Examiners' Report

Principal Examiner Feedback

Summer 2019

Pearson Edexcel GCSE (9 – 1)

In Statistics (1ST0)

Higher Paper 1H

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GCSE (9 – 1) Statistics – 1ST0
Principal Examiner Feedback – Higher Paper 1

Introduction

General comments

This is the first entry of the new specification in GCSE Statistics. Some of the questions are very much as one would have seen in the old specification, but some are quite new with an increased emphasis on explanation and interpretation. Moreover, some of the questions are completely unstructured testing the Statistical Enquiry Cycle which presents fresh challenges.

Most students rose to these challenges presented in this specification very well. We insist on use of correct statistical language in this examination, and so will not for example accept the word ‘range’ to describe spread of data in the interquartile range because the range is a statistical measure of dispersion.

It is worth mentioning here that when drawing any form of graph or diagram, students would be well advised to use a ruler and a sharp pencil. Careless diagrams inevitably lost marks as examiners must be certain that points/lines have been drawn in the correct place.

Question 1

In part (a) the vast majority of students were able to complete the choropleth map correctly. There were very few responses that did not achieve full marks.

Most students answered part (b) were able to interpret the map. Some students failed to refer to the data provided by the map in their answer, talking about children tending to be where play equipment is, but not stating that the higher numbers of children are found in the top left. Some noted that there were 9+ in the top left, but didn’t use the terms more/most/highest concentration or otherwise indicate that elsewhere where fewer children. Few students correctly argued that her comment may not be valid as only the number of children were known and not the location of the equipment. A minority failed to decide whether or not Grace’s conclusion was valid without which the mark was not awarded.

Question 2

Most students answered parts (a) and (b) successfully, which meant that, when they came to answering part (c) they were nearly always giving correct statements based on the original data.

In part (c) pleasingly, there were many 3 or 4 mark answers, largely from correct comparisons of medians and IQRs/ or ranges. Less common was a statement about the skew or symmetry of the data, but when it was given, it was often correct. A significant

minority however lost this mark for using the phrase 'symmetrical skew'. Most students were successful in contextually interpreting at least one of their comparisons although only one was required to score the mark available here. It was clear that many students approached this question with a practiced strategy which meant they covered all aspects of the data,
A minority of students did not address the question at all and gave values rather than comparisons. Others wrongly put their efforts into comparing or describing individual quartiles or the maximum or minimum which scored no marks.

Question 3

Part (a) was generally well answered question. Most students understood fully how to calculate the number required for a stratified sample. The most common answer was 90 rather than 89. The main error seen was a failure to round their answer to an integer value. Another common error was to multiply by 100 (sample size) instead of 200.

In part (b) quite often students wrote 'only one gender collected' or 'single sex school'. Some students at this level normally find it difficult to explain concepts.

In part (c) most students realised that the response required here needed to be in the context of the question, although 'age' was a frequent incorrect answer.

Part (d) was generally well understood and answered correctly. A few tried to incorporate M (male) into the explanation which confused the issue and lost them the mark. Inevitably there were those who confused this with independent events.

Question 4

In part (a) only a minority of students were able to explain how IQR, a statistical measure, could inform the public about house prices. The best answers related how IQRs would give a sense of the spread or variability of house prices then and now or that IQR would remove extreme values from consideration. While much of the paper focused on successful use of statistical measures this question demanded that students could relate this measure to day to day situations and non-statisticians, which proved difficult for many. A common error seen was to describe the IQR as a 'range' of prices, which is not acceptable because the range is another statistical measure of dispersion.

Part (b) was more successful, but mainly because 'people won't understand IQR' was an easy and successful refrain (and indeed was very correct). A good sized minority also pointed out that IQR does not include the full range of prices.

Question 5

The majority of students in part (a) answered this part correctly with answers referring to outliers/anomalies/extremes regularly seen, with just a few referring to skew to secure the mark. A noticeable proportion gave 'if you want to find the median' as their answer or made reference to drawing boxplots. A common incorrect response was ‘when the data is spread out’.

In part (c) students who found the value of 12.5 were able to answer the next part (for the A mark) correctly. The most frequent calculation error seen was to add 1.5 x IQR to the median or rarely the LQ. However there were some errors related to BODMAS, e.g. 8 +1.5 × 3 = 28.5. Some had no idea that a calculation was required and simply guessed that it was an outlier and wrote about how large 14 was compared to other values given.

Question 6

In part (a) most students correctly stated that the Crude Birth Rate (CBR) being greater than the Crude Death Rate (CDR) implied a population increase, with some successfully referring to ‘per thousand’ rather than rate. The minority who didn’t score as they said more people were born than died. This misconception applied throughout this question.

In part (b), although many students appreciated that factors such as migration will decrease population, very few explained that it would have to exceed the extra numbers being born. Many wrong answers were given from concerns the accuracy of the figures (that “crude” implied inaccurate), unreported births and deaths and other seemingly logical reasons.

In part (c), with the formula given this was well answered with careless place value causing a few errors but, more importantly, not giving an integer value for the number of births costing some their accuracy mark.

In part (d), students needed to include 3 elements in their answer, 64 per thousand, St Lucia and 60 to 69 age group - the most commonly missed one was per thousand with St Lucia also often absent (6.4% was an acceptable but rarely seen interpretation).

Part (e) required a statement comparing the crude death rates of both islands **and** a correct interpretation of the standard population table. A mark was given for an explanation that included a partial interpretation of the standard population table. Those explanations stating that ‘there are more deaths in Barbados because the CDR in Barbados is greater than the CDR in St Lucia and the standard population of people in the 60+ age group is higher’ received no marks. The standard population table needed an interpretation. While most stated that the CDR for Barbados was higher, their explanations were rarely worthy of both marks. There is a general misunderstanding of the difference between proportions and absolute numbers so it was common for students to assert that Barbados had more, older people or even more people. Not all students realised that the standard population table was only an extract giving the only older age groups and so they focused on the oldest age group rather than the table as a whole.

Question 7

Part (a) was generally, this was answered well, but there was some ambiguity around proportion within the chart and totals. Considering that this is a standard question on Pie Charts in GCSE mathematics, it was surprising that a significant majority failed to simply write down that we do not know totals. Some students interpreted the results in context of what might have been occurring during those months of the year, showing a lack of understanding of what the question was asking. Most answers realised the pie charts didn't show the total number of visitors. However some students stated 'they aren't comparative pie charts' with no explanation. Other students wrote that there must have been more people on holiday in July because it was summer. Some students said there were more visitors on Business in January because the percentage was higher, despite the question saying that there weren't. Some students also thought the pie charts displayed the same number of visitors because they were the same size. Some students wrote about scenarios related to the problem, e.g. weather and tourism, rather than the mathematical facts. Some students used the word frequency instead of total or number of travellers as this is often the name of the column in the pie chart table. It shows that they were not contextualising the problem. Some were aware that they should be different sizes, but could not explain further.

Part (b) involved an understanding of reverse percentages. Most students either scored 2 marks or none at all. Of those who were successful, the most common method was to divide by 37 and then multiply by 32. There was one who used a multiplier to get from 37 to 32 but did not achieve a correct final answer because of rounding their scale factor too early. The most common misconception was to divide by 100 and then multiply by 32 or to work out 32% of 1080733.

In part (c) not many students said that the sizes of the angles would stay the same, and only a few responses stated **why** we would draw comparative pie charts. Most responses stated that comparative pie charts were required, and that the radii would be different, and some of those then attempted to show the formula to work out the different radii and had successful calculations. However, many then thought that the radii increased by a proportion of $\frac{4020}{2931}$. Several responses tried to find the radius of the other chart using erroneous mathematics such as, $\text{radius (July)} = \sqrt{\frac{4020}{2931}\times \text{radius (January)}}$. A number of students completely missed the point by describing how you would draw a pie chart (dividing by 360, etc). The majority of students attempted this question, there were very few completely blank responses.

Question 8

In part (a) many students correctly identified that the value of 5.9 kg it was a poor estimate as it was lower than 25th percentile but there was a large number who thought it was poor as there was no column in the table for the 30th percentile and so incorrectly talked about interpolation and even extrapolation.

Parts (b) and (c) was well answered by a large proportion of students who calculated the inter percentile ranges correctly and thereby gained the first two method marks. However some lost marks as they didn’t then make a comparison or failed to mention the words inter percentile range and so lost the third mark. A significant minority referred to the IQR here. Going on from here to part (c) many students were able to correctly interpret their inter percentile ranges in (b) by talking about the spread, but a minority lost the mark here as they made comments like the girls gain more weight. A few just stated the IPR comparison again with no interpretation at all.

Question 9

This is an example of a Statistical Enquiry Cycle question which is new to this specification. Students answering this question on the capture/recapture method had varying degrees of success. Most students used the numerical estimate approach and arrived at the required answer of 4900. Many students then failed to compare their calculated sample size with the Internet's estimate thus losing a mark.
The marks available for discussion of appropriateness of Giovani's **method** seemed more difficult to gain. Many failed to comment on the appropriateness at all and did not gain this mark. They were then less secure in taking a stance on the assumptions made, sometimes losing this second mark also because they gave converse reasons, thereby implying that the method was not appropriate. Many of the students thought that his method was inappropriate given reasons like 3 days was too long, tags would have fallen off.

Question 10
In part(a) (i), the large majority of students found it difficult to interpolate, instead giving median class interval (some attempted to find mean). The given table tempted some to take the midpoint of the $150 \leq t \leq 200$ as the median. Those who did know how to interpolate tended to score the full 3 marks – note use of $(n + 1)$ instead of n was allowed. Some erroneously calculated an estimate of the mean.

In part (a) (ii) most were able to answer this with confidence using their median though a few lost the marks for comparing with the median class or their mean which we did not allow.

In part (b) the large majority of responses calculated skew correctly from the given formula. Indeed it was rare to see an incorrect value given.

Part(c)
Most students identified it as negative skew, but were unable to interpret what negative skew meant in context of the question. Only a few scored the full marks giving "contextualised" interpretation either more than half of 60 year olds spend longer than the mean time on social media OR values below the median have a greater spread than values above the median.

Question 11
In part (a) students who understood normal distributions were able to calculate ranges and recite the percentage boundaries. Many students scored M1 or M2 for calculating how

many standard deviations above or below the mean 37 and 19 were. Very few students scored the third M1 mark without going on to get 81.5%. There were some who recalled the percentages incorrectly, for example, 65% and not 68% and therefore lost the third M mark. Lots of students listed the percentages for different standard deviations, ie 68% and 95%, but then chose one of those to compare with the 80% value. Usually students chose 95% and went on to say that showed the probability between 13 minutes and 37 minutes (ignoring the question stating 19 minutes). Sketching the curve with mean point and standard deviations shown was a popular method even with students who only scored M1 or M2. Some students calculated 81.5% with little working, but missed the conclusion mark.

In part (b) the majority of students explained that the skew (or lack of symmetry) makes the normal distribution an inappropriate model. A few stated "not symmetrical skew" which is meaningless as there is no such thing as "symmetrical skew". Common errors included stating that the distribution is not continuous, or a comparison of mean, median, mode (which are not given). Some others try erroneously to explain in context without reference to the distribution shown, with spurious details such as "busses are often late".

Part (c) was not well answered with very few students achieving full marks. A number missed this question out entirely. Many knew to draw a bell-shaped curve centred on the mean, but fewer knew to draw the tails to exactly plus or minus three standard deviations. Care should be taken to draw diagrams as accurately as possible, even if they are referred to as a sketch.

In part (d) a lot of students were calculating 0.6×0.3 or $0.6 + 0.3$ so 0.18 and 0.9 were very frequently seen answers. Some used Venn diagrams to support their calculations but even of those that did, few knew how to use the diagram correctly. If students knew the formula and wrote it down they almost always achieved the correct answer.

Question 12

In part (a) most students generally wrote the negation of the reason for the inappropriateness of Method 1 as the reason for the appropriateness of Method 2. Students who didn't score well on this question often gave reasons that involved 'weights' from the question without explanation.

In part (b) a good number of the students who began with the correct formula went on to achieve the correct value for *n* and correctly rounded this value. Where errors developed, the numerator was usually written correctly and errors were much more often seen in the denominator. When calculating an answer like this it is important to assess the feasibility of the final answer, so class sizes achieved of 64 – the result of using 3 as the denominator – is clearly incorrect. A few students used the correct method and gave a non-integer answer. Very few students used a trial and improvement method, although if these were correct, we gave full credit.

In part (c) most students decided on C as the incorrect equation and of those that did, most of those explained that the reason for this was the negative gradient or correlation. A significant number of students failed to achieve full marks as they stated that the coefficient was negative (we required gradient or correlation) and didn't interpret this in context. Only a small proportion of students managed to explain the contextual explanation, but those who attempted this explanation did so well. Very few students gave B as the incorrect equation and those that gave A explained that this was because of the negative intercept.

In part (d) the vast majority of students knew that they were expected to find the gradient and the intercept. The most common gradients calculated were 5/6 and 4/5 [credit was given for values of b in the range $0.8 \le b \le 0.833$ together with fractional equivalents]. The students who failed to achieve the correct gradient often calculated $\frac{\Delta x}{\Delta y}$. Some of those who lost the accuracy mark in the gradient did so because they drew a very small/inaccurate triangle. There were a lot of students who found an erroneous intercept with some clearly reading the scale incorrectly. Most students who found the gradient and intercept correctly then managed to put these in the correct places in the equation for the line. We allowed the equation written in the form $y = bx + a$.

Question 13

In part (a) many students recognised and named the random response technique. Some failed to make two points (as indicated by the 2 marks allocated). The majority judged the method appropriate, while others came up with supposed reasons why it might not be appropriate. Some failed to conclude whether or not they felt the method was appropriate. The most common appropriate responses were; answering it honestly and that it was a sensitive question.

Part (b) was well answered by many students who showed a full method. Sometimes these methods were presented after one or more failed attempts. In some cases the reasoning was difficult to follow. This was a **show** question, perhaps unusual in Statistics, but centres should encourage their students to show **every step** of working to demonstrate to examiners that the calculation is understood.

Summary

Based on their performance on this paper, students should:

- Practise writing clear explanations, bearing in mind exactly what is asked in the question and what evidence you should give to support your answer. The open response questions [question 7(c) and Question 9] require not only a description but calculations to support explanations, together with reasons why such a statistical method would be used.
- Learn the specific attributes of various statistical measures. For example, the IQR allows comparison of the spread of the middle 50% of the data.
- Understand the implication of the word ‘rate’ as in crude birth rate etc.,
- Use correct statistical language throughout. A notable recurring error in this series was the use of the words ‘symmetrical skew’, which is a contradiction in terms and cannot be awarded any marks. Another example occurred in question 12(c) with many candidates failing to use the word gradient or correlation in respect of the line of best fit.
- Read questions very clearly. Question 10 asked for an estimate of the median using linear interpolation, whereas a number of candidates calculated an estimate of the mean.
- In a show question [Question 13(b)], every step of the calculation must be shown to satisfy examiners that the correct method has indeed been applied.

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