# Examiners' Report
# Principal Examiner Feedback

## Summer 2023

Pearson Edexcel GCE
Further Mathematics (8FM0)
Paper 24 Further Statistics 2

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Summer 2023
Publications Code 8FM0_24_2306_ER*

## Introduction

Most students seemed well prepared for this paper and there were noticeably fewer scripts where the student appeared to have missed out large areas of the specification. There were opportunities for students to make a start in all the questions but 1(c), 2(c), 3(e) and the end of 4(b) proved more discriminating and enabled the grade A students to shine.
Although the entry was very small, all the marks were awarded at some point, so no part of the paper was inaccessible for this group.

## Comments on individual questions

### Question 1

Most students could make a start on this question and started to rank the scores. A few didn't know how to deal properly with the tied ranks, but many scored the first two method marks. Most went on to use their $\sum d^2$ in the standard formula for Spearman's rank correlation but a few realised that they should be using the product moment correlation coefficient (pmcc) formula on their ranks and usually went on to obtain the correct answer. A few simply used the pmcc formula on the scores but it was encouraging to see that only one or two students found their $d^2$ from the scores rather than the ranks. In part (b) most gave correct hypotheses in terms of $\rho$ and the majority used the correct critical value of 0.7833. A correct statement about the significance of the test was almost always seen and many also interpreted this clearly mentioning "scores" and the "tasks".
Part (c) was more discriminating. Most recommended that *Q* and *R* were used because they had the greatest correlation, but a few identified that because the correlation between *P* and *R* was closer to zero this suggested that these two tasks were identifying different skills and therefore *Q* could be omitted.

### Question 2

Nearly all knew that to find the cumulative distribution function the probability density function needed to be integrated. This was carried out correctly and some used limits of 1 and *x* whilst others had a constant of integration and used F(1) = 0 to establish F(*x*) for *x* between 1 and 3. Most went on to state the cumulative distribution function correctly.
In part (b) some simply evaluated F(1.8) and didn't seem to realise that to find P($X$ > 1.8) they needed 1 – F(1.8).
Part (c) was not answered well. The common error was to find E($X$) = 1.85 and then simply work out $\frac{3}{\mathrm{E}(X)}+2$ however a few realised that this was an example of E(g($X$)), used $\int_1^3 \left(\frac{3}{x}+2\right) \mathrm{f}(x)\, \mathrm{d}x$ and usually obtained the correct answer. Part (d) was approached with more success and most differentiated correctly and showed that $x=\sqrt{3}$ was the turning point, however only a few managed to achieve the final mark.

Some gave a convincing argument that this was a local maximum but failed to show that it was a global maximum by considering the values of f($x$) when $x = 1$ and $x = 3$. The handful of students who did achieve the final mark did so by giving a sketch showing that the curve, of which f($x$) is a part, passed through (0, 0) and (3, 0) and had a maximum between these two points.

**Question 3**

Part (a) was answered very well and almost all students scored both marks here. The responses to part (b) were more mixed. Many stated that it was consistent because the value of $r$ was "close to 1" or represented "strong" positive correlation. Some weaker students thought that because the value of $r$ was between 1 and $-1$ that represented suitable evidence. The calculations in part (c) were usually correct with only a handful of students using $\frac{S_{hv}}{S_{vv}}$ for the gradient. There was some confusion in part (d). Although many knew that the sum of the residuals should always = 0, some thought it had to be $\leqslant 1$. In part (e) most simply substituted 1.96 into their equation for the regression line and completely ignored the information about Pat's misread of the residual. Those that did consider this and calculated the actual residual to be 1.23 usually went on to complete this part correctly.

**Question 4**

In part (a) many identified that they should be considering $P(-3 < X < 2) = \frac{1}{3}$ but even those who missed this were able to demonstrate that they could use the uniform distribution to form a suitable equation for $k$. In part (b) most could see how to start and wrote down two correct equations for $a$ and $b$ using the given values for E($X$) and Var($X$). Usually these were solved successfully to obtain the correct values for $a$ and $b$. Several students stopped at this point, but a good number went on to try and use their values to find P($Y > 7.5$). There seemed to be some confusion about which "end" of the distribution to use and several students found P($Y < 7.5$) instead. This error is like the mistake highlighted in question 2(b).
Some of those who got this far stopped at this point, but a few went on to use a suitable binomial model and those with the correct probability for P($Y > 7.5$) usually obtained the correct answer.

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