## 4.11 Statistical tests

scientia

### 4.11.1 $\chi^2$ test for independence

Consider the following set of data:

	Action	Horror	Comedy	Total
color-blind	120	90	40	250
non color-blind	110	95	45	250
Total	230	185	85	500

To be able to do a  $\chi^2$  test, you first need to put the data in a matrix.

#### Enter the data

(1) Press , select Matrix & Vector > Create > Matrix. Set the matrix amount of rows and columns (here:  $2 \times 3$ ), and enter the data.

<sup>30</sup> Store the matrix as A. To do that press **ctrl** then **v** and enter A:

<b>∢ 1.1 ▶</b>		*Doc	CAPS	RAD 📘 🗙
120 9 110 9	$\begin{bmatrix} 0 & 40 \\ 5 & 45 \end{bmatrix} \rightarrow a$	$\begin{bmatrix} 1\\ 1 \end{bmatrix}$	20. 90. 10. 95.	40. 45.]
I				

#### Do the test

(1) Press  $\vec{m}$ , select Statistics > Stat Tests >  $\chi^2$  2-way Test. Set matrix [A] as Observed. Press  $\vec{n}$ , these results should be displayed:

"Title"	"χ² 2–way Test"
'' X <sup>2</sup> ''	0.864
"PVal"	0.649
"df"	2.
"ExpMatrix"	"[]"
"ExpMatrix" "CompMatrix"	"[]"

# 4.11.2 $\chi^2$ goodness of fit test

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Consider a person counting the amount of cyclists he sees passing by his street each day:

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
50	60	42	48	52	58	61

The null and alternative hypthesis are

 $H_0$ : An equal amount of cyclists pass by his street each day.

 $H_1$ : A different amount of cyclists pass by his street each day.

We want to know at a significance level of 0.05 if he must accept null hypothesis.

- ① Create a new document and select Add List & Spreadsheet.
- ② Fill column A with the amount of cyclist each day. Fill column B with the average amount of cyclists (here: 52.8).

<b>∢</b> 1.1	>	*Doo	с	RA	vd 📋 🗙
A		в	С	D	1
=					
1	50.	52.8			
2	60.	52.8			
з	42.	52.8			
4	48.	52.8			
5	52.	52.8			•
В					• •

3 Press , select Statistics > Stat Tests >  $\chi^2$  GOF. Fill the parameters as follows:

χ² GOF	
Observed List:	a[] 🕨
Expected List:	b[]
Deg of Freedom, df:	6
1st Result Column:	c[]
Draw:	Shade P Value
	OK Cancel

Press enter . These results should be displayed:

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Title	χ² GOF
χ²	5.57
PVal	0.473
df	6.
CompLis	{0 <b>.</b> 14848

The results should be  $\chi^2 = 5.57$  (for the critical value) an p = 0.473 (for the significance level), rounded.

We must then accept the null hypothesis.

#### 4.11.3 The student's t-test

Consider the following data:

$x_1$	2.8	3.2	2.7	3.5	3.0	2.9	4.1	3.9	
$x_2$	3.1	3.5	2.8	3.7	4.2	2.6	3.2	2.9	3.8

You want to test whether the  $x_1$  data is on average a than  $x_2$  ( $\mu_1 > \mu_2$ ), at a significance level of 10%

① Create a new document and select Add List & Spreadsheet. Fill column A with x1 values and column B with x2 values.

◀ 1.	1 🕨	*Doo	5	rad 📘 🗙
	A	в	c c	
=				-
1	2.8	3.1		
2	3.2	3.5		
З	2.7	2.8		
4	3.5	3.7		
5	3.	4.2		•
В			· · · · · ·	4 F

Press , select Stastistics > Stat Tests > 2-Sample t Test. Select Data as data input and fill the parameters as follows:



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2–Sample t Test			
List 1:	a[]	•	
List 2:	b[]	►	
Frequency 1:	1	•	
Frequency 2:	1	►	
Alternate Hyp:	Ha: μ1 > μ2	►	
Pooled:	No	►	<b>`</b>
		_	•
	OK		Cancel

Press enter . These results should be displayed:

Title	2–Samp
Alternate	μ1 > μ2
t	-0.191
PVal	0.575
df	14.8

The *t*-value should be t = -0.191 and the *p*-value should be p = 0.575 (rounded). Therefore we must accept the null hypothesis (we **cannot** infer that  $\mu_1 > \mu_2$ ).