A-LEVEL
MATHEMATICS

MS1B – Statistics 1B
Report on the Examination

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General

The paper was successful in that it provided opportunities for the majority of candidates to obtain more than minimal marks whilst, at the same time, it provided the best candidates with differentiated challenges. As has now become the norm, candidates made good use of both their calculators' statistical functions for mean, standard deviation, correlation and regression, and of the provided booklet of formulae and tables. A significant minority of candidates opted to also use their calculators' functions applicable to the normal and binomial distributions and, less frequently, those applicable to confidence limits. Some of these candidates suffered a quite severe loss of marks because 'incorrect answer with no method scores zero marks'.

Question 1

Almost all candidates scored full marks in part (a) by using, as expected, the summary data. A small minority used either an incorrect formula, even though it was given in the booklet, or made careless numerical errors. Given that almost every past paper has asked for an interpretation of r, it was disappointing to see the frequent loss of a mark in part (b) through a description of other than 'moderate' for the value 0.498. All too often 'weak', 'moderately weak', 'moderately strong', 'strong' or even 'weak to strong' or 'neither weak or strong' were the descriptors but almost always attached to the correct word 'positive' and an adequately described context. Centres may find the following general guidelines helpful for the future.

- $0.9 < r < 0.99$ indicates (very) strong/almost exact positive correlation
- $0.7 < r < 0.9$ indicates strong positive correlation
- $0.3 < r < 0.7$ indicates moderate/some positive correlation
- $0.1 < r < 0.3$ indicates (very) weak/almost no (positive) correlation
- $0.0 < r < 0.1$ indicates no (positive) correlation
- Similar guidelines apply for negative values.

Question 2

Candidates scoring full marks in this question were very much in the minority. In part (a), most candidates used the statistical functions on their calculators. An accurate stated value for the mean suggested the use of correct mid-points. Whilst variance estimates of either 2.42 or 2.46 were the norm, it was apparent that far too many candidates either rounded before squaring or simply did not square their value for the standard deviation. Most candidates found a correct value for the mean in part (b). Multiplying, instead of dividing, by 25.4 was by far the most common mistake and resulted in a cricket balls with mean diameters of more than 1730 inches or 44 metres! The linear scaling, involving division, of variance, rather than standard deviation, caused great difficulty with 25.4 being by far the most common divisor. A small number of candidates spent time and effort on first dividing the mid-points by 25.4 before recalculating the mean and the variance but often with complete success.

Question 3

This question on probability proved to be a very good discriminator. Answers to part (a) were rarely incorrect and the vast majority of candidates scored both marks in part (b) where $\frac{0.56}{1}$ and $\frac{0.2}{1}$ were accepted. Answers to part (c) identified those candidates who could not cope with conditional probabilities and so gave answers of 0.05 and 0.72, whereas those with the requisite knowledge generally score full marks for 0.25 and 0.9. Here answers of $\frac{0.05}{0.2}$ and $\frac{0.72}{0.8}$ each lost a mark. Only the strongest candidates were able to make significant progress in part (d) with only a small proportion of fully correct answers. Some candidates simply multiplied the three column totals (no marks) and some multiplied the three correct row totals but ignored the conditionality (one mark). Of those who multiplied the correct three conditional probabilities (two marks) many failed multiply the result by 6, opting instead for 1 or 3.

Question 4

It was rare for candidates not to score the two marks in part (a) and the six marks in part (b)(i) where, in the latter, the use of calculators' in-built regression functions was almost universal. Where marks were lost in part (b)(i), it was usually for not plotting (oversight?) or plotting inaccurately the correctly calculated line. It was evident in many cases that lines had been plotted by eye (some sufficiently accurate) or by using only the point $(\bar{x}, \bar{y})$, instead of using two calculated (end) points. In part (b)(ii), weaker candidates simply restated their values of b and a or introduced correlation for no marks. Better candidates attempted interpretations in context, though these were at times confused or contradictory. The strongest candidates identified the value of b as time in hours per ridge tile and that of a as, for example, preparation time. Answers to part (c) almost without exception scored the one mark available. However, part (d) was a different story altogether and showed clear evidence of a lack of understanding of residuals. In part (d)(i), it was not unusual to see the value of the pmcc (r) or even r^6 calculated. Where some idea of a residual was in evidence, many candidates substituted 6, instead of 20, in their equations. Even correct substitutions were sometimes spoilt by premature rounding and more than half of otherwise correct answers had the incorrect sign. In part (c)(ii), very few candidates indeed appreciated that the sum was zero. Common responses included 'extrapolation' or a repeating of 'gives no useful information'.

Question 5

Most candidates answered parts (a)(i) & (ii) correctly either by use of tables or, less frequently, direct from calculators. A minority used 1.8, instead of 1.81, or used $z = 1.25$ after calculating its value as 1.125 in part (a)(i), or omitted the area change in part (a)(ii). Part (a)(iii) caused more difficulty; this despite its similarity to requests on previous papers. This was almost entirely due to 1.81 being both the value of x and μ. Having found that $z = 0$, too many candidates then used 0 instead of 0.5 as a probability. Only the strongest candidates scored full marks in part (b), although the clues in the question gave other candidates an opportunity for some marks. Thus in part (b)(i), most candidates stated a correct value for z but failed to derive the equation. In part (b)(ii), the majority of candidates stated $z = (+)1.96$ and then apparently were not concerned when, as a result, $\sigma < 0$. Attempts at solving the pair of simultaneous equations were at times laborious and involved dubious algebra. The most straightforward approach in this context was to subtract one equation from the other to 'eliminate' μ, solve the resultant equation for σ, and then, by substitution into one of the original equations, find μ. The significant minority of candidates who stuck with equations involving 0.88 and/or 0.975 scored at most one mark in part (b).

Question 6

Candidates generally scored highly on part (a) of this question although a small number of candidates 'crashed out' by interpreting $\mathrm{B}(40, 0.35)$ as $\mathrm{N}(40, 0.35)$. In parts (a)(i) to (iii), the usual errors occurred at times:

- **not** including 15 in 'at most 15';
- equating 'more than 10' to '1 – fewer than 10';
- **not** equating 'more than 12 but fewer than 18' to '17 or fewer minus 12 or fewer'.

In part (a)(iv), further confusion with the normal distribution arose with 0 as a common incorrect answer. Those who correctly found the mean to be 14 invariably then opted to use the formula correctly rather than use tables. As expected, part (b) was a challenge that was completed reasonably successfully by many candidates. When stated, alternatives to the necessary condition of 'random' were often interesting to say the least. In addition to the expected 'independent', it was not unusual to see CLT (perhaps it was felt that it would be needed somewhere on the paper?), conditions for a normal approximation to binomial (not within S1 specification), or explanations regarding the availability of landlines versus mobiles! In calculating the probability, good candidates handled the switch from $p = 0.7$ to $p = 0.3$ correctly whilst others picked up one or two method marks for seen valiant attempts which led to recognisable, but incorrect, final answers.

Question 7

Answers to this question covered the full range of marks available. In part(a), possibly a slightly larger proportion of candidates than on previous papers standardised correctly using $\frac{10-10.15}{0.3/\sqrt{12}}$ although some then failed to carry out the area change. Too many candidates scored no marks for using $\frac{10-10.15}{0.3}$. In part (b), the calculation of the confidence interval was usually based on a correct expression even if not numerically correct. The most common mistakes were use of either an incorrect z-value or the use of $n = 12$ from part (a). Far too many, otherwise correct, answers lost the final mark by ignoring the accuracy instruction. In part (c), candidates were much more successful in justifying Claim 1 than Claim 2. Most realised that, for the former, they had to compare 300 with their confidence level, but too many candidates scored no marks for a comparison of a claimed mean value with a sample mean. In justifying Claim 2, the majority of candidates made incorrect references to the confidence interval including only 99% of pouches or vague comments regarding the sample mean and standard deviation. Only the strongest candidates considered $\bar{x} - ns$ and even then did not always explicitly compare the result with 300.

Mark Ranges and Award of Grades

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

Converting Marks into UMS marks

Convert raw marks into Uniform Mark Scale (UMS) marks by using the link below.

UMS conversion calculator