Pearson Edexcel GCE

Centre Number

Candidate Number

A level Further Mathematics
Further Statistics 1
Practice Paper 3

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. A discrete random variable X has the probability function

$$P(X=x) = \begin{cases} k\,(1-x)^2 & x=-1,\,0,\,1 \text{ and } 2 \\ 0 & \text{otherwise.} \end{cases}$$

(a) Show that $k = \dfrac{1}{6}$.

(3)

(b) Find $E(X)$.

(2)

(c) Show that $E(X^2) = \dfrac{4}{3}$.

(2)

(d) Find $\text{Var}(1-3X)$.

(3)

(Total 10 marks)

2. A doctor takes a random sample of 100 patients and measures their intake of saturated fats in their food and the level of cholesterol in their blood. The results are summarised in the table below.

Cholesterol level Intake of saturated fats	High	Low
High	12	8
Low	26	54

Using a 5% level of significance, test whether or not there is an association between cholesterol level and intake of saturated fats. State your hypotheses and show your working clearly.

(Total 10 marks)

3. Each cell of a certain animal contains 11 000 genes. It is known that each gene has a probability 0.0 005 of being damaged.

A cell is chosen at random.

(a) Suggest a suitable model for the distribution of the number of damaged genes in the cell.

(2)

(b) Find the mean and variance of the number of damaged genes in the cell.

(2)

(c) Using a suitable approximation, find the probability that there are at most 2 damaged genes in the cell.

(3)*

(Total 7 marks)

*Part (c) would have been 4 marks in the old specification and 3 marks in the new specification.

4. A traffic officer monitors the rate at which vehicles pass a fixed point on a motorway. When the rate exceeds 36 vehicles per minute he must switch on some speed restrictions to improve traffic flow.

    (a) Suggest a suitable model to describe the number of vehicles passing the fixed point in a 15 s interval.

<div align="right">(1)</div>

The traffic officer records 12 vehicles passing the fixed point in a 15 s interval.

    (b) Stating your hypotheses clearly, and using a 5% level of significance, test whether or not the traffic officer has sufficient evidence to switch on the speed restrictions.

<div align="right">(6)</div>

    (c) Using a 5% level of significance, determine the smallest number of vehicles the traffic officer must observe in a 10 s interval in order to have sufficient evidence to switch on the speed restrictions.

<div align="right">(3)</div>

<div align="right">(Total 10 marks)</div>

5. The probability that John wins a coconut in a game at the fair is 0.15.
John plays a number of games.

    (a) Find

        (i) the probability of John winning his second coconut on his 7th game.

<div align="right">(2)</div>

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

<div align="right">(1)</div>

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

<div align="right">(2)</div>

Sue 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 Sue plays.

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

<div align="right">(5)</div>

<div align="right">(Total 10 marks)</div>

6. A proportion p of letters sent by a company are incorrectly addressed and if p is thought to be greater than 0.05 then action is taken.

Using H_0: $p = 0.05$ and H_1: $p > 0.05$, a manager from the company takes a random sample of 40 letters and rejects H_0 if the number of incorrectly addressed letters is more than 3.

(a) Find the size of this test.

(2)

(b) Find the probability of a Type II error in the case where p is in fact 0.10.

(2)

Table 1 below gives some values, to 2 decimal places, of the power function of this test.

p	0.075	0.100	0.125	0.150	0.175	0.200	0.225
Power	0.35	s	0.75	0.87	0.94	0.97	0.99

Table 1

(c) Write down the value of s.

(1)

A visiting consultant uses an alternative system to test the same hypotheses. A sample of 15 letters is taken. If these are all correctly addressed then H_0 is accepted. If 2 or more are found to have been incorrectly addressed then H_0 is rejected. If only one is found to be incorrectly addressed then a further random sample of 15 is taken and H_0 is rejected if 2 or more are found to have been incorrectly addressed in this second sample, otherwise H_0 is accepted.

(d) Find the size of the test used by the consultant.

(3)

Figure 1 shows the graph of the power function of the test used by the consultant.
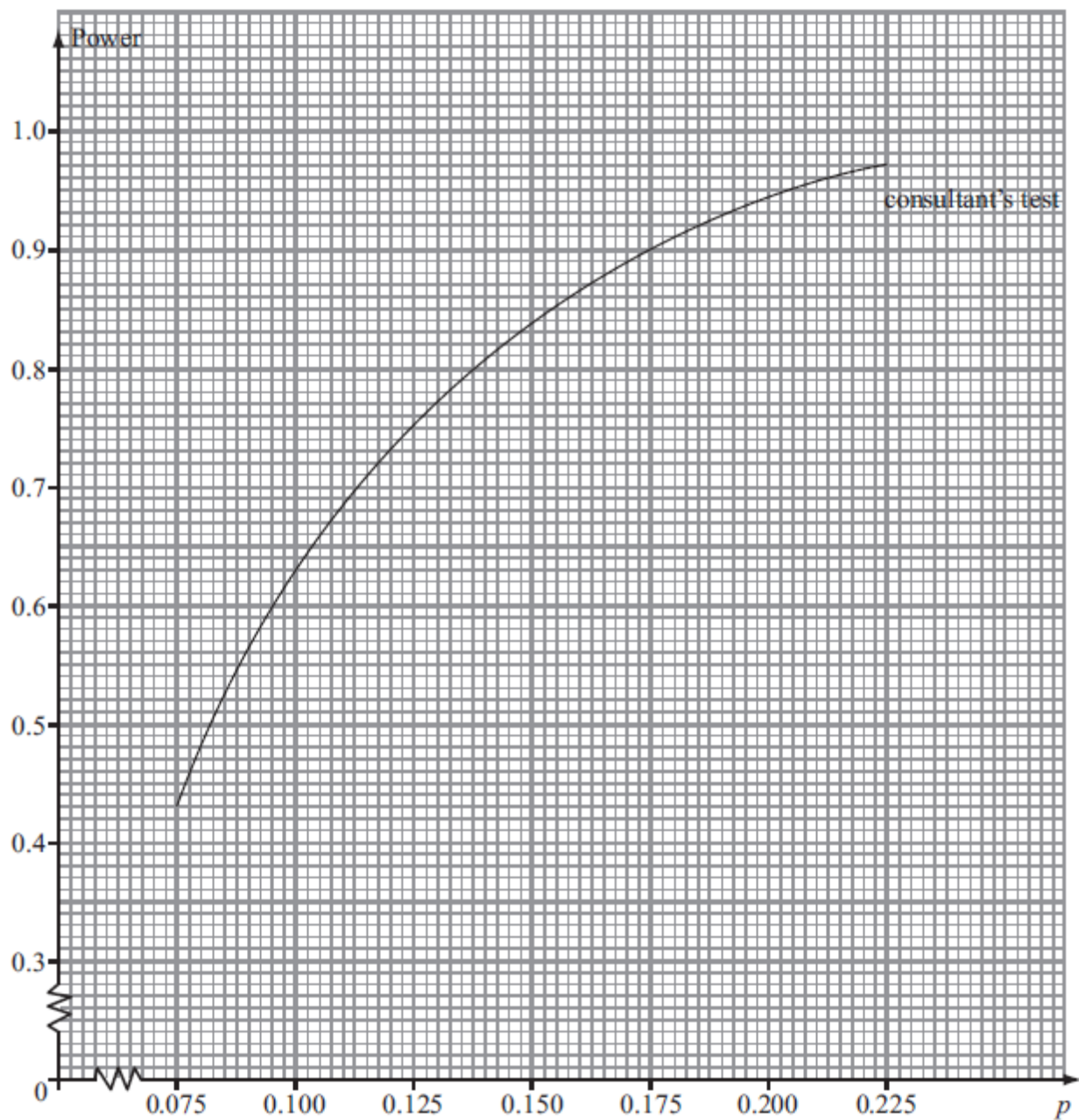

Figure 1

(e) On Figure 1 draw the graph of the power function of the manager's test.

(2)

(f) State, giving your reasons, which test you would recommend.

(2)

(Total 12 marks)

7. A shop hires out carpet cleaners by the day. The number of requests X per day to hire a cleaner can be modelled as a Poisson distribution with mean 3.

(a) Find, in terms of e, the probability that on a particular day there will be

    (i) exactly 2,

    (ii) at least 4

    requests to hire a cleaner.

                                                (5)

The random variable Y represents the number of carpet cleaners hired on a particular day. The shop has 4 cleaners.

(b) Show that the probability generating function of Y, $G_Y(t)$ is given by

$$G_Y(t) = e^{-3}(1 + 3t + 4.5t^2 + 4.5t^3 - 13t^4) + t^4.$$

                                                (3)

(c) Use the probability generating function to find the mean and the standard deviation of Y.

                                                (8)

(Total 16 marks)

TOTAL FOR PAPER: 75 MARKS