

Tutorial Week 5: Rational Decision Making

Guidelines

You may discuss the content of the questions with your classmates. But everyone should work on and be ready to present ALL the solutions.

Problem 1: Allais Paradox

The Allais paradox (Allais, 1953) is a well-known problem potentially suggesting that humans are “predictably irrational” (Ariely, 2009)¹. People are given a choice between lotteries A and B and then between C and D, which have the following prizes:

A: 80% chance of \$4000 C: 20% chance of \$4000
B: 100% chance of \$3000 D: 25% chance of \$3000

Most people consistently prefer B over A (i.e., taking the sure payoff), and C over D (taking the higher EMV).

- Show that the normative analysis (i.e., describing how a rational agent should act) disagrees. [Hint: Set $U(\$0) = 0$; show that the preferences between A, B and C, D are opposites, hence a contradiction.]
- Prove that the judgments $B \succ A$ and $C \succ D$ in the above Allais paradox violate the axiom of substitutability. [Hint: You may wish to consider using the axiom of decomposability.]

Problem 2: Preference Modelling

Alex is given the choice between two games:

- **Game 1:** a fair coin is flipped and if it comes up heads, Alex receives \$100. If the coin comes up tails, Alex receives nothing.

¹For a possible explanation of such a paradox, refer to page 620 of AIMA textbook.

- **Game 2:** a fair coin is flipped twice. Each time the coin comes up heads, Alex receives \$50, and Alex receives nothing for each coin flip that comes up tails.

Alex prefers Game 2 to Game 1. Argue that Alex would prefer to receive \$50 compared to being allowed to participate in Game 1.

Problem 3: Basic Risky Decision

Richie Bean is trying to strike it big in the stock market during the economic downturn. He is considering buying some options to a very risky stock on a diamond mine in Africa. There is only a 10% chance that the stock price will rise if he exercises his options, but the payoff is \$200,000. It costs \$10,000 to buy and exercise the options. The alternative is not to buy at all, in which case Mr. Bean's profit is zero.

- a. Draw an influence diagram to represent Mr. Bean's problem. Clearly indicate all the options/outcomes and numbers. Should he buy the options? Use the solution approaches mentioned in the lecture to substantiate your answer.
 - b. Draw a decision tree to represent Mr. Bean's problem. Clearly indicate all the options/outcomes and numbers. Should he buy the options? Show all the details in your decision tree.
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