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 istro Mohammad (1993)]:

	1	Wind Direction			
کی منہ	WESE 6	- WINE C	WYSKe	Total	
37, 3	8	13	14	60	

Using $\alpha=0.10$,

- 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:

	Streng	Strength of Shell		
Weak	Moderate	Strong	Total	
27	68	45	150	

Using $\alpha=0.05$,

- 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 1/4, 1/2, and 1/4 respectively.

عمق الاستانة . 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 o, 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
1020Manual engine	Control(o)	400	50	450
Nitrogen	ı kg	292	35	327
Rate Per	2 kg	345	35	380
Tree	3 kg	452	33	485

Test whether the proportions of sunburned fruits are the same for trees receiving the 4 nitrogen rates. Use α =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)]:

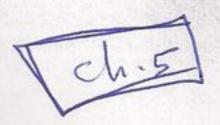
Habit				
Source	Non Smoker	Smoker	Total	
School	15	6	21	
Doctors	18	12	30	
Media	62	41	103	
Others	21	11	32	
More than one	159	64	223	
Total	275	134	409	

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.



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)]:

	1	Wind Directio	n	1 1000 0 1000 0 200
	CE	NE	NW	Total
S	SE	12	14	60
25	8	13	14	

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

proportions.	1 3	1 4	1 total
11/2	13	14	N=60
Oi 25	15	15	N=60
E:= "Pi 15			

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 $\chi^2 > \chi^2_{1-\alpha,k-1} = \chi^2_{0.9,3} = 6.251$

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_o at α=0.10

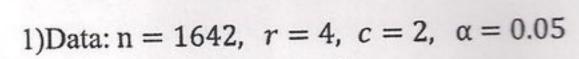
i.e we can not conclude that at least one of the proportions of wind directions in Riyadh for days in May to September are different from $\frac{9}{20}$, $\frac{2}{20}$, $\frac{5}{20}$ and $\frac{4}{20}$ respectively.

il	'	2	3	1 4	1 total
o _i	25	8	13	14	4260
E .:= "P.	27	6	15	12	4260

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
	Control(0)	400	50	450
	1 kg	292	35	327
Nitrogen Rate Per	2 kg	345	35	380
Tree	3 kg	452	33	485
	9	. 1489	153	siving the

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



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

H₁: The 4 orange tree populations are **not homogenous (different)** with respect to proportions sunburned.

3) The statistic:
$$\chi^2 = \underbrace{\mathcal{E}}_{i=1}^{2} \underbrace{\mathcal{E}}_{j=1}^{2} \underbrace{\mathcal{O}_{ij}^2}_{F_{ij}} - \kappa = 6.088$$

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

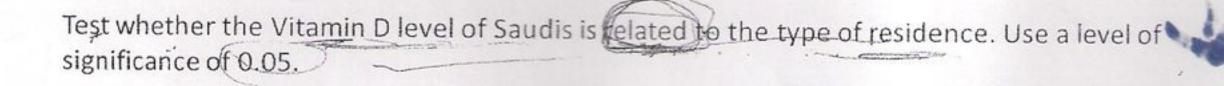
Thus, Fail to reject H_0 at $\alpha=0.05$

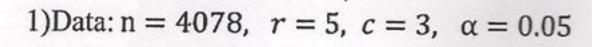
We can not conclude that the 4 orange tree populations are different (not homogenous) with respect to the proportions that are sunburned.

A	1	2=<	total
1	011 = 400	012=50	0,=450
1	E = 408.07	E12=41.43	
2	021=292	022=35	02. = 327
^	E21=296.53	E 22 = 30.47	
3	031=345 E31=344.59	032=35 E32=35.41	03. =380
4:	Eu = 452	O42=33 E42=45.19	04.=485
total	0,=1489	0.2=153	u= 1642

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)]:

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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	2,50	886	1187		
Total	182	851	3045	(4078)		





(or no related) of variable 2.

2) Hypothesis: Ho: residence type independent of vitamin D level. H1: residence type dependent (related) of vitamin D level.

3) The statistic:
$$\chi^2 = \frac{\sum_{i=1}^{2} \sum_{j=1}^{2} \frac{o_{i,j}^2}{\sum_{i=1}^{2} \sum_{j=1}^{2} \frac{o_{i,j}^2}{\sum_{i=1}^{2} \sum_{j=1}^{2} \frac{o_{i,j}^2}{\sum_{j=1}^{2} \sum_{i=1}^{2} \frac{o_{i,j}^2}{\sum_{j=1}^{2} \sum_{i=1}^{2} \frac{o_{i,j}^2}{\sum_{j=1}^{2} \sum_{i=1}^{2} \frac{o_{i,j}^2}{\sum_{i=1}^{2} \sum_{j=1}^{2} \frac{o_{i,j}^2}{\sum_{i=1}^{2} \sum_{j=1}^{2} \frac{o_{i,j}^2}{\sum_{i=1}^{2} \sum_{j=1}^{2} \frac{o_{i,j}^2}{\sum_{j=1}^{2} \sum_{i=1}^{2} \frac{o_{i,j}^2}{\sum_{j=1}^{2} \sum_{i=1}^{2} \frac{o_{i,j}^2}{\sum_{j=1}^{2} \sum_{i=1}^{2} \frac{o_{i,j}^2}{\sum_{j=1}^{2} \sum_{i=1}^{2} \frac{o_{i,j}^2}{\sum_{i=1}^{2} \sum_{j=1}^{2} \frac{o_{i,j}^2}{\sum_{i=1}^{2} \sum_{j=1}^{2} \frac{o_{i,j}^2}{\sum_{j=1}^{2} \sum_{i=1}^{2} \frac{o_{i,j}^2}{\sum_{j=1}^{2} \sum_{j=1}^{2} \frac{o_{i,j}^2}}{\sum_{j=1}^{2} \sum_{j=1}^{2} \frac{o_{i,j}^2}{\sum_{j=1}^{2} \sum_{j=1}$$

4) Reject Ho if $\chi^2 > \chi^2_{1-\alpha,(r-1)(c-1)} = \chi^2_{0.95,8} = 15.507$ (or related) of variable 2.

Thus, Fail to reject H₀ 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	O11=6 E1=5.98	C12=31 E12=27.96	013 = 97 E13 = 100.06	9. =134
2	021=16 E21=19.55	22 = 73 E22 = 91.40	023 = 349 E23 = 327.05	02.=438
3	031 = 45 E31 = 38.87	032=174	033 = 65 2 E33 = 650.37	03.5871
4	O41 = 64. 62	Ouz = 323 Eux = 302.17	Ou3 = 1061 E43 = 1081.21	04. = 1448
(=5.	OS1=51 ES1=52.98	052 = 250 E52 = 247.7	053 = 886	2 05.21187
tobal		0.2=851	0.3=304	8 N = 404