

**EXAMPLE:** If the test statistic is  $T$  (instead of  $z$ ), reject the null hypothesis if  $T$  is less than or equal to the critical value. Fail to reject the null hypothesis if  $T$  is greater than the critical value. For the sample of matched pairs in the first two rows of Table 13-4,  $T = 11$  and the critical value is 11, so we reject the null hypothesis.

**Table 13-4** Taxi-Out Times and Taxi-In Times for American Airlines Flight 21

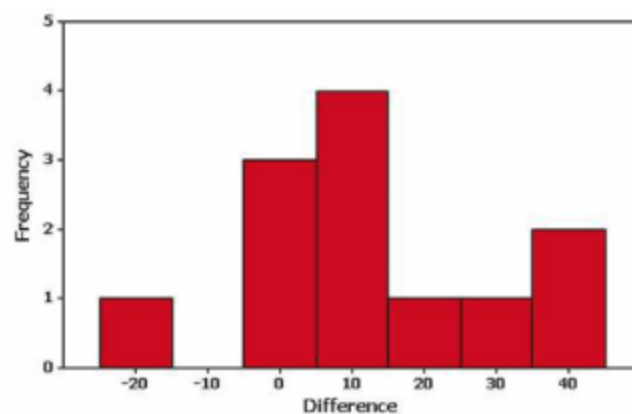
|                     |    |    |     |    |     |    |    |    |    |    |     |    |
|---------------------|----|----|-----|----|-----|----|----|----|----|----|-----|----|
| Taxi-out time (min) | 13 | 20 | 12  | 17 | 35  | 19 | 22 | 43 | 49 | 45 | 13  | 23 |
| Taxi-in time (min)  | 13 | 4  | 6   | 21 | 29  | 5  | 27 | 9  | 12 | 7  | 36  | 12 |
| $d$ (difference)    | 0  | 16 | 6   | -4 | 6   | 14 | -5 | 34 | 37 | 38 | -23 | 11 |
| Rank of $ d $       |    | 7  | 3.5 | 1  | 3.5 | 6  | 2  | 9  | 10 | 11 | 8   | 5  |
| Signed rank         |    | 7  | 3.5 | -1 | 3.5 | 6  | -2 | 9  | 10 | 11 | -8  | 5  |

### Example 1 Flight Data

The first two rows of Table 13-4 include taxi times for a sample of American Airlines Flight 21 from New York to Los Angeles (from Data Set 15 in Appendix B). Use the sample data in the first two rows of Table 13-4 to test the claim that there is no difference between taxi-out times and taxi-in times. Use the Wilcoxon signed-ranks test with a 0.05 significance level.

### Solution

**Requirement check** (1) The data are a simple random sample. (2) The histogram of the differences in the third row of Table 13-4 is shown in the accompanying display. The left side of the graph should be roughly a mirror image of the right side, which does not appear to be the case. But with only 11 differences, the difference between the left and right sides is not too extreme, so we will consider this requirement to be satisfied. ✓



The null hypothesis is the claim of no difference between the taxi-out times and the taxi-in times, and the alternative hypothesis is the claim that there is a difference.

$H_0$ : There is no difference. (The median of the differences is equal to 0.)

$H_1$ : There is a difference. (The median of the differences is not equal to 0.)