Example 7.7 - Chi-squared test of random numbers

Here are 100 random number from textbook

$$R := \begin{pmatrix} 0.34 & 0.90 & 0.25 & 0.89 & 0.87 & 0.44 & 0.12 & 0.21 & 0.46 & 0.67 \\ 0.83 & 0.76 & 0.79 & 0.64 & 0.70 & 0.81 & 0.94 & 0.74 & 0.22 & 0.74 \\ 0.96 & 0.99 & 0.77 & 0.67 & 0.56 & 0.41 & 0.52 & 0.73 & 0.99 & 0.02 \\ 0.47 & 0.30 & 0.17 & 0.82 & 0.56 & 0.05 & 0.45 & 0.31 & 0.78 & 0.05 \\ 0.79 & 0.71 & 0.23 & 0.19 & 0.82 & 0.93 & 0.65 & 0.37 & 0.39 & 0.42 \\ 0.99 & 0.17 & 0.99 & 0.46 & 0.05 & 0.66 & 0.10 & 0.42 & 0.18 & 0.49 \\ 0.37 & 0.51 & 0.54 & 0.01 & 0.81 & 0.28 & 0.69 & 0.34 & 0.75 & 0.49 \\ 0.72 & 0.43 & 0.56 & 0.97 & 0.30 & 0.94 & 0.96 & 0.58 & 0.73 & 0.05 \\ 0.06 & 0.39 & 0.84 & 0.24 & 0.40 & 0.64 & 0.40 & 0.19 & 0.79 & 0.62 \\ 0.18 & 0.26 & 0.97 & 0.88 & 0.64 & 0.47 & 0.60 & 0.11 & 0.29 & 0.78 \end{pmatrix}$$

This is just to make the display nice - 10x10. To use them, they have to be in a one dimensional vector

$i := 0..\,9$ $\qquad$ $j := 0..\,9$

$R_{linear_{i+10\cdot j}} := R_{j,i}$

$R := R_{linear}$

To make the intervals work right, set a slight offset

$\varepsilon := 1\cdot 10^{-15}$

$interval := 0..\,9$

$a_{interval} := \dfrac{interval}{10} + \varepsilon$

$a_{10} := 1$

And compute the observed and expected number of random values in the intervals

$O := hist(a, R)$ $\qquad$ $E_{interval} := \dfrac{1}{10}\cdot length(R)$

O =

	0
0	8
1	8
2	10
3	9
4	12
5	8
6	10
7	14
8	10
9	11

E =

	0
0	10
1	10
2	10
3	10
4	10
5	10
6	10
7	10
8	10
9	10

a =

	0
0	$1 \cdot 10^{-15}$
1	0.1
2	0.2
3	0.3
4	0.4
5	0.5
6	0.6
7	0.7
8	0.8
9	0.9
10	1

O − E =

	0
0	-2
1	-2
2	0
3	-1
4	2
5	-2
6	0
7	4
8	0
9	1

$(O - E)^2 =$

	0
0	4
1	4
2	0
3	1
4	4
5	4
6	0
7	16
8	0
9	1

$$T_i := \frac{(O_i - E_i)^2}{E_i}$$

T =

	0
0	0.4
1	0.4
2	0
3	0.1
4	0.4
5	0.4
6	0
7	1.6
8	0
9	0.1

Finally, sum the terms to find chi-squared

$$\sum_{i=0}^{9} T_i = 3.4$$

$$\chi 2 := \sum_{i=0}^{9} \frac{(O_i - E_i)^2}{E_i}$$

$$\chi 2 = 3.4$$