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Cognitive and Motivational Biases in Risk and Decision Analysis

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Schedule Talk

- Approaches to Decision Making Research
- Prescriptive vs Descriptive Decision Research
- Cognitive Biases in Risk and Decision Analytic Modelling
- Motivational Biases in Risk and Decision Analytic Modelling
- Debiasing judgments in Risk and Decision Analytic Modelling

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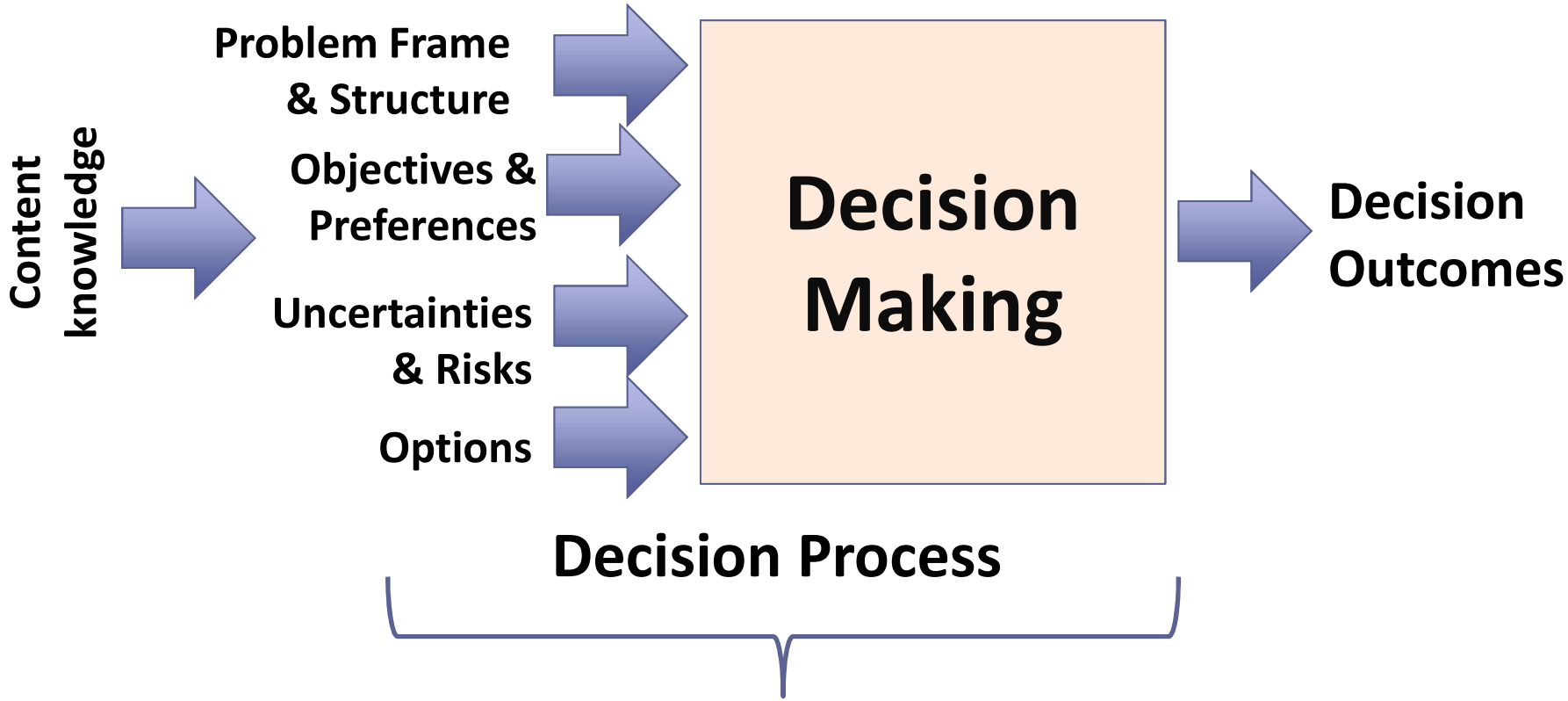
Approaches to Decision Making Research



- Normative: how should fully rational decision makers decide?
- Descriptive: how do real decision makers decide?
- Prescriptive: how can real decision makers decide better?

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The Prescriptive-Descriptive Split in Decision Analysis

- All research prior to the 1950s (from Bernoulli to Savage) was prescriptive
- Some researchers criticized the DA principles of descriptive grounds (Ellsberg, Allais) already in the 50s
- Edwards laid the foundation of scientific descriptive work, but with a prescriptive agenda

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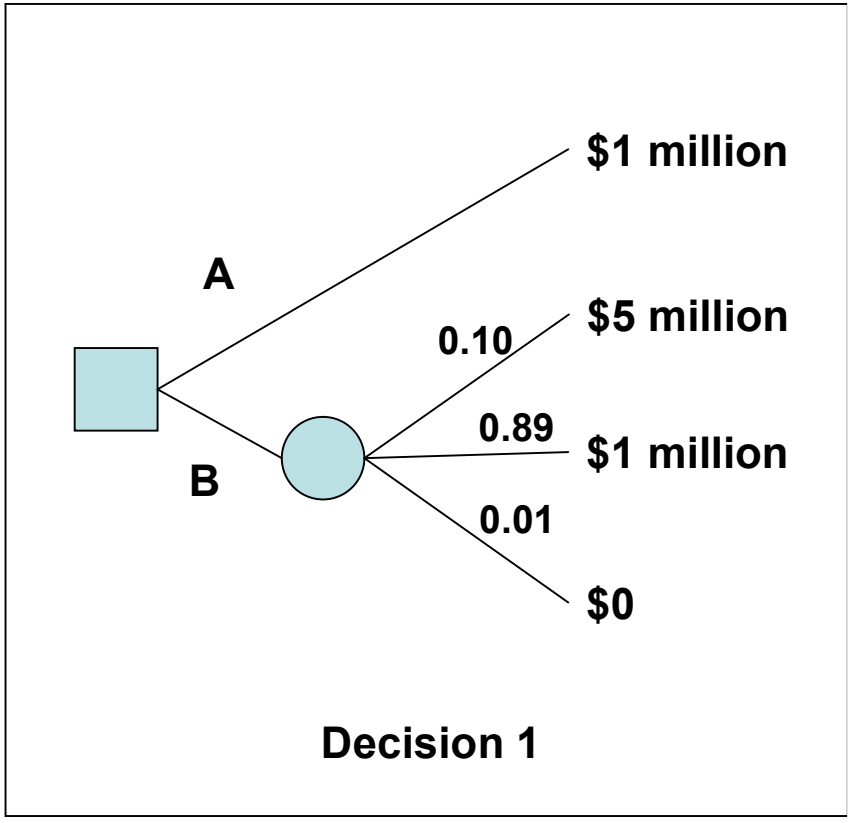
Which one would you prefer?



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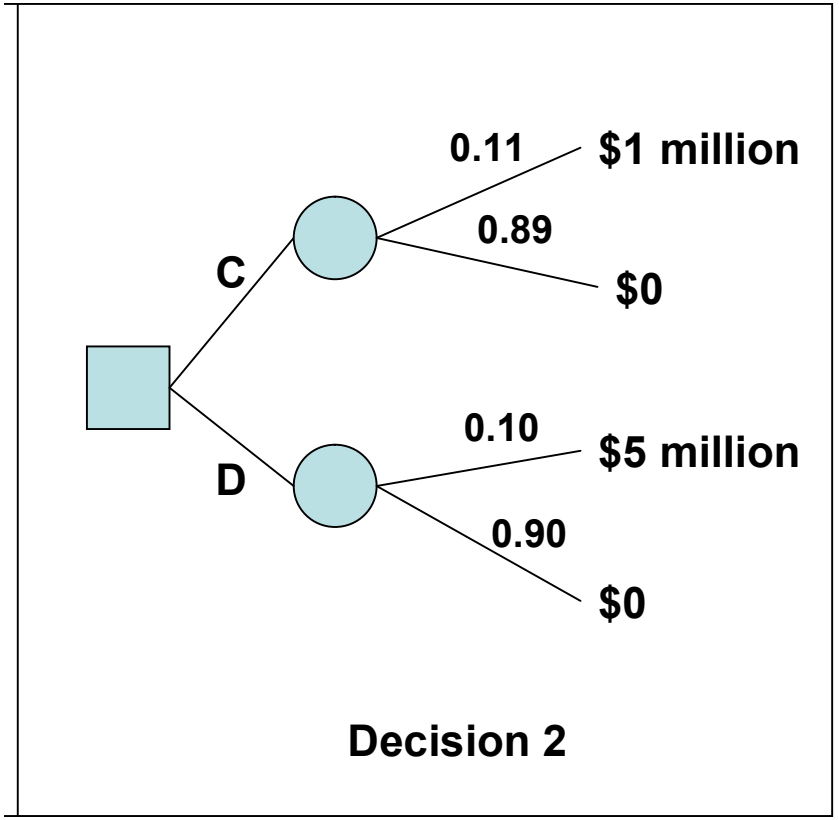
Which one would you prefer?



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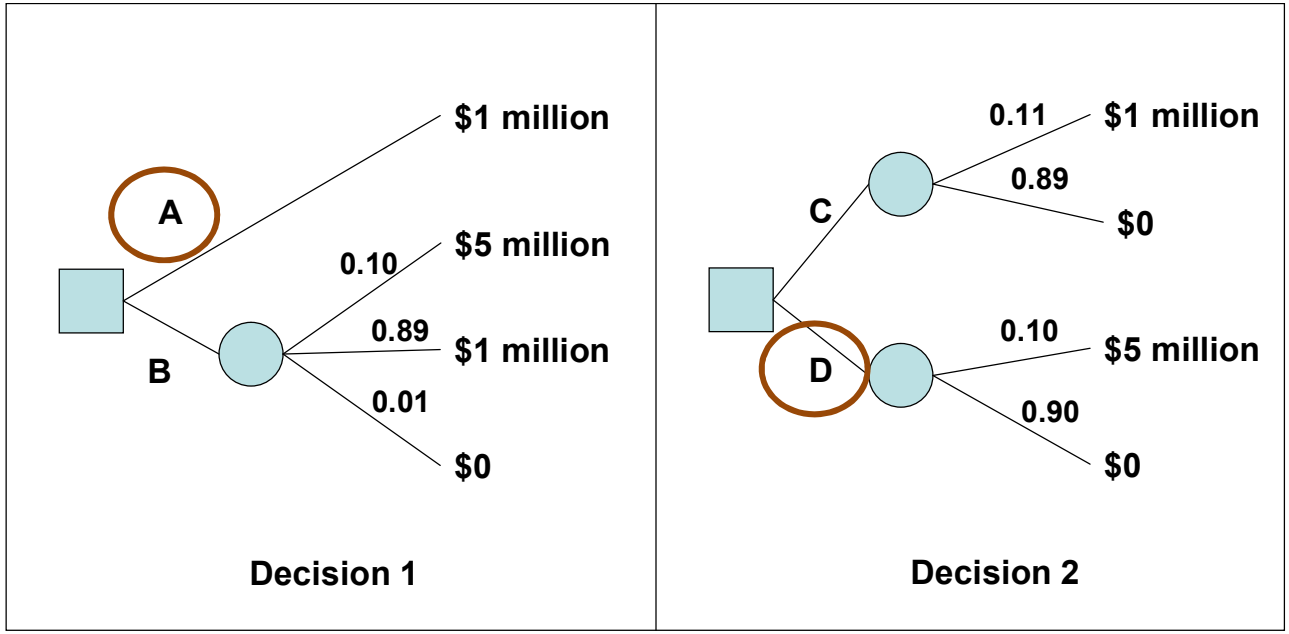
Which one would you prefer?



Experimentally, most subjects confronted with these choices prefer A over B, in Decision 1; and D over C, in Decision 2.

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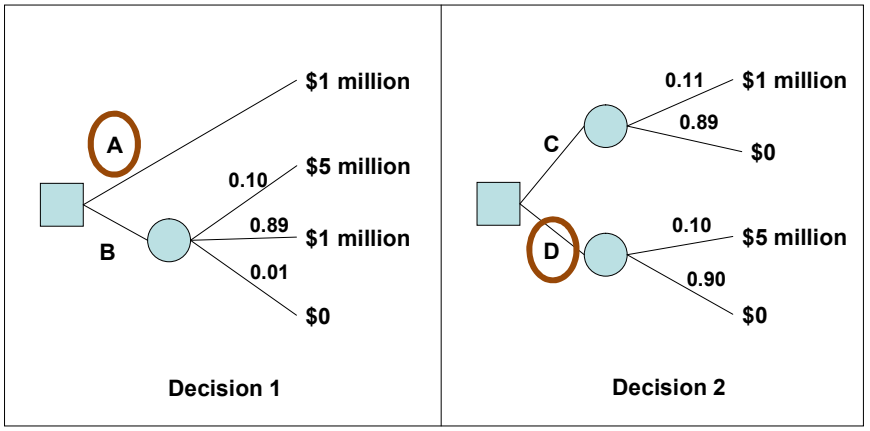
The Allais Paradox



$EU(.) = \sum p_i\, u_i(a)$

Let U($0) = 0; U ($5 million) = 1

- Decision 1:

  EU(A) = U($1 million)

  EU(B) = 0.10 U($5 million) + 0.89 U($1 million) + 0.01 U($0)

  EU(B) = 0.10 + 0.89 U($1 million)

  As A is preferred to B: EU(A) > EU(B) => U($1 million) > 0.10 + 0.89 U($1 million)

  Thus: U($1 million) > 0.91

- Decision 2:

  EU(C) = 0.11 U($1 million) + 0.89 U($0) = 0.11 U($1 million)

  EU(D) = 0.10 U ($5 million) + 0.90 U($0) = 0.10

  As D is preferred to C: EU(D) > EU(C) => 0.10 > 0.11 U($1 million)

  Thus U($1 million) < 0.91, therefore a paradox.

Normative models are not descriptively valid!

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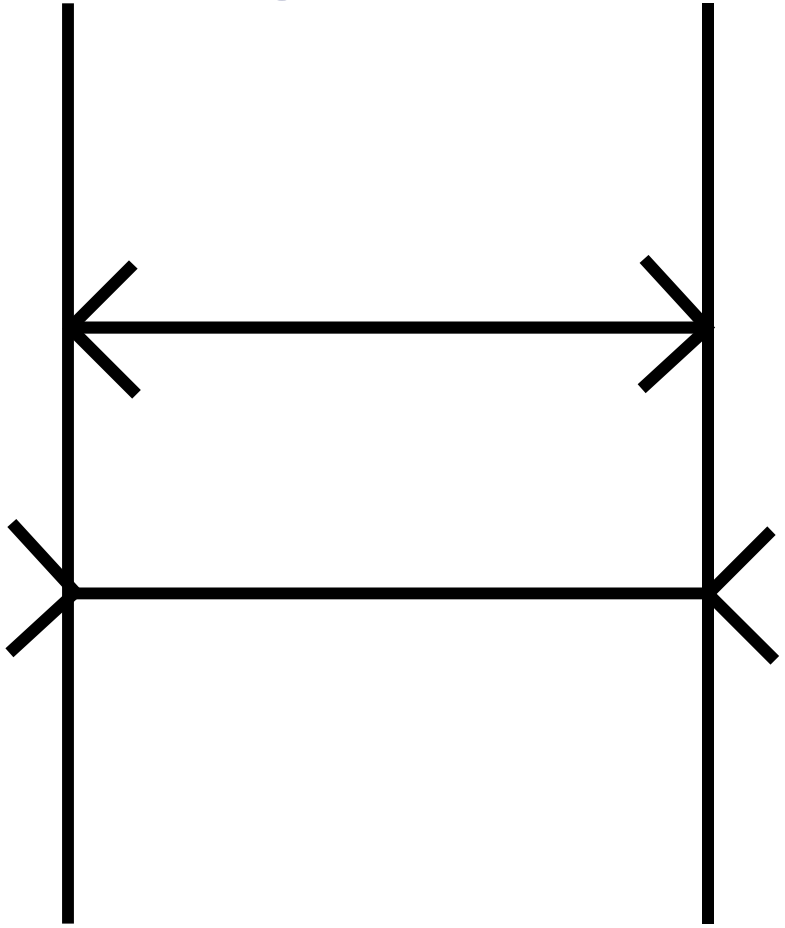
Which one is longer?



Perceptual Illusion

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Gains-Losses Framing

Imagine that Finland is preparing for the outbreak of an unusual avian flu outbreak, which is expected to kill 600 people. Two alternative programmes have been proposed.

"B" people close your eyes

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Which do you prefer?
Don't talk: write T1 or T2 on your paper

T1. Program T1 will save 200 people.

T2. Program T2 gives a one-third probability that 600 people will be saved and a two-thirds probability that no people will be saved.

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Alternatives: Courses of action

Imagine that Finland is preparing for the outbreak of an unusual avian flu outbreak, which is expected to kill 600 people. Two alternative programmes have been proposed.

"A" people close your eyes

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Which do you prefer?
Don't talk: write T3 or T4 on your paper

T3. Under Programme T3 400 people will die.

T4. Program T4 gives a one-third probability that nobody will die and a two-thirds probability that 600 people will die.

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DATA COLLECTION

"A" people: how many

- Preferred T1 to T2?

"B" people: how many

- Preferred T3 to T4?

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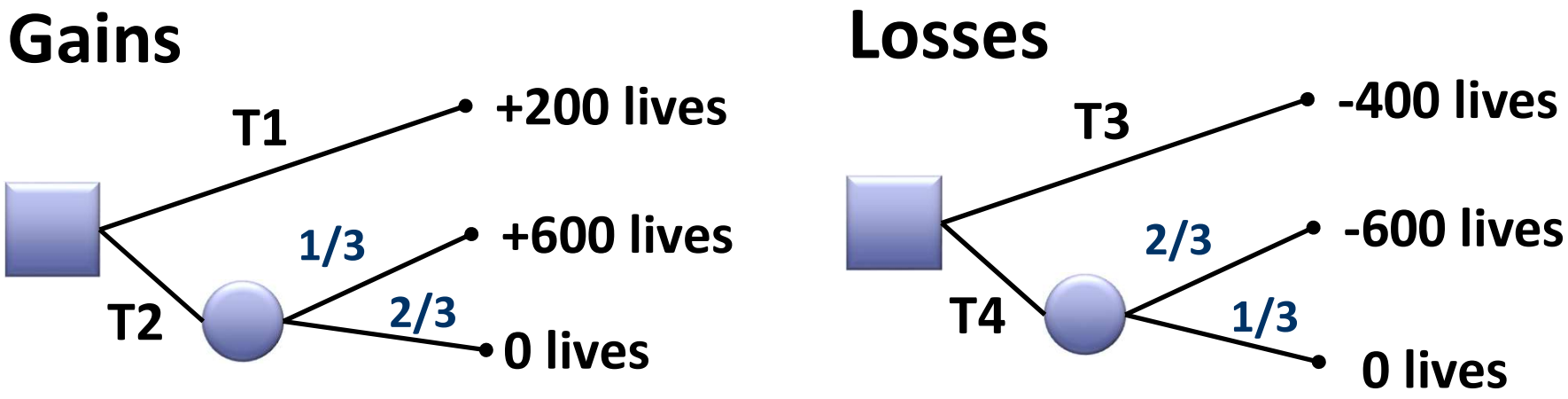
Same problem, different frames



Ref: Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science, 211(30), 453-458.*

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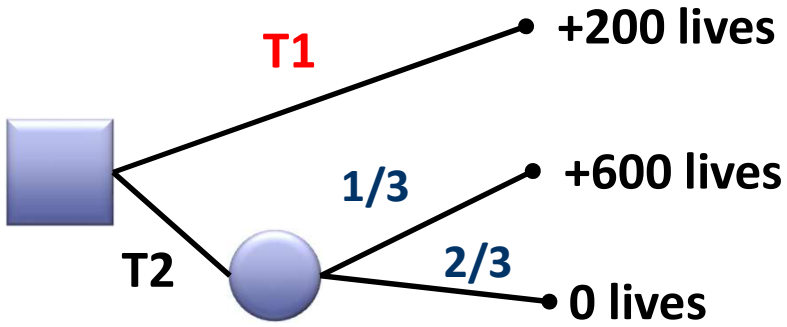
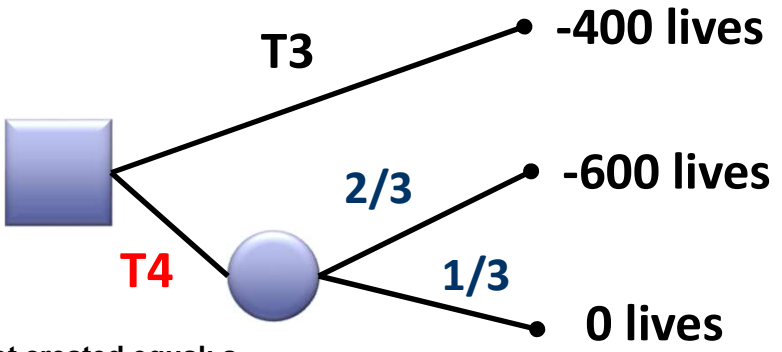
Gains-Losses Framing

- Framing in terms of gains may elicit risk-averse behaviour (T1 preferred to T2).
- Framing in terms of losses may elicit risk-seeking behaviour (T4 preferred to T3, a preference reversal from T1 preferred to T2).
- Be careful how you frame the courses of action!





Ref: Levin, I. P., Schneider, S. L., & Gaeth, G. J. (1998). All frames are not created equal: a typology and critical analysis of framing effects. *Organizational Behavior and Human Decision Processes, 76(2), 149-188.*

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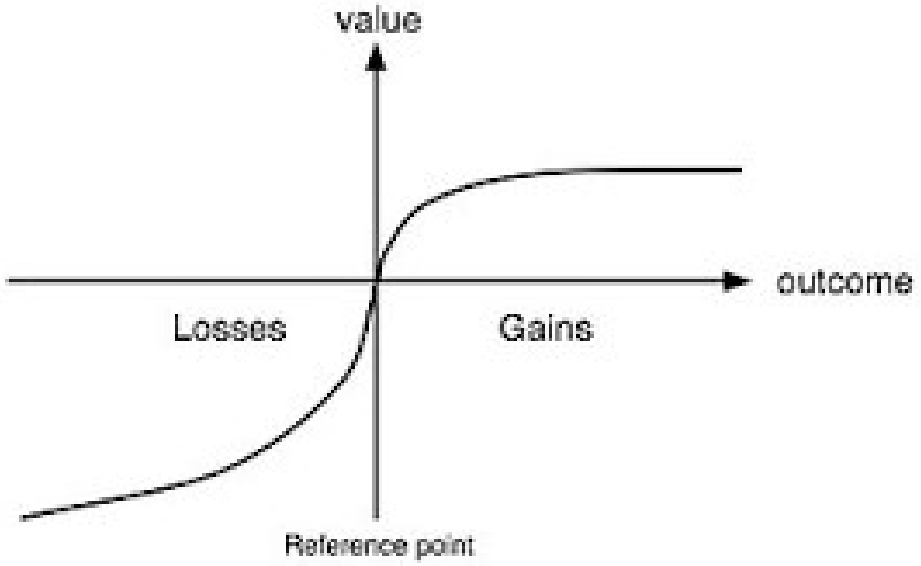
Prospect Theory

- People evaluate values as gains or losses relative to some reference level (or status quo)



- People are more risk averse for gains than for losses, and this is captured by the steeper curve in losses than gains.

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The Prescriptive-Descriptive Split of the 1970s

- Prescriptive work since 1960:
  - 1960's: Experimental applications of DA
  - 1970's: Multiattribute utility theory and influence diagrams
  - 1980's: Major applications
  - 1990's: Computerization
  - 2000 and beyond: portfolio decision analysis, utility dependencies (e.g. copulas), etc.

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The Prescriptive-Descriptive Split of the 1970s

- Descriptive work
  - 1950s and 60s: Early violations of SEU (Allais, Ellsberg)
  - 1970s: Probability Biases and Heuristics (**cognitive illusion paradigm**)
  - 1980s: Utility biases and Prospect Theory
  - 1990s: Generalized expected utility theories and experiments
  - 2000 and beyond: fine tuning Prospect Theory, heuristics, etc.

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Two Ways Decision Analysts Deal with Biases

- The easy way
  - Biases exist and are harmful
  - Decision analysis helps people overcome these biases
- The hard way
  - Some biases can occur in the decision analysis process **whenever a judgment is needed in the model** and may distort the analysis
  - Need to understand and correct for these biases in decision analysis

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Three main modelling Tasks

- Modelling Values
- Modelling Uncertainties
- Modelling Choices

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Modelling Values with Decision Analysis

Selection of transporters and negotiation of pricing

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Route: Sao Paulo and Salvador

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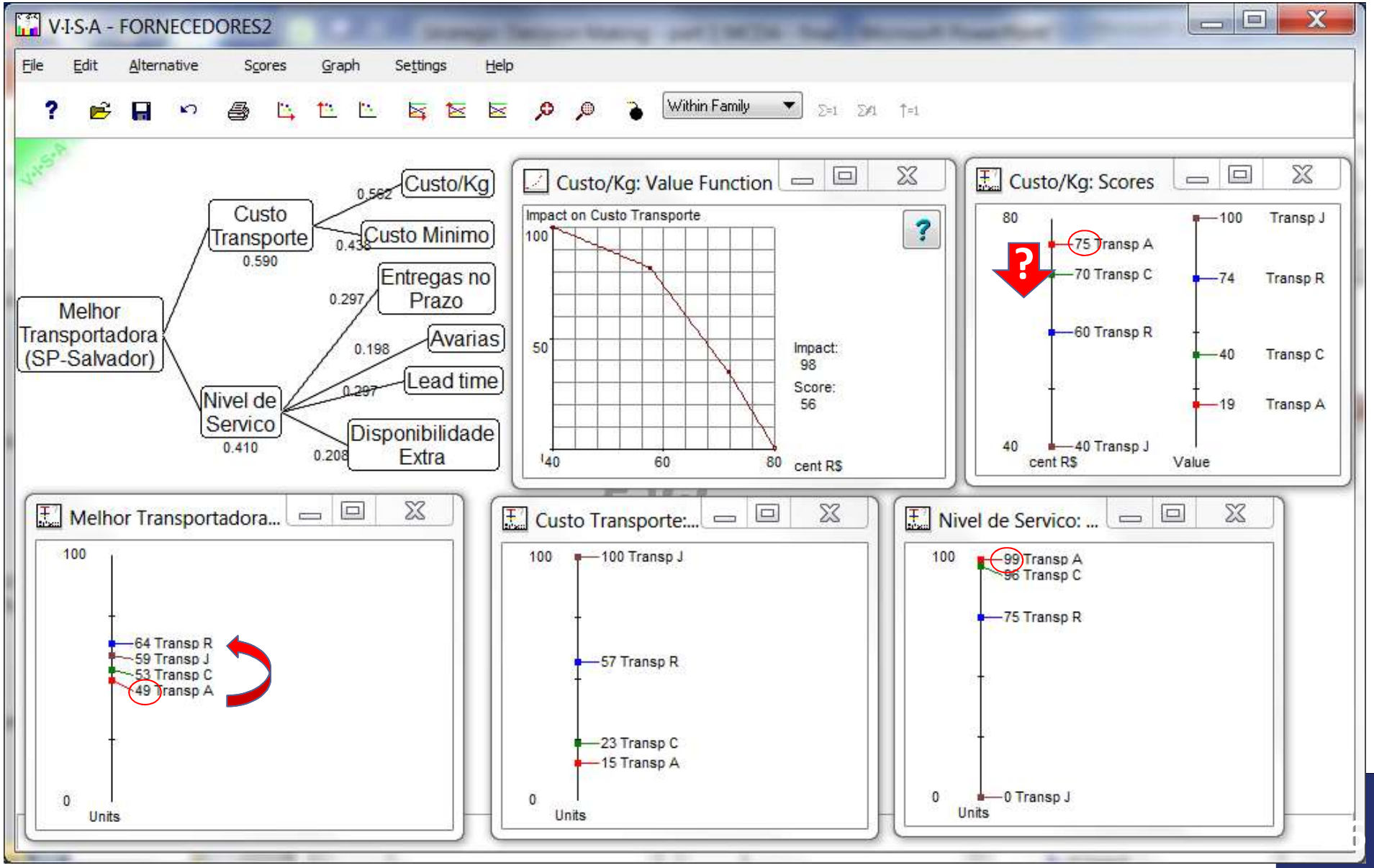

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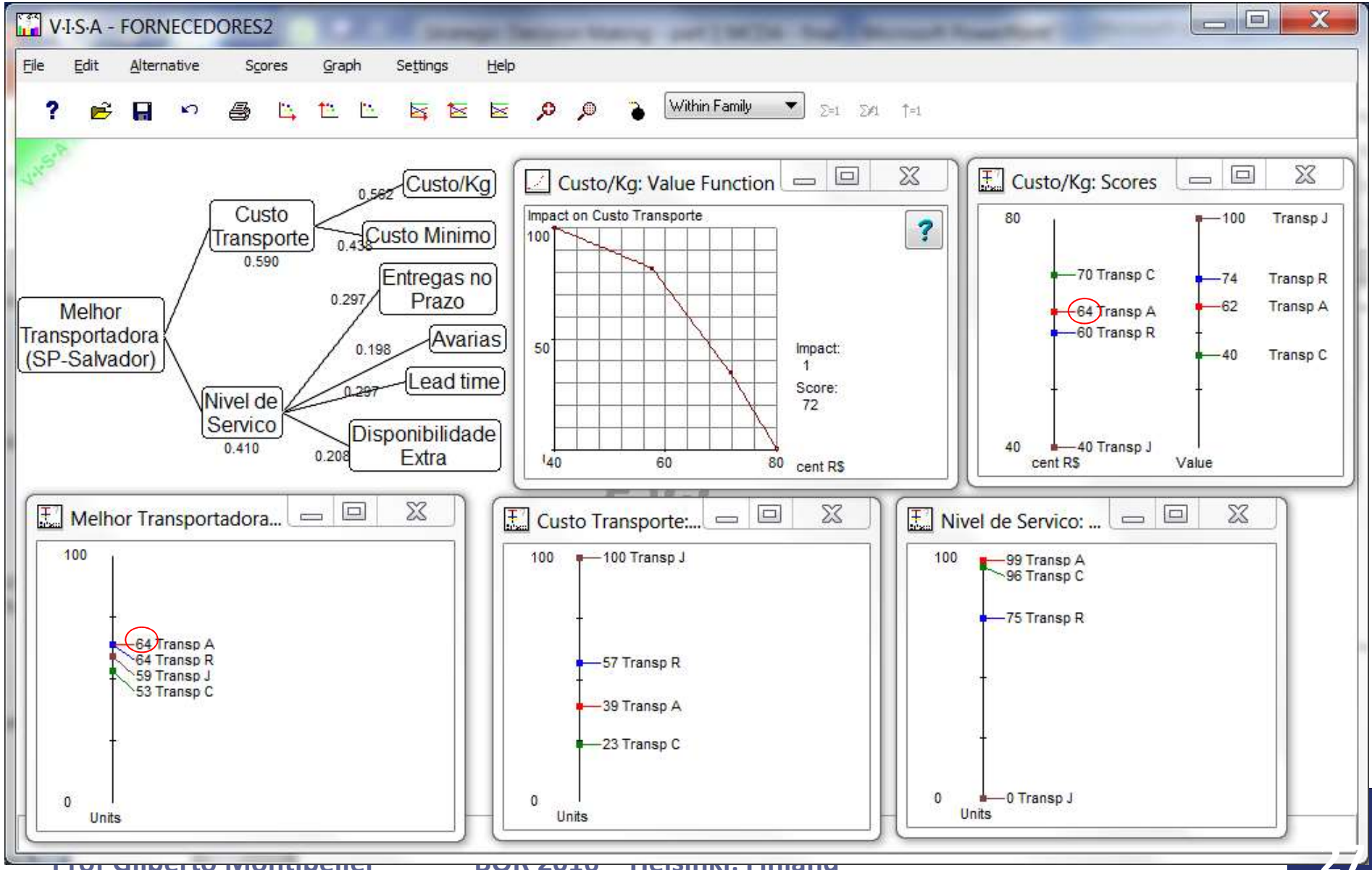

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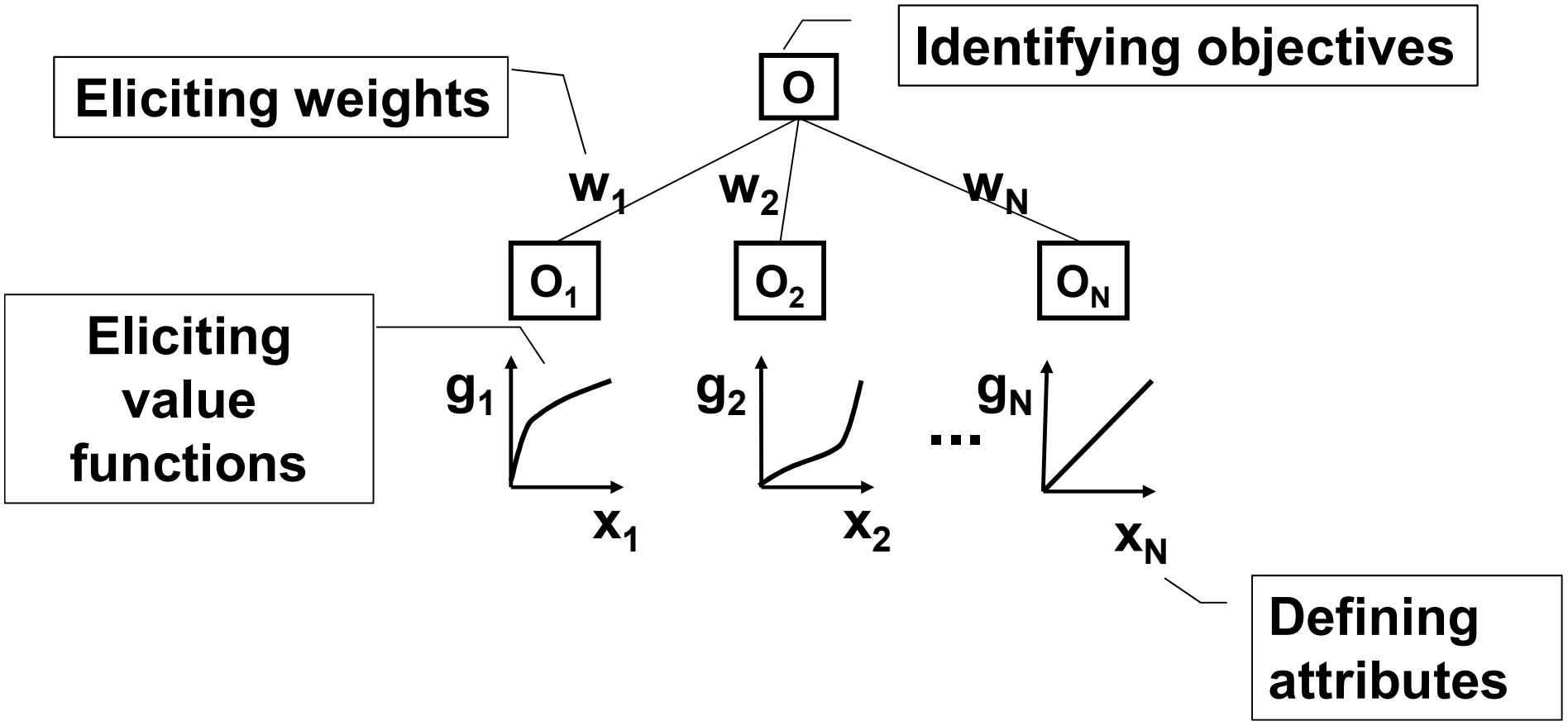
Judgements in Modelling Values



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Modelling Uncertainties with Risk Analysis

Estimating pollution levels in Southern California

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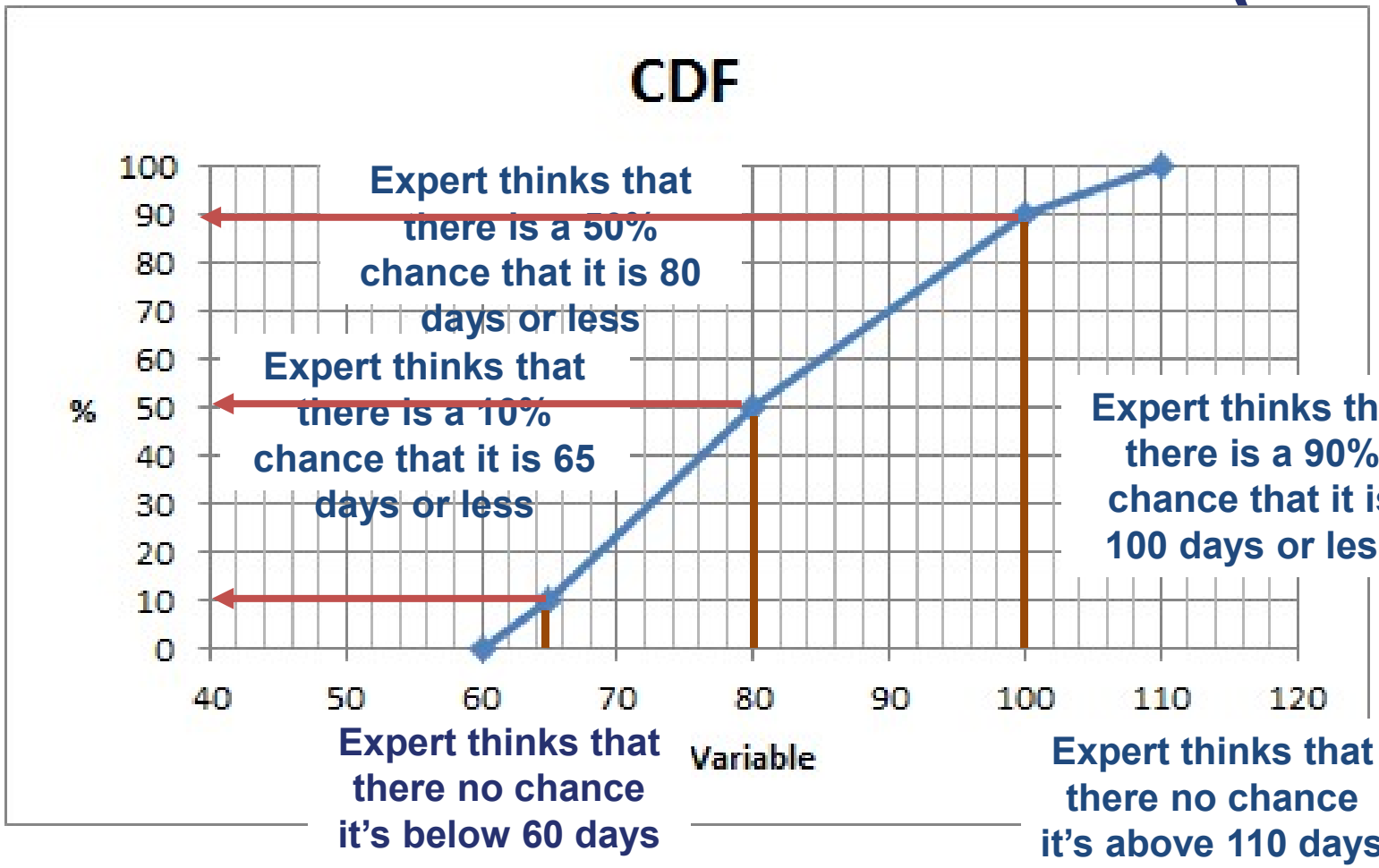
A Cumulative Distribution Function (CDF)



Variable: Number of DAYS when ozone levels over an eight-hour period violated the federal standard in Southern California

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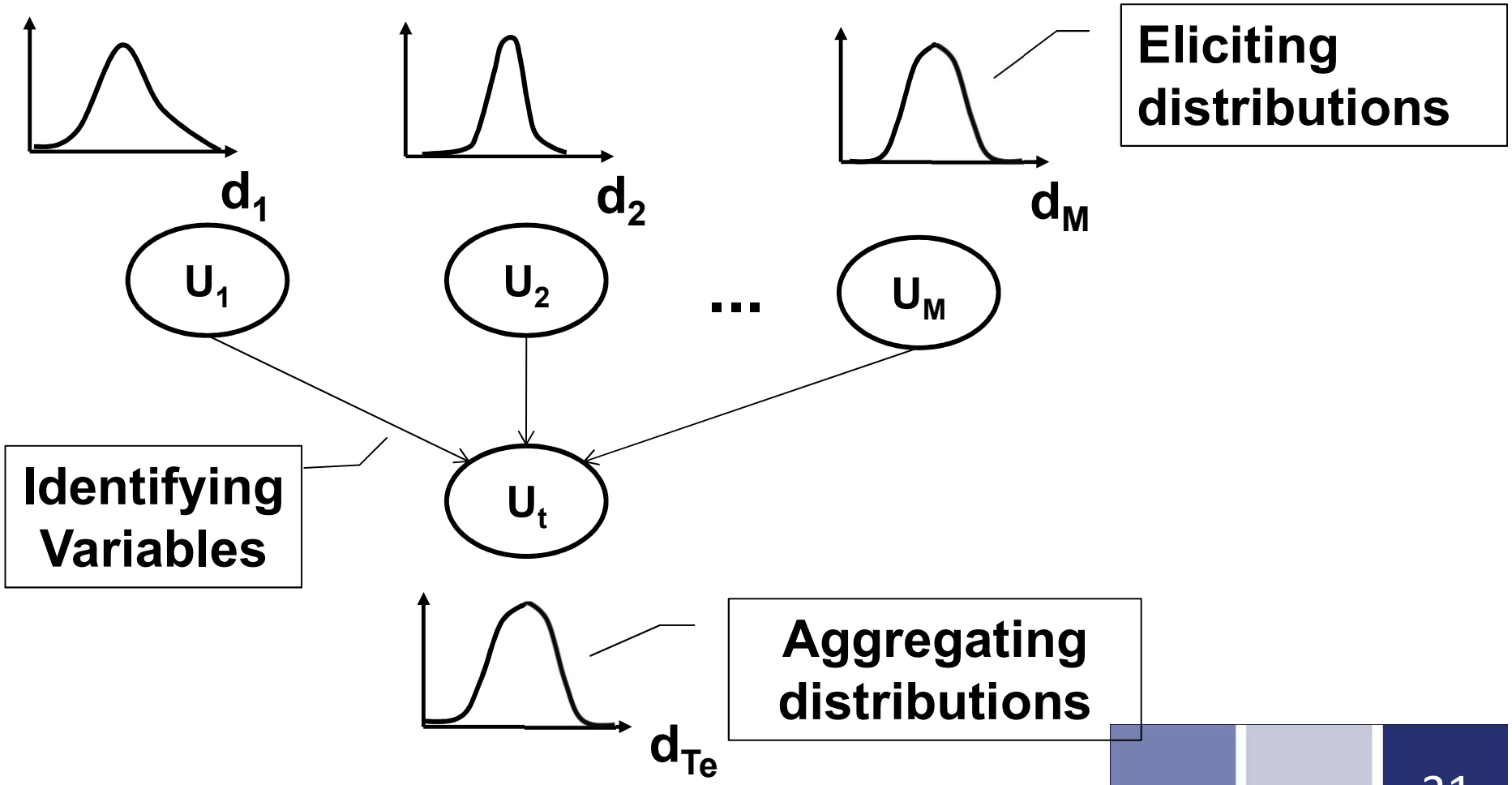
Judgements in Modelling Uncertainty



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Modelling Choices with Decision Analysis

Supporting a Commercial Law Firm in deciding the strategy for a commercial dispute

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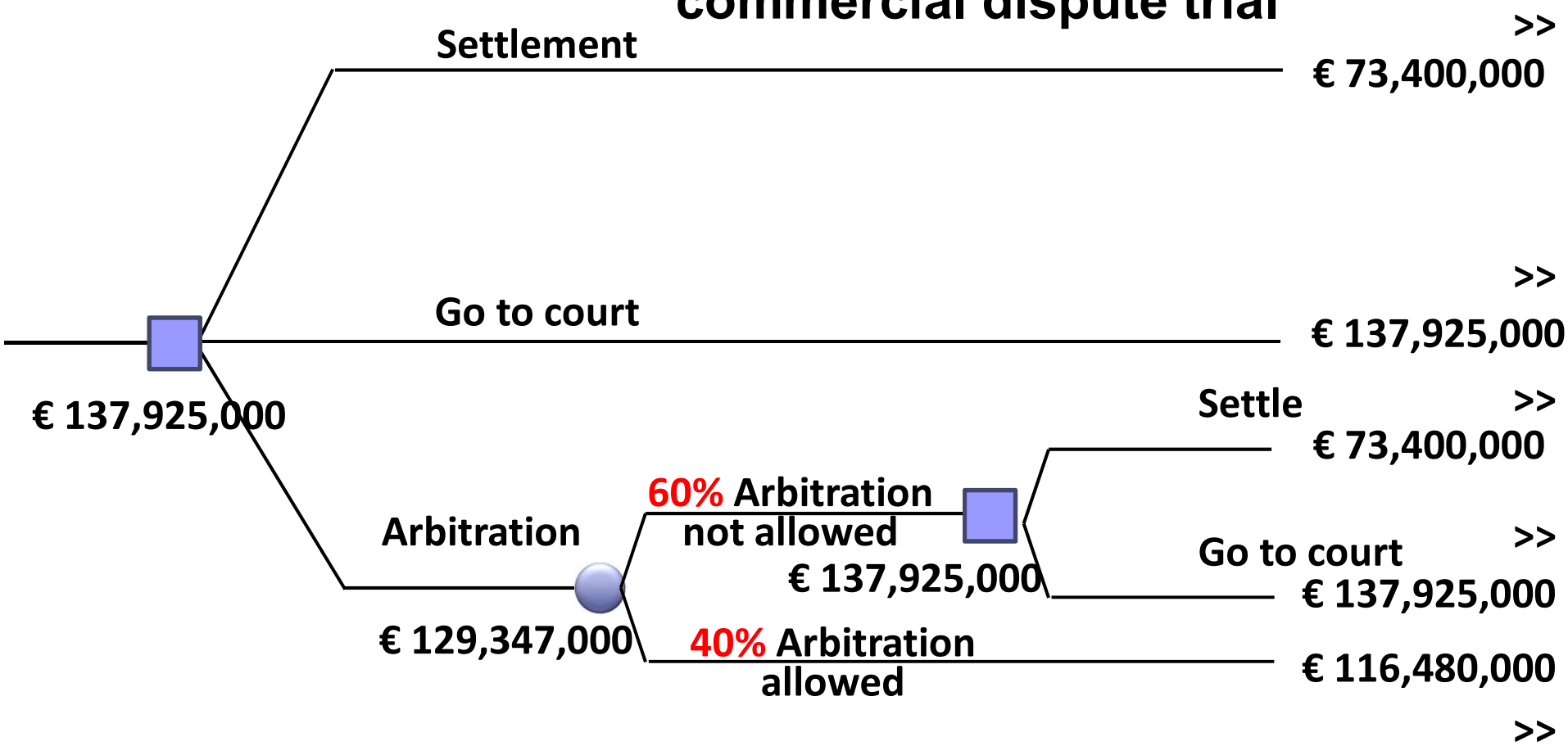
Deciding the strategy for a commercial dispute trial



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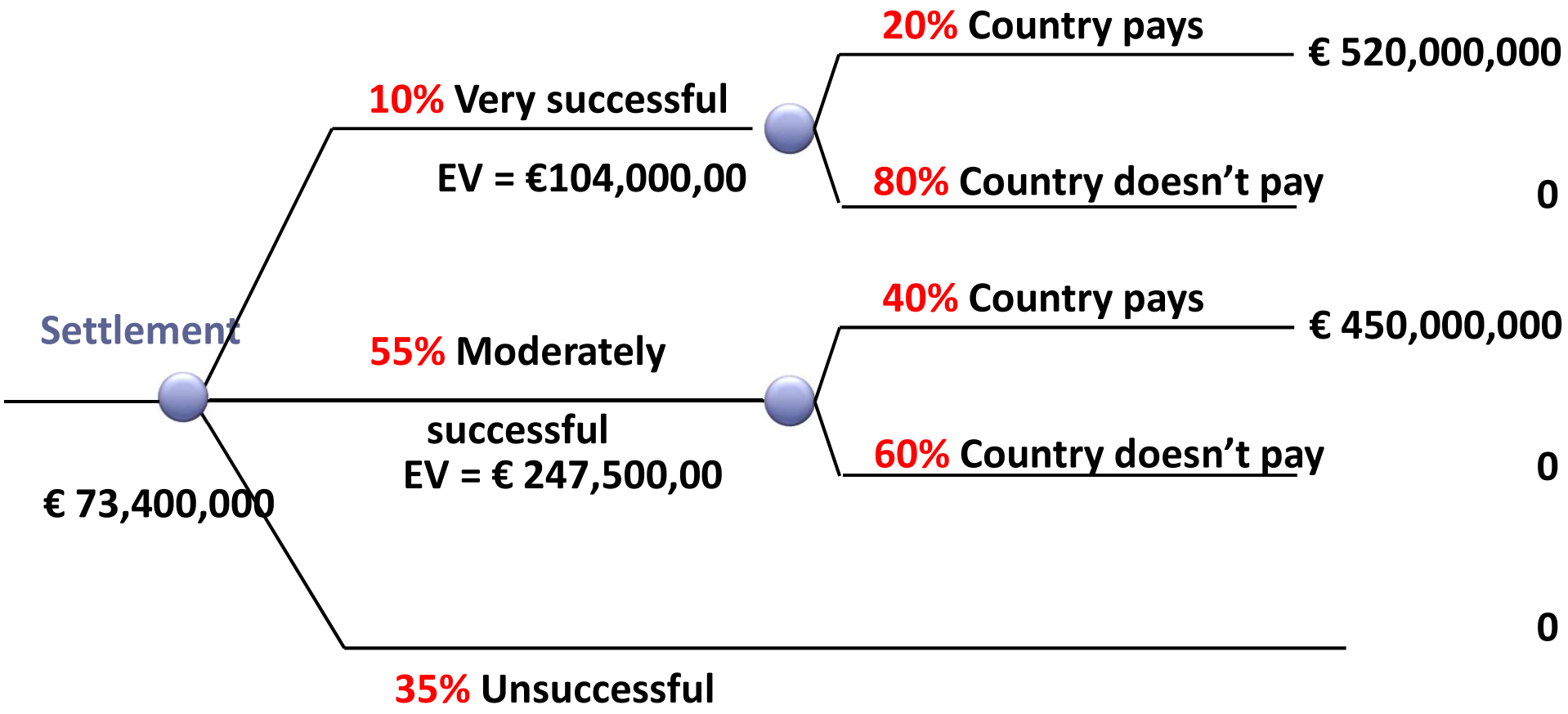
Expected Value - Settlement



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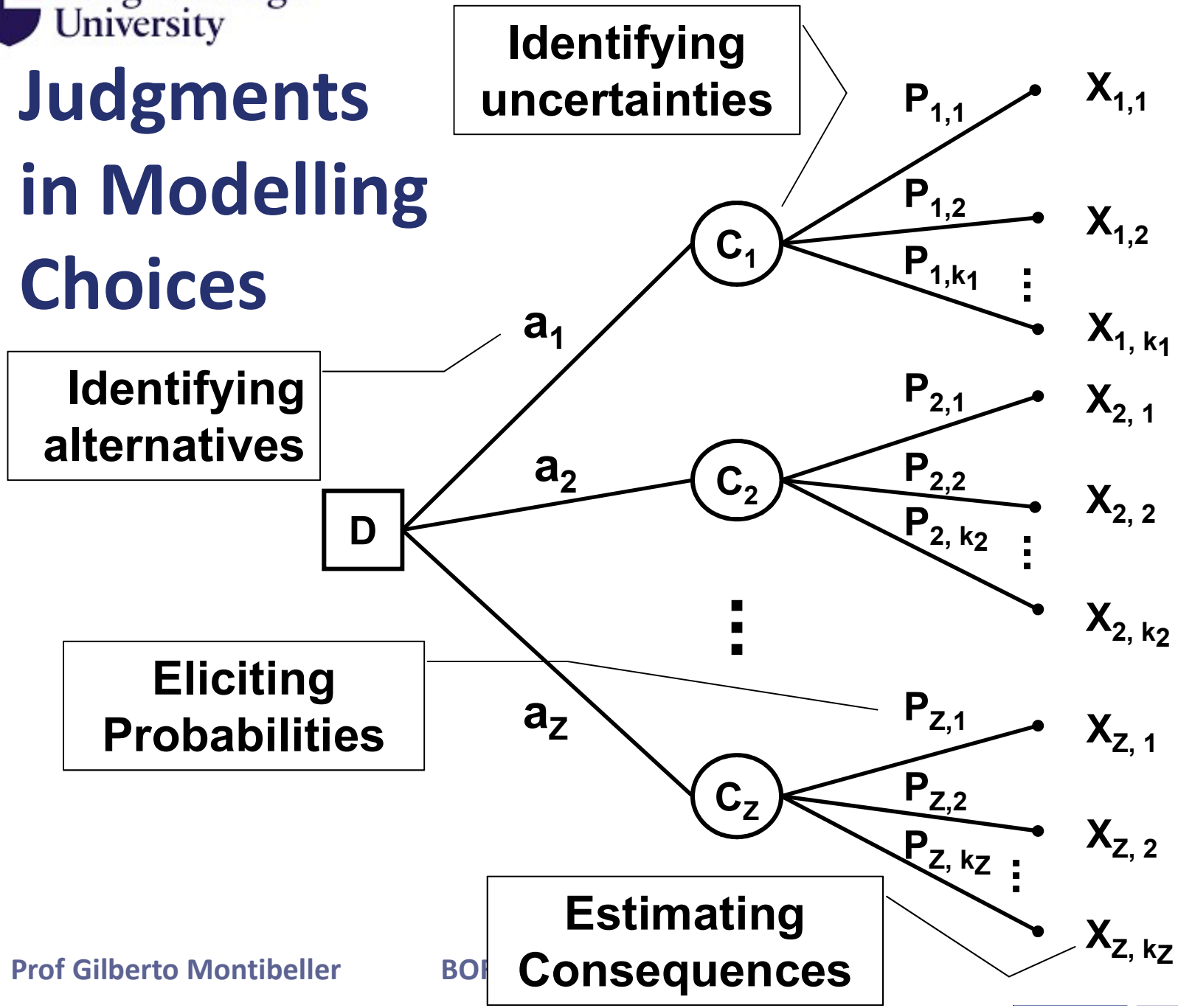
Judgments in Modelling Choices



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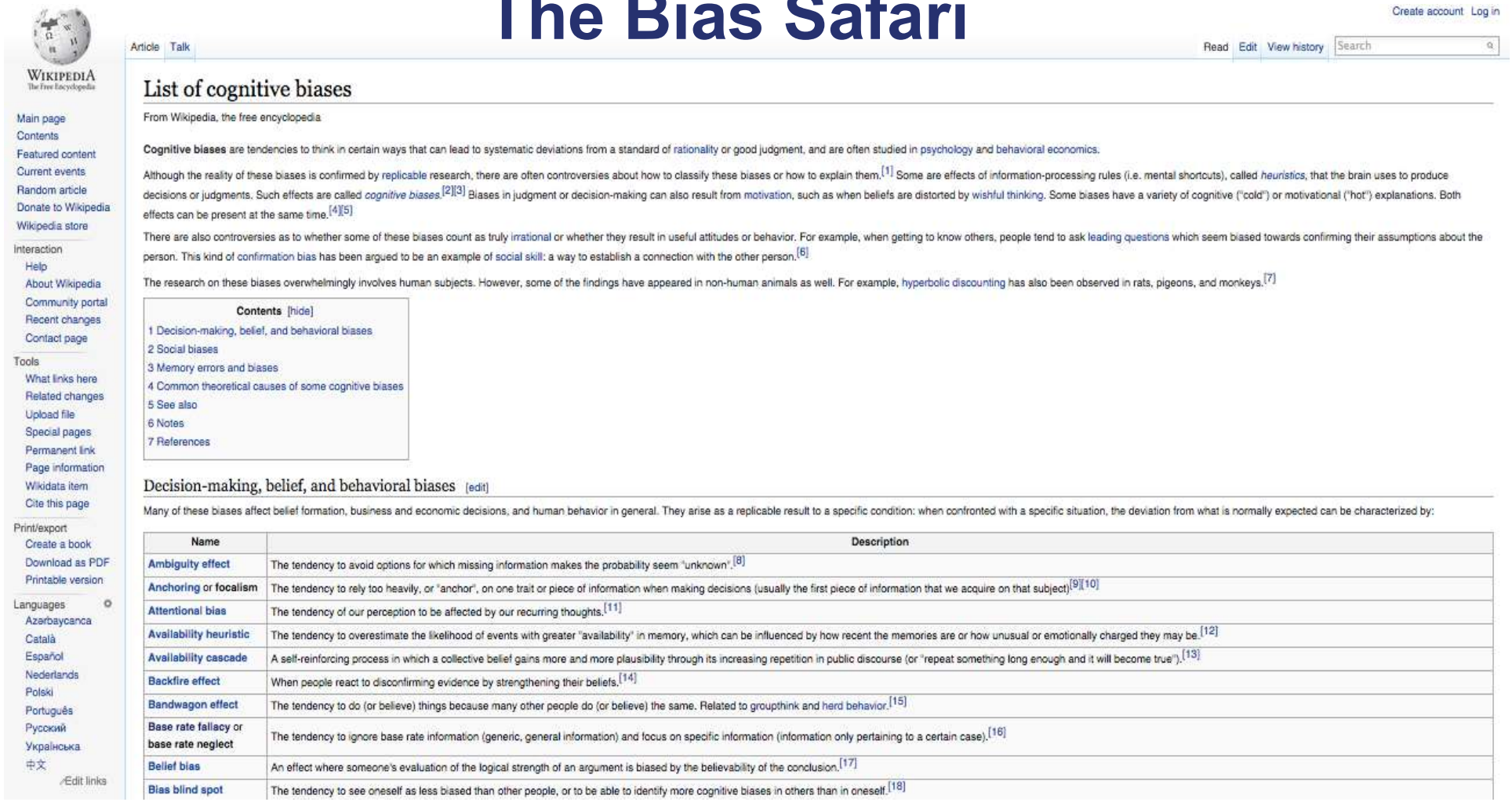
The Bias Safari



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List of cognitive biases

From Wikipedia, the free encyclopedia

Cognitive biases are tendencies to think in certain ways that can lead to systematic deviations from a standard of rationality or good judgment, and are often studied in psychology and behavioral economics.

Although the reality of these biases is confirmed by replicable research, there are often controversies about how to classify these biases or how to explain them.[1] Some are effects of information-processing rules (i.e. mental shortcuts), called *heuristics*, that the brain uses to produce decisions or judgments. Such effects are called *cognitive biases*.[2][3] Biases in judgment or decision-making can also result from motivation, such as when beliefs are distorted by wishful thinking. Some biases have a variety of cognitive ("cold") or motivational ("hot") explanations. Both effects can be present at the same time.[4][5]

There are also controversies as to whether some of these biases count as truly irrational or whether they result in useful attitudes or behavior. For example, when getting to know others, people tend to ask leading questions which seem biased towards confirming their assumptions about the person. This kind of confirmation bias has been argued to be an example of social skill: a way to establish a connection with the other person.[6]

The research on these biases overwhelmingly involves human subjects. However, some of the findings have appeared in non-human animals as well. For example, hyperbolic discounting has also been observed in rats, pigeons, and monkeys.[7]

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1 Decision-making, belief, and behavioral biases
2 Social biases
3 Memory errors and biases
4 Common theoretical causes of some cognitive biases
5 See also
6 Notes
7 References

Decision-making, belief, and behavioral biases [edit]

Many of these biases affect belief formation, business and economic decisions, and human behavior in general. They arise as a replicable result to a specific condition: when confronted with a specific situation, the deviation from what is normally expected can be characterized by:

Name	Description
Ambiguity effect	The tendency to avoid options for which missing information makes the probability seem "unknown".[8]
Anchoring or **focalism**	The tendency to rely too heavily, or "anchor", on one trait or piece of information when making decisions (usually the first piece of information that we acquire on that subject)[9][10]
Attentional bias	The tendency of our perception to be affected by our recurring thoughts.[11]
Availability heuristic	The tendency to overestimate the likelihood of events with greater "availability" in memory, which can be influenced by how recent the memories are or how unusual or emotionally charged they may be.[12]
Availability cascade	A self-reinforcing process in which a collective belief gains more and more plausibility through its increasing repetition in public discourse (or "repeat something long enough and it will become true").[13]
Backfire effect	When people react to disconfirming evidence by strengthening their beliefs.[14]
Bandwagon effect	The tendency to do (or believe) things because many other people do (or believe) the same. Related to groupthink and herd behavior.[15]
Base rate fallacy or **base rate neglect**	The tendency to ignore base rate information (generic, general information) and focus on specific information (information only pertaining to a certain case).[16]
Belief bias	An effect where someone's evaluation of the logical strength of an argument is biased by the believability of the conclusion.[17]
Bias blind spot	The tendency to see oneself as less biased than other people, or to be able to identify more cognitive biases in others than in oneself.[18]

89 and growing!!!

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More vs Less Relevant Biases

More Relevant Biases

- They occur in the tasks of eliciting inputs into a decision and risk analysis (DRA) from experts and decision makers.
- Thus they can significantly distort the results of an analysis.

Less Relevant Biases

- They do not occur or can easily be avoided in the usual tasks of eliciting inputs for DRA

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Relevant Cognitive Biases

Cognitive biases are distortions of judgments that violate a normative rules of probability or expected utility

- Anchoring
- Availability
- Certainty effect
- Equalizing bias
- Gain-loss bias
- Myopic problem representation
- Omission bias
- Overconfidence
- Scaling biases
- Splitting bias
- Proxy bias
- Range insensitivity bias

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Value the consequences

- "B" people close your eyes and keep them closed until told to open them.
- "A" people write an answer to the following question.
- The height of California's tallest red wood tree is…
  a) more than 50 metres.
  b) less than 50 metres.

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Value the consequences

- “A” people close your eyes and keep them closed until told to open them.
- “B” people write an answer to the following question.
- The height of California’s tallest red wood tree is…
  a) more than 350 metres.
  b) less than 350 metres.

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Value the consequences

- Everybody answer the following question.
- What is the height of the tallest red wood tree in California?
- How many “A” people wrote less than 90m?
- How many “B” people wrote less than 90m?
- Why the difference?

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Anchoring effect!

- Each group's question: Is the height of California's tallest red wood tree more or less than…
  - "A" people: …50 metres.
  - "B" people: …350 metres.
- Anchoring is a strong bias when people are asked to produce a number, even when a given candidate value is arbitrary.
- Correct answer: 115.55 metres

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Anchoring

- **Bias**: estimation of a numerical value is based on an initial value (anchor).
- **Evidence**: estimation tasks, pricing decisions, and also in negotiations.

- **Debiasing Tools:**
  - ✓ Avoid anchors
  - ✓ Provide multiple and counteranchors
  - ✓ Use different experts who have different anchors

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Availability / Easy of Recall

- **Bias**: the probability of an event that is easily recalled is overstated.
- **Evidence**: Simple frequency estimates; frequency of lethal events; rare events anchored on recent examples.

- **Debiasing Tools:**
  - ✓ Conduct probability training
  - ✓ Provide counter examples
  - ✓ Provide statistics

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Certainty Effect

- **Bias**: people prefer sure things to gambles with similar expected utilities.
- **Evidence**: Probability- versus certainty-equivalent methods produce different results.

- **Debiasing Tools:**
- Avoid sure things in utility elicitation
- Separate value and utility elicitation
- Explore relative risk attitude parametrically

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Choosing a Personal Doctor

- You have just moved to a new country.
- You need to choose a personal doctor from among those in your community.

Task A: List all of the objectives that you would use to make this decision.

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B. select all the objectives relevant to you

1. is knowledgeable and up-to-date
2. has experience in his/her field
3. makes conversations pleasant and enjoyable
4. discusses multiple treatment options
5. considers treatments other than medicine
6. is a clear and thorough communicator
7. is affiliated with excellent hospital
8. is located conveniently for appointments
9. will be in current location for many years
10. handles the paperwork for insurance, etc.
11. is of a particular age or gender
12. respects and empathizes with my concerns
13. strives to minimize expenses I have to pay
14. has partners to cover when not available
15. has a nurse practitioner for minor matters
16. tells me my options and their consequences
17. makes it easy to schedule appointments
18. doesn't rush through examinations
19. has an excellent reputation
20. focuses on wellness in addition to sickness
21. can explain medical situations in lay terms
22. is courteous and respectful
23. as competent and friendly office staff
24. prompt on appointments and returning calls
25. recommends to me based on pros and cons
26. can schedule emergencies soon
27. knows many quality specialists for referrals
28. respects my thinking
29. is available for telephone communication
30. will admit lack of knowledge and mistakes
31. will make house calls

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Task C:
Choose your top 3 most relevant objectives from A and B

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How many objectives…

- Did you generate when you first wrote them down?
- Did you select from the list?
- Of your 3 most relevant were among those you first wrote down?

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Results of behavioural experiments

- We often generate about half of the relevant objectives.
- The objectives that are missed are not trivial - roughly as relevant as those identified at first
- Occurs often in important professional and personal decisions

S. Bond, K. Carlson, R. Keeney (2008). "Generating Objectives: Can Decision Makers Articulate What They Want?."*Management Science* : 56-70.

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Omission of an Important Variable

- **Bias**: The bias occurs when an important variable is overlooked.
- **Evidence**: Definition of objectives; identification of decision alternatives; and hypothesis generation.

- **Debiasing Tools:**

✓ Prompt for alternatives and objectives

✓ Ask for extreme or unusual scenarios

✓ Use group elicitation techniques

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An exercise

<u>Individually</u>: For each of the following ten items, provide a low and high guess such that you are 90% sure the correct answer falls between the two.

Slide adapted from
Dr Barbara Fasolo

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An exercise

1. Martin Luther King's age at death
2. Length of the Nile River (in miles or kilometres)
3. Number of countries that are members of OPEC
4. Number of books in the Old Testament
5. Diameter of the moon (in miles or kilometres)
6. Weight of an empty Boeing 747(in pounds or tons)
7. Year in which Wolfgang Amadeus Mozart was born
8. Gestation period (in days) of an Asian elephant
9. Air distance from London to Tokyo (in miles or kilometres)
10. Deepest (known) point in the oceans (in feet or meters)

Slide by Dr Barbara Fasolo

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Answers

1. Martin Luther King's age at death **39 years**
2. Length of the Nile River **4,127 mi 6 642 km**
3. Number of countries that are members of OPEC **12**
4. Number of books in the Old Testament **39**
5. Diameter of the moon **3,476 km 2,160 miles**
6. Weight of an empty Boeing 747 **390,000 pounds 195 tons**
7. Year in which Wolfgang Amadeus Mozart was born **1756**
8. Gestation period (in days) of an Asian elephant **645 days**
9. Air distance from London to Tokyo **5,959 mi 9 590 km**
10. Deepest (known) point in the oceans **36,198 ft 11,033 m**

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How many of you

- Had more than 1 answer outside the interval?
  - Overconfidence!
- Had no answers outside the interval?
  - Underconfidence

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Overconfidence

- **Bias**: estimates are above the actual performance (overestimation) or the range of variation is too narrow (overprecision).
- **Evidence**: Widespread occurrence in quantitative estimates (defense, legal, financial, and engineering decisions).

- **Debiasing Tools:**
  - ✓ Probability training
  - ✓ Start with extreme estimates, avoid central tendency anchors
  - ✓ Use counterfactuals to challenge extremes
  - ✓ Use fixed-value elicitations

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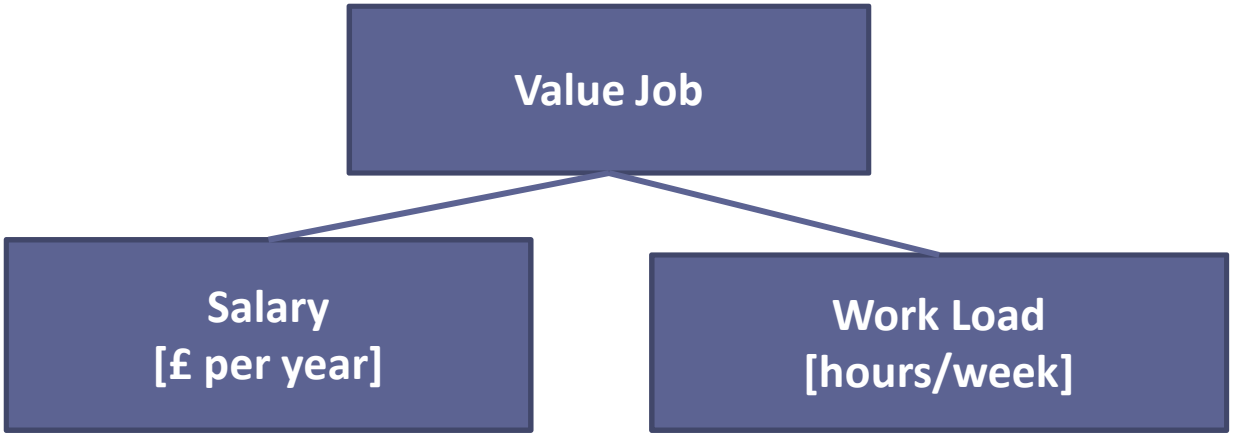
Eliciting Criteria Weights



Imagine that you are considering a new job offer:

- Which objective is more important for you,
  Salary or Work Load?
- Give weights to each criteria (so they sum up 100%)

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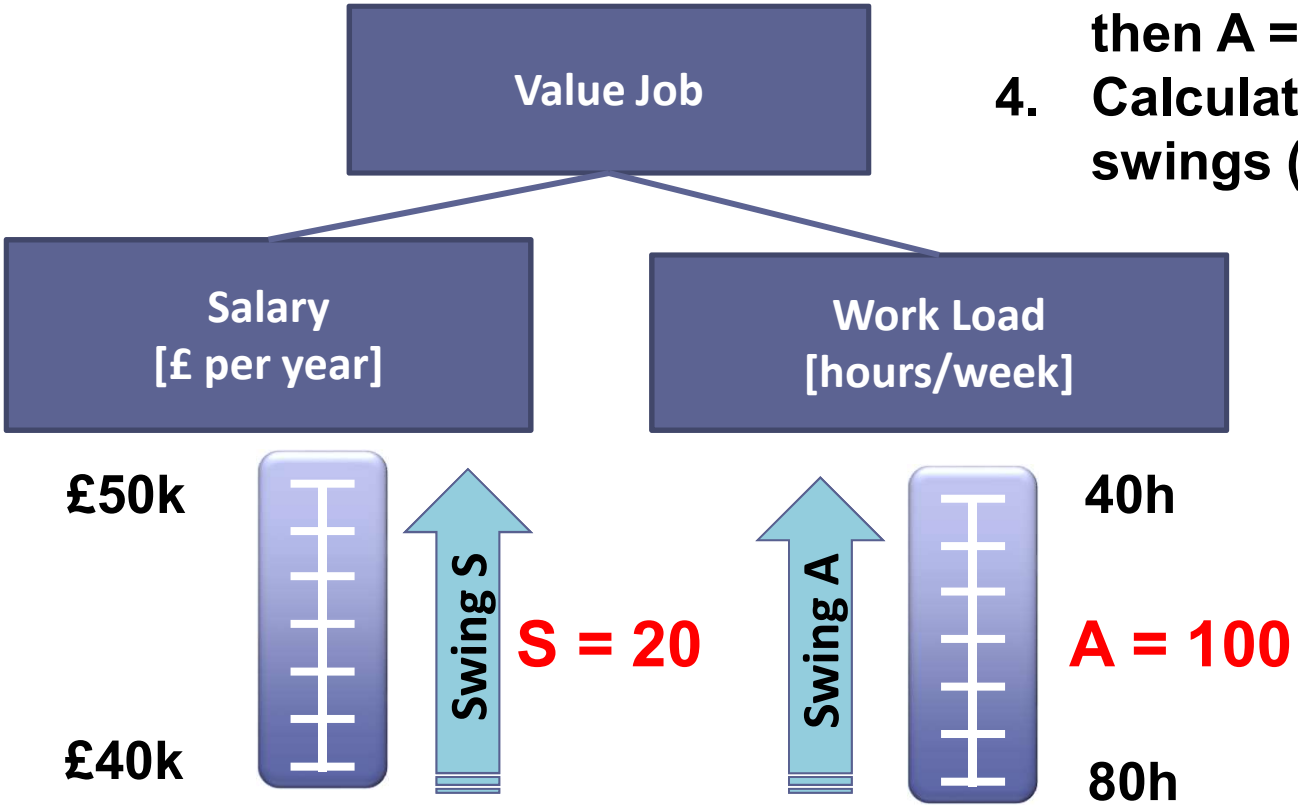
Eliciting Criteria Weights

1. Order swings (e.g. S >A)
2. Anchor most valuable swing as 100 (e.g. A = 100)
3. Evaluate the other swings in relation to first (e.g. if A = 100 then A = 20)
4. Calculate the normalised swings (e.g w_S and w_A)



$w_S = S/(S + A)$ = 17% $w_A = A/(S + A)$ = 83%

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Range insensitivity bias

- **Bias**: Weights of objectives are not properly adjusted to changes in the range of attributes.
- **Evidence**: Elicitation of weights in multiattribute utility and value measurement

- **Debiasing Tools:**
- Make attribute ranges explicit and use swing weighting procedures
- Use trade-off or pricing-out procedures
- Use multiple elicitation procedures and cross-checks

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Cognitive Biases that Matter (Continued)

- **Equalizing bias**: DMs allocate similar weights to all objectives or similar probabilities to all events.
- **Gain-loss bias**: alternative descriptions of a choice, either as gains or as losses, may lead to different answers.
- **Myopic problem representation**: an oversimplified problem representation is adopted.

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Cognitive Biases that Matter (Continued)

- **Scaling biases**: A family of stimulus-response biases affecting valuation and estimation of consequences.
- **Splitting bias**: the way objectives are grouped in a value tree affects their weights.
- **Proxy bias**: Proxy attributes receive larger weights than the respective fundamental objectives.

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Less Relevant Cognitive Biases

- Base rate bias
- Conjunction fallacy
- Ambiguity aversion
- Conservatism
- Gambler's fallacy
- Hindsight bias
- Hot hand fallacy
- Insensitivity to sample size
- Non-regressiveness
- Status quo biases
- Sub/Superadditivity of probabilities

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Motivational Biases

Motivational biases are distortions of judgments because of desires for specific outcomes, events, or actions

- Affect-Influenced Bias
- Confirmation bias
- Undesirability of a negative event or outcome (precautionary thinking, pessimism)
- Desirability of a positive event or outcome (wishful thinking, optimism)
- Desirability of options or choices

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Affect-Influenced Bias

- **Bias**: There is an emotional predisposition for, or against, a specific outcome or option that taints judgments.
- **Evidence**: Studies it causes an inverse perceived relationship between positive and negative consequences.

- **Debiasing Tools:**
- Avoid loaded descriptions of consequences in the attributes
- Cross-check judgments with alternative elicitation protocols
- Use multiple experts with alternative points of view

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Confirmation

- **Bias**: There is a desire to confirm one's belief, leading to unconscious selectivity in the acquisition and use of evidence.
- **Evidence**: Medical diagnostics, judicial reasoning, and scientific thinking.

- **Debiasing Tools:**
- Use multiple experts with different points of view about hypotheses
- Challenge probability assessments with counterfactuals
- Probe for evidence for alternative hypotheses

Desirability of a positive event or consequence

- **Bias**: the desirability of an outcome leads to an increase in the extent to which it is expected to occur (wishful thinking).
- **Evidence**: estimates of probabilities of future outcomes in expert foresight, estimates of costs and duration in projects.

- **Debiasing Tools:**
  - ✓ Use multiple experts with alternative points of view
  - ✓ Use scoring rule and place hypothetical bets against the desired event or consequence
  - ✓ Use decomposition and realistic assessment of partial probabilities

Desirability of a negative event or consequence

- **Bias**: This bias occurs when there is a desire to be cautious, prudent, or conservative in estimates that may be related to harmful consequences.
- **Evidence**: Probabilities of life events; long-term estimated of future events in expert foresight.

- **Debiasing Tools:**
- ✓ Use multiple experts with alternative points of view
- ✓ Use scoring rule and place hypothetical bets against the desired event or consequence
- ✓ Use decomposition and realistic assessment of partial probabilities

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Desirability of a options/choices

- **Bias**: over/ underestimating probabilities, consequences, values, or weights in a direction that favors a desired alternative
- **Evidence**: Only anecdotal evidence, such as the biased estimates of probabilities and impacts in risk assessment by Defra (described by Rothstein & Downer (2012))

- **Debiasing Tools:**
- ✓ Use analysis with multiple stakeholder providing different value perspectives
- ✓ Use multiple experts with different opinions
- ✓ Use incentives and adequate levels of accountability

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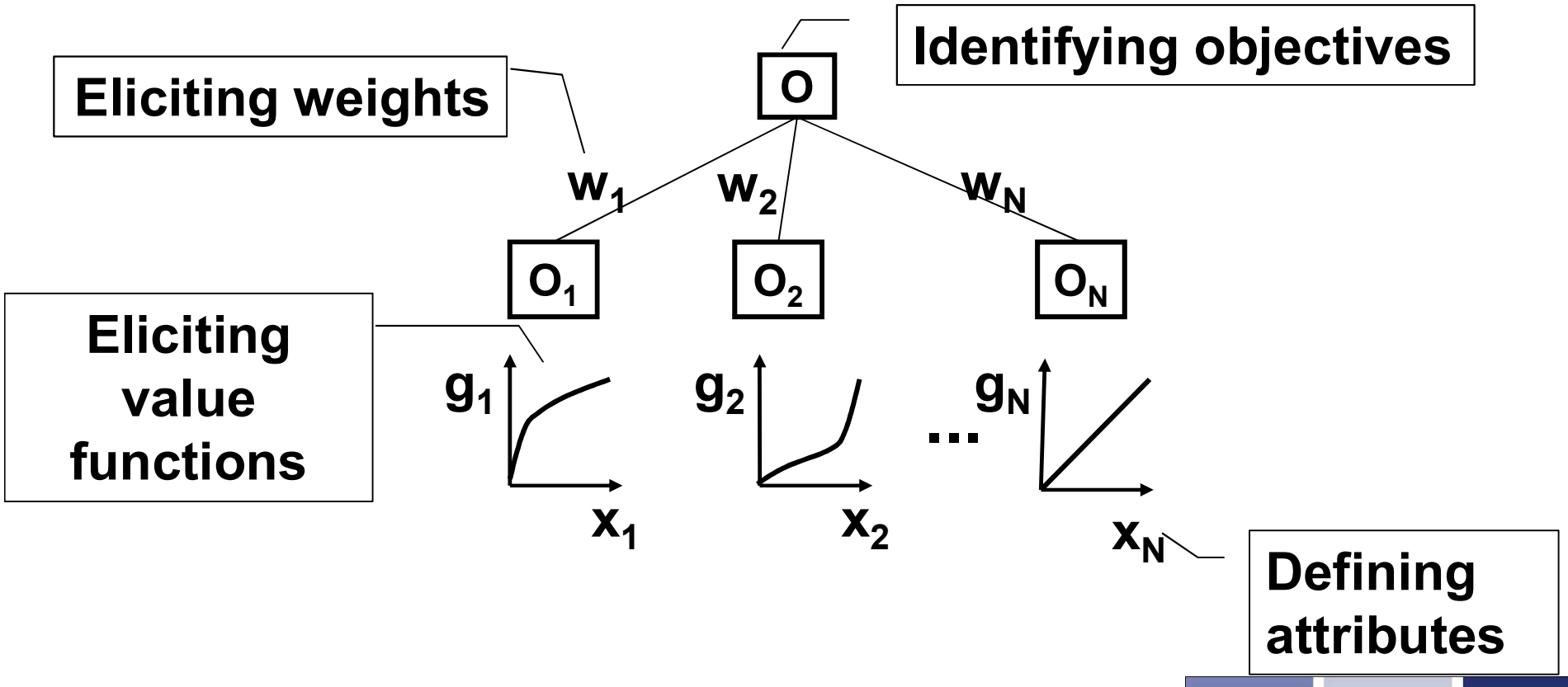
Mapping Biases – Value Modeling



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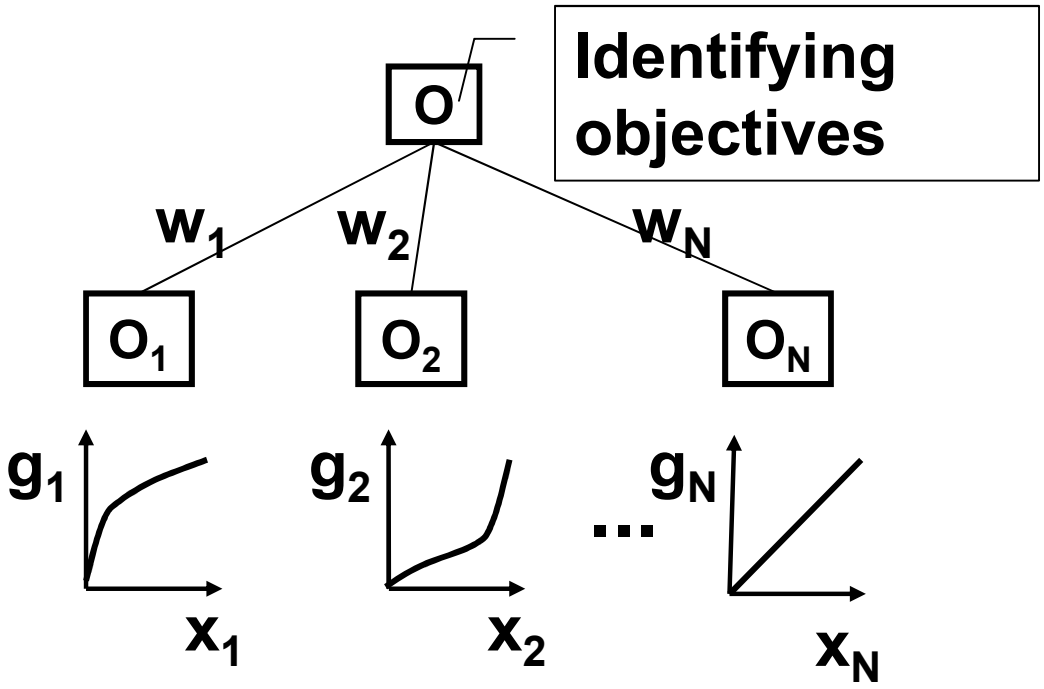
Mapping Biases – Value Modeling



Biases:

- Availability bias (C)
- Myopic problem representation (C)
- Omission bias (C)

Debiasing:

- Providing categories;
- Prompting for more objectives;
- Stimulating creativity.

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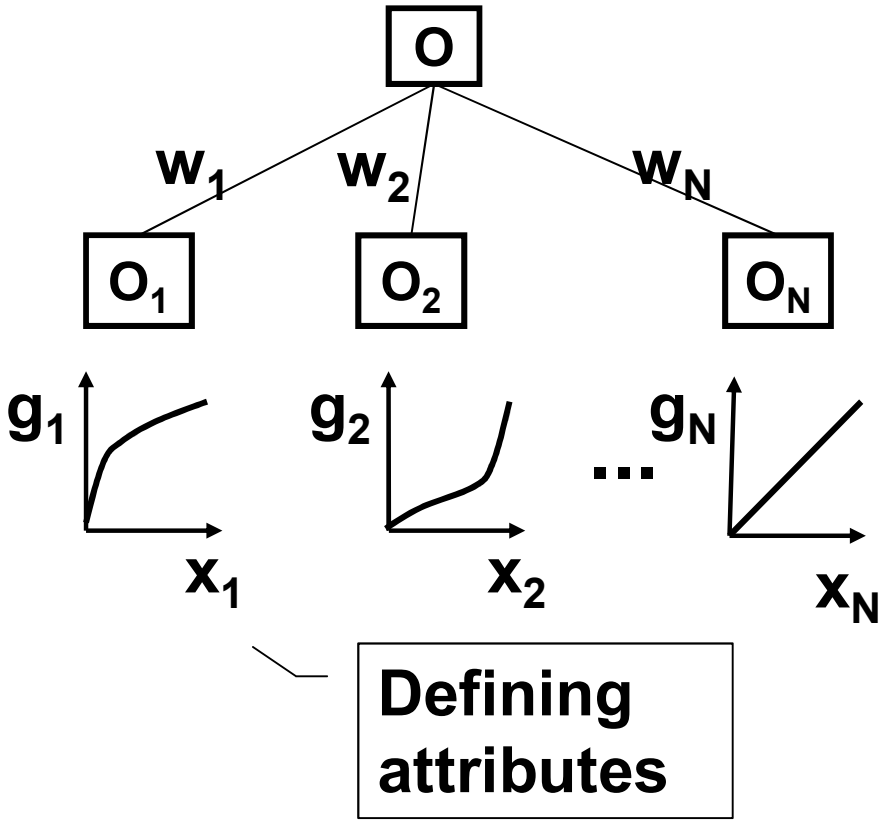
Mapping Biases – Value Modeling



Biases:

- Gain–loss bias (C)
- Proxy bias (C)
- Scaling biases (C)

Debiasing:

- Using natural scales for attributes;
- Carefully selecting attribute endpoints.

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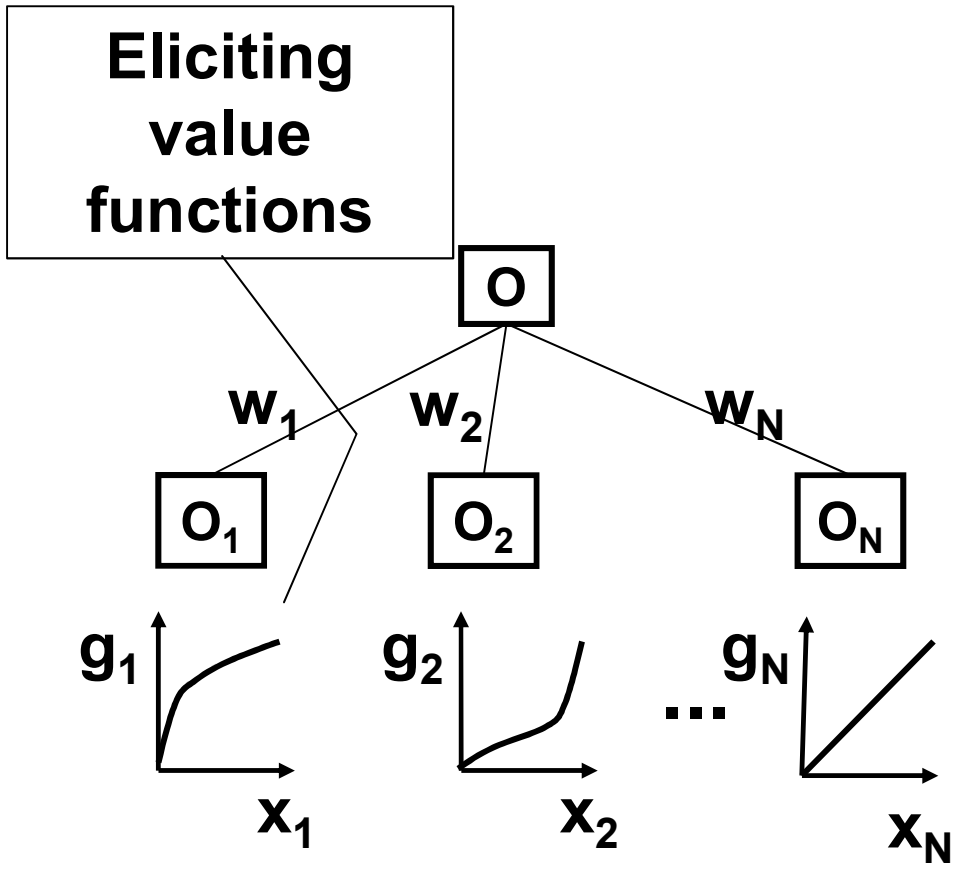
Mapping Biases – Value Modelling



Biases:

- Anchoring bias (C)
- Certainty effect bias (C)
- Gain–loss bias (C)
- Affect-influenced bias (M)
- Desirability of options (M)

Debiasing:

- Separating value and utility modeling;
- Separating assessments of gains and losses;
- Using group procedures.

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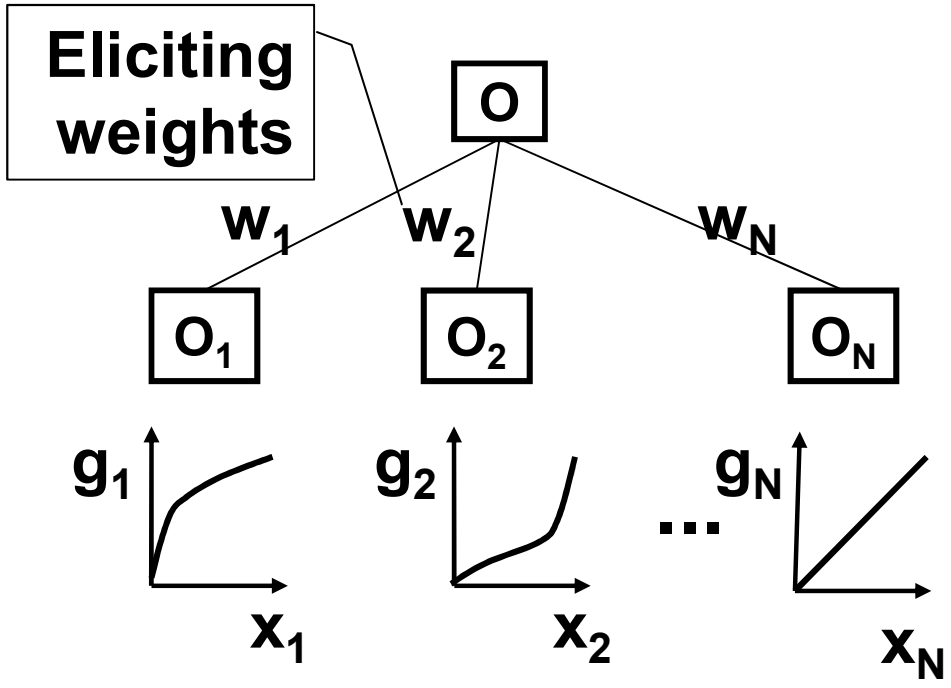
Mapping Biases – Value Modeling



Biases:

- Equalizing bias (C)
- Gain–loss bias (C)
- Proxy bias (C)
- Range insensitivity bias (C)
- Splitting bias (C)
- Affect-influenced bias (M)
- Desirability biases (M)

- **Debiasing:**
- Using group elicitation;
- Avoiding the use of direct importance;
- Cross-checking weights with trade-off and pricing out methods;
- Avoiding the use of proxy attributes.

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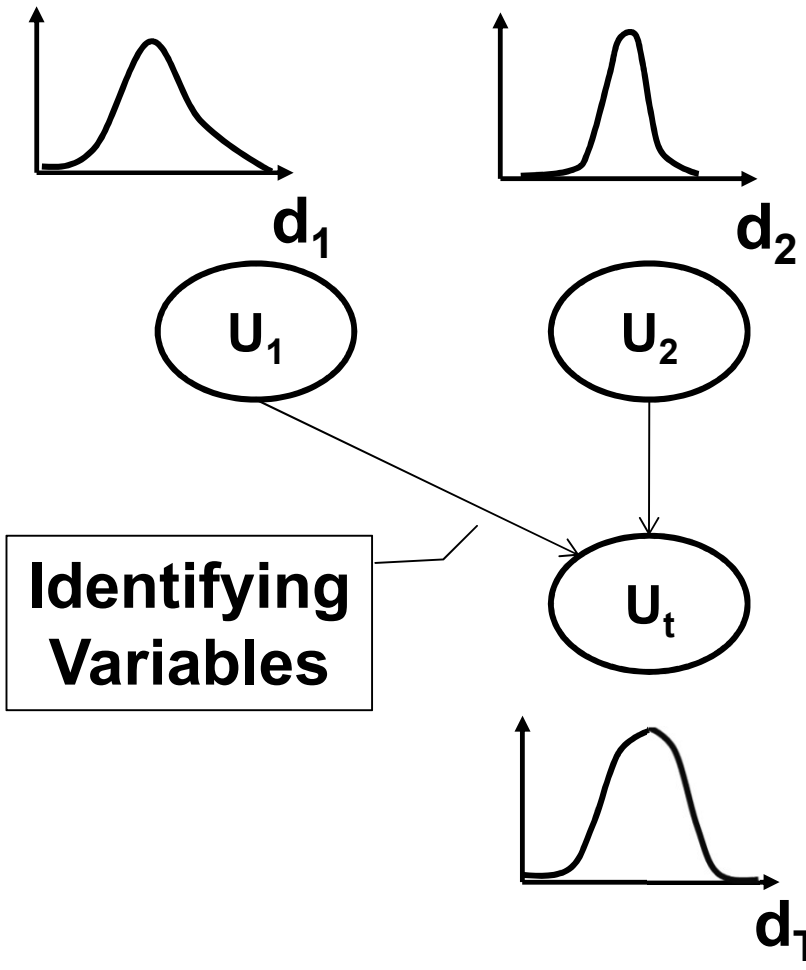
Mapping Biases – Risk Analysis



- Availability bias (C)
- Myopic problem representation(C)
- Omitted variable bias (C)
- Overconfidence bias (C)
- Confirmation bias (M)

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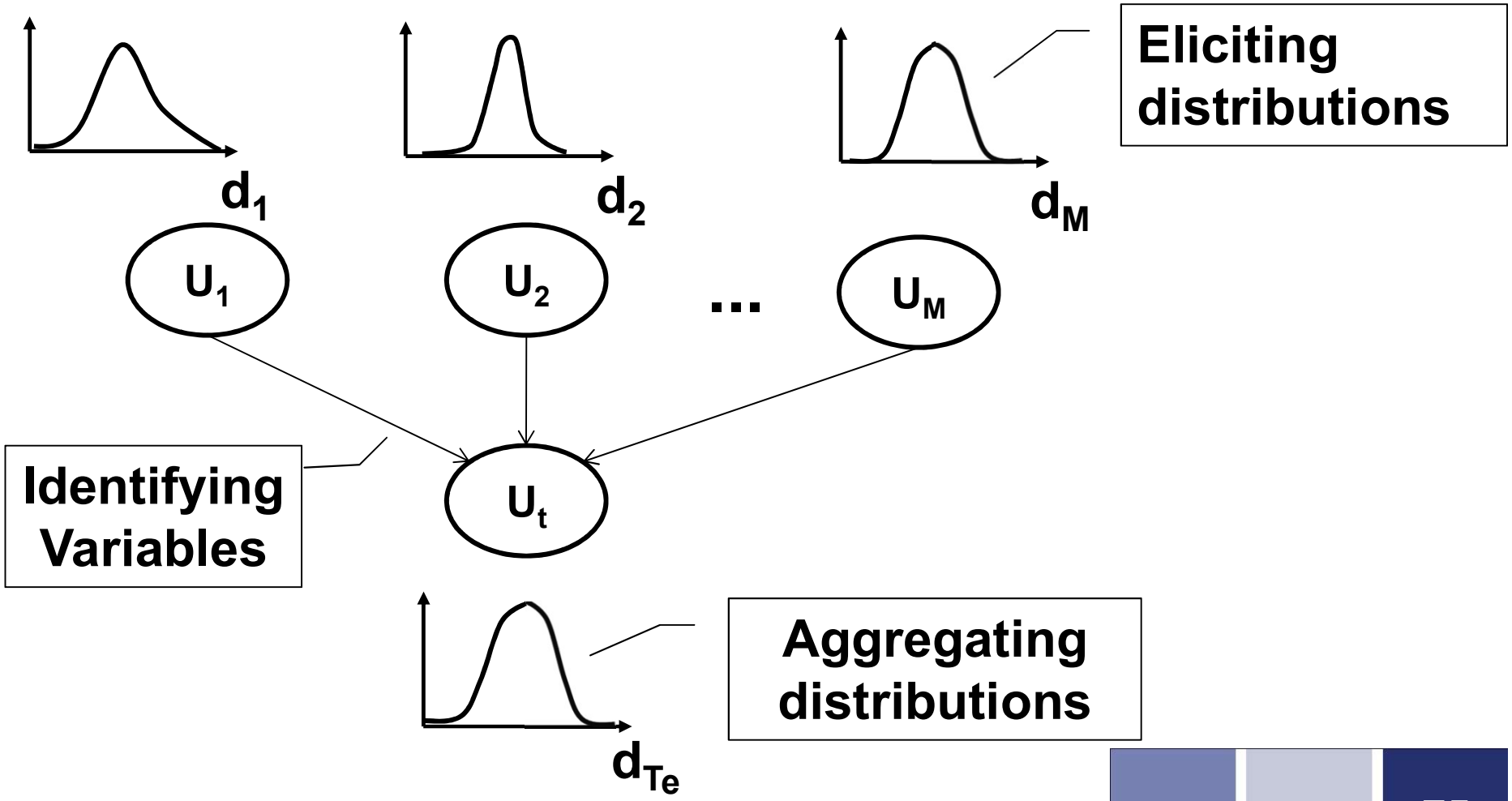
Mapping Biases - Modelling Uncertainty



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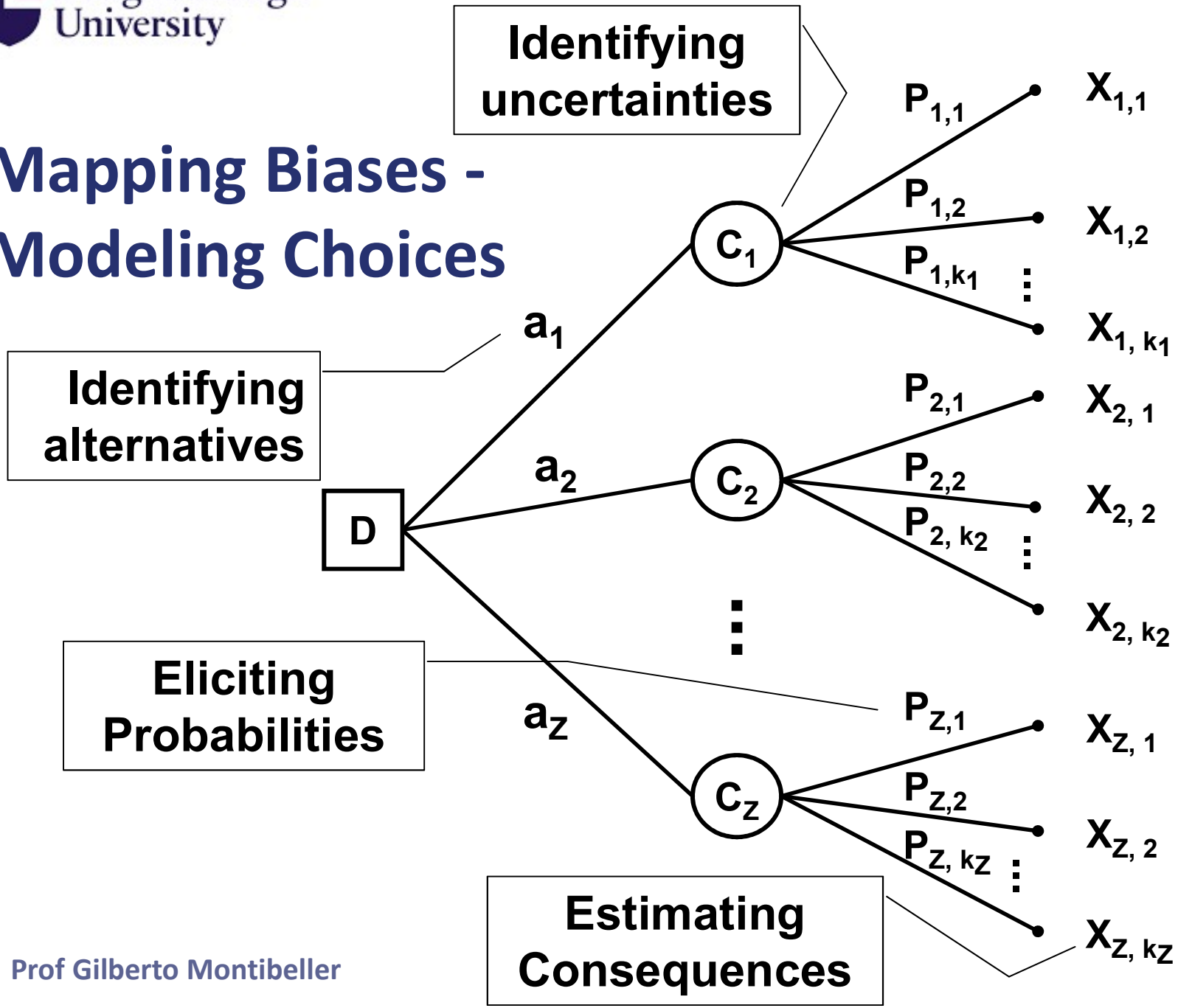
Mapping Biases - Modeling Choices



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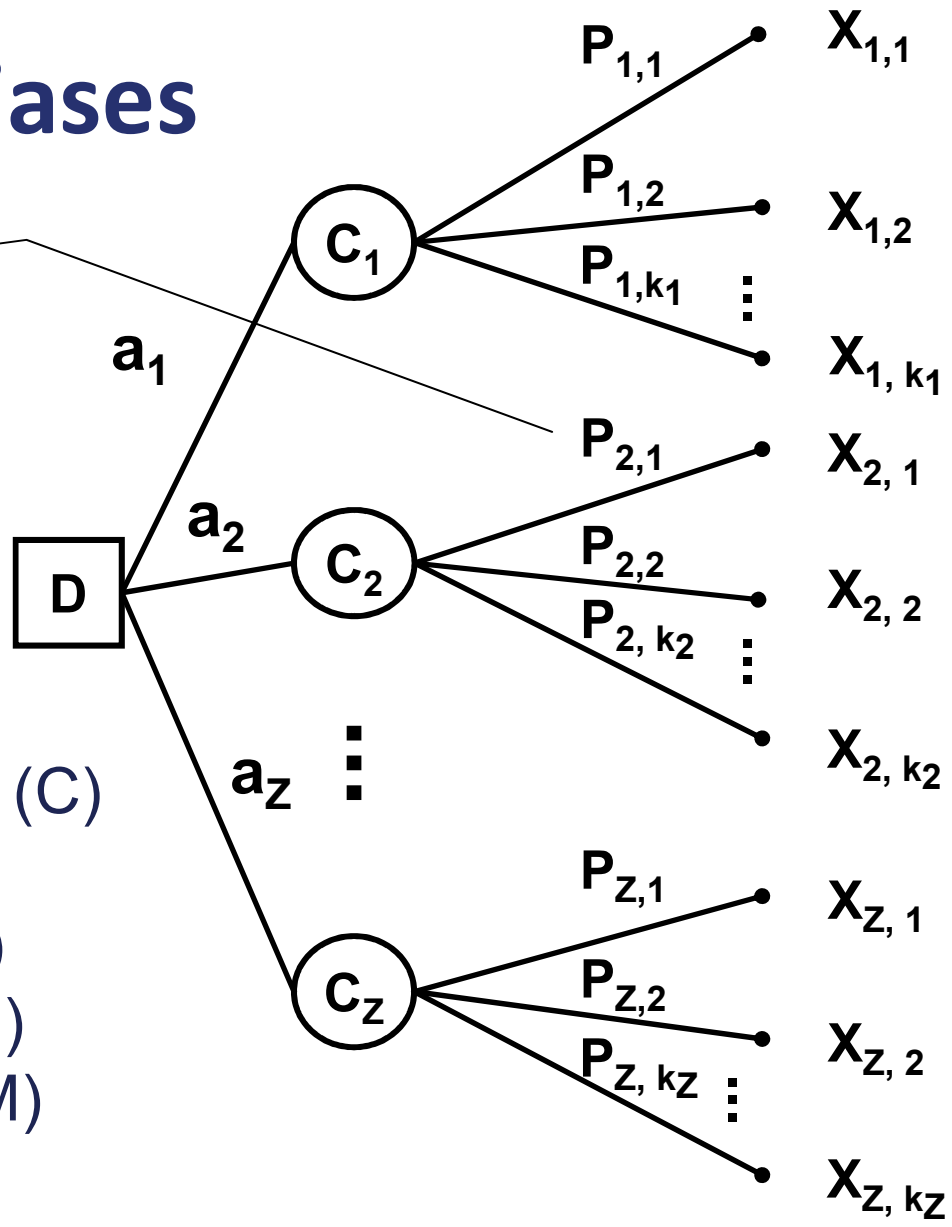
Mapping Biases

Eliciting Probabilities

- Anchoring bias (C)
- Availability bias (C)
- Equalizing bias (C)
- Gain-loss bias (C)
- Overconfidence bias (C)
- Splitting bias (C)
- Affect-Influenced (M)
- Confirmation bias (M)
- Desirability biases (M)



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Judgements are Constructed

- Adequate Elicitation Protocols
- Requisite Modelling
- Debiasing Tools

Cognitive processing

Elicitation protocol

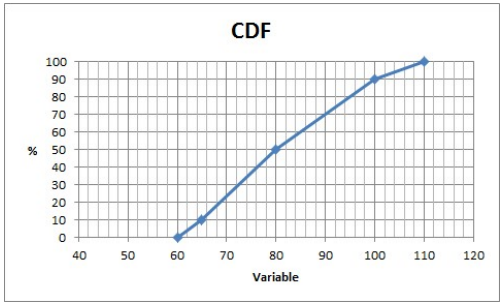
Analyst

Elicit Judgment

Make Judgment

Decision Maker

Represent



Revise Judgment

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Debiasing

- Older experimental literature shows low efficacy
- Recent literature is more optimistic
- Decision analysts have developed many (mostly untested) best practices, which we reviewed:
  - Prompting
  - Challenging
  - Counterfactuals
  - Hypothetical bets
  - Less bias prone techniques
  - Involving multiple experts or stakeholders

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Current Research Project: Debiasing

- Existing literature focused on demonstrate bias (e.g. overconfidence)
- Few attempts of assessing the effectiveness of debiasing tools in controlled experiments
- No previous attempt of assessing the effectiveness of sophisticated debiasing tools employed by decision analysts in practice
- Aim: Create a research protocol for assessing debiasing tools employed in DRA practice.

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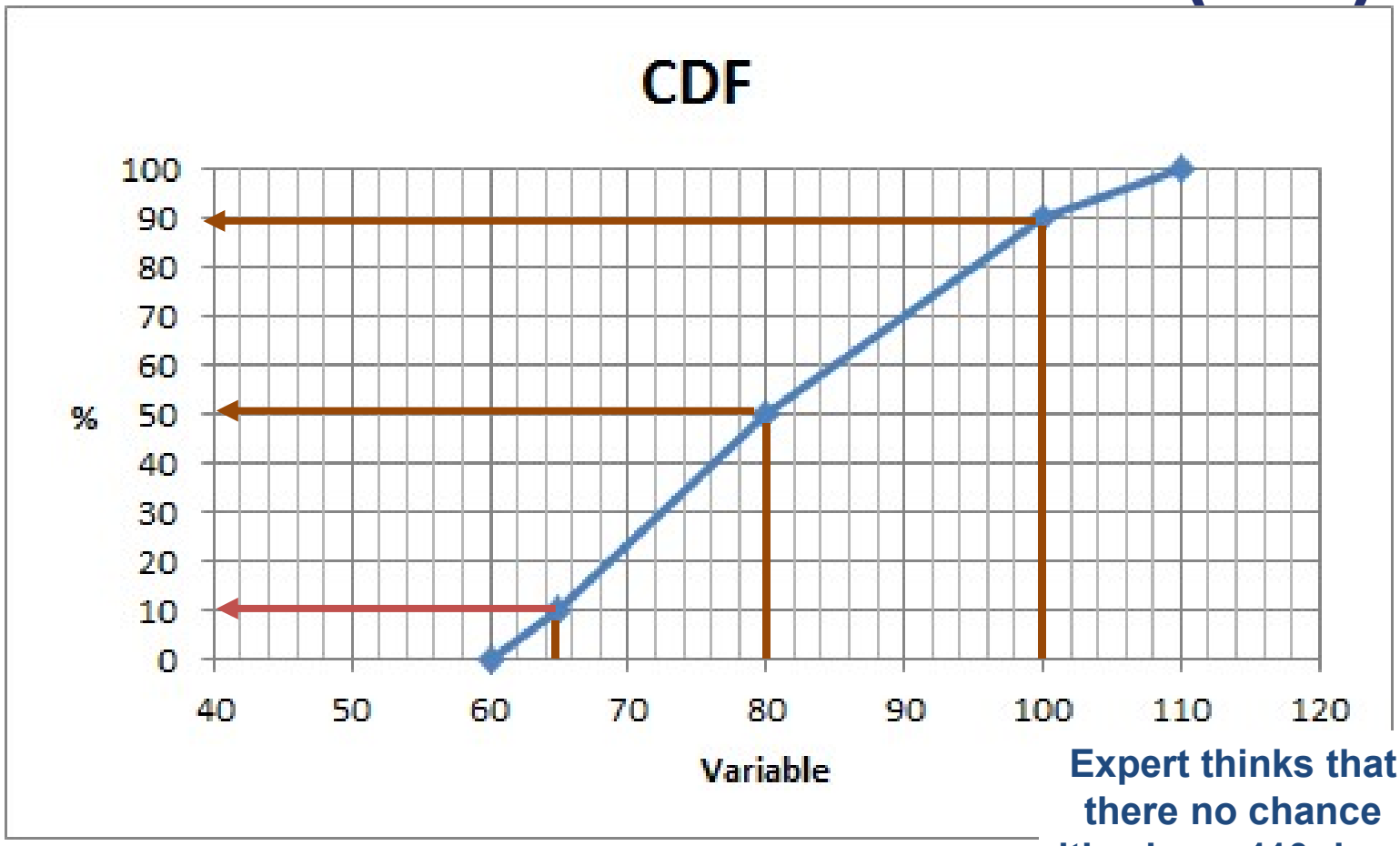
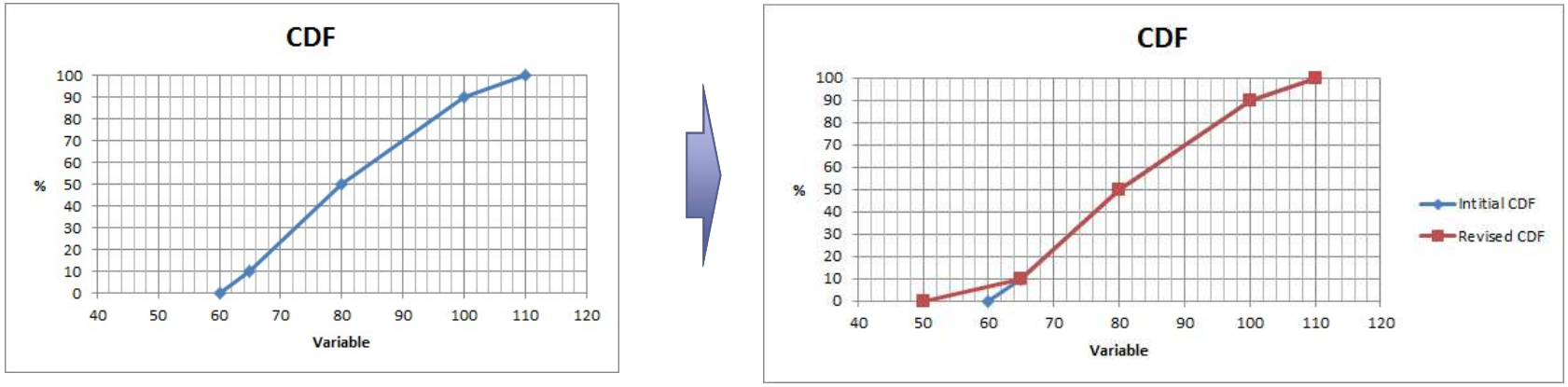
A Cumulative Distribution Function (CDF)



Expert thinks that there no chance it's above 110 days

Variable: Number of DAYS when ozone levels over an eight-hour period violated the federal standard in Southern California

Stretching the Distributions - Counterfactuals



DA: Can you think about an explanation under which the true answer is lower than your initial lowest estimate? Yes (Y) or No (N)?

Expert: Yes, I am aware that California has been implementing policies for pollution control since the 1970s.

DA: Considering this explanation, please adjust the lowest initial estimate DOWNWARD

(The same protocol for the upper bound.)

Expert: 50 days

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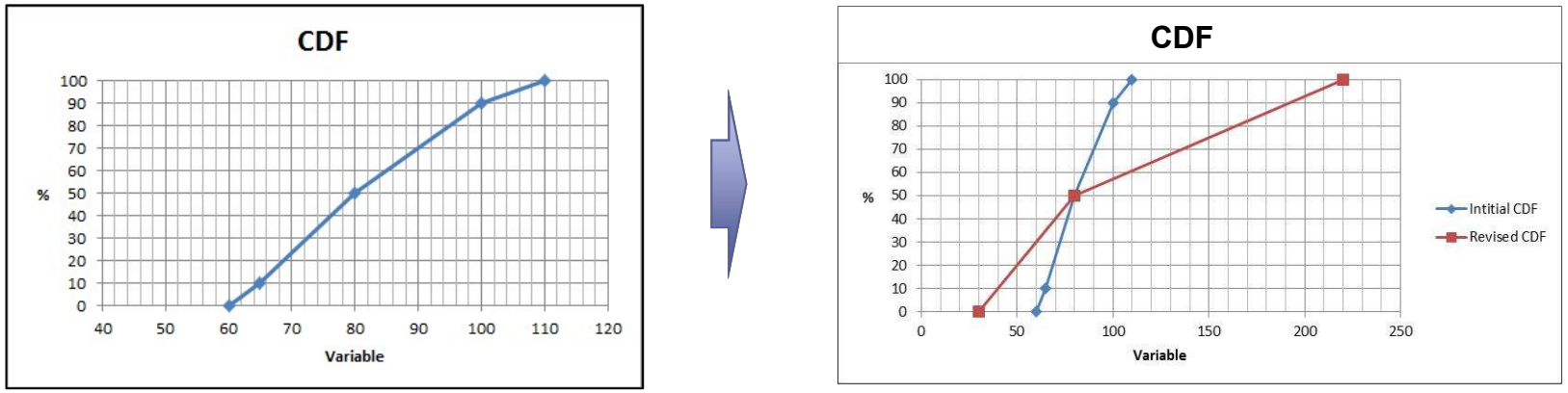
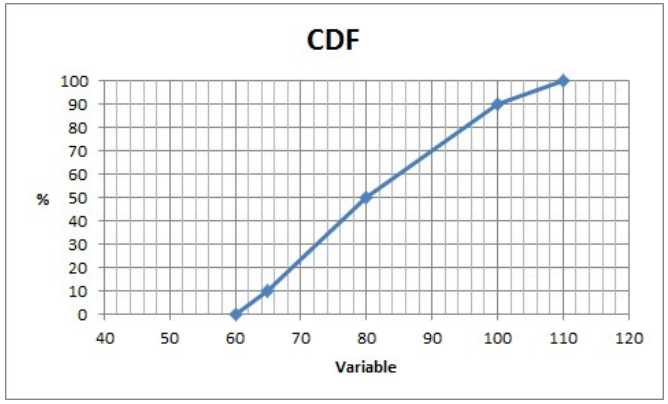
Stretching Automatically the Distributions

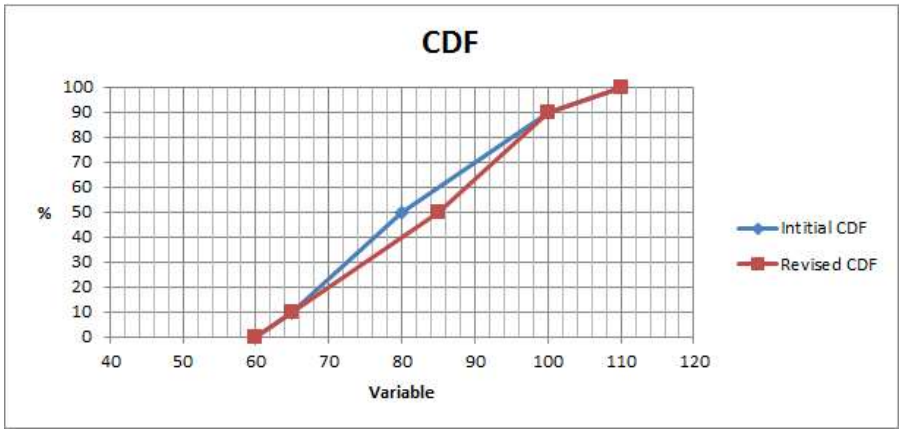


DA: You might have missed the true value in your original range.

We have thus automatically stretched the original range dividing by ½ the lower bound and multiplying by 2 times the upper bound.

Calibrating the Median





DA: If you had to place a bet on either side of your Median (80 days), which side would you bet on, above (A), below (B), or at the Median (C)?

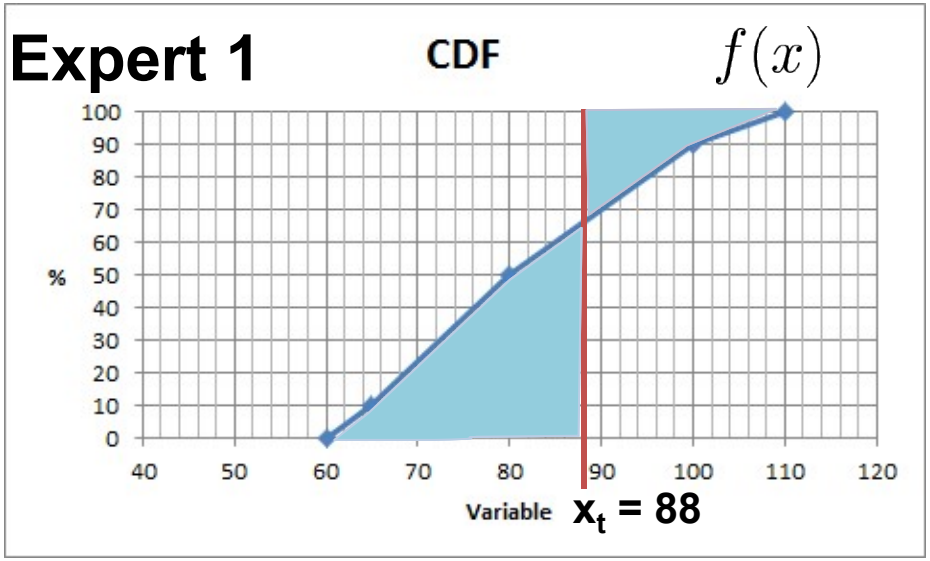
Expert: Higher side

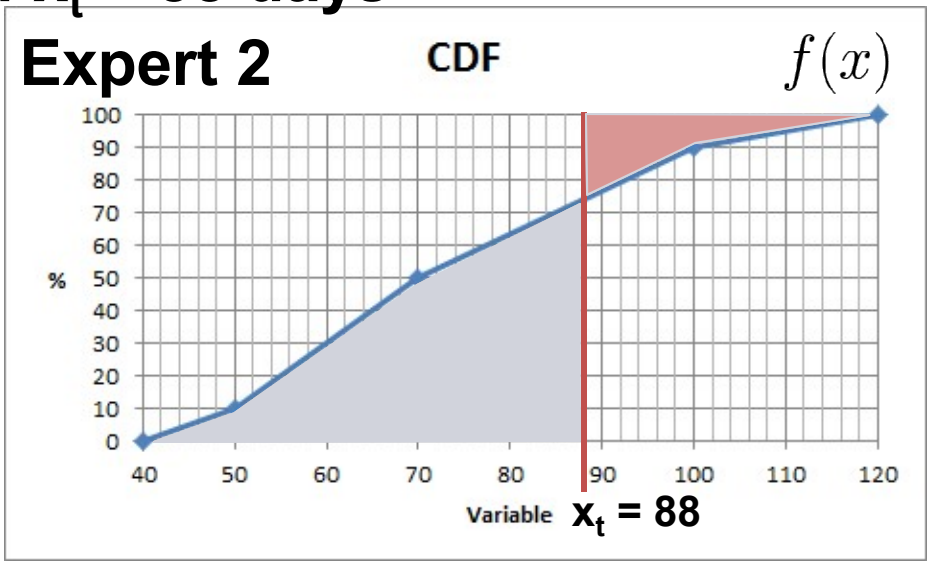
Since you would bet on the higher side, you probably think it is more likely. Adjust the Median UPWARD so that you would be indifferent between betting on the upper or lower side.

Expert: 85 days

Accuracy of Judgments

True value: x_t = 88 days





Who provided a more accurate distribution? **Expert 1 (smaller area)**

$$S = \int_0^{x_t} (f(x))^2 \, dx + \int_{x_t}^{\infty} (1 - f(x))^2 \, dx$$

Matheson and Winkler Scoring Rule

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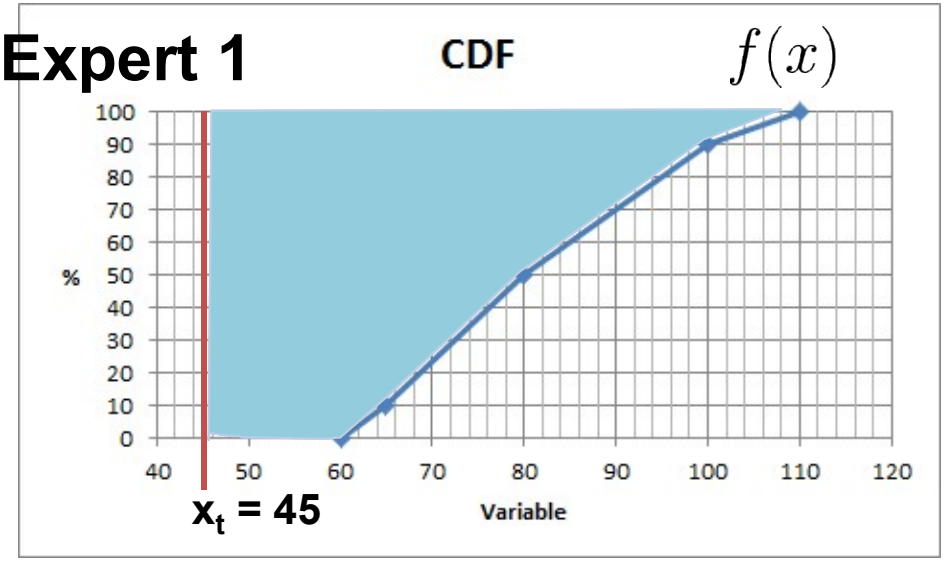
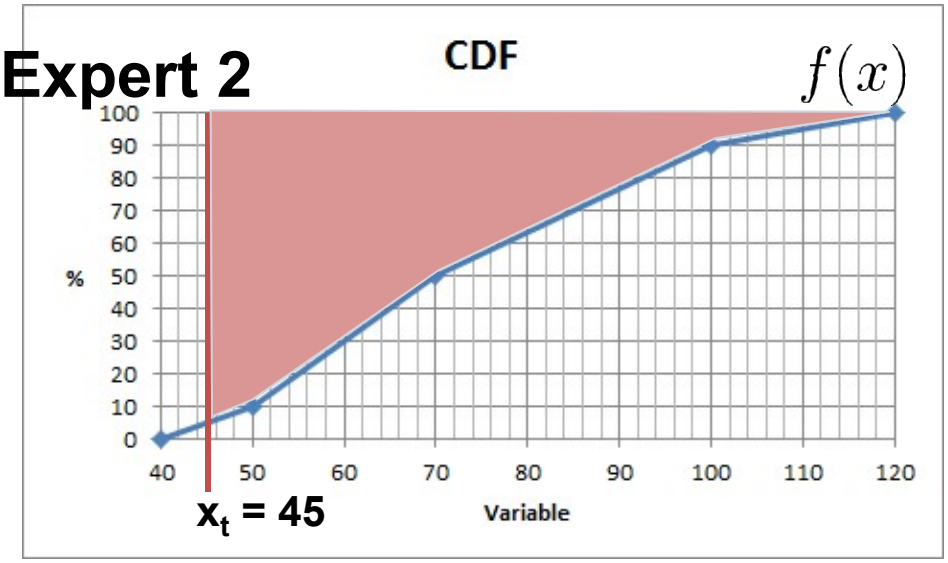
Calibration of Judgments

But if the true value were 45 days, Expert 2 would be better
(smaller area and true value within the range).





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Minimising Biases in Multi-Criteria Prioritisations

A Decision Support System for the Prioritisation of Value-for-Money Studies

The Evaluation of VFM Studies

- **Individual assessors evaluate each project on every criterion** (decomposed assessments are more reliable and avoids group biases)
- **Projects are assessed on impacts, not on scores** (reduces anchoring & response scale biases)

- **Aggregated scores are calculated and presented; Median and SD are calculated; high dispersions are highlighted** (Median is insensitive to outliers)
- **Group can review and re-assess scores for high dispersion projects** (supporting the sharing of information and opinions)

- **Projects are prioritised on Value-for-Money**
- **Project can be inserted into the portfolio** (balance between technical criteria and portfolio feasibility)
- **Value of portfolio and £ loss of non-optimal portfolios are calculated** (quantifying the trade-off between technical criteria and portfolio feasibility)

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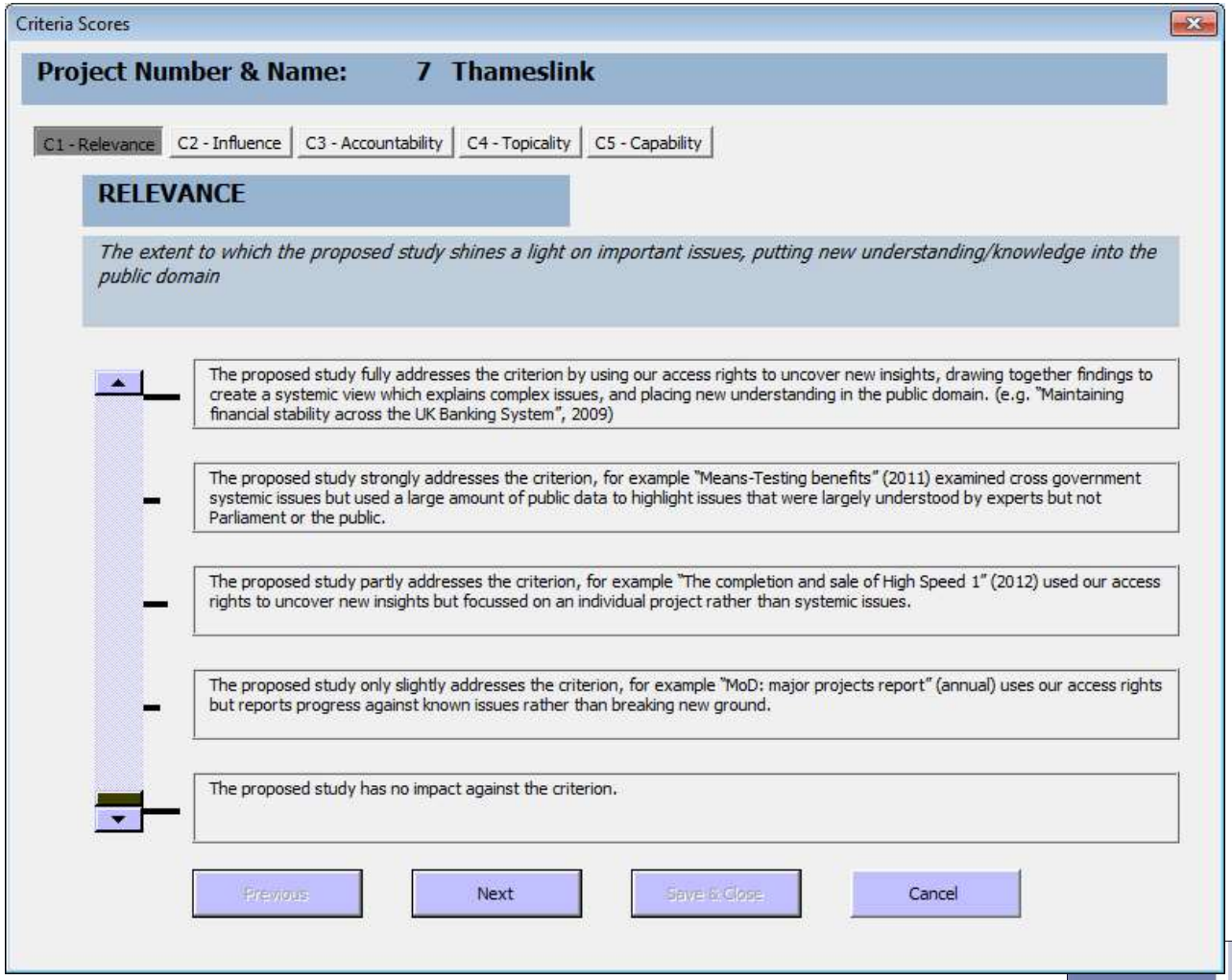
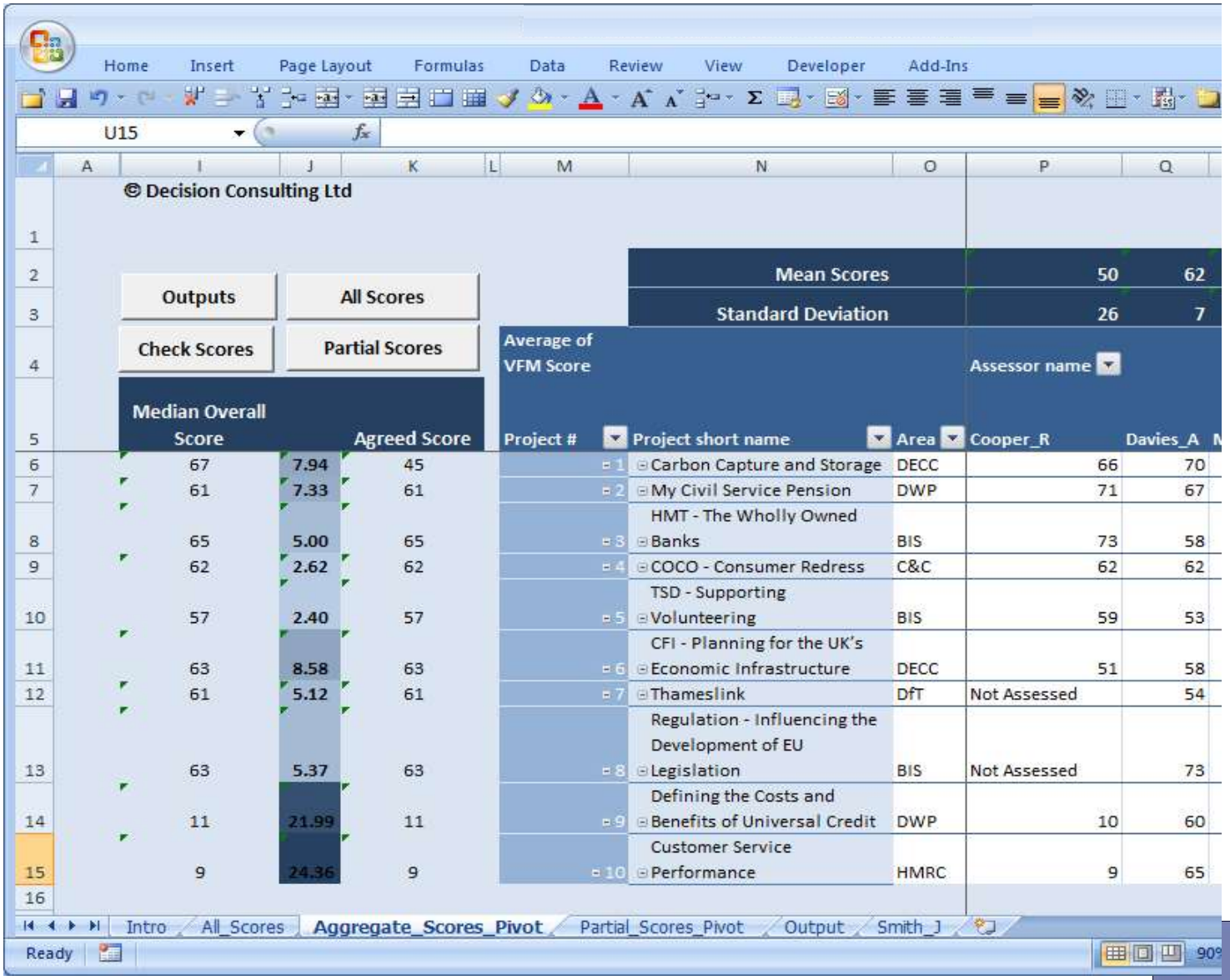
The Evaluation of Projects



The Decision Support System



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Outputs | All Scores | Check Scores | Partial Scores

Median Overall Score		Agreed Score
67	7.94	45
61	7.33	61
65	5.00	65
62	2.62	62
57	2.40	57
63	8.58	63
61	5.12	61
63	5.37	63
11	21.99	11
9	24.36	9

		Mean Scores	50	62
		Standard Deviation	26	7
Average of VFM Score			Assessor name	
Project #	Project short name	Area	Cooper_R	Davies_A
1	Carbon Capture and Storage	DECC	66	70
2	My Civil Service Pension	DWP	71	67
3	HMT - The Wholly Owned Banks	BIS	73	58
4	COCO - Consumer Redress	C&C	62	62
5	TSD - Supporting Volunteering	BIS	59	53
6	CFI - Planning for the UK's Economic Infrastructure	DECC	51	58
7	Thameslink	DfT	Not Assessed	54
8	Regulation - Influencing the Development of EU Legislation	BIS	Not Assessed	73
9	Defining the Costs and Benefits of Universal Credit	DWP	10	60
10	Customer Service Performance	HMRC	9	65

Intro | All_Scores | Aggregate_Scores_Pivot | Partial_Scores_Pivot | Output | Smith_J

Ready

Individual Scores

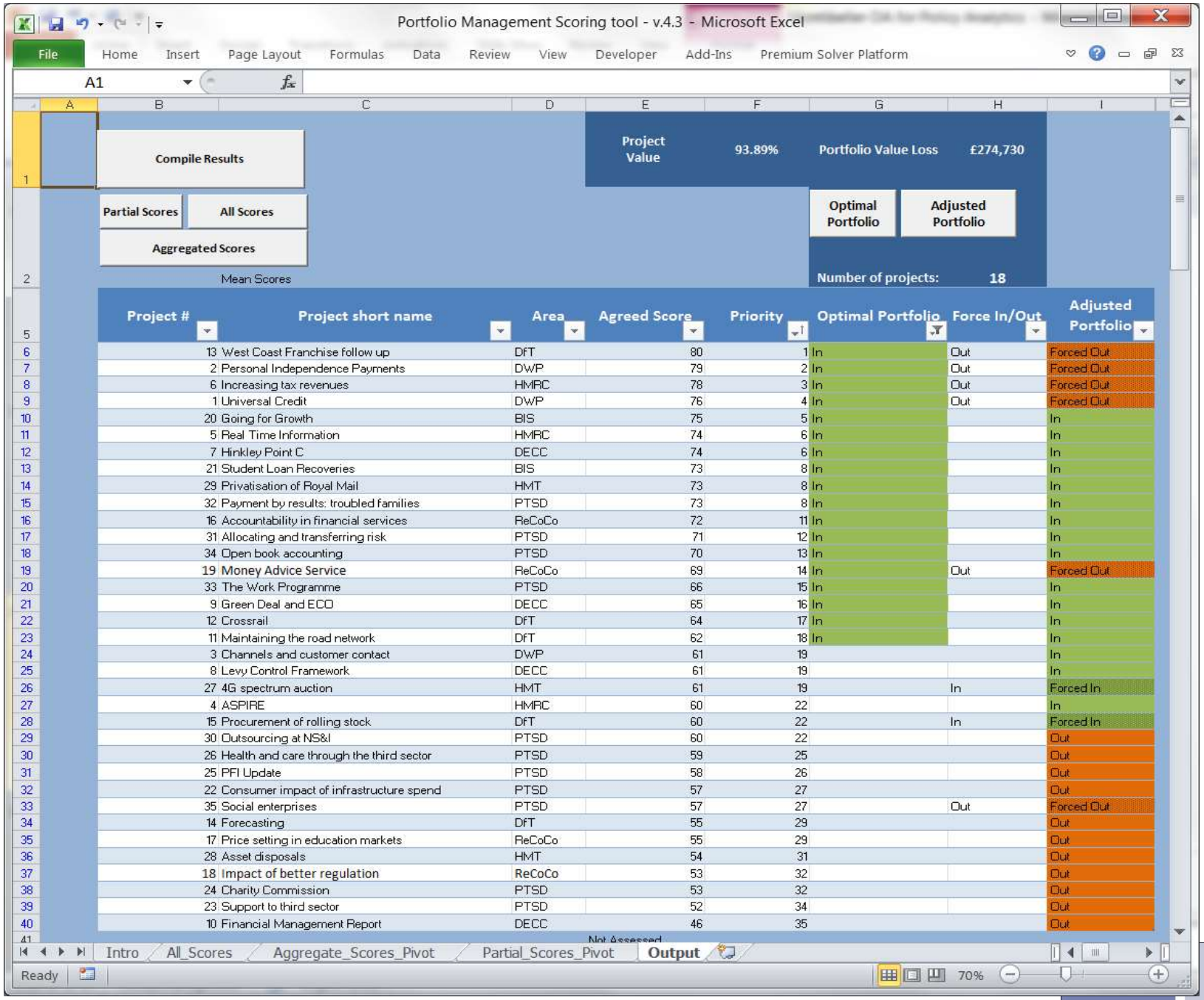
The Decision Support System

Project Value	98.45%	Portfolio Value Loss	£19,330

Optimal Portfolio	Adjusted Portfolio
Number of projects:	5

Agreed Score	Priority	Optimal Portfolio	Force In/Out	Adjusted Portfolio
80	1	In		In
79	2	In		In
78	3	In	Out	Forced Out
76	4	In		In
75	5	In	Out	Forced Out
74	6			In
74	6			Out
73	8		In	Forced In
73	8			Out
73	8			Out

Analysing the Portfolio



Adjusting the Portfolio

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The DSS Supporting the Prioritisation

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Recommended Readings

Montibeller, Gilberto, and Detlof von Winterfeldt. "Cognitive and Motivational Biases in Decision and Risk Analysis." *Risk Analysis* 35, no. 7 (July 1, 2015): 1230–51. doi:10.1111/risa.12360 (**and all the 175 references there!**).

Ferretti, Valentina, Sule Guney, Gilberto Montibeller and Detlof von Winterfeldt. Testing Best Practices to Reduce the Overconfidence Bias in Multi-Criteria Decision Analysis. *Proceedings of the 2016 49th Hawaii International Conference on System Sciences*, IEEE: 1547-1555.

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Thank you for your attention!

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