



Rewarding Learning

ADVANCED  
General Certificate of Education  
2009

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## Mathematics

Assessment Unit S4

*assessing*

Module S2: Statistics 2

[AMS41]



WEDNESDAY 17 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 seven** 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

$\ln z \equiv \log_e z$

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**Answer all seven questions.**

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

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

- 1** Nathan is looking for a link between the temperature of a liquid ( $y^\circ\text{C}$ ) and the time ( $x$  minutes) for which a current has been passing through it. His findings are given in **Table 1** below.

**Table 1**

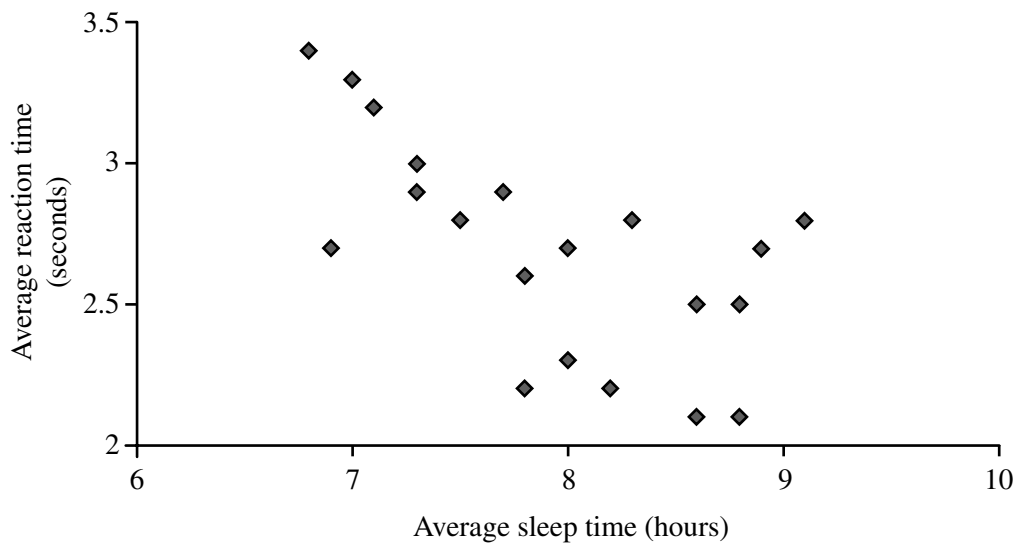
Time ( $x$ minutes)	10	20	30	40	50	60
Temperature ( $y^\circ\text{C}$ )	29.3	35.1	43.7	51.5	56.9	64.2

The summary values are

$n$	$\Sigma x$	$\Sigma y$	$\Sigma x^2$	$\Sigma y^2$	$\Sigma xy$
6	210	280.7	9100	14011.69	11063

- (i) Find the regression equation of temperature on time. [6]
- (ii) Estimate the temperature of the liquid after thirty-five minutes. [2]

- 2 The relationship between sleep and reaction time is being explored by Paula, a medical student. A group of volunteers was monitored for the amount of sleep they got over a period of time and Paula then asked them to take part in a test of reaction times. The scatter diagram in **Fig. 1** below shows the results of average reaction time ( $y$ , in seconds) against average sleep time ( $x$ , in hours).



**Fig. 1**

Summary values are:

$n$	$\Sigma x$	$\Sigma y$	$\Sigma x^2$	$\Sigma y^2$	$\Sigma xy$
20	158.5	53.7	1266.01	146.95	422.24

The product–moment correlation coefficient for these data is approximately  $-0.64$ . Paula recognises that outliers may be affecting this value. She identifies two points as possible outliers:  $(6.9, 2.7)$  and  $(9.1, 2.8)$ .

- (i) Recalculate the summary values for the 18 data pairs without these points. [5]
- (ii) Calculate the value of the product–moment correlation coefficient using the remaining eighteen data values. [4]
- (iii) What might Paula deduce from the value obtained in part (ii)? [2]

- 3 (i) Explain the meaning of the term “point estimate”. [2]

Fred is investigating the number of hours per week ( $X$ ) that teenagers spend online in connection with their studies. He takes his information from a sample of fifty teenagers at a large school. The results of his findings are given below.

$$\Sigma x = 690 \qquad \Sigma x^2 = 10120$$

- (ii) Calculate point estimates for the population mean and population variance. [4]

- (iii) Find a 95% confidence interval for the mean time spent by teenagers studying online. [5]

- 4 A manufacturer claims that the batteries for their mobile phones last for at least 10 hours when fully charged. Twelve mobile phone batteries are tested and the times (in hours) that they lasted are:

10.4    10.2    10.3    9.6    10.1    8.7    9.2    10.3    9.3    9.6    10.0    9.7

- Test the manufacturer’s claim at 5% level. [13]

- 5 The masses ( $X$ ) of eggs produced at a certain farm for a local supermarket are Normally distributed with mean 75 g and variance  $6 \text{ g}^2$ . They are packed into cartons of six. The average mass of the six eggs in a carton is given by the distribution  $\bar{X}_6$

- (i) Write down the mean and variance of  $\bar{X}_6$  [2]

A carton of six eggs is chosen at random.

- (ii) Find the probability that the average mass of the eggs in the carton is greater than 76 g. [4]

- 6 The 34 fifteen-year-old girls at a private school all take an IQ test. The average IQ of the girls at the school was 111.6. The statistics office say that the national average IQ is 110 with standard deviation 5.8

Test at 5% level whether the pupils' IQ differs from the national average. [10]

- 7 The coffee machine in a cafeteria dispenses an amount of coffee followed by an amount of milk into a cup. The amount of coffee dispensed is Normally distributed with mean 212 ml and variance  $2.2 \text{ ml}^2$ . The amount of milk dispensed is Normally distributed with mean 25 ml and variance  $1.7 \text{ ml}^2$ .

(i) Find the mean and variance of the combined amount of coffee and milk dispensed. [4]

The machine has the option to add a concentrated sweetener to the mixture. The amount of sweetener added is Normally distributed with mean 1 ml and variance  $0.1 \text{ ml}^2$ . This option is chosen by 38% of customers.

The cups into which the mixture is dispensed have a capacity of 240 ml.

(ii) Show that approximately 10% of cups will overflow. [12]

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

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