Write your name here

Surname	Other names

Pearson
Edexcel GCE

Centre Number

Candidate Number

A level Further Mathematics
Further Statistics 1
Practice Paper 4

You must have:
Mathematical Formulae and Statistical Tables (Pink)

Total Marks

Instructions

- Use black ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- Fill in the boxes at the top of this page with your name, centre number and candidate number.
- Answer all the questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – there may be more space than you need.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are **7** questions in this question paper. The total mark for this paper is **75**.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.
- Calculators must not be used for questions marked with a * sign.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

1. Jane shoots at a target until she hits it. The random variable J is the number of shots needed by Jane to hit the target.

(a) State a suitable distribution to model J.

(1)

(b) Given that the mean of J is 5, calculate the probability of Jane

(i) hitting the target for the first time on her 4th shot,

(3)

(ii) taking at least 3 shots to hit the target for the first time.

(3)

(c) State any assumptions you have made using this model.

(2)

(Total 9 marks)

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2. The discrete random variable X has probability distribution given by

x	-1	0	1	2	3
$\mathrm{P}(X = x)$	$\frac{1}{5}$	a	$\frac{1}{10}$	a	$\frac{1}{5}$

where a is a constant.

(a) Find the value of a.

(2)

(b) Write down $\mathrm{E}(X)$.

(1)

(c) Find $\mathrm{Var}(X)$.

(3)

The random variable $Y = 6 - 2X$.

(d) Find $\mathrm{Var}(Y)$.

(2)

(e) Calculate $\mathrm{P}(X \geq Y)$.

(3)

(Total 11 marks)

3. A robot is programmed to build cars on a production line. The robot breaks down at random at a rate of once every 20 hours.

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

(3)

Find the probability that, in an 8 hour period,

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

(3)

(c) there are exactly 2 breakdowns.

(2)

In a particular 8 hour period, the robot broke down twice.

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

(2)

(Total 10 marks)

4. The probability of Richard winning a coconut in a game at the fair is 0.12.

Richard plays a number of games.

(a) Find

(i) the probability of Richard winning his second coconut on his 8th game,

(2)

(ii) the expected number of games Richard will need to play in order to win 3 coconuts.

(1)

(b) State two assumptions that you have made in part (*a*).

(2)

Mary plays the same game, but has a different probability of winning a coconut. She plays until she has won r coconuts. The random variable G represents the total number of games Mary plays.

(c) Given that the mean and standard deviation of G are 18 and 6 respectively, determine whether Richard or Mary has the greater probability of winning a coconut in a game.

(5)

(Total 10 marks)

5. A research station is doing some work on the germination of a new variety of genetically modified wheat.

They planted 120 rows containing 7 seeds in each row.

The number of seeds germinating in each row was recorded. The results are as follows

Number of seeds germinating in each row	0	1	2	3	4	5	6	7
Observed number of rows	2	6	11	19	25	32	16	9

(a) Write down two reasons why a binomial distribution may be a suitable model.

(2)

(b) Show that the probability of a randomly selected seed from this sample germinating is 0.6.

(2)

The research station used a binomial distribution with probability 0.6 of a seed germinating. The expected frequencies were calculated to 2 decimal places. The results are as follows:

Number of seeds germinating in each row	0	1	2	3	4	5	6	7
Expected number of rows	0.20	2.06	s	23.22	t	31.35	15.68	3.36

(c) Find the value of s and the value of t.

(2)

(d) Stating your hypotheses clearly, test, at the 1% level of significance, whether or not the data can be modelled by a binomial distribution.

(7)

(Total 13 marks)

6. The random variable X has probability generating function

$$G_X(t) = k[t^3(2 + 3t) + (1 + t)^4],$$

where k is a positive constant.

(a) Show that $k = \dfrac{1}{21}$.

(2)

Find

(b) $E(X)$,

(3)

(c) $Var(X)$,

(4)

(d) $P(X = 3)$.

(2)

(Total 11 marks)

7. A poultry farm produces eggs which are sold in boxes of 6. The farmer believes that the proportion, p, of eggs that are cracked when they are packed in the boxes is approximately 5%. She decides to test the hypotheses

$$H_0: p = 0.05 \quad \text{against} \quad H_1: p > 0.05.$$

To test these hypotheses she randomly selects a box of eggs and rejects H_0 if the box contains 2 or more eggs that are cracked. If the box contains 1 egg that is cracked, she randomly selects a second box of eggs and rejects H_0 if it contains at least 1 egg that is cracked. If the first or the second box contains no cracked eggs, H_0 is immediately accepted and no further boxes are sampled.

(a) Show that the power function of this test is

$$1 - (1 - p)^6 - 6p(1 - p)^{11}.$$

(3)

(b) Calculate the size of this test.

(2)

Given that $p = 0.1$,

(c) find the expected number of eggs inspected each time this test is carried out, giving your answer correct to 3 significant figures,

(3)

(d) calculate the probability of a Type II error.

(2)

Given that $p = 0.1$ is an unacceptably high value for the farmer,

(e) use your answer from part (*d*) to comment on the farmer's test.

(1)

(Total 11 marks)

TOTAL FOR PAPER: 75 MARKS