RSS 2007: Discrete Choice Modelling of Food Product Eco-labels

by Iain Pardoe
University of Oregon

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Overview

1. Introduction
2. Background
3. Designing the stated choice experiment
4. Testing the design
5. Running the survey and analyzing results

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1. Introduction 3 / 17

Introduction

- Eco-labels first introduced to the U.S. in the early 1970s to certify organic fruits and vegetables.
- Labels have evolved since then to represent various aspects of sustainable agricultural practices, environmental health, wildlife preservation, etc.
- This talk describes design of a large-scale stated choice survey to investigate consumer reactions to eco-label characteristics such as pesticide use, environmental practices, certification, and price for:
  - apples;
  - eggs.
- Part of a multi-year, multi-site project to study demand impacts and implementation of eco-labels funded by the U.S. Dept. of Agriculture.

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2. Background 4 / 17

Research team

- Cathy Durham (Agricultural and Resource Economics Department, Oregon State University)
- Aaron Johnson (Agricultural and Resource Economics Department, Oregon State University)
- Rob King (Department of Applied Economics, University of Minnesota)
- Jill McCluskey (School of Economic Sciences, Washington State University)
- Iain Pardoe (Department of Decision Sciences, Lundquist College of Business, University of Oregon)
- Cathy Roheim (Department of Environmental and Natural Resource Economics, University of Rhode Island)

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Research plan

- Evaluate eco-label characteristics that lead to increased product demand and how to effectively reach consumers with that information in retail settings.
  - Through focus groups and surveys that measure willingness-to-pay for eco-label characteristics.
- Test eco-labeling promotion and evaluate impact on retail demand.
  - Through collecting data from grocery stores over time and evaluating promotional signage variation at those stores.
- Assess how well results from willingness-to-pay analysis compare with those of demand study.
  - Through looking at demand impact of signage at point of purchase, and implied demand effect of willingness-to-pay results.

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Survey question example

If you were planning to buy apples, and you were able to select from the following choices that were all equally ripe and fresh, which choice would you buy? Consider all 3 production practices (Pesticide Usage, Provision for Wildlife Habitat, Water Protection), Certifier and Price when selecting your answer.

A blank space means no special practice is undertaken.

NO Synthetic Pesticides Allowed	On-Farm Wildlife Habitat Provided	Water Protection Provided	Government Certifier	Price $1.19/#
Integrated Pest Management			3rd Party Certifier	Price $1.49/#
Conventional Pesticides				Price $0.89/#
I would Not Buy any of these products				

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Stated choice experiment

- Multinomial logit model of McFadden (1974)
  (aka choice-based conjoint).
- Alternative to full-profile conjoint that applies a non-linear model to aggregate choice data.
- $\Pr\big(Y = j \big| \boldsymbol{x}_i\big) = \dfrac{\exp(\boldsymbol{\beta}^T \boldsymbol{x}_{ij})}{\sum_{h \in C_i} \exp(\boldsymbol{\beta}^T \boldsymbol{x}_{ih})}.$
- Use SAS software to design and analyze the choice experiment.

  - TS-722: Marketing Research Methods in SAS (Kuhfeld, 2005);
  - Macros at support.sas.com/techsup/technote/ts722.zip.

- Also use Limdep software for more advanced modelling.

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Factors, levels, choice sets

- Five factors with 3/2/2/3/4 levels (selected through focus group work):

  - Pesticides (conventional, IPM, organic);
  - Wildlife habitat provision (no, yes);
  - Water protection (no, yes);
  - Certification (none, 3rd party, government);
  - Price ($0.89, $1.19, $1.49, $1.79).

- Four alternatives in each choice set:

  - Two "eco-labeled" alternatives
    (which cannot be $0.89);
  - One near-constant "conventional" alternative (which can only be $0.89 or $1.19);
  - One constant "none" alternative.

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Choice experiment design

- Generic design (since no "brands").
- However, third alternative is always "conventional."
- Design should be *large* enough to allow fitting of most complicated model anticipated:

  ○ Possible interactions of price with other factors;
  ○ Possible alternative-specific effects for eco-labeled vs. conventional;
  ○ Possible cross-effects of (say) conventional price on eco-labeled alternatives;
  ○ Demographic effects.

- Design should be *small* enough to be practical:

  ○ Survey asks other questions too, so choice experiment restricted to 8 choice sets.

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Creating the design

- 24 may be a reasonable design size since it divides 2, 3, and 4 (numbers of factor levels) and 8 (max choice sets per subject).
- Use `%MktEx` macro to create candidate choice sets.
- Use "flags" to restrict alternatives:
  ○ first two have at least one non-low level for each factor and one of three highest prices;
  ○ third has low levels for each factor and one of two lowest prices;
  ○ fourth has missing values for each factor.
- Use `%ChoicEff` macro to search the candidate sets for an efficient design with 24 choice sets:
  ○ alternatives from candidate sets are swapped in and out of design;
  ○ uses a modified Fedorov algorithm to optimize choice model variance matrix.

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Blocking the design

- For this application, a design with 24 choice sets is too large to show all the sets to each subject.
- Use %MktBlock macro to block design into 3 blocks of 8 choice sets each:
  - tries to create block factor that is uncorrelated with every attribute of every alternative.
- Proposed design:

Block	Set	Alt	x1	x2	x3	x4	x5
1	1	1	IPM	No	No	3rd	$1.79
		2	Org	Yes	Yes	None	$1.49
		3	Conv	No	No	None	$1.19
		4	.	.	.	.	.
1	2	1	Conv	Yes	Yes	Govt	$1.49
		2	IPM	No	No	3rd	$1.79
		3	Conv	No	No	None	$1.19
		4	.	.	.	.	.

etc.

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4. Testing the design

Testing the design

- Data collection is expensive, so need to evaluate design to make sure it will work *first*.
- Generate artificial data to check most complicated models anticipated are estimable.
- Estimate models with artificial data using PROC PHREG:

  - basic multinomial logit model, plus;
  - interactions between price and other factors;
  - alternative-specific price effects for eco-labeled vs. conventional;
  - cross-effect of conventional price on eco-labeled alternatives;
 - interactions between demographics and choice factors.
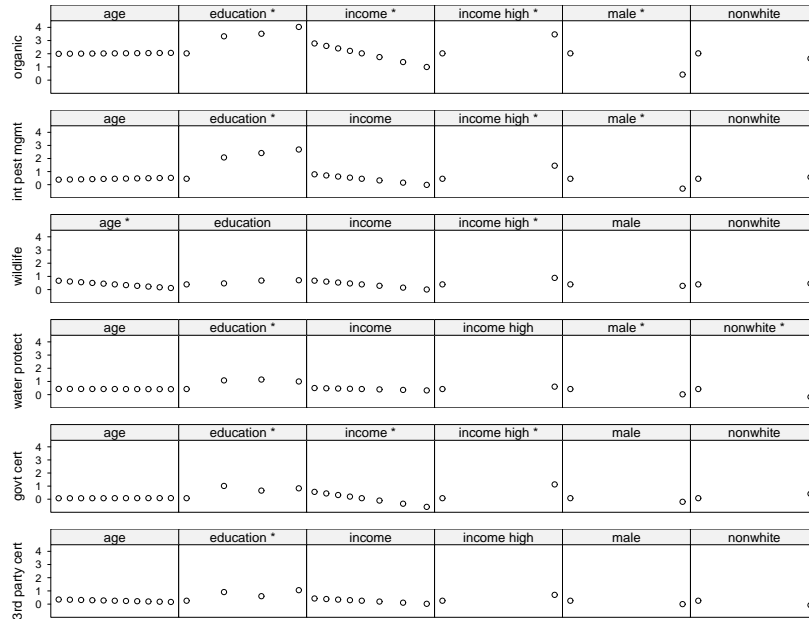
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Running the survey and analyzing results

- Generate surveys:
  - 8 apple choice sets (one block per subject);
  - 8 egg choice sets (same design, different block);
  - Supplementary questions.
- Administer survey:
  - Tablet computers;
  - Three locations (OR, MN, RI);
  - Different types of location (e.g., farmers' markets, conventional grocery stores, natural food stores);
  - Aim for 500 subjects at each location;
  - $5 incentive.
- Early results … price effects correct direction, significant positive results for eco-label characteristics.

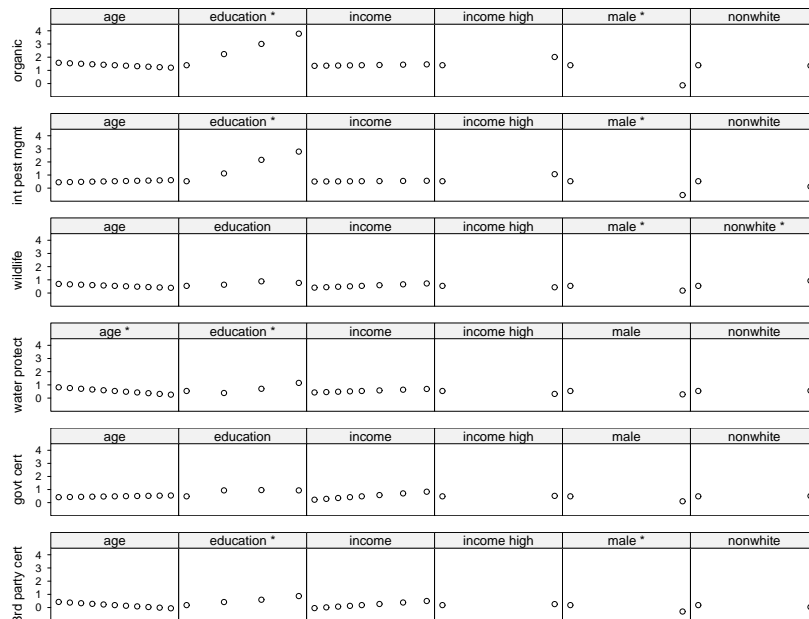© Iain Pardoe, 2007   13 / 17

Tentative Oregon results

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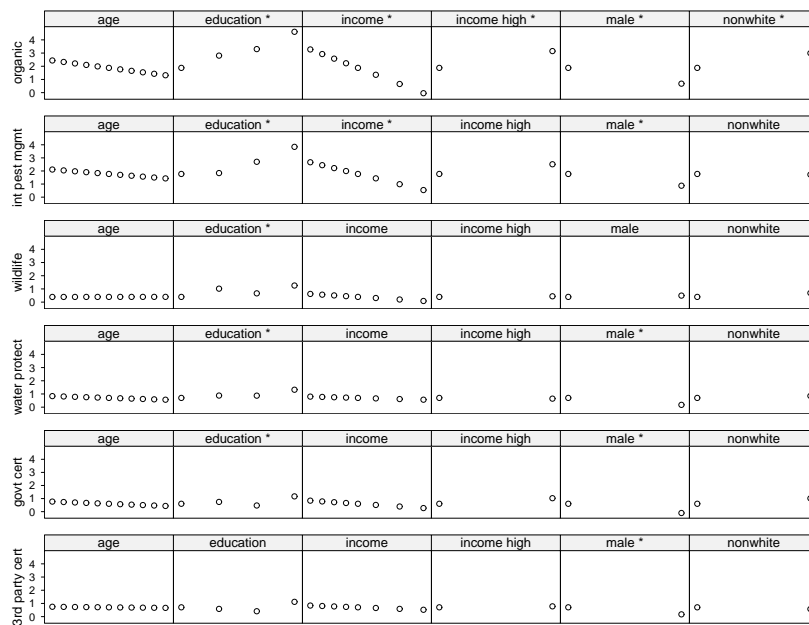
Tentative Minnesota results

Tentative Rhode Island results

Acknowledgments