Chapter 13:
Inferential Statistics and Distributions

Getting Started: Mean Height of a Population

Getting Started is a fast-paced introduction. Read the chapter for details.

Suppose you want to estimate the mean height of a population of women given the random sample below. Because heights among a biological population tend to be normally distributed, a *t* distribution confidence interval can be used when estimating the mean. The 10 height values below are the first 10 of 90 values, randomly generated from a normally distributed population with an assumed mean of 165.1 centimeters and a standard deviation of 6.35 centimeters (**randNorm(165.1,6.35,90)** with a seed of 789).

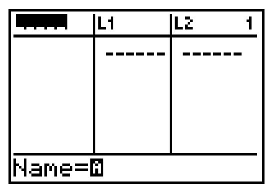
Height (in centimeters) of Each of 10 Women

169.43   168.33   159.55   169.97   159.79   181.42   171.17   162.04   167.15   159.53

1. Press [STAT] [ENTER] to display the stat list editor.

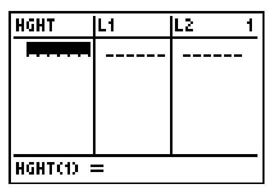
   Press [▲] to move the cursor onto **L1**, and then press [2nd] [INS] to insert a new list. The **Name=** prompt is displayed on the bottom line. The **A** cursor indicates that alpha-lock is on. The existing list name columns shift to the right.

   Note: Your stat editor may not look like the one pictured here, depending on the lists you have already stored.



2. Enter **[H] [G] [H] [T]** at the **Name=** prompt, and then press [ENTER] to create the list to store the women's height data.

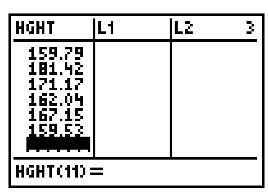
   Press [▼] to move the cursor into the first row of the list. **HGHT(1)=** is displayed on the bottom line. Press [ENTER].



3. Press **169** [.] **43** to enter the first height value. As you enter it, it is displayed on the bottom line.

   Press [ENTER]. The value is displayed in the first row, and the rectangular cursor moves to the next row.

   Enter the other nine height values the same way.



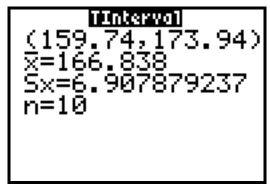
4. Press [STAT] [◄] to display the **STAT TESTS** menu, and then press [▼] until **8:TInterval** is highlighted.

5. Press [ENTER] to select **8:TInterval**. The inferential stat editor for **TInterval** is displayed. If **Data** is not selected for **Inpt:**, press [◄] [ENTER] to select **Data**.

   Press [▼] [2nd] [LIST] and press [▼] until **HGHT** is highlighted and then press [ENTER].

   Press [▼] [▼] [.] **99** to enter a 99 percent confidence level at the **C-Level:** prompt.

6. Press [▼] to move the cursor onto **Calculate**, and then press [ENTER]. The confidence interval is calculated, and the **TInterval** results are displayed on the home screen.



Interpreting the results

The first line, (**159.74,173.94**), shows that the 99 percent confidence interval for the population mean is between about 159.74 centimeters and 173.94 centimeters. This is about a 14.2 centimeters spread.

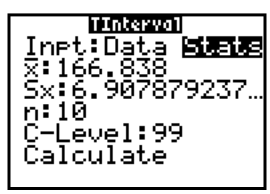
The .99 confidence level indicates that in a very large number of samples, we expect 99 percent of the intervals calculated to contain the population mean. The actual mean of the population sampled is 165.1 centimeters, which is in the calculated interval.

The second line gives the mean height of the sample $\bar{x}$ used to compute this interval. The third line gives the sample standard deviation **Sx**. The bottom line gives the sample size **n**.

To obtain a more precise bound on the population mean μ of women's heights, increase the sample size to 90. Use a sample mean $\bar{x}$ of 163.8 and sample standard deviation **Sx** of 7.1 calculated from the larger random sample. This time, use the **Stats** (summary statistics) input option.

1. Press [STAT] [◄] **8** to display the inferential stat editor for **TInterval**.

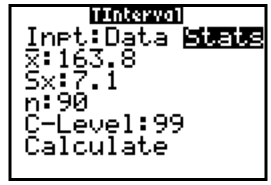
   Press [►] [ENTER] to select **Inpt:Stats**. The editor changes so that you can enter summary statistics as input.



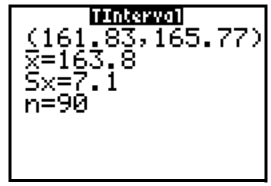
2. Press [▼] **163** [.] **8** [ENTER] to store 163.8 to x̄.

   Press **7** [.] **1** [ENTER] to store 7.1 to **Sx**.

   Press **90** [ENTER] to store 90 to **n**.



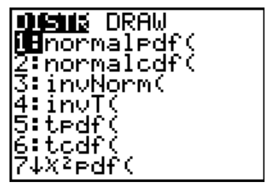
3. Press [▼] to move the cursor onto **Calculate**, and then press [ENTER] to calculate the new 99 percent confidence interval. The results are displayed on the home screen.



If the height distribution among a population of women is normally distributed with a mean μ of 165.1 centimeters and a standard deviation σ of 6.35 centimeters, what height is exceeded by only 5 percent of the women (the 95th percentile)?

4. Press [CLEAR] to clear the home screen.

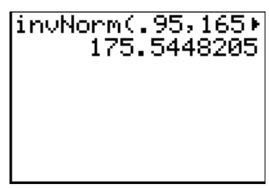
   Press [2nd] [DISTR] to display the **DISTR** (distributions) menu.



5. Press **3** to open the **invNorm(** wizard. Enter the information as follows:

   Press [.] **95** [▼] **165** [.] **1** [▼] **6** [.] **35** [▼] (95 is the area, 165.1 is μ, and 6.35 is σ).

6. Press [ENTER] to paste the function and [ENTER] again to calculate the result.

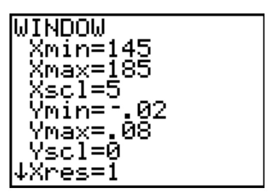


The result is displayed on the home screen; it shows that five percent of the women are taller than 175.5 centimeters.

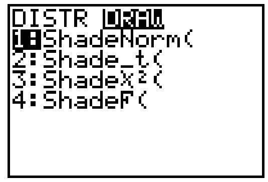
Now graph and shade the top 5 percent of the population.

7. Press [WINDOW] and set the window variables to these values.

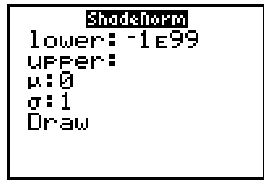
   Xmin=145 **Ymin=⁻.02** **Xres=1**
   Xmax=185 **Ymax=.08**
   Xscl=5 **Yscl=0**



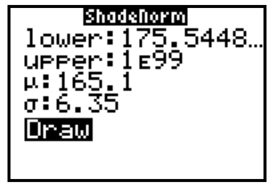
8. Press [2nd] [DISTR] [▸] to display the **DISTR DRAW** menu.



9. Press [ENTER] to open a wizard for the input of the **ShadeNorm(** parameters.

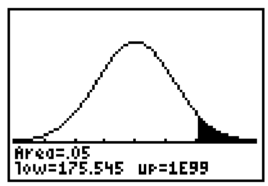


10. Enter **175** [.] **5448205** for the lower bound and press [▾]. Enter **1** [2nd] [EE] **99** for the upper bound and press [▾]. Enter the mean μ of **165** [.] **1** for the normal curve and press [▾]. Enter a standard deviation σ of **6** [.] **35**.



11. Press [▾] to select **Draw** and then press [ENTER] to plot and shade the normal curve.

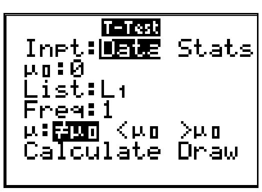
    Area is the area above the 95th percentile. **low** is the lower bound. **up** is the upper bound.



Inferential Stat Editors

Displaying the Inferential Stat Editors

When you select a hypothesis test or confidence interval instruction from the home screen, the appropriate inferential statistics editor is displayed. The editors vary according to each test or interval's input requirements. Below is the inferential stat editor for **T-Test**.



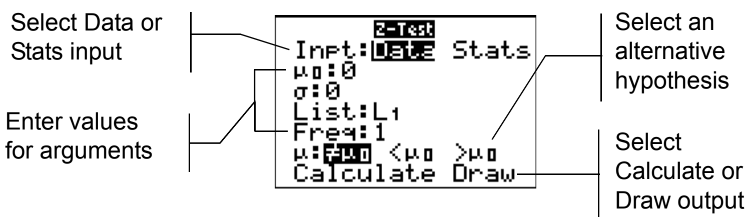
Note: When you select the **ANOVA(** instruction, it is pasted to the home screen. **ANOVA(** does not have an editor screen.

Using an Inferential Stat Editor

To use an inferential stat editor, follow these steps.

1. Select a hypothesis test or confidence interval from the **STAT TESTS** menu. The appropriate editor is displayed.
2. Select **Data** or **Stats** input, if the selection is available. The appropriate editor is displayed.
3. Enter real numbers, list names, or expressions for each argument in the editor.
4. Select the alternative hypothesis (≠ , **<**, or **>**) against which to test, if the selection is available.
5. Select **No** or **Yes** for the **Pooled** option, if the selection is available.
6. Select **Calculate** or **Draw** (when **Draw** is available) to execute the instruction.
   - When you select **Calculate**, the results are displayed on the home screen.
   - When you select **Draw**, the results are displayed in a graph.

This chapter describes the selections in the above steps for each hypothesis test and confidence interval instruction.



Selecting Data or Stats

Most inferential stat editors prompt you to select one of two types of input. (**1-PropZInt** and **2-PropZTest**, **1-PropZInt** and **2-PropZInt**, χ^2**-Test**, χ^2**GOF-Test**, **LinRegTInt**, and **LinRegTTest** do not.)

- Select **Data** to enter the data lists as input.
- Select **Stats** to enter summary statistics, such as $\bar{x}$, **Sx**, and **n**, as input.

To select **Data** or **Stats**, move the cursor to either **Data** or **Stats**, and then press [ENTER].

Entering the Values for Arguments

Inferential stat editors require a value for every argument. If you do not know what a particular argument symbol represents, see the Inferential Statistics Input Descriptions tables.

When you enter values in any inferential stat editor, the TI-84 Plus stores them in memory so that you can run many tests or intervals without having to reenter every value.

Selecting an Alternative Hypothesis (≠ < >)

Most of the inferential stat editors for the hypothesis tests prompt you to select one of three alternative hypotheses.

- The first is a ≠ alternative hypothesis, such as $\mu \neq \mu 0$ for the **Z-Test**.
- The second is a **<** alternative hypothesis, such as $\mu 1 < \mu 2$ for the **2-SampTTest**.

- The third is a **>** alternative hypothesis, such as p1>p2 for the **2-PropZTest**.

To select an alternative hypothesis, move the cursor to the appropriate alternative, and then press [ENTER].

Selecting the Pooled Option

Pooled (**2-SampTTest** and **2-SampTInt** only) specifies whether the variances are to be pooled for the calculation.

- Select **No** if you do not want the variances pooled. Population variances can be unequal.
- Select **Yes** if you want the variances pooled. Population variances are assumed to be equal.

To select the **Pooled** option, move the cursor to **Yes**, and then press [ENTER].

Selecting Calculate or Draw for a Hypothesis Test

After you have entered all arguments in an inferential stat editor for a hypothesis test, you must select whether you want to see the calculated results on the home screen (**Calculate**) or on the graph screen (**Draw**).

- **Calculate** calculates the test results and displays the outputs on the home screen.
- **Draw** draws a graph of the test results and displays the test statistic and p-value with the graph. The window variables are adjusted automatically to fit the graph.

To select **Calculate** or **Draw**, move the cursor to either **Calculate** or **Draw**, and then press [ENTER]. The instruction is immediately executed.

Selecting Calculate for a Confidence Interval

After you have entered all arguments in an inferential stat editor for a confidence interval, select **Calculate** to display the results. The **Draw** option is not available.

When you press [ENTER], **Calculate** calculates the confidence interval results and displays the outputs on the home screen.

Bypassing the Inferential Stat Editors

To paste a hypothesis test or confidence interval instruction to the home screen without displaying the corresponding inferential stat editor, select the instruction you want from the **CATALOG** menu. Appendix A describes the input syntax for each hypothesis test and confidence interval instruction.

```
2-SampZTest(
```

Note: You can paste a hypothesis test or confidence interval instruction to a command line in a program. From within the program editor, select the instruction from either the **CATALOG** (Chapter 15) or the **STAT TESTS** menu.

STAT TESTS Menu

STAT TESTS Menu

To display the **STAT TESTS** menu, press STAT ◄. When you select an inferential statistics instruction, the appropriate inferential stat editor is displayed.

Most **STAT TESTS** instructions store some output variables to memory. For a list of these variables, see the Test and Interval Output Variables table.

EDIT CALC TESTS	
1: Z-Test...	Test for 1 μ, known σ
2: T-Test...	Test for 1 μ, unknown σ
3: 2-SampZTest...	Test comparing 2 μ's, known σ's
4: 2-SampTTest...	Test comparing 2 μ's, unknown σ's
5: 1-PropZTest...	Test for 1 proportion
6: 2-PropZTest...	Test comparing 2 proportions
7: ZInterval...	Confidence interval for 1 μ, known σ
8: TInterval...	Confidence interval for 1 μ, unknown σ
9: 2-SampZInt...	Confidence interval for difference of 2 μ's, known σ's
0: 2-SampTInt...	Confidence interval for difference of 2 μ's, unknown σ's
A: 1-PropZInt...	Confidence interval for 1 proportion
B: 2-PropZInt...	Confidence interval for difference of 2 proportions
C: χ^2-Test...	Chi-square test for 2-way tables
D: χ^2-GOF Test...	Chi-square Goodness of Fit test
E: 2-SampFTest...	Test comparing 2 σ's
F: LinRegTTest...	*t* test for regression slope and ρ
G: LinRegTInt...	Confidence interval for linear regression slope coefficient b
H: ANOVA(	One-way analysis of variance

Note: When a new test or interval is computed, all previous output variables are invalidated.

Inferential Stat Editors for the STAT TESTS Instructions

In this chapter, the description of each **STAT TESTS** instruction shows the unique inferential stat editor for that instruction with example arguments.

- Descriptions of instructions that offer the **Data/Stats** input choice show both types of input screens.

- Descriptions of instructions that do not offer the **Data/Stats** input choice show only one input screen.

The description then shows the unique output screen for that instruction with the example results.

- Descriptions of instructions that offer the **Calculate/Draw** output choice show both types of screens: calculated and graphic results.
- Descriptions of instructions that offer only the **Calculate** output choice show the calculated results on the home screen.

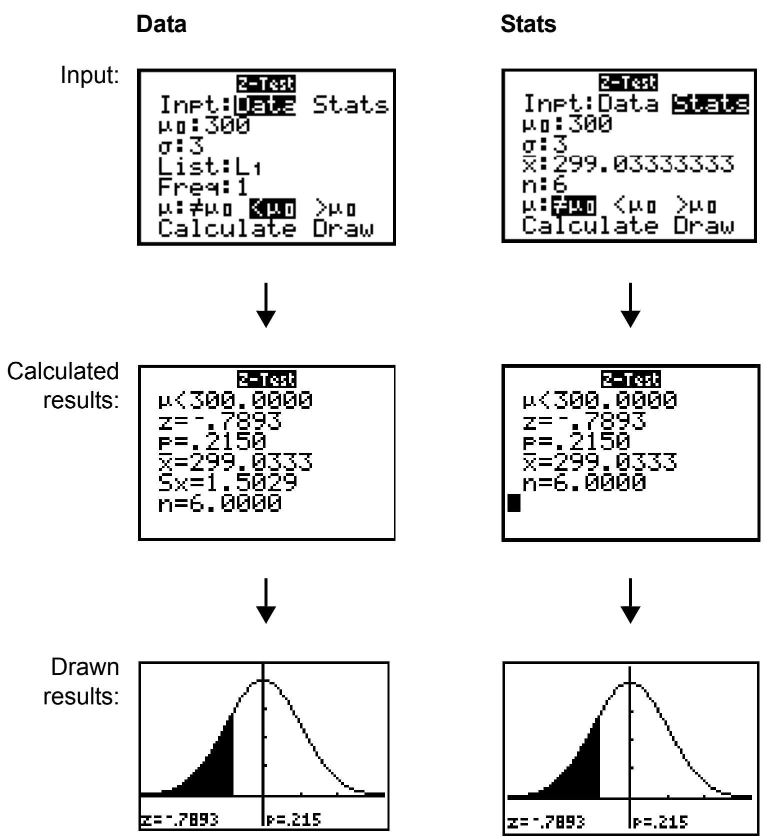
Z-Test

Z-Test (one-sample z test; item **1**) performs a hypothesis test for a single unknown population mean μ when the population standard deviation σ is known. It tests the null hypothesis H_0: $\mu=\mu_0$ against one of the alternatives below.

- H_a: $\mu\neq\mu_0$ (μ:$\neq\mu$**0**)
- H_a: $\mu<\mu_0$ (μ:**<**μ**0**)
- H_a: $\mu>\mu_0$ (μ:**>**μ**0**)

In the example:

L1={299.4, 297.7, 301, 298.9, 300.2, 297}



Note: All **STAT TESTS** examples assume a fixed-decimal mode setting of 4 (Chapter 1). If you set the decimal mode to **Float** or a different fixed-decimal setting, your output may differ from the output in the examples.

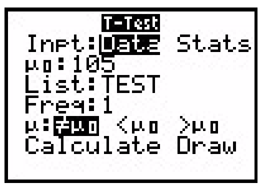
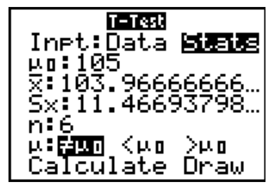
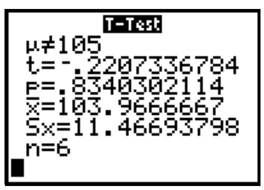
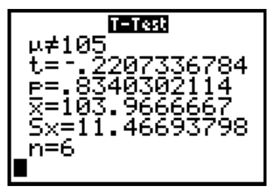
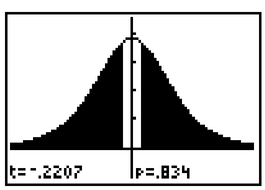
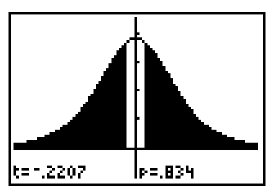
T-Test

T-Test (one-sample *t* test; item **2**) performs a hypothesis test for a single unknown population mean μ when the population standard deviation σ is unknown. It tests the null hypothesis H_0: $\mu=\mu_0$ against one of the alternatives below.

- H_a: $\mu\neq\mu_0$ (μ:≠μ**0**)
- H_a: $\mu<\mu_0$ (μ:**<**μ**0**)
- H_a: $\mu>\mu_0$ (μ:**>**μ**0**)

In the example:

TEST={91.9, 97.8, 111.4, 122.3, 105.4, 95}

	Data	**Stats**
Input:		
Calculated results:		
Drawn results:		

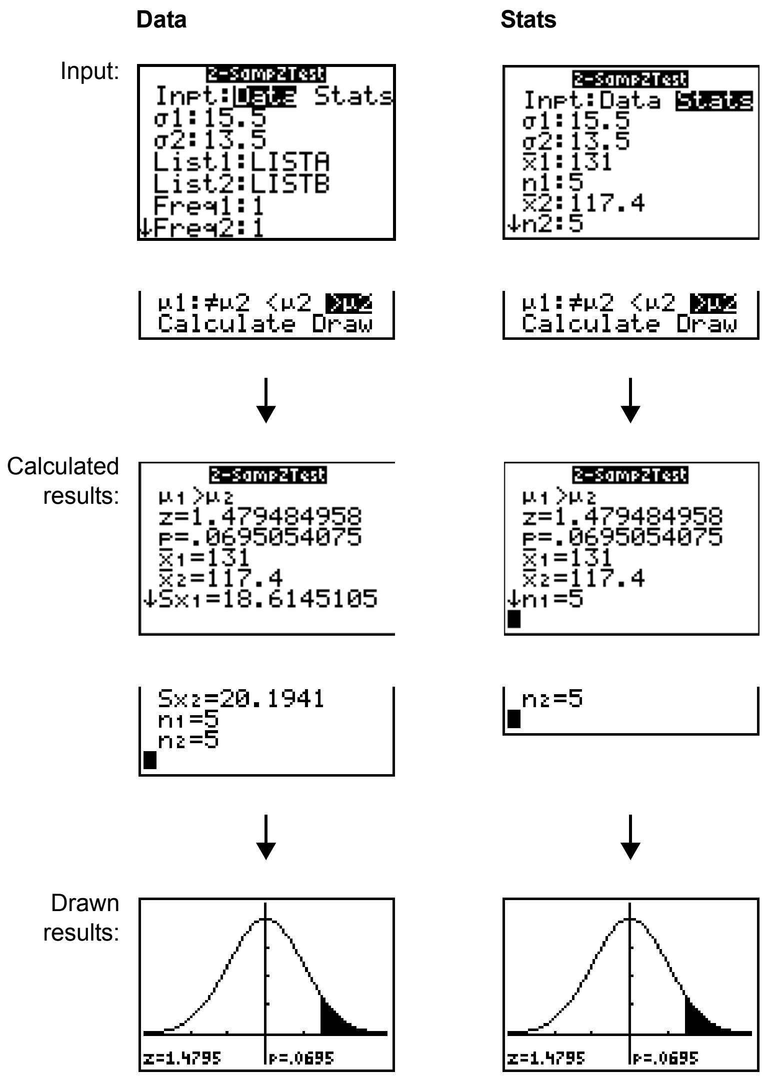
2-SampZTest

2-SampZTest (two-sample z test; item **3)** tests the equality of the means of two populations (μ_1 and μ_2) based on independent samples when both population standard deviations (σ_1 and σ_2) are known. The null hypothesis H_0: $\mu_1=\mu_2$ is tested against one of the alternatives below.

- H_a: $\mu_1\neq\mu_2$ (μ**1:**$\neq\mu$**2**)
- H_a: $\mu_1<\mu_2$ (μ**1:**<μ**2**)
- H_a: $\mu_1>\mu_2$ (μ**1:**>μ**2**)

In the example:

LISTA={154, 109, 137, 115, 140}
LISTB={108, 115, 126, 92, 146}



2-SampTTest

2-SampTTest (two-sample *t* test; item **4**) tests the equality of the means of two populations (μ_1 and μ_2) based on independent samples when neither population standard deviation (σ_1 or σ_2) is known. The null hypothesis H_0: $\mu_1=\mu_2$ is tested against one of the alternatives below.

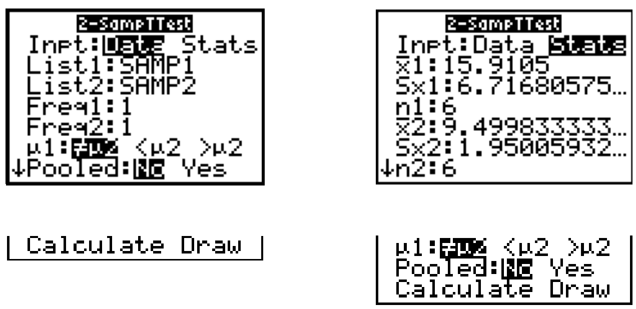
- H_a: $\mu_1 \neq \mu_2$ (μ**1:**$\neq\mu$**2**)
- H_a: $\mu_1 < \mu_2$ (μ**1:<**μ**2**)
- H_a: $\mu_1 > \mu_2$ (μ**1:>**μ**2**)

In the example:

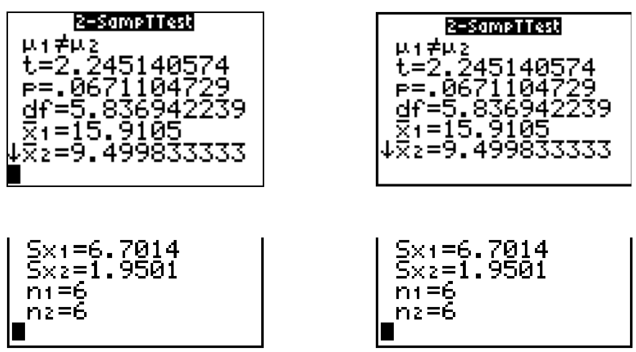
SAMP1={12.207, 16.869, 25.05, 22.429, 8.456, 10.589}
SAMP2={11.074, 9.686, 12.064, 9.351, 8.182, 6.642}

Data **Stats**

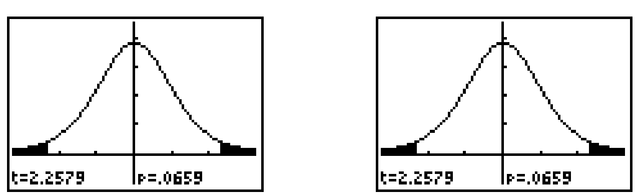
Input:



Calculated results:



Drawn results:

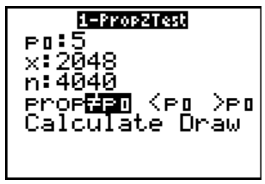


1-PropZTest

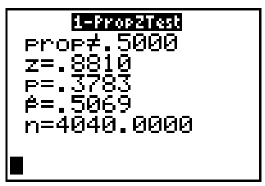
1-PropZTest (one-proportion z test; item **5**) computes a test for an unknown proportion of successes (prop). It takes as input the count of successes in the sample x and the count of observations in the sample n. **1-PropZTest** tests the null hypothesis H_0: prop=p_0 against one of the alternatives below.

- H_a: prop$\neq p_0$ (**prop:≠p0**)
- H_a: prop$<p_0$ (**prop:<p0**)
- H_a: prop$>p_0$ (**prop:>p0**)

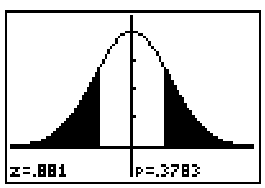
Input:



Calculated results:



Drawn results:

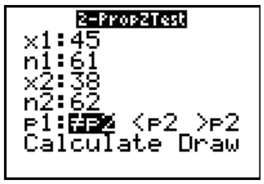


2-PropZTest

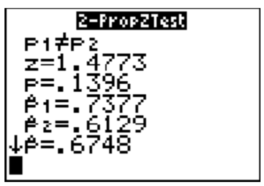
2-PropZTest (two-proportion z test; item **6**) computes a test to compare the proportion of successes (p_1 and p_2) from two populations. It takes as input the count of successes in each sample (x_1 and x_2) and the count of observations in each sample (n_1 and n_2). **2-PropZTest** tests the null hypothesis H_0: $p_1=p_2$ (using the pooled sample proportion $\hat{p}$) against one of the alternatives below.

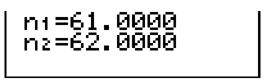
- H_a: $p_1 \neq p_2$ (**p1:≠p2**)
- H_a: $p_1 < p_2$ (**p1:<p2**)
- H_a: $p_1 > p_2$ (**p1:>p2**)

Input:

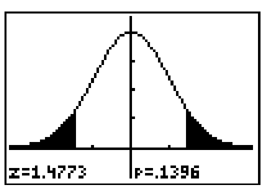


Calculated results:





Drawn results:



ZInterval

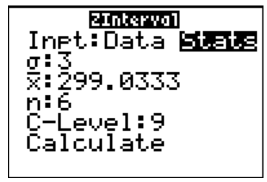
ZInterval (one-sample *z* confidence interval; item **7**) computes a confidence interval for an unknown population mean μ when the population standard deviation σ is known. The computed confidence interval depends on the user-specified confidence level.

In the example:

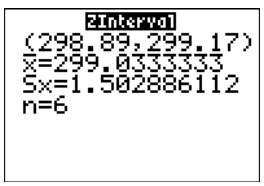
L1={299.4, 297.7, 301, 298.9, 300.2, 297}

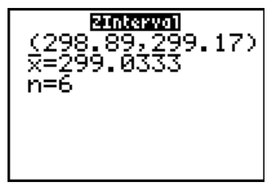
Data **Stats**

Input:



Calculated results:





TInterval

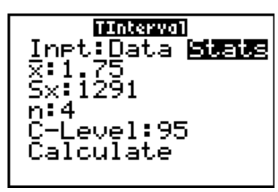
TInterval (one-sample *t* confidence interval; item **8**) computes a confidence interval for an unknown population mean μ when the population standard deviation σ is unknown. The computed confidence interval depends on the user-specified confidence level.

In the example:

L6={1.6, 1.7, 1.8, 1.9}

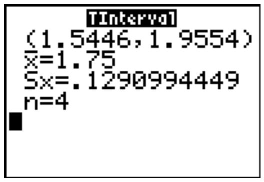
Data **Stats**

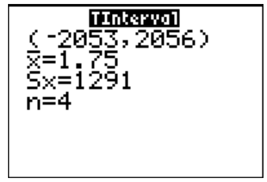
Input:



Data **Stats**

Calculated results:





2-SampZInt

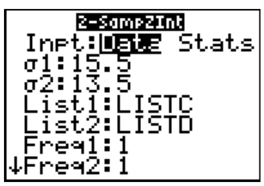
2-SampZInt (two-sample *z* confidence interval; item **9**) computes a confidence interval for the difference between two population means ($\mu_1-\mu_2$) when both population standard deviations (σ_1 and σ_2) are known. The computed confidence interval depends on the user-specified confidence level.

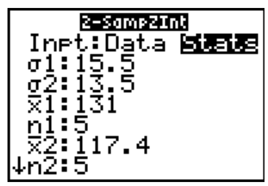
In the example:

LISTC={154, 109, 137, 115, 140}
LISTD={108, 115, 126, 92, 146}

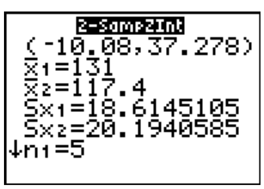
Data **Stats**

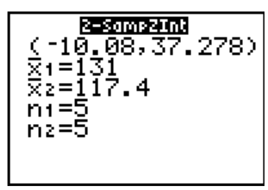
Input:

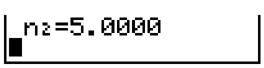




Calculated results:







2-SampTInt

2-SampTInt (two-sample *t* confidence interval; item **0**) computes a confidence interval for the difference between two population means ($\mu_1 - \mu_2$) when both population standard deviations (σ_1 and σ_2) are unknown. The computed confidence interval depends on the user-specified confidence level.

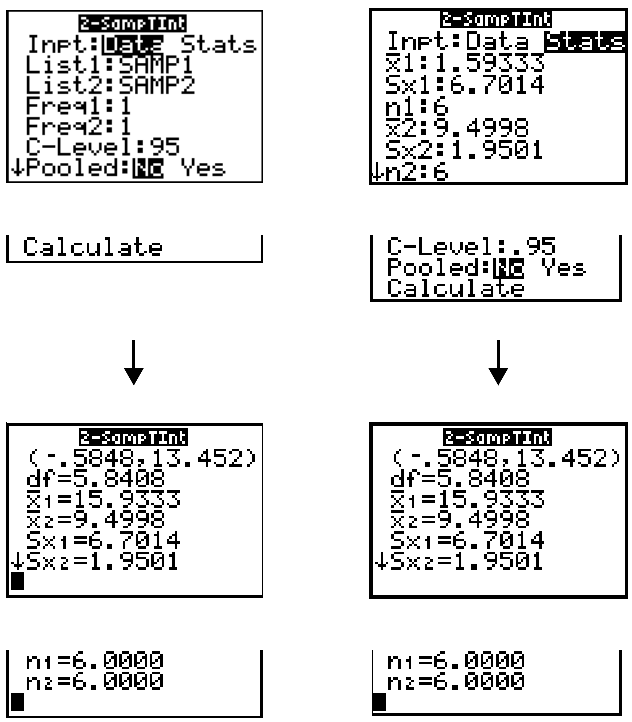
In the example:

SAMP1={12.207, 16.869, 25.05, 22.429, 8.456, 10.589}
SAMP2={11.074, 9.686, 12.064, 9.351, 8.182, 6.642}

Data **Stats**

Input:

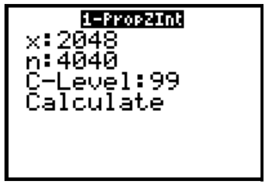
Calculated results:



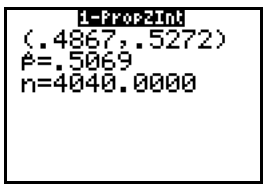
1-PropZInt

1-PropZInt (one-proportion *z* confidence interval; item **A**) computes a confidence interval for an unknown proportion of successes. It takes as input the count of successes in the sample *x* and the count of observations in the sample *n*. The computed confidence interval depends on the user-specified confidence level.

Input:



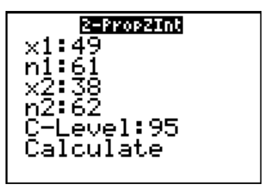
Calculated results:



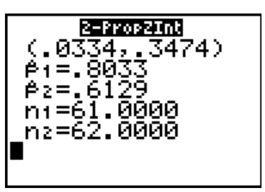
2-PropZInt

2-PropZInt (two-proportion *z* confidence interval; item **B**) computes a confidence interval for the difference between the proportion of successes in two populations (p_1-p_2). It takes as input the count of successes in each sample (x_1 and x_2) and the count of observations in each sample (n_1 and n_2). The computed confidence interval depends on the user-specified confidence level.

Input:



Calculated results:



χ^2-Test

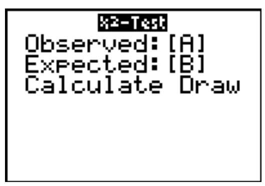
χ^2**-Test** (chi-square test; item **C**) computes a chi-square test for association on the two-way table of counts in the specified *Observed* matrix. The null hypothesis H_0 for a two-way table is: no association exists between row variables and column variables. The alternative hypothesis is: the variables are related.

Before computing a χ^2-Test, enter the observed counts in a matrix. Enter that matrix variable name at the **Observed:** prompt in the χ^2-Test editor; default=**[A]**. At the **Expected:** prompt, enter the matrix variable name to which you want the computed expected counts to be stored; default=**[B]**.

Matrix editor:

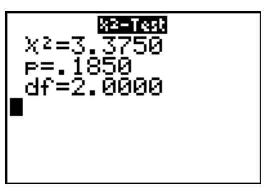
Note: Press [2nd] [MATRX] [▶] [▶] **1** to select **1:[A]** from the **MATRX EDIT** menu.

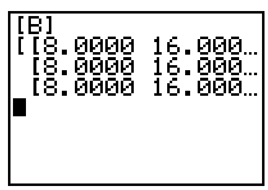
Input:



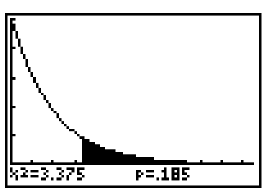
Note: Press [2nd] [MATRX] [▼] [ENTER] to display matrix **[B]**.

Calculated results:





Drawn results:

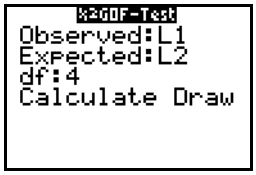


χ^2GOF-Test

χ^2GOF-**Test** (Chi Square Goodness of Fit; item D) performs a test to confirm that sample data is from a population that conforms to a specified distribution. For example, χ^2 GOF can confirm that the sample data came from a normal distribution.

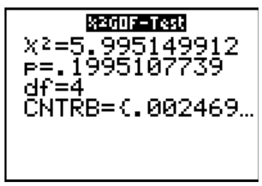
In the example:
list 1={16, 25, 22, 8, 10}
list 2={16.2, 21.6, 16.2, 14.4, 12.6}

The Chi-square Goodness of Fit input screen:

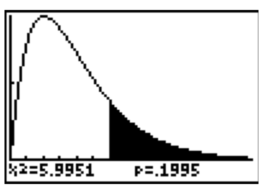


Note: Press STAT ► ► to select **TESTS**. Press ▼ several times to select **D:X^{2}GOF-Test...** Press ENTER. To enter data for df (degree of freedom), press ▼ ▼ ▼. Type 4.

Calculated results:



Drawn results:



2-SampFTest

2-SampFTest (two-sample F-test; item **E**) computes an F-test to compare two normal population standard deviations (σ_1 and σ_2). The population means and standard deviations are all unknown.

2-SampFTest, which uses the ratio of sample variances $Sx1^2/Sx2^2$, tests the null hypothesis H_0: $\sigma_1=\sigma_2$ against one of the alternatives below.

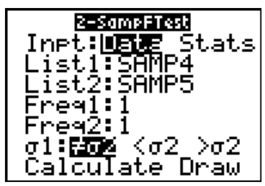
- H_a: $\sigma_1\neq\sigma_2$ (σ**1:≠**σ**2**)
- H_a: $\sigma_1<\sigma_2$ (σ**1:<**σ**2**)
- H_a: $\sigma_1>\sigma_2$ (σ**1:>**σ**2**)

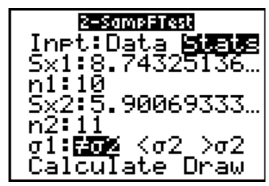
In the example:

SAMP4={7,⁻4, 18, 17, ⁻3, ⁻5, 1, 10, 11, ⁻2}
SAMP5={⁻1, 12, ⁻1, ⁻3, 3, ⁻5, 5, 2, ⁻11, ⁻1, ⁻3}

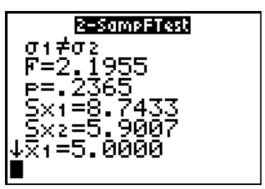
Data | **Stats**

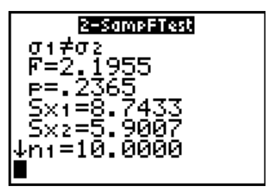
Input:

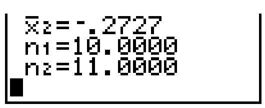




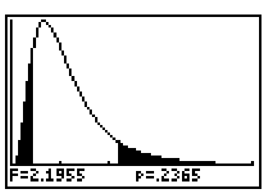
Calculated results:

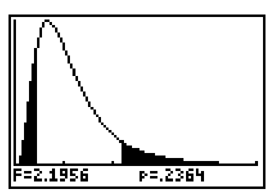






Drawn results:





LinRegTTest

LinRegTTest (linear regression *t* test; item **F)** computes a linear regression on the given data and a *t* test on the value of slope β and the correlation coefficient ρ for the equation $y=\alpha+\beta x$. It tests the null hypothesis H_0: β=0 (equivalently, ρ=0) against one of the alternatives below.

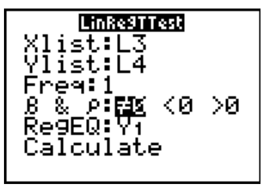
- H_a: β≠0 and ρ≠0 (β **&** ρ**: ≠0**)
- H_a: β<0 and ρ<0 (β **&** ρ**:<0**)
- H_a: β>0 and ρ>0 (β **&** ρ**:>0**)

The regression equation is automatically stored to **RegEQ** (**VARS Statistics EQ** secondary menu). If you enter a Y= variable name at the **RegEQ:** prompt, the calculated regression equation is automatically stored to the specified Y= equation. In the example below, the regression equation is stored to **Y1**, which is then selected (turned on).

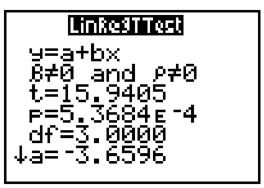
In the example:

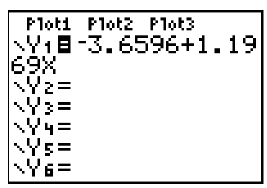
L3={38, 56, 59, 64, 74}
L4={41, 63, 70, 72, 84}

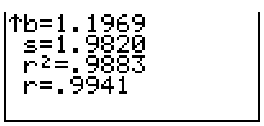
Input:



Calculated results:







When **LinRegTTest** is executed, the list of residuals is created and stored to the list name **RESID** automatically. **RESID** is placed on the **LIST NAMES** menu.

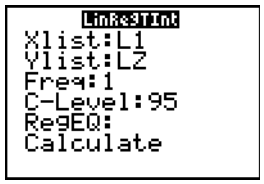
Note: For the regression equation, you can use the fix-decimal mode setting to control the number of digits stored after the decimal point (Chapter 1). However, limiting the number of digits to a small number could affect the accuracy of the fit.

LinRegTInt

LinRegTInt computes a linear regression T confidence interval for the slope coefficient b. If the confidence interval contains 0, this is insufficient evidence to indicate that the data exhibits a linear relationship.

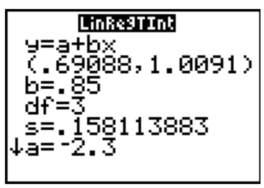
In the example:
list 1={4, 5, 6, 7, 8}
list 2={1, 2, 3, 3.5, 4.5}

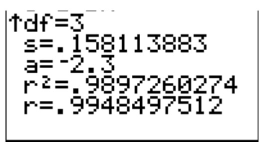
LinRegTInt input screen:



Note: Press [STAT] [▸] [▸] to select **TESTS**. Press [▾] several times to select **G:LinRegTint...** Press [ENTER]. Press [▾] several times to select **Calculate**. Press [ENTER].

Calculated results:





Xlist, Ylist is the list of independent and dependent variables. The list containing the **Freq** (frequency) values for the data is stored in **List**. The default is 1. All elements must be real numbers. Each element in the **Freq** list is the frequency of occurrence for each corresponding data point in the input list specified in the **List** fields. RegEQ (optional) is the designated Yn variable for storing the regression equation. StoreRegEqn (optional) is the designated variable for storing the regression equation. The C level is the Confidence level probability with default = .95.

ANOVA(

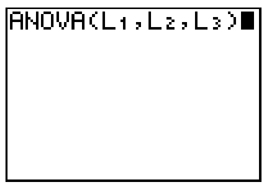
ANOVA((one-way analysis of variance; item **H**) computes a one-way analysis of variance for comparing the means of two to 20 populations. The **ANOVA** procedure for comparing these means involves analysis of the variation in the sample data. The null hypothesis H_0: $\mu_1=\mu_2=...=\mu_k$ is tested against the alternative H_a: not all $\mu_1...\mu_k$ are equal.

ANOVA(*list1*,*list2*[,...,*list20*]**)**

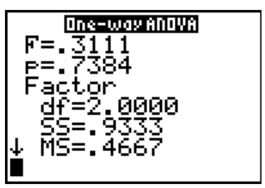
In the example:

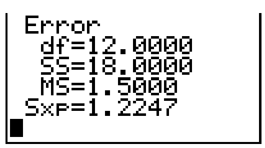
L1={7 4 6 6 5}
L2={6 5 5 8 7}
L3={4 7 6 7 6}

Input:



Calculated results:





Note: SS is sum of squares and **MS** is mean square.

Inferential Statistics Input Descriptions

The tables in this section describe the inferential statistics inputs discussed in this chapter. You enter values for these inputs in the inferential stat editors. The tables present the inputs in the same order that they appear in this chapter.

Input	Description
μ_0	Hypothesized value of the population mean that you are testing.
σ	The known population standard deviation; must be a real number > 0.
List	The name of the list containing the data you are testing.
Freq	The name of the list containing the frequency values for the data in **List**. Default=1. All elements must be integers ≥ 0.
Calculate/**Draw**	Determines the type of output to generate for tests and intervals. **Calculate** displays the output on the home screen. In tests, **Draw** draws a graph of the results.
$\bar{x}$, **Sx**, **n**	Summary statistics (mean, standard deviation, and sample size) for the one-sample tests and intervals.
σ**1**	The known population standard deviation from the first population for the two-sample tests and intervals. Must be a real number > 0.
σ**2**	The known population standard deviation from the second population for the two-sample tests and intervals. Must be a real number > 0.
List1, **List2**	The names of the lists containing the data you are testing for the two-sample tests and intervals. Defaults are **L1** and **L2**, respectively.
Freq1, **Freq2**	The names of the lists containing the frequencies for the data in **List1** and **List2** for the two-sample tests and intervals. Defaults=1. All elements must be integers ≥ 0.
$\bar{x}$**1**, **Sx1**, n**1**, $\bar{x}$**2**, **Sx2**, n**2**	Summary statistics (mean, standard deviation, and sample size) for sample one and sample two in the two-sample tests and intervals.
Pooled	Specifies whether variances are to be pooled for **2-SampTTest** and **2-SampTInt**. **No** instructs the TI-84 Plus not to pool the variances. **Yes** instructs the TI-84 Plus to pool the variances.
$\mathbf{p_0}$	The expected sample proportion for **1-PropZTest**. Must be a real number, such that $0 < p_0 < 1$.
x	The count of successes in the sample for the **1-PropZTest** and **1-PropZInt.** Must be an integer ≥ 0.
n	The count of observations in the sample for the **1-PropZTest** and **1-PropZInt**. Must be an integer > 0.
x1	The count of successes from sample one for the **2-PropZTest** and **2-PropZInt**. Must be an integer ≥ 0.
x2	The count of successes from sample two for the **2-PropZTest** and **2-PropZInt**. Must be an integer ≥ 0.

Input	Description
n1	The count of observations in sample one for the **2-PropZTest** and **2-PropZInt**. Must be an integer > 0.
n2	The count of observations in sample two for the **2-PropZTest** and **2-PropZInt**. Must be an integer > 0.
C-Level	The confidence level for the interval instructions. Must be ≥ 0 and < 100. If it is ≥ 1, it is assumed to be given as a percent and is divided by 100. Default=0.95.
Observed (Matrix)	The matrix name that represents the columns and rows for the observed values of a two-way table of counts for the χ^2**-Test** and χ^2**GOF-Test**. **Observed** must contain all integers ≥ 0. Matrix dimensions must be at least 2×2.
Expected (Matrix)	The matrix name that specifies where the expected values should be stored. **Expected** is created upon successful completion of the χ^2**-Test** and χ^2**GOF-Test**.
df	df (degree of freedom) represents (number of sample categories) - (number of estimated parameters for the selected distribution + 1).
Xlist, **Ylist**	The names of the lists containing the data for **LinRegTTest** and **LinRegTInt**. Defaults are **L1** and **L2**, respectively. The dimensions of **Xlist** and **Ylist** must be the same.
RegEQ	The prompt for the name of the Y= variable where the calculated regression equation is to be stored. If a Y= variable is specified, that equation is automatically selected (turned on). The default is to store the regression equation to the **RegEQ** variable only.

Test and Interval Output Variables

The inferential statistics variables are calculated as indicated below. To access these variables for use in expressions, press VARS **5** (**5:Statistics**), and then select the **VARS** menu listed in the last column below.

Variables	Tests	Intervals	LinRegTTest, ANOVA	VARS Menu
p-value	**p**		**p**	TEST
test statistics	**z, t,** χ^2**, F**		**t, F**	TEST
degrees of freedom	**df**	**df**	**df**	TEST
sample mean of x values for sample 1 and sample 2	$\bar{x}$**1**, $\bar{x}$**2**	$\bar{x}$**1**, $\bar{x}$**2**		TEST
sample standard deviation of x for sample 1 and sample 2	**Sx1, Sx2**	**Sx1, Sx2**		TEST
number of data points for sample 1 and sample 2	**n1, n2**	**n1, n2**		TEST
pooled standard deviation	**SxP**	**SxP**	**SxP**	TEST

Variables	Tests	Intervals	LinRegTTest, ANOVA	VARS Menu
estimated sample proportion	$\hat{p}$	$\hat{p}$		TEST
estimated sample proportion for population 1	$\hat{p}$**1**	$\hat{p}$**1**		TEST
estimated sample proportion for population 2	$\hat{p}$**2**	$\hat{p}$**2**		TEST
confidence interval pair		**lower, upper**		TEST
mean of x values	$\bar{x}$	$\bar{x}$		XY
sample standard deviation of x	**Sx**	**Sx**		XY
number of data points	**n**	**n**		XY
standard error about the line			**s**	TEST
regression/fit coefficients			**a, b**	EQ
correlation coefficient			**r**	EQ
coefficient of determination			**r2**	EQ
regression equation			**RegEQ**	EQ

Note: The variables listed above cannot be archived.

Distribution Functions

DISTR menu

Note: Selection of any of the DISTR functions will take the user to a wizard screen for that function.

To display the DISTR menu, press [2nd] [DISTR].

DISTR DRAW		
1:	normalpdf(	*nn* probability density function
2:	normalcdf(	*nn* cumulative distribution function
3:	invNorm(	Inverse cumulative normal distribution
4:	invT(	Inverse cumulative Student-*t* distribution
5:	tpdf(	Student-*t* probability density
6:	tcdf(	Student-*t* distribution probability
7:	χ^2pdf(	Chi-square probability density
8:	χ^2cdf	Chi-square distribution probability
9:	**F**pdf(	**F** probability density
0:	**F**cdf(	**F** distribution probability

DISTR DRAW	
A: binompdf(	Binomial probability
B: binomcdf(	Binomial cumulative density
C: poissonpdf(	Poisson probability
D: poissoncdf(	Poisson cumulative density
E: geometpdf(	Geometric probability
F: geometcdf(	Geometric cumulative density

Note: ⁻1E99 and 1E99 specify infinity. If you want to view the area left of *upperbound*, for example, specify *lowerbound*= ⁻1E99.

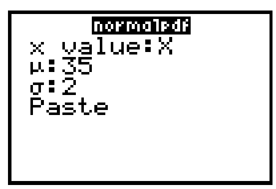
normalpdf(

normalpdf(computes the probability density function (**pdf**) for the normal distribution at a specified *x* value. The defaults are mean μ=0 and standard deviation σ=1. To plot the normal distribution, paste **normalpdf(** to the Y= editor. The probability density function (pdf) is:

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}, \sigma > 0$$

normalpdf(*x*[,μ,σ]**)**

Note: For this example,
Xmin = 28
Xmax = 42
Xscl = 1
Ymin = 0
Ymax = .2
Yscl = .1

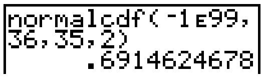


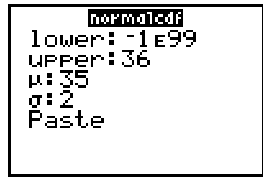
Note: For plotting the normal distribution, you can set window variables **Xmin** and **Xmax** so that the mean μ falls between them, and then select **0:ZoomFit** from the **ZOOM** menu.

normalcdf(

normalcdf(computes the normal distribution probability between *lowerbound* and *upperbound* for the specified mean μ and standard deviation σ. The defaults are μ=0 and σ=1.

normalcdf(_lowerbound_**,**_upperbound_[,μ,σ]**)**

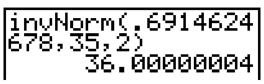




invNorm(

invNorm(computes the inverse cumulative normal distribution function for a given _area_ under the normal distribution curve specified by mean μ and standard deviation σ. It calculates the _x_ value associated with an _area_ to the left of the _x_ value. $0 \le area \le 1$ must be true. The defaults are μ=0 and σ=1.

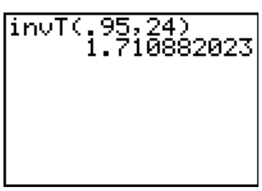
invNorm(_area_[,μ,σ]**)**

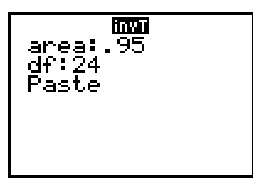


invT(

invT(computes the inverse cumulative Student-t probability function specified by Degree of Freedom, df for a given Area under the curve.

invT(_area,df_**)**



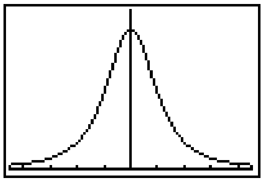


tpdf(

tpdf(computes the probability density function (**pdf**) for the Student-_t_ distribution at a specified _x_ value. _df_ (degrees of freedom) must be > 0. To plot the Student-_t_ distribution, paste **tpdf(** to the Y= editor. The probability density function (**pdf**) is:

$$f(x) = \frac{\Gamma[(df+1)/2]}{\Gamma(df/2)} \quad \frac{(1+x^2/df)^{-(df+1)/2}}{\sqrt{\pi df}}$$

tpdf(*x*,*df***)**

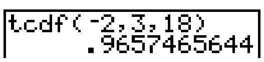


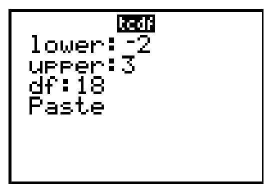
Note: For this example,
Xmin = ⁻4.5
Xmax = 4.5
Ymin = 0
Ymax = .4

tcdf(

tcdf(computes the Student-*t* distribution probability between *lowerbound* and *upperbound* for the specified *df* (degrees of freedom), which must be > 0.

tcdf(*lowerbound*,*upperbound*,*df***)**



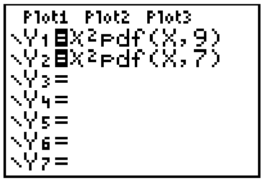


χ^2**pdf(**

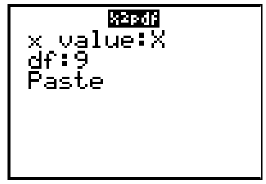
χ^2**pdf(** computes the probability density function (**pdf**) for the χ^2 (chi-square) distribution at a specified *x* value. *df* (degrees of freedom) must be an integer > 0. To plot the χ^2 distribution, paste χ^2**pdf(** to the Y= editor. The probability density function (**pdf**) is:

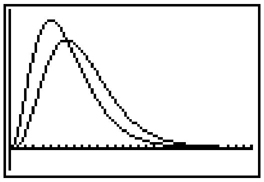
$$f(x) = \frac{1}{\Gamma(df/2)}(1/2)^{df/2}x^{df/2-1}e^{-x/2}, x \ge 0$$

χ^2pdf(x,df)



Note: For this example,
Xmin = 0
Xmax = 30
Ymin = ⁻.02
Ymax = .132

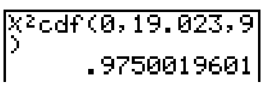


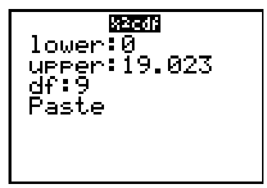


χ^2cdf(

χ^2cdf(computes the χ^2 (chi-square) distribution probability between *lowerbound* and *upperbound* for the specified *df* (degrees of freedom), which must be an integer > 0.

χ^2cdf(*lowerbound*,*upperbound*,*df***)**





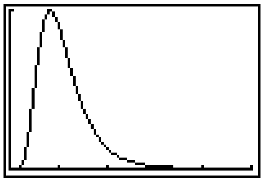
Fpdf(

Fpdf(computes the probability density function (**pdf**) for the **F** distribution at a specified *x* value. *numerator df* (degrees of freedom) and *denominator df* must be integers > 0. To plot the **F** distribution, paste **Fpdf(** to the Y= editor. The probability density function (**pdf**) is:

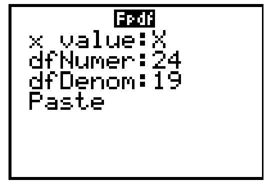
$$f(x) = \frac{\Gamma[(n+d)/2]}{\Gamma(n/2)\Gamma(d/2)}\left(\frac{n}{d}\right)^{n/2} x^{n/2-1}(1+nx/d)^{-(n+d)/2}, x \geq 0$$

where n = numerator degrees of freedom
d = denominator degrees of freedom

Fpdf(*x*,*numerator df*,*denominator df***)**



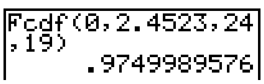
Note: For this example,
Xmin = 0
Xmax = 5
Ymin = 0
Ymax = 1

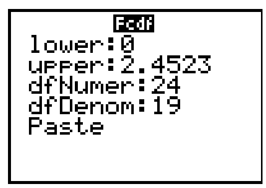


Fcdf(

Fcdf(computes the **F** distribution probability between *lowerbound* and *upperbound* for the specified *numerator df* (degrees of freedom) and *denominator df*. *numerator df* and *denominator df* must be integers > 0.

Fcdf(*lowerbound*,*upperbound*,*numerator df*,*denominator df***)**





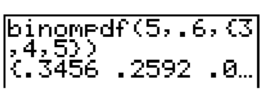
binompdf

binompdf(computes a probability at *x* for the discrete binomial distribution with the specified *numtrials* and probability of success (p) on each trial. *x* can be an integer or a list of integers. $0 \le p \le 1$ must be true. *numtrials* must be an integer > 0. If you do not specify *x*, a list of probabilities from 0 to *numtrials* is returned. The probability density function (**pdf**) is:

$$f(x) = \binom{n}{x} p^x (1-p)^{n-x}, x = 0,1,...,n$$

where n = *numtrials*

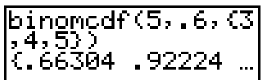
binompdf(*numtrials*,*p*[,*x*]**)**

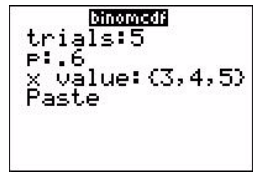


binomcdf(

binomcdf(computes a cumulative probability at x for the discrete binomial distribution with the specified *numtrials* and probability of success (p) on each trial. x can be a real number or a list of real numbers. $0 \le p \le 1$ must be true. *numtrials* must be an integer > 0. If you do not specify x, a list of cumulative probabilities is returned.

binomcdf(*numtrials*,*p*[,*x*]**)**



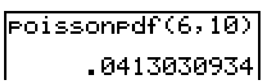


poissonpdf(

poissonpdf(computes a probability at x for the discrete Poisson distribution with the specified mean μ, which must be a real number > 0. x can be an integer or a list of integers. The probability density function (**pdf**) is:

$$f(x) = e^{-\mu}\mu^{x}/x!, x = 0,1,2,...$$

poissonpdf(μ,x**)**



poissoncdf(

poissoncdf(computes a cumulative probability at x for the discrete Poisson distribution with the specified mean μ, which must be a real number > 0. x can be a real number or a list of real numbers.

poissoncdf(μ,x**)**