Version 1.0

General Certificate of Education (A-level)
June 2012

Mathematics MS/SS1B

(Specification 6360)

Statistics 1B

Report on the Examination

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Set and published by the Assessment and Qualifications Alliance.

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General

The average level of achievement on this paper was slightly below that seen on the more recent papers. Also, there was a corresponding small increase in the spread of marks due to slight increases in the proportions of very strong and very weak scripts.

Where appropriate, students showed sufficient working to allow some method marks to be awarded for incorrect numerical answers and, at the same time, usually made appropriate use of their calculators and the supplied blue AQA booklet of formulae and statistical tables. Nevertheless, it was very disheartening to see the number of transcription errors from question to student script and/or simple, even silly, numerical mistakes that inevitably proved costly. Students should be more careful about reading the questions and entering values into their calculators and perhaps even more aware of the need to assess the sensibility of numerical answers so calculated.

Despite having been mentioned in previous reports, discursive answers were by far the worst answered parts of the paper. Even when attempted, they often lacked structure and clarity or even sense in terms of English. Typical of these were many answers to Questions 3(c)(iii), 6(b)(ii) & 7(b). Discursive answers will continue to be examined on future papers and students should be aware that incoherent attempts will inevitably lose the marks available.

Question 1

As intended, this straightforward question on correlation enabled most students to make a confident start with most scoring at least 3 and often 4 marks. When this was not the case, it was often due to using 0.410 instead of -0.410. Other less common errors in part (a) were to omit the square root, add S_{xx} and S_{yy}, or calculate $\frac{S_{xy}}{S_{xx}}$. In part (b), some students omitted the word 'negative', used an inappropriate adjective such as 'no', or considered the correlation to be between 'length' and 'thickness'. It was evident from some very poor attempts that a few students may not have understood the methodology for part (a) although they nevertheless attempted part (b).

Question 2

Part (a) caused few students any problems. A small minority stated '34' for the mode whilst, in part (a)(ii), a few others attempted to treat the data as continuous or calculated the interquartile range by using $(132 - 44 = 88 \rightarrow 22)$. As expected, except for a fairly common listing on the question paper of mid-points, the majority of answers to part (b) were obtained directly from calculators. However, many students obtained inaccurate or even completely incorrect answers. The inaccuracies were, in the main, due to using incorrect mid-points and/or replacing the value of 54 by 52 or even 50. Such students usually scored 2 of the 4 marks available. A minority of students ignored the frequencies and simply worked with mid-points and $n = 12$ so obtaining incorrect answers for no reward. More students than expected had difficulty with part (c). All that was required, for 2 follow-through marks, was to simply add $\frac{280}{175} = 1.6$ to the mean value in part (b). About $1/3^{\text{rd}}$ of students did this correctly. Of the remaining $2/3^{\text{rds}}$, about 1/2 made no attempt and a similar proportion attempted a variety of methods. Many such methods were invalid (eg [(mean from (b)) $\times$ 1.6] or [$(\Sigma fx + 280)/176$]) but some were valid although lengthy and often inaccurate (eg [(recalculated$\Sigma fx + 280)/175$]) and so usually scored at most one mark.

Question 3

The great majority of students scored the 4 marks in part (a) by obtaining values of a and b directly from their calculators; calculations of sum of squares and products followed by use of formulae were extremely rare. Plotted lines in parts (b) &(c)(i) were sufficiently accurate to gain full marks in the majority of cases. However, very few students indicated any method for the reference points (2 were sufficient for each line) used to plot their lines. This could have helped those students who plotted an incorrect line recover a lost mark. The use of simultaneous equations was quite common in part (c)(ii) despite the fact that the answer could be read directly from the graph. Whilst this approach favoured some students who had incorrectly drawn lines, many students' solutions resulted in totally impossible temperatures. A minority of students gave the value of y instead of x as their answer. Very few students scored both marks in part (c)(iii). Many gave **two non-distinct** statements by stating that 'at low temperatures more of *Salt B* dissolved whereas at high temperatures more of *Salt A* dissolved'. There were also many worthless comments about the relative strengths of correlation (suggesting that this was shown by the gradients of the lines) and comparisons at $0°C$ (by reference to the intercepts). Students who tried to comment about 'rate of change' often suggested that '*Salt A* dissolved faster than *Salt B*' with some even stating that '*Salt A* was faster than *Salt B*'.

Question 4

In answering this question, a significant proportion of students ignored the instruction regarding answers 'to three decimal places' and simply left them as fractions. This was not penalised in part (a) but was penalised in parts (b) & (c). Most students answered parts (a)(i) & (ii) correctly but in part (a)(iii), many incorrectly assumed independence and so multiplied together their previous two answers. Part (a)(iv) caused significantly more students a problem. Whilst many obtained the correct numerator of 153, they used a denominator of 640 instead of 172. Few students were able to make significant progress in part (b). Many responses lacked any attempt at a numerical justification, whilst others tried to identify new values to use from the table rather than following the instruction (and hint) to use answers from part (a). Such answers usually lacked explanation, left answers as fractions that were difficult to compare, or did not consider like-for-like situations (eg $B = 3$ with $B \leq 3$). Most students scored only 1 or 2 marks in part (c). Whilst most were able to quote the three correct numerators, many used 194^3 or $(640 \times 639 \times 638)$ in the denominator and even more failed to multiply by $3! = 6$. Sadly, it was also not rare to see the three correct fractions added together.

Question 5

Stronger students often scored full marks on this question, perhaps due to the question not requiring a qualitative response. Most students scored well in part (a) as they were usually well aware of how to standardise or how to use their calculators' in-built function. When errors did occur it was often down to rounding z-values to one decimal place thereby obtaining inaccurate answers or, particularly in part (a)(ii), finding the complement of the probability required. In part (b)(i), most students obtained 0.372 although some methods were not always clear and others were somewhat contrived. Notable among these was $[0.59871 + 0.77337 - 1]$ which could be argued to be less convincing than $[0.59871 + (1 - 0.77337)]$, particularly in a 'show that' request? Nevertheless, this and other unusual approaches that were justifiable were awarded the 2 marks available. This was not the case for those students who relied entirely on their calculators' in-built function to such an extent that they simply stated $[(\mathrm{P}(X < 5.3) - \mathrm{P}(X < 5.1))$ **or** $(\mathrm{P}(Z < 0.25) - \mathrm{P}(Z < -0.75))] =$ 0.372..... = 0.372. Although questions similar to parts (b)(ii) & (c) have appeared fairly regularly on previous papers, many students still struggle to distinguish between the two situations. Typical approaches were to use $\frac{0.2}{\sqrt{4}}$ in part (b)(ii) and then use $\frac{0.5}{\sqrt{6}}$ (right!) or 0.5 in part (c). Other less common errors in part (b)(ii) were 0.372^4 or $1 - 0.372^4$ and, in part (c), were the use of $\frac{1-0.372}{6}$ or the omission of the necessary area change.

Question 6

The changes in values of *p* through this question proved to be quite challenging for some students. However, only the weakest students failed to score some marks in part (a)(i); often due to the omission of $\binom{30}{2}$ or an error in the indices. Part (a)(ii) caused more students a problem with a significant number trying to perform separate calculations for $p = 0.22$ and $p = 0.13$ before giving up since probabilities for neither value were tabulated. Those students who worked with $p = 0.35$ usually then made correct use of tables, rather than multiple formula calculations, although extracting a probability for an incorrect value (9 instead of 10) was still too prevalent. Disappointingly, given its regular examination on previous papers, for these and other students this uncertainty continued into part (a)(iii) which often resulted in the loss of at least one mark. Almost all students obtained correct values for the mean and variance in part (b)(i) although, for some students, there was some uncertainty as to whether the value of 17.16 was the variance or the standard deviation. Answers to part (b)(ii) were very disappointing with few students scoring more than one mark. All too often students compared the two means and the two standard deviations (using $\sqrt{17.16}$) but then did not even comment on the pairwise similarities or, more often than not, they simply stated 'results valid' or 'accept both claims'. In order to improve responses to such requests, teachers may wish to view the mark scheme to see what was required for the 3 marks.

Question 7

The better students generally scored full marks in part (a) usually by working in litres. However, far too many students provided answers that ranged from worthless to scoring at most 3 marks. Errors seen in abundance were:

- an incorrect evaluation of $\frac{181.80}{36}$; this despite the use of a calculator;
- the use of 5, 181.80 or even $\frac{181.80}{8}$ instead of 5.05;
- the use of 75 or 0.75 instead of 0.075;
- an incorrect z-value;
- the omission of the divisor of $\sqrt{36}$.

Many of these errors resulted in absurd confidence intervals that students appeared to simply accept as correct. The one mark for answering the first claim in part (b) was only available to those better students who had obtained a correct confidence interval in part (a)(ii). Even so, many such students made no comparison using the stated mean of 5 litres but merely commented that their calculated mean of 5.05 was greater than 5. This was very disappointing particularly given similar requests on previous papers. In answering the second claim in part (b), many students again referred to their confidence interval and so scored no marks. Of those that correctly evaluated $\frac{8}{36}$ as 22%, far too many were not sufficiently explicit in comparing this with 10% and so scored only 1 of the 2 marks available. It was extremely rare to see an answer worthy of the mark in part (c). Most students made reference to sample size although some suggested that the question had stated that volume was normally distributed! The minority who had some idea of what was required were almost always not sufficiently precise or careful enough in their answers. Thus it was common to read references to 'the sample', 'the data' or 'it' rather than for example 'the (parent) population' or 'volume (of bleach)'.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results statistics page of the AQA Website. UMS conversion calculator www.aqa.org.uk/umsconversion