Modeling Demand for Telecom Services Using Surveys

Paul Rappoport, Temple University
James Alleman, University of Colorado

Experts Dialogue: Adjusting Forecasting Methods to the Needs of the Telecommunications Sector

International Telecommunication Union

Geneva, Switzerland
25-26 October 2004
Outline

- Statement of the Problem
- Theoretical Structures
- Surveys and Data
- Results
- Conclusions
Problem(s)

1. Can willingness to pay (WTP) information be obtained from surveys and used to describe “demand”? 
2. How are estimates of elasticities computed from WTP studies? 
3. Can the use of WTP be generalized and applied to a range of products and services?
Models of Consumer Choice

- Probability Models
  - Probit model of WTP
  - Discrete – continuous choice models
- Contingent Valuation
  - Lognormal Demand
- Conjoint and related models
Probability models

- Probit Model
  - Ask if a product is of interest
  - Ask how much more they would be willing to pay for a product with specified features

- Discrete – continuous
  - Stage 1 - assess level of interest
  - Stage 2 – assess how much more they would be willing to pay

- Difficult to estimate demand (and elasticities)
Discrete Choice

Models from Surveys

- Dial-up vs Cable Modem
- Dial-up vs DSL
- Cable Modem vs DSL
## Access Elasticities

<table>
<thead>
<tr>
<th></th>
<th>Dial-up</th>
<th>CM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dial-up</td>
<td>-0.230</td>
<td>0.518</td>
</tr>
<tr>
<td>CM</td>
<td>0.010</td>
<td>-0.895</td>
</tr>
</tbody>
</table>
## Dial-up vs DSL Access

<table>
<thead>
<tr>
<th></th>
<th>Dial-up</th>
<th>DSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dial-up</td>
<td>-0.168</td>
<td>0.423</td>
</tr>
<tr>
<td>DSL</td>
<td>0.040</td>
<td>-1.364</td>
</tr>
</tbody>
</table>
## CM vs DSL Access

<table>
<thead>
<tr>
<th></th>
<th>Cable Modem</th>
<th>DSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable Modem</td>
<td>-0.587</td>
<td>0.766</td>
</tr>
<tr>
<td>DSL</td>
<td>0.618</td>
<td>1.462</td>
</tr>
</tbody>
</table>
Issues

- Assumes respondents has a joint decision to make – (1) whether or not to pay more for something and (2) how much more to pay.
- Estimation problems - question (2) represents a censored sample
- Requires a complex sampling frame
Conjoint

- Requires a complex sampling framework – generally time consuming and expensive.
- Typically limited to small samples
- Address product attributes
- Focus is market research and segmentation – not demand modeling
Contingent Valuation: Overview

- Method that requires asking people directly, in a survey, how much they would be willing to pay for a specific service.

- “Contingent” in the sense that people are asked their willingness to pay, contingent on specific hypothetical scenario.
Contingent Valuation and Demand

- Focus is on the price of the service – thus economic value associated with a service is generally bounded.
- Application is directed towards the estimation of price elasticities.
- Underlying theoretical structure is lognormal demand (common for most choice models).
- Demand curve – representation of WTP.
Lognormal Demand Curves

Let 
\[ p_{oi} \] be the tolerance price of the ith household
\[ p \] be the actual market price

Then 
\[ q_i = 1 \text{ if } p_{oi} \geq p \]
\[ q_i = 0 \text{ otherwise} \]

Assuming that \( p_{oi} \) is distributed as a lognormal with parameters \( \mu_p \) and \( \sigma_p^2 \)
Lognormal Demand

We have:

\[ P(q_i = 1 \mid p) = P(p_{oi} \geq p) = 1 - \Lambda(p; \mu_p, \sigma_p^2) \]

Let \( Q \) represent the expected proportion of buyers we have:

\[ Q(p) = 1 - \Lambda(p; \mu_p, \sigma_p^2) = \Lambda(1/p; -\mu_p, \sigma_p^2) \]
Suggestion by Cramer*

- Frame questions in a survey to ask the most one would be willing to pay for a product or service
- Construct the cumulative distribution of responses as a function of the observed WTP responses
- Resulting distribution, under reasonable assumptions, is a demand function

*Empirical Econometrics
Lognormal Demand Cont.

Demand for Product X

Price (WTP)

Q(p)
Survey Methodology

- Sampling Frame
  - Qualify Respondent
  - Use RDD approach
- Sample Size
- Framing the Questions
- The Data
Who is a Qualified Respondent?

- **Currently Subscribe to Broadband?**
  - Length of time?
  - Current provider
  - Price

- **If Not, is Broadband Available?**
  - Why not
  - Likely
Sampling Methodology

Random Digit Dialing

- All households in the underlying population have the same probability of being selected
- Telephone based

Issues

- Fatigue (number of questions)
- Complexity (trying to ask too much)
- Telephone issues (Do not Call)
Sample size and related issues

- Trade off between size and cost
- WTP analysis requires large number of responses (> 2000)
- Projection to underlying population requires computing weights correctly
- Historically, mixed results when asking about expenditures
Framing the question: Switching Intent

- Ask about relative importance
  - Quality
  - Price
  - Provider
- How does they rate their current provider
- Ask about likelihood to switch
- Ask about reasons for switching
Demand for Broadband
Broadband: Consider

- Little price variation at a point in time
- Observed price is market price – not Willingness to Pay
- Broadband – confusion? Requires definition (DSL, Cable Modem, ISDN?)
- Does Broadband availability matter
- What does a non response mean?
Survey Data

- 2,011 responses to an omnibus survey administered during the first quarter, 2002.
- Questions included for broadband service (DSL, Cable Modem), and other electronic products (DVD players and Digital Cameras).
- Questions were included covering WTP
Phrasing the Question

Question 1  What is the least price at which the respondent would consider the item too expensive

Question 2  What is the highest price at which he would dismiss it as a shoddy article of inferior quality
Computation

- Compute the fraction of respondents quoting a threshold price that exceeds a price $p$.
- Plot $Q(p)$ against $p$
- Estimate lognormal parameters from the data
- Elasticity given by $\pi = \frac{d \log Q(p)}{d \log(p)}$
Results

- Demand for Cable modem Service
- Demand for DSL Service
- Demand for DVD Players
- Demand for Digital Cameras
Preliminary Findings: Demand for Cable Modem Service

Figure 1: Cable Modem Demand
## Cable Modem Elasticity

<table>
<thead>
<tr>
<th>Price</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>$20</td>
<td>-0.53</td>
</tr>
<tr>
<td>$30</td>
<td>-0.59</td>
</tr>
<tr>
<td>$40</td>
<td>-0.75</td>
</tr>
<tr>
<td>$50</td>
<td>-0.98</td>
</tr>
<tr>
<td>$60</td>
<td>-2.25</td>
</tr>
<tr>
<td>$70</td>
<td>-3.34</td>
</tr>
</tbody>
</table>
The Demand for ADSL

Preliminary Findings DSL
DVD Players

Figure 4: Demand for DVD

![Graph showing the demand for DVD players across different price points. The x-axis represents the price (WTP) in dollars, ranging from 0 to 600+. The y-axis represents the proportion of demand as a percentage. The graph illustrates a downward trend, indicating that as the price increases, the proportion of people willing to pay that price decreases.]
Digital Cameras

Demand for Digital Camera

Proportion

Price (WTP)
Elasticity

Initial estimates are in line with previously published values

Rappoport, Taylor, Kridel
- CM: -0.81, -1.05
- DSL: -1.17, -1.55

WTP
- CM: -0.75, -0.98
- DSL: -1.17, -1.76
Conclusions

- Theory of consumer choice “works” (easily implemented)
- Illustrates potential value using CV approach
- Derived elasticities in line with other published results
**Issues and Further Research**

- Further testing of wording of questions for CV required
- Test question design that focuses on specific attributes and a consumer’s WTP for attributes on the margin (hedonic price approach)
- Explore ways to incorporate demographics directly
Issues and Further Research (cont.)

- Use successive surveys to track “demand” curves
- Use WTP approach to estimate saturation levels
- Incorporate demographics directly by estimating a first stage function (WTP = 0 vs WTP >0)
Contact

¬ Paul Rappoport
  Prapp4@comcast.net

¬ James Alleman
  James.Alleman@Colorado.edu