



Rewarding Learning

ADVANCED  
General Certificate of Education  
2014

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## Mathematics

Assessment Unit S4

*assessing*

Module S2: Statistics 2

[AMS41]

MONDAY 23 JUNE, MORNING

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### 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 a 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 Sandra believes that there is a link between fitness and attitude to healthy eating. Ten university students took part in an experiment. They completed a quiz about their attitude to healthy eating and also underwent a series of fitness tests. Their scores are given in **Table 1** below.

**Table 1**

Attitude score ( $x$ )	39	44	21	64	57	47	27	75	34	52
Fitness score ( $y$ )	65	78	52	84	92	89	71	98	56	75

The summary statistics are:

$n$	$\Sigma x$	$\Sigma x^2$	$\Sigma y$	$\Sigma y^2$	$\Sigma xy$
10	460	23 666	760	59 860	36 933

- (i) Calculate the product–moment correlation coefficient between attitude and fitness. [5]
- (ii) Comment on the value obtained in part (i). [1]
- 2 A Normally distributed random variable has mean 350 and variance 125  
Twenty observations of the variable are recorded.
- Find the probability that the mean of the twenty observations lies between 348 and 353 [7]

- 3 Angela measures the hand spans (to the nearest centimetre) of a sample of pupils in her year group. Her results are summarised in **Table 2** below.

**Table 2**

Hand span (cm)	14–16	17–19	20–23
Frequency	25	43	7

- (i) Calculate estimates for the mean and variance of the hand span of pupils in this year group. [3]
- (ii) Using your values from (i) calculate a 95% confidence interval for the mean hand span of pupils in this year group. Give your answer to 4 significant figures. [5]
- (iii) Give one assumption regarding the hand spans of pupils in this year group. [1]
- 4 A thermistor is a resistor whose resistance  $R$  ohms varies with temperature  $T$  degrees Celsius. Harry carried out an experiment on a thermistor recording its resistance at different temperatures. His results are given in **Table 3** below.

**Table 3**

Temperature $T$ degrees Celsius	100	90	80	70	60	50
Resistance $R$ ohms	994	1054	1091	1158	1210	1245

The summary statistics are:

$n$	$\Sigma T$	$\Sigma R$	$\Sigma T^2$	$\Sigma R^2$	$\Sigma TR$
6	450	6752	35 500	7 644 322	497 450

- (i) Find the regression equation of resistance on temperature. [6]
- (ii) Calculate an estimate of the resistance of this thermistor at 75 °C. [2]

- 5 The manufacturer of a drug for pain relief claimed that on average capsules contained 85 mg of active ingredient. Tests on a random sample of 100 capsules resulted in a sample mean of 84.7 mg and standard deviation 0.8 mg.

Test the manufacturer's claim at 5% level of significance. [9]

- 6 You have been asked to carry out an experiment to find the linear relationship between the length of a spring ( $l$  cm) and the mass of the load applied ( $m$  grams). From your experiment you are expected to establish the regression equation of length on load.

Using terms associated with linear regression describe how you would approach this experiment. [5]

- 7 Standard-sized chocolate chip cookies have masses which are Normally distributed with mean 30 grams and standard deviation 2 grams. They are sold in packets of six.

- (i) Find the probability that the total mass of cookies in a packet (chosen at random) exceeds 185 grams. [6]

The cookies are also available in large size. Their masses are Normally distributed with mean 50 grams and standard deviation 3 grams.

- (ii) Find the probability that the total mass of cookies in a packet of standard-sized cookies (chosen at random) is more than 10 grams lighter than 4 times the mass of a large-sized cookie (chosen at random). [7]

- 8 A potato farmer sells potatoes in 5 kg bags. He uses a machine to package the potatoes. The machine is getting old and the farmer suspects that it isn't doing its job properly. He randomly selects eleven bags and records the weight,  $x$  kg, of each bag so as to carry out a hypothesis test.

The summary statistics are:

$$\sum x = 52.5 \quad \sum x^2 = 252$$

- (i) The farmer suspects that the mean weight delivered by the machine is not 5 kg. Stating your hypotheses, carry out the hypothesis test at 5%. [13]

- (ii) Suppose instead, the farmer had suspected that the mean weight delivered by the machine is below 5 kg. Stating your hypotheses, carry out the hypothesis test at 5%. [5]