AQA

A-LEVEL
FURTHER MATHEMATICS

7367/3S Paper 3 Statistics
Report on the Examination

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General

The paper offered ample opportunities for all students to score a reasonable number of marks. There was an improvement in the quality of written responses and this was reflected in a stronger overall performance on the challenging questions on the paper. In particular, there was an improvement in the quality of the conclusions written for hypothesis tests, with well-prepared students clearly using the language modelled in previous mark schemes.

Question 1

The majority of students scored the mark for this question. The most common incorrect answer was obtained by students who used the formula for a continuous uniform distribution rather than a discrete uniform distribution.

Question 2

The majority of students scored the mark for this question. The most common incorrect answer was obtained by students who only found P(0.5 < X < 1) rather than P(X < 1).

Question 3

In part (a), the majority of students scored full marks. The most common errors included incorrect attempts using integration by parts, sign errors and the use of infinity as the upper limit. Some students did not show complete working, particularly when using $\mathrm{F}(0) = 0$ to find a constant of integration. Many students used x as both the variable they were integrating with respect to and the upper limit of their integral, which is incorrect but was condoned on this occasion.

In part (b), the majority of students scored full marks. The most common error was to only find $\mathrm{F}(1)$ rather than the required probability. Some students used the probability density function rather than the cumulative distribution function. A minority of students treated the variable as if it were discrete and used P(X > 1) = P($X \geq 2$).

Question 4

In part (a), the vast majority of students scored full marks. The most common errors included finding the wrong Poisson probability, usually finding the probability of exactly 30 flowers or the probability of more than 30 flowers. Some students used a parameter of 10, 16, or both, instead of 26.

In part (b), the majority of students scored at least one mark. Most students identified the need to compare variances or standard deviations from the model and the survey, stating the values clearly. A minority of students didn't obtain the correct pair of values, usually comparing 26 with 10 or just obtaining one value. Many students did not score the final mark because they observed that the two values were not equal rather than noting they are significantly different. Some students used the general conditions of the Poisson distribution or concluded incorrectly that Poisson distributions do not have standard deviations so the distribution must be normal.

Question 5

In part (a), the majority of students scored at least one mark. Many students used the formula for the population variance rather than the unbiased estimator of the variance. A majority of these students also used a z-score instead of a t-score. Some students who attempted the correct approach rounded their intermediate results too much to justify that their final values were correct to the required level of accuracy.

In part (b), approximately the same proportion of students scored the mark as did not. Many students either did not make it clear that it was 85 that they were referring to or explicitly mentioned 86.5 instead. A significant proportion of students attempted the hypothesis test instead of using the confidence interval. However, in most cases this did not follow the instruction of the question as a reason was not stated for their conclusion.

In part (c), the majority of students did not score the mark. The most common errors included giving a definite conclusion, a conclusion without context or an incorrect conclusion. Some students attempted to describe the confidence interval instead.

Question 6

In part (a), the majority of students scored full marks, with few students dropping marks once they obtained three correct linear simultaneous equations. Some students set $\mathrm{E}(X^2)$ equal to 0.56 instead of the variance or either did not square the mean or squared the probabilities. Those who obtained a correct equation using $b + 2c$ instead of 1.2 for the mean were more likely to make algebraic slips when solving their simultaneous equations but some were able to solve them correctly. A minority of students used integration, thinking that they were working with continuous random variables.

In part (b), the majority of students scored full marks but a significant proportion of students used an incorrect formula for the variance of a linear combination of random variables. For example, not squaring the 2 or subtracting the two components instead of adding them were common. A minority of students subtracted 11.

Question 7

In part (a), the majority of students scored at least six marks. Common errors included definite or incorrect conclusions or conclusions which lacked context. Some students did not use Yates' correction or used an incorrect formula for the correction, usually leaving -0.5 outside the bracket. There were some errors made with the hypotheses such as stating them the wrong way round, not mentioning the variables or not including hypotheses at all. There were some students who incorrectly referred to correlation instead of association. Students who obtained an incorrect critical value were usually attempting a two-tailed test.

In part (b), a slim majority of students scored the mark. Many students either included no context, gave a description of a Type II error, or gave an incomplete description. Again, a minority of students referred to correlation instead of association.

Question 8

In part (a), the vast majority of students scored full marks with some losing a mark for not showing sufficient steps for a "show that" question. Some students integrated the cumulative distribution function and scored no marks.

In part (b), the majority of students scored at least two marks. Students most commonly dropped the final mark for not using ln (3/2) = ln 3 – ln 2. Use of brackets would have made many students' work clearer to follow but this was not penalised provided no errors were seen. Some students set up incorrect equations to solve, usually as a result of integrating the cumulative distribution function. A minority of students substituted 0.5 for x instead of setting the cumulative distribution function equal to 0.5.

In part (c), the majority of students scored at least three marks but many students scored no marks. Many students omitted $\mathrm{d}x$ from their integrals and did not use brackets when that would have made their working clear, though this was not penalised. Some students made algebraic slips or made an error when subtracting a negative after substituting in limits. A significant proportion of students assumed that substituting in zero would lead to all terms equalling zero. Students who started with an incorrect probability density function that was not similar to the actual function found it difficult to score marks, but some students managed to score for using integration by parts or substituting limits when their expression was similar.

Question 9

In part (a), the majority of students scored at least one mark. Many students either found 0.25 to be the probability, which was actually the constant value of the probability density function, or found the probability of less than or equal to 10.5 instead of greater than. The majority of students scored the second mark for correctly identifying whether Lianne would buy the battery or not based on their probability but some students either reached an incorrect conclusion or did not state one at all.

In part (b), the majority of students scored at least one mark but many students scored no marks. The most commonly scored mark was for identifying a normal distribution as an alternative model but some students named the exponential distribution as a distribution they were familiar with, that is sometimes used for the probability of time intervals. A minority of students chose discrete distributions such as binomial or Poisson, arguing incorrectly that a histogram is for discrete data. Students struggled to articulate why the histogram showed that the rectangular distribution was not a good model, often resorting to descriptions of the situation instead. Many students wrote about the probability not being constant when they should have referred to the frequency density.

Mark Ranges and Award of Grades

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