

Chapter 14 / **Example 18****Type I and type II errors**

A machine produces components needed for a software company. The probability of a fault occurring in the production of a single component has to be less than 0.02. A sample of size 50 is taken from the output and tested to see if any were faulty. A test was performed with the hypotheses $H_0: p = 0.02$ and $H_1: p > 0.02$ at a 5% significance level.

- a** State a suitable model for the number of faults in the sample; include any additional assumptions you are making.
- b** Find
 - i** the critical region for the test
 - ii** the probability of a type I error.
- c** Earlier testing indicates that the probability of a fault is 0.04. If this is the case find the probability of a type II error.

$X \sim B(50, 0.02)$

If $P(X \geq a) < 0.05$ then $P(X \leq a - 1) > 0.95$

Press **[F1]** **[Y=]** to display the equation entry screen.

Press **[2nd]** **[VARS]** (**[DISTR]**) B:binomcdf(

Enter 50 as the number of trials, 0.02 as the probability of success and X as the X value.

Navigate down to Paste and press **[ENTER]**.

```
binomcdf
trials:50
p:0.02
x value:X
Paste
```

Press **[2nd]** **[F5]** (**[TABLE]**)

```
Plot1 Plot2 Plot3
Y1=binomcdf(50,0.02,X)
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=
Y9=
```

A table of values is displayed.

Scroll down the table using \uparrow .

From the table, $P(X \leq 2) = 0.922$ and $P(X \leq 3) = 0.982$.

The critical region is $X \geq 4$

$P(X \geq 4) = 1 - P(X \leq 3) = 1 - 0.9822 = 0.0178$

This is the probability of a type I error.

X	Y1			
0	.36417			
1	.73577			
2	.92257			
3	.98224			
4	.99679			
5	.99952			
6	.99994			
7	.99999			
8	1			
9	1			
10	1			
X=0				

Chapter 14 / **Example 18**

Type I and type II errors

Press **2nd** **MODE** **[QUIT]**.

Press **2nd** **[VAR]** (**[DISTR]**) B:binomcdf(

Enter 50 as the number of trials, 0.04 as the probability of success and 3 as the X value.

Navigate down to Paste and press **[ENTER]**.

```
binomcdf
trials:50
p:0.04
x value:X
Paste
```

Press **[ENTER]**.

$P(X \leq 3 \mid p = 0.04) = 0.861$

This is the probability of a type II error.

```
binomcdf(50,0.04,3)
.....8608692089
```