Making Choices about Risk

When does a situation involve risk?

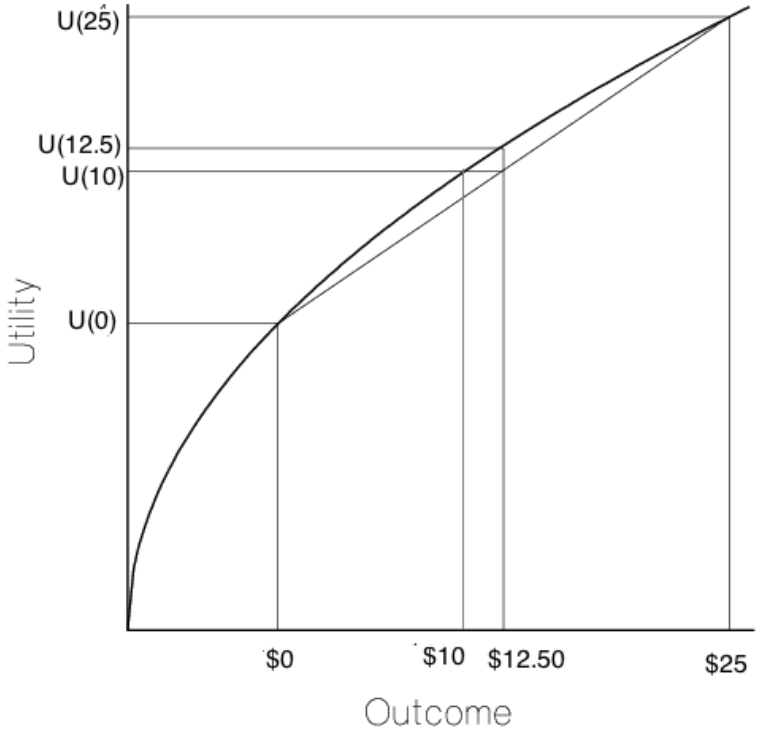
- When there are different potential outcomes that occur with known probability.
  - Should I buy a million dollar lottery ticket for $5 if I know that the probability that I win is 1/10,000?
  - Should the government invest in constructing new levees to prevent flooding knowing that a flood will occur with a probability of 15%?

Intuitively, we are risk averse if we are willing to take less than the expected payoff from a gamble to avoid the risk associated with gambling. From the question on the midterm, the expected payoff of the coin-flip was 12.50, but I was indifferent between gambling or taking $10. In this case, I was willing to take less than the expected payoff from gambling → I am risk averse. If I was indifferent between taking 12.50 or gambling, I am risk neutral. If I would rather take my chances (hoping I get $25) than take 12.50 I would be considered a risk lover.

Analytically, if I am indifferent between taking $10 and taking the gamble (coin flip), this implies that

$$U(10) = 0.5U(0) + 0.5U(25)$$

This is represented graphically as



Any point along the straight line connecting the two potential payoffs is our expected utility from gambling. If there are two potential outcomes w1 and w2 that occur with probabilities p1 and p2, our expected utility is given as

$EU = p_1u(w_1) + p_2u(w_2)$

The utility of the expected payoff if just the utility we get from receiving the expected payoff from the gamble for certain.

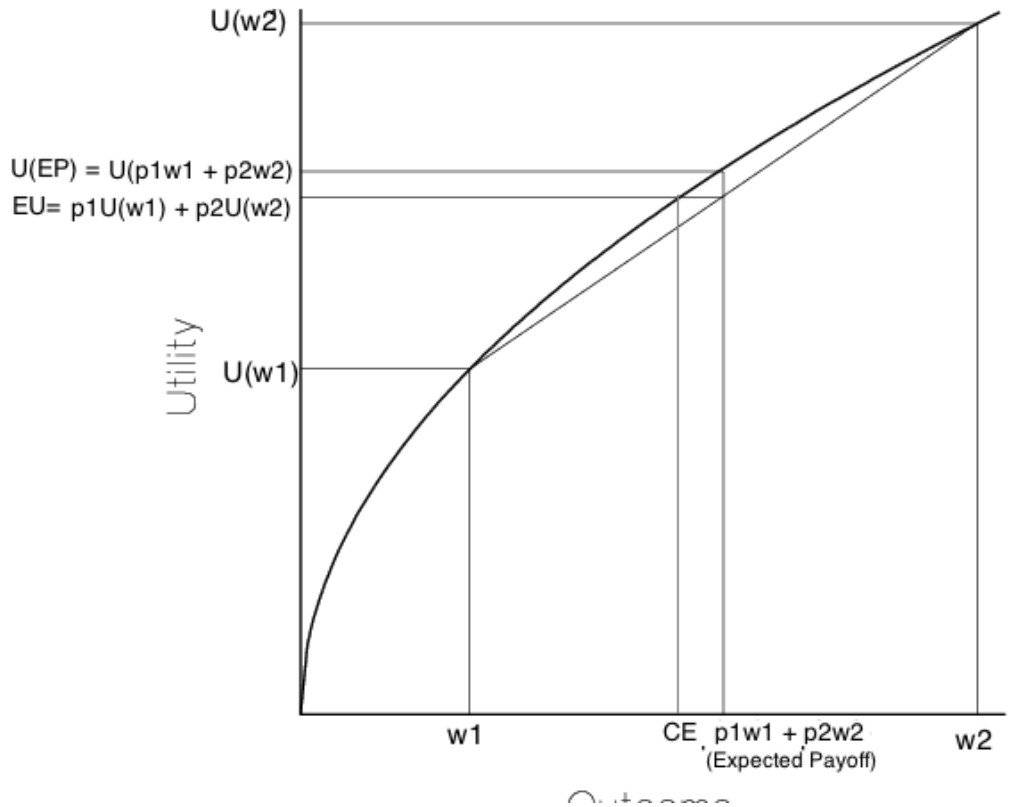
$U(EP) = U(p_1w_1 + p_2w_2)$

If EU>U(EP) → Risk Loving

If EU<U(EP) → Risk Averse

If EU = U(EP) → Risk neutral

Our attitude towards risk depends on the form of our utility function. In the graph below, U(EP) > EU, which implies that we are risk averse.



We can think of our decision about whether or not we would like to gamble in terms of a certainty equivalent. The **certainty equivalent** is the minimum amount of money you are willing to accept to avoid gambling. If this amount is less than the expected payoff of the gamble, you are considered risk averse. If your certainty equivalent is equal to the expected payoff of the gamble, you are considered risk neutral. In the above example (from the midterm), my certainty equivalent is $10. This is where I am indifferent between gambling and taking a sure thing.

$$\mathbf{U(CE) = EU}$$

Problem 1) Suppose we are only concerned with the amount of money we have, w. Our utility function u(w) measures our satisfaction at different levels of wealth. If there are two potential outcomes w1 and w2 that occur with probabilities p1 and p2, what would our utility function look like? Label our expected utility of the gamble and our utility of the expected payoff. Label the certainty equivalent.