Edexcel Maths S2

Topic Questions from Papers

Binomial Distribution

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1. It is estimated that 4% of people have green eyes. In a random sample of size n, the expected number of people with green eyes is 5.

(a) Calculate the value of n.

(3)

The expected number of people with green eyes in a second random sample is 3.

(b) Find the standard deviation of the number of people with green eyes in this second sample.

(4)

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5. In a manufacturing process, 2% of the articles produced are defective. A batch of 200 articles is selected.

(a) Giving a justification for your choice, use a suitable approximation to estimate the probability that there are exactly 5 defective articles.

(5)

(b) Estimate the probability there are less than 5 defective articles.

(2)

Leave blank

5. A manufacturer produces large quantities of coloured mugs. It is known from previous records that 6% of the production will be green.

A random sample of 10 mugs was taken from the production line.

(a) Define a suitable distribution to model the number of green mugs in this sample.

(1)

(b) Find the probability that there were exactly 3 green mugs in the sample.

(3)

A random sample of 125 mugs was taken.

(c) Find the probability that there were between 10 and 13 (inclusive) green mugs in this sample, using

(i) a Poisson approximation,

(3)

(ii) a Normal approximation.

(6)

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Question 5 continued

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2. The random variable J has a Poisson distribution with mean 4.

(a) Find P($J \geqslant 10$).

(2)

The random variable K has a binomial distribution with parameters $n = 25$, $p = 0.27$.

(b) Find P($K \leqslant 1$).

(3)

Q2

(Total 5 marks)

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3. For a particular type of plant 45% have white flowers and the remainder have coloured flowers. Gardenmania sells plants in batches of 12. A batch is selected at random.

Calculate the probability that this batch contains

(a) exactly 5 plants with white flowers,

(3)

(b) more plants with white flowers than coloured ones.

(2)

Gardenmania takes a random sample of 10 batches of plants.

(c) Find the probability that exactly 3 of these batches contain more plants with white flowers than coloured ones.

(3)

Due to an increasing demand for these plants by large companies, Gardenmania decides to sell them in batches of 50.

(d) Use a suitable approximation to calculate the probability that a batch of 50 plants contains more than 25 plants with white flowers.

(7)

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Question 3 continued

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7. (a) (i) Write down two conditions for $X \sim \text{Bin}(n, p)$ to be approximated by a normal distribution $Y \sim \text{N}(\mu, \sigma^2)$.

(2)

(ii) Write down the mean and variance of this normal approximation in terms of n and p.

(2)

A factory manufactures 2000 DVDs every day. It is known that 3% of DVDs are faulty.

(b) Using a normal approximation, estimate the probability that at least 40 faulty DVDs are produced in one day.

(5)

The quality control system in the factory identifies and destroys every faulty DVD at the end of the manufacturing process. It costs £0.70 to manufacture a DVD and the factory sells non-faulty DVDs for £11.

(c) Find the expected profit made by the factory per day.

(3)

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Question 7 continued

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2. The probability of a bolt being faulty is 0.3. Find the probability that in a random sample of 20 bolts there are

(a) exactly 2 faulty bolts,

(2)

(b) more than 3 faulty bolts.

(2)

These bolts are sold in bags of 20. John buys 10 bags.

(c) Find the probability that exactly 6 of these bags contain more than 3 faulty bolts.

(3)

Leave blank

2. In a large college 58% of students are female and 42% are male. A random sample of 100 students is chosen from the college. Using a suitable approximation find the probability that more than half the sample are female.

(7)

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5. A factory produces components of which 1% are defective. The components are packed in boxes of 10. A box is selected at random.

(a) Find the probability that the box contains exactly one defective component.

(2)

(b) Find the probability that there are at least 2 defective components in the box.

(3)

(c) Using a suitable approximation, find the probability that a batch of 250 components contains between 1 and 4 (inclusive) defective components.

(4)

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1. A bag contains a large number of counters of which 15% are coloured red. A random sample of 30 counters is selected and the number of red counters is recorded.

(a) Find the probability of no more than 6 red counters in this sample.

(2)

A second random sample of 30 counters is selected and the number of red counters is recorded.

(b) Using a Poisson approximation, estimate the probability that the total number of red counters in the combined sample of size 60 is less than 13.

(3)

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1. A manufacturer supplies DVD players to retailers in batches of 20. It has 5% of the players returned because they are faulty.

(a) Write down a suitable model for the distribution of the number of faulty DVD players in a batch.

(2)

Find the probability that a batch contains

(b) no faulty DVD players,

(2)

(c) more than 4 faulty DVD players.

(2)

(d) Find the mean and variance of the number of faulty DVD players in a batch.

(2)

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2. Bhim and Joe play each other at badminton and for each game, independently of all others, the probability that Bhim loses is 0.2

Find the probability that, in 9 games, Bhim loses

(a) exactly 3 of the games,

(3)

(b) fewer than half of the games.

(2)

Bhim attends coaching sessions for 2 months. After completing the coaching, the probability that he loses each game, independently of all others, is 0.05

Bhim and Joe agree to play a further 60 games.

(c) Calculate the mean and variance for the number of these 60 games that Bhim loses.

(2)

(d) Using a suitable approximation calculate the probability that Bhim loses more than 4 games.

(3)

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1. A disease occurs in 3% of a population.

(a) State any assumptions that are required to model the number of people with the disease in a random sample of size n as a binomial distribution.

(2)

(b) Using this model, find the probability of exactly 2 people having the disease in a random sample of 10 people.

(3)

(c) Find the mean and variance of the number of people with the disease in a random sample of 100 people.

(2)

A doctor tests a random sample of 100 patients for the disease. He decides to offer all patients a vaccination to protect them from the disease if more than 5 of the sample have the disease.

(d) Using a suitable approximation, find the probability that the doctor will offer all patients a vaccination.

(3)

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5. The probability of an electrical component being defective is 0.075
The component is supplied in boxes of 120

(a) Using a suitable approximation, estimate the probability that there are more than 3 defective components in a box.

(5)

A retailer buys 2 boxes of components.

(b) Estimate the probability that there are at least 4 defective components in each box.

(2)

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Question 5 continued

Q5

(Total 7 marks)

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8. In a large restaurant an average of 3 out of every 5 customers ask for water with their meal.

A random sample of 10 customers is selected.

(a) Find the probability that

(i) exactly 6 ask for water with their meal,

(ii) less than 9 ask for water with their meal.

(5)

A second random sample of 50 customers is selected.

(b) Find the smallest value of n such that

$$P(X < n) \geqslant 0.9$$

where the random variable X represents the number of these customers who ask for water.

(3)

Leave blank

Question 8 continued

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3. A random variable X has the distribution B(12, p).

(a) Given that $p = 0.25$ find

(i) $P(X < 5)$

(ii) $P(X \geqslant 7)$

(3)

(b) Given that $P(X = 0) = 0.05$, find the value of p to 3 decimal places.

(3)

(c) Given that the variance of X is 1.92, find the possible values of p.

(4)

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Question 3 continued