P(7 runs) $= 10/84$, each of the G values of 3, 4, 5, 6, 7 can easily occur by chance, whereas $G = 2$ is unlikely because P(2 runs) is less than 0.025. The lower critical value of G is therefore 2, and there is no upper critical value that can be equaled or exceeded.

d. Critical value of $G = 2$ agrees with Table A-10. The table lists 8 as the upper critical value, but it is impossible to get 8 runs using the given elements.

Chapter 13: Quick Quiz

1. Distribution-free test
2. 2, 5, 2, 2, 4
3. The efficiency rating of 0.91 indicates that with all other factors being the same, rank correlation requires 100 pairs of sample observations to achieve the same results as 91 pairs of observations with the parametric test for linear correlation, assuming that the stricter requirements for using linear correlation are met.
4. The Wilcoxon rank-sum test does not require that the samples be from populations having a normal distribution or any other specific distribution.
5. $G = 4$
6. Because there are only two runs, all of the values below the mean occur at the beginning and all of the values above the mean occur at the end, or vice versa. This indicates an upward (or downward) trend.
7. Sign test and Wilcoxon signed-ranks test
8. Rank correlation
9. Kruskal-Wallis test
10. Test claims involving matched pairs of data; test claims involving nominal data; test claims about the median of a single population

Chapter 13: Review Exercises

1. The test statistic of $z = -1.65$ is not less than or equal to the critical value of $z = -1.96$. Fail to reject the null hypothesis of $p = 0.5$. There is not sufficient evidence to warrant rejection of the claim that in each World Series, the American League team has a 0.5 probability of winning.
2. The test statistic of $x = 0$ is less than or equal to the critical value of 0. There is sufficient evidence to reject the claim of no difference. It appears that there is a difference in cost between flights scheduled 1 day in advance and those scheduled 30 days in advance. Because all of the flights scheduled 30 days in advance cost less than those scheduled 1 day in advance, it is wise to schedule flights 30 days in advance.
3. The test statistic of $T = 0$ is less than or equal to the critical value of 0. There is sufficient evidence to reject the claim that differences between fares for flights scheduled 1 day in advance and those scheduled 30 days in advance have a median equal to 0. Because all of the flights scheduled 1 day in advance have higher fares than those scheduled 30 days in advance, it appears that it is generally less expensive to schedule flights 30 days in advance instead of 1 day in advance.
4. The sample mean is 54.8 years. $n_1 = 19$, $n_2 = 19$, and the number of runs is $G = 18$. The critical values are 13 and 27. Fail to reject the null hypothesis of randomness. There is not sufficient evidence to warrant rejection of the claim that the sequence of ages is random relative to values above and below the mean. The results do not suggest that there is an upward trend or a downward trend.
5. $r_s = 0.714$. Critical values: ± 0.738. Fail to reject the null hypothesis of $\rho_s = 0$. There is not sufficient evidence to support the claim that there is a correlation between the student ranks and the magazine ranks. When ranking colleges, students and the magazine do not appear to agree.
6. The test statistic of $z = -0.88$ is not in the critical region bounded by $z = -1.96$ and 1.96. There is not sufficient evidence to warrant rejection of the claim that the population of differences has a median of zero. Based on the sample data, it appears that the predictions are reasonably accurate, because there does not appear to be a difference between the actual high temperatures and the predicted high temperatures.
7. Convert $T = 230.5$ to the test statistic $z = -0.62$. Critical values: $z = \pm 1.96$. (Tech: P-value $= 0.531$.) There is not sufficient evidence to warrant rejection of the claim that the population of differences has a median of zero. Based on the sample data, it appears that the predictions are reasonably accurate, because there does not appear to be a difference between the actual high temperatures and the predicted high temperatures.
8. Test statistic: $H = 6.6305$. Critical value: $\chi^2 = 5.991$. (Tech: P-value $= 0.0363$.) Reject the null hypothesis of equal medians. Interbreeding of cultures is suggested by the data.
9. $R_1 = 60$, $R_2 = 111$, $\mu_R = 85.5$, $\sigma_R = 11.3248$, test statistic: $z = -2.25$. Critical values: $z = \pm 1.96$. (Tech: P-value $= 0.0243$.) Reject the null hypothesis that the populations have the same median. Skull breadths from 4000 B.C. appear to have a different median than those from A.D. 150.
10. $r_s = 0.473$. Critical values: ± 0.587. Fail to reject the null hypothesis of $\rho_s = 0$. There is not sufficient evidence to support the claim that there is a correlation between weights of plastic and weights of food.

Chapter 13: Cumulative Review Exercises

1. $\bar{x} = 14.6$ hours, median $= 15.0$ hours, $s = 1.7$ hours, $s^2 = 2.9$ hour^2, range $= 6.0$ hours
2. a. Convenience sample
   b. Because the sample is from one class of statistics students, it is not likely to be representative of the population of all full-time college students.
   c. Discrete
   d. Ratio
3. H_0: $\mu = 14$ hours. H_1: $\mu > 14$ hours. Test statistic: $t = 1.446$. Critical value: $t = 1.729$ (assuming a 0.05 significance level). P-value > 0.05 (Tech: 0.0822). Fail to reject H_0. There is not sufficient evidence to support the claim that the mean is greater than 14 hours.
4. The test statistic of $x = 5$ is not less than or equal to the critical value of 4. There is not sufficient evidence to support the claim that the sample is from a population with a median greater than 14 hours.