Rewarding Learning

ADVANCED
General Certificate of Education
2014

Mathematics

Assessment Unit S4

assessing

Module S2: Statistics 2

[AMS41]

MONDAY 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 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	Σx	Σx^2	Σy	Σy^2	Σxy
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]

8468   **2**

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	ΣT	ΣR	ΣT^2	ΣR^2	ΣTR
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:

$$\Sigma x = 52.5 \qquad \Sigma x^2 = 252$$

(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]

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