Candidate surname

Other names

**Pearson Edexcel
Level 3 GCE**

Centre Number

Candidate Number

Specimen Paper

Paper Reference **8FM0/23**

Further Mathematics
**Advanced Subsidiary
23: Further Statistics 1**

You must have:
Mathematical Formulae and Statistical Tables, calculator

Total Marks

**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
- 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** 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.
- 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.

Turn over ▶

S 6 0 7 4 2 A 0 1 1 2

Pearson

1. In a survey, 200 people aged 25 and older were randomly selected and asked how much time they spend on social media each day. The table below shows a summary of the results.

		Less than 1 hour	1 hour or more
Age	25 to 54	60	74
	55 and older	32	34

Noah carries out a test, at the 5% level of significance, to see if there is an association between age and time spent on social media. He uses the hypotheses

H_0: There is no association between age and time spent on social media.
H_1: There is an association between age and time spent on social media.

He calculates $\sum \dfrac{(O - E)^2}{E} = 0.245$ for this information.

(a) State the conclusion of the test. Justify your answer.

(2)

(b) Explain why having a large number of age groups may cause a problem when carrying out the hypothesis test.

(1)

Jade decides to take the same information and subdivide the age groups.

She then uses the information in the partially complete table below to carry out a test, at the 5% level of significance, of the same hypotheses.

		Observed				$\dfrac{(O - E)^2}{E}$	
		Less than 1 hour	1 hour or more			Less than 1 hour	1 hour or more
	25 to 34	18	28		25 to 34	0.47	0.40
	35 to 44	20	25		35 to 44	0.02	0.02
Age	45 to 54	22	21		45 to 54	0.25	0.21
	55 to 64	25	15		55 to 64	2.37	2.02
	65 and older	7	19		65 and older		

(c) Complete Jade's hypothesis test. State clearly the degrees of freedom and the critical value used in the test.

(4)

(d) State, giving a reason, which of the conclusions in part (a) and part (c) you believe to be the more reliable.

(1)

Question 1 continued

S 6 0 7 4 2 A 0 4 1 2

(Total for Question 1 is 8 marks)

S60742A0512

2. The discrete random variable X has probability distribution given by

x	2	3	6	11
$P(X = x)$	$\dfrac{1}{50}$	a	$\dfrac{1}{25}$	b

The discrete random variable $Y = X^2$

Given that $E(Y) = 50.3$

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

(3)

(b) Find $P(9 - Y > 0)$

(2)

Independent observations X_1, X_2, X_3, ..., X_{120} of X are taken.

The random variable T represents the total number of these 120 observations that are even.

(c) Find

(i) $E(T)$

(ii) $Var(T)$

(2)

(d) Find, using a suitable approximation, $P(T > 10)$

(3)

(Total for Question 2 is 10 marks)

3. A hotel has 30 rooms. The manager models the number of empty rooms each Friday night using a binomial distribution, B(30, 0.08)

The manager recorded the number of empty rooms in the hotel each Friday night over a period of 80 weeks.

Number of empty rooms	0	1	2	3	4	5	6 or more
Frequency	14	18	22	11	10	5	0

The table below shows the expected frequencies using the manager's model.

Number of empty rooms	0	1	2	3	4	5 or more
Expected frequency	6.56	17.11	r	17.50	10.27	s

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

(2)

(b) Stating your hypotheses clearly, test the manager's model at the 5% level of significance.

(6)

(c) Suggest an improved model for the number of empty rooms in the hotel each Friday night.

(2)

S 6 0 7 4 2 A 0 8 1 2

(Total for Question 3 is 10 marks)

S60742A0912

4. An office has a photocopier and a printer. The photocopier and the printer break down independently.

The number of breakdowns per month for the photocopier follows a Poisson distribution with mean 2.4

The number of breakdowns per month for the printer follows a Poisson distribution with mean 1.6

(a) Determine which machine is more likely to break down exactly twice in one month.

(2)

(b) Work out the probability that both machines break down at most once in one month.

(2)

In a randomly selected month there were 4 breakdowns.

(c) Find the probability that in this month the photocopier broke down more than the printer.

(4)

A repair company carried out repairs on the photocopier and the printer. Following the repairs, there were a total of 3 breakdowns in two months.

(d) Test, at the 5% level of significance, whether or not there is evidence that the rate of breakdowns has decreased following the repairs.

(4)

S 6 0 7 4 2 A 0 1 1 1 2

(Total for Question 4 is 12 marks)

TOTAL FOR FURTHER STATISTICS 1 IS 40 MARKS

S 6 0 7 4 2 A 0 1 2 1 2