Paper Reference 8FM0–23
Pearson Edexcel
Level 3 GCE

Further Mathematics

Advanced Subsidiary
Further Mathematics options
23: Further Statistics 1
(Part of options B, E, F and G)

Thursday 17 May 2018 – Afternoon

YOU MUST HAVE:

Mathematical Formulae and Statistical Tables, calculator

ITEMS INCLUDED WITH QUESTION PAPERS
Data Book
Answer Book

Q60154A

Pearson

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

INSTRUCTIONS

In the boxes on the Answer Book and on the Data Book, write your name, centre number and candidate number.

Answer ALL questions and ensure that your answers to parts of questions are clearly labelled.

Answer the questions in the Answer Book or on the separate data sheets – there may be more space than you need.

Do NOT write on the Question Paper.

You should show sufficient working to make your methods clear. Answers without working may not gain full credit.

Answers should be given to three significant figures unless otherwise stated.

INFORMATION

A booklet 'Mathematical Formulae and Statistical Tables' is provided.

The total mark for this part of the examination is 40
There are 4 questions.

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.

Answer ALL questions.

Write your answers in the Answer Book provided.

Turn over

1. Refer to Table 1 and Table 2 for Question 1 in the Data Book.

A researcher is investigating the distribution of orchids in a field.

He believes that the Poisson distribution with a mean of $1 \cdot 75$ may be a good model for the number of orchids in each square metre.

He randomly selects 150 non–overlapping areas, each of one square metre, and counts the number of orchids present in each square.

The results are recorded in Table 1 in the Data Book.

He calculates the **expected** frequencies as shown in Table 2 in the Data Book.

(a) Find the value of r giving your answer to 2 decimal places.

(1 mark)

(continued on the next page)

1. continued.

The researcher will test, at the 5% level of significance, whether or not the data can be modelled by a Poisson distribution with mean 1·75

(b) State clearly the hypotheses required to test whether or not this Poisson distribution is a suitable model for these data.

(1 mark)

The test statistic for this test is 2·0 and the number of degrees of freedom to be used is 4

(c) Explain fully why there are 4 degrees of freedom.

(2 marks)

(d) Stating your critical value clearly, determine whether or not these data support the researcher's belief.

(2 marks)

(continued on the next page)

1. continued.

The researcher works in another field where the number of orchids in each square metre is known to have a Poisson distribution with mean $1 \cdot 5$

He randomly selects 200 non–overlapping areas, each of one square metre, in this second field, and counts the number of orchids present in each square.

(e) Using a Poisson approximation, show that the probability that he finds at least one square with exactly 6 orchids in it is $0 \cdot 506$ to 3 decimal places.
(4 marks)

(Total for Question 1 is 10 marks)

2. The number of heaters, H, bought during one day from **Warmup** supermarket can be modelled by a Poisson distribution with mean $0 \cdot 7$

(a) Calculate $P(H \geq 2)$

(1 mark)

The number of heaters, G, bought during one day from **Pumraw** supermarket can be modelled by a Poisson distribution with mean 3, where G and H are independent.

(b) Show that the probability that a total of fewer than 4 heaters are bought from these two supermarkets in a day is $0 \cdot 494$ to 3 decimal places.

(2 marks)

(c) Calculate the probability that a total of fewer than 4 heaters are bought from these two supermarkets on at least 5 out of 6 randomly chosen days.

(3 marks)

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2. continued.

December was particularly cold.

Two days in December were selected at random and the total number of heaters bought from these two supermarkets was found to be 14

(d) Test whether or not the mean of the total number of heaters bought from these two supermarkets had increased.

Use a 5% level of significance and state your hypotheses clearly.

(5 marks)

(Total for Question 2 is 11 marks)

3. A fair six–sided black die has faces numbered 1, 2, 2, 3, 3 and 4

The random variable B represents the score when the black die is rolled.

(a) Write down the value of E(B)

(1 mark)

(continued on the next page)

3. continued.

Refer to the table for Question 3(b) in the Data Book.

A white die has 6 faces numbered 1, 1, 2, 4, 5 and c where $c > 5$

The discrete random variable W represents the score when the white die is rolled and has probability distribution given in the table.

Greg and Nilaya play a game with these dice.

Greg throws the black die and Nilaya throws the white die.

Greg wins the game if he scores at least two more than Nilaya, otherwise Greg loses.

The probability of Greg winning the game is $\frac{1}{6}$

(b) Find the value of a and the value of b

Show your working clearly.

(5 marks)

(continued on the next page)

3. continued.

The random variable $X = 2W - 5$

Given that $E(X) = 2 \cdot 6$

(c) find the exact value of $Var(X)$

(6 marks)

(Total for Question 3 is 12 marks)

4. Abram carried out a survey of two treatments for a plant fungus.

The contingency table below shows the results of a survey of a random sample of 125 plants with the fungus.

		Treatment		
		No action	Plant sprayed once	Plant sprayed every day
Outcome	Plant died within a month	15	16	25
	Plant survived for 1 – 6 months	8	25	10
	Plant survived beyond 6 months	7	14	5

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4. continued.

Refer to the table for Question 4 in the Data Book.

Abram calculates expected frequencies to carry out a suitable test.

Seven of these are given in the partly–completed table shown in the Data Book.

The value of $\sum \frac{(O-E)^2}{E}$ for the 7 given values is 8·29

Test at the 2·5% level of significance, whether or not there is an association between the treatment of the plants and their survival.

State your hypotheses and conclusion clearly.

(Total for Question 4 is 7 marks)

TOTAL FOR FURTHER STATISTICS 1 IS 40 MARKS

END OF PAPER
