



Introduction to Open Source Conjoint



 John Paul Helveston, Ph.D.

 The George Washington University |
Dept. of Engineering Management and
Systems Engineering

 June 15, 2023

Target audience

You are familiar with:

- Conjoint analysis / discrete choice experiments
- Choice modeling / utility models
- R / programming in general

Install Software!

<https://jhelvy.github.io/2023-qux-conf-conjoint/software>

Hello World!



John Helveston, Ph.D.

Assistant Professor, Engineering Management & Systems Engineering

- 2016-2018 Postdoc at [Institute for Sustainable Energy](#), Boston University
- 2016 PhD in Engineering & Public Policy at Carnegie Mellon University
- 2015 MS in Engineering & Public Policy at Carnegie Mellon University
- 2010 BS in Engineering Science & Mechanics at Virginia Tech
- Website: www.jhelvy.com

Technology Change Lab

I study how consumers, firms, markets, and policy affect technological change, with a focus on accelerating the transition to low-carbon technologies

Electric & Sustainable Vehicle Technologies



Market & Policy Analysis

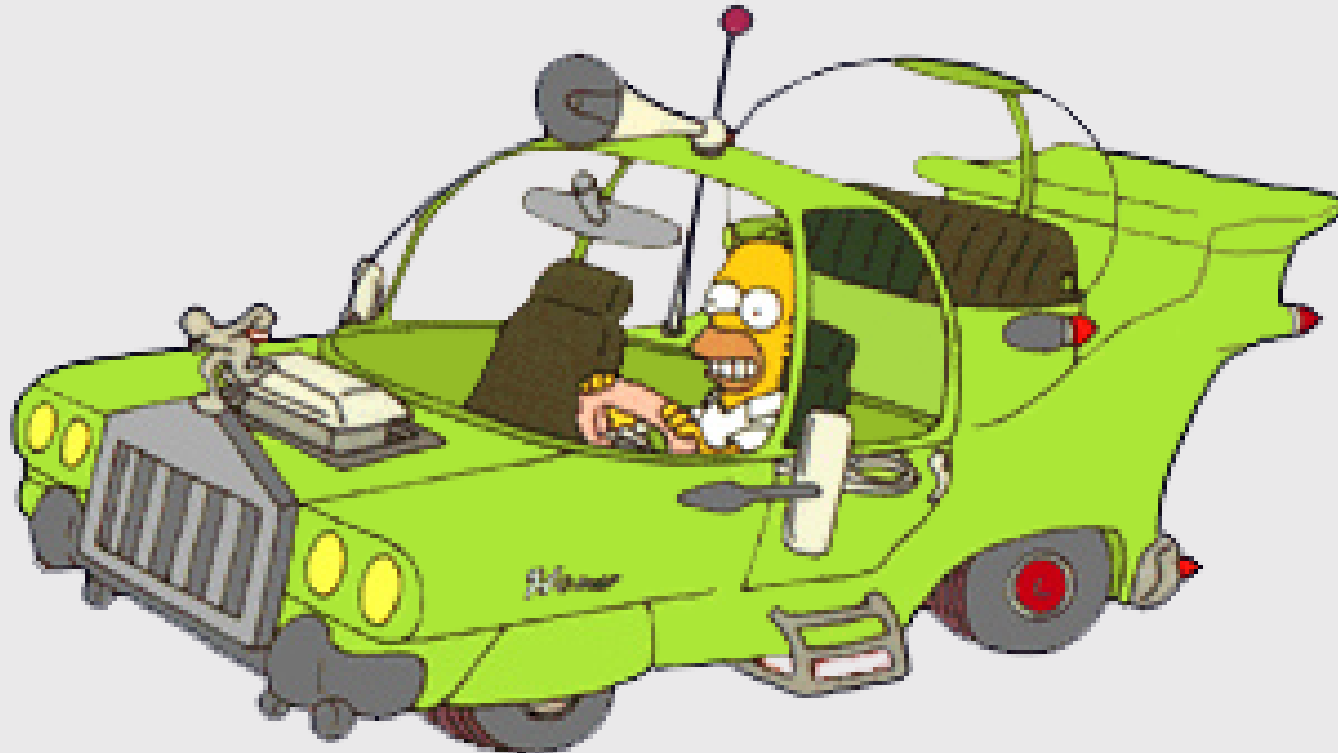


How can you find out know what people want?



Directly asking people what they want isn't always helpful

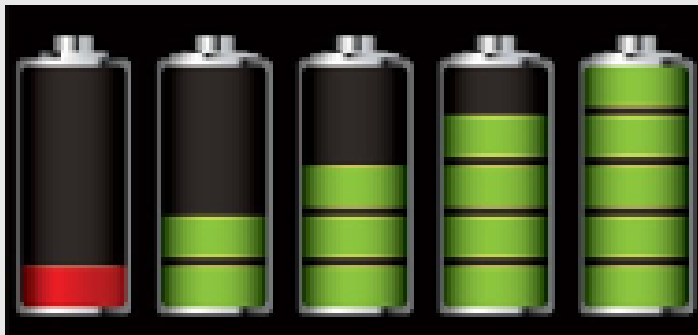
(People want everything)



Which feature do you care more about?



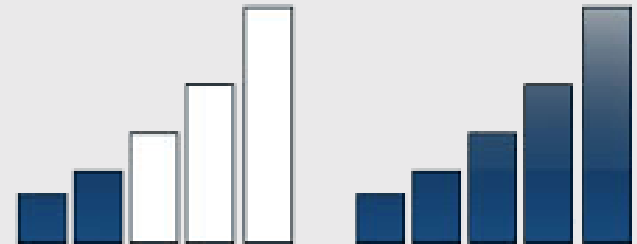
Battery Life?



Brand?




Signal quality?



Conjoint Analysis:

Use choice data to model preferences

<u>Attribute</u>	<u>Phone 1</u>	<u>Phone 2</u>	<u>Phone 3</u>
Price	\$400	\$450	\$350
Brand			
Battery Life			
Signal Quality			

Use random utility framework to predict probability of choosing phone j

1. $u_j = \beta_1 \text{price}_j + \beta_2 \text{brand}_j + \beta_3 \text{battery}_j + \beta_4 \text{signal}_j + \varepsilon_j$

2. Assume $\varepsilon_j \sim$ iid Gumbel distribution

3. Probability of choosing phone j : $P_j = \frac{e^{\beta' x_j}}{\sum_k^J e^{\beta' x_k}}$

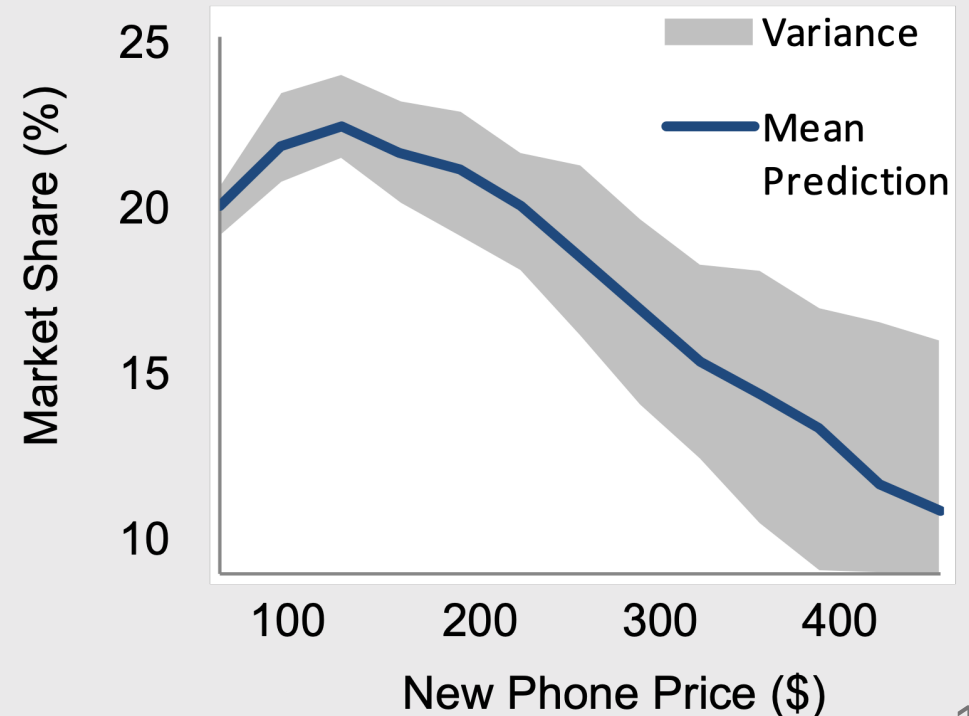
4. Estimate $\beta_1, \beta_2, \beta_3, \beta_4$ via maximum likelihood estimation

Willingness to Pay

Respondents on average are willing to pay \$XX to improve battery life by XX%

Make predictions

$$P_j = \frac{e^{\hat{\beta}'x_j}}{\sum_k^J e^{\hat{\beta}'x_k}}$$



Choice-Based Conjoint Analysis Steps

1. Design a survey (design of experiment)
2. Implement it online
3. (Collect data) <- not covering this today
4. Estimate models

Software for Choice-Based Conjoint Analysis



Experiment Design	✓	✓	✓	✓
Online Surveys	✓			
Model Estimation	✓	✓	✓	

- Licenses cost \$\$\$
- Not reproducible

FOSS for Choice-Based Conjoint Analysis

Experiment Design

R:

- {cbcTools}
- {ExpertChoice}
- {support.CEs}
- {idefix}
- {choiceDes}

Online Surveys

R:

- formr

Model Estimation

R:

- {logitr}
- {apollo}
- {mlogit}
- {gmnl}
- {mixl}

Other:

- Python: {xlogit}
- Stan

FOSS for Choice-Based Conjoint Analysis

Experiment Design



by John Paul Helveston

Online Surveys



by Ruben C. Arslan and
Cyril S. Tata

Conjoint adaptation by
John Paul Helveston

Model Estimation



by John Paul Helveston

Back to workshop website:

<https://jhelvy.github.io/2023-qux-conf-conjoint/>

@JohnHeston 

@jhelvy 

@jhelvy 

jhelvy.com 

jph@gwu.edu 