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GCE Statistics S2 (6684) Paper 1

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Question 1

Parts (a), (b) and (c) of this question were accessible to the majority of candidates with many gaining full marks. An incorrect answer of $\frac{1}{6}$ was occasionally given for part (a) and in part (b) a few candidates divided by 2 rather than 12.

In part (c) the most common error was finding $\mathrm{P}(X < 7)$.

A high proportion of candidates found part (d) of this question challenging and their understanding of conditional probability in the context of the question was poor. The most common incorrect responses included

finding $\mathrm{P}(4 < X < 6)$ or $\mathrm{P}(X < 6) - \mathrm{P}(X < 4)$

or $\mathrm{P}\left(X < 6 \middle| X < 4\right)$. The most successful candidates used U[4,9] and a diagram.

Question 2

Responses to this question generally reflected candidates' understanding with a high percentage gaining 5 of the 7 available marks. A common error in giving the hypotheses was to write the alternative hypothesis as $p < 0.5$ or $p \neq 0.5$. Occasionally letters other than 'p' were used. The majority of candidates used the correct Binomial and successfully calculated the probability 0.0214. The most common error was to use the incorrect statement $\mathrm{P}(X \geq 21) = 1 - \mathrm{P}(X \leq 21)$ or calculate $\mathrm{P}(X = 21)$. It is pleasing to see that a higher proportion of candidates are able to use statistical tables accurately.

Having calculated a correct probability of 0.0214 and stated that the null hypothesis should be rejected, a number of candidates showed that they had not read the question carefully by stating incorrectly that 'David's claim is supported/correct'. Many candidates do not use the full context of the question in their final statement. For the final statement, if the statement saying 'David is not correct' was not used, the candidates needed to include the words 'forecast', 'radio' and 'tossing/flipping a coin'.

Question 3

Parts (a) to (c) of this question seemed straightforward for candidates with many fully correct answers. A significant minority of candidates incorrectly used a Poisson approximation. A common error in part (b) was to find $\mathrm{P}(X > 3) = 1 - \mathrm{P}(X \leq 2)$. Part (c) was well answered with the majority of candidates solving $n \times 0.15 = 5$.

Part (d) proved challenging to many candidates, with many not being able to identify an appropriate method to use. Overall, most candidates attempting this showed that they needed to find a value which would satisfy $1-\mathrm{P}(X=0)>0.95$ or $\mathrm{P}(X=0)<0.05$ and used various methods to solve this including logs and 'trial and improvement'. Candidates who used tables rather than solving $0.85^n<0.05$ to find a value for 'n' usually gave a solution n = 20. Incorrect methods included solving $0.15n>0.95$ and using 0.95^n.

Question4

This question was well answered, with a high proportion of candidates gaining full marks. The choice of Poisson was recognised easily and, in most cases, justified with appropriate properties. One mark was lost frequently by candidates who did not write the answer in the context of 'hits'.

A large proportion of scripts showed excellent solutions to both parts (c) and (d). Errors were rare, but perhaps the most common was to write a final answer correct to two significant figures only. The inequalities were handled well by almost all candidates, although there were a tiny number who wrote, for example, $\mathrm{P}(X=10)=\mathrm{P}(X\le 11)-\mathrm{P}(X\le 10)$ in part (c) and $\mathrm{P}(X\ge 15)=1-\mathrm{P}(X\le 15)$ in part (d)
A pleasing majority of candidates obtained full marks to part (e), with clear, confident and accurate responses. Most of these candidates achieved the perfect combination of a fully detailed method together with economy of expression.
Marks lost in this part were mainly due to using a value 69.5 instead of 70.5 in the standardisation or no continuity correction at all. Few candidates made no attempt at this part of the question.

Question 5

In part (a) a significant minority of candidates used a Normal approximation to the Binomial, despite the fact that the Binomial parameters, 120 and 0.075, can only be described as large and small respectively. Those candidates who made their method clear were able to score some marks but those who simply wrote their answers down gained few marks if any. However, a large number of scripts were awarded full marks.

There were some interesting features to the overall response to part (b). Some candidates used an elaborate method that consisted of defining a new Binomial distribution, B(2, 0.9788), and then using the formula for Binomial probability to complete their solution. This was almost always successful, but contrasts (in the amount of work involved) with those candidates who used the multiplication rule for independent events and therefore simply wrote 0.9788×0.9788 or 0.9788^2.

The most curious aspect of part (b) was the frequency with which candidates retraced their steps by repeating their work for part (a), before proceeding with part (b). Intriguingly, it was not uncommon for candidates to have been incorrect in part (a), but to go on and write a different solution to part (a), correct this time, as part of (b). Unfortunately, correct answers only earn marks when they occur in the parts to which they relate. If only these candidates had reflected on the discrepancy between their two attempts they could have corrected part (a) and earned full marks.

Question 6

Most of the sketches seen in part (a) were of the correct shape. However, a disappointingly low number were awarded the second mark. Labelling the coordinates of end points and joins are essential when graphs are either in sections or else do not extend indefinitely in any direction.

In part (b) the most common method was to use integration and use the fact that total probability must be equal to one. However, there were a few candidates who wrote $\int_1^k \left(x-\frac{1}{2}\right)\mathrm{d}x=1$ forgetting about the probability distribution for $0 \le X \le 1$.

The second most common method was to calculate the areas of the simple shapes involved: either a rectangle and a parallelogram or else a rectangle and a triangle. This required some fiddly details, but it was pleasing to note that many fully correct responses were seen using this method.

Not all candidates were able to complete part (b) successfully. Some arrived at the correct equation $x^2-x-1=0$ and then stopped, as if they had never seen a quadratic equation before. It would appear that some candidates were a little too hasty when their next (and only) line following $x^2-x-1=0$ was $\frac{1}{2}\left(1+\sqrt{5}\right)$, which is the answer given in the question. Such candidates need to be reminded of the ‘Advice to Candidates’ on the front of the examination paper: “You should show sufficient working to make your methods clear to the Examiner. Answers without working may not gain full credit.”

Some candidates made extra work for themselves by omitting the simple expedient of ‘clearing fractions first’. The equation $x^2-x-1=0$ is much easier to deal with than the same equation $\frac{1}{2}x^2-\frac{1}{2}x-\frac{1}{2}=0$. For instance, there were candidates who obtained a correct expression $\dfrac{\frac{1}{2}\pm\sqrt{1.25}}{1}$ who were then unable to relate this to the required answer.
There were many fully correct answers to part (c) but there was also the usual significant number of candidates who failed to consider the constant ½ which needs to be added to $\int_1^x \left(t-\frac{1}{2}\right)\mathrm{d}t$. The constant can be obtained in various ways, the simplest being to look at the sketch in part (a). By way of contrast, there

were a few candidates who managed to obtain the correct value of the constant by the hardest possible route in this case: solving $\mathrm{F}\left(\frac{1}{2}\left(1+\sqrt{5}\right)\right)=1$.

The candidates who were correct in (c) were generally also correct in (d). The most common error was to use $\left(\frac{1}{2}\times1.5^2-\frac{1}{2}\times1.5+0.5\right)-\left(\frac{1}{2}\times0.5^2-\frac{1}{2}\times0.5+0.5\right)$ where the 0.5 has been substituted into the wrong part of $\mathrm{F}(x)$.

There was a variety of ways of solving part (d). It is a matter of some concern that not all candidates made their method clear. This particularly affected those candidates whose answers in (c) were incorrect: they could have gained some marks if some explanation of their method had been provided.

Disappointingly few candidates responded to the hint “write down” in part (e). The most effective, and simplest, methods were visual. Half the area, as already noted in part (c), is to the left of $X=1$. Furthermore, the highest point on the graph occurs when $X=k$. However, there were many correct answers obtained by other methods, for example, by solving the quadratic equation $\frac{1}{2}m^2-\frac{1}{2}m+\frac{1}{2}=0.5$.

Question 7

Some candidates were familiar with the term ‘critical region’, but for all but a tiny number, ‘significance level’ was uncharted territory.

Part (b) was answered well by the majority of candidates. The main error was the use of the incorrect notation for a critical region i.e. $\mathrm{P}(X\le3)$.

There were many good solutions to part (c) that demonstrated correct identification of the situation “as bad or worse than that observed”, accurate calculation of the relevant probability and a clear conclusion in context..

A small number of candidates found $\mathrm{P}(X=13)$, clearly failing to grasp the central concept of an event “as bad or worse than that observed”. $\mathrm{P}(X>14)$ also featured in some scripts, bearing no relation to either this latter concept or any attempt to find the critical region.

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