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THE CHOICE OF SKI AREAS: ESTIMATION OF A GENERALIZED CES PREFERENCE ORDERING WITH CHARACTERISTICS

Edward R. Morey*

Abstract—A Generalized CES (GENCES) preference ordering is developed and estimated. It incorporates characteristics of both the individual and the activities. The GENCES is used to explain the share of ski time an individual allocates to each ski area as a function of site characteristics, skiing ability, and costs. The stochastic specification limited the shares to the 0–1 simplex. This specification was found to be more appropriate than the conventional normality assumption. The null hypothesis that preferences are homothetic and additive is rejected. Characteristics, ability, and costs are important determinants of demand. The estimated elasticities provide numerous insights into skier behavior.

I. Introduction

MOREY (1981) incorporated characteristics of activities and characteristics of the individual into a CES utility function. This characteristic CES was used to explain how a representative individual allocates his ski days among alternative sites. The physical characteristics of the ski areas and the individual's skiing ability were explicit arguments in the utility function; the budget allocation was given along with the parametric costs of skiing (including travel costs, entrance fees, equipment costs, and the opportunity cost of his time). Estimation confirmed the hypothesis that costs, ability, and characteristics are all important determinants of the allocation of ski days. Inclusion of characteristics also simplifies estimation and makes it possible to estimate the demand for not yet existing sites as a function of their proposed characteristics and costs.

However, the characteristic CES imposes homotheticity and direct additivity. These restrictions are unlikely to hold for a group of close substitutes such as skiing at different sites. One would therefore like to test for homotheticity and direct additivity rather than impose them a priori.

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This paper develops a preference ordering, the generalized CES (GENCES), that includes characteristics and that admits both nonhomothetic and non-additive preferences. A stochastic specification was chosen that limited the shares to the 0–1 simplex. This stochastic specification was found to be more appropriate than the conventional assumption that the shares are normally distributed. Estimation shows that the GENCES predicts the allocation of ski days significantly better than the CES, causing us to reject the null hypothesis that preferences are both homothetic and directly additive. The estimated expenditure elasticities highlight the importance of admitting nonhomothetic preferences. The other elasticities, particularly the characteristic elasticities, provide numerous insights into skier behavior.

II. A Model of Skier Behavior

This section develops a model which describes how an individual allocates his skiing budget among ski areas. The allocation is hypothesized to depend in part on the parametric costs of skiing at different sites. The skier allocates his budget among sites so as to maximize the utility he receives from skiing given these costs. The utility produced by skiing activities is assumed weakly separable from the utility produced by other activities. Therefore, the skiing budget, once determined, is allocated among the different sites independently of total income, and the prices, characteristics, and preferences for non-skiing activities.

The utility an individual derives from skiing activities is hypothesized to depend on the amount of and types of terrain at the different sites. Ski terrain is designed for specific ability levels, hence one's ability to enjoy an area depends on one's skiing ability in conjunction with the amounts of novice, intermediate, and advanced terrain at the site. Specifically, the rational skier is assumed to solve the following problem:

$$\text{Maximize } U = U(Y,A) \quad (1)^{1}$$

$$\text{with respect to } Y$$

$$\text{subject to } \tau = \Gamma' Y \quad (2)$$

where

$Y \equiv [y_j]$, where $y_j \equiv$ the amount of skiing activity j produced by the individual per season, where one unit of y_j is one day of skiing at site j. There are J ski areas such that $j = 1,2,\cdots,J$.

$\Gamma \equiv [\gamma_j] \equiv$ the cost (measured in units of time) of skiing activity j. γ_j is the hours required to produce one day of skiing at site j. It includes skiing time, transportation time, and the time required to earn the money that is needed to purchase (or rent) the skiing equipment and the lift ticket.

$\tau \equiv$ the individual's total time allotment to skiing activities.

$A \equiv [a_{kj}]$, where $a_{kj} \equiv$ the amount of characteristic k that the individual can utilize at site j. Specifically,

$a_{1j} \equiv$ the acres of ski runs at site j which the individual is capable of skiing. Skiers are assumed incapable of skiing terrain which has a difficulty rating in excess of their ability level.

$a_{2j} \equiv$ the acres of ski runs at site j specifically designed for the individual's skiing ability.

The hypothesis that preferences are directly additive and homothetic was successfully tested by developing and estimating the GENCES preference ordering. The indirect form of the GENCES utility function is

$$\chi(\Gamma,A,\tau) = [-g(\Gamma,A)/\tau] + [g(\Gamma,A)/f(\Gamma,A)] \quad (3)^{2}$$

where

$$g(\Gamma,A) = \left[\sum_{j=1}^{J} h(a_{1j},a_{2j})^{-1/(\beta-1)} \times \gamma_j^{\beta/(\beta-1)}\right]^{(\beta-1)/\beta} \quad (4)$$

$$f(\Gamma,A) = \left[\sum_{j=1}^{J} d(a_{1j},a_{2j})^{-1/(\beta-1)} \times \gamma_j^{\beta/(\beta-1)}\right]^{(\beta-1)/\beta} \quad (5)$$

$$h(a_{1j},a_{2j}) = \alpha_0 + \alpha_1 a_{1j} + \alpha_2 (a_{1j}a_{2j})^{1/2} + \alpha_3 a_{2j} + \alpha_4 a_{1j}^{1/2} + \alpha_5 a_{2j}^{1/2} \quad (6)$$

and where

$$d(a_{1j},a_{2j}) = \epsilon_0 + \epsilon_1 a_{1j} + \epsilon_2 (a_{1j}a_{2j})^{1/2} + \epsilon_3 a_{2j} + \epsilon_4 a_{1j}^{1/2} + \epsilon_5 a_{2j}^{1/2}. \quad (7)$$

The GENCES has quadratic expenditure functions and doesn't impose direct additivity a priori. Activities are not restricted to have positive expenditure elasticities. If $\epsilon_n = c\alpha_n$, $n = 0,1,2,\cdots,5$, where c is some constant; then $d(a_{1j},a_{2j}) = ch(a_{1j},a_{2j})$ and the GENCES (3) reduces to the CES.[3]

It is easy, although somewhat tedious, to show that the proportion of ski days spent at a particular site for the GENCES is

$$s_j^* = y_j^* \Big/ \sum_{k=1}^{J} y_k^* \qquad j = 1,\cdots,J \quad (8)$$

[1] The characteristics (A) enter as conditioning variables in the optimization problem. The Lancaster (1966) utility function is a special case of (1). For other examples of empirical work with characteristics see Domencich and McFadden (1975), Manski and McFadden (1981), and Pollak and Wales (1978). Burt and Brewer (1971) incorporated site characteristics into a recreational demand model but the analysis lacks a strong theoretical foundation.

[2] An indirect utility function must be nondecreasing in τ, nonincreasing in Γ and quasiconcave in Γ in the neighborhood of the price (Γ)—characteristic (A)—expenditure (τ) point that is parametric to the individual. These conditions hold for 161 of the 163 individuals in my sample. Quasiconvexity in Γ was violated for two atypical skiers (they skied 36 and 51 times, respectively; the average was 9). This demonstrates that the GENCES functional form is a legitimate representation of a class of preference orderings. Necessary and sufficient conditions, on the parameters, for the GENCES to be globally well-behaved do not exist.

[3] Howe, Pollak, and Wales (1979) have identified the class of indirect utility functions which have demand functions quadratic in expenditures. This class, expanded to include characteristics, encompasses the GENCES (3) as a special case. In an unpublished note, Pollak (1976) identifies a different generalization of the CES. His form also implies quadratic expenditure functions.

where

$$y_j^* = \left[\left(\frac{\gamma_j}{h(a_{1j},a_{2j})}\right)^{\rho} \tau \Big/ W\right] + \frac{\gamma_j^{\rho}\tau^2}{f(\Gamma,A)}\left[\frac{d(a_{1j},a_{2j})^{-\rho}}{Z} - \frac{h(a_{1j},a_{2j})^{-\rho}}{W}\right] \tag{9}$$

and where

$$\rho = 1/(\beta - 1) \tag{10}$$

$$W = \sum_{k=1}^{J} \gamma_k \left(\frac{\gamma_k}{h(a_{1k},a_{2k})}\right)^{\rho} \tag{11}$$

and

$$Z = \sum_{k=1}^{J} \gamma_k \left(\frac{\gamma_k}{d(a_{1k},a_{2k})}\right)^{\rho}. \tag{12}$$

All the GENCES share equations (8) are identical. The only thing that varies from one site's share equation to another is the value of the exogenous variables $(\gamma_j, a_{1j}, a_{2j})$. If two sites ($j$ and k) are identical, that is, if $\gamma_j = \gamma_k$ and $a_{ij} = a_{ik}$, $i = 1,2$, then s_j^* will equal s_k^*.

III. Data

The sample consists of 163 randomly selected single post-secondary Colorado student skiers. There is a complete record of where each individual skied during the 1967/68 season along with their skiing ability and other pertinent information. Each individual attended school (resided) in one of the following eleven Colorado cities: Denver, Boulder, Ft. Collins, Greeley, Golden, The Air Force Academy, Colorado Springs, Pueblo, Alamosa, Gunnison, and Durango. Their ski trips were predominately one day trips and were limited almost exclusively to the fifteen areas listed in table 1. Ski days are consumed in integer units and many students only skied a few days during the season. The observed shares are therefore discretely distributed between zero and one, with many being zero. The skier-specific characteristics that vary are skiing ability and location of residence.

The cost of each activity was calculated for each individual using the lift ticket prices in conjunction with data on rental fees, distances travelled, vehicle operating costs, and the value of the individual's time. The opportunity cost of time was assumed constant across the students and equal to the U.S. Federal minimum wage. The data were not sufficiently detailed to assume otherwise. It was assumed that the production of a one day ski trip is a Leontief process (for more details see Morey (1981), p. 351). Therefore the marginal cost of skiing activity j is parametric to the individual and equals

$$\gamma_j = \left[\begin{pmatrix}\text{lift ticket}\\ \text{price at}\\ \text{site } j\end{pmatrix} + \begin{pmatrix}\text{ski}\\ \text{equipment}\\ \text{rental fee}\end{pmatrix} + b_j\begin{pmatrix}\text{per mile}\\ \text{transportation}\\ \text{costs}\end{pmatrix}\right] \Big/ w + c_j \tag{13}$$

where

$b_j \equiv$ twice the distance from the individual's residence to site j.

$w \equiv$ the opportunity cost (in \$) of the individual's time.

$c_j \equiv$ skiing time (constant across individuals in the sample) plus travel time.

IV. Stochastic Specification

Empirical implementation requires a stochastic specification that is simple and consistent with the observed properties of the shares. Many of the observed shares in the sample are zero. Each share ($s_j = y_j/T$, where T is the total number of ski days) can only take one of $(T + 1)$ discrete values in the 0–1 range, where $\Sigma_{j=1}^{J} s_j = 1$. Each share is therefore perfectly correlated with the other $J - 1$ shares. One would also expect the distribution of the shares to be skewed, especially for shares with expected values near zero or one. The distribution of the shares is also expected to vary across individuals as a function of T. One would like a stochastic specification that is consistent with these properties, where $E(s_j) = s_j^*$.

It is therefore assumed that the individual's density function for s_j, $j = 1, \cdots, J$, is

$$f(s_1, s_2, \ldots, s_J; T; \theta) = \left(T! \Big/ \prod_{j=1}^{J} y_j!\right)\left(\prod_{j=1}^{J} (s_j^*)^{y_j}\right) \tag{14}$$

where $\theta \equiv [\theta_r] \equiv [\alpha_0, \alpha_1, \cdots, \alpha_5;\ \epsilon_0, \epsilon_1, \cdots, \epsilon_5; \rho]$ is the parameter vector. Wilks (1962, p. 139), among others, has shown that if the s_j have this density

TABLE 1.—ACTUAL AND PREDICTED AGGREGATE SHARES

	Aspen	Vail	A-Basin	Breckenridge	Loveland	Winter Park	Broadmoor	Crested Butte	Lake Eldora	Monarch	Mt. Werner	Wolf Creek	Purgatory	Cooper	Hidden Valley
Actual Share	.202	.164	.116	.065	.093	.158	.005	.025	.061	.028	.047	.007	.014	.007	.008
Predicted Share															
$GENCES_M$	.212	.161	.106	.077	.109	.090	.021	.023	.056	.022	.031	.008	.009	.055	.022
$GENCES_{N2}$	.217	.156	.115	.084	.117	.092	.015	.020	.052	.019	.030	.007	.008	.052	.023
$GENCES_{N1}$	.328	.215	.115	.055	.119	.069	.011	.009	.039	.004	.005	.001	.001	.021	.010

function, then,

$$\begin{aligned} E(s_j) &= s_j^* \qquad j = 1,2,\cdots,J \\ \text{var}(s_j) &= (s_j^*)(1-s_j^*)/T \qquad j \neq k \\ \text{cov}(s_j,s_k) &= -(s_j^*)(s_k^*)/T \qquad k = 1,2,\cdots,J. \end{aligned}$$

The distribution of the s_j are skewed, except in the case where $s_j^* = 1/J\ \forall_j$. The variance on s_j approaches zero as s_j^* approaches either zero or one. The covariance matrix satisfies the condition that $\Sigma_{k=1}^J \text{cov}(s_j s_k) = 0$, where all the covariance ($j \neq k$) are negative.

This density function (14) has the mathematical form of the multinomial distribution; however, it is not assumed that s_j^* is the probability that site will be chosen on a given trip, and it is not assumed that the choice of each trip, for a given individual, is independent. This is contrary to the multinomial interpretation of the variables in (14) but this does not preclude one from utilizing the mathematical properties of (14) given that $1 > s_j^* > 0$, $\Sigma s_j^* = 1$, and $\Sigma y_j = T$. For brevity (14) will be referred to as a multinomial density function.

This qualified multinomial was chosen as an appropriate density function because it is simple and appropriately restricts the random variable s_j to be discretely distributed between zero and one such that $E(s_j) = s_j^*$ and $\Sigma s_j = 1$. The form is restrictive in that all covariances are negative, but not overly so. Since the shares must sum to one, negative covariances must dominate (see Woodland (1979, p. 365)). The multinomial doesn't admit shares that are strictly zero. This latter limitation is not expected to constrain since the multinomial will admit a large number of shares at a discrete positive value sufficiently close to zero.

If it is assumed that the choice of shares by one individual is completely independent of any other individual's choice, then the likelihood function for a sample of N skiers is

$$L = \prod_{i=1}^{N} f(s_{1i}, s_{2i}, \cdots, s_{Ji}; T_i; \theta). \qquad (15)$$

The i subscript refers to the i^{th} individual, where $i = 1,\cdots,N$. The maximum likelihood estimate of the parameters for a particular sample is the $\hat{\theta}$ which globally maximizes the likelihood function (15). Rao (1965, pp. 295–296) has shown that these maximum likelihood estimates will be consistent and asymptotically efficient.

A conventional assumption in the estimation of share equations is that the $J-1$ shares have a normal distribution. Woodland (1979) cites numerous examples. As Woodland notes, shares cannot be normally distributed. The normal distribution assumes the shares are continuously distributed from $-\infty$ to $+\infty$, implying there is a positive probability that shares will be outside the 0–1 simplex. Normality also assumes the shares are symmetrically distributed. This seems unlikely for shares near zero or one. The conventional normal specification also assumes the covariance matrix is constant across individuals. This assumption is also questionable. However, one can make the counter-argument that "the normal distribution may be an adequate description of the true density function if the elements of the covariance matrix are small and the means are not near zero or unity, for then the density outside the unity simplex will be negligible" (Woodland (1979), p. 362). Woodland, using sampling experiments and data from different studies involving systems of share equations that were not normally distributed, showed that the normal distribution was quite robust; i.e., estimates obtained assuming normality were in general close to the estimates obtained using a Dirichlet distribution, a continuous distribution that limits the shares to the 0–1 simplex. However, Woodland's samples involved shares that could be described as continuously distributed and did not include shares with values near zero or one. One must ask whether the robustness of the normality assumption carries over to samples where the shares are discretely distributed and where many of the shares are zero. A priori there is no reason to suspect it will. Attempts to estimate the skiing shares assuming either a normal or truncated normal distribution are reported in the next section.

The problem of determining where an individual will ski can also be modeled in a logit framework. This was considered by Morey (1981). It was shown that the logit model did not explain the allocation of ski days as well as the CES model where a multinomial error specification was assumed. One might also consider an error specification that assumes normality but maps the density lying outside the unit simplex onto its boundary. This is an extension of the Tobit (1958) model. For a successful application of this approach to meat consumption see Wales and Woodland (1983). Given the large number of ski areas in the sample, this approach is not computationally tractable.

V. Empirical Results

The sample of student skiers was used to obtain estimates of the parameter vector θ. Assuming the shares are multinomially distributed, maximum likelihood estimates are those values of θ which maximize the log of the likelihood function.

$$l^* = \sum_{i=1}^{163} \sum_{j=1}^{15} y_{ji} \log(s_{ji}{}^*) \tag{16}$$

where y_{ji} is the actual number of trips individual i took to site j and the $s_{ji}{}^*$ is individual i's predicted share for site j. The share equations are homogeneous of degree zero with respect to the α parameters so α_0 was set equal to one. The share equations are homogeneous of degree zero in the ϵ parameters when $\epsilon_n = c\alpha_n$, $n = 0,1,2,3,4,5$ (the CES case) so ϵ_0 was set equal to one to facilitate estimation. The log of the likelihood function (16) was maximized using a modified Newton method formulated by Fletcher (1972) and supported by the University of British Columbia Computer Center (Bird and Moore (1975)). Both a GENCES model and a CES model were estimated. Note that for the CES model $\alpha_n = \epsilon_n$, $n = 1,2,\cdots,5$. On the basis of a likelihood ratio test, the GENCES model predicts the allocation of ski days significantly better (at 0.001) than the CES model. One must therefore reject the null hypothesis that preferences are both homothetic and directly additive.

One can get an indication of the goodness of fit of the GENCES with the multinomial specification ($GENCES_M$) by examining the actual and the predicted shares for the fifteen sites (see table 1).[4] A modified R^2 (Baxter and Cragg (1970), p. 320) of 0.57 also indicates that the model is explaining a substantial proportion of the variation in the shares.

The $GENCES_M$ predicted shares for a few of the Boulder students are reported in table 2. The predicted shares vary substantially across sites for a given individual as a function of the site's characteristics. They vary across individuals for a given site as a function of the individual's skiing ability, residential location, and skiing budget. Note the strong influence of the skiing budget on the shares (contrast the Aspen shares for the two intermediate skiers from Boulder in table 2). The importance of allowing for nonhomothetic preferences can also be seen by examining expenditure

[4] Alternatively, it was also assumed that the first fourteen shares were normally distributed with mean $(s_1^*, s_2^*, \cdots, s_{14}^*)$ and covariance matrix Ω. If one maximizes the likelihood function assuming normality and if one does not constrain the expected number of trips to each site to be nonnegative, meaningful results are not obtained. Many of the y_{ji}^* are negative which results in s_{ji}^* inconsistent with the definition of the observed shares. This happened because the normality assumption admits negative shares and because the sample contains many observed shares of zero. The model was also estimated assuming normality but imposing the constraint that $y_{ji}^* = 0$ if initially $y_{ji}^* \leq 0$. The normal is obviously not the true density function in this case, it allows for no pile up of density at zero, but one can still question the robustness of the estimates. This model, referred to as $GENCES_{N1}$ in table 2, did not predict the aggregate shares as well as the multinomial model. The model was also estimated assuming the shares were distributed as a truncated normal with a constraint imposed that restricted the s_j^* to the interior or the 0–1 simplex. A truncated normal is here defined to mean a normal distribution where the density outside of the 0–1 simplex is uniformly added to the density in the 0–1 simplex. This stochastic distribution would be quite appropriate if the observed shares are continuously distributed between zero and one. The constraint is required because they are not. The aggregate shares predicted by this model, referred to as $GENCES_{N2}$ in table 2, are similar to the aggregate shares predicted by the $GENCES_M$. This suggests that the truncated normality specification with the constraint imposed is robust. However, one should note that even though the aggregate shares are quite similar the two models predict quite different shares for many of the individuals. The shares and elasticity estimates reported in the rest of the paper are for the $GENCES_M$.

TABLE 2.—s_{ji}^*, SOME OF THE INDIVIDUALS' PREDICTED SHARES

$J =$	Aspen	Vail	A-Basin	Breckenridge	Loveland	Winter Park	Broadmoor	Crested Butte	Lake Eldora	Monarch	Mt. Werner	Wolf Creek	Purgatory	Cooper	Hidden Valley
Boulder															
Advanced:															
$\tau = 313,\ T = 12$	.1890	.1828	.1206	.0883	.1051	.0832	.0132	.0143	.0744	.0188	.0284	.0063	.0048	.0449	.0262
$\tau = 42,\ T = 2$	.1266	.1473	.1275	.0949	.1350	.1044	.0099	.0157	.0750	.0187	.0369	.0064	.0061	.0554	.0401
Intermediate:															
$\tau = 337,\ T = 11$	.2290	.1383	.0967	.0604	.1347	.1116	.0164	.0187	.0518	.0129	.0338	.0052	.0046	.0616	.0242
$\tau = 37,\ T = 2$	.0812	.0189	.1364	.0937	.1763	.1483	.0145	.0225	.0981	.0244	.0527	.0073	.0061	.0887	.0310
Novice:															
$\tau = 300,\ T = 12$	.0957	.1911	.1029	.0680	.1266	.1172	.0251	.0278	.0683	.0171	.0364	.0076	.0069	.0736	.0357
$\tau = 37,\ T = 2$	.0857	.1341	.1162	.0760	.1430	.1325	.0238	.0314	.0694	.0172	.0407	.0070	.0071	.0829	.0330

elasticities, $Ey_{ji}^*\tau$. The homothetic CES requires that $Ey_{ji}^*\tau = 1\ \forall j$ and i. The GENCES's $Ey_{ji}^*\tau$, however, vary from -0.239 to 1.95. The negative elasticities are particularly significant, helping to demonstrate the importance of admitting non-additive preferences.

The demand for most sites is cost elastic. The own price elasticities of demand vary a lot but most fall between -2.1 and -2.5. This is a confirmation of the travel-cost technique. The estimated Allen elasticities of substitution, which vary from 1.8 to 2.7., indicate that there is a lot of potential for substitution among the sites.

The most interesting elasticities are the characteristic elasticities $Ey_{ji}^*a_{1j}$ and $Ey_{ji}^*a_{2j}$, where $Ey_{ji}^*a_{1j} = \partial \ln y_{ji}^* / \partial \ln a_{1j}|_{\dot{a}_{2j}=0}$ and $Ey_{ji}^*a_{2j} \equiv \partial \ln y_{ji}^* / \partial \ln a_{2j}|_{\dot{a}_{1j}=0}$. $Ey_{ji}^*a_{1j}$ measures how responsive the individual's demand for site j is to an increase in total skiable terrain where the increase is in terrain designed for individuals of lesser skiing ability. $Ey_{ji}^*a_{2j}$ measures how responsive the individual's demand for site j is to an increase in acreage designed for their ability level holding total skiable acreage constant. The sum of the two elasticities $(Ey_{ji}^*a_{1j} + Ey_{ji}^*a_{2j})$ measures how responsive the individual's demand for site j is to an increase in a_{2j} holding the quantity of the other skiable acreage constant.

The majority of the $Ey_{ji}^*a_{1j}$ are positive and the majority of the $Ey_{ji}^*a_{2j}$ are negative. However, there are exceptions, particularly for advanced skiers who skied a lot, such as the advanced skier from Boulder who took twelve trips (see table 3). With the exception of Vail, the sum of the two characteristic elasticities are predominantly positive. A negative $(Ey_{ji}^*a_{1j} + Ey_{ji}^*a_{2j})$ indicates the individual is satiated in terms of the terrain at site j designed for his ability level. The common result that $Ey_{ji}^*a_{1j} > 0$, $Ey_{ji}^*a_{2j} < 0$, and $Ey_{ji}^*a_{1j} + Ey_{ji}^*a_{2j} > 0$ indicates that the individual's demand for site j will increase if the acreage he can ski at the site increases but the individual prefers the increase to be in terms of terrain designed for less than his stated ability level. A negative elasticity with respect to a_{2j} is quite reasonable when one remembers that skiing ability measures capability, not preference. When an intermediate skier is defined as one who has the capabilities to ski on both novice and intermediate terrain, one should not be surprised if he prefers the novice terrain. Exaggeration could also generate these results. However, one would also expect that many skiers, particularly advanced and intermediate skiers who ski a lot, prefer terrain that taxes their abilities. For such individuals one would expect $Ey_{ji}^*a_{2j} > 0$ and even $Ey_{ji}^*a_{1j} < 0$.

VI. Conclusion

The GENCES is a useful algebraic specification for consumer preferences. For the skiing problem it predicted the allocation of skiing days significantly better than the CES preference ordering and provided numerous insights into skier behavior. More generally, the GENCES helps to fulfill the need for a functional form that does not impose direct additivity or homotheticity a priori, but is still simple enough to estimate. Much is gained by explicitly including the characteristics as arguments in the utility function. One can account for differences in the demand for activities by variations in the values of the independent vari-

TABLE 3.—$Ey^*_{ji}a_{1j}$ AND $Ey^*_{ji}a_{2j}$, SOME OF THE INDIVIDUALS' CHARACTERISTIC ELASTICITIES

	Aspen	Vail	A-Basin	Breckenridge	Loveland	Winter Park	Broadmoor	Crested Butte	Lake Eldora	Monarch	Mt. Werner	Wolf Creek	Purgatory	Cooper	Hidden Valley
Boulder															
Advanced															
$\tau = 313$, $T = 12$	−5.44	−12.8	0.871	1.19	−0.273	−0.229	0.830	−0.225	0.642	0.258	−2.10	1.41	2.52	−0.591	1.95
	(8.34)	(13.5)	(0.132)	(−0.093)	(0.682)	(0.572)	(−0.291)	(−0.276)	(0.003)	(−0.191)	(0.827)	(−1.75)	(−4.74)	(0.391)	(−1.26)
$\tau = 42$, $T = 2$	−1.19	−3.70	0.834	0.946	0.510	0.554	0.800	0.713	0.762	0.763	0.381	0.968	1.17	0.564	1.13
	(1.74)	(2.86)	(−0.071)	(−0.152)	(0.165)	(0.148)	(−0.047)	(−0.008)	(0.047)	(0.020)	(0.193)	(−0.261)	(−0.618)	(0.141)	(−0.327)
Intermediate															
$\tau = 337$, $T = 11$	8.56	26.2	1.85	2.06	1.96	1.60	0.753	−0.951	2.24	1.55	2.31	0.672	−0.288	1.55	1.19
	(−5.08)	(−44.2)	(−0.907)	(−1.29)	(−0.902)	−0.650	(−0.306)	(−0.402)	(−1.31)	(−2.97)	(−1.86)	(−2.92)	(−3.88)	(−0.885)	(−0.667)
$\tau = 37$, $T = 2$	4.37	23.4	1.13	1.19	1.17	1.06	0.777	0.671	1.15	1.15	1.28	0.929	0.864	1.07	0.926
	(−4.05)	(−40.3)	(−0.433)	(−0.482)	(−0.532)	(−0.352)	(−0.042)	(−0.001)	(−0.391)	(−0.479)	(−0.593)	(−0.347)	(−0.395)	(−0.319)	(−0.160)
Novice															
$\tau = 300$, $T = 12$	6.49	6.02	1.77	1.69	1.82	1.89	1.05	2.77	1.10	1.44	2.02	1.47	2.41	1.81	0.907
	(−4.71)	(−5.25)	(−1.18)	(−1.15)	(−1.23)	(−1.31)	(−0.555)	(−2.67)	(−0.478)	(−1.13)	(−1.71)	(−1.28)	(−3.01)	(−1.27)	(−0.376)
$\tau = 37$, $T = 2$	2.84	3.70	1.27	1.22	1.30	1.33	0.877	1.44	0.960	1.01	1.28	0.913	1.17	1.26	0.829
	(−2.63)	(−4.22)	(−0.632)	(−0.538)	(0.695)	(−0.722)	(−0.214)	(−0.817)	(−0.260)	(−0.334)	(−0.610)	(−0.297)	(−0.585)	(−0.606)	(−0.176)

Note: The $Ey^*_{ji}a_{2j}$ are in brackets.

ables (prices and characteristics) in the share equation, rather than have the variations appear in the form of differing share functions, each specific to only one name-specific activity. Estimation is simplified; there is only one equation to estimate. It is also possible to estimate the conditional demand for a proposed recreational site. This technique for estimating the demand for proposed sites as a function of their proposed characteristics and costs is superior to many of the techniques currently used.

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