

General Certificate of Education
January 2005
Advanced Level Examination



MATHEMATICS (SPECIFICATION A)
Unit Statistics 2

MAS2/W

Thursday 27 January 2005 Afternoon Session

In addition to this paper you will require:

- an 8-page answer book;
- the AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Time allowed: 1 hour 20 minutes

Instructions

- Use blue or black ink or ball-point pen. Pencil should only be used for drawing.
- Write the information required on the front of your answer book. The *Examining Body* for this paper is AQA. The *Paper Reference* is MAS2/W.
- Answer **all** questions.
- All necessary working should be shown; otherwise marks for method may be lost.
- The **final** answer to questions requiring the use of tables or calculators should normally be given to three significant figures.
- Tie loosely any additional sheets you have used to the back of your answer book before handing it to the invigilator.

Information

- The maximum mark for this paper is 60.
- Mark allocations are shown in brackets.

Advice

- Unless stated otherwise, formulae may be quoted, without proof, from the booklet.

Answer **all** questions.

1 Boxes of miniature Easter eggs each contain 12 eggs. It is known that 9% of such eggs are made with white chocolate and are distributed randomly throughout all boxes of eggs.

(a) (i) Write down the probability distribution for S , the number of eggs made with white chocolate in a box of miniature Easter eggs. *(1 mark)*

(ii) Show that, in a randomly selected box of miniature Easter eggs, $P(S \geq 4) = 0.018$, correct to three decimal places. *(2 marks)*

(b) Patricia bought 300 boxes of these miniature Easter eggs.

Use a distributional approximation to calculate the probability that at least 3 of these boxes contained 4 or more eggs made with white chocolate. *(5 marks)*

2 The continuous random variable X has the following cumulative distribution function.

$$F(x) = \begin{cases} 0 & x < 0 \\ \frac{x^3}{64} & 0 \leq x \leq 4 \\ 1 & x > 4 \end{cases}$$

(a) Calculate $P(2 \leq X \leq 3)$. *(2 marks)*

(b) Find the probability density function, $f(x)$, for $0 \leq x \leq 4$. *(2 marks)*

(c) Evaluate:

(i) $E(X)$; *(3 marks)*

(ii) $\text{Var}(X)$. *(3 marks)*

3 Peter buys exactly one scratch card each day. On any day, the probability of a win with the scratch card he buys is 0.1.

(a) Write down the probability distribution for X , the number of days for him to gain his first win. *(1 mark)*

(b) Calculate the probability that he wins for the first time on the fourth day that he buys a scratch card. *(2 marks)*

(c) Show that Peter must buy a scratch card on 29 days in order for him to have at least a 95% chance of a win. *(4 marks)*

- 4 A survey of 420 single people was conducted in order to find out whether there is evidence of an association between their gender and the type of holiday that they prefer.

The results of this survey are as follows.

	Beach holiday	Adventure holiday
Male	118	98
Female	90	114

Investigate, at the 5% level of significance, the claim that there is an association between the gender of a single person and the type of holiday that they prefer. (10 marks)

- 5 X and Y are two independent random variables such that $X \sim N(120, 36)$ and $Y \sim N(90, 13)$.

(a) For the random variable $X - Y$, write down the value of:

(i) $E(X - Y)$; (1 mark)

(ii) $\text{Var}(X - Y)$. (1 mark)

(b) Calculate $P(X - Y > 40.5)$. (4 marks)

(c) The random variable T is defined by $T = X_1 + X_2 + 2Y$, where X_1 and X_2 are two independent observations on X .

(i) Find values for the mean and variance of T . (3 marks)

(ii) Calculate $P(T < 400)$. (4 marks)

- 6 The committee of a Former Pupils' Association claims that the mean age, μ , of the association's members is more than 48 years. The standard deviation of the ages of the association's members is known to be 8 years.

To investigate the committee's claim, a random sample of 100 members is taken and the mean age is found to be 49.2 years.

(a) Stating null and alternative hypotheses and using the 5% level of significance, test the committee's claim. (7 marks)

(b) Calculate the probability of a Type II error when $\mu = 50$ years. (5 marks)

END OF QUESTIONS

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE