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1. (a) Explain what you understand by a census. (1)

(b) Give one reason, other than to save time and cost, why a sample is taken rather than a census. (1)

(c) Suggest a suitable sampling frame from which to obtain this sample. (1)

(d) Identify the sampling units. (1)

(Total 4 marks)

Q1

Turn over

- (b) more than 3 faulty bolts. (2)

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

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Question 2 continued

Lined area for writing the answer to Question 2.

(Total 7 marks)

Q2

Small box for marking the question.

Turn over



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Question 3 continued

Lined area for writing the answer to Question 3.

(Total 11 marks)

Q3

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Turn over



$$F(y) = \begin{cases} 0 & y < 1 \\ k(y^4 + y^2 - 2) & 1 \leq y \leq 2 \\ 1 & y > 2 \end{cases}$$

- [illegible]

11/11/2016



Question 4 continued

Lined area for writing the answer to Question 4.

(Total 7 marks)

Q4

Small box for marking the question.

Turn over



- Test Dhriti's claim at the 5% level of significance. State your hypotheses clearly.

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Question 5 continued

Lined area for writing the answer to Question 5.

(Total 7 marks)

Q5

Small box for marking the question.

Turn over



- [illegible]

11/11/2016



Question 6 continued

Lined area for writing the answer to Question 6.

(Total 12 marks)

Q6

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Turn over



7. (a) Explain what you understand by

- (i) a hypothesis test,
- (ii) a critical region.

(3)

During term time, incoming calls to a school are thought to occur at a rate of 0.45 per minute. To test this, the number of calls during a random 20 minute interval, is recorded.

- (b) Find the critical region for a two-tailed test of the hypothesis that the number of incoming calls occurs at a rate of 0.45 per 1 minute interval. The probability in each tail should be as close to 2.5% as possible.

(5)

- (c) Write down the actual significance level of the above test.

(1)

In the school holidays, 1 call occurs in a 10 minute interval.

- (d) Test, at the 5% level of significance, whether or not there is evidence that the rate of incoming calls is less during the school holidays than in term time.

(5)

11/11/2016



Question 7 continued

Lined area for writing the answer to Question 7.

(Total 14 marks)

Q7

Two small boxes for marking the question.

Turn over

8. The continuous random variable X has probability density function $f(x)$ given by

$$f(x) = \begin{cases} 2(x-2) & 2 \leq x \leq 3 \\ 0 & \text{otherwise} \end{cases}$$

(a) Sketch $f(x)$ for all values of x . (3)

(b) Write down the mode of X . (1)

Find

(c) $E(X)$, (3)

(d) the median of X . (4)

(e) Comment on the skewness of this distribution. Give a reason for your answer. (2)

11/11/2016

11/11/2016

Q8

END

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Question 1 continued

Turn over

Question 1 continued

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(Total 10 marks)

Q1

Turn over

- (7)

Question 2 continued

[illegible]

(Total 7 marks)

Q2

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Turn over

Given that

(a) find the critical region for the test statistic such that the probability in each tail is as close as possible to 2.5%.

(3)

(2)

Question 3 continued

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(Total 5 marks)

Q3

Turn over

- A cell is chosen at random.

- (b) Find the mean and variance of the number of damaged genes in the cell. (2)

Question 4 continued

Turn over

Question 4 continued

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(Total 8 marks)

Q4

Turn over

- (a) State the distribution to model the number of times the coin shows a head. (2)

(b) exactly 8 heads, (2)

- Sue has a different coin which she believes is biased in favour of heads. She throws the coin 15 times and obtains 13 heads.

- (d) Test Sue's belief at the 1% level of significance. State your hypotheses clearly. (6)

Question 5 continued

Turn over

Question 5 continued

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(Total 12 marks)

Q5

Turn over

- The agent received some training to increase the number of calls handled per hour. During a randomly selected 30 minute interval after the training the agent handles 14 calls.

-
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Question 6 continued

Turn over

Question 6 continued

[illegible]

(Total 13 marks)

Q6

Turn over

$$f(x) = \begin{cases} \frac{1}{2}x & 0 \leq x < 1 \\ kx^3 & 1 \leq x \leq 2 \\ 0 & \text{otherwise} \end{cases}$$

(a) Show that $k = \frac{1}{5}$ (4)

(c) Specify fully the cumulative distribution function $F(x)$. (7)

(e) Comment on the skewness of the distribution of X . (2)

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Question 7 continued

Turn over

Question 7 continued

Turn over

Question 7 continued

(Total 20 marks)

Q7

TOTAL FOR PAPER: 75 MARKS

END

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Question 1 continued

Lined area for writing the answer to Question 1.

(Total 11 marks)

Q1	

Turn over



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Question 2 continued

Lined area for writing the answer to Question 2.

(Total 9 marks)

Q2

Small box for marking the question.

Turn over



This observation is used to test $H_0 : p = 0.3$ against $H_1 : p \neq 0.3$

- (b) State the actual significance level of this test. (2)

(c) State a conclusion that can be drawn based on this value giving a reason for your answer. (2)



Question 3 continued

Lined area for writing the answer to Question 3.

(Total 7 marks)

Q3

Small box for marking the question.

Turn over



- $$f(t) = \begin{cases} kt & 0 \leq t \leq 10 \\ 0 & \text{otherwise} \end{cases}$$

- (d) Write down the mode of the distribution of T . (1)

It is suggested that the probability density function, $f(t)$, is not a good model for T .

- (e) Sketch the graph of a more suitable probability density function for T . (1)

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Question 4 continued

Lined area for writing the answer to Question 4.

(Total 12 marks)

Q4

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Turn over



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Question 5 continued

Lined area for writing the answer to Question 5.

(Total 9 marks)

Q5

Small box for marking the question.

Turn over



- (a) (i) Test, at the 10% level of significance, whether or not there is evidence that the rate of visits is greater on a Saturday than on weekdays. State your hypotheses clearly.

(7)

- (1)

(6)

10/10/2014



Question 6 continued

Lined area for writing the answer to Question 6.

(Total 14 marks)

Q6

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Turn over



$$f(x) = \begin{cases} -\frac{2}{9}x + \frac{8}{9} & 1 \leq x \leq 4 \\ 0 & \text{otherwise} \end{cases}$$

- (3)

- (2)

- (6)

(2)

— 100 —

11/11/2016

Q7

END

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

(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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Question 1 continued

(Total 5 marks)

Q1

- Stating your hypotheses clearly and using a 5% level of significance, test whether or not there has been a decrease in the number of deformed red blood cells in Emily's blood.

Question 2 continued

(Total 6 marks)

Q2

3. A random sample $X_1, X_2, \dots, X_n$ is taken from a population with unknown mean μ and unknown variance σ^2 . A statistic Y is based on this sample.

(a) Explain what you understand by the statistic Y . (2)

(b) Explain what you understand by the sampling distribution of Y . (1)

(c) State, giving a reason which of the following is **not** a statistic based on this sample.

(i) $\sum_{i=1}^n \frac{(X_i - \bar{X})^2}{n}$ (ii) $\sum_{i=1}^n \left(\frac{X_i - \mu}{\sigma} \right)^2$ (iii) $\sum_{i=1}^n X_i^2$ (2)

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Question 3 continued

(Total 5 marks)

Q3

Question 4 continued

(Total 8 marks)

Q4

5. An administrator makes errors in her typing randomly at a rate of 3 errors every 1000 words.

(a) In a document of 2000 words find the probability that the administrator makes 4 or more errors.

(3)

The administrator is given an 8000 word report to type and she is told that the report will only be accepted if there are 20 or fewer errors.

(b) Use a suitable approximation to calculate the probability that the report is accepted.

(7)

Question 5 continued

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Question 5 continued

(Total 10 marks)

Q5

6. The three independent random variables A , B and C each has a continuous uniform distribution over the interval $[0, 5]$.

(a) Find $P(A > 3)$. (1)

(b) Find the probability that A , B and C are all greater than 3. (2)

The random variable Y represents the maximum value of A , B and C .

The cumulative distribution function of Y is

$$F(y) = \begin{cases} 0 & y < 0 \\ \frac{y^3}{125} & 0 \leq y \leq 5 \\ 1 & y > 5 \end{cases}$$

(c) Find the probability density function of Y . (2)

(d) Sketch the probability density function of Y . (2)

(e) Write down the mode of Y . (1)

(f) Find $E(Y)$. (3)

(g) Find $P(Y > 3)$. (2)

Question 6 continued

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Question 6 continued

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(Total 13 marks)

Q6

7.

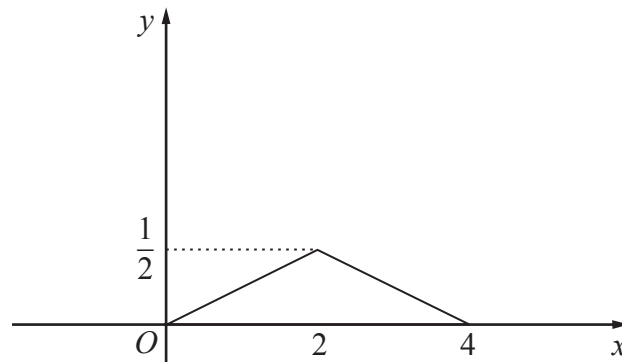


Figure 1

Figure 1 shows a sketch of the probability density function $f(x)$ of the random variable X . The part of the sketch from $x = 0$ to $x = 4$ consists of an isosceles triangle with maximum at $(2, 0.5)$.

(a) Write down $E(X)$.

(1)

The probability density function $f(x)$ can be written in the following form.

$$f(x) = \begin{cases} ax & 0 \leq x < 2 \\ b - ax & 2 \leq x \leq 4 \\ 0 & \text{otherwise} \end{cases}$$

(b) Find the values of the constants a and b .

(2)

(c) Show that σ , the standard deviation of X , is 0.816 to 3 decimal places.

(7)

(d) Find the lower quartile of X .

(3)

(e) State, giving a reason, whether $P(2 - \sigma < X < 2 + \sigma)$ is more or less than 0.5

(2)

Question 7 continued

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Question 7 continued

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(Total 15 marks)

Q7

- (b) Find the probability of more than 10 faults in 60 metres of cloth. (3)

(c) Write down an equation for x and show that $x = 1.7$ to 2 significant figures. (4)

(d) Find the retailer's expected profit. (4)

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Question 8 continued

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(Total 13 marks)

TOTAL FOR PAPER: 75 MARKS

END

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

- (2)

(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)



Question 1 continued

Lined area for writing the answer to Question 1.

(Total 8 marks)

Q1

Small box for marking the question.

Turn over



$$F(x) = \begin{cases} 0, & x < -2 \\ \frac{x+2}{6}, & -2 \leq x \leq 4 \\ 1, & x > 4 \end{cases}$$

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Question 2 continued

Lined area for writing the answer to Question 2.

(Total 10 marks)

Q2

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Turn over



- (a) Find the probability that it will work continuously for 5 hours without a breakdown. (3)

(b) the robot will break down at least once,

- (c) there are exactly 2 breakdowns. (2)

(d) Write down the probability that the robot will break down in the following 8 hour period. Give a reason for your answer. (2)

11/11/2016



Question 3 continued

Lined area for writing the answer to Question 3.

(Total 10 marks)

Q3

Two small boxes for marking, likely for marks and a total score.

Turn over



$$f(x) = \begin{cases} k(x^2 - 2x + 2) & 0 < x \leq 3 \\ 3k & 3 < x \leq 4 \\ 0 & \text{otherwise} \end{cases}$$

(a) Show that $k = \frac{1}{9}$ (4)

(c) Find the mean of X . (3)

(d) Show that the median of X lies between $x=2.6$ and $x=2.7$ (4)

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11/11/2016



Question 4 continued

Lined area for writing the answer to Question 4.

(Total 17 marks)

Q4

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Turn over

- Find the probability that

- (3)

(6)



Question 5 continued

Lined area for writing the answer to Question 5.

(Total 9 marks)

Q5

Small box for marking the answer to Question 5.

Turn over



- (d) Comment on this finding in light of your critical region. (2)



Question 6 continued

Lined area for writing the answer to Question 6.

(Total 10 marks)

Q6

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Turn over



- (a) Find the mean μ and the variance σ^2 of the values of this population of coins. (3)

(b) List all the possible samples. (2)

11/11/2016

Q7

END

1. Explain what you understand by

- (b) a statistic. (1)

(c) State the population and the statistic in this case. (2)

- (d) Explain what you understand by the sampling distribution of this statistic. (1)

Question 1 continued

(Total 5 marks)

Q1

Turn over

- Find the probability that, in 9 games, Bhim loses

- 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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Question 2 continued

[illegible]

(Total 10 marks)

Q2

Turn over

- Find the probability that the length of the longer side of the rectangle is more than 6 cm long.

[illegible]

Question 3 continued

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(Total 5 marks)

Q3

Turn over

- $$F(x) = \begin{cases} 0 & x < 1 \\ \frac{4}{9}(x^2 + 2x - 3) & 1 \leq x \leq 1.5 \\ 1 & x > 1.5 \end{cases}$$

- (c) Find $P(X \geq 1.2)$
- (2)**

(d) Find the probability that the lantern will still be working after 12 hours. (2)

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Question 4 continued

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(Total 10 marks)

Q4

Turn over

- (a) Explain why the Poisson distribution may be a suitable model in this case. (1)

(b) (i) all users connect at their first attempt,
(ii) at least 4 users fail to connect at their first attempt.

(5)

(c) Using a suitable approximation, test whether or not the mean number of users per hour who failed to connect at their first attempt had increased. Use a 5% level of significance and state your hypotheses clearly. (9)

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Question 5 continued

Turn over

Question 5 continued

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(Total 15 marks)

Q5

Turn over

- (2)

- (3)

- (2)

(d) Comment on the company's claim in the light of this value. Justify your answer.

- (2)

(e) Test at the 1% level of significance whether or not the probability of a faulty bolt has decreased. State your hypotheses clearly.

- (6)

Question 6 continued

Turn over

Question 6 continued

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(Total 15 marks)

Q6

Turn over

$$f(y) = \begin{cases} ky(a-y) & 0 \leq y \leq 3 \\ 0 & \text{otherwise} \end{cases}$$

(a) (i) Explain why $a \geq 3$

(6)

(b) show that $a = 4$ and write down the value of k .

(6)

(c) sketch the probability density function,

(2)

(1)

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Question 7 continued

Turn over

Question 7 continued

Turn over

Q7

END