

4.5 Conditional Probability

Name: _____ Class: _____ Date: _____

Total: 9 marks

KEY WORDS multiplication rule 乘法法则 • conditional probability 条件概率 • probability 概率

Objective

Build the skills to answer exam questions on **conditional probability**.

You must be able to:

- calculate a **conditional probability** 条件概率, $P(A | B) = \frac{P(A \cap B)}{P(B)}$
- apply the **multiplication rule** 乘法法则, $P(A \cap B) = P(A) \cdot P(B | A)$

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ Conditional probability

$$P(A | B) = \frac{P(A \cap B)}{P(B)}$$

is the probability of A **given** that B has occurred.

■ Multiplication rule

$$P(A \cap B) = P(A) \cdot P(B | A).$$

■ Example

If $P(A \cap B) = 0.2$ and $P(B) = 0.5$, then $P(A | B) = \frac{0.2}{0.5} = 0.4$.

2 Practice

2.1 Write the formula for $P(A | B)$. [1]

2.2 If $P(A \cap B) = 0.12$ and $P(B) = 0.4$, find $P(A | B)$. [2]

2.3 State the multiplication rule.

[1]

3 Exam-style questions

3.1 $P(A \mid B)$ equals

[1]

- **A** $\frac{P(A \cap B)}{P(B)}$
- **B** $P(A) + P(B)$
- **C** $P(A) \cdot P(B)$
- **D** $\frac{P(B)}{P(A)}$

3.2 The multiplication rule gives $P(A \cap B) =$

[1]

- **A** $P(A) + P(B \mid A)$
- **B** $P(A) \cdot P(B \mid A)$
- **C** $\frac{P(A)}{P(B)}$
- **D** $P(A) - P(B)$

3.3 In a class, $P(\text{likes maths and science}) = 0.3$ and $P(\text{science}) = 0.6$.

(a) Find $P(\text{likes maths} \mid \text{science})$.

[2]

(b) Write the general formula for $P(A \mid B)$.

[1]

Solutions

$$\mathbf{2.1} \quad P(A \mid B) = \frac{P(A \cap B)}{P(B)}.$$

$$\mathbf{2.2} \quad P(A \mid B) = \frac{0.12}{0.4} = 0.3.$$

$$\mathbf{2.3} \quad P(A \cap B) = P(A) \cdot P(B \mid A).$$

3.1 A.

3.2 B.

$$\mathbf{3.3} \quad (\text{a}) \quad \frac{0.3}{0.6} = 0.5. \quad (\text{b}) \quad P(A \mid B) = \frac{P(A \cap B)}{P(B)}.$$