General Certificate of Education

Mathematics 6360

MS2B Statistics 2B

Report on the Examination

2010 examination – January series

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General

The average level of achievement on this paper was similar to the standard achieved in the January series of both 2008 and 2009. Candidates appeared very well-prepared and generally knew what to expect. However, a better understanding of simple probability and, especially the derivation of binomial probabilities, would have helped the majority of candidates.

Candidates appeared very well-prepared and generally appeared to know what to expect. However, a better understanding of the derivation of binomial probabilities would have helped the majority of candidates. Compared with recent papers, the stating of hypotheses was rather disappointing, with far more candidates failing to state any hypothesis at all, especially in Question 4. Also, the stating of conclusions in context was often far too positive or missing altogether. The use of previous papers, in conjunction with their Examiners' Reports would, in many cases, enhance the preparation of candidates.

Question 1

This was the best answered question on the paper with many candidates gaining full marks. Those losing marks did so by either failing to state their hypotheses correctly or by not giving an appropriate conclusion in context. A few candidates thought, incorrectly, that they should use $\sqrt{\frac{30}{29} \times 4.8}$ for their value of s, this in spite of the value of s^2 being given in the question. Most candidates used a correct critical value; either $z = 2.3263$ or $t = 2.462$ were acceptable.

Question 2

Surprisingly, this was the worst attempted question on the paper. The majority of candidates gained both marks in part (a), but many failed to recognise that the continuous random variable, T, followed a rectangular distribution. Consequently, there were many attempts using calculus to find the values and, although these were often correct, this wasted time that could perhaps have been better used in answering other more difficult questions.

Part (b) was only answered correctly by the better candidates. Many did not understand that $\mathrm{P}(-2 < T < 2)$ was required and so simply attempted to evaluate $\mathrm{P}(T > 2)$ with the result that $\frac{23}{30}$ was the most prevalent incorrect answer. Too many candidates treated T as a discrete random variable with $\mathrm{P}(T > 2) = 1 - \mathrm{P}(T \le 1)$ often seen, whilst others again used unnecessary integration rather than simple areas of rectangles.

Question 3

The great majority of candidates either did not state an assumption or simply stated incorrectly one of "It is Normal", "Sample is Normal", "Data are normally distributed" or "Shots are normally distributed". None of these responses gained any credit. Candidates should have stated "The parent population is / The lengths of shots are / The distances achieved are normally distributed". Almost all candidates found $\bar{x} = 184$ but their calculations of s or s^2 were less well done.

Some candidates did not seem to understand how to find the required value from the given information, with $s = \sqrt{1240} = 35.2$ seen too often. However, most candidates found the correct value of s^2 followed by a correct evaluation of the required t-statistic. Candidates should understand that, when the value of the population standard deviation is unknown and the sample size is small, then a t-test and **not** a z-test should be used, otherwise marks will be lost. Conclusions in context were sometimes either too positive or missing altogether.

Question 4

This was the second most common source of marks for the majority of candidates, with many fully-correct solutions seen. However, far too many candidates failed to state their hypotheses but still felt justified in drawing some sort of conclusion. The question required candidates to combine two rows. However, some candidates were thrown by the observed value of 2 which did not give an expected value of less than 5. This usually led to incorrect combining and even to the use of Yates' correction when a 2×2 table resulted. In fact, many candidates did not attempt to combine at all.

In part (b), only the more able candidates gave the correct interpretation that 'More students than expected pass their test first time' or 'Fewer students than expected fail their test first time'. Many candidates appeared not to understand the question and so simply compared age groups.

Question 5

Only the most able candidates managed to find the solution to part (a) by stating correctly that $\mathrm{P}(X > 15) = 1 - \mathrm{P}(X \le 15) = 1 - 0.18943 = 0.811$. For those using tables for $\mathrm{B}(25, 0.3)$, the most popular misconceptions were to obtain $\mathrm{P}(X \le 15) = 0.9995$, and then **either** thinking that this gave the correct answer **or** that, since the value of $p = 0.3$ had been obtained by subtracting 0.7 from 1, the correct answer was found by subtracting 0.9995 from 1. Very few candidates were able to use the binomial tables correctly and so $\mathrm{P}(X > 15) = \mathrm{P}(X' \le 9) = 0.8106$ was very rarely seen.

Answers to part(b)(i) were usually correct as were those to part (b)(ii), except by those candidates who, on not finding $\lambda = 4.9$ in the tables, incorrectly thought that the use of $\lambda = 5$ was close enough. In part (b)(iii), candidates were asked to write down the **distribution** of the random variable T. Although the majority stated that $\lambda = 7.5$ they did not state that the distribution was Poisson and consequently lost a mark. There were many fully correct solutions to $\mathrm{P}(T > 16)$ with most candidates realising that $\mathrm{P}(T > 16) = 1 - \mathrm{P}(X \le 16) = 0.002$.

Question 6

The great majority of candidates gave the correct answer to part (a)(i), though a small minority stated that $a = 100$. In part (a)(ii), although most candidates gave the correct answer, not many were able to *write down* the value of $\mathrm{E}(X)$ by looking at the symmetry of the distribution; the majority of candidates used $\mathrm{E}(X) = \sum_{\text{all } x} x \times \mathrm{P}(X = x)$ to find the correct answer. Part (a)(iii) was done well with very many correct answers seen. However, some candidates, having found that $\mathrm{Var}(X) = \frac{25}{36}$, failed to go on to calculate the standard deviation. Some of those candidates, who used decimals rather than fractions, occasionally ended up with $\mathrm{Var}(X) = 0.69$ giving $\mathrm{sd}(X) = 0.831$ and as a consequence, lost an accuracy mark. It is emphasised that, as final answers are normally required to be given correct to 3 significant figures unless otherwise stated, working throughout should be to at least 4 significant figures.

Part (b) of this question was not well done by the majority of candidates. The most popular misconception, which gained no marks, was that Joanne made a loss because $\mathrm{P}(\text{Loss}) = \frac{7}{9} > \mathrm{P}(\text{Win}) = \frac{2}{9}$. In fact $\mathrm{P}(\text{Loss}) = \frac{5}{9} > \mathrm{P}(\text{Win}) = \frac{4}{9}$ which lead to the conclusion that Joanne could expect to make a loss.

When the correct reason for a loss was given, candidates were often then unable to calculate the magnitude of the loss with $\frac{5}{9}\times 100\times 50 - \frac{4}{9}\times 100\times 90 = -1222\frac{2}{9}$ often seen. Candidates should have calculated $\frac{5}{9}\times 100\times 50 - \frac{4}{9}\times 100\times 40 = 1000\text{p}$ (£10) **or** $50\times 100 - \frac{4}{9}\times 100\times 90 = 1000\text{p}$ (£10). A considerable number of candidates' answers were penalised by 1 mark for rounding $\frac{5}{9}\times 100$ to 56 and $\frac{4}{9}\times 100$ to 44. This led to $56\times 50 - 44\times 40 = 1040\text{p}$ (£10.40) as the amount lost by Joanne.

Question 7

In part(a)(i), many candidates did not realise that an estimate for the standard error of the mean was given by $d = \frac{s}{\sqrt{n}}$ and consequently that $d^2 = \frac{93.0}{12} = 7.75$. In part (a)(ii), where many correct answers were seen, some candidates used $z = 1.2816$ as their critical value whereas $t_{11} = 1.363$ was required. Others, confused by part (a)(i), often used $64.8 \pm 1.363\times\frac{\sqrt{7.75}}{\sqrt{12}}$ rather than $64.8 \pm 1.363\times\sqrt{7.75}$.

In part (b)(i), the correct answer was seen more often than not. Unfortunately, some candidates stated $(60, 70)$ or $(54.8, 74.8)$ as their answer, neither of which gained the mark available.

There were a lot of excellent solutions to part (b)(ii) from, in general, the more able candidates. The correct critical value of $t = 1.796$ often led to the correct answer of 90%. However, since candidates found that $t_{0.95} = 1.796$, some then quoted 95% as the answer. Unfortunately, some candidates insist on using z-tables for all calculations on confidence intervals (and indeed hypothesis testing in general) and consequently used $z = 1.79$ or $z = 1.80$ which, from tables, gave incorrect values of 92.8% or 92.6% respectively.

Question 8

In the previous Report on the Examination, it stated that too many candidates seemed to be under the misapprehension that a request for a 'sketch' entitled them to draw a very poor quality graph or copy some unscaled diagram taken from the display on their graphics calculators. This still seemed to be the case and all such attempts lost some or all of the marks available. The axes should have been drawn with the aid of a ruler and pencil and, as a minimum, should have contained the appropriate scales; $O(0, 0)$, $(1, 0)$ and $(2, 0)$ on the x-axis and $(0, 0.5)$ and $(0, 1)$ on the y-axis. The two concave arcs were often seen as being convex or as straight lines.

In part (b), there were many correct solutions with $\int_0^1 \frac{1}{2}\left(x^2+1\right)\mathrm{d}x = \frac{2}{3}$ often seen. Unfortunately, those candidates who drew straight lines in their sketches, usually ended up with $\mathrm{P}\left(X \le 1\right) = \frac{1}{2}\left(0.5+1\right) = \frac{3}{4}$; this gained no credit.

Part (c) was answered very well by many candidates with the standard of algebra and integration showing a marked improvement. However, it should be noted that, where an answer is given on the examination paper, sufficient method must be shown to ensure that full marks are awarded.

Part (d)(i) was answered very well by many candidates. However, some candidates, having found that $\mathrm{Var}\left(X\right) = \frac{4}{5} - \left(\frac{19}{24}\right)^2 = \frac{499}{2880}$, then were unable to write down the value of k as 2880. Whilst most candidates obtained the correct answer in part (d)(ii), a minority thought incorrectly that $\mathrm{E}\left(X^2\right) = \left(\frac{19}{24}\right)^2$ even though the correct value of $\frac{4}{5}$ was given in the question. Part(d)(iii) was quite well attempted although some candidates used $\mathrm{Var}\left(12X-5\right) = 12 \times \mathrm{Var}\left(X\right)$ or even $\mathrm{Var}\left(12X-5\right) = 12^2 \times \mathrm{Var}\left(X\right) - 5$.

Mark Ranges and Award of Grades

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