Pearson Edexcel

# Examiners' Report
Principal Examiner Feedback

Summer 2018

Pearson Edexcel GCE Further Mathematics
Statistics S3 Paper 6691_01

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## Introduction

Candidate performance was excellent, and questions were answered very well with many fully correct solutions. Weaker candidates found the paper accessible and standard methods were well known and applied accurately. There were very few candidates who seemed unprepared for this paper.

## Report on individual questions

### Question 1

This question proved to be a good start to the paper for almost all candidates with a large majority scoring nearly full marks. Unfortunately, not all candidates provided enough context for their conclusions in part (b) and part (d). It was noticeable that some candidates did, but only for only one of the two relevant parts. The method and calculation for Spearman's rank correlation was well known and almost always accurately calculated. A few candidates made occasional errors in their ranking of one of the variables, but typically their working was clear which minimised the loss of marks. In part (e), many candidates were aware that the conclusions to part (b) and part (d) probably meant that there may be some sort of non-linear relationship between the variables.

### Question 2

A variety of attempts were seen to part (a), most of which earned some marks. Some were long-winded, others were vague and imprecise. There were also some very impressive responses which demonstrated not just sound understanding of the statistics, but also excellent communication skills. Many candidates were awarded all the marks in part (b), with an organised, clear and accurately carried out significance test. The most common error related to the hypotheses. Some candidates used incorrect notation, for example $\bar{x}_p$ instead of $\mu_p$ etc. A few candidates failed to identify, for example, $\mu_1$ and $\mu_2$ and unfortunately it was not unusual to see a null hypothesis of $H_0 : \mu_p = \mu_s$, or even $H_0 : \mu_p \leq \mu_s + 6$. Later in part (b) some candidates wrote, inexplicably "1.188… > 1.6449, so reject $H_0$".

Many candidates came close to scoring marks by mentioning the Central Limit Theorem in part (c) but omitted to mention the large sample sizes. Some candidates stated an assumption was necessary, even when the Central Limit Theorem applied.

## Question 3

Candidates often scored all four marks in part (a). Only a few candidates were unfamiliar with a correct method or formula for an unbiased estimate of variance. A variety of alternative methods were seen and implemented correctly. There were also many candidates earning full marks in part (b). However, many of them started slowly, including many probability statements before arriving at a correct equation. One complicating factor was multiplication by two. A number of candidates included the factor of 2 on the right-hand side only leading to an incorrect equation of $0.1 = 2 \times 2.5758 \times \frac{0.5}{\sqrt{n}}$.

## Question 4

The majority of candidates were familiar with the theory, but not all earned all the marks for part (a). A significant proportion of candidates did not attempt to find the width of the confidence interval. Expressions such as $\mu \pm 2.5758 \times \frac{\sigma}{\sqrt{120}}$ were often seen. This was only a problem for those candidates who used this expression to find half of the required width. Some candidates multiplied by two at some point and arrived at the correct answer. Other candidates started, possibly more efficiently, with the expression $2 \times 2.5758 \times \frac{\sigma}{\sqrt{120}}$. There were some completely correct solutions to part (b) however, many candidates neglected to follow at least one of the instructions in the question. Even when candidates did attempt to state the significance level, this was not always correct with 5% seen on many occasions, although 2.5%, 90% and 1.645 were also seen. Many candidates did earn full marks in part (c). It was not uncommon for candidates to be under the impression that the mid-point of the confidence interval was 6, rather than 5.695, which resulted in an incorrect method.

## Question 5

This proved to be a very well answered question for a majority of candidates. In part (a) and part (b) some confusion over notation was evident, the difference between $3C$ and $C_1 + C_2 + C_3$ for example, but otherwise they were well done. On this occasion most candidates made the correct decisions when calculating the variance in both parts. Inevitably, there were those who failed to square the 3 in part (a) and those who did square the 8 and 3 in part (b). Occasionally there was some confusion at times over which tail was required. In part (c) many candidates did not sufficiently refer back to the context required.

**Question 6**

A large proportion of candidates earned the mark for the hypotheses in part (a). The situation was reversed in part (d), where almost all candidates specified a value for the parameter, usually $p = 0.51$, and consequently lost the mark. In part (b) and part (c) there were candidates who used some or all of David's results, but incorrectly. One common approach was to work backwards from the observed frequency of 12, leading to the incorrect value of $p = 0.468$. A few candidates used the frequency 18. A small number of candidates worked backwards from all of David's observed frequencies to arrive at five separate estimates for $p$. These candidates then averaged these five values. Curiously, many candidates were aware that the correct value of $p$ was 0.51. Some candidates worked backwards from John's value of 8.65, but then crossed out this work and started again using the correct method. It was not uncommon to see $\nu = 4$ used in part (e), but other candidates not only stated $\nu = 3$ but also provided the reason. A few candidates went further than required by explaining that it was not necessary to combine cells in this case.