Solution for Homework 12

20.2 (a) The percentages, respectively, are 11/20 = 55%, 68/91 ≈ 74.7%, and 3/8 = 37.5%.

(b) Some (but not too much) time spent in extracurricular activities seems to be beneficial.

20.4 (a)

	<2	2 to 12	>12	Total
C or better	13.78	62.71	5.51	82
D or F	6.22	28.29	2.49	37
Total	20	91	8	119

(b) The first and the last columns have lower numbers than we expect in the "passing" row (and higher numbers in the "falling" row), while the middle column has the reversed: More passed than we would expect if all proportion were equal. As we observed in 20.2, it appears that a moderate amount of the time spent in extracurricular activities is beneficial.

20.6 (a) The chi-square statistic is 6.926.

(b) P = 0.031. Rejecting H_0 means that we conclude that there *is* a relationship between hours spent in extracurricular activities and performance in the course.

(c) The highest contribution comes from column 3, row 2 (">12 hours of extracurricular activities, D or F in the course"). Too much time spent on these activities seems to hurt academic performance.

(d) No: There may be a lurking variable that affects both (e.g. a personality trait that "causes" students to do well and also to participate in extracurricular activities in moderation). This was an observational study; one cannot effectively assign "treatments" such as participation in extracurricular activities.

20.8 (a) df = (r-1)(c-1) = 2

(b) On the df = 2 row of Table E, we find that $5.99 < \chi^2 < 7.38$, so $0.025 < P < 0.05$.

(c) If H_0 were true, the mean of χ^2 would be 2 (the degree of freedom); the computed value is considerably (and significantly) larger than 2.

20.10 (a) We find $\chi^2 = 10.827$ with df = 3, and P = 0.013. We have fairly strong evidence that gender and choice of major are related.

(b) One expected count is less than 5, which is only one-eighth (12.5%) of the counts in the table, so the chi-square procedure is acceptable.

(c) Graph and table are omitted. The biggest difference between women and men is in Administration: A higher percentage of women chose this major. Meanwhile, greater proportion of men chose other fields, especially Finance.

(d) The largest chi-square components are the two from the "Administration" row. Many more women than we expect (91 actual, 76.36 expected) chose this major, whereas only 40 men chose this (54.64 expected).

(e) 386 responded, so 336/722 ≈ 46.5% did not respond.

20.18 (a) The percentages are, respectively, 7.01%, 14.02%, and 13.05%.

(b)	Black	Other
Household	172	2283
	242.36	2212.64
Nonhousehold	167	1024
	117.58	1073.42
Teachers	86	573
	65.6	593.94

(c) Expected counts are all much bigger than 5, so the chi-square test is safe. We test H_0: there is no relationship between worker class and race, vs. Ha: there is some relationship.

(d) With df = 2, $P < 0.0005$.

(e) Black female child-care workers are more likely to work in nonhousehold or preschool positions.

20.21 (a) After computing the marginal totals, we find $400/1780 \approx 0.225$, $416/2239 \approx 0.186$, and $188/1356 \approx 0.139$. A student's likelihood of smoking increases when one parent smokes, and increases when both smoke.

(b) The null hypothesis says that parents' smoking habits do not affect their children.

(c)	Student smokes	Student does not smoke	Total
Both parents smoke	332.49	1447.51	1780
One parent smokes	418.22	1820.78	2239
Neither parent smokes	253.29	1102.71	1356
Total	1004	4371	5375

(d) In column 1, row 1, the expected count is much smaller than the actual count; meanwhile, the actual count is lower than expected in the lower left. This agrees with what we observed in (a): Children of non-smokers are less likely to smoke.

(e) The chi-square statistic is 37.566 with df = 2; P is essentially 0. By rejecting null, we conclude that there *is* a relationship between parents' smoking habits and those of their children.

20.22 (a)

	Hatched	Did not hatch	Total
Cold	16	11	27
	18.63	8.37	
Neutral	38	18	56
	38.63	17.37	
Hot	75	29	104
	71.74	32.26	
Total	129	58	187

(b) In order of increasing temperature, the proportions are $16/27 \approx 59.3\%$, $38/56 \approx 67.9\%$, and $75/104 \approx 72.1\%$. The percentage hatching increases with temperature; the cold water did not prevent hatching, but made it less likely.

(c) With $\chi^2 = 1.703$ and degrees of freedom df = 2, we find that the results are not significant, even at $\alpha = 0.25$.