

# Behavioural Economics

## PSYC3310: Specialist Topics In Psychology

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## Seminar 3: Decision Making under Certainty

CSIRO-UWA | Behavioural  
Economics  
Laboratory

# Decision making under certainty

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Economics

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- The standard model under the microscope
  - focus on rational choice under certainty
- Decision making under certainty
  - examine violations of rational choice theory:
    - opportunity costs
    - the decoy effect
    - speaker 1: sunk costs
    - speaker 2: loss aversion and the endowment effect
    - speaker 3: anchoring and adjustment

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Next ...

- Standard model assumes choice alternatives can be ranked according to desirability
- **Strong preference relation**
  - $X$  is “definitely preferred” to  $Y$
  - can be stated as:  $X \succ Y$
- **Weak preference relation**
  - $X$  is “at least as good as”  $Y$
  - can be stated as:  $X \succeq Y$
- **Indifference**
  - $X$  is “as good as”  $Y$
  - can be stated as:  $X \sim Y$

Key point:

- Standard model assumes that preferences are **stable**

# Definitions: Preferences

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## Key point:

- Standard model assumes that preferences are **stable**



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# Definitions: Utility

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- Utility is an index or measure of preference
- We can express a person's preference ordering over a set of options numerically by assigning larger numerical values to more preferred options
- Suppose you prefer Coke (C) to Fanta (F), and Fanta to Sprite (S)
- We can express this preference ordering as a **utility function** which associates each alternative with a number
- $u(C) = 3$ ;  $u(F) = 2$ ;  $u(S) = 1$ ; yielding the sequence  $\langle 1,2,3 \rangle$

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- A utility function must satisfy two properties
  - assign a value to each alternative (ties are admitted)
  - larger values should be assigned to more preferred alternatives
- This view of utility is known as **ordinal utility** because it enables you to order preferences
- Other interpretations of utility are possible (we won't bother ourselves with them for now)

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- This involves making a decision between two or more alternatives
- In the standard model, choice is assumed to be **revealed preference**
- Given the alternatives,  $X$  and  $Y$ , if you choose  $X$  then this “reveals” that you prefer it to  $Y$
- Preferences and choices are assumed to be identical in the standard model

# The standard model: Formal specification

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According to the standard model, individual  $i$  at time  $t = 0$  maximises expected utility subject to a probability distribution  $p(s)$  of the states of the world  $s \in S$ :

$$\max_{x_i^t \in X_i} \sum_{t=0}^{\infty} \delta^t \sum_{s_t \in S_t} p(s_t) U(x_i^t | s_t)$$

- $U(x|s)$  is the utility function, defined over the payoff  $x_i^t$  of individual  $i$
- Future utility is discounted with a time-consistent discount factor  $\delta$



# The standard model: Assumptions by components

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(1)	(2)	(3)	(4)
$\max_{x_i^t \in X_i}$	$\sum_{t=0}^{\infty} \delta^t$	$\sum_{s_t \in S_t} p(s_t)$	$U(x_i^t   s_t)$

1. Individuals maximize expected utility **(1)**, **(3)**, and **(4)**
2. An individual's utility is governed by entirely selfish concerns **(4)**
3. Individuals are Bayesian probability estimators **(3)**
4. Individuals have consistent time preferences **(2)**
5. All income and assets are completely fungible **(4)**

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(1)	(2)	(3)	(4)
$\max_{x_i^t \in X_i}$	$\sum_{t=0}^{\infty} \delta^t$	$\sum_{s_t \in S_t} p(s_t)$	$U(x_i^t   s_t)$

1. Preferences **(4)** and choice **(1)** = Seminars 3, 6, and 8
2. Belief formation **(3)** = Seminar 4
3. Expected Utility Theory **(1)**, **(3)**, and **(4)** = Seminar 5
4. Temporal Discounting **(2)** = Seminar 7

# The standard model: Aspects of decision making

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(1)	(2)	(3)	(4)
$\max_{x_i^t \in X_i}$	$\sum_{t=0}^{\infty} \delta^t$	$\sum_{s_t \in S_t} p(s_t)$	$U(x_i^t   s_t)$

1. **Preferences** - the rankings people have over a set of options based on their attitudes and values towards their outcomes **(4)**
2. **Beliefs** - the probabilities people associate with various outcomes occurring **(3)**
3. **Rationality** **(1), (2), (3), and (4)**
  - People's preferences based on attitudes and values **(4)**
  - People modify beliefs in face of new evidence **(3)**
  - People discount future outcomes **(2)**
  - People make optimal choices **(1)**

# The standard model: An example

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Suppose you have to choose between two 3310 topics:

- (1) Behavioural Economics (BE)
- (2) Cognition and Emotion (CE)

Choice	State of world $s \in S$	Probability $p(s)$	Utility $U(x s)$
BE	Exciting	0.8	60
	Dull	0.2	30
CE	Exciting	0.05	60
	Dull	0.95	30

$$U(\text{BE}) = (0.8 \times 60) + (0.2 \times 30) = \mathbf{54}$$

$$U(\text{CE}) = (0.05 \times 60) + (0.95 \times 30) = \mathbf{31.5}$$

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- Standard model explains preferences—**component 4** in the earlier equation—using a set of axioms and principles
- **Axioms**
  - basic propositions that cannot be proven and must be taken for granted
  - fundamental to the model
- **Principles**
  - auxiliary assumptions of the model
  - relevance varies depending on circumstance
- Distinction between axioms and principles is important for evaluating shortcomings of the standard model

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# Transitivity

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- Given three alternatives  $X$ ,  $Y$  and  $Z$ , if an individual prefers  $X$  to  $Y$  and  $Y$  to  $Z$  then they should also prefer  $X$  to  $Z$
- This can be expressed as:
  - *if  $X \succeq Y$  and  $Y \succeq Z$ , then  $X \succeq Z$*
- Similarly, if an individual is indifferent between  $X$  and  $Y$  and  $Y$  and  $Z$ , they must also be indifferent between  $X$  and  $Z$
- This can be expressed as:
  - *if  $X \sim Y$  and  $Y \sim Z$ , then  $X \sim Z$*



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# Completeness

When a person compares two alternatives  $X$  and  $Y$  this must lead to one of three mutually exclusive outcomes:

- The individual prefers  $X$  to  $Y$ 
  - $X \succeq Y$
- The individual prefers  $Y$  to  $X$ 
  - $Y \succeq X$
- The individual is indifferent between  $X$  and  $Y$ 
  - $X \sim Y$

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- This axiom follows from the completeness axiom and states that an option is at least as good as itself
  - $X \succeq X$
- This axiom is generally regarded as trivial

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# Revealed preference

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- If an individual chooses  $X$  over  $Y$  then it is assumed that  $X$  is preferred to  $Y$ —known as revealed preference
- This axiom states that if  $X$  is revealed as directly/indirectly preferred to  $Y$ —and the two goods are not the same—then  $Y$  cannot be revealed as directly/indirectly preferable to  $X$

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- Any state of the world that results in the same outcome, regardless of one's choice, can be discarded or ignored
- If you prefer the prospect  $\mathbf{q} = (\$3000, 1)$  to the prospect  $\mathbf{r} = (\$4000, 0.8)$  ...
- ... you should prefer the prospect  $\mathbf{q}' = (\$3000, 0.25)$  to the prospect  $\mathbf{r}' = (\$4000, 0.2)$
- The final two prospects have 25% of the probabilities of the first two prospects
- These should cancel one another out

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# Dominance

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- If option  $X$  is better than option  $Y$  in one state of the world and at least as good in all other states then  $X$  is dominant over  $Y$  and should be preferred
  - if Behavioural Economics ( $X$ ) is more “exciting” than Cognition and Emotion ( $Y$ ) and both are of “moderate” difficulty, then Behavioural Economics should be preferred
- Related to the reflexivity axiom
- A simpler and therefore stronger assumption than cancellation/independence

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- People should have the same attitude toward an object irrespective of how it is described
- Describing a packet of mince meat as 5% fat or 95% fat free should not influence your attitude towards it or your valuation of it
- Related—like the dominance principle—to the reflexivity axiom

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# Invariance

## Behavioural Economics

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Next ...

- Most important principle and essential for any normative theory
- States that different representations of the same choice problem should not yield different preferences
- Preferences should be:
  - description invariant: unaffected by the description of the choice options
  - procedure invariant: unaffected by the procedure used to elicit a person's preferences
  - "framing effects" should not happen
- Violations of this principle = bad news for standard model

# The Standard Model: Principles

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# Utility maximisation

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Next ...

- Decision makers maximise expected utilities
- Taken as a **descriptive** and **normative** statement:
  - viz.—people *do* behave in this way, and *ought* to behave in this way in order to maximise welfare
- This normative aspect is related to the concept of rationality



# Next ... departures from rationality in choice under certainty

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### Next ...

- Opportunity costs
- Decoy effect
- Sunk costs (Speaker 1)
- Endowment effects and loss aversion (Speaker 2)
- Anchoring and adjustment (Speaker 3)

# Departures from rationality: Opportunity costs

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Next ...

- An **opportunity cost** is the cost you pay when you forego one course of action in favour of another
- Suppose you invest some money in a high interest savings account with your bank
- At the end of the year, you earn \$900 in interest
- However, you forewent the opportunity to invest your money in a better savings account with another bank which would have earned \$1,400 in interest
- The opportunity cost—or **implicit cost**—is \$1,400 with an economic loss of  $\$900 - \$1,400 = -\$500$

# Departures from rationality: Opportunity costs

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Next ...

- Opportunity costs are pervasive—whenever we make a choice we forego another at some cost:
  - you can't watch The Bachelor and Q&A at the same time
  - you can't simultaneously be in a monogamous relationship with two different people (unless you're The Bachelor)
  - you can't read about behavioural economics at the same times as reading about fly fishing
  - you can't support both The Eagles and the Freo Dockers (you can only rationally support the latter)
- We can think of opportunity costs in terms of decision trees
- ...

# Departures from rationality: Opportunity costs

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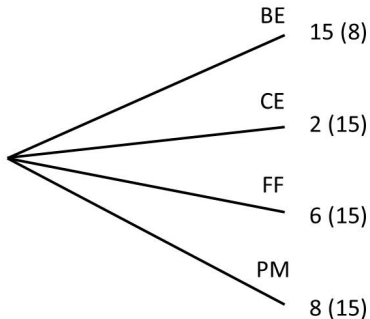
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Next ...



**Decision Tree With utilities and opportunity costs (in brackets).** BE = behavioural economics; CE = cognition & emotion; FF = fascinated by faces; PM = performance monitoring and cognitive control

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Next ...

- Opportunity costs are irrational according to the standard model—you should never choose an alternative whose opportunity cost is higher than its utility
- This is a demanding condition
- Think of rationally choosing the person you will marry:
  - you must have complete and transitive preferences over all alternatives—about half the world's population!
  - you must make sure your choice of spouse is not inferior to any other choice
  - in short, you would need a great deal of computational and reasoning power

# Departures from rationality: The Decoy Effect

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Next ...

- When people must choose between two alternatives—target vs. competitor—the addition of a third alternative—known as the decoy—that is inferior to the target, but not the competitor, increases preference for the target (e.g. Huber et al., 1982, 1983)
- Known variously as the *decoy effect*, *attraction effect*, and *asymmetric dominance effect*
- The effect is an example of **preference reversal**

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Next ...

- You are an avid reader of *The Economist* magazine and are faced with the following subscription dilemma:
  - 1 1-year online subscription for \$59
  - 2 1-year print subscription for \$125
  - 3 1-year online and print subscription for \$125
- Which option would you choose?

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  - 2 1-year print subscription for \$125
  - 3 1-year online and print subscription for \$125
- Which option would you choose?
  - When presented with options 1 and 3, 32% choose option 3
  - When presented with all three options, 84% choose option 3
- *Option 2 is merely a decoy ...*



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- The decoy effect violates an assumption of the standard economic model known as the **independence of irrelevant alternatives**:
  - suppose you prefer option  $x$  over option  $y$  on a menu containing two options
  - adding a third option  $z$  to the menu should not change your preference for  $x$  over  $y$
  - you might reasonably prefer  $z$  over  $x$  but you cannot suddenly prefer  $y$  over  $x$  simply because there is another item on the menu
- The decoy effect provides evidence of the instability of preferences, which is at variance with the standard economic model

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