Examiners' Report

Principal Examiner Feedback

Summer 2017

Pearson Edexcel GCSE

In Statistics (2ST01)

Higher Paper 1H

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Publications Code 5ST1H_01_1706_ER

GCSE Statistics 5ST1H
Principal Examiner Feedback – Higher Paper 1

General Comments

Students on the whole seemed to find the paper accessible and generally had time to attempt all questions. Students, in general, used correct statistical language which is expected when comparing distributions. When interpreting or discussing results, where more than one mark is available for a question, students should be aware that the number of marks generally indicates the number of comments expected.

Topics which students generally did well on included work with composite bar charts, advantages and disadvantages of sampling methods, data collection techniques and calculating Spearman's rank correlation coefficient.

There are some topics in particular which were not well attempted including conditional probabilities, weighted means, chain base index numbers and standardised scores. Work needs to be done on memorising the required formulae that are not given such as the rule for outliers and the formula for standardised scores. "Sampling frame" is still a widely misunderstood term in statistics.

There was some evidence of a lack of care in reading scales on graphs. For example in Q2c many read off the incorrect values on the cumulative frequency axis and in Q13b students often were careless plotting the sample range correctly.

Report on individual questions

Question 1

This question provided an accessible start to the paper with most students being able to demonstrate their knowledge of time series graphs. In part (a) nearly all students read the scale properly to identify the correct value off the graph for the year 2014. It was extremely rare to see an incorrect line of best fit in part (b)(i) and most of those were because of the lines being significantly out of tolerance or due to no line being drawn at all. A significant number of students lost the marks in (b)(ii) due to saying positive correlation and occasionally, but much more rarely, positive skew.

It was pleasing to see many students using appropriate statistical language in part (c), ie "extrapolation", whilst others correctly mentioned that trend may not continue. Some students, however, were concerned that the line of best fit would go off the graph or referred to individual dips like in 2009 and hence lost the mark.

Question 2

Though most students are confident with using a cumulative frequency graph in part (a), the interpretation skills required in parts (b) and (c) discriminated at the top end. In part (a)(i), many students gained the mark. For those who did not, the most common errors were inaccurately reading the scale on the vertical axis or reading the cumulative frequency well below 30. Similarly, in part (a)(ii), despite understanding the need to subtract two figures, the scale caused issues for a significant number of students.

In part (b) many achieved 2 marks for stating that the data from the USA would not represent the UK, whilst others correctly identified the data as being out of date. Students who scored no marks showed little comprehension of what was being asked and gave answers such as "it is not sensible because it doesn't include all age groups".

Part (c) was challenging for some as students needed to first identify for themselves the key figures that needed to be compared in this question. Students should take care when comparing figures that they have been stated clearly first, though credit was given to values of the median and IQR seen on the cumulative frequency graph. Where the median and the IQR were found accurately full marks were generally achieved. Many errors came from reading the value of the median and the upper and lower quartiles inaccurately leading to answers outside the acceptable boundaries. Most students made correct statements comparing the two sets of data but sometimes gave no figures to support their comparisons. Frequently students got tablets versus smartphones confused with USA versus UK. Some students did not understand the meaning of IQR, interpreting it as meaning the average age was younger/older. Fewer discussed the "average" rather than the median and occasionally the mean was used in a comparison.

Question 3

This question was very well answered as reading and interpreting composite bar charts are well understood by nearly all students at this level. In part (a) there were very little problems achieving full marks. Minor slips included giving an answer of 58 in part (a)(ii) or 39 (coming from 59 – 20). On a small number of occasions students gave the values from the 16 – 34 age group.

The standard of presentation in part (b) was very impressive as the overwhelming majority of students drew an accurate composite bar chart with correct shading. Of those who did not score marks, some students arrived at a cumulative total percentage less than 100. Others made slight errors misreading one line to represent 1 percent rather than 2 percent.

Again, part (c) was also answered well by a majority of the students. There are still some students, however, that do not understand that comparative language is required rather than just a listing of all the figures involved. "Whereas', "but" and "only" are not acceptable comparative descriptors. Many students did not fully understand the survey that was carried out and

seemed to think that people were being asked their opinion of the price of a stamp. The number of marks should indicate to students the number of required comparisons.

Question 4

The concept of a sampling frame remains a difficult one for many students and part (a) of this question was not very well answered. By far the most common answer was the incorrect answer of "census". Some indicated a sampling method. Others identified the population rather than the sampling frame – omitting the idea of a list or register. The most commonly observed correct answers were "electoral roll" and "a list of all voters in Great Britain". There were a good number of correct responses seen in part (b) with the most frequently observed correct answer of "quicker", although "higher response rate" and "questions can be explained" were also popular correct responses.

Again part (c) was well answered with the most common correct response indicating that not everyone would have or answer a telephone. Many described potential interviewer bias. Biased questions should not appear on any questionnaire or survey. Finally in part (d) there were a reasonable number of fully correct answers seen, however there were a large number of students who were able to get to 80(%) but did not know how to proceed to convert this into a number out of 1000

Question 5

There were good performances in this question with part (c) discriminating the most able students. Virtually all students scored a mark in part (a) and it is now incredibly rare to see a question given instead of a hypothesis. Mostly correct answers were also seen in part (b) with numerical/number being more frequent than using the term quantitative. A number of students chose gender stating it was better as there were only two outcomes; rarely was hair colour chosen.

Many students realised the appropriate variable was time in part (c) but far fewer used the term "continuous". It was more common to see explanations such as "because data can be put into groups more easily" or that time was the variable they were interested in for the original hypothesis. A large proportion of students chose the wrong variable altogether. In part (d) it was fairly common to see median here though not always correctly spelled and students must note that medium is not allowed. Mean and interquartile range were popular incorrect answers.

Question 6

This question was significantly more challenging than the first five questions on this paper and gave ample opportunity for more able students to display their knowledge. Part (a) was virtually always correct, although a few students gave 115 arising from $55 + 41 + 57 \div 3$. There was much confusion amongst students who thought the "weighted mean" meant the mean of the weights in part (b)(i). Very few were able to identify that the

lowest score had the highest weighting or that the highest score had the lowest weighting. Again part (b)(ii) was not well answered with the majority of students giving an answer of 33.3 – simply dividing the sum of the weightings by 3

A better response was seen in parts (c) and (d). In part (d), many were able to score at least 1 mark for realising that the answer was between 34 and 46. Where students did not gain any marks the most common errors were to give answers of 34 or 46. In part (d) many were able to accurately use the formula for standard deviation given on the formulae sheet and present their answer to an appropriate degree of accuracy. Minor slips included forgetting to square the mean and, on some occasions, omitting the square root sign.

There were a number of students who gained the mark in part (e) for stating an appropriate advantage of the standard deviation, usually "it includes all of the data" . Common answers scoring no marks included "it is more accurate" and "takes into account outliers". It was very rare for skewness to be mentioned.

Question 7

Though there were plenty of hints throughout the question about the price of the annual season rail ticket increasing, many still failed to understand this and overall the performance on this question was mixed, though perhaps better than in previous series. Part (a) caused a certain amount of confusion with a good number of students giving a technical definition of what a chain base index number shows rather than concentrating on the specific task in hand. Many also thought that prices were decreasing as the chain base numbers were decreasing. However, a good number of those who scored the first mark went on to give a complete description to score the second.

Part (b) was generally well answered. The most common incorrect method was to multiply by 100 and divide by 109. Many gave an answer which contradicted with their responses to part (a) which should have caused them some concern.

Many students found part (c) challenging and there was a reluctance to continue the method used in part (b). A number of students added the 9, 6, 4 etc. rather than multiplying the 1.09, 1.06, 1.04 etc. therefore 24% was a very common incorrect finding. Most students who completed the method from part (b) correctly went on to reach 26% and a correct solution. It was also common to see $3032 \times 1.09 \times 1.06 \times \ldots$ and 25% of 3032 found and compared.

Question 8

Many students seemed unprepared for this question as they failed to remember the rule for determining outliers in part (b). In part (a), answers seen were generally correct. Most opted for the statement "the median is more than £200 000" or "the median is £240 000" . The use of the "mean" was rare as was incomplete/incorrect discussion of quartiles.

The overall response to part (b) was generally disappointing. Some students ignored the question's instruction "show, by calculation" and merely argued that £500 000 was an outlier since it was well above the other points. Of those who made a valid attempt, most knew that they needed the IQR and calculated this successfully. There was some confusion as to what was supposed to be multiplied by 1.5 and often students chose to multiply the upper quartile instead of the IQR. Another common mistake was to add their result to the median. Nearly all of the students who made a correct calculation went on to give one of the required conclusions.

Question 9

Overall the sampling methods tested in this question were well understood despite students being unable to give their correct names in part (c). In part (a) most students tried to rely on stock answers and listed reasons why primary data is better than secondary data such as "reliable" and "accurate" rather than realising that it was unlikely the survey will have been done before. Part (b) was very well answered by most students with all of the answers on the mark scheme being very common. A common incomplete answer was that "he will not get a lot of data" .

In part (c), students did struggle to identify the sampling methods being described though in general they were able to identify stratified sampling better than cluster sampling. All of the answers on the mark scheme in part (d) were popular and many students scored at least one mark for stating an advantage of Method 2. It was also common for students to just give one correct reason and elaborate on it in detail rather than give two reasons. Just repeating the description of the method was also common and this scored no marks.

In part (e) most students were able to score at least 1 mark on this question for giving at least 3 quantitative response boxes with units. Very rarely did students score 0 marks because they had subjective/non-quantitative response boxes such as "not far/far other". The two most common causes of only 1 mark being scored were response boxes that overlapped or that were not exhaustive. Students are advised to be careful if they use inequalities that they do so correctly.

Question 10

The overall performance on this Spearman's rank question was pleasing with the majority of students achieving at least 5 marks here. In part (a)(i) many students were able to rank the GDP, although some Students ranked in the reverse order so were not able to obtain the given Σd^2 score of 10. Of

those students who ranked correctly, virtually all worked out the difference and followed through to the correct answer in part (a)(ii). Most students correctly used the (given) formula for correlation but a significant number tried to apply the formula using $n = 10$ instead of $n = 7$. Another common mistake is to square Σd^2 before multiplying it by 6

In part (b) the majority of students were able to identify the type of correlation which matched their value from part (a)(ii). A small number of students put the strength of the correlation but not the type so gained no marks. Additionally, a few students gave an answer which was an interpretation of positive correlation, which was condoned.

Part (c) was attempted with varying degrees of success. Some students explained the expected change to the values rather than to the correlation. Students who gained this mark were often also able to explain why there was no effect, though some incorrectly believed "it would change but remain positive" . Though the majority of students attempted part (d), it was done so with limited success. Most students linked the question back to their correlation in part (b) so usually stated that Daniel could use the result (or not if they gave a negative correlation). Only a small number of students took the hint from the emboldened word "causes" and identified that correlation does not mean causation.

Question 11

Though most students accessed the earlier parts of this question, part (c) was one of the most discriminating questions on the entire paper. In part (a) many were able to use the Venn diagram to correctly give all 3 required probabilities. The most common mistake in (a)(i) occurred with students giving an answer of $\frac{10}{30}$. When all three probabilities were wrong it was often a case of writing down numbers from the Venn diagram and not expressing these as probabilities.

Part (b) saw a mixed response from students. Of those who realised the need to multiply two probabilities, many scored a method mark for $\frac{6}{30} \times \frac{6}{30}$. Some Students did draw a tree diagram but still often forgot to reduce the denominator on the second fraction.

Many students ignored the instruction in part (c) to compare two probabilities so ended up writing a lot and scoring no marks. Some students compared numbers eg 6 and 10 or 5 and 6 and those who did compare probabilities usually chose $\frac{6}{30}$ and $\frac{10}{30}$ because they hadn't picked up that the phrase "when it rains…..." was signalling a conditional probability. Students who did write down one of the conditional probabilities usually chose $\frac{6}{11}$ as this was the easier one to see from the Venn diagram. Occasionally students who had successfully calculated both conditional probabilities lost the second mark because they had failed to conclude that Greg was wrong.

Question 12

Overall, there was good performance on this question involving the Petersen capture-recapture method. Part (a) was perhaps the trickiest with many not realising that the sample was in proportion to the population and found differences and added them back onto first sample size. Consequently 61 was a popular incorrect answer.

Correct answers to part (b) were commonly seen though not always expressed clearly. Students were able to explain that, to ensure reliability in the second sample, the first sample needed sufficient time to disperse randomly in the population - more often expressed as "mix back in" . In part (c), most students correctly stated that leaving a year between samples would be unreliable and went on to support their decision with a good reason or two. Many gave both "tags falling off" and "geese dying" as their reasons. A minority gave good reasons but did not state the effect on reliability.

Question 13

Despite not seeing a question involving sample ranges in quality assurance before, students did make a fairly good attempt here and many correct answers were seen. Part (a) had a mixed response with some students wanting to switch off the machine immediately. Others suggested throwing the sample away. Written expression was not always sufficiently clear.

It was disappointing to see students attempting to find the range in part (b)(i) by subtracting the first number from the last number in the list rather than the lowest from the highest. However others found the mean or median and then were unable find a way to plot this on the quality control chart. Of those who found an answer less than 6 in part (b)(i), many were able to gain a follow through mark for a correct plot in (b)(ii). Still some slips were seen as the scale went up by 0.2 and this meant a loss of accuracy for some. Again, a number of correct answers or follow through answers were given in part (b)(iii) with most making a comment about "shutting off" or "fixing" the machine.

Question 14

This quesiton allowed the most able students to show their strengths with weaker students struggling to progress past part (a). In (a)(i), it was common to see a correct answer. In (a)(ii) correct answers were generally seen though some opted to multiply 0.7×2 to come up with the most common incorrect answer of 0.14

Part (b) saw a mixed response with some students earning 1 mark for finding one probability (usually 0.7^5) but making no further progress. Others worked with 7 and 3 instead of probabilities and scored no marks. Of those who did select the three appropriate probabilities, they generally went on to add them up accurately.

Of those who attempted part (c), many thought that simply calculating $P(X = 4)$ was enough. When more than one probability was calculated, often all six probabilities were shown. A few gave no justification and thus lost the A mark.

Whilst most students did correctly state that a binomial distribution was not appropriate in part (d), many did not adequately express why this was the case. Many simply repeated the wording from the question and did not go on to justify their response. A minority of students said that it could be modelled by binomial distribution because there were only two colours of marbles.

Question 15

It was clear that many students did not remember the formula to calculate standardised scores and often scored no marks in this final question of the paper. In part (a) many students were unsure how to find the standardised score and a range of incorrect methods were seen. A common error was taking away the actual score from the mean leading to a positive answer. Others divided the score by the mean. Some students lost the accuracy mark by giving a truncated answer of –0.6 instead of correctly rounding it to –0.7

There was a better response in part (b) with many students understanding that a higher standardised score meant better performance in this case. Even those who lost marks in part (a) were able to gain follow through marks here. Looking at which score was nearer the mean was a common wrong comparison rather than stating which was higher or lower. Also, many wanted to compare their standardised score with 1.

In part (c), very few students gained full marks. When marks were gained it was generally for working out the standardised score. Students" knowledge and understanding of the normal distribution was poor. Many used the idea of 2 standard deviations from the mean but failed to express knowledge that 95% of the data should lie within 2 standard deviations of the mean. Of those students who did gain method marks many arrived at the wrong conclusion based on the information they had found. It was common for students to think a normal distribution was acceptable because it was within 3 standard deviations without any appreciation that there should be some values higher than 1.3 standard deviations above the mean.

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