



GCE AS/A level

0984/01

MATHEMATICS – S2
Statistics

A.M. MONDAY, 10 June 2013

1½ hours

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 random variable X is normally distributed with mean 10 and standard deviation 2.

(a) (i) Evaluate $P(X \leq 10.5)$.

(ii) Given that $P(X \geq x) = 0.1$, find the value of x . [5]

(b) The independent random variable Y is normally distributed with mean 12 and standard deviation 3.

(i) Evaluate $P(X + 2Y < 36)$.

(ii) Given that X_1, X_2, X_3 is a random sample from the distribution of X and Y_1, Y_2 is a random sample from the distribution of Y , evaluate

$$P(X_1 + X_2 + X_3 < Y_1 + Y_2). \quad [11]$$

2. The amount of coffee dispensed into a cup by an automatic machine may be assumed to be normally distributed with mean μ ml and standard deviation 4 ml. Successive amounts are independent. One morning, the machine was used 50 times and the amounts dispensed, x ml, were measured. It was found that $\sum x = 9980$.

(a) Find 95% confidence limits for μ , giving your answers correct to one decimal place. [5]

(b) Determine the minimum sample size which would give a 95% confidence interval for μ having width less than 1. [4]

3. A teacher in a large college wishes to investigate whether or not boys and girls perform equally well in examinations in practical mathematics. She therefore selects a random sample of 8 boys and 8 girls and gives them an examination.

The marks obtained were as follows.

Boys	52, 47, 62, 75, 51, 69, 56, 70
Girls	48, 39, 56, 69, 71, 45, 43, 59

You may assume that these are random samples from normal populations with a common standard deviation of 7.5.

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

(b) Determine the p -value of these results and state your conclusion in context. [10]

4. A politician believes that 40% of the voters support him but his agent believes that his support is greater than this. They decide to question a random sample of voters to try to resolve the situation.
- (a) State suitable hypotheses. [1]
 - (b) They question a random sample of 50 voters, of whom 25 state that they support the politician. Determine the p -value and state your conclusion in context at the 5% significance level. [4]
 - (c) They now decide to question a random sample of 400 voters, of whom 181 state that they support the politician. Determine an approximate p -value and state your conclusion in context. [7]
5. The number of accidents occurring per day along a certain stretch of road can be modelled by a Poisson distribution. The value of the mean μ has been 1.2 in the past but the local council has recently introduced a lower speed limit in the hope of reducing the value of μ .
- (a) State suitable hypotheses for testing whether or not lowering the speed limit has had the desired effect. [1]
 - (b) It is decided to count the number of accidents, x , occurring in a 60-day period and to define the critical region as $x \leq 58$.
 - (i) Determine the significance level.
 - (ii) Given that the value of μ has actually fallen to 0.8, determine the probability of concluding that there has been no reduction in the value of μ . [12]
6. The radius R of a circle is a continuous random variable that is uniformly distributed on the interval $[6, 8]$.
- (a) Let C denote the circumference of the circle. Determine
 - (i) the mean and the variance of C ,
 - (ii) $P(C \leq 45)$. [7]
 - (b) Let A denote the area of the circle. Determine
 - (i) $P(A \geq 150)$,
 - (ii) $E(A)$. [7]