2.3 Statistics: Probability: Test Pack

EDEXCEL 9MA0 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A machine in a factory produces items in batches of 20. A quality inspector models the number of defective items in a randomly chosen batch, D, using the distribution D ~ B(20, 0.05).

(a) State two assumptions needed for this binomial model to be a suitable model for D. **(2)**

(b) Using this model, calculate P(D = 2), giving your answer to 3 significant figures. **(3)**

(Total for Question 1 is 5 marks)

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2 For two events A and B, P(A) = 0.3, P(B) = 0.45 and P(A or B) = 0.65.

(a) Find P(A and B). **(2)**

(b) Show that A and B are not independent. **(3)**

(c) State, with a reason, whether A and B could be mutually exclusive. **(2)**

(Total for Question 2 is 7 marks)

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3 A bag contains 3 red counters and 5 blue counters. Two counters are taken at random from the bag, one after the other, without replacement.

(a) Draw a tree diagram, labelling each branch with its probability, and state the probability that both counters are red. **(4)**

(b) Find the probability that the two counters are the same colour. **(2)**

(c) Given that the two counters are different colours, find the probability that the first counter was red. **(2)**

(Total for Question 3 is 8 marks)

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4 The events A and B are independent, with P(A) = 1/4 and P(B) = 2/3.

(a) Find P(A and B) and P(A or B). **(4)**

(b) The independent events C and D satisfy P(D) = 2/3 and P(C or D) = 3/4. Find P(C). **(3)**

(c) Find P(A | B') and state what this shows about A and B. **(3)**

(Total for Question 4 is 10 marks)

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5 For events A and B, $P(A) = 0.4$, $P(B) = 0.35$ and $P(A \mid B) = 0.6$.

(a) Find $P(A \text{ and } B)$. **(2)**

(b) Find $P(B \mid A)$. **(2)**

(c) Find $P(A \text{ or } B)$. **(2)**

(d) Determine whether A and B are independent. **(2)**

(Total for Question 5 is 8 marks)

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6 A factory uses two machines to produce components. Machine A produces 60% of all components and Machine B produces the remaining 40%. Machine A produces defective components at a rate of 3%, and Machine B produces defective components at a rate of 5%.

(a) Find the probability that a randomly selected component is defective. **(3)**

(b) Given that a component is defective, find the probability that it was produced by Machine B. **(3)**

(c) Two components are selected independently at random. Find the probability that exactly one of the two components is defective. **(3)**

(Total for Question 6 is 9 marks)

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Mark scheme · 2.3 Statistics: Probability: Test Pack

Question 1

(a) the probability that an item is defective is constant for every item in the batch, oe **B1**

(a) whether one item is defective is independent of whether any other item is defective, oe **B1**

(a) Answer: Any two of: constant probability of an item being defective for each item; items are defective independently of one another; fixed number of items n = 20; only two outcomes (defective or not defective)

(b) use of binomial formula with correct combination, e.g. $20C2 \times 0.05^2 \times 0.95^{18}$ **M1**

(b) correct substitution: $190 \times 0.0025 \times 0.95^{18}$ **M1**

(b) awrt 0.189 **A1**

(b) Answer: P(D = 2) = 0.189 (3 s.f.)

Question 2

(a) P(A) + P(B) - P(A or B) **M1**

(a) cao 0.10 **A1**

(a) Answer: P(A and B) = 0.10

(b) compute P(A) x P(B) = 0.3 x 0.45 **M1**

(b) P(A) x P(B) = 0.135, compared with P(A and B) = 0.10 (ft from a) **A1**

(b) cso: since 0.135 does not equal 0.10, A and B are not independent **A1**

(b) Answer: Not independent, since P(A)P(B) = 0.135 not equal to P(A and B) = 0.10

(c) No **B1**

(c) reason: since P(A and B) = 0.10, which is not equal to 0 (mutually exclusive events would require P(A and B) = 0), oe **B1**

(c) Answer: No, since P(A and B) = 0.10 not equal to 0

Question 3

(a) first branches 3/8 (red) and 5/8 (blue) **B1**

(a) second branches 2/7, 5/7 after red; 3/7, 4/7 after blue **B1**

(a) P(RR) = 3/8 x 2/7 **M1**

(a) 3/28 **A1**

(a) Answer: 3/28

(b) P(RR) + P(BB) **M1**

(b) 13/28 **A1**

(b) Answer: 13/28

(c) conditional probability: P(RB)/P(different) **M1**

(c) 1/2 **A1**

(c) Answer: 1/2

Question 4

(a) independent so P(A and B) = P(A) x P(B) **M1**

(a) 1/6 **A1**

(a) P(A or B) = P(A) + P(B) - P(A and B) **M1**

(a) 3/4 **A1**

(a) Answer: P(A and B) = 1/6, P(A or B) = 3/4

(b) forms p + 2/3 - 2/3p = 3/4 **M1**

(b) rearranges: p(1 - 2/3) = 1/12 **M1**

(b) P(C) = 1/4 **A1**

(b) Answer: P(C) = 1/4

(c) P(A | B') = P(A and B')/P(B') = P(A)P(B')/P(B') **M1**

(c) 1/4 **A1**

(c) it equals P(A), confirming that A and B are independent **B1**

(c) Answer: 1/4

Question 5

(a) P(A|B) x P(B) **M1**

(a) cao 0.21 **A1**

(a) Answer: P(A and B) = 0.21

(b) P(A and B) / P(A), following through from part (a) **M1ft**

(b) cao 0.525 **A1**

(b) Answer: P(B | A) = 0.525

(c) P(A) + P(B) - P(A and B), following through from part (a) **M1ft**

(c) cao 0.54 **A1**

(c) Answer: P(A or B) = 0.54

(d) compute P(A) x P(B) = 0.4 x 0.35 = 0.14 **M1**

(d) cso: since 0.14 does not equal 0.21 (=P(A and B) from a), A and B are not independent **A1**

(d) Answer: Not independent, since P(A)P(B) = 0.14 not equal to P(A and B) = 0.21

Question 6

(a) P(D) = P(A)P(D|A) + P(B)P(D|B) **M1**

(a) correct substitution: 0.6 x 0.03 + 0.4 x 0.05 **M1**

(a) cao 0.038 **A1**

(a) Answer: P(defective) = 0.038

(b) P(B and D) = 0.4 x 0.05 = 0.02 **M1**

(b) P(B and D) / P(D), following through from part (a) **M1ft**

(b) cao 10/19 (awrt 0.526) **A1**

(b) Answer: P(Machine B | defective) = 10/19 (awrt 0.526)

(c) 2 x P(D) x P(D'), oe, using P(D) ft from a **M1**

(c) correct substitution: 2 x 0.038 x 0.962 **M1**

(c) awrt 0.0731 **A1**

(c) Answer: P(exactly one defective) = 0.0731 (3 s.f.)

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