

## Week 11 Seminar Tasks

### Probability Theory & Statistics

#### READING

Lecture 10-11 Notes (available on Blackboard)

Chapters 30, 31. Croft, T and Davison R (2016) *Foundation maths*, 6th ed. Harlow: Pearson.

#### TASK 1.

*See Lecture 10 Notes*

**Task 1.1.** Exercises 31.2 (1-7) from Chapter 31. Croft, T and Davison R (2016) *Foundation maths*, 6th ed. Harlow: Pearson.

#### Exercise 31.2



1. A die is thrown. Find
  - (a) the probability of obtaining a score less than 6
  - (b) the probability of obtaining a score more than 6
  - (c) the probability of obtaining an even score less than 5
  - (d) the probability of obtaining an even score less than 2
2. There are four Aces in a pack of 52 playing cards. What is the probability that a card selected at random is not an Ace?
3. A drawer contains six red socks, six black socks and eight blue socks. Find the probability that a sock selected at random from the drawer is
  - (a) black
  - (b) red
  - (c) red or blue
4. Two dice are thrown together and their scores are added together. By considering all the possible outcomes, find the probability that the total score will be
  - (a) 12
  - (b) 0
  - (c) 1
  - (d) 2
  - (e) more than 5
5. A basket contains 87 good apples and three bad ones. What is the probability that an apple chosen at random is bad?
6. A box contains 16 red blocks, 20 blue blocks, 24 orange blocks and 10 black blocks. A block is picked at random. Calculate the probability that the block is
  - (a) black
  - (b) orange
  - (c) blue
  - (d) red or blue
  - (e) red or blue or orange
  - (f) not orange
7. Three coins are tossed. By considering all possible outcomes calculate the probability of obtaining
  - (a) two heads and one tail
  - (b) at least two heads
  - (c) no heads

**Task 1.2.** Exercises 31.4 (1-4) from Chapter 31. Croft, T and Davison R (2016) Foundation maths, 6th ed. Harlow: Pearson.

#### **Exercise 31.4**

1. A die is thrown and a coin is tossed. What is the probability of getting an even score on the die and a tail?
2. Suppose you have two packs each of 52 playing cards. A card is drawn from the first and a card is drawn from the second. What is the probability that both cards are the Ace of Spades?
3. A coin is tossed eight times. What is the probability of obtaining eight tails?
4. A die is thrown four times. What is the probability of obtaining four '1's?

*NOTE:* You may find the solutions for the above exercises in the textbook.

## TASK 2.

*See Lecture 10 Notes*

**Task 2.1.** A fair die is rolled twice, and we obtain two numbers:  $X_1$  = “result of the first roll”, and  $X_2$  = “result of the second roll”. Let A and B be the events defined as follows: A is “ $X_1 < X_2$ ”; B is “You observe a 6 at least once”.

- Define the probability space, D, in set builder notation and its cardinality.
- Find the cardinality of event A represented as a subset of the probability space D. Find the probability of event A
- Find the cardinality of event B represented as a subset of the probability space D. Find the probability of event B.

**Task 2.2.** A fair die is rolled twice, and we get two numbers: X = “result of the first roll” and Y = “result of the second roll”.

- What is the probability that  $X = 4$
- What is the probability that  $Y = 4$
- What is the probability that both  $X = 4$  and  $Y = 4$

**Task 2.3.** A fair die is rolled twice, and we obtain two numbers:  $X_1$  = “result of the first roll”, and  $X_2$  = “result of the second roll”. Let A be the event that “ $X = 4$  or  $Y = 4$ ” and B be the event that “ $X + Y = 7$ ”.

- What is  $P(B)$ ?
- What is  $P(A \cap B)$ ?
- Given that the sum of the rolls of two dice (X and Y) is 7 (this is event B), what is the probability that either X or Y (or both) is 4 (this is event A)? In other words, if we already know that the sum of the two dice is 7, how likely is it that one of the dice shows a 4? Find the Conditional Probability  $P(A|B)$ .

### TASK 3. STATS BASICS

*See Lecture 11 Notes*

As part of a performance evaluation, a series of stress tests were conducted on a new software application. The dataset below records the time (in milliseconds) it took for the application to complete different tasks during these tests.

Dataset: Task Completion Times (in milliseconds)

Task	Time (ms)
T1	120
T2	115
T3	130
T4	110
T5	125
T6	105
T7	135
T8	95

You are required to manually calculate the following statistical measures to analyse the software's performance:

- **Mean:** Calculate the average task completion time.
- **Range:** Determine the range of task completion times.
- **Median:** Find the median task completion time, which represents the central tendency of the dataset.
- **Mode:** Identify the most frequent task completion time. If all times are unique, note that the dataset has no mode.
- **Standard Deviation:** Compute the standard deviation to gauge the consistency of the task completion times.
- **Variance:** Calculate the variance to measure the degree of spread in the task completion times.
- **Interquartile Range (IQR):** Determine the IQR to evaluate the spread of the middle 50% of the task completion times.