Risks in Mainstream Economics

Main Resource:

Ch.5 of Microeconomics by Pindyck&Rubinfeld (Microeconomics)

Outline

1. Describing Risk
2. Preferences Toward Risk
3. Reducing Risk
4. Risky Assets

1 DESCRIBING RISK

Risk

- In broad terms, **risk** involves exposure to some type of danger and the possibility of loss or injury.
- In finance and investing, **risk** often refers to the chance an outcome or investment's actual gains will differ from an expected outcome or return.
- In finance, standard deviation is a common metric associated with risk.
- To describe risk quantitatively, we begin by listing all the possible outcomes of a particular action or event, as well as the likelihood that each outcome will occur

TABLE 5.1 Income from Sales Jobs

	OUTCOME 1		OUTCOME 2		Expected Income ($)
	Probability	Income ($)	Probability	Income ($)	
Job 1: Commission	.5	2000	.5	1000	1500
Job 2: Fixed Salary	.99	1510	.01	510	1500

1 DESCRIBING RISK

Probability

- **probability** Likelihood that a given outcome will occur.

Subjective probability is the perception that an outcome will occur.

Expected Value

- **expected value** Probability-weighted average of the payoffs associated with all possible outcomes.
- **payoff** Value associated with a possible outcome.

The ***expected value*** measures the *central tendency*—the payoff or value that we would expect on average.

$$\begin{aligned}\text{Expected value} &= \Pr(\text{success})(\$40/\text{share}) + \Pr(\text{failure})(\$20/\text{share}) \\ &= (1/4)(\$40/\text{share}) + (3/4)(\$20/\text{share}) = \$25/\text{share}\end{aligned}$$

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

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

Variability

- **variability** Extent to which possible outcomes of an uncertain event differ.

TABLE 5.1 Income from Sales Jobs

	OUTCOME 1		OUTCOME 2		Expected Income ($)
	Probability	Income ($)	Probability	Income ($)	
Job 1: Commission	.5	2000	.5	1000	1500
Job 2: Fixed Salary	.99	1510	.01	510	1500

- **deviation** Difference between expected payoff and actual payoff.

TABLE 5.2 Deviations from Expected Income ($)

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

Standard Deviation

- Standard deviation is a popular measure of variability or risk.
- **Standard Deviation** Square root of the weighted average of the squares of the deviations of the payoffs associated with each outcome from their expected values.
- Formula of standard deviation (σ) is

$$\sigma = \sqrt{\sum_{i=1}^{N} P(X_i)(X_i - E(X))^2}$$

- The higher the value of standard deviation, the higher the variability or risk.

Variability

Table 5.3 Calculating Variance ($)

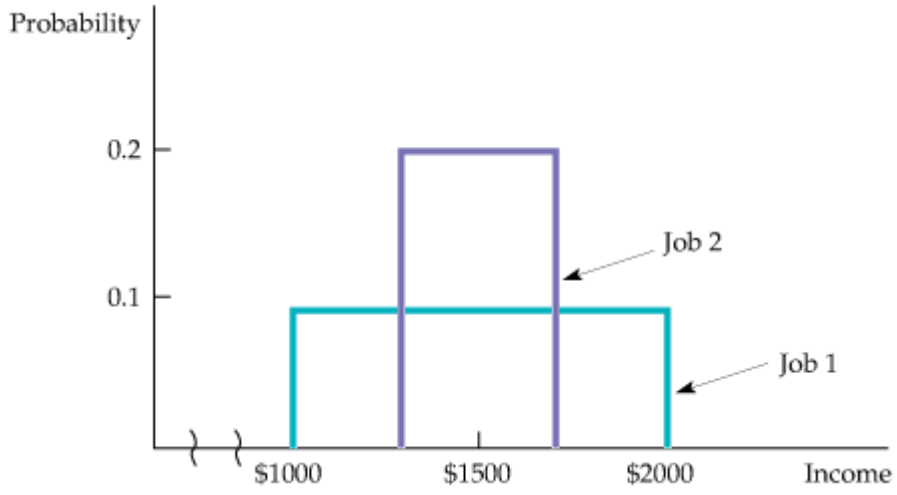
	Outcome 1	Deviation Squared	Outcome 2	Deviation Squared	Weighted Average Deviation Squared	Standard Deviation
Job 1	2000	250,000	1000	250,000	250,000	500
Job 2	1510	100	510	980,100	9900	99.5

Figure 5.1

Outcome Probabilities for Two Jobs

The distribution of payoffs associated with Job 1 has a greater spread and a greater standard deviation than the distribution of payoffs associated with Job 2.

Both distributions are flat because all outcomes are equally likely.



Decision Making under Risk

- Situation in table 5.3 might be clear.
- However, many situations involve some tradeoffs (Look at Table 5.4)

Table 5.4 Incomes from Sales Jobs—Modified ($)

	Outcome 1	Deviation Squared	Outcome 2	Deviation Squared	Expected Income	Standard Deviation
Job 1	2100	250,000	1100	250,000	1600	500
Job 2	1510	100	510	980,100	1500	99.5

- Job 1 has higher expected income as well as higher standard deviation.
- How people decide on situations like the above example?

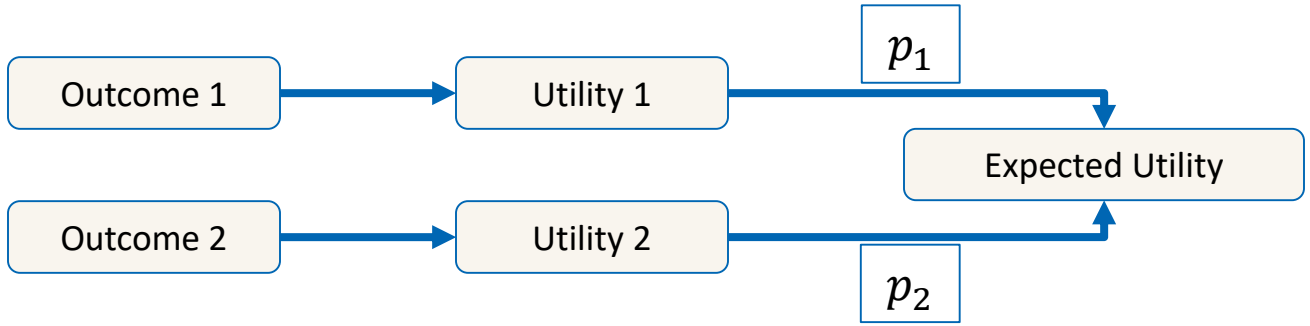
2 PREFERENCES TOWARD RISK

The **expected utility** 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.

$$U(o_1, o_2, p_1, p_2) = p_1 u(o_1) + p_2 u(o_2)$$

o_1 is outcome 1 p_1 is probability that o_1 occurs

o_2 is outcome 2 p_2 is probability that o_2 occurs



Note that generally,

$$U(P) = \sum_{i=1}^{N} P(X_i) u(X_i)$$

Example: A person is earning $15,000.
She is considering a new, but risky job
0.50 chance of $5,000
0.50 chance of $25,000

Suppose she gets
12 units of utility from $5,000
21 units of utility from $15,000
24 units of utility from $25,000
Must compare utility from the risky job with utility from the current job.

For current job: $U_c = 1*21 = 21$
For risky job: $U_r = 0.5*12 + 0.5*24 = 18$
Therefore, the person prefers to stay in the current job.

Figure 5.3

Risk Averse, Risk Loving, and Risk Neutral

In (**a**), a consumer's marginal utility diminishes as income increases.

The consumer is risk averse because she would prefer a certain income of $20,000 (with a utility of 16) to a gamble with a .5 probability of $10,000 and a .5 probability of $30,000 (and expected utility of 14).

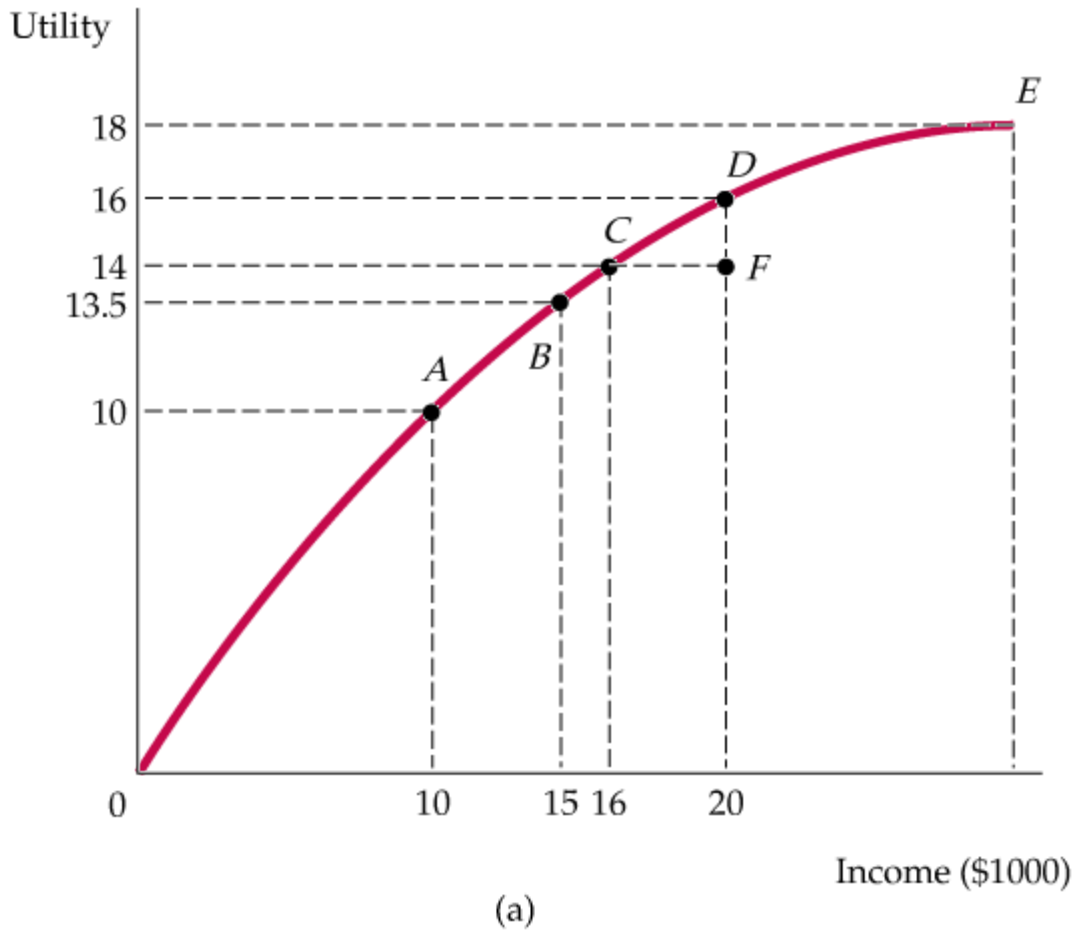


Figure 5.3

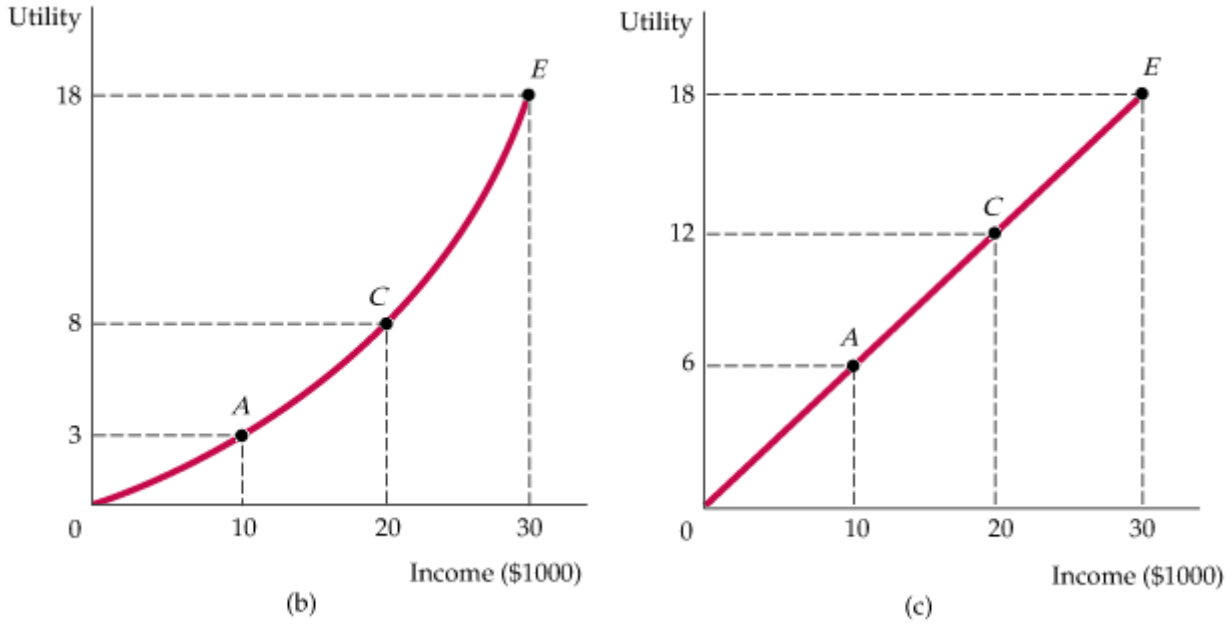
Risk Averse, Risk Loving, and Risk Neutral

In (**b**), the consumer is risk loving:

She would prefer the same gamble (with expected utility of 10.5) to the certain income (with a utility of 8).

Finally, the consumer in (**c**) is risk neutral,

and indifferent between certain and uncertain events with the same expected income.



- **expected utility** Sum of the utilities associated with all possible outcomes, weighted by the probability that each outcome will occur.

2 PREFERENCES TOWARD RISK

Different Preferences Toward Risk

- **risk averse** Condition of preferring a certain income to a risky income with the same expected value.
- **risk neutral** Condition of being indifferent between a certain income and an uncertain income with the same expected value.
- **risk loving** Condition of preferring a risky income to a certain income with the same expected value.

Different Preferences Toward Risk

Risk Premium

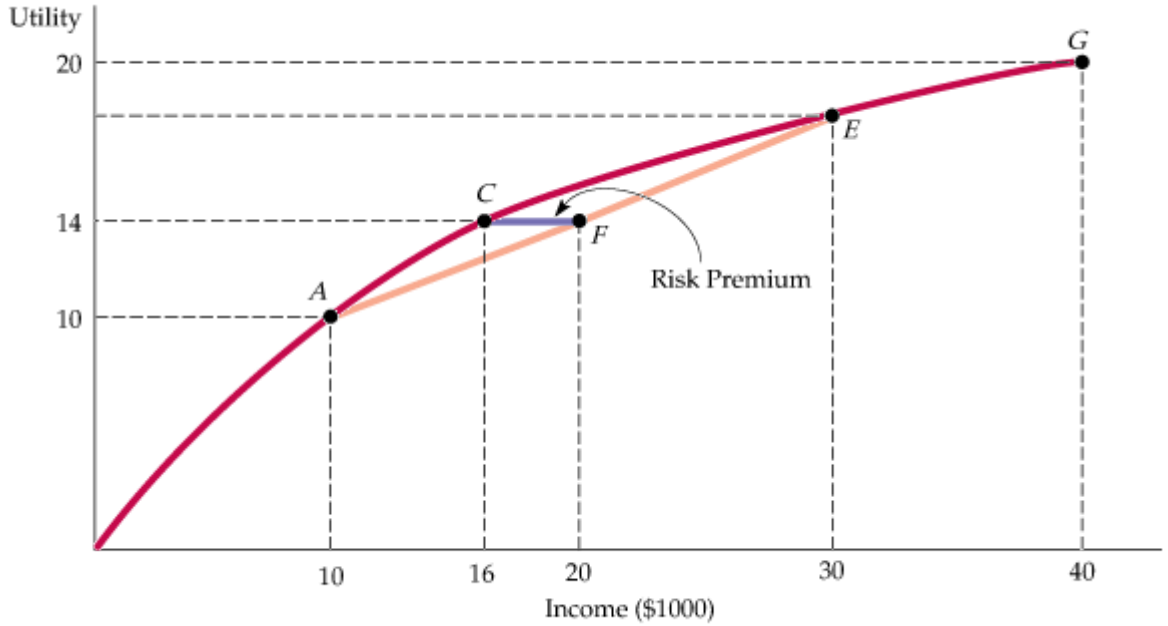
- **risk premium** Maximum amount of money that a risk-averse person will pay to avoid taking a risk.

Figure 5.4

Risk Premium

The risk premium, CF, measures the amount of income that an individual would give up to leave her indifferent between a risky choice and a certain one.

Here, the risk premium is $4000 because a certain income of $16,000 (at point C) gives her the same expected utility (14) as the uncertain income (a .5 probability of being at point A and a .5 probability of being at point E) that has an expected value of $20,000.



2 PREFERENCES TOWARD RISK

Different Preferences Toward Risk

Risk Aversion and Income

The extent of an individual's risk aversion depends on the nature of the risk and on the person's income.

Other things being equal, risk-averse people prefer a smaller variability of outcomes.

The greater the variability of income, the more the person would be willing to pay to avoid the risky situation.

Different Preferences Toward Risk

Risk Aversion and Indifference Curves

Figure 5.5

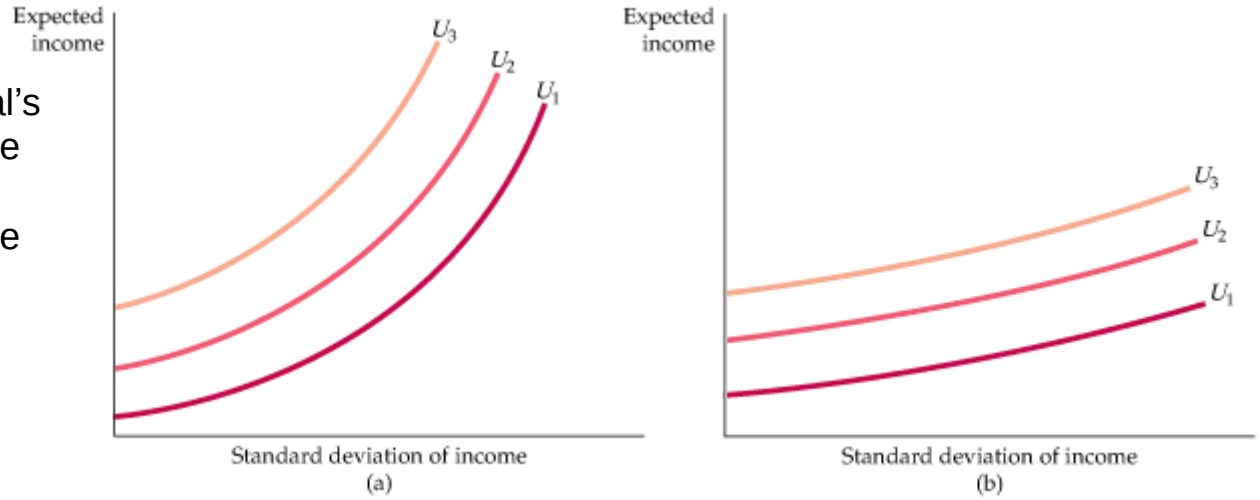
Risk Aversion and Indifference Curves

Part (**a**) applies to a person who is highly risk averse:

An increase in this individual's standard deviation of income requires a large increase in expected income if he or she is to remain equally well off.

Part (**b**) applies to a person who is only slightly risk averse:

An increase in the standard deviation of income requires only a small increase in expected income if he or she is to remain equally well off.



Diversification

- **diversification** Practice of reducing risk by allocating resources to a variety of activities whose outcomes are not closely related.

TABLE 5.5 Income from Sales of Appliances ($)

	Hot Weather	Cold Weather
Air conditioner sales	30,000	12,000
Heater sales	12,000	30,000

- **negatively correlated variables** Variables having a tendency to move in opposite directions.

The Stock Market

- **mutual fund** Organization that pools funds of individual investors to buy a large number of different stocks or other financial assets.

- **positively correlated variables** Variables having a tendency to move in the same direction.

Insurance

TABLE 5.6 The Decision to Insure ($)

Insurance	Burglary (Pr = .1)	No Burglary (Pr = .9)	Expected Wealth	Standard Deviation
No	40,000	50,000	49,000	3000
Yes	49,000	49,000	49,000	0

The Law of Large Numbers

The ability to avoid risk by operating on a large scale is based on the *law of large numbers*, which tells us that although single events may be random and largely unpredictable, the average outcome of many similar events can be predicted.

Actuarial Fairness

- **actuarially fair** Characterizing a situation in which an insurance premium is equal to the expected payout.

The Value of Information

- **value of complete information**
  Difference between the expected value of a choice when there is complete information and the expected value when information is incomplete.

4 RISKY ASSETS

Assets

- **asset** Something that provides a flow of money or services to its owner.

An increase in the value of an asset is a *capital gain*; a decrease is a *capital loss.*

Risky and Riskless Assets

- **risky asset** Asset that provides an uncertain flow of money or services to its owner.

- **riskless (or risk-free) asset** Asset that provides a flow of money or services that is known with certainty.

Asset Returns

- **return** Total monetary flow of an asset as a fraction of its price.
- **real return** Simple (or nominal) return on an asset, less the rate of inflation.

Expected versus Actual Returns

- **expected return** Return that an asset should earn on average.
- **actual return** Return that an asset earns.

TABLE 5.8 Investments—Risk and Return (1926–2006*)

	Average Rate of Return (%)	Average Real Rate of Return (%)	Rate Risk (Standard Deviation, %)
Common stocks (S&P 500)	12.3	9.2	20.1
Long-term corporate bonds	6.2	3.1	8.5
U.S. Treasury bills	3.8	0.7	3.1

**Source: Stocks, Bonds, Bills, and Inflation: 2007 Yearbook,* Morningstar, Inc.