

How to Use the TINV Function in SAS (With Examples)

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The TINV function in SAS is a fundamental statistical tool designed to return the inverse of the Student's t-distribution based on a specified probability and the associated degrees of freedom (df). This function is indispensable for various advanced statistical computations, particularly in areas like confidence interval estimation and rigorous hypothesis testing. Understanding its proper syntax is key to leveraging its power in data analysis, allowing researchers to accurately determine critical values. Examples of how to use the TINV function in SAS are detailed in the subsequent sections.

Understanding the TINV Function Syntax

The **TINV** function in SAS provides a direct method for calculating critical values derived from the t distribution. This critical value is essential for defining rejection regions in statistical tests, which is a necessary step in hypothesis evaluation.

The function employs the following, concise syntax structure:

TINV(p, df)

Where the arguments represent:

p: Represents the cumulative probability or the area under the density curve to the left of the critical value. In many statistical applications, this is calculated as 1 minus the chosen significance level (alpha, α), depending on the type of test being conducted.

df: Represents the degrees of freedom (df) for the test, typically calculated as $n - 1$ or a similar formula based on the sample size and the specific statistical test utilized.

The following practical examples demonstrate how to utilize the **TINV** function across the three primary types of hypothesis testing scenarios: the left-tailed test, the right-tailed test, and the two-tailed test, highlighting the critical difference in how the probability argument (p) must be supplied.

Example 1: Calculating the t Critical Value for a Left-Tailed Test

In a left-tailed test, we are only interested in whether the test statistic falls significantly below the null hypothesis mean. We need to determine the critical value that corresponds to the lower tail area, which is equivalent to the significance level (α).

Consider a scenario where we seek the t critical value for a left-tailed test using a standard significance level (α) of 0.05 and degrees of freedom (df) equal to 22 . Since the TINV function calculates the inverse cumulative distribution function based on the probability to the left of the critical point, we directly input the significance level as the

probability (p), as we are looking for the value defining the lower 5% tail.

We utilize the **TINV** function within a SAS data step to perform this crucial calculation:

```
/*create dataset that contains t critical value*/
```

```
data my_data;  
critical_val=tinv(.05, 22);  
put critical_val=;  
run;
```

```
/*view results*/  
proc print data=my_data;
```

Obs	critical_val
1	-1.71714

Based on the output, the t critical value corresponding to a significance level of $\mathbf{0.05}$ and $\mathbf{22}$ degrees of freedom is calculated as **-1.71714**. This negative value serves as the boundary for the rejection region in the lower tail of the distribution.

Therefore, if the calculated test statistic from our sample analysis is less than this value (i.e., falls further into the negative tail), the results are considered statistically significant, leading to the rejection of the null hypothesis in this left-tailed hypothesis testing context.

Example 2: Calculating the t Critical Value for a Right-Tailed Test

When conducting a right-tailed test, the focus is on determining whether the test statistic is significantly greater than the expected value under the null hypothesis. The critical value will define the upper boundary of the acceptance region, marking the point where only 5% of the distribution lies above it.

Using the same parameters--a significance level (α) of $\mathbf{0.05}$ and $\mathbf{22}$ degrees of freedom--we must adjust the probability input for the TINV function. Since TINV calculates the cumulative probability from the left, a right-tailed test with $\alpha = 0.05$ requires us to use $p = 1 - \alpha$, or $\mathbf{0.95}$. This probability represents the entire area covering the left tail and the non-rejection region.

Here is the necessary SAS code implementation for the right-tailed critical value calculation:

```
/*create dataset that contains t critical value*/  
data my_data;  
critical_val=tinv(.95, 22);  
put critical_val=;  
run;  
  
/*view results*/  
proc print data=my_data;
```

Obs	critical_val
1	1.71714

The resulting t critical value for a right-tailed test with $\alpha = 0.05$ and $\mathbf{df} = 22$ is precisely **1.71714**. This value is the positive counterpart to the critical value found in Example 1, reflecting the inherent symmetry of the Student's t-distribution around zero.

Consequently, if the calculated test statistic exceeds this threshold (i.e., is greater than 1.71714), we conclude that the results are statistically significant, providing sufficient evidence to reject the null hypothesis in favor of the alternative hypothesis.

Example 3: Calculating the t Critical Values for a Two-Tailed Test

A two-tailed test is employed when we want to detect if the sample mean is significantly different from the null hypothesis mean in either the positive or negative direction. This type of hypothesis testing requires two critical values that define two separate rejection regions--one in the lower tail and one in the upper tail.

If we maintain a total significance level (α) of $\mathbf{0.05}$ and $\mathbf{22}$ degrees of freedom, this α must be split equally between the two tails. This means the probability assigned to the lower tail (which the TINV function uses to find the negative critical value) is $\mathbf{0.05 / 2 = 0.025}$.

To find the critical values, we call the **TINV** function using the halved probability value. Due to the distribution's symmetry, using 0.025 will return the negative critical value, and its positive counterpart is automatically known:

```
/*create dataset that contains t critical value*/  
data my_data;
```

```
critical_val=tinv(.05/2, 22);  
put critical_val=;  
run;
```

```
/*view results*/  
proc print data=my_data;
```

Obs	critical_val
1	-2.07387

As is characteristic of a two-tailed test, there are two symmetric critical values defining the rejection boundaries. Based on the calculation using $p=0.025$, the t critical values are **-2.07387** and **2.07387**.

For statistical significance to be achieved, the calculated test statistic must fall into one of the rejection regions--either less than $\mathbf{-2.0739}$ or greater than $\mathbf{2.0739}$. Any test statistic falling between these two values lies within the acceptance region, meaning there is insufficient evidence to reject the null hypothesis at the 0.05 significance level.

Conclusion and Related SAS Resources

The [TINV function](#) is a powerful yet straightforward tool in SAS for determining the inverse cumulative probability of the t-distribution. Mastering its application--specifically how to handle the probability input (p) based on whether the test is left-tailed, right-tailed, or two-tailed--is essential for accurate statistical reporting and robust [confidence interval estimation](#).

By consistently applying the correct probability argument and [degrees of freedom](#), analysts can efficiently derive the critical values necessary to make informed decisions regarding [hypothesis testing](#) in SAS environments.

The following tutorials explain how to perform other common tasks in SAS: