GCE AS/A level

0984/01

MATHEMATICS – S2
Statistics

P.M. THURSDAY, 12 June 2014

1 hour 30 minutes

ADDITIONAL MATERIALS

In addition to this examination paper, you will need:

- a 12 page answer book;
- a Formula Booklet;
- a calculator;
- statistical tables (Murdoch and Barnes or RND/WJEC Publications).

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Answer **all** questions.

Sufficient working must be shown to demonstrate the **mathematical** method employed.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

1. The times taken, in minutes, for trains to travel between two stations on a particular day were recorded and are given below.

48·2 49·4 56·2 44·6 47·3 55·2 50·8 53·9

It may be assumed that this is a random sample from a normal distribution with mean μ mins and standard deviation 4 mins. Determine a 90% confidence interval for μ. [6]

2. The weights of the oranges sold on a market stall are normally distributed with mean 248 grams and standard deviation 8 grams. The weights of the lemons sold on the market stall are normally distributed with mean 85 grams and standard deviation 1·5 grams.

(a) Find the upper quartile of the weights of the lemons. [2]

(b) Ann buys 8 oranges. Calculate the probability that the total weight of her oranges is less than 2000 grams. [5]

(c) Bethan buys 1 orange and 1 lemon. Calculate the probability that the weight of her orange is more than three times the weight of her lemon. [7]

3. A new species of animal has been found on an uninhabited island. A zoologist wishes to investigate whether or not there is a difference in the mean weights of males and females of the species. She traps some of the animals and weighs them with the following results.

Males (kg)	5·3, 4·6, 5·2, 4·5, 4·3, 5·5, 5·0, 4·8
Females (kg)	4·9, 5·0, 4·1, 4·6, 4·3, 5·3, 4·2, 4·5, 4·8, 4·9

You may assume that these are random samples from normal populations with a common standard deviation of 0·5 kg.

(a) State suitable hypotheses for this investigation. [1]

(b) Determine the *p*-value of these results and state your conclusion in context. [9]

4. Gwilym buys a new computer game. He claims that he wins, on average, 60% of games played. His friend Huw believes that Gwilym wins less than 60% of games played.

(a) To investigate these conflicting claims, Gwilym plays the game 20 times and wins 7 of them.

(i) State suitable hypotheses for testing these claims.

(ii) Determine the *p*-value of the above result and state your conclusion in context. [7]

(b) During the following week, Gwilym plays the game 80 times and wins 37 of them. Use a suitable approximation to determine the *p*-value and state your conclusion in context. [7]

5. The random variables X and Y are independent observations from the binomial distribution B(6, 0·2). Given that $U = XY$, determine the value of

(a) $E(U)$, [2]

(b) Var(U). [6]

6. When John types a page of a document, the number of errors can be modelled by a Poisson distribution with mean μ. He claims that the value of μ is 1·5 but his employer wants to test this claim so they define the following hypotheses.

$$H_0 : \mu = 1{\cdot}5; \quad H_1 : \mu \neq 1{\cdot}5$$

(a) John is asked to type a 10-page document and the critical region is taken as $x \leqslant 10$ or $x \geqslant 20$, where x denotes the total number of errors in the document.

(i) Find the significance level of this test.

(ii) Find the probability of incorrectly accepting H_0 when the value of μ is actually 1·0. [7]

(b) John now types a 50-page document and makes 92 errors. Find the *p*-value and state your conclusion. [6]

7. The sides of a square are of length L cm and its area is A cm^2. Given that A is uniformly distributed on the interval [15, 20], find

(a) $P(L \leqslant 4)$, [3]

(b) $E(L)$, [4]

(c) Var(L). [3]

END OF PAPER

