ANALYSIS OF STRENGTH-OF-PREFERENCE MEASURES IN DICHOTOMOUS CHOICE MODELS

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Abstract.—Choice models are becoming increasingly useful for soliciting and analyzing multiple objective decisions faced by recreation managers and others interested in decisions involving natural resources. Choice models are used to estimate relative values for multiple aspects of natural resource management, not individually but within the context of other relevant decision attributes. They are especially useful for understanding and evaluating acceptable tradeoffs for decision attributes that do not have market prices. Choice models often use a paired-comparison dichotomous choice format for soliciting preferences from stakeholders. We explore the use and analytics involved in incorporating a strength-of-preference scale within this format. An ordered logit model that includes a strength-of-preference scale is compared to a commonly used dichotomous choice logit specification. A case study of back country wilderness users in Yosemite National Park is used as an illustrative example.

1.0 INTRODUCTION

Managers of recreation areas must make decisions that balance diverse desires and preferences of users while ensuring long-term integrity and sustainability of ecological systems entrusted to their care. National Park managers are charged with protecting important cultural and natural resources as well as providing a high quality visitor experience to the public (Runte, 1997). This dual mission often requires tradeoffs. For example, visitors often seek solitude in pristine conditions but also may want freedom from management constraints and regulation.

Choice or conjoint models are becoming increasingly useful for soliciting and analyzing multiple objective decisions faced by recreation managers and others interested in decisions involving natural resources. Choice models are used to estimate relative values for multiple aspects of natural resource management, not individually, but within the context of other relevant decision attributes. They are especially useful in understanding and evaluating acceptable tradeoffs for decision attributes that do not have market prices. Choice models often employ a paired-comparison dichotomous choice format for soliciting preferences from stakeholders. We explore the use and analytics involved in incorporating a strength-of-preference scale within this format. An ordered logit model that incorporates a strength-of-preference scale is compared to a commonly used dichotomous choice logit specification. A case study of back country wilderness users in Yosemite National Park is used as an illustrative example.

2.0 METHODS

Conjoint analysis, a form of choice modeling, is a technique for measuring psychological judgments and is frequently used in marketing research to measure consumer preferences (Green et al., 1988). Participants choose between alternative products or scenarios that display varying levels of selected attributes. The utility of each attribute can be inferred from the respondent's overall evaluations. These partial utilities indicate the relative importance of each attribute's contribution to overall preference or utility. They can

be combined to estimate relative preferences for any combination of attribute levels. Conjoint techniques are well suited for soliciting and analyzing preferences in recreation management and planning that frequently entail tradeoffs between costs and benefits that are not represented efficiently in market transactions.

This study uses a paired-comparison choice (conjoint) model to solicit and analyze user preferences for and acceptable tradeoffs among six attributes of the wilderness experience in Yosemite National Park. The attributes are: number of groups encountered per day while hiking (Hike), opportunity to camp out of sight and sound of other groups (S&S), signs of human use at campsites as depicted by photos (Site), encountering stock or signs of stock use (Stk), regulation of camping (Reg), and probability of receiving an overnight back-country permit under different use levels (Per). Respondents chose between scenarios comprised of varying levels for each of the six attributes listed above. Table 1 lists the range of levels for each attribute.

The paired scenarios were chosen using an orthogonal fractional design and were organized into four blocks of nine comparisons (Green & Srinivasan, 1978; Louviere, Hensher & Swait. 2000; Seiden 1954). Seven-hundred and twelve park users participated in a survey that included nine paired scenario choices. Respondents indicated their strength of preference for one alternative over another on a scale that included 10 intervals ranging from a strong preference for alternative A to a strong preference for alternative B for each of the nine pairs. The sample analyzed here includes 6,258 paired comparisons. Some respondents failed to complete the paired comparison portion of the user survey and a few others did not choose an alternative for one or more of the comparisons. There were 150 missing values out of a possible 6,408 comparisons.

A random utility model that describes the preference structures of respondents was estimated using an ordered logit model (McKelvey & Zavonia 1975; Swallow, Opaluch & Weaver, 2000) and a simple dichotomous choice logit model. For the ordered logit model, the dependent variable was coded 10 if the respondent strongly preferred alternative A and 1 if alternative B was strongly preferred. Middle ratings indicated weak or moderate preference for one alternative over the other. The dependent variable was coded 1 if alternative A was preferred (any level) and 0 if B was preferred for the simple logit specification. The independent variables for both models were

Table 1. Attribute levels

Attribute	Attribute levels
Number of other groups encountered per day	1. Fewer than 5 other groups per day while hiking 2. 5 to 15 other groups per day while hiking 3. More than 15 other groups per day while hiking
Opportunity to camp out of sight and sound of other groups	1. All nights 2. A majority of nights 3. A minority of nights
Campsite condition	Three levels of campsite condition depicted by photos with signs of use increasing from photo 1 to photo 3
Chance of receiving an overnight back-country permit	1. Most visitors able to get permit for preferred trip 2. Most visitors able to get permit for at least second choice trip 3. Only a minority of visitors able to get a back-country permit
Campsite regulation	1. Allowed to camp anywhere 2. Allowed to camp anywhere in a specified zone 3. Required to camp in an assigned site in a specified zone
Encountering signs of stock or stock use	1. Never 2. Minority of days 3. Majority of days

the effects coded contrasts between each of the six attribute levels for each paired comparison.

3.0 RESULTS AND DISCUSSION

Among other considerations, such as respondent characteristics, two questions are of interest when analyzing respondent preferences and selecting a desired management strategy or mix of attribute levels: What are the preferred levels of each attribute, and how important are the attributes relative to one another? It is important to consider both aspects of preference when formulating a management strategy or when considering a change in the levels provided.

The parameter estimates (partial utilities) for the ordered logit and simple logit models (also reported in Newman et al., 2005) are shown in Table 2. Each coefficient estimates the partial utility or the contribution of a particular attribute level to the total utility of an alternative. The total utility or preference score for any alternative can be computed as the sum of the individual partial utilities associated with the attribute levels. The effect of a change in an attribute can be determined by varying its level while holding the others constant and examining the resulting change in overall utility or preference.

Direct comparison of the partial utilities between the two models is not particularly useful because utility is scaled differently within each specification. To determine differences between the model estimates, it is necessary to examine the relative nature of the estimates within each model. Figure 1 shows the relative importance of each attribute to overall preference. The importance scores were computed by dividing the utility range for a particular attribute by the sum of the utility ranges for all of the attributes. Differences between models in the relative importance of each attribute to overall preference for an alternative were small and substantive conclusions are similar. However, the relative importance of the attributes appears slightly exaggerated for the attributes of highest and lowest importance (campsite condition and opportunity to camp out of the sight and sound of other campers, respectively).

Differences in the partial utility estimates were minor. However, there was one notable difference in preferences for campsite condition. The partial utilities estimated for increasing levels of evidence of human use at campsites are shown in Figure 2. Both specifications indicate high dissatisfaction with level 3, the most degraded campsite. The simple logit estimates suggest that respondents were indifferent between levels 1 and 2, while the additional information available provided by the strength of preference rating indicates reduced preference for level 2 (some evidence of human use) over level 1 (a more pristine campsite). Standard errors were smaller across all attributes for the ordered logit specification.

4.0 CONCLUSIONS

Respondents in dichotomous choice surveys often desire to express their preferences in a more detailed manner than a simple choice of alternative. Providing respondents with a means to express their strength-of-preference for one alternative over another in dichotomous choice surveys permits them to more

Table 2.—Parameter estimates for ordered logit and simple logit specifications

	Level 1		Level 2		Level 3	
Attribute	Ordered logit	Simple logit	Ordered logit	Simple logit	Ordered logit	Simple logit
Encounters per day	0.317	0.380	0.037	0.020	–0.354	–0.400
Camp out of sight & sound	0.147	0.123	0.235	0.044	–0.171	–0.183
Campsite condition	0.332	0.351	0.228	0.348	–0.560	–0.700
Chance of permit	0.145	0.143	0.024	0.040	–0.170	–0.183
Campsite regulation	0.122	0.135	0.153	0.152	–0.276	–0.287
Encountering stock	0.319	0.331	–0.087	–0.084	–0.232	–0.247

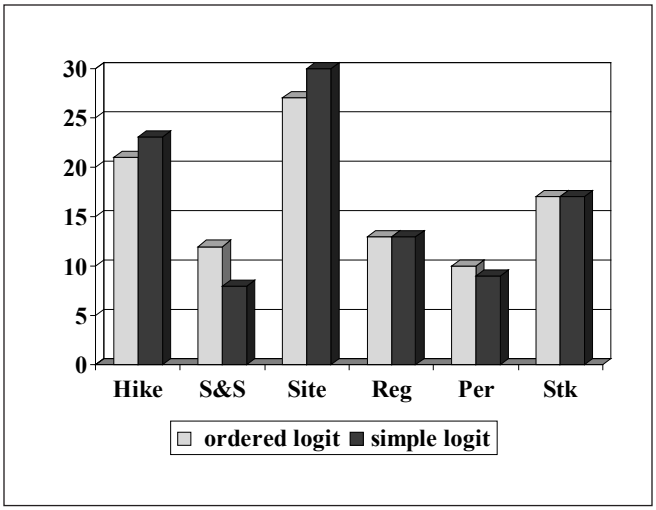

Figure 1.—Relative importance of attribute.

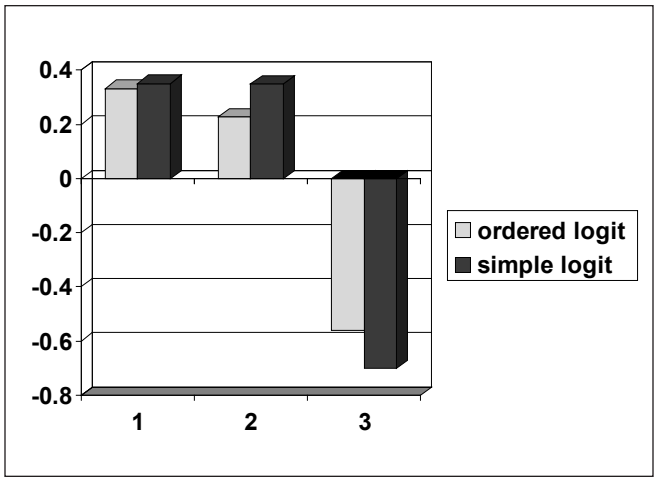

Figure 2.—Partial utilities with increasing levels of campsite degradation as depicted by photos.

accurately express their preferences and may lead to improved results. By explicitly recognizing the difference between strongly and weakly preferred alternatives, analysts have more information to use in model estimation. Swallow et al. (2000) suggest that this will generally result in smaller standard errors and improved likelihood of achieving statistically significant results with smaller sample sizes, often a limiting factor in choice surveys. Although the Yosemite sample was quite large, the smaller standard errors obtained using the strength-of-preference information (ordered logit specification) support this notion.

5.0 CITATIONS

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