Rewarding Learning

ADVANCED
General Certificate of Education
2011

Mathematics

Assessment Unit S4

assessing

Module S2: Statistics 2

[AMS41]

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WEDNESDAY 22 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.

1 Mr Faller is in charge of rugby at his school. He has been given six tickets for pupils to attend an international match. Having made enquiries among the pupils he finds that there are 62 pupils who have expressed an interest. Mr Faller decides to use a table of random numbers to decide who the lucky 6 will be.

Explain carefully each step involved in the process of selection. [5]

2 The scores in History and English of ten pupils in a school are recorded in order to explore if there may be any link between performances in the two subjects. The results are given in **Table 1** below.

Table 1

Pupil	A	B	C	D	E	F	G	H	I	J
History x	67	49	80	71	75	60	72	55	61	84
English y	72	55	78	75	78	57	80	58	67	76

Summary values of these data are:

n	$\sum x$	$\sum y$	$\sum x^2$	$\sum y^2$	$\sum xy$
10	674	696	46542	49280	47775

(i) Calculate the product-moment correlation coefficient for these data. [5]

(ii) Comment on the value obtained in part **(i)**. [2]

3 A materials engineer is developing a metal cable which has to withstand a range of temperatures. She carries out some tests to determine the force, y (N), required to break the cable at various temperatures, x (°C). Her data are given in **Table 2** below.

Table 2

Temperature (°C), x	10	20	30	40	50
Force (N), y	110	107	102	95	88

Summary values of these data are:

n	$\sum x$	$\sum y$	$\sum x^2$	$\sum y^2$	$\sum xy$
5	150	502	5500	50722	14500

(i) Find the regression equation of force on temperature. [6]

(ii) Estimate the force required if the temperature was 25 °C. [2]

(iii) Explain why it would be unwise to estimate the force required at a temperature of 65 °C. [1]

4 Anna takes measurements as part of her research on the variable X.
Her summary values are as follows:

$$n = 80 \qquad \sum x = 1996 \qquad \sum x^2 = 49975$$

Assuming Normality find a 95% confidence interval for the mean of X. [7]

5 Bottles of aftershave have "50 ml" written on them. Mark suspects that they contain less than the manufacturer claims. He decides to test this and manages to acquire a sample of 8 unopened bottles. He measures the amount of aftershave, x ml, in them.

The results of Mark's findings are as follows:

$$\sum x = 399.2 \qquad \sum x^2 = 19925.12$$

(i) Calculate the mean and variance of the data. [3]

(ii) Test Mark's suspicion at 5% level. [10]

6 **(i)** Explain clearly the meaning of the term *Alternative Hypothesis*. [2]

A local newspaper declared in an article that on average teenagers watch twenty-five hours of television per week. The statistics class in a school decided to test whether or not that was true. They carried out a survey within their school asking pupils about the amount of television watching, x hours, they did per week.

The results are summarised as follows:

$$n = 50 \qquad \sum x = 1285 \qquad \sum x^2 = 33183$$

(ii) Test the newspaper's claim at 5% level. [10]

7 A manufacturer produces tubes of sweets that contain 10 sweets individually wrapped in paper.
The masses (in grams) of individual sweets are Normally distributed with mean 6 and standard deviation 0.9
The masses of the paper wrappers (in grams) are Normally distributed with mean 0.2 and standard deviation 0.02

Find the probability that the mass of the contents of a tube of sweets chosen at random lies between 60 g and 65 g. [10]

8 A company supplies bottles of water for sale in supermarkets. The bottles are labelled as containing 500 ml. The setting of the machine for filling each bottle is such that the amount of water dispensed, X ml, has the distribution N(502,18). The bottles then are packaged in packs of six.

Let $\bar{X}_6$ be the average amount of water per bottle in a pack.

(i) Write down the type, mean and variance of the distribution of $\bar{X}_6$ [3]

(ii) Find the probability that a pack chosen at random has an average amount per bottle less than 500 ml. [4]

The water is delivered to supermarkets in crates containing 8 packs.

(iii) Find the probability that a crate chosen at random contains at least 2 packs whose average amount per bottle is less than 500 ml. [5]