

General Certificate of Education
November 2004
Advanced Subsidiary Examination



**MATHEMATICS AND STATISTICS
(SPECIFICATION B)
Unit Statistics 1**

MBS1

Tuesday 2 November 2004 Afternoon Session

In addition to this paper you will require:

- a 12-page answer book;
- the AQA booklet of formulae and statistical tables;
- two sheets of graph paper for use in Questions 5 and 8;
- a ruler.

You may use a graphics calculator.

Time allowed: 1 hour 45 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 MBS1.
- 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.

Information

- The maximum mark for this paper is 80.
- Mark allocations are shown in brackets.

Advice

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

Answer **all** questions.

1 The demand for cheese rolls at a sandwich shop may be modelled by a Poisson distribution with mean 14 per day.

(a) Find the probability that, on a particular day, the demand for cheese rolls is:

(i) 11 or fewer;

(ii) exactly 14. *(3 marks)*

(b) On a particular day, the shopkeeper prepares 18 cheese rolls. Find the probability that all will be sold on that day. *(2 marks)*

2 The following three statements are the results of Damien's calculations for a sample of towns in England.

Statement 1

The product moment correlation coefficient, between the percentage unemployed and the percentage of the population with qualifications beyond GCSE, is 0.65.

Statement 2

The product moment correlation coefficient, between the number of reported crimes of violence in 2003 and the number of chartered accountants, is 1.15.

Statement 3

The product moment correlation coefficient, between the number of reported crimes of violence in 2003 and the number of mathematics teachers, is 0.82.

Classify **each of the three** statements as either:

A plausible

B probably incorrect

C definitely incorrect

Give a reason for each of your answers.

(6 marks)

3 (a) A university holds a list of all 410 students who graduated from the mathematics department between 1998 and 2002. Describe how random numbers could be used to select a random sample of size 20 from these 410 students. *(5 marks)*

(b) The 20 students selected are each contacted and asked to complete a questionnaire.

If the mean income in 2003 of all 410 students is a parameter:

(i) define the population; *(2 marks)*

(ii) give an example, in this context, of a statistic. *(2 marks)*

(c) If the mean income in 2003 of all 410 students is a statistic, define a possible population. *(1 mark)*

4 George and Jose are friends who play together after school. On fine days, they have a choice of playing computer games or going to the park. The probability that, on any fine day, they will prefer to play computer games is 0.8 for George and, independently, 0.7 for Jose.

(a) Find the probability that on a particular fine day:

(i) both George and Jose prefer to play computer games;

(ii) both George and Jose prefer to go to the park;

(iii) exactly one of George or Jose prefers to go to the park. *(5 marks)*

(b) Tony is another friend who plays with George and Jose after school. The probability that, on a fine day, Tony prefers to play computer games is 0.95 when George prefers to play computer games and 0.15 when George prefers to go to the park. Tony's preferences are independent of those of Jose.

Find the probability that on a particular fine day:

(i) all three boys prefer to play computer games;

(ii) two or more of the boys prefer to play computer games. *(5 marks)*

5

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- 6 Spyros manages a unit trust. He invests clients' money in companies listed on the stock market and is judged each year on whether or not his investments have outperformed the stock market average.

Spyros decides which companies to invest in by asking his young daughter to stick a pin in a list of possible companies. Using this strategy, the probability that he will outperform the stock market average in any particular year is 0.5. This probability may be assumed independent for each year.

- (a) Find the probability that, in a 6-year period, Spyros will outperform the stock market average in:
- (i) more than 4 years; *(3 marks)*
 - (ii) all 6 years. *(2 marks)*
- (b) In 1997, a journal reported that out of 900 unit trusts only 14 had managed to outperform the stock market average in each of the 6 years from 1991 to 1996. Comment on this in the light of your answer to part (a)(ii). *(3 marks)*

- 7 An airline operates a service between Manchester and Paris. The flight time may be modelled by a normal distribution with mean 85 minutes and standard deviation 8 minutes.

- (a) Find the probability that a particular flight time is:
- (i) less than 75 minutes; *(3 marks)*
 - (ii) between 75 minutes and 81 minutes. *(3 marks)*
- (b) In order to gain publicity for the service, the airline decides to refund fares when a flight time exceeds q minutes. Find the value of q such that the probability of fares being refunded on a particular flight is 0.001. *(4 marks)*
- (c) Find the probability that:
- (i) the mean of four randomly selected flight times will be less than 81 minutes; *(4 marks)*
 - (ii) the mean flight time will be less than 81 minutes for four passengers selected at random from all passengers on a particular flight. *(2 marks)*

8 [A sheet of graph paper is provided for use in this question.]

Naomi attends a health club. As part of her training programme, she is timed, on different occasions, to carry out predetermined numbers of step-ups. The table below shows the number of step-ups, x , and the time taken, y seconds, to complete them.

x	20	25	30	35	40	45	50	55	60	65
y	53	66	77	96	125	147	186	222	254	298

- (a) Draw a scatter diagram of the data. *(2 marks)*
- (b) Calculate the equation of the regression line of y on x and draw the line on your diagram. *(6 marks)*
- (c) Calculate the residuals for the points where Naomi completed:
- (i) 45 step-ups;
 - (ii) 65 step-ups. *(3 marks)*
- (d) (i) Use your regression equation to predict the time that Naomi would take to complete 62 step-ups. *(1 mark)*
- (ii) Give a reason why the prediction made in part (d)(i) is unlikely to be accurate. *(1 mark)*
- (e) A new trainer suggests that, instead of undertaking a predetermined number of step-ups, Naomi should complete as many step-ups as possible in predetermined periods of time. How, if at all, would your method of calculation of the regression equation for data generated in this way differ from your method of calculation in part (b)? Justify your answer. *(2 marks)*

END OF QUESTIONS