

B/GRAPH ENHANCEMENT DISK
by Robert Wilson

This software is provided on an unprotected disk because the authors and Antic both believe that the buyer should be able to make backup copies for his or her use ONLY. Because it is unprotected, we expect you to respect the copyright and NOT give, sell, or even lend copies of this program to anyone else.

The authors spent many hours designing, writing, and testing this product. Their income depends on it's sales. The unauthorized reproduction of this software and/or user manual is illegal. Please help us to protect and enforce the author's rights in this product so we may continue to provide you with unprotected software. No part of this product may be reproduced and/or distributed in any form or by any means without the prior written consent of Antic.

This is a powerful program and its potential for misuse and error is greater in the hands of a novice. Please make sure you know how to use this product properly before attempting to do important work with it. Antic and the authors disclaim liability for losses of any kind or nature, financial or otherwise, incurred or alleged to have been incurred as a result of this product.

Antic is a trademark of Antic Publishing, Inc.

This set of 2 disks is organized as follows. Documentation is on this Side 1 of Disk A. Side 1 of Disk B is used to boot the software if you do not own B/GRAPH. Side 2 of Disk A is Enhancement disk #1. Side 2 of Disk B is Enhancement disk 2. More information will be found in the introduction

TABLE OF CONTENTS

INTRODUCTION

X-Y PLOTTING

- The Graph
- Advanced Editing
- Keypad Setup
- Data Scree
- Summary of key use

BUBBLE CHARTS AND HORIZONTAL BAR

- Adding lines
- Examining the chart
- Horizontal bars
- Opposed horizontal bars
- Data editor
- Removing Scales
- Rescaling
- Opposed bars

MULTIPLE REGRESSION

- Independent variables
- Data entry and form
- Loading the demo file
- Correlation matrix
- Doing the regression

- Which factors to graph
- CHOW tests
- Covariance matrix
- Dummy variables
- Plotting variables
- Special notes
- Multicollinearity

FILE MANIPULATION

- The second menu
- Double exponential smoothing
- Mortgage Amortization
- Internal rate of return
- Present Value
- Future value
- General algebra
- Factor rollover
- Percent conversion
- Not applicable data estimation
- Sorting
- Zero mean
- Browse

PLOTTING YOUR GRAP

- Load file
- Plot file
- Manual or autoscaling
- Pen colors
- Skipping factors
- Area fills
- Horizontal and vertical grids
- Values over points
- Pie charts
- Pie chart overlays
- Bubble charts
- Triangle charts
- Bar charts
- Outlined bars
- Floating bars
- Adding labels
- Box creation
- Draw lines
- Limitations on graph types
- Special features
- Two sided scaling
- Graphing a function
- Mannesmann Tally Pixy
- Impossible graphs
- Special warning

INTRODUCTION

Thank you for purchasing the B/GRAPH enhancement disk. This series of programs completes the B/GRAPH program environment for 8 bit Atari computers. You will find that these two disks contain a number of advanced graphing, plotting and analytical program modules.

These programs along with the main B/GRAPH programs provide the Atari user with capabilities comparable to those found on software systems costing hundreds of dollars more.

These programs and tutorial are designed solely for use by persons who own and are familiar with B/GRAPH. It is possible to use these programs without owning B/GRAPH but the documentation assumes familiarity with the operations of B/GRAPH. Owners of version 1.0 of B/GRAPH must copy the file START from the First Enhancement disk to disk 1 of their B/GRAPH 1.0. START must be deleted from the original B/GRAPH 1.0 disk before doing this. This is necessary since the programs on the enhancement disk expect some machine code to be in position. These pieces of machine code were not present on version 1.0.

The advanced graphing capabilities are a response to the requests of many owners of B/GRAPH for specific features. Some of these may not relate to the uses to which YOU put B/GRAPH but if you experiment with them, you may well find that they offer a fresh new way of displaying your data.

The advanced statistical functions such as Multiple Regression will only be of use to those who are already using the simple Regression module in B/GRAPH. While we have attempted to explain something of the manner of using the advanced analytical tools on these disks, it is impossible to do more than touch on the theory behind their uses. Please refer to the textbooks listed in the main B/GRAPH manual for further information.

The plotter program will be found to offer almost all of the features found in high end plotter packages. While primarily designed for use with the Atari 1020 plotter, the Radio Shack CGP-115 and Mannesmann Tally Pixy 3 are also supported.

The Radio Shack CGP-115 is almost identical to the Atari 1020 (they are both made by Sharp), but rather than being a serial device that plugs into the Atari daisy chain, it uses a standard Centronics parallel connector. Thus it requires the use of an Atari 850 interface or equivalent.

The Tally Pixy is a flat bed plotter offering superior plotting capabilities where larger plots are required. Several additional plotting features are available when using this device and these are displayed on the menus when the Tally is chosen. Note that although the Tally is available with either a serial or a parallel interface we support only the parallel version.

Unfortunately, the plotter package does not support plotters such as the Houston Instruments or Hewlet Packard models. These are serial devices and would require different support than that written here for the plotters that we do support. As well, a market survey has shown that the number of Atari users with these expensive commercial plotters is exceedingly small. To those few who have such requirements, we express our regrets for being unable to support such a small minority.

LOADING THE PROGRAMS

If you own B/GRAPH the simplest way to run these programs is to select the "Enhancement Disk" option from the main B/GRAPH menu.

If you do not own B/GRAPH then ensure that you have the basic cartridge installed in your 800 or 1200 (users of XL or XE series computers do not need

to do this), insert the boot disk into drive one and turn on the computer. This will give you access to most of the plotter features which are normally on the second enhancement disk. The only option not available is the editor. To get to the other features simply select "Other Enhancement Disk" from the menu after inserting the appropriate enhancement disk in drive 1. Even if you have B/GRAPH you may want to use this form of initialization since plotting with your 1020 or other plotter can be done with no need for a disk swap.

SOME B/GRAPH COMMANDS

For users who are not familiar with B/GRAPH you will find most commands either documented or intuitive. Some of the others are:

Whenever a file name is requested a directory can be obtained by typing the drive number and "RETURN". Simply pressing "RETURN" with no drive number will display a directory of disk 1.

When a graph is on screen or you are browsing data pressing the "START" key will dump the screen or data to a printer. The data is centered for an 80 column printer. The editor on the plotter disk is the one exception. It will dump the screen assuming a 40 column printer. This is for users with only a 1020 in their system. Note that pressing "START" will not result in a printout from the actual editing screen itself but only from the "browse" screen.

In editing data missing data is handled by entering "NA" for the data. Leaving the data field blank will be taken as a desired end to the data input. Actually any non numeric data will be taken as NAs.

If you do not have one of the graphics printers listed on the startup program you must select one in any event. This data is used for sending graphics dumps to the printer. If your printer is not supported (either directly or as a compatible) then simply don't do any graphics dumps since they won't work.

DISCLAIMER AND WARNING

Although every effort has been taken to ensure that the mathematical formulae and programming execution thereof are correct, neither ANTIC nor the program author can guarantee that such is the case. Do not base any decisions on the results of this program without checking with another source.

B/GRAPH is a trademark of Irata Press Ltd

X-Y PLOTTING

The X-Y plotting program is used for data which is not of a time series nature. It is often desirable to have a numeric X axis rather than an axis measured in months, years or units as is done in the main B/GRAPH graphing module. To accomplish this, rather than having a single Factor defining a set of data points, this program requires two sets; one for the X axis and one for the Y axis. The first point in Factor 1 will be matched with the first point in Factor 2 to get the X-Y position of the data point.

A second option for data organization exists. If you simply press the "Atari" or inverse key once before selecting the graph type then factor 1 will be used for the "X" coordinate and factors 2 3 and 4 will be the possible "Y" coordinate. The normal method would be to pair factor 1 with 2, factor 3 with 4 and 5 with 6. An example of a need for the optional method would be a study of the tensile strength of 3 different metals at a given set of temperatures. The set of temperatures would be the common X axis variables.

The X-Y Plotting program allows for up to 8 factors to be entered although only

3 pairs of points can be graphed. This is because the program is much more than a simple plotter of X-Y data. It is also a much more sophisticated data editor than exists in the main graphing module on B/GRAPH disk 1.

Why 8 factors? Because another program on the Enhancement disk, Multiple Regression, can produce results with 8 factors and thus the editor serves double duty.

Enough discussion, let's see how the program works. The main menu looks almost identical to the one you are used to in the main B/GRAPH graphing module except for the "Key Pad Set Up" option. We will get to that shortly. As usual, to see how the program works let's first create a graph.

Type "C". The first item you are asked for is the X-axis description. This will be the label put below the X-axis. You will then be asked for the Top Title, Subtitle, Y-axis (Side) title and the Graph Number. These are all the same questions as in the regular B/GRAPH program. You are then asked for a name for Factor 1. Enter "Test 1". You are now presented with the familiar B/GRAPH data entry screen. Enter the values 5 7 12 and 11 then type ESC and answer yes to both the "Are you sure?" and "Another Factor?" questions. You are then asked for a name for Factor 2. Enter "Test 2". You will see that this name will not appear on the screen when the graph is drawn. For data, enter 11 13 8 5 and type ESC. This time when asked for another factor enter "N". The screen will briefly display a "Working" message and then ask you for a type of graph.

THE GRAPH

The only types of graphs supported are Point and Line graphs. Type "P" for Point Graph and your graph will soon appear on the screen. Notice that we show numeric values for the X-axis. Typing "A" will attach the points and C, H, I and X all work normally. Fills do not work because of the nature of the curves this program will produce. All the other commands which you usually use work as expected.

ADVANCED EDITING

You may be wondering why you had to type a name for the second factor if it isn't used. Actually, you didn't have to type one, a simple RETURN would have sufficed. The reason that the question is there is that this is the only B/GRAPH module to allow more than 3 factors to be edited so the program may be used for other than X-Y plots. Indeed, rather than plotting the points as a graph, you could have typed ESC when asked for a graph type, returned to the menu and saved the data. This program allows quick ways of running through the data for updating large files and supports the Atari CX85 numeric keypad. This makes this program a natural for data entry and you may find yourself using this program for all data entry regardless of the module used for plotting. It must be noted that any point labels created in the Pie Chart or Bubble Chart programs will be lost on entry to this module. This was done to conserve space. As both of these other modules support only 16 points per factor it is unlikely that the quick features of this module will be needed.

To continue now, press OPTION to get back to the main menu. Press "U" for Update Current Graph. Immediately press "F". The program switches to the next

factor. Instead of having to page through as many as 5 pages of data to get to a new factor you simply press "F". If you want to change the 87th element in the 7th factor this is a great time saver. If you have more than 1 page of data per factor you will find an even more interesting feature. In update mode pressing OPTION + a page number will send you immediately to that page. Of course any change that you had made to the page you were working on will not be saved because you have not "entered" the data. Thus to change the 87th element of factor 7 (which would have taken 78 keystrokes to get to before) would take only 7 keystrokes; the letter "F" 6 times and OPTION 5. For large data files this is a must. You do pay a price for this however. On the regular B/GRAPH data entry screen the largest and smallest items are updated as it reads each screen. The time to do this is not noticeable since it is doing a lot already. In this program the largest and smallest values are determined after all values are input. This means that the computer sits for a while before allowing a graph selection.

Of course you can not leave missing areas of data. If you have 3 factors you can press "F" when you are typing the third to go to a fourth, but you can not use the "F" key to get to a fifth since the fourth isn't completed. Similarly you can go to page 3 on an update only if you had a minimum of 2 complete pages of data before the update. Also unlike the regular B/GRAPH update you are asked for the type of graph if any desired. This is a time saver if all you want to do is change a number and resave. It can take a while to plot 300 or so points.

The next three commands on the main menu are the same as in regular B/GRAPH except that on loading a file you will be asked for a graph type if any. At this point get back to the main menu and insert B/GRAPH disk 2. Load the file AJAX.TIC. This is a 3 factor market graph with 40 points in each factor. We will use this file to explore some of the features. After the file loads return to the main menu by pressing ESC. Press "U" for update. While holding down the OPTION key press a "3". You immediately skip to page 3 of data. Since there were exactly 2 pages of data before this is allowed. Press "F" now. You go to factor 2 page 1. At this point you can not get back to factor 1 so there is no way of updating it. Change the first value from an 8 to a 100. Now press OPTION-2. You skip to page 2. Press OPTION-1 to return to page 1. Note that the number you changed to 100 is still 8. This is because the change was never "entered".

Suppose that you have made the changes desired to a factor but you don't want to go through the hassle of paging through factors. Hold down the SELECT key and press ESC. You will now be exited from the data entry mode and no further data will be lost. To verify this use the update option again and press "F" twice. As you can see the third factor is still there.

If you decide that you do not want to continue entering factors after answering "Y" to the question "Another Factor?" simply hold down OPTION and press ESC. The current factor and all subsequent will cease to exist.

NOTE THAT IT IS UP TO YOU TO INSURE THAT YOU DO NOT LEAVE HOLES IN YOUR DATA. IT IS QUITE POSSIBLE TO INCREASE THE NUMBER OF POINTS IN FACTOR 1 AND THEN EXIT FROM UPDATE WITHOUT CHANGING OTHER FACTORS. THIS COULD VERY EASILY RESULT IN GARBAGE BEING IN THOSE LOCATIONS THAT YOU HAVE NOT CHECKED.

KEYPAD SETUP

The Key Pad setup option is rather interesting. As mentioned, this module supports the Atari CX85 keypad. The keypad must be inserted in joystick port number 2 to operate. The keypad has 4 function keys on the left hand side. When first started the keys have been designated as follows.

FUNCTION KEY #1 --- ESC key
FUNCTION KEY #2 --- a space
FUNCTION KEY #3 --- delete backspace
FUNCTION KEY #4 --- "Y"

We thought that this was the most useful combination for B/GRAPH since a space can be used as a no answer in many of the yes/no questions as well as an eraser. You may however, change any of these keys to any single keypress you desire. You may not however select a key to be the START, OPTION or SELECT keys. If you select the keypad setup option you will be asked to press a key for each function key in turn. Since the handler is reloaded each time you enter this program you will have to r the procedure each time as well.

The last selections on the menu are the same as in regular B/GRAPH.

THE DATA SCREEN

You may have wondered "What happens to the second (data) screen with 8 factors?". The screen resolution of the Atari only allows us to safely display 3 factors at a time. When there are more than 3 factors the program informs you of this fact and asks you which 3 factors you would like to see.

SUMMARY OF KEY USES

OPTION + # N --- Moves directly to page N in an update.

OPTION + ESC --- Exits data entry and truncates data entry to last factor

SELECT + ESC --- Exits data entry and keeps all remaining factors. Used in updates.

ESC --- Used to inform the program that you have finished data entry for that page.

OPTION --- Used to return to menu from second screen or when graph displayed.

SELECT --- Used to go from the graph display to the second screen.

START --- Used to print out either the graph or the second screen.

BUBBLE CHARTS AND HORIZONTAL BARS

This program is designed to generate Bubble charts (also known as circle charts) and Horizontal Bar graphs. Bubble charts are a way of displaying three dimensional data on a 2 dimensional graph. They are used primarily in market segmentation analysis.

Using a three factor data file, the first factor's data is used for the X-axis position. The second factor gives the Y-axis position. The third factor is used to determine the relative areas of the bubbles drawn. A common use of bubble

charts is that of analysing performance. To do this the graph is divided into sections with vertical and horizontal lines. These grids then designate performance levels on 2 different factors. You might, for example, want to analyse sales by size of market region and the growth potential of the region. The X-axis in this case might represent the size of market and the Y-axis would be the growth potential of the region. The actual sales results in each region would be represented by the size of the bubbles. You might for example break markets into small, medium and large and divide the growth aspect into declining, stagnant and growing. Lines would be drawn on the graph to separate out the 9 different possible combinations. What you would like to see is that your biggest sales are in the large growing regions. You would be displeased if your most successful operations were in small declining areas. This type of graph is often referred to as a "dogs vs winners" chart.

Another common use is for determining market niches which have been neglected by your competition.

The data file COMP.BUB provided on the disk gives an example of the use of bubble charts for analysis. Load this file now with the "" option from the menu. After reading in the data the computer will ask you for a graph type to display. Type "C" for "Circle Chart".

After a pause the computer will ask you if you want horizontal lines. Answer yes to this question and you will be asked the value on the Y axis at which to draw the line. In this example answer 50. The reason for 50 is that performance criteria are ranked from 20 to 100 in this data file. You will now see that you are again asked whether you want horizontal lines. You are allowed up to 10 different lines. Answer NO this time. You are now asked about vertical lines. Answer YES and put a line at 1000. Answer YES again and put a second line at 2000. Answer NO for the next request. The computer will now pause for a few seconds and start to draw your graph. You will notice that the lines have been drawn at the requested locations.

ADDING LINES AFTERWARD

Though you will most often find that you are familiar enough with your data to know where lines should be added to a bubble chart this is not always the case. The easiest way to deal with this eventuality is to display the graph without any lines and then press "SELECT" once the graph is displayed to view the underlying data. Once you have decided on where you wish to place lines you press "OPTION" to return to the menu; "R" to redisplay the graph and "S" to switch graph types. By again selecting "Circle graph" you can add the lines. In actuality it takes longer to read this description than to actually do the above set of key strokes. If you are familiar with B/GRAPH these commands should not be foreign to your experience.

EXAMINING THE CHART

Now back to the bubble chart. The area within the circles gives a pictorial display of the market share by sales dollars of the various computer manufacturers (the data by the way is artificial and at least one of the companies included is no longer in operation). The X-axis is the price of the various computer systems and the Y axis is the relative performance level. Note that the data in factor 3 must be all positive since we can not have negative area. There are as well a maximum of 16 bubbles possible.

HORIZONTAL BARS

Horizontal bars should need little explanation as they are simply a variant of

the vertical bars as generated by B/GRAPH. Horizontal bars though are sometimes found to be more suitable when comparing items rather than simply displaying relative amounts. Studies have shown that the eye can distinguish finer differences in the horizontal plane than in the vertical. This probably has something to do with the survival of our ancient ancestors but in any event is true.

The Y-axis legend is the name for the item. The name may be up to 8 characters long. The bars may be of three types, regular, stacked or opposed. The first two are the same as in the regular version of B/GRAPH. Opposed requires some explanation.

OPPOSED HORIZONTAL BARS

The opposed type of bar graph can be used with two factors only. The sign of the data must be the same throughout a factor and the sign must be reversed between the 2 factors (ie. one factor must be all positive and the other must be all negative. When the data is plotted there will be no offset between the factors. The bars will touch in the middle.

For regular bars the total number of points is 16 for 1 factor; 14 for 2 factors and 9 for 3 factors. For segmented or opposed bars there may be 16 elements in each factor. An example using opposed bars will be dealt with after we deal with the data screen.

THE DATA SCREEN

The main menu is virtually identical to that for the main graphing program. Type "C" to create a graph. After answering the usual questions you come to the data screen. The data entry screen is identical to that found in the pie chart program of B/GRAPH. The left hand column contains labels and the right hand column contains values.

Enter the following numbers

5 7 9 12 13

The labels used are of no consequence at this point. Type "ESC and then "Y". Type "Y" for another factor. As you can see whatever labels you typed in before are now displayed. As you enter data for the second factor you will see that the cursor still jumps back and forth from the label column to the values column. Any changes that you make to the labels will be accepted once the screen is read. To enter data without changing the labels simply press the "RETURN" key twice after entering a value. For factor two enter the following data.

11 12 13 14 15

Now go on to a third factor and enter the following values.

23 1112 34 11 45

The program will now ask you for a graph type. Type "C" for a circle chart and don't bother with lines on the graph. The graph will be drawn with your labels under each circle and a numeric scaling on the bottom axis based on the values in factor 1. Often on a bubble chart you would prefer not to have numerics on

any axis since you are dealing with qualitative rather than quantitative data.

REMOVING SCALES ON BUBBLE CHARTS

To see the effect of removing the scaling press "S" to switch graph types and hold down the "CTRL" key while pressing "C".

Press "S" again and choose "B" for a three factor bar chart. The labels you previously entered are now on the left side axis used to describe the bars.

RESCALING

With the three factor bar chart on the screen press "R" to rescale the graph. You are presented with the rescaling menu in the same manner as for the main graphing module of B/GRAPH. Note that in this case you are rescaling the X-axis not the Y. Note also that you can not rescale bubble charts.

OPPOSED BARS REVISITED

Press "OPTIO" to return to the main menu and display the file POPUL.BQAR from the disk. When asked for a graph type press "O" for opposed. The graph quickly displays the population of the United States by age and sex. The data is in millions and is taken from the 1981 census. Unfortunately all of the female data shows up as negatives. For the program to display the graph one factor must be all negative. Since this is not the optimum method of portrayal the program allows for suppression of minus signs. Press "S" to switch graph types and reselect the graph. This time hold down the "CTRL" key while you press "O". The graph is redisplayed without negatives.

MULTIPLE REGRESSION

The multiple regression program operates in a manner very similar to the Regression program found on B/GRAPH disk 2. The simple regression program on B/GRAPH disk 2 allowed you to examine the relationship between one variable and various forms of one other variable. The relationships took the form of the following equation.

$$Y=A + B * f(X) + C * g(X) + D * h(X)$$

Although you could have many forms of X, you were limited to X. While this is quite useful, suppose you were trying to project the sales of cigars in the United States. From past data you might be able to get the following data: Population, Population between 20 and 60 split by sex, historical price levels of cigars versus cigarettes, personal disposable income, unemployment and inflation figures. Of course you would also have total cigar sales for each of the past years. You might feel that at least four of these variables would have an effect on sales. If you decided to use the regression program in regular B/GRAPH you would find that only one variable could be used. Thus the need for this program.

INDEPENDENT VARIABLES

Obviously we can't simply use X by itself anymore as the sole variable. For the sake of completeness note that in the formula above X is known as the

independent variable and Y as the dependent variable since it depends on X. For multiple regression we still refer to Y as the dependent variable but we now have many independent variables. We will refer to these as X1, X2, X3 etc. The form of equation then becomes something like this:

$$Y=A + B* f(X1) + C* g(X1) + D* h(X2) + E* i(X3)$$

DATA ENTRY AND FORM

This multiple regression program can handle 6 independent variables. Because of the size of the program no data entry facility exists in the program. Data entry must be in some other B/GRAPH program

The last factor in a data file will be considered to be the Y variable. Thus if a 7 factor file is read into the program factors 1 to 6 would be X1 to X6 while factor 7 would be Y.

In looking at the menu you will see that it is very similar to the regression program on B/GRAPH disk 2. There are some differences and these will be discussed as we get to them. As a first note you will see that there is no PLOT function. This was omitted as it exists in the other program already and the space was desperately needed for other uses.

LOADING THE DEMO FILE

If you press "D" and load the file REGTST from the disk, you will immediately discover the first difference between the two regression programs. The question "Input number of degrees?" now asks for a number between 1 and 12 not 1 and 11 as before. The reason is that in the simple regression program we assumed that everyone would want a constant term so we set up a constant plus a number of degrees. There are often occasions when you want to force the constant to zero so in this program if you want a constant you must enter one of the degrees as "1". Entering the constant 1 will result in the constant term being calculated as the coefficient of 1.

In this example enter 3 for the number of degrees. When asked for the form of the first degree enter "X1". For the second enter "X2". For the third enter "X3*X3". Note the use of X1. The variable "X" does not exist in this program. If you enter X as the form of one of the degrees the program will be unable to solve the problem. After a brief pause the program will return and ask you if you want to print the correlation matrix, save it or continue.

CORRELATION MATRIX

The correlation matrix is a necessary and very important part of any multiple regression whereas it was of no importance in simple regression. The matrix measures the correlation between the variables used in your regression. Presence of significant correlation between the independent variables may indicate a problem with the regression and projections made with the fitted formula may well be inaccurate for data which lies significantly outside the experience reflected in the sample. This will be discussed further under multicollinearity. For now it suffices to say that the matrix has D rows and D+1 columns where D is the degree of function chosen. Each row represents the correlation of the variable with itself and each other variable. The last column is the correlation of the dependent variable Y with each of the other

variables. You can either print the matrix or save it to disk. That choice needs to be made at this time as the space used for the correlation matrix will be reused for the covariance matrix. To recreate the matrix you would have to redo the regression. In saving the matrix to disk the first two numbers saved are the degree of equation and the number of data points in the regression. Following that comes the matrix data by row. Once you have saved or printed the matrix you return to this menu to give you the option of doing the other.

If you have a printer please print out the matrix now. If you do not have a printer you will have to take our word for what the results are.

The matrix as expected is a 3 by 4 array. The diagonal elements are all 1 since a variable is perfectly correlated to itself. The 3 by 3 part at the left of the matrix is symmetric; ie the element in row 1 column 3 is the same as that in row 3 column 1. This of course expected as the correlation of variable 3 with 1 must be the same as 1 with 3.

Now, what do these numbers tell us? They tell us that the correlation of variable 1 with 2 is .249 and .155 with variable 3. Note that this correlation is of X_1 with X_3^2 since the third form chosen was actually X_3^2 not simply X_3 . The correlation of variable 2 with variable 3 is only .105. What does this mean? In this case all values are quite low. There is no reason to think that the collinearity of the variables is going to cause any difficulties.

The last column indicates the correlation between the variables and the actual observed values of the dependent variable. This shows you that the highest correlation is with X_3^2 . Variable X_1 is not very important in the final analysis as it turns out.

DOING THE REGRESSION

After pushing "C" to continue the screen will again blank while the regression is completed. The screen then reappears with the usual result screen. The fit to the data is very good as can be seen by the numbers. The standard deviations of the coefficients are quite small indicating that the variables all appear to be significant. As usual press SELECT to get the graph. Wait a minute. What's this question?

WHICH FACTORS TO GRAPH?

For a multiple regression we can't simply graph the calculated points against the independent variables as we did in the simple regression program. After all with 6 possible independent variables it would be a little slow even if we could graph in 7 or 8 dimensions. Instead what we graph are various combinations of factors. By graphing the Y values against each of the independent variables in turn we can get an idea of the possible relationships involved. By graphing the residuals (the difference between the actual and calculated Y values) we get an understanding of possible auto correlation or other bad aspects of the regression. When we press SELECT to go from the graph to the second screen the 2 variables plotted will be displayed along with the calculated Y values. By pressing "S" when a graph is displayed we can switch the variables which we are graphing.

Returning to the main menu the next item on the list is value interpolation.

This is similar to the same choice in the simple regression module. Since there are up to 6 variables to enter we allow only one point per page rather than the 20 we allowed in the simple case.

CHOW TESTS

The "Chow Test" option requires some explaining. This test was named after its inventor and is used to determine whether the regression coefficients are stable over time. To do this you must choose a break point for the test. For example; if you have the sales of car air-conditioners regressed against population over the last 20 years you might want to determine if the relationship has been stable over that period. You might feel that the relationship over the last 10 years has been different than the preceding 10. To check this you would answer 10 to the request "Enter number of points in first sample". The program then calculates three regressions, one for the whole period, one for the first 10 years and one for the last 10. It then uses the results to calculate an "F" statistic which can be compared against a set of tables. Since we are testing the hypothesis that the samples do not vary significantly a high "F" value indicates that the regression coefficients have not been stable.

LIST COVARIANCE MATRIX

The next menu item which is new is "List Covariance Matrix". The covariance matrix is a square matrix with the number of rows and columns equal to the degrees you set in the regression. The values give the covariance of the coefficients with each other. The resulting matrix is symmetric. The values indicate whether any two coefficients are really the same in that they move in tandem. The listing is done to the printer. If no printer is attached then the program returns to the menu.

The next option outputs the covariance matrix to a disk file. The order of output to disk is as follows: the degree of regression; the variance for the total regression; the values of the matrix and lastly the coefficients themselves.

DUMMY VARIABLES AND OTHER FORMS

Often you want to examine the effect of some variable which can not be quantified per se. For example; if we sold cigarettes we might want to consider the effect of the Surgeon General's Reports on the effect of smoking on health. The two reports were published in about 1964 and 1978 respectively. Unlike population or inflation this is a non quantifiable item. To handle this type of variable, economists have come up with a process of using "dummy variables". If we had cigarette sales data from 1955 to 1982 and we thought that the first year affected by the reports was 1965 with 2 times the effect in 1979 and later, we would introduce a variable defined as follows.

For the first 10 years the value would be 0, becoming 1 for the next 14 years and 2 for the remaining 4 years. When the regression was done a coefficient would be generated for this dummy variable. In B/GRAPH we have two ways of

handling such dummy variables. The first and most direct way is simply to set up a factor with the data in it when you enter your variables. This is far and away the preferred method and is the one which you will use the majority of the time. There are times, though, when you have 6 independent variables already. We have, therefore, created the ability to have dummy factors to simulate your dummy variables. To create an effective dummy variable you need simply to enter an expression in ATARI BASIC syntax which will result in the appropriate values as the program runs through the data points.

The variable "I" is used as a counter as B/GRAPH runs through the data points in the file. Since dummy variables usually have values such as 0, 1 or 2 it is quite simple to write a boolean expression which equates to the desired values. To simulate the dummy variable in our example above we would simply enter one of the forms of the regression as:

$$(I>10) + (I>24)$$

This would result in 10 values of zero, followed by 14 values of one and 4 values of two.

Every silver lining, however, must be contained inside a cloud. While this will work and it will produce correct calculated values for the Y variable it will not allow value interpolation to work in any reasonable form. As well, it should be fairly obvious that this technique is really only useful when the dummy values follow the order of the points. For example, you might want dummy variables for sex and for income group. To use the dummy factor approach you would have to arrange your data in an order such that you could express the values of the dummy variables as a function of I.

B/GRAPH allows 12 degrees but only 6 independent variables. Part of the reason for this is for dummy variables but primarily it is to allow for different forms of the same variables. It is often desirable to have a function which varies with not only X1 but also the LOG of X1. Most programs insist that you do the transformations yourself and enter the transformations as additional variables. This approach is wasteful of valuable computer memory and a pain for the user since he usually has to type all the numbers in again. Thus we have allowed for more than the apparent 6 independent variables through this approach. You can even use compound forms such as

$$\text{LOG}(X1 * X2 + \text{SIN}(X3))^{(1/X3)}$$

PLOTTING VARIABLES

This program restricts you to plotting the actual variables from the file you are using. You can not plot transformed variables or dummy factors. This is not a particularly big limitation but you should be aware of it.

You can of course ignore a variable in the regression. Just because your file has a value for X3 doesn't mean that you have to use it. Indeed the selective exclusion of variables is one of the best ways of seeing whether the variable is, or isn't, material to the regression.

SPECIAL NOTES

When setting your various forms remember that should the numbers in one degree

of the regression be simply a linear multiple of another there is no unique solution to the question and the computer will be unable to solve the problem.

Another problem can arise if you use too many long expressions for your forms of equation. B/GRAPH will be quite happy to take any form of equation as long as it is in legal syntax. This means that it will quite happily accept a line which is 2 lines long. If you used 12 forms all as long it is quite possible that you could run out of space in the computer. If this happens the only remedy would be turning off the computer and starting over. We do not expect anyone to run into this limitation but it is there. Twelve expressions such as:

```
COS(PI*3/180*X1 +EXP(SIN(X2/X6)))
```

would be handled with no problem whatsoever so this limitation is unlikely to occur.

MULTICOLLINEARITY

The mathematical theory behind regression states that the independent variables should be independent of one another --- that is that the correlation between the variables should be zero. If this condition is not met then there may be some question about the predictive capability of the regression equation.

The term "multicollinearity" is used to denote the presence of linear or near linear relationships among the explanatory (usually called independent) variables. If such relationships exist then the explanatory variables are not independent variables and this causes the problem. If the variables are perfectly linearly related then the coefficient of correlation is one and it is impossible to solve the regression. At the other extreme the coefficients of correlation are all zero then there are absolutely no problems with the estimates of the regression coefficients. In this situation the variables are said to be orthogonal. It is rare when either of these conditions exist. There is almost always some degree of collinearity. Multicollinearity is a phenomenon inherent in most relationships simply because of the nature of reality. There is as of yet no conclusive evidence of the degree of collinearity acceptable. When two or more explanatory variables tend to move in the same way at the same time it is very difficult to decide which of them is causing the change in the observed variable. An example would be a regression of boys weight against their age and height, since age and height follow each other quite closely.

Multicollinearity can cause high standard deviations in the coefficients of the regression. If you feel that a certain factor should have a better fit than is apparently being shown by your regression, check the correlation matrix to see if that variable has a fairly high correlation with some other variable. If it does redo the regression leaving the other variable out. This approach may give you a better feel for the true relationship.

As an example, a study of sales of cold drinks at an amusement park was made. The explanatory variables were attendance and temperature. The study did not get a low standard deviation for the coefficient of either variable. A study of the correlation matrix showed a high correlation between the variables. By redoing the regression leaving out temperature a much lower standard deviation was found for attendance.

We may still use a regression model showing evidence of strong multicollinearity to make projections if we can be sure that the type of collinearity will continue in the future. If it is expected that the relationships between explanatory variables is changing then the nature of the relationship should be determined and the model respecified.

FILE MANIPULATION

The main menu for file manipulation closely resembles the one in the main B/GRAPH program. Some of the functions are the same, some similar and some entirely different. There are valid reasons for including those which are identical. Firstly, this version handles up to 8 factors not just 3. Secondly such items as DIF conversion are best left on a disk with which they might be used. If they were only on the first B/GRAPH disk then you would have to switch disks to perform the operation.

THE SECOND MENU

Due to the large number of functions in this program a few had to be moved to an optional menu. These functions are accessed by first typing "0" to get to that menu and then the appropriate letter for the function desired. Where the functions are on the optional menu it will be mentioned in the documentation. Note that all functions return to the main menu regardless of which one they themselves are on.

DOUBLE EXPONENTIAL SMOOTHING

Exponential smoothing uses a slightly different exponential smoothing algorithm than the module of the same name in B/GRAPH. The version in this program is actually double exponential smoothing which is used when the data to be smoothed has a definite trend to it. The simple exponential smoothing found on B/GRAPH disk one produces a somewhat less close fit on trend type data. Naturally this version is a trifle slower due to the extra calculations.

MORTGAGE AMORTIZATION

The "Mortgage Amortization" module will calculate the outstanding balance each year on a mortgage loan. Press "M" to select this option. For example answer 25 in this case. If you press only RETURN or the number 1 you will be returned to the main menu. You are asked next for the interest rate in percent. Answer 10 to this. You are next asked for the number of interest conversions per year.

Rates of interest on loans are usually quotes on a nominal annual basis. For example your credit card may quote a nominal rate of 18.0 percent when it is actually 1.5 percent per month. To see why this is not the same as 18.0 per year consider what happens to a loan of 100 dollars on which no payments are made for a year. At the end of the year the outstanding balance would be 119.56. Thus the effective rate is actually 19.56 percent not 18. For mortgages in the United States the practice in the past has been to quote an annual effective rate of interest. In this case you would answer 1 to the question. In

Canada the normal method is to quote a nominal annual rate of interest with a 6 month compounding feature. In this case you would answer 2. Installment loans from department stores or credit cards are almost always quoted on a nominal annual basis with compounding monthly but due to consumer pressure are putting the effective rate in as well. If you put in the annual effective rate and choose 1 for conversion period you will get the same results as putting in the nominal rate and choosing 12 for the conversions. This program assumes monthly payment of the mortgage.

For the sake of this example enter "1". You are then asked for the size of the loan. Answer "50000" to this. The program will tell you that it is working and will then return to the menu.

The program produces a three factor file. Press "B" to browse the data. The first factor is the amount of interest paid in each year. The second is the amount of principle repaid in each year. The third is the amount of principle remaining at the end of each year. If you look at the results you will see that the total payments made each year are 5270.97 or 439.25 per month. The discouraging thing is that after 10 years you still owe almost 42000 and you would have paid over 52000 to the mortgage holder. Over the period of the loan you would have to pay almost 82000 in interest on a 50000 loan.

INTERNAL RATE OF RETURN

The "Obtain internal rate of return" selection results in the calculation of an interest rate represented by a series of payments in factor 1. To use this selection the data must be in a specific format. Payments made in one direction should be positive, while those in the other should be negative. For example, if you borrow 3000 dollars to buy a computer to be paid back by payments of 100 dollars for 36 months then the factor should have -3000 as its first element followed by 36 values of 100. There will be 37 data points in all. The program would calculate a monthly rate of interest for the loan equivalent to a VISA card rate. The program assumes that payments are at the start of each period. No change is made to the actual data. This module is on the optional menu

PRESENT VALUE

The Present value of a factor item (on the optional menu) will calculate the value of remaining items in a factor. You specify the factor to alter and the interest rate to use. You also must tell the program whether to assume that the items occur at the start or the end of the period. The factor you choose is permanently altered so you should duplicate it if you want it afterwards. The routine works as follows. The last item in the factor is either left alone or discounted for one period's interest, depending on whether items are at the start or end of a period. This is because in the last period you have only one item left. For each earlier item the value is the sum of the current item, discounted for one period if at the end of the period, plus the present value of the next item discounted for one period.

As an example, assume you had a factor with 36 values of 100, representing a loan repayment scheme at 1 percent per month. When you take out the loan you make a payment of 100 at the end of each month. If you specify 1 percent as the interest and tell the program that the items are at the end of the month you will end up with a factor giving the outstanding loan balance at the start of each month. The first value will be the actual amount of the loan you took out. Of course the values in each item do not have to be the same. The program will

FUTURE VALUE

This option works almost identically to present value. The main difference is that the result represents what all previous values accumulate to. The first value is simply the first element accumulated with one period's interest if items are at the start of the period. An example would be putting money into the bank each month. This item is also on the optional menu.

GENERAL ALGEBRA

The general algebra selection works as expected except that inter factor operations are explicitly allowed. Factor 1 is referenced as X1, factor 2 as X2 and so on to factor 8 as X8. You can thus define factor 4 to be $\text{LOG}(X1)/\text{SIN}(X3)$ with no problem. Note that the variable "X" which you used in the equivalent function on B/GRAPH disk 1 does not exist in this program. The variables "I" and "Z" do exist however. Note that the program assumes that radians as opposed to degrees are to be used for trigonometric functions. If your data is in degrees and you want the SIN of the data you can do one of 2 things. You could enter $\text{SIN}(X1/180*\text{PI})$ or you could enter the rather bizarre expression:
Z:DEG:Z=SIN(X1)

The expression will first simply assign Z to itself, then set the computer to degree mode and finally do the calculation of the SIN.

Aside from the variables Z, I and X1 to X8 as shown on the screen you may also use the following variables in your expressions: "PI" which is the mathematical constant 3.14159265; "FN" which is the number of factors in the data set less 1 and "COUNT" which is the number of points in each factor less 1. Thus if we wanted to divide all items in factor 1 by the number of factors you could enter the following formula:

$$X1/(1+FN)$$

FACTOR ROLLOVER

Factor rollover works the same way as on B/GRAPH disk 1. Inclusion here is to facilitate setting up lagged variables for multiple regression.

PERCENT CONVERSION

The same as on the regular program except that it works with more factors.

NOT APPLICABLE DATA ESTIMATION

This is not the same as the version on B/GRAPH disk 1. Indeed this version requires 2 factors and no missing data is allowed in factor 1. Changes are made to factor 2 only. The method used is called Lagrangian Interpolation which involves fitting a curve through all the known points. This leads to very

complex equations and can be a trifle slow if there is a great deal of data and several missing points. This problem is outweighed by the accuracy of the interpolated results. It will not work if 2 items in factor 1 are the same. It is not particularly good at extrapolation of data beyond the range of factor 1 data.

SORTING

The sorting option, selected by typing "S" on the optional menu is rather useful. You may sort all factors or only one. If you select All factors then the order of each factor will be altered to follow the order of the factor you choose as an index. For example, if you had three factors representing stats on baseball players for average, home runs, and RBIs and you sorted them on average then the data for homeruns and RBIs would be moved as well. Thus if a player had a 300 average with 20 homeruns and 100 RBIs, the values would still correspond after sorting. If you chose to sort only 1 factor then the 300 would move in the file but the other 2 numbers would stay where they are.

When sorting all of the factors you can choose primary and secondary sort fields. This means that in the example above you could sort the data in ascending order of batting average and if these were tied then in ascending order of homeruns and if still tied then by RBIs. To do this you would simply enter 1 as the first priority factor, 2 as the second and 3 as the third. If you only wanted one priority in a three factor file simply hit RETURN when asked for the second priority. You will be asked if the data is to be sorted UP or DOWN. After that choice the screen will blank to perform the sort. The sort is actually quite slow since we used a rudimentary exchange sort to save space.

ZERO MEAN

The zero mean of factor option (optional menu) will for each factor calculate the mean of the factor and subtract it from each value. The mean for each factor will be displayed and can be printed. Why do this? you might ask. The main reason is for use in conjunction with the multiple regression program. The multiple regression program (like all multiple regression programs) uses a mathematical identity to simplify the calculation of the sum of squares about the mean.

This method is used because it is much faster than doing it by the individual calculation method. Although exact on paper, there are times when computers are not so exact. If the deviations about the mean are quite small as compared to the mean itself you may get improper results. This occurs because computers have a finite number of digits which they can carry. On the ATARI this number is 9. Round off errors in the 10th place can accumulate producing erroneous results. For example the numbers 1234567890 and 1234567895 would be held internally as the same number. Thus if you were to find the difference the computer would tell you it was 0 not 5. In solving the equations to complete the regression such errors can accumulate. By making the mean of each factor zero we significantly reduce the chance of round off errors. However, the equation that results is not Y in relation to X1 X2 etc but rather X1 minus the mean of X1 and X2 minus the mean of X2 etc. Therefore you have to remember what those means are. That is why the means are displayed by this option.

BROWSE

The browse mode is basically similar to that in the regular B/GRAPH module except that you have more than 3 factors. Therefore if there are more than 3 factors in the file you have to tell it which three to display.

The remaining functions are all the same as on the regular B/GRAPH menu.

PLOTTING YOUR GRAPH

First turn on your plotter and from the second enhancement disk menu load the plotter program for other than pie charts. If you do not turn on your plotter you will be so informed and told to press any key after turning on your plotter.

At the menu you will have the following options:

- Load a file
- Plot data
- Add labels
- Graph function
- Box create
- Draw line
- Exit back to the menu

If you are using a Mannesmann Tally plotter you will have another option -- Select location. This will be discussed later.

LOAD FILE

The procedure for loading a file is the same as for any B/GRAPH file. After the file has been loaded a screen is displayed which tells you:

- 1 How many factors in the graph;
- 2 How many points in each factor;
- 3 The largest value in the file;
- 4 The smallest value in the file;

Take a moment to make a note of these values. You will probably need them later. To return to the menu press OPTION.

As an example load the file AJAX.TIC from B/GRAPH disk 2.

PLOT A FILE

When you choose this option (do so now) the first question you are asked is whether you want Automatic or Manual control. If you choose automatic then the computer will determine scaling, pen colors and textures. If you choose manual then you will have a chance to select these items. We will use the AJAX data to illustrate the capabilities of the program on a line graph. Select manual control.

You are asked if the plot is an overlay or not. If the plot is an overlay then the previous values for scaling will be used and the graph outline and titles will not be drawn. Answer NO to this question.

You are now asked to select the type of graph. You have quite a choice. All of

the graph types available on B/GRAPH and its enhancement disk are available on this program or the companion program for pie and bubble charts. In addition there are a few graph types which aren't available on B/GRAPH. Press "1" to choose a line graph.

You are next asked if you will be using a right hand scale at some point on this plot. The program needs to know so it can scale the graph correctly. Right hand scales are done using overlays and will be covered later. Answer no to this question. You are asked the size and color of the title. It may be large medium or small. The same questions are asked for the subtitle. If you choose a large size for the subtitle then the subtitle may interfere with some of the graph. It would certainly interfere with horizontal grids. For horizontal bar graphs the large option for subtitles is not allowed. If it is chosen you will get regular size.

MANUAL OR AUTOSCALING

You are now asked if you want manual or autoscaling of the graph. Let's use manual this time. Press "M". You are asked for the maximum Y value and then the minimum. If you were doing an X-Y plot you would be asked the max and min for the X-axis as well. You may select Auto scaling at this time by typing "AUTO" and then RETURN. Select AUTO at this time and we will go back to the autoscaling of the program.

LINE TYPES

You will be asked for the type of line desired. This is a number from 0 to 8 for the Pixy and from 0 to 15 for the 1020 and CGP115 plotters. Some Atari 1020s tend to be subject to paper slew when dotted lines are chosen. If you have such a machine select 0 which is a solid line. In automatic mode the program selects 0 then 1 2 3 4 etc for the Tally Pixy plotter and 0 3 6 9 etc for the other two plotters. You can check your plotter instruction manual to see what the various selections look like. If you want the defaults simply press the "RETURN" key. On the Pixy plotter line style combines with a line space command. The program alters this automatically so a line type of 3 chosen for the second factor will not be quite the same as the same type chosen for the seventh factor.

PEN COLORS AND SKIPPING FACTORS

You will now be asked for the pen color for each factor before it is drawn. If you press ESC then the factor will be skipped entirely. This can be quite useful when you really only want one factor from a multi-factor file. Note that pressing ESC on a market graph will have the same effect as pressing RETURN.

AREA FILLS

Once the lines have all been drawn you will be asked if you want to fill the graph. Answer "Y" this time. You will be asked the number of the factor from which to start. Selecting factor 0 will use the baseline. Enter "2" this time. You are now asked the factor to be the other edge of the fill. You are not allowed to choose the baseline for this. Select "3" for this trial. You will now see a screen asking about the density of the fill. As you can see there is quite a choice. Obviously the tighter the fill the longer it will take. Press "3" for a medium stripe. You now have to choose the color. Simply hit RETURN and we will use the previously selected pen. After the graph is filled you will

again be asked if you want to fill the graph. Had this been a one factor graph the question would not have been asked. Answer "N" to this question.

HORIZONTAL AND VERTICAL GRIDS

You are next asked about horizontal and vertical grids. These are similar to the grids allowed on the screen versions of B/GRAPH. You are then asked about boxing the graph.

VALUES OVER POINTS

If you had 16 or fewer points in each factor you would have had the option of printing the values over the drawn points. This works with line scatter and vertical bars only. The values may be small medium or large, but most of the time small or regular will be used.

PIES AND BUBBLES

The plots of pie and bubble charts are in another program for space reasons but the menus and operations are so similar that they will be discussed here.

We are quite proud of our pie chart plotting program. To see why, load the file WATERL.PIE from B/GRAPH disk 2. After returning to the menu press "P" for plot. Select manual control and answer "N" to the overlay question. You will have a choice of five types of plots.

1 Pie charts with labels in a box. This is the type of graph B/GRAPH produces on the screen

2 Pie charts with labels outside the pie. This is a more traditional chart with the labels around the perimeter of the pie and the percentages under the labels. If the slices are small the program may not be able to fit the label onto the graph. In this case it will be omitted. For such graphs type 1 is more suited.

3 Bubble charts with X-axis. Numeric values will be placed along the X-axis.

4 Bubble charts with no X-axis numerics.

5 Triangle charts. For these you should have your data sorted from smallest to largest.

Select type 1. You will then be asked if you want to explode sector 1. Yes, that's right, in the plotter program we allow exploded pie charts. Not just one factor but any, some, all or none. Select exploded just for fun.

We are next asked for the fill density. Selection 6 will draw the sector outline but leave it blank. Selection 7 will skip the sector entirely. This can be used to produce incomplete pies but is most often used in overlays. Select whatever choice you want but don't select 7.

You are now asked for the pen to use for this sector. You are now asked if you want the striping to be vertical or horizontal. By allowing stripes in both directions the number of available patterns is increased. The plotter will now go and do it's thing. You will be asked these questions for each sector.

After doing all of the sectors you will be asked to specify color and size for both the title and subtitle.

Had you pressed shift at the same time as number 1 or 2 then the sector outline for the pie slice would not be drawn. The pie slice differentiation would be by the patterns only.

PIE CHART OVERLAYS

What is an overlay of a pie chart? You may have noticed that although you were allowed horizontal and vertical stripes you were not allowed checkered patterns. Well by doing an overlay you can place a blue horizontal stripe on a red vertical and get a plaid sector.

BUBBLE CHARTS

Once you select bubble charts the plotter goes on its way and draws the complete chart in pen color 1. Aside from the color and size of titles you have no choices until the graph is completed. After drawing the graph you have the choice of having vertical or horizontal lines. As these questions are the same as in the screen version please see the bubble chart discussion earlier in this manual.

TRIANGLE CHARTS

This graph type is used to display proportions when you want to portray a hierarchy of the data. A chart of population percentage by income level might be an example. Choices of colors and patterns are the same as with pie charts.

BAR CHARTS

If you are using the manual option for bar charts, after choosing the pen color you will be asked to select the fill pattern. The available patterns are:

- 1 Solid
- 2 Lines at a 45 degree angle upwards to the right
- 3 Lines at a 45 degree angle downwards to the right
- 4 Horizontal stripes
- 5 Cross hatching
- 6 Small squares
- 7 Vertical stripes
- 8 Wide diagonal up
- 9 Wide diagonal down
- 10 blank

The default values follow the above order except that for horizontal bar graphs, horizontal stripes are replaced by vertical stripes.

Note that 3 D bars are not automatic but are selected at the main menu by toggling CTRL-D

OUTLINED BARS

Another type of bar chart exists which is not listed on the menus. If just before choosing Horizontal or Regular bars you quickly press and release the "ATARI" key (inverse key on XL and XE models) the bars will be displayed normally but the scaling will be as for Segmented bars. After the bars are plotted side by side, pen number 1 will be used to draw an open bar which surrounds all of the bars for a given point and has height equal to the sum of the bars inside. This type of graph is useful when you want to see the totals but you still want to be able to determine the relationships between the components.

Pressing the inverse key before selecting segmented bars will result in connecting lines being drawn between bars. 3 D is not available in this mode.

FLOATING BARS

Floating bars may be either vertical or horizontal. Regular bars start at the baseline and go up or down to the point indicated by the value in the factor. Floating bars do not start from a rigid position but rather from a value specified in a factor. Each bar requires a starting and ending location so you need two factors to define one bar. The maximum number of sets of floating bars is thus 4 since we have only 8 factors available. The total number of bars is the same as for regular bars. In each pair of factors the first value gives the starting position and the second the ending. The second factor determines the name used for each bar. The texture used in default mode is also the same as if we were plotting every second factor.

ADDING ADDITIONAL LABELS

This option allows you to custom label the graph. You move the pen around on the graph using the cursor keys or joystick until it is where you want the label. You press RETURN or the fire button to tell the computer that you are ready. After choosing the color you input the label. You then choose the size of the label and the direction. Labels may be placed regularly; they may run down the graph from top to bottom; up the graph from bottom to top or be upside down and backwards. After the label is drawn you are asked to move the cursor to the next label position.

BOX CREATE

You can use this option to put boxes around labels. You choose the starting point and opposite corner as for placing labels RETURN. After choosing the color the box will be drawn.

DRAW LINES

This option is virtually identical to box create except that a line is drawn through the 2 points not a box.

X-Y SPECIAL

By pressing and releasing the Atari (inverse video) key before selecting an XY

PLOT you change the interpretation of the factors. The first factor becomes the X variable for all combinations and factors 2 through the total become Y variables. Thus with 8 factors in a file you get 7 dataset pairs as opposed to 4.

LIMITATIONS ON GRAPH TYPES

- | | |
|-----------------------------|---|
| 1 Line graphs | Maximum 8 factors. |
| 2 Scatter graphs | Maximum 8 factors. |
| 3 Bar graphs | Maximum 119 points. Max 8 factors. |
| 4 Segmented bars | Maximum 8 factors. No negatives in file. |
| 5 Market tics | Requires 2 or 3 factors. With only 2 no tics are displayed |
| 6 Market connected | Same as market tics. |
| 7 Pie charts | Maximum 16 points. Only first factor used. No negatives. |
| 8 Horizontal bars | 16 data points in each factor.max 64 total points. 8 factors |
| 9 Segmented horizontal bars | No negatives. 16 points per factor. |
| 10 XY scatter graph | must have at least 2 factors. |
| 11 XY line graph | must have at least 2 factors.No fills. |
| 12 Opposed bars | Must have exactly 2 factors with no more than 16 points in each. All of one factor positive. All of other negative. Negative signs suppressed by holding down CTRL while selecting. |
| 13 Bubble charts | Must have exactly 3 factors. 16 points maximum per factor. No negatives in Factor 3. |

SPECIAL FEATURES

Normally labelling of files is done as a time series (months years units etc). However, if there are 16 or fewer points in each factor then the labels typed in to correspond with the points may be used as the labels. This may be done for line, scatter, bar and segmented bar charts. To obtain this result simply hold down the shift key while selecting the graph type.

On overlays the factor description will continue to be printed on the right hand side for up to 17 factors. If you have a graph with more than 17 factors you will have to manually label them or use the custom labelling option. As the number of bars gets larger the bars get narrower. At some point the patterns distinguishing the bars become non discernable. In this case you should ensure

sufficient color differentiation.

Line graphs may be drawn as continuous lines (normal mode) or as step functions. To use a step approach press the "inverse" (Atari) key once quickly and then choose your line graph. This feature does not exist for X-Y line graphs.

TWO SIDED SCALING

Often we wish to show two sets of data on the same graph but they have totally different value ranges. An example would be the share price of IBM plotted along with the daily volume of trades in the shares. To properly show the relationships you need two sided scales. The screen resolution of the Atari virtually rules out doing this on the screen, but on paper it is no problem. The procedure is a bit cumbersome to use (and even worse to explain) but here goes anyway.

You plot the first graph, which must use the usual left hand axis for scaling. When asked if you will want 2 sided scaling answer "Y". You next graph any other files to be plotted against the left axis as overlays. For each file you will be asked if you want it graphed against the right axis. Simply answer "N". When you come to the file which you want on the right hand axis do it as an overlay but say "Y" to graphing against the right hand axis. At this point the scaling will be switched to the right hand side and the right side scaling will be placed on the graph. If you have further files to be placed against the right axis still say that they are not to be plotted against the right hand axis. This seems strange but the program will plot them against the right side axis anyway. If you were to answer yes the program would try to redraw the right hand axis again.

DRAWING THE GRAPH OF A FUNCTION

This function does not exist in the Pie chart program. This selection allows you to plot a mathematical function which you define. It is quite similar to the screen version in the simple regression program on B/GRAPH disk 2. The process is a bit slow since it calculates 100 data points. You start by entering a formula such as SIN(X) when asked. Any valid BASIC expression may be used as long as the expression does not exceed 100 characters. You must use the value X which is the value along the X-axis. You should always choose manual scaling since the computer uses this data to determine the points. The mathematical constant PI is available as a variable. It has the value 3.14159265.

LOG SCALING

There is as well a program for doing most graph types with either log scaling or semi log scaling. This program is selected from the main menu in the same manner as the pie chart program. The program is virtually identical to the program for doing lines and bars etc. The only graph type missing is the opposed bar chart type of graph. Naturally you can not take the log of negative numbers. The only difference on the menu selection is that "CTRL L" is used to select either log log or semi log scaling for XY plots. The current setting is shown at the bottom of the menu. As well "CTRL G" selects between full grids or partial grids. With full grids you get a grid for each tenth between two major grid lines. As a log scale is different from regular scales these extra grid lines are not evenly spaced. Using an Atari 1020 plotter we have found that

full grids can be used for Y axis ranges of 10000 to 1 (ie a high of 1,000,000 and a low of 100 or a high of 1 and a low of .0001). For the X axis the range is more like 10,000,000.

USE WITH MANNESMANN TALLY PIXY PLOTTER

When using the Tally Pixy plotter you will have the option of doing full page graphs or somewhat smaller ones. By selecting the "Set location" option you can choose to have the plot in any of the 4 corners or full page. The program versions on the "Boot" disk are somewhat different in that you can position the graph into any rectangle you desire. You are asked to specify the starting position in millimeters. The Pixy needs 18 mm from the left minimum and 22 from the top. The maximum position from the left is 263 and 202 from the top. You can as well use Landscape or Portrait orientation. Landscape has the top of the graph along the long edge of the paper. One use of this feature is that you can create a letter leaving a desired space for a graph and then graph directly into the space. Beware that using a large size title may cause the plot to run just outside the space allotted. The best advice is to experiment. You must at least use 1/4 of the available dimension (up or accross). The smallest graph is thus 1/16th of a page. If you do not need the fine spacing then the versions of the program on the other disk are better optimized for pie charts especially.

The Pixy adjusts the size of the graph depending on whether there is right hand scaling in use.

IMPOSSIBLE GRAPHS

The plotter program is capable of creating graphs which B/GRAPH itself can not create.

An example of an impossible graph is an 8 factor horizontal bar chart. There is no way to easily create the set of data needed directly in B/GRAPH. The XY plotting program is the only module that allows direct entering of more than 3 factors of data but it doesn't support labels.

To rectify this problem we have put a data editor on the second enhancement disk. The program is basically the editor part of the XY plotting program except that if there are 16 or fewer points you are allowed labels. As well the factor names and labels can be 10 characters wide as opposed to 8. Files created with this module can not be read with regular B/GRAPH programs but only by the plotting programs. There are 2 special features of the data editor. Two of the choices on the menu are "Percent Conversion" and "Filled Area Set UP". The former converts the data to percents. For example if the January sales for 3 regions were 10 20 and 30 then the option would convert these to 16.67 33.33 and 50.00 which are the percentages of the total that each is. This makes possible component stacked bar charts where each bar is the same size but different make up. The second choice sums the factors for any data value. In our example this would give values of 10 30 and 60. This allows stacked line graphs or Area graphs. If the 2 options are used in succession then a line graph with the top line at 100 throughout is possible. These 2 options allow for some quite effective graphs. This program and the plotting programs can of course read regular B/GRAPH files.

SPECIAL WARNING

On Atari XL and XE computers an operating system bug can occasionally cause the plotter program to hang up. After 3 minutes the program will continue on from where it left off. The Atari translator disk fixes the problem.