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# **Further Mathematics**

7366/2S Paper 2 Statistics

Report on the Examination

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**General**

The paper offered ample opportunities for all students to score reasonable marks and so there was less evidence of non-response compared to previous sittings. 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. Incorrect answers were roughly split between choosing the probability (0.45) corresponding to the mode or the most common probability value (0.25).

**Question 2**

Well over three-quarters of students scored the mark. The most common error was to choose the entry in the observed table (Observed B-Z) with a frequency less than 5.

**Question 3**

Over three-quarters of students scored full marks though a significant proportion scored one or no marks. Those scoring one mark tended to have an incorrect  $z$  value, usually the one corresponding to the 94% level rather than the 97% level. A minority had the correct value but an incorrect formula for the confidence interval, most commonly not square-rooting the variance or attempting to convert it into the unbiased estimate. Those scoring no marks either made a combination of these errors or made no progress in their solution.

**Question 4**

**(a)** Over half of students scored full marks on this part but a significant proportion of students lost the final mark for not giving a more accurate answer before rounding to the given answer. Those scoring fewer marks either used incorrect formulae or made calculation errors.

**(b)** Slightly more students scored full marks in this part than part **(a)**. Some students identified the correct probability but did not evaluate it. Some made calculation errors, the most common being to omit the 1.5. The other common error was to find an incorrect median and find the corresponding probability.

**Question 5**

**(a)(i)** Over half of students scored the mark on this part. The most common incorrect answers seen included the binomial, Poisson or normal distributions or a generic discrete random variable.

**(a)(ii)** Well over three-quarters of students scored the mark on this part, although many misidentified the distribution in part **(a)(i)**. The most common error was to find a binomial probability instead.

**(b)(i)** Less than a quarter of students scored full marks on this part. Many students only referred to the observed frequencies and did not describe what would be expected for a discrete uniform distribution. Many were too definitive with their comparisons saying that the observed frequencies should be 125 rather than close to 125, allowing for the randomness of the process. Some students found it difficult to express what they meant using the correct language, referring to probabilities rather than relative

frequencies. A minority of students made comments that related to the binomial or Poisson distributions instead, which gained no credit.

**(b)(ii)** Students performed better in this part with nearly half scoring full marks. Many gave an incomplete solution, only referring to either calculating the relative frequencies or replacing the probabilities in the model, rather than both. A minority of students incorrectly referred to changing the situation to fit the model better. Those who had chosen different distributions in part **(a)(i)** often referred to those distributions. Students who didn't use the correct language in part **(b)(i)** often continued to refer to frequency rather than relative frequency in this part. Some students who didn't remember the term from GCSE Maths, described the calculation instead and were able to access the marks.

### Question 6

**(a)** Over three-quarters of students scored full marks on this part. A significant proportion lost a mark for finding  $P(X < 2)$  instead. The most common error was to integrate between 3 and 5 instead of 2 and 5, muddling the continuous distribution with a discrete one.

**(b)** Over half of students scored full marks on this part. A significant proportion did not use the correct limits on their integral to form their quadratic equation or formed the correct equation but did not solve it correctly. Students scoring no marks tended to try to find the mean instead of the median.

**(c)** Less than half of students scored full marks on this part but some lost one or more marks for rounding intermediate values. Over a quarter of students scored no marks. Most of these students found the variance of  $X$  and then raised it to the power of -3.

### Question 7

**(a)** Less than half of students scored full marks on this part with many dropping a mark for either incorrect hypotheses or giving a definite or incomplete conclusion. Incomplete conclusions often omitted "mean" or "per hour." Students who were less successful did not identify the correct probability required, often finding the probability of exactly 11 customers in an hour. Some students attempted a critical region method but often got it confused with the acceptance region. Very few students attempted a one-tailed test instead, but some compared their probability with 0.05 instead of 0.025.

**(b)** Over a quarter of students scored full marks on this part with nearly as many dropping one mark. The question required that the answer was fully justified but those losing the final mark did not justify their choice of probabilities to add together. Those scoring fewer marks calculated a range of probabilities but did not identify the correct ones to add together. There was significant non-response.

**(c)** Over half of students scored the mark on this part. The most common incorrect answer was to state that events need to occur singly for the Poisson model. Although some customers came to the store as part of a group they would have still entered the store singly in continuous time and so this answer was not accepted. Students not referring to the standard Poisson assumptions discussed whether customers would buy things in the store which was not related to the model and could not gain a mark.

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

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