Chapter 10 Solutions

Section 10.1

1. H_0: The proportion of students signing up for Math 72 is the same for each semester.
   H_1: At least one proportion is different from the others.
   The sample size is n = $\sum O$ = 530. Dividing this into equal proportions amongst classes gives an expected frequency of E = 530/7 = 75.714

O = Observed Frequencies	E = Expected Frequencies	$(O-E)^2/E$
41	75.714	15.91617251
75	75.714	0.006738544
159	75.714	91.61428571
67	75.714	1.00296496
112	75.714	17.38975741
37	75.714	19.79541779
39	75.714	17.80296496
	$\chi^2 = \sum(O-E)^2/E$ =	163.528301

The test statistic is $\chi^2 = \sum(O-E)^2/E$ = 163.5283
There are k = 7 categories resulting $d.f.$ = 6. α = 0.05
The critical value is χ^2 = 12.5916; The p-value is $1.05925 \cdot 10^{-32}$

We reject the null hypothesis. *The data do not support the claim that the proportions of students signing up for Math 72 were the same for each semester offered.*

3. H_0: The sample is drawn from a normal population, so proportions in the specified intervals match the empirical rule.
   H_1: The sample is not drawn from a normal population, so proportions in the specified intervals differ significantly from the empirical rule.

O = Observed Frequencies	E = Expected Frequencies	$(O-E)^2/E$
1	1.3	0.069230769
1	7.02	5.162450142
29	17.68	7.247873303
17	17.68	0.026153846
2	7.02	3.58980057
2	1.3	0.376923077
Test Statistic:	$\chi^2 = \sum(O-E)^2/E$ =	16.47243171

Alpha	Number of Categories
0.05	6

Critical Value
χ^2 = 16.7496

p-value
0.005617049

The test statistic is $\chi^2 = \sum(O-E)^2/E$ = 16.4724
There are k = 6 categories resulting $d.f.$ = 5. α = 0.005
The critical value is χ^2 = 16.7496; The p-value is 0.00562

We fail to reject the null hypothesis. *At the chosen level of significance, we are unable to reject the claim that the sample is taken from a normal population. Still, the p-value was quite small, indicating some significant departures from the frequencies expected from a perfectly normal sample.*

5. H_0: The coin is unbiased, so proportions of numbers of heads out of five should be those predicted by the binomial distribution with $n = 5$, and $p = 0.5$.
H_1: The coin is biased, so the proportions do not match those predicted by the binomial distribution.

O=Observed Frequencies	E=Expected Frequencies	(O-E)^2/E	Alpha	Number of Categories
59	62.5	0.196	0.05	6
316	312.5	0.0392		
596	625	1.3456		Critical Value
663	625	2.3104		11.07049775
320	312.5	0.18		
76	62.5	2.916		p-value
Test Statistic:	$\chi^2 = \sum(O-E)^2/E =$	6.9872		0.221594008

The test statistic is $\chi^2 = \sum(O-E)^2/E = 6.9872$
There are $k = 6$ categories resulting $d.f. = 5$. $\alpha = 0.05$
The critical value is $\chi^2 = 11.0705$; The p-value is 0.2215

We fail to reject the null hypothesis. *We are unable to reject the claim that the coin is unbiased, so proportions of numbers of heads out of five are those predicted by the binomial distribution with* $n = 5$, *and* $p = 0.5$.

Section 10.2

1. H_0: Marijuana use is independent of political views.
   H_1: They are dependent

Observed Frequencies

	Never	Rarely	Frequently	Totals
Liberal	479	173	119	771
Conservative	214	47	15	276
Other	172	45	85	302
Totals	865	265	219	1349

Expected Frequencies

	Never	Rarely	Frequently
Liberal	494.3773	151.4566	125.166
Conservative	176.9755	54.21794	44.80652
F=Other	193.6471	59.32543	49.02743

$(O-E)^2/E$

	Never	Rarely	Frequently
Liberal	0.478302	3.064353	0.303758
Conservative	7.745764	0.960912	19.82811
Other	2.41986	3.459189	26.39392

D.F.:	4	**Chi-Square T.S.:**	64.6542	**p-value**
Alpha:	0.01	**Chi-Square C.V.:**	13.2767	3.04E-13

The test statistic is $\chi^2 = \sum(O-E)^2/E = 64.6542$
There are 3 rows and 3 columns resulting in $d.f. = (3-1)(3-1) = 4$. $\alpha = 0.01$
The critical value is $\chi^2 = 13.2767$; The p-value is $3.04 \cdot 10^{-13} = 0.000000000000304$.
Reject the null hypothesis. The data do not support the claim that marijuana use is independent of political views. The dependency is highly significance and indicated by the extraordinarily small p-value.

3. H_0: Grades are independent of gender.
H_1: They are dependent

Observed Frequencies

	female	male	Totals
A	3	3	6
B	19	18	37
C	19	21	40
D	4	10	14
Totals	45	52	97

Expected Frequencies

	female	male
A	2.783505	3.216495
B	17.16495	19.83505
C	18.5567	21.4433
D	6.494845	7.505155

$(O\text{-}E)^2/E$

	female	male
A	0.016838	0.014572
B	0.19618	0.169771
C	0.01059	0.009164
D	0.958337	0.82933

D.F.:	3	**Chi-Square T.S.:**	2.2048	**p-value**
Alpha:	0.01	**Chi-Square C.V.:**	11.3449	0.5310

The test statistic is $\chi^2 = \sum(O\text{-}E)^2/E = 2.2048$
There are 4 rows and 2 columns resulting in $d.f. = (4-1)(2-1) = 3$. $\alpha = 0.01$
The critical value is $\chi^2 = 11.3449$; The p-value is $3.04 \cdot 10^{-13} = 0.5310$.
Fail to reject the null hypothesis. The data make it evident that grades are not dependent on gender.

5. H_0: Survival is independent of gender.
H_1: They are dependent

Observed Frequencies

	Survived	Died	Totals
Male	23	29	52
Female	25	9	34
Totals	48	38	86

Expected Frequencies

	Survived	Died
Male	29.02326	22.97674
Female	18.97674	15.02326

$(O\text{-}E)^2/E$

	Survived	Died
Male	1.250019	1.578971
Female	1.911793	2.414897

D.F.:	1	**Chi-Square T.S.:**	7.1557	**p-value**
Alpha:	0.01	**Chi-Square C.V.:**	6.6349	0.00747

The test statistic is $\chi^2 = \sum(O\text{-}E)^2/E = 7.1557$
There are 2 rows and 2 columns resulting in $d.f. = (2 - 1)(2 - 1) = 1$. $\alpha = 0.01$
The critical value is $\chi^2 = 6.6349$; The p-value is 0.00747.
Reject the null hypothesis. It appears that survival is dependent on gender.