13-4 Wilcoxon Rank-Sum Test for Two Independent Samples

Key Concept This section describes the *Wilcoxon rank-sum test,* which uses ranks of values from two *independent* samples to test the null hypothesis that the samples are from populations having equal medians. The Wilcoxon rank-sum test is equivalent to the **Mann-Whitney *U* test** (see Exercise 13), which is included in some other textbooks and technologies (such as Minitab). Here is the basic idea underlying the Wilcoxon rank-sum test: If two samples are drawn from identical populations and the individual values are all ranked as one combined collection of values, then the high and low ranks should fall evenly between the two samples. If the low ranks are found predominantly in one sample and the high ranks are found predominantly in the other sample, we have an indication that the two populations have different medians.

Unlike the parametric t tests for two independent samples in Section 9-3, the Wilcoxon rank-sum test does *not* require normally distributed populations and it can be used with data at the ordinal level of measurement, such as data consisting of ranks. In Table 13-2 we noted that the Wilcoxon rank-sum test has a 0.95 efficiency rating when compared to the parametric test. Because this test has such a high efficiency rating and involves easier calculations, it is often preferred over the parametric test, even when the requirement of normality is satisfied.

CAUTION Don't confuse the Wilcoxon rank-sum test for two *independent* samples with the Wilcoxon signed-ranks test for matched pairs. Use Internal Revenue Service as the mnemonic for IRS to remind yourself of "**I**ndependent: **R**ank **S**um."

DEFINITION The **Wilcoxon rank-sum test** is a nonparametric test that uses ranks of sample data from two independent populations to test this null hypothesis: H_0: Two independent samples come from populations with equal medians. (The alternative hypothesis H_1 can be any one of the following three possibilities: The two populations have *different* medians, or the first population has a median *greater than* the median of the second population, or the first population has a median *less than* the median of the second population.)

Wilcoxon Rank-Sum Test

Objective

Use the Wilcoxon rank-sum test with samples from two independent populations for the following null and alternative hypotheses:

H_0: The two samples come from populations with equal medians.

H_1: The median of the first population is different from (or greater than, or less than) the median from the second population.

Notation

n_1 = size of Sample 1

n_2 = size of Sample 2

R_1 = sum of ranks for Sample 1

R_2 = sum of ranks for Sample 2

R = same as R_1 (sum of ranks for Sample 1)

μ_R = mean of the sample R values that is expected when the two populations have equal medians

σ_R = standard deviation of the sample R values that is expected with two populations having equal medians

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