



GCE AS/A level

0983/01



S15-0983-01

MATHEMATICS – S1
Statistics

A.M. TUESDAY, 9 June 2015

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 random variable X has the binomial distribution $B(10, 0.3)$ and $Y = 2X + 1$. Calculate
 - (a) the mean and the variance of Y , [5]
 - (b) $P(Y = 7)$. [3]

2. The events A and B are such that

$$P(A) = 0.4, P(B) = 0.5 \text{ and } P(A \cup B) = 2 \times P(A \cap B).$$
 - (a) Show that $P(A \cap B) = 0.3$. [2]
 - (b) Evaluate $P(A|B)$. [2]
 - (c) Evaluate $P(B|A')$. [3]

3. A bag contains 10 sweets of which 5 are red, 3 are green and 2 are yellow. Ann chooses a sweet at random from the bag and immediately puts it in her pocket so that nobody can see what colour it is. Bethan then chooses a sweet at random from the remaining 9 sweets. Calculate the probability that
 - (a) Ann chooses a green sweet, [1]
 - (b) Bethan chooses a yellow sweet, [3]
 - (c) Ann and Bethan choose sweets of different colours. [3]

4. The number of members, X , of a club attending a monthly meeting is modelled by a Poisson distribution with mean 10.
 - (a) Determine the probability that, at a randomly chosen meeting, the number of members attending is
 - (i) exactly 9,
 - (ii) less than 12. [4]
 - (b) Determine the smallest value of n such that $P(X \geq n)$ is less than 0.01. [2]

5. At a certain university, 60% of the students are male and 40% are female. It is known that 75% of the male students own a bicycle and 30% of the female students own a bicycle. One of the students is selected at random.

- (a) Calculate the probability that the selected student
- (i) is a male student who owns a bicycle,
 - (ii) owns a bicycle. [5]
- (b) Given that the selected student owns a bicycle, calculate the probability that this student is female. [3]

6. (a) A factory manufactures cups. The manager knows from past experience that 5% of the cups produced are defective. Given a random sample of 50 of these cups, determine the probability that the number of defective cups in this sample is

- (i) exactly 2,
- (ii) between 3 and 8 (both inclusive). [6]

- (b) The factory also manufactures plates. The manager knows that 1.5% of the plates produced are defective. Use an appropriate Poisson distribution to find, approximately, the probability that a random sample of 250 of these plates contains exactly 4 defective plates. [3]

7. The discrete random variable X has the following probability distribution.

$$P(X = x) = \frac{k}{x} \quad \text{for } x = 2, 3, 4, 6,$$

$$P(X = x) = 0 \quad \text{otherwise.}$$

- (a) Show that $k = \frac{4}{5}$. [2]
- (b) Determine $E(X)$. [2]
- (c) Given that X_1 and X_2 are independent observations from the distribution of X , determine the probability that the product $X_1 X_2$ is equal to 12. [4]

TURN OVER

8. Fred is a cricket player. When he throws a ball at the wicket from a point P , he hits it with probability 0.3. You may assume that successive throws are independent.

(a) One morning, he goes out to practise his throwing from the point P . Calculate the probability that he hits the wicket for the first time with his third throw. [2]

George is also a cricket player. When he throws a ball at the wicket from the point P , he hits it with probability 0.2. You may again assume that successive throws are independent.

- (b) On another morning, Fred and George decide to play a game in which they throw balls, alternately, at the wicket from the point P . The winner is the player who is first to hit the wicket. Given that George throws first, calculate the probability that Fred
- (i) wins the game with his first throw,
 - (ii) wins the game with his second throw,
 - (iii) wins the game. [7]

9. The continuous random variable X has probability density function f given by

$$f(x) = \frac{4}{9} (4x - x^3) \quad \text{for } 1 \leq x \leq 2,$$

$$f(x) = 0 \quad \text{otherwise.}$$

(a) Determine $E\left(\frac{1}{X}\right)$. [4]

- (b) (i) Find an expression for $F(x)$, valid for $1 \leq x \leq 2$, where F denotes the cumulative distribution function of X .
- (ii) Hence calculate $P(1.25 \leq X \leq 1.75)$.
- (iii) Calculate the median of X . [9]

END OF PAPER