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Calculator Lesson 35

Statistics

The statistical functions on the HP 50g are significantly more advanced than on the 48 series calculators and are clearly explained in Chapter 16 of the small User's Manual that comes with the calculator. Unfortunately, some of the convenience of the statistical functions on the 48 series is lost. This is particularly true if one wants to draw graphs or use the functions in programs. The good news is that the old statistics directory is still hiding in the HP 50g. This lesson will be restricted to that directory.

The directory can be accessed by typing **96 MENU** then pressing ENTER. We now see 6 directories: F1-DATA, F2-ΣPAR, F3-1VAR, F4-PLOT, F5-FIT, and F6-SUMS. If you find yourself needing to get in and out of this directory frequently, it would be convenient to have a program to get in. Store the program << 96 MENU >> as STATD for STATistics Directory. Each time you need to get into the directory, just press the corresponding function key. NOTE: the symbol << >> is found as RS +.

Press F1-DATA and see 4 commands, F1-Σ+, F2-Σ-, F3-CLΣ, and F4-ΣDAT. As is true about all submenus, the last item, and always in the F6 position, is a command to return you to the menu from whence you came. In this case it is F6-STAT. The statistical commands work from a file called ΣDAT. This file must contain a matrix with one or more columns. The commands in this directory are intended to manipulate that file.

F1-Σ+ will add a data point to the file. If ΣDAT is empty, the first use of F1-Σ+ will create the matrix and insert the item on the command line or on level 1 of the stack to the matrix. If your data consists of just a single list of numbers, enter the first number, press F1-Σ+, enter the second, press F1-Σ+, etc. until you have entered all of your data. A matrix with one column will be created. If your data consists of ordered pair, triplets, etc., you must create a vector with the first set of numbers then press F1-Σ+. After the first entry, it is not necessary to create the vector. For each set you can simply put the numbers from the set separated by SPC on the command line then press F1-Σ+. A matrix with the appropriate number of columns will be created. If you press VAR you will see that the file ΣDAT has been added to your directory.

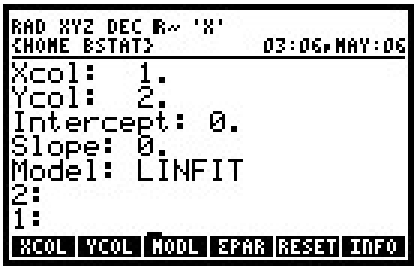
F2-Σ- is for data correction. If you believe you may have made an error in your last entry, press F2-Σ-. The last data point will be removed from the file and place on the stack. If you find that it is correct, simply press F1-Σ+ to put it back. If it is wrong, you can fix it and press F1-Σ+ to place it back in the file and continue entering data. If the data point is a vector, you will want to press DA to put it in the Matrix Writer to make the correction. See Lesson 30 for information about the Matrix Writer.

F3-CLΣ clears ΣDAT when you are ready to start entering a new data set. More precisely, it deletes the file ΣDAT from you directory. If you press VAR after F3-CLΣ you will find that the file ΣDAT is no longer there. It is probably a good idea to press F3-CLΣ before starting a new data set just to make sure you are in fact starting a new file.

F4-ΣDAT gives you access to the file ΣDAT. Press F4-ΣDAT and the matrix in ΣDAT will be placed on the stack so you can see and review it. It may be convenient to press DA to place the matrix in the Matrix Writer where it is easier to see and correct if necessary. If you do make any changes to the matrix, press LS ΣDAT to put the new version in the file. Some folks

prefer to create the matrix in the Matrix Writer and use LS ΣDAT to put it in the file rather than using the Σ+ command. If you intend to use the current data set later, but need to create a different data set press F4-ΣDAT to put the current set on the stack then store it in your directory with your own name. When you need it again, recall it to the stack and use LS ΣDAT to return it to ΣDAT.

Press F6-STAT to return to the main statistics menu, then press F2-ΣPAR. You will see the display on the right. The settings on this display are not important if your data consists of just one column. If the data consists of two or more columns, these settings affect several of the commands in many of the directories that follow. Many of the commands apply to the column labeled Xcol and the curve fitting commands rely on Xcol and Ycol. If you use one or more of the curve fitting commands Intercept and Slope will have values in them. The names Intercept and Slope only make sense if the fit is linear, but the calculator can fit data with four different models: linear, logarithmic, exponential, and power. If we assign the symbol *b* to the number called Intercept and *m* to the number called Slope, the fits are



$$y = mx + b$$
$$y = b + m \cdot \ln(x)$$
$$y = be^{mx}$$
$$y = bx^{m}.$$

To change the column to be called Xcol, put the desired column number on the command line and press F1-XCOL. To change the column to be called Ycol, put the desired column number on the command line and press F2-YCOL.

To change the model, press F3-MODL. This puts you into a new directory that gives you five choices for the type of fit; F1-LINFI for linear, F2-LOGFI for logarithmic, F3-EXPFI for exponential, F4-PWRFI for power, and F5-BESTF for best fit. BESTF will choose the best of the four fits. Pressing any of F1 through F4, will return you to the ΣPAR screen, but will NOT compute the Intercept and Slope for the model you have selected. If, however, your press F5-BESTF, it will return you to the ΣPAR screen and it WILL compute the Intercept and Slope for the model it has selected.

As soon as you enter this directory, a file called ΣPAR is created. You can see this by pressing VAR. The file contains a list with the values of Xcol, Ycol, Intercept, Slope, and Model in that order. Pressing F4-ΣPAR puts that list on the stack, and if the screen has been cleared, it is refreshed.

F5-RESET resets the values in ΣPAR to the default values shown in the screen image above.

F6-INFO refreshes the screen, as does F4- ΣPAR, but does not put the list on the stack.

Press NXT then F6-STAT to return to the main statistics menu, then F3-1VAR to enter a directory of commands for one variable statistics.

F1-TOT computes the total of the columns in ΣDAT. If the data consist of one column, the sum is left as a number on level 1 of the stack. If the data has two or more columns, the sums are left in a vector on level one of the stack. The rest of the commands in this directory, with the exception of BINS, behave the same way. F2-MEAN computes the arithmetic mean (average) of

each column. F3-SDEV computes the sample standard deviation of each column. F4-MAXΣ finds the maximum value in each column. F5-MINΣ finds the minimum value in each column.

Now press NXT to get to the next page in this directory (we will discuss BINS below when we are ready to talk about BARPLOT). F1-VAR computes the sample variance of each column. F2-PSDEV computes the population standard deviation. P3-PVAR computes the population variance of each column.

Now press NXT to return to the first page of this directory. Before we can draw a bar graph, we must create a frequency distribution of our data. That is what F6-BINS does for us. The required input is the lower class boundary of the first class on level 3, the class width on level 2, and the number of classes on level 1. When the input is in place, press F6-BINS. The output is a one column matrix with the frequencies on level 2 and a vector with two elements on level 1. The first element of that vector is the number of data points that were missed because they were less that the left boundary of the first class and the second is the number of data points that were missed because they were bigger than the right boundary of the last class. The frequencies are computed for the column of ΣDAT that is defined as Xcol is ΣPAR.

Now press NXT, F6-STAT, F4-PLOT. F1-BARPL will create a bar graph of the data in Xcol of ΣDAT. That column must, of course, be a frequency distribution. Typically, if you have a matrix of raw data in ΣDAT, you will use BINS to create a frequency distribution of the desired column, then store the resulting matrix in ΣDAT. (BE SURE TO FIRST SAVE THE MATIX OF RAW DATA IF YOU WILL NEED IT AGAIN.) Check ΣPAR to make sure that Xcol is column 1. Now press F1-BARPL to create a bar graph. Press F6-CANCL to return to the PLOT menu.

F2-HISTP is used to create a histogram of the data in Xcol of ΣDAT. The default is to break the data into 13 classes. If you want a different class width than that computed by default, you need to put the desired **class width** on level 1 of the stack and type the command RES, then press F2-HISTP. Press F6-CANCL to return to the PLOT menu.

F3-SCATR is used to create a scatter plot of the data in Xcol and Ycol of ΣDAT. Pressing F4-STATL when the graph is showing will cause the curve for the chosen model to be superimposed on the scatter plot. Press F6-CANCL to return to the PLOT menu.

NOTE: If any of the plot commands are used in a program the graph does not show when the program stops unless it is followed by the command PICTURE. As an alternative, you can issue the PICTURE command, (accessed by pressing LA), after the program stops and the image will show. If you have more than one graph in a program, you will need to put a HALT command after each, then press F6-CANCL followed by LS CONT (the ON button) when you are ready to continue to the next one.

Press F6-STAT on the PLOT menu to return to the main statistics menu, then F5-FIT. We now see six commands related to least squares data fitting. F1-ΣLINE will put the function for the selected model on the stack where Xcol is treated as the independent variable and Ycol as the dependent variable. F2-LR will put the intercept on level 2 of the stack and the slope on level 1. These need to be interpreted depending on the model as indicated in the paragraph about ΣPAR above. Also, theyΣ have labels attached, so if they are to be used for further computation in a program, the labels should be stripped off with the OBJ→ command found in LS PRG F5-TYPE F1-OBJ→. With a given value of *y* on level 1 of the stack you can find the corresponding value of *x* with F3-PREDX. With a given value of *x* on level 1 of the stack you can find the

corresponding value of *y* with F4-PREDY. By pressing F5-CORR you get the coefficient of correlation for the data in Xcol and Ycol, and you can find the coefficient of determination by squaring that number. F6-COV gives you the sample covariance for the data in Xcol and Ycol. Press NXT then F1-PCOV for the population covariance of those columns.

Now press F6-STAT and F6-SUMS. F1-ΣX and F2-ΣY will compute the sums of the elements in Xcol and Ycol respectively. F3-ΣX2 and F4-ΣY2 will find the sums of the squares of the elements in Xcol and Ycol respectively. F5-ΣXY computes the sum of the (x,y) pairs in Xcol and Ycol. Finally, F6-NΣ gives the number of data points the columns. Press NXT F6-STAT to return to the main statistics menu.

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