IYGB GCE

Mathematics FS1

Advanced Level

Practice Paper Q

Difficulty Rating: 3.1800/1.4184

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 cumulative distribution of a discrete random variable X is given by

x	1	2	4	5
$\mathrm{F}(x)$	$\frac{3}{20}$	$\frac{2k+3}{20}$	$\frac{k+5}{10}$	$\frac{k+2}{4}$

where k is a positive constant.

a) Show clearly that $k = 2$. **(2)**

b) Find the value of …

i. … $\mathrm{E}(X)$. **(2)**

ii. … $\mathrm{E}\left(X^2\right)$. **(2)**

c) Calculate $\mathrm{Var}(20X - 2)$. **(3)**

Question 2

A discrete random variable X has Poisson distribution with mean λ.

Given that $\mathrm{P}(X = 8) = \mathrm{P}(X = 9)$, determine the value of $\mathrm{P}(4 < X \leq 10)$. **(6)**

Question 3

The discrete random variable X has distribution

$$X \sim \mathrm{B}(n, p).$$

a) Derive **from first principles** $\mathrm{G}_X(t)$, the probability generating function of X. **(2)**

b) Use $\mathrm{G}_X(t)$ to calculate the mean and variance of X. **(8)**

Question 4

A cinema manager believes that there is an association between the gender of his customers and the type of film they come to watch. The table below shows 1000 viewers in this cinema classified by gender and by the type of film they watched.

	Action Film	**Comedy Film**	**Romance Film**
Male	239	185	140
Female	155	150	131

Use a χ^2 test, at the 5% level of significance, to investigate whether there is evidence to support the manager's claim. **(12)**

Question 5

It is thought that calls arrive at a company telephone switchboard at the steady rate of 7 per minute.

a) Find the probability that, in a given minute, there will be more than 5 but at most 10 calls arriving the company's telephone switchboard. **(3)**

A 5 minute interval is divided into 10 equal 30 second intervals.

b) Find the probability that there will be at least one 30 second interval without a single call arriving the company's telephone switchboard. **(4)**

The telephone operator claims that the rate of calls has risen recently, and asks her manager for a helper.

The manager investigates this matter and finds that in a randomly chosen minute, 13 calls reached the telephone switchboard.

c) Test at the 5% level of significance, whether there is evidence to support the telephone operator's claim.

State your hypotheses clearly. **(6)**

Question 6

It is thought that a proportion p, of the tiles produced in a factory, have minor flaws.

A quality test, based on a random sample of 10 tiles from the daily production is devised, in order to test if p is greater than 0.1.

The hypothesis that $p = 0.1$ is rejected, if more than 4 tiles with flaws are found in the sample. The table below shows the power function for this test.

p	0.15	0.2	0.25	0.3	0.35	0.4
power	0.0099	0.0328	***k***	0.1503	0.2485	0.3669

a) Find the size of this test. **(3)**

b) Determine the value of k, in the above table. **(3)**

A second test, based on a random sample of 20 tiles from the daily production is proposed, in order to test if p is greater than 0.1.

The hypothesis that $p = 0.1$ is rejected if more than 9 tiles with flaws are found in the sample.

c) Find the probability of a Type I error occurring, when using the second test. **(3)**

The table below shows the power function for the second test.

p	0.15	0.2	0.25	0.3	0.35	0.4
power	0.0021	0.0173	0.0713	0.1894	0.3697	0.5754

d) Plot the graphs of the two power functions in the same set of axes. **(3)**

e) Using these graphs, state the value of p, when the two graphs meet, briefly explaining the significance if p is smaller or greater than this value. **(2)**

Question 7

It has been established over a long period of time that the probability that an electricity company operative will be able to take a reading from a house meter, due to the resident being at home, is 0.4 .

a) Determine the probability that the first reading to be taken will be on, or before, the 7^{th} house visit. **(3)**

b) Find the probability that the operative will be able to take …

i. … exactly 3 readings in his first 7 visits. **(2)**

ii. … his 3^{rd} reading on his 7^{th} visit. **(2)**

iii. … his 3^{rd} reading on, or before his 7^{th} visit. **(4)**