still gets the same rank. Likewise, no matter how far the smallest observation is below the next smallest, it still gets the rank of 1.

Try Exercise 15.4

Nonparametric Estimation Comparing Two Groups

Throughout this text, we've seen the importance of *estimating* parameters. We learn more from a confidence interval for a parameter than from a significance test about the value of that parameter. Nonparametric estimation methods, like nonparametric tests, do not require the assumption of normal population distributions.

When the response is quantitative, we can compare a measure of center for the two groups. Chapter 10 did this for the mean. Nonparametric methods are often used when the response distribution may be skewed. Then, it can be more informative to summarize each group by the *median.* We then estimate the difference between the population medians for the two groups.

Most software for the Wilcoxon test reports point and interval estimates comparing medians. (Some software, such as MINITAB, refers to the equivalent Mann-Whitney test instead. See Exercise 15.35.) Although this inference does not require a normal population assumption, it *does* require an extra assumption, namely that *the population distributions for the two groups have the same shape.*

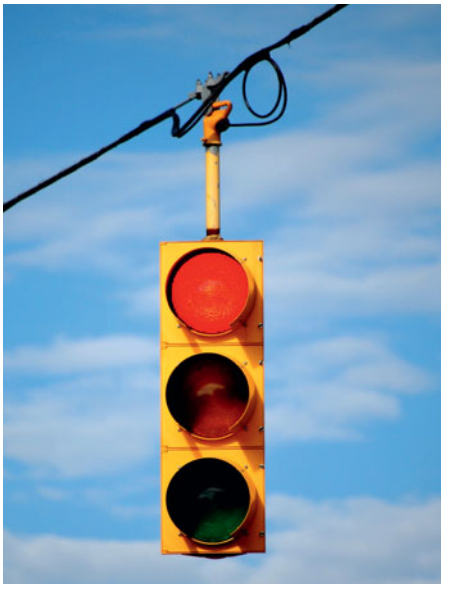
Under the extra assumption, here's how software estimates the difference between the population medians. For every possible pair of subjects, one from each group, it takes the difference between the response from the first group and the response from the second group. The point estimate is the median of all those differences. Software also reports a confidence interval for the difference between the population medians. The mechanics of this are beyond the scope of this text.

Wilcoxon test

Example 4

Difference Between Median Reaction Times

Picture the Scenario



Example 3 used the Wilcoxon test to compare reaction time distributions in a simulated driving experiment for subjects using cell phones and for a control group. The MINITAB output in Table 15.6 shows results of comparing the distributions using medians. (It uses the Greek letter name *eta*, which is η, to denote the median.)

Table 15.6 MINITAB Output for Comparing Medians for Cell Phone Group and Control Group

```
                N       Median
Cell phone      32      569.00
Control         32      530.00
Point estimate for ETA1-ETA2 is 44.50
95.1 Percent CI for ETA1-ETA2 is (8.99, 79.01)
Test of ETA1 = ETA2 vs. ETA1 not = ETA2 is significant at 0.0184
```

ETA is MINITAB notation for the median

P-value