LEVEL 3
CERTIFICATE IN MATHEMATICAL STUDIES

1350/2A Option A (Statistical Techniques)
Report on the Examination

1350/2A
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General

Students generally performed well across the paper and non-attempts were very rare compared to previous examination series. There was more evidence of competence in using the advanced scientific calculator, especially in the statistical operations. Although performance on the questions that require qualitative response has improved, some students don't refer to the specific requirement in the questions and often lose the final mark. Good responses were seen across the whole paper, with notable improvements in work on critical analysis, sampling methods and regression lines.

Question 1

Students scored well on this question. In part **(a)**, the vast majority of students were able to work out the correct ratio. A common incorrect response was the first option, from using the reverse order for the ratio.

In part **(b)**, most students chose the first alternative method to check if the given data supported the claim. On some occasions, mistakes were made as a result of choosing the wrong values from the table. While most students were able to work out the total number of medals for the two countries identified, some made arithmetic errors in the division or rounded the final values incorrectly. Students who used the second alternative method often made incorrect conclusions. Those who followed this method usually scored two marks but lost the final mark. A few students continued with further incorrect methods after getting the right answer and as a result they did not gain the final accuracy mark. There were instances of missing brackets which were not recovered and led to incorrect answers.

Question 2

Just over one third of students scored full marks in part **(a).** The common responses were relating to adding the y-axis, adding gridlines or avoiding the symbols from overlapping each other. Some students made criticisms about the graphs, but did not make any recommendations to improve them. These students were able to gain one mark for writing at least two errors on the graphs. Common incorrect responses on the improvement included labelling the axes or using colours.

In part **(b)**, most students correctly identified from the preliminary material that 35 (children aged 7) equated to 42% of the data. A smaller percentage of students went on to apply a valid reverse percentage method to establish the correct answer, with many students attempting to combine their findings with other percentages from the graph. There was no tolerance of subsequent working on the mark scheme.

Students found identifying or describing the mistake difficult in part **(c)**, in many cases offering an alternative method instead. The most common incorrect response was suggesting that there needed to have been a conversion to minutes. Building on this conversion would still typically lead to a correct re-calculation for two marks, with 28% of students being awarded two marks as such. There are many examples in the additional guidance on the mark scheme that highlight the

tolerance for the range of responses, but simply stating that 4hr 45m does not equate to 4.54 hours would have been adequate.

Very few students obtained the single mark available on part **(d)**. The ideal response was to reference unknown population sizes, but there was a common misconception that different sample sizes impacted the claim. A typical incorrect response was that a small percentage from a large sample was greater than a large percentage of a small sample. The mark scheme was tolerant of some other responses, such as those that indicated the survey may not be representative. Simply stating that a sample was taken was insufficient. Some students did make the argument that children (or parents) may disclose incorrect information due to the age restrictions for social media. This was accepted.

Although students were instructed not to comment on the graphs in part **(e)**, some students proceeded to do so and therefore could not gain any credit for their remarks. However, most students were able to make at least one valid comment, with the most common being to point out the mixture of fractions and percentages. Another common valid comment was to note various issues with the age groups used. Some students stated that the report would have been better if actual numbers of people were used rather than percentages. This was not accepted as a valid reason because it would have made it more difficult to make comparisons between ages or groups of ages.

Part **(f)** required students to use the values given in the question along with one sourced from the preliminary material to make an estimate. The required value from the preliminary material was stated as two thirds in the text but 66% on graph 2. Both values led to the same rounded answer and we accepted working that used either. Many students made place value errors when working with millions and billions. The mark scheme allowed for such errors without penalty up to a maximum of four marks. Those who scored between one and three marks generally missed one or two parts of the chain of calculations required. It was also common to see the currency conversion applied incorrectly.

Question 3

Two thirds of students scored the mark in part **(a).** The common incorrect response was assuming the highest positive value shows strongest correlation.

In part **(b),** most students were able to match the correct scatter diagram.

Students recognised that correlation does not imply causation in part **(c).** Some of them suggested that a third variable (weather or temperature) affected the two variables. However, a few students did not conclude that the statement given was incorrect. The common error occured where students related the scatter diagram to a negative correlation and concluded that the statement was correct.

Question 4

Very few students scored the mark in part **(a).** Most tried to work out the values from their calculator or recalled the wrong value, with incorrect answers of 68 or 69 or 99 commonly seen.

Parts **(b), (c)** and **(d)** were generally answered well and demonstrated good use of advanced scientific calculators. Students are better prepared in using the statistical functions on their calculators. Many students showed the value of the z-score and a few demonstrated a better understanding of normal distribution by using diagrams.

A large majority of students could not use the inverse distribution to work out the correct z-score for the given probability in part **(e).** Although they went on to set an equation by using the probability as their z-score, this did not gain any marks. Students who drew the normal distribution diagram generally went on to score full marks.

Question 5

Most students were able to plot both points correctly in part **(a).** Where a few pupils plotted only one correct point, it was usually the point (22.6, 131) that was incorrectly plotted, due to pupils not reading the scale correctly.

In part **(b)(i)** there was good use of calculators, with students writing down their calculated values for a and b (and r). Those who found the coefficients generally went on to give the correct regression line. A few students gave the incorrect regression equation for t on h, often losing the final mark.

Some students could not draw the line using their regression equation but drew the line of best fit for part **(b)(ii).** Most students who used the regression equation to calculate two or more coordinates were able to plot these points and draw the correct regression line.

Many students were able to score full marks in part **(c)(i)** by substituting the value of t into their regression equation to find the correct value of h. For those opting to find the value of h using the graph, many were able to find the correct value by drawing the line $t = 20.5$.

Part **(c)(ii)** was not answered well. Few students recognised that the data had been extrapolated.

Question 6

Most students were able to score the first mark. Using a simple random method by using a random number generator is a common approach, although some students simply didn't specify that the population needs to be numbers 1-180 or 0-179.Very few students went on to mention the need to ignore repeats to gain the final mark.

Of those who chose the method of putting names in a hat, most managed to score full marks. Some students made the question far more complicated than was required due to not taking notice of the reference to a simple random sample. They attempted to use a systematic random sample or a stratified sample, which gained no credit.

Question 7

Many students were able to make a good attempt at finding the confidence interval in part **(a).** Those students who knew the method for finding the limits could still earn several marks even if they had an incorrect mean or incorrect z-value. There were also instances of premature rounding or truncating, which led to an inaccurate answer. Some students were unable to find the correct z value for a 98% interval from the supplied tables or from their calculator, and a few wrote their limits in reverse order on the answer line. Most gained three marks for setting up the correct equation. Errors in the equation related to the incorrect use of 8 as the standard deviation.

In part **(b),** some students referred back to the sample mean of 33 from the previous part and therefore stated the population could not be 32, which was incorrect. Many stated correctly that 32 lies within their confidence interval and scored full marks. Some students scored no mark in this part as they had not previously written a confidence interval.

Students were expected to compare their calculated confidence interval with the new interval given in part **(c).** Observing that the interval for 2022 is higher and does not overlap with their interval for 1982, students could justify the population mean had increased but could not give a reason for their conclusion. Some students recognised that each of the limits in the new interval were higher than their respective limit in the original interval. However, this was not sufficient to conclude that the mean had increased. A sense that the intervals no longer overlapped (for example the lower limit for 2022 is higher than the upper limit for 1982) was required. Very few students scored full marks in this part, which proved to be the most challenging part in this paper.

Question 8

Arithmetic errors were seen frequently in part **(a).** Students could recall that the estimate for the population mean can be found by dividing the total of all the scores by the total sample size. Common incorrect responses involved finding the sum of the point estimates and dividing it by 4. A small number of students misinterpreted the question and stated that the sample of size 75 with point estimate 38.4 would give the best possible estimate of the population mean. Whereas this is correct for the samples in the table, they did not realise that combining samples, and therefore increasing the sample size, would lead to a better estimate for the population mean. Several students correctly found the total frequency of 175 but then divided this total by 4, which is incorrect.

Although many students gained the mark for the correct explanation in part **(b),** a good proportion of students explained that having the figures correct to more decimal places or using every piece of raw data would improve the accuracy of their estimate.

Part **(c)** was generally well answered. Some students who knew how to enter the data on their calculator were unsure which summary statistics value was the product moment correlation coefficient, and so listed this along with the regression line coefficients of a and b. It was common for students to have missed the minus sign from the front of their pmcc when transferring it to the answer space. However, they could still score the mark for describing the correlation if this was consistent with their answer.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.