Probability

Skills sheet · SL AA 4.5 · 4.6 · 4.11

KEY FACTS

$P(A') = 1 - P(A)$; expected number $n\,P(A)$ D1

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$ P1

$P(A \mid B) = \dfrac{P(A \cap B)}{P(B)}$ D2

Independent: $P(A \cap B) = P(A)P(B)$ D3

Trees: multiply along, add across P2.

Exclusive is not independent W2.

Without replacement: the second stage changes.

WHAT UNLOCKS

- "or" $\rightarrow$ the addition rule, or a Venn diagram.
- "given that" $\rightarrow$ divide by the probability of the condition.
- two stages $\rightarrow$ a tree.
- "independent?" $\rightarrow$ compare $P(A \cap B)$ with $P(A)P(B)$.

WORKED EXAMPLE ①

$P(A) = 0.5$, $P(B) = 0.3$, $P(A \cap B) = 0.1$. **Find** $P(A \cup B)$. no GDC

$0.5 + 0.3 - 0.1$ (M1)

0.7 A1

Method

The addition rule

① Add the two probabilities.
② Take off the overlap once.
③ Check the answer is at most 1.

WORKED EXAMPLE ②

With the same events, find $P(A \mid B)$. no GDC

$\frac{0.1}{0.3}$ (M1)

$\frac{1}{3}$ A1

Method

A conditional probability

① Find $P(A \cap B)$.
② Divide by the condition.
③ Compare with $P(A)$.

Divide by $P(B)$***, not*** $P(A)$.

FLUENCY

●○○ **1.** A fair die: $P(\text{prime})$ no GDC

●○○ **2.** $P(A) = 0.35$: $P(A')$ no GDC

●○○ **3.** A fair die rolled 300 times: expected number of sixes no GDC

●○○ **4.** Mutually exclusive, $P(A) = 0.2$, $P(B) = 0.45$: $P(A \cup B)$ no GDC

●○○ **5.** Independent, $P(A) = 0.3$, $P(B) = 0.5$: $P(A \cap B)$ no GDC

●○○ **6.** $P(A \cap B) = 0.12$, $P(B) = 0.4$: $P(A \mid B)$ no GDC

REASONING

●●● **Question 1.** Two fair dice are rolled. [no GDC]

(a) Find the probability that the sum is 7. [1]

(b) Given that the sum is 8, find the probability of a double. [2]

●●● **Question 2.** Of 30 people, 18 drink tea, 14 drink coffee and 5 drink neither. [no GDC]

(a) Find the number who drink both. [2]

(b) Find the probability that a person drinks tea only. [1]

●●● **Question 3.** $P(A) = 0.6$, $P(B) = 0.5$ and $P(A \cup B) = 0.8$. [no GDC]

(a) Determine whether A and B are independent. [3]

PROBLEMS

●●● **Question 4.** 2 % of a population have a condition. A test is positive for 95 % of those who have it and for 10 % of those who do not. [with GDC]

(a) Find the probability that a person tests positive. [2]

(b) Given a positive test, find the probability that the person has the condition. [2]

●●● **Question 5.** A and B are independent, $P(A) = 0.4$ and $P(A \cup B) = 0.7$. [no GDC]

(a) Find $P(B)$. [3]

ANSWERS

1 $\frac{3}{6} = \frac{1}{2}$

2 0.65

3 50

4 0.65

5 0.15

6 0.3

Q1 (a) $\frac{6}{36} = \frac{1}{6}$ (b) $\frac{1}{5}$ (pairs 26, 35, 44, 53, 62)

Q2 (a) $18 + 14 - 25 = 7$ (b) $\frac{11}{30}$

Q3 $P(A \cap B) = 0.3 = 0.6 \times 0.5$: independent

Q4 (a) $0.02 \times 0.95 + 0.98 \times 0.1 = 0.117$ (b) $\frac{0.019}{0.117} = 0.162$

Q5 $0.4 + x - 0.4x = 0.7,\ x = 0.5$

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