Overview: Demand

• Demand for Anti-Ulcer Drugs
  – Data, Estimation
  – Interpretation of Empirical Results

• Modeling of Consumer Choice

Demand Analysis

• Today
  – Empirical Demand Analysis
  – Modeling of Consumer Demand

• Later
  – Demand and Product Characteristics
  – Discrete Choice Models
  – Network Effects
  – Dynamic Adjustments in Demand
Market Demand for Anti Ulcer Drugs

• Typical Empirical Application
  – Rapid Growth Market
  – Changes in Market Structure

• Focus on Price Effects and Advertising Effects
  – Price Elasticity and Advertising Elasticity

• Example of Practical Modeling Considerations

Market Demand for Anti-Ulcer Drugs

• Monthly Observations, Aug. 1977 - May 1993
• Four Drugs: Tagamet, Axid, Pepcid, Zantac
  Prescription (prior to OTC versions)

• Variables
  LQ - Log (Market Quantity)
  LP - Log (Market Price)
  LADV - Log (Cumulative Advertising)
  T - Time Trend
• Data Source: Berndt, Bui, Reiley and Urban (1994)
Market Demand for Anti-Ulcer Drugs

- Model is of the Form:
  \[ LQ = \alpha + \text{Elas}_p \ LP + \text{Elas}_{ADV} \ LADV + \tau \ T + \epsilon \]

- Basic Estimates
  \[ LQ = -10.04 - 1.16 \ LP + .88 \ LADV + .001 \ T + \epsilon \]

- Namely \( \text{Elas}_p = -1.16, \ \text{Elas}_{ADV} = .88 \) (Not bad!)

- But….

Model Specification Analysis

Yikes!!! Something is wrong!!!

- What Could Cause the Residual Pattern?

- What should we do about it??
Introduction of Anti-Ulcer Drugs

• Drugs Did Not Appear Simultaneously
• Introduction Dates
  Tagamet (Smith Kline): August 1977
  Zantac (Glaxo): June 1983
  Pepcid (Merck): October 1986
  Avid (Lilly): April 1988

• How is this incorporated?

Final Estimation Results

• Refined Model is of the Form:
  \[ LQ = \alpha + \text{Elast}_P \text{ LP} + \text{Elast}_A \text{ ADV} + \varepsilon \]
  where

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<thead>
<tr>
<th></th>
<th>Elasticities</th>
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<tbody>
<tr>
<td></td>
<td>P</td>
</tr>
<tr>
<td>One Drug</td>
<td>-1.67</td>
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<tr>
<td>Two Drugs</td>
<td>-0.65</td>
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<tr>
<td>Three Drugs</td>
<td>-0.65</td>
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<tr>
<td>Four Drugs</td>
<td>-0.65</td>
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Retail Pricing and Promotions

- Retail pricing involves list prices as well as promotions, or temporary price reductions
- Modeling and estimation applied here too, in early growth phase
- Household models and targeted couponing
Consumer Choice Models

• How Do Consumers Make Decisions?

• Behavioral Assumption: Consumers Act in Their Best Interests
   – Interests = “Preferences” or “Utility”
   – Best Interests = “Maximize Utility” over available choices.

• Utility Maximization
   Choose Quantities of Goods: A, B, ..., by maximizing Utility Function
   \[ U(A,B,...) \]
   subject to Budget Constraint: \[ p_a A + p_B B + ... = I \]

Consumer Choice Models (2)

Optimal: \[ MRS_{AB} = \frac{p_A}{p_B}, \text{ etc., namely} \]

\[ \frac{MU_A}{p_A} = \frac{MU_B}{p_B} = (\text{all goods}); \text{“Equal Bang per Buck”} \]

Result: Individual Demand Functions

\[ A = D_A(p_A,p_B,....,I) \quad B = D_B(p_A,p_B,....,I) \]

Empirical Models Build in Consumer Differences, Demographics, etc.
Figure 3.12 Maximizing Consumer Satisfaction

Clothing (units per week)

Food (units per week)

$U_3$

$U_2$

$U_1$

Budget Line
Take Away Points

• Demand curves are real: they can be estimated!
• Estimation involves
  – Model specification
  – Estimation
  – Interpretation and modification
• A basic understanding of regression output allows you to critically assess claims based on it.
• Utility maximization models are the workhorse of economics and finance, among others