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ABSTRACT

Specific programs and software resources are described in this report on function plotters to be used in secondary mathematics instruction. Products are entered in alphabetical order and the following information is provided for each package included: (1) producer; (2) hardware needed; (3) required peripherals; (4) grade level; (5) price; (6) copyright date; (7) policies; (8) objectives; (9) support materials; (10) descriptions; (11) comments; and (12) other review sources. (PK)

THE Northwest Regional Educational Laboratory

TECHNOLOGY PROGRAM

PRODUCT DESCRIPTIONS:

FUNCTION PLOTTERS FOR SECONDARY MATH TEACHERS

A MicroSIFT Quarterly Report

August 1987

by

Dave Weaver
Monica Nelson
Anne Batey

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Advanced Mathematics

Producer: MECC
Hardware: Apple II + e GS, 48K
Required Peripherals: Disks for storage
Grade Level: 9-college
Price: $35.00 **Copyright:** 1981
Policies. Backup included, network version available, multiple-unit disk. Lab packs available containing five sets for $89.00.

Objectives: Analytical geometry, graphing, limits, roots of polynomials, integration, matrices, linear algebra

Support Materials: Teacher guide, student worksheets, transparency masters

Description: This package contains 13 utility programs designed for use with advanced high school college mathematics courses which can be broken down into two broad categories--calculus and linear algebra. One of the programs is a very diversified general purpose graphing utility program. Many of the standard functions can be plotted as well as quadratic relations such as hyperbolas and ellipses. This program is excellent for comparing graphs entered in y=f(x) and x=f(y). Equations can be entered in parametric, Cartesian or polar form. Manipulation of the graphed function such as zooming, rescaling, scrolling and shifting can be executed at a single key stroke.

Comments: High-level mathematics are presented in a concise manner with good explanations. Not appropriate for younger students. Only one of the 13 programs will graph functions, the remaining 12 display calculations in tabular form. This package was formerly titled "Mathematics Volume 4 - Advanced."

Other Review Sources: 1987 Educational Software Preview Guide, 1986 Minnesota High Quality Courseware

Arbplot

Producer: Conduit
Hardware: Apple II + e c, 48K
Grade Level: 9-12
Price: $125.00 **Copyright:** 1982
Policies: No backup, network version available, replacement disks for $10.00. Lab packs available containing five sets for $250.00.

Objectives: Graphing functions

Support Materials: Teacher's guide (additional instructor guide available for $10.00)

Description: This collection of specialized graphing programs takes the student through features of calculus such as definitions of functions, derivatives, definite and indefinite integrals and directional fields. "Arbplot"offers graphic treatment of many topics in two-dimensional

differential and integral calculus. The menu-driven programs allow for plotting curves in explicit or parametric form, using rectangular or polar coordinates, bounded or unbounded, and continuous or uncontinuous. The manual presents tactics for using the programs in various classroom situations, including planning and showing slide shows. There are two disks in this package which cover a broad spectrum of functions, however, the menus are easy and simple to follow.

Comments: The versatility and in-depth treatment of functions make "Arbplot " an extremely comprehensive tool for calculus teachers. Can be used to introduce various topics in function plotting or as a discovery package.

Other Review Sources: 1987 Educational Software Preview Guide, MicroSIFT, The Mathematics Teacher

CactusPlot: A Mathematics Utility

Producer: CactusPlot Company, The
Hardware: Apple II + e c GS, 48K, IBM PC
Required Peripherals: Data disk for storing data
Grade Level: 9-12
Price: $60.00 **Copyright:** 1987
Policies: Backup included, replacement disks or additional disks are available for $15.00, site licensing is available.

Objectives: Graphing

Support Materials: User manual

Description: "CactusPlot" is a general purpose graphing utility containing most of the features teachers and students need yet is easy to use and learn. A 15-option single keystroke menu offers such manipulative operations as integration over a particular interval, plotting additional points, adding a new function, drawing a secant line to the graph at any point and calculating its slope, and others. "CactusPlot" will graph linear functions of introductory algebra, polynomials, the functions of trigonometry, or the exponential and logarithmic functions of calculus and applied mathematics. Up to five functions may be active at one time. It also provides additional numerical information on the functions which it graphs, such as a table of values.

Comments: "CactusPlot" is flexible and powerful. It makes computations easy and gives students readier access to the properties of functions. Since the program does not offer an introductory explanation of the commands, use of the manual is necessary until the command keys are learned.

Other Review Sources: 1986 Minnesota High Quality Courseware, Journal of Mathematics and Computer Education, Science Software Quarterly

Calcu-Plot

Producer: Human Systems Dynamics
Hardware: Apple II + e c, 48K
Required Peripherals: Data disk for storing data
Grade Level: 11-college
Price: $150.00 **Copyright:** 1983
Policies: No backup.

Objectives: Graphing polar and Cartesian equations, derivatives, integrals

Support Materials: 134-page user's manual

Description: "Calcu-Plot" is a general purpose graphing utility designed to plot equations on both Cartesian and polar coordinate systems. The Cartesian Plot program offers a choice of sixteen standard equations. Students can plot from one to three functions or a combination of functions and first and second derivatives or the integral. The Polar Plot program plots only one equation but allows many revolutions of the function. Nine standard polar equations are available. The versatility of "Calcu-Plot" includes tabulation of points, creative graphics such as adding titles and notes to a graph. With "Calcu-Plot" students can create their own equation files, review, edit and test those files.

Comments: This menu-driven program is easy to use. A demonstration program enables the user to quickly become familiar with the use of the program.

Calculus Illustrated

Producer: Wadsworth Publishing Company
Hardware: Apple II + e c, 64K
Grade Level: 11-12
Price: $21.50 **Copyright:** 1986
Policies: Backup for an additional $10.00, multiple-unit discount, replacement disks for $10.00.

Objectives: Graphing functions related to calculus

Support Materials: Student workbook

Description: "Calculus Illustrated" is a versatile and flexible collection of specialized graphing utilities for the calculus and precalculus student. It investigates almost every aspect of calculus including limits, integration, differentiation, secants and continuity. One can analyze different types of behavior by functions that are defined in pieces; this is especially useful in examining the concept of continuity. A secant line is drawn at a desired location approximating the tangent at that point; by single keystrokes the user can get as accurate as he/she wants. "Calculus Illustrated" efficiently graphs the derivatives and antiderivatives of any function on the same screen, different graphs or the same. The student workbook does well in taking you through the package in logical and simple steps.

Comments: A very useful package for precalculus and calculus. It is easy to use and operate and one does not feel overwhelmed when running the package, in spite of its subject material.

Calculus Toolkit, The

Producer: Addison-Wesley
Hardware: Apple II + e c, 48K, IBM PC
Grade Level: 11-12
Price: $149.95 **Copyright:** 1984
Policies: Backup included, multiple booting.

Objectives: Graphing, functions, limits, finding roots, differentiation, integration, conic sections, complex numbers, sequence, series, vectors

Support Materials: User manual, student workbook

Description: This collection of 27 specialized graphing utility and tutorial programs is designed to supplement a full-year calculus course. This high-level package includes programs for graphing the many different functions commonly encountered in a study of calculus, generating tables of function values, investigating vector fields, graphing solutions of differential equations, evaluating definite integrals, and exploring limits, conic sections, and complex numbers. Every program makes excellent uses of the computer's graphic capabilities. Three-dimensional surfaces are explored with impressive graphing. The programs are very extensive in their format and often give too much information at one time. Single keystrokes allow students to move a secant line up or down until the tangent is approximated.

Comments: This package is almost overwhelming. The material covered is very complex and students would have to progress slowly. The graphics are quickly and accurately drawn for the complexity of the function. After a program is executed, the student cannot return to the main menu to choose another program, instead the disk is rebooted.

Computer Graphing Experiments Volume 1: Algebra One & Algebra Two

Producer: Addison-Wesley
Hardware: Apple II + e c, 32K
Grade Level: 8-12
Price: $80.00 **Copyright:** 1982
Policies: Backup included.

Objectives: Graphing linear and quadratic functions and inequalities, simultaneous linear equations, variation

Support Materials: Teacher's guide, student worksheets to accompany the programs

Description: This package is a collection of six specialized graphing utility programs and 24 accompanying student exercises are designed for use by individuals or small groups of students to

supplement the graphing concepts in an algebra course. Each discovery-type worksheet requires the student(s) to use one of the graphing utility programs to enter values or equations and draw conclusions from the resulting graphs. The programs will only allow the student to vary the preset parameters appropriate for the specific type of equation under consideration. The worksheets as a whole are carefully sequenced and structured to reinforce generalizations about the concept covered. The six utility programs enable graphing of linear, quadratic, exponential, logarithmic, absolute value, greatest integer, polynomial and user-defined functions. An important feature is the graphing of inequalities.

Comments: This is a very easy-to-use program. The worksheets should be used to get the most benefit from each program.

Other Review Sources: 1987 Educational Software Preview Guide, MicroSIFT. 1986 Minnesota High Quality Courseware, Curriculum Review

Computer Graphing Experiments Volume 2: Trigonometric Functions

Producer: Addison-Wesley
Hardware: Apple II + e c, 32K
Grade Level: 10-12
Price: $80.00 **Copyright:** 1982
Policies: Backup included.

Objectives: Graphing trigonometric functions

Support Materials: Teacher's guide, student worksheets to accompany the programs

Description: This package, the second of a series of four, is a collection of five specialized graphing utility programs and 20 accompanying student worksheets presenting the graphs of the trigonometric functions and graphs in polar coordinates. Each worksheet is designed to be used with one of the the graphing utility programs, to enter values or equations and draw conclusions from resulting graphs. A major part of this program is devoted to the sine, cosine, and tangent functions, changing the amplitude and period to discover patterns. Although the programs can be used by themselves, the worksheets as a whole are carefully sequenced and structured to reinforce generalizations about the concept covered. Students can define their own functions and have them plotted.

Comments: This package would be ideal for any student who needs brushing up on his/her trigonometric functions or who wishes to explore the many avenues of these functions in-depth. To obtain the most advantage from this package, a student would have to use the worksheets with the programs.

Other Review Sources: 1987 Educational Software Preview Guide, EPIE, MicroSIFT, 1986 Minnesota High Quality Courseware, The Computing Teacher, The Mathematics Teacher

Computer Graphing Experiments Volume 3: Conic Sections

Producer: Addison-Wesley
Hardware: Apple II + e c, 32K
Grade Level: 10-12
Price: $80.00 **Copyright:** 1982
Policies: Backup included.

Objectives: Graphing conic sections (parabolas, circles, ellipses & hyperbolas)

Support Materials: Teacher's guide, student worksheets to accompany the programs

Description: This package, the third of a series of four, is a collection of six specialized graphing utility programs and 23 accompanying student worksheets designed for use by individuals or small groups of students to supplement the graphing concepts in conic sections. Each discovery-type worksheet requires the student(s) to use one of the graphing utility programs to enter values or equations and draw conclusions from the resulting graphs. One program takes a general formula of any conic section and has the user input different constants. The user can then explore such features as symmetry and the graphing of an inequality. One program will also allow the user to create pictures using conic sections.

Comments: The graphs are drawn more slowly than other packages. The worksheets should be used to accompany the programs for maximum benefit. Explorations and discoveries are started from the worksheets, not the program. The use of color is a nice touch.

Other Review Sources: 1987 Educational Software Preview Guide, California TIC Mathematics Resource Guide, EPIE, MicroSIFT, 1986 Minnesota High Quality Courseware, The Mathematics Teacher, The Computing Teacher

Computer Graphing Experiments Volume 4: Calculus

Producer: Addison-Wesley
Hardware: Apple II + e c, 32K
Grade Level: 11-12
Price: $80.00 **Copyright:** 1985
Policies: Backup included.

Objectives: Graphing functions related to calculus

Support Materials: Teacher's guide, student worksheets to accompany the programs

Description: This package, the fourth in a series of four, includes 10 specialized programs and 21 accompanying student worksheets designed for use by individuals or small groups of students to supplement the graphing concepts in calculus. Each discovery-type worksheet requires the student(s) to use one of the graphing utility programs to enter values or equations and draw

conclusions from the resulting graphs. The worksheets as a whole are carefully sequenced and structured to reinforce generalizations about the concept covered. The 10 utility programs enable graphing of conic sections, user-defined functions and their inverse, parametric equations, limits of a function, tangent to a curve, derivative of a function, definite integral (area under a curve) and three-dimensional graphs. As students become familiar with the program, single keystrokes allow for moving from module to module.

Comments: It is important that students use the worksheets as they explore the concepts covered by the utility graphing programs. The worksheets make graphing suggestions that the student would not be able to infer using the software alone. It is a very simple package to use.

Discovery Learning in Trigonometry

Producer: Conduit
Hardware: Apple II + e c, 48K, IBM PC/XT/PCjr 192K
Grade Level: 10-12
Price: $75.00 **Copyright:** 1986
Policies: Backup included, network version available, replacement disks for $10.00. Lab packs available containing five sets for $150.00.

Objectives: Graphing trigonometric functions

Support Materials: User's guide (additional instructor guide available for $6.00)

Description: This collection of specialized graphing programs allows the student to explore the characteristics of trigonometric functions on both the Cartesian and polar coordinate systems. "General Trigonometry" and "General Polar Trigonometry" are general purpose graphing utilities designed specifically for trigonometric functions. Equations are entered in the form F(x)=_____ or R(a)=_____, entries appear in standard algebraic notation, the x-axes may be labeled in terms of π, and the graph may be plotted on any of three sizes of grid. The programs "Trigonometry Trends" and "Polar Trends" allows the used to enter equations which incorporate a constant c. The programs will then show how the constant influences the graph by plotting the equation three time on the same graph with c = 1, 2 and 3. In "Trigonometric Problem Solving" the student is given the graph of an unknown function for which they must enter the equation. Each equation the student enters is plotted on the same graph as the target graph. Seven levels of difficulty are available. The program also includes self running demonstrations of the capabilities of the graphing utility programs. The manual is mostly a series of six student ready lessons with accompanying reproducible masters.

Comments: The programs are very easy to use and learn because they are limited to graphing trigonometric functions. The student ready exercises make a nice addition to the package but they lack closure. Each exercise would need to be followed by a discussion which would help the student understand the generalizations demonstrated in the exercises.

Electronic Blackboard: Algebra

Producer: COMPress
Hardware: Apple II + e c, 48K
Grade Level: 8-12
Price: $95.00 **Copyright:** 1983
Policies: No backup, multiple-unit discount, replacement disks for free. Lab packs available containing five sets for $215.00.

Objectives: Graphing

Support Materials: User manual with tutorial section

Description: This demonstration and review tool covers Cartesian coordinates, lines and linear functions, quadratics and polynomials, conic sections, logarithms, exponentials and inequalities. The programs are broken down into very simple components which enables students to use this program with ease and confidence. Color and animated graphics illustrate difficult concepts in an interactive demonstration environment. Numerous examples of a particular concept can be graphed to show families of functions and the effects of changing variables. Nearly all of the 17 modules have three modes: Display, for a preset sequence of examples; Interactive, for user selected parameters; and Target, for a target graph that the user attempts to duplicate with the proper inputs. The simulated blackboard adds creativity to this package.

Comments: Highly recommended for the algebra student beginning work on a Cartesian coordinate system. Can easily supplement the various parts of Algebra 2 courses, especially in the graphing of functions.

Other Review Sources: 1987 Educational Software Preview Guide, MicroSIFT

Electronic Blackboard: Function Plotter

Producer: COMPress
Hardware: Apple II + e c, 48K
Grade Level: 10-12
Price: $50.00 **Copyright:** 1983
Policies: No backup, multiple-unit discount, replacement disks for free. Lab packs available containing five sets for $110.00.

Objectives: Graphing functions

Support Materials: User manual with tutorial section

Description: "Function Plotter" is a general purpose graphing utility, the third package in a series of three, concentrating on graphing user-defined functions. Simulating a blackboard on the screen, "Function Plotter" adds a bit more in creativity than its competitors. Each of the three modules has an option page for students to pick and choose various commands. One command allows for inverses to be overlaid on the original graph. An exploratory exercise on transformations, such as translations and reflections, is included. Up to two functions can be

entered at one time, however, many functions can be overlaid on one graph. The last program is a game in which the student inputs an equation to intercept points on a graph.

Comments: "Function Plotter" graphs almost any precalculus function. There are easy-to-learn commands which make computer experience unnecessary. The equations are plotted quickly. The transformations are dynamic. The "Function Plotter" utility is also a component of another package available from COMPress titled "Electronic Study Guide for Trigonometry: Trigonometric Graphing."

Other Review Sources: 1987 Educational Software Preview Guide, MicroSIFT

Electronic Blackboard: Trigonometry

Producer: COMPress
Hardware: Apple II + e c, 48K
Grade Level: 10-12
Price: $50.00 **Copyright:** 1983
Policies: No backup, multiple-unit discount, replacement disks for free. Lab packs available containing five sets for $110.00.

Objectives: Graphing trigonometric functions

Support Materials: User manual with tutorial section

Description: This demonstration tool is the second in a series of three. Emphasis is on trigonometric functions; beginning with the basics of angle measurement, special triangles, introduction to sines, cosines and tangents and ending with the graphing of complex trigonometric functions. Four of the seven modules have three modes: Display, for a preset sequence of examples; Interactive, for user-selected parameters; and Target, for a target graph that the students attempt to duplicate with proper inputs. "Wrapping" is illustrated in an interactive demonstration environment. Color and animated graphics illustrate difficult concepts in an interactive environment.

Comments: Limited to use in trigonometry. The user is never allowed to enter a function of his own choosing. The simulated blackboard is an effective feature.

Other Review Sources: 1987 Educational Software Preview Guide, MicroSIFT, Courseware Report Card

Equation Math

Producer: MECC
Hardware: Apple II+, IIe, IIc, IIGS, 128K
Grade Level: 9-12
Price: $55.00 (3.5 inch disk available for $59.00) **Copyright:** 1987
Policies: Backup included, network version available, lab pack available containing 5 sets for $99.00.

Objectives: Graphing linear, quadratic and polar equations

Support Materials: Teacher's manual, student worksheets

Description: "Equation Math" is a general purpose graphing utility which consists of three separate programs. Exploring Equations enables the user to graph and explore the standard graph forms of linear, quadratic, or trigonometric equations. Polygraph allows graphing of most any type of equation on the Cartesian coordinate plane. Polar is similar to Polygraph except it uses a polar coordinate system. An elastic window is available which allows the user to zoom in on a particular area of the curve. Context-relevant help screens are available throughout. The teacher's manual includes students' worksheets which explore various topics in the programs.

Comments: This package is easy to use and is valuable to students who are just learning the idea of function plotting as well as for more advanced students.

Function Graphing

Producer: E. Kamischke
Hardware: Apple II + e c GS, 48K
Grade Level: 8-12
Price: Standard School Package-- $90.00 **Copyright:** 1985
Programmers Package-- $100.00
Student Version-- $30.00
Policies: 30-day preview upon request, lifetime warranty.

Objectives: Graphing functions, coordinate geometry, inverses, calculus

Support Materials: User manual, student worksheets

Description: This general purpose graphing utility package is designed for use as a demonstration tool for teachers and for open-ended investigations by individuals or small groups of students. Major features include fifteen built-in functions and the ability to graph defined functions, their inverses, reflections, sums, derivatives and integrals. "Function Graphing" is available in a standard school package which includes a building site license, a programmer's pack which also includes the BASIC and assembly language program listing, and a student version.

Comments: Because a review copy was unavailable, this descriptions is based on the publishers description.

Graph-Calc

Producer: COMPress
Hardware: IBM PC, 128K
Required Peripherals: CGA card & monitor
Grade Level: 12-college
Price: $75.00 **Copyright:** 1986
Policies: Backup included, multiple-unit discount . Lab packs available containing five sets for $135.00.

Objectives: Graphing, functions, derivatives, integrals

Support Materials: 39-page student manual, instructor guide

Description: "Graph-Calc" is a general purpose graphing utility consisting of three programs which together plot equations on rectangular and polar coordinates. Students can input a wide variety of functions and have their graphs drawn quickly. Graphs can be manipulated by changing the scale to zoom or expand on a certain area. Quick access to a calculator option is helpful in solving difficult expressions. A function and its derivative or integral can be compared as they appear on two half-graphs. A feature unique to "Graph-Calc" is a sub-program called Checker. Checker allows students to solve equations, derivatives and integrals by inputting answers line by line. The computer checks their work and tells them if it is right or wrong.

Comments: "Graph-Calc" does not have some of the standard features other calculus graphing packages have such as shading in the integral. The graphs are quickly drawn and the amount of information is not overwhelming to the user.

Graph Plotter

Producer: SRA (Science Research Associates)
Hardware: Apple II + e c, 48K
Grade Level: 10-12
Price: $40.00 **Copyright:** 1984
Policies: Backup included, replacement disks for $15.00.

Objectives: Graphing

Support Materials: Teacher's guide, student workbook

Description: Once the commands are learned, "Graph Plotter" becomes a powerful general purpose utility package for graphing functions. It includes transformations, equation solving, differentiation, integration and inverses. "Graph Plotter" is a discovery package allowing students to explore the results of rotating, reflecting, translating, and enlarging. The teacher's guide gives several applications of "Graph Plotter" to be demonstrated in the classroom. Menus make it easy to jump from one capability to the next without getting lost. At a single keystroke all the commands can be displayed.

Comments: "Graph Plotter" is a highly flexible teaching tool with many uses. encouraging teachers to develop and use their own ideas ir the classroom. "Graph Plotter" is likely to encourage divergent thinking in approaches in mathematical problems. "Graph Plotter" would most benefit students in trigonometry or higher.

Other Review Sources: California TIC Mathematics Resource Guide

Graphing Equations

Producer: Conduit
Hardware: Apple II + e c, 48K
Grade Level: 8-12
Price: $45.00 **Copyright:** 1983
Policies: Backup included, network version available, copy protected, replacement disks for $10.00. Lab packs available containing six sets for $90.00.

Objectives: Graphing linear and quadratic equations

Support Materials: Teacher's guide (additional instructor guide available for $2.00)

Description: "Graphing Equations" contains four programs to develop skills in identifying the equations of given graphs and writing equations which will produce a desired graph. Instructions are at the start of each program. "Equation Plotter" is a general purpose graphing utility capable of graphing conic sections, absolute value, square root, logarithmic, exponential, and trigonometric functions. The graphs are displayed on a grid helping to identify intersection points. The three other activities included on the disk are: Linear and Quadratic Graphs in which students may choose to be given the graphs of lines, parabolas, circles, ellipses, hyperbolas or mixed for which they must enter the equation; Green Globs, in which students score points by defining equations whose graph will intercept the most Green Globs scattered randomly over a coordinate grid; and Hacker, in which students enter probe equations which they hope will intercept a hidden graph . From these interception points, the students must enter the equation of the hidden graph. A management option allows the teacher to maintain the "Top Ten" scorers list.

Comments: This package is flexible for students of different levels. The function plotting program is easy to use and allows equations to be entered and displayed in algebraic form rather than a computer notation.

Other Review Sources: 1987 Educational Software Preview Guide, Alberta Computer Courseware Evaluations, MicroSIFT, 1986 Minnesota High Quality Courseware, Classroom Computer Learning, Creative Computing, Electronic Learning, The Mathematics Teacher, The Physics Teacher

Graphing Trigonometric Functions

Producer: Bergwall Educational Software
Hardware: Apple II + e c, 48K
Grade Level: 10-12
Price: $49.00 **Copyright:** 1985
Policies: Backup included, lab packs and site licensing available.

Objectives: Graphing trigonometric functions

Support Materials: User manual

Description: This demonstration tool allows teachers to display a family of curves of a trigonometric function showing such things as: change in frequency and amplitude, reciprocals of the function, and sine and cosine curves derived from a unit circle. "Graphing Trigonometric Functions" is limited to demonstration; students cannot enter their own functions. Each graph has a set of options for modifying the previously drawn graph. The graphs are clear and well-labeled. This program can graphically solve selected trigonometric equations. A discussion of frequency and amplitude is included in a tutorial format.

Comments: The focus of this package is not to teach students how to graph trigonometric functions, but to give the instructor the ability to display the graphic changes that occur as the parameters of a function are altered.

Green Globs & Graphing Equations

Producer: Sunburst Communications
Hardware: Apple II + e c GS, 48K, IBM PC/PCjr, 128K, Tandy 1000, 256K
Grade Level: 9-12
Price: $65.00 **Copyright:** 1986
Policies: Backup included, network version available, multiple-unit discount. Lab packs available containing 10 sets for $195.00.

Objectives: Graphing, linear equations, quadratic equations, conic sections

Support Materials: Teacher's guide, student workbook

Description: "Green Globs and Graphing Equations" is identical to the Conduit product "Graphing Equations" with the addition of teacher support materials to assist integration into the classroom. See the description in "Graphing Equations" for more information.

Comments: Appropriate for a wide range of student abilities and experience levels. Effective in the classroom to introduce graphs of equations and to illustrate the concept of "what if."

Other Review Sources: 1987 Educational Software Preview Guide, Alberta Computer Courseware Evaluations, California TIC Mathematics Resource Guide, The Computing Teacher

Heath Graph Maker

Producer: Collamore/D Heath
Hardware: Apple II e c GS, 128K
Grade Level: 8-12
Price: Available Fall 1987 **Copyright:** 1988
Policies: Backup included, lab packs, site licensing and network versions available.

Objectives: Graphing ordered pairs, equations and inequalities; conic sections, algebraic transformations

Support Materials: User manual and teacher's guide

Description: This general purpose graphing utility packages offers such sophisticated features as context-relevant help screens, single key scrolling, an elastic zoom window, and easy-to-use print and save options. The program includes modules for graphing sets of ordered pairs, equations and inequalities. Equations and inequalities are entered in algebraic form and the programs have the ability to interpret equations in forms as complex as $4x^2 + y^2 = 9$ or $x-3=(2y+5)^2$. The transformation program allows the user to see how rotations, translations, dilations and reflections affect the general form of the equations for lines, parabolas, circles, ellipses and hyperbolas. The ability to automatically display asymptotes and to calculate the coordinates of the intersection of two graphs make the package particularly useful in a study of coordinate geometry. Two games are also provided which can be used to motivate students to practice their graphing skills.

Comments: This review is based upon an evaluation of a prereleased version of the product.

MathCAD

Producer: Addison-Wesley
Hardware: IBM PC/XT/AT, 512 K
Required Peripherals: IBM Color Graphics Adapter or compatible, DOS 2.0 or higher
Grade Level: 10-College
Price: Available Fall 1987 for approximately $249.00 **Copyright:** 1987

Objectives: Algebra, trigonometry, calculus, statistics, engineering

Support Materials: Student's manual and instructor's manual

Description: "MathCAD" is a general purpose mathematics utility which enables the user to perform calculations, graphing and mathematical analysis functions. Using a freeform, truly mathematical notation the computer will display values, create tables and generate graphs. Additional features include the ability to add text anywhere to the screen, automatic error checking, importing data from disk files, printing and saving the entire calculation as an integrated document. Built-in functions include circular and hyperbolic, standard deviation, Fornier transformation, differentiation, integration, summation, factorials and many more. The strength of this package lies in its flexibility for entering and editing mathematical equations and formulas and then performing "what-if" calculations and analyses.

Comments: This review is based on an evaluation of a demonstration disk released prior to the final version of the product.

Mathgrapher: A Complete Graphing Utility

Producer: HRM Software
Hardware: Apple II + e c, 48K, Commodore 64
Required Peripherals: Data disk for storing data
Grade Level: 8-12
Price: $69.00 **Copyright:** 1984
Policies: Backup included, network version available. Lab packs available containing 10 sets for $207.00.

Objectives: Graphing

Support Materials: User manual

Description: "Mathgrapher" is a general purpose graphing utility which will plot the graph of a given function in standard or parametric form on rectangular or polar coordinates. Major features include zooming in and out by changing the domain, generating tables of values, calculating the slope of a function at a point, derivatives, and approximating the area under a curve. A calculator function will allow the student to stop and do a quick calculation in the middle of running the program. Functions and graphs may be saved to disk. Tables of values may be printed but graphs cannot be printed without the aid of a screen dump program. Graphs can be overlaid upon the same set of axes then some or all can be replotted over a different domain and range. A secant option approximates the derivative of a function at any point. A table of values for x and y is also available.

Comments: This function plotter is very useful and versatile. The two graphing menus, basic and advanced, allow for different level students to use with ease.

Other Review Sources: 1987 Educational Software Preview Guide

MCP Function Plotter

Producer: Microcomputer Curriculum Project
Hardware: Apple II + e c, 64K
Grade Level: 8-12
Price: $49.00 **Copyright:** 1986
Policies: Backup included, multiple booting, lab packs available.

Objectives: Graphing functions & relations

Support Materials: User manual

Description: "Function Plotter" is user-friendly yet is an amazingly versatile and powerful general purpose graphing utility. It will plot the graph of any given function on a rectangular coordinate plane. Students work with four "pull-down" menus which are available while "Function Plotter" is being used. Up to 20 functions can be entered and graphed at one time, in different colors. A constant storage location is available as well as zooming in and out in any of four directions. At a single key stroke, the cursor will move around a curve and identify the coordinates of its current location. Each function can be stored in memory and recalled by simply entering "F" and the number of the desired function. New functions can be defined as composites of previously defined functions, something not seen in many other packages.

Comments: This is a simple but comprehensive package. The pull-down menus make it easy to learn and use.

PC Graphics

Producer: Dynacomp
Hardware: IBM PC/jr, 128K
Required Peripherals: Color graphics (card and monitor)
Grade Level: 9-12
Price: $49.95 **Copyright:** 1986
Policies: No backup, multiple-unit discount, replacement disks for $5.00.

Objectives: Function plotting, parametric and polar equations

Support Materials: 58-page manual

Description: "PC Graphics" is a general purpose graphing utility consisting of four programs which allow students to graph parametric equations, polar equations, equations in two variables on the Cartesian coordinate system and equations in three variables on a three-dimensional coordinate system. Almost any conceivable function or relation can be graphed. Students are in control at all times and have the option of altering the axes, positioning the origin for scrolling and modifying data. At a single keystroke a help menu is available. Students can embed up to three parameters in their equations. Points of intersection can be displayed, rotations and placement of a secondary set of axes can be requested.

Comments: This package would be helpful for the trigonometry student going on to calculus or who just wants to explore in detail many functions already known to him. Use of color is a very good effect.

SuperGraph

Producer: Ventura Educational Systems
Hardware: Apple II + e c, 48K
Grade Level: 8-12
Price: $59.95 **Copyright:** 1986
Policies: Backup for an additional $10.00, replacement disks for $10.00.

Objectives: Graphing, functions

Support Materials: Teacher's guide, student workbook

Description: "SuperGraph" is a general purpose graphing utility which will plot linear, quadratic, polynomial, logarithmic and exponential functions. For each function, the student enters the scale, tick interval, domain, graph color, sound and graphing accuracy can be changed. "SuperGraph" does allow for vertical and horizontal functions to be plotted. Built-in constants for algebra, calculus and physics make a nice addition along with built-in conversions between degrees, radians and gradients.

Comments: "SuperGraph" is a good package for students just starting to plot functions. It is quick and accurate, however, not as versatile as others because there are no operations for manipulating a curve. Recommended for Algebra and Algebra 2 students.

SuperPlot: Function Graphing Program

Producer: EduSoft
Hardware: Apple II + e c GS, 64K
Grade Level: 8-12
Price: $49.95 **Copyright:** 1985
Policies: No backup, copyable, multiple-unit discount.

Objectives: Graphing

Support Materials: User manual

Description: "SuperPlot" is a general purpose graphing utility with the customary set of features for graphing, but its simplicity sets it apart. Students can work with five functions at a time, each a different color. SuperPlot quickly graphs any polynomial, trigonometric, logarithmic, or exponential function. The student can quickly and easily zoom in or out, expand, or scroll on either axis or simultaneously. Functions are displayed in standard algebraic notations making use of raised exponents, pi, and the algebraic notation for multiplication and division. Graphs may be stored to disk and printed. The color, sound and limits can be changed at a single key stroke.

Comments: "SuperPlot" is a powerful and valuable tool. Its simple to follow menu allows learning at new levels for students. There are a few features included for the use in trigonometric functions and those operations related to calculus.

Surfaces for Multivariable Calculus

Producer: Conduit
Hardware: Apple II + e c, 48K
Grade Level: 11-College
Price: $65.00 **Copyright:** 1981
Policies: No backup, replacement disks for $10.00. Lab packs available containing five sets for $130.00.

Objectives: 3-dimensional graphing of functions in two variables

Support Materials: Instructor's guide (additional instructor guide available for $3.00)

Description: This demonstration tool is designed for use by the classroom instructor to display three-dimensional graphs of functions in two variables. "Display Surface" is a slide-show type program which displays the surfaces of eight common functions including dog saddle, bivariate normal distribution and hyperbolic paraboloid. "Surface Sketching" is a demonstration of the process of sketching three-dimensional graphs. "Directional Derivative" displays a plane intersecting a complicated surface. The instructor controls the sequence by first showing the surface, then cutting the surface with a plane and finally highlighting the line of intersection to show the partial derivative is simply the derivative of a curve on a plane. In both of these programs the instructor may rotate the selected surface in two directions or expand and contract it. "Surface Construction" enables the instructor to define their own graph by entering the function, the domain, number of points and viewing parameters. Graphs may be saved to disk.

Comments: A student version of this package titled "Surface" is available from Conduit for $65.00.

TecMath: Differentiation

Producer: Technical Educational Consultants
Hardware: Apple II + e c GS, 48K
Grade Level: 11-12
Price: $60.00 **Copyright:** 1987
Policies: Backup for additional $15.00.

Objectives: Graphing, concept of derivative

Support Materials: User manual

Description: This hands-on tutorial and demonstration package, one in a package of four, is designed to support a calculus course. There are two tutorial programs which cover applied maximum/minimum problems and related rate problems. The tutorial programs are broken down into simple parts and contain examples and suggestions helpful in solving applied maximum-minimum and related rates problems. Such features as having two graphs on one screen allow students to compare graphs of the first or second derivative of a function of their choice. Programs use animation and visual techniques to help in developing an intuitive

perception. This package includes quick page forwarding, repeating or backup single keystrokes. An "instructor's disk" is included with a purchase of the entire series which contains graphing utilities designed for "electronic blackboard" type demonstrations.

Comments: "TecMath: Differentiation" is designed for those who wish to learn by experiment, discovery, and interaction. Concepts are broken down into understandable parts and the tutorials are very good.

Other Review Sources: California TIC Mathematics Resource Guide, The Mathematics Teacher

TecMath: Graphing

Producer: Technical Educational Consultants
Hardware: Apple II + e c GS, 48K
Grade Level: 11-12
Price: $60.00 **Copyright:** 1987
Policies: Backup for an additional $15.00.

Objectives: Graphing functions, function vs. relation

Support Materials: User manual

Description: "Graphing" is a general purpose graphing utility and tutorial program which supports a precalculus or calculus course and illustrates the characteristics of many families of functions. Students or teachers can enter any function and get a graph that can be viewed, printed, or stored on disk. The disk includes three utility programs designed as: graph sketching tools, a tutorial on families of functions to reinforce ideas learned in the utilities, and one utility for printing and storing. The 61-page manual contains four sets of lessons and additional exercises. The student can enter the traditional types of functions and have them graphed quickly. This package is simple and does not allow for manipulation of functions. An "instructor's disk" is included with a purchase of the entire series which contains graphing utilities designed for "electronic blackboard" type demonstrations.

Comments: Should help students gain a better understanding of the relationship between sets of ordered pairs and the definitions of a function, as well as the difference between functions and relations that are not functions.

Other Review Sources: California TIC Mathematics Resource Guide, The Mathematics Teacher

TecMath: Integration

Producer: Technical Educational Consultants
Hardware: Apple II + e c GS, 48K
Grade Level: 11-12
Price: $60.00 **Copyright:** 1987
Policies: Backup for an additional $15.00.

Objectives: Graphing functions, concept of integral

Support Materials: User manual

Description: "Integration" is one in a package of four programs devoted to the study of calculus. The emphasis of this program is integration and contains two tutorial programs and three utility programs. The tutorial programs do an excellent job in explaining the theory of integration and demonstrating solutions to volume of revolution problems. The utility programs allow students to enter a function of their choice then graph the antiderivative, approximate the area under the curve by the Riemann Sum and perform numerical integration. Students can alter the limits and number of divisions to integrate. Single keystrokes allow for quick page forwarding, repeating or backing up. An instructor's disk is included with a purchase of the entire series which contains graphing utilities designed for "electronic blackboard" demonstrations.

Comments: These programs allow hands-on experience in learning calculus and because of advanced animation and visual techniques, give an intuitive perception of the subject.

Other Review Sources: California TIC Mathematics Resource Guide, The Mathematics Teacher

TecMath: Taylor Polynomial Approximations

Producer: Technical Educational Consultants
Hardware: Apple II + e c GS, 48K
Grade Level: 11-12
Price: $60.00 **Copyright:** 1987
Policies: Backup for an additional $15.00.

Objectives: Graphing functions with Taylor approximations

Support Materials: User manual

Description: The emphasis of this program is on Taylor polynomial approximations of any given function. It is one in a series of four, all geared toward the study of calculus. There are four tutorial programs, each becoming more complex in their subject matter. The tutorials are not as interactive as some others--the student reads and answers a few questions about Taylor approximations. The program will give the Taylor approximation for any function entered by the student. An instructor's disk is included with a purchase of the entire series which contains graphing utilities designed for "electronic blackboard" type demonstrations.

Comments: This is a good program for students who like to experiment and discover facts on their own. Very easy to operate.

Other Review Sources: California TIC Mathematics Resource Guide, The Mathematics Teacher

PRODUCER LIST

Addison-Wesley Publishing Company 415/854-0300
2725 Sand Hill Road, Menlo Park, CA 94025
MARKETING POLICIES--Preview: 30-day approval basis. Requests for examination materials are granted by local representatives. Discount: Individual discount prices. Warranty and Returns: Special authorization required.

Bergwall Educational Software 800/645-1737
106 Charles Lindbergh Blvd., Uniondale, NY 11553
MARKETING POLICIES--Preview: 21-day preview. Discount: $20 quantity discount, lab pack and site licensing available. Warranty and Returns: 30-day money back guarantee, replace free of charge if defective through normal use.

Cactus Software - The CactusPlot Company 602/945-1667
1442 North McAllister, Tempe, AZ 85281
MARKETING POLICIES--Preview: 30-day money back preview. Discount: Five disk discount. Warranty and Returns: After 30 days, $15 per disk replacement.

Collamore/D Heath 800/235-3565
125 Spring St., Lexington, MA 02173
MARKETING POLICIES--Preview: 30-day preview with purchase order. Discounts. Lab packs, site licensing and network versions available. Call 800/235-3565. Warranty and Returns: Damaged disks replaced for $8 for up to two years after purchase.

COMPress 603/764-5831
P.O. Box 102, Wentworth, New Hampshire 03282
MARKETING POLICIES--Preview: 30-day preview and evaluation plan. Discount. For multiple copy purchase, discount for more than five copies available. Warranty and Returns. Return with written explanation, receive free replacement copy.

Conduit 319/335-4100
University of Iowa, Oakdale Campus, Iowa City, IA 52242
MARKETING POLICIES--Preview: 30-day period. Discount: Orders for 10 or more titles receive 20% discount. Warranty and Returns: 30-day warranty; $10.00 for a replacement copy of each diskette.

Dynacomp, Inc. 800/828-6772
1064 Gravel Road, Webster, NY 14580
MARKETING POLICIES--Preview: 30-day full refund return. Discount. Large quantity discount available. Warranty and Returns: 1 year return--$5.

EduSoft 800/EDU-SOFT 415/548-2304
P.O. Box 2560 Dept. 52, Berkeley, CA 94702
MARKETING POLICIES--Preview: 30-day preview policy. Discount. None. Warranty and Returns: After 30-days, $5 to replace a disk. Others: Site license available for $45.

HRM Software 800/431-2050 or 914/769-6900
175 Tompkins Avenue, Pleasantville, NY 10570
MARKETING POLICIES--Preview: 30-day free preview. Discount: $1000 or more, receive free program of choice. Warranty and Returns: Return with invoice for full refund or replacement.

Human Systems Dynamics 800/451-3030
9010 Reseda Blvd. Suite 222, Northridge, CA 91324
MARKETING POLICIES--Preview: 10-day preview. Discount: Quantity discounts available (call 1-800-451-3030). Warranty and Returns: 10-day full refund return policy, after 10-days, $10 for replacement. Others: Free technical advice for any program.

Kamischke, E. 616/929-0722
1220 Reads Run, Traverse City, MI 49684
MARKETING POLICIES--Preview: 30 days upon request. Discount: Site licensing included with standard school ($90) and programmer's ($100) package. Warranty and Returns: Lifetime warranty.

MECC 612/481-3500
3490 Lexington Avenue North, St. Paul, MN 55126
MARKETING POLICIES-- Preview: 30-day preview. Discount: Members can receive up to 40% off listed price. Warranty and Returns: Free replacement.

Microcomputer Curriculum Project (MCP) 319/273-6259
Price Laboratory School, University of Northern Iowa, Cedar Falls, IA 50613-3593
MARKETING POLICIES-- Preview: None. Discount: Volume discounts available, up to 15%, lab packs available. Warranty and Returns: None.

SRA/Science Research Associates. 800/621-0476 or 312/984-7384
155 North Wacker Drive, Chicago, IL 60606
MARKETING POLICIES-- Preview: 30-day free preview available. Discount: Quantity discounts available up to 15% for 250 or more units ordered. Warranty and Returns. 90-day full refund, after 90 days, $5 per disk.

Sunburst Communications USA-800/431-1934, Canada-800/247-6756
39 Washington Avenue, Pleasantville, NY 10570-9971
MARKETING POLICIES-- Preview: 30-day preview. Discount: Individual discounts available on large orders. Warranty and Returns: Lifetime replacement warranty.

Technical Educational Consultants 516/681-1773
76 North Broadway Suite 2010, Hicksville, NY 11801
MARKETING POLICIES-- Preview: Free 30-day examination. Discount: Individual discounts available. Warranty and Returns: 90-day full refund policy.

Ventura Educational Systems 805/499-1407
3440 Brokenhill Street, Newbury Park, CA 91320
MARKETING POLICIES-- Preview: 30-day preview. Discount: 50 or more of different titles 15% discount. Warranty and Returns: Full money return or replacement if damaged from normal use.

Wadsworth Inc. School Div.Dept-S85 415/595-2350
10 Davis Drive, Belmont, CA 94002
MARKETING POLICIES-- Preview: Preview upon request, 30-days. Discount: If used as a training program, receive net price. Warranty and Returns: Replacement disk free when defective disk sent in.

Northwest Regional Educational Laboratory

Dr. Robert R. Rath, Executive Director
Dr. Ethel Simon-McWilliams, Associate Director

The Northwest Regional Educational Laboratory (NWREL) is an independent, nonprofit research and development institution established in 1966 to assist education, government, community agencies, business and labor in improving quality and equality in educational programs and processes by

- Developing and disseminating effective educational products and procedures
- Conducting research on educational needs and problems
- Providing technical assistance in educational problem solving
- Evaluating effectiveness of educational programs and projects
- Providing training in educational planning, management, evaluation and instruction
- Serving as an information resource on effective educational programs and processes including networking among educational agencies, institutions and individuals in the region

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