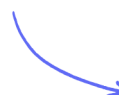


Practice Paper 6 (Probability & Statistics 2)

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Total Marks

/50

- 1 (a)** In England, it is known that 5% of the population have ginger hair. Kenneth, the owner of a hairdressing salon, has 40 appointments available each day. He models the number of clients with ginger hair that attend his salon in a day using a binomial distribution.

State the assumptions that Kenneth has made by using a binomial distribution.

(2 marks)

- (b)** Assuming all 40 appointments are filled, find the probability that at least one person has ginger hair.

(2 marks)

- (c)** Assuming all 40 appointments are filled each day, the number of clients with ginger hair attending an appointment over a two-day period is denoted G . It can be assumed that clients on each day are independent of each other. Explain why a Poisson distribution can be used to approximate G . State the appropriate Poisson distribution.

(2 marks)

- (d)** Using the Poisson distribution, find the probability at most 5 clients with ginger hair will have an appointment at the salon over the two-day period.

(3 marks)

- 2 (a)** The masses, M grams, of a random sample of 80 potatoes from a farm are summarised as follows.

$$n = 80 \qquad \sum m = 17764 \qquad \sum m^2 = 4103225$$

Calculate unbiased estimates of the population mean and variance.

(3 marks)

- (b)** Calculate a 90% confidence interval for the population mean.

(3 marks)

- (c)** Explain why it was necessary to use the Central Limit theorem in your answer to part (b).

(1 mark)

- 3 (a)** Frank has a variable tariff for his electricity and gas bills. His monthly electricity bill is \$ E and his monthly gas bill is \$ G . E and G are independent random variables with distributions $N(85, 9.4^2)$ and $N(53, 12.45)$ respectively.

Find the probability that the total electricity and gas bill in a month exceeds \$150.

(4 marks)

- (b)** Frank has a part-time job tutoring college students. His monthly income from this job can be modelled as a Normal distribution with mean \$504 and standard deviation \$41. Frank uses this income to pay for his gas and electricity bills, he puts the remaining money into his partner's bank account each month.

- (i) Find the probability that Frank puts between \$350 and \$450 into his partner's bank account in a month.
- (ii) What assumption did you make in part (b)(i) regarding his income and his bills.

(5 marks)

- 4 (a)** The continuous random variable X follows a continuous uniform distribution over the interval $(3,28)$ so that its probability density function is

$$f(x) = \begin{cases} \frac{1}{25} & 3 \leq x \leq 28 \\ 0 & \text{otherwise} \end{cases}$$

Find

- (i) $P(X < 15)$
- (ii) $P(20 < X < 30)$
- (iii) $P(X = 25)$

(3 marks)

- (b)** (i) Write down $E(X)$.
(ii) Find $Var(X)$.

(3 marks)

- 5 (a)** The number of mistakes made by a student, Priya, in a 20-minute revision period is modelled as a Poisson distribution with mean of 1.2. The number of mistakes made by a different student, Qays, in a 30-minute revision period is modelled as a Poisson distribution with a mean of 2.2.

Find the probability that Priya makes exactly 2 mistakes and Qays makes exactly 1 mistake within a one-hour revision period. Write your answer in the form $\frac{a}{b}e^c$ where a , b , and c are integers to be found. State any assumptions that are needed.

(3 marks)

- (b)** The number of mistakes made by Priya and Qays in a one-hour revision period are added together. Given that they make exactly 9 mistakes in total in a one-hour revision period, find the probability that Priya made exactly 5 mistakes in that same revision period.

(4 marks)

- (c)** Given that Priya makes exactly 5 mistakes in a one-hour revision period, find the probability that Priya and Qays made exactly 9 mistakes in total in that same revision period.

(2 marks)

- (d) In a week before a test, Priya has ten 30-minute revision periods. Estimate the number of these revision periods during which Priya will make a mistake.

(3 marks)

- 6 (a)** The IQ of a student at Calculus High can be modelled as a random variable with the distribution $N(126, 50)$. The headteacher decides to play classical music during lunchtimes and suspects that this has caused a change in the average IQ of the students.

Write suitable null and alternative hypotheses to test the headteacher's suspicion.

(1 mark)

- (b)** The headteacher selects 10 students and asks them to complete an IQ test. Their scores are:

127, 127, 129, 130, 130, 132, 132, 132, 133, 138

Test, at the 5% level of significance, whether there is evidence to support the headteacher's suspicion.

(5 marks)

- (c)** It was later discovered that the 10 students used in the sample were all in the same advanced classes.

Comment on the validity of the conclusion of the test based on this information.

(1 mark)