

Exemplars



GCSE (9-1) Statistics

Pearson Edexcel Level 1/Level 2 GCSE (9-1) in Statistics (1ST0)

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About this exemplar pack

This pack has been produced to support teachers delivering the new GCSE (9–1) Statistics specification (first assessment summer 2019).

The pack contains exemplar student responses to selected questions from the GCSE (9–1) Statistics sample assessment materials. It shows real student responses and how the examining team follows the mark schemes to demonstrate how the students would be awarded marks on these questions.

The pack provides exemplars for both Foundation tier and Higher tier. The common questions, which appear on both tiers, have been grouped together in their own section.

Each exemplar begins with the question and its mark scheme together with comments from the examiner on the question. Then follow three student exemplars for each question together with accompanying examiner comments on how the mark scheme has been applied and the marks awarded. Student responses are given in descending order of marks awarded.

Both papers at each tier address the Assessment Objective AO1, AO2 and AO3.

Students must:		% in GCSE
AO1	Demonstrate knowledge and understanding, using appropriate terminology and notation, of standard statistical techniques used to: <ul style="list-style-type: none">• collect and represent information• calculate summary statistics and probabilities	55
AO2	Interpret statistical information and results in context and reason statistically to draw conclusions <i>Where questions/tasks targeting this Assessment Objective will also credit students for their ability to 'demonstrate knowledge and understanding of standard statistical techniques (AO1) and/or to 'assess the appropriateness of statistical methodologies and the conclusions drawn through the application of the statistical enquiry cycle' (AO3), an appropriate proportion of the marks for the question/task must be attributed to the corresponding Assessment Objective(s).</i>	25
AO3	Assess the appropriateness of statistical methodologies and the conclusions drawn through the application of the statistical enquiry cycle <i>Where questions/tasks targeting this Assessment Objective will also credit students for their ability to 'demonstrate knowledge and understanding of standard statistical techniques' (AO1) and/or to 'interpret statistical information and results in context and reason statistically to draw conclusions' (AO2), an appropriate proportion of the marks for the question/task must be attributed to the corresponding Assessment Objective(s).</i>	20
Total		100%

Foundation tier

Exemplar question 1: Foundation Paper 1, question 3

3 Leyla wants to find out how often people in her town eat in a restaurant.

She asked a sample of 30 people how many times they had eaten in a restaurant during the last week.

Here are Leyla's results.

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

(a) Fill in the tally chart for this information **and** complete the frequency column.

Number of times	Tally	Frequency
1		
2		
3		
4		
5		

(2)

(b) Write down the mode.

.....
(1)

(c) Work out the number of people in Leyla's sample who had eaten in a restaurant fewer than 4 times during the last week.

.....
(2)

(d) Suggest a suitable diagram that Leyla could use to represent her data.

.....
(1)

(Total for Question 3 is 6 marks)

Mark scheme

Question number	Answer	Additional guidance	Mark																		
3(a)	B1B1 <table border="1" data-bbox="438 403 917 806"> <thead> <tr> <th>Number of times</th> <th>Tally</th> <th>Frequency</th> </tr> </thead> <tbody> <tr> <td>1</td> <td> </td> <td>14</td> </tr> <tr> <td>2</td> <td> </td> <td>7</td> </tr> <tr> <td>3</td> <td> </td> <td>4</td> </tr> <tr> <td>4</td> <td> </td> <td>3</td> </tr> <tr> <td>5</td> <td> </td> <td>2</td> </tr> </tbody> </table>	Number of times	Tally	Frequency	1		14	2		7	3		4	4		3	5		2	1 st B1 any one row or one column correct 2 nd B1 all correct	(2)
Number of times	Tally	Frequency																			
1		14																			
2		7																			
3		4																			
4		3																			
5		2																			
3(b)	B1ft 1		(1)																		
3(c)	M1 '14' + '7' + '4' A1ft 25	M1 for the addition of correct 3 numbers from their tally chart A1 ft their tally chart	(2)																		
3(d)	B1 e.g. bar chart	B1 for any suitable diagram, e.g. pie chart, bar line chart	(1)																		

Examiner comments

This question tests the early stages of the Statistical Enquiry Cycle (SEC). Here students are required to process collected data and suggest a suitable way to represent it. Students must consider the type of data when deciding which diagram would be suitable.

The question is designed to allow students to follow their own line of reasoning and follow through (ft) is available if mistakes are made in part (a).

Student response A

(a) Fill in the tally chart for this information **and** complete the frequency column.

Number of times	Tally	Frequency
1	 	14
2	 	7
3		4
4		3
5		2

(2)

(b) Write down the mode.

14

(1)

(c) Work out the number of people in Leyla's sample who had eaten in a restaurant fewer than 4 times during the last week.

$$7 + 14 + 4$$

25

(2)

(d) Suggest a suitable diagram that Leyla could use to represent her data.

Pie Chart

(1)

Examiner comments

- (a) B1 B1 correct tallies and correct frequencies
- (b) B0 incorrect answer. 14 is the greatest frequency, not the mode
- (c) M1 A1 correct answer
- (d) B1 a suitable diagram

5 marks awarded (5/6)

Student response B

- (a) Fill in the tally chart for this information **and** complete the frequency column.

Number of times	Tally	Frequency
1		13
2		7
3		4
4		3
5		2

(2)

- (b) Write down the mode.

1

(1)

- (c) Work out the number of people in Leyla's sample who had eaten in a restaurant fewer than 4 times during the last week.

$$\begin{array}{r} 13 \\ 7 \\ \hline 20 \end{array}$$

24

(2)

- (d) Suggest a suitable diagram that Leyla could use to represent her data.

bar chart

(1)

Examiner comments

- (a) B1 B0 (at least) one row correct (incorrect answer overall as there is one error – 13 instead of 14)
 (b) B1 correct answer that follows from their frequencies
 (c) M1 A1 correct answer that follows from their frequencies
 (d) B1 correct answer

5 marks awarded (5/6)

Student response C

(a) Fill in the tally chart for this information **and** complete the frequency column.

Number of times	Tally	Frequency
1	 	14
2	 	21
3		25
4		28
5		30

(2)

(b) Write down the mode.

2
(1)

(c) Work out the number of people in Leyla's sample who had eaten in a restaurant fewer than 4 times during the last week.

$$30 - 5$$

25
(2)

(d) Suggest a suitable diagram that Leyla could use to represent her data.

Scatter graph
(1)

Examiner comments

(a) B1 B0 for one (first) row correct (incorrect response overall as cumulative frequencies are used)

(b) B0 incorrect answer

(c) M1 A1 correct answer

(d) B0 incorrect answer, not a suitable diagram in this context

3 marks awarded (3/6)

Exemplar question 2: Foundation Paper 1, question 4

4 A researcher is investigating how much the employees at a large company are paid.

One hypothesis she investigates is

“Men are paid more than women”.

The researcher could find it difficult to collect information to test her hypothesis.

(a) Give one difficulty the researcher could have when trying to find out how much each employee is paid.

.....
 (1)

(b) State the population for this investigation.

..... (1)

(c) (i) Explain the difference between primary data and secondary data.

.....
 (2)

(ii) The researcher plans to collect primary data. Give a reason why.

..... (1)

The researcher plans to give a questionnaire to 60 employees of the company.

She asks the first 30 males and the first 30 females who come into work one morning to complete her questionnaire.

(d) Give one advantage and one disadvantage of this sampling method.

Advantage.....

.....
 Disadvantage.....

..... (2)

(Total for Question 4 is 7 marks)

Mark scheme

Question number	Answer	Additional guidance	Mark
4(a)	B1 e.g. Some employees may not wish to give their salary (confidential/personal).		(1)
4(b)	B1 All of the employees at the company.		(1)
4(c)(i)	B1 e.g. primary data is data you collect yourself.		(2)
4(c)(ii)	B1 e.g. secondary data is data collected by someone else. B1 e.g. known reliability, no secondary data available		(1)
4(d)	B1 Advantage: <ul style="list-style-type: none"> e.g. Convenient e.g. Equal number of males and females represented B1 Disadvantage: <ul style="list-style-type: none"> e.g. Not representative e.g. Biased e.g. Employees coming early may have similar pay 	1 st B1 any one correct advantage 2 nd B1 any one correct disadvantage	(2)

Examiner comments

Here students are tested on understanding the difficulties in sourcing sensitive data. They must demonstrate knowledge of different methods for collecting data (primary versus secondary) and explain why in this situation primary data is more suitable. An analysis of a given sampling method is then required. If students give more than one advantage/disadvantage, they must not be contradictory for the marks to be scored in part (d).

In part (b), a common mistake is for students to omit the word 'all'.

Student response A

- (a) Give one difficulty the researcher could have when trying to find out how much each employee is paid.

Takes time (1)

- (b) State the population for this investigation.

Everyone in the ~~company~~ ^{Company} (1)

- (c)(i) Explain the difference between primary data and secondary data.

primary is when you find it yourself. Secondary is when someone else gets the information for you (2)

- (ii) The researcher plans to collect primary data. Give a reason why.

~~Secondary~~ Secondary is untrustworthy (1)

- (d) Give one advantage and one disadvantage of this sampling method.

Advantage Easy

Disadvantage people doing different things start at different times (2)

Examiner comments

- (a) B0 not an appropriate difficulty in this situation
 (b) B1 correct answer
 (c)(i) B1 B1 correct answer for primary data and correct answer for secondary data
 (c)(ii) B1 'secondary data is untrustworthy' is an acceptable answer
 (d) B1 B1 acceptable advantage and acceptable disadvantage (taken as implying 'Employees coming early have similar characteristics')

6 marks awarded (6/7)

Student response B

(a) Give one difficulty the researcher could have when trying to find out how much each employee is paid.

They might not tell you.

(1)

(b) State the population for this investigation.

male and female workers

(1)

(c)(i) Explain the difference between primary data and secondary data.

You collect Primary data yourself. Secondary data is collected by someone else and you get it off the internet

(2)

(ii) The researcher plans to collect primary data. Give a reason why.

It hasn't been collected before

(1)

(d) Give one advantage and one disadvantage of this sampling method.

Advantage It is quick and easy. If they arrive at the same time they do the same job

Disadvantage It is not a spread of people so it isn't a fair sample

(2)

Examiner comments

(a) B1 acceptable answer

(b) B0 incorrect answer- no reference to 'all' the male and female workers

(c) (i) B1 B1 correct answer for primary data and correct answer for secondary data

(c) (ii) B1 correct answer- equivalent to no secondary data available

(d) B1 B1 correct advantage (ignoring comment about doing the same job) and correct disadvantage

6 marks awarded (6/7)

Student response C

- (a) Give one difficulty the researcher could have when trying to find out how much each employee is paid.

Employees may not be willing to disclose this information. (1)

- (b) State the population for this investigation.

The employees at the large company. (1)

- (c)(i) Explain the difference between primary data and secondary data.

Primary data is data that you personally collect, and secondary data is data that is collected by someone else. (2)

- (ii) The researcher plans to collect primary data. Give a reason why.

So she definitely knows the data is trustworthy. (1)

- (d) Give one advantage and one disadvantage of this sampling method.

Advantage Lets the data.

Disadvantage The males could be offended, the females could be opinionated. (2)

Examiner comments

- (a) B1 correct answer
 (b) B0 incorrect answer – no reference to ‘all’ the employees
 (c) (i) B1 B1 correct answer for primary data and correct answer for secondary data
 (c) (ii) B1 acceptable answer – equivalent to known reliability
 (d) B0 B0 incorrect advantage and incorrect disadvantage

4 marks awarded (4/7)

Exemplar question 3: Foundation Paper 1, question 6

6 Richard works in an animal rescue centre.

Richard has collected data on the weights, in kilograms, of 10 male cats and the weights, in kilograms, of 10 female cats at the centre.

Male	3.0	3.2	3.3	3.5	3.6	3.8	3.9	4.2	4.4	4.9
Female	3.0	3.1	3.1	3.2	3.3	3.3	3.5	3.7	3.9	9.5

Richard wants to compare the average weight of the male cats with the average weight of the female cats.

Richard thinks that he should use either the mean or the median.

(a) Which one of the mean or the median do you think he should use?

Give a reason for your answer.

(2)

Richard plans to use a scatter diagram in order to compare the weights of the male cats with the weights of the female cats.

(b) Discuss whether or not a scatter diagram would be a suitable diagram to use.

(2)

(Total for Question 6 is 4 marks)

Mark scheme

Question number	Answer	Additional guidance	Mark
6(a)	<p>B2 for median AND a correct reason, e.g.</p> <ul style="list-style-type: none"> reference to the extreme value in the female cat weights reference to the median not being affected by extreme values <p>OR if B2 not earned...</p> <p>B1 for an incomplete answer e.g. median with an attempt at a reason,</p> <p>OR correct reason without a conclusion</p> <p>OR if B1 not earned...</p> <p>SC B1 for mean AND uses all of the data</p>	<p>B2 for a complete answer assessing the appropriateness of the choice of average.</p> <p>OR if B2 not earned...</p> <p>B1 for an incomplete answer assessing the appropriateness of the choice of average.</p>	(2)
6(b)	<p>B2 Not suitable as the data is not bivariate/in related pairs oe</p> <p>OR if B2 not earned...</p> <p>B1 Not suitable, with attempt at a reason</p>	<p>B2 for a complete answer assessing the appropriateness of the choice of diagram</p> <p>OR if B2 not earned...</p> <p>B1 for an incomplete answer assessing the appropriateness of the choice of diagram</p>	(2)

Examiner comments

In this question, the new assessment objective AO3 is being tested. Students must assess which average is appropriate in the given context. Here the clue is that one of the female cat weights is significantly higher than the others. Given the effect that this has on the mean, the median is more appropriate.

In part (b), the appropriateness of the choice of diagram is being tested. An understanding of bivariate data is required here to understand that a scatter diagram is not appropriate. Incomplete answers can score B1 provided that the student has understood that a scatter diagram is not suitable and attempted to support their answer with a reason.

Student response A

Richard wants to compare the average weight of the male cats with the average weight of the female cats.

Richard thinks that he should use either the mean or the median.

- (a) Which one of the mean or the median do you think he should use?
Give a reason for your answer.

Median because of outliers

Richard plans to use a scatter diagram in order to compare the weights of the male cats with the weights of the female cats.

- (b) Discuss whether or not a scatter diagram would be a suitable diagram to use.

No because you can't label both ~~axis~~ axis

Examiner comments

- (a) B2 for median and reference to outliers
(b) B1 for 'no' and an attempt at a reason (which is incorrect)

3 marks awarded (3/4)

Student response B

Richard wants to compare the average weight of the male cats with the average weight of the female cats.

Richard thinks that he should use either the mean or the median.

- (a) Which one of the mean or the median do you think he should use?
Give a reason for your answer.

the mean because it encompasses each individual number whereas median just states the middle number.

Richard plans to use a scatter diagram in order to compare the weights of the male cats with the weights of the female cats.

- (b) Discuss whether or not a scatter diagram would be a suitable diagram to use.

A scatter diagram would not be a suitable diagram because it will not display clearly the comparison due to the amount of dots and the 4 variables (male, female, male weight, female weight) he would be better off using boxplots. (2)

(Total for Question 6 is 4 marks)

Examiner comments

(a) B1 (Special Case) for mean AND 'uses all the data'

(b) B1 incomplete answer, i.e. 'not suitable' with an attempt at a reason

2 marks awarded (2/4)

Student response C

Richard wants to compare the average weight of the male cats with the average weight of the female cats.

Richard thinks that he should use either the mean or the median.

- (a) Which one of the mean or the median do you think he should use?
Give a reason for your answer.

Mean, so he can find out what is the average weight of male, and female cats so he can compare them.

Richard plans to use a scatter diagram in order to compare the weights of the male cats with the weights of the female cats.

- (b) Discuss whether or not a scatter diagram would be a suitable diagram to use.

~~Yes~~ A scatter diagram wouldn't be suitable because ~~even~~ the data two variables have no relationship at all, one doesn't effect the other.

Examiner comments

(a) B0 incorrect answer with incorrect reason. The special case (SC) does not apply here as there is no mention of the mean using all of the data

(b) B1 for 'not suitable' with an attempt at a reason. The reason given is incomplete as although there is mention that the variables have no relationship it does not make reference to the fact that the data must be in related **pairs**

1 mark awarded (1/4)

Exemplar question 4: Foundation Paper 1, question 9

9 The directors of a company want to make changes to the company's pension scheme.

The directors want to find out what the employees think about the proposed changes to the pension scheme.

The directors will collect the information by using one of two data collection methods.

Method 1: each employee will be interviewed by one of the directors.

Method 2: each employee will complete a questionnaire without filling in their name.

There are 100 employees in the company.

Discuss how appropriate each of these two data collection methods are.

(Total for Question 9 is 4 marks)

Mark scheme

Question number	Answer	Additional Guidance	Mark
9	<p>B1 B1 B1 B1 for each of four aspects from:</p> <ul style="list-style-type: none"> • Understanding e.g. Questions/responses can be explained in an interview or may not be understood in a questionnaire • Candour e.g. Employee may be less open/honest in an interview or questionnaire can be done without pressure • Resources e.g. Interviewing can be time consuming/expensive or questionnaire can be done by all at the same time (or in their own time, or more cheaply) • Inclusivity e.g. interviews more likely to include all employees or questionnaires might not be returned or directors' views are not included by interview • Interviewer bias e.g. Possible bias from director (in interview)/ no interviewer bias with questionnaire 	B1 for each correct comment assessing the appropriateness of the data collection methods	(4)

Examiner comments

This question is testing the new assessment objective, AO3. Students must assess the appropriateness of two data collection methods in the given context. The question is open allowing the students to answer freely. The mark scheme allows for a number of categories to be considered. Students can only gain one mark per category, so repetition is not rewarded. It should be advised that students plan their answers before they begin so that they ensure they are discussing different aspects of the data collection methods.

Student response A

The first method would be inappropriate as it is very time consuming to interview 100 workers and some workers may not give their honest opinion when speaking to a director of the company face to face. The second method would be far better as it takes up a lot less of the company's time and employees may feel they can be more honest if filling it out anonymously. However, some employees might be too lazy to fill it out and not care because the company doesn't know it's them, something that wouldn't be an issue if they were to all be called into an interview.

Examiner comments

B1 for a correct comment referring to resources (time consuming)

B1 for a correct comment referring to candour (may not give honest opinion to director)

B1 for a correct comment referring to inclusivity (some employees may not fill it out)

B0 comments only cover 3 of the 5 categories

3 marks awarded (3/4)

Student response B

Method 1 is appropriate as the interviewer can explain the questions to the employee to ensure they understand the question.

Method 1 is not appropriate as the interviewer may influence the employees answers, causing them to be biased.

Method 2 is appropriate as it is anonymous so the employees are more likely to answer personal questions truthfully. Method 2 is not appropriate as some employees may not fully understand the question(s), leading to the wrong results

(Total for Question 9 is 4 marks)

Examiner comments

B1 for a correct comment referring to understanding (interviewer can explain question)

B1 for a correct comment referring to interviewer bias (interviewer may influence answers)

B1 for a correct comment referring to candour (employees are more likely to answer personal questions truthfully)

B0 comments only cover 3 of the 5 categories.

3 marks awarded (3/4)

Student response C

method 1 is a good way to collect data from a smaller amount of people. It would take a lot of time to do this and would be very expensive. The company should not use this method.

Method 2 is a good way to collect data from a large amount of people (much like the amount the company want to). It isn't very expensive and it can be filled out by the workers in their own time. The company should use this method.

(Total for Question 9 is 4 marks)

Examiner comments

B1 for a correct comment referring to resources (time consuming/expensive). Note that only 1 mark is available for each aspect.

B0 B0 B0 comments only refer to 1 of the 5 categories

1 mark awarded (1/4)

Exemplar question 5: Foundation Paper 1, question 10

- 10 The table shows information about the ages, when elected, of French presidents and UK prime ministers for the years 1850 to 2015

	Lowest value	Lower quartile	Median	Upper quartile	Highest value
French presidents	40	53	60.5	65	74
UK prime ministers	43	53	56.5	63	70

(Source: Wikipedia)

Compare and interpret the spread of ages of French presidents with UK prime ministers for the years 1850 to 2015

(Total for Question 10 is 5 marks)

Mark scheme

Question number	Answer	Additional guidance	Mark
10	<p>M1A1A1 for calculation of range or IQR OR for a pair of box plots drawn</p> <p>Range</p> <p>M1 74 – 40 or 70 – 43 A1 34 A1 27</p> <p>OR</p> <p>IQR</p> <p>M1 65 – 53 or 63 – 53 A1 12 A1 10</p> <p>B1 for e.g. The range/IQR for French presidents is greater than the range/IQR for UK prime ministers oe</p> <p>B1 for e.g. The ages of French presidents are more varied than the ages of UK prime ministers</p>	<p>M1 for a calculation of range or IQR OR for a pair of box plots drawn</p> <p>A1 for one correct value OR for one correct box plot</p> <p>A1 for second correct value to allow a comparison to be made OR for second correct box plot (same scale) to allow comparisons to be made</p> <p>B1 for a correct comparison of ranges or IQRs</p> <p>B1 for a correct contextual interpretation of comparison of spread</p>	(5)

Examiner comments

There is a requirement to include extended response questions in the new specification. These questions tend to be around 5 or 6 marks and require students to draw together information or carry out several unstructured processes. Here the requirement is for students to calculate an appropriate measure of spread and then analyse the calculation in the context of the question. The choice of spread is left up to the student but requires the student to select the appropriate values. More information than needed is given to the students.

Students sometimes answer without properly reading the question and waste time commenting about the medians. Both a comparison and an interpretation are required. Interpretations should always be given in context.

Student response A

Compare and interpret the spread of ages of French presidents with UK prime ministers for the years 1850 to 2015

Range	IQR	
34	11	French
27	10	UK

Both the range and IQR are bigger for french presidents meaning there was a wider spread of ages
 On average French presidents are older - median is 60.5 instead of 56.5

Examiner comments

A fully correct solution with correct contextual interpretation.

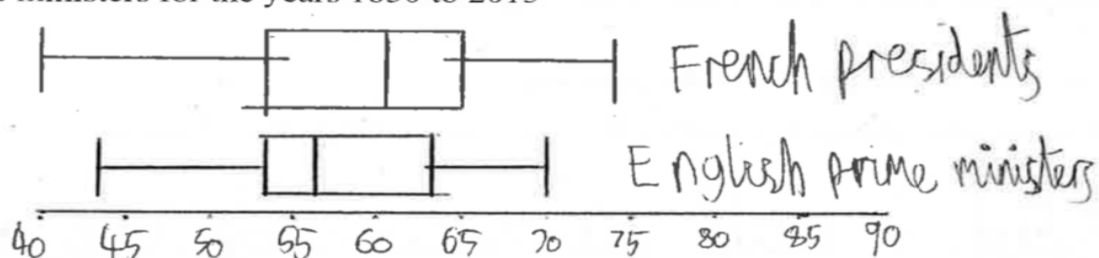
M1 A1 A1 for 34 and 27 (correct answers without working). We ignore the IQRs as correct ranges have been given

B1 B1 for a correct comparison of range ('range ... bigger for French presidents'), correct contextual interpretation ('wider spread of ages')

5 marks awarded (5/5)

Student response B

Compare and interpret the spread of ages of French presidents with UK prime ministers for the years 1850 to 2015



French presidents are generally older than English prime ministers, although the youngest French president was younger than the youngest English prime minister. ~~that~~ they both had very similar upper and lower quartiles, signifying similarly and tightly grouped average ages. French presidents' age range is significantly higher.

Examiner comments

M1 A1 A1 two correct comparative box plots drawn on the same scale to allow comparisons

B1 B0 correct comparison of range, no contextual interpretation

4 marks awarded (4/5)

Student response C

Compare and interpret the spread of ages of French presidents with UK prime ministers for the years 1850 to 2015

$$74 - 40 = 34$$

$$70 - 43 = 37$$

UK prime ministers have a wider spread of 37

Examiner comments

M1 for the calculation of range $74 - 40$ or $70 - 43$, A1 for 34, A0 37 is incorrect

B0 incorrect answer (follow through not available in this question)

2 marks awarded (2/5)

Exemplar question 6: Foundation Paper 2, question 1

1 Jenny wants to find out what students at her school think about the after-school clubs.

Jenny is going to use a questionnaire.

Here is one of the questions she wants to put on the questionnaire.

It is great that we have a range of clubs at school, isn't it?		
Yes <input type="checkbox"/>	No <input type="checkbox"/>	Don't know <input type="checkbox"/>

(a) This is not a suitable question.
Explain why.

.....
(1)

Here is another of the questions that Jenny wants to put on the questionnaire.

How many times a week do you go to an after-school club?		
1-2 <input type="checkbox"/>	2-3 <input type="checkbox"/>	4-5 <input type="checkbox"/>

(b) Discuss whether or not this is a suitable question for the questionnaire.

.....
.....
.....
(2)

(Total for Question 1 is 3 marks)

Mark scheme

Question number	Answer	Additional guidance	Mark
1(a)	B1 It is a leading question / it is biased	B1 for assessing the appropriateness of the given question	(1)
1(b)	<p>B2 for a complete answer, e.g.</p> <ul style="list-style-type: none"> • Not suitable AND the response boxes overlap • Not suitable AND no option for never / cannot say 6 or more <p>OR if B2 not earned...</p> <p>B1 for an incomplete answer e.g. giving reasons but no conclusion</p> <p>OR</p> <p>B1 for one of</p> <ul style="list-style-type: none"> • Contains a time frame • It is a closed question which is better than an open question 	<p>B2 for assessing the appropriateness of the given question and reaching the correct conclusion</p> <p>OR if B2 not earned...</p> <p>B1 for an incomplete attempt at assessing the appropriateness of the given question</p>	(2)

Examiner comments

AO3 is tested here as students must examine the appropriateness of questions on a questionnaire. The idea of a leading question should be familiar to students as this is not a new topic to the specification. Likewise, overlapping response boxes and exhaustive response boxes are concepts that should be familiar to those studying Statistics. Part (b) requires students to give a conclusion as well as a reason for their answer. To score full marks both a conclusion and a correct supporting reason are required.

Student response A

(a) This is not a suitable question.

Explain why.

..... Because it's a leading question

(b) Discuss whether or not this is a suitable question for the questionnaire.

..... ~~This is not as there is an overlap~~ This isn't a suitable
 question as there is an overlap as if you did ^{very} 2 wet weeks
 you wouldn't know what box to tick

Examiner comments

A fully correct response.

B1 leading question is a correct response

B2 correct response – states not suitable with a correct reason (overlap)

3 marks awarded (3/3)

Student response B

(a) This is not a suitable question.

Explain why.

..... it is confusing

(1)

(b) Discuss whether or not this is a suitable question for the questionnaire.

..... it is not as there is no 0
 answer box for if you don't go and
 inbetween the numbers is a decimal
 So it would be 1.5, 2.5, 4.5. (2)
 Also 1-2 and 2-3 cross over

Examiner comments

B0 'confusing' is not an appropriate reason in this example

B2 correct response – states not suitable with a correct reason (no option for never) (ignoring reference to decimal boundaries)

2 marks awarded (2/3)

Student response C

(a) This is not a suitable question.

Explain why.

Yes. It's a leading question

(1)

(b) Discuss whether or not this is a suitable question for the questionnaire.

It has ~~the~~ the same numbers
for ~~option one~~ and some options

(2)

Examiner comments

B1 leading question is a correct response

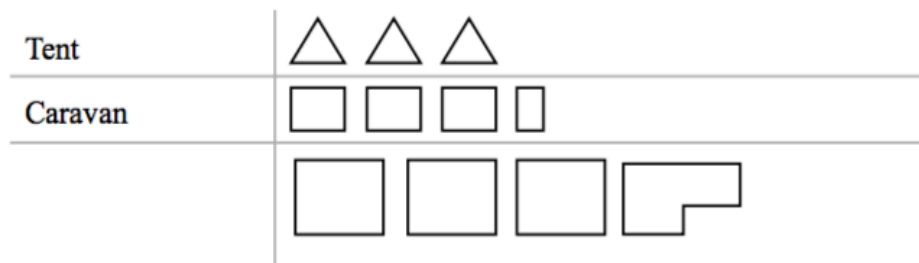
B1 for an incomplete answer, i.e. a correct reason (equivalent to overlap) but there is no conclusion

2 marks awarded (2/3)

Exemplar question 7: Foundation Paper 2, question 4

4 Rebecca collected information about the type of accommodation that 30 people stayed in the last time they went on holiday.

She drew this diagram to show her results.



Write down three things that could be misleading or that are wrong in Rebecca's diagram.

- 1
- 2
- 3

(Total for Question 4 is 3 marks)

Mark scheme

Question number	Answer	Additional guidance	Mark
4	<p>B1B1B1 for three correct things identified. e.g.</p> <ul style="list-style-type: none"> • No label for the third row • Different shaped symbols (triangles and rectangles) • Different sized symbols / symbols not aligned • No key • No title 	<p>B1 × 3 for demonstrating understanding of key features of a pictogram</p>	(3)

Examiner comments

This question asks for students to identify three things that are wrong or misleading about the presented diagram. Students must demonstrate that they understand the important features of a pictogram. A key is essential as is correct labelling and consistent use of shapes/symbols so comparisons can easily be made. As the answers listed in the mark scheme are 'e.g.' alternative responses can score marks as long as they give an appropriate reason why the pictogram is incorrect or misleading.

Student response A

1. The size of the third picture would suggest that that type of accommodation was most popular.
2. There is no label for the third accommodation type.
3. There is no key to show the amount each picture represents.

Examiner comments

A fully correct response.

B1 correct comment referring to size of symbols

B1 correct comment referring to missing label

B1 correct comment referring to missing key

3 marks awarded (3/3)

Student response B

1. She has no key
2. She uses shapes to represent numbers
3. She has not labeled one of her columns

Examiner comments

B1 correct comment referring to missing key

B0 the comment about using shapes to represent numbers is incorrect

B1 correct comment referring to missing label

2 marks awarded (2/3)

Student response C

1. She hasn't named the 3rd row
2. The drawing can be misleading
3. If people might have stayed in other places of accommodation

Examiner comments

B1 correct comment referring to missing label

B0 'the drawing can be misleading' is insufficient

B1 as there are no labels and no key, it cannot be determined if these are the only types of accommodation stayed in by the 30 people, so this is a suitable answer

2 marks awarded (2/3)

Common questions

Exemplar question 8: Foundation/Higher Paper 1, question 11/2

- 11 Kerry is investigating whether there is a difference in the lengths of the text messages sent by boys and sent by girls at her school.

She writes the following hypothesis for the investigation.

“The length of text messages sent by girls is greater than the length of text messages sent by boys”.

Kerry decides to use a census of the 800 students in her school.

She is going to ask each student to record the number of characters in their last text message.

Kerry then collects this information from each student through an online database.

Part of the database is shown below.

	Gender	Length of text message
1	male	73
2	F	68
3	girl	thirty five
4	boy	114,
5	boy	85
6	girl	
7	M	56
8	48	boy
9	girl	5
10	G	75
11	B	41
12	girl	28

- (a) Give **two** reasons why Kerry must clean the data before processing it.

Reason 1:

.....

Reason 2:

.....

(2)

- (b) Discuss how Kerry’s data collection plan could affect the reliability of her conclusions.

(2)

(Total for Question 11 is 4 marks)

Mark scheme

Question number	Answer	Additional guidance	Mark
11/2(a)	B1B1 for two correct reasons <ul style="list-style-type: none"> • e.g. data given in different formats • e.g. remove extraneous symbols • e.g. remove anomalies/outliers • e.g. data given in wrong order 	B1 for each correct reason for the need to clean data on the database prior to processing it	(2)
11/2(b)	B1B1 for two correct aspects <ul style="list-style-type: none"> • e.g. large sample size increases reliability • e.g. issues due to how the data collection is carried out may decrease reliability (recorded by students and not by Kerry/students may type in information wrong) • e.g. for an example of factors that might not be consistent in the data collection which may decrease reliability (last message might not represent all text messages sent) • e.g. non-response decreases reliability 	B1 for each correct comparison assessing the reliability of the conclusions drawn	(2)

Examiner comments

As part of the new specification, it is important that students have experience dealing with data sets using appropriate technology such as spreadsheets. Common issues associated with spreadsheets, particularly the need to clean data, are tested here. When data is inputted by many different people, it is inevitable that it will be in different formats and will require pre-processing. Data cleaning includes many aspects: writing things in the same format, identifying outliers or anomalies, removing extraneous symbols, etc.

The interdependency of the different stages of the Statistical Enquiry Cycle is one of its key features. Here students need to examine the effects that the method of data collection will have on conclusions drawn. Drawing together knowledge of different stages of the cycle is an important feature of the new specification.

This is a common question to both tiers.

Student response A

(a) Give **two** reasons why Kerry must clean the data before processing it.

Reason 1: So that it is ~~not~~ readable

Reason 2: Make sure it is all in the same format.

(b) Discuss how Kerry's data collection plan could affect the reliability of her conclusions.

Kerry is not ~~collecting~~ counting/measuring the ~~length~~ length of her text messages herself. This could mean that the information Kerry is being sent is not reliable as people could be lying about the length. Another issue is that Kerry is only asking for the last text, this is bad as that text message could be an anomaly. Kerry should ask for the last 5 or 10 text messages to make sure they all fit into a rough pattern.

Examiner comments

(a) B0 incorrect reason

B1 correct reason, refers to different formats

(b) B1 correct aspect, refers to an issue in the data collection, i.e. 'secondary data'

B1 correct aspect, refers to a factor that might not be consistent in the data collection, i.e. last text message 'not representative'

3 marks awarded (3/4)

Student response B

(a) Give **two** reasons why Kerry must clean the data before processing it.

Reason 1: because the ~~same~~ words that mean the same thing are written in different ways

Reason 2: ~~one bit of data~~ one bit of data is in the wrong column

(2)

(b) Discuss how Kerry's data collection plan could affect the reliability of her conclusions.

the data collection plan could affect it because the data could then be plotted wrong. Also it would only be the last message meaning that the last could be an abnormal size that they rarely send.

Examiner comments

(a) B1 correct reason, refers to different formats

B1 correct reason, refers to data given in wrong order

(b) B1 B0 one correct aspect, refers to a factor that might not be consistent in the data collection, i.e. last text message 'not representative'

3 marks awarded (3/4)

Student response C

(a) Give two reasons why Kerry must clean the data before processing it.

Reason 1: Have a look for outliers.

Reason 2: make it easier to read from.

(b) Discuss how Kerry's data collection plan could affect the reliability of her conclusions.

one student may of made up something
which may affect the mean.
that last text message may just be
a one of.
the online data may of been wrong.

Examiner comments

(a) B1 B0 one correct reason, refers to outliers

(b) B1 B0 one correct aspect, refers to a factor that might not be consistent in the data collection, i.e. last text message 'not representative'

2 marks awarded (2/4)

Exemplar question 9: Foundation/Higher Paper 1, question 14/5

- 14 The table shows information about the retail price index (RPI) and the price of a second-class stamp (in pence) in the United Kingdom for January 1996, January 2006 and January 2016

	Jan 1996	Jan 2006	Jan 2016
Retail price index (RPI)	100	129	172
Price of second-class stamp (pence)	20	23	54

(Sources: *ons.gov.uk* and *royalmail.com*)

Describe how the increase in the price of a second-class stamp compares with the RPI over the ten years to January 2006 **and** over the twenty years to January 2016

(Total for Question 14 is 5 marks)

Mark scheme

Question number	Answer	Additional guidance	Mark
14/5	<p>M1A1A1 for appropriate calculations to compare 1996 with 2006 or 1996 with 2016 e.g.</p> <p>Comparing index numbers</p> $\text{M1 } \frac{23}{20} \times 100 \text{ or } \frac{54}{20} \times 100$ <p>A1 115 A1 270</p> <p>OR</p> <p>Comparing prices</p> $\text{M1 } 20 \times \frac{129}{100} \text{ or } 20 \times \frac{172}{100}$ <p>A1 25.8 A1 34.4</p> <p>B1 for e.g. from 1996 to 2006 the change/increase in price was less than the RPI</p> <p>B1 for e.g. from 1996 to 2016 the change/increase in price was higher than the RPI</p>	<p>M1 for a calculation that could be used to compare 1996 with 2006 or 2016</p> <p>A1 for one correct value</p> <p>A1 for second correct value that allows a comparison to be made</p> <p>B1 for a correct contextual statement for 2006 or 2016</p> <p>B1 for a correct contextual statement for 2006 and 2016</p>	(5)

Examiner comments

The specification requires students to be able to interpret data related to rates of change over time. They must also use different types of index numbers including retail price index (RPI). This question is an extended response question where students must select appropriate calculations and then interpret them in context. Here, they must calculate the appropriate index number for the price of a second-class stamp for 2006 and 2016 and then compare these values with the RPI for those years.

Students should use comparative language when making comparisons e.g. 'greater than', 'less than', etc.

This is a common question to both tiers.

Student response A

	Jan 1996	Jan 2006	Jan 2016
Retail price index (RPI)	100	129	172
Price of second-class stamp (pence)	20	23	54

100 115 ~~110~~ 270
 (Sources: ons.gov.uk and royalmail.com)

Describe how the increase in the price of a second-class stamp compares with the RPI over the ten years to January 2006 and over the twenty years to January 2016

(2006) Index number = $\frac{\text{current price}}{\text{base year price}} \times 100$

Index number = $\frac{23}{20}$

Index number = 115

2016 Index number = $\frac{\text{current price}}{\text{base year price}} \times 100$

Index number = $\frac{54}{20} \times 100$

~~270~~ ~~235~~ 270

From 1996 - 2006
 The increase in price of the second class stamp is less than the retail price. ~~15%~~ 15% increase compared to 29% of the retail price. However ~~from~~ from 1996 - 2006 the price of second class stamp increases by ~~2~~ significantly more (Total for Question 5 is 5 marks) than ~~170%~~ 170% compared to 72% increase in retail price

Examiner comments

A fully correct solution with correct contextual statements.

M1 A1 A1 for 115 and 270

B1 B1 correct contextual statements for 2006 and 2016

5 marks awarded (5/5)

Student response B

RPI ~~an~~ increased 29% from January 1996 to 2006, while the price of second class stamps increased ~~15%~~ 15% from Jan 1996 to 2006. The RPI increased more.

RPI ~~an~~ increased 72% over the 20 years from 1996 to 2016, while second class stamps increased 170% since 1996. This shows the stamps increase was greater over 20 years.

Examiner comments

A fully correct solution with correct contextual statements.

M1 A1 A1 for '15% increase', i.e. 115 AND '170% increase', i.e. 270

B1 B1 correct contextual statements for 2006 and 2016

5 marks awarded (5/5)

Student response C

as the RPI increases so does
 the price of a second class
 stamp and over the 20 years
 the second class stamp price
 has doubled but the RPI hasn't

$$\frac{23}{20} = 1.15$$

$$\frac{23}{20} \times 100 = 115$$

$$\frac{54}{20} \times 100 = 270$$

Examiner comments

M1 A1 A1 for 115 and 270

B0 B0 no acceptable contextual statements

3 marks awarded (3/5)

Exemplar question 10: Foundation/Higher Paper 2, question 14/5

14 Gary is going to investigate the amounts of time students spend watching TV.

He is going to write a plan for this investigation.

His hypothesis is

“The amount of time that boys spend watching TV is greater than the amount of time that girls spend watching TV”.

Write down three other things he should include in his plan.

Explain why each of these things is appropriate.

You must refer to more than one stage of the statistical enquiry cycle.

(Total for Question 14 is 6 marks)

Mark scheme

Question number	Answer	Additional guidance	Mark
14/5	<p>Collecting data B1 for identifying one appropriate thing that should be included in the plan for collecting data and B1 for explaining why this aspect is appropriate</p> <p>OR</p> <p>B1 for deciding what data to collect and/or how to collect and record it and B1 for an appropriate reason</p> <p>OR</p> <p>B1 for a strategy to process data and B1 for an appropriate reason</p> <p>OR</p> <p>B1 for designing a collection method for primary/secondary data and B1 for an appropriate reason</p> <p>OR</p> <p>B1 for appreciating the importance of acknowledging sources and B1 for an appropriate reason</p> <p>OR</p> <p>B1 for recognising where issues of sensitivity may influence data availability and B1 for an appropriate reason</p> <p>Processing and presenting B1 for planning to organise and/or process data and B1 for an appropriate reason</p> <p>OR</p>	<p>B1B1B1 for each of three planned elements and B1B1B1 for each of three appropriate reasons from their three things in the statistical enquiry cycle. Maximum 4 marks if only one aspect (from Collecting data, Processing and presenting, Interpreting and Evaluating) is referenced.</p> <p>B1 for e.g. use amount of time measured to the nearest minute and B1 for e.g. this is sufficient as there will be a large range of times</p> <p>B1 for e.g. collect data for 23 boys and 23 girls and B1 for e.g. this will make the calculation of quartiles easier</p> <p>B1 for e.g. use random sampling and B1 for e.g. this reduces bias as Gary's friends/class/peers may generally watch the same programs</p> <p>B1 for e.g. use primary data and B1 for e.g. this increases reliability as Gary will know how the data was collected</p> <p>B1 for e.g. A student (Gary) should collect the data and B1 for e.g. students are more likely to give an honest answer to a fellow student (less threatening)</p> <p>B1 for e.g. use a grouped frequencies table for the data and B1 for e.g. as this will enable a quick way of estimating the mean or this can be used to draw a histogram</p>	(6)

Question number	Answer	Additional guidance	Mark
14/5 <i>continued</i>	<p>B1 for planning to generate diagrams and/or visualisations to represent the data and B1 for an appropriate reason OR B1 for planning to generate statistical measures to compare data and B1 for an appropriate reason</p> <p>Interpreting B1 for planning to interpret diagrams and/or calculations/measures and B1 for an appropriate reason OR</p> <p>B1 for planning to make an inference and/or prediction and B1 for an appropriate reason</p> <p>Evaluating B1 for planning to identify weaknesses in approach or representation and B1 for an appropriate reason OR</p> <p>B1 for planning to refine the processes to elicit further clarification of the hypothesis and B1 for an appropriate reason</p>	<p>B1 for e.g. use box plots and B1 for e.g. these will enable the comparison of both the medians and the IQRs (i.e. the distributions) of the data</p> <p>B1 for e.g. interpret results for each individual school year and B1 for e.g. as different years could have different watching habits</p> <p>B1 for e.g. by comparing means and B1 for e.g. you can see whether the amount of time that boys spend watching TV is greater, in general, than the amount of time that girls spend watching TV</p> <p>B1 for e.g. use the results from the school to predict the results nationally and B1 for e.g. as students in different parts of the country are likely to have the same watching habits</p> <p>B1 for e.g. choose not to display the information in histograms and B1 for e.g. as “the target audience” may not know how to interpret them</p> <p>B1 for e.g. consider using more than one type of visual representation (for the same information) and B1 for e.g. as different representations focus on different aspects of the data</p>	

Examiner comments

This question represents one of the new types of questions that must feature in the new specification. New requirements include having open response questions and having questions that test more than one aspect of the Statistical Enquiry Cycle (SEC). Also tested here is AO3 as the appropriateness of each decision must be justified.

For questions like this, students should spend a few minutes planning their responses so that they cover all of the demands of the question. Each thing included in the plan should be justified, so it would be appropriate to provide the justification immediately after the thing is stated.

Note that there are no marks given for grammar and spelling, as long as the intention is clear. This means that other styles of answers could also be considered for full marks such as setting out the responses in a table. When discussing a particular type of diagram, the correct name for the diagram should be used. Also, when discussing 'averages' and 'spread' appropriate statistical language should be used and this should include the correct name of the statistical calculation being described.

It is important that students take note of the guidance given in the question that more than one stage of the SEC must be included in their response. The mark scheme stipulates that if this is not the case a maximum of 4 marks can be awarded.

This is a common question to both tiers.

Student response A

Do a simple random sample of 30 ~~boy~~ ^{male} students and 30 female students. A simple random sample is quick and fair. Record the number of hours spent watching TV per day. Create ~~to~~ 2 box plots for male and female showing amount of time spent watching TV per day. This allows him to compare the median, IQR and skewness. Calculate standard deviation for a comparison of spread.

Examiner comments

B1 B1 for identifying one appropriate thing that should be included in the plan for collecting data, i.e. simple random sampling AND explaining why this aspect is appropriate, i.e. 'fair'

B1 for a strategy to process data, i.e. 30 males and 30 females (no reason given)

B1 B1 for planning to generate diagrams, i.e. boxplots AND an appropriate reason, i.e. to compare medians, IQR and skewness

Note: more than one aspect of the statistical enquiry cycle is referred to, so 5 marks may be awarded

5 marks awarded (5/6)

Student response B

He should include a diagram (e.g. a scatter graph) so he can accurately compare his data. He should also eliminate any outliers he may have so that he can see the correlation. He should also write where he got his data from to make sure it is reliable. He should also clean his data to make sure there are no mistakes.

Examiner comments

B0 for planning to generate diagrams (scatter graph inappropriate)

B1 for identifying one appropriate thing that should be included in the plan for collecting data, i.e. remove outliers (no reason given)

B1 for identifying one appropriate thing that should be included in the plan for collecting data, i.e. identify the source (incorrect reason given)

B1 B1 for identifying one appropriate thing that should be included in the plan for collecting data, i.e. clean the data AND an appropriate reason, i.e. 'to make sure there are no mistakes'

4 marks awarded (4/6)

Student response C

• How much data he is going to collect from each gender so he can compare as well as have an equal amount for each, as well as having enough data to find ~~outliers~~ outliers etc.

• Finding outliers so that if there aren't / are any, he can state how accurate his hypothesis is.

• Finding an ^{average} ~~median~~ for both genders so he can compare and find out what gender ^{in general} ~~is average~~ watches the most.

Examiner comments

B1 for a strategy to process data, i.e. 'equal amount of each' (no acceptable reason)

B1 for identifying one appropriate thing that should be included in the plan for collecting data, i.e. consider outliers (incorrect reason given)

B0 B1 planning to generate statistical measures, i.e. 'averages' is not sufficient as the type of average should be specified in the plan, an appropriate reason, i.e. 'find out what gender in general watches the most'

3 marks awarded (3/6)

Higher tier

Exemplar question 11: Higher Paper 1, question 8

- 8 The table gives information about the monthly average price per litre, in pence, of diesel over a period of five months.

The table also gives some of the chain base index numbers, correct to one decimal place, for this information.

	May	June	July	August	September
Monthly average price (p)	109.1	111.8	112.7	111.2	113.1
Chain base index number		102.5	100.8		

(Source: *theaa.com*)

- (a) Calculate the chain base index numbers for August and September and write them in the table.

Give each value correct to one decimal place.

(2)

- (b) (i) Calculate the geometric mean of the four chain base index numbers.

You must show your working.

Give your answer correct to one decimal place.

.....
(2)

- (ii) Interpret your answer.

.....
.....
.....
(2)

(Total for Question 8 is 6 marks)

Mark scheme

Question number	Answer	Additional guidance	Mark
8(a)	M1 for either $111.2/112.7 \times 100$ (=98.7) OR $113.1/111.2 \times 100$ (=101.7) A1 for 98.7 and 101.7	M1 for correct calculation of chain base index number. May be implied by one correct answer A1 both correct	(2)
8(b)(i)	M1ft for $\sqrt[4]{(102.5 \times 100.8 \times 98.7 \times 101.7)}$ A1ft for 100.9	M1ft for correct calculation of the geometric mean of the four chain base index numbers A1ft correct answer ft their answers in (a)	(2)
8(b)(ii)	B1ft for (average) rate of 'increase' ... B1ft ... is '0.9%' per month	B1ft for correct contextual interpretation as rate of increasing B1ft for complete correct contextual interpretation of their value for geometric mean	(2)

Examiner comments

The geometric mean is a new topic to the specification. Students should be able to show how it is calculated and give an interpretation of it in context. In this question it is essential that students show their working as it is possible to obtain the 'correct' answer from incorrect working, i.e. using the arithmetic mean instead of the geometric mean.

Students should also be encouraged to show all of their working. If a correct answer has been obtained and then incorrectly rounded, full credit may still be earned. Even when work is done on the calculator, it is important to show clearly the method being used.

Student response A

	May	June	July	August	September
Monthly average price (p)	109.1	111.8	112.7	111.2	113.1
Chain base index number		102.5	100.8	98.7	101.7

(Source: theaa.com)

- (a) Calculate the chain base index numbers for August and September and write them in the table.
Give each value correct to one decimal place.
- (b)(i) Calculate the geometric mean of the four chain base index numbers.
You must show your working.
Give your answer correct to one decimal place.

$$\frac{102 + 102.5 + 100.8 + 98.7 + 101.7}{5} = 100.9$$

$$\frac{100.9}{(2)}$$

- (ii) Interpret your answer.

The average price is increasing each month by an average of 0.9%

Examiner comments

- (a) M1 A1 for 98.7 and 101.7 given in the table
 (b)(i) M0 A0 incorrect answer (uses arithmetic average)
 (ii) B1 B1 correct contextual interpretation as a rate of increase of 0.9%

4 marks awarded (4/6)

Student response B

- (a) Calculate the chain base index numbers for August and September and write them in the table.
Give each value correct to one decimal place.

$$\text{August} \rightarrow \frac{111.2}{100.8} \times 100 = 110.317 \Rightarrow 110.3 \text{ (1dp)}$$

$$\text{September} \rightarrow \frac{113.1}{110.317 \dots} \times 100 = 102.5223022 \Rightarrow 102.5 \text{ (1dp)}$$

- (b)(i) Calculate the geometric mean of the four chain base index numbers.
You must show your working.
Give your answer correct to one decimal place.

$$\text{Geometric mean} = \sqrt[n]{x_1 \times x_2 \times \dots \times x_n}$$

$$4 \sqrt{102.5 \times 110.3 \times 100.8 \times 102.5} = 103.9708874$$

$$\dots 104.0 \dots \Rightarrow 104.0 \text{ (1dp)}$$

- (ii) Interpret your answer.

..This shows us that the average increase of the monthly price has gone up by 4% on average. - Increase on average by 4%.

(2)

Examiner comments

- (a) M0 A0 both answers are incorrect and the method used is also incorrect
(b)(i) M1 A1ft correct answer which follows through from their answers in part (a)
(ii) B1 B1ft correct contextual interpretation as a rate of increase which follows through from their answer to part (b)(i)

4 marks awarded (4/6)

Student response C

	May	June	July	August	September
Monthly average price (p)	109.1	111.8	112.7	111.2	113.1
Chain base index number		102.5	100.8	98.6	101.7

(Source: theaa.com)

- (a) Calculate the chain base index numbers for August and September and write them in the table.
Give each value correct to one decimal place.

$$\frac{111.2}{112.7} \times 100 = 98.6$$

$$\frac{113.1}{111.2} \times 100 = 101.7$$

- (b)(i) Calculate the geometric mean of the four chain base index numbers.
You must show your working.
Give your answer correct to one decimal place.

100.9

- (ii) Interpret your answer.

the monthly average price has increased

Examiner comments

- (a) M1 A0 for 101.7 is correct and implies the method mark, but 98.6 is incorrect
(b)(i) M0 A0 although a correct answer has been given, this could have been obtained from calculating the arithmetic mean. The question states that working is required, so here the method mark cannot be awarded, and hence no marks are scored
(ii) B1 B0 correct contextual interpretation as a rate ('monthly') of increase, but there is no interpretation of the value of the geometric mean

2 marks awarded (2/6)

Exemplar question 12: Higher Paper 1, question 13

- 13 A film company employs Gary to investigate the film-watching habits of people living in the UK.

Gary is going to use a questionnaire.

Here is Question 1 on Gary's questionnaire.

Question 1

Spin a fair coin.

If you get **Heads**, tick box A.
If you get **Tails**, answer this question.

Have you downloaded a film illegally during the last month?

If **yes**, tick box A. If **no**, tick box B.

A B

The method used to decide whether or not to answer a question by spinning a coin is called the random response technique.

- (a) Explain why this method is used.

(1)

Gary sends the questionnaire to a sample of people living in a town.

He uses a telephone directory as the sample frame.

For Question 1

743 people ticked box A

679 people ticked box B

- (b) Calculate an estimate of the proportion of the people in the sample who had downloaded a film illegally during the last month.

(3)

Gary is going to write a report on the outcome of Question 1.

He is going to use the answer to part (b) as an estimate of the proportion of all the people living in the UK who had downloaded a film illegally during the last month.

- (c) Is it appropriate for Gary to use the answer to part (b)?

Give **two** reasons for your answer.

(3)

(Total for Question 13 is 7 marks)

Mark scheme

Question number	Answer	Additional guidance	Mark
13(a)	B1 for e.g. this is a sensitive question or people may not want to answer it otherwise	B1 for a correct response referring to the sensitivity of the question	(1)
13(b)	e.g. M1 for $0.5 \times (743 + 679) (= 711)$ M1 for $\frac{743 - "711"}{"711"}$ A1 for 0.045(007...)	M1 for method to estimate the number of people who answered yes because they got Heads M1 for method to estimate the proportion of people who have downloaded illegally A1 for a correct proportion, e.g. 0.045 or 4.5% or better	(3)
13(c)	B1 for not appropriate B1 for a correct reason, e.g. the town may not be representative of the UK B1 for a different correct reason, e.g. the telephone directory may not include everyone in the town	B1 B1 B1 for assessing the appropriateness of the statistical methodology with correct reasons	(3)

Examiner comments

Students need to recognise that the question on the questionnaire, given its sensitive nature, would lead to a biased response as many people would not answer it truthfully or at all. Here the 'random response' technique is used to minimise the bias.

Students find the calculation of the proportion required in part (b) difficult and it is a common mistake to divide by the total.

Part (c) is testing AO3 as students need to decide whether it would be appropriate to use the questionnaire's results to represent all people living in the UK. This part also tests students' understanding of a 'sample frame,' a concept that students quite often find challenging.

Student response A

(a) Explain why this method is used.

it is used because most people would lie about downloading a film illegally so it takes that into account

(b) Calculate an estimate of the proportion of the people in the sample who had downloaded a film illegally during the last month.

$$743 + 679 = 1422$$

$$\frac{32}{1442} = 0.02225$$

$$= 2.25\%$$

$$\frac{1422}{2} = 711$$

$$743 - 711 = 32$$

$$\underline{\underline{0.02225}} \quad (3)$$

(c) Is it appropriate for Gary to use the answer to part (b)?
Give two reasons for your answer.

No, the sample was only taken from one town so may not represent the UK as a whole. Also he uses a telephone directory as a sampling frame

Examiner comments

- (a) B1 for reference to the fact that people are likely to not answer it truthfully
 (b) M1 for correct method leading to 711 (M0 A0 incorrect method to estimate proportion)
 (c) B1 for no
 B1 for a correct reason, i.e. as only from one town (not representative)
 B1 for a different correct reason, i.e. refers to use of telephone directory

5 marks awarded (5/7)

Student response B

(a) Explain why this method is used.

~~To make the sample even more random~~
 To make the sample random

(b) Calculate an estimate of the proportion of the people in the sample who had downloaded a film illegally during the last month.

~~743 - 371.5 = 371.5~~ ~~371.5~~ $\frac{32}{679+32}$

$743 \div 2 = 1422$ $743 - 711 = 32$ $\frac{32}{679+32}$

$\frac{1422}{2} = 711$ $743 - 711 = 32$ 0.045 (3)

(c) Is it appropriate for Gary to use the answer to part (b)?
 Give two reasons for your answer.

No

- People are inclined to lie and say no
- People who would say yes might not take the test

Examiner comments

(a) B0 incorrect reason as it does not consider the sensitive nature of the question

(b) M1 M1 A1 correct answer

(c) B1 for no (B0 B0 as both supporting reasons are incorrect)

4 marks awarded (4/7)

Student response C

(a) Explain why this method is used.

This is because the question is a sensitive subject so the anonymity of the reason of ticking A reduces bias and makes it more ethical.

(b) Calculate an estimate of the proportion of the people in the sample who had downloaded a film illegally during the last month.

$$\frac{743}{679}$$

(c) Is it appropriate for Gary to use the answer to part (b)?

Give **two** reasons for your answer.

No, because for people who ticked box A may have been due to them tossing a coin on heads.
Also, this sample may be unrepresentative because it's only from one town so the results cannot be generalised.

Examiner comments

(a) B1 for reference to sensitive question

(b) M0 M0 A0 incorrect answer

(c) B1 for no

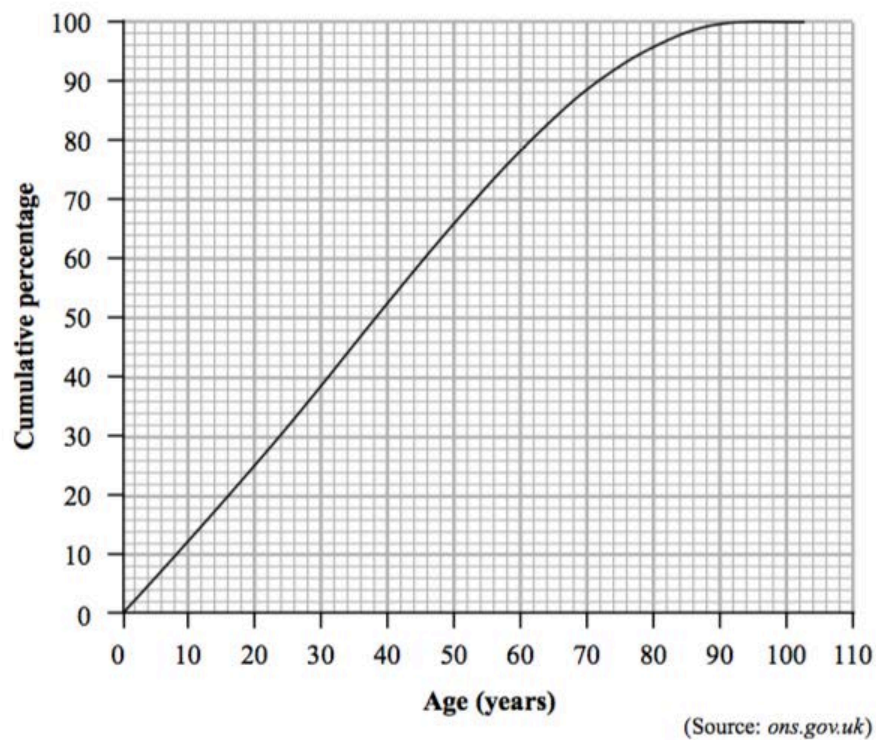
B1 for a correct reason, i.e. not representative

B0 there is no second correct reason given

3 marks awarded (3/7)

Exemplar question 13: Higher Paper 2, question 8

8 The cumulative percentage graph shows information about the ages of the people living in the UK in 2014



(a) Find the 10th to 90th interpercentile range for this information.

..... years
(2)

Here are some statistics about the ages of the people living in Manchester in 2014

Median	29 years
10th to 90th interpercentile range	53 years

(b) Compare the distribution of the ages of people living in Manchester in 2014 with that for the UK in 2014

(3)

The table below gives more information about the ages of people living in Manchester in 2014

Mean	32 years
Standard deviation	19.3 years

(Source: *ons.gov.uk*)

- (c) (i) Calculate the skew for the ages of people living in Manchester in 2014
(ii) Interpret the skew in context.

(3)

(Total for Question 8 is 8 marks)

Mark scheme

Question number	Answer	Additional guidance	Mark
8(a)	M1 ($P_{90} - P_{10} =$) $72 - 8$ A1 64	M1 for subtracting two percentiles identified from graph, at least one correct. May be seen on graph. A1 Accept [63~65] if working shown <u>and</u> P_{10} or P_{90} correct.	(2)
8(b)	B1 UK median is 38 (from graph) B1ft Manchester has a smaller 10 to 90 percentile range B1ft for either <ul style="list-style-type: none"> Manchester population (9 years) younger on average Manchester population has less variation of ages 	B1 for stating UK median is 38 (or 9 years higher than Manchester). B1ft for correct statistical reasoning. (Follow through their answer to (a) for 2 nd and 3 rd B1 mark) B1ft for one contextual interpretation of average or spread comparisons. Accept equivalent/converse statements about UK population.	(3)
8(c)(i)	M1 (Skew =) $\frac{3(32 - 29)}{19.3}$ A1 $= 0.4663...$	M1 for demonstrating correct use of formula A1 for 0.47 or better	(3)
8(c)(ii)	B1ft (Positive skew means that) the majority in the population are younger with fewer older people, OR there is a greater spread of ages at the upper end	B1ft allow any equivalent wording for a correct contextual interpretation of their skew value. (This mark may be gained independently following comparison of mean/median)	

Examiner comments

This question highlights some new parts of the specification. The interpercentile range is used as a measure of spread and students should know how to calculate it from given information. Here they need to accurately read off the cumulative percentage graph to obtain the values. It is important to state values obtained from a graph before using them.

Here the comparison of the distribution requires a measure of central tendency and a measure of spread. At least one of these comparisons should be made in the context of the question.

The formula for the calculation of skew is given on the formula page of the examination paper. Although students do not need to memorise this formula, they must be able to interpret its outputs. A positive value means positive skew with a greater spread of values above the median. The interpretation of skew in context is one of the more demanding parts of the specification.

Student response A

10% 90%
↑ ↑

(a) Find the 10th to 90th interpercentile range for this information.

$$\begin{aligned} 10\% &= 8 \text{ years old} \\ 90\% &= 72 \text{ years old} \\ 72 - 8 &= 64 \text{ years} \end{aligned}$$

~~8 and 72~~ ⁶⁴ years

(b) Compare the distribution of the ages of people living in Manchester in 2014 with that for the UK in 2014

The median of ages in Manchester is lower at 29 years compared to the rest of the UK which is 38 years. Manchester also have a lower interpercentile range at 53 years, compared to the rest of the UK which is 64 years. (3)

(c) (i) Calculate the skew for the ages of people living in Manchester in 2014

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

$$\frac{3 \times (32 - 29)}{19.3} = 0.46632 \rightarrow 0.466 \text{ (3sf)}$$

0.466

(*) (ii) Interpret the skew in context.

positive at 0.466
The skew is relatively small, meaning the variation of ages in Manchester is low.

Examiner comments

- (a) M1 A1 correct answer
- (b) B1 B1 B0 for median 38 and correct comparison of their 10-90 percentile range, but there is no interpretation given in context for either comparison
- (c) (i) M1 A1 correct answer
- (c) (ii) B0 incorrect contextual interpretation

6 marks awarded (6/8)

Student response B

- (a) Find the 10th to 90th interpercentile range for this information.

$$12 = 3 = 14$$

$$61 = 64$$

..... years

- (b) Compare the distribution of the ages of people living in Manchester in 2014 with that for the UK in 2014

On Average there ^{Average} age of manchester was higher than in the UK however, ~~and~~ the ^{10th} to ^{90th} percentile was higher in the UK with it being 63 instead of 53 (3)

- (c) (i) Calculate the skew for the ages of people living in Manchester in 2014

$$\frac{3(32 - 29)}{19.3} = 0.466$$

$$0.466$$

- (ii) Interpret the skew in context.

This shows it has a slight positive skew which means people are ~~less~~ on average younger than older in Manchester (3)

Examiner comments

- (a) M1 A1 correct answer
 (b) B0 B1 B0 no statement of the median. Correct (reverse) comparison of 10-90 percentile range (ignore figures). No correct contextual conclusion is given
 (c) (i) M1 A1 correct answer
 (c) (ii) B1 correct contextual interpretation

6 marks awarded (6/8)

Student response C

- (a) Find the 10th to 90th interpercentile range for this information.

$$\frac{100 - 12}{88}$$

88

..... years

- (b) Compare the distribution of the ages of people living in Manchester in 2014 with that for the UK in 2014

The median age for the UK is 38, Manchester is 29, Manchester's 10th to 90th interpercentile range is 53 years. The UK's is 88. The average age of the UK is higher than Manchester's, there is a larger age range for the UK. (3)

- (c) (i) Calculate the skew for the ages of people living in Manchester in 2014

$$\frac{3(32 - 29)}{19.3} =$$

0.5

- (ii) Interpret the skew in context.

Manchester's age skew is low meaning that Manchester's age variance is low, therefore most people in Manchester are in a small age gap. (3)

Examiner comments

- (a) M0 A0 incorrect answer
 (b) B1 B0 B1 for median 38, there is a statement of values for the 10–90 percentile range but no explicit comparison. The comment 'the average age of the UK is higher' scores the final B1 mark for a correct contextual comparison
 (c) (i) M1 A0 correct use of formula, incorrect answer (greater accuracy required)
 (c) (ii) B0 incorrect contextual interpretation

3 marks awarded (3/8)

Exemplar question 14: Higher Paper 2, question 9

- 9 The table shows the results in two events of the women's heptathlon for Jessica Ennis-Hill in the 2015 World Championships.

The mean and standard deviation for each of these two events for all the athletes who completed the heptathlon are also given.

	Jessica Ennis-Hill	Mean	Standard deviation
Long Jump (metres)	6.43	6.10	0.26
High Jump (metres)	1.86	1.79	0.066

(Source: *iaaf.org*)

- (a) Use standardised scores for this information to compare Jessica Ennis-Hill's performance in the Long Jump with her performance in the High Jump.

Explain how you reach your conclusion.

(5)

The table below shows Jessica Ennis-Hill's result for the Javelin Throw.

It also shows information about the mean and the standard deviation for this event of all the athletes who completed the heptathlon.

	Jessica Ennis-Hill	Mean	Standard deviation
Javelin Throw (metres)	42.51	x	5.85

(Source: *iaaf.org*)

Jessica Ennis-Hill's standardised score for the Javelin Throw was -0.32

- (b) Work out the value of x .

(2)

(Total for Question 9 is 7 marks)

Mark scheme

Question number	Answer	Additional guidance	Mark
9(a)	<p>M1A1A1 for calculating standardised scores</p> <p>M1 Long jump: $\frac{6.43 - 6.10}{0.26}$, High jump: $\frac{1.86 - 1.79}{0.066}$</p> <p>A1 Long jump: 1.3 A1 High jump: 1.1</p> <p>B2 for e.g. Better performance in long jump (relative to their competitors) as there is a higher standardised score in long jump</p> <p>OR (if B2 not scored)</p> <p>B1 for e.g. Better performance in long jump (relative to their competitors) with an attempt at a reason</p>	<p>M1 for either correct calculation</p> <p>A1 for awrt 1.3 A1 for awrt 1.1</p> <p>B2 for a correct contextual interpretation of results with a correct reason using standardised scores</p> <p>OR (if B2 not scored)</p> <p>B1 for a correct contextual interpretation of results with an attempt at a reason</p>	(5)
9(b)	<p>M1 $-0.32 = \frac{42.51 - x}{5.85}$</p> <p>A1 ($x =$) 44.382</p>	<p>M1 for demonstrating correct use of formula.</p> <p>A1 for awrt 44.38</p>	(2)

Examiner comments

Standardised scores should be a well-known topic to Higher tier students as their calculation and interpretation were also required material for the old specification. This question uses real-life data as its source and whenever possible students should have experience working with data from a variety of sources in a variety of contexts.

Students should know that explicit comparisons need to be made. Simply repeating the calculated values does not count as a comparison.

Student response A

- (a) Use standardised scores for this information to compare Jessica Ennis-Hill's performance in the Long Jump with her performance in the High Jump.

Explain how you reach your conclusion.

$$\text{Long Jump} = \frac{6.43 - 6.10}{0.26} = 1.269 \dots$$

$$\text{High Jump} = \frac{1.86 - 1.79}{0.066} = 1.060 \dots$$

Jessica did better in long jump as she has a higher standardised score for it than high jump.

- (b) Work out the value of x.

$$\frac{42.51 - x}{5.85} = -0.32$$

$$-0.32 \times 5.85 = -1.872$$

$$-1.872 + 42.51 = 40.638$$

$$\frac{40.638}{(2)}$$

Examiner comments

- (a) M1 A1 A1 for answers which round to (awrt) 1.3 and 1.1
 B2 correct contextual interpretation with correct reason
 (b) M1 for demonstrating a correct use of formula
 A0 incorrect answer

6 marks awarded (6/7)

Student response B

	Jessica Ennis-Hill	Mean	Standard deviation	Standardised Score
Long Jump (metres)	6.43	6.10	0.26	1.2642307
High Jump (metres)	1.86	1.79	0.066	1.06

- (a) Use standardised scores for this information to compare Jessica Ennis-Hill's performance in the Long Jump with her performance in the High Jump.

Explain how you reach your conclusion.

She did better in the long jump with a ~~score~~ standardised score of 1.3 compared to a 1.06 in the high jump.

- (b) Work out the value of x .

44.382

Examiner comments

(a) M1 A1 A1 for answers which round to (awrt) 1.3 and 1.1

B1 correct contextual interpretation with attempt at reason (reason is insufficient as there is no explicit comparison)

(b) M1 A1 here a correct answer without working can score full marks

6 marks awarded (6/7)

Student response C

- (a) Use standardised scores for this information to compare Jessica Ennis-Hill's performance in the Long Jump with her performance in the High Jump.

Explain how you reach your conclusion.

$$\frac{6.43 - 6.10}{0.26} = 1.27$$

$$\frac{1.86 - 1.79}{0.066} = 1.06$$

her ~~score~~ performance in the long high jump has more deviation than her performance in the long jump. Therefore, she has more consistency in the high jump as opposed to the long jump.

- (b) Work out the value of x .

$$-0.32 \times 5.85 =$$

$$\frac{42.51 - x}{5.85} = -0.32$$

$$42.51 - x = -1.872$$

$$-1.872 - -0.32 = -1.552$$

$$42.51 + 1.552 = 44.062$$

$$\frac{42.51 - 44.062}{5.85} = -0.27$$

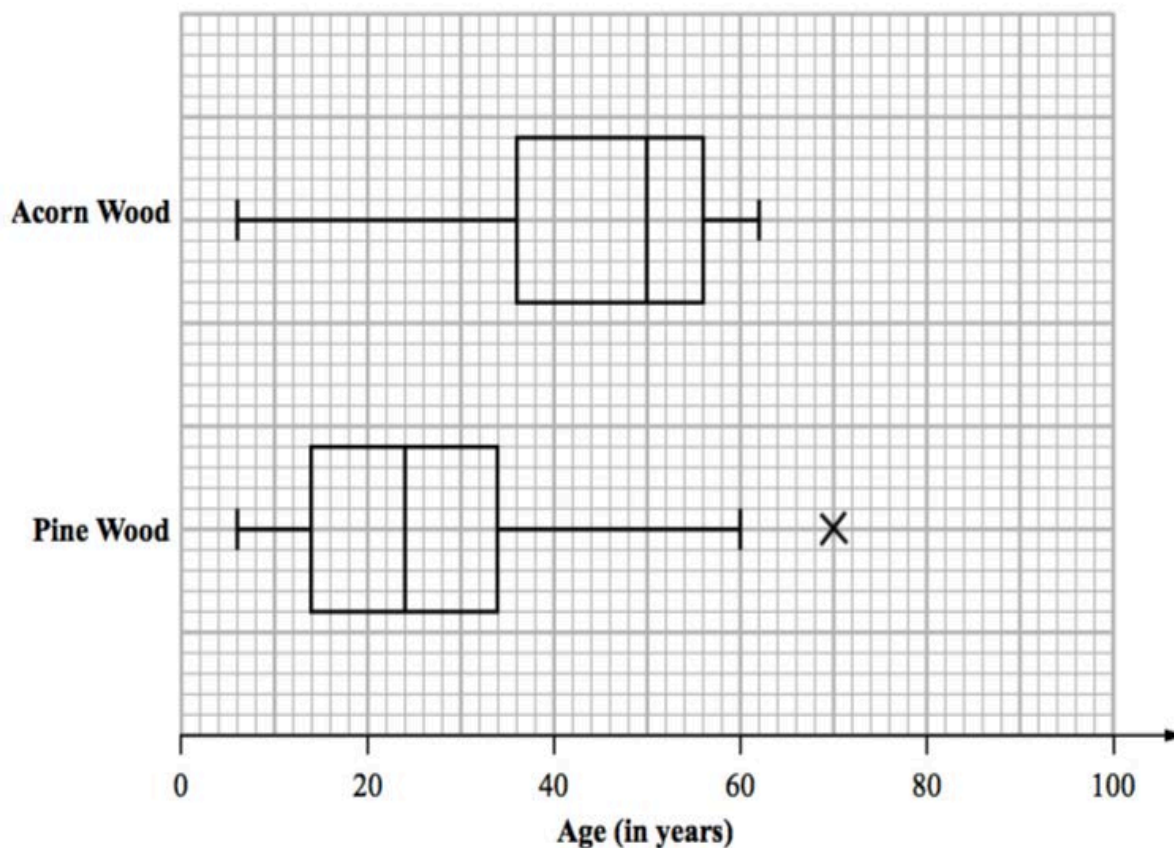
Examiner comments

- (a) M1 A1 A1 for answers which round to (awrt) 1.3 and 1.1
 B0 incorrect contextual interpretation
 (b) M1 for demonstrating a correct use of formula
 A0 incorrect answer

4 marks awarded (4/7)

Exemplar question 15: Higher Paper 2, question 11

- 11 The box plots give information about the distributions of the ages of the trees in Acorn Wood and in Pine Wood.



- (a) Justify, by calculation, that 70 is an outlier for Pine Wood.

(3)

Simon uses the information in the box plots to conclude that

“The average age of the trees in Acorn Wood is greater than the average age of the trees in Pine Wood.

Both distributions have the same spread.

Both distributions have a positive skew.”

- (b) Comment on Simon’s conclusions with reference to his use of statistical words and the accuracy of his statements.

Give reasons for your answer.

(5)

(Total for Question 11 is 8 marks)

Mark scheme

Question number	Answer	Additional guidance	Mark
11(a)	<p>B1 for LQ = 14, UQ = 34</p> <p>M1 for $34 + 1.5 \times ('34' - '14')$ (= 64)</p> <p>70 is an outlier as $70 > 64$</p>	<p>B1 for 14 or 34</p> <p>M1 for $34 + 1.5 \times ('34' - '14')$ with their quartiles</p> <p>A1 for demonstrating understanding of calculations for outliers</p>	(3)
11(b)	<p>B1 B1 B1 B1 B1 for each of five correct aspects</p> <p>e.g.</p> <ul style="list-style-type: none"> • Use of statistical words, e.g. average/spread is too vague in this context (conclusion not appropriate) • Comparing medians (conclusion appropriate) • Comparing ranges or IQRs, e.g. IQRs are the same (conclusion appropriate) or Pine Wood range greater than Acorn Wood range (conclusion not appropriate) • Identifying Acorn Wood as having a negative skew (conclusion not appropriate) • Identifying Pine Wood as having no skew or is symmetrical (conclusion not appropriate) 	<p>B1 B1 B1 B1 B1 for each of five correct comments assessing the appropriateness of the conclusions</p>	(5)

Examiner comments

This question tests both students' knowledge of outliers and students' understanding of appropriate statistical language. The rule for outliers will not be given so students are required to memorise it. Here it is appropriate to use $UQ + 1.5 \times IQR$ for the upper limit for determining outliers as the information has been presented in a box plot and the quartiles are readily available.

Part (b) requires the use of correct statistical vocabulary. Students should be precise when referring to 'average' and 'spread'. Answers should focus on all the different aspects given in the question. As a general rule when comparing box plots, comparisons of medians, IQRs and skews should be made.

Student response A

(a) Justify, by calculation, that 70 is an outlier for Pine Wood.

$$\begin{aligned} \cancel{34 - 14} &= 20 \\ 1.5 \times 20 &= \cancel{30} \\ 34 \times 1.5 &= 51 \end{aligned}$$

(b) Comment on Simon's conclusions with reference to his use of statistical words and the accuracy of his statements.

Give reasons for your answer.

He said both Acorn wood and Pinewood have positive skew but Acorn wood is negatively skewed and Pinewood is symmetrically skewed. He also said they have the same spread as the IQR for both is the same but the range is different. Instead of saying the average is greater he should say the median age of trees in Acorn would be greater.

Examiner comments

(a) B1 for 14 and 34 seen

M0 A0 incorrect method for outliers

(b) Five correct aspects

B1 for identifying Acorn Wood as having a negative skew

B1 for identifying Pine Wood as being symmetrical

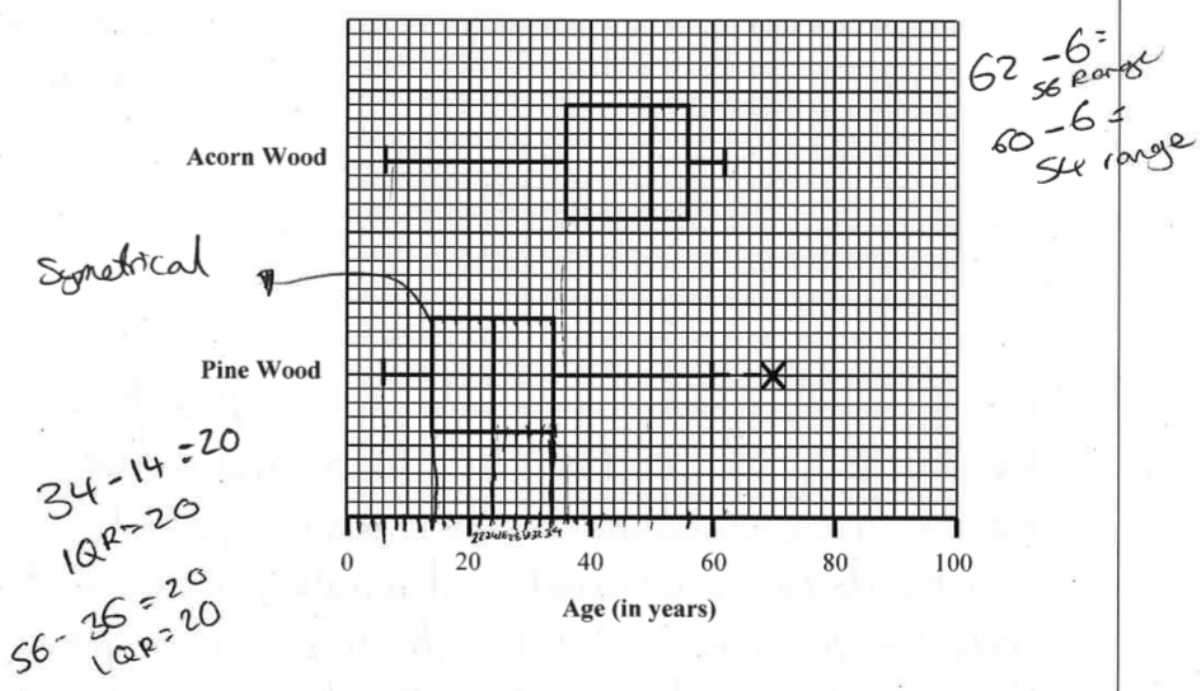
B1 for identifying both distributions as having the same IQR

B1 correct comparison of medians

B1 for correct comment regarding use of statistical words (medians not averages)

6 marks awarded (6/8)

Student response B



(a) Justify, by calculation, that 70 is an outlier for Pine Wood.

$$\begin{array}{r} \text{Mean} + \text{Upper Quartile} \\ 24 + \overset{34}{\cancel{30}} = \overset{58}{\cancel{54}} \end{array}$$

$$\begin{array}{r} \text{Mean} = 24 \\ \text{Upper Quartile} = \overset{34}{\cancel{30}} \end{array}$$

$70 > \overset{58}{\cancel{54}}$ so therefore must be an outlier as its higher than the mean and upper quartile added together.

Simon uses the information in the box plots to conclude that

“The average age of the trees in Acorn Wood is greater than the average age of the trees in Pine Wood. - Acorn mean is 50
- pine mean is 24
Both distributions have the same spread.

Both distributions have a positive skew.”

- (b) Comment on Simon's conclusions with reference to his use of statistical words and the accuracy of his statements.

Give reasons for your answer.

Parts of Simons conclusion are correct and others aren't. Overall he is correct on the average age of the trees in Acorn Wood is greater than the average age of the trees in Pine wood because the mean for Acorn is 50 years whereas the Pine is 24 years - he needs to back his conclusion up with numbers. He is also corrected about the spread if he had talked specifically about the IQR as both have 20 years. However if he was talking about the range he would have been incorrect as the ~~the~~ Acorn has 56 and the Pine has 54. Moreover both distributions aren't positively skewed as stated as the pine wood is symmetrical instead. In conclusion he needs to add numbers and be more specific in his conclusion as it isn't clear which calculation he is talking about. (5)

Examiner comments

(a) B1 for 14 and 34

M0 A0 incorrect method for outliers

(b) B1 correct comparison of IQRs as equal (or correct comparison of ranges)

B1 correctly identifies Pine Wood as symmetrical

B1 correct comment regarding use of statistical words

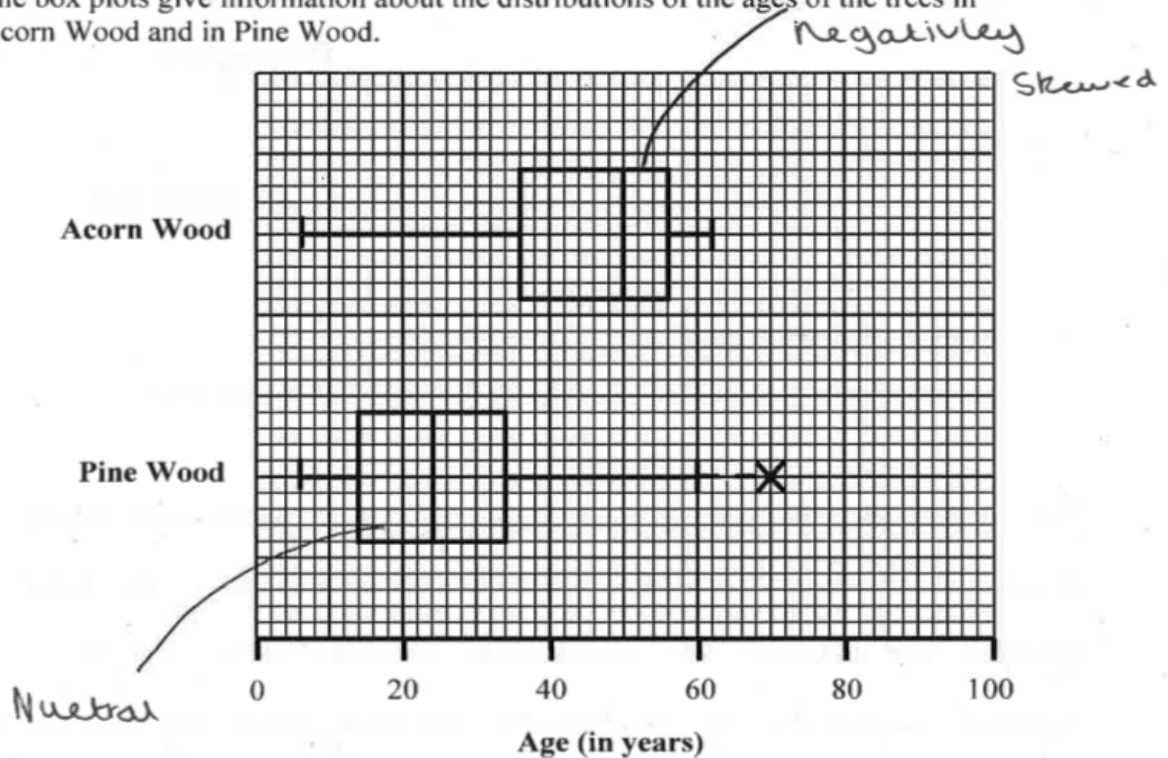
B0 compares means instead of medians

B0 no comment about the skewness of Acorn Wood

4 marks awarded (4/8)

Student response C

- 11 The box plots give information about the distributions of the ages of the trees in Acorn Wood and in Pine Wood.



- (a) Justify, by calculation, that 70 is an outlier for Pine Wood.

$$\text{Skew} = \frac{3(\text{mean} - \text{median})}{\text{Standard deviation}}$$

youngest tree for acorn wood - 6

youngest tree for pine wood - 6

oldest tree for acorn wood - 62

oldest tree for pine wood - 70

70 is an outlier because the difference between the two oldest trees is 8 and whisker in the box plot is longer which means it's an outlier. (3)

- (b) Comment on Simon's conclusions with reference to his use of statistical words and the accuracy of his statements.

Give reasons for your answer.

The statement that Simon has given are partially correct. The average age of acorn wood is greater than pine wood because the median on the box plot is higher. However, the distributions are different and the acorn wood is negatively skewed. The accuracy of his words are good.

Examiner comments

(a) B0 M0 A0 incorrect answer

(b) B1 correct comparison of medians

B1 correctly identifies Acorn Wood has having negative skew

B0 no comparison of IQRs

B0 no comment about the statistical language used

B0 no comment about the symmetry or lack of skewness of Pine Wood. The comment 'neutral' on the box plot for Pine Wood was seen, but this is not accepted as equivalent to 'symmetric' or 'no skew'. In general, students should always be advised to write their answers in the working space provided. Comments on diagrams may not always be considered.

2 marks awarded (2/8)

Exemplar question 16: Higher Paper 2, question 13

- 13 Peter thinks that the ages at inauguration of the presidents of the USA are normally distributed.

He collects information about the ages at inauguration, in years, of 43 presidents of the USA from the internet.

The grouped frequency table gives information about his results.

Age at inauguration (x years)	Frequency (f)
$42 \leq x < 47$	4
$47 \leq x < 52$	11
$52 \leq x < 57$	13
$57 \leq x < 62$	10
$62 \leq x < 72$	5

(Source: *robinsonlibrary.com*)

- (a) Write down one disadvantage of collecting information from the internet. (1)

Peter uses a spreadsheet to calculate the following summary statistics for the information in the table.

$$\sum fx = 2361 \qquad \sum fx^2 = 131\,334.5$$

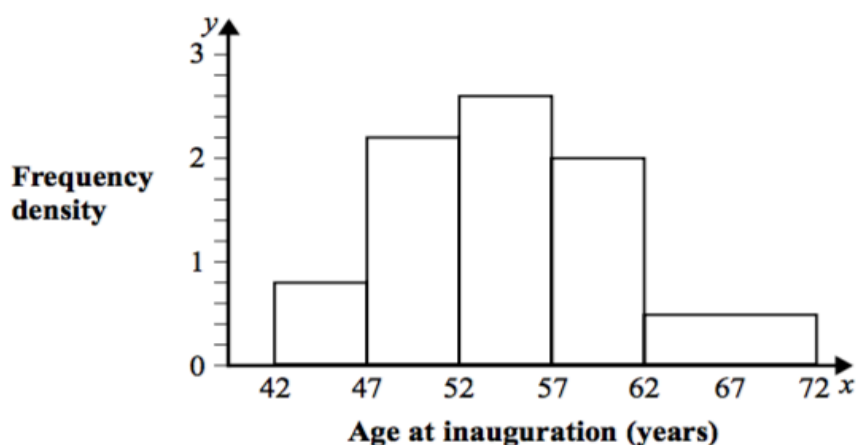
where the values of x are the class midpoints.

- (b) Show that an estimate of the standard deviation of the ages at inauguration is 6.29

You may use Peter's summary statistics.

(2)

Peter now draws this histogram to show the information in the grouped frequency table.



- (c) Calculate an estimate for the proportion of these 43 presidents whose age at inauguration was within 1 standard deviation of the mean.

Give your answer correct to 2 significant figures.

(5)

Peter states that the age at inauguration of these presidents is normally distributed.

(d) Do you agree?

Use your answer to part (c) to justify your answer.

(1)

(Total for Question 13 is 9 marks)

Mark scheme

Question number	Answer	Additional guidance	Mark
13(a)	M1 for correct answer, e.g. may be out of date, sources may be unreliable, etc.	B1 for a correct disadvantage of collecting data using technology	(1)
13(b)	B1 for $\frac{131334.5}{43}$ or $\frac{2361}{43}$ B1 for $\sqrt{\frac{131334.5}{43} - \left(\frac{2361}{43}\right)^2}$ or $\frac{131334.5}{43} - \left(\frac{2361}{43}\right)^2$ leading to correct answer	B1 for a correct use of 43 in a calculation B1 for showing a correct complete calculation	(2)
13(c)	e.g. M1 LB = mean – 6.29 (= 48.62) M1 UB = mean + 6.29 (= 61.2) M1 (mean – 52) × 2.6 + (52 – LB) × 2.2 (= 15.002) (57 – mean) × 2.6 + (61.2 – 57) × 2 (= 13.834) '15.002' + '13.834' (= 28.836) M1 28.836 ÷ 43 A1 = 0.671	M1 for correct method to find number of presidents 1 sd below mean M1 for correct method to find number of presidents 1 sd above mean M1 for correct method to find total number of presidents within 1 sd of mean M1 for correct method to find proportion of presidents within 1 sd of mean A1 for answers rounding to 0.67 or 67%	(5)
13(d)	B1 for e.g. yes, close to 68%	B1 for referring to 68%	(1)

Examiner comments

A deeper understanding of the Normal distribution is part of the new specification. This question sets out to test this by guiding students to calculate the standard deviation and

use it to work out the proportion of data that lies within one standard deviation of the mean of the given data set on the ages of presidents at inauguration.

The formula for standard deviation is given on the formula page and students are advised to write this down before substituting values into it. When an answer is given in the question, sufficient working must be shown for all marks to be scored.

Part (c) requires clear working to be shown, particularly if method marks are to be scored following a slip or an error in working.

The specification sets out what knowledge of the Normal distribution is required. It states that 'values more than three standard deviations from the mean are very unusual; ... approximately 95% of the data lie within two standard deviations of the mean and that 68% (just over two thirds) lie within one standard deviation of the mean'. These values should be used when deciding whether the Normal distribution is a good model for a given data set.

Student response A

(a) Write down one disadvantage of collecting information from the internet.

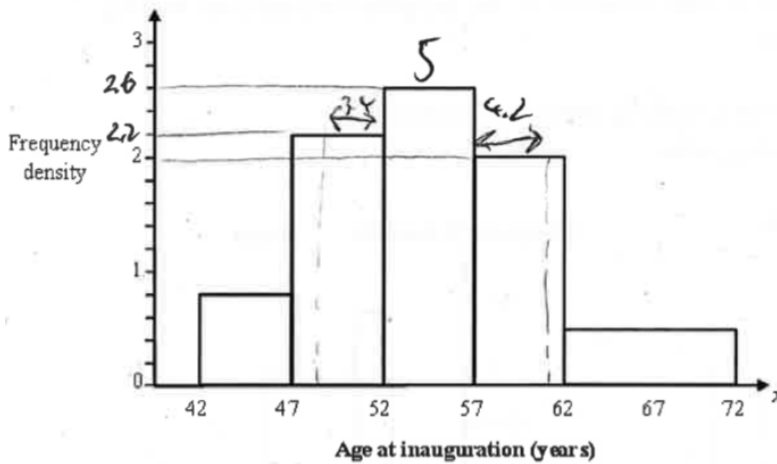
..... Could be made up

(b) Show that an estimate of the standard deviation of the ages at inauguration is 6.29

You may use Peter's summary statistics.

$$\sqrt{\frac{131334.5}{43} - \left(\frac{2361}{43}\right)^2} = 6.286 = 6.29$$

Peter now draws this histogram to show the information in the grouped frequency table.



(c) Calculate an estimate for the proportion of these 43 presidents whose age at inauguration was within 1 standard deviation of the mean.

Give your answer correct to 2 significant figures.

$$\text{Mean} = \frac{2361}{43} = 54.9$$

$$54.9 \pm 6.29 = (48.6, 61.2)$$

$$(3.5 \times 2.2) + (5 \times 2.6) + (4.2 \times 2) = \frac{29.1}{43}$$

..... 0.68

(d) Do you agree?

Use your answer to part (c) to justify your answer.

Yes I agree, 0.68 is roughly equal
to what you would expect.

Examiner comments

(a) B1 accepted as meaning unreliable

(b) B1 B1 correct and complete calculation

(c) M1 M1 correct method to find mean ± 6.29

M1 correct method to find total number of presidents within 1 sd of mean (note that the 3.5 in the calculation has been incorrectly transcribed from 3.4 in the diagram)

M1 correct method to find proportion of presidents within 1 sd of mean

A0 final answer is not given to the correct accuracy

(d) B1 for yes and reference to 0.68 (68%)

8 marks awarded (8/9)

Student response B

(a) Write down one disadvantage of collecting information from the internet.

secondary data can be unreliable

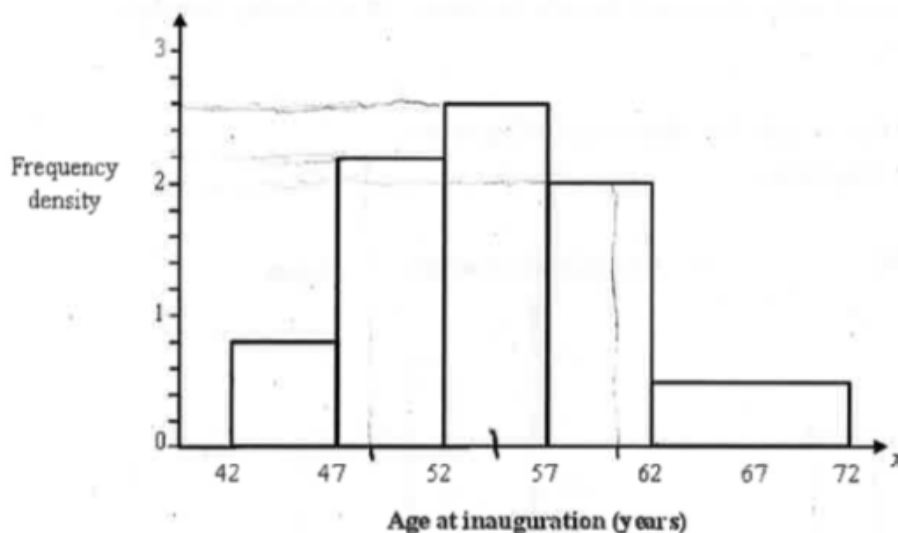
(b) Show that an estimate of the standard deviation of the ages at inauguration is 6.29

You may use Peter's summary statistics.

$$\sqrt{\frac{\sum x^2}{n} - \left(\frac{\sum x}{n}\right)^2} = \sqrt{\frac{131\,334.5}{43} - \left(\frac{2361}{43}\right)^2}$$

$$= \sqrt{39.51} = 6.29 \quad (2)$$

Peter now draws this histogram to show the information in the grouped frequency table.



- (c) Calculate an estimate for the proportion of these 43 presidents whose age at inauguration was within 1 standard deviation of the mean.

Give your answer correct to 2 significant figures.

$$\bar{x} = 54.91$$

$$s_x = 6.29$$

$$54.91 \pm 6.29$$

$$+ : 61.2$$

$$- : 48.62$$

$$52 \rightarrow 57 \quad b-a = 57-52 = 5$$

$$48.62 \rightarrow 52 \quad b-a = 52-48.62 = 3.38$$

$$57 \rightarrow 61.2 \quad b-a = 61.2-57 = 4.2$$

$$b \times h = 5 \times 2.6 = 13$$

$$3.38 \times 2 = 6.76 \quad +$$

$$4.2 \times 2.2 = 9.24 \quad +$$

29

- (d) Do you agree?

Use your answer to part (c) to justify your answer.

$$\frac{29}{43} = 0.67 = 67\% \quad \therefore \text{normally distributed}$$

because $\frac{2}{3}$ of data lies within ± 1 s.d. of the mean as required for distribution to be normal (1)

(Total for Question 13 is 9 marks)

Examiner comments

(a) B1 for unreliable

(b) B1 B1 correct and complete calculation

(c) M1 M1 correct method to find mean ± 6.29

M1 correct method to find total number of presidents within 1 sd of mean

M0 A0 no attempt to find proportion (note that working must be seen in part (c) – the proportion in part (d) cannot earn credit here)

(d) B1 yes and reference to $\frac{2}{3}$ is accepted (note: the specification allows 'just over $\frac{2}{3}$ ' or 68% lies within 1 standard deviation of the mean)

7 marks awarded (7/9)

Student response C

- (a) Write down one disadvantage of collecting information from the internet.

It may be wrong or biased.

(1)

- (b) Show that an estimate of the standard deviation of the ages at inauguration is 6.29

You may use Peter's summary statistics.

$$s = \sqrt{\frac{\sum fx^2 - \frac{(\sum fx)^2}{n}}{n-1}} = \sqrt{\frac{131334.5 - \frac{(2361)^2}{43}}{42}} = 6.29$$

- (c) Calculate an estimate for the proportion of these 43 presidents whose age at inauguration was within 1 standard deviation of the mean.

Give your answer correct to 2 significant figures.

$$\begin{aligned} \text{Mean} &= 54.616 \pm 6.29 \\ &= 48.326 \leq x \leq 60.906 \end{aligned}$$

$$(5 \times 2.6) + (3.7 \times 2.2) + (1.1 \times 0.5) = 21.69$$

$$\frac{21.69}{43} \times 100 = 50.44$$

0.504

~~50.44~~

- (d) Do you agree?

Use your answer to part (c) to justify your answer.

Examiner comments

(a) B1 accepted as meaning unreliable

(b) B1 B0 though 43 has been used correctly, this is the incorrect formula (The student has assumed that this is the standard deviation of the sample and has attempted an unbiased estimate of the population standard deviation. This does not lead to the given answer)

(c) M1 M1 correct method to find 'mean' +/- 6.29 for their mean

M0 incorrect method to find total number of presidents within 1 sd of mean

M1 A0 attempt to find proportion but answer is incorrect

(d) B0 question not attempted

5 marks awarded (5/9)

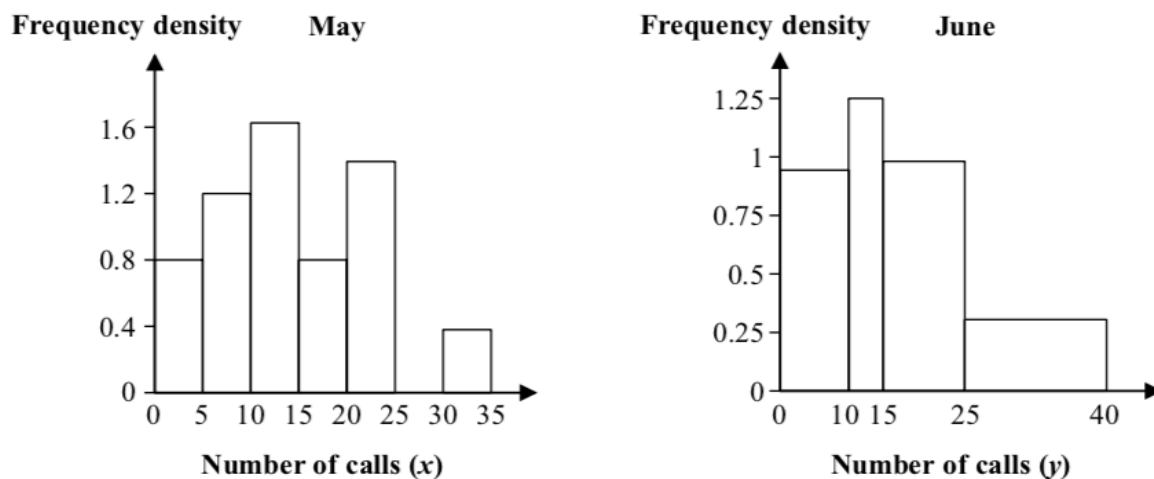
Exemplar question 17: Higher Paper 2, question 15

15 Jai is investigating the numbers of calls received by a helpline.

He recorded the number of calls received by the helpline on each day in May and on each day in June.

Jai wanted to compare the results by drawing histograms.

He drew the following diagrams.



Discuss whether these diagrams are appropriate in order to compare the results.

(Total for Question 15 is 3 marks)

Mark scheme

Question number	Answer	Additional guidance	Mark
15	<p>B1 B1 B1 for each of three correct aspects</p> <ul style="list-style-type: none"> • e.g. diagrams are not appropriate for discrete data • e.g. amount of data is not appropriate as too small for the number of intervals used • e.g. it is not appropriate to compare the two diagrams as different class intervals / different frequency density scales are used 	<p>B1 B1 B1 for each of three correct comments assessing the appropriateness of the diagrams used</p>	(3)

Examiner comments

The appropriateness of chosen statistical diagrams is examined here and this tests the new A03 assessment objective. Students should consider the type of data being represented when they are deciding whether or not a diagram is appropriate. Here, a histogram should not be used with discrete data. Diagrams should be constructed with suitable scales for comparability. This means that it would be appropriate for the same class widths to be used and similar scales on the frequency density axes.

Student response A

- The scales on these two diagrams are different which means they can't be accurately compared.
- Histograms are for continuous data only, this is discrete data so a different graph should have been used
- The class widths are different so the data cannot be contrasted

Examiner comments

Two correct aspects

B1 for referring to comparability (different class widths)

B1 for referring to choice of diagram (histograms not appropriate for discrete data)

2 marks awarded (2/3)

Student response B

I do not think they are appropriate as we don't know whether or not a major accident was in one of those months altering the results of the helpline as usual. The frequency density scales are different and the number of calls are different between graphs. The left graph has the number of calls going up by the same scale whereas the right one goes up by random amounts and the gaps aren't the same.

Examiner comments

One correct aspect

B1 for referring to comparability (different frequency density scales)

1 mark awarded (1/3)

Student response C

no as the number of calls
are different and the frequency
density is greater for the graph
of May. The number of calls is
greater in June.

Examiner comments

B0 no correct aspects (the comment referring to frequency density scales is not specific)

0 marks awarded (0/3)