

UNIVERSITI TEKNOLOGI MALAYSIA
SEMESTER II, SESSION 2014/2015
SSCE/SSE 2193: ENGINEERING STATISTICS

Chapter 5 Exercises

1. A random sample of 200 printed boards has been collected and the following number of defects was observed:

Number of defects	0	1	2	3	4	5	6	7 and more
Observed Frequency	10	40	54	45	32	8	6	5

Can we conclude that the number of defects follows the Poisson distribution with mean 2.6 at significance level $\alpha = 0.05$?

2. A random sample of 100 electrical components produced in a factory has been selected and the following number of defective components was recorded:

Number of defective	0	1	2	3	4	5	6 and more
Frequency	5	10	18	19	16	12	20

Can we conclude that the number of defective electrical components follows the Poisson distribution at significance level $\alpha = 0.01$?

3. A manufacturing engineer is testing a power supply used in a notebook computer. The complete table of observed frequencies is as follows:

Class interval	Observed frequencies O_i
$x < 4.948$	12
$4.948 \leq x < 4.986$	14
$4.986 \leq x < 5.014$	12
$5.014 \leq x < 5.040$	13
$5.040 \leq x < 5.066$	12
$5.066 \leq x < 5.094$	11
$5.094 \leq x < 5.132$	12
$x \geq 5.132$	14

Test the hypothesis whether the output voltage is adequately described by a normal distribution with mean 5.04V and standard deviation 0.08V at a significance level $\alpha = 0.05$.

4. A machine is supposed to mix 40% peanuts, 30% hazelnuts, 20% cashews, and 10% pecans. A can containing 500 of these mixed nuts was found to have 269 peanuts, 112 hazelnuts, 74 cashews, and 45 pecans. At the 0.05 level of significance, test the hypothesis that the machine is mixing the nuts according to the required percentages.
5. It is believed that the ratio of Bumiputera, Orang Asli, and others students intake in Faculty of Engineering is 14:3:3. A sample of 500 students chosen at random shows the following data:

	Bumiputera	Orang Asli	Others
Number of Students	345	78	77

Do we have a reason to accept the above ratio at significance level $\alpha = 0.01$?

6. A random sample of semiconductor devices is taken to observe the relationship between classification and status for each device. The results are as follows:

Status	Classification	
	Defective	Non Defective
Rejected	80	20
Non rejected	40	60

Test the hypothesis that the status and classification are independent at significance level $\alpha = 0.05$

7. A study was conducted to determine whether the type of painkiller administered to patients is influencing the level of pain felt by patient and the following data set was obtained:

Painkiller	Level of Pain		
	No	A Little	Strong
A	20	30	10
B	10	35	15

Test whether the level of pain and the type of painkiller are independent at significance level $\alpha = 0.01$.

8. A total of 1000 PVC pipes are sampled and categorized with respect to both length and diameter specification. The results are presented in the following table:

Length	Diameter		
	Too Thick	Meet Specification	Too Wide
Too Short	20	115	15
Meet Specification	65	550	45
Too Long	35	145	10

Test at 1% significance level whether the length and the diameter of the PVC pipes are independent.

9. A set of data was collected to determine whether the proportions of defective components produced by workers were the same for the day, evening, and night shifts. The following data were collected:

	Shift		
	Day	Evening	Night
Defective	100	200	200
Non defective	150	200	150

Use a 0.05 level of significance to determine if the proportions of defective components are the same for all three shifts.

10. A QC inspector took a set of sample data to determine whether the proportions of output components for two shifts produced by machine A, B and C were the same. The following data were collected:

	Machine		
	A	B	C
Shift 1	100	120	180
Shift 2	120	180	100

Use a 0.05 level of significance to determine if the proportions of output components for shift 1 are the same for all three machines.

Answers

1. $k = 7$, then $\nu = 6$; $\chi_{test}^2 = 5.6807 < 12.592$; Fail to reject H_0 .
2. $k = 6$, $p = 1$ where $\hat{\lambda} = 3.47$, then $\nu = 4$;
 $\chi_{test}^2 = 3.682 < 13.277$; Fail to reject H_0 .
3. $k = 8$, then $\nu = 7$; $\chi_{test}^2 = 0.6333 < 14.067$; Fail to reject H_0 .
4. $k = 4$; then $\nu = 3$; $\chi_{test}^2 = 40.692 > 7.815$; reject H_0 .
5. $k = 3$; then $\nu = 2$; $\chi_{test}^2 = 0.2448 < 9.21$; Fail to reject H_0 .
6. Independence test: $\nu = 1$; $\chi_{test}^2 = 33.33 > 3.841$ (without Yates' correction); reject H_0 ;
Status and classification are significantly DEPENDENT at $\alpha = 0.05$.
7. Independence test: $\nu = 2$; $\chi_{test}^2 = 4.7179 < 9.21$; Fail to reject H_0 ;
Level of pains and type of painkiller are INDEPENDENT.
8. Independence test: $\nu = 4$; $\chi_{test}^2 = 13.3808 > 13.277$; reject H_0 ;
Length and diameter are significantly DEPENDENT at $\alpha = 0.01$.
9. Homogeneity test: $\nu = 2$; $\chi_{test}^2 = 17.1428 > 5.991$; reject H_0 .
The proportions of defective components are NOT the same, i.e. they are significantly not homogeneous at $\alpha = 0.05$.
10. Homogeneity test: $\nu = 2$; $\chi_{test}^2 = 36.6753 > 5.991$; reject H_0 ;
The proportions of output components for shift 1 are significantly not the same for all 3 machines.