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YAEC-86

YANKEE ATOMIC ELECTRIC COMPANY
RESEARCH AND DEVELOPMENT PROGRAM

JOFIT - A LEAST SQUARES BESSEL J_0
FITTING PROGRAM FOR THE IBM-704 COMPUTER

R&D SUBCONTRACT NO.1 under
USAEC-YAEC CONTRACT AT (30-3)-222

JULY 23, 1958

WESTINGHOUSE ELECTRIC CORPORATION
ATOMIC POWER DEPARTMENT

PITTSBURGH, 30

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JOFIT - A LEAST SQUARES BESSEL J_0 FITTING
PROGRAM FOR THE IBM-704 COMPUTER

By

Jacek Jedruch

Reactor Engineering Department

For The Yankee Atomic Electric Company
Under Research and Development Subcontract
No. 1 of USAEC-YAEC Contract AT(30-3)-222

July 23, 1958

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I ABSTRACT

The JOFIT code fits, by a least squares technique, the curve $y = A J_0 [B (x-C)]$ from 4 to 500 points of observed data, computing the parameters A, B, C and the standard deviation of the final values of A, B, C, i.e. S_A , S_B , S_C . It is also possible to investigate the error in a region about the final values of A, B, C by computing the sums of the squares of the residuals at a series of points in this neighborhood.

Typical computing and editing time for a 50 point problem is 2 minutes.

Any size IBM-704 computer is adequate, and drums and tapes are not used.

II INTRODUCTION

This code is a modification of the COFIT - A Least Squares Cosine Fitting Program for the IBM-704, WAPD-TM-26, developed by Betty L. Anderson and Thomas J. Lawton. For that reason this report is in part a reproduction of WAPD-TM-26 with only such changes as were necessary for the description of the modified code. The mathematical analysis used in the COFIT code has been essentially retained, with substitutions of operative functions where necessary. In addition, due to the fact that the Bessel J_0 and J_1 subroutines will accept only positive arguments, changes in the program have been made to accommodate negative arguments occurring in reactor calculations.

The option of not specifying the initial guess of A, B and C, given in the COFIT code has been removed from this code.

III MATHEMATICAL ANALYSIS

It has been observed that certain types of experimental data may be fitted by a Bessel function of first kind and zero order, J_0 , of the following form:

$$y = A J_0 \left[B (x - C) \right]$$

For purposes of analysis it is of interest to determine the parameters A , B , C that "best" fit the data, as well as the standard deviations S_A , S_B , S_C due to the uncertainties in the measured data.

With the set of N measurements y_i ($i = 1, 2, \dots, N$), $4 \leq N \leq 500$ and errors (standard deviations) Δy_i given, it is possible to use the standard least squares analysis in an iterative scheme to determine the constants.

The functional form may be expressed as

$$\begin{aligned} f_i &= A J_0 \left[B (x_i - C) \right] \\ &= (A_0 + a) J_0 \left\{ (B_0 + b) \left[x_i - (C_0 + c) \right] \right\}, \end{aligned}$$

where a , b , c are small increments on A_0 , B_0 , C_0 , the initial estimates of the parameters.

The function f_i may be expanded in a Taylor series about the point (A_0, B_0, C_0)

$$\begin{aligned}
f_i(A, B, C) = f_i(A_0, B_0, C_0) &+ \left. \frac{\partial f_i}{\partial A} \right|_0 a + \left. \frac{\partial f_i}{\partial B} \right|_0 b + \left. \frac{\partial f_i}{\partial C} \right|_0 c + \\
&+ \frac{1}{2!} \left(\frac{\partial^2 f_i}{\partial A^2} \right)_0 a^2 + \frac{1}{2!} \left(\frac{\partial^2 f_i}{\partial B^2} \right)_0 b^2 + \frac{1}{2!} \left(\frac{\partial^2 f_i}{\partial C^2} \right)_0 c^2 + \\
&+ \left(\frac{\partial^2 f_i}{\partial A \partial B} \right)_0 a b + \left(\frac{\partial^2 f_i}{\partial A \partial C} \right)_0 a c + \left(\frac{\partial^2 f_i}{\partial B \partial C} \right)_0 b c + \dots
\end{aligned}$$

Neglect terms containing the products of increments, as very small, and define:

$$\left. \frac{\partial f_i}{\partial A} \right|_0 = u_i, \quad \left. \frac{\partial f_i}{\partial B} \right|_0 = v_i, \quad \left. \frac{\partial f_i}{\partial C} \right|_0 = w_i$$

$$\text{then } u_i = J_0 \left[B_0 (x_i - C_0) \right]$$

$$v_i = -(x_i - C_0) A_0 J_1 \left[B_0 (x_i - C_0) \right]$$

$$w_i = A_0 B_0 J_1 \left[B_0 (x_i - C_0) \right]$$

The deviations, d_i , of the experimental points y_i from the curve f_i are given by:

$$d_i = y_i - f_i(A_o, B_o, C_o) - u_i a - v_i b - w_i c,$$

$$d_i = F_i - u_i a - v_i b - w_i c,$$

where $F_i = y_i - f_i(A_o, B_o, C_o)$

The least squares principle now asserts that the quantity

$$\delta^2 = \sum_{i=1}^N \left(\frac{d_i}{\Delta y_i} \right)^2 \text{ is to be minimized with respect to the constants,}$$

$$\text{i.e. } \frac{\partial \delta^2}{\partial A} = \frac{\partial \delta^2}{\partial B} = \frac{\partial \delta^2}{\partial C} = 0 \text{ are the defining equations for a,}$$

b and c, in which the squares of the residuals, d_i^2 , are weighted by the inverse square of their errors, $p_i = 1/(\Delta y_i)^2$.

Performing these differentiations leads to the equations:

$$\sum_{i=1}^N \left(\frac{1}{\Delta y_i} \right)^2 (F_i - u_i a - v_i b - w_i c) u_i = 0$$

$$\sum_{i=1}^N \left(\frac{1}{\Delta y_i} \right)^2 (F_i - u_i a - v_i b - w_i c) v_i = 0$$

$$\sum_{i=1}^N \left(\frac{1}{\Delta y_i} \right)^2 (F_i - u_i a - v_i b - w_i c) w_i = 0$$

set

$$\mu_i = \frac{u_i}{\Delta y_i}, \quad v = \frac{v_i}{\Delta y_i}, \quad \omega_i = \frac{w_i}{\Delta y_i}, \quad \rho_i = \frac{F_i}{\Delta y_i}$$

and indicate summation by parentheses, i.e.,

$$(\mu_i \mu_i) = \sum_{i=1}^N \mu_i \mu_i$$

The following solutions are obtained for a, b, c

$$a = \frac{\begin{vmatrix} (\rho_i \mu_i) & (\mu_i v_i) & (\mu_i \omega_i) \\ (\rho_i v_i) & (v_i v_i) & (v_i \omega_i) \\ (\rho_i \omega_i) & (\omega_i v_i) & (\omega_i \omega_i) \end{vmatrix}}{D}$$

$$b = \frac{\begin{vmatrix} (\mu_i \mu_i) & (\rho_i \mu_i) & (\mu_i \omega_i) \\ (\mu_i v_i) & (\rho_i v_i) & (v_i \omega_i) \\ (\mu_i \omega_i) & (\rho_i \omega_i) & (\omega_i \omega_i) \end{vmatrix}}{D}$$

$$c = \frac{\begin{vmatrix} (\mu_i \mu_i) & (\mu_i v_i) & (\rho_i \mu_i) \\ (\mu_i v_i) & (v_i v_i) & (\rho_i v_i) \\ (\mu_i \omega_i) & (v_i \omega_i) & (\rho_i \omega_i) \end{vmatrix}}{D}$$

$$D = \begin{vmatrix} (\mu_i \mu_i) & (\mu_i v_i) & (\mu_i \omega_i) \\ (\mu_i v_i) & (v_i v_i) & (v_i \omega_i) \\ (\mu_i \omega_i) & (v_i \omega_i) & (\omega_i \omega_i) \end{vmatrix}$$

By defining the following minors

$$D_{11} = (v_i v_i) (\omega_i \omega_i) - (v_i \omega_i)^2,$$

$$D_{22} = (\mu_i \mu_i) (\omega_i \omega_i) - (\mu_i \omega_i)^2,$$

$$D_{33} = (\mu_i \mu_i) (v_i v_i) - (v_i \mu_i)^2,$$

$$D_{12} = D_{21} = (\omega_i v_i) (\mu_i \omega_i) - (\mu_i v_i) (\omega_i \omega_i),$$

$$D_{13} = D_{31} = (\mu_i v_i) (v_i \omega_i) - (\mu_i \omega_i) (v_i v_i),$$

$$D_{23} = D_{32} = (v_i \mu_i) (\mu_i \omega_i) - (\mu_i \mu_i) (v_i \omega_i),$$

a, b, c may be expressed as

$$a = \frac{(\rho_i \mu_i) D_{11} + (\rho_i v_i) D_{12} + (\rho_i \omega_i) D_{13}}{D},$$

$$b = \frac{(\rho_i \mu_i) D_{12} + (\rho_i v_i) D_{22} + (\rho_i \omega_i) D_{23}}{D},$$

$$c = \frac{(\rho_i \mu_i) D_{13} + (\rho_i v_i) D_{23} + (\rho_i \omega_i) D_{33}}{D},$$

where

$$D = (\mu_i \mu_i) D_{11} + (\mu_i v_i) D_{12} + (\mu_i \omega_i) D_{13}.$$

The above solutions for a, b, c are the first corrections to A_0, B_0, C_0 . Since the method described depends upon the use of only the first order terms of the Taylor expansion, it is necessary to repeat the calculation with A_1, B_1, C_1 substituted for A_0, B_0, C_0 , where $A_1 = A_0 + a, B_1 = B_0 + b, C_1 = C_0 + c$.

This procedure is repeated until the convergence criteria are satisfied.

$$\left| \frac{A_n - A_{n-1}}{A_{n-1}} \right| < \epsilon_1, \quad \left| \frac{B_n - B_{n-1}}{B_{n-1}} \right| < \epsilon_2, \quad \left| \frac{C_n - C_{n-1}}{C_{n-1}} \right| < \epsilon_3.$$

Measures of error in A, B and C due to inaccuracy in the values of y_i are given by the following quantities:

$$\Delta A = \sqrt{\frac{D_{11}}{D}}, \quad \Delta B = \sqrt{\frac{D_{22}}{D}}, \quad \Delta C = \sqrt{\frac{D_{33}}{D}}$$

The standard deviations of the estimates for A, B, C are calculated by the following formulas:

$$S_A \sim \Delta A \sqrt{\frac{\delta^2}{N-3}}, \quad S_B \sim \Delta B \sqrt{\frac{\delta^2}{N-3}}, \quad S_C \sim \Delta C \sqrt{\frac{\delta^2}{N-3}}.$$

It may be shown that if Δy_i is the standard deviation of the y_i , $\delta^2 \sim N-3$, and $S_A = \Delta A$ etc.

The first zero intercept of the function, R, and the standard deviation of the estimate of R, S_R , are calculated by means of the following formulas

$$R = \frac{2.40480}{B}$$

$$\Delta R = \frac{2.40480}{B^2} \Delta B$$

and

$$S_R \sim \Delta R \sqrt{\frac{\delta^2}{N-3}}$$

It is also possible, by making an appropriate choice of print-out, to perform an error search about the final values of A, B, C. The value of δ^2 is calculated at the points $(A \pm S_A, B \pm S_B, C \pm S_C)$. Choices of print-out will be described in the next section.

IV PREPARATION OF INPUT

There are three types of input to be provided by the problem originator: (1) Title Card, (2) Instruction Card, (3) Data Cards.

The Title Card may contain any combination of letters, numbers and spacing in columns 1 - 72 for identification purposes. The machine does not use this input, but merely reprints it as a title of the output.

The Instruction Card must be punched precisely as described below. There are ten words of information, each preceded by a sign. Some of the words are in the fixed, some in the normalized floating decimal point notation.

If the data to be fitted forms a mirror image about the y axis, the calculation will not converge unless a very lax convergence criterion for C , say $\epsilon_3 = +505$, is used.

Word	Symbol	Fixed or Floating	Identification
1	0	Fixed	Zero
2	ϵ_1	Normalized Floating	Percentage Convergence Criteria
3	ϵ_2		
4	ϵ_3		
5	N	Fixed	Number of points, $4 \leq N \leq 500$ Number of Data Cards
6	TONUC		
7	A	Normalized Floating	Initial Guesses
8	B		
9	C		
10	PR	Fixed	Print Routine Constant

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After the last digit of word No. 10, there must be a + followed by zeros through column 72 of the card. Each of the first 72 columns of the instruction card must contain one, and only one, punch.

Normalized floating point numbers are represented by a sign and two digit characteristic C, followed by a fractional part D. The characteristic is defined as $C = 50 + d$ where the number $x = D \times 10^d$ and $-37 \leq d \leq 38$ and $0.1 \leq D \leq 1$. The fraction D may have from one to eight digits, but it must be in normalized form, i.e. the left-most digit must not be zero. Thus, together with the characteristics the normalized floating point number consists of at least three and at most ten digits. Floating point zeros must be written +000.

Initial guesses of A, B and C must be provided by the problem originator.

The print routine constant, PR, provides a choice of output, which will be described in the next section. Combinations of data type available with each printing routine constant are shown below.

PR	Data Type
0	0
1	0,1
2	0,1,2
3	0,2

Data Cards have seven words per card, each preceded by a sign. The order of words is as follows:

Word	Symbol	Fixed or Floating	Identification
1	C.N.	Fixed	Card Number
2	X	Normalized Floating	Abscissa
3	Y		Ordinate
4	ΔY		Error of Y
5	X		Abscissa
6	Y		Ordinate
7	ΔY		Error of Y

In case there is an odd number of points to a problem, there will be only four words on the last card. The column after the last digit of information must always be punched with a + followed by zeros through column 72 of the card. One blank card should follow each problem. A "704" listing of a deck of input cards appears in Appendix A.

V DESCRIPTION OF OUTPUT

Output is of three types, identifiable by a 0 (blank), 1, or 2 in the first word of the print-out.

A blank identifies Type 0, which has two lines of print of the following form.

	R		S_R		δ^2
A_f	S_A	B_f	S_B	C_f	S_C

There will be N lines of print of Type 1, containing the following information.

1		x_i	y_i/A_f	$J_o [B_f (x_i - C_f)]$	$d_1/\Delta y_1$
---	--	-------	-----------	-------------------------	------------------

Data Type 2 has 27 lines of print expressing δ^2 as a function of all combinations of $A \pm S_A$, $B \pm S_B$, $C \pm S_C$. The format and method for combining these is as follows:

2	A	B	C	δ^2
2	A	B	$C + S_C$	δ^2
2	A	B	$C - S_C$	δ^2
2	A	$B + S_B$	C	δ^2
2	A	$B + S_B$	$C + S_C$	δ^2
2	A	$B + S_B$	$C - S_C$	δ^2
2	A	$B - S_B$	C	δ^2
<hr/>				
2	$A + S_A$	B	C	δ^2
<hr/>				
2	$A - S_A$	$B - S_B$	$C - S_C$	δ^2

All output is in a floating point form, printed six words to a line. Each word consists of a decimal point, a seven digit fraction, and a two digit exponent. Both fraction and exponent are signed. The number is read as a fraction times 10 raised to the power of the exponent.

An example of printout using $PR = 2$ appears in Appendix B, and a program listing appears in Appendix C.

VI OPERATING INSTRUCTIONS

1. Board - Share Board No. 2
2. Switches and Tapes - None
3. Ready Printer and Read in Cards.
 - a. Binary Card Loader - UACSB1 or an equivalent loader which may be stored from 000 to $(144)_8$.
 - b. Program Deck - Identified by JOFIT
 - c. Input Deck
 1. Title Card
 2. Card No. 0 - Instruction card
 3. Card No. 1 - No. N - Data Cards.

Note: The program deck need not be read in for consecutive problems. Any number of problem decks may be stacked behind the program deck. The code reads in one problem, prints results, restores the paper, then reads in the next problem deck.

4. Stops
 - a. "Incorrect Read In" will be printed in case of a read-in error.
Check the order and numbering of the cards.
 - b. $(00427)_8$ - Machine Error.
 - c. $(05173)_8$ - Copied card image does not match card image computed from BCD.

d. $(05226)_8$ - Original BCD does not match BCD reconverted from binary.

Note: In case of errors a, b, c, d, transfer to $(154)_8$ and read in data deck again.

e. $(05311)_8$ - Double Punch, Blank Column.

f. $(05524)_8$ - Range Error. Floating decimal is out of range.

Note: In case of errors (e) or (f) run out data, transfer to $(154)_8$ and start the next problem.

g. "No Solution" will be printed in case an attempt is made to divide by zero or to extract the square root of a negative number.

h. "Incorrect Data" will be printed if one of the Δy_i is zero.

VII. ACKNOWLEDGEMENT

The author wishes to thank Betty L. Anderson and Thomas J. Lawton for permission to reproduce much of their report titled: "COFIT - A Least Squares Cosine Fitting Program for the IBM-704," WAPD-TM-26. The program described in this report is a modification of the COFIT code with changes made only where necessary to adapt it to fitting the Bessel J_0 function.

APPENDIX A

Listing of a Deck of Input Cards

[illegible]

APPENDIX B

JOFIT Output with Print Routine 2

JOFIT TEST RUN E=475 N=25 A=511 B=497 C=512 J.JEDRUCH

.1000000	01	-.1325900	02	.7907876	00	.8092603	00	-.1832156	-01
.1000000	01	-.1215400	02	.8398691	00	.8391417	00	.7213837	-03
.1000000	01	-.1104900	02	.8485500	00	.8667987	00	-.1809933	-01
.1000000	01	-.9944100	01	.9389595	00	.8921085	00	.4646783	-01
.1000000	01	-.8839200	01	.9356121	00	.9149635	00	.2047972	-01
.1000000	01	-.7734300	01	.9388486	00	.9352640	00	.3555297	-02
.1000000	01	-.6625400	01	.9348055	00	.9529211	00	-.1796742	-01
.1000000	01	-.5524500	01	.9472573	00	.9678577	00	-.2043182	-01
.1000000	01	-.4419600	01	.9805496	00	.9800082	00	.5370317	-03
.1000000	01	-.3314700	01	.9918622	00	.9893195	00	.2521934	-02
.1000000	01	-.2209800	01	.9973067	00	.9957506	00	.1543428	-02
.1000000	01	-.1104900	01	.9813058	00	.9992733	00	-.1782051	-01
.1000000	01	.0000000	-39	.1008246	01	.9998723	00	.8305449	-02
.1000000	01	.1104900	01	.9989300	00	.9975447	00	.1373913	-02
.1000000	01	.2209800	01	.9736532	00	.9923010	00	-.1849524	-01
.1000000	01	.3314700	01	.1007873	01	.9841641	00	.2351516	-01
.1000000	01	.4419600	01	.9863672	00	.9731696	00	.1308971	-01
.1000000	01	.5524500	01	.9703664	00	.9593658	00	.1091058	-01
.1000000	01	.6625400	01	.9372354	00	.9428132	00	-.5532208	-02
.1000000	01	.7734300	01	.9344829	00	.9235843	00	.1080943	-01
.1000000	01	.8839200	01	.8998395	00	.9017631	00	-.1907858	-02
.1000000	01	.9944100	01	.8321660	00	.8774450	00	-.4490865	-01
.1000000	01	.1104900	02	.8424098	00	.8507361	00	-.8258122	-02
.1000000	01	.1215400	02	.8274273	00	.8217498	00	.5631056	-02
.1000000	01	.1325900	02	.8130900	00	.7906146	00	.2229159	-01

	.3472126	02		.1027601	01		.8342974	-02
.9918213	00	.5939469	-02	.6926016	-01	.2049805	-02	-.3263938 00 .2208484 00

.2000000	01	.9918213	00	.6926016	-01	-.3263938	00	.8342974	-02
.2000000	01	.9918213	00	.6926016	-01	-.1055454	00	.8725204	-02
.2000000	01	.9918213	00	.6926016	-01	-.5472422	00	.8725806	-02
.2000000	01	.9918213	00	.7130996	-01	-.3263938	00	.9126874	-02
.2000000	01	.9918213	00	.7130996	-01	-.1055454	00	.9467081	-02
.2000000	01	.9918213	00	.7130996	-01	-.5472422	00	.9560013	-02
.2000000	01	.9918213	00	.6721035	-01	-.3263938	00	.9089101	-02
.2000000	01	.9918213	00	.6721035	-01	-.1055454	00	.9506261	-02
.2000000	01	.9918213	00	.6721035	-01	-.5472422	00	.9337435	-02
.2000000	01	.9977608	00	.6926016	-01	-.3263938	00	.9103432	-02
.2000000	01	.9977608	00	.6926016	-01	-.1055454	00	.9511611	-02
.2000000	01	.9977608	00	.6926016	-01	-.5472422	00	.9440716	-02
.2000000	01	.9977608	00	.7130996	-01	-.3263938	00	.8797089	-02
.2000000	01	.9977608	00	.7130996	-01	-.1055454	00	.9163848	-02

•2000000 01	•9977608 00	•7130996-01-	•5472422 00	•9283849-02
•2000000 01	•9977508 00	•6721035-01-	•3263938 00	•1093039-01
•2000000 01	•9977508 00	•6721035-01-	•1055454 00	•1137283-01
•2000000 01	•9977603 00	•6721035-01-	•5472422 00	•1113416-01
•2000000 01	•9858818 00	•6926016-01-	•3263938 00	•9103441-02
•2000000 01	•9858818 00	•6926016-01-	•1055454 00	•9460004-02
•2000000 01	•9858818 00	•6926016-01-	•5472422 00	•9531254-02
•2000000 01	•9858818 00	•7130996-01-	•3263938 00	•1096455-01
•2000000 01	•9858818 00	•7130996-01-	•1055454 00	•1127850-01
•2000000 01	•9858818 00	•7130996-01-	•5472422 00	•1154348-01
•2000000 01	•9858818 00	•6721035-01-	•3263938 00	•8781551-02
•2000000 01	•9858818 00	•6721035-01-	•1055454 00	•9173707-02
•2000000 01	•9858818 00	•6721035-01-	•5472422 00	•9073902-02

APPENDIX C

Listing of JOFIT Program

			00144		ORG 100
00144	-0	53400	1	04260	RDIN LXN L9,1
00145	-0	53400	2	04262	LXD L24,2
00146	0	53400	4	04262	LXA L24,4
00147	0	76200	0	00321	RCD
00150	0	70000	2	04256	CPY CD+72,2
00151	2	00001	2	00152	TIX RDIN+6,2,1
00152	2	00001	4	00150	TIX RDIN+4,4,1
00153	2	00001	1	00146	TIX RDIN+2,1,1
00154	0	53400	1	04262	BEG LXA L24,1
00155	0	76200	0	00321	RCD
00156	0	70000	1	01104	TITLE CPY IMAGE+24,1
00157	2	00001	1	00156	TIX TITLE,1,1
00160	0	53400	1	04262	LXA L24,1
00161	0	76600	0	00361	WPR
00162	0	70000	1	01104	CPY IMAGE+24,1
00163	2	00001	1	00162	TIX TITLE+4,1,1
00164	0	76600	0	00361	WPR
00165	0	07400	4	04730	INST1 TSX W\$WH001,4
00166	+	0000000000001			DEC 1
00167	+	3470000000000			OCT 3470000000000
00170	0	02000	0	00212	TRA DATA
00171	0	02000	0	01031	TRA ERR1
00172	0	50000	0	06415	CLA W\$WH001+821
00173	-0	10000	0	00171	TNZ INST1+4
00174	-0	53400	1	04260	LXD L9,1
00175	0	50000	1	06421	CLA W\$WH001+825,1
00176	0	60100	1	01107	STO EPS+3,1
00177	2	00001	1	00175	TIX INST1+8,1,1
00200	0	50000	0	06421	CLA W\$WH001+825
00201	0	60100	0	04302	STO N
00202	0	50000	0	06422	CLA W\$WH001+826
00203	0	60100	0	04300	STO TONUC
00204	-0	53400	1	04260	LXD L9,1
00205	0	50000	1	06426	CLA W\$WH001+830,1
00206	0	60100	1	04320	STO CO+1,1
00207	2	00001	1	00205	TIX INST1+16,1,1
00210	0	50000	0	06426	CLA W\$WH001+830
00211	0	60100	0	04301	STO PR
00212	-0	75400	0	00000	DATA PXD 0,0
00213	0	60100	0	04277	STO COUNT
00214	0	50000	0	04300	CLA TONUC
00215	0	76100	0	00000	NOP
00216	0	53400	1	04302	LXA N,1
00217	0	07400	4	04730	TSX W\$WH001,4
00220	+	0000000001000			OCT 1000
00221	+	3740000000000			OCT 3740000000000

002	0	02000	0	00251		TRA GUESS	
00223	0	02000	0	01031		TRA ERR1	
00224	0	50000	0	04277		CLA COUNT	
00225	0	40000	0	04257		ADD L1	
00226	0	60100	0	04277		STO COUNT	
00227	0	50000	0	06415		CLA W\$WH001+821	
00230	0	40200	0	04277		SUB COUNT	
00231	-0	10000	0	01031		TNZ ERR1	
00232	0	50000	0	06416		CLA W\$WH001+822	
00233	0	60100	1	02073		STO X,1	
00234	0	50000	0	06417		CLA W\$WH001+823	
00235	0	60100	1	03057		STO Y,1	
00236	0	50000	0	06420		CLA W\$WH001+824	
00237	0	60100	1	04043		STO DELY,1	
00240	2	00001	1	00242		TIX NEXT1,1,1	
00241	0	02000	0	00251		TRA GUESS	
00242	0	50000	0	06421	NEXT1	CLA W\$WH001+825	
00243	0	60100	1	02073		STO X,1	
00244	0	50000	0	06422		CLA W\$WH001+826	
00245	0	60100	1	03057		STO Y,1	
00246	0	50000	0	06423		CLA W\$WH001+827	
00247	0	60100	1	04043		STO DELY,1	
00250	2	00001	1	01053		TIX NEXT2,1,1	
00251	0	50000	0	04315	GUESS	CLA AO	
00252	0	10000	0	00256		TZE GUESS+5	
00253	0	50000	0	04316		CLA BO	
00254	0	10000	0	00257		TZE GUESS+6	
00255	0	02000	0	00260		TRA INIT	
00256	0	00000	0	00000		HTR	A GUESS ZERO
00257	0	00000	0	00000		HTR	B GUESS ZERO
00260	0	50000	0	04263	INIT	CLA LEOL	
00261	0	62100	0	00403		STA SW1	
00262	0	50000	0	04264		CLA LMIN	
00263	0	62100	0	00405		STA SW3	
00264	0	50000	0	04260		CLA L9	
00265	0	60100	0	04112		STO STOR	3 INTO STORAGE
00266	0	60100	0	04113		STO STOR+1	OF INDEX REGISTERS
00267	0	50000	0	04275		CLA LD2	
00270	0	60100	0	04114		STO STOR+2	
00271	0	50000	0	04274		CLA LANEW	
00272	0	62100	0	00737		STA SW5	
00273	0	76000	0	00012		DCT	
00274	0	76100	0	00000		NOP	
00275	0	14000	0	00276		TOV INIT+14	
00276	0	16100	0	00277		TQO UN	
00277	0	53400	1	04302	UN	LXA N,1	
00300	0	53400	2	04260		LXA L9,2	

00301	-0	75400	0	00000	PXD	0,0
00302	0	60100	2	04126	STO	SUM+9,2
00303	2	00001	2	00302	TIX	UN+3,2,1
00304	0	60100	0	04304	STO	RESSQ
00305	0	50000	1	04043	DEUX	CLA DELY,1
00306	0	10000	0	01040	TZE	ERR2
00307	0	50000	1	02073	CLA	X,1
00310	0	30200	0	04317	FSB	CO
00311	0	60100	0	04305	STO	DIF
00312	0	56000	0	04305	LDQ	DIF
00313	0	26000	0	04316	FMP	BO
00314	0	60100	0	04306	STO	ARG
00315	0	76000	0	00003	TROIS	SSP
00316	0	07400	4	06461	TSX	J0,4
00317	0	60100	0	04307	STO	CSN
00320	0	56000	0	04307	LDQ	CSN
00321	0	26000	0	04315	FMP	AO
00322	0	60100	0	04043	STO	COMMON
00323	0	50000	1	03057	CLA	Y,1
00324	0	30200	0	04043	FSB	COMMON
00325	0	24000	1	04043	FDH	DELY,1
00326	-0	60000	0	04311	STQ	RHO
00327	0	50000	0	04307	CLA	CSN
00330	0	24000	1	04043	FDH	DELY,1
00331	-0	60000	0	04312	STQ	MU
00332	0	50000	0	04306	CLA	ARG
00333	-0	12000	0	00336	QUATR	TMI JOFIT
00334	0	07400	4	06533	TSX	J1,4
00335	0	02000	0	00341	TRA	JOFT1
00336	0	76000	0	00003	JOFIT	SSP
00337	0	07400	4	06533	TSX	J1,4
00340	0	76000	0	00002	CHS	
00341	0	60100	0	04310	JOFT1	STO SN
00342	0	56000	0	04310	LDQ	SN
00343	0	26000	0	04315	FMP	AO
00344	0	60100	0	04310	STO	SN
00345	0	56000	0	04310	LDQ	SN
00346	0	26000	0	04316	FMP	BO
00347	0	24000	1	04043	FDH	DELY,1
00350	-0	60000	0	04314	STQ	OMEGA
00351	0	50200	0	04310	CLS	SN
00352	0	24000	1	04043	FDH	DELY,1
00353	0	26000	0	04305	FMP	DIF
00354	0	60100	0	04313	STO	NU
00355	-0	53400	2	04260	LXD	L9,2
00356	0	56000	0	04311	PROD1	LDQ RHO
00357	0	26000	2	04315	FMP	OMEGA+1,2

SN-ASINB*X-C

CALCULATE
SUMS

003	0	30000	2	04120	FAD	SUM+3,2	RHOMU
00301	0	60100	2	04120	STO	SUM+3,2	RHONU
00362	2	00001	2	00356	TIX	PROD1,2,1	RHOOMEGA
00363	-0	53400	2	04260	LXD	L9,2	
00364	0	56000	0	04312	LDQ	MU	
00365	0	26000	2	04315	FMP	OMEGA+1,2	
00366	0	30000	2	04123	FAD	SUM+6,2	
00367	0	60100	2	04123	STO	SUM+6,2	
00370	2	00001	2	00364	TIX	PROD2,2,1	
00371	0	53400	2	04261	LXA	L2,2	
00372	0	56000	0	04313	LDQ	NU	
00373	0	26000	2	04315	FMP	OMEGA+1,2	
00374	0	30000	2	04125	FAD	SUM+8,2	
00375	0	60100	2	04125	STO	SUM+8,2	
00376	2	00001	2	00372	TIX	PROD3,2,1	
00377	0	56000	0	04314	LDQ	OMEGA	
00400	0	26000	0	04314	FMP	OMEGA	
00401	0	30000	0	04125	FAD	SUM+8	
00402	0	60100	0	04125	STO	SUM+8	
00403	0	02000	0	00404	SW1	TRA	EOL
00404	2	00001	1	00305	EOL	TIX	DEUX,1,1
00405	0	02000	0	00406	SW3	TRA	MINOR
00406	0	56000	0	04124	MINOR	LDQ	SUM+7
00407	0	26000	0	04124	FMP	SUM+7	
00410	0	60100	0	04043	STO	COMMON	
00411	0	56000	0	04123	LDQ	SUM+6	
00412	0	26000	0	04125	FMP	SUM+8	
00413	0	30200	0	04043	FSB	COMMON	
00414	0	60100	0	04126	STO	D	
00415	0	56000	0	04122	LDQ	SUM+5	
00416	0	26000	0	04122	FMP	SUM+5	
00417	0	60100	0	04043	STO	COMMON	
00420	0	56000	0	04120	LDQ	SUM+3	
00421	0	26000	0	04125	FMP	SUM+8	
00422	0	30200	0	04043	FSB	COMMON	
00423	0	60100	0	04131	STO	D+3	
00424	0	56000	0	04121	LDQ	SUM+4	
00425	0	26000	0	04121	FMP	SUM+4	
00426	0	60100	0	04043	STO	COMMON	
00427	0	56000	0	04120	LDQ	SUM+3	
00430	0	26000	0	04123	FMP	SUM+6	
00431	0	30200	0	04043	FSB	COMMON	
00432	0	60100	0	04133	STO	D+5	
00433	0	56000	0	04121	LDQ	SUM+4	
00434	0	26000	0	04125	FMP	SUM+8	
00435	0	60100	0	04043	STO	COMMON	
00436	0	56000	0	04124	LDQ	SUM+7	

00440	0	30200	0	04043	FMP SUM+5	
00441	0	60100	0	04127	FSB COMMON	
00442	0	56000	0	04122	STO D+1	
00443	0	26000	0	04123	LDQ SUM+5	
00444	0	60100	0	04043	FMP SUM+6	
00445	0	56000	0	04121	STO COMMON	
00446	0	26000	0	04124	LDQ SUM+4	
00447	0	30200	0	04043	FMP SUM+7	
00450	0	60100	0	04130	FSB COMMON	
00451	0	56000	0	04120	STO D+2	
00452	0	26000	0	04124	LDQ SUM+3	
00453	0	60100	0	04043	FMP SUM+7	
00454	0	56000	0	04121	STO COMMON	
00455	0	26000	0	04122	LDQ SUM+4	
00456	0	30200	0	04043	FMP SUM+5	
00457	0	60100	0	04132	FSB COMMON	
00460	-0	75400	0	00000	STO D+4	
00461	0	60100	0	04134	PXD 0,0	
00462	-0	53400	2	04260	STO D+6	
00463	0	56000	2	04131	LXD L9,2	
00464	0	26000	2	04123	LDQ D+3,2	DEN
00465	0	30000	0	04134	FMP SUM+6,2	
00466	0	60100	0	04134	FAD D+6	
00467	2	00001	2	00463	STO D+6	
00470	0	10000	0	01045	TIX DEN,2,1	
00471	0	02000	0	00472	TZE ERR3	
00472	-0	53400	2	04260	TRA CINO	
00473	-0	75400	0	00000	LXD L9,2	CINO
00474	0	60100	0	04320	PXD 0,0	
00475	0	56000	2	04131	STO INCA	
00476	0	26000	2	04120	LDQ D+3,2	NUM1
00477	0	30000	0	04320	FMP SUM+3,2	
00500	0	60100	0	04320	FAD INCA	NUMERATOR
00501	2	00001	2	00475	STO INCA	INCCA
00502	0	24000	0	04134	TIX NUM1,2,1	
00503	-0	60000	0	04320	FDH D+6	STORE
00504	0	56000	0	04115	STQ INCA	
00505	0	26000	0	04127	LDQ SUM	
00506	0	60100	0	04321	FMP D+1	
00507	0	56000	0	04116	STO INCB	INCB
00510	0	26000	0	04131	LDQ SUM+1	
00511	0	30000	0	04321	FMP D+3	NUMERATOR
00512	0	60100	0	04321	FAD INCB	INCB
00513	0	56000	0	04117	STO INCB	
00514	0	26000	0	04132	LDQ SUM+2	
00515	0	30000	0	04321	FMP D+4	
					FAD INCB	

00515	0	24000	0	04134	FDH D+6	STORE
00517	-0	60000	0	04321	STQ INCB	
00520	0	56000	0	04115	LDQ SUM	
00521	0	26000	0	04130	FMP D+2	
00522	0	60100	0	04322	STO INCC	
00523	0	56000	0	04116	LDQ SUM+1	
00524	0	26000	0	04132	FMP D+4	NUMERATOR
00525	0	30000	0	04322	FAD INCC	INCC
00526	0	60100	0	04322	STO INCC	
00527	0	56000	0	04117	LDQ SUM+2	
00530	0	26000	0	04133	FMP D+5	
00531	0	30000	0	04322	FAD INCC	
00532	0	24000	0	04134	FDH D+6	STORE
00533	-0	60000	0	04322	STQ INCC	INCC
00534	-0	53400	4	04260	LXD L9,4	
00535	0	50000	4	04323	CLA INCC+1,4	
00536	0	24000	4	04320	FDH CO+1,4	CONVERGENCE
00537	-0	60000	0	04043	STQ COMMON	TESTS
00540	0	50000	0	04043	CLA COMMON	
00541	0	76000	0	00003	SSP	
00542	0	34000	4	01107	CAS EPS+3,4	
00543	0	02000	0	00600	TRA SEPT	
00544	0	76100	0	00000	NOP	
00545	2	00001	4	00535	TIX SIX,4,1	
00546	0	50000	0	04265	CLA LVAR0	
00547	0	62100	0	00405	STA SW3	
00550	0	50000	0	04270	CLA LCONV	
00551	0	62100	0	00403	STA SW1	
00552	0	50000	0	04301	CLA PR	
00553	0	34000	0	04261	CAS L2	
00554	0	02000	0	00572	TRA INIT3	
00555	0	02000	0	00560	TRA INIT2	
00556	0	10000	0	00565	TZE INIT0	
00557	0	02000	0	00574	TRA INIT1	
00560	0	50000	0	04266	CLA LVAR1	INIT2
00561	0	62100	0	01021	STA SW2	
00562	0	50000	0	04272	CLA LPLUS	
00563	0	62100	0	00724	STA SW4	
00564	0	02000	0	00600	TRA SEPT	
00565	0	50000	0	04271	CLA LFIN	INIT0
00566	0	62100	0	00724	STA SW4	
00567	0	50000	0	04263	CLA LEOL	
00570	0	62100	0	01021	STA SW2	
00571	0	02000	0	00600	TRA SEPT	
00572	0	50000	0	04263	CLA LEOL	INIT3
00573	0	02000	0	00561	TRA INIT2+1	
00574	0	50000	0	04266	CLA LVAR1	INIT1

00: 0 62100 0 01021
00576 0 50000 0 04271
00577 0 62100 0 00724
00600 -0 53400 1 04260
00601 0 50000 1 04320
00602 0 30000 1 04323
00603 0 60100 1 04320
00604 2 00001 1 00601
00605 0 02000 0 00277
00606 0 56000 0 04315
00607 -0 60000 0 04135
00610 0 56000 0 04316
00611 -0 60000 0 04140
00612 0 56000 0 04317
00613 -0 60000 0 04143
00614 0 53400 1 04260
00615 -0 53400 4 04260
00616 0 50000 1 04146
00617 0 30000 4 04326
00620 0 60100 1 04147
00621 0 50000 1 04146
00622 0 30200 4 04326
00623 0 60100 1 04150
00624 2 00003 1 00625
00625 2 00001 4 00616
00626 0 50000 0 04267
00627 0 62100 0 00405
00630 0 50000 0 04263
00631 0 62100 0 01021
00632 0 02000 0 00277
00633 0 50000 0 04276
00634 0 40000 0 04302
00635 0 60100 0 04043
00636 0 76000 0 00000
00637 0 30000 0 04043
00640 0 30200 0 04344
00641 0 60100 0 04043
00642 0 50000 0 04304
00643 0 24000 0 04043
00644 -0 60000 0 04335
00645 0 50000 0 04126
00646 0 24000 0 04134
00647 0 26000 0 04335
00650 0 60100 0 04043
00651 0 50000 0 04043
00652 0 07400 4 04345
00653 0 02000 0 01045

SEPT

PLUSA

NEWA

NEWB

VARO

STA SW2
CLA LFIN
STA SW4
LXD L9,1
CLA CO+1,1
FAD INCC+1,1
STO CO+1,1
TIX SEPT+1,1,1
TRA UN
LDQ AO
STQ ALPHA
LDQ BO
STQ BETA
LDQ CO
STQ GAMMA
LXA L9,1
LXD L9,4
CLA GAMMA+3,1
FAD DEVC+1,4
STO GAMMA+4,1
CLA GAMMA+3,1
FSB DEVC+1,4
STO GAMMA+5,1
TIX NEWB,1,3
TIX NEWA,4,1
CLA LVAR2
STA SW3
CLA LEOL
STA SW2
TRA UN
CLA CHAR
ADD N
STO COMMON
CLM
FAD COMMON
FSB CON+6
STO COMMON
CLA RESSQ
FDH COMMON
STQ FACT
CLA D
FDH D+6
FMP FACT
STO COMMON
CLA COMMON
TSX SQRT,4
TRA ERR3

9INTO IR1
3INTO IR4
CALCULATE
A PLUS OR MINUS DELTA
ETC.

00733 0 00000 0 04315
 00734 0 00000 0 04316
 00735 0 00000 0 04317
 00736 0 00000 0 04304
 00737 0 02000 0 00740
 00740 -0 53400 1 04112
 00741 -0 53400 2 04113
 00742 -0 53400 4 04114
 00743 0 50000 1 04140
 00744 0 60100 0 04315
 00745 0 50000 2 04143
 00746 0 60100 0 04316
 00747 0 50000 4 04146
 00750 0 60100 0 04317
 00751 2 00001 4 00761
 00752 -0 53400 4 04260
 00753 2 00001 2 00761
 00754 -0 53400 2 04260
 00755 2 00001 1 00761
 00756 0 50000 0 04273
 00757 0 62100 0 00737
 00760 0 02000 0 00277
 00761 -0 63400 1 04112
 00762 -0 63400 2 04113
 00763 -0 63400 4 04114
 00764 0 02000 0 00277
 00765 0 07400 4 04376
 00766 0 00000 0 04340
 00767 0 00000 0 00000
 00770 0 00000 1 02073
 00771 0 00000 0 04330
 00772 0 00000 0 04307
 00773 0 00000 0 04303
 00774 0 02000 0 00404
 00775 0 56000 0 04312
 00776 0 26000 0 04320
 00777 0 30200 0 04311
 01000 0 60100 0 04043
 01001 0 56000 0 04312
 01002 0 26000 0 04321
 01003 0 30000 0 04043
 01004 0 60100 0 04043
 01005 0 56000 0 04314
 01006 0 26000 0 04322
 01007 0 30000 0 04043
 01010 0 76000 0 00002
 01011 0 60100 0 04303

SW5
 ANEW

SAVE

VAR1

CONV

PZE AO,0
 PZE BO,0
 PZE CO,0
 PZE RESSQ,0
 TRA ANEW
 LXD STOR,1
 LXD STOR+1,2
 LXD STOR+2,4
 CLA ALPHA+3,1
 STO AO
 CLA BETA+3,2
 STO BO
 CLA GAMMA+3,4
 STO CO
 TIX SAVE,4,1
 LXD L9,4
 TIX SAVE,2,1
 LXD L9,2
 TIX SAVE,1,1
 CLA LEND
 STA SW5
 TRA UN
 SXD STOR,1
 SXD STOR+1,2
 SXD STOR+2,4
 TRA UN
 TSX S023,4
 PZE CON+2,0
 PZE 0,0
 PZE X,1
 PZE NORMY,0
 PZE CSN,0
 PZE RES,0
 TRA EOL
 LDQ MU
 FMP INCA
 FSB RHO
 STO COMMON
 LDQ MU
 FMP INCB
 FAD COMMON
 STO COMMON
 LDQ OMEGA
 FMP INCC
 FAD COMMON
 CHS
 STO RES

PICK UP
 APPROPRIATE
 A,B,C

SAVE CONTENTS
 OF IR1,2,4

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547 034

00654	0	60100	0	04323	STO DEVA
00655	0	50000	0	04131	CLA D+3
00656	0	24000	0	04134	FDH D+6
00657	0	26000	0	04335	FMP FACT
00660	0	60100	0	04043	STO COMMON
00661	0	50000	0	04043	CLA COMMON
00662	0	07400	4	04345	TSX SQRT,4
00663	0	02000	0	01045	TRA ERR3
00664	0	60100	0	04324	STO DEVB
00665	0	50000	0	04133	CLA D+5
00666	0	24000	0	04134	FDH D+6
00667	0	26000	0	04335	FMP FACT
00670	0	60100	0	04043	STO COMMON
00671	0	50000	0	04043	CLA COMMON
00672	0	07400	4	04345	TSX SQRT,4
00673	0	02000	0	01045	TRA ERR3
00674	0	60100	0	04325	STO DEVC
00675	0	50000	0	04341	CLA CON+3
00676	0	30000	0	04341	FAD CON+3
00677	0	24000	0	04316	FDH BO
00700	-0	60000	0	04326	STQ H
00701	0	26000	0	04324	FMP DEVB
00702	0	24000	0	04316	FDH BO
00703	-0	60000	0	04327	STQ DEVH
00704	0	76600	0	00361	WPR
00705	0	07400	4	04376	TSX S023,4
00706	0	00000	0	00000	PZE 0,0
00707	0	00000	0	04326	PZE H,0
00710	0	00000	0	00000	PZE 0,0
00711	0	00000	0	04327	PZE DEVH,0
00712	0	00000	0	00000	PZE 0,0
00713	0	00000	0	04304	PZE RESSQ
00714	0	07400	4	04376	TSX S023,4
00715	0	00000	0	04315	PZE AO,0
00716	0	00000	0	04323	PZE DEVA,0
00717	0	00000	0	04316	PZE BO,0
00720	0	00000	0	04324	PZE DEVB,0
00721	0	00000	0	04317	PZE CO,0
00722	0	00000	0	04325	PZE DEVC,0
00723	0	76600	0	00361	WPR
00724	0	02000	0	00725	TRA FIN
00725	0	76600	0	00361	WPR
00726	0	76000	0	00361	SPR 1
00727	0	02000	0	00154	TRA BEG
00730	0	07400	4	04376	TSX S023,4
00731	0	00000	0	04343	PZE CON+5,0
00732	0	00000	0	00000	PZE 0,0

SW4
FIN

VAR2

01012	0	56000	0	04303	LDQ	RES
01013	0	26000	0	04303	FMP	RES
01014	0	30000	0	04304	FAD	RESSQ
01015	0	60100	0	04304	STO	RESSQ
01016	0	50000	1	03057	CLA	Y,1
01017	0	24000	0	04315	FDH	AO
01020	-0	60000	0	04330	STQ	NORMY
01021	0	02000	0	00404	SW2	TRA EOL
01022	-0	12000	0	01026	ERR4	TMI ERR4+4
01023	0	30200	0	04342	FSB	CON+4
01024	0	60100	0	04306	STO	ARG
01025	0	02000	0	00315	TRA	TROIS
01026	0	30000	0	04342	FAD	CON+4
01027	0	60100	0	04306	STO	ARG
01030	0	02000	0	00315	TRA	TROIS
01031	0	53400	1	04262	ERR1	LXA L24,1
01032	0	76600	0	00361	WPR	
01033	0	70000	1	04176	CPY	CD+24,1
01034	2	00001	1	01033	TIX	ERR1+2,1,1
01035	0	76600	0	00361	WPR	
01036	0	76000	0	00361	SPR	1
01037	0	00000	0	00154	HTR	BEG
01040	0	53400	1	04262	ERR2	LXA L24,1
01041	0	76600	0	00361	WPR	
01042	0	70000	1	04226	CPY	CD+48,1
01043	2	00001	1	01042	TIX	ERR2+2,1,1
01044	0	02000	0	00725	TRA	FIN
01045	0	53400	1	04262	ERR3	LXA L24,1
01046	0	76600	0	00361	WPR	
01047	0	70000	1	04256	CPY	CD+72,1
01050	2	00001	1	01047	TIX	ERR3+2,1,1
01051	0	02000	0	00725	TRA	FIN
01052	0	02000	0	00725	END	TRA FIN
01053	0	02000	0	04747	NEXT2	TRA W\$WH001+15
				01054	IMAGE	BSS 24
				01104	EPS	BSS 3
				02073	X	BES 500
				03057	Y	BES 500
				04043	DELY	BES 500
				04043	COMMON	BSS 39
				04112	STOR	BSS 3
				04115	SUM	BSS 9
				04126	D	BSS 7
				04135	ALPHA	BSS 3
				04140	BETA	BSS 3
				04143	GAMMA	BSS 3
				04146	CD	BSS 72

01	5	0	00000	0	00000	L0	PZE	
04257		0	00000	0	00001	L1	PZE	1,0,0
04260		0	00003	0	00011	L9	PZE	9,0,3
04261		0	00000	0	00002	L2	PZE	2,0,0
04262		0	00110	0	00030	L24	PZE	24,0,72
04263		0	00000	0	00404	LEOL	PZE	EOL
04264		0	00000	0	00406	LMIN	PZE	MINOR
04265		0	00000	0	00633	LVAR0	PZE	VAR0
04266		0	00000	0	00765	LVAR1	PZE	VAR1
04267		0	00000	0	00730	LVAR2	PZE	VAR2
04270		0	00000	0	00775	LCONV	PZE	CONV
04271		0	00000	0	00725	LFIN	PZE	FIN
04272		0	00000	0	00606	LPLUS	PZE	PLUSA
04273		0	00000	0	01052	LEND	PZE	END
04274		0	00000	0	00740	LANEW	PZE	ANEW
04275		0	00002	0	00000	LD2	PZE	0,0,2
04276		+	2330000000000			CHAR	OCT	2330000000000
04277		0	00000	0	00000	COUNT		
04300		0	00000	0	00000	TONUC		
04301		0	00000	0	00000	PR		
04302		0	00000	0	00000	N		
04303		0	00000	0	00000	RES		
04304		0	00000	0	00000	RESSQ		
04305		0	00000	0	00000	DIF		
04306		0	00000	0	00000	ARG		
04307		0	00000	0	00000	CSN		
04310		0	00000	0	00000	SN		
04311		0	00000	0	00000	RHO		
04312		0	00000	0	00000	MU		
04313		0	00000	0	00000	NU		
04314		0	00000	0	00000	OMEGA		
04315		0	00000	0	00000	AO		
04316		0	00000	0	00000	BO		
04317		0	00000	0	00000	CO		
04320		0	00000	0	00000	INCA		
04321		0	00000	0	00000	INCB		
04322		0	00000	0	00000	INCC		
04323		0	00000	0	00000	DEVA		
04324		0	00000	0	00000	DEVB		
04325		0	00000	0	00000	DEVC		
04326		0	00000	0	00000	H		
04327		0	00000	0	00000	DEVH		
04330		0	00000	0	00000	NORMY		
					04331	MIN	BSS	2
					04333	MAX	BSS	2
04335		0	00000	0	00000	FACT		
04336		+	175463146314			CON	DEC	.75E-1,.16666667,1.0,1.2024,.3294199E7,2.0,3.0

04337 +176525252527
 04340 +201400000000
 04341 +201463640762
 04342 +226622077340
 04343 +202400000000
 04344 +202600000000

04345 UASQR4 LIB
 04376 RL0023 LIB
 04730 W HED
 04730 WH001 LIB
 06461 HED

06461	0	60100	0	06525	JO	STO	J0+36
06462	0	50000	0	06522		CLA	J0+33
06463	0	60100	0	06532		STO	J0+41
06464	0	60100	0	06526		STO	J0+37
06465	0	56000	0	06525		LDQ	J0+36
06466	0	26000	0	06523		FMP	J0+34
06467	0	60100	0	06527		STO	J0+38
06470	0	56000	0	06527		LDQ	J0+38
06471	0	26000	0	06527		FMP	J0+38
06472	0	60100	0	06527		STO	J0+38
06473	0	76000	0	00000		CLM	
06474	0	60100	0	06530		STO	J0+39
06475	0	50000	0	06530		CLA	J0+39
06476	0	30000	0	06522		FAD	J0+33
06477	0	60100	0	06530		STO	J0+39
06500	0	56000	0	06530		LDQ	J0+39
06501	0	26000	0	06530		FMP	J0+39
06502	0	60100	0	06531		STO	J0+40
06503	0	56000	0	06526		LDQ	J0+37
06504	0	26000	0	06527		FMP	J0+38
06505	0	24100	0	06531		FDP	J0+40
06506	-0	60000	0	06526		STQ	J0+37
06507	0	50000	0	06524		CLA	J0+35
06510	-0	40000	0	06526		SBM	J0+37
06511	0	12000	0	06520		TPL	J0+31
06512	0	50000	0	06526		CLA	J0+37
06513	0	76000	0	00002		CHS	
06514	0	60100	0	06526		STO	J0+37
06515	0	30000	0	06532		FAD	J0+41
06516	0	60100	0	06532		STO	J0+41
06517	0	02000	0	06475		TRA	J0+12
06520	0	50000	0	06532		CLA	J0+41
06521	0	02000	4	00001		TRA	1.4
06522	+201400000000					DEC	1.0
06523	+200400000000					DEC	0.5
06524	+146527461670					DEC	0.00000001

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06525	0	00000	0	00000	HTR	0
06526	0	00000	0	00000	HTR	0
06527	0	00000	0	00000	HTR	0
06530	0	00000	0	00000	HTR	0
06531	0	00000	0	00000	HTR	0
06532	0	00000	0	00000	HTR	0
06533	0	60100	0	06577	J1 STO	J1+36
06534	0	56000	0	06577	LDQ	J1+36
06535	0	26000	0	06575	FMP	J1+34
06536	0	60100	0	06605	STO	J1+42
06537	0	60100	0	06600	STO	J1+37
06540	0	56000	0	06600	LDQ	J1+37
06541	0	26000	0	06600	FMP	J1+37
06542	0	60100	0	06601	STO	J1+38
06543	0	50000	0	06574	CLA	J1+33
06544	0	60100	0	06602	STO	J1+39
06545	0	50000	0	06602	CLA	J1+39
06546	0	30000	0	06574	FAD	J1+33
06547	0	60100	0	06603	STO	J1+40
06550	0	56000	0	06603	LDQ	J1+40
06551	0	26000	0	06602	FMP	J1+39
06552	0	60100	0	06604	STO	J1+41
06553	0	56000	0	06600	LDQ	J1+37
06554	0	26000	0	06601	FMP	J1+38
06555	0	24100	0	06604	FDP	J1+41
06556	-0	60000	0	06600	STQ	J1+37
06557	0	50000	0	06576	CLA	J1+35
06560	-0	40000	0	06600	SBM	J1+37
06561	0	12000	0	06572	TPL	J1+31
06562	0	50000	0	06603	CLA	J1+40
06563	0	60100	0	06602	STO	J1+39
06564	0	50000	0	06600	CLA	J1+37
06565	0	76000	0	00002	CHS	
06566	0	60100	0	06600	STO	J1+37
06567	0	30000	0	06605	FAD	J1+42
06570	0	60100	0	06605	STO	J1+42
06571	0	02000	0	06545	TRA	J1+10
06572	0	50000	0	06605	CLA	J1+42
06573	0	02000	4	00001	TRA	1.4
06574	+201400000000				DEC	1.0
06575	+200400000000				DEC	0.5
06576	+146527461670				DEC	.00000001
06577	0	00000	0	00000	HTR	0
06600	0	00000	0	00000	HTR	0
06601	0	00000	0	00000	HTR	0
06602	0	00000	0	00000	HTR	0
06603	0	00000	0	00000	HTR	0

06604 0 00000 0 00000
06605 0 00000 0 00000
00144

HTR 0
HTR 0
END RDIN