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USE OF TRAVEL COST MODELS IN PLANNING: A CASE STUDY

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This article examines the use of the travel cost method in tourism-related decision making in the area of nonconsumptive wildlife-associated recreation. A travel cost model of nonconsumptive wildlife-associated recreation, developed by Zawacki, Marsinko, and Bowker, is used as a case study for this analysis. The travel cost model estimates the demand for the activity based on the premise that those who live farther from the recreation opportunity will have to spend more to participate and, hence, will participate less often. The model is examined, and the nonmarket benefits obtained from the model, application of the results to decision making, problems associated with using the model, and the use of the results to supplement economic impact analyses are discussed. One important problem associated with this type of model is the lack of agreement on the value of participant time, a variable that can directly affect the value of the experience. The model can be used to assess the effect of demographic variables, such as race, as well as the effect of substitute activities and sites.

Travel cost   Travel cost model   Tourism   Recreation   Economic impact

Economic impact studies measure the impact of expenditures on the economy of a particular area. These studies are used to evaluate the effect of facilities and services in the area and, frequently, to solicit support or funding for the facility and/or service providers. For example, state parks in South Carolina were expected by the state to cover their operating costs from parking and activity fees. Local county parks were criticized by the county supervisor as not being able to generate enough fees to justify expansion or new parks. Managers of both state and county parks protested, citing money spent in the area by users of the facilities. As a result of the frustration felt by these managers, a state park manager designed a survey to conduct an economic impact analysis. The survey has not yet been conducted, awaiting a decision by state-level administrators, who wish to pursue the study at all state parks (A. Davis, Superintendent, Oconee State Park, Mountain Rest, SC, personal communication, 2001).

The need for, and the value of, these analyses is obvious. Tourist attractions can have an economic

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impact on surrounding areas. Even if the provider cannot cover costs with fees, the overall economic effect of the attraction can be a benefit to the local area. In the case of state and county parks, increased regional expenditures imply increased taxes and these can be used to help fund the parks. In the case of private facilities, they must usually be self-supporting, which, in part, explains why private competition with state and county parks is not common.

Because economic impact studies focus on economic contributions in an area, they fail to address the value of the attraction to the user. The value to the user is responsible for the demand for the facility or service and is, therefore, the factor that determines whether, and how frequently, an individual will visit an area. Individuals value a trip based on their expected benefits from the trip. Theoretically, if their expected benefits are less than the cost of the trip, they do not take the trip. If their expected benefits are greater than the cost, they take the trip. When their expected benefits from the trip exceed the cost, the trip is taken and a net benefit is accrued. This net benefit is referred to in the economic literature as consumer surplus, and it represents a value that can be useful to policy makers, managers, and other decision makers associated with the recreation and tourism industry. Specifically, it can be useful as a guide to setting fees, budget allocations, and policy-related decisions.

This article examines the use of the travel cost method in tourism-related decision making in the area of nonconsumptive wildlife-associated recreation. Specifically, a travel cost model of nonconsumptive wildlife-associated recreation developed by Zawacki, Marsinko, and Bowker (2000) is used. This article examines the model and discusses the nonmarket benefits obtained from the model, application of the results to decision making, problems associated with using the model, and the use of the results to supplement economic impact analyses.

Methodology

Data Source

This article is based on a study that used the nonconsumptive portion of the 1991 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (FHWAR) as the primary source of data. A detailed description of the survey can be found in USDI Fish and Wildlife Service (1993). The survey is conducted in two phases and serves as the major source of information on national wildlife-associated recreation. The first phase is a screening interview in which households provide socioeconomic information and identify wildlife-related recreation participants. The second phase is focused on selected participants from the screening survey. In this phase, detailed information is collected about participation and expenditures on hunting, fishing, and nonconsumptive wildlife recreation. The nonconsumptive portion encompasses those in the screening survey who indicated participation or potential participation in nonconsumptive wildlife recreation. Data are collected for residential and nonresidential participation. Nonresidential nonconsumptive wildlife recreation consists of trips taken by those 16 years of age or older to a site at least 1 mile from the home for the primary purpose of observing, feeding, or photographing wildlife. Residential nonconsumptive wildlife recreation is done within one mile of home and includes the previously mentioned activities plus maintaining natural areas or plantings for wildlife.

To reduce recall bias, respondents were interviewed three times during 1991, a change from previous surveys that were conducted only once per year. Each observation in the screening survey includes a weight that reflects the number of people in the general population represented by that observation. Several adjustments were made to this weight in the detailed survey, including one to account for the overrepresentation of nonconsumptive participants in the second-phase sample. The nonconsumptive portion of the survey contains 22,723 observations. These observations represent 76.1 million people, or the 40% of the population of the United States in 1991 who participated in residential and nonresidential nonconsumptive wildlife recreation.

Travel Cost Model

A travel cost model was applied to the nonconsumptive dataset in order to estimate the demand and consumer surplus for these activities by the relevant population, and to determine which variables affect the demand and consumer surplus. In addition, several methodological issues, which could affect management and tourism decisions, were addressed.

The travel cost method uses actual travel-related expenditures as a basis to estimate the demand for a site. The technique relies on establishing a relationship between these expenditures incurred by travelers to a site or combination of sites and the number of trips taken. Those who incur higher expenditures are expected to visit the sites less frequently than those who spend less. In general, those who live farther from the sites will incur higher expenditures than those who live closer to the sites. Hof (1993) demonstrates that this relationship can be exploited to derive consumer surplus for access to a site or for a given experience. Within the limitations of this dataset, the general specification of demand for recreation trips is:

$$Y_{ij} = f(C_{ij}, S_{ij}, R_{ij}, D_{ij}) \qquad (1)$$

where Y_{ij} is the number of trips by the *i*th individual to state *j*, C_{ij} is the cost of *i*th individual's trip to state *j* including time cost, S_{ij} is the *i*th individual's substitute variables including costs of alternate activities in state *j* and cost of nonconsumptive recreation in alternate states, R_j is resource supply information for state *j*, and D_i is a vector of socioeconomic variables for individual *i*.

Travel cost has been used extensively in forest-related recreation research to value site access as well as changes in site quality (Boxall, McFarlane, & Gartrell, 1996; Casey, Vukina, & Danielson, 1995; Christensen, Stewart, & King, 1993; Englin, Boxall, Chakraborty, & Watson, 1996; Mendelsohn, Hof, Peterson, & Johnson, 1992; Richards, King, Daniel, & Brown, 1990; Walsh, Ward, & Olienyk 1989). Recently, Cho, Lee, and Var (2001) used a zonal travel cost model on two recreation sites in Korea and discussed the applicability of the model to decisions about development and investment in tourism resources. The travel cost method is based on actual behavior. This contrasts to contingent valuation, another popular nonmarket valuation technique, which is based on stated behavioral intentions.

Survey respondents to the nonconsumptive wildlife recreation portion of the FHWAR can be classified into one of two groups: those who take trips and those who do not. Those who do not take trips are residential wildlife consumers only (i.e., they observe, photograph, or feed wildlife, or maintain natural areas or plantings specifically for wildlife within 1 mile of their home). However, they are assumed to be part of the relevant population for potential participation in nonresidential activities. Those who are neither trip takers nor residential wildlife consumers are not considered as potential market entrants. An untruncated estimator is applied to the entire data set (trip takers and non-trip takers) to estimate a travel cost demand function from which consumer surplus can be derived. Alternatively, a truncated estimator is used to estimate a demand function for the portion of the data set consisting of only nonresidential participants (trip takers).

The negative binomial count data model was used in this study. Following Yen and Adamowicz (1993), the negative binomial probability distribution can be represented as:

$$P(Y_i = y_i; y_i = 0,1,2,\ldots) = \frac{\Gamma\left(y_i + \frac{1}{\alpha}\right)}{\Gamma(y_i + 1)\Gamma\left(\frac{1}{\alpha}\right)} (\alpha\lambda_i)^{y_i} (1 + \alpha\lambda_i)^{-\left(y_i + \frac{1}{\alpha}\right)} \qquad (2)$$

where $\lambda_i = \exp(\beta, C_i, S_i, R_i, D_i)$, β is a vector of coefficients, Γ represents the gamma function, α is the overdispersion parameter, the expected value, $E(Y_i)$ is λ_i, and the variance, $Var(Y_i)$, is $\lambda_i(1 + \alpha\lambda_i)$.

When the data come from a truncated distribution, the mean function of the count data model is misspecified. Creel and Loomis (1990) state that using an untruncated estimator on truncated data will result in "biased and inconsistent" parameter estimates. When the data are truncated, the probability distribution applies only to values above zero. Grogger and Carson (1991) present count models for truncated data. A zero-truncated negative binomial probability distribution is represented as:

$$P(Y_i = y_i; y_i = 1,2,3,\ldots) = \frac{\Gamma\left(y_i + \frac{1}{\alpha}\right)(\alpha\lambda_i)^{y_i} (1 + \alpha\lambda_i)^{-\left(y_i + \frac{1}{\alpha}\right)}}{\Gamma(y_i + 1)\Gamma\left(\frac{1}{\alpha}\right)P(Y_i > 0)} \qquad (3)$$

where

$$P(Y_i = 0) = (1 + \alpha\lambda_i)^{-(1/\alpha)}$$

$$P(Y_i > 0) = 1 - (1 + \alpha\lambda_i)^{-(1/\alpha)}$$

$$E(y_i) = \frac{\lambda}{1-(1+\alpha\lambda_i)^{-\frac{1}{\alpha}}}$$

$$Var(y_i) = \frac{E(y_i)\left[1-(1+\alpha\lambda_i)^{-\frac{1}{\alpha}}\right]^{1+\alpha} E(y_i)}{\left[1-(1+\alpha\lambda_i)^{-\frac{1}{\alpha}}\right]^{\alpha}}$$

Truncated estimators may be appropriate when the objective is to estimate economic value for a known group of users (Loomis et al., 1991). However, truncated estimators may not be appropriate when the goal of the study is to extrapolate the demand to the general population, because nonparticipants may not have the same demand parameters as participants (Hellerstein, 1991).

Variables Used in the Model

Trip expenditures are the basic data used in the model. The cost of a trip in Zawacki et al.'s (2000) study is an individual's total expenditures in a state divided by the individual's total number of trips in that state. Because of discrepancies in the literature about which trip costs to include (English & Bowker, 1996), the model is estimated with two versions of this variable. Full cost (TRIPCOSTF) includes food, lodging, transportation, and fees, which include guide fees, access fees, pack trip, and equipment rental. Reduced cost (TRIPCOSTR) includes what are considered the minimum necessary costs of a trip, which are transportation costs and fees. Trip cost for those who have not taken a trip is the average cost for state residents of a nonconsumptive trip in their state. This assumes that, if nonparticipants should decide to participate, it would occur in their home state. The specification does not account for those who may not participate because the wildlife they desire to view is not located in their home state. Although this article focuses on selected variables, a complete list and description of variables used in the original study is included in Table 1. These variables are discussed in greater detail in Zawacki et al. (2000).

The time spent traveling can be part of the cost of traveling. Presently, researchers do not agree whether and how much to value this time. This presents a potential problem, which is discussed in more detail in the next section. Travel time is handled in this model in three ways. It is valued at $0, one fourth, and one half of the wage rate. The wage rate is calculated from annual household income, which assumes individuals in the household will behave as if the household income is their income. Travel is assumed to occur at 50 miles per hour and the distance traveled is the distance to the site visited most frequently in a state. Although reported expenditures are for all trips within a state, the mileage and cost of time are related only to the most frequently visited location within a state.

High costs occur in the dataset and they have a significant effect on the results. Although respondents were asked to include only trips for which the primary purpose was the specified nonconsumptive wildlife recreation activities, it is possible that some respondents included multipurpose trips. High mileages also occur and high mileages tend to be associated with multipurpose trips (Smith & Kopp, 1980). Thus, the top 5% of the cost and the top 5% of the mileage observations were treated as outliers and eliminated from the final analyses. The adjusted data include 20,699 observations, of which 3799 are from respondents taking trips to more than one state.

The demographic variables age, income, race (white and nonwhite), and place of residence are also included in the model. This enables the estimation of the effect of these variables on participation in these activities.

Another factor of interest is the opportunity for recreational activities of this type in each state. This was treated as a supply variable and was represented by the available resources in each state. Specifically, it was defined as acres of forest and rangeland per capita in the state in which the trip was taken. Forest survey data (Powell, Faulkner, Darr, Ahu, & MacCleery, 1993) were used to obtain these acreages, and the definition of forest and rangeland are therefore those used in the forest survey. Although this is a broad measure of supply, it is one that is available for each state and consistent from state to state.

Table 1

List of Variables Included in the Analysis

TRIPCOSTF	Full reported expenditures plus the cost of time per trip. Cost categories include transportation, fees, food, and lodging.
TRIPCOSTR	Reduced reported expenditures plus the cost of time per trip. Cost categories include transportation and fees.
HUNTCOSTF	Full average cost of hunting in state where nonconsumptive trip was taken plus the cost of time per trip. Cost categories include transportation, fees, food, and lodging.
HUNTCOSTR	Reduced average cost of hunting in state where nonconsumptive trip was taken plus the cost of time per trip. Cost categories include transportation and fees.
FISHCOSTF	Full average cost of fishing in state where nonconsumptive trip was taken plus the cost of time per trip. Cost categories include transportation, fees, food, lodging, bait, and ice, and boat rental, launching, mooring, storage, maintenance, insurance, and fuel.
FISHCOSTR	Reduced average cost of fishing in state where nonconsumptive trip was taken plus the cost of time per trip. Cost categories include transportation, fees, bait, and ice, and boat rental, launching, mooring, storage, maintenance, insurance, and fuel.
SUBCOSTF	Full average cost of trip (reported expenditures and time cost per trip) to alternate states. Cost categories include transportation, fees, food, and lodging.
SUBCOSTR	Reduced average cost of trip (reported expenditures and time cost per trip) to alternate states. Cost categories include transportation and fees.
HUNT	1 if has ever hunted; 0 otherwise.
FISH	1 if has ever fished; 0 otherwise.
INT HUNT	Interaction term; HUNT * HUNTCOST.
INT FISH	Interaction term; FISH * FISHCOST.
INT HUNTTRIP	Interaction term; HUNT * TRIPCOST.
INT FISHTRIP	Interaction term; FISH * TRIPCOST.
SUPPLY	Acres of forest and rangeland per capita in state trip was taken.
INCOME	Household income in thousands of dollars.
AGE	Individual's age in years.
AGESQ	Age squared in hundreds of years.
RACE	1 if white; 0 otherwise.
URBAN	1 if lives in an urban area; 0 otherwise.

Substitutes are important because they bring in a measure of competition for a participant's time and for a given site. Substitute activities are those that someone might participate in instead of nonconsumptive wildlife-associated recreation. Thus, they are activities that can compete with the primary activity. Substitute sites are alternate locations with similar resources where someone may participate in the same activity. A change in the cost of the substitute affects the market for the primary activity and/or site.

Because the data source is a secondary dataset, substitute activities are limited to those available in the dataset. These consist of hunting and fishing. Many nonconsumptive wildlife-associated recreationists hunt and/or fish. The average costs of a day of hunting and fishing are considered to be the cost of these substitutes. It is assumed that these activities are viable substitutes for those who have hunted and/or fished in the past. Hunting and fishing are not considered as substitutes for those who have never hunted or fished. This assumption avoids forcing these activities on nonconsumptive wildlife-associated recreationists who are against hunting and/or fishing.

Substitute sites are important because most participants have location as well as activity choices. A change in the cost of the substitute affects the market at the primary site. States are the most detailed level of site specificity given in the dataset. Therefore, substitute sites are considered to be other states. The average cost of a trip to an alternative state was used as the value of this variable. Two versions of this substitute cost were modeled: the full cost version and the reduced cost version, which correspond to the variables TRIPCOSTF and TRIPCOSTR, respectively.

Results

Effect of the Variables

The trip cost variables are significant and an increase in these variables will increase the consumer surplus and, thus, the value of the experience. This is to be expected, because the value of the trip to the participant is based on what the participant spent to make the trip. Likewise, models using the full cost specification (TRIPCOSTF) result in larger consumer surplus estimates than models using the reduced cost specification (TRIPCOSTR). Thus, construction of these variables is critical. Results from the truncated model, using the reduced cost (TRIPCOSTR) and with time valued at one fourth the wage rate, are shown in Table 2.

Respondents living in an urban area are likely to take fewer trips, and white respondents are likely to take more trips than respondents who are not white. Demographic variables such as these are important to managers of all types because they help define the market and identify underrepresented segments of the market. This information can be used as both a stimulus and guide for conducting further analyses, such as investigating why nonwhites participate less than whites. This would be of particular interest to those promoting tourism because it might lead to market expansion strategies.

The supply variable is significant and its coefficient is positive, indicating that a decrease in forest and/or range land will result in a decrease in the number of trips. This is of importance to natural resource managers because it links the resource to the value of the experience. It provides these managers with increased justification for maintaining the natural areas and, potentially, for increased funding. It is important to planners, managers, and marketers involved with tourism for similar reasons. Protecting the resource ensures continued tourism and continued expenditures by tourists. Making more land available to the public may increase this type of tourism, although the study did not address this specifically.

Table 2
Model Estimation Results

Variable	Truncated (n = 10,303) Coefficient	t Ratio	Mean
TRIPCOSTR	–0.246E-01	–35.391	19.02
INT HUNTTRIP	–0.522E-02	–4.812	9.24
INCOME	0.106E-02	1.672	39.48
AGE	–0.776E-02	–1.446	38.74
AGESQ	0.164E-01	2.737	16.95
URBAN	–0.142	–4.579	0.25
RACE	0.289	4.181	0.96
SUPPLY	0.182E-02	6.784	29.20
HUNT	0.523	13.629	0.48
FISH	0.232	6.512	0.82
INT HUNT	–0.124E-02	–4.754	19.76
INT FISH	–0.395E-02	–11.371	28.12
SUBCOSTR	0.275E-02	12.473	48.74
Constant	0.726	5.129	
α	5.631	13.597	
Log-likelihood	-27953.64		
Chi-square	93268.96		
Pseudo-R^2	0.63		

Hunting and fishing were considered as potential substitute activities. These variables were significant and negative for those who currently take nonconsumptive trips (truncated model). This means that the relationship between nonconsumptive wildlife-associated recreation and both hunting and fishing was complementary rather than substitute. Thus, an increase in the cost of hunting or fishing will not cause participants to take more nonconsumptive wildlife-associated recreation trips and fewer hunting or fishing trips. Instead, an increase in the cost of hunting, for example, will result in lower participation levels in both hunting and nonconsumptive wildlife-associated recreation. This could be caused by several factors. For example, many of the components of trip-associated costs are the same for all three activities. An increase in the cost of gasoline increases the cost of all three activities and, thus, decreases participation in all of them. These relationships are important because they provide planners, managers, and marketers with an idea of what to expect if costs change. If an area offers hunting, fishing, and nonconsumptive wildlife-associated recreation, and the costs of hunting and fishing increase, planners, managers, and marketers can expect a decrease in participation in all three activities along with a corresponding decrease in expenditures in the area.

Alternate states were considered as potential substitute sites in the study, due to the structure of the secondary dataset used. Respondents could participate in their home state or another state. In this case, the variable was significant and positive, indicating the existence of a true substitute relationship. As the cost of a nonconsumptive wildlife-associated recreation trip in another state increases, participants will take more trips in the primary state (the state in which the original trip was taken). The opposite is also true. A decrease in the cost of a trip in another state is likely to send participants out of state to participate. This is important when assessing the effects of policy changes that directly affect the cost of a nonconsumptive wildlife-associated recreation trip. A policy change that results in a per-trip increase in revenue to a state can be offset by a loss of participation in that state and a corresponding participation increase in alternate states. In general, substitute sites can be any type of substitute location that offers the same type of activity. Therefore, this is important to those dealing with commercial tourism in that increased costs to participate at one location can result in the participant moving to a competitor's location. Although basic economic theory makes this obvious in some situations, the travel cost model can help determine whether a site or activity is a substitute or complement, as well as determine the magnitude of the potential effect on the demand for the primary activity at the primary site.

Methodological Issues and Cautions

The travel cost model is based on the cost associated with travel to and from the site. Some of these costs are not as precisely estimated as others. The rationale behind travel cost models is that recreationists travel to sites because they expect to receive more in the way of benefits from the experience than the costs they incur. People who incur a greater travel cost, such as those who live further from the site, tend to visit a site less frequently.

As with any nonmarket valuation technique, the travel cost model has several methodological issues associated with it. Different statistical models will generate different results and, over the years, the travel cost model has evolved so that the model of choice has changed. It is still evolving. An open issue is whether truncated (participants only) or untruncated (participant and nonparticipant) models should be used. Yen and Adamowicz (1993) suggested that untruncated models are more accurate and precise and that incurring additional expenditures to collect data about nonparticipants could be worthwhile. Their study found larger consumer surplus estimates using truncated models, while this study found smaller estimates using truncated models. In addition, this study found truncated models to be more precise in that they resulted in smaller consumer surplus variances.

Most of the models currently in use do not separate the decision to participate from decisions about frequency of participation. Truncated models consider only participants and, therefore, everyone has previously made the decision to participate. Untruncated models operate under the assumption that everyone in the population is a potential participant, an unlikely scenario in many cases. Models that separate the decision to participate from the frequency decision are currently being investigated. These models are probably more realistic in that they take into account the fact that not all people are potential participants.

Another issue of potentially serious consequence deals with the value of travel time. At issue is whether the time spent traveling to and from a site should be considered part of the travel cost, and, if so, at what rate. This study considered travel time at \$0, one fourth, and one half of the wage rate, where the wage rate was calculated based on annual household income. Higher travel cost indicates a greater willingness to pay and, hence, a greater value obtained. Thus, choosing a higher wage rate factor will likely increase the travel cost and the estimated net benefit received by the participant. The effect of the wage rate factor on consumer surplus can be seen in Table 3. If travel time is valued at \$0, the consumer surplus per trip is \$24.40. Consumer surplus increases as the value of travel time increases. Consumer surplus at one half the wage rate is about three times the consumer surplus when travel time is valued at \$0. Selection of a higher wage rate factor thus places a greater value on the activity. Unfortunately, researchers do not now agree on the optimum wage rate factor. Thus, the researcher can affect the results by his or her choice of wage rate factor. Perhaps of greater consequence, someone with a vested interest in a venture could choose a wage rate factor

Table 3

Effect of Wage Rate Factors (Value of Travel Time) on Consumer Surplus for a Nonconsumptive Wildlife-Associated Recreation Trip by Nonhunters Using a Truncated Negative Binomial Model

Wage Rate Factor[a]	Consumer Surplus (\$) Per Trip	SD
0	\$24.40	0.8
One quarter	\$40.70	1.1
One half	\$72.30	2.2

[a]Value of travel time calculated as a fraction of household income.

that supports a political position. A relatively unbiased method of handling the wage rate issue is to present it as we have done here, using several factors.

Thus, selection of the model, construction of the variables, and selection of the wage rate factor all affect the values generated by the model. Two individuals with opposing viewpoints could, if they wished, construct models that support their goals. While this is true of other methods of estimating values, nonmarket valuation methods such as the travel cost model are probably more susceptible to this type of manipulation.

Discussion

Travel cost models enable estimation of the value of the recreational experience to the user. This can be useful to managers and planners working with tourism and natural resources, partly because it may be possible to capture some of this value. Estimating nonmarket values can be useful to managers and planners in setting entrance fees, assessing the economic effects of management and policy decisions, enabling the inclusion of nonmarket benefits in benefit/cost analyses, and aiding in financial resource allocation decisions. Estimating economic gains or losses associated with changes in visitation to an area is a powerful tool for managers of public areas as they make a case for maintenance budgets or new programs. Travel cost models can provide information that links specific variables (e.g., the supply variable in this study) to visitation and, thus, value. They can help assess whether alternate activities and sites have a substitute or complementary relationship (or no relationship) with the primary site and primary location. Thus, they can be used to assess the direction and magnitude of the effect of changes in cost of alternate activities and sites on demand and on revenues at the primary site and in the surrounding area. Travel cost models can also provide information about the relationship between demographic variables such as race and visitation. This information can then be used to investigate potential markets and possibly justify additional marketing efforts.

There are numerous problems associated with using the travel cost model. Most of these stem from the methodology. Although it has been around for many years, travel cost, like other nonmarket valuation methodologies, is still being developed. There is disagreement among researchers about model and variable structure, and specific issues such as the value of time. Evaluation and presentation of several alternatives, such as several values for time, provides the decision maker with a range of values that can be factored into the decision process. The potential for misuse of the model exists. Although this is also a potential problem with conventional financial and management decision models, the lack of standardization in the travel cost model makes it more susceptible to this type of misuse. However, the travel cost model, even in its current state of development, can provide valuable information for managers and planners.

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