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Examiners' Report
Principal Examiner Feedback

Summer 2019

Pearson Edexcel GCE AS Mathematics

In Further Statistics 1 (9FM0/3B)

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General introduction

The paper was accessible to all the candidates and there was little evidence that they could not complete it in the time allowed. Q4 required some stamina and a good understanding about the Poisson distribution as a model but there were still plenty of candidates scoring 18 or 19 marks here. It was Q7(c) that proved particularly discriminating and only the very best candidates scored full marks here.

Report on Individual Questions

Question 1

Part (a) was a straightforward opener and most candidates answered this correctly. In part (b) many recognised that a negative binomial model was required and this was often correct although some lost an accuracy mark for failing to give their answer correct to 3 significant figures. The other common error here, and in part (c), was to try and use a geometric model. In the final part most could use the formula given in the formula booklet correctly but some weren't totally sure about the notation and therefore which values to use.

Question 2

This was another well answered question with over 50% of the candidates scoring full marks. Most identified the Poisson distribution as a suitable model here and usually they had the correct mean too. A number lost marks here over the interpretation of "more than 4 calls" and statements such as $\mathrm{P}(C > 4) = 1 - \mathrm{P}(C \leqslant 3)$ were fairly common. Part (b) was a little more demanding and whilst a number were able to use a Poisson distribution to obtain the probability of 0.189 they often did not realise that this was the parameter of a binomial distribution and answers of $0.189^3 \times (1 - 0.189)$ without the appropriate binomial coefficient were often seen. A few candidates rounded to 3 decimal places rather than 3 significant figures and, without sight of their full answer from their calculator, the examiners could not award the final mark. Whilst most identified two correct Poisson distributions e.g. $X\sim\mathrm{Po}(\frac{5}{3})$ and $Y \sim \mathrm{Po}(5)$ there were 3 common errors: some added the required probabilities instead of multiplying them together; others calculated $\mathrm{P}(X = 1)\times\mathrm{P}(Y = 0) + \mathrm{P}(X = 0)\times\mathrm{P}(Y = 1)$ and some used a $\mathrm{Po}(\frac{5}{3}+5)$ distribution.

Question 3

This turned out to be the most successfully answered question on the paper with nearly 70% scoring full marks. Even those who did not spot the need to use the central limit theorem could often score the first 3 marks although some still struggled to use the correct formula for the variance with – E(X), instead of – E(X^2), a common error. Use of correct notation was not good with the statements like $X \sim \mathrm{N}\left(3, \sqrt{\frac{2.6}{80}}\right)$ often being <u>used</u> correctly as $\bar{X} \sim \mathrm{N}\left(3, \sqrt{\frac{2.6}{80}}^{\,2}\right)$. Candidates should be aware that there is an assessment objective in the new specification that requires "correct use of mathematical notation" and correct handling of normal distribution notation may be required in future assessments.

Question 4

Part (a) was answered well with the majority identifying a suitable binomial distribution although a few did think a Poisson was appropriate here. In part (b) the most common error was a failure to pool the last two classes and this often led to the test being carried out using 4 degrees of freedom and the subsequent acceptance of the binomial model. Part (c) though was answered very well with most candidates scoring full marks here. There was some impressive, but totally unnecessary, work here to establish the value of □□used by Simone; a number used the given expected frequencies for 2 and 4 oak trees and solved the resulting equations instead of simply using the mean value from the given data. In part (d) most candidates incorrectly quoted the value of the parameter; this was penalised in part (d) but condoned for the final mark of part (e). Part (e) was answered well but some used an incorrect value for the degrees of freedom. There were some good answers to the final part with many appreciating that the suitability of the Poisson model suggested that the oak trees were randomly spread in the woodland and this would imply that it was wild and not cultivated. Whilst many thought that the woodland was probably wild some were unable to give a suitable reason based on the results of the tests.

Question 5

Part (a) was usually answered well but a few candidates were going from $P(X \leqslant 13)$ to $X \geqslant 13$ as the critical region and occasionally candidates were using Po(2.5) instead of of Po(7.5). Most candidates knew how to find the probability in part (b). Many identified the binomial model in part (c) but some were confused about the appropriate value for n (3 being a common error) and others made rounding errors which meant that their final answer was not accurate enough. In the final part most knew what a Type II error was and how to find its probability but sometimes a Po(2.1) model was used rather than the required Po(6.3).

Question 6

Part (a) was answered very well and most obtained the correct value for k though sometimes this was incorrectly expressed as – ln2. In part (b) it was clear that most candidates knew how to use the probability generating function to find the variance but there were a number who struggled to differentiate the given function correctly. A significant minority wrote $G(t)$ as $k[\ln 2 - \ln(2 - t)]$ and they fared better although some did not realise that ln2 was a constant and a spurious ½ appeared. Those who did differentiate correctly and simplified their answer invariably were able to complete this part of the question. Part (c) was more of a challenge but a good number attempted this. Many realised that a Maclaurin expansion was required and finding the third derivative was the most common approach. Unfortunately some forgot to divide by 3! but nearly a quarter of the candidates secured full marks on this question.

Question 7

Part (a) was answered very well with most using the correct geometric distribution but some used $1 - P(B \geqslant 4)$ rather than $1 - P(B > 5)$. Part (b) was usually answered very well too with the most common error being to use $E(B^2) = [E(B)]^2$. Part (c) was the most challenging question on the paper. Many obtained the first mark for identifying the correct distribution for the number of the spin when it first lands on red. The main problem was that candidates didn't know how to find $E(e^X)$ with $e^{E(X)}$ being the most common incorrect approach. Some tried to argue from comparing the graphs of $y = e^x$ and $y = x^2$

but there was no consideration of appropriate probabilities and some numerical approaches floundered in the same way. A small number found the correct probability generating function $G(t)$ and then gave the very succinct solution $G(e)$ but this was rare! Over 5% though did find the correct value of $E(e^X)$ and after comparing this with $E(B^2)$ were able to secure all the marks for this question.

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