Examiners' Report
Principal Examiner Feedback

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Pearson Edexcel
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Paper 23: Further Statistics 1

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Introduction

Candidates were generally well prepared and were able to access all of the questions on the paper. For questions with a given answer, candidates need to ensure that sufficient working has been shown. Conclusions to hypothesis tests and modelling assumptions should always be given in context if possible.

Question 1

Virtually all candidates were able to identify the need to model the number of call-outs by a Poisson distribution and again most used the correct distribution, Po(7.2), in part (a). Only a few candidates attempted a cumulative probability rather than the required probability, $P(X = 7)$.

In part (b), the required answer was given in the question so candidates are expected to show sufficient working as to how they arrived at their answer. Most gave a correct probability statement and followed this with a 4 (or more) decimal place 0.0219… answer which made it clear how they obtained the given answer of 0.022. Of the errors seen, the most common was to use $P(Y \geq 28) = 1 - P(Y \leq 27)$.

Although the formulae for the mean and variance of a binomial distribution are given in the formula booklet, a surprising number of candidates left parts (c)(i) and (c)(ii) blank. Candidates should be aware that 'expectation' signifies a mean and that the answer does not necessarily need to be a whole number. The most common mistake in part (ii) was to omit the square root sign for the standard deviation.

Part (c)(iii) was answered well on the whole. There were still quite a few candidates who ignored the instruction to use a Poisson approximation and opted to calculate the exact binomial probability, hence scoring no marks here. Of those who identified the correct Poisson distribution, most went on to obtain the correct probability. However, a few calculated $P(W \leq 6)$ rather than $P(W \geq 6)$.

Question 2

Most candidates made a good start to this question stating the hypotheses in part (a) the correct way round (with the correct use of association) and carrying out an appropriate test. The expected values for the test were almost always found correctly and most calculated the value of the test statistics to an appropriate degree of accuracy. The calculation of the degrees of freedom caused some difficulty for weaker candidates with $8 - 1 = 7$ sometimes being seen. Candidates did well to conclude the hypothesis test in context.

Part (b) proved more challenging for most. Many attempted to find the probability distribution from scratch working out the probabilities for 0, 1, 2 and 3 heads separately. The instruction 'write down' alongside the fact that only 1 mark was available for this part should have both provided clues that no calculations were needed. Some candidates misinterpreted ‘unbiased’ for the uniform distribution and assumed that all outcomes were equally likely.

Most went on to use their distribution in their hypotheses is part (c). It is important to note that we are testing not just whether a binomial distribution is suitable, but whether the distribution B(3, 0.5) is suitable. Many used their distribution correctly to work out the expected values for the hypothesis test. The biggest mistake made was failing to realise the need to combine the left hand row and the right hand row so that there were only 4 cells required.

Question 3

Candidates made generally good attempts at this question; however, numerical slips prevented many from scoring full marks. Most understood to solve this problem they would need two equations: one using $\Sigma p = 1$ and one using $\Sigma px = 3.8$. Weaker candidates left *x* in their equations and made little progress. Of those successfully solving their simultaneous equations and finding a correct value of *k* and *m*, many struggled to accurately replace these values in their expression for $\mathrm{E}(X^2)$. A few made the common error by failing to square $\mathrm{E}(X)$ when finding the variance.

Question 4

Most were able to identify the correct Poisson distribution in part (a) but many just listed stock answers when stating the necessary modelling assumption. An answer in context about the independence of the cyclists was required. Having already been told that the number of cyclists in each direction can be modelled by a Poisson distribution, the question here focussed on why the two distributions could be added to form Po(11).

Part (b) was one of the most discriminating parts of the paper and a fully correct response using conditional probabilities and the Poisson distribution were rarely seen. The most common successful method was to use $C \sim \mathrm{B}(12, \frac{8}{11})$ and to calculate $\mathrm{P}(C \geq 11)$.

A number of fully correct hypothesis tests were seen in part (c) with most conclusions given in context. On a number of occasions, candidates used incorrect notation or attempted to write their hypotheses using words. When calculating the test statistic, $\mathrm{P}(X = 14)$ was sometimes used instead of $\mathrm{P}(X \leq 14)$.

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