Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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8340321517

FURTHER MATHEMATICS **9231/42**

Paper 4 Further Probability & Statistics **October/November 2022**

1 hour 30 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **12** pages.

1 A basketball club has a large number of players. The heights, x m, of a random sample of 10 of these players are measured. A 90% confidence interval for the population mean height, μ m, of players in this club is calculated. It is assumed that heights are normally distributed. The confidence interval is $1.78 \leqslant \mu \leqslant 2.02$.

Find the values of $\sum x$ and $\sum x^2$ for this sample. [6]

2 In the colleges in three regions of a particular country, students are given individual targets to achieve. Their performance is measured against their individual target and graded as 'above target', 'on target' or 'below target'. For a random sample of students from each of the three regions, the observed frequencies are summarised in the following table.

		Region			
		A	*B*	*C*	Total
Performance	Above target	62	41	44	147
	On target	102	94	95	291
	Below target	56	45	61	162
	Total	220	180	200	600

Test, at the 10% significance level, whether performance is independent of region. [7]

3 A scientist is investigating the masses of birds of a certain species in country *X* and country *Y*. She takes a random sample of 50 birds of this species from country *X* and a random sample of 80 birds of this species from country *Y*. She records their masses in kg, x and y, respectively. Her results are summarised as follows.

$$\Sigma x = 75.5 \qquad \Sigma x^2 = 115.2 \qquad \Sigma y = 116.8 \qquad \Sigma y^2 = 172.6$$

The population mean masses of these birds in countries *X* and *Y* are μ_x kg and μ_y kg respectively.

Test, at the 5% significance level, the null hypothesis $\mu_x = \mu_y$ against the alternative hypothesis $\mu_x > \mu_y$. State your conclusion in the context of the question. [8]

4 The continuous random variable X has probability density function f given by

$$\mathrm{f}(x) = \begin{cases} k & 0 \leqslant x < 1, \\ kx & 1 \leqslant x \leqslant 2, \\ 0 & \text{otherwise,} \end{cases}$$

where k is a constant.

(a) Show that $k = \frac{2}{5}$. [1]

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(b) Find the interquartile range of X. [5]

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(c) Find Var(X). [4]

5 A 6-sided dice, A, with faces numbered 1, 2, 3, 4, 5, 6 is biased so that the probability of throwing a 6 is $\frac{1}{4}$. The random variable X is the number of 6s obtained when dice A is thrown twice.

(a) Find the probability generating function of X. [2]

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A second dice, B, with faces numbered 1, 2, 3, 4, 5, 6 is unbiased. The random variable Y is the number of 6s obtained when dice B is thrown twice.

The random variable Z is the total number of 6s obtained when both dice are thrown twice.

(b) Find the probability generating function of Z, expressing your answer as a polynomial. [3]

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(c) Find Var(Z). [3]

(d) Use the probability generating function of Z to find the most probable value of Z. [1]

6 The manager of a technology company *A* claims that his employees earn more per year than the employees at technology company *B*. The amounts earned per year, in hundreds of dollars, by a random sample of 12 employees from company *A* and an independent random sample of 12 employees from company *B* are shown below.

Company *A*	461	482	374	512	415	452	502	427	398	545	612	359
Company *B*	454	506	491	384	361	443	401	472	414	342	355	437

(a) Carry out a Wilcoxon rank-sum test at the 5% significance level to test whether the manager's claim is supported by the data. [9]

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(b) Explain whether a paired sample *t*-test would be appropriate to test the manager's claim if earnings are normally distributed. [1]

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Additional page

If you use the following page to complete the answer to any question, the question number must be clearly shown.

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