Chapter 11

Section 11-2

1. The test is to determine whether the observed frequency counts agree with the claimed uniform distribution so that frequencies for the different days are equally likely.
3. Because the given frequencies differ substantially from frequencies that are all about the same, the χ^2 test statistic should be large and the P-value should be small.
5. Test statistic: $\chi^2 = 1934.979$. Critical value: $\chi^2 = 12.592$. P-value $= 0.000$. There is sufficient evidence to warrant rejection of the claim that the days of the week are selected with a uniform distribution with all days having the same chance of being selected.
7. Critical value: $\chi^2 = 16.919$. P-value > 0.10 (Tech: 0.516). There is not sufficient evidence to warrant rejection of the claim that the observed outcomes agree with the expected frequencies. The slot machine appears to be functioning as expected.
9. Test statistic: $\chi^2 = 10.375$. Critical value: $\chi^2 = 19.675$. P-value > 0.10 (Tech: 0.497). There is not sufficient evidence to warrant rejection of the claim that homicides in New York City are equally likely for each of the 12 months. There is not sufficient evidence to support the police commissioner's claim that homicides occur more often in the summer when the weather is better.
11. Test statistic: $\chi^2 = 5.860$. Critical value: $\chi^2 = 11.071$. P-value > 0.10 (Tech: P-value $= 0.320$). There is not sufficient evidence to support the claim that the outcomes are not equally likely. The outcomes appear to be equally likely, so the loaded die does not appear to behave differently from a fair die.
13. Test statistic: $\chi^2 = 13.483$. Critical value: $\chi^2 = 16.919$. P-value > 0.10 (Tech: 0.142). There is not sufficient evidence to warrant rejection of the claim that the likelihood of winning is the same for the different post positions. Based on these results, post position should not be considered when betting on the Kentucky Derby race.
15. Test statistic: $\chi^2 = 29.814$. Critical value: $\chi^2 = 16.812$. P-value < 0.005 (Tech: 0.000). There is sufficient evidence to warrant rejection of the claim that the different days of the week have the same frequencies of police calls. The highest numbers of calls appear to fall on Friday and Saturday, and these are weekend days with disproportionately more partying and drinking.
17. Test statistic: $\chi^2 = 7.579$. Critical value: $\chi^2 = 7.815$. P-value > 0.05 (Tech: 0.056). There is not sufficient evidence to warrant rejection of the claim that the actual numbers of games fit the distribution indicated by the proportions listed in the given table.
19. Test statistic: $\chi^2 = 6.682$. Critical value: $\chi^2 = 11.071$ (assuming a 0.05 significance level). P-value > 0.10 (Tech: 0.245). There is not sufficient evidence to warrant rejection of the claim that the color distribution is as claimed.
21. Test statistic: $\chi^2 = 3650.251$. Critical value: $\chi^2 = 20.090$. P-value < 0.005 (Tech: 0.000). There is sufficient evidence to warrant rejection of the claim that the leading digits are from a population with a distribution that conforms to Benford's law. It does appear that the checks are the result of fraud (although the results cannot confirm that fraud is the cause of the discrepancy between the observed results and the expected results).
23. Test statistic: $\chi^2 = 1.762$. Critical value: $\chi^2 = 15.507$. P-value > 0.10 (Tech: 0.988). There is not sufficient evidence to warrant rejection of the claim that the leading digits are from a population with a distribution that conforms to Benford's law. The tax entries do appear to be legitimate.
25. a. 6, 13, 15, 6
    b. 0.1587, 0.3413, 0.3413, 0.1587 (Tech: 0.1587, 0.3413, 0.3414, 0.1586)
    c. 6.348, 13.652, 13.652, 6.348 (Tech: 6.348, 13.652, 13.656, 6.344)
    d. Test statistic: $\chi^2 = 0.202$ (Tech: 0.201). Critical value: $\chi^2 = 11.345$. P-value > 0.10 (Tech: 0.977). There is not sufficient evidence to warrant rejection of the claim that heights were randomly selected from a normally distributed population. The test suggests that the data are from a normally distributed population.

Section 11-3

1. Because the P-value of 0.216 is not small (such as 0.05 or lower), fail to reject the null hypothesis of independence between the treatment and whether the subject stops smoking. This suggests that the choice of treatment doesn't appear to make much of a difference.
3. $df = 2$ and the critical value is $\chi^2 = 5.991$.
5. Test statistic: $\chi^2 = 3.409$. Critical value: $\chi^2 = 3.841$. P-value > 0.05 (Tech: 0.0648). There is not sufficient evidence to warrant rejection of the claim that the form of the 100-Yuan gift is independent of whether the money was spent. There is not sufficient evidence to support the claim of a denomination effect.
7. Test statistic: $\chi^2 = 25.571$. Critical value: $\chi^2 = 3.841$. P-value < 0.005 (Tech: 0.000). There is sufficient evidence to warrant rejection of the claim that whether a subject lies is independent of the polygraph test indication. The results suggest that polygraphs are effective in distinguishing between truths and lies, but there are many false positives and false negatives, so they are not highly reliable.
9. Test statistic: $\chi^2 = 42.557$. Critical value: $\chi^2 = 3.841$. P-value < 0.005 (Tech: 0.000). There is sufficient evidence to warrant rejection of the claim that the sentence is independent of the plea. The results encourage pleas for guilty defendants.
11. Test statistic: $\chi^2 = 0.164$. Critical value: $\chi^2 = 3.841$. P-value > 0.10 (Tech: 0.686). There is not sufficient evidence to warrant rejection of the claim that the gender of the tennis player is independent of whether the call is overturned.
13. Test statistic: $\chi^2 = 14.589$. Critical value: $\chi^2 = 9.488$. P-value < 0.01 (Tech: 0.0056). There is sufficient evidence to warrant rejection of the claim that the direction of the kick is independent of the direction of the goalkeeper jump. The results do not support the theory that because the kicks are so fast, goalkeepers have no time to react, so the directions of their jumps are independent of the directions of the kicks.