

Chapter 14 / Example 13

Goodness of fit to Poisson distribution

Flaws in a length of material are thought to be modelled by a Poisson distribution with a mean of two flaws per metre.

Fifty 1 m lengths of material are inspected and the number of flaws in each are recorded in the table below.

Number of flaws	0	1	2	3	≥ 4
Frequency	5	10	18	11	6

- If $X \sim \text{Po}(2)$ find $P(X = 0)$, $P(X = 1)$, $P(X = 2)$, $P(X = 3)$ and $P(X \geq 4)$.
- Hence find the expected values if the number of flaws follows a Poisson distribution with a mean of two flaws per metre.
- Write down the null and alternative hypotheses and the degrees of freedom for the test.
- Find the p -value.
- State the conclusion for this test.

Press **MENU** 2 **STAT** to display the List Editor screen.

Type the numbers 0, 1, 2, 3 in the first column.

Press **EXE** after each number to move to the next cell.

```

 $\chi^2$  GOF Test
 $\chi^2 = 1.28254725$ 
 $p = 0.86432961$ 
 $df = 4$ 
CNTRB: List3
  
```

Press **F5** DIST **F6** \triangleright **F1** POISSON **F1** Ppd

Choose Data: List

List: List1

λ : 2

Save Res: List2

press **EXE**.

To enter List 2 press **F2** LIST and type 2.

```

Poisson P.D
Data      :List
List      :List1
 $\lambda$      :2
Save Res: List2
Execute
[CALC]
  
```

The GDC displays the first four probabilities.

```

Poisson P.D
1| 0.1353
2| 0.2706
3| 0.2706
4| 0.1804

0.1353352832
  
```

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Press **EXIT** twice to return to the List Editor screen.

The probabilities calculated are in List2.

	List 1	List 2	List 3	List 4
SUB				
1	0	0.1353		
2	1	0.2706		
3	2	0.2706		
4	3	0.1804		
		0.1353352832		

GRAPH CALC TEST INTR DIST ▶

Press **MENU** 1 **RUN-MAT** to display the Run-Matrix screen for arithmetical calculations.

Type 50 ×

Press **OPTN** **F1** LIST **F1** List

Type 2, press **→** **F1** List, type 3 and press **EXE**.

50×List 2→List 3
{6.766764162,13.5335▶
□
List List→Mat Dim Fill(Sec ▶

Press **MENU** 2 **STAT** to display the List Editor screen.

The GDC now displays expected frequencies in the third column.

	List 1	List 2	List 3	List 4
SUB				
1	0	0.1353	6.7667	
2	1	0.2706	13.5333	
3	2	0.2706	13.5333	
4	3	0.1804	9.0223	
			0	

GRAPH CALC TEST INTR DIST ▶

Press **F5** DIST **F6** ▶ **F1** POISSON **F2** Pcd

Choose Data: **F2** Var

Lower: 4

Upper: 100

λ : 2

Save Res: **F1** None

Press **EXE**.

Poisson C.D
Data :Variable
Lower :4
Upper :100
λ :2
Save Res:None
Execute
CALC

The GDC shows $P(X \geq 4)$

Poisson C.D
p=0.14287654

Press **EXIT** twice to return to the List Editor screen.

Move to the cell below the last entry in List 3

Type 50 ×

Press **SHIFT** **(-)** [Ans]


Press **EXE**.

	List 1	List 2	List 3	List 4
SUB				
3	2	0.2706	13.5333	
4	3	0.1804	9.0223	
5			7.1438	
6				

GRAPH CALC TEST INTR DIST ▶


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Press  to move to the next column.

Enter the observed frequencies in the second column.

	List 1	List 2	List 3	List 4
SUB				
1	0	0.1353	6.7667	5
2	1	0.2706	13.533	10
3	2	0.2706	13.533	18
4	3	0.1804	9.0223	11
				11

GRAPH CALC TEST INTR DIST 


Press **F3** TEST **F3** CHI **F1** GOF


Observed: List4

Expected: List3

df: 4

CNTRB: List5

Navigate down to Execute using  and press **F1** CALC.

χ^2 GOF Test
 Observed: List4
 Expected: List3
 df : 4
 CNTRB : List5
 Save Res: None
 GphColor: Blue
 [None] LIST 

p -value = 0.482

$0.482 > 0.05$

This result is not significant so no reason to reject H_0 that the number of flaws follows a Poisson distribution.

Note that the p -value found is more accurate than the value in the example as the expected values have not been rounded.

χ^2 GOF Test
 $\chi^2 = 3.47457851$
 $p = 0.48175425$
 df = 4
 CNTRB: List5