Paper Reference 9FM0/3B
Pearson Edexcel
Level 3 GCE

Further Mathematics

Advanced
PAPER 3B: Further Statistics 1

Time: 1 hour 30 minutes

YOU MUST HAVE
Mathematical Formulae and Statistical Tables (Green), calculator

YOU WILL BE GIVEN
Data Booklet
Answer Booklet

X69194A

Pearson

Candidates may use any calculator permitted 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 Booklet and on the Data Booklet, 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 Booklet – 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.

Values from statistical tables should be quoted in full. If a calculator is used instead of the tables the value should be given to an equivalent degree of accuracy.

Inexact answers should be given to three significant figures unless otherwise stated.

Turn over

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.

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 Table 1 and Table 2 for Question 1 in the Data Booklet.

   A researcher is investigating the number of female cubs present in litters of size 4

   He believes that the number of female cubs in a litter can be modelled by $B(4, 0 \cdot 5)$

   He randomly selects 100 litters each of size 4 and records the number of female cubs.

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

   He calculated the expected frequencies shown in Table 2 in the Data Booklet.

   (a) Find the value of r and the value of s

   (3 marks)

(continued on the next page)

1. continued.

(b) Carry out a suitable test, at the 5% level of significance, to determine whether or not the number of female cubs in a litter can be modelled by $B(4, 0\cdot5)$

You should clearly state your hypotheses and the critical value used.

(6 marks)

(Total for Question 1 is 9 marks)

2. **Refer to the table for Question 2 in the Data Booklet.**

The discrete random variable X has probability distribution (shown in the table in the Data Booklet) where b is a constant and $b > 5$

(a) **Find $E(X)$ in terms of b**

(1 mark)

Given that $\mathrm{Var}(X) = 34{\cdot}26$

(b) **find the value of b**

(4 marks)

(c) **Find $P(X^2 < 2 - 3X)$**

(4 marks)

(Total for Question 2 is 9 marks)

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3. During the summer, mountain rescue team A receives calls for help randomly with a rate of $0 \cdot 4$ per day.

(a) Find the probability that during the summer, mountain rescue team A receives at least 19 calls for help in 28 randomly selected days.
(2 marks)

The leader of mountain rescue team A randomly selects 250 summer days from the last few years. She records the number of calls for help received on each of these days.

(b) Using a Poisson approximation, estimate the probability of the leader finding at least 20 of these days when more than 1 call for help was received by mountain rescue team A
(4 marks)

(continued on the next page)

3. continued.

Mountain rescue team A believes that the number of calls for help per day is lower in the winter than in the summer.

The number of calls for help received in 42 randomly selected winter days is 8

(c) Use a suitable test, at the 5% level of significance, to assess whether or not there is evidence that the number of calls for help per day is lower in the winter than in the summer. State your hypotheses clearly.
(4 marks)

(continued on the next page)

3. continued.

During the summer, mountain rescue team B receives calls for help randomly with a rate of $0 \cdot 2$ per day, independently of calls to mountain rescue team A

The random variable C is the total number of calls for help received by mountain rescue teams A and B during a period of n days in the summer.

On a Monday in the summer, mountain rescue teams A and B each receive a call for help.

Given that over the next n days $P(C = 0) < 0 \cdot 001$

(d) calculate the minimum value of n

(3 marks)

(e) Write down an assumption that needs to be made for the model to be appropriate.

(1 mark)

(Total for Question 3 is 14 marks)

4. In a game a spinner is spun repeatedly.
When the spinner is spun, the probability of it landing on blue is $0 \cdot 11$

(a) Find the probability that the spinner lands on blue

(i) for the first time on the 6th spin,
(2 marks)

(ii) for the first time before the 6th spin,
(2 marks)

(iii) exactly 4 times during the first 6 spins,
(2 marks)

(iv) for the 4th time on or before the 6th spin.
(4 marks)

(continued on the next page)

4. continued.

Zac and Izana play the game.

They take turns to spin the spinner.

The winner is the first one to have the spinner land on blue.

Izana spins the spinner first.

(b) Show that the probability of Zac winning is $0 \cdot 471$ to 3 significant figures.

(3 marks)

(Total for Question 4 is 13 marks)

5. **A random sample of 150 observations is taken from a geometric distribution with parameter $0 \cdot 3$**

Estimate the probability that the mean of the sample is less than $3 \cdot 45$

(Total for Question 5 is 5 marks)

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6. Refer to the table for Question 6 in the Data Booklet.

The discrete random variable V has probability distribution shown in the table in the Data Booklet.

(a) Show that the probability generating function of V is

$$G_V(t) = t^2\left(\frac{2}{5}t + \frac{3}{5}\right)^2$$

(2 marks)

(continued on the next page)

6. continued.

The discrete random variable W has probability generating function

$$G_W(t) = t\left(\frac{2}{5}t + \frac{3}{5}\right)^5$$

(b) Use calculus to find

(i) $E(W)$

(2 marks)

(ii) $\mathrm{Var}(W)$

(4 marks)

Given that V and W are independent,

(c) find the probability generating function of $X = V + W$ in its simplest form.

(2 marks)

(continued on the next page)

6. continued.

The discrete random variable $Y = 2X + 3$

(d) Find the probability generating function of Y

(2 marks)

(e) Find $P(Y = 15)$

(2 marks)

(Total for Question 6 is 14 marks)

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7. A machine fills bags with flour.

The weight of flour delivered by the machine into a bag, X grams, is normally distributed with mean μ grams and standard deviation 30 grams.

To check if there is any change to the mean weight of flour delivered by the machine into each bag, Olaf takes a random sample of 10 bags.

The weight of flour, x grams, in each bag is recorded and $\bar{x} = 1020$

(a) Test, at the 5% level of significance,

$H_0 : \mu = 1000$ against $H_1 : \mu \neq 1000$

(4 marks)

(continued on the next page)

7. continued.

Olaf decides to alter the test so that the hypotheses are $H_0 : \mu = 1000$ and $H_1 : \mu > 1000$ but keeps the level of significance at 5%

He takes a second sample of size n and finds the critical region, $\bar{X} > c$

(b) Find an equation for c in terms of n

(2 marks)

When the true value of μ is 1020 grams, the probability of making a Type II error is $0 \cdot 0050$, to 2 significant figures.

(c) Calculate the value of n and the value of c

(5 marks)

(Total for Question 7 is 11 marks)

TOTAL FOR PAPER IS 75 MARKS

END OF PAPER
