WELSH JOINT EDUCATION COMMITTEE
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MATHEMATICS S1

Statistics

P.M. THURSDAY, 18 January 2007

($1\frac{1}{2}$ 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 bag contains 9 balls of which 2 are red, 3 are blue and 4 are yellow. Bill chooses 3 of these balls at random without replacement. Find the probability that

(a) he chooses 3 yellow balls, [2]

(b) he chooses no blue balls, [2]

(c) he chooses 1 ball of each colour. [3]

2. The events A and B are such that

$$P(A) = 0{\cdot}48,\ P(B) = 0{\cdot}38,\ P(A \cap B) = 0{\cdot}28.$$

Calculate

(a) $P(A \cup B)$, [2]

(b) $P(A' \cap B')$, [2]

(c) $P(B \mid A')$. [4]

3. The random variable X has the distribution B(n, 0·1). Given that the mean and standard deviation of X are equal, find the value of n. [5]

4. Mair chooses a number at random from the set {2, 3, 4}. Whichever number Mair chooses, she then tosses that number of fair coins.

(a) Find the probability that all the coins tossed land 'heads'. [4]

(b) Given that all the coins land 'heads', find the probability that she chose the number 2. [3]

5. *(a)* It is known that 35% of a certain type of seed produce red flowers. A gardener buys 20 of these seeds. Find the probability that

(i) exactly 5 seeds produce red flowers,

(ii) fewer than 8 seeds produce red flowers. [5]

(b) It is also known that 3% of these seeds produce yellow flowers. The manager of a Garden Centre buys 500 of these seeds. Use a distributional approximation to find the probability that

(i) exactly 10 seeds produce yellow flowers,

(ii) more than 12 seeds produce yellow flowers. [5]

6. The probability distribution of the discrete random variable X is given in the following table.

x	1	2	3	4	5
$P(X = x)$	0·3	p	0·1	q	0·05

(a) Show that $p + q = 0{\cdot}55$. [1]

(b) Given that $E(X) = 2{\cdot}75$, show that $p = 0{\cdot}15$ and $q = 0{\cdot}4$. [4]

(c) Find the variance of X. [3]

(d) The random variable Y is defined by $Y = 4X + 2$.

(i) Find the mean and variance of Y.

(ii) Find $P(Y < 15)$. [6]

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

$$f(x) = 20\,(x^3 - x^4), \qquad \text{for } 0 \leqslant x \leqslant 1,$$
$$f(x) = 0, \qquad \text{otherwise,}$$

(a) Find $E(X)$. [4]

(b) (i) Obtain an expression for $F(x)$, valid for $0 \leqslant x \leqslant 1$, where F denotes the cumulative distribution function of X.

(ii) Evaluate $P(0{\cdot}4 \leqslant X \leqslant 0{\cdot}6)$.

(iii) The upper quartile of X is denoted by q. Show that

$$16q^5 - 20q^4 + 3 = 0.$$ [8]

8. Students on a typing course are each given a page to type. You may assume that the number of errors made on a page follows a Poisson distribution with mean μ where the value of μ varies from student to student.

(a) For Alan, $\mu = 3{\cdot}75$. Without the use of tables, find the probability that he makes exactly 3 errors. [2]

(b) A page is unsatisfactory if it contains at least 5 errors.

(i) For Belle, $\mu = 2{\cdot}4$. Find the probability that her page is unsatisfactory.

(ii) The probability that Ceri's page is unsatisfactory is 0·2194. Using tables, find the value of μ for Ceri. [4]

(c) Diane is the best pupil in the class and for her, $\mu = 0{\cdot}6$. She is given n pages to type. Assuming that each page is independent of all others,

(i) show that the probability that there are no errors on any of these pages is $e^{-0{\cdot}6n}$,

(ii) find the minimum value of n for which this probability is less than 0·01. [6]