

Learning the Geometric Distribution: A Guide to `geometpdf()` and `geometcdf()` on the TI-84 Calculator

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Understanding the Geometric Distribution

The [geometric distribution](#) stands as a cornerstone concept within [probability](#) theory, specifically designed to model scenarios involving waiting times. Unlike distributions that count successes over a fixed number of trials, the geometric distribution focuses exclusively on the number of non-successful attempts--or failures--that occur before the very first success is achieved. This unique focus makes it highly relevant for analyzing sequences of independent events where we are looking for the 'first occurrence' of a desired outcome. To properly apply this distribution, two rigorous conditions must be met, rooted in the concept of [Bernoulli trials](#).

Each trial conducted must be an independent event, resulting in only two mutually exclusive outcomes: **success** or **failure**.

The probability of success, conventionally denoted by the variable p , must remain absolutely **constant** across every single trial in the sequence.

When a [random variable](#) X is modeled by this distribution, we are quantifying the number of failures, k , that precede the initial success. The precise probability of observing exactly k failures before the first success is mathematically defined by the Probability Mass Function (PMF). This function is essential for calculating exact point probabilities.

The formula for the Geometric Probability Mass Function (PMF) is:

$$P(X=k) = (1-p)^k p$$

In this expression, the term $(1-p)^k$ represents the cumulative probability of experiencing k consecutive failures (where $1-p$ is the probability of failure on any given trial), immediately multiplied by p , which is the probability of achieving success on the very next, or $(k+1)$ th, trial. Understanding these core parameters is crucial for accurate statistical modeling:

k: The specific number of failures observed before the first success occurs.

p: The constant probability of success on any single trial.

Probability Mass Function (PDF) vs. Cumulative Distribution Function (CDF)

When navigating the landscape of [discrete probability distributions](#), such as the geometric distribution, analysts must carefully select the appropriate function--the Probability Mass Function (PMF) or the Cumulative Distribution Function (CDF)--based specifically on the nature of the statistical question being addressed. These two functions serve fundamentally distinct roles in calculating probabilities associated with discrete variables, and mistaking one for the other can lead to significant interpretive errors.

The [Probability Mass Function](#) (PMF), which corresponds to the built-in function `geometpdf()` on

the [TI-84 calculator](#), is used exclusively to determine the probability of an exact, singular outcome. For the geometric distribution, this translates to finding the probability that the first success occurs on precisely the $(k+1)$ th trial, meaning we observe exactly k failures beforehand. This function is required whenever the problem statement includes language like "exactly," "on the n th trial," or "precisely."

In contrast, the [Cumulative Distribution Function](#) (CDF), represented by the `geometcdf()` function, calculates the probability across a range of outcomes. The CDF provides the cumulative probability that the number of failures encountered before the first success is less than or equal to a specified value, k . Essentially, it sums up the probabilities of 0 failures, 1 failure, 2 failures, up to k failures. This is particularly useful for questions involving thresholds or limits, such as "at most," "less than," or "within n trials."

The formula for calculating the Geometric Cumulative Distribution Function (CDF) is:

$$P(X \leq k) = 1 - (1-p)^{k+1}$$

To streamline these calculations using the [TI-84 calculator](#), we rely on the specialized distribution menu:

`geometpdf(p, k)`: Calculates the probability of experiencing **exactly** k failures before the first success ($P(X=k)$).

`geometcdf(p, k)`: Calculates the probability of experiencing **at most** k failures before the first success ($P(X \leq k)$).

Example 1: Using `geometpdf()` for Exact Probability

Consider a practical scenario involving market research or polling. A researcher is conducting a survey outside a civic center to assess public opinion regarding a newly proposed community ordinance. Based on prior data, the researcher estimates the probability that any randomly selected person supports the law is constant at $p = 0.2$. The specific question the researcher seeks to answer is: What is the **exact probability** that the fourth person interviewed is the very first individual encountered who supports the new legislation?

This problem requires finding the probability of a precise sequence of events: three consecutive failures (non-supporters) followed immediately by the first success (the supporter). Therefore, the number of failures, k , is 3, and the probability of success, p , is 0.2. Since we are seeking an exact point probability ($P(X=3)$), the appropriate tool is the **`geometpdf()`** function.

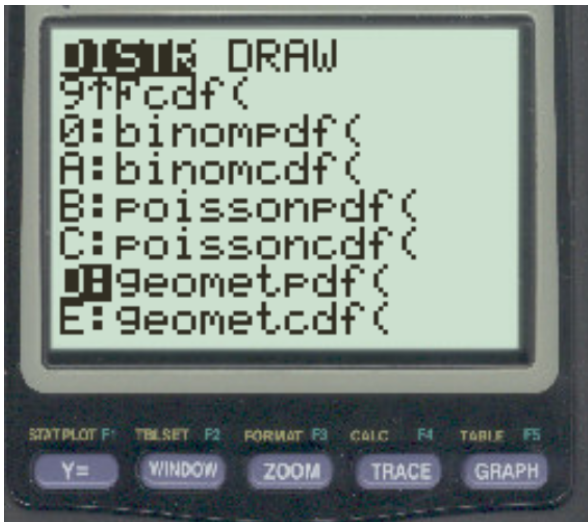
To execute this calculation on your TI-84, meticulously follow these procedural steps:

Access the comprehensive distribution menu by pressing the 2nd key, immediately followed by the

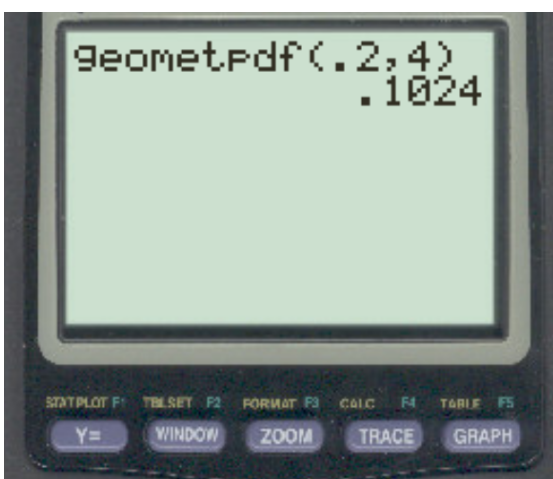
VARs key (which is labeled DISTR above the key).

Navigate downward through the alphabetical list of distributions until you locate the function **`geometpdf()`**. Press ENTER to select and activate the function.

Modern TI-84 models will present an intuitive screen prompt, guiding you to input the necessary parameters, as illustrated below. If your model does not show a prompt, you must type the arguments separated by a comma.



Input the success probability $p = 0.2$ and the number of failures (X value) $k = 3$. After confirming these inputs, select the option labeled Paste and press ENTER. The resulting display on the home screen will show the complete function call: `geometpdf(0.2, 3)`.



A final press of the ENTER key will execute the computation, yielding the result **0.1024**. This calculation confirms that there is exactly a 10.24% probability that the researcher will speak with

three non-supporters before finding the first person who supports the law, making the fourth interview the point of first success.

Example 2: Using `geometcdf()` for Cumulative Probability

Next, let us examine a scenario requiring cumulative probability, typically encountered in financial risk modeling. Consider a senior banker who primarily handles sensitive client interactions. Historical data indicates that 4% of all clients visiting this specific banker are doing so for the purpose of filing for bankruptcy. This establishes our success probability as $p = 0.04$. The relevant question in this context is: What is the cumulative probability that the banker will meet with less than nine total clients before encountering the very first client who is filing for bankruptcy?

Interpreting the condition "less than nine total clients" before the first success means the success must occur on or before the 9th trial. This implies the number of failures, k , can range from 0 (success on the first trial) up to 8 (success on the ninth trial). Therefore, we are calculating $P(X \leq 8)$. Since this problem necessitates summing the probabilities over a range of outcomes, we must employ the `geometcdf()` function.

To accurately compute this cumulative probability on your TI-84 graphing calculator, execute these precise steps:

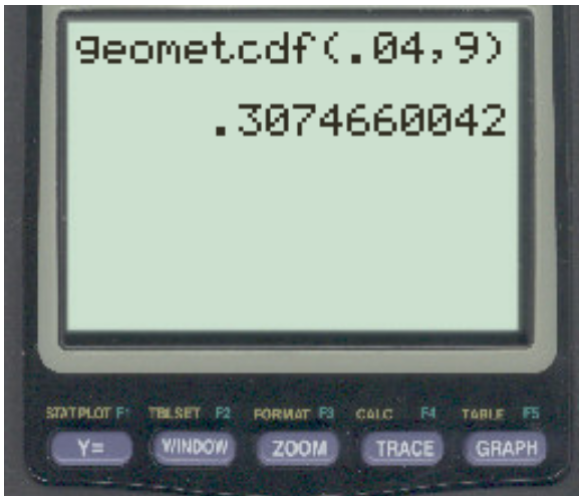
Initiate access to the distribution list by pressing the 2nd key followed by the VARS key (DISTR). Scroll down the menu, past `geometpdf()`, until you locate `geometcdf()`. Press ENTER to select it.

The calculator will then prompt you for the required input parameters. We input the success probability $p = 0.04$ and the maximum allowable number of failures (X value) $k = 8$. The parameter screen will appear as follows:



After entering the values ($P=0.04$, $X=8$) and selecting Paste, press ENTER. The command

displayed on the home screen confirms the function call: `geometcdf(.04, 9)`.



The resulting probability, upon execution, is **0.307466**. This result signifies that there is approximately a 30.75% chance that the banker will encounter the first bankruptcy filer within the first nine client meetings (i.e., after 8 or fewer non-filers).

Interpreting Results and Practical Applications

The capacity to accurately calculate probabilities using the geometric distribution is highly valuable across various professional disciplines, providing deep insights into expected waiting times for target events. Whether applied in [quality control](#) (e.g., how many items fail inspection before the first successful item), financial modeling, or engineering reliability studies, the geometric model offers a powerful framework for quantifying risk and expectation.

A central element of effective interpretation, particularly when utilizing the CDF, is maintaining a clear understanding of the definition of the [random variable](#) X . In the geometric context, X consistently represents the number of failures that occur **before** the first success. Therefore, when we calculated $P(X \leq 8)$ in Example 2, we were determining the cumulative probability that the first successful trial occurred anywhere between the 1st trial (0 failures) and the 9th trial (8 failures).

It is essential to differentiate the geometric distribution from the related [binomial distribution](#), as they address fundamentally different questions. The binomial distribution is utilized when counting the total number of successes within a fixed, predetermined number of trials. Conversely, the geometric distribution focuses on the number of trials required to achieve the first success, meaning the number of trials itself is the variable being measured, not fixed beforehand.

For users who wish to strengthen confidence in their analytical work, especially when dealing with high-stakes statistical conclusions, validating the results generated by the TI-84 functions through

external means is highly recommended. Utilizing alternative statistical software or reliable online calculators can provide a necessary cross-reference, thereby deepening the understanding of the underlying mathematical principles at play.

Bonus: We encourage users to practice by utilizing external geometric distribution calculators to confirm the probabilities derived from `geometpdf()` and `geometcdf()`, helping to solidify mastery over various complex probability scenarios.

Additional Resources for Mastery

Achieving proficiency in statistical analysis requires a comprehensive understanding of both theoretical distributions and the practical application of computational tools. To further enhance your expertise regarding discrete distributions and advanced calculator usage, consulting authoritative statistical documentation and textbooks is highly advisable.

Mastering the specialized functions related to probability distributions--specifically knowing when to deploy the PDF versus the CDF--is not merely a technical skill but a foundational requirement for executing robust and accurate statistical analysis in academic and professional settings. Consistent practice with complex scenarios will solidify your command over these powerful TI-84 features.