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Research article

Valuing setting-based recreation for selected visitors to national forests in the southern United States☆

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ABSTRACT

In this study we estimate selected visitors' demand and value for recreational trips to settings such as developed vs. undeveloped sites in U.S. national forests in the Southern United States using the travel cost method. The setting-based approach allows for valuation of multi-activity trips to particular settings. The results from an adjusted Poisson lognormal estimator corrected for truncation and endogenous stratification reveal that economic value per trip estimates are higher for wilderness compared to day-use developed settings, overnight-use developed settings, and general forest areas. Estimates of these economic values are important to resource managers because their management decisions and actions typically control recreational settings. For example, managers control developed campground capacity in a national forest, but typically not the number of campers below the capacity constraint and the number and types of activities visitors engage in during a multi-activity trip to a developed campground (within limits since some activities such as discharging a firearm are not permitted in a developed campground).

1. Introduction

We present a conceptual model and empirical estimates of recreation demand and consumer surplus for visitors to national forests in the Southern United States for different setting types. Manfredo et al. (1983) define settings as "places where activities take place and include all physical (e.g., topography, water, wildlife, fish, meadow), social (e.g., number of other people, types of other people), and managerial (e.g., fee systems, permits, facilities) resources and conditions of these places" (p. 264). This definition identifies three facets of recreation demand and supply: preferences and demand for an activity opportunity, an experience opportunity, and a setting opportunity (Driver and Brown, 1978, 1975).

The National Visitor Use Monitoring Program (NVUM) of the U.S. Department of Agriculture (USDA) Forest Service classifies settings into four categories: Wilderness (WILD), Overnight-use Developed Settings (OUDS), Day-use Developed Settings (DUDS), and General Forest Areas (GFA). WILD areas are officially designated wilderness subject to the provisions of the U.S. Wilderness Act of 1964. DUDS have facilities for day-use activities including picnicking, boating, and developed-trail hiking. OUDS have facilities for overnight stays for activities such as developed camping. GFA are areas which have undeveloped facilities for activities like nature viewing, hunting, developed and undeveloped-trail hiking, and some motorized sports (English et al., 2002).

Given that resource managers are often interested in knowing about visitors' preferences for specific activities, modeling main-activity-based trips has been emphasized in previous studies (Creel and Loomis, 1990; Breffle and Morey, 2000; Scarpa et al., 2007). In contrast, the setting-based approach offers a framework to relate specific recreational experiences to preferences for different settings. As explained below, we believe there are certain advantages to using the setting-based approach to value outdoor recreation in national forests as compared to the main-activity approach.

As pointed out by Manfredo et al., 1983, certain recreational experiences cannot be defined or classified based only on one individual activity since visitors may engage in several activities during the same trip (p. 265). This "multi-activity trip" has long been recognized in the literature (e.g., see Loomis et al., 2000). According to NVUM results, most national forest visitors participate in several different recreation activities during the same trip (USDA Forest Service., 2013).

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Multi-activity trips are a resource management concern because recreation managers typically manage and have more control over settings or sites rather than activities which are chosen by visitors (McCool, 2006). For instance, the USDA Forest Service, with the consent of the U.S. Congress, can designate an area within a national forest as an official “Wilderness Area” and then manage it as such (e.g., building no roads into the area). Official Wilderness Area designation places certain restrictions on activities that can occur there (e.g., motorized recreation is prohibited), but within these restrictions visitors are free to engage in many different activities while visiting the area. For example, a trip to a wilderness (WILD) setting may include different combinations of mountain climbing, fishing, horseback riding, hiking, nature study, photography, and backpacking.

The motivation for managing settings in national forests by changing the physical, social, and managerial attributes of different sites is based on the USDA Forest Service Recreation Opportunity Spectrum (ROS) (Clark and Stankey, 1979; Driver and Brown, 1978). Under ROS, by managing certain setting attributes, managers can provide different opportunities and beneficial outcomes to enhance a visitor's recreational experience (Brown and Ross, 1982). The ROS spectrum goes from very natural and primitive settings—that provide more opportunities for solitude, risk taking, and self-reliance—to very developed and urban settings that provide more opportunities for security, comfort, and socializing (USDA Forest Service, 2015).

There are a number of studies that model primitive opportunities provided by WILD settings (Baker, 1996; Casey et al., 1995; Englin and Shonkwiler, 1995; Hellerstein, 1991; Loomis, 2000). The study described in this paper adds to the current repository of economic estimates for WILD settings, while deriving new estimates for developed and general settings in national forests. We use the travel cost method to estimate the empirical models. A visitor is viewed as choosing trips to settings based, in part, on site qualities and travel costs from home to each locale (Ward and Loomis, 1986).

Knowing the economic value of trips to particular settings can facilitate assessment of tradeoffs involving setting or site management. For example, combined with data on the quantity of trips to particular settings such as provided by NVUM results, setting-based economic value (e.g., consumer surplus) per trip estimates can help answer the question: “Should more management resources including scarce budgets and staff efforts be allocated to setting type A vs. setting type B?”

The remainder of this paper is organized as follows. In the next section we present our general theoretical framework and model. This section is followed by a presentation of the empirical model and data. Results and discussion ensue, followed by a brief summary and conclusions.

2. Theoretical model

Setting-based recreation trip demand and the value of recreation site access are estimated using the Travel Cost Model (TCM). The TCM uses costs incurred by an individual or group traveling from their origin (e.g., primary residence) to the destination as a proxy for the trip price. Price (travel cost) and quantity (number of trips) data can then be used to estimate a demand function that is applied to measure trip demand and values (Freeman, 2003).

The setting-based recreation travel cost demand function corresponds theoretically to a Marshallian demand function of the general form:

$$y_i^k = y^k(p_i, z_i, q_k). \tag{1}$$

where the dependent variable y_k represents annual trips to the k_{th} recreation setting by individual i or group i, p_i represent the full travel cost of a trip to an individual or group, z_i represents socio-economic characteristics of an individual or group including income, and q_k represents setting characteristics. Because recreation trips by nature are non-negative integers, the dependent variable in (1) takes on non-negative integer values. Thus ordinary least-squares (OLS) regression is inappropriate to estimate the demand model. The basic model that satisfies the non-negative integer, or count data process, is the Poisson model (Hellerstein, 1991).

However, when a variable is over-dispersed (i.e., the conditional mean and variance are not equal), as is often the case with recreation trips, then the Poisson model's simple parameterization must be replaced by a model which captures this over-dispersion. Such models include the Poisson lognormal model (Greene, 2007, p. 8) and the more commonly used Negative Binomial model (Greene, 2007, p. 5). The difference in these models lies in the distributional assumption of the unobserved factor, ε. The unobserved factor follows a normal distribution in the Poisson lognormal model, and a gamma distribution in the Negative Binomial model. For our analysis, we chose to model annual trips as a Poisson lognormal model.

We introduce the unobserved factor ε as a normally distributed random variable with mean zero and standard deviation σ equal to 1,

$$\begin{aligned}\widehat{\lambda} &= \exp\left(x'\beta + \sigma\varepsilon\right) \quad \varepsilon \sim N(0,1)\\ x &= (p_i, z_i, q_k)\end{aligned} \tag{2}$$

The demand model and corresponding economic value estimations are governed not only by the nature of the error distribution of the demand function, but also by the sampling procedure (Haab and McConnell, 2002). The two most common sampling schemes are random sampling of the population or on-site sampling of visitors. While on-site surveys provide a convenient mechanism for insuring that a sample includes site users, the resulting sample is no longer representative of the recreationist population as a whole.

The probability distribution for the on-site visitors is different from the one specified for the general population (Moeltner and Shonkwiler, 2005). This is because of the joint effect of truncation (exclusion of non-users) and endogenous stratification (over-sampling frequent visitors). Truncation and endogenous stratification can result in biased and inconsistent estimates. To correct for this joint effect in on-site surveys, the distribution of trip data collected on-site becomes the product of the population distribution and the odds of being included in the sample (Egan and Herriges, 2006; Englin and Shonkwiler, 1995; Shaw, 1988). For our analysis, we use an adjusted Poisson lognormal model, corrected for truncation and endogenous stratification that corresponds to the univariate case in Egan and Herriges (2006) where j = 1 and h (ε) follows a standard normal distribution:

$$\begin{aligned} g(\tilde{y}|x) &= \frac{\tilde{y}}{\delta}\int \frac{\exp\left(-\widehat{\lambda}\right)\left(\widehat{\lambda}\right)^{\tilde{y}}}{\tilde{y}!}\frac{\exp\left(-1/2\varepsilon'\varepsilon\right)}{(2\pi)^{1/2}}d\varepsilon, \quad \tilde{y} = 1,2,\ldots\\ \delta &= \lambda\exp\left(\sigma^2\Big/2\right)\end{aligned} \tag{3}$$

Maximum likelihood estimates for our adjusted Poisson lognormal model, corrected for truncation and endogenous stratification, are obtained by maximizing the unconditional log likelihood function with respect to the model parameters. The integrals in the log likelihood function do not exist in closed form. Therefore, we approximated these integrals using the mean–variance adaptive Gauss-Hermite quadrature approach suggested by Liu and Pierce (1994).