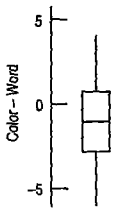
b) H_0: $\mu_D = 0$; H_A: $\mu_D \neq 0$



Boxplot of the differences looks symmetric with no outliers.

$t = -1.70$; P-value = 0.0999; do not reject H_0, because $P > 0.05$. The data do not provide evidence that the color or written word dominates.

34. a) $373.50
    b) They are 95% confident that the average loss in a home burglary is between $1644 and $2391, based on their sample.
    c) 95% of all random samples will produce confidence intervals that contain the true mean loss.
35. a) Different samples give different means; this is a fairly small sample. The difference may be due to natural sampling variation.
    b) H_0: $\mu = 100$; H_A: $\mu < 100$
    c) Batteries selected are a SRS (representative); fewer than 10% of the company's batteries; lifetimes are approximately Normal.
    d) $t = -1.0$; P-value = 0.1666; do not reject H_0. This sample does not show that the average life of the batteries is significantly less than 100 hours.
    e) Type II.
36. a) Based on these data, we are 90% confident that the average hamster litter will have between 7.11 and 8.33 babies.
    b) Larger—to be more confident, we need a wider interval.
    c) About 27 (based on t^*_{24}).

CHAPTER 26

1. a) Chi-square test of independence. We have one sample and two variables. We want to see if the variable *Account Type* is independent of the variable *Trade Type*.
   b) Other test. *Account Size* is quantitative, not counts.
   c) Chi-square test of homogeneity. We want to see if the distribution of one variable, *Courses*, is the same for two groups (resident and nonresident students).
2. a) Chi-square goodness-of-fit test. We want to see if the distribution of defects is uniform over the work days.
   b) Other test. *Cholesterol Level* is quantitative, not counts.
   c) Chi-square test of independence. We have data on two variables, *Political Leaning* and *Major*, for one group of students.
3. a) 10 b) Goodness-of-fit
   c) H_0: The die is fair (all faces have $p = 1/6$).
   H_A: The die is not fair.
   d) Count data; rolls are random and independent; expected frequencies are all bigger than 5.
   e) 5 f) $\chi^2 = 5.600$, P-value = 0.3471
   g) Because the P-value is high, do not reject H_0. The data show no evidence that the die is unfair.
4. a) Yellow, red: 21.2; orange, blue, green: 10.6; brown; 31.8
   b) Goodness-of-fit
   c) H_0: The distribution is as specified by the company.
   H_A: The distribution is not as specified.
   d) Count data; bag may not be a random sample, but most likely representative; expected counts are all bigger than 5.
   e) 5 f) $\chi^2 = 9.315$, P-value = 0.0972
   g) Because the P-value is high, do not reject H_0. These data do not provide evidence that the distribution is other than specified.
5. a) Weights are quantitative, not counts.
   b) Count the number of each kind of nut, assuming the company's percentages are based on counts rather than weights.
6. Data are averages, not counts.
7. H_0: The police force represents the population (29.2% white, 28.2% black, etc.). H_A: The police force is not representative of the population. $\chi^2 = 16516.88$, df = 4, P-value = 0.0000. Because the P-value is so low, we reject H_0. These data show that the police force is not representative of the population. In particular, there are too many white officers in relationship to their membership in the community.
8. H_0: Murders among women have the same distribution of weapons as all murders (63.4% guns, etc.). H_A: Murders among women have a different distribution of weapons than all murders. $\chi^2 = 389.54$, df = 3, P-value < 0.0001. Because the P-value is so low, we reject H_0. Women's murders do not have the same distribution of weapons as all murders nationwide. Women are much less likely to be killed by other weapons and more likely to be killed by personal attack.
9. a) $\chi^2 = 5.671$, df = 3, P-value = 0.1288. With a P-value this high, we fail to reject H_0. Yes, these data are consistent with those predicted by genetic theory.
   b) $\chi^2 = 11.342$, df = 3, P-value = 0.0100. Because of the low P-value, we reject H_0. These data provide evidence that the distribution is not as specified by genetic theory.
   c) With small samples, many more data sets will be consistent with the null hypothesis. With larger samples, small discrepancies will show evidence against the null hypothesis.
10. H_0: Digits are all equally likely (all occur with frequency 1/10). H_A: Digits are not all equally likely. $\chi^2 = 5.509$, df = 9, P-value = 0.7879. Because the P-value is large, we do not reject H_0. These data provide no evidence that the digits in pi are not all equally likely.
11. a) 96/16 = 6 b) Goodness of Fit
    c) H_0: The number of large hurricanes remains constant over decades.
    H_A: The number of large hurricanes has changed.
    d) 15 e) P-value = 0.63
    f) The very high P-value means these data offer no evidence that the numbers of large hurricanes has changed.
    g) The final period is only 6 years rather than 10 and already 7 large hurricanes have been observed. Perhaps this decade will have an unusually large number of such hurricanes.
12. a) Goodness of Fit b) 655/49 = 13.367
    c) H_0: All numbers are equally likely;
    H_A: Some numbers are more likely than others.
    d) 48 e) 0.93
    f) The very high P-value means these data offer no evidence that some numbers are more likely to come up than others.
13. a) Independence
    b) H_0: Breastfeeding success is independent of having an epidural.
    H_A: There's an association between breastfeeding success and having an epidural.
14. a) Homogeneity
    b) H_0: The same proportion of articles used statistics in the three time periods surveyed. H_A: The proportion of articles using statistics changed over time.
15. a) 1 b) 159.34
    c) Breastfeeding behavior should be independent for these babies. They are fewer than 10% of all babies; we assume they are representative. We have counts, and all the expected counts are at least 5.
16. a) 2 b) 21.85
    c) These are counted data. One article shouldn't affect another (except perhaps for the rare article based on a previous one in an earlier year cohort included in this study). We can regard the selected years as representative of those nearby, and the authors (judging by their title) seem to want to regard these articles as representative of those appearing in other similar-quality medical journals, so they're fewer than 10% of all articles. All expected counts are at least 5.

17. a) 5.90 b) P-value < 0.005
    c) The P-value is very low, so reject the null. There's evidence of an association between having an epidural and subsequent success in breastfeeding.
18. a) 2.82 b) P-value < 0.001
    c) The P-value is very low, so reject the null. There's evidence that the percentage of medical journal articles that include statistics has changed over time.
19. a) $\frac{(190 - 159.34)}{\sqrt{159.34}} = 2.43$
    b) It appears that babies whose mothers had epidurals during childbirth are much less likely to be breastfeeding 6 months later.
20. a) $\frac{(14 - 21.85)}{\sqrt{21.85}} = -1.68$
    b) The residuals for No stats are decreasing and those for Stats are increasing over time, indicating that, over time, fewer articles are appearing without statistics.
21. These factors would not be mutually exclusive. There would be yes or no responses for every baby for each.
22. The methods would not have been mutually exclusive. Articles might use more than one statistical method.
23. a) 40.2% b) 8.1% c) 62.2% d) 285.48
    e) H_0: Survival was independent of status on the ship. H_A: Survival depended on the status.
    f) 3
    g) We reject the null hypothesis. Survival depended on status. We can see that first-class passengers were more likely to survive than passengers of any other class.
24. a) 15.0% b)13.0% c) 730.4
    d) Independence
    e) H_0: *Rank* is independent of *Sex*. H_A: *Rank* and *Sex* are not independent.
    f) Count data; not a random sample, but all NYPD officers; expected counts all greater than 5.
    g) 5
    h) Because the P-value is so low, we reject H_0. *Sex* and *Rank* in the NYPD are not independent.
25. First class passengers were most likely to survive, while 3rd-class passengers and crew were under-represented among the survivors.
26. Women are overrepresented at the lower ranks and underrepresented at every rank from sergeant up.
27. a) Experiment—actively imposed treatments (different drinks)
    b) Homogeneity
    c) H_0: The rate of urinary tract infection is the same for all three groups. H_A: The rate of urinary tract infection is different among the groups.
    d) Count data; random assignment to treatments; all expected frequencies larger than 5.
    e) 2 f) $\chi^2 = 7.776$, P-value = 0.020.
    g) With a P-value this low, we reject H_0. These data provide reasonably strong evidence that there is a difference in urinary tract infection rates between cranberry juice drinkers, lactobacillus drinkers, and the control group.
    h) The standardized residuals are

	Cranberry	Lactobacillus	Control
Infection	−1.87276	1.19176	0.68100
No Infection	1.24550	−0.79259	−0.45291

    From the standardized residuals (and the sign of the residuals), it appears those who drank cranberry juice were less likely to develop urinary tract infections; those who drank lactobacillus were more likely to have infections.
28. a) Homogeneity
    b) H_0: The distribution of *Car Origin* is the same for students and staff. H_A: The distribution of *Car Origin* is different for students and staff.
    c) Count data; random survey of cars in lots (probably can't generalize to other universities); expected frequencies greater than 5.
    d) $\chi^2 = 7.828$, df = 2, P-value = 0.020.
    e) With a P-value this low, we reject H_0. The distribution of car origins differs between students and staff. Examination of the residuals shows that students are more likely than staff to drive European cars and less likely than staff to drive American cars.
29. a) Independence
    b) H_0: *Political Affiliation* is independent of *Sex*. H_A: There is a relationship between *Political Affiliation* and *Sex*.
    c) Counted data; probably a random sample, but can't extend results to other states; all expected frequencies greater than 5.
    d) $\chi^2 = 4.851$, df = 2, P-value = 0.0884.
    e) Because of the high P-value, we do not reject H_0. These data do not provide evidence of a relationship between *Political Affiliation* and *Sex*.
30. a) Prospective study; individuals were selected and then subsequently followed.
    b) Independence
    c) $\chi^2 = 3.677$, df = 3, P-value = 0.2985. Because of the high P-value, we do not reject H_0. These data do not provide evidence of a relationship between the amount of fish in the diet and prostate cancer. (Data are for totals and cancer, not noncancer and cancer.)
    d) No. There may be many other factors involved.
31. H_0: *Political Affiliation* is independent of *Region*. H_A: There is a relationship between *Political Affiliation* and *Region*. $\chi^2 = 13.849$, df = 4, P-value = 0.0078. With a P-value this low, we reject H_0. *Political Affiliation* and *Region* are related. Examination of the residuals shows that those in the West are more likely to be Democrat than Republican; those in the Northeast are more likely to be Republican than Democrat.
32. a) Survey b) Homogeneity
    c) $\chi^2 = 4.030$, df = 4, P-value = 0.4019. Because the P-value is so high, we fail to reject H_0. These data do not show evidence of a change in attitudes about the ideal family between 1991 and 2001.
33. a) Homogeneity
    b) H_0: The grade distribution is the same for both professors. H_A: The grade distributions are different.
    c)

	Dr. Alpha	Dr. Beta
A	6.667	5.333
B	12.778	10.222
C	12.222	9.778
D	6.111	4.889
F	2.222	1.778

    Three cells have expected frequencies less than 5.
34. a) Homogeneity
    b) H_0: The crime distribution is the same for both phases of the moon. H_A: The crime distributions are different for the different moon phases.
    c)

	Full moon	Not full
Violent	2.558	2.442
Property	19.442	18.558
Drugs/alcohol	23.535	22.465
Domestic abuse	12.791	12.209
Other offenses	7.674	7.326

    Two cells have expected counts less than 5.

35. a)

	Dr. Alpha	Dr. Beta
A	6.667	5.333
B	12.778	10.222
C	12.222	9.778
Below C	8.333	6.667

All expected frequencies are now larger than 5.
b) Decreased from 4 to 3.
c) $\chi^2 = 9.306$, P-value = 0.0255. Because the P-value is so low, we reject H_0. The grade distributions for the two professors are different. Dr. Alpha gives fewer A's and more grades below C than Dr. Beta.

36. a) Combine Violent and Domestic abuse into one category (or Violent and Other).
b) $\chi^2 = 2.877$, df = 3, P-value = 0.4109. Because the P-value is so high, we do not reject H_0. These data do not provide any evidence of a difference in type of illegal activity in different moon phases.

37. $\chi^2 = 14.058$, df = 1, P-value = 0.0002. With a P-value this low, we reject H_0. There is evidence of racial steering. Blacks are much less likely to rent in Section A than Section B.

38. $\chi^2 = 453.476$, df = 1, P-value < 0.0001. With a P-value this low, we reject H_0. Survival was related to gender. Females were much more likely than males to survive (72.98% to 21.20%).

39. a) $z = 3.74936$, $z^2 = 14.058$.
b) P-value (z) = 0.0002 (same as in Exercise 25).

40. a) $z = 21.29498$. b) $z^2 = 453.476$.
c) Both P-values are near 0.

41. $\chi^2 = 5.89$, df = 3, P = 0.117. Because the P-value is >0.05, these data show no evidence of an association between the mother's age group and the outcome of the pregnancy.

42. $\chi^2 = 178.453$, df = 12, P-value < 0.0001, Because the P-value is so low, we reject H_0. There is a difference is education level among the different age groups. The largest component indicates those 35 to 44 were less likely to have only a high-school diploma. The second-largest indicates the same age group is more likely than other age groups to have at least four years of college.

CHAPTER 27

1. a) $\widehat{Error} = 453.22 - 8.37\ YearSince1970$; according to the model, the error made in predicting a hurricane's path was about 453 nautical miles, on average, in 1970. It has been declining at a rate of about 8.37 nautical miles per year.
b) H_0: $\beta_1 = 0$; there has been no change in prediction accuracy. H_A: $\beta_1 \neq 0$; there has been a change in prediction accuracy.
c) With a P-value < 0.001, I reject the null hypothesis and conclude that prediction accuracies have in fact been changing during this period.
d) 58.5% of the variation in hurricane prediction accuracy is accounted for by this linear model on time.

2. a) $\widehat{\%Other} = -3.068 + 0.615\%\ Marijuana$. The percentage of ninth graders in these countries who have used other drugs is estimated to have increased 0.615% for each 1% increase in the percentage of ninth graders who have used marijuana.
b) H_0: There is no (linear) relationship between use of marijuana and other drugs, $\beta_1 = 0$. H_A: There is a relationship, $\beta_1 \neq 0$.
c) $t = 7.85$, P-value = 0.0001. With such a low P-value, we reject H_0. Percentage of teens using other drugs seems to be positively related to percentage using marijuana.
d) Percentage using marijuana accounts for 87.3% of the variation in other drug usage for ninth graders in these countries.
e) The use of other drugs is associated with marijuana use, but there is no proof of causality. There may be lurking variables.

3. a) $\widehat{Budget} = -31.387 + 0.714\ RunTime$. The model suggests that movies cost about \$714,000 per minute to make.
b) A negative starting value makes no sense, but the P-value of 0.07 indicates that we can't discern a difference between our estimated value and zero. The statement that a movie of zero length should cost \$0 makes sense.
c) Amounts by which movie costs differ from predictions made by this model vary, with a standard deviation of about \$33 million.
d) 0.154 \$m/min
e) If we constructed other models based on different samples of movies, we'd expect the slopes of the regression lines to vary, with a standard deviation of about \$154,000 per minute.

4. a) $\widehat{Price} = -0.312 + 94.5\ Size$. The model suggests that Saratoga houses cost about \$94.5 per square foot.
b) The P-value for the intercept is 0.50. That means that we cannot discern a difference between the intercept value and zero. A value of \$0 for a house of zero size makes sense.
c) Amounts by which house prices differ from predictions made by this model vary, with a standard deviation of about \$54,000.
d) \$2.393/sq. ft.
e) If we constructed other models based on different samples of houses, we'd expect the slopes of the regression lines to vary, with a standard deviation of about \$2.39 per square foot.

5. a) The scatterplot looks straight enough, the residuals look random and nearly normal, and the residuals don't display any clear change in variability.
b) I'm 95% confident that the cost of making longer movies increases at a rate of between 0.41 and 1.02 million dollars per additional minute.

6. a) The scatterplot looks straight enough, the residuals look random and nearly normal, and the residuals don't display any clear change in variability.
b) I'm 95% confident that Saratoga housing costs increase at a rate of between \$89.8 and \$99.2 per square foot.

7. a) H_0: $\beta_1 = 0$; there's no association between calories and sodium content in all-beef hot dogs. H_A: $\beta_1 \neq 0$: there is an association.
b) Based on the low P-value (0.0018), I reject the null. There is evidence of an association between the number of calories in all-beef hot dogs and their sodium contents.

8. a) H_0: There is no linear relationship between *Age* and *Cholesterol Level*, $\beta_1 = 0$. H_A: Cholesterol levels change with age, $\beta_1 \neq 0$
b) $t = 3.00$, P-value = 0.0056. Because the P-value is so small, we reject H_0. These data show a significant positive relationship between *Age* and *Cholesterol Level*.

9. a) Among all-beef hot dogs with the same number of calories, the sodium content varies, with a standard deviation of about 60 mg.
b) 0.561 mg/cal
c) If we tested many other samples of all-beef hot dogs, the slopes of the resulting regression lines would be expected to vary, with a standard deviation of about 0.56 mg of sodium per calorie.

10. a) Among adults of the same age, cholesterol levels vary with a standard deviation of about 46 points.
b) 0.2574 pts/yr
c) If we tested many other samples of adults, the slopes of the resulting regression lines would be expected to vary with a standard deviation of 0.26 cholesterol points per year of age.

11. I'm 95% confident that for every additional calorie, all-beef hot dogs have, on average, between 1.07 and 3.53 mg more sodium.

12. I'm 95% confident that, on average, adult cholesterol levels increase between 0.27 and 1.28 points per year of age.

13. a) H_0: Difference in age at first marriage has not been changing, $\beta_1 = 0$. H_A: Difference in age at first marriage has been changing, $\beta_1 \neq 0$.
b) Residual plot shows no obvious pattern; histogram is not particularly Normal, but shows no obvious skewness or outliers.