

Interactive Computer Graphics and Data Presentation
Reflections of P.S.U.

A Thesis
Presented to
the Chancellor's Scholars Council
of Pembroke State University

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the Chancellor's Scholars Program

by
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INTRODUCTION

As society moves into an age of information, computers become increasingly evident as an integral part of this transition. With their ability to store and process vast amounts of information and data, computers have assumed major roles in many areas of the modern world such as education where they aid in instruction, industry where they are used to control machinery, scientific research where they aid in analysis, entertainment where they create colored pictures from previously existing black and white pictures, and communications where they are used to manage large networks. Much of the integration of computers into the various areas of society has been due to micro-computers. With their affordability, speed, availability, memory capacity, and calculating power, micro-computers have been incorporated into laboratories, offices, classrooms, and homes, allowing for activities today which were only imaginable in years past. Today micro-computers are used in activities ranging from the very personal level such as balancing checkbooks and writing research papers to activities that are of national interest such as aviation and space travel, as well as countless other activities which would not have been possible without the introduction of the micro-computer. The significance and impact of micro-computers is apparent in our society with its video games, rockets carrying men to the moon, engines which tune themselves according to the condition of their exhaust gases, and weapons which autonomously distinguish tanks from boulders.

There are many areas of computer science which are rapidly growing with the needs of society to process information. One that is especially rich for exploration involves the graphic applications of the micro-computer. Using micro-computers as a means of producing graphic images is useful in many areas such as flight simulation for training pilots, creating music videos, analyzing satellite photographs, producing video games, and the analysis and presentation of data. Although all of these applications of computer graphics are important, my project focuses upon the latter: the useful application of the micro-computer to the presentation and analysis of data. The crux of my project is a computer program, or list of instructions, which demonstrates some of the capabilities of the micro-computers found at Pembroke State to process information and data. In particular the information which is presented by the micro-computer in my project pertains to the development of Pembroke State University and changes in the university as it has grown with the technological age.

My project as mentioned involves a collection of computer programs which I have designed to examine specific aspects of the university as they are related to questions I have concerning the history Pembroke in areas such as physical development, historic events, and the geographic location of alumni. These programs are Dynamic Map, which recreates diagrams locating major building of the campus as they have appeared during the past seventy-nine years; Historic Timeline, a program designed to list the historical events pertaining to Pembroke State, North Carolina, the United States, and the World from 1887 until 1987; Commuter, which explores the use of speed as a quantity which can be directly displayed while animating

changes in commuter levels and enrollment; Alumni Dispersion, a subprogram designed to display information concerning the dispersion of alumni over the U.S. and North Carolina, and Data Analysis, which provides graphs of statistics concerning Pembroke State. In each of its five sub-programs this program emphasizes the micro-computer's ability to create vivid graphic images which may offer insight to information which previously existed in numeric form. In so doing, it also exploits the computer's ability to vary the form and direction of the presentation according to the varying interest of the user. Thus, this project seeks to demonstrate a medium which would not have been possible prior to the computer age. In the remainder of this paper I will provide a more in depth explanation concerning the nature and motivation of this project and in so doing emphasize the role of each subprogram in the total project. I will also offer a general overview of the methods I used in creating my project as well as a brief discussion of other considerations involved in this programming project. In conclusion I have also included a brief discussion of the insight which this project has given me.

MOTIVATION AND NATURE OF PROJECT

Individual sub-programs are the component parts of this project. The first sub-program which has been labeled "Historic Timeline" uses the computer's memory and display capabilities to list key events on the development of Pembroke State as they may have related to events in the development of North Carolina, the United States, and the World (see example III). Since lists have been a primary means of expressing data and information for centuries,

'Historic Timeline' illustrates how the modern computing device may be adapted to perform age old task such as storing, retrieving, and sorting lists, whether they be lists of events or items like those found in 'Historic Timeline' or a Christmas shopping list. Such a listing of events presented in table form allows the user who is interested in Pembroke State to gain a more global view of the topic. This global view may add a new dimension to the insight a person might have concerning the Pembroke State because it allows the user to infer relationships concerning related events that might not have been evident if the person interested in the university was forced search from page to page in books rather than concentrate on lists displayed via computer terminal. Other applications of how helpful computer lists are can be found where vast amounts of information must be stored and retrieved. For example, consider Mary Livermore Library which is now transferring card catalogs from filing cabinets to computer terminals where searches can be carried out through a keyboard, memory bank, and a display terminal.

Historic Timeline allows the user to select a particular year of interest to which the computer responds by displaying the desired information in five categories, which are the year, P.S.U. events, N.C. events, U.S. events, and World events. The preceding five years information is displayed above and the following five years information below. The display was created in this way to in order to create an overlap of information which perhaps will increase the perspective this program offers to the user. Though the real power of the computer is not fully exploited by this particular sub-program as it manipulates displays it no doubt offers a great deal of insight in to the potential of these machines.

The second sub-program sketches maps of Pembroke State as it appeared at various stages in its development. This part of the project, which is referred to as "Dynamic Map", is much like a blueprint or an insurance map such as those used by the Sanborn Insurance Company only it is a great deal more versatile because it enables the user to move forward and backward through the physical development of the campus at the touch of a key. As the user presses the arrow keys the computer generates drawings which depict buildings and roads as they would have appeared if viewed from above during the history of the university. The implications of such a presentation are two fold.

First the use of the computer to represent the development of Pembroke State not only reflects the ability of the computer to manage such a task but also implies a great about the university itself. Consider the strong statements this series of computer images makes concerning this university and the directions in which it has physically grown during the course of the past one hundred years. Reflect also upon the transitions both the community and the rest of the world have undergone as building after building has been added to this campus from first Old Main to the most recent James B. Chavis University Center.

The second implication of "Dynamic Map" deals with the usefulness and applications of such a tool to display and alter images which in some way may model real phenomena. When the phenomena is one of change, the display is one of 'animation' and in the case of "Dynamic Map" the animation is interactive and controlled by the user. The display of images depicting physical change such as those seen in this program and the versatility of their display

though possible prior to the advent of micro-computers would not have been as successful without the micro-computer. The buildings to be represented and their positions are based on the user's decisions which the computer responds to without perceptible delay. The notion of representing physical change with a computer terminal, which is the primary interest of "Dynamic Map", is a notion that has been shown to have many applications to microcosms such as those of molecules and cells or to macrocosms such as orbits of planets and the shifting of continents. The micro-computer offers a great deal in this area of depicting physical phenomena evolving in time. Through the dynamic re-creation of physical phenomena, a great deal of future programs will do much like "Dynamic Map" and exploit the power of micro-computers. Evidence of this application can be seen throughout the evolution of the micro-computer as these machines have been used with existing forms of presentation to further understanding in areas such as climatology, strategic national defense, and image processing where computers interpret various types of photographs taken from hi - tech cameras aboard satellites above the Earth's surface or created with radio waves through solid materials or from an instamatic camera. With the realization of the vast amount of information existing in pictorial form computer programs such as "Dynamic Map" become very practical.

The third subprogram is referred to as "Alumni Dispersion" because it depicts the geographic dispersion of Pembroke State University's graduates throughout the N.C. and the continental U.S. The motivation behind this particular sub - program is much like that on which weather maps are created. By examining a meteorological phenomena such as high pressure zones, cold fronts and other weather

patterns in a more global sense trends and relationships can be seen. This more global approach to a subject may lead to a greater appreciation of not only physical phenomena but also sociological, economic, and other phenomena which occur over both large and small geographic regions. This concept of using a map to depict data is by no means a new technique information representation but much like 'Historic Timeline' 'Alumni Dispersion' lends itself to use on the micro-computer.

Consider the many ways which this relatively simple concept might be applied to studying a given situation, especially if its display were coupled with animation. In situations where the information is not static and interpretation relies a great deal on changes in the information this technique of presentation would perhaps offer more insight than any other means of visual display. This means of dynamic display would be of great value to an economics instructor trying to convey ideas of economic trends, and it would provide much to the history student trying to see the inter-relationship of key historic events. Also consider the value such a device would have for someone studying a subject involving a sequence of related operations where the ability to reverse the sequence at any time would aid in the understanding of the the sequence.

The data concerning alumni dispersion is only one of the many areas which lend themselves to the type of presentation which 'Alumni Dispersion' achieves but it amply illustrates the use of such a technique and the utility of the device which generates a presentation of this form. With the potential of the micro-computer to animate such information as that seen in 'Alumni Dispersion' the value of the micro-computer as a tool for presentation is increasingly

apparent. Applications of this capability of the micro-computer exist in areas where vast quantities of changing data with geographic significance are maintained for analysis. By graphically representing not only the data but also illustrating the changes in the data there is potential for increased understanding concerning relationships which may not be revealed in the more traditional methods of data representation .

The idea of representing change that has had an important role in the prior sub-programs is also a vital aspect in the fourth 'Commuters', the fourth sub-program of this project. The intent of this particular sub-program is to convey information about the commuter students at Pembroke State University using basic techniques of animation. By creating movement on screen, this 'Commuters' sub-program explores a way which micro-computer may be used to represent quantitative information through physically changing the position of particular images on screen relative to others.

Data was gathered concerning the number of commuting Pembroke State students on specific years from the mid - 1960's until the present. This data became a factor in the movement of a car representing that year. The cars from each of the years make up the changing screen which reflects how the number of commuting students has changed. Since the value of graphic technique is often based on how much information the particular technique conveys I also used area as a reflection of change. The area of the cars is proportional to the number of students enrolled at P.S.U. during the years cars have been created.

The use of speed as means of representing of quantity is a

technique which warrants much further exploration. It seems that using length and area of geometric shapes to represent quantity is a traditional means of graphically depicting data which has already been complimented by the micro-computer and a means which the micro-computer lends itself to quite naturally. However, 'Commuters', by using the some of the animating capabilities of the micro-computer, illustrates another vital quality of these machines awaiting exploitation. Programs like 'Commuters' may serve of great importance in a physics lab studying particle motion or in some department of transportation where numeric data concerning traffic flow on a super-highway would be more useful in an animated representation. These are only two of the many situations in which the concept of computer animation as a form of data representation is invaluable.

The fifth and final sub-program is called 'Data Analysis' and, though much of the program has been concerned with the analysis of data, this particular sub-program takes a much more traditional approach. This program was created to graphically present various types of numeric data from different periods throughout Pembroke State's development which may be of particular interest to the user. After the set of data is selected, the computer generates a scatter plot of the data or two sets of data if that option is chosen. This scatter plot is made up of connected data points. From the generated graphs relationships may be inferred directly by the user. The program also takes the data a step further and and correlates the dependent variables of each data set graphing this correlation and drawing a line of correlation or line that best fits through the third graph. This third graph further enables the user to interpret

relationships in terms of strong or weak correlation.

This fifth subprogram adds much to the entire program because of its adaptability and versatility. In a sense 'Data Analysis' could stand alone as a program. It was created with the notion of future modification and to be easily adapted to data not only about Pembroke State University but from many other fields of endeavor. It was also designed to perhaps demystify collections of numeric data that are challenging to interpret and understand without graphic representation.

Programs such as "Data Analysis" yield much to the understanding of vast amounts of statistics generated by modern society. Programs of this type have applications in many areas of study. The importance of such programs also adds to the importance of the machines, the micro-computer, for which these programs are written. So much information concerning society and physical phenomena is maintained in numeric form and this information would perhaps be less useful without a means of interpreting such as micro-computers which are quite efficient at converting this data into meaningful and relevant graphic images.

PROCEDURES AND METHODS

Having discussed the general nature of my project, the activities which went into the completion may be of interest. Therefore the following paragraphs offers a step by step explanation of how this program was carried through various stages of completion.

The first and the most critical part of this project was determining what types of information concerning Pembroke State would

be appropriate for a presentation using the micro-computer. In focusing my attention to the aspects of the university which I would present I considered questions such as 'What did Pembroke State look like fifty years ago?', 'Is there any correlation between male students and female students at Pembroke State?', and 'What was happening elsewhere in the world when Old Main was constructed?'. With some idea of what information I wanted to work with I then began to envision the methods I would use for presentation. During this phase of development, I searched for a means to create the presentation. Late in the spring of this year I began working with Turbo Graphix Toolbox and Turbo Pascal which became the programming language or instructions for this project.

Turbo Graphix Toolbox is a collection of programmed procedures or instructions which allows the programmer to create various types of graphic displays without becoming a computer graphics specialist. The commands available in Turbo Pascal, and the Turbo Graphix Toolbox apply to specific task that the micro-computer is programmed to perform. These commands are part of languages to which the computer responds. For the most part, the commands used in this program are used to turn "pixels" ,tiny phosphorus dots which make up the screen, on and off. Exactly how these pixels would be manipulated depends a great deal on the programmer and the commands at his disposal. For example a commands such as;

```
BEGIN CLEARSCREEN; SELECTWINDOW(1);
SELECTWORLD(3);
DRAWPOLYGON(###.##.%%.**) ;
END;
```

would be part of a procedure that would clear the screen create a

specified part of the screen in which to manipulate pixels, determine the dimensions of that specified part of the screen, and draw a multisided figure in that area based on the given specifications. Exactly where to draw and what to draw that was determined in the planning stage and relied a great deal on the commands available to me. This project consist of thousands of commands such as the example given, with each having a distinct role in the total program. This was an ideal language or set of commands for me to work with since I wanted to write a tailor made program to create the presentation I desired rather than rely on someone else's pre-designed program. As I became familiar with Turbo Graphix I became increasingly aware of the many possibilities of graphic presentation awaiting exploration with the use of Turbo Pascal and the Graphic Toolbox. With an idea of what I wanted to present and a means of presenting it, I began to work on the various subprograms I have included as well as others. With each subprogram I tried to develop a novel and successful means to convey the information which was available.

The first subprogram I wrote was 'Historic Timeline'. It was the most difficult of all of the programs because during the time I programmed it, I was familiarizing myself with Turbo Graphix Toolbox and Turbo Pascal. As I designed 'Historic Timeline', I sought to create a means to display events concerning P.S.U. and the rest of the world. In creating and displaying this list of events I relied on the computer's memory to manage a large list of events which are chronologically ordered. This ordered list of events has been stored on a diskette independently of the program itself and can be updated at any time in the future.

'Historic Timeline' allows the user to input some year which is of interest it then searches through its ordered list to find the events which correspond to the desired year. After finding the appropriate events, the computer then displays them according to my specifications(see example III). Much of the work done with this program dealt with the display and the most effective way to present the events, as well as deciding which events to display.

The second major program which I designed which is a part of this project is 'Dynamic Map'. With 'Dynamic Map', I essentially am trying to illustrate change in the appearance of Pembroke State. I achieved this illustrated change by programming the micro-computer to draw and erase overhead drawings of key buildings corresponding to the time they have stood on our campus.

The method I used to program the shapes of the buildings required me take a large scale map of the campus and scale it to the dimensions of the computer display terminal. I did the scaling by plotting each vertex of each building based on a coordinate system which was one meter X one meter. These vertices have been saved as part of 'Dynamic Map' and are used to create polygons on screen in the appropriate position and time which are scale models of the original building. To see how involved some of the plotting of various structure became refer to example 5 which describes the coordinates of the James B. Chavis Student Center.

The third sub-program which I developed was 'Commuters'. This program afforded me an opportunity to explore animation techniques using the micro-computer. I should also add that throughout the course of the entire project I worked on most of these sub-programs at the same time I was either creating, or refining the others. The

order I discuss them is the order in which the original idea for each of them occurred to me. This is important to know because even as I write this paper 'Commuters' is still being developed. However, 'Commuters' will in some way reflect change in the number and distribution of commuter students at Pembroke State University over the past twenty years. While it is usual to represent quantities and their changes by the length or area of some geometric shape, 'Commuters' seeks to explore the possibility of representing quantities by speeds and movements. With for instance cars of different shapes and sizes being drawn, moved, erased, and redrawn the computer simulates motion which I have designed to illustrate the varying number of commuting students at Pembroke State as it may be related to total enrollment.

The forth subprogram is 'Data Analysis' and was written to aid in the interpretation of existing annual statistics concerning Pembroke State as well as other areas of interest for which the exist data. This program processes a collection of time-series data that exists independent of the program and which can be updated or changed at any time. This program performs a variety of important operations. The first operation it performs is to plot one set of data on screen alone in graphic form of a scatter plot and connected data points, or by plotting two sets of data side by side on screen for comparison. It then can graph a scatter plot the two sets, and the line of best fit calculated to minimize the sum of the squares of the residuals. This calculation was quite involved since one set of data may not coincide chronologically with another set of data or data for any single year may be missing. For example statistics concerning S.A.T. Scores may exist only from 1978 - 1984, and statistics for Male

Enrollment may exist from 1967 - 1987. This poses a programming problem since this data only coincides in the years 1978 -1984 so any correlation calculation must be sure to include only statistics from the years 1978 - 1984. I resolved this problem by comparing data much like I did with 'Historic Data' and retaining only that which coincides for calculation purposes. Identifying and solving problems such as these gave me a better appreciation of the work, calculations, and mathematics which is involved in the production of modern business and analysis programs.

The concluding sub-program which I wrote originated from an idea I had to use a weather map to display the dispersion of Pembroke State's Alumni over the United States and North Carolina. I programmed the computer to save a screen on which a map of the United States was created by tiny dots much in the same way an 'Etch a Sketch' works. The picture I saved can be recalled at a later time at which the dispersion of alumni in various geographic regions will be indicated by either number or symbols. This was the simplest of all the programs to create and although it was comparatively easy to make it has an impact which is as strong as any of the other programs.

The objectives and goals of this project were achieved by dividing the program into sub-parts which in original form were prototypes of some idea. These prototypes were developed as individual parts using the available commands while not losing sight of the main program but also not trying to treat it as a single objective. This 'divide and conquer' technique of programming is most helpful in situations such as this where the program is large. An alternative form of programming which is to treat the project as a

whole leads to confusion when the commands become tangled and the logic behind the directions become ambiguous and lost in heaps of computer code. Refining and testing these prototypes was also much easier than working with the program as a whole. As the prototypes reached operational status they became part of the main program where they would perform their assigned task.

This basic pattern of envisioning, researching, prototyping, and refining was present throughout the project each part of which was equally necessary to the entire project. As to the many thousands of commands used to create this program their explanation would be beyond the scope of this paper. However in the final copy of this paper I hope to include a listing of programs which I wrote in order to enable the micro-computer to manage this presentation.

OTHER CONSIDERATIONS

Since the success of this computer program relies a great deal on how easily information can be obtained from it, one of the primary concerns in its design was user friendliness. With the user in mind a leaflet (see example 1) was created which would guide the user through starting the program and to serve as a source of help during the program's operation. The use of external support for computer programs can be a very important factor in the success of a program especially in cases when the backgrounds of the users vary and can not be predicted. However as more powerful computers and programs are developed more and more of the external support such as this leaflet is being integrated into the program itself.

After the program is in operation, much of what then occurs is

based on the choices of the user as he moves from lists of various options which are referred to in computer terminology as 'menus'. These menus are much like those in a restaurant except, instead of listing food items, the computer menu lists the user's options in directing the computer to do desired tasks.

The decisions the user makes are essential to how the program functions, and it is for this reason that as the user's means of interacting with the computer should be efficient and clear. With this notion of of easy user interaction in mind, this program makes use of what I refer to as a 'choice - pad', which is a listing of choices the user selects from by placing a marker next to the desired option. This marker is referred to as a cursor and indicates the present screen position. There are several important things to note about this technique of interaction. First in importance is the ease with which it can be used. By relying on only a handful five keys this entire program can be used where alternate forms of interaction might include making selections from among all 88 keys on the keyboard. This latter task of choosing keys may require more concentration for those not familiar with the keyboard and may lead to more confusion than the simple activity of moving a cursor with arrow keys while watching the cursor move in the direction which is indicated by the key pressed. Another factor is that the actual manipulation of the screen may give the user a sense of involvement that is not present when choices are present only in letter form which is a widely used alternate form of computer interaction. Example 2 represents a more efficient use of the choice pad by grouping related sets of options on the screen simultaneously in order for the user to see the choices he makes as

well as the options from which he must choose. This use of multiple choice pads can be beneficial for the user who must make a series of decisions with each decision directly influencing the others. This technique of displaying choices with the context in which they are being made is important in creating the kind of factors which minimize the user's confusion and lead to user friendly programs.

CONCLUSIONS

There are many conclusions to which this project may lead concerning the value of the micro-computer as a tool for analysis and exploration. It may also offer new insight to some the graphic capabilities of the micro-computer and various areas where these capabilities can be applied as well as the adaptability of the micro-computer as an evolving form of communication and expression. Yet of the many and various conclusions and insights which it may lead to, I sincerely feel that it has helped me to better realize the resources of helpful people and tools which exist at Pembroke State University. It has been this realization and the past ten months of work on my project that has taught me persistence in times when my project was destroyed and had to be reconstructed as well as the times when it was praised by my advisors. I hope that my efforts may in some way be useful to others in attempts to gain insight about Pembroke State as my project represents not only the statistics concerning this university but as it also reflects an effort on my part which would not have been possible without the support of Pembroke State.

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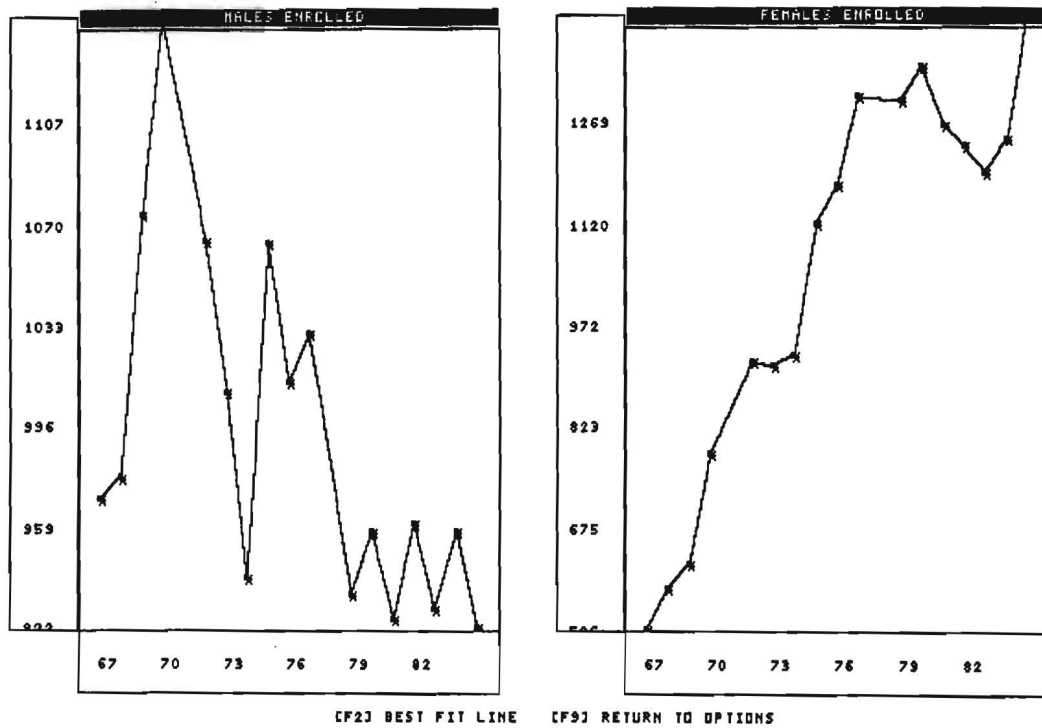
<p>COMPARE GRAPHS YES NO EXIT</p>	<p>GUIDE <ARROW> TO MOVE CURSOR <ENTER> TO ENTER CHOICE <F2> LINE OF BEST FIT <F3> RETURN TO COMPARE <F9> RETURN TO MENU</p>
<p>OPTION LIST</p> <p>BIOLOGY DEGREE BUSINESS DEGREE EDUCATION DEGREE FINE ARTS DEGREE HOME ECONOMICS DEGREE LETTERS DEGREE PHIL. AND REL. DEGREE MATHEMATICS DEGREE PHYSICAL SCIENCE DEGREE PSYCHOLOGY DEGREE SOCIAL SCIENCE DEGREE</p>	

COMPARATIVE LIST OF EVENTS				
YEAR	PENBROKE STATE	NORTH CAROLINA	UNITED STATES	WORLD
1887	INDIANS PETITION FOR NORMAL SCHOOL		CONGRESS PASSES INTER-STATE COMMERCE ACT	
1888	W.L. MOORE PRINCIPAL AND INSTRUCTOR			JACK THE RIPPER MURDERS IN LONDON
1889	EZRA BAUDER HIRED FOR FALL TERM AS PRINCIPAL	BUCK DUKE ORGANIZES AMERICAN TOBACCO CO.	INDIAN TERRITORY IN OK.	PUNCH CARD SYSTEM MADE BY HOLLERITH
1890	SCHOOL NOT IN OPERATION FROM JULY TO OCTOBER			GLOBAL INFLUENZA EPIDEMICS
1891	CHARLES STEWART IS PRINCIPAL AND TEACHER	PICHDY ARRIVES AT BILTHORE		BEGINNINGS OF WIRELESS TELEGRAPHY
1892			GROVER CLEVELAND RE-ELECTED PRESIDENT	DIESEL PATENTS INTERNAL COMBUSTION ENGINE
1893			DEPRESSION CRIPPLES ECONOMY	
1894	REV. DAVID SIMPSON TAKES CHARGE OF SCHOOL			X-RAYS DISCOVERED
1895	TOWN OF PENBROKE	BILTHORE HOUSE COMPLETE		GILLETTE INVENTS SAFETY RAZOR
1896	P. B. HIXEN BECOMES		WILLIAM MCKINLEY ELECT-PRESIDENT	BEGINNING OF KLONDIKE GOLDRUSH
1897		LOCAL TAXES FIRST USED		SEVERE FAMINE IN INDIA
	TARGET YEAR	NEXT FIVE YEARS	LAST FIVE YEARS	EXIT

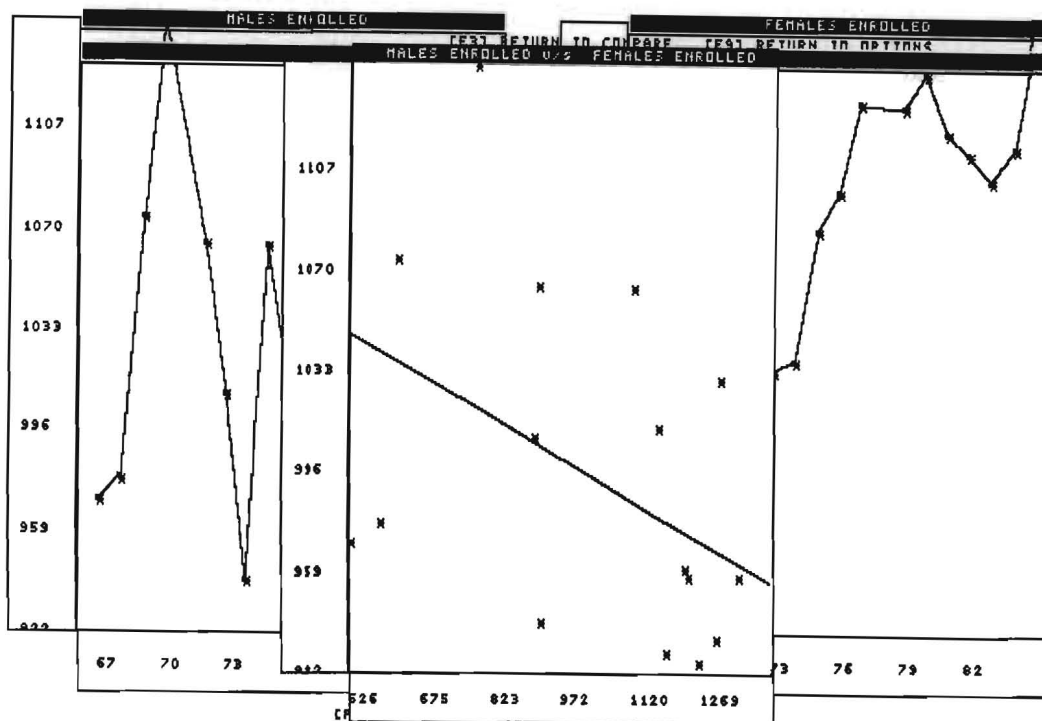
EXAMPLE III PRODUCT OF HISTORIC TIMELINE

COMPARATIVE LIST OF EVENTS				
YEAR	PENBROKE STATE	NORTH CAROLINA	UNITED STATES	WORLD
1977			CARTER BECOMES PRESIDENT	NUCLEAR PROLIFERATION ACT SIGNED
1978	CROSS COUNTRY WINS NATIONAL CHAMPIONSHIP			POPE PAUL VI DIES
1979	DR. GIUEHS NAMED CHANCELLOR		CARTER - BREZHNEV SIGN SALT II	Soviets INVADE AF - GHANISTAN
1980				
1981			RONALD REAGAN BECOMES PRESIDENT	PRINCE CHARLES AND LADY DIANA WED
1982	32 INTERNATIONAL STUDENTS ATTEND P.S.U.			SOVIET LEADER BREZHNEV DIES
1983			JIM THORPE'S MEDALS RETURNED	LECH WELESIA RECEIVES NOBEL PRIZE
1984	FRANCIE ADLER P.S.U. GRADUATE MISS NC		"1984" BECOMES FASTEST SELLING BOOK IN US	
1985		NC BECOMES LOCATION OF MOTION PICTURES		
1986		JAMES MARTIN GOVERNOR	CHALLENGER DISASTER	
1987	P.S.U. CELEBRATES HUNDRETH BIRTHDAY	PTL SCANDAL	IRAN-CONTRA HEARINGS	
	TARGET YEAR	NEXT FIVE YEARS	LAST FIVE YEARS	EXIT

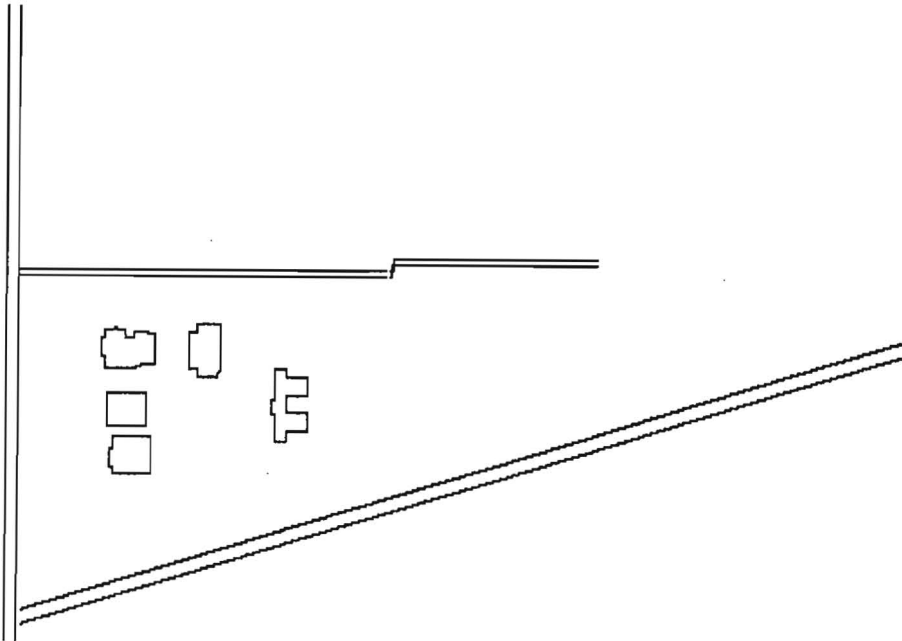
EXAMPLE III PRODUCT OF HISTORIC TIMELINE



EXAMPLE OF DATA ANALYSIS

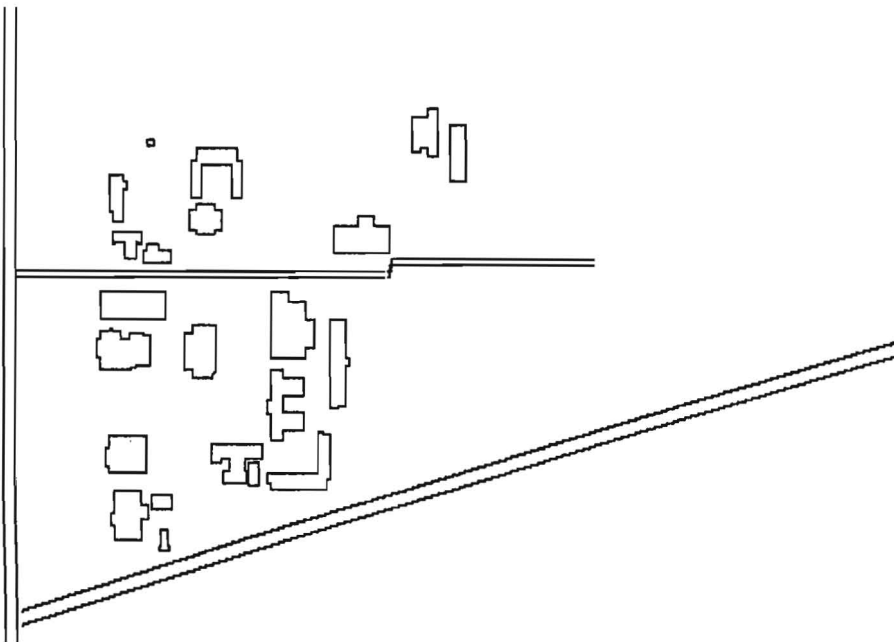


EXAMPLE OF DATA ANALYSIS



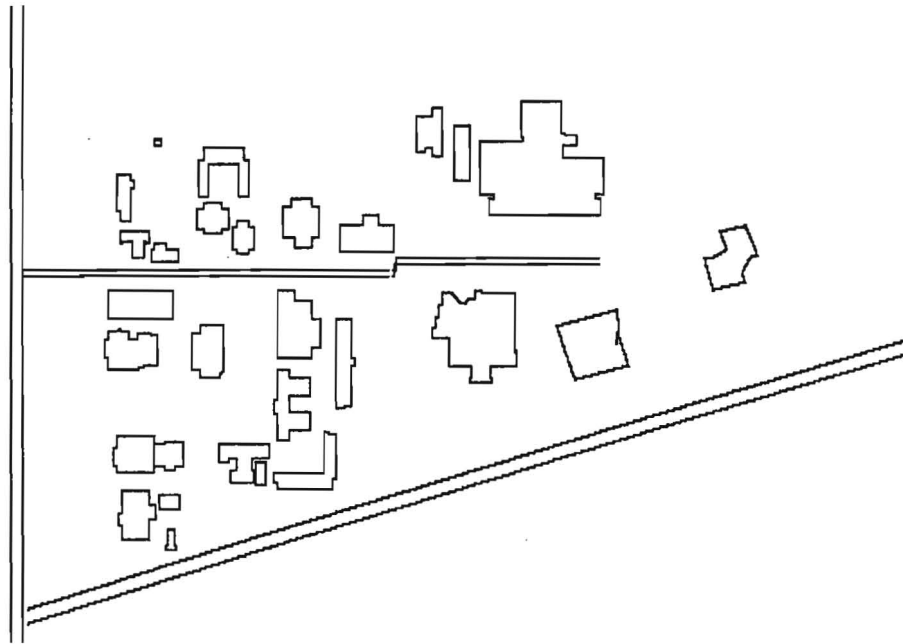
1950

PRODUCT OF DYNAMIC MAP



1971

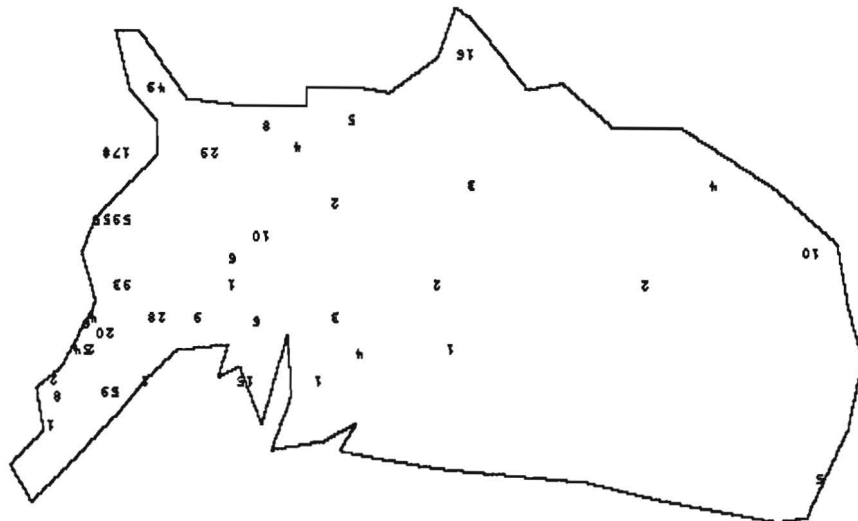
PRODUCT OF DYNAMIC MAP



1987

PRODUCT OF DYNAMIC MAP

PRODUCT OF ALUMNI DISPERSION



U.S. DISPERSION

EXAMPLE OF PROGRAM CODE

Line 369 Col 1 Insert Indent B:RECPROT.PAS

```

xxxsum := 0;
yyysum := 0;
count := state(pos[y2].num);
FOR i := 1 to iii do BEGIN           (sums x values)
  sumx := sumx + parray3[i,1];
END;
FOR i := 1 to iii do BEGIN         (sums y values)
  sumy := sumy + parray3[i,2];
END;
meanx := sumx/iii;                 (finds mean values)
meany := sumy/iii;
FOR i := 1 to iii do BEGIN         (sums the differences)
  xsum := parray3[i,1] - meanx;
  ysum := parray3[i,2] - meany;
  sumxy := xsum * ysum;
  sumxx := xsum * xsum;
  xysum := xysum + sumxy;
  xxsum := xxsum + sumxx;
END;                                (calculate slope)
slope := xysum / xxsum;
if (chol = 1) then begin
  ys1 := (slope * lox[y2]) + meany - (slope * meanx); (finds end points)
  ys2 := (slope * hix[y2]) + meany - (slope * meanx); (drawslines)
end;

```

REFLECTIONS OF P.S.U.

AN ADVENTURE IN INTERACTIVE GRAPHIC PROGRAMMING

USER'S GUIDE

Line 392 Col 1 Insert Indent B:RECPROT.PAS

```

end;
if (chol = 2) then begin
  ys1 := (slope * lox[y2]) + meany - (slope * meanx); (finds end points)
  ys2 := (slope * hix[y2]) + meany - (slope * meanx); (drawslines)
end;
END; (bestfitline)

```

Procedure option1;

```

BEGIN (option1)                    (scatter plot)
  selectworld(13);
  selectwindow(13);
  drawborder;
  if vi = 1 then BEGIN
    FOR i := 1 to pos[y1].num do BEGIN
      drawtextw(parray1[i,1],parray1[i,2],1,'*');
    END;
  END;
  if vi = 2 then BEGIN
    FOR i := 1 to pos[y1].num do BEGIN
      drawtextw(parray2[i,1],parray2[i,2],1,'*');
    END;
  END;
END;

```

CONTENTS

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INTRODUCTION

REFLECTIONS OF P.S.U. is the product of a Chancellor's Scholars Project designed to illustrate some of the graphic capabilities of micro-computers and how these capabilities may be applied to the analysis of data.

The data used in REFLECTIONS OF P.S.U. is taken from the statistics of Pembroke State University in areas such as enrollment, physical development, and historical events.

REFLECTIONS OF P.S.U. is divided into five sub-programs each of which have a unique role in the main program and will be discussed after start up instructions are given.

REFLECTIONS OF P.S.U. is designed to allow the user to explore areas of interest and to examine some of the micro-computer's graphic capabilities. So without further delay please explore REFLECTIONS OF P.S.U.

START UP

Correctly starting REFLECTIONS OF P.S.U. is essential to examining it so please pay close attention to these instructions until familiar with them.

#1 REMEMBER short of physically damaging the diskettes on which REFLECTIONS OF P.S.U. is stored you will not destroy the program by making ordinary mistakes. DON'T PANIC !! If you encounter difficulty retry start up procedures or seek assistance.

#2 This program is stored on two diskettes labeled A: and B: Place diskette A: in diskdrive A and diskette B: in disk drive B of a machine which is off.

#3 With diskdrive doors closed and disk are in drives switch the computer on.

#4 If you have a printer attached to your computer and you wish to make printed copies of what appears on the screen type 'graphics' after you see A> and then <ENTER>.

#5 To run REFLECTIONS OF P.S.U. type 'PSU' when A> appears and then press <ENTER>.

#6 After a brief description of the program a list of options will appear. To enter choice press appropriate function key example <F1>.

The following INSTRUCTION SCREENS will appear as various choices are made.

DYNAMIC MAP

DYNAMIC MAP PRESENTS A SERIES OF OVERHEAD DRAWINGS OF
PEMBROKE STATE UNIVERSITY AS IT APPEARED AT
VARIOUS STAGES OF ITS DEVELOPMENT.

TO VIEW THE YEAR BY YEAR DEVELOPMENT OF THE
UNIVERSITY USE ARROW KEYS ON
NUMBER PAD.

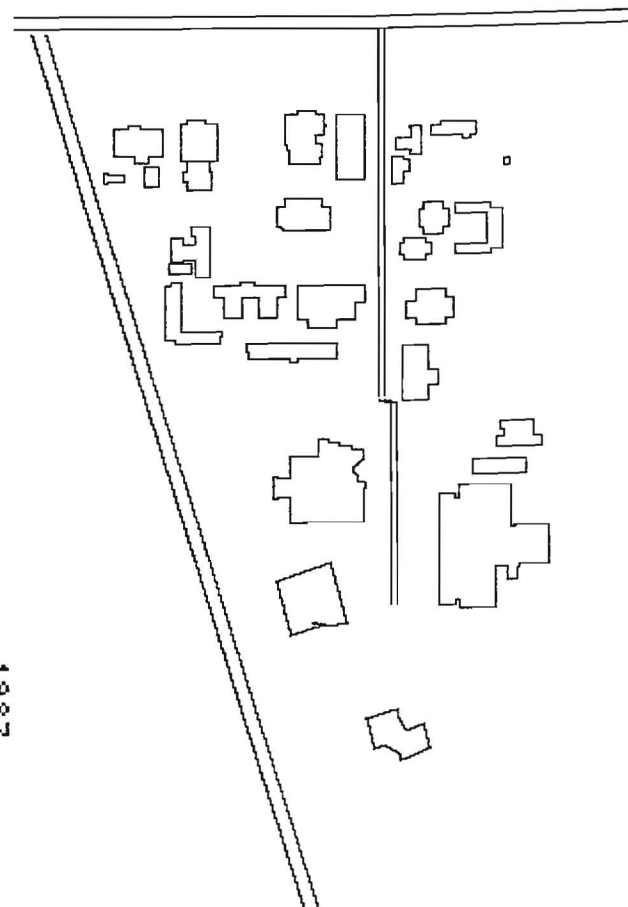
RIGHT ARROW KEY [->] FORWARD THROUGH TIME

LEFT ARROW KEY [<-] BACKWARD THROUGH TIME

[space bar] TO RETURN TO MAIN MENU

(CAUTION ; BE SURE THAT NUMBER LOCK IS OFF)
(NOTE : MAPS ARE ORIENTED WITH RAILROAD TRACKS ON)
(RIGHT OF SCREEN AND PHILADELPHUS ROAD ON)
(BOTTOM OF SCREEN)

Strike a key when ready . . .



HISTORIC TIMELINE

HISTORIC TIMELINE IS A SERIES OF TIMELINES WHICH DEFINE SOME OF THE MAJOR EVENTS WHICH HAVE OCCURRED SINCE THE BEGINNING OF PEMBEROKE STATE UNIVERSITY IN 1887 UNTIL THE PRESENT.

THESE EVENTS ARE ARRANGED IN THE FOLLOWING CATEGORIES
 YEAR | PEMBEROKE | NORTH CAROLINA | UNITED STATES | WORLD
 TO VIEW A PARTICULAR YEAR

MOVE BOX USING
 RIGHT ARROW KEY [->]
 LEFT ARROW KEY [<-]

PRESS [RETURN/ENTER] FIVE] ADVANCES LIST 5 YEARS
 (TARGET] ENTER APPROPRIATE YEAR [NEXT FIVE] RETURNS TO MAIN MENU
 (LAST FIVE] LIST PREVIOUS 5 YEARS [EXIT] RETURNS TO MAIN MENU
 Strike a key when ready . . .

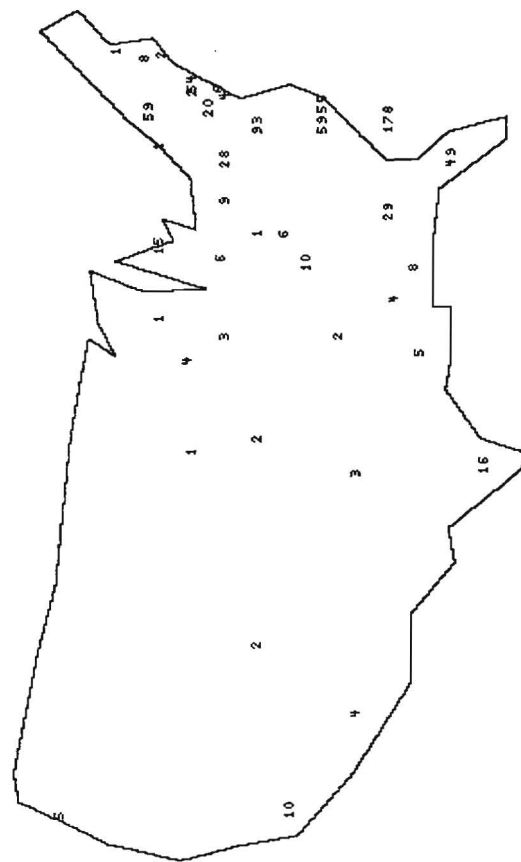
COMPARATIVE LIST OF EVENTS												
YEAR	PEBEROKE STATE	NORTH CAROLINA	UNITED STATES	WORLD								
1943	COLLEGE HAS FACULTY OF SIXTEEN		US VICTORY ON GUADALCANAL	PENICILLIN SUCCESSFULLY USED IN TREATMENT								
1944		CHERRY ELECTED GOVERNOR	BATTLE OF THE BULGE									
1945	LIBRARY INCREASED TO 7000 VOLUMES		ROOSEVELT DIES TRUMAN BECOMES PRESIDENT	WORLD WAR II ENDS								
1946	INDIANHEAD SCHOOL YEARBOOK STARTED			TRUCE DECLARED IN CHINESE CIVIL WAR								
1947	ROBESON COUNTY FAIR HELD ON CAMPUS											
1948	STUDENT COUNCIL STARTED	H. KERR SCOTT ELECTED GOVERNOR		GHANDI ASSASSINATED								
1949	SCHOOL RENAMED PEMBEROKE STATE COLLEGE			APARTHEID PROGRAM ESTABLISHED IN S. AFRICA								
1950			KOREAN WAR BEGINS	WORLD POPULATION 2.3 BILLION PEOPLE								
1951		INTEGRATION BEGINS AT UNC GRADUATE SCHOOLS	TRUMAN DISMISSES MacARTHUR									
1952			EISENHOWER ELECTED PRESIDENT	JERICHO EXCAVATED								
1953			McARTHUR INVESTIGATIONS									
<table border="0" style="width: 100%;"> <tr> <td style="text-align: center;">TARGET YEAR</td> <td style="text-align: center;">NEXT FIVE YEARS</td> <td style="text-align: center;">LAST FIVE YEARS</td> <td style="text-align: center;">EXIT</td> </tr> <tr> <td style="text-align: center;"><input type="text"/></td> <td style="text-align: center;"><input type="text"/></td> <td style="text-align: center;"><input type="text"/></td> <td style="text-align: center;"><input type="text"/></td> </tr> </table>					TARGET YEAR	NEXT FIVE YEARS	LAST FIVE YEARS	EXIT	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
TARGET YEAR	NEXT FIVE YEARS	LAST FIVE YEARS	EXIT									
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>									

DISPERSION
DISPERSION DEPICTS THE GEOGRAPHIC LOCATION OF MEMBERS
OF THE
PEMBROKE STATE UNIVERSITY ALUMNI ASSOCIATION
THROUGHOUT
THE CONTINENTAL UNITED STATES AND NORTH CAROLINA.

PRESS [U] TO SEE UNITED STATES MAP
PRESS [N] TO SEE NORTH CAROLINA MAP
PRESS [E] TO EXIT AND RETURN TO MAIN MENU

Strike a key when ready . . .

U.S. DISPERSION



DATA ANALYSIS

DATA ANALYSIS PROVIDES GRAPHIC PRESENTATION OF DATA
CONCERNING VARIOUS ASPECTS OF PEMBRROKE STATE UNIVERSITY.

UNDERLINE CHOICE USING UP AND DOWN

ARROW KEYS THEN PRESS [RETURN/ENTER] TO ENTER CHOICE

COMPARE	OPTION LIST#
[YES] COMPARE TWO SETS OF DATA	[UP ARROW] MOVE UNDERLINE UP
[NO] GRAPH SINGLE SET OF DATA	[DOWN ARROW] MOVE UNDERLINE DOWN
[EXIT] RETURN TO MAIN MENU	[PG UP] SEE PREVIOUS OPTION LIST
	[PG DN] SEE NEXT OPTION LIST

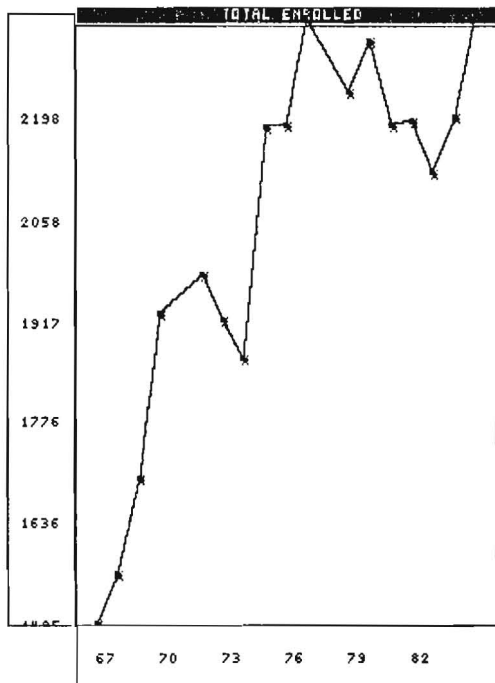
AFTER DESIRED GRAPH IS DRAWN PRESS [F2] TO SEE SETS OF
DATA GRAPHED IN RELATION TO EACH OTHER AND LINE OF BEST FIT
FOR THIS DATA SET

PRESS [F3] TO RETURN TO ORIGINAL GRAPHS
PRESS [F9] TO RETURN TO DATA ANALYSIS MENU

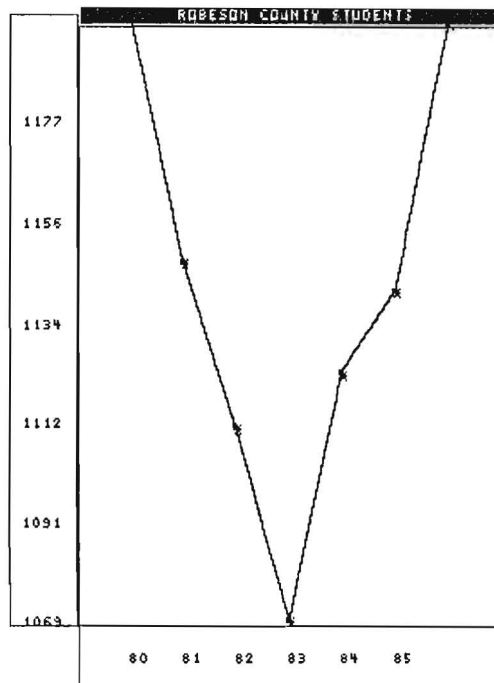
Strike a key when ready . . .

<p>COMPARE GRAPHS</p> <p><u>YES</u></p> <p>NO</p> <p>EXIT</p>	<p>GUIDE</p> <p><ARROW> TO MOVE CURSOR</p> <p><ENTER> TO ENTER CHOICE</p> <p><F2> LINE OF BEST FIT</p> <p><F3> RETURN TO COMPARE</p> <p><F9> RETURN TO MENU</p>
---	---

<p>OPTION LIST#</p> <p>BIOLOGY DEGREES</p> <p>BUSINESS DEGREES</p> <p>EDUCATION DEGREES</p> <p>FINE ARTS DEGREES</p> <p>HOME ECONOMICS DEGREES</p> <p>LETTERS DEGREES</p> <p>PHIL AND REL DEGREES</p> <p>MATHEMATICS DEGREES</p> <p>PHYSICAL SCIENCE DEGREES</p> <p>PSYCHOLOGY DEGREES</p> <p>SOCIAL SCIENCE DEGREES</p>
--



CF2] BEST FIT LINE



CF9] RETURN TO OPTIONS