



**GCE AS/A level**

**0984/01**

**MATHEMATICS – S2**

**Statistics**

**A.M. WEDNESDAY, 15 June 2016**

**1 hour 30 minutes plus your additional time allowance**

## **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 or your usual method.

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 independent random variables  $X$  and  $Y$  are such that  $X$  has a Poisson distribution with mean  $2$  and  $Y$  has a Poisson distribution with mean  $3$ . Given that  $W = XY$  determine

- (a) the mean and the variance of  $W$ ,

[6 marks]

- (b)  $P(W = 4)$ .

[4 marks]

2. Sue keeps chickens in her garden. She selects, at random, 10 of the eggs produced and weighs them. The results, in grams, are shown below.

**62.5          64.2          61.5          65.2**

**66.2          63.8          60.1          63.2**

**64.4          66.1**

You may assume that this is a random sample from a normal distribution with a standard deviation of **1.9**.

- (a) Determine a **95%** confidence interval for the mean weight of eggs produced by Sue's chickens.  
[6 marks]

- (b) Sue was hoping to obtain a **95%** confidence interval of width **1** at most. Calculate the minimum sample size necessary to achieve this.  
[4 marks]

3. For a certain breed of dog, the weights of the males are normally distributed with mean **40 kg** and standard deviation **2.5 kg**. The weights of the females are normally distributed with mean **32 kg** and standard deviation **1.5 kg**.

(a) Calculate the upper quartile of the weights of male dogs of this breed.

[2 marks]

(b) A random selection is made of **3** males and **2** females of the breed.

Calculate the probability that

(i) the combined weight of the **5** dogs exceeds **185 kg**

(ii) the combined weight of the **3** males is less than twice the combined weight of the **2** females.

[12 marks]

4. The independent random variables  $X$  and  $Y$  are such that  $X$  is  $N(\mu_x, 1.5^2)$  and  $Y$  is  $N(\mu_y, 2.5^2)$

In order to test the hypotheses

$$H_0 : \mu_x = \mu_y \quad ; \quad H_1 : \mu_x \neq \mu_y$$

a random sample of size **8** is taken from the distribution of  $X$  and a random sample of size **12** is taken from the distribution of  $Y$ .

The means of these two samples are denoted by  $\bar{X}$  and  $\bar{Y}$  respectively.

The significance level is to be **10%**.

- (a) Determine the critical region in the form

$$|\bar{X} - \bar{Y}| > k$$

where the value of  $k$  is to be found.

[5 marks]

- (b) (i) If, in fact,  $\mu_x - \mu_y = 0.5$ , find the probability of incorrectly accepting  $H_0$ .
- (ii) Comment on your result in (i).

[9 marks]

5. A seed manufacturer claims that **70%** of seeds of a certain variety will germinate but the manager of a garden centre claims that the germination rate is less than this.

(a) A trial is therefore conducted in which **50** seeds of this variety are planted. It is found that **32** of these seeds germinate.

(i) State suitable hypotheses to test these claims.

(ii) Calculate the  $p$ -value of this result and state your conclusion in context.

[7 marks]

(b) A further trial is conducted in which **500** seeds of this variety are planted and it is found that **329** of these seeds germinate. Carry out a hypothesis test using a normal approximation and state your conclusion in context.

[7 marks]

6. A piece of string of length **20 cm** is cut at a random point. The length of the longer piece is denoted by  **$X$  cm** and the length of the shorter piece is denoted by  **$Y$  cm**. You may assume that  **$X$**  is uniformly distributed on the interval  **$[10, 20]$** .

(a) Determine  **$P(Y < 8)$** .

[2 marks]

(b) (i) Express  **$Y$**  in terms of  **$X$** .

(ii) Determine  **$P(XY > 64)$** .

[6 marks]

(c) Calculate  **$E(XY)$** .

[5 marks]

END OF PAPER