Week 1(b)

Previously seen terms

Expected value of an outcome = $p_A A + p_B B + p_C C$

Utility function = mathematical representation of a consumer's preferences

If $U(A) > U(B)$, then consumer likes A better than B.

Utility values represent rank orderings only.

Example:

$U_1(A) = 5$ and $U_1(B) = 1$

AND

$U_2(A) = 25$ and $U_2(B) = 1$

Both functions tell us that the consumer likes A better than B.

These utility functions represent the same preferences because they generate the same ranking.

St. Peters Paradox

The Saint Petersburg paradox, is a theoretical game used in economics, to represent a classical example were, by taking into account only the expected value as the only decision criterion, the decision maker will be misguided into an irrational decision.

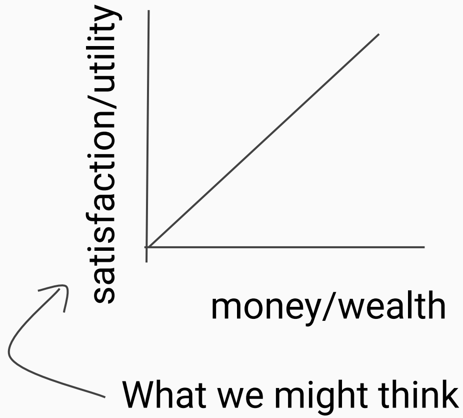
EXAMPLE -> consider a coin flip game where the game starts with a fixed fee and ends at tails with 2^n money in prize

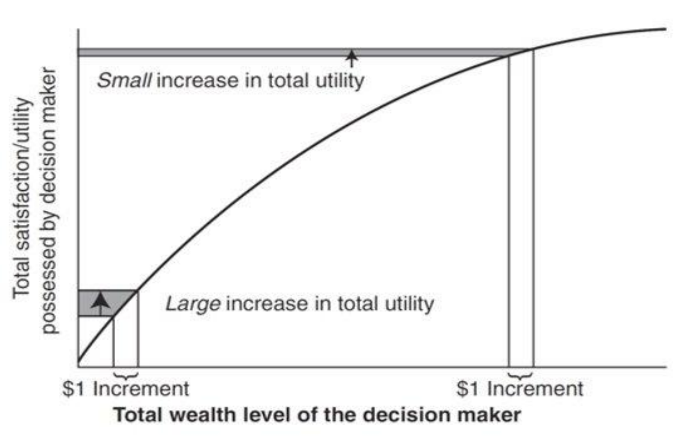
Expected Value = 2*0.5+4*0.25+8*0.125+... =1+1+1...=infinity

HOW MUCH WOULD YOU BE WILLING TO PAY?

St. peters Paradox

Diminishing marginal utility - more the money you have less is the change in utility.





Bernoulli's solution

Assuming the marginal utility declines with increase in wealth, the St. petersburg game may converge to a finity expected utility that the player would be willing to pay to play the game.

As a result of diminishing marginal utility , it is then possible that a game's expected utility value will be less than it's monetary expected value.

Expected Utility Value

If:

- Outcome A occurs with probability p_A
- Outcome B occurs with probability p_B
- Outcome C occurs with probability p_C

Then:

A consumer's expected utility from these outcomes is defined as:

$$EU = p_A U(A) + p_B U(B) + p_C U(C)$$

<u>Gamble #1:</u>
20% chance of winning \$4000
80% chance of winning \$0

<u>Gamble #2:</u>
25% chance of \$3000
75% chance of \$0

Suppose consumer's utility of money is $U(X) = \sqrt{X}$.

Expected utility of Gamble #1 =

$$0.20\sqrt{4000} + 0.80(0) = 12.65$$

Expected utility of Gamble #2 =

$$0.25\sqrt{3000} + 0.80(0) = 13.69$$

Kinds of decision making model

Normative model - The normative theory of decision making is a prescriptive approach that aims to determine the rational or optimal decision-making process. It provides guidelines or norms for decision-making in order to achieve the best possible outcome based on rationality and logical reasoning. Normative theories suggest how individuals or decision-makers should make choices by considering factors such as utility, probabilities, risks, and trade-offs.

Descriptive model - It tells how people actually make decision….OR….The descriptive model of decision making aims to describe how individuals or groups actually make decisions, rather than prescribing how they should make decisions as in normative theories. It seeks to understand and explain the cognitive processes, biases, heuristics, and environmental factors that influence decision-making behavior.

Kinds of decision making model

As-If model - In this individual's behaviour or choices can be modelled "as-if" they have certain utilities and probabilities and maximize expected utility…..OR…….The "as-if" model assumes that individuals may not have complete information or possess unlimited cognitive capacities, and they may be subject to various biases and heuristics. However, despite these limitations, their behavior can be explained or predicted by assuming that they are attempting to maximize their expected utility or make rational decisions based on available information.

Process Model - tells us how the agent actually carries out these computations….OR….The process model of decision making focuses on understanding the cognitive and behavioral processes that individuals go through when making decisions. It aims to describe and explain the step-by-step sequence of activities and mental processes that occur during decision making.

Allais Paradox

Maurice Allais(nobel prize winner) published a paper that contradicts the expected utility theory through many experiments he conducted.

EXAMPLE ->

- **First set of gambles (lotteries)**
- Gamble A: (1.0)$1 million
- Gamble B: (.10)$5 million + (.89)$1 million + (.01)$0

- **Second set**
- Gamble C: (.11)$1 million + (.89)$0
- Gamble D: (.10)$5 million + (.90)$0

Looking at the choices....

- What are the expected values of A and B?

$$E(V_A) = 1.0 \times \$1m = \$1m$$
$$E(V_B) = .10 \times \$5m + .89 \times \$1m + 0.01 \times \$0 = \$1.39m$$

- If someone chooses A over B, they are presumably maximizing expected utility, not expected value.

- What are the expected values of C and D?

$$E(V_C) = 0.11 \times \$1m + 0.89 \times \$0 = \$110{,}000$$
$$E(V_D) = .10 \times \$5m + 0.90 \times \$0 = \$500{,}000$$

- If someone chooses D over C, they are presumably maximizing expected value.
- If you chose A over B and D over C, you are violating expected utility theory.

Re-arranging the gamble

IT'S THE SAME THING!!!

- **First set of gambles (lotteries)**
- Gamble A: (.11)$1m + (.89) $1m
- Gamble B: (.10)$5m + (.01)$0 + (.89)$1m

- **Second set**
- Gamble C: (.11)$1m + (.89)$0
- Gamble D: (.10)$5m + (.01)$0 + (.89)$0

Why the paradox?

The Allais paradox demonstrates that individuals' choices deviate from the predictions of expected utility theory and highlights the influence of factors such as risk aversion, loss aversion, and the way options are presented or framed.