Pearson Edexcel International Advanced Level

Friday 17 October 2025

Morning (Time: 1 hour 30 minutes)

Paper reference **WST01/01A**

Mathematics

International Advanced Subsidiary/Advanced Level
Statistics S1
Question Paper

You must have:
Answer book (sent separately).
Do not return this question paper with the answer book.

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1. A medical researcher is studying the relationship between age (x years) and volume of blood (y ml) pumped by each contraction of the heart.

The researcher obtained the following data from a random sample of 8 patients.

Age (x)	20	25	30	45	55	60	65	70
Volume (y)	74	76	77	72	68	67	64	62

[You may use $\sum x = 370$, $S_{xx} = 2587.5$, $\sum y = 560$, $\sum y^2 = 39418$, $S_{xy} = -710$]

(a) Calculate S_{yy}

(2)

(b) Calculate the product moment correlation coefficient for these data.

(2)

(c) Interpret your value of the correlation coefficient.

(1)

The researcher believes that a linear regression model may be appropriate to describe these data.

(d) State, giving a reason, whether or not your value of the correlation coefficient supports the researcher's belief.

(1)

(e) Find the equation of the regression line of y on x, giving your answer in the form $y = a + bx$

(4)

Jack is a 40-year-old patient.

(f) (i) Use your regression line to estimate the volume of blood pumped by each contraction of Jack's heart.

(ii) Comment, giving a reason, on the reliability of your estimate.

(2)

(Total for Question 1 is 12 marks)

2. The discrete random variable X has probability function $\mathrm{p}(x)$ and cumulative distribution function $\mathrm{F}(x)$ given in the table below.

x	1	2	3	4	5
$\mathrm{p}(x)$	0.10	a	0.28	c	0.24
$\mathrm{F}(x)$	0.10	0.26	b	0.76	d

(a) Write down the value of d

(1)

(b) Find the values of a, b and c

(3)

(c) Write down the value of $\mathrm{P}(X > 4)$

(1)

Two independent observations, X_1 and X_2, are taken from the distribution of X.

(d) Find the probability that X_1 and X_2 are both odd.

(2)

Given that X_1 and X_2 are both odd,

(e) find the probability that the sum of X_1 and X_2 is 6
Give your answer to 3 significant figures.

(3)

(Total for Question 2 is 10 marks)

3. Two youth clubs, *Eastyou* and *Westyou*, decided to raise money for charity by running a 5 km race.

All the members of the youth clubs took part and the time, in minutes, taken for each member to run the 5 km was recorded.

The times for the *Westyou* members are summarised in Figure 1.

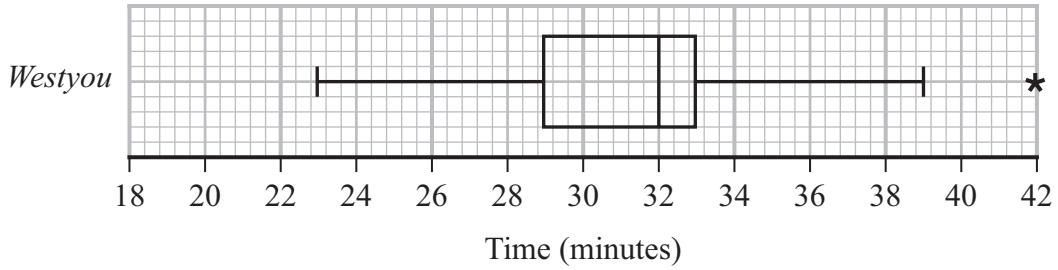


Figure 1

(a) Write down the time that is exceeded by 75% of *Westyou* members.

(1)

The times for the *Eastyou* members are summarised by the stem and leaf diagram below.

Steam	Leaf	
2	0 2 3 4	(4)
2	5 6 8 8 8 9 9	(7)
3	0 0 0 0 0 1 1 1 2 2 2 2 3 4	(14)
3	5 5 5 7 9	(5)

Key: 2 | 0 means 20 minutes

(b) Find the value of the median and interquartile range for the *Eastyou* members.

(3)

An outlier is a value that falls either

more than $1.5 \times (Q_3 - Q_1)$ above Q_3

or more than $1.5 \times (Q_3 - Q_1)$ below Q_1

(c) On the grid on page 11 of the Answer Book, draw a box plot to represent the times of the *Eastyou* members.

(4)

(d) State the skewness of each distribution. Give reasons for your answers.

(3)

(Total for Question 3 is 11 marks)

4. At a school athletics day, the distances, in metres, achieved by students in the long jump are modelled by the normal distribution with mean 3.3 m and standard deviation 0.6 m

(a) Using standardisation, find an estimate for the proportion of students who jump less than 2.5 m

(2)

The long jump competition consists of 2 jumps.

All the students can take part in the first jump and the 40% who jump the greatest distance in their first jump qualify for the second jump.

(b) Using standardisation, find an estimate for the minimum distance achieved in the first jump in order to qualify for the second jump.
Give your answer correct to 4 significant figures.

(3)

(c) Find an estimate for the median distance achieved in the first jump by those who qualify for the second jump.
Show your working clearly.

(3)

The distance of the second jump is independent of the distance of the first jump and is modelled with the same normal distribution.

Students who jump a distance greater than 4.1 m in their second jump receive a certificate.

At the start of the long jump competition, a student is selected at random.

(d) Find the probability that this student will receive a certificate.

(3)

(Total for Question 4 is 11 marks)

5. A bag contains 19 red beads and 1 blue bead only.

Linda selects a bead at random from the bag. She notes its colour and replaces the bead in the bag.

She then selects a second bead at random from the bag and notes its colour.

Find the probability that

(a) both beads selected are blue,

(1)

(b) exactly one bead selected is red.

(2)

In another bag there are 9 beads, 4 of which are green and the rest are yellow.

Linda selects 3 beads from this bag at random without replacement.

(c) Find the probability that 2 of these beads are yellow and 1 is green.

(3)

Linda replaces the 3 beads and then selects another 4 at random without replacement.

(d) Find the probability that at least 1 of the beads is green.

(3)

(Total for Question 5 is 9 marks)

6. The discrete random variable X has probability distribution

x	–4	–3	1	2	5
$P(X = x)$	a	b	a	b	0.2

(a) Find $E(X)$ in terms of a and b

(1)

For this probability distribution, $\text{Var}(X) = E(X^2)$

(b) (i) Write down the value of $E(X)$

(ii) Find the value of a and the value of b

(5)

(c) Find $\text{Var}(1 - 3X)$

(3)

Given that $Y = 1 - X$, find

(d) (i) $P(Y < 0)$

(ii) the largest possible value of k such that $P(Y < k) = 0.2$

(4)

(Total for Question 6 is 13 marks)

7. Yujie is investigating the weights of 10 young rabbits. She records the weight, x grams, of each rabbit and the results are summarised below.

$$\sum x = 8360 \qquad \text{and} \qquad \sum (x - \bar{x})^2 = 63\,840$$

(a) Calculate the mean and the standard deviation of the weights of these rabbits.

(3)

Given that the median weight of these rabbits is 815 grams,

(b) describe, giving a reason, the skewness of these data.

(2)

Two more rabbits weighing 776 grams and 896 grams are added to make a group of 12 rabbits.

(c) State, giving a reason, how the inclusion of these two rabbits would affect the mean.

(2)

(d) By considering the change in $\sum (x - \bar{x})^2$, state what effect the inclusion of these two rabbits would have on the standard deviation.

(2)

(Total for Question 7 is 9 marks)

TOTAL FOR PAPER IS 75 MARKS

Please check the examination details below before entering your candidate information

Candidate surname StemUp Model Solution | Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Friday 17 October 2025

Morning (Time: 1 hour 30 minutes)

Paper reference **WST01/01A**

Mathematics

International Advanced Subsidiary/Advanced Level
Statistics S1
Answer Book

You must have:
Question paper (sent separately)
Mathematical Formulae and Statistical Tables (Yellow), calculator

Total Marks

Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Values from the statistical tables should be quoted in full. If a calculator is used instead of the tables, the value should be given to an equivalent degree of accuracy.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 7 questions in this question paper. The total mark for this paper is 75.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Turn over ▶

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Question 1

Write the answer to Question 1 on these 4 pages

(a) $S_{yy} = \Sigma y^2 - \frac{(\Sigma y)^2}{n} = 39418 - \frac{560^2}{8} = 39418 - 39200$

$S_{yy} = 218$

(b) $r = \frac{S_{xy}}{\sqrt{(S_{xx}S_{yy})}} = \frac{-710}{\sqrt{(2587.5 \times 218)}} = -0.945344...$

$r = -0.945$

(c) As age increases, the volume of blood pumped (by each contraction) decreases.

(d) Yes, it supports the belief, since $r = -0.945$ is close to -1.

(e) $b = \frac{S_{xy}}{S_{xx}} = \frac{-710}{2587.5} = -0.274396...$

$\bar{x} = \frac{370}{8} = 46.25, \quad \bar{y} = \frac{560}{8} = 70$

$a = \bar{y} - b\bar{x} = 70 - (-0.274396...) \times 46.25 = 82.6908...$

$y = 82.7 - 0.274x$

(f) (i) $y = 82.6908... - 0.274396... \times 40 = 71.715...$

Volume $\approx$ 71.7 ml (about 72 ml)

(ii) The estimate is reliable, since 40 lies within the range of the ages in the data (20 to 70), so it is interpolation.

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Question 1 continued

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Question 1 continued

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(Total for Question 1 is 12 marks)

Question 2

Write the answer to Question 2 on these 4 pages

(a) $d = F(5) = 1$

(b) $a = F(2) - F(1) = 0.26 - 0.10 = 0.16$

$b = F(3) = 0.26 + 0.28 = 0.54$

$c = F(4) - F(3) = 0.76 - 0.54 = 0.22$

$a = 0.16, \quad b = 0.54, \quad c = 0.22$

(c) $P(X > 4) = P(X = 5) = 0.24$

(d) $P(X \text{ odd}) = P(1) + P(3) + P(5) = 0.10 + 0.28 + 0.24 = 0.62$

$P(X_1 \text{ and } X_2 \text{ both odd}) = 0.62^2 = 0.3844$

(e) Both odd and sum 6: (1, 5), (5, 1), (3, 3)

$P(\text{sum} = 6 \text{ and both odd}) = 0.10 \times 0.24 + 0.24 \times 0.10 + 0.28 \times 0.28$

$= 0.024 + 0.024 + 0.0784 = 0.1264$

$$P(\text{sum} = 6 \mid \text{both odd}) = \frac{P(\text{sum} = 6 \text{ and both odd})}{P(\text{both odd})} = \frac{0.1264}{0.3844} = 0.328824\ldots$$

$= 0.329$ (3 s.f.)

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Question 2 continued

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(Total for Question 2 is 10 marks)

Question 3

Write the answer to Question 3 on these 4 pages

(a) Lower quartile of Westyou = 29 minutes

(b) $n = 30$: median $= \frac{15\text{th} + 16\text{th}}{2} = \frac{30 + 30}{2} = 30$

Median = 30 minutes

$\frac{30}{4} = 7.5 \Rightarrow Q_1 = 8\text{th value} = 28$; $\frac{3 \times 30}{4} = 22.5 \Rightarrow Q_3 = 23\text{rd value} = 32$

$IQR = Q_3 - Q_1 = 32 - 28 = 4$ minutes

(c) Upper limit: $32 + 1.5 \times 4 = 38$, Lower limit: $28 - 1.5 \times 4 = 22$

Outliers: 20 (< 22) and 39 (> 38)

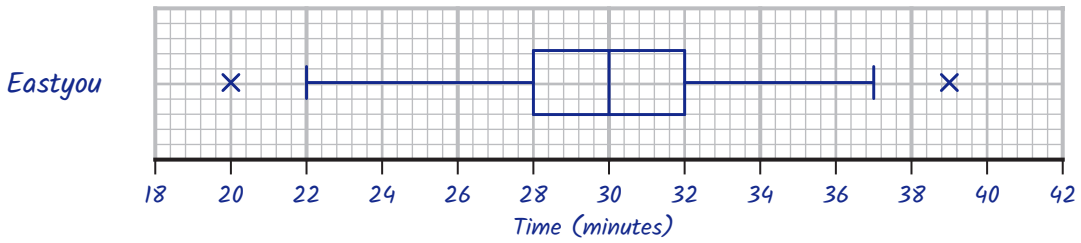
Whiskers to 22 (smallest non-outlier) and 37 (largest non-outlier)

Box plot drawn on the grid on page 11.

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Question 3 continued



Use this grid for your answer to part (c) if you make a mistake cross through this grid and use the spare grid on page 13

(d) Westyou: $Q_2 - Q_1 = 32 - 29 = 3$, $Q_3 - Q_2 = 33 - 32 = 1$

$Q_2 - Q_1 > Q_3 - Q_2$, so Westyou has negative skew.

Eastyou: $Q_2 - Q_1 = 30 - 28 = 2$, $Q_3 - Q_2 = 32 - 30 = 2$

$Q_2 - Q_1 = Q_3 - Q_2$, so Eastyou has no skew (symmetrical).

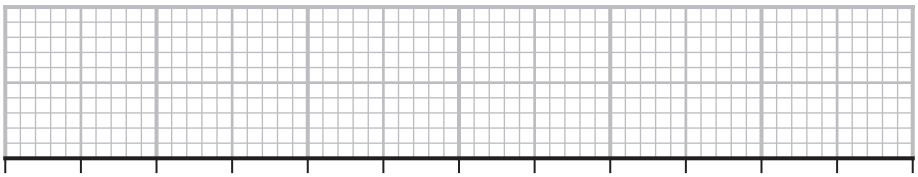
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Question 3 continued

Only use this grid if you have made a mistake on the first grid.



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(Total for Question 3 is 11 marks)

Question 4

Write the answer to Question 4 on these 4 pages

Let J = length of a jump (m), $J \sim N(3.3, 0.6^2)$

(a) $P(J < 2.5) = P\left(Z < \frac{2.5 - 3.3}{0.6}\right) = P(Z < -1.33)$

$= 1 - 0.9082 = 0.0918$

Proportion ≈ 0.0918

(b) $P(J > d) = 0.4 \Rightarrow P(J < d) = 0.6$

$\frac{d - 3.3}{0.6} = 0.2533$

$d = 3.3 + 0.6 \times 0.2533 = 3.45198$

Minimum distance = 3.452 m

(c) Median m of qualifiers: $P(J > m \mid J > d) = \frac{P(J > m)}{0.4} = 0.5$

$\Rightarrow P(J > m) = 0.2$

$\frac{m - 3.3}{0.6} = 0.8416$

$m = 3.3 + 0.6 \times 0.8416 = 3.80496$

Median ≈ 3.80 m

(d) $P(J > 4.1) = P\left(Z > \frac{4.1 - 3.3}{0.6}\right) = P(Z > 1.33) = 0.0918$ (same as (a))

$P(\text{certificate}) = P(\text{qualify}) \times P(J > 4.1) = 0.4 \times 0.0918$

$= 0.03672 \approx 0.0367$

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Question 4 continued

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(Total for Question 4 is 11 marks)

Question 5

Write the answer to Question 5 on these 4 pages

$P(\text{red}) = \frac{19}{20} = 0.95, \quad P(\text{blue}) = \frac{1}{20} = 0.05$

(a) $P(\text{both blue}) = 0.05 \times 0.05 = 0.0025$

(b) $P(\text{exactly one red}) = 2 \times 0.95 \times 0.05 = 0.095$

(c) 4 green, 5 yellow

$P(2 \text{ yellow, } 1 \text{ green}) = 3 \times \frac{5}{9} \times \frac{4}{8} \times \frac{4}{7} = 3 \times \frac{80}{504}$

$= \frac{10}{21}$

(d) $P(\text{no green}) = P(\text{all yellow}) = \frac{5}{9} \times \frac{4}{8} \times \frac{3}{7} \times \frac{2}{6} = \frac{120}{3024} = \frac{5}{126}$

$P(\text{at least 1 green}) = 1 - \frac{5}{126} = \frac{121}{126}$

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Question 5 continued

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(Total for Question 5 is 9 marks)

Question 6

Write the answer to Question 6 on these 4 pages

(a) $E(X) = -4a - 3b + a + 2b + 5 \times 0.2$

$E(X) = 1 - 3a - b$

(b) (i) $Var(X) = E(X^2) - [E(X)]^2 = E(X^2) \Rightarrow [E(X)]^2 = 0$

$E(X) = 0$

(ii) $1 - 3a - b = 0 \Rightarrow 3a + b = 1$

$\Sigma p = 1$: $a + b + a + b + 0.2 = 1 \Rightarrow 2a + 2b = 0.8 \Rightarrow a + b = 0.4$

Subtracting: $2a = 0.6$

$a = 0.3, \quad b = 0.1$

(c) $E(X^2) = 16(0.3) + 9(0.1) + 1(0.3) + 4(0.1) + 25(0.2)$

$= 4.8 + 0.9 + 0.3 + 0.4 + 5 = 11.4$

$Var(X) = 11.4 - 0^2 = 11.4$

$Var(1 - 3X) = (-3)^2 Var(X) = 9 \times 11.4 = 102.6$

(d) $Y = 1 - X$: y: 5, 4, 0, −1, −4 with probabilities 0.3, 0.1, 0.3, 0.1, 0.2

(i) $P(Y < 0) = P(1 - X < 0) = P(X > 1) = P(X = 2) + P(X = 5)$

$= 0.1 + 0.2 = 0.3$

(ii) $P(Y < k) = 0.2 \Rightarrow$ only $Y = -4$ included: $P(Y = -4) = 0.2$

$P(Y < k) = P(X > 1 - k) = 0.2 \Rightarrow 1 - k = 2$

Largest $k = -1$

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Question 6 continued

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(Total for Question 6 is 13 marks)

Question 7

Write the answer to Question 7 on these 3 pages

(a) $\bar{x} = \frac{\Sigma x}{n} = \frac{8360}{10} = 836$

Mean = 836 g

$\sigma = \sqrt{\left(\frac{\Sigma(x - \bar{x})^2}{n}\right)} = \sqrt{\left(\frac{63840}{10}\right)} = \sqrt{6384} = 79.8999...$

Standard deviation = 79.9 g

(b) Mean (836) > median (815),

so the data are positively skewed.

(c) $\frac{776 + 896}{2} = \frac{1672}{2} = 836$, which equals the mean $\bar{x}$

(New mean = $\frac{8360 + 776 + 896}{12} = \frac{10032}{12} = 836$)

So there is no change in the mean.

(d) $896 - 836 = 60$ and $836 - 776 = 60$, $(\pm 60)^2 = 3600$

New $\Sigma(x - \bar{x})^2 = 63840 + 2 \times 3600 = 71040$

New $\sigma^2 = \frac{71040}{12} = 5920 < \frac{63840}{10} = 6384$

New $\sigma = \sqrt{5920} = 76.9 < 79.9$

So the standard deviation will decrease.

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Question 7 continued

Question 7 continued

(Total for Question 7 is 9 marks)

TOTAL FOR PAPER IS 75 MARKS

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