



General Certificate of Education
June 2009
Advanced Level Examination

MATHEMATICS
Unit Statistics 3

MS03

Friday 19 June 2009 1.30 pm to 3.00 pm

For this paper you must have:

- an 8-page answer book
 - the blue AQA booklet of formulae and statistical tables.
- You may use a graphics calculator.

Time allowed: 1 hour 30 minutes

Instructions

- Use black ink or black 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 MS03.
- Answer **all** questions.
- Show all necessary working; 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 75.
- The marks for questions are shown in brackets.

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.

Answer **all** questions.

- 1 An analysis of a random sample of 150 urban dwellings for sale showed that 102 are semi-detached.

An analysis of an independent random sample of 80 rural dwellings for sale showed that 36 are semi-detached.

- (a) Construct an approximate 99% confidence interval for the difference between the proportion of urban dwellings for sale that are semi-detached and the proportion of rural dwellings for sale that are semi-detached. *(6 marks)*
- (b) Hence comment on the claim that there is no difference between these two proportions. *(2 marks)*

- 2 A hotel chain has hotels in three types of location: city, coastal and country. The percentages of the chain's reservations for each of these locations are 30, 55 and 15 respectively.

Each of the chain's hotels offers three types of reservation: Bed & Breakfast, Half Board and Full Board.

The percentages of these types of reservation for **each** of the three types of location are shown in the table.

| | | Type of location | | |
|---------------------|-----------------|------------------|---------|---------|
| | | City | Coastal | Country |
| Type of reservation | Bed & Breakfast | 80 | 10 | 30 |
| | Half Board | 15 | 65 | 50 |
| | Full Board | 5 | 25 | 20 |

For example, 80 per cent of reservations for hotels in city locations are for Bed & Breakfast.

- (a) For a reservation selected at random:
- (i) show that the probability that it is for Bed & Breakfast is 0.34; *(2 marks)*
- (ii) calculate the probability that it is for Half Board in a hotel in a coastal location; *(2 marks)*
- (iii) calculate the probability that it is for a hotel in a coastal location, given that it is for Half Board. *(4 marks)*
- (b) A random sample of 3 reservations for Half Board is selected.

Calculate the probability that these 3 reservations are for hotels in different types of location. *(5 marks)*

- 3 The proportion, p , of an island's population with blood type A Rh⁺ is believed to be approximately 0.35 .

A medical organisation, requiring a more accurate estimate, specifies that a 98% confidence interval for p should have a width of at most 0.1 .

Calculate, to the nearest 10, an estimate of the minimum sample size necessary in order to achieve the organisation's requirement. (6 marks)

- 4 Holly, a horticultural researcher, believes that the mean height of stems on Tahiti daffodils exceeds that on Jetfire daffodils by more than 15 cm.

She measures the heights, x centimetres, of stems on a random sample of 65 Tahiti daffodils and finds that their mean, \bar{x} , is 40.7 and that their standard deviation, s_x , is 3.4 .

She also measures the heights, y centimetres, of stems on a random sample of 75 Jetfire daffodils and finds that their mean, \bar{y} , is 24.4 and that their standard deviation, s_y , is 2.8 .

Investigate, at the 1% level of significance, Holly's belief. (8 marks)

- 5 The random variable X has a binomial distribution with parameters n and p .

- (a) Given that

$$E(X) = np \quad \text{and} \quad E(X(X - 1)) = n(n - 1)p^2$$

find an expression for $\text{Var}(X)$. (3 marks)

- (b) Given that X has a mean of 36 and a standard deviation of 4.8 :

(i) find values for n and p ; (3 marks)

(ii) use a distributional approximation to estimate $P(30 < X < 40)$. (4 marks)

- 6 The table shows the probability distribution for the number of weekday (Monday to Friday) morning newspapers, X , purchased by the Reed household per week.

| | | | | | | |
|----------|------|------|------|------|------|------|
| x | 0 | 1 | 2 | 3 | 4 | 5 |
| $P(X=x)$ | 0.16 | 0.15 | 0.25 | 0.25 | 0.15 | 0.04 |

- (a) Find values for $E(X)$ and $\text{Var}(X)$. (3 marks)
- (b) The number of weekday (Monday to Friday) evening newspapers, Y , purchased by the same household per week is such that

$$E(Y) = 2.0, \quad \text{Var}(Y) = 1.5 \quad \text{and} \quad \text{Cov}(X, Y) = -0.43$$

Find values for the mean and variance of:

- (i) $S = X + Y$;
- (ii) $D = X - Y$. (5 marks)
- (c) The total cost per week, L , of the Reed household's weekday morning and evening newspapers may be assumed to be normally distributed with a mean of £2.31 and a standard deviation of £0.89.

The total cost per week, M , of the household's weekend (Saturday and Sunday) newspapers may be assumed to be independent of L and normally distributed with a mean of £2.04 and a standard deviation of £0.43.

Determine the probability that the total cost per week of the Reed household's newspapers is more than £5. (5 marks)

- 7 The daily number of customers visiting a small arts and crafts shop may be modelled by a Poisson distribution with a mean of 24.
- (a) Using a distributional approximation, estimate the probability that there was a total of at most 150 customers visiting the shop during a given 6-day period. (5 marks)
- (b) The shop offers a picture framing service. The daily number of requests, Y , for this service may be assumed to have a Poisson distribution.

Prior to the shop advertising this service in the local free newspaper, the mean value of Y was 2. Following the advertisement, the shop received a total of 17 requests for the service during a period of 5 days.

- (i) Using a Poisson distribution, carry out a test, at the 10% level of significance, to investigate the claim that the advertisement increased the mean daily number of requests for the shop's picture framing service. (5 marks)
- (ii) Determine the critical value of Y for your test in part (b)(i). (3 marks)
- (iii) Hence, assuming that the advertisement increased the mean value of Y to 3, determine the power of your test in part (b)(i). (4 marks)

END OF QUESTIONS

There are no questions printed on this page

There are no questions printed on this page

There are no questions printed on this page