A-LEVEL MATHS (EDEXCEL 9MA0) · STATISTICS YEAR 1 · CHAPTER 5: PROBABILITY · A* EXAM PRACTICE

Hints online, answers free with an account:
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Probability: A* questions

73 marks

Date

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X A* exam questions

A to A*

Extended Edexcel-style questions. Show every step. The hints are at the end of the sheet. Use one at a time.

X1 The events A, B and C have $\mathrm{P}(A) = 0.4$, $\mathrm{P}(B) = 0.5$ and $\mathrm{P}(C) = 0.3$. The events A and B are independent, and the events A and C are independent. The probability that all three events happen is 0.05, and the probability that none of them happens is 0.22.

(a) Find $\mathrm{P}(A \text{ and } B)$ and $\mathrm{P}(A \text{ and } C)$. [2 marks]

Answer .....

(b) Show that $\mathrm{P}(B \text{ and } C) = 0.15$. [4 marks]

Answer .....

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(c) Determine whether B and C are independent. Give a reason. [2 marks]

Answer .....

(d) Find the probability that exactly one of the three events happens. [3 marks]

Answer .....

Total for X1: 11 marks

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X2 A machine has three components, A, B and C, which work or fail independently. The machine works when A works and at least one of B and C works. The probabilities that A, B and C work are 0.9, 0.8 and p. The probability that the machine works is 0.846. Find p. Find the probability that exactly one of the three components fails, and the probability that exactly one component fails and the machine still works. [8 marks]

Answer .....

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X3 A climber makes up to three attempts to climb a wall. She stops as soon as she succeeds, or after three attempts. The probability that she succeeds on her first attempt is p. If she fails, the probability of success on her second attempt is $p + 0.1$, and if she fails again, the probability of success on her third attempt is $p + 0.2$. The probability that she fails all three attempts is 0.12.

(a) Show that $50p^3 - 135p^2 + 121p - 30 = 0$, and hence find the value of p, explaining why there is only one possible value. [4 marks]

Answer .....

(b) Find the probability that she succeeds on her second attempt. [2 marks]

Answer .....

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(c) Find the probability that she makes more than one attempt. [2 marks]

Answer .....

(d) She climbs the wall on two different days, independently. Find the probability that she makes more attempts on the first day than on the second day. [4 marks]

Answer .....

Total for X3: 12 marks

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X4 The events A and B are independent. The probability that both happen is 0.18, and the probability that neither happens is 0.32. Given that $\mathrm{P}(A) > \mathrm{P}(B)$, find $\mathrm{P}(A)$ and $\mathrm{P}(B)$. [8 marks]

Answer .....

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X5 A bag contains 3 red counters, 4 green counters and n blue counters. Three counters are taken from the bag at random, without replacement. The probability that the three counters are all different colours is $\frac{3}{11}$.

(a) Show that $n^3 + 18n^2 - 157n + 210 = 0$. [4 marks]

Answer .....

(b) Find the value of n, showing that there is only one possible value. [3 marks]

Answer .....

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(c) Find the probability that the three counters are all the same colour. [2 marks]

Answer .....

(d) Find the probability that at least two of the three counters are green. [3 marks]

Answer .....

Total for X5: 12 marks

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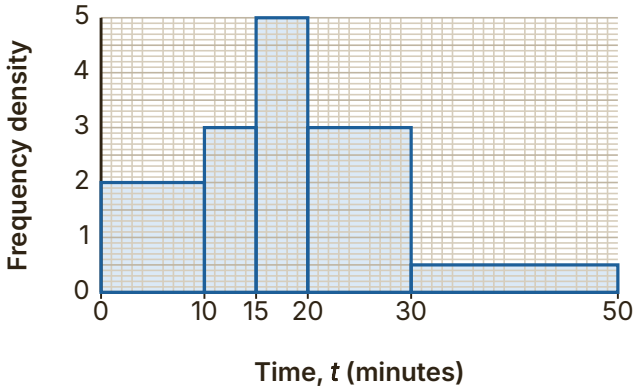
X6 The histogram shows the times, in minutes, that 100 customers spent in a shop. A customer is chosen at random.

(a) Find the probability that the customer spent at least 20 minutes in the shop. [2 marks]



Answer .....

(b) Estimate the probability that the customer spent between 12 and 25 minutes in the shop. [3 marks]

Answer .....

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(c) Two customers are chosen at random. Find the probability that both spent less than 15 minutes in the shop. [3 marks]

Answer .....

(d) The event L is "the customer spent less than 15 minutes" and the event M is "the customer spent at least 10 minutes". Determine whether L and M are independent. [3 marks]

Answer .....

Total for X6: 11 marks

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X7 When Nia serves in tennis, the probability that her first serve is in is 0.6. If her first serve is out, she has a second serve, and the probability that her second serve is in is 0.85. If both serves are out she loses the point. When her first serve is in, she wins the point with probability 0.7. When her second serve is in, she wins the point with probability 0.45.

(a) Show that the probability that Nia wins a point on her serve is 0.573. [3 marks]

Answer .....

(b) Determine whether the events "her first serve is in" and "she wins the point" are independent. [3 marks]

Answer .....

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(c) Assuming points are independent, find the probability that she wins exactly one of her next two service points. [2 marks]

Answer .....

(d) Her coach says that if she improves her second serve, so that it is in with probability s, she will win more than 60% of her service points. Assuming the other probabilities stay the same, show that the coach is wrong. [3 marks]

Answer .....

Total for X7: 11 marks

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F How did it go?

Colour one circle on each line.

	Not yet	Nearly	Yes
I can use the addition rule for three events and independence to fill a Venn diagram.	○	○	○
I can form and solve an equation (quadratic or cubic) for an unknown probability and reject impossible roots.	○	○	○
I can find probabilities for draws without replacement and for trees with a stop rule.	○	○	○
I can test two events for independence using numbers and give a conclusion.	○	○	○

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Hints

Use one hint at a time. Cover the ones below it with a sheet of paper.

X1

Hint 1 For independent events, $\mathrm{P}(A \text{ and } B) = \mathrm{P}(A) \times \mathrm{P}(B)$. The probability that at least one event happens is $1 - 0.22$.

Hint 2 For three events, $\mathrm{P}(A \text{ or } B \text{ or } C)$ is the three single probabilities, minus the three pair totals, plus the probability of all three. Draw a Venn diagram to see why.

Hint 3 Fill a Venn diagram from the centre: each pair total minus 0.05, then each single probability minus everything else inside its circle.

X2

Hint 1 B and C both fail with probability $0.2(1 - p)$, so at least one of them works with probability $1 - 0.2(1 - p)$. The machine also needs A.

Hint 2 "Exactly one fails" is three separate cases. In each, one component fails and the other two work.

Hint 3 Look at each of the three cases in turn: does the machine still work when only that component fails?

X3

Hint 1 To fail all three she fails each attempt in turn: $(1 - p)$, then $1 - (p + 0.1)$, then $1 - (p + 0.2)$. Multiply and expand.

Hint 2 Try $p = 0.4$ in the cubic, then divide by $(5p - 2)$ and look at the discriminant of what is left.

Hint 3 She makes three attempts whenever the first two fail, whatever happens on the third. List the pairs (day 1, day 2) where day 1 is larger.

X4

Hint 1 "Neither" is the complement of "A or B". Write $\mathrm{P}(A \text{ or } B)$ in terms of a, b and ab.

Hint 2 You now know $a + b$ and ab. Substitute $b = 0.86 - a$ into $ab = 0.18$.

Hint 3 The quadratic gives both probabilities at once. Use $\mathrm{P}(A) > \mathrm{P}(B)$ to decide which is which.

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X5

Hint 1 Work out the probability for one order, say red then green then blue. Each of the six orders has the same probability.

Hint 2 Try small whole numbers in the cubic. Once you have one root, divide to get a quadratic.

Hint 3 For "at least two green", add "exactly two green" (the non-green counter can come first, second or third) and "three green".

X6

Hint 1 The area of each bar is its frequency. Multiply each height by its class width.

Hint 2 From 12 to 15 is 3 of the 5 minutes of the class $10 \leqslant t < 15$, so take $\frac{3}{5}$ of its frequency. Do the same for 20 to 25.

Hint 3 The second customer is chosen from 99. For (d), "L and M" is the class $10 \leqslant t < 15$.

X7

Hint 1 Draw a tree: first serve in or out; if out, second serve in or out; then win or lose. There are two routes to winning.

Hint 2 Two events are independent when the probability of both is the product of their probabilities. Find "first in and wins" from one branch of the tree.

Hint 3 Write the probability of winning with s in place of 0.85. Even $s = 1$ only reaches 0.6.

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