Appendix B Technology

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Technology Tool Cross-Reference Table

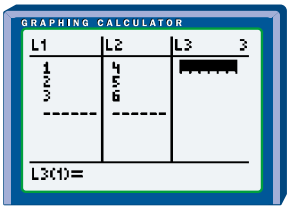
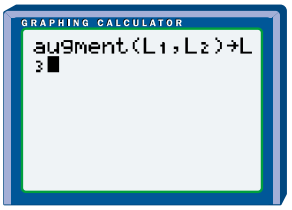
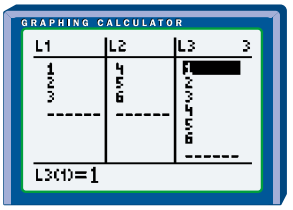
Use the terms listed in the following table to help you determine the best technology tool to use for your calculations. For details on how to use each of these terms, refer to the corresponding entry in the appropriate section of Appendix B.

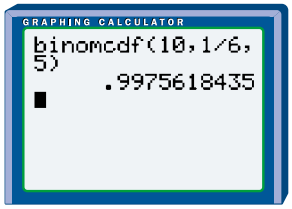
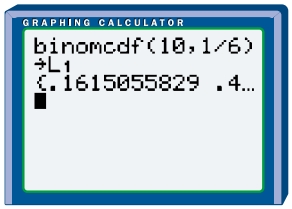
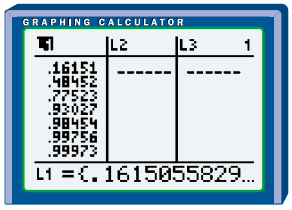
Topic	Graphing Calculator	Spreadsheets	Fathom™
Binomial Distribution	binomcdf(function binompdf(function	BINOMDIST function	binomialCumulative() function binomialProbability() function
Box-and-Whisker Plot	STAT PLOT		graph icon
Combinations	nCr function	combinations function	combinations function
Confidence Intervals	ZInterval instruction		
Correlation Coefficient	DiagnosticOn / Off LinReg instruction STAT PLOT	Chart feature CORREL function	correlation coefficient scatter plot
Factorials	! function	FACT(n) function	
Geometric Distribution	geometpdf(function		
Graphing Data	STAT PLOT TRACE instruction window settings Y= editor	Chart feature	graph icon scatter plot
Hypothesis Testing	Z-Test instruction		
Linear Regression	LinReg instruction STAT PLOT	line of best fit	linear regression
Line of Best Fit	LinReg instruction STAT PLOT	line of best fit	linear regression

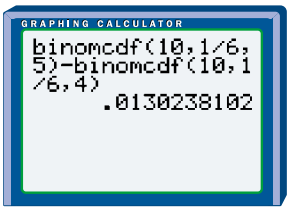
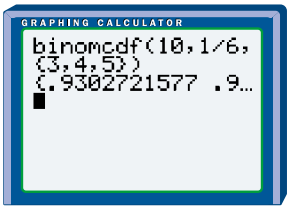
Topic	Graphing Calculator	Spreadsheets	Fathom™
Matrix Operations	copy matrices multiply matrices store matrices	Matrices: addition and subtraction inverse multiplication scalar multiplication storing transpose	
Measures of Central Tendency	mean(function median(function 1-Var Stats command	average mean median mode	mean median mode
Measures of Spread	1-Var Stats command standard deviation	standard deviation	standard deviation
Non-linear Regression	Non-linear regression: CubicReg instruction ExpReg instruction QuadReg instruction		
Normal Distribution	invNorm(function normalcdf(function normalpdf(function ShadeNorm(function	NORMDIST function	normalCumulative function normalQuantile function
Organizing Data	augment(function cumSum(function prod(function seq(function SortA(function sum(function	COUNTIF function Fill feature filtered search MAX function search Sort feature SUM function	caseIndex function case table collection count function filter inspector sort sum function uniqueRank() function
Permutations	nPr function	permutations function	
Quartiles	interquartile range semi-interquartile range 1-Var Stats command		interquartile range quartiles semi-interquartile range
Random Numbers	randInt (function randNorm(function	random integers random real numbers	random function randomInteger function randomNormal function
Rounding Numbers	round(function	INT function ROUND function	
Scatter Plots	STAT PLOT	Chart feature	graph icon scatter plot
Standard Deviation	standard deviation 1-Var Stats	standard deviation	standard deviation
Variance	1-Var Stats	variance	variance
Z-scores			zScore function

Graphing Calculator

Note: Unless otherwise stated, all keystrokes are for the TI-83 Plus or TI-83 graphing calculator.

Function or Task	Keystroke(s), Menu, or Screen
augment(function augment(listA,listB)	The augment(function found under the LIST OPS menu is used to join together the elements of list A and list B. **Example:** Select 1:Edit… from the STAT EDIT menu to create lists L1 and L2 as shown:  Press 2nd MODE to QUIT to the home screen. Press 2nd STAT ▶ to display the LIST OPS menu. Select 9:augment(and type L1 , L2). Press STO▸ L3.  Press ENTER. You can inspect L3 by selecting 1:Edit… from the STAT EDIT menu. 

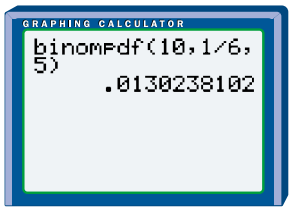
Function or Task	Keystroke(s), Menu, or Screen
binomcdf(function binomcdf(numtrials,p,x)	The binomcdf(function allows you to calculate the probability that an experiment whose only possible outcomes are success or failure, with a probability of success given by p, achieves x or fewer successes in the number of trials given by numtrials. The value for x can also be a list of numbers. If x is not specified, then a list of values from x = 0 to x = numtrials is generated. **Example 1:** A die is rolled ten times. What is the probability of getting five or fewer 2s? Press 2nd VARS to display the DISTR menu. Scroll down the screen and select A:binomcdf(. Type 10 , 1 ÷ 6 , 5) and press ENTER.  The probability is approximately 0.998. **Example 2:** To find all of the cumulative probabilities for Example 1, above, from x = 0 to x = 10 and store them in list L1, retrieve the binomcdf(function as above, but leave out the parameter x. Then, press STO▸ followed by 2nd L1 ENTER.  You can scroll through the list of probabilities using the right arrow key. You can also inspect list L1 by selecting 1:EDIT… from the STAT EDIT menu. 

Function or Task	Keystroke(s), Menu, or Screen
	Example 3: If you want only a single probability, for example, that you get exactly five 2s in ten rolls of a die, you need to subtract the cumulative probability that x = 4 from the cumulative probability that x = 5, as shown below:  *Note*: You can more easily calculate a single probability using the **binompdf(function**. **Example 4:** Suppose that you want the cumulative probabilities of getting 3, 4, or 5 twos. This can be done as follows:  *Note:* Brace brackets {} are required for the list of x values.
binompdf(function binompdf(numtrials,p,x)	The binompdf(function allows you to calculate the probability that an experiment whose only possible outcomes are success or failure, with a probability of success given by p, achieves x successes in the number of trials given by numtrials. x may also be a list of numbers. If x is not specified, then a list of values from x = 0 to x = numtrials is generated. This list can be stored in one of the graphing calculator's lists.

Function or Task	Keystroke(s), Menu, or Screen

Example 1:

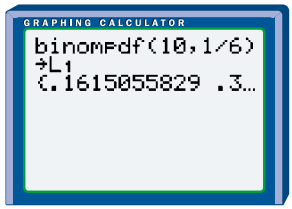
A die is rolled ten times. What is the probability of rolling exactly five 2s? Press [2nd] [VARS] to display the DISTR menu. Scroll down the screen and select 0:binompdf(. Type 10 [,] 1 [÷] 6 [,] 5 [)] and press [ENTER].



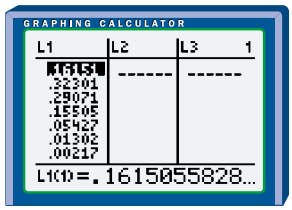
The probability is approximately 0.013.

Example 2:

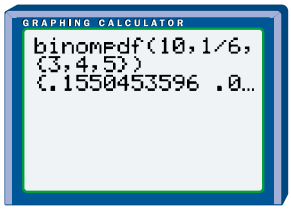
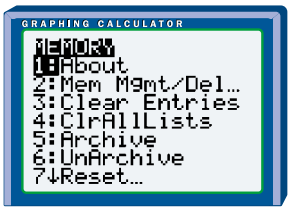
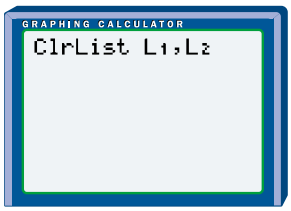
To calculate all of the probabilities for Example 1, above, from x = 0 to x = 10 and store them in list L1, retrieve the binompdf(function as above, but leave out the parameter x. Then, press [STO▸] followed by [2nd] L1 [ENTER].

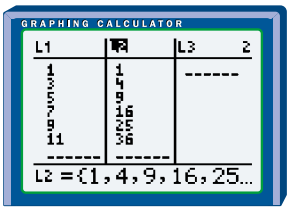


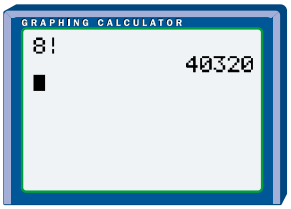
You can scroll through the list of probabilities using the right arrow key. You can also inspect list L1 by selecting 1:EDIT… from the STAT EDIT menu.

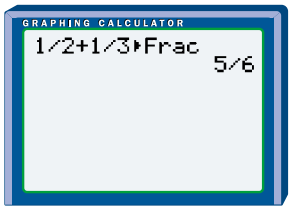
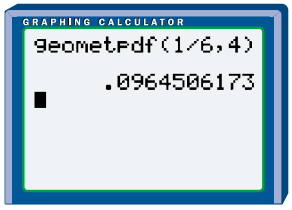


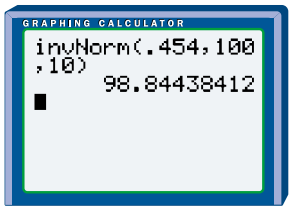
Once the probabilities are stored in the list, you can graph them using STAT PLOT.

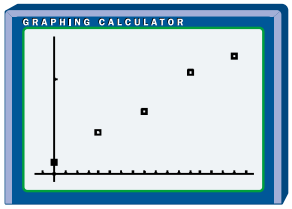
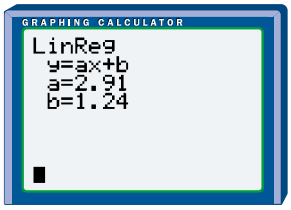
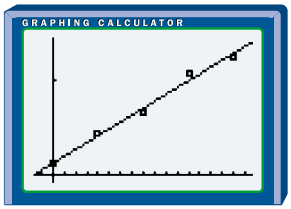
Function or Task	Keystroke(s), Menu, or Screen
	Example 3: Suppose that you want only the probabilities of getting 3, 4, or 5 twos. This can be done as follows:  *Note:* Brace brackets {} are required for the list of x values.
ClrAllLists command	To clear all lists at once, press 2nd + to access the MEMORY menu.  Select 4:ClrAllLists and press ENTER. A Done message will indicate that all lists have been cleared. You can check the lists by selecting 1:EDIT… from the STAT EDIT menu.
ClrList command ClrList listname1, listname2,…	The ClrList command found under the STAT EDIT menu is used to clear the entries in one or more lists. It also removes any formula associated with the list name. For example, to clear lists L1 and L2, select 4:ClrList from the STAT EDIT menu and type L1 , L2.  Press ENTER. *Note*: If you want to clear all of the lists at once, it is faster to use the **ClrAllLists command**.

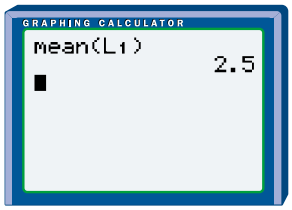
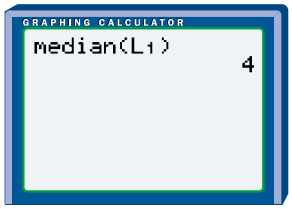
Function or Task	Keystroke(s), Menu, or Screen
copy matrices	Suppose that you want to copy the elements of matrix [A] to matrix [B]. Enter matrix [A] into the TI-83 Plus as described under **store matrices**. $A = \begin{bmatrix} 14 & 10 & 12 \\ 12 & 14 & 10 \\ 8 & 7 & 5 \\ 18 & 15 & 14 \end{bmatrix}$ On the TI-83 Plus, press 2nd x^{-1} 1 STO▸ 2nd x^{-1} 2 ENTER. This will copy matrix [A] to matrix [B]. On the TI-83, press MATRX 1 STO▸ MATRX 2 ENTER. This will copy matrix [A] to matrix [B]. *Note*: On the TI-83 Plus, the MATRX menu is accessed by pressing 2nd x^{-1}. On the TI-83, the MATRX menu is accessed by pressing the MATRX key.
cumSum(function cumSum(listname)	The cumSum(function returns the cumulative sum of the elements in a list. It is useful for calculating cumulative frequencies for a distribution. **Example:** Enter the numbers 1, 3, 5, 7, 9, and 11 in L1 by selecting 1:Edit… from the STAT EDIT menu. Move the cursor on top of the list name for L2. Press 2nd STAT ▸ to display the LIST OPS menu. Select 6:cumSum(and type L1) . Press ENTER. 

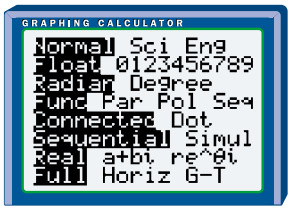
Function or Task	Keystroke(s), Menu, or Screen
DiagnosticOn	When you use one of the regression functions to generate a curve of best fit, the calculator will calculate correlation coefficients that allow you to judge how good the fit was. However, you must first turn on the diagnostic mode. Press 2nd 0 to access the CATALOG menu. Scroll down the list until you line up the black arrow on the screen with DiagnosticOn. Press the ENTER key to select DiagnosticOn. Press ENTER again to turn on the diagnostic mode. Try one of the examples of linear regression or non-linear regression in this appendix to see the coefficients displayed on the screen. In a similar manner, you can turn off the diagnostic mode by accessing the CATALOG menu and selecting DiagnosticOff.
! function value !	The TI-83/TI-83 Plus does not have a factorial key. To calculate a factorial, use the ! function found on the MATH PRB menu. **Example:** To evaluate 8!, press 8 MATH ▶ ▶ ▶ (or MATH ◀) to display the MATH PRB menu. Select 4:! and press ENTER.  *Note*: The TI-83/TI-83 Plus has the same maximum 69! limit that most scientific calculators have. Most spreadsheets have higher limits.

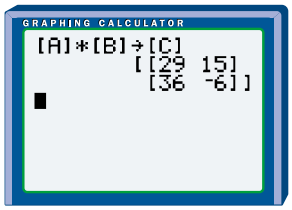
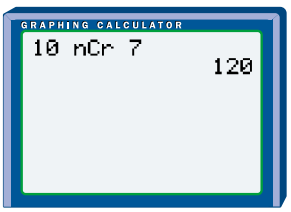
Function or Task	Keystroke(s), Menu, or Screen
>Frac function value >Frac	The >Frac function found under the MATH menu will display the results of a calculation in fractional form. **Example:** To add $\frac{1}{2}+\frac{1}{3}$, and display the result as a fraction rather than as a decimal, type 1 [÷] 2 [+] 1 [÷] 3 [MATH] 1 [ENTER]. 
geometpdf(function geometpdf(p,x)	The geometpdf(function calculates the probability that the first success of an event will occur on trial x, given a probability of success p. **Example:** Calculate the probability that the first roll of doubles on a pair of dice occurs on the fourth roll. In this case, p = $\frac{1}{6}$ and x = 4. Press [2nd] [VARS] to display the DISTR menu. Select D:geometpdf(and type 1 [÷] 6 [,] 4 [)] and press [ENTER].  There is a probability of about 0.096 that the first doubles will occur on the fourth roll of the dice. This value is also the probability for a waiting time of three trials.

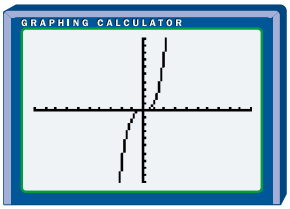
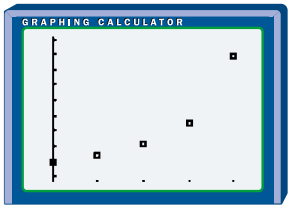
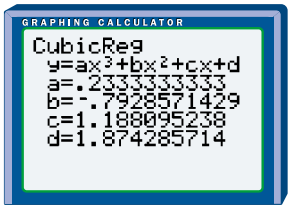
Function or Task	Keystroke(s), Menu, or Screen
invNorm(function invNorm(p,mean,standard deviation)	The invNorm(function is the opposite of the normalcdf(function. It allows you to calculate the distribution function which gives a probability specified by p using a normal distribution with a given mean and standard deviation. The mean and standard deviation are optional. If they are not specified, then the mean is assumed to be zero, and the standard deviation is assumed to be one. **Example:** A particular IQ test has a mean of 100 and a standard deviation of 10. There is a probability of 0.454 that a given participant scored at or below a particular IQ, and you wish to find this IQ. Press 2nd VARS to display the DISTR menu. Select 3:invNorm(and type .454 , 100 , 10) and press ENTER.  The correct IQ is approximately 98.84.
interquartile range	The interquartile range of the elements of a list may be determined by carrying out the 1-Var Stats command on a list of data as described on page 529. The results of the 1-Var Stats command include the first quartile Q1 and the third quartile Q3. The interquartile range is calculated by subtracting Q3 – Q1.
Linear regression	See LinReg instruction

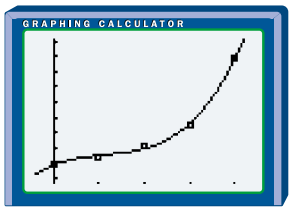
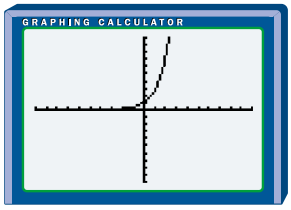
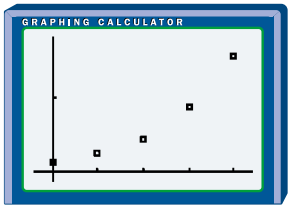
Function or Task	Keystroke(s), Menu, or Screen
LinReg instruction LinReg(ax+b) Xlist, Ylist, Function	You can use the LinReg method of regression if it looks like your scatter plot resembles a linear function. **Example:** Clear all functions in the Y= editor. Clear all lists using the ClrAllLists command. Press STAT PLOT and turn off all plots except Plot1. Ensure that you are set for a scatter plot, that Xlist is L1, and that Ylist is L2. Use the STAT EDIT menu to enter the integers 0, 1, 2, 3, and 4 into L1 and to enter the numbers 1.2, 4.3, 6.5, 10.8, and 12.5 into L2. Press the ZOOM key and select 9:ZoomStat to fit the axes to the data.  Press STAT ▶ to display the STAT CALC menu. Select 4:LinReg(ax+b) and type L1 , L2 , Y1. (To display Y1 press VARS ▶. Select 1:Function. Select 1:Y1.) Press ENTER.  Press GRAPH.  The regression equation is stored in the Y= editor. If you press Y=, you will see the equation generated by the calculator.

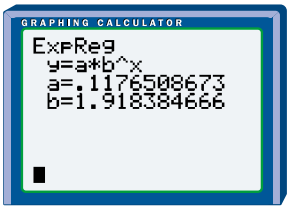
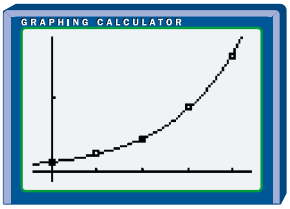
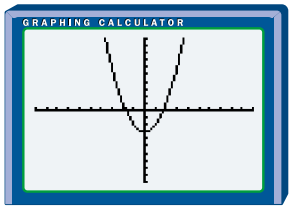
Function or Task	Keystroke(s), Menu, or Screen
mean(function mean(listname)	The mean(function located under the LIST MATH menu returns the mean of the list specified by listname. **Example:** Select 1:Edit… from the STAT EDIT menu to enter the numbers 1, 2, 3, and 4 into L1. Press 2nd MODE to QUIT to the home screen. Press 2nd STAT ▶ ▶ to display the LIST MATH menu. Select 3:mean(and type L1). Press ENTER. 
median(function median(listname)	The median(function located under the LIST MATH menu returns the median of the list specified by listname. **Example:** Select 1:Edit… from the STAT EDIT menu to enter the numbers 1, 2, 3, 4, 5, 6, and 7 into L1. Press 2nd MODE to QUIT to the home screen. Press 2nd STAT ▶ ▶ to display the LIST MATH menu. Select 4:median(and type L1). Press ENTER. 

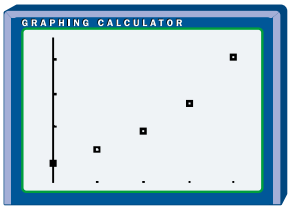
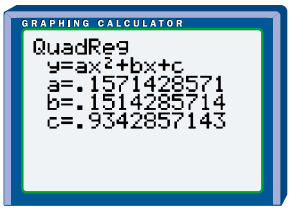
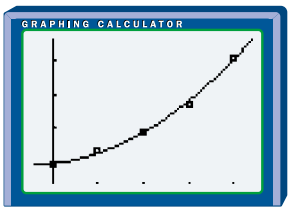
Function or Task	Keystroke(s), Menu, or Screen
mode settings	If you press the MODE key, you will see a number of mode settings that affect the way the TI-83/TI-83 Plus displays and interprets numbers and graphs.  a) You have a choice of normal, scientific, or engineering format for real numbers. b) You may choose a fixed number of decimal points for floating point numbers from 0 to 9. c) You may measure angles in radians or degrees. d) You may choose your graph plotting as Func (y as a function of x), Par (x and y are functions of a parameter t), Pol (polar coordinates r as a function of θ), or Seq (to plot sequences). e) You may choose to connect or not to connect the dots plotted for functions. f) You may plot your functions sequentially or simultaneously. g) You may display numbers as Real (real numbers), a+bi (complex numbers in vector form), or re^θi (complex numbers in polar form). h) You may plot your graph Full (Screen), as the top half of the screen with text at the bottom in Horiz mode or in the left half of the screen with the corresponding table in the right half of the screen in G-T mode.

Function or Task	Keystroke(s), Menu, or Screen
multiply matrices	To multiply matrix [A] by matrix [B], store the matrices [A] and [B] using the method described in **store matrices**. $A = \begin{bmatrix} 5 & 1 & -2 \\ 4 & -2 & 0 \end{bmatrix}$ $B = \begin{bmatrix} 7 & 0 \\ -4 & 3 \\ 1 & -6 \end{bmatrix}$ Using the TI-83 Plus, multiply the matrices by pressing 2nd x^{-1} 1 × 2nd x^{-1} 2 STO▸ 2nd x^{-1} 3 ENTER. Using the TI-83, multiply the matrices by pressing MATRX 1 × MATRX 2 STO▸ MATRX 3 ENTER. These keystrokes will multiply [A] by [B] and store the result in [C]. The elements of [C] will be displayed on the screen.  *Note*: On the TI-83 Plus, the MATRX menu is accessed by pressing 2nd x^{-1}. On the TI-83, the MATRX menu is accessed by pressing the MATRX key.
nCr function value1 nCr value2	To calculate a combination, use the nCr function located under the MATH PRB menu. **Example:** Evaluate the number of subsets of 10 objects taken 7 at a time, or 10 choose 7. Type 10. Press MATH ▸ ▸ ▸ (or MATH ◂) to display the MATH PRB menu. Select 3:nCr and type 7. Press ENTER. 

Function or Task	Keystroke(s), Menu, or Screen
Non-linear regression: CubicReg instruction CubicReg Xlist, Ylist, Function	You can use the CubicReg method of regression if it looks like your scatter plot resembles a cubic function, as shown below:  **Example:** Clear all functions in the Y= editor. Clear all lists using the ClrAllLists command. Press STAT PLOT and turn off all plots except Plot1. Ensure that you are set for a scatter plot, that Xlist is L1, and that Ylist is L2. Select 1:Edit… from the STAT EDIT menu to enter the integers 0, 1, 2, 3, and 4 into L1 and to enter the numbers 1.9, 2.4, 3.1, 4.5, and 8.9 into L2. Press the ZOOM key and select 9:ZoomStat to fit the axes to the data.  Press STAT ▶ to display the STAT CALC menu. Select 6:CubicReg and type L1 , L2 , Y1 (To display Y1, press VARS ▶. Select 1:Function. Select 1:Y1.) Press ENTER. 

Function or Task	Keystroke(s), Menu, or Screen
	Press GRAPH.  The regression equation is stored in the Y= editor. If you press Y=, you will see the equation generated by the calculator.
Non-linear regression: ExpReg instruction ExpReg Xlist, Ylist, Function	You can use the ExpReg method of regression if it looks like your scatter plot resembles an exponential function, as shown below:  **Example:** Clear all functions in the Y= editor. Clear all lists using the ClrAllLists command. Press STAT PLOT and turn off all plots except Plot1. Ensure that you are set for a scatter plot, that Xlist is L1, and that Ylist is L2. Select 1:Edit... from the STAT EDIT menu to enter the integers 0, 1, 2, 3, and 4 into L1 and to enter the numbers 0.11, 0.25, 0.42, 0.85 and 1.55 into L2. Press the ZOOM key and select 9:ZoomStat to fit the axes to the data. 

Function or Task	Keystroke(s), Menu, or Screen
	Press STAT ▶ to display the STAT CALC menu. Select 0:ExpReg and type L1 , L2 , Y1. (To display Y1, press VARS ▶. Select 1:Function. Select 1:Y1.) Press ENTER.  Press GRAPH.  The regression equation is stored in the Y= editor. If you press Y=, you will see the equation generated by the calculator.
Non-linear regression: QuadReg instruction QuadReg Xlist, Ylist, Function	You can use the QuadReg method of regression if it looks like your scatter plot resembles a quadratic function, as shown below:  **Example:** Clear all functions in the Y= editor. Clear all lists using the ClrAllLists command. Press STAT PLOT and turn off all plots except Plot1. Ensure that you are set for a scatter plot, that Xlist is L1, and that Ylist is L2. Select 1:Edit… from the STAT EDIT menu to enter the integers 0, 1, 2, 3, and 4 into L1 and to enter the numbers 0.9, 1.3, 1.9, 2.7, and 4.1 into L2.

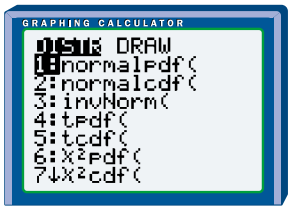
Function or Task	Keystroke(s), Menu, or Screen
	Press the ZOOM key and select 9:ZoomStat to fit the axes to the data.  Press STAT ▶ to display the STAT CALC menu. Select 5:QuadReg and type L1 , L2 , Y1. (To display Y1, press VARS ▶. Select 1:Function. Select 1:Y1.) Press ENTER.  Press GRAPH.  The regression equation is stored in the **Y= editor**. If you press Y=, you will see the equation generated by the calculator.
normalcdf(function normalcdf(lowerbound, upperbound, mean, standard deviation)	The normalcdf(function allows you to calculate the probability that a given data point lies between lowerbound and upperbound using a normal distribution with a given mean and standard deviation. The mean and standard deviation are optional. If they are not specified, then the mean is assumed to be zero, and the standard deviation is assumed to be one.

Function or Task	Keystroke(s), Menu, or Screen

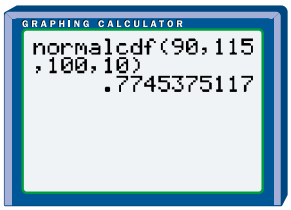
Example 1:

A particular IQ test has a mean of 100 and a standard deviation of 10. Determine the probability that a given participant scored between 90 and 115.

Press 2nd VARS to display the DISTR menu.



Select 2:normalcdf(and type 90 , 115 , 100 , 10). Press ENTER.

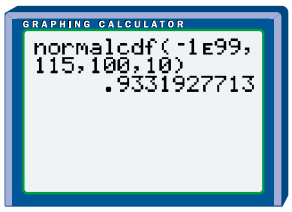


The probability that a given participant scored between 90 and 115 is approximately 0.7745.

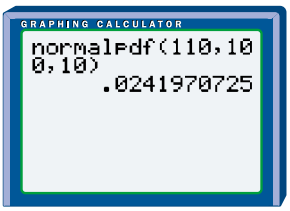
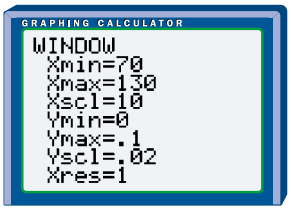
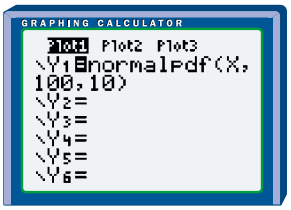
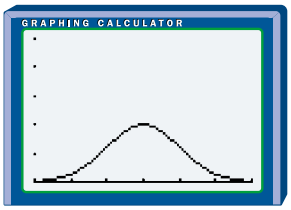
Example 2:

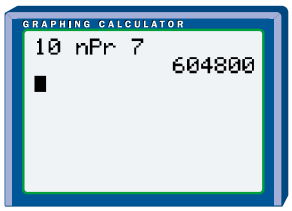
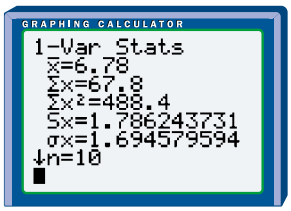
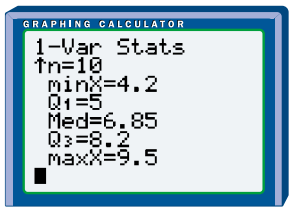
Calculate the probability that a participant scored 115 or less.

In this case, the value of lowerbound is $-\infty$. You can approximate $-\infty$ using a negative number like -1×10^{99}. Select the normalcdf(function as above. Type –1 and press 2nd , to access the EE (Enter Exponent) function. Type 99 , 115 , 100 , 10) and press ENTER.



The probability of scoring 115 or less is approximately 0.933.

Function or Task	Keystroke(s), Menu, or Screen
normalpdf(function normalpdf(x,mean,standard deviation)	The normalpdf(function calculates the probability density function at a specified value for variable x using a normal distribution with a given mean and standard deviation. The mean and standard deviation are optional. If they are not specified, the mean is assumed to be zero, and the standard deviation is assumed to be one. **Example:** A particular IQ test has a mean of 100 and a standard deviation of 10. Determine the probability density function at a value of $x = 110$. Press [2nd] [VARS] to select the DISTR menu. Select 1:normalpdf(and type 110 [,] 100 [,] 10 [)]. Press [ENTER].  The probability density is approximately 0.024. This function can also be used to plot the probability distribution. Change your **window settings** to:  Press the [Y=] key to display the **Y= editor**, then press [2nd] [VARS] to display the the DISTR menu. Select 1:normalpdf(. Press [X,T,θ,n] [,] 100 [,] 10 [)]. Press [GRAPH].   You can then use the **TRACE instruction** to inspect the graph.

Function or Task	Keystroke(s), Menu, or Screen
nPr function value1 nPr value2	To calculate a permutation, use the nPr function available located under the MATH PRB menu. **Example:** Evaluate the number of arrangements of 10 objects taken 7 at a time. Type 10. Press MATH ▶ ▶ ▶ (or MATH ◀) to display the MATH PRB menu. Select 2:nPr and type 7. Press ENTER. 
1-Var Stats command 1-Var Stats Xlist, Freqlist	The TI-83/TI-83 Plus can calculate various statistical variables for a list of numbers specified by Xlist. Similar variables for grouped data can be calculated by adding the Freqlist. **Example 1:** Ten automobiles were tested for fuel economy, and were found to burn the following amounts of fuel, measured in litres per 100 km. 8.4, 5.0, 4.8, 5.9, 7.3, 8.2, 6.4, 8.1, 9.5, 4.2 Use the **ClrAllLists command** to clear the lists in your calculator if necessary. Select 1:Edit... from the STAT EDIT menu to enter the above numbers into L1. Press STAT ▶ to display the STAT CALC menu. Select 1:1-Var Stats. Press 2nd 1 to type L1 and press ENTER. You can scroll down to see more statistics:  

Function or Task	Keystroke(s), Menu, or Screen

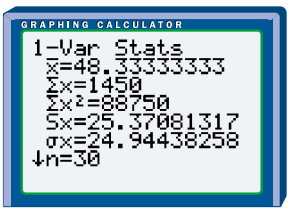
The meanings are:
$\bar{x}$ is the mean
Σx is the sum of all the values
Σx^2 is the sum of the squares of the values
Sx is the sample standard deviation
σx is the population standard deviation
n is the number of values in the list
minX is the lowest value
Q_1 is the first quartile
Med is the median
Q_3 is the third quartile
maxX is the highest value

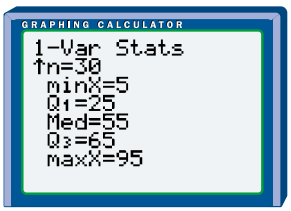
Example 2:

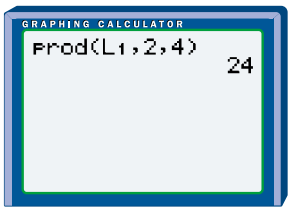
Twenty people were asked to write down the amount of cash they were carrying. The data were arranged into intervals. The frequency of occurrence in each interval was noted. The results were as follows:

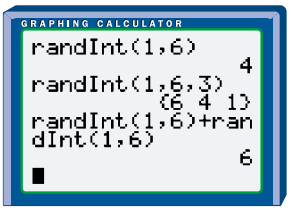
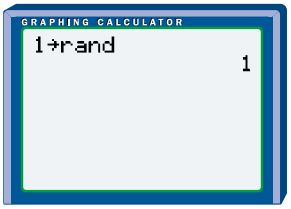
Midpoint($)	Frequency
5	3
15	2
25	3
35	2
45	4
55	6
65	5
75	2
85	1
95	2

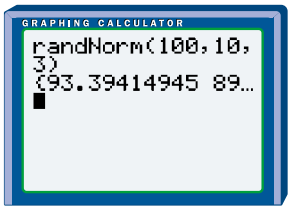
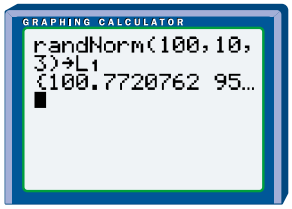
Use the ClrAllLists command to clear all the lists, if necessary. Enter these data into L1 and L2, respectively. Select the 1-Var Stats command as described in Example 1, but this time type L1 [,] L2. Press [ENTER].

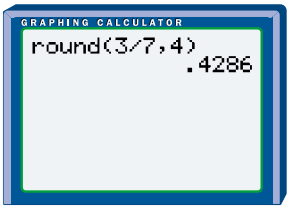
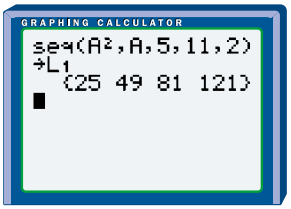


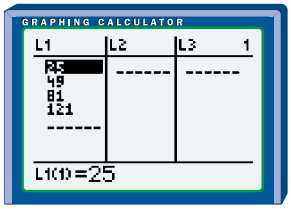
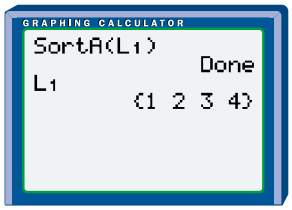


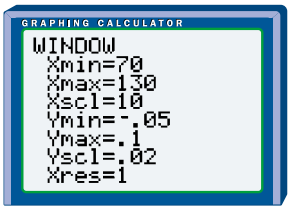
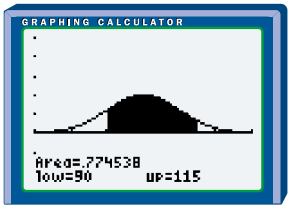
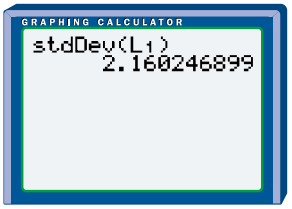
Function or Task	Keystroke(s), Menu, or Screen
prod(function prod(list,start,end)	The prod(function is used to find the product of the elements of a list beginning with element start and finishing with element end. If start and end are not specified, then the entire list is used. **Example:** Select 1:Edit… from the STAT EDIT menu to enter 1, 2, 3, 4, and 5 in L1. Press [2nd] [MODE] to QUIT to the home screen. Press [2nd] [STAT] [▶] [▶] to display the LIST MATH menu. Select 6:prod(and type L1 [,] 2 [,] 4 [)]. Press [ENTER]. 
quartiles	The quartiles of the elements of a list may be determined by carrying out the **1-Var Stats command** on the list, as described on page 529. The results of the **1-Var Stats command** include the first quartile Q_1 and the third quartile Q_3.
randInt(function randInt(lowerbound, upperbound, numtrials)	When simulating probability problems, it is useful to be able to generate random integers. This can be done using the randInt(function located under the MATH PRB menu. The function is followed by a lowerbound, an upperbound, and an optional numtrials. **Example 1:** Simulate one roll of one die. The lowerbound is 1, the upperbound is 6, and you do not need to enter the numtrials, since the default value is assumed to be 1. Press [MATH] [▶] [▶] [▶] (or [MATH] [◀]) to display the MATH PRB menu. Select 5:randInt(and type 1 [,] 6 [)]. Press [ENTER]. You will get a random integer between 1 and 6 as shown in the first calculation of the screen shot following Example 3.

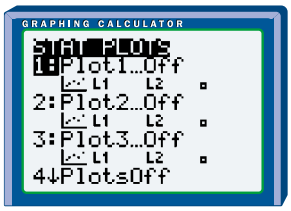
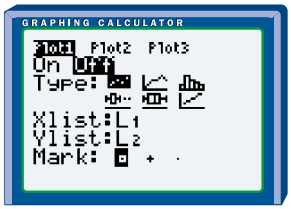
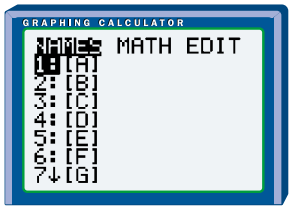
Function or Task	Keystroke(s), Menu, or Screen
	Example 2: If you want three rolls of the die, press the same keystrokes to select 5:randInt(again, but this time type 1 [,] 6 [,] 3 [)]. Press [ENTER]. You will get a list of three random rolls of the die as shown in the second calculation of the screen shot following Example 3. **Example 3:** You can use the function twice to get the sum of two dice rolled independently, as shown in the third calculation of the following screen shot.  *A Note About Seeds*: Whenever you use the random integer function, you will generate the same series of random integers. The start of the series is controlled by the value of the variable **rand** which is stored internally in the TI-83 Plus, and is set to zero by default. If you change the default value to something else, you can generate a different series. For example, you can change the default to 1 using the keystrokes 1 [STO▸] [MATH] [◂] 1 [ENTER]. 

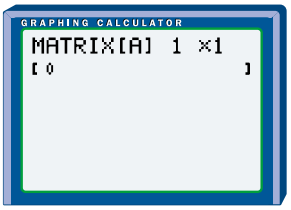
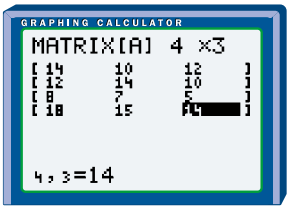
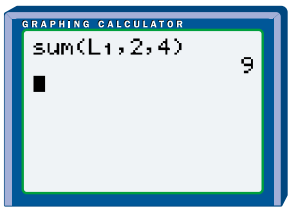
Function or Task	Keystroke(s), Menu, or Screen
randNorm(function randNorm(mean, standard deviation, numtrials)	You can use the randNorm(function to select a random number from a normal distribution with a given mean and standard deviation. If numtrials is not specified, you get one random number. If you want more one random number, set the value for numtrials. **Example 1:** A particular IQ test has a mean of 100 and a standard deviation of 10. Find three random values assuming a normal distribution. Press MATH ▶ ▶ ▶ (or MATH ◀) to display the MATH PRB menu. Select 6:randNorm(and type 100 , 10 , 3). Press ENTER. You will get three random IQs from the distribution similar to the following screen:  Use the right arrow key to scroll through the other values. You can store these results in a list if you wish by adding STO▸ 2nd 1 (to use L1) to the randNorm(function as shown in the following screen:  *A Note About Seeds*: The random number seed discussed in the section on the randInt(function also applies to the randNorm(function.

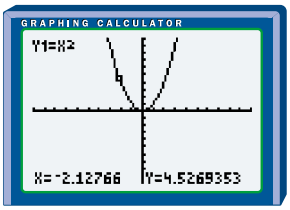
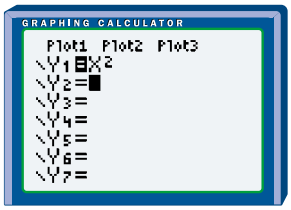
Function or Task	Keystroke(s), Menu, or Screen
round(function round(operand,#decimals)	The round(function located under the MATH NUM menu will return the operand correctly rounded to the number of decimal places specified in #decimals. The operand can be a number, an expression, a list name or a matrix name. In the case of a list or a matrix, the function will round all of the elements. **Example:** Evaluate the fraction $\frac{3}{7}$ rounded correctly to four decimal places. Press MATH ▶ to display the MATH NUM menu. Select 2:round(and type 3 ÷ 7 , 4). Press ENTER. 
semi-interquartile range	The semi-interquartile range is one half of the interquartile range. See interquartile range.
seq(function seq(expression, variable, begin, end, increment)	You can use the seq(function to create a list of numbers with various properties. If the value of increment is not specified, it is assumed to be one. **Example 1:** Enter a list of the squares of the odd numbers from 5 to 11 inclusive. The value of begin is 5, end is 11, and increment is 2. Press the 2nd STAT ▶ to display the LIST OPS menu. Select 5:seq(**and** type ALPHA A and press x^2. Type , ALPHA A , 5 , 11 , 2). Press STO▸ 2nd 1 to store the result in L1. Press ENTER. 

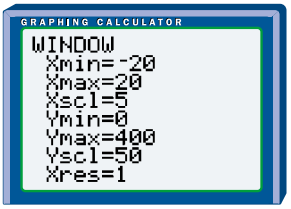
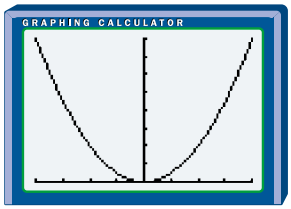
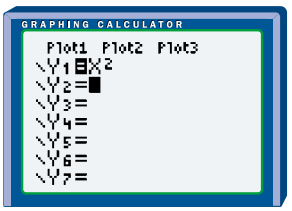
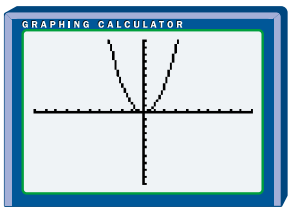
Function or Task	Keystroke(s), Menu, or Screen
	Notice the list of odd number squares, as expected. These numbers have also been stored in list L1. You can inspect L1 by selecting 1:Edit… from the STAT EDIT menu. 
SortA(function SortA(listname)	The SortA(function located under the LIST OPS menu will sort the list specified by listname into ascending order. **Example:** Select 1:Edit… from the STAT EDIT menu to enter 1, 3, 4, and 2 into L1. Press 2nd STAT ▶ display the LIST OPS menu. Select 1:SortA(and type L1). Press ENTER. Press 2nd 1 to display list L1.  *Note*: A related function is the SortD(function which sorts a list in descending order.
ShadeNorm(function ShadeNorm(lowerbound, upperbound, mean, standard deviation)	The ShadeNorm(function allows you to shade the area under the probability density graph that a given data point lies between lowerbound and upperbound using a normal distribution with a given mean and standard deviation. The mean and standard deviation are optional. If they are not specified, then the mean is assumed to be zero, and the standard deviation is assumed to be one.

Function or Task	Keystroke(s), Menu, or Screen
	Example 1: A particular IQ test has a mean of 100 and a standard deviation of 10. Display and shade the probability density function that a given participant scored between 90 and 115. First, adjust your **window settings** as shown:  Press 2nd VARS ▶ to display the DISTR DRAW menu. Select 1:ShadeNorm(. Type 90 , 115 , 100 , 10) and press ENTER.  Notice that the probability represented by the shaded area has also been displayed.
standard deviation stdDev(listname)	The stdDev(function located under the LIST MATH menu returns the standard deviation of the list specified by listname. **Example:** Select 1:Edit… from the STAT EDIT menu to enter the numbers 1, 2, 3, 4, 5, 6, and 7 into L1. Press 2nd MODE to QUIT to the home screen. Press 2nd STAT ▶ ▶ to display the LIST MATH menu. Select 7:stdDev(and type L1). Press ENTER. 

Function or Task	Keystroke(s), Menu, or Screen
STAT PLOT	The plot routines which are used to plot graphs of data entered into the lists of the TI-83/TI-83 Plus are controlled by the STAT PLOT screen. This screen is accessed by pressing [2nd] [Y=]. The screen contains five options:  Options 1, 2, and 3 control the three plot routines. Three different statistical plots can be displayed on the graphing screen at one time. Option 4 turns all plots off, and option 5 turns all plots on. If you select a plot, say Plot1, then you will see the following screen:  The first line is used to turn Plot1 On or Off. The second line allows you to select the type of graph you want: scatter plot, *xy*-plot, histogram, modified box plot, box plot, or normal probability plot. The next line or lines let you choose which list or lists will provide the data for the axis or axes. The last line lets you choose one of three symbols to display data points.
store matrices	Store the following matrix in the TI-83/TI-83 Plus: $A = \begin{bmatrix} 14 & 10 & 12 \\ 12 & 14 & 10 \\ 8 & 7 & 5 \\ 18 & 15 & 14 \end{bmatrix}$ On the TI-83 Plus, press [2nd] [x^{-1}] to access the MATRX menu.  On the TI-83, press the [MATRX] key to access the MATRX menu.

Function or Task	Keystroke(s), Menu, or Screen
	Press ▶ ▶ (or ◀) to display the MATRX EDIT menu. Select 1:[A], which is matrix [A]. The default dimensions are 1×1 as shown in the following screen:  Change these dimensions to 4×3. Notice that the matrix enlarges to the required dimensions. Scroll to the first element using the right blue arrow key. Type 14 and press ENTER. Continue to fill in the elements of the matrix by typing each element and pressing ENTER. Once all elements are entered, you will see: 
sum(function sum(list,start,end)	The sum(function is used to find the sum of the elements of a list beginning with element start and finishing with element end. If start and end are not specified, then the entire list is used. **Example:** Select 1:Edit… from the STAT EDIT menu to enter the list of numbers 1, 2, 3, 4, and 5 in L1. Press 2nd STAT ▶ ▶ to display the LIST MATH menu. Select 5:sum(and type L1 , 2 , 4). Press ENTER. 

Function or Task	Keystroke(s), Menu, or Screen
TRACE instruction	The TRACE instruction allows you to move a cursor along a graph while a readout of the coordinates is displayed as shown below.  **Example:** Display and trace along the graph of $y = x^2$. Turn off all plots using the STAT PLOT screen. Press the [Y=] key to display the Y= editor. Press the variable key, marked [X,T,θ,n] followed by the [x^2] key. To view the graph of $y = x^2$ in the standard viewing window, press [ZOOM] 6. To trace along the graph, press [TRACE]. The tracing cursor will appear on the graph. The coordinates of the location of the cursor are displayed at the bottom of the screen. Use the blue left and right arrow keys to move the cursor along the graph.
window settings	The window settings for the current viewing window can be adjusted by pressing the [WINDOW] key. You can set the limits and scales on both the horizontal and the vertical axes. **Example:** Suppose you want to plot the function $y = x^2$ for values of x ranging from –20 to +20. Start by entering the function into the Y= editor. Press [Y=]. Clear any existing functions at this time. Move to Y1 using the blue arrow keys if necessary. Press [X,T,θ,n]. Press [x^2]. 

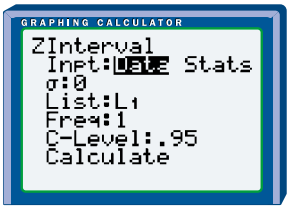
Function or Task	Keystroke(s), Menu, or Screen
	Press WINDOW. Set Xmin to –20, Xmax to +20, Xscl to 5, Ymin to 0, Ymax to 400, Yscl to , and Xres to 1. Press GRAPH.   Notice where the marks are on the axes. Return to the window settings screen, and experiment with the settings. Check the graph to see the effects of your changes.
Y= editor	The Y= editor is accessed by pressing Y=. The Y= editor allows you to enter functions for graphing or tabling purposes. **Example:** To graph $y = x^2$, press the Y= key. To obtain the variable X, press X,T,θ,n. Press x^2. Press ZOOM 6 to view the graph of $y = x^2$ in the standard viewing window.   You may add as many functions as you have space for. You can select or deselect whether a function is plotted by moving the cursor to the equal sign in the function, and pressing ENTER key to toggle selection/deselection.
ZInterval instruction	The ZInterval instruction allows you to find a desired confidence interval for the mean from a finite sample of a distribution whose population mean is not known, but whose standard deviation is known.

Function or Task	Keystroke(s), Menu, or Screen

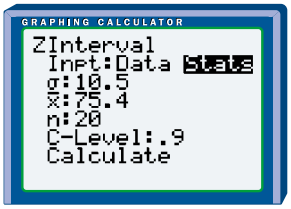
Example:

Suppose that a manufacturer knows that the standard deviation for the drying time of latex paints is 10.5 min. A sample of 20 items are painted, and the mean drying time for the sample is found to be 75.4 min. What is the 90% confidence interval for the mean of the population of paint drying times? To determine this, you can use the ZInterval instruction found under the STAT TESTS menu.

Press STAT ▶ ▶ to display the STAT TESTS menu. Select 7:ZInterval.

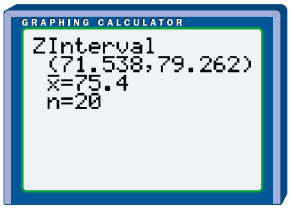


Note that you perform the test with either raw Data or Stats already calculated from a sample. Press ▶ ENTER to select the Stats option. Set the remaining parameters as shown:

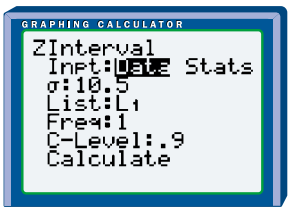
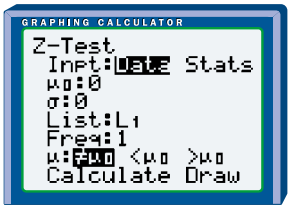


Note that 10.5 is the standard deviation of the distribution, 75.4 is the sample mean, 20 is the number of samples, and 0.9 is the confidence level desired.

Use the arrow keys to scroll down to Calculate and press ENTER.

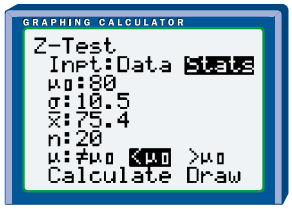


You can be 90% certain that the population mean lies between about 71.5 and 79.3. In this same manner, you can calculate confidence intervals for other confidence levels.

Function or Task	Keystroke(s), Menu, or Screen
	The calculation on page 541 can also be performed using raw Data. Press STAT ▶ ▶ to display the STAT TESTS menu. Select 7:ZInterval. This time select the Data option. Note that the parameters you typed in are still there.  Note that your sample data must be entered in L1 (or whatever other list you specify) before attempting to Calculate the confidence interval.
Z-Test instruction	The Z-Test instruction allows you to test the mean from a finite sample of a distribution whose mean is not known, but whose standard deviation is known. **Example:** A manufacturer knows that the standard deviation for the drying time of latex paints is 10.5 min. A sample of 20 items are painted, and the mean drying time is found to be 75.4 min. How confident can the manufacturer be that this would represent the mean drying time of the paint if a larger number of samples were taken? To determine this, you can use the Z-Test instruction located in the STAT TESTS menu to determine the probability that the real mean is 80, and that 75.4 is just a statistical variation. Press STAT ▶ ▶ to display the STAT TESTS menu. Select 1:Z-Test to obtain the following screen: 

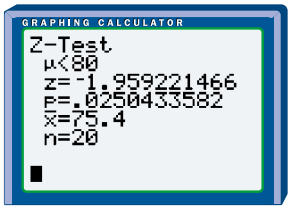
Function or Task	Keystroke(s), Menu, or Screen

You can perform the test with either raw Data or Stats already calculated from a sample. Use the arrow key, and press ENTER to select the Stats option. Set the remaining parameters as shown on the right:



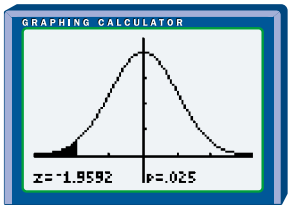
Note that 80 is the hypothesized mean, 10.5 is the standard deviation, 75.4 is the sample mean, and 20 is the number of samples.

Use the arrow keys to scroll down to Calculate and press ENTER.



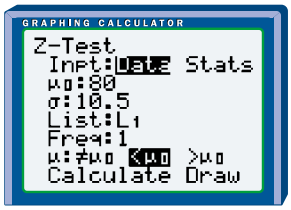
Note that the probability that the real mean is 80 is approximately $p = 0.025$. In the same manner, you can test other values for the mean of the distribution.

You can also display the results graphically. Press STAT ▶ ▶ to display the STAT TESTS menu. Select 1:Z-Test. Note that the parameters you typed in are still there. Use the arrow keys to scroll down, and this time select the Draw option at the bottom of the screen. Press ENTER.



The shaded area represents the probability of getting a sample mean of 75.4 or less if the real mean is 80.

The same test can be performed using raw Data. Press STAT ▶ ▶ to display the STAT TESTS menu. Select 1:Z-Test. This time select the Data option.



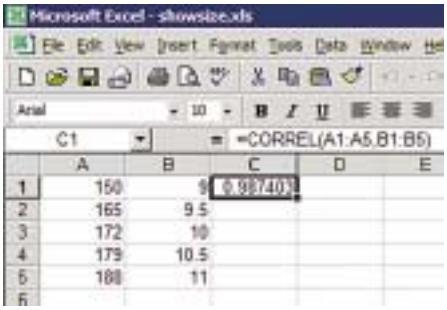
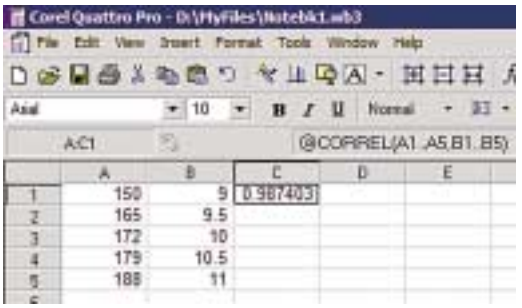
Your sample data must be entered in L1 (or whatever other list you specify) before attempting to Calculate or Draw.

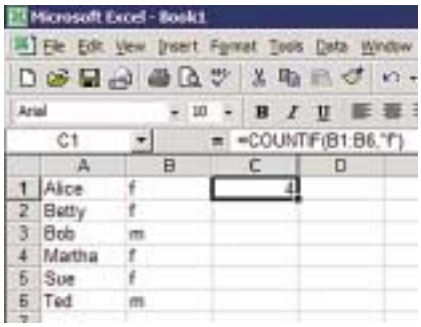
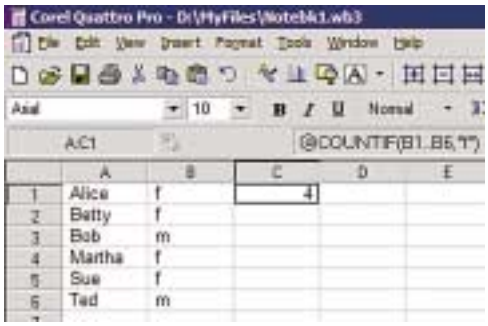
Spreadsheets (Microsoft® Excel and Corel® Quattro® Pro)

Note: The methods provided apply for Microsoft® Excel 2000 and Corel® Quattro® Pro 8 and 9. Methods may vary slightly for other versions.

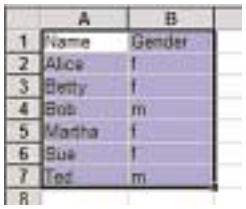
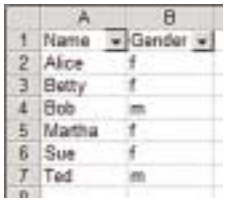
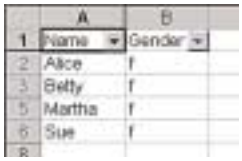
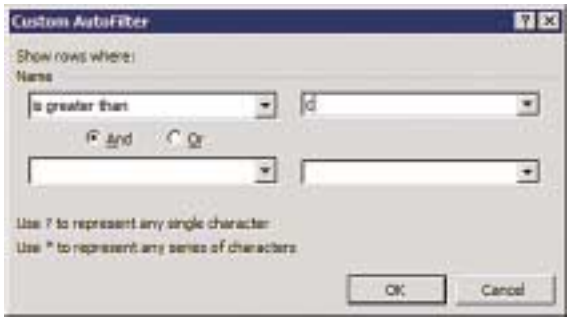
Function or Task	Keystroke(s), Menu, or Screen
absolute cell referencing	See References: relative referencing absolute referencing mixed referencing
add worksheets **Microsoft® Excel:** Insert / Worksheet **Corel® Quattro® Pro:** Insert / Sheet	**Microsoft® Excel:** If a new worksheet is required, choose Insert / Worksheet. The new worksheet will be inserted before the currently selected worksheet. Simply drag the TAB for a worksheet to move it in the worksheet list. **Corel® Quattro® Pro:** If a new worksheet is required, choose Insert / Sheet. The new worksheet will be inserted before the currently selected worksheet. Simply drag the TAB for a worksheet to move it in the worksheet list.
average **Microsoft® Excel:** =AVERAGE(array) **Corel® Quattro® Pro:** @AVG(array)	**Microsoft® Excel:** The average function is =AVERAGE(array). **Example:** To find the average of 6, 7, 8, 9, and 10, type =AVERAGE(6,7,8,9,10) and press Enter. The result will be 8. To find the average of cells B1 through B10, type =AVERAGE(B1:B10) and press Enter. **Corel® Quattro® Pro:** The average function is @AVG(array). **Example:** To find the average of 6, 7, 8, 9, and 10, type @AVG(6,7,8,9,10) and press Enter. The result will be 8. To find the average of cells B1 through B10, type @AVG(B1..B10) and press Enter.

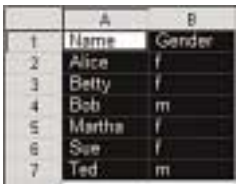
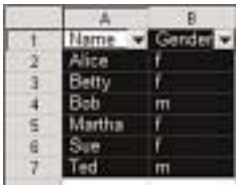
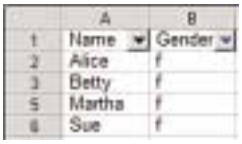
Function or Task	Keystroke(s), Menu, or Screen
BINOMDIST function **Microsoft® Excel:** =BINOMDIST(x,n,p,FALSE) **Corel® Quattro® Pro:** @BINOMDIST(x,n,p,FALSE)	The BINOMDIST function returns the binomial distribution probability of an individual term. It returns the probability of getting exactly x successes in n trials of a binomial distribution, where the probability of success on each trial is p. **Example:** Consider the rolling of two dice 20 times. What is the probability of rolling exactly four doubles? In this case, $x = 4$, $n = 20$, and $p = \frac{1}{6}$. Hence, BINOMDIST (4,20,1/6,FALSE) will return a value of approximately 0.202.
cell references	See References: relative referencing absolute referencing mixed referencing
Chart feature Insert/Chart…	To make a chart (graph) select the range of x and y data, then choose Insert/Chart…. Be sure to select the column headings too. Step through the Chart Wizard/Expert, supplying the information required. In Corel® Quattro® Pro, you will need to choose an area on the worksheet to put the graph.
combinations function (nCr function) **Microsoft® Excel:** =COMBIN(n,r) **Corel® Quattro® Pro:** @COMB(r,n)	**Microsoft® Excel:** The combinations function is =COMBIN(n,r). **Example:** To find ${}_{10}C_7$ type =COMBIN(10,7) and press Enter. The result will be 120. **Corel® Quattro® Pro:** The combinations function is @COMB(r,n). **Example:** Notice how the n and r are in counter-intuitive positions. To find ${}_{10}C_7$ type @COMB(7,10) and press Enter. The result will be 120.

Function or Task	Keystroke(s), Menu, or Screen
CORREL function **Microsoft® Excel:** =CORREL(array1,array2) **Corel® Quattro® Pro:** @CORREL(array1,array2)	The correlation coefficient for two attributes may be calculated using the CORREL function. **Microsoft® Excel:** **Example:** Enter the data as shown below.  In cell C1, enter =CORREL(A1:A5,B1:B5). The result should be approximately 0.987. **Corel® Quattro® Pro:** **Example:** Enter the data as shown below.  In cell C1, enter @CORREL(A1..A5,B1..B5). The result should be approximately 0.987.

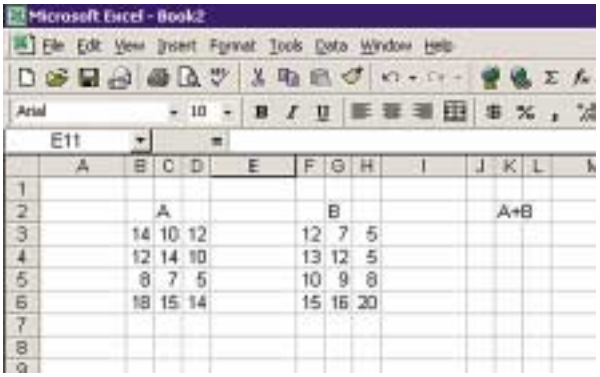
Function or Task	Keystroke(s), Menu, or Screen
COUNTIF function **Microsoft® Excel:** =COUNTIF(array,value) **Corel® Quattro® Pro:** @COUNTIF(array,value)	The COUNTIF function will count the number of cells in an array that match a value. **Microsoft® Excel:** **Example:** Enter the data as shown below.  In cell C1, enter =COUNTIF(B1:B6,"f"). The result should be 4. **Corel® Quattro® Pro:** **Example:** Enter the data as shown below.  In cell C1, enter @COUNTIF(B1..B6,"f"). The result should be 4.

Function or Task	Keystroke(s), Menu, or Screen
FACT(n) function **Microsoft® Excel:** =FACT(n) **Corel® Quattro® Pro:** @FACT(n)	**Microsoft® Excel:** The factorial (!) function is =FACT(n). **Example:** To find 8!, type =FACT(8) and press Enter. The result will be 40 320. *Note*: Microsoft® Excel has a maximum: $170! \doteq 7.3 \times 10^{306}$ **Corel® Quattro® Pro:** The factorial (!) function is @FACT(n). **Example:** To find 8!, type @FACT(8) and press Enter. The result will be 40 320. *Note*: Corel® Quattro® Pro has a maximum: $170! \doteq 7.3 \times 10^{306}$
Fill feature **Microsoft® Excel:** Edit/Fill/Series… **Corel® Quattro® Pro:** Edit/Fill/Fill Series…	Many times you need cells filled with a series of numbers. The series of numbers may be linear or a growth. **Microsoft® Excel:** **Example:** Suppose you need to fill a series of cells with a series, such as 2, 4, 8, … 1 048 576. Enter 1 into cell A1. Now, choose cells A1 through A21 and select Edit/Fill/Series…. Select Growth, enter a step value of 2, and press OK. **Corel® Quattro® Pro:** **Example:** Suppose you need to fill a series of cells with a series, such as 2, 4, 8, … 1 048 576. Enter 1 into cell A1. Now choose cells A1 through A21 and select Edit/Fill/Fill Series…. Enter a starting value of 1, a step value of 2, and a stop value of 1 048 576 (or leave the stop value field blank). Now select Growth and press OK.

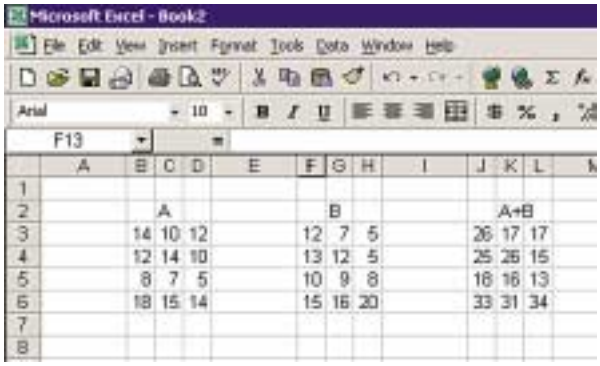
Function or Task	Keystroke(s), Menu, or Screen
filtered search **Microsoft® Excel:** Data / Filter / Auto Filter **Corel® Quattro® Pro:** Tools / QuickFilter	Quite often it is necessary to display on the screen cells whose value meet a certain criteria. **Microsoft® Excel:** **Example:** Enter and then select the data as shown below:  Now choose Data / Filter / Auto Filter.  Choose the Gender filter by selecting the down arrow beside the word Gender. Choose "f". Now, only the females are displayed.  Now choose All under the Gender filter. All names are displayed. To display only the names that start with a letter greater than "C," choose the Name filter. Select Custom.... Fill in the dialog box as follows and click on OK:  Choose Data / Filter / Auto Filter again to turn off the filtering.

Function or Task	Keystroke(s), Menu, or Screen
	Corel® Quattro® Pro: **Example:** Enter and then select the data as shown below.  Now choose Tools / QuickFilter.  Choose the Gender filter by selecting the down arrow beside the word Gender. Choose "f". Now, only the females are displayed.  Now choose Show All under the Gender filter. All names are displayed. To display only the names that start with a letter greater than "C," choose the Name filter. Select Custom.... Fill in the dialog box as follows and click on OK:  Choose Tools / QuickFilter again to turn off the filtering.

Function or Task	Keystroke(s), Menu, or Screen
Fraction feature **Microsoft® Excel:** Format/Cells…/Fraction **Corel® Quattro® Pro:** Format/Selection… /Numeric Format/Fraction	**Microsoft® Excel:** To display real numbers as fractions, select the cells and then use Format/Cells…/Fraction. Within the dialog box, choose the type of fraction required. **Corel® Quattro® Pro:** To display real numbers as fractions, select the cells and then use Format/Selection…/Numeric Format/Fraction. Within the dialog box, set the denominator required.
INT function **Microsoft® Excel:** =INT(n) **Corel® Quattro® Pro:** @INT(n)	**Microsoft® Excel:** The integer truncation function is =INT(n). **Example:** To convert 8.7 to an integer, type =INT(8.7) and press Enter. The result will be 8. *Note*: The INT function simply removes the decimal portion of the number without rounding. It is recommended that you use the **ROUND function** if rounding is required. **Corel® Quattro® Pro:** The integer truncation function is @INT(n). **Example:** To convert 8.7 to an integer, type @INT(8.7) and press Enter. The result will be 8. *Note*: The INT function simply removes the decimal portion of the number without rounding. It is recommended that you use the **ROUND function** if rounding is required.
inverse matrices	See **Matrices: inverse**
linear regression	See **line of best fit**

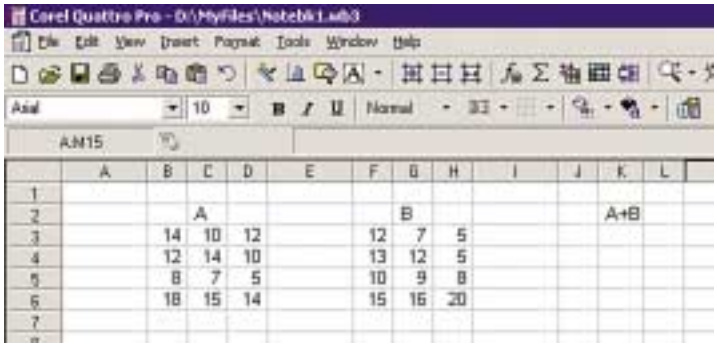
Function or Task	Keystroke(s), Menu, or Screen
line of best fit	**Microsoft® Excel:** In Microsoft® Excel, set up a table with the data for which you wish to determine the line of best fit. Use the **CORREL function** to calculate the correlation coefficient. Use the **Chart feature** to create a scatter plot. Find the line of best fit by selecting Chart/Add Trendline. Check that the default setting is Linear. Select the straight line that appears on your chart, then click Format/Selected Trendline/Options. Check the Display equation on chart box. You can also display r^2. **Corel® Quattro® Pro:** In Corel® Quattro® Pro, set up a table with the data you wish to determine the line of best fit for. Use the **CORREL function** to calculate the correlation coefficient. Use the **Chart feature** to create a scatter plot. Find the line of best fit by selecting Tools/Numeric Tools/Regression. Enter the cell ranges for the data, and the program will display regression calculations including the constant (b), the x-coefficient (or slope, a), and r^2.
Matrices: addition and subtraction	**Microsoft® Excel:** Set up your spreadsheet as follows: 

Function or Task	Keystroke(s), Menu, or Screen
	In cell J3, type: =B3+F3 (use "–" for subtraction). Copy this formula across to L3 and then copy this row down to J6 through L6. The result should be as follows:

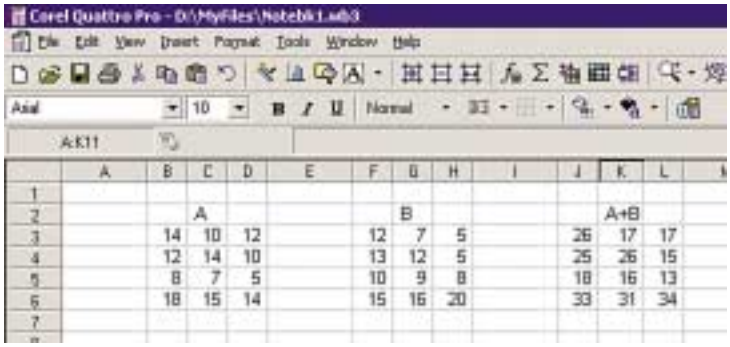


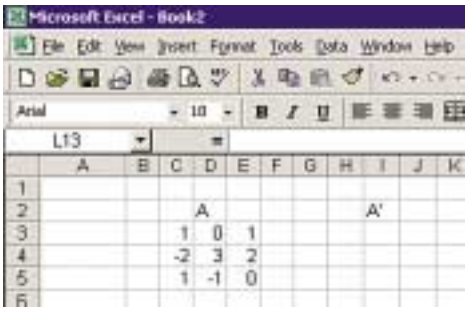
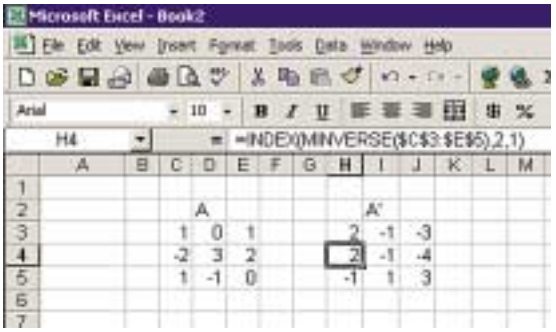
Corel® Quattro® Pro:

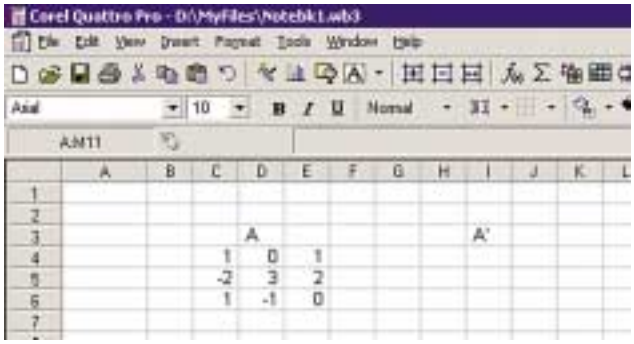
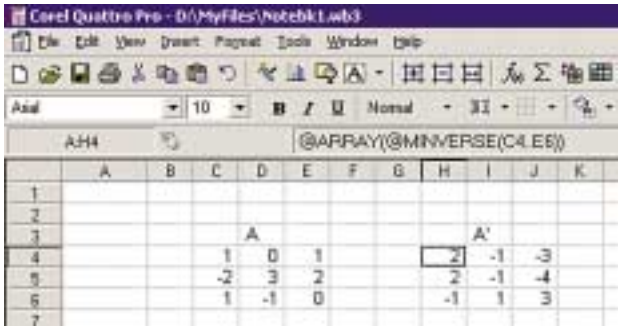
Set up your spreadsheet as follows:

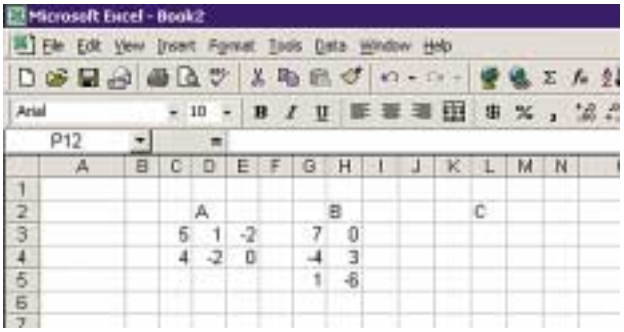
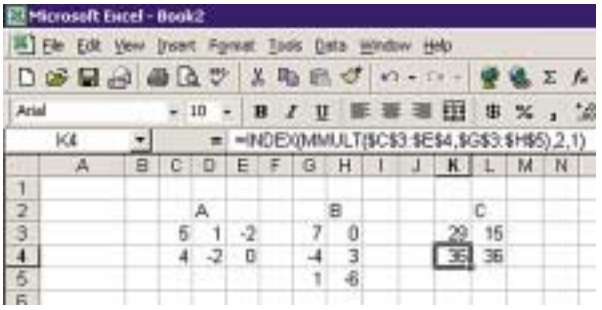


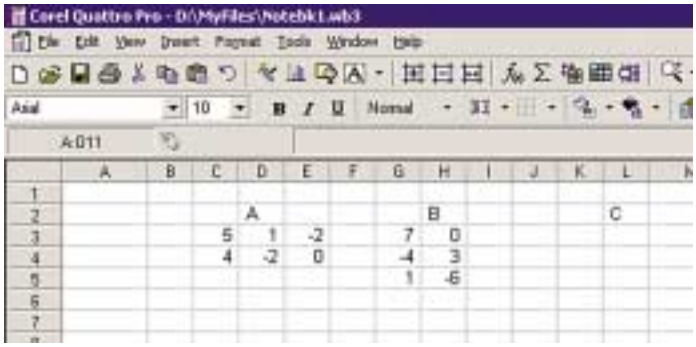
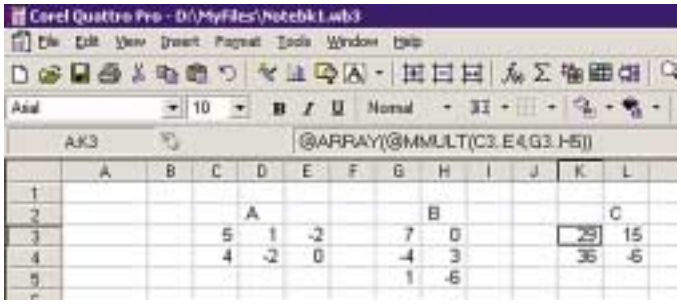
In cell J3, type: +B3+F3 (use "–" for subtraction). Copy this formula across to L3, and then copy this row down to J6 through L6. The result should be as follows:

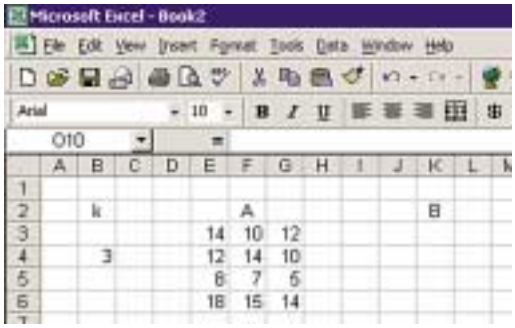
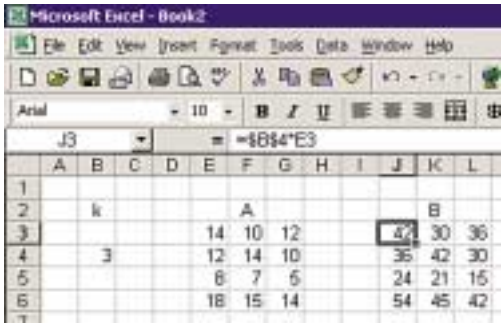
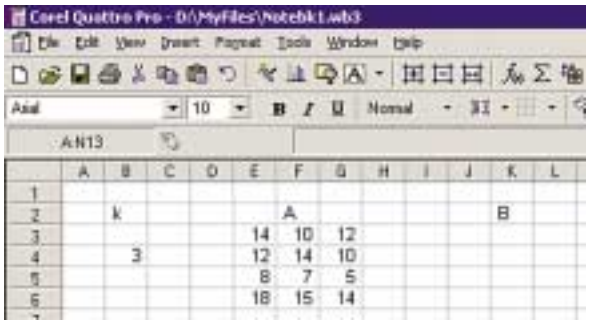


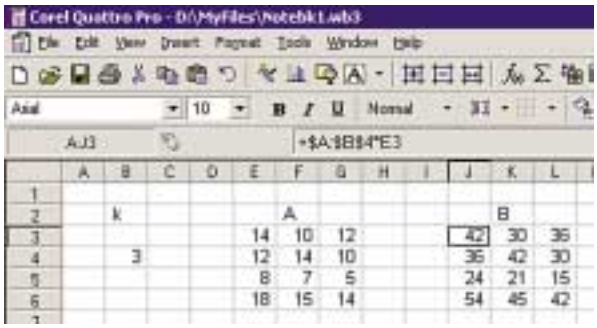
Function or Task	Keystroke(s), Menu, or Screen
Matrices: inverse **Microsoft® Excel:** =INDEX(array, row, col) =MINVERSE(array) **Corel® Quattro® Pro:** @ARRAY(array) @MINVERSE(array)	**Microsoft® Excel:** In Microsoft® Excel, two functions are required to obtain the inverse of a matrix. The first function is INDEX (array, row, col) and the second is MINVERSE(array). The MINVERSE function creates a second array that is the inverse of a given array. The INDEX function allows you to specify the row/column of the matrix element to display. That is, you need not display the entire inverse of a matrix, but rather you can choose to display any individual element. Set up your spreadsheet as follows:  In cell H3, type: =INDEX(MINVERSE($C$3:$E$5),1,1) In cell I3, type: =INDEX(MINVERSE($C$3:$E$5),1,2) In cell J3, type: =INDEX(MINVERSE($C$3:$E$5),1,3) Be sure to use **absolute cell referencing** as indicated by the "$". Notice how the column number changes as you move from left to right. Copy this row down two more rows. Change the row number for each subsequent row as you did the column number in the examples above. The result should be as follows: 

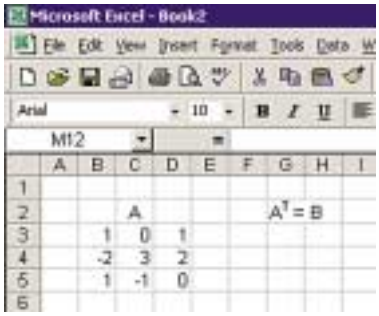
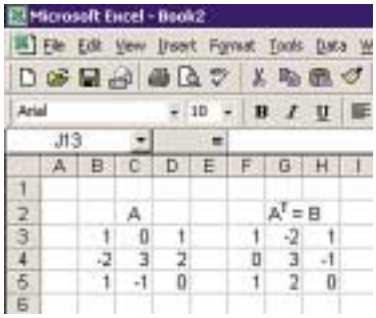
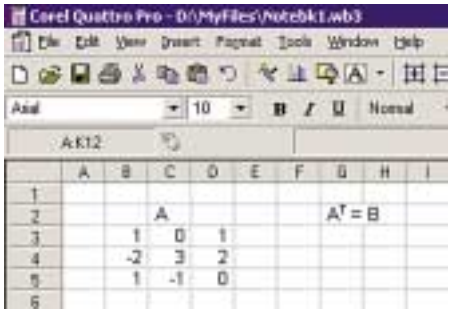
Function or Task	Keystroke(s), Menu, or Screen
	Corel® Quattro® Pro: Corel® Quattro® Pro 8 uses two functions to find the inverse of a matrix, ARRAY(array) and MINVERSE(array). The MINVERSE function creates a second array that is the inverse of a given array. The ARRAY function retrieves the resulting individual row/column elements and displays them in an array. Set up your spreadsheet as follows:  In cell H4, type: @ARRAY(@MINVERSE(C4..E6)) The result should be as follows:  In Corel® Quattro® Pro 9, use Tools / Numeric Tools / Invert instead.

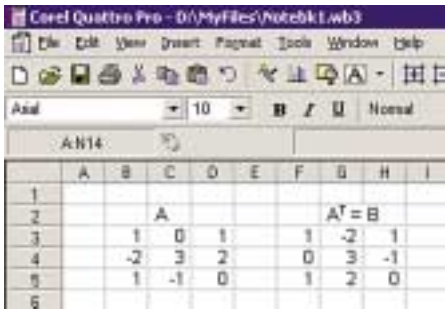
Function or Task	Keystroke(s), Menu, or Screen
Matrices: multiplication **Microsoft® Excel:** =INDEX(array, row, col) =MMULT(array1,array2) **Corel® Quattro® Pro:** @ARRAY(array) @MMULT(array1,array2)	**Microsoft® Excel:** In Microsoft® Excel, two functions are required to multiply matrices. The first function is INDEX (array, row, col) and the second is MMULT(array1,array2). The MMULT function creates a third array that is the result of multiplying two matrices. The INDEX function allows you to specify the row/column of the matrix element to display. That is, you need not display the entire inverse of a matrix, but rather you can choose to display any individual element. Set up your spreadsheet as follows:  In cell K3, type: =INDEX(MMULT($C$3:$E$4,$G$3:$H$5),1,1) In cell L3, type: =INDEX(MMULT($C$3:$E$4,$G$3:$H$5),1,2) Be sure to use **absolute cell referencing** as indicated by the "$". Notice how the column number changes as you move from left to right. Copy this row down one more row. Change the row number for this subsequent row as you did the column number in the examples above. The result should be as follows: 

Function or Task	Keystroke(s), Menu, or Screen
	Corel® Quattro® Pro: Corel® Quattro® Pro 8 uses two functions to multiply matrices, ARRAY(array) and MMULT(array1,array2). The MMULT function creates a third array that is the result of multiplying two matrices. The ARRAY function retrieves the resulting individual row/column elements and displays them in an array. Set up your spreadsheet as follows:  In cell K3, type: @ARRAY(@MMULT(C3..E4,G3..H5)) The result should be as follows:  In Corel® Quattro® Pro 9, use Tools/Numeric Tools/Multiply instead.

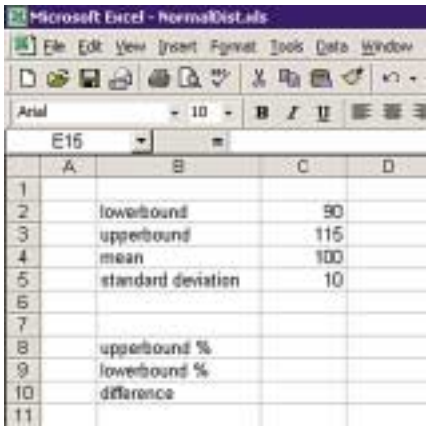
Function or Task	Keystroke(s), Menu, or Screen
Matrices: scalar multiplication	**Microsoft® Excel:** Set up your spreadsheet as follows:  In cell J3, type: =$B$4*E3. Be sure to use **absolute cell referencing** as indicated by the "$". Copy this formula across to L3. Now copy J3 to L3 down to J6 to L6. The result should be as follows:  **Corel® Quattro® Pro:** Set up your spreadsheet as follows: 

Function or Task	Keystroke(s), Menu, or Screen
	In cell J3, type: +$B$4*E3. Be sure to use **absolute cell referencing** as indicated by the "$". Copy this formula across to L3. Now copy J3 to L3 down to J6 to L6. The result should be as follows: 
Matrices: storing	**Microsoft® Excel:** You store a matrix in Microsoft® Excel as you would any array. Simply enter the matrix (array) into whichever cells you wish to use. A sample matrix (array) is shown:  **Corel® Quattro® Pro:** You store a matrix in Corel® Quattro® Pro as you would with any array. Simply enter the matrix (array) into whichever cells you wish to use. A sample matrix (array) is shown: 

Function or Task	Keystroke(s), Menu, or Screen
Matrices: transpose **Microsoft® Excel:** Edit/Paste Special... **Corel® Quattro® Pro:** Edit/Paste Special...	**Microsoft® Excel:** Set up your spreadsheet as follows:  Select and copy the matrix. Choose the location for the transpose of the matrix. From the Edit menu choose Paste Special... . In the Paste Special... dialog box choose Transpose and then OK. The result should be as follows:  **Corel® Quattro® Pro:** Set up your spreadsheet as follows: 

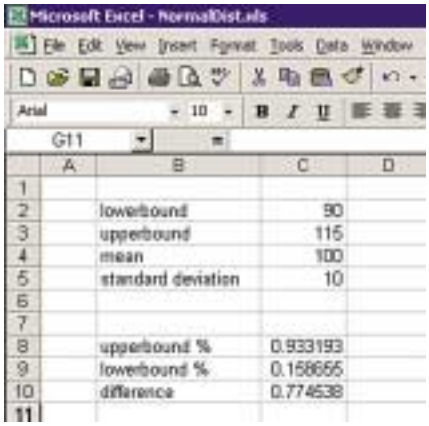
Function or Task	Keystroke(s), Menu, or Screen
	Select and copy the matrix. Choose the location for the transpose of the matrix. From the Edit menu choose Paste Special…. In the Paste Special… dialog box choose Transpose Rows and Columns and then OK. The result should be as follows: 
MAX function **Microsoft® Excel:** =MAX(array) **Corel® Quattro® Pro:** @MAX(array)	**Microsoft® Excel:** The maximum value function is =MAX(array). **Example:** To determine the maximum value in a series of cells such as from A1 to A15, enter =MAX(A1:A15) and press Enter. **Corel® Quattro® Pro:** The maximum value function is @MAX(array). **Example:** To determine the maximum value in a series or matrix such as from cell A1 to A15, enter @MAX(A1..A15) and press Enter.
matrix operations	See **Matrices: addition and subtraction** **Matrices: inverse** **Matrices: multiplication** **Matrices: scalar multiplication** **Matrices: storing** **Matrices: transpose**

Function or Task	Keystroke(s), Menu, or Screen
mean **Corel® Quattro® Pro:** @MEAN(array) See also **average**.	**Microsoft® Excel:** See **average**. **Corel® Quattro® Pro:** The mean value function is @MEAN(array). **Example:** To determine the mean value in a series of cells such as from A1 to A15, enter @MEAN(A1..A15) and press Enter.
median **Microsoft® Excel:** =MEDIAN(array) **Corel® Quattro® Pro:** @MEDIAN(array)	**Microsoft® Excel:** The median function is =MEDIAN(array). **Example:** To find the median of 6, 7, 8, 9, and 10, type =MEDIAN(6,7,8,9,10) and press Enter. The result will be 8. To find the median of cells B1 through B10, type =MEDIAN(B1:B10) and press Enter. **Corel® Quattro® Pro:** The median function is @MEDIAN(array). **Example:** To find the median of 6, 7, 8, 9, and 10, type @MEDIAN(6,7,8,9,10) and press Enter. The result will be 8. To find the median of cells B1 through B10, type @MEDIAN(B1..B10) and press Enter.
mode **Microsoft® Excel:** =MODE(array) **Corel® Quattro® Pro:** @MODE(array)	**Microsoft® Excel:** The mode function is =MODE(array). **Example:** To find the mode of 6, 7, 8, 9, and 10, type =MODE(6,7,8,8,9,10) and press Enter. The result will be 8. To find the mode of cells B1 through B10, type =MODE(B1:B10) and press Enter.

Function or Task	Keystroke(s), Menu, or Screen
	Corel® Quattro® Pro: The mode function is @MODE(array). **Example:** To find the mode of 6, 7, 8, 9, and 10, type @MODE(6,7,8,8,9,10) and press Enter. The result will be 8. To find the mode of cells B1 through B10, type @MODE(B1..B10) and press Enter.
multiplying matrices	See **Matrices: multiplication** **Matrices: scalar multiplication**
NORMDIST function **Microsoft® Excel:** =NORMDIST(boundary, mean, standard deviation,TRUE) **Corel® Quattro® Pro:** @NORMDIST(boundary, mean, standard deviation,1)	**Microsoft® Excel:** The NORMDIST(boundary, mean, standard deviation,TRUE) function allows you to calculate the probability that a given data point lies within a boundary using a normal distribution with a given mean and standard deviation. To calculate the probability that a given data point lies between a *lower boundary* and an *upper boundary*, set up your spreadsheet as follows:  In cell C8, type: =NORMDIST(C3,C4,C5,TRUE) to find the *upper boundary* probability. In cell C9, type: =NORMDIST(C2,C4,C5,TRUE) to find the *lower boundary* probability. In cell C10, type: =C8-C9 to find the probability that a given data point lies between a *lower boundary* and an *upper boundary*.

Function or Task	Keystroke(s), Menu, or Screen

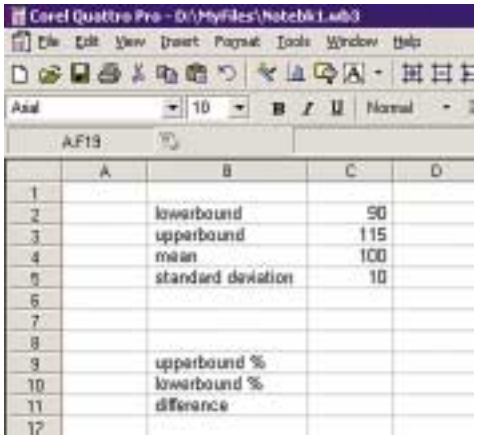
The result should be as follows:



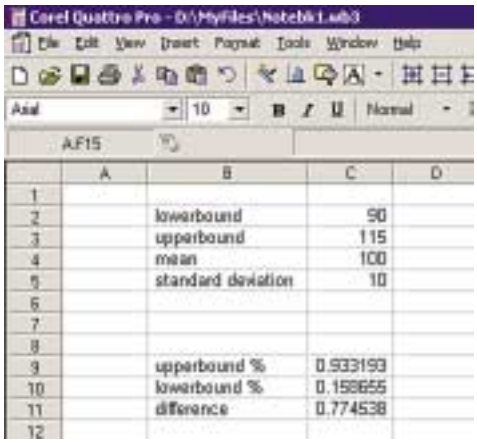
Corel® Quattro® Pro:

The @NORMDIST(boundary, mean, standard deviation,1) function allows you to calculate the probability that a given data point lies within a boundary using a normal distribution with a given mean and standard deviation.

To calculate the probability that a given data point lies between a *lower boundary* and an *upper boundary*, set up your spreadsheet as follows:



In cell C9, type: @NORMDIST(C3,C4,C5,1) to find the *upper boundary* probability.
In cell C10, type: @NORMDIST(C2,C4,C5,1) to find the *lower boundary* probability.
In cell C11, type: +C9-C10 to find the probability that a given data point lies between a *lower boundary* and an *upper boundary*.

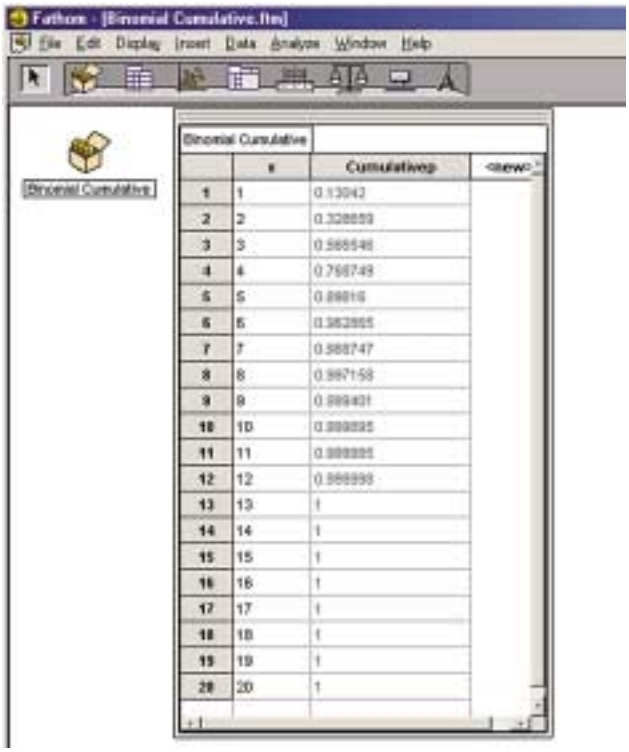
Function or Task	Keystroke(s), Menu, or Screen
	The result should be as follows: 
permutations function (nPr function) **Microsoft® Excel:** =PERMUT(n,r) **Corel® Quattro® Pro:** @PERMUT(n,r)	**Microsoft® Excel:** The permutations function for Microsoft® Excel is =PERMUT(n,r). **Example:** To find ${}_{10}P_7$, type =PERMUT(10,7) and press Enter. The result will be 604 800. **Corel® Quattro® Pro:** The permutations function for Corel® Quattro® Pro is @PERMUT(*n*,*r*). Notice that, unlike the **combinations function**, the *n* and *r* are in intuitive positions. **Example:** To find ${}_{10}P_7$, type @PERMUT(10,7) and press Enter. The result will be 604 800.
RAND function	See **random integers** **random real numbers**

Function or Task	Keystroke(s), Menu, or Screen
random integers **Microsoft® Excel:** =lower+round(diff*rand(),0) or =RANDBETWEEN(lower, upper) **Corel® Quattro® Pro:** @RANDBETWEEN(lower, upper)	**Microsoft® Excel:** To generate random integers, use the formula =lower+round(diff*rand(),0). The variable *diff* = *upper* – *lower*. **Example:** To generate a random integer from 6 to 10, type =6+round(4*rand(),0) You can copy this formula to other cells to generate more random integers. *Note:* You can use the RANDBETWEEN(lower,upper) function only if you have installed the Analysis ToolPak. If this function is not available, run the Setup program to install the Analysis ToolPak. After you install the Analysis ToolPak, you must enable it by using the Add-Ins command on the Tools menu. **Corel® Quattro® Pro:** To generate random integers, use the formula @RANDBETWEEN(lower,upper) **Example:** To generate a random integer from 6 to 10, type @RANDBETWEEN(6,10) You can copy the formula to other cells to generate more random integers.
random real numbers **Microsoft® Excel:** =RAND() **Corel® Quattro® Pro:** @RAND	**Microsoft® Excel:** To generate random real numbers, use the formula =RAND(). There is no argument for this function. Simply type the function into any cell. =RAND() will generate a real number from 0 to 1. =6*RAND() will generate a real number from 0 to 6. **Corel® Quattro® Pro:** To generate random real numbers, use the formula @RAND. There is no argument for this function. Simply type the function into any cell. @RAND will generate a real number from 0 to 1. @RAND*6 will generate a real number from 0 to 6.

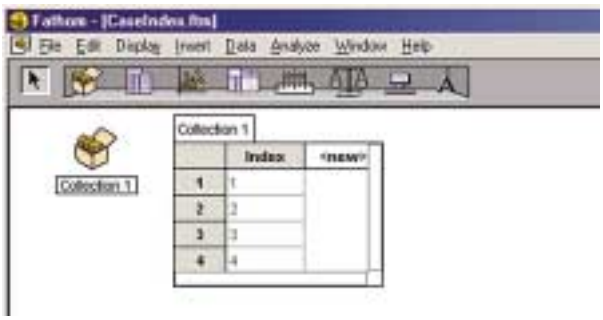
Function or Task	Keystroke(s), Menu, or Screen
reference data from cells in another worksheet	To reference data that exist in another worksheet or file is very similar to accessing data on a single worksheet. **Microsoft® Excel:** **Example:** Suppose that you have two worksheets. Set cell B2 in Sheet 2 equal to cell A1 in Sheet 1. Select cell B2 on Sheet 2 (where the data are going). Press "=". Select Sheet 1 and then cell A1 and press Enter. Cell B2 on Sheet 2 will now be equal to cell A1 on Sheet 1. The formula in cell B2 on Sheet 2, will be =Sheet1!A1. **Corel® Quattro® Pro:** **Example:** Suppose that you have two worksheets. Set cell B2 in Sheet B equal to cell A1 in Sheet A. Select cell B2 on Sheet B (where the data are going). Press "+". Select Sheet A and then cell A1 and press Enter. Cell B2 on Sheet B will now be equal to cell A1 on Sheet A. The formula in cell B2 on Sheet B will be +A:A1.
References: **relative referencing** **absolute referencing** **mixed referencing**	In spreadsheets there are two types of referencing. *Relative referencing*: These are references to cells that are relative to the position of the formula. *Absolute referencing*: These are references to cells that always refer to a cell's specific location. Depending on the task you wish to perform in a spreadsheet, you can use either type of referencing. If a dollar sign precedes the letter or the number, such as $B$7, the column or row reference is absolute. *Note*: Relative cell references automatically adjust when you copy them, while absolute cell references always point at the same cell. *Mixed referencing*: If you copy the following reference down a column, B$7, then the resulting formulas will always refer to cell B7, because the row has an absolute reference. But, if you copy the formula across a row then the resulting formulas will reference row 7 absolutely and will reference column B relatively.

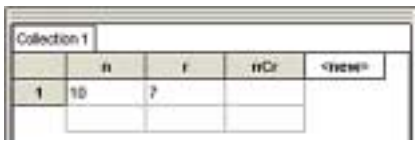
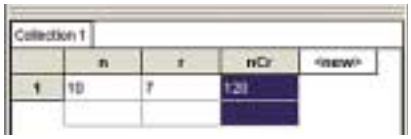
Function or Task	Keystroke(s), Menu, or Screen
relative cell referencing	See **References:** **relative referencing** **absolute referencing** **mixed referencing**
ROUND function **Microsoft® Excel:** =ROUND(n,d) **Corel® Quattro® Pro:** @ROUND(n,d)	**Microsoft® Excel:** The rounding function is =ROUND(n,d). **Example:** To round 8.787 to the nearest tenth, type =ROUND(8.787,1) and press Enter. The result will be 8.8. **Corel® Quattro® Pro:** The rounding function is @ROUND(n,d). **Example:** To round 8.787 to the nearest tenth, type @ROUND(8.787,1) and press Enter. The result will be 8.8.
search	The search function is accessed by choosing Find... from the Edit menu or by pressing CTRL-F.
Sort feature **Microsoft® Excel:** Data/Sort.. **Corel® Quattro® Pro:** Tools/Sort..	**Microsoft® Excel:** The sort feature is available through the Data menu. Select the range of cells you wish to sort, then choose Data/Sort.... **Corel® Quattro® Pro:** The sort feature is available through the Tools menu. Select the range of cells you wish to sort then choose Tools/Sort....

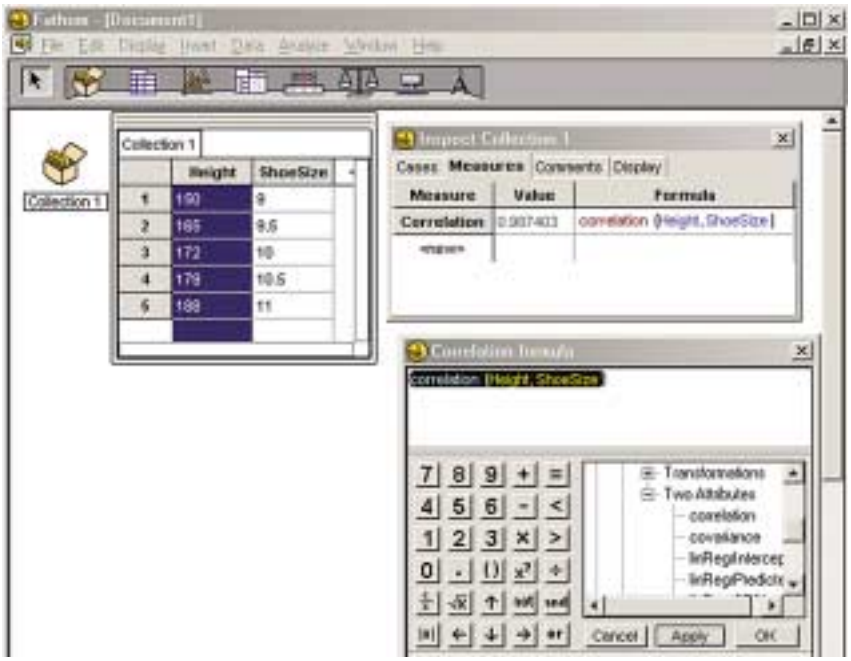
Function or Task	Keystroke(s), Menu, or Screen
standard deviation **Microsoft® Excel:** ***Population*** =STDEVP(array) ***Sample*** =STDEV(array) **Corel® Quattro® Pro:** ***Population*** @STD(array) ***Sample*** @STDS(array)	**Microsoft® Excel:** The standard deviation function is =STDEV(array). **Example:** Determine the standard deviation of a sample listed in cells from A1 to A15. Enter =STDEV(A1:A15) and press Enter. **Corel® Quattro® Pro:** The standard deviation function is @STDS(array). **Example:** Determine the standard deviation of a sample listed in cells from A1 to A15. Enter @STDS(A1..A15) and press Enter.
SUM function **Microsoft® Excel:** =SUM(array) **Corel® Quattro® Pro:** @SUM(array)	**Microsoft® Excel:** **Example:** Determine the sum of a series of cells such as from A1 to A15. Enter =SUM(A1:A15) and press Enter. **Corel® Quattro® Pro:** **Example:** Determine the sum of a series of cells such as from A1 to A15. Enter @SUM(A1..A15) and press Enter.
Variance **Microsoft® Excel:** ***Population*** =VARP(array) ***Sample*** =VAR(array) **Corel® Quattro® Pro:** ***Population*** @VAR(array) ***Sample*** @VARS(array)	**Microsoft® Excel:** The variance function is =VAR(array). **Example:** To find the sample variance of 6, 7, 8, 9, and 10, type =VAR(6,7,8,9,10) and press Enter. The result will be 1.142857. To find the sample variance of cells B1 through B10, type =VAR(B1:B10) and press Enter. **Corel® Quattro® Pro:** The variance function is @VAR(array). **Example:** To find the sample variance of 6, 7, 8, 9, and 10, type @VARS(6,7,8,9,10) and press Enter. The result will be 1.142857. To find the sample variance of cells B1 through B10, type @VARS(B1..B10) and press Enter.

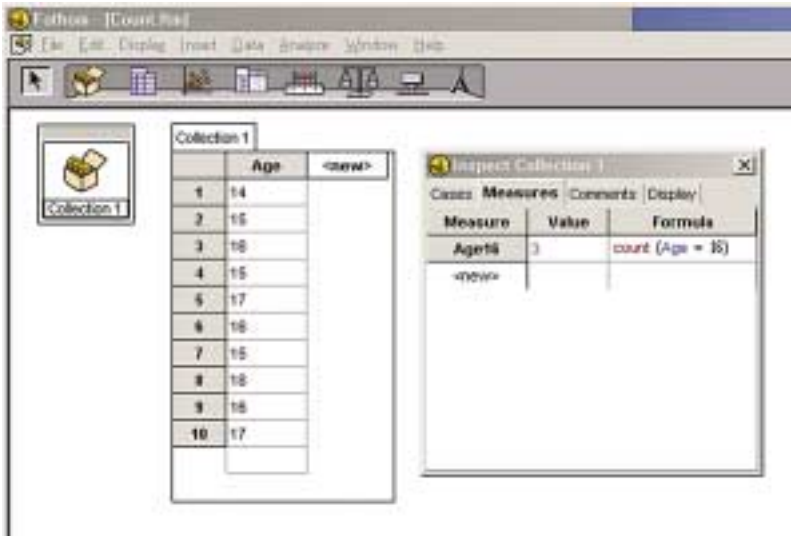
Function or Task	Keystroke(s), Menu, or Screen
binomialCumulative() function binomialCumulative(x,n,p, min,max)	The binomialCumulative() function is found under the Functions/Distributions/Binomial menu. This function returns the probability of getting x or fewer successes in n trials of a binomial distribution where the probability of success on each trial is p. Normally, x will take on values from 0 to n. However, if min and max are specified, then the value of x will go from min to max in steps of (max – min)/n. **Example:** Consider the rolling of two dice 20 times. What is the probability of rolling up to four doubles? In this case, $x = 4$, $n = 20$ and $p = \frac{1}{6}$. Hence, binomialCumulative(4,20,1/6) will return a value of approximately 0.769. You can use this function in a **case table** to create a table of cumulative probabilities as shown in the following screen: 

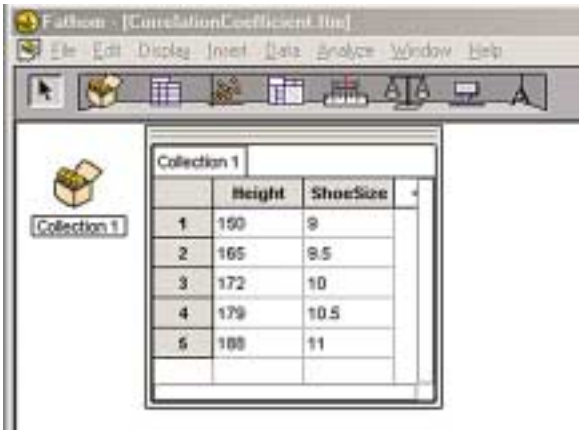
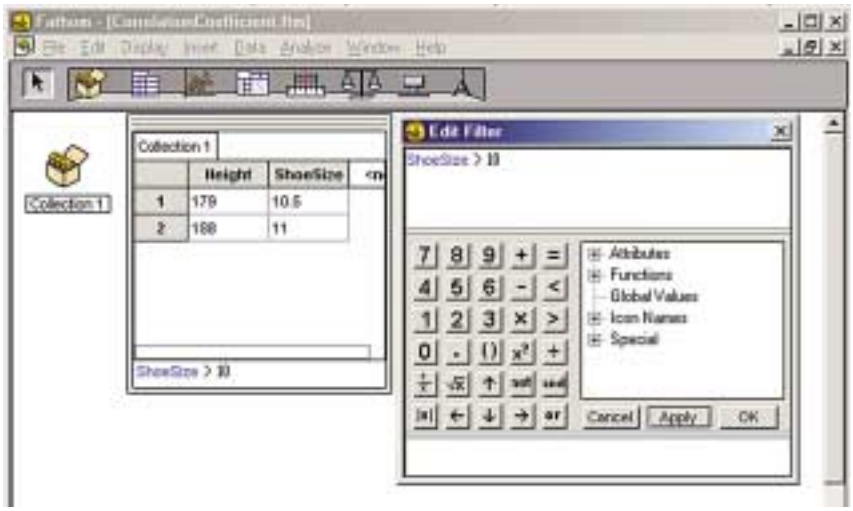
Function or Task	Keystroke(s), Menu, or Screen
binomialProbability() function binomialProbability(x,n,p, min,max)	The binomialProbability() function is found under the Functions/Distributions/Binomial menu. It returns the probability of getting exactly x successes in n trials of a binomial distribution, where the probability of success on each trial is p. **Example:** Consider 20 rolls of 2 dice. What is the probability of rolling exactly four doubles? In this case, $x = 4$, $n = 20$, and $p = \frac{1}{6}$. Hence, binomialProbability(4,20,1/6) will return a value of approximately 0.202. You can use this function in a **case table** to create a table of probabilities as shown in the following screen: 

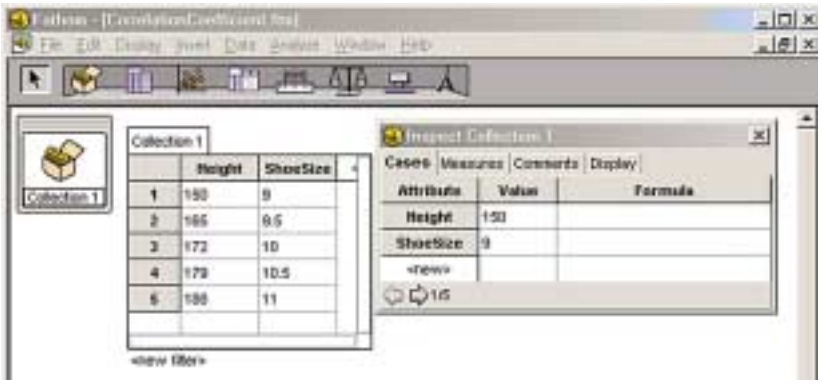
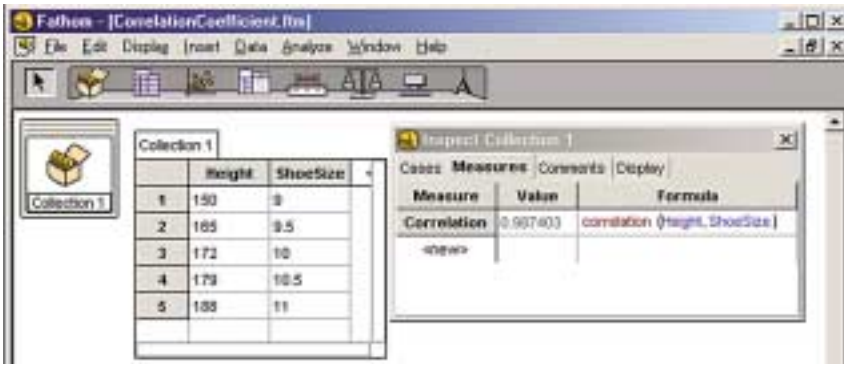
Function or Task	Keystroke(s), Menu, or Screen
caseIndex function	The caseIndex function located under Functions/Special menu is like the "row number" in a spreadsheet. **Example:** Suppose that you want an attribute which runs from 1 to 20, perhaps to be used in the calculation of another attribute. Start Fathom and open a new document if necessary. Drag a **collection** box to the workspace. Drag a **case table** to the workspace. Double-click on <new> and rename it Index. Right-click on the **case table**, select New Cases and type in 20. Notice that the Index attribute is now numbered from 1 to 20, as shown in the following screen: 
case table	Fathom keeps data for a particular **collection** in a case table which is linked to that **collection**. Run Fathom and open a new document, if necessary. Drag a **collection** box to the workspace. Note that it is called Collection 1. Now, drag a case table to the workspace. Notice that it is linked to Collection 1. Now that you have a case table, you can specify the attributes you want to keep track of. Suppose that this collection will contain information about the CDs that you own. One attribute might be the title of the CD. Double-click on <new>, and type in Title. Under Title, you can type the CD titles that you own. ▼

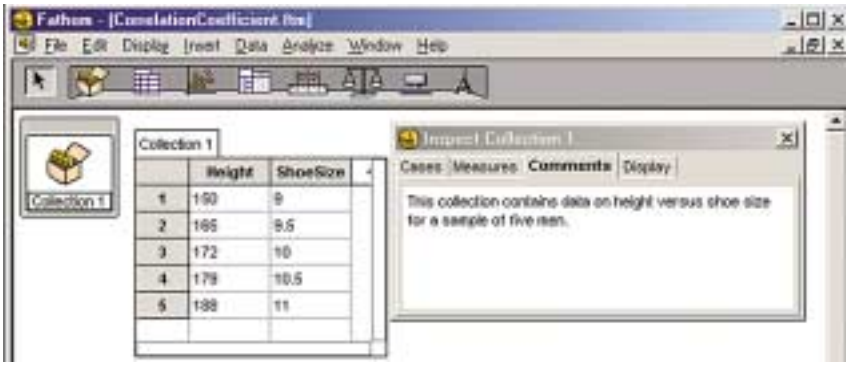
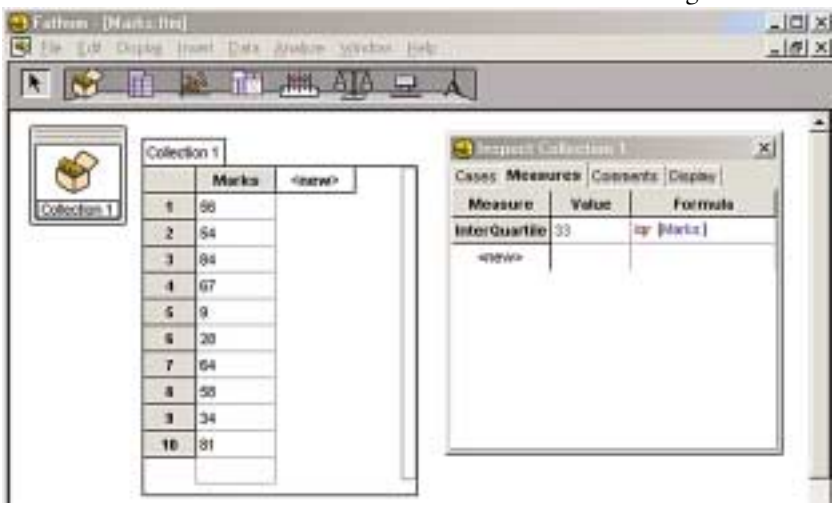
Function or Task	Keystroke(s), Menu, or Screen
	Your screen should look like this:  In a similar manner you can add other attributes, like Artist, Number of Tracks, or whatever else is important. Data can also be copied from other Windows applications to the clipboard, and pasted into a case table.
collection	Fathom keeps track of data entered using the collection metaphor. Each collection is identified by a collection box that may be named in such a way as to identify the collection. For example, suppose that you wanted to keep track of your CD collection in Fathom. Start Fathom and open a new document, if necessary. Drag a collection box to the workspace. Notice that its default name is Collection 1. Double-click on the name. In the dialog box, type an appropriate name, like CD Collection. You can now add a **case table** with appropriate attributes for your collection.
combinations function combinations(n,r)	The combinations function or ${}_nC_r$ is combinations(n,r). **Example:** To evaluate the number of subsets of 10 objects taken 7 at a time, or 10 choose 7, make a new **collection** and create a **case table** as follows:  Right click on the nCr attribute and choose Edit Formula. Now choose Functions / Arithmetic / Combinations. Double-click on Combinations. Choose Attributes and double-click on n. Press "," and then double-click on r. Click on Apply and then click on OK. You will see: 

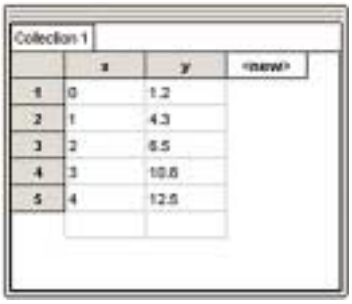
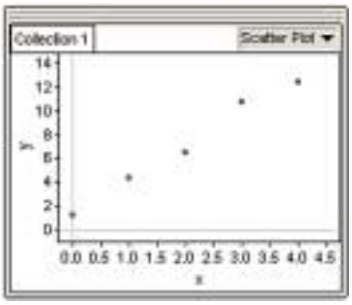
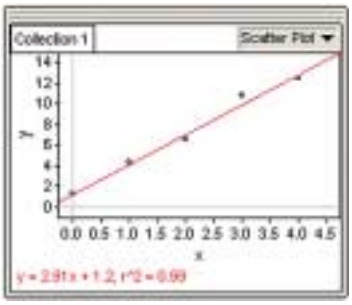
Function or Task	Keystroke(s), Menu, or Screen
correlation coefficient	The correlation coefficient for two attributes may be calculated using the correlation function under the Functions / Statistical / Two Attributes menu. **Example:** Create a **collection** and **case table** for Height versus ShoeSize, as shown in the screen shot below. Double click on the **collection** box to open the **inspector**, and select the Measures tab. Create a <new> measure called Correlation. Right-click under the Formula column in the Correlation row, and select Edit Formula. Select the correlation function under the Functions / Statistical / Two Attributes menu, and type Height,ShoeSize between the brackets. Click OK. Note that you get a correlation coefficient of about 0.987 between Height and ShoeSize. 

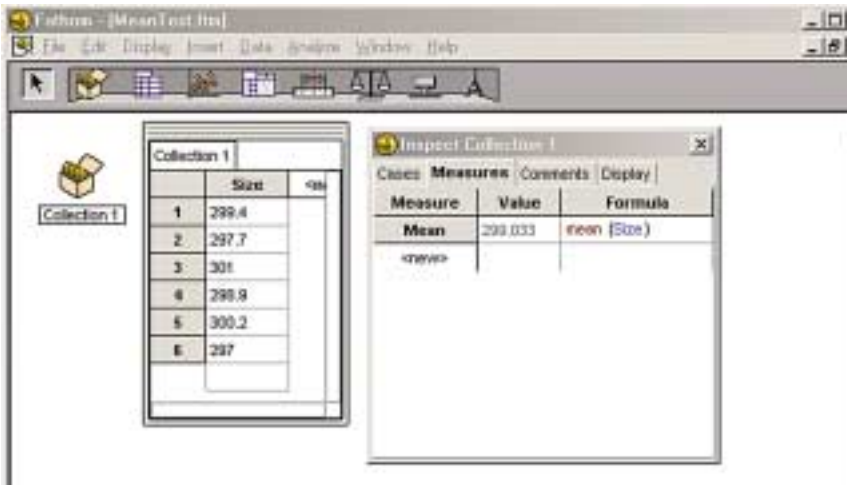
Function or Task	Keystroke(s), Menu, or Screen
count function	When given a list of data for an attribute, Fathom™ can count how many times a specific condition occurs using the count function under Functions / Statistical / One Attribute menu. For example, suppose that you have a **collection** of data on the students in your school, and you would like to count how many have an entry of 16 under the attribute Age. To see how this function works, run Fathom™ and open a new document if necessary. Drag a **collection** box and then a **case table** to the workspace. Rename the <new> attribute to Age, and enter ages of 14, 15, 16, 15, 17, 16, 15, 18, 16, and 17. Double-click on the **collection** box to open the **inspector**. Select the Measures tab, and rename <new> to Age16. Right-click in the Formula column in the Age16 row, and select the count function under Functions / Statistical / One Attribute menu. Between the brackets, type in the condition Age=16. Click on OK. Notice that the value changes to 3, the number of occurrences of age 16, as shown in the following screen: 

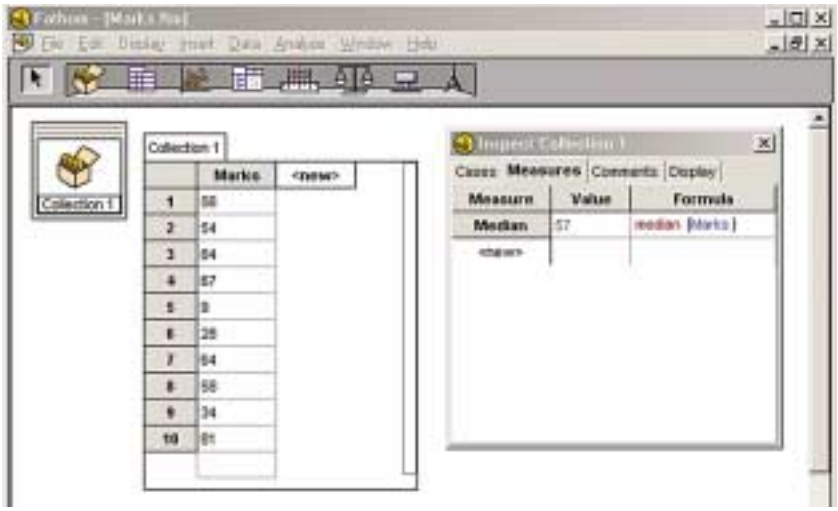
Function or Task	Keystroke(s), Menu, or Screen
filter	A filter may be added to an object in order to select only a subset of the data that is of interest. **Example:** Create a **collection** and a **case table** as shown in the screen shot below:  Suppose that you want to show only shoe sizes greater than 10. Click on the **case table** to select it, and select Add Filter from the Data menu. Then, type in the condition ShoeSize>10 and click on OK. You will see: 

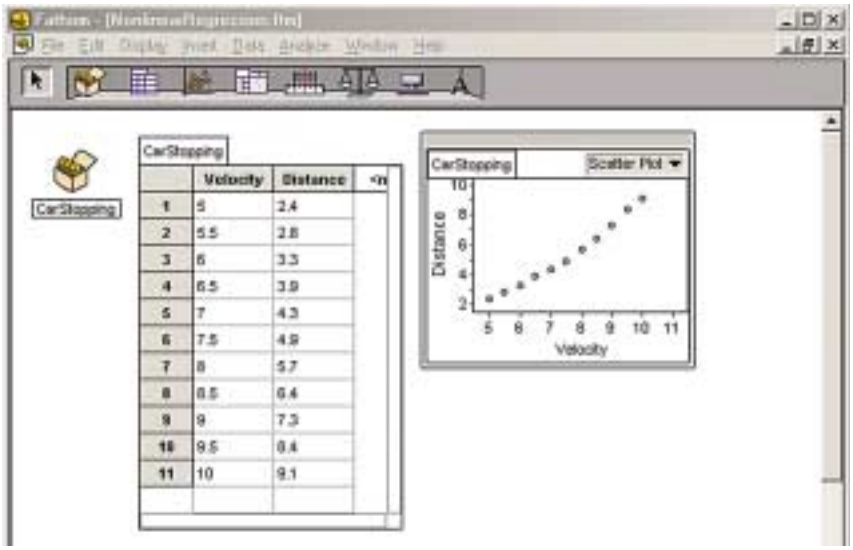
Function or Task	Keystroke(s), Menu, or Screen
graph icon	The graph icon is the third selection on the shelf, to the right of the **collection** box icon and the **case table** icon, as shown in the screenshot below:  You can create a new graph by clicking on the graph icon, holding the left mouse button down, and dragging it onto the workspace. You can then drag attributes from a **case table** to the axes of the graph.
inspector	The inspector for a **collection** can be opened by double-clicking on the **collection** box. A new window will appear, with several panes. The first pane is the Cases pane, as shown in the following screen:  This pane allows you to inspect the **collection** case by case, and is particularly useful for collections that have many attributes. The second pane is the Measures pane, which allows you to define measures for the **collection**, such as the **mean**, and **correlation coefficient**, some of which are described elsewhere in this appendix. 

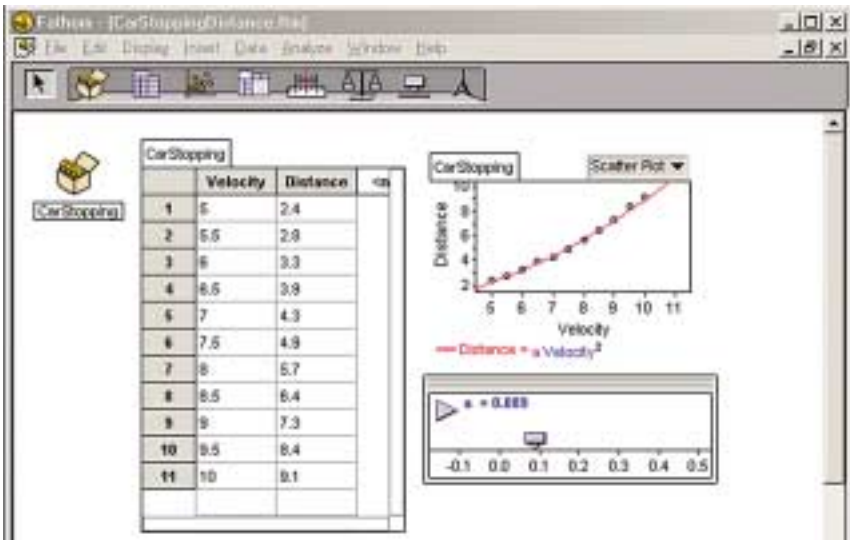
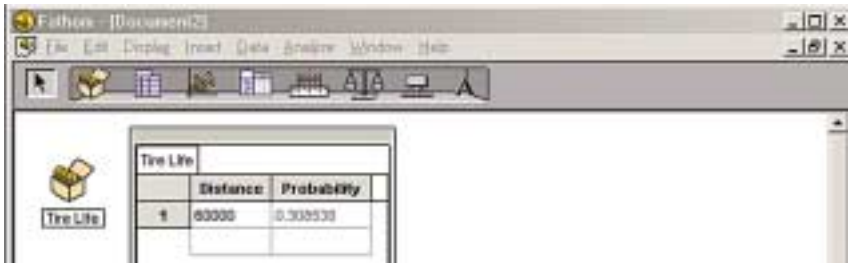
Function or Task	Keystroke(s), Menu, or Screen
	The third pane is the Comments pane, which allows you to add comments relevant to the collection, as shown below:  The last pane is the Display pane, which allows you to control how the data for a collection appears on the screen. More detail on how to program this feature is available in the *Fathom™ Reference Manual*.
interquartile range iqr(attribute)	The interquartile range function found under the Functions / Statistical / One Attribute menu is used to calculate the interquartile range for an attribute. **Example:** Create a collection and case table as shown in the following screen:  Double-click on the collection box to open the inspector for the collection, and select the Measures tab. Rename <new> to InterQuartile. Right-click on the Formula column for the InterQuartile measure, and select Edit Formula. Select the iqr() function under the Functions / Statistical / One Attribute menu, and type Marks between the brackets. You will see the interquartile range calculated under Value, as in the screen shown above.

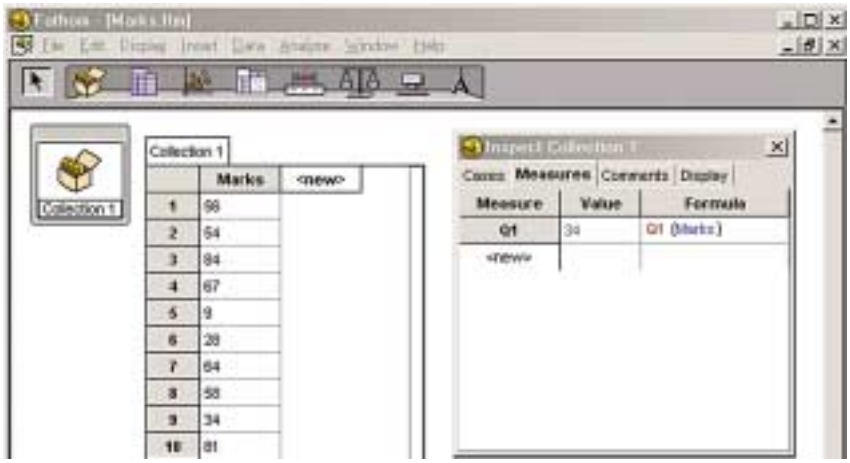
Function or Task	Keystroke(s), Menu, or Screen
linear regression	Fathom™ generates a **linear regression** line and values when it graphs data. Set up a new **collection** as follows:  Graph the data as follows:  Right-click on the graph and choose Least-Squares Line.  The graph displays an equation of best fit with $a = 2.91$ and $b = 1.2$. The graph also shows the coefficient of determination, r^2.
line of best fit	See **linear regression**.

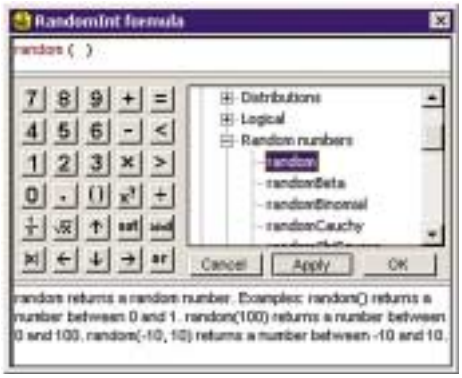
Function or Task	Keystroke(s), Menu, or Screen
mean	The mean function found under the Functions / Statistical / One Attribute menu is used to calculate the mean of an attribute. **Example:** Create a **collection** and **case table** as shown in the following screen:  Double-click on the **collection** box to open the **inspector** for the collection, and select the Measures tab. Rename <new> to Mean. Right-click on the Formula column for the Mean measure, and select Edit Formula. Select the mean() function under the Functions / Statistical / One Attribute menu, and type Size between the brackets. You will see the mean calculated under Value, as in the screen shown above.

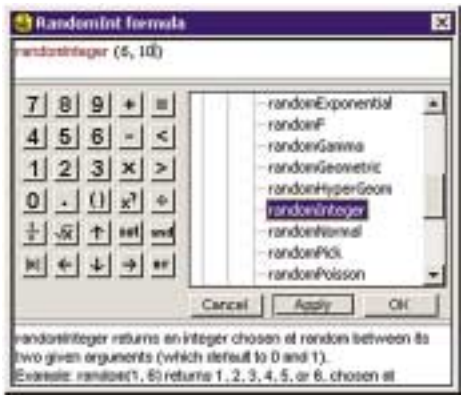
Function or Task	Keystroke(s), Menu, or Screen
median	The median function found under the Functions / Statistical / One Attribute menu is used to calculate the median for an attribute. **Example:** Create a **collection** and **case table**, as shown in the screen shot below:  Double-click on the **collection** box to open the **inspector** for the **collection**, and select the Measures tab. Rename <new> to Median. Right-click on the Formula column for the Median measure, and select Edit Formula. Select the median() function under the Functions / Statistical / One Attribute menu, and type Marks between the brackets. You will see the median calculated under Value, as in the screen shown above.
mode	There is no mode function in Fathom™. You can find the mode for an attribute a by following the procedure for the **median** and then using the formula given below. The derivation of this formula is beyond the scope of this appendix. mean(a, rank(a) - uniqueRank(a) = max(rank(a) - uniqueRank(a))) Another way to find the mode is to **sort** the attribute a and then scroll down the column looking for values that occur multiple times.

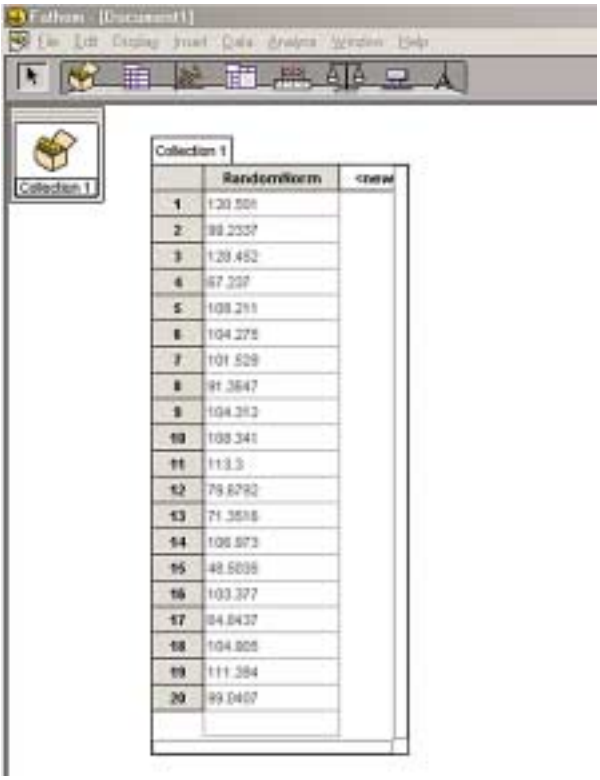
Function or Task	Keystroke(s), Menu, or Screen
non-linear regression	Fathom does not have built-in non-linear regression functions. However, you can plot functions on top of a scatter plot and even control parameters using sliders, in an attempt to match a function to the scatter plot. **Example:** Create a **collection**, **case table**, and graph as shown in the screen shot below:  It looks like the relation might be quadratic. To try a fit, select the graph, and then select Plot Function from the Graph menu. You can now enter a formula for Distance as a function of Velocity. You might type in .09×Velocity². If this formula does not work, you can try another coefficient. However, a more convenient way to do it is to use a Slider. Drag a Slider from the shelf to the workspace, and rename it a. Select Plot Function from the Graph menu, and enter the formula aVelocity².

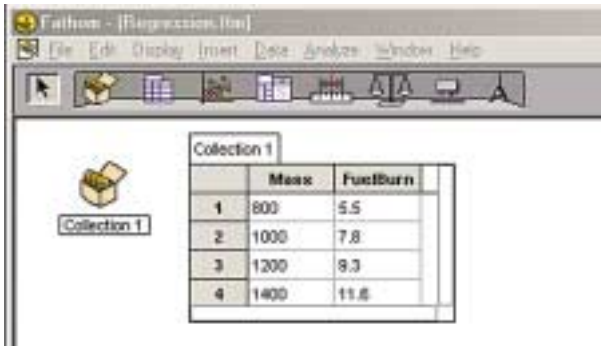
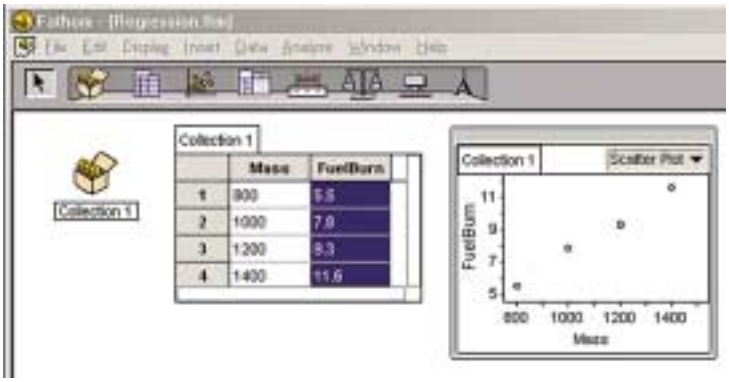
Function or Task	Keystroke(s), Menu, or Screen
	 Adjust the values on the slider until the function appears to match your scatter plot the best. If the quadratic function does not work, you can try other functions.
normalCumulative function normalCumulative (x, mean, standard deviation)	The normalCumulative function located under the Functions/Distributions/Normal menu allows you to calculate the probability that a given data point is less than x using a normal distribution with a given mean and standard deviation. **Example:** Suppose that a particular model of tire has a lifetime with a mean of 64 000 km and a standard deviation of 8000 km. What is the probability that a tire will wear out at 60 000 km or less? Create a **collection** and a **case table** as shown in the following screen:  Right-click on the Probability attribute, and select the normalCumulative function under the Function/Distributions/Normal menu. Type Distance,64000,8000 between the brackets. You will get a probability of approximately 0.309.

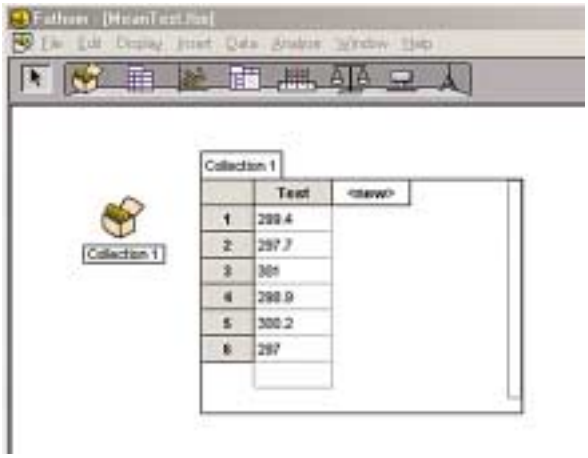
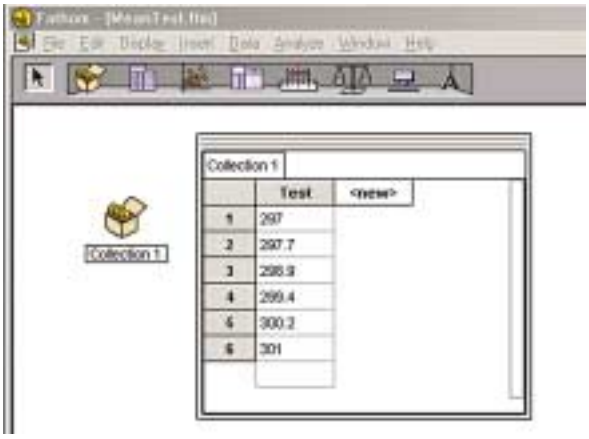
Function or Task	Keystroke(s), Menu, or Screen
normalQuantile function normalQuantile(p, mean, standard deviation)	The normalQuantile function located under the Functions / Distributions / Normal menu is the opposite of the **normalCumulative function**. Given a probability p, it allows you to calculate the value of x using a normal distribution with a given mean and standard deviation such that the probability that a given data point is less than or equal to x is p. **Example:** Suppose that a particular model of tire has a lifetime with a mean of 64 000 km and a standard deviation of 8000 km. What distance will see 25% of the tires wear out? Create a **collection** and a **case table** as shown in the following screen:  Right-click on the Distance attribute, and select the normalQuantile function under the Functions / Distributions / Normal menu. Type Probability,64000,8000 between the brackets. You will get a distance of approximately 58 604 km.
quartiles	The quartile functions in Fathom™ are Q1 and Q3, found under the Functions / Statistical / One Attribute menu. **Example:** Create a **collection** and **case table** as shown in the following screen: 

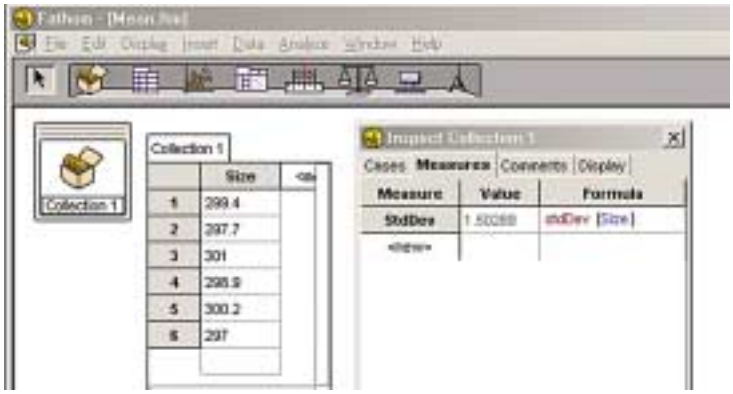
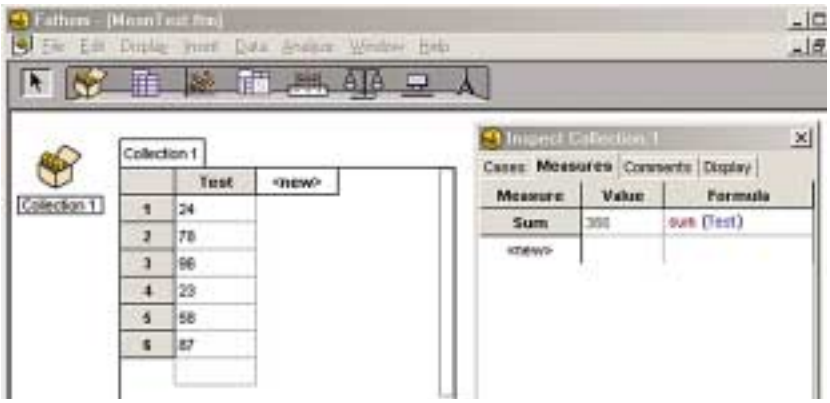
Function or Task	Keystroke(s), Menu, or Screen
	Double-click on the **collection** box to open the **inspector** for the **collection**, and select the Measures tab. Rename <new> to Q1. Right-click on the Formula column for the Median measure, and select Edit Formula. Select the Q1 function under the Functions / Statistical / One Attribute menu, and type Marks between the brackets. You will see the first quartile calculated under Value, as shown in the screen shown above. You can calculate Q3 in a similar manner.
random function random()	Fathom™ has 17 different random functions. random( ) will generate a random real number from 0 to 1. **Example:** Generate ten random numbers from 0 to 1. Open a new **collection**. Create a new **case table**. Double-click on the <new> attribute and rename it Random. To add ten new cases, right-click on the Random attribute and select New Cases…. Type in 10 and press Enter. Right-click on the Random attribute and choose Edit Formula. Choose Functions. Double-click on random. Choose OK. You now have 10 random real numbers between 0 and 1. 
randomInteger function randomInteger(lower, upper)	The randomInteger function will generate random integers from lower to upper. **Example:** Generate 20 random numbers from 6 to 10. Open a new **collection**. Create a new **case table**. Double-click on the <new> attribute and rename it RandomInt.

Function or Task	Keystroke(s), Menu, or Screen
	To add 20 new cases, right-click on the RandomInt attribute and select New Cases…. Type in 20 and press Enter. To generate the random numbers, right-click on the RandomInt attribute and choose Edit Formula.  Now choose Functions. Double-click on randomInteger(). Type 6,10 between the brackets. Choose OK. You now have 20 random numbers between 6 and 10.
randomNormal function randomNormal(mean, standard deviation)	The randomNormal function will generate random numbers from a normal distribution with a given mean and a given standard deviation. **Example:** Generate 20 random numbers from a normal distribution with a mean of 100 and a standard deviation of 10. Open a new **collection**. Create a new **case table**. Double-click on the <new> attribute and rename it RandomNorm. To add 20 new cases, right-click on the RandomNorm attribute and select New Cases…. Type in 20 and press Enter. To generate the random numbers, right-click on the RandomNorm attribute and choose Edit Formula.

Function or Task	Keystroke(s), Menu, or Screen
	 Choose Functions. Double-click on randomNorm(). Type 100,10 between the brackets. Choose OK. You now have 20 random numbers from a normal distribution with a mean of 100 and a standard deviation of 10.

Function or Task	Keystroke(s), Menu, or Screen
scatter plot	You can draw a scatter plot by dragging attributes from a **case table** to a graph. **Example:** Create a **collection** and a **case table** as shown in the following screen:  Drag the **graph icon** from the shelf to the workspace. Drag the Mass attribute to the horizontal axis of the graph. Drag the FuelBurn attribute to the vertical axis of the graph. You will see: 
semi-interquartile range	The semi-interquartile range is one half of the **interquartile range**. See **interquartile range**.

Function or Task	Keystroke(s), Menu, or Screen
sort	You can sort the entries in a **case table** using the Sort Ascending and Sort Descending functions under the Data menu. **Example:** Create a **collection** and **case table** as shown in the following screen:  Click on the Test attribute to select the attribute column. Click on the Data menu, and select Sort Ascending.  If you want the data sorted in descending order, then select Sort Descending from the Data menu.

Function or Task	Keystroke(s), Menu, or Screen
standard deviation ***Population*** popstdDev() ***Sample*** stdDev()	The popstdDev() and stdDev() functions found under the Functions / Statistical / One Attribute menu are used to calculate the standard deviation of an attribute. **Example:** Create a **collection** and **case table** as shown in the following screen:  Double-click on the **collection** box to open the **inspector** for the **collection**, and select the Measures tab. Rename <new> to StdDev. Right-click on the Formula column for the StdDev measure, and select Edit Formula. Select the stdDev() function under the Functions / Statistical / One Attribute menu, and type Size between the brackets. You will see the sample standard deviation calculated under Value.
sum function	The sum function under the Functions / Statistical / One Attribute menu can be used to find the sum of the entries under an attribute. **Example:** Create a **collection** and **case table** as shown below: 

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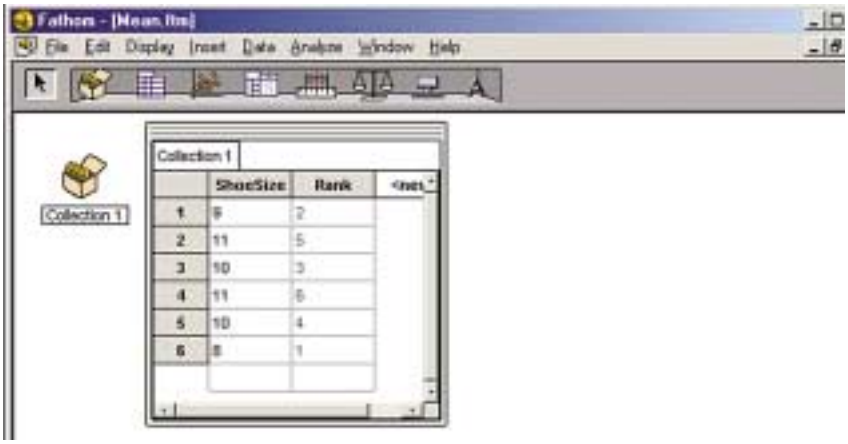
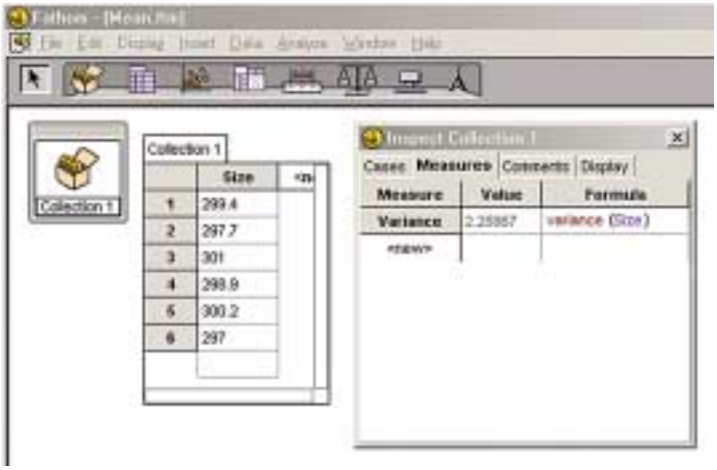
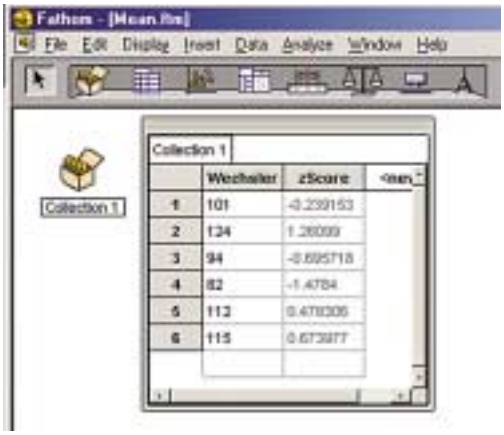
Function or Task	Keystroke(s), Menu, or Screen
	Double-click on the **collection** box to open the **inspector**, and rename <new> to Sum. Right-click the Formula column at the Sum row and select Edit Formula. Select the sum function under the Functions / Statistical / One Attribute menu and type Test between the brackets. You will see the value of 366 under the Value column.
uniqueRank() function	The uniqueRank() function under the Functions / Statistical / Transformations menu is used to rank the entries in an attribute column of a **case table**. **Example:** Create a **collection** and a **case table** as shown in the following screen:  Right-click on the Rank attribute, and select Edit Formula. Select uniqueRank() from the Functions / Statistical / Transformations menu and type ShoeSize between the brackets. The Rank attribute will now show the ranking of each entry under the ShoeSize attribute. *Note*: If the ShoeSize attribute is sorted before applying the uniqueRank() function, then the ranks will be in order.

Function or Task	Keystroke(s), Menu, or Screen
variance ***Population*** popVariance() ***Sample*** Variance()	The popVariance and variance functions located under the Functions / Statistical / One Attribute menu compute the square of the **standard deviation**. **Example:** Create a **collection** and **case table** as shown in the following screen:  Double-click on the **collection** box to open the **inspector** for the **collection**, and select the Measures tab. Rename <new> to Variance. Right-click on the Formula column for the Variance measure, and select Edit Formula. Select the variance function under the Functions / Statistical / One Attribute menu, and type Size between the brackets. You will see the sample variance calculated under Value.

Function or Task	Keystroke(s), Menu, or Screen
zScore function also known as sampleZscore	The zScore function under the Functions / Statistical / Transformations menu calculates how many sample standard deviations a value is from the mean. For example, if a sample has a mean of 100 and a standard deviation of 10, then a value of 120 would have a zScore of 2. **Example:** Create a **collection** and a **case table** as shown in the following screen:  Right-click on the zScore attribute, and select Edit Formula. Select zScore() from the Functions / Statistical / Transformations menu and type Wechsler between the brackets. The zScore for each entry in the Wechsler attribute is now displayed in the zScore attribute column.