



Oxford Cambridge and RSA

**Thursday 16 May 2019 – Afternoon**

**AS Level Further Mathematics A**

**Y532/01 Statistics**

**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.
- 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 the Printed Answer Booklet. The question number(s) must be clearly shown.
- You are permitted to use a scientific or graphical calculator in this paper.
- 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  $g\text{ m s}^{-2}$ . 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.

Answer **all** the questions.

- 1 When a spinner is spun, the outcome is equally likely to be 1, 2 or 3. In a competition, the spinner is spun twice and the outcomes are added to give a total score  $T$ .
- (a) Show that the expectation of  $T$  is 4. [3]
- (b) Find the variance of  $T$ . [3]
- A competitor pays £1.50 to enter the competition and receives £ $X$ , where  $X = 0.3T$ .
- (c) (i) Find the expectation of the competitor's profit. [1]
- (ii) Find the variance of the competitor's profit. [2]
- 2 On any day, the number of orders received in one randomly chosen hour by an online supplier can be modelled by the distribution  $Po(120)$ .
- (a) Find the probability that at least 28 orders are received in a randomly chosen 10-minute period. [2]
- (b) Find the probability that in a randomly chosen 10-minute period on one day and a randomly chosen 10-minute period on the next day a total of at least 56 orders are received. [3]
- (c) State a necessary assumption for the validity of your calculation in part (b). [1]
- 3 (a) Shula calculates the value of Spearman's rank correlation coefficient  $r_s$  for 9 pairs of rankings. Find the largest possible value of  $r_s$  that Shula can obtain that is less than 1. [4]
- (b) A set of bivariate data consists of 5 pairs of values. It is known that for this data the value of Spearman's rank correlation coefficient is  $-1$  but the value of Pearson's product-moment correlation coefficient is not  $-1$ . Sketch a possible scatter diagram illustrating the data. [2]
- 4 The members of a team stand in a random order in a straight line for a photograph. There are four men and six women.
- (a) Find the probability that all the men are next to each other. [3]
- (b) Find the probability that no two men are next to one another. [4]

5 Sixteen candidates took an examination paper in mechanics and an examination paper in statistics.

- (a) For all sixteen candidates, the value of the product moment correlation coefficient  $r$  for the marks on the two papers was 0.701 correct to 3 significant figures.

Test whether there is evidence, at the 5% significance level, of association between the marks on the two papers. [4]

- (b) A teacher decided to omit the marks of the candidates who were in the top three places in mechanics and the candidates who were in the bottom three places in mechanics. The marks for the remaining 10 candidates can be summarised by

$$n = 10, \sum x = 750, \sum y = 690, \sum x^2 = 57\,690, \sum y^2 = 49\,676, \sum xy = 50\,829.$$

- (i) Calculate the value of  $r$  for these 10 candidates. [2]

- (ii) What do the two values of  $r$ , in parts (a) and (b)(i), tell you about the scores of the sixteen candidates? [1]

6 A bag contains a mixture of blue and green beads, in unknown proportions. The proportion of green beads in the bag is denoted by  $p$ .

- (a) Sasha selects 10 beads at random, with replacement.

Write down an expression, in terms of  $p$ , for the variance of the number of green beads Sasha selects. [1]

Freda selects one bead at random from the bag, notes its colour, and replaces it in the bag. She continues to select beads in this way until a green bead is selected. The first green bead is the  $X$ th bead that Freda selects.

- (b) Assume that  $p = 0.3$ .

Find

- (i)  $P(X \geq 5)$ , [2]

- (ii)  $\text{Var}(X)$ . [1]

- (c) In fact, on the basis of a large number of observations of  $X$ , it is found that  $P(X = 3) = \frac{4}{25} \times P(X = 1)$ .

Estimate the value of  $p$ . [5]

**Turn over for Questions 7 and 8**

- 7 In a standard model from genetic theory, the ratios of types  $a$ ,  $b$ ,  $c$  and  $d$  of a characteristic from a genetic cross are predicted to be 9:3:3:1. Andrei collects 120 specimens from such a cross, and the numbers corresponding to each type of the characteristic are given in the table.

Type	$a$	$b$	$c$	$d$
Frequency	51	33	30	6

Andrei tests, at the 1% significance level, whether the observed frequencies are consistent with the standard model.

- (a) State appropriate hypotheses for the test. [1]
- (b) Carry out the test. [6]
- (c) State with a reason which one of the frequencies is least consistent with the standard model. [1]
- (d) Suggest a different, improved model by changing exactly two of the ratio values. [1]
- 8 Alex claims that he can read people's minds. A volunteer, Jane, arranges the integers 1 to  $n$  in an order of Jane's own choice and Alex tells Jane what order he believes was chosen.
- They agree that Alex's claim will be accepted if he gets the order completely correct or if he gets the order correct apart from two numbers which are the wrong way round.
- They use a value of  $n$  such that, if Alex chooses the order of the integers at random, the probability that Alex's claim will be accepted is less than 1%.
- Determine the smallest possible value of  $n$ . [7]

**END OF QUESTION PAPER**

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