GCE Examinations

Statistics
Module S2

Advanced Subsidiary / Advanced Level

Paper A

Time: 1 hour 30 minutes

Instructions and Information

Candidates may use any calculator except those with a facility for symbolic algebra and / or calculus.

Full marks may be obtained for answers to ALL questions.

Mathematical and statistical formulae and tables are available.

This paper has 7 questions.

Advice to Candidates

You must show sufficient working to make your methods clear to an examiner. Answers without working will gain no credit.

Written by Shaun Armstrong & Chris Huffer

1. A golfer believes that the distance, in metres, that she hits a ball with a 5 iron, follows a continuous uniform distribution over the interval [100, 150].

(a) Find the median and interquartile range of the distance she hits a ball, that would be predicted by this model.

(3 marks)

(b) Explain why the continuous uniform distribution may not be a suitable model.

(2 marks)

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2. The continuous random variable X has the following cumulative distribution function:

$$\mathrm{F}(x) = \begin{cases} 0, & x < 0, \\ \frac{1}{64}(16x - x^2), & 0 \leq x \leq 8, \\ 1, & x > 8. \end{cases}$$

(a) Find $\mathrm{P}(X > 5)$. **(2 marks)**

(b) Find and specify fully the probability density function $\mathrm{f}(x)$ of X. **(3 marks)**

(c) Sketch $\mathrm{f}(x)$ for all values of x. **(3 marks)**

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3. An electrician records the number of repairs of different types of appliances that he makes each day. His records show that over 40 working days he repaired a total of 180 CD players.

(a) Explain why a Poisson distribution may be suitable for modelling the number of CD players he repairs each day and find the parameter for this distribution.

(4 marks)

(b) Find the probability that on one particular day he repairs

(i) no CD players,

(ii) more than 6 CD players. **(3 marks)**

(c) Find the probability that over 10 working days he will repair more than 6 CD players on exactly 3 of the days.

(3 marks)

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4. A teacher wants to investigate the sports played by students at her school in their free time. She decides to ask a random sample of 120 pupils to complete a short questionnaire.

(a) Give two reasons why the teacher might choose to use a sample survey rather than a census.

(2 marks)

(b) Suggest a suitable sampling frame that she could use. **(1 mark)**

The teacher believes that 1 in 20 of the students play tennis in their free time. She uses the data collected from her sample to test if the proportion is different from this.

(c) Using a suitable approximation and stating the hypotheses that she should use, find the critical region for this test. The probability for each tail of the region should be as close as possible to 5%.

(6 marks)

(d) State the significance level of this test. **(1 mark)**

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5. As part of a business studies project, 8 groups of students are each randomly allocated 10 different shares from a listing of over 300 share prices in a newspaper. Each group has to follow the changes in the price of their shares over a 3-month period.

At the end of the 3 months, 35% of all the shares in the listing have increased in price and the rest have decreased.

(a) Find the probability that, for the 10 shares of one group,

(i) exactly 6 have gone up in price,

(ii) more than 5 have gone down in price. **(5 marks)**

(b) Using a suitable approximation, find the probability that of the 80 shares allocated in total to the groups, more than 55 will have decreased in value.

(6 marks)

Turn over

6. A shoe shop sells on average 4 pairs of shoes per hour on a weekday morning.

(a) Suggest a suitable distribution for modelling the number of sales made per hour on a weekday morning and state the value of any parameters needed.
(1 mark)

(b) Explain why this model might have to be modified for modelling the number of sales made per hour on a Saturday morning.
(1 mark)

(c) Find the probability that on a weekday morning the shop sells

(i) more than 4 pairs in a one-hour period,

(ii) no pairs in a half-hour period,

(iii) more than 4 pairs during each hour from 9 am until noon. **(6 marks)**

The area manager visits the shop on a weekday morning, the day after an advert appears in a local paper. In a one-hour period the shop sells 7 pairs of shoes, leading the manager to believe that the advert has increased the shop's sales.

(d) Stating your hypotheses clearly, test at the 5% level of significance whether or not there is evidence of an increase in sales following the appearance of the advert.
(4 marks)

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7. The continuous random variable T has the following probability density function:

$$\mathrm{f}(t) = \begin{cases} k(t^2 + 2), & 0 \le t \le 3, \\ 0, & \text{otherwise.} \end{cases}$$

(a) Show that $k = \frac{1}{15}$. **(4 marks)**

(b) Sketch $\mathrm{f}(t)$ for all values of t. **(3 marks)**

(c) State the mode of T. **(1 mark)**

(d) Find $\mathrm{E}(T)$. **(5 marks)**

(e) Show that the standard deviation of T is 0.798 correct to 3 significant figures.
(6 marks)

END

GCE Examinations

Statistics
Module S2

Advanced Subsidiary / Advanced Level

Paper B

Time: 1 hour 30 minutes

Instructions and Information

Candidates may use any calculator except those with a facility for symbolic algebra and / or calculus.

Full marks may be obtained for answers to ALL questions.

Mathematical and statistical formulae and tables are available.

This paper has 6 questions.

Advice to Candidates

You must show sufficient working to make your methods clear to an examiner. Answers without working will gain no credit.

Written by Shaun Armstrong & Chris Huffer

1. *(a)* Explain what you understand by the term sampling frame when conducting a sample survey.

(1 mark)

(b) Suggest a suitable sampling frame and identify the sampling units when using a sample survey to study

(i) the frequency with which cars break down in the first 3 months after being serviced at a particular garage,

(ii) the weight loss of people involved in trials of a new dieting programme.

(4 marks)

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2. An ornithologist believes that on average 4.2 different species of bird will visit a bird table in a rural garden when 50 g of breadcrumbs are spread on it.

(a) Suggest a suitable distribution for modelling the number of species that visit a bird table meeting these criteria.

(1 mark)

(b) Explain why the parameter used with this model may need to be changed if

(i) 50 g of nuts are used instead of breadcrumbs,

(ii) 100g of breadcrumbs are used. **(2 marks)**

A bird table in a rural garden has 50 g of breadcrumbs spread on it.

Find the probability that

(c) exactly 6 different species visit the table, **(2 marks)**

(d) more than 2 different species visit the table. **(4 marks)**

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3. In a test studying reaction times, white dots appear at random on a black rectangular screen. The continuous random variable X represents the distance, in centimetres, of the dot from the left-hand edge of the screen. The distribution of X is rectangular over the interval [0, 20].

(a) Find $P(2 < X < 3.6)$. **(2 marks)**

(b) Find the mean and variance of X. **(3 marks)**

The continuous random variable Y represents the distance, in centimetres, of the dot from the bottom edge of the screen. The distribution of Y is rectangular over the interval [0, 16].

Find the probability that a dot appears

(c) in a square of side 4 cm at the centre of the screen, **(4 marks)**

(d) within 2 cm of the edge of the screen. **(4 marks)**

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4. It is believed that the number of sets of traffic lights that fail per hour in a particular large city follows a Poisson distribution with a mean of 3.

Find the probability that

(a) there will be no failures in a one-hour period, **(1 mark)**

(b) there will be more than 4 failures in a 30-minute period. **(3 marks)**

Using a suitable approximation, find the probability that in a 24-hour period there will be

(c) less than 60 failures, **(5 marks)**

(d) exactly 72 failures. **(4 marks)**

Turn over

5. Six standard dice with faces numbered 1 to 6 are thrown together.

Assuming that the dice are fair, find the probability that

(a) none of the dice show a score of 6, **(3 marks)**

(b) more than one of the dice shows a score of 6, **(4 marks)**

(c) there are equal numbers of odd and even scores showing on the dice. **(3 marks)**

One of the dice is suspected of being biased such that it shows a score of 6 more often than the other numbers. This die is thrown eight times and gives a score of 6 three times.

(d) Stating your hypotheses clearly, test at the 5% level of significance whether or not this die is biased towards scoring a 6.

(7 marks)

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6. The continuous random variable X has the following probability density function:

$$\mathrm{f}(x) = \begin{cases} \frac{1}{6}x, & 0 \leq x \leq 2, \\ \frac{1}{12}(6 - x), & 2 \leq x \leq 6, \\ 0, & \text{otherwise.} \end{cases}$$

(a) Sketch $\mathrm{f}(x)$ for all values of x. **(4 marks)**

(b) State the mode of X. **(1 mark)**

(c) Define fully the cumulative distribution function $\mathrm{F}(x)$ of X. **(9 marks)**

(d) Show that the median of X is 2.536, correct to 4 significant figures. **(4 marks)**

END

GCE Examinations

Statistics
Module S2

Advanced Subsidiary / Advanced Level

Paper C

Time: 1 hour 30 minutes

Instructions and Information

Candidates may use any calculator except those with a facility for symbolic algebra and / or calculus.

Full marks may be obtained for answers to ALL questions.

Mathematical and statistical formulae and tables are available.

This paper has 7 questions.

Advice to Candidates

You must show sufficient working to make your methods clear to an examiner. Answers without working will gain no credit.

Written by Shaun Armstrong & Chris Huffer

1. *(a)* Explain briefly what you understand by the terms

(i) population,

(ii) sample. **(2 marks)**

(b) Giving a reason for each of your answers, state whether you would use a census or a sample survey to investigate

(i) the dietary requirements of people attending a 4-day residential course,

(ii) the lifetime of a particular type of battery. **(4 marks)**

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2. The manager of a supermarket receives an average of 6 complaints per day from customers.

Find the probability that on one day she receives

(a) 3 complaints, **(3 marks)**

(b) 10 or more complaints. **(2 marks)**

The supermarket is open on six days each week.

(c) Find the probability that the manager receives 10 or more complaints on no more than one day in a week.

(4 marks)

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3. The sales staff at an insurance company make house calls to prospective clients. Past records show that 30% of the people visited will take out a new policy with the company.

On a particular day, one salesperson visits 8 people. Find the probability that, of these,

(a) exactly 2 take out new policies, **(3 marks)**

(b) more than 4 take out new policies. **(2 marks)**

The company awards a bonus to any salesperson who sells more than 50 policies in a month.

(c) Using a suitable approximation, find the probability that a salesperson gets a bonus in a month in which he visits 150 prospective clients.

(5 marks)

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4. A rugby player scores an average of 0.4 tries per match in which he plays.

(a) Find the probability that he scores 2 or more tries in a match. **(5 marks)**

The team's coach moves the player to a different position in the team believing he will then score more frequently. In the next five matches he scores 6 tries.

(b) Stating your hypotheses clearly, test at the 5% level of significance whether or not there is evidence of an increase in the number of tries the player scores per match as a result of playing in a different position.

(5 marks)

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5. The continuous random variable X has the following cumulative distribution function:

$$\mathrm{F}(x) = \begin{cases} 0, & x < 0, \\ \frac{1}{432}x^2(x^2 - 16x + 72), & 0 \le x \le 6, \\ 1, & x > 6. \end{cases}$$

(a) Find $\mathrm{P}(X < 2)$. **(2 marks)**

(b) Find and specify fully the probability density function $\mathrm{f}(x)$ of X. **(4 marks)**

(c) Show that the mode of X is 2. **(6 marks)**

(d) State, with a reason, whether the median of X is higher or lower than the mode of X.

(1 mark)

Turn over

6. A shop receives weekly deliveries of 120 eggs from a local farm. The proportion of eggs received from the farm that are broken is 0.008

(a) Explain why it is reasonable to use the binomial distribution to model the number of eggs that are broken in each delivery.

(3 marks)

(b) Use the binomial distribution to calculate the probability that at most one egg in a delivery will be broken.

(4 marks)

(c) State the conditions under which the binomial distribution can be approximated by the Poisson distribution.

(1 mark)

(d) Using the Poisson approximation to the binomial, find the probability that at most one egg in a delivery will be broken. Comment on your answer.

(5 marks)

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7. The random variable X follows a continuous uniform distribution over the interval [2, 11].

(a) Write down the mean of X. **(1 mark)**

(b) Find $P(X \geq 8.6)$. **(2 marks)**

(c) Find $P(|X - 5| < 2)$. **(2 marks)**

The random variable Y follows a continuous uniform distribution over the interval $[a, b]$.

(d) Show by integration that

$$E(Y^2) = \tfrac{1}{3}(b^2 + ab + a^2).$$ **(5 marks)**

(e) Hence, prove that

$$\mathrm{Var}(Y) = \tfrac{1}{12}(b - a)^2.$$

You may assume that $E(Y) = \tfrac{1}{2}(a + b)$. **(4 marks)**

END

GCE Examinations

Statistics
Module S2

Advanced Subsidiary / Advanced Level

Paper D

Time: 1 hour 30 minutes

Instructions and Information

Candidates may use any calculator except those with a facility for symbolic algebra and / or calculus.

Full marks may be obtained for answers to ALL questions.

Mathematical and statistical formulae and tables are available.

This paper has 7 questions.

Advice to Candidates

You must show sufficient working to make your methods clear to an examiner. Answers without working will gain no credit.

Written by Shaun Armstrong & Chris Huffer

1. The continuous random variable X has the following cumulative distribution function:

$$\mathrm{F}(x) = \begin{cases} 0, & x < 2, \\ k(19x - x^2 - 34), & 2 \le x \le 5, \\ 1, & x > 5. \end{cases}$$

(a) Show that $k = \frac{1}{36}$. **(2 marks)**

(b) Find $\mathrm{P}(X > 4)$. **(2 marks)**

(c) Find and specify fully the probability density function $\mathrm{f}(x)$ of X. **(3 marks)**

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2. Suggest, with reasons, suitable distributions for modelling each of the following:

(a) the number of times the letter J occurs on each page of a magazine, **(3 marks)**

(b) the length of string left over after cutting as many 3 metre long pieces as possible from partly used balls of string,

(3 marks)

(c) the number of heads obtained when spinning a coin 15 times. **(3 marks)**

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3. A primary school teacher finds that exactly half of his year 6 class have mobile phones.

He decides to investigate whether the proportion of pupils with mobile phones is different from 0.5 in the year 5 class at his school. There are 25 pupils in the year 5 class.

(a) State the hypotheses that he should use. **(1 mark)**

(b) Find the largest critical region for this test such that the probability in each "tail" is less than 2.5%.

(4 marks)

(c) Determine the significance level of this test. **(1 mark)**

He finds that eight of the year 5 pupils have mobile phones and concludes that there is not sufficient evidence of the proportion being different from 0.5

(d) Stating the new hypotheses clearly, find if the number of year 5 pupils with mobile phones would have been significant if he had tested whether or not the proportion was less than 0.5 and used the largest critical region with a probability of less than 5%.

(3 marks)

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4. A hardware store is open on six days each week. On average the store sells 8 of a particular make of electric drill each week.

Find the probability that the store sells

(a) no more than 4 of the drills in a week, **(2 marks)**

(b) more than 2 of the drills in one day. **(5 marks)**

The store receives one delivery of drills at the same time each week.

(c) Find the number of drills that need to be in stock after a delivery for there to be at most a 5% chance of the store not having sufficient drills to meet demand before the next delivery.

(3 marks)

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5. In a party game, a bottle is spun and whoever it points to when it stops has to play next. The acute angle, in degrees, that the bottle makes with the side of the room is modelled by a rectangular distribution over the interval [0, 90].

Find the probability that on one spin this angle is

(a) between 25° and 38°, **(2 marks)**

(b) 45° to the nearest degree. **(2 marks)**

The bottle is spun ten times.

(c) Find the probability that the acute angle it makes with the side of the room is less than 10° more than twice.

(6 marks)

Turn over

6. A teacher is monitoring attendance at lessons in her department. She believes that the number of students absent from each lesson follows a Poisson distribution and wished to test the null hypothesis that the mean is 2.5 against the alternative hypothesis that it is greater than 2.5 She visits one lesson and decides on a critical region of 6 or more students absent.

(a) Find the significance level of this test. **(2 marks)**

(b) State any assumptions made in carrying out this test and comment on their validity.

(3 marks)

The teacher decides to undertake a wider study by looking at a sample of all the lessons that have taken place in the department during the previous four weeks.

(c) Suggest a suitable sampling frame. **(1 mark)**

She finds that there have been 96 pupils absent from the 30 lessons in her sample.

(d) Using a suitable approximation, test at the 5% level of significance the null hypothesis that the mean is 2.5 students absent per lesson against the alternative hypothesis that it is greater than 2.5. You may assume that the number of absences follows a Poisson distribution.

(6 marks)

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7. In a competition at a funfair, participants have to stay on a log being rotated in a pool of water for as long as possible. The length of time, in tens of seconds, that the competitors stay on the log is modelled by the random variable T with the following probability density function:

$$\mathrm{f}(t) = \begin{cases} k(t-3)^2, & 0 \le t \le 3, \\ 0, & \text{otherwise.} \end{cases}$$

(a) Show that $k = \frac{1}{9}$. **(5 marks)**

(b) Sketch $\mathrm{f}(t)$ for all values of t. **(3 marks)**

(c) Show that the mean time that competitors stay on the log is 7.5 seconds. **(5 marks)**

When the competition is next run the organisers decide to make it easier at first by spinning the log more slowly and then increasing the speed of rotation. The length of time, in tens of seconds, that the competitors now stay on the log is modelled by the random variable S with the following probability density function:

$$\mathrm{f}(s) = \begin{cases} \frac{1}{12}(8-s^3), & 0 \le s \le 2, \\ 0, & \text{otherwise.} \end{cases}$$

(d) Find the change in the mean time that competitors stay on the log. **(5 marks)**

END

GCE Examinations

Statistics
Module S2

Advanced Subsidiary / Advanced Level

Paper E

Time: 1 hour 30 minutes

Instructions and Information

Candidates may use any calculator except those with a facility for symbolic algebra and / or calculus.

Full marks may be obtained for answers to ALL questions.

Mathematical and statistical formulae and tables are available.

This paper has 7 questions.

Advice to Candidates

You must show sufficient working to make your methods clear to an examiner. Answers without working will gain no credit.

Solomon Press

Written by Shaun Armstrong & Chris Huffer

1. *(a)* State one advantage and one disadvantage in using a census rather than a sample survey in statistical work.

(2 marks)

(b) Give an example of a situation in which you would choose to use a census rather than a sample survey and explain why.

(2 marks)

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2. An advert for *Tatty's Crisps* claims that 1 in 10 bags contain a free scratchcard game.

Tatty's Crisps can be bought in a Family Pack containing 10 bags. Find the probability that the bags in one of these Family Packs contain

(a) no scratchcards, **(2 marks)**

(b) more than 2 scratchcards. **(2 marks)**

Tatty's Crisps can also be bought wholesale in boxes containing 50 bags. A pub Landlord notices that her customers only found 2 scratchcards in the crisps from one of these boxes.

(c) Stating your hypotheses clearly, test at the 10% level of significance whether or not this gives evidence of there being fewer free scratchcards than is claimed by the advert.

(4 marks)

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3. A class of children are each asked to draw a line that they think is 10 cm long without using a ruler. The teacher models how many centimetres each child's line is longer than 10 cm by the random variable X and believes that X has the following probability density function:

$$f(x) = \begin{cases} \frac{1}{8}, & {}^{-}4 \leq x \leq 4, \\ 0, & \text{otherwise.} \end{cases}$$

(a) Write down the name of this distribution. **(1 mark)**

(b) Define fully the cumulative distribution function $F(x)$ of X. **(4 marks)**

(c) Calculate the proportion of children making an error of less than 15% according to this model.

(3 marks)

(d) Give two reasons why this may not be a very suitable model. **(2 marks)**

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4. A bag contains 40 beads of the same shape and size. The ratio of red to green to blue beads is 1 : 3 : 4 and there are no beads of any other colour.

In an experiment, a bead is picked at random, its colour noted and the bead replaced in the bag. This is done ten times.

(a) Suggest a suitable distribution for modelling the number of times a blue bead is picked out and give the value of any parameters needed.

(2 marks)

(b) Explain why this distribution would not be suitable if the beads were not replaced in the bag.

(1 mark)

(c) Find the probability that of the ten beads picked out

(i) five are blue,

(ii) at least one is red. **(6 marks)**

The experiment is repeated, but this time a bead is picked out and replaced n times.

(d) Find in the form $a^n < b$, where a and b are exact fractions, the condition which n must satisfy in order to have at least a 99% chance of picking out at least one red bead.

(3 marks)

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5. A charity receives donations of more than £10 000 at an average rate of 25 per year.

Find the probability that the charity receives

(a) exactly 30 such donations in one year, **(3 marks)**

(b) less than 3 such donations in one month. **(5 marks)**

(c) Using a suitable approximation, find the probability that the charity receives more than 45 donations of more than £10 000 in the next two years.

(5 marks)

Turn over

6. The length of time, in tens of minutes, that patients spend waiting at a doctor's surgery is modelled by the continuous random variable T, with the following cumulative distribution function:

$$\mathrm{F}(t) = \begin{cases} 0, & t < 0, \\ \frac{1}{135}(54t + 9t^2 - 4t^3), & 0 \le t \le 3, \\ 1, & t > 3. \end{cases}$$

(a) Find the probability that a patient waits for more than 20 minutes. **(3 marks)**

(b) Show that the median waiting time is between 11 and 12 minutes. **(3 marks)**

(c) Define fully the probability density function $\mathrm{f}(t)$ of T. **(3 marks)**

(d) Find the modal waiting time in minutes. **(4 marks)**

(e) Give one reason why this model may need to be refined. **(1 mark)**

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7. A student collects data on the number of bicycles passing outside his house in 5-minute intervals during one morning.

(a) Suggest, with reasons, a suitable distribution for modelling this situation. **(3 marks)**

The student's data is shown in the table below.

Number of bicycles	0	1	2	3	4	5	6 or more
Frequency	7	14	10	2	1	2	0

(b) Show that the mean and variance of these data are 1.5 and 1.58 (to 3 significant figures) respectively and explain how these values support your answer to part *(a)*.
(6 marks)

An environmental organisation declares a "car free day" encouraging the public to leave their cars at home. The student wishes to test whether or not there are more bicycles passing along his road on this day and records 16 bicycles in a half-hour period during the morning.

(c) Stating your hypotheses clearly, test at the 5% level of significance whether or not there are more than 1.5 bicycles passing along his road per 5-minute interval that morning.

(5 marks)

END

GCE Examinations

Statistics
Module S2

Advanced Subsidiary / Advanced Level

Paper F

Time: 1 hour 30 minutes

Instructions and Information

Candidates may use any calculator except those with a facility for symbolic algebra and / or calculus.

Full marks may be obtained for answers to ALL questions.

Mathematical and statistical formulae and tables are available.

This paper has 6 questions.

Advice to Candidates

You must show sufficient working to make your methods clear to an examiner. Answers without working will gain no credit.

Written by Shaun Armstrong & Chris Huffer

1. *(a)* The random variable X follows a Poisson distribution with a mean of 1.4

Find $P(X \leq 3)$. **(3 marks)**

(b) The random variable Y follows a binomial distribution such that $Y \sim B(20, 0.6)$.

Find $P(Y \leq 12)$. **(4 marks)**

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2. A driving instructor keeps records of all the learners she has taught. In order to analyse her success rate she wishes to take a random sample of 120 of these learners.

(a) Suggest a suitable sampling frame and identify the sampling units. **(2 marks)**

She believes that only 1 in 20 of the people she teaches fail to pass their test in their first two attempts. She decides to use her sample to test whether or not the proportion is different from this.

(b) Using a suitable approximation and stating clearly the hypotheses she should use, find the largest critical region for this test such that the probability in each "tail" is less than 2.5%.

(6 marks)

(c) State the significance level of this test. **(1 mark)**

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3. In an old computer game a white square representing a ball appears at random at the top of the playing area, which is 24 cm wide, and moves down the screen. The continuous random variable X represents the distance, in centimetres, of the dot from the left-hand edge of the screen when it appears. The distribution of X is rectangular over the interval [4, 28].

(a) Find the mean and variance of X. **(3 marks)**

(b) Find $P(|X - 16| < 3)$. **(3 marks)**

During a single game, a player receives 12 "balls".

(c) Find the probability that the ball appears within 3 cm of the middle of the top edge of the playing area more than four times in a single game.

(3 marks)

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4. A music website is visited by an average of 30 different people per hour on a weekday evening. The site's designer believes that the number of visitors to the site per hour can be modelled by a Poisson distribution.

(a) State the conditions necessary for a Poisson distribution to be applicable and comment on their validity in this case.

(3 mark)

Assuming that the number of visitors does follow a Poisson distribution, find the probability that there will be

(b) less than two visitors in a 10-minute interval, **(3 marks)**

(c) at least ten visitors in a 15-minute interval. **(3 marks)**

(d) Using a suitable approximation, find the probability of the site being visited by more than 100 people between 6 pm and 9 pm on a Thursday evening.

(5 marks)

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5. Four coins are flipped together and the random variable H represents the number of heads obtained. Assuming that the coins are fair,

(a) suggest with reasons a suitable distribution for modelling H and give the value of any parameters needed,

(4 marks)

(b) show that the probability of obtaining more heads than tails is $\frac{5}{16}$. **(4 marks)**

The four coins are flipped 5 times and more heads are obtained than tails 4 times.

(c) Stating your hypotheses clearly, test at the 5% level of significance whether or not there is evidence of the probability of getting more heads than tails being more than $\frac{5}{16}$.

(5 marks)

Given that the four coins are all biased such that the chance of each one showing a head is 50% more than the chance of it showing a tail,

(d) find the probability of obtaining more heads than tails when the four coins are flipped together.

(4 marks)

Turn over

6. The continuous random variable X has the following probability density function:

$$f(x) = \begin{cases} \frac{1}{16}x, & 2 \leq x \leq 6, \\ 0, & \text{otherwise.} \end{cases}$$

(a) Sketch f(x) for all values of x. **(2 marks)**

(b) Find E(X). **(3 marks)**

(c) Show that Var(X) = $\frac{11}{9}$. **(5 marks)**

(d) Define fully the cumulative distribution function F(x) of X. **(4 marks)**

(e) Show that the interquartile range of X is $2(\sqrt{7} - \sqrt{3})$. **(5 marks)**

END