Managerial Economics in a Global Economy, 5th Edition by Dominick Salvatore

Chapter 13

Risk Analysis

Risk and Uncertainty

- Risk
  - Situation where there is more than one possible outcome to a decision and the probability of each outcome is known
- Uncertainty
  - Situation where there is more than one possible outcome to a decision and the probability of each outcome is unknown

Measuring Risk Probability Distributions

- Probability
  - Chance that an event will occur
- Probability Distribution
  - List of all possible events and the probability that each will occur
- Expected Value or Expected Profit

$$E(\pi) = \bar{\pi} = \sum_{i=1}^{n} \pi_i \cdot P_i$$

Measuring Risk
Probability Distributions

Calculation of Expected Profit

Project	State of Economy	Probability (P)	Outcome (π)	Expected Value
A	Boom	0.25	$600	$150
	Normal	0.50	500	250
	Recession	0.25	400	100
	Expected profit from Project A			$500
B	Boom	0.25	$800	$200
	Normal	0.50	500	250
	Recession	0.25	200	50
	Expected profit from Project B			$500

Measuring Risk Probability Distributions

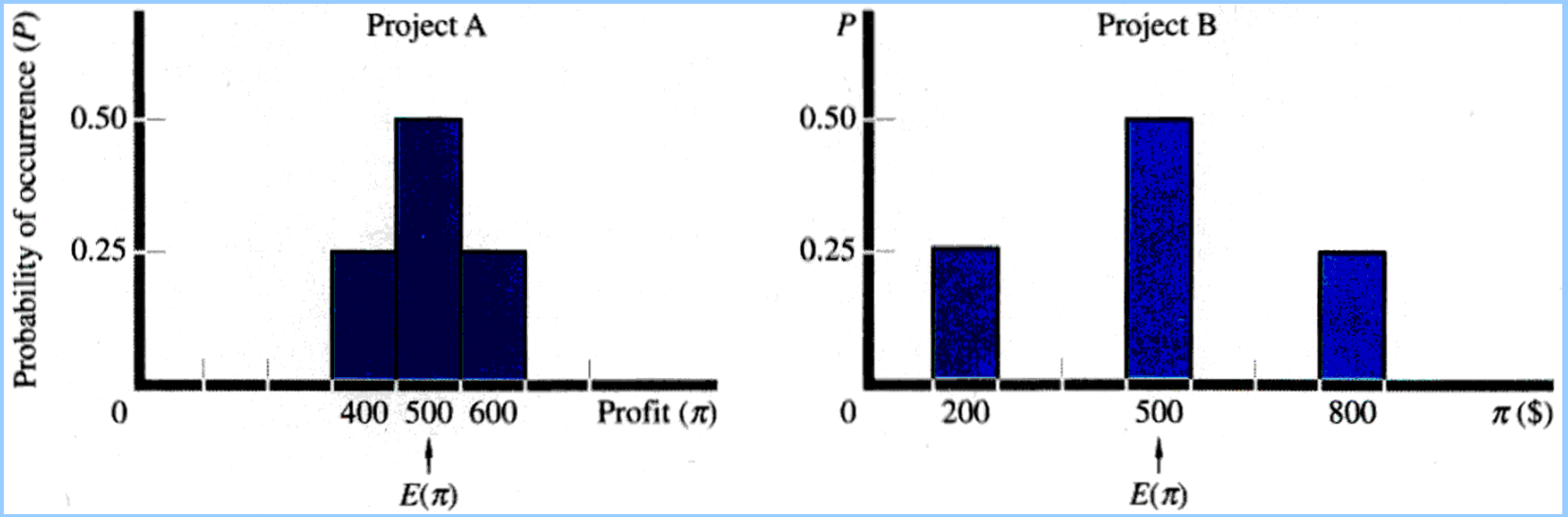
- Discrete Probability Distribution
  - List of individual events and their probabilities
  - Represented by a bar chart or histogram
- Continuous Probability Distribution
  - Continuous range of events and their probabilities
  - Represented by a smooth curve

Measuring Risk
Probability Distributions

Discrete Probability Distributions

Project A; E(π) = 500, Low Risk

Project B: E(π) = 500, High Risk

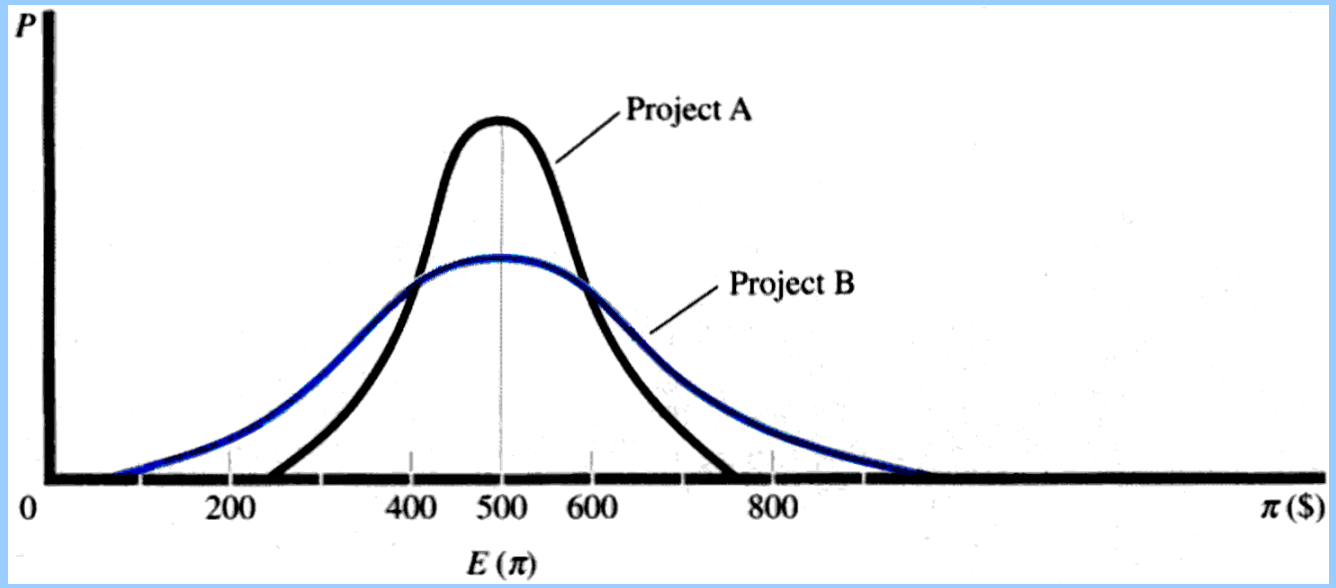


Measuring Risk
Probability Distributions

Continuous Probability Distributions

Project A: E(π) = 500, Low Risk

Project B: E(π) = 500, High Risk



Measuring Risk
Probability Distributions

An Absolute Measure of Risk: The Standard Deviation

$$\sigma = \sqrt{\sum_{i=1}^{n} (X_i - \bar{X})^2 \cdot P_i}$$

Measuring Risk
Probability Distributions

Calculation of the Standard Deviation
Project A

$$\sigma = \sqrt{(600-500)^2(0.25)+(500-500)^2(0.50)+(400-500)^2(0.25)}$$

$$\sigma = \sqrt{5,000} = \$70.71$$

Measuring Risk
Probability Distributions

Calculation of the Standard Deviation
Project B

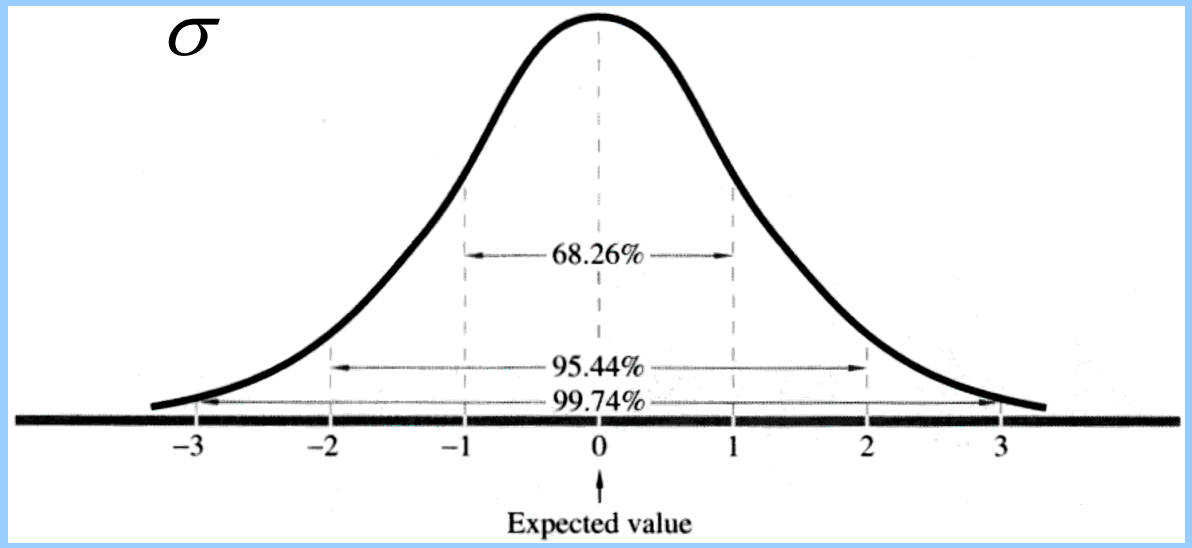
$$\sigma = \sqrt{(800-500)^2(0.25)+(500-500)^2(0.50)+(200-500)^2(0.25)}$$

$$\sigma = \sqrt{45,000} = \$212.13$$

Measuring Risk
Probability Distributions

The Normal Distribution

$$Z = \frac{\pi_i - \bar{\pi}}{\sigma}$$



Measuring Risk
Probability Distributions

A Relative Measure of Risk: The Coefficient of Variation

$$v = \frac{\sigma}{\bar{\pi}}$$

Project A

$$v_A = \frac{70.71}{500} = 0.14$$

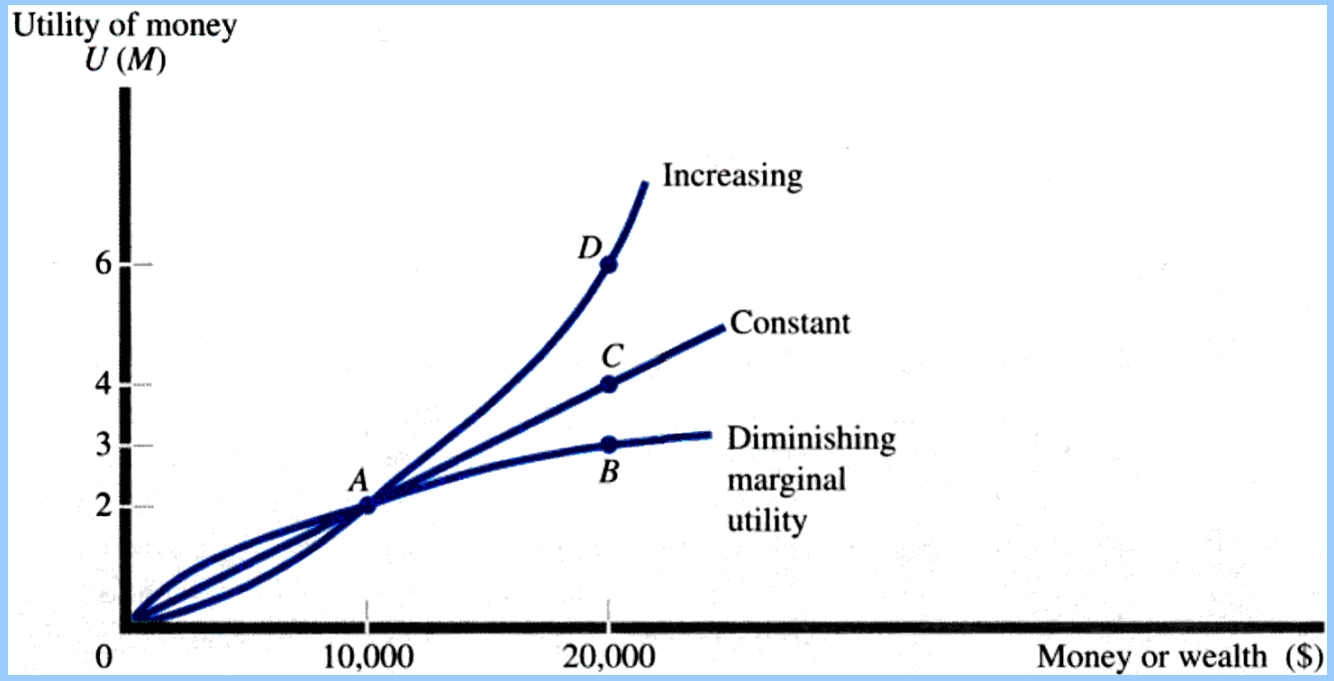
Project B

$$v_B = \frac{212.13}{500} = 0.42$$

Utility Theory

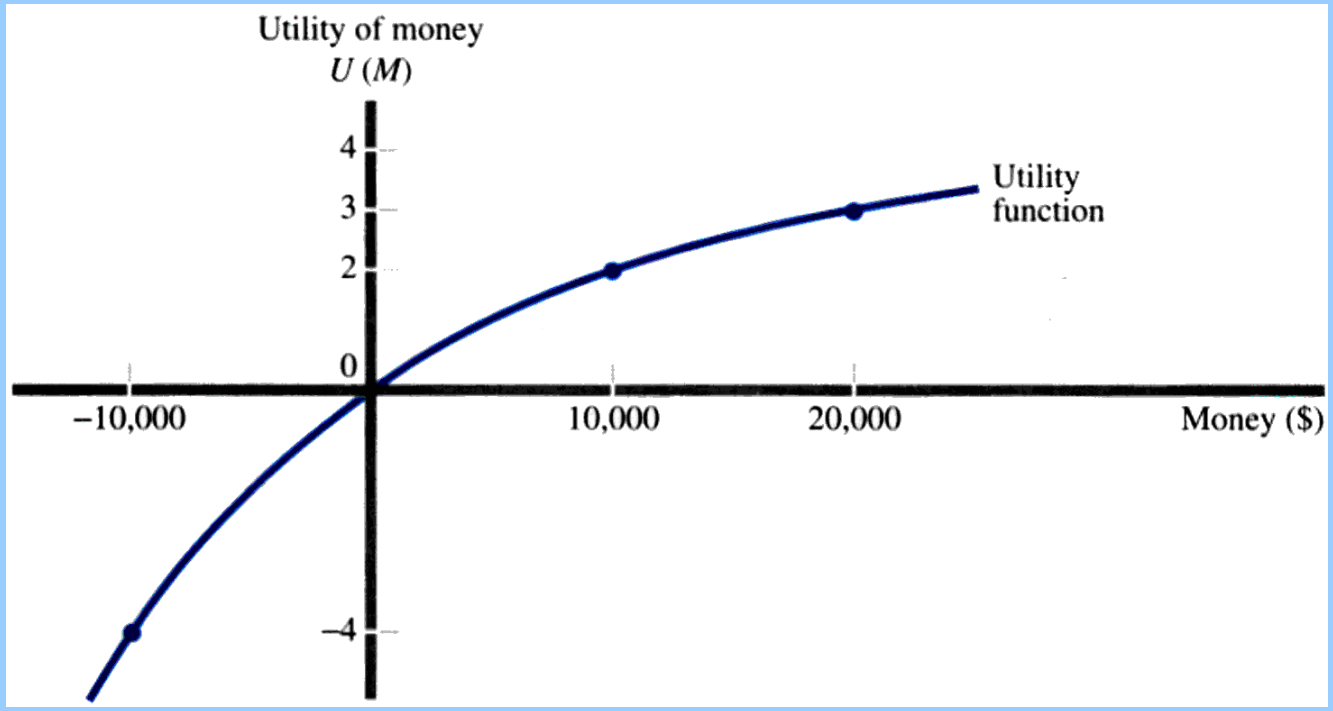
- Risk Averse
  - Must be compensated for taking on risk
  - Diminishing marginal utility of money
- Risk Neutral
  - Are indifferent to risk
  - Constant marginal utility of money
- Risk Seeking
  - Prefer to take on risk
  - Increasing marginal utility of money

Utility Theory



Utility Theory

Utility Function of a Risk Averse Manager



Adjusting Value for Risk

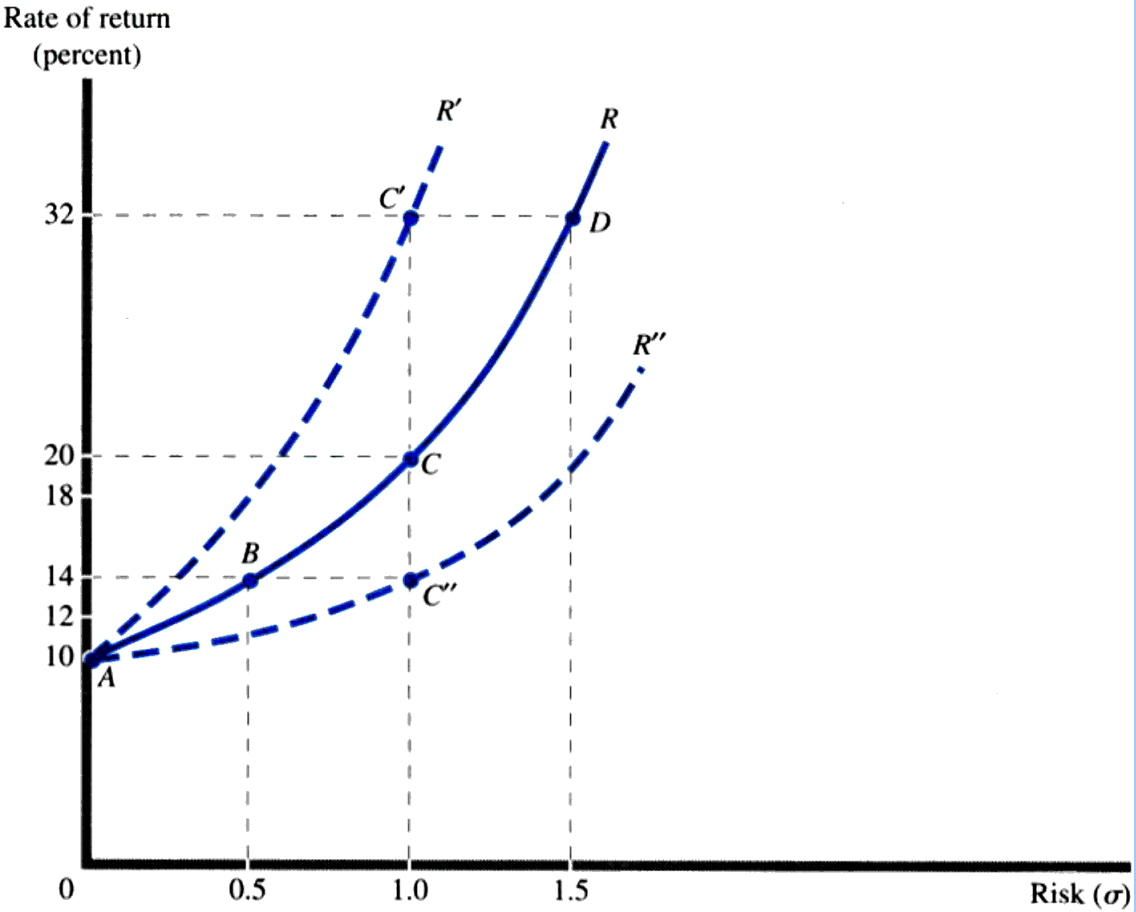
- Value of the Firm = Net Present Value

$$NPV = \sum_{t=1}^{n} \frac{\pi_t}{(1+r)^t}$$

- Risk-Adjusted Discount Rate

$$k = r + Risk\ Premium \qquad NPV = \sum_{t=1}^{n} \frac{\pi_t}{(1+k)^t}$$

Adjusting Value for Risk



Adjusting Value for Risk

- Certainty Equivalent Approach

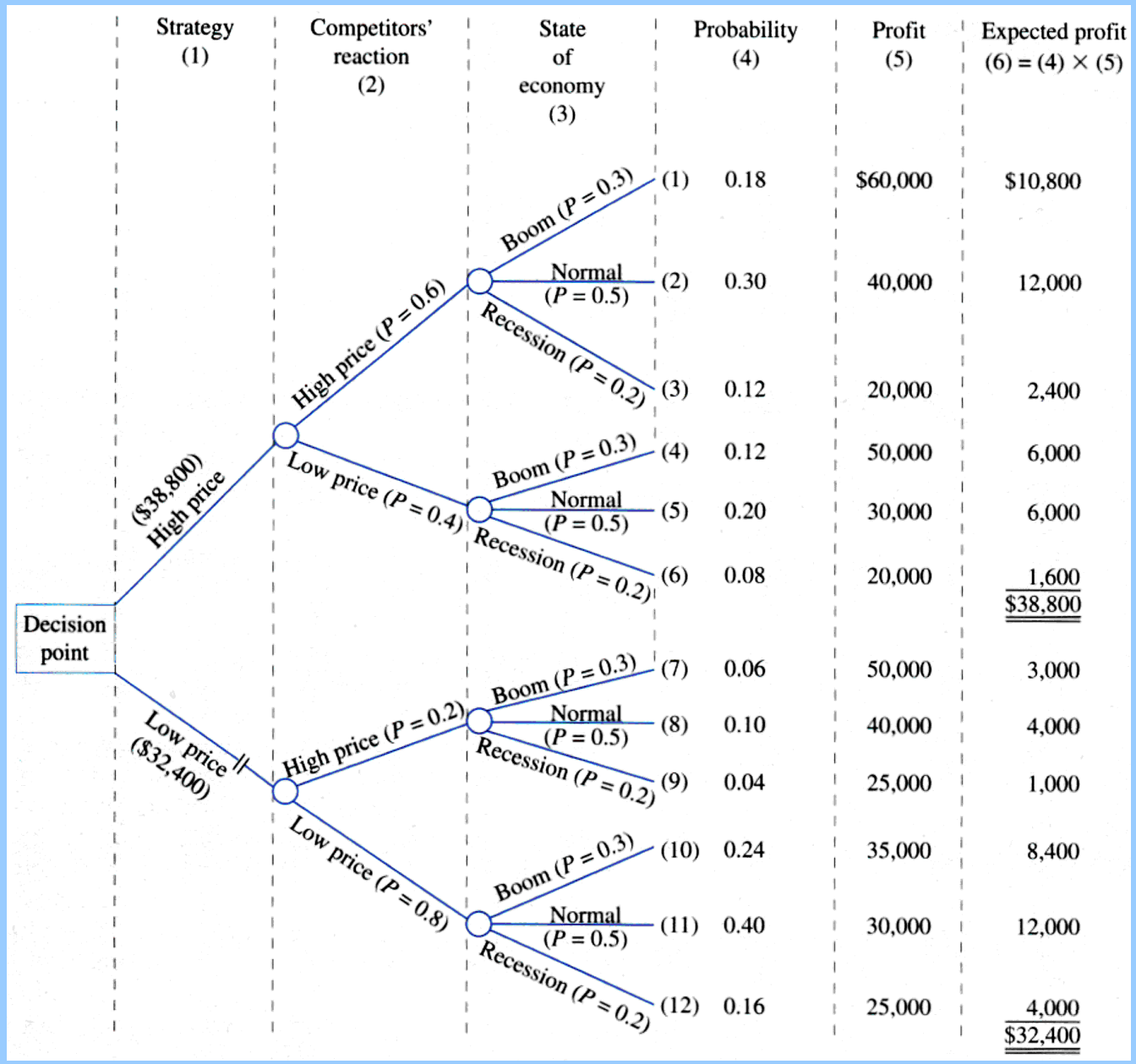
$$NPV = \sum_{t=1}^{n} \frac{\alpha R_t}{(1+r)^t}$$

- Certainty Equivalent Coefficient

$$\alpha = \frac{equivalent\ certain\ sum}{expected\ risky\ sum} = \frac{R_t^*}{R_t}$$

Other Techniques

- Decision Trees
  - Sequence of possible managerial decisions and their expected outcomes
  - Conditional probabilities
- Simulation
  - Sensitivity analysis



Uncertainty

- Maximin Criterion
  - Determine worst possible outcome for each strategy
  - Select the strategy that yields the best of the worst outcomes

Uncertainty: Maximin

The payoff matrix below shows the payoffs from two states of nature and two strategies.

	State of Nature		
Strategy	Success	Failure	Maximin
Invest	20,000	-10,000	-10,000
Do Not Invest	0	0	0

Uncertainty: Maximin

The payoff matrix below shows the payoffs from two states of nature and two strategies.

For the strategy “Invest” the worst outcome is a loss of 10,000. For the strategy “Do Not Invest” the worst outcome is 0. The maximin strategy is the best of the two worst outcomes - Do Not Invest.

	State of Nature		
Strategy	Success	Failure	Maximin
Invest	20,000	-10,000	-10,000
Do Not Invest	0	0	0

Uncertainty: Minimax Regret

The payoff matrix below shows the payoffs from two states of nature and two strategies.

	State of Nature	
Strategy	Success	Failure
Invest	20,000	-10,000
Do Not Invest	0	0

Uncertainty: Minimax Regret

The regret matrix represents the difference between the a given strategy and the payoff of the best strategy under the same state of nature.

	State of Nature		Regret Matrix	
Strategy	Success	Failure	Success	Failure
Invest	20,000	-10,000	0	10,000
Do Not Invest	0	0	20,000	0

Uncertainty: Minimax Regret

For each strategy, the maximum regret is identified. The minimax regret strategy is the one that results in the minimum value of the maximum regret.

	State of Nature		Regret Matrix		Maximum
Strategy	Success	Failure	Success	Failure	Regret
Invest	20,000	-10,000	0	10,000	10,000
Do Not Invest	0	0	20,000	0	20,000

Uncertainty: Informal Methods

- Gather Additional Information
- Request the Opinion of an Authority
- Control the Business Environment
- Diversification

Foreign-Exchange Risk

- Foreign-Exchange Rate
  - Price of a unit of a foreign currency in terms of domestic currency
- Hedging
  - Covering foreign exchange risk
  - Typically uses forward currency contracts

Foreign-Exchange Risk

- Forward Contract
  - Agreement to purchase or sell a specific amount of a foreign currency at a rate specified today for delivery at a specified future date.
- Futures Contract
  - Standardized, and more liquid, type of forward contract for predetermined quantities of the currency and selected calendar dates.

Information and Risk

- Asymmetric Information
  - Situation in which one party to a transaction has less information than the other with regard to the quality of a good
- Adverse Selection
  - Problem that arises from asymmetric information
  - Low-quality goods drive high-quality goods out of the market

Information and Risk

- Moral Hazard
  - Tendency for the probability of loss to increase when the loss is insured
- Methods of Reducing Moral Hazard
  - Specifying precautions as a condition for obtaining insurance
  - Coinsurance

