Econ 100A: Intermediate Microeconomic Analysis
Lecture 8

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Plan of Today's Lecture

- Describing Risk
  - Outcomes & their probabilities
    - Objective & subjective probabilities
  - Expected Value & Standard Deviation
- Preferences towards risk – graphical analysis
  - Risk averse
  - Risk neutral (will accept fair bets)
  - Risk loving
- Price of the risk: Risk premium
- How to reduce risk:
  - Diversification
  - Insurance
  - Search (and purchase) of information
- Risk-return trade-off (We skipped technical details)
- Behavioral economics

Certainty versus Uncertainty

- Choice with certainty is reasonably straightforward
- How do we make choices when certain variables (income or / and prices) are uncertain?
  - How to make choices when risk is present?
  - How to measure risk?
  - How do we describe risk?
- We must know: outcomes (mutually exclusive and exhaustive)
  - All of the possible outcomes
  - The **probability** (or likelihood) with which each outcome occurs. Probabilities should add up to 100%
- Probability estimates:
  - Subjective - perception that a certain outcome occurs (a feeling)
  - Objective – relies on frequency with which certain events tend to occur
- 2 measures to help describe and compare risky choices:
  1. Expected Value
  2. Variability (characterized by standard deviation)

Expected Value, M., p. 155

- **Expected Value**
  - The probability-weighted average of the payoffs or values resulting from all possible outcomes
    - Expected value measures the central tendency; i.e., the payoff or value expected on average
- 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

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

Variability, M., p. 155

- Even if expected values are equal, the variability can differ
- Variability comes from **deviations** in payoffs
  - Difference between expected payoff and actual payoff
- Greater variability from expected values signals greater risk
- **Standard deviation** is a measure of variability

Example: two jobs differing by expected incomes & standard deviations

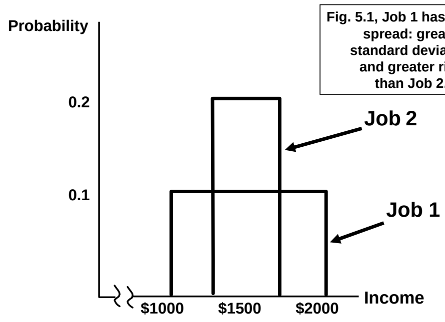


Fig. 5.1, Job 1 has greater spread: greater standard deviation and greater risk than Job 2.

Measure of Risk: **Standard Deviation**

- **Standard deviation** is equal to the square root of the average of the squares of the deviations of the payoffs associated with each outcome from their expected value
- **Standard deviation** is a measure of risk
  - Measures how variable your payoff will be
  - More variability means more risk
  - Individuals generally prefer less variability – less risk

Expected Value and Standard Deviation (Formally)

- 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

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

- The standard deviation is written:

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

Risk and Crime Deterrence

- Attitudes toward risk affect willingness to break the law
- Suppose a city wants to deter people from double parking
- What would be a better deterrent: monetary fines or jail time?
- Fines & expected penalty: The goal to deter double parking
  - If benefit of double parking is $5, than fine has to exceed $5)
  - If not every violator is caught, but only one out of 10? Then, fine has to exceed $50

Tomkat's promotional event

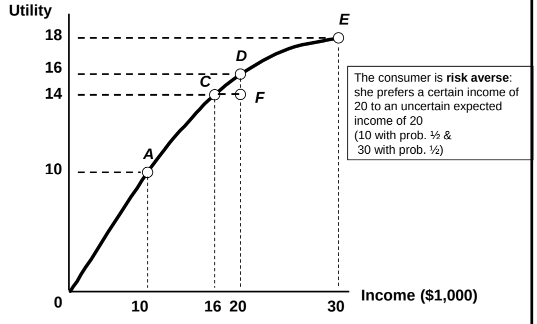
- Expenses on Band: 5, Probabilities: sun & rain ½
- Tomkat's **net gains (expected profit)**
- First option: I: Outdoors
  - If Sun & If Rain $X_1 = 15$ & $X_2 = -5$
- Q: how much Tomkat will earn if he has perfect weather forecast? 7.50 ➔ for this example, the value of perfect information is 2.50
  - Because with perfect information, then if Sun outdoors, if rain indoors (or could cancel the event if bad weather)
- Second option: II: Indoors
  - Sun & Rain: $X_1 = 10$ & $X_2 = 0$
- I: EV=5, Var=100=$1/2(15-5)^2 + 1/2(-5-5)^2$, STD=10
- II: EV=5, Var=25=$1/2(10-5)^2 + 1/2(0-5)^2$, STD=5
- **Fair bet** is a gamble with zero expected value:

EV(fair bet) = 0

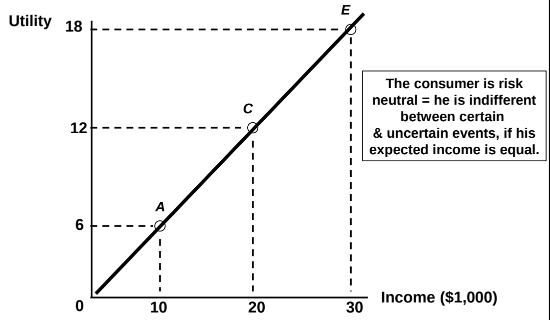
Preferences Toward Risk

- Risk Averse
  - 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
  - This is the most common attitude towards risk
    - Ex: Market for insurance exists because people are risk averse
- Risk Neutral
  - A person who shows no preference between a certain income, and an uncertain income with the same expected value
  - Constant marginal utility of income
- Risk Loving
  - A person who shows a preference toward an uncertain income over a certain income with the same expected value
  - Increasing marginal utility of income
    - Examples: Gambling, some criminal activities

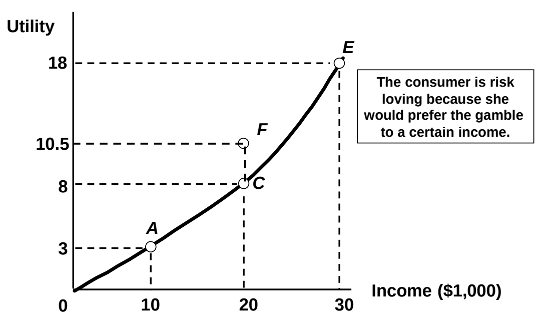
Risk Averse Utility Function



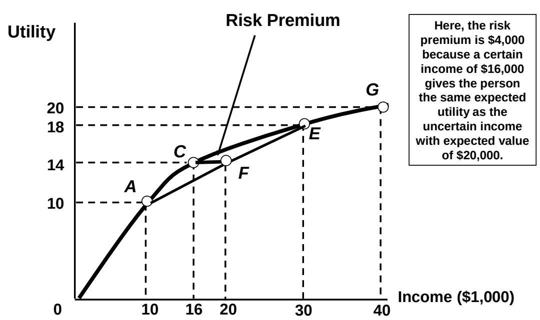
Risk Neutral Utility Function



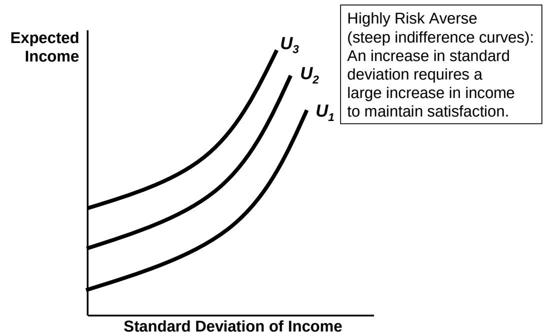
Risk Loving Utility Function



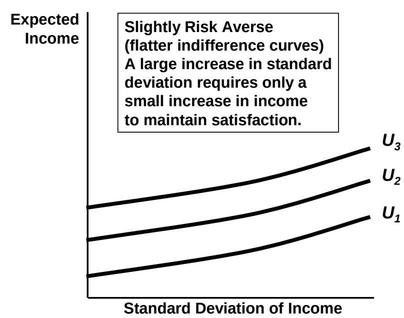
Risk Premium – an Example



Indifference Curves of a Highly Risk Averse



Indifference Curves of a Slightly Risk Averse



Reducing Risk via (1. Diversification)

- Diversification
  - Reducing risk by allocating resources to a variety of activities whose outcomes are not closely related
- Example: a firm has a choice of selling heaters, air conditioners or both. How to decide what to produce & sell?

	Hot Weather (Prob. ½)	Cold Weather (Prob. ½)
Air conditioner sales	$30,000	$12,000
Heater sales	12,000	30,000

How to Diversify Using The Stock Market

- If invest all money in one stock, then take on a lot of risk
  - If that stock loses value, you lose all your investment value
- Can spread risk out by investing in many different stocks or investments
  - Ex: Mutual funds

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Reducing Risk via (2. Insurance)

- Insurance is actuarially fair when it is a fair bet (for the definition of a fair bet, see slide 10)
- Risk averse are willing to pay to avoid risk
- If the cost of insurance equals the expected loss (actuarially fair insurance), risk averse people will buy enough insurance to recover fully from a potential financial loss
- The law of large numbers:
- Insurance companies know that although single events are random and largely unpredictable, the average outcome of many similar events can be predicted
- When insurance companies sell many policies, they face relatively little risk.
  - Insurance companies can be sure total premiums paid will equal total money paid out
  - Companies set the premiums so money received will be enough to pay *expected* losses

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Reducing Risk via (3. Information Acquisition)

- How information helps to reduce risk?
- Risk often exists because we don't know all the information surrounding a decision
- Because of this, information is valuable and people are willing to pay for it
- How to price (value) information?
- The value of *complete* information
  - The difference between the expected value of a choice with complete information and the expected value when information is incomplete (see slide 10 for an example)

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Behavioral Economics

- Objective and subjective probabilities
- Some psychological puzzles:
  - How come that people buy travel insurance (i. e., risk averse), and then head to Las-Vegas (i.e., risk loving)?
  - Reference points:
    - If one owns a good, he values it higher than if he does not.
  - Fairness:
    - If the good is discounted, price increases feel OK, but if the list price increases, consumers could be outraged (also related to the reference point puzzle)

Summary of Today & Plan of Next Lecture

- Ch. 5 Certainly we are living with uncertainty
- Today we covered risk attitudes
  - Risk averse
  - Risk neutral
  - Risk loving
- Risk Premium
- Reducing Risk (if risk averse ➔ want to pay to reduce risk) via:
  - Diversification
  - Insurance
  - Search (and purchase) of information
- Risk return tradeoff (if more risk ➔ risk-averse individual needs a higher return (to achieve equal utility level)
- Behavioral economics [or how subjective the human choices are!] uses insights from psychology to explain consumer choices
- Next Lecture: We will start Chapter 6 (supply side)
- Have a Nice Day