

Chapter 14 / Example 15

Estimating parameters

The lengths of fish caught in a lake are thought to be normally distributed. To test this belief 200 fish were caught and measured and the results are shown in the table below.

Length (x cm)	$0 < x < 10$	$10 < x < 15$	$15 < x < 20$	$20 < x < 25$	$25 < x < 30$	$30 < x < 40$
Number of fish	45	55	38	27	25	10

Using estimates of the mean and standard deviation of the population taken from the sample data, test the hypothesis at the 5% level that the lengths of the fish are normally distributed.

Open a new document and add a Lists & Spreadsheet page.

Type 'x' in the first cell.

Type the mid-interval values: 5, 12.5, 17.5, 22.5, 27.5, 35 in the first column.

Press **enter** or **▼** after each number to move to the next cell.

A	B	C	D
x			
5			
12.5			
17.5			
22.5			
27.5			

Type 'n' in the cell to the right of 'x'.

Enter the frequencies in the second column.

Use the **▲ ▼ ► ◀** keys on the touchpad to navigate the spreadsheet.

A	B	C	D
x	n		
5	45		
12.5	55		
17.5	38		
22.5	27		
27.5	25		

To find the summary statistics

Press **menu** 4:Statistics | 1:Stat Calculations | 1:One-Variable Statistics...

Click the touchpad on OK or press **enter**.

One-Variable Statistics

Num of Lists: 1

OK Cancel

Open the drop down lists with **►** and select using **▼** and **enter**.

Choose 'x' for X1 List and 'n' for Frequency List.

The next two choices remain empty.

The 1st Result Column can remain as c[] as this is the third column in the spreadsheet.

Press **enter** or use the touchpad to click OK.

One-Variable Statistics

X1 List: x

Frequency List: n

Category List:

Include Categories:

1st Result Column: c[]

OK Cancel

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The GDC displays a list of statistics for the data.

From the sample

$$\bar{x} = 16.1 \text{ cm}, Sx = 8.46 \text{ cm}.$$

H_0 : The fish in the lake have an $N(16.1, 8.46^2)$ distribution.

H_1 : The fish in the lake do not have an $N(16.1, 8.46^2)$ distribution.

A	x	B	n	C	D
1	5	45	Title	=OneVar(One-Va...
2	12.5	55	\bar{x}		16.1125
3	17.5	38	Σx		3222.5
4	22.5	27	Σx^2		66181.3
5	27.5	25	$sx := Sx \dots$		8.46474

DI = "One-Variable Statistics"

Calculate the expected values directly in the table.

Type 'p' in the first cell of the next empty column.

Press **menu** 4:Statistics | 2:Distributions | 2:Normal Cdf...

Leave Lower Bound as -9E999 and type 10 for Upper Bound

For μ open the drop down lists with **►** and select stat1. \bar{x} using **▼** and **enter**.

For σ select stat1.sx and **enter**.

Press **enter**.

Normal Cdf

Lower Bound: -9E999

Upper Bound: 10

μ : 'stat1. \bar{x}

σ : 'stat1.sx

Draw: ☐ Shade area

OK Cancel

The probability is entered directly in the table.

Repeat for the remainder of the column, using the boundaries:

10-15, 15-20, 20-25, 25-30 and 30-9E999

To enter E ($\times 10^{\square}$) press **EE**.

B	n	C	D	E	p
1	45	Title	One-Va...	0.235112	
2	55	\bar{x}	16.1125		
3	38	Σx	3222.5		
4	27	Σx^2	66181.3		
5	25	$sx := Sx \dots$	8.46474		

E1 = normcdf(-9E999,10,'stat1. \bar{x} ','stat1.sx')

When you have entered all the probabilities, move to the next column and type 'e' in the first cell.

In the cell below type $p \times 200$ and press **enter**.

You will be asked if this is p is a column or variable. Choose variable.

B	n	C	D	E	p
2	55	\bar{x}	16.1125	0.212606	
3	38	Σx	3222.5	0.229257	
4	27	Σx^2	66181.3	0.176152	
5	25	$sx := Sx \dots$	8.46474	0.096435	
6	10	$\sigma x := \sigma n \dots$	8.44355	0.050437	

E6 = normcdf(30,9E999,'stat1. \bar{x} ','stat1.sx')

The GDC calculates the expected values which are shown in the column labelled 'e'.

C	D	E	p	F	e
1	Title	One-Va...	0.235112	=p*200	47.0225
2	\bar{x}	16.1125	0.212606		42.5212
3	Σx	3222.5	0.229257		45.8514
4	Σx^2	66181.3	0.176152		35.2305
5	$sx := Sx \dots$	8.46474	0.096435		19.287

F5 = 19.286972841569

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To calculate the p -value

Press **menu** 4:Statistics | 4:Stat Tests | 7: χ^2 GOF...

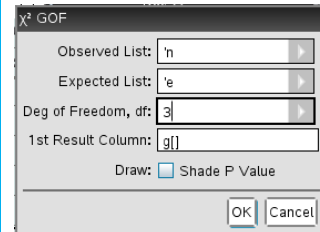
Open the drop down lists with **►** and select using **▼** and **enter**

Observed List: n

Expected List: e

Since the mean and standard deviation were both estimated, the number of degrees of freedom is $6 - 1 - 1 - 1 = 3$.

Click the touchpad on OK or press **enter**



p -value = 0.0334.

$0.0334 < 0.05$, the result is not significant so there is insufficient evidence to reject the null hypothesis that the lengths of fish in the lake follow a normal distribution.

	E p	F e	G	H
		= 'p*200		= χ^2 GOF('t
1	0.235112	47.0225	Title	χ^2 GOF
2	0.212606	42.5212	χ^2	8.70941
3	0.229257	45.8514	PVal	0.033415
4	0.176152	35.2305	df	3.
5	0.096435	19.287	CompLis...	(0.08698...
#3	=0.033414598712264			