Chapter 5

3.13. Suppose that wind in Riyadh from May to September comes from one of the directions – south (S), southeast (SE), northeast (NE) or northwest (NW). For a sample of such days the following frequencies are observed [Based on Hummeida and Mohammad (1993)]:

Wind Direction				
S	SE	NE	NW	Total
25	8	13	14	60

Using α=0.10,

a) Test if the wind directions in Riyadh from May to September occur with equal proportions.

b) Test if the frequency of the wind directions in Riyadh during this time is different from a 9:2:5:4 ratio.

3.14. Suppose we measure the strength of the shell of an egg for a sample of white chicken eggs and obtain the following frequencies:

Strength of Shell			
Weak	Moderate	Strong	Total
37	68	45	150

Using α=0.05,

a) Test if the levels of strength of white egg shells occur with equal proportions.

b) Test if proportions of the levels of strength are different from ¼ , ½ , and ¼ respectively.

3.15. In a study on the effect of nitrogen fertilizer on the quality of fruit of local orange trees [Youssef et al. (1985)], nitrogen in the form of $(NH_4)_2SO_4$ was applied at rates 0, 1, 2, and 3 kg per tree. Independent samples of fruits were taken from the four types of trees and the number sunburned fruit was recorded:

		Fruit		
		Not Sunburned	Sunburned	Total
Nitrogen Rate Per Tree	Control(0)	400	50	450
	1 kg	292	35	327
	2 kg	345	35	380
	3 kg	452	33	485

Test whether the proportions of sunburned fruits are the same for trees receiving the 4 nitrogen rates. Use $\alpha=0.05$.

3.16. Formation of vitamin D depends on exposure to ultraviolet radiation in sunlight. A sample of Saudis was classified by the type of residence and the level of vitamin D [Sedrani et al. (1992)]:

	Vitamin D Level			
Residence type	Insufficient < 5 ng/ml	Low 5-10 ng/ml	Sufficient > 10 ng/ml	Total
Tent	6	31	97	134
Mud house	16	73	349	438
Flat	45	174	652	871
Villa	64	323	1061	1448
Brick house	51	250	886	1187
Total	182	851	3045	4078

Test whether the Vitamin D level of Saudis is related to the type of residence. Use a level of significance of 0.05.

3.19. A sample of medical students was classified by smoking habit and the source of information about the dangers of smoking obtaining the following frequencies [Jarallah (1992)]:

	Habit		
Source	Non Smoker	Smoker	Total
School	15	6	21
Doctors	18	12	30
Media	62	41	103
Others	21	11	32
More than one	159	64	223
Total	275	134	409

Can we conclude that the smoking habit is related to the source of information about dangers of smoking. Use α=0.05.

3.20. Random samples of 4 types of fish in the Arabian Gulf were examined for the presence or absence of helminth parasites obtaining the counts [El-Naffar et al. (1992)]:

		Fish type				
		1	2	3	4	Total
helminth parasites	Present	136	78	104	55	373
	Absent	80	42	61	35	218
	Total	216	120	165	90	591

Can we conclude that the proportions of present ant absent parasites are the same for the four types of fish. Use a level of significance of 0.10.

ch.5

3.13. Suppose that wind in Riyadh from May to September comes from one of the directions – south (S), southeast (SE), northeast (NE) or northwest (NW). For a sample of such days the following frequencies are observed [Based on Hummeida and Mohammad (1993)]:

Wind Direction				
S	SE	NE	NW	Total
25	8	13	14	60

Using α=0.10,

a) Test if the wind directions in Riyadh from May to September occur with equal proportions.

i	1	2	3	4	total
O_i	25	8	13	14	$n=60$
$E_i = np_i$	15	15	15	15	$n=60$

1)Data: $n = 60,\ k = 4,\ \alpha = 0.10$

2)Hypothesis: $H_0: p_1 = p_2 = p_3 = p_4 = \frac{1}{4}$

H_1: *at least one* p_i *is different*

3) The statistic: $\chi^2 = \sum_{i=1}^{4} \frac{O_i^2}{E_i} - n = 10.25$

4) Reject H_0 if $\chi^2 > \chi^2_{1-\alpha,k-1} = \chi^2_{0.9,3} = 6.251$

Thus, reject H_0 at α=0.10

i.e we conclude that at least one of the proportions of wind directions in Riyadh for days in May to September is different.

b) Test if the frequency of the wind directions in Riyadh during this time is different from a 9:2:5:4 ratio.

1)Data: $n = 60,\ k = 4,\ \alpha = 0.10$

2)Hypothesis: $H_0: p_1 = \frac{9}{20}, p_2 = \frac{2}{20}, p_3 = \frac{5}{20}, p_4 = \frac{4}{20}$

H_1: *at least one* p_i *is different from given*

3) The statistic: $\chi^2 = \sum_{i=1}^{4} \frac{O_i^2}{E_i} - n = 1.4148$

4) Reject H_0 if $\chi^2 > \chi^2_{1-\alpha,k-1} = \chi^2_{0.9,3} = 6.251$

Thus, Fail to reject H_0 at α=0.10

i.e we can not conclude that at least one of the proportions of wind directions in Riyadh for days in May to September are different from $\frac{9}{20}, \frac{2}{20}, \frac{5}{20}$ *and* $\frac{4}{20}$ respectively.

i	1	2	3	4	total
O_i	25	8	13	14	$n=60$
$E_i = np_i$	27	6	15	12	$n=60$

3.15. In a study on the effect of nitrogen fertilizer on the quality of fruit of local orange trees [Youssef et al. (1985)], nitrogen in the form of $(NH4)2SO4$ was applied at rates 0, 1, 2, and 3 kg per tree. Independent samples of fruits were taken from the four types of trees and the number sunburned fruit was recorded:

		Fruit		
		Not Sunburned	Sunburned	Total
Nitrogen Rate Per Tree	Control(0)	400	50	450
	1 kg	292	35	327
	2 kg	345	35	380
	3 kg	452	33	485
		1489	153	

Test whether the proportions of sunburned fruits are the same for trees receiving the 4 nitrogen rates. Use $\alpha=0.05$.

1)Data: $n = 1642,\ r = 4,\ c = 2,\ \alpha = 0.05$

or the 4 populations are homo. (or the same) w.r.t the variable

2)Hypothesis: H_0: *The 4 orange tree populations are* **homogenous (same)** *with respect to proportions sunburned.*

H_1: *The 4 orange tree populations are* **not homogenous (different)** *with respect to proportions sunburned.*

or

the 4 populations are not homo. (or not the same) w.r.t the variable

3) The statistic: $\chi^2 = \sum_{i=1}^{r=4} \sum_{j=1}^{c=2} \frac{O_{ij}^2}{E_{ij}} - n = 6.088$

4) Reject H_0 if $\chi^2 > \chi^2_{1-\alpha,(r-1)(c-1)} = \chi^2_{0.95,3} = 7.815$

Thus, Fail to reject H_0 at $\alpha=0.05$

We can not conclude that the 4 orange tree populations are different (not homogenous) with respect to the proportions that are sunburned.

	1	2=c	total
1	$O_{11}=400$ $E_{11}=408.07$	$O_{12}=50$ $E_{12}=41.93$	$O_{1.}=450$
2	$O_{21}=292$ $E_{21}=296.53$	$O_{22}=35$ $E_{22}=30.47$	$O_{2.}=327$
3	$O_{31}=345$ $E_{31}=344.59$	$O_{32}=35$ $E_{32}=35.41$	$O_{3.}=380$
4=r	$O_{41}=452$ $E_{41}=439.81$	$O_{42}=33$ $E_{42}=45.19$	$O_{4.}=485$
total	$O_{.1}=1489$	$O_{.2}=153$	$n=1642$

where $E_{ij} = \frac{O_{i.}\, O_{.j}}{n}$

3.16. Formation of vitamin D depends on exposure to ultraviolet radiation in sunlight. A sample of Saudis was classified by the type of residence and the level of vitamin D [Sedrani et al. (1992)]:

	Vitamin D Level			
Residence type	Insufficient < 5 ng/ml	Low 5-10 ng/ml	Sufficient > 10 ng/ml	Total
Tent	6	31	97	134
Mud house	16	73	349	438
Flat	45	174	652	871
Villa	64	323	1061	1448
Brick house	51	250	886	1187
Total	182	851	3045	4078

Test whether the Vitamin D level of Saudis is related to the type of residence. Use a level of significance of 0.05.

1)Data: n = 4078, $r = 5$, $c = 3$, $\alpha = 0.05$

or the variable 1 is indep. (or no related) of variable 2.

2)Hypothesis: H_0: *residence type independent of vitamin D level.*

H_1: *residence type dependent (related) of vitamin D level.*

or

the variable 1 is dep. (or related) of variable 2.

3) The statistic: $\chi^2 = \sum_{i=1}^{r=5}\sum_{j=1}^{c=3} \frac{O_{ij}^2}{E_{ij}} - n = 9.461$

4) Reject H_0 if $\chi^2 > \chi^2_{1-\alpha,(r-1)(c-1)} = \chi^2_{0.95,8} = 15.507$

Accept

Thus, Fail to reject H_0 at α=0.05

We can not conclude that the residence type is related (not independent) of Vitamin D level for Saudis.

	1	2	c = 3	total
1	$O_{11}=6$, $E_{11}=5.98$	$O_{12}=31$, $E_{12}=27.96$	$O_{13}=97$, $E_{13}=100.06$	$O_{1.}=134$
2	$O_{21}=16$, $E_{21}=19.55$	$O_{22}=73$, $E_{22}=91.40$	$O_{23}=349$, $E_{23}=327.05$	$O_{2.}=438$
3	$O_{31}=45$, $E_{31}=38.87$	$O_{32}=174$, $E_{32}=181.76$	$O_{33}=652$, $E_{33}=650.37$	$O_{3.}=871$
4	$O_{41}=64$, $E_{41}=64.62$	$O_{42}=323$, $E_{42}=302.17$	$O_{43}=1061$, $E_{43}=1081.21$	$O_{4.}=1448$
r=5	$O_{51}=51$, $E_{51}=52.98$	$O_{52}=250$, $E_{52}=247.7$	$O_{53}=886$, $E_{53}=886.32$	$O_{5.}=1187$
total	$O_{.1}=182$	$O_{.2}=851$	$O_{.3}=3045$	$n=4078$