F 2- 1-30

TITLE: Statistical Subroutines
Floating Point Input

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COMPUMATIX STATISTICAL SUBROUTINES
(FLOATING POINT INPUT)

I. Storage Allocation

A) Standard Subroutines

Program #	Location	Description
10.4	0000-0263	Program Input
11.2	0300-0563	Data Input (Fixed)
12.1A	0600-0850	Data Output (Fixed)
25.0R	0900-1163	Float - Unfloat
24.0	1200-2163	Floating Point Interpretive
11.6-12.6	2200-2763	Floating Point Input-Output
29.0	2800-2963	Matrix Inversion

B) Statistical Subroutines:

Sample Problem #	Location	Description
1	3000-3215	Floating Point Δ Matrix Prep., Print, Float
2	3219-3263 *	Δ Matrix Scale
3	3300-3515	Calculate Means, Standard Deviations and correlation Coefficient Δ Matrix (Print)
4	3516-3606	Convert Δ Rij Matrix to □ Rij Matrix (Modified)

Sample Problem #	Location	Description
5	3607-3660	Invert □ Rij Matrix and Print
	3661	XP1600
6	3662-4005	Compute and Print: Beta Weights, Regression Coefficients; Partial Correlation Coefficient and Standard Error of the Independent Variables; the Constant Term (B_0) and its' Standard Error; the Sample Multiple Correlation Coefficient and Standard Error of Estimate; the Universe Multiple Correlation Coefficient and Standard Error of Estimate.
	4006	XZ0000 Stop
7	4007-4106	Compute Y, Y_{cal} $(Y-Y_{cal})$ and Print (Floating Point)

C) Data and Computational Storage

Area	For	Required
6200-6231	Standard Deviations	N
4132-4163	Coefficient of Equation	N
4200-6131	Δ Data Matrix and Correlation) Coefficient Matrix) □ Rij Matrix and Inverse)	$N^2 + 2N + 1$
4201-4201 +N	Means	N
6132-6163	Scale Factors	(N + 1)
6200-6231	Record	(N + 1)
6232-6263	Temp. and Line Set	----

(Data and Computational Storage - Cont'd)

Area	For	Required
6300-6363	Temp. for Floating Point, Etc.	-----

* Note: 3215 XU3300 (To skip scaling)

3215 XU3220 (To do scaling)

3220 3221	XR1200) XU1200)	Enter Floating Point
3222	XI0000	Read Scale Factors
3223	XE0000	Exit F. P.
3224	Lo. Matrix Scaling Sub.	

II. Operation:

A) Load hex tapes A and Ba (See storage allocation A and B for tape contents). Note exception: 10.4 is not on tape A or Ba.

B) Insert sample problem data tape in the typewriter and depress break points 4 and 8. Start the tape reading via a program input routine (10.0, 10.3 or 10.4). All start fill and transfers are on the tape.

C) The computer will halt on the stop and transfer instruction (.0003000'). A start compute signal will initiate the computation (or B.P. # 32 could have been depressed).

D) The program will proceed to the completion of the regression analysis and then stop in location 4006 (XZ0000).

E) A start compute signal will cause an entry into the subroutine to compute the residuals, (Y-Ycal). The regression equation coefficients are stored correctly by the subroutine that computes them in Floating Point and need not be entered before the first record of the original data is re-read.

III. Format:

A) Set carriage return stop at 4.

B) Set tabs at 12, 20, 28, 36, 44, etc.
N + 1 tabs. (8 numbers apart).

C) For very large problems the automatic C. R. must be used or all spacing tabs in program # 1 and 3 removed (See write ups) and a column type printout used.

D) Since break points separate every major phase of this group of subroutines, these spaces may be used for exits to heading printing operations or other calculations, without disrupting actual program steps.

IV. General:

A) The subroutine designates as "No. 2" (Scaling) has not been used in this sample problem since then, in general, special handling would be required in the residual computation.

B) The subroutines were assembled except for locations 3219-3223 and 4006 by filling the following subroutine Lo on top of the previous subroutine L_F.

FLOATING POINT DATA

COMPUMATIX INC.

SAMPLE PROBLEM STATISTICS SUBROUTINES (FLOATING POINT)

;006233'

xz0003' no. of variables

xz0005' no. of records

xz6200' Lo. of record

xz4200' Lo. of Δ data matrix

xz1200' Lo. of floating point

xz4201' Lo. of means

xz6200' Lo. of standard deviations

xz0000' Lo. of sq. Rij matrix

xz6132' Lo. of scale factors

xz2800' Lo. of matrix inversion (29.0)

xz4132' Lo. of coefficients of regression equation

depress break points 4 and 8 for straight thru operation

to the residual computation

.0003000'

data

+006200'1''4'1'-0000000''

+006200'1'1'4'3'-0000000''

+006200'1'3'3'2'-0000000''

+006200'1'6'2'5'-0000000''

+006200'1'8''4'-0000000''

DATA CONTINUED

N		ΣX_1		ΣX_2		ΣY	
.5000000	01	.1800000	02	.1300000	02	.1500000	02
		ΣX_1^2		$\Sigma X_1 X_2$		$\Sigma X_1 Y$	
		.1100000	03	.2500000	02	.7100000	02
				ΣX_2^2		$\Sigma X_2 Y$	
				.4500000	02	.3200000	02
						ΣY^2	
						.5500000	02
$\bar{X}_1$		$\bar{X}_2$		$\bar{Y}$			
.3600000	01	.2600000	01	.3000000	01		
σ_{x_1}		σ_{x_2}		σ_y			
.3006659	01	.1496663	01	.1414213	01		
r_{11}		r_{12}		r_{1y}			
.1000000	01	.9688981-	00	.7996129	00		
		r_{22}		r_{2y}			
		.1000000	01	.6614376-	00		
				r_{yy}			
				.1000000	01		

Inverse of r_{ij} Matrix

.6084443	02	.4759427	02	.1717134-	02		
.4759427	02	.3900739	02	.1225603-	02		
.1717134-	02	.1225603-	02	.6623824	01		
β_{x1}		b_{x1}		$r_{1y.2}$		σ_{bx1}	
.2592361	01	.1219344	01	.8553412	00	.5222230	00
β_{x2}		b_{x2}		$r_{2y.2}$		σ_{bx2}	
.1850295	01	.1748364	01	.7624686	00	.1049098	01
		b_0				σ_{b0}	
		.5935385-	01			.3885488	00
R		σ_{EST}		$\hat{R}$		$\hat{\sigma}_{EST}$	
.9214280	00	.5494909	00	.8354996	00	.8688215	00

DATA - CONTINUED

Data repeated for residual computation

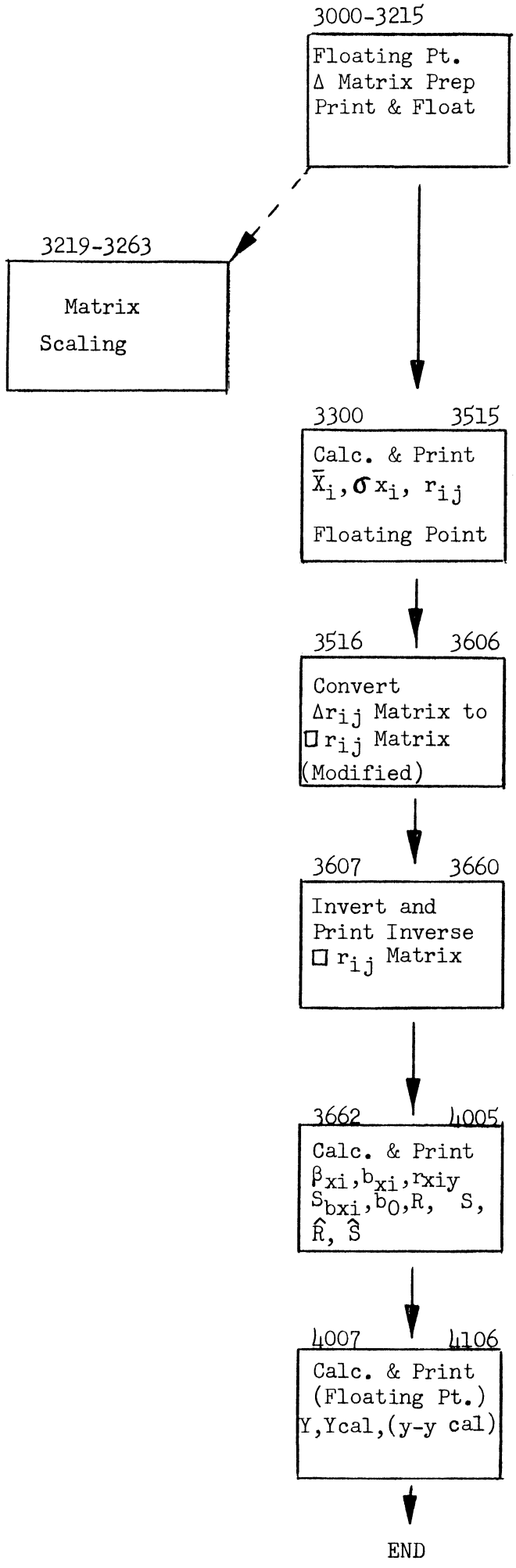
```
+006200'1''4'1'-0000000''
.1000000   01   .1058073   01   .5807304-   01-

+006200'1'1'4'3'-0000000''
.3000000   01   .2277417   01   .7225832    00

+006200'1'3'3'2'-0000000''
.2000000   01   .2967740   01   .9677398-   00

+006200'1'6'2'5'-0000000''
.5000000   01   .4877406   01   .1225934    00

+006200'1'8''4'-0000000''
.4000000   01   .3819365   01   .1806345    00
```



Statistics Subroutines
Floating Point Data

TITLE: Least Squares Floating Point Triangular Matrix Preparation

AUTHOR: William F. Burggrabe
Compumatix, Incorporated

DATE: August 28, 1959

PURPOSE: Given N records of n variables of the form 1, X_1, X_2, ... X_n in floating point this subroutine will prepare the upper triangle of the least squares matrix. The matrix rows are stored sequentially in the following format:

$$N,\ \Sigma X_1,\ \Sigma X_2,\ \ldots\ \Sigma X_n;\ \Sigma X_1^2,\ \Sigma X_1 X_2 \ldots \Sigma X_1 X_n;$$
$$\Sigma X_2^2,\ \ldots\ \Sigma X_2 X_n;\ \ldots;\ \Sigma X_n^2$$

At the completion of the processing for N records, the matrix may be optionally printed out.

RESTRICTIONS:

1) Normal restrictions of 24.0, 11.6 - 12.6

2) No limit to the number of records provided no overflow is encountered; the number of variables is limited only by available machine storage.

   Required computational storage:

   Data L_o to $L_o + n + 1$

   Matrix L_o to $L_o + \frac{(n+1)(n+2)}{2}$

3) The following information must be supplied:

6233	n
6234	N
6235	L_o Record
6236	L_o Δ Matrix
6237	L_o Floating Point System

4) Data Format - see input

5) Print Out - see output

6) The records are not permanently stored.

GENERAL INFORMATION ON METHOD:

Since little mathematical description need be given, a description of the program sequence will be outlined here.

1) Initialization

Clear the matrix storage area to zero

2) Matrix Preparation

N-records, n variables

3) Optional print out of floating point matrix.
(Transfer control up)

A break point stop separates each phase of the operation, as well as the processing of each record.

CODING INFORMATION

A) Storage: Subroutine 2 tracks 16 sectors

External storage as noted under restriction 3 and the following:

	6258 Ctr
	6259 Ctr
	6260 Temp
	(6261 n + 1 @ 29
Computed	(6262 n + 2 @ 29
	(6363 $\frac{(n+1)\ (n+2)}{2}$ @ 29

Data L_o to $L_o + n + 1$

Matrix L_o to $L_o + \frac{(n+1)\ (N+2)}{2}$

B) Linkage and calling sequence: Since this is one of a group of statistical subroutines, location 6233 to 6263 have been reserved for initialization information and no calling sequence is required.

```
Linkage R Lo + 215
        U Lo
```

C) Input : As described under Restriction 3 and:

Data format

First record.

```
+ PP Data Lo' 1' X1' X2' .....Xn' -0000000''
```

Following records.

+ PP Data Lo + 1 X_1' X_2' ... X_n' -0000000''

The leading "one" may be present in all records if desired. In this case all records have the same code word as the first record.

D) Output: The computed matrix is stored sequentially beginning in the specified location. It may be printed out in floating point in the following format:

N	ΣX_1	ΣX_2	...	ΣX_n
tab	ΣX_1^2	$\Sigma X\ X_2$	...	ΣX_n
tab	tab	ΣX_2^2	...	ΣX_n
				.
				.
				.
	tab tab etc. ...			ΣX_n^2

The tabs may be suppressed by changing Lo + 206 to T (Lo+207) or U(Lo + 47)
Note: Transfer Control down exits from Print Routine

E) Location of constants:

L_o + 111	1 @ 29
+ 112	3wwj (Mask)
+ 113	1 @ 3
+ 119	1 @ 29
+ 121	1 @ 29
+ 203	0 and delay

F) The actual matrix preparation time is approximately:

$$\frac{(n+1)\ (N+2)}{2}\ (1.30) + .031\ (n+1)$$ N = seconds compute time

+ Data read in time

G) Program stops:

Lo + 39 BP 4 after initialization
Lo + 42 BP 8 after last record of matrix prep.
Lo + 159 BP 4 after each record, except last
Lo + 214 BP 4 after printing matrix

FLOATING POINT MATRIX PREPARATION

Operating Procedure

Prepare the data tape as per instructions under input and fill the required storage locations 6233-6237 as under restriction 3. Insert the data tape in reader and transfer to the routine Lo or use a main program with the required linkage.

After inialization a stop (BP 4) in Lo + 39 will occur. Depression of start compute lever will cause the first record to be read, the necessary computation for that record and an exit to (BP 4) in Lo + 159 prior to reading the next record. (This feature allows for machine stoppage on large problems)

After all records have been processed, the program will halt on BP 8 in Lo + 42. If it is desired to eliminate the floating point matrix print out, depress transfer control before continuing the program. This causes a transfer to Lo + 214 (BP 4) the end of the print sequence. (NOTE: Depression of the transfer control switch during the printing operation will cause an exit from the print routine at the end of the particular line being printed).

A start compute signal will transfer control back to the main program.

SAMPLE PROBLEM FLOATING POINT Δ MATRIX PREP.

```
;006233'xz0003'  no. variables
;006234'xz0005'  no. records
;006235'xz6200'  Lo. record
;006236'xz5000'  Lo. Δ matrix
;006237'xz1200'  Lo. floating point
```

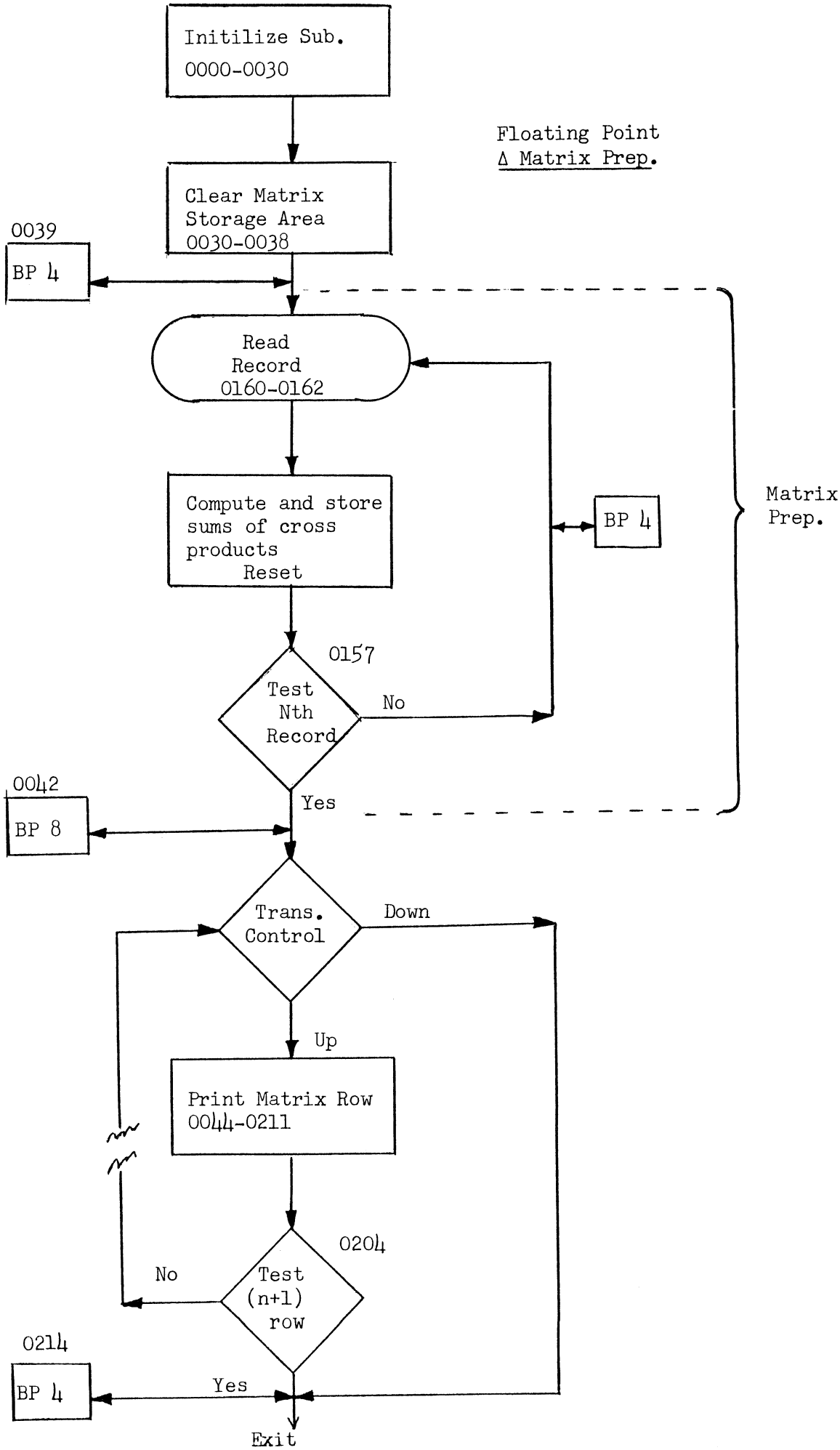
External Storage

```
.0003000'   transfer to matrix prep.  data follows
```

```
+006200'1''4'1'-0000000''
+006200'1'1'4'3'-0000000''
+006200'1'3'3'2'-0000000''
+006200'1'6'2'5'-0000000''
+006200'1'8''4'-0000000''
```

Data

```
.5000000  01   .1800000  02   .1300000  02   .1500000  02
               .1100000  03   .2500000  02   .7100000  02
                            .4500000  02   .3200000  02
                                           .5500000  02
```


Initilize Sub.
0000-0030
Floating Point
Δ Matrix Prep.
Clear Matrix
Storage Area
0030-0038
0039
BP 4
Read
Record
0160-0162
Compute and store
sums of cross
products
Reset
BP 4
Matrix
Prep.
0157
Test
Nth
Record
No
Yes
0042
BP 8
Trans.
Control
Down
Up
Print Matrix Row
0044-0211
0204
Test
(n+1)
row
No
0214
BP 4
Yes
Exit

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JOB NO. | PROGRAM NO. F2-130 | PROGRAM PREPARED BY: Burggrabe | PROGRAM CHECKED BY: POOL Review | DATE 4-29-59

PROBLEM: Floating Point Δ Matrix Prep | TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		00 0 0	X	B 6233	/	n	
		0 1	A	0111	/	1 @ 29	
		0 2	X	H 6261	/	(n+1) @ 29	
		0 3	A	0111	/	☒ 1 @ 29	
		0 4	X	H 6262	/	(n+2) @ 29	
		0 5	X	N 6261	/	(n+1) @ 29	$\frac{(n+1)(n+2)}{2}$ @ 27
		0 6	M	0113	/	1 @ 3	$\frac{(n+1)(n+2)}{2}$ @ 29
		0 7	X	C 6263	/	☒ $\frac{(n+1)(n+2)}{2}$ @ 29	
		0 8	X	B 6235	/	Lo Record	
		0 9	Y	0103	/	}	
		1 0	Y	0104	/	} Init. Matrix	Prep
		1 1	Y	0110	/	☒ }	
		1 2	X	A 6261	/	}	
		1 3	Y	0114	/	}	
		1 4	X	B 6236	/	Lo Δ Matrix	
		1 5	Y	0105	/	☒ }	
		1 6	Y	0106	/	} Matrix Prep	
		1 7	Y	0100	/	}	
		1 8	Y	0032	/	Clear	
		1 9	Y	0049	/	☒ Print	
		2 0	X	A 6263	/	$\frac{(n+1)(n+2)}{2}$ @ 29	
		2 1	X	C 6260	/	Matrix L_f +1	
		2 2	X	S 6234	/	No records @	29
		2 3	C	0120	/	☒ Matrix Prep Ctr	
		2 4	X	B 6237	/	Lo Floating	Point
		2 5	Y	0101	/	} arith	
		2 6	Y	0102	/	}	
		2 7	Y	0160	/	☒ } data in	
		2 8	Y	0161	/	}	
		2 9	Y	0047	/	} Print	
		3 0	Y	0048	/	}	
		3 1	B	0203	/	☒ o	

FORM LP-10

☒ CARRIAGE RETURN

ROYAL McBEE, J13561X

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JOB NO.

PROGRAM NO. F2-130

PROGRAM PREPARED BY: Burggrabe

PROGRAM CHECKED BY: POOL Review

DATE 4-29-59

PROBLEM: Floating Point Δ Matrix Prep

TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0032	C[ ]		/	Σ area	
		0033	B	0032	/		
		0034	A	0111	/	1 @ 29	
		0035	Y	0032	/	☒	
		0036	E	0112	/		
		0037	XS	6260	/		
		0038	T	0031	/		
		0039	XZ	0400	/	☒	
		0040	R	0122	/	} Matrix Prep	
		0041	U	0160	/	} Linkage	
		0042	XZ	0800	/		
		0043	800T	0214	/	☒ Skip matrix Print	
		0044	XB	6261	/	n + 1 @ 29	
		0045	XC	6259	/	ctr 1 → (n+1)	
		0046	XC	6258	/	ctr 2 → 0	
		0047	R[ ]		/	☒ F.P. linkage	
		0048	U[ ]		/		
		0049	B[ ]		/	$\Sigma X_i X_j$ n	
		0050	XP	0000	/	Print $\Sigma X_i X_j$	
		0051	XE	0000	/	☒ Exit F.P.	
		0052	B	0049	/		
		0053	A	0111	/	1 @ 29	
		0054	Y	0049	/		
		0055	XB	6258	/	☒ ctr 2	
		0056	A	0111	/	1 @ 29	
		0057	XH	6258	/		
		0058	XS	6259	/	ctr 1	
		0059	T	0047	/	☒	
		0060	XP	1600	/	cr. end of line	
		0061	XC	6258	/	ctr 2 → 0	
		0062	XB	6259	/	ctr 1	(Line number)
		0063	U	0200	/	☒	

FORM LP-12

☒ CARRIAGE RETURN

/ = CONDITIONAL STOP CODE

LGP-30 CODING SHEET

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JOB NO.	PROGRAM NO.	PROGRAM PREPARED BY:	PROGRAM CHECKED BY:	DATE
	F2-130	Burggrabe	POOL Review	4-29-59
PROBLEM:				TRACK
Floating Point Δ Matrix Prep				01

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0100	[	]	/	Lo Δ Matrix	
		01	R	[ ]	/		
		02	U	[ ]	/		
		03	P	[ ]	/	☒ X_1	
		04	M	[ ]	/	X_j	
		05	A	[ ]	/	$\sum_{1}^{k} X_i X_j$	
		06	H	[ ]	/	$\sum_{1}^{k+1} X_i X_j$	
		07	XE	0000	/	☒	
		08	B	0105	/		
		09	U	0125	/		
,00000008	'	10	[	]	/	Data Lo	
		11		4	/	☒ 1 @ 29	
		12		3www j	/	Mask	
		13	1000	0000	/	1 @ 3	
		14	[	]	/	Data L_f + 1	
		15	8	1000	/	☒ cr in hex	
		16			/	delay	
		17	8	1000	/	(Hex) cr in hex	
		18	U	0121	/	Exit Path	
,00000006	'	19		4	/	☒ 1 @ 29	
		20			/	-n @ 29	
		21		4	/	1 @ 29 & delay	
		22	U	[ ]	/	Exit Matrix Prep.	
		23			/	☒	
		24		4	/	1 @ 29	
		25	A	0111	/	1 @ 29	
		26	Y	0105	/		
		27	Y	0106	/	☒	
		28	U	0131	/		
		29			/		
		30			/		
		31	B	0103	/	☒	

☒ CARRIAGE RETURN

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JOB NO. | PROGRAM NO. F2-130 | PROGRAM PREPARED BY: Burggrabe | PROGRAM CHECKED BY: POOL Review | DATE 4-29-59

PROBLEM: Floating Point Δ Matrix Prep | TRACK 01

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
		0132	A	0111		1 @ 29	
		33	E	0112		3wwj mask	
		34	Y	0103			
		35	S	0114		Data L_f +1	
		36	T	0101			
		37	U	0145			
		38	Y	0103			
		39	Y	0104			
		40	E	0112		3wwj mask	
		41	U	0142			
		42	S	0114			
		43	T	0101			
		44	U	0148			
		45	B	0124		1 @ 29	
		46	A	0104			
		47	U	0138			
		48	B	0100		Lo Δ Matrix	
		49	Y	0106			
		50	Y	0105			
		51	B	0110		Lo Data	
		52	Y	0103		Lo Data	
		53	Y	0104			
		54	B	0119			
		55	A	0120		-N @ 29	
		56	H	0120			
		57	T	0159			
		58	U	0115		Exit Path →	
		59	XZ	0400		BP 4 stop	after each record
		60	R	[ ]		←	U here
		61	U	[ ]			for Matrix prep portion
		62	XI	0000		Input data	
		63	U	0103			

FORM LP-12

CARRIAGE RETURN

CONDITIONAL STOP CODE

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL

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JOB NO.	PROGRAM NO.	PROGRAM PREPARED BY:	PROGRAM CHECKED BY:	DATE
	F2-130	Burggrabe	POOL Review	4-29-59

PROBLEM: Floating Point Δ Matrix Prep

TRACK 0 2

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0200	S	0111	/	1@ 29	
		01	XH	6259	/		
		02	S	0111	/	1@ 29	
		03	XZ	0000	/	☒ delay & 0	
		04	800T	0212	/	→ Exit Path	finished last line
		05	XS	6233	/	n@ 29	(How many tabs)
		06	T	0208	/		
		07	U	0047	/	☒ Print next	line of numbers
		08	XP	2400	/	tab	
		09	XZ	0000	/	delay	
		10	A	0111	/	1 @ 29	
		11	U	0206	/	☒	
		12	XP	1600	/	cr.	
		13	XZ	0000	/		
		14	XZ	0400	/	B.P. 4 stop	after printing
		15	U	[ ]	/	☒	
		16			/		
		17			/		
		18			/		
		19			/	☒	
		20			/		
		21			/		
		22			/		
		23			/	☒	
		24			/		
		25			/		
		26			/		
		27			/	☒	
		28			/		
		29			/		
		30			/		
		31			/	☒	

FORM LP-10

ROYAL McBEE J13541X

☒ CARRIAGE RETURN

/ = CONDITIONAL STOP CODE

TITLE: Triangular Matrix Scaling

AUTHOR: William F. Burggrabe
Compumatix, Incorporated

DATE: September 4, 1959

PURPOSE: Given a matrix in floating point of the form ...

$$\begin{matrix} N & \Sigma \frac{X_1}{C_1} & \Sigma \frac{X_2}{C_2} & \cdots & \Sigma \frac{X_n}{C_n} \\ & \Sigma \left(\frac{X_1}{C_1}\right)^2 & \Sigma \frac{X_1}{C_1} \times \frac{X_2}{C_2} & \cdots & \Sigma \frac{X_1}{C_1} \times \frac{X_n}{C_n} \\ & & & & \vdots \\ & & & & \Sigma \left(\frac{X_n}{C_n}\right)^2 \end{matrix}$$

And scale factors 1, C_1, C_2 ... C_n compute the matrix.

$$\begin{matrix} N & \Sigma X_1 & \Sigma X_2 & \Sigma X_3 & \cdots & \Sigma X_n \\ & \Sigma X_1^2 & \Sigma X_1 X_2 & \cdots\cdots & & \Sigma X_1 X_n \\ & & & & & \vdots \\ & & & & & \Sigma X_n^2 \end{matrix}$$

RESTRICTIONS:

1) The following locations must contain:

6236	Lo matrix
6237	Lo floating point 24.0
6241	Lo scale factors
6261	(n+1) @ 29 - Matrix order

2) The scale factors in floating point must be stored in the same order as the matrix components.

3) Normal Limitations of 24.0, 11.6 - 12.6.

4) All scale factors must be stored. (i.e.) Where a scale factor is unity it must be stored

$$(1 \times 1 \times N = N,\ 1 \times C_1 \times \frac{X_1}{C_1} = X_1 \text{ , etc.}$$

CODING INFORMATION:

A) Subroutine storage - 41 sectors

External storage	6236	Lo Δ Matrix
	6237	Lo Floating Point
	6241	Lo scale factors
	6260	Temp storage
	6261	(n+1) @ 29*

B) Linkage

R	Lo + 40
U	Lo

C) Input - the following must be stored in memory

1) Δ Matrix in floating point
2) Scale factors in floating point

D) Output Scaled Δ matrix. Stored in the same location as unscaled matrix.

E) Constants

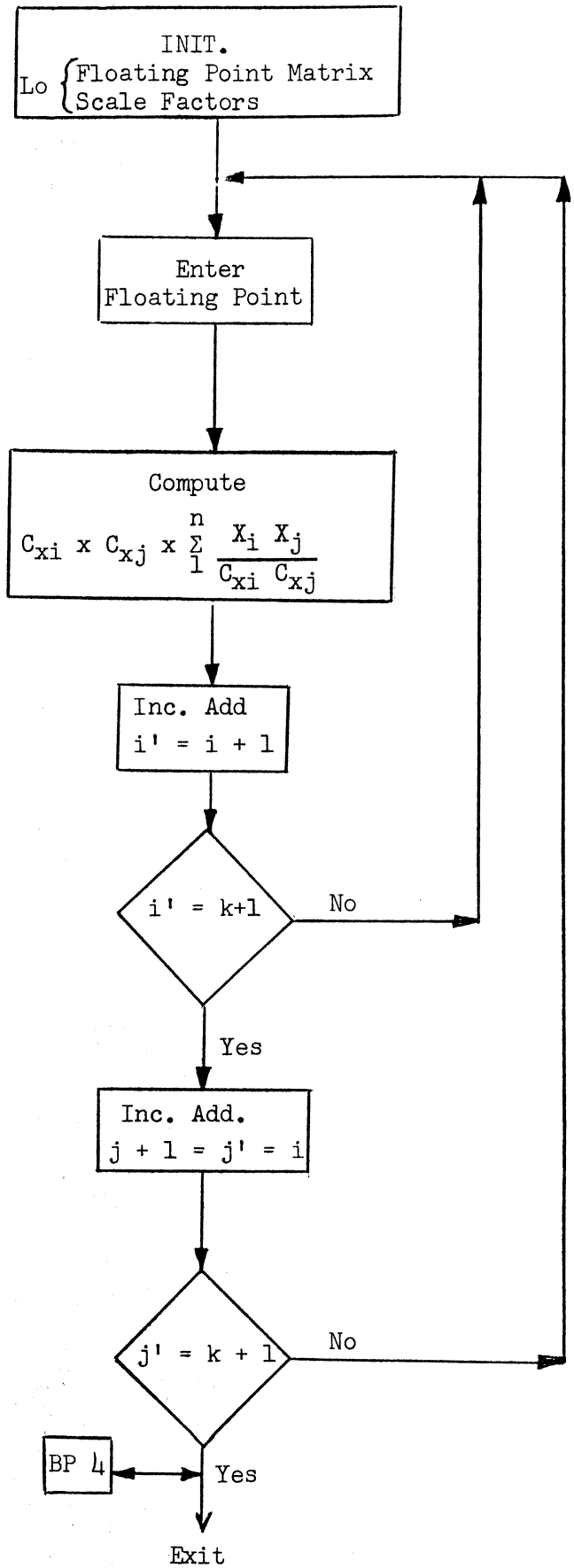
Lo + 30	XZ6363 Mask
Lo + 31	1 @ 29

F) Timing (n+1)(n+2) x .65 sec.

* From CI Δ matrix prep. routines.

Δ

MATRIX SCALING



LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL | PAGE 1 / 2

JOB NO. | PROGRAM NO. F2-130 | PROGRAM PREPARED BY: Burggrabe | PROGRAM CHECKED BY: POOL Review | DATE 4-9-59

PROBLEM: Matrix Scale | TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0000	XB	6237	/	Lo F. P.	
		0001	Y	0011	/		
		0002	Y	0012	/		
		0003	XB	6236	/	☒ Lo Matrix	
		0004	Y	0013	/		
		0005	Y	0017	/		
		0006	XB	6241	/	Lo Scale Factors	
		0007	Y	0014	/	☒	
		0008	Y	0016	/		
		0009	XA	6261	/	(n+1) @ 29 → L_f +1 (Scale Factors)	
		0010	XY	6260	/		
		0011	R	[ ]	/	☒ F.P. Linkage	
		0012	U	[ ]	/		
		0013	P	[ ]	/	$\Sigma X_i X_j$	
		0014	M	[ ]	/	$C X_i$	
		0015	XU	0000	/	☒ Acc → Mult.	
		0016	M	[ ]	/	$C X_i$	
		0017	H	[ ]	/	$C X_i$ $C X_j$ $\Sigma X_i X_j$	
		0018	XE	0000	/	Exit F.P.	
		0019	B	0013	/	☒ Add of $\Sigma X_i X_j$	
		0020	A	0031	/	1 @ 29	
		0021	Y	0013	/		
		0022	Y	0017	/		
		0023	B	0014	/	☒ Add. of CX_i	
		0024	A	0031	/	1 @ 29	
		0025	Y	0014	/		
		0026	E	0030	/	Mask	
		0027	XS	6260	/	☒ L_f +1 of	CX's
		0028	T	0011	/	Loop	
		0029	U	0032	/		
		0030	XZ	6363	/	Mask	
		0031	XZ	0001	/	☒ 1@ 29	

FORM LP-10

ROYAL McBEE, J13841X

☒ CARRIAGE RETURN

/ = CONDITIONAL STOP CODE

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL

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JOB NO.

PROGRAM NO. F2-130

PROGRAM PREPARED BY: Burggrabe

PROGRAM CHECKED BY: POOL Review

DATE 4-9-59

PROBLEM: Matrix Scale

TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
		00032	B	0016			
		33	A	0031		1 @ 29	
		34	Y	0014			
		35	Y	0016		X	
		36	E	0030			
		37	X S	6260			
		38	T	0011		loop	
		39	X Z	0400		X	BP 4 stop after scaling
		40	U	[ ]			
		41					
		42					
		43				X	
		44					
		45					
		46					
		47				X	
		48					
		49					
		50					
		51				X	
		52					
		53					
		54					
		55				X	
		56					
		57					
		58					
		59				X	
		60					
		61					
		62					
		63				X	

FORM LP-12

X CARRIAGE RETURN

TITLE: Calculation of means, standard deviations and correlation coefficient triangular matrix

AUTHOR: William F. Burggrabe, Jr.
Compumatix, Incorporated

DATE: September 23, 1959

PURPOSE: Given a floating point Δ matrix as prepared by either the fixed or floating point Δ matrix preparation subroutine, compute the means, standard deviations and the all simple correlation coefficients.

n = Number variables

N = Number records

The Rij matrix replaces all cross product terms in the original matrix. The means and standard deviations (n values each) will be stored in the correct order starting in the Lo specified. Each value is printed out in normal floating point form as computed. (See sample problem).

RESTRICTIONS:

1) Normal restrictions of 24.0, 11.6 - 12.6

2) Required computational storage

mean Lo thru Lo + (n-1)

σx Lo thru Lo + (n-1)

Δ Data matrix Lo thru Lo + $\frac{(n+1)\ (n+2)}{2}$ -1

Δ Rij matrix replaces all but first row of Δ data matrix

3) The following information must be supplied:

Location	6233	n @ 29
	6236	Lo Δ data matrix
	6237	Lo floating point
	6238	Lo means
	6239	Lo standard deviations
	6258)	
	6259)	Temp. storage area
	6260)	
	6261	n + 1 @ 29*

* Supplied by Compumatix, Inc. Δ Matrix Prep. Progs.

4) Output: 24.0 - 12.6 format

GENERAL INFORMATION ON METHOD:

The equations used are:

1) $\bar{X}_i = \frac{\Sigma X_i}{N}$

2) Standard deviation

$$\sigma x_i = \sqrt{\frac{\Sigma X_i^2}{N} - (\bar{X})^2}$$

3) Correlation coefficient

$$Rij = \frac{\frac{\Sigma X_i X_i}{N} - \bar{X}_i \bar{X}_j}{\sigma x_i \quad \sigma x_j}$$

CODING INFORMATION:

A) Storage - subroutine 2 tracks and 17 sectors

Calculated storage as described above under "restrictions" 2 and 3

B) No calling sequence required.

Linkage (R Lo + 216
(U Lo

C) Input: None

D) Output: Format of 24.0 - 12.6

All answers are printed as computed. The correct number of tabs preceeds the printing of each diagonal element of rij matrix (see sample problem). The tabs may be eliminated by changing t[0209] in 0207 to u[0208] or u0127.

E) Constants 0024 1 @ 29
0201 XZ6363 mask

and areas mentioned under Restriction (3).

F) Timing: The approximate times including printing are:

Means: 3 n sec.

Standard deviations: 4 n sec.

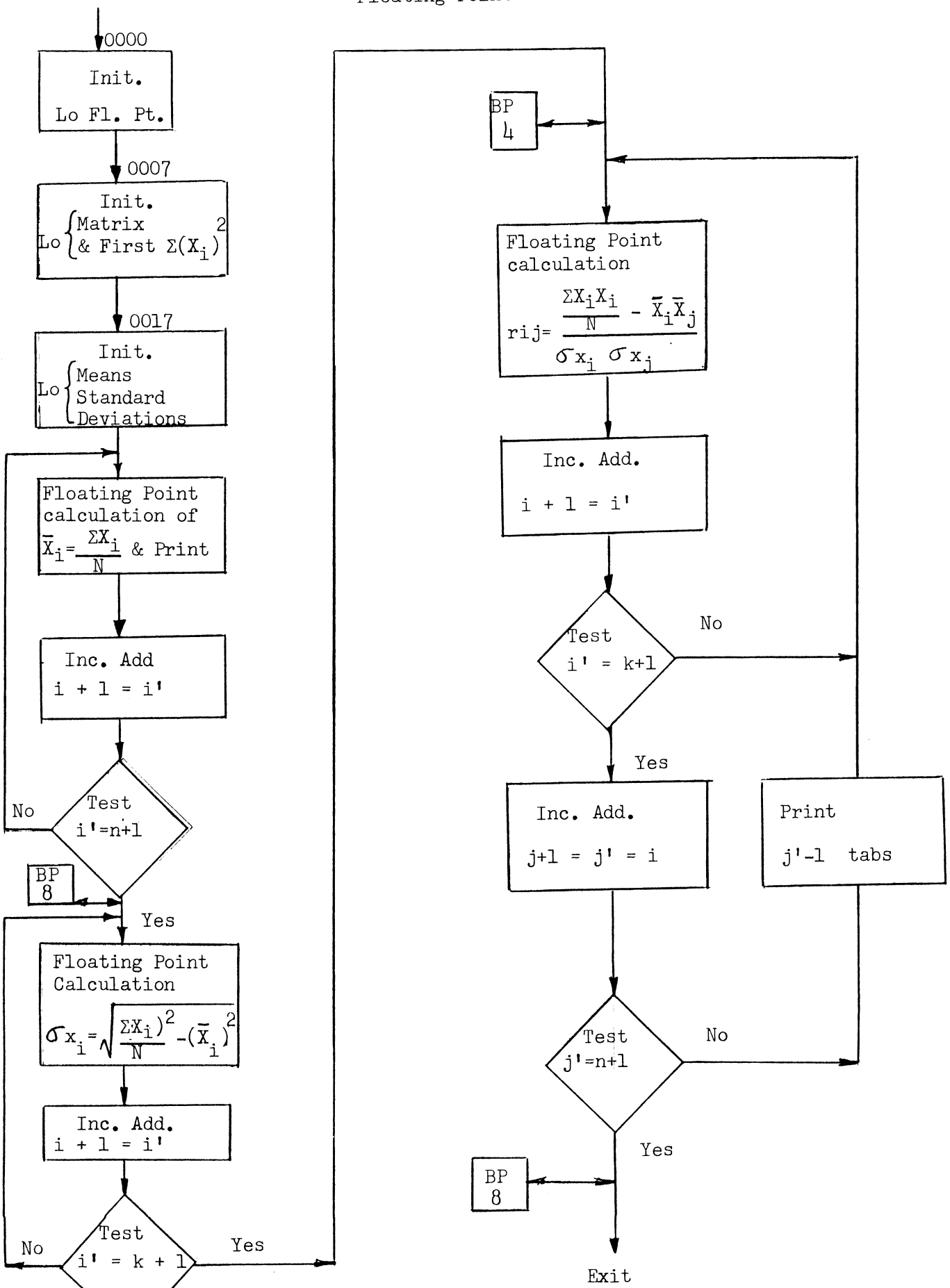
rij matrix: n(n+1) x 2.25 sec.

Where n is the total numberof variables.

G) Program stops:

0051	Breakpoint 8	$\bar{X}_i$	calculations complete
0022	Breakpoint 4	σx_i	calculation complete
0215	Breakpoint 8	rij	calculation complete

Flow Diagram
Calculation of Means, Standard Deviations and Correlation Coefficient Triangular Matrix Floating Point



LGP-30 CODING SHEET

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JOB NO.	PROGRAM NO.	PROGRAM PREPARED BY:	PROGRAM CHECKED BY:	DATE
	F2-130	Burggrabe	POOL Review	4-20-59
PROBLEM: Given: Δ Matrix: Compute & Print $\bar{X}_i$, σ_{xi} , Rij Matrix (F.P.)				TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0000	XB	6237	/	Lo Floating Point	
		0001	Y	0033	/	mean } sub	
		0002	Y	0034	/	mean }	
		0003	Y	0056	/	☒	
		0004	Y	0056	/		
		0005	Y	0127	/	rij } sub	
		0006	Y	0128	/	rij }	
		0007	XB	6236	/	☒ Lo Δ Matrix	
		0008	Y	0036	/	mean } Lo of N	
		0009	Y	0061	/	σ }	
		0010	Y	0133	/	rij	
		0011	A	0024	/	☒ 1 @ 29	
		0012	Y	0035	/	Lo first	$\sum_{1}^{n}(X_i)$ (For mean)
		0013	XA	6233	/	gives Lo first	$\sum_{1}^{n}(X_i)^2$ (N @ 29)
		0014	Y	0060	/	σx_i sub	
		0015	Y	0132	/	☒ rij } sub	
		0016	Y	0137	/	rij }	
		0017	XB	6238	/	Lo mean	
		0018	Y	0037	/	mean sub	
		0019	Y	0057	/	☒ σx_i } sub	
		0020	Y	0058	/	σx_i }	
		0021	Y	0129	/	rij } sub	
		0022	Y	0130	/	rij }	
		0023	XP	1600	/	☒ cr.	
		0024	XZ	0001	/	delay & 1 @	29
		0025	XB	6239	/	Lo standard deviations	
		0026	Y	0100	/	σx_i sub	
		0027	Y	0135	/	☒	
		0028	Y	0136	/		
		0029	XB	6236	/	Lo Δ Matrix	
		0030	XA	6261	/	n + 1 @ 29	
		0031	XC	6260	/	☒ Mean L_f +1	to test out

FORM LP-10

ROYAL McBEE, J13541X

☒ CARRIAGE RETURN

/ = CONDITIONAL STOP CODE

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL

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JOB NO.

PROGRAM NO. F2-130

PROGRAM PREPARED BY: Burggrabe

PROGRAM CHECKED BY: POOL Review

DATE 4-20-59

PROBLEM: Given: Δ Matrix; Compute & Print $\bar{X}_i, \sigma_{xi}$ Rij Matrix (F.P.)

TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0032	XP	1600	/	cr.	
		33	R	[ ]	/	F. Point	
		34	U	[ ]	/		
		35	B	[ ]	/	☒ $\sum_{n} X_i$	
		36	D	[ ]	/	No. of records	
		37	H	[ ]	/	$\bar{X}_i$	
		38	XP	0000	/	Print $\bar{X}_i$	
		39	XE	0000	/	☒ Exit Floating Point	
		40	B	0037	/	Add $\bar{X}_i$	
		41	A	0024	/	1 @ 29	
		42	Y	0037	/		
		43	B	0035	/	☒ Add. $\sum X_i$	
		44	A	0024	/	1 @ 29	
		45	Y	0035	/		
		46	E	0201	/	3wwj mask	
		47	XS	6216	/	☒	
		48	T	0033	/	loop back n times	
		49	XP	1600	/	cr.	
		50	XZ	0000	/	delay	
		51	XZ	9800	/	☒ BP 8 stop after means	
		52	XB	6261	/	(n+1)@ 29	
		53	XC	6260	/	Temp 1 (ctr)	
		54	XP	1600	/	Δ Matrix L_f +1(set for σx_i)(Temp 1)	
		55	R	[ ]	/	☒ F.P.	
		56	U	[ ]	/		
		57	P	[ ]	/	$\bar{X}_i$	
		58	M	[ ]	/	$\bar{X}_i$	
		59	XH	6259	/	☒ Temp 2	$(\bar{X}_i)^2$
		60	B	[ ]	/	$\sum_{n} X^2_i$	
		61	D	[ ]	/	No of records	
		62	XS	6259	/	$\bar{X}_i^2$	
		63	XR	0000	/	☒ $\sqrt{}$	

FORM LP-12

☒ CARRIAGE RETURN

METAL MARK 11154 1X

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JOB NO.	PROGRAM NO.	PROGRAM PREPARED BY:	PROGRAM CHECKED BY:	DATE
	F2-130	Burggrabe	POOL Review	4-20-59
PROBLEM:				TRACK
Given: Δ Matrix; Computes & Print X_i, σ_{xi}, Rij Matrix (F.P.)				00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		9100	H	[ ]	/	Standard Deviation	
		101	XP	90100	/	Print stand. Div.	
		102	XE	90100	/		
		103	B	90517	/	☒ Add. of $\bar{X}_i$	
		104	A	90214	/	1 @ 29	
		105	Y	90517	/		
		106	Y	90518	/		
		107	B	91000	/	☒ Add of σ_{xi}	
		108	A	90214	/	1 @ 29	
		109	Y	91010	/		
		110	XB	62600	/	Temp 1 (n+1, n,n-1,etc.)	
		111	S	90214	/	☒ 1 @ 29	
		112	XH	62600	/	Temp 1	
		113	A	90600	/	Add. of ΣX_i^2 (n)	
		114	Y	90600	/		
		115	B	90214	/	☒ 1 @ 29	
		116	XS	62600	/	Temp 1 (Test out when = 1)	
		117	T	90555	/	loop back	(n times)
		118	XP	16000	/	cr.	
		119	XZ	90000	/	☒	
		120	XP	16000	/	cr.	
		121	XZ	90000	/		
		122	XZ	94000	/	Bp. 4 stop after σ_{x_i} cal.	
		123	XB	62388	/	☒ Lo mean	
		124	XA	62333	/	n @ 29	
		125	XC	62600	/	mean L_f +1	(Temp 1)
		126	XC	62599	/	tab counter	(Temp 2)
		127	R	[ ]	/	☒ F.P.	
		128	U	[ ]	/		
		129	P	[ ]	/	$\bar{X}_i$	
		130	M	[ ]	/	$\bar{X}_j$	
		131	XH	62588	/	☒ Temp 3	$(\bar{X}_i \bar{X}_j)$

FORM LP-10

ROYAL MCBEE, J13541X

☒ CARRIAGE RETURN

/ = CONDITIONAL STOP CODE

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JOB NO. | PROGRAM NO. F2-130 | PROGRAM PREPARED BY: Burggrabe | PROGRAM CHECKED BY: POOL Review | DATE 4-20-59

PROBLEM: Given: Δ Matrix; Computes & Print X_i, σ_{xi}, Rij Matrix (F.P.) | TRACK 01

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	☒					
		01 32	B [ ]		'		$\Sigma X_i X_j$
		33	D [ ]		'		No. of records
		34	XS	6258	'		Temp. 3
		35	D [ ]		'	☒	σ_{xi}
		36	D [ ]		'		σ_{xi}
		37	H [ ]		'		rij
		38	XP	0000	'		Print rij
		39	XE	0000	'	☒	Exit F.P.
		40	B	0132	'		add $\Sigma X_i X_j$
		41	A	0024	'		1 @ 29
		42	Y	0132	'		
		43	Y	0137	'	☒	
		44	B	0136	'		add σ_{xi}
		45	A	0024	'		1 @ 29
		46	Y	0136	'		
		47	B	0130	'	☒	add $\bar{X}_j$
		48	A	0024	'		1 @ 29
		49	Y	0130	'		
		50	E	0201	'		3wwj mask
		51	XS	6260	'	☒	mean L_f +1
		52	T	0127	'		
		53	B	0135	'		add σ_{xi}
		54	A	0024	'		1 @ 29
		55	Y	0135	'	☒	
		56	Y	0136	'		
		57	B	0129	'		add $\bar{X}_i$
		58	A	0024	'		1 @ 29
		59	Y	0129	'	☒	
		60	Y	0130	'		
		61	E	0201	'		3wwj mask
		62	XS	6260	'		mean L_f +1
		63	T	0202	'	☒	

FORM LP-12

☒ CARRIAGE RETURN

ROYAL M BIT J135-41X

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JOB NO. | PROGRAM NO. F2-130 | PROGRAM PREPARED BY: Burggrabe | PROGRAM CHECKED BY: POOL Review | DATE 4-20-59

PROBLEM: Given: Δ Matrix; Computes & Print X_i, σ_{xi}, Rij Matrix (F.P.)

TRACK 02

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	X					
		0200	U	0213	/	Exit Path →	
		01	XZ	6363	/	mask for extract's	
		02	XP	1600	/	cr.	
		03	XB	6259	/	X tab ctr	
		04	A	0024	/	1 @ 29	increase tab ctr by 1
		05	XC	6259	/		
		06	XS	6259	/	make acc. negative	
		07	T	0209	/	X print tab	
		08	U	0127	/	Exit tab loop	
		09	XZ	0000	/	delay	
		10	XP	2400	/	tab	
		11	A	0024	/	X 1@ 29	
		12	U	0207	/	loop	
		13	XP	1600	/	cr.	
		14	XZ	0000	/		
		15	XZ	0800	/	X	
		16	U	[ ]	/		
		17			/		
		18			/		
		19			/	X	
		20			/		
		21			/		
		22			/		
		23			/	X	
		24			/		
		25			/		
		26			/		
		27			/	X	
		28			/		
		29			/		
		30			/		
		31			/	X	

FORM LP-10

X CARRIAGE RETURN

ROYAL McBEE, J13541X

TITLE: Convert triangular Rij matrix to a square Rij matrix -- modified.

AUTHOR: William F. Burggrabe, Jr.
Compumatix, Incorporated

DATE: October 13, 1959

PURPOSE: Given a triangular matrix as prepared by the subroutine "Calculation of Means, Standard Deviations and Δ Correlation Coefficient Matrix", convert the Δ correlation coefficient portion to a square Rij matrix with the initial location of Δ Rij equal to the initial location of the □ Rij. This routine also sets automatically location 6240 to the correct address.

RESTRICTIONS:

A) The Lo Δ Rij matrix = Lo □ Rij matrix

B) The entire subroutine is in fixed point and will operate on both fixed and floating point format matricies, but will not operate on matricies in an extended range format.

C) External storage as on attached sheet.

METHOD: The subroutine takes advantage of the symmetry of the matrix and sets cell ij = cell ji. A looping process builds both the row and column cells of the square matrix while stepping through the matrix from the bottom.

CODING INFORMATION:

A) Storage: 56 sectors

B) Constants:
Lo + 51 1 @ 2
Lo + 52 1 @ 29
Lo + 53 Mask

C) Linkage:
R [Lo + 55]
U [Lo]

D) Stops: Break point 4 at end of conversion

E) Timing: Approximately $\frac{n(n+1)}{6}$ seconds.

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL

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JOB NO.	PROGRAM NO.	PROGRAM PREPARED BY:	PROGRAM CHECKED BY:	DATE
	F2-130	Burggrabe	POOL Review	10-13-59

PROBLEM: External Storage Δ → □ Rij Modified

TRACK: 62

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		6232			/		
		33	X Z	[ ]	/	n @ 29	No variables *
		34			/		
		35			/	☒	
		36	X Z	[ ]	/	Lo Δ Data	Matrix *
		37			/		
		38			/		
		39			/	☒	
		40	X Z	[ ]	/	Lo □ rij Matrix	
		41			/		
		42			/		
		43			/	☒	
		44			/		Note: * These locations
		45			/		must be filled prior
		46			/		to entry into the
		47			/	☒	subroutine.
		48			/		
		49			/		
		50			/		Note ✓: These locations
		51			/	☒	normally filled by
		52			/		Δ Matrix Prep sub.
		53			/		
		54			/		
		55			/	☒	
		56			/		
		57			/		
		58	[ ]		/		
		59	[ ]		/	☒	Temp storage
		60	[ ]		/		
		61	[ ]		/	n + 1 @ 29	* ✓
		62			/		
		63	[ ]		/	☒ $\frac{(n+1)(n+2)}{2}$	@ 29 * ✓

FORM LP-12

☒ = CARRIAGE RETURN

/ = CONDITIONAL STOP CODE

ROYAL M 011 J13541X

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JOB NO.	PROGRAM NO.	PROGRAM PREPARED BY:	PROGRAM CHECKED BY:	DATE
	F2-130	Burggrabe	POOL Review	10-10-59
PROBLEM:				TRACK
Δ Rij → □ Rij Matrix Conversion				00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
;0000 Lo	/						
/0000 Lo	/	☒					
		0000	XB	6236	/	Lo Δ data Matrix	
		0001	XA	6263	/	$\frac{(n+1)(n+2)}{2}$ @ 29	
		0002	S	0052	/	1 @ 29	
		0003	Y	0017	/	☒ B [ ]	L_f Δ data matrix
		0004	XB	6236	/	Lo Δ data matrix	
		0005	XA	6261	/	n + 1 @ 29	
		0006	XC	6240	/	Lo Δ rij matrix & Lo □ rij matrix	
		0007	XC	6260	/	☒ Temp # 1 → 0	
		0008	XC	6259	/	Temp # 2 → 0	Init. ctr's
		0009	XC	6258	/	Temp # 3 → 0	
		0010	XB	6233	/	n @ 29	
		0011	XN	6233	/	☒ n @ 29	
		0012	M	0051	/	1 @ 2 → n^2 @ 29	
		0013	XA	6240	/	Lo □ rij matrix	
		0014	S	0052	/	1 @ 29	L_f □ rij matrix
		0015	Y	0018	/	☒ H [ ]	
		0016	Y	0019	/	C [ ]	
		0017	B	[ ]	/	rij Δ matrix	
		0018	H	[ ]	/	rij □ (row)	
		0019	C	[ ]	/	☒ rij □ (Col)	
		0020	B	0017	/	B [ ]	
		0021	S	0052	/	1 @ 29	
		0022	Y	0017	/	B [ ]	
		0023	B	0018	/	☒ H [ ]	
		0024	S	0052	/	1 @ 29	
		0025	Y	0018	/	H [ ]	
		0026	XY	6258	/	Temp # 3	
		0027	B	0019	/	☒ C [ ]	
		0028	XS	6233	/	n @ 29	
		0029	Y	0019	/	C [ ]	
		0030	E	0053	/	3wwj Mask	
		0031	XS	6258	/	☒ Temp # 3	

☒ CARRIAGE RETURN

/ = CONDITIONAL STOP CODE

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL | PAGE 2 / 2

JOB NO. | PROGRAM NO. F2-130 | PROGRAM PREPARED BY: Burggrabe | PROGRAM CHECKED BY: POOL Review | DATE 10-10-59

PROBLEM: Δ Rij → □ Rij Matrix Conversion | TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0032	T	0034	/	Test out	
		33	U	0017	/	loop	
		34	B	0019	/	C[ ]	
		35	XA	6259	/ ☒	Temp 2	0,1,2,...n-1
		36	Y	0018	/	H[ ]	
		37	XB	6259	/	Temp 2	}
		38	A	0052	/	1@ 29	} Inc. ctr. 2
		39	XC	6259	/ ☒	Temp 2	}
		40	XB	6258	/	= old H[ ]	
		41	XA	6260	/	Temp 1	0,n,2n...(n-1)n
		42	Y	0019	/	C[ ]	
		43	XB	6260	/ ☒	Temp 1	}
		44	XA	6233	/	n @ 29	} Inc. ctr. 1
		45	XC	6260	/	Temp 1	}
		46	B	0018	/	H[ ]	
		47	E	0053	/ ☒	3wwj	Mask
		48	XS	6240	/	Lo □ rij matrix	
		49	T	0054	/	test out	
		50	U	0017	/	loop →	
,0000 0003	'	51	2000	0000	/ ☒	1 @ 2	
		52		4	/	1 @ 29	
		53		3wwj	/	Mask	
		54	XZ	0400	/	BP 4 stop after conversion	
		55	U	[ ]	/ ☒	Exit	
.0000 0000	'	56			/		
		57			/		
		58			/		
		59			/ ☒		
		60			/		
		61			/		
		62			/		
		63			/ ☒		

☒ CARRIAGE RETURN

FORM LP-12

ROYAL M-011 J13541X

TITLE: Compute and Print Matrix Inverse

AUTHOR: William F. Burggrabe, Jr.
Compumatix, Incorporated

DATE: April 24, 1959

PURPOSE: A) Initialize and transfer control to the matrix inversion routine (29.0)

B) Printout the inverse if it is desired (transfer control up).

RESTRICTIONS:

1) Normal restrictions of 24.0, 12.6 and 29.0

2) See attached sheet for external information that must be supplied.

3) Output - 12.6 format

CODING INFORMATION:

A) Storage: 55 sectors and under two above.

B) Linkage: R (Lo + 54)
U (Lo)

C) Input: None

D) Output: 12.6 format with a carriage return after each row.

NOTE: Transfer control down skips printing to Lo + 53.

E) Constants:

Lo + 28	1 @ 29
Lo + 29	14 @ 29
Lo + 30	XZ0149
Lo + 31	1 @14

F) Timing:

Inversion: Approximately 1.08 n^3 seconds
Printout: Approximately 2 n^2 seconds

G) Program Stops:

Lo + 15*	B.P. 8 inversion complete
Lo + 53	B.P. 4 printing complete

*Depression of transfer control before continuing causes a transfer to Lo + 53, thus eliminating the printing phase of the program.

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL

PAGE 1 / 1

JOB NO.	PROGRAM NO.	PROGRAM PREPARED BY	PROGRAM CHECKED BY	DATE
	F2-130	Burggrabe	POOL Review	4-24-59

PROBLEM: External Storage

TRACK 62

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		6232			/		
		33	XZ	[ ]	/	n @ 29 = Matrix order	*
		34			/		
		35			/	☒	
		36			/		
		37	XZ	[ ]	/	Lo floating point	*
		38			/		
		39			/	☒	
		40	XZ	[ ]	/	Lo □ rij Matrix	*
		41			/		
		42	XZ	[ ]	/	Lo inversion sub. 29.0	*
		43			/	☒	
		44			/		
		45			/		Note: * These locations
		46			/		must be filled prior
		47			/	☒	to entry into sub-
		48			/		routine
		49			/		
		50			/		
		51			/	☒	
		52			/		
		53			/		
		54			/		
		55			/	☒	
		56			/		
		57			/		
		58			/		
		59	[ ]		/	☒ Temp & Ctr	
		60	[ ]		/	Temp & Ctr	
		61			/		
		62			/		
		63			/	☒	

☒ CARRIAGE RETURN

FORM LP-12

ROYAL-McBEE 11354TX

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL | PAGE 1 / 2

JOB NO. | PROGRAM NO. F2-130 | PROGRAM PREPARED BY: Burggrabe | PROGRAM CHECKED BY: POOL Review | DATE 4-24-59

PROBLEM: Call-in, Compute & Print - Inverse (Rice F.P.M.I.) | TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
; 0 0 0 Lo	/						
/ 0 0 0 Lo	/	☒					
		0000	X B	6233	/	n @ 29	
		0001	D	0031	/	1 @ 14	
		0002	X A	6240	/	Lo □ rij matrix	
		0003	C	0014	/	☒	
		0004	X B	6242	/	Lo matrix Inversion Sub (Rice M.I.)	
		0005	Y	0013	/		
		0006	A	0029	/	XZ0014	
		0007	Y	0012	/	☒	
		0008	A	0030	/	XZ0149	
		0009	Y	0011	/		
		0010	X B	6237	/	Lo Floating Point	
		0011	Y	[ ]	/	☒ (Matrix Inversion Lo + 163)	
		0012	R	[ ]	/	} Matrix Inversion Linkage	
		0013	U	[ ]	/		
		0014	[ ]		/	Code word	
		0015	X Z	0800	/	☒ BP 8 stop after inversion	
		0016	X C	6260	/	Clear acc.	
		0017	8 0 0 T	0053	/	Skip inverse print-out	
		0018	X C	6260	/	ctr 1 → 0	
		0019	X C	6259	/	☒ ctr 2→0	
		0020	X B	6237	/	Lo Floating Point	Init. Print
		0021	Y	0032	/		
		0022	Y	0033	/		
		0023	X B	6240	/	☒ Lo □ Rij matrix inverse	
		0024	Y	0034	/		
		0025	X P	1600	/	cr.	
		0026	X Z	0000	/	delay	
		0027	U	0032	/	☒ transfer over constants	
		0028	X Z	0001	/	1 @29	
		0029	X Z	0014	/	14@ 29	
		0030	X Z	0149	/	Used to set up	~~Lo + 163 in~~ Rice F.P.M.I.
		0031	X Y	0000	/	☒ 1@ 4	

☒ CARRIAGE RETURN

FORM LP-10

ROYAL McBEE J13541X

Royal McBee Corporation
DATA PROCESSING DIV.
PORT CHESTER, NEW YORK

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL

PAGE 2 / 2

JOB NO.

PROGRAM NO.: F2-130

PROGRAM PREPARED BY: Burggrabe

PROGRAM CHECKED BY: POOL Review

DATE: 4-24-59

PROBLEM: Call-in, Compute & Print - Inverse (Rice F.P.M.I.)

TRACK: 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/				/		
	/	☒			/		
		0032	R	[ ]	/	}	F.P. linkage
		33	U	[ ]	/	}	
		34	B	[ ]	/		No. to print
		35	XP	0000	/	☒	Print No.
		36	XE	0000	/		Exit F.P.
		37	B	0034	/		add. of no. printed
		38	A	0028	/		1 @ 29
		39	Y	0034	/	☒	
		40	XB	6260	/		ctr 1
		41	A	0028	/		1 @ 29
		42	XH	6260	/		ctr 1
		43	XS	6233	/	☒	n @ 29
		44	T	0032	/		loop n times
		45	XP	1600	/		cr.
		46	XC	6260	/		ctr 1 → 0
		47	XB	6259	/	☒	ctr 2
		48	A	0028	/		1 @ 29
		49	XH	6259	/		ctr 2
		50	XZ	0000	/		delay
		51	XS	6233	/	☒	n @ 29
		52	T	0032	/		loop n times
		53	XZ	0400	/		BP 4 stop after printing
		54	U	[ ]	/		Exit
		55			/	☒	
		56			/		
		57			/		
		58			/		
		59			/	☒	
		60			/		
		61			/		
		62			/		
		63			/	☒	

FORM LP-12

☒ CARRIAGE RETURN

TITLE: Calculation of Beta Weights, Regression Coefficients; Partial Correlation Coefficient and Standard Error of the Independent Variables; the Constant Term (b_0) and its Standard Error; the Sample Multiple Correlation Coefficient and Standard Error of Estimate; the Universe Multiply Correlation Coefficient and Standard Error of Estimate.

AUTHOR: William F. Burggrabe, Jr.
Compumatix, Incorporated

DATE: May 26, 1960

PURPOSE: Given the inverse of the correlation coefficient matrix, the means and standard deviations of the variables; compute and printout the above.

RESTRICTIONS:

1) The last row and column of the matrix contain elements corresponding to the dependent variable. (Explanation under "Method").

2) Normal restrictions of 24.0 and 12.6

3) See attached sheet for external storage of information that must be supplied.

4) 25.OR in 0900

METHOD:

A) Given a correlation coefficient matrix of the form:

	X_1	X_2	X_3	...	Y
X_1	R_{11}	R_{12}	R_{13}	...	R_{1y}
X_2	R_{21}	R_{22}	R_{23}	...	R_{2y}
X_3	R_{31}	R_{32}	R_{33}	...	R_{3y}
.	.	.	.		.
.	.	.	.		.
.	.	.	.		.
Y	R_{y1}	R_{y2}			R_{yy}

An inverse of the (Rij) matrix is computed yielding:

	X_1	X_2	...	Y
X_1	$\frac{1}{V_{1,23 \ldots Y}}$	$\frac{\beta_{21,34 \ldots}}{V_{2,13 \ldots y}}$	...	$\frac{\beta_{y1,23 \ldots}}{V_{y,123 \ldots}}$
X_2	$-\frac{\beta_{12,34 \ldots}}{V_{1,23 \ldots y}}$	$\frac{1}{V_{2,13 \ldots y}}$	...	$\frac{\beta_{y2,13 \ldots}}{V_{y,123 \ldots}}$
. . .	. . .	. . .		. . .
Y	$-\frac{\beta_{1y,23 \ldots}}{V_{1,23 \ldots y}}$	$-\frac{\beta_{2y,13 \ldots}}{V_{2,13 \ldots y}}$	...	$\frac{1}{V_{y,123 \ldots}}$

B) Where:

1. The β's, Beta weights, are equal to the coefficients of the equation:

$$\frac{Y^1 - \bar{Y}}{\sigma_Y} = \beta_1 \frac{(X-\bar{X})_1}{\sigma_{x_1}} + \beta_2 \frac{(X-\bar{X})_2}{\sigma_{x_2}} + \ldots + \beta_{n-1} \frac{(X-\bar{X})_{n-1}}{\sigma_{x_{n-1}}}$$

Y^1 = Predicted Value

$\beta 1 = \beta_{y1,23 \ldots}$

$\beta_2 = \beta_{y2,13 \ldots}$

$\bar{x}_i, \bar{Y}$ = means

σ_{xi}, σ_y = standard deviations

The β's are obtained by dividing each column element by the principle diagonal element in that column.
NOTE: All β's for <u>all</u> multiple regression equations (i.e.,
are available in the inverse.

2. The regression coefficients are obtained from the beta weights as follows:

$$b_0 = \bar{Y} - \bar{X}_1 \frac{\sigma_y}{\sigma_{x1}} \beta_1 - \bar{X}_2 \frac{\sigma_y}{\sigma_{x2}} \beta_2 - \bar{X}_3 \frac{\sigma_y}{\sigma_{x3}} \beta_3 - \ldots$$

$$b_1 = \beta_1 \frac{\sigma_y}{\sigma_{x1}}$$

$$b_2 = \beta_2 \frac{\sigma_y}{\sigma_{x2}} \quad , \quad \text{Etc.}$$

3. The partial correlation coefficients are obtained by:

$$r^2_{ab,cde\ \ldots} = \frac{\left(\frac{\beta_{ab,cde\ \ldots}}{V_{a,bcde\ \ldots}}\right) \cdot \left(\frac{\beta_{ba,cde\ \ldots}}{V_{b,acde\ \ldots}}\right)}{\left(\frac{1}{V_{a,bcde\ \ldots}}\right) \cdot \left(\frac{1}{V_{b,acde\ \ldots}}\right)}$$

However, because of the symmetry of the inverse,

$$\frac{\beta_{ab,cde\ \ldots}}{V_{a,bcde\ \ldots}} = \frac{\beta_{ba,cde\ \ldots}}{V_{b,acde\ \ldots}}$$

Therefore, each partial correlation coefficient may be obtained by dividing the corresponding off principal diagonal element by the square root of the product of the row, column elements of the principal diagonal.

4. Standare error of regression coefficient --

$$S_{bi} = \hat{S}. \sqrt{\frac{(1-r^2_{iy,123\ \ldots})}{N\sigma^2_i\ (1-R^2_{i,123\ \ldots})}}$$

5. The regression multiple correlation coefficients for the n equations are computed as follows:

$$R^2_{a,bcde} = 1 - \frac{1}{\text{ath diag. element}}$$

or--

$$R = \sqrt{1 - \frac{1}{\frac{1}{V_{y,123\ \ldots}}}}$$

Etc.

6. The standard error of estimate is:

$$S = \sigma_y \sqrt{1 - R^2}$$

7. Universe multiple correlation coefficient --

$$\hat{R} = \sqrt{1 - (1-R^2)\left(\frac{N-1}{N-n}\right)}$$

8. Universe standard error of estimate --

$$\hat{S} = \sigma_y \sqrt{(1-\hat{R}^2)\left(\frac{N}{N-1}\right)}$$

C) The program that has been written assumes the dependent variable cells to occupy the last column and/or row. However, a routine could be written for any other designation, or since the program does not alter the inverse, rows and columns could be interchanged, to put the correct elements in the proper locations for this program.

CODING INFORMATION:

A) Storage 3 tracks 10 sectors plus external storage on attached sheet.

B) Linkage R (Lo + 309)
U (Lo)

C) Input None

D) Output 12.6 - format (See sample problem)

Order: β_1, b_1, $R_{1y,2}$ ... S_{b1} C.R.

β_2, b_2, $R_{2y,1}$ ... S_{b2} C.R.

etc.

Bn-1, bn-1, Rn-1y,1 ... C.R.

Tab b_o Tab S_{bO} C.R.

C.R.

R, , S , $\hat{R}$, $\hat{S}$

E) Constants Lo + 226 1 @29
Lo + 240 1 @2
Lo + 148 Floating point "1"

F) Timing: Approximately 10 n seconds

G) Stops: Lo + 308 B.P. 4 stop at completion of program

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL

PAGE 1 OF 1

JOB NO.	PROGRAM NO.	PROGRAM PREPARED BY:	PROGRAM CHECKED BY:	DATE
	F2-130	Burggrabe	POOL Review	1-15-60

PROBLEM: External Storage

TRACK: 62

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		62 32			/		
		33	XZ	[ ]	/		n @ 29 order of inverse *
		34	XZ	[ ]	/		n @ 29 no. of records *
		35			/	☒	
		36			/		
		37	XZ	[ ]	/		Lo Floating Point *
		38	XZ	[ ]	/		Lo means *
		39	XZ	[ ]	/	☒	Lo standard deviations *
		40	XZ	[ ]	/		Lo inverse (□ rij matrix) *
		41			/		
		42			/		
		43	XZ	[ ]	/	☒	Lo regression coefficients *
		44			/		
		45			/		
		46			/	*	Note: These locations must
		47			/	☒	be filled prior to entering
		48			/		into subroutine
		49			/		
		50			/		
		51			/	☒	
		52			/		
		53	[ ]		/		
		54	[ ]		/		
		55	[ ]		/	☒	
		56	[ ]		/		
		57	[ ]		/		
		58	[ ]		/		Temp
		59	[ ]		/	☒	Temp
		60	[ ]		/		Temp
		61	[ ]		/		n + 1 @ 29 *
		62			/		
		63			/	☒	

FORM LP-12

☒ = CARRIAGE RETURN

/ = CONDITIONAL STOP CODE

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL

PAGE 1 / 7

JOB NO.

PROGRAM NO.: F2-130

PROGRAM PREPARED BY: Burggrabe

PROGRAM CHECKED BY: POOL Review

DATE: 1-15-60

PROBLEM: β_{xi}, b_{xi}, Partial Corr. Coeff, S_{bxi}, b_o, & est, R, σ est, $\hat{R}$, $\hat{\sigma}$ est

TRACK: 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0000	XB	6233	/	n@ 29	
		0001	XN	6233	/	n@ 29	
		0002	M	0240	/	1@ 2	
		0003	S	0226	/	☒ 1@ 29	
		0004	XA	6240	/	Lo □ Matrix	Inverse
		0005	Y	0060	/	Add[1/V_n]	
		0006	XB	6233	/	n@ 29	
		0007	S	0226	/	☒ 1@ 29	
		0008	XH	6254	/	Temp ctr	
		0009	XA	6240	/	Lo □ Matrix	Inverse
		0010	Y	0117	/	$-\beta_i/V_n$	
		0011	Y	0131	/	☒	
		0012	XB	6240	/	Lo □ Matrix	Inverse
		0013	Y	0127	/	Add $1/V_i$	
		0014	XB	6239	/	Lo σ's	
		0015	Y	0123	/	☒ Add [σx_i]	
		0016	Y	0140	/	"	
		0017	Y	0141	/	"	
		0018	XA	6254	/	n-1@ 29	
		0019	Y	0112	/	☒ Add [σ x]	
		0020	Y	0122	/	"	
		0021	Y	0252	/	"	
		0022	XB	6243	/	Lo Reg. Coeff	
		0023	Y	0231	/	☒ Add [b_o]	
		0024	A	0226	/	1 @29	
		0025	Y	0124	/	Add [b_{xi}]	
		0026	Y	0210	/		
		0027	XB	6238	/	☒ Lo means	
		0028	Y	0209	/		
		0029	XA	6254	/	n-1@29	
		0030	Y	0229	/	Add $\bar{Y}$	
		0031	XB	6237	/	☒ Lo floating point	

☒ CARRIAGE RETURN

FORM LP-10

ROYAL McBEE, J13541X

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL | PAGE 2 / 7

JOB NO. | PROGRAM NO. F2-130 | PROGRAM PREPARED BY: Burggrabe | PROGRAM CHECKED BY: POOL Review | DATE 1-15-60

PROBLEM: β_{xi}, b_{xi}, Partial Corr. Coeff., S_{bxi}, b_o, & est, R, σ est, $\hat{R}$, $\hat{\sigma}$ est | TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0032	Y	00057	/		
		33	Y	00058	/		
		34	Y	01155	/		
		35	Y	01156	/	☒	
		36	Y	02007	/		
		37	Y	02008	/		
		38	Y	02227	/		
		39	Y	02228	/	☒	
		40	Y	02241	/		
		41	Y	02242	/		
		42	Y	02258	/		
		43	Y	02259	/	☒	
		44	XB	62334	/	N @ 29	
		45	S	02226	/	1 @ 29	
		46	XR	09225	/	Float	25.0R
		47	XU	09000	/	☒	
		48	XZ	00229	/		
		49	XC	62257	/	n-1	
		50	XB	62334	/	n @ 29	
		51	XS	62333	/	☒ n @ 29	
		52	XR	09225	/	Float	25.0R
		53	XU	09000	/		
		54	XZ	00229	/		
		55	XC	62258	/	☒ N-P	
		56	XC	62253	/	Temp → 0	
		57	R	[ ]	/	24.0	
		58	U	[ ]	/		
		59	B	01448	/	☒ "1"	
		60	D	[ ]	/	$1/V_n$	
		61	XH	62259	/	$(1-R^2)$	
		62	XD	62258	/		
		63	XH	62258	/	☒ $(1-R^2)/(N-1)$	

FORM LP-12

☒ CARRIAGE RETURN

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL | PAGE 3 / 7

JOB NO. | PROGRAM NO. F2-130 | PROGRAM PREPARED BY: Burggrabe | PROGRAM CHECKED BY: POOL Review | DATE 1-15-60

PROBLEM: β_{xi}, b_{xi}, Partial Corr. Coeff. S_{bxi}, b_o, & est, R, σ ext, $\hat{R}$, $\hat{\sigma}$ est | TRACK 01

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0100	X U	00000	/	Acc → M	
		01	X M	62577	/	(n-1) →	$(1-\hat{R}^2)$
		02	X Y	00000	/	Change signs →	$-1+\hat{R}^2$
		03	A	01488	/	☒ "1" →	$\hat{R}^2$
		04	X H	62600	/		
		05	X B	62577	/	N-1	
		06	A	01488	/		
		07	X H	62555	/	☒	
		08	X U	00000	/		
		09	X M	62588	/		
		10	X R	00000	/		
		11	X U	00000	/	☒	
		12	M [ ]		/	σ_y	$\hat{\sigma}$ est
		13	X H	62588	/		
		14	X E	00000	/	Exit	F.P.
		15	R [ ]		/	☒ 24.0	
		16	U [ ]		/		
		17	P [ ]		/	$-\beta/V_n$	
		18	X M	62599	/	V_n	
		19	X Y	00000	/	☒ Change sign	
		20	X P	00000	/	Print β_i	
		21	X U	00000	/	Acc → M	
		22	M [ ]		/	σy	
		23	D [ ]		/	☒ σx_i	
		24	H [ ]		/	b_{xi}	
		25	X P	00000	/		
		26	B	01488	/	"1"	
		27	D [ ]		/	☒ $1/V_i$	
		28	X H	62577	/	$(1-R_i)$	
		29	X M	62577	/	$\beta_i \cdot V_i$	
		30	X U	00000	/		
		31	M [ ]		/	☒ $-\beta_i/V_i$	$-\beta_{iy} \cdot \beta_{yi}$

☒ CARRIAGE RETURN

FORM LP-10

ROYAL McBEE, J13541X

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL

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JOB NO.	PROGRAM NO.	PROGRAM PREPARED BY:	PROGRAM CHECKED BY:	DATE
	F2-130	Burggrabe	POOL Review	1-15-60

PROBLEM: β_{xi}, b_{xi}, Partial Corr. Coeff, S_{bxi}, b , & est, R, σ est, $\hat{R}$, $\hat{\sigma}$ est

TRACK: 01

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	☒					
		01 32	XY	0000	'		
		33	XH	6256	'	$r^2_{iy \cdot xxx}$	Partial
		34	XR	0000	'	$\sqrt{}$	riy xxxx
		35	XP	0000	'	☒	
		36	B	0148	'	"1"	
		37	XS	6256	'	r^2	
		38	XD	6257	'	$(1-R_i^2)$	
		39	XD	6255	'	☒ N	
		40	D[ ]		'	σx_i	
		41	D[ ]		'	σx_i	$(1-r^2)/N\sigma(1-R_i^2)$
		42	XR	0000	'	$\sqrt{}$	$\sqrt{C_{ii}}$
		43	XU	0000	'	☒ Acc → M	
		44	XM	6258	'	$\hat{\sigma}$ est	
		45	XP	0000	'	Print	(S_{bxi})
		46	XE	0000	'		
		47	XP	1600	'	☒	
,0000 0001	'	48	4000	0002	'	F.P. "1"	& delay
		49	B	0117	'	Add $[-\beta_i/V_n]$	
		50	XA	6233	'	n@ 29	
		51	Y	0117	'	☒	
		52	Y	0131	'		
		53	B	0123	'	D[σx_i]	
		54	A	0226	'	1@ 29	
		55	Y	0123	'	☒	
		56	Y	0140	'		
		57	Y	0141	'		
		58	B	0124	'	H[b_{xi}]	
		59	A	0226	'	☒ 1@ 29	
		60	Y	0124	'		
		61	B	0127	'	D[$1/V_i$]	
		62	XA	6261	'	(n+1) @ 29	
		63	Y	0127	'	☒	

☒ CARRIAGE RETURN

FORM LP-12

ROYAL M DIV J13541X

LGP-30 CODING SHEET

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JOB NO. | PROGRAM NO. F2-130 | PROGRAM PREPARED BY: Burggrabe | PROGRAM CHECKED BY: POOL Review | DATE 1-15-60

PROBLEM: β_{xi}, b_o, Partial Corr. Coeff. S_{bxi}, b_o, & est, R, σ est, $\hat{R}$, $\hat{\sigma}$ est | TRACK 02

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0200	XB	6253	/	ctr	
		01	A	0226	/	1 @ 29	
		02	XH	6253	/	ctr	
		03	XS	6254	/	☒ n-1 @ 29	
		04	T	0115	/		
		05	XC	6253	/	ctr	
		06	XC	6256	/	Σ area	
		07	R	[ ]	/	☒ 24.0	
		08	U	[ ]	/		
		09	P	[ ]	/	$\bar{X}_i$	
		10	M	[ ]	/	b_{xi}	
		11	XA	6256	/	☒ Σ	
		12	XH	6256	/	Σ	
		13	XE	0000	/	Exit F. P.	
		14	B	0209	/	P [$\bar{x}_i$]	
		15	A	0226	/	☒ 1 @ 29	
		16	Y	0209	/		
		17	B	0210	/		
		18	A	0226	/	1 @ 29	
		19	Y	0210	/	☒	
		20	XB	6253	/	ctr	
		21	A	0226	/	1 @ 29	
		22	XH	6253	/	ctr	
		23	XS	6254	/	☒ (n-1) @ 29	
		24	T	0207	/		
		25	XP	2400	/	tab	
		26	XZ	0001	/	1 @ 29 & delay	
		27	R	[ ]	/	☒ 24.0	
		28	U	[ ]	/		
		29	B	[ ]	/	$\bar{Y}$	
		30	XS	6256	/	Σ	
		31	H	[ ]	/	☒ b_o	

☒ CARRIAGE RETURN

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JOB NO. | PROGRAM NO. F2-130 | PROGRAM PREPARED BY: Burggrabe | PROGRAM CHECKED BY: POOL Review | DATE 1-15-60

PROBLEM: β_{xi}, b_{xi}, Partial Corr. Coeff, S_{bxi}, b_o, & est, R, σ est, $\hat{R}$, $\hat{\sigma}$ est | TRACK 02

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0232	XP	0000	/		
		33	XB	6255	/	N	
		34	XR	0000	/	$\sqrt{\ }$ →	$\sqrt{N}$
		35	XH	6255	/	☒	
		36	XB	6258	/	$\hat{\sigma}$ est	
		37	XD	6255	/	$\sqrt{N}$	
		38	XE	0000	/	Exit F.P.	
		39	XP	2400	/	☒ tab	
,0000 0001	/	40	2000	0000	/	1@ 2 & delay	
		41	R	[ ]	/		
		42	U	[ ]	/		
		43	XP	0000	/	☒ S_{ax}	
		44	XB	6259	/	$1-R^2$	
		45	S	0148	/	"1"	
		46	XY	0000	/	change signs	R^2
		47	XR	0000	/	☒ $\sqrt{\ }$	R
		48	XH	6257	/	R	
		49	XB	6259	/	$1-R^2$	
		50	XR	0000	/	$\sqrt{\ }$	
		51	XU	0000	/	☒ Acc → M	
		52	M	[ ]	/	σ y →	σ est
		53	XH	6259	/	σ ext	
		54	XE	0000	/		
		55	XP	1600	/	☒ cr.	
		56	XZ	0000	/		
		57	XP	1600	/	cr.	
		58	R	[ ]	/		
		59	U	[ ]	/	☒	
		60	XB	6257	/	R	
		61	XP	0000	/		Print
		62	XB	6259	/	σ est	
		63	XP	0000	/	☒	Print

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☒ CARRIAGE RETURN

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JOB NO. | PROGRAM NO. F2-130 | PROGRAM PREPARED BY: Burggrabe | PROGRAM CHECKED BY: POOL Review | DATE 1-15-60

PROBLEM: β_{xi}, b_{xi}, Partial Corr. Coeff, S_{bxi}, b_o, & est, R, σ est, $\hat{R}$, $\hat{\sigma}$ est | TRACK 03

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		03 00	X B	6260	/	$\hat{R}^2$	
		01	X R	0000	/		
		02	X P	0000	/		
		03	X B	6258	/	☒ $\hat{\sigma}$ est	
		04	X P	0000	/		
		05	X E	0000	/		
		06	X P	1600	/	cr.	
		07	X Z	0000	/	☒ delay	
		08	X Z	0400	/	stop	BP. 4
		09	U [ ]		/	Exit	
		10			/		
		11			/	☒	
		12			/		
		13			/		
		14			/		
		15			/	☒	
		16			/		
		17			/		
		18			/		
		19			/	☒	
		20			/		
		21			/		
		22			/		
		23			/	☒	
		24			/		
		25			/		
		26			/		
		27			/	☒	
		28			/		
		29			/		
		30			/		
		31			/	☒	

FORM LP-10

☒ CARRIAGE RETURN

ROYAL McBEE J13541X

TITLE: Calculation of Y^1 and $(y-y^1)$ given a set of coefficients and a set of records.

AUTHOR: Allen G. Renz
Compumatix, Incorporated

DATE: October 6, 1959

PURPOSE: To read in a set of records, each record containing values for X_1, X_2 .... X_n and Y, and calculate a predicted value of Y_1 Y^1, using a set of coefficients stored in the machine also calculate $(y-y^1)$ and print out Y_1 Y^1, and $(y-y^1)$.

RESTRICTIONS:

A) Normal restrictions of 24.0, 11.6 and 12.6

B) Coefficients must be stored in machine prior to reading the first record, in order (i.e. b_0, b_{x1}, ... b_{xn})

C) The program requires one track

D) The number of variables is limited only by machine storage available.

CODING INFORMATION:

A) Storage

1) Program - one track

2) F.P.I.S. - 16 tracks

3) External storage - 6232 to 6263 (see attached sheet)

B) No calling sequence is required.

Linkage: R (Lo + 57)
U (Lo + 00)

C) Input is in 11.6 floating point input format in the following sequence:

First record

± P (Lo record)' 1' X_1' X_2' ... X_n' Y' -0000000''

Following records

± P (Lo record + 1)' X_1' X_2' ... X_n' Y' -0000000''

D) Output: Output is in floating point format. Three columns are printed out: Y, Y^1, and $(y-y^1)$.

E) Location of constants:

Lo + 46 1 @ 29
Lo + 63 XZ6363 Mask

F) Timing:

[(7 + 1.2n) sec. + record read time] N

where n = No. variables

N = No. records

G) Program stops:

Lo + 47 (B.P. 4) after print out of each record

Lo + 56 (B.P. 8) after completion of N records

External Storage Required

Y' and (y-y') Floating Point Calculation

6233 - n, No. of variables @ q = 29

6234 - N, No. of records @q = 29

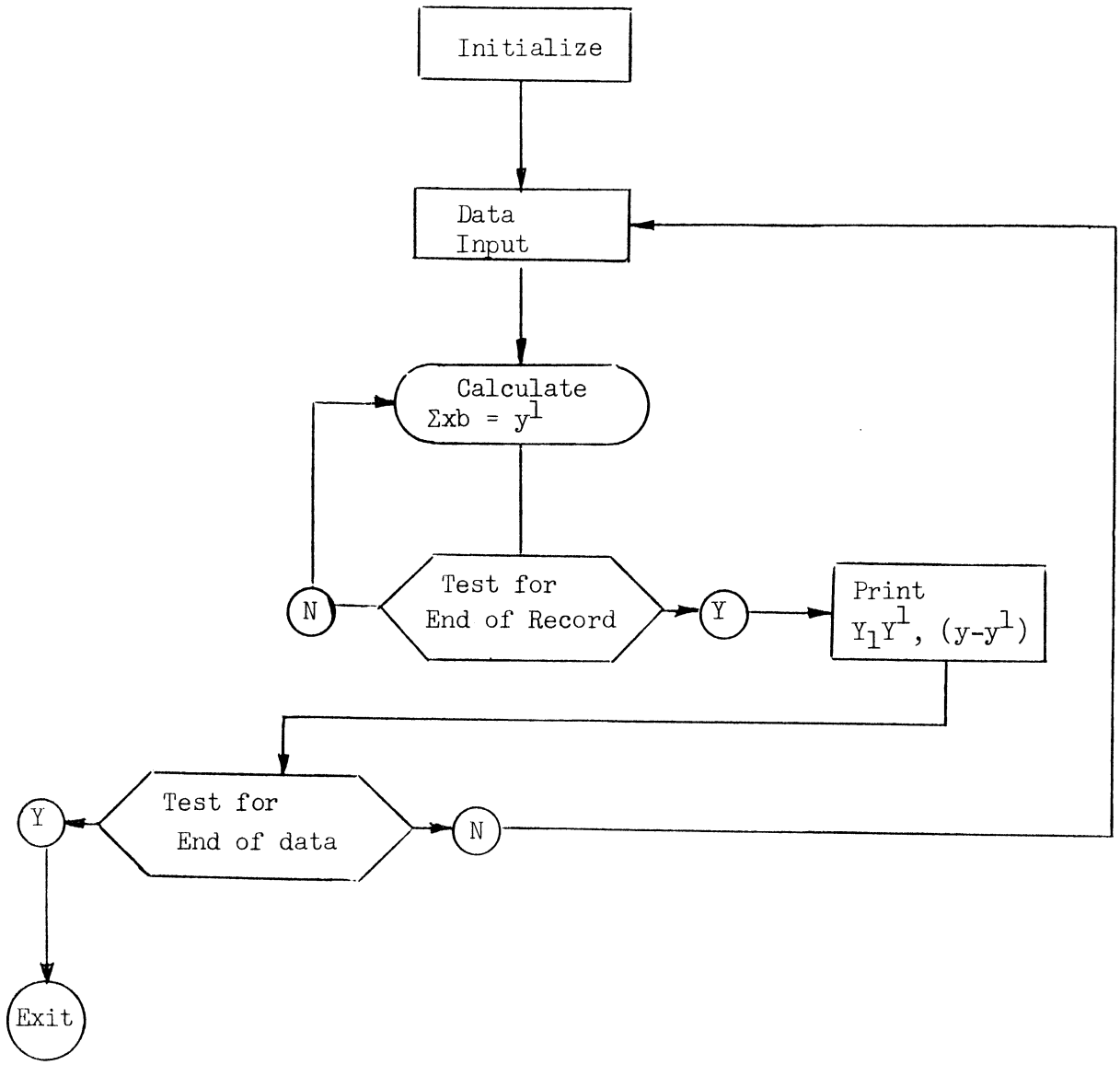
6235 - Lo of record

6237 - Lo of Floating Point Int. System

6243 - Lo of Coefficients

6258-6260 - Temporary storage

Calculation of Y^1 and $(y-y^1)$



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JOB NO.

PROGRAM NO. F2-130

PROGRAM PREPARED BY: Burggrabe

PROGRAM CHECKED BY: POOL Review

DATE 10-5-59

PROBLEM: Calculation of Y' & (Y-Y') [Floating Point]

TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
;0000 Lo	/						
/000 Lo	/	☒					
		0000	XB	6235	/	Lo Record	
		001	Y	0021	/		
		002	XA	6233	/	n @ 29	L_f record
		003	Y	0036	/	☒	
		004	Y	0058	/		
		005	XB	6243	/	Lo Coeff.	
		006	Y	0022	/		
		007	XB	6237	/	☒ Lo Floating	Point
		008	Y	0017	/		
		009	Y	0018	/		
		010	Y	0033	/		
		011	Y	0034	/	☒	
		012	Y	0060	/		
		013	Y	0061	/		
		014	XC	6260	/	Acc → 0	
		015	XS	6234	/	☒ N @ 29	
		016	XC	6260	/	-N @ 29	
		017	XR	[ ]	/		
		018	XU	[ ]	/		
		019	XI	0000	/	☒	
		020	XC	6258	/		
		021	XP	[ ]	/	X_i	
		022	XN	[ ]	/	bx_i →	Σ bx in Acc.
		023	XE	0000	/	☒	
		024	B	0022	/		
		025	A	0046	/	1 @ 29	
		026	Y	0022	/		
		027	B	0021	/	☒	
		028	A	0046	/	1 @ 29	
		029	Y	0021	/		
		030	E	0063	/	XZ 6363	
		031	S	0058	/	☒	

☒ CARRIAGE RETURN

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ROYAL McBEE J13541X

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JOB NO.	PROGRAM NO.	PROGRAM PREPARED BY:	PROGRAM CHECKED BY:	DATE
	F2-130	Burggrabe	POOL Review	10-5-59

PROBLEM: Y' &(Y-Y') Floating Point

TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		00032	T	00060	/		
		33	XR	[ ]	/		
		34	XU	[ ]	/		
		35	XH	62588	/	☒ Y'	
		36	XB	[ ]	/	Y	
		37	XP	00000	/		Print Y
		38	XS	62588	/	Y'	
		39	XH	62599	/	☒ (Y-Y')	
		40	XB	62588	/		
		41	XP	00000	/		Print Y'
		42	XB	62599	/		
		43	XP	00000	/	☒	Print (Y-Y')
		44	XE	00000	/		
		45	XP	16000	/		
		46	XZ	00001	/		
		47	XZ	04000	/	☒ Stop after	print out
		48	XB	62355	/	Lo record	
		49	Y	00211	/		
		50	XB	62433	/	Lo Coeff.	
		51	Y	00222	/	☒	
		52	XB	62600	/		
		53	A	00046	/		
		54	XH	62600	/		
		55	T	00117	/	☒	
		56	XZ	08000	/	Stop after	N records
		57	U	[ ]	/	Exit	
		58	[ ]		/	L_f Record	
		59			/	☒	
		60	XR	[ ]	/		
		61	XU	[ ]	/		
		62	U	00211	/		
		63	XZ	63633	/	☒ Mask	

☒ CARRIAGE RETURN

FORM LP-12

ROYAL McBEE J13541X