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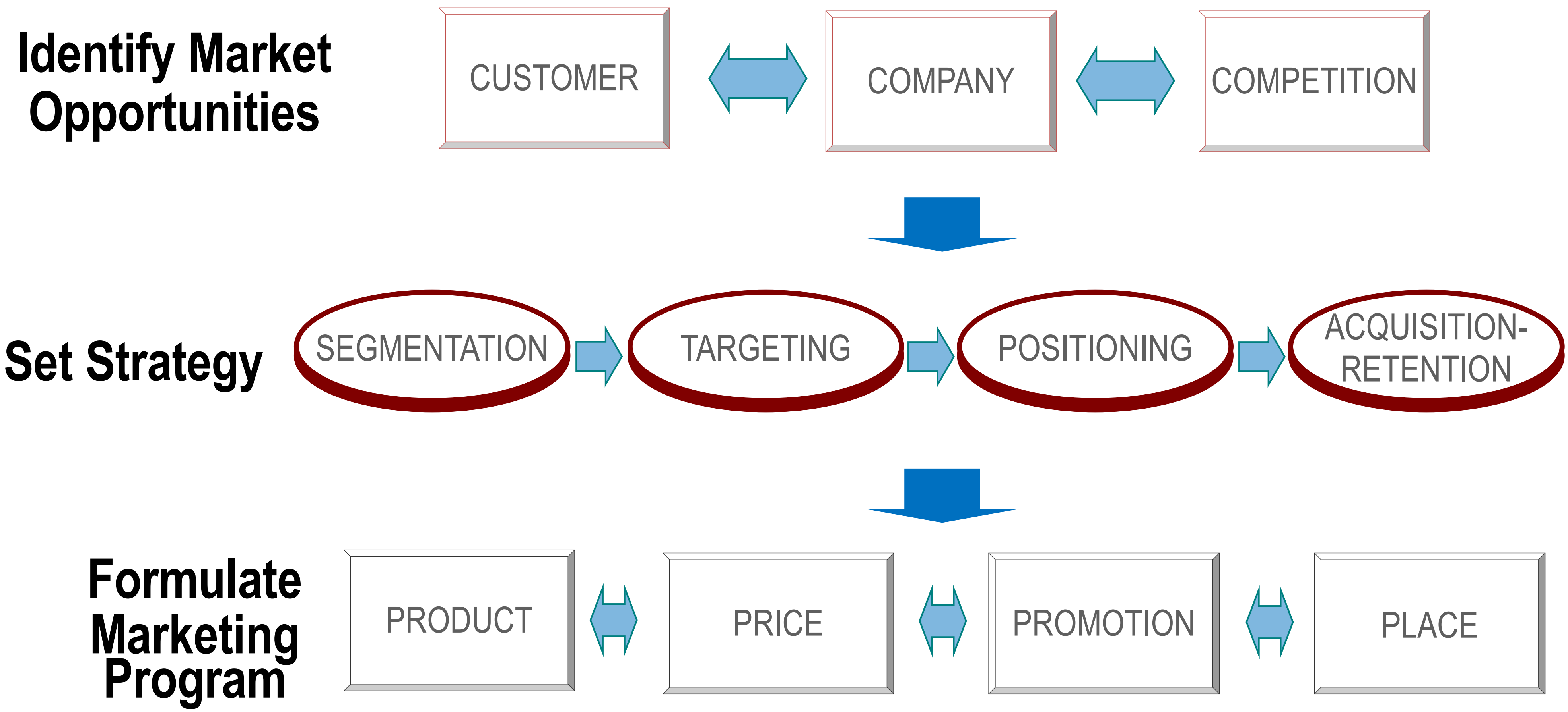
Introduction to Marketing Analytics

Session 4: Product

Professor Ricardo Montoya


Identify Market Opportunities
CUSTOMER
COMPANY
COMPETITION
Set Strategy
SEGMENTATION
TARGETING
POSITIONING
ACQUISITION-RETENTION
Formulate Marketing Program
PRODUCT
PRICE
PROMOTION
PLACE

Agenda

- New Product Development
  - Why do firms introduce new products?
  - Why do some good product ideas go bad?
  - What factors affect customers' adoption of new products?

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New Products

New Products - Discussion

- Think of a new product. What is new about the product?


Zippedi
CORN FLAKES
Fitness
NUEVO
pioneer LX

Covid-19
New restrictions…new behaviors

- **New Starbucks Premium Instant Elevates Multi-Serve Instant Coffee (April 29, 2021)**

New to the World…

MODO

XBOX

TiVo

TiVo, TV your way.™

PREWASHED in 100% NATURAL
Fit
CHLORINE FREE

New To the World

NETFLIX

New Economy

Uber

airbnb

Spotify

New to the World?

Total
Total Fresh Stripe
2 in 1 toothpaste & mouthwash
Sparkling White
Sensation Whitening
Sensitive Maximum Strength
Tartar Control
Tartar Control Plus Whitening
Baking Soda & Peroxide Whitening
Tartar Control with Baking Soda & Peroxide
Cavity Protection
Star Wars
Barbie toothpaste
Looney Tunes toothpaste
My First Colgate Toothpaste with Barney

About 5 - 10% of new products are truly new

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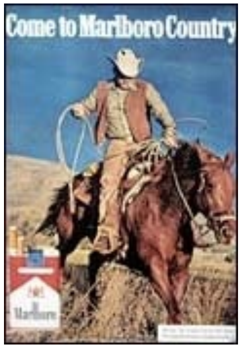
Types of New Products

MARKET

FIRM

Newness	L	M	H
L *Not Very New*	**Cost Reductions** 11%		**Repositionings** 7%
M *Moderately New*		**Product Line Extensions** 26%	
H *Very New*	**New Product Lines** 20%		**New to the World** 10%



New Products - Discussion

- Think of a new product. What is new about the product?
- **Why do you think the company introduced it?**

MODO

XBOX

TiVo

TiVo, TV your way.™

PREWASHED in 100% NATURAL
Fit
CHLORINE FREE

Support Additional Usage

Roomba (2002)

Braava (2013)

Line Extension for Segmentation

Comfort INN
COMFORT SUITES
QUALITY
SLEEP INN
Clarion
CAMBRIA SUITES
MainStay Suites
Suburban EXTENDED STAY HOTEL
Econo Lodge
RODEWAY INN

CHOICE HOTELS INTERNATIONAL

Better Meet Needs of Slightly Different Sub-segments Through Differentiation

Dannon - c.1947

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Address Needs of Potential Emerging Segments

Address Needs of Potential Emerging Segments

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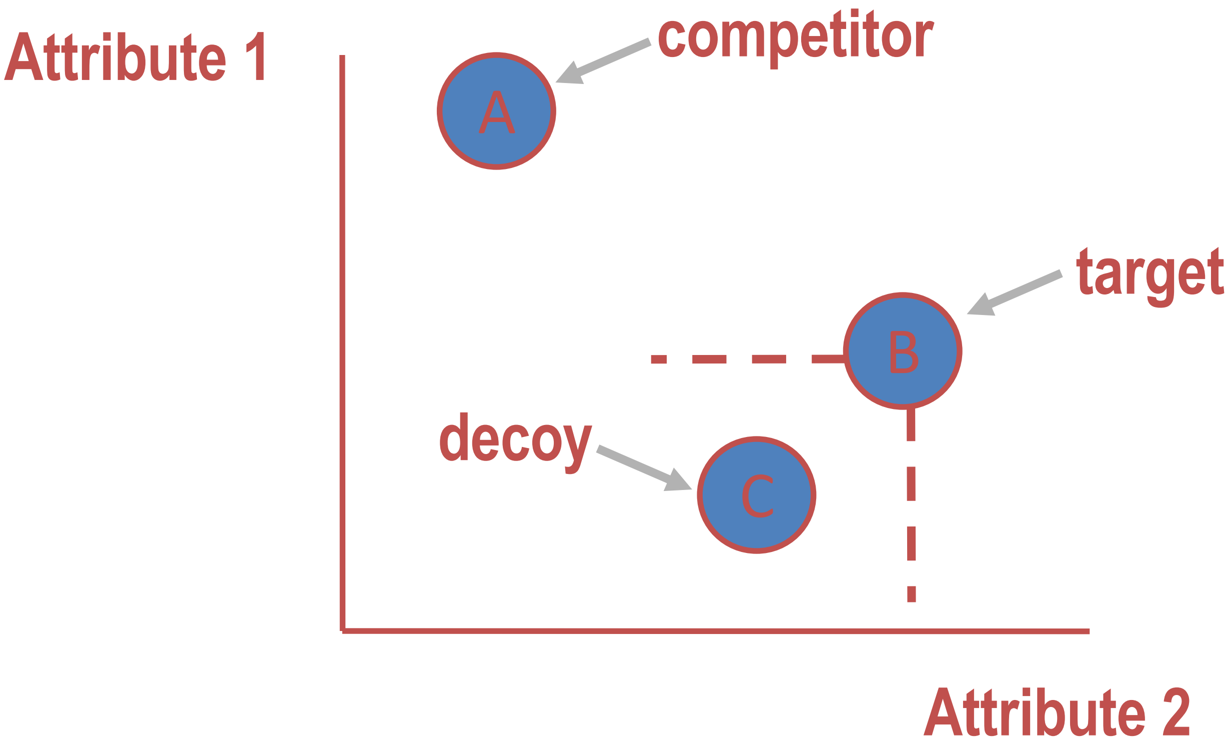
Variety Seeking

Enhance Sales of Current Products

Asymmetric Dominance Effect



Enhance Sales of Current Products

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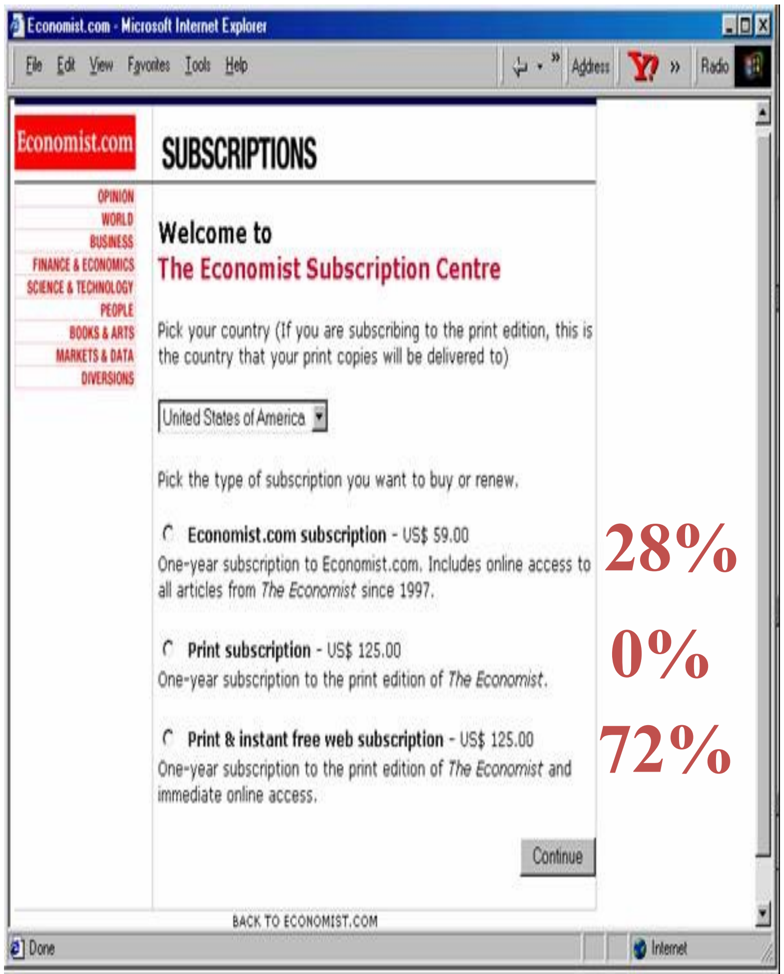
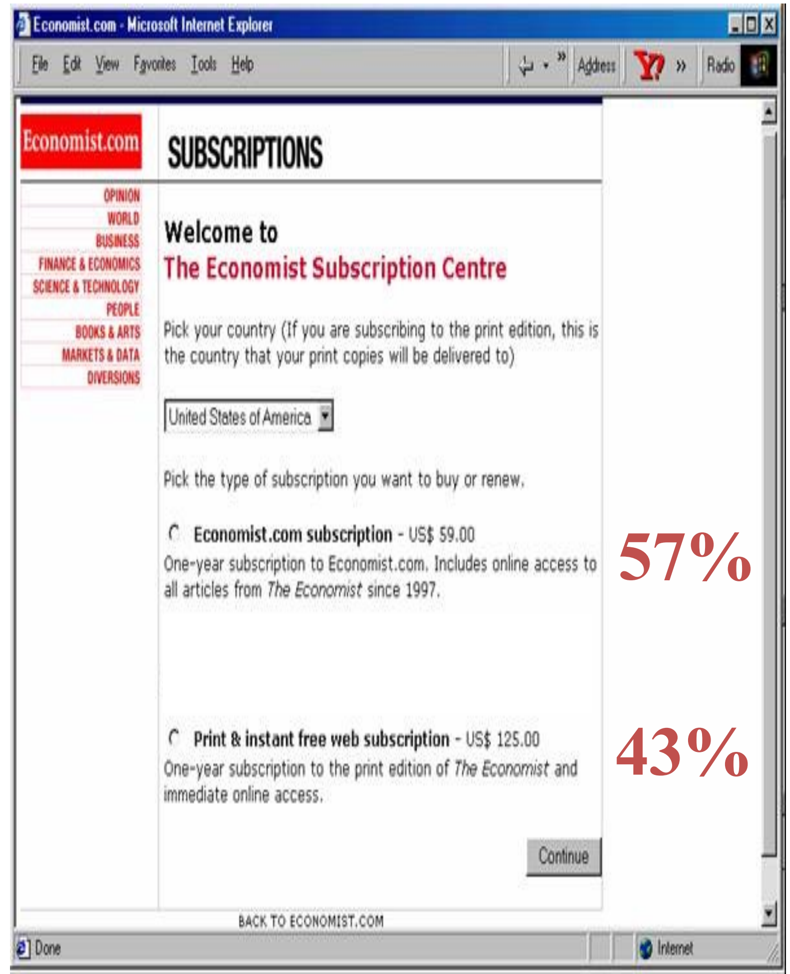
Asymmetric Dominance Effect





Source: Kivetz, Netzer, & Srinivasan 2004

Counter Encroachment by New Alternatives

Control Shelf Space

Alter Brand Image

Why Do Firms Introduce New Products?

- Support additional usage
- Better meet needs of slightly different sub-segments through differentiation

CUSTOMER

- Address needs of p... ging segments
- Encourage variety seeking
- Enhance sales of current products
- Counter encroachment by alternative products

COMPETITION

- Control shelf sp...
- Alter brand imag...

COMPANY

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New Products - Discussion

- What is new about the product?
- Why do you think the company introduced it?
- **Do you think it will be a success or a failure and why?**
- **If you think the product will fail, what would you do differently?**

Why Good Ideas Go Bad?

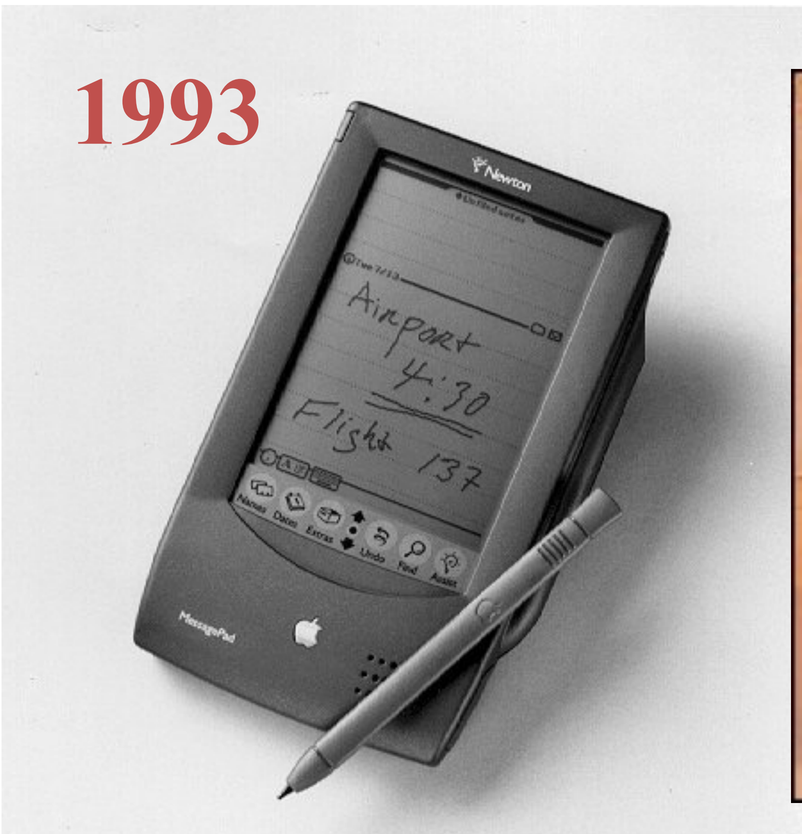
1986

2013

Google Glass

Problems with Product Quality or Product Attributes

1993



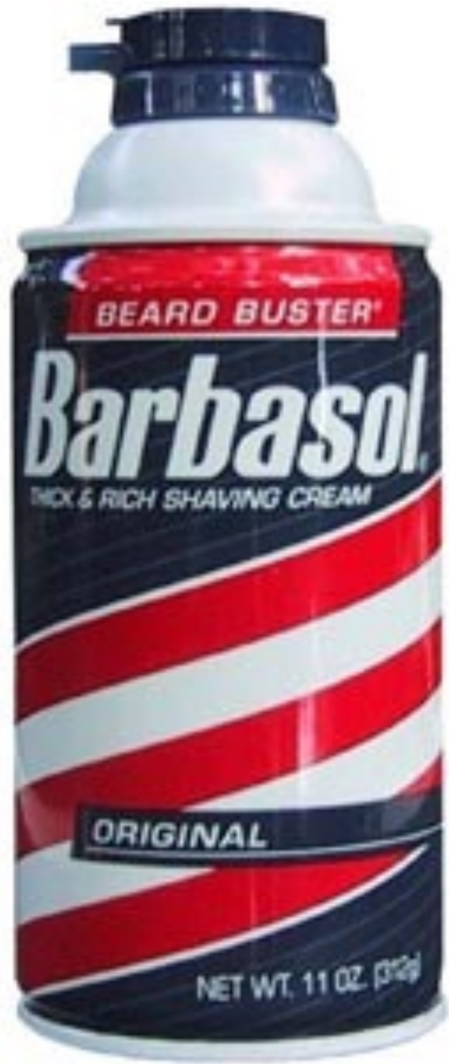
2004

Problems with Product Quality or Product Attributes

1974

2017

Problems with Pricing



Problems with Distribution (Place)

Holly Farms **1988**

Acquired by Tyson **1989**

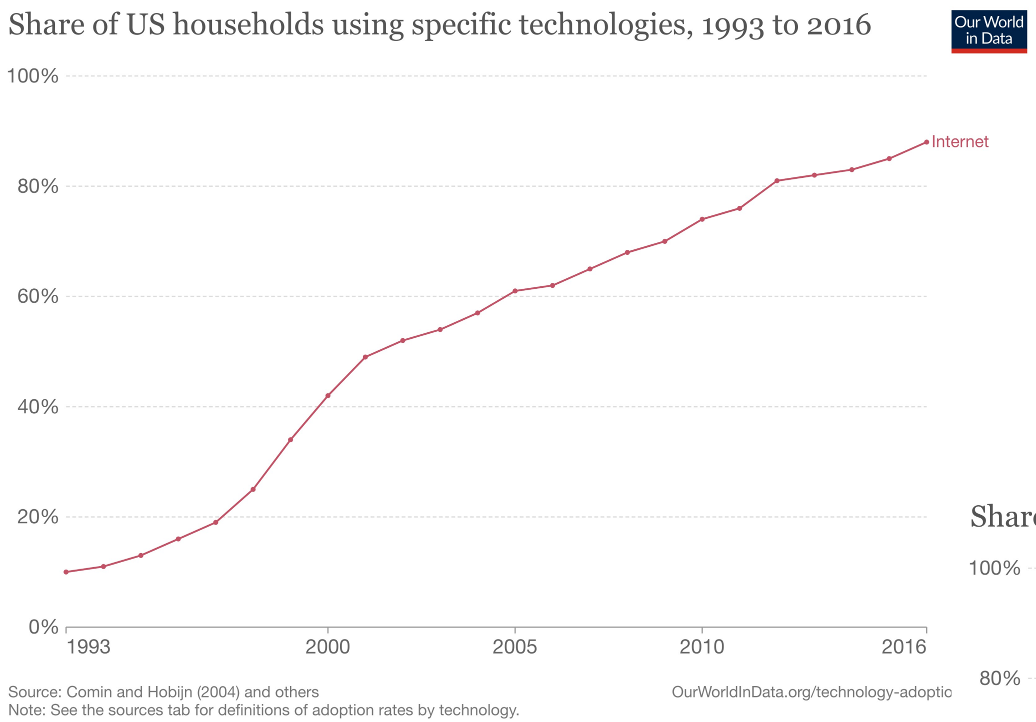
Problems with Promotion and Advertising

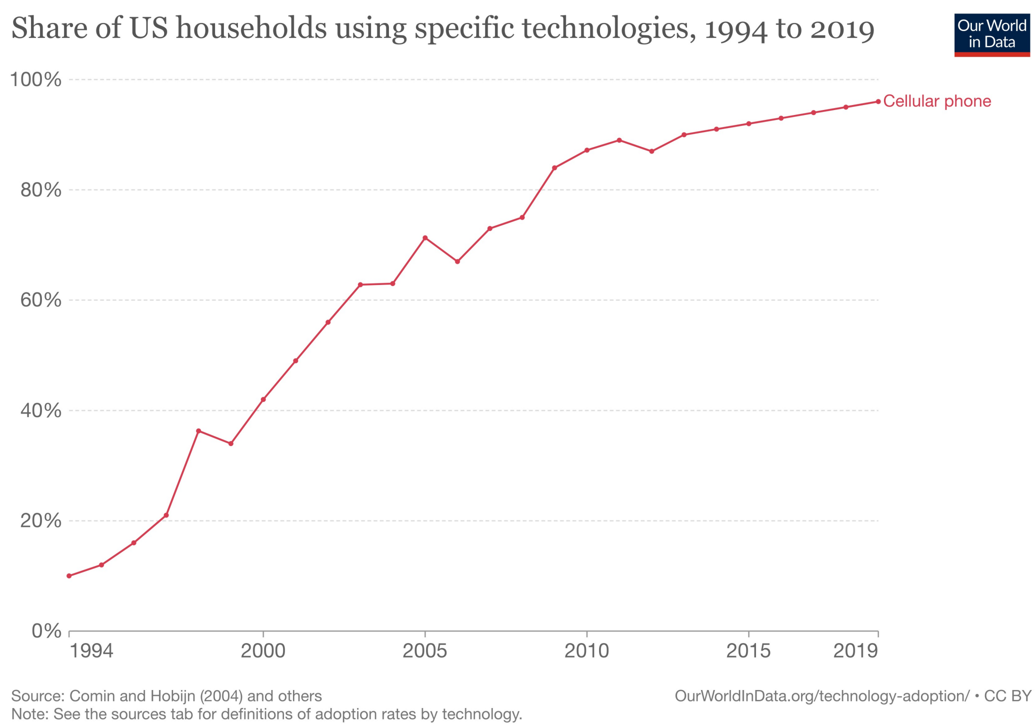
1977

2006

Predict the Future?

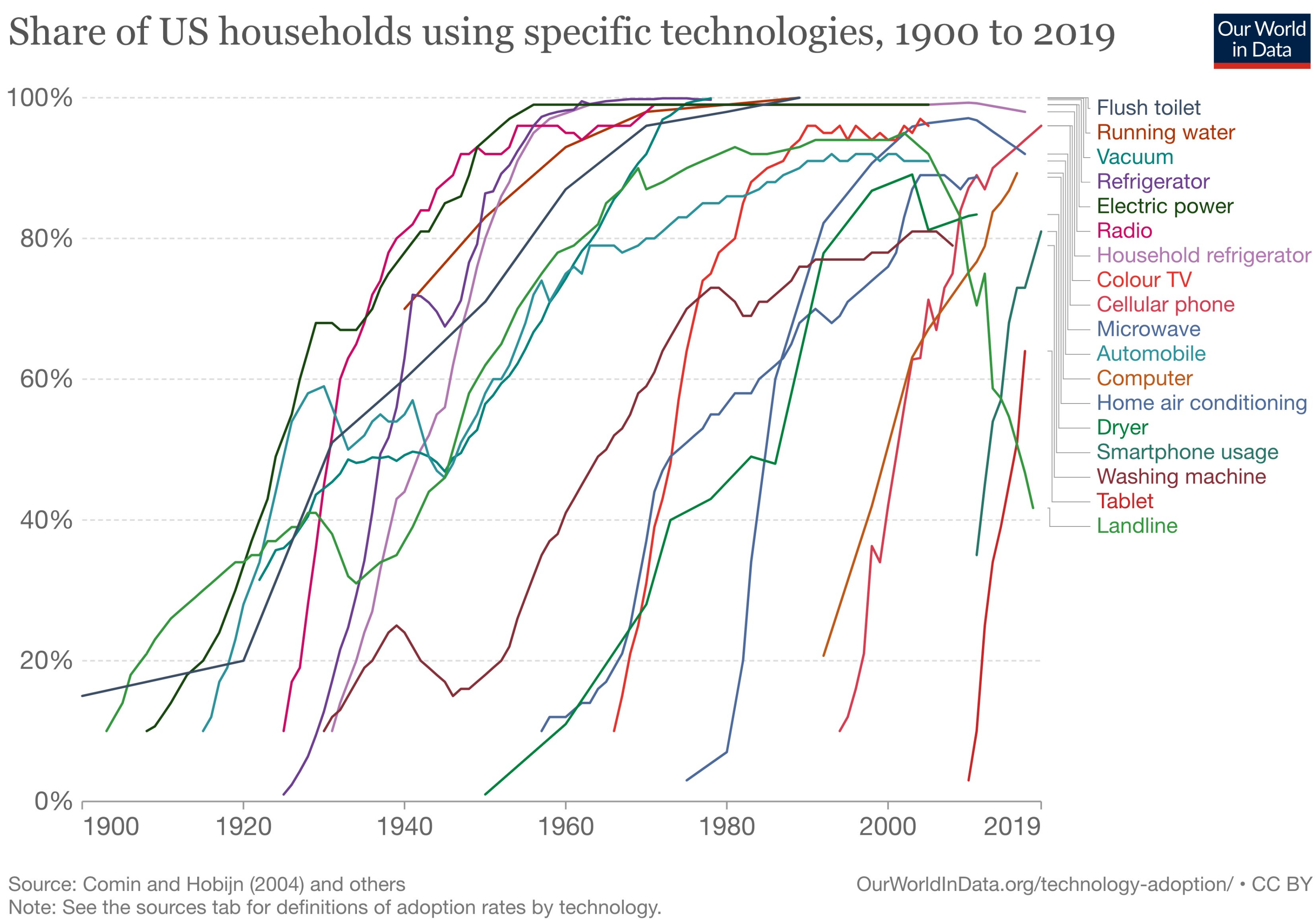
S-Shaped Diffusion Curve of New Products





- Bass Model

Diffusion Curve of Technology Adoption



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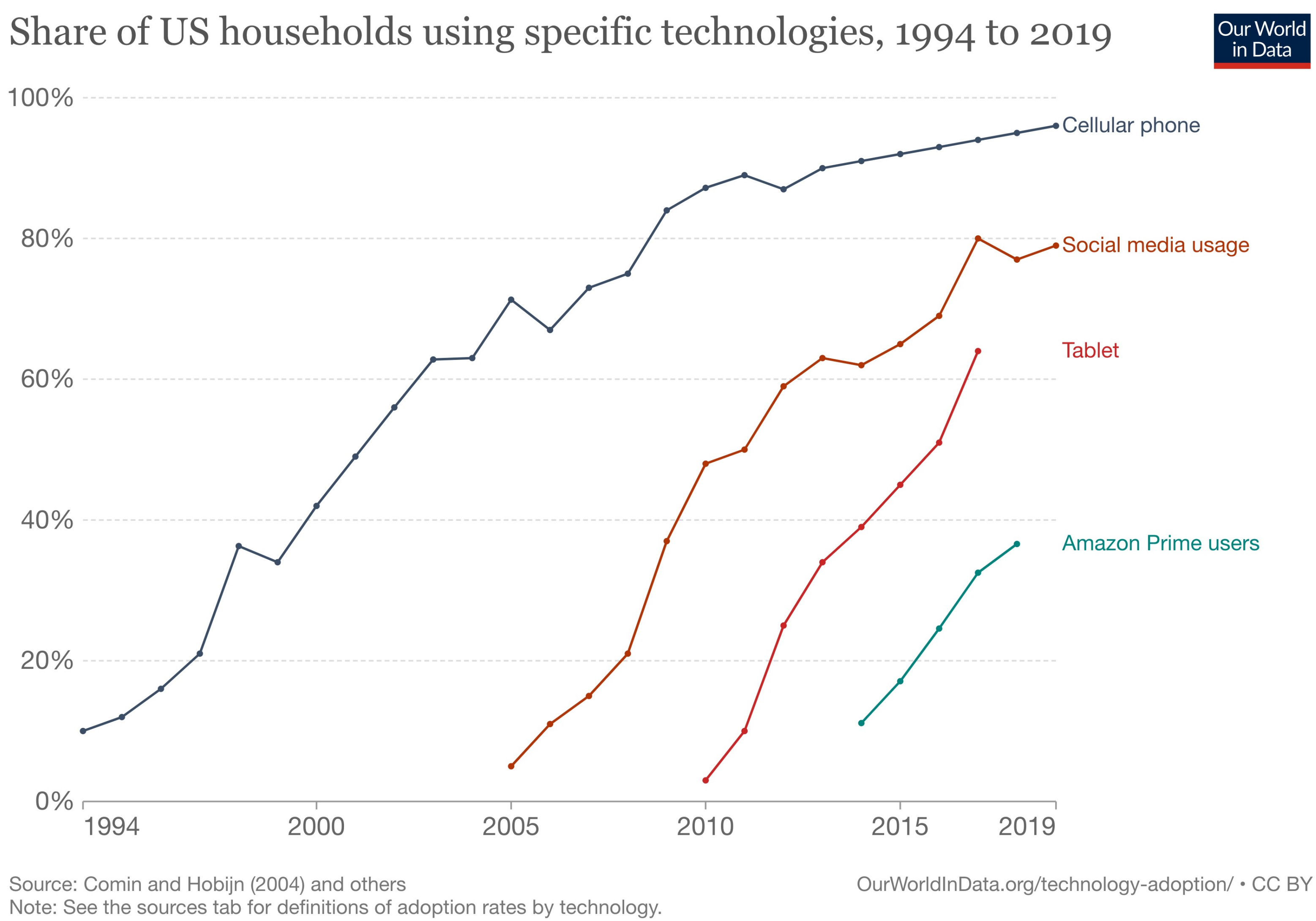
Diffusion Curve of Technology Adoption



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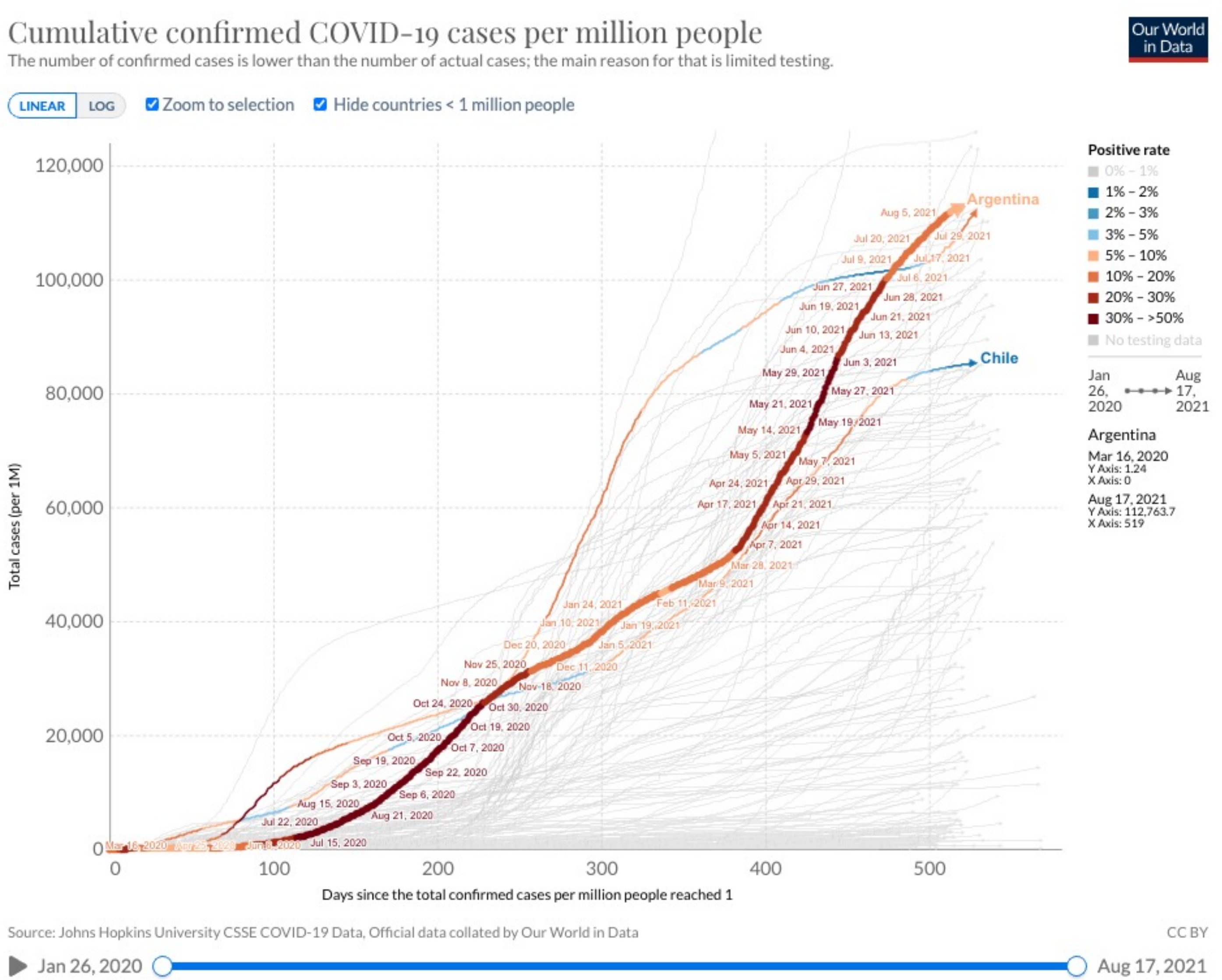
Diffusion Curve Covid-19



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Factors Affecting Customer Adoption

- Advantage
- Compatibility
- Complexity
- Observability
- Risk
- Divisibility

Main Takeaways (New Products)

- Why do firms introduce new products?
  - ➢ Think of the 3Cs…
- Why do some good product ideas go bad?
  - ➢ Think of the 4Ps…
- What factors affect customers’ adoption of new products?
  - ➢ Think of ACCORD!

Modeling Choice Decisions

Modeling Choice Decisions

- Imagine the following decisions
  - Buying a house
  - A company deciding whether to enter a market
  - A student deciding a career to study

- We need a structure to model this kind of behavior

Examples of Some Applications

- Problems that require the use of choice models in marketing
  - Purchases in supermarkets
  - Use of promotions
  - Search and purchases in multichannel environments
  - Answers to preference surveys (conjoint analysis)
  - Redemptions in loyalty programs
  - Movies to see on VOD systems (video-on-demand)
  - And many, many others…

Discrete Choice Models

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Utility Maximization

- We want to describe P_{ni}, the probability that an agent n ($n = 1, \dots, N$) chooses alternative *i* (*i*=1,… ,*I*)

- We assume that the consumer (the firm) decides among the available alternatives by maximizing an underlying utility u_{ni} (profit π_{ni})
  - Choosing the alternative that yields the highest utility within the choice set

- The utility u_{ni} is known by the decision maker, but not for the analyst and therefore we decompose it in deterministic component (v_{ni}) and a stochastic component (ϵ_{ni})
  - Only the deterministic component is observable to the analyst

$$u_{ni} = v_{ni} + \epsilon_{ni}$$

Properties of Choice Models

- Finite number of alternatives
  - The decision maker chooses among a finite number of alternatives (choice set)
- Mutually exclusive
  - If not originally in the data, exclusive alternatives must be constructed
    - If alternatives A and B are not exclusive, create alternatives: A only, B only, both A & B
  - Exhaustives
    - All possible alternatives must be included (include none of the other alternatives)

Derivation of Choice Probabilities

- Utility of alternative i
  - $u_{ni} = v_{ni} + \epsilon_{ni}$
- Consumer chooses alternative i
  - If and only if $u_{ni} > u_{nj}\ \forall j \neq i$

$$
\begin{aligned}
P_{ni} &= \Pr\left(u_{ni} > u_{nj}, \forall j \neq i\right) \\
&= \Pr\left(v_{ni} + \epsilon_{ni} > v_{nj} + \epsilon_{nj}, \forall j \neq i\right) \\
&= \Pr\left(\epsilon_{nj} - \epsilon_{ni} < v_{ni} - v_{nj}, \forall j \neq i\right) \\
&= \int_{\epsilon} I\left(\epsilon_{nj} - \epsilon_{ni} < v_{ni} - v_{nj}, \forall j \neq i\right) f(\epsilon_n) d\epsilon_n
\end{aligned}
$$

Some cases

- Different assumptions about the distribution of error would imply different models
  - Logit, probit, mixed logit, etc
- The integral has closed-form solution for some cases
  - Logit, nested logit, hierarchical logit
  - iid extreme value distribution assumption
  - In these cases Maximum Likelihood Estimation (MLE) is useful to estimate the model's parameters
- In cases without closed-form solution, the integral must be evaluated numerically through simulation

Example

- Supermarket purchases of soda (coca-cola, pepsi, others)
  - Consumer *i*
  - Purchase occasion *t*
  - Product *j*
- Let u_{ijt} utility that product *j* gives to customer *i* at purchase occasion *t*
  - $u_{ijt} = v_{ijt} + \varepsilon_{ijt}$
- What can we include in v_{ijt}?

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Error terms are IID extreme value

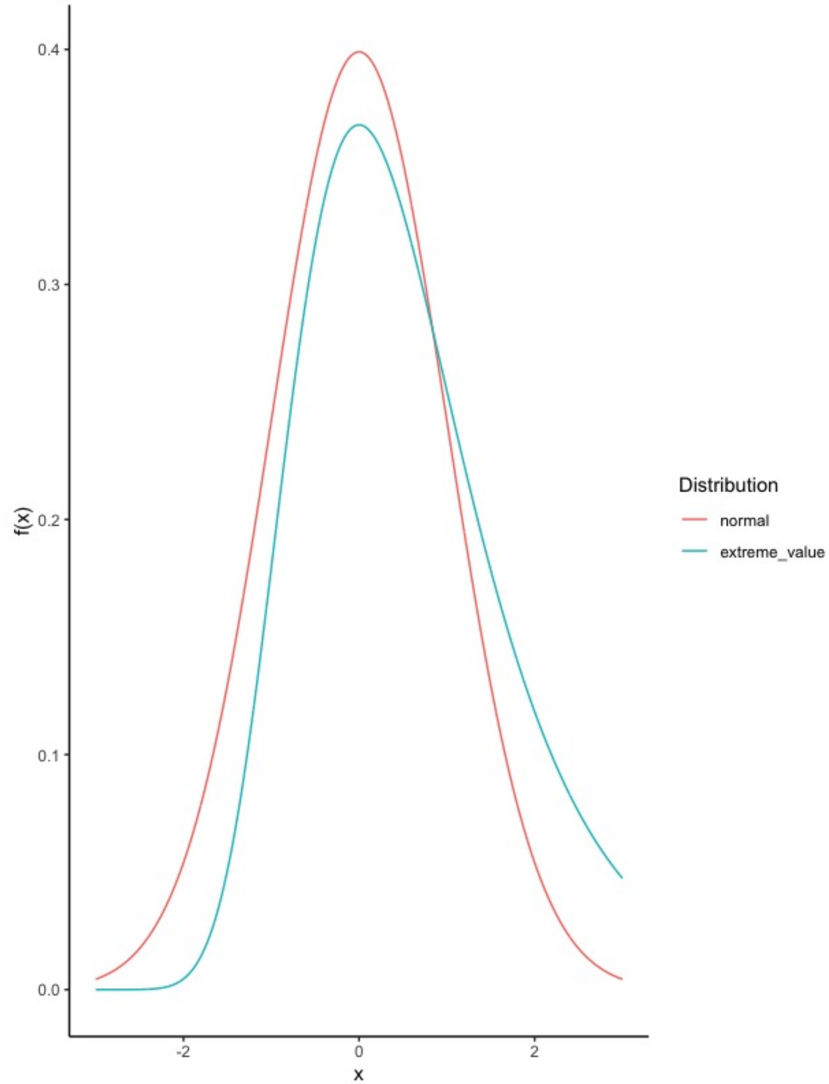
Logit

Logit: Definition

- The logit model results from assuming that each ε_{ni} is independently distributed Extreme Value:

$$F(\varepsilon_{ni}) = e^{-e^{-\varepsilon_{ni}}}$$
$$f(\varepsilon_{ni}) = e^{-\varepsilon_{ni}}e^{-e^{-\varepsilon_{ni}}}$$

- This distribution is also known as Gumbel or Extreme Value type I



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Logit: Choice Probability

$$P_{ni} = \Pr\left(v_{ni} + \varepsilon_{ni} > v_{nj} + \varepsilon_{nj}, \forall j \neq i\right)$$
$$= \Pr\left(\varepsilon_{nj} < \varepsilon_{ni} + v_{ni} - v_{nj}, \forall j \neq i\right)$$

$$P_{ni} = \int_{\varepsilon_{ni}} \underbrace{\left(\prod_{j \neq i} e^{-e^{-\left(\varepsilon_{ni}+v_{ni}-v_{nj}\right)}}\right)}_{P_{nj}|\varepsilon_{ni}} \underbrace{e^{-\varepsilon_{ni}} e^{-e^{-\varepsilon_{ni}}}}_{f(\varepsilon_{ni})} d\varepsilon_{ni}$$

t = exp(-ε_{ni})
dt =-exp(-ε_{ni})dε_{ni}

$$P_{ni} = \int_{-\infty}^{0} -\exp\left(-t\sum_j e^{-\left(v_{ni}-v_{nj}\right)}\right) dt = \left.\frac{\exp\left(-t\sum_j e^{-\left(v_{ni}-v_{nj}\right)}\right)}{-\sum_j e^{-\left(v_{ni}-v_{nj}\right)}}\right|_0^{\infty} \rightarrow \boxed{P_{ni} = \frac{e^{v_{ni}}}{\sum_j e^{v_{nj}}}}$$

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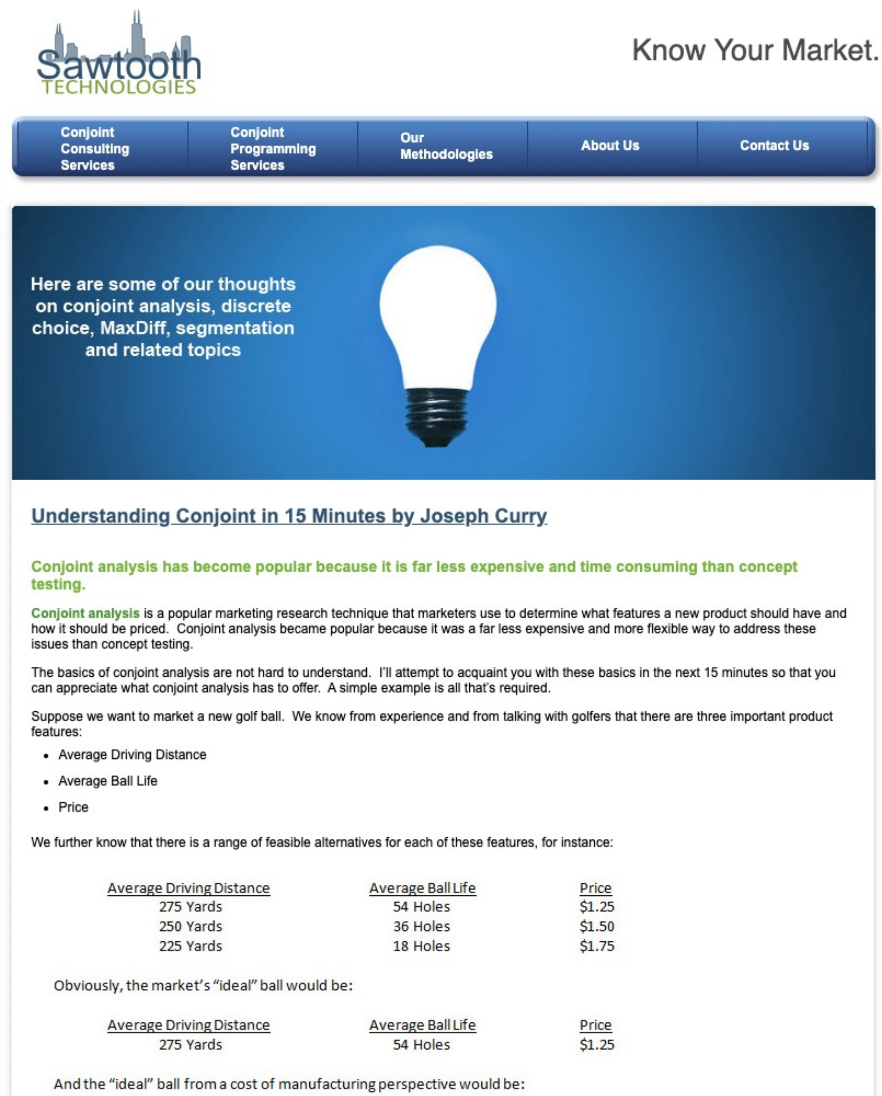
Choice-based Conjoint

Type of Conjoint Analysis

- State of the art
  - Choice-based conjoint
  - Adaptive
  - Sawtooth software



Sawtooth TECHNOLOGIES

Know Your Market.

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Here are some of our thoughts on conjoint analysis, discrete choice, MaxDiff, segmentation and related topics

Understanding Conjoint in 15 Minutes by Joseph Curry

Conjoint analysis has become popular because it is far less expensive and time consuming than concept testing.

Conjoint analysis is a popular marketing research technique that marketers use to determine what features a new product should have and how it should be priced. Conjoint analysis became popular because it was a far less expensive and more flexible way to address these issues than concept testing.

The basics of conjoint analysis are not hard to understand. I'll attempt to acquaint you with these basics in the next 15 minutes so that you can appreciate what conjoint analysis has to offer. A simple example is all that's required.

Suppose we want to market a new golf ball. We know from experience and from talking with golfers that there are three important product features:

- Average Driving Distance
- Average Ball Life
- Price

We further know that there is a range of feasible alternatives for each of these features, for instance:

Average Driving Distance	Average Ball Life	Price
275 Yards	54 Holes	$1.25
250 Yards	36 Holes	$1.50
225 Yards	18 Holes	$1.75

Obviously, the market's "ideal" ball would be:

Average Driving Distance	Average Ball Life	Price
275 Yards	54 Holes	$1.25

And the "ideal" ball from a cost of manufacturing perspective would be:

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Example Choice-based Conjoint

- Digital Cameras
  - 125 subjects
  - 5 attributes, 4 levels each
  - 20 questions (16 for training/calibration, 4 for testing)
- Attributes
  - Price: 200, 300, 400, 500 (US$)
  - Resolution: 2, 3, 4, 5 (Megapixels)
  - Battery Life: 150, 300, 450, 600 (pictures)
  - Optical Zoom: 2, 3, 4, 5 x
  - Camera size: SLR, Medium, Pocket, ultra compact

Design

Choose a Camera

From the choices presented here, please select your <u>most</u> preferred camera choice.

Question 1 of 20

Features	Choice A	Choice B	Choice C	Choice D
Price	$300	$300	$400	$400
Resolution	2 Megapixels	3 Megapixels	2 Megapixels	2 Megapixels
Battery Life	300 pictures	600 pictures	150 pictures	600 pictures
Optical Zoom	4x	2x	5x	2x
Camera Size	SLR sized	SLR sized	Medium sized	SLR sized

0 25 50 75 100

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Choice Model

- We assume a Multinomial logit choice model
- Individual n, alternative j, question t
- 5 attributes with 4 levels each implies 15 dummies
  - base level = Price 500, Resolution 2MP, Battery Life 150p, Optical Zoom 2x, Camera Size SLR

$$v_{njt} = \beta_1 Price_{njt}^{400} + \cdots + \beta_{15} CS_{njt}^{UltraCompact}$$

$$P_{njt} = \frac{\exp\left(v_{njt}\right)}{\sum_k \exp(v_{nkt})}$$

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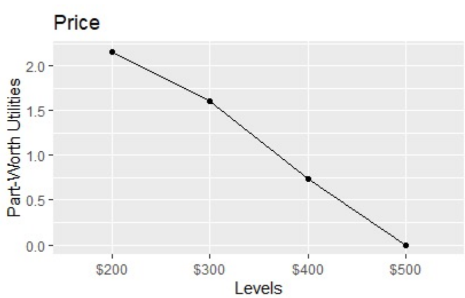
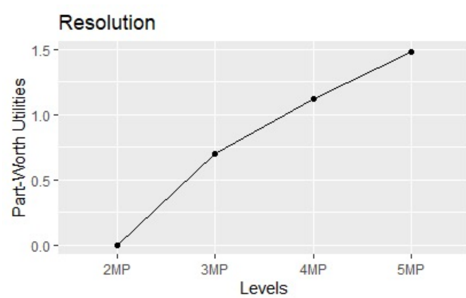
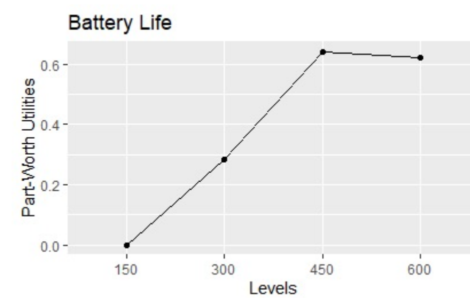
Model and Results

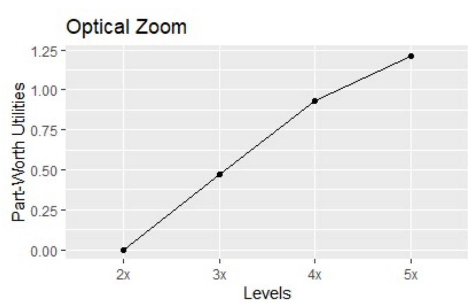
- Modeling in R

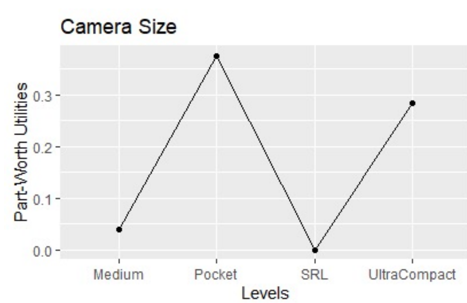
```r
plainlogit <- mlogit(chosen_alt ~ 0 + Price400 + Price300 + Price200 + Resolution3MP + Resolution4MP + Resolution5MP
                     + BL300 + BL450 + BL600 + OZ3X + OZ4X + OZ5X + CSMedium + CSPocket + CSUltraCompact,
                     data = data.logit)
```











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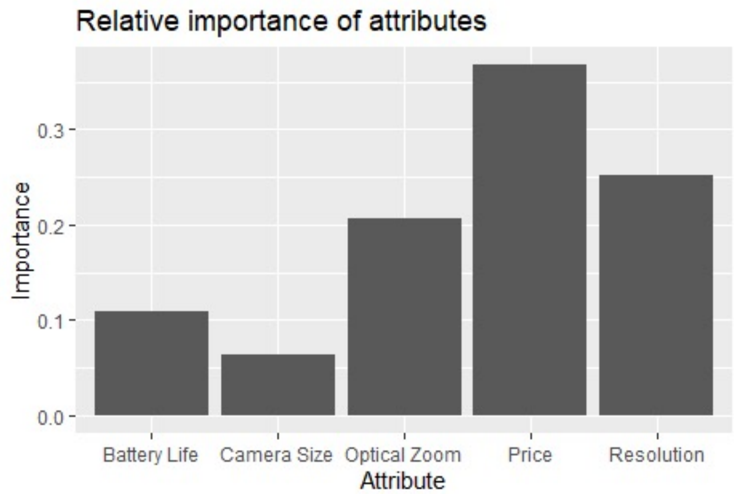
Results

```
## Coefficients :
##                  Estimate Std. Error t-value Pr(>|t|)
## Price.400           0.7343     0.1074    6.84  8.1e-12 ***
## Price.300           1.6010     0.1008   15.89  < 2e-16 ***
## Price.200           2.1627     0.0940   23.01  < 2e-16 ***
## Resolution.3MP      0.7020     0.0937    7.49  6.8e-14 ***
## Resolution.4MP      1.1202     0.0922   12.15  < 2e-16 ***
## Resolution.5MP      1.4850     0.0857   17.32  < 2e-16 ***
## BL.300              0.2847     0.0885    3.22   0.0013 **
## BL.450              0.6426     0.0820    7.83  4.7e-15 ***
## BL.600              0.6221     0.0874    7.12  1.1e-12 ***
## OZ.3x               0.4692     0.0992    4.73  2.2e-06 ***
## OZ.4x               0.9302     0.0893   10.41  < 2e-16 ***
## OZ.5x               1.2147     0.0874   13.90  < 2e-16 ***
## CS.Medium           0.0384     0.0812    0.47   0.6366
## CS.Pocket           0.3758     0.0791    4.75  2.0e-06 ***
## CS.UltraCompact     0.2846     0.0787    3.61   0.0003 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Log-Likelihood: -2030
```

Model Results

- Ideal digital camera:
  - Low price (200 US$)
  - 5 megapixels
  - Battery life of 450 pictures
  - 5x optical zoom
  - Pocket size



Model Results

- The utility of getting a camera with 5 megapixels relative to getting one of 2 megapixels is:

$$u(Resolution.5MP) - u(Resolution.2MP) = 1.4850$$

- The utility of paying a low price relative to paying a high price is:

$$u(Price.200) - u(Price.500) = 2.1627$$

- The price range is:

$$US\$500 - US\$200 = US\$300$$

- Hence, the willingness to pay for a 3 extra MP is:

$$\frac{US\$300}{2.1627} * 1.485 = US\$205.99$$

Model Results

- Including the heterogeneity across respondents
- Mixed logit

```
mixedlogit2 <- mlogit(chosen_alt ~ 0 + Price400 + Price300 + Price200 + Resolution3MP
                      + Resolution4MP + Resolution5MP + BL300 + BL450 + BL600 + OZ3X
                      + OZ4X + OZ5X + CSMedium + CSPocket + CSUltraCompact,
                      rpar = c(Price400 ="n", Price300 ="n", Price200 ="n",
                               Resolution3MP ="n", Resolution4MP ="n", Resolution5MP ="n",
                            BL300 ="n", BL450 ="n", BL600 ="n", OZ3X ="n", OZ4X ="n",
                            OZ5X ="n", CSMedium ="n", CSPocket ="n", CSUltraCompact ="n"),
                      correlation = TRUE, data = data.logit, panel = TRUE)
```

  - Assume random coefficients are normally distributed across the respondents

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Model Results

- The output should look like this:

```
Coefficients :
                             Estimate Std. Error z-value  Pr(>|z|)
Price400                    1.2373871  0.1659053  7.4584 8.749e-14 ***
Price300                    2.9098800  0.1781798 16.3311 < 2.2e-16 ***
Price200                    3.4565085  0.1770709 19.5205 < 2.2e-16 ***
Resolution3MP               1.0979361  0.1504207  7.2991 2.898e-13 ***
Resolution4MP               1.8817822  0.1573867 11.9564 < 2.2e-16 ***
Resolution5MP               2.3610692  0.1472248 16.0372 < 2.2e-16 ***
BL300                       0.7213590  0.1601211  4.5051 6.635e-06 ***
BL450                       1.3231613  0.1622235  8.1564 4.441e-16 ***
BL600                       1.2292077  0.1550604  7.9273 2.220e-15 ***
OZ3X                        1.1060940  0.1829590  6.0456 1.489e-09 ***
OZ4X                        1.8726725  0.1698338 11.0265 < 2.2e-16 ***
OZ5X                        2.2814167  0.1649571 13.8304 < 2.2e-16 ***
CSMedium                    0.4926950  0.1500134  3.2843 0.0010222 **
CSPocket                    0.9660882  0.1505700  6.4162 1.397e-10 ***
CSUltraCompact              1.1912076  0.1469165  8.1081 4.441e-16 ***
chol.Price400:Price400      1.2508851  0.1760448  7.1055 1.199e-12 ***
chol.Price400:Price300      1.8546057  0.1679862 11.0402 < 2.2e-16 ***
chol.Price300:Price300      1.7911545  0.1628669 10.9977 < 2.2e-16 ***
```

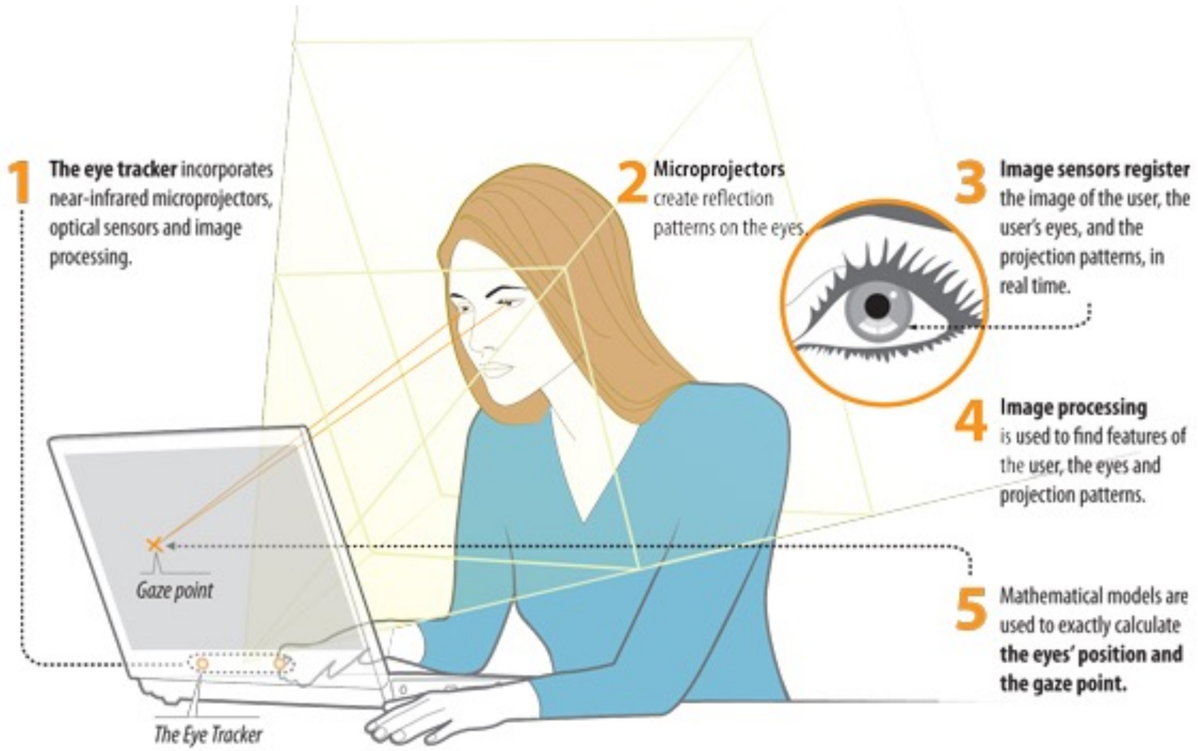
Model Results

- Random Coefficients:

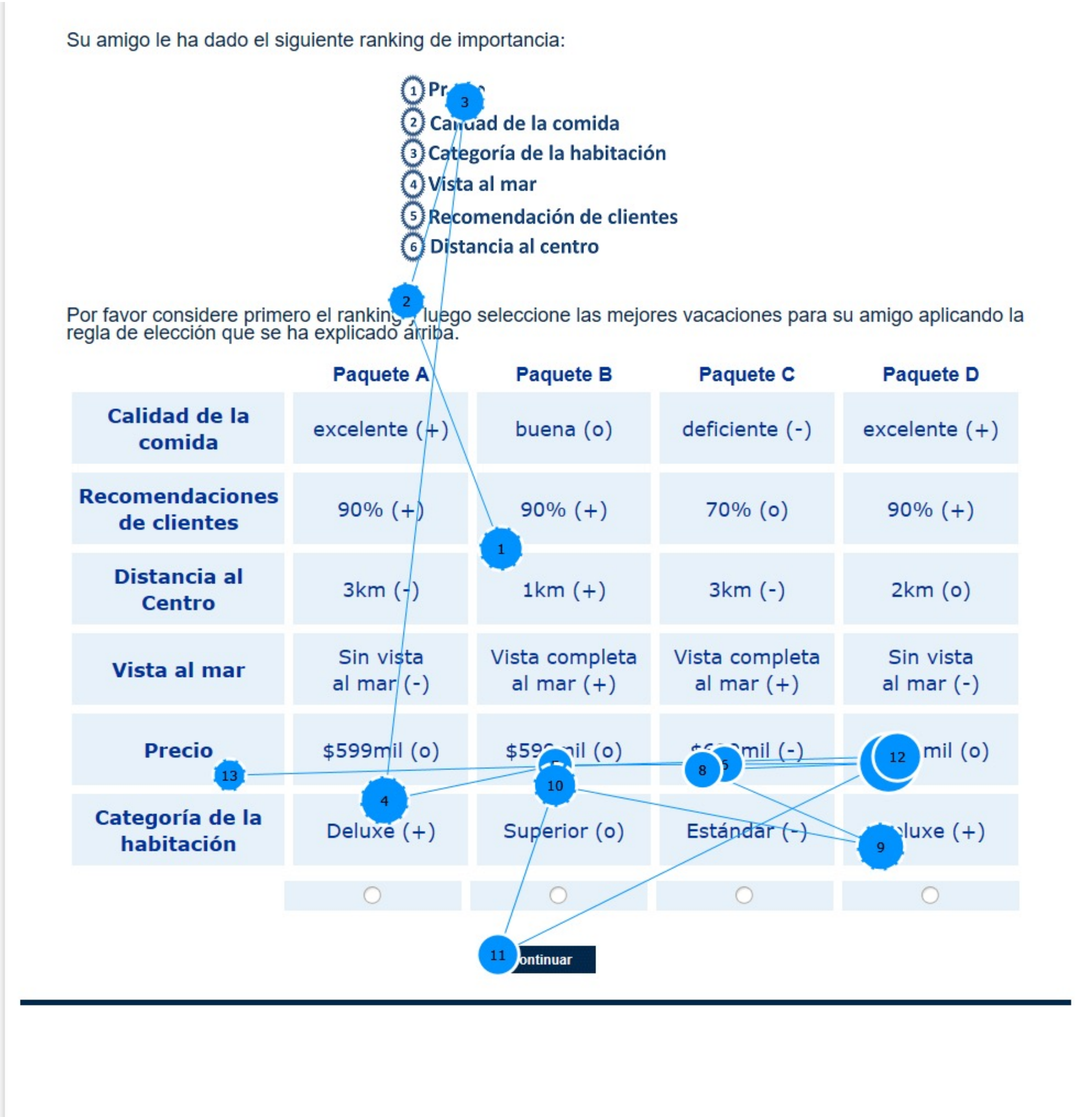
```
random coefficients
               Min.    1st Qu.    Median      Mean  3rd Qu. Max.
Price400       -Inf  0.39367790 1.2373871 1.2373871 2.081096  Inf
Price300       -Inf  1.17082143 2.9098800 2.9098800 4.648939  Inf
Price200       -Inf  1.36817665 3.4565085 3.4565085 5.544840  Inf
Resolution3MP  -Inf  0.69695940 1.0979361 1.0979361 1.498913  Inf
Resolution4MP  -Inf  0.85078283 1.8817822 1.8817822 2.912782  Inf
Resolution5MP  -Inf  0.80862412 2.3610692 2.3610692 3.913514  Inf
BL300          -Inf  0.25143253 0.7213590 0.7213590 1.191285  Inf
BL450          -Inf  0.60974875 1.3231613 1.3231613 2.036574  Inf
BL600          -Inf  0.46584469 1.2292077 1.2292077 1.992571  Inf
OZ3X           -Inf -0.50378660 1.1060940 1.1060940 2.715975  Inf
OZ4X           -Inf  0.09357707 1.8726725 1.8726725 3.651768  Inf
OZ5X           -Inf  0.46431406 2.2814167 2.2814167 4.098519  Inf
CSMedium       -Inf -0.31274604 0.4926950 0.4926950 1.298136  Inf
CSPocket       -Inf  0.04656451 0.9660882 0.9660882 1.885612  Inf
CSUltraCompact -Inf  0.06969789 1.1912076 1.1912076 2.312717  Inf
```

Cutting-edge Research

- Eye-tracking



Eye-tracking



UNIVERSIDAD
TORCUATO DI TELLA

Introduction to Marketing Analytics

Session 4: Product

Professor Ricardo Montoya