OBJECTIVES

- Explain how managers should make strategic decisions when faced with incomplete or imperfect information

MANAGEMENT TOOLS

- Expected value
- Decision trees
- Techniques to reduce uncertainty
- Expected utility

RISK AND PROBABILITY

- Risk: Hazard or chance of loss
- Probability: Likelihood or chance that something will happen

RISK AND PROBABILITY

- Frequency definition of probability: Event's limit of frequency in a large number of trials
  - Probability of event A = P(A) = r/R
    - R = Large number of trials
    - r = Number of times event A occurs

PROBABILITY DISTRIBUTIONS AND EXPECTED VALUES

- Subjective definition of probability: Degree of a manager's confidence or belief that the event will occur
  - Rules of probability
    - Probabilities may not be less than zero nor greater than one.
    - Given a list of mutually exclusive, collectively exhaustive list of the events that can occur in a given situation, the sum of the probabilities of the events must be equal to one.

PROBABILITY DISTRIBUTIONS AND EXPECTED VALUES

- Subjective definition of probability (cont'd)
  - Probability distribution: A table that lists all possible outcomes and assigns the probability of occurrence to each outcome

$$\text{Expected profit} = E(\pi) = \sum_{i=1}^{N} \pi_i P_i$$

  - π_i = Profit associated with the outcome i
  - P_i = Probability of outcome i

COMPARISONS OF EXPECTED PROFIT

- Example: Jones Corporation is considering a decision involving pricing and advertising. The expected value if they raise price is

Profit	Probability	(Probability)(Profit)
$800,000	0.50	$400,000
-600,000	0.50	-300,000
	Expected Profit =	$100,000

  - The payoff from not increasing price is $200,000, so that is the optimal strategy.

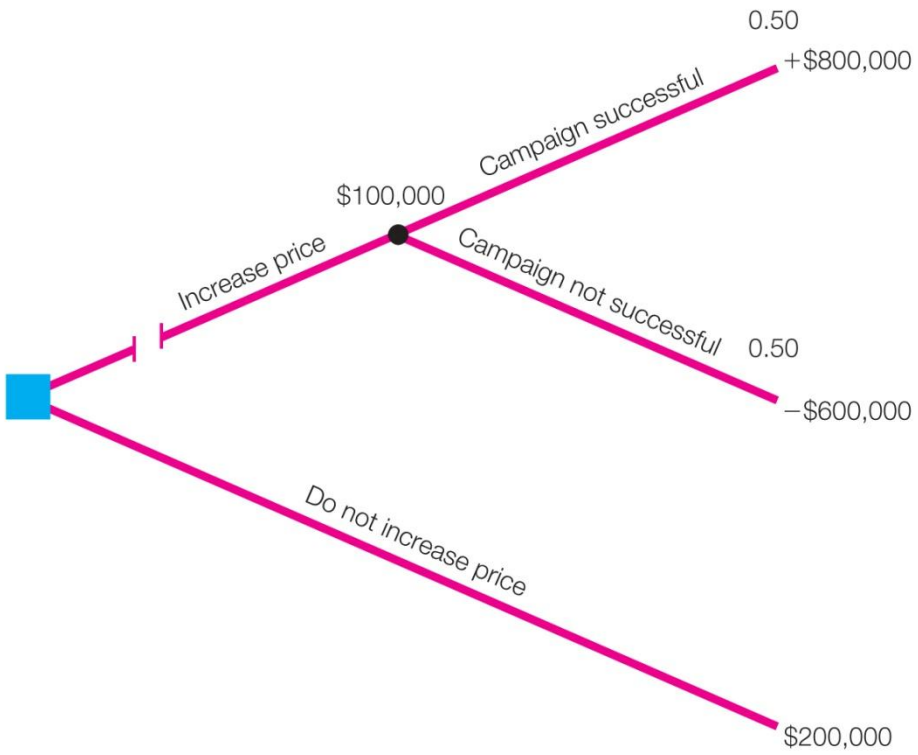
ROAD MAP TO DECISIONS

- Decision tree: Diagram that helps managers visualize their strategic future
- Figure 14.1: Decision Tree, Jones Corporation

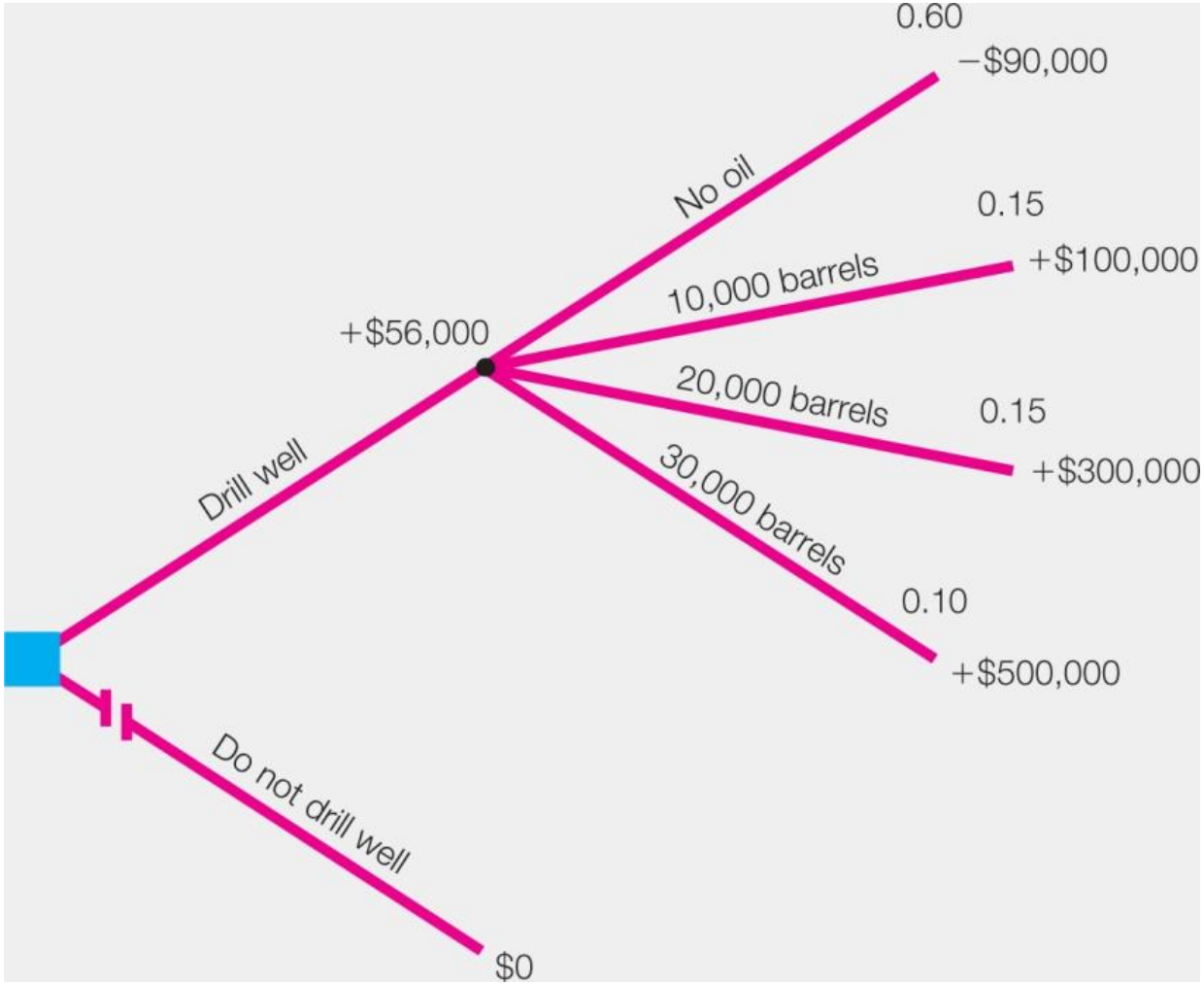
DECISION TREE, JONES CORPORATION

FIGURE 14.1

Decision Tree, Jones Corporation



DECISION TREE, GENCO EXPLORATION



THE EXPECTED VALUE OF PERFECT INFORMATION

- Expected Value of Perfect Information (EVPI)
  - Increase in expected profit from completely accurate information concerning future outcomes
  - Jones Example (Figure 14.1)
    - Given perfect information, the company will increase price if the campaign will be successful and will not increase price if the campaign will not be successful.
    - Expected profit = ((800,000+200,000)/2)= $500,000, so EVPI = $500,000 – $200,000 = $300,000

MEASURING ATTITUDES TOWARD RISK: THE UTILITY APPROACH

- Example
  - A small business is offered the following choice:
    1. A certain profit of $2,000,000
    2. A gamble with a 50–50 change of $4,100,000 profit or a $60,000 loss. The expected value of the gamble is $2,020,000.
  - If the business is risk averse, it is likely to take the certain profit.
- Utility function: Function used to identify the optimal strategy for managers conditional on their attitude toward risk

MEASURING ATTITUDES TOWARD RISK: THE UTILITY APPROACH

- Constructing a Utility Function
  - Expected utility: The sum of the utility of each outcome times the probability of the outcome's occurrence

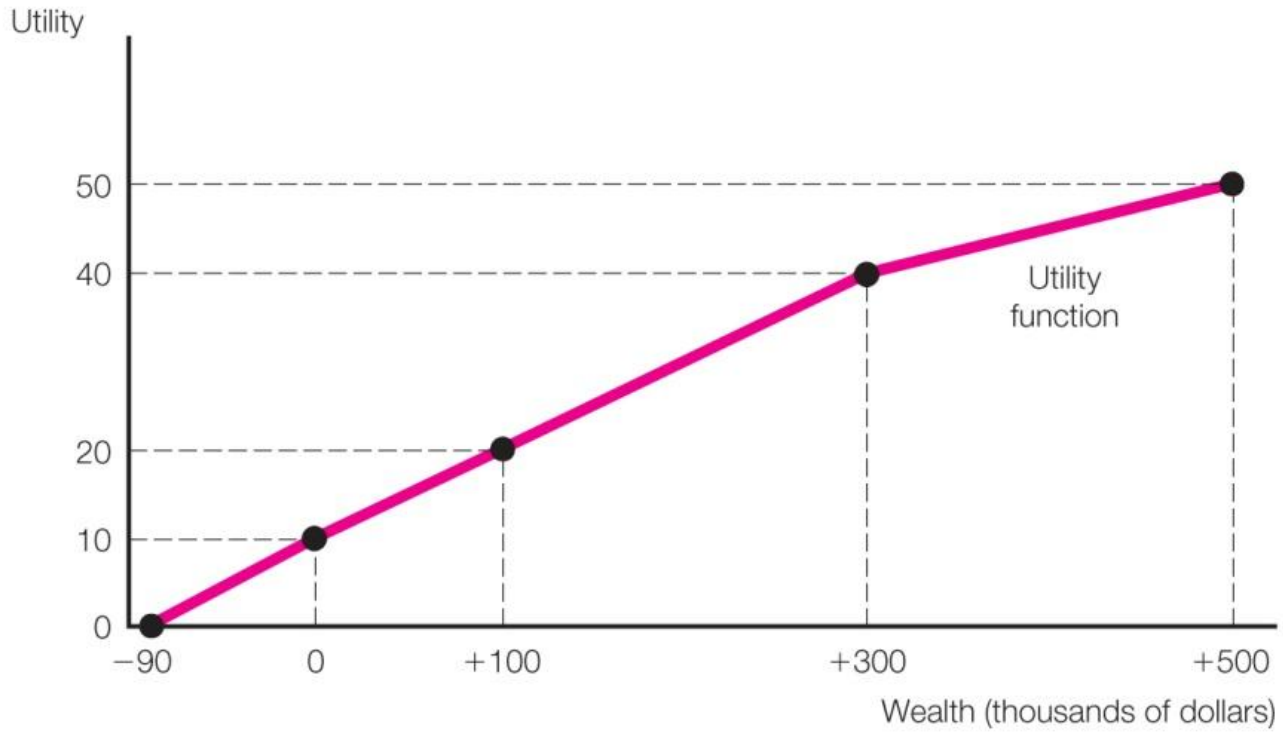
MEASURING ATTITUDES TOWARD RISK: THE UTILITY APPROACH

- Constructing a Utility Function (cont'd)
  - Procedure
    1. Arbitrarily assign utility levels to two payoffs with the higher payoff set to a higher level of utility certain profit of $2,000,000. For the Genco Exploration example, set U(–90) = 0 and U(500) = 50.
    2. Next, ask the decision maker what value of P (probability) would make them indifferent between a certain amount (say 100) and the following gamble: P(50) + (1 – P)(0).
    3. Suppose the decision maker sets P = 0.4, then U(100) = (0.4)(50) + (0.6)(0) = 20.
    4. Continuing with this method will allow the derivation of utility for any possible payoff.

UTILITY FUNCTION

FIGURE 14.2

Utility Function



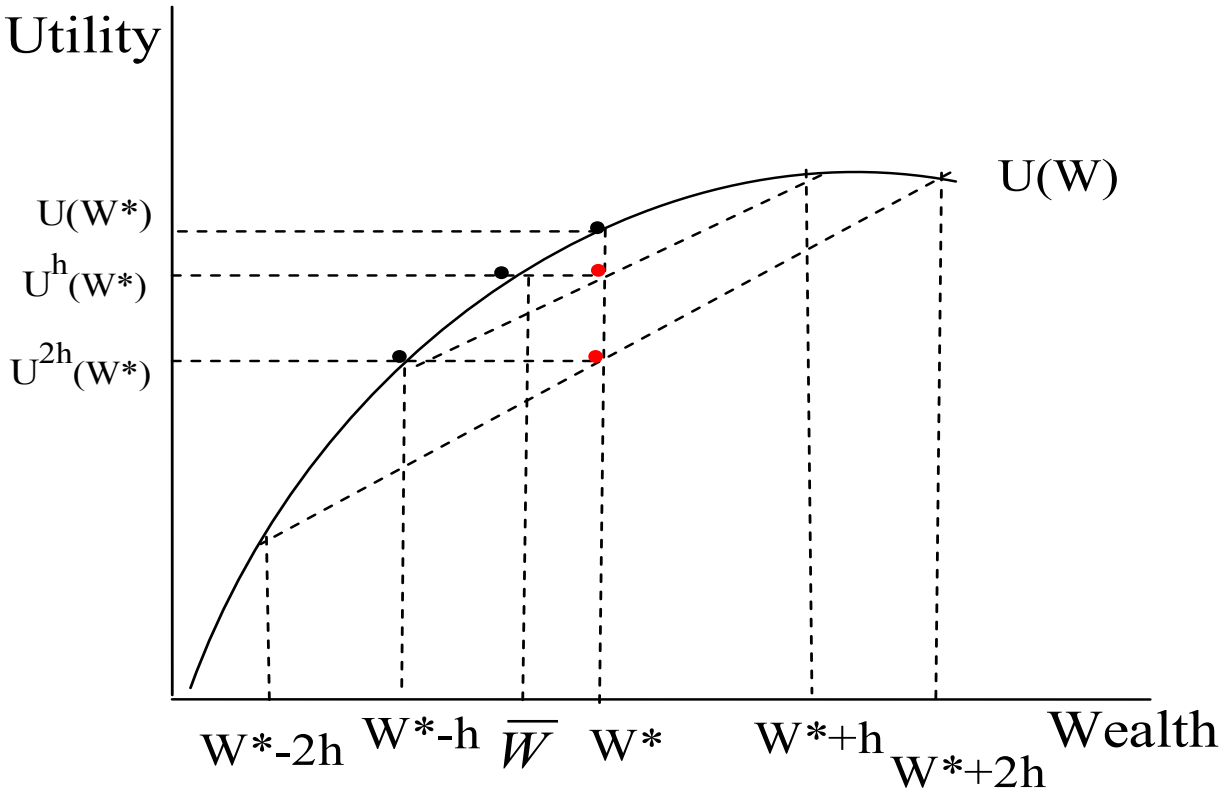
ATTITUDES TOWARD RISK: THREE TYPES

- Risk averters: When managers prefer a choice with a more certain outcome to one with a less certain outcome when confronted with gambles offering equal expected wealth
  - Utility function has diminishing marginal utility.

ATTITUDES TOWARD RISK: THREE TYPES

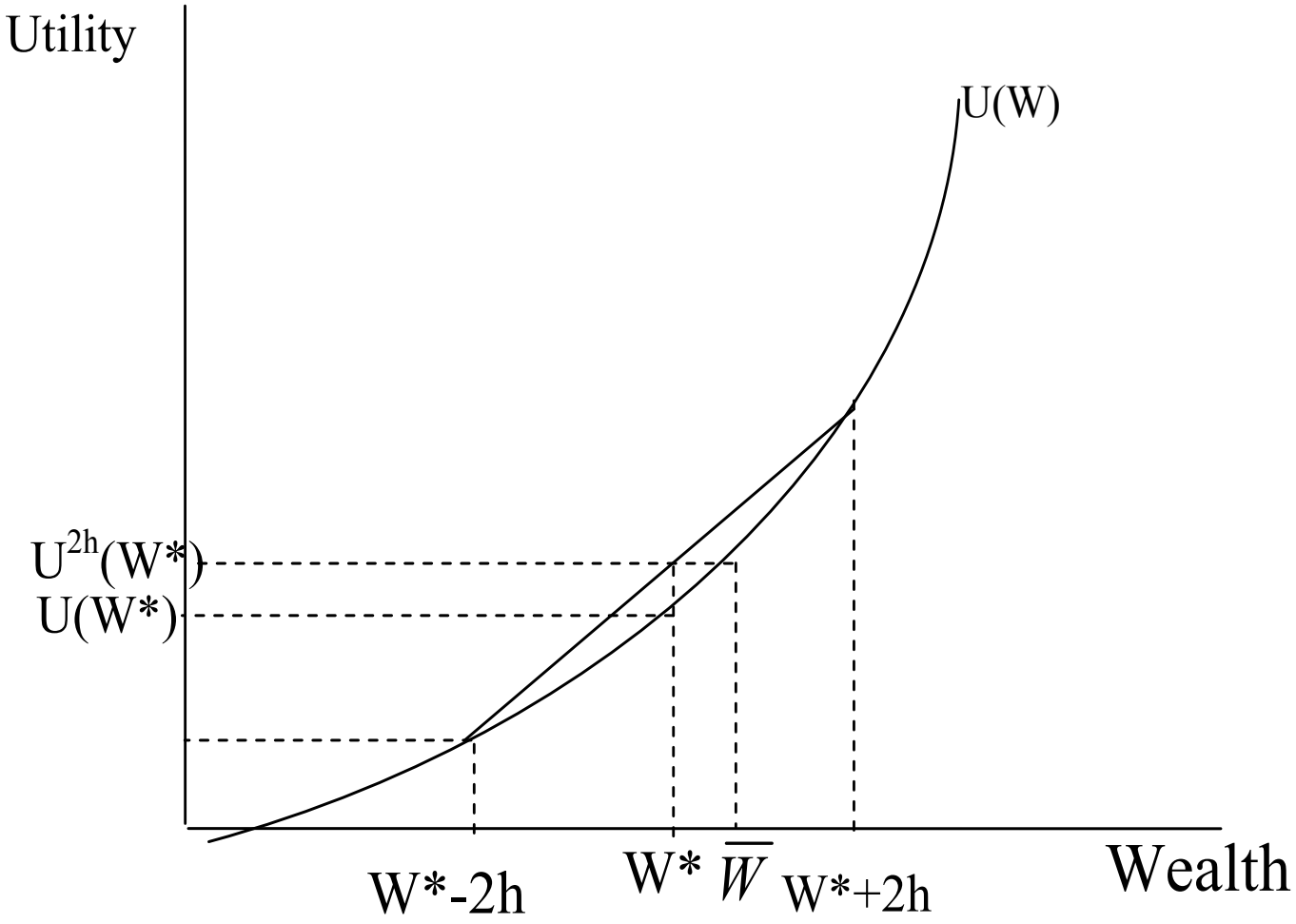
- Risk lovers: When managers prefer a gamble with a less certain outcome to one with a more certain outcome, when confronted with gambles offering equal expected wealth
  - Utility function has increasing marginal utility.
- Risk neutral: When a manager maximizes expected wealth, regardless of risk
  - Utility function is linear and marginal utility is constant.

The graph below denote a risk adverse player. Notice that utility from gamble 2 is less than gamble 1 which is less than the certainty equivalence.

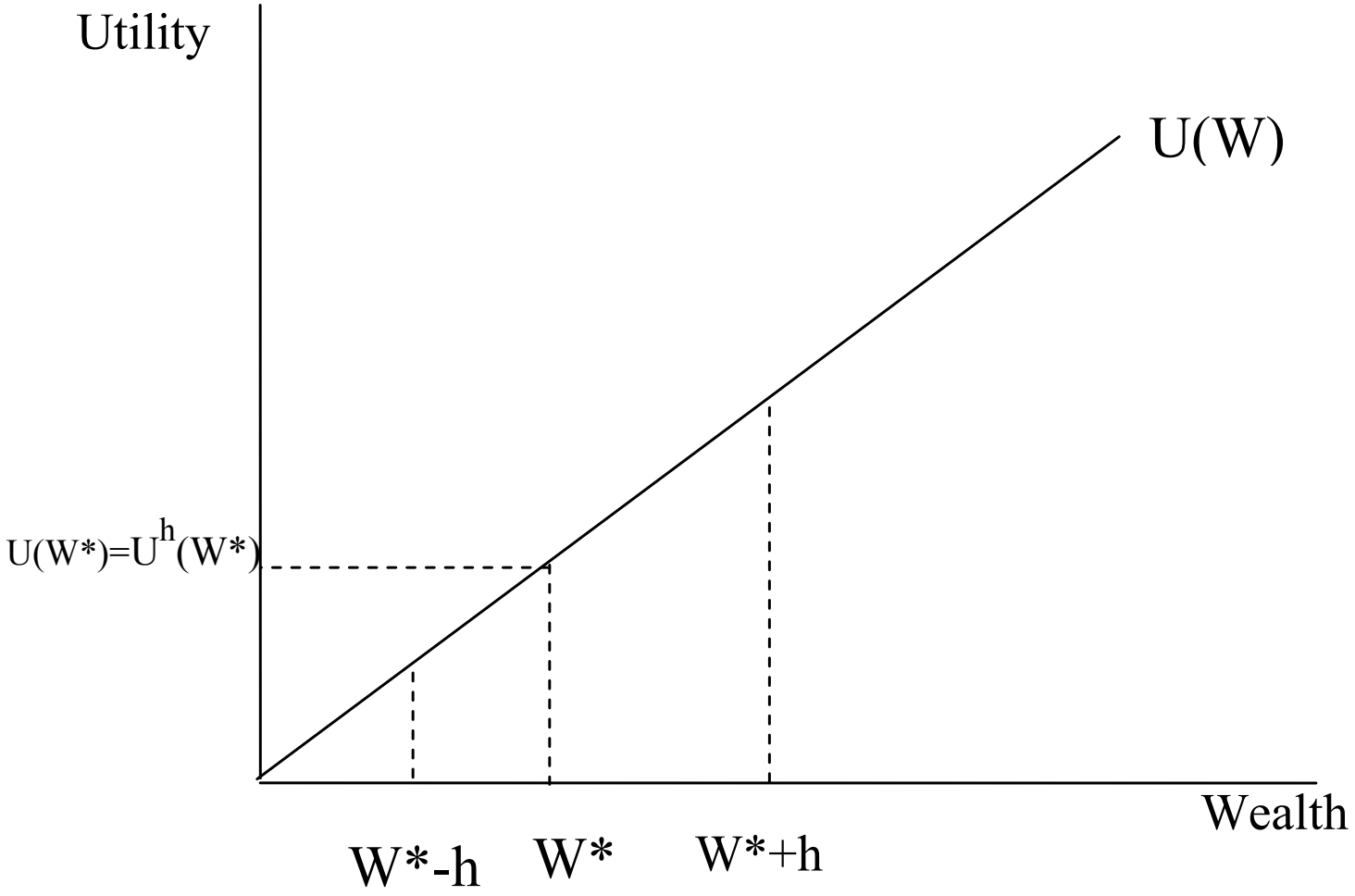


An individual who always refuses fair bets is said to be risk averse. If individual exhibits a diminishing marginal utility of wealth, they will be risk averse as a consequence, they will be willing to pay something to avoid taking fair bets (insurance).

If utility is convex (increasing marginal utility of wealth) the player prefers the gamble to the certainty equivalence. The more risky the gamble, the better. This player is said to be risk seeking.



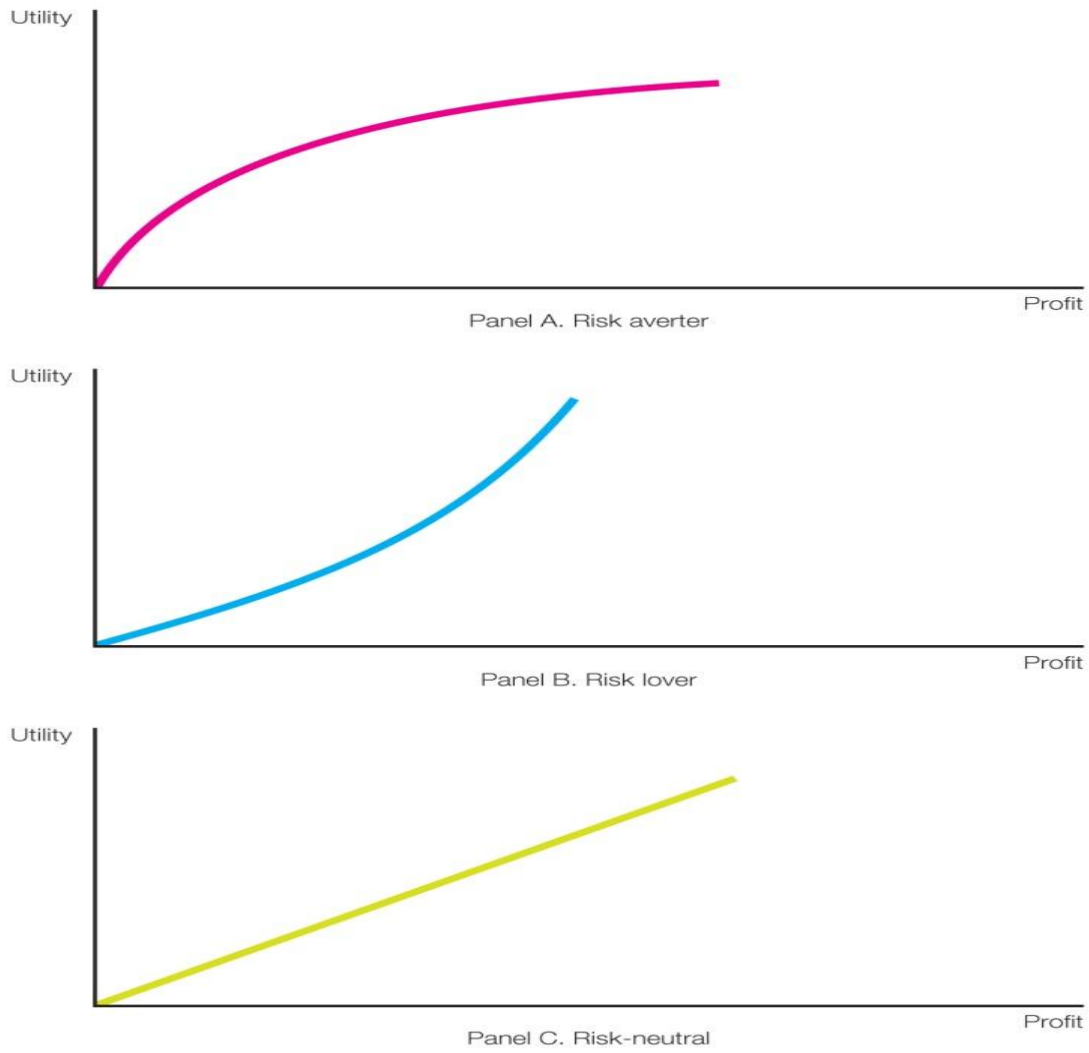
If the utility function for wealth is linear (constant marginal utility of wealth) the player is indifferent between the gamble and the certainty equivalence (Risk Neutral).



THREE TYPES OF UTILITY FUNCTIONS

FIGURE 14.3

Three Types of Utility Functions



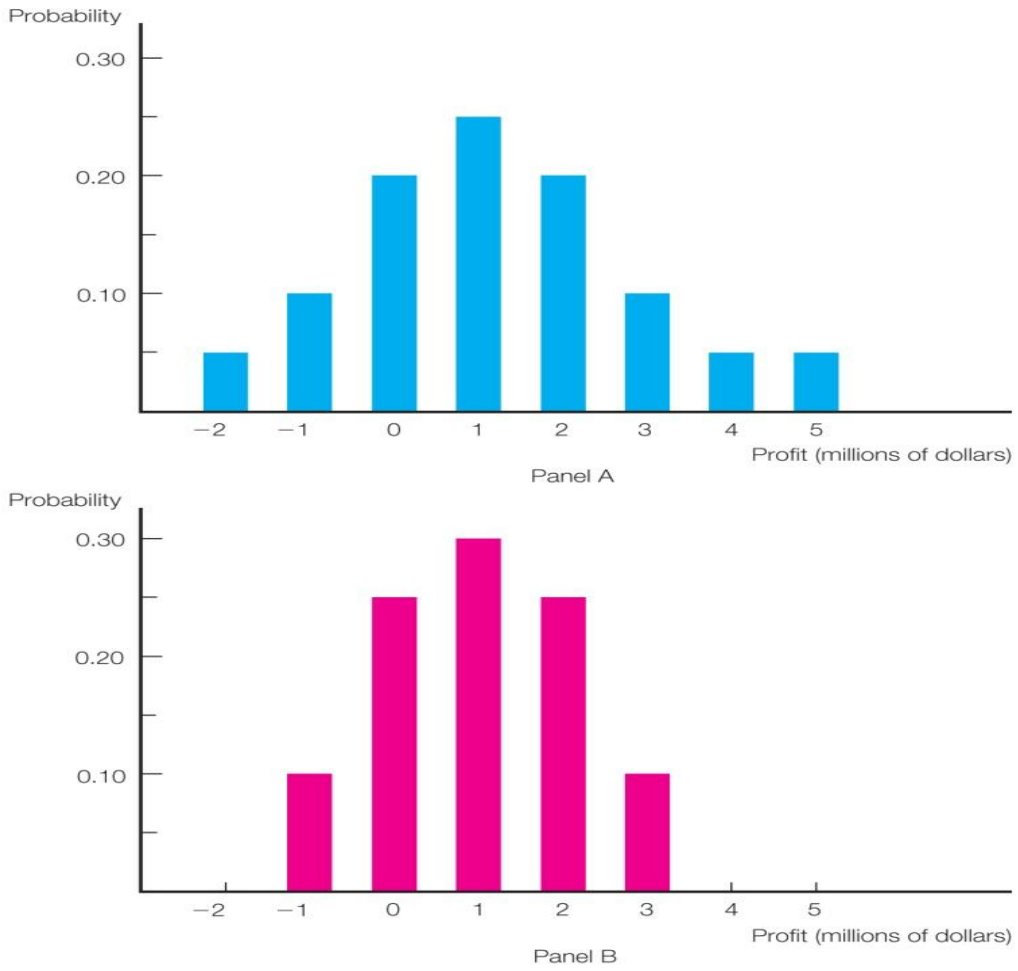
THE STANDARD DEVIATION AND COEFFICIENT OF VARIATION: MEASURES OF RISK

- Standard deviation: The most frequently used metric for dispersion in a probability distribution
  - $$\sigma = \left(\sum_{i=1}^{N} P_i [\pi_i - E(\pi)]^2 \right)^{0.5}$$
- Coefficient of variation: $V = \sigma / E(\pi)$
- Figure 14.4: Probability Distribution of the Profit from an Investment in a New Plant

PROBABILITY DISTRIBUTION OF THE PROFI T FROM AN INVESTMENT IN A NEW PLANT

FIGURE 14.4

Probability Distribution of the Profit from an Investment in a New Plant



ADJUSTING THE VALUATION MODEL FOR RISK

- Certainty equivalent approach: When a manager is indifferent between a certain payoff and a gamble, the certainty equivalent (rather than the expected profit) can identify whether the manager is risk averse, risk loving, or risk neutral.

ADJUSTING THE VALUATION MODEL FOR RISK

- Certainty equivalent approach (cont'd)
  - If the certainty equivalent is less than the expected value, then the decision maker is risk averse.
  - If the certainty equivalent is equal to the expected value, then the decision maker is risk neutral.
  - If the certainty equivalent is greater than the expected value, then the decision maker is risk loving.

ADJUSTING THE VALUATION MODEL FOR RISK

- The present value of future profits, which managers seek to maximize, can be adjusted for risk by using the certainty equivalent profit in place of the expected profit.

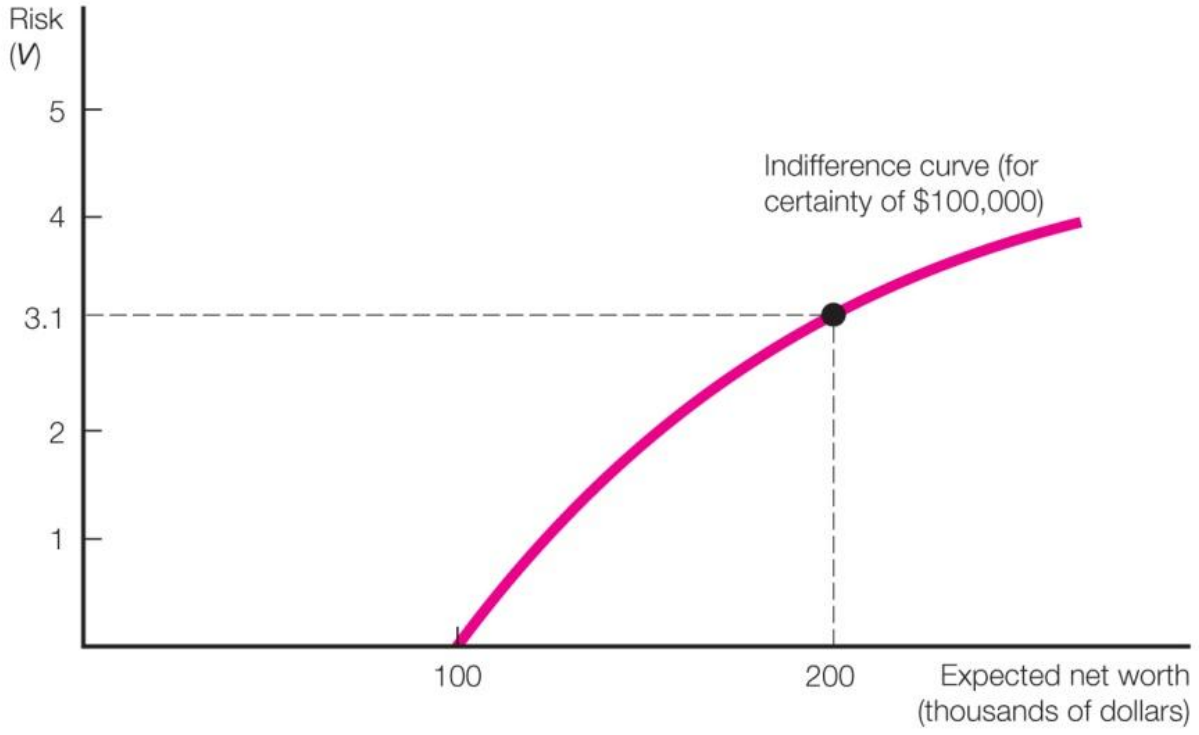
ADJUSTING THE VALUATION MODEL FOR RISK

- Indifference curves
  - Figure 14.5: Manager's Indifference Curve between Expected Profit and Risk
  - With expected value on the horizontal axis, the horizontal intercept of an indifference curve is the certainty equivalent of the risky payoffs represented by the curve.
  - If a decision maker is risk neutral, indifference curves will be vertical.

MANAGER'S INDIFFERENCE CURVE BETWEEN EXPECTED PROFIT AND RISK

FIGURE 14.5

Manager's Indifference Curve between Expected Profit and Risk



CERTAINTY EQUIVALENCE AND THE MARKET FOR INSURANCE

- Example
  - Managers hold $900 million in debt.
    - There is a 25% chance that the value of the bonds will fall to $400 million.
    - There is a 75% chance that the value of the bonds will remain constant.
    - Expected value =.25(400) + .75(900)= $775 million

CERTAINTY EQUIVALENCE AND THE MARKET FOR INSURANCE

- Example (cont'd)
  - Managers use the following utility function defined on wealth (W): $U = W^{0.5}$
    - Expected utility = $.25(400)^{0.5} + .75(900)^{0.5} = 27.5$
    - Certainty equivalent = $W^* = U^2 = (27.5)^2 = \$756.25$ million
    - The certainty equivalent should be the manager's reservation price for selling the bonds at a discount.

CERTAINTY EQUIVALENCE AND THE MARKET FOR INSURANCE

- Example
  - LBI Insurance Company provides full coverage of loss and is risk neutral.
    - LBI's expected payout is $125 million, so that is the minimum price for the policy.
    - The most that the policy is worth to the buyer is the difference between $900 million and the certainty equivalent of $756.25 million, or $143.75 million.
    - The risk premium is the difference between LBI's reservation price for the policy and the maximum amount the buyer would pay: $143.75 – $125 = $18.75 million.

MANAGER'S INDIFFERENCE CURVE BETWEEN EXPECTED RATE OF RETURN