



A Level

# **Further Mathematics**

7367/3S Paper 3 Statistics

## Report on the examination

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## General

The paper was accessible to the full range of students, with ample opportunity for all to demonstrate their understanding, whilst still presenting appropriate challenge to those at the top end. Students typically performed most strongly on items requiring routine manipulation of standard formulae or straightforward calculation. By contrast, questions demanding interpretation, or significant algebraic manipulation, were generally handled less well. It is recommended that future students ensure they practise these aspects thoroughly, as the ability to interpret and manipulate expressions remains central to the specification.

## Question 1

The majority of students achieved the available mark. The most frequent error was to multiply the standard deviation by 5 squared without squaring the standard deviation to achieve the variance.

## Question 2

Nearly all students were successful in this question. A small number of students selected the most common probability.

## Question 3

The majority of students scored the mark. The most common error was to select “He could have made a Type II error but not a Type I error”.

## Question 4

**(a)** Approximately three quarters of students achieved full marks for this part, indicating a sound understanding of the topic. Some students identified the correct calculation, but the mode of their calculator was set to degrees instead of radians or made other calculation errors. Those scoring no marks tended to integrate the function. A significant proportion unnecessarily differentiated then integrated the function, achieving the given function.

**(b)** Over three quarters of students achieved full marks. A minority of students lost the final mark for not showing enough working to achieve the given answer. Those scoring no marks tended to integrate the given function.

**(c)** Approximately two thirds of students achieved full marks with many losing the final mark for not considering where the function was equal to zero, inadequate notation (for example

omitting the equals sign) or giving a cumulative distribution function structure with a region where the function was equal to one. Those scoring no marks tended to integrate the given function.

## Question 5

**(a)** This part was completed successfully by over a half of students. Some lost the final mark for giving the variance of  $R$  as one twelfth without giving an unsimplified equivalent first and so not showing that they didn't just use the given answer to identify it. A significant proportion of students used at least one incorrect formula with some using the given answer to derive the second variance. A minority of students found the variances using first principles, whereas memorising the formulae would have saved them much time in the exam.

**(b)** More than a half of students scored full marks for this part with some losing the final mark for not considering and rejecting the possible solution of 2. The most common error was the use of incorrect formulae for the expectations of  $D$  and  $R$ .

## Question 6

**(a)** Approximately two thirds of students obtained at least three marks for this part. Some students found  $\sigma^2$  and  $z$  rather than  $s^2$  and  $t$ . Another common error was to identify the critical value as 1.372 rather than 1.812. Less successful students used an incorrect formula for  $s^2$  or the confidence interval.

**(b)** In this part, less than half of students were awarded at least two marks. Many did not recognise that a hypothesis test was required and scored no marks. Errors made in part (a) meant that some students were unable to access the final mark. However, those who did have correct working in both parts lost the final mark due to insufficient context in their conclusion or for writing a definite conclusion. Sometimes the first mark was lost for not writing the hypotheses but otherwise the solution was correct.

## Question 7

**(a)** Over half of students scored at least six marks for this part with many losing the final mark for calculation errors or for only giving one of the scores. Some students obtained the correct equation but were unable to solve it, particularly how to deal with  $100^n$ . A significant proportion of students used calculators to get round this difficulty. Less successful students were unable to set up the correct equation, usually being unable to obtain  $E(X^n)$ .

**(b)** Approximately one third of students achieved the mark for this part, with errors made in part (a) resulting in the mark not being available for most students. Students who were successful in part (a) also lost the mark due to giving solutions that did not satisfy the conditions, most commonly 0, 90 and 8760 or equivalent. There was a significant proportion of non-response.

## Question 8

Approximately half of students achieved full marks. However, a number of students omitted a conclusion, did not provide it in context, or wrote a definitive conclusion without using appropriate language such as “suggest” or “support”. In several cases, students omitted the hypotheses or provided incomplete statements: for instance, omitting variables. A minority wrote the correct hypotheses the wrong way round and most made a corresponding error in their conclusion. Errors in rejecting the null hypothesis were occasionally seen, often stemming from incorrect comparisons. Some students incorrectly identified the critical value or made calculation errors, including not using Yates correction for the test statistic.

## Question 9

**(a)** Approximately a third of students achieved at least five marks for this part, but many lost the final mark for either not having a limiting process, missing notation in their integrals or using  $\lambda = 2$  without justification to achieve the given answer. Some students used a large value for their upper limit. Less successful students either found cumulative probability rather than the mean or used the Poisson distribution rather than the exponential distribution.

**(b)** Over half of students achieved full marks. A significant proportion of students lost the final mark for not stating the Poisson model. Those scoring no marks tended to state the given answer with no evidence of calculation or attempted to use an exponential model instead.

**(c)** Approximately two thirds of students achieved full marks. Most who recognised the binomial model tended to achieve full marks but about a fifth of students did not and so scored no marks. There was a significant non-response rate.

## Mark Ranges and Award of Grades

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