

# LAB EXERCISE 1

## QUESTION 1

Alice is playing Dungeons and Dragons, a game based around 20-sided dice. To beat a particularly tough monster, she must roll a number higher than the monster's armour rating of 15.

- a) What is the probability that Alice rolls above 15 on her 20-sided die?
- b) Suppose Alice is allowed to re-roll the die once, if she doesn't like the first result (in the game, this is called *advantage*). What is the probability that she rolls above 15 in *either* the first *or* the second roll?

## QUESTION 2

Consider a project with three critical tasks: A, B, and C. The probability of task A being completed on time is 0.8, task B is 0.7, and task C is 0.9. The tasks are independent. What is the probability that all three tasks are completed on time?

## QUESTION 3

In a manufacturing process, a company produces two types of products, A and B. The products may be defective (D) or non-defective (ND). The company has historical data on the occurrence of defects for each product type. The probabilities are as follows:

- Probability of a defective product given it is of type A is 0.03
- Probability of a defective product given it is of type B is 0.05
- Probability of selecting a product of type A is 0.6

What is the probability of selecting a product of type A *and* it being defective?

## QUESTION 4

Jeremy wants to know whether it will rain tomorrow. He checks the weather on two channels, A and B. The weatherman on channel A says the probability of rain is 70%; the weatherman on channel B says 40%. From previous experience, Jeremy believes the probability that channel A is correct to be 80%, and the probability that channel B is correct to be 60%. What is the probability that it will rain tomorrow (hint: use the law of total probability)?

## QUESTION 5

A company has developed a highly advanced AI system to detect fraudulent transactions. The developers are very proud. 95% of fraudulent transactions are flagged by the AI. The system unfortunately also flags 5% of legitimate transactions as fraudulent (false positives) – but as this number is quite low, the developers do not worry too much.

As it turns out, 1% of all transactions are actually fraudulent.

- a) If the system analyzes 10,000 transactions, how many would be flagged as fraudulent in total (including both true and false positives)?
- b) Out of those flagged, how many would actually be fraudulent? What proportion of flagged transactions are truly fraudulent?
- c) Explain why the rarity of fraud affects the reliability of the AI's prediction.