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General Certificate of Education (A-level)
June 2012

# Mathematics MS2B

# (Specification 6360)

# Statistics 2B

# *Report on the Examination*

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## General

It was very pleasing to see many fully-correct solutions to each of the questions. However, on the other hand, it was disappointing to find that an increasing number of students can neither manipulate numerical and algebraic expressions nor work out numerical answers to questions that require *exact* answers. Students who relied solely on their calculators, all too often fell short on the skills required to answer such questions. There were also more students writing down answers directly from their calculators without showing any method. Unfortunately, where these answers were incorrect no marks could be awarded.

## *Question 1*

Many students still seemed not to understand whether to use *t*-values or *z*-values in constructing confidence intervals or carrying out hypothesis tests. In this question, the sample size was *small* and was selected from a *normal population* with *unknown variance* so *t*-values should have been used. Unfortunately many students neither used a *t*-statistic nor did they give their answers to one decimal place as requested. Consequently many more students than expected failed to gain full marks. In part (b), marks were lost by those students who failed to state that 40 did or did not, depending on the confidence interval constructed, lie in the confidence interval. It was not sufficient to simply state "Mean in CI" since this could have referred to 36.4 rather than to the value of 40.

## *Question 2*

This question was very well answered, with most students correctly using *z*-values. There were, however, some who either failed to state any hypotheses or stated them in an incorrect form. Some students seemed determined to use *t*-values whatever was given in the question, whilst others either stated a conclusion that was far too positive or failed to relate a conclusion to the context. In part (b), most students were able to determine what error, if any, was made in the test conducted in part (a).

## *Question 3*

In part (a), most students were able to indicate that the differentiation of F(*x*) was required even though use of the correct notation was often sadly lacking. In part (b), those who realised that they were dealing with a continuous *rectangular* distribution, found parts (i), (ii) and (iii) very easy; simply writing down the required answers. Unfortunately, in part (b)(i), some students thought that the answer was 0.6 whilst others assumed a discrete distribution and consequently attempted to find $1-\mathrm{P}(X \le 6)$. In part (b)(ii), a common incorrect answer was $\mathrm{P}(X \ne 7) = 0$. In part (b)(iii), the correct answer $\mathrm{E}(X) = 5$ was usually seen but most students, unnecessarily, used calculus to evaluate $\int_{-5}^{15} \frac{x}{20}\,\mathrm{d}x$ thus wasting time. In part (b)(iv), the great majority chose to correctly evaluate $\int_{-5}^{15} \frac{3x^2}{20}\,\mathrm{d}x$ to achieve the required answer of 175.

## *Question 4*

This was the best answered question on the paper with many fully correct solutions seen. Almost all students managed to complete the table in part (a) correctly. Weaker students found part (b) very difficult to fathom. However, there were very many fully correct solutions with most making good use of the probabilities found in part (a). Part (c) was especially well done with many correct solutions to all parts. However, some students lost credit for using premature approximation or for failing to write down the value of the standard deviation having correctly found the value for the variance.

## *Question 5*

Many fully successful solutions were seen to part (a). In part (b), some students were unable to cope with the fact that the value of $\lambda = 1.5$ was not given in Table 2 of the supplied booklet. Thus some tried to use this table by finding the average of the values of $\mathrm{P}(X \le 1)$ for $\lambda = 1.4$ and $\lambda = 1.6$. This incorrect method gained no credit. Answers to part (c)(i) were almost always correct as were those to part (c)(ii), except for the students who thought that they needed to evaluate $1 - \mathrm{P}(X \le 15)$. The great majority of students realised that the binomial distribution was required in part (c)(iii). Unfortunately, one of the two required terms was often missing.

## *Question 6*

As has been the case on previous papers, this was again one of the best answered questions. Most students managed to state correct hypotheses and then evaluate the required expected values. Most realised that ‘degree classes 2(ii) and 3’ needed to be combined and did so successfully, and for the correct reason that $E_i < 5$ for those students gaining a ‘degree class 3’ degree having gained an ‘A-level grade A’. This usually led to the correct final column and hence the correct value of 13.5 for $X^2$. Correct conclusions, in context, were then usually seen. Unfortunately some students, who realised that they had to combine in some way, decided incorrectly, to combine ‘degree classes 1 and 3 or 2(i) and 3’. This obviously lost marks. Other students combined ‘degree classes 2(i) and 2(ii)’ and consequently lost most of the marks for the question whilst others combined for the wrong reason by indicating that $O_i < 5$ necessitated combining cells, or failed to combine any ‘degree classes’. There were many excellent answers given to part (b). However, incorrect statements such as “Those receiving a class1 obtained fewer grade B’s at A-level than expected” gained no credit.

## *Question 7*

Students should not have expected to gain full marks when they failed to use a ruler to help them draw the straight lines required to complete the graph. *Freehand sketches* were not good enough since they were asked to *draw* a graph. Part (b) was usually completed successfully. Although students produced some excellent solutions to part (c), these were not always fully explained. Only the very best students managed a fully correct solution to all parts of (c). Many, in part (c)(iii), simply multiplied together their answers to parts (c)(i) and (c)(ii), obviously believing that the events $X > 2.5$ and $1.5 < X < 4.5$ were independent. This was incorrect and so gained no credit. Many students used calculus to find the required areas, often with more success than those who attempted to use a combination of areas of simple geometric shapes (rectangle, trapezium, triangle). Students using the latter method seemed unable, on the whole, to cope with calculations involving fractions, often writing $\frac{5}{12}$ as 0.41 or 0.416 before attempting to calculate the required area. Marks were often lost, especially in parts (c)(iii) and (c)(iv), due to students' inability to write their answers in an **exact** form as requested. The correct answer to part (c)(iii) of $\frac{17}{48}$ was often seen as the answer to part (c)(iv). Some students gave excellent solutions to this question by first finding the cumulative distribution function F($x$). Unfortunately, some weaker students who attempted this method were unable to find the correct form for F($x$) and so lost marks.

## 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