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Examiner's Report
Principal Examiner Feedback

Summer 2018

Pearson Edexcel International A Level
In Statistics S3 (WST03/01)

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General introduction

Students were generally well prepared for the demands of this paper although they found this more challenging than previous papers in the series. The calculation of Spearman's rank correlation coefficient continues to be well attempted by most students as is the calculation of probabilities from combinations of independent normal distributions. Question 4 was the most challenging on the paper and discriminated the most able students. Questions involving standard error were less well successfully answered. Students should continue to take care when completing a hypothesis test to use correct notation, where appropriate, in their hypotheses.

Report on individual questions

Question 1

Question 1 provided a successful start to the paper for many students as they confidently displayed knowledge of Spearman's rank correlation coefficient and the associated hypothesis test. The attempt at rankings in part (a) was generally well done, though some used reverse rankings which caused some problems later on the question. Most were able to score full marks for obtaining a correct value of the coefficient.

In part (b), the hypotheses needed to match the rankings from (a) and this caused some trouble for those trying to test for a negative correlation when they had set up their rankings to show a positive correlation. Correct notation was generally used and a one-tailed test was virtually always selected. Most were able to state the correct critical value and successfully concluded that 'Russell's claim is true'.

Part (c) was again well answered with the correct critical value nearly always being stated. There were some students who compared this critical value with their calculated value in (a) rather than the given value in the question.

The understanding that the hypothesis tests showed that there is likely to be a non-linear relationship between BMI and time taken was more difficult and some lost the mark in part (d). Here students often tried to restate one or both of the conclusions to part (b) and (c) without interpreting what these results both meant together.

Question 2

This was the most successfully answered question on the paper as nearly 40% of students achieved full marks. In part (a), virtually all students were able to arrive at the correct proportion with some breaking it down into a series of steps.

In part (b), most students were able use the binomial distribution to calculate r correctly and used the method that the total frequency was 75 to obtain an accurate value of s.

The most commonly missed mark on this question was for setting up the hypotheses in part (c) as some tried to include $p = 0.82$ in the hypotheses even though this was calculated from

the data. Most pooled correctly when the expected frequencies summed below 5, though on some occasions the pooling was incorrectly based on the observed frequencies or did not take place at all. Most understood the need to evaluate $n - 1 - 1$ to find the appropriate degrees of freedom here and virtually all selected the associated critical value from the tables. A correct conclusion was again nearly always stated.

Question 3

Question 3 was more challenging than the opening two questions on this paper with part (b) causing students the most difficulty. The unbiased estimates of the mean and the variance in part (a) were nearly always correct.

In part (b), many students ignored the instruction to treat the combined sample as a single sample. This meant that some went on to find the mean and standard error for the 30 duck eggs only, or that some used a weighted standard deviation. Of those who correctly treated it as a single sample, there was still a large proportion who neglected to divide by $\sqrt{50}$ to find the standard error.

Many were able to recover in part (c) by setting up hypotheses generally using the correct notation and attempting a one-tailed test. Mistakes in calculating the test statistics included neglecting to divide by $\sqrt{50}$ or using the wrong standard error altogether. Those who found the correct test statistics virtually always compared it with a correct critical value and gave an appropriate conclusion in context.

Question 4

This was the most demanding question on the paper with over a quarter of students making no progress whatsoever. Although students were generally able to find the mean number of reported first-aid incidents per 1000 employees, they struggled to apply this result to calculate the appropriate expected number of incidents at each warehouse i.e. they did not take into account that each warehouse had a different number of employees.

In part (a), a variety of hypotheses were seen with some believing that a Poisson distribution was suitable whilst others tested for a uniform distribution. In both of these cases, it was common to see the same expected number of incidents used for each warehouse. Some method marks were scored for these special cases. Weaker students attempted to calculate the expected number of employees at each warehouse rather than or in addition to incidents. A correct critical value meant that some were able to pick up at least one mark on this question. This was the least successfully answered part on the entire paper.

Part (b) was also generally not well answered. Students often tried to explain a systematic sample on the number of employees and not the number of incidents. Some partially correct responses discussed selecting every 4^{th} record from warehouse *C*, but failed to mention that the first selection needed to be randomly selected. Some weaker students, however, attempted to describe a stratified sample.

Question 5

This was one of the most accessible questions on the paper with nearly 40% of students scoring full marks. Most were able to work backwards from the given confidence interval in part (a) to find the correct value of σ. The *z*-value of 1.96 was almost always correctly selected though some incorrectly used 1.6449. Some overcomplicated the calculation by using simultaneous equations, but most arrived at the correct result.

Again, part (b) was generally well answered and good attempts were seen here even when slips were made in part (a). In a number of cases, the last two marks were not scored when students gave a final answer of 96.4% which was the probability of being in the tail and not the confidence interval. Some left the answer as 0.928 having not realised that *c* was a percentage.

Question 6

Question 6 was one of the more discriminating questions on the paper and students found this to be the second most difficult overall. In part (a), most students scored some marks for finding E(*Y*) and Var(*Y*), but many stopped there. Those who attempted to find the distribution for $\bar{Y}$ virtually all recognised that it was a normal distribution but often forgot to divide the variance by 60 or did not do so until part (b).

Many students struggled with part (b) as they were unsure as to what to use for the standard error in the confidence interval. Some lost marks by dividing by 60 for a second time having already found the correct distribution in part (a). Others only attempted the upper boundary of the confidence interval calculating the maximum value rather than the confidence interval of the maximum value. Some were able to pick up the mark for correctly identifying the value 2.3263. Only the most able scored full marks here and successfully converted from the mean of the uniform distribution to its maximum value.

Question 7

Students generally found the final question of the paper to be accessible, particularly part (i) with stronger students going on to make good progress in part (ii) as well. In (i)(a) it was quite pleasing to see a large number of correct attempts at Var(*T*) and in fact many scored full marks here. Again in part (i)(b), the subtraction did not fool many students and most were able to correctly find E(*A* – *B*) and Var(*A* – *B*) and correctly carry out the standardisation to find the required probability.

Part (ii) was more challenging as although many were able to identify that $\mathrm{E}(X_1 - \bar{X}) = 0$, most struggled to correctly work out $\mathrm{Var}(X_1 - \bar{X})$ with the most common incorrect answer coming in as $\frac{5\sigma^2}{4}$. In most cases the unknown σ cancelled out in the standardisation allowing access to the final method mark. Most equated their standardisation to 1.2816 but a surprising number of students at this level gave less accurate *z*-values between 1.28 and 1.29. Again the final part of this question discriminated the most able students on this paper with just over 15% scoring full marks.

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