

Venn diagrams and the addition law

About 55 minutes Calculator allowed 44 marks



Hints online, answers free with an account:
mathswariz.uk/worksheets/stats-venn-diagrams-and-the-addition-law/

Date _____

A Do Now

The first question is what today's lesson needs. The others bring back earlier topics.

- A1** Needed today [2 marks]

A biased dice is rolled 100 times and shows a six 25 times. It is rolled 1200 more times. Estimate how many sixes it shows.

A2 From chapter 6 [2 marks]

Kemi has the lengths of some phone calls in a grouped table only. Kemi works out an estimate of the mean, 40.8, and says it is exactly the mean of these values. Is Kemi right? Give a reason.

Answer

- A3** From chapter 9 [2 marks]

For a ski shop's sales, the trend line reads 345 at Q4 of year 2 and rises by 2 every quarter. The mean seasonal variation for Q3 is -34. Predict the sales for Q3 of year 3.

A4 From chapter 10 [2 marks]

Two sets of data on temperature and sales have PMCC 0.45 (set A) and -0.35 (set B). Jon says set A shows the stronger correlation. Is Jon right? Give a reason.

Answer

B Example, then your turn

Your teacher works through each example with you. Then try the one beside it.

EXAMPLE 1

Spinner *A* is numbered 1 to 4 and spinner *B* is numbered 1 to 3. Both are spun and the scores are added. Work out the probability that the total is 5.

Hint List every pair of scores in a table: 4 rows and 3 columns.

- B1** Two fair dice are rolled. Work out the probability that the difference between the two scores is 3 or more. [2 marks]

Answer

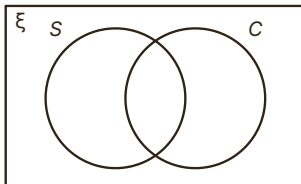
EXAMPLE 2

In a town, $P(\text{dog}) = 0.35$, $P(\text{cat}) = 0.25$ and $P(\text{dog and cat}) = 0.08$ for a household. Work out $P(\text{dog or cat})$ and $P(\text{neither})$.

Hint Households with both are counted twice if you just add.

EXAMPLE 3

A gym has 120 members. 58 use the pool (S), 47 go to classes (C) and 34 do neither. (a) Complete the Venn diagram. (b) Work out $P(C \cap S')$. (c) Describe in words the members in $S \cap C'$.

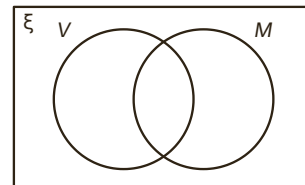


Hint Start with neither: $120 - 34 = 86$ members are inside the circles.

- B2** At a shop, the probability that a customer buys bread is 0.55, buys milk is 0.4 and buys both is 0.22. Work out the probability that a customer buys neither bread nor milk. [3 marks]

Answer

- B3** A vet sees 90 dogs. 52 are vaccinated (V), 31 are microchipped (M) and 23 are neither. [2 marks]



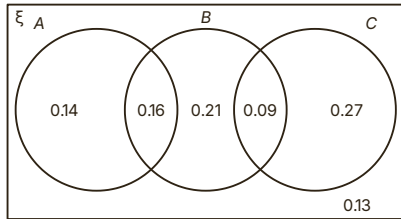
- (a) Complete the Venn diagram. [2 marks]
- (b) One of the dogs is chosen at random. Work out $P(M \cap V')$. [1 mark]

Answer

Total for B3: 3 marks

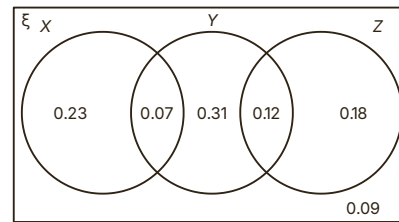
EXAMPLE 4

The Venn diagram shows the probabilities of three events A , B and C . (a) Which two events are mutually exclusive? Give a reason. (b) Are A , B and C exhaustive? Give a reason. (c) Work out $P(A \cup C)$.



Hint Mutually exclusive events have no overlap. Exhaustive events cover every outcome.

B4 The Venn diagram shows the probabilities of three events X , Y and Z .



(a) Which two events are mutually exclusive? Give a reason. [2 marks]

(b) Are X , Y and Z exhaustive? Give a reason. [1 mark]

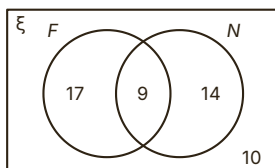
(c) Work out $P(X \cup Z)$. [2 marks]

Answer

Total for B4: 5 marks

c Practice

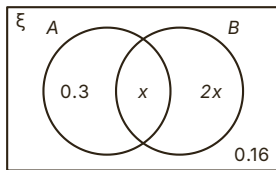
C1 The Venn diagram shows 50 library members and whether they borrowed fiction (F) or non-fiction (N). One is chosen at random. Work out $P(F \cup N')$. [2 marks]



Answer

C2 For two events, $P(A) = 0.45$, $P(B) = 0.3$ and $P(A \cup B) = 0.75$. Are A and B mutually exclusive? Are they exhaustive? Give a reason for each answer. [2 marks]

- C3** The Venn diagram shows the probabilities of two events A and B . Work out $P(B)$.



[3 marks]

- C4** Two fair four-sided dice, each numbered 1 to 4, are rolled and the scores are multiplied. Work out the probability that the result is a square number.

[2 marks]

Answer

Answer

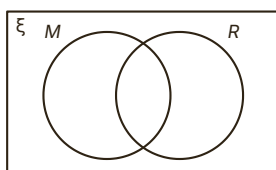
D Exam-style questions

- D1** In a club, the probability that a member plays football is 0.42, plays tennis is 0.31 and plays both is 0.12. Ola says, "The probability that a member plays football or tennis is $0.42 + 0.31 = 0.73$."

[2 marks]

Is Ola correct? You must show your working.

- D2** Ivan asks 75 people on a train platform whether they listen to music (M) and whether they read (R) on the train. 49 listen to music, 31 read, 19 do both and the rest do neither.



- (a) Complete the Venn diagram.

[2 marks]

- (b) One of the 75 people is chosen at random. Work out $P(M' \cap R)$.

[2 marks]

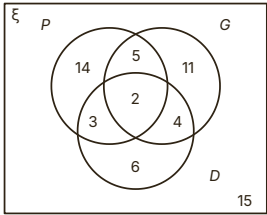
Answer

- (c) Ivan says, "More than half of all train passengers listen to music." Comment on Ivan's statement.

[2 marks]

Total for D2: 6 marks

D3 The Venn diagram shows the 60 students at a music school who play the piano (P), the guitar (G) or the drums (D).



(a) Describe in words the students in the region that holds 4. [1 mark]

(b) A student is chosen at random. Work out the probability that the student plays at least two of the instruments. [2 marks]

Answer

Total for D3: 3 marks

E Extension

No route is given. The hints are at the end of the sheet. Use one at a time.

E1 For two events, $P(A) = 2P(B)$ and $P(A \cap B) = 0.1$. The probability that neither A nor B happens is 0.2. Work out the probability that exactly one of A and B happens. [3 marks]

Answer

Extension hints

Cover these with paper. Uncover one at a time.

- E1 **Hint 1** Write $P(A \cup B)$ in two ways.
- Hint 2** $P(A \cup B) = 1 - 0.2 = 0.8$, and also $2P(B) + P(B) - 0.1$.
- Hint 3** $3P(B) = 0.9$, so $P(B) = 0.3$. Exactly one is $P(A \cup B) - P(A \cap B) = 0.8 - 0.1 = 0.7$.

How did it go?

Colour one circle on each line: not yet, nearly, yes.

- I can complete a Venn diagram, including the region outside the circles, and use it. ☐ ☐ ☒
- I can use the addition law and decide whether events are mutually exclusive or exhaustive. ☐ ☐ ☒
- I can read and write set notation and describe a region in words. ☐ ☐ ☒