

General Certificate of Education  
June 2005  
Advanced Level Examination



**MATHEMATICS (SPECIFICATION A)**  
**Unit Statistics 4**

**MAS4/W**

Tuesday 28 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 MAS4/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 Ten biathlon competitors were each given scores out of 100 for their muscular coordination,  $x$ , and shooting ability,  $y$ . The data collected are summarised as follows.

$$\begin{array}{lll} \sum x = 689 & \sum y = 759 & \sum xy = 53\,052 \\ \sum x^2 = 49\,277 & \sum y^2 = 58\,679 & n = 10 \end{array}$$

- (a) Calculate the value of the product moment correlation coefficient for these data. *(5 marks)*
- (b) Comment briefly on the value that you have obtained in part (a). *(1 mark)*
- 2 A survey was carried out on customers who were about to purchase gammon at a supermarket. From a random sample of 144 of these customers, 82 preferred smoked gammon to unsmoked gammon.

Calculate an approximate 95% confidence interval for the proportion of customers preferring smoked gammon. *(4 marks)*

- 3 The table below records the number of goals scored for and against 10 teams in a school hockey league.

Team	A	B	C	D	E	F	G	H	I	J
Goals for	34	25	21	31	23	23	17	17	15	16
Goals against	15	21	19	16	24	17	19	26	30	33

- (a) (i) Calculate the value of Spearman's rank correlation coefficient. *(7 marks)*
- (ii) For the above data give a disadvantage of calculating Spearman's rank correlation coefficient, rather than the product moment correlation coefficient. *(1 mark)*
- (b) Assuming that the above data are a random sample from a distribution with correlation coefficient  $\rho_s$ , investigate, at the 1% level of significance, the hypothesis that  $\rho_s < 0$ . *(4 marks)*

4 Over a period of time, when aiming for the bull's-eye, a darts player hits it with one dart in every five.

(a) After a period of practice, the player's darts hit the bull's-eye 15 times out of 50 attempts.

Investigate, at the 5% level of significance, whether this shows an improvement in the player's ability to hit the bull's-eye. *(4 marks)*

(b) Find the least number of darts, out of 50, that need to hit the bull's-eye, in order to demonstrate an improvement at the 1% level of significance. *(2 marks)*

5 The table below shows the values of the explanatory variable,  $x$ , and the response variable,  $y$ , in an experiment.

$x$	0	0	1	1	2	3	3	4	4	4
$y$	11	12	11	13	12	14	17	15	18	22

It is believed that  $x$  and  $y$  are related by the equation  $y = cd^x$ , where  $c$  and  $d$  are constants.

(a) Assuming that the equation above is valid, explain why a straight line will result when  $\ln y$  is plotted against  $x$ . *(2 marks)*

(b) Find the equation of the least squares regression line of  $\ln y$  on  $x$ .

You may use the following information calculated from the above data.

$$\begin{aligned} \sum x &= 22 & \sum (\ln y) &= 26.492 \\ \sum x^2 &= 72 & \sum x(\ln y) &= 61.107 \end{aligned} \quad (5 \text{ marks})$$

(c) Hence estimate the values of  $c$  and  $d$ . *(3 marks)*

(d) Estimate the value of  $y$  when  $x = 2.5$ . *(2 marks)*

**TURN OVER FOR THE NEXT QUESTION**

Turn over ►

- 6 At a certain university, a random sample of 250 students from the arts faculty showed 73 in favour of a particular candidate who was standing for the presidency of the students' union. Another random sample of 250 students from the science faculty showed 91 in favour of the same candidate.

Test, at the 5% level of significance, whether support for this candidate is the same in both faculties. (7 marks)

- 7 An unbiased estimator is to be found for the parameter  $\lambda$ .

- (a) If  $E(X) = a\lambda + b$ , where  $a$  and  $b$  are constants, show that

$$\frac{X - b}{a}$$

is an unbiased estimator for  $\lambda$ .

(3 marks)

- (b) The continuous random variable  $X$  has the following probability density function.

$$f(x) = \begin{cases} \frac{2}{9}(\lambda + 3 - x) & \lambda \leq x \leq \lambda + 3 \\ 0 & \text{otherwise} \end{cases}$$

- (i) Find  $E(X)$  and hence find an unbiased estimator for  $\lambda$ . (7 marks)
- (ii) Five observations were taken on  $X$ . The following values were observed.

4.2    5.1    6.3    6.8    7.6

Find an unbiased estimate of  $\lambda$ .

(3 marks)

**END OF QUESTIONS**