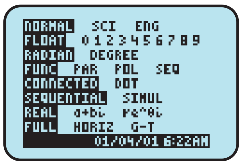
# TI-83/TI-84 Plus Reference

Pearson

Created in conjunction with Texas Instruments

## Calculator Initial Setup and Basic Operation

**MODE SETTINGS** Turn the calculator on by pressing the ON key. Press MODE to access these settings:




To change any setting to those shown here, use the arrow keys ▽ ◁ ▷ △ to highlight the correct option, then press ENTER to make the change. Press CLEAR when done.

**SCREEN BRIGHTNESS** Increase darkness of the display by pressing 2ND, then pressing and holding the up arrow key △. Decrease darkness of the display by pressing 2ND, then pressing and holding ▽.

**TURN OFF CALCULATOR** Turn the calculator off by pressing 2ND, then ON.

**CLEAR SCREEN** Press CLEAR to clear the screen.

If an entry is required and CLEAR doesn't work, select the QUIT option by pressing 2ND MODE.

**ACCESSING FUNCTIONS ABOVE KEYS** The 2ND key enables the function or character with the same color printed above other keys.

*Example:* The distribution menu is identified by DISTR printed above the VARS key in the same color as the 2ND key, so access the DISTR menu by pressing 2ND VARS.

**ACCESSING ALPHA CHARACTERS ABOVE KEYS** The ALPHA key enables the alphabet characters printed above other keys. *Example:* Press ALPHA 1 to display the character Y.

**MATH OPERATIONS** Use + × − ÷ for addition, multiplication, subtraction, division. Press ENTER to evaluate.

*Example:* To evaluate $5 \times 4$, press 5 × 4 ENTER to get the result of 20.

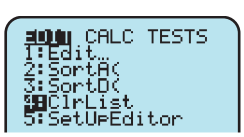
> **NOTE** Use − for *subtraction*, as in $8 - 3$.
> Use (−) for *negative sign*, as in $^{-}5$.

**POWER/EXPONENT** Use ^ for an exponent.
*Example:* To evaluate $2^3$, press 2 ^ 3 ENTER to obtain the result of 8.

## Lists of Data

**CLEARING AND ENTERING LISTS** L1, L2, L3, L4, L5, L6 can be used to enter and store lists of data. *Hint:* Clear lists before entering data.

**CLEAR LISTS** Press STAT to get the menu in the screen shown here. Press ▽ to scroll down and select **4:ClrList**, then press ENTER. The screen should display ClrList. Enter the lists to be cleared, separated by commas.

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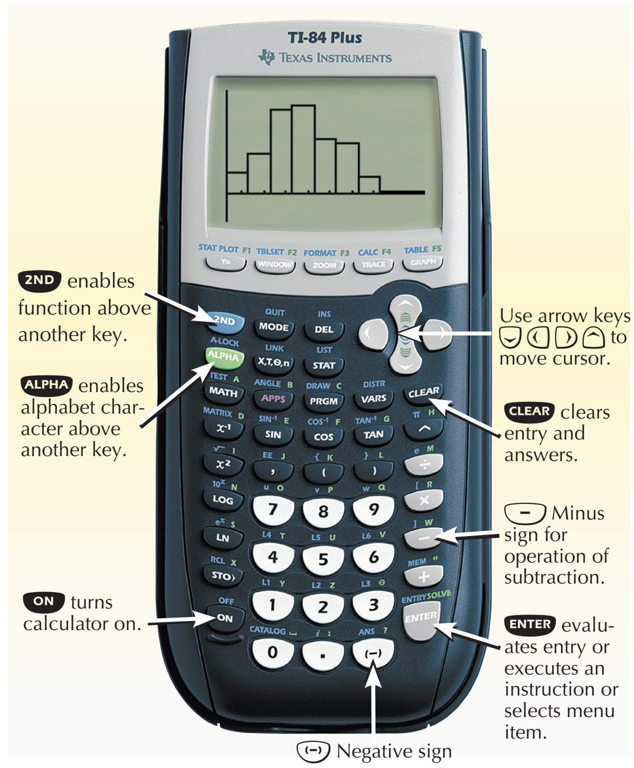
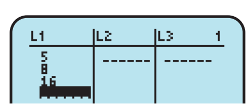



*Example:* To clear lists L1 and L2, select the ClrList menu item and then press 2ND 1 , 2ND 2. Press ENTER to execute.

**ENTER AND STORE DATA IN A LIST** To enter and store data in any of the six lists L1, L2, L3, L4, L5, L6, press STAT, then select the default menu item of EDIT by pressing ENTER. Use the arrow keys to move the cursor to the desired list. Enter a value and press ENTER, enter another value and press ENTER, and so on, until all data values have been entered. To exit the list screen, select QUIT by pressing 2ND MODE.

*Example:* To enter the values 5, 8, 16 in list L1, the screen should appear as shown below.

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**SORTING A LIST OF DATA** To sort (arrange in order) a list of data, press STAT, then use the arrow keys to select **SortA(** if an ascending order is desired, or select **SortD(** if a descending order is desired. Press ENTER, then enter the list name.

*Example:* To sort the data in list L1 in ascending order, enter **SortA(L1)** and press ENTER.

**NAMING A LIST OF DATA** Lists L1, L2, L3, L4, L5, L6 are likely to be used often, but they do not have meaningful names. To store a list with a meaningful name, save the list with a name by using the STO› key.

*Example:* To store the data in L1 as a list with the name of AGE, enter L1 → AGE by pressing the sequence of keys indicated here:

| L1 | → | A | G | E |
|---|---|---|---|---|
| 2ND 1 | STO› | ALPHA MATH | ALPHA TAN | ALPHA 0. |

The list of data named AGE will be stored until it is removed.

**RETRIEVING A NAMED LIST OF DATA** To retrieve a named list of data, access the LIST menu by pressing 2ND STAT, then use the down arrow key ⌄ to scroll to the desired list, then press ENTER ENTER. The data will be displayed in one or more rows enclosed within a set of braces. The named list can be used with other functions, such as the construction of a confidence interval or a hypothesis test.

**DELETING A NAMED LIST** *Hint:* Depending on the calculator model, storing too much data can create memory problems, so it is wise to delete any lists that are obsolete. Follow these steps to delete a named list from memory.

1. Access the MEM (memory) menu by pressing 2ND +.
2. Use the down arrow key to scroll to **2:Mem Mgmt/Del,** then press ENTER.
3. Scroll to **4:List** as shown in the screen at the right.
4. Press ENTER.
5. Scroll to the name of the list to be deleted.
6. Press DEL and the named list will be deleted from memory.


## Apps (Applications)

Some earlier editions of the Triola statistics series come with a CD-ROM that includes an app consisting of the lists of data found in Appendix B. An app can be downloaded to the calculator, so that the lists of data sets are available for the entire course. (The TI-83 does not allow the use of apps.) Download instructions can be obtained from the Texas Instruments Web site. Refer to Appendix B in the textbook for the names of the individual lists.

## Graphs: Initial Setup

Many graphing difficulties can be avoided by performing an initial setup consisting of these two steps:

1. Press the Y= key, and then press CLEAR to delete any existing expressions, so that the screen appears as shown below. Then select QUIT by pressing 2ND MODE.


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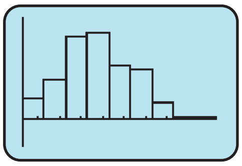
2. Select **STAT PLOTS** by pressing 2ND Y=. Verify that only the first plot is in the On state, as shown below. If any other plot is On, change it to Off by scrolling to it, pressing ENTER, then scrolling to the right to highlight **Off**. Then press ENTER and select QUIT by pressing 2ND MODE.

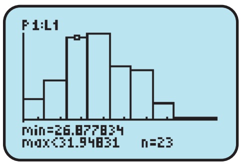

## Histogram

1. Enter the data values and store them as a list, such as L1 or a named list, such as AGE. Also, perform the initial setup described in the preceding two steps.
2. Select the **STAT PLOTS** menu by pressing 2ND Y=. The screen should appear as shown in step 2 above.
3. Press ENTER.
4. Be sure that the Plot1 screen is On. Use the arrow keys to select the type of graph. The screen below shows the histogram highlighted, as it should be.


5. For the Xlist entry, enter the label or name of the list containing the data to be graphed. The above screen shows that the histogram will be graphed using the data in list L1.
6. For the Freq (frequency) entry, enter 1 so that each value is used once.
7. Press ZOOM 9 to select **ZoomStat**, which allows the calculator to determine the class width and boundaries.

Shown below is a typical histogram. By pressing TRACE and using the arrow keys, heights of the bars can be identified. The second display shows that the third class has frequency $n = 23$ and includes values greater than or equal to 26.877834 (indicated by min = 26.877834) and less than 31.94831 (indicated by max < 31.94831). To use your own class width and boundaries, press WINDOW and make your own entries (where Xscl is the bar width), then press GRAPH.

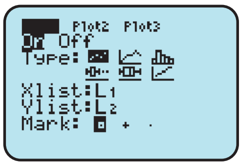




## Scatterplot

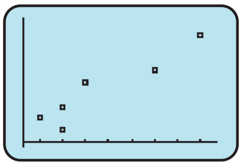
A scatterplot requires paired data, so enter the data in two lists, such as L1 and L2. Named lists can also be used.

1. Enter the paired data in two lists, such as L1 and L2. Also, perform the initial setup described under the heading of Graphs: Initial Setup.
2. Select the **STAT PLOTS** menu by pressing 2ND Y=.
3. Press ENTER.
4. Be sure that the Plot1 screen is On. Use the arrow keys to select the type of graph. The screen at the right shows the generic scatterplot highlighted, as it should be.



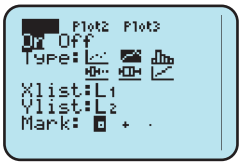

5. For the Xlist entry, enter the label or name of the list containing the data to be used for the *x* variable. For the Ylist entry, enter the label or name of the list containing the data to be used for the *y* variable. The above screen shows that the scatterplot will be graphed using the data in lists L1 and L2.
6. For the bottom item of Mark, select the character to be used for plotting the points in the scatterplot.
7. Press ZOOM 9 to select **ZoomStat**, which allows the calculator to automatically select settings that allow the graph to fit the screen. (To use your own settings, press WINDOW, enter your own settings, then press GRAPH.)

Shown here is a typical scatterplot. By pressing TRACE and using the arrow keys, coordinates of individual points can be identified.



## Frequency Polygon

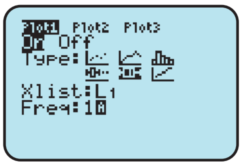
1. First, manually construct a frequency distribution as a table with class midpoint values listed in the first column and the corresponding class frequencies listed in the second column.
2. Enter the class midpoint values in list L1.
3. Enter the class frequencies in list L2.
4. Select the **STAT PLOTS** menu by pressing 2ND Y=.
5. Press ENTER.
6. Make the selections shown in the screen below.




7. Press ZOOM 9 to select **ZoomStat**, which allows the calculator to automatically use settings that allow the graph to fit the screen.

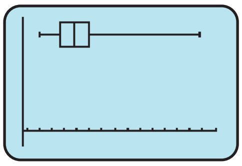
## Boxplot

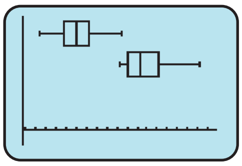
1. To obtain a boxplot from a single list of values, enter the data values and store them as a list, such as L1 or a named list, such as AGE. Also, perform the initial setup described under the heading of Graphs: Initial Setup.
2. Select the **STAT PLOTS** menu by pressing 2ND Y=.
3. Press ENTER.
4. Be sure that the Plot1 screen is On. Use the arrow keys to select the boxplot as shown in the screen below.



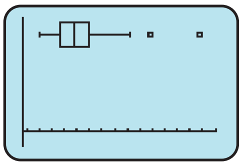

5. For the Xlist entry, enter the label or name of the list containing the data to be graphed. The above screen shows that the boxplot will be graphed using the data in list L1. By selecting the generic boxplot in the middle of the second row of the graph types, you are selecting the basic boxplot described in the textbook. If you select the other boxplot, the result will be a *modified boxplot*, which shows outliers.
6. For the Freq (frequency) entry, enter 1 so that each value is used once.
7. Press ZOOM 9 to select **ZoomStat**, which allows the calculator to automatically select settings that allow the graph to fit the screen.

To obtain boxplots for two or three lists of data, follow the above steps, but turn on Plot2 and/or Plot3. Use Plot2 and/or Plot3 to set up boxplots for the additional data sets. Shown below is a screen showing a single boxplot, along with another screen showing two boxplots. Whether using one, two, or three boxplots, press TRACE and use the arrow keys to see values of the minimum, maximum, and quartiles.





The screen shown below is an example of a *modified boxplot*. The points at the right are outliers.



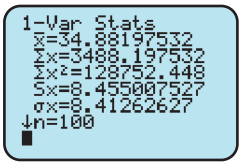
**HINT** Comparisons of two or three data sets are made easier if the boxplots are graphed in the same window.

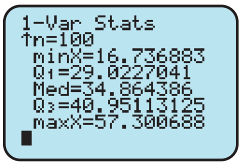
## Descriptive Statistics

**FROM A LIST OF DATA** Use the following procedure to find statistics including the mean, standard deviation, and the five-number summary.

1. Enter the data in a list, such as L1. A named list, such as AGE, can also be used.
2. Press STAT.
3. Use the right or left arrow keys to select the menu item of **CALC**, as shown in the screen below.


4. Select the first menu item of **1-Var Stats** by simply pressing ENTER (because that option is the default).
5. The screen should display 1-Var Stats, and we must now identify the list to be used for the calculations. Enter the label or name, such as L1 or AGE, then press ENTER.
6. There are more results than can be shown on one screen, so press ▽ to scroll down to the remaining results. Shown below are typical results.




*Interpret* the results: Sx is the *sample* standard deviation, and σx is the *population* standard deviation. Introductory statistics courses usually use the sample standard deviation for most applications, so the value of Sx is usually preferred.

**FROM A FREQUENCY DISTRIBUTION** If the data are summarized in the form of a frequency distribution table, use the following procedure.

1. Enter the class midpoints in list L1.
2. Enter the corresponding class frequencies in list L2.
3. Follow the above six steps for obtaining descriptive statistics from a single list of data, but make this change: In step 5 above, enter L1, L2 (including the comma). Before pressing ENTER in step 5 above, the screen should display **1-Var Stats L1, L2**.
4. Press ENTER and the results will be displayed.

## Counting Formulas

**Factorials** For *n*!, first enter *n*, then press MATH and use the arrow keys to select **PRB**. Select **!** and press ENTER ENTER.

**Permutations** To evaluate $_nP_r$, first enter the value of *n*, then press MATH and use the arrow keys to select **PRB**. Select $_n\mathbf{P}_r$, enter the value of *r*, then press ENTER.

**Combinations** To evaluate $_nC_r$, first enter the value of *n*, then press MATH and use the arrow keys to select **PRB**. Select $_n\mathbf{C}_r$, enter the value of *r*, then press ENTER.

## Binomial Distribution

1. Press 2ND VARS for the DISTR (distribution) menu.
2. The DISTR menu includes these two items:
   - **binompdf(** Gives binomial probabilities for *individual* values of *x*.
   - **binomcdf(** Gives *cumulative* probabilities (sum of the probabilities for values from 0 up to and including a desired value of *x*).
3. Select one of the items from step 2. Both items require an entry of *n*, *p*, and an optional entry of *x*.
   *Examples* based on $n = 8$ and $p = 0.4$:
   - binompdf(8, 0.4, 3) Provides probability for $x = 3$
   - binompdf(8, 0.4) Provides the nine probabilities for $x = 0$ through $x = 8$

**HINT** Use the format of **binompdf(n, p, x)**, which corresponds to the binomial probability formula.

## Poisson Distribution

1. Press 2ND VARS for the DISTR (distribution) menu.
2. Select **poissonpdf**, which is used with the format of **poissonpdf(μ, x)**, where *x* is the number of successes.

*Example:* **poissonpdf(0.929, 2)** yields the Poisson probability corresponding to $\mu = 0.929$ and $x = 2$.

## Normal Distribution

**FINDING AREA** To find the area under the curve of a normal probability distribution between two known values:

1. Press 2ND VARS for the DISTR (distribution) menu.
2. Select **normalcdf**, which is used with the format **normalcdf(lower bound, upper bound, μ, σ)**
3. Press ENTER and the area will be displayed.

*Example:* **normalcdf(80, 105, 100, 15)** yields the area between 80 and 105, assuming $\mu = 100$ and $\sigma = 15$.

**HINT** If there is no lower bound or no upper bound, enter a very large number, as indicated below.
- Cumulative area from the left with no actual lower bound: Enter –99999999 for the lower bound.
- Cumulative area from the right with no actual upper bound: Enter 99999999 for the upper bound.

**FINDING VALUE** To find the value of *x* corresponding to a known area of a normal probability distribution, use this procedure:

1. Press 2ND VARS for the DISTR (distribution) menu.
2. Select **invNorm**, then proceed to use the *cumulative area from the left* in this format:
   **invNorm(cumulative area from the left, μ, σ)**
3. Press ENTER and the value of *x* will be displayed.

*Example:* With $\mu = 100$ and $\sigma = 15$, the entry of **invNorm(0.90, 100, 15)** yields the value of *x* corresponding to an area of 0.90 to its left. This is the 90th percentile.

**HINT** On calculators with an APPS key, run the **CtlgHelp** App. Select an item from the DISTR menu; press + before pressing ENTER to see the format.

## Student *t* Distribution

### FINDING AREA

1. Press [2ND] [VARS] for the DISTR (distribution) menu.
2. Select **tcdf**, which is used with this format:
   **tcdf(lower bound, upper bound, df)**
3. Press [ENTER] and the area will be displayed.

*Example:* **tcdf(–1, 2, 25)** yields the area between $t = -1$ and $t = 2$, assuming that there are 25 degrees of freedom.

### FINDING VALUE

1. Press [2ND] [VARS] for the DISTR (distribution) menu.
2. Select **invT, which is used with this format:**
   **invT(cumulative area from the left, df)**

*Example:* For 5 degrees of freedom, **invT(0.95, 5)** yields the *t* value with an area of 0.95 to its left.

## Chi-Square Distribution: Finding Area

1. Press [2ND] [VARS] for the DISTR (distribution) menu.
2. Select $\chi^2$**cdf**, which is used with this format:
   $\chi^2$ **cdf(lower bound, upper bound, degrees of freedom)**
3. Press [ENTER] and the area will be displayed.

*Example:* $\chi^2$**cdf(5, 7, 3)** yields the area between 5 and 7 assuming that the number of degrees of freedom is 3.

**NOTE** There is no function for finding a value given an area under a $\chi^2$ distribution, but a program can be used instead. See, for example, Michael Lloyd's program X2AREA which is provided with the textbook.

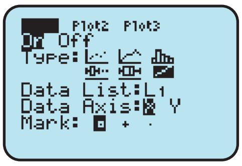
## *F* Distribution: Finding Area

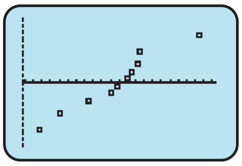
1. Press [2ND] [VARS] for the DISTR (distribution) menu.
2. Select **Fcdf**, which is used with this format:
   **Fcdf(lower bound, upper bound, num. df, den. df)**
3. Press [ENTER] and the area will be displayed.

## Assessing Normality

To determine whether sample data appears to come from a normally distributed population, construct a histogram, sort the data and examine the minimum and maximum values to identify outliers, and construct a **normal quantile plot:**

1. Select the **STAT PLOTS** menu by pressing [2ND] [Y=].
2. Press [ENTER]. With the Plot1 screen On, use the arrow keys to make the selections in the first screen below, then press [ZOOM] [9]. The result will be a normal quantile plot, as in the second screen below.



## Confidence Intervals

1. Press [STAT], then use the arrow keys to select **TESTS**.
2. Use the arrow keys to scroll to the appropriate confidence interval, then press [ENTER].

**HINT** The TESTS menu includes confidence interval functions and hypothesis testing functions. Function names ending with *Interval* (or *Int*) generate confidence interval limits, but those ending with Test are used for hypothesis tests.

### CONFIDENCE INTERVAL FOR ONE PROPORTION:

**1-PropZInt** You must know the number of successes *x* and the sample size *n*. Enter the values of *x* and *n*, enter a value for the confidence level, such as 0.95, scroll to **Calculate** and press [ENTER]. The result will consist of confidence interval limits enclosed within parentheses.

### CONFIDENCE INTERVAL ESTIMATE OF $p_1 - p_2$:

**2-PropZInt** You must know the number of successes *x* and the sample size *n* for each of the two samples. Enter those values and enter a value for the confidence level, such as 0.95, scroll to **Calculate** and press [ENTER]. The result will consist of confidence interval limits enclosed within parentheses.

### CONFIDENCE INTERVAL FOR ONE MEAN:

**ZInterval or TInterval** Use TInterval if $\sigma$ is not known (which is the usual case).

Inpt: For the first input line labeled **Inpt**, select **Data** if you have a list of data values (such as L1 or a named list such as AGE), or select **Stats** if you know the summary statistics (such as *n* and $\bar{x}$). Make the required entries, scroll to **Calculate**, then press [ENTER]. The result will consist of confidence interval limits enclosed within parentheses.

### CONFIDENCE INTERVAL ESTIMATE OF $\mu_1 - \mu_2$:

**2-SampZInt or 2-SampTInt** Use 2-SampTInt if $\sigma_1$ and $\sigma_2$ are not known.

Inpt: For the first input line labeled Inpt, select **Data** if you have the two lists of data values (such as L1and L2 or named lists such as AGE1 and AGE2), or select **Stats** if you know the summary statistics for both samples. Make the required entries and scroll to **Calculate**, then press [ENTER].

*Note:* If using 2-SampTInt, the prompt of **Pooled** requires a choice of No or Yes, so choose No if it is *not* assumed that $\sigma_1 = \sigma_2$ (so the sample variances are not pooled), but choose Yes if that assumption is made. *Recommendation:* Select No.

### CONFIDENCE INTERVAL FOR $\mu_d$ FROM MATCHED PAIRS

To obtain a confidence interval estimate of the mean difference between matched pairs ($\mu_d$), follow these steps:

1. Enter the pairs of data in lists L1 and L2.
2. Create a list of the differences by entering $L1 - L2 \rightarrow L3$ with [2ND] [1] [−] [2ND] [2] [STO›] [2ND] 3 [ENTER].
3. With the differences now stored in list L3, use **TInterval** as described above. Select the **Inpt** option of **Data**, and enter L3 on the line labeled List.

The result will be confidence interval limits for the estimate of $\mu_d$.

## Hypothesis Tests: Proportions and Means

1. Press STAT, then use the arrow keys to select **TESTS**.
2. Use the arrow keys to choose the correct test.

| | |
|---|---|
| One proportion: | **1-PropZTest** |
| Two proportions: | **2-PropZTest** |
| One mean: | **Z-Test or T-Test** (Use T-Test if $\sigma$ is not known.) |
| Two means: | **2-SampZTest or 2-SampTTest** (Use 2-SampTTest if $\sigma_1$ and $\sigma_2$ are not known.) |

3. Press ENTER.

*Notes:*

- Results include *P*-values but not critical values, so the *P*-value method of hypothesis testing is used.
- A line near the bottom of the screen of inputs will include the symbols below. Choose one of them.
  - $\neq$ Two-tailed test
  - $<$ Left-tailed test
  - $>$ Right-tailed test
- The last line provides a choice between Calculate (with results displayed) or Draw, which provides a graph with the *P*-value area shaded.
- If given a prompt of **Inpt** (input) with a choice of **Data** or **Stats**, select **Data** if the data are stored as lists, or select **Stats** if the summary statistics are already known.
- If a prompt of **Freq** (frequency) is shown, enter 1 to indicate that each sample value occurs once.
- **2-SampTTest:** If using 2-SampTTest, the prompt of **Pooled** requires a choice of No or Yes, so choose No if it is not assumed that $\sigma_1 = \sigma_2$, but choose Yes if that assumption is made. *Recommendation*: Select No so that the variances are not pooled.

## Hypothesis Test

**MATCHED PAIRS** To test a claim about the mean difference between matched pairs ($\mu_d$), follow these steps:

1. Enter the pairs of data in lists L1 and L2.
2. Create a list of the differences by entering L1 − L2 → L3, which is accomplished by pressing these keys: 2ND 1 − 2ND 2 STO 2ND 3 ENTER.
3. With the differences now stored in list L3, select **T-Test**.
4. Select the Inpt option of Data, and enter L3 on the line labeled List.
5. The prompt of $\mu$0 requests the value to be used for the mean difference, so the typical entry is 0.

**TWO VARIANCES** Press STAT, use the arrow keys to select **TESTS**, then scroll down to select **2-SampFTest**.

## Correlation and Regression

1. Enter the paired data in lists (such as L1 and L2, or named lists such as AGE and HT).
2. Press STAT, select **TESTS**, then select **LinRegTTest**.
3. For Xlist, enter the list (such as L1 or AGE) to be used for *x*.
4. For Ylist, enter the list (such as L2 or HT) to be used for *y*.
5. For Freq (frequency), enter 1.
6. For $\beta$ & $\rho$ select the option of $\neq 0$ (for a null hypothesis of $H_0$: $\rho = 0$).
7. Scroll down to **Calculate** and press ENTER. Results include intercept (*a*) and slope (*b*) of regression equation and linear correlation coefficient *r*. Results do not all fit on one screen, so scroll down to see all of the results.

more➤

## Goodness-of-Fit

**For the TI-84 Plus only.**

1. Enter observed freqs in L1 and expected freqs in L2.
2. Press STAT, select **TESTS**, and select $\chi^2$ **GOF-Test**.
3. Enter df (which is 1 less than number of categories).
4. Scroll to **Calculate** and press ENTER.

## Contingency Table

1. Access the Matrix menu by pressing 2ND $x^{-1}$. (For TI-83, press the key with **MATRIX** on its face.)
2. Use the arrow keys to select **EDIT**, then press ENTER.
3. Enter the dimensions of the contingency table, such as $2 \times 3$, then proceed to enter the table frequencies.
4. Press STAT, select **TESTS**, then select $\chi^2$**-Test**.
5. The Observed matrix should be matrix A, consisting of the observed frequencies.
6. Scroll to **Calculate** and press ENTER.

## One-Way Analysis of Variance

1. Enter the samples of data as lists, such as L1, L2, L3, or as named lists.
2. Press STAT, select **TESTS**, scroll down to **ANOVA(** and press ENTER.
3. Now enter the list labels or names, separated by commas.
   *Example:* If the sample data are in lists L1, L2, L3, enter those lists so that the screen display is **ANOVA(L1, L2, L3)**.
4. Press ENTER and the results will be displayed. The first two lines show the test statistic *F* and the *P*-value.

**NOTE** Programs are available for two-way analysis of variance, multiple regression, and some nonparametric tests.

## Generating Random Data

To generate random data, press MATH and select **PRB**.

- For data from a normal distribution, select **randNorm** and enter $\mu$, $\sigma$, and sample size *n*, all separated by commas, as in randNorm(100, 15, 50).
- For integers, select **randInt** and enter the minimum, maximum, and sample size *n*, all separated by commas, as in randInt(1, 6, 50).

*The instructions and key sequences shown for the TI-84 Plus calculator also apply to the TI-84 Plus CE, TI-84 Plus C, TI-84 Plus Silver Edition, TI-83, TI-83 Plus, and TI-83 Silver Edition.*