IYGB GCE

Mathematics FS1

Advanced Level

Practice Paper O
Difficulty Rating: 3.1933/1.2827

Time: 1 hour 30 minutes

Candidates may use any calculator allowed by the regulations of this examination.

Information for Candidates

This practice paper follows closely the Pearson Edexcel Syllabus, suitable for first assessment Summer 2018.

The standard booklet "Mathematical Formulae and Statistical Tables" may be used.
Full marks may be obtained for answers to ALL questions.
The marks for the parts of questions are shown in round brackets, e.g. **(2)**.
There are 7 questions in this question paper.
The total mark for this paper is 75.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.
Non exact answers should be given to an appropriate degree of accuracy.
The examiner may refuse to mark any parts of questions if deemed not to be legible.

Question 1

The probability distribution of a discrete random variable X is given by

$$P(X = x) = \begin{cases} kx^2 & x = 3, 4, 5 \\ 0 & \text{otherwise} \end{cases}$$

a) Determine the value of the constant k. **(2)**

b) Find the value of …

    i. … $E(X)$. **(2)**

    ii. … $\text{Var}(X)$. **(3)**

c) Determine …

    i. … $E(5X - 4)$. **(2)**

    ii. … $\text{Var}(5X - 4)$. **(2)**

Question 2

The data in the table below shows the time, in seconds, for the fastest qualifying lap for 8 different Formula One racing drivers, and their finishing order in the actual race.

Fastest Qualifying Lap	49.12	49.34	49.07	48.55	49.40	49.27	49.77	48.87
Finishing Position	5	6	1	3	7	4	8	2

a) Calculate Spearman's rank correlation coefficient for this data. **(4)**

b) Test whether or not there is any association between the fastest qualifying lap time and the finishing position for Formula One racing drivers, at the 5% level of significance, stating your hypotheses clearly. **(3)**

Question 3

A random sample of 250 employees of a certain town were classified by their level of education and their eventual average annual earnings.

	Non Graduates	**Graduates**	**Post Graduates**
Up to £10000	17	6	3
£10001 to £25000	97	16	3
£25001 to £40000	42	21	8
Over £40000	24	10	6

Use the sample to investigate whether there is any association between level of education and the eventual average annual earnings of the employees.

Use a χ^2 test, at the 1% level of significance. (**12**)

Question 4

From a Poisson distribution with parameter λ, a single observation w is taken and is to be used to test, at the 5% level of significance,

$$H_0 : \lambda = k \qquad \text{against} \qquad H_1 : \lambda \neq k \,,$$

where k is a positive integer.

Find the actual significance for the test if the critical region is

$$W \leq 1 \ \cup \ W \geq 12 \,. \tag{6}$$

Question 5

A large office block is illuminated by light tubes which when they fail they are replaced by the block's caretaker.

The mean number of tubes that fail on a particular weekday, Monday to Friday, is 1.

The mean number of tubes that fail on a random two day weekend, is 0.5.

    a) Find the probability that …

        i. … exactly 4 light tubes fail on a particular Wednesday. **(2)**

        ii. … more than 2 light tubes fail on a particular weekend. **(2)**

        iii. … less than 4 light tubes fail on a particular complete, 7 day week. **(2)**

The caretaker looks at his stock one Monday morning.

He wants to have the probability of running out of light tubes before the next Monday morning, less than 1 %.

    b) Calculate the smallest number of tubes he must have in stock. **(4)**

Question 6

Dolphins are thought to communicate with each other by high pitch noises they produce. The frequency, v kHz, of the noise made by a dolphin is recorded at 15 different sea depths, d m. These data are summarized below.

$$\sum d = 385.5, \ \sum d^2 = 11543.25, \ \sum v = 22.5, \ \sum v^2 = 38.25, \ \sum dv = 650.25$$

a) State, with a reason, which is the explanatory variable in the above described scenario and state the statistical name of the other variable. **(2)**

b) Find the value of S_{dd}, S_{vv} and S_{dv} for this data. **(3)**

c) Calculate the product moment correlation coefficient between d and v. **(2)**

d) Interpret the value of the product moment correlation coefficient in the context of this question. **(1)**

e) Give a reason to support the fitting of a regression line of the form

$$v = a + bd ,$$

where a and b are constants. **(1)**

f) Determine the value of a and b, correct to three significant figures. **(4)**

g) Interpret in the context of this question the physical meaning of a and b. **(2)**

Question 7

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

$$f(x) = \begin{cases} \dfrac{1}{60} x^3 & 2 \le x \le 4 \\ 0 & \text{otherwise} \end{cases}$$

a) Find the value of $E(X)$. **(3)**

b) Show that the standard deviation of X is 0.516, correct to 3 decimal places. **(4)**

The cumulative distribution function of X, is denoted by $F(x)$.

c) Find and specify fully $F(x)$. **(3)**

d) Determine $P(X > 3.5)$. **(2)**

e) Calculate the median of X, correct to two decimal places. **(2)**