# Valuation methods: theory and practice

- Travel cost method
- Contingent valuation
- Choice experiments

# Travel Cost Method

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# Basic premise of TCM

- … the costs and time that people incur during a recreational trip to a ‘natural resource’ site can be used to infer the value of that site.

# TCM origins

- Harold Hotelling originally proposed the basic notion of the method in a letter to Park Services in 1947.
- Jack Clawson and Marion Knetsch refined method in 1966.
- Since then it has been widely adopted and refined.

# Applications of TCM

- The method can be used to estimate the economic benefits (or costs) resulting from:
  - Current access to a recreation site
  - Elimination of an existing recreation site
  - Addition of a new recreation site
  - Changes in environmental quality at a recreation site.
- Note: TCM can only measure ‘Use values’

# TCM approaches

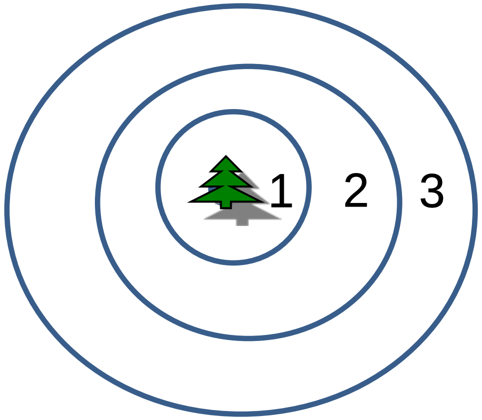
- Zonal TCM
- Individual TCM
- Random Utility TCM

# Zonal TCM

- The original and simplest approach.
- Uses mostly secondary data, with some simple data collected from visitors.
- It is restricted to estimating the value of recreational services of a site as a whole.
- It can not easily value change in quality of recreation site, or consider factors that may be important determinants of value.

# Zonal TCM

1. Define zones surrounding the site – concentric circles or geographical divisions (e.g. counties).




2. Collect information on number of visitors from each zone made in the last year

# Zonal TCM

3. Calculate visitation rates per 1000 population in each zone = Total visits per year from a zone / zone's population in '000s.

| Zone | Total visits/Year | Zone Population | Visits/1000 |
|---|---|---|---|
| 0 | 400 | 1000 | 400 |
| 1 | 400 | 2000 | 200 |
| 2 | 400 | 4000 | 100 |
| 3 | 400 | 8000 | 50 |
| Beyond 3 | 0 | | |
| Total Visits | 1600 | | |

# Zonal TCM

4. Calculate the average travel cost per trip to the site for each zone.
   - Calculate average round trip travel distance and travel time
   - Assume Zone 0 = zero travel distance and time
   - Multiply average travel distance for each zone by standard cost per mile (£0.3 per mile)
   - Multiply average travel time for each zone by the cost of time (e.g. average hourly rate, £9/hour or £0.15/minute)
   - Add travel and time cost together

# Zonal TCM

| Zone | Round trip travel distance (miles) | Distance X cost/mile (£0.3) | Round trip travel time (minutes) | Travel time X cost / minute (£0.15) | Total Travel Cost / Trip |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 20 | £6.00 | 30 | £4.50 | £10.50 |
| 2 | 40 | £12.00 | 60 | £9.00 | £21.00 |
| 3 | 80 | £24.00 | 120 | £18.00 | £42.00 |

# Zonal TCM

5. Determine 'Trip Generation Function' which provides a model of site use.

   Regress visits/1000 against travel costs from each zone. (May also include demographic and other data in model)

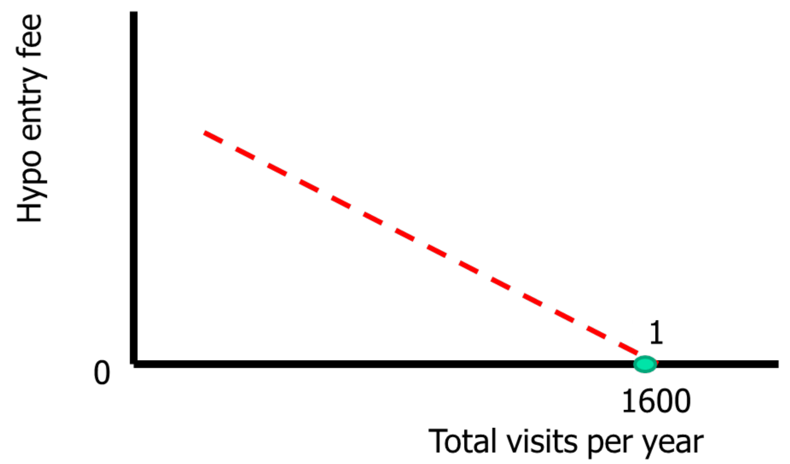
*REGRESS;Lhs=VISIT_1000;Rhs=ONE,TRAVELCOST$*

| Dep. var. = VISIT_1000

| Variable | Coefficient | Standard Error | t-ratio | P[\|T\|>t] | Mean of X |
|---|---|---|---|---|---|
| **Constant** | **330.0000000** | 64.475909 | 5.118 | .0361 | |
| **TRAVELCO** | **-7.755102041** | 2.6799613 | -2.894 | .1016 | 18.375000 |

# Zonal TCM

6. Construct a Demand function (hypothetical entry fee against visits) for the site based on the Trip Generation Function.
   – Point 1 (Current situation): No. of visits (at hypo entry fee =£0) $\Rightarrow$ 1600 visits per year.



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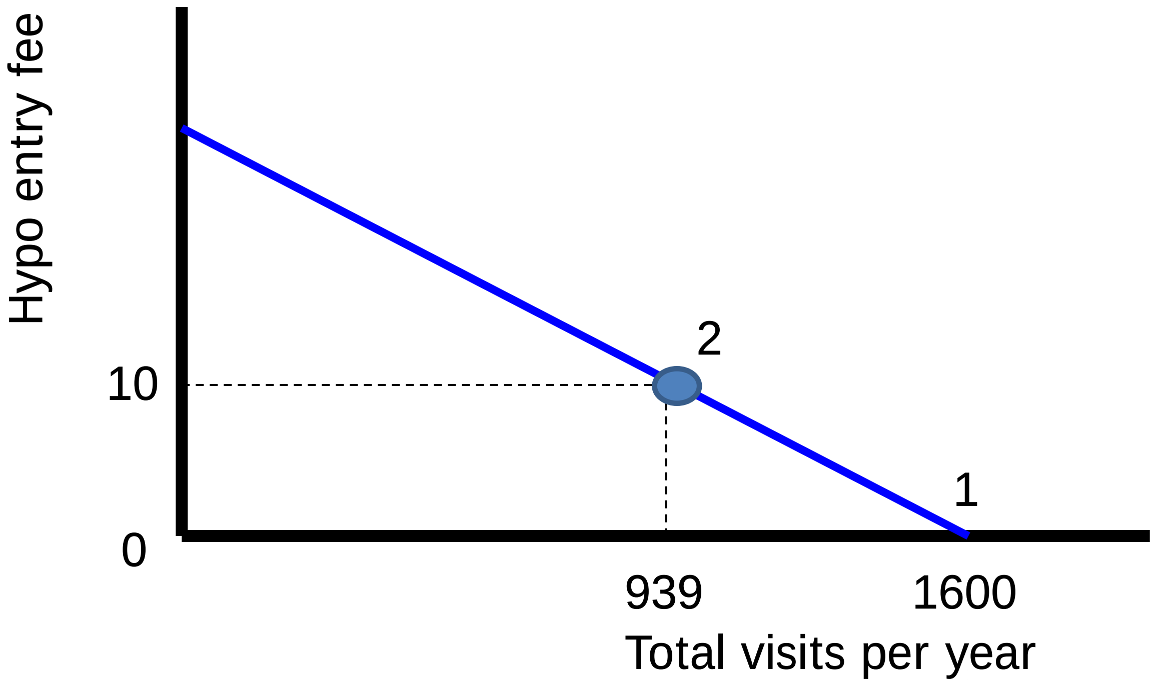
# Zonal TCM

**Point 2 on the demand curve: Assume hypo entry fee = £10.**

- Visits/1000 (zone 0) = 330 – 7.755 * travel cost = 330 – 7.755 * 10 = **249**
- Visits/1000 (zone 1) = 330 – 7.755 * travel cost = 330 – 7.755 * 20.50 = **169**

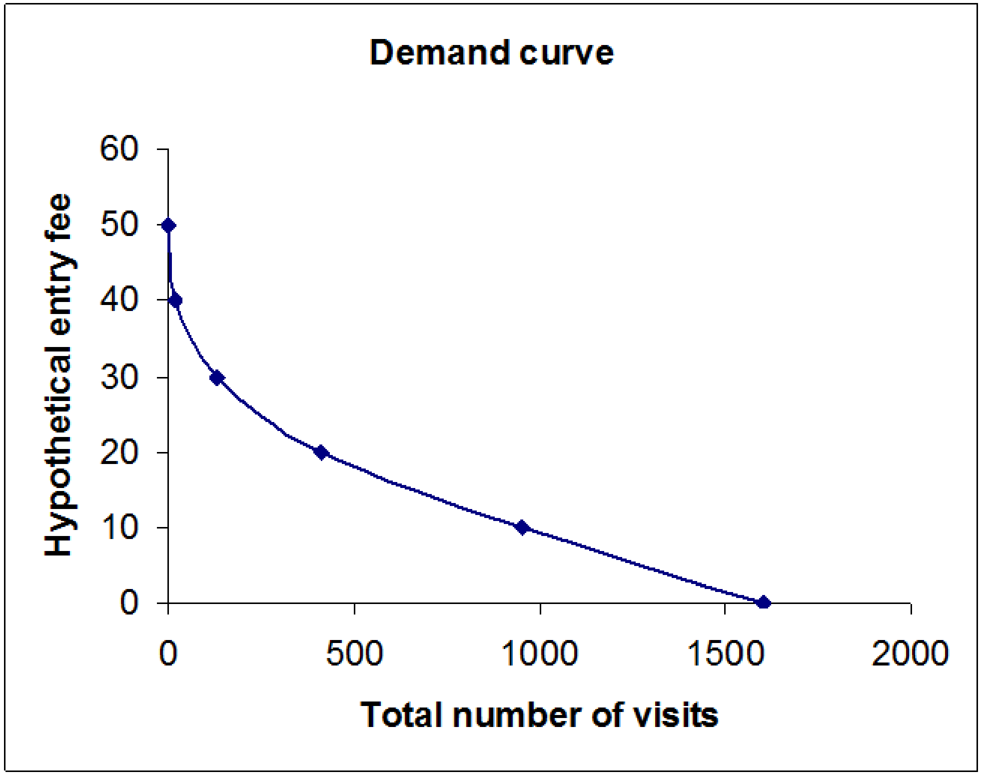
| Zone | Basic Travel Cost | Travel Cost plus £10 | Visits/1000 | Population | Total Visits |
|---|---|---|---|---|---|
| **0** | £0 | **£10** | **249** | **1000** | **249** |
| **1** | £10.50 | **£20.50** | **169** | **2000** | **338** |
| **2** | £21.00 | **£31.00** | **88** | **4000** | **352** |
| **3** | £42.00 | **£52.00** | **0**[1] | **8000** | **0** |
| | | | | **Total Visits** | **939** |

# Zonal TCM



# Zonal TCM

- In the same way, the number of visits for increasing hypo entry fees can be calculated.
- Value of site is the area under the demand curve.



# Zonal TCM assumptions

- Populations in zones are homogeneous
- All face the same travel costs
- Travel is viewed in the same way as an entry fee
- Value of '*time*':
    - how much
    - travel time part of recreational experience
- Visitors who go to more than one site

- The individual and random utility TCM address many of these assumptions

# Individual TCM

- The Individual TCM is similar to the Zonal TCM, but uses survey data from individuals visitors (rather than average data from each zone) to estimate the TGF.
- ITCM requires more data and more complicated analysis, but is more precise.

# Random Utility TCM

- RU TCM assumes that individuals will pick the site that they prefer, out of all sites, i.e. they make tradeoffs between site quality and price of travel to site.
- Method requires data on:
  - All possible sites that a visitor might select
  - Their quality characteristics
  - Travel costs to each site

# Random Utility TCM

- Using this info, the researcher can predict:
  - The choice to e.g. go fishing or not
  - Factors that determine which site is selected.
  - Info collected on site quality also allows the value of changes in quality to be estimated.

# TCM Issues: Type of traveller

- TCM is best suited to sites which draw only day-trip visitors.
- However, many sites are visited by :
  - People on multi-destination trips, e.g. on holiday. Only including the local travel would underestimate value.
  - People who stop at site only because they happen to pass by it. Including all travel costs would be inappropriate.
- These types of visitors violate two TCM assumptions:
  1. That the travel costs which people incur to visit a site are a good proxy for the amount they value the use of the site.
  2. That the travel costs can be simply calculated.

# TCM Issues: Time

- How should cost of time be included in TCM?
  - Value of time = fixed % of wage rate?
  - Raises question: Should only travel time be counted or time on site also be included?

  - There has been great debate on the value of time in TCM studies.
  - See Cesario (1976) for discussion.

# TCM Issues: Specification of Trip Generation Function.

- The zonal TCM model.
  - Demographic variables are aggregated across the zone's inhabitants (as opposed to on an individual basis).
  - This may increase error or decrease the likelihood of finding significant features.
  - This raises questions about whether the zonal model is compatible with individual utility-maximisation theory.

- The individual TCM model
  - Demographic variables are included for each visitor.
  - This is more compatible with utility-maximisation theory, but necessitates more data collection.
- The zonal TCM
  - In addition to demographic variables, environmental quality variables at site and substitute sites are included.

# TCM conclusion

- The TCM aims to estimate the use value of a recreation site.
- The early TCM models utilised a large number of assumptions to simplify the analysis.
- More recent TCM versions have improved the specification of the TGF, improving both the accuracy and flexibility of value estimates, as well as relaxing some of the main assumptions.

# Contingent valuation method

# Contingent Valuation Method

- Uses surveys to elicit the maximum WTP for a hypothetical market for the environmental good.

- Value of environmental good

  = mean WTP X affected population.

# Structure of a CV questionnaire

- A detailed description of the environmental good and the hypothetical circumstances under which it is made available to respondents;
- WTP elicitation question;
- Questions relating to respondents' characteristics: socio-economic, preferences relevant to the good.

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# Create a ‘hypothetical’ market

- Required because of the absence of an ‘actual’ market for the good.

- Hypothetical market needs to be:
    - understandable
    - meaningful
    - Plausible

- E.g. Increases in taxation to fund improvements to biodiversity on farms.

# Payment Vehicle

- The instrument used to make the payment towards the good:
    - Increases in taxation
    - Donations to trust funds
    - Entrance fees
    - Higher payments for goods

- Aim to reduce ‘Protest bids’.

# Elicitation question

- Attempts to establish the respondent's maximum WTP (WTA) for the good.

| | **Actual WTP obtained** | **Discrete indicator of WTP** |
|---|---|---|
| **Single question** | Open-ended, Payment card, | Discrete choice, Referendum |
| **Iterated series of questions** | Bidding game | Discrete choice with follow-up |

# Open ended: Red Kite survey

- 'What is the maximum annual amount of money you would be willing to donate towards the Welsh Kite Trust in order to ensure continued protection of the Red Kite in mid Wales?'

(Christie 2007)

# Payment card - biodiversity

Please indicate which amount shown on the card your household would be willing to pay as an annual increase in your tax bill over a period of 5 years for the biodiversity improvements in Cambridgeshire that have just been discussed.

Christie (2006)

£0.75
£1.50
£3.00
£6.00
£12.00
£24.00
£48.00
£96.00
£192.00
£384.00
£768.00

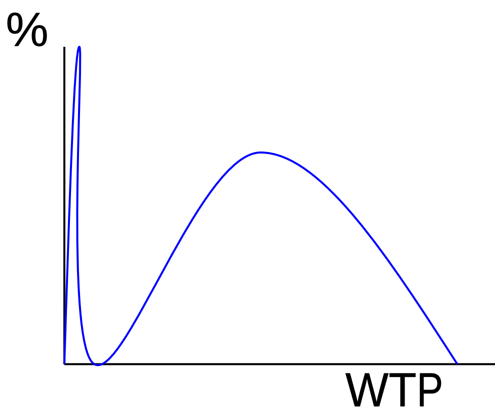
# Referendum / Discrete choice: Lake water quality

- Would you vote ‘yes’ on a referendum to improve water quality in the lake to the level described in Plan A? The proposed programme would cost you $100:
  - Yes [ ]
  - No [ ]

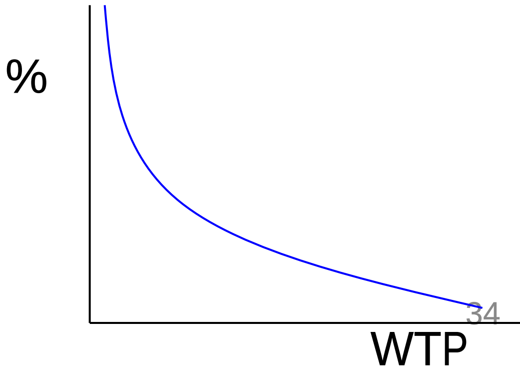
(Christie, 2009)

# Analysis of responses

- Open ended:
  - Relatively simple to estimate mean WTP
  - May be refined by using Tobit models to take account of peak at £0 WTP.




- Discrete choice / payment card
  - Logit regression models.
  - Takes account of % response to different bid levels.



# Analysing responses: Theoretical basis

- Random Utility Theory (RUT)
  - The Utility U that individual *i* gains from the consumption of a good is made up of a observable deterministic component V (the utility function) and a random component *ε*.

- $U_i = V_i + \varepsilon$

- $V_i = \alpha_i + \beta(\text{Bid}_i) + \mu Z_i$

- $WTP = \alpha / \beta(\text{Bid}_i)$

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# Attaining meaningful responses

- Before you answer this question, please consider the following:
  - The amount that you state should reflect the *benefit that you would receive* from the biodiversity improvements in Cambridgeshire.
  - In order to make this payment, *you may need to reduce the amount that you spend on other things.*
  - If the total amount people are willing to pay is not enough, the policy may not be introduced.
  - In studies similar to this, people have had a tendency to over state their WTP. You therefore need to think about whether you would really be willing to pay the stated amount in your response.

# Attaining meaningful responses

- Follow-up question
  - I choose the policy option because I considered that the benefits were worth the costs to me.
  - I did not choose the policy option because the benefits were no worth the costs.
  - I choose the policy option irrespective of cost
  - I did not choose the policy option as I did not want to pay more tax.
  - I choose randomly

# Biases

- Systematic errors which affect CV results.
  - Incentives to misrepresent responses, e.g. strategic bias.
  - Implied cue bias, e.g. starting point bias.
  - Scenario misspecification bias, e.g. Part-whole bias
  - Improper sampling design or benefit aggregation.

# Ensuring accurate valuations

- Always pilot test your survey to identify sources of bias.
- Undertake validity tests
    - Content validity: Does the survey accurately reflect the good?
    - Construct validity: Compare findings with other measures (e.g. TCM) or model responses using regression.
    - Criterion validity: Regress WTP against socio-economic and attitudinal characteristics
- NOAA guidelines (Arrow *et al*. 1993)

# The NOAA Panel of experts

- A panel of experts, chaired by Arrow and Solow, was set up to provide advice on…

- *'is the contingent valuation method capable of providing estimates of lost nonuse or existence values that are reliable enough to be used in natural resource damage assessments?'.*

# NOAA Panel Conclusions

- Published in the Federal Register on 15 January 1993
- *'… the Panel concludes that CV studies can produce estimates reliable enough to be the starting point of a judicial process of damage assessment, including lost passive use values'*

- But, the Panel were not happy with previous studies and therefore set out some guidelines for future CV studies.

# NOAA Panel report (Arrow et al. 1993)

- Guidelines for conducting CV included…
  - Use personal interviews
  - Use referendum format
  - Accurate and understandable description of programme
  - Reminder of budget constraints
  - Reminder of substitute goods
  - Follow-up questions to discover reason for choice.

# NOAA Panel report cont.

- *Burden of proof* requirements:
- *"… if a CV survey suffered from any of the following maladies, we would judge the findings 'unreliable':*
  - *A high non-response rate to the entire survey or to the valuation question*
  - *Inadequate responsiveness to the scope of the environmental insult*
  - *Lack of understanding of the task by the respondent*
  - *Lack of belief in the full restoration scenario*
  - *'yes' or 'no' votes on the hypothetical referendums that are not followed up or explained by making reference to the costs and / or value of the program"*

# An application of the CV method

Exxon Valdez oil spill, Alaska (Carson et al, 1992)

March 1989, largest oil spill in the US

- 11m gallons of oil
- 10,000 sq miles of water
- 20,000 bird died.

– CV study aimed to estimate the value of a scheme to prevent future oil spills

– Referendum method used:

| | | | | |
|---|---|---|---|---|
| Tax level: | $10 | $30 | $60 | $120. |
| % WTP: | 67 | 52 | 51 | 34 |

– Median WTP = $31

– Non-use value in US (excl. Alaska) = $2.8 billion

# Advantages of CVM

- Virtually no limit on the range of environmental values which can be estimate.
- Can estimate use and passive use values.
- Is accepted by economists and policy-makers.
- Clear set of guidelines (NOAA guidelines following the Exxon Valdez oil spill)

# Problems of CVM

- Hypothetical nature of question means that respondents never actually pay - strategic bidding.
- The way in which the WTP question is posed may biases value estimates.
- Protest bidders

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# Choice experiments

# Choice Modelling

- An attribute-based stated preference method of environmental valuation.
- Enables values to be attained for different levels of attributes of environmental policy.

# Survey instrument design

- In choice modelling, respondents are required to choose between three choice options
  - … where each choice options is described in terms of policy attributes…
  - … where attributes are described as levels

# Choice experiments / modelling

- Examples: Elk hunting (Adamowicz, 1994):

| | Package A | Package B | Status Quo |
|---|---|---|---|
| No. of Elks | 10 | 25 | 5 |
| Landscape | Open | Forest | Forest |
| Party size | 3 | 10 | 8 |
| Price | $45 | $15 | $10 |

| | Forest A | Forest B |
|---|---|---|
| Type of trail | Only multi-user trails (walkers, cyclists and horse riders) available. No dedicated cycle trails. | Multi-use trails + dedicated way marked, long distance (+ 20 miles) cross country bike trails. |
| Optional trail obstacles | A range of optional trail obstacles provided including jumps, drop-offs, and north shore. | No optional trail obstacles. |
| Bike wash facilities | Bike washing facilities available. | No bike wash facilities. |
| Changing and shower facilities | No changing / shower facilities. | Changing / shower facilities available. |
| General facilities | Facilities included car parking, toilets, BBQ / picnic area, café and forest shop. | Facilities include car parking and toilets only. |
| Information | Only basic information on the forest, trails, and wildlife provided. | Detailed and up-to-date information on the forest, trails, and wildlife provided at forest centre, in leaflets, along trails and on website |
| Surrounding | Forest enhanced to increase opportunities to view wildlife, features of interest and view points. | Forest not managed to increase opportunities to view wildlife, points of interest and view points. |
| Distance | Forest located **150 miles** from your home. | Forest located **75 miles** from your home. |

I prefer: Forest A [ ] Forest B [ ] Stay at Home [ ]

**Christie M,** et al. (2007) Valuing enhancements to forest recreation using choice experiments and contingent behaviour methods. *Journal of Forest Economics*. 13(2), 75-102.)

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# Designing the choice tasks: Factorial Designs

- … are designs in which each level of each attribute is combined with every level of all other attributes.
- For example, a $2^3$ complete factorial design has 3 attributes, each with 2 levels
  - A: (-1, +1)
  - B: (-1, +1)
  - C: (-1, +1)
- Each combination of the 2 levels of the 3 attributes gives 8 (i.e. 2 x 2 x 2) unique treatments of attribute combinations.

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# Example of $2^3$ complete factorial design

| Treatment | A | B | C |
|---|---|---|---|
| 1 | -1 | -1 | -1 |
| 2 | +1 | -1 | -1 |
| 3 | -1 | +1 | -1 |
| 4 | +1 | +1 | -1 |
| 5 | -1 | -1 | +1 |
| 6 | +1 | -1 | +1 |
| 7 | -1 | +1 | +1 |
| 8 | +1 | +1 | +1 |

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# Designing choice task

- A complete factorial design for the Forest recreation study:
    - 5 attributes at 2 levels
    - 3 attribute at 4 levels
  - … would generate 2048 unique combinations
  - ie $2^5 + 4^3 = (2x2x2x2x2x4x4x4) = 2048$

- Clearly, as the number of attributes and levels increase, we get into difficulties of needing very large sample sizes.

- An orthogonal, fractional factorial experimental design will reduce this number of combinations.

# Fractional factorial designs

- … involve the selection of a particular subset (e.g. fraction) of a complete factorial, so that particular effects can be estimated as efficiently as possible.
- Fractional designs, however, involve:
  - a loss of statistical information.
  - requires assumptions about the non-significance of higher order effects, i.e. the interaction between two or more attributes.

# Fractional factorial design ($2^3$)

| | Main effects | | | 2-way interaction | | | 3-way |
|---|---|---|---|---|---|---|---|
| Fraction 1 | A | B | C | BC | AC | AB | ABC |
| 1 | -1 | -1 | -1 | +1 | +1 | +1 | -1 |
| 2 | -1 | +1 | +1 | +1 | -1 | -1 | -1 |
| 3 | +1 | -1 | +1 | -1 | +1 | -1 | -1 |
| 4 | +1 | +1 | -1 | -1 | -1 | +1 | -1 |
| Fraction 2 | | | | | | | |
| 5 | -1 | -1 | +1 | -1 | -1 | +1 | +1 |
| 6 | -1 | +1 | -1 | -1 | +1 | -1 | +1 |
| 7 | +1 | -1 | -1 | +1 | -1 | -1 | +1 |
| 8 | +1 | +1 | +1 | +1 | +1 | +1 | +1 |

# Fractional factorial designs

- Fraction 1: is the irregular fraction, i.e. ABC = -1
  - A = -BC
  - B = -AC
  - C = -AB
- Fraction 2: is the regular fraction, i.e. ABC = +1
  - A = BC
  - B = AC
  - C = AB
- In the design of CE, we use the regular fraction.
- The fractional factorial design now only requires 4 treatments (instead of 8 in the full factorial).
- In the Forest recreation example, factorial designs allow us to reduce the number of treatments frc

# Fractional factorial designs

- In our $2^3$ CE which has 4 treatments:
  - Our estimate of the main effect (A) could be the estimate of A or the two-way interaction BC or some other combination of A and BC.
  - Thus, we will only estimate A *if and only if* the two-way interaction BC is not significant (equals zero).
  - Thus, we need to avoid collinearity in our attributes within the CE design, i.e. we need to ensure that our attributes are not linked to each other.

# Choice set design

- In designing a CE choice set, we have
  - Status quo (described as existing levels of attributes)
  - Choice A (described according to a fractional factorial design)
  - Choice B (described according to a different fractional factorial design)

# Choice set design ($2^3$)

**Right is the $2^3$ fractional factorial design.**

**Below is the design of 1 of the 4 choice sets.**

| | | | |
|---|---|---|---|
| 5 | -1 | -1 | +1 |
| 6 | -1 | +1 | -1 |
| 7 | +1 | -1 | -1 |
| 8 | +1 | +1 | +1 |

| Attribute | Choice 1 (Based on 5) | Choice 2 (Based on 7) | SQ |
|---|---|---|---|
| A | -1 | +1 | -1 |
| B | -1 | -1 | -1 |
| C | +1 | -1 | -1 |

# Choice set design

- Generally, respondents can cope with between 5 - 10 choice tasks within a single questionnaire.
- In the Forest recreation example, the $2^5 + 4^3$ design gave rise to 16 choice sets. The choice tasks were therefore split between 2 sub samples (each receiving 8 choice tasks).
- 'Orthoplan' in SPSS can be used to design the fractional factorial design.

# Analysis: Theoretical assumptions

- Random Utility Theory
  - The Utility U that individual *i* gains from the consumption of a good is made up of a observable deterministic component V (the utility function) and a random component *ε*.

- Lancastrian consumer theory
  - Utility for a good can be decomposed into separable utilities of the good's attributes

- $U_{ij} = V_{ij} + \varepsilon_{ij}$

- $V_{ij} = \alpha_{ij} + \beta(\text{Bid}_j) + \gamma X_j + \mu Z_i$
  - *where X is environmental attributes and Z are respondents characteristics*

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# CE analysis

- Similar to CV, CE is based on Random Utility Theory.
  - $U_{ij} = V_{ij} + \varepsilon_{ij}$
  - $V_{ij} = \alpha_{ij} + \beta(\text{Bid}_j) + \gamma X_j + \mu Z_i$
  - *where X is environmental attributes and Z are respondents characteristics*
- However, choice set C contains 3 options (A, B, SQ)

$$\Pr\left[i \mid C\right] = \Pr\left[U_i > U_j\right], \forall j \in C$$

$$= \Pr\left[\left(V_i + \varepsilon_i\right) > \left(V_j + \varepsilon_j\right)\right]$$

$$= \Pr\left[\left(V_i - V_j\right) > \xi\right],$$

- Rather than using the logit model (as in CV), we need to use the Multinomial logit (MNL) model

$$\Pr\left[i \mid C\right] = \frac{\exp\left(\mu V_i\right)}{\sum_{j \in C} \exp\left(\mu V_j\right)}$$

- More sophisticated models include the nested logit model and the random parameters logit model.

# Logit model for forest study

| | *Model 1 All cyclists (Choice)* | *Model 2 All cyclists (Frequency)* | *Model 3 Leisure Cyclists (Frequency)* | *Model 4 Mountain bikers (Frequency)* | *Model 5 Downhill riders (Frequency)* |
|---|---|---|---|---|---|
| ASC | 0.099 (0.802) | -0.324*** (-6.246) | -0.532*** (-2.800) | -0.369*** (-6.544) | -0.427*** (-4.639) |
| Trails (Dedicated cross country) | 0.124** (2.377) | 0.106*** (4.550) | 0.033 (0.386) | 0.125*** (4.934) | 0.018 (0.456) |
| Tails (Dedicated single track) | 0.358*** (6.672) | 0.154*** (6.488) | 0.083 (0.981) | 0.182*** (7.122) | 0.002 (0.060) |
| Trails (Dedicated downhill) | 0.245*** (4.320) | 0.178*** (7.334) | -0.053 (-0.597) | 0.162*** (6.15) | 0.342*** (8.298) |
| Obstacles (jumps and drop-offs) | 0.264*** (9.406) | 0.138*** (11.512) | 0.030 (0.681) | 0.134*** (10.346) | 0.192*** (9.365) |
| Bike wash facilities | 0.060** (2.128) | 0.078*** (6.386) | 0.092** (2.010) | 0.073*** (5.572) | 0.045** (2.160) |
| Changing and shower facilities | 0.076*** (2.854) | 0.029** (2.451) | -0.001 (-0.028) | 0.031** (2.444) | -0.011 (-0.544) |
| Parking, toilets, picnic | 0.008 (0.121) | 0.014 (0.497) | 0.031 (0.320) | 0.023 (0.734) | 0.051 (1.004) |
| Parking, toilets, picnic, café, shop | 0.066 (1.011) | 0.019 (0.669) | 0.010 (0.108) | 0.006 (0.181) | 0.042 (0.842) |
| Parking, toilets, picnic, café, shop, play areas | 0.066 (0.990) | 0.029 (0.991) | 0.103 (1.064) | 0.033 (1.035) | -0.033 (-0.633) |
| Detailed information | -0.006 (0.205) | 0.003 (0.269) | 0.004 (0.096) | 0.007 (0.556) | 0.050** (2.437) |
| Enhanced surroundings | 0.011 (0.379) | -0.004 (-0.335) | 0.039 (0.871) | -0.011 (-0.842) | -0.069*** (-3.358) 11 |
| Distance | -0.018*** (15.019) | -0.018*** (-35.555) | -0.028*** (-13.962) | -0.018*** (-6.544) | -0.015*** (-17.371) |

# *WTP (attribute)* = $\gamma X / -\beta(Bid_i)$

Cyclists highly valued cycle specific improvements.

- **Leisure cyclists**: Bike wash (£3)
- **Mountain bikers**: Single track (£10), Downhill (£8), Obstacles (£7), X-country (£7), bike wash (£4), shower (£2), multi-use (-£25)
- **Downhillers**: Downhill (£23), Obstacles (£13), bike wash (£3), info (£3), surroundings (-£4)

# Choice experiments

**Advantages**

- Good for eliciting the value of the various elements of an environmental good.
- Simple and logical choice options.

**Problems**

- Respondents need to have a good knowledge of environmental good.
- Complex experimental design and statistics required.

# Summary

- There are a range of methods available to value environmental goods and services: different methods will be suited to different goods and different elements of value.
- Travel cost is restricted to valuing use vlaues.
- Stated Preference methods are able to elicit both use and passive-use values.
- Stated Preference methods are also flexible and therefore may be used to value almost any good.

# Further Reading

- General Valuation methods
  - Hodge (1995). ‘Environmental Economics’
  - Garrod and Willis (1999) *Economic valuation of the environment*. Edward Elgar.

- Travel Cost method
  - Bell, F and Leeworthy V (1990). Recreational demand by tourists for saltwater beach days. *J. Env. Eco and Mgt 18, 189-205*
  - Cesario (1976) Value of time in recreation benefits studies. Land Economics 52, 32-41.
  - Clawson, M and Knetsch, J. (1966) *Economics of Outdoor Recreation.* John Hopkins University Press: Baltimore.
  - Hotelling, H. (1949), Letter, In: *An Economic Study of the Monetary Evaluation of Recreation in the National Parks*, Washington, DC: National Park Service.
  - Karasin (1998) *The Travel Cost Method : Background, Summary, Explanation and Discussion*, Discussion paper: Centre for Economic and Social Studies on the Environment, l'Université Libre de Bruxelles.
  - McConnell, K (1985). ‘The economics of Outdoor Recreation.’ In Kneese and Sweeny (Eds) *Handbook of Natural and Resource and Energy Economics*. Elserier: Amsterdam.
  - Shaw D (1991) Recreational demand by tourists for saltwater beach days: Comment. *J. Env. Eco and Mgt 20, 284-289.*

# Further reading (cont.)


- Contingent valuation
  - Arrow, K. J., R. Solow, P. Portney, E. Leamer, R. Radner, and H Shuman. "Report of NOAA Panel on Contingent Valuation," *Federal Registration*, 58(1993): 4016-4614.
  - Carson *et al*. (1992) *A contingent valuation study of lost passive use values resulting from the Exxon Valdez Oil Spill*. Report to the Attorney General of the State of Alaska.
  - Christie M, Hanley, N, Warren, J, Murphy K, Wright R and Hyde T. (2006) Valuing the diversity of biodiversity *Ecological Economics.* 58(2), 304-317.
  - Christie M and Azevedo C (2009). Testing the Consistency Between Standard Contingent Valuation, Repeated Contingent Valuation, and Choice Experiments. *Journal of Agricultural Economics* 60(1), 154-170.
  - Christie M (2007) An examination of the disparity between hypothetical and actual willingness to pay for Red Kite conservation using the contingent valuation method. *Canadian Journal of Agricultural Economics* 55, 159-169.
  - Mitchell and Carson (1989) 'Using Surveys to Value Public Goods: The CV method'
  - Hanley (1989) Valuing rural recreation sites: An empirical comparison of approaches. Journal of Agricultural Economics, **40**, 361-375.
- Choice experiments
  - Louviere, Hensher and Swait (2000). *Stated Choice Methods: Analysis and Applications*. Cambridge University Press: Cambridge
  - Hensher, Rose and Greene (2005). *Applied Choice Analysis: A Primer*. Cambridge University Press: Cambridge
  - Adamowicz *et al* (1994) 'Combining Revealed and Stated Preference Methods for Valuing Environmental Amenities'
  - Christie M**,** Hanley, N and Hynes S. (2007). Valuing enhancements to forest recreation using choice experiments and contingent behaviour methods. *Journal of Forest Economics*. 13(2), 75-102.)