TN 34: WORKING PAPER: OUTLINE OF DATA ANALYSIS FOR ASSESSING OUTDOOR RECREATION DEMANDS

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INTRODUCTION

This paper was prepared by Knetsch in 1969-1970. At that time, the Canadian Outdoor Recreation Demand Study analysis Group within Parks Canada was being formed and such a paper was needed to give guidance in the analyses of the CORDS data. Presenting this Working Paper in a slightly edited form affords researchers and research managers the opportunity to develop insights into how ideas have evolved and how quantitative advances have been made.

In the view of major contributors to the CORDS the Working Paper was (and as of 1976 remained) a useful and provocative document for understanding the thrust of continuing research efforts. This edited version includes references to a number of Technical Notes. These Notes are analyses carried out long after the original paper was prepared. The references are offered to the reader as evidence of Knetsch's insight into the direction that analysis should go. Given that the paper identifies major aspects of how CORDS progressed, the paper provides a fitting introduction to the rest of this volume.

ABSTRACT

This paper was originally a series of notes on how the CORDS research should proceed. It expands on an earlier paper by suggesting how to carry out tasks now listed as: (14) Participation and Supply Analysis and (15) Use Prediction Analysis.

Initial discussion of what is meant by outdoor recreation demands is presented to provide a rationale for further discussion. Some of the major analyses that were proposed are then outlined, using examples to illustrate the methods of analysis. As well the presentation contains:

(1) a set of points on the use that can be made of the results of the investigations proposed, and (2) some indications of future research directions that might be considered when the main approaches suggested have been followed.

THE NATURE OF DEMAND

There is little doubt that one of the most important and productive tools of economic analysis is the notion of demand. It can be of immense usefulness in determining consistent and rational outdoor recreation policies and in determining how we can best utilize and manage recreation resources. If demand relationships can be understood with even a modicum of success, various kinds of productive analyses are possible that provide at least partial answers to many difficult problems. This is not to suggest, *as was pointed out in the original design paper*, that demand analyses can provide clear-cut answers to planning problems. They cannot. Rather, it is to suggest that demand analyses can provide important information useful for planning and policy decisions.

There has been much concern with the trends in recreation use of various facilities. In part, these trends reflect increases in the demand for outdoor recreation facilities and areas. Still, there has been considerable ambiguity connected with the usual statements

used in explanation of these. Furthermore, knowledge of these trends does not solve the problem of how best to accommodate the demands for outdoor recreation. In fact, parochial recitation of the number of recreation visits accommodated each year clouds the hard issues of how much recreation, and of what sort, should be provided. (For trends, see Ch. IX, TN 13 and TN 22.)

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Confusion persists in a variety of domains. It continues regarding statements about recreation consumption (e.g., the number of visitors we observe) and the demand for a commodity. In a similar vein there is often confusion between the need for commodities or services such as outdoor recreation and the demand for it. Need, as often expressed, designates a capacity of some sort that is judged to be adequate to accommodate a given target level of use. Often funds are appropriated to individual jurisdictions in accordance with such estimated needs. However, this can have a perverse influence on the rational provision of outdoor recreation facilities. Demand for, or more correctly the use of, a facility is often far more a function of its availability. Increasing the opportunities, therefore, may merely stimulate more of the same type of facility use.

Understanding concepts and their application pervades not only recreation planning but other areas of public expenditure as well. An example of equating need with use forecasts is that of the highway program in the U.S., where a highway travel report estimated that there is a "need" to devote 320-billion dollars to road construction over the next 15 years. It would have been more useful to ask what parts of this total highway "need" offer a return sufficient to justify expenditures of public funds. In other words, with a clear determination of the demand, one could make a more rational estimate of the different consequences of alternative actions in relation to levels of spending - far more useful information on which to base highway plans.

The most important characteristic of demand, and how it is to be used in recreation planning, is that it referring to it correctly involves a conditional or functional statement. That is, it is not an absolute number but a magnitude dependent upon the levels of other factors. In general, demand for any commodity springs from the notion that a consumer making a purchase does so because she/he feels that it will serve some real or fancied use. Consumers express their wants and desires by expressing different demands for different commodities. The consumer often desires more of many goods and services, but is constrained by income levels. Consequently, her/his demands for different commodities express relative preferences among commodities, given income constraints. In an economic system based on market forces, knowledge of these demands serves to inform producers of the relative quantities of different commodities that can be profitably marketed.

The demand for commodities is the amount which purchasers choose to buy. However, this amount is determined by factors that limit demand. For most goods and services, the lower the price the more will be demanded by any single individual and by the market - the collection of all individuals.

The income of individuals is also a factor. Normally, and there are exceptions to this, the higher an individual's income the greater the quantity of individual goods and services he will demand. A third factor is the price of closely related commodities, the substitutes and complements of the goods in question. The demand for goods can be

highly sensitive to changes in the price or the availability of other goods. In some cases, the demand is nearly invariant. Necessities characterize the latter group.

A fourth factor that must be considered is the tastes and preferences of the individuals, in other words how they make up their minds, their attitudes, their adherence to fashions, customs and so forth. Tastes and preferences are usually taken as "given" in economic analyses with a focus on the consequences of economic factors that influence the demand for any given commodity. The concern is with HOW consumers make up their minds in terms of the quantities which they demand of different goods and services, not with WHY and how they make decisions. With most analyses there is no particular interest in explaining choices, but merely in determining what the reaction is and how it will change, depending upon change in economic factors of price, the availability or price of substitutes, and incomes. Consumers make choices among different commodities and, when circumstances change, their choices reflect this. The patterns of choice are particularly apparent where consumers are viewed as groups, thus minimizing the influence of individual deviations.

In the case of outdoor recreation, the principles just outlined apply supply. The difference has to do with the individual conditions. Tastes and preferences of individuals are a factor with regard to recreation just as they are with regard to the demand for any commodity. The income of individuals is similarly a factor. Higher incomes usually result in greater demands for most recreation services, although here again there are exceptions and these may be important to know about. Skiing is undoubtedly highly responsive to income changes; hunting is likely to be far less so and there may even be a negative relation. Regarding alternative commodities, the relative availability and accessibility of substitute recreation areas or substitute demands for time and money have an effect on the demand for any given recreation site or any recreation opportunity.

It is in the area of price that the demands for outdoor recreation and the demand formulations for most commodities differ. There is a difference in particulars and not a difference in principles. The role of price vis a vis recreation is usually covert. For a variety of good reasons we generally make outdoor recreation opportunities available publicly - outside the market conditions. Although the private market does exist, it usually does so for a fairly small range of recreation facilities and services, with the bulk being provided publicly.

Fees and charges, even though used to a certain extent in public areas, are not normally prices which serve the usual market function of allocation. Instead, in recreation the price variable (in terms of a demand analysis) largely pertains to the relative availability or accessibility of recreation opportunities. This availability is often measured in terms of locational proximity although other measures or determinants of availability exist as well (seeTN 5, TN 17, TN 25 in Ch. VIII).

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Thus when one speaks of the demand for outdoor recreation, the statement is one of "condition" and is, in principle, similar to statements about scarce commodities generally. The factors determining consumption of them remain the same in principle. It is only in the particulars that the formulations differ. The role of proximity in "need" is far more important than for most consumables. This partially stems from the non-market nature of the demands. In part, however, it also stems from the immobility of most resources used for recreation purposes. This is a characteristic somewhat peculiar to

recreation and tourism. Recreation activities are consumed at the site rather than purchased and consumed more ubiquitously.

AGGREGATE DEMAND ANALYSIS

Given the general nature of demand, and in the specific context of outdoor recreation, a series of what might be termed aggregate demand studies can provide important insight into the characteristics of the demand for various kinds of outdoor recreation services. The emphasis of such studies is upon the determination and explanation of the variation in the amount of outdoor recreation demanded by different segments of the population. (seeCh. IV, TN 6, TN 12, TN 20; Ch. IX, TN 13; and Ch. X TN 33). Such studies differ from investigations concerned more with the demand for a certain outdoor recreation facility, or a given recreation area such as a park. (in various chs. see TN 1, TN 4, TN 7, TN 8, TN 11, TN 14, TN 18, TN 19, TN 30, TN 31, TN 34, TN 35, and TN 38). Studies also focus on allocation or setting up economic accounts (seeCh. VIII, TN 5, TN 17, TN 25, TN 26, TN 39, TN 40, TN 41).

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The major intent of aggregate studies is to relate participation in the various forms of outdoor recreation to a range of socio-economic variables and supply characteristics. The basic analyses consist of obtaining data on participation of different segments of the population in the different forms of outdoor recreation and then attempting to explain these variations in participation rates in terms of both the different supply characteristics facing these different individuals and their differing socio-economic attributes. The underlying notion is that the rates at which individuals in the population participate in various forms of recreation is dependent, first of all, upon such things as their income levels, their education and so forth, and also upon the availability of opportunities of various kinds. For such analysis to be meaningful information is needed on a cross-section of the population to identify the characteristics of the individuals and the rates at which they participate in different recreation activities, as well as something of the different opportunities that may confront them. For example, one normally would expect to find that the rate at which different members of the population participate in skiing is somewhat related to their income levels. This is explained by the necessity to purchase equipment and other expenses attendant on this type of activity. So normally we would find that higher income levels are associated with higher rates of skiing activity. Similarly, we would also expect to find that the visits to (for example) National Parks are dependent upon the distance of different individuals from such areas. In aggregate demand studies it is the characterization of these relationships which are of primary interest.

These studies are useful in examining the population as a whole and the variation which this population exhibits with respect to its outdoor recreation rates among populations living in different parts of the country, in rural areas versus large metropolitan areas, and between high incomes and low incomes. While socio-economic characteristics may be predetermined and fixed for most planning questions, supply characteristics are not, nor are they policy determinations for providing outdoor recreation in the future. Participation information can be expected to be useful for deciding a number of broad planning and policy questions. For example, if it is found that individuals of given locational or socio-economic characteristics are participating at far lower levels in certain activities than others, there may well be an effort made to make facilities more available to

them, assuming the lower rate does not reflect lower preference for that activity. (The CORDS Data Documentation is in a volume on data that is not being reproduced in an electronic form. The volume is available in some Canadian libraries).

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DEVELOPMENT OF DEMAND ANALYSIS INQUIRIES

Demand analysis can proceed on two basic fronts. In the first, the emphasis is placed on fairly simple and straightforward tabulations and cross-tabulations of information on participation in various forms of outdoor recreation and the different characteristics of the population. Some tables have been prepared for data collected in CORDS contracts (see e.g., Ch. IX, TN 22). From these tabulations a number of gross indications of differences in participation rates becomes evident. In many cases the explanations of patterns may be fairly readily understandable, while in others what tables imply is not clear. In part, patterns may be attributable to differences in characteristics of populations and in part due to differences in supply availability. Regardless of large differences not being explained, it is useful to know, for example, the participation rates in large cities as compared with participation rates in small cities and in rural areas, and also the variation in participation in different activities in different provinces. (there is discussion of the CORDS National Surveys in Volume III: Data Collection and Documentation, which is only available from libraries).

A second type of analysis relates the differences in participation to various associated factors in a more systematic and analytical manner. The best example of such a study, as of 1969, was Cicchetti, Seneca and Davidson's, hereafter referred to as the Rutgers' Study (see [1] at the end of this Note). The data of the Rutgers' Study were obtained from a most ambitious data collection program. Unfortunately, the scarcity of adequate supply data and the meager ability to formulate meaningful supply variables proved a severe deficiency. The supply information used was very crude. Nonetheless the study did utilize several supply variables which provided meaningful answers and, perhaps more importantly, provided a demonstration of a methodology that could be applied to the CORDS program. The Rutgers' Study set out to explain participation rates using a two-step procedure. First, a "conditional probability" for participation in a specific activity was developed in relation to socio-economic and supply variables (seeCh. 4, TN 12 and TN 20 for similar CORDS analysis). The aim was to determine if a respondent was a participant or not: that is, whether he/she had, during the course of the year preceding, engaged in particular outdoor recreation activity for which a predictive equation was developed. There was no attempt to indicate whether or not a single individual would participate in a given recreation activity; instead the focus was on the probability of his/her being a participant dependent upon the level of the explanatory variables.

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Data were readily at hand for the socio-economic variables. For the supply variables, it was necessary to depend on a crude set of variables obtained from available 'inventory work'. Some general inventory results were the supply information for the empirical work. There were some data on the number of facilities of various kinds by country throughout the U.S. To use these data, respondents were identified by country of residence and thus inventory data were linked with the county of the respondents. This type of supply variables includes, d, distance from large bodies of water (by 50 and 100

mile groupings), recreation land acreage, wetland acres, water acres, water acres by class, and acreage of various Bureau of Outdoor Recreation classified lands.

There were also data on facilities on a state-by-state basis. These proved to be less useful than those by county, but some of these data were used. They included the number of swimming pools, the number of sports establishments, the number of golf courses and numbers of other commercial establishments.

In the Rutgers' Study, the probability of a participant engaging in swimming was found to be dependent upon the following variables in a statistically significant way:

age of the respondent, race, sex, size of the population unit in which the respondent usually resides, education level, family income, owner or renter of the domicile of usual residence, size of the family, number of children from ages 6 to 11, region of the country, occupation of respondent, class of work of the sample person (self-employed or not), occupation status (blue collar, white collar), population of the sample unit, population of the state, distance from the ocean or Great Lakes, receipts of recreation and amusement establishments in the area in which the respondent lived, number of commercial recreation facilities, population density, median income of the state.

If all members of the population were faced with approximately equal supply configurations, supply variables would not be expected to be significant. However, this is not likely to be the case for most forms of recreation. For those in which access to an opportunity is an important determinant, and for which the spread of the opportunities is uneven, supply variables take on increased importance (seeCh. V, TN 29).

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Having determined the conditional probability of participation the analysis then proceeded to a second step of determining the degree of participation for all of those individuals previously identified as being participants in a particular activity. That is, given that their activity level is greater than zero, all respondents qualifying on these grounds were then subjected to a separate analysis in which the level of participation was analyzed. A series of variables was related to different participation levels and an attempt was made to establish significant relationships between these variables and variations in participation levels.

This two-step method proved to be a very useful one. It overcomes many of the problems that occur when there are a large number of non-participants in an activity.

Furthermore, it allows for different equations to be calculated to explain different levels of participants. It would be expected, for example, that different variables would explain whether a person is a participant or not and determine the level at which a participant engaged in an activity. Not only would there be different variables that would likely be important/ but also the relative importance of variables that were important in both cases should differ. There were various difficulties encountered with explanation of the sign of individual variables, whether a factor contributed positively or negatively, but on the whole the analysis proceeded in a fairly straightforward manner.

The Rutgers' Study was thus successful in establishing a useful methodology. It was also useful in pointing out a number of empirical findings that will be of great interest to planners dealing with recreation problems, although the degree of explanation was in some cases disappointing. For all of the different recreation activities investigated such factors as age, income levels, race, sex, education, home ownership, family size and composition, region of the country, occupational class, population size in the local area,

and distance from major recreation opportunities were found to be the most significant. (For similar results, there was an Appendix to TN 12 that was available through the LEISURE STUDIES DATA BANK, Waterloo Research Institute. This document may no longer be available).

Given some quantification of the relationship between participation in the various recreation activities and various factors that are found to be associated with them, projections of future recreation demands are possible. Such estimates can be made from projections of future populations and their socio-economic characteristics, given some assumption concerning the future supply configuration. The most useful of such projections would be those obtained under different levels of future supplies of recreation facilities. Comparisons of future activity under different assumed supply conditions would give some quantitative information to policy planners in assessing current development and also in deciding among levels and types of future expansion. (in particular see TN 12, TN 13 and TN 29).

In the Rutgers' Study, two levels of future demands were used to illustrate the methods and results. The first assumed a future pace of expansion of supply of recreation opportunities comparable to current allocation. The second assumed a more ambitious rate. For example, the swimming equations for the northeast region of the United States yielded the following forecast. It was estimated that in 1965, the year of the survey, approximately 350-million activity-days of swimming occurred. Under the first assumption of more limited future recreation development, the projected activity-days of swimming in the region (given the projected population and other characteristics of that population) are 450-million days in 1980 and 740-million days in 2000. Under the more expansionist assumption for future development, the projections are for 630-million days in 1980 and 890-million days in 2000.

Needless to say, the quality of these projections is dependent upon the quality of the data and on their analysis (see TN 6, TN 20, and TN 35 on accuracy and other problems). In the case of the Rutgers' Study there were well recognized limits, particularly with respect to the quantification of the supply variables. The deficiency in characterization of supply is particularly troublesome when, for most activities, the demonstrated importance of the strong effect of proximity to facilities is considered. The shortcoming is particularly important when attempting to discern differences in future demands, as they may vary depending upon the levels of provision that are made available. In particular there must be concerns regarding supply measurement in relation to facility provision and proximity (see TN 5, TN 16 and TN 17).

There are, of course, certain limits to the usefulness of the analysis in a study such as the Rutgers' effort. However, their general procedures and analyses are well worth imitation. There is much insight to be gained from such a study in terms of both an indication of future demands and in a fuller appreciation of the various factors that influence recreation behaviour among the different segments of the population. (For an integrated CORDS perspective, see TN 33).

SITE DEMAND STUDIES

There are a number of policy, planning and, to some extent, management questions on which aggregate demand studies can provide some useful insight. There are

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others, however, on which guidance related to more specific sites or to alternative areas is desirable. For example, if more efficient and orderly development of future recreation areas is to be attained, guidelines will need to be developed to predict the likely use of alternative locations of facilities and types of development (see TN 3 on alternatives and TN 33 on the integration of a Rutgers'-type model with a destination area oriented model). Estimates of the amount of recreation use that can be expected at a particular site, or alternative sites (given proposed or known characteristics of the users) are necessary. The estimated use figures should reflect the effect of planning variables such as the location of individual sites, the type of development carried out, and the competing opportunities available to the relevant populations as well as some of the socio-economic characteristics of these populations.

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The estimation procedures used to project recreation visits or levels of use of a given recreation area are based on quantifying the relationship between observed use of recreation sites and the various factors that influence this use. The suggested procedure makes use of visit data from a number of sites, for example a series of parks from a provincial system. Using fairly standard and straightforward multiple regression methods, one may determine which of a number of different variables are significant determinants of facility use and their contribution or weight in determining this use. (For some considerations see TN 19 and TN 35 on the need to use other methods than "simple" regression). These factors would normally be expected to include such things as the distance of the site from population centres of various sizes, possibly a number of socio-economic characteristics of these populations, some characteristics of the sites, and the alternative recreation opportunities that are available to the users and potential users.

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It would be expected, for example, that all other things being equal, a park nearer to a population centre would draw more visitors than one which is more distant. In such a case it is the negative effect of distance that brings about the difference in the attendance between the two. With observations on park use from a number of sites, a pattern would normally prevail in which the use levels would show a fairly consistent reduction with increased distances. If the distance effect is significant, as one would normally expect it to be, the degree of importance, in terms of how much reduction would be expected per mile or per hour, can be estimated. (On the effect of distance, see TN 14).

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If there were only the distance factor to consider in making use estimates for a new park, they could be made graphically by plotting the observed points, drawing a curve, and reading the use of a new park off the resulting graph. Alternatively, when more variables are involved, much the same thing can be done by statistically estimating the coefficients or parameters of an equation that can be employed to predict use.

The general procedures can he illustrated by an example. The United States Army Corps of Engineers operates a series of reservoirs throughout the United States, many of which receive extensive recreation use. Consider seven reservoirs in the Sacramento district of the Corps for which these use data were collected over four years, 1966 through 1969. During user surveys, interviews were conducted with approximately 40,000 visitors on their party's visit to these sites. While the data were collected on both day-users and overnight visitors, analysis was carried out only for day-users, that is, people visiting the site but not remaining overnight.

The origins of the visitors were classified into area groupings based primarily on county or parts of county units. Incidentally, some earlier analyses have used concentric rings around sites as the unit of observation. The county units, however, while introducing more variations in the data, allow more meaningful location specific variables to be measured. As distance from the reservoir increased, the size of the origin area unit used in the analysis was also increased (see TN 1 where this analysis procedure was followed very closely). The number of aerial units that were taken as being the points of origin for each of the reservoirs varied from 22 for Isabella reservoir to 26 for Pine Lake and Success reservoirs. In all, a total of 168 observations of origin to lake destinations flows were used in the analysis of the visitor characteristics for the seven reservoirs.

A number of independent variables were used in attempts to explain the variation in the observed visit numbers from each of the origins to the lakes. One variable included was the road miles from the aerial unit of origin to a reservoir of destination for a visit. The origin was taken to be the population centroid of the "general" origin area. It was, of course, expected that, as this distance became larger, the number of recreators making the visit to the particular site would decrease. A second variable was the population of the origin units. No data were collected on the incomes of the visitors but average per capita incomes were a variable defined for each origin area.

The size of the reservoir measured in acres of the recreation pool was also a variable used in the analysis. A size indication was deemed necessary to account for the increased capacity of the different reservoirs. This was also considered a crude measure of the attractiveness of a recreation site (see TN 9 and other work cited there). A number of alternative size or capacity variables were included in the analysis but ultimately only gross acreage was kept because it proved to be as good as any other transformed acreage variable in this case.

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Another variable was included to account for the alternative recreation opportunities of a similar nature available to residents of the various population origin areas. It would be expected that if readily available substitute areas were available to a population in a given area, fewer visitors would be inclined to make the trip to the reservoir in question than if substitutes were not available (see TN 1, TN 3, TN 11 and TN 33, also, on substitutability, see TN 32 and TN 37). The variable to measure is one that accounts for other lakes and reservoirs, with the value being larger as the number of lakes available to a population increased and larger with their proximity.

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The equation which was finally derived based on the observed visit patterns was as follows:

$$V(i,j)= -3303+P(i)(2.09-.24W(j)\ ½)/D(i,j) +.0037W(j)+28.8/A(i)2$$

WHERE

V(i,j) = number of recreationists going from population centre i to lake j,

P(i) = the population in the aerial unit

D(i,j) = distance between the population centres and the reservoirs,

W(j) = size of the recreation pool in the individual reservoirs, and

A(i) = measure of alternative lakes and reservoirs available to the different populations.

The variation among the area units proved insufficient to obtain reliable estimates of the coefficient so this variable was dropped from the analysis. Had income data on the

visitors been available it might have been possible to relate the number of visitors from each of the counties to each of the lakes by income.

Nevertheless, all the individual coefficients were significant at the one percent level. This expression accounted for or "explained" approximately 94 percent of the variation in visitor totals among the observations. That is, of the variations in the individual visit totals among the 168 observations, all but about six percent was "explained" by this equation. (On the meaning R2 and how regressions should be carried out, see TN 19 and TN 35).

In the case of the reservoir study the emphasis was on predicting use for a new reservoir. Because of the nature of the existing lakes and the anticipated nature of any new reservoirs, there was little need to concentrate undue attention on individual lake characteristics. Undoubtedly the lakes differ somewhat but as in the case of most recreation areas, to predict their use well, more detail (or rather how they differ in terms of specifics) would no doubt be required. Ultimately, this must be subjected to empirical investigation. (On how attractivity relates to park characteristics, see TN 4.)

While distances were measured in road miles in this study, improvements may have been possible with the use of travel time. It may also be noted that the reservoir model was for one type of recreator - the day visitor. Analysis of visit relationships for overnight visitors would need to be done in an analogous manner, but separately. It would be expected that different variables might well be important and that even the coefficients or parameters of the same variables would differ: the effects of distance on the camper will not be the same as they are on the day-use visitor. In the case of the Canadian parks it would seem reasonable that a similar separation of visitor types should be made for analysis purposes (see TN 30, also TN 18 on enroute visitors). In these cases, there is the further matter of considering substitute or alternative areas. In the reservoir study, only other reservoirs and lakes were considered as substitutes - as indeed they no doubt are. However, other areas may also be important in this regard. Proximity to the ocean or to the mountains or to Las Vegas might have been tested. In regard to provincial parks there is usually a range of areas that should be similarly tested (see TN 37).

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CONCLUSION

The range of consideration in demand analysis is wide. In some useful studies the variables are few and the models simple: this was true for the reservoir study but less true for the Rutgers' Study. Ultimately, a far greater number of concerns will need to be dealt with effectively. Income and population changes are certainly important in some studies and here more information is desirable on how use varies with these factors (see TN 12 and TN 13). How attendance figures may be expected to change over time may be important (see TN 7). Simple formulations may be used to answer fairly broad questions, but detail is necessary to provide guidance for more precise planning. In this regard an analysis is largely open-ended.

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It is the last point that best typifies the type of analyses being suggested throughout. It is not really that it is never ending, but rather that different kinds and depths of analyses may be used depending upon the problems being confronted. And, of course, initial analyses will suggest further questions. While unexplained variance or (more euphemistically) 'unknowns' will persist and call for judgment based on the

experience of planners, the chances of helpful guidance stemming from such quantitative study is a certainty.

[1] *The Demand and Supply of Outdoor Recreation: An Econometric Analysis*, Ph.D. Thesis: Rutgers University, 1969. Also, with J.J. Seneca and P. Davidson, Washington, D.C.: U.S. Department of Interior, Bureau of Outdoor Recreation, Contract No. 7-14-07-4, 1969. Available at http://www.pacificeconomicsgroup.com/cjc/#publications.