

# Solutionbank S1

## Edexcel AS and A Level Modular Mathematics

### Review Exercise

#### Exercise A, Question 1

#### Question:

In a factory, machines  $A$ ,  $B$  and  $C$  are all producing metal rods of the same length. Machine  $A$  produces 35% of the rods, machine  $B$  produces 25% and the rest are produced by machine  $C$ . Of their production of rods, machines  $A$ ,  $B$  and  $C$  produce 3%, 6% and 5% defective rods respectively.

**a** Draw a tree diagram to represent this information.

**b** Find the probability that a randomly selected rod is

**i** produced by machine  $A$  and is defective,

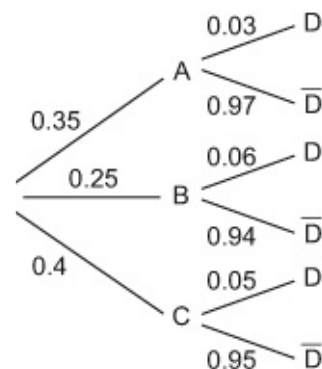
**ii** is defective.

**c** Given that a randomly selected rod is defective, find the probability that it was produced by machine  $C$ .

#### Solution:

Give your answers to at least 3 significant figures unless otherwise stated in the question.

**a**



Remember to label all the branches and put all the probabilities on.

**bi**

$$P(A \cap D) = 0.35 \times 0.03, = \underline{\mathbf{0.0105}} \quad \text{or} \quad \frac{21}{2000}$$

**ii**

$$P(D) = P(A \cap D) \text{ or } P(B \cap D) \text{ or } P(C \cap D)$$

$$= 0.0105 + (0.25 \times 0.06) + (0.4 \times 0.05) \quad \text{If often helps to write down which combinations you want.}$$

$$= \underline{\mathbf{0.0455}} \quad \text{or} \quad \frac{91}{2000}$$

**c**  $P(C | D) = \frac{P(C \cap D)}{P(D)} = \frac{0.4 \times 0.05}{0.0455}$

$$= \underline{\mathbf{0.440}} \quad \text{or} \quad \frac{40}{91}$$

The words “given that” in the question tell you to use conditional probability.

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### Review Exercise

#### Exercise A, Question 2

#### Question:

Summarised opposite are the distances, to the nearest mile, travelled to work by a random sample of 120 commuters.

Distance (to the nearest mile)	Number of commuters
0–9	10
10–19	19
20–29	43
30–39	25
40–49	8
50–59	6
60–69	5
70–79	3
80–89	1

For this distribution,

- a** describe its shape,
- b** use linear interpolation to estimate its median.

The mid-point of each class was represented by  $x$  and its corresponding frequency by  $f$  giving  $\Sigma fx = 3550$  and  $\Sigma fx^2 = 138\,020$

- c** Estimate the mean and standard deviation of this distribution.

One coefficient of skewness is given by

$$\frac{3(\text{mean} - \text{median})}{\text{standard deviation}}$$

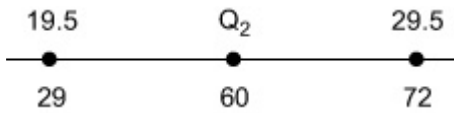
- d** Evaluate this coefficient for this distribution.
- e** State whether or not the value of your coefficient is consistent with your description in part **a**. Justify your answer.
- f** State, with a reason, whether you should use the mean or the median to represent the data in this distribution.
- g** State the circumstance under which it would not matter whether you used the mean or the median to represent a set of data.

#### Solution:

- a** Positive skew

- b** We do not need to do any rounding as the data is

Median :  $\frac{120}{2} = 60^{\text{th}}$  term so in the 20 – 29 class grouped.



$$\frac{Q_2 - 19.5}{29.5 - 19.5} = \frac{60 - 29}{72 - 29}$$

$$Q_2 = 19.5 + \frac{31}{43} \times 10$$

$$= \underline{\underline{26.7}}$$

c Mean =  $\frac{3550}{120} = \underline{\underline{29.6}}$

$$\sigma = \sqrt{\frac{138020}{120} - \left(\frac{3550}{120}\right)^2}$$

$$= 16.5829$$

$$= \underline{\underline{16.6}}$$

d  $\frac{3(29.6 - 26.7)}{16.6} = 0.5199 \dots$

$$= \underline{\underline{0.520}}$$

e Yes it is as  $0.520 > 0$

f Use Median

Since the data is skewed

g If the data are symmetrical or skewness is zero

Draw a diagram if it helps to get the fractions. Remember to use the class boundaries. Here they are 19.5 and 29.5 as there are gaps in the data. The end values on the bottom are the cumulative frequency for the previous class and this class.

Using  $\frac{\sum fx}{\sum f}$

Use  $\sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$  and the accurate value for the mean

Use the accurate figures to do this calculation. Although you can write down the numbers to 3 s.f. If you use the rounded off figures you get 0.524 which may lose a mark.

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## Edexcel AS and A Level Modular Mathematics

### Review Exercise Exercise A, Question 3

#### Question:

A teacher recorded, to the nearest hour, the time spent watching television during a particular week by each child in a random sample. The times were summarised in a grouped frequency table and represented by a histogram.

One of the classes in the grouped frequency distribution was 20–29 and its associated frequency was 9. On the histogram the height of the rectangle representing that class was 3.6 cm and the width was 2 cm.

- a Give a reason to support the use of a histogram to represent these data.
- b Write down the underlying feature associated with each of the bars in a histogram.
- c Show that on this histogram each child was represented by  $0.8 \text{ cm}^2$ .

The total area under the histogram was  $24 \text{ cm}^2$ .

- d Find the total number of children in the group.

#### Solution:

a Time is a continuous variable

b Area is proportional to frequency

c Area of bar =  $3.6 \times 2 = 7.2$

9 children represented by 7.2 so:  $\frac{7.2}{9} = 0.8$

or  $\frac{7.2}{0.8} = 9$  or  $0.8 \times 9 = 7.2$

1 child represented by 0.8

d Total =  $\frac{24}{0.8} = \underline{\underline{30}}$

Remember it is the area of the bar which represents the frequency in a histogram.

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## Edexcel AS and A Level Modular Mathematics

### Review Exercise

#### Exercise A, Question 4

#### Question:

**a** Give two reasons to justify the use of statistical models.

It has been suggested that there are seven stages involved in creating a statistical model. They are summarised below, with stages 3, 4 and 7 missing.

Stage 1. The recognition of a real-world problem.

Stage 2. A statistical model is devised.

Stage 3.

Stage 4.

Stage 5. Comparisons are made against the devised model.

Stage 6. Statistical concepts are used to test how well the model describes the real-world problem.

Stage 7.

**b** Write down the missing stages.

#### Solution:

**a** Any 2 lines from

Used to simplify or represent a real world problem.

Cheaper or quicker (than producing the real situation) or more easily modified

To improve understanding of the real world problem

Used to predict outcomes from a real world problem (idea of predictions)

**b** (3) Model used to make predictions.

(4) Experimental data collected

(7) Model is refined. (Steps 2(or 3) to 5(or 6) are repeated)

You could put 3 and 4 the other way round.

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## Edexcel AS and A Level Modular Mathematics

### Review Exercise

#### Exercise A, Question 5

#### Question:

The following table summarises the distances, to the nearest km, that 134 examiners travelled to attend a meeting in London.

Distance (km)	Number of examiners
41–45	4
46–50	19
51–60	53
61–70	37
71–90	15
91–150	6

- a** Give a reason to justify the use of a histogram to represent these data.
- b** Calculate the frequency densities needed to draw a histogram for these data.

*(Do not draw the histogram.)*

- c** Use interpolation to estimate the median  $Q_2$ , the lower quartile  $Q_1$ , and the upper quartile  $Q_3$  of these data.

The mid-point of each class is represented by  $x$  and the corresponding frequency by  $f$ . Calculations then give the following values

$$\Sigma fx = 8379.5 \text{ and } \Sigma fx^2 = 557\,489.75$$

- d** Calculate an estimate of the mean and an estimate of the standard deviation for these data.

One coefficient of skewness is given by

$$\frac{Q_3 - 2Q_2 + Q_1}{Q_3 - Q_1}$$

- e** Evaluate this coefficient and comment on the skewness of these data.
- f** Give another justification of your comment in **e**.

#### Solution:

- a** Distance is a continuous variable.
- b** F.D. =  $\frac{\text{frequency}}{\text{class width}} \Rightarrow 0.8, 3.8, 5.3, 3.7, 0.75, 0.1$
- c**  $Q_2$  is the  $\frac{134}{2} = 67^{\text{th}}$  term so is in the class 51 – 60

$$\frac{Q_2 - 50.5}{60.5 - 50.5} = \frac{67 - 23}{76 - 23}$$

$$Q_2 = \underline{\mathbf{58.8}}$$

$Q_1$  is the  $\frac{134}{4} = 33.5^{\text{th}}$  term

$$\frac{Q_1 - 50.5}{60.5 - 50.5} = \frac{33.5 - 23}{76 - 23}$$

$$Q_1 = \underline{\mathbf{52.5}}$$

$Q_3$  is the  $3 \times \frac{134}{4} = 100.5^{\text{th}}$  term

$$\frac{Q_3 - 60.5}{70.5 - 60.5} = \frac{100.5 - 76}{113 - 76}$$

$$Q_3 = \underline{\mathbf{67.1}}$$

**d** Mean =  $\frac{8379.5}{134}$

$$= \underline{\mathbf{62.5}}$$

Standard deviation =  $\sqrt{\frac{557489.75}{134} - \left(\frac{8379.5}{134}\right)^2}$

$$= \underline{\mathbf{15.8}}$$

**e**  $\frac{Q_3 - 2Q_2 + Q_1}{Q_3 - Q_1} = \frac{67.1 - 2 \times 58.8 + 52.5}{67.1 - 52.5}$

$$= \underline{\mathbf{0.137}} \Rightarrow \text{POSITIVE SKEW}$$

**f** For positive skew Mean > median and  $62.5 > 58.8$

or

$$Q_3 - Q_2 (8.3) > Q_2 - Q_1 (6.3)$$

or

$$\frac{3(62.5 - 58.8)}{15.8} = 0.703 > 0$$

Therefore positive skew.

Using  $\frac{\sum fx}{\sum f}$

Using  $\sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$  and the accurate

value for the mean. Using the rounded off version will give the wrong answer.

You should put the figures as well as the reason to show skew. Simply stating for example mean > median is not enough.

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## Edexcel AS and A Level Modular Mathematics

### Review Exercise

#### Exercise A, Question 6

#### Question:

Aeroplanes fly from City A to City B. Over a long period of time the number of minutes delay in take-off from City A was recorded. The minimum delay was five minutes and the maximum delay was 63 minutes. A quarter of all delays were at most 12 minutes, half were at most 17 minutes and 75% were at most 28 minutes. Only one of the delays was longer than 45 minutes.

An outlier is an observation that falls either  $1.5 \times$  (interquartile range) above the upper quartile or  $1.5 \times$  (interquartile range) below the lower quartile.

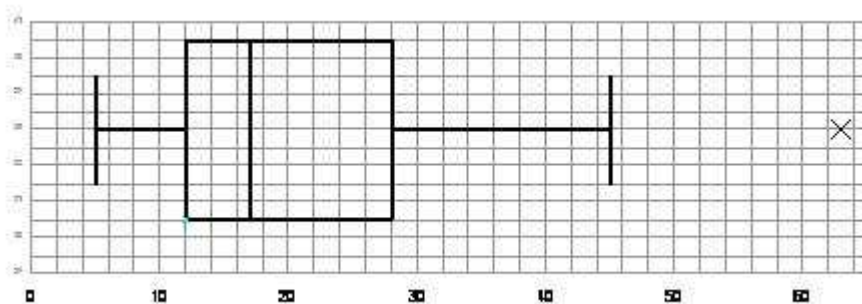
- a On graph paper, draw a box plot to represent these data.
- b Comment on the distribution of delays. Justify your answer.
- c Suggest how the distribution might be interpreted by a passenger who frequently flies from City A to City B.

#### Solution:

$$a \quad 1.5(Q_3 - Q_1) = 1.5(28 - 12) = 24$$

$$Q_3 + 24 = 52 \Rightarrow 63 \text{ is outlier}$$

$$Q_1 - 24 = -12 < 0 \text{ no outliers}$$



You must always check for outliers before drawing a box plot. Show your working and state what the outliers are if there are any. Or say no outliers if there are none.

The Outlier is marked by the cross.

The end of the whisker is put 45 since the question states that only one of the values is greater than 45. If we had not been told this the whisker would have gone at 52.

Always label the axis

b The distribution is positive skew since

$$Q_2 - Q_1 (5) < Q_3 - Q_2 (11)$$

c Many delays are small so passengers should find these acceptable.

Use figures to back up your reason

Always interpret in the context of the question



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## Edexcel AS and A Level Modular Mathematics

### Review Exercise

#### Exercise A, Question 7

#### Question:

In a school there are 148 students in Years 12 and 13 studying Science, Humanities or Arts subjects. Of these students, 89 wear glasses and the others do not. There are 30 Science students of whom 18 wear glasses. The corresponding figures for the Humanities students are 68 and 44 respectively.

A student is chosen at random.

Find the probability that this student

**a** is studying Arts subjects,

**b** does not wear glasses, given that the student is studying Arts subjects.

Amongst the Science students, 80% are right-handed. Corresponding percentages for Humanities and Arts students are 75% and 70% respectively.

A student is again chosen at random.

**c** Find the probability that this student is right-handed.

**d** Given that this student is right-handed, find the probability that the student is studying Science subjects.

#### Solution:

	Glasses	No glasses	Totals
Science	18	12	30
Arts	27	23	50
Humanities	44	24	68
Totals	89	59	148

Drawing a two way table enables you to see the data clearly. A Venn diagram would be too complicated as 5 circles would be needed

$$\mathbf{a} \quad P(\text{Arts}) = \frac{50}{148} = \frac{25}{74} = \mathbf{0.338}$$

$$\mathbf{b} \quad P(\text{no glasses} / \text{Arts}) = \frac{P(\overline{G} \cap A)}{P(A)} = \frac{23 / 148}{50 / 148} = \frac{23}{50} = \mathbf{0.46}$$

$$\mathbf{c} \quad P(\text{Right handed}) = P(S \cap \text{RH}) + P(A \cap \text{RH}) + P(H \cap \text{RH})$$

$$= \frac{30}{148} \times 0.8 + \frac{50}{148} \times 0.7 + \frac{68}{148} \times 0.75$$

$$= \frac{55}{74} = \mathbf{0.743}$$

$$\mathbf{d} \quad P(\text{Science} / \text{right handed}) = \frac{P(S \cap \text{RH})}{P(\text{RH})} = \frac{\frac{30}{148} \times 0.8}{\frac{55}{74}}$$

$$= \frac{12}{55} = \mathbf{0.218}$$

The words “given that” in the question tell you to use conditional probability.

It often helps to write down which combinations you want.

The words “given that” in the question tell you to use conditional probability.

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## Edexcel AS and A Level Modular Mathematics

### Review Exercise

#### Exercise A, Question 8

#### Question:

Over a period of time, the number of people  $x$  leaving a hotel each morning was recorded. These data are summarised in the stem and leaf diagram below.

Number leaving	3 2 means 32	Totals
2	7 9 9	(3)
3	2 2 3 5 6	(5)
4	0 1 4 8 9	(5)
5	2 3 3 6 6 6 8	(7)
6	0 1 4 5	(4)
7	2 3	(2)
8	1	(1)

For these data,

**a** write down the mode,

**b** find the values of the three quartiles.

Given that  $\Sigma x = 1335$  and  $\Sigma x^2 = 71\,801$ , find

**c** the mean and the standard deviation of these data.

One measure of skewness is found using

$$\frac{3(\text{mean} - \text{mode})}{\text{standard deviation}}$$

**d** Evaluate this measure to show that these data are negatively skewed.

**e** Give two other reasons why these data are negatively skewed.

#### Solution:

**a** Mode is **56**

**b**  $Q_1$  is the  $\frac{27}{4} = 6.75$  which rounds up to 7<sup>th</sup> term  $Q_1 = \underline{35}$

$Q_2$  is the  $\frac{27}{2} = 13.5$  which rounds up to 14<sup>th</sup> term  $Q_2 = \underline{52}$

$Q_3$  is the  $3 \times \frac{27}{4} = 20.25$  which rounds up to 21<sup>st</sup> term  $Q_3 = \underline{60}$

**c** Mean =  $\frac{1335}{27} = 49.4$  or  $\underline{49\frac{4}{9}}$

$$\text{Standard deviation} = \sqrt{\frac{71801}{27} - \left(\frac{1335}{27}\right)^2} = \underline{14.6}$$

Rounding needs to be used as the data is discrete

$$\text{Using } \frac{\Sigma fx}{\Sigma f}$$

$$\text{Using } \sqrt{\frac{\Sigma fx^2}{\Sigma f} - \left(\frac{\Sigma fx}{\Sigma f}\right)^2}$$

$$\mathbf{d} \frac{3(49.4 - 56)}{14.4} = \underline{\underline{-1.343}}$$

**e** For negative skew;

Mean < median < mode (49.4 < 52 < 56)

$$Q_2 - Q_1 (17) > Q_3 - Q_2 (8)$$

$$\frac{3(49.4 - 52)}{14.6} = -0.534$$

Any 2 of these would be acceptable but you should put the figures as well as the reason to show skew. Simply stating for example mean < median < mode is not enough.

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## Edexcel AS and A Level Modular Mathematics

### Review Exercise

#### Exercise A, Question 9

#### Question:

A bag contains nine blue balls and three red balls. A ball is selected at random from the bag and its colour is recorded. The ball is not replaced. A second ball is selected at random and its colour is recorded.

**a** Draw a tree diagram to represent the information.

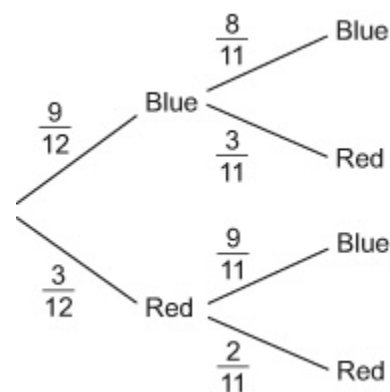
Find the probability that

**b** the second ball selected is red,

**c** both balls selected are red, given that the second ball selected is red.

#### Solution:

**a**



Remember to label all the branches and put all the probabilities on.

$$\begin{aligned} \mathbf{b} \ P(\text{Second ball is red}) &= \frac{9}{12} \times \frac{3}{11} + \frac{3}{12} \times \frac{2}{11} \\ &= \frac{1}{4} \end{aligned}$$

It often helps to write down which combinations you want.

$$\mathbf{c} \ P(\text{Both are red} \mid \text{Second ball is red}) = \frac{\frac{3}{12} \times \frac{2}{11}}{\frac{1}{4}} = \frac{2}{11}$$

The words “given that” in the question tell you to use conditional probability.

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## Edexcel AS and A Level Modular Mathematics

### Review Exercise

#### Exercise A, Question 10

#### Question:

For the events  $A$  and  $B$ ,

$$P(A \cap B') = 0.32, P(A' \cap B) = 0.11 \text{ and } P(A \cup B) = 0.65.$$

**a** Draw a Venn diagram to illustrate the complete sample space for the events  $A$  and  $B$ .

**b** Write down the value of  $P(A)$  and the value of  $P(B)$ .

**c** Find  $P(A|B')$ .

**d** Determine whether or not  $A$  and  $B$  are independent.

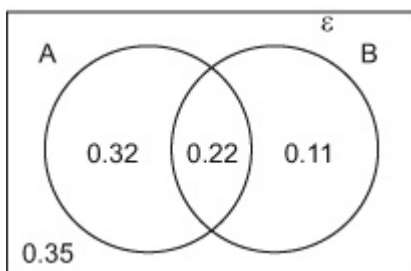
#### Solution:

$$\mathbf{a} \quad P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$0.65 = 0.32 + 0.11 + P(A \cap B)$$

$$P(A \cap B) = 0.22$$

$$1 - 0.32 - 0.22 - 0.11 = 0.35$$



$$\mathbf{b} \quad P(A) = 0.32 + 0.22 = \mathbf{0.54}$$

$$P(B) = \mathbf{0.33}$$

$$\mathbf{c} \quad P(A | B') = \frac{P(A \cap B')}{P(B')} = \frac{0.32}{0.67} = \frac{\mathbf{32}}{\mathbf{67}}$$

$$\mathbf{d} \quad \text{For independence } P(A \cap B) = P(A)P(B)$$

$$\text{For these data } 0.22 \neq 0.54 \times 0.33 = 0.1782$$

$\therefore$  NOT independent

When drawing a Venn diagram remember to draw a rectangle around the circles and add the probability 0.35.

The words “given that” in the question tell you to use conditional probability.

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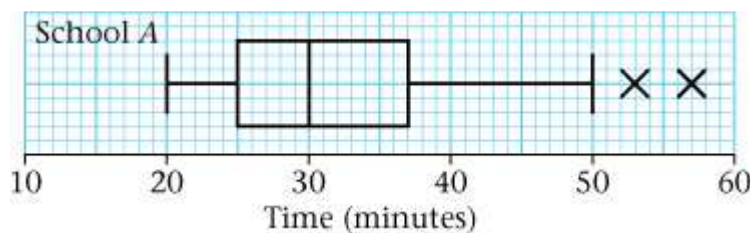
### Review Exercise

#### Exercise A, Question 11

#### Question:

a Describe the main features and uses of a box plot.

Children from schools *A* and *B* took part in a fun run for charity. The times, to the nearest minute, taken by the children from school *A* are summarised in Figure 1.



bi Write down the time by which 75% of the children in school *A* had completed the run.

ii State the name given to this value.

c Explain what you understand by the two crosses (×) on Figure 1.

For school *B* the least time taken by any of the children was 25 minutes and the longest time was 55 minutes.

The three quartiles were 30, 37 and 50 respectively.

d On graph paper, draw a box plot to represent the data from school *B*.

e Compare and contrast these two box plots.

#### Solution:

a Indicates max/median/min/upper quartile/lower quartile

Indicates outliers

Indicates skewness

Allows comparisons

Indicates range / IQR/ spread

bi 37 minutes

ii Upper quartile /third quartile /75<sup>th</sup> percentile

c Outliers

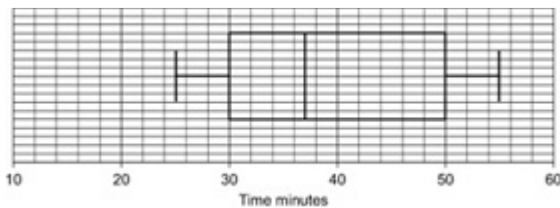
Observations that are different from the other observations and need to be treated with caution.

These two children probably walked/ took a lot longer.

**d**  $IQR = 20$

$Q_1 - 1.5 \times 20 = 0$  therefore no outliers

$Q_3 + 1.5 \times 20 = 80$  therefore no outliers



**e** Children from school A generally took less time.

50% of B  $\leq$  37 mins, 75% of A  $<$  37 mins  
(similarly for 30)

Median of A  $<$  median of B

A has outliers, (B does not)

Both positive skew

$IQR$  of A  $<$   $IQR$  of B, range of A  $>$  range of B

You must always check for outliers before drawing a box plot. Show your working and state what the outliers are if there are any. Or say no outliers if there are none.

Use the same scale as the one in the question so they are easy to compare. As there are no outliers you must use the highest and lowest values for the end of the whiskers.

You should always try to compare a measure of location, a measure of spread and skewness. Doing say the  $IQR$  and range will be treated as one comparison not two

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## Edexcel AS and A Level Modular Mathematics

### Review Exercise

#### Exercise A, Question 12

#### Question:

Sunita and Shelley talk to each other once a week on the telephone. Over many weeks they recorded, to the nearest minute, the number of minutes spent in conversation on each occasion. The following table summarises their results.

Time (to the nearest minute)	Number of conversations
5–9	2
10–14	9
15–19	20
20–24	13
25–29	8
30–34	3

Two of the conversations were chosen at random.

**a** Find the probability that both of them were longer than 24.5 minutes.

The mid-point of each class was represented by  $x$  and its corresponding frequency by  $f$ , giving  $\Sigma fx = 1060$ .

**b** Calculate an estimate of the mean time spent on their conversations.

During the following 25 weeks they monitored their weekly conversations and found that at the end of the 80 weeks their overall mean length of conversation was 21 minutes.

**c** Find the mean time spent in conversation during these 25 weeks.

**d** Comment on these two mean values.

#### Solution:

**a**  $P(\text{both longer than } 24.5) = \frac{11}{55} \times \frac{10}{54}$  Note the numbers reduce in the fractions as they are different conversations

$$= \frac{1}{27} \text{ or } 0.0\dot{3}\dot{7} \text{ or } 0.037 \text{ to } 3 \text{ sf}$$

**b** Estimate of mean time spent

on their conversations is  $= \frac{1060}{55}$

$$= 19\frac{3}{11} \text{ or } 19.\dot{2}\dot{7}$$

**c**  $\frac{1060 + \Sigma fy}{80} = 21$

Using  $\frac{\text{total time}}{\text{total number}}$

$$\Sigma fy = 620$$



$$\bar{y} = \frac{620}{25} = \underline{\underline{24.8}}$$

**d** Increase in mean value.

Length of conversations increased considerably during the 25 weeks relative to the 55 weeks.

You need to put your comment in the context of the question

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## Edexcel AS and A Level Modular Mathematics

### Review Exercise

#### Exercise A, Question 13

#### Question:

A group of 100 people produced the following information relating to three attributes. The attributes were wearing glasses, being left-handed and having dark hair.

Glasses were worn by 36 people, 28 were left-handed and 36 had dark hair. There were 17 who wore glasses and were left-handed, 19 who wore glasses and had dark hair and 15 who were left-handed and had dark hair. Only 10 people wore glasses, were left-handed and had dark hair.

**a** Represent these data on a Venn diagram.

A person was selected at random from this group.

Find the probability that this person

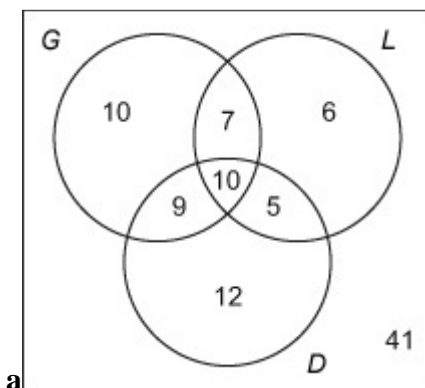
**b** wore glasses but was not left-handed and did not have dark hair,

**c** did not wear glasses, was not left-handed and did not have dark hair,

**d** had only two of the attributes,

**e** wore glasses given they were left-handed and had dark hair.

#### Solution:



$$\mathbf{b} \quad P(G, \bar{L}, \bar{D}) = \frac{10}{100} = \frac{1}{10}$$

$$\mathbf{c} \quad P(\bar{G}, \bar{L}, \bar{D}) = \frac{41}{100}$$

$$\mathbf{d} \quad P(\text{Only two attributes}) = \frac{9+7+5}{100} = \frac{21}{100}$$

$$\mathbf{e} \quad P(G \mid L \& D) = \frac{P(G \mid L \& D)}{P(L \mid D)} = \frac{\frac{10}{100}}{\frac{15}{100}} = \frac{10}{15} = \frac{2}{3}$$

Start in the middle of the Venn diagram and work outwards. Remember the rectangle and those not in any of the circles. Your numbers should total 100.

The words “given that” in the question tell you to use conditional probability.

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## Edexcel AS and A Level Modular Mathematics

### Review Exercise

#### Exercise A, Question 14

#### Question:

A survey of the reading habits of some students revealed that, on a regular basis, 25% read quality newspapers, 45% read tabloid newspapers and 40% do not read newspapers at all.

- a Find the proportion of students who read both quality and tabloid newspapers.
- b Draw a Venn diagram to represent this information.

A student is selected at random. Given that this student reads newspapers on a regular basis,

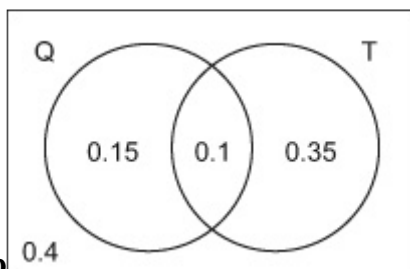
- c find the probability that this student only reads quality newspapers.

#### Solution:

a  $P(Q \cup T) = P(Q) + P(T) - P(Q \cap T)$

$$0.6 = 0.25 + 0.45 - P(Q \cap T)$$

$$P(Q \cap T) = \underline{\mathbf{0.1}}$$



When drawing a Venn diagram remember to draw a rectangle around the circles and add the probability 0.4.

Remember it is the total in circle A = 0.25 and the total in circle B = 0.45.

c  $P(Q \cap T' \mid Q \cup T) = \frac{0.15}{0.6} = \frac{1}{4} = \underline{\mathbf{0.25}}$

The words “given that” in the question tell you to use conditional probability.

# Solutionbank S1

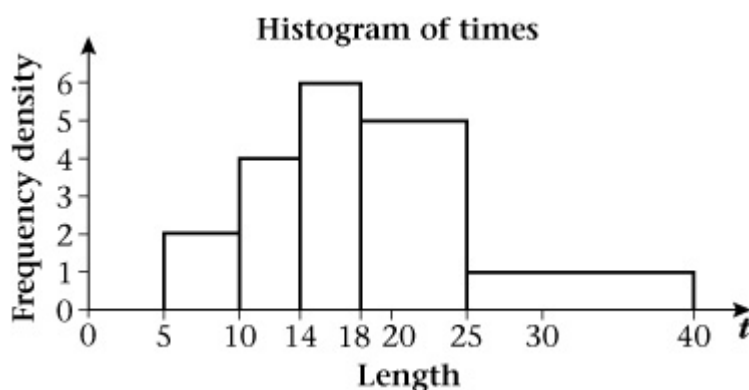
## Edexcel AS and A Level Modular Mathematics

### Review Exercise

#### Exercise A, Question 15

#### Question:

Figure 2 shows a histogram for the variable  $t$  which represents the time taken, in minutes, by a group of people to swim 500 m.



a Copy and complete the frequency table for  $t$ .

$t$	5–10	10–14	14–18	18–25	25–40
<b>Frequency</b>	10	16	24		

b Estimate the number of people who took longer than 20 minutes to swim 500 m.

c Find an estimate of the mean time taken.

d Find an estimate for the standard deviation of  $t$ .

e Find the median and quartiles for  $t$ .

One measure of skewness is found using

$$\frac{3(\text{mean} - \text{median})}{\text{standard deviation}}$$

f Evaluate this measure and describe the skewness of these data.

#### Solution:

a 18 – 25 group, area =  $7 \times 5 = \mathbf{35}$

25 – 40 group, area =  $15 \times 1 = \mathbf{15}$

b  $(25 - 20) \times 5 + (40 - 25) \times 1 = \mathbf{40}$

c Mid points are 7.5, 12, 16, 21.5, 32.5

$$\sum f = 100$$

Check the bars given to see whether the area equals the frequency or is proportional to the frequency. Here it equals the frequency.

Calculating the area on the histogram for time  $> 20$

The word estimate is used in the question when the midpoints are used to calculate the mean and standard deviation.

$$\begin{aligned}\sum ft &= (10 \times 7.5) + (16 \times 12) + (24 \times 16) + (35 \times 21.5) + (15 \times 32.5) \\ &= 1891\end{aligned}$$

$$\frac{\sum ft}{\sum f} = \frac{1891}{100} = \mathbf{18.91}$$

$$\mathbf{d} \quad \sum ft^2 = (10 \times 7.5^2) + (16 \times 12^2) + (24 \times 16^2) + (35 \times 21.5^2) + (15 \times 32.5^2) = 41033$$

$$\sigma = \sqrt{\frac{41033}{100} - \left(\frac{1891}{100}\right)^2} = \mathbf{7.26}$$

$$\text{Using } \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

$$\mathbf{e} \quad Q_2 \text{ is the } \frac{100}{2} = 50^{\text{th}} \text{ term}$$

No Rounding is needed when calculating the quartiles etc as the data is grouped.

$$Q_2 = \mathbf{18}$$

$$Q_1 \text{ is the } \frac{100}{4} = 25^{\text{th}} \text{ term}$$

The 50<sup>th</sup> term is at the end of the 14 – 18 class so it is 18 as there are no gaps in the classes

$$\frac{Q_1 - 10}{14 - 10} = \frac{25 - 10}{26 - 10}$$

$$Q_1 = \mathbf{13.75}$$

$$Q_3 \text{ is the } 3 \times \frac{100}{4} = 75^{\text{th}} \text{ term}$$

$$\frac{Q_3 - 18}{25 - 18} = \frac{75 - 50}{85 - 50}$$

$$Q_3 = \mathbf{23}$$

$$\mathbf{f} \quad \frac{3(18.91 - 18)}{7.26} = \mathbf{0.376} \text{ therefore it is positive skew}$$

# Solutionbank S1

## Edexcel AS and A Level Modular Mathematics

### Review Exercise

#### Exercise A, Question 16

#### Question:

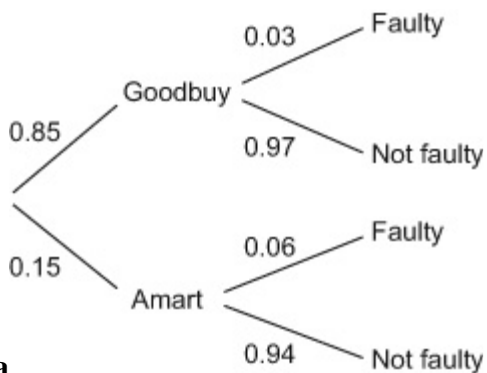
A company assembles drills using components from two sources. Goodbuy supplies 85% of the components and Amart supplies the rest. It is known that 3% of the components supplied by Goodbuy are faulty and 6% of those supplied by Amart are faulty.

**a** Represent this information on a tree diagram.

An assembled drill is selected at random.

**b** Find the probability that it is not faulty.

#### Solution:



**a**

**b**  $P(\text{Not faulty}) = P(G \cap \text{NF}) + P(A \cap \text{NF})$   
 $= (0.85 \times 0.97) + (0.15 \times 0.94)$   
 $= \underline{\underline{0.9655}}$

Remember to label all the branches and put all the probabilities on.

It often helps to write down which combinations you want.

# Solutionbank S1

## Edexcel AS and A Level Modular Mathematics

### Review Exercise Exercise A, Question 17

#### Question:

Data is coded using  $y = \frac{x-120}{5}$ . The mean of the coded data is 24 and the standard deviation is 2.8. Find the mean and the standard deviation of the original data.

#### Solution:

$$\frac{x-120}{5} = 24$$

$$x = 240 \text{ therefore mean} = \mathbf{240}$$

$$\begin{aligned} \text{standard deviation} &= 2.8 \times 5 \\ &= \mathbf{14} \end{aligned}$$

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