

Session 3.2: 'Rational Choice and the Framing of Decisions'?

Introduction

'Decision traps' (as previously introduced) occur, in the main, when humans err in selecting the appropriate information on which to base a decision. Our attention turns, now, to theories about how to calculate or reason about which, amongst the alternative choices presented to a decision-maker(s), constitute the optimal choice. In this section we consider the pitfalls which may arise in 'rational' decision theory – choosing on the basis of reasoning and calculating the most beneficial outcome of a choice. A broad distinction between strategic and operational decision-making is introduced, together with case studies of the risks associated with both short-term and longer-term decision-making.

Making strategic (and often operational) decisions is about reasoning under uncertainty. If all business executives and managers were omniscient and had access to all relevant information (and were entirely rational), then making a rational decision would simply be a matter of using logic to deduce the 'correct' (optimal) decision derived from certainty about the past, the present and the laws governing the future. For human beings (even the most rational), however, deducing the future from a complete knowledge of past and present facts is impossible. **'Decision Theory'** (Decision Analysis) is the science which investigates the forms of reasoning available to decide on the best outcome in conditions of uncertainty.

In other words, forecasting the future and deciding upon which actions are best to maximize advantage or minimize loss in the future has to be based upon **probability** judgments, in conditions of incomplete knowledge. Just as 'decision traps' may arise from errors in the human reasoning processes which underpin decision-making, so decision-makers have, also, to guard against pitfalls / paradoxes which beset the theoretical basis of decision theory. These are the concern of this week's study – especially in relation to the practical application of decision support tools based on the assumption that the 'best' decisions are those which, by rational calculation of the 'odds' and the 'expected value', are most likely to achieve the best (or the least worst) result.

In preparation for this week's work, thus, it may be worthwhile to review your understanding of the basic arithmetic of probability and of inferences based on probability judgments. A brief summary (in slide format) of the basic arithmetic of probability is available from the "Basic Probability Slides" file download from this week's materials on Moodle.

We start with some illustrations of (theoretical) decision-making – based on the primary assumption of (rational) decision theory: that, when reasoning about the best option for a future action, the correct decision is the one that favours the most probable outcome. *(If you bought a lottery ticket, did you make your decision to buy by reasoning about what is the most probable outcome?)*

Pitfalls of Decision Theory (in its classical form):

As in the first session, we start in the mists of history (*"Those who don't know history are destined to repeat it!"* – now, who said that?¹). The arithmetic of probability theory probably (*sic*) goes back to the first human beings who ever made a bet or played a game of chance. Much of the foundation of what, in modern times, we debate in the domain of "decision theory" or "decision science", however, we can trace back to the mathematician Daniel Bernoulli (1700-1782 – mentioned in the [Dan Gilbert video](#) from Week 1). Bernoulli is credited with inventing both one of the most commonly debated 'pitfalls' of (rational) decision theory and with a mathematical solution to its paradoxical consequences for decision-makers.

The 'pitfall' (of decision theory) Bernoulli presents is known as the "*St. Petersburg Paradox*" (because he was in the Russian city when he wrote about it). Like most of the 'pitfalls' cited below, it is a purely hypothetical (and abstract) "paradox" which contrasts the 'expected gain' from an option with the 'price (or loss)' of choosing that option and not "winning".

I will present some detail of the "St. Petersburg Paradox" here, because it helps to introduce Bernoulli's solution – which is fundamental to (rational) decision theory. There are many other variants and additions to Bernoulli's paradox which will form the basis for one of this week's activities – so I will merely provide relevant sources and ask that you consider their importance for decision theory.

St. Petersburg Paradox

Bernoulli asks us to consider a simple 'casino' game based on tossing a fair coin (which can result in 'heads' (H) or 'tails' (T)). As always, the probability of H or T at each toss of the coin is exactly $\frac{1}{2}$. The casino offers a game of chance for a single player in which a fair coin is tossed at each stage. The winning pot (W) starts at £1 and is doubled every time a head H appears. The first time a tail T appears, the game ends and the player wins whatever is in W. Thus the player wins £1 if a tail appears on the first toss, £2 if a head appears on the first toss and a tail on the second, £4 if a head appears on the first two tosses and a tail on the third, £8 if a head appears on the first three tosses and a tail on the fourth, and so on. In short, the player wins $£2^{k-1}$ if the coin is tossed k times until the first tail. The casino, however, requires that each player pay a price, up front, in order to enter the game (each time).

Bernoulli's question is: "*At what price is it rational for a player to enter the game?*"

Now consider the options:

- i. If the entry price ("stake" = S) is £1, then one loses nothing if the first toss is T. One wins back the stake from W. The casino cannot profit from an entry price of £1.

¹ Actually, it is a little controversial: The words "*Those who don't know history are destined to repeat it*", as a comment, are attributed to Edmund Burke (1729 – 1797, British statesman and political thinker), though some say he said "... *doomed to repeat it*". A later version is attributed (by partisan historians of ideas) to the American philosopher, George Santayana (1863-1952), "*Those who cannot remember the past are condemned to repeat it.*" (in his 'Reason in Common Sense, Life of Reason', vol. 1).

- ii. What would be a fair price to pay the casino in order to enter the game?
To answer this we need to consider what would be the average payout:
With probability $\frac{1}{2}$, the player wins £1; with probability $\frac{1}{4}$, the player wins £2;
with probability $\frac{1}{8}$, the player wins £4, and so on.

Assuming the game can continue as long as the coin toss results in heads, in particular that the casino has *unlimited resources*, this sum grows indefinitely, and so the possible win for the player, at least in this idealised form, is an **infinite** amount of money. Considering nothing but the expectation of the net change in one's gains, one should therefore play the game **at any price** if offered the opportunity.

Of course, that is not realistic. The chances of winning an infinite amount from W are infinitely small. This is the **paradox**. Viewed from the perspective of what you may win, you should pay **any price** demanded to enter the game. Viewed from the perspective of what you may lose, **any payment above £1** is a risk. Is there a price (between £1 and infinity) at which it is a reasonable (rational) decision to pay to enter the game?

The 'St. Petersburg Paradox' is, of course, unrealistic – for (at least) two reasons:

- The assumption that a casino has unlimited resources is impractical; even Las Vegas casinos have a limit on the maximum return a bet may yield.

[One may compare Bernoulli's thought experiment, in this sense, to [Pascal's Wager](#), which compares finite gains to infinite losses (invalidly, finite and infinite quantities are not comparable)].

There are, however, versions of the 'paradox' which reappear when the maximum possible payout is fixed at some (large) finite amount².

- The assumption that (rationally) the price you pay to enter the game is based solely on the likelihood that you may win is faulty. This is precisely the assumption that Bernoulli, himself, challenged in proposing a resolution of the apparent paradox of the St. Petersburg 'game'.

Bernoulli proceeded to dismantle his own "paradox" by pointing out that the decision to buy ("enter the game") should not be based solely on the "odds" of winning, but upon the "value" to the decision-maker of entering the game. Stated simply, if I have £1 available to gamble, then the most I can afford to pay to "enter the game" is £1 (irrespective of the likelihood of my winning). Alternatively, if I have £1 million available to gamble, then I may risk a much higher price to "enter the game". So the price at which it is reasonable to "enter the game" is relative to the "value" (to me) of gaining versus losing.

² See, for example: Rieger, Marc Oliver; Wang, Mei (2006). "Cumulative prospect theory and the St. Petersburg paradox". *Economic Theory* **28** (3): 665–679 – but, be warned, there is a lot of utility theory mathematics in this reading. The original work on calculating expected utility for bounded versus unbounded gains comes from Kenneth Arrow, (1974), "The use of unbounded utility functions in expected-utility maximization: Response". *Quarterly Journal of Economics* (The MIT Press) **88** (1): 136–138

Bernoulli, himself, expressed this much better:

“The determination of the value of an item must not be based on the price, but rather on the utility it yields.... There is no doubt that a gain of one thousand ducats [unit of currency] is more significant to the pauper than to a rich man though both gain the same amount.” (Bernoulli, 1738)

In other words, it is not solely the odds of winning that determines one's decision to play, it is also the value to you of the prospective gain balanced against the 'risk' – in part determined by the utility the money you pay to 'enter the game' would have for you if you did not pay to enter. Of course, great wealth is subject to the economic principle of *diminishing marginal utility*: as the wealth (money, assets, resources) you accumulate increases, so the relative value to you of acquiring more decreases (as does the associated risk of not gaining).

The application of Bernoulli's hypothetical paradox may not, initially, appear to have much relevance to rational decision-making in business contexts. Yet, at its core is the highly relevant question of how best to balance the likelihood of success (probability) against the risk of loss (value of gain) in business decision-making.

Bernoulli's introduction of the concept of “*expected utility*” and the supporting mathematical framework he defined for it has become a central academic and professional domain, not just for economists but for decision scientists, business and finance analysts, and – though not without its detractors – has become an essential tool in all these fields of quantitative analysis.

These notes have concentrated upon Bernoulli's St. Petersburg Paradox – because debating its significance for economic forecasting, human decision-making, risk assessment and prediction of outcomes has given rise to so many concepts and models central to the decision sciences. This pitfall in reasoning about “rational choice”, however, is only one amongst a number of (so-called) “paradoxes” (or unexpected results) which have been debated within the disciplines of decision theory and quantitative analysis of decision-making. One of the main activities for this week's work is to examine, interpret and illustrate how one of the other anomalies in the attempt to present quantitative support for rational (optimal) decision-making (by individuals and by groups) may contribute to the selection of appropriate tools to analyse and predict the probable success of strategic and operational decisions taken in business contexts.

Here are three examples of other “pitfalls” of quantitative analysis of decision-making which have generated considerable debate in the “decision theory” community and which form the basis for this week's main activity. In each case, the “pitfall” is named and useful references to its significance and its (possible) resolution are listed alongside.

Activity 1:**Related problems of rational decision theory:**

Pitfall	References
Prisoners' Dilemma	1. Richmond Campbell, Lanning Sowden, (1985), "Paradoxes of Rationality and Cooperation: Prisoner's Dilemma and Newcomb's Problem" : Univ. of British Columbia Press ISBN: 0774802154 (See especially Chapter 1, pp. 1 - 21). 2. LessWrong Wiki: http://wiki.lesswrong.com/wiki/Prisoner%27s_dilemma (Accessed: 28/07/2013)
Newcomb's Problem	1. Richmond Campbell, Lanning Sowden, (1985), "Paradoxes of Rationality and Cooperation: Prisoner's Dilemma and Newcomb's Problem" : Univ. of British Columbia Press ISBN: 0774802154 (See especially Chapter 1, pp. 22 - onwards). 2. LessWrong Wiki: http://wiki.lesswrong.com/wiki/Newcomb%27s_problem (Accessed: 25/07/2013)
Network Traffic Problem	1. See references in: Wikipedia / Braess' Paradox, http://en.wikipedia.org/wiki/Braess%27s_paradox (Accessed: 22/07/2013). 2. Amnon Rapoport, Tamar Kugler, Subhasish Dugar, Eyran J. Gisches, "Choice of routes in congested traffic networks: Experimental tests of the Braess Paradox", Games and Economic Behavior 65 (2009) 538–571 – downloadable from: http://www.parisschoolofeconomics.eu/IMG/pdf/Choices_of_routes.pdf (Accessed: 08/07/2013) <i>[Note: Try not to be distracted by the complex game-theoretic and statistical analysis – focus your reading on the discussion of implications in Sections 4, 5, especially in relation to individual choice versus co-operation in selection of routes and costs.]</i>

Select **one** of the 'pitfall' problems listed above. Use the references provided to make notes to explain in your own terms how the 'paradox' arises. Ensure you understand the mathematical reasoning behind the unexpected result. Read through the comments and suggested solutions discussed on the 'LessWrong wiki' web site or the references in the Rapoport (et alia, 2009) article. Make notes on the debate over the solutions and comment upon which proposal you believe to be your preferred solution. Formulate an example (drawn from your own work or life experience) which you think illustrates the risk to deciding rationally that the problem poses. *[For example, suppose two children in your family have been naughty and done something wrong together. If you were the parent considering how to punish their bad behaviour, would you consider how the "Prisoners' Dilemma" may affect whether one child (or both) 'owns up' to what they did?]*

When you have completed this initial research, you should have a set of notes on each 'pitfall' problem together with your own explanation of how it may be solved and an example or two of situations in which the problem may arise. Share these online with others in your group – compare your preferred solutions to theirs and follow up any sources they may have used which you had not seen.

Guidance:

The activity does not expect you to become an expert ‘decision theorist’ in one week (unless you are one already!), nor to assimilate all the logical and mathematical complexities of ‘game theory’ or ‘econometrics’. Keep your focus upon what the core ideas of decision theory are saying about what makes making decisions ‘rational’ – and how well or badly these principles may apply to real world decision-making situations. Consider carefully whether the principle of *maximisation of expected utility* can be applied to situations of group decision-making, together with the extent to which group decisions (in business contexts) rely upon the co-operation of the managers or executives responsible for making those decisions.

Purpose:

The aim of this activity is to draw your attention to the large volume of research and theorising that has been devoted – not simply to such hypothetical, unrealistic examples of making a decision, but to the differences in decision theory principles and concepts (*causal* versus *evidential* decision theory) which derive from the core idea of (rational) decision theory (from Bernoulli) that, in conditions of uncertainty, the best action to decide upon amongst competing alternatives is the one that *maximises expected utility* to you as a rational agent – given the probabilities of each outcome.

What do the pitfalls tell us about the practicalities of rational decision-making in business?

Undoubtedly, the ‘pitfalls’ and ‘paradoxes’ discussed so far will seem remote from the practicalities of decision-making in business contexts. Our aim in the rest of this weeks’ activities will be to evaluate how the academic issues about decision theory may affect our approach to how best to ensure that strategic and operational decisions within a business context are ‘optimal’. This will feed naturally into our introduction of ‘decision-support tools and techniques’ which constitute the focus of Week’s 3 – 7 of this module.

The question for our further investigation is:

Is decision-making within organisations (corporate enterprise, SME’s, governmental departments, . . .) “rational” (in the sense of “maximising expected utility”, as introduced above)?

There are two different aspects to the question addressed here: the first concerns whether organisational (group) decision-making can ever be “rational”; the second concerns the most appropriate means / procedures to adopt to ensure that group decision-making may optimise the decisions taken.

To do so, we will focus upon two readings which form the basis for the remaining activities for this week. The readings are supplemented by some references to well-known (group) strategic decision-making procedures.

Structured Procedures for Group Decision-Making.

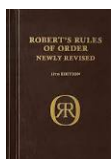
Perhaps the oldest and best-known structured set of procedures for group decision making is Robert's Rules of Order³ – first published in 1876 and now into its 11th edition as a manual for the conduct of meetings. It was originally intended as a guide to parliamentary procedure (actually the US Congress), but it came to be used widely for the conduct of almost any formal meeting (in organisations, clubs, societies, businesses) which has a Chairperson, a prepared Agenda, and members eligible to propose motions and vote on actions to take. A brief outline of the basics of 'Robert's Rules' is available from [here](http://www.robertsrules.org/rulesintro.htm) (<http://www.robertsrules.org/rulesintro.htm> , Accessed: 14/07/2013)

In more recent times, some commentators (see, for example, Atlee, T., and Zubizarreta, R., at [The Co-Intelligence Institute](#), (Accessed: 17/07/2013)) have been critical of the excessive formality of Robert's Rules for group decision-making in business and their lack of attention to group dynamics and conflict resolution. Alternative procedures for structured group decision-making have been put forward - ranging from consensus-based to "Delphi" methods. The following table provides core references for some of these alternative approaches:

Consensus Based Methods	Hartnett, T., (2011), " <i>Consensus-Oriented Decision-Making: The CODM Model for Facilitating Groups to Widespread Agreement</i> " (See reference at: http://www.consensusbook.com/ (Accessed: 20/07/2013). Society of Friends (Quaker) approaches to consensus-based decision-making: (See references at Wikipedia / Consensus Decision-Making , (Accessed: 15/05/2013).
Delphi Voting Methods	Green K.C., J. Scott Armstrong, J. S., and Andreas Graefe, A., (2007), " <i>Methods to Elicit Forecasts from Groups: Delphi and Prediction Markets Compared</i> ", at http://mpra.ub.uni-muenchen.de/4999/ , MPRA Paper No. 4999, (PDF format, Accessed: 23/07/2013). Mike Travis, <i>Introduction to the Delphi Method</i> (1), http://www.youtube.com/watch?v=FFfKOSTftcs (Accessed: 20/07/2013)

A more radical proposed answer to the question whether decision-making in organisations can be "rational" in the senses defined above is to deny that organisational (strategic) decision-making is ever entirely rational. A reference from the core text for this module discusses this possibility:

Brunsson, N., (1982, in Salaman (ed.), 2002), "*The Irrationality of Action and Action Rationality: Decisions, Ideologies, and Organisational Actions*", (orig.



³ Brig. Gen. H. M. Robert, (1876), "Robert's Rules of Order", Da Capo Press – 11th edition, 2011.

Journal of Management Studies, 19, 1, also in Salaman, G., (2002), pp. 108 – 116).

Activity 3:

Review the criticisms of “Robert’s Rules” from the sources cited. Evaluate and illustrate from your own experience of meetings you have attended how effective it is to adhere to these formal mechanisms of proposing motions, requiring that they be seconded, debating the motion and conducting a formal vote.

Both Delphi and consensus-based procedures for group decision-making also require procedural rules. Argue whether these may overcome the limitations of Robert’s Rules. Try to make your discussion balanced by considering both the benefits and limitations of these structured methods.

Use the online discussion forum to invite others to assess your arguments and counterarguments, also to evaluate and comment upon others’ interpretations of how well or badly consensus-based or Delphi methods may contribute to effective group decision-making.

Guidance

You should give thought to the reasons for procedural rules in group decision-making. You may also wish to consider whether the strengths / weaknesses of each ‘system’ of rules arise from the context of the meeting (who the group are, what the meeting’s purpose is) and/or from how the rules are applied. Look at others’ examples of meetings which have / have not been effective in reaching an optimal decision – in the online forum posts. To what extent are these similar to or different from your own experience of formally structured group meetings?

Purpose

The main purpose of this activity is to evaluate procedural rule-based systems for making group decision-making meetings effective, whilst minimising conflict and ‘dominance’ within responsible groups.

Summary of Week 2 Activities

Activity 1: Consider the implications of one of three well-known “paradoxes” of rational decision theory. Evaluate the potential risk to “maximising expected utility” to which the paradox gives rise. (See Reading).

Activity 2: Identify and explain the typical differences between individual and group decision-making and problems which may arise for the latter.

Activity 3: Read and post examples, based on the references provided, relevant to structured procedures for group decision-making. (2 hours)

References used:

Bernoulli, D., (1738), “*Specimen theoriae novae de mensura sortis*”, English translation in Bernoulli, D. (1954). “*Exposition of a New Theory on the Measurement of Risk*” (PDF). *Econometrica* 22 (1): 23–36. JSTOR 1909829

Brunsson, N., (1982, in Salaman (ed.), 2002), "*The Irrationality of Action and Action Rationality: Decisions, Ideologies, and Organisational Actions*", (orig. Journal of Management Studies, 19, 1, also in Salaman, G., (2002), pp. 108 – 116).

Campbell, R., Sowden, L., (1985), "*Paradoxes of Rationality and Cooperation: Prisoner's Dilemma and Newcomb's Problem*" : Univ. of British Columbia Press
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Green K.C., J. Scott Armstrong, J. S., and Andreas Graefe, A., (2007), "*Methods to Elicit Forecasts from Groups: Delphi and Prediction Markets Compared*", at <http://mpa.ub.uni-muenchen.de/4999/> , MPRA Paper No. 499

Hartnett, T., (2011), "*Consensus-Oriented Decision-Making: The CODM Model for Facilitating Groups to Widespread Agreement*" (See reference at: <http://www.consensusbook.com/> (Accessed: 20/07/2013)).

Janis, Irving L., "A Perfect Failure: the Bay of Pigs", in (ed.) Salaman, G., (2008) "*Decision Making for Business: A Reader*", (repr. 2008), Open University, Sage Publications, Chapter 1, pp. 9 – 39, London: ISBN 978-0-7619-7411.

LessWrong Wiki: http://wiki.lesswrong.com/wiki/Newcomb%27s_problem
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Rapoport, A., Kugler, T., Dugar, S., Gisches, E. J., "Choice of routes in congested traffic networks: Experimental tests of the Braess Paradox", *Games and Economic Behavior* 65 (2009) 538–571

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Whyte, G., (1989), "*Groupthink Reconsidered*", Academy of Management Review, 14, No. 1, pp. 40 – 56.

Wikipedia / Braess' Paradox, http://en.wikipedia.org/wiki/Braess%27s_paradox
(Accessed: 22/07/2013).