

## Solutions to Weekly Assignment 4

- (1)  $H_0$  : Gender & Political Preference Independent  
 $H_1$  : Gender & Political Preference Associated

Significance level  $\phi.05$

Test Statistic  $\chi^2 = \sum \frac{(O-E)^2}{E} \sim \chi^2(df)$  under  $H_0$   
 $df = (r-1)(c-1)$

Observed Test Statistic

Observed (O)						
	Tory	Labour	LibDem	SNP	Other	
Male	61	152	49	98	25	385
Female	92	125	62	105	31	415
	153	277	111	203	56	800

Expected (E)  $\left( = \frac{\text{Row Total} \times \text{Column Total}}{\text{Overall Total}} \right)$

	Tory	Labour	LibDem	SNP	Other	
Male	73.63	133.31	53.42	97.69	26.95	385
Female	79.37	143.69	57.58	105.31	29.05	415
	153	277	111	203	56	800

$$\chi^2 = \frac{(61-73.63)^2}{73.63} + \frac{(152-133.31)^2}{133.31} + \dots + \frac{(31-29.05)^2}{29.05}$$

$$= 2.167 + 2.621 + 0.366 + 0.001 + 0.141$$

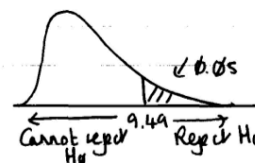
$$+ 2.010 + 2.432 + 0.339 + 0.001 + 0.131 = 10.209 //$$

Rejection Region  $\phi.05$ ; One tailed;  $\chi^2(4)$

$$df = (r-1) \times (c-1)$$

$$= (2-1) \times (5-1) = 4$$

$$\text{Critical Value} = \chi^2(4; \phi.05) = 9.49$$



p value =  $P(\text{chisquared with 4 df} > 10.209) = 0.03$  (between 0.05 and 0.025)

Conclusion Observed Test Statistics (10.209) is in the Rejection Region (10.209 > 9.49) so can reject  $H_0$  in favour of  $H_1$  at 5% level i.e. sufficient evidence to conclude that there is an association between gender and political preference.

2. (a)  $H_0$  : Income & Magazine Read Independent  
 $H_1$  : Income & Magazine Read Associated

Significance level  $\phi.05$

Test Statistic  $\chi^2 = \sum \frac{(O-E)^2}{E} \sim \chi^2(df)$  under  $H_0$   
 $df = (r-1) \times (c-1)$

### Observed Test Statistic

Observed (O)	<10000	10-15,000	>15000	
A	24	60	55	139
B	15	40	48	103
	39	100	103	242

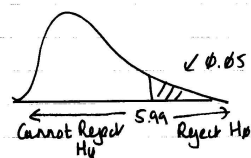
Expected (E)	<10000	10-15000	>15000	Expected = RowT x ColT OverallT
A	22.40	57.44	59.16	139
B	16.60	42.56	43.84	103
	39	100	103	242

$$\chi^2 = \frac{(24-22.4)^2}{22.4} + \frac{(60-57.44)^2}{57.44} + \dots + \frac{(48-43.84)^2}{43.84}$$

$$= 0.114 + 0.114 + 0.293 + 0.154 + 0.154 + 0.395$$

$$= 1.224 //$$

Rejection Region:  $0.05$ ; One Tailed;  $\chi^2(2) = \frac{(n-1) \times (c-1)}{(2-1) \times (3-1)} = 2$



$$\text{Critical Value} = \chi^2(2; 0.05) = 5.99$$

p value =  $P(\chi^2(2) > 1.224) \approx 0.6$  (between 0.25 & 0.9 - see tables)

Conclusion Observed Test Statistic not in the rejection region &  $p > 0.05$  so cannot reject  $H_0$  in favour of  $H_1$  at 5% level. i.e. insufficient evidence to conclude that there is an association between income & magazine read.

## Minitab : Solutions

### Question 1

(i) Chi-Square Test: Tory, Labour, LibDem, SNP, Other

Expected counts are printed below observed counts

Chi-Square contributions are printed below expected counts

	Tory	Labour	LibDem	SNP	Other	Total
1	61	152	49	98	25	385
	73.63	133.31	53.42	97.69	26.95	
	2.167	2.621	0.366	0.001	0.141	
2	92	125	62	105	31	415
	79.37	143.69	57.58	105.31	29.05	
	2.010	2.432	0.339	0.001	0.131	
Total	153	277	111	203	56	800

Chi-Sq = 10.209, DF = 4, P-Value = 0.037

Formal Test:  $\chi^2$  Test of Independence

$H_0$ : Gender & Political Preference Independent

$H_1$ : Gender & Political Preference Associated

Test Statistic  $\chi^2 = 10.209$ ,  $p = 0.037$

Question 2

(i) Chi-Square Test: under 10000, 10000 - 15000, 15000 and over

Expected counts are printed below observed counts

Chi-Square contributions are printed below expected counts

	under 10000	10000 - 15000		
	10000	15000	and over	Total
1	24	60	55	139
	22.40	57.44	59.16	
	0.114	0.114	0.293	
2	15	40	48	103
	16.60	42.56	43.84	
	0.154	0.154	0.395	
Total	39	100	103	242

Formal Test :  $\chi^2$  Test of Independence

$H_0$  :Magazine Read & Salary Independent

$H_1$  : Magazine Read & Salary Associated

Test Statistic  $X^2= 1.224$  p=0.542

Chi-Sq = 1.224, DF = 2, P-Value = 0.542