



Examiners' Report Principal Examiner Feedback

Summer 2019

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

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General introduction

Candidates were generally well prepared for the demands of this paper with many strong performances seen. Q5 was the most discriminating on the paper followed by Q6(c) and Q7. The calculation of probabilities from combinations of independent normal distributions remains a strong topic for candidates at all levels. Candidates should be advised to comment in the context of the question not only when completing a hypothesis test but also when referring to assumptions required to carry out the tests.

Report on individual questions

Question 1

This question provided a very accessible start to the paper with nearly two thirds of candidates achieving full marks by demonstrating their knowledge of stratified sampling. In some cases, candidates failed to mention the need to label the candidates separately in *each* group but most did state the need to select their samples using random numbers and the calculations were usually correct. In part (b), the most common answer given was that stratified sampling reflects the population structure. Some candidates just stated that it is more accurate but failed to mention to obtain estimates for each strata.

Question 2

Part (a) was fully correct for the majority of candidates who were able to state their hypotheses using the correct context and key words (gender and activity). Some, however, are still mixing up the null and alternative hypotheses when carrying out a test for association. Virtually all candidates were able to calculate the expected values to the required degree of accuracy and the correct test statistic and there was little trouble in determining the degrees of freedom for the test. The conclusion was nearly always given in context.

In part (b) many stated Bushcraft with an incorrect reason. The most common incorrect response was to make a comment about the difference between the **number** of boys and girls being more in Bushcraft. This was not accepted as it did not explicitly state that this meant its contribution to the test statistic was greatest.

Question 3

Parts (a) and (b) of this question were most successful with only the most able candidates giving a correct response in part (c). The method and calculation for Spearman's rank correlation was well known and almost always accurately calculated in part (a). A few candidates made errors in the ranking of one of the variables, but typically their working was clear which minimised the loss of marks. In part (b), there were again many good responses here with most candidates able to identify the correct critical value from the tables and compare this with their value to reject the null hypothesis. Most had correct hypotheses though a significant minority still write them in terms of r or simply state them in words. The most common mark to be missed was for the final conclusion lacking some context e.g. no

referenced to rank, singer/voice and age, or referencing correlation. Some candidates chose a two-tailed test when a one-tailed test was expected.

There were very few attempts that scored both marks in part (c) with the majority being unaware of the need to use the product moment correlation coefficient. Often candidates chose to ignore the tied ranks.

Question 4

Q4 caused some candidates difficulty because of the change of units required in finding the interval. It should have been apparent to candidates that an interval which contained zero would likely not be appropriate in this context. Most were able to score the method mark for selecting an appropriate z-value and giving an expression in the correct form for the confidence interval in part (a).

Part (b) was less successful as candidates did not often explain their answer in the context of the problem.

Most were able to obtain a correct (or correct follow through) answer in part (c) by comparing 0.22kg with their confidence interval and reaching a suitable conclusion.

Question 5

Q5 proved to be the most demanding question on the paper and whilst one third of candidates achieved full marks, just over 10% made no progress at all. Many made a promising start by finding $E(X)$ correct for the given distribution, but many struggled to go on to find $\text{Var}(X)$ with a range of incorrect methods used and sometimes worryingly the use of $E(X^2)$ used as $\text{Var}(X)$. The next most common error was then to use their $\text{Var}(X)$ in the standardisation, ignoring the application of the central limit theorem here. Even for those who used an incorrect distribution for the sample mean, the final method mark was still scored for a correct follow through probability expression. The unstructured nature of the question proved challenging for weaker candidates on this paper.

Question 6

This question was generally well answered with part (b) having the highest success rate for candidates. In part (a), the hypotheses were generally set up correctly, but there were some errors arriving at the correct standard deviation to use in the standardisation. Some mistakes were seen in the placement of the square root whilst others attempted to add together two

variance leading to the common incorrect expression $\sqrt{\left(\frac{70^2}{125} + \frac{70^2}{125}\right)}$.

There was little difficulty in obtaining the correct critical value and drawing the correct contextual conclusion.

Part (b) was often fully correct with the hypotheses causing the most difficulty here. Some candidates opted to use suffixes of A and B in their hypotheses without first defining them whilst others forgot to include the difference of 100 in the hypotheses. The critical value and conclusion were most often correct.

Many tried to rely on stock answers in part (c) and (c)(i) was generally poorly answered. Many commented on the standard deviation or made generic comments about the central limit theorem or the large value of n in this part. Part (c)(ii) was answered more successfully.

Question 7

Overall candidates found this question on goodness of fit more challenging than usual and this proved to be the second most difficult question on the paper. Just over one in five candidates achieved full marks. There was a lot of effort put in by candidates in part (a) to obtain the correct observed and expected values in this part, but this was often done correctly.

It was very common for candidates to omit the 2.8 from the hypotheses in part (b). A lack of working meant that it was sometimes difficult to tell if candidates were pooling the appropriate cells. Many attempted to pool the last three groups since one of the observed frequencies was below 5. Others wasted time by ignoring the given 9.86 and started the calculation from scratch. Here there was some difficulty obtaining the correct degrees of freedom by understanding that the 2.8 was given so there was no need to subtract another 1. Follow through was available for those who did not have the correct pooling. The conclusion of the test was virtually always given with sufficient context.

Question 8

The final question on this paper turned out to be the most accessible with nearly two thirds of candidates achieving full marks. Occasionally, the calculation of the variance in part (a) caused problems with squares being missed or sign changes not applied. Some gave the wrong tail, i.e. $1 - \text{correct answer}$.

Again part (b) was very successfully attempted with most obtaining the required distribution. In some cases the variance was given as $7^2 + 4 \times \sigma^2$. Some weaker candidates were confused when trying to solve their standardisation equation making errors with the square root and some candidates were not using z-value with compatible signs.

