## 4.11 Statistical tests

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

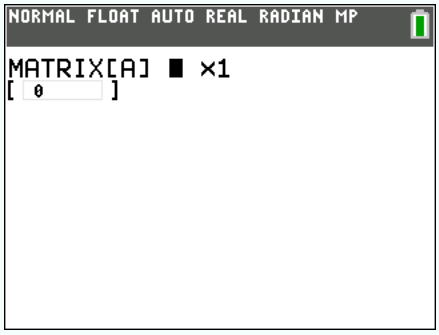
Consider the following set of data:

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

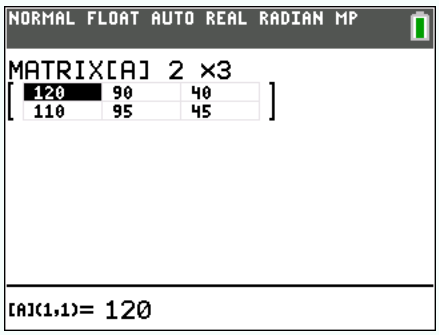
To be able to do a $\chi^2$ test, you first need to put the data in a matrix.

**Enter the data**

① Press 2nd , matrix D $x^{-1}$ , EDIT, [A]:




② Ignoring the "Total" rows and columns, set the matrix amount of rows and columns (here: $2 \times 3$), and enter the data:

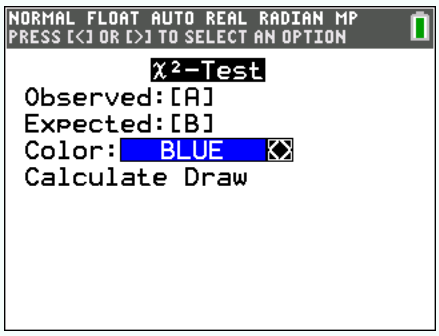


**Do the test**

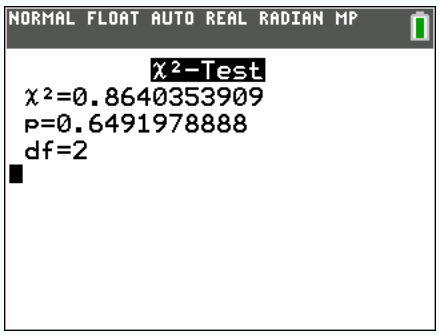
① Press list stat, TESTS, $\chi^2$-Test....

Set matrix [A] as Observed by pressing 2nd, matrix D $x^{-1}$, L1 Y 1.

Set a new matrix, e.g. matrix [B], as Expected by pressing 2nd, matrix D $x^{-1}$, L2 Z 2:




② Press Calculate. The following result should appear:




df means "degrees of freedom"

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

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

$\boldsymbol{H_0}$ **:** An equal amount of cyclists pass by his street each day.

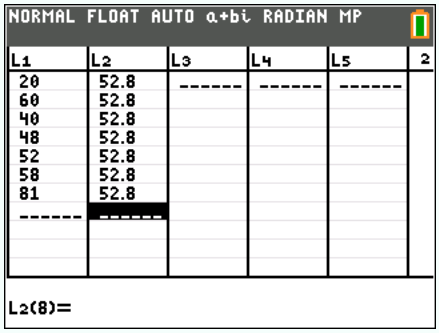
$\boldsymbol{H_1}$ **:** A different amount of cyclists pass by his street each day.

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

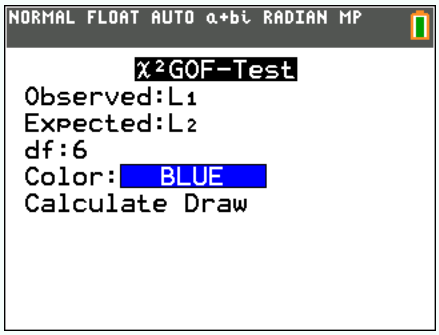
① Press list stat, `Edit...` and enter the data in a list (here: $L_1$)

② fill $L_2$ with the average amount of cyclists (here: 52.8).

Tip: you can highlight $L_2$ and write `0*L1+52.8` to fill it quickly.




③ Press list stat, `TESTS`, `χ² GOF-Test` and fill the parameters as follows:




`df`$= 7 - 1$ (degrees of freedom),

`Color` doesn't matter

Press `Calculate`

The results should be $\chi^2 = 6.467$ (for the critical value) an $p = 0.373$ (for the epsignificance level), rounded.

We must then accept the null hypothesis.

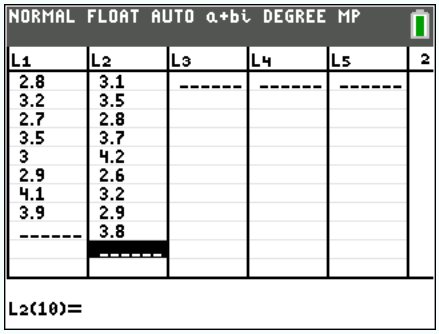
### 4.11.3 The student's t-test

Consider the following data:

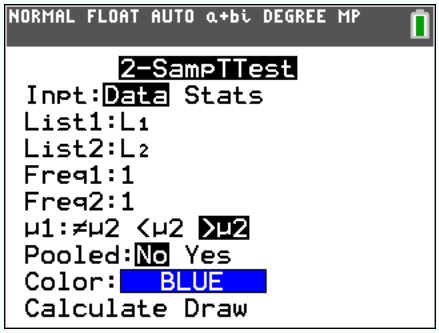
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| $x_1$ | 2.8 | 3.2 | 2.7 | 3.5 | 3.0 | 2.9 | 4.1 | 3.9 | |
| $x_2$ | 3.1 | 3.5 | 2.8 | 3.7 | 4.2 | 2.6 | 3.2 | 2.9 | 3.8 |

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 Press list stat, `Edit...` and enter both lists (here: $x_1$ in $L_1$ and $x_2$ in $L_2$):




② Press list stat, `TESTs`, `2-SampTTest...` and enter the parameters as follow:




Press 2nd, 1 (L1) to get $L_1$,

`Color` doesn't matter

Press `Calculate`.

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 $\mu_1 > \mu_2$).