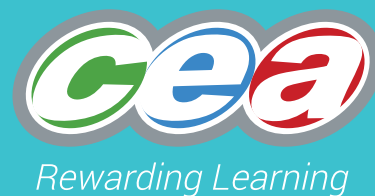


GCSE



Chief Examiner's Report Statistics

Summer Series 2019



Foreword

This booklet outlines the performance of candidates in all aspects of CCEA's General Certificate of Secondary Education (GCSE) in Statistics for this series.

CCEA hopes that the Chief Examiner's and/or Principal Moderator's report(s) will be viewed as a helpful and constructive medium to further support teachers and the learning process.

This booklet forms part of the suite of support materials for the specification. Further materials are available from the specification's section on our website at www.ccea.org.uk.

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GCSE STATISTICS

Chief Examiner's Report

This was the first suite of four papers for the new qualification in GCSE Statistics and the first series in which awards were made. A very wide range of responses were seen to many items on the question papers and some patterns to answering were detected. The reports on the individual units below should provide feedback to teachers and pupils preparing for examinations in future series to assist with, among other things, identifying common, avoidable errors.

In many places, candidates answer in very general terms with little or no reference to the context of the question. Centres are reminded that questions addressing Assessment Objective 2 require candidates to answer in context (GCSE Statistics Specification, page 16). Specific examples of this are outlined in the reports for each paper below.

The standard of presentation in the papers is, in general, very good. A few candidates did not have a ruler which made it more difficult to draw some of the charts required and some did not have a protractor so could not accurately draw the pie chart in Unit 2 (Foundation) or measure the angles in Unit 2 (Higher). A list of required equipment is given on the front of the question paper and the same equipment is required for all papers.

Fully correct answers to all questions across each of the four papers were frequently seen and there was no evidence to suggest that candidates had insufficient time in any paper.

Assessment Unit 1: Foundation Tier

In general, the standard of answering was very good on this paper. Candidates seemed to be familiar with most topics on the specification and questions allowed them to demonstrate a good level of understanding. It was unfortunate, however, that many marks were lost in this paper by candidates failing to engage with the context of the question and giving generalised, learned-off responses which were inappropriate under the circumstances.

- Q1** Most candidates obtained full marks in the first two parts of this question. Part (c) was not as well answered by some candidates, with many referring to pictograms in general rather than to this specific context as required by the question.
- Q2** Part (a) was well done by the vast majority of candidates. Most candidates made very good attempts at Part (b), realising that 'agree' was the most appropriate option given the data in the table. A number of candidates attempted to justify their conclusions using general statements which were unrelated to the data in the question, such as claiming that girls read more than boys so there would be more girls at the library than boys. Part (c) was less well answered with very few candidates able to note that that the given data may be unrepresentative.
- Q3** The tally and frequency columns in Part (a) were well done by almost all candidates. Most did realise that the data could be represented by a bar chart but very few could justify this by noting that the data was discrete. References to the aesthetic nature of a bar chart or how it would be easy to read were very popular but neither response could gain any marks as the question referred to the appropriateness of the chart. There were many errors noted in Part (c)(i) even though candidates were free to use the frequency table or the original data to calculate the mean. A very common error was to divide by the number of groups rather than the total frequency. The range calculation in Part (c)(ii) was better but a few candidates worked out $6 - 1$ rather than $6 - 0$. Most candidates made a reasonable attempt at Part (d) but full marks were rarely awarded. In comparisons questions like these, candidates need to compare the value of the mean and range for each location and explain what each one means in the context of the question.

- Q4** This question on probability was generally well done by most candidates. A common error was for candidates to express their answers to Part (c) as fractions rather than frequencies as requested.
- Q5** Part (a) was answered correctly by almost all candidates. In Part (b) a number of candidates drew a multiple bar chart using frequencies rather than percentages which made the comparisons unreliable since the sizes of the samples were different, which candidates should have realised from their answer to Part (a). A small number drew compound bar charts. Any valid conclusion was acceptable for Part (c) but many candidates could not get this mark as they focused on the frequencies rather than proportions. A common incorrect response was that Comedy was the most popular type of film even though Thriller was more popular among Sarah's results. Since Part (d) was multiple choice, it was difficult to decide if those candidates who got the mark knew the answer or guessed it. Each of the responses were seen in roughly equal proportions.
- Q6** Parts (a) and (b) were well done. Part (c) required an interpretation of the median value but very few candidates could do this correctly. Most tended to compare the quoted value with the other values in the table. Part (d) was well answered with South East being the most popular response, owing to its high employment rate.
- Q7** Only a very small number of candidates were able to identify the sampling method in Part (a). Part (b) was fairly well answered but it was evident that many candidates had not done anything like this before as they did not know what to do with the 72 at the start.
- Q8** The stem and leaf diagram was very well done in Part (a) with most candidates getting 2 or 3 marks. Many candidates did not get the last mark as they did not supply a key for each part of the diagram. Part (b) was fairly well done too. The comparisons in Part (c) were sometimes good but often unconvincing. Candidates had a tendency to compare all five numbers in the table without referring to what any of them meant. The easiest route to full marks was to compare the values of the median and interquartile range for each of the days and give an interpretation of the result.
- Q9** Most candidates noticed that they had to read 10 values from the scatter diagram and find the mean of these for Part (a). Lines of best fit in Part (b) were mostly very good but some candidates did not plot the double mean point, even though the required values were given in the question. Part (c) was well answered and, in particular, contextual descriptions of the correlation in Part (c)(ii) were very good. Part (d) required candidates to notice that Ella lived within the range of distances for which the line of best fit had been drawn. Candidates found Part (d)(ii) difficult to answer with many giving the result of using the line to estimate the result rather than explaining why its use was appropriate.
- Q10** This was a very demanding question and most candidates found it very difficult. Very few were able to describe how to take a systematic sample in Part (a); many described the procedure for a simple random sample. Similarly, very few could identify opportunity sampling in Part (b). The frequency polygons were drawn with only the class end-points visible on the horizontal axis but this did not help with Part (c) and hardly any candidate got either part correct. In fact, it was extremely rare that answers were given as a class interval which would indicate that candidates did not know what this meant. Some candidates made reasonable comparisons in Part (d) so were able to get at least one mark. Quite a number interpreted the relatively uniform distribution of frequencies in Helen's results as evidence of consistency whereas, in fact, the reverse was true. In Part (d) many candidates knew that the results from Peter's sample would be more reliable but were unable to give a reason why.

Assessment Unit 1: Higher Tier

There was a wide range of responses to questions on this paper and the full range of marks was seen. Examiners noted the outstanding nature of some candidates' answers and it was very encouraging to see this level of engagement with the subject content. While answers to standard questions were generally well done, answers to those questions requiring mathematical manipulation were often poorly done. There was evidence that some candidates sitting this paper had never seen certain topics: questions on standard deviation, binomial distribution and standardised scores were frequently not attempted which suggests that these candidates may have been better sitting the Foundation Tier paper.

- Q1** Although a reasonably standard type of question, responses varied considerably. The advantages in Part (a) were well known and most candidates referred to time and/or cost. A common response was that the survey question was a closed question which was not relevant in the context of the question. Some candidates misread Part (b) and commented on the response section rather than the question. Reasons for conducting a pilot survey were weak; most candidates were able to give one clear reason but many struggled to give two reasons which were sufficiently independent of each other. Part (d) was well answered.
- Q2** Most candidates had no problems with Parts (a), (b) or (d). For Part (c) some candidates mentioned that the median was the middle value but hardly any candidates pointed out that the median was a measure of average.
- Q3** Apart from some minor errors, in Part (a) the majority of candidates knew to read off the 10 distances from the scatter diagram in order to calculate the mean. In Part (b), a noticeable number did not know how to plot the double mean point and draw their line of best fit through it, even though the values, and instruction, were given in the question. Part (c) was well answered. In Part (d) quite a few responses described how the line of best fit could be used to estimate the monthly rent rather than why; responses to Part (d) were often poorly phrased.
- Q4** This question was very poorly answered, in general. Very few candidates knew the procedure for selecting a systematic sample in Part (a), in particular the choosing of a random starting point. Many were able to identify the sampling method in Part (b) as opportunity (convenience) sampling. Extracting the median and modal classes from the frequency polygons in Part (c) was not well done with hardly any candidates even expressing their answer as a class group. Consequently, comparisons in Part (d) were weak with most commenting on variability of the frequencies between Helen's and Peter's results. A lot of candidates interpreted the relative uniformity of frequencies across the classes in Helen's results as an indication that these results were more reliable, so were unable to access marks in Part (e).
- Q5** Parts (a) and (b) were well answered by most candidates. Part (c) proved more challenging as a lot of candidates did not know when to add and when to multiply probabilities. The relative frequency in Part (d) was done well and most candidates were able to give a reasonable interpretation of the result for Part (e).
- Q6** Finding the median and quartiles and drawing the box plots for Parts (a), (b) and (d) were done well by the candidates who noted that the total frequency was 80 and not 90 or 100. The rule for identifying an upper outlier was not known and very few candidates were able to access any marks in Part (c). Even those who did correctly calculate the critical value of 32.5 did not get the last mark for simply concluding that the value on the graph (37) exceeded this. Most candidates knew that the range would stay the same and that the median would increase for Part (f) but very few stated that the median would increase by 5 minutes. In Part (e) many candidates made observations which were not significant, such as comparing maximums or

comparing minimums. Also, many responses made observations without interpreting the meaning of the observation.

- Q7** Parts (a) and (b) were well answered, though a small number of candidates used the values of the previous moving averages in their calculations rather than the raw values from the table. Part (c) was mostly well done with the main error being that candidates connected all the points representing the moving averages rather than drawing a straight line to indicate the secular trend. The use of extrapolation in Part (d) was not known by most candidates. A few candidates calculated the mean of the seasonal variations for Quarter 1 but when this method was observed the standard of working out was often not sufficiently clear and candidates seemed to be using the graph to read off values which were already provided in the table.
- Q8** It was clear that many candidates had not seen a question like this. Even though it led to obvious inconsistencies, many candidates assumed that the 96 people who owned a phone owned no other devices. Even those who did proceed correctly forgot to calculate the number of people who did not own any devices. Probability in Part (c) was mostly good; many candidates who did not draw the Venn Diagram correctly were still able to access this mark by using the numbers provided in the question. Part (d) was not well answered.
- Q9** Very few candidates made any progress with this question. A small number did calculate the correct probability in Part (a) but picked up no more marks. It was surprising that so few candidates knew the term 'binomial distribution' for Part (b)(i). It was also surprising that hardly any candidates were able to identify n and p from the limited context of the question; in the majority of cases no attempt was even made to answer Part (b)(ii). Only the very strongest candidates were able to attempt Parts (c) and (d) even though the required expansion was supplied on the question paper (which will always be the case).
- Q10** Many candidates were able to make some attempt at a few parts of this question. Most candidates got at least 1 mark for correctly positioning the maximum in their sketch of the distribution in Part (a) but very few got the second one as the range of marks tended to go all the way from 40 to 100. Calculation of the standardised score was done well by the stronger candidates and interpretations for (c) were often convincing. Candidates found calculating the mean from summary statistics in (d) challenging. A significant number were not able to make any progress at all in finding the standard deviation. Part (e) was well done by those who were able to do Part (d) and it was very encouraging to note some very good understanding of this topic demonstrated

Assessment Unit 2: Foundation Tier

Questions on this paper were answered well by most candidates. The more open questions requiring written responses were able to differentiate between candidates.

- Q1** Part (a) was straightforward and well answered. Candidates tended to misread Part (b) with many focusing on why children wouldn't want to go to a museum rather than referring to the chart. Part (c) was answered well by most candidates, though a small number did not seem to know what a compound bar chart was.
- Q2** Answers to Part (a) were very good with most candidates scoring 2 out of the 3 available marks. The most common errors were candidates criticising the question rather than the response section and candidates giving the same reason twice. Very few candidates knew what a pilot survey was for (b).
- Q3** Parts (a), (c), (d) and (f) were generally well answered. In Part (b) many candidates referred to the look of the chart rather than why Lucy had used it.
- Q4** Parts (a) and (b) were well answered by the majority but some were caught out in (b)(ii) by not being specific enough. Very few candidates were able to answer Part (c) as they simply did not know the definition of a NNN. There was a large variation in responses to Part (d) and achieving all three marks was a struggle for many. The thickness of the line was noticed by many but very few referenced the fact that one point had been incorrectly plotted.
- Q5** This question was very well answered by the majority of candidates. Some candidates lost marks by converting their correct probability values into decimals and over-rounding them, rendering them ambiguous. Candidates should be discouraged from pointlessly changing vulgar fractions to decimals as this can result in a very unfortunate loss of marks.
- Q6** Most candidates had little difficulty in completing the table in Part (a) or drawing the pie chart in Part (b) but some inaccuracy in measuring the angles was evident in some scripts, possibly because the candidates in question did not have a protractor. Only the strongest candidates were able to answer Part (c) as most were unable to see the connection to earlier parts of the question.
- Q7** Suggestions in Part (a) were good and completing the Venn diagram in Part (b) was good too. However, quite a number of candidates did not include the 9 households who did not recycle either plastic or cardboard in their diagram, even though this led to the answer to Part (c) which most did correctly. Extracting the correct frequencies from the Venn diagram for the probability in Part (d) was very well done.
- Q8** This question made direct reference to information in the pre-release but it was clear that not all candidates had read this. Those who had read it found the question straightforward and gained the six available marks with hardly any difficulty. However, those who had not read the pre-release really struggled with each part. Some did try to give plausible responses but these attempts were mostly unsuccessful.
- Q9** This was a standard question about data collection and most candidates answered well, particularly Parts (a) and (b). In Part (c)(i) many candidates tried to describe situations in which quota sampling would be appropriate but this was not asked. A lack of understanding of simple random sampling was evident in Part (c)(ii).
- Q10** This question, relating to information in the pre-release, was very well answered by most candidates. A small number of candidates drew vertical lines for Part (a) and some seemed to have no understanding of index numbers for Part (d) but otherwise this questions provided a good source of marks for most.

Q11 This question required candidates to write a plan for an investigation which was closely related to the pre-release information. Similar to Question 8, candidates who had not read the pre-release found this question difficult to answer. Those who had read it scored much better as they were familiar with the scenario. Some structure was given in the question in the form of bullet points though it was surprising that a number of candidates did not follow this structure.

Assessment Unit 2: Higher Tier

- Q1** This question made direct reference to the information in the pre-release document. Candidates who were familiar with this document had very few problems with this question. Some candidates clearly found the context challenging, indicating that they had probably not read the pre-release document. Answers to Part (a) were generally good. The question required candidates to know what the term census meant in its technical usage within Statistics but some described the National Census. The advantages and disadvantages of taking a census were well known, though candidates should be reminded that they need to express their reasons clearly to gain the marks. Vague responses, such as ‘accurate’ for an advantage should be expressed more clearly as ‘results are accurate since the whole population has been examined’. For Part (c) the reasons given by the candidates who had read the pre-release document were very good but some had to make up their own reasons and many of these were incorrect. Similarly, marks in Part (d) tended to be available mainly to the candidates who had worked through the pre-release. The main issue with responses was trying to give the same reason twice.
- Q2** Answers to this question were very good with majority of candidates gaining most of the available marks.
- Q3** Just like in the Foundation Tier paper, this question was very well answered.
- Q4** There were better attempts to this question than the corresponding question on the Foundation Tier paper. The best attempts in Part (a) set their work out to match the bullet points given in the question. Part (b) was less well answered with many inappropriate diagrams and calculations being suggested.
- Q5** While there were many fully correct answers to Part (a), it was surprising to note the number of candidates who were unable to locate the median and quartiles from a set of discrete data. Many candidates seemed to be unclear as to whether to use fractions of n or $n + 1$ to locate the position of the median and quartiles. For those who prefer to take this approach, the most successful strategy is to work out the values of $\frac{1}{4}n$, $\frac{1}{2}n$ and $\frac{3}{4}n$ then decide which value(s) to pick for the median and quartiles based on whether the results are integers or not. If the result has a fractional part, round up to the next integer and pick the number in that position; if the result is an integer, find the arithmetic mean of the number in that position and the next one. Alternative approaches are, of course, perfectly acceptable and will be credited appropriately.
- Q6** Almost all candidates knew that Rob had collected secondary data in Part (a). For Part (b) the stronger candidates successfully proposed a relationship between the number of visitors with the admission charge, though it was disappointing to note that a few candidates expressed their answer to this part in the form of a research question, so were unable to access the mark. Answers to Part (c) were mostly correct, pointing out that r cannot be less than -1 , though some candidates thought that the negative number was the problem rather than the magnitude of it. It was encouraging to note that many candidates were able to use their calculators efficiently to work out the product-moment correlation coefficient in Part (d) although a small number tried to

work out Spearman's rank, for which no marks were available. Interpretation for Part (e) was generally weak and candidates would benefit from practice at interpreting the value of correlation coefficient in context as this is a standard technique. A very common problem was the assumption that a negative number implied no relationship. Candidates should know how to interpret the strength of the correlation as well as what is implied by the sign of the coefficient.

Q7 The advantages and disadvantages of grouping were well known and candidates scored fairly well in Part (a). Finding an estimate of the mean for Part (b) proved to be somewhat more challenging for some candidates and even those who knew the general procedure assumed that the widths of all of the classes were the same so incorrectly picked 27.5 as the midpoint of the final class instead of 30. Even though the answer was provided on the question paper, most of those who made the mistake did not revise their answer. Parts (c) and (d) were answered correctly by only the most able of candidates who noticed that two-thirds of the frequencies were enclosed by one standard deviation on either side of the mean when the data are normally distributed. Drawing the histogram for Part (e) was generally very good with most candidates correctly working out the appropriate frequency densities and plotting these correctly on the grid provided. Only a small number plotted frequencies. Since only a few candidates were able to answer Part (d) correctly, only a subset of these were able to give a correct answer to Part (f) by correctly linking the shape of the histogram to the assumption made by Carla.

Q8 Surprisingly few candidates were able to select both correct words in Part (a) and, again, it was surprising the number of candidates who were unable to read the correct value of 10.6 from the scatter diagram. In Part (c) a number of candidates mistook the *appropriateness* of drawing a line of best fit with the *usefulness* of doing so; these are not the same thing. A line of best fit is appropriate in this case because the points on the scatter diagram suggest a linear relationship. Very few candidates were able to convincingly give an interpretation of the 24.9 in the equation of the line of best in Part (d). Most just described it as the gradient of the line, which is not an interpretation. Questions addressing AO2, which this one does, require interpretation in context so candidates need to answer in the context of the question. In this example, the linear model predicted an additional 24.9 visitors for every 1°C rise in midday temperature.

The substitution of $x = 16$ into the equation of the line in Part (e) was well done by those candidates who made the effort to write out their working carefully:

$$\begin{aligned} y &= -25.5 + 24.9(16) \\ &= -25.9 + 398.4 \\ &= 372.9 \text{ (or 373)}. \end{aligned}$$

Some got $y = -9.6$ having violated BIDMAS. Candidates are free to use a calculator for this work but should do so carefully.

Part (f) was not well done. A significant number of candidates tried to continue the line of best fit in the diagram back to reach the y -axis, not realising that this is not the true y -intercept because of the false origin. Those who understood the function of the two coefficients in the equation were able to do this with no difficulty. Majority of candidates were able to get at least one of the two available marks in Part (g) with most spotting that the line did not apply to a temperature of 0°C and fewer noticing that the line had been drawn for data collected in April and not January.

Q9 The majority of candidates were able to give the correct interpretation of the index number in Part (a) as representing a 13.4% increase on the 2013 price. In Parts (b) and (c) there was some confusion among candidates over what should be divided or

multiplied by what. For Part (b) candidates could choose to increase the 2015 price by 6.4% or take the 2017 price as 91.3% and reverse this to find 100% and most of those who answered it correctly chose the former approach. There was no such choice for Part (c) so candidates had to know to express £3.89 as a percentage of £2.88 and use this as the index number. Answers to Part (d) were, in general, weak, with most saying something like 'it gives a more accurate result' or similar. Part (e) was challenging but it was very encouraging to note that many candidates were able to access at least some of the marks for knowing that the individual index numbers for each level of membership were required before taking account of the weighting. In contrast to Part (d), answers to (f) were much better with most acknowledging the impact of the weights on the representativeness of the average.

Q10 Parts (a) and (b) were straightforward and for Part (a) the vast majority observed that the longer radius in the 2017 pie chart indicated that there were more visitors than in 2016. Answers to Part (b) were generally good, though some were distracted by the fact that there were two charts even though this part referred to only one of them. There was evidence in some scripts of candidates not having a protractor.

Part (c) was only answered correctly by the most able candidates. Some tried to work out a scale factor based on lengths of the radii or diameters but didn't really know what to do next. Some also assumed that the angles in both pie charts were equal and tried to use a scale factor with their answer to Part (b) to work out the number of adults who visited in 2017. The approach outlined in the Mark Scheme equates the frequency per square centimetre $\frac{f}{r^2} = \frac{F}{R^2}m$ for the pie charts but any equivalent approach is acceptable for full credit.

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