Chapter 03 and Chapter 04

Binomial and Normal Distributions Using Minitab

Biostatistics

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Constructing a Binomial Distribution Table

Example

A survey from Jordan reported that 5% of Jordanians are afraid of being alone in a house at night. If a random sample of 20 Jordanians is selected, then find the following probabilities using the binomial probability distribution table:

a) Exactly 5 people in the sample are afraid of being alone at night?

Answer: 0.002245

b) At most 3 people in the sample are afraid of being alone at night?

Answer: 0.984099

c) At least 3 people in the sample are afraid of being alone at night?

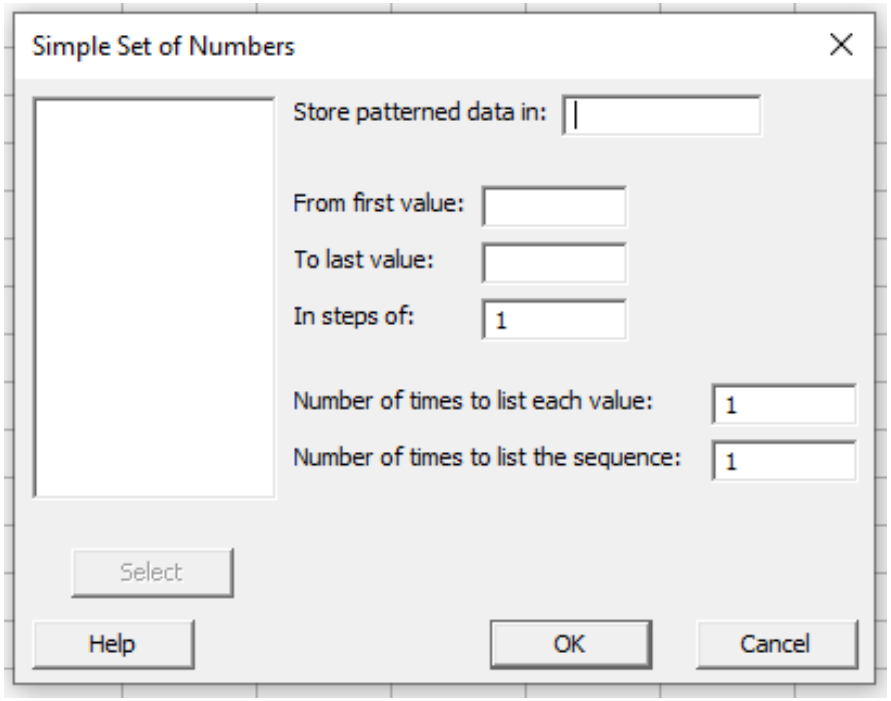
Answer: 0.075483

Notation: Let the discrete random variable X be the number of Jordanian people in the sample who are afraid of being alone at night, then X will have a binomial distribution with $n = 20$ and $p = 5\% = 0.05$, that is $X \sim B(20, 005)$, and its probability distribution is given as follows:

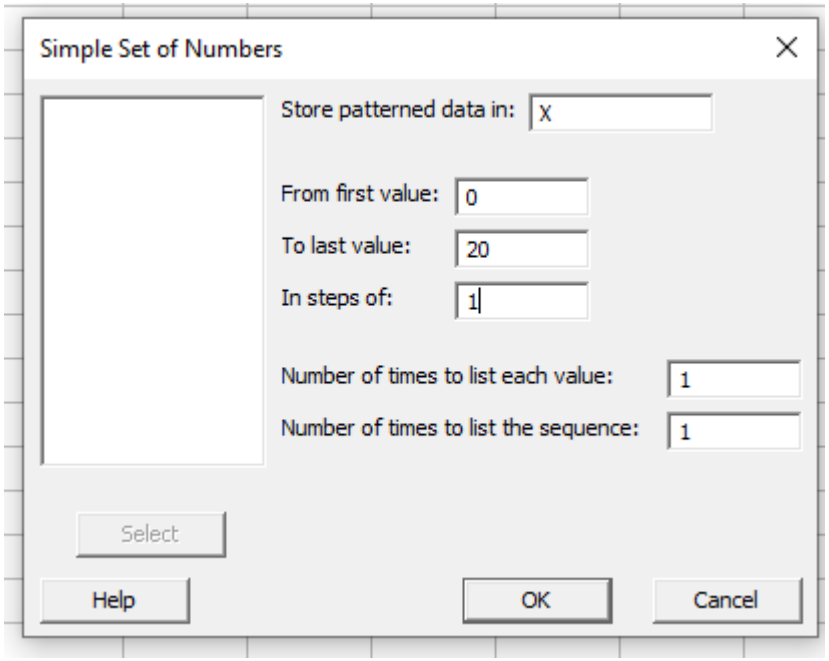
$$f(x) = P(X = x) = \begin{cases} \binom{20}{x} (0.05)^x (0.95)^{20-x}, & x = 0, 1, \dots, 20 \\ 0, & Otherwise \end{cases}$$

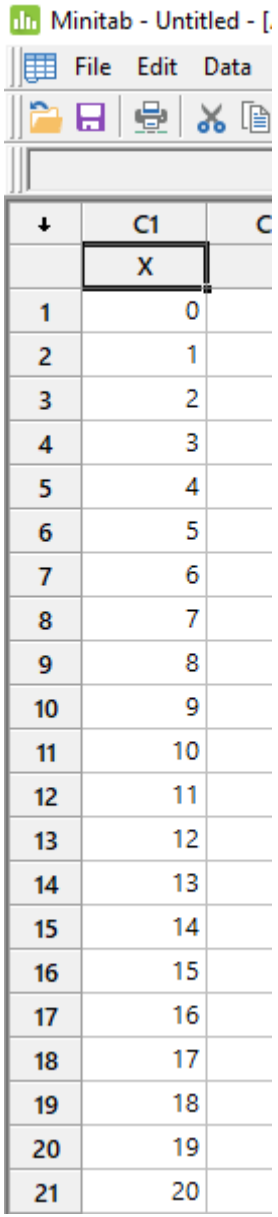
Steps

1. Start your **Minitab** program by double click on the icon Minitab 17 .
2. To enter the integers from 0 to 20 in the column (C1) select
   Calc > Make Patterned Data > Simple Set of Numbers…

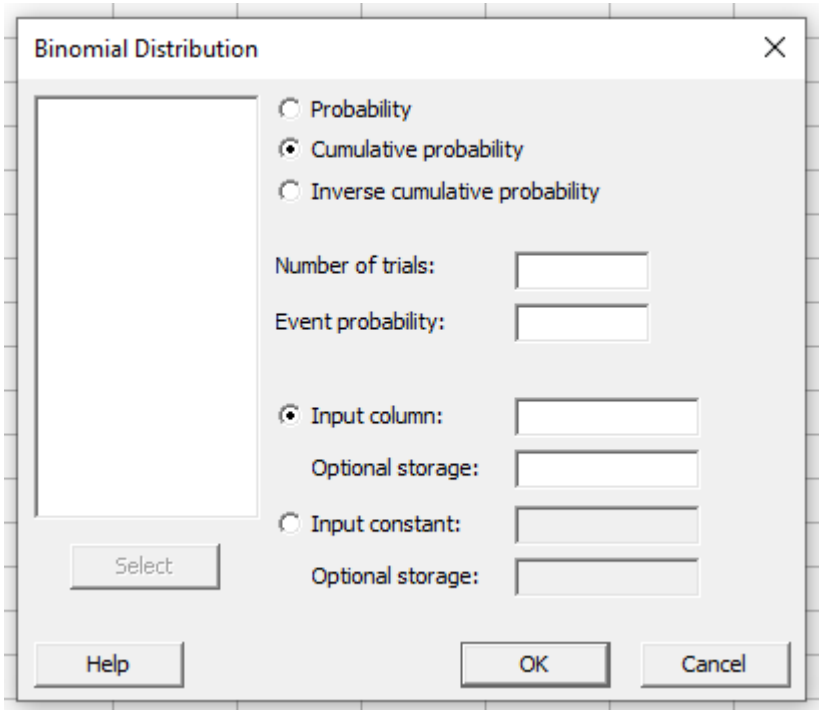


3. You must enter three values as follows:
   (a) Enter **X** in the box for **Store pattern data in: Minitab** will use the first empty column of the active worksheet and name it **X**. Press **Tab**.
   (b) Enter the value of **0** for **From first value**. Press **Tab**.
   (c) Enter the value of **20** for **To last value**. This value should be n.
   (d) **In steps of:** should be **1**.
4. Click on **OK**.
5. From menu bar Select **File > Save Worksheet As…** .
6. In **File name** write the name Afraid Alone and determine the place where you want to save your data (Desktop, Folder, ….) then press on **Save** to complete the process.

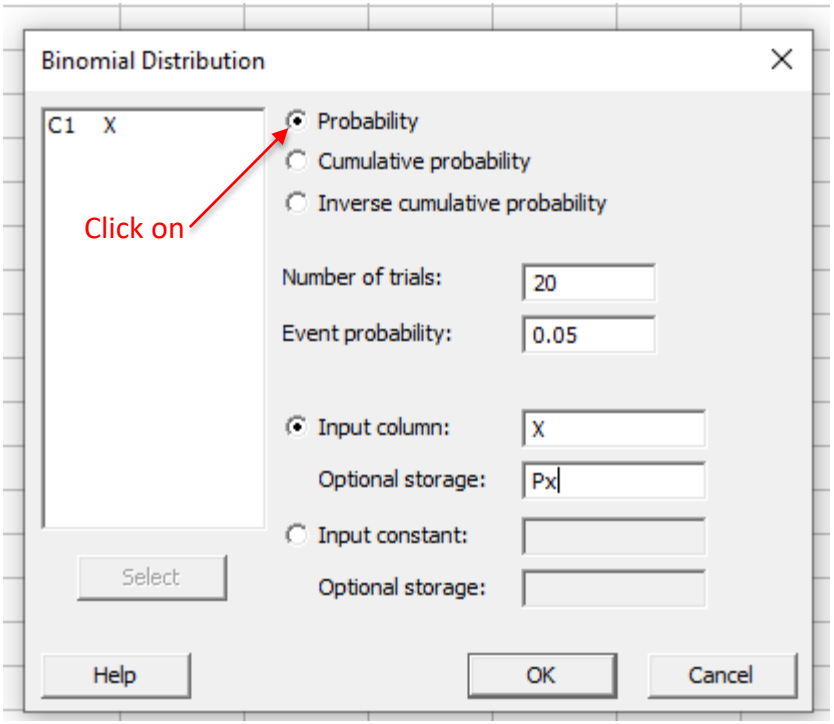




7. To calculate the Binomial Probabilities Px = P(X=x) select
Calc > Probability Distribution > Binomial… .



8. In the dialog box you must enter five items values as follows:
   (a) Click the button for **Probability**.
   (b) In the box for **Number of trials:** enter **20**, the value of n.
   (c) In the box for **Event probability:** enter **0.05**, the value of probability of success p.
   (d) Check the button for **Input column:** and type the column name , **X**.
   (d) Click in the box for **Optional storage:** and type **Px**. The first available column will be named Px and the calculated probabilities will be stored in it.
9. Click on **OK**.
10. The results will appear in the worksheet.



Minitab - Untitled - [Afraid Alone.mtw ***]

File Edit Data Calc Stat Graph Editor

	C1	C2	C3	C4
	X	Px		
1	0	0.358486		
2	1	0.377354		
3	2	0.188677		
4	3	0.059582		
5	4	0.013328		
6	5	0.002245		
7	6	0.000295		
8	7	0.000031		
9	8	0.000003		
10	9	0.000000		
11	10	0.000000		
12	11	0.000000		
13	12	0.000000		
14	13	0.000000		
15	14	0.000000		
16	15	0.000000		
17	16	0.000000		
18	17	0.000000		
19	18	0.000000		
20	19	0.000000		
21	20	0.000000		

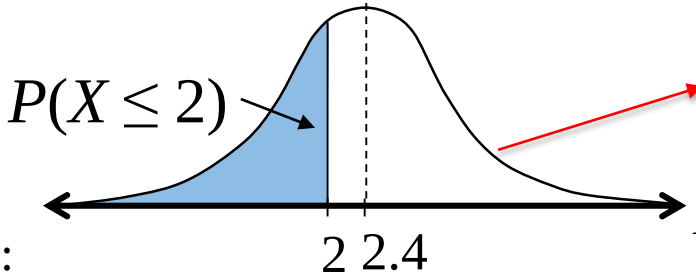
Calculating Probabilities Using Normal Distribution

Example

A survey in Jordan indicates that health clubs use their computers in an average of 2.4 years before upgrading to a new machine. The standard deviation is 0.5 year. A health club is selected at random. Find the probability that the health club will use it for less than or equal to 2 years before upgrading. Assume that the variable X is normally distributed?

Solution

To find the area (probability) to the left of 2, that $P(X \leq 2)$ as shown in the figure below:



Normal Distribution

$\mu = 2.4 \quad \sigma = 0.5$

we proceed as follows:

$$z = \frac{x - \mu}{\sigma} = \frac{2 - 2.4}{0.5} = -0.80$$

$P(X \leq 2) = P(Z \leq -0.80)$

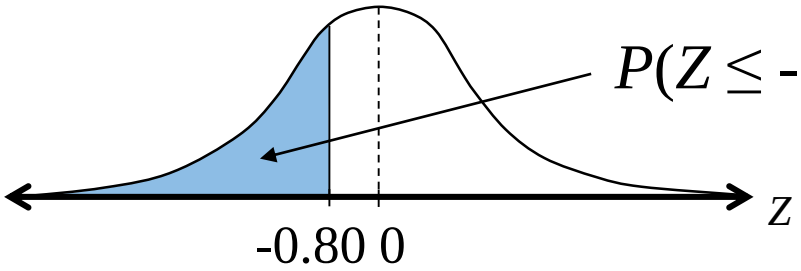
$= \Phi(-0.80)$

$= 1 - \Phi(0.80) = 1 - 0.7881$

$= 0.2119$ From Table 3 – Column A

Standard Normal Distribution

$\mu = 0 \quad \sigma = 1$



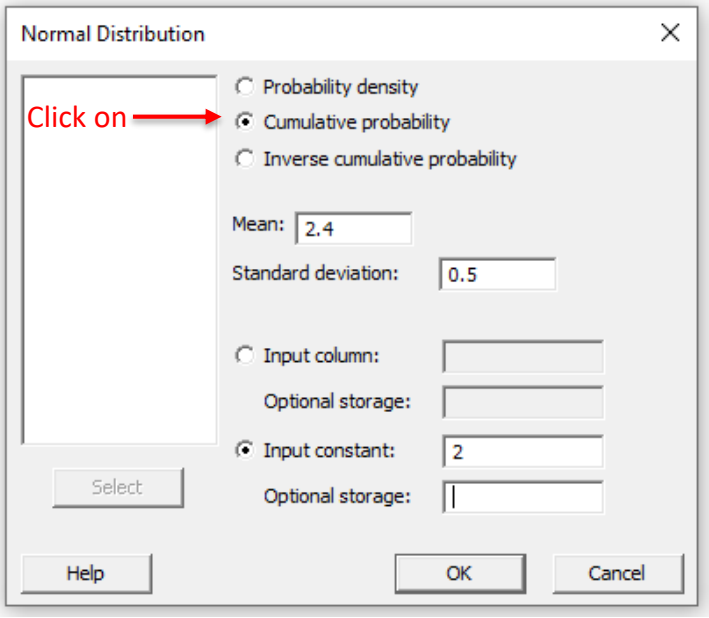
Steps

1. Start your **Minitab** program by double click on the icon  .

2. To calculate the Probability $P(X \leq 2)$ select

Calc > Probability Distribution > Normal… .

3. Click the button for **Cumulative probability**.
4. The **Mean:** should be 2.4 and the **Standard deviation:** 0.5.
5. Click the button for **Input Constant:** then click inside the text box and type 2.
6. Leave the **Optional storage** box empty. If you choose **Optional storage**, type in the name of a constant such as **K1**.
7. Click **OK**.
8. The results will be displayed in the Session Window as follows:



Cumulative Distribution Function

Normal with mean = 2.4 and standard deviation = 0.5

x	P(X ≤ x)
2	0.211855

Example

A survey in Jordan indicates that for each visit to the gym, a customer spends an average of 45 minutes with a standard deviation of 12 minutes. The length of time spent in the gym is normally distributed and is represented by the variable X. Find the time that 67% of the customers will be in the gym less than or equal to it?

Solution

$$P(Z \leq z_0) = 0.6700$$

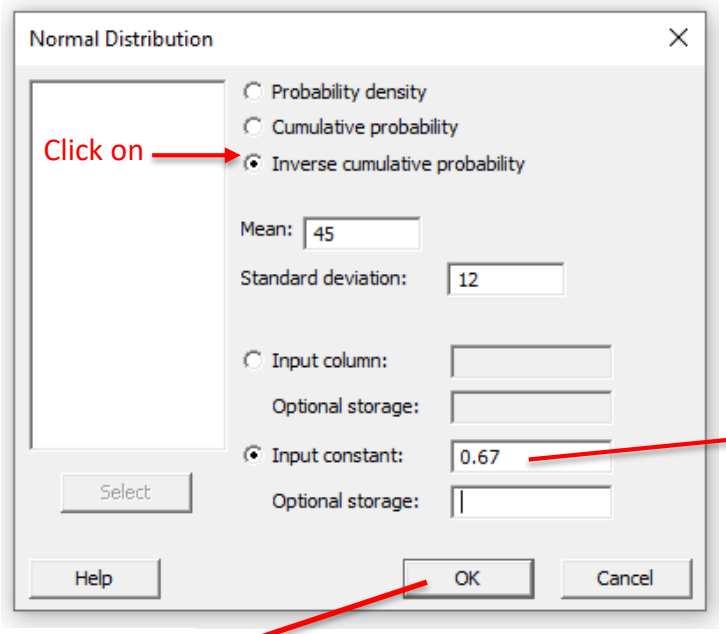
$$P(Z \leq (x - 45) / 12) = 0.6700$$

$$(x - 45) / 12 = \Phi^{-1}(0.6700)$$

$$(x - 45) / 12 = 0.44$$

$$x = 12*0.44 + 45$$

$$x = 50.28 \text{ minutes}$$



Inverse Cumulative Distribution Function

Normal with mean = 45 and standard deviation = 12

P(X ≤ x)	x
0.67	50.2790