Examiners' Report
Principal Examiner Feedback

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Pearson Edexcel GCE Advanced Level
in Further Mathematics
Paper 3B: Statistic 1 (9FM0/3B)

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Introduction

The paper was accessible to all the candidates and most appeared to have sufficient time to complete it. Candidates seemed well prepared for all aspects of the specification. Questions 1(c), 5(b), 5(c) and 7(b) were the most demanding parts of the paper. In general, questions that require justification and statistical reasoning were less well answered.

Report on Individual Questions

Question 1

Part (a) was generally accessible with many scoring well. For part (i) most used the calculator function but some did write out the full calculation of the probability required. A small number of candidates gave an answer with less than the required 3 significant figure accuracy.

In part (b) the majority of candidates were successful, but on some occasions some did not form appropriate hypotheses in terms of a parameter. A common error was the minority finding $P(X=10)$ instead of the tail probability. Most took the easier route of finding the probability to compare with 5%, rather than finding the critical region. The interpretation of the found probability was generally correct and in context but there were a few who thought a ‘value’ higher than 0.05 was significant.

Part (c) was far more challenging for many. Most gained some access by understanding the need to use Po(4) as the true distribution but often they used this distribution to try and identify the critical region. Many looked for a right-hand critical region not realising that 1 in five minutes is a lower rate than 2 in five minutes. Many did not make their method clear. If they had more explicitly identified what they thought was the critical region, then further credit may have been gained. A few blank responses were seen here.

Question 2

In part (a) many recognised this as a poor approximation due to p not being small and/or n not being large. Those not scoring thought 10 was large for n, or more commonly simply compared mean with variance. Some thought it was indeed a good approximation since $10 \times 0.4 = 4$.

Many candidates earned the mark in part (b) for mention of independence although for some it seemed more they were listing conditions for events to be Poisson modelled, rather than conditions for combining variables. Common comments that did not score suggested X and Y had to be over the same interval.

Whilst many correctly found the variance of W, often they did not then go on to use it with the Po(7) model to answer the question. Some poor understanding was demonstrated with statements such as $P(7 < 2.4)$ or $P(Po(7) < 2.4)$

Question 3

Though many complete correct responses were seen here some candidates tried to oversimplify the question by only considering Suzanne or Jon and not both. Whilst most recognised this was a geometric distribution a significant number were unable to work with the context and found P(X=4) instead of P(X=7) in part (a). A very small minority failed to recognise that p was 0.2

In part (b) some made the same error misunderstanding the context as in (a), but also common was finding $1–p^5$ instead of $(1–p)^5$. The simplest way to think of this problem is that it is asking for the probability of the first 5 outcomes being ‘failure’, hence 0.8^5.

Nearly all were successful in part (c) here although some stopped once they found variance and failed to square root.

The successful candidates in part (d) listed out the first few ways Suzanne could win the game, leading to recognition that the required probability was the sum of an infinite geometric series.

Question 4

Question 4 provided a good source of marks for most candidates with only part (c) discriminating the most able. Part (a) was very accessible with only an occasional candidate forgetting to square mean when subtracting.

Answers to part (b) were well structured and most found the correct distribution for Y and used this to calculate the required probability.

Part (c) caused more of a problem with a significant number of candidates thinking that E(XY)=E(X)E(Y) leading to common incorrect answer of 19. Successful candidates listed all of the options for XY.

Question 5

Part (a) was an accessible start to the question. A small number seemed to be attempting expectation. Some simply wrote down 6/40 which was not sufficient.

In part (b), hypotheses were usually stated first and often correct. A common error was to include p = 0.15 in the hypotheses which is not correct for this problem. (This was not penalised in the conclusion although should not have been there either.)
Expected values were usually shown evaluated, and the need for pooling identified. Most pooled correctly and found one degree of freedom. (Some were not explicit that it is low expected frequencies that lead to the need for pooling rather than low observed frequencies.) A fair number missed the demand to explain their degrees of freedom calculation, but many did explain that the value of p was calculated from the data.

A corresponding critical value was stated by most, even when the degrees of freedom was incorrect, and concluded correctly. A small number used the wrong column in the tables and some believed that the statistic being below the critical value meant a significant result. Surprisingly, a significant number of candidates evaluated a test statistic, despite being given the value, and worryingly some of these compared their value to the stated one as though it were the critical value.

Part (c) was challenging for most and one of the most discriminating parts of the paper. Few gained full marks here, but a large number gained a mark for recognising the need to still pool the same classes. Few considered how the change might affect the proportion of defective pins and so, without complete reasoning, could not access the mark for recognising that there would be no effect on the test statistic.

Question 6

Candidates on the whole seem well-prepared for this question on probability generating functions – though a significant minority did lack familiarity and made little or no attempt. Some were substituting given *x* values for *t* in part (a). Many missed that they simply needed to consider the absence of a t^3 term in the expansion to give an answer of zero.

For part (b)(i), candidates were usually successful to consider the t^4 coefficient to find the value of *b*. Unfortunately some omitted the 1/64 in the coefficient. More common was recognising the need to consider $G_x(1) = 1$ to find the relationship between *a* and *b*. Most who took the right approach correctly dismissed negative values for *a* and *b*. Success finding P(*X*=2) again then rested with familiarity with the significance of the coefficients. Those successful with (i) were usually also correct in (ii) and follow through marks were available here. Some earned a mark for knowing $G_x'(1)$ was needed for E(*X*).

In part (c), a number of blank responses were seen. Some left their answer in terms of *a* and *b* rather than substituting their values. Often the mark was gained for knowing to multiply by t^2. A worryingly not uncommon error was those who incorrectly simplified $(t^3)^2$ to t^5. A small number mixed up where to put the t^2 and t^3.

Question 7

Most candidates recognised the discrete uniform distribution in part (a), correctly finding its mean and variance. Many then correctly identified the sampling distribution of the mean as a normal distribution (using the CLT) although many made an error with the variance failing to divide by 45. Attempts at standardisation were commonly shown although some used the original variance. Whilst there were many completely correct attempts there were one or two with sign errors on their value of *z* leading to an incorrect answer that was higher than the mean.

Many candidates struggled in part (b) through lack of rigour in their statements. Comments often lacked reference to **sample** mean when referring to using normal distribution as an approximation. Only a small number referred to the need for sample size to be large.

Part (c) was commonly successful although common errors were using the original variance or finding the complement of power.

Whilst most correctly suggested the power would increase in part (d), many failed to refer to a reduction in variance as the reason, instead giving vague reasons such as ‘increasing number of rolls would make it more accurate’. Some gave as their reasoning that P(Type II) would decrease, without reference to variance.

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