



Oxford Cambridge and RSA

AS Level Further Mathematics A

Y532/01 Statistics

Thursday 17 May 2018 – Afternoon
Time allowed: 1 hour 15 minutes



You must have:

- Printed Answer Booklet
- Formulae AS level Further Mathematics A

You may use:

- a scientific or graphical calculator

INSTRUCTIONS

- Use black ink. HB pencil may be used for graphs and diagrams only.
- Complete the boxes provided on the Printed Answer Booklet with your name, centre number and candidate number.
- Answer **all** the questions.
- **Write your answer to each question in the space provided in the Printed Answer Booklet.** If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.
- The acceleration due to gravity is denoted by $g \text{ m s}^{-2}$. Unless otherwise instructed, when a numerical value is needed, use $g = 9.8$.

INFORMATION

- The total mark for this paper is **60**.
- The marks for each question are shown in brackets [].
- **You are reminded of the need for clear presentation in your answers.**
- The Printed Answer Booklet consists of **12** pages. The Question Paper consists of **4** pages.

1 A book reviewer estimates that the probability that he receives a delivery of books to review on any one weekday is 0.1. The first weekday in September on which he receives a delivery of books to review is the X th weekday of September.

(i) State an assumption needed for X to be well modelled by a geometric distribution. [1]

(ii) Find $P(X = 11)$. [2]

(iii) Find $P(X \leq 8)$. [2]

(iv) Find $\text{Var}(X)$. [2]

(v) Give a reason why a geometric distribution might not be an appropriate model for the first weekday in a calendar year on which the reviewer receives a delivery of books to review. [1]

2 The probability distribution for the discrete random variable W is given in the table.

w	1	2	3	4
$P(W = w)$	0.25	0.36	x	x^2

(i) Show that $\text{Var}(W) = 0.8571$. [7]

(ii) Find $\text{Var}(3W + 6)$. [1]

3 In the manufacture of fibre optical cable (FOC), flaws occur randomly. Whether any point on a cable is flawed is independent of whether any other point is flawed. The number of flaws in 100 m of FOC of standard diameter is denoted by X .

(i) State a further assumption needed for X to be well modelled by a Poisson distribution. [1]

Assume now that X can be well modelled by the distribution $\text{Po}(0.7)$.

(ii) Find the probability that in 300 m of FOC of standard diameter there are exactly 3 flaws. [2]

The number of flaws in 100 m of FOC of a larger diameter has the distribution $\text{Po}(1.6)$.

(iii) Find the probability that in 200 m of FOC of standard diameter and 100 m of FOC of the larger diameter the total number of flaws is at least 4. [3]

- 4 Judith believes that mathematical ability and chess-playing ability are related. She asks 20 randomly chosen chess players, with known British Chess Federation (BCF) ratings X , to take a mathematics aptitude test, with scores Y . The results are summarised as follows.

$$n = 20, \sum x = 3600, \sum x^2 = 660\,500, \sum y = 1440, \sum y^2 = 105\,280, \sum xy = 260\,990$$

- (i) Calculate the value of Pearson's product-moment correlation coefficient r . [2]
- (ii) State an assumption needed to be able to carry out a significance test on the value of r . [1]
- (iii) Assume now that the assumption in part (ii) is valid. Test at the 5% significance level whether there is evidence that chess players with higher BCF ratings are better at mathematics. [4]
- (iv) There are two different grading systems for chess players, the BCF system and the international ELO system. The two sets of ratings are related by

$$\text{ELO rating} = 8 \times \text{BCF rating} + 650.$$

Magnus says that the experiment should have used ELO ratings instead of BCF ratings. Comment on Magnus's suggestion. [1]

- 5 (i) A team of 9 is chosen at random from a class consisting of 8 boys and 12 girls. Find the probability that the team contains no more than 3 girls. [4]
- (ii) A group of n people, including Mr and Mrs Laplace, are arranged at random in a line. The probability that Mr and Mrs Laplace are placed next to each other is less than 0.1. Find the smallest possible value of n . [4]

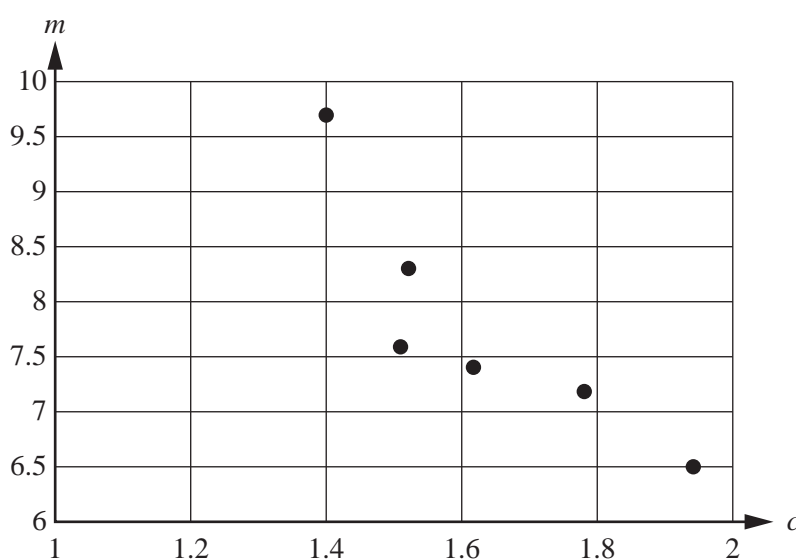
6 **In this question you must show detailed reasoning.**

The random variable T has a binomial distribution. It is known that $E(T) = 5.625$ and the standard deviation of T is 1.875. Find the values of the parameters of the distribution. [5]

- 7 An environmentalist measures the mean concentration, c milligrams per litre, of a particular chemical in a group of rivers, and the mean mass, m pounds, of fish of a certain species found in those rivers. The results are given in the table.

c	1.94	1.78	1.62	1.51	1.52	1.4
m	6.5	7.2	7.4	7.6	8.3	9.7

- (i) State which, if either, of m and c is an independent variable. [1]
- (ii) Calculate the equation of the least squares regression line of c on m . [3]
- (iii) State what effect, if any, there would be on your answer to part (ii) if the masses of the fish had been recorded in kilograms rather than pounds. ($1 \text{ kg} \approx 2.2 \text{ pounds}$.) [1]
- (iv) The data is illustrated in the scatter diagram. Explain what is meant by ‘least squares’, illustrating your answer using the copy of this diagram in the Printed Answer Booklet. [3]



- 8 The table shows the results of a random sample drawn from a population which is thought to have the distribution $U(20)$.

Range	$1 \leq x \leq 8$	$9 \leq x \leq 12$	$13 \leq x \leq 20$
Observed frequency	12	y	$28 - y$

Find the range of values of y for which the data are not consistent with the distribution at the 5% significance level. [9]

END OF QUESTION PAPER

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