**SOLUTION**

The null and alternative hypotheses for this test can be written as follows.

$H_0$: The braking distances for the three pads are the same.

$H_a$: At least one of the braking distances is different.

In Table 17.6.3 we are given the ranks of the observations. We then need to determine $R_1$, $R_2$, and $R_3$, corresponding to the sums of the ranks assigned to the observations for brake pads A, B, and C. The sum of the ranks for each brake pad is as follows.

$$R_1 = 21$$

$$R_2 = 55$$

$$R_3 = 44$$

Having the ranks, we can now calculate the test statistic, $H$.

$$\begin{aligned} H &= \frac{12}{N(N+1)}\sum_{i=1}^{k}\frac{R_i^2}{n_i} - 3(N+1) \\ &= \frac{12}{15(15+1)}\left(\frac{21^2}{5}+\frac{55^2}{5}+\frac{44^2}{5}\right) - 3(15+1) \\ &= 6.02 \end{aligned}$$

Referring to Appendix A, Table G, we see that $\chi^2_{0.05} = 5.991$. Thus, we want to reject the null hypothesis if the test statistic, $H$, is greater than or equal to 5.991. Since the test statistic exceeds the critical value ($6.02 > 5.991$), we reject the null hypothesis and conclude that the braking distances are sufficiently different.

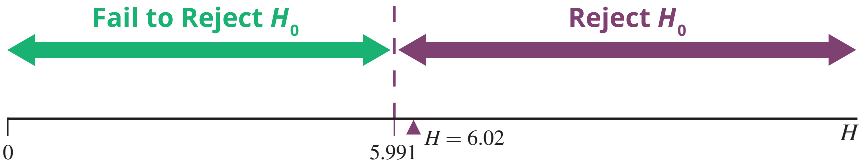


Figure 17.6.2

**Technology**

For instructions on performing the Kruskal-Wallis test using technology, please visit stat.hawkeslearning.com and navigate to **Discovering Business Statistics, Second Edition > Technology Instructions > Nonparametrics > Kruskal-Wallis Test**.

## 17.6 Exercises

### Basic Concepts

1. Which parametric test corresponds to the nonparametric Kruskal-Wallis test?
2. What are the null and alternative hypotheses associated with the Kruskal-Wallis test?
3. What are the assumptions associated with the Kruskal-Wallis test?
4. How is the Kruskal-Wallis test similar to the Wilcoxon rank-sum test?
5. What is the test statistic for the Kruskal-Wallis test? How is it calculated?
6. What is the rejection rule for the Kruskal-Wallis test?
7. How many populations can be compared using the Kruskal-Wallis test?

## Exercises

**8.** An Internet service provider is considering four different servers for purchase. Potentially, the company would be purchasing hundreds of these servers, so it wants to make sure it is making the best decision. Initially, five of each type of server are borrowed, and each is randomly assigned to one of the 20 technicians (all technicians are similar in skill). Each server is then put through a series of tasks and rated using a standardized test. The higher the score on the test, the better the performance of the server. The data are as follows.

| Server Test Scores | | | |
|---|---|---|---|
| **Server 1** | **Server 2** | **Server 3** | **Server 4** |
| 48.5 | 56.4 | 52.1 | 64.3 |
| 46.5 | 68.2 | 56.3 | 68.3 |
| 52.4 | 68.5 | 48.3 | 72.2 |
| 54.1 | 64.2 | 52.2 | 70.6 |
| 58.9 | 60.1 | 54.8 | 56.5 |

Perform a Kruskal-Wallis test on these data using $\alpha = 0.10$. Are there differences between the servers?

**9.** The following summary is obtained from an experiment where groups of cows were fed according to one of the four different feeding schedules, and their milk productions were recorded. The data given show the daily milk production in gallons for each cow. Test at $\alpha = 0.10$ to examine whether or not the milk production for all four schedules is the same.

| Milk Production by Schedule (Gallons) | | | | | |
|---|---|---|---|---|---|
| **Schedule 1** | 11.5 | 12.7 | 12.9 | 10.1 | 10.5 |
| **Schedule 2** | 9.1 | 10.7 | 9.5 | 10.9 | 10.4 |
| **Schedule 3** | 12.4 | 11.9 | 10.0 | 11.4 | 12.1 |
| **Schedule 4** | 12.8 | 12.6 | 11.7 | 11.3 | 10.9 |

**10.** The following data set contains the reading speed (in words per minute) of second grade students.

| Reading Speeds (wpm) | | |
|---|---|---|
| **Public School** | **Private School** | **Home School** |
| 54 | 66 | 65 |
| 67 | 55 | 64 |
| 63 | 62 | 60 |
| 105 | 69 | 72 |
| 61 | 71 | 68 |

Is there sufficient evidence at the 0.01 level of significance to conclude that the reading speeds vary by school type?