

## AS Level Further Mathematics A

### Y532 Statistics

Sample Question Paper

Version 2

## Date – Morning/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



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### 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.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.
- 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 number of marks 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 pages.

Answer **all** the questions.

- 1 Two music critics,  $P$  and  $Q$ , give scores to seven concerts as follows.

Concert	1	2	3	4	5	6	7
Score by critic $P$	12	11	6	13	17	16	14
Score by critic $Q$	9	13	8	14	18	16	20

- (i) Calculate Spearman's rank correlation coefficient,  $r_s$ , for these scores. [4]

- (ii) Without carrying out a hypothesis test, state what your answer tells you about the views of the two critics. [1]

- 2 The probability distribution of a discrete random variable  $W$  is given in the table.

$w$	0	1	2	3
$P(W = w)$	0.19	0.18	$x$	$y$

- Given that  $E(W) = 1.61$ , find the value of  $\text{Var}(3W + 2)$ . [7]

- 3 Carl believes that the proportions of men and women who own black cars are different. He obtained a random sample of people who each owned exactly one car. The results are summarised in the table below.

	Black	Non-black
Men	69	71
Women	30	55

- Test at the 5% significance level whether Carl's belief is justified. [8]

- 4 (i) Four men and four women stand in a random order in a straight line. Determine the probability that no one is standing next to a person of the same gender. [3]

- (ii)  $x$  men, including Mr Adam, and  $x$  women, including Mrs Adam, are arranged at random in a straight line. Show that the probability that Mr Adam is standing next to Mrs Adam is  $\frac{1}{x}$ . [3]

- 5 (i) The random variable  $X$  has the distribution  $\text{Geo}(0.6)$ .
- (a) Find  $P(X \geq 8)$ . [2]
- (b) Find the value of  $E(X)$ . [1]
- (c) Find the value of  $\text{Var}(X)$ . [1]
- (ii) The random variable  $Y$  has the distribution  $\text{Geo}(p)$ . It is given that  $P(Y < 4) = 0.986$  correct to 3 significant figures. Use an algebraic method to find the value of  $p$ . [3]
- 6 Sabrina counts the number of cars passing her house during randomly chosen one minute intervals. Two assumptions are needed for the number of cars passing her house in a fixed time interval to be well modelled by a Poisson distribution.
- (i) State these two assumptions. [2]
- (ii) For each assumption in part (i) give a reason why it might not be a reasonable assumption for this context. [2]
- Assume now that the number of cars that pass Sabrina's house in one minute can be well modelled by the distribution  $\text{Po}(0.8)$ .
- (iii) (a) Write down an expression for the probability that, in a given one minute period, exactly  $r$  cars pass Sabrina's house. [1]
- (b) Hence find the probability that, in a given one minute period, exactly 2 cars pass Sabrina's house. [1]
- (iv) Find the probability that, in a given 30 minute period, at least 28 cars pass Sabrina's house. [3]
- (v) The number of bicycles that pass Sabrina's house in a 5 minute period is a random variable with the distribution  $\text{Po}(1.5)$ . Find the probability that, in a given 10 minute period, the total number of cars and bicycles that pass Sabrina's house is between 12 and 15 inclusive. State a necessary condition. [4]

- 7 The discrete random variable  $X$  is equally likely to take values 0, 1 and 2.  $3N$  observations of  $X$  are obtained, and the observed frequencies corresponding to  $X = 0$ ,  $X = 1$  and  $X = 2$  are given in the following table.

$x$	0	1	2
Observed frequency	$N - 1$	$N - 1$	$N + 2$

The test statistic for a chi-squared goodness of fit test for the data is 0.3. Find the value of  $N$ .

[4]

- 8 The following table gives the mean per capita consumption of mozzarella cheese per annum,  $x$  pounds, and the number of civil engineering doctorates awarded,  $y$ , in the United States in each of 10 years.

$x$	9.3	9.7	9.7	9.7	9.9	10.2	10.5	11.0	10.6	10.6
$y$	480	501	540	552	547	622	655	701	712	708

source: www.tylervigen.com

- (i) Find the equation of the regression line of  $y$  on  $x$ . [2]

You are given that the product moment correlation coefficient is 0.959.

- (ii) Explain whether this value would be different if  $x$  is measured in kilograms instead of pounds. [1]

It is desired to carry out a hypothesis test to investigate whether there is correlation between these two variables.

- (iii) Assume that the data is a random sample of all years.

- (a) Carry out the test at the 10% significance level. [6]

- (b) Explain whether your conclusion suggests that manufacturers of mozzarella cheese could increase consumption by sponsoring doctoral candidates in civil engineering. [1]

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