

# Chapter 11

## Decision Theory

### Exercises

#### 11. 1.

A bicycle store would like to order bicycles for the coming month. Orders for the bicycles must be placed in quantities of 20. The cost per bicycle is \$70 dollars if they order 20, \$67 if they order 40, \$65 if they order 60 and \$64 if they order 80.

The bicycles will be sold for \$100 each. Any bicycles left over at the end of month can be sold at \$45 each.

If the bicycle store runs out of bicycles, then it will suffer a loss of “goodwill” among its customers. This goodwill is estimated to be \$5 per customer who was unable to buy a bicycle. It is further estimated that the demand for bicycles in coming month will be 10, 30, 50, or 70, with probabilities of 0.2, 0.4, 0.3, and 0.1 respectively.

1. Create a payoff table.
2. Find the best action under each of the following decision criteria:
  - i. Maximax
  - ii. Maximin
  - iii. Minimax
  - iv. Minimax regret
  - v. Expected value

#### 11. 2.

Mrs. Greedy is thinking of investing in the stock market. Suppose she is considering four alternatives: investing \$8000, \$4000, \$2000, or \$1000. These are the four choices that are within her control. The consequences of her investment, in terms of her profit or losses, are dependent on the market and beyond her control.

Mrs. Greedy's *payoff table* is as follows:

|         | Profit        |             |             |
|---------|---------------|-------------|-------------|
|         | $p_1 = 0.1$   | $p_2 = 0.5$ | $p_3 = 0.4$ |
| Invest: | Strong market | Fair market | Poor market |
| \$8000  | \$800         | \$200       | -\$400      |
| \$4000  | \$400         | \$100       | -\$200      |
| \$2000  | \$200         | \$50        | -\$100      |
| \$1000  | \$100         | \$25        | -\$50       |

Given the utility function

$$u(v) = 2v - \frac{v^2}{100000},$$

1. Find an “optimal” investment strategy.
2. Determine the decision-maker’s risk attitude.

**11. 3.**

A dress buyer for a large department store must place order with a dress manufacturer 9 months before the dresses are needed. One decision is as to the number of knee-length dresses to stock. The ultimate gain to the department store depends both on this decision and on the fashion prevailing 9 months later.

The buyer’s estimate of gains (in thousands of €) are given in the following table:

|                  | Knee lengths are high fashion | Knee lengths are acceptable | Knee lengths are not acceptable |
|------------------|-------------------------------|-----------------------------|---------------------------------|
| Probability      | 0.40                          | 0.35                        | 0.25                            |
| Order none       | -50                           | 0                           | 80                              |
| Order a little   | -10                           | 30                          | 35                              |
| Order moderately | 60                            | 45                          | -30                             |
| Order a lot      | 80                            | 40                          | -45                             |

Given the following preference function

$$\Phi(a_i) = 2\mu_i - 0.05\sigma_i,$$

recommend a decision.

**11. 4.**

A company is investigating the possibility of producing and marketing backyard storage sheds. Undertaking this project would require the construction of either a large or a small manufacturing plant. The market for the product produced – storage sheds – could either be favourable or unfavourable. The company has, of course, the option of not developing the new product at all.

Develop a decision tree for this situation.