# TI-86 Inferential Statistics and Distribution Functions

## Loading and Installing Inferential Statistics and Distribution Features on Your TI‑86

To load the inferential statistics and distribution features onto your TI‑86, you need a computer and the TI‑86 Graph Link software and cable. You also need to download the statistics program file from the Internet and save it on your computer.

### Loading the Inferential Statistics and Distribution Features into TI‑86 Memory

*When sending a program from your computer to the TI‑86, the calculator must **not** be in Receive mode. The Receive mode is used when sending programs or data from one calculator to another.*

❶ Start the TI‑86 Graph Link on your computer.

WLink86.exe

❷ Turn on your TI‑86 and display the home screen.

[ON]
[2nd] [QUIT]

❸ Click on the Send button on the TI‑86 Graph Link toolbar to display the Send dialog box.

**TI-GRAPH LINK for the TI-86**
File  Edit  Link  Tools  Devices  Window  Help

❹ Specify the statistics program file as the file you want to send.

infstat1.86g

❺ Send the program to the TI‑86. The program and its associated executable file become items on the PRGM NAMES menu.

*Other files associated with the assembly language program (**exstats**, **exstats2**, **statedit**) appear on the PRGM NAMES menu, but you need not do anything with them.*

❻ Exit Graph Link.

### Installing the Inferential Statistics and Distribution Features for Use

Use the assembly language program **Infstats** to install the inferential statistics and distribution features directly into the TI‑86's built-in functions and menus. After installation, the inferential statistics and distribution features are available each time you turn on the calculator. You do not need to reinstall them each time. When you run assembly language programs that do not install themselves into the [2nd] [MATH] [MORE] menu, their features are lost when you turn off the calculator.

All examples assume that **Infstats** is the only assembly language program installed on your TI‑86. The position of STAT on the MATH menu may vary, depending on how many other assembly language programs are installed.

*For assembly language programs that must be installed, up to three can be installed at a time (although the TI‑86 can store as many as permitted by memory). To install a fourth, you must first uninstall (page 3) one of the others.*

❶ Select **Asm(** from the CATALOG to paste it to a blank line on the home screen.

[2nd] [CATLG-VARS] [F1]
[▼] (move ▶ to
**Asm(** ) [ENTER]

```
CATALOG
▶Asm(
 AsmComp(
 AsmPrgm
```

❷ Select **Infstat** from the PRGM NAMES menu to paste **Infstats** to the home screen as an argument.

[PRGM] [F1] (select
**Infstat** [ )] )

```
Asm(Infstats)
```
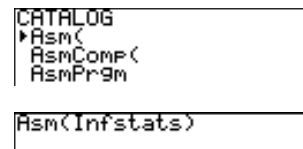
*The variables that will be overwritten are listed on page 26.*

❸ Run the installation program.  ENTER

**Caution:** If you have values stored to variables used by the statistical features, they will be overwritten. To save your values, press F5 to exit, store them to different variables, and then repeat this installation.

```
Caution
Var/funct names will
be overwritten. See
documentation for
var/funct(s) used
by this program.

Continue        Exit
```

❹ Continue the installation. Your version number may differ from the one shown in the example.  F1

```
var/funct(s) used
by this program.

Continue        Exit

Infstats v0.2
                Done
```

❺ Display the home screen.  CLEAR

## Displaying the STAT (Inferential Statistics and Distribution) Menu  2nd [MATH] MORE

*If other assembly language programs are installed, STAT may be in a menu cell other than 2nd [MATH] MORE F2.*

When you install the inferential statistics and distribution program on your TI-86 and activate it, **STAT** becomes the last item on the **MATH** menu.

| NUM | PROB | ANGLE | HYP | MISC | ▶ | INTER | STAT | | | |
|-----|------|-------|-----|------|---|-------|------|--|--|--|

Inferential Statistics and Distribution Menu

## The STAT Menu  2nd [MATH] MORE F2

| TESTS | DISTR | DRAW | FUNC | Uninst | ▶ | RsltOn | RsltOf | | | |
|-------|-------|------|------|--------|---|--------|--------|--|--|--|

Inferential Statistics Test Editors

Distribution Shading

Uninstall Instruction

Results Off (Default)

Distribution Functions

Inferential Statistics Test Functions

Results On (Intermediate calculation results display)

## Uninstalling the Inferential Statistics and Distribution Features

*When you uninstall the inferential statistics and distribution features, the statistics assembly language programs (Infstats, exstats, exstats2, and statedit) remain in memory, but the STAT option is removed from the MATH menu.*

❶ Display the STAT menu, and then select **Uninst**.  2nd [MATH] MORE F2  F5

```
TESTS DISTR DRAW FUNC Uninst▶
```

❷ If you are sure you want to uninstall, select **Yes** from the confirmation menu. The STAT menu is removed and the home screen is displayed. Your version number may differ from the one shown in the example.  F4

```
Uninstall
Infstats v0.2
Are you sure?

              YES   NO
```

*Deleting the program does not delete the variables associated with the program.*

**Deleting the Inferential Statistics and Distribution Program from TI–86 Memory**

❶ Select **DELET** from the MEM menu.    2nd [MEM] F2

```
┌────┬────┬────┬────┬─────┐
│ALL │REAL│CPLX│LIST│VECTR▸│
└────┴────┴────┴────┴─────┘
```

❷ Select **PRGM** from the MEM DELET menu.    MORE F5

```
┌─────┬────┬───┬────┬─────┐
│MATRX│STRNG│EQU│CONS│PRGM ▸│
└─────┴────┴───┴────┴─────┘
```

❸ Move the selection cursor to **Infstats**, and then delete it.    ▼ (as needed)   ENTER

```
DELETE:PRGM
▸Infstats   4235 PRGM
```

❹ Move the selection cursor to **exstats** and then delete it. Scroll down and delete **exstats2** and **statedit**.    ▼ (as needed)   ENTER

```
DELETE:PRGM
▸exstats    4679 PRGM
 exstats2   4570 PRGM
 statedit   3779 PRGM


┌─────┬─────┬──┬──┬──┐
│PAGE↓│PAGE↑│  │  │  │
└─────┴─────┴──┴──┴──┘
```

❺ Display the home screen.    CLEAR
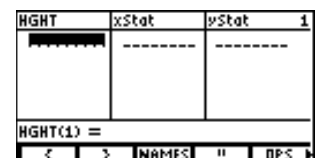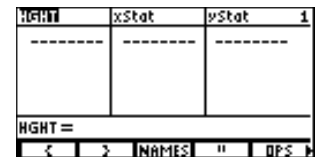
# Example: Mean Height of a Population

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 65 inches and a standard deviation of 2.5 inches.

This example uses an inferential statistics editor. An editor prompts you for test information. See page 7 for another example of using an inferential statistics editor. You can also enter test parameters without using an editor. See page 8 for an example of bypassing the inferential statistics editors.

**Height (in Inches) of Each of 10 Women**

| 66.7 | 66.3 | 62.8 | 66.9 | 62.9 | 71.4 | 67.4 | 63.8 | 65.8 | 62.8 |

❶ Create a new list column. The ▧ cursor indicates that alpha-lock is on. The existing list name columns shift to the right.    2nd [STAT] F2 ▲   2nd [INS]

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

```
┌────────┬─────┬─────┬─┐
│▬▬▬▬▬▬▬│xStat│yStat│1│
│  ──────│─────│─────│ │
│        │     │     │ │
│        │     │     │ │
│        │     │     │ │
│Name=▧  │     │     │ │
├────┬────┬────┬──┬──┤
│fStat│xStat│yStat│  │  │
└─────┴─────┴─────┴──┴──┘
```

❷ Enter the list name at the **Name=** prompt. The list to which you will store the women's height data is created.    [H] [G] [H] [T]   ENTER

```
┌────┬─────┬─────┬─┐
│HGHT│xStat│yStat│1│
│────│─────│─────│ │
│    │     │     │ │
│    │     │     │ │
│HGHT=   │     │     │
├──┬──┬─────┬──┬───┤
│ ‹ │ › │NAMES│ " │OPS ▸│
└──┴──┴─────┴──┴───┘
```

❸ Move the cursor onto the first row of the list. **HGHT(1)=** is displayed on the bottom line.    ▼

```
┌────┬─────┬─────┬─┐
│HGHT│xStat│yStat│1│
│▬▬▬│─────│─────│ │
│    │     │     │ │
│    │     │     │ │
│HGHT(1) =│     │     │
├──┬──┬─────┬──┬───┤
│ ‹ │ › │NAMES│ " │OPS ▸│
└──┴──┴─────┴──┴───┘
```

❹ Enter the first height value. As you enter it, it is displayed on the bottom line.

66 `.` 7 `ENTER`

| HGHT | xStat | yStat | 1 |
|------|-------|-------|---|
| 71.4 | | | |
| 67.4 | | | |
| 63.8 | | | |
| 65.8 | | | |
| 62.8 | | | |

HGHT(11) =

| `<` | `>` | NAMES | " | OPS ▶ |
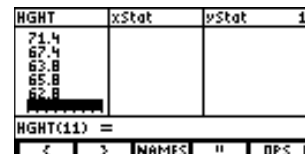
The value is displayed in the first row, and the rectangular cursor moves to the next row. Enter the other nine height values the same way.

❺ Display the inferential statistics editor for **TIntl** (TInterval) from the STAT TESTS menu.

`EXIT` `2nd` `[MATH]`
`[MORE]` `F2` `F1` `[MORE]`
`F3`

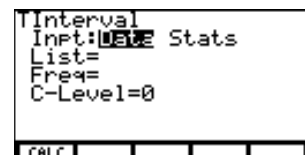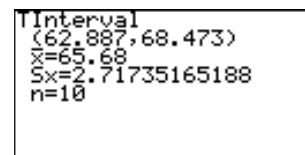| TESTS | DISTR | DRAW | FUNC | Uninst |
| 2Prp2 | ZInt1 | TInt1 | ZInt2 | TInt2 ▶ |

❻ Select **Data** in the **Inpt** field.

If **Stats** is selected, press `◄` `ENTER`

TInterval
Inpt:**DATA** Stats
List=
Freq=
C-Level=0

| CALC | | | | |

❼ Enter the test requirements:

- Set alpha-lock and enter the **List** name.

`▼` `ALPHA` `ALPHA`
[H] [G] [H] [T]

- Enter 1 at the **Freq=** prompt.

`▼` 1

- Enter a 99 percent confidence level at the **C-Level=** prompt.

`▼` `.` 99

TInterval
Inpt:**DATA** Stats
List=HGHT
Freq=1
C-Level=.99

| CALC | | | | |

❽ Calculate the test. The results are displayed on the home screen.

`F1`

TInterval
(62.887,68.473)
x̄=65.68
Sx=2.71735165188
n=10

**Note:** Press `EXIT`, `CLEAR`, or `ENTER` to clear the results from the screen.

### Interpreting the Results

The first line **(62.887,68.473)** shows that the 99 percent confidence interval for the population mean is between about 62.9 inches (5 feet 2.9 inches) and 68.5 inches (5 feet 8.5 inches). This is about a 5.6-inch 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 65 inches, which is in the calculated interval.

The second line gives the mean height of the sample x̄ 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 $\mu$ of women's heights, increase the sample size to 90. Use a sample mean x̄ of 64.5 and sample standard deviation Sx of 2.8 calculated from the larger random sample. This time, use the **Stats** (summary statistics) input option.

**❾** Display the inferential statistics and distribution editor for **TIntl** and select **Stats** in the **Inpt** field.

CLEAR 2nd [MATH]
MORE F2 F1 MORE
F3 ▶ ENTER

```
TInterval
 Inpt:Data Stats
x̄=65.68
Sx=2.71735165188
n=10
C-Level=.99

CALC
```

**❿** Enter the test requirements:

• Store 64.5 to x̄

• Store 2.8 to Sx

• Store 90 to n

▼ 64 . 5 ENTER

2 . 8 ENTER

90 ENTER

```
TInterval
 Inpt:Data Stats
x̄=64.5
Sx=2.8
n=90
C-Level=.99

CALC
```

**⓫** Calculate the test. The results are displayed on the home screen.

F1

```
TInterval
(63.723,65.277)
x̄=64.5
Sx=2.8
n=90
```

If the height distribution among a population of women is normally distributed with a mean μ of 65 inches and a standard deviation σ of 2.5 inches, what height is exceeded by only 5 percent of the women (the 95th percentile)?

**⓬** Display the STAT DISTR (Distributions) menu.
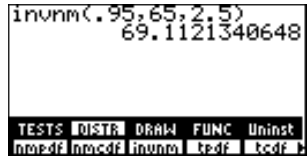
CLEAR 2nd [MATH]
MORE F2 F2

```
TESTS DISTR DRAW FUNC Uninst
nmpdf nmcdf invnm tpdf tcdf ▶
```

**⓭** Paste **invnm(** to the home screen. (**invnm** stands for Inverse Normal.)

F3

```
invnm(
```

*The parameters are* **invnm(***area[, μ, σ]***).**

**⓮** Enter .95 as the area, 65 as μ, and 2.5 as σ.

. 95 , 65 , 2 . 5 ) ENTER

```
invnm(.95,65,2.5)
           69.1121340648




TESTS DISTR DRAW FUNC Uninst
nmpdf nmcdf invnm tpdf tcdf ▶
```
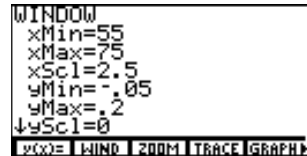
The result is displayed on the home screen; it shows that five percent of the women are taller than 69.1 inches (5 feet 9.1 inches).

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

**⓯** Set the window variables to these values:

**xMin=55   yMin=⁻.05   xRes=1**

**xMax=75   yMax=.2**

**xScl=2.5   yScl=0**

GRAPH F2

```
WINDOW
 xMin=55
 xMax=75
 xScl=2.5
 yMin=⁻.05
 yMax=.2
↓yScl=0
y(x)= WIND ZOOM TRACE GRAPH▶
```

```
 xRes=1
y(x)= WIND ZOOM TRACE GRAPH▶
```

**⓰** Display the STAT DRAW menu.

EXIT 2nd [MATH]
MORE F2 F3

```
TESTS DISTR DRAW FUNC Uninst
ShdN Shdt ShdChi ShdF
```

**⓱** Paste **ShdNm(** to the home screen. (**ShdNm** stands for Shade Normal.)

F1

```
invnm(.95,65,2.5)
           69.1121340648
ShdNm(



TESTS DISTR DRAW FUNC Uninst
ShdN Shdt ShdChi ShdF
```

*The parameters are* **ShdNm(**lowerbound, upperbound [ , *μ*, *σ*]**)**.

⓲ The answer (**Ans** 69.1121340648) from step 14 is the lower bound. 1E99 is the upper bound. The normal curve is defined by a mean μ of 65 and a standard deviation σ of 2.5.

2nd [ANS] , 1 EE 99 , 65 , 2 . 5 )

```
invnm(.95,65,2.5)
             69.1121340648
ShdNm(Ans,1E99,65,2.5
)



TESTS DISTR DRAW FUNC Uninst
 ShdN  Shdt  ShdChi ShdF
```

⓳ Plot and shade the normal curve. **Area=** is the area above the 95th percentile. **low=** is the lower bound.  **up=** is the upper bound.

You can remove the menu from the bottom of the screen.

ENTER

CLEAR

```
Area=.05
low=69.1121      up=1E99
```
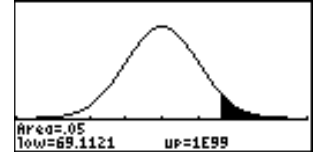
# Inferential Statistics Editors

### Displaying the Inferential Statistics 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.

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

### Using an Inferential Statistics Editor

This example uses the inferential statistics editor for **TTest**.

❶ Select a hypothesis test or confidence interval from the STAT TESTS menu. The appropriate editor displays.

2nd [MATH] [MORE] F2 F1 F2 (displays the TTest editor)

```
T-Test
 Inpt:DATA Stats
 μ0=
 List=
 Freq=
 μ:≠μ0 <μ0 >μ0

 CALC DRAW
```

*Select* **Data** *to enter the data lists as input. Select* **Stats** *to enter summary statistics, such as x̄, Sx, and n as inputs.*

❷ Select **Data** or **Stats** input, if the selection is available.

▶ or ◀ ENTER

```
T-Test
 Inpt:DATA Stats
 μ0=
 List=
 Freq=
 μ:≠μ0 <μ0 >μ0

 CALC DRAW
```

❸ Enter real numbers, list names, or expressions for each argument in the editor. See the input descriptions table on page 24.

▼ 65 ▼ [H] [G] [H] [T] ▼ 1 ▼

```
T-Test
 Inpt:DATA Stats
 μ0=65
 List=HGHT
 Freq=1
 μ:≠μ0 <μ0 >μ0

 CALC DRAW
```

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

❹ Select the alternative hypothesis against which to test, if the selection is available.

ENTER

```
T-Test
 Inpt:DATA Stats
 μ0=65
 List=HGHT
 Freq=1
 μ:≠μ0 <μ0 >μ0

 CALC DRAW
```
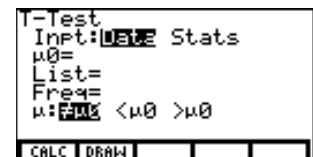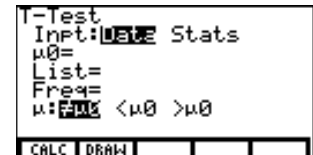
*Select **No** or **Yes** for the Pooled option, if the selection is available. The Pooled option is available for **Tsam2** and **TInt2** only. Press ▶ or ◀ ENTER to select an option.*

- *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.*

❺ Select **Calc** or **Draw** (when Draw is available) to execute the instruction.

F1 or F2

- When you select **Calc**, the results are displayed on the home screen.

F1

- When you select **Draw**, the results are displayed in a graph (not available for a confidence interval).

F2

```
┌CALC┬DRAW┬────┬────┬────┐
```

```
T-Test
μ≠65
t=.791339908997
p=.449097175649
x̄=65.68
Sx=2.71735165188
n=10
```

t=.7913        p=.4491

## Bypassing the Inferential Statistics Editors

You can paste a hypothesis test or confidence interval instruction to the home screen without displaying the corresponding inferential statistics editor. You can also paste a hypothesis test or confidence interval instruction to a command line in a program.

❶ Turn **RsltOn** (Results On).

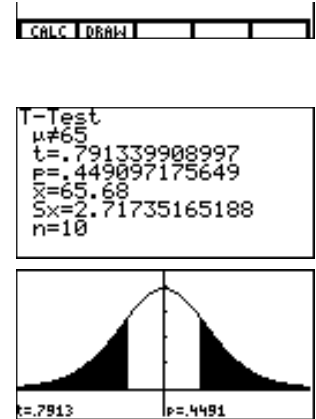**Note:** The default is **RsltOf** (Results Off).

2nd [MATH] MORE F2 MORE F1 ENTER

```
RsltOn                    Done
```

```
┌RsltOn┬RsltOf┬────┬────┬────┐
```
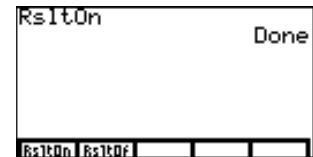
❷ Select the instruction from the STAT FUNC menu.

CLEAR MORE F4 F2 (for the TTest instruction)

```
TTest
```

```
TESTS DISTR DRAW FUNC Uninst
2Test TTest 2Sam2 Tsam2 2Prp1▶
```

*This example uses summary statistics. See pages 35-38 for a list of FUNC (Function) menu parameters.*

❸ Input the syntax for each hypothesis test and confidence interval instruction. Complete the syntax by using one of the options below:

( 65 , 65.68 , 2.71735165188 , 10 , 0 ,

```
TTest(65,65.68,2.7173
5165188,10,0,
```
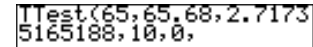
- Enter 0 (zero) as the last parameter to display the results on the home screen.

0 ) ENTER

```
TTest(65,65.68,2.7173
5165188,10,0,0)
```

```
T-Test
μ≠65
t=.791339908997
p=.449097175649
x̄=65.68
Sx=2.71735165188
n=10
```
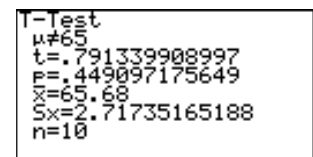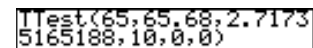
**Note:** The home screen does not display the results if you use **RsltOf**.

```
TTest(65,65.68,2.7173
5165188,10,0,0)
                    Done
```
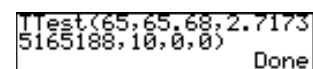
– or –

- Enter 1 as the last parameter to display the results in a graph. The graph is drawn whether you use **RsltOn** or **RsltOf**.

1 ) ENTER

```
TTest(65,65.68,2.7173
5165188,10,0,1)
```
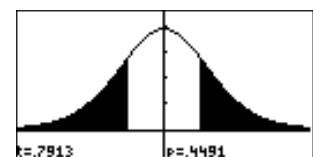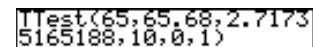
You can remove the menu from the bottom of the screen.

CLEAR

t=.7913        p=.4491

# Inferential Statistics Editors for the STAT TESTS Instructions

**STAT TESTS (Inferential Statistics Tests) Menu**    [2nd] [MATH] [MORE] [F2] [F1]

| TESTS | DISTR | DRAW | FUNC | Uninst | ▶ | RsltOn | RsltOf | | | |
|-------|-------|------|------|--------|---|--------|--------|---|---|---|
| ZTest | TTest | Zsam2 | Tsam2 | ZPrp1 | ▶ | ZPrp2 | ZIntl | TIntl | ZInt2 | TInt2 |
| | | | | | ▶ | ZPin1 | ZPin2 | Chitst | FSam2 | TLinR |
| | | | | | ▶ | ANOVA | | | | |

| Test Name | Description | Function |
|-----------|-------------|----------|
| **ZTest** | One-sample $Z$-test | Test for one $\mu$, known $\sigma$ |
| **TTest** | One-sample $t$-test | Test for one $\mu$, unknown $\sigma$ |
| **Zsam2** | Two-sample $Z$-test | Test comparing two $\mu$'s, known $\sigma$'s |
| **Tsam2** | Two-sample $t$-test | Test comparing two $\mu$'s, unknown $\sigma$'s |
| **ZPrp1** | One-proportion $Z$-test | Test for one proportion |
| **ZPrp2** | Two- proportion $Z$-test | Test comparing two proportions |
| **ZIntl** | One-sample $Z$ confidence interval | Confidence interval for one $\mu$, known $\sigma$ |
| **TIntl** | One-sample $t$ confidence interval | Confidence interval for one $\mu$, unknown $\sigma$ |
| **ZInt2** | Two-sample $Z$ confidence interval | Confidence interval for difference of two $\mu$'s, known $\sigma$'s |
| **TInt2** | Two-sample $t$ confidence interval | Confidence interval for difference of two $\mu$'s, unknown $\sigma$'s |
| **ZPin1** | One-proportion $Z$ confidence interval | Confidence interval for one proportion |
| **ZPin2** | Two-proportion $Z$ confidence interval | Confidence interval for difference of two proportions |
| **Chitst** | Chi-square test | Chi-square test for two-way tables |
| **FSam2** | Two-sample $F$-test | Test comparing two $\sigma$'s |
| **TLinR** | Linear regression $t$-test | $t$-test for regression slope and $\rho$ |
| **ANOVA** | One-way analysis of variance | One-way analysis of variance |

This section provides a description of each STAT TESTS instruction and shows the unique inferential statistics 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 drawn results.
- Descriptions of instructions that offer only the **Calculate** output choice show the calculated results on the home screen.

All examples on pages 10 through 23 assume a fixed-decimal mode setting of four. If you set the decimal mode to **Float** or a different fixed-decimal setting, your output may differ from the output in the examples.

Be sure to turn off the y= functions before drawing results.

To remove the menu from a drawing, press CLEAR.

### Ztest

This one-sample *Z*-test, shown as Z-Test in the editor, performs a hypothesis test for a single unknown population mean $\mu$ when the population standard deviation $\sigma$ is known. It tests the null hypothesis $H_0$: $\mu=\mu_0$ against one of the alternatives below.

- $H_a$: $\mu\neq\mu_0$ ($\mu$:$\neq\mu0$)
- $H_a$: $\mu<\mu_0$ ($\mu$:$<\mu0$)
- $H_a$: $\mu>\mu_0$ ($\mu$:$>\mu0$)

In the example:

**L1=**{299.4  297.7  301  298.9  300.2  297}
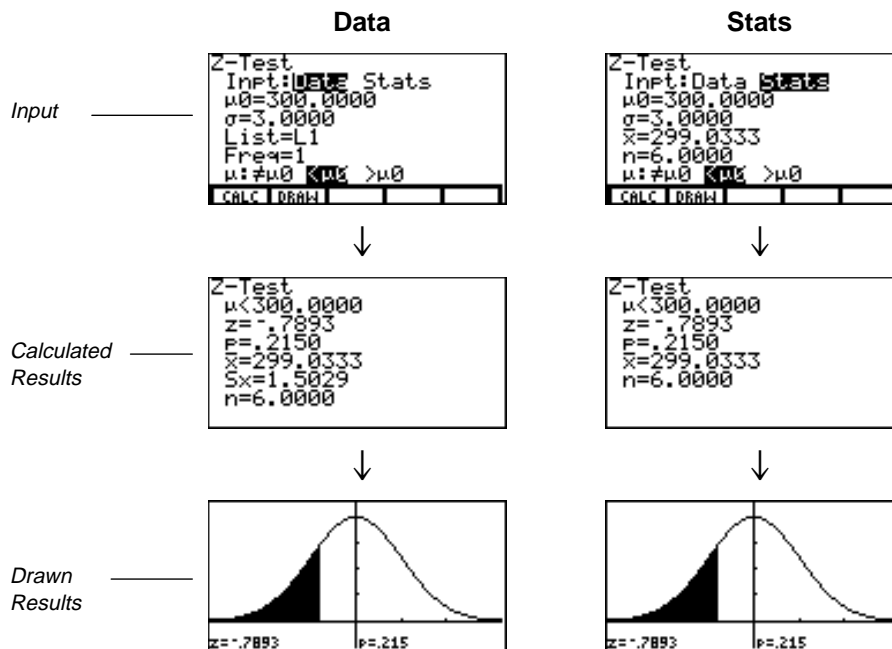
### TTest

This one-sample $t$-test, shown as T-Test in the editor, performs a hypothesis test for a single unknown population mean μ when the population standard deviation σ is unknown. It tests the null hypothesis $H_0$: $μ=μ_0$ against one of the alternatives below.

- $H_a$: $μ≠μ_0$ (μ:≠μ0)
- $H_a$: $μ<μ_0$ (μ:<μ0)
- $H_a$: $μ>μ_0$ (μ:>μ0)

In the example:

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

| Data | Stats |
|---|---|

*Input*

```
T-Test
 Inpt:DATA Stats
µ0=105
List=TEST
Freq=1
µ:≠µ0 <µ0 >µ0

 CALC  DRAW
```

```
T-Test
 Inpt:Data STATS
µ0=105.0000
x̄=103.9667
Sx=11.4669
n=6.0000
µ:≠µ0 <µ0 >µ0

 CALC  DRAW
```

↓                ↓

*Calculated Results*

```
T-Test
µ≠105.0000
t=-.2207
P=.8340
x̄=103.9667
Sx=11.4669
n=6.0000
```

```
T-Test
µ≠105.0000
t=-.2207
P=.8340
x̄=103.9667
Sx=11.4669
n=6.0000
```

↓                ↓

*Drawn Results*



```
t=-.2207        p=.834
```



```
t=-.2207        p=.834
```
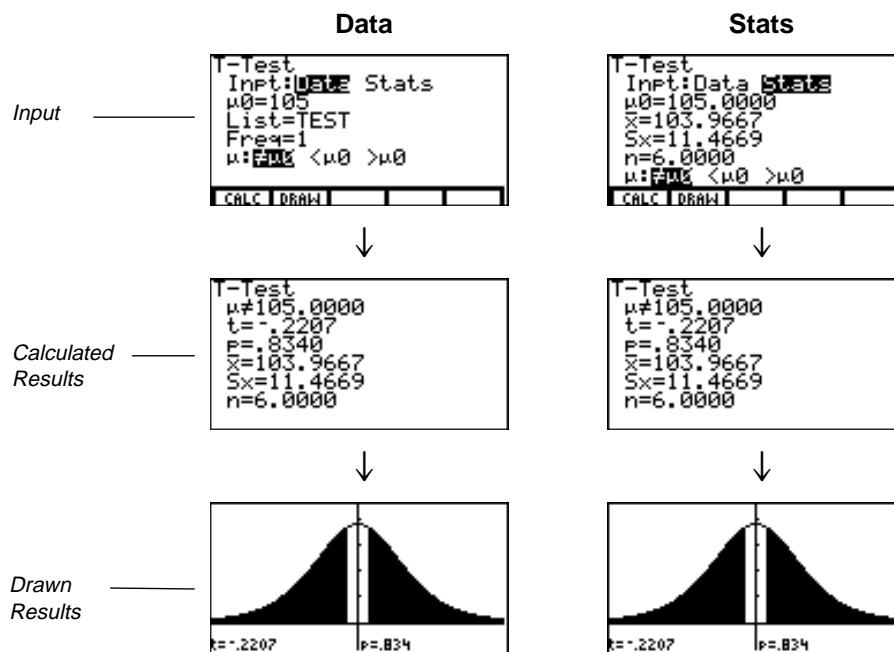
### Zsam2

This two-sample $Z$-test, shown as 2-SampZTest in the editor, tests the equality of the means of two populations ($\mu_1$ and $\mu_2$) based on independent samples when both population standard deviations ($\sigma_1$ and $\sigma_2$) are known. The null hypothesis $H_0$: $\mu_1=\mu_2$ is tested against one of the alternatives below.

- $H_a$: $\mu_1 \neq \mu_2$ ($\mu 1{:}\neq\mu 2$)
- $H_a$: $\mu_1 < \mu_2$ ($\mu 1{:}<\mu 2$)
- $H_a$: $\mu_1 > \mu_2$ ($\mu 1{:}>\mu 2$)

In the example:

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

|  | **Data** | **Stats** |
|---|---|---|
| *Input* |  |  |
|  | ↓ | ↓ |
| *Calculated Results* |  |  |
|  | ↓ | ↓ |
| *Drawn Results* |  |  |
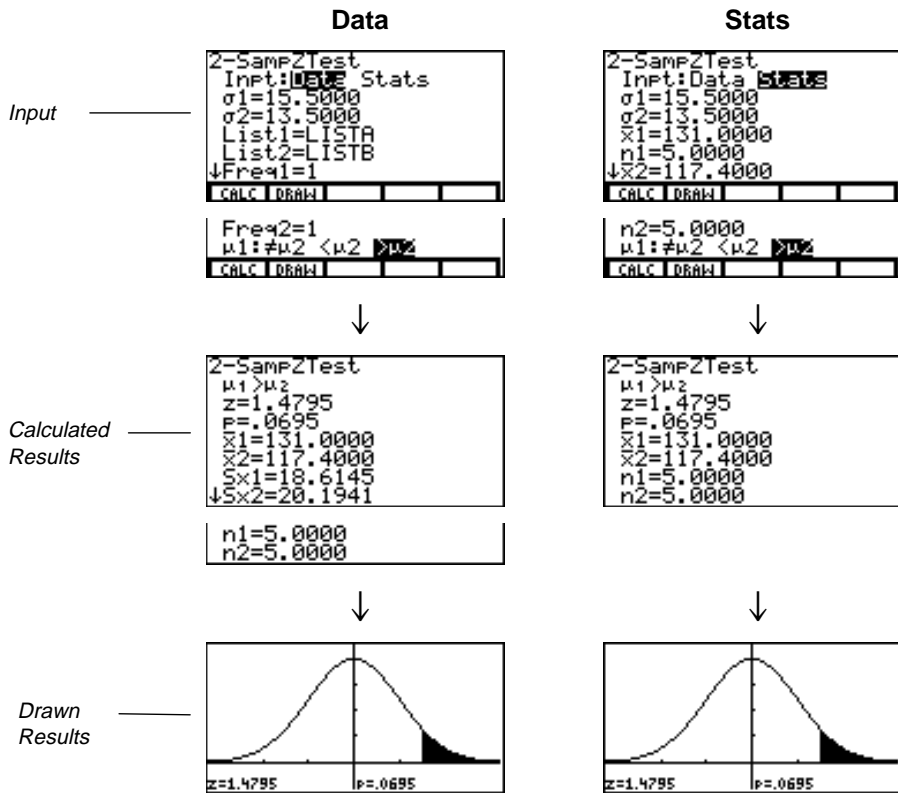
### Tsam2

This two-sample *t*-test, shown as 2-SampTTest in the editor, tests the equality of the means of two populations ($\mu_1$ and $\mu_2$) based on independent samples when neither population standard deviation ($\sigma_1$ or $\sigma_2$) is known. The null hypothesis $H_0$: $\mu_1 = \mu_2$ is tested against one of the alternatives below.

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

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}

The pooled option is available for **Tsam2** and **TInt2** only. **No** means that population variances can be unequal. **Yes** means that population variances are assumed to be equal.

**Data**                    **Stats**

*Input*

*Calculated Results*

*Drawn Results*
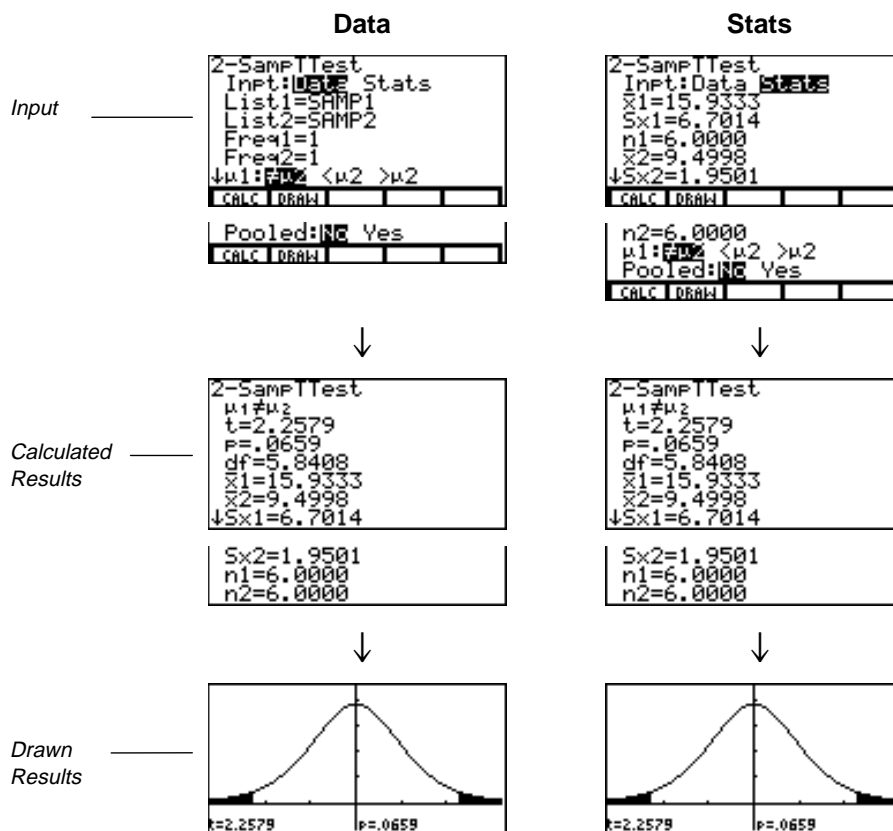
### ZPrp1

This one-proportion $Z$-test, shown as 1-PropZTest in the editor, 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 $n$. **ZPrp1** tests the null hypothesis $H_0$: prop=$p_0$ against one of the alternatives below.

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

*Input*

```
1-PropZTest
 p0=.5000
 x=2048.0000
 n=4040.0000
 Prop:≠P0 <P0 >P0

 CALC  DRAW
```

↓

*Calculated Results*

```
1-PropZTest
 Prop≠.5000
 z=.8810
 P=.3783
 Phat=.5069
 n=4040.0000
```

phat represents $\hat{p}$

↓

*Drawn Results*

```
z=.881          p=.3783
```
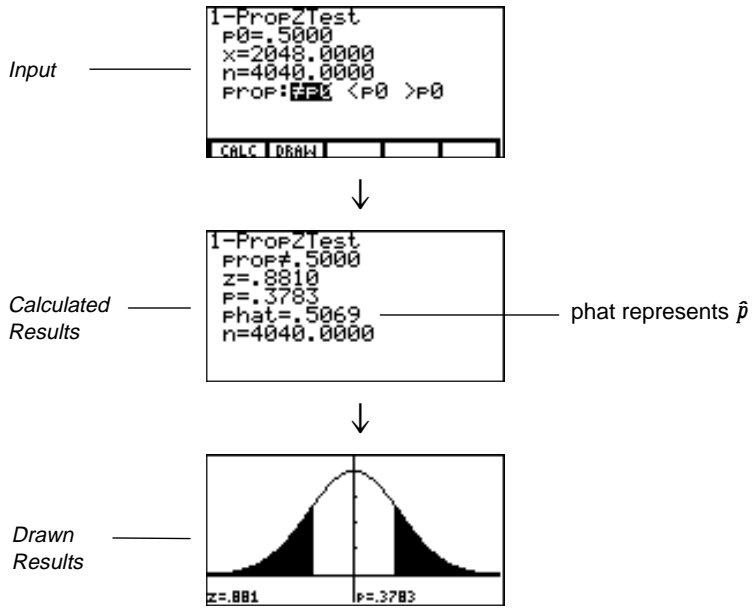
### ZPrp2

This two-proportion $Z$-test, shown as 2-PropZTest in the editor, computes a test to compare the proportion of successes (p1 and p2) from two populations. It takes as input the count of successes in each sample ($x1$ and $x2$) and the count of observations in each sample ($n1$ and $n2$). **ZPrp2** tests the null hypothesis H0: p1=p2 (using the pooled sample proportion $\hat{p}$) against one of the alternatives below.

Phat represents $\hat{p}$ in the editor. Phat1 represents $\hat{p}_1$, and phat2 represents $\hat{p}_2$.

- 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*

```
2-PropZTest
x1=45.0000
n1=61.0000
x2=38.0000
n2=62.0000
p1:≠p2 <p2 >p2

 CALC  DRAW
```

↓

*Calculated Results*

```
2-PropZTest
p1≠p2
z=1.4773
p=.1396
Phat1=.7377
Phat2=.6129
Phat=.6748
↓n1=61.0000

 n2=62.0000
```

phat1 represents $\hat{p}_1$
phat2 represents $\hat{p}_2$
phat represents $\hat{p}$

↓

*Drawn Results*

z=1.4773    p=.1396

### ZIntl
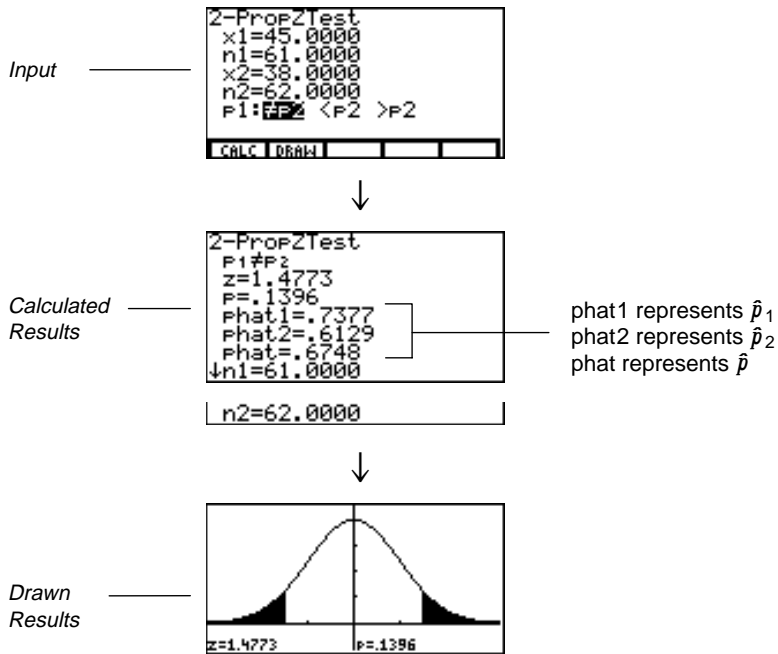
This one-sample $Z$ confidence interval, shown as ZInterval in the editor, computes a confidence interval for an unknown population mean μ when the population standard deviation σ is known. The computed confidence interval depends on the user-specified confidence level.

In the example:

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

|  | **Data** | **Stats** |
|---|---|---|
| *Input* | ```ZInterval Inpt:DATA Stats σ=3.0000 List=L1 Freq=1 C-Level=.9 ⌐CALC⌐``` | ```ZInterval Inpt:Data STATS σ=3.0000 x̄=299.0333 n=6.0000 C-Level=.9 ⌐CALC⌐``` |
| | ↓ | ↓ |
| *Calculated Results* | ```ZInterval (297.02,301.05) x̄=299.0333 Sx=1.5029 n=6.0000``` | ```ZInterval (297.02,301.05) x̄=299.0333 n=6.0000``` |

### TIntl
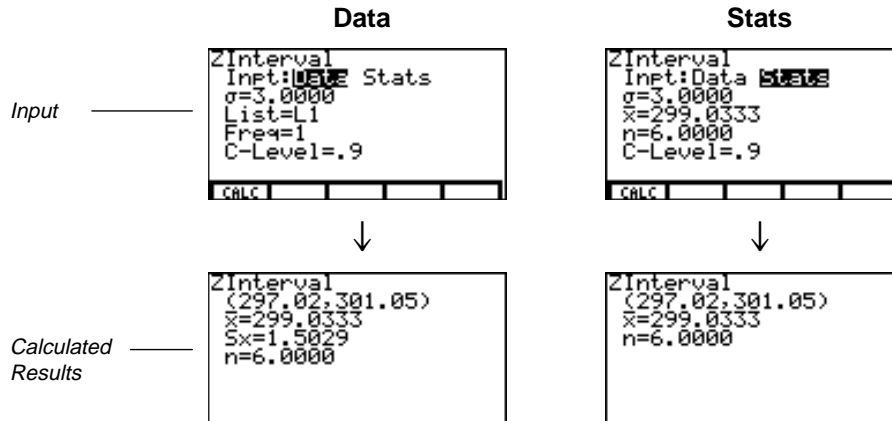
This one-sample $t$ confidence interval, shown as TInterval in the editor, computes a confidence interval for an unknown population mean μ when the population standard deviation σ is unknown. The computed confidence interval depends on the user-specified confidence level.

In the example:

**L6=**{1.6  1.7  1.8  1.9}

|  | **Data** | **Stats** |
|---|---|---|
| *Input* | ```TInterval Inpt:DATA Stats List=L6 Freq=1 C-Level=.9500 ⌐CALC⌐``` | ```TInterval Inpt:Data STATS x̄=1.7500 Sx=.1291 n=4.0000 C-Level=.95 ⌐CALC⌐``` |
| | ↓ | ↓ |
| *Calculated Results* | ```TInterval (1.5446,1.9554) x̄=1.7500 Sx=.1291 n=4.0000``` | ```TInterval (1.5446,1.9554) x̄=1.7500 Sx=.1291 n=4.0000``` |
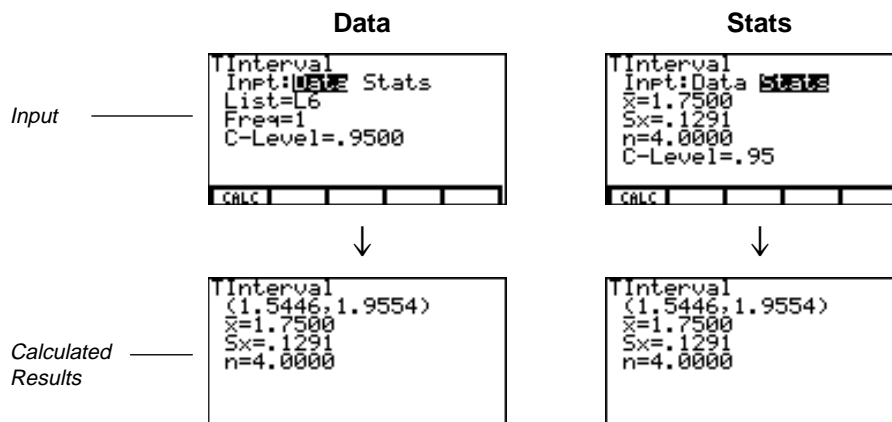
### ZInt2

This two-sample $Z$ confidence interval, shown as 2-SampZInt in the editor, computes a confidence interval for the difference between two population means ($\mu_1 - \mu_2$) when both population standard deviations ($\sigma_1$ and $\sigma_2$) 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*

```
2-SampZInt
 Inpt:Data Stats
σ1=15.5000
σ2=13.5000
List1=LISTC
List2=LISTD
↓Freq1=1
 CALC
```

```
2-SampZInt
 Inpt:Data Stats
σ1=15.5000
σ2=13.5000
x̄1=131.0000
n1=5.0000
↓x̄2=117.4000
 CALC
```

```
 Freq2=1
 C-Level=.9900
 CALC
```

```
 n2=5.0000
 C-Level=.9900
 CALC
```

$\downarrow$ $\qquad\qquad\qquad$ $\downarrow$

*Calculated Results*

```
2-SampZInt
(-10.08,37.278)
x̄1=131.0000
x̄2=117.4000
Sx1=18.6145
Sx2=20.1941
n1=5.0000
n2=5.0000
```

```
2-SampZInt
(-10.08,37.278)
x̄1=131.0000
x̄2=117.4000
n1=5.0000
n2=5.0000
```

### TInt2

This two-sample $t$ confidence interval, shown as 2-SampTInt in the editor, computes a confidence interval for the difference between two population means ($\mu_1 - \mu_2$) when both population standard deviations ($\sigma_1$ and $\sigma_2$) 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}

The pooled option is available for **TInt2** and **Tsam2** only. **No** means that population variances can be unequal. **Yes** means that population variances are assumed to be equal.

| | **Data** | **Stats** |
|---|---|---|
| *Input* | 2-SampTInt<br>Inpt:**Data** Stats<br>List1=SAMP1<br>List2=SAMP2<br>Freq1=1<br>Freq2=1<br>↓C-Level=.9500<br>CALC<br><br>Pooled:**No** Yes<br>CALC | 2-SampTInt<br>Inpt:Data **Stats**<br>x̄1=15.9333<br>Sx1=6.7014<br>n1=6.0000<br>x̄2=9.4998<br>↓Sx2=1.9501<br>CALC<br><br>n2=6.0000<br>C-Level=.9500<br>Pooled:**No** Yes<br>CALC |
| | ↓ | ↓ |
| *Calculated Results* | 2-SampTInt<br>(-.5848,13.452)<br>df=5.8408<br>x̄1=15.9333<br>x̄2=9.4998<br>Sx1=6.7014<br>Sx2=1.9501<br>↓n1=6.0000<br><br>n2=6.0000 | 2-SampTInt<br>(-.5849,13.452)<br>df=5.8408<br>x̄1=15.9333<br>x̄2=9.4998<br>Sx1=6.7014<br>Sx2=1.9501<br>↓n1=6.0000<br><br>n2=6.0000 |

### ZPin1

This one-proportion $Z$ confidence interval, shown as 1-PropZInt in the editor, 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* ⎯⎯⎯⎯

```
1-PropZInt
 x=2048.0000
 n=4040.0000
 C-Level=.9900



 CALC
```

↓

*Calculated Results* ⎯⎯⎯⎯

```
1-PropZInt
 (.4867,.5272)
 Phat=.5069
 n=4040.0000
```
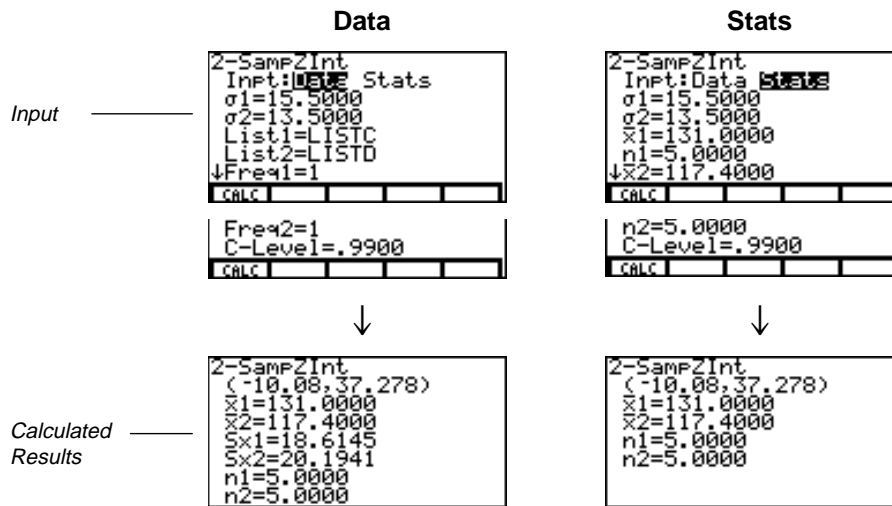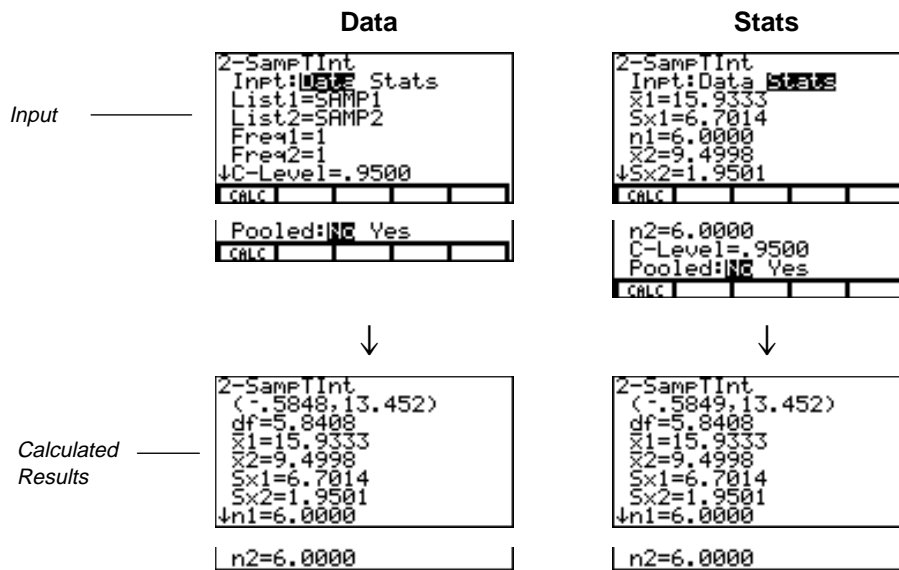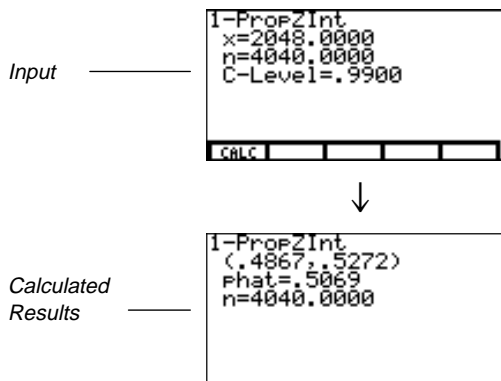
### ZPin2

This two-proportion $Z$ confidence interval, shown as 2-PropZInt in the editor, 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* ⎯⎯⎯⎯

```
2-PropZInt
 x1=49.0000
 n1=61.0000
 x2=38.0000
 n2=62.0000
 C-Level=.9500

 CALC
```

↓

*Calculated Results* ⎯⎯⎯⎯

```
2-PropZInt
 (.0334,.3474)
 Phat1=.8033
 Phat2=.6129
 n1=61.0000
 n2=62.0000
```
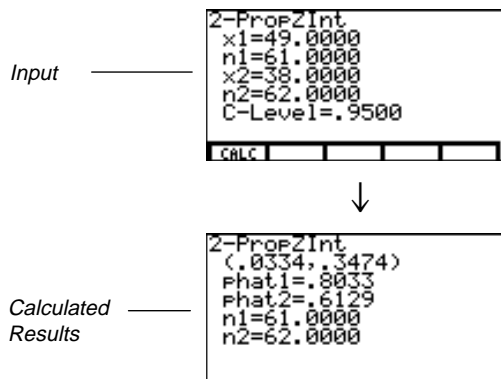
### Chitst

This test, shown as Chi$^2$-Test in the editor, computes a chi-square test for association on the two-way table of counts in the matrix you specify at the **Observed** prompt. 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 **Chitst**, enter the observed counts in a matrix. Enter that matrix variable name at the **Observed** prompt in the editor. At the **Expected** prompt, enter the matrix variable name to which you want the computed expected counts to be stored.

*Matrix Editor*

```
MATRX:A        3   ×2
[ 5.0000    19.0000      ]
[ 8.0000    16.0000      ]
[ 11.0000   13.0000      ]



INSr  DELr  INSc  DELc  ▶REAL
```

**Note:** Press [2nd] [MATRX] [F2] [A] [ENTER] to select Matrix A from the MATRX EDIT menu.

*Input*

```
Chi²-Test
 Observed=A
 Expected=B



CALC  DRAW
```

↓

*Calculated Results*

```
Chi²-Test
chi=3.3750
p=.1850
df=2.0000
```

```
MATRX:B        3   ×2
[ 8.0000    16.0000      ]
[ 8.0000    16.0000      ]
[ 8.0000    16.0000      ]


INSr  DELr  INSc  DELc  ▶REAL
```

**Note:** Press [2nd] [MATRX] [F2] [B] [ENTER] to display Matrix B.

↓

*Drawn Results*

```
X²=3.375          p=.185
```

### FSam2

This two-sample F-test, shown as 2-SampFTest in the editor, computes an F-test to compare two normal population standard deviations ($\sigma_1$ and $\sigma_2$). The population means and standard deviations are all unknown. **FSam2**, 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.

- $H_a$: $\sigma_1 \neq \sigma_2$ ($\sigma1:\neq\sigma2$)
- $H_a$: $\sigma_1 < \sigma_2$ ($\sigma1:<\sigma2$)
- $H_a$: $\sigma_1 > \sigma_2$ ($\sigma1:>\sigma2$)

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* |  |  |
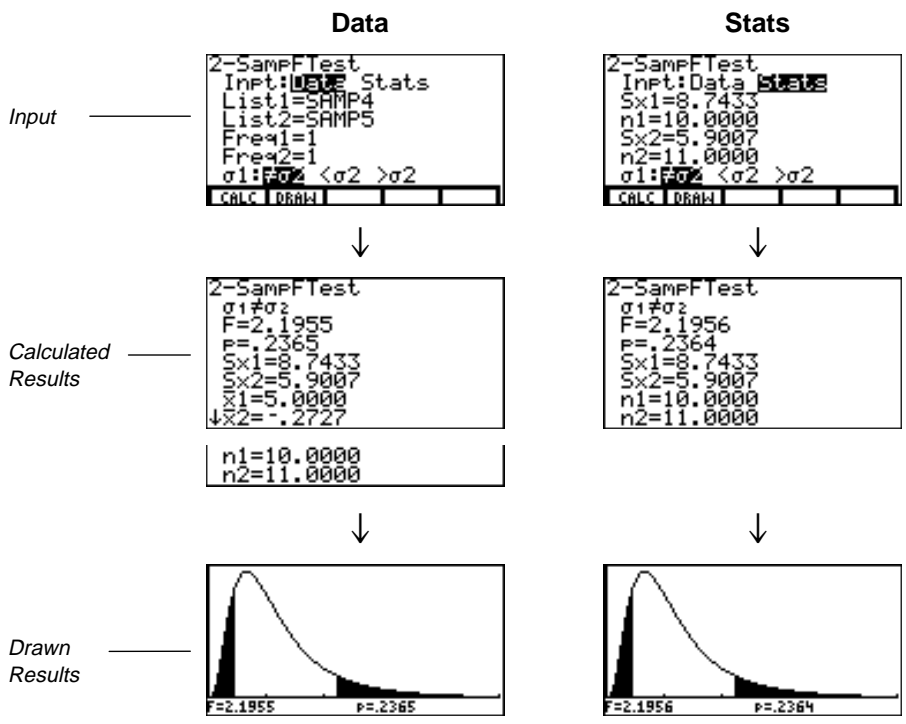
### TLinR

This linear regression *t*-test, shown as LinRegTTest in the editor, 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, $\rho=0$) 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)

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

The regression equation is automatically stored to **RegEQ** ( [2nd] [STAT] [F5] [MORE] [MORE] [F2] ). 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* ————

```
LinRegTTest
Xlist=L3
Ylist=L4
Freq=1
β & ρ:≠0 <0 >0
RegEQ=y1

CALC
```

↓

*Calculated Results* ————

```
LinRegTTest
y=a+bx
β≠0 and ρ≠0
t=15.9405
p=5.3684ᴇ-4
df=3.0000
a=-3.6596
↓b=1.1969
```

```
s=1.9820
r²=.9883
r=.9941
```

```
Plot1 Plot2 Plot3
\y1■-3.6596+1.1969X
\y2=
\y3=
\y4=
\y5=
y(x)= WIND ZOOM TRACE GRAPH
  x     y    INSf DELf SELCT▶
```

**ANOVA**

This test computes a one-way analysis of variance for comparing the means of 2 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}

```
ANOVA(L1,L2,L3)
```

*Input*

↓

```
ANOVA
 F=.3111
 P=.7384
 Factor
  DF=2.0000
  SS=.9333
  MS=.4667
↓Error
```

*Calculated Results*

Intermediate calculation results display only when **RsltOn** is selected from the STAT menu.

```
  DF=12.0000
  SS=18.0000
  MS=1.5000
 Sxp=1.2247      Done
```

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

# Inferential Statistics and Distribution Input Descriptions

This table describes the inferential statistics and distribution inputs. You enter values for these inputs in the inferential statistics editors. The table presents the inputs in the same order as they appear in the editor examples on pages 10-23.

| Input | Description |
|-------|-------------|
| $\mu_0$ | Hypothesized value of the population mean that you are testing. |
| $\sigma$ | 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 $\geq 0$. |
| **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. |
| $\sigma 1$ | The known population standard deviation from the first population for the two-sample tests and intervals. Must be a real number > 0. |
| $\sigma 2$ | 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. |
| **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 $\geq 0$. |
| $\bar{x}1$, **Sx1, n1**, $\bar{x}2$, **Sx2, n2** | 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 **Tsam2** and **TInt2**. **No** does not pool the variances. **Yes** pools the variances. |
| $p_0$ | The expected sample proportion for **ZPrp1**. Must be a real number such that $0 < p_o < 1$. |
| **x** | The count of successes in the sample for the **ZPrp1** and **ZPin1**. Must be an integer $\geq 0$. |
| **n** | The count of observations in the sample for the **ZPrp1** and **ZPin1**. Must be an integer > 0. |
| **x1** | The count of successes from sample one for the **ZPrp2** and **ZPin2**. Must be an integer $\geq 0$. |
| **x2** | The count of successes from sample two for the **ZPrp2** and **ZPin2**. Must be an integer $\geq 0$. |
| **n1** | The count of observations in sample one for the **ZPrp2** and **ZPin2** Must be an integer > 0. |
| **n2** | The count of observations in sample two for the **ZPrp2** and **ZPin2**. Must be an integer > 0. |
| **C-Level** | The confidence level for the interval instructions. Must be $\geq 0$ and <100. If it is $\geq 1$, it is assumed to be given as a percent and is divided by 100. Default=0.95. |

| Input | Description |
|---|---|
| **Observed (Matrix)** | The matrix name that represents the columns and rows for the observed values of a two-way table of counts for the **Chitst**. **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 **Chitst**. |
| **Xlist, Ylist** | The names of the lists containing the data for **TLinR**. 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. |
| **y** | Always use lowercase characters for stored regression equations. |

## Test and Interval Output Variables

The inferential statistics and distribution variables are calculated as indicated below. To access these variables for use in expressions, press [2nd] [CATLG-VARS] and then select the menu listed in the Variables and Catalog/Variables Menu column below.

All inferential statistics variables begin with the letters **st** to separate them from other variables.

If you upload TI–86 variables that contain the sigma (σ) or mu (μ) symbols to your computer, the Graph Link program will prompt you to rename them. This is because computer file names cannot contain these symbols. When you download the renamed variables to your TI–86, Graph Link restores the symbols and the files are loaded in the calculator under their original names.

**Important:** If you do not rename the sigma variables (stσ.86n, stσ1.86n, and stσ2.86n), they are stored on the computer under the names st_.86n, st_1.86n, and st_2.86n. You cannot delete or rename these files on your computer, and you will not be able to download them to your calculator.

| Variables and<br>    Catalog / Variables Menu | TI-86 Variables | | | Math<br>Symbols |
|---|---|---|---|---|
| | Tests | Intervals | TLinR,<br>ANOVA | |
| p-value<br>    REAL | **stp** | | **stp** | **p** |
| test statistics<br>    REAL | **stz, stt,<br>stchi, stF** | | **stt, stF** | **z, t, $\chi^2$, F** |
| degrees of freedom<br>    REAL | **stdf** | **stdf** | **stdf** | **df** |
| sample mean of x values for<br>sample 1 and sample 2<br>    REAL | **stmean1,<br>stmean2** | **stmean1,<br>stmean2** | | **$\bar{x}_1$, $\bar{x}_2$** |
| sample standard deviation of x<br>for sample 1 and sample 2<br>    REAL | **stSx1,<br>stSx2** | **stSx1,<br>stSx2** | | **Sx1,<br>Sx2** |
| number of data points for<br>sample 1 and sample 2<br>    REAL | **stn1, stn2** | **stn1, stn2** | | **n1, n2** |
| pooled standard deviation<br>    REAL | **stSxp** | **stSxp** | **stSxp** | **SxP** |
| estimated sample proportion<br>    REAL | **stphat** | **stphat** | | **$\hat{p}$** |
| estimated sample proportion<br>for population 1<br>    REAL | **stphat1** | **stphat1** | | **$\hat{p}_1$** |
| estimated sample proportion<br>for population 2<br>    REAL | **stphat2** | **stphat2** | | **$\hat{p}_2$** |
| confidence interval pair<br>    REAL | | **stLOWER,<br>stUPPER** | | **lower,<br>upper** |
| mean of x values<br>    REAL | **stxbar** | **stxbar** | | **$\bar{x}$** |
| sample standard deviation of x<br>    REAL | **stSx** | **stSx** | | **Sx** |

| Variables and Catalog / Variables Menu | TI-86 Variables | | | |
| --- | --- | --- | --- | --- |
| | Tests | Intervals | TLinR, ANOVA | Math Symbols |
| number of data points<br>REAL | **stn** | **stn** | | **n** |
| standard error about the line<br>REAL | | | **sts** | **s** |
| regression/fit coefficients<br>STAT | | | **a, b** | **a, b** |
| correlation coefficient<br>REAL | | | **str** | **r** |
| coefficient of determination<br>REAL | | | **stlrsqr** | **r²** |
| regression equation<br>STAT | | | **RegEQ** | **RegEQ** |
| factor DF, degrees of freedom<br>REAL | | | **stfDF** | **DF** |
| factor SS, sum of square<br>REAL | | | **stfSS** | **SS** |
| factor MS, mean square<br>REAL | | | **stfMS** | **MS** |
| error DF, degrees of freedom<br>REAL | | | **steDF** | **DF** |
| error SS, sum of square<br>REAL | | | **steSS** | **SS** |
| error MS, mean square<br>REAL | | | **steMS** | **MS** |

# Distribution (DISTR) Functions

## STAT DISTR (Inferential Statistics Distribution) Menu    [2nd] [MATH] [MORE] [F2] [F2]

| TESTS | DISTR | DRAW | FUNC | Uninst | ▶ | RsltOn | RsltOf | | | |
|-------|-------|------|------|--------|---|--------|--------|------|------|------|
| nmpdf | nmcdf | invnm | tpdf | tcdf | ▶ | chipdf | chicdf | Fpdf | Fcdf | bipdf |
| | | | | | ▶ | bicdf | pspdf | pscdf | gepdf | gecdf |

| Instruction | Function |
|-------------|----------|
| **nmpdf** | Normal probability density |
| **nmcdf** | Normal distribution probability |
| **invnm** | Inverse cumulative normal distribution |
| **tpdf** | Student-*t* probability density |
| **tcdf** | Student-*t* distribution probability |
| **chipdf** | Chi-square probability density |
| **chicdf** | Chi-square distribution probability |
| **Fpdf** | F probability density |
| **Fcdf** | F distribution probability |
| **bipdf** | Binomial probability |
| **bicdf** | Binomial cumulative density |
| **pspdf** | Poisson probability |
| **pscdf** | Poisson cumulative density |
| **gepdf** | Geometric probability |
| **gecdf** | Geometric cumulative density |

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

### nmpdf

Computes the probability density function (pdf) for the normal distribution at a specified *x* value. The defaults are mean $\mu=0$ and standard deviation $\sigma=1$. To plot the normal distribution, paste **nmpdf** to the y= editor. The pdf is:

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

**nmpdf(**$x$[,$\mu$,$\sigma$]**)**

*For plotting the normal distribution, you can set window variables **xMin** and **xMax** so that the mean $\mu$ falls between them, and then press [GRAPH] [F3] [MORE] [F1] to fit the graph in the window.*
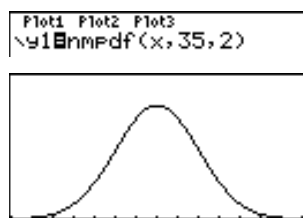


**Note:** For this example,
**xMin = 28**
**xMax = 42**
**xScl = 1**
**yMin = 0**
**yMax = .25**
**yScl = 1**
**xRes = 1**

### nmcdf

Computes the normal distribution probability between *lowerbound* and *upperbound* for the specified mean $\mu$ and standard deviation $\sigma$. The defaults are $\mu=0$ and $\sigma=1$.

**nmcdf(***lowerbound,upperbound*[,$\mu$,$\sigma$]**)**

```
nmcdf(-1E99,36,35,2)
        .691462467787
```

### invnm

Computes the inverse cumulative normal distribution function for a given *area* under the normal distribution curve specified by mean $\mu$ and standard deviation $\sigma$. 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 $\mu=0$ and $\sigma=1$.

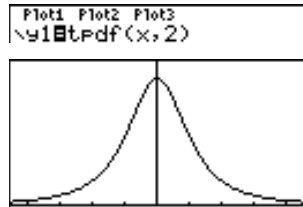**invnm(***area*[,$\mu$,$\sigma$]**)**

```
invnm(.6914624678,35,
2)
        36.0000000358
```

### 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 pdf is:

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

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

```
Plot1 Plot2 Plot3
\y1■tpdf(x,2)
```

**Note:** For this example,
**xMin = ⁻4.5**
**xMax = 4.5**
**xScl = 1**
**yMin = 0**
**yMax = .4**
**yScl = 1**
**xRes = 1**

### 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***)**

```
tcdf(-2,3,18)
        .965746564388
```
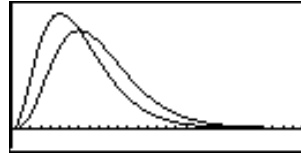
### chipdf

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

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

**chipdf(***x,df***)**



**Note:** For this example,
**xMin = 0**
**xMax = 30**
**xScl = 1**
**yMin = ‾.02**
**yMax = .132**
**yScl = 1**
**xRes = 1**

### chicdf

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

**chicdf(***lowerbound,upperbound,df***)**



### 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 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***)**
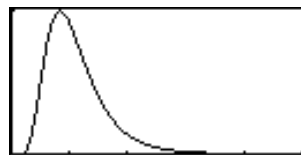


**Note:** For this example,
**xMin = 0**
**xMax = 5**
**xScl = 1**
**yMin = 0**
**yMax = 1**
**y Scl = 1**
**xRes = 1**

### 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***)**

```
Fcdf(0,2.4523,24,19)
            .974998957633
```

### bipdf

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. $0 \leq p \leq 1$ 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 pdf is:

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

where $n = numtrials$

**bipdf(***numtrials,p*[,$x$]**)**

```
bipdf(5,.6,{3,4,5})
   {.3456 .2592 .07776}
```

### bicdf

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. $0 \leq p \leq 1$ must be true. *numtrials* must be an integer > 0. If you do not specify $x$, a list of cumulative probabilities is returned.

**bicdf(***numtrials,p*[,$x$]**)**

```
bicdf(5,.6,{3,4,5})
     {.66304 .92224 1}
```

### pspdf

Computes a probability at $x$ for the discrete Poisson distribution with the specified mean $\mu$, which must be a real number > 0. $x$ can be an integer or a list of integers. The pdf is:

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

**pspdf(***$\mu,x$***)**

```
pspdf(6,10)
            .041303093412
```

### pscdf

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.

**pscdf(μ,$x$)**

```
pscdf(.126,{0,1,2,3})
{.881614846785 .9926…
```

### gepdf

Computes a probability at $x$, the number of the trial on which the first success occurs, for the discrete geometric distribution with the specified probability of success $p$. $0 \le p \le 1$ must be true. $x$ can be an integer or a list of integers. The pdf is:

$$f(x) = p(1-p)^{x-1}, x = 1,2,\dots$$

**gepdf($p$,$x$)**

```
gepdf(.4,6)
            .031104
```

### gecdf

Computes a cumulative probability at $x$, the number of the trial on which the first success occurs, for the discrete geometric distribution with the specified probability of success $p$. $0 \le p \le 1$ must be true. $x$ can be a real number or a list of real numbers.

**gecdf($p$,$x$)**

```
gecdf(.5,{1,2,3})
        {.5 .75 .875}
```

# DRAW (Distribution Shading) Functions

**STAT DRAW (Inferential Statistics Draw) Menu**   [2nd] [MATH] [MORE] [F2] [F3]

| TESTS | DISTR | DRAW | FUNC | Uninst | ▶ | RsltOn | RsltOf | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ShdN | Shdt | ShdChi | ShdF | | ▶ | | | | | |

| Instruction | Function |
|---|---|
| **ShdN** | Shades normal distribution |
| **Shdt** | Shades Student-*t* distribution |
| **ShdChi** | Shades $\chi^2$ distribution |
| **ShdF** | Shades F distribution |

DRAW instructions draw various types of density functions, shade the area specified by *lowerbound* and *upperbound*, and display the computed area value.

Before you execute a DRAW instruction:

• Set the window variables so the desired distribution fits the screen.
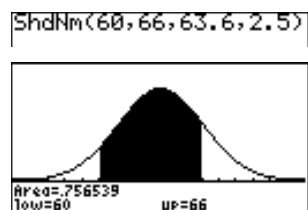• Turn off the y= functions.

To clear the drawings, select **CLDRW** from the GRAPH DRAW menu.

To remove the menu from a drawing, press [CLEAR].

### ShdN

Draws the normal density function specified by mean $\mu$ and standard deviation $\sigma$ and shades the area between *lowerbound* and *upperbound*. The defaults are $\mu=0$ and $\sigma=1$.

**ShdN(**lowerbound,upperbound[,$\mu$,$\sigma$]**)**



**Note:** For this example,
**xMin = 55**
**xMax = 72**
**xScl = 1**
**yMin = ⁻.05**
**yMax = .2**
**yScl = 1**
**xRes = 1**

### Shdt

Draws the density function for the Student-*t* distribution specified by *df* (degrees of freedom) and shades the area between *lowerbound* and *upperbound*.

**Shdt(**lowerbound,upperbound,df**)**
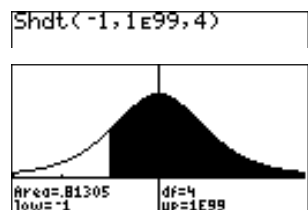


**Note:** For this example,
**xMin = ⁻3**
**xMax = 3**
**xScl = 1**
**yMin = ⁻.15**
**yMax = .5**
**yScl = 1**
**xRes = 1**

### ShdChi

Draws the density function for the $\chi^2$ (chi-square) distribution specified by *df* (degrees of freedom) and shades the area between *lowerbound* and *upperbound*.

**ShdChi(***lowerbound,upperbound,df***)**

```
ShdChi(0,4,10)
```



```
Area=.052653    df=10
low=0           up=4
```
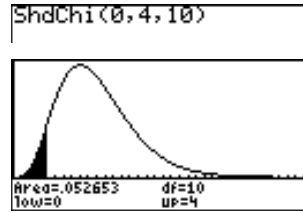
**Note:** For this example,
**xMin = 0**
**xMax = 35**
**xScl = 1**
**yMin = ⁻.025**
**yMax = .1**
**yScl = 1**
**xRes = 1**

### ShdF

Draws the density function for the F distribution specified by *numerator df* (degrees of freedom) and *denominator df* and shades the area between *lowerbound* and *upperbound*.

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

```
ShdF(1,2,10,15)
```



```
Area=.37534
low=1           up=2
```
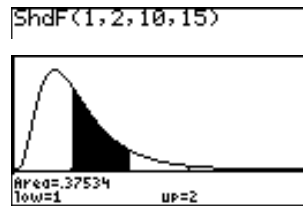
**Note:** For this example,
**xMin = 0**
**xMax = 5**
**xScl = 1**
**yMin = ⁻.25**
**yMax = .9**
**yScl = 1**
**xRes = 1**

# FUNC (Function) Parameters

## STAT FUNC (Inferential Statistics Functions) Menu    [2nd] [MATH] [MORE] [F2] [F4]

| TESTS | DISTR | DRAW | FUNC | Uninst |
|-------|-------|------|------|--------|
| Ztest | TTest | ZSam2 | Tsam2 | ZPrp1 |

| RsltOn | RsltOf | | | |
|--------|--------|-------|--------|-------|
| ZPrp2 | ZIntl | TIntl | ZInt2 | TInt2 |
| ZPln1 | ZPln2 | Chitst | FSam2 | TLinR |
| ANOVA | | | | |

| Test Name | Function |
|-----------|----------|
| **ZTest** | Test for $1 \mu$, known $\sigma$ |
| **TTest** | Test for $1 \mu$, unknown $\sigma$ |
| **ZSam2** | Test comparing $2 \mu$'s, known $\sigma$'s |
| **Tsam2** | Test comparing $2 \mu$'s, unknown $\sigma$'s |
| **ZPrp1** | Test for 1 proportion |
| **ZPrp2** | Test comparing 2 proportions |
| **ZIntl** | Confidence interval for $1 \mu$, known $\sigma$ |
| **TIntl** | Confidence interval for $1 \mu$, unknown $\sigma$ |
| **ZInt2** | Confidence interval for difference of $2 \mu$'s, known $\sigma$'s |
| **TInt2** | Confidence interval for difference of $2 \mu$'s, unknown $\sigma$'s |
| **ZPln1** | Confidence interval for 1 proportion |
| **ZPln2** | Confidence interval for difference of 2 proportions |
| **Chitst** | Chi-square test for 2-way tables |
| **FSam2** | Test comparing $2 \sigma$'s |
| **TLinR** | $t$-test for regression slope and $\rho$ |
| **ANOVA** | One-way analysis of variance |

You can bypass the inferential statistics editors and paste a hypothesis test or confidence interval instruction to the home screen. This section provides the parameters of each STAT FUNC instruction.

- Instructions that offer the **Data/Stats** input choice show both sets of input parameters.
- Instructions that do not offer the **Data/Stats** input choice show one set of input parameters.

The following table lists the function arguments alphabetically.

| Function Argument and Result |
| --- |

**ANOVA(**$list1,list2$[$,list3,...,list20$]**)**

> Performs a one-way analysis of variance for comparing the means of 2 to 20 populations.

**Chitst(**$observedmatrix,expectedmatrix$[$,drawflag$]**)**

> Performs a chi-square test. $drawflag$=**1** draws results; $drawflag$=**0** calculates results.

**FSam2** $listname1,listname2,$[$freqlist1,freqlist2,alternative,drawflag$]

where $listname1,listname2$ refers to lists you have created in the list editor.

> Performs a two-sample F-test. $alternative$= ⁻**1** is < ; $alternative$=**0** is ≠ ; $alternative$=**1** is >. $drawflag$=**1** draws results; $drawflag$=**0** calculates results.

**FSam2** $Sx1,n1,Sx2,n2$[$,alternative,drawflag$]

where $Sx1,n1,Sx2,n2$ refers to summary statistics that you must enter.

> Performs a two-sample F-test. $alternative$= ⁻**1** is < ; $alternative$=**0** is ≠ ; $alternative$=**1** is >. $drawflag$=**1** draws results; $drawflag$=**0** calculates results.

**TInt2** $listname1,listname2$[$,freqlist1,freqlist2,confidence\ level,pooled$]

where $listname1,listname2$ refers to lists you have created in the list editor.

> Computes a two-sample $t$ confidence interval. $pooled$=**1** pools variances; $pooled$=**0** does not pool variances.

**TInt2** $\bar{x}1,Sx1,n1,\bar{x}2,Sx2,n2$[$,confidencelevel,pooled$]

where $\bar{x}1,Sx1,n1,\bar{x}2,Sx2,n2$ refers to summary statistics that you must enter.

> Computes a two-sample $t$ confidence interval. $pooled$=**1** pools variances; $pooled$=**0** does not pool variances.

**TIntl** $listname,$[$freqlist,confidence\ level$]

where $listname$ refers to a list you have created in the list editor.

> Computes a $t$ confidence interval.

**TIntl** $\bar{x},Sx,n$[$,confidence\ level$]

where $\bar{x},Sx,n$ refers to summary statistics that you must enter.

> Computes a $t$ confidence interval.

**TLinR** $Xlistname,Ylistname,$[$freqlist,alternative,regequ$]

where $Xlistname,Ylistname$ refers to lists you have created in the list editor.

> Performs a linear regression and a $t$-test. $alternative$= ⁻**1** is < ; $alternative$=**0** is ≠ ; $alternative$=**1** is >.

**Tsam2** $listname1,listname2,$[$freqlist1,freqlist2,alternative,pooled,drawflag$]

where $listname1,listname2$ refers to lists you have created in the list editor.

> Computes a two-sample $t$-test. $alternative$= ⁻**1** is < ; $alternative$=**0** is ≠ ; $alternative$=**1** is >. $pooled$=**1** pools variances; $pooled$=**0** does not pool variances. $drawflag$=**1** draws results; $drawflag$=**0** calculates results.

| Function Argument and Result |
| --- |

**Tsam2** $\overline{x}1,Sx1,n1,\overline{x}2,Sx2,n2$[,*alternative,pooled,drawflag*]

where $\overline{x}1,Sx1,n1,\overline{x}2,Sx2,n2$ refers to summary statistics that you must enter.

> Computes a two-sample *t*-test. *alternative*= ⁻**1** is < ; *alternative*=**0** is ≠ ; *alternative*=**1** is >. *pooled*=**1** pools variances; *pooled*=**0** does not pool variances. *drawflag*=**1** draws results; *drawflag*=**0** calculates results.

**TTest** $\mu0,listname$[,*freqlist,alternative,drawflag*]

where $\mu0,listname$ refers to the hypothesized value and to a list you have created in the list editor.

> Performs a *t*-test with frequency *freqlist. alternative*= ⁻**1** is < ; *alternative*=**0** is ≠ ; *alternative*=**1** is >. *drawflag*=**1** draws results; *drawflag*=**0** calculates results.

**TTest** $\mu0, \overline{x},Sx,n$[,*alternative,drawflag*]

where $\mu0, \overline{x},Sx,n$ refers to summary statistics that you must enter.

> Performs a *t*-test with frequency *freqlist. alternative*= ⁻**1** is < ; *alternative*=**0** is ≠ ; *alternative*=**1** is >. *drawflag*=**1** draws results; *drawflag*=**0** calculates results.

**ZInt2(**$\sigma_1 ,\sigma_2,listname1,listname2$[,*freqlist1,freqlist2,confidence level*]**)**

where $\sigma_1 ,\sigma_2,listname1,listname2$ refers to the known population standard deviations (from the first and second populations) and lists you have created in the list editor.

> Computes a two-sample *Z* confidence interval.

**ZInt2(**$\sigma_1 ,\sigma_2 ,\overline{x}1,n1,\overline{x}2,n2$[,*confidence level*]**)**

where $\sigma_1 ,\sigma_2 ,\overline{x}1,n1,\overline{x}2,n2$ refers to summary statistics that you must enter.

> Computes a two-sample *Z* confidence interval.

**ZIntl** $\sigma,listname$[,*freqlist,confidence level*]

where $\sigma,listname$ refers to the known population deviation and a list you have created in the list editor.

> Computes a *Z* confidence interval.

**ZIntl** $\sigma,\overline{x},n$[,*confidence level*]
where $\sigma,\overline{x},n$ refers to summary statistics that you must enter.

> Computes a *Z* confidence interval.

**ZPIn1(**$x,n$[,*confidence level*]**)**

> Computes a one-proportion *Z* confidence interval.

**ZPIn2(**$x1,n1,x2,n2$[,*confidence level*]**)**

> Computes a two-proportion *Z* confidence interval.

**ZPrp1(**$p0,x,n$[,*alternative,drawflag*]**)**

> Computes a one-proportion *Z*-test. *alternative*= ⁻**1** is < ; *alternative*=**0** is ≠ ; *alternative*=**1** is >. *drawflag*=**1** draws results; *drawflag*=**0** calculates results.

**ZPrp2(**$x1,n1,x2,n2$[,*alternative,drawflag*]**)**

> Computes a two-proportion *Z*-test. *alternative*= ⁻**1** is < ; *alternative*=**0** is ≠ ; *alternative*=**1** is >. *drawflag*=**1** draws results; *drawflag*=**0** calculates results.

| Function Argument and Result |
|---|
| **ZSam2(**$\sigma_1$ ,$\sigma_2$,*listname1,listname2*[,*freqlist1,freqlist2,alternative,drawflag*]**)**<br><br>where $\sigma_1$ ,$\sigma_2$,*listname1,listname2* refers to the known population standard deviations (from the first and second populations) and lists you have created in the list editor.<br><br>      Computes a two-sample *Z*-test. *alternative*= ‾**1** is < ; *alternative*=**0** is ≠ ; *alternative*=**1** is >. *drawflag*=**1** draws results; *drawflag*=**0** calculates results. |
| **ZSam2(**$\sigma_1$ ,$\sigma_2$ ,$\overline{x}1$,*n1*,$\overline{x}2$,*n2*[,*alternative,drawflag*]**)**<br><br>where $\sigma_1$ ,$\sigma_2$ ,$\overline{x}1$,*n1*,$\overline{x}2$,*n2* refers to summary statistics that you must enter.<br><br>      Computes a two-sample *Z*-test. *alternative*= ‾**1** is < ; *alternative*=**0** is ≠ ; *alternative*=**1** is >. *drawflag*=**1** draws results; *drawflag*=**0** calculates results. |
| **ZTest(**$\mu0$,$\sigma$,*listname*[,*freqlist,alternative,drawflag*]**)**<br><br>where $\mu0$,$\sigma$,*listname* refers to the hypothesized value, the known population deviation, and a list you have created in the list editor.<br><br>      Performs a *Z*-test with frequency *freqlist*. *alternative*= ‾**1** is < ; *alternative*=**0** is ≠ ; *alternative*=**1** is >. *drawflag*=**1** draws results; *drawflag*=**0** calculates results. |
| **ZTest(**$\mu0$,$\sigma$,$\overline{x}$,*n*[,*alternative,drawflag*]**)**<br><br>where $\mu0$,$\sigma$,$\overline{x}$,*n* refers to summary statistics that you must enter.<br><br>      Performs a *Z*-test. *alternative*= ‾**1** is < ; *alternative*=**0** is ≠ ; *alternative*=**1** is >. *drawflag*=**1** draws results; *drawflag*=**0** calculates results. |

# Menu Map for Inferential Statistics and Distribution Functions

**MATH menu (where STAT is automatically placed)** 2nd [MATH]

| NUM | PROB | ANGLE | HYP | MISC | ▶ | INTER | STAT | | | |
|-----|------|-------|-----|------|---|-------|------|---|---|---|

**(MATH) STAT (Inferential Statistics and Distribution) Menu** 2nd [MATH] MORE F2

| TESTS | DISTR | DRAW | FUNC | Uninst | ▶ | RsltOn | RsltOf | | | |
|-------|-------|------|------|--------|---|--------|--------|---|---|---|

**STAT TESTS (Inferential Statistics Tests) Menu** 2nd [MATH] MORE F2 F1

| TESTS | DISTR | DRAW | FUNC | Uninst | ▶ | RsltOn | RsltOf | | | |
|-------|-------|-------|-------|--------|---|--------|--------|-------|-------|-------|
| ZTest | Ttest | Zsam2 | Tsam2 | ZPrp1 | ▶ | ZPrp2 | ZIntl | TIntl | ZInt2 | TInt2 |
| | | | | | ▶ | ZPin1 | ZPin2 | Chitst | FSam2 | TLinR |
| | | | | | ▶ | ANOVA | | | | |

**STAT DISTR (Inferential Statistics Distribution) Menu** 2nd [MATH] MORE F2 F2

| TESTS | DISTR | DRAW | FUNC | Uninst | ▶ | RsltOn | RsltOf | | | |
|-------|-------|------|------|--------|---|--------|--------|------|------|-------|
| nmpdf | nmcdf | invnm | tpdf | tcdf | ▶ | chipdf | chicdf | Fpdf | Fcdf | bipdf |
| | | | | | ▶ | bicdf | pspdf | pscdf | gepdf | gecdf |

**STAT DRAW (Inferential Statistics Draw) Menu** 2nd [MATH] MORE F2 F3

| TESTS | DISTR | DRAW | FUNC | Uninst | ▶ | RsltOn | RsltOf | | | |
|-------|-------|--------|------|--------|---|--------|--------|---|---|---|
| ShdN | Shdt | ShdChi | ShdF | | ▶ | | | | | |

**STAT FUNC (Inferential Statistics Functions) Menu** 2nd [MATH] MORE F2 F4

| TESTS | DISTR | DRAW | FUNC | Uninst | ▶ | RsltOn | RsltOf | | | |
|-------|-------|-------|-------|--------|---|--------|--------|--------|-------|-------|
| ZTest | Ttest | ZSam2 | Tsam2 | ZPrp1 | ▶ | ZPrp2 | ZIntl | TIntl | ZInt2 | TInt2 |
| | | | | | ▶ | ZPIn1 | ZPIn2 | Chitst | FSam2 | TLinR |
| | | | | | ▶ | ANOVA | | | | |