General Certificate of Education

# Mathematics 6360

**MS2B Statistics 2B**

# Report on the Examination

*2010 examination – June series*

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## General

Candidates appeared to be very well-prepared for this examination. It was very pleasing to see the many fully-correct solutions to each of the questions on the paper. However, candidates should have taken more care in giving numerical answers to the degree of accuracy requested in the question. Candidates should also have realised that, where answers were given in a question, these were put there to help them reach the correct conclusion. Greater care should have been taken in answering such questions; to achieve full marks, a complete and accurate method had to be demonstrated.

## Question 1

The majority of candidates either did not state an assumption or simply stated incorrectly that "It is normal" or "Sample is normal" or "Data are normally distributed" or "Customers are normally distributed". None of these responses gained any credit. Candidates should have stated that "The parent population is normal" or "The number of customers is normally distributed". Almost all candidates found that $\overline{x} = 82$ and that $s = 5.58$ (or $s^2 = 31.1$).

The correct evaluation of the required $t$-statistic $(1.86)$ was often seen. However, some candidates appeared not to 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 must be used. As a result, too many lost a significant number of marks. Conclusions in context were sometimes either too positive or missing altogether.

## Question 2

This was the most common source of marks for the majority of candidates, with many fully-correct solutions seen. However, too many candidates still failed to state their hypotheses but nevertheless felt justified in drawing some sort of conclusion. Since a $2 \times 2$ table was given, the use of Yates' correction was required, something that some candidates failed to do.

## Question 3

Too many candidates seemed to think that a request for a 'sketch' entitled them to draw a very poor quality graph. A horizontal straight line was expected but not always seen.

Some candidates failed to draw a graph of the given function, instead using the given value of $k = \frac{1}{2}$ to draw a graph of $\mathrm{f}(x) = \begin{cases} \frac{1}{2} & -\frac{3}{2} \le x \le \frac{1}{2} \\ 0 & \text{otherwise} \end{cases}$, which obviously lost credit.

In part(a)(ii), where the answer was given, too little method was frequently seen for the candidate to be awarded full marks.

In part (b), the majority of candidates used the formula $\mathrm{E}(X) = \frac{1}{2}(a+b)$ to correctly calculate the mean. However, the calculation of the **exact** numerical value of the standard deviation was less well done. Many candidates found the variance to be $\frac{1}{3}$ but then either failed to state the value of the standard deviation or gave a decimal value (usually $0.577$) where an **exact** value (equivalent to $\frac{1}{\sqrt{3}}$) was required.

In part (c)(i), many found the correct answer of $\frac{3}{8}$. Unfortunately there were several candidates who used this value in working out their answer to part (c)(ii). Consequently, an answer of $\frac{5}{8}$

was a popular incorrect answer, along with the inevitable zero! However, most candidates did realise that $\mathrm{P}\left(X \neq -\frac{1}{4}\right) = 1 - \mathrm{P}\left(X = -\frac{1}{4}\right) = 1 - 0 = 1$.

## Question 4

Almost all candidates found that $\bar{x} = 0.035$ but their calculations of $s$ or $s^2$ were less well done. Several candidates did not seem to understand how to find the required value from the given information, with $s = \sqrt{0.12705} = 0.3564$ often seen. Most of the candidates who found the correct value of $s^2$ usually correctly evaluated the required $t$-statistic.

Yet again, some candidates appeared not to understand that, when the value of the population standard deviation is unknown and the sample size is small, then $t$-values and **not** $z$-values should be used, otherwise significant marks will be lost. Too many candidates also ignored the request for the limits to be given to three decimal places.

## Question 5

The majority of candidates gained full marks for parts (a)(i) and (a)(ii). However, in part (a)(iii), although there were many correct answers seen, there were far too many candidates who could not interpret correctly the expression 'at least 5 but fewer than 10'.

In part (b), candidates were asked to write down the **distribution** of the number of telephone calls received each hour. Although the majority stated that $\lambda = 0.875$, they did not state that the distribution was Poisson and consequently lost a mark. Part (c)(ii) was answered correctly by, in the main, only the most able candidates. Some who correctly realised that $\mathrm{P}(Y \geq 4) = 1 - \mathrm{P}(Y \leq 3)$ was required then omitted $\mathrm{P}(Y = 0)$ when evaluating $\mathrm{P}(Y \leq 3)$ or used $\lambda = 7$ in their calculations. The reasons given in part (d) were not always expressed well enough to gain credit.

## Question 6

Part (a) was usually answered well. However, in part (a)(iii), too many candidates did not show a sufficiently complete and accurate method to gain full marks.

There were many correct solutions seen to part (b). In part (b)(i), those candidates who seemed to have very little or no idea simply attempted to multiply the corresponding values in the two tables together and then wrote the given answer of 0.24; this gained no credit.

In part (b)(ii), most candidates realised that binomial probabilities were required, but unfortunately candidates often only considered one term. Even when two terms were attempted, the incorrect expression $0.24^4 \times 0.76 + 0.24^5$ was often seen.

Part (b)(iii) was only answered correctly by the most able candidates. Some found $\mathrm{P}(R = 4 \text{ and } S \leq 4) = 0.11$ and thought that this was the required answer, whilst others realised that they had to divide $\mathrm{P}(R = 4 \text{ and } R + S \leq 8)$ by 0.24 but were unable to find the correct value for the numerator.

## Question 7

Part (a) was answered very poorly by too many candidates. Candidates were asked to **state** values for the median and lower quartile of $X$. This should have indicated to candidates that the answers required little work, but this was often not picked up. Some candidates obtained the correct values but these were often invalidated by incorrect methods. Those candidates who employed calculus often had more success, as they realised that $\mathrm{F}(m) = 0.5$ and $\mathrm{F}(q_1) = 0.25$ were required.

Part (b) was often done well by those candidates who realised that $\mathrm{F}(x) = \frac{1}{54}(x-4)^3 + c$, as they usually went on to use either $\mathrm{F}(1) = \frac{1}{2}$ or $\mathrm{F}(4) = 1$ to show that $c = 1$. Some candidates, having been given the answer in the question, simply wrote this down at the end of what was usually a totally incorrect method.

Part (c) was usually done by correctly attempting to evaluate $\mathrm{F}(3) - \mathrm{F}(2)$ but the arithmetic then defeated many.

Most candidates realised that $\mathrm{F}(q) = \frac{3}{4}$ was required and consequently went on to gain full marks for part (d)(i). The correct answer to part (d)(ii) was often seen, even by those candidates who could not do part (d)(i). However, some failed to give the answer to three decimal places and so lost the mark.

## Mark Ranges and Award of Grades

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