

We will start with travel-cost models, and neoclassical type travel-cost models in particular.

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The basis of the section will be five related papers by me. They represent over 20 years of work.

Morey, E.R., "The Demand for Site-Specific Recreational Activities: A Characteristics Approach," *Journal of Environmental Economics and Management*, Vol. 8 (No. 4), December 1981, 245-271

Morey, E.R., "The Choice of Ski Areas: Estimation of a Generalized CES Preference Ordering with Characteristics", *The Review of Economics and Statistics*, Vol. 66 (4), November 1984, 584-590.

Morey, E.R., "Characteristics, Consumer Surplus and New Activities: A Proposed Ski Area", *Journal of Public Economics*, Vol. 26 (2), March 1985, 221-236, (An earlier version was presented at the 1984 American Economic Association meetings in Dallas.)

Hanemann, M., and E.R. Morey, "Separability, Partial Demand Systems and Consumer's Surplus Measures," *Journal of Environmental Economics and Management*. Vol. 22, 1992, pp. 241-258.

Two Nested Constant-Elasticity-of-Substitution Models of Recreational Participation and Site Choice: An "Alternatives" Model and an "Expenditures" Model" with William Breffle and Pamela Greene, *American Journal of Agricultural Economics*. May 2001.

Summarizing them.

The first estimates a **partial** demand system for ski areas in Colorado.

The second paper generalizes the preference ordering in the first paper (CES to Generalized CES)

The third paper uses the estimated preferences to derive consumer's surplus measures. It says a bunch of wrong stuff

My paper with Michael lays out what the theory that demonstrates that some of the stuff I said about the welfare measures in the JPub paper is incorrect.

The AJAE paper generalizes these partial neoclassical demand models to include participation in the model. It presents two ways of doing this.

Ready set go

The demand for site-specific recreational activities

work through paper

Some of this paper has already been covered in the notes about the evolution of consumer's surplus measures

start with specification of the utility function

Let $Y \equiv [y_j]$ where j is the number of days the individual skis site j

Let $Z \equiv [z_j]$ where j is the quantity consumed of commodity j , The vector $\frac{Y}{Z}$ is the vector

of all commodities.

Let $A \equiv [a_{kj}]$ where a_{kj} is the amount of characteristic k associated with ski area j

Let C denote the characteristics of the Z commodities.

Assume that preferences can be represented by the direct utility function

$$U = U(Y, A, Z, C) = U(u(Y, A), Z, C)$$

That is, assume that ski days and the characteristics of those days are weakly separable from other commodities in the preference ordering.

The paper estimates the parameters in the partial utility function, $u(Y, A,)$ - also called a sub-aggregator function.

This was not clear to me when I wrote the paper.

An important issue is what can one determine about the cv and ev from the partial demand system. (I got this wrong in the JPub paper - and corrected it in the paper with Michael)

The 81 JEEM paper assumes a CES preference ordering

$$u = u(Y, A) = \sum_{j=1}^J h_j y_j^\beta$$

generalized to include characteristics of the site and individual. That is

$$h_j = h(a_{1j}, a_{2j}, \dots, a_{5j}) = \alpha_0 + \alpha_1 a_{1j} + \alpha_2 (a_{1j} a_{2j})^{1/2} + \alpha_3 a_{2j} + \alpha_4 a_{1j}^{1/2} \dots$$

where a_{kj} = the amount of effective characteristics k at site j . For now, I have suppressed the subscript for individual i . a_{1j} is the acres of ski terrain at site j on which the individual can ski. a_{2j} is the acres at site j designed for the individual's skiing ability. a_{3j} is VTF. a_{4j} is average

annual snowfall, and a_{5j} is an index of all other characteristics.

Soon we will start discrete choice RUMs. For that read the appendix to the JEEM paper, review logit and probit models in your econometrics text, start reading two rums uncloaked, and the Maine paper.

Assume the individual knows the levels of all five characteristics at all J sites, but the researcher only observes the first four. The model therefore has a random component from the researcher's perspective.

Let γ_j be the cost (in units of time) of a day of skiing at site, and τ the individual's total time allotment to skiing (including the working time required to pay for it (it could be expressed in \$))

Assume that determination of τ is exogenous to the model and that our goal is to explain only the allocation of τ among the J sites; that is, the proportion of time allocated to each site.

Maximizing the subaggregator function, subject to the skiing budget constraint, and expressing the answers in terms of site shares

$$s_j^* = y_j^*/T^* = 1/\sum_{k=1}^J \left[\frac{\gamma_k h(a_{1k}, a_{2k}, \dots, a_{5k})}{\gamma_j h(a_{1j}, a_{2j}, \dots, a_{5j})} \right]^\sigma$$

where $T^* = \sum_{k=1}^J y_k^* = y_k^*$ and $\sigma = -1/(\beta - 1)$, which is the Allen elasticity of substitution

Note that the included characteristics explain all the differences between sites. They all have the same share/demand functions.

The goal is to use some data to come up with statistical estimates of β and the α 's that have desirable statistical properties (we will go for max like estimates)

Data:

sample of 163 college skiers.

They reside in one of 11 Colorado cities (spread around the state)

For each student in the sample know where they live, skiing ability, and how many times they skied at each site during the season.

Use this information, along with some assumptions to calculate $\gamma_{ji} \forall j, i$. Specifically assume

$$\gamma_{ji} = \frac{[(\text{lift ticket price site } j) + 3.50 + b_{ji}(.017)]}{1.15} + \frac{b_{ji}}{45} + 6$$

where \$1.15 is the minimum wage, 45 is average driving speed, 6 is average time spent skiing per day, \$3.50 daily ski rental, \$0.017 is vehicle operating cost per person per mile, and b_{ji} is the round trip distance from individual i 's city to ski area j .

Note that the consumer's surplus estimates are going to be quite sensitive to what is assumed about the costs. The higher the cost, the higher the CS.

site characteristics:

For each ski area collected site characteristic data

Econometric specification (the likelihood function)

The y_{ji} 's (observed number of days to site j) are random variables from the researcher's perspective. y_{ji} is a random variable from our perspective. It is also a function of the parameters. We need to assume some joint density function for the vector of these random variables. I assumed

$$f(y_{1i}, y_{2i}, \dots, y_{ji} : T; \beta, \alpha) = \left(\frac{T!}{\prod_{j=1}^J y_{ji}!} \right) \left(\prod_{j=1}^J (s_j^*)^{y_{ji}} \right)$$

That is I assumed the vector of ski days has a multinomial distribution. The multinomial parameters are the s_j^* , which are functions of the parameters (β and α), the site characteristics, where the individual lives, and his or her skiing ability.

Why did I choose this specification? Consistent with the statistical properties of the shares

The resulting log likelihood function is

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

Estimation is accomplished by finding those values of the parameters that maximize this function. These are called the max lik estimates.

Parameter Estimates and hypothesis testing

The influence of the characteristics is interesting. Note that the marginal value of a characteristics can be positive or negative, and can vary in sign across sites for a given individual. E.g. For most individuals at most sites, increasing the amount skiable terrain, holding constant the amount at their ability level, makes them better off, but not everyone at every site. In contrast, increasing terrain designed for their ability level, holding constant total skiable terrain makes most skiers at most sites worse off. But not expert skiers at sites with lots of expert terrain.

Model explains aggregate behavior quite well. It, like all model, does not do a great job explaining each individual's behavior.

Some problems with this model. It is partial, CES is restrictive, doesn't allow corner solutions

The restrictive of the CES preference ordering motivated the ReStat paper. Consumer's surplus measures are dollar measures of utility changes so often sensitive to what is assumed about preferences. The second paper develops what I called a Generalized CES preference ordering and then estimates it.

The GENCES has the CES as a special case. Unlike the CES, it allows for income effects. That is, the shares are a function of the budget allocation to skiing.

One rejects the null hypothesis that preferences are CES.

In the GENCES paper preferences were expressed in terms of the indirect utility function rather than the direct utility function (remember that these are actually subaggregator functions)

The JPub paper defines the compensating variation and equivalent variation

The indirect partial "utility" function is

$$u = \chi(\tau, \Gamma, A) =$$

and in expenditure form is

$$e = e(u, \Gamma, A)$$

You can find the exact functional forms for the CES and GENCES in the paper. So, one can define the a partial cv_p for a change from (Γ^0, A^0) to (Γ^1, A^1) as

$$cv_p = e(u^o, \Gamma^o, A^o) - e(u^o, \Gamma^1, A^1)$$

where u^o is the maximum "skiing utility" in the original state. In contrast,

$$ev_p = e(u^1, \Gamma^1, A^1) - e(u^1, \Gamma^0, A^0)$$

Note that if there are no income effects $cv_p = ev_p$.

Note that, I have defined cv_p as the partial cv evaluated at u^o . The concept is actually more general, one could define $cv_p(u^k) = e(u^k, \Gamma^o, A^o) - e(u^k, \Gamma^1, A^1)$, where u^k could be any level including u^o or u^1 .

What is the relationship between cv_p and cv ? $cv_p \leq cv$. This is true for both improvements and deteriorations (remember for deteriorations that cv is negative). $ev_p > ev$. Note that cv_p is calculated at τ^o and ev_p is calculated at τ^1 .

What's the intuition?

The JPub paper calculates cv_p and ev_p for the introduction of a new ski area (Copper mountain). Can do this because assumed no site-specific variables.

Copper mountain existed when the models were estimated, but not when the data was collected, so knew its location, characteristics, etc.

Go to Table 2 in the JPub paper.

Table 2
Some CVs, EVs, and predicted shares for Copper.

Residence	Skiing		Number of ski days	CES			GENCES		
	Ability	Budget		Predicted share Copper	CV	EV	Predicted share Copper	CV	EV
Denver	N	\$20.75	1	0.1977	\$3.99	\$4.95	0.1035	\$1.56	\$1.68
	N	61.38	3	0.1977	11.82	14.64	0.1020	\$4.55	4.91
	I	82.46	4	0.1474	11.82	13.87	0.1346	8.26	9.15
	I	332.21	12	0.1474	47.82	55.86	0.1300	30.25	32.79
	A	83.06	4	0.1427	11.11	12.83	0.1282	7.67	8.40
	A	317.54	12	0.1427	42.49	49.06	0.1089	24.53	25.95
Pueblo	N	94.95	4	0.1807	17.41	21.32	0.0931	6.58	7.06
	I	191.20	6	0.1377	26.41	30.64	0.1251	17.73	19.37
	I	378.44	10	0.1377	52.27	60.64	0.1183	32.35	34.76
	A	636.67	25	0.1326	81.26	93.15	0.0792	36.48	37.14
Gunnison	I	47.93	2	0.1285	6.42	7.41	0.1118	4.38	4.81
	I	237.95	8	0.1285	31.85	36.77	0.1051	19.85	21.40
	A	27.27	5	0.1215	3.34	3.80	0.1087	2.32	2.53
	A	170.62	1	0.1215	20.87	23.77	0.0983	13.13	14.06
Durango	I	17.02	1	0.1098	2.12	2.42	0.0996	1.49	1.63
	I	190.49	5	0.1098	23.75	27.13	0.0923	15.30	16.49
	A	190.49	5	0.0989	21.20	23.85	0.0818	13.41	14.29
	A	570.79	12	0.0989	63.51	71.46	0.0623	30.54	31.37

Sum of the CVs for the 163 individuals: CES = \$5556.20; GENCES = \$3034.58.
Sum of the EVs for the 163 individuals: CES = \$6459.96; GENCES = \$3236.52.