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Acy M 35-3.9
~~KSL 514 - 319~~

TITLE: Symmetric Matrix Inversion

TYPE: Closed with 3 preset parameters

CAPACITY: $2 \leq n \leq 136$ where n is the order of the matrix

TEMPORARY STORAGE: 0 - 9

ACCURACY: A function of the order and conditioning of the matrix

NUMBER OF WORDS: 786 words on drum

226 + 3n words in Williams Memory

DESCRIPTION: The routine inverts a symmetric matrix on the entry

q	TI nF
	50 q
q+1	26 (IN)
	00 x + pF
q+2	S F
	- -

There are several input options and output options. The input matrix may be square or lower triangular and may be read in from the drum or from tape. The output may be punched or stored on the drum. If stored on the drum, it will be in the form of a lower triangular matrix. If punched, it may be in the form of a square, lower triangular or a column of the diagonal entries. The input matrix can be scaled by 10^y and the punched output can have the number of decimal places designated.

PROGRAM PARAMETER:

1) T designates type of matrix input
   S - triangular
   5 - square
2) I designates input option
   0 - tape input (see note 1)
   9 - drum input from drum location specified by S5
3) n is the order of the matrix
4) x is the output option
   0 - punch a lower triangular matrix
   1024 - punch a square matrix
   2048 - punch a column of the diagonal entries

3072 - store lower triangular matrix on drum beginning at location specified by S5.

5) p is the number of decimal places in the punched output

6) S is the scaling parameter for the input matrix

0 0 y - positive scaler (see Note 2)

LL 4096 - |y| - negative scaler

EXAMPLES:

1) Input a square matrix of order 20 from the drum and punch the output as a triangular matrix to 6 places. Scale the input by 10^2.

The entry is

q	59 20F
	50 q
q+1	26 (IN)
	00 6F
q+2	00 2F
	-- --

2) Input a triangular matrix of order 40 from tape. Scale the input by 10^{-1} and punch the inverse as a square matrix to 5 places.

The entry is

q	S0 40F
	50 q
q+1	24 (IN)
	00 1029F
q+2	LL 4095F
	-- --

THE INPUT MATRIX:

The input matrix is in the form of signed fractions. It may be read in from the drum beginning at location S5 or it may be read in from tape.

TAPE INPUT

1) Triangular case. The matrix is punched by rows and terminated by a J.

2) Square case. The matrix is punched by rows with an N terminating each row. Terminate the matrix with a J..

THE OUTPUT MATRIX: The output is punched as signed fractions.

TAPE OUTPUT

1) Lower triangular case. The matrix is punched by rows. 2 carriage returns and line feeds separate each row. The matrix is terminated by a J.
2) Square case. The matrix is punched by rows with an N terminating each row. The matrix is terminated by a J.
3) Diagonal case. A single column of diagonal elements are punched.

A p-place number follows the output in the above cases. This designates the location of the decimal point by locating the point to the right of the column in which a 1 appears. The output must be rescaled by 10^{y+1}.

The routine also can store the output as a lower triangular matrix on the drum beginning at location S5.

PRESET PARAMETERS: Before this routine is read in, the following parameters should be stored in location 3, 4, and 5. They are of the form 00F 00vF

v { S3 - location of this routine in Williams Memory
  { S4 - " " " " drum
  { S5 - " " matrix in drum

PROGRAMMED STOPS: There are 3 programmed stops. Moving the white switch up and down at these points will allow the program to exit from this routine.

FF000 - Matrix is singular

FF001 - " " over-scaled

FF002 - Diagonal element $\geq 1 - 2^{-39}$

DURATION: The computation time is $[.004n^3 + .08n^2 + .1n]$ seconds where n is the order of the matrix.

NOTE 1: The left hand order of q+1 can be changed to 24 (IN) during tape input. The matrix may then be read in with a black switch start.

NOTE 2 : The input matrix should be scaled by 10^y so that the largest element is $< 1/2$ in machine representation. Y is any integer.

DATE April 11, 1961
PROGRAMMED BY F. Shimamoto
APPROVED BY J. Snyder

nj

LOCATION		ORDER	NOTES
		00 226	
		S3 02K	
226	(Y)	J0 18	
		S3 50L	Store part 1 on drum
227		26 (Y1)	
		00 S4	
228		00 134F	
		26 999F	
229		J0 S3	
		50 3L	
230		26 (Y1)	
		00 135S4	Store part 2 on drum
231		00 151F	
		26 999F	
232		J0 S3	
		50 6L	
233		26 (Y1)	
		00 287S4	Store part 3 on drum
234		00 153F	
		26 999F	
235		J0 S3	
		50 9L	
236		26 (Y1)	
		00 441S4	Store part 4 on drum
237		00 88F	
		26 999F	
238		J0 88S3	
		50 12L	
239		26 (Y1)	
		00 530S4	Store part 5 on drum
249		00 26F	
		26 999F	
241		J0 88S3	
		50 15L	
242		26 (Y1)	
		00 557S4	Store part 6 on drum

LOCATION		ORDER	NOTES	PAGE 2	KSL 5.14
243		00 22F			
		26 999F			
244		J0 88S3			
		50 18L			
245		26 (Y1)			
		00 580S4	Store part 7 on drum		
246		00 10F			
		26 999F			
247		J0 S3			
		50 21L			
248		26 (Y1)			
		00 591S4	Store part 8 on drum		
249		00 56F			
		26 999F			
250		J0 S3			
		50 24L			
251		26 (Y1)			
		00 648S4	Store part 9 on drum		
252		00 137F			
		26 999F			
		00 153S3			
		02 K			
153	(N)	00 F			
		00 F	Constants		
154	(P)	00 F			
		00 F			
155	(X)	00 F			
		00 F			
156	(S)	00 F			
		00 F			
157	(I)	00 F			
		00 F			
158	(MS)	00 F			
		00 F			
159	(Z)	00 F			
		00 F			

LOCATION		ORDER	NOTES
160	(V1)	7J 226S3	
		40 226S3	
161	(V2)	00 F	
		00 F	
162	(V3)	L4 F	
		40 F	
163	(1)	00 F	
		00 1F	
164	(1-1)	00 1F	
		00 1F	
165	(+)	00 F	
		00 10F	
166	(-)	00 F	
		00 1000 0000 0000 J	
167	(+1)	00 F	
		00 9999 9999 9999 J	
168	(34)	00 F	
		00 34F	
169	(C1)	00 F	
		00 F	
170	(D1)	26 139S3	
		00 F	
		00 K	
171	(MTR)	50 18S3	
		50 L	
172		26 (Y1)	
		00 S4	Playback part 1
173		00 134F	
		26 18S3	
174		50 S3	
		50 3L	
175		26 (Y1)	
		00 135S4	Playback part 2
176		00 151F	
		26 S3	

LOCATION		ORDER	NOTES
177		50 S3	
		50 6L	
178		26 (Y1)	
		00 287S4	Playback part 3
179		00 153F	
		26 S3	
180		50 S3	
		50 9L	
181		26 (Y1)	
		00 441S4	Playback part 4
182		00 88F	
		26 S3	
183		50 S3	
		50 12L	
184		26 (Y1)	
		00 648S4	Playback part 9
185		00 137F	
		22 F	
186	(Y1)	00 K	
		00 18S3	
		02 K	
18		L5 (V2)	
		42 43(1A)	Initialize addresses for (1A)
19		42 26(1A)	
		42 41(1A)	
20		00 20F	
		46 6(1A)	
21		F5 (V2)	
		42 23(1A)	
22		42 24(1A)	
		42 12(1A)	
23		L5 (V3)	
		42 6(1A)	
24		F5 (V3)	
		42 10(1A)	
25		42 78(1A)	
		42 79(1A)	

LOCATION		ORDER	NOTES
		00 K	
26	(1A)	L5 (1)	
		40 2F	
27		L4 (1)	
		40 3F	
28		L1 (N)	
		L4 (1)	
29		40 (C1)	
		40 7F	
30		L5 (1)	
		40 6F	
31		85 11F	
		00 S5	
32		40 F	
		L5 F	
33		40 4F	
		22 8L	
34		50 226S3	Playback one row of A
		50 8L	
35		26 (Y1)	
		00 2S5	
36		00 2F	
		L1 F	
37		L4 4F	
		40 1F	
38		L5 226S3	
		40 F	
39		L3 1F	
		32 25L	
40		L7 1F	
		00 20F	
41		46 20L	
		46 24L	
42		L1 1F	
		32 23L	
43		L4 4F	
		40 4F	

LOCATION	ORDER	NOTES
44	L5 (V2)	
	42 19L	
45	42 20L	
	L5 F	
46	10 F	
	40 F	
47	F5 20L	
	L0 24L	
48	36 25L	
	F5 19L	
49	22 18L	
	L5 F	
50	10 F	
	40 F	
51	41 1F	
	L5 226S3	
52	40 F	
	L7 F	
53	L2 F	
	32 30L	
54	F5 1F	
	40 1F	
55	L5 F	
	10 1F	
56	26 26L	
	L3 1F	
57	32 39L	
	L7 1F	
58	00 20F	
	46 36L	
59	F1 2F	
	40 5F	
60	L5 (V1)	
	42 35L	
61	42 36L	
	L5 F	

LOCATION	ORDER	NOTES
62	10 F	
	40 F	
63	F5 5F	
	40 5F	
64	32 39L	
	F5 35L	
65	22 34L	
	L7 4F	
66	L4 (1)	
	00 20F	
67	46 45L	
	L3 F	Test for singularity: jump if yes.
68	36 124L	
	50 226S3	
69	75 (+1)	
	66 F	
70	S5 F	
	40 8F	Form $\frac{a_{ik}}{a_{ii}}$
71	10 1F	
	00 1F	
72	32 46L	
	40 226S3	
73	L1 6F	
	40 5F	
74	F5 43L	
	42 50L	
75	F5 42L	
	42 51L	
76	42 54L	
	L5 F	
77	40 F	
	L5 F	
78	40 9F	
	36 53L	
79	50 8F	
	79 F	Form ℓ_{ij}

LOCATION	ORDER	NOTES
80	L4 9F	
	40 F	
81	F5 5F	
	40 5F	
82	32 58L	
	F5 50L	
83	42 50L	
	F5 51L	
84	22 49L	
	F1 2F	
85	40 F	
	L5 (V1)	
86	42 61L	
	42 62L	
87	L7 5F	
	L2 F	
88	32 63L	
	L7 F	
89	40 5F	
	F5 F	
90	40 F	
	36 66L	
91	F5 61L	
	26 60L	
92	F1 2F	
	40 9F	
93	LL 5F	
	32 111L	Test if $\ell_{ij} \geq 1/2$: jump if no
94	F5 F	
	42 74L	
95	F0 (1)	
	L0 1F	
96	40 F	
	L3 F	
97	32 78L	
	L5 (V1)	

LOCATION	ORDER	NOTES
98	42 73L	
	42 75L	
99	50 (1)	
	L5 F	
100	10 2F	
	00 1F	
101	32 75L	
	40 F	
102	F5 9F	
	32 78L	
103	40 9F	
	F5 73L	
104	26 72L	
	L5 F	
105	L4 F	
	40 F	
106	J0 226S3	
	50 80L	
107	26 (Y1)	
	00 2S5	Store row of L
108	00 2F	
	F5 7F	
109	32 93L	
	40 7F	
110	L5 10L	
	L4 (1-1)	
111	40 10L	
	46 82L	
112	42 78L	
	42 79L	
113	F5 2F	
	40 2F	
114	L4 (1)	
	L4 9L	
115	40 9L	
	40 81L	

LOCATION		ORDER	NOTES
116		F5 12L	
		42 12L	
117		42 23L	
		42 24L	
118		F5 6F	
		40 6F	
119		22 8L	
		F5 (C1)	
120		36 115L	
		F5 6L	
121		42 6L	
		L4 (1)	
122		42 10L	
		42 78L	
123		42 79L	
		F5 (V2)	
124		42 12L	
		42 23L	
125		42 24L	
		L5 3F	
126		40 2F	
		L4 (1)	
127		40 3F	
		L4 (C2)	
128		40 (C2)	
		40 9L	
129		40 81L	
		L5 3F	
130		00 20F	
		46 10L	
131		46 82L	
		F5 25L	
132		42 25L	
		42 42L	
133		42 46L	
		L5 3F	

LOCATION	ORDER	NOTES
134	L4 5L	
	40 5L	
135	L5 12L	
	L4 (1-1)	
136	46 12L	
	F5 (C1)	
137	26 3L	
	F5 F	
138	40 F	
	L7 5F	
139	50 F	
	00 1F	
140	40 5F	
	26 67L	
141	L5 (1)	
	40 3F	
142	L1 (N)	
	40 F	
143	40 5F	
	L5 (V3)	
144	42 119L	
	42 120L	
145	L5 (MS)	
	L4 F	
146	32 121L	
	L7 F	
147	40 (MS)	
	F5 F	
148	32 3(MTR)	
	40 F	
149	F5 119L	
	26 118L	
150	FF F	
	22 12(MTR)	FF000: matrix singular. wh. sw. to continue.

LOCATION		ORDER	NOTES PAGE 12 KSL 5.14
151	(C2)	26 (Y1)	
		00 2S5	
152		22 (Y)	
		26 1N	
		00 K	
		00 S302K	
0		L5 (V2)	
		42 18(2A)	Initialize addresses for (2A)
1		42 104(IT)	
		42 105(IT)	
2		L5 (V3)	
		42 6(2A)	
3		42 33(2A)	
		40 53(IT)	
4		42 94(IT)	
		42 95(IT)	
5		L5 (N)	
		42 87(IT)	
6		00 20F	
		46 87(IT)	
		00 K	
7	(2A)	F5 (MS)	
		00 20F	
8		46 2L	
		L5 (+1)	
9		10 F	
		00 1F	
10		40 6F	
		L5 (V1)	
11		42 13L	
		42 14L	
12		L5 3F	
		L4 13L	

LOCATION	ORDER	NOTES	PAGE 13	KSL 5.14
13	40 4F			
	L5 F			
14	L4 (MS)			
	40 2F			
15	50 226S3	Playback row of L		
	50 8L			
16	26 (Y1)			
	00 S5			
17	00 1F			
	L3 2F			
18	36 18L			
	L7 2F			
19	00 20F			
	46 14L			
20	01 1F			
	L5 F			
21	10 F			
	40 F			
22	F5 13L			
	42 13L			
23	42 14L			
	L0 4F			
24	36 18L			
	22 13L			
25	L5 226S3			
	40 F			
26	L5 6F			
	40 226S3			
27	J0 226S3	Store row of L (rescaled)		
	50 20L			
28	26 (Y1)			
	00 S5			
29	00 1F			
	F5 5F			

LOCATION		ORDER	NOTES
30		36 33L	
		40 5F	
31		F5 6L	
		42 6L	
32		F5 3F	
		40 3F	
33		L4 9L	
		40 9L	
34		40 21L	
		L5 10L	
35		L4 (1-1)	
		46 10L	
36		46 22L	
		L5 18L	
37		L4 (1-1)	
		40 18L	
38		F5 19L	
		42 19L	
39		22 3L	
		50 F	
40		L1 (MS)	
		40 F	
		00 K	
41	(IT)	L5 (C2)	
		40 18L	Form L^{-1} routine
42		40 77L	
		L1 (N)	
43		40 2F	
		L4 (1)	
44		40 1F	
		L5 87L	
45		L0 (1-1)	
		40 3F	

LOCATION	ORDER	NOTES
46	L0 (1-1)	
	L4 22L	
47	40 22L	
	L1 1F	
48	L4 88L	
	40 88L	
49	L5 70L	
	L0 2F	
50	40 87L	
	L5 3F	
51	L4 53L	
	40 53L	
52	42 16L	
	L1 2F	
53	40 3F	
	40 4F	
54	00 20F	
	46 19L	
55	46 78L	
	F5 (MS)	
56	00 20F	
	46 30L	
57	L1 (MS)	
	40 F	
58	50 226S3	Playback row of L
	50 17L	
59	26 (Y1)	
	00 F	
60	00 F	
	L5 18L	
61	L0 91L	
	L4 90L	
62	40 5F	
	40 6F	

LOCATION	ORDER	NOTES
63	L1 226S3	
	40 226S3	Form $\ell_{i-1,i}^{-1}$
64	F5 1F	
	32 76L	
65	L5 22L	
	L0 (1)	
66	42 29L	
	42 34L	
67	42 57L	
	L5 86L	
68	40 37L	
	41 F	
69	41 7F	
	41 8F	
70	50 7F	
	L5 F	
71	10 F	
	00 1F	
72	26 35L	
	40 3F	
73	85 11F	
	00 F	
74	40 9F	
	50 9F	
75	L5 7F	
	74 F	
76	40 9F	
	S5 F	Form ℓ_{ij}^{-1}
77	40 7F	
	L5 9F	
78	10 1F	
	00 1F	
79	L4 F	
	40 F	
80	LL F	
	36 44L	

LOCATION	ORDER	NOTES
81	L5 F	
	10 1F	
82	40 F	
	F5 8F	
83	40 8F	
	L5 37L	
84	L4 (1-1)	
	46 37L	
85	F5 34L	
	42 34L	
86	L0 88L	
	32 64L	
87	L5 5F	
	40 32L	
88	L4 3F	
	40 5F	
89	F5 3F	
	22 31L	
90	L5 F	
	00 1F	
91	40 F	
	F5 8F	
92	36 57L	
	26 66L	
93	L3 8F	
	36 57L	
94	L4 F	
	40 F	
95	L1 8F	
	50 (1)	
96	00 20F	
	L4 30L	
97	46 30L	
	50 F	

LOCATION	ORDER	NOTES
98	L1 F	
	40 F	
99	L5 89L	
	L0 57L	
100	32 74L	
	L5 6F	
101	L0 4F	
	40 5F	
102	40 6F	
	L5 4F	
103	L0 (1)	
	40 3F	
104	40 4F	
	L5 57L	
105	22 24L	
	50 7F	
106	L1 8F	
	L0 (MS)	
107	40 8F	
	LL F	
108	36 49L	
	L7 8F	
109	00 20F	
	46 71L	
110	F5 29L	
	42 70L	
111	42 71L	
	L5 226S3	
112	10 F	
	40 F	
113	F5 70L	
	L0 87L	
114	36 52L	
	F5 70L	

LOCATION	ORDER	NOTES
115	22 69L	
	L5 22L	
116	L0 (1-1)	
	40 22L	
117	J0 226S3	
	50 76L	
118	26 (Y1)	
	00 F	Store row of L^{-1}
119	00 F	
	F5 1F	
120	36 92L	
	40 1F	
121	L5 18L	
	L4 2F	
122	40 18L	
	40 77L	
123	F5 2F	
	40 2F	
124	L5 88L	
	L0 (1)	
125	42 88L	
	L1 (1-1)	
126	26 10L	
	50 F	
127	10 1F	
	00 1F	
128	00 F	
	00 F	
129	L5 7F	
	74 226S3	
130	L1 F	
	40 226S3	
131	85 11F	
	00 F	

LOCATION	ORDER	NOTES
132	26 (Y1)	
	00 3F	
133	L1 (MS)	
	40 3F	
134	L1 (N)	
	40 2F	
135	L5 (MS)	
	L4 F	
136	32 96L	
	L7 F	
137	40 (MS)	
	F5 94L	
138	42 94L	
	42 95L	
139	F5 2F	
	32 99L	
140	22 93L	
	L1 (N)	
141	40 2F	
	40 5F	
142	L1 (MS)	
	L6 3F	
143	32 6(MTR)	
	40 F	
144	L7 F	
	00 20F	
145	46 105L	
	L5 F	
146	10 F	
	40 F	
147	F5 2F	
	32 6(MTR)	
148	40 2F	
	F5 104L	

LOCATION		ORDER	NOTES
149		42 104L	
		42 105L	
150		22 104L	
		50 F	
151		22 3(Y)	
		26 1N	
		00 K	
		00 S302K	
0		L5 (V2)	
		42 4(D)	Initialize addresses for (3A)
1		42 6(D)	
		42 22(D)	
2		42 23(D)	
		L5 (V3)	
3		42 (3A)	
		92 147F	
		00 K	
4	(3A)	L5 (MS)	
		L4 F	
5		L4 (1)	
		42 7L	
6		L5 (V1)	
		42 6L	
7		42 8L	
		22 4L	
8		50 226S3	}
		50 4L	} Playback row of L^{-1}
9		26 (Y1)	}
		00 S5	}
10		00 1F	
		50 F	
11		7J (4)	
		10 F	

LOCATION	ORDER	NOTES
12	00 1F	
	40 F	
13	F5 8L	
	42 6L	
14	42 8L	
	L0 24L	
15	32 12L	
	22 6L	
16	J0 226S3	
	50 12L	
17	26 (M1)	
	00 S5	Store row of L^{-1} (rescaled)
18	00 1F	
	F5 5F	
19	40 5F	
	36 (D)	
20	F5 24L	
	42 24L	
21	F5 L	
	42 L	
22	F5 23L	
	40 23L	
23	L4 5L	
	40 5L	
24	40 13L	
	L5 6L	
25	L4 (1-1)	
	46 6L	
26	46 14L	
	26 L	
27	00 F	
	00 1F	
28	00 1F	
	40 227S3	

LOCATION		ORDER	NOTES
		00 K	
29	(R)	40 1F	
		K5 F	Reciprocal routine (R)
30		42 16L	
		43 13L	
31		41 F	
		50 F	
32		26 5L	
		LJ F	
33		00 1F	
		40 1F	
34		F5 13L	
		42 13L	
35		LJ 1F	
		40 F	
36		32 3L	
		LJ F	
37		40 F	
		66 1F	
38		11 1F	
		L5 F	
39		36 12L	
		K1 F	
40		50 L	
		26 13L	
41		S5 F	
		50 L	
42		10 38F	
		00 F	
43		10 1F	
		40 1F	
44		S5 F	
		40 F	
45		L5 1F	
		22 F	

LOCATION		ORDER	NOTES
		00 K	
46	(D)	L5 (N)	
		L4 10L	Form D^{-1} routine (D)
47		40 2F	
		L4 33L	
48		40 3F	
		L3 (MS)	
49		L4 (34)	
		32 4L	Test for over-scaling of matrix: jump if no.
50		26 34L	
		L5 F	
51		32 5L	
		50 5L	
52		26 (R)	
		40 F	
53		01 1F	
		L6 1F	
54		40 1F	
		09 1F	
55		L6 1F	
		36 35L	Test if diagonal element $\geq 1-2^{-39}$: jump if yes.
56		L5 F	
		40 226S3	
57		L7 5F	
		L2 1F	
58		32 13L	
		L7 1F	
59		40 5F	
		F5 10L	
60		42 10L	
		L0 2F	
61		32 17L	
		F5 4L	
62		42 4L	
		42 6L	

LOCATION	ORDER	NOTES
63	22 4L	
	L5 (+)	
64	40 2F	
	L5 (-)	
65	40 6F	
	L7 5F	
66	L0 2F	
	36 28L	
67	50 6F	
	7J 226S3	
68	50 6F	
	74 F	
69	00 39F	
	40 F	
70	F5 21L	
	42 21L	
71	L0 3F	
	36 (MP)	
72	F5 22L	
	42 22L	
73	42 23L	
	26 21L	
74	F5 (Z)	
	40 (Z)	
75	50 (+)	
	75 2F	
76	S5 F	
	40 2F	
77	50 (-)	
	7J 6F	
78	26 19L	
	50 F	
79	5S 6F	
	3J F	

LOCATION		ORDER	NOTES PAGE 26 KSL 5.14
80		FF 1F	
		22 12(MTR)	FF001: Matrix over-scaled. wh. sw. to continue.
81		FF 2F	
		22 12(MTR)	FF002: Diagonal element $\geq 1\text{-}2^{-39}$. wh. sw. to continue.
		00 K	
82	(MP)	L1 (N)	
		40 1F	Form $(L^{-1})^{T}$ D^{-1} L^{-1} routine (MP)
83		41 7F	
		L5 (1)	
84		40 6F	
		F5 (1)	
85		40 5F	
		L5 (V2)	
86		42 4F	
		42 18L	
87		L5 55L	
		L4 (D1)	
88		40 17L	
		L5 55L	
89		L4 56L	
		40 47L	
90		41 3F	
		L5 6F	
91		40 2F	
		L5 (V3)	
92		42 12L	
		L5 1F	
93		40 F	
		L5 (1)	
94		40 8F	
		41 F	
95		F5 F	
		40 F	
96		32 16L	
		F5 12L	

LOCATION	ORDER	NOTES
97	42 12L	
	22 12L	
98	50 226S3	Playback row of L^{-1}
	50 16L	
99	26 (T)	
	00 S5	
100	00 1F	
	50 F	
101	7J 226S3	
	40 9F	
102	L1 8F	
	40 F	
103	L5 (V3)	
	40 24L	
104	L5 (V1)	
	42 23L	
105	50 9F	Form a_{ij}^{-1}
	7J F	
106	L4 F	
	40 F	
107	F5 F	
	32 35L	
108	40 F	
	L5 24L	
109	L4 (1-1)	
	40 24L	
110	F5 23L	
	22 22L	
111	F5 1F	
	32 9(MTR)	
112	40 1F	
	L5 5F	
113	40 6F	
	L4 (1)	

LOCATION	ORDER	NOTES
114	40 5F	
	L4 55L	
115	40 55L	
	L5 (1-1)	
116	46 18L	
	F5 4F	
117	26 4L	
	F5 3F	
118	40 3F	
	L4 1F	
119	32 42L	
	F5 8F	
120	40 8F	
	F5 2F	
121	40 2F	
	L4 17L	
122	40 17L	
	L5 18L	
123	L4 (1-1)	
	40 18L	
124	22 16L	
	L5 1F	
125	40 F	
	L5 6F	
126	40 8F	
	L5 (V3)	
127	42 46L	
	42 48L	
128	42 49L	
	L5 F	
129	86 11F	
	00 F	Store a_{ij}^{-1}
130	L7 7F	
	L2 F	

LOCATION		ORDER	NOTES
131		32 50L	
		L7 F	
132		40 7F	
		F5 F	
133		36 29L	
		40 F	
134		F5 8F	
		40 8F	
135		L4 47L	
		40 47L	
136		F5 46L	
		26 45L	
137		00 F	
		00 S5	
138		86 11F	
		00 F	
		00 K	
139	(T)	K5 F	
		42 2L	Playback row of matrix routine (T)
140		L4 (1)	
		42 4L	
141		42 10L	
		L5 F	
142		L0 (D1)	
		L4 13L	
143		40 7L	
		L5 F	
144		10 20F	
		40 9F	
145		S5 F	
		42 8L	
146		85 11F	
		00 F	
147		32 8L	

LOCATION	ORDER	NOTES
	40 F	
148	F5 F	
	40 F	
149	L0 9F	
	32 F	
150	F5 7L	
	40 7L	
151	F5 8L	
	22 6L	
152	85 11F	
	00 F	
153	22 6(Y)	
	26 1N	
	00 K	
	00 S302K	
0 (OUT)	F5 (1)	
	L4 (Z)	
1	40 (Z)	
	41 1F	
2	L5 (+1)	
	40 2F	
3	L3 (MS)	
	36 13L	
4	40 F	
	LL 7F	
5	32 9L	
	F5 (Z)	
6	40 (Z)	
	50 (-)	
7	7J 2F	
	40 2F	
8	50 (-)	
	75 7F	

LOCATION	ORDER	NOTES
9	22 10L	
	50 1F	
10	L5 7F	
	00 1F	
11	40 7F	
	F5 F	
12	36 13L	
	26 4L	
13	L5 (1)	
	40 3F	
14	L7 7F	
	L0 (-)	
15	36 21L	
	50 (+)	
16	75 3F	
	S5 F	
17	40 3F	
	50 (+)	
18	77 7F	
	S5 F	
19	40 7F	
	F5 1F	
20	40 1F	
	26 14L	
21	L5 1F	
	L0 (Z)	
22	36 27L	
	40 F	
23	L5 (-)	
	40 (Z)	
24	F5 F	
	36 27L	
25	40 F	
	50 (-)	

LOCATION	ORDER	NOTES
26	7J (Z)	
	22 23L	
27	L1 (N)	
	40 4F	
28	F5 (MS)	
	00 20F	
29	46 40L	
	46 57L	
30	46 72L	
	L5 (1)	
31	40 5F	
	L4 72L	
32	40 6F	
	41 F	
33	50 226S3	Playback row of A^{-1}
	50 33L	
34	26 (T)	
	00 S5	
35	00 1F	
	L3 1F	
36	36 54L	
	L5 (V1)	
37	42 38L	
	42 40L	
38	50 3F	
	751 F	
39	00 39F	
	10 1F	
40	00 F	
	40 F	
41	F5 40L	
	L0 6F	
42	32 44L	
	F5 40L	

LOCATION	ORDER	NOTES
43	26 37L	
	50 F	
44	J0 226S3	Store row of A^{-1}
	50 44L	
45	26 (Y1)	
	00 S5	
46	00 1F	
	F5 4F	
47	40 4F	
	32 60L	
48	L5 35L	
	L4 (1-1)	
49	46 35L	
	46 46L	
50	F5 5F	
	L4 34L	
51	40 34L	
	F5 5F	
52	L4 45L	
	40 45L	
53	F5 5F	
	26 31L	
54	L5 (V1)	
	42 55L	
55	42 57L	
	50 F	
56	7J 2F	
	10 1F	
57	00 F	
	40 F	
58	F5 57L	
	L0 6F	
59	32 44L	
	F5 57L	

LOCATION	ORDER	NOTES
60	22 54L	
	F5 (P)	
61	00 7F	
	40 F	Form number of elements per line counter.and number of decimal places to be printed.
62	L5 (P)	
	00 20F	
63	46 81L	
	L5 84L	
64	66 F	
	01 7F	
65	40 3F	
	92 515F	
66	50 S3	
	50 66L	
67	26 (Y1)	
	00 591S4	Playback part 8
68	00 56F	
	L3 (X)	
69	32 85L	
	L4 (1)	Test for output option
70	32 73L	
	L4 (1)	
71	32 76L	
	22 12(MTR)	
72	00 F	
	40 226S3	
73	50 88S3	
	50 73L	
74	26 (Y1)	
	00 530S4	Playback part 5
75	00 26F	
	26 88S3	
76	50 88S3	
	50 76L	

LOCATION		ORDER	NOTES
77		26 (Y1)	
		00 580S4	Playback part 7
78		00 10F	
		26 88S3	
79		92 834F	
		92 147F	Punch J. Punch 5 line feed/carriage return
80		92 515F	
		L5 (Z)	Punch delay
81		50 F	
		50 81L	Print point indicator
82		26 S3	
		92 147F	Punch 5 line feed/carriage return
83		92 515F	
		22 12(MTR)	Punch delay
84		00 F	
		00 66F	
85		50 88S3	
		50 85L	Playback part 6
86		26 (Y1)	
		00 557S4	
87		00 22F	
		26 88S3	
88		22 9(Y)	
		26 1N	
		00 S302K	
	(P16)	00 K	
		22 21(Y)	
		26 1N	Print routine (P16)
		00 K	
		00 88S302K	
88		L5 81(OUT)	
		46 8L	Print square matrix
89		L1 (N)	

LOCATION	ORDER	NOTES
	40 5F	
90	F5 4F	
	40 4F	
91	40 6F	
	L1 (N)	
92	40 7F	
	L1 3F	
93	40 8F	
	L1 4F	
94	40 9F	
	36 7L	
95	85 11F	
	00 S5	
96	50 F	Print a_{ij}^{-1}
	50 8L	
97	26 (P16)	
	F5 7F	
98	32 19L	
	40 7F	
99	F5 8F	
	32 17L	
100	40 8F	
	F5 9F	
101	32 15L	
	40 9F	
102	F5 7L	
	40 7L	
103	26 7L	
	F5 6F	
104	40 6F	
	L4 7L	
105	22 14L	
	92 131F	Punch line feed/carriage return
106	92 515F	

LOCATION	ORDER	NOTES
	L1 3F	Punch delay
107	26 12L	
	92 770F	Punch N
108	F5 5F	
	36 79(OUT)	
109	40 5F	
	F5 4F	
110	L4 25L	
	40 25L	
111	40 7L	
	92 131F	Punch line feed/carriage return
112	92 515F	
	26 2L	Punch delay
113	85 11F	
	00 S5	
114	22 12(Y)	
	26 1N	
	00 K	
	00 88S302K	
88	L5 81(OUT)	
	46 10L	Print triangular matrix
89	L1 (N)	
	40 5F	
90	F5 4F	
	40 4F	
91	00 20F	
	46 6L	
92	50 226S3	Playback row of A^{-1}
	50 4L	
93	26 (Y1)	
	00 S5	
94	00 1F	
	L5 (V1)	

LOCATION	ORDER	NOTES
95	42 9L	
	L1 4F	
96	40 6F	
	L1 3F	
97	40 7F	
	L5 F	
98	50 F	
	50 10L	Print a_{ij}^{-1}
99	26 (P16)	
	F5 6F	
100	36 17L	
	40 6F	
101	F5 9L	
	42 9L	
102	F5 7F	
	32 15L	
103	26 9L	
	92 131F	Punch line feed/carriage return
104	92 515F	
	22 8L	Punch delay
105	F5 5F	
	36 79(OUT)	
106	40 5F	
	F5 4F	
107	L4 5L	
	40 5L	
108	92 135F	
	92 515F	Punch 2 line feed/carriage return, delay
109	26 2L	
	50 F	
110	22 15(Y)	
	26 1N	
	00 K	

LOCATION		ORDER	NOTES
		00 88S302K	
88		L5 81(OUT)	
		46 3L	Print diagonal entries
89		L1 (N)	
		40 4F	
90		85 11F	
		00 S5	
91		50 F	
		50 3L	Print a_{ij}^{-1}
92		26 (P16)	
		F5 9L	
93		40 9L	
		L4 2L	
94		40 2L	
		92 131F	Punch line feed/carriage return
95		92 515F	
		F5 4F	Punch delay
96		32 79(OUT)	
		22 1L	
97		00 F	
		00 2F	
98		22 18(Y)	
		26 1N	
		00 K	
		00 S302K	
0	(IN)	01 19F	
		42 (N)	Form (N)
1		L4 (V1)	
		42 (V2)	
2		L4 (N)	
		42 (V3)	
3		00 20F	
		46 (V3)	
4		L4 (1)	
		42 20L	

LOCATION	ORDER	NOTES
5	L4 (1)	
	42 14(MTR)	Plant link
6	42 22L	
	36 14L	Test for square or triangular input: jump if triangular.
7	00 4F	
	36 16L	Test for tape or drum input: jump if tape.
8	L5 40(N12)	
	40 27(4A)	
9	L5 41(N12)	
	40 29(4A)	
10	L5 (n)	
	00 20F	
11	46 19(4A)	
	L5 44(N12)	
12	40 50(4A)	
	L5 45(N12)	
13	40 51(4A)	
	22 19L	
14	00 4F	
	36 19L	Test for tape or drum input: jump if tape.
15	40 (I)	
	22 19L	Form (I)
16	L5 43(N12)	
	40 47(4A)	
17	L5 42(N12)	
	40 60(4A)	
18	L5 39(N12)	
	40 23(N12)	
19	41 (I)	
	L5 (V3)	Clear (I)
20	42 34(M)	
	L5 F	
21	42 (P)	
	10 20F	Form (P)

LOCATION		ORDER	NOTES
22		42 (X)	
		L5 F	Form (X)
		00 K	
23	(4A)	10 20F	
		40 (S)	Form (S)
24		L3 (S)	
		36 13L	
25		L5 (S)	
		32 7L	
26		40 4F	
		L5 (-)	Store negative scaler
27		40 3F	
		F5 4F	
28		36 13L	
		40 4F	
29		50 3F	
		7J (-)	
30		26 4L	
		L1 (S)	
31		40 4F	
		L5 (+)	Store positive scaler
32		40 3F	
		F5 4F	
33		36 13L	
		40 4F	
34		50 3F	
		75 (+)	
35		S5 F	
		26 9L	
36		L5 (1)	
		40 5F	
37		L1 (N)	
		40 4F	
38		L3 (I)	

LOCATION		ORDER	NOTES
		32 45L	
39		L3 (S)	
		32 62L	
40		50 226S3	
		50 17L	Playback row of input
41		26 (Y1)	
		00 S5	
42		00 1F	
		50 19L	Scale row of input
43		26 (M)	
		22 21L	
44		J0 226S3	
		50 21L	Store row of input
45		26 (Y1)	
		00 S5	
46		00 1F	
		F5 4F	
47		32 62L	
		40 4F	
48		F5 5F	
		40 5F	
49		L4 22L	
		40 22L	
50		40 18L	
		L5 23L	
51		L4 (1-1)	
		46 23L	
52		46 19L	
		22 17L	
53	(M)	K5 F	
		42 37L	Scale input routine (M)
54		42 42L	
		L1 5F	
55		40 6F	
		L1 (S)	
56		32 39L	
		L5 (V1)	

LOCATION	ORDER	NOTES
57	42 35L	
	42 36L	
58	50 3F	
	75 F	
59	00 39F	
	40 F	
60	F5 6F	
	32 F	
61	40 6F	
	F5 35L	
62	26 34L	
	L5 (V1)	
63	40 41L	
	50 3F	
64	7J F	
	40 F	
65	F5 6F	
	32 F	
66	40 6F	
	L5 41L	
67	L4 (1-1)	
	26 40L	
68	50 F	
	41 6F	
69	50 226S3	Read in matrix from tape
	50 46L	
70	26 (N12)	
	F5 6F	
71	40 6F	
	L0 5F	
72	32 50L	
	L5 2F	
73	26 4(N12)	
	L3 (S)	

LOCATION		ORDER	NOTES
74		32 53L	
		50 51L	Scale row of input
75		26 (M)	
		22 53L	
76		J0 226S3	
		50 53L	Store row of input
77		26 (Y1)	
		00 S5	
78		00 1F	
		F5 4F	
79		32 62L	
		40 4F	
80		F5 5F	
		40 5F	
81		L4 54L	
		40 54L	
82		L5 55L	
		L4 (1-1)	
83		46 55L	
		L5 (V1)	
84		46 21(N12)	
		41 6F	
85		22 49L	
		L1 (N)	
86		40 5F	
		41 (MS)	
87		41 (Z)	
		41 F	Clear scale vector
88		F5 5F	
		40 5F	
89		32 (MTR)	
		F5 64L	
90		42 64L	
		22 64L	
	(N12)	00 K[illegible]	Input routine (N12) (Modified)

LOCATION	ORDER	NOTES
91	K5 F	
	42 5L	
92	46 21L	
	01 7F	
93	L4 18L	
	42 16L	
94	81 4F	
	L0 25L	
95	42 20L	
	L0 38L	
96	50 26L	
	32 F	
97	89 1F	
	22 9L	
98	10 3F	
	F4 F	
99	00 2F	
	F4 F	
100	00 1F	
	40 F	
101	11 1F	
	80 4F	
102	L0 25L	
	36 7L	
103	40 2F	
	01 4F	
104	L4 14L	
	42 15L	
105	42 17L	
	50 24L	
106	89 1F	
	50 F	
107	L4 F	
	26 L	
108	S0 F	
	66 F	

LOCATION		ORDER	NOTES
109		10 1F	
		SJ 961L	
110		40 F	
		L1 F	
111		40 1F	
		L5 F	
112		40 F	
		L5 21L	
113		L4 L	
		46 21L	
114		22 47(4A)	
		00 F	
115		00 F	
		00 005000 0000 0000 F	
116		80 F	
		00 10F	
117		01 1229F	
		59 3258F	
118		00 F	
		00 500F	
119		00 F	
		00 5F	
120		00 F	
		00 50000 F	
121		00 F	
		00 50F	
122		00 F	
		00 500 0000 F	
123		00 F	
		00 500 0000 0000 F	
124		00 F	
		00 5000 0000 F	
125		00 F	
		00 5000 F	
126		00 F	
		00 500 000 000 F	

LOCATION	ORDER	NOTES
127	00 F	
	00 500 000 F	
128	00 F	
	00 5000 000 000 F	
129	80 F	
	00 2F	
130	L5 2F	
	26 4(N12)	
131	22 27(4A)	
	L5 23(4A)	
132	26 50(4A)	
	50 F	
133	46 55(4A)	
	22 46(4A)	
134	26 (N12)	
	22 50(4A)	
135	L5 18(4A)	
	F4 (N)	
136	40 18(4A)	
	22 17(4A)	
137	22 24(Y)	
	26 1N	