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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

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 $g\,\mathrm{m\,s^{-2}}$. 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
$\mathrm{P}(W = w)$	0.19	0.18	x	y

Given that $\mathrm{E}(W) = 1.61$, find the value of $\mathrm{Var}(3W + 2)$. **[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 $\text{P}(X \geq 8)$. **[2]**

(b) Find the value of $\text{E}(X)$. **[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 $\text{P}(Y < 4) = 0.986$ 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]**