ADVANCEMENTS IN METHODOLOGY FOR PROJECTING FUTURE RECREATION PARTICIPATION

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Abstract.--Examination of past national outdoor recreation projection modeling work and of recent forecasting research has revealed advancements in data development, statistical methods, choice theory, and interpretation of recreation participation forecasting models. These advancements provide substantial opportunity to improve the accuracy and application of forecasting models. Improved model specification, more appropriate parameter expression, and more applicable data sets can result from adoption of the identified opportunities. The next round of national projection modeling will incorporate the advancements in recreation forecasting technology described in this paper.

Additional keywords: Trends, population surveys, discrete choice modeling, futures, outdoor recreation, forecasting.

Government outdoor recreation planners and market analysts associated with private industry need reliable estimates of future outdoor recreation participation and demand. A great deal of work over the past several years by social scientists and modelers, especially economists and geographers, has been aimed at improving both the models and the data to yield reliable and reasonably accurate projections. Significant advancements have been made, although improvements are still needed on several fronts. First among these advancements, methodology for population sampling and survey instrument design have improved to a point such that meaningful descriptions of recreation participation, participant characteristics, and participation circumstances and constraints can be provided. Second, national recreation participation data bases are now routinely updated at approximately 5-year intervals providing opportunities for updating participation models and projections. These updated data also permit validation of the accuracy of the resulting projections by comparing estimated actual participation with participation projections previously developed. Third, technological advancements in computer hardware and software have greatly decreased the time and costs of developing comprehensive participation projection models. Fourth, statistical methodology and recreation choice theory have advanced to a point that much better models with greater predictive power and more interpretable results are now possible. Finally, better data and better projections of the participation correlates in structural models, which are used to project participation probabilities and quantities, are more refined and thus can offer more realistic projections.

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IN: Proceedings, National Outdoor Recreation Trends Symposium II, Myrtle Beach, SC, Feb. 24-27, 1985. Coordinated by Clemson U.

In this paper we review the evolution of the state-of-the-art in recreation participation modeling and projection from 1960 to now. We report opportunities for adopting and furthering innovations for the next rounds of national projections which we will develop for the 1990 Resources Planning Act Assessment of Outdoor Recreation and Wilderness. The emphasis of this paper is on the fourth area of advancement noted above--statistical methodology and recreational choice theory. Population models, as opposed to site models, and structural models, as opposed to time series, are the focus of this methodological review.

The paper is organized to present first a history of participation projection modeling research and development and to examine the apparent accuracy of some previous projections. Subsequent sections describe the evolution of regional and national population projection modeling methodology, recent projections and their implications for technology improvements and more recent advancements and issues. Finally, the issues and uses concerning the next round of national and regional participation projection models and the resulting forecasts are discussed.

HISTORY OF NATIONAL PROJECTIONS AND MODELING

With establishment of the 1960 Outdoor Recreation Resources Review Commission (ORRRC) came a need to look toward future growth and trends in outdoor recreation participation. Realizing a need to go beyond speculation or extrapolation from cross-sectional participation data, such as the 1960 National Recreation Survey (NRS), the ORRRC commissioned Charles Proctor at North Carolina State University to undertake a multivariate analysis of the 1960 NRS. His approach was to factor analyze participation in 15 recreational activities. The resulting factor scores were used as dependent variables in regressions on the socioeconomic variables hypothesized to be correlated with the participation levels reflected in the factor scores (Proctor 1962). This was one of the earliest attempts to apply multivariate analysis techniques to attempt development of structural models. A second study by Mueller et al. (1962) used a University of Michigan national participation survey. The analysis used a multiple classification analysis and, while focusing on socioeconomic variables as potential activity correlates, advanced Proctor's analysis by including facility constraints--one of the earliest attempts to model "supply effects."

The next major efforts were undertaken by economists and involved a series of econometric based models (Cicchetti 1972). These modeling studies considered socioeconomic variables and supply variables, including water area per capita, recreation beaches, and swimming pools. The individual activity equations estimated the probability of participation in an activity, based on the values of the significant independent variables. Probabilities could be estimated for specific population cohorts, and as well, numbers of recreationists could be forecast for future years given knowledge of future population distributions and likely recreation supply changes.

Cicchetti et al. (1969) sought to improve these earlier econometric models through an analysis of the 1960 and 1965 NRS data. Twenty-five activities were modeled with the greatest distinction being much improved measures of the quantity and quality of recreation opportunities (supply variables). Inclusion of supply variables improved the specification of the conditional probability models which were similar to those developed in earlier studies. In essence, inclusion of supply variables more fully specified a model of recreation choice behavior and served to reduce specification bias in the estimated partial coefficients estimating the relationship between probability of participation and the significant independent variables. With the addition of supply variables, models were developed to explain quantity of participation. Previous studies attempting such models had failed to account for a sufficient proportion of the variation in quantity of particiption to produce significant models.

The Cicchetti et al. (1969) study, in building upon several previous modeling studies, produced the following specific results:

1. the effect of age on participation was strongly negative,
2. income was positively related at a decreasing rate as income was varied upward,
3. white and non-white participation rates were different, and
4. supply variables greatly improved models of variation in participation quantity.

The models resulting from the Cicchetti study were used to forecast recreation participation to the years 1980 and 2000. (Cicchetti's projections will be examined in the next section of this paper.) This study also began a more in-depth examination of the identification and aggregation problems in recreation participation modeling (Cicchetti et al. 1969, pp. 42-65) and initiated an exploration of the statistical properties of various forms of estimators, including ordinary least squares (OLS), generalized least squares (GLS), probit, and logit (Cicchetti et al. 1969, p. 77).

Kalter and Gosse (1970) also used the 1965 NRS to develop models of both probability and quantity of participation for 5 activities. These researchers disaggregated participation amounts by type of occasion (short outing, overnight trip, vacation, etc.) which enabled inclusion of cost and distance measures implicit in the supply set available to the participant. Estimates of proportion of variance in the dependent variable explained by these models seemed greatly improved over those of Cicchetti and associates (1969). However, some of this apparent improvement resulted from including total occasion cost and distance as dependent variables. Variation in these variables was partially a function of days of participation, the dependent variable. Also, average participation values were used across income-education cohorts having the effect of reducing initial variation in the dependent variable to which a model was subsequently fitted.

Cicchetti (1972) concluded that better data enabling better measures of respondents' participation, the opportunities available, frequency of repeat participation at specific sites, and previous participation experience were needed to advance the methodology of participation modeling. Cicchetti correctly described recreation choice behavior as a series of "complex interdependent decisions." This choice behavior, exhibited by participation, is obviously more complex than the models being developed in the late 1960s and early 1970s since most of the variation in participation among population units was yet "unexplained."

In the early 1970s, the U.S. Department of the Interior developed projections of participation for 1978 (USDI Bureau of Outdoor Recreation 1973). Using regression procedures, the USDI analysts (1) estimated the percentage of population participating by activity as a function of population socioeconomic characteristics and (2) estimated per capita participation as a function of price per activity day and socioeconomic characteristics of the participating population. The next step was to project 1978 values of the 1972 population-level socioeconomic characteristics and, using these models, project an estimate of 1978 participation based on the projected changes in these characeristics (USDI Bureau of Outdoor Recreation 1973, p. 14). The unique contribution of this work was the addition of price as a participation determinant, representing another step toward the classical economic demand model. Price elasticities between -0.06 and -0.35 and income elasticities between 0.09 and 0.35 were estimated. Unfortunately, supply variables were not considered in these models.

The most recent set of population projection models was developed in 1977 (Hof and Kaiser 1983) for the Forest Service's Renewable Resources Planning Act (RPA) Assessment (USDA Forest Service 1980). The explicit objective of this work was to provide state-of-the-art projections of growth of recreation participation for the years 1990, 2000, 2010, 2020, and 2030. Hof and Kaiser developed structural models estimating an _a priori_ theoretical specification of the national recreation market structure as follows:

$$Q_c = f(P, X_i, Y_j),$$

$$Q_p = g(P, X_i, Y_j),$$

where:

Q_c = quantity of recreation consumed.

Q_p = quantity of recreation provided by the public sector.

P = price or price surrogate.

X_i = traditional demand shifters.

Y_j = supply shifters, including political and financial variables affecting public sector supply.

The reduced form model used to specify the set of statistical models representing different aggregations of activities was of the form:

$$Q_c = f(P, X_i, Q_p).$$

Data for model estimation included the 1977 NRS, the 1975 National Association of Conservation Districts inventory of private recreation resources, and various public sector recreation supply files. The partial regression coefficients for each of the significant variables representing the above model arguments were statistically estimated and future values for these variables projected for use with the estimated models parameters to produce participation projections for 26 activities and 3 groups of activities for the nation and for each of 9 regions.

Projections resulting from this work were used in the RPA planning process of the Forest Service, in the Renewable Resources Conservation Act Appraisal of rural lands by the Soil Conservation Service, in the USDI Third Nationwide Outdoor Recreation Plan, and by several states and private groups in their separate planning and market analysis efforts.

Hof and Kaiser concluded that correct specification of a recreation participation function is not totally clear unless explicit assumptions are made about whether the participation variable(s) being projected represents an equilibrium or a disequilibrium result. Secondly, they concluded that observed participation is not independent of public sector supply decisions. Thus, recreation policy-making and planning processes should not use projected participation levels as allocative targets. There are implicit social welfare overtones because agency decisions in part determine current participation levels, and therefore projections of future participation levels as well. In short, projected participation levels are not equivalent to projected future demands.

The projections made by Hof and Kaiser represent the most comprehensive recreation modeling effort yet. As such, they have contributed greatly to improving modeling technology.

PREVIOUS PROJECTIONS

Page limitations prohibit a comprehensive examination and evaluation of previous participation projections. However, it is both useful and interesting to examine examples of previous projections relative to actual participation estimates. The usefulness of this examination is to surface reasons for the degree to which these projections were or were not accurate. Our comparisons of actual and projected participation focuses on 4 activities (swimming, playing outdoor games and sports, boating, and picnicking) and one measure of participation (number of persons participating).

Projections by the ORRRC in 1960, the Bureau of Outdoor Recreation in 1965, Cicchetti in 1969, and Hof in 1977 are presented in Table 1. Also shown are estimated actual number of participants resulting from NRS studies concurrent with the target year of previous projections, as well as Census estimates of population for past years and projected population to 2000 (USDA Forest Service 1985).

In general, all projections preceeding those developed by Hof and Kaiser seem to have grossly overstated future numbers of participants in the 4 example activities. Those developed by BOR in 1965 seem to have overstated participation the most. Some of the apparent methodological weaknesses that probably contributed most to these over projection include:

Table 1.--Estimated current and projected future outdoor recreation participation in 4 activities for selected years.

Activity and source of estimate	Year			
	1960	1965	1980	2000
	(Millions of people)			
SWIMMING				
ORRRC (1960)	58.7[a]	--	110.6	161.0
BOR (1965)	--	67.8[a]	146.2	260.6
Cicchetti (1969)	--	67.8[a]	119.7	168.2
Hof (1977)	--	--	75.5[a]	91.4
Concurrent NRS	58.7[a]	67.8[a]	75.5[a]	--
PLAYING OUTDOOR GAMES AND SPORTS				
ORRRC (1960)	39.2[a]	--	68.0	107.0
BOR (1965)	--	53.7[a]	92.4	169.7
Cicchetti (1969)	--	53.7[a]	93.9	169.1
Hof (1977)	--	--	47.1[a]	54.8
Concurrent NRS	39.2[a]	53.7[a]	47.1[a]	--
BOATING				
ORRRC (1960)	28.7[a]	--	52.8	97.0
BOR (1965)	--	33.9[a]	59.7	106.8
Cicchetti (1969)	--	33.9[a]	43.9	55.8
Hof (1977)	--	--	32.0[a]	60.2
Concurrent NRS	28.7[a]	33.9[a]	32.0[a]	--
PICNICKING				
ORRRC (1960)	69.2[a]	--	105.2	156.0
BOR (1965)	--	80.5[a]	119.1	182.7
Cicchetti (1969)	--	80.5[a]	131.5	213.1
Hof (1977)	--	--	76.8[a]	91.2
Concurrent NRS	69.2[a]	80.5[a]	76.8[a]	--
POPULATION GROWTH	180.7	194.3	227.7	255.6

[a]Estimated number of participants for each listed year, based on current year's National Recreation Survey (NRS).

SOURCES: ORRRC Study Report 25, 1962, Washington, D.C., Table 10, p. 27; Bureau of Outdoor Recreation, Outdoor Recreation Trends, April 1962, pp. 14-18; C. J. Cicchetti, 1973, Forecasting Recreation in the United States, D. C. Heath and Company, Lexington, Mass., Table 7-2, p. 168; USDA Forest Service, 1980, An Assessment of the Forest and Range Land Situation in the United States, Table 3.2, p. 100; H. Ken Cordell and Lawrence A. Hartmann (1984), Trends in Outdoor Recreation in the Two Decades since ORRRC, in Proceedings of the Southeastern Recreation Research Conference, Asheville, NC, Table 1, p. 4.

1) price variables or surrogates of price were absent or minimally treated,

2) substitute resources and activities, such as indoor activities and new activities, were not adequately accounted for in the models,

3) supply variables were either not considered or were inadequately considered permitting the implicit, and probably unrealistic assumption that future supply would not be constraining.

The work by Hof was much more comprehensive in its treatment of price and supply variables. However, as with previous modeling studies, the proportion of variation in the participation measures explained by the models was quite low with multiple coefficients of determination (R^2s) ranging from 0.05 to 0.26. The apparent model underspecification increased the potential for biased and unstable coefficients, and therefore biased projections.

THE MOST RECENT PROJECTIONS

The most recent projections of future outdoor recreation consumption resulted from Hof's work and were reported in the Forest Service's 1979 RPA Assessment (USDA Forest Service 1980). Single activities and activity groups formed the basis for these projections. Using 1977 as the base year, projections of an index to participation growth were developed and represented percentage change in number of people expected to participate in the future up to the year 2030. In Figure 1 projections for land, water, and snow and ice

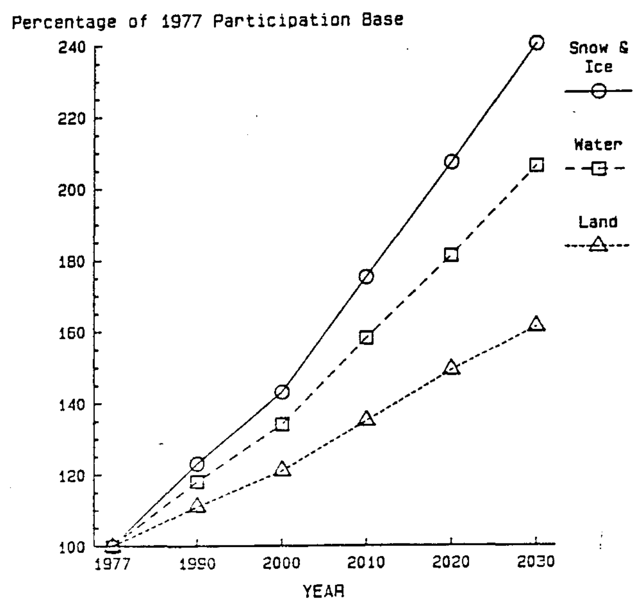

Figure 1.--Projections of indices of participation growth in land, water, and snow and ice groupings of recreational activities, 1977-2030.

SOURCE: Assessment of the Forest and Range Land Situation in the United States, USDA Forest Service, 1980.

based activities are shown. The highest rate of growth was projected first for snow and ice activities, second for water activities, and third for land activities. Growth of numbers of people projected to participate by 2030, however, showed a different ordering because the base population of participants was highest by a large margin for land activities and second highest for water activities.

Table 2 provides a further examination of the Forest Service projections. Shown are past and projected future average annual percentage growth in land and water activity participation and in population, Gross National Product (GNP) and per capita disposable personal income (DPI). GNP and DPI are standardized to base year 1967 to adjust for inflation. The 1960 and 1982 participation estimates resulted from the NRS projects conducted in those years. The projections for 1977-2000 resulted from Hof's projections for the 1979 RPA Assessment. Past and present average annual growth of population, GNP, and DPI reflect the general trends of aggregate determinants of participation growth for the relevant periods.

Table 2.--Past and projected average annual percentage growth in number of participants in land and water based activities, population, Gross National Product and per capita personal income

Characteristic	Average annual percentage growth Past (1960-1982)	Future (1977-2000)	Ratio (Future/Past)
Land Participation	2.46	0.91	0.37
Water Participation	1.42	1.48	1.04
U.S. Population	1.29	0.70	0.54
Gross National Product[a]	4.95	3.11	0.63
Disposable Income[a]	3.18	2.17	0.68

[a]Inflation adjusted dollars, base year 1967.

SOURCES: Cordell and Hartmann 1984, and USDA Forest Service 1985.

In general, past participation growth is greater than the annual rate of growth projected for the future, although participation in water activities is projected to accelerate slightly over past growth. This projected general slackening of the rate of annual growth of participation is consistent with slowing population, GNP, and DPI growth. In Table 2, a value in column 4 that is less than 1.0 indicates a smaller projected future growth rate than the past growth rate. This consistency in growth rate trends in participation, population, and the economy in past years, relative to projected growth in future years, indicates that the models used to develop the 1979 projections may be sensitive to, or at least reflective of, gross population and economic changes. This sensitivity supports of our observation that the state of the art by 1977 had advanced to a stage such that a more realistic future was being forecast. Still, improvements in modeling and data development technology are needed. Results of recent research point to some of the more promising possible improvements.

RECENT RESEARCH AND METHODOLOGICAL ADVANCES

Structural Models

Perhaps one of the most important issues that has been addressed in recent years relates to the basic assumptions, goals, and limitations of aggregate and disaggregate formating models (Stynes 1983). Aggregate models generally fall into two categories, trip generation and trip distribution. Both models rely upon information gathered at and/or generalized to populations of relatively large geographic areas. Trip generation models estimate the probability or frequency of participation in activities, whereas trip distribution models account for the geographic distribution of activity throughout a study region. Ewing (1983) has reviewed the distinction between trip generation and trip distribution models. Alternative formulations of trip distribution models are discussed by Baxter (1981) and Fotheringham (1983).

Disaggregate choice models, on the other hand, focus on individuals, households, or small areal units as observations for calibration of model parameters. They assume the same type of causality relationships as more aggregate models, but they also assume that investigating the choice behavior of decision makers at the disaggregate level permits more precise identification of the important explanatory variables which can be used to manipulate (alter) behavior. These models (e.g., Peterson et al. 1983) almost always assume that individual differences among behavioral choice mechanisms are slight and can be averaged out and that choice mechanisms can be revealed from behavior. This type of model is usually probabilistic such as logit, multinomial logit, dogit, and probit models (Wrigley 1982). Wrigley includes a categorization for the appropriateness of each model and a description of their current applications.

A third type of structural model can be referred to as a totally disaggregate attitudinal and/or behavioral model (Louviere 1976). This type of model involves experimental designs and attempts to isolate the effects of relevant decision making attributes from the confounding effects of differing environmental situations. Because these models are totally disaggregate and do not depend upon revealed behavior or assumptions about interpersonal communalities, they are best suited for examining behavioral intentions and subjective impressions (Allton and Lieber 1983; Lieber and Fesenmaier 1984).

Although the decade-long debate concerning levels of analysis and the choice of appropriate modeling procedure appears to have been resolved (Daly 1982), another important issue facing forecasters has only recently been fully acknowledged. Many of the models describing processes underlying recreation behavior have been simplistic in that they have incorporated most, if not all, of the conventional assumptions underlying the concept of rational choice (Simon 1957). Recent studies have argued that under many circumstances one might not expect individuals' decision making process to result in an 'optimal' solution. Krumpe and McLaughlin (1982), for example, argue that an individual's choice of place for a particular activity basically follows a sequential process whereby certain constraints enable one to simplify the choice process. In contrast to earlier models which include the possibility of compensation between certain aspects of a place (and which ultimately leads to optimal choice given the respective attributes), the model proposed by Krumpe and McLaughlin embraces much of the theory underlying elimination-by-aspects--EBA (Tversky 1972). EBA theory allows individuals' decisions to result in an apparently suboptimal choice (Park 1978; Fishburn 1974). In addition, the Krumpe and McLaughlin model includes perceived constraints for evaluating alternatives; positive attributes (those attributes that facilitate activity) are evaluated only for alternatives deemed 'acceptable'. As a result of this research by Krumpe and McLaughlin (1982) and others (Tversky 1972; Williams and Ortuzar 1982), it has become clear that individuals may adopt a number of different choice strategies, depending upon the conditions of a particular choice. Thus, under certain circumstances an individual might simplify choice situations using some sort of EBA framework (Tversky 1972). On the other hand, the same individual might adopt two different strategies, one for evaluation and preference formation and another for choice (Einhorn and Hograrth 1981).

The description of the effects of different choice strategies could be among the most significant recent developments in forecasting research. Understanding choice strategies has enabled evaluation of the importance of various inputs into decision processes. For example, Stynes (1982) and Stynes et al. (1985) have begun to investigate the importance of information about recreation opportunities in determining participation choices and patterns. Gitelson and Crompton (1983) have evaluated the importance of alternative sources of information for travel decisions. In other areas, Schreyer et al. (1984) and Fesenmaier and Lieber (1984) considered the influence of past experiences on recreation behavior--including participation in activities associated with a particular site. Others have begun to investigate repetitive and variety seeking behavior in recreational travel (Hanson 1980). Finally, Beaman et al. (1979), Smith and Knopp (1981), Fesenmaier and Lieber (1985), Cordell and English (1985), and Clawson (1984) have begun evaluating how the geographical distribution of recreation facilities effects individual recreation behavior. This offers tremendous potential improvement in accounting for supply effects on participation. In summary, recent research has strongly suggested that variables such as information, past behavior and experiences, and the interaction between opportunity and geography constitute principal dimensions underlying individuals' choice processes.

Statistical Methods and Data Development

Parallel with advancements in modeling of recreation choice processes is the emphasis on discrete choice modeling (Peterson et al. 1982, 1983, 1984; Stynes and Peterson 1984). Prominent is the logit model, including binomial and multinomial versions, which can be used to predict individual choices from a set of alternatives of known characteristics. The dependent variable in discrete choice models is usually reported behavior (the actual choice of destination) and the independent variables are *a priori* defined attributes.

In contrast to other types of models which use similar data, i.e., linear regression and gravity models, logit models are particularly well suited to modeling individual recreation behavior. The results of logit models are inherently restricted to a range of 0 to 1, which in turn allows direct interpretation (Wrigley 1982). In addition, models using the logit transformation can easily be expressed in linear form (Stynes and Peterson 1984). Finally, depending upon the assumptions of choice process, both compensatory and non-compensatory models can be developed (Williams and Ortuzar 1982).

The multinomial logit model requires a number of assumptions that may not be desirable. The most important is the assumption of independence of irrelevant alternatives (called the IIA Assumption). At its best, this assumption enables the evaluation of a variety of different scenarios facing decisionmakers. On the other hand, this assumption often leads to counterintuitive results when alternatives are not sufficiently distinctive (Stynes and Peterson 1984; Tversky 1972). Two recent articles in recreation concerning the IIA Assumption indicate that nested logit models (essentially EBA models) and an accurate identification of the available opportunity set, are ways of meeting this assumption (Lin 1983; Curry et al. 1983).

Concomitant with the introduction of logit models, others have shown that decompositional multiattribute preference models constitute a potentially useful and flexible approach to the analysis of recreation behavior (Lieber and Fesenmaier 1984; Louviere 1978; Propst 1979; Timmermans 1982). Unlike logit-based discrete choice models, preference models typically use individuals' expressed overall preference ordering of a set of hypothetical alternatives. These alternatives are characterized in terms of a combination of attributes (bundles of attributes), where the individual is asked to evaluate each bundle or scenario and then identify preference ordering. A decision rule may then be empirically specified by linking the preference ordering to the respective attributes of the different alternatives.

A recent study where this approach was applied to trail area choice in Chicago found considerable variation in individuals' evaluations of alternative opportunities (Lieber and Fesenmaier 1984). In this study an interactive model best described trail preferences of the urban residents sampled. However, the weights (importance) of the respective attributes describing the trails varied substantially from person-to-person. This study also showed that preference models can be effective tools to evaluate a variety of physical-environmental management strategies and thus, predict how individuals will respond to opportunities not currently available.

Other Methodological and Data Improvements

Hof and Dwyer (1979) have made other suggestions primarily aimed at improving structural participation projection models. 1) They suggest using frequency of participation in addition to probabilistic participation measures to express choice behavior. They also suggest a unit of measure more consistent with advancements in choice theory than number of participants, for example, psychologically based choice evaluations as discussed by Driver and Brown (1975). 2) Because there are many sources of measurement error, a set of consistent surveys or a "time-diary" approach are needed to increase reliability. 3) Past models have implicitly assumed that relationships identified by regression analysis remain constant throughout the projection period. Consistent cross-sectional surveys at different points in time would provide a basis for better testing this assumption. 4) In some cases it is necessary to use historical trends to project independent variables. Hof and Dyer recommend that more work be aimed at projecting future changes in these variables, especially socio-economic variables. 5) Multicollinearity can be expected with multivariate regression procedures. If significant multicollinearity is indicated, ridge regression and other "collinearity control" techniques should be considered to reduce potential parameter estimation bias. 6) Other demand shifters, such as political whimsy, previously determined public policy, and vote-trading behavior, may be important, and though pragmatically difficult to include, should be incorporated in structural models. 7) Another potentially serious problem is aggregation bias in participation equations. This problem arises when data from a cross-sectional survey describing individual behavior are used to project population participation subject to extrapolations of trends in the explanatory variables. Regression models developed from cross-sectional surveys of individuals and intended to estimate the relationships between hypothesized participation determinants and some given measure of individual recreation consumption should only be used to project population level participation if the heroic assumption that population behavior and characteristics are homogeneous is adopted. 8) Due to problems of heteroskedasticity, generalized least squares, logit, or probit analysis are recommended instead of ordinary least squares, especially when the sample size is small and a probabilistic dependent variable is used.

Other suggested methodological considerations include Mittleider, et al. (1980) who emphasized that cross-sectional data do not take into account temporal changes of patterns of participation. Thus long-run projections based on these data may be subject to considerable error. Napier and Maurer (1981) found that factor analytic techniques helped increase explained variance. Witt and Goodale (1981) reported that non-linear regression models also can increase explained variance. Yu (1981) examined factor analysis to combine several socio-demographic variables into a single composite score for use in modeling participation.

As previously discussed, prediction models using a discrete choice dependent variable for participation in a given activity yield only information on the probability that certain numbers of people will participate, not the extent of their participation. Our preliminary analysis of the 1982-1983 NRS indicates that a relatively small proportion of users account for a relatively large proportion of total participation occasions. Cicchetti (1973) suggested a two-stage model, the first stage predicting probability of participation and the second stage predicting quantity of participation for those who do participate.

Contemporary Issues in Recreation Forecasting

Thus far, our discussion has centered on some of the achievements and suggestions by researchers for developing more interpretable and accurate forecasting models. It is clear that major advancements have been made, each in turn being a response to the methodological issue(s) of that time. Contemporary issues and problems include individuals' use of information, the role of past experience, and the extent to which established habits effect recreation behavior. But there are a number of other concerns that must be addressed.

Characterizing opportunity sets.--Chief among these other concerns is characterizing opportunity sets (Williams and Ortuzar 1982; Richardson 1982; Ansatt 1977). The relative location of each and every recreation facility is different when viewed from the location of each recreationist. For aggregate gravity model formulations, there is substantial controversy as to the manner in which such effects can be modeled (Baxter 1981; Fortheringham 1983; Ewing 1983). Fesenmaier and Lieber (1985) and Cordell and English (1985) have recently advocated an indexing approach. Because of its simplicity, such an approach is useful for measuring the effects of opportunities upon participation. The indexes are simply counts of facilities within different distance zones outward from the location of the recreationist and differs from the approach originally advocated by Breheny (1978). In order to separate the spatial structure effects relative to the origin from the potentially agglomerative effects of locationally proximate facilities relative to the destination, the authors also suggest that simple counts for the number of facilities within distance zones outward from the location of the facility actually visited also be made. This procedure eliminates the need to a priori discount the effect of distance which is an inherent problem with gravity model formulations.

For disaggregate modeling approaches, incorporating choice sets as part of decision making experiments appears to be an appropriate way to control context or situational effects in uncovering aspatial decision principles. The essential problem for each decision making experiment is to systematically vary the facilities (the combinations of attributes with known levels) in a choice set and to compare the probability of a facility being present in any choice set (the combination of attributes) with both the choice probabilities of the decision maker and his real behavior in the environment (Eagle 1984).

Better knowledge of recreation choice mechanisms.--Both the index approach and the further use of experimental designs in characterizing spatial structures may lead to improvements in precision and accuracy and lessening of specification errors in forecasting models. Nevertheless, any such advances cannot lead to the elimination of all spatial structure effects because we do not currently know how to change the characterization of spatial structures or experimental opportunity choice sets to account for the different levels of knowledge about facilities possessed by decision makers. Two people living in the same place may have different choice sets because of different lengths of residents, preference, or knowledge. How can one incorporate into a forecasting model the constraining effects of information filters?

To overcome this problem, we need to re-examine the current model of man; that is optimizing, rational man. Beyond the algebraic models of man currently in use, others are possible (Anderson 1981). If one were to view man as a more complex being, one might need to consider a model of man in which the prime directive is to simplify situations (Tversky 1972) or as a framer of decisions (Tversky and Kahneman 1981). Further, we ought to consider how subliminal or subconcious factors affect behavior. Marketing researchers have long ago recognized the effect of packaging and color in evoking responses. Lastly, perhaps we ought to consider the potentially dominating effect that personality can have upon behavior (Slovic et al. 1974).

Without such a re-evaluation, our structural models are likely to remain static. Totally disaggregate experimental analyses may lead to the development of better specified structural models, perhaps even dynamic models. Experimental designs may help us to identify variables which can reflect patterns of repetitive choice behavior. Experimental research in marketing on brand loyalty, for example, may lead to analyses which define variables that can be used to characterize the diversification of behavior (e.g., variety seeking) across facilities as compared to a concentration of activity at a few facilities. These variables as well as a characterization of the way individuals acquire information about the availability and conditions present at facilities (as well as their relative location) may then be incorporated into models to increase predictive power.

Managerial use of forecasting models.--Although a topic of great concern to quantitative specialists and planners, no discussion of forecasting methods would be complete without a consideration of management philosophy. To what degree might forecasting methods be used to control or manipulate supply or to control or manipulate participation choices? Beyond rationing and redistributing use according to efficiency and equity criteria, will managers follow a dedicated use pattern or multiple use pattern of resource use? Both alternatives lead to management problems (Jubenville and Becker 1983; LaPage 1983). All of these questions and many more are prescriptive in nature. We raise them here because they constrain the type of recreation forecasting model which should be used in planning.

Identification of other behavior determining factors.--The early 1980s presented a new wave of research including investigations of motivations and non-participation. Crandall (1980) presented a list of 17 motivational categories for leisure participation. Romsa and Hoffman (1980) investigated reasons for non-participation and found that among the most active social groups, inadequate recreation opportunity was the most important determinant of non-participation; next was lack of time and costs of participation. Boothby et al. (1981) also investigated non-participation and found that the most frequently cited reasons were loss of interest, lack of facilities, lack of physical fitness and physical disabilities, leaving a youth organization, moving away from the area, and lack of time. Jackson's (1983) study of non-participation determined 15 barriers to participation, including time, money, opportunity, knowledge, ability, overcrowding, lack of partners, shyness, and lack of transportation. Napier and Mauer (1981) considered local community factors, spillover-compensatory factors, and opportunity factors.

SUMMARY AND DISCUSSION

Since the ORRRC study in 1960, significant advances in the methodology of modeling and forecasting outdoor recreation participation have been realized.

This achievement is no small wonder in view of the lack of a concerted, centralized program of research aimed specifically at the problem of improving forecasting modeling. Advancements have resulted mostly from the entrepreneuship and work of social scientists who have pursued their individual professional interest in forecasting research. A smaller, although significant, amount of methodological advancement has resulted from mostly federal and some state efforts to develop forecasting capabilities to support comprehensive assessment and planning mandates.

While recent models and their resulting forecasts and interpretations still are obviously in need of much improvement, previous modeling experience and recent research seem to offer some very promising opportunities. These opportunities include:

1) More complete specification of structural models to include price, opportunity set, complementary and substitute opportunities, demand shifters and exogenous constraints.

2) Recognition of the partial dependence of measured and, therefore, forecast participation upon public supply and management where allocative and policy decisions are in question.

3) More accurate projection of the independent variables in forecasting models and accounting for potential aggregation bias where predicted summary values of these independent variables are used.

4) Selection of the appropriate level of analysis and type of model to suit the intended use of the participation forecasts.

5) Better understand and account for choice processes and the elements most important in these choice processes to enable better definition and specification of the factors in number 1 above, as well as specification of other potential participation determining factors.

6) Adopt improved statistical procedures such as advanced applications of discrete choice modeling (e.g., logit) and 2-stage models to build in quantity of participation predictive capability.

7) Better understand and therefore interpret the assumptions underlying alternative forecasting models and choice process formulations. Concommitant with this step is basing model specification, analysis and interpretation on relevant, state-of-the-art theory.

8) Develop data sets which match the data needs of improved model specifications and statistical approaches.

9) Provide flexibility in modeling procedures to enable dynamic capabilities that account for potential changes in behavioral relationships, new factors and value changes, and new participation innovations.

10) Account for personal and background factors, many of which, such as physical fitness, are not currently measured.

Currently the only on-going, comprehensive national assessment of outdoor recreation is incorporated in the Renewable Resources Planning Act (RPA) Assessment developed at 10-year intervals by the USDA Forest Service. The next RPA Assessment will be reported in 1989. Work toward development of the recreation participation forecasts for this Assessment are underway currently at the Forest Service's Athens, Georgia, research location. This work will incorporate to the fullest extent possible the above listed modeling improvement opportunities.

The projection horizons for the 1989 Assessment are the years 2000, 2010, 2020, 2030, 2040--a look into the future more than 50 years from now. This projection horizon is required by the RPA law for the purpose of identifying needs for Forest Service programs that can lead to meeting future societal needs from better management of the Nation's 1.78 billion acres of forest and range land and associated water. Thus the projections developed through the current RPA modeling work will influence policies concerning a very large resource base for many years to come.

The models and forecasts we will develop are typically widely used, beyond meeting Forest Service needs alone. Incorporation of improved methodological and data development technology should greatly enhance the useability of the forecasting results to a somewhat diverse clientele of users.

The principal data sources for the developing and projecting with the RPA models are the recent National Recreation Participation Survey, a county-by-county supply indexing system with flexible data disaggregation capabilities being developed by the Forest Service, future projections of aggregate population and economic factors, a nationwide on-site survey of users of federal and state lands, and Census population enumeration and characteristic files. Improvements in developing and using these data files are undertaken as opportunities to be a part of the primary data collection process are available. The sources for improvements in the methodology employed to structure, estimate, and interpret model factors have been identified and evaluated as advancements in this paper. The trends in the methodology for projection model development that we have described offer substantial opportunities to synthesize these advancements.

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