Oxford Cambridge and RSA

Friday 16 May 2025 – Afternoon

AS Level Further Mathematics A

Y532/01 Statistics

Time allowed: 1 hour 15 minutes

You must have:
- the Printed Answer Booklet
- the Formulae Booklet for AS Level Further Mathematics A
- a scientific or graphical calculator

QP

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided in the **Printed Answer Booklet**. If you need extra space use the lined page at the end of the Printed Answer Booklet. The question numbers must be clearly shown.
- Fill in the boxes on the front of the Printed Answer Booklet.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.
- Give non-exact numerical answers correct to **3** significant figures unless a different degree of accuracy is specified in the question.
- The acceleration due to gravity is denoted by $g\,\mathrm{m\,s^{-2}}$. When a numerical value is needed use $g = 9.8$ unless a different value is specified in the question.
- Do **not** send this Question Paper for marking. Keep it in the centre or recycle it.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- This document has **4** pages.

ADVICE
- Read each question carefully before you start your answer.

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1 A six-sided dice may or may not be equally likely to land on any one of its faces. It has two faces numbered 5 and the other four faces are numbered 1, 2, 3 and 4. The dice is thrown 60 times, and the outcome on each throw is recorded. The results are shown in the table.

Outcome	1	2	3	4	5
Frequency	7	13	11	15	14

It is required to carry out a test at the 5% significance level of whether the probabilities of the outcomes 1, 2, 3, 4 and 5 are in the ratio 1 : 1 : 1 : 1 : 2.

(a) State suitable hypotheses for the test. **[1]**

(b) Carry out the test. **[6]**

2 On any day, flights of helicopters and aeroplanes pass within sight of a certain building only during a daytime period of 12 hours, from 7.00 am to 7.00 pm.

The random variable H is the number of helicopters that pass within sight of the building during a randomly chosen daytime period of 12 hours.

(a) State **two** assumptions needed for H to be well modelled by a Poisson distribution. **[2]**

Assume now that H can be well modelled by the distribution Po(1.8).

(b) Find the probability that, during a randomly chosen daytime period of 12 hours, the number of helicopters that pass within sight of the building is 2, 3 or 4. **[2]**

(c) During a period of t hours (within the daytime period of 12 hours), the probability that no helicopters pass within sight of the building is 0.95.

Use an algebraic method to determine the value of t. **[3]**

(d) During a randomly chosen daytime period of t hours (where t is the value found in part **(c)**) two helicopters pass within sight of the building.

Explain whether this casts doubt on the validity of the model. You do not need to carry out any calculations. **[1]**

Throughout the daytime period of 12 hours on any day, aeroplanes pass within sight of the building at a fixed constant rate of 1 aeroplane every 4 minutes.

(e) Explain whether the number of aeroplanes that pass within sight of the building on any day is likely to be well modelled by a Poisson distribution. **[1]**

(f) Find the expected value of the total number of helicopters and aeroplanes that pass within sight of the building on a randomly chosen day. **[1]**

3 **(a)** It is required to test whether there is a relationship between two numerical variables.

State why in certain circumstances it would be better to use a test based on Spearman's rank correlation coefficient rather than a test based on the product-moment correlation coefficient. **[1]**

(b) A publisher wants to test whether there is any association between the ratings given by two readers, A and B, to books. The publisher selects 7 books at random and gives a copy of each book to each reader. Each reader gives a rating out of 20, where 20 is high and 0 is low, to each of the 7 books. The ratings are shown in the table.

Book	P	Q	R	S	T	U	V
Reader A	3	7	8	12	13	18	19
Reader B	17	15	16	14	4	5	13

(i) In the Printed Answer Booklet, complete the table giving the ranks of the ratings given by Reader A and Reader B. **[2]**

(ii) Use Spearman's rank correlation coefficient to test at the 5% significance level whether there is any association between the readers' ratings of books. **[7]**

4 In a science experiment, the values of a variable W are selected by the scientist. The experiment involves measuring the corresponding values of the variable V. The results are summarised as follows.

$n = 10 \quad \sum v = 176.2 \quad \sum w = 87.5 \quad \sum v^2 = 4077.64 \quad \sum w^2 = 951.25 \quad \sum vw = 1963.4$

(a) Calculate the value of the product-moment correlation coefficient. **[2]**

(b) By identifying the controlled variable in the experiment, calculate the equation of the appropriate least squares regression line. **[3]**

It is required to obtain an estimate of the value of the response variable when the value of the controlled variable is 10.0.

(c) **(i)** Find the value of the required estimate. **[1]**

(ii) Use the appropriate mean and standard deviation to determine whether 10.0 is likely to be within the range of the data for the controlled variable. **[2]**

(iii) Explain whether the estimate found in part **(c)(i)** is likely to be reliable. **[2]**

(d) Explain what is meant by the words "least squares" in the phrase "least squares regression line". **[1]**

5 The probability distribution of a discrete random variable U is given in the table.

u	0	1	2	3
$\mathrm{P}(U = u)$	r	0.3	p	$0.5 - p$

(a) Find the value of the constant r. **[1]**

(b) Determine an expression for $\mathrm{Var}(U)$ in terms of p. Give your answer in the form $a - (p + b)^2$, where a and b are constants. **[4]**

(c) Use your expression in part **(b)** to determine the smallest possible value of $\mathrm{Var}(U)$. **[3]**

(d) Find the value of $\mathrm{E}(U)$ that corresponds to the smallest possible value of $\mathrm{Var}(U)$. **[1]**

6 A spinner has probability 0.2 of landing on an edge coloured blue. The spinner is spun repeatedly. The number of spins required, up to and including the first spin on which the spinner lands on an edge coloured blue, is denoted by X.

(a) Find $\mathrm{P}(X \leqslant 9)$. **[3]**

(b) Determine the value of $\mathrm{E}(X^2)$. **[4]**

(c) **In this question you must show detailed reasoning.**

The spinner is spun n times. The probability that X takes the value n is 0.041 943 correct to 6 decimal places. In these n spins, the number of times the spinner lands on an edge coloured blue is denoted by Y.

Find the variance of Y. **[6]**

END OF QUESTION PAPER

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