

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

**Further Mathematics  
Advanced  
Paper 3B: Further Statistics 1**

**Tuesday 18 June 2019 – Morning**

**Time: 1 hour 30 minutes plus your  
additional time allowance.**

**MATERIALS REQUIRED FOR  
EXAMINATION**

**Mathematical Formulae and Statistical  
Tables (Green), calculator**

**ITEMS INCLUDED WITH QUESTION  
PAPERS**

**Diagram Book  
Answer Book**

**V61180A**

**Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for algebraic manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.**

# **INSTRUCTIONS**

**In the boxes on the Answer Book and on the Diagram 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 diagrams – 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.**

**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.**

**Answer ALL questions.**

**Write your answers in the  
Answer Book provided or on the  
diagrams.**

1. **A chocolate manufacturer places special tokens in 2% of the bars it produces so that each bar contains at most one token.**

**Anyone who collects 3 of these tokens can claim a prize.**

**Andreia buys a box of 40 bars of the chocolate.**

- (a) **Find the probability that Andreia can claim a prize.  
(2 marks)**

**(continued on the next page)**

**1. continued.**

**Barney intends to buy bars of the chocolate, one at a time, until he can claim a prize.**

**(b) Find the probability that Barney can claim a prize when he buys his 40th bar of chocolate.**

**(3 marks)**

**(c) Find the expected number of bars that Barney must buy to claim a prize.**

**(1 mark)**

**(Total for Question 1 is 6 marks)**

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**Turn over**

- 2. Indre works on reception in an office and deals with all the telephone calls that arrive.**

**Calls arrive randomly and, in a 4 – hour morning shift, there are on average 80 calls.**

- (a) Using a suitable model, find the probability of more than 4 calls arriving in a particular 20 – minute period one morning.  
(3 marks)**

**(continued on the next page)**

**2. continued.**

**Indre is allowed 20 minutes of break time during each 4 – hour morning shift, which she can take in 5 – minute periods.**

**When she takes a break, a machine records details of any call in the office that Indre has missed.**

**One morning Indre took her break time in 4 periods of 5 minutes each.**

**(b) Find the probability that in exactly 3 of these periods there were no calls.**

**(2 marks)**

**(continued on the next page)**

**Turn over**

**2. continued.**

**On another occasion Indre took  
1 break of 5 minutes and 1 break of  
15 minutes.**

**(c) Find the probability that Indre  
missed exactly 1 call in each of  
these 2 breaks.**

**(3 marks)**

**(Total for Question 2 is 8 marks)**

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**3. Refer to the table for Question 3 in the Diagram Book.**

**A biased spinner can land on the numbers 1, 2, 3, 4 or 5 with the probabilities shown in the Diagram Book.**

**The spinner will be spun 80 times and the mean of the numbers it lands on will be calculated.**

**Find an estimate of the probability that this mean will be greater than  $3.25$**

**(Total for Question 3 is 6 marks)**

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- 4. Refer to the tables for Question 4 in the Diagram Book.**

**Liam and Simone are studying the distribution of oak trees in some woodland.**

**They divided the woodland into 80 equal squares and recorded the number of oak trees in each square.**

**The results are summarised in Table 1**

**(continued on the next page)**

**4. continued.**

**Liam believes that the oak trees were deliberately planted, with 6 oak trees per square and that a constant proportion  $p$  of the oak trees survived.**

**(a) Suggest the model Liam should use to describe the number of oak trees per square.**

**(2 marks)**

**(continued on the next page)**

**Turn over**

**4. continued.**

**Liam decides to test whether or not his model is suitable and calculates the expected frequencies given in Table 2**

- (b) Showing your working clearly, complete the test using a 5% level of significance.**
- You should state your critical value and conclusion clearly.**
- (7 marks)**

**(continued on the next page)**

**4. continued.**

**Simone believes that a Poisson distribution could be used to model the number of oak trees per square. She calculates the expected frequencies given in Table 3**

**(c) Find the value of  $S$  and the value of  $t$ , giving your answers to 2 decimal places.**

**(4 marks)**

**(d) Write down hypotheses to test the suitability of Simone's model.**

**(1 mark)**

**(continued on the next page)**

**Turn over**

**4. continued.**

**The test statistic for this test is  
8.749**

**(e) Complete the test.**

**Use a 5% level of significance  
and state your critical value and  
conclusion clearly.**

**(3 marks)**

**(f) Using the results of these tests,  
explain whether the origin of  
this woodland is likely to be  
cultivated or wild.**

**(2 marks)**

**(Total for Question 4 is 19 marks)**

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**Turn over**

- 5. Information was collected about accidents on the Seapron bypass. It was found that the number of accidents per month could be modelled by a Poisson distribution with mean  $2.5$**

**Following some work on the bypass, the numbers of accidents during a series of 3 – month periods were recorded.**

**The data were used to test whether or not there was a change in the mean number of accidents per month.**

**(continued on the next page)**

**Turn over**

**5. continued.**

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

**You should state the probability in each tail.**

**(5 marks)**

**(b) State  $P(\text{Type I error})$  using this test.**

**(1 mark)**

**(continued on the next page)**

**5. continued.**

**Data from the series of 3 – month periods are recorded for 2 years.**

- (c) Find the probability that at least 2 of these 3 – month periods give a significant result.**
- (3 marks)**

**(continued on the next page)**

**5. continued.**

**Given that the number of accidents per month on the bypass, after the work is completed, is actually  $2.1$  per month,**

- (d) find  $P(\text{Type II error})$  for the test in part (a)**  
**(3 marks)**

**(Total for Question 5 is 12 marks)**

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6. The discrete random variable  $X$  has probability generating function

$$G_X(t) = k \ln\left(\frac{2}{2-t}\right)$$

where  $k$  is a constant.

- (a) Find the exact value of  $k$   
(1 mark)
- (b) Find the exact value of  $\text{Var}(X)$   
(7 marks)
- (c) Find  $P(X = 3)$   
(4 marks)

(Total for Question 6 is 12 marks)

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7. A spinner can land on red or blue.  
When the spinner is spun, there is a probability of  $\frac{1}{3}$  that it lands on blue.  
The spinner is spun repeatedly.

The random variable **B** represents the number of the spin when the spinner first lands on blue.

(a) Find

(i)  $P(B = 4)$

(ii)  $P(B \leq 5)$

(4 marks)

(continued on the next page)

Turn over

**7. continued.**

**(b) Find  $E(B^2)$**

**(3 marks)**

**Steve invites Tamara to play a game with this spinner.**

**Tamara must choose a colour, either red or blue.**

**Steve will spin the spinner repeatedly until the spinner first lands on the colour Tamara has chosen.**

**The random variable  $X$  represents the number of the spin when this occurs.**

**(continued on the next page)**

**Turn over**

**7. continued.**

**If Tamara chooses red, her score  
is  $e^X$**

**If Tamara chooses blue, her score  
is  $X^2$**

**(c) State, giving your reasons and  
showing any calculations you  
have made, which colour you  
would recommend that Tamara  
chooses.**

**(5 marks)**

**(Total for Question 7 is 12 marks)**

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**TOTAL FOR PAPER IS 75 MARKS**

**END OF PAPER**

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