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Examiners' Report/ Principal Examiner Feedback

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GCE

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Introduction

Candidates would appear to have had enough time to complete this paper. There were few questions where no attempt had been made to produce an answer.

The level of work was generally very good. Many candidates were well prepared for the examination and candidate's answers were well presented.

Report on individual questions

Question 1

This question proved to be a very good start to the paper for a large majority of candidates. In part (a) the assumptions were written "in context". However, there are still too many scripts where there was no mention of context at all. Many simply wrote a list of reasons as to why a Poisson distribution should be used rather than stating the assumptions that had been made.

In parts (b) and (c) fully correct solutions were seen in a large majority of candidates. However, there were a small number who failed to spot the change in the value of the parameter n from (b) to (c).

In part (d) most candidates provided a clear and accurate solution. However, there were a few candidates who used a Normal approximation, which is clearly inappropriate in this situation since "n is large and p is small" applies in this case and therefore indicates the use of a Poisson approximation. A small but significant number of candidates used a Binomial distribution despite the question requesting that a suitable approximation be used. A common error from those using a Poisson approximation was the use of $P(X\leq 4)$ instead of $P(X\leq 5)$.

Question 2

The overall response to this question was disappointing. A common incorrect 'alternative hypothesis' of $p < 0.2$ was frequently seen implying that 'not guessing' is an inferior strategy to 'guessing'. Other common errors included the use of $p = 0.4$ instead of $p = 0.2$ and using $P(X = 4)$ or $P(X\leq 4)$ instead of $P(X\geq 4)$. There were also problems with candidates' conclusions. It was fairly common for candidates to provide complete and correct responses to the entire question except the final contextual conclusion. Their correct statement "do not reject the null hypothesis" was often followed by an incorrect comment in context such as: "So she was not guessing" or "So reject the teacher's claim".

Question 3

This question was a good source of marks for many candidates. In parts (a) and (b) the candidates who chose to use the formula generally did so successfully. The few who attempted integration to obtain a solution did so with variable success. In part (c) a few candidates who attempted to use the formula $\text{Var}(X) = \text{E}(X^2) - (\text{E}(X))^2$ were unable to correctly rearrange it to obtain $\text{E}(X^2) = \text{Var}(X) + (\text{E}(X))^2$.
The most common error was to get $\text{E}(X^2) = \text{Var}(X) - (\text{E}(X))^2$.
A small number of candidates used an alternative method, starting from 'first principles':
$\text{E}(X^2) = \int_{-1}^{3} \frac{1}{4}x^2 \text{d}x = \left[\frac{x^3}{12}\right]_{-1}^{3} = \frac{27}{12} - \frac{-1}{12} = \frac{7}{3}$. Most of these candidates were successful, although a final answer of 13/6 was obtained by a few candidates who failed to deal successfully with the two negatives. Part (e) was very well done by a large majority of candidates: a clear and concise method was provided together with fully detailed working leading to the correct answer.

Question 4

Many candidates gained full marks in this question. In particular, it is to be noted that most candidates had few problems with either the hypotheses or the conclusion. A sizeable minority of candidates used > instead of < in H_1. The most common error was to use $\text{P}(X = 3)$ instead of $\text{P}(X \le 3)$. There were also a number of candidates who failed to place their conclusion in context.

Question 5

The majority of candidates were able to attempt all parts of this question. However, part (a), proved to be a challenge to many. It was common to find candidates verifying rather than showing that *y* = 4 – 8*x*, by substituting in either value in each pair of co-ordinates to get the other or showing that $\int_0^{0.5} (4 - 8x)\,\text{d}x = 1$ and then stating '$\text{f}(x) = 4 - 8x$ for $0 \le x \le 0.5$'. For a minority finding the gradient of the line also proved challenging, with a variety of methods seen. Often seen was $m = \frac{4}{0.5} = 8$ using a diagram as an aid, with only the more observant candidates adding a note to explain why it must be negative. In some cases, candidates gave exemplary responses to the first part of part (a) but did not then proceed to specify f(*x*) fully, hence losing two marks. Part (b) was generally well answered by the majority of candidates. In part (c) the most common errors were to find F(0.5) or to solve f(*x*) = 0.5. The common incorrect modes given in part (d) were 4 or 0.5.

The majority of candidates were able to follow through their answers to part (c) and (d) to give the correct direction and reason for the skewness of *X*. A few candidates also calculated the mean, usually correctly, which was unnecessary.

Question 6

This question was answered well by a high proportion of candidates reflecting a good understanding of the Poisson distribution and also the use of the normal approximation to Poisson with many gaining full marks. In part (a) the main error was using Po(150).
In part (b) a minority of candidates failed to use a context when stating the conditions for any Poisson distribution or, if in context, failed to use words that implied "cars arrive" or "rate of arrival". For part c(i) the most common error seen was a rounded answer of 0.082. When finding the probability in part c(ii), a small minority of candidates calculated $P(X > 3) = 1 - P(X \leq 2)$ or found $P(X \leq 3)$. In part (d), the most common error was for candidates to write $P(X > m) = 1 - P(X \leq m - 1)$ and, having successfully shown that $P(X \leq 15 \mid X \sim Po(10)) = 0.93150$, then write $m - 1 = 15$ so $m = 16$. The majority of candidates used a normal approximation successfully in part (e) and gained full marks.

Question 7

Many competent and exemplary responses were seen here showing that candidates were well prepared for this type of question and a high percentage gained full marks on parts (a) to (c). In part (a) the majority of candidates realised that they had to find F(X) with only a small minority neglecting to put the integral = 1. Common errors in part (b) included writing $\mathrm{E}(X) = \int_0^9 x\mathrm{f}(x)\mathrm{d}x$ and then finding $\int_0^9 \mathrm{f}(x)\mathrm{d}x$ or when multiplying $x\mathrm{f}(x)$ making the very basic error of omitting to multiply the second term by x. In part (c) the most common error when using $\int_5^9 k(81x - x^3)\mathrm{d}x$ was to use a lower limit of 6 rather than 5. A small minority of candidates who used $P(X > 5) = 1 - P(X \leq 5)$ found $P(X \leq 5)$ then forgot to find $1 - P(X \leq 5)$. Part (d) was perhaps the most challenging part of a question in the paper. There were many exemplary responses but also a high proportion of incorrect attempts at using the binomial. The most common error was to swap the p and $1 - p$ over. Candidates who used a 'common sense' approach and listed the possibilities were generally successful.

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