



H07-test The Binomial Distribution: Test Pack

EDEXCEL 1ST0 · Calculator allowed · about 25 minutes

Total Marks

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

- 1** A random variable X can only be modelled by a binomial distribution if certain conditions apply to the trials being carried out. State the condition described in each part below.
- (a) State a condition on the number of trials. (1)
- (b) State a condition on the possible outcomes of each trial. (1)
- (c) State a condition on the probability of success. (1)
- (d) State a condition on how the trials relate to each other. (1)

(Total for Question 1 is 4 marks)

2 A machine produces small bolts. Historical records show that 6% of the bolts produced are undersized. On a particular day, the machine produces 250 bolts. Let X be the number of undersized bolts among the 250, so that $X \sim B(250, 0.06)$.

(a) State two assumptions, in the context of this machine, that must hold for X to be modelled in this way. (2)

(b) Calculate $E(X)$, the mean number of undersized bolts expected among the 250 bolts produced that day. (2)

(c) After a repair to the machine, the mean number of undersized bolts per batch of 250 falls to 10. Find the new value of p , the probability that an individual bolt is undersized. (2)

(Total for Question 2 is 6 marks)

3 At a garden centre, 90% of tomato seeds germinate, independently of each other. A gardener plants 6 seeds in tray A and, separately, 6 seeds in tray B. Let X be the number of seeds that germinate in tray A, so that $X \sim B(6, 0.9)$.

(a) Find $P(X = 6)$, the probability that all 6 seeds in tray A germinate. (2)

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(b) The number of seeds that germinate in tray B is independent of tray A. Find the probability that all 6 seeds germinate in both trays. (2)

.....
(c) Find $P(X = 5)$, the probability that exactly 5 of the 6 seeds in tray A germinate. (3)

.....
(d) State, with a reason, whether it is more likely that exactly 5 seeds germinate in tray A or that exactly 6 seeds germinate in tray A. (1)

(Total for Question 3 is 8 marks)

4 A biased coin has $P(\text{Heads}) = p$ on each throw. The coin is thrown 5 times. Let X be the number of heads obtained.

(a) Show that $P(X = 2) = 10 p^2 (1 - p)^3$, as required. (2)

(b) Given that $p = 0.4$, use your expression from part (a) to find the value of $P(X = 2)$. (3)

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(Total for Question 4 is 5 marks)

Mark scheme · H07-test The Binomial Distribution: Test Pack

Question 1

- (a) **B1** there must be a fixed (known) number of trials, n
- (a) **Answer: There must be a fixed number of trials, n .**
- (b) **B1** each trial must have exactly two possible outcomes, usually called success and failure
- (b) **Answer: Each trial must have exactly two possible outcomes (success or failure).**
- (c) **B1** the probability of success, p , must be constant (the same) for every trial
- (c) **Answer: The probability of success, p , must be the same for every trial.**
- (d) **B1** the trials must be independent of one another
- (d) **Answer: The trials must be independent of one another.**

Question 2

- (a) **B1** each bolt is undersized (or not) independently of the other bolts
- (a) **B1** the probability that a bolt is undersized stays constant at 6% throughout the day's production
- (a) **Answer: Each bolt's outcome is independent of the others; the probability of a bolt being undersized stays at 6% throughout production.**
- (b) **M1** 250×0.06 , oe $(E(X) = np)$
- (b) **A1** 15 cao
- (b) **Answer: 15**
- (c) **M1** $250p = 10$, oe (uses $E(X) = np$)
- (c) **A1** $p = 0.04$ oe cao
- (c) **Answer: 0.04**

Question 3

- (a) **M1** $6C6 = 1$ and 0.9^6 , oe
- (a) **A1** awrt 0.531
- (a) **Answer: 0.531 (awrt)**
- (b) **M1** 0.531441^2 , oe (squares the answer to part (a) using independence)
- (b) **A1** awrt 0.282
- (b) **Answer: 0.282 (awrt)**
- (c) **M1** $6C5 = 6$ identified
- (c) **M1** $6 \times 0.9^5 \times 0.1$, oe substitution
- (c) **A1** awrt 0.354
- (c) **Answer: 0.354 (awrt)**
- (d) **B1** 6 seeds germinating, since $P(X = 6)$ awrt 0.531 is greater than $P(X = 5)$ awrt 0.354
- (d) **Answer: 6 seeds germinating is more likely, since 0.531 is greater than 0.354.**

Question 4

- (a) **M1** $5C2 = 10$ identified
- (a) **A1** correctly shows $P(X = 2) = 10 p^2 (1-p)^3$, matching the given expression
- (a) **Answer: $10 p^2 (1 - p)^3$**
- (b) **M1** substitutes $p = 0.4$: $10 \times 0.4^2 \times 0.6^3$
- (b) **M1** $0.4^2 = 0.16$ and $0.6^3 = 0.216$ evaluated
- (b) **A1** 0.346 awrt (or exact 0.3456)
- (b) **Answer: 0.3456 (= 0.346 to 3 s.f.)**