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# MATHEMATICS S1

## Statistics

A.M. THURSDAY, 8 June 2006

($1\frac{1}{2}$ 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

Answer **all** questions.

## 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.** A tin contains 3 sweets, 2 of which are green and 1 is red. Ann selects 1 of these sweets at random and eats it. Brian then selects 1 of the remaining 2 sweets at random and eats it. Charles then takes the remaining sweet and eats it. Find the probability that the red sweet is eaten by

*(a)* Ann, [1]

*(b)* Brian, [2]

*(c)* Charles. [2]

**2.** The events $A$ and $B$ are such that

$$P(A) = 0{\cdot}2,\ P(B) = 0{\cdot}6,\ P(A \cup B) = 0{\cdot}75.$$

*(a)* Determine whether or not $A$ and $B$ are independent. [4]

*(b)* Find the probability that exactly one of $A$ and $B$ occurs. [4]

**3.** The random variable $X$ has a Poisson distribution with mean 4. The random variable $Y$ is defined by

$$Y = 2X + 8.$$

*(a)* Show that the mean and variance of $Y$ are equal. [5]

*(b)* John thinks that, because of this, $Y$ has a Poisson distribution. Explain briefly why this is not the case. [1]

**4.** *(a)* The number of visitors calling per day at a small office may be assumed to have a Poisson distribution with mean 12. **Using an appropriate table**, find the probability that the number of visitors calling on a randomly chosen day is

(i) more than 10,

(ii) exactly 15. [5]

*(b)* The number of letters arriving per day at the office may be assumed to have a Poisson distribution with mean 6·3. **Without the use of tables,** find the probability that the number of letters arriving on a randomly chosen day is

(i) exactly 5,

(ii) less than 3. [5]

**5.** A village shop sells eggs supplied by three local farms. Farm A supplies 40% of the eggs, Farm B supplies 35% of the eggs and Farm C supplies 25% of the eggs. It is known that 4% of the eggs from Farm A are double-yolked, 5% from Farm B are double-yolked and 6% from Farm C are double-yolked. One of these eggs is chosen at random.

*(a)* Find the probability that it is double-yolked. [3]

*(b)* Given that the chosen egg is double-yolked,

(i) find the probability that it came from Farm A,

(ii) determine which farm it was most likely to have come from. [6]

**6.** *(a)* When a drawing pin is thrown onto a table, the probability that it will fall 'point upwards' is 0·2. All 50 drawing pins in a packet are thrown onto a table. Given that $X$ denotes the number falling 'point upwards',

(i) identify the distribution of $X$,

(ii) find the mean and standard deviation of $X$,

(iii) find $P(8 \leqslant X \leqslant 12)$. [8]

*(b)* It is known that 1% of drawing pins are defective. A shopkeeper buys 1000 drawing pins. Use an appropriate distributional approximation to find the probability that less than 10 of them are defective. [4]

**7.** The probability distribution of the discrete random variable $X$ is given in the following table.

| $x$ | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| $P(X = x)$ | $k$ | $2k$ | $3k$ | $4k$ | $5k$ |

*(a)* Show that $k = \frac{1}{15}$. [2]

*(b)* Find the mean and variance of $X$. [6]

*(c)* The random variable $Y$ is defined by $Y = X_1 + X_2$, where $X_1$, $X_2$ are independent observations on $X$. Find $P(Y = 6)$. [4]

**8.** The continuous random variable $X$ has cumulative distribution function $F$ given by

$$F(x) = 0 \qquad \text{for } x < 0,$$

$$F(x) = \frac{1}{2}(x^2 + x) \qquad \text{for } 0 \leqslant x \leqslant 1,$$

$$F(x) = 1 \qquad \text{for } x > 1.$$

*(a)* Find

(i) $P(0{\cdot}25 \leqslant X \leqslant 0{\cdot}5)$,

(ii) the median of $X$. [7]

*(b)* (i) Obtain an expression for $f(x)$ that is valid for $0 \leqslant x \leqslant 1$, where $f$ denotes the probability density function of $X$.

(ii) Evaluate $E(X)$. [6]