LATIN SQUARE ANALYSIS

F4-208

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SC-0487

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Title: Latin Square Analysis

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Installation: Lederle Labs., American Cyanamid Co., Pearl River, N. Y.

Date: May 18, 1960

Classification: F4-208

Abstract

The program computes the analysis of variance of experiments performed with a Latin Square design using fixed point double precision arithmetic. The program will analyze 3 x 3 to 16 x 16 squares. The maximum number of replicate squares, dependent on the size of the squares, ranges from 40 16 x 16 squares to 203 3 x 3 squares.

The program, which contains its own input routine, requires a special input format in which the design and observation data are combined as a single word.

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Description:

The purpose of this program is to perform the analysis of variance of data obtained from a Latin Square design. The program is designed to handle 3 X 3 to 16 X 16 squares with or without replication of the squares. If there are more than two replicate squares, the program will also function for 2 X 2 squares provided that three instructions are changed (see Modifications, 1). The maximum number of squares which the program will handle varies with the square size. The number of squares is determined by the inequalities:

$$S + 3SR + 3R \leq 2048 \text{ and } S \leq 256$$

where S is the number of squares and R is the number of rows, columns, and treatments.

These yield the following restrictions:

Number of Rows, Columns, Treatments (R)	Maximum # of Squares (S)	Total Data (SR^2)
2	256	1,024
3	203	1,827
4	156	2,496
5	127	3,175
6	106	3,816
7	92	4,508
8	80	5,120
9	72	5,832
10	65	6,500
11	59	7,139
12	54	7,776
13	50	8,450
14	46	9,016
15	43	9,675
16	40	10,240

Input:

The program contains a data input routine which requires a special data format. Each data word must be of the form

(h)	i	j	k	a	b	c	d

where "abcd" is a four decimal digit non-negative number corresponding to the observation which is stored at a q of 30 and "hijk" is the design information.

The data observations should be scaled by a constant factor so that they are as large as possible subject to the restrictions that the total sum of squares in Squares and the sum of squares for Squares are each less than 2^{30}. If, for example, all the observations are of the form X.XX, they should be scaled by 1000 and entered as XXX0. If some of the observations in this set are of the form 0.XX, they are entered as 0XX0. Each data observation must be exactly four digits in length.

It is possible to enter some five decimal digit numbers, provided that they are less than 16,665. This is possible because the binarization routine does not restrict the letters a, b, c, d to the numeric values 0 to 9 but allows them to take on any hexadecimal value 0 to w. For example 11,240 is equivalent to g240 and 16,665 is equivalent to wwww.

The position of each observation in the design is uniquely described by the subscript hijk, that is, the value X_{hijk} is the observation from the i-th row and j-th column of the h-th square which was subject to the k-th treatment. The subscripts i, j and k assume the values 0 to r where r = R - 1 and R is the number of rows, columns, or treatments.

Since the use of h for designation of square would restrict the program to a maximum of 16 squares, this designation is not used by the program and, hence, its use in the data format is optional. The i, j and k are used by the program to set up the appropriate subtotal accumulators for the analysis.

The omission of the use of the h-designation by the program requires that the R^2 observations for each square be loaded sequentially as a block. The order of entry within the square is completely arbitrary, although, when it is convenient, the arrangement of the data into appropriate rows and columns makes a more attractive appearance for "hard copy" work. Also, the use of a color shift before and after the "(h)ijk" enhances the appearance.

The program contains an optional transformation of the data to y = 1000 log (scaled X) which is controlled by the Transfer Control switch. Other transformations may be made by appropriate modifications. For an example see Modifications (2).

The data tape should contain:

1. A description of the job, the scaling of the data and other pertinent information followed by a conditional stop.

2. An input word: ssr [Lo(data)]'
where ss is the number of squares (S) less 1 in hexadecimal (at most two hex-characters)

r is the number of rows, columns or treatments less 1 (in hex)

Lo(data) is the initial location of data storage in track-sector notation. It is necessary to provide $R^2 + 3R + S + 3RS$ sequential locations for data and subtotal storage ($R^2 + 3R + 1$ for a single square).

Example: To analyze twenty 11 X 11 squares with initial location of data as 4000, the input word would be 13f4000'. The data and storage would occupy the locations 4000 to 5301.

3. The data in the form (h)ijkabcd

Example: For the data (treatment in parenthesis)

	Column		
Row	1	2	3
1	4260(B)	1280(A)	3270(C)
2	960(A)	2790(C)	4040(B)
3	3080(C)	4120(B)	1160(A)

the tape would contain:

0014260'0101280'0223270'
1000960'1122790'1214040'
2023080'2114120'2201160'

(Note that the h is not included in the input words)

The layout of the storage of data and subtotals is as follows:

from	to, but not including	
Lo(data)	$Lo+R^2$	Observations for one square
$Lo+R^2$	$Lo+R^2+R$	Row totals over all squares
$Lo+R^2+R$	$Lo+R^2+2R$	Column totals over all squares
$Lo+R^2+2R$	$Lo+R^2+3R$	Treatment totals over all squares
$Lo+R^2+3R$	$Lo+R^2+3R+S$	Square totals
$Lo+R^2+3R+S$	$Lo+R^2+3R+S+SR$	Row totals by square
$Lo+R^2+3R+S+SR$	$Lo+R^2+3R+S+2SR$	Column totals by square
$Lo+R^2+3R+S+2SR$	$Lo+R^2+3R+S+3SR$	Treatment totals by square

If the data are for one square only, space need not be provided for the last three groups.

A check total on the design information is verified after the data for each square have been loaded If the check sum is not correct the program will stop at Lo + 1028 and it indicates that the numbers of observations in the rows, columns, or treatments are not the same. Check the data tape for the last square loaded.

Output:

The output for the program includes 100 times the scaled means for "Overall", "Rows", "Columns", "Treatments", "Squares", "Rows in Squares", "Columns in Squares" and "Treatments in Squares"; the analysis of variance; and 1000 times the standard error of a scaled treatment difference. For details, see the sample problem.

Method:

The statistical techniques used by the program are treated in most texts on Statistical Design and/or Analysis. A rather complete treatment is given in Bennett, C. and Franklin, N., Statistical Analysis in Chemistry and the Chemical Industry, John Wiley & Sons, New York, 1954.

The sums of squares in Squares are computed in the Double Precision Sum of Squares or Products routine (F1-164). The uncorrected (for mean) sums of squares for Rows, Columns, Treatments, Squares and interactions are computed in the second phase of DPSOSOP, that is, Lo + 0111 to Lo + 0144, and the corrections for grand mean are computed in the third phase Lo + 0145 to Lo + 0235.

Accuracy:

The maximum error of the means is a -1 in the last place and the maximum error in sums of squares is -1 times the number of subtotals in the sum of squares. This results in a maximum error of $\pm$ 2 in the last place of the mean squares.

Timing:

The estimated running times for the program with no transformations, using flexowriter input and output, based on minimal numbers of test problems are:

$100 + 19R + 15S + SR^2 + 2.8R^2(S - 1)$ seconds for repeated squares and $116 - 11R + 3.5R^2$ seconds for a single square.

Modifications:

1. In order to permit the program to handle three or more 2 X 2 Latin Squares

Change	To	From
Lo + 0752	B1018	B1056
0753	U0754	XD6329
0937	U0939	B1016

2. In order to change the transformation from 1000 log (scaled X) to, say, 100 $\sqrt{\text{scaled X}}$

Change	To		From	
0238	XRyy50	(15.1)	XRXX24	Log Routine
39	XUyy00		XUXX00	
40	U0242		XZ0030	
0300	100 @ 15		1000 @ 24	

If other transformations are used, the following information is of importance:

1. The scaled number abcd is in the accumulator at a q of 30 at Lo + 0238.

2. After transformation the number should be rescaled at a q of 30 so that the largest datum is in the range of 1000 to 10,000. Only under rare circumstances allow the largest datum to exceed 16,500.

3. The result of the transformation need not be a positive number.

4. Operating Procedure:

a. Load the following subroutines in the locations specified:

1.	Integer Printout (J4-172)	in 1000 to 1058
2.	Fast Square Root (15.1)	in 1600 to 1650
3.	Logarithm (18.0) (If transformation is desired)	in 1700 to 1857
4.	Alphanumeric (19.0)	in 1900 to 1957
5.	Data Output "30" (J4-173)	in 2500 to 2651
6.	Double Precision Sum of Squares or Products (F1-164)	in 6000 to 6263

If it is necessary because of space requirements, or desirable because of the user's drum map, to relocate the subroutines 1 to 5, this may be done by using the appendix program to alter the calling sequences in the Latin Square program. The operating procedure for the appendix program is given below. It is recommended that the location of F1-164 be left as specified because of the many changes required.

b. Load the Latin Square Analysis program in any desired location providing 11 tracks for its storage (12 tracks, 8 sectors if the appendix program is used to alter subroutine locations). Since the program is partially optimized it is recommended that the initial location of the program correspond to sector 00 of some track. The program uses all of track 63 except sectors 03, 08, 26 to 28, 38 to 40, 43 to 46, 52, 53 and 58 for storage. For details see pages 14 and 15.

c. Provide $R^2 + 3R + S + 3SR$ sequential locations for data and subtotal storage ($R^2 + 3R + 1$ if the data are from a single square).

d. Set the tabs at intervals of at least 6 providing an automatic carriage return at the end of the line, if S times R is greater than the number of numbers printable on one line. The number of tabs before the ACR should be determined by the size and number of squares in the design. For example, with four 3 X 3 squares set the ACR at the end of the sixth tabulation; with three 5 X 5 squares, set the ACR at the end of the fifth or tenth tabulation. The row, column and treatment means within squares print out in order for each successive square.

e. Transfer Control Switch
Up - if no transformation of the data is desired
Down - if 1000 log (scaled X) is desired.

f. Place the data tape in the reader, depress "Manual Input" on the flexowriter, One Op. - Clear Counter - Normal - Start on the console and halt and transfer to the initial location of the program. Press "start compute" on the flexowriter once, raise the "Manual Input" switch, and press "start compute" a second time.

g. After printing the standard error of a treatment difference the computer will stop at Lo + 1010. If a second set of data are to be analyzed, press "start compute" and the program will return to Lo for its analysis.

Appendix Program Operating Procedure:

a. After loading the Latin Square Analysis program beginning in Lo, load the appendix program in Lo + 1100 with a modifier of Lo.

b. At the completion of loading, (.0000000), depress manual input and press start compute.

type XZ (Lo J4-172), press start compute
type XZ (Lo 15.1), press start compute
type XZ (Lo J4-173), press start compute
type XZ (Lo 18.0), press start compute
type XZ (Lo 19.0), press start compute

Halt and transfer to Lo + 1100. Press "start compute" on flexowriter twice. The program will stop at Lo + 1162.

c. Place the data tape in the reader and press "start compute" to begin the Latin Square program. At this point, the appendix program may be destroyed in memory.

Program Stops:

Location	Remarks
0345	If stop occurs during or immediately following data input, the sum of squares within the square just entered is greater than $2^{30} - 1$. A "start compute" will cause the program to continue with an erroneous value for the Sum of Squares. If the stop occurs during the printing of the Analysis of Variance, a Sum of Squares is greater than $2^{30} - 1$. Do not press "start compute" because the program will return to the end of the data input phase.
0347	Sums of Squares within squares exceeds $2^{30} - 1$. A "start compute" will cause the program to continue with an erroneous Sum of Squares. The error term of the Analysis of Variance will be incorrect.
1028	During input: Error in design information on data tape. Start returns to Lo of Program.
1010	End of Problem.

Descaling of Output:

If the analysis is performed on the untransformed scaled data and the data was scaled by multiplying the observations by 10^n, then the output is descaled by dividing it by 10^x where:

x	
n + 2	for means
2n	for Sums of Squares and Mean Squares
n + 3	for the standard error of a treatment difference

If the logarithmic transformation has been used then:

divide means by 100,000 and subtract n
divide S.O.S. and M.S. by 1,000,000 and
divide S. E. (treatment Δ) by 1,000,000

Sample Problems:

Two problems are supplied, one for a single square and one for multiple squares. Both problems were run with the transfer control switch up.

Acknowledgement:

I wish to thank Dr. Roebert L. Stearman for his valuable suggestions concerning the scope of this program.

.0004200
LATIN SQUARE F4-208

sample 1, 1 7x7 square, 10 x data'
063000'
0000980'0111170'0220890'0330640'0440630'0551320'0662440'
1010690'1140670'1200700'1360700'1451110'1530600'1622180'
2020370'2150830'2260830'2310740'2430700'2500750'2641690'
3030650'3160600'3240910'3350560'3420610'3510590'3601500'
4040560'4130440'4210700'4320680'4400880'4561110'4652200'
5051130'5121050'5230650'5300510'5460830'5540570'5612330'
6060640'6100620'6250650'6340860'6410450'6521080'6631870'

100 x scaled means

gr. mean
93591

r							
	115285	94999	84428	77428	93857	100999	88142
c							
	71714	76857	76142	66999	74428	85999	202999
t							
	84857	95285	97999	79285	84142	111428	102142

ANALYSIS OF VARIANCE

Effect	d.f.	S O S	Mean Square
rows	6	631724	105287
col.	6	9915695	1652615
trtmt	6	548668	91444
error	30	1354098	45136

1000s.e.(trtmt Δ) = 113560

———	appears in alternate color
– –	optionally appears in alternate color

.0004200
LATIN SQUARE F4-208

sample 2, 2 3x3 squares, 1000 x data'
123000'
0002080'0121190'0211860'
1012680'1100850'1220960'
2021130'2111830'2200380'

0001000'0113370'0222350'
1011790'1120960'1200640'
2020820'2100630'2212730'

100 x scaled means

gr. mean
151388

r
197500 131333 125333

c
158333 147166 148666

t
93000 237666 123500

s
143999 158777

s r
170999 149666 111333 223999 112999 139333

s c
196333 128999 106666 120333 165333 190666

s t
110333 212333 109333 75666 262999 137666

ANALYSIS OF VARIANCE

Effect	d.f.	S O S	Mean Square
rows	2	1924410	962205
col.	2	44076	22038
trtmt	2	6978544	3489272
squ	1	98271	98270
s x r	2	642343	321171
s x c	2	2024545	1012272
s x t	2	587477	293738
error	4	182562	45640

1000s.e.(trtmt Δ) = 123342

LGP-30 CODING SHEET

PREPARED FOR | PAGE / OF

JOB NO. | PROGRAM NO. F4-208 | PROGRAM PREPARED BY | PROGRAM CHECKED BY | DATE

PROBLEM: STORAGE | TRACK 63

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	.						
	.	☒					
		6300			.		N_2 IN (3)
		0001			.		N_1 IN (1), CTR IN (1)
		0002			.		N_2 IN (1) UNC SOS(T)L
		0003			.	☒	
		0004			.		UNC SOS(T)H
		0005			.		SOS(SQ)
		0006			.		$L_0(S_h C_j)$
		0007			.	☒	UNC SOS(R)L
		0008			.		
		0009			.		UNC SOS(R)H
		0010			.		UNC SOS(S)L
		0011			.	☒	UNC SOS(SxR)H
		0012			.		UNC SOS(S)H
		0013			.		$L_0(S_h T_K)$
		0014			.		CK Σ (3); UNC SOS(SxR)L
		0015			.	☒	UNC SOS(SxC)H
		0016			.		$[(\Sigma x)^2/SR^2]_L$
		0017			.		UNC SOS(S·C)L
		0018			.		$[(\Sigma x)^2/SR^2]_H$
		0019			.	☒	UNC SOS(C)H
		0020			.		UNC SOS(SxT)L
		0021			.	ABCD (3);	UNC SOS(C)L
		0022			.	CK Σ Acc (3);	UNC SOS(SxT)H
		0023			.	☒	Σ R_L (6)
		0024			.		Σ R_H (6)
		0025			.		(h)ijk ABCD (3)
		0026			.		
		0027			.	☒	
		0028			.		
		0029			.		r = R - 1 @29
		0030			.		SR^2 @29
		0031			.	☒	SOS(Sx⁻⁻)

ROYAL MCBEE, ATHENS, O. H826722E

LPR 5124-1

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☒ CARRIAGE RETURN

CONDITIONAL STOP CODE

LGP-30 CODING SHEET

PREPARED FOR:

PAGE / OF

JOB NO. | PROGRAM NO. F4-208 | PROGRAM PREPARED BY | PROGRAM CHECKED BY: | DATE

PROBLEM: STORAGE

TRACK 63

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
		6332					SOS (C)
		3333					SOS (R)
		3434				i (3);	SOS (S×R)
		3535				$L_o(T_K)$;	SOS (S×C)
		3636					SOS (T)
		3737				$[R^2-1]H[L_o]$ CTR (3); DUMP (7)	
		3838					
		3939					
		4040					
		4141					k (3)
		4242					$L_o(R_i)$
		4343					
		4444					
		4545					
		4646					
		4747					$\Delta = S-1$ @ 29
		4848					$[R^2-1]H[L_o]$
		4949					$L_o(S_h R_i)$
		5050					
		5151					SR/2 @ 10
		5252					
		5353					
		5454					S CTR (2)
		5555					j @ 29 (3)
		5656					$L_o(C_j)$
		5757					$T = T + \Sigma X$
		5858					
		5959					SOS @ 30 (8)
		6060				DUMP (1);	d.f. @ 29 (8)
		6161					V... @ 0 (8)
		6262				TP ST (1);	SOS IN SQ'S
		6363				TP ST (1),	N. (3)

LPR 5124-2

ROYAL MCBEE, ATHENS,) HU76277X

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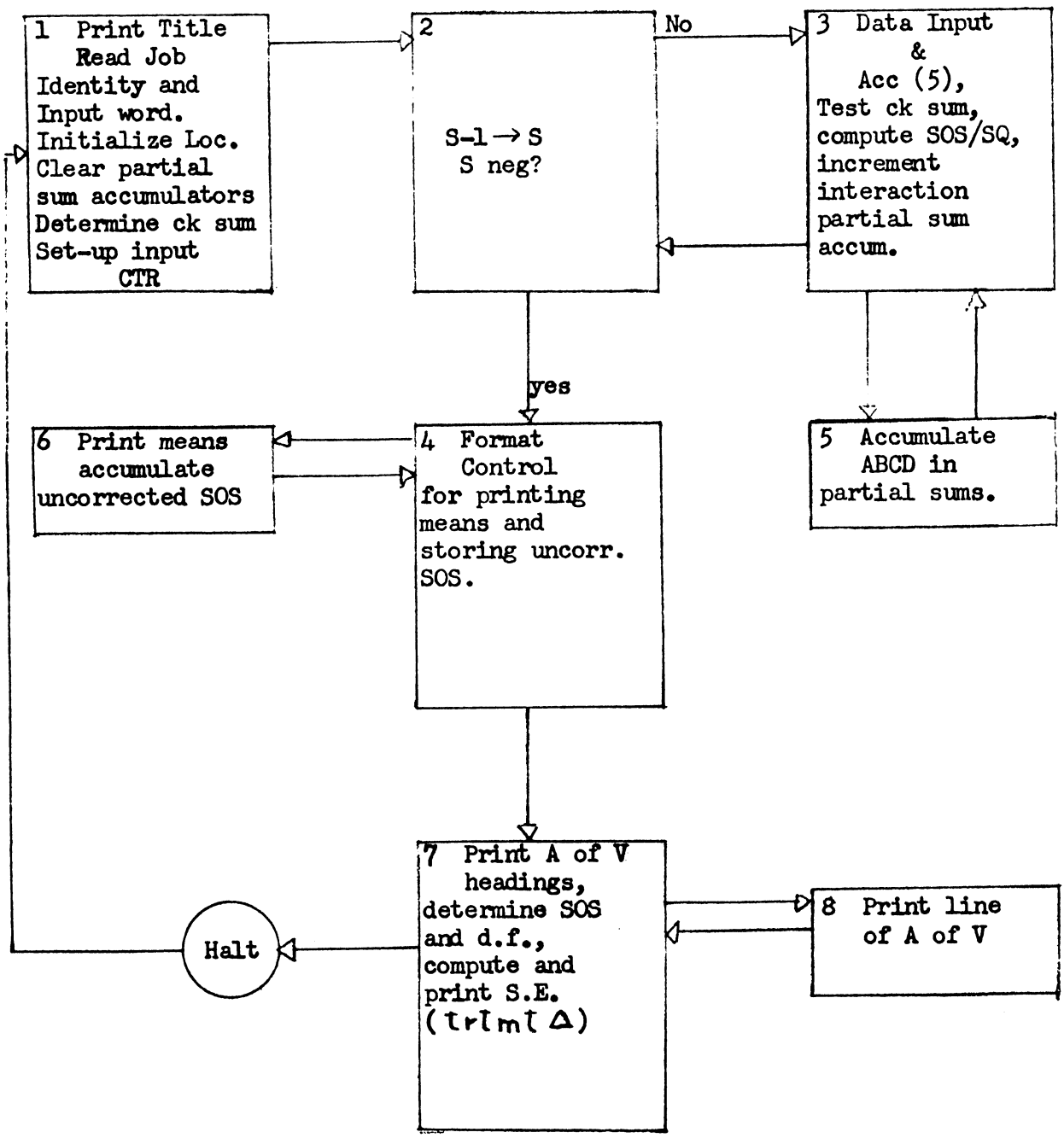
CARRIAGE RETURN

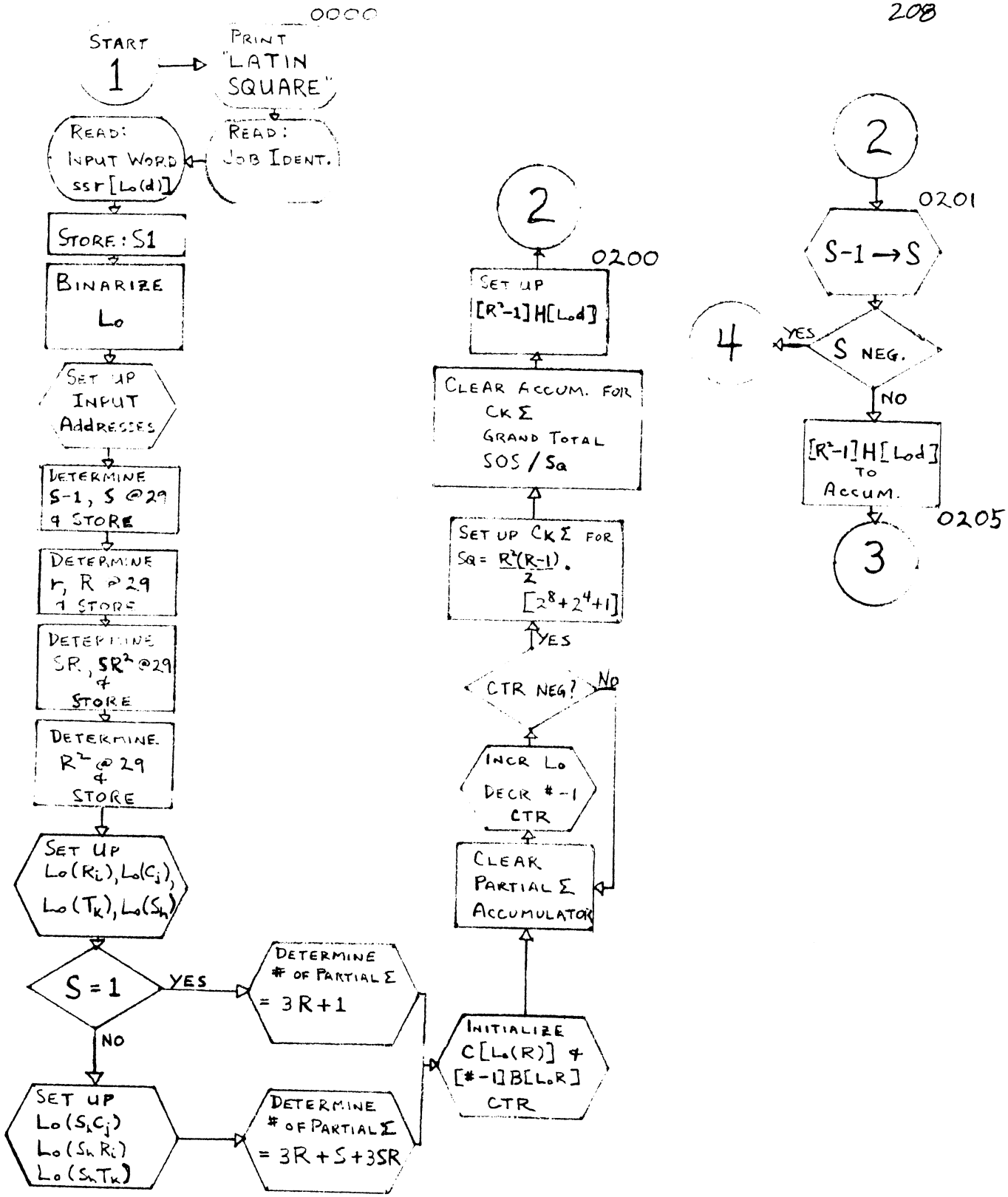
= CONDITIONAL STOP CODE

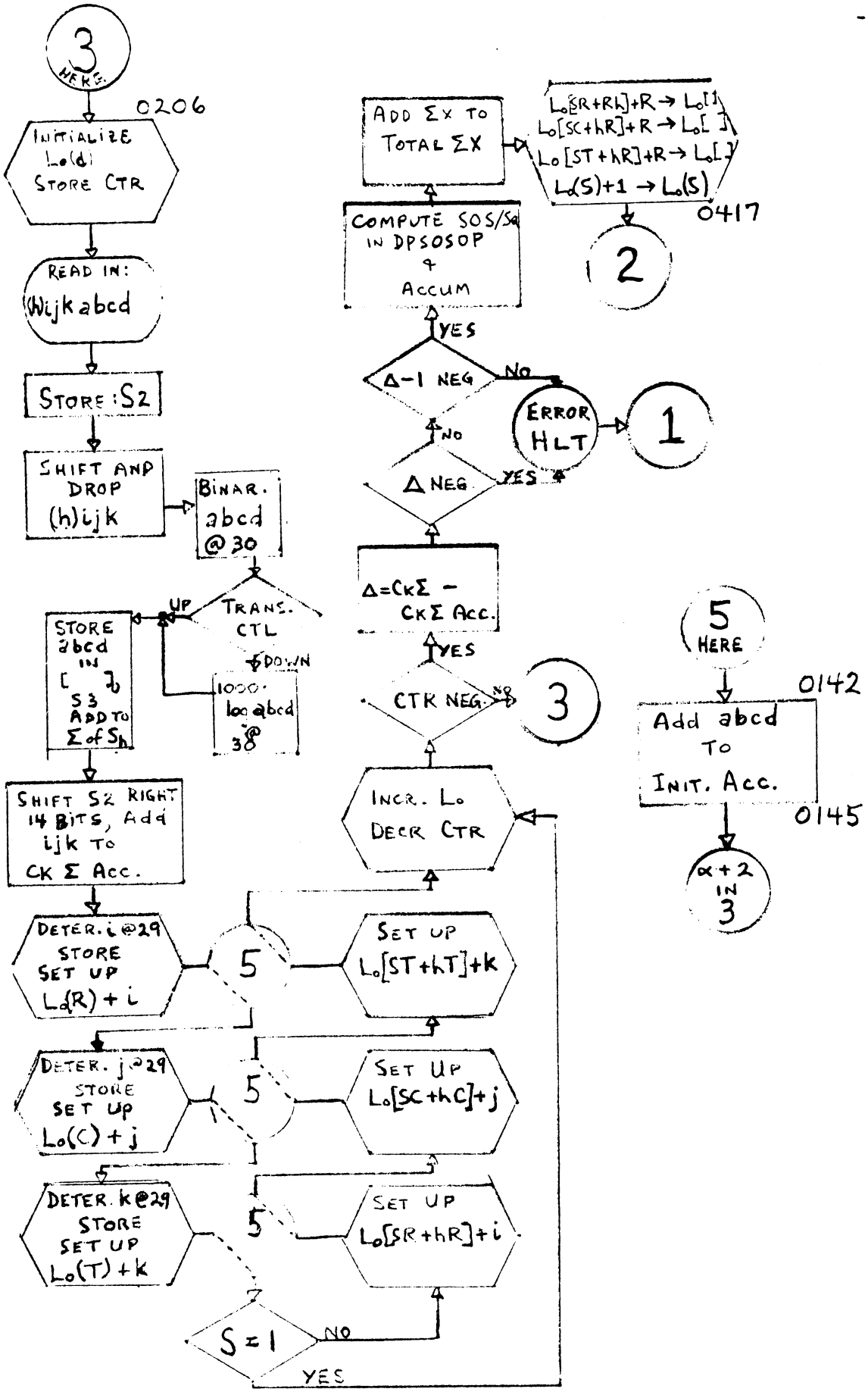
Latin Square Analysis
R. A. Lamm
Classification: F4 -208

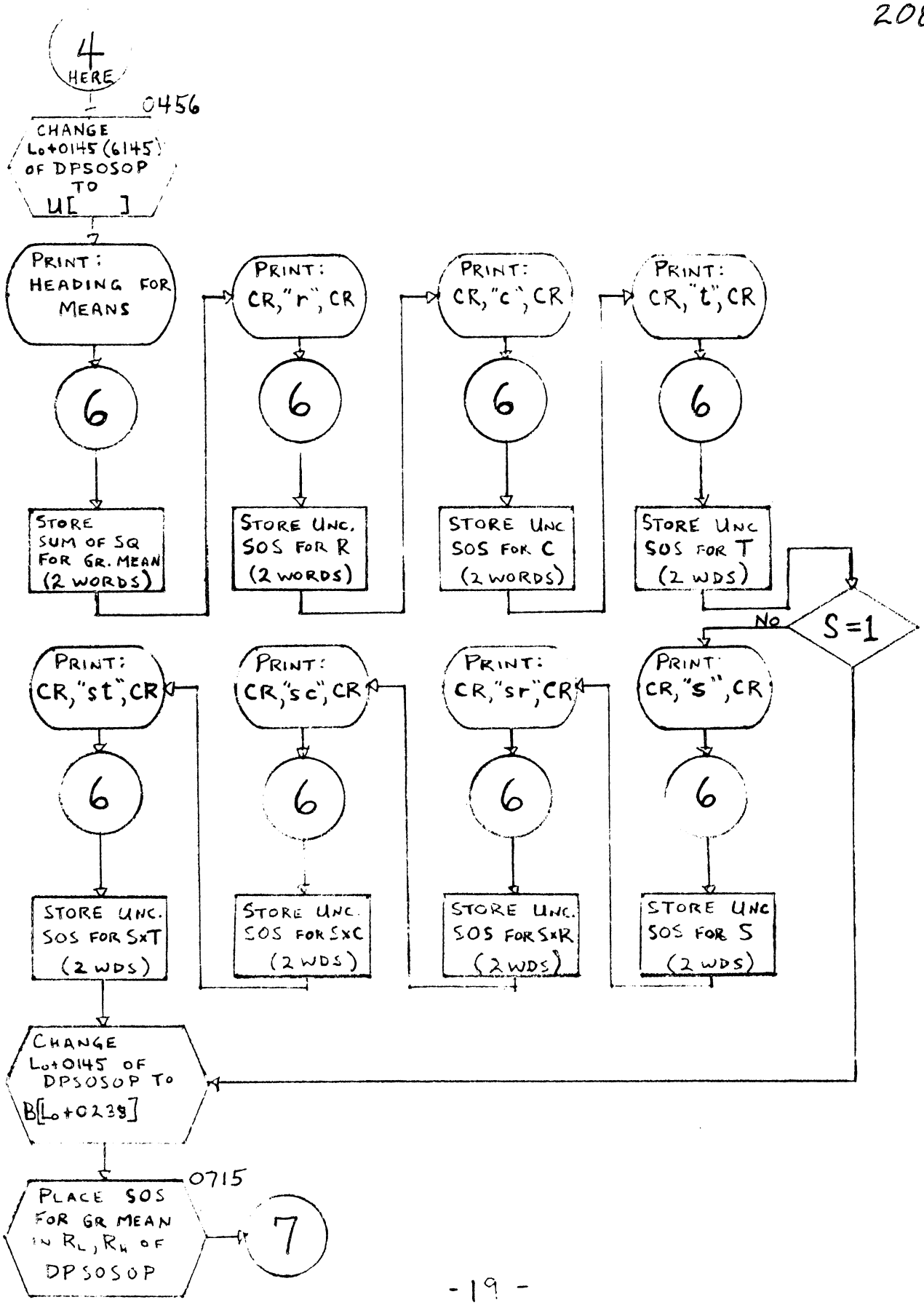
GENERAL BLOCK DIAGRAM

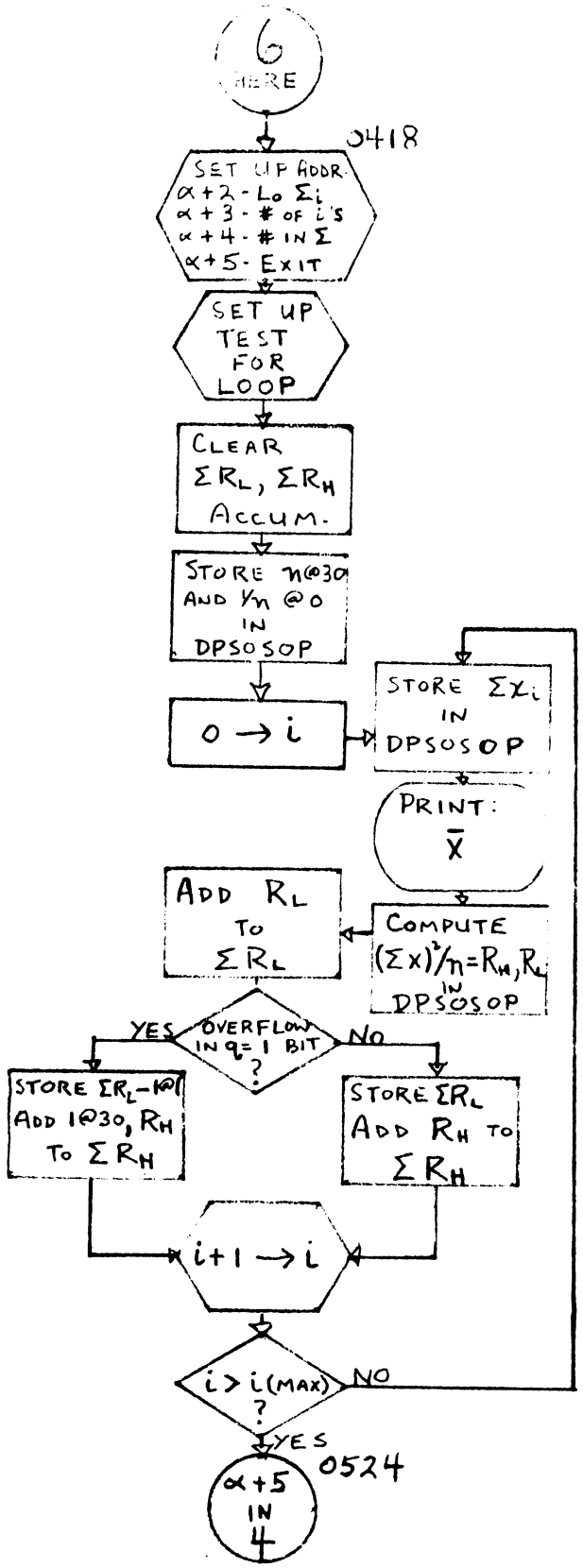


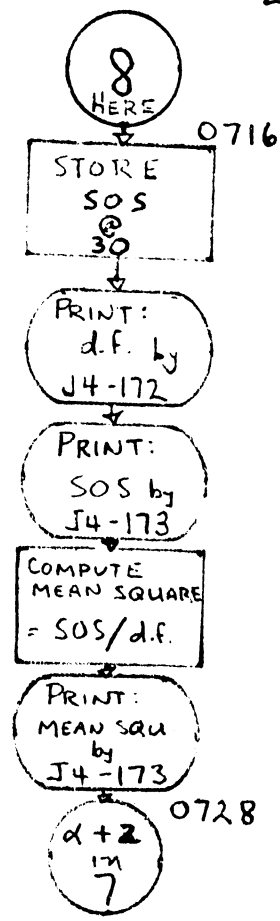
(for details see numbered sections on succeeding pages)


0000
START
1
PRINT "LATIN SQUARE"
READ: JOB IDENT.
READ: INPUT WORD ssr[Lo(d)]
STORE: S1
BINARIZE Lo
SET UP INPUT ADDRESSES
DETERMINE S-1, S @29 & STORE
DETERMINE r, R @29 & STORE
DETERMINE SR, SR² @29 & STORE
DETERMINE R² @29 & STORE
SET UP Lo(Ri), Lo(Cj), Lo(Tk), Lo(Sh)
S = 1
YES
NO
DETERMINE # OF PARTIAL Σ = 3R+1
SET UP Lo(SiCj) Lo(ShRi) Lo(ShTk)
DETERMINE # OF PARTIAL Σ = 3R+S+3SR
INITIALIZE C[Lo(R)] & [#-1]B[LoR] CTR
CLEAR PARTIAL Σ ACCUMULATOR
INCR Lo DECR #-1 CTR
CTR NEG?
NO
YES
SET UP Ck Σ FOR Sa = R²(R-1)/2 . [2⁸+2⁴+1]
CLEAR ACCUM. FOR Ck Σ GRAND TOTAL SOS / Sa
SET UP [R²-1]H[Lod]
0200
2
4
2
0201
S-1 → S
S NEG.
YES
NO
[R²-1]H[Lod] TO Accum.
0205
3

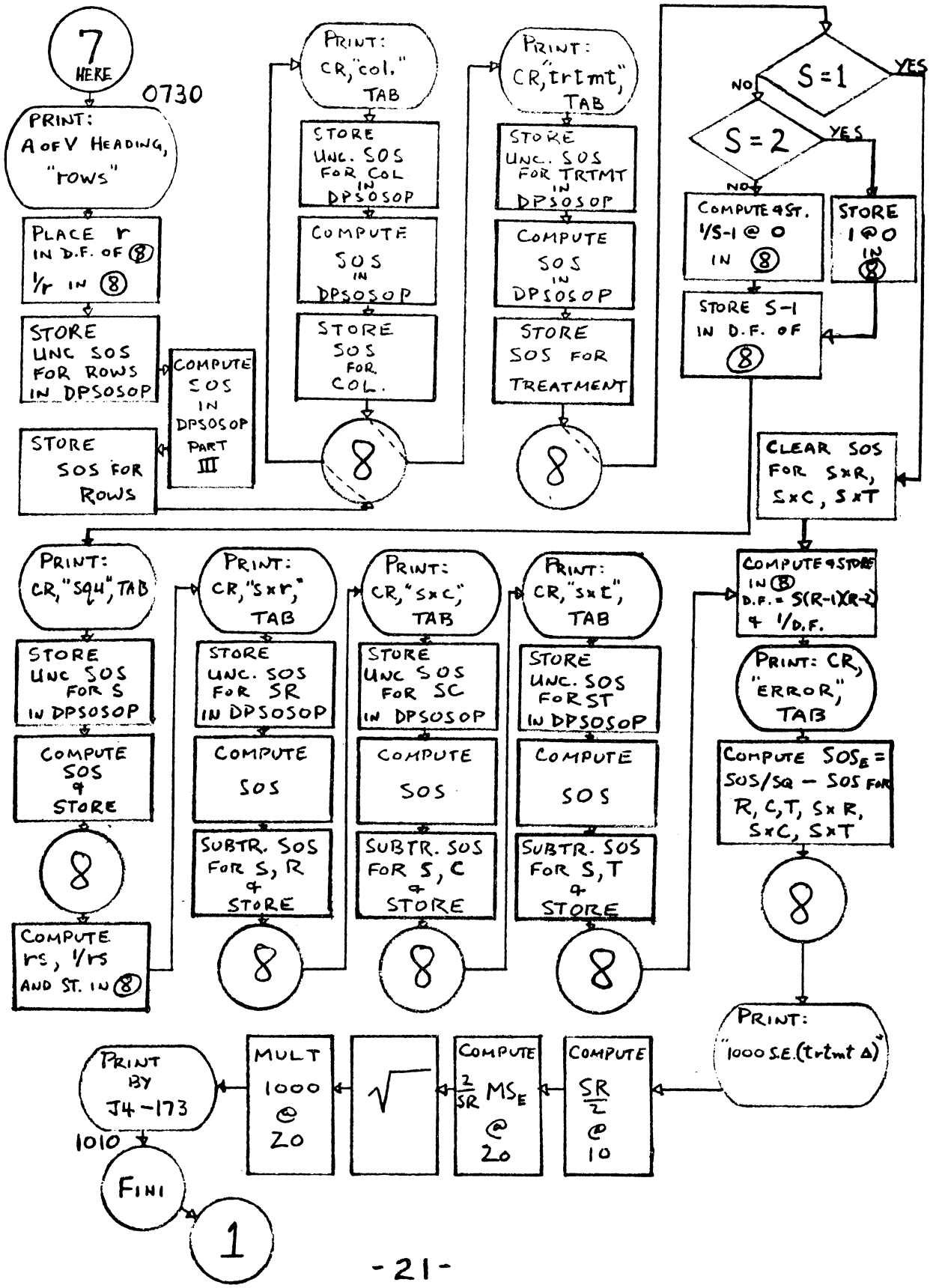

3 HERE
0206
INITIALIZE Lo(d) STORE CTR
READ IN: Wijk abcd
STORE: S2
SHIFT AND DROP (h)ijk
BINAR. abcd @30
TRANS. CTL
UP
DOWN
1000 - loo abcd 38
STORE abcd IN [ ] S3 ADD TO Σ of Sh
SHIFT S2 RIGHT 14 BITS, Add ijk TO CK Σ Acc.
DETER. i @29 STORE SET UP L₀(R) + i
5
SET UP Lo[ST+hT]+k
DETER. j @29 STORE SET UP Lo(C) + j
5
SET UP Lo[SC+hC]+j
DETER. k @29 STORE SET UP Lo(T) + k
5
SET UP Lo[SR+hR]+i
S = 1
NO
YES
INCR. Lo DECR CTR
CTR NEG
NO
3
YES
Δ=CkΣ - CkΣ Acc.
Δ NEG
YES
NO
Δ-1 NEG
NO
ERROR HLT
1
YES
COMPUTE SOS/Sq IN DPSOSOP & Accum
ADD Σx TO TOTAL Σx
Lo[SR+RW]+R → Lo[ ]
Lo[SC+hR]+R → Lo[ ]
Lo[ST+hR]+R → Lo[ ]
L₀(S)+1 → L₀(S)
0417
2
5 HERE
0142
Add abcd To Init. Acc.
0145
α+2 IN 3


4 HERE
0456
CHANGE Lo+0145 (6145) OF DPSOSOP TO U[ ]
PRINT: HEADING FOR MEANS
6
STORE SUM OF SQ FOR GR. MEAN (2 WORDS)
PRINT: CR,"r",CR
6
STORE UNC. SOS FOR R (2 WORDS)
PRINT: CR,"c",CR
6
STORE UNC SOS FOR C (2 WORDS)
PRINT: CR,"t",CR
6
STORE UNC SOS FOR T (2 WDS)
S=1
No
PRINT: CR,"s",CR
6
STORE UNC SOS FOR S (2 WDS)
PRINT: CR,"sr",CR
6
STORE UNC. SOS FOR SxR (2 WDS)
PRINT: CR,"sc",CR
6
STORE UNC. SOS FOR SxC (2 WDS)
PRINT: CR,"st",CR
6
STORE UNC. SOS FOR SxT (2 WDS)
CHANGE Lo+0145 OF DPSOSOP TO B[Lo+0238]
0715
PLACE SOS FOR GR MEAN IN RL, RH OF DPSOSOP
7





NOTE: R_L, R_H ARE NOTATION OF DPSOSOP (F1-164)


7 HERE
0730
PRINT: A OF V HEADING, "ROWS"
PLACE r IN D.F. OF (8) 1/r IN (8)
STORE UNC SOS FOR ROWS IN DPSOSOP
COMPUTE SOS IN DPSOSOP PART III
STORE SOS FOR ROWS
PRINT: CR, "col." TAB
STORE UNC. SOS FOR COL IN DPSOSOP
COMPUTE SOS IN DPSOSOP
STORE SOS FOR COL.
8
PRINT: CR, "trtmt", TAB
STORE UNC. SOS FOR TRTMT IN DPSOSOP
COMPUTE SOS IN DPSOSOP
STORE SOS FOR TREATMENT
8
S=1
YES
NO
S=2
YES
NO
COMPUTE 9ST. 1/S-1 @ 0 IN (8)
STORE 1 @ 0 IN (8)
STORE S-1 IN D.F. OF (8)
CLEAR SOS FOR S×R, S×C, S×T
PRINT: CR, "SQ4", TAB
STORE UNC SOS FOR S IN DPSOSOP
COMPUTE SOS 9 STORE
8
COMPUTE rs, 1/rs AND ST. IN (8)
PRINT: CR, "S×r," TAB
STORE UNC. SOS FOR SR IN DPSOSOP
COMPUTE SOS
SUBTR. SOS FOR S, R 9 STORE
8
PRINT: CR, "S×C", TAB
STORE UNC SOS FOR SC IN DPSOSOP
COMPUTE SOS
SUBTR. SOS FOR S, C 9 STORE
8
PRINT: CR, "S×T", TAB
STORE UNC. SOS FOR ST IN DPSOSOP
COMPUTE SOS
SUBTR. SOS FOR S, T 9 STORE
8
COMPUTE 9 STORE IN (8) D.F. = S(R-1)(R-2) 9 1/D.F.
PRINT: CR, "ERROR", TAB
COMPUTE SOS_E = SOS/SQ − SOS FOR R, C, T, S×R, S×C, S×T
8
PRINT: "1000 S.E. (trtmt Δ)"
COMPUTE SR/2 @ 10
COMPUTE 2/SR MS_E @ 20
√
MULT 1000 @ 20
PRINT BY J4-173
1010
FINI
1

LGP-30 CODING SHEET

F4-208

PREPARED FOR:			PAGE 1 OF 22
JOB NO.:	PROGRAM NO.: F4-208	PROGRAM PREPARED BY: R.A. LAMM	PROGRAM CHECKED BY:	DATE: 5/18/60
PROBLEM: LATIN SQUARE ANALYSIS			TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION (OPERATION / ADDRESS)	STOP	CONTENTS OF ADDRESS	NOTES
	.					
	.	☒				
		0000	xR1900	.		} α-NUMERIC
		01	xU1900	.		} (19.0)
)00000005	'	02	2018100J	.		
		03	725F2232	.	☒	"LATIN SQUARE"
		04	067F7452	.		
		05	721F4F18	.		
		06	082020VQ	.		
		07	xP0057	.	☒	} READ IN JOB CODE
		08	xI0000	.	← 1@13	} AND DATA SCALING
		09	xP0059	.		
		10	xC6360	.		SET ACCUM = 0
		11	xI0000	.	☒ ← 1@13	READ IN: ~~~ [L_{OD}]
		12	xH6362	.		TEMP. STORAGE (1)
		13	N1056	.	1@29	BEGIN TO BIN. L_{OD}
		14	E0729	.	3WWWJ	
		15	xH6301	.	☒	N_1
		16	E1059	.	3J3JO	
		17	M0346	.	-6@4	
		18	U0022	.		
		19	Y0236	.	☒ (0031)	} INITIAL LOC OF
		20	Y0508	.		} DATA
		21	U0027	.		
		22	xA6301	.	(0018)	N_1
		23	xH6302	.	☒	N_2
		24	E1046	.	WWWWWOO	
		25	M1061	.	-3/4@0	
		26	U0030	.		
		27	Y0344	.	☒ (0021)	} INIT LOC OF DATA
		28	Y0343	.		} IN DPSOSOP CALL SEQ
		29	U0032	.		
		30	xA6302	.	(0026)	N_2
		31	U0019	.	☒	

ROYAL McBEE, ATHENS, O. H6?4??E

LPR 5124-1

☒ CARRIAGE RETURN

' CONDITIONAL STOP CODE

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PREPARED FOR:

PAGE 2 OF 22

JOB NO.

PROGRAM NO. F4-208

PROGRAM PREPARED BY: R. A. L.

PROGRAM CHECKED BY:

DATE

PROBLEM: LATIN SQUARE

TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
		☒					
		00 32	B	1054		1 @ 14 (0029)	
		33	x M	6362		TP ST (1)	AAN [LOD]
		34	x H	6363		TP ST (2)	16 AN + n @ 29
		35	M	1021	☒	1 @ 4	
		36	E	1022		3WJ	
		37	x H	6347			AA @ 29 = S-1
		38	A	1060		1 @ 29	
		39	x H	6354	☒		S CTR FOR INPUT LP
		40	C	0628			S @ 29
		41	x B	6363		TP ST (2)	
		42	E	1014		3J	
		43	x H	6329	☒	R-1 @ 29	= n = c = t
		44	A	1016		1 @ 29	
		45	H	0553			
		46	H	0704			
		47	H	0642	☒		STORE R IN CALL. SEQ.
		48	H	0613			
		49	H	0655			
		50	H	0601			
		51	N	0628	☒	S @ 29	
		52	M	1028		1 @ 2	
		53	H	0554			
		54	H	0602			
		55	H	0641	☒		STORE SR IN CALL. SEQ.
		56	H	0614			
		57	H	0654			
		58	H	0703			
		59	N	0553	☒	R @ 29	
		60	M	0518		1 @ 2	
		61	H	0542			SR² @ 29 IN
		62	x C	6330			CALL. SEQ & STORE
		63	B	0642	☒	R @ 29	

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☒ CARRIAGE RETURN

CONDITIONAL STOP CODE

PREPARED FOR:

PAGE 3 OF 22

JOB NO. | PROGRAM NO. FA-208 | PROGRAM PREPARED BY: R.A.L. | PROGRAM CHECKED BY: | DATE

PROBLEM: LATIN SQUARE | TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	·				·		
	·	☒			·		
		0100	N	0601	·	R @ 29	
		01	M	0244	·	1 @ 2	
		02	H	0345	·	R^2 @ 29	IN DPSOSOP CALL. SEQ.
		03	A	0508	·	☒	B[L_0]
		04	x Y	6342	·		} L_0 R_i
		05	Y	0552	·		}
		06	A	0642	·	R @ 29	
		07	x Y	6356	·	☒	} L_0 C_j
		08	Y	0600	·		}
		09	A	0553	·	R @ 29	
		10	x Y	6335	·		} L_0 T_K
		11	Y	0612	·	☒	}
		12	A	0655	·	R @ 29	
		13	Y	0232	·		}
		14	Y	0231	·		} L_0 S_h
		15	Y	0627	·	☒	}
		16	x B	6347	·	N @ 29	
		17	S	1060	·	1 @ 29	
		18	T	0140	·		→ SKIP INTERACTIONS
		19	B	0627	·	☒ L_0 S_h	
		20	A	0628	·	S @ 29	
		21	x Y	6349	·		} L_0 S_h x K_i
		22	Y	0640	·		}
		23	A	0602	·	☒ SR @ 29	
		24	Y	0653	·		} L_0 S_h x C_j
		25	x Y	6306	·		}
		26	A	0641	·	SR @ 29	
		27	x Y	6313	·	☒	} L_0 S_h x T_K
		28	Y	0702	·		}
		29	A	0602	·	SR @ 29	
		30	S	1016	·	1 @ 29	
		31	S	0552	·	☒ B[L_0 R_i]	

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JOB NO.	PROGRAM NO. F4-208	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY:	DATE
PROBLEM: LATIN SQUARE				TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	.				.		
	.	☒					
		012	N	0011	.	1@13	
		013	A	0552	.	B[Lo Ri]	
		014	U	0149	.		
		015	C[ ]		.	☒ (0151)	ZERO Σ LOCATIONS
		016	xB	6301	.		[ ]B[ ] CTR
		017	S	1052	.	WWWWJ	1@11 − 1@29
		018	T	0152	.		
		019	U	0149	.	☒	
		040	B	0627	.	(0118)	Lo Sh
		041	U	0131	.		
		042	xB	6321	.		DATUM @ 30
		043	A[ ]		.	☒ (5)	PARTIAL Σ ACCUM
		044	C[ ]		.		OF DATA INPUT
		045	U[ ]		.		
		046	B	1018	.	(0331)	7WWWWW'WQ≈1@0
		047	U	0834	.	☒	
		048	xI	0000	.		1@13
		049	Y	0135	.	(0134)	(0139)
		050	xC	6301	.		
		051	U	0135	.	☒	
		052	xB	6329	.	n@29 (0138)	=(R−1)/2 @28
		053	N	0432	.		2^8+2^4+1 @30
		054	N	0345	.	R^2@29	
		055	M	0334	.	☒ 1@4	
		056	xC	6314	.		CK Σ
		057	xC	6322	.		CK Σ ACCUM.
		058	xC	6362	.		SOS IN SQ.
		059	xC	6357	.	☒	TOT ΣX
		060	B	0345	.	R^2@29	
		061	S	0333	.	1@29	
		062	N	0148	.	1@13	
		063	A	0236	.	☒ H[Lod]	

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PAGE 5/22

JOB NO. | PROGRAM NO. F4-208 | PROGRAM PREPARED BY: R.A.L. | PROGRAM CHECKED BY: | DATE

PROBLEM: LATIN SQUARE | TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	·						
	·	☒					
		0200	xC	6348	·		$[R^2-1]H[L_{0_D}]$
		01	xB	6354	·		S CTR
		02	S	1045	·	1@29	
		03	T	0456	·	☒	→ INPUT FIN. → (4)
		04	xC	6354	·		S CTR (REDUCED)
		05	xB	6348	·		$[R^2-1]H[L_{0_D}]$ ST.
		06	xP	00056	·		START (3)
		07	Y	0236	·	☒ H[L$_{0_D}$]	
		08	xC	6337	·	CTR	{ READ IN
		09	xI	00059	·		{ h i j k A B C D
		10	xH	6325	·		DATA WORD STORAGE
		11	N	0226	·	☒ 1@30	
		12	E	1027	·	1WWWQ	DROP CODE - REG. E.N.
		13	xH	6363	·		N$_1$
		14	E	0350	·	1Q1Q0	
		15	M	1058	·	☒ -6@4	
		16	U	0220	·		
		17	Y	0232	·	(0511)	
		18	Y	0231	·		
		19	U	0405	·	☒	
		20	xA	6363	·	(0216)	N$_1$
		21	xH	6300	·		N$_2$
		22	E	0351	·	1WQ00	
		23	U	0227	·	☒	
),0000003	'	24	40000000		·		1@1
		25	40000000		·		1@1
		26		2	·		1@30
		27	M	1063	·	☒ (0223)	-156@8
		28	xA	6300	·		N$_2$
		29	800T	0238	·		→ 1000 LOOP ABOVE
		30	U	0235	·		
		31	A[L$_{S_h}$]		·	☒ (0237)	

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☒ CARRIAGE RETURN

= CONDITIONAL STOP CODE

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PREPARED FOR:				PAGE 6 OF 22
JOB NO.	PROGRAM NO. F4-208	PROGRAM PREPARED BY: R.A.L	PROGRAM CHECKED BY:	DATE
PROBLEM: L. SQ.				TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION (OPERATION / ADDRESS)	STOP	CONTENTS OF ADDRESS	NOTES
		☒				
		0232	C[Lo Sh]			
		33	U0245			
		34				
		35	xH6321		☒ (0230) or (0243)	TP, ST, ABCD
		36	H[Lo D]			
		37	U0231			
		38	xR1724		(0229)	} Log10 (18.0)
		39	xU1700		☒	
		40	xZ0030			
		41	xZ0002			
		42	M0300		1000 @ 24	
		43	U0235		☒	
)0000001	'	44	20000000			1 @ 2
		45	B1017		1@14 (0233)	
		46	xM6325		☐ijk ABCD	
		47	E1012		☒ 3WWJ	RETAIN ijk
		48	U0249			
		49	xA6322			} CK Σ ACCUM.
		50	xC6322			
		51	U0252		☒	
		52	B1024		1@22	
		53	xM6325		☐ijk ABCD	
		54	E1026		3J	
		55	xH6334		☒	i @ 29
		56	xA6342		Lo Ri	
		57	Y0143			} (5) ADD ABCD TO Ri
		58	Y0144			
		59	R0145		☒	
		60	U0142			
		61	U0302			
)0000004	'	62	40000000			1@1
		63			☒	

LPR 5124-2

☒ CARRIAGE RETURN

' = CONDITIONAL STOP CODE

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LGP-30 CODING SHEET

PREPARED FOR:

PAGE 7 OF 22

JOB NO. | PROGRAM NO. F4-208 | PROGRAM PREPARED BY: R.A.L. | PROGRAM CHECKED BY: | DATE

PROBLEM: LAT. SR. | TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	·						
	·	☒					
		0300	1	W4004	·		1000 @ 24
		01		4	·		1 @ 27
		02	B	1031	·	1@18 (0261)	
		03	xM	63255	·	☒ i j K A B C D	
		04	E	1026	·	3J	
		05	xH	63555	·		j @ 29
		06	xA	63566	·	Lo Cj	
		07	Y	01443	·	☒	ADD ABCD TO Cj (5)
		08	Y	01444	·		
		09	R	01445	·		
		10	U	01442	·		
		11	U	03524	·	☒	
		12	xB	63344	·	i @ 29 (0400)	
		13	xA	63499	·	Lo Sh Ri	
		14	Y	01443	·		
		15	Y	01444	·	☒	ADD ABCD TO Sh Ri (5)
		16	R	01445	·		
		17	U	01442	·		
		18	U	03199	·	2	
		19	xB	63555	·	☒ j @ 29	
		20	xA	63066	·	Lo Sh Cj	
		21	Y	01443	·		
		22	Y	01444	·		ADD ABCD TO Sh Cj (5)
		23	R	01445	·	☒	
		24	U	01442	·		
		25	U	03266	·	2	
		26	xB	63411	·	K @ 29	
		27	xA	63133	·	☒ Lo Sh Tk	
		28	Y	01443	·		
		29	Y	01444	·		ADD ABCD TO Sh Tk (5)
		30	R	01445	·		
		31	U	01442	·	☒	

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☒ CARRIAGE RETURN

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LGP-30 CODING SHEET

PREPARED FOR:

PAGE 8 OF 22

JOB NO. | PROGRAM NO. F4-208 | PROGRAM PREPARED BY: RAL | PROGRAM CHECKED BY: | DATE

PROBLEM: LAT. SQ. | TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	.						
	.	☒					
		0312	U	0401	.		
)0000002	'	313		4	.		1@29
		314	8000000		.		1@4
		315	xB	63114	.	☒ (0403)	CK Σ
		316	xS	63222	.		CK Σ Acc.
		317	T	1028	.		→ ERROR HALT
		318	S	1053	.	1@30	
		319	T	1042	.	☒	→ CLEAR CK Σ Acc
		320	U	1028	.		→ ERROR HLT
		321	xR	60000	.	(1044)	
		322	xU	60000	.		
)0000004	'	323	M[Lod]		.	☒	DPSOSOP
		324	M[Lod]		.		CALL. SER.
		325	Z[R3]		.		
		326	K	0000000	.		-6@4 + ERROR HLT
		327	xA	63622	.	☒	} SOS IN SQ.
		328	xC	63622	.		
		329	U	0509	.		
)0000002	'	330	1Q	1Q0	.		MASK
		331	1W	Q00	.	☒	"
		332	B	1017	.	1@14 (0:11)	
		333	xM	63225	.	☐ CjK ABCD	
		334	E	1026	.	3J	
		335	xH	63411	.	☒	K@29
		336	xA	63355	.	Lo T_K	
		337	Y	01443	.		
		338	Y	01444	.		(5) ADD A B C D TO T_K
		339	R	01445	.	☒	
		340	U	01442	.		
		341	xB	63447	.	A@29	
		342	S	05411	.	1@29	
		343	T	04011	.	☒	→ SKIP INTER. SET.

LPR 5124-2

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☒ CARRIAGE RETURN

= CONDITIONAL STOP CODE

PREPARED FOR:

PAGE 9 OF 22

JOB NO. | PROGRAM NO. F4-208 | PROGRAM PREPARED BY: R.A.L. | PROGRAM CHECKED BY: | DATE

PROBLEM: LAT. SQ. | TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
		☒					
		0400	U	0312		(0332) OR (0363)	[ ]HL[ ] CTR
		01	xB	6337			
		02	S	1052		WWWWJ	
		03	T	0335		☒	
		04	U	0206			
		05	xB	6357		TOT ΣX (0219)	
		06	xA	6249		ΣX	
		07	xC	6357		☒	
		08	xB	6306		Lo Sh Cj	
		09	A	0655		R@29	
		10	xC	6306		Lo Sh Ri	
		11	xB	6349		☒	INCREMENT
		12	A	0655		R@29	Lo Sh Ri
		13	xC	6349			Lo Sh Cj
		14	xB	6313		Lo Sh Tk	Lo Sh Tk
		15	A	0601		☒ R@29	
		16	xC	6313			
		17	U	0201			→ RETURN TO (2)
		18	B	0433		B[α+2]	BEGIN (6) HERE
		19	A	0541		☒ 1@29	
		20	Y	0435		A[α+3]	
		21	Y	0443		B[α+3]	
		22	A	0301		1@29	
		23	Y	0438		☒ B[α+4]	
		24	A	1060		1@29	
		25	Y	0524		U[α+5]	
		26	U	0433			
		27	xH	6249		☒ (0447)	STORE ΣX IN DPSOSOP
		28	xH	6252			
		29	N	1015		100@31	
		30	xM	6259		1/n@0	
		31	U	0448		☒	

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☒ CARRIAGE RETURN

– CONDITIONAL STOP CODE

LGP-30 CODING SHEET

PREPARED FOR:

PAGE 10/22

JOB NO. | PROGRAM NO. F4-208 | PROGRAM PREPARED BY: R.A.L. | PROGRAM CHECKED BY: | DATE

PROBLEM: LAT. SQ. | TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	·						
	·	☒					
,0,0,0,0,0,0,2		0,4,3,2		2,2,2	·		2^8+2^4+1 @30
		3,3		B[α+2]	·	(0426)	
		3,4		Y,0,4,4,6	·		
		3,5		A[α+3]	·	☒	
		3,6		C,0,5,0,8	·		FOR TEST LOOP
		3,7		x,C,6,3,2,3	·	$\Sigma R_L = 0$	
		3,8		B[α+4]	·		
		3,9		M,0,2,2,5	·	☒ 1@1	
		4,0		x,C,6,2,5,3	·	n@30	
		4,1		x,C,6,3,2,4	·	$\Sigma R_H = 0$	
		4,2		U,0,4,4,3	·		
		4,3		B[α+3]	·	☒	
		4,4		x,D,6,3,3,0	·	SR^2@29	
		4,5		x,C,6,2,5,9	·	1/n@0	
		4,6		B[L_0]	·		
		4,7		U,0,4,2,7	·	☒	
		4,8		x,R,2,6,5,1	·	(0431)	DATA OUTPUT 30
		4,9		x,U,2,5,0,0	·		100 SCALED MEAN
		5,0		U,0,4,5,9	·		
		5,1		x,C,6,3,3,7	·	☒ (0829)	CLEAR ACC
		5,2		x,C,6,3,3,1	·		SOS FOR SxT=0
		5,3		x,C,6,3,3,4	·		" " SxR=0
		5,4		x,C,6,3,3,5	·		" " SxC=0
		5,5		U,1,0,3,9	·	☒	
		5,6		B,0,3,4,5	·	(0203)	R^2 @29
		5,7		C,0,6,2,9	·		
		5,8		U,0,5,2,5	·		
		5,9		x,R,6,1,4,5	·	☒ (0450)	$(\Sigma x)^2/n$ IN
		6,0		x,U,6,1,1,1	·		DPSOSOP
		6,1		U,0,5,0,0	·		
		6,2			·		
		6,3			·	☒	

☒ CARRIAGE RETURN

CONDITIONAL STOP CODE

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ROYAL MCBEE, ATHENS, O. H826222

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PREPARED FOR:				PAGE 11 OF 22
JOB NO.	PROGRAM NO. F4-208	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY:	DATE
PROBLEM: LAT. SQ.				TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION / ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	.					
	.	☒				
		0500	xB6250	.	R_L (0461)	
		01	xA6323	.	ΣR_L	
		02	S0224	.	1@1	
		03	T0512	.	☒	
		04	xC6323	.	ΣR_L	
		05	xB6324	.	ΣR_H	
		06	A1049	.	1@30	
		07	U0515	.	☒	
		08	B[ ]	.		LOOP TEST
		09	B0231	.	(0349)	
		10	A1060	.	1@29	
		11	U0217	.	☒	
		12	A0262	.	1@1 (0503)	
		13	xC6323	.	ΣK_L	
		14	xB6324	.	ΣR_H	
		15	xA6251	.	☒ R_H	
		16	xC6324	.	ΣR_H	
		17	U0519	.	↓	
)00000001	'	18	20000000	.		1@2
		19	B0446	.	☒	INCREMENT
		20	A1056	.		L. ΣX
		21	Y0446	.		
		22	S0508	.		
		23	T0446	.	☒	→ PROCESS NEXT ΣX
		24	U[α+5]	.		EXIT ⑥
		25	B0611	.	U[ ]	BEGIN ④ HERE
		26	xC6145	.		
		27	xR1900	.	☒	} (19.0)
		28	xU1900	.		
)00000009	'	29	2020130J	.		
		30	0404064A	.		
		31	067F6F72	.	☒	

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ROYAL MCBEE, ATHENS, O. M826227

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JOB NO. | PROGRAM NO. FA-208 | PROGRAM PREPARED BY: R.H.L. | PROGRAM CHECKED BY: | DATE

PROBLEM: LAT. SQ. | TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	·						
	·	☒					
		05 32	0J	4F2F06	·		"100 X SCALED MEANS
		33	3F	4F7232	·		GR. MEAN"
		34	7F	202057	·		
		35	1F	2A063F	·	☒	
		36	4F	723220	·		
		37	18	VQ0000	·		
		38		R0433	·		}
		39		U0418	·	☒	} CALL SEQ.
		40		xB6357	·	TOT ΣX	} OF (6)
		41		x≠0001	·		}
		42		z[ ]	·		} SR@29
		43		xB6323	·	☒ ΣR_L	
		44		xC6316	·		LOW ORDER (Σx)²/n
		45		xB6324	·	ΣK_H	
		46		xC6318	·		HIGH " "
		47		xR1900	·	☒	}
		48		xU1900	·		} (19.0)
)00000001	'	49	20	1F20VQ	·		"R"
		50		R0433	·		}
		51		U0418	·	☒	}
		52		B[L₀Rᵢ]	·		} (6)
		53		z[ ]	·		} R@29
		54		z[ ]	·		} SR@29
		55		xB6323	·	☒	
		56		xC6307	·	→	UNC SOS FOR ROWS
		57		xE6324	·		
		58		xC6309	·		
		59		xR1900	·	☒	} (19.0)
		60		xU1900	·		}
)00000001	'	61	20	6F20VQ	·		"C"
		62		R0433	·		}
		63		U0418	·	☒	} (6)

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JOB NO. | PROGRAM NO. FA-208 | PROGRAM PREPARED BY: R.A.L. | PROGRAM CHECKED BY: | DATE

PROBLEM: LAT. SQ. | TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	☒					
		0600	B	[Loc$_j$]	·		
		01	Z	[ ]	·		R @ 29
		02	Z	[ ]	·		SR @ 29
		03	xB	6324	·	☒	
		04	xC	6319	·	→	Unc. SOS for Col.
		05	xB	6323	·		
		06	xC	6321	·		
		07	xR	1900	·	☒	} (19.0)
		08	xU	1900	·		} (19.0)
)00000001	'	09	205F	20VQ	·		"t"
		10	R	0433	·		
		11	U	0418	·	☒	
		12	B	[LoT_R]	·		⑥
		13	Z	[ ]	·		R @ 29
		14	Z	[ ]	·		SR @ 29
		15	xB	6323	·	☒	
		16	xC	6302	·	→	Unc. SOS for Tr.
		17	xB	6324	·		
		18	xC	6304	·		
		19	xB	6347	·	☒ N @ 29	
		20	S	1056	·	1 @ 29	
		21	T	0709	·	→	Skip Sq. Effects
		22	xR	1900	·		} (19.0)
		23	xU	1900	·	☒	} (19.0)
)00000001	'	24	207F	20VQ	·		"s"
		25	R	0433	·		
		26	U	0418	·		
		27	B	[LoS_R]	·	☒	⑥
		28	Z	[ ]	·		S @ 29
		29	Z	[ ]	·		R^2 @ 29
		30	xB	6323	·		
		31	xC	6310	·	☒	Unc. SOS for Sq.

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JOB NO.	PROGRAM NO. FA-208	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY:	DATE
PROBLEM: LAT. SQ.				TRACK

PROGRAM INPUT CODES	STOP	LOCATION	OPERATION / ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	·					
	·	☒				
		0632	xB6324	·		
		33	xC6312	·		
		34	xR1900	·		} (19.0)
		35	xU1900	·	☒	
00000002	'	36	207F061F	·		"SR"
		37	20VQ0000	·		
		38	R0433	·		} ⑥
		39	U0418	·	☒	
		40	B[L.SR]	·		
		41	Z[ ]	·		SR@29
		42	Z[ ]	·		R@29
		43	xB6323	·	☒	
		44	xC6314	·		→ UNC. SOS FOR S×R
		45	xB6324	·		
		46	xC6311	·		
		47	xR1900	·	☒	} (19.0)
		48	xU1900	·		
00000002	'	49	207F066F	·		"SC"
		50	20VQ0000	·		
		51	R0433	·	☒	} ⑥
		52	U0418	·		
		53	B[LSC]	·		
		54	Z[ ]	·		SR@29
		55	Z[ ]	·	☒	R@29
		56	xB6324	·		
		57	xC6315	·		→ UNC. SOS FOR S×C
		58	xB6323	·		
		59	xC6317	·	☒	
		60	xR1900	·		} (19.0)
		61	xU1900	·		
00000002	'	62	207F065F	·		"St"
		63	20VQ0000	·	☒	

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PREPARED FOR:

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JOB NO. | PROGRAM NO. F4-208 | PROGRAM PREPARED BY: R.A.L. | PROGRAM CHECKED BY: | DATE

PROBLEM: LAT. SQ. | TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	·						
	·	☒					
		0700	R	0433	·		
		01	U	0418	·		
		02	B	[LOST]	·		⑥
		03	Z	[ ]	·	☒	SR@29
		04	Z	[ ]	·		R@29
		05	xB	6323	·		
		06	xC	6320	·	→	UNC. SOS FOR SXT
		07	xB	6324	·	☒	
		08	xC	6322	·		
		09	B	1020	·	xB6238	RESTORE DPSOSOP
		10	xC	6145	·		
		11	xB	6318	·	☒ TOT R_H	SET $(\Sigma X)^2/SR^2$ IN
		12	xC	6251	·		DPSOSOP
		13	xB	6316	·	TOT R_L	END ④
		14	xC	6250	·		
		15	U	0730	·	☒	
		16	xC	6359	·	SOS @ 30	START ⑧ HERE
		17	xB	6360	·	d.f. @ 29	
		18	xR	1056	·		INTEGER PRINTOUT
		19	xU	1000	·	☒	
		20	xB	6359	·	SOS @ 30	
		21	U	0722	·	↘	
		22	xR	2651	·		DATA OUTPUT 30
		23	xU	2500	·	☒	PRINT SOS
		24	xB	6359	·	SOS @ 30	
		25	xM	6361	·	1/d.f. @ 0	
		26	xR	2651	·		D.O. 30
		27	xU	2500	·	☒	
)	0000002	' 28	U	[ ]	·		EXIT ⑧ HERE
		29	3	WWWJ	·		MASK
		30	xR	1900	·	(0715)	BEGIN ⑦
		31	xU	1900	·	☒	(19.0)

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JOB NO.	PROGRAM NO. F4-208	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY:	DATE
PROBLEM: LAT. SQ.				TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	·						
	· ☒						
),0000018	'	07 32	2020	3018	·		
		33	1072	3272	·		"ANALYSIS OF
		34	0J12	7F22	·		VARIANCE
		35	7F06	4654	·	☒	
		36	063A	721F	·		
		37	2272	326F	·		
		38	4F20	204F	·		EFFECT, D.F.,
		39	0854	544F	·	☒	SOS, MEAN
		40	6F5F	302F	·		SQUARE
		41	2A54	2A30	·		
		42	107F	0646	·		
		43	067F	303F	·	☒	
		44	084F	7232	·		
		45	0610	7F08	·		
		46	7452	721F	·		
		47	4F18	201F	·	☒	
		48	467J	7F30	·		
		49	VQ00	0000	·		ROWS "
		50	xB63	29	·	r @ 29	
		51	xC63	60	·	☒	d.f. OF (8)
		52	B105	6	·	1 @ 29	
		53	xD63	29	·		
		54	xC63	61	·		1/d.f. @ 0 OF (8)
		55	xB63	09	·	☒	}
		56	xC62	48	·		} STORE UNC. SOS
		57	xB63	07	·		} FOR ROWS IN
		58	xC62	38	·		} DPSOSOP
		59	xR62	35	·	☒	}
		60	xU61	45	·		} $\Sigma X^2 - (\Sigma X)^2/SR^2$
		61	xH63	33	·		SOS FOR ROWS
		62	R072	8	·		} (8)
		63	U071	6	·	☒	}

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JOB NO.	PROGRAM NO. F4-208	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY:	DATE
PROBLEM: LAT. SQ.				TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	·						
	·	☒					
		0800	x R 1900		·		} (19.0)
		01	x U 1900		·		}
)00000002	'	02	206F	460J	·		"COL."
		03	2A30	VQ00	·	☒	
		04	x B 6319		·		} STORE
		05	x C 6248		·		UNC. SOS FOR
		06	x B 6321		·		COLUMNS IN
		07	x C 6238		·	☒	DPSOSOP
		08	x R 6235		·		} PART III
		09	x U 6145		·		} DPSOSOP
		10	x H 6332		·		SOS FOR COL.
		11	R 0728		·	☒	} (8)
		12	U 0716		·		}
		13	U 0814		·	↘	
		14	x R 1900		·		} (19.0)
		15	x U 1900		·	☒	}
)00000002	'	16	205F	1F5F	·		
		17	3F5F	30VQ	·		"TRTMT"
		18	x B 6304		·		}
		19	x C 6248		·	☒	} STORE UNC. SOS
		20	x B 6302		·		} FOR TRTMT IN
		21	x C 6238		·		} DPSOSOP
		22	x R 6235		·		} PART III
		23	x U 6145		·	☒	} DPSOSOP
		24	x H 6336		·		SOS FOR TR.
		25	R 0728		·		} (8)
		26	U 0716		·		}
		27	x B 6347		·	☒ ≠ @29	
		28	S 1057		·	1 @29	
		29	T 0451		·	→	CLEAR NT. SOS
		30	S 1016		·	1 @29	(SKIP SQ & INTERRG.
		31	T 0146		·	☒ →	d.f. = 1

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JOB NO. | PROGRAM NO. F4-208 | PROGRAM PREPARED BY: K.A.L. | PROGRAM CHECKED BY: | DATE

PROBLEM: LAT. SQ. | TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	.						
	.	☒					
		0,8,3,2	B	1,0,4,7	·	1 @ 29	
		3,3	x D	6,3,4,7	·	Δ @ 29	
		3,4	x C	6,3,6,1	·		1/d.f. @ 0 in (8)
		3,5	x B	6,3,4,7	·	☒ Δ @ 29	
		3,6	x C	6,3,6,0	·		d.f. @ 29 in (8)
		3,7	x R	1,9,0,0	·		}
		3,8	x U	1,9,0,0	·		} (19.0)
)0,0,0,0,0,0,2	'	3,9	2,0,7F	7,4,5,2	·	☒	
		4,0	3,0,V,Q	0,0,0,0	·		" SQU "
		4,1	x B	6,3,1,2	·		}
		4,2	x C	6,2,4,8	·		} UNC SOS FOR
		4,3	x B	6,3,1,0	·	☒	} SQ IN DPSOSOP
		4,4	x C	6,2,3,8	·		}
		4,5	x R	6,2,3,5	·		} PART III
		4,6	x U	6,1,4,5	·		} DPSOSOP
		4,7	x H	6,3,0,5	·	☒	SOS FOR SQU
		4,8	R	0,7,2,8	·		} (8)
		4,9	U	0,7,1,6	·		}
		5,0	x B	6,3,2,9	·	r @ 29	
		5,1	x N	6,3,4,7	·	☒ Δ @ 29	
		5,2	M	1,0,2,8	·	1 @ 2	
		5,3	x C	6,3,6,0	·		d.f. of (8)
		5,4	B	1,0,1,9	·	1 @ 29	
		5,5	x D	6,3,6,0	·	☒ rA @ 29	
		5,6	x C	6,3,6,1	·		1/d.f. @ 0 OF (8)
		5,7	x R	1,9,0,0	·		}
		5,8	x U	1,9,0,0	·		} (19.0)
)0,0,0,0,0,0,2	'	5,9	2,0,7F	0,6,4,A	·	☒	" Δ x r "
		6,0	0,6,1F	3,0,V,Q	·		
		6,1	x B	6,3,1,1	·		} UNC SOS FOR
		6,2	x C	6,2,4,8	·		} SxR IN
		6,3	x B	6,3,1,4	·	☒	} DPSOSOP

LPR 5124-2

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JOB NO. | PROGRAM NO. F4-208 | PROGRAM PREPARED BY: R.A.L. | PROGRAM CHECKED BY: | DATE

PROBLEM: LAT. SQ. | TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	.						
	.	☒					
		0900	x	C6238	.		
		01	x	R6235	.		} PART III
		02	x	U6145	.		} DPSOSOP
		03	x	S6305	.	☒ SOS, SQ.	
		04	x	S6333	.	SOS, RWS	
		05	x	H6334	.		SOS FOR SXR
		06		R0728	.		} (8)
		07		U0716	.	☒	
		08	x	R1900	.		} (19.0)
		09	x	U1900	.		
)00000002	'	10	207F	064A	.		"SXC"
		11	066F	30VQ	.	☒	
		12	x	B6315	.		
		13	x	C6248	.		
		14	x	B6317	.		
		15	x	C6238	.	☒	
		16	x	R6235	.		
		17	x	U6145	.		
		18	x	S6332	.	SOS, COL.	
		19	x	S6305	.	☒ SOS, SQ.	
		20	x	H6335	.		SOS FOR SXC
		21		R0728	.		} (8)
		22		U0716	.		
		23	x	R1900	.	☒	} (19.0)
		24	x	U1900	.		}
)00000002	'	25	207F	064A	.		"SXT"
		26	065F	30VQ	.		
		27	x	B6322	.	☒	
		28	x	C6248	.		
		29	x	B6320	.		
		30	x	C6238	.		
		31		U1032	.	☒	

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JOB NO.	PROGRAM NO. F4-208	PROGRAM PREPARED BY: R A.L.	PROGRAM CHECKED BY:	DATE
PROBLEM: LAT. SQ.				TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	·						
	·	☒					
		09 32	S	1047	·	1@29	(1040)
		33	xN	6329	·	r @29	
		34	N	0628	·	S @29	
		35	M	1021	·	☒ 1@4	
		36	xC	6360	·		S(R-1)(R-2) @29
		37	B	1016	·	1@29	
		38	xD	6360	·		
		39	xC	6361	·	☒	1/d.f. m(8)
		40	xR	1900	·		}
		41	xU	1900	·		} (19.0)
)00000002	·	42	204F	1F1F	·		
		43	461F	30VQ	·	☒	"ERROR"
		44	xB	6362	·	SOS / SQ.	
		45	xS	6331	·	SOS, S×t	
		46	xS	6332	·	SOS, C	
		47	xS	6333	·	☒ SOS, R	
		48	xS	6334	·	SOS, S×R	
		49	xS	6335	·	SOS, S×C	
		50	xS	6336	·	SOS, T	
		51	R	0728	·	☒	} (8)
		52	U	0716	·		}
		53	xR	1900	·		} (19.0)
		54	xU	1900	·		
)00000008	'	55	2020	180J	·	☒	
		56	0404	047F	·		
		57	2A4F	2A10	·		
		58	4J08	5F1F	·		"1000 S.E. (trtMT. Δ) =
		59	5F3F	5F06	·	☒	
		60	1024	0406	·		
		61	1606	0818	·		
		62	VQ00	0000	·		
		63	B	0614	·	☒ SR@29	= SR/2 @28

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LGP-30 CODING SHEET

PREPARED FOR:

PAGE 21/22

JOB NO. | PROGRAM NO. FA-208 | PROGRAM PREPARED BY: R.A.L. | PROGRAM CHECKED BY: | DATE

PROBLEM: LAT. SQ. | TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	·						
	·	☒					
		1 0 0 0	N	0008	·	1 @ 13	
		0 1	x C	63511	·		SR/2 @ 10
		0 2	x B	63591	·	SOS (ERROR)	@ 30 FROM (8)
		0 3	x M	63611	·	☒ 1/d.f. @ 0	
		0 4	x D	63511	·	SR/2 @ 10	
		0 5	x R	16500	·		} √ (15.1)
		0 6	x U	16000	·		}
		0 7	M	10500	·	☒ 1000 @ 20	
		0 8	x R	26511	·		} D 0 "30"
		0 9	x U	25000	·		}
		1 0	XZ	00000	·	END OF	PROGRAM
		1 1	U	00000	·	☒	→ BEGIN PROGRAM
,00000017	'	1 2		3WWJ	·		MASK
		1 3			·		
		1 4		3J	·		MASK
		1 5		64	·	☒	100 @ 31
		1 6		4	·		1 @ 29
		1 7		20000	·		1 @ 14
		1 8		7WWWWWWQ	·		≈ 1 @ 0
		1 9		4	·	☒	1 @ 29
		2 0		B3Q98	·		x B 6238
		2 1		80000000	·		1 @ 4
		2 2		3WJ	·		MASK
		2 3			·	☒	
		2 4		200	·		1 @ 22
		2 5			·		
		2 6		3J	·		MASK
		2 7		1WWWQ	·	☒	MASK
		2 8		200000000	·		1 @ 2 and ERROR
		2 9		U0000	·		HALT
,00000002	'	3 0			·		
		3 1		2000	·	☒	1 @ 18

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PREPARED FOR:				PAGE 22/22
JOB NO.	PROGRAM NO. FA - 208	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY:	DATE
PROBLEM: LAT. SQ.				TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	.						
	.	☒					
		10 32	x	R6235	.	(0931)	
		33	x	U6145	.		
		34	x	S6305	.	SOS (S)	
		35	x	S6336	.	☒ SOS (T)	
		36	x	H6331	.		SOS FOR SXT
		37		R0728	.		} (8)
		38		U0716	.		
		39	x	B6329	.	☒ n @ 29	
		40		U0932	.		
		41			.		
		42	x	C6321	.	(0339)	
		43	x	C6322	.	☒	CK Σ Acc = 0
		44		U0341	.		
,0000019	'	45		4	.		1 @ 29
		46		WWWW00	.		MASK
		47		4	.	☒	1 @ 29
		48			.		
		49		2	.		1 @ 30
		50		1W4000	.		1000 @ 20
		51			.	☒	
		52		WWWWJ	.		1 @ 11 - 1 @ 29
		53		2	.		1 @ 30
		54		20000	.		1 @ 14
		55			.	☒	
		56		4	.		1 @ 29
		57		4	.		1 @ 29
		58		K0000000	.		-6 @ 4
		59		3J3J0	.	☒	MASK
		60		4	.		1 @ 29
		61		F0000000	.		-3/4 @ 0
		62			.		
		63		G2000000	.	☒	-156 @ 8

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LGP-30 CODING SHEET

PREPARED FOR:				PAGE OF
LATIN SQUARE				1A/3A
JOB NO.	PROGRAM NO.	PROGRAM PREPARED BY:	PROGRAM CHECKED BY:	DATE
	F4 -208	R.A.L.		
PROBLEM: INITIALIZE LOCATIONS OF SUBROUTINES				TRACK

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
/0000 Lo LATSQ	·						
;0000 Lo	·	☒					
		1100	B	1207	·		Lo[α-NUM] (19.0)
		01	Y	0837	·		
		02	Y	0838	·		
		03	Y	0953	·	☒	
		04	Y	0954	·		
		05	Y	0527	·		
		06	Y	0528	·		
		07	Y	0857	·	☒	
		08	Y	0858	·		
		09	Y	0559	·		
		10	Y	0560	·		
		11	Y	0647	·	☒	
		12	Y	0648	·		
		13	Y	0635	·		
		14	Y	0000	·		
		15	Y	0001	·	☒	
		16	Y	0731	·		
		17	Y	0660	·		
		18	Y	0661	·		
		19	Y	0634	·	☒	
		20	U	1121	·		
		21	Y	0800	·		
		22	Y	0801	·		
		23	Y	0909	·	☒	
		24	U	1125	·		
		25	Y	0940	·		
		26	Y	0941	·		
		27	U	1128	·	☒	
		28	Y	0814	·		
		29	Y	0815	·		
		30	Y	0730	·		
		31	Y	0908	·	☒	

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LGP-30 CODING SHEET

PREPARED FOR: LATIN SQUARE

PAGE 2A OF 3A

JOB NO.

PROGRAM NO. F4-208

PROGRAM PREPARED BY:

PROGRAM CHECKED BY:

DATE

PROBLEM: INIT. LOC. OF SUBROUTINES

TRACK

PROGRAM INPUT CODES	STOP	LOCATION	OPERATION	ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
		☒					
		1132		Y0547			
		33		Y0548			
		34		Y0622			
		35		Y0607		☒	
		36		Y0608			
		37		Y0923			
		38		Y0924			
		39		Y0623		☒	
		40		B1205			Lo D.O. 30
		41		Y0727			
		42		Y0449			
		43		Y1009		☒	
		44		Y0723			
		45		A1168		2	xZ0151
		46		Y0448			
		47		Y0726		☒	
		48		Y0722			
		49		Y1008			
		50		B1203			Lo INTEGER PRTOUT
		51		Y0719		☒	
		52		A1200			xZ0056
		53		Y0718			
		54		B1204			Lo [√‾] (15.1)
		55		Y1006		☒	
		56		A1201			xZ0050
		57		Y1005			
		58		B1206			Lo [log x] (18.0)
		59		Y0239		☒	
		60		A1202			xZ0024
		61		Y0238			
		62		U0000		↺	
		63		xZ0151		☒	

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PREPARED FOR: LATIN SQUARE		PAGE 3A OF 3A
JOB NO.	PROGRAM NO. F4-208	PROGRAM PREPARED BY:
PROGRAM CHECKED BY:		DATE
PROBLEM: INIT. LOC. OF SUBROUTINES		TRACK

PROGRAM INPUT CODES	STOP	LOCATION	OPERATION	ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
		12 00	x	Z0056			
		01	x	Z0050			
		02	x	Z0024			
		03		[ ]		J4-172	Lo INTEGER PRTOUT
		04		[ ]			Lo(√) (15.1)
		05		[ ]		J4-173	Lo DATA OUTPUT 30
		06		[ ]			Lo(log) (18.0)
		07		[ ]			Lo(α-Num) (19.0)
		08					
		09					
		10					
		11					
		12					
		13					
		14					
		15					
		16					
		17					
		18					
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		29					
		30					
		31					

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