

General Certificate of Education  
June 2005  
Advanced Level Examination



**MATHEMATICS (SPECIFICATION A)**  
**Unit Statistics 2**

**MAS2/W**

Wednesday 22 June 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.

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Answer **all** questions.

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- 1 The number of hits per day,  $X$ , on a property website can be modelled by a Poisson distribution with mean 50.

Using a distributional approximation, calculate the probability that, on a randomly selected day, there are at least 60 hits on this property website. (5 marks)

- 2 Jenny is practising for a clay-pigeon shooting competition. The probability that she scores a hit with any one shot is 0.8.

Assume that each shot is independent of every other shot.

- (a) Write down the probability distribution for  $Y$ , the number of shots that Jenny takes at the target in order to score her first hit. (1 mark)
- (b) Calculate the probability that Jenny first hits the target with her fifth attempt. (2 marks)
- (c) Find values for the mean and variance of  $Y$ . (2 marks)

- 3 The time,  $T$  minutes, that Suneil waits to access a telephone banking service may be modelled by the following probability density function.

$$f(t) = \begin{cases} \frac{6}{19}t & 0 \leq t \leq 2 \\ \frac{6}{19}t(3-t) & 2 \leq t \leq 3 \\ 0 & \text{otherwise} \end{cases}$$

- (a) Sketch the graph of  $f(t)$ . (2 marks)
- (b) (i) Show that the probability that Suneil waits less than 30 seconds is 0.0395, correct to three significant figures. (2 marks)
- (ii) Suneil makes 50 calls to this telephone banking service each month.

Assuming that each call is independent of every other call, use a distributional approximation to calculate the probability that he has to wait less than 30 seconds on fewer than 4 occasions during a month. (5 marks)

- (c) Calculate Suneil's mean waiting time. (5 marks)

- 4 The height,  $x$  centimetres, of each of 200 students from a sixth form college is recorded.

The frequency distribution of these 200 heights is given in the following table.

<b>Height</b>	$x < 150$	$150 \leq x < 158$	$158 \leq x < 162$	$162 \leq x < 170$	$x \geq 170$
<b>Frequency</b>	11	67	31	64	27

Use a  $\chi^2$  goodness-of-fit test, at the 5% level of significance, to test whether the normal distribution with  $\mu = 160$  and  $\sigma^2 = 64$  is a suitable model for these data. (12 marks)

- 5 The time taken,  $X$  seconds, by boys of a certain age to run 100 metres may be modelled by a normal random variable with mean 16 and variance 2.25.

The time taken,  $Y$  seconds, by girls of the same age to run 100 metres may be modelled by a normal random variable with mean 18 and variance 4.

- (a) (i) Write down the distribution of  $Y - X$ . (2 marks)
- (ii) A girl and a boy are each selected at random.

Calculate the probability that the time taken by the girl to run 100 metres is less than the time taken by the boy to run 100 metres. (3 marks)

- (b) Four boys are selected at random to form team B and four girls are selected at random to form team G.

Each of these children runs 100 metres and their times may be assumed to be independent.

Calculate the probability that the difference between the total time taken by team B and the total time taken by team G is more than 5 seconds. (7 marks)

**TURN OVER FOR THE NEXT QUESTION**

- 6 The marks,  $X$ , obtained by students in their mathematics examination may be assumed to be a random variable with mean  $\mu$  and variance 32.

After the introduction of a new programme of revision classes, it is claimed that the value of the mean has increased from its previous value of 65.

In order to investigate this claim, a random sample of 50 students' marks is taken and the mean,  $\bar{x}$ , calculated.

- (a) Write down null and alternative hypotheses in order to investigate the claim. *(2 marks)*
- (b) Assuming  $H_0$  to be true, write down the distribution of  $\bar{X}$ . *(2 marks)*
- (c) It is decided to reject the null hypothesis if the sample mean exceeds 66.4.

Calculate the probability of a Type I error and hence write down the significance level of this test. *(4 marks)*

- (d) Calculate the probability of a Type II error in the case when  $\mu$  has increased to 67. *(4 marks)*

**END OF QUESTIONS**