THE NUMBER CRUNCHER

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ROCKWELL INTERNATIONAL CEDAR RAPIDS, IOWA

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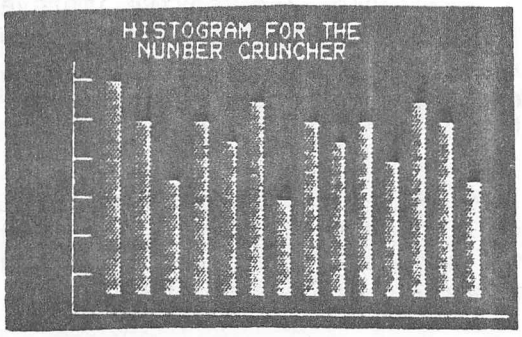
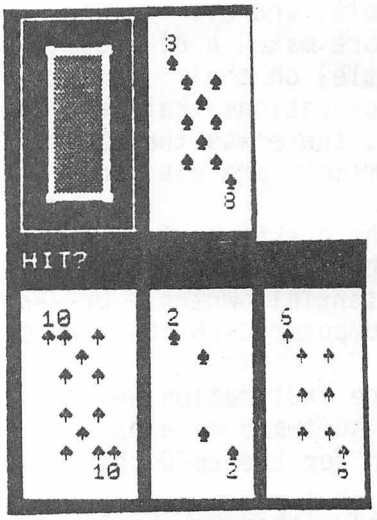
COMMODORE PET -- COMPUTER OR A TOY?

Collins opinion generally divided by the Mason-Dixon line.



Bar-graph of internal
Random Number Generator



From Blackjack 2 game

Previously owned calculators wanted:

HP-67 or 97: Stanley J. Smith 137-138, X2441.
Scientific, prefer HP, $10 - $20: Gayle Buroker, X4087.

TIME TO RE-UP

To continue receiving this dandy document on the care and feeding of personal analytic engines, see the last page.

THE PET 2001: COMPUTER OR TOY?

Our co-workers in Dallas think highly enough of the PET to have arranged for a discount to employees ($720 instead of $795), and for payroll deduction, and no carrying charge on the payroll deduction. As you can see, much of the math, scientific, and engineering software for the PET was written in Dallas. And Dallas has set-up a system---through Wanda Fox---whereby software and cassette recordings of any of their listed programs are available. Here in Cedar Rapids a few have taken the PET serious enough to have placed one in Building 106 and six in Building 137, all avaible to employees for company work. Since the start of the payroll deduction plan 309 PETS have been bought by employees, with 42 of them in Cedar Rapids. Evidently some of us--who have full access to all the computers within the company--still want a PET in our homes.

Why, not a computer

I believe that most of the reasons why the PET was not considered a computer have now been taken care of between Commodore and the PET users groups. In the beginning Commodore seemed to feel little reaponsibility beyond selling the unit. No technical documentation such as principles of operation or schematics were available, and even the instruction manual was merely a few-page pamphlet. Now Commodore makes a diagnostic tape and schematics available, and they've improved (a little) on their instruction books. Today there are enough PET owners, clubs, and publications that just love to talk software, so that problem no longerexists. Before, there was the bare PET. Today, floppies, printers, other peripherals, and added memory are available.

The question of computational accuracy is, to me, still unanswered. Perhaps, if Number Cruncher readers want it, we can organize a show-and-tell for PET owners and potential owners. Or---again if there is sufficient interest---the Eastern Iowa Computer Club could be persuaded to have a meeting devoted to the PET.

One frustration we at Collins have, is that the PET uses a 6502 chip; but all of the software development at Collins, software that would be nice to utilize, is written for the 6800 chip.

For a thorough evaluation, read "PET's First Report Card; An Objective Evaluation", Kilobaud, May 1978. But remember that at this early date Commodore had not taken care of things that they now have.

Some "Unlisted" calculator programs

The following are some programs I've run across that may not be listed in the Current Awareness Bulletin.

"HP-67/97 Tracks Communication Satellites", Electronics, March 1, 1979

"Replacement Analysis In Your Pocket", Industrial Engineering, October 1978. (for the SR-52).

"Computing Calculators in Communications Engineering Design," Mobile Times, March 1979 (for TI 58 and 59)

HP-19C/29C Programming Problems

The Queen Board game on pp. 52-54 of the applications book will work if you add step 49 "RCL 2", and change step 79 "GTO9" to"GTO5".

Bob Miller 108-115

Rockwell AIM-65 User Report?

Perhaps in the next issue we can have a report from someone in Cedar Rapids who has one of these machines.

Eastern Iowa Computer Club

For those interested in seeing what this club is all about, visitors are welcome to their 7:00 P.M. meetings on the last Sunday of every month at the REC Building in Marion. They have a flea market from 7:00 - 7:30 when their regular meeting starts. Presently their club project is building MODEMS so their computers can stay at home and still talk to each other. In the future they see building a central system to handle message switching between the stay-at-home computers. In May the 100 sum members are planning a software contest. Presently there are about 6 members with PETs.

If you'd like a copy of their newsletter drop a card so stating to:

Eastern Iowa Computer Club
Box 164
Hiawatha, Iowa 52233

"Next Week We (Pet users) Gotta Get Organized"

There has been some interest in having a seperate Collins Users-Club for PET users. If you are using, or intend to use, the PET please answer the last-page questionnaire as to:

(A) The Number Cruncher being adequate as a users club.
(B) PET users need their own group.
(C) PET users should join the Eastern Iowa Computer Club.

PET Basic for HP (RPN) Calculator Users

An introduction to BASIC programming for those who are use to solving problems on an RPN type calculator.

BASIC would be learned by programming the PET to do what you now do on your handheld calculator plus providing graphic display, programming capability, and data storage capability. As an example, how do you do complex arithmetic on the PET? FORTRAN does it neatly, the RPN calculators do it acceptably, and BASIC

doesn't do it at all. So you would have to learn how to make the best of the worst situation. This learning and experimenting process will yield a familiarity with BASIC that should be of value in programming desk-top computers such as the HP-9825, HP9845, and any large computer using BASIC.

The course would probably be held two days a week from 4:30 - 5:30 or during lunch breaks. If you're interested, so indicate on the last page "re-up" sheet.

Low-Cost Home Computer Sales

Electronic News, 3/12/79 quotes a Dataquest study of low-cost home computer sales:

Radio Shack	100,000 units
Commodore	25,000 units
Apple	20,000 units
MITS/Pertec	3,000 units

PET computers Available for Company Work

There is a PET in 106 and five in building 137 for employees to use for company work. In 137 they are located in the Automatic Test Equipment lab, Reliability, the computer terminal room, and two in engineering areas. So heres a chance to (meekly) show the 1100/80 that you can be a little independent.

Micro-Software News

A new newsletter is being published to inform employees of new additions to the Micro-Software Database on file in Dallas. Requests to be on the mailing list should be addressed to Wanda Fox, 407-120.

NOW AVAILABLE IN THE CEDAR RAPIDS INFORMATION CENTERS:

As a service to the Cedar Rapids ROCKWELL-COLLINS personnel, the Information Centers are now ordering programmable calculators and microcomputers on a twelve month payroll deduction plan. This plan is offered at no interest charge. Following is the current price list:

Manufacturer	Retail Price	*Employee Price
Commodore		
PET 2001	$795.00	$720.00
Hewlett-Packard		
HP-67	$450.00	$373.50**
HP-97	$750.00	$622.50
Texas Instruments		
TI 59	$299.95	$239.95
PC 100A (Printer)	$199.95	$159.95
~~Rockwell International~~		
~~AIM-65~~		
~~1K Byte Memory~~	~~$375.00~~	~~$325.00 + $4.75 freight~~
~~4K Byte Memory~~	~~$450.00~~	~~$390.00 + $4.75 freight~~

* Employee price does not include state and local tax.
** Depending on volume ordered the discount may be either 16% or 17%.

Order forms are available from:

Jan Gorman	106-216 Information Center	x2138
Debra Hawes	137-127 Information Center	x2343

December 14, 1978

SOME SOFTWARE AVAILABLE FROM THE MICRO-SOFTWARE DATABASE

The following programs may be ordered by contacting Wanda Fox, Dallas Casnet 437-2330 or by sending written request to 407-120.

Programs in BASIC

ACCESSION NUMBER	TITLE
001203	Inventory
001231	Function Approximation
001232	Fast Fourier Transform Subroutine
001245	Bond Yields
001246	Financial Projections
001247	Financial Projections Plotting Routines
001248	Annuities for Payments and Withdrawals for Loans
001249	Profit Analysis
001250	Interest Rates for Various Interests with Different Compound
001251	Rate of Retirement Pay
001252	Savings Account Accumulation
001253	Population Projections
001335	Fast Fourier Transforms

Programs for PET

001227	Microwave Network Analysis
001230	Formatting Dollars and Cents
001244	PET Broadband Matching
001283	Base Conversion
→ 001306	6502 Assembler for PET

Programs for HP-19C/29C

001271	Resistive/Reactive Circuit Calculations
001272	Impedance of a Ladder Network
001273	Standard Resistance Values
001274	Exponential Growth of Decay
001275	Equations of Motion
001276	Kinetic Energy
001277	RPM/Torque/Power
001278	Black-Body Thermal Radiation
001279	Conservation of Energy
001280	Mohr Circle for Stress
001281	Polynomial Evaluation Real and Complex
001282	Sine Cosine and Exponential Integrals
001284	Cubic Equations
001285	Synthetic Division
001286	Hyperbolic Functions-Inverse Hyperbolic Functions
001287	Polynomial Evaluation Real or Complex
001288	Roots of F(x) Equal 0 in an Interval

Programs for HP-19C/29C

ACCESSION NUMBER	TITLE
001289	3X3 Matrix Inversion
001290	Base B Arithmetic
001291	Gaussian Quadrature (Finite ab F(x) DX)
001292	Gaussian Quadrature (Finite A F(x) DX)
001293	Bessel Function (J(x))
001294	Gamma Function
001298	Hexadecimal to/from Decimal Conversion
001302	Bubble Sort
001307	Direct Reduction Loan Amortization Schedule
001308	Internal Rate of Return
001309	Straight Line Depreciation Schedule
001310	Sum of Years Digits Depreciation Schedule
001311	Variable Rate Declining Balance Depreciation Schedule
001312	Crossover Point Declining Balance to Straight Line Depreciation
001313	Nominal/Effective - Effective/Nominal Rate Conversion
001314	Lease Versus Purchase
001315	Break-Even Analysis

Programs for HP-25

001201	Thyristor Conduction Angle/Output Power
001266	Normal Probability Functions (Derivatives)
001295	Factor of an Integer
001299	Hexadecimal to/from Decimal Conversion
001300	Numerical Quadrature Integration
001387	Probability Function Chi-Square
001388	Probability Functions Poisson Individual and Cumulative Sum
001394	Negative Binomial and Cumulative Distribution
001395	Binomial and Cumulative Binomial Distribution
001396	Hypergeometric and Cumulative Hypergeometric Distribution
001400	Bessel Functions, First Kind, Integer Order

Programs for HP-67/97

001205	Bridged T Resistor Analysis for Thin Film Trimming
001228	Signal-to-Noise Detection for Target Detection
001229	Radar Parameter Equations
001254	Sound System Design
001296	Four Dimension Curve Fit
001297	Successive Bisections
001301	Numerical Quadrature Integration
001303	Sunrise/Sunset
001304	Newton's Secant Method
001305	English to Decimal Feet Conversion
001316	Dual Radial Position Fixer
001364	Put and Call Option Fair Values
001365	Call Option Evaluation
001366	Routines for Option Writers
001367	Empirical (Chicago Board Option Exchange) Call Pricing
001368	Warrant and Option Hedging
001369	Bull Spread Option Strategy
001370	Butterfly Options
001371	Stock Price 30-Week Moving Average with Data Storage
001372	Exponential Smoothing
001373	Multiple Linear Regression
001374	Curve Fitting Selecting Best Function
001377	Analysis of DC Parameters of Current-Mirror Circuit
001389	Calendar Algorithms
001390	Federal Income Averaging Tax
001391	Curve Fitting
001392	Curve Fitting
001393	One Card Curve Fit
001397	Sidereal Time
001398	Base to Base

Programs for Rockwell Model 960

001208	Quantitive Addition
001209	Pseudo Random Numbers
001210	Permutations and Combinations
001211	Spearman's Rank Correlation Coefficient for Ranked Data
001212	Chi-Square Distribution
001213	F-Distributuion
001214	Student's T-Distribution
001215	Inverse Normal Distribution
001216	Cumulative Normal Distribution

Programs for Rockwell Model 960 (continued)

ACCESSION NUMBER	TITLE
001217	Hypergeometic Distribution
001218	Poisson Distribution
001219	Binomial Distribution/Normal Distribution
001220	Chi-Square for an RxC Congingency Table
001221	Chi-Square One Variable of Classification
001222	One Variable of Classification Analysis of Variance
001223	Linear Regression Analysis
001224	Student's T for Independent Samples
001225	Ratio of Variance Two Samples
001234	Two Variable Descriptive Statistics
001235	Arithmetic Harmonic and Geometric Means
001236	Mean and Standard Deviation for Grouped Data
001237	Mean and Standard Deviation for Ungrouped Data
001238	Sorting
001239	Matrix Inversion
001240	Numerical Integration by Trapezoid Rule
001241	Traverse Bearing and Entry
001242	Three Point Problem
001243	Miscellaneous Surveyor's Conversion
001255	Integer Base Conversion
001256	Quadratic Formula
001257	Solution of Differential Equations
001258	Complex Functions
001259	Triangle Solution
001260	Ploygon Analysis
001261	Stadia and Topo Reduction
001262	Circular Curve Data
001263	Intersection of Lines and Curves
001264	Inverse-Traverse from Stored Coordinates
001265	Cut and Fill Volumes Given Cross Sections of Volume
001266	Surveyor Triangle Solution
001267	Cul-de-Sac Points of Tangency of Various Curves
001268	End-Across Given Offsets and Evaluation of the Points Surrounding Area
001269	Street Intersection
001270	Traverse Adjustments Three Methods
Programs for SR-52	
001233	Replacement Analysis for Equipment
001375	Z-Transform Evaluator
001376	4X4 Eigenanalysis Substract Eigenvector
Programs for SR-56	
001207	LaGrange Interpolation Formula
Programs for TI-59	
001202	Queue Performance
001204	Cost Analysis Cost Estimating Model
001206	Marginal Ray Trace
001317	Linear Programming
001318	Learning Curves Logarithmic Least Squares
001319	Ogive-Hours Distribution of Effort by Percentage
001320	File Management
001321	Linear Inches of Holes
001322	Bend Allowance
001323	Inflation Projection
001324	Ogive Percent Given Total Hours and Number of Periods
001325	Prepreg Summation
001326	Blank Versus Route (1)
001327	Blank Versus Route (2)
001328	Blanking Tonnage
001329	Statistical Analysis
001330	Crawford Learning Curve
001331	Crawford and Wright Learning Curve
001332	Calculate Square, Cubic and Linear Inches
001333	Drawing Scale Factor
001334	Annualized Turn Over Rate
001336	Stress Due to an Interference Fit of Two Circular Parts
001337	Forces at a Point
001338	Calculation of Landing Gear Wheel/Tire Rated Static and Turning Loads
001339	Grade Percent Calculation
001340	Moment of Inertia
001341	Wall Footing Design
001342	Beams in Flexure
001343	Aviation Library Diagnostic

Programs for TI-59 (continued)

ACCESSION NUMBER	TITLE
001344	Flight Plan With Wind
001345	Flight Plan and Navigation
001346	Long Range Flight Plan
001347	Atmosphere Speed Temperature and Altitude
001348	Predicting Freezing Levels Lowest Usable Flight Levels
001349	Wind Components and Average Vector
001350	Wind Triangle
001351	Dead Reckoning
001352	Rhumbline Navigation
001353	Great Circle Flying
001354	Line of Sight Distance and DME Speed Correction
001355	Position and Navigation by One VOR
001356	Area Navigation
001357	Course Correction
001358	Rate of Climb Turn Performance
001359	General Weight and Balance
001360	Customized Weight and Balance
001361	Pilot Unit Conversions
001362	RNAV Flight Planning
001363	Time Zone Conversions
001378	Testing Differences Between Proportions
001379	Histogram
001380	Equation Solver
001381	Single Stage Model Rocket Performance
001382	Cubic Crystallography
001383	Lighting Calculations by the Lumen Method
001384	Computed Constants of a Circular Light Polarizer
001385	RPN Simulator
001386	Stop Watch Timer

Programs in BASIC

ACCESSION NUMBER	TITLE
001486	Arctangent Algorithm
001487	Function Approximation with Two Variables

Programs for PET

001488	CAUER for Designing Lowpass Elliptic Filters
001489	B and C PLOT and The COMPONENT for Designing Butterworth and Chebyshev Filters
001490	Transient No. 1 for PET
001492	SYNTHESIZER - Divisor Constants for Phase Lock Loop Frequency Synthesizer
001493	FACTORS - Prime Factors of a Given Number
001494	PADS - Attenuator Networks
001495	FLC - Reactance of an L or C Element and Resonant Frequency
001496	FILTERS - Program for Active Filters-low and high pass
001497	PI NET - Pi-Network Impedance Matching
001498	COIL - Characteristics and Unknown Values
001499	ANT PAT - Antenna Patterns
001500	ANTCZ - Antenna Clearance Area for Skywave Propagation
001501	POLY - Area of a Polygon going in a Clockwise Direction
001502	POLY II - Area of a Polygon with additional units of measure
001503	TV ANT - TV Antenna Length for any Channel
001504	L, T, and Pi Network Matching
001507	Fano Broadband Matching
001510	Z by Piecewise Hilbert Transform
001511	Recursive Ladder Network
001513	Q Distribution
001514	Q Function Subroutine for Unconstrained Variables

Programs for HP-25

001431	Stripline Near One Plane (Microstrip)-Loss Power Factor
001432	Stripline Near One Plane (Microstrip)-Analysis
001433	Stripline Near One Plane (Microstrip)-Synthesis
001434	Stripline Between Two Planes-Analysis, Loss Power Factor
001435	Stripline Between Two Planes-Synthesis

Programs for HP-67/97

001427	Filter Loss/Mainline VSWR, Single Half Wave Length Shunt Bias Filter
001428	Filter Loss/Mainline VSWR Single Quarter
001429	Compensated Shunt Bias Filter
001430	Stripline Microstrip Analysis, Synthesis and Loss
001470	Geographic Coordinates to Universal Tranverse Mercator and Conversely
001471	Sunrise, Sunset and Twilight
001472	Geodetic Distances and Bearings

Programs for HP-67/97 (Continued)

ACCESSION NUMBER	TITLE
001473	Reentry Trajectories
001474	Satellite Orbital Elements
001475	Satellite Tracking
001476	Laser Equations for Propagation in the Atmosphere
001477	Optimum Allocation of Resources
001478	Log-Linear Cumulative Average and Unit Cost
001479	Time Phased Procurement Costing
001480	Cost/Benefit Stream
001481	Normal Function or Distribution and its Inverse
001482	Q Function (Offset Coverage Function)
001483	Linear Programming and 3X3 Matrix
001484	Fourth-Order Differential Equations
001485	Ten Point Gaussian Integration
001491	Three Quadrature Hybrid Conbiner Amplitude Analysis
001506	Transmission Line Matching
001509	Norton L to T or Pi Transformers
001512	Four Complex Functions Program
001515	Quadratic Functions
001516	Products and Displacements
001517	Q Squared Plus One to Parallel Z and Parallelled Reactance
001518	Lowpass to Bandpass Scaling and Minimum Standing Wave Ratio

Programs for SR-52

001444	Plot Mathematical Functions with PC-100

Programs for SR-56

001436	Parallel Impedance Addition
001437	Low-Pass Ladder Z-IN
001438	Passive Low-Pass Analysis
001439	Voltage Intersection of 3 Tesistors
001440	Active High-Pass Analysis
001441	Pi Network Impedance Matching
001442	Newton Iterative Solution
001443	Butterworth Lowpass Filter
001448	Transfer Function of Crystal Detectors

Programs for TI-59

001401	Master Library Diagnostic
001402	Matrix Inversion Determinants and Simultaneous Equations
001403	Matrix Addition and Multiplication
001404	Complex Arithmetic
001405	Complex Functions
001406	Complex Trigonometric Functions
001407	Polynomial Evaluation
001408	Zeros of Functions
001409	Simpson's Approximation (Continuous)
001410	Simpson's Approximation (Discrete)
001411	Triangle Solution (1)
001412	Triangle Solution (2)
001413	Curve Solution
001414	Normal Distribution
001415	Random Number Generator
001416	Combinations Permutions and Factorials
001417	Moving Averages
001418	Compound Interest
001419	Annuities
001420	Day of the Week and Days Between Dates
001421	Checking/Savings Account Management
001422	Degree, Minute and Second Operations
001423	Unit Conversions (1) Length
001424	Unit Conversions (2) Volume, Weight and Temperature
001425	Evaluation of Rosette Strain Gauge (60° and 45°) Data
001426	Combined Stresses (Mohr Circle Calculations)
001445	Convolve Functions in Time Domain
001446	Disassemble Micro-processor Machine Code
001447	Noise Bandwidth and RMS-Voltage Computations
001449	Statistics Library Diagnostic
001450	Random Number Generator
001451	Univariate Data
001452	Bivariate Data
001453	Trivariate Data
001454	Analysis of Variance Data
001455	Histogram Data
001456	Means and Moments
001457	Histogram Construction

Programs for TI-59 (Continued)

ACCESSION NUMBER	TITLE
001458	Theoretical Histogram
001459	Univariate Data Transforms
001460	Bivariate Data Transforms
001461	T-Statistic Evaluation
001462	Contingency Table Analysis Two-Way Classification
001463	Analysis of Variance
001464	Rank-Sum Test
001465	Multiple Linear Regression
001466	Normal Distribution
001467	Binomial Distribution
001468	Chi-Square Distribution
001469	F-Distribution
001505	Q Squared Plus One Series to Parallel Z and Paralleled Reactance
001508	Broadband Matching

The complete index of available software is given as Working Paper WP'78-1012.

ON ACCURACY

Your calculator or for that matter any calculator or digital computer is a finite number machine.

As a consequence calculators and computers are not absolutely accurate for all operations on all numbers; the displayed accuracy depending on the algorithms used and the number of decimal places carried.

Table 1 illustrates the problem. The numbers in the table were obtained on an HP-65 by performing the operation:

$$(\sqrt{x})\ (x^2)-x = 0 \quad \text{error}$$

Table 2 is a listing of accurate valves of the powers of 2 with which to compare the accuracy of your calculator. Often times the error is fairly obvious. For example on the HP-65.

$$2^{25} = 33554431.86$$

In this example the absolute error is 0.14. An interesting aspect of this example is that if we perform the inverse operation we will get 2.000 000 000 whether or not we add in the error quantity 0.14.

For most work the error problem is inconsequential since the accuracy is usually several orders of magnitude better than the accuracy of the input data or the accuracy required for the output data.

Ed Houghton

Table 2 Powers of 2

2^0	1
2^1	2
2^2	4
2^3	8
2^4	16
2^5	32
2^6	64
2^7	128
2^8	256
2^9	512
2^{10}	1024
2^{11}	2048
2^{12}	4096
2^{13}	8192
2^{14}	16384
2^{15}	32768
2^{16}	65536
2^{17}	131072
2^{18}	262144
2^{19}	524288
2^{20}	1048576
2^{21}	2097152
2^{22}	4194304
2^{23}	8388608
2^{24}	16777216
2^{25}	33554432
2^{26}	67,108,864
2^{27}	134,217,728
2^{28}	268,435,456
2^{29}	536,870,912
2^{30}	1,073,741,824
2^{31}	2,147,483,648
2^{32}	4,294,967,296
2^{33}	8,589,934,592
2^{34}	1,717,986,9184
2^{35}	3,435,973,8368

ON CURVE FITTING WITH

N-DEGREE POLYNOMIALS

OR

POLY WANTS A TRACKER

To extend Jim King's PET Directory Program to work with the longer C60 cassette it was necessary to find the empirical time relationship between normal speed and fast-forward to points along the tape. It was then necessary to find a mathematical curve that tracked this well enough to be used by PET. Determining the empirical relationship and finding a mathematical fit led me to areas that may be of interest to other number crunchers. A not too succinct summary is that:

(1) Using the first n terms of an m term polynomial approximation can be grossly inferior to using all the terms of the smaller, n degree polynomial.

(2) An algebraic expression of the mechanical relationship between the times with normal and fast-forward speeds tracks the empirical relationship better than a general n degree polynomial of the same complexity.

The Emperical relationship between normal time and Fast-Forward time.

In order to measure the time relationship I had to somehow mark points along the tape and then measure the number of seconds to each point in both normal run and fast-forward. I did this by noting when the perimeter of the tape being wound passed each of the calibration marks on the little window of the cassette. It was bad enough trying to eye-ball this with poor light, while watching the mirror on the bottom of the cassette to eliminate parallax, and while watching a stop watch, but that the tape didn't pack evenly so the tape perimeter wobbled back and forth along the scale. I ended by noting the time when the tape wobbled as far above each mark as below. (Reminds me of the limerick that starts, "There was a young lady from Mobile," and ends, "Or an off-center emery wheel.") The following table presents pairs of times to various points on the tape and Figure 1 shows the measured relationship between slue time:

T_S, and normal run time, T_R

The mathematical relationship between "RUN" and "FAST-FWD" times to the same point.

To derive the relationship the following assumptions were made:

(1) In "RUN" speed the tape moves past the read-head at a constant linear speed.

MEASURED RELATIONSHIP BETWEEN TIMES AT NORMAL SPEED AND FAST FORWARD

Cassette Scale	Time in Seconds Real	Slue
0	0	0
5	135	12
10	220	18
15	320	26
20	435	33
25	570	40
30	685	48
35	840	55
40	975	62
45	1155	70
50	1295	76
55	1465	85
60	1640	92
65	1840	98
67	1922	102

(2) At slue speed (FAST-FWD), the tape take-up spool is driven at a constant rotary speed.

(3) The tape has constant thickness, thus providing a one-to-one relation between the circumference (linear) speed of the tape and the rotary speed.

These assumptions led to the following equation of normal run time, T_R, as a function of slue time, T_S, to common points along the tape.

$$T_R = C_1 T_S + C_2 T_S^2 \qquad (1)$$

Unfortunately PET wants to know slue time as a function of normal run time. Using the quadratic equation gives:

$$T_S = -K_1 + \sqrt{K_2 + K_3 T_R} \qquad (2)$$

Using three pairs of points (including 0, 0) from figure 1, the constants can be determined. The problem remains, which set of three points out of the 15 will provide the best tracking for the algebraic expression?

The Statistics II pack for the HP-9825 desk top computer has, (Jim King pointed out to me), a program for finding the best least-square-error fit between an empirical curve and an N-degree polynomial. Equation (1) is a second degree polynomial so I used the 9825 to find its coefficients and then used the quadratic equation to find the constants in equation (2):

$$T_S = -69.59 + \sqrt{4904.46 + 12.756\ T_R} \qquad (3)$$

Figure 2 shows equation (3) and the measured points on the same graph. Evidently the assumptions of constant tape thickness, constant linear "RUN" speed, and constant "FST-FWD" angular speed were justified. Following this article is the derivation of slue speed time, T_S, as a function of run speed time, T_R.

A polynomial fit to the non-polynomial relationship.

The HP-9825 worked so nicely for the polynomial of the inverse relationship, and the program was so easy to use, that I thought it would be interesting to see if a low degree polynomial would fit the direct relationship as neatly as the quadratic-root equation. The empirical curve was obviously non-linear, so there was no point in trying a first degree polynomial. The 9825 gave as the least square error fit the following second degree polynomial:

$$T_S = 2.279 + .07239\ T_R - 1.0953 \cdot 10^{-5}\ T^2$$

Figue 3 presents this equation along with the measured data. So, with the same number of constants and only one more operation the second degree polynomial is only slightly less of a fit as you can see comparing figures 2 and 3.

The grand fallacy

Even though I use the same number of terms in PET, might not I be better off fitting a third degree polynomial to the data? The HP-9825 gave the third degree polynomial as:

$$T_S = 0.8278 + .08305\ T - 2.532 \cdot 10^{-5}\ T^2 + 4.96 \cdot 10^{-9}\ T^3$$

Figue 4 presents the results of leaving out the last term of a third degree polynomial.

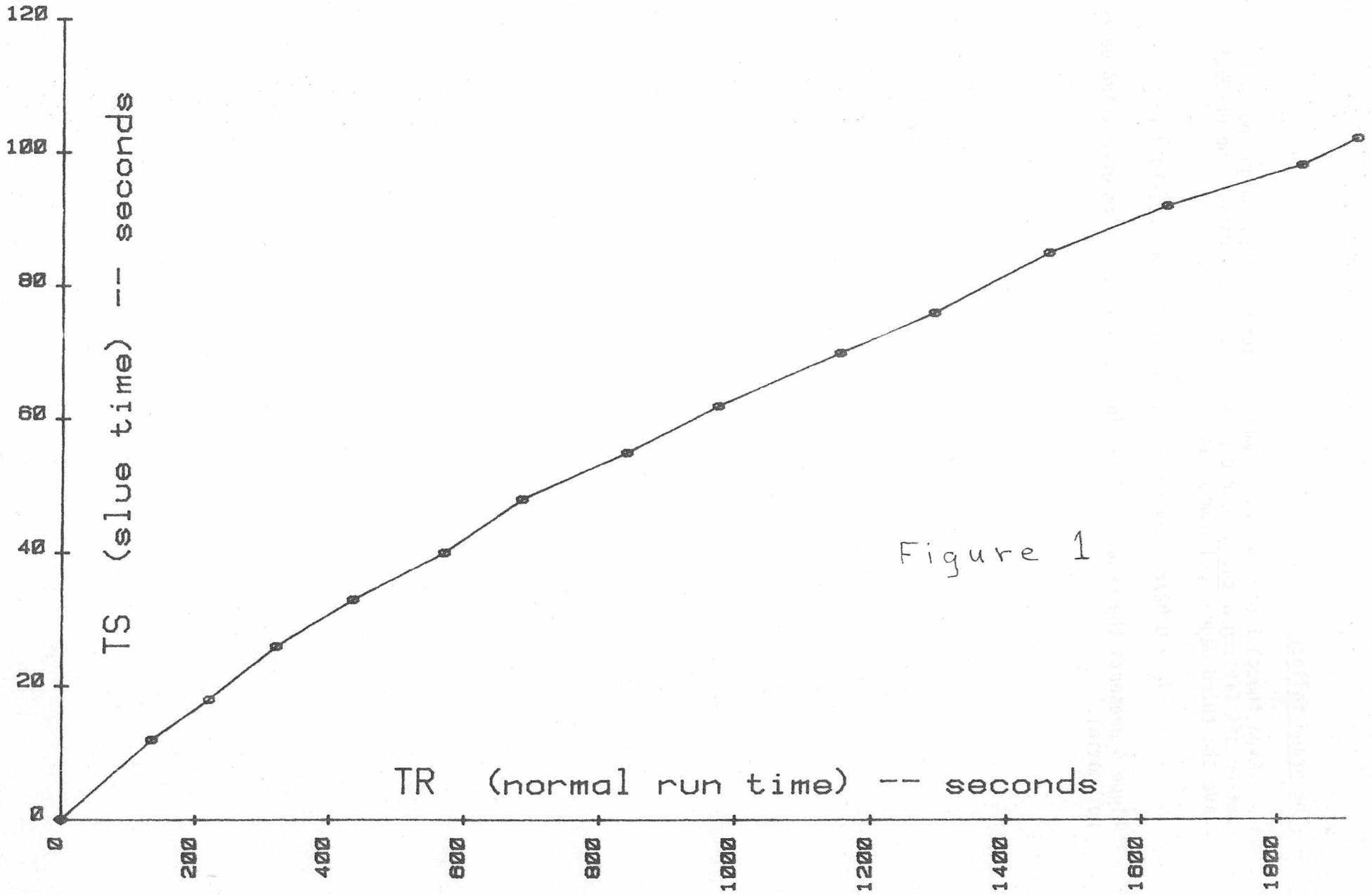

120
100
80
60
40
20
0
TS (slue time) -- seconds
0
200
400
600
800
1000
1200
1400
1600
1800
TR (normal run time) -- seconds

Figure 1

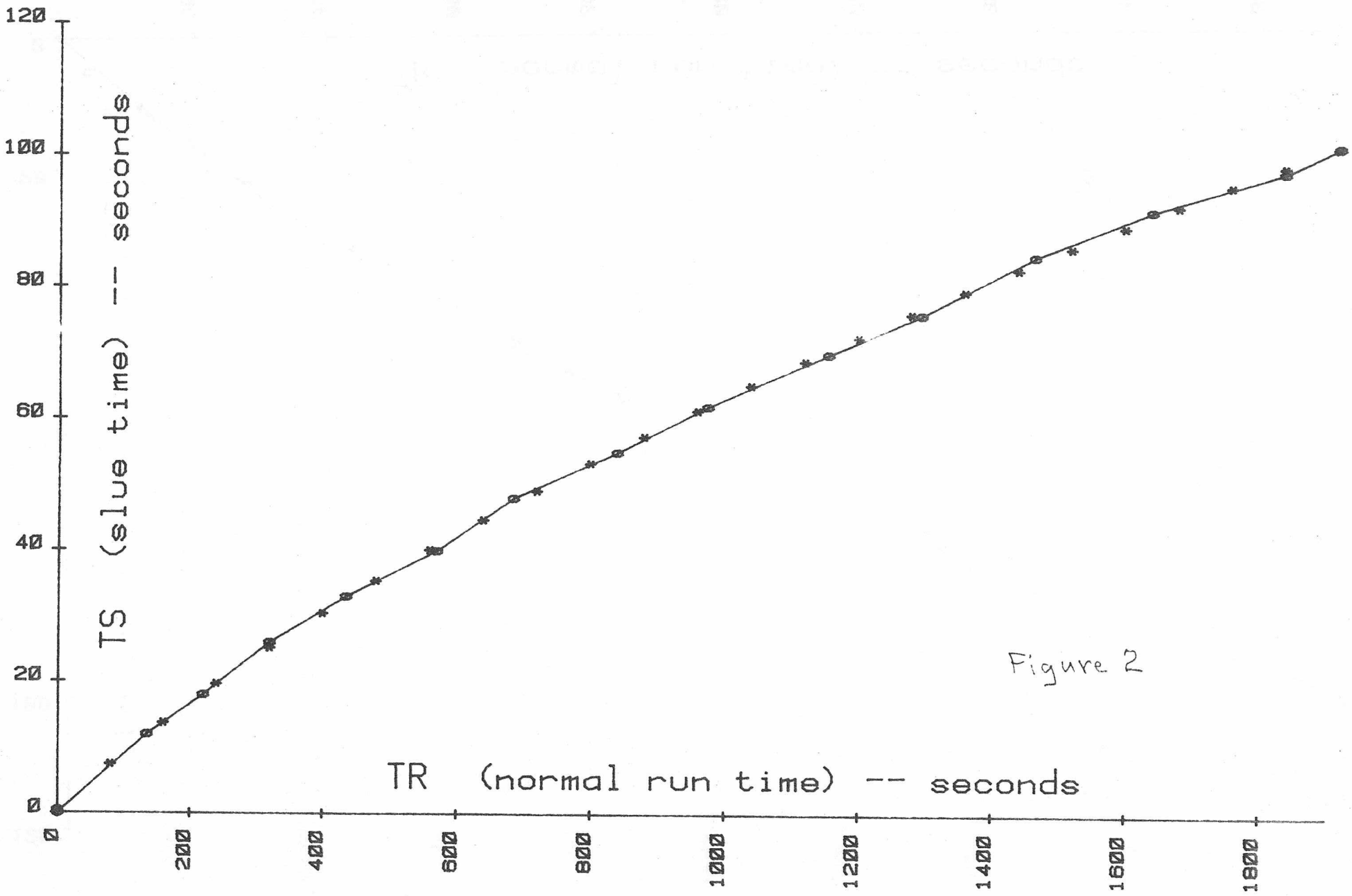

120
100
80
60
40
20
0
TS (slue time) -- seconds
0
200
400
600
800
1000
1200
1400
1600
1800
TR (normal run time) -- seconds

Figure 2

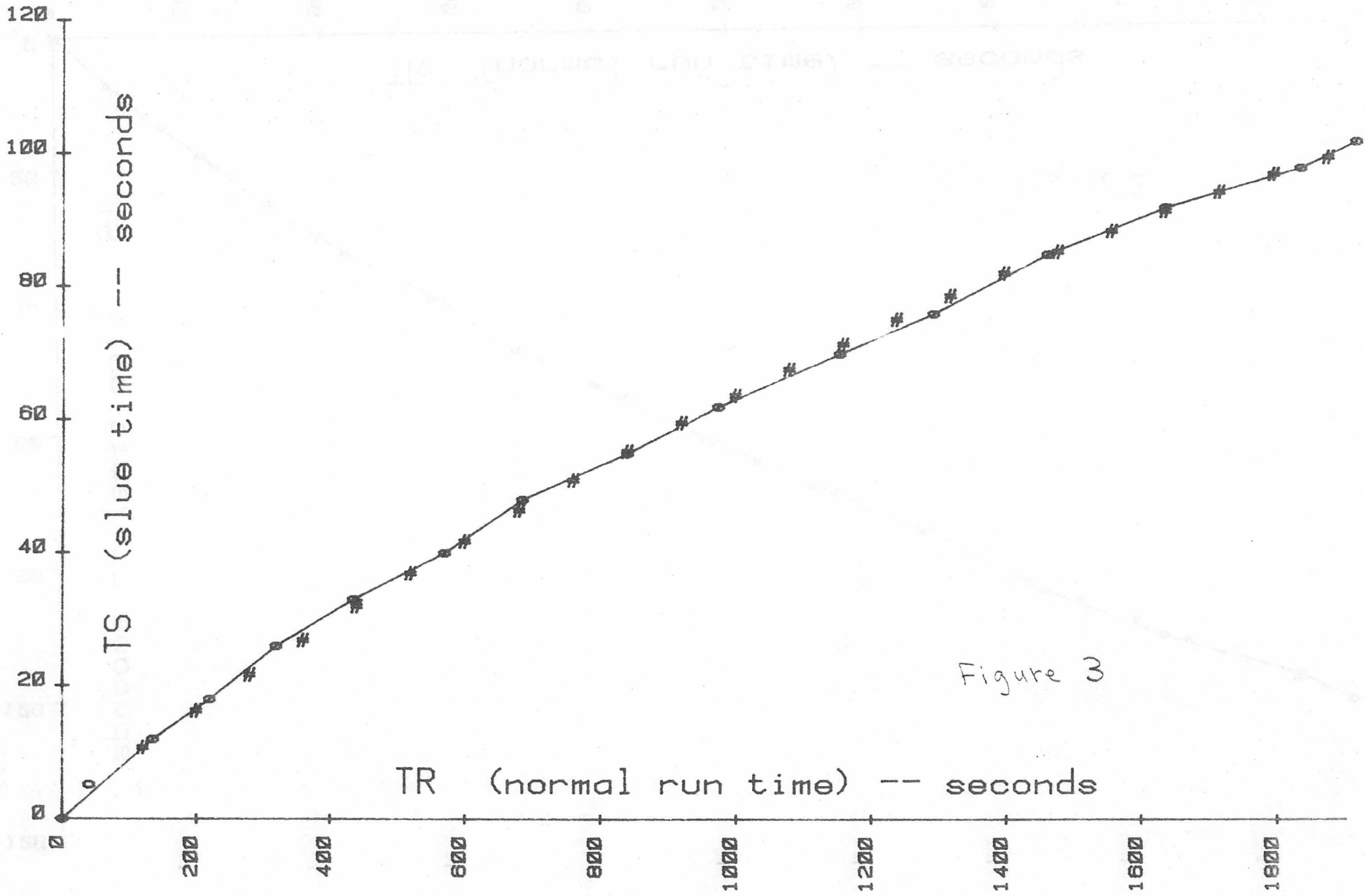

120
100
80
60
40
20
0
TS (slue time) -- seconds
0
200
400
600
800
1000
1200
1400
1600
1800
TR (normal run time) -- seconds

Figure 3

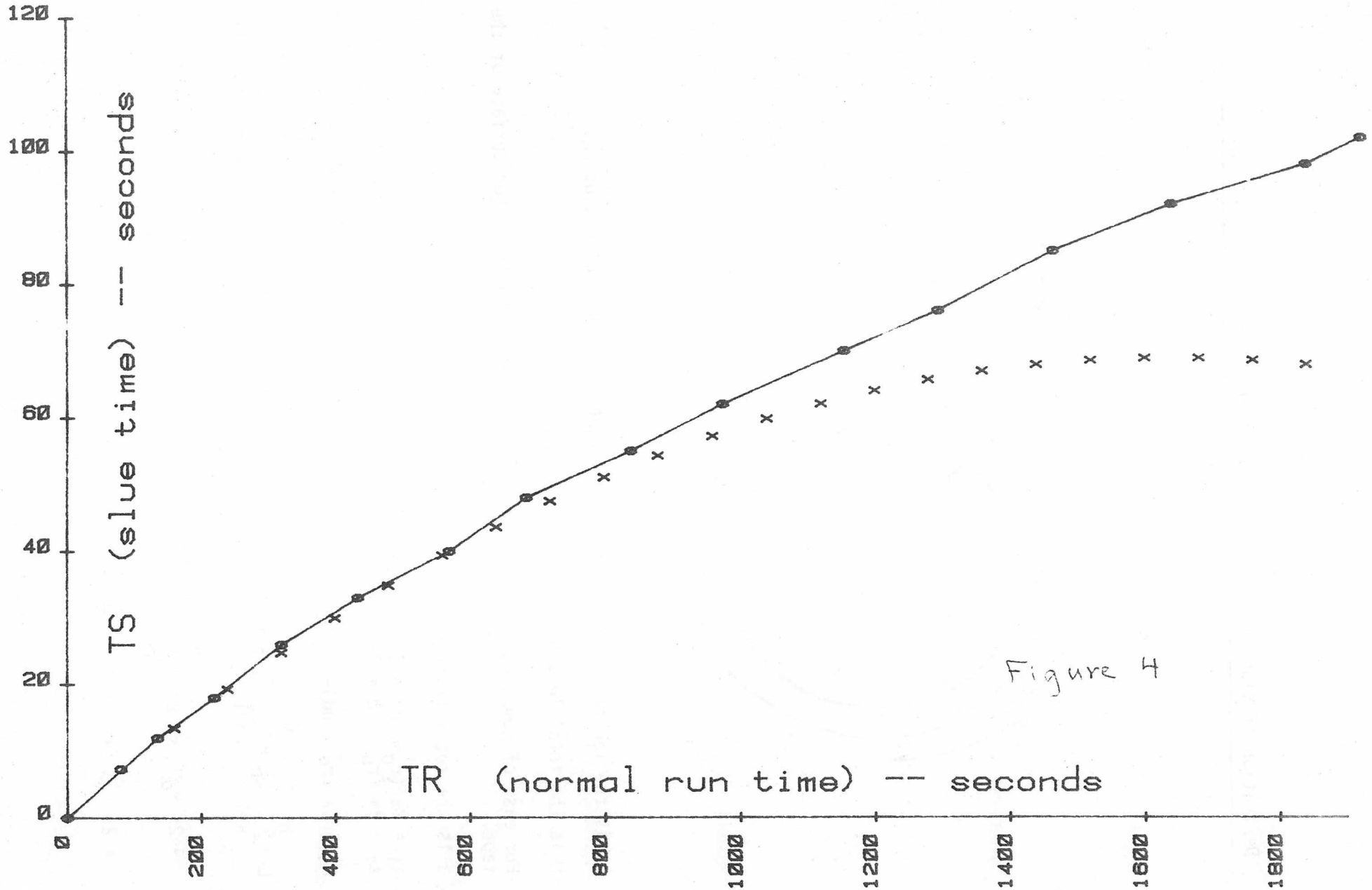
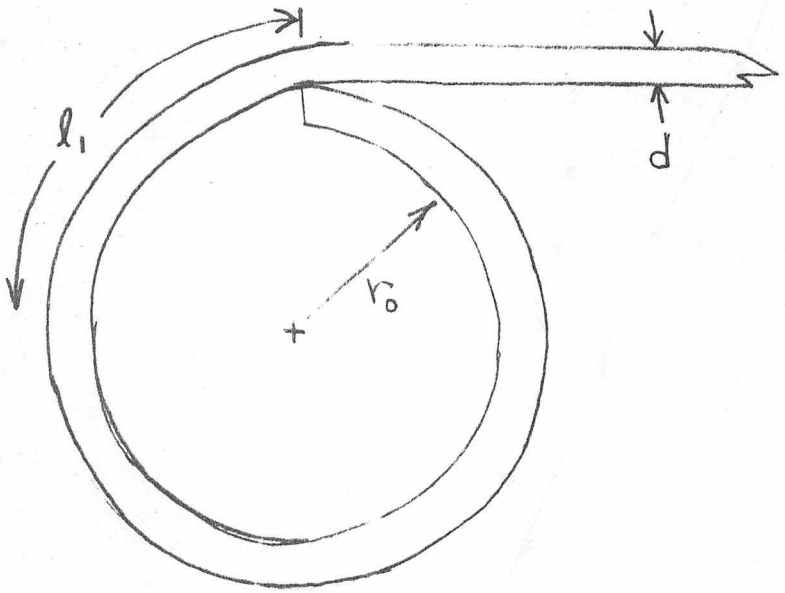

120
100
80
60
40
20
0
TS (slue time) -- seconds
0
200
400
600
800
1000
1200
1400
1600
1800
TR (normal run time) -- seconds

Figure 4

Derivation of slue time, T_S, as a function of normal run time T_R.



ℓ_1 is the length of the first turn of tape on a spool of radius r_o.

L is the total length of tape for N turns.

For ease of computation assume magnetic coating is on the outer surface of the tape.

d is the total thickness of the tape.

$$\ell_1 = 2\pi (r_o + d) = 2\pi r_o + 2\pi d$$
$$\ell_2 = 2\pi (r_o + 2d) = 2\pi r_o + 2\pi (2d)$$

$$\ell_n = 2\pi (r_o + nd) = 2\pi r_o + 2\pi (nd)$$

$$L = \sum_{n=1}^{N} \ell_n = \sum_{n=1}^{N} (2\pi r_o + 2\pi nd)$$

$$\vdots$$

$$= 2\pi r_o N + 2\pi d \sum_{n=1}^{N} n$$

$$= 2\pi r_o N + 2\pi d \left[\frac{N(N+1)}{2}\right]$$

With a constant rotary speed, ω, the number of turns, N, to a given spot on the tape is:

$$N = \omega T_S$$

In the normal run speed the length of tape to the same spot is:

$$L = kT_R$$

Where k is the linear drive speed in inches / second. Assuming $N >> 1$.

$$L = 2\pi\, N r_o + 2\pi\, d\, \frac{N^2}{2}$$

$$kT_R = 2\pi \left[r_o\, (\omega T_S) + \frac{d}{2}\, (\omega T_S)^2 \right]$$

PET Tape-Directory Program

Jim King, GTPD's Director of Engineering has written a program that provides a Fast-Forward slue to a named program on cassette. This can be used instead of the normal-speed tape search for the named program. On a C60 cassette the maximum time on a rewound tape to the header of a program is reduced from 30 minutes to 1.5 minutes.

Jim's program first presents a table-of-contents for the tape of up to 15 programs per tape side. The PET user types in the first unique characters of a title (the whole name need not be typed), simultaneously presses the RETURN key and the Fast-Forward lever on the tape unit, and then the tape unit STOP lever when told to do so by PET. This positions the tape from 10 to 20 normal-speed seconds before the header. The LOAD or RUN command is then used to load the program.

The program operates by taking the normal run time in seconds associated with the named program, uses an equation to convert this to Fast-Forward time, and sets a clock that tells the user when the fast-forward time has elapsed. The program uses the first three terms of a power series to approximate the relation between normal run time and fast-forward time to the same point on the tape. The approximation is valid for up to 15 minutes, the maximum run time on a C30 cassette. The directory Table of Contents can have up to 15 programs listed.

I've modified Jim's program by including instructions on how to add titles and how to use the directory, increased the listings from 15 to 24, and changed the time relationship equation to one that can be used with up through C60 cassettes (if they all have the same thickness tape). With the directory and instructions both in the same program it takes an intolerable 90 seconds to load. So I made the first program on a tape the directory and the second, the instructions for using the directory. Those who no longer need instructions can have the directory on the screen in 40 seconds.

My instructions for adding a new program to the tape and directory say you must have the tape positioned, ready for loading, before you key your new program into the PET. I thought this necessary because I required loading the previous program in order to position the tape properly. The LOAD instruction would of course wipe out any program in PET.

Allan Tupker pointed out a scheme whereby getting to the proper point does not require destroying the program in the PET. First, the tape is rewound to some point before the present last-program. Then type VERIFY

"(last program name)". The VERIFY instruction gets you just past the last recorded program without destroying any program in the computer.

Anybody wanting a copy of Jim's faster-loading directory of up to 15 programs on a C30 cassette, or my programs for up to 24 programs on a C60 cassette, should send a Maxell (or equivalent quality) cassette to: Bob Gehring, MS 137-~~124~~-138.

A PET LIBRARY-TAPE FOR THE OCCASIONAL USER

A major problem in running a PET program, that you wrote weeks ago, is that of having adequate prompts and instructions. Back when you wrote the program you obviously didn't need detailed instruction, and even if you did write instructions, by now they are probably fugitive notes that can't be found. And if you have a program written by someone else, that you never have run, the problem can be even worse. You can of course (or rather you or the program writer could have) used some of the limited program capability to include instructions as part of the program. I can get about 100 average sized programs on a C60 cassette so it would seem reasonable to use tape to store instructions and documentation instead of the so-dear capability of the main program.

DOC Sample

The documentation sample I use consists of five pages (CRT screens) of text. Each page consists of twenty-two (22) lines of thirty-nine (39) characters of text for about one hundred fifty (150) words per page. The next to the last line is blank, and the last line has the page number and instruction for flipping pages, such as:

"p.5 Type L,N,1,2,.....5"

Where typing L gives the last previous page, N the next page, and 1 page 1.

The Files on Tape

My one-tape library tape has the following sequence of files:

INDEX 24: A table of contents listing plus the timer program for a "Fast Forward" slue to a named program from the table.

INDEX 24 INSTRUCTIONS: These are the instructions for adding new programs to, and using the index.

DOC SAMPLE: This consists of five blank pages that can be copied, text added, and placed in front of each new program that is added to the tape. If the documentation has the same name as its program, the high-speed slue takes you directly to the documentation first. Then a LOAD instruction will load the program. If there are times when you want to go directly to the program first, you could carry separate names in the index.

DOC, FIRST PROGRAM

FIRST PROGRAM

DOC, SECOND PROGRAM

Tutorial Tape on PET BASIC

BASIC BASIC

We have procured from Commodore a copy of tutorial presentation of the BASIC language. This tape is designed to be used on a PET. The tape presents information to the user and then poses questions and problems to be solved. This is an ideal tool for the uninitiated micro-computer user.

The tape can be borrowed from Bob Gehring, 137-~~124~~ 138. The following are titles to sections of the tape:

1. Introduction, Line numbers
2. Variables, Input, List, run
3. Print, End
4. Numbers, Strings, Expressions, Hierarchy, Let, Homework (H.W.)
5. H.W., IF/Then, GOTO, H.W.
6. H.W., Read/Data, Arrays
7. Looping, For/Next, H.W.
8. H.W., GOSUB, On__GOTO, On__GOSUB
9. Saving Programs, Sample Programs

10-15. Six Sample Programs

Frank Helsell Looking for PET Pals

Frank Helsell, 137-152 wonders if there are other PET owners interested in audio and music applications for the PET?

PET Periodical Publications

PET users may be interested in the following periodicals. Some of these may no longer be published.

PET Newsletter
Lawrence Hall of Science
University of California
Berkley, California

I have not seen this, but it is recommended by our friends in Dallas.

The PET Cassette
929 North Port Drive
Room 6
Madison, Wisc. 53704

Wanda Fox, Dallas, has received several issues late last year.

PET User Notes
P.O. Box 371
Montgomery, Penn. 18936

This is available through the Current Awareness Bulletin.

The PET Paper
Box 43
Audubon, PA. 19407

I have the first five issues of this, with the last one dated July 1978. I don't know if they are still publishing. The first issue I have is 14 pages, and the last issue 26 pages. The following is the table of contents for the last issue:

Standard Symbols
User Group Info
PET Prose
Advertising and Subscription Rates
PET Parade
Simple Memory Test for your PET
The Legend of the Marvelous, Magical, Mystical, Miraculous Micromachine.
Use a Baudot Teletype With Your PET by Jerome Salko
PEEKing & POKEing at PET
The Status Word (ST)
New PET Accessories
Flea Market Software Exchange
Software Shelf Software Sales
RENUM & UNLIST: A Listing
PET I/O (reprinted from SPHINX by Richard Tobey)
Reader Questionnaire

If anyone wants to borrow my copies, drop a note to: Bob Gehring, 137-124

Software Hardware Products Directory
New England Electronics Co., Inc.
248 Bridge St.
Springfield, MA 01103
(413) 739-9626

DOCUMENTATION

WB#1 "Getting Started with Your PET"
WB#2 "PET String and Array Handling"
WB#3 "PET Graphics"
WB#4 "PET Cassette and Input/Output"
WB#5 "PET Miscellaneous"

The Music Box: Hardware and software enabling user to compose, play, and hear music on the PET. $49.95

Other programs: War games package #1, LEM lunar lander, Blackjack, Deflection, Hunt the WUMPUS, PET Othello, NEECO Game Pack, Masterbrain, Grades, Slot Machine, Statistics, Queen, Depreciation, Biorhythm, Bullfight,...Poker, Two Player Chess, Accounting PAK #1, Business Graphics,...Schedule Planner #2

In support of the dual drive disk system; Diskmon, Diskmon Assembler Listing, Pet Assembler Programming Guide, FORTRAN, PLM.

PET PUBS

The following publications will be of interest to PET computer users.

Commodore PET Users Club Newsletter

Commodore Business Machines, Inc. has formed the Commodore U.S. PET USER's CLUB. The charter of the User's Club is to provide a method of sharing up to date information, applications and programs relating to the PET computer between the many PET owners, users and manufacturers. We have received Volume I, Issue 1 of the Commodore Pet Users Club Newsletter. This newsletter contains product news, details on current software, time saving tips on programming, peripherals and attachments, and a User's Directory to other sources of PET information. The cost of a one year's membership in the Users Club is $15.00. Membership applications are available from Wanda Fox, Mail Code 407-120, casnet 437-2330, in Dallas.

WORKBOOK 6 - TIS SERIES NOW AVAILABLE

We have acquired workbook 6 in the TIS workbook series. This workbook titled "PET CONTROL AND LOGIC STATEMENTS" is available for review in each local library or Information Center. The workbook can be purchased for $3.95 plus tax from the following address:

Total Information Services
P.O. Box 921
Los Alamos, New Mexico 87544

Literature for PET

A series of information manuals are available for the PET micro-computer. The set consist of six manuals covering the following subjects:

MEDIT (Micro editor for PET)
Getting Started with Your PET - Workbook 1
String and Array Handling - Workbook 2
Graphics - Workbook 3
Cassette - Workbook 4
Miscellaneous - Workbook 5

The cost of this set is $34.20 including tax and shipping. They can be be ordered from the following address:

Total Information Services
P.O. Box 921
Los Alamos, New Mexico 87544

A set of these manuals are available in each local library of Information Center for review before ordering.

PET PROGRAMS DOCUMENTATION

ON FILE AT

BUILDING 137 TERMINAL ROOM

Index #	Title
000126	Gaussian Random Number Generator
000157	Atmospheric PSK/FSK
000181	A Pet Optimizer
000328	Prime Factors of Integers
000329	Area of a Polygon
000330	Parts of a Triangle
000331	Analysis of Two Vectors
000332	Operations of Two Vectors
000333	Angle Conversion: Radians to Degrees
000334	Angle Conversion: Degrees to Radians
000335	Coordinate Conversion
000336	Coordinate Plot
000337	Plot of Polar Equation
000338	Plot of Functions
000339	Linear Interpolation
000340	Curvilinear Interpolation
000341	Integration: Simpson's Rule
000342	Integration: Trapezoidal Rule
000343	Integration: Gaussian Quadrature
000344	Derivative
000345	Roots of Quadratic Equations
000346	Real Roots of Polynomials: Newton
000347	Roots of Polynomials: Half-interval Search
000348	Trig Polynomial
000349	Simultaneous Equations
000350	Linear Programming
000351	Matrix Addition, Subtraction, Scalar Multiplication

Index #	Title
000352	Matrix Multiplication
000353	Matrix Inversion
000354	Permutations and Combinations
000355	Mann-Whitney U Test
000356	Mean, Variance, Standard Deviation
000357	Geometric Mean and Deviation
000358	Binomial Distribution
000359	Poisson Distribution
000360	Normal Distribution
000361	Chi-square Distribution
000362	Chi-square Test
000363	Student's t - distribution
000364	Student's t - distribution Test
000365	F -distribution
000366	Linear Correlation Coefficient
000367	Linear Regression
000368	Multiple Linear Regression
000369	Nth Order Regression
000370	Geometric Regression
000371	Exponential Regression
000372	System Reliability
000379	Program: Pierre
000402	Computerized Loop Antenna Design - in Basic
000405	CONV: Description, Users, Instructions, Limitations
000406	FILTER: Description, Users, Instructions, Limitations
000407	FIT: " " " "
000408	INTEGRATION 1: " " " "

INDEX #	Title				
000409	INTEGRATION 2:	Description,	Users,	Instructions,	Limitations
000410	INTENSITY:	"	"	"	"
000411	LOLA:	"	"	"	"
000412	MACRO:	"	"	"	"
000413	MAX. MIN.:	"	"	"	"
000414	NAVAID:	"	"	"	"
000415	OPTICAL:	"	"	"	"
000417	PSD:	"	"	"	"
000418	RAND 1:	"	"	"	"
000419	RAND 2:	"	"	"	"
000420	SOLVE:	"	"	"	"
000421	SPHERE TRIAN:	"	"	"	"
000422	STARS:	"	"	"	"
000423	TRACK:	"	"	"	"
000424	TRIANGLE:	"	"	"	"
000426	VECTOR:	"	"	"	"
000427	BINOMIAL:	"	"	"	"
000428	CHI-SQ:	"	"	"	"
000429	COEFF:	"	"	"	"
000430	CONFIDENCE 1:	"	"	"	"
000431	CONFIDENCE 2:	"	"	"	"
000432	CORRELATIONS:	"	"	"	"
000433	CURVE:	"	"	"	"
000434	DIFFERENCES:	"	"	"	"
000436	EXP-DISTRI:	"	"	"	"
000437	LEAST SQUARES:	"	"	"	"
000438	PAIRED:	"	"	"	"
000441	POLYNOMIAL FIT:	"	"	"	"

INDEX #	Title
000442	REGRESSION: Description, Users, Instructions, Limitations
000443	STAT 1: " " " "
000444	STAT 2: " " " "
000445	T-DISTRIBUTION: " " " "
000447	VARIANCE 1: " " " "
000448	VARIANCE 2: " " " "
000449	XY: " " " "
000732	Pet Poisson Distribution
000921	Determination of Trunk Requirements Alternate Route Networks
0-0984	Circuit
001131	Some Erlang B and Erlang C Formulae for Traffice Analysis on Pet Computer
001132	Basic Program to Compute Link Efficiency for High-Level Data Link Control for Pet Computer
001142	Approximation of Piecewise Curves by Expansion Into Series of Chebychev Polynomials
001188	Design of Primary High Usage, Intermediate High Usage, and Final Trunk Bundles Using Basic Programs Written for Pet
001227	Microwave Network Analysis for PET
001244	Broadband Matching for PET

Basic Software Library -- Vol. II Engineering and Statistics

Scientific Research Inst. 1976
P.O. Box 490099
Key Biscayne, FL 33149

Index to Other Volumes:

Vol. 1

Part 1, Business and Personal Bookkeeping
Part 2, Games and Pictures

Vol. 2

Part 3, Math and Engineering
Part 4, Plotting and Statistics Programs
Appendix A, Basic statement definitions

Vol. 3

Part 5, Advanced Business Programs

Vol. 4

General purpose programs

Vol. 5

Experimenter's Programs
Appendix B, Statement Conversion Algorithms

Vol. 6

A Complete Business System

Getting Started With Your PET (about 100 pp.)

I. Introduction
II. PET BASIC calculator mdoe
III. Inputting a program
IV. Getting information out of your program.
V. Getting information into your program
VI. Data representation
VII. Using the cassette for program storage

PET PROGRAMS ON MAG TAPE AT CEDAR BLDG. 137

Bob Gehring, 137-124 has mag tape copies of the following programs. Send him a tape cassette (Maxell best) for a copy of any of these. His documentation copies cannot be recopied, so write to Wanda Fox, 407-120 for documentation copies.

Database Accession Number	Program Title
157 *	"ATMOS PSK/FSK"
181 *	"A PET OPTIMIZER"
379 *	"PIERRE"
732 *	"PET POISON DIST"
1131	"FINLOSS" "INFLOSS" "FINDELAY" "INFDELAY"
1132	"HDLC"
1142	"GENERAL VLACH" "EVEN VLACH" "ODD VLACH"
1188	"PRIMARY HU" "EQUIVALENT RANDO" "INTERMEDIATE HU" "FINAL ROUTES"
1227	"M.W.NTWRK.ANALYS"
1244 *	"LEVMAT102078" PET BROADBAND MATCHING
1283	"BASE CONVERSION"
1306 *	"ASSEM1" "EXEC" "MODIFYED EDIT" "6502 DISASSEMB" "ASSEM2, EDIT" "EDIT"

Database Accession Number	Program Title
1488 *	"CAUER"
1490 *	"TRANSIENT #1"
1492 *	"SYNTHESIZER"
1493 *	"FACTORS"
1494 *	"PADS"
1494 *	"FLC"
1496 *	"FILTERS"
1497 *	"PI NET"
1498 *	"COIL"
1499 *	"ANT PAT"
1500 *	"ANT CZ"
1501 *	"POLY"
1502 *	"POLY II"
1503 *	"TV ANT"

*TAPE 2 BASIC BASIC - Side A - Contents through Lesson #4-4

Side B - Lesson #5-1 through Sample Programs

*Bob Gehring has a copy of the documentation for these programs