

Binomial Distribution

Question Paper 4

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|-------------------|---------------------------|
| Level | International A Level |
| Subject | Maths |
| Exam Board | CIE |
| Topic | Discrete random variables |
| Sub Topic | Binomial Distribution |
| Booklet | Question Paper 4 |

Time Allowed: 80 minutes

Score: / 66

Percentage: /100

Grade Boundaries:

| A* | A | B | C | D | E | U |
|------|--------|-----|-------|-------|-----|------|
| >85% | '77.5% | 70% | 62.5% | 57.5% | 45% | <45% |

1 On a production line making cameras, the probability of a randomly chosen camera being substandard is 0.072. A random sample of 300 cameras is checked. Find the probability that there are fewer than 18 cameras which are substandard. [5]

2 (i) State three conditions which must be satisfied for a situation to be modelled by a binomial distribution. [2]

George wants to invest some of his monthly salary. He invests a certain amount of this every month for 18 months. For each month there is a probability of 0.25 that he will buy shares in a large company, there is a probability of 0.15 that he will buy shares in a small company and there is a probability of 0.6 that he will invest in a savings account.

(ii) Find the probability that George will buy shares in a small company in at least 3 of these 18 months. [3]

3 Fiona uses her calculator to produce 12 random integers between 7 and 21 inclusive. The random variable X is the number of these 12 integers which are multiples of 5.

(i) State the distribution of X and give its parameters. [3]

(ii) Calculate the probability that X is between 3 and 5 inclusive. [3]

Fiona now produces n random integers between 7 and 21 inclusive.

(iii) Find the least possible value of n if the probability that none of these integers is a multiple of 5 is less than 0.01. [3]

4 Robert uses his calculator to generate 5 random integers between 1 and 9 inclusive.

(i) Find the probability that at least 2 of the 5 integers are less than or equal to 4. [3]

Robert now generates n random integers between 1 and 9 inclusive. The random variable X is the number of these n integers which are less than or equal to a certain integer k between 1 and 9 inclusive. It is given that the mean of X is 96 and the variance of X is 32.

(ii) Find the values of n and k . [4]

5 In a certain country, on average one student in five has blue eyes.

(i) For a random selection of n students, the probability that none of the students has blue eyes is less than 0.001. Find the least possible value of n . [3]

(ii) For a random selection of 120 students, find the probability that fewer than 33 have blue eyes. [4]

6 In Scotland, in November, on average 80% of days are cloudy. Assume that the weather on any one day is independent of the weather on other days.

(i) Use a normal approximation to find the probability of there being fewer than 25 cloudy days in

Scotland in November (30 days). [4]

(ii) Give a reason why the use of a normal approximation is justified. [1]

- 7 On a certain road 20% of the vehicles are trucks, 16% are buses and the remainder are cars.
- (i) A random sample of 11 vehicles is taken. Find the probability that fewer than 3 are buses. [3]
 - (ii) A random sample of 125 vehicles is now taken. Using a suitable approximation, find the probability that more than 73 are cars. [5]
- 8 The probability that New Year's Day is on a Saturday in a randomly chosen year is $\frac{1}{7}$.
- (i) 15 years are chosen randomly. Find the probability that at least 3 of these years have New Year's Day on a Saturday. [4]
 - (ii) 56 years are chosen randomly. Use a suitable approximation to find the probability that more than 7 of these years have New Year's Day on a Saturday. [5]
- 9 A shop sells old video tapes, of which 1 in 5 on average are known to be damaged.
- (i) A random sample of 15 tapes is taken. Find the probability that at most 2 are damaged. [3]
 - (ii) Find the smallest value of n if there is a probability of at least 0.85 that a random sample of n tapes contains at least one damaged tape. [3]
 - (iii) A random sample of 1600 tapes is taken. Use a suitable approximation to find the probability that there are at least 290 damaged tapes. [5]