Conjoint Analysis

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What is Conjoint Analysis?

CON - JOINT
**conjoint**

/kanˈdʒɔɪnt/ 🎧

**adjective**

adjective: conjoint

combining all or both people or things involved.
"the conjoint involvement of the two cerebral hemispheres"

**Origin**

OLD FRENCH

conjoindre

ENGLISH

conjoint

Middle English: from Old French, past participle of conjoindre (see conjoin).

Translate conjoint to  
Choose language ⬇️

Use over time for: conjoint
What is Conjoint Analysis?

- Products are represented as bundles of attributes.
- Levels of each attribute define the product.

**Product (Stimulus)**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brand:</td>
<td>Coca Cola</td>
</tr>
<tr>
<td>Packaging:</td>
<td>Can</td>
</tr>
<tr>
<td>Volume:</td>
<td>12 oz</td>
</tr>
<tr>
<td>Taste:</td>
<td>Classic</td>
</tr>
</tbody>
</table>
What is Conjoint Analysis?

None of them
Conjoint analysis is a survey-based technique that allows the analyst to understand people’s preferences for a [product / service / brand / medical treatment / job / course] and especially the trade-offs they make in making choices.
Trade-Off between Product Attributes

9 US dollars  
114K US dollars
Why Conjoint Analysis?

- In *direct surveys*, respondents might say they consider all attributes important
  - Not informative
- Conjoint enforces *tradeoffs* between attributes
  - All attributes evaluated at once
  - Respondents evaluate “complete” products with both strong and weak attributes
- Conjoint reduces problem of *socially desirable answers*
- Conjoint adds *realism*
  - In real-life consumers evaluate products, not isolated attributes (*do they consciously know which attributes matter?*)
- Conjoint analysis is *straightforward*
  - Suitable software is available (Sawtooth)
Why is that Relevant?

- Every year, many new products are introduced…

Retailing

Technology

Entertainment

Online/Social Networks
Why is that Relevant?

- But very few succeed…

Retailing

More …

Entertainment

Technology

Online/Social Networks
Course Objectives

- That is a major issue for companies...

Top 20 companies in R&D investments (Euro million)

1. Toyota Motor, Japan (4)
2. Microsoft, USA (3)
3. Volkswagen, Germany (6)
4. Novartis, Switzerland (8)
5. Samsung Electronics, South Korea (7)
6. Pfizer, USA (2)
7. Roche, Switzerland (1)
8. Intel, USA (12)
9. General Motors, USA (9)
10. Merck, USA (5)
11. Johnson & Johnson, USA (10)
12. Daimler, Germany (13)
13. Panasonic, Japan (15)
14. Honda Motor, Japan (17)
15. Nokia, Finland (11)
16. Sanofi, France (14)
17. GlaxoSmithKline, UK (16)
18. Sony, Japan (19)
19. Siemens, Germany (18)
20. Nissan Motor, Japan (25)
Course Objectives

- At the end of this course, you will be able to help companies design products that work:
  
  - Which new product to launch?
    
    - How to position existing products better?
    
    - How to price existing and new products?
  
  - How to manage product portfolios / product line designs?
Naar welk product gaat je keuze uit?

- 0% suiker vervangen door Stevia  €1,99
- 50% suiker vervangen door Stevia  €1,69
- 30% suiker vervangen door Stevia  €1,69
- 50% suiker vervangen door Stevia  €1,99

© Valerie Vos, MSc Thesis 2015
Why Do We Need a Course for This?

- Product design decisions are highly complex...

De nieuwe MacBook Air.
Power in overvloed. De hele dag.

11-inch vanaf € 1.029 | 13-inch nu vanaf € 1.129
Why Do We Need a Course for This?

- A product is characterized by many, many, many attributes…
<table>
<thead>
<tr>
<th>MacBook Model</th>
<th>Starting Price</th>
<th>Processor</th>
<th>RAM</th>
<th>Storage Options</th>
<th>Graphics</th>
<th>Battery</th>
<th>Other Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-inch MacBook Air</td>
<td>From $999</td>
<td>1.2GHz dual-core Intel Core i5</td>
<td>4GB</td>
<td>Up to 512GB flash</td>
<td>Intel HD Graphics 5000</td>
<td>Integrated 38-watt-hour lithium-polymer battery</td>
<td>Two USB 3 ports</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or 1.7GHz dual-core Intel Core i7</td>
<td></td>
<td>storage</td>
<td></td>
<td>45W MagSafe power adapter with cable management system</td>
<td>Thunderbolt port</td>
</tr>
<tr>
<td>13-inch MacBook Air</td>
<td>From $1199</td>
<td>2.5GHz dual-core Intel Core i5 or 2.9GHz dual-core Intel Core i7 processor</td>
<td>4GB or 8GB memory</td>
<td>Up to 1TB 5400-rpm hard drive; or up to 512GB solid-state drive</td>
<td>Intel HD Graphics 5000</td>
<td>Integrated 54-watt-hour lithium-polymer battery</td>
<td>Two USB 3 ports</td>
</tr>
<tr>
<td>13-inch MacBook Pro</td>
<td>From $1799</td>
<td>2.3GHz, 2.6GHz, or 2.7GHz quad-core Intel Core i7 processor</td>
<td>4GB or 8GB memory</td>
<td>Up to 1TB 5400-rpm hard drive; or up to 512GB solid-state drive</td>
<td>Intel HD Graphics 4000</td>
<td>Integrated 77.5-watt-hour lithium-polymer battery</td>
<td>Thunderbolt port</td>
</tr>
<tr>
<td>15-inch MacBook Pro</td>
<td>From $1799</td>
<td>2.5GHz or 2.6GHz dual-core Intel Core i5; or 2.9GHz or 2.0GHz dual-core Intel Core i7 processor</td>
<td>4GB or 8GB memory</td>
<td>Up to 1TB 5400-rpm hard drive; or up to 512GB solid-state drive</td>
<td>Intel HD Graphics 4000</td>
<td>Integrated 74-watt-hour lithium-polymer battery</td>
<td>Two Thunderbolt ports</td>
</tr>
<tr>
<td>15-inch MacBook Pro with Retina display</td>
<td>From $1799</td>
<td>2.4GHz, 2.7GHz, or 2.8GHz quad-core Intel Core i7 processor</td>
<td>8GB memory</td>
<td>Up to 16GB memory</td>
<td>Intel HD Graphics 4000</td>
<td>Integrated 95-watt-hour lithium-polymer battery</td>
<td>Two Thunderbolt ports</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.6 pounds</td>
<td>0.75 inch thin; 3.57 pounds</td>
<td>Up to 768GB flash storage</td>
<td></td>
<td></td>
<td>HDMI port</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.8 pounds</td>
<td>0.71 inch thin; 4.46 pounds</td>
<td>Up to 768GB flash storage</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Specifications**

- **Battery**
  - MacBook Air: Integrated 38-watt-hour lithium-polymer battery
  - MacBook Pro: Integrated 77.5-watt-hour lithium-polymer battery

- **Display**
  - 11.6-inch MacBook Air: 1.2GHz dual-core Intel Core i5 or 1.7GHz dual-core Intel Core i7 processor
  - 13-inch MacBook Air: 2.5GHz dual-core Intel Core i5 or 2.9GHz dual-core Intel Core i7 processor
  - 13-inch MacBook Pro: 2.3GHz, 2.6GHz, or 2.7GHz quad-core Intel Core i7 processor
  - 15-inch MacBook Pro: 2.5GHz or 2.6GHz dual-core Intel Core i5; or 2.9GHz or 2.0GHz dual-core Intel Core i7 processor

- **Other Features**
  - Two USB 3 ports
  - Thunderbolt port
Why Do We Need a Course for This?

- And some of these attributes are very complex to understand
Examples of Application

More than just product design...
Customer Complains on Social Media
How Customer Service Can Turn Angry Customers into Loyal Ones

by Wayne Huang, John Mitchell, Carmel Dibner, Andrea Ruttenberg, and Audrey Tripp

JANUARY 16, 2018

https://hbr.org/2018/01/how-customer-service-can-turn-angry-customers-into-loyal-ones
Identifying Relevant Attributes

- How to respond to customer complaints?
  - Should we react at all?

Customers who received any kind of response to their tweet were willing to pay
  - $9 more for a ticket on that airline in the future.
  - $8 more, on average, for a monthly wireless plan from that carrier
Identifying Relevant Attributes

- How to respond to customer complaints?

- Should we be personal or not?

Being personal also helps: when a customer service agent added their name or initials in their first reply to a customer, we observed that their willingness to pay increased by
  - $14 for a future flight on that airline
  - $3 more for a monthly plan
Identifying Relevant Attributes

- How to respond to customer complaints?
  - Should we be fast?

Responding Quickly to Customer Complaints Makes People Willing to Pay More in the Future

A study of tweets to airlines shows that when a tweet is answered in five minutes or less, the customer will pay almost $20 more for a ticket on that airline in the future.

![Bar chart showing the additional amount willing to pay based on response time.](chart.png)

SOURCE: WAYNE HUANG ET AL.

© HBR.ORG
Health Care

- This is not only relevant for marketing... Actually, the problem (and conjoint) is also applied many other fields, including medicine.

Cancer treatment:

- Likelihood of success
- Risks
- Pain factors
- Side effects
- Life disruption
Economics

- Evaluate transportation alternatives
- Compare energy alternatives
- Measure environmental impact
Law

- Measure effects of litigation
- Damage assessment
- Identify boundaries between firms
- Evaluate punishment alternatives
- Select jury members
Human Resources

- Screen potential employees
- Design compensation packages
- Select health care plans
- Evaluate performance
- Predict employee responses
Conjoint Experts

- **Software developers**
  - Sawtooth
  - Latent Gold
  - SPSS
  - SAS

- **Analysts**
  - Skim group
  - Ipsos
  - GfK
  - ...

- **Companies using conjoint**
  - P&G
  - Unilever
  - 3M
  - Microsoft
  - Caterpillar
  - IBM
  - Philips
  - Binck
  - ...

- **Master theses**
Did You Know?

13,000

Calendar

2011
Course Structure
Course Overview

I. Conjoint Design
II. Conjoint Analysis
III. Choice Simulator
Part 1. Conjoint Design

- **Ranking-based conjoint:**
  - Choose the most-preferred product, then the second most-preferred product, … until the least-preferred product

- **Rating-based conjoint:**
  - Give a score to each product in turn

- **Choice-based conjoint:**
  - Choice between different variants
Below are the smartphones you said you would seriously consider. Please click on the smartphone that you are most likely to buy for your own use.

That smartphone (and perhaps others) will disappear and you will be asked for your second preference.

As before, at your option, you may sort the smartphones by up to three features.

```
(attribute 1) ▼  (attribute 2) ▼  (attribute 3) ▼  Sort
```

---

*Yee, Dahan, Hauser and Orlin (2007)*
Rating-Based Conjoint

Indicate your preference for this Ice Cream offering.

<table>
<thead>
<tr>
<th>Ice Cream Flavor</th>
<th>Vanilla</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mix-In</td>
<td>Brownie Chunks</td>
</tr>
<tr>
<td>Topping</td>
<td>Caramel</td>
</tr>
<tr>
<td>Cone</td>
<td>Waffle Cone</td>
</tr>
<tr>
<td>Scoops</td>
<td>3 Scoops</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Preference</th>
<th>Very Dissatisfied</th>
<th>Dissatisfied</th>
<th>Somewhat Dissatisfied</th>
<th>Neutral</th>
<th>Somewhat Satisfied</th>
<th>Satisfied</th>
<th>Very Satisfied</th>
</tr>
</thead>
</table>
# Rating-Based Conjoint

<table>
<thead>
<tr>
<th>Stimulus/Camera</th>
<th>Resolution</th>
<th>Optical Zoom</th>
<th>Screen Size</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camera 1</td>
<td>10 megapixels</td>
<td>3×</td>
<td>3 inches</td>
<td></td>
</tr>
<tr>
<td>Camera 2</td>
<td>6 megapixels</td>
<td>5×</td>
<td>2 inches</td>
<td></td>
</tr>
<tr>
<td>Camera 3</td>
<td>10 megapixels</td>
<td>5×</td>
<td>3 inches</td>
<td></td>
</tr>
<tr>
<td>Camera 4</td>
<td>6 megapixels</td>
<td>3×</td>
<td>2 inches</td>
<td></td>
</tr>
<tr>
<td>Camera 5</td>
<td>6 megapixels</td>
<td>5×</td>
<td>3 inches</td>
<td></td>
</tr>
<tr>
<td>Camera 6</td>
<td>10 megapixels</td>
<td>3×</td>
<td>2 inches</td>
<td></td>
</tr>
<tr>
<td>Camera 7</td>
<td>6 megapixels</td>
<td>3×</td>
<td>3 inches</td>
<td></td>
</tr>
<tr>
<td>Camera 8</td>
<td>10 megapixels</td>
<td>5×</td>
<td>2 inches</td>
<td></td>
</tr>
</tbody>
</table>
## Rating-Based Conjoint

<table>
<thead>
<tr>
<th>Stimulus/Camera</th>
<th>Resolution</th>
<th>Optical Zoom</th>
<th>Screen Size</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camera 1</td>
<td>10 megapixels</td>
<td>3×</td>
<td>3 inches</td>
<td>7</td>
</tr>
<tr>
<td>Camera 2</td>
<td>6 megapixels</td>
<td>5×</td>
<td>2 inches</td>
<td>7</td>
</tr>
<tr>
<td>Camera 3</td>
<td>10 megapixels</td>
<td>5×</td>
<td>3 inches</td>
<td>9</td>
</tr>
<tr>
<td>Camera 4</td>
<td>6 megapixels</td>
<td>3×</td>
<td>2 inches</td>
<td>5</td>
</tr>
<tr>
<td>Camera 5</td>
<td>6 megapixels</td>
<td>5×</td>
<td>3 inches</td>
<td>6</td>
</tr>
<tr>
<td>Camera 6</td>
<td>10 megapixels</td>
<td>3×</td>
<td>2 inches</td>
<td>5</td>
</tr>
<tr>
<td>Camera 7</td>
<td>6 megapixels</td>
<td>3×</td>
<td>3 inches</td>
<td>6</td>
</tr>
<tr>
<td>Camera 8</td>
<td>10 megapixels</td>
<td>5×</td>
<td>2 inches</td>
<td>7</td>
</tr>
</tbody>
</table>
Problems of Rating-Based Conjoint

- **Not realistic**
  - In real-life, we buy products rather than rating them

- **Not clear whether spread in ratings is due to real preferences or due to response style**
  - E.g., small spread in example above, weak preferences or cautious answers?

- **Implications for sales levels and market shares are not clear**
  - Sales and shares result from consumer choices, not ratings
  - *What would be the rating threshold?*

- **Why don’t we ask the respondents to choose a product directly, rather than asking them to rate products?**
Choice-Based Conjoint

- Choose the most-preferred product only

_Toubia, Hauser and Garcia (2007)_

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From the choices presented here, please select your most preferred choice.

<table>
<thead>
<tr>
<th>Features</th>
<th>Choice A</th>
<th>Choice B</th>
<th>Choice C</th>
<th>Choice D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wine Type</td>
<td>Aromatic White</td>
<td>Aromatic White</td>
<td>Aromatic White</td>
<td>Aromatic White</td>
</tr>
<tr>
<td>Region</td>
<td>Sonoma/Napa California USA</td>
<td>S. America (Chile, Argentina)</td>
<td>Australia/NZ</td>
<td>Australia/NZ</td>
</tr>
<tr>
<td>Closure Type</td>
<td>Traditional Cork</td>
<td>Traditional Cork</td>
<td>Metacork</td>
<td>Traditional Cork</td>
</tr>
<tr>
<td>Price Range</td>
<td>$AU15.00-$19.99</td>
<td>$AU15.00-$19.99</td>
<td>$AU15.00-$19.99</td>
<td>$AU15.00-$19.99</td>
</tr>
<tr>
<td>Type of Winery</td>
<td>Small Boutique</td>
<td>Small Boutique</td>
<td>Small Boutique</td>
<td>Mid-Sized regionally known</td>
</tr>
</tbody>
</table>
Choice-Based Conjoint

- Choice set 1:

  - **Camera A**
    - 6 megapixels
    - optical zoom 5x
    - screen: 2 inches

  - **Camera B**
    - 10 megapixels
    - optical zoom 3x
    - screen: 3 inches
Choice-Based Conjoint

- Choice set 1:
- Choice set 2:

Camera C
- 6 megapixels
- optical zoom 3×
- screen: 2 inches

Camera D
- 10 megapixels
- optical zoom 5×
- screen: 3 inches
Choice-Based Conjoint

- Choice set 1:
- Choice set 2:
- ...
- Choice set n = 8:

[Diagram showing two camera options:]

- **Camera Y**
  - 10 megapixels
  - optical zoom 3×
  - screen: 2 inches

- **Camera Z**
  - 10 megapixels
  - optical zoom 5×
  - screen: 3 inches
Choice-Based Conjoint

- We record the choices made by every customer during the \( n \) tasks (i.e. choice sets).
- Because, in every choice set, a different combination of attribute levels is used, we can derive the effect of different combinations of attribute levels on choice.

\[ \text{preferences} = \text{attribute part-worths} \]

- As we repeat the conjoint exercise across many customers, we can also detect whether different customers have different preferences.

\[ \text{Customer-specific preferences} \]
Advantages of Choice-Based Conjoint

- **Tradeoffs** are enforced even more
- **Realistic**: the choice-setting mimics real-life
- Accommodates **no-choice option** (”none of the offered alternatives is attractive”, “I would stick to my current product”) ➔ sales proxy
- Avoids the need of ad-hoc rules to predict **market shares**
- No **subjective scaling**
- Choice is cognitively **less demanding** than ratings (Louviere 1994)
Part 2. Conjoint Analysis

- **Logistic Regression**
- DV = product chosen or not
- IV = product attributes

\[ DV = \logit(IV) \]

e.g. choice = f(price, quality, color, speed, discount,...)
But What if We Have Different Tastes..

- What if you prefer the freedom of an Android while I like the synchronization feature of the iPhone?

- *Latent-class and Hierarchical Bayes* are the answers
Part 2. Conjoint Analysis

- **Aggregate level (same part-worths for all respondents)**
  - Assuming same preferences may give misleading results
  - + High precision, as all respondents are combined
  - Method of analysis: LOGIT

- **Segment level (different part-worths for different segments)**
  - + Realistic, as segments take into account different preferences
  - + High precision if all respondents are used in one big analysis
  - Method of analysis: LATENT CLASS ANALYSIS (LCA)

- **Individual level (different part-worths for each respondent)**
  - + Realistic, as respondent have different preferences
  - + High precision thanks to the joint estimation
  - – How many strategies should the firm implement given the diversity of preferences?
  - Method of analysis: HIERARCHICAL BAYES (HB)
Part 3. Market Simulations

*Competitive market scenarios to predict which products respondents would choose*
What Can the Choice Simulator Do?

• Lets you **predict** which SKU respondents or segments of the population will choose (estimate demand and market share)

• Lets you play “what-if” games to investigate the **value of modifications to** an existing product or alternative

• Lets you investigate **product line extensions**