

Write your name here

Surname					Other names			
Pearson		Centre Number			Candidate Number			
Edexcel GCE		<input type="text"/>	<input type="text"/>					
AS and A level Further Mathematics Further Statistics 1 Practice Paper Poisson & binomial distributions								
You must have: Mathematical Formulae and Statistical Tables (Pink)							Total Marks <input type="text"/>	

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 9 questions in this question paper. The total mark for this paper is 94.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.

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. Patients arrive at a hospital accident and emergency department at random at a rate of 6 per hour.
- (a) Find the probability that, during any 90 minute period, the number of patients arriving at the hospital accident and emergency department is
- (i) exactly 7,
- (ii) at least 10.
- (5)**

A patient arrives at 11.30 a.m.

- (b) Find the probability that the next patient arrives before 11.45 a.m.
- (3)**
- (Total 8 marks)**
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2. (a) Write down the conditions under which the Poisson distribution can be used as an approximation to the binomial distribution.
- (2)**

The probability of any one letter being delivered to the wrong house is 0.01.
On a randomly selected day Peter delivers 1000 letters.

- (b) Using a Poisson approximation, find the probability that Peter delivers at least 4 letters to the wrong house.

Give your answer to 4 decimal places.

(3)

(Total 5 marks)

3. A disease occurs in 3% of a population.

(a) State any assumptions that are required to model the number of people with the disease in a random sample of size n as a binomial distribution. (2)

(b) Using this model, find the probability of exactly 2 people having the disease in a random sample of 10 people. (3)

(c) Find the mean and variance of the number of people with the disease in a random sample of 100 people. (2)

A doctor tests a random sample of 100 patients for the disease. He decides to offer all patients a vaccination to protect them from the disease if more than 5 of the sample have the disease.

(d) Using a suitable approximation, find the probability that the doctor will offer all patients a vaccination. (3)

(Total 10 marks)

4. A student is investigating the numbers of cherries in a *Rays* fruit cake. A random sample of *Rays* fruit cakes is taken and the results are shown in the table below.

Number of cherries	0	1	2	3	4	5	≥ 6
Frequency	24	37	21	12	4	2	0

- (a) Calculate the mean and the variance of these data. (3)
- (b) Explain why the results in part (a) suggest that a Poisson distribution may be a suitable model for the number of cherries in a *Rays* fruit cake. (1)

The number of cherries in a *Rays* fruit cake follows a Poisson distribution with mean 1.5.

A *Rays* fruit cake is to be selected at random.
Find the probability that it contains

- (c) (i) exactly 2 cherries,
(ii) at least 1 cherry. (4)

Rays fruit cakes are sold in packets of 5.

- (d) Show that the probability that there are more than 10 cherries, in total, in a randomly selected packet of *Rays* fruit cakes, is 0.1378 correct to 4 decimal places. (3)

Twelve packets of *Rays* fruit cakes are selected at random.

- (e) Find the probability that exactly 3 packets contain more than 10 cherries. (3)

(Total 14 marks)

5. A company receives telephone calls at random at a mean rate of 2.5 per hour.
- (a) Find the probability that the company receives
- (i) at least 4 telephone calls in the next hour,
 - (ii) exactly 3 telephone calls in the next 15 minutes.
- (5)**
- (b) Find, to the nearest minute, the maximum length of time the telephone can be left unattended so that the probability of missing a telephone call is less than 0.2.
- (3)**

The company puts an advert in the local newspaper. The number of telephone calls received in a randomly selected 2 hour period after the paper is published is 10.

- (c) Test at the 5% level of significance whether or not the mean rate of telephone calls has increased. State your hypotheses clearly.
- (5)**
- (Total 13 marks)**
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6. A random variable X has the distribution $B(12, p)$.
- (a) Given that $p = 0.25$, find
- (i) $P(X < 5)$,
 - (ii) $P(X \geq 7)$.
- (3)**
- (b) Given that $P(X = 0) = 0.05$, find the value of p to 3 decimal places.
- (3)**
- (c) Given that the variance of X is 1.92, find the possible values of p .
- (4)**
- (Total 10 marks)**
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7. The probability of an electrical component being defective is 0.075.

The component is supplied in boxes of 120.

- (a) Using a suitable approximation, estimate the probability that there are more than 3 defective components in a box.

(5)

A retailer buys 2 boxes of components.

- (b) Estimate the probability that there are at least 4 defective components in each box.

(2)

(Total 7 marks)

8. As part of a selection procedure for a company, applicants have to answer all 20 questions of a multiple choice test. If an applicant chooses answers at random the probability of choosing a correct answer is 0.2 and the number of correct answers is represented by the random variable X .

- (a) Suggest a suitable distribution for X .

(2)

Each applicant gains 4 points for each correct answer but loses 1 point for each incorrect answer. The random variable S represents the final score, in points, for an applicant who chooses answers to this test at random.

- (b) Show that $S = 5X - 20$.

(2)

- (c) Find $E(S)$ and $\text{Var}(S)$.

(4)

An applicant who achieves a score of at least 20 points is invited to take part in the final stage of the selection process.

- (d) Find $P(S \geq 20)$.

(4)

Cameron is taking the final stage of the selection process which is a multiple choice test consisting of 100 questions. He has been preparing for this test and believes that his chance of answering each question correctly is 0.4.

- (e) Using a suitable approximation, estimate the probability that Cameron answers more than half of the questions correctly.

(5)

(Total 17 marks)

9. A telesales operator is selling a magazine. Each day he chooses a number of people to telephone. The probability that each person he telephones buys the magazine is 0.1.
- (a) Suggest a suitable distribution to model the number of people who buy the magazine from the telesales operator each day. (1)
- (b) On Monday, the telesales operator telephones 10 people. Find the probability that he sells at least 4 magazines. (3)
- (c) Calculate the least number of people he needs to telephone on Tuesday, so that the probability of selling at least 1 magazine, on that day, is greater than 0.95. (3)

A call centre also sells the magazine. The probability that a telephone call made by the call centre sells a magazine is 0.05. The call centre telephones 100 people every hour.

- (d) Using a suitable approximation, find the probability that more than 10 people telephoned by the call centre buy a magazine in a randomly chosen hour. (3)

(Total 10 marks)

TOTAL FOR PAPER: 94 MARKS