Examiners' Report
Principal Examiner Feedback

Summer 2025

Pearson Edexcel GCE

In A Level Further Mathematics (9FM0)

Paper 4B Statistics 2

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Introduction

The 9FM0-4B Further Statistics 2 paper provided opportunities for candidates to demonstrate their understanding of the specification. The paper was accessible to all candidates, who were able to select and apply the more advanced statistical techniques in a variety of scenarios.

Time did not appear to be an issue, and it was rare for candidates to not attempt all questions on the paper. The most demanding part of a question on the paper was 7(a), although many candidates still attempted it, even though their approach demonstrated a misunderstanding of the topic.

Question 1

This opening question on the topic of linear regression was a good opening question for candidates with many scoring the majority of the marks.

In part (a), most candidates were able to show the two required answers, although frustratingly some candidates miscopied the value from their calculator or they missed the squared off the calculation which cost them a mark.

Part (b) was usually correctly answer with candidates using the given values to find the equation of the regression line y on x. Occasionally, candidates who had made a slip in part (a) used their incorrect value (despite the correct values given in the question) which resulted in some inaccuracies in their final answer.

Part (c) required candidates to find the residual sum of squares which was usually found correctly.

In part (d), candidates had to find a residual using their equation of the regression line. Most candidates were able to answer this correctly, although on occasion a candidate would subtract the wrong way round.

If candidates were going to drop any marks, it was usually in part (e). Candidates were asked to give a reason that might support the claim that a particular value was an outlier using parts (c) and (d). Some candidates did not attempt any form of calculation suing these parts so the mark was not available, whilst others did not attempt a correct comparison – usually by forgetting to square their residual to compare with the residual sum of squares.

Question 2

This question was on Spearman's rank and testing for correlation and most candidates found this a very accessible question and were able to score most, if not all, of the marks.

In part (a), candidates were usually successful in calculating Spearman's rank correlation coefficient. This was assisted by the data already being ranked which meant that candidates were less likely to make an initial error with ranking the data and doing this consistently for both sets. The occasional error occurred when finding the distances, not squaring the differences in the ranks or using an incorrect formula (often by omitting the 1 – at the beginning).

In part (b), candidates were usually successful in setting up correct null and alternative hypotheses. The most common errors were using r instead of ρ with some incorrectly deducing that agreement meant a two-tailed instead of a one-tailed test. Candidates usually found the correct critical value and made a correct comparison and those who did set up a two-tailed test were able to score this mark for a correct critical value under that test. Others lost the final mark for not mentioning the context in the conclusion.

Question 3

This question required candidates to conduct a test to see whether two variances were the same. Candidates found this question more challenging, so it was rare for full marks to be achieved, usually part (b) being where marks were not scored.

In part (a), candidates were usually successful in setting up correct null and alternative hypotheses. The notation for the variance (or standard deviation) was sometimes difficult to decipher, but use of s or s^2 was very rare. Candidates then usually attempted to find the correct test statistic, although the main error was in forgetting to use the sample variances instead of the standard deviations. The critical value was usually correct, and candidates usually made a correct comparison between the test statistic and the critical value.

Part (b) was rarely fully correct. Candidates often did not fully answer (b)(i) which required an explanation regarding the importance of the conclusion to the test in (a) with respect to the test carried out on the difference between two means. Just stating you can find a pooled estimate for the population variance was not sufficient without explaining that the variances were equal was a required assumption to carry out the t-test. Some candidates also did not correctly interpret the significance of the p-value, whilst others did not correctly mention the effect on the mean yield (instead of just 'yield').

Question 4

This question was more demanding and required candidates to carry out a hypothesis test on the variance, as well as constructing a confidence interval. Candidates found this question more demanding, but they were still able to score a high number of the available marks.

In part (a), candidates were able to typically find the correct proportion using a normal distribution. It was usually only incorrect rounding which was the only error here.

In part (b), candidates were usually successful in setting the correct null and alternative hypotheses. It was unfortunate that σ and 6 looked very similar in some responses, although this was condoned (rather than it being regarded as test for the difference between two variances). Candidates usually found a correct unbiased estimate for the variance, although some used an incorrect formula, or divided by n instead of $n-1$. The critical value found was sometimes found for the wrong tail (instead of the lower required tail). Some candidates also not realising that the test statistic was lower than the critical value in this case meant that there was sufficient evidence that the variance of the weights was lower. Giving a correct conclusion in context also resulted in a mark lost with the word 'weight' omitted in some cases.

Part (c) was usually fully correct, however, the main cause of the loss of all marks was for failing to use a critical value from the *t*-distribution. A significant number used 1.96 from the normal distribution was not appropriate.

Part (d)(i) was not often fully answered with candidates not using the data to support their conclusion fully. Candidates needed to state that 131 was in the confidence interval, however, it was often omitted from their explanations. In part (d)(ii), it was pleasing to see so many candidates who recognised the need to use their unbiased estimate for the variance as well as a suitable value for the mean (often 130 was chosen here). Many candidates scored both marks, although not stating the two parameters they had chosen resulted in no method shown and no marks awarded.

Question 5

This question tested continuous random variables and candidates were usually able to make good progress in most of the parts.

Part (a) required candidates to find probabilities using a uniform distribution. Usually candidates were able to score full marks, although some candidates did not give the exact values, whilst some struggled to find the required interval in (a)(ii) which involved conditional probability.

Part (b) was focused on a different continuous random variable and nearly all candidates were able to use the cumulative distribution function to score the mark in this part.

In part (c), candidates found the sketch a challenge, with many not clearly labelling 1 and 4 on the horizontal axis. Vertical values were not required and nor were axis labels on this occasion. Some candidates extended the graph beyond the defined interval, and some graphs which went below the horizontal axis were seen. The mode was usually correctly stated.

Part (d) required candidates to find the expected value for the random variable. Usually a correct expression was found, but a number of candidates struggled to make any valid progress to integrate the function correctly. Those who did, often opted for the substitution method, whilst others who elected to use integration by parts seemed to make more errors dealing with the coefficients.

Question 6

This 17-mark question on delivery rates was very demanding for candidates as it involved two different hypothesis tests. It was very rare for full marks to be scored, although it was pleasing to see most candidates scoring the majority of them.

Candidates usually successfully answered part (a), although the method to find the unbiased estimate for the variance was incorrect.

In part (b) candidates were required to mention that the delivery rates were normally distributed and the variances were equal. It was rare for both assumptions to be given so this mark was usually not scored.

Part (c) was usually answered well with most candidates able to demonstrate their ability to carry out a two-sample *t*-test. The conclusion, in some cases, however was not sufficiently in context, or 'mean' was missing in their statement.

Part (d) involved carrying out a paired *t*-test. Most candidates made some progress with this, however, a number did not show their working sufficiently to evidence how they found an unbiased estimate for the variance and this meant that they lost marks in finding the test statistic. Others set up another two-sample *t*-test which could only score two of the available marks.

Question 7

This was the most demanding question on the paper and it was extremely rare to see any meaningful progress made in part (a). It was unusual to see more than half of the available marks scored for the question overall.

In part (a) candidates were typically able to find the expected value for $\overline{X} - Y$, however in most cases this was the only mark scored. Sometimes candidates did start to write an expression involving the individual values taken from the sample but made no attempt to simplify the expression or appreciate that some of the observations were the same (and so remove/combine some of the repeats). This meant that no further marks were scored.

In part (b), candidates usually selected the correct interval with a valid reason, although it was surprising to see a considerable number who explained that Nina's estimator had a greater variance which was not correct.

Despite the difficulties encountered in part (a), a pleasing number of candidates made good progress in the final part of this question. Usually, they were able to form a valid equation involving 1.96 and the value of n was condoned. A high number used the wrong value for n for the unbiased estimator used, which resulted in an incorrect estimate for the variance, however there were still many who proceeded correctly to the answer.

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