13.4

(a) We wish to test the hypotheses

H_0 : The 1996 proportions of PhD's among the various ethnic groups are the same as in 1980.

H_A : At least one of the proportions is different.

The expected counts for 1996 are:

Race	Count
White, non-Hisp	236.7
Black, non-Hisp	11.7
Hisp	4.2
Asian or Pac. Is	8.1
American Indian/Alaskan Native	1.2
Nonres alien	38.4

All expected counts are greater than 1, however, 2 of the 6 = 33% of the expected counts are less than 5. This means that our statistic will not necessarily be close enough to chi-square distributed for our conclusions to be reliable. Therefore, we proceed with caution.

$X^2 = 60.02852$. The p-value for the test is less than 0.005 from the table. A p-value this low would mean that we have very significant evidence against the null. So we conclude that we have evidence that the 1996 proportions of PhD's are different from the 1981 distribution.

(b) The terms of our X^2 statistic are given below. We can see that the larges contributor to the test statistic is the difference in the proportion of non-resident aliens being awarded PhD's. There were 27% awarded in 1996 to this group, but only 12.8% in 1981

9.612548
0.247009
0.771429
4.297531
0.033333
45.06667

13.12 All students should buy a bag of M&M's and test the theoretical distribution someday. Since nobody did this when it was assigned. I am not going to do it either.

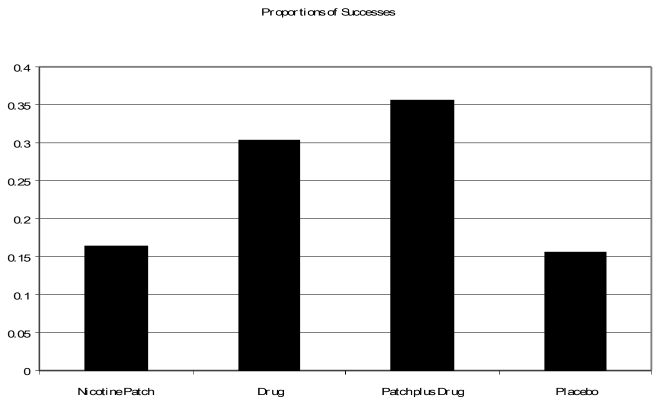
13.14

(a) The two-way table is shown here.

Tx	Successes	Failures
Nicotine Patch	40	204
Drug	74	170
Patch plus Drug	87	158
Placebo	25	135

(b) The proportions of successes in each of the four categories are

Tx	Proportions of Successes
Nicotine Patch	0.163934426
Drug	0.303278689
Patch plus Drug	0.355102041
Placebo	0.15625



It appears that the Patch plus drug had the highest success rate with the drug alone treatment coming in a close second.

(d) The null hypothesis says that there is no difference in the success rates of the various treatments.

(e) Here are the expected counts with the differences of the Observed and Expected Counts

Tx	Successes	Failures	O - E
Nicotine Patch	61.751	182.249	-21.751
Drug	61.751	182.249	12.249
Patch plus Drug	62.004	182.996	24.996
Placebo	40.493	119.507	-15.493

(f) We notice that the O – E values for the successes follow the same sort of pattern as the bar graph above illustrates.

13.16

(a) The 8 terms of the X^2 statititic are:

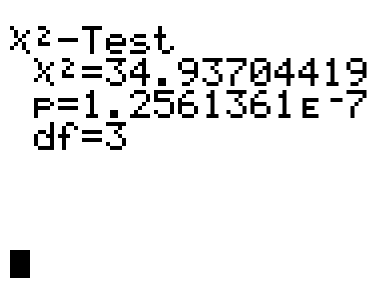
7.662	2.596
2.430	0.823
10.076	3.414
5.928	2.008
X^2 =	34.937

(b) From table E, the p-value < 0.0005, which is significiant. This means that we have evidence that the success rates are not the same for all of the various treatments.

(c) The term that contributes most to the statistic is 10.076, the $(O - E)^2/E$ for the successes of the patch plus drug. This is not surprising but consistent with our descriptions in exercise 13.14.

(d) First we conclude that the proportions of success in quitting smoking are not the same for the three treatments. Our analysis shows that people who use both the patch and the new drug have a higher chance for success.

(e)

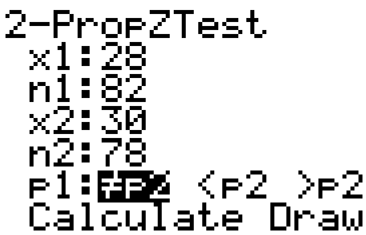


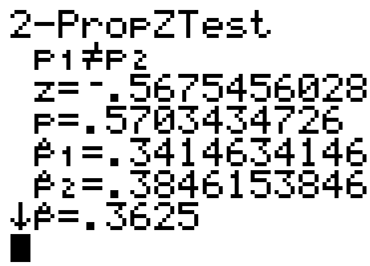
13.24

(a) Let p_1 = the proportion of the gastric freezing patients that improved, and p_2 = the proportion of the placebo group that improved. We test the hypotheses

$H_0: p_1 = p_2$

$H_A: p_1 \neq p_2$



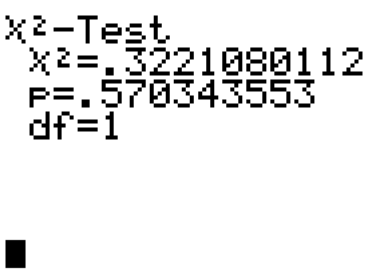


(b) Observed Counts

Treatment	Improved	Not Improved
GF	28	54
Plac	30	48

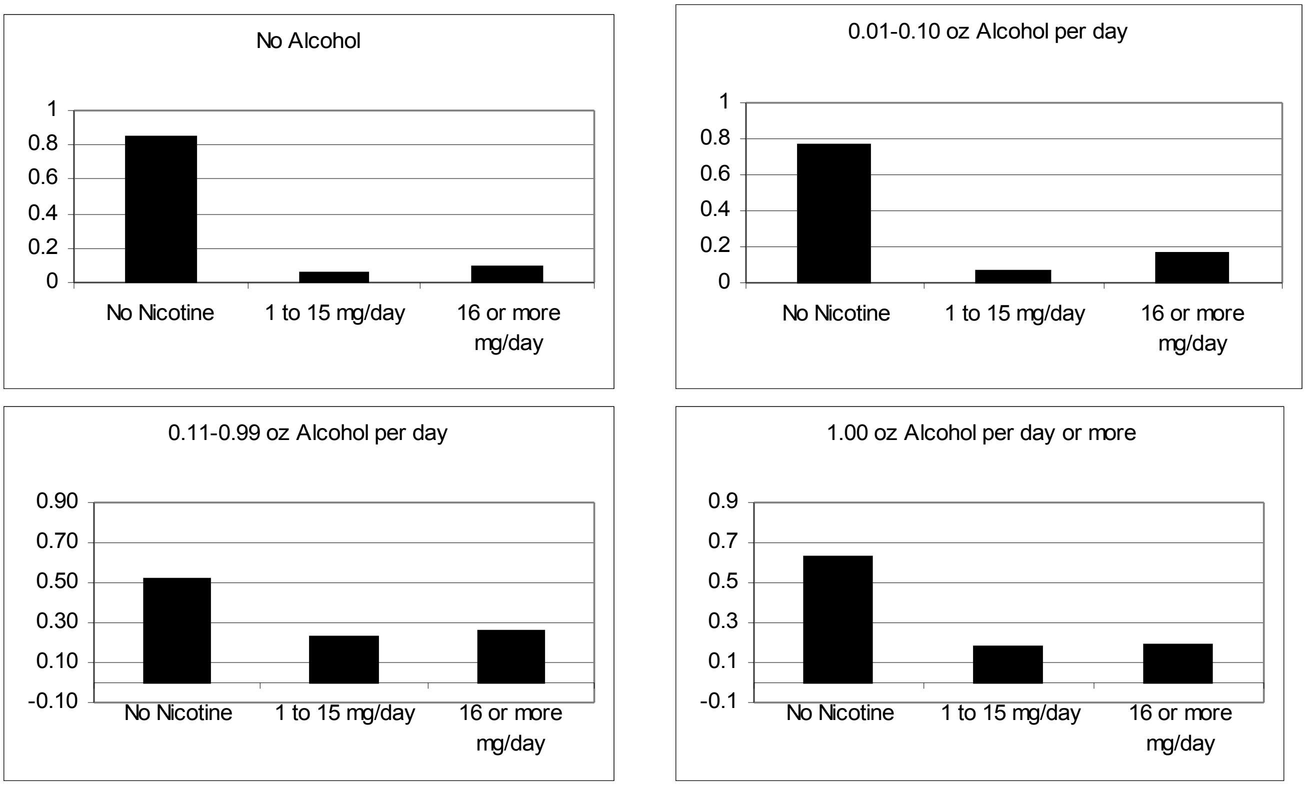
Expected Counts

Treatment	Improved	Not Improved
GF	29.725	52.275
Plac	28.275	49.725



(c) There is no significant evidence to support the claim that the gastric freezing treatment has a different proportion of improved patents than a placebo.

13.32



We observe from the graphs that there may be a slight, if any, positive association between alcohol consumption and nicotine use in these mothers. It appears that among the mothers who did not use alcohol, we have the highest non-nicotine use rate. The highest nicotine usage occurred in the 0.11-0.99 mg/day group, however, not the 1.00 oz or more group.

We will test the hypotheses

H_0: There is no association between Alcohol consumption and Nicotine use in pregnant women.
H_A: There is an association.

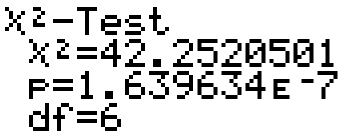
Our observed data is summarized in the two-way table

	Nicotine (mg/day)			
Alcohol (oz/day)	None	1 to 15	16 or more	Total
None	105	7	11	123
0.01-0.10	58	5	13	76
0.11-0.99	84	37	42	163
1.00 or more	57	16	17	90
Total	304	65	83	452

Our expected counts (assuming the null hypothesis is true):

		Nicotine	
Alcohol	**None**	**1 to 15**	**16 or more**
None	82.726	17.688	22.586
0.01-0.10	51.115	10.929	13.956
0.11-0.99	109.628	23.440	29.931
1.00 or more	60.531	12.942	16.527

All expected counts are >5, so we proceed with the chi-square test of association.



The low p-value of our test indicates that there is strong evidence against the null hypothesis. That is, we have strong evidence that there is an association between alcohol consumption and nicotine use in women.

13.33

We wish to test if the proportion of rats that develop tumors who can control the shock p_1, is less than the proportion of rats that develop tumors who cannot control the shock, p_2. The hypotheses are

$$H_0: p_1 = p_2$$
$$H_A: p_1 < p_2$$

We can use the chi-square test to get the same result as a 2-proportion z-test *when the test is two-sided*. Since this test is a one-sided test, we must use the z-test.

The 2-prop z-test gives $z = -2.854$, $p = 0.002$. We have significant evidence to conclude that the "happy rats" developed fewer tumors.

13.36

We will perform a chi-square goodness of fit test to test the hypotheses:

H_0: The proportions of green seeded plants, $p_1 = 3/4$, and the proportion of yellow seeded plants, $p_2 = 1/4$.
H_a: The proportions are different.

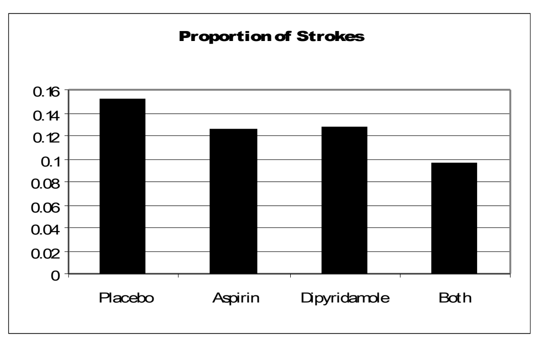
The expected counts from our sample of $n = 880$ are $\frac{3}{4}(880) = 660$ green-seeded and $\frac{1}{4}(880) = 220$ yellow seeded.

Since both expected counts are >5, we proceed. $X^2 = 2.6727$. Our p-value = $P(\chi^2 > 2.6727) = 0.1021$. Since we would obtain proportions about this size of green and yellow-seeded plants about 10% of the time if the null hypothesis is true, we do not have very significant evidence to doubt (reject) the hypothesized model.

13.38

Shown here is the two-way table for the number of strokes per treatment. Also shown is a bar graph comparing the number of strokes for each treatment. It appears that Aspirin and Dipyridamole have about the same "success" rate, but that both treatments together do a better job preventing strokes.

Treatment	Number of Strokes	No Stroke
Placebo	250	1399
Aspirin	206	1443
Dipyridamole	211	1443
Both	157	1493



We will test whether the differences in the proportions are statistically significant. That is we test the hypotheses

H_0: The proportions of Strokes for each treatment are all the same.
H_a: At least one of the proportions is different.

The two-way table of the expected counts, and the corresponding terms of the chi-square statistic:

Treatment	Number of Strokes	No Stroke
Placebo	205.812784	1443.187216
Aspirin	205.812784	1443.187216
Dipyridamole	206.4368373	1447.563163
Both	205.9375947	1444.062405

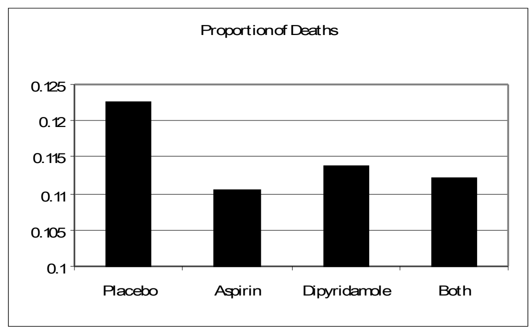
Treatment	Number of Strokes	No Stroke
Placebo	9.486825937	1.352915295
Aspirin	0.0001703	2.42864E-05
Dipyridamole	0.100865979	0.014384487
Both	11.62919367	1.658438142
	X-squared =	24.24281809

$p = P(\chi(3)^2 > 24.243) = \chi_{cdf}^2(24.243,\ 1E99,\ 3) = 0.0000222$

The terms of our statistic that contribute most to the total value are the 9.486 (for the strokes with placebo) and 11.63 (corresponding to strokes with both treatments).

We repeat the analysis without all of the words—just the graphs and test.

Treatment	Number of Deaths	Number of Survivors
Placebo	202	1447
Aspirin	182	1467
Dipyridamole	188	1466
Both	185	1465



Treatment	Number of Deaths	Number of Survivors
Placebo	189.0780067	1459.921993
Aspirin	189.0780067	1459.921993
Dipyridamole	189.6513178	1464.348682
Both	189.1926689	1460.807331

Treatment	Number of Deaths	Number of Survivors
Placebo	0.883116523	0.114374544
Aspirin	0.264960369	0.034315654
Dipyridamole	0.014378231	0.001862159
Both	0.092913074	0.012033396
	X-squared =	1.417953949

$p = P(\chi(3)^2 > 1.41795) = \chi_{cdf}^2(1.41795,\ 1E99,\ 3) = 0.701$

We note that there is significant evidence that the proportions of strokes among the treatments is different, but not that the proportions of deaths are different from treatment to treatment. From our bar graphs, and our inferences, we might conclude that there is significant evidence that using aspirin and Dipyridamole may decrease the number of strokes in stroke patients, but has no significant effect on the survival rate of stroke patients.

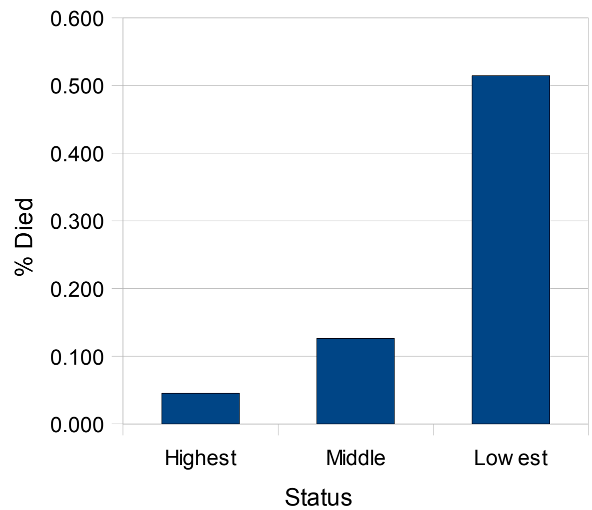
13.39

(a) We will test whether p_1, the proportion of men who die in such situations, is greater than p_2, the proportion of women that die: $H_0: p_1 = p_2$ vs $H_a: p_1 > p_2$.

We consider the sample from the Titanic a random sample from their peers-- that is, a random sample of men, and a random sample of women in such situations.
We note that 680, 168, 126 and 317 are all greater than 5, so we proceed.

The TI-84 2-PropZTest gives $z = 18.226$ and p-value ≈ 0 . There is strong statistical evidence that a higher proportion of men die in such situations than women. It is a man's responsibility to protect a woman, even to the point of dying in her place.

(b) Observe a bar graph of the percents of women who died among the three economic classes.



By far, most of the women who died were of the lowest social status.

We will now test whether the propotions of women who died differ among the economic classes.

$H_0: p_{high} = p_{mid} = p_{low}$ vs
H_a: At least one of these propotions is different.

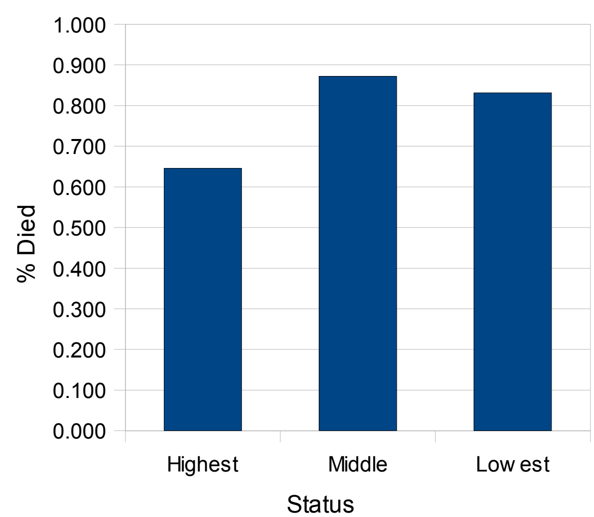
The expected counts from the two-way table are:

	Died	Survived
High	37.54	94.46
Middle	29.3	73.7
Low	59.16	148.84

We note that all of these counts are greater than 5, so we proceed.

The χ^2-test gives $X^2 = 103.767$, with a p-value of 2.93×10^{-23} . This very low p-value is very significant evidence against the null hypothesis. There is strong statistical evidence that there is a difference in the proportions of women who died according to their social status.

(c) The bar graph comparing percents of men by status that died is shown to the right. It appears that middle class men fared the worst-- the greatest proportion of these died.



The χ^2-test for men gives $X^2 = 34.62$, with a p-value of 3.03×10^{-8} . This test leads to a similar conclusion as that for women.