

Chapter 14 / **Example 2**

# Test for binomial probability

A food scientist is trying to determine whether a new version of cheddar cheese is regarded as more tasty than the original type.

In order to do this he decides to carry out a test with 20 people in which they are given the two types of cheese without knowing which is the original and which is new, and he asks them to pick the one they prefer. His null hypothesis is that there is no preference, so each cheese is equally likely to be selected, and his alternative hypothesis is that the new cheese is preferred. He decides to perform the test with a 5% significance level.

Let  $X$  be the number of people in the test who prefer the new cheese.

- 1** If  $p$  is the proportion of people in the population who would prefer the new cheese, state the null and alternative hypotheses.
- 2** Find the critical region for this test.
- 3** State the least possible significance level of the test

In the test, 18 out of the 20 people preferred the new cheese.

- 4** State the conclusion of the test.
- 5**
  - a** Find  $P(X \geq 18)$  under the assumption that the null hypothesis is true.
  - b** How does this confirm your answer to question **3**?

$H_0: p = 0.5$ ,  $H_1: p > 0.5$

$X \sim B(20, 0.5)$ . Find  $P(X \geq 18) \leq 0.05$  i.e. find  $P(X \leq s) > 0.95$

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

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

Enter 20 as the number of trials, 0.5 as the probability of success and  $X$  as the  $X$  value.

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

```
binomcdf
trials:20
p:0.5
x value:X
Paste
```

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

```
Plot1 Plot2 Plot3
Y1=binomcdf(20,0.5,X)
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=
Y9=
```

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A table of values is displayed.

Scroll down the table using  $\uparrow$ .

From the table,  $P(X \leq 13) > 0.942$  and  $P(X \leq 14) > 0.979$ .

The critical region is  $X \geq 15$

$$P(X \geq 15) = 1 - P(X \leq 14) = 1 - 0.9793 = 0.0207$$

The least possible significance level is 2.07%

18 is in the critical region so we reject the null hypothesis.

X	Y1			
4	.00591			
5	.02069			
6	.05766			
7	.13159			
8	.25172			
9	.41119			
10	.5881			
11	.74828			
12	.86841			
13	.94234			
14	.97931			

X=4

Press y [QUIT].

$$P(X \geq 18) = 1 - P(X \leq 17)$$

Type 1 – then press  $\alpha$  [F4] 1:Y1 and type (17)

The  $p$ -value is 0.000201.

1-Y1(17)	
	2.012252808E-4