

Math Virtual Learning

AP stats / Binomial and Geometric Setting

May 6th, 2020



Lesson: May , 2020

Objective/Learning Target:

Students will review the binomial and geometric settings and apply the TI-84 calculator functions for each setting.

Review #1

What are the four properties that we need to identify in order to determine that a binomial distribution is an appropriate model for a dataset?

Review #2

What are the four properties that we need to identify in order to determine that a geometric distribution is an appropriate model for a data set?

Answers

#1: Each trial must have a binary result (yes/no, present/absent, success/failure). Each trial must be independent of the other trials. There needs to be a fixed number of trials. The probability of success needs to remain constant.

#2: Each trial must have a binary result (yes/no, present/absent, success/failure). Each trial must be independent of the other trials. Trials continue until a success happens. The probability of success needs to remain constant.

Note that both answers only vary in one property. The binomial has a predetermined number of trials and the geometric potentially has an infinite number of trials (although not likely).

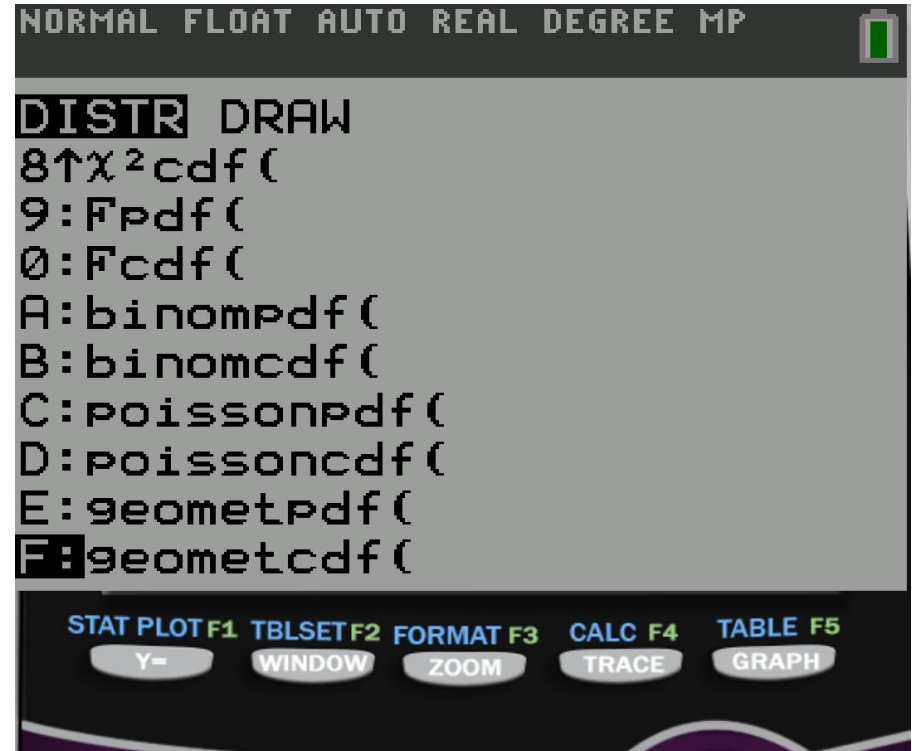
The Binomial and Geometric Setting

Both the geometric and Binomial distributions help inform statisticians on how to make inferences when our parameter of interest is a p -hat. In fact, if you take the formulas for the mean and standard deviation and divide them by the sample size, we get the mean and standard deviation formula for our p -hat sampling distributions. This transformation is just to change the scale from counts to proportions. Geometric distributions are used to estimate how long we should expect to wait to see a positive case and are used in more complex analyses. In order to review this material, please view the following video.

[Binomial and Geometric Distributions](#)

Calculator Functions

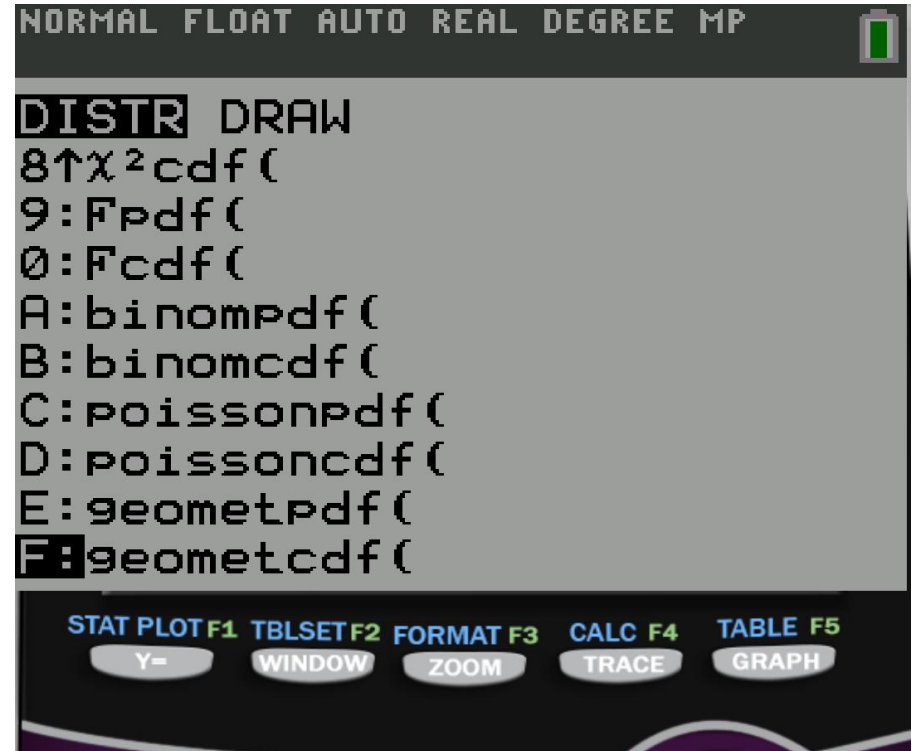
In class, we really focused on the equations and doing this all by hand. Now, let's look at applying some technology. If you press second and then VARS on the TI-84 calculators, we get the distributions menu. This includes normal, student's t, chi squared, and several other common distributions. Scrolling down, you will see that we have functions for both the binomial and geometric setting.



Calculator Functions

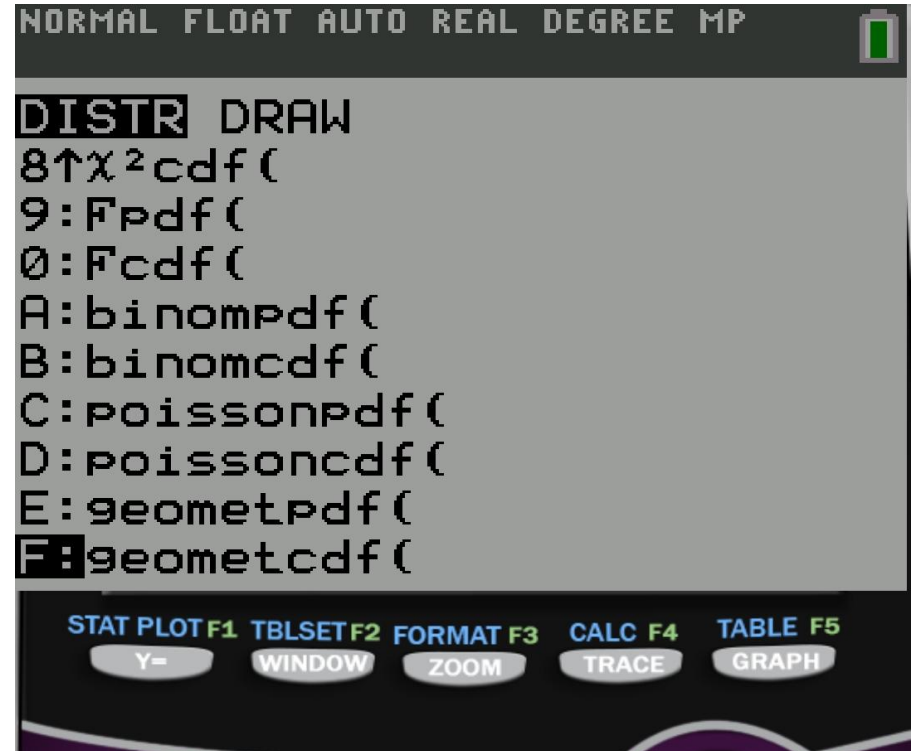
There are two types:

Point density function: This calculates the probability at a single point. Say I have $n=10$, and want to know the probability of 3 successes. The PDF function can do this.



Calculator Functions

Cumulative density function: This is good for calculating the probability of all values less than or equal to a value. So if I have $n=10$ and want to know the probability of 3 or less successes this is the function to use.



Example

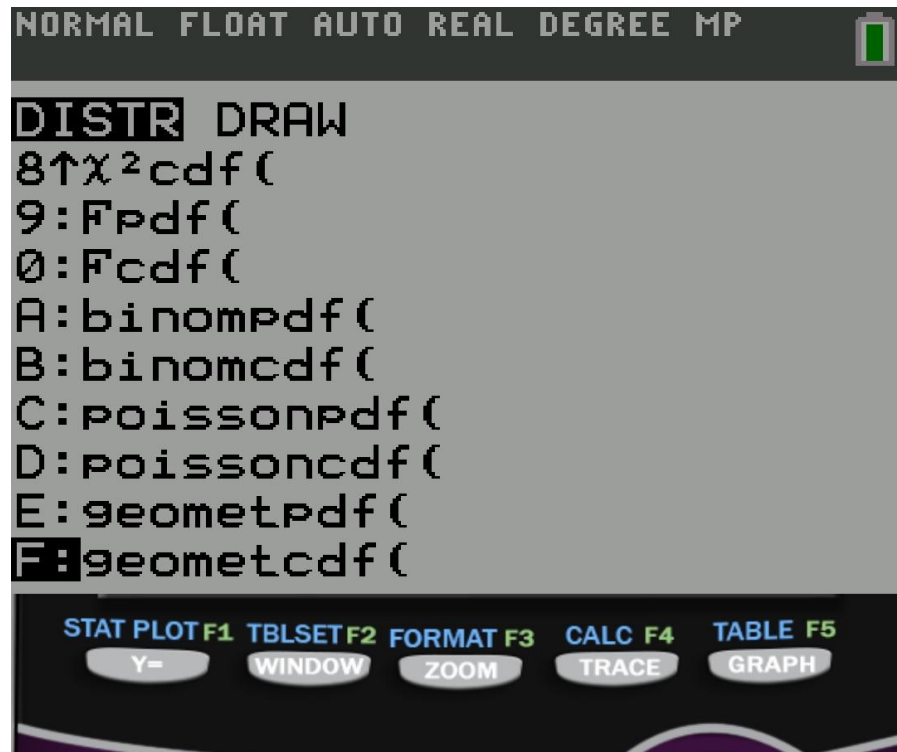
You are taking a multiple choice test with 20 questions. You need to get at least 70% or 14 right answers to pass the test, but you didn't study. If each question has 4 answers to choose from and one right answer, what is the probability of guessing your way to a right answer?

Each question is binary, right or wrong answer. We can assume the questions are independent if you are just randomly guessing (if you read and try to answer would this still be true?). We have exactly 20 questions so fixed trials, and the probability is being correct is 25% for each problem. So we know the binomial setting is appropriate.

Example

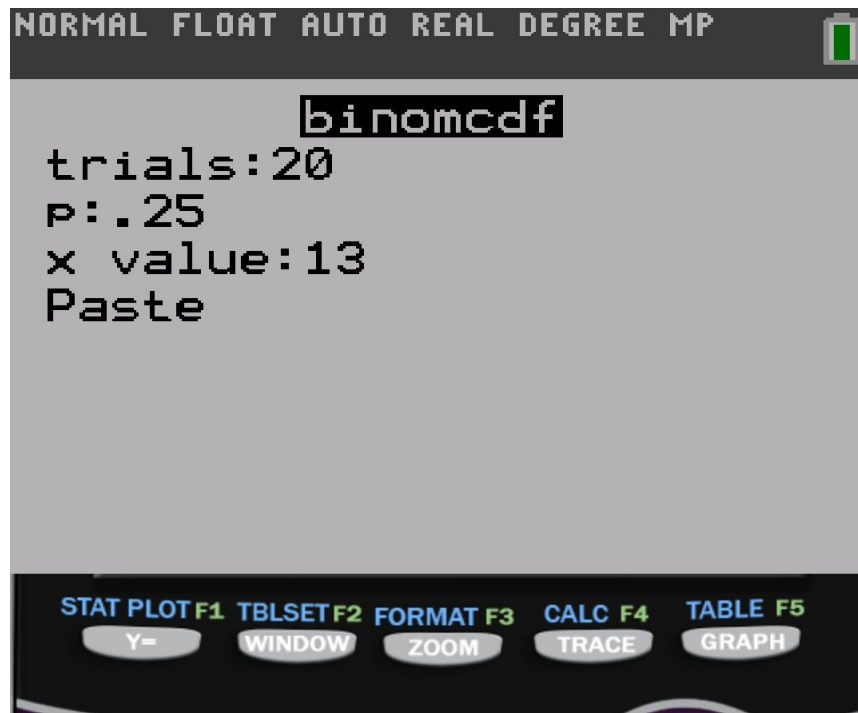
Since any score equal to or above a 14 is passing we know we want the probability from a range of values... so a CDF function. Thus we will use BinomialCDF (option B) on the TI-84 calculator.

This function always calculates the probabilities in the less than direction. So we will calculate the probability of failing first.



Example

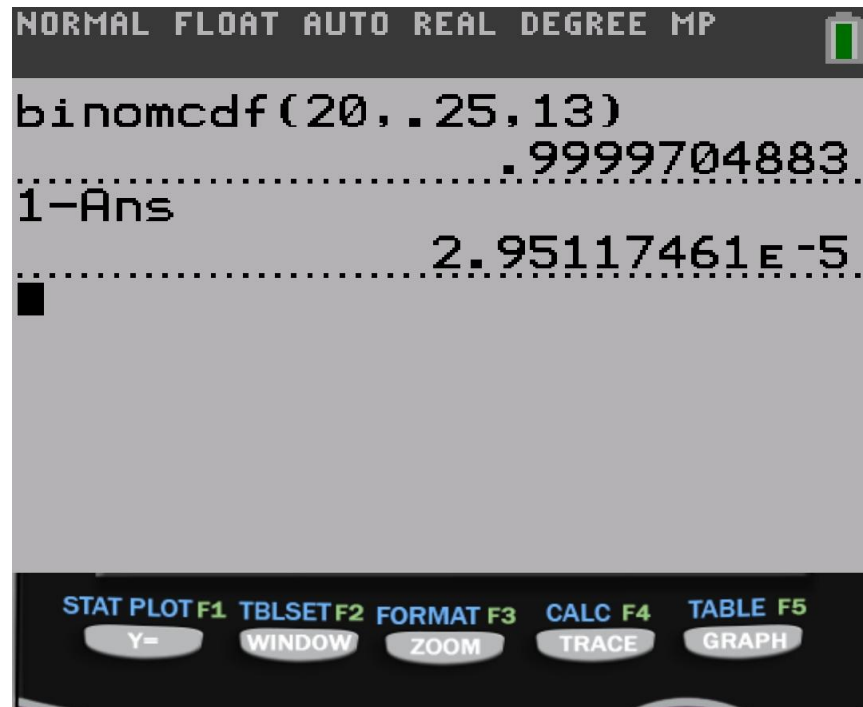
If we get 13 or less correct answers we fail. In the calculator we put in 20 trials, with a 0.25 probability, and an x-value of 13. This tells us we have a 99.997% chance of failing the test. How do we get the chance of success?



Example

We can use the complement rule for probability. Take the probability of failing and subtract from 1. This gives us a very small probability that is about 0.003% chance of passing.

This method allows us to skip over the process of calculating each probability separately and adding.



Extra Practice Part 1

3. A test consisting of 25 multiple-choice questions with 5 answer choices for each question is administered. For each question, there is only 1 correct answer.
 - (a) Let X be the number of correct answers if a student guesses randomly from the 5 choices for each of the 25 questions. What is the probability distribution of X ?

Extra Practice Part 2

This test, like many multiple-choice tests, is scored using a penalty for guessing. The test score is determined by awarding 1 point for each question answered correctly, deducting 0.25 point for each question answered incorrectly, and ignoring any question that is omitted. That is, the test score is calculated using the following formula.

$$\text{Score} = (1 \times \text{number of correct answers}) - (0.25 \times \text{number of incorrect answers}) + (0 \times \text{number of omits})$$

For example, the score for a student who answers 17 questions correctly, answers 3 questions incorrectly, and omits 5 questions is

$$\text{Score} = (1 \times 17) - (0.25 \times 3) + (0 \times 5) = 16.25.$$

- (b) Suppose a student knows the correct answers for 18 questions, answers those 18 questions correctly, and chooses randomly from the 5 choices for each of the other 7 questions. Show that the expected value of the student's score is 18 when using the scoring formula above.
- (c) A score of at least 20 is needed to pass the test. Suppose a student knows the correct answers for 18 questions, answers those 18 questions correctly, and chooses randomly from the 5 choices for each of the other 7 questions. What is the probability that the student will pass the test?

Extra Practice - ANSWERS

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