

Binomial Probability Distribution

In a binomial setting, we can compute probabilities of certain outcomes. This used to be done with tables, but with graphing calculator technology, these problems are solved quickly and easily. The first type is the binomial probability distribution where you are asked to find the probability of an exact number of things happening.

Before beginning a problem using the binomial features of the calculator, you must make sure it meets the criteria for a binomial setting. A binomial distribution is one in which four conditions are met:

1. There are a fixed number of observations. We call this number n .
2. Each observation is independent. In other words, in a situation such as tossing a coin, the 5th toss is not dependent on any of the previous four tosses. These are independent events.
3. Each observation falls into only TWO categories: success or failure. The probability of success is labeled as p and the probability of failure is $1 - p$ (some books call this q).
4. The probability of success, p , is the same for each of the n observations.

If these conditions are met, you may proceed with solving the problem using the binomial features of the calculator.

Problem 1:

A basketball player has a free throw percentage of 75%. In a single game, the player shoots 12 free throws. Compute the following probabilities.

- a. What is the probability that she makes exactly 6?
- b. What is the probability that she makes exactly 75% or 9 of the free throws?
- c. What is the probability that she makes all 12?

In this situation, there are a fixed number of observations ($n = 12$) which are all independent. There are only two options for each free throw, make or not. The probability of making the free throw is .75 and the probability of missing the free throw is .25. These probabilities apply to each free throw in the game.

Keystrokes for the *fx-9750G Plus*

From the main menu, go to STAT.



Press EXE. You will see lists that may or may not have data in them. This is not an issue for computing binomial probabilities.



Press F5 to obtain the different distribution options that are available.

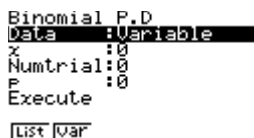


Press F5 again to obtain the binomial distributions.

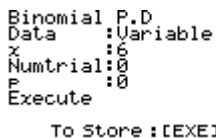


Press F1 to get the binomial probability distribution. You will have to input information in order for the calculator to solve the problem

Our information is not in a list so we choose F2 to input our own variables.

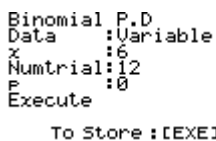


Press the down arrow to input the number of success you are trying to find out about. (In part a, this number is 6.)



Press EXE.

Enter the number of trials to be used. (In each of our problems, this is 12.)



Press EXE.

Enter the probability of success. (In each of our problems, this is .75.)

```
Binomial P.D
Data :Variable
x :6
Numtrial:12
P :.75
Execute
To Store :[EXE]
```

Press EXE.

There should be a *CALC* command above F1.

```
Binomial P.D
Data :Variable
x :6
Numtrial:12
P :0.75
Execute
[CALC]
```

Press F1 to compute the probability.

```
Binomial P.D
P(x)=0.040149
```

Binomial Cumulative Distributions

When dealing with a binomial setting, you are often asked to find probabilities dealing with "greater than" and "less than" situations. These are handled easily on your calculator as long as you know what the calculator is doing and input the correct information. Using the binomial cumulative distribution function of the calculator means that you are summing probabilities from 0 to x . So if a problem asks for the probability of 6 or fewer things happening, you need to have the calculator sum $P(0) + P(1) + \dots + P(6)$.

However, if a problem asks you to find the probability of more than 5 things happening, this cannot be input directly into the calculator without some preliminary work. $P(\text{more than } 5) = P(5) + P(6) + \dots + P(n)$ where n is the number of observations in the problem. But remember that the calculator can only compute probabilities less than or equal to a certain value. So this situation becomes $1 - [P(0) + P(1) + P(2) + P(3) + P(4)]$ which is input in the calculator's binomial cumulative distribution screen with an x value of 4. Then make sure to subtract the value you get from 1. It is always helpful to write out what you have to compute first BEFORE jumping to the calculator.

Problem:

A basketball player has a free throw percentage of 75%. In a single game, the player shoots 12 free throws. Compute the following probabilities.

- What is the probability that she makes less than 9?
- What is the probability that she makes at least 8?
- What is the probability that she makes between 7 and 10?

This is a binomial situation so we can proceed with the binomial cumulative distribution computations. However, let's figure out "x" in each case before we begin.

In part (a) we need $P(\# \text{ make} < 9)$ which is $P(0) + P(1) + \dots + P(8)$ so $x = 8$. For part (b) we are looking for $P(\text{at least } 8)$ which means $P(8) + P(9) + P(10) + P(11) + P(12)$. This means we need to use $x = 7$ in the calculator and subtract our answer from 1. Part (c) needs $P(8) + P(9)$ so we have to use $x = 7$ and $x = 10$ and subtract the two answers.

Keystrokes for the *fx-9750G Plus*

From the main menu, go to STAT.



Press EXE. You will see lists that may or may not have data in them. This is not an issue for computing binomial probabilities.



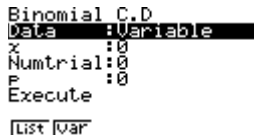
Press F5 to obtain the different distribution options that are available.



Press F5 again to obtain the binomial distributions.

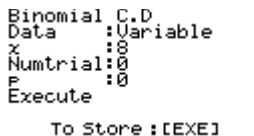


Press F2 to get the binomial cumulative distribution. You will have to input information in order for the calculator to solve the problem



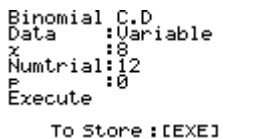
Our information is not in a list so we choose F2 to input our own variables.

Press the down arrow to input the number of success you are trying to find out about. (In part a, this number is 8.)



Press EXE.

Enter the number of trials to be used. (In each of our problems, this is 12.)



Press EXE.

Enter the probability of success. (In each of our problems, this is .75.)

```
Binomial C.D.  
Data :Variable  
x :8  
Numtrial:12  
P :.75  
Execute  
To Store :[EXE]
```

Press EXE.

There should be a *CALC* command above F1.

```
Binomial C.D.  
Data :Variable  
x :8  
Numtrial:12  
P :0.75  
Execute  
[CALC]
```

Press F1 to compute the probability.

```
Binomial C.D.  
P(x)=0.35122
```

Mean and Standard Deviation of a Binomial Distribution

Once you have determined that a distribution is indeed normal, computing the mean and standard deviation of that distribution is not a complicated process. In fact, you only need two simple formulas and can do the computations from the RUN menu on your calculator.

The formulas are:

$$\text{mean} = np$$

$$\text{standard deviation} = \sqrt{np(1-p)}$$

Problem 1:

A basketball player has a free throw percentage of 75%. In a single game, the player shoots 12 free throws. Find the mean and standard deviation for this player

Problem 2:

The basketball player from Problem #1 comes from a university where 70% of its female basketball players get degrees. If there are 20 women on the team find the mean number of graduates. What is the standard deviation?

Problem 3:

When 1025 people were surveyed and asked if they smoked, 32% said yes. What is the mean number of smokers in this group?

Keystrokes for the *fx-9750G Plus*

From the main menu, go to RUN and press EXE.



To compute the mean, type in the number of trials, n , the multiplication sign, and then p , the probability of success.

To compute the standard deviation, press SHIFT x2 and input n , p , and q ($1 - p$).

The screens for each problem are shown.

Problem 1: $n = 12$ and $p = .75$

```
12x.75          9
√(<12><.75><.25>
0.6495190528
```

Problem 2: $n = 20$ and $p = .7$

```
20x.7          14
√(<20><.7><.3>
0.9391485505
```

Problem 3: $n = 1025$ and $p = .32$

```
1025x.32          328
```