Mind on Statistics

Chapter 15

Section 15.1

1. A student survey was done to study the relationship between class standing (freshman, sophomore, junior, or senior) and major subject (English, Biology, French, Political Science, Undeclared, or Other). What are the degrees of freedom for the chi-square statistic?
   A. 24
   B. 20
   C. 15
   D. 5
   KEY: C

2. A student survey was done to study the relationship between where students live (dormitory, apartment, house, co-op, or parent's home) and how they usually get to campus (walking, bus, bicycle, car, or subway). What are the degrees of freedom for the chi-square statistic?
   A. 5
   B. 16
   C. 20
   D. 25
   KEY: B

3. A chi-square statistic was computed for a two-way table having 4 degrees of freedom. The value of the statistic was 9.49. What is the p-value?
   A. 0.005
   B. 0.001
   C. 0.01
   D. None of the above
   KEY: D

4. A chi-square statistic was computed for a two-way table having 20 degrees of freedom. The value of the statistic was 29.69. What is the p-value?
   A. 0.025
   B. 0.05
   C. 0.075
   D. None of the above
   KEY: C

5. A chi-square statistic was computed for a two-way table having 1 degree of freedom. The value of the statistic was 10.83. What is the p-value?
   A. 0.001
   B. 0.005
   C. 0.01
   D. None of the above
   KEY: A

6. A chi-square statistic was computed for a two-way table having 1 degree of freedom. The value of the statistic was 6.00. What is the p-value or p-value range?
    A. p-value < 0.001
    B. $0.01 < p$-value < 0.025
    C. $0.025 < p$-value < 0.05
    D. None of the above
KEY: B

7. A chi-square statistic was computed for a two-way table having 20 degrees of freedom. The value of the statistic was 30.00. What is the p-value or p-value range?
    A. p-value $= 0.05$
    B. $0.05 < p$-value < 0.075
    C. $0.025 < p$-value < 0.05
    D. None of the above
KEY: B

8. A student survey was done to study the relationship between class standing (freshman, sophomore, junior, or senior) and favorite type of take-out food (pizza, Chinese food, burgers, sandwich, or other). The chi-square test statistic was 25. What is the p-value or p-value range?
    A. $0.01 < p$-value < 0.025
    B. $0.025 < p$-value < 0.05
    C. $0.05 < p$-value < 0.075
    D. None of the above
KEY: A

9. A student survey was done to study the relationship between gender and favorite television program watched on Sunday mornings (sports, news, or other). The chi-square test statistic was 10. What is the p-value or p-value range?
    A. $0.005 < p$-value < 0.01
    B. $0.01 < p$-value < 0.025
    C. $0.025 < p$-value < 0.05
    D. None of the above
KEY: A

10. Suppose that the chi-square statistic equals 10.9 for a two-way table with 4 rows and 2 columns. In which range does the approximate p-value fall for this situation?
    A. Less than 0.001
    B. Between 0.01 and 0.025
    C. Between 0.025 and 0.05
    D. Between 0.10 and 0.25
KEY: B

11. Which one of the following is NOT true about the table of expected counts for a chi-square test?
    A. The expected counts are computed assuming the null hypothesis is true.
    B. The expected counts are computed assuming the alternative hypothesis is true.
    C. The expected counts have the same row and column totals as the observed counts.
    D. The pattern of row percents is identical for all rows of expected counts.
KEY: B

12. A chi-square test involves a set of counts called "expected counts." What are the expected counts?
    A. Hypothetical counts that would occur if the alternative hypothesis were true.
    B. Hypothetical counts that would occur if the null hypothesis were true.
    C. The actual counts that did occur in the observed data.
    D. The long-run counts that would be expected if the observed counts are representative.
KEY: B

13. Which of the following gives statistically significant results at the 0.05 level of significance?
    A. $\chi^2 = 7$, df = 3
    B. $\chi^2 = 20$, df = 11
    C. $\chi^2 = 24$, df = 15
    D. $\chi^2 = 10$, df = 5
KEY: B

14. Which of the following gives statistically significant results at the 0.01 level of significance?
    A. $\chi^2 = 9.1$, df = 2
    B. $\chi^2 = 5.3$, df = 1
    C. $\chi^2 = 13.8$, df = 4
    D. $\chi^2 = 14.1$, df = 5
KEY: C

15. Which of the following gives statistically significant results?
    A. $\chi^2 = 10.23$, df = 5, $\alpha = 0.05$
    B. $\chi^2 = 10.23$, df = 4, $\alpha = 0.01$
    C. $\chi^2 = 10.23$, df = 7, $\alpha = 0.10$
    D. $\chi^2 = 10.23$, df = 3, $\alpha = 0.025$
KEY: D

16. Suppose that a two-way table displaying sample information about gender and opinion about the legalization of marijuana (yes or no) is examined using a chi-square test. The necessary conditions are met and the chi-square value is calculated to be 15. What conclusion can be made?
    A. Gender and opinion have a statistically significant relationship
    B. Gender and opinion do not have a statistically significant relationship
    C. It is impossible to make a conclusion because we don't know the sample size.
    D. It is impossible to make a conclusion because we don't know the degrees of freedom.
KEY: A

17. Which of the following relationships could be analyzed using a chi-square test?
    A. The relationship between height (inches) and weight (pounds).
    B. The relationship between satisfaction with K-12 schools (satisfied or not) and political party affiliation.
    C. The relationship between gender and amount willing to spend on a stereo system (in dollars).
    D. The relationship between opinion on gun control and income earned last year (in thousands of dollars).
KEY: B

18. For which of the following tests is the null hypothesis not of the form parameter = null value?
    A. A test for the difference in two proportions.
    B. A test for the mean of paired differences.
    C. A test for the difference in means for independent samples.
    D. A chi-square test of independence.
KEY: D

Questions 19 to 23: In the General Social Survey, respondents were asked what they thought was most important to get ahead: hard work, lucky breaks, or both. Minitab output for 1026 respondents, by gender, is shown below:

```
Expected counts are printed below observed counts

                Male   Female    Total
   Hard work      284      393      677
              292.31   384.69

   Lucky breaks    84      121      205
               88.51   116.49

   Both            75       69      144
               62.18    81.82

   Total          443      583     1026

Chi-Sq =  0.236 + 0.180 + 0.230 + 0.175 + 2.645 + 2.010 = 5.476
P-Value = 0.065
```

19. What is the null hypothesis for this situation?
    A. There is a relationship between gender and opinion on what is important to get ahead in the sample.
    B. There is no relationship between gender and opinion on what is important to get ahead in the sample.
    C. There is a relationship between gender and opinion on what is important to get ahead in the population.
    D. There is no relationship between gender and opinion on what is important to get ahead in the population.
KEY: D

20. What is the alternative hypothesis for this situation?
    A. There is a relationship between gender and opinion on what is important to get ahead in the sample.
    B. There is no relationship between gender and opinion on what is important to get ahead in the sample.
    C. There is a relationship between gender and opinion on what is important to get ahead in the population.
    D. There is no relationship between gender and opinion on what is important to get ahead in the population.
KEY: C

21. What is the value of the test statistic?
    A. 443
    B. 583
    C. 5.476
    D. None of the above
KEY: C

22. What are the degrees of freedom for the test statistic?
    A. 2
    B. 3
    C. 4
    D. None of the above
KEY: A

23. At a significance level of 0.05, what is the conclusion?
    A. Reject the null hypothesis and conclude there is no relationship between the variables.
    B. Reject the null hypothesis and conclude there is a relationship between the variables.
    C. Do not reject the null hypothesis and conclude the evidence is not strong enough to show a relationship between the two variables.
    D. Do not reject the null hypothesis and conclude there is a relationship between the variables.
KEY: C

Questions 24 to 28: In the General Social Survey, respondents were asked "If your party nominated a woman for President, would you vote for her if she were qualified for the job?" Minitab output for 953 respondents, by race, is shown below:

```
Expected counts are printed below observed counts

          white       black       other     Total
  yes       713          82          30       825
          709.00       84.84       31.16

   no       106          16           6       128
          110.00       13.16        4.84

Total       819          98          36       953

Chi-Sq =  0.023 +  0.095 +  0.044 + 0.146 +  0.612 +  0.281 =  1.199
P-Value = 0.549
```

24. What is the null hypothesis for this situation?
    A. There is a relationship between race and opinion on voting for a female president in the sample.
    B. There is no relationship between race and opinion on voting for a female president in the sample.
    C. There is a relationship between race and opinion on voting for a female president in the population.
    D. There is no relationship between race and opinion on voting for a female president in the population.
KEY: D

25. What is the alternative hypothesis for this situation?
    A. There is a relationship between race and opinion on voting for a female president in the sample.
    B. There is no relationship between race and opinion on voting for a female president in the sample.
    C. There is a relationship between race and opinion on voting for a female president in the population.
    D. There is no relationship between race and opinion on voting for a female president in the population.
KEY: C

26. What is the value of the test statistic?
    A. 953
    B. 1.199
    C. 0.549
    D. None of the above
KEY: B

27. What are the degrees of freedom for the test statistic?
    A. 2
    B. 3
    C. 4
    D. None of the above
KEY: A

28. At a significance level of 0.05, what is the conclusion?
    A. Reject the null hypothesis and conclude there is no relationship between the variables.
    B. Reject the null hypothesis and conclude there is a relationship between the variables.
    C. Do not reject the null hypothesis and conclude the evidence is not strong enough to show a relationship between the two variables.
    D. Do not reject the null hypothesis and conclude there is a relationship between the variables.
KEY: C

29. A sociologist uses a z-test to examine the difference between the proportions of men and women opposed to capital punishment. The value of the z-statistic is $z = 4$. Suppose the sociologist had instead used a chi-square test to analyze the data. What would be the value of the chi-square statistic?
    A. 2
    B. 4
    C. 16
    D. Not enough information is given to determine the value.
KEY: C

Questions 30 to 33: A researcher conducted a study on college students to see if there was a link between gender and how often they have cheated on an exam. She asked two questions on a survey:
(1) What is your gender? Male ____ Female ____
(2) How many times have you cheated on an exam while in college?
    Never __ 1 or 2 times ____ 3 or more times ___
A two-way table of observed counts follows:

Gender	Cheated on an exam?			
	Never	1 or 2 times	3 or more times	Total
Male	60	20	20	100
Female	60	30	10	100
Total	120	50	30	200

30. Considering the researcher's objectives, what is the appropriate null hypothesis to test?
    A. $p = 0.50$ where p = probability of answering "Never" to question (2) on the survey.
    B. There is a difference between males and females with regard to the distribution of responses.
    C. There is no relationship between the two variables.
    D. There is a relationship between the two variables.
KEY: C

31. What are the degrees of freedom for the test statistic?
    A. 6
    B. 5
    C. 3
    D. 2
KEY: D

32. How many female students would you expect to have cheated once or twice if the null hypothesis were true?
    A. 20
    B. 25
    C. 30
    D. 50
KEY: B

33. The value of the χ^2-test statistic is 5.33. Are the results statistically significant at the 5% significance level?
    A. Yes, because 5.33 is greater than the critical value of 3.84.
    B. Yes, because 5.33 is greater than the critical value of 4.01.
    C. No, because 5.33 is smaller than the critical value of 5.99.
    D. No, because 5.33 is smaller than the critical value of 11.07.
KEY: C

Questions 34 to 37: Is there a relationship between the color of one's eyes and the comparative lengths of one's index and ring fingers? Students were asked "which finger is longer: your index finger or your ring finger? Or are they the same?" They also reported the color of their eyes (blue, brown, green, or hazel). The analysis of the results is given below.

```
Expected counts are printed below observed counts

                Comparison of finger lengths

            Same    'Index'      'Ring'    Total
                    Longer       Longer
 blue         5        26           28       59
             7.47     18.03        33.49
 brown       13        22           58       93
             1.78     28.43        52.79
 green        6         6           15       27
             3.42      8.25        15.33
 hazel        5        16           29       50
             6.33     15.28        28.38
  Total      29        70          130      229

P-Value = 0.115
```

34. What is the appropriate statistical technique to analyze the data?
    A. A chi-square test for association.
    B. A chi-square goodness-of-fit test.
    C. A two-sample t-test.
    D. Analysis of variance.
KEY: A

35. From the analysis shown, what can we conclude at the 10% significance level?
    A. There is a statistically significant relationship between eye color and the comparative length of the index and ring fingers.
    B. There is no statistically significant relationship between eye color and the comparative length of the index and ring fingers.
    C. There is insufficient information given because the degrees of freedom of the test statistic are not specified.
    D. There is a statistically significant relationship between eye color and the comparative length of the index and ring fingers for some eye colors but not for others.
KEY: B

36. What are the degrees of freedom for this test?
    A. 2
    B. 3
    C. 6
    D. 12
KEY: C

37. What is the expected count for "blue eyes" and "same"?
    A. 59/3
    B. 29/4
    C. 229/12
    D. (59)(29)/229
KEY: D

Questions 38 to 41: In the 1994 General Social Survey, a nationwide survey done every other year in the United States, the 1,185 respondents who had ever been married were asked the age at which they first wed and whether they had ever been divorced. The two-way table below summarizes the observed counts for the relationship between "age first wed" (categorized into four age groups) and "ever divorce" (no or yes). A chi-square value and *p*-value are given below the table.

```
Rows: Age First Wed      Columns: Ever Divorced

               No      Yes      All
 Under 20      150     173      323
 20-24         340     194      534
 25-29         156      69      225
 30+            76      27      103
 All           722     463      1185

Chi-Square = 44.00, DF = ___  ,  P-Value = 0.000
```

38. What is the appropriate null hypothesis for this table?
    A. In the sample, there is a relationship between "age first wed' and "ever divorced".
    B. In the population represented by the sample, there is a relationship between "age first wed' and "ever divorced".
    C. In the sample, there is no relationship between "age first wed' and "ever divorced".
    D. In the population represented by the sample, there is no relationship between "age first wed' and "ever divorced".
KEY: D

39. The *p*-value is given as 0.000. This value was calculated as
    A. the area to the right of 44.00 under a chi-square distribution with df = 3.
    B. the area to the right of 44.00 under a chi-square distribution with df = 8.
    C. the area to the left of 44.00 under a chi-square distribution with df = 3.
    D. the area to the left of 44.00 under a chi-square distribution with df = 8.
KEY: A

40. What is the expected count for the "Under 20" and "No" cell?
    A. (323)(1/3)
    B. 150
    C. (323)(722)/1185
    D. (1185)(1/8)
KEY: C

41. Among those first wed under the age of 20, what proportion has ever been divorced?
    A. 173/1185
    B. 173/463
    C. 173/150
    D. 173/323
KEY: D

Questions 42 to 45: Students in a statistics class were asked, "With whom do you find it easier to make friends: person of the same sex, person of opposite sex, or no preference?" A table summarizing the responses by gender is given below. Minitab results for a chi-square test for these data were "Chi-Sq = 7.15 *p*-value = 0.028."

| Gender | With whom is it easier to make friends? | | | |
	no preference	opposite sex	same sex	Total
Male	40	50	30	120
Female	40	20	20	80
Total	80	70	50	200

42. What is the null hypothesis for this situation?
    A. The variables "gender" and "with whom is it easier to make friends?" are dependent in the population.
    B. There is a relationship between gender and whom it is easier to make friends with in the population.
    C. The distribution of the answers to the question "with whom is it easier to make friends?" for male students differ from that of the female students.
    D. There is no relationship between gender and whom it is easier to make friends with in the population.
KEY: D

43. What percentage of female students think it is easier to make friends with a girl?
    A. 15%
    B. 25%
    C. 30%
    D. 60%
KEY: B

44. What is the expected number of female students who think it is easier to make friends with a girl, if the null hypothesis were true?
    A. 20
    B. 25
    C. 30
    D. 32
KEY: A

45. What are the degrees of freedom for this situation?
    A. 2
    B. 3
    C. 4
    D. 5
KEY: A

Questions 46 to 52: In the General Social Survey, respondents were asked if they agreed with the following statement: "In spite of what some people say, the lot (situation/condition) of the average man is getting worse, not better." Minitab output, summarizing the results for 989 respondents by race, is shown below:

```
Expected counts are printed below observed counts

             white      black      other      Total
agree          476         86         26        588
            505.36      60.05      22.59

disagree       374         15         12        401
            344.64      40.95      15.41

Total          850        101         38        989

Chi-Sq =  1.706 + 11.216 +  0.514 + 2.501 + 16.446 +  0.754 =   33.135
P-Value = 0.000
```

46.   State the null hypothesis and alternative hypotheses.
KEY: Null hypothesis: There is no relationship between race and belief that the lot of the average man is getting worse. Alternative hypothesis: There is a relationship between race and belief.

47.   What is the percentage of white respondents who agree that the human lot is getting worse?
KEY: Percentage of Whites = 476/850 = 56%.

48.   What is the percentage of black respondents who agree that the human lot is getting worse?
KEY: Percentage of Blacks = 86/101 = 85%.

49.   What is the value of the test statistic?
KEY: Test statistic = 33.135.

50.   What are the degrees of freedom?
KEY: Degrees of freedom = 2.

51.   What is the p-value or p-value range?
KEY: p-value < 0.001 (p-value = 0.000 in the Minitab output).

52.   At a significance level of 0.05, what is the conclusion?
KEY: Reject the null hypothesis and conclude that there seems to be a relationship between race and belief that the lot of the average man is getting worse.

Questions 53 to 59: A randomly selected group 78 seniors is asked about their plans after graduation. Is there a relationship between the gender of the students and what they plan to do when they graduate from college? SPSS was used to analyze the data. Part of the output is shown below:

Gender * Plan Crosstabulation

Count

		Plan			Total
		Graduate School	Look for a job	Take a year off	
Gender	Male	12	22	9	43
	Female	13	19	3	35
Total		25	41	12	78

53. State the null hypothesis and alternative hypotheses.
KEY: Null hypothesis: There is no relationship between gender and after college plans in the population of all college seniors.
Alternative hypothesis: There is a relationship between gender and after college plans in the population of all college seniors.

54. What percentage of male students plan to take a year off?
KEY: Percentage = 9/43 = 20.9%

55. What percentage of female students are planning to go to graduate school?
KEY: Percentage = 13/35 = 37.1%

56. What is the expected number of female students going to graduate school under the null hypothesis?
KEY: 11.22

57. What are the degrees of freedom for this test?
KEY: $df = (3 − 1)(2 − 1) = 2$

58. Another part of the output is shown below:

Chi-Square Tests

	Value
Pearson Chi-Square	2.465[a]
N of Valid Cases	78

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.38.

What is the p-value or p-value range?
KEY: $0.25 < p$-value < 0.50 (or p-value $= 0.292$).

59. At a significance level of 0.10, what is the conclusion?
KEY: The results are not significant. We may conclude that there does not seem to be a relationship between gender and after college plans in the population of all college seniors represented by this sample.

Chapter 15

Questions 60 to 66: The table below shows the counts by gender and highest degree attained for 498 respondents in the General Social Survey.

| | **Highest Degree** | | | | | |
Gender	**No High School Degree**	**High School Degree**	**Junior College**	**Bachelor Degree**	**Graduate Degree**	**Total**
Male	49	95	11	39	23	217
Female	52	166	14	37	12	281
Total	101	261	25	76	35	498

60. State the null hypothesis and alternative hypotheses.
KEY: Null hypothesis: There is no relationship between gender and highest degree in the population.
Alternative hypothesis: There is a relationship between gender and highest degree in the population.

61. What percentage of male respondents has more than just a high school degree?
KEY: Percentage = (11 + 39 + 23)/217 = 33.6%

62. What percentage of female respondents has a graduate degree?
KEY: Percentage = 12/281 = 4.3%

63. What is the expected number of female respondents with a graduate degree under the null hypothesis?
KEY: 19.75

64. What is the contribution to the chi-square statistic of the cell "female respondents with a graduate degree"?
KEY: 3.04

65. What are the degrees of freedom for this test?
KEY: df = $(5 - 1)(2 - 1) = 4$

66. Contributions to the chi-square test statistic of 4 cells are greater than 3. With this information, what do you already know about the p-value?
KEY: p-value < 0.05

Section 15.2

Questions 67 to 70: In the General Social Survey, respondents were asked "If your party nominated a woman for President, would you vote for her if she were qualified for the job?" A two-way table summarizing the results for 953 respondents, by gender, is shown below:

Gender	Vote for female candidate?		
	Yes	No	Total
Female	488	66	554
Male	335	64	399
Total	823	130	953

67. If the null hypothesis of equal proportions of "Yes" votes for males and females were true, what is the expected number of females in the sample who would give a "Yes" response to having a female president?
    A. 488.0
    B. 478.4
    C. 344.6
    D. None of the above
KEY: B

68. If the null hypothesis were true, what is the expected number of females in the sample who would give a "No" response to having a female president?
    A. 54.4
    B. 66.0
    C. 75.6
    D. None of the above
KEY: C

69. The chi-square test statistic = 3.35. What is the p-value or p-value range?
    A. $0.01 < p$-value < 0.025
    B. $0.015 < p$-value < 0.05
    C. $0.05 < p$-value < 0.075
    D. None of the above
KEY: C

70. At a significance level of 0.05, what is your conclusion?
    A. The null hypothesis is rejected: the relationship between gender and support for a female president is statistically significant.
    B. The null hypothesis is rejected: the relationship between gender and support for a female president is not statistically significant.
    C. The null hypothesis is not rejected: the relationship between gender and support for a female president is statistically significant.
    D. The null hypothesis is not rejected: the relationship between gender and support for a female president is not statistically significant.
KEY: D

Questions 71 to 74: In the General Social Survey, respondents were asked "Do you favor or oppose the death penalty for persons convicted of murder?" A two-way table summarizing the results for 1447 respondents, by gender, is shown below:

Gender	Favor or oppose death penalty?		
	Favor	**Oppose**	**Total**
Female	600	211	811
Male	534	102	636
Total	1134	313	1447

71. If the null hypothesis of equal proportions of "Favor" responses for males and females were true, what is the expected number of females in the sample who would favor the death penalty?
    A. 498.4
    B. 600.0
    C. 635.6
    D. None of the above
KEY: C

72. If the null hypothesis were true, what is the expected number of males in the sample who would favor the death penalty?
    A. 137.6
    B. 498.4
    C. 534.0
    D. None of the above
KEY: B

73. The chi-square test statistic $= 20.9$. What is the p-value or p-value range?
    A. p-value < 0.001
    B. $0.001 < p$-value < 0.005
    C. $0.05 < p$-value < 0.075
    D. None of the above
KEY: A

74. At a significance level of 0.05, what is your conclusion?
    A. The null hypothesis is rejected: the relationship between gender and support for death penalty is statistically significant.
    B. The null hypothesis is rejected: the relationship between gender and support for death penalty is not statistically significant.
    C. The null hypothesis is not rejected: the relationship between gender and support for death penalty is statistically significant.
    D. The null hypothesis is not rejected: the relationship between gender and support for death penalty is not statistically significant.
KEY: A

Questions 75 to 78: In the General Social Survey, respondents were asked "Would you approve of an adult male punching a stranger if the stranger was drunk and bumped into the man and his wife on the street?" A two-way table summarizing the results for 1006 respondents, by gender, is shown below:

Gender	Would you approve of punch?		
	Yes	No	Total
Female	46	523	569
Male	35	402	437
Total	81	925	1006

75. If the null hypothesis of equal proportions of "Yes" votes for males and females were true, what is the expected number of females in the sample who think it would be all right to punch a drunken stranger?
    A. 35.19
    B. 45.81
    C. 401.81
    D. None of the above
KEY: B

76. If the null hypothesis were true, what is the expected number of males in the sample who think it would be all right to punch a drunken stranger?
    A. 35.19
    B. 45.81
    C. 401.81
    D. None of the above
KEY: A

77. The chi-square test statistic = 0.002. What is the p-value or p-value range?
    A. p-value = 0.002
    B. p-value < 0.001
    C. p-value > 0.50
    D. None of the above
KEY: C

78. At a significance level of 0.05, what is your conclusion?
    A. The null hypothesis is rejected: the relationship between gender and approval for punching is statistically significant.
    B. The null hypothesis is rejected: the relationship between gender and approval for punching is not statistically significant.
    C. The null hypothesis is not rejected: the relationship between gender and approval for punching is statistically significant.
    D. The null hypothesis is not rejected: the relationship between gender and approval for punching is not statistically significant.
KEY: D

Questions 79 to 83: In the General Social Survey, respondents were asked, "Do you agree with the following statement? "In spite of what some people say, the lot (situation/condition) of the average man is getting worse, not better." The results, for 989 respondents by gender, are shown below.

	"Lot is getting worse"		
Gender	**Agree**	**Disagree**	**Total**
Female	356	200	556
Male	234	199	433
Total	590	399	989

79.   What are the null and alternative hypotheses?
KEY: Null hypothesis: There is no difference between the population proportions of men and women who believe that the lot of the average man is getting worse.
Alternative hypothesis: There is a difference between the population proportions of men and women who believe that the lot of the average man is getting worse.

80.   If the null hypothesis were true, what is the expected number of women in the sample who agree that the lot of the average man is getting worse?
KEY: 331.69

81.   If the null hypothesis were true, what is the expected number of men in the sample who agree that the lot of the average man is getting worse?
KEY: 258.31

82.   The chi-square test statistic $= 10.09$. What is the p-value or p-value range?
KEY: $0.001 < p$-value < 0.005 or p-value $= 0.0015$

83.   At a significance level of 0.05, what is your conclusion?
KEY: There is a statistically significant difference between the proportions of men and women in the population who agree that the human lot is getting worse.

Questions 84 to 86: A group of 3rd grade students is given a craft project to take home. Half of the children received an instruction sheet with the project that included photos of examples. The other half of the children were just given general (verbal) instructions from the teacher. At the end of the project the children were asked if they enjoyed doing the project.

	Enjoyed project		
Instructions	**Yes**	**No**	**Total**
Written	15	6	21
Verbal	12	12	24
Total	17	18	35

84.   If the null hypothesis (that there is no association between the type of instruction and the enjoyment of the children in the population) were true, what is the expected number of children in the sample who received verbal instructions and enjoyed the project?
KEY: 11.66

85.   What is the value of the test statistic?
KEY: 2.14

86.   Are the results statistically significant at $\alpha = 0.05$?
KEY: At df $= 1$, we have a critical value of 3.84. The test statistic of 2.14 is *not* greater than the critical value, so we do *not* reject the null hypothesis (p-value > 0.05).

Questions 87 to 90: The table below shows the opinions of 908 respondents in the General Social Survey to the question "Do you believe there is life after death?"

	Life After Death?		
Gender	Yes	No	Total
Male	282	109	391
Female	408	109	517
Total	690	218	908

87. If the null hypothesis (that there is no association between gender and believing in life after death) were true, what is the expected number of male respondents who believe in life after death?
KEY: 297.13

88. If the null hypothesis (that there is no association between gender and believing in life after death) were true, what is the expected number of female respondents who believe in life after death?
KEY: 392.87

89. What is the value of the test statistic?
KEY: 5.63

90. Are the results statistically significant at $\alpha = 0.05$?
KEY: At df = 1, we have a critical value of 3.84 and 5.63 is greater than the critical value, so we reject the null hypothesis (p-value < 0.05).

Questions 91 to 94: The table below shows the responses from a sample of 680 people in the General Social Survey to the question, "Do you sometimes drink more than you think you should?"

	Drink more than should?		
Gender	Yes	No	Total
Male	151	177	328
Female	92	260	352
Total	243	437	680

91. If the null hypothesis (that there is no association between gender and drinking more than one should) were true, what is the expected number of male respondents who drink more than they should?
KEY: 117.21

92. If the null hypothesis (that there is no association between gender and drinking more than one should) were true, what is the expected number of female respondents who drink more than they should?
KEY: 125.79

93. What is the value of the test statistic?
KEY: 29.3

94. Are the results statistically significant at $\alpha = .01$?
KEY: At df = 1, we have a critical value of 6.63 and 29.3 is *much* greater than the critical value, so we reject the null hypothesis (p-value < 0.01; we even know that p-value < 0.001).

Section 15.3

95. For a chi-square test for goodness-of-fit, which of the following is a valid null hypothesis?
    A. $p_1 = 0.3$, $p_2 = 0.4$, $p_3 = 0.3$
    B. There is no relationship between blood type and hair color in the population.
    C. $p_1 = 0.25$, $p_2 = 0.5$, $p_3 = 0.5$
    D. All of the above are valid null hypotheses.
KEY: A

96. A medical researcher hypothesizes that, within a particular ethnic group, the distribution of blood types is: 50% have type O, 25% have type A, 20% have type B, and 5% have type AB. He gathers blood type data for a random sample of 400 people from this ethnic group, and summarizes the observed counts in the following table.

Blood type	O	A	B	AB	Total
Count	185	106	85	24	400

Suppose that a chi-square goodness of fit test is performed, and the null hypothesis is the researcher's hypothesis. What are the expected counts for blood types O, A, B, and AB, respectively?
    A. 100, 100, 100, 100
    B. 185, 106, 85, 24
    C. 200, 100, 80, 20
    D. 50, 25, 20, 5
KEY: C

Questions 97 to 99: A marketing research group shows three different television advertisements for the same product to each of sixty people to see if the ads are equally effective or not. Each participant is asked which of the three advertisements they believe is most effective. The following table summarizes the counts of how many people found each advertisement to be the most effective.

Advertisement	1	2	3	Total
Count	16	30	14	60

97. What is an appropriate null hypothesis for this study?
    A. In the sample, the advertisements are not believed to be equally effective.
    B. In the population represented by the sample, the advertisements are not believed to be equally effective.
    C. In the sample, equal proportions of people believe each advertisement to be most effective.
    D. In the population represented by the sample, equal proportions of people would believe each advertisement to be most effective.
KEY: D

98. The degrees of freedom for a chi-square test in this situation are
    A. 1
    B. 2
    C. 3
    D. 59
KEY: B

99. What is the value of the chi-square statistic for testing the null hypothesis that equal proportions of people find each advertisement to be most effective?
    A. 7.6
    B. 6.9
    C. 0.38
    D. 82.54
KEY: A

Questions 100 to 105: A gambler wanted to test whether or not a die was fair. He rolled the die 180 times and got the results shown below. For example, the number "1" appeared on 40 rolls.

Die Result	1	2	3	4	5	6	Total
Count	40	40	30	30	20	20	180

100.What is the null hypothesis for this chi-square goodness of fit test?
    A. The probabilities of a 1, 2, …, 6 are 40/180, 40/180, …, 20/180, respectively.
    B. The die is not fair: the probabilities of getting a particular number (e.g. "1") are not all equal.
    C. The die is fair: the probability of getting any particular number (e.g. "1") is 1/6.
    D. None of the above
KEY: C

101.If the die is fair, what is the expected number of times the number "1" should appear in 180 rolls of the die?
    A. 40
    B. 30
    C. 20
    D. None of the above
KEY: B

102.What are the degrees of freedom for the chi-square goodness of fit statistic?
    A. 6
    B. 5
    C. 4
    D. None of the above
KEY: B

103.What is the value for the goodness of fit chi-square statistic?
    A. 0.00
    B. 6.50
    C. 13.33
    D. None of the above
KEY: C

104.What is the p-value range?
    A. p-value < 0.005
    B. $0.01 < p$-value < 0.025
    C. $0.05 < p$-value < 0.075
    D. None of the above
KEY: B

105.At a significance level of 0.05, what is your conclusion?
    A. The null hypothesis is rejected: the die does not seem to be fair.
    B. The null hypothesis is rejected: the die appears to be fair.
    C. The null hypothesis is not rejected: there is insufficient evidence to conclude the die is not fair.
    D. The null hypothesis is not rejected: there is sufficient evidence to conclude the die is fair.
KEY: A

Questions 106 to 111: A student wants to test a claim made by a pizza company. The claim is that the proportion of students whose favorite pizza is pepperoni is 40%, vegetarian is 40%, and all others is 20%. The student takes a random sample of 100 students, and obtained the following results.

Favorite Pizza	Pepperoni	Vegetarian	Other	Total
Number of Students	35	45	20	100

106. What are the null and alternative hypotheses for a chi-square goodness of fit test?
KEY: Null hypothesis: The population proportion of students whose favorite pizza is pepperoni, vegetarian, and others is what the company claims: i.e. 40%, 40%, and 20%, respectively.
Alternative hypothesis: the population proportions are not 40%, 40%, and 20%.

107. What are the degrees of freedom for the chi-square goodness of fit test?
KEY: 2 degrees of freedom.

108. If the null hypothesis were true, what are the expected numbers of students in the sample whose favorite pizza is pepperoni, vegetarian, or other?
KEY: 40 students (Pepperoni); 40 students (Vegetarian); 20 students (Other)

109. What is the value of the chi-square goodness of fit statistic?
KEY: 1.25

110. What is the p-value or p-value range?
KEY: p-value > 0.50 or p-value = 0.5353

111. At a significance level of 0.05, what is the conclusion?
KEY: The evidence is not strong enough to reject the company's claim that the proportions of favorite pizzas for pepperoni, vegetarian, and other are 40%, 40%, and 20%, respectively.

Questions 112 to 117: At entrance C of the football stadium there are 3 swing gates for the spectators. On football Saturday, two high school students sit at this entrance and count the number of people who enter through each of the swing gates for an hour. On Monday, during their statistics class, they wish to determine if the percentages of people who use each of the three gates on football Saturday are equal. The data they collected during the hour on football Saturday is shown below.

Swing gate	Left gate	Middle gate	Right gate	Total
Number of spectators	377	457	399	1233

112. What are the null and alternative hypotheses for a chi-square goodness of fit test?
KEY: Null hypothesis: The population proportions of spectators who use each of the three gates are equal, i.e. 1/3. Alternative hypothesis: the population proportions are not all equal to 1/3%.

113. What are the degrees of freedom for the chi-square goodness of fit test?
KEY: df = 2

114. If the null hypothesis were true, what are the expected numbers of spectators in the sample for each gate?
KEY: 1233/3 = 411

115. What is the value of the chi-square goodness of fit statistic?
KEY: 8.31

116. What is the p-value or p-value range?
KEY: $0.01 < p$-value < 0.025 or p-value $= 0.016$

117. At a significance level of 0.05, what is the conclusion?
KEY: The results were significant, so it does not seem that the three gates are being used equally often by the population of spectators represented by this sample.