



Interactive Preference Measurement for Consumer Decision Support

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Consumer Decision Support Systems

- **Decision Theory Framework: Objective Function, Individual Level Utility**
 - Recommend 'best' product
- **Need an Individual Utility Function**
 - Attribute based product space
 - Specifically understand high utility region
- **Data: Experimental – Sequence of Questions**
- **Timing: Real-time processing**



Helping Customers Make Good Choices in Crowded Markets

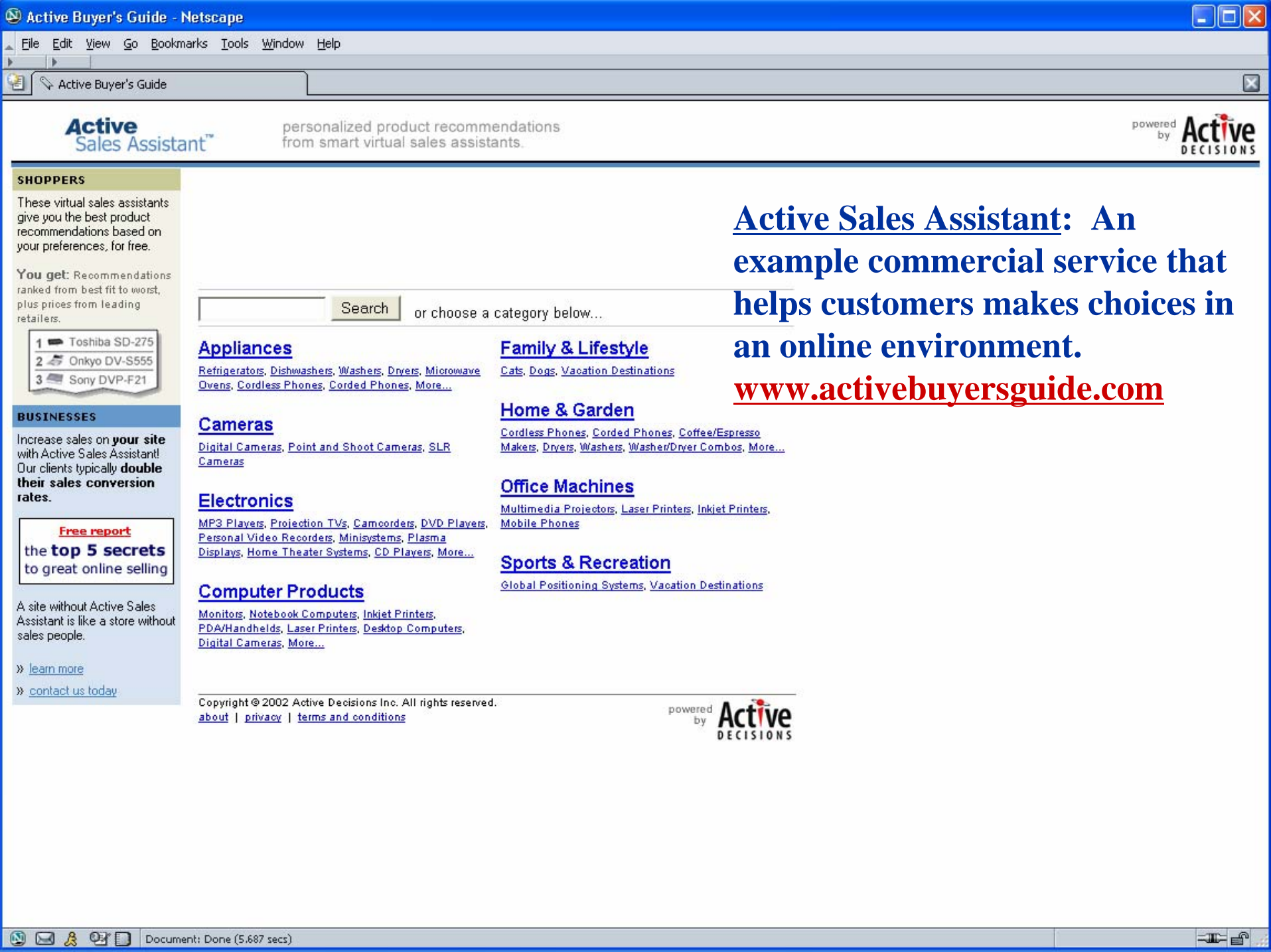
Consumers face an increasing array of choices:

- **Over 8,200 mutual funds**
- **Over 500 models of cars**
- **Over 30,000 products in a grocery store**
- **Over 100,000 prescription drugs**

Choosing is not so Easy!



Finding the right one makes my headache worse!



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You get: Recommendations ranked from best fit to worst, plus prices from leading retailers.

- 1 Toshiba SD-275
- 2 Onkyo DV-S555
- 3 Sony DVP-F21

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Search or choose a category below...

Appliances

Refrigerators, Dishwashers, Washers, Dryers, Microwave Ovens, Cordless Phones, Corded Phones, More...

Family & Lifestyle

Cats, Dogs, Vacation Destinations

Home & Garden

Cordless Phones, Corded Phones, Coffee/Espresso Makers, Dryers, Washers, Washer/Dryer Combos, More...

Cameras

Digital Cameras, Point and Shoot Cameras, SLR Cameras

Office Machines

Multimedia Projectors, Laser Printers, Inkjet Printers, Mobile Phones

Electronics

MP3 Players, Projection TVs, Camcorders, DVD Players, Personal Video Recorders, Minisystems, Plasma Displays, Home Theater Systems, CD Players, More...

Sports & Recreation

Global Positioning Systems, Vacation Destinations

Computer Products

Monitors, Notebook Computers, Inkjet Printers, PDA/Handhelds, Laser Printers, Desktop Computers, Digital Cameras, More...

Active Sales Assistant: An example commercial service that helps customers makes choices in an online environment. www.activebuyersguide.com

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Digital Cameras Guide

Need help deciding which Digital Camera to buy? Get highly personalized and completely unbiased product recommendations with our decision guide!

- Full Product Specs
- Pictures & Reviews
- Side-by-Side Compare
- Where-to-buy links

choose a search method...



Power Search

Get recommendations quickly based on your price, brand, and feature preferences.



Get Advice

Get recommendations based on how you intend to use your digital cameras.



Decision Guide

Get recommendations by making trade-offs between price, brand, and features.

you can also [read buying tips](#)

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Digital Cameras [FEATURES](#) | [GLOSSARY](#)

steps: 1 Price & Features 2 Settings 3 Brands 4 Tradeoffs 5 Fine Tune 6 Profile > RESULTS

What is the most you are willing to pay for a Digital Camera?

min \$ 0 max \$ 400 [show price range](#)

(optional) (required)

Which features do you care about? tip: click any feature for description

- [Image Capacity \(at hi-res\)](#)
Number of hi-res pics stored in the memory provided
- [Plays MP3s](#)
- [Camera Size](#)
- [Flash Type](#)
Options for flash, such as auto, hot shoe, flash sync
- [Delay Between Shots](#)
How long the camera takes to process & store an image
- [Resolution](#)
Number of pixels in an image; more pixels = sharper picture
- [Rapid-Fire Shots](#)
Allows for multiple shots w/one touch of the button
- [Ease of Download](#)
How the camera downloads pics to your computer/printer
- [Optical Zoom](#)

5 steps to go [Next >>](#)

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steps: 1 Price & Features 2 Settings 3 Brands 4 Tradeoffs 5 Fine Tune 6 Profile > RESULTS

You do not have to answer every item below, only those that you care about.

Do you have any minimum or maximum requirements?

Image Capacity (at hi-res) Resolution

10 at least 1600 x 1200 pixels at least

How desirable are these features to you?

Flash Type	Never Buy	(desirable)			Must Have
		< less	more >		
None	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Off/On/Auto	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Red-Eye Reduction	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flash Sync	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Hot Shoe	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Compared to each other, how important is each feature?

tip: click any feature for description

	no opinion	<least (important) most>				
Resolution	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Brand	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Image Capacity (at hi-res)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Price	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Flash Type	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

4 steps to go Next >>



personalized product recommendations from smart virtual sales assistants.



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How desirable are these brands to you? "Never Buy" will eliminate that brand from your results

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	Never Buy	(desirable)			
		<	less	more	>
Achiever	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
AGFA	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aiptek	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aiwa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Alpha Vision Tech	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Argus	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bell & Howell	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
BenQ	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Canon	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Casio	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Concord Cameras	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Contax	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Cool-I-Cam	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Creative Labs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Crystal Digital	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Delta	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Dolphin Peripherals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
Epson	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Ezonics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Fujifilm	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Hewlett Packard	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Intel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
JVC	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
KB Gear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Kodak	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Konica	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Kyocera	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Largan	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>

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Digital Cameras

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steps: 1 Price & Features 2 Settings 3 Brands 4 Tradeoffs 5 Fine Tune 6 Profile > RESULTS

Assuming all other features are the same, which product do you prefer?

click for definition

<p>Digital Camera A</p> <p> 20 images at hi-res</p> <hr style="width: 50%; margin: 5px auto;"/> <p> \$200</p>	<p>← prefer more</p> <p>→ prefer more</p>	<p>Digital Camera B</p> <p> 50 images at hi-res</p> <hr style="width: 50%; margin: 5px auto;"/> <p> \$300</p>
--	---	--

For best results, there may be up to 4 tradeoff questions

Next >>

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steps: 1 Price & Features 2 Settings 3 Brands 4 Tradeoffs 5 Fine Tune 6 Profile > RESULTS

How likely would you purchase these example products?

This step fine tunes your results by calculating how well existing products fit your needs.

	Example A	Example B	Example C
<u>Brand</u>	Fujifilm	Oregon Scientific	Achiever
<u>Price</u>	\$343.96	\$300	\$100
<u>Flash Type</u>	Flash Sync, Hot Shoe, Red-Eye Reduction, Off/On/Auto	Hot Shoe, None	Hot Shoe, None
<u>Image Capacity (at hi-res)</u>	20	50	50
<u>Resolution</u>	1600x1200 pixels	2048 x 1536 pixels	2560 x 1920 pixels
Answer all 3 >	Definite	Likely	Unlikely

1 step to go Next >>

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results

sorted by: [RANK] sort direction expand list to: [5 results]

rank	Brand & Model	avg. street price	Compare
------	---------------	-------------------	---------

1 [Fujifilm FinePix 30i](#)

20 images at hi-res - Flash Sync Flash Type, Hot Shoe Flash Type, Red-Eye Reduction Flash Type, Off/On/Auto Flash Type - 1600 x 1200 pixels Resolution - 2.5X Optical Zoom - Download via USB cable, Download via removable memory - 5 Rapid-Fire Shots - 0.8 sec Delay Between Shots - Pocket Camera Size - Plays MP3s

\$343.96 US [WHERE TO BUY](#) compare

[more features](#)

2 [Minolta Dimage S304](#)

10 images at hi-res - Hot Shoe Flash Type, Red-Eye Reduction Flash Type, Off/On/Auto Flash Type - 2048 x 1536 pixels Resolution - 4X Optical Zoom - Download via USB cable, Download via removable memory - 9 Rapid-Fire Shots - 3 sec Delay Between Shots - Medium Camera Size - Does Not Play MP3s

\$459.85 US [WHERE TO BUY](#) compare

[more features](#)

3 [Sony Cyber-shot DSC-P31](#)

118 images at hi-res - Red-Eye Reduction Flash Type, Off/On/Auto Flash Type - 1600 x 1200 pixels Resolution - 1X Optical Zoom - Download via USB cable - 16 Rapid-Fire Shots - 2 sec Delay Between Shots - Medium Camera Size - Does Not Play MP3s

\$220.00 US [WHERE TO BUY](#) compare

[more features](#)

***not acceptable because you said:**
Flash Type : Must Have Hot Shoe

4 [Ezonics VistaCAM Echo](#)

12 images at hi-res - Off/On/Auto Flash Type - 2048 x 1536 pixels Resolution - 0X Optical Zoom - Download via USB cable, Download via removable memory - 5 Rapid-Fire Shots - 2 sec Delay Between Shots - Pocket Camera Size - Does Not Play MP3s

\$105.27 US [WHERE TO BUY](#) compare

[more features](#)

***not acceptable because you said:**
Flash Type : Must Have Hot Shoe

[Vivitar ViviCam 3695](#)

18 images at hi-res - Red-Eye Reduction Flash Type, Off/On/Auto Flash Type - 2048 x 1536 pixels Resolution - 0X Optical Zoom - Download via USB cable - 3 Rapid-Fire Shots - 4 sec Delay

\$129.95 [WHERE TO BUY](#) compare

More Headaches for Customers!



**Filling out all these ratings
also gives me a
headache!**



Desirable Characteristics of Simplified Preference Assessment Methods

- **Interactive**
- **Adaptive**
- **Focused/brief**
- **Real-time (< 5 seconds response latency)**
- **Share information across customers**
- **Have memory of past purchases of customer**
- **Useability**
- **Generate customer confidence**

(sample)



Model Development

Strategy for sequential questions:

- i. Predictive error minimization
- ii. 'Treed' models
- iii. Probabilistic fast polyhedral

Prior Measurement And Analysis

- Obtain data either from a survey, or from past purchases.
- Generate prior distribution for model.
- Generate optimal questions (Treed only)

Online Measurement And Analysis

Based on ex ante modeling, dynamically determine best sequence of questions to ask (except with Treed approach).

**OPTIMAL
RECOMMENDATIONS**

Ex ante conjoint model building

Dialog at Web site

- **Study 1**: Sequential questioning to minimize predictive error around the most desirable option.
- **Study 2**: Making recommendations to impatient customers using demographic information.
- **Study 3**: Probabilistic fast polyhedral: Estimation and sequential design.



Study 1: Ratings and the Predictive Error

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Model Development

Strategy for sequential
questions:

- i. Predictive error
minimization

Ex ante conjoint model building

Predictive Squared Error Loss Function

$$L_{n+1} = \left(y_{n+1} - \mathbf{c}^T \boldsymbol{\beta}_{n+1} \right)^2$$

y_{n+1} : next rating to be given

\mathbf{c} : element of design space
(a product profile)

$\boldsymbol{\beta}_{n+1}$: next estimate of partworths

Preposterior risk

$$R_{n+1} = E_{y_{n+1}, \beta_{n+1} | D_n, X_{n+1}, c} [L_{n+1}]$$

X_{n+1} : next profile to be rated
(decision task at hand)

$$D_n = \{X_1, \dots, X_n, y_1, \dots, y_n\}$$

Predictive Distribution

$$y_{n+1} \mid X_{n+1}, \beta_{n+1} =_d N\left(X_{n+1}^T \beta_{n+1}, \sigma^2\right)$$

Prior

$$\beta_{n+1} \mid D_n, \beta_0, \Sigma, \sigma^2 =_d N\left(B^{-1}b, B^{-1}\right)$$

$$B^{-1} = \Sigma^{-1} + \frac{1}{\sigma^2} \sum_{i=1}^n X_i X_i^T \qquad b = \Sigma^{-1} \beta_0 + \frac{1}{\sigma^2} \sum_{i=1}^n X_i y_i$$

$$\beta_1 =_d N(\beta_0, \Sigma) \quad : \text{informative starting prior}$$

Minimizing preposterior risk

$$R_{n+1} = E_{y_{n+1}, \beta_{n+1} | D_n, X_{n+1}, c} [L_{n+1}]$$

$$R_{n+1} = \underbrace{\sigma^2}_{\text{positive}} + (X_{n+1} - c)^T \underbrace{(\Sigma^{-1} + \beta_n \beta_n^T)}_{\text{positive definite}} (X_{n+1} - c)$$

$X_{n+1} = c$: minimizes preposterior risk

What part of the design space does the decision maker care about?

Minimizing risk based on what is important to the individual:

$\mu_n(c)$:density on design space reflects areas of interest to decision maker

Ω :design space, set of possible products

Minimizing expected risk based on what is important to the individual:

$$\min_{X_{n+1} \in \Omega} E_{\mu} [R_{n+1}] = E_{\mu} [R_{n+1} | X_{n+1} = c] = E_{\mu} [c]$$

Possible densities

- 1. Singleton: mass on design point with largest utility**
- 2. Proportional: mass proportional to utility**

Possible densities

1. **Singleton: mass on design point with largest utility**

$$\mu_n(\mathbf{c}) = I \left\{ \mathbf{c}^T \beta_n = \max_{\mathbf{c}^* \in \Omega} \{ \mathbf{c}^{*T} \beta \} \right\}$$

2. **Proportional: mass proportional to utility**

$$\mu_n(\mathbf{c}) \propto \mathbf{c}^T \beta_n I \{ \mathbf{c} \in \Omega \}$$

$$- \min_{\mathbf{c}^* \in \Omega} \{ \mathbf{c}^{*T} \beta_n \} I \left\{ \min_{\mathbf{c}^* \in \Omega} \{ \mathbf{c}^{*T} \beta_n \} < 0 \right\}$$

(sample)



Model Development

Strategy for sequential questions:

- i. Predictive error minimization

Prior Measurement And Analysis

- Obtain data either from a survey or past purchases.
- Generate prior distribution for model.

Chinese Dinner Study

Ex ante conjoint model building

- **Study context:**
 - Chinese Dinners
 - 8 attributes, 2, 3, or 4 options each
 - 4 profiles for predictive validation
- **Phase I -- Obtain Prior Distribution: β_0, Σ**
 - 24 subjects
 - 27 profiles to rate (Orthogonal design)

Study 1: Ratings and the Predictive Error

(sample)



Model Development

Strategy for sequential questions:

- i. Predictive error minimization

Prior Measurement And Analysis

- Obtain data either from a survey or past purchases.
- Generate prior distribution for model.

Online Measurement And Analysis

Based on ex ante modeling, dynamically determine best sequence of questions to ask.

**OPTIMAL
RECOMMENDATIONS**

Ex ante conjoint model building

Dialog at Web site

- **Phase II – Dynamic Approach**
 - **20 students**
 - **Dynamically generated product profiles using singleton density**



Study 1: Ratings and the Predictive Error Software Implementation

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Welcome to conjoint analysis from mktgeng.com

Please Enter Your E-mail Id

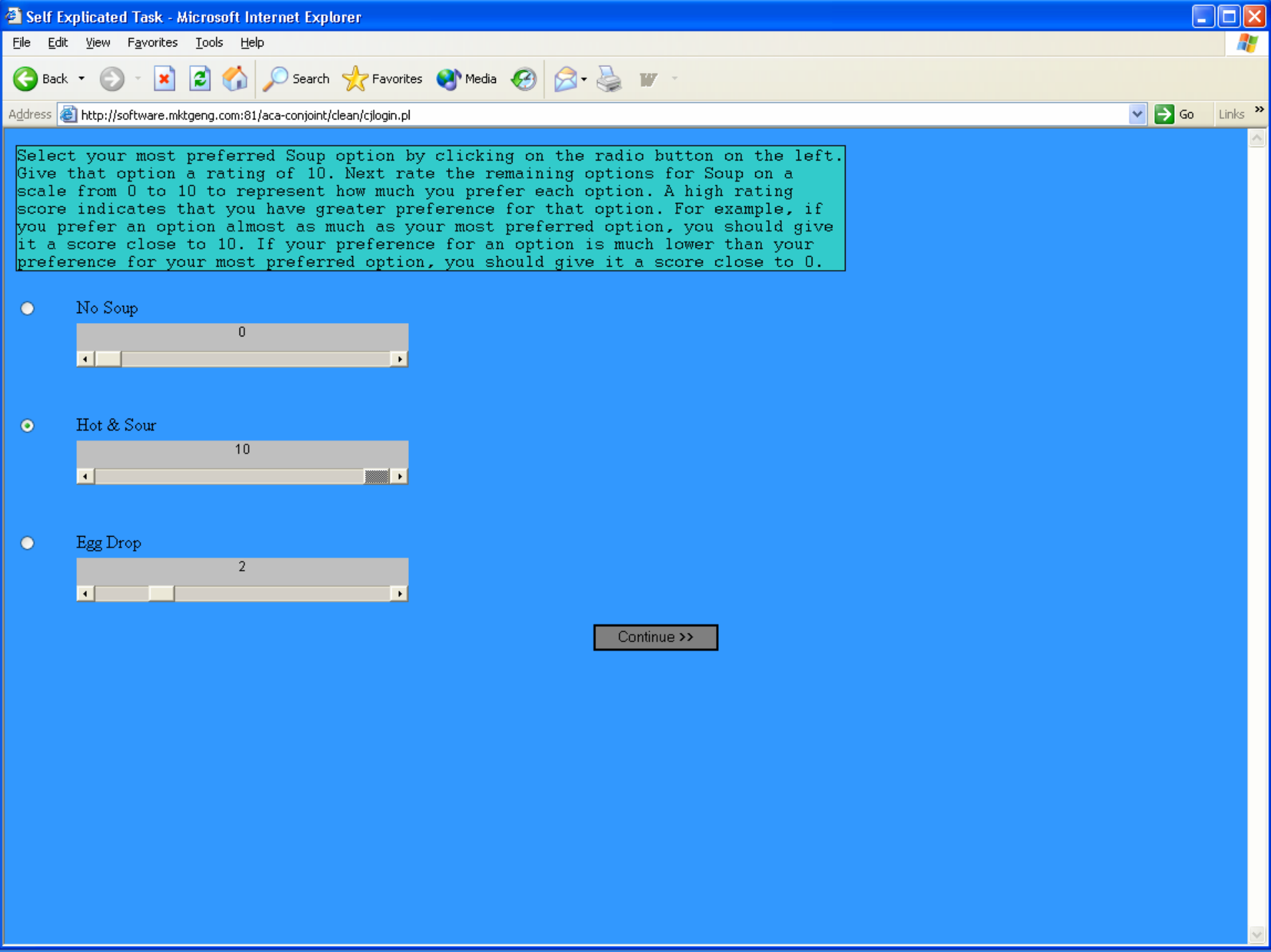
Please enter any special id given to you
If no special id was provided, you may leave this field blank

Instructions

In this section, you will be presented with a set of product attributes as part of a product rating task. Each product attribute has a number of options. For example, in a study of cars, the product attributes of interest might be price, color, type of engine and the options for color might be red, blue, and white.

First, for each product attribute, you will be asked to select the option that you prefer the most. Next you will be asked to rate the remaining options for that attribute on a scale from 0 to 10 to represent how much you prefer each option. A high rating score indicates that you have greater preference for that option. For example, if you prefer an option almost as much as your most preferred option, you should give it a score close to 10. If your preference

Continue >>



Select your most preferred Soup option by clicking on the radio button on the left. Give that option a rating of 10. Next rate the remaining options for Soup on a scale from 0 to 10 to represent how much you prefer each option. A high rating score indicates that you have greater preference for that option. For example, if you prefer an option almost as much as your most preferred option, you should give it a score close to 10. If your preference for an option is much lower than your preference for your most preferred option, you should give it a score close to 0.

- No Soup
0
- Hot & Sour
10
- Egg Drop
2

Continue >>

Please distribute 100 points among the following product attributes. You should give higher number of points to those attributes which are more important to you when deciding on a Chinese dinner. Note that the points should sum to 100.

Soup:	0
Rice/Noodle:	0
Sauce:	0
Vegetables:	0
Meat:	0
Spring Roll:	0
Quantity:	0
Price:	0

Continue >>

Instructions

In this section, you will be asked to rate a number of potential Chinese dinners that you have. Each dinner will be described in terms of the product options that you have already seen.

Rate each dinner on a scale from 0 to 100. Give a higher rating score to a dinner that you prefer more, and lower rating score to a dinner you prefer less.

To review the instructions at any time, click the Help button located at the top right of this page.

Continue >>

Question 1 :
Indicate your preference for a Chinese Dinner with the following options.

Soup: Egg Drop
Rice/Noodle: Brown Rice
Sauce: Hot & Spicy Szechuan
Vegetables: Standard vegetables (e.g.,
broccoli, mushrooms)
Meat: Chicken
Spring Roll: Vegetable
Quantity: Quart (2 pints)
Price: \$ 3.99

64

Submit

Question 2 :
Indicate your preference for a Chinese Dinner with the following options.

Soup: No Soup
Rice/Noodle: Brown Rice
Sauce: Hot & Spicy Szechuan
Vegetables: Standard vegetables (e.g.,
broccoli, mushrooms)
Meat: Chicken
Spring Roll: Vegetable
Quantity: Quart (2 pints)
Price: \$ 3.99

53

Submit

Question 3 :

Indicate your preference for a Chinese Dinner with the following options.

Soup: Egg Drop
Rice/Noodle: Brown Rice
Sauce: Sweet & Sour
Vegetables: Standard vegetables (e.g.,
broccoli, mushrooms)
Meat: Chicken
Spring Roll: Vegetable
Quantity: Quart (2 pints)
Price: \$ 3.99

Submit

- **Expectations**
 - Profiles being rated have a higher preferred score, on average, as number of profiles rated increases
 - Calculate average rating, across all participants, each time a profile was rated

$$\bar{y}_n = \sum_{i=1}^{IND} \frac{y_{i,n}}{IND}$$

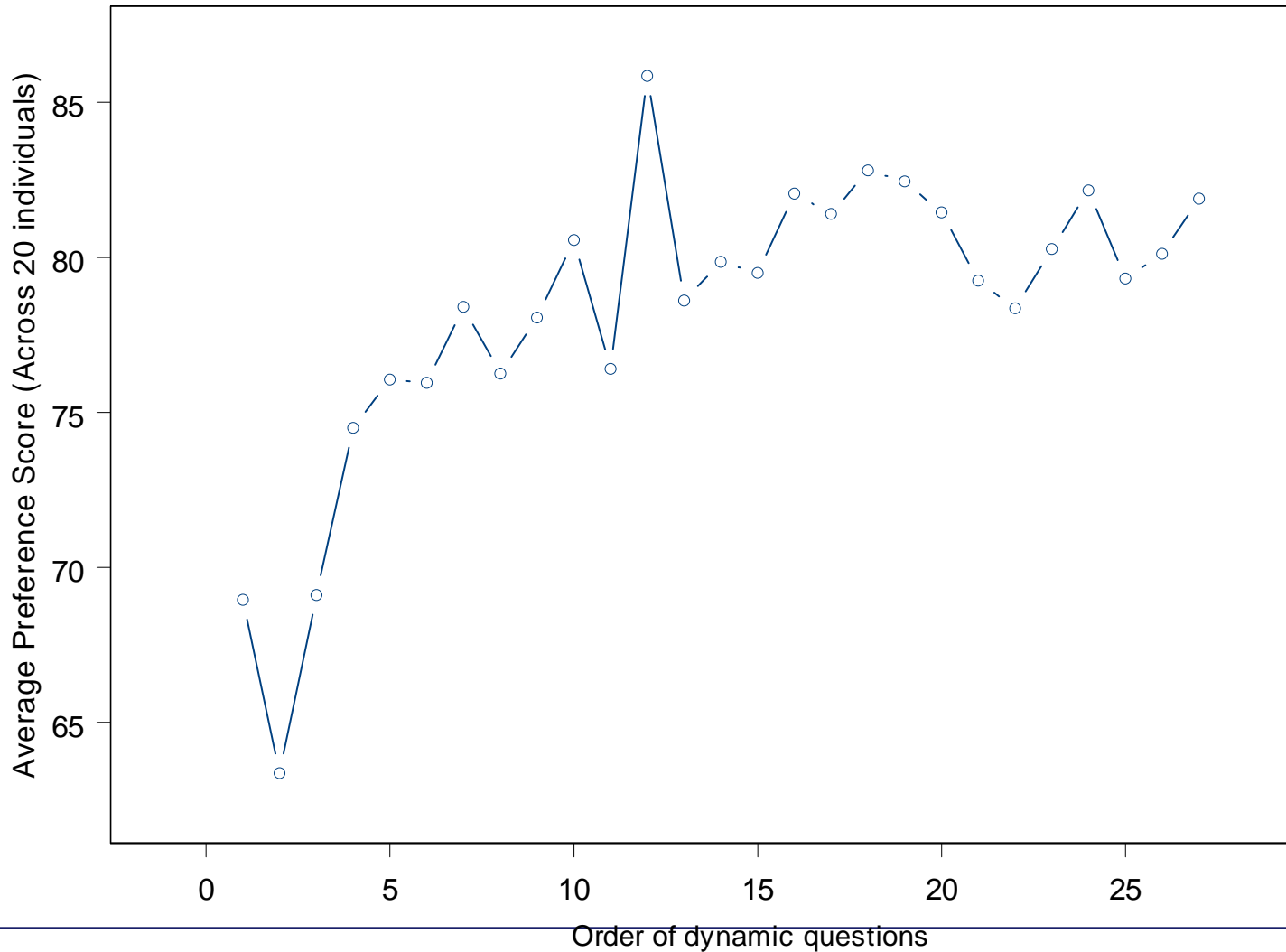
- **Expectations**

- Profiles being rated have a higher preferred score, on average, as number of profiles rated increases
- Ability to forecast rating of most preferred profile increases over time (MSE gets smaller)
 - Consider how well dynamic estimates predict the rating of the last profile
 - Calculate MSE for last profile (across all participants) based on dynamic estimates of partworths

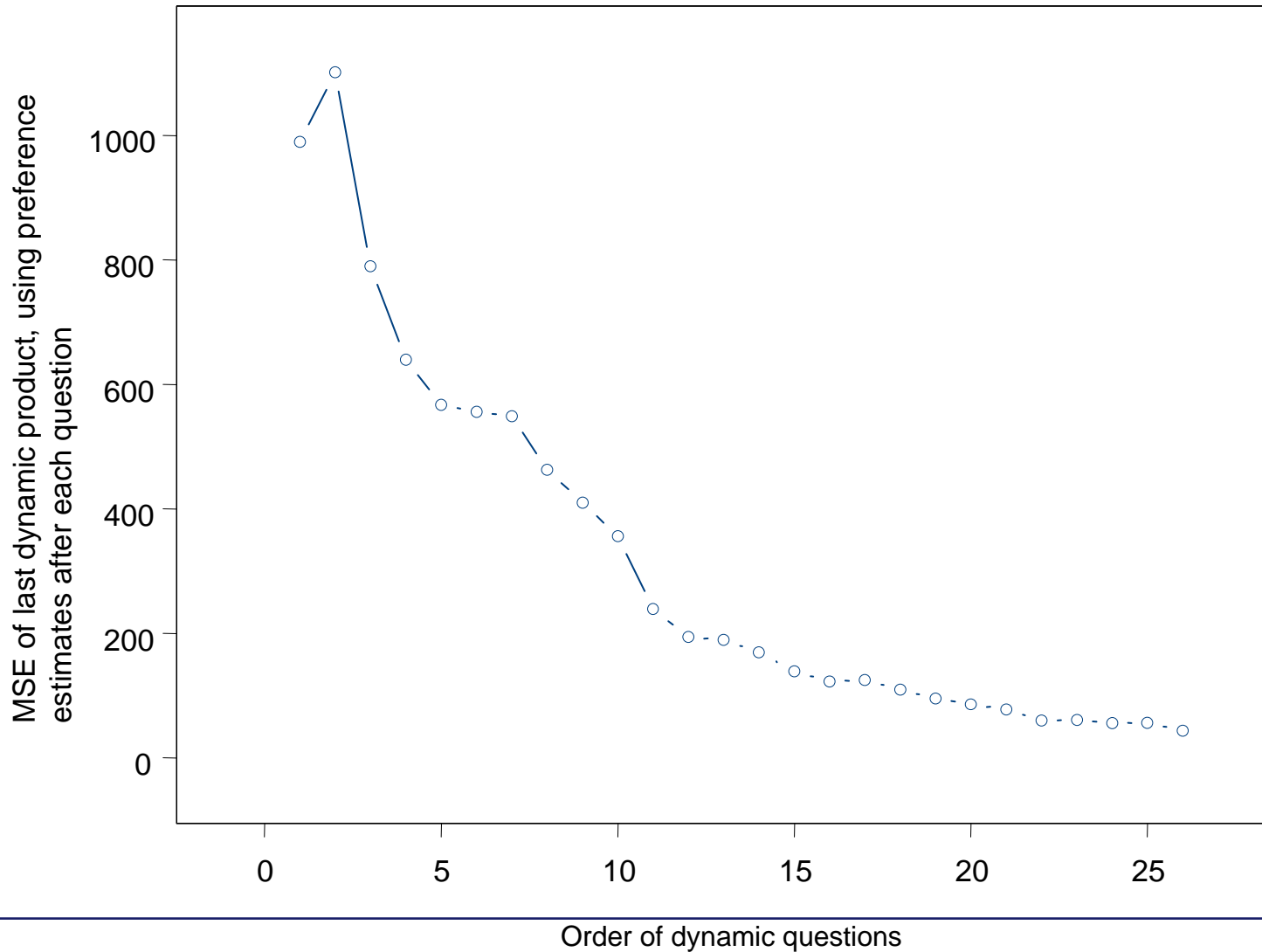
$$MSE_n = \frac{1}{IND} \sum_{i=1}^{IND} \left(y_{i,N} - \beta_n^T X_{i,N} \right)^2$$

- **Expectations**
 - Profiles being rated have a higher preferred score, on average, as number of profiles rated increases
 - Ability to forecast rating of most preferred profile increases over time (MSE gets smaller)
 - Ability to forecast over other parts of the design space decreases over time (MSE gets larger)
 - Calculate the MSE (across all participants) for the hold-out profiles, based on dynamic estimates

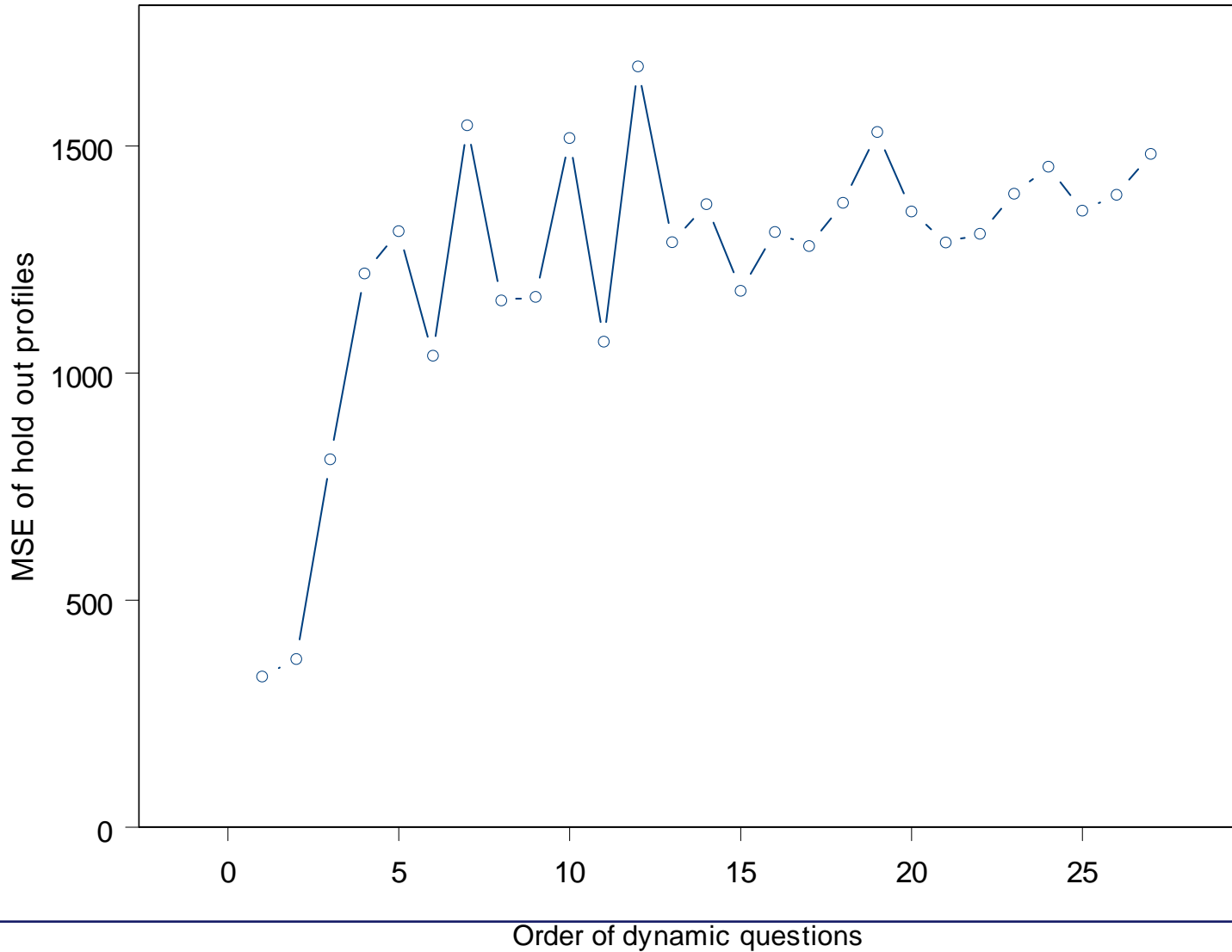
$$\bar{y}_n = \sum_{i=1}^{IND} \frac{y_{i,n}}{IND}$$



$$MSE_n = \frac{1}{IND} \sum_{i=1}^{IND} (y_{i,N} - \beta_n^T X_{i,N})^2$$



MSE of Holdout Predictions





Study 3: Probabilistic Fast Polyhedral Model

PENNSSTATE



Model Development

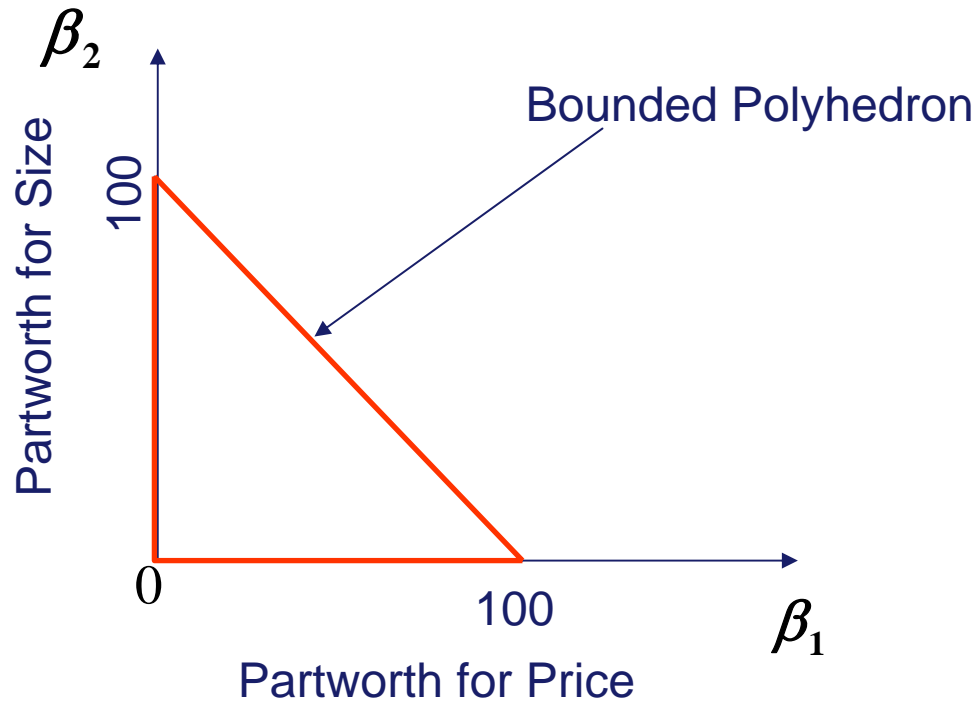
Strategy for sequential
questions:

- iii. Probabilistic fast
polyhedral

Ex ante conjoint model building

- **Polyhedral Approaches for Conjoint Analysis (Toubia et al. Marketing Science, 2003).**
 - Question sequence & Estimation of partworth utilities
- **Key idea:**
 - Represent feasible values of partworths as a bounded polyhedron.
 - Reduce polyhedron rapidly with ‘optimal’ questions.
 - ‘Center’ of polyhedron is the partworth estimate.
- **However, response errors (i.e., responses that lead to infeasible regions) are treated in a theoretically appealing manner.**
- **Our aim: Extend polyhedral method to incorporate response error using a well-defined probability model.**

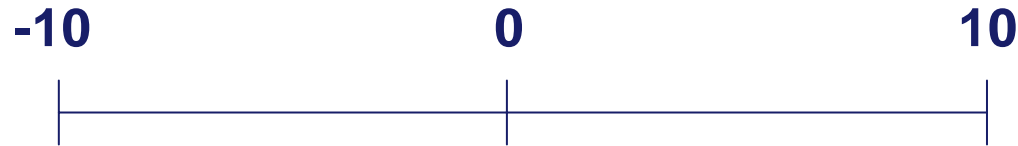
Study 3: FASTPACE: Two-attribute Laptop Example



Study 3: FASTPACE example cont'd

Ask respondent:

How much do you prefer product 1 over product 2?



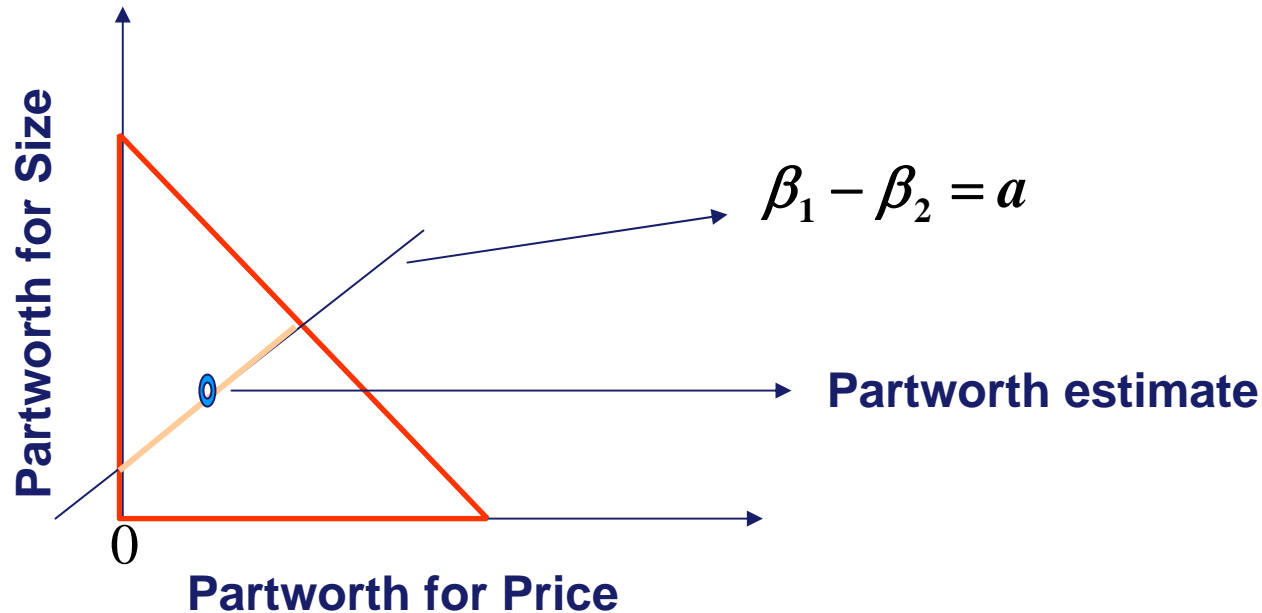
Description
of Product 1

Description
of Product 2

Attribute	Product 1	Product 2
Price	\$ 91	\$ 70
Size	Large	Medium

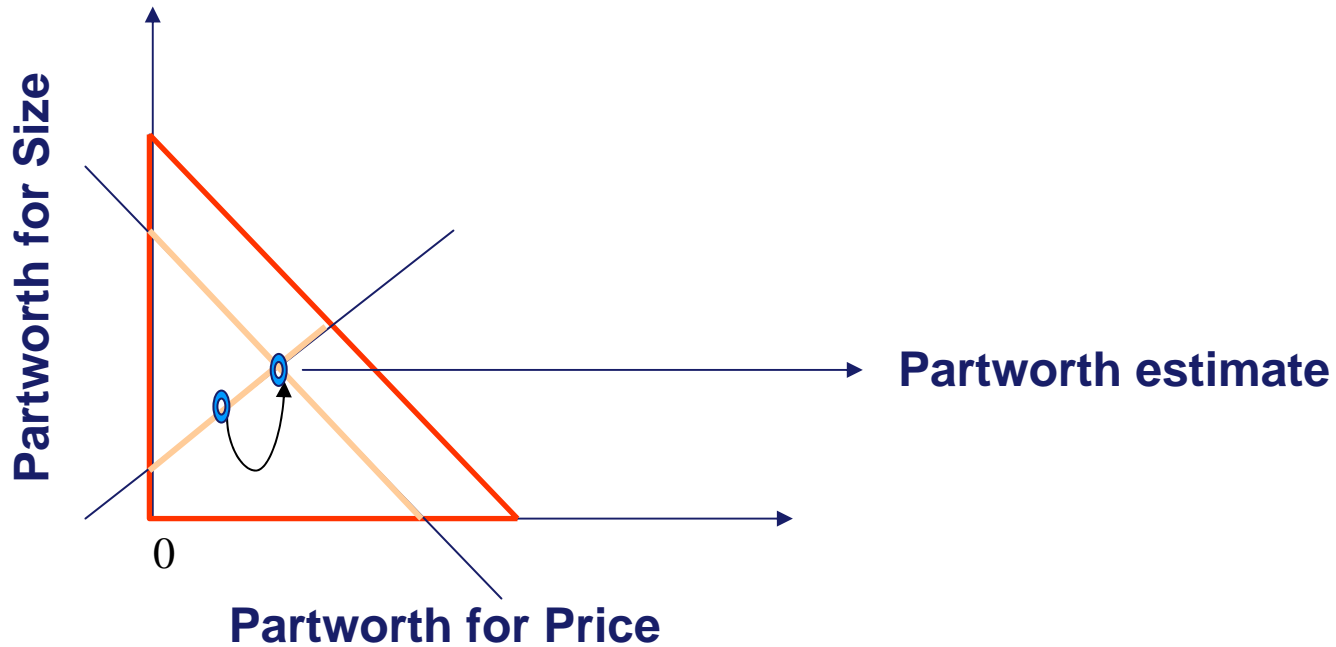
Study 3: FASTPACE example cont'd

- Set least desirable level of attributes to 0.
- Each response results in a reduction of the dimensionality of the polyhedron.



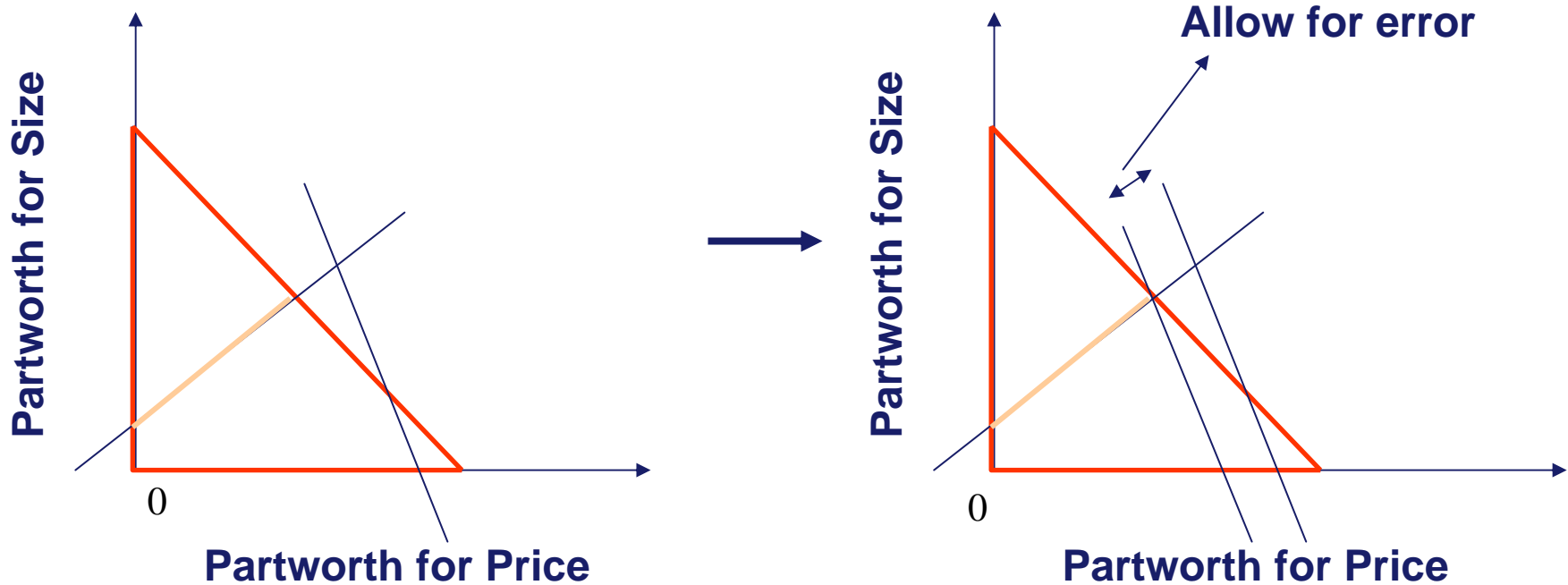
Study 3: FASTPACE example cont'd

- Ask another question and refine our estimates.



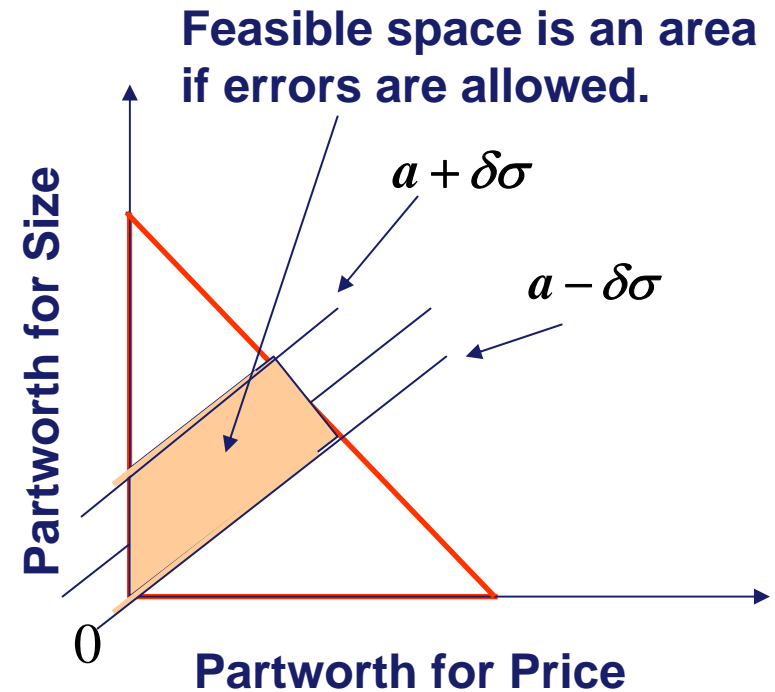
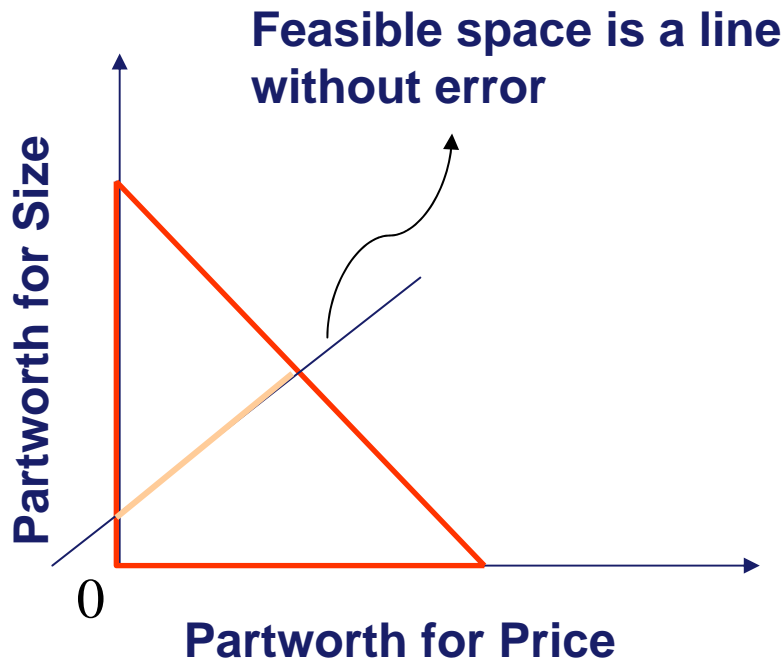
Study 3: FASTPACE Example cont'd

- Response error is allowed only when inconsistent responses are detected.



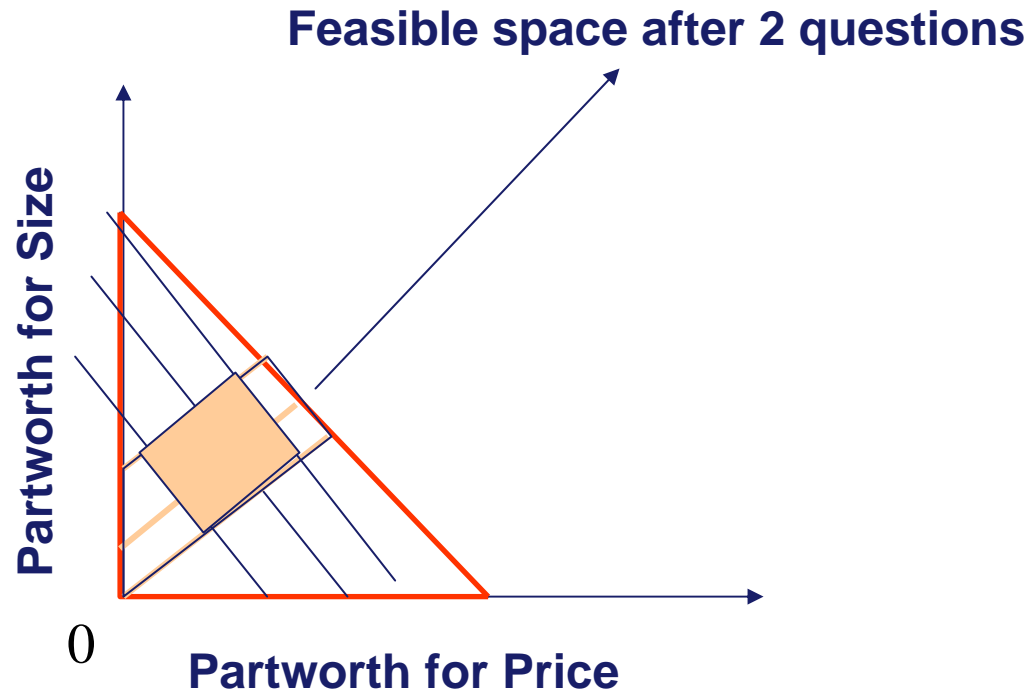
Study 3: Extending FASTPACE

- Incorporate response error within FASTPACE framework using a general probability model.



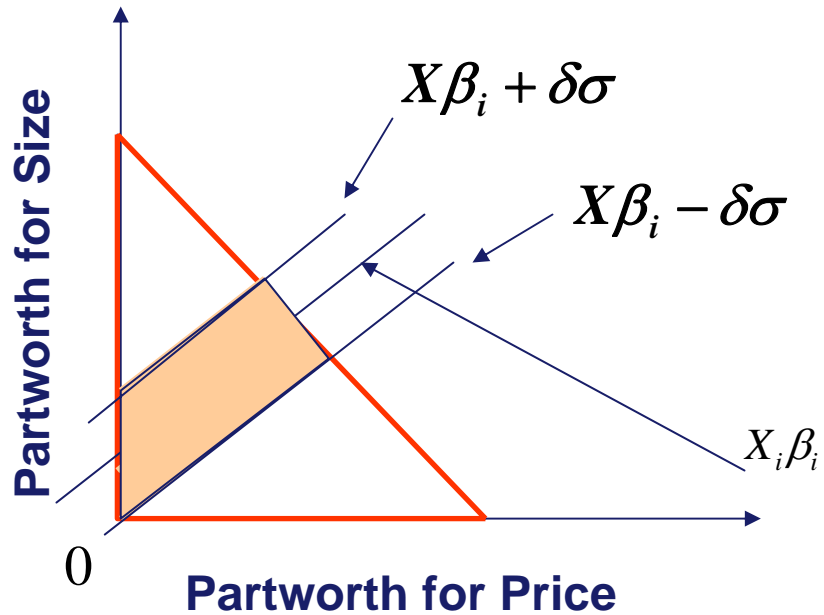
Study 3: Extending FASTPACE

- After next question, the space shrinks further.
- Procedure ensures that there is always some probability mass in the feasible region.



- Enhanced HB Regression Framework

$$a_i \sim N(X_i\beta_i, \sigma^2) I(X_i\beta_i - \delta\sigma \leq a_i \leq X_i\beta_i + \delta\sigma)$$



- Probability Model for the parameters

$$\beta_i \sim N(\bar{\beta}, \Sigma) I(\beta_i \geq 0) I(\sum \beta_i \leq 100)$$

$$\sigma^2 \sim IG(shape, scale)$$

- Assume prior distributions for $\bar{\beta} \sim N(.,.)$, $\Sigma \sim IW(.,.)$

Study 3: Preliminary Results

- Initial test of model done using laptop bag study of Toubia et al (2003).
- Details:
 - 88 respondents.
 - Respondent answered self-explicated questions followed by 20 paired comparison questions.
 - Each paired comparison question had product descriptions consisting of 3 attributes that were chosen from 10 attributes.
 - Each attribute had 2 levels.
- Hold-out task: Respondents rank-ordered 5 bags (selected randomly out of 16 available bags).
- Goal of test: To examine how well FASTPACE and our model predict the ranking of the bags.

- Preliminary results show that our model performs on par with FASTPACE on holdout task (their laptop bags data).
- Our rank order correlation with actual choice: 0.68
- FASTPACE rank order correlation: 0.68
- Their Sawtooth software HB model's rank order correlation: 0.64

- **Implement question design**
 - FASTPACE based on structure of polyhedron.
 - Our approach: Based on probability model.
- **Fully nest FASTPACE within our HB model**
 - Currently, FASTPACE is conceptually nested within our model.
 - However, operationally, FASTPACE uses min-max criteria whereas we use min sum of squared errors criteria (i.e., OLS-type minimization).
- **Develop implementation techniques for question sequencing and estimation in real-time web environments.**

Study 3: Conclusion

- **We extend FASTPACE by incorporating response errors in a theoretically appealing manner.**
- **With test data (and without full nesting of FASTPACE within our approach), HB does as well as FASTPACE.**
- **Further research in progress to establish domains of applicability of our HB model (especially with reference to FASTPACE).**



Your thoughts/suggestions for future research?
