How to Find Z-Critical Values Using invNorm on a TI-84 Calculator

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December 5, 2025

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RECOMMENDED CITATION

stats writer (2025). *How to Find Z-Critical Values Using invNorm on a TI-84 Calculator*. PSYCHOLOGICAL SCALES. Retrieved from https://scales.arabpsychology.com/?p=105847

Understanding the invNorm() Function on the TI-84

The **invNorm()** function is one of the most powerful and frequently used tools available in the statistical toolkit of the TI-84 calculator. This function is essential for professionals and students performing statistical analysis, particularly when working with the Normal distribution. Unlike the traditional **normalcdf()** function which calculates the area (probability) given a boundary, **invNorm()** performs the inverse operation: it determines the boundary (the Z-score or X-value) required to achieve a specified cumulative probability.

Statisticians typically utilize **invNorm()** to find Z-critical values. These critical values are boundaries that define the rejection region in hypothesis testing. They represent the specific points on the standard normal curve that separate the critical region (where we reject the null hypothesis) from the acceptance region. Mastering this function is key to accurately interpreting confidence intervals and conducting various statistical tests efficiently.

This guide provides a detailed walkthrough on how to locate, input, and interpret the results of the **invNorm()** function across various common statistical scenarios, ensuring that you can leverage the full computational power of your TI-84 device for advanced probabilistic calculations.

Essential Syntax and Parameters for invNorm()

The structure of the **invNorm()** command requires specific inputs that define the characteristics of the probability distribution you are analyzing. It adheres to the standard format used by many statistical software packages, making it intuitive once the parameters are understood.

This function uses the following syntax:

invNorm(probability, μ, σ)

Understanding each component is vital for accurate calculation:

probability: This is the most crucial input. It represents the **cumulative area** (or probability) under the curve to the **left** of the boundary you are trying to find. This value must be between 0 and 1. For two-tailed tests or right-tailed tests, careful manipulation of the significance level is required before inputting the probability.
μ **(mu):** This denotes the population mean. When calculating standard Z-scores or critical values on the standard normal distribution, where μ = 0, this parameter is often omitted (or set to 0). However, when finding a raw data score (X-value), you must input the actual mean of the distribution.
σ **(sigma):** This denotes the population standard deviation. Similar to the mean, for calculations involving the standard normal curve, this is 1.0. For finding raw data scores, you must use the

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actual standard deviation of the population.

Note that if the mean (μ) and standard deviation (σ) are omitted, the TI-84 assumes you are working with the **Standard Normal Distribution** (Z-distribution), where μ = 0 and σ = 1.

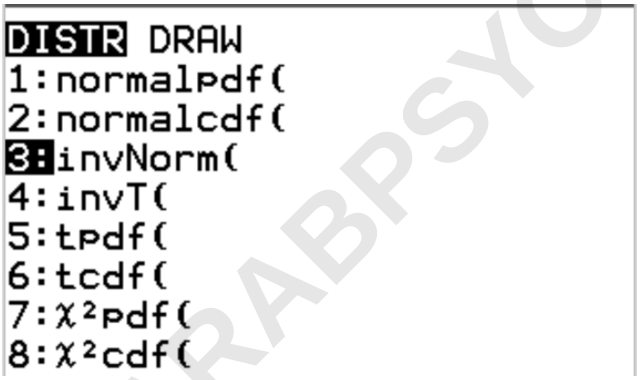
Locating and Accessing the DISTR Menu

Accessing **invNorm()** is straightforward and involves navigating through the distribution menu (DISTR) on the TI-84 calculator. This menu organizes all probability and distribution functions.

To access this function on a TI-84 calculator, follow these steps precisely:

Press the 2nd key, located on the upper left-hand side of the keypad.
Immediately press the VARS key (which has 'DISTR' written above it).
This action will take you to the **DISTR** (Distribution) screen, listing various probability functions.
Scroll down until you find the **invNorm()** option, typically listed as item 3. Select it by pressing the corresponding number or hitting ENTER.

The calculator screen will then prompt you to enter the required parameters (Probability, μ, σ, and optionally, Tail selection on newer models). Always ensure your inputs match the requirements of your statistical problem.



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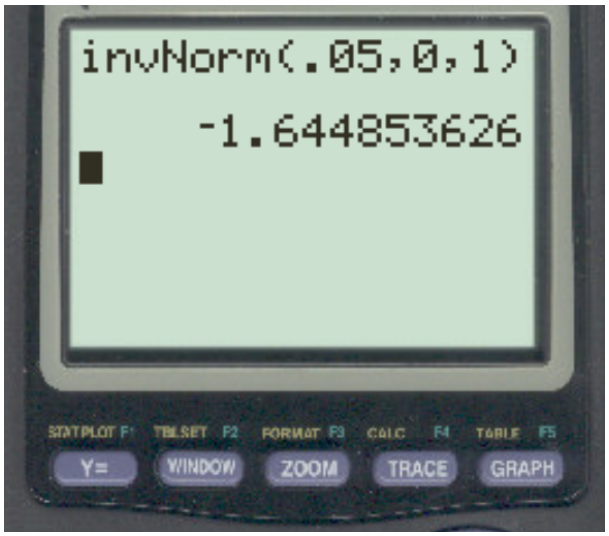
The following practical examples demonstrate how to apply this function to find critical values and define cut-off scores under different statistical testing scenarios.

Example 1: Z-Critical Values for Left-Tailed Hypothesis Tests

Suppose a researcher is conducting a left-tailed hypothesis test using a significance level, denoted as α (alpha), equal to .05. In a left-tailed test, the rejection region is located entirely in the left tail of the distribution. Since **invNorm()** requires the cumulative probability to the left of the critical boundary, we input the significance level α directly.

The goal is to determine the Z-critical value that corresponds to this alpha level of 0.05. We use the standard normal distribution parameters (μ=0, σ=1):

invNorm(.05, 0, 1)



The calculated answer is z = **-1.64485**. This Z-score separates the bottom 5% of the distribution from the remaining 95%, establishing the critical boundary.

Example 2: Z-Critical Values for Right-Tailed Hypothesis Tests

Now, consider a right-tailed hypothesis test, also using $\alpha = .05$. The rejection region is located in the far right tail. Because **invNorm()** calculates the area to the left, we must adjust our probability input.

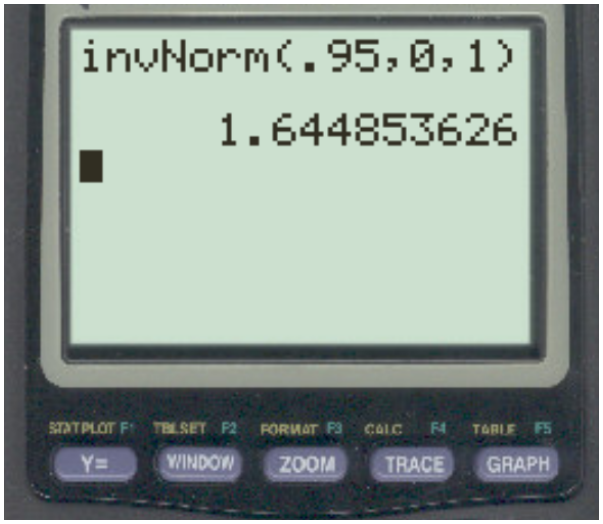
To find the critical point that has 5% area to its right, we calculate the cumulative area to its left: $1 - \alpha$.

Left-cumulative Probability = 1 - 0.05 = 0.95.

The calculation we input into the TI-84 for the standard normal curve (μ=0, σ=1) is:

invNorm(.95, 0, 1)

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The resulting Z-critical value is the positive score that defines the boundary for the critical region in the right tail.

The answer is z = **1.64485**.

Example 3: Calculating Z-Critical Values for Two-Tailed Tests

Two-tailed tests require two critical values, splitting the significance level (α) equally between the two tails of the Normal distribution. Using $\alpha = 0.05$ means we have $\alpha/2 = 0.025$ area in the far left tail and 0.025 area in the far right tail.

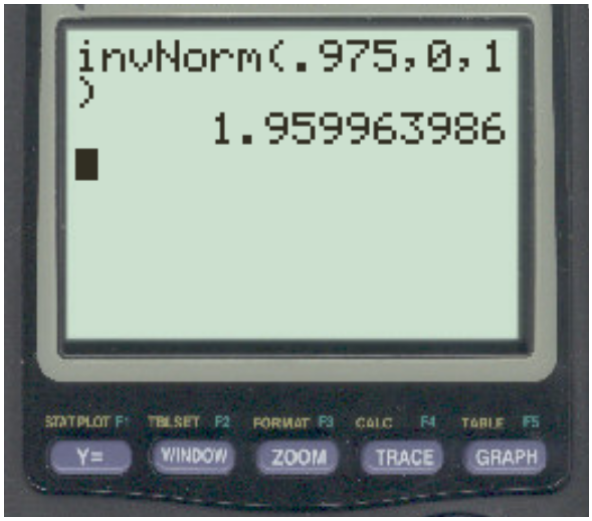
To find the positive critical value, we must calculate the cumulative area to its left, which is $1 - \alpha/2$.

Cumulative Probability = 1 - (0.05 / 2) = 0.975.

We input this cumulative probability into the **invNorm()** function:

invNorm(.975, 0, 1)

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The calculated positive Z-critical value is z = **1.96**. Due to the symmetry of the standard normal curve, the negative critical value is -1.96. The two critical values for this test are thus ±1.96.

Example 4: Calculating Cut-Off Scores for the Top Percentage

The **invNorm()** function excels at converting percentile ranks directly back into raw data scores (X-values) when specific population parameters are known. This is achieved by including the population mean (μ) and standard deviation (σ) in the command.

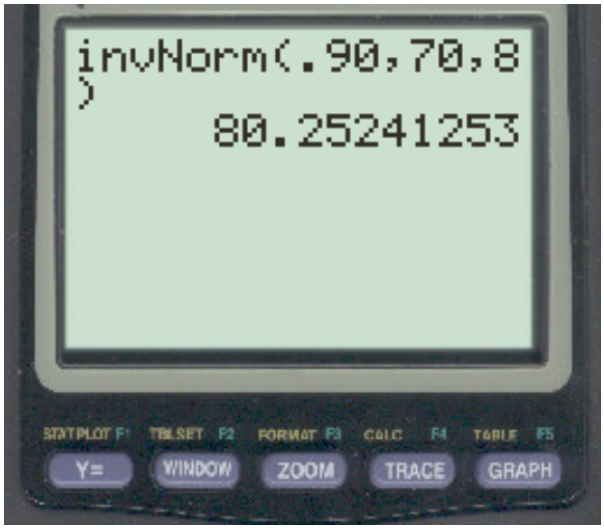
Suppose exam scores are normally distributed with a mean (μ) of 70 and a standard deviation (σ) of 8. We seek the score (X-value) that separates the top 10% (0.10) from the rest.

Since we are looking for the top 10%, the cumulative area to the left of this cut-off score must be 1 - 0.10 = 0.90.

We must include the non-standard parameters (μ = 70, σ = 8) in the function call:

invNorm(.90, 70, 8)

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The calculator returns the raw score directly. The answer is **80.25**. This score represents the minimum threshold required to be in the top decile.

Example 5: Calculating Cut-Off Scores for the Bottom Percentage

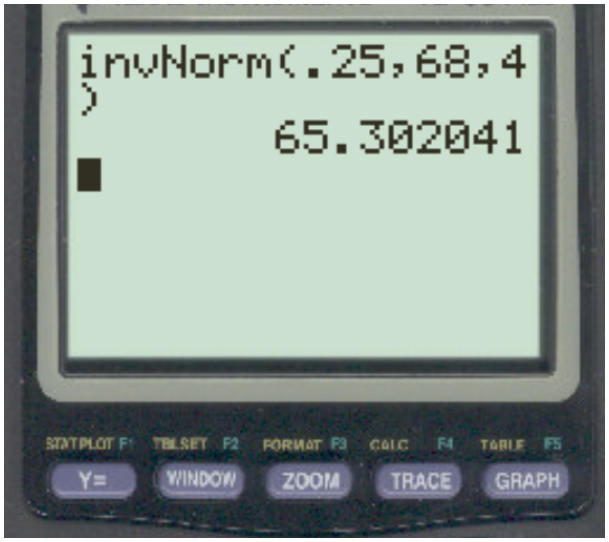
Consider a scenario where male heights in a city are normally distributed with a mean (μ) of 68 inches and a standard deviation (σ) of 4 inches. We aim to find the height that separates the bottom 25% from the rest.

Because we are interested in the bottom 25% (0.25), and **invNorm()** calculates area to the left, we can input this probability directly.

We include the non-standard parameters (μ = 68, σ = 4) in the function call:

invNorm(.25, 68, 4)

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This calculation determines the height X such that 25% of males are shorter than X.

The answer is **65.3** inches.

Advanced Considerations and Summary

When using the **invNorm()** function, especially in advanced statistical work, it is crucial to confirm the distribution type and ensure precise parameter inputs. Newer TI-84 models (such as the TI-84 Plus CE) may include a "Tail" argument (Left, Center, or Right) that simplifies calculations by removing the need to manually determine the cumulative area (1 - α) for right-tailed tests. However, if your calculator lacks this feature, strictly adhere to the rule that **invNorm()** always calculates based on the area to the **left**.

Always confirm whether the problem requires a **Z-critical value** (standard normal distribution: μ=0, σ=1) or a **raw X-value** (using specific population mean and standard deviation). Mistaking one for the other is a common source of error in statistical computations. The correct use of **invNorm()** provides an efficient pathway for defining critical boundaries and translating probabilistic results back into meaningful data units.

The versatility of the **invNorm()** function makes it indispensable for statistical inference, serving as the primary tool for:

Defining rejection regions for hypothesis tests.
Establishing boundaries for confidence intervals.
Translating percentile ranks back into original data units (X-values).

By mastering the syntax and the crucial distinction between cumulative probability and the

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significance level, you can execute complex statistical problems rapidly and accurately on your TI-84 graphing calculator.

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