

Level 3 Certificate

MATHEMATICAL STUDIES

Paper 2A Statistical Techniques

Time allowed: 1 hour 30 minutes

Materials

- a clean copy of the Preliminary Material, Formulae Sheet and Statistical Tables (enclosed)
- a scientific or graphics calculator
- a ruler.

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page.
- Show all necessary working; otherwise, marks for method may be lost.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.

Preliminary Material

Paper 2A/2B/2C

June 2025

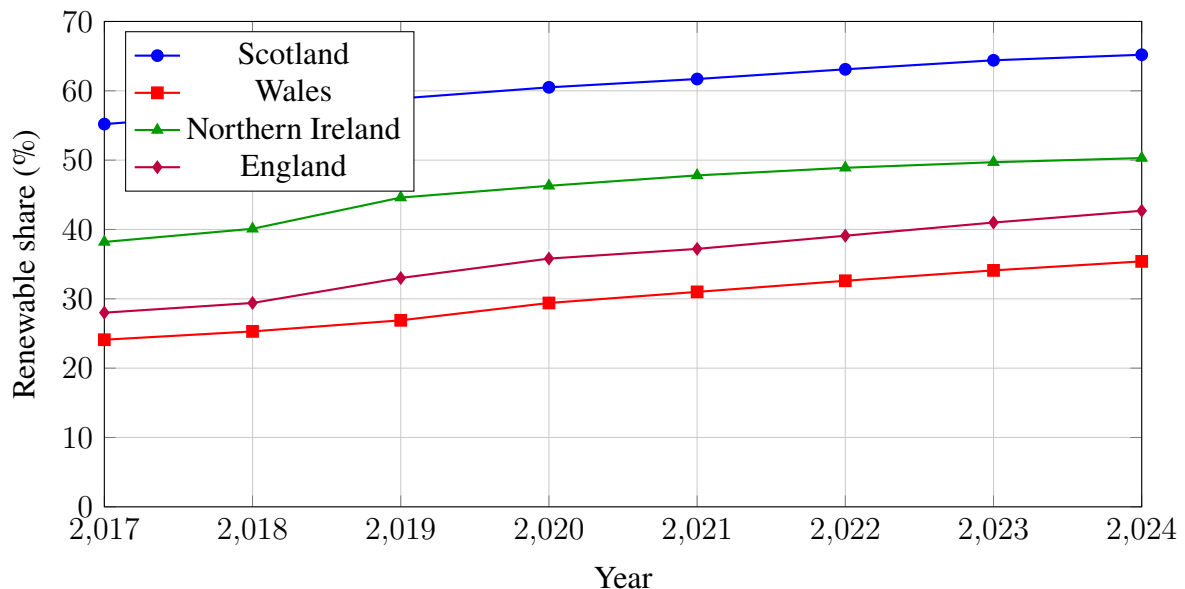
This material is provided to candidates and teachers for use during preparation for the examination. A clean copy will be provided in the exam.

Electricity generation

The UK Government publishes annual statistics on how electricity is generated. In recent years, the UK has continued to move away from fossil fuels and towards renewable sources such as wind, solar and bioenergy. Between 2017 and 2024, the proportion of electricity generated from renewable fuels increased in all four nations, while fossil fuel generation declined as coal use fell and more renewable capacity was installed.

Across the UK, renewable generation rose from about 30% of total electricity in 2017 to almost 45% in 2024. Scotland continues to generate the highest proportion of electricity from renewable sources, while England remains the largest generator overall.

Chart 1: Renewable share of electricity generation by country, 2017–2024



Electricity generation by fuel

The table below summarises electricity generation in England in 2024. Values are rounded to the nearest GWh.

ELECTRICITY GENERATED (GWh)		England 2024
Fossil fuels		92 480
	Coal	1 120
	Oil	980
	Gas	90 380
Nuclear		41 520
Renewables		89 740
	Hydro natural flow	140
	Wind	39 820
	Solar	13 540
	Bioenergy	36 240
Other fuels		4 960
Pumped storage		0
TOTAL		228 700

END OF PRELIMINARY MATERIAL

Answer all questions in the spaces provided.

1 A new housing development will contain 80 properties of different types. The table shows the planned numbers.

Type of property	Planned number
1-bedroom flat	14
2-bedroom flat	16
2-bedroom house	20
3-bedroom house	18
4-bedroom house	7
5-bedroom house	5

(a) Work out the ratio of houses to flats. Circle your answer.

[1]

- 7 : 9
- 5 : 3
- 9 : 7
- 9 : 11

(b) The local council has minimum requirements for cycle parking:

- 1 space per bedroom for properties up to and including 3 bedrooms
- 3 spaces for each 4-bedroom property
- 4 spaces for each 5-bedroom property
- plus some visitor cycle parking.

The plans include 196 cycle parking spaces in total.

Do the plans meet the minimum requirements? You must show your working.

[3]

(c) The developers want to change the mix of 2-bedroom flats and 2-bedroom houses. They make more profit on 2-bedroom houses than on 2-bedroom flats.

To approve the new plans, the council insists that:

- there must still be 80 properties in total
- at least 25% of the properties must be classified as *affordable housing*.

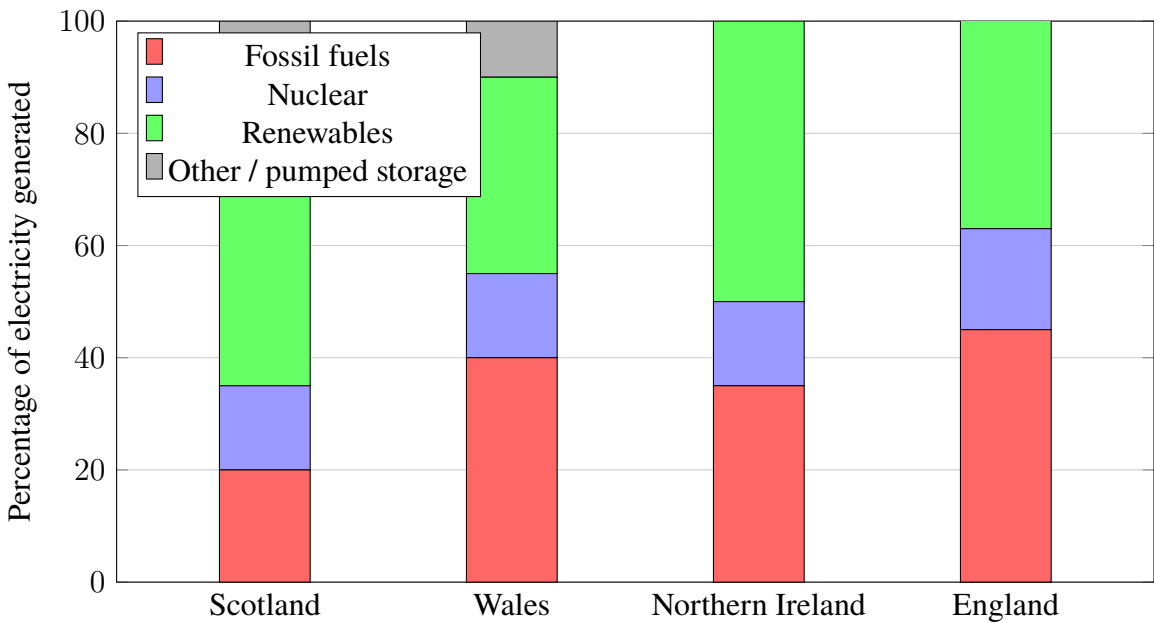
The table shows which property types are classified as affordable.

Type of property	Affordable?	Planned number
1-bedroom flat	Yes	12
2-bedroom flat	Yes	
2-bedroom house	No	
3-bedroom house	Yes	18
4-bedroom house	No	6
5-bedroom house	No	4

Complete the table to show the numbers of 2-bedroom flats and 2-bedroom houses that would be approved and give the greatest profit. [3]

2 Use the **Electricity generation** Preliminary Material.

(a) The bar chart below shows how each of the four nations of the UK generated electricity in 2024.



Suggest two improvements that could be made to this bar chart.

[2]

(b) Two newspapers report on electricity generation in England in 2024.

“Electricity generated by renewables was more than 80% of that generated from fossil fuels.”
Morning Herald

“The ratio of wind to other renewables is about 4 : 5.”

Daily Energy Review

Using the data in the Preliminary Material, comment on the validity of each newspaper’s claim.
You must show your working. [5]

(c) In 2024, Northern Ireland generated 4 300 GWh of electricity from renewables. The average price of electricity was 15.2p per kWh. (1 GWh = 1 000 000 kWh.)

Anna says, “In 2024, Northern Ireland generated electricity from renewables worth over £600 million.”

Is she correct? You must show your working. [3]

(d) In 2024, Wales generated 7 900 GWh of electricity from renewables. The renewable share for Wales in 2024 is shown in Chart 1.

Work out the total amount of electricity generated in Wales from all fuels in 2024. [2]

(e) Bobby wants to estimate the mean percentage of electricity generated by renewables in the UK in 2024. He adds together the four percentages from Chart 1 and divides by 4. His answer does not agree with the UK average given in the article.

Critically analyse Bobby's method, explaining why his percentage does not match the UK average. You do not need to carry out any calculations. [1]

3 The normal distribution is one of the most important probability distributions in statistics.

Draw a line from each box on the left to the correct value on the right.

[2]

Mean of the standardised normal distribution

0

0.5

Standard deviation of the standardised normal distribution

0.67

1

4 The Intelligence Quotient (IQ) of staff in an office is normally distributed with mean μ and variance 400. A random sample of 25 staff have their IQ measured. The mean of their results is 106.

The manager wants to construct a 90% confidence interval for μ .

(a) Circle the z -value, correct to two decimal places, needed to construct a 90% confidence interval.
[1]

- 0.90 • 1.28 • 1.64 • 2.58

(b) Calculate a 90% confidence interval for μ . [3]

(c) The manager claims that the mean IQ of staff in the office is 115. Use your answer to part (b) to comment on this claim. [2]

5 An ordinary 6-sided dice is thrown 150 times. The scores are shown below.

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4  5  2  4  3  3  4  6  6  3  5  1  4  4  5
6  5  3  2  6  3  6  2  6  5  3  6  1  5  4
2  6  2  4  2  1  3  6  1  2  6  6  5  2  2
5  4  4  5  5  5  3  1  1  2  1  1  3  5  6
6  6  1  6  1  3  5  5  5  6  4  5  5  3  2
3  6  1  5  5  6  5  1  3  1  6  3  3  2  6
3  1  3  4  5  2  4  1  2  2  5  2  5  2  5
2  1  2  5  6  6  6  3  2  1  4  5  4  6  4
1  3  6  5  6  6  5  3  3  3  4  3  4  4  4
6  4  1  4  5  5  5  5  6  4  2  5  4  2  5

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(a) A random number generator is used to choose a random sample of three scores. The numbers generated are 12, 89 and 143.

State their corresponding dice scores.

[2]

(b) Ali, Becky and Carly each take a random sample from the 150 scores and calculate a point estimate of the mean.

	Sample size	Point estimate
Ali	10	3.7
Becky	10	4.1
Carly	30	3.9

Whose point estimate is likely to be closest to the mean score of all 150 throws? Give a reason for your answer.

[1]

(c) Use your scores in part (a) and the point estimates from the table to calculate a more representative point estimate of the mean. You may assume that each score is in at most one sample.

[4]

(d) Is the dice fair? Give a reason for your answer.

[2]

6 (a) State the value of perfect negative correlation.

[1]

6 (b) The table gives the time spent running and distance travelled for 8 members of a running club.

Time (minutes)	Distance (km)
26	3.1
30	4.5
34	5.9
39	8.7
44	7.8
48	4.6
51	6.3
56	7.9

Using the product moment correlation coefficient, state the type and strength of the correlation between time and distance.

[2]

7 The heights, X metres, of yucca plants at a garden centre are normally distributed with mean 1.62 and standard deviation 0.28.

(a) Write the distribution in notation form. [1]

(b) Calculate $P(X < 2.0)$. [2]

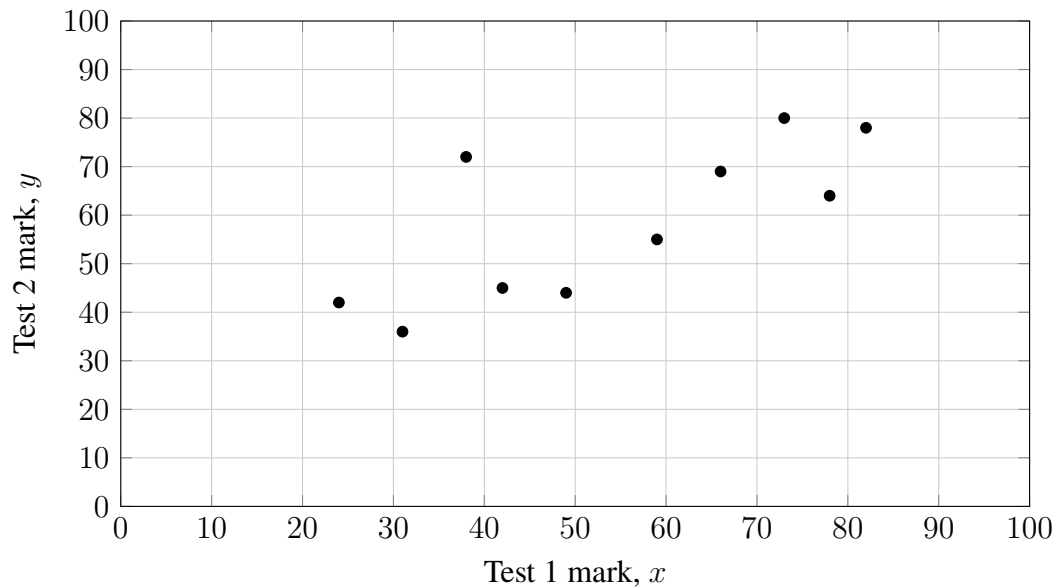
(c) Calculate $P(X < 1.4)$. [2]

(d) 60% of the yucca plants have a height of more than k metres. Work out the value of k . [3]

8 12 students in a class were due to sit two tests. One student was absent for test 1 and a different student was absent for test 2. The marks are shown in the table. x is the mark for test 1, y is the mark for test 2.

Student	A	B	C	D	E	F	G	H	I	J	K	L
x	24	82	49	73	38	59	78	29	31	42	66	abs
y	42	78	44	80	72	55	64	abs	36	45	69	52

The marks of the 10 students who sat both tests are shown on the scatter diagram.



(a) The teacher says that one student's pair of marks could be an outlier. Which student is this? [1]

(b) Calculate the equation of the regression line of y on x . Do not include the outlier. [2]

(c) Use your regression line to estimate the missing marks. [3]

- Test 2 mark for student H
- Test 1 mark for student L

(d) Each student is awarded an overall grade based on the total mark t of their two tests. m is the mean of the values of t , including the outlier and the two estimated marks.

Student	A	B	C	D	E	F	G	H	I	J	K	L
x	24	82	49	73	38	59	78	29	31	42	66	
y	42	78	44	80	72	55	64		36	45	69	52

Grades are awarded as follows:

Grade 5	$t \geq 1.4m$
Grade 4	$1.1m \leq t < 1.4m$
Grade 3	$0.8m \leq t < 1.1m$
Grade 2	$0.6m \leq t < 0.8m$
Grade 1	$t < 0.6m$

Which students were awarded Grade 3? You must show your working.

[6]

END OF QUESTIONS