# What are…
# Discrete Choice Experiments?

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5/7/2016 – Bath
NCRM Research Methods Festival

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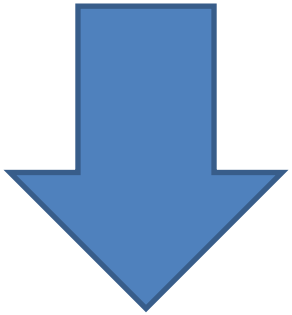
# ECONOMICS AND CHOICE

# Economics and choice

Resources are scarce and choices must be made



These choices give us information about individual preferences

# HOW DO WE OBSERVE CHOICES?

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**Revealed** Preferences:
"What did you do?"

**Stated** Preferences:
"What would you do?"

# HOW DO WE OBSERVE CHOICES?

**Revealed** Preferences:
"What did you do?"

**Pros:**
Face validity – people actually make the choice
Simple to analyse

**Cons:**
Choices must exist in reality (new products?)
Hard to get data on alternatives not chosen

# HOW DO WE OBSERVE CHOICES?

**Revealed** Preferences:
"What did you do?"

**Stated** Preferences:
"What would you do?"

# HOW DO WE OBSERVE CHOICES?

**Pros:**
Flexible – can focus on important tradeoffs
Not limited to existing alternatives

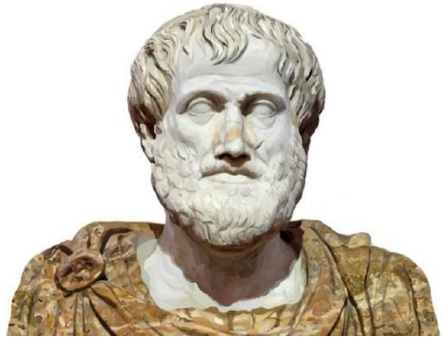
**Cons:**
Lower external validity – Hypothetical bias?

**Stated** Preferences:
"What would you do?"

# Lancaster's theory of demand

***"The whole is greater than the sum of its parts"***

*Aristotle, ~300 BC*



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**exactly**

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*Kelvin Lancaster, 1966*

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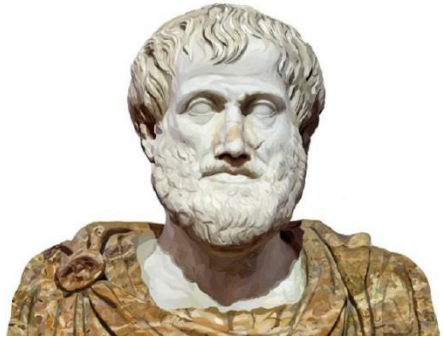


# Lancaster's theory of demand

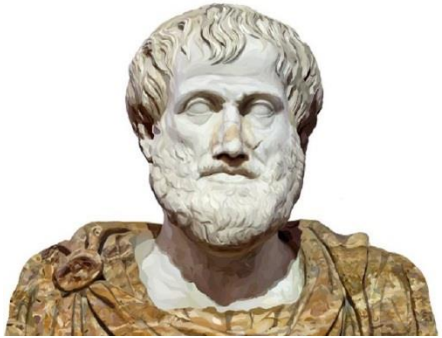
**exactly**

***"The whole is ~~greater than~~ the sum of its parts"***

*Kelvin Lancaster, 1966*

*"The total utility gained from a product or service is the sum of the individual utilities provided by the attributes of that good"*

*Aristotle, ~300 BC*



# Discrete Choice Experiments

# Discrete Choice Experiments: Brexit

| Choice | IN | Vote Leave |
| --- | --- | --- |

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| Economic impact | GDP increases by 1% per year | GDP increases by 0.5% per year |

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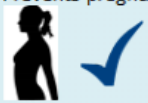
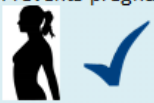
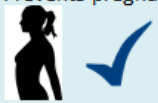
# Discrete Choice Experiments: Brexit

| Choice | IN | Vote Leave |
|---|---|---|
| Economic impact | GDP increases by 1% per year | GDP increases by 1% per year |
| Net Migration | 300,000 per year | 150,000 per year |
| Prime Minister | | |

# Discrete Choice Experiments: New HIV Prevention Products

**Here are the products and this is what they do. Please select the product you would most prefer.**

| 3 | A | B | C | Condom |
|---|---|---|---|---|
| **Product** | Injection | Oral PrEP | Diaphragm and Microbicide Gel | Condom |
| **HIV Protection** | 95% risk reduction 19 of 20 people remain HIV negative | 75% risk reduction 15 of 20 people remain HIV negative | 95% risk reduction 19 of 20 people remain HIV negative | 95% risk reduction 19 of 20 people remain HIV negative |
| **Pregnancy Protection** | Prevents pregnancy  | Prevents pregnancy  | Does not prevent pregnancy | Prevents pregnancy  |

# Discrete Choice Experiments: Essay Cheating

| | Buy Essay 1 | Buy Essay 2 | Buy Essay 3 | Buy None of Them |
|---|---|---|---|---|
| **Price of Essay** | £100 | £75 | £100 | |
| **Risk of Being Caught** | 1 in 100 | 1 in 100 | 1 in 1000 | |
| **Penalty if Caught** | Repeat the Year | 0% for the Unit | Repeat the Year | |
| **Quality of the Essay** | 1st Class | 2(i) | 3rd Class | |
| **What would you do? Tick one option (√)** | ☐ | ☐ | ☐ | ☐ |

# Results

- Attribute preferences
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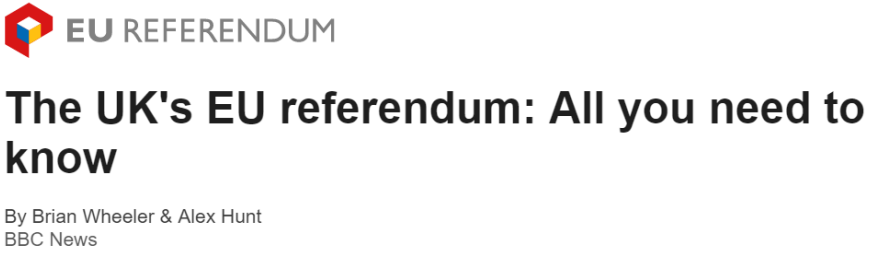

# Results

- Attribute preferences
  - “What is the most important attribute of the Brexit choice?”
- Demand forecasts (market share)
  - “How many people will vote to leave?”

# Demand forecasts (market share)

Client X

| | Liquid for inhalation | Powder for inhalation | None |
|---|---|---|---|
| liminster | 9 | 8 | |
| developing a cough | 4.30% | 25.30% | |
| developing hoarse voice | 3.30% | 12.70% | |
| ket cost | 10 | $6.00 | |
| | 28.93% | 68.00% | 3.08% |
| | 29.91% | 70.09% | |
| | 32.07% | 56.16% | 11.77% |
| | 36.46% | 63.54% | |
| | 30.34% | 64.51% | 5.14% |
| | 32.42% | 67.58% | |

WTP

| | Liquid for inhalation | Powder for inhalation | None |
|---|---|---|---|
| **Patient** | | | |
| liminster | $2.92 | $0.24 | |
| developing a cough | $3.00 | $0.03 | |
| developing hoarse voice | $8.87 | $0.74 | |
| **Carer** | | | |
| liminster | $3.90 | $0.53 | |
| developing a cough | $5.12 | $0.42 | |
| developing hoarse voice | - | - | |
| **Combined** | | | |
| liminster | $2.54 | $0.21 | |
| developing a cough | - | $0.41 | |
| developing hoarse voice | $0.71 | $0.23 | |

| | Patient | Carer | Combined |
|---|---|---|---|
| surplus (powder) | $196.16 | $115.29 | $163.08 |

Patient market shares

Scenario (with no choice)




Scenario (without no choice)




Carer market shares

Scenario (with no choice)




Scenario (without no choice)




Combined market shares

Scenario (with no choice)




Scenario (without no choice)

# Results

- Attribute preferences
  - “What is the most important attribute of the Brexit choice?”
- Demand forecasts
  - “How many people will vote to leave?”
- Willingness to pay
  - “How much would GDP need to increase by for you to accept a migration increase of 100,000?”

# Summary: Advantages of DCEs

- Provide policy relevant information
  - What is important to people?
  - How might people trade-off between attributes?
  - Simulation of possible scenarios

# Summary: Advantages of DCEs

- Provide policy relevant information
  - What is important to people?
  - How might people trade-off between attributes?
  - Simulation of possible scenarios
- Basic results easy to interpret
  - Well received by policy makers
- Easy for participants to understand
  - Mimic real choice behaviour

# Summary: Disadvantages of DCEs

- Hypothetical choices
  - Limited external validity?
- Simplified (simplistic?) approach to choices

# Summary: Disadvantages of DCEs

- Hypothetical choices
  - Limited external validity?
- Simplified (simplistic?) approach to choices
- Complex to design and analyse
- Cognitively demanding surveys
  - Heuristics, fatigue, etc.

# Questions?

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same
social and mathematical epidemiology

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# References

Dan Rigby, Michael Burton, Kelvin Balcombe, Ian Bateman, Abay Mulatu, Contract cheating & the market in essays, Journal of Economic Behavior & Organization, Volume 111, March 2015, Pages 23-37, ISSN 0167-2681, http://dx.doi.org/10.1016/j.jebo.2014.12.019.

Quaife M, Eakle R, Cabrera M, Vickerman P, Tsepe M, Cianci F, Delany-Moretlwe S, Terris-Prestholt F, Preferences for ARV-based HIV prevention methods among men and women, adolescent girls and female sex workers in Gauteng Province, South Africa: a protocol for a discrete choice experiment. BMJ Open. 2016 Jun 27;6(6):e010682. doi: 10.1136/bmjopen-2015-010682.

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# Methods for Eliciting Preferences

| QUANTITATIVE TECHNIQUES | | |
|---|---|---|
| **Ranking Techniques** | **Rating Techniques** | **Choice-Based Techniques** |
| ▪Simple ranking<br>▪Qualitative discriminant process<br>▪Conjoint analysis | ▪Likert scale<br>▪Visual analogue scale<br>▪Guttmann scales<br>▪Conjoint analysis<br>▪Semantic differential technique<br>▪Satisfaction surveys<br>▪SERVQUAL | ▪Simple choice exercises<br>▪Discrete Choice Experiments<br>▪Analytic hierarchy process<br>▪Standard gamble<br>▪Time trade-off<br>▪Willingness to pay<br>▪Allocation of points |

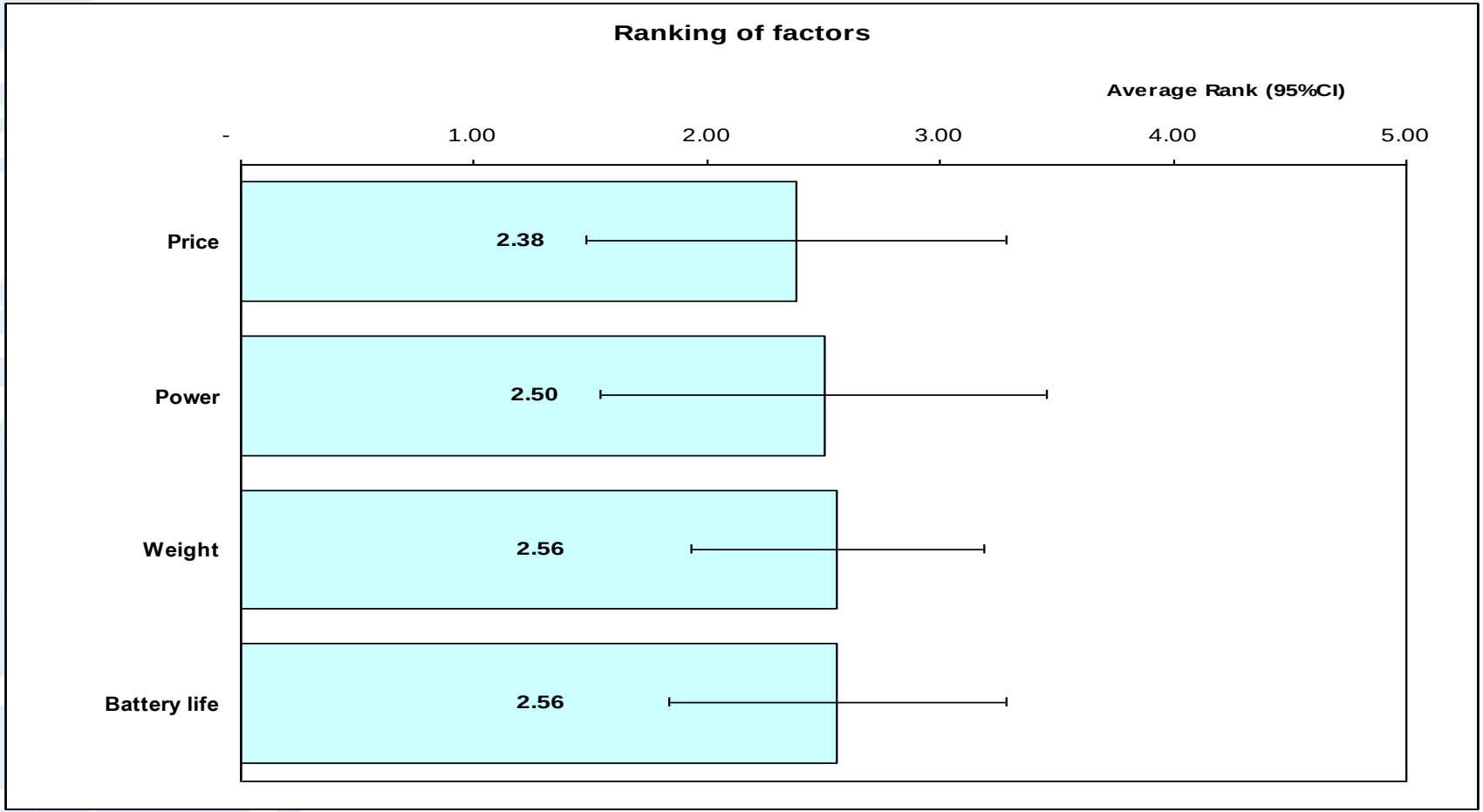
| QUALITATIVE TECHNIQUES | |
|---|---|
| **Individual Approaches** | **Group Approaches** |
| ▪One-to-one interviews<br>▪Dyadic interview<br>▪Case study analysis<br>▪Delphi technique<br>▪Complaints procedures | ▪Focus groups<br>▪Concept mapping<br>▪Citizen juries<br>▪Consensus panels<br>▪Public meetings<br>▪Nominal group techniques |

*Ryan, et al. (2001) Health Technology Assessment, 5(5)*

# Ranking

**RANK the Importance of the following FIVE factors in your choice of a laptop from 1 (Most Important) to 4 (Least Important):**

| | Rank |
|---|---|
| 1. Power | |
| 2. Weight | |
| 3. Battery life | |
| 4. Price | |


Ranking of factors
Average Rank (95%CI)
-
1.00
2.00
3.00
4.00
5.00
Price
2.38
Power
2.50
Weight
2.56
Battery life
2.56

# Limitations of ranking

- No relative strength of preferences
- Unclear implementation of decision rule from results

# Information obtained in a DCE

$$V = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_k X_k$$

Where

$\alpha$: alternative-specific constant

$X_j$: attributes

$\beta_j$: parameters (relative importance of attributes)

# Discrete Choice Model Estimation

Individuals maximise $U_{ij}$ which is composed of and explainable systematic component $V_{ij}$ and a random component $\varepsilon_{ij}$:

$$U_{ij} = V_{ij} + \varepsilon_i j$$

Where:

$$V_{ij} = \beta_1 X_{1j} + \beta_2 X_{2j} + \beta_3 Z_{3j} + ... + \beta_k X_{kj} + \beta_k Z_{kj}$$

Where each $\beta$ term represents the weight that individual $n$ places on the corresponding design attributes $X_k j$. $Z_{kj}$ represents individual socio-demographic characteristics.

According to random utility theory (RUT) we assume that individuals choose alternative such that they maximise utility.

# Estimation – Multinomial logit

$$P_{ij} = \frac{\exp(\boldsymbol{X}_j'\boldsymbol{\beta})}{\sum_{q=1}^{J}\exp(\boldsymbol{X}_q'\boldsymbol{\beta})}$$

- Assumptions:
  - All errors independent and follow type-1 extreme distribution
  - Error terms and choice probabilities subject to iia restriction
  - Does not account for heterogeneity in preferences across individuals
- Computationally quick and easy to run, good to scope out model structure
- MNL (or nested logit) unlikely to be acceptable final model

# Estimation – Random parameter logit (mixed logit)

The mixed logit model explicitly accounts for respondent heterogeneity in value judgements, allowing parameters to vary by respondent, $i$, such that:

$$\beta_{ki} = \bar{\beta}_k + \eta_{ki}$$

Where $\bar{\beta}_k$ is the population mean and $\eta_{ki}$ the individual deviation representing heterogeneity in value judgements.

$$= \int \left( \frac{\exp(\boldsymbol{X}_j'\boldsymbol{\beta} + \boldsymbol{U}_j'\eta_i)}{\sum_{q=1}^{J} \exp(\boldsymbol{X}_q'\boldsymbol{\beta} + \boldsymbol{U}_q'\eta_i)} \right) f(\eta_i|\boldsymbol{\theta}) d\eta_i$$

- Introduces random parameters
  - Accounts for heterogeneity
  - Allows for correlation across error terms, negates requirement for iia assumption

# Historical Development of DCEs

- Origins
  - Psychometrics (conjoint analysis)
  - Econometrics (choice modelling)
- Application
  - Market research
  - Transport economics
  - Environmental economics
  - Health economics (Late 1990s)

# Applications of DCE in health

- Valuing patients' preferences
  - Patients' experience factors vs. health outcomes
  - WTP for QALY
- Patients' service preferences
- Pharmaceutical industry
- Service providers' treatment preferences
- Labour supply decisions

# Steps in DCE studies

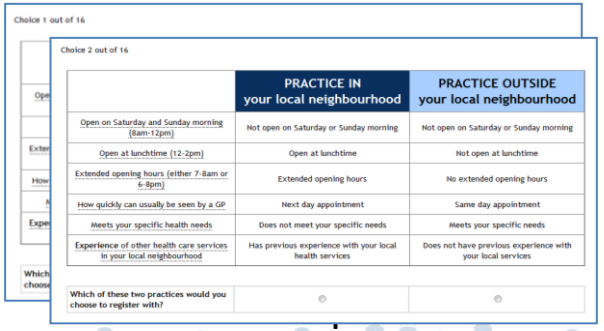
## 1. DCE design

| ATTRIBUTE | LEVELS |
|---|---|
| 1. Whether the practice is open at lunchtime (12-2pm) | ▪ Never<br>▪ Sometimes |
| 2. Whether the practice has extended opening hours | ▪ Yes<br>▪ No |
| 3. How quickly you can normally be seen by a GP in this practice | ▪ Same day<br>▪ Next day<br>▪ A few days later<br>▪ A week or more |

## 2. Experimental design

| set | r0 | r1 | r2 | u0 | u1 | u2 |
|---|---|---|---|---|---|---|
| **1** | 1 | 1 | 2 | 2 | 2 | 1 |
| **2** | 1 | 1 | 3 | 2 | 1 | 1 |
| **3** | 1 | 2 | 4 | 2 | 1 | 1 |
| **4** | 1 | 2 | 3 | 2 | 2 | 1 |
| **5** | 1 | 2 | 4 | 2 | 2 | 1 |
| **6** | 1 | 1 | 4 | 2 | 2 | 1 |
| **7** | 1 | 1 | 3 | 2 | 2 | 1 |
| **8** | 1 | 1 | 4 | 2 | 1 | 1 |

## 3. Survey



## 4. Data

| Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|
| 0 | 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 | 1 |
| 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 |

## 5. Analysis