VALUATION USING HOUSEHOLD PRODUCTION

14.42 LECTURE PLAN 15: APRIL 14, 2011

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PASTURE 1: ONE SITE

- Introduce intuition via PowerPoint slides
- Draw demand curve with "nearby" and "far away" towns.

Question: Why do I say "Demand Curve" in quotes?
Answer: This gives the intuitive identification, but it does not tell us about welfare.

Left Board 1: Model:
This model straight from Kolstad Chapter 9:
Maximize utility subject to time and budget constraints.
$Max_{x,v}$ U(x,v)
v=visits to park
x=numeraire good.

Price of x = 1
Price of visiting the park = f

Budget Constraint
s.t. wL = x+fv
 w=wage rate
 L=Labor hours

Time Constraint:
$T=L+t_t v$
t_t=Travel time to the park
T = total time endowment

- What's weird about this? The consumer is either working or traveling to parks at all times.
- How to deal with it? Add another variable for other use of leisure time. Make it exogenous: the key is that park time trades off with work time, so it's costly.

Substitute time constraint into budget constraint:
$wT = x+[wt_t+f] v$
$= x+[p_t+f] v$
p_t = Time Cost per visit = wt_t

$=x+p_v v$
p_v=Total cost per visit= p_t+f

p_v is the per-visit cost. That's all that matters to determining demand. Notice that what's nice is that a dollar of entry fee is equivalent to a dollar in travel cost.

The maximization gives a demand function for park visits that depends on the total price:
$v=v(p_v,y)=v(p_t+f,y)$
    y=Income

Question: Now, how do I go from distance to prices?
Answer: I need w: the opportunity cost of travel time.

<u>Right Board 1:</u>
Draw a graph of (Distance=Price) on the y-axis and Visitation/(Person*Year) on the x-axis.

- PowerPoint slides

Question: Is the wage rate an appropriate way of translating distance to travel cost?

- Hours may be fixed
    - So the tradeoff is with leisure time. Need to know the shadow price of leisure time.
- People may have different utility or disutility from traveling vs. working

Question: Is this consumer surplus from the park?
No: We now assume that this same demand curve applies for all cities, and aggregate over the population in each city.

Question: Is it reasonable to assume that all cities have the same demand curve?

- Sorting: people live near outdoors if they like to be outdoors
- Bigger cities further away but have higher incomes

Question: If cities have different demand curves, does that affect the quality of our demand curve estimates?
Answer: the fact that the curve doesn't fit perfectly is a natural result of the cities having different demand curves. We're only biased if the variation in demand is correlated with distance to the park.

Push Question 1: Could the variation in demand curves be correlated with distance to the park?
    Answer: Yes
Push Question 2: What does this mean for the validity of our estimator?
    Answer: Omitted variables bias

PASTURE 2: TWO SITES
PowerPoint: Add the Presidentials

Question: Why is demand higher for the Presidentials?

- Higher mountains
- More open space
- Skiing is possible

Question: Do we know which factor explains this?
Answer: No. But we might want to know.

PASTURE 3: LOGIT MODEL

Left Board 2: Logit Model

Question: Let's say we wanted to estimate these demand functions in order to carry out welfare analysis. What's the problem?
Push question: What's the dimensionality of this problem?
Answer: Number of parameters grows exponentially with the number of sites!

Setup:
Individuals indexed by i, Sites indexed by j.
Assume all consumers homogeneous up to a constant
Divide utility into two parts: homogeneous utility and individual-specific error
$u_{ij} = \delta_j + \varepsilon_{ij}$

δ_j=Homogeneous average utility
ε_{ij} =Unobserved random error

1[Consumer i Chooses site j] = $u_j > u_k$, all k

Logistic
Question: Say there is no variation in ε across consumers. What happens?
Answer: Everybody chooses the same product. So we need the error.

We transform this into a demand function by assuming a convenient distribution of ε: Logistic.

- PowerPoint slide: logistic distribution.

Consider the choice of one site vs. an "outside option"
Normalize utility of outside option to 0.
Pr(Monadnock) = Pr(u_M>0)

- Comment: this is a binary choice model – like whether or not I go to college, or whether I work in fishing sector vs. agriculture sector, etc.

$=\int 1[\delta_M+\varepsilon>0]\ f(\varepsilon)\ d\varepsilon$
$=\int 1[\varepsilon > -\delta_M\ ]\ f(\varepsilon)\ d\varepsilon$
$=\int_{-\delta}^{\infty}\ f(\varepsilon)\ d\varepsilon$
$=1-F(-\delta)$

Assume F is the logistic CDF. This gives a convenient functional form!

$=1 – 1/(1+e^{\delta})$
$=e^{\delta}/(1+e^{\delta})$

- Intuition here: Higher δ means higher probability of Monadnock.

Pr(Outside Option) = 1- Pr(Monadnock) = 1 - $e^{\delta}/(1+e^{\delta})$
= $1/(1+e^{\delta})$

If all consumers homogeneous, then these probabilities can be turned into market shares:
s_M = Pr(Monadnock) = $e^{\delta}/(1+e^{\delta}) = e^{\delta}\ s_0$
s_0=Outside option share
$s_M/s_0 = e^{\delta M}$
$\log s_M – \log s_0 = \delta_M$

- Point to the logistic distribution on the PowerPoint slide

<u>Multiple Sites:</u>
The whole point of this was to say something about multiple sites. Skip math, but under appropriate distributional assumptions for ε_{ij}, we have:
$Pr_j = e^{\delta}/(1+\Sigma_{k=1}^{K}e^{\delta})$

where k indexes choices and K is the number of choices.
The set of k is called the choice set. It is mutually exclusive and exhaustive.
Outside option is defined k=0

A couple lines of algebra give an equation for the market share for all choices as a function of δ:
$\log s_j – \log s_0 = \delta_j$

Pause here. This is a key intermediate result. But:

- Delta isn't really of much interest. We can't do anything with it per se. We really want price elasticity and utility from different amenities.
- Plus although the dimensionality of the problem is now linear, we can reduce it further.

<u>Characteristic Space</u>

- PowerPoint slide

Model δ as a function of characteristics

What characteristics?

- Height
- Length of hiking trails
- Total open space

$u_{ij}=\delta_j+\varepsilon_{ij} =\beta X_j-\eta p_{vj}+ \xi_j+\varepsilon_{ij}$

X_j=Attributes of the site j

PASTURE 4: EMPIRICAL EXAMPLE OF DISCRETE CHOICE ESTIMATION

Linear regression example.

Say that this only works under a technical assumption: that the variance of the error terms is the same.

(Otherwise have to do something more complicated, the GMM or ML model)

$\log s_j – \log s_0 =\beta X_j-\eta p_{vj} + \xi_j$

Use this to estimate β and η.

- PowerPoint slides on data and estimation

What concerns?

- True functional form not linear!
- ξ correlated with characteristics!
- ξ correlated with price!

What else is this useful for? Modeling demand for many other types of discrete choices:

- Yogurt. What attributes?
    - Amount of sugar
    - Fruit/plain
    - Amount of fat
    - Domestic/Imported
    - Price
- Cars. What attributes?
    - Horsepower
    - Weight
    - MPG
    - Price

<u>Welfare</u>

Consumer surplus for one consumer:

$CS_i = (1/\eta)\ E[\max_j (\delta_j+\varepsilon_{ij})\ ]$

Consumer surplus over distribution of ε:
$E(CS) = (1/\eta) \ln (\Sigma_j e^{\delta j})$ + Constant

Counterfactuals:
Notice that δ is really a function of observable attributes
We can replace the log-sum term with a different choice set and determine consumer surplus as the difference in the two scenarios!

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