



A-level

# **Further Mathematics**

7367/3S Paper 3 Statistics

Report on the Examination

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## General

The paper offered opportunities for all students to score reasonable marks. Students performed best on questions that required mathematical manipulation or calculation of standard expressions. Questions requiring interpretation were answered less well.

### Question 1

Nearly all students scored the mark. The most common incorrect answer was to identify the variance rather than the standard deviation.

### Question 2

About half of students scored the mark. Many students confused the mean and the parameter and circled the fourth answer.

### Question 3

Over three-quarters of students scored the mark. The most common incorrect answers were the middle of the interval and the root of the equation which did not lie within the interval.

### Question 4

About half of students scored full marks. Many dropped one or two marks due to errors with the hypotheses, omitting the conclusion or not putting it in context. Errors in the hypotheses included an incorrect null hypothesis such as using an inequality or not expressing them using correct notation. Some conclusions omitted the full context or were too definite. Students losing more marks either incorrectly did not reject the null hypothesis or did not attempt to calculate the correct probability. However, it was condoned when students calculated the correct probability but mislabelled it. A small proportion of students attempted a critical region approach. A significant proportion of students only scored one mark, usually for giving the correct hypotheses but attempting a normal distribution hypothesis test.

### Question 5

Nearly three-quarters of students scored full marks, but a significant proportion scored no marks, usually for attempting to find the mean value of a function or the median of the random variable instead. Those attempting a correct approach but not scoring full marks usually made calculation or sign errors. This included using an incorrect formula for integration by parts. A minority of students obtained an expression equivalent to the given answer but were unable to simplify it.

**Question 6**

**(a)** Nearly three quarters of students scored the mark. Many students gave answers that could be considered a subset of the requirement, for example that the distribution needed to be symmetrical, but that was not enough to be given the mark. Some students stated other distributions or gave answers that were not related to distributions at all.

**(b)** Over a third of students scored full marks. Many dropped one or two marks due to errors with the hypotheses or conclusion. Errors in the hypotheses included an incorrect null hypothesis such as using an inequality or not expressing them using correct notation. Some conclusions were incorrect, too definite or omitted the context. Students losing more marks usually made an error either with calculating the unbiased estimate of the variance or incorrectly identified the critical value, often finding the one-tailed equivalent. A small proportion of students attempted either a critical region or a confidence interval approach. A significant proportion of students only scored one mark, usually for giving the correct hypotheses but attempting a normal distribution hypothesis test instead of a  $t$ -distribution test.

**Question 7**

**(a)** Over half of students scored the mark on this part. The most common incorrect answer was to square  $n - 1$  rather than just  $n$ . Some students attempted to find an expression using first principles but were unable to make sufficient progress.

**(b)** Over a third of students scored full marks on this part but more scored no marks. Many students did not recognise the link between the two variables and so were unable to progress their solution. It was common to replace  $n$  with  $3n + 10$  in their expression from part **(a)**. Some students did not follow the instructions in the question, either by attempting a solution through first principles which didn't follow the "hence" instruction or by not showing sufficient working, which didn't follow the "justify your answer" instruction. There was significant non-response.

**Question 8**

Over a third of students scored full marks. Many did not show sufficient working to show that they had achieved the given answer correctly and so lost the final mark. A significant proportion of students only scored one or two marks, usually by finding the mean and the associated probability but not understanding what other probabilities they needed in order to apply the conditional probability formula.

**Question 9**

**(a)** The vast majority of students scored full marks on this part. Those not obtaining full marks often misread the information given and so assigned at least one correct value to the wrong cell, which impacted the calculation of the remaining values.

**(b)** About half of students scored full marks on this part. Some students lost marks by writing the hypotheses the wrong way round and continuing this error with the conclusion. Some hypotheses were missing the variables. A minority of students gave definite conclusions or used the wrong terminology. Some made calculation errors or identified an incorrect critical value by treating the test as two-tailed.

**Question 10**

**(a)** Nearly three-quarters of students scored full marks on this part though a significant proportion scored no marks for using an incorrect formula. The most common error was to identify an incorrect  $z$  value, usually corresponding to a lower tail of 91% rather than 95.5%.

**(b)(i)** Over half of students scored the mark. Those that didn't often did not refer to 10.36 to make their reasoning clear or did not give a decision as to whether the null hypothesis was rejected.

**(b)(ii)** Over half of students scored no marks on this part as they did not identify the correct values and did not use the correct distribution for the probabilities. A significant proportion scored one mark, and this was usually for using the correct distribution to find a probability associated with the confidence interval found in part **(a)**. There was significant non-response.

### **Mark Ranges and Award of Grades**

Grade boundaries and cumulative percentage grades are available on the [Results Statistics](#) page of the AQA Website.