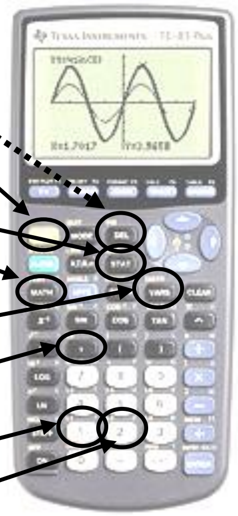
TI-83 Plus INS / DEL 2ND STAT MATH DISTR / VARS , L1 / 1 L2 / 2		**Help with function inputs:** If you have the TI-84, you can get the list of inputs for functions that don't have menus by selecting the function and then pressing the "+" key, before pressing ENTER. For many functions, a wizard helps with the entry of the parameters. Most of the wizards are more or less self-explanatory. Most of the descriptions below are for the older versions without the wizards.

How to enter data into a list (L1, L2, L3, L4, L5, or L6)**:** Use **STAT → Edit**

a. To clear existing data:
   i. Clear any existing data in the desired list by using **DEL** for each value.
   ii. Or, to delete all the data in a long list (*fast but risky*), move the cursor to the top of the list, until the list name (e.g. L1) is highlighted. Press **CLEAR**, then **ENTER**.

   [If you accidently press **DEL** instead of **CLEAR**, when the name of the list is highlighted, then that list becomes hidden. Restore the list by pressing **STAT → SetUpEditor, ENTER, ENTER**]

b. To enter new data: Type in each data point and press **ENTER** after each one.

Compute the mean, median, standard deviation, etc.:

1. After data is in a list, press: **STAT → Calc → 1 Var Stats,** then press **ENTER.**
2. If your data is in L1, press **2ND, 1,** then **ENTER**.
3. This computes the mean, standard deviation, & more. Scroll down to see it all.

Example: Enter 1, 2, 3, 4, 5 into L1 and compute the 1-variable stats:

x = 3	Mean	↑n = 5		
Σx = 15	Sum of Data Values	minX = 1	Minimum	(0%)
Σx^2 = 55	Sum of Squares of Data Values	Q1 = 1.5	1st Quartile	(25%)
Sx = 1.58	Sample Standard Deviation	Med = 3	Median	(50%)
σx = 1.41	Population Standard Deviation	Q3 = 4.5	3rd Quartile	(75%)
↓n = 5	Number of Data Values	maxX = 5	Maximum	(100%)

To **Sort** the data in a list: Use **STAT → Edit** and use the down arrow to select **SortA** & press **ENTER**. For L1, press **2ND, 1,** then **ENTER**. **SortA** sorts in ascending order; **SortD** sorts in descending order.

Histograms, Box-plots and Scatter-plots:

1. Select **STAT PLOT** (Press "**2ND**" "**Y=**", top left button).
2. Highlight Plot 1 then press ENTER.
3. Turn it "On", if needed. Select the plot type you want. If needed, change XLIST AND YLIST.
4. Press **GRAPH**. Get an appropriate scale via ZOOM → ZoomStat ENTER.
5. TRACE will identify the points on the plot.
6. WINDOW allows you to customize the axes.
7. Via FORMAT (2ND ZOOM), you can turn the grid on, turn the axes labels on.

<u>**Probability Functions**</u>

Factorial: **MATH → PRB → !**
Format: First enter "n", then select !
Example: 6! Would be 6, MATH → PRB →**!** <u>ENTER</u>, <u>ENTER</u>. Answer = 720

Combinations: **MATH → PRB → nCr.** Number of Combinations of n things taken r at a time
Format: First enter "n", then select the function "**nCr**", then enter r.
Example: $_{10}C_2$ would be 10 **nCr** 2 <u>ENTER</u>. Answer = 45

Permutations: **MATH → PRB → nPr**. Number of Permutations of n things taken r at a time
Format: First enter "n", then select the function "**nPr**", then enter r.
Example: $_{10}P_2$ would be 10 **nPr** 2 <u>ENTER</u>. Answer = 90

Probability Distribution Defined by a Table
Use L1 for the possible values. Use L2 for their probabilities (frequency distribution).
Press **STAT → Calc → 1 Var Stats, ENTER**.
On a newer model TI calculator, a wizard then appears:

The wizard is: 	Enter **L1** for the **List**. Enter **L2** for the **FreqList**. Highlight **Calculate** & press **ENTER**

On an older model TI calculator do this: Press "**L1, L2**" **ENTER**.

<u>**Theoretical Probability Distribution Functions**</u>
Press **2ND→VARS** for the **DISTR** menu.

<u>Binomial Probability Distribution Function</u>: DISTR→ **binompdf(:**
Format #1: **binompdf(***n***,** *p, x***)**
Computes the probability for exactly x successes in n trials, with a single trial probability of success = p.
Format #2: **binompdf(***n***,** *p***)**
Computes the probabilities for all values of x from 0 to n, with a single trial probability of success = p. These can then be stored into a list such as L2 via STO→L2, where L2 is selected by pressing 2ND "2".
Then you can get the mean & standard deviation of this distribution:
Enter 0 thru n into L1. Then select STAT→CALC→1-Var Stats L1,L2 ENTER.

<u>Binomial Cumulative Distribution Function</u>: DISTR→ **binomcdf(:**
Format #1: **binomcdf cdf(***n***,** *p, x***)**
Computes the cumulative probability for 0 to x successes in n trials with a single trial probability of success = p.

<u>Poisson Probability Distribution Function</u>: DISTR→ **poissonpdf(:**
Format #1: **poissonpdf cdf(**μ, *x***)**
Computes the probability for exactly x successes for a Poisson distribution with mean = μ.

<u>Poisson Cumulative Distribution Function</u>: DISTR→ **poissoncdf(:**
Format #1: **poissoncdf cdf(**μ, *x***)**
Computes the cumulative probability for 0 to x successes for a Poisson distribution with mean = μ.

Theoretical Probability Distribution Functions (cont'd)

Press **2ND→VARS** for the **DISTR** menu.

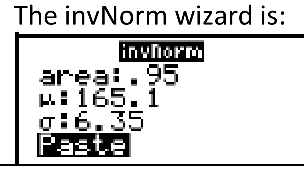
Normal Cumulative Distribution Function: DISTR→ **normalcdf(:**
Format #1: **normalcdf(***lowerbound***,** *upperbound***)**
Computes the cumulative probability (area under the curve) between lowerbound and upperbound for the standard normal distribution, which has μ=0 and σ=1.
The lower bound is typically negative; use the "(-)" key below the "3" to enter negative numbers.
The comma button is above the "7".
Enter z-scores for the lower and upper bounds.

$$z = \frac{(x-\mu)}{\sigma}$$

Format #2: **normalcdf(***lowerbound***,** *upperbound,*μ,σ**)**
Computes the cumulative probability (area under the curve) between lowerbound and upperbound for a normal distribution with mean μ and standard deviation σ.
Enter x values, not z-scores, for the lower and upper bounds.
When computing the probability for the mean of a sample, use the standard error of the mean for σ:

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

Inverse Normal Distribution: DISTR→ **invNorm(:**

Computes the inverse of the cumulative normal distribution. The output is the z-score such that the area under the curve to the left of z is the input area. The area must be between 0 and 1.	The invNorm wizard is: 

For older TI models:
Format #1: z = **invNorm (***area***)** for a standard normal distribution
Format #2: x = **invNorm (***area,*μ*,*σ**)** for a general normal distribution**.**

T-Distribution Cumulative Distribution Function: DISTR→ **tcdf(:**
Format: **tcdf(***lowerbound***,** *upperbound, df***)**
Computes the cumulative distribution probability between lowerbound and upperbound for the t-distribution, with *df* degrees of freedom. *df* = n-1, where n is the number of data in the sample.
This used when the true standard deviation, σ, is unknown. The inputs are t-statistics:

$$t = \frac{(\bar{x}-\mu)}{s_{\bar{x}}} = \frac{(\bar{x}-\mu)}{\left(\frac{s}{\sqrt{n}}\right)}, \quad \text{where } s_{\bar{x}} = \frac{s}{\sqrt{n}}$$

Inverse T-Distribution DISTR→ t = **invT(:** (TI-84 only)
Format: **invT(***area, df***)**
Computes the inverse of the cumulative t-distribution. The output is the z-score such that the area under the curve to the left of z is the input *area* for the input degrees of freedom, *df*.
The area must be between 0 and 1.

Chi-Squared Cumulative Distribution Function: DISTR→***X***^{2}**cdf(:**
Format: ***X***^{2}**cdf(***lowerbound***,** *upperbound, df***)**
Computes the cumulative distribution probability between lowerbound and upperbound for the X^2-distribution, with *df* degrees of freedom. *df* = n-1.

$$\chi^2 = \frac{(n-1)s^2}{\sigma^2}$$

<u>Confidence Intervals:</u> STAT→TESTS

All of these give you a menu to fill in.

STAT → TESTS **→ 1-PropZInt:** (one-proportion confidence interval) Computes a confidence interval for an unknown proportion (prop) of successes.

Enter these statistics:

x: __The number of “successes”.

n: __The number of items in the sample

C-Level: The confidence level (typically .90, .95, .98 or .99)

Calculate

This returns (among other things):

The confidence interval in the form (p_1, p_2)

STAT → TESTS **→ TInterval:** (one-sample t confidence interval) Computes a confidence interval for an unknown population mean μ when the population standard deviation, σ, is <u>unknown</u>.

When you know the sample mean, select:

Input: Data **<u>Stats</u>** (If “Stats” is not highlighted, then arrow to it & press ENTER)

Otherwise, select Data, and it will compute the stats from the data in a specified list.

Then enter these statistics:

$\bar{x}$: __The sample mean

Sx: __The computed standard deviation.

n: __The number of data in the sample

C-Level: The confidence level (typically .90, .95, .98 or .99)

Calculate

This returns (among other things):

The confidence interval in the form (x_1, x_2)

STAT → TESTS **→ ZInterval:** (one-sample z confidence interval) Computes a confidence interval for an unknown population mean μ when the population standard deviation, σ, is <u>known</u>.

When you know the sample mean, select:

Input: Data **<u>Stats</u>** (If “Stats” is not highlighted, then arrow to it & press ENTER)

Otherwise, select Data, and it will compute the stats from the data in a specified list.

Then enter these statistics:

σ: __The known standard deviation.

$\bar{x}$: __The sample mean

n: __The number of data in the sample

C-Level: The confidence level (typically .90, .95, .98 or .99)

Calculate

This returns (among other things):

The confidence interval in the form (x_1, x_2)

STAT → TESTS → **2-PropZInt:** (two-proportion confidence interval) Computes a confidence interval for difference between the proportions of success in two populations (p_1 - p_2).

Enter these statistics:

x1: __The number of "successes" in sample 1.
n1: __The number of items in sample 1
x2: __The number of "successes" in sample 2.
n2: __The number of items in sample 2
C-Level: The confidence level (typically .90, .95, .98 or .99)
Calculate

This returns:
The confidence interval in the form (p_1, p_2)

STAT → TESTS → **2-SampTInt:** (two-sample t confidence interval) Computes a confidence interval for difference between two population means (μ_1 - μ_2) when the population standard deviation,σ1 and σ2, are <u>unknown</u>.

When you know the sample mean, select:
Input: Data **<u>Stats</u>** (If "Stats" is not highlighted, then arrow to it & press ENTER)
Otherwise, select **Data**, and it will compute the stats from the data in a specified list.
Then enter these statistics:

$\bar{x}1$: ___The mean of sample 1
Sx2: ___The computed standard deviation.
n1: ___The number of data in sample 1
$\bar{x}2$: ___The mean of sample 2
Sx2: ___The computed standard deviation.
n2: ___The number of data in sample 2
C-Level: The confidence level (typically .90, .95, .98 or .99)
Pooled: No or Yes
Calculate

This returns (among other things):
The confidence interval in the form (x_1, x_2)

STAT → TESTS → **2-SampZInt:** (two-sample z confidence interval) Computes a confidence interval for difference between two population means (μ_1 - μ_2) when the population standard deviation,σ1 and σ2, are known.

When you know the sample means, select:
Input: Data **<u>Stats</u>** (If "Stats" is not highlighted, then arrow to it & press ENTER)
Otherwise, select Data, and it will compute the stats from the data in specified lists.
Then enter these statistics:

σ1: ___The known standard deviation for sample 1
σ2: ___The known standard deviation for sample 2
$\bar{x}1$: ___The mean of sample 1
n1: ___The number of data in sample 1
$\bar{x}2$: ___The mean of sample 2
n2: ___The number of data in sample 2
C-Level: The confidence level (typically .90, .95, .98 or .99)
Calculate

This returns (among other things):
The confidence interval in the form (x_1, x_2)

<u>Statistics Tests:</u> STAT→TESTS

All of these give you a menu to fill in.

STAT → TESTS **→ 1-PropZTest:** (one-proportion z test) Computes a test for an unknown proportion (prop) of successes. It tests the null hypothesis H_0: prop = p_0 against one of these alternatives:

· H_1: prop ≠ p_0 · H_1: prop < p_0 · H_1: prop > p_0

Enter these statistics:

p_0: ___The assumed proportion of the Null Hypothesis, H_0. (p_0 is between 0 & 1)

x: ___The number of "successes".

n: ___The number of items in the sample

prop: ≠ p_0 < p_0 > p_0 Highlight the one corresponding to your H_1 and press ENTER

Calculate / Draw: Normally, highlight "Calculate" & press ENTER.

This returns (among other things):

z – The z-score

P – The "P-Value"

STAT → TESTS **→ 2-PropZTest:** (two-proportion z test) Computes a test for an unknown proportion (prop) of successes (p_1 and p_2) from two populations. It tests the null hypothesis H_0: p1 = p2 (using the pooled sample proportion $\hat{p}$) against one of these alternatives:

· H_1: p1 ≠ p2 · H_1: p1 < p2 · H_1: p1 > p2

Enter these statistics:

x1: ___The number of "successes" in sample 1.

n1: ___The number of items in sample 1

x2: ___The number of "successes" in sample 2.

n2: ___The number of items in sample 2

p1: ≠ p2 < p2 > p2 Highlight the one corresponding to your H_1 and press ENTER

Calculate / Draw: Normally, highlight "Calculate" & press ENTER.

This returns (among other things):

z – The Z-score

P – The "P-Value"

$\hat{p}$ – The pooled (combined) sample proportion

STAT → TESTS → **T-Test:** Performs a hypothesis test for a single unknown population mean μ when the population standard deviation σ is unknown. It tests the null hypothesis H_0: $\mu=\mu_0$ against one of these alternatives:

· H_1: $\mu \neq \mu_0$ · H_1: $\mu < \mu_0$ · H_1: $\mu > \mu_0$

When you know the sample mean, select:

Inpt: Data **Stats** (If "Stats" is not highlighted, then arrow to it & press ENTER)

Otherwise, select **Data**, and it will compute the stats from the data in a specified list.

Then enter these statistics:

μ_0: ___The assumed mean of the Null Hypothesis, H_0.

$\bar{x}$: ___The sample mean

s: ___The sample's standard deviation.

n: ___The number of data in the sample

μ: $\neq\mu_0$ $< \mu_0$ $>\mu_0$ Highlight the one corresponding to your H_1 and press ENTER

Calculate or Draw: Normally, highlight "Calculate" & press ENTER.

This returns (among other things):
t – The t-test statistic
P – The "P-Value"

STAT → TESTS → **Z-Test:** Performs a hypothesis test for a single unknown population mean μ when the population standard deviation,σ, is known. It tests the null hypothesis H_0: $\mu=\mu_0$ against one of these alternatives:

· H_1: $\mu \neq \mu_0$ · H_1: $\mu < \mu_0$ · H_1: $\mu > \mu_0$

When you know the sample mean, select:

Inpt: Data **Stats** (If "Stats" is not highlighted, then arrow to it & press ENTER)

Otherwise, select **Data**, and it will compute the stats from the data in a specified list.

Then enter these stats:

μ_0: ___The assumed mean of the Null Hypothesis, H_0.

σ: ___The known standard deviation.

$\bar{x}$: ___The sample mean

n: ___The number of data in the sample

μ: $\neq\mu_0$ $< \mu_0$ $>\mu_0$ Highlight the one corresponding to your H_1 and press ENTER

ENTER

Calculate or Draw: Normally, highlight "Calculate" & press ENTER.

This returns (among other things):
z – The z-score
P – The "P-Value"

STAT → TESTS → **2-SampTTest:** (two-sample t test) Tests the equality of the means of two populations (μ_1 and μ_2) based on independent samples when <u>neither</u> population standard deviations (σ_1 and σ_2) is known. It tests the null hypothesis H_0: $\mu_1=\mu_2$ against one of these alternatives:

· H_1: $\mu_1 \neq \mu_2$ · H_1: $\mu_1 < \mu_2$ · H_1: $\mu_1 > \mu_2$

When you know the sample mean, select:

Input: Data **<u>Stats</u>** (If "Stats" is not highlighted, then arrow to it & press ENTER)

Otherwise, select **Data**, and it will compute the stats from the data in specified lists.

Then enter these statistics:

$\bar{x}1$: ___The mean of sample 1
Sx1: ___The computed standard deviation for sample 1
n1: ___The number of data in sample 1
$\bar{x}2$: ___The mean of sample 2
Sx2: ___The computed standard deviation for sample 2
n2: ___The number of data in sample 2
μ1: ≠ μ2 < μ2 >μ2 Highlight the one corresponding to your H_1 and press ENTER
Pooled: No or Yes
Calculate or Draw: Normally, highlight "Calculate" & press ENTER.

This returns (among other things):
t – The t-test statistic
P – The "P-Value"

STAT → TESTS → **2-SampZTest:** (two-sample z test) Tests the equality of the means of two populations (μ_1 and μ_2) based on independent samples when both population standard deviations (σ_1 and σ_2) are <u>known</u>. It tests the null hypothesis H_0: $\mu=\mu_0$ against one of these alternatives:

· H_1: $\mu_1 \neq \mu_2$ · H_1: $\mu_1 < \mu_2$ · H_1: $\mu_1 > \mu_2$

When you know the sample mean, select:

Input: Data **<u>Stats</u>** (If "Stats" is not highlighted, then arrow to it & press ENTER)

Otherwise, select **Data**, and it will compute the stats from the data in specified lists.

Then enter these statistics:

σ1: ___The known standard deviation for sample 1
σ2: ___The known standard deviation for sample 2
$\bar{x}1$: ___The mean of sample 1
n1: ___The number of data in sample 1
$\bar{x}2$: ___The mean of sample 2
n2: ___The number of data in sample 2
μ1: ≠ μ2 < μ2 >μ2 Highlight the one corresponding to your H_1 and press ENTER
Calculate or Draw: Normally, highlight "Calculate" & press ENTER.

This returns (among other things):
z – The z-score
P – The "P-Value"

Linear Regression

STAT→TESTS→**LinRegTTest:** (linear regression t test) Computes a linear regression on the given data for the equation y = a + bx. (Note this is different than the "LinReg" function.) It also computes the correlation coefficient, **r,** and the t-statistic, which can be used for significance. It tests the null hypothesis **H_0: ρ = 0** (equivalently, **β = 0**) against one of these alternatives:

· H_1: $\beta \neq 0$ and $\rho \neq 0$ · H_1: $\beta < 0$ and $\rho < 0$ · H_1: $\beta > 0$ and $\rho > 0$

First, you need to enter your X data in list L1 and the Y-Data in list L2. This is done through STAT→TESTS→Edit. Then, select STAT→TESTS→LinRegTTest and enter and these statistics:

Xlist: L1 (where the X data is stored)
Ylist: L2 (where the Y data is stored)
Freq: 1 (leave it at 1)
β&ρ: ≠ 0 < 0 > 0 (Generally, we'll choose ≠ 0 for the alternate hypothesis H_1: $\beta \neq 0$ and $\rho \neq 0$)
RegEq (leave it blank)
Calculate

This returns (among other things):
P – the "P-Value"
a (for y = a + bx)
b (for y = a + bx)
r^2 – square of r
r – correlation coefficient

Goodness of Fit Test

Only available on TI-84 Calculators

STAT→TESTS→**χ^2-GOFTest** (Chi-Square Goodness of Fit Test) Computes a chi-square test to determine if a given distribution fits or conforms to some claimed distribution.

First, you need to enter your observed values in list L1 and the expected values in list L2. This is done through STAT→TESTS→Edit. Then select STAT→TESTS→**χ^2-GOFTest** and enter these statistics:

Observed: L1 (where the observed frequencies are stored)
Expected: L2 (where the expected frequencies are stored)
df: ___One less than the number of categories in the sample (k – 1)
Calculate

This returns (among other things):
χ^2 – The chi-squared statistic
P – the "P-Value"

χ^2 Test for a Contingency Table

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

First, you need to enter your data into Matrix A. This is done thru MATRIX (2ND x^{-1})
Select the "ENTER" tab and press the ENTER key.
Set the size of your matrix on the first line.
Enter the data in the matrix in the lines below.

Then, select STAT→TESTS**→χ^2-Test**. This expects the following:

Observed: [A] (This is the matrix where the given data is stored)
Expected: [B] (The calculator computes the expected values here. You don't need to enter anything into B)
Calculate

This returns (among other things):
χ^2 – The chi-squared statistic
P – the "P-Value"

ANOVA Test

STAT→ TESTS→ **ANOVA** Tests the equality of three or more means.

First, you need to enter your data values in lists L1, L2, L3, etc. This is done through STAT→TESTS**→**Edit. Then select STAT→ TESTS→ **ANOVA** and enter the lists separated by commas and close the parentheses: "L1 , L2 , L3)" The results should look like: **ANOVA(**L_1**,** L_2, L_3**)** then press **ENTER**.

This returns (a bunch of stuff):
You want the P-value.

Additional TI-83/84 calculator references and tutorials:
http://education.ti.com/educationportal/sites/US/nonProductMulti/training_online_tutorials.html?bid=4
http://math.escweb.net/index.htm
http://mathbits.com/MathBits/TISection/Openpage.htm
http://www.felderbooks.com/papers/ti.html
You can download a guidebook for your TI-83/84 calculator from:
http://education.ti.com/educationportal/downloadcenter/SoftwareList.do?website=US&tabId=2&paneId=17