About Myself

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Advanced Transportation EGR (Fall)
Transportation Facilities Design (Fall)
Professor: Dr. Leslie McCarthy
Study of Traveler Route Choice Behavior under Personalized Real-time Traffic Information

James Pokorny

July 23, 2010

Nextrans at Purdue
Presentation Outline

• Introduction to Real-time traffic information
• Study Objectives of project
• Stated Preference survey design
• Developing Ordered Probit Model
• Model Output
• Conclusions
Real-Time Traffic Information Provision

• A few providers of real-time traffic information:
  – NAVTEQ
  – INRIX
  – State DOTs and Navigators (511, Georgia Navigator)

• Real-time traffic information is provided via email, text message, and voice message in many U.S. cities.

• Content of information can include warning of congestion, expected delay, and alternate route suggestions.
Example of Technologies involved in Real-Time Traffic Information System

Data collection:
- Real-time traffic data are collected using various technologies.

Data aggregation and translation:
- Private and public entities aggregate and translate these data into information.

Information dissemination:
- Information is disseminated to the public through various technologies.

- Aerial surveillance helicopters
- Video surveillance cameras
- Fixed sensors
- Vehicle probes
- Telephone
- Television
- Internet
- Radio/highway advisory radio
- Dynamic message signs
- Devices used in vehicles (e.g., cell phones, navigation devices)

ITIF-Ezell 2010
Study Objectives

• Due to the increased penetration of communication technologies in real-time traffic information provision there is a need to understand the benefits for commuters.

  – What role does real-time traffic information play in route choice behavior of commuters?

  – Do commuter attitudes impact the decision to switch to a suggested alternative?

  – To understand the propensity of commuters to switch routes in various situations when they are given real-time traffic information.
Questions of Interest

• What amount of predicted travel time savings can cause commuters to switch route?

• What content of real-time traffic information is enough for commuters to switch route?

• What events cause a commuter to rely on real-time traffic information more than others?
Stated Preference (SP) Survey Process

• SP Survey: Used to obtain commuter propensities by presenting hypothetical travel events

• The SP exercise consists of four procedures...
  – 1. Format design
  – 2. Experiment design
  – 3. Data collection
  – 4. Analysis
## Experiment Design

- List of factors that may impact commuters' behavior of switching routes given real-time traffic information.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-Economic</td>
<td>Gender, Age, Education, Dependency</td>
</tr>
<tr>
<td>Familiarity</td>
<td>Familiarity with alternative routes, Familiarity with real-time traffic information</td>
</tr>
<tr>
<td>Situational</td>
<td>Night-time, Construction, Congestion, Incident, Adverse Weather</td>
</tr>
</tbody>
</table>
## Survey Design Process (1/4)

### Socio-Economic Characteristics of Respondents

### 1. General Background

1. **What is your gender?**
   - Male
   - Female

2. **What is your age bracket?**
   - Under 20
   - 21-30
   - 31-49
   - 50-65
   - Over 65

3. **What is your highest level of education?**
   - High School
   - Some College
   - College
   - Post Graduate

4. **How many people depend on your vehicle for transportation to work or school?**
   - 0
   - 1
   - 2
   - 3 or more
## Survey Design Process (2/4)

### Travel Time and Familiarity of Respondents

<table>
<thead>
<tr>
<th>2. General Commuting Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Choose the value that is closest to your average commute time to work?</strong></td>
</tr>
<tr>
<td>☐ 10 minutes or less</td>
</tr>
<tr>
<td><strong>2. How familiar are you with your alternative routes to work?</strong></td>
</tr>
<tr>
<td>☐ Very unfamiliar</td>
</tr>
<tr>
<td><strong>3. How familiar are you with personalized real-time traffic information (e.g. through cell phone)?</strong></td>
</tr>
<tr>
<td>☐ Very unfamiliar</td>
</tr>
</tbody>
</table>
### 3. Attitudes and Preferences

The following questions should be answered with your most commonly used route to work in mind.

1. **Would you consider switching your current route if given real-time traffic information on your personal device (e.g. cell phone)?**
   - [ ] Very unlikely
   - [ ] Unlikely
   - [ ] Neutral
   - [ ] Likely
   - [ ] Very Likely

2. **How much predicted travel time savings would cause you to switch from your current route to a suggested alternate?**
   - [ ] 5 Minutes or less
   - [ ] 6-10 Minutes
   - [ ] 11-20 Minutes
   - [ ] 21-30 Minutes
   - [ ] More than 30 Minutes

3. **Would you consider switching from your current route to a suggested alternative for the following situations?**

<table>
<thead>
<tr>
<th></th>
<th>Very unlikely</th>
<th>Unlikely</th>
<th>Neutral</th>
<th>Likely</th>
<th>Very likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Night-time travel</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Adverse weather</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Construction zone</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Traffic congestion</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>
4. Would you consider switching from your current route even if you believed the suggested alternative would take longer?

- Very unlikely
- Unlikely
- Neutral
- Likely
- Very likely

5. If an incident were to occur on your current route, real-time traffic information can provide you details on the crash. Please indicate your likelihood of switching route based upon the content of information you would receive.

<table>
<thead>
<tr>
<th>Incident occurrence only.</th>
<th>Very unlikely</th>
<th>Unlikely</th>
<th>Neutral</th>
<th>Likely</th>
<th>Very likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incident occurrence and expected delay.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incident occurrence, expected delay, and suggested alternative route.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incident occurrence, expected delay, suggested alternative route, and predicted travel time savings on suggested alternative route.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Indianapolis Traffic Study
## Synthetic Survey Respondent Characteristics

<table>
<thead>
<tr>
<th>Question</th>
<th>0-10 minutes</th>
<th>11-30</th>
<th>31-60</th>
<th>&gt;60 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>64.6% (Male)</td>
<td>35.4% (Female)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>13.4% (&lt;20 years)</td>
<td>46.3% (21-30 years)</td>
<td>31.7% (31-49 years)</td>
<td>6.1% (50-65 years)</td>
</tr>
<tr>
<td>Education</td>
<td>19.5% (HighSchool)</td>
<td>22.0% (SomeCollege)</td>
<td>22.0% (College)</td>
<td>36.6% (Post Graduate)</td>
</tr>
<tr>
<td>Dependent</td>
<td>37.8% (0 people)</td>
<td>35.4% (1 person)</td>
<td>17.1% (2 people)</td>
<td>9.8% (3+ people)</td>
</tr>
<tr>
<td>Commute</td>
<td>26.3% (&lt;10 minutes)</td>
<td>46.3% (11-30)</td>
<td>21.3% (31-60)</td>
<td>6.3% (&gt;60 minutes)</td>
</tr>
</tbody>
</table>
Ordered Probit Model (1/2)

• Since the dependent variable uses a Likert scale the ordered probit model is appropriate.

• The ordered probit model uses compiled data to estimate the commuter’s likelihood of switching to a suggested alternative route given personalized real-time traffic information.
Ordered Probit Model (2/2)

- **Advantage**
  - Can include ordered nature of discrete data.

- **Disadvantage**
  - Difficult to understand the effects of the independent variables on the interior category probabilities.
    - e.g. Unlikely, Neutral, Likely

- To obtain sense of direction of interior categories the marginal effects were computed.
## Model Development & Analysis

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Coefficient</th>
<th>T-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.436</td>
<td>29.849</td>
</tr>
<tr>
<td>Commuter aged 21-30 years</td>
<td>-0.099</td>
<td>-1.955</td>
</tr>
<tr>
<td>Commuter with 0 dependents</td>
<td>0.085</td>
<td>1.699</td>
</tr>
<tr>
<td>Commuters familiar with alternatives</td>
<td>-0.085</td>
<td>-1.549</td>
</tr>
<tr>
<td>Unlikely to switch in nighttime.</td>
<td>-0.088</td>
<td>-1.738</td>
</tr>
<tr>
<td>Likely to switch for construction zone</td>
<td>0.143</td>
<td>2.665</td>
</tr>
<tr>
<td>Neutral toward traffic congestion</td>
<td>-0.068</td>
<td>-1.295</td>
</tr>
<tr>
<td>Very Unlikely to switch given only incident occurrence</td>
<td>-0.077</td>
<td>-1.364</td>
</tr>
<tr>
<td>Neutral toward switch given incident, delay, and suggested alternative</td>
<td>-0.133</td>
<td>-2.510</td>
</tr>
</tbody>
</table>

Number of Observations: 2000
Log Likelihood at Zero: -3073.627   Log Likelihood at Convergence: -3059.256
## Marginal Effects

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Very Unlikely</th>
<th>Unlikely</th>
<th>Neutral</th>
<th>Likely</th>
<th>Very Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 21-30</td>
<td>0.016</td>
<td>0.020</td>
<td>0.0009</td>
<td>-0.015</td>
<td>-0.022</td>
</tr>
<tr>
<td>0 Dependents</td>
<td>-0.016</td>
<td>-0.017</td>
<td>-0.0016</td>
<td>0.012</td>
<td>0.019</td>
</tr>
<tr>
<td>Fam. Alter.</td>
<td>0.014</td>
<td>0.017</td>
<td>0.0007</td>
<td>-0.012</td>
<td>-0.019</td>
</tr>
<tr>
<td>Unlikely to switch Night</td>
<td>0.014</td>
<td>0.017</td>
<td>0.0009</td>
<td>-0.013</td>
<td>-0.019</td>
</tr>
<tr>
<td>Likely to switch Const.</td>
<td>-0.021</td>
<td>-0.029</td>
<td>-0.0036</td>
<td>0.020</td>
<td>0.034</td>
</tr>
<tr>
<td>Neutral to switch Cong.</td>
<td>0.011</td>
<td>0.013</td>
<td>0.0007</td>
<td>-0.010</td>
<td>-0.015</td>
</tr>
<tr>
<td>Very Unlikely given Inc. only</td>
<td>0.012</td>
<td>0.015</td>
<td>0.0006</td>
<td>-0.011</td>
<td>-0.017</td>
</tr>
<tr>
<td>Neutral given Inc. Delay and Alternative</td>
<td>0.022</td>
<td>0.026</td>
<td>0.0008</td>
<td>-0.020</td>
<td>-0.029</td>
</tr>
</tbody>
</table>
Conclusions

- A few insignificant factors:
  - Adverse weather
  - Travel time savings
  - Familiarity with real-time traffic information

- A few significant factors in my model:
  - Constant (highly significant)
  - Construction zone
  - Age 21-30
THANK YOU

Questions?