57	85	68	60	73	78	65											
11 Niagara Falls	128	79	68	46	190	76	79	47	83	126										
12 Oakville	72	23	42	12	161	42	42	21	51	96	58									
13 Orillia	23	78	135	106	243	123	106	113	123	177	151	96								
14 Owen Sound	74	92	113	126	195	97	84	112	99	129	165	115	96							
15 Port Colborne	134	85	71	52	187	76	79	50	86	123	23	63	157	162						
16 St. Catharines	117	68	60	38	177	62	64	35	71	113	12	46	140	157	22					
17 Sarnia	207	169	118	147	52	125	134	137	121	62	187	157	230	166	189	174				
18 Stratford	127	78	53	70	106	40	43	64	28	38	114	81	150	127	113	99	93			
19 Toronto	55	25	65	34	180	61	58	42	69	114	80	24	78	116	86	69	177	98		
20 Windsor	270	217	170	198	51	173	185	189	178	118	238	210	293	262	231	226	102	159	234	

[a]Source: Ontario Department of Highways, Road Mileage Chart, 1968.

(A)

(B)

(C

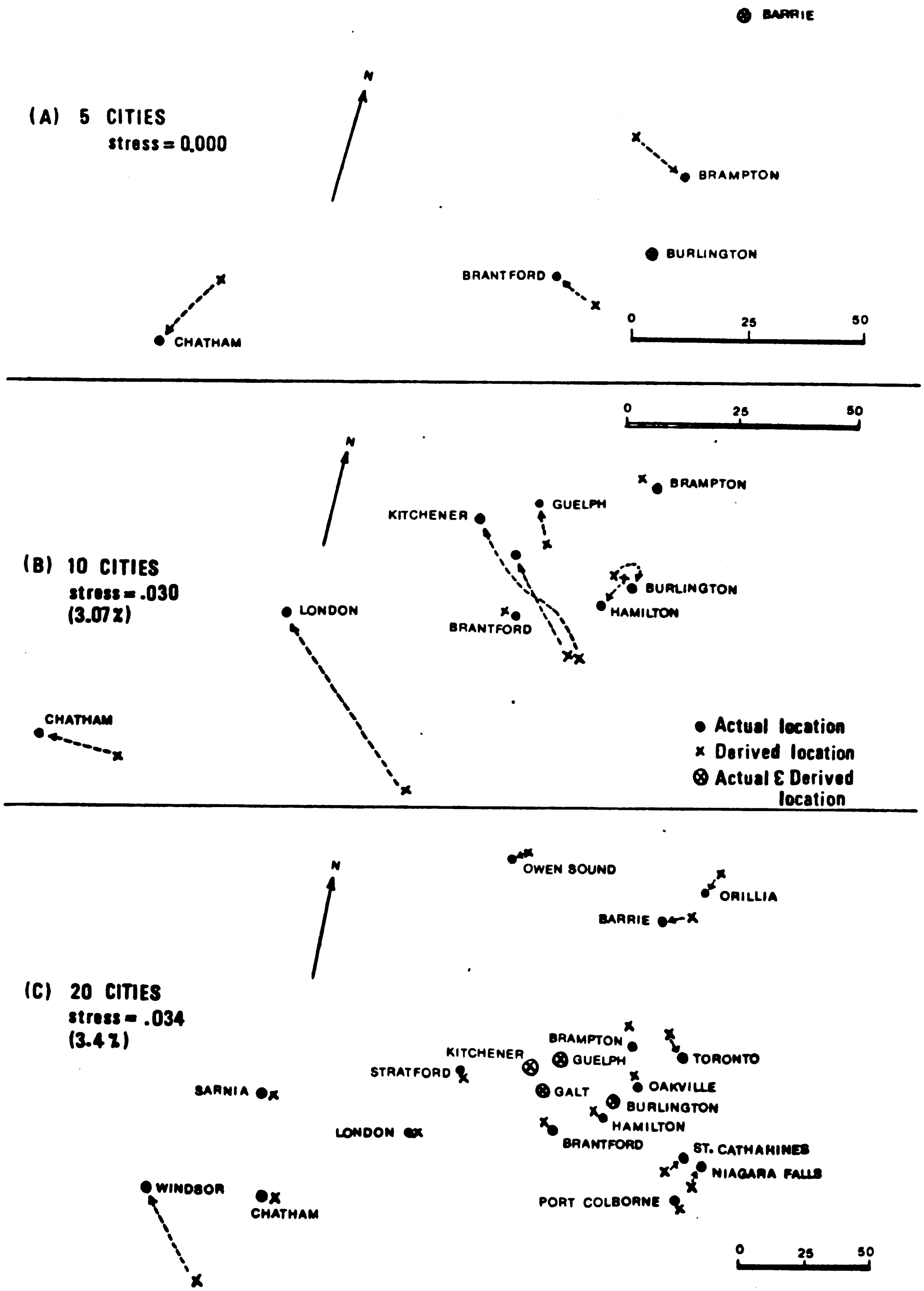

Fig. 5.--Two-dimensional scaling of Ontario cities.

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In the fifteen and twenty center analyses, stress remained around 2-3%, however the fit of the derived locations to the actual locations improved substantially (Figure 5, part C) illustrates the 20 center cases. Obviously, the greater the number of pairwise comparisons, the more accurate will be the derived locations.

It can be seen that in this example, the scaling technique does a reasonably good job of reconstructing the original scale (map) from which the similarities data were obtained. It is quite likely that the fit would have been improved by using airline distances between the urban centers instead of road mileages, particularly where road routes are circuitous (for example, St. Catharines - Toronto).[1]

There are obvious differences between the data used in this example and the data to be employed in a typical analysis. In the example, the original configuration, from which the inter-city distances were obtained, was known (a two-dimensional surface). Thus a rationale was provided for selecting the two-dimensional scaling configuration. It is evident that such a basis for selecting dimensionality will not normally exist.

Kruskal has suggested that stress values be employed to determine dimensionality.[2] Stress values and associated dimensions are plotted along the two axes of a graph and these points are connected.

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[1]It is also possible that adoption of a scaling procedure which reduced the possibility of a degenerate scaling solution (as discussed earlier) might have led to a closer correspondence between observed and derived distances.

[2]Ibid.

Existence of a significant change in slope provides a rationale for selection of that dimensionality for the scale.

This multidimensional scaling technique thus appears to be a useful tool for determining the optimal dimensionality of the preference space which locational types appear to occupy, as well as the relative positions of locational types within this space. The method also provides an indication of the loss of accuracy which results from collapsing this space into fewer dimensions.

To the extent that locational preferences can be represented by a unidimensional scaling of locational types, a preference (indifference) surface can be derived using the one-dimensional scale values from the Kruskal technique. Equal-preference lines representing this surface may be interpolated from the values assigned to each locational type. The fact that preferences are consistent does not preclude the existence of anomalies in the preference surface, since consistency in preferences need not involve consistency over distance and/or attractiveness attributes. Thus consistency is no guarantee that the preference surface can be easily represented and interpreted in terms of these criteria. Obviously, interpretation of the preference surface, in terms of preference variation over distance-attractiveness combinations, is facilitated when few or no anomalies are present.

Further Analysis of Locational Preferences: Comparing Population Subgroups and Identifying Random Choice

Comparing Preferences of Population Subgroups

A further aspect of the methodology concerns the investigation of the relationship between locational preferences and various characteristics of the population members. One method of commencing such an examination is to group population members on the basis of one or more characteristics and to derive preference surfaces and scales for each group by the method already described. The detailed comparison of preferences derived for the groups, however, involves techniques not previously discussed. The following example outlines an approach to this problem.

Assume that locational choice data can be compiled for groups formulated on the basis of three characteristics of the camper population: for example, income, camping experience and type of camping party. If each characteristic is differentiated into two categories, eight different subgroups are possible. Table 9 indicates hypothetical choices between two locational types (A and B) for these eight groups.[1] Each of the 450 population members has been assigned to one of the 16 groups on the basis of income, camping experience and camping party attributes, as well as his choice between locational types A and B.

[1]The example used here is after Blalock (H.M. Blalock, Social Statistics [New York: McGraw-Hill Book Co. Inc., 1960] pp. 234-239).

TABLE 9

HYPOTHETICAL CAMPER SUBGROUPS BASED ON CHARACTERISTICS OF CAMPERS

Income	Camping experience	Loc. type A chosen over B		Loc. type B chosen over A		Totals
		Family group	Non-family group	Family group	Non-family group	
Less than $10,000.	Less than 5 yrs.	60	40	20	16	136
	5 yrs. or more	40	18	24	38	120
$10,000. or more	Less than 5 yrs.	40	6	24	32	102
	5 yrs. or more	24	2	12	54	92
Totals		164	66	80	140	450

Among these attributes, what comparisons would appear to be most meaningful? A logical criterion would be that the groups compared be mutually exclusive, that is, there is no chance of individuals belonging to more than one of the groups being compared.[1] If, for example, two mutually-exclusive income groups are compared, it is not clear that observed differences in preferences can be attributed to income differences, since individuals in the groups vary in other respects

[1]For example, if a particular income group is compared with a group having a certain amount of camping experience, it is apparent that a number of individuals could belong to both groups, since possession of the one attribute does not preclude possession of the other.

than just income. Thus, to show impact of income differences, it is desirable, where possible, to control for variation in other known attributes. In the example below, the relationship between locational preference and income class is examined, while controlling for variations in experience and type of camping group. From the previous table, the following series of contingency tables can be derived (Table 10).

TABLE 10

CONTINGENCY TABLES FOR

HYPOTHETICAL CAMPER SUBGROUPS

Income	Less than 5 yrs. experience		5 yrs. experience or more	
	Loc. type A chosen over B	Loc. type B chosen over A	Loc. type A over B	Loc. type B over A
	Family group			
Less than $10,000.	60	20	40	24
$10,000. or more	40	24	24	12
	Non-family group			
Less than $10,000.	40	16	18	38
$10,000. or more	6	32	2	54

The chi-square test is appropriate to test these contingency tables for significant differences in preference. The results of this test are indicated below (Table 11).

TABLE 11

CHI-SQUARE TEST RESULTS:

HYPOTHETICAL CAMPER SUBGROUPS

Type of camping party	Camping experience	Chi-square χ^2	Significance level	ϕ^2
Family	0-5 yrs.	2.565	not signif.	.017
	5 + yrs.	.188	not signif.	.002
Non-family	0-5 yrs.	28.064	$p < .001$	.298
	5 + yrs.	15.582	$p < .001$	.139

For the non-family group there is a moderatley strong relationship between preference for locational type A over B and income less than $10,000. This relationship is somewhat stronger for campers with 0-5 yrs. experience.

While only two locational types are considered here, this analysis could be expanded to consider the entire revealed preference matrix of locational types. A matrix of chi-square values could then be formulated which could be used to indicate, for each pair of locational types, whether or not significant differences in preference exist for the two population subgroups.

Two problems are evident in the above application of chi-square analysis. One is that the chi-square test is inappropriate when expected cell values are small (i.e. when the smallest expected frequency is less than five) or when the population is small (i.e. less than 20). The other problem relates to the fact that chi-square values are directly proportional to the size of the population trested.[1] Since varying population sizes are anticipated for different locational types, some method of compensating for these differences is desirable.

The problem of dealing with small expected frequencies and/or small populations may be resolved by employing the Fisher exact probability test.[2] This test can determine significance of differences in preferences among pairs of locational types, where only a few choices are observed. Thus the matrix resulting from the analysis of choice data would consist of both chi-square and Fisher exact probability values and significant differences could be identified.

The second problem of varying population sizes is more difficult to resolve because of the existence of both chi-square and Fisher exact probability values. Where the chi-square test has been employed, the chi-square value can be divided by the total population (X^2/N) to give a coefficient (ϕ^2) which, for a 2 X 2 contingency table, varies from 0 (no difference) to 1 (maximum difference). However, no equivalent coefficient can be calculated for the Fisher exact probabilities. The only feasible solution appears to be the setting up

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[1]For example, in the case of the following two contingency tables, the chi-square statistic for the second table is double that of the first, despite the similarity of the proportions (after Blalock, Social Statistics, p. 226).

30	20	50
20	30	50
50	50	100

60	40	100
40	60	100
100	100	200

[2]S. Siegel, Nonparametric Statistics for the Behavioral Sciences (New York: McGraw-Hill Book Co. Inc., 1956), pp. 96-104.

of arbitrary dividing points for both the ϕ^2 coefficient and the Fisher exact probability values which differentiate between "significant" (for the purposes of our analysis) and "non-significant" differences in preference. Various summary statistics for the matrix of test results are discussed in conjunction with test results in Chapter V.

It is apparent that, in determining the number of variables to be included in the comparison technique, and the number of categories in each variable to be considered, one major influence is that of number of individuals included. It may not be possible to subdivide the population as much as desired, simply because the number of cases in each cell becomes too small. It is essential to achieve a balance such that significant variables are included yet frequencies of the cells remain large enough to permit the analysis.

Identifying Randomness of Choice Among Locational Types

It is also feasible, using the technique discussed in the previous section, to identify instances where choices appear to be random in nature.

As indicated earlier, the probability matrix derived in the revealed preference approach serves as an indicator of preference between pairs of locational types. If the probabilities for type A being preferred over B, and B being preferred over A are both 0.5, then indifference between the locational types is defined (that is, they are equally preferred).

In situations where pairwise probabilities are close to 0.5, it might be suspected that these simply represent random fluctuations from an indifference relationship. In other words, if individuals do not care which of two locational types they select, their random choices would be expected to yield pairwise probabilities which are not significantly different from 0.5 (the indifference situation). By testing observed frequencies against frequencies expected if the indifference relationship applied, those cases with insignificant differences can be identified. The chi-square and Fisher's exact tests are appropriate for this purpose and are each applied under conditions noted in the previous section. Where differences from 0.5 probabilities are not significant, it might be concluded that the pairwise choices here simply mask a relationship of indifference. Again, various summary statistics can be employed to indicate the general pattern of apparent random choice. These are described later in conjunction with the application of the test.

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CHAPTER III

APPLYING THE MODEL TO LOCATIONAL CHOICE IN RECREATION: DATA CONSIDERATIONS

A revealed preference approach to the modelling of preferences for location has been outlined in the previous chapter. Discussion of the means of applying this model to specific data on the location choices of recreation resource users comprises the topic of this chapter.

Information on Choice of Location

Data Requirements

As previously noted, the basic information required in the revealed preference approach concerns the interaction of individuals with locations, in this case, the movement of individuals from origins to destination locations for recreation purposes. Also essential are measures of site attributes of the destinations and their situation with respect to origins of users frequenting them.

There are a number of desirable attributes regarding origin-destination flow data utilized in the revealed preference approach. It is important that the interactions included should involve a common purpose as much as possible and be measured in a consistent manner.[1]

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[1] For example, it would be useful to be able to indicate not only origins and destinations of trips, but also particular routes chosen, stopovers along the way and so on.

Since each interaction provides information about a limited number of pairwise locational choices, it is necessary to include a sufficient number of interactions so that data is available for most if not all of the possible pairwise choices. Attempted control of extraneous variables which might adversely affect the analysis is another desirable feature of the data. For example, since locational preferences and the characteristics of destination alternatives can undergo change over time, the time period over which the interaction data is collected should be as short as possible.[1] Where sampling of interactions is undertaken, steps should be taken to ensure an adequate and representative sample of the population in order that conclusions may be drawn about the entire population, not simply the sample.

To facilitate the compiling and analysis of interaction data, frequently it is necessary to limit the number of origins and destinations included. In many cases this may be accomplished simply by grouping nearby origins or destinations and determining a representative point location for each group. The validity of such generalizations depends on a number of criteria such as: size of total area involved, size of the areas encompassing the grouped locations, the degree to which clustering of origins and destinations occurs, and the extent to which distance and site attributes are generalized in the revealed

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[1]For instance, it could be hypothesized that the locational preference of campers differ depending on the particular season of the year. Information compiled over several seasons would mask such differences.

preference analysis.[1]

Distance between origin and destination locations can be indicated in a variety of ways. The simplest approach involves the use of straight-line mileages between origins and destinations. For greater accuracy, however, actual mileages of the shortest routes might be employed.

A number of models utilizing origin-destination distances have employed travel time and/or travel cost estimates to represent these distances.[2] The value of employing such estimates depends on whether or not they are more realistic than simple mileage measures. The assumption in these studies is that travel time - cost measures are more relevant criteria to recreation resource users than simple mileage measures. As is apparent in recent writings, such an assumption

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[1]Ellis, (J.B. Ellis, "Systems Analysis of Provincial Park Camping: 1966 Park User Survey," A Report prepared for Parks Branch, Ontario Department of Lands and Forests [Toronto: Mimeographed, 1968], pp. 33-36.) and Chubb, (M. Chubb, Outdoor Recreation Planning in Michigan by a Systems Analysis Approach, pp. 91-99.) discuss problems in generalizing origin-destination information concerning recreation resource users.

[2]For example, Ellis (J.B. Ellis, A Systems Model for Recreational Travel in Ontario: Further Results. [Downsview, Ontario: Ontario Department of Highways Report NO. RR148, 1969] p. 13) has employed the following formula to determine "resistance" of highway links between origins and destinations.

$$R_h = (L_h/S_h + 0.67 \times 0.031_h)1.25$$

where L_h is length of link h in miles
S_h is average speed over link h (m.p.h.)
0.67 and 1.25 are constants
0.03 is average cost of vehicle operation ($ per mile)

Note that resistance increases disproportionately with increasing time-distance in this function.

may not be realistic.[1,2]

Certain systematic inaccuracies in the predictions of interaction models (particularly the gravity model) has been attributed to inadequate representation of the distance variable.[3] It has been suggested that perceived distance rather than actual distance is the important measure to be incorporated into the model. However, little information about distance perception of recreation resource users is available, and hypotheses are few.[4] Given this situation, it would seem desirable, for the purposes of this study, to determine locational preferences in terms of "objective" characteristics of spatial structure (i.e. distances expressed by mileage) rather than in terms of subjectively-derived measures of uncertain representativeness. Hopefully, the results will point out certain characteristics of perceived distances.

Origin-Destination Data for Ontario Provincial Park Campers

As already intimated, the interaction pattern to be analyzed in this study concerns the movement of Ontario provincial park campers from hometown origins to provincial park destinations. Much of the origin-destination data to be employed in the analysis was obtained

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[1] J. Beaman, Distance and the "Reaction" to Distance as a Function of Distance, CORDS. Technical Note No. 14 (Ottawa: National Parks Branch, 1972).

[2] R.I. Wolfe, "Communications," Journal of Leisure Research, II (1970), pp. 84-87.

[3] R.I. Wolfe, "The Inertia Model," Journal of Leisure Research, IV (1972), pp. 73-76.

[4] Ibid.

from a 1966 survey of a sample of provincial park users.[1] This survey, carried out during July and August 1966, attempted to obtain a minimum sample of fifty camping parties frequenting each of the provincial parks.[2]

The representativeness of the sample data has been questioned. Eleven of the 81 parks, for example, have sample sizes significantly lower than the specified minimum of fifty. Also, Ellis has noted discrepancies between certain sample characteristics and known population characteristics.[3] While these conditions would be important if conclusions were to be drawn about all campers in each park (as Ellis and Wolfe sought to do), they are less significant when interest is in the entire Ontario provincial park camping population (as in this study).

There is, however, one aspect of the sample affecting its representativeness for this study. This is the apparent variation in sampling fractions from one park to another, as a result of specifying a sample size of one percent or fifty camping parties (whichever is larger). The effect of this requirement is to raise above one percent the sampling fractions of the less-patronized destinations, and thus

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[1]This park user survey was jointly undertaken by the Ontario Department of Lands and Forests and the Ontario Department of Highways. The relevant questionnaire (long form) and its accompanying instructions are included as Appendix V. Wolfe, (R.I. Wolfe, A Use Classification of Parks by Analysis of Extremes: Final Report of a Recreational Travel Study [Downsview, Ontario: Ontario Department of HIghways Report No. RR134, 1969]) and Ellis (Ellis, A Systems Model, Further Results) have discussed various aspects of the survey.

[2]A "camping party" consisted of individuals entering the park in one vehicle. The sample to be obtained was specified as one percent of the camping parties or fifty parties, whichever figure was larger.

[3]Ellis, A Systems Model, Further Results, p. 11.

over-represent these users in the sample.[1] The impact of this variation in sampling fractions is examined in the following chapter.

The destinations included in the survey consisted of the 81 provincial parks having campground facilities.[2] There was little difficulty in representing these destinations in terms of point locations since parks were not grouped in the analysis.

Each sampled camping party originating in Ontario was assigned to one of 89 origin centers in the province which most closely approximated its hometown location. Campers originating outside the province were designated only by region or state of origin. These parties from non-Ontario origins were eliminated from consideration,[3] not only because of insufficient information about origin locations, but also because it is unrealistic to conceptualize them as choosing primarily among Ontario provincial park alternatives.[4]

It was decided to reduce the origin-destination matrix to a more manageable size by combining origin centers situated reasonably close to each other, resulting in 54 instead of 89 origin points.[5]

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[1] Appendix VII provides information about these sampling fractions.

[2] These destinations are listed in Table 12 and their locations are indicated in Figure 6.

[3] Thereby reducing the sample size by about 35 percent to approximately 3300 camping parties.

[4] Correspondingly, the failure to include non-Ontario destinations as alternatives for Ontario campers must be recognized as a weakness of this study which was unavoidable because of the lack of data.

[5] These origins are indicated in Table 13 and Figure 6.

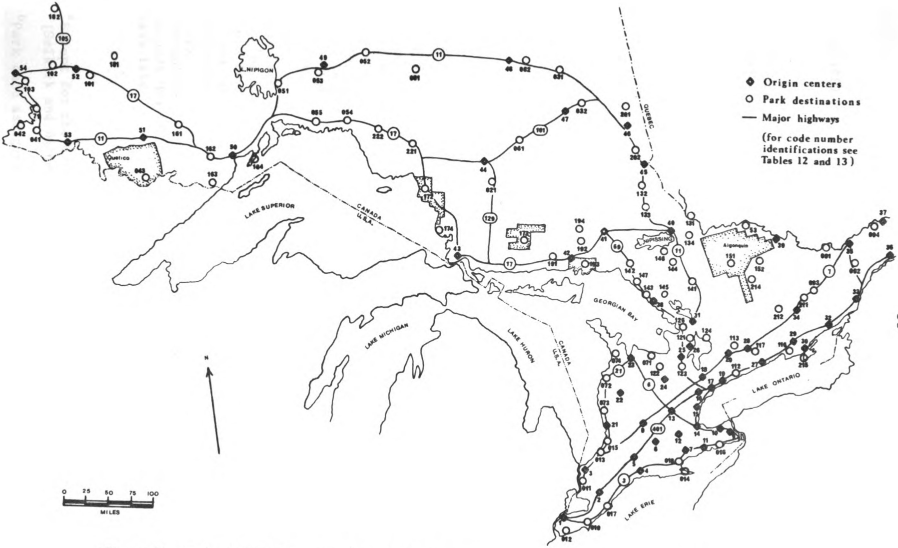

Figure 6.--Major Origin Centers and Park Destinations: Ontario Provincial Park Campers, 1966.

TABLE 12

ONTARIO PROVINCIAL PARK DESTINATIONS, 1966: NAMES AND CODE NUMBERS[a]

Clay Creek	011[b]	Devil's Glen	122
Holiday Beach	012	Earl Rowe	123
Ipperwash	013	Mara	124
Long Point	014	Sibbald Point	125
Pinery	015	Six Mile Lake	126
Rock Point	016	Antoine	131
Rondeau	017	Finlayson Point	132
Turkey Point	018	Marten River	133
Wheatley	019	Samuel de Champlain	134
Five Mile Lake	021	Arrowhead Lake	141
Greenwater	031	Grundy Lake	142
Kettle Lakes	032	Killbear Point	143
Caliper Lake	041	Mikisew	144
Lake of the Woods	042	Oastler Lake	145
Quetico	043	Restoule	146
Blacksand	051	Sturgeon Bay	147
Klotz Lake	052	Algonquin	151
MacLeod Lake	053	Carson Lake	152
Neys	054	Driftwood	153
Rainbow Falls	055	Inwood	161
Ivanhoe Lake	061	Kakabeka Falls	162
Craigleith	071	Middle Falls	163
Inverhuron	072	Sibley	164
Point Farms	073	Lake Superior	172
Sauble Falls	074	Mississagi	173
Nagagamisis	081	Pancake Bay	174
Remi Lake	082	Ojibway	181
Fitzroy	091	Pakwash	182
Rideau River	092	Chutes	191
Silver Lake	093	Fairbank	192
South Nation	094	Killarney	193
Aaron	101	Windy Lake	194
Blue Lake	102	Esker Lakes	201
Rushing River	103	Kap-Kig-Iwan	202
Sioux Narrows	104	Black Lake	211
Balsam Lake	111	Bon Echo	212
Darlington	112	Lake St. Peter	214
Emily	113	Outlet Beach	215
Presqu'ile	116	Obatanga	221
Serpent Mounds	117	White Lake	222
Bass Lake	121		

[a]Except for the deletion of Clay Creek and the addition of two parks (Selkirk and Bonnechere), the 1968 list of destinations is unchanged.

[b]Park code assigned by Ontario Department of Lands and Forests.

TABLE 13

ORIGIN CENTERS USED IN THE ANALYSIS OF

ONTARIO PROVINCIAL PARK CAMPER DATA, 1966

1 Windsor
2 Chatham, Wallaceburg
3 Sarnia
4 St. Thomas
5 London
6 Woodstock
7 Simcoe
8 Stratford
9 Niagara Falls, Welland, Port Colborne
10 St. Catharines
11 Dunnville
12 Brantford
13 Kitchener, Waterloo, Galt, Preston, Guelph
14 Hamilton, Dundas Burlington
15 Oakville, Georgetown
16 Brampton, Mississauga
17 Metropolitan Toronto
18 Aurora, Newmarket, Richmond Hill
19 Oshawa, Whitby
20 Lindsay
21 Goderich
22 Walkerton
23 Owen Sound
24 Orangeville
25 Barrie
26 Orillia
27 Cobourg
28 Peterborough
29 Belleville, Picton
30 Trenton
31 Gravenhurst, Haliburton
32 Kingston, Napanee
33 Brockville
34 Smith Falls
35 Ottawa, Rockland
36 Prescott, Cornwall, Morrisburg
37 Hawkesbury, Alexandria
38 Parry Sound
39 Pembroke
40 North Bay, Sturgeon Falls
41 Sudbury
42 Espanola, Little Current
43 Sault Ste. Marie, Thessalon
44 Chapleau, White River
45 New Liskeard
46 Kirkland Lake
47 Timmins, Cochrane
48 Kapuskasing
49 Geraldton
50 Thunder Bay (Port Arthur, Fort William), Nipigon
51 Atikokan
52 Dryden, Sioux Lookout
53 Fort Frances
54 Kenora

While some loss in accuracy occurred, this was judged to be small.[1]

As noted, the "camping party" was designated as the unit for which information was to be compiled. A number of writers have suggested that "camper days" (number of campers times length of stay in days) is a much more precise measure of park usage than party visits.[2] For this study, however, the camping party was considered to closely approximate the decision-making unit and hence was a more appropriate measure of locational choice than camper days. Length of stay (measured in camper days) can be treated later as one variable differentiating camping parties.

One of the benefits anticipated from the user survey concerned the question of importance of use of parks as stopovers by campers on extended trips. Lack of such information forced previous modelling efforts to assume that each camping party travelled directly from hometown to park and back again to hometown. Such an assumption is obviously unrealistic in a number of cases. A "carbon-tracer" procedure, whereby visits of camping parties sampled were to be recorded for each park visited following the initial interview, proved to be largely unsuccessful in revealing patterns of subsequent visits.[3] In fact,

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[1] In fact, an estimated 85 percent of Ontario residents camping in provincial parks originated in or near 13 major Ontario centers in 1966.

[2] Ellis, A Systems Model, Further Results, p. 14.

[3] Wolfe, (Wolfe, A Use Classification of Parks, pp. 2-3.) discusses this failure and the reasons for it.

because of faults in the questionnaire,[1] it is difficult to identify those parties in the sample utilizing parks as stopover points only.

It would appear to be desirable in the analysis to separate "stop-over" visits from other camping party visits because of the substantial differences in locational preferences that might be expected between these two types of visitors. It appears logical that the range of alternative destinations is considerably more restricted for stop-over visits than for other types of visits.

Since the questionnaire data does not permit a distinction between stop-over campers and other types for the sample, an attempt was made to separate out those park destinations having high proportions of stop-over campers. While information on these proportions is lacking for 1966, estimates are available for the 1970 camping season.[2] The 1970 proportions were employed since they were considered unlikely to differ significantly from the 1966 situation.

If the criterion is adopted that parks having proportions of stop-over campers greater than fifty percent should be separated from those having proportions of fifty percent or less, several facts emerge. For one thing, with only three exceptions, all parks north of a line through Algonquin Park are designated as stop-over parks (each

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[1]Notably a previous stopover or planned subsequent stopover was recorded only if it involved a period of two or more nights (Ibid., p. 19). Thus one-night stopovers were ignored.

[2]Ontario Department of Lands and Forests, "Park Use Statistical Report, 1970," (Mimeographed). Information concerning length of stay of campers was used to distinguish between stop-over and destination campers.

having more than fifty percent stop-over campers). In fact by this criterion, over one-half of all parks are defined as stop-over parks (46 out of 81 parks). Clearly, such a division of the park system into two parts -- one, consisting of distant "stop-over" parks, and the other consisting of nearby "destination" type parks -- is unsatisfactory for analysis of locational preferences. It would be impossible to ascertain preferences of campers other than the stop-over type for the more distant locations, or of stop-over campers for closer locations. The separation of park destinations thus is not considered to be a satisfactory solution to the problem of separating stop-over campers from other types.

A more fundamental problem in separating stop-over campers from other campers relates to the definition of "stop-over camper". It seems likely that there is a continuum of types of stay ranging from "one night stop-over" to "park as sole destination" along which individual camping parties might be placed. Accordingly, it would be difficult to draw a line between stopovers and other stays. It would also be misleading, since the type of visit may not be distinguished correctly by such a procedure.

In a situation where purposes of park stays were well-defined it would seem desirable to distinguish among different types of stays and deal separately with locational preferences related to them. In the absence of such information it would appear pointless to attempt to separate out imperfectly only one such group. Rather, it was concluded that each destination choice, regardless of the characteristics of the chooser or the situation under which it was made, should be regarded as contributing to the overall preference structure of Ontario campers.[1]

Measuring the Attractiveness of Parks for Campers

General Considerations

The derivation of attractiveness measures for destination sites has proved to be difficult, largely due to problems in defining "attractiveness" as well as problems in quantifying and measuring those characteristics it is considered to encompass.

What are some of the desirable features of a technique adopted for rating site attractiveness? Certainly one important aspect should be the minimizing of subjectivity both in the rating scheme and in its application (i.e. results should be replicable by different evaluators using similar criteria). The evaluation process, then, should be well-defined and the attributes to be examined should be specified in detail and operationally defined. The criteria should also be consistent with information about the basis on which individuals choose among destination sites.

For the purposes of this study, one of the most important characteristics of an attraction index is that it be derived independently of the specific destination choice patterns exhibited by the individuals of concern. Since the revealed preference approach has

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[1]Later in the study, attempts are made to relate such variables to differences in locational preference.

hypothesized the combining of distance and site attractiveness attributes in choices made among alternative destinations, the use of raw choice data to define site attractiveness alone obviously would be contrary to this hypothesis and hence unacceptable.

Relative to problems of measuring attractiveness of destinations for most other types of recreational pursuits, measuring attractivity of parks for camping has certain advantages.[1] In contrast to other pursuits, number of destinations to be treated is limited, and these sites are well-defined by park boundaries. Also, many of the attributes of park sites frequently can be ascertained from available information.[2] In addition, since campers have been scrutinized more closely than other recreational groups, more is known about their preferences for destination facilities than about those of other groups.

Prior to the consideration of specific attraction indices, several questions should be briefly dealt with. For one thing, since the destinations of interest include only provincial parks, are there significant differences among the site characteristics of these parks which influence their attractiveness to users? Cursory examination of parks quickly points to the affirmative. In fact, the term "provincial park" includes areas having widely varying natural environments and

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[1]Chubb, Outdoor Recreation Planning in Michigan, pp. 155-56.

[2]This situation contrasts to that of cottaging or boating, for example, where much more extensive, more diverse, and less well-known destinations frequently must be dealt with.

facilities for recreational activities.[1] Recognition of diversity within the parks system is evident in the provincial park classification scheme used in Ontario to identify park areas having different management and use objectives.[2]

Given that variation in site characteristics of Ontario provincial parks does exist, to what extent are campers aware of such variation and consider it in choosing among destinations? The results of the 1966 survey of Ontario provincial park users provide some information on this question, suggesting that there is a link between recreation activity preferences of campers and the facilities available for such activities in the parks they patronize.[3] It appears that campers have at least some awareness of differences in park characteristics and consequently choose their park destinations accordingly. For all parks, an average of 4.2% of the camping sample expressed an intention to go boating.[4] However, in parks where boat launching facilities were not available (and therefore boating would be difficult or impossible), the average percentage preferring boating dropped to

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[1]Appendix II gives some indication of the lack of uniformity of Ontario provincial parks.

[2]Ontario Department of Lands and Forests, Classification of Provincial Parks in Ontario (Toronto: 1967). Park classes include: Primitive Parks, Wild River Parks, Natural Environment Parks, Recreation Parks, and Nature Reserves.

[3]Question 26 of the camper questionnaire asked which two activities were considered most important to the enjoyment of this park visit. Note the possibility for discrepancies between intention and participation.

[4]These figures were derived by averaging together the number of first and second choices for each activity (expressed as a percentage) for each park and then averaging for all parks in the group.

half of the overall average (2.1%). Similarly, for the entire park system, an average of 29.3% of the campers in each park intended to go swimming. For the parks where swimming facilities were negligible, this average dropped to 12.7%.[1]

Evidence that campers do not seek the same things in a camping experience suggests that different attraction ratings might be devised to serve different types of campers. For example, a number of studies have distinguished between the "wilderness camper" and the "social camper" having markedly different purposes and preferences.[2] However, in most cases, campers have been so classified not by ascertaining their motives or desires, but rather by defining destinations as wilderness or social destinations on the basis of their attributes. The characteristics of the users of such parks then become the attributes of wilderness or social campers. Thus these types of campers are designated in terms of the specific pattern of opportunities which exists. For instance the fact that most campers must travel considerable distances to reach wilderness parks results in wilderness campers being defined as campers willing to travel long distances to destinations. Is it not possible that there are "wilderness" campers who make the best of closer, less desirable parks simply because of the poorer accessibility of the more ideal parks, in essence trading

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[1]The possibility exists that in some cases, the park may simply serve as a base for a recreation activity pursued outside the park boundaries.

[2]The following reference is an example of this type of study. J.B. Ellis, A Systems Model for Recreational Travel in Ontario: A Progress Report (Downsview, Ontario: Ontario Department of Highways, Report No. RR126, 1967), pp. 16-30.

off quality for accessibility?

Therefore, to the extent that different camper groups are defined by their locational preferences (as above), separate analysis of locational preferences of these groups is not very meaningful since the results would largely "reveal" the preferences whereby the groups were defined. Given the inadequate information available on true motives and preferences of the camper sample utilized in this analysis, there is little point in devising separate park attractiveness indices for different camping groups.

Techniques for Measuring Park Attractiveness

Simple Attraction Functions. -- One of the simplest and most easily applied measures of park attraction is the type discussed by Ellis[1] utilizing a simple function to determine attraction (as indicated below).

$$A_d = C_d S_d \frac{(W_d + K_1 Q_d)}{K_2}$$

where A_d is the attraction value for park d
C_d is the index of relative camping capacity of the park (0.2, 0.6, 1.0, 2.0, or 3.0)
S_d is a value denoting the presence of any special factor (0, 0.75, or 1.25)
W_d is an index of relative quality of water-related resources (0.2, 0.6, 1.0, 1.5, 2.0)
Q_d is an index of relative quality of outdoor setting (0.5, 1.0, or 2.0)
K_1 and K_2 are constants

[1]Ellis, A Systems Model, Progress Report, p. 8.

As is apparent in the definitions of the variables, the chief disadvantage is the amount of subjective judgment involved both in the designation of possible values as well as in assignment of such values to particular parks. Such a technique, however, appears to have some use as a "stop-gap" device, serving in the absence of a more satisfactory scheme.

This technique has been applied to Ontario provincial parks[1] and the results are listed in the first column of Table 14. Comparison of highly rated parks against those with low ratings suggests that relative capacity is perhaps the most important factor in this rating (the final attractiveness ratings correlate quite highly with capacity ratings).

A technique employed by Cheung is another example of a relatively easily applied function measuring park attractiveness which requires little detailed information on park characteristics.[2] The attraction function attempts to incorporate measures of both the general popularity of specific activities and the facilities available for such activities at particular parks.[3]

Again the arbitrary definition of values assigned to park characteristics and the degree of subjectivity are major problems. Also certain measures of usage incorporated into the index calculations

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[1] Ibid., p. 10.

[2] Cheung, A Day-Use Park Visitation Model, pp. 4-5.

[3] Facilities for a more popular activity thus receive a higher rating than do those for a less popular activity.

INDICES MEASURING ATTRACTIVENESS OF SITE: ONTARIO PROVINCIAL PARKS

Code	Park Name	Initial Attraction Index[a]	Factor Analysis Approach (after Ellis[b])					Index of Attr. of Area[h]	Av. Length of Stay[i]
			Adjusted Inherent Attraction[c]	Relative Capacity[d]	Attraction Index[e]	Adjustment for July-Aug. % Occupancy[f]	Revised Attraction Index[g]		
011	Clay Creek		.13	.24	.03		.03	0	2.1
012	Holiday Beach	.17	.73	.29	.21		.21	29	2.2
013	Ipperwash	1.00	1.65	1.36	2.24	.68	1.53	42	6.4
014	Long Point	2.00	1.05	1.68	1.76		1.76	21	2.7
015	Pinery	3.00	1.77	5.75	10.18	.84	8.59	29	4.3
016	Rock Point	.27	.52	.24	.13		.13	17	1.6
017	Rondeau	4.00	2.77	3.13	8.67		8.67	12	3.2
018	Turkey Point	2.00	1.12	2.38	2.67		2.67	14	2.2
019	Wheatley		.61	.45	.28		.28	23	2.6
021	Five Mile Lake	.60	.52	.45	.23		.23	82	2.4
031	Greenwater	.20	1.67	.21	.35		.35	57	2.1
032	Kettle Lakes	.44	1.56	.49	.76		.76	44	2.7
041	Caliper Lake	.60	.28	.46	.13		.13	51	1.7
042	Lake of the Woods		.71	.45	.32		.32	24	2.6
043	Quetico	1.20	1.67	.62	1.04		1.04	49	4.8
051	Blacksand	1.00	.47	.86	.40		.40	15	1.9
052	Klotz Lake	.15	.13	.17	.02		.02	60	2.0
053	MacLeod Lake	.27	1.29	.38	.36		.36	66	2.5
054	Neys	.60	.19	.56	.11		.11	86	1.1
055	Rainbow Falls	1.00	1.29	.90	1.16		1.16	51	1.2
061	Ivanhoe Lake	1.33	.88	.73	.64		.64	10	4.2
071	Craigleith	.73	1.52	.88	1.39	.98	1.37	31	2.5
072	Inverhuron	2.00	1.38	1.66	2.29		2.29	7	3.6
073	Point Farms		1.06	.95	1.01		1.01	22	2.7
074	Sauble Falls	.73	.76	.75	.57	.75	.43	50	3.3
081	Nagagamisis	.80	.46	.41	.19		.19	44	4.8
082	Remi Lake	.60	.68	.41	.28		.28	51	1.9
091	Fitzroy	.64	1.54	1.29	1.99		1.99	9	2.0
092	Rideau River	1.46	1.87	.98	1.83		1.83	20	2.8
093	Silver Lake	1.46	.85	1.01	.85		.86	26	3.2
094	South Nation	.73	.13	.14	.02	.78	.016	81	1.3

Factor Analysis Approach (after Elli...

Code	Park Name	Initial Attraction Index	Adjusted Inherent Attraction	Relative Capacity	Attraction Index	Adjus... for J... Aug. Occupa...	...sted ...ract... ...lex		Av. Length of Stay
							.17	5[illegible]	1.1
							.27	3[illegible]	1.6

TABLE 14 Continued

Code	Park Name	Factor Analysis Approach (after Ellis): Initial Attraction Index	Adjusted Inherent Attraction	Relative Capacity	Attraction Index	Adjustment for July-Aug. % Occupancy	Revised Attraction Index	Index of Attr. of Area	Av. Length of Stay
101	Aaron	.60	.52	.36	.19	.90	.17	52	1.1
102	Blue Lake	.80	.52	.51	.27		.27	34	1.6
103	Rushing River	.44	1.04	.60	.62	.75	.46	56	2.5
104	Sioux Narrows	.60	.28	.31	.09		.09	63	1.9
111	Balsam Lake	.44	.52	.64	.33		.33	15	2.7
112	Darlington	.71	.90	1.18	1.06		1.06	32	1.5
113	Emily	.44	1.43	.67	.96		.96	17	3.3
116	Presqu'ile	1.46	2.07	2.56	5.30		5.30	18	2.4
117	Serpent Mounds	.73	2.05	.67	1.37	.83	1.14	38	2.8
121	Bass Lake	.73	1.48	.80	1.18	.84	1.00	19	2.5
122	Devil's Glen	.13	.22	.21	.05		.05	0	1.7
123	Earl Rowe	.18	.24	.51	.12	.77	.09	37	2.1
124	Mara		.84	.51	.43		.43	10	2.3
125	Sibbald Point	3.00	1.84	3.72	6.85		6.85	19	3.4
126	Six Mile Lake	1.33	.70	.87	.61		.61	52	2.8
131	Antoine		.24	.15	.04		.04	34	2.0
132	Finlayson Point	.64	.39	.58	.23		.23	68	2.0
133	Marten River	.73	2.39	1.48	3.52		3.52	22	2.8
134	Samuel de Champlain	1.33	2.04	1.14	2.32		2.32	34	1.6
141	Arrowhead Lake		.13	.51	.07		.07	36	1.5
142	Grundy Lake	3.33	1.75	.25	.43		.43	40	3.0
143	Killbear Point	5.00	1.56	3.68	5.74		5.74	34	5.1
144	Mikisew	.60	.52	.63	.33		.33	24	3.6
145	Oastler Lake	.80	.97	.78	.76	.59	.45	68	2.9
146	Restoule	1.00	1.31	1.32	1.73		1.73	25	4.6
147	Sturgeon Bay	.80	.66	.44	.29	.76	.22	85	3.2
151	Algonquin	6.00	2.49	6.70	16.68	.94	15.71	48	3.2
152	Carson Lake	.15	.28	.23	.06	.90	.05	46	2.4
153	Driftwood	.44	.50	.50	.25	.92	.23	45	2.5
161	Inwood	1.00	.13	.32	.04		.04	83	1.0
162	Kakabeka Falls	.75	1.12	.55	.65		.65	33	1.3
163	Middle Falls	.23	.57	.10	.06		.06	34	1.0

Code	Park Name	Initial Attraction	Factor Analysis Approach (after Ellis)					Index of		Av. Length of
			Adjusted Inherent	Relative	Attraction	Adjustment for July-	Revised Attraction		of	

TABLE 14 Continued

Code	Park Name	Initial Attraction Index	Factor Analysis Approach (after Ellis): Adjusted Inherent Attraction	Relative Capacity	Attraction Index	Adjustment for July-Aug. % Occupancy	Revised Attraction Index	Index of Attr. of Area	Av. Length of Stay
164	Sibley	2.00	1.09	1.78	1.94		1.94	36	1.8
172	Lake Superior	4.00	1.02	1.60	1.63		1.63	48	1.4
173	Mississagi		.13	.19	.03		.03	29	2.1
174	Pancake Bay	2.00	.70	1.47	1.03		1.03	23	1.4
181	Ojibway		.45	.35	.16		.16	28	4.1
182	Pakwash		.28	.29	.08		.08	80	4.1
191	Chutes	.44	.24	.36	.09	.76	.07	59	1.1
192	Fairbank	.44	.89	.67	.60		.60	13	1.5
193	Killarney	.33	.13	.51	.07	.84	.06	10	2.6
194	Windy Lake	.60	.70	.39	.27	.96	.26	41	3.3
201	Esker Lakes	.44	1.73	.69	1.19		1.19	23	2.9
202	Kap-Kig-Iwan	.28	1.03	.33	.34		.34	28	1.4
211	Black Lake	.73	1.39	1.02	1.42		1.42	11	2.3
212	Bon Echo	2.00	2.28	2.04	4.65	.90	4.19	6	3.2
214	Lake St. Peter	.20	1.49	.31	.46	.97	.45	36	2.3
215	Outlet Beach	2.00	2.46	2.04	5.02	.72	3.62	26	4.3
221	Obatanga	.80	.46	.43	.20		.20	63	1.6
222	White Lake	.80	.85	1.15	.98		.98	49	1.2

[a]Ellis, A Systems Model, Progress Report, p. 10.

[b]Ellis, A Systems Model, Further Results.

[c]These consist of the adjusted factor scores (Ibid., pp. 7-8).

[d]Number of campsites divided by the mean number of campsites (195) (Ibid., pp. 7-8).

[e]The product of multiplying the adjusted inherent attraction index by the relative capacity index (Ibid., pp. 7-8).

[f]See Appendix IV.

[g]Attraction index multiplied by adjustment for July-Aug. percentage occupancy (where indicated).

[h]The proportion of the 1966 camper sample giving an affirmative response to Question 23, Appendix V.

[i]Ontario Department of Lands and Forests "1966 Park Use Statistical Report" (Toronto: 1967).

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do not appear to be independent of the specific spatial patterns of alternatives within which they were observed, a problem which is recognized by Cheung.

Factor Analysis Technique. -- The availability of fairly detailed data on park characteristics and the desirability of a more objective approach in evaluating park attractiveness have led to employment of a factor analysis approach.[1] Since the approach is discussed in detail elsewhere,[2] only the major elements are referred to here.

The factor analysis approach attempts to replace a large number of indices of park characteristics by a relatively small number of factors which appear to underlie such indices.[3] The interrelationships which are found to exist among such indices are considered as indicators of the possible presence of one or more underlying factors related to the indices in varying degrees. The contribution of the individual indices to such factors depends on the extent of their correlation with the factors as reflected in their factor loadings.

In the factor analyses of both Michigan state parks[4]

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[1]C.S. Van Doren, "An Interaction Travel Model for Projecting Attendance of Campers at Michigan State Parks" (unpublished Ph.D. dissertation, Department of Geography, Michigan State University, 1967).

[2]Ibid., Michigan State University, Department of Resource Development, Michigan Outdoor Recreation Demand Study, pp. 5.1-5.82.

[3]A good introduction to factor analysis can be found in Blalock, Social Statistics, pp. 383-89.

[4]Van Doren, "An Interaction Travel Model."

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and Ontario provincial parks,[1] approximately 56 site indices of a binary character (only presence or absence is recorded) were utilized.[2] In both cases, the existence of three broad dimensions underlying the specific indices was hypothesized and apparently borne out by the results of the analyses. The three dimensions are defined as water-related features, comfort-convenience aspects, and "backwoods" attributes (the last one is presumably a wilderness dimension). The key indices contributing to these dimensions, identified by their relatively high factor loadings, can thus be regarded as representative of park attributes relevant to these dimensions.[3]

The variation in scores for individual parks derived by totalling the factor loadings for those key characteristics present, can be considered a measure of their degree of difference. For example, considering two key indices under the water-related dimension, presence of more than one boat ramp contributes roughly twice as much weight to the park score as does the presence of a separate day-use beach (having factor loadings of .59 and .28 respectively). As the number of key indices possessed by a park increases, the higher its score becomes. Thus those parks well-represented on each of the three dimensions achieve the highest scores while those with more limited representation have lower scores.

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[1]Ellis, "Systems Analysis of Provincial Park Camping."

[2]For Ontario provincial parks, this information was obtained from Park Description Forms first completed for each park in 1966. The 56 indices used in the Ontario analysis are listed in Appendix III.

[3]For the Ontario analysis, these key variables and their factor loadings are indicated in Appendix III.

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The initial results of the rating of Ontario provincial parks using factor analysis were adjusted to compensate for cases in which a park apparently possessed none of the key indices identified in the analysis.[1] Also, the individual scores were adjusted to achieve a mean attraction score which is more easily interpretable (each score was divided by 1.53 to obtain a mean score of 1.00). The adjusted attraction scores are presented in the second column of Table 14.

On the assumption that capacity influences attractiveness, a relative capacity index was then derived for each park based on the number of campsites in the park in 1966, and adjusted to give the mean number (195) an index value of 1.00. (Column 3 of Table 14) This capacity index was multiplied by the adjusted attraction index to give an overall attraction index (Column 4 of Table 14).

Certain characteristics of the attraction ratings derived from the factor analysis are revealed in Table 15. Parks achieving high ratings are generally those possessing many of the key attributes defined in the factor analysis as well as having relatively large capacities to accommodate campers. Correspondingly, those with low ratings have few or none of the key attributes and small relative capacities.

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[1] Seven of the parks (Clay Creek, Klotz Lake, South Nation, Arrowhead Lake, Inwood, Mississagi, and Killarney) fell into this category and were assigned an arbitrary "base-line" score equivalent to approximately seventy percent of that of the lowest-rated index utilized (Ellis, "Systems Analysis of Provincial Park Camping," p. 12.).

TABLE 15

ATTRACTION INDEX EXTREMES: ONTARIO PROVINCIAL PARKS

(FACTOR ANALYSIS APPROACH)

High[a]

Park	Inherent Attraction[b]	Relative Capacity[c]
Algonquin	2.49	6.70
Pinery	5.75	1.77
Rondeau	3.13	2.77
Sibbald Point	3.72	1.84
Killbear Point	3.68	1.56
Presqu'ile	2.56	2.07
Outlet Beach	2.04	2.46
Bon Echo	2.04	2.28
Marten River	1.48	2.39
Turkey Point	2.38	1.12
Samuel de Champlain	1.14	2.04
Inverhuron	1.66	1.38
Fitzroy	1.29	1.54
Sibley	1.78	1.09

Low[a]

Park	Inherent Attraction[b]	Relative Capacity[c]
Sioux Narrows	.28	.31
Chutes	.24	.36
Pakwash	.28	.29
Arrowhead Lake	.13	.51
Killarney	.13	.51
Carson Lake	.28	.23
Middle Falls	.57	.10
Devil's Glen	.22	.21
Inwood	.13	.24
Antoine	.24	.15
Clay Creek	.13	.24
Mississagi	.13	.19
Klotz Lake	.13	.17
South Nation	.13	.14

[a]Columns represent the 14 highest and 14 lowest park attraction values (Column 4 of Table 14) ranked from high to low

[b]Column 2 of Table 14.

[c]Column 3 of Table 14.

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The rationale behind the use of factor analysis in defining attractiveness is that variation among parks can be summarized by extracting those indices most representative of this variation, hypothesizing that the factors they represent are dimensions meaningful to users in evaluating attractiveness. In this case, then, it is hypothesized that campers evaluate park attractiveness on the basis of water-based features, comfort-convenience aspects and "backwoods" characteristics. Factor analysis results in the scoring of parks along these dimensions. While such a hypothesis appears consistent with available evidence,[1] it cannot be tested conclusively. While judgment is still necessary in determining the variables to be included and in deciding which factor solution seems to be "best", the approach appears to be considerably less subjective than other approaches considered.

Paired Alternatives Approach. -- Recently, a new technique for determining park attractivity based on observed interaction patterns has been proposed.[2] Because of its similarity to the revealed preference approach of this study, this technique is briefly examined here.

In brief, the approach is based on the assumption that distance to destination is an impediment to interaction with that destination, an impediment which always increases as distance increases. Thus individuals by-passing closer destinations are assumed to have judged their chosen destination as more attractive than the closer

[1]For example, the identification of social and wilderness type campers.

[2]J.H.C. Ross, Attractivity Indices, A Report to the National and Historic Parks Branch, Canada Department of Indian Affairs and Northern Development (Ottawa: 1971).

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destinations by their willingness to encounter greater difficulty by travelling further. By recording all choices between the chosen destination and closer destinations (if any), a comparison matrix can be set up. Note that the choices of those choosing the closest destination are not considered in this approach. Also, for any two destinations, choice is recorded for only one preference, the further destination over the nearer, never vice versa. From the comparison matrix indicating for all pairs of destinations the number of times the further was chosen over the nearer, an averaging technique is utilized to determine attractiveness ratings. Such attractivity scores indicate destination attractiveness in terms of the proportion of times a destination was chosen over closer destinations as opposed to being rejected in favour of more distant destinations.

The major problem with this technique is that the attractivity measures do not seem to be independent of the spatial pattern of origin and destination locations. Considering two destinations, it seems obvious that frequently there will be inequalities in the number of times one can be recorded as having been chosen over the other. Thus for a destination far from major population centers, there is considerable opportunity for it to be recorded as preferred over closer destinations, but little opportunity for others to be recorded as preferred over it. Consequently, the further the destination from major origin centers, th

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the higher its attractivity rating is likely to be.[1,2]

A further problem relates to the assumption made concerning the negative impact of distance. The goal of the revealed preference approach here is to determine the way in which site attractiveness and distance are combined. The use of attractiveness measures based on an assumption about the evaluation of distance would appear to act against this purpose.

Despite the problems noted above, this method of measuring attractiveness does show promise. Unlike other techniques discussed, it has the advantage of using the choice data of the subjects to derive a measure which presumably reflects their evaluation of attractiveness. With refinement, it should ultimately prove useful in future studies.

Evaluation and Conclusions

Of the approaches to the measurement of attractivity of park destinations reviewed, the factor analysis method appears to be the most logical one to adopt for this study. It has the advantage of being reasonably objective, of incorporating considerable information about site characteristics, and of maintaining

[1]Cursory examination of the results Ross has obtained for Saskatchewan provincial parks supports this conclusion. When the parks are ranked in terms of attractivity scores and in terms of distance from Regina (the major population concentration in the province), the correlation between these ranks is virtually a perfect one. Despite the greater complexity of the Ontario provincial park system, a similar effect might well be expected in applying the technique to this system.

[2]One way of resolving this problem might be to employ proportions of possible choices as measures instead of actual numbers of choices. Thus the measures would represent the number of individuals preferring a particular destination as a proportion of the total number of individuals who could exhibit such a preference.

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pattern of destination alternatives.

In adopting an index of attractiveness in this study, the assumption is made that the index truly reflects evaluation of site attractiveness in the location choice process. It is thus desirable to try to ascertain whether such a relationship does exist between the designated index and the evaluation reflected in choice data. It has been suggested that measures of consistency of choice among destination attraction classes having similar distance-from-origin characteristics might be used to assess the validity of the attraction measures. Thus, if the attraction measures are valid, one would expect choices among destinations with similar distance characteristics to be consistent with these measures.

In order to assess this consistency, the revealed preference data for each of the eight distance classes was set up in the form of a matrix, each cell indicating the proportion of times destinations in one attractiveness category were selected over those in other categories at a similar distance.[1] Only pairwise choices between locational types with similar distance characteristics were considered here. Hence, by necessity only a relatively small proportion (one-eighth) of the total number of pairwise choices in the original matrix were utilized.

The analysis employed the same test for consistency discussed earlier with reference to the entire pairwise choice matrix. The eight matrices together with the results of consistency tests are shown in Figure 7. It is evident that consistency is complete for all but

[1]Derivation of the locational types used is discussed later.

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Distance Class		5
	51	
1	41	
	31	
	21	
	11	
	52	
2	42	
	32	
	22	
	12	
	53	
3	43	
	33	
	23	
	13	
	54	
4	44	
	34	
	24	
	14	

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Locational types

Distance Class		51	41	31	21	11	
	51	-	0	0	0	0	
1	41	1	-	1	0	0	C_c=1.0
	31	1	0	-	0	0	I_d=0.1
	21	1	1	1	-	0	
	11	1	1	1	1	-	

		52	42	32	22	12	
	52	-	0	0	0	0	C_c=1.0
2	42	1	-	0	0	0	I_d=0.1
	32	1	0	-	0	0	
	22	1	1	1	-	0	
	12	1	1	1	1	-	

		53	43	33	23	13	
	53	-	0	0	0	0	
3	43	1	-	1	0	0	C_c=1.0
	33	1	0	-	0	0	I_d=0.1
	23	1	1	1	-	0	
	13	1	1	1	1	-	

		54	44	34	24	14	
	54	-	0	1	0	0	
4	44	1	-	1	0	0	C_c=1.0
	34	0	0	-	0	0	I_d=0.2
	24	1	1	1	-	0	
	14	1	1	1	1	-	

Locational types

Distance Class		55	45	35	25	15	
	55	-	0	0	0	0	
5	45	1	-	1	1	1	C_c=1.0
	35	1	0	-	0	0	I_d=0.4
	25	1	0	1	-	1	
	15	1	0	1	0	-	

		56	46	36	26	16	
	56	-	0	1	0	1	
6	46	1	-	1	1	1	C_c=1.0
	36	0	0	-	0	1	I_d=0.7
	26	1	0	1	-	1	
	16	0	0	0	0	-	

		57	47	37	27	17	
	57	-	1	0	1	1	C_c=0.6
7	47	0	-	0	0	0	I_d=0.5
	37	1	1	-	1	0	
	27	0	1	0	-	1	
	17	0	1	1	0	-	

		58	48	38	28	18	
	58	-	0	1			
8	48	1	-	0			C_c=0.0
	38	0	1	-			I_d=0.33
	28						
	18						

C_c = Coefficient of Consistency

I_d = Index of Discrepancy

Figure 7. -- Preference matrices, consistency and discrepancy indices using the factor analysis measure of site attractiveness.

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the two longest distance classes. The longest distance class data are incomplete because of a lack of information on certain pairwise choices, hence little confidence should be placed in results showing complete inconsistency.

However, in order to interpret better the meaning of these results, several points should be made about the measure of consistency used. The measure simply compares the number of circular triads (cyclic triples) observed in the data against the maximum possible number of circular triads. Such a measure says nothing about the preference ordering of the locational types included. What is of concern is the extent of agreement among the pairwise choice data, not the nature of the preference ordering. An intransitivity is recorded regardless of whether it is found that $A \rightarrow B$, $B \rightarrow C$ and $C \rightarrow A$ or $C \rightarrow B$, $B \rightarrow A$, $A \rightarrow C$. Thus, even though for a particular distance category the choices among locational types may be perfectly consistent, this does not imply that the highest attractiveness type is most preferred followed by the next highest and so on down to the lowest attractiveness category.

It is desirable then, in addition to the measure of consistency to have some indication of the extent to which the preference ordering hypothesized in the attraction index is maintained in the pairwise choices observed. One simple measure of this agreement in preference ordering is merely to count the number of times in pairwise comparisons that there is a departure from the expected ordering of locational types. An index can be created by expressing these departures as a proportion of the maximum number of departures possible. For example, if the expected ordering of five locational types is A (most preferred), B, C, D, E (least preferred), this would be achieved if t

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if the following matrix of observed pairwise choices was discovered (Table 16). The presence of a 0 in the lower half of the matrix would indicate a departure from the expected ranking, hence a maximum of 10 such departures is possible.

TABLE 16

PREFERENCE MATRIX INDICATING CONSISTENCY WITH EXPECTED PREFERENCE RANKING

	A	B	C	D	E
A	-	0	0	0	0
B	1	-	0	0	0
C	1	1	-	0	0
D	1	1	1	-	0
E	1	1	1	1	-

(cells indicate proportion of choices for column locational type over row type -- 1 indicating proportions 0.5 and 0, proportions 0.5)

Figure 7 indicates matrices for each of the eight distance categories with locational types for each of these matrices ordered from highest to lowest attractiveness category. Departures from the expected ranking are indicated by 0's (underlined) in the lower half of each matrix. The three lowest distance classes each have only one departure from the expected ranking, in all cases involving slightly greater preference for the third most attractive type over the second highest type. The higher distance classes exhibit a greater number of departures from the expected ranking, however, only in the case of the sixth class do these departures constitute more than one-half of the maximum number possible.

Two other measures of attraction were also examined in order to compare the above results with those of other indices.[1] One such

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[1]These attraction values are indicated in Columns 7 and 8 of Table 14.

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measure uses average length of stay of campers at a park as a measure of site attractiveness, with the assumption that the longer the average length of stay, the more attractive is the park.[1] The other measure employs the results of a question of the 1966 Ontario Park User Survey concerning attractiveness of the area in which the park is situated. The assumption is made that the higher the proportion of campers viewing the area as attractive, the more attractive is the park destination located in that area.[2] Locational types were derived using each of these measures of attraction and employing similar distance-from-origin categories as in the preceding analysis.

The results of analysis of the choice data using the two attraction indices discussed above are indicated in Table 17. The coefficients of consistency among choices are quite high for most of the distance categories of both attraction indices. It thus appears that locational choices can be found to be equally consistent even when several different attractiveness measures are used. Hence, consistency measures do not seem to be of great assistance in assessing the validity of one measure of attractiveness compared to another one.

Values for the discrepancy index indicating proportion of pairwise choices which differ from the expected direction of preference reveal significantly greater discrepancies for the latter two attract-

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[1]This assumption has been employed in other studies (e.g. Hodgson, "Campground Features," pp. 31-35) and appears to be supported by some evidence (c.f. W.F. LaPage, The Role of Customer Satisfaction in Managing Commercial Campgrounds [Upper Darby, Penn.: North East Forest Experiment Station, U.S.D.A. Forest Service Research Paper, NE-105, 1968].).

[2]Such an interpretation is largely untested, however it is employed here to provide a simply derived measure against which other indices might be compared.

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TABLE 17

RESULTS OF TESTS OF THE ATTRACTION INDICES

Length of Stay Index			Attractiveness of Area Index		
Distance Category	Coefficient of Consistency	Discrepancy Index	Distance Category	Coefficient of Consistency	Discrepancy Index
1	1.0	.10	1	0.8	.40
2	1.0	.10	2	1.0	.30
3	1.0	.50	3	1.0	.30
4	0.6	.60	4	1.0	.20
5	1.0	.20	5	1.0	.30
6	0.8	.60	6	1.0	.30
7	1.0	.50	7	0.5	.50
8	1.0	.50	8	1.0	.17

iveness indices than for the index initially examined. This result suggests that of those indices examined, the factor analysis measure is the most meaningful index of site attractiveness.

The tests of attraction measures have not included the simple attractivity function derived by Ellis and discussed initially in this section. In fact, the attractivity scores derived from this function are quite highly correlated with the factor analysis attractivity scores (correlation coefficient of 0.81), suggesting that the two techniques are measuring much the same types of site attributes, and hence that results of the test would be quite similar.

In conclusion then, it appears that of those measures of attraction whose application is currently feasible, the factor analysis approach represents the most appropriate index of site attractiveness. Good possibilities exist for improving attractiveness measures through employment of other techniques (notably that of Ross) however additional research is required.

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CHAPTER IV

LOCATIONAL PREFERENCES OF ONTARIO PROVINCIAL PARK CAMPERS

This chapter is concerned with applying the revealed preference approach to the interaction system for Ontario provincial park campers, identified in the previous chapter. Initially an effort is made to formulate hypotheses regarding the nature of such preferences. This is followed by derivation and discussion of locational preferences under several slightly different model formulations.

The Nature of Locational Preferences of Campers - Hypotheses

It should be reiterated that the term "locational preferences" as employed in this study refers to preferences among different combinations of distance and site attributes of destinations. Locational preferences, in essence, define the trade-off between distance and site attributes which is established by the individuals concerned. The preferences of interest, then, are not simply those for site characteristices or distance characteristics alone, but rather, for combinations of these characteristics.

Relatively little information is available on preferences of recreationists for combinations of site and distance characteristics. Most studies have dealt with either the site characteristics or the dista

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distance characteristics, assuming the variable not examined is constant.[1] Thus if a graph is envisaged illustrating variations in preferences over distance (horizontal axis) and site attributes (vertical axis), such studies might provide information about variation along one dimension but rarely along both dimensions. Such predominantly one-dimensional studies are of some use in suggesting hypotheses, provided that their restriction to one dimension is noted.

An initial hypothesis is that individual preference structures of Ontario campers will be quite similar -- i.e. that campers have relatively similar locational preferences. A variety of evidence lends support to such a hypothesis, including the results of a number of studies already discussed in the dissertation.[2] Similarity of individual preferences would be indicated by values approaching 1.0 or 0.0 in the probability matrix (expressing the probability of choice of locational type A over B when both are available).

Another hypothesis which appears plausible is that the aggregated pairwise locational choices of Ontario campers will have a

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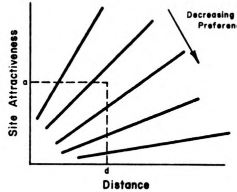
[1]For example, Aldskogius, (H. Aldskogius, "Vacation House Settlement in the Siljan Region," Geografiska Annaler, XLIX B (1967), pp. 67-95.) concentrates on the site dimension while disregarding the position dimension. Also in Shafer and Thompson, "Models that Describe Use of Adirondack Campgrounds," parks located at roughly similar distances from population centers were chosen to minimize the effects of unequal distances on park patronage.

[2]See, for example, the studies by Wolfe (Wolfe, Parameters of Recreational Travel in Ontario, and Wolfe, A Use Classification of Parks).

fairly high degree of consistency. In other words, aggregating such choices leads to the formulation of an aggregate preference structure which has considerable consistency. This attribute will be measured by the coefficient of consistency referred to earlier, with values approaching 1.0 indicating a high degree of consistency.

Focusing on those site attributes that contribute to "attractiveness", hypotheses can be advanced concerning the combining of attractiveness and distance attributes. If rational choice behavior is assumed, it might by hypothesized that, given a choice between two destinations at similar distances, preference will be shown for the one having the more attractive site characteristics. We might also expect that, given two destinations of approximately equal attractiveness, the one closer to the origin center will be preferred. Thus preferences might be expected to be greater with increasing attractiveness or decreasing distance (other things being equal). The possibility exists that the 'trip' aspects may be an important contributor to the recreation experience and thus that increased distance may not always be regarded as a liability. Despite this possibility, it is hypothesized that in a majority of cases, distance is regarded as a liability.

According to the above hypotheses then, a preference surface of the form illustrated in Figure 8 is envisioned (the lines join equally-preferred alternatives). At distance d (or any distance), the greater the attractiveness of the destination the higher the percentage of individuals choosing that destination over other alternatives. Similarily, at attractiveness a (or any attractiveness) the shorter the distance of the destination, the higher will be the percentage choosing it.



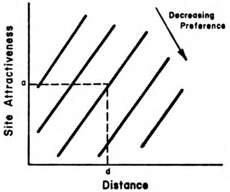
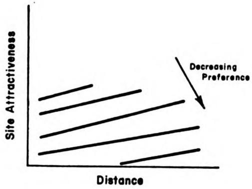


Figure 8.--Hypothetical preference surfaces showing increases in preference for destinations with higher attractiveness and/or shorter distances.



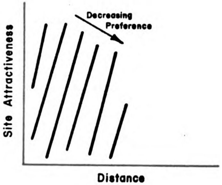


Figure 9.--Hypothetical preference surfaces where little substitution between distance and attractiveness of destinations is possible.

The hypotheses advanced above have not dealt with site attractiveness and distance characteristics simultaneously. That is, no rationale for choice has been suggested when both attractiveness and distance characteristics differ between two alternatives. Thus, aside from broad limits, the slope and alignment of the lines of preference have not been specified.

In general, the greater the extent to which substitution between distance and attractiveness is possible, the more the preference lines will depart from a vertical or horizontal position. Maximum tradeoffs between the two variables are indicated by slopes approaching that of the diagonal. The two illustrations in Figure 9 show situations where relatively little substitution is possible.

One might expect that it is easier to determine and evaluate distance as opposed to attractiveness of destinations. Attractiveness tends to be evaluated more subjectively than distance. Thus it might be anticipated that distance variations would have a greater impact on locational choices than changes in attractiveness. Accordingly a preference surface similar to the one on the right of Figure 9 might be hypothesized.

While there appears to be little point in further hypothesizing about locational preferences, because of the lack of information on which to base such hypotheses, one further aspect might be mentioned -- the alignment of the preference lines. A parallel alignment of such lines suggests, for instance, that a given change in distance always can be traded for a given change in attractiveness (i.e., a 50 mile difference has the same effect, whether talking about the difference between 50 and 100 miles or the difference between 500 and 550 miles). On the other hand, lack of parallel alignment indicates that a given distance interval is substituted for varying attractiveness intervals depending on location on the preference surface.

Wolfe has suggested the existence of an inertia factor which tends to increase one's resistance to short trips (i.e. the effort required to get going on any trip is constant) and decreases one's resistance to long trips (little effort is required in extending distance travelled).[1] This hypothesis would suggest for short distances, substitution of a greater than average attractiveness interval per distance interval, (i.e. steeper slope) while for long distances, substitution of a lesser than average attractiveness interval per distance interval (i.e. lesser slope).

Derivation and Analysis of Locational Preferences

Distance and Attractiveness Classes

The attractiveness and distance measures to be utilized in the revealed preference model have already been discussed. It remains to define the classes into which these data are grouped for analysis.

It is apparent that there are limits to the number of attractiveness and distance classes that can be handled readily because of the necessity of analyzing pairwise choices among all attractiveness-distance combinations (locational types). For example, with only three attractiveness categories and three distance categories, nine different

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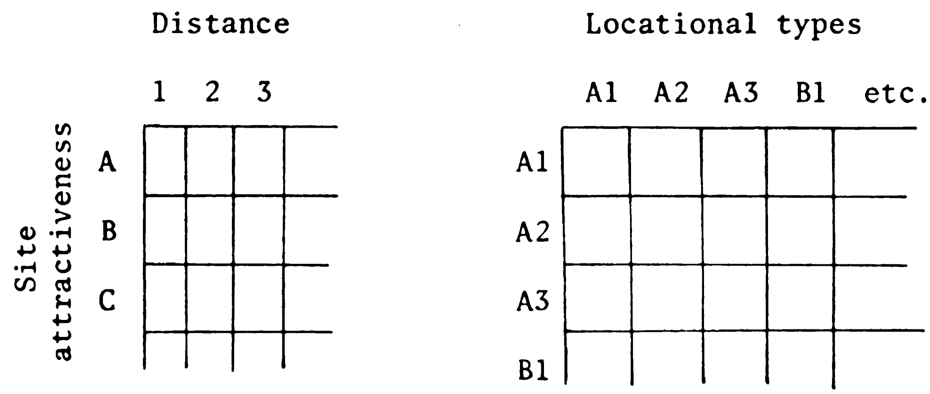
[1]R.I. Wolfe, "The Inertia Model," Journal of Leisure Research, IV (1972), pp. 73-76.

combinations of these are possible creating a total of 72 pairwise choices to be examined -- excluding the diagonal cells pairing similar locational types (Table 18). There are also limits beyond which it is not useful to subdivide the attractiveness and distance measures. If little additional information is derived from using a greater number of classes, there is little point in undertaking the extra effort required.

TABLE 18

MATRIX REPRESENTATION OF LOCATIONAL TYPES



Without a considerable amount of experimentation, it is difficult to determine the number of combinations which is most desirable in terms of both economy of effort and sufficiency of detail. While such experimentation would have been useful, it represented a tangential aspect of the study and therefore was not undertaken. Consequently, in the interests of economizing on computer time and capacity, it was decided that a maximum of forty locational types would be handled.

The attractivity indices derived from factor analysis of Ontario provincial park attributes were employed following slight modifications to some park attraction scores to take into account degree of usage of park camping capacity (Column 5 and 6 of Table 14).[1] In fact, these adjustments had a negligible impact on the attractivity ranking of parks. Each of these attraction scores was assigned to one of five attraction classes (Figure 10). The primary concern in establishing the class limits was to achieve roughly similar numbers of parks in each category and to position class divisions where natural breaks in values seemed to occur.

Origin-destination distances (in miles) were calculated for all possible combinations of the 54 Ontario origins and 81 Ontario provincial park destinations designated earlier.[2] There is a wide range in origin-destination distances, from less than 20 miles to well over 1,000 miles.[3] From the graph in Figure 12 however, it is apparent that approximately three-quarters of the 1966 sample of camping parties travelled less than 500 miles to park destinations.

Two distance classifications were established for use in the revealed preference analysis. One classification scheme defined eight equal distance classes of 75 miles, thus excluding origin-destination

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[1]The adjustments were made in recognition that while, theoretically, a camper may choose any park as a destination, in peak periods, use of a given park to capacity or near capacity may well deter a substantial number of campers from utilizing such a park. Appendix IV discusses this aspect and the method of refining the index which was adopted.

[2]Where sufficiently accurate, straight-line distances, calculated from locational co-ordinates of origins and destinations, were used. However due to the shape of the province, a number of destinations can be reached only by circuitous routes (Figure 6). In these cases, mileages for the shortest possible highway routes were substituted.

[3]Highway 17 for example, traverses a distance of approximately 1350 miles across Ontario from Quebec to Manitoba, and even this distance does not represent the longest possible origin-destination trip within the province.

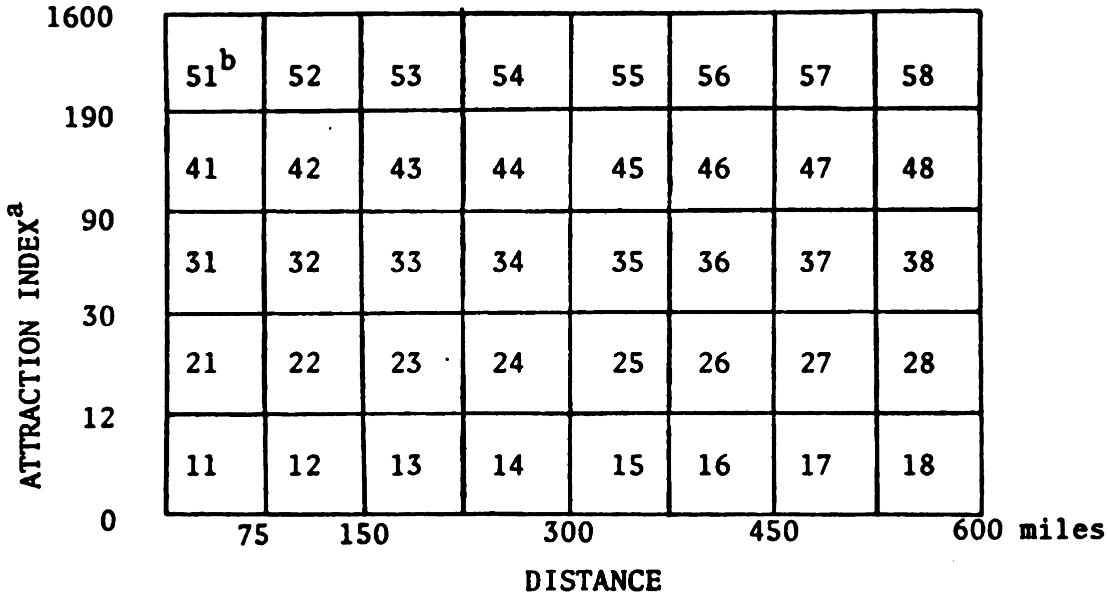

Fig. 10.-Definition of locational types:
equal mileage intervals used in defining distance classes

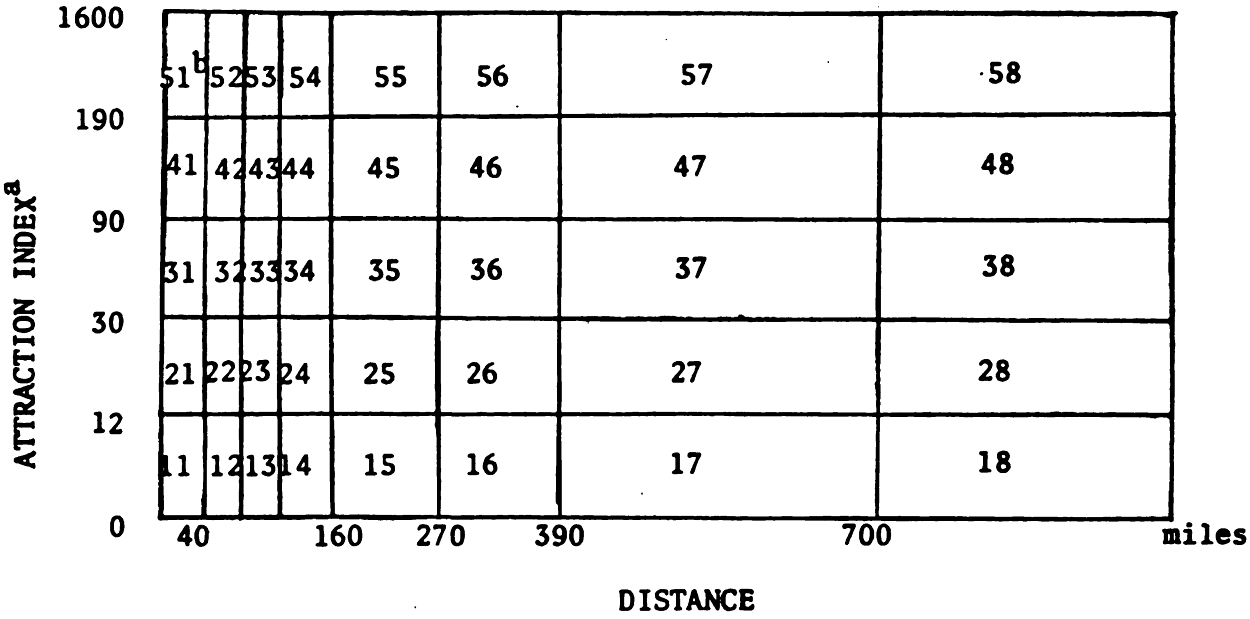

Fig. 11.--Definition of locational types:
equal 1966 camper sample proportions used as a criterion for the distance classes

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[a]Index values refer to the modified factor analysis indices, multiplied by 100 to simplify presentation.

[b]Locational type identification number

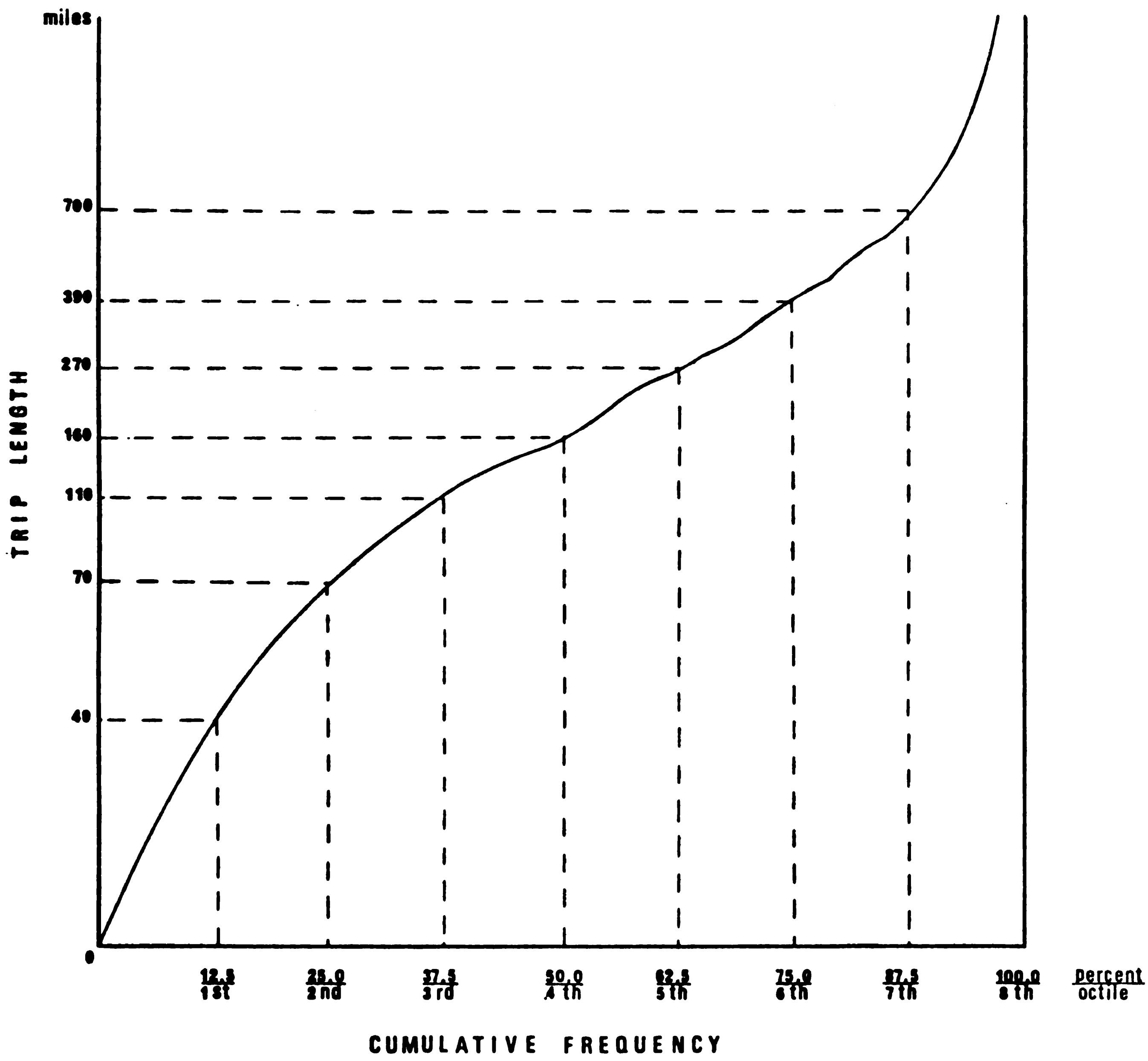

Fig. 12. Distance classes defined by cumulative frequencies of trip lengths (1966 camper sample).

distances of more than 600 miles. Since less than twenty percent of sampled camping parties travelled more than 600 miles to a park destination, this limit appears justifiable. The other distance classification method divided the range of origin-destination distances into eight categories, each including approximately the same proportion of the 1966 sample of campers. That is, the lowest distance class included the lowest one-eighth of the origin-destination trips of the sample, ordered in terms of distance. The class boundaries are indicated by the dashed lines in Figure 12 dividing the sample into octiles, each constituting 12.5 percent of the total sample size.

Each distance classification has certain advantages. Establishment of distance classes using similar mileage intervals permits the examination of preferences over uniformly changing distance categories, however -- as observed from Figure 12 -- the lowest two classes contain more than half of the camping parties included in the sample. Adoption of the distance classification based on equal sample proportions ensures that roughly similar numbers of trips will be included in each distance category. This method also includes the entire range of origin-destination distances in the categories established.

The locational types, formed by combining each attraction class with each distance class, are illustrated in Figures 10 and 11 for the two distance categorizations adopted. These locational types are identified by a two-digit number, the first digit referring to rank of attraction class (lowest attraction class = 1), and the second digit indicating rank of distance class (shortest distance class = 1).

Identifying Locational Preferences: Case I- 1966 Camper Sample, Equal Mileage Classes

The 1966 camper data, consisting of 3,426 camping parties listing Ontario hometowns interviewed at Ontario provincial parks (long form questionnaire) is analyzed initially using equal distance classes in defining locational types.[1] The headings adopted below indicate the major steps in the analysis. Because of space limitations only selected portions of the results have been reproduced.

The Problem of Variability in Sampling Fractions. -- As noted in the previous chapter, because of the sampling technique employed in the 1966 survey of Ontario provincial park campers, there is considerable variability from park to park in the proportions of park users sampled in this survey. The effect has been over-representation in the sample of parks with low numbers of users, frequently those of lesser attractiveness (Appendix VII). Obviously, such variability could have a significant effect on locational preferences derived for the sample, perhaps chiefly by indicating that parks of lesser attractiveness were chosen more frequently than they actually were.

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[1]The 1966 Park User Survey data was obtained from the Ontario Department of Lands and Forests in the form of punched cards (one card per interview). A listing of the computer program utilized to perform the revealed preference analysis is included as a part of Appendix VI. This program is a modification of that developed by Kern and Rushton (R. Kern and G. Rushton, "REVPREF: Paired Comparisons Analysis from Revealed Spatial Preference Data" Technical Report No. 95 [Computer Institute for Social Science Research, Michigan State University, 1969, Mimeographed]). Several other programs were developed to compile the data and calculate origin-destination distances but are not listed here.

It was thus considered desirable to attempt to eliminate this variability in sampling fraction. The solution adopted was to expand each park sample to a 100 percent sample by multiplying the original sample by the reciprocal of the sampling fraction for that park. This involves multiplying each origin-destination linkage identified in the sample by the reciprocal of the park's sampling fraction. Such an expansion assumes that the original sample is representative of the entire population. However, the advantage gained by reducing variability of the sampling fractions appear to justify such an assumption in this case.

Initial Ranking of Locational Types. -- Following the assigning of interaction data to the revealed preference data matrix indicating choices between each pair of available locational types, a probability matrix is created representing, for pairs of locational types, probabilities of choosing one over the other. The ranking of locational types by percentage of pairwise comparisons in which they were preferred over other types (i.e., having a probability of selection of greater than 0.5). is derived from the probability matrix and is shown in Table 19. This ranking is one indication of preference for locational types -- those locational types near the top of the ranks are preferred to most, while those at the bottom largely are by-passed for others.

The notable feature of this preference ranking is the substantial correlation between rank on the preference scale and distance rank of locational types. Those locational types with the shortest distances are highly ranked on the preference scale, while those with longer distances achieve progressively lower preference ranks. There is evidence of little correlation between preference rank and degree of attractiveness of locational types, however.

TABLE 19

LOCATIONAL TYPES RANKED BY PERCENTAGE OF TIMES PREFERRED OVER OTHER TYPES IN PAIRWISE COMPARISONS - CASE I

Rank	Locational type	Rank	Locational type	Rank	Locational type
1	51	14	34	27	36
2	52	15	54	28	18
3	31	16	23	29	26
4	41	17	13	30	56
5	21	18	24	31	17
6	32	19	55	32	37
7	53	20	44	33	48
8	42	21	35	34	45
9	33	22	16	35	14
10	11	23	15	36	57
11	22	24	47	37	27
12	12	25	25	38	46
13	43	26	38		

The locational preferences of Ontario campers, then, appear to be closely related to the distance attributes of the locational types, but much less closely related to attractiveness characteristics.

Degree of Consistency of the Data. -- The extent to which the above preference ordering of locational types is shown to be consistent has an important bearing on the further scaling of locational preferences. Without a high degree of consistency, choice probabilities do not permit scaling of preferences on a one-dimensional scale and the construction of the commonly employed preference surface becomes impossible.

The test for weak stochastic transitivity of the choice probabilities for Ontario campers results in a coefficient of consistency of 0.989 (where a coefficient of 1.0 indicates complete consistency).[1] Thus, by this criterion, the aggregated choices of Ontario campers among the locational types are quite highly consistent.

Table 20 provides a graphic illustration of the extent of this consistency. Were the choice probabilities fully transitive, the lower left half of the matrix would consist entirely of 1's (indicating probabilities greater or equal to 0.5) and the upper right half would consist of 0's (probabilities less than 0.5). Intransitivities are identified by the discrepancies from this pattern (circled in Table 20).

This high degree of consistency of the aggregated choices is important in several respects. For one thing, it suggests that the locational choices of Ontario campers can be conceptualized as the application of a unidimensional preference ranking of locational types to the set of destination alternatives. In addition, such consistency indicates that while the choice probabilities represent accumulations of choices by many individuals, these aggregated results are to a considerable extent, in harmony with each other (with respect to contributing to a consistent scaling of preferences).

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[1]The test, discussed in Chapter II, measures the proportion of intransitive triplets occurring in the ordered probability matrix (an intransive triplet occurs when, for example, A is preferred to B, and B to C, but C is preferred to A).

TABLE 20

TRANSITIVITY MATRIX - CASE I

LOCATIONAL TYPES

	33	25	17	34	26	27	1	9	18	2	3	10	35	11	19	36	12	28	4	37	13	29	8	31	20	6	30	7	5	14	21	23	22	16	39	24	38	40	15
33	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
25	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
34	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
26	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
27	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
35	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
36	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.	1.	0.	0.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	1.	0.	0.	1.	0.	1.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
28	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	1.	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
37	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	0.	0.	0.	0.	1.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
13	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.	1.	0.	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
29	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	0.	1.	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
31	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.	1.	0.	1.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
30	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.	0.	1.	1.	1.	0.	0.	1.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.
7	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.	0.	1.	0.	1.	0.	0.	0.	1.	0.	0.	0.	0.	0.
14	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	1.	0.	0.	0.	0.	0.	0.
21	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.	1.	0.	1.	0.	0.	0.	0.	0.	0.	1.
23	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.	0.	1.	0.
22	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.	0.	1.	0.	0.	0.	0.	0.
16	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.	1.	0.	0.	0.	1.	0.	1.	0.
39	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	0.	0.	0.
24	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.	0.
38	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	0.	0.
40	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	0.	1.	1.	1.	0.	1.
15	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	0.	1.	1.	1.	1.	1.	1.	0.	0.

TRANSITIVITY BY ROW= 0.98972

Perceived Similarity between Locational Types. -- It is readily seen that considerable information from the revealed preference analysis has not yet been utilized. The pairwise choice probabilities thus far have been used only to the extent of determining whether they are less than, equal to , or greater than 0.5. As noted by Rushton, these probabilities may be interpreted as independent measures of perceived dissimilarity between locational types.[1] That is, the closer to 0.5 are the probabilities expressing preference for A over B, and for B over A, the greater the revealed similarity between the two locational types is considered to be. Note that it is the similarity between locational types as revealed by pairwise choices that is being considered here. It should be apparent that this measure of degree of similarity between pairs of locational types is directly related to the degree of dissimilarity of choices between the locational types. For example, if the choice probabilities for locational type A over B and B over A are both 0.5, similarity is indicated between these two locational types. However probabilities of 0.5 also indicate that disagreement occurred among individuals choosing between the two types, with half choosing A over B and the other half choosing B over A. This topic of agreement among choosers is discussed later.

By representing choice probabilities in terms of absolute difference from 0.5, measures of locational type dissimilarity are obtained in which 0.0 indicates completely similar types (proximity

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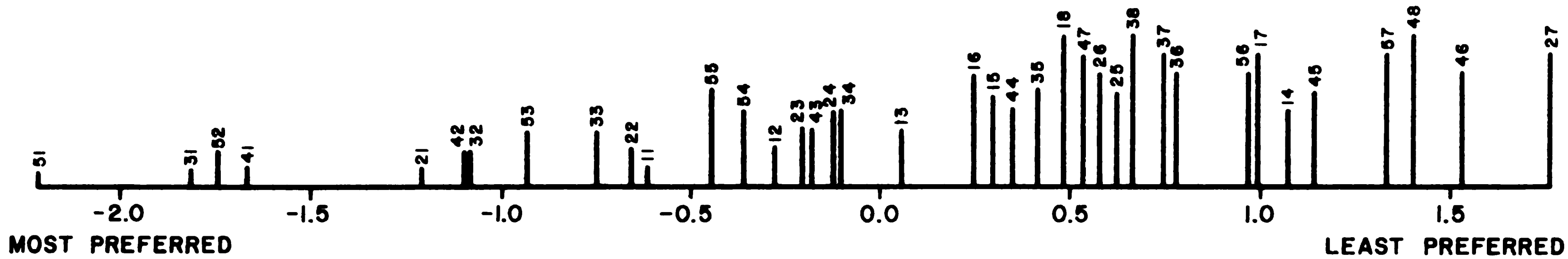
[1]Rushton, "The Scaling of Locational Preferences."

matrix). Such measures constitute the input for the multidimensional scaling technique discussed earlier.

Interval Scaling of Locational Types. -- Figure 13 indicates the computed scale positions on the first dimension for the 38 locational types for which choice data were available. The stress value for this first dimension is 0.295.[1] The highest negative value represents the most preferred locational type while the highest positive value on the scale represents the least preferred type.

Several features of this preference scale (Figure 13) are readily apparent. With minor exceptions, the ranking of locational types in this scale is similar to the initial preference ranking discussed previously -- i.e., high correlation between preference rank and distance class -- with the lowest distance locational types being most preferred. Those pairs of locational types most closely situated together on the scale have the same distance attributes, or at most, differ by only one distance category. This provides further evidence of the importance of distance attributes in influencing preferences for location. Considering the entire scale, the greatest clustering of locational types occurs in the middle of the scale and involves types with intermediate attractiveness and distance characteristics. The suggestion is that preferences differ little among these intermediate

[1]The stress value indicates only a fair correspondence between the dissimilarity values and the derived scale values. However stress values for the two and three-dimensional scalings were not deemed sufficiently lower to justify the adoption of multidimension scale in this situation.



(number above the line identifies the locational type, and height of the line indicates the distance category)

Figure 13.--Unidimensional preference scale: Ontario provincial park campers, 1966 (Case I).

types, but are more strongly differentiated with respect to the extreme locational types identified, an interesting observation.

Preference Surface. -- Finally, Figure 14 illustrates the preference (indifference) surface constructed using the values assigned to the locational types in the unidimensional scale. This surface provides additional information about locational preferences, as is seen below.

The preference surface reveals the extent to which the locational preferences already identified can be understood in terms of distance and attractiveness attributes. As noted earlier in this chapter, the characteristics of the equal-preference lines (connecting equally preferred points on the surface) which model the surface are important indicators of preferences for location.

The most apparent features of the preference surface of Ontario campers (Case I) are the alignment and slopes of the equal-preference lines (commonly called indifference curves). Over the locational types covering distances up to about 300 miles, these preference lines are aligned roughly parallel to each other and tend toward a vertical slope. It might be concluded, with certain exceptions, that a given change in distance anywhere over this portion of the surface is "traded-off" for a constant change in attractiveness. The diagonal nature of these lines indicates that substitution between distance and site attractiveness is considerable. In general, individuals are willing to travel longer distances to more attractive destinations and shorter distances to less attractive destinations. The most preferred locational type is that having the highest attractiveness and the shortest distance

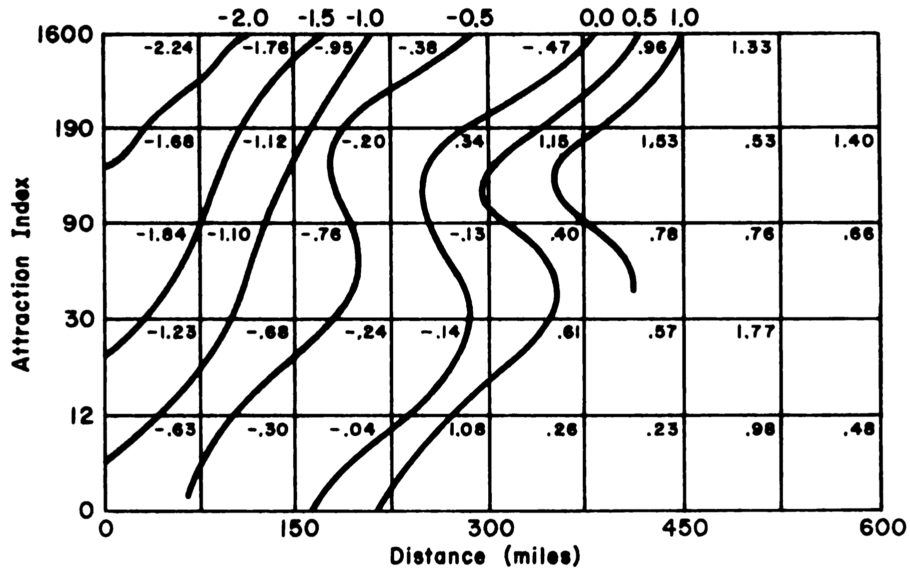


Figure 14. -- Locational Preference surface: Ontario provincial park campers, 1966 (Case I).

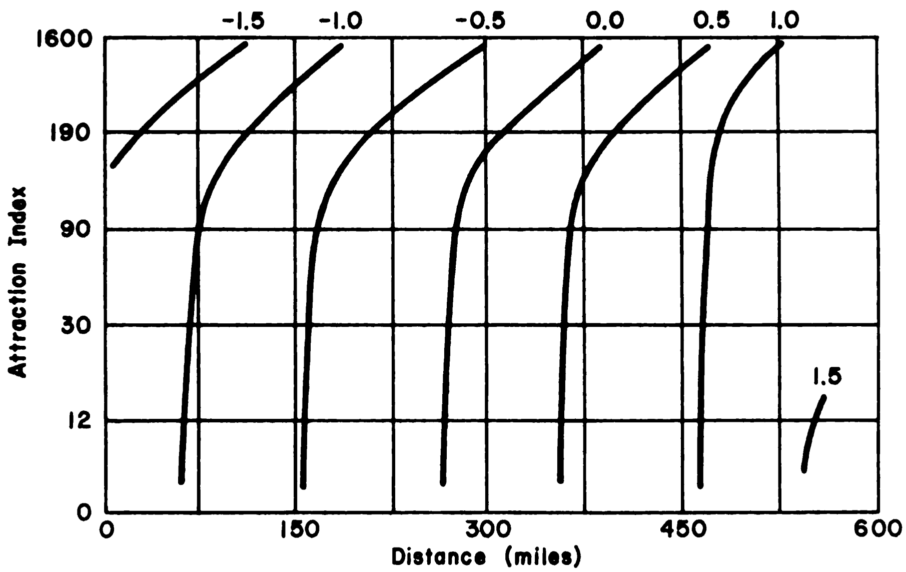


Figure 15. -- Locational Preference surface fitted to Case I preference scores by multiple regression analysis.

(upper left hand corner, number 51).

In the portion of the surface beyond a distance of 300 miles, little order relative to distance or attractiveness attributes can be detected in the preferences. Thus these preferences cannot be represented meaningfully by preference lines here. Virtually all that can be said is that there seems to be little relationship between preferences for these locational types and distance or attractiveness attributes. It is possible that preferences for locational types having distances of more than 300 miles are based on different criteria little related to distance itself or the measure of site attractiveness adopted. Perhaps criteria concerning what constitutes an attractive destination are different depending on distance travelled -- i.e., those travelling long distances seek a different type of camping opportunity than those travelling shorter distances. The preference surface then, gives rise to a number of hypotheses which might be investigated in future research.

Further Analysis of Relationships. -- As already noted, the above preference surface represents an effort to ascertain the extent to which variations in preference for park destinations can be understood in terms of both attractiveness and distance-from-origin attributes of the destinations. These relationships can be explored further through attempting to fit a surface to the preference scores on the basis of attractiveness and distance values. This can be accomplished through the use of multiple regression analysis, employing the attractiveness and distance variables as independent variables and the preference score variable as the dependent variable. The analysis can reveal the extent to which variation in the dependent variable (preference score) is accounted for by variation in the independent variables (attractiveness and distance measures).[1]

The following regression equation was derived from the analysis:

$$y = 0.005x_1 - 0.0006\ x_2 - 1.3243$$

(where y represents the preference score
x_1 represents the distance variable
x_2 represents the attractiveness variable)

Together, these two independent variables accounted for 76.94 percent of the variation in the preference variable (R^2 value of .7694). Thus it is evident that differences in preference among destinations are quite highly related to differences in attractiveness and distance of these destinations. Concerning the two independent variables, the distance variable is by far the most important in accounting for preference variation. Of the 76.94% variation accounted for, the distance variable contributed 72.90%.

Figure 15 illustrates the surface fitted to the preference scores through the multiple regression analysis. Curves in the preference lines of this surface are the result of the scale employed to represent the attractiveness values -- as is apparent from above, the equation used to derive this surface was a linear one. The importance of the distance attribute relative to preferences is indicated by the near-vertical slope of the preference lines over much of this surface. The relative lack of substitution between distance and attraction apparent here, seems to be the result of smoothing out some of the anomalies of the

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[1]Details of the multiple regression analysis are not discussed here. See the discussion by Blalock (Blalock, Social Statistics, pp. 326-58).

original preference surface and departs somewhat from conclusions drawn from that surface.

Randomness of Choice. -- It has been noted that the probabilities for pairs of locational types are indicative of the amount of agreement among individuals choosing between the various types (0.5 indicating maximum disagreement).

One possible factor in situations where such disagreement occurs may be that individuals are indifferent to which one of a pair of locational types they select, and thus tend to make random choices resulting in pairwise choice probabilities which tend toward a value of 0.5. Figure 16 summarizes the results of testing the pairwise choices of the camper sample for lack of significant difference from 0.5. The figures represent for each locational type, the number of pairwise choices where choice probabilities are not significantly different from 0.5.[1]

The results of the above test are striking. It appears that for a relatively large proportion of the choices involving locational types with distances over 300 miles, randomness in choice is a plausible explanation. This suggests that there may be considerable randomness involved in choices of destinations located some distance away from the chooser. Such conclusions should be regarded only as tentative, though, because of several problems in the data and tests utilized.[2]

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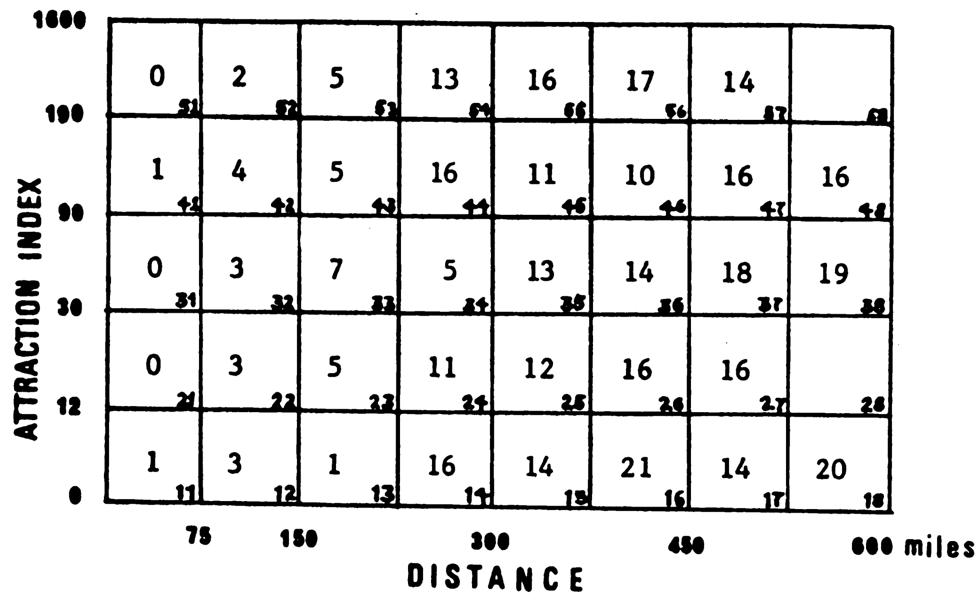
[1]The .05 level of significance was employed for both chi-square and Fisher's exact tests.

[2]Discussion of these matters is deferred to Chapter V since the tests are used to a much greater extent in that part of the analysis.



(figures represent number of pairwise choices insignificantly different, at the .05 level, from 0.5 probability)

Fig. 16.--Test for randomness of choice: Ontario provincial park campers, 1966 (Case I).

Identifying Locational Preferences: Case II - 1966 Camper Sample, Distance Classes with Equal Sample Proportions

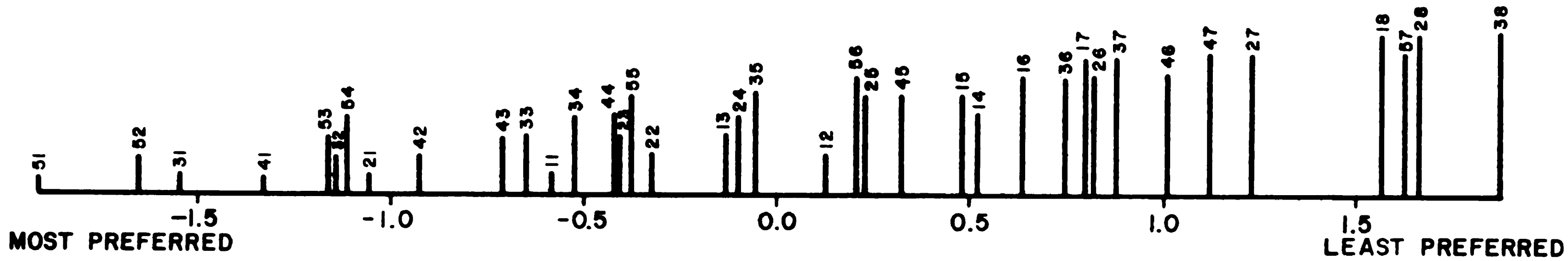
Analysis similar to that discussed for Case I was carried out using the expanded 100 percent sample of Ontario provincial park campers and similar attraction indices for the park destinations, but altering the distance categories used in defining locational types. This redefinition of locational types, involving the setting up of distance classes having roughly equal proportions of the camper sample, has been discussed previously and is shown in Figures 11 and 12. It was considered desirable to repeat the analysis to include the entire range of distances travelled by campers sampled (rather than the 600 mile limit applied in Case I) and equalize the sample numbers over the distance classes established.

Comparison of Results: Case I and Case II. -- The ranking of locational types by proportion of pairwise comparisons in which they were preferred over other types, differs very little from the Case I ranking and is not reproduced here. Again there is a significant relationship between distance and preference ranks.

The coefficient of consistency achieved by the Case II preference ranking is 0.997, indicating a fractionally higher degree of consistency than the Case I data, but again the differences between the two cases are insignificant.

Figure 17 shows the unidimensional interval scale of locational types for the Case II data. Stress value for this first dimension is 0.196, somewhat lower than the corresponding value for Case I (in fact, not much higher than the stress value for the three-dimensional scale for Case I).[1] As in Case I, there is close correspondence between this ranking of locational types and the one initially obtained. The chief difference between Case I and Case II interval scales appears to be a somewhat greater differentiation among lesser preferred locational types in the Case II situation. Also there appears to be a closer relationship between preference and distance attributes in the Case II scale. One interpretation of these differences in scales is that the distance categories employed in Case II may be more meaningful in grouping to-

[1]Again, stress values for higher dimension scales do not differ sufficiently from the one-dimensional case to justify their use.



(number above the line identifies the locational type, and height of the line indicates the distance category)

Figure 17.--Unidimensional preference scale: Ontario provincial park campers, 1966 (Case II).

gether destinations which appear similar to the choosers. Again as in Case I, differentiation among types is less pronounced in the center of the preference scale than at the extremes of greatest or least preference.

The locational preference surface has a somewhat different configuration than that of Case I (Figure 18). Similarities are evident though in the preference lines representing the portion of the surface including distances up to 300 miles or so. As in Case I, the preference lines here are predominantly diagonal and parallel to each other, indicating existence of substitutions between distance and attractiveness. For the longer distance portions of the surface, there is some tendency toward a reverse preference for site attractiveness (i.e. locational types with higher attractiveness classes are less preferred to those at similar distances with lower attractiveness). This trend, however, is not well-defined.

An attempt was made to fit a surface to the preference scores for Case II employing distance and attractiveness variables in a multiple regression analysis. The following regression equation was obtained, accounting for 80.32 percent of the variation in the preference scores (R^2 of .8032):

$$y=0.0035x_1 - 0.0007x_2 - 0.7427$$

(y represents the preference variable
x_1 represents the distance variable
x_2 represents the attractiveness variable)

Thus much of the variation in preferences for destinations is accounted for by variation in distance and attractiveness of the destinations.

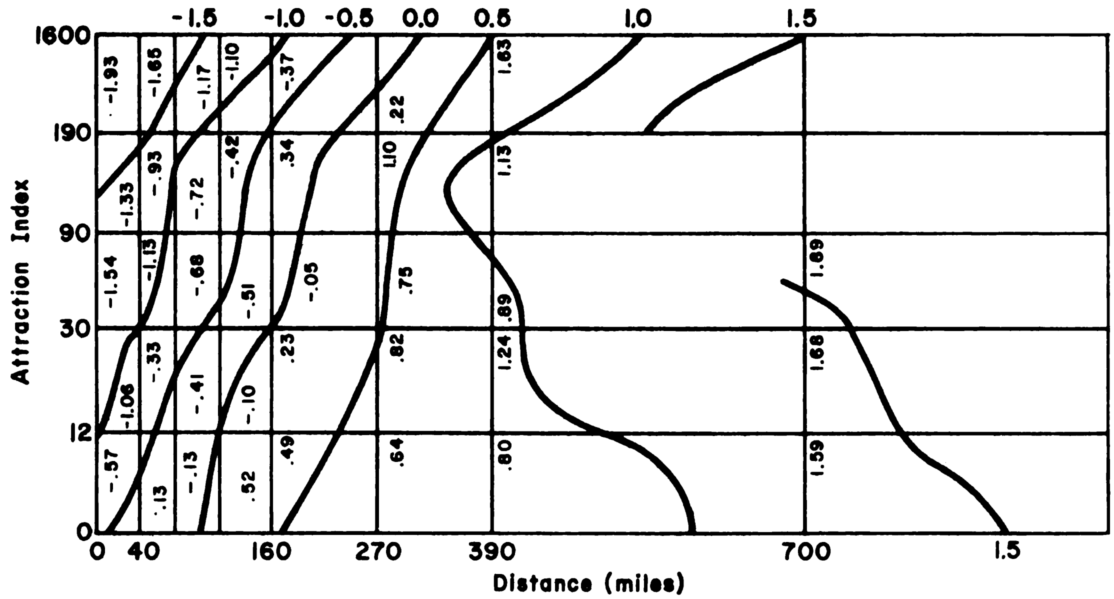


Figure 18.-- Locational preference surface: Ontario provincial park campers, 1966 (Case II).

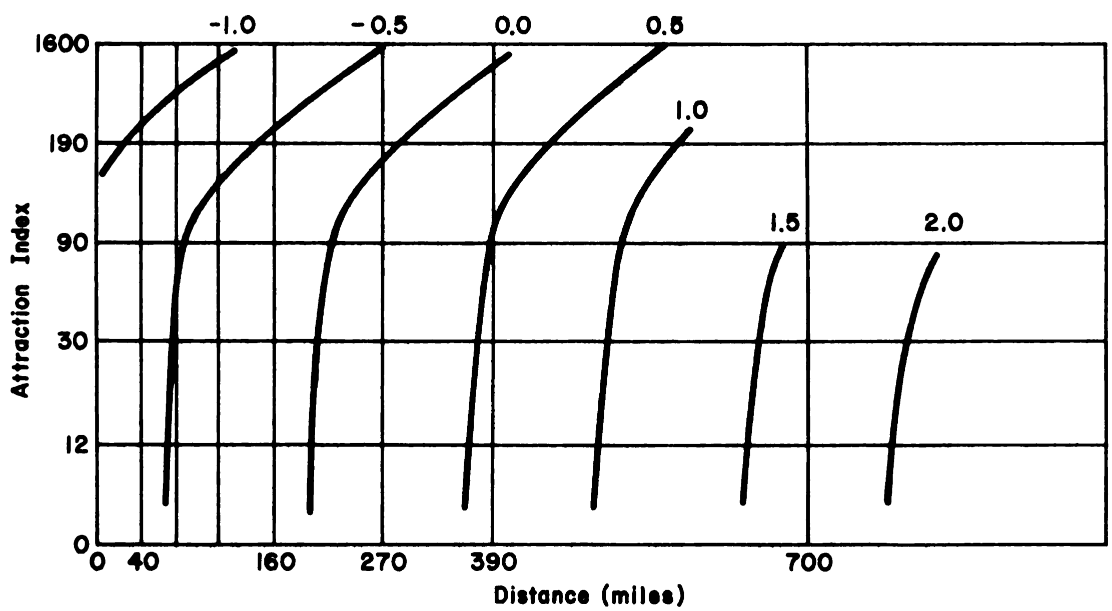


Figure 19.-- Locational preference surface fitted to Case II preference scores by multiple regression analysis.

As in the Case I situation, virtually all of the "explanation" of preference variation is achieved by the distance variable (75.58 percent out of the total of 80.32 percent).

Figure 19 portrays the preference surface derived from the above regression equation. The configuration of the preference lines resembles that of Case I, apart from a somewhat more pronounced trend here toward distance-attractiveness tradeoffs.

Identifying Locational Preferences: Case III - 1968 Camper Survey, Distance Classes with Equal Sample Proportions

The results of a 1968 survey of Ontario provincial park campers were also analyzed to determine locational preference characteristics. It was felt that a comparison between the 1966 and 1968 situations with respect to locational preferences would be of considerable interest because it might indicate something about the stability of preference structures over time. It has been asserted that preference structures have greater stability than the spatial system within which such preferences have been observed.[1] The possession of information on locational choice of campers for both 1966 and 1968 allows limited examination of such as assertion. Also, the 1968 survey involved a 100 percent sample of campers regarding origins and destinations and hence provides the opportunity to compare

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[1] Rushton, "Analysis of Spatial Behavior," p. 400. G. Rushton, "Temporal Changes in Space-Preference Structures," Proceedings, Association of American Geographers, (1969), pp. 129-132.

locational preferences obtained from a sample (1966) with those of the entire population (1968).[1]

<u>Comparison of Preferences, 1966 and 1968 Campers</u>.--The definition of locational types for the analysis of the 1968 data is similar to that used in Case II, so comparisons are made chiefly between Cases II and III.

The ranking of locational types by percentage of times they are preferred over other types is shown in Table 21. The similarities between the Case I and II rankings are striking. It is apparent that there is very little difference between 1966 and 1968 data in the proportion of times that particular locational types were preferred over other types.

The above preference ranking of 1968 data attained a coefficient of consistency of 0.991, virtually identical to that of the Case II analysis. It is interesting that the difference in size of the population included in the analysis (771,306 individuals for Case III versus the sample of 3,426 individuals serving as a base for Case II) has no apparent influence on degree of consistency. This result supports the assertion that meaningful conclusions can be drawn about collective preferences through the aggregation of data on individual choices. It also suggests that little information is lost

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[1] There are two potential sources of variation between the preference structures derived from the 1966 and 1968 data sets--sampling variability and changes in preference over time. Thus it would appear that only if preferences are found to be similar can conclusions be drawn about stability of preferences and utility of sampling (since any variation in preferences could not be apportioned between the two potential sources).

TABLE 21

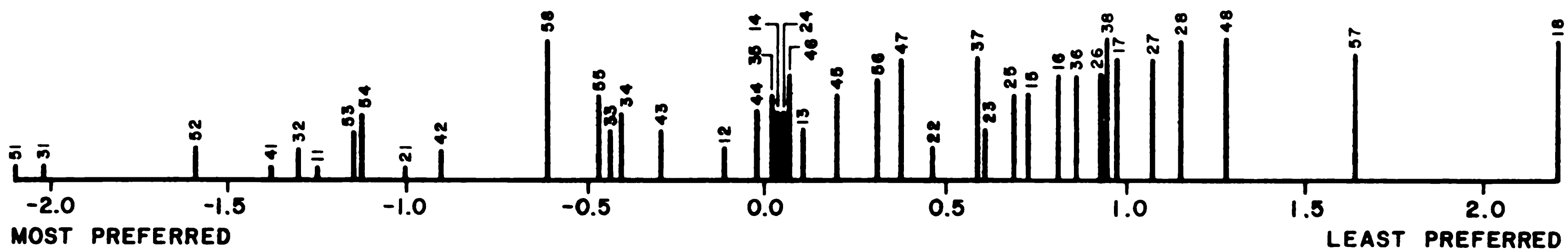
LOCATIONAL TYPES RANKED BY PERCENTAGE OF TIMES PREFERRED OVER OTHER TYPES - CASE III

Rank	Locational type	Rank	Locational type	Rank	Locational type
1	31	14	35	27	15
2	51	15	43	28	25
3	52	16	44	29	37
4	11	17	46	30	36
5	41	18	13	31	16
6	54	19	12	32	58
7	53	20	24	33	17
8	21	21	45	34	38
9	32	22	14	35	26
10	42	23	22	36	27
11	55	24	56	37	48
12	34	25	23	38	57
13	33	26	47	39	28
				40	18

in sampling locational choices of a population, despite the large number of origin-destination combinations contained in the initial data.

Interval scaling of locational types along one dimension for the Class III data is shown in Figure 20. The stress measure for this derived scale is 0.269, somewhat higher than the figure for the Class II scale. With minor exceptions, the ranking of locational types here coincides with the initial preference ranking. Also a comparison of the 1968 and 1966 (Case II) rankings indicates considerable agreement between the two preference rankings.

There are definite similarities between the Case II and III interval scales. There is a tendency in the 1968 scale toward a progression from highly preferred types with high site attractiveness to least preferred types with low site attractiveness, a trend also noted in



(number above the line identifies the locational type, and height of the line indicates the distance category)

Figure 20.--Unidimensional preference scale: Ontario provincial park campers, 1968 (Case III).

the 1966 scale. Somewhat greater clustering of the middle-occurring locational types is evident in the 1968 scale, suggesting that even less distinction is made between these intermediate types than in the 1966 data. This observation is interesting because it suggests that campers in effect separate out some of the locational types attaching strong preferences or dislikes to these, while lumping the remaining locational types together as an intermediate group to which they are largely indifferent. The possibility of such choice behavior has important implications for planning of camping opportunities.

The preference surface for the 1968 data is shown in Figure 21. As in the other cases, the most easily interpreted portion of the surface is the left-hand portion covering distances up to 300 miles or so. There appears to be a tendency, for somewhat lesser emphasis on attractiveness characteristics and greater emphasis on distance attributes in the trade offs than in the Case II situation, as reflected in the differing slopes of the preference lines. With that exception, the Case II and III surface (for distances up to 300 miles) are quite similar. Little can be interpreted from the right hand side of the 1968 surface, except that the reversed slopes of the 1966 surface are not apparent here. The least preferred portion of the surface involves locational types having the greatest distances and the lowest site attractiveness.

An attempt to fit a surface to the Case III preference scores was less successful here than in the two previous cases. The regression equation which follows, accounted for just over 59 percent of the variation in preference scores (R^2 of .5938):

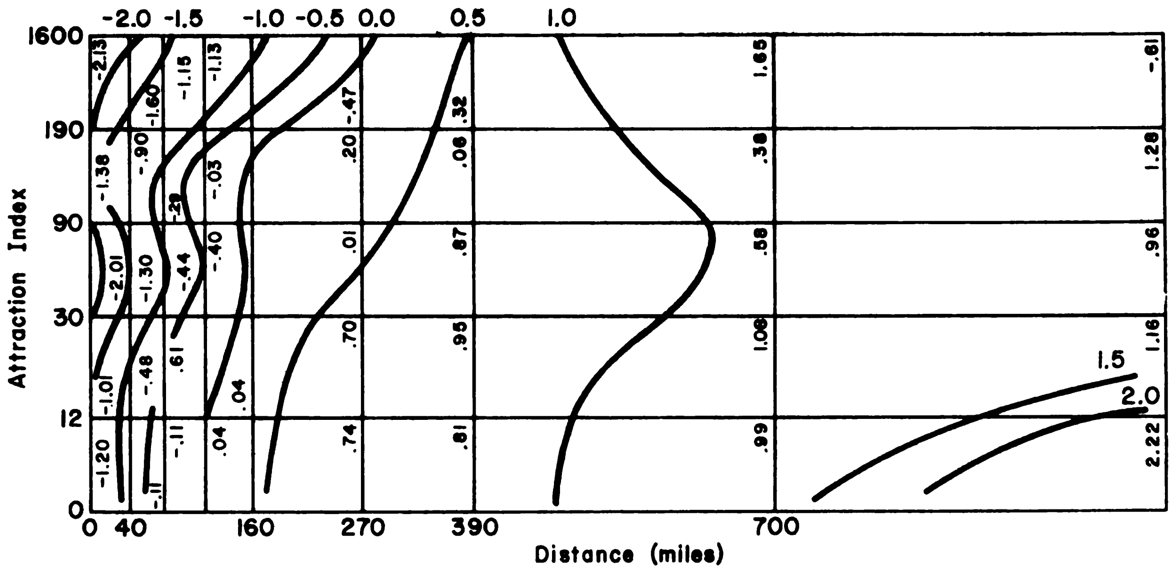


Figure 21.-- Locational preference surface: Ontario provincial park campers, 1968 (Case III).

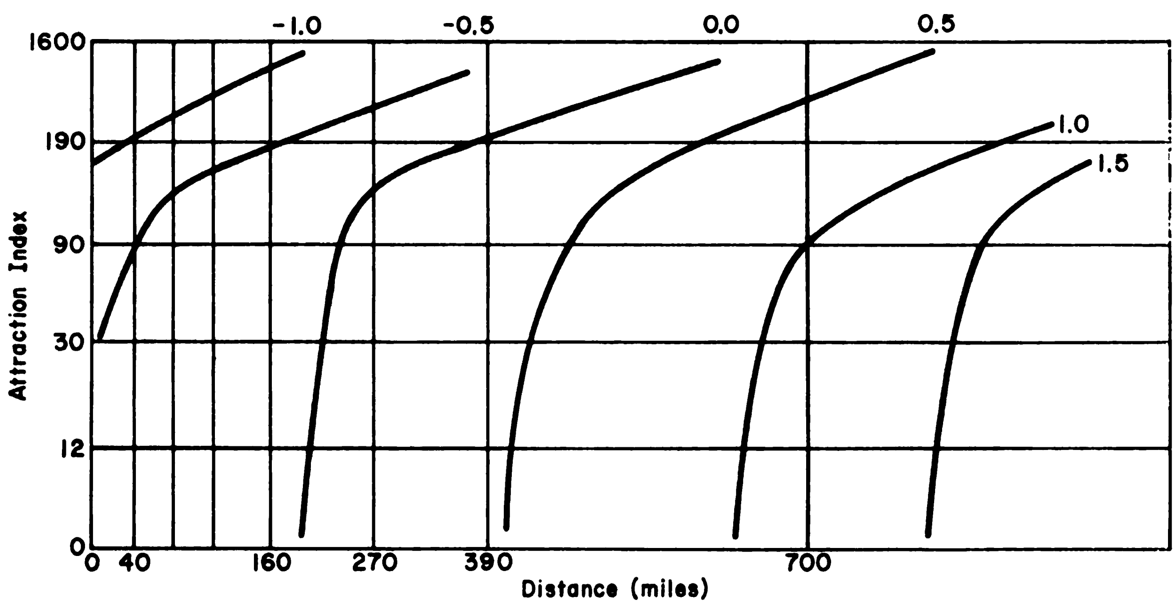


Figure 22.-- Locational preference surface fitted to Case III preference scores by multiple regression analysis.

$$y = 0.0025\,x_1 - 0.0010\,x_2 - 0.4879$$

where

(y is the preference variable

x_1 is the distance variable

x_2 is the attractiveness variable)

As in the other cases, the distance variable accounts for much of the preference variation explained (47.35 percent out of 59.38 percent), however this variable does not achieve quite the dominance that it did in the preceding cases.

The preference surface derived from the regression analysis is shown in Figure 22. As is apparent from the amount of explanation achieved, the preference lines do not resemble closely those of the original surface. Compared to the two other derived surfaces, the slope of the preference lines here indicates somewhat greater substitutability between distance and attractiveness.

It would appear then, that the preferences of campers in 1968 (Case III) are less closely related to the attractiveness and distance characteristics of destinations than in the 1966 situations. As noted earlier, it cannot easily be ascertained whether such variation arises from differences in the nature of the 1966 and 1968 samples or whether it indicates changes in locational preferences of the camping population.

experienced campers may be less "rational" than those of the more experienced group because of haphazard choice or conscious choice based on incomplete information. Thus, for example, the inexperienced campers may choose more distant and/or less attractive destinations more frequently over other alternatives than do the more experienced campers.[1]

With respect to length of stay, Wolfe's analysis of the 1966 camper data indicated that the average length of stay derived for each park showed some degree of relationship to location of the park. The majority of parks having the lowest averages were found to be in Northern Ontario, suggesting that these parks tend to be frequented for shorter than average visits. The employment of an average figure for each park obviously weakens the analysis since many differing combinations of lengths of stay could lead to the same average figure for a park. It seems logical to hypothesize that individuals frequenting parks for only a short stay (stopover or weekend campers) will have different locational preferences than those staying for longer periods. While it is apparent that the choice situations of these two groups are different, it is difficult to suggest what differences in locational preferences there might be between the two groups. It might be expected that the longer-stay camper would place greater emphasis on park attractiveness and less emphasis on accessibility of the park. Accessibility is likely to be of much greater importance to the short-stay camper but this accessibility may be either with respect to his home (weekend camper) or with respect to his trip route (stopover camper). Thus the difference in locational preference may not be as clear-cut as

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[1] This assumes of course that "rational" choice behavior involves choice of the nearest and most attractive destinations over others.

first envisaged. Perhaps the main hypothesis that might be advanced here is that longer-stay campers will choose more attractive destinations over less attractive ones with greater consistency than the short-stay campers.

Analysis of Camper Subgroups for Preference Differences

Test for Relationships among the Variables

The approach to comparing locational preferences involves subdividing the sample into mutually exclusive groups on the basis of scores on the three variables of interest. If, however, it can be determined that little relationship exists among the three variables, then little is gained by subdividing for the three variables simultaneously. Instead, the analysis can include the entire sample and thus require repeating only three times, once for each variable.

Assume, for example, that each of the three variables referred to above was investigated separately over the entire sample and that significant differences in preference were found between the two subcategories for each variable. That is, professional-managerial occupations differed from other occupations, inexperienced campers differed from more experienced campers, and short-stay campers differed from longer-stay ones. However, it is possible that a majority of the professional-managerial sample is inexperienced and hence that the observed occupational differences simply reflect differences in camping experience. Accordingly, it is desirable to test for relationships among these variables before proceeding with the analysis of preference differences. If significant relationships are not found, there would be less need to introduce controls for the other variables while examining the effects of differences in one variable. That is, the absence of significant relationships would indicate that similar proportions of the subgroups are found in each of the two subdivisions being compared, and thus it is unlikely that significant preference differences would be due to the influence of either of the other two variables.

The differences between observed and expected subgroup sizes were examined for each of the three variables using the chi-square test. Results are presented below (Table 24). It may be concluded that significant differences in subgroup size do exist between the subdivisions

TABLE 24

CHI-SQUARE TESTS FOR SIGNIFICANT DIFFERENCES IN SUBGROUP SIZES

Variable	Chi-square	Significance
Occupation: Professional-managerial versus Other	11.7206	beyond .01
Camping experience: 0-2 years versus 3 or more years	52.9773	beyond .001
Length of stay: 1-2 nights versus 3 or more nights	49.7635	beyond .0001

of each of the three variables. The results thus confirm the desirability of controlling for the effects of the other variables when examining differences in locational preference with respect to each variable.

For the eight subgroups which have been identified, there is a total of 28 pairwise comparisons which might be made. However, not all of these are of interest, since obviously some of the comparisons involve groups differing in more than one characteristic. Thus, only twelve of the pairwise comparisons are useful in the analysis--four for each of the three variables. Because of the lengthy (in terms of computer time) computations required, only seven of these paired groups were examined for differences in locational preferences (Table 25).

TABLE 25

CAMPER SUBGROUPS COMPARED
FOR PREFERENCE DIFFERENCES

No.	Subgroups compared	Constants	Variable examined
1	A and E	1-2 nights' stay Professional-managerial occupations	Camping experience
2	B and F	3 or more nights' stay Professional-managerial occupations	Camping experience
3	C and G	1-2 2 nights' stay Other occupations	Camping experience
4	D and H	3 or more nights' stay Other occupations	Camping experience
5	A and B	0-2 years' camping experience Professional-managerial occupations	Length of stay
6	C and D	0-2 years' camping experience Other occupations	Length of stay
7	A and C	0-2 years' camping experience 1-2 nights' stay	Occupation

Procedure in Comparing Locational Preferences

While the methodology for comparing subgroups has been introduced,[1] a number of additional points concerning the procedure must be dealt with. These aspects are discussed in the following paragraphs.

As noted earlier, the procedure involves application of the revealed preference analysis for each of the pairs of subgroups compared. Pairwise data presented in the revealed preference data matrices are then tested for significant differences by the chi-square test, or in the case of small frequencies, Fisher's exact probability test.[2]

The ϕ^2 coefficient is used to attempt to deal with the problem of varying frequencies for the pairwise choices in the revealed preference matrices. As noted by Rushton, random samples frequently yield considerable data for some choices, yet very little data for others.[3] Since chi-square test results vary with cell frequencies (i.e. significant differences are more easily obtained with larger frequencies) the possibility exists that the significant differences identified in the analysis are simply those cells having the highest choice frequencies. While such differences may be more significant in a statistical sense, they are not necessarily indicative of a strong relationship.[4] It appears that it is more useful to employ a

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[1] See pp. 44-50.

[2] The computer program performing this analysis is included as Appendix VI. The portions involving the chi-square and Fisher's exact tests are after a program written by Ewing (G.O. Ewing, "An Analysis of Consumer Space Preferences Using the Method of Paired Comparisons" (unpublished Ph.D. dissertation, Department of Geography, McMaster University, 1971).

[3] Rushton, "Behavioral Correlates of Urban Spatial Structure," pp. 55-56.

[4] See the discussion in Blalock (Blalock, <u>Social Statistics</u>, pp. 225-234.)

measure of association, such as the ϕ^2 coefficient, to indicate strength of relationship rather than statistical significance.

As noted earlier, there is no comparable measure of association which might be employed with the Fisher's exact probability test. However, since this test is employed only with small samples (where smallest expected frequency is less than five or where the population is less than 20), variations in sample size are insignificant and no such compensation as in the chi-square test is necessary.

To identify "significant" degrees of association (but not necessarily statistically significant), the .05 level of significance was chosen for the Fisher's exact test, and a ϕ^2 value of .03841 for the chi-square test. In the case of the chi-square test, this means that any sample size of 100 or more identified as significant will have statistical significance at or beyond the .05 level (chi-square value of 3.841 or more).[1]

For each comparison of subgroups, then, a half-matrix can be derived showing for pairwise comparisons of locational types, those revealing significant preference differences between the two subgroups. From such a matrix, the proportion of significant differences out of the total of pairwise comparisons involving each type can be determined.

While designation of proportion of significant differences for each locational type is a useful indication of differences in preference for different types, a question remains about the significance of these proportions. Are these proportions significantly higher than might be

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[1] Admittedly, this specification of "significant" relationships is an arbitrary one, but probably no more so than the levels of statistical significance frequently employed.

expected from randomly-composed groups drawn from the same sample? If not, little importance can be attached to these differences since they might easily have arisen by chance, unrelated to the variable under consideration. Ewing has approached this problem by deriving proportions for a series of pairs of randomly-composed groups drawn from the sample population and designating as significant only those proportions greater than 94% of the proportions derived from the random comparisons.[1] A similar solution is adopted in this study. However, the situation here is complicated by the fact that each subgroup comparison involves a different part of the population. Thus comparisons of random groups must be carried out for each of these portions of the total population, not just for the total population as was the case with Ewing's analysis.

Comparisons of Camper Subgroups

The results of the subgroup comparisons are discussed individually in the order in which they are listed in Table 25. Locational types used in these comparisons are the same as those defined in Case I of the previous chapter (i.e. factor analysis park attraction indices and equal mileage intervals for the distance classes).[2]

Subgroups A and E (Camping Experience).--This subsample consists of camping parties headed by persons in professional or managerial occupations and staying only briefly (1-2 nights) at their chosen park destination. This group was divided on the basis of extent of provincial park camping

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[1] Ewing, "An Analysis of Consumer Space Preferences," p. 150.

[2] See Figure 10.

experience (0-2 years - Group A versus 3 or more years - Group E). Sample sizes employed in the analysis were 212 and 248 for A and E respectively.[1]

Figure 23 indicates for each locational type, the proportion of pairwise comparisons (between that type and all other available types) where significant differences occur between the two subgroups.[2] It is evident that for a number of locational types, significant differences occur in a sizeable proportion of cases. Out of the total number of pairwise comparisons for all locational types in the matrix, 28.8% were found to have significant differences.

The assessment of the significance of these proportions in indicating differences between the two subgroups however, involves determining whether or not the proportions are greater than might be expected it randomly-composed subgroups were compared. In this instance, results of comparing groups composed of random selections from A and E indicated that few locational types possess proportions of significant differences which are greater than might be expected from random groups.[3] Thus it appears that variation in camping experience of those in professional or managerial occupations staying only briefly at the park destination does not lead to substantial differences in locational preferences.

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[1] Camping parties rejected from the initial sample (Table 23) were chiefly those from non-Ontario origins, or those travelling more than 600 miles to a park destination (the equal mileage classes employed cover only distances of 0-600 miles).

[2] "Significance" of these differences is determined by the ϕ^2 and Fisher's exact probability values as outlined earlier.

[3] Here, the initial comparison using random groups served to indicate that few of the proportions were likely to be greater than expected under random groups. Thus further random group comparisons were not derived.

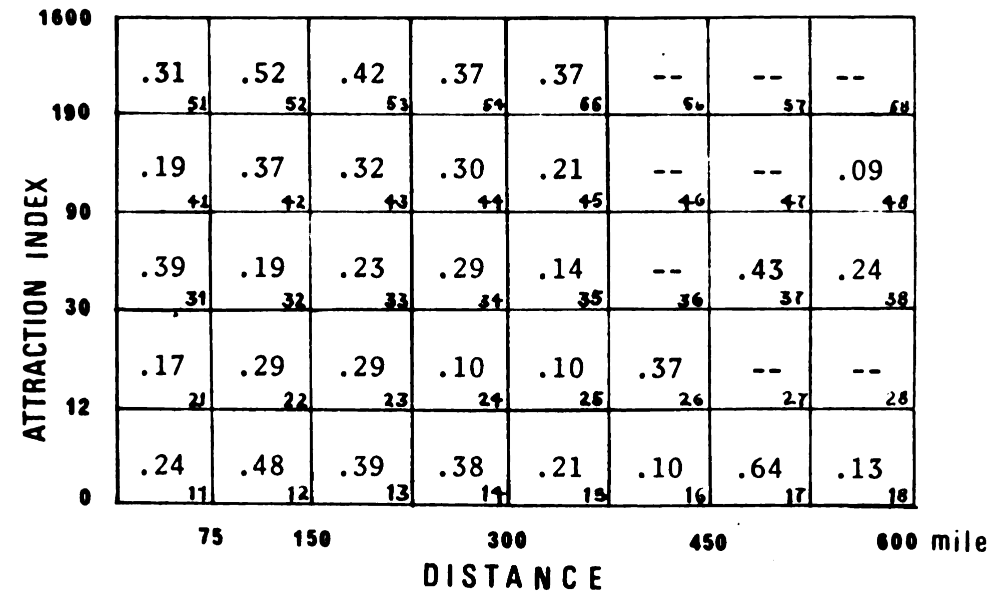

Fig. 23.--Groups A and E - Proportion of pairwise comparisons of locational types where significant differences in preference are observed.

Subgroups B and F (Camping Experience).--The population here includes camping parties headed by individuals in professional or managerial occupations, staying three or more nights at their park destination. Again, this group was differentiated in terms of provincial park camping experience (Group B has 0-2 years while Group F has 3 or more years). Group sizes for the analysis were 168 for B and 347 for F (down from initial group sizes of 295 and 509 for B and F respectively).

The proportions of pairwise comparisons indicating significant differences between the subgroups are presented in Figure 24. Almost one-third of the available locational types have significant difference proportions of .50 or more. Of the total number of pairwise comparisons, 36.7% revealed significant differences between the two subgroups.

Comparison of the above proportions with those derived from randomly-composed groups suggests that some of these proportions are substantially

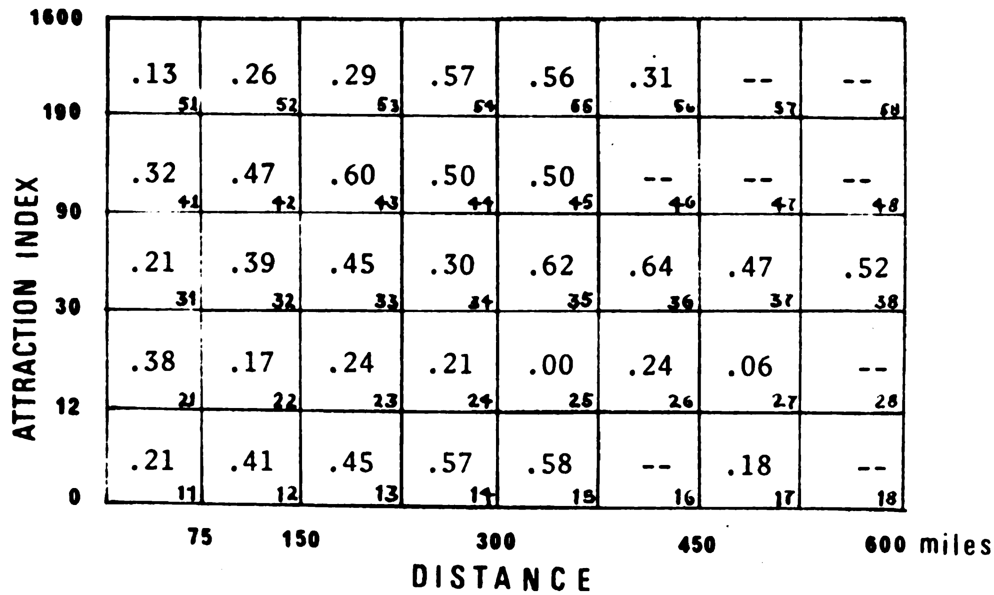

Fig. 24.--Groups B and F - Proportion of pairwise comparisons of locational types where significant differences in preference are observed.

higher than expected by chance (Table 26). Because of the small number of random group comparisons, the supporting evidence here must be viewed as suggestive rather than conclusive.[1] Locational types having higher than expected proportions are chiefly those from the higher attractiveness and medium distance categories. It is thus suggested that the two subgroups have different preferences for these types of destinations.

The analysis thus far has pointed toward certain preference differences, but has not dealt with the nature of such differences. Further information about subgroup differences can be obtained by looking at the direction of significant preference differences between the two groups. Figure 25 indicates for each locational type, the proportion of

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[1] The chief factor mitigating against the generation of further random group comparisons was the excessive amount of computer time this would have required. It was felt that this disadvantage outweighed any increase in precision of the results.

TABLE 26

PROPORTIONS OF PAIRWISE COMPARISONS OF LOCATIONAL TYPES WHERE SIGNIFICANT PREFERENCE DIFFERENCES OCCUR: SUBGROUPS B AND F AND RANDOM GROUPS

Locational type	Proportion of significant differences B vs. F	Random groupings I	II	III	Locational type	Proportion of significant differences B vs. F	Random groupings I	II	III
11	.21	.47	.33	.17	35	* .62	.38	.27	.21
12	*[a] .41	.26	.35	.16	36	* .64	.04	.17	.05
13	* .45	.33	.43	.13	36	.47	.45	.62	.55
14	.57	.13	.68	.64	38	.52	.59	.30	.35
15	* .58	.07	.07	.07	41	.32	.32	.26	.23
16	-	-	-	-	42	* .47	.30	.40	.37
17	.18	.65	.56	.08	43	* .60	.35	.39	.26
18	-	-	-	-	44	* .50	.24	.35	.04
21	.38	.31	.45	.31	45	* .50	.48	.35	.18
22	.17	.31	.21	.55	46	-	-	-	-
23	.24	.32	.32	.19	47	-	-	-	--
24	.21	.38	.29	.36	48	-	-	-	-
25	.00	.12	.36	.19	51	.13	.20	.23	.10
26	.24	.21	.18	.85	52	.26	.39	.29	.19
27	.06	.14	.16	.21	53	.29	.48	.26	.19
28	-	-	-	-	54	.57	.48	.22	.60
31	.21	.62	.31	.38	55	.56	.64	.13	.30
32	.39	.39	.42	.26	56	* .31	.18	.16	.18
33	* .45	.32	.32	.32	57	-	-	-	-
34	.30	.38	.43	.21	58	-	-	-	-

[a] Asterisk indicates those proportions which appear to be larger than expected by chance

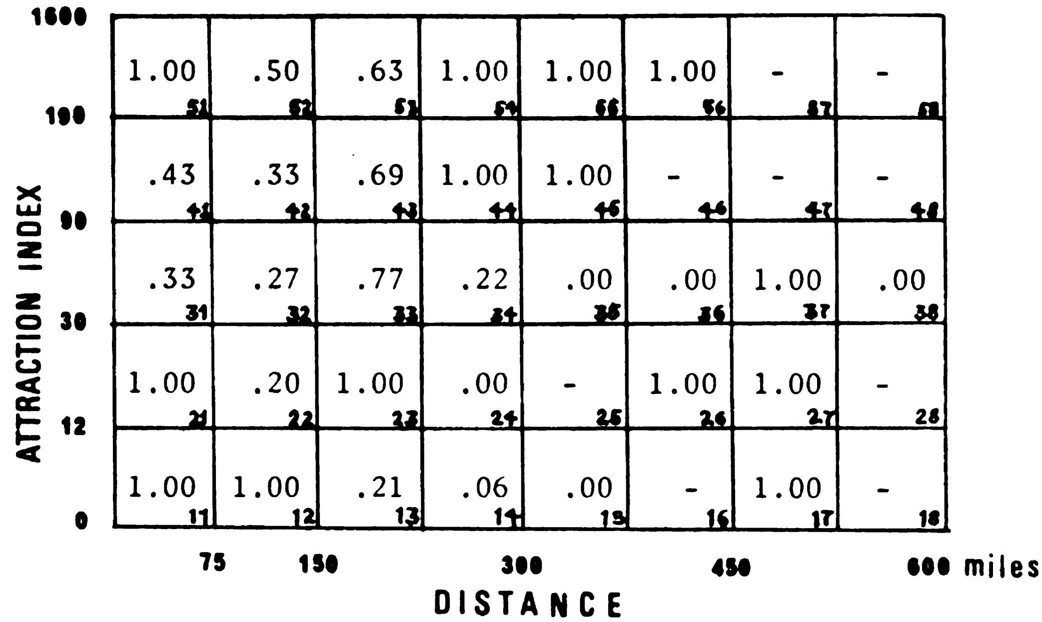

Figure 25. -- Groups B and F - Proportion of the number of pairwise comparisons with significant differences, where B reveals lower preferences than F.

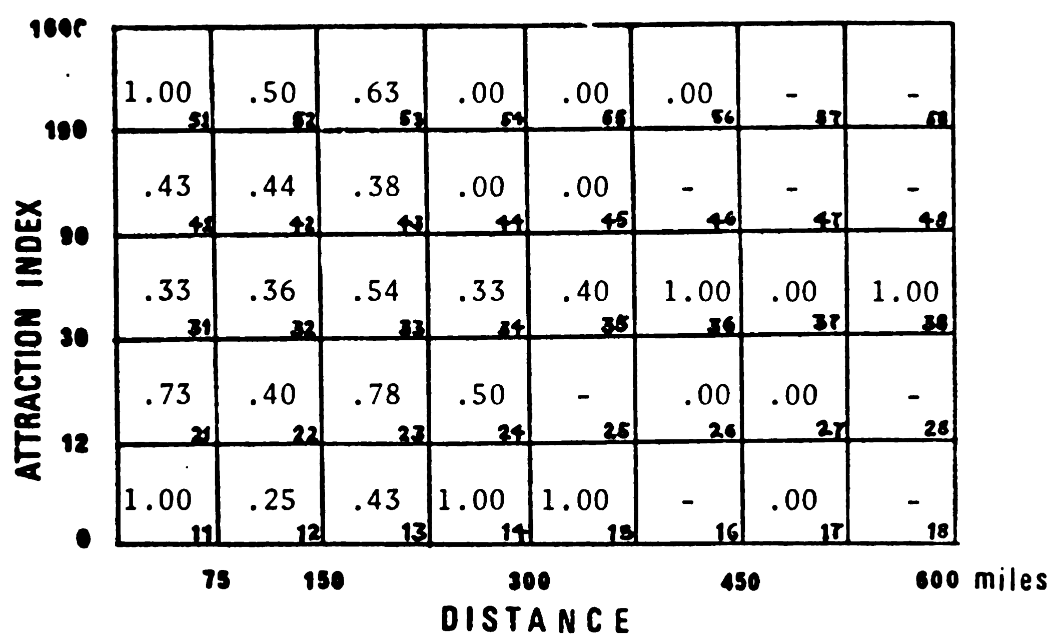

Figure 26. -- Groups B and F - Proportion of the number of pairwise comparisons with significant differences, where B reveals greater indifference than F.

significant differences which are less preferred by B than by F.[1] For the matrix as a whole, it is evident that B reveals lower preference than F for many of the locational types in the higher attractiveness categories, and higher preferences than F for locational types of lower attractiveness and intermediate distances. One interpretation of these trends is that Group B campers, having less experience than those of Group F, tend to select less attractive destinations more often than F, perhaps because of lack of familiarity with the range of alternatives. When attention is confined to the locational types having a greater than expected proportion of significant differences, the same trends are apparent.

Figure 26 shows the proportions of significant differences where Group B reveals greater disagreement or indifference than Group F (i.e. the proportion of times the locational type is chosen over others is closer to 0.5 for Group B than for Group F). It is evident that a number of these values are opposites of the values in the previous matrix (Figure 25), particularly for the longer distance categories. For the most part, these are situations where Group B members had an opportunity to select these locational types but were never observed to do so. Hence B is recorded as having lower preferences than F for these locational types, as well as less disagreement than F in choices involving these types. Apart from these cases, there is little evidence suggesting that Group B has significantly greater or less agreement in its preference than Group F.

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[1] "Less preferred" means that the locational type is chosen a lower proportion of times over another when both are available.

With respect to the hypothesis advanced earlier about differences in camping experience, for this subgroup of campers (from professional-managerial occupations, staying three or more nights at park), it appears that preferences of the inexperienced group are somewhat less rational than those of the more experienced group. However, the hypothesis of greater indifference (disagreement) among the inexperienced group is not confirmed by these data.

Subgroups C and G (Camping Experience). -- This subsample includes campers from occupations other than professional-managerial types staying 1-2 nights at their destination, and is subdivided on the basis of camping experience (Group C is inexperienced while Group G is experienced). Group sizes used in the analysis were 381 and 577 for C and G respectively.

The proportion of significant differences in preference between the two subgroups is shown in Figure 27. In contrast to the previous comparison, proportions of significant differences are generally low. Of the total comparisons made between pairwise choices of the groups, 23.9% were designated as significantly different.

Comparison of these significant difference proportions with proportions derived from randomly-composed subgroups revealed that only a few locational types had proportions which were unlikely to have arisen by chance. Accordingly, it is concluded that these two groups do not show substantial differences in their locational preferences. This conclusion agrees with that of the first comparison (Groups A through E).

ATTRACTION INDEX								
1600–190	.14 (51)	.33 (52)	.26 (53)	.63 (54)	.67 (66)	.22 (56)	.29 (57)	-- (58)
190–90	.26 (41)	.29 (42)	.25 (43)	.14 (44)	.33 (45)	.12 (46)	.16 (47)	.29 (48)
90–30	.20 (31)	.26 (32)	.25 (33)	.22 (34)	.15 (35)	.07 (36)	.03 (37)	.03 (38)
30–12	.11 (21)	.26 (22)	.25 (23)	.24 (24)	.17 (25)	.06 (26)	-- (27)	-- (28)
12–0	.17 (11)	.20 (12)	.57 (13)	.60 (14)	.17 (15)	.42 (16)	.03 (17)	.12 (18)

75 150 300 450 600 miles

DISTANCE

Fig. 27.--Groups C and G - Proportion of pairwise comparisons of locational types where significant differences in preference are observed.

Subgroups D and H (Camping Experience). -- The final comparison on the basis of camping experience involves campers from occupations other than professional-managerial staying three or more nights at the park destination. Sizes of the two groups analyzed were 372 for D (the inexperienced group) and 896 for H (the experienced group).

As in the previous case, significant difference proportions (Figure 28) are generally not large. The overall percentage of significant differences for the matrix is 19.9. A comparison involving randomonly-composed groups yielded significant difference proportions which equalled or exceeded the above proportions in most cases. It appears then, that no major differences in locational preferences occur between these two subgroups.

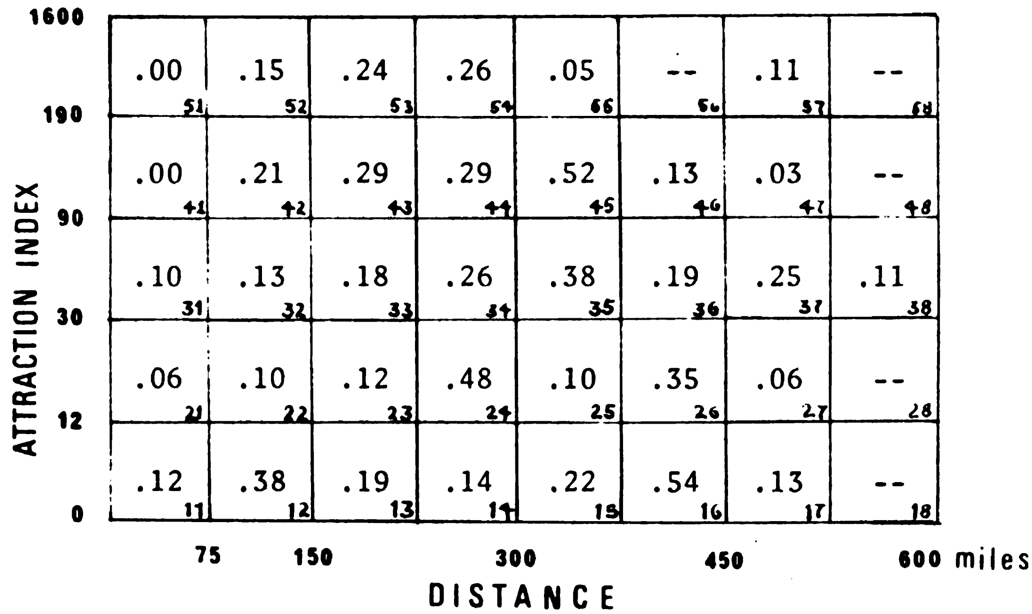

Fig. 28.--Groups D and H - Proportion of pairwise comparisons of locational types where significant differences in preference are observed.

Subgroups A and B (Length of Stay). -- Characteristics common to these two groups include 0-2 years' camping experience and professional-managerial occupation types. The groups are differentiated by length of stay, with Group A staying 1-2 nights and Group B staying three or more nights.[1]

Significant difference proportions derived for the comparison are substantial for a number of locational types (Figure 29). There is a tendency for the larger proportions to be associated with the lower distance categories, suggesting that preference differences are strongest with respect to these locational types. The overall percentage of significant differences for the matrix of locational types is 30.8.

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[1]Groups sizes for the analysis were 212 and 168 for A and B respectively.

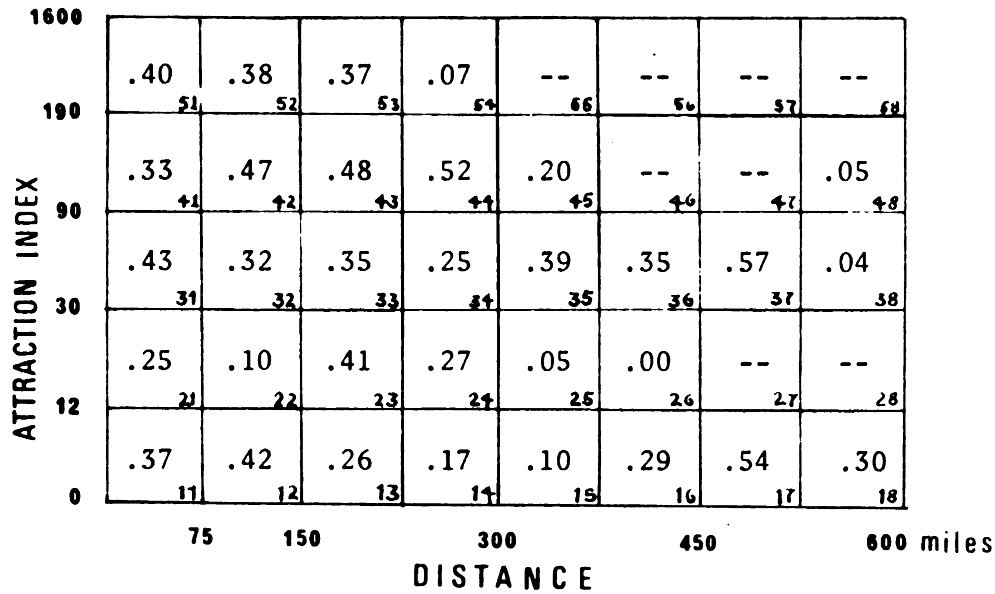

Fig. 29.--Groups A and B - Proportion of pairwise comparisons of locational types where significant differences in preference are observed.

Table 27 compares the above proportions of significant differences with those derived for two pairs of randomly-composed sub-groups. Although the evidence is not conclusive (as noted earlier), it appears that the A versus B difference proportions for some locational types are greater than might be expected by chance. Most of these locational types are associated with shorter distance categories.[1]

Further information on preference differences between Groups A and B is provided in Figure 30. There appears to be a tendency for A to exhibit greater preferences than B for locations in the lower attraction categories and lower preferences than B for the higher attraction categories. A possible explanation for such differences

[1]These locational types are identified by asterisks in Table 27.

TABLE 27

PROPORTIONS OF PAIRWISE COMPARISONS OF LOCATIONAL TYPES WHERE SIGNIFICANT PREFERENCE DIFFERENCES OCCUR: SUBGROUPS A AND B AND RANDOM GROUPS

Locational type	Proportion of significant differences A vs. B	Random groupings I	Random groupings II	Locational type	Proportion of significant differences A vs. B	Random groupings I	Random groupings II
11	.37	.17	.57	35	.39	.35	.45
12	*[a] .42	.26	.19	36	* .35	.31	.15
13	.26	.32	.26	37	.57	.63	.10
14	.17	.27	.23	38	.04	.04	.12
15	.10	.56	.10	41	.33	.68	.13
16	* .29	.11	.07	42	* .47	.30	.23
17	* .54	.36	.21	43	* .48	.39	.32
18	.30	.13	.33	44	* .52	.29	.17
21	* .25	.18	.07	45	.20	.45	.36
22	.10	.40	.13	46	-	-	-
23	.41	.35	.23	47	-	-	-
24	.27	.25	.29	48	.05	.05	.10
25	.05	.30	.52	51	* .40	.27	.23
26	.00	.48	.08	52	* .38	.31	.21
27	-	-	-	53	.37	.37	.79
28	-	-	-	54	.07	.50	.60
31	* .43	.31	.18	55	-	-	-
32	.32	.39	.23	56	-	-	-
33	.35	.29	.45	57	-	-	-
34	.25	.47	.50	58	-	-	-

[a]Asterisk indicates those proportions which appear to be larger than expected by chance

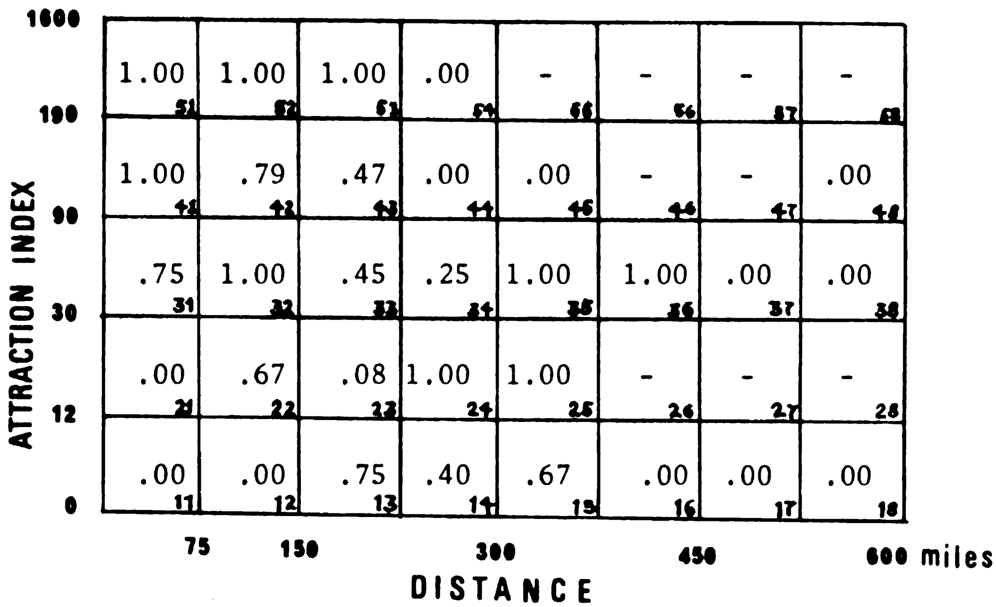

Figure 30. -- Groups A and B - Proportion of the number of pairwise comparisons with significant differences, where A reveals lower preference than B.

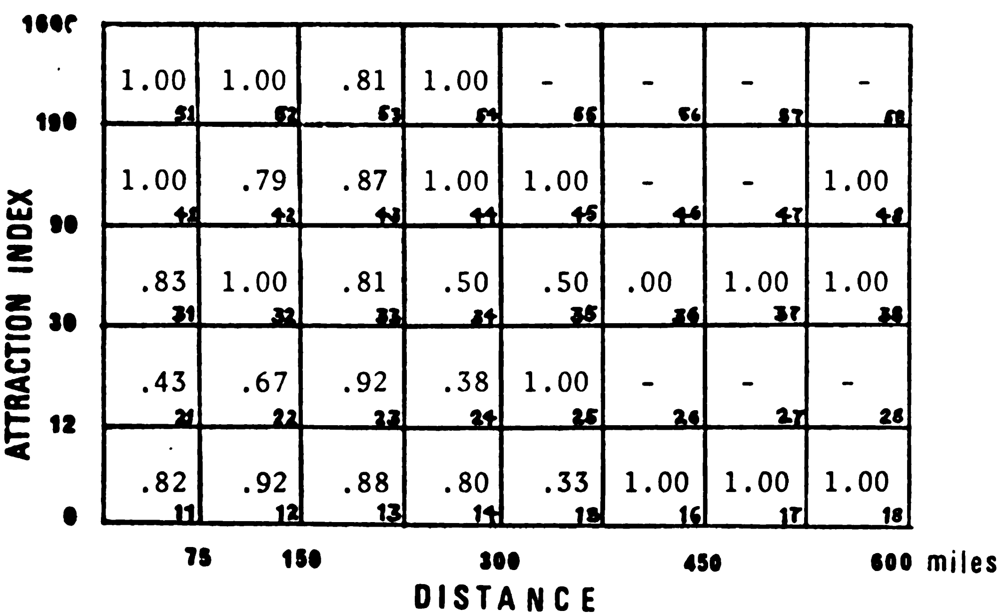

Figure 31. -- Groups A and B - Proportion of the number of pairwise comparisons with significant differences, where A reveals greater indifference than B.

is that short-stay campers (A) attach less importance to attractiveness of destination than longer-stay campers (B), and hence exhibit less variation in preference among attractiveness categories.[1]

Figure 31 tends to support the above observation on preference differences. For the large majority of locational types, Group A shows greater disagreement than Group B, particularly in the three highest attraction cateogories. Again it is suggested that longer-stay campers exhibit more agreement in their preferences than short-stay campers particularly with respect to the more highly attractive destinations. The short-stay campers show greater disagreement, perhaps because they do not differentiate among types of location to the extent of the longer-stay campers, or perhaps because their locational decisions are based on a variety of criteria (for example, the weekend camper versus the stopover camper).

The major hypothesis advanced earlier is thus confirmed by the analysis, i.e. longer-stay campers do appear to prefer more attractive destinations over less attractive ones more consistently than short-stay campers.

Subgroups C and D (Length of Stay). -- These two groups include campers with 0-2 years' camping experience, from occupations other than professional or managerial types. They are differentiated on the basis of length of stay.[2]

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[1]Unlike this relation with attraction classes, there appears to be little noticeable relationship between distance categories and direction of preference differences.

[2]Group C had 381 camping parties while Group D had 372.

As in the previous comparison, sizeable proportions of significant differences are apparent for many locational types (Figure 32). For all pairwise comparisons of available locational types, the percentage of significant preference differences between the two groups is 40.8. The comparison of these significant difference proportions with those from randomly-composed subgroups is presented in Table 28. The results suggest that many of the proportions for the C versus D comparison are larger than those which might have arisen through chance. These significant proportions (identified by asterisks) are well-distributed through the matrix of locational types, with a slight tendency toward concentration in the shorter distance categories.

Figure 33 indicates the proportion of significant differences in preference in which C's preferences are lower than D's. In the lowest attraction category and the longer distance categories, Group C generally has higher preferences than D, which in the higher attraction categories and lower distance categories, Group C's preferences are chiefly lower than D's preferences. Similar to the preceding comparison, short-stay campers appear to have greater preference for destinations of lower attractiveness and lesser preference for the more highly attractive destinations than the longer-stay campers. In addition, short-stay campers seem to have greater preference for the more distant destinations. This situation may be the result of stopover camping by short-stay campers.

From the data presented in Figure 34, it appears that, on the whole, Group C members disagree more regarding locational preference than do Group D campers. This observation follows that made concerning

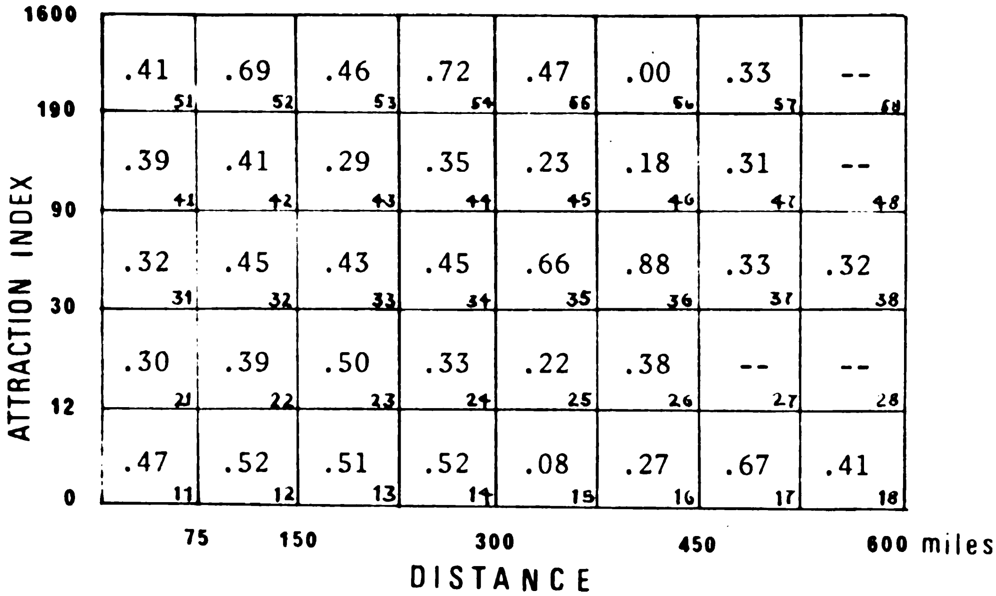

Fig. 32.--Groups C and D - Proportion of pairwise comparisons of locational types where significant differences in preference are observed.

the previous comparison, providing further evidence that short-stay campers do not differentiate among locational types to the same extent as longer-stay campers.

This comparison of subgroup preferences thus draws much the same conclusions as the previous comparison about the relationship between length of stay and locational preferences. The two additional comparisons possible involving length of stay variation have not been undertaken in this study. It would be of interest to investigate these to ascertain whether similar conclusions are reached.

Subgroups A and C (Occupation). -- The final comparison of subgroups undertaken here involves camping parties with little experience (0-2 years) and staying only 1-2 nights at their destination. This group is divided on the basis of occupation, professional-managerial

TABLE 28

PROPORTIONS OF PAIRWISE COMPARISONS OF LOCATIONAL TYPES WHERE SIGNIFICANT PREFERENCE DIFFERENCES OCCUR: SUBGROUPS C AND D AND RANDOM GROUPS

Locational type	Proportion of significant differences C vs. D	Random groupings I	II	III	Locational type	Proportion of significant differences C vs. D	Random groupings I	II	III
11	.47	.57	.18	.18	35	* .66	.18	.14	.06
12	*[a] .52	.31	.09	.36	36	.58	.69	.07	.21
13	* .51	.40	.23	.29	37	.33	.39	.09	.13
14	* .52	.35	.18	.26	38	* .32	.10	.03	.21
15	.08	.64	.07	.48	41	* .39	.24	.21	.18
16	.27	.71	.37	.29	42	* .41	.38	.29	.32
17	.67	.60	.00	.74	43	* .29	.20	.14	.26
18	* .41	.16	.25	.13	44	.35	.47	.50	.17
21	.30	.33	.12	.27	45	.23	.24	.13	.48
22	.39	.45	.06	.24	46	.18	.21	.38	.38
23	* .50	.29	.34	.26	47	.31	.26	.61	.24
24	* .33	.21	.28	.29	48	-	-	-	-
25	.22	.15	.56	.12	51	* .41	.11	.15	.06
26	.38	.46	.03	.37	52	* .69	.34	.16	.23
27	-	-	-	-	53	* .46	.34	.17	.14
28	-	-	-	-	54	* .72	.19	.10	.23
31	.32	.26	.23	.35	55	.47	.47	.07	.44
32	.45	.45	.18	.18	56	.00	.13	.14	.15
33	* .43	.31	.26	.37	57	* .33	.13	.16	.13
34	* .45	.35	.24	.21	58	-	-	-	-

[a] Asterisk indicates those proportions which appear to be larger than expected by chance

ATTRACTION INDEX

190–1000	.86 (51)	.79 (52)	.76 (53)	1.00 (54)	1.00 (55)	.00 (56)	1.00 (57)	- (58)
90–190	.75 (41)	.80 (42)	.60 (43)	.67 (44)	.00 (45)	.00 (46)	.00 (47)	- (48)
30–90	.50 (31)	.53 (32)	.73 (33)	.00 (34)	1.00 (35)	.00 (36)	.40 (37)	.00 (38)
12–30	.50 (21)	.92 (22)	.88 (23)	.90 (24)	.17 (25)	.00 (26)	- (27)	- (28)
0–12	.00 (11)	.12 (12)	.33 (13)	.00 (14)	.50 (15)	.33 (16)	.00 (17)	.00 (18)

75 150 300 450 600 miles

DISTANCE

Figure 33. -- Groups C and D - Proportion of the number of pairwise comparisons with significant differences, where C reveals lower preferences than D.

ATTRACTION INDEX

190–1000	.86 (51)	.71 (52)	.59 (53)	.00 (54)	.00 (55)	1.00 (56)	.00 (57)	- (58)
90–190	.75 (41)	.67 (42)	.60 (43)	.33 (44)	1.00 (45)	1.00 (46)	.89 (47)	- (48)
30–90	.50 (31)	.60 (32)	.60 (33)	.80 (34)	.34 (35)	1.00 (36)	.60 (37)	1.00 (38)
12–30	.70 (21)	.54 (22)	.41 (23)	.40 (24)	.67 (25)	1.00 (26)	- (27)	- (28)
0–12	.25 (11)	.82 (12)	.44 (13)	.94 (14)	1.00 (15)	1.00 (16)	1.00 (17)	1.00 (18)

75 150 300 450 600 miles

DISTANCE

Figure 34. -- Groups C and D - Proportion of the number of pairwise comparisons with significant differences, where C reveals greater indifference than D.

types versus other types.[1]

The percentage of significant differences out of all pairwise comparisons of locational types is 27.5 for this matrix (Figure 35). While a few of the proportions of significant differences are reasonably large, comparisons with proportions derived from randomly-composed groups indicated that an insignificant number of the locational types had proportions above those which might have been derived by chance. Thus it is suggested that few important differences in locational preference occur between these two subgroups on the basis of occupation differences. Since this was the only comparison of subgroups distinguished by occupation type, it is not possible to draw general conclusions beyond the comparison just made.

Subgroup Comparisons - Conclusions

From the results of the comparison discussed above, a number of conclusions may be drawn. It appears that of the three characteristics of camping parties examined, length of stay at the park destination is the one most likely to be linked to differences in locational preferences. Both comparisons made regarding length of stay showed that important differences in locational preferences were associated with variation in length of stay. Regarding the extent of camping experience (the variable investigated most completely), only in one of the four comparisons were preference differences found to be substantial. The third variable, occupation type, was not investigated sufficiently to permit generalizations about its relationship to differences in preference.

[1]Sizes of groups used in the analysis were 212 and 381 for A and C respectively.

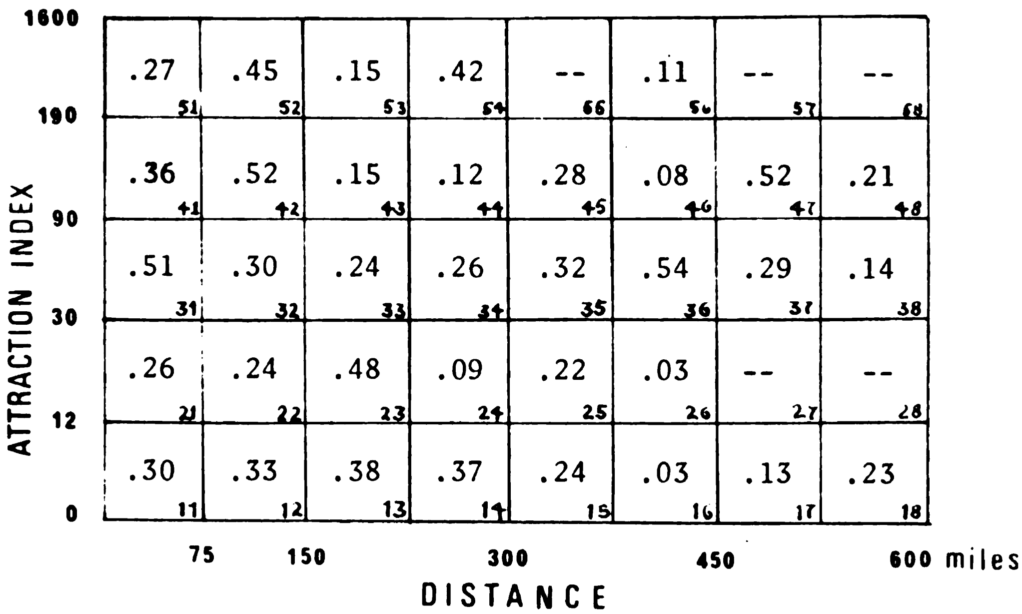

Fig. 35.--Groups A and C - Proportion of pairwise comparisons of locational types where significant differences in preference are observed.

Of the hypotheses advanced earlier concerning the nature of preference differences with respect to the three variables, only those relating to length of stay largely were substantiated. It was found that the longer-stay camping parties did tend to prefer the more attractive destination types to a greater degree than the short-stay parties. The suggestion that no clear relationship would exist between distance to destination and existence of preference differences between the short-stay and longer-stay groups were also supported. With respect to degree of camping experience, only in the case of professional-managerial occupations staying three or more nights is the hypothesis supported that the inexperience group will show less rationality in preference than the experienced group. The little evidence available for the occupation variable does not substantiate the hypotheses advanced earlier.

There are several considerations which restrict the conclusions which can be drawn from these comparisons of subgroup locational preferences. For one thing, a number of rather arbitrary decisions were made during the analysis which may have influenced the results to some degree. For example, different critical values separating individuals into groups for comparison purposes might have been selected. Also, the comparison might have been restricted to individuals with extreme values for certain of the variables (e.g. extent of camping experience). Altering the method of indicating significant differences in preferences or the critical values chosen to separate significant from non-significant results might also have had an impact on the results obtained.

Ewing in his analysis found that grouping of individuals on the basis of common spatial behavior and then linking these groups to socio-economic attributes was a more powerful method of identifying preference differences.[1] This would appear to be a useful additional approach to apply to the camper data.[2]

Finally, it would have been desirable to carry out all twelve of the possible comparisons of subgroups. This would have allowed more extensive conclusions to be drawn, particularly regarding the occupations variable.

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[1]Ewing, "An Analysis of Consumer Space Preferences."

[2]It would seem essential that the spatial behavior attributes chosen be distinct from the data used to define locational preferences. Otherwise one would seem to be saying only that grouping by preference differences is associated with significant differences in preference.

CHAPTER VI

CONCLUSIONS

This study has had as its purpose the outlining and application of a model for revealing locational preferences of a population frequenting recreation destinations -- in this case, campers in Ontario provincial parks. The first part of this modelling effort involved the derivation of preference structures representative of the entire camper population under examination, while the second part investigated the extent to which subgroups within the camper population possessed differing preference structures. This concluding section is concerned with two questions -- firstly, "Of what use has the analysis been in revealing the locational preferences of Ontario campers?" and secondly, "Of what potential use might the approach be in the analysis and prediction of choices of individuals among recreation destination alternatives?"

Locational Preferences of Ontario Campers

The analysis has revealed that a considerable degree of order is discernible in the preferences of Ontario campers for various provincial park destinations. Despite the fact that it was necessary to generalize park destinations into "locational types" based on somewhat arbitrary distance and site-attractiveness criteria, it was possible to derive a preference ordering of such locational types with which the choices of Ontario campers are quite highly consistent. The implications of such a finding are significant since it suggests that, while choice situations and choices obviously differ among members of this group, there is some degree of similarity in the preferences underlying the choices made.

The preference scales obtained for Ontario campers also appear to have some relationship to the criteria used to define locational types --particularly the distance-from-origin criterion. There is a definite tendency for the more preferred locational types to involve shorter distances than less preferred types. Again, this finding is important, suggesting that preferences for location have definite associations with distance of the destination, while having somewhat weaker ties with the measure of site attractiveness employed.

The modelling through regression analysis of the derived preference scales in terms of distance and attractiveness attributes of destinations provided definite evidence of the weak relationship of the attractiveness variable to preference ratings and the relatively strong relationship of distance to preferences. This result could signify that little importance is attached to variation in site attractiveness--i.e., that park destinations are perceived as more or less uniformly attractive. More plausibly, perhaps, the result could indicate that the measure of site attractiveness employed, does not adequately measure "attraction" of park destinations relative to the individuals engaged in choosing among the destinations.

Despite the fact that site attractiveness as defined in this study appeared to be less significant than distance-from-origin in influencing preferences, there is evidence of "trade-offs" made by campers between distance and site attractiveness--largely in the case of alternatives 300 miles or less from origin centers. That is, campers show some willingness to substitute lower site attractiveness for a decrease in distance or higher attractiveness for an increase in distance (or vice-versa). Thus some measure of support is provided for the view that campers base preferences on both site and situation characteristics.

The comparison between the preference structures of 1966 and 1968 Ontario campers, while identifying certain differences--for example, the fact that 1968 preferences are less strongly related to distance and attractiveness attributes--suggests that in general the structures are similar. This result thus provides a measure of support for the assertion that preferences have considerable stability over time.

Limited evidence was presented indicating that Ontario campers exhibit greater agreement in their preferences for shorter-distance locational types than for longer-distance types. One implication here is that campers have greater and more uniform knowledge of closer destinations and hence show more agreement in choices of these types.

The analysis of preference differences among a number of subgroupings of the Ontario camper sample indicated that in the majority of cases, significant differences in locational preferences could not be linked to differences in the camper characteristics under examination. That is, while certain preference differences were identified, these were no greater for the subgroups of interest than for other randomly-composed groups. Only in the case of variation in length of stay did subgroup differences appear to be greater than expected. These conclusions suggest that other variables should be examined for significance, perhaps, as suggested earlier, those tied to spatial behavior.

In conclusion then, it is evident that a substantial amount of information about camper locational preferences has been revealed by the analysis, thus demonstrating the usefulness of this approach.

Future Research Possibilities

The following is concerned with a few of the possibilities for future application of the revealed preference model in recreation research.

Prediction of Spatial Movement

The gravity and systems models discussed earlier are both concerned with the prediction of spatial flows of people between origins and destinations. The utility of such models has been evaluated largely by examining the degree of accuracy of their predictions. While a concern with prediction has not been evident in the dissertation, this aspect does appear to offer promise for future research. The following demonstrates some of the possibilities for using the locational preference model of this study in a predictive capacity.

The rationale behind the use of the preference model for predicting spatial interaction lies in the hypothesis that locational preferences are relatively stable over time, unlike spatial behavior which may change frequently.[1] As noted above, this dissertation has

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[1] Rushton, "The Scaling of Locational Preferences," and Rushton, "Behavioral Correlates of Urban Spatial Structure."

provided limited evidence supporting such a hypothesis (Chapter IV). This hypothesized stability of preferences then provides a basis for predicting future interactions.

Method of Prediction.--Using the pairwise preference probabilities obtained from choices between locational types, it is possible to derive the expected flow pattern from origins to destinations, provided the total numbers from each origin are known or can be estimated.[1]

Given that locational types A, B, and C are available for choice, the probability of A being selected from these three is defined by the following:[2]

$$P(A) = \frac{p(A)}{p(A)+p(B)+p(C)} = \frac{1}{1+\frac{p(B)}{p(A)}+\frac{p(C)}{p(A)}}$$

An estimate of p(B)/p(A) can be derived from the pairwise preference probabilities (i.e. p(B chosen over A)/p(A chosen over B). A similar estimate for p(C)/p(A) can be obtained using the pairwise probabilities for A and C.

Similarly, to derive the probability of B being chosen from the three locational types, the following is used:

$$P(B) = \frac{p(B)}{p(A)+p(B)+p(C)} = \frac{\frac{p(B)}{p(A)}}{1+\frac{p(B)}{p(A)}+\frac{p(C)}{P(A)}}$$

---

[1]The method applied here is after deTemple (D. deTemple, "A Space Preference Approach to the Determination of Individual Contact Fields in the Spatial Diffusion of Harvestore Systems in N.E. Iowa" (unpublished Ph.D. dissertation, Dept. of Geography, Michigan State University), pp. 32-35).

[2]Where P(A) is the probability of A being chosen from the three locational types, and p(A) is the probability of A being chosen from all available locational types.

The method may be expanded to include more than three available locational types simply by adding pairwise probabilities representing the additional locational types to the denominator. It is apparent that the choice probabilities derived for the available locational types will sum to 1.0.

Thus, for a given originlocation, available locational types can be ascertained, their choice probabilities derived, and these are then multiplied by the total number of campers estimated for that origin to obtain the predicted number of campers for each locational type.

Application to Hamilton Campers.--The technique discussed above has been applied to the system of provincial park alternatives available to Hamilton campers. The objective is to predict flows of Hamilton campers to each of the locational types available from this origin. In this instance data are available whereby these predicted flows may be compared with actual patronage of locational types. In fact, the application employs the preference structure of the 1966 sample of Ontario campers (Case I) to predict locational choices of Hamilton campers in 1968 (which can be checked against known patronage in 1968).

With reference to Ontario provincial parks, 26 locational types are available to Hamilton campers.[1] The choice probabilities derived for each of these locational types by the method outlined above are indicated in Figure 36. These probabilities were muliplied by the total number of Hamilton campers in 1968 (38,382) to obtain the initial predictions for patronage of locational types (Column 3 of Table 29).

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[1] Locational types are those employed in Case I.

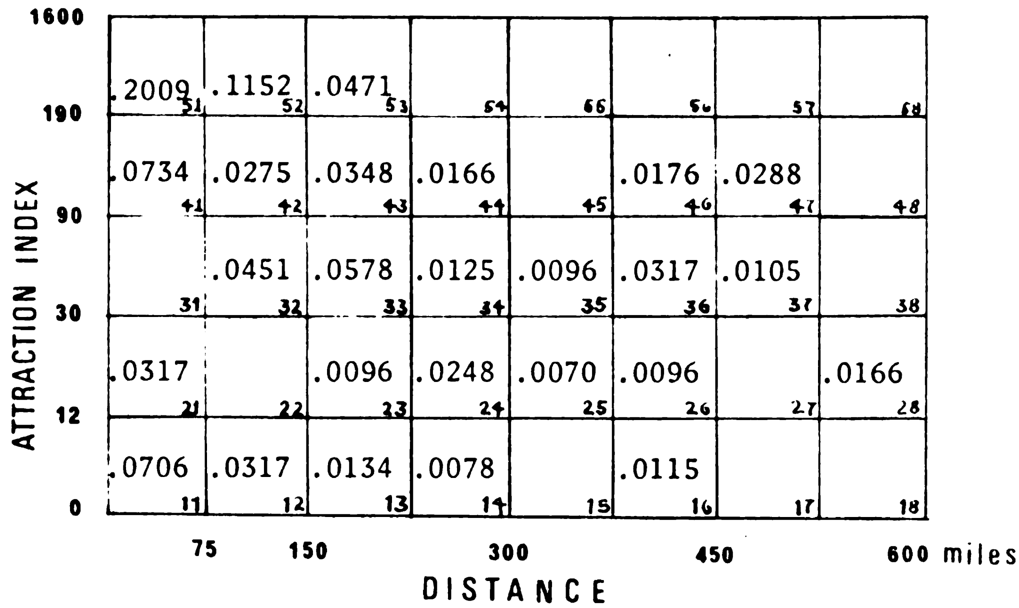

Fig. 36.--Choice probabilities for Hamilton campers.

It is obvious that in many cases, the initial prediction differs considerably from the actual attendance recorded for that locational type. Column 4 of Table 29 indicates error in prediction as a percentage of the recorded attendance. It was hypothesized that a major cause of these errors is the fact that the locational types include varying numbers and sizes of park alternatives.[1] Thus two adjustments were made, the first to compensate for varying numbers of parks (Columns 5 and 6, Table 29), and the second to allow for variation in park size, in terms of total numbers of users (Columns 7 and 8, Table 29).[2]

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[1] Number of parks, for example, varies between one and six.

[2] These adjustments consisted of multiplying the initial prediction by the result of dividing the relevant park number or size figure for that locational type by the average number or size figure for all locational types.

TABLE 29

PREDICTION OF LOCATIONAL CHOICES OF HAMILTON CAMPERS (1968)
FROM PREFERENCE STRUCTURE OF ONTARIO CAMPERS (1966)

Locational type	Actual attendance (1968)	Initial prediction attendance	Initial prediction % error	Adjustment for no. of parks attendance	Adjustment for no. of parks % error	Adjustment for no. of campers attendance	Adjustment for no. of campers % error	Ellis' predictions % error
11	621	2,710	336	1,807	191	1,626	162	33
21	481	1,217	153	406	-16	118	-75	37
41	3,022	2,817	-7	1,878	-38	2,679	-11	6
51	1,513	7,711	409	2,568	70	1,824	21	-104
32	3,814	1,731	-55	2,307	-40	2,761	-28	29
42	3,433	1,056	-69	2,112	-38	2,214	-36	10
52	6,167	4,422	-28	7,370	20	18,545	201	-17
13	821	514	-37	343	-58	183	-78	26
23	8351	368	-56	368	-56	163	-80	31
33	3,397	2,218	-35	2,957	-13	3,585	6	16
43	798	1,336	67	891	12	610	-24	-57
53	8,792	1,808	-79	2,410	-73	8,266	-6	-7
14	93	299	222	199	114	29	-69	62
24	380	952	151	317	-17	162	-57	79
34	124	480	287	160	30	54	-56	40
44	317	637	100	212	-33	128	-60	-17
54	824	1,397	70	931	13	690	-16	-45
25	47	269	472	90	91	16	-66	17
35	161	368	129	123	-24	47	-71	-4
16	532	441	-17	441	-17	185	-65	64
26	47	368	683	123	162	29	-39	22
36	466	1,217	161	1,217	161	397	-15	10
46	725	676	-7	451	-38	430	-41	5
37	72	403	460	134	86	28	-61	11
47	625	1,105	77	368	-41	917	47	-3
28	275	637	132	425	55	243	-12	49

Substantial improvements in prediction are evident for the great majority of locational types for both of the modifications made. Where adjustments were made concerning number of parks, 15 of the 26 locational types had prediction errors of less than 300 individuals. Where allowance was made for total patronage of parks, 18 locational types had prediction errors of less than 350. Mean prediction error (percent) for locational types was slightly lower for the patronage modification than for the park numbers modification (54 % versus 58 %). However, in terms of the median prediction error, the reverse was true 39% for number of parks adjustment versus 52% for patronage adjustment).

No attempt is made here to further pursue the best fit between observed and predicted attendance. The purpose was simply to demonstrate by way of an example, that possibilities do exist for employing the revealed preference model in a predictive capacity. When it is recalled that the predictions for 1968 Hamilton campers were made on the basis of the preferences of a sample of all Ontario campers in 1966, the results appear to be quite promising.[1] Certainly this aspect of the preference model merits investigation in future research.

Other Research Problems

A variety of additional research needs are apparent from this study, some of which are briefly identified below.

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[1] Compared to the results of the systems model, for example, in predicting patronage of similarly composed locational types, the preference model predictions are somewhat poorer (Column 9 of Table 29). However, the systems model is concerned with predicting total numbers of users for park destinations, possibly a somewhat easier task than predicting numbers of users from a particular origin. Also, the systems model was tested with the same user data employed in its formulation (i.e. data for 1966 park users).

One of the most pressing needs is for improved techniques to measure attractiveness of destinations for recreation purposes. Specifically, the measures adopted should be firmly based on site attribute preferences determined for the population under consideration. The technique advanced by Ross[1] represents an effort to identify such preferences held by choosers, and ultimately, with improvements could prove to be useful in this respect.

The question of defining locational types for recreation opportunities also needs much more investigation. A series of experiments for one or more data sets which investigated various definitions of locational types would be of considerable value here in formulating criteria for setting up locational types.

Once steps have been taken to resolve the problems noted above, it should be possible to refine and extend the results of this study. It would be useful, for example, to repeat the park user preference analysis for different points in time or for different spatial systems, and determine the nature of differences in preference structure. In addition, the analysis might be carried out for other types of recreational pursuits, and comparisons made between activities.

In conclusion, it should be noted that there are additional research needs which are related to the revealed preference model itself, and not specifically to its application to choice behavior in

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[1] Ross, "Attractivity Indices."

recreation. Such problems have been adequately discussed elsewhere and hence are not dealt with here.[1]

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[1]See for example:
Rushton, "The Scaling of Locational Preferences."
_______, "Behavioral Correlates of Urban Spatial Structure."
Ewing, "An Analysis of Consumer Space Preferences."

APPENDIX

APPENDIX I

A CLASSIFICATION OF DECISION THEORIES[a]

Type of Response		Type of Outcome: CERTAIN (Riskless)	Type of Outcome: UNCERTAIN (Risky)
Static (no provision for change over time)	DETERMINISTIC (Algebraic)	- probabilities governing responses are 0, ½, or 1 - outcome determined by stimulus presentation and response (riskless) - method can be either selection among outcomes or ranking of outcomes (simple choice vs. ranking)	- probabilities governing responses are 0, ½, or 1 - stimulus presentation and response determine only a probability distribution over the outcomes (risky) - method can be simple choice or ranking)
	PROBABILISTIC	- no restriction on probabilities governing responses - outcome determined by stimulus presentation and response (riskless) - method can be either simple choice or ranking	- no restriction on probabilities governing responses - stimulus presentation and response determine only a probability distribution over the outcome (risky) - method can be either simple choice or ranking
Dynamic (same cells as above only allowances for change over time are made)			

[a]After Luce and Suppes (R.D. Luce and P. Suppes, "Preferences, Utility and Subjective Probability," Handbook of Mathematical Psychology, Volume III, eds. R.D. Luce, R.R. Bush and F. Galanter (New York: J. Wiley, 1965), pp. 249-410).

APPENDIX II

SOME CHARACTERISTICS OF ONTARIO PROVINCIAL PARKS, 1966

L&F CODE	DHO MAP	RESORT AREA	NAME	AREA (ac)	SITES TENT	SITES TRAILER	BEACH TYPE	BEACH LENGTH ft.	TREE COVER GOOD SPARCE NONE	TREE COVER HARDWOOD MIXED CONIFER	LAKE AREA	BOAT LAUNCH RAMPS
011	3	30	Clay Creek	10	23	23	0	0	?	M	St. Clair River	1
012	4	40	Holiday Beach	252	252	83	Sand	1700	G	M	Erie	1
013	2	38	Ipperwash	109	116	150	Sand	1400	G	M	Huron	2
014	9	37	Long Point	840	720	98	Sand	1600+ 3 mi	S	M	Erie	1
015	1	36	Pinery	5200	974	101	Sand	24000	G	M	Huron	2
016	12	42	Rock Point	190	47	5	?	600	S	H	Erie	1
017	6	41	Rondeau	11480	480	122	Sand	7750	G	H	Erie	2
018	11	32	Turkey Point	770	410	64	Sand	1200	G	M	Erie	1
019	5	41	Wheatley	616	40	23	Sand Gravel	6600	G	H	Erie	1
021	90	5	Five Mile Lake	1000	67	30	Sand	600	G	M	1004a.c.	1
031	70	8	Greenwater	10000	35	16	Sand	300	G	M	2 lakes 80ac	2
032	60	8	Kettle Lakes	2304	83	12	Sand	1000	G	C	4 lakes 44ac	3
041	88	2	Caliper Lake	240	67	30	Sand	300	G	M	10 sq.mi. 6400ac	1
042	87	2	Lake of the Woods	2127	65	13	Sand	1500	G	H	(1485 sq.mi.)	1
043	85	2	Quetico	1750sm	101	30	Sand	300	G	M	1 ½ sm	2
044	85	2	Quetico Interior Users									
051	76	4	Blacksand	3353	100		Sand	3500	G	M	1730 sm	1
052	73	4	*Klotz Lake	210	33		NONE		G	M	2.5 sm	1
053	74	4	MacLeod	300	54		Sand Pebbles	4240	G	H	16.8 sm	2
054	66	4	Neys	7736	94		Sand	5200	G	M	Superior	1
056	76	4	Rainbow Falls	1163	136	20	Sand	300	G	M	2150ac	2
061	63	8	Ivanhoe	2070	127	16	Sand	8600	G	M	530 ac	4
071	26	30	Craigleith	27	180	20	Rocky unsuitable		G	M	G. Bay	1
072	23	35	Inverhuron	620	281	40	Rocky Sand	300	G	C	L. Huron	1
073	22	35	Point Farms	384	187	35	Sand	1800	G	–	L. Huron	1
074	24	34	Sauble Falls	43	113	33	NONE		G	H	River	1
081	72	8	Nagagamisis	11878	62	10	Sand	7000	G	M	6800ac	–
082	71	8	Remi Lake	6800	70	10	?	600	G	C	16 sm	–
091	31	10	Fitzroy	415	230	23	Man Made	150	G	M	River	2
092	33	18	Rideau River	143	161	30	Man Made	330	G	C	River	2
093	32	18	Silver Lake	70	179	18	Sand	660	G	H	700ac	1
094	34	20	South Nation	13	28	3	None far from tents	River	G	M	River	1
101	81	3	Aaron	124	55	15	Gravel	700	G	M	7600ac	1
102	82	3	Blue Lake	620	80	20	Sand	1000	G	C	670ac	1
103	83	1	Rushing River	386	81	25	Sand	480	G	M	6100	1
104	84	1	Sioux Narrows	284	10	80	Sand	150	G	M	67 150 sq.mi.	1
111	19	23	Balsam Lake	1040	200		Man Made	–	G	M	21 sm	1
112	28	28	Darlington	380	230		Sand Gravel	1000	S	M	Ontario	2
113	30	23	Emily	67	130		Man Made Sand	600	S	M	River	3
116	27	21	Presqu'ile	1721	900		Rock Sand	1½ mi	G	M	Ontario	1
117	28	22	Serpent Mounds	70	130		Sand	600	S	H	28	3
121	21	30	Bass Lake	142	12		?	200	G	?	?	0
122	16	28	Devil's Glen	14	40	0		0	G	M	0	0
123	17	28	Earl Rowe	108	60	40	Man Made	150	G	M	River	0
124	20	20	Mara	90	85	16	Sand	700	G	?	Simcoe	1
125	18	20	Sibbald Point	485	547	60	Gravel Sand	2000	G	M	Simcoe	1
128	13	13	Six Mile Lake	177	190	21	Man Made	200	G	H	?	1
131	42	9	Antoine	40	24	6	0	0	G	M	Ottawa River	1
132	44	8	Finlayson Point	75	90	16	Man Made	?	G	M	Temagami	4
133	43	8	Marten River	1075	737	10	Sand	300	G	M	Lake and R	0
134	41	9	Samuel de Champlain	2880	724	19	Man Made	100	G	M	Lake and R	0
141	10	12	Arrowhead	1000	40	20	Man Made	300	G	H	50	1
142	61	9	Grundy Lake	6313	445	46	Sand	1650	?	M	680ac 6 lakes	5
143	40	11	Killbear Point	2313	600	122	Sand	14000	G	M	G. Bay	4
144	63	12	Mikisew	90	100	20	?	1600	G	M	2300	1
145	40	11	Oastler Lake	20	80	64	Sand Rock	600	S	H	300	1
146	60	12	Restoule	1600	228	34	?	4000	?	M	3000	3
147	60	11	Sturgeon Bay	70	60	27	Man Made	190	S	H	G. Bay	1
151	46	16	Algonquin Park	2910 sm	1318	–	Sand	3200	G	M	Many Lakes Rivers	3
152	48	17	Carson Lake	15	46	–	?	100	G	C	4 sm	1
153	47	16	Driftwood	604	90	0	Sand	4000	G	M	Ottawa River	1
154	46	16	Algonquin Park Interior Users									
161	80	3	Hawood	82	50	12	Sand	100	G	M	20	0
162	78	4	Kakabeka Falls	881	102	24	Sand	1600	G	M	River	0
163	78	4	Middle Falls	10	15	5	0	0	G	H	River	0
164	77	4	Sibley	95 sm	315	35	Sand Gravel	7200	G	M	2000?	2
172	62	5	Lake Superior	338000	208	47	Sand	7000	G	M	Lake Superior	1
173	57	5	Mississagi	90000	19	19	Sand	400	G	M	730	0
174	61	5	Pancake Bay	710	150	130	Sand	10800	G	M	Lake Superior	1
181	80	3	Ojibway	6130	56	12	Man Made	300	G	M	7 lakes 16 000 ac	2
182	80	3	Pakwash	1700	60	30	Sand	4500	G	M	70 000	1
191	56	6	Chutes	746	97	0	Sand	550	G	?	River	0
192	54	6	Fairbank	85	120	12	Sand	1300	G	H	6 sm	1
193	56	6	Killarney	90000	60	0	Sand	600	G	H	6 sm	1
194	56	6	Windy Lake	263	102	16	Sand	4000	G	M	12 sm	1
201	66	6	Esker Lakes	7680	130	5	Man Made	900	G	M	424	1
202	66	6	Kap-Kig-Iwan	720	54	10	0	0	G	M	River	0
211	30	16	Black Lake	70	160	40	Man Made	400	G	M	105	3
212	30	17	Bon Echo	16600	300	160	Sand	900	G	M	Sharbot 3860 3830	3
214	48	17	Lake St. Peter	61	40	30	?	700	?	M	578	2
215	36	21	Outlet Beach	366	300	100	Sand	2000	G	M	Lake Ontario	3
221	64	5	Obatanga	94 sm	61	22	Sand	1000	G	C	River	1
222	66	5	White Lake	3860	160	67	Sand	3600	G	M	36 sm	2

L&F CODE	NAME	WALKING TRAILS NO.	WALKING TRAILS LENGTH mi.	HIKING TRAILS NO.	HIKING TRAILS LENGTH	SCENIC VALUE BELOW AV. ABOVE AV. EXCELLENT	NO. OF PARKS WITHIN 50 MI.	DIST. FROM HWY.	DISTANCE FROM SHOPS mi.	PEAK WAIT MIN.	SWIM	FISH	COMMENT
011	Clay Creek	0	–	0	–	E	0	On 40	30	0	?	?	Chemical Valley. Gt. Lakes Shipping
012	Holiday Beach	0	–	0	–	A	2	On 18A	10	3	/	?	Near U.S. [illegible]
013	Ipperwash	0	–	0	–	A	2	On 21	11	20 hrs	/	/	Kettle rocks
014	Long Point	0	–	0	–	A	3	On 59	7	1	/	/	Naturalizing, bird migration, historic sites
015	Pinery	4	1	1	1	AA	2	On 21	7	5	/	?	Kettle Grand Bend, relics
016	Rock Point	0	–	0	–	B	1	8	8	2	/	?	Fossils
017	Rondeau	3	6½	1	2½	E	2	4	12	2	/	/	Baseball, tennis, swim, amusements, Bay.
018	Turkey Point	0	–	0	–	A	2	10	13	7	/	/	Golf
019	Wheatley	0	–	0	–	AA	2		1	1	/	?	
021	Five Mile Lake	1	1	0	–	AA	1 coming	On 129	23	6	/	?	Free camping on nearby crown lands.
031	Greenwater	1	1½	2	4½	AA	–	8	30	2	/	/	Canoe trips on R. Moosonee
032	Kettle Lakes	1	2½	2	3	A	0	2	22	?	/	?	
041	Caliper Lake	0	–	0	–	BA	1	1	6	7	/	F	Most popular for fish, hunting.
042	Lake of the Woods	0	–	2	1½	AA	0	2	5	4	/	F	Excellent fishing
043	Quetico	5	4	0	–	AA	0	1/3	30	15	/ /	F	
044	Quetico Interior Users												
051	Blacksand	Many	7	Many	7	AA	0	3	6	0	too cold	/	Very picturesque
052	*Klotz Lake	0	–	0	–	A	1	On 11	30	0	?	F	
053	MacLeod	1	1	1	1	A	1	On 11	6	0	S	F	Good fishing holds campers longer than normal
054	Neys	1	1	1	1	AA	1	1½	15	0	too cold	?	Location on L. Sup. + scenery + lots of people
056	Rainbow Falls	2	3	2	3	AA	1	On 17	6	–	S	?	Location on L. Sup. + scenery + lots of people
061	Ivanhoe	1	1	0	–	AA	0	87	8	0	/	F	Moderately good fishing, very scenic
071	Craigleith	0	–	0	–	A	2	On 26	9		Skin dive	F	Trout. Blue Mts.
072	Inverhuron	1	1½	1	1½	A	2	4	13	2	/	F	Good Fishing in nearby streams
073	Point Farms	0	–	0	–	A	2	On 21	8	2	/	?	
074	Sauble Falls	*		1	9	A	1	9	11	7	Not well	F	Sauble 1 mi away Sauble Beach, amusements
081	Nagagamisis	0	–	0	–	AA	0	Pm 631	30	10	/	F	Natural state attractive
082	Remi Lake	1	½	0	–	BA	0	2½	6	10	/	F	Fly in fishing, paper mill tour
091	Fitzroy	0	-	0	–	AA	1	9	12	7	?	?	Chats Falls hydro tour
092	Rideau River	0	–	0	–	A	1	On 16	5	10	?	?	
093	Silver Lake	0	–	0	–	A	1	On 7	10	10	?	?	
094	South Nation	0	–	0	–	A	0	On 17	3	0	Water N.G.		Dam upstream. Too small for Montreal. Ottawa traffic on Hwy. 17
101	Aaron	0	–	0	–	A	1	On 17	10	5		?	Overnight stop. No points of interest
102	Blue Lake	0	–	0	–	AA	2	On 647 8 mi. 17	6	5	/	?	
103	Rushing River	2	1	0	–	AA	2	On 71	17	10	/	F	Excellent on major route from USA [illegible]
104	Sioux Narrows	0	–	0	–	A	3½	On 71	2	0	/	/	
111	Balsam Lake	0	–	0	–	BA	3	On 48	6	10	/	F	On Trent Waterway, boating
112	Darlington	0	–	0	–	A	1	1	3	5	?	0	Mosport, CNE
113	Emily	0	–	0	–	BA	3	2	6	8	/	F	Mud near shore. Heavy boat traffic
116	Presqu'ile	3	6	3	6	A	4	3	3	2	/	Poor	Lake rough for boats
117	Serpent Mounds	0	–	0	–	AA	3	8	2	3	/	F	Woods
121	Bass Lake	0	–	0	–	A	2	½	½	7	/	?	Leacock
122	Devil's Glen	0	–	0	–	AA	5	On 24	12	0	0	0	No water
123	Earl Rowe	0	–	0	–	A	5	1	2	2	/	F	Camp Borden, generates use. Soldiers, friends
124	Mara	0	–	0	–	A	2	1	1½	4	5	F	Leacock. Lake cruisers
125	Sibbald Point	0	–	0	–	A	2	1½	3	5	0	?	
128	Six Mile Lake	0	–	0	–	A	4	On 103	6	4	/	?	Land locked from Trent system
131	Antoine	0	–	0	–	A	2	12	4½	0	0		No swimming allowed, undertow
132	Finlayson Point	0	–	0	–	AA	2	On 11	1	4	/	F	Deep, heavy boat traffic, good resort
133	Marten River	0	–	0	–	E	1	On 11	37	4	5	F	Ideal for camping
134	Samuel de Champlain	1	½	1	5	E	2	On 67	9	4	/	?	Voyageur's Hwy
141	Arrowhead	0	–	0	–	BA	2	½	4	0	/	?	
142	Grundy Lake	0	–	0	–	A	3	1/8	80	0	/	F	Scenic, voyageur rock
143	Killbear Point	1	2	0	–	E	3	11	22	5	/	F	Scenic
144	Mikisew	1	½	0	–	BA	1	10	10	0	/	?	
145	Oastler Lake	0	0	?	-	A	3	On 69	6	6?	/	F	Well established
146	Restoule	1	1	0	-	A	1	20	8	0	/	?	Bad road
147	Sturgeon Bay	0	–	6?	–	A	3	On 69	3	0	/	F	
151	Algonquin Park	5	7	2	35	AA	8	On 60	N.A.?	5	5	F	
152	Carson Lake	0	–	0	–	A	3	On 60	3	0	/	?	Formerly DHO roadside mainly Alg.
153	Driftwood	0	–	0	–	E	3	1	4	10	0	?	Ottawa R. of Laurentian Mts.
154	Algonquin Park Interior Users												
161	Hawood	0	–	0	–	BA	0	On 17	1	4	/	?	Overnight
162	Kakabeka Falls	1	1	0	–	AA	1	On 17,	½	6	?	?	Closeness to Lakehead
163	Middle Falls	0	0	0	–	AA	1	1	40	3	0?	?	No boating. Near U.S. overnight
164	Sibley	5	6½	2	7	AA	4		34	4	/	/	
172	Lake Superior	0	–	0	–	AA	3	On 17	12	7	Cold	F	Cold. Circle route pictographs. Very scenic
173	Mississagi	0	–	0	–	A	2	½	10	4	Poor	?	Mine tours. Elliot L.
174	Pancake Bay	0	–	0	–	A	2	On 17	8	7	Poor	?	Cold, rough water. Scenic
181	Ojibway	2	4	2	4	A	1	2	15	6	/	F	Only park in area. Muskie
182	Pakwash	0	–	0	–	BA	0	½	13	0	/	?	
191	Chutes	1	2	0	–	A	1	½	1	5	Buoyed	?	Swimming dangerous
192	Fairbank	1	1½	1	1½	A	1	13	7	6	Poor	?	
193	Killarney	0	–	0	–	AA	0	On 637	5	5	/	?	
194	Windy Lake	0	–	0	–	A	0	½	3	5	/	?	Hiking
201	Esker Lakes	2	2	1	5	AA	0	12	23	2	/	?	
202	Kap-Kig-Iwan	1	3	0	–	E	0	1½	2	2	0	?	Current and Undertow: no water activities
211	Black Lake	0	–	0	–	A	2	On 7	8	2	/	?	
212	Bon Echo	1	2	0	–	AA	1	On 41	6	3	/	F	Pictographs
214	Lake St. Peter	1	2	0	–	AA	1	1½	10	2	/	F	
215	Outlet Beach	0	–	0	–	AA	3	10	10	2	/	?	Excellent sand
221	Obatanga	1	½	1	1½	A	2	1	22	20	/	?	Circle route, wild life, some isolation, grandeur
222	White Lake	1	½	0	–	A	1	1½	22	45	/	F	Short swimming season (cool)

* BRUCE TRAIL.

(Compiled by Parks Branch, Department of Lands and Forests)

APPENDIX III

ONTARIO PROVINCIAL PARKS[a] - ATTRACTION VARIABLES EMPLOYED IN THE FACTOR ANALYSIS[b]

Number	Attribute	Percent of parks having this attribute (1966)	Significant attributes: factor loadings[c]		
			Water-related factor	Comfort-convenience factor	Backwoods-nature factor
1	Water available in campsites	32.9			
2	Hydro available for trailers	4.9	.31		
3	Water available for trailers	17.0			
4	Children's play areas	31.7	.37		
5	Open space area	12.2			
6	Adult play areas	8.5			
7	Comfort stations in campground	29.3	.50		
8	Refreshment concession	13.4	.48		
9	Groceries concession	19.5	.33		
10	Special attraction concession	6.1	.42		
11	Location on a great lake	34.7			
12	Location on a land lake 100-1000 acres	14.6			
13	Location on a land lake 1000-5000 acres	18.3			
14	Location on a land lake over 5000 acres	15.9			
15	Location on a river	20.7			
16	Water activity limitations due to weeds	2.4			
17	Water activity limitations due to currents or waves	3.7			
18	Water activity limitations due to boating or swimming restrictions	17.1			
19	Water activity limitations due to poor water quality	8.5			
20	Water activity limitations due to steep drop-off	9.8			
21	Water activity limitations due to poor bottom	4.9			
22	Water activity limitations due to combination of above	3.7			
23	Beach length nil - 1000 ft.	32.9			
24	Beach length 1000-4000 ft.	34.2			
25	Beach length over 4000 ft.	20.7			
26	Beach is sand	81.7			
27	Beach is sand and gravel	6.1			
28	Beach is man-made	35.4			
29	Separate day-use beach	32.9		.28	
30	Changehouses available	78.1		.43	

APPENDIX III --Continued

Number	Attribute	Percent of parks having this attribute (1966)	Significant attributes: factor loadings[c]		
			Water-related factor	Comfort-convenience factor	Backwoods-nature factor
31	Diving raft available	12.2		.31	
32	Additional beach available	2.4		.36	
33	Beach patrol service	47.6			
34	Tree cover is nil	2.4			
35	Tree cover is sparse	14.6			
36	Tree cover is dense	82.9			
37	Trees are hardwood	18.3			
38	Trees are mixed	68.3			
39	Trees are coniferous	11.0			
40	Boat ramps nil	13.4			
41	Boat ramps one	51.2			
42	Boat ramps more than one	34.4		.59	
43	Trail length over 1 mile	25.6			.29
44	Interpretive activities (any kind)	18.3			.49
45	Scenic value is below average	7.3			
46	Scenic value is average	51.2			
47	Scenic value is above average	32.9			
48	Scenic value is exceptional	8.5			
49	Nearby attractions nil	34.2			
50	Nearby attractions urban amusements	2.4			
51	Nearby attractions outdoor amusements	20.8			.33
52	Nearby attractions cultural attraction	6.1			
53	Nearby attractions combination of above	36.6			
54	Park is new (estab. 1956-66)	6.1			
55	Park is recent (estab. 1962-64)	11.0			
56	Park is well established (1961 or earlier)	82.9			

[a]Parks without campgrounds are excluded.

[b]Ellis, "Systems Analysis of Provincial Park Camping," pp. 8-11.

[c]The factor loadings are indicative of the relative contributions of the variables identified as key contributors to the three factors.

APPENDIX IV

PARK CAPACITY AND LOCATIONAL PREFERENCES

One problem envisaged in the identification of locational preferences of park users is that of capacity limits. Individuals may not be able to choose among all exisiting alternatives simply because these locations have limits as to the number of persons who can be accomodated. Consequently, preferences may be obscured in the analysis. Methods of dealing with this problem are discussed briefly below.

Degree of Confidence in Revealed Preference Results

While there appears to be no method of determining to what extent capacities of parks have obscured true locational preferences, it does appear possible to use extent to which capacities are filled as one measure of confidence in the validity of the revealed preferences. That is, the closer capacities of parks are to being completely filled, the greater the possibility that locational preferences are being obscured by capacity limits.

Consider a hypothetical example. A population of 1000 camping parties from one origin center can choose among five locational alternatives.

Type A - capacity of 400 camping parties
Type B - capacity of 100 camping parties
Type C - capacity of 300 camping parties
Type D - capacity of 700 camping parties
Type E - capacity of 300 camping parties

Assume that the true preferences of this population are:

	most pref.				least pref.
	B ⟶	E ⟶	A ⟶	C ⟶	D
no. of campsites desired	350	225	200	150	75

Assuming that if the most preferred type is not open to a party the next most preferred type will be selected, the following situation prevails:

> 350 want B but only 100 can choose it, therefore 250 will choose E.
> 225 want E but only 50 can choose it, therefore 175 will choose A.
> 200 want A and choose it.
> 150 want C and choose it.
> 75 want D and choose it.

Therefore, preferences change to the following:

A →	E →	C →	B →	D
375	300	150	100	75

These are the "revealed" preferences.

Therefore, probabilities of a camping party visiting these locations according to apparent (revealed) versus true preferences are:

Locational type	Apparent (revealed)	True
A	.375 (most pref.)	.200
E	.300	.225
C	.150	.150
B	.100	.350
D	.075 (least pref.)	.075

The goal is to be able to predict, when true preferences are unknown, where discrepancies between apparent and true probabilities will be the greatest.

Locational type	Discrepancy between apparent and true probabilities	Percentage of capacity filled
B	.250	100
A	.175	94
E	.075	100
C	0	50
D	0	11

These discrepancies occur either where capacity restrictions lead to under-estimations of true preferences (B), or where overflow from a higher preference location leads to over-estimation of true preferences (A and E). As seen in the above table, knowledge of percentage of capacity filled enables prediction of <u>where</u> discrepancies might be expected but not the <u>extent</u> of these differences nor their <u>direction</u> (over- versus under-estimation of true preferences for a locational type). Since the true preference ordering is not known, the locational types to which overflow might be diverted cannot be ascertained. Although in this case A and E were identified as types where discrepancies might be found, many situations can be envisaged where overflows would not lead to high percentages of capacity filled.

Therefore, assuming only the revealed preferences of the individuals in the above example are known, these would be expressed as

$$A \longrightarrow E \longrightarrow C \longrightarrow B \longrightarrow D$$

but indicating that confidence in preferences for B, A, and E is not high because of the extent to which their capacities are filled.

The example treated above is a simple situation where campers are from one origin center and choose among five parks having different characteristics. Complications arise where campers are from more than one origin center and choose among parks which may have considerable similarity (reflected by their grouping into locational types). In this case, one locational type may include one (or several) park(s) for campers from one origin center, but a different park(s) for campers from another origin center. Thus assigning a particular figure for extent to which capacity is filled would be a difficult task. Averaging of these percentage figures within each locational type with perhaps some weighting on basis of patronage would appear to be one feasible solution.

<u>An Alternative Approach</u>

The above approach to the capacity problem recognizes that at times, because of capacity limitations, campers cannot choose the location they prefer. A second approach might be to view capacity limitations as part of the group of park characteristics considered by campers in formulating their preferences. Thus the assumption is made that to all potential visitors to a park, the risk that capacity might be filled constitutes a detrimental feature of that park. The degree of risk is reflected in the percentage of total capacity which is utilized.

The evaluation of the importance of capacity limitations as a detrimental characteristic is a difficult matter. Obviously to campers who have been turned away from filled parks, this characteristic is the one dominating their behavior. Others, however, may simply rate a park as less attractive because of the possibility they may be turned away. The problem is to arrive at some sort of average rating of this characteristic relative to other characteristics evaluated.

As already noted, Ellis[1] in adding camping capacity (but not percentage filled) to his rating system for parks, assigned an index multiplier of 1 to a park having "average" capacity. The extent to which parks deviate from this average determines changes in this multiplier. For example, a park with twice as much capacity as average would have a multiplier of 2.

In this case, the parks of interest are those which are considerably above "average" regarding percentage of capacity filled. It was decided arbitrarily to set the value of 65% as an index multiplier of 1. Then, any park with values above this figure would be devalued accordingly. For example, a park with 85% of capacity filled would receive a multiplier of 0.76. For a park with 100% of capacity filled, the multiplier would be 0.65.

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[1] J.B. Ellis,"Systems Analysis of Provincial Park Camping: 1966 Park Users Survey,"report prepared for Parks Branch, Ont. Dept. of Lands and Forests (Toronto: January 1968).

This procedure was applied to the park attraction indices derived by Ellis,[1] using data expressing percentage of park camping capacity utilized during the peak use months of July and August.[2] Of the total 81 parks, 21 had percentages filled of 65 or more. However, the adjustment of these attraction scores made little difference in the ranking of parks by their attractiveness. Also of interest is the fact that little correlation was found between park attraction values and percentage of capacity filled. If the validity of the attraction scores is accepted, then the attractiveness of a park does not appear to be significantly related to the degree of use of camping facilities.[3]

This approach to the capacity problem appeared to be a more practical one than the one discussed initially, and was adopted in modifying park attraction scores for the study. Obviously, though, it would be desirable to establish a sounder basis for determining the effects of park capacity limits on locational choices of campers.

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[1] Ibid.

[2] Ontario Department of Lands and Forests, "Park Use Statistical Report, 1967" (Toronto, 1968, Mimeographed).

[3] As noted in Chapter I, percentage of capacity utilized is really a product of two types of decisions; decisions by campers to utilize particular parks and decisions by park administration to alter or maintain camping capacity. Therefore these percentages may simply reflect abilities of administrators to estimate demand for camping facilities.

APPENDIX V

1966 ONTARIO PROVINCIAL PARK USER SURVEY: CAMPER QUESTIONNAIRE[a]

(Long Form Questionnaire)

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1. Park Number - see park code sheet.

2. Sticker Number - from special survey sticker affixed to vehicle.

3. Date - day (use 2 digit code i.e.,01 to 31) and month (use 1 digit code i.e., May 1, June 2, July 3, Aug. 4, Sept. 5, Oct. 6)
e.g., July 9th would appear as 093; Sept. 11th - 115.

4. Where is your home? *(Use hometown code sheet).*
If U.S. resident - what was your point of entry into Canada?

5. Do you live in an apartment, single family detached dwelling, or . . . .?

6. (a) In the area where you live, are there outdoor recreation facilities within a ten minute walk, or not?
- If 'no' mark 'none' on form.
- If 'yes' go to 6 (b).

   (b) How would you rate these facilities?

7. Number of persons in car including infants - direct count.

8. We would like to know the approximate age of each person in your party. Into which of these age groups do the members of your party fall? Please provide the information separately for males and females - *use card*

9. Are there any persons in your party who do not live in the same household as you do? If 'yes', how many?

10. (a) What kind of work do you do? *(write in)*

    (b) What type of organization or company are you employed by? *(write in)*

    DO NOT CODE OCCUPATION UNDER ITEM NO. 10.

11. Would you indicate the category on this card which fits the last year in which you went to school? *- use card*

12. Is this trip part of your annual vacation?

13. How long is your vacation in the average year?

14. Approximately how many nights do you expect to stay in the park on this visit?

15. (a) How long is it since you left your home on this trip?
- If 'one' night' record hometown code as 'origin' and go the question 16.
- If 'two nights' or more, ask 15 (b).

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[a]Ontario Dept. of Lands and Forests and Ontario Dept. of Highways

(b) Have you spent two nights or more at the same location between here and your home?
- If 'no' record hometown code as 'origin' and go to question 16.
- If 'yes' ask question 15 (c)

(c) What was the last place where you spent two nights? Record location as 'origin'.

16. How would you classify your stop-over accommodation in ....(origin)?
- If 'home', this can be entered directly from Question 15 without asking question.

17. How many miles have you travelled since you left .... (origin)?

18. Excluding stops, how many hours have you travelled since you left ....(origin)?

19. (a) When you leave the park, do you plan on staying two nights or longer at any location before you return home?
- If 'no' record hometown as 'destination'.
- If 'yes' ask 19 (b).

(b) At which location do you plan to stop-over? (Record as destination)

20. How would you classify your stop-over accommodation in .... (destination)?

21. During the ten year period from 1956 to 1965, about how many years did you camp in Provincial Parks?

22. (a) Have you visited this park previously this year?
- If 'yes' - How many camping visits have you made to this park this year?
How many day visits have you made to this park this year?

(b) Have you visited any other Provincial Parks this year?
- If 'yes' - How many camping visits have you made to other parks this year?
How many day visits have you made to other parks this year?

23. Would you have come to this area on this trip if there were no Provincial Park here?

24. If 'yes' to 23 - If this park did not exist, what alternative accommodation would you use?

25. Camping equipment - enter directly - no question required.
- mark only one category. If camper-back, or bus type of camping vehicle (e.g., V.W. camping bus) - mark under '15'.

26. What activities do you intend to participate in during this visit? Which two would you consider most important to the enjoyment of your visit? (Include activities such as fishing and sightseeing which are not necessarily pursued within park boundaries) Mark only two.

27. What do you estimate the total amount of money will be, not including park fees, which you will spend in the immediate area during this camping visit? (Ten dollar range).

28. (a) Have you found the park facilities and services to be generally satisfactory?
- If 'no'
(b) What have you found unsatisfactory?

29. In an average summer, how many visits (for recreational purposes) would you usually make to each of the following:- cottage, private park, commercial resort, other?

APPENDIX V--Continued

DEPARTMENT OF HIGHWAYS | DEPARTMENT OF LANDS AND FORESTS.

1. PARK NUMBER 0 1 2 3 4 5 6 7 8 9

2. 0 1 2 3 4 STICKER NUMBER 5 6 7 8 9

3. 0 1 2 3 4 DATE 5 6 7 8 9

4. 0 1 2 3 4 HOME TOWN 5 6 7 8 9

5. SINGLE SEMI DUPLEX TOWN H APT RESIDENCE TYPE ROOM OTHER

6. RECREATION FACILITIES
EXC. GOOD AVE. POOR NONE

7. NUMBER IN CAR
0 1 2 3 4 5 6 7 8 9

8. AGE AND SEX 0 1 2 3 4 MALE
0 - 4
5 - 14
15 - 19
20 - 24
25 - 34
35 - 54
55 - 64
65 +

AGE AND SEX 0 1 2 3 4 FEMALE
0 - 4
5 - 14
15 - 19
20 - 24
25 - 34
35 - 54
55 - 64
65 +

INTERVIEWER CODE

OCCUPATION OF DRIVER

TYPE OF COMPANY

9. NUMBER NOT IN RESPONDENTS FAMILY
0 1 2 3 4 5 6 7 8 9

10. MANAGER PROF OR TECH TEACHER CLERICAL SALES OCCUPATION SERVICE TRANSPORT PRIMARY CRAFTSMAN LABOURER

11. GRADE PART HS HI GRAD POST HS PART U EDUCATION U GRAD

12. PART ANNUAL VACATION YES NO

13. LENGTH OF VACATION (WEEKS)

14. 0 1 2 3 4 LENGTH OF VISIT (NIGHTS) 5 6 7 8 9

15. 0 1 2 3 4 ORIGIN OF TRIP 5 6 7 8 9

16. HOME FRIENDS RESORT HOTEL PROV PK ORIGIN CLASS PRIV PK PUB PK

17. 0 1 2 3 4 MILES TRAVELLED 5 6 7 8 9

18. 0 1 2 3 4 HOURS TRAVELLED 5 6 7 8 9

19. 0 1 2 3 4 DESTINATION 5 6 7 8 9

20. HOME FRIENDS RESORT HOTEL PROV PK DESTINATION CLASS PRIV PK PUB PK

21. YEARS CAMPED 1956 - 1965

22. 0 1 2 3 4 5 6 7 8 9
THIS PARK: CAMPING 1966 / DAY VISIT
ALL PARK: CAMPING 1965 / DAY VISIT

23. COME IF NO PARK ? YES NO

24. ACCOMMODATION IF NO PROVINCIAL PARK: PUB PK PRIV PK HOTEL RESORT OTHER

25. EQUIPMENT CANOE TENT TR. HOUSE TRAILER 15' 16-20' 21-25' 26' COMBIN

26. SWIM FISH BOAT HIKE W SKI ACTIVITIES SIGHT RELAX

27. <10 10-20 21-30 31-40 41-50 TOTL EXPENDITURE 51-60 61-70 71-80 81-90 >90

28. LAUNDRY FLUSH T SHOWERS PLAY GRD. BOAT LG. FACILITY AND SERVICE CAMP ST. PARK MT. INSECT OTHER

29. 0 1 2 3 4 5 6 7 8 9
COTTAGE
PROV PK
COMMERC RESORT
OTHER

APPENDIX VI

COMPUTER PROGRAM FOR REVEALED PREFERENCE ANALYSIS AND COMPARISON OF SUBGROUP PREFERENCES

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C     PROGRAM TO FORM 2 REVPREF MATRICES AND DETERMINE SIMILARITIES
      DIMENSION AIOG(88), VC(88),VCA(81),AID(81),AIEF(88), AINN(88), AIE
     1(81),AIN(81), A(40,40),  AIB(10,10),AIA(10,10),G(2,40,40),DA(100),
     2DB(100),B(100),ICA(100),ICC(100),ATT(3,81),AK(20),ITEMP(20),NPI(81
     3),X(40,40),Z1(40,40),TYPIST(40,40),F(40,40),Y(40,40),LXX(40),BP(10
     44),H(104),AA(104),NTA(100),CA(100),ICB(100),AP(100),C(104),Z2(40,4
     50)
      COMMON FF(3,53,81),J,K
      READ (5,1) IB,ND,MM,IT,NOGLIM,IOR
    1 FORMAT (6I5)
      READ (5,2) (AIOG(K), AIEF(K), AINN(K), VC(K), K=1,88)
      READ (5,2) (AID(K), AIE(K), AIN(K), VCA(K), K=1,ND)
    2 FORMAT (16F5.0)
C     READ IN DISTANCES MATRIX
      DO 12 K=1,ND
      READ (5,11) (FF(3,J,K), J=1,IOR)
   11 FORMAT (2F4.0,4X,7F4.0,8X,5F4.0,12X/16X,3F4.0,32X,2F4.0,4X,2F4.0/9
     1F4.0,4X,2F4.0,8X,2F4.0,4X,2F4.0,4X/4X,1F4.0,4X,3F4.0,4X,2F4.0,8X,2
     2F4.0,4X,3F4.0,4X,2F4.0/1F4.0,8X,2F4.0,8X,1F4.0)
   12 CONTINUE
      READ (5,9) INID, ININ
    9 FORMAT (2I5)
      DO 10 NM=1,2
      DO 3 J=1,IOR
      DO 4 K=1,ND
      FF(NM,J,K)=0.0
    4 CONTINUE
    3 CONTINUE
      IF(NM.EQ.2) INID=ININ
      DO 8 L=1,INID
      READ (5,6) TA,TB,TC,TD,TE,TF
    6 FORMAT (1X,A1,1X,A2,6X,A1,1X,A1,1X,A1,1X,A1)
      REWIND 9
      WRITE (9,7) TA,TB,TC,TD,TE,TF
    7 FORMAT (A1,A2,1X,A1,A1,A1,A1)
      REWIND 9
      READ (9,5) AIDN,AIOW
    5 FORMAT (1F3.0,1X,1F4.0)
      CALL SEARCH (88,AIDN,    K,IER,XY,AIOG,VC,88)
      IF (IER.NE.0) GO TO 8
      CALL SEARCH (81,AIOW,    KA,IER,YY,AID,VCA,81)
      IF (IER.NE.0) GO TO 8
      J=XY
      K=YY
      IF (J.GT.53) GO TO 8
      FF(NM,J,K)=FF(NM,J,K)+1.0
    8 CONTINUE
   10 CONTINUE
C     READ IN ATTRACTION MEASURES
      READ (5,21) ((ATT(J,K),K=1,ND),J=1,IB)
   21 FORMAT (16F5.0)
C     POSITION TEST OF TRANSITIVITY ASSUMPTION IN REVEALED SPACE PREF
C     THEORY
C     A*J,K< WHERE K COLS AND J ROWS
C
C     MM=NO. OF GROUPS OF ATTRACTION MEASURES, IT=DISTANCE SIZE GROUP
C     NOGLIM IS THE APPROX. LIMIT FOR THE MILES GROUPS
C
C     FIND NUMBER OF DISTANCE GROUPS  AND COMPUTE ACTUAL LIMITS
C     ON THE MILES
      NDG=(NOGLIM-IT)/IT+1
      IF (NDG*IT.LT.NOGLIM) NDG=NDG+1
      MXP=NDG*IT
      MXX=MXP+1
      NLC=NDG*MM
C     READ ATTRACTION LIMITS
      READ (5 ,840)(AK(J),J=1,MM)
C     CONSUMER OBSERVED BEHAVIOR PATTERN MASTER LOOP
C      ZERO TO 2
      WRITE (6 ,1122) IB,ND,MM,IT,NOGLIM,IOR
 1122 FORMAT ('1NO.OF ATTRACTION MEASURES',I6/'0NO. OF DESTINATION AREAS
     1',I6/'0NO. OF GROUPS ATTRACTION MEASURES',I6/'0DISTANCE SIZE GROUP
     2',I5/'0APPROX LIMIT FOR THE MILES GROUPS',I6/'0NO. OF ORIGINS',I6)
      WRITE (6 ,1123)((ATT(J,K),K=1,ND),J=1,IB)
 1123 FORMAT ('-ATTRACTION MEASURES'//(1X,20F6.1))
      DO 14 NM=1,2
      IF (NM.EQ.1) GO TO 109
      IB=1
      ND=81
      MM=5
      IT=250
      NOGLIM=2000
      IOR=53
      NLC=40
  109 DO 110 I=1,10
      DO 110 J=1,10
      AIB(I,J)=0.0
  110 AIA(I,J)=0.0
      IP=0
      AAA=0.0
      DO 130 J=1,NLC
      DO 120 K=1,NLC
  120 G(NM,J,K)=0.
      K=1
      DB(K)=G(NM,J,K)
      DA(K)=DB(K)
      D(K)=DA(K)
  130 CONTINUE
      DO 330 I=1,NLC
      ICA(I)=I
  330 ICC(I)=I
      DO 10 K=1,IOR
C     FIND POSSIBLE INTERACTIONS FOR THIS ORIGIN AREA
C     NPI=40<
      DO 33 L=1,ND
      AAA=AAA+FF(NM,K,L)
      AAT=ATT(1,L)
      DO 36 M=1,MM
      IF(AAT.LT.AK(M))GO TO 37
   36 CONTINUE
   37 JDI=FF(3,K,L)/FLOAT(IT)+.999999
      IF (JDI.GT.NDG) GO TO 32
      NPI(L)=(M-1)*NDG+JDI
      GO TO 33
   32 NPI(L)=0
   33 CONTINUE
      DO 30 J=1,ND
      AAT=ATT(1,J)
      DO 39 M=1,MM
      IF(AAT.LT.AK(M))GO TO 45
   39 CONTINUE
   45 JDI=FF(3,K,J)/FLOAT(IT)+.999999
      IF (JDI.GT.NDG) GO TO 30
      IF (JDI.NE.0) GO TO 22
      WRITE (6,23) K,J
   23 FORMAT (2I4)
      JDI=JDI+1
   22 KLJ=(M-1)*NDG+JDI
      DO 34 L=1,ND
      IF(L.EQ.J) GO TO 34
      IF (NPI(L).EQ.0) GO TO 34
      NNA=NPI(L)
      G(NM,NNA,KLJ)=G(NM,NNA,KLJ)+FF(NM,K,J)
   34 CONTINUE
   30 CONTINUE
C     WRITE OUT THE BASIC REVEALED PREFERENCE DATA MATRIX
      DO 420 J=1,NLC,20
      JF=J+19
      IF (JF.GT.NLC) JF=NLC
      WRITE (6 ,1020)
      WRITE (6 ,1030) AAA,(I,A(I),I=J,JF)
      DO 422 K=1,NLC
      DO 421 L=J,JF
      K1=L-J+1
      ITEMP(K1)=G(NM,K,L)
  421 CONTINUE
      WRITE(6,1041) ICA(K), ITEMP
 1041 FORMAT(I3,3X,20I6)
  422 CONTINUE
  420 CONTINUE
C     PROBABILITY THAT COL LOCATION PREFERRED TO ROW LOCATION
      REWIND 3
      DO 440 J=1,NLC
      DO 430 K=1,NLC
      A(J,K)=G(NM,J,K)
      A(K,J)=G(NM,K,J)
      IF (J.EQ.K) GO TO 430
      IF (ABS(A(J,K)+A(K,J)).GT.0.0000001) GO TO 425
      B(K)=0.0
      GO TO 430
  425 B(K)=A(J,K)/(A(J,K)+A(K,J))
  430 CONTINUE
      B(J)=0.
  440 WRITE (3)  (B(K),K=1,NLC)
      REWIND 3
      DO 450 J=1,NLC
  450 READ (3 ) (A(J,K),K=1,NLC)
      DO 460 I=1,NLC,20
      JF=I+19
      IF (JF.GT.NLC) JF=NLC
      WRITE (6 ,1050) (ICA(K),K=I,JF)
      DO 460 J=1,NLC
  460 WRITE (6 ,1060) ICA(J),(A(J,IJ),IJ=I,JF)
      WRITE (6 ,1120) (AK(J),J=1,MM)
      WRITE (6 ,1121) ND
 1121 FORMAT (' NUMBER OF DESTINATION AREAS',I6)
      NLD=1
      DO 465 J=1,NLC
      AA(J)=0.0
      DO 465 I=1,NLC
      AA(J)=AA(J)+A(I,J)
  465 CONTINUE
      DO 490 J=1,NLC
      AP(J)=0.
      FTEMP=NLC
      DO 480 I=1,NLC
      IF ((A(I,J).NE.0..OR.A(J,I).NE.0.).AND.A(I,J).NE.-1.) GO TO 470
      A(J,I)=-1.
      A(I,J)=A(J,I)
      FTEMP=FTEMP-1.
      GO TO 480
  470 IF (A(I,J).GT.0.5) AP(J)=AP(J)+1.
```

```
491 CONTINUE
    IF (ABS(FTEMP).LE.0.0000001) GO TO 489
    AP(J)=AP(J)/FTEMP*100.
489 IF (ABS(AA(J)).GE.0.0000001) GO TO 1300
    GO TO 490
1300 BP(NLD)=AP(J)
    ICB(NLD)=ICC(J)
    NLD=NLD+1
490 CONTINUE
495 NLC=NLD-1
    CALL SORT (BP,NLC,ICB,ICB,ICB,1,-1.)
    NLCA=NLC-1
    CA(1)=0.
    DO 500 I=1,NLCA
    ICAI=ICB(I)
    ICBF=ICB(I+1)
500 CA(I+1)=A(ICBF,ICBI)
    WRITE (6 ,1070)
    WRITE (6 ,1080)
    WRITE (6 ,1090) (ICA(I),ICB(I),BP(I),CA(I),I=1,NLC)
    REWIND 2
    DO 510 I=1,NLC
    ICBA=ICB(I)
510 WRITE (2)  (A(J,ICBA),J=1,40)
    REWIND 2
    DO 520 I=1,NLC
520 READ (2)  (A(J,I),J=1,40)
    REWIND 3
    DO 530 I=1,NLC
    IKL=ICB(I)
    WRITE (3)  (A(IKL,IJ),IJ=1,NLC)
530 CONTINUE
    DO 540 I=1,NLC,20
    J=I+19
    IF (J.GT.NLC) J=NLC
    WRITE (6 ,1100) (ICB(K),K=I,J)
    DO 540 K=1,NLC
    IKL=ICB(K)
540 WRITE (6 ,1060) IKL,(A(IKL,IJ),IJ=I,J)
    REWIND 3
    DO 550 J=1,NLC
550 READ (3)  (A(J,K),K=1,NLC)
C     THIS IS WHEN THE RAW TRANSITIVITY MATRIX IS COMPUTED.  IT IS STORE
C     ON TAPE FOR LATER USE.
    REWIND 1
    DO 570 J=1,NLC
    DO 560 K=1,NLC
    IF (J.EQ.K) GO TO 560
    C(K)=0.
    IF (A(J,K).GT.A(K,J)) C(K)=1.
    IF (A(K,J).EQ.A(J,K)) C(K)=2.
560 CONTINUE
    C(J)=0.
    WRITE (1)  (C(K),K=1,NLC)
570 CONTINUE
    REWIND 4
    Z3=CNINV(.99)
    Z4=CNINV(.001)
    DO 580 J=1,NLC
    DO 580 K=1,J
    IF (A(J,K).EQ.1.0) AHOLD=Z3
    IF (A(J,K).EQ.0.0) AHOLD=Z4
    IF (A(J,K).EQ.-1.0) AHOLD=-9.0
    IF (A(J,K).NE.1.0.AND.A(J,K).NE.0.0.AND.A(J,K).NE.-1.0) AHOLD=CNIN
   1V(A(J,K))
580 WRITE (4)  AHOLD
    DO 590 J=1,NLC
    DO 590 K=1,NLC
    IF (A(J,K).EQ.-1.) A(J,K)=2.
    A(J,K)=ABS(A(J,K)-.5)
C     3300 IS RED
590 IF (A(J,K).EQ.1.5) A(J,K)=-1.
    DO 600 I=1,NLC,20
    J=I+19
    IF (J.GT.NLC) J=NLC
    WRITE (6 ,1110) (ICB(K),K=I,J)
    DO 600 K=1,NLC
    WRITE (6 ,1060) ICB(K),(A(K,IJ),IJ=I,J)
    WRITE (7,1130) (A(K,IJ),IJ=I,J)
600 CONTINUE
    REWIND 1
    WRITE (6 ,1140)
    WRITE (6 ,1150) (ICB(I),I=1,NLC)
    DO 610 I=1,NLC
    READ (1 ) (A(I,J),J=1,NLC)
610 WRITE (6 ,1160) ICB(I),(A(I,J),J=1,NLC)
    AT=0.
    DO 631 ILA=1,NLC
    JLA=NLC-ILA+1
    ILB=ILA+1
    IF (ILB.GT.NLC) GO TO 631
    DO 630 ILC=ILB,NLC
    JLB=NLC-ILC+1
    IF (A(JLA,JLB).EQ.2.) GO TO 630
    ILD=ILC+1
    IF (ILD.GT.NLC) GO TO 630
    DO 620 ILE=ILD,NLC
    JLC=NLC-ILE+1
    IF (A(JLA,JLC).EQ.2.) GO TO 620
    IF (A(JLB,JLC).NE.2.) AT=AT+1.
620 CONTINUE
630 CONTINUE
631 CONTINUE
    DO 641 I=1,NLC
    ILA=I+1
    IF (ILA.GT.NLC) GO TO 641
    DO 640 J=ILA,NLC
    IF (A(I,J).NE.2.) GO TO 640
    A(I,J)=0.
    A(J,I)=1.
640 CONTINUE
641 CONTINUE
    WRITE (6 ,1170) AT
    WRITE (6 ,1180)
    WRITE (6 ,1150) (ICB(I),I=1,NLC)
    DO 650 I=1,NLC
650 WRITE (6 ,1160) ICB(I),(A(I,J),J=1,NLC)
    TA=0.
    DO 670 I=1,NLC
    TB=0.
    DO 660 J=1,NLC
    IF (A(I,J).EQ.1.) TB=TB+1.
660 CONTINUE
670 TA=TA+TB*TB
    TB=1.-(NLC*(NLC-1.)*(2.*NLC-1.)/12.-TA/2.)/AT
    WRITE (6 ,1190) TB
C
810 FORMAT (10A8)
820 FORMAT (  1H1,20X,10A8)
830 FORMAT (4I4)
840 FORMAT (13F6.0)
850 FORMAT (5(I4,2I3,I6))
860 FORMAT (3I2,3I4,6(I5,6X,F7.0))
870 FORMAT (3I2,3I4,6(I5,13X))
880 FORMAT (1H ,25HMISSING DATA FOR TOWN ID ,I4,10H HSLD. ID ,I4)
890 FORMAT (1H0,16HDISTANCE FROM ID,I6,11H TO HSLD ID,I6,3H IS,I5,4H M
   1ILES)
900 FORMAT (  1H1,34X, 66HTABLE      REVEALED SPACE PREFERENCE-RAW DATA
   1 MATRIX BY RESPONDENTS./)
910 FORMAT (55X, 28H1=LOCATIONAL TYPE PATRONIZED./55X,1H*, 25H=LOCATIO
   1NAL TYPE REJECTED./51X, 33HBLANK=LOCATIONAL TYPE NOT PRESENT./)
920 FORMAT ( 24H                    HOUSEHOLD ,37X, 16HLOCATIONAL TYPES./,
   118H          ,6X,  8H NUMBER ,2X,30I3/)
930 FORMAT (15X,I4,5X,30(2X,A1))
940 FORMAT (  1H1,46X, 40HTABLE      DEFINITION OF LOCATIONAL TYPES.//)
950 FORMAT (8X, 10HLOCATIONAL 12X, 15HDISTANCE  GROUPS,14X, 16HTOWN SI
   1ZE GROUPS,14X, 29HLOCATIONAL  TYPE   SELECTION)
960 FORMAT (10X,  5HTYPES,19X   7H(MILES),21X, 12H(POPULATION),18X, 30
   1HPOSSIBLE  ACTUAL  INDIFFERENCE)
970 FORMAT (92X, 27HCHOICES   CHOICES   SURFACE)
980 FORMAT (12X,I2,19X,I3,  3H - ,I3,16X,I6,  3H - ,I7,18X,F8.2,F8.2,4
   1X,F6.2)
990 FORMAT (  1H1,43X, 58HTABLE      FREQUENCY THAT LOCATIONAL TYPES WE
   1RE INTERACTIVE.//42X, 11HTOTAL TIMES,F8.0,9H POSSIBLE,F4.0,8H PERC
   2ENT,F10.2//25X,  4HTYPE,19X,  8HSELECTED,16X,  8HREJECTED,16X, 13H
   3PERCENT TOTAL./)
1000 FORMAT (22X,I6,        19X,F6.0, 19X,F6.0, 17X,F10.2)
1010 FORMAT (//, 30HTHE TOTAL OF THE ACTUAL COL. =,F10.2)
1020 FORMAT (  1H1,33X, 73HTABLE      REVEALED PREFERENCE DATA MATRIX-C
   1OMPARISON OF LOCATIONAL TYPES./)
1030 FORMAT (13X, 92HCELLS SHOW NUMBER OF TIMES SAMPLE HOUSEHOLDS PREFE
   1RRED COLUMN LOCATIONAL TYPE TO ROW TYPE.(,F8.0,12H HOUSEHOLDS).//5
   2X,20I6/)
1040 FORMAT (I3,3X,20F6.1)
1050 FORMAT (  1H1,30X, 74HTABLE      PROBABILITY THAT COLUMN LOCATIONAL
   1 TYPE IS PREFERRED TO ROW TYPE.//5X,20I6/)
1060 FORMAT (I3,3X,20F6.2)
1070 FORMAT (  1H1,20X, 94HTABLE      RANK LOCATIONAL TYPES BY PERCENT O
   1F TIMES THEY ARE REVEALED PREFERRED TO OTHER TYPES.///)
1080 FORMAT (10X,  5HRANK ,5X, 10HLOC. TYPES,5X, 16HPERCENT .GT. 0.5,5X
   1, 32HRELATIONSHIP TO NEAREST NEIGHBOR./)
1090 FORMAT (2(11X,I2),15X,F6.2,15X,F10.2)
1100 FORMAT (  1H1,30X, 74HTABLE      PROBABILITY THAT COLUMN LOCATIONAL
   1 TYPE IS PREFERRED TO ROW TYPE./30X, 77H(LOCATIONAL TYPES ORDERED
   2BY THEIR RANK  IN TABLE    WITH -1 FOR MISSING DATA).//5X,20I6/)
1110 FORMAT (  1H1,32X, 73HTABLE      PERCEIVED SIMILARITY BETWEEN LOCAT
   1IONAL TYPES--PROXIMITY MATRIX./33X, 72H(ABSOLUTE DIFFERENCE OF PRO
   2BABILITIES  FROM .5 WITH -1 FOR MISSING DATA).//5X,20I6/)
1120 FORMAT (1H0, 18H ATTRACTION LIMITS, 10F6.0)
1130 FORMAT (15F5.2)
1140 FORMAT (  1H1,35X, 65HTABLE      TRANSITIVITY TEST FOR CONSISTENCY
   1OF PREFERENCE SURFACE.//9X,119H(CELL VALUE IS 1 IN J TH COLUMN AND
   2 I TH ROW WHEN PROBABILITY THAT J WILL BE CHOSEN OVER I (J P I) IS
   3 GREATER THAN 0.5).//)
1150 FORMAT (60X, 16HLOCATIONAL TYPES.//6X,40I3/)
1160 FORMAT (I3,3X,40F3.0)
1170 FORMAT ( 65H1TABLE      TRANSITIVITY MATRIX REVISED (COOMBS THEORY
   1OF DATA PG., 41H356) NUMBER  OF POSSIBLE CYCLIC TRIPLES =,F8.2)
1180 FORMAT (48X, 40H  INCOMPLETE TRIPLES ARE MADE TRANSITIVE.//)
1190 FORMAT (//, 22H TRANSITIVITY  BY ROW=,F10.5)
1200 FORMAT (  1H1,27X, 84HTABLE      Z VALUES FOR DISTANCES BETWEEN LOC
   1ATIONAL TYPES (-9.0 IS FOR MISSING DATA).//60X, 16HLOCATIONAL TYPE
   2S./5X,15I8/)
1210 FORMAT (I3,3X,15(F8.4))
1220 FORMAT (  1H1,40X, 58HTABLE      INTER-POINT DISTANCES BETWEEN LOCA
   1TIONAL   TYPES.//60X, 16HLOCATIONAL TYPES./5X,15I8/)
1230 FORMAT (///38X, 60HSOURCE   CALCULATED FROM INTER-POINT Z VALUES I
   1N TABLE      .)
  14 CONTINUE
```

```
C     TEST FOR SIMILARITY OF REVPPEF MATRICES
      NLC=40
      DO 1800 K=1,NLC
      DO 1810 J=1,NLC
      A(J,K)=G(1,J,K)
      F(J,K)=G(2,J,K)
 1810 CONTINUE
 1800 CONTINUE
      DO 2000 M=1,3
      IF (M.EQ.1) GO TO 2030
      DO 2100 K=1,NLC
      DO 2110 J=1,NLC
      IF (M.EQ.3) GO TO 2120
      IF (A(J,K).EQ.0..AND.A(K,J).EQ.0.) GO TO 2130
      F(J,K)=(A(J,K)+A(K,J))/2.
      GO TO 2110
 2130 F(J,K)=0.
      GO TO 2110
 2120 F(J,K)=G(2,J,K)
 2110 CONTINUE
 2100 CONTINUE
      IF (M.EQ.2) GO TO 2030
      DO 2200 K=1,NLC
      DO 2210 J=1,NLC
      IF (F(J,K).EQ.0..AND.F(K,J).EQ.0.) GO TO 2220
      A(J,K)=(F(J,K)+F(K,J))/2.
      GO TO 2210
 2220 A(J,K)=0.
 2210 CONTINUE
 2200 CONTINUE
 2030 CONTINUE
      DO 1500 J=1,NLC
      DO 1510 K=J,NLC
      IF (K.EQ.J) GO TO 1520
      IF ((A(J,K)+A(K,J)).EQ.0.0) GO TO 1520
      IF ((F(J,K)+F(K,J)).EQ.0.0) GO TO 1520
      IF ((A(J,K)+F(J,K)).EQ.0.0) GO TO 1520
      IF ((A(K,J)+F(K,J)).EQ.0.0) GO TO 1520
      GO TO 1530
 1520 Z1(J,K)=-9.9
      Z2(J,K)=-9.9

      TYPTST(J,K)=0.
      GO TO 1510
 1530 X(J,K)=0.0
      Y(J,K)=0.0
      X(J,K)=A(J,K)+A(K,J)
      Y(J,K)=F(J,K)+F(K,J)
      IF ((X(J,K)+Y(J,K)).GE.40.) GO TO 1560
      GO TO 1570
 1560 CALL CHISO (A,X,Z1,TYPTST,J,K,F,Y,Z2)
      GO TO 1510
 1570 IF ((X(J,K)+Y(J,K)).GE.20.) GO TO 1580
      GO TO 1590
 1580 X1=((A(J,K)+F(J,K))*X(J,K))/(X(J,K)+Y(J,K))
      Y1=((A(J,K)+F(J,K))*Y(J,K))/(X(J,K)+Y(J,K))
      X2=((A(K,J)+F(K,J))*X(J,K))/(X(J,K)+Y(J,K))
      Y2=((A(K,J)+F(K,J))*Y(J,K))/(X(J,K)+Y(J,K))
      IF (X1.GE.5..AND.X2.GE.5..AND.Y1.GE.5..AND.Y2.GE.5.) GO TO 1560
 1590 CALL FFPTST (A,X,Z1,TYPTST,J,K,F,Y,Z2)
 1510 CONTINUE
 1500 CONTINUE
      DO 1600 I=1,NLC,15
      DO 1610 J=1,NLC
      JY=J
      IF (J.GT.15.AND.I.LT.16) JY=15
      IF (J.GT.30.AND.I.LT.31.AND.I.GE.16) JY=30
      WRITE (6,1620) (Z1(JK,J), JK=1,JY)
 1620 FORMAT (15F8.3)
 1610 CONTINUE
 1600 CONTINUE
      DO 1900 I=1,NLC,15
      DO 1910 J=1,NLC
      JY=J
      IF (J.GT.15.AND.I.LT.16) JY=15
      IF (J.GT.30.AND.I.LT.31.AND.I.GE.16) JY=30
      WRITE (6,1620) (Z2(JK,J), JK=1,JY)
 1910 CONTINUE
 1900 CONTINUE
      DO 1700 K=1,NLC
      WRITE (6,1720) (TYPTST(J,K), J=1,K)
 1720 FORMAT (1F4.0,39F3.0)
 1700 CONTINUE
 2000 CONTINUE
      RETURN
      END
```

```
      FUNCTION CNINV (W)
      REAL*8 B
      DIMENSION B(14)
      DATA B/                2.5066282746,1.0471975512,1.1519173063,.983277
     1707,1.0491256241,.9865395910,1.0267733943,.9895243626 3,1.01772755
     204,.99156F6947,1.0129949723,.9929996C72,1.0101375135,.9940424961/
      X=W-.5
      AS=B(14)
      P1=0.
      P2=B(1)
      Q2=1.
      Q1=Q2
      UX=X*X
      TX=1.-.005*UX+SQRT(1.-4.*UX)
      TX=(2.(164*UX)/TX
      B(14)=AS/(1.-TX)
      DO 10 J=2,14
      BUX=B(J)*UX
      PX=P2-BUX*P1
      QX=Q2-BUX*Q1
      P1=P2
      P2=PX
      Q1=Q2
      Q2=QX
   10 CONTINUE
      V=(X*PX)/QX
      IF (.2498-UX) 20,30,30
   20 CALL NPOA (V,2,ORD,XP,E)
      XD=XP-X
      U=XD/ORD
      V=V-U/(1.+V*U/2.)
      IF (1.E-7-ABS(XD)) 20,30,30
   30 B(14)=AS
      CNINV=V
      RETURN
      END
```

```
      SUBROUTINE NPOA (XARG,ITYPE,ORD,AREA,ERR)
C     C? UCSD NPOA
      IF (IABS(ITYPE)-6) 10,10,160
   10 ERR=ABS(XARG)
      AREA=0.0
      IF (ITYPE) 30,160,20
   20 ERR=0.707106781*ERR
   30 KTYPE=IABS(ITYPE)
      IF ((ERR**2)-98.C29) 60,60,40
   40 ORD=0.0
      IF (IABS(ITYPE)-6) 50,150,50
   50 AREA=1.0
      GO TO 80
   60 ORD=1.128379167*EXP(-(ERR**2))
      IF (IABS(ITYPE)-6) 70,130,70
   70 AREA=1.0/(1.0+0.3275911*ERR)
      AREA=1.0-((((0.94C64607*AREA-1.287822453)*AREA+1.25969513)*AREA-0.
     1252128668)*AREA+0.225836846)*AREA*ORD
   80 GO TO (130,90,100,110,120), KTYPE
   90 AREA=AREA/2.0
      GO TO 130
  100 AREA=1.0-AREA
      GO TO 130
  110 AREA=(1.0-AREA)/2.0
      GO TO 130
  120 AREA=(1.0+AREA)/2.0
  130 IF (ITYPE) 150,160,140
  140 ORD=0.353553390 5*ORD
  150 ERR=0.0
      GO TO 170
  160 ERR=1.0
  170 RETURN
      END
```

```
      SUBROUTINE SORT (A,N,B,C,D,K,SWITCH)
C       SORT    THIS SUBROUTINE SORTS ARRAY A, AND MAY REARRANGE B AND C.
C       THE N VALUES FROM A(1) TO A(N) ARE SORTED IN ALGEBRAIC ORDER.
C       IF SWITCH IS +, ASCENDING ORDER.
C       IF SWITCH IS -, DESCENDING ORDER.
C       IF SWITCH IS 0, ACCORDING TO LAST NON-ZERO VALUE OF SWITCH.
C       IF K=0, NEITHER OF ARRAYS B AND C IS TOUCHED.
C       IF K=1, ARRAY B IS REARRANGED.
C       IF K=2, ARRAYS B AND C ARE BOTH REARRANGED.
C       IF K=3, ARRAYS B AND C AND D ARE ALL REARRANGED.
C       REARRANGING OF ARRAYS B, C, D IS IN ACCORDANCE WITH THE
C       REARRANGEMENT OF A DURING SORTING, SO THAT CORRESPONDING ENTRIES
C       IN THE ARRAYS CONTINUE TO OCCUPY CORRESPONDING POSITIONS.
      DIMENSION A(100), B(100), C(100), D(100)
      INTEGER B,C,D
      IF (SWITCH) 10,20,10
   10 SW=SWITCH
   20 KP1=K+1
      NM1=N-1
      IF (NM1) 150,150,30
   30 DO 90 I=1,NM1
      IP1=I+1
      DO 90 J=IP1,N
      IF (A(I)-A(J)) 80,80,40
   40 TEMP=A(I)
      A(I)=A(J)
      A(J)=TEMP
      GO TO (80,70,60,50), KP1
   50 TEMP=D(I)
      D(I)=D(J)
      D(J)=TEMP
   60 TEMP=C(I)
      C(I)=C(J)
      C(J)=TEMP
   70 TEMP=B(I)
      B(I)=B(J)
      B(J)=TEMP
   80 CONTINUE
   90 CONTINUE
      IF (SW) 100,150,150
  100 NHALF=N/2
      DO 140 I=1,NHALF
      IC=N+1-I
      TEMP=A(I)
      A(I)=A(IC)
      A(IC)=TEMP
      GO TO (140,130,120,110), KP1
  110 TEMP=D(I)
      D(I)=D(IC)
      D(IC)=TEMP
  120 TEMP=C(I)
      C(I)=C(IC)
      C(IC)=TEMP
  130 TEMP=B(I)
      B(I)=B(IC)
      B(IC)=TEMP
  140 CONTINUE
  150 RETURN
      END
```

```
      SUBROUTINE CHBSJ (A,X,Z1,TYPTST,J,K,F,Y,Z2)
      DIMENSION A(40,40),X(40,40),Z1(40,40),TYPTST(40,40),F(40,40),Y(40,
     140),Z2(40,40)
      Z2(J,K)=(((X(J,K)+Y(J,K))*(ABS(A(J,K)*F(K,J))-(F(J,K)*A(K,J))-(X(J
     1,K)+Y(J,K))/2.)**2)/((A(J,K)+A(K,J))*(F(J,K)+F(K,J))*(A(J,K)+F(J,K
     2))*(A(K,J)+F(K,J))))
      Z1(J,K)=Z2(J,K)/(X(J,K)+Y(J,K))
      IF (Z2(J,K).GE.3.841.AND.Z1(J,K).GE.0.038) GO TO 5
      IF (Z2(J,K).LT.3.841.AND.Z1(J,K).GE.0.038) GO TO 6
      IF (Z2(J,K).GE.3.841.AND.Z1(J,K).LT.0.038) GO TO 7
      TYPTST(J,K)=55.
      GO TO 8
    5 TYPTST(J,K)=44.
      GO TO 8
    6 TYPTST(J,K)=54.
      GO TO 8
    7 TYPTST(J,K)=45.
    8 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE FEPTST (A,X,Z1,TYPTST,J,K,F,Y,Z2)
      DIMENSION A(40,40),X(40,40),Z1(40,40),TYPTST(40,40),F(40,40),Y(40,
     140),B(4),GG(5),NUM(4),DENOM(5),RCSUM(4),I(4),Z2(40,40)
      REAL NUM
      INTEGER B,GG,RCSUM,TEMPZ,AMIN
      WRITE (6,12) A(J,K), A(K,J), F(J,K), F(K,J)
   12 FORMAT (1H, 4F6.2)
      B(2)=A(J,K)
      B(1)=A(K,J)
      B(4)=F(J,K)
      B(3)=F(K,J)
      DO 60 M=1,4
   60 I(M)=B(M)
      WRITE (6,51)(B(N),N=1,4)
   51 FORMAT (1H,4I4)
      IF (B(1).EQ.0.0.OR.B(2).EQ.0.0.OR.B(3).EQ.0.0.OR.B(4).EQ.0.0) GO T
     1O 62
      IF ((B(1)/B(2)).EQ.(B(3)/B(4))) GO TO 61
      GO TO 62
   61 Z1(J,K)=0.0
      TYPTST(J,K)=1.
      RETURN
   62 GG(1)=A(K,J)+A(J,K)+F(K,J)+F(J,K)
      GG(2)=B(1)
      GG(3)=B(2)
      GG(4)=B(3)
      GG(5)=B(4)
      ALPHA=0.05
      RCSUM(1)=B(1)+B(2)
      RCSUM(2)=B(3)+B(4)
      RCSUM(3)=B(1)+B(3)
      RCSUM(4)=B(2)+B(4)
      DO 9 M=1,3
      L=M+1
      DO 9 N=L,4
      IF (RCSUM(N).GT.RCSUM(M)) GO TO 11
      GO TO 9
   11 TEMPZ=RCSUM(M)
      RCSUM(M)=RCSUM(N)
      RCSUM(N)=TEMPZ
    9 CONTINUE
      AMIN=B(1)
      DO 27 N=2,4
      IF (B(N).LT.AMIN) AMIN=B(N)
   27 CONTINUE
      WRITE (6,52) AMIN
   52 FORMAT (1H ,I4)
   50 JMIN=AMIN+1
```

```
      PP=0.
      KU=1
      DO 10 M=1,JMIN
      DO 14 JJ=1,4
      NUM(JJ)=1.
   14 DENOM(JJ)=1.
      DENOM(5)=1.
      DO 26 JL=2,4
      LL=JL+1
      DO 26 JL=LL,N
      IF (GG(L).GT.GG(JL)) GO TO 28
      GO TO 26
   28 TEMPZ=GG(JL)
      GG(JL)=GG(L)
      GG(L)=TEMPZ
   26 CONTINUE
      DO 15 JJ=1,4
      IF (RCSUM(JJ).GT.GG(JJ)) GO TO 16
      GO TO 17
   16 KK=RCSUM(JJ)-GG(JJ)
      DO 20 JV=1,KK
      NUM(JJ)=NUM(JJ)*RCSUM(JJ)
      RCSUM(JJ)=RCSUM(JJ)-1
   20 CONTINUE
      GO TO 15
   17 IF (RCSUM(JJ).EQ.GG(JJ)) GO TO 15
      GO TO 18
   18 KK=GG(JJ)-RCSUM(JJ)
      DO 21 JV=1,KK
      DENOM(JJ)=DENOM(JJ)*GG(JJ)
      GG(JJ)=GG(JJ)-1
   21 CONTINUE
   15 CONTINUE
      KK=GG(5)-1
      IF (KK.LE.0) GO TO 34
      GO TO 35
   35 DO 37 LU=1,KK
      DENOM(5)=DENOM(5)*GG(5)
      GG(5)=GG(5)-1
   37 CONTINUE
   34 PP=PP+(NUM(1)*NUM(2)*NUM(3)*NUM(4))/(DENOM(1)*DENOM(2)*DENOM(3)*DE
     1NOM(4)*DENOM(5))
      IF (M.EQ.1) GO TO 22
      GO TO 23
   22 P1=PP
      PP=0.
      GO TO (23,1,2),KU
   23 IF(I(1).EQ.AMIN.AND.I(3).NE.AMIN.OR.I(4).EQ.AMIN.AND.I(2).NE.AMIN)
     1GO TO 1
      GO TO 63
   63 IF(I(2).EQ.AMIN.AND.I(4).NE.AMIN.OR.I(3).EQ.AMIN.AND.I(1).NE.AM
     1GO TO 2
      GO TO 64
   64 IF(I(1).EQ.AMIN.AND.I(3).EQ.AMIN) GO TO 65
      GO TO 66
   65 IF(X(J,K).GT.Y(J,K)) GO TO 1
      GO TO 2
   66 IF(I(2).EQ.AMIN.AND.I(4).EQ.AMIN) GO TO 67
      GO TO 68
   67 IF(X(J,K).GT.Y(J,K)) GO TO 2
      GO TO 1
   68 WRITE(6,69)(I(JC),JC=1,4),J,K
   69 FORMAT(1H ,4I4,I4,I4,' NO PATH')
      Y(J,K)=0.0
      TYPTST(J,K)=1.
      RETURN
    1 KU=2
      B(1)=B(1)-1.
      B(2)=B(2)+1.
      B(3)=B(3)+1.
      B(4)=B(4)-1.
      GO TO 40
    2 KU=3
      B(1)=B(1)+1.
      B(2)=B(2)-1.
      B(3)=B(3)-1.
      B(4)=B(4)+1.
   40 GG(2)=B(1)
      GG(3)=B(2)
      GG(4)=B(3)
      GG(5)=B(4)
   10 CONTINUE
      WRITE (6,53)(GG(N),N=2,5)
   53 FORMAT(1H ,4I4)
      Z1(J,K)=PP+P1
      Z2(J,K)=-C.0
      TYPTST(J,K)=3.
      IF (Z1(J,K).LE.0.050) TYPTST(J,K)=2.
      RETURN
      END
```

```
      SUBROUTINE SEARCH(IDIM,X,K,IER,Y,V,VC,IDIM1)
      DIMENSION V(IDIM1),VC(IDIM1)
      IF(V(1).GT.X.OR.V(IDIM).LT.X) GO TO 29
      IO=1
 9999 I=0
      L=IDIM
    1 M=(I+L)/2
      IF(V(M)-X)2,3,4
    2 IF(M.LE.I) GO TO 7
      I=M
      GO TO 1
    4 L=M
      GO TO 1
    7 M=L
    3 GO TO (3333,9910,9929,9944,9950,9900),IO
 3333 Y=VC(M)
      K=M
      IF (V(M).NE.X) GO TO 35
      IER=0
      RETURN
      ENTRY BUILD2(IDIM,X,V,VC,WORK,IDIM1)
      DIMENSION WORK(IDIM1)
      K=1
   10 IO=2
      GO TO 9999
      ENTRY BUILD1(IDIM,X,V,WORK,IDIM1)
      K=2
      IO=2
      GO TO 9999
 9910 MM1=M-1
      LIM=IDIM-MM1
      DO 11 J=1,LIM
   11 WORK(J)=V(MM1+J)
      DO 12 J=1,LIM
   12 V(M+J)=WORK(J)
      V(M)=X
      GO TO (20,13),K
   13 RETURN
   20 DO 24 J=1,LIM
   24 WORK(J)=VC(J+MM1)
      DO 25 J=1,LIM
   25 VC(J+M)=WORK(J)
      VC(M)=Y
      RETURN
      ENTRY SLINT(IDIM,X,Y,IER,V,VC,IDIM1)
      IF (V(1).GT.X.OR.V(IDIM).LT.X) GO TO 35
      IO=3
      GO TO 9999
 9929 IF (M.EQ.1) GO TO 678
      IF (V(M).NE.X.AND.V(M-1).NE.X) GO TO 31
      IF (V(M).NE.X) M=M-1
  678 Y=VC(M)
   29 IER=2
      RETURN
   31 Y=(VC(M)*(X-V(M-1))-VC(M-1)*(X-V(M)))/(V(M)-V(M-1))
      IER=0
      RETURN
   35 IER=1
      RETURN
      ENTRY NEARMG(IDIM,X,K,IER,Y,V,VC,IDIM1)
      IF (V(IDIM)-X)29,35,44
   44 IF (V(1).GT.X) GO TO 29
      IO=4
      GO TO 9999
 9944 K=M-1
   40 K=K+1
      IF (V(K).EQ.X) GO TO 40
      Y=VC(K)
      IER=0
      RETURN
      ENTRY NEARSM(IDIM,X,K,IER,Y,V,VC,IDIM1)
      IF (V(1)-X)50,35,29
   50 IF (V(IDIM).LT.X) GO TO 29
      IO=5
      GO TO 9995
 9950 K=M
   55 K=K-1
      IF (V(K).EQ.X) GO TO 55
      Y=VC(K)
      IER=0
      RETURN
      ENTRY CLOSE(IDIM,X,K,IER,Y,V,VC,IDIM1)
      IO=6
      GO TO 9999
 9900 K=M
      IF(M.EQ.1) K=2
      IF (ABS(V(K)-X).GT.ABS(V(K-1)-X)) K=K-1
      IER=2
      IF (V(K).EQ.X) IER=0
      IF(V(K).GT.X) IER=1
      IF (V(1).GT.X.OR.V(IDIM).LT.X) IER=3
      Y=VC(K)
      RETURN
      END
```

APPENDIX VII

SAMPLING INFORMATION: ONTARIO PROVINCIAL PARK CAMPERS, 1966[a]

Park Code	Total Ontario Permits[b]	Original Sample[c]	Sampling Fraction	Revised Sample[d]
011	383	44	11.49%	383
012	614	44	7.17	614
013	3,631	65	1.79	3,631
014	4,890	71	1.45	4,890
015	13,021	164	1.26	13,021
016	511	24	4.70	511
017	6,405	79	1.23	6,405
018	3,601	72	2.00	3,601
019	997	47	4.71	997
021	297	29	9.76	297
031	643	51	7.93	643
032	1,460	47	3.22	1,460
041	240	17	7.08	240
042	138	15	10.87	138
043	1,172	42	3.58	1,172
051	552	12	2.17	552
052	535	42	7.85	535
053	722	35	4.85	722
054	1,082	27	2.50	1,082
055	2,011	58	2.88	2,011
061	1,143	35	3.06	1,143
071	4,312	46	1.07	4,312
072	5,722	44	0.77	5,722
073	2,015	26	1.29	2,015
074	4,175	49	1.17	4,175
081	631	31	4.91	631
082	951	34	3.58	951
091	2,001	43	2.15	2,001
092	2,511	25	1.87	2,511
093	3,321	36	1.08	3,321
094	532	27	5.07	532
101	1,238	32	2.58	1,238
102	849	27	3.18	849
103	1,069	9	0.84	1,069
104	137	8	5.84	137
111	3,054	50	1.64	3,054
112	2,250	37	1.64	2,250
113	3,719	40	1.08	3,719
116	6,487	116	1.79	6,487
117	3,580	44	1.23	3,580
121	4,527	25	0.55	4,527

APPENDIX VII -- Continued

Park Code	Total Ontario Permits[b]	Original Sample[c]	Sampling Fraction	Revised Sample[d]
122	825	25	2.82%	825
123	1,968	47	2.39	1,968
124	1,644	47	2.86	1,644
125	10,701	60	0.56	10,701
126	3,448	19	0.55	3,448
131	271	64	23.62	271
132	2,790	29	0.95	2,790
133	3,397	41	1.21	3,397
134	1,952	36	1.82	1,952
141	271	46	16.97	271
142	8,395	100	1.19	8,395
143	10,197	67	0.66	10,197
144	2,361	50	2.12	2,361
145	4,106	43	0.90	4,106
146	1,188	49	4.12	1,188
147	1,564	38	2.43	1,564
151	20,818	171	0.82	20,818
152	1,164	47	4.04	1,164
153	1,276	42	3.29	1,276
161	1,621	15	0.93	1,621
162	2,385	53	2.22	2,385
163	123	9	7.32	123
164	1,558	28	1.80	1,558
172	2,923	0	0.00	2,923
173	595	0	0.00	595
174	3,756	0	0.00	3,756
181	75	8	10.67	75
182	98	10	10.20	98
191	2,059	43	2.09	2,059
192	2,047	46	2.25	2,047
193	728	45	6.18	728
194	871	50	5.74	871
201	709	48	6.77	709
202	691	53	7.67	691
211	2,419	46	1.90	2,419
212	6,250	49	0.78	6,250
214	1,205	52	4.32	1,205
215	6,940	43	0.64	6,940
221	1,236	10	0.81	1,236
222	1,331	31	2.33	1,331

[a]Derived from 1966 camper questionnaire returns and 1966 park use statistics.

[b]Total number of camping permits multiplied by the proportion of camping parties originating in Ontario.

[c]Number of Ontario camping parties responding to the long form questionnaire.

[d]Sample size revised to include 100% of the total number of Ontario camping parties frequenting the park.

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