



Rewarding Learning

ADVANCED

General Certificate of Education

2017

# Mathematics

Assessment Unit S4

*assessing*

Module S2: Statistics 2



AMS41

[AMS41]

**FRIDAY 23 JUNE, MORNING**

## TIME

1 hour 30 minutes.

## INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number on the Answer Booklet provided.

Answer **all eight** questions.

Show clearly the full development of your answers.

Answers should be given to three significant figures unless otherwise stated.

You are permitted to use a graphic or scientific calculator in this paper.

## INFORMATION FOR CANDIDATES

The total mark for this paper is 75

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

A copy of the **Mathematical Formulae and Tables booklet** is provided.

Throughout the paper the logarithmic notation used is  $\ln z$  where it is noted that  $\ln z \equiv \log_e z$

**Answer all eight questions.**

**Show clearly the full development of your answers.**

**Answers should be given to three significant figures unless otherwise stated.**

**Normal and t-distribution values should be read from the tables provided.**

- 1** A sample of university students took part in a test which looked into the relationship between a person's weight ( $x$ , kg) and lung capacity ( $y$ , litres). The data is given in **Table 1** below.

**Table 1**

Weight ( $x$ , kg)	65	72	64	88	81	59	75	73
Lung Capacity ( $y$ , litres)	5.1	5.7	4.9	4.9	5.4	5.1	5.8	6.0

- (i) Stating all summary values, find the product-moment correlation coefficient for these data. [6]
- (ii) Comment on the value obtained in (i). [2]

- 2** A motor oil manufacturer is testing the effect of temperature ( $x$ , °C) on the density ( $y$ , g/cm<sup>3</sup>) of one of their products. The summary information is shown below.

$n$	$\sum x$	$\sum y$	$\sum x^2$	$\sum y^2$	$\sum xy$
9	540	7.683	38400	6.561041	457.25

- (i) Find the regression equation of density on temperature. [6]
- (ii) Estimate the density of the oil at 65°C. [2]

- 3** (i) Using your calculator generate 10 random numbers. [1]
- (ii) Using these numbers select a random sample of size 3 from any population of size 40. Clearly explain your method. [5]

- 4 A medical student is asked to ascertain the average body temperature of 14-year-olds. He takes the temperature ( $x$ , °C) of a random sample of fifty 14-year-olds. His results are summarised below.

$$\sum x = 1856.4$$

$$\sum x^2 = 68\,933.47$$

- (i) Find a 95% confidence interval for the average body temperature of 14-year-olds, giving your answer to an appropriate degree of accuracy. [8]
- (ii) Explain carefully what your answer to (i) means. [1]

- 5 Two years ago the mean cost of a family visit to the cinema (£  $x$ ) was £25.50. A sample of recent family visits to the cinema produced the following summary information.

$$n = 40$$

$$\sum x = 1033.63$$

$$\sum x^2 = 26\,806.94$$

Find if there is sufficient evidence at 5% level to claim that the mean cost has increased. [10]

- 6 The makers of a brand of fishing line claim that it has a breaking strength of 20 N. To investigate this claim Alison takes some measurements of breaking strength. Her results (in N) are given below.

19.7   20.4   19.6   18.8   19.5   19.4   20.1   20.3   19.6   19.2   18.2   19.4

Carry out a test at 5% level to see if the makers' claim is justified. [12]

- 7 According to a company which packages salt for use in dishwashers, their bags contain an average of 3000 grams (as stated on the bags) with standard deviation 60 grams. The mass of the contents is normally distributed. A random sample of 10 bags of salt is chosen and weighed.

Find the probability that the mean mass of the sample lies within 20 grams of the stated mass. [6]

- 8 (a) Two independent random variables  $S$  and  $T$  are such that  $S \sim N(25,10)$  and  $T \sim N(40,8)$ .  
 $S_1, S_2$  and  $S_3$  are independent variables each with the same distribution as  $S$ .  
 $T_1$  and  $T_2$  are independent variables each with the same distribution as  $T$ .

Find:

(i)  $P(S_1 + S_2 + S_3 > T_1 + T_2),$  [5]

(ii)  $P(2S_1 - S_2 > 2T_1 - T_2).$  [5]

- (b) Two independent variables  $X$  and  $Y$  are such that  $X \sim N(10,4)$  and  $Y \sim N(20,3)$ .

If  $aX + bY \sim N(10,112)$ , where  $a$  and  $b$  are integers, find  $a$  and  $b$ . [6]

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**THIS IS THE END OF THE QUESTION PAPER**

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