AS

STATISTICS

SS03 – Statistics 03

Report on the Examination

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General comments

Students found the decision regarding which hypothesis test to use to be challenging. Identifying the type of data given and whether the data are paired or from independent samples was often incorrectly done by students.
Students made a good attempt at all questions but the wrong choice of test was not uncommon.
Students should use the given context when stating conclusions and assumptions.

Question 1

Part (a)
A matched pairs test using the Wilcoxon signed-rank test. Students generally found the test statistic correctly but it was not uncommon to a Mann-Whitney statistic or a correlation coefficient evaluated in error.
The correct test statistic, identified clearly, and the correct critical value were usually found. It is important for students to realise that the Wilcoxon signed-rank test is a lower tail test and to take care that a consistent comparison between a test statistic and a critical value, either both lower tail, or both upper tail or both tails quoted, must be evidenced to avoid an incorrect conclusion being drawn.
In the conclusion, it is necessary to refer to ‘average’ or ‘median’.

Part (b)(i)
The context with reference to identifying that it is the ‘students’ who can be regarded as a random sample and that it is the ‘differences in scores’ that must be symmetrically distributed is necessary.

Part (b)(ii)
The meaning of a Type I error should be stated correctly and expressed in context.

Question 2

A Mann-Whitney U-test on two independent samples. The ability to recognise this is important for students to be successful. Mistakes were: carrying out a ‘matched pairs Wilcoxon signed-rank test’ test, evaluating a correlation coefficient from the data or regarding the table as being a contingency table and carrying out a test for association.
The correct test statistic and the corresponding critical value, when the Mann-Whitney U-test was correctly undertaken, were usually compared consistently. The conclusion should be stated in context, using the wording given in the question. Common errors included omitting that ‘on average’ there was no evidence to suggest the patients taking the recommended painkiller had to wait fewer days for their back pain to go away completely or students failed to include the context of the question.

Part (b)
The purpose of all adults being given tablets and the same instructions was to ensure that all the adults felt that they were being treated the same, otherwise the knowledge that they were being treated differently could have affected the outcome, or that a difference in the outcome would be due to the drug treatment and is more likely to be detected, if it exists. To simply state’ to avoid’ bias’, ‘to avoid experimental error’ or ‘to be fair’ will not gain full marks.

Question 3

This Kruskal-Wallis test was correctly identified and successfully carried out in general. If 'labels' are used in subscripts to identify groups, then this should be clearly identified by the student. The correct test statistic and critical value were generally found and the correct decision to reject the null hypothesis made.
Conclusions should be expressed in context, mentioning that there is evidence of a difference in average scores for at least two music types. The recommendation that 'no music' is likely to correspond to the achievement of higher scores should include some numerical reference to median (not total) scores or ranks.

Question 4

A contingency table requiring a test for association. The correct test statistic, together with clear workings, should be shown together with the relevant critical value. This was done very well and the decision to reject the null hypothesis made. The conclusion should be stated in context, using the wording given in the question.
Part (b)
The three major contributions to the association found in part (a) or the major sources of association should be identified, mentioning these were more likely to occur than had been expected, in context.
Part (c)
The conclusions of the survey, relating the given types of food with the given parties, only applied to 'readers of the newspaper' or people aged '40 to 50 years'. This was generally successfully answered.

Question 5

Part (a)(i)
One of the variables was already ranked and therefore a Spearman's coefficient of rank correlation, not a product moment correlation coefficient, was the appropriate measure of correlation. Students should be encouraged to show the ranks used and find the correlation coefficient by entering the ranks into their calculator and finding the product moment correlation coefficient for these ranks.
Finding the differences in the ranks and using the formula is an alternative acceptable approach but can lead to a higher proportion of incorrect answers.
Three significant figures should be used for the final answer.

Part (a)(ii)
A test on the correlation coefficient found in the previous part. There were many totally correct solutions with correct conclusions in context. Common mistakes were finding the critical value for a one-tail test or finding the critical value from the product moment correlation coefficient tables. Conclusions were, and should be, stated in context.

Part (b)(i)
This required students to find the product moment coefficient of correlation for the given data. This was successfully done with most answers indicating that a calculator had been used successfully to directly obtain the answer.

Part (b)(ii)
A test for positive correlation which required a one-tail alternative hypothesis to be stated and a one-tail critical value to be quoted. Conclusions were, and should be, stated in context

Part (b)(iii)
The necessary distributional assumption is that 'Running times and budgets have a bivariate normal distribution'. Simply stating 'must be random and normal' will not gain any marks.

Part (b)(iv)
The sign test required is a familiar test and the signs were usually found correctly. The correct binomial probability, compared with 0.10, and correct acceptance of the null hypothesis, stated in context was frequently seen.
Common mistakes included incorrectly counting the total '+' or '-' signs, not finding a binomial probability or comparing the binomial probability with the significance level for a two-tail test.

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UMS conversion calculator