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 16 May 2019 – Afternoon

MATERIALS REQUIRED FOR EXAMINATION
Mathematical Formulae and Statistical Tables (Green), calculator

ITEMS INCLUDED WITH QUESTION PAPERS
Data Book
Answer Book

X61867A

Pearson

Candidates may use any calculator allowed by Pearson regulations. 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.

---

1. Refer to the table for Question 1 in the Data Book.

A leisure club offers a choice of one of three activities to its 150 members on a Tuesday evening.

The manager believes that there may be an association between the choice of activity and the age of the member and collected the data shown in the table.

(a) Write down suitable hypotheses for a test of the manager's belief.

(1 mark)

The manager calculated expected frequencies to use in the test.

(b) Calculate the expected frequency of members aged 60 or over who choose snooker, used by the manager.

(1 mark)

(continued on the next page)

1. continued.

(c) Explain why there are 6 degrees of freedom used in this test.

(2 marks)

The test statistic used to test the manager's belief is 19·583

(d) Using a 5% level of significance, complete the test of the manager's belief.

(2 marks)

(Total for Question 1 is 6 marks)

---

2. Refer to the tables in the Data Book for Question 2

A spinner used for a game is designed to give scores with the probabilities shown in Table 1

The spinner is spun 80 times and the results are shown in Table 2

Test, at the 10% level of significance, whether or not the spinner is giving scores as it is designed to do.

Show your working and state your hypotheses clearly.

(Total for Question 2 is 7 marks)

---

3. Andreia's secretary makes random errors in his work at an average rate of $1 \cdot 7$ errors every 100 words.

(a) Find the probability that the secretary makes fewer than 2 errors in the next 100–word piece of work.
(2 marks)

Andreia asks the secretary to produce a 250–word article for a magazine.

(b) Find the probability that there are exactly 5 errors in this article.
(2 marks)

(continued on the next page)

3. continued.

Andreia offers the secretary a choice of one of two bonus schemes, based on a random sample of 40 pieces of work each consisting of 100 words.

In scheme A the secretary will receive the bonus if more than 10 of the 40 pieces of work contain no errors.

In scheme B the bonus is awarded if the total number of errors in all 40 pieces of work is fewer than 56

(c) Showing your calculations clearly, explain which bonus scheme you would advise the secretary to choose.
(5 marks)

(continued on the next page)

3. continued.

Following the bonus scheme, Andreia randomly selects a single 500–word piece of work from the secretary to test if there is any evidence that the secretary's rate of errors has decreased.

(d) Stating your hypotheses clearly and using a 5% level of significance, find the critical region for this test.

(4 marks)

(Total for Question 3 is 13 marks)

---

4. Refer to the table for Question 4 in the Data Book.
The discrete random variable X has the probability distribution shown, where q and r are probabilities.

(a) Write down, in terms of q, $P(X \leq 0)$

(1 mark)

(b) Show that

$$E(X^2) = \frac{7}{15} + 13q + 16r$$

(2 marks)

(continued on the next page)

4. continued.

Given that

$$E(X^3) = E(X^2) + E(6X)$$

(c) find the value of q and the value of r

(7 marks)

(d) Hence find

$$P(X^3 > X^2 + 6X)$$

(4 marks)

(Total for Question 4 is 14 marks)

TOTAL FOR FURTHER STATISTICS 1 IS 40 MARKS

END OF PAPER
