



# Cambridge International AS & A Level

CANDIDATE  
NAMECENTRE  
NUMBER

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  |  |  |
|--|--|--|--|--|

CANDIDATE  
NUMBER

|  |  |  |  |
|--|--|--|--|
|  |  |  |  |
|--|--|--|--|

## MATHEMATICS

9709/61

Paper 6 Probability &amp; Statistics 2

May/June 2025

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

### INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

### INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **12** pages.

- Use a suitable approximating distribution to find  $P(X \leq 3)$ . [3]

This image shows a full page of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page, typical of notebook or legal stationery. There are no margins, text, or other markings on the page.



- (a) Find  $P(\bar{X} > 6.2)$ . You are **not** expected to use a continuity correction. [6]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

- (b)** State why the Central Limit Theorem was needed in the calculation in part **(a)**. [1]

.....

.....

.....

.....

.....



- 3 The time,  $T$  minutes, for a certain daily bus journey is normally distributed. The bus company claims that the mean of  $T$  is 45. A passenger believes that the mean of  $T$  is actually greater than 45. She notes the times taken for this journey on a random sample of 60 days. The results are summarised below.

$$n = 60 \qquad \Sigma t = 2750 \qquad \Sigma t^2 = 127000$$

- (a) Calculate unbiased estimates of the population mean and variance. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

- (b) Test the passenger's belief at the 5% significance level. [5]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....





- 4 At an entertainment centre, the cost for using a particular video game is \$0.40 per minute. The number of minutes for which people use the video game has mean 15 and variance 9.

(a) Find the mean and variance of the amount people pay for using the video game. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Each day, 35 people independently use the video game.

(b) Find the mean and variance of the total amount paid by 35 people. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



- [illegible]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.



It is given that  $\frac{5}{2}P(Y = 3) + P(Y = 4) = P(Y = 5)$ .

[3]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

- DO NOT WRITE IN THIS MARGIN

[1]

[illegible]

- DO NOT WRITE IN THIS MARGIN

This image shows a full page of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page, providing a template for handwriting practice or general writing. There are no margins, text, or other markings on the page.



(c) Calculate an approximate 95% confidence interval for the proportion of students at Florence's college who own a Pumpkin phone. [3]

This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for writing. The lines are evenly spaced and extend across the entire width of the page, providing a guide for letter height and placement. There is no text or other markings on the page.

7

$$f(x) = \begin{cases} (1 + \cos \pi x) & 0 \leq x \leq 1, \\ 0 & \text{otherwise.} \end{cases}$$

(a) Show that  $P\left(X < \frac{1}{2}\right) = \frac{1}{2} + \frac{1}{\pi}$ . [3]

[illegible]



[5]

This image shows a full page of white paper designed for handwriting practice. It features approximately 20 evenly spaced horizontal dotted lines running from left to right across the entire width of the page. There are no margins, text, or other markings present.

[illegible]

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.



# Cambridge International AS & A Level

CANDIDATE  
NAME
CENTRE  
NUMBER

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  |  |  |
|--|--|--|--|--|

CANDIDATE  
NUMBER

|  |  |  |  |
|--|--|--|--|
|  |  |  |  |
|--|--|--|--|

## MATHEMATICS

9709/62

Paper 6 Probability &amp; Statistics 2

May/June 2025

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

### INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

### INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.





- Explain how a single throw of a fair six-sided dice could be used to make the choice. [1]

.....

.....

.....

**(b)** Find the probability that the difference between the times taken by these two students to complete the test is more than 12 minutes. [5]

[illegible]

- DO NOT WRITE IN THIS MARGIN

[3]

[illegible]



[1]

---

[3]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dotted lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

- DO NOT WRITE IN THIS MARGIN

[4]

DO NOT WRITE IN THIS MARGIN



- Using a hypothesis test at the 5% significance level, the manager finds that there is sufficient evidence to conclude that the new value of  $\mu$  is greater than 10.5.

Stating a necessary assumption, find the smallest possible value of  $\bar{x}$ . [4]

This image shows a full page of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page, typical of notebook or legal stationery. There are no margins, text, or other markings on the page.



6 Use suitable approximating distributions to answer the following.

(a) The random variable  $W$  has the distribution  $B(700, 0.005)$ .

(i) Find  $P(W \geq 4)$ .

[3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

Two values of  $W$  are chosen at random.

(ii) Find the probability that the sum of these two values is less than 3.

[3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....





Use a suitable approximating distribution to find  $P(X > 205)$ . [4]

[illegible]



7 The random variable  $X$  has probability density function given by

$$f(x) = \begin{cases} \frac{kx^2}{a^2} & 0 \leq x \leq a, \\ 0 & \text{otherwise,} \end{cases}$$

where  $k$  and  $a$  are positive constants.

(a) Show that  $k = \frac{3}{a}$ . [3]

.....

.....

.....

.....

.....

.....

.....

.....

It is given that  $E(X) = 1$ .

(b) Find the value of  $a$ . [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....





[3]

[illegible]

- (a)** Use a binomial distribution with a 5% significance level to test Birgitte's suspicion. [5]

[illegible]



Later, Birgitte carries out a similar test at the 5% significance level, using another 30 throws of the dice.

(b) Calculate the probability of a Type I error. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(c) Given that the value of  $p$  is actually 0.02, calculate the probability of a Type II error. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



This image shows a full page of a document template designed for handwriting practice or general writing. It consists of approximately 20 evenly spaced horizontal dotted lines across the entire width of the page. The background is plain white, and there are no margins, headers, footers, or other markings present.





Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at [www.cambridgeinternational.org](http://www.cambridgeinternational.org) after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.





# Cambridge International AS & A Level

CANDIDATE  
NAME
CENTRE  
NUMBER

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  |  |  |
|--|--|--|--|--|

CANDIDATE  
NUMBER

|  |  |  |  |
|--|--|--|--|
|  |  |  |  |
|--|--|--|--|

## MATHEMATICS

9709/63

Paper 6 Probability &amp; Statistics 2

May/June 2025

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

### INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

### INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **12** pages. Any blank pages are indicated.

- (a) Find the probability that, in a randomly chosen 1-minute period, at least 2 customers arrive. [3]

[illegible]

- (i) State a suitable approximating distribution for  $X$ , giving the value(s) of any parameter(s). [2]

.....

.....

.....

- (ii) Use your approximating distribution to find  $P(20 < X < 30)$ . [3]

This image shows a full page of white paper with horizontal dashed lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



- 2 The lengths of pencils made at a factory are normally distributed. The standard deviation of the lengths is  $\sigma$  cm, and the mean is supposed to be 10 cm. An inspector thinks that the mean is actually greater than 10 cm. He takes a random sample of 50 pencils produced at the factory and finds that the mean of these 50 lengths is 10.03 cm. He then carries out a hypothesis test.

(a) He finds that the value of the test statistic  $z$  is 1.995 correct to 3 decimal places.

- (i) Calculate the value of  $\sigma$ . [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

- (ii) Carry out the hypothesis test at the 2.5% significance level. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Explain whether it was necessary to use the Central Limit Theorem in carrying out the test. [1]

.....

.....

.....

.....





- 3 A machine dispenses coffee into cups. The volume,  $V\text{cm}^3$ , of coffee in a cup was measured for a random sample of 150 cups. The results were summarised as follows.

$$\Sigma v = 46\,350 \qquad \Sigma v^2 = 14\,410\,800$$

- (a) (i) Calculate unbiased estimates of the population mean,  $\mu$ , and population variance,  $\sigma^2$ . [3]

.....

.....

.....

.....

.....

.....

.....

- (ii) Calculate a 95% confidence interval for  $\mu$ . [3]

.....

.....

.....

.....

.....

.....

.....

Another random sample of  $n$  cups of coffee is taken, where  $100 < n < 120$ . A 95% confidence interval for  $\mu$  is calculated using this sample. You may assume that, for large samples, unbiased estimates of  $\sigma^2$  are very similar.

- (b) Without calculation, state whether this confidence interval would be wider or narrower than the confidence interval found in part (a)(ii). Give a reason for your answer. [2]

.....

.....

.....

.....

.....





- 4 Emma needs to choose one person at random from three people,  $P$ ,  $Q$  and  $R$ . She plans to throw two fair coins and note the number,  $n$ , of heads. If  $n$  is 0, she will choose  $P$ . If  $n$  is 1, she will choose  $Q$ . If  $n$  is 2, she will choose  $R$ .

- (a) By considering probabilities, show that the choice made by this method is not random. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Later, Emma has to choose two people at random from three people.

- (b) Describe how Emma could use a single throw of a fair six-sided dice to make this random choice. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



- DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN


$$f(x) = \begin{cases} ax & 0 \leq x \leq b, \\ 0 & \text{otherwise,} \end{cases}$$

(a) Show that  $a = \frac{2}{b^2}$ . [3]

[illegible]

**(b)** Show that  $P(X < E(X)) = \frac{4}{9}$ . [6]

[illegible]

- In the month following the change, there were 35 job applicants, and  $r$  of these had first-class degrees. The firm carried out a hypothesis test at the 4% significance level to test the director's belief.

- (a) Use a binomial distribution to find the largest value of  $r$  that would provide sufficient evidence that the director's belief is correct. [6]

This image shows a full page of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page, providing a template for handwriting practice or general note-taking. There are no margins, text, or other markings on the page.



**(b)** Explain the meaning of a Type I error in this context, and state the probability of a Type I error. [2]

[illegible]

(c) Given that the proportion of job applicants with first class degrees this year is actually 0.05, find the probability of a Type II error. [2]

[illegible]

[illegible]





Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at [www.cambridgeinternational.org](http://www.cambridgeinternational.org) after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.





# Cambridge International AS & A Level

CANDIDATE  
NAMECENTRE  
NUMBER

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  |  |  |
|--|--|--|--|--|

CANDIDATE  
NUMBER

|  |  |  |  |
|--|--|--|--|
|  |  |  |  |
|--|--|--|--|

## MATHEMATICS

9709/65

Paper 6 Probability &amp; Statistics 2

May/June 2025

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

### INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

### INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.



**BLANK PAGE**





- (a) Find  $P(S \leq 3)$ . [3]

[illegible]

- [illegible]

2

$n = 200$

$$\Sigma(x-2) = 60$$

$$\Sigma(x-2)^2 = 20$$

(a)

[6]

[illegible]

(b)

[1]

[illegible]



- 3 Maroulla's calculator can generate random numbers between 0.000 and 0.999 inclusive, correct to 3 significant figures. She plans to use her calculator to choose a sample of members from the 851 members in her health club. She numbers the members from 1 to 851. Then she uses her calculator to generate some random numbers. She multiplies each random number by 851 and rounds **up** to the next whole number to give the number of a member in the sample. This is called a 'member number'.

- (a) Maroulla's first random number is 0.401.

Find the member number that is produced by this random number. [1]

.....

.....

.....

.....

- (b) Find all possible random numbers, correct to 3 decimal places, that would produce the following member numbers.

- (i) A member number of 680. [1]

.....

.....

.....

.....

.....

- (ii) A member number of 850. [1]

.....

.....

.....

.....

.....

- (c) Explain briefly how your answers to part (b) show that Maroulla's method does not produce a random sample. [1]

.....

.....

.....

.....

.....



- 
- This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.



- [illegible]





- Find the probability that the mean,  $\bar{F}$ , of the final marks of a random sample of 25 candidates is greater than 143. [5]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

[illegible]

(c) Find the probability of a Type I error. [2]

[illegible]



- 7 A firm makes a certain type of battery-powered toy. The battery life is denoted by  $X$  hours and the population mean of  $X$  is supposed to be 12. The Quality Control department wished to test whether the population mean of  $X$  is actually less than 12. They tested a random sample of 50 of these toys and found that the sample mean,  $\bar{X}$ , was 11.4.

- (a) State suitable null and alternative hypotheses for the test. [1]

.....

.....

.....

You may assume that the standard deviation of the battery life is 2.3 hours.

- (b) Show that the value  $\bar{X} = 11.4$  leads to rejection of the null hypothesis at the 5% significance level. [2]

.....

.....

.....

.....

.....

.....

.....

.....

- (c) It is given that the value  $\bar{X} = 11.4$  leads to rejection of the null hypothesis at the  $\alpha\%$  significance level.

Find the set of possible values of  $\alpha$ . [2]

.....

.....

.....

.....

.....

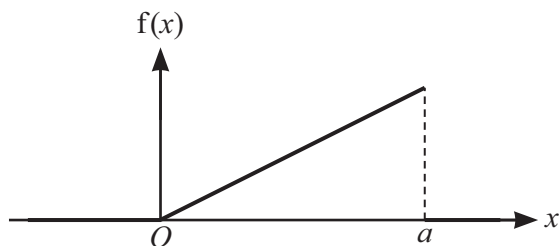
.....

.....

.....

.....





It is given that the median of  $X$  is  $\sqrt{2}$ .

- .....
- .....
- .....
- .....
- .....

- 
- This image shows a full page of white paper with horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

[illegible]





Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at [www.cambridgeinternational.org](http://www.cambridgeinternational.org) after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.

