

Ch. 9

Exercise 17:

The time required for 50 different employees to compute and record the number of hours worked during the week was measured with the following results in minutes:

Use the chi-square test (as in Example 9.14) to test the hypothesis that these service times are exponentially distributed. Let the number of class intervals be $k=6$. Use a level of significance of $\alpha=0.05$.

Chapter 9 homework

Problem 17 $i := 0..9$

$emp_time_i = emp_time_{i+10} = emp_time_{i+20} = emp_time_{i+30} = emp_time_{i+40}$

1.88	3.53	1.42	0.39	0.8
0.54	0.53	1.28	0.34	5.5
1.9	1.8	0.82	0.01	4.91
0.15	0.79	2.16	0.1	0.35
0.02	0.21	0.05	1.1	0.36
2.81	0.8	0.04	0.24	0.9
1.5	0.26	1.49	0.26	1.03
0.53	0.63	0.66	0.45	1.73
2.62	0.36	2.03	0.17	0.38
2.67	2.03	1	4.29	0.48

$N := \text{length}(emp_time)$ $N = 50$

Hypothesis $H_{(sub)0}$: values are exponentially distributed

estimate λ_e by computing mean of values

$$\lambda_e := \frac{1}{\text{mean}(emp_time)}$$

$$\lambda_e = 0.829$$

Create 6 classes with equal probability based on an exponential distribution with appropriate mean. The 6th class ends at infinity

$$c := 0..5 \quad p := \frac{1}{6}$$

$$a_c := \frac{-1}{\lambda_e} \cdot \ln(1 - c \cdot p) \quad a_6 := \infty$$

calculate number of values in each class:

$$a = \begin{pmatrix} 0 \\ 0.22 \\ 0.489 \\ 0.836 \\ 1.325 \\ 2.161 \\ 1 \times 10^{307} \end{pmatrix}$$

$h := \text{hist}(a, emp_time)$

$$h = \begin{pmatrix} 8 \\ 11 \\ 9 \\ 5 \\ 10 \\ 7 \end{pmatrix}$$

expected frequency:

$$E_c := p \cdot N$$

Calculate the χ^2 statistic

$$\chi_{sq} := \sum_c \frac{(h_c - E_c)^2}{E_c}$$

$$\chi_{sq} = 2.8$$

With 6 classes, there are 4 degrees of freedom, so the χ^2 threshold for $\alpha = 0.05$ is:

$$\chi_{sq,0.05,4} := 9.49$$

The result is less than the threshold, so we cannot reject the null hypothesis.
The distribution may be exponential

Exercise 23(a&b):

A simulation is to be conducted of a job shop that performs two operations, milling and planing, in that order. It would be possible to collect data about processing times for each operation, then generate random occurrences for each distribution. However, the shop manager says that times may be related; large milling jobs take lots of planing. Data are collected for the next 25 orders with the following results in minutes:

- (a) plot milling time on the horizontal axis and planing time on the vertical axis. Do these data seem dependent?
- (b) Compute the sample correlation between milling and planing time.

problem 23

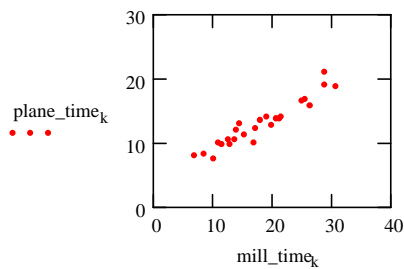
k := 0..24 i := 0..12 j := 13..24

plane_time_i = plane_time_j =

10.6	16.6
13.9	21.2
14.1	9.9
10.1	10.7
8.4	14
8.1	13
16.9	11.5
13.7	9.9
10.2	13.2
12.1	12.5
16	14.2
18.9	19.1
7.7	

mill_time_i = mill_time_j =

12.3	24.6
20.4	28.5
18.9	11.3
16.5	13.3
8.3	21
6.5	19.5
25.2	15
17.7	12.6
10.6	14.3
13.7	17
26.2	21.2
30.4	28.4
9.9	



Values seem to be related to each other

$$\text{corr}(\text{plane_time}, \text{mill_time}) = 0.956$$

Correlation is nearly 1 (the maximum) verifying that the values are highly correlated