Chapter 5

Uncertainty and Consumer Behavior

Q: Value of Stock

- Investment in offshore drilling exploration:
- Two outcomes are possible
  - (   ) – the stock price increases from \$30 to \$40/share. (Probability of success = 25 %)
  - (   ) – the stock price falls from \$30 to \$20/share. (Probability of failure = 75 %)

Expected Value

$$EV = \Pr(\text{success})(\text{value of success}) + \Pr(\text{failure})(\text{value of failure})$$

$$EV = 1/4(\$40/\text{share}) + 3/4(\$20/\text{share})$$

$$EV = \$25/\text{share}$$

Expected Value

- In general, for n possible outcomes:
  - Possible outcomes having payoffs X_1, X_2, … X_n
  - Probabilities of each outcome is given by Pr_1, Pr_2, … Pr_n

$$E(X) = Pr_1 X_1 + Pr_2 X_2 + \ldots + Pr_n X_n$$

Describing Risk

- (   )
  - The extent to which possible outcomes of an uncertain event may differ
  - How much variation exists in the possible choice

Q: Which Job?

- Suppose you are choosing between two part-time sales jobs that have the same expected income (\$1,500)
  - The first job is based entirely on commission.
  - The second is a (almost) salaried position.
  - The third is a salaried position.

Variability

- There are two equally likely outcomes in the first job--$2,000 for a good sales job and $1,000 for a modestly successful one.
- The second pays $1,510 most of the time (.99 probability), but you will earn $510 if the company goes out of business (.01 probability).
- The third pays $1,500.

Variability

	Outcome 1		Outcome 2	
	Prob.	**Income**	**Prob.**	**Income**
Job 1: Commission	.5	2000	.5	1000
Job 2: Fixed Salary	.99	1510	.01	510

Variability

- ( )
- EV_1 = ½ $2,000 + ½ $1,000 = $1,500
- EV_2 = (0.99)$1,510+(0.01)$510 = $1,500
- EV_3 = $1,500

Variability

- Greater variability from expected values signals greater risk.
- Variability comes from ( ) in payoffs
  - Difference between expected payoff and actual payoff

Variability – An Example

Deviations from Expected Income ($)

	Outcome 1	Deviation	Outcome 2	Deviation
Job 1	$2000	$500	$1000	-$500
Job 2	1510	10	510	-990

Variability

- We can measure variability with standard deviation

Variability

- The ( ) is written:

$$\sigma = \sqrt{\Pr_1\left[X_1 - E(X)\right]^2 + \Pr_2\left[X_2 - E(X)\right]^2}$$

Standard Deviation – Example

- Standard deviations of the two jobs are:

$$\sigma = \sqrt{\Pr_1\left[X_1 - E(X)\right]^2 + \Pr_2\left[X_2 - E(X)\right]^2}$$

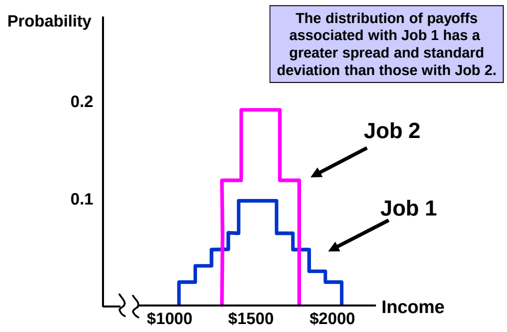
$$\sigma_1 = \sqrt{0.5(\$250{,}000) + 0.5(\$250{,}000)}$$
$$\sigma_1 = \sqrt{250{,}000} = 500$$

$$\sigma_2 = \sqrt{0.99(\$100) + 0.01(\$980{,}100)}$$
$$\sigma_2 = \sqrt{9{,}900} = 99.50$$

Q: Revised

- What if the outcome probabilities of two jobs have unequal probability of outcomes
  - Job 1: greater spread & standard deviation
  - You will choose job 2 again

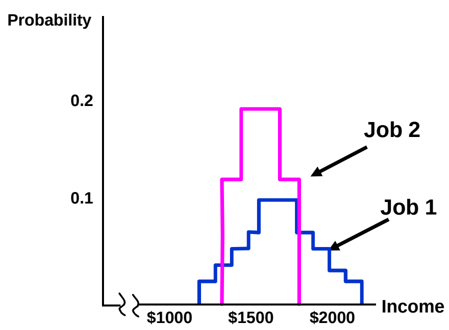
Unequal Probability Outcomes



Q: Re-Revised

- Suppose we add $200 to each payoff in Job 1 which makes the expected payoff = $1700.
  - Job 1: expected income of $1,700 and a standard deviation of $500.
  - Job 2: expected income of $1,500 and a standard deviation of $99.50

Unequal Probability Outcomes



St. Petersburg Paradox

- Game: Toss a coin
- Payoff:
  - If H at the 1st toss: $2^1 = 2$
  - If H at the 2nd toss: $2^2 = 4$
  - …
  - If H at the nth toss: 2^n
- The fee for the game: 10
- What is the EV of the game?

Preferences Toward Risk

- Can expand evaluation of risky alternative by considering utility that is obtained by risk
  - A consumer gets utility from income
  - Payoff measured in terms of utility

Example

- A person is earning $15,000 and receiving 13.5 units of utility from the job.
- She is considering a new, but risky job.
  - 0.50 chance of $30,000
  - 0.50 chance of $10,000

Example

- Utility at $30,000 is 18
- Utility at $10,000 is 10
- Must compare utility from the risky job with current utility of 13.5
- To evaluate the new job, we must calculate the (   ) of the risky job

Preferences Toward Risk

- The (   ) of the risky option is the sum of the utilities associated with all her possible incomes weighted by the probability that each income will occur.

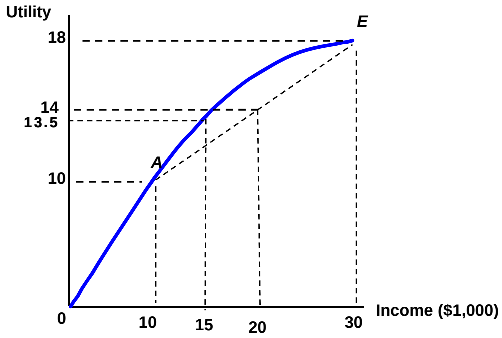
E(u) = (Prob. of Utility 1) *(Utility 1)
+ (Prob. of Utility 2)*(Utility 2)

Example

- The Expected Utilility is:

  E(u) = (1/2)u($10,000) + (1/2)u($30,000)
  = 0.5(10) + 0.5(18)
  = 14
  - E(u) of new job is 14 which is greater than the current utility of 13.5 and therefore preferred.

Example



Example 2

- Game: Toss a fair coin
- Game 1
  - H: +$100 T: -$0.5
- Game 2
  - H: +$200 T: -$100
- Game 3
  - H: +$20,000 T: -$10,000

Expected Values

- EV_1 = (1/2)$100 + (1/2)(-$0.5) = $49.75
- EV_2 = (1/2)$200 + (1/2)(-$100) = $50
- EV_3 = (1/2)$20,000 + (1/2)(-$10,000)
  = $5,000

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Expected Utility

- Suppose $U(M) = M^{1/2}$, M = $10,000
- $U(M) = 10{,}000^{1/2} = 100$
- $EU_1 = (1/2)\ 10{,}100^{1/2} + (1/2)\ 9{,}999.5^{1/2}$
  = 100.248
- $EU_2 = (1/2)\ 10{,}200^{1/2} + (1/2)\ 9{,}900^{1/2}$
  = 100.247
- $EU_3 = (1/2)\ 30{,}000^{1/2} + (1/2)\ 0^{1/2}$
  = 86.603

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Example 3

- Q: Your utility function is $U(M) = M^{1/2}$ and your initial wealth is 36. Will you play a gamble in which you win 13 with probability of ½ and lose 11 with probability of ½ ?
  - $U(M) = 36^{0.5} = 6$
  - EV = ½ (36+13) + ½ (36-11) = 37
  - EU = ½ $(36+13)^{0.5}$ + ½ $(36–11)^{0.5}$
    = ½ 7 + ½ 5 = 6

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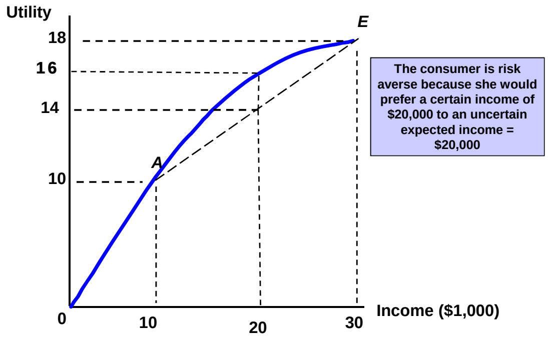
Preferences Toward Risk

- ( )
  - A person who prefers a certain given income to a risky income with the same expected value.
  - The person has a diminishing marginal utility of income
  - Most common attitude towards risk

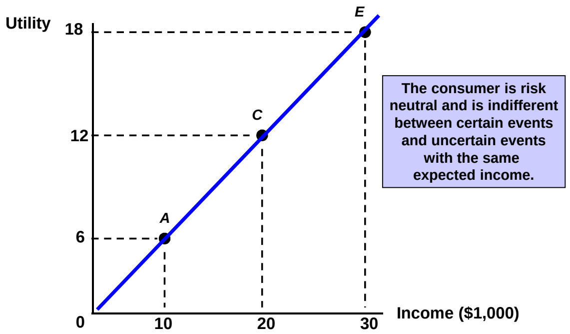
Risk Averse



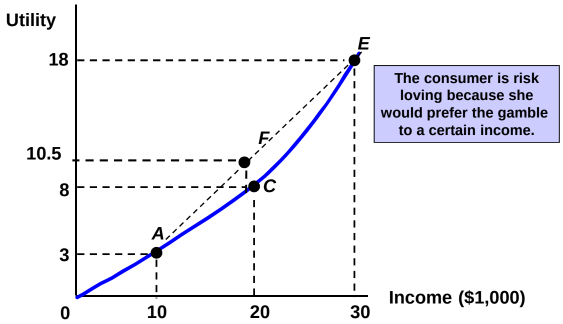
Preferences Toward Risk

- A person is said to be ( ) if they show no preference between a certain income, and an uncertain income with the same expected value.
- Constant marginal utility of income

Risk Neutral



Risk Loving



Preferences Toward Risk

- The ( ) is the maximum amount of money that a risk-averse person would pay to avoid taking a risk.
- The risk premium depends on the risky alternatives the person faces.

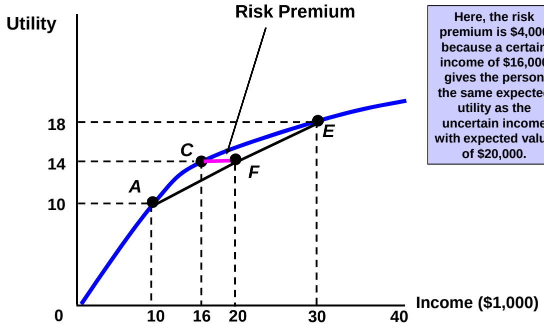
Risk Premium – Example

- From the previous example
  - A person has a .5 probability of earning $30,000 and a .5 probability of earning $10,000
  - The expected income is $20,000 with expected utility of 14.

Risk Premium – Example

- Point F shows the risky scenario – the utility of 14 can also be obtained with certain income of $16,000
- This person would be willing to pay up to $4000 (20 – 16) to avoid the risk of uncertain income.

Risk Premium – Example



Here, the risk premium is $4,000 because a certain income of $16,000 gives the person the same expected utility as the uncertain income with expected value of $20,000.

Reducing Risk

- Consumers are generally risk averse and therefore want to reduce risk
- Three ways consumers attempt to reduce risk are:
  1. (   )
  2. (   )
  3. (   )