

TITLE: Hierarchial Analysis of Variance

AUTHOR: Richard A. Lamm

ABSTRACT:

This routine performs a complete analysis of variance for data from a repeated subsampling design with an arbitrary number of stratifications and arbitrary number of observations within the stratifications. The amount of data analysed is restricted only by the available drum memory.

DISCLAIMER:

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FOR POOL MEMBERS ONLY

1. Title: Hierarchical Analysis of Variance
 Author: Richard A. Lamm
 Date: December 7, 1959
 Installation: Lederle Laboratories, Pearl River, New York
 Classification: F-4

2. Purpose:

To perform a complete analysis of variance for data from a repeated subsampling (nested subsampling) design with an arbitrary number of stratifications and arbitrary numbers of observations within the stratifications. Transformation of the data to $1000 \log x$ is controlled by the Transfer Control button.

3. Restrictions:

- a. All observation data must be entered (coded) at a q of 30. Generally, data should be coded so that they are 4 decimal digits in length.
- b. No (coded) Sum of Squares for a level may exceed $2^{30} - 1$.
- c. No (coded) mean may exceed $2^{19} - 1$.
- d. The amount of data is restricted only by the available drum memory.
- e. The number of lines in the Analysis of Variance is limited to 11. If more lines are required, it is necessary to change Lo+0642 from XC6300 to XcTtss in order to provide 3L consecutive sectors for storage of the analysis, where L is the number of lines.
- f. There must be at least two observations within each cell of the lowest hierarchical level, since the Σx and $\Sigma n_{ijk} \dots$ are stored sequentially in pairs in the location of the data. This restriction is not necessary if there is a sufficient number of observations in the beginning cells to prevent the storage of partial sums on unused data. However, a 'divide check' will occur at Lo / 22 of F4-164 if n is 1. Press start compute to continue. The result will be correct.
- g. Memory Allocation. (Routines in parenthesis are not used with this program)

- 0000-0263 (Program Input, 10.4)
- 0300-0563 Data Input No. 3, 11.2
- 0600-0963 (Decimal Memory Printout)
- 1000-1058 Integer Printout
- 1100-1231 (Data Output No. 1, 12.0)
- 1232-1263 Modifications to Data Input No. 3
- 1300-1531 Data Output No. 2, 12.1
- 1532-1563 Storage of Data Input No. 3 Modification Results
- 1600-1663 (Square Root, 15.1)
- 1700-1863 $\log_k x$, 18.0
- 1900-1963 Alphanumeric, 19.0
- 2000-2063 (Modifiable Hexadecimal Input)
- 2100-2163 (Antilog Printout)
- 2200-2263 Zero Suppression for 12.0 and 12.1
- 2300-2363 (Exponential, 17.0)
- 2400-2463 (Antilog)
- 2500-2663 Data Output "30"
- 2700-5963 Available for Program and Data Storage
- 6000-6263 Double Precision Sum of Squares or Products
- 6300-6332 Analysis of Variance Results
- 6333-6363 Intermediate Results-See Attached Code Sheet for Track 63

- h. If it is desirable to obtain the mean square for each of the individual level 1 cells (Level 0 Mean Square), the following changes are required;

<u>Location</u>	<u>Present</u>	<u>Change To</u>
0047	Y0124	Y0507
0124	A[]	U0460
0152	B0120	U0509

(All addresses are understood to be Lo+)

4. Method:

The method used is the same as may be found in many books on statistical methods, e.g., R. L. Anderson and T. A. Bancroft. Statistical Theory in Research. McGraw-Hill Book Company, Inc., New York (1952). See paragraphs 22.3 and 22.4. The sums of squares are obtained as follows:

$$\text{Level 0} \quad \sum_s \dots \sum_j \sum_t \left[\sum_i \frac{n_{ijk\dots s}^2}{n_{ijk\dots s}} - \frac{(\sum_i X)^2}{n_{ijk\dots s}} \right]$$

$$\text{Level 1} \quad \sum_s \dots \sum_j \sum_t \frac{(\sum_i X)^2}{n_{ijk\dots s}} - \sum_s \dots \sum_j \frac{(\sum_t \sum_i X)^2}{\sum_t n_{ijk\dots s}}$$

etc.

5. Coding Information:

- a. Storage. The program requires 7 tracks of storage for instructions and constants. In addition, it uses 6300 to 6300+3L-1, where L is the number of lines in the Analysis of Variance and 6333, (6342), 6344, (6346), 6347, 6349, 6350, (6355), 6356-60, 6362 and 6363. The addresses in parenthesis are used only with the alternate output.

- b. This program uses:

Subroutine	Location
Data Input No. 3 with Lederle Modifications	0300
Integer Printout	1000
Data Output No. 2	1300
Log _k x (If transformation is desired)	1700
Alphanumeric	1900
Data Output "30"	2500
Double Precision Sum of Squares or Products	6000

There is no calling sequence required for this program. Halt and transfer to Lo for computations.

- c. Input.

A data tape should contain;

1. Experiment designation or heading followed by a conditional stop.
2. The coding of the data, e.g. 1000 x, followed by a conditional stop. There should be no carriage return preceding this information.

3. Data as follows:

a. 0+29(Lo_d)'n_{1111...}'...'n_{ijk...}'-0000000'

where n_{ijk...} is the number of observations in the ith cell of the first level, in the jth cell of the second level, in the kth cell of the third level, etc.

0+296363'n_{.11...}'...'n_{.jk...}'-0000000'

where n_{.jk...} is the number of first level cells in the jth second level cell, in the kth third level cell, etc. etc. to

0+296363'n_{...s}'-0000000'

0+296363'1'-0000000'

0+306363'data'-0000000'

As a check: $\sum n_{ijk...}$ = Number of observations
 $\sum n_{.jk...}$ = Number of n_{ijk...}'s
 $\sum n_{.k...}$ = Number of n_{.jk...}'s

b. Example of Input:

The data from table 10.14.1 of G. Snedecor. Statistical Methods. Iowa State College Press, 5th Ed. 1957. gives Calcium concentrations in leaves of turnip plants in units of %. The data are:

Plant	1			2			3			4			
	1	2	3	1	2	3	1	2	3	1	2	3	
Deter.	1	3.28	3.52	2.88	2.46	1.87	2.19	2.77	3.74	2.55	3.78	4.07	3.31
	2	3.09	3.48	2.80	2.44	1.92	2.19	2.66	3.44	2.55	3.87	4.12	3.31

The data tape would contain:

Calcium Concentration in Leaves of Turnip Plants (%)' 1000 times %' CR
 0+295000'2'2'2'2'2'2'2'2'2'2'2'2'-0000000' CR
 0+296363'3'3'3'3'-0000000' CR
 0+296363'4'-0000000' CR
 0+296363'1'-0000000' CR
 0+306363'3280'3090'3520'3480'...4070'4120'3310'3310'-0000000''

Since there are two determinations for each of the twelve leaves the first line contains twelve 2's. Next, there are three leaves in each of the four plants, hence four 3's are entered. There are four plants in the experiment, hence the 4 is entered next. The input of the numbers within levels must always terminate with 0+296363'1'-0000000'. The data are loaded sequentially beginning with the determinations within the first leaf of the first plant proceeding on to the determinations within the second leaf of the first plant, etc.

d. Output:

1. The standard output (not using the changes of 3.h) for this example contains:

- a. Means: Level 0. These are the mean determinations for each leaf. It should be noted that there are 4 groups of 3 means each. Each mean within a group is the mean for a leaf, and each group corresponds to a plant.
- b. Means: Level 1. These four means are for the three leaves within the four plants and therefore they are the plant mean determinations.
- c. Means: Level 2. This mean is for the four plants in the

experiment (the grand mean).

d. Analysis of Variance

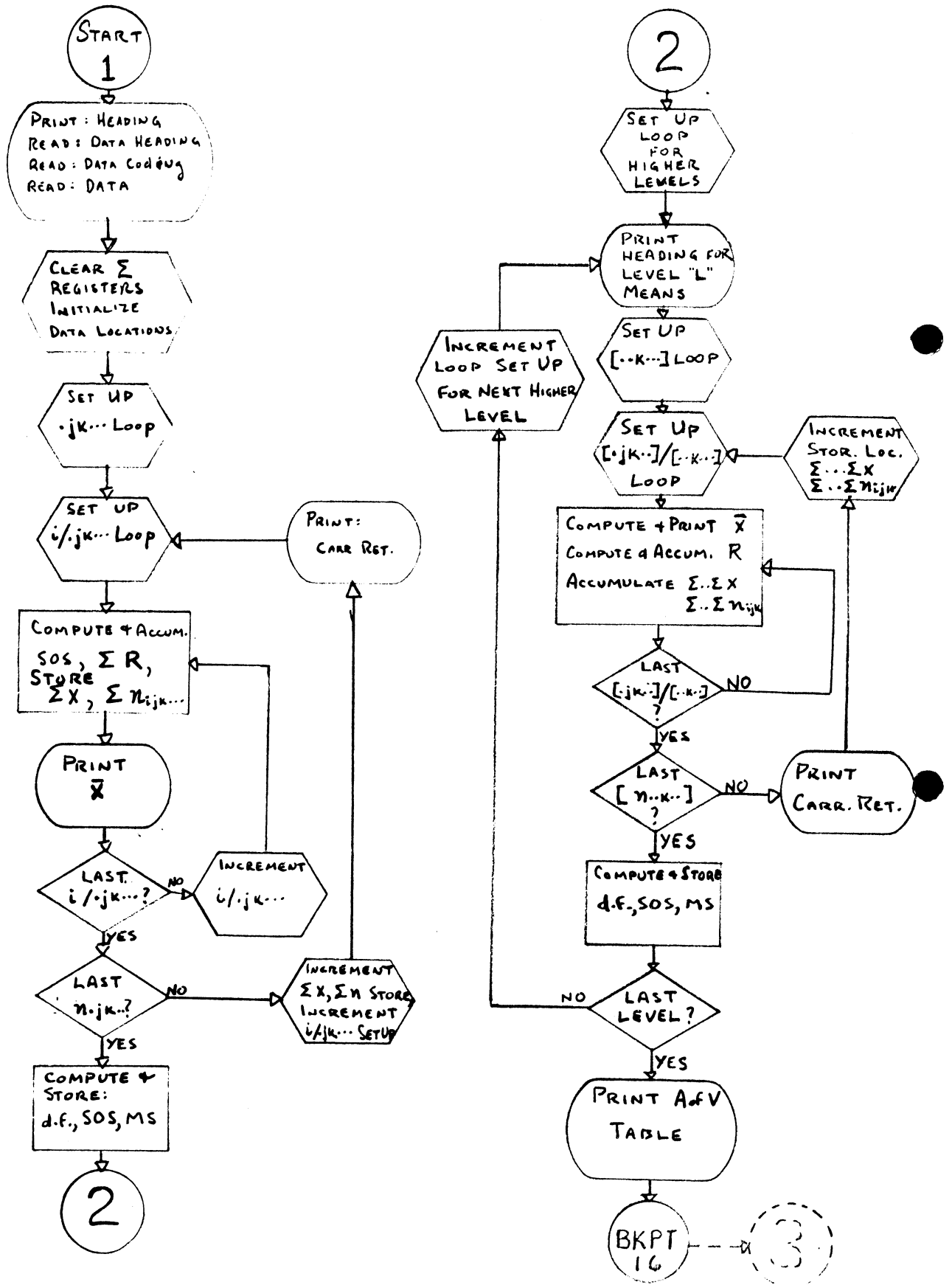
The Level 0 Mean Square is for Determinations within Leaves.

The Level 1 Mean Square is for Leaves within Plants.

The Level 2 Mean Square is for Among Plants.

2. The alternate output gives the mean square (variance) of determinations within each leaf printed after the leaf mean (Means: Level 0) in the alternate color.

FLOW CHART



Sample Problem
Standard Output
Characters which are underlined are
printed in the alternate color.

HIERARCHIAL ANALYSIS OF VARIANCE

Calcium Concentration in Leaves of Turnip Plants (%)
y = 1000 times %

0+295000'2'2'2'2'2'2'2'2'2'2'2'2'2'-0000000' 12
0+296363'3'3'3'3'-0000000' 4
0+296363'4'-0000000' 1
0+296365'1'-0000000' 1
0+306363'3260'3090'3520'3480'2880'2460'2440'1870'1920'2190'2190'
2770'2660'3740'3440'2550'3780'3870'4070'4120'3310'3310'-0000000' 24

Means: Level 0

3165.000	3500.000	2840.000
2450.000	1895.000	2190.000
2715.000	3590.000	2550.000
3025.000	4095.000	3310.000

Means: Level 1

3175.000	2178.334	2951.667	3743.334
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Means: Level 2

3012.084

ANALYSIS OF VARIANCE

<u>Level</u>	<u>d.f.</u>	<u>S O S</u>	<u>Mean Square</u>
2	3	7560344	2520114
1	6	2630202	387775
0	12	79850	6654

LGP-30 CODING SHEET

PREPARED FOR:

LGP-30, RFC-4000 USE-11

(14)

JOB NO.

PROGRAM NO.

PROGRAM PATTERN

PROGRAM CHECKED BY:

PL-165

R. A. LAMM

R.A.L.

2/17/59

PROBLEM:

HIERARCHIAL ANALYSIS OF VARIANCE

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		NOTES	CONTENTS OF ADDRESS
			OPERATION	ADDRESS		
		0 0	XR	19.00		} ALPHANUMERIC (19.0)
		0 1	XU	19.00		
0.0.0.0.0.1.0		0 2	20	18.10.62		
		0 3	22	4E.1E.72		
		0 4	1F	6F.6.2.22		} HIERARCHIAL ANALYSIS OF VARIANCE
		0 5	72	0J.0.6.72		
		0 6	32	72.0J.12		
		0 7	7F	22.7F.06		
		0 8	46	54.0.6.3A		
		0 9	72	1F.2.2.72		
		1 0	32	6F.4F.20		
		1 1	08	18.20.VQ		} READ DATA DESIGNATION (19.0)
		1 2	xP	00.62		
		1 3	xI	00.00		
		1 4	xR	19.00		
		1 5	xU	19.00		
0.0.0.0.0.0.3		1 6	18	20.13.0.6		
		1 7	10	16.0.8.0.6		"y ="
		1 8	VQ	00.00.00		
		1 9	xP	00.0.5		} READ DATA CODING
		2 0	xI	00.0.0		
		2 1	xP	12.0.7		COLOR SHIFT
		2 12	xZ	00.0.0		DELAY
		2 13	xR	03.0.3		} DATA INPUT #3 WITH MODIF.
		2 14	xU	03.0.0		
		2 15	xB	12.40		H[1532 + NUMBER OF -CONDONS]
		2 16	S	06.48		1@29
		2 17	800	T0.6.12		T.C. → TRANSFORM TO LOGS
		2 18	Y	02.17		B[L(N)]
		2 19	S	06.44		1@29
		3 0	Y	00.34		
		3 1	xB	15.63		Lo(y)

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - 1001

JOB NO. PROGRAM NO. PROGRAM PREPARED BY: PROGRAM CHECKED BY: DATE

FL-165 R.A.L. POOL Review 12-7-59

PROBLEM: HIERARCHIAL A of V

PAGE 2 OF 14

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		<input checked="" type="checkbox"/>					
		0,0,3,2	X	Y 1,5,6,2			
		3,3	X	B 1,5,6,2			
		3,4	S	[1,5,*,*]			
		3,5	X	C 1,5,6,2	<input checked="" type="checkbox"/>		
		3,6	B	0,0,3,4			
		3,7	S	0,2,0,9		1 @ 29	
		3,8	Y	0,0,3,4			
		3,9	S	0,2,1,8	<input checked="" type="checkbox"/>	X S 1532	
		4,0	T	0,0,4,2			
		4,1	U	0,0,3,3			
		4,2	B	0,6,4,2		X C 6300	Lo of A of V Results
		4,3	Y	0,2,1,9	<input checked="" type="checkbox"/>		d.f.
		4,4	Y	0,2,2,1			d.f.
		4,5	A	0,2,0,3		1 @ 29	
		4,6	Y	0,1,2,5			RESIDUAL SUB
		4,7	Y	0,1,2,4	<input checked="" type="checkbox"/>		
		4,8	Y	0,2,2,2			
		4,9	Y	0,0,5,6			
		5,0	A	0,4,2,9		1 @ 29	
		5,1	C	0,2,2,3	<input checked="" type="checkbox"/>		Mean Squares
		5,2	X	C 6,3,5,6			$\sum C^2 = KL$
		5,3	X	C 6,3,5,7			$\sum C^2 = 2H$
		5,4	X	C 6,3,5,9			$\sum C^2 = 2H$
		5,5	X	C 6,3,6,0	<input checked="" type="checkbox"/>		$\sum C^2 = 2H$
		5,6	C	[6,3,0,1]			SUM OF SQUARES
		5,7	X	B 1,5,6,3		L(y _i)	
		5,8	Y	0,1,2,0			
		5,9	Y	0,1,2,1	<input checked="" type="checkbox"/>		
		6,0	Y	0,1,6,3			
		6,1	A	0,6,4,7		1 @ 29	
		6,2	Y	0,2,0,1			
		6,3	X	B 1,5,6,2	<input checked="" type="checkbox"/>	Lo (NORM...)	

DETERMINE AND
 FORMULA OF DATA
 (L(1,1,1,1))

10-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-1000 Manual Operation - POOL
 PAGE OF 3 (14)
 JOB NO. PROGRAM NO. PROGRAM CHECKED BY: POOL Review DATE 12-7-59
 PH-165 R.A.L.
 PROBLEM: HIERARCHAL ACFV TRACK 01

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		0.0	X	01116			
		0.1	X	1532		NUMBER of n_{ijk} ...	
		0.2	Y	0114			
		0.3	X	1533		NUMBER of n_{ijk} ...	
		0.4	Y	0641		$A[L(n..k...)]$	TEST FOR OUTER LOOP
		0.5	X	1900			} (19.0)
		0.6	X	1900			
00000006'		0.7	2	0201810			
		0.8	3	F084F72			
		0.9	3	27F101A			
		1.0	0	G0J084F			
		1.1	3	A4F0J06			
		1.2	0	42018VQ			
		1.3	B	0116		$B[L(n_{ijk}...)]$	
		1.4	A	$L(n_{ijk}...)$			
		1.5	Y	0633		$B[L(n_{ijk}...)]$	TEST FOR INNER LOOP
		1.6	B	$L(n_{ijk}...)$			
		1.7	Y	0122			
		1.8	X	R6000			} DOUBLE PRECISION SUM OF SQUARES OR PRODUCTS (DPSOSOP) (SEE 0225,0517)
		1.9	Y	U6000			
		2.0	M	$L_0(y)$			
		2.1	M	$L_0(y)$			
		2.2	Z	$n_{ijk}...$			
		2.3	X	Z0001		$U0336$	
		2.4	A	$[6301]$			
		2.5	C	$[6301]$			
		2.6	X	B6250		RL	
		2.7	X	A6356		ΣRL	
		2.8	X	H6350		T.S.	
		2.9	E	0651		3WWWXXXX	
		3.0	X	C6356			
		3.1	X	B6350		T.S.	

LOP-30 CODING SHEET

PREPARED FOR DTP-30, R. G. ...	PROGRAM CHECKED BY ... Review	PAGE OF 4 / (14)
JOB NO. ...	PROGRAM CHECKED BY ...	DATE 12-7-59
PROBLEM ...		TRACK 01

PROGRAM INPUT CODES	LOC.	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
						40000000	
						1 @ 29	
						RH	
							} Σ RH
						Σ y @ 30	
							} Σ Σ y
						n _{ijk} @ 29	
							} Σ n _{ijk} ...
						n _{ijk} @ 29	
						1 @ 18	
						n _{ijk} @ 11	
						Σ y _{ijk} ...	
							} TEMP STORAGE DATA OUTPUT #2 (12.1A)
						M[L(y)]	
						n _{ijk} @ 29	
							} B[L(n _{ijk} ...)]
						1 @ 29	
							} B[L(n _{ijk} ...)]
							} CARR. RET.
						Σ Σ y	

I.GP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL			PAGE OF
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY: R.A.L.	5 / (14)
PROGRAM CHECKED BY: POOL Review			DATE 12-7-59
PROBLEM: HIERARCHIAL A of V			TRACK 02

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		0 2 0 0	x B	6 3 5 9		$\sum \pi_{ijk} \dots$	FOR j, k... FIXED
		0 1	C	$[L_0(y)+1]$			
		0 2	x C	6 3 6 0			$\sum \sum y = 0$
		0 3	x Z	0 0 0 1	⊗		DELAY
		0 4	x P	1 6 5 4			
		0 5	x C	6 3 5 9			$\sum \pi_{ijk} \dots = 0$
		0 6	B	0 2 0 1			
		0 7	A	0 4 2 9	⊗	1 @ 29	
		0 8	Y	0 1 6 3			
		0 9	x Z	0 0 0 1			DELAY
		1 0	A	0 6 4 6		1 @ 29	
		1 1	Y	0 2 0 1	⊗		
		1 2	B	0 1 1 4		$A[L(\pi_{jk} \dots)]$	
		1 3	A	0 6 5 6		1 @ 29	
		1 4	Y	0 1 1 4			
		1 5	S	0 6 4 1	⊗	$A[L(\pi_{k} \dots)]$	
		1 6	T	0 1 1 3			
		1 7	B	[]		N @ 29	
		1 8	x S	1 5 3 2			NUMBER OF $\pi_{ijk} \dots$
		1 9	C	[6 3 0 0]	⊗	d.f. @ 29	
		2 0	B	0 6 5 6			
		2 1	D	[6 3 0 0]			→ 1/d.f. @ 0
		2 2	M	[4 3 0 1]			SOS @ 30
		2 3	C	[6 3 0 2]	⊗		MEAN SQ @ 30
		2 4	B	0 6 5 3		U0336	
		2 5	C	0 1 2 3			
		2 6	B	0 6 5 5			
		2 7	x C	6 3 4 9	⊗		LEVEL COUNTER
		2 8	B	0 2 2 3			
		2 9	A	0 6 4 4		1 @ 29	
		3 0	Y	0 4 2 5		L(d.f.)	
		3 1	A	0 6 4 6	⊗	1 @ 29	

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL			PAGE OF 6 / (14)
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY R.A.L.	PROGRAM CHECKED BY: POOL Review
PROBLEM: HIERARCHIAL A OF V			DATE 12-7-59
			TRACK 02

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		0.2		Y0431		CL(SOS)	
		3 3		A0655		1@29	
		3 4		Y0435		CL(MS)	
		3 5		B0641		X A[Lo(n..kl)]	
		3 6		Y0308			
		3 7		Y0309			
		3 8		B0103		x A 1533	
		3 9		Y0423		X	
		4 0		A0655		1@29	
		4 1		Y0263			
		4 2		U0538			BEGIN OUTER
		4 3		x R 1900		X	} LOOP
		4 4		x U 1900			} (19.0)
y 0.0000.05		4 5		18103F08			
		4 6		4F72327F			MEANS : LEVEL -
		4 7		101A060J		X	
		4 8		084F3A4F			
		4 9		0J06VQ00			
		5 0		x B 6349			LEVEL CTR.
		5 1		x R 1056		X	} INTEGER
		5 2		x U 1000			} PRINTOUT
		5 3		x R 1900			} (19.0)
		5 4		x U 1900			} (19.0)
y 0.0000.01		5 5		202018VQ		X	CR., CR., C.S
		5 6		x B 1563			Lo(y)
		5 7		Y0315			
		5 8		Y0402			
		5 9		A0645		X	1@29
		6 0		Y0311			
		6 1		Y0404			
		6 2		B0308			
		6 3		A[1534]		X	

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL				PAGE OF 7 / (14)
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY R.A.L.	PROGRAM CHECKED BY: POOL Review	DATE 12-7-59
PROBLEM: HIERARCHIAL ACFV				TRACK 03

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		0300	Y	0459		AL I	TEST FOR MIDDLE LOOP
		01	x	B6356		ΣRL	
		02	x	C6238		ΣXL	
		03	x	B6357		ΣRH	
		04	x	C6248		ΣXH	
		05	x	C6357			ΣRH = 0
		06	x	C6356			ΣRL = 0
		07	B	0315			BEGIN MIDDLE LOOP
		08	A	[L(n-k)]			
		09	A	[L(n-k)]			
		10	Y	0458		BL I	TEST FOR INNER LOOP
		11	B	[L(n)+1]		Σ _{nijk} @ 29	BEGIN INNER LOOP
		12	x	H6363		TEMP. ST.	LOOP
		13	x	A6359			
		14	x	C6359			Σ...Σ _{nijk} @ 29
		15	B	[L(n)]			
		16	x	H6252			
		17	x	H6249			
		18	x	A6360			Σ...Σ _y @ 30
		19	x	C6360			
		20	x	B6363			TEMP STORE Σ...Σ _{nijk}
		21	M	0657		1 @ 1	
		22	x	H6253		Σ...Σ _{nijk} @ 30	
		23	D	0663		1 @ 19	
		24	x	H6362		Σ...Σ _{nijk} @ 11	Temp. STORE
		25	x	B6249		Σ...Σ _y @ 30	
		26	x	D6362			
		27	x	H6363		1 @ 19	
		28	x	R1305			DATA OUTPUT #2
		29	x	U1300			PRINT MEAN
		30	x	Z0119			
		31	x	B6255		1 @ 30	

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL			PAGE OF 8 / (14)
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY R.A.L.	PROGRAM CHECKED BY: POOL Review
PROBLEM: HIERARCHIAL A of V			DATE 12-7-59
			TRACK 03

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		<input checked="" type="checkbox"/>					
		0332	x	D6253			
		33	x	C6259		1/n @ 0	
		34	x	R6235			} ΣXY - R _n
		35	x	U6111	<input checked="" type="checkbox"/>		(DPS0507)
		36	x	B6262		DLb	
		37	T	O353			→ MAKE DLb "+", REDUCE
		38	x	C6238		ΣXYL	DHb
		39	x	B6261	<input checked="" type="checkbox"/>	DHb	
		40	x	C6248		ΣXYH	
		41	x	B6250		RL	
		42	x	A6356			ΣRL
		43	x	H6358	<input checked="" type="checkbox"/>	Temp STORE	
		44	E	O659		3uuuuuuu@	
		45	x	C6356			ΣRL
		46	x	B6358		T.S.	
		47	E	O662	<input checked="" type="checkbox"/>	40000000	
		48	M	O411		1 @ 29	
		49	x	A6251		RH	
		50	x	A6357			} ΣRH
		51	x	C6357	<input checked="" type="checkbox"/>		}
		52	U	O358			
		53	A	O654		1 @ 1	HERE FOR NEG. DLb
		54	x	C6238			
		55	x	B6261	<input checked="" type="checkbox"/>	DHb	
		56	x	S6255		1 @ 30	
		57	U	O340			
		58	P	O311		B[29] + 1	
		59	A	O645	<input checked="" type="checkbox"/>	1 @ 29	
		60	Y	O315			
		61	A	O647		1 @ 29	
		62	Y	O311			
		63	S	O458	<input checked="" type="checkbox"/>		

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL			PAGE OF 9 / (14)
JOB NO.	PROGRAM NO. FL-165	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY: POOL Review
PROBLEM: HIERARCHIAL A of V			DATE 12-7-59
			TRACK 04

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		0400	T	0311			END INNER LOOP
		001	X	B6360		$\Sigma \dots \Sigma y$	
		002	C	$[L_0(y)]$			
		003	X	B6359			
		004	C	$[L_0(y)+1]$		$\Sigma \dots \Sigma n_{ijk} \dots$	
		005	X	P1655			CARR. RET.
		006	X	C6359			} CLEAR SUMMATION REGISTERS
		007	X	C6360			
		008	B	0404			
		009	A	0645		1@29	
		100	Y	0402			
		101	X	Z0001			DELAY
		102	X	P1662			CARR. RET.
		103	A	0656		1@29	
		104	Y	0404			
		105	B	0308			
		106	A	0645			
		107	Y	0308			
		108	X	Z0000			DELAY
		109	Y	0309			
		200	S	0459		AL]	TEST FOR MIDDLE LOOP
		201	T	0307			END MIDDLE LOOP
		202	B	$[1532]$			
		203	S	$[1533]$			
		204	X	H6362		d.f.@29	TEMP. ST.
		205	C	$[6303]$			d.f. for A of V
		206	X	B6248		ΣXYH	
		207	X	S6255		1@30	
		208	T	0430			
		209	X	Z0001			- ERROR HALT - SOS $\geq 2^{30}$
		300	X	B6238			
		301	C	$[6304]$			SOS of A of V

LOGIC CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - FOL			PAGE OF 10/(14)
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY R.A.L.	PROGRAM CHECKED BY FOL Review
PROBLEM: HIERARCHICAL ANALYSIS			DATE 12-7-59
			TRACK 04

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		CONTENTS OF ADDRESS	NOTES	
			OPERATION	ADDRESS			
		0.4,3,2		U,0,6,3,5		→ TEST FOR d.f. = 1	
		3,3	X	D,6,3,4,2		d.f. = 29	
		3,4	X	M,6,3,3,2		SOS @ 30	
		3,5		C,4,2,0,9	⊗	MEAN SQ @ 30 FOR	
		3,6		B,0,4,3,5			
		3,7		A,0,2,0,9		1 @ 29	
		3,8		Y,0,4,2,5			
		3,9		A,0,4,1,1	⊗	1 @ 29	
		4,0		Y,0,4,3,1			
		4,1		A,0,6,5,6		1 @ 29	
		4,2		Y,0,4,3,5			
		4,3		B,0,4,2,3	⊗		
		4,4		Y,0,4,2,2			
		4,5		Y,0,4,5,1			
		4,6		A,0,4,1,1		1 @ 29	
		4,7		Y,0,4,2,3	⊗		
		4,8		B,0,2,6,3			
		4,9		A,0,2,0,9		1 @ 29	
		5,0		Y,0,2,6,3			
		5,1		B,1,5,3,3	⊗		
		5,2		S,0,6,5,0		2 @ 29	
		5,3		T,0,5,1,7		→ PRINT A of V	
		5,4	X	B,6,3,4,9		} INCREMENT LEVEL COUNTER	
		5,5		A,0,2,0,3	⊗		1 @ 29
		5,6	X	C,6,3,4,9			
		5,7		U,0,2,4,2		END OUTER LOOP	
		5,8		B,1,1,1,1		TEST FOR LOOP	
		5,9		A,1,1,1,1	⊗	TEST FOR LOOP	
		6,0	X	C,6,3,4,6		SOS @ 30	
		6,1		B,0,1,2,2		2 @ 29	
		6,2		S,0,6,4,8		1 @ 29	
		6,3	X	H,6,3,4,2	⊗	d.f. @ 29	

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL				PAGE OF 11 / (14)
JOB NO.	PROGRAM NO. P4-165	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY: POOL Review	DATE 12-7-59
PROBLEM: HIERARCHIAL A of V				TRACK 05

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		0500	S	0650		2 @ 29	
		01	T	0660			→ d.f. ≤ 1
		02	B	0645		1 @ 29	
		03	x D	6342	×	d.f. @ 29	→ 1/2 d.f. @ 0
		04	x M	6346		SOS @ 30	
		05	x C	6355		MEAN SQUARE @ 30	
		06	x B	6346		SOS @ 30	
		07	A	[301]	×	Σ SOS @ 30	
		08	U	0125			
		09	x P	1259			COLOR SHIFT
		10	x B	6355		M.S. @ 30	
		11	x Z	0000	×		DELAY
		12	x R	2651			} OUTPUT "30"
		13	x U	2500			
		14	x P	1200			C.S.
		15	B	0120	×		
		16	U	0153			
		17	B	0203		1 @ 29	} RESTORE DPSOSOP CALLING SEQ.
		18	C	0123			
		19	x R	1900	×		} (19.0)
		20	x U	1900			
0,0,0,0,0,1,6		21	2,0,2,0,3,0,1,8				
		22	1,0,7,2,3,2,7,2				
		23	0, J, 1, 2, 7, F, 2, 2		×		ANALYSIS OF VARIANCE
		24	7, F, 0, 6, 4, 6, 5, 4				
		25	0, 6, 3, A, 7, 2, 1, F				
		26	2, 2, 7, 2, 3, 2, 6, F				
		27	4, F, 2, 0, 2, 0, 0, J		×		LEVEL d.f.
		28	0, 8, 4, F, 3, A, 4, F				"SOS" MEAN SQUARE
		29	0, J, 3, 0, 2, F, 3, A				
		30	5, 4, 2, A, 3, 0, 1, 0				
		31	7, F, 0, 6, 4, 6, 0, 6		×		

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL				PAGE OF 12/(14)
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY: POOL Review	DATE 12-7-59
PROBLEM: HIERARCHIAL A of V				TRACK 05

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		<input checked="" type="checkbox"/>					
		0532	7F	303F08			
		33	4F	723206			
		34	10	7F0874			
		35	52	721F4F	<input checked="" type="checkbox"/>		
		36	20	2018VQ			
		37	U	0541			
		38	B	0101			
		39	Y	0422	<input checked="" type="checkbox"/>		
		40	11	0243			
		41	B	0425			
		42	S	0203		1@29	} INITIALIZE A of V PRINTOUT
		43	Y	0559	<input checked="" type="checkbox"/>	1@29	
		44	S	0209		1@29	
		45	Y	0555			
		46	S	0411		1@29	
		47	Y	0552	<input checked="" type="checkbox"/>		
		48	x	B6349			
		49	x	H6344			A of V LINE CTR
		50	x	R1056			} INTEGER PRINTOUT
		51	x	U1000	<input checked="" type="checkbox"/>		
		52	B	[63 * *]		d.f.@29	
		53	x	R1056			} INTEGER PRINTOUT
		54	x	U1000			
		55	B	[63 * *]	<input checked="" type="checkbox"/>	S05@30	
		56	x	R2651			} OUTPUT "30"
		57	x	U2500			
		58	U	0559			
		59	B	[63 * *]	<input checked="" type="checkbox"/>	M.S.@30	
		60	x	R2651			} OUTPUT "30"
		61	x	U2500			
		62	U	0563			
		63	x	P1649	<input checked="" type="checkbox"/>		CARR RET.

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL			PAGE OF 13 / (14)
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY: POOL Review
PROBLEM: HIERARCHIAL A of V			DATE 12-7-59
			TRACK 06

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		0 0 0	B	0552			
		0 1	S	0644		1@29	
		0 2	Y	0559			
		0 3	S	0646		1@29	
		0 4	xZ	0000			DELAY
		0 5	Y	0555			
		0 6	S	0656		1@29	
		0 7	Y	0552			
		0 8	x B	6344			A of V LINE CTR.
		0 9	S	0645		1@29	
		1 0	T	0663			→ TO BKPT 16
		1 1	U	0549			
		1 2	Y	0616			HERE FOR LOG
		1 3	x B	1563			TRANSFORMATION
		1 4	Y	0618			
		1 5	Y	0624			
		1 6	A	[15 * *]		N@29	
		1 7	Y	0633			
		1 8	B	[L(x)]			
		1 9	x R	1724			} LOG ₁₀ X (18.0)
		2 0	x U	1700			
		2 1	x Z	0030			
		2 2	x Z	0002			
		2 3	M	0652		1000@24	
		2 4	C	[L(y)]			y = TRANS X
		2 5	B	0618			
		2 6	A	0655		1@29	
		2 7	Y	0618			
		2 8	Y	0624			
		2 9	S	0633		B[L ₁ (y)]	
		3 0	T	0618			
		3 1	B	0616			

LGP-30 CODING SHEET

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

JOB NO. PROGRAM NO. F4-165 PROGRAM PREPARED BY: R.A.L. PROGRAM CHECKED BY: POOL Review

PROBLEM: HIERARCHIAL A of V

PAGE 14 OF 14 (14)

DATE 12-7-59

TRACK 06

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		0.6.3.2	U	0,0,2,8			
		3.3	B	[]			TEST FOR LOOP
		3.4	x B	6,3,6,2		d.f.@29	
		3.5	S	0,6,5,0		2@29	
		3.6	T	0,6,3,9			
		3.7	B	0,2,0,9		1@29	
		3.8	U	0,4,3,3			
		3.9	x B	6,2,3,8			SOS = M.S. @ 30
		4.0	U	0,4,3,5			
		4.1	A	[]			TEST OF LOOP
		4.2	x C	6,3,0,0		(SEE 0042)	Lo of A of V STORAGE
2,000,000,1,0		4.3		2,000			1@18
		4.4		4			} 1@29
		4.5		4			
		4.6		4			
		4.7		4			
		4.8		4			
		4.9					
		5.0		8			2@29
		5.1	3	WWW,WWW,Q			MASK
		5.2	1	W4,0,0			1000@24
		5.3	U	0,3,3,6			
2,000,000,0,6		5.4	4	0,0,0,0,0,0			1@1 (MASK)
		5.5		4			} 1@29
		5.6		4			
		5.7	4	0,0,0,0,0,0			1@1
		5.8					
		5.9	3	WWW,WWW,Q			MASK
		6.0	x B	6,3,4,6			SOS @ 30
		6.1	U	0,5,0,5			
2,000,000,0,1		6.2	4	0,0,0,0,0,0			1@1
		6.3	x Z	1,6,0,0			1@19 - BREAK POINT -

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL			PAGE OF 15 / 14	
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY: R. A. Lamm	PROGRAM CHECKED BY: POOL Review	DATE 12-7-59
PROBLEM: STORAGE			TRACK 6300	

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		6300					} A of V RESULTS FOR PRINTOUT
	<input checked="" type="checkbox"/>	6300					
		3 3					Uijk... @ 11 TEMP ST.
		3 4					
		3 5			<input checked="" type="checkbox"/>		
		3 6					
		3 7					
		3 8					
		3 9			<input checked="" type="checkbox"/>		
		4 0					
		4 1					
		4 2					(d.f. @ 29)
		4 3			<input checked="" type="checkbox"/>		
		4 4					A of V LINE CTR
		4 5					
		4 6					(SOS @ 30)
		4 7			<input checked="" type="checkbox"/>		Acc $\Sigma \dots \Sigma$ Uijk...
		4 8					
		4 9					LEVEL COUNTER
		5 0					TEMP. STOR.
		5 1			<input checked="" type="checkbox"/>		
		5 2					
		5 3					
		5 4					
		5 5			<input checked="" type="checkbox"/>		(MEAN SQ. @ 30)
		5 6					Σ RL
		5 7					Σ RH
		5 8					TEMP STOR.
		5 9			<input checked="" type="checkbox"/>		Σ Uijk...
		6 0					$\Sigma \dots \Sigma$ y
		6 1					
		6 2					T.S. Σ Uijk... @ 11, d.f. @ 29
		6 3			<input checked="" type="checkbox"/>		T.S. \bar{y} FOR PRINTOUT



LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL			PAGE OF 1 (14)
JOB NO.	PROGRAM NO. FL-165	PROGRAM PREPARED BY: R.A. LAMM	PROGRAM CHECKED BY: R.A.L.
PROBLEM: HIERARCHIAL ANALYSIS OF VARIANCE			DATE 12/7/59
			TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		0,0,0,0	XR	19,00		} ALPHANUMERIC (19.0)	
		0,1	XU	19,00			
0,0,0,0,0,1,0		0,2	20,1,8,1,0,6,2				
		0,3	2,2,4,F,1,F,7,2		⊗		
		0,4	1,F,6,F,6,2,2,2			"HIERARCHIAL ANALYSIS OF VARIANCE"	
		0,5	7,2,0,J,0,6,7,2				
		0,6	3,2,7,2,0,J,1,2				
		0,7	7,F,2,2,7,F,0,6		⊗		
		0,8	4,6,5,4,0,6,3,A				
		0,9	7,2,1,F,2,2,7,2				
		1,0	3,2,6,F,4,F,2,0				
		1,1	0,8,1,8,2,0,V,Q		⊗		
		1,2	xP,0,0,6,2			} READ DATA DESIGNATION (19.0)	
		1,3	xI,0,0,0,0				
		1,4	xR,19,0,0				
		1,5	xU,19,0,0		⊗		
0,0,0,0,0,0,3		1,6	1,8,2,0,1,2,0,6				
		1,7	1,0,1,6,0,8,0,6			"y = "	
		1,8	V,Q,0,0,0,0,0,0				
		1,9	xP,0,0,0,5		⊗	} READ DATA CODING	
		2,0	xI,0,0,0,0				
		2,1	xP,1,2,0,7			COLOR SHIFT DELAY	
		2,2	xZ,0,0,0,0				
		2,3	xR,0,3,0,8		⊗	} DATA INPUT #3 WITH MODIF.	
		2,4	xU,0,3,0,0				
		2,5	xB,1,2,4,0			H[1532 + NUMBER OF -000000]	
		2,6	S,0,6,4,8			1@29	
		2,7	8,0,0,T,0,6,1,2		⊗	T.C. → TRANSFORM TO LOGS	
		2,8	Y,0,2,1,7			B[L(N)]	
		2,9	S,0,6,4,4			1@29	
		3,0	Y,0,0,3,4				
		3,1	xB,1,5,6,3		⊗	L ₀ (4)	

LGP-30 CODING SHEET

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

JOB NO. PROGRAM NO. F4-165 PROGRAM PREPARED BY: R.A.L. PROGRAM CHECKED BY: POOL Review

PROBLEM: HIERARCHIAL A of V

PAGE OF 2 (14) DATE 12-7-59 TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		0,0,3,2	x	Y 15,6,2			
		3,3	x	B 15,6,2			DETERMINE AND STORE Lo of DATA (Lo of (N _{ijk}))
		3,4	S	[15, x, x]			
		3,5	x	C 15,6,2			
		3,6	B	0,0,3,4			
		3,7	S	0,2,0,9		1 @ 29	
		3,8	Y	0,0,3,4			
		3,9	S	0,2,1,8		x S 1532	
		4,0	T	0,0,4,2			
		4,1	U	0,0,3,3			
		4,2	B	0,6,4,2		x C 6300	
		4,3	Y	0,2,1,9			d.f.
		4,4	Y	0,2,2,1			d.f.
		4,5	A	0,2,0,3		1 @ 29	
		4,6	Y	0,1,2,5			RESIDUAL S _{ij}
		4,7	Y	0,1,2,4			" "
		4,8	Y	0,2,2,2			" "
		4,9	Y	0,0,5,6			" "
		5,0	A	0,4,2,9		1 @ 29	
		5,1	C	0,2,2,3			MEAN SQUARES
		5,2	x	C 63,5,6			$\sum C_{FL} = KL$
		5,3	x	C 63,5,7			$\sum C_{FH} = KH$
		5,4	x	C 63,5,9			$\sum N_{ijk}$
		5,5	x	C 63,6,0			$\sum \epsilon y$
		5,6	C	[63,0,1]			Sum of SQUARES
		5,7	x	B 15,6,3		L(y _i)	
		5,8	Y	0,1,2,0			
		5,9	Y	0,1,2,1			
		6,0	Y	0,1,6,3			
		6,1	A	0,6,4,7		1 @ 29	
		6,2	Y	0,2,0,1			
		6,3	x	B 15,6,2			Lo (N _{ijk})

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL				PAGE OF 3 (14)
JOB NO.	PROGRAM NO. PL-165	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY: POOL Review	DATE 12-7-59
PROBLEM: HIERARCHIAL A of V				TRACK 01

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		<input checked="" type="checkbox"/>					
		0 1 0 0	Y	0 1 1 6			
		0 1	x A	1 5 3 2		NUMBER of $n_{ijk}...$	
		0 2	Y	0 1 1 4			
		0 3	x A	1 5 3 3	<input checked="" type="checkbox"/>	NUMBER of $n_{ijk}...$	
		0 4	Y	0 6 4 1		$A[L(n..k...)]$	TEST FOR OUTER LOOP
		0 5	x R	1 9 0 0			} (19.0)
		0 6	x U	1 9 0 0			
00000006'		0 7	2 0 2 0	1 8 1 0	<input checked="" type="checkbox"/>		
		0 8	3 F	0 8 4 F 7 2			
		0 9	3 2 7 F	1 0 1 A			
		1 0	0 6 0 J	0 8 4 F			
		1 1	3 A 4 F	0 J 0 6	<input checked="" type="checkbox"/>		
		1 2	0 4 2 0	1 8 V Q			
		1 3	B	0 1 1 6		$B[L(n_{ijk}...)]$	
		1 4	A	$[L(n_{ijk}...)]$			
		1 5	Y	0 6 3 3	<input checked="" type="checkbox"/>	$B[L(n_{ijk}...)]$	TEST FOR INNER LOOP
		1 6	B	$[L(n_{ijk}...)]$			
		1 7	Y	0 1 2 2			
		1 8	x R	6 0 0 0			} DOUBLE PRECISION SUM OF SQUARES OR PRODUCTS (DPSOSOP) (SEE 0225, 0517)
		1 9	x U	6 0 0 0	<input checked="" type="checkbox"/>		
		2 0	M	$[L(n_{ijk}...)]$			
		2 1	M	$[L(n_{ijk}...)]$			
		2 2	Z	$[n_{ijk}...]$			
		2 3	x Z	0 0 0 1	<input checked="" type="checkbox"/>	or U0336	
		2 4	A	$[6301]$			
		2 5	C	$[6301]$			
		2 6	x B	6 2 5 0		RL	
		2 7	x A	6 3 5 6	<input checked="" type="checkbox"/>	ΣRL	
		2 8	x H	6 3 5 0		T.S.	
		2 9	E	0 6 5 1		3WWWXXXX	
		3 0	x C	6 3 5 6			
		3 1	x B	6 3 5 0	<input checked="" type="checkbox"/>	T.S.	

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL			PAGE OF 4 (14)
JOB NO.	PROGRAM NO. FL-165	PROGRAM PREPARED BY R.A.L.	PROGRAM CHECKED BY: POOL Review
PROBLEM: HIERARCHIAL A of V			DATE 12-7-59
			TRACK 01

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		⊗					
		01132	E	0654		40000000	
		33	M	0655		1@29	
		34	xA	6251		RH	
		35	xA	6357	⊗		} ΣRH
		36	xC	6357			
		37	xB	6252		Σy@30	
		38	xA	6360			} ΣΣy
		39	xC	6360	⊗		
		40	B	0122		n _{ijk} @29	
		41	xA	6359			} Σ n _{ijk} ...
		42	xC	6359			
		43	B	0122	⊗	n _{ijk} ...@29	
		44	D	0643		1@18	
		45	xC	6333		n _{ijk} @11	
		46	xB	6252		Σy _{ijk} ...	
		47	xD	6333	⊗		
		48	xH	6363			TEMP STORAGE
		49	xR	1305			} DATA OUTPUT #2 (12.1A)
		50	xU	1300			
		51	xZ	0119	⊗		
		52	B	0120		M[L(y)]	
		53	A	0122		n _{ijk} ...@29	
		54	Y	0121			
		55	Y	0120	⊗		
		56	B	0116		B[L(n _{ijk} ...)]	
		57	↑ A	0429		1@29	
		58	Y	0116			
		59	S	0633	⊗	B[L(n _{ijk} ...)]	
		60	└ T	0116			
		61	xP	1647			CARR. RET.
		62	xB	6360		ΣΣy	
		63	C	L(y)]	⊗		

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL				PAGE OF 5 / (14)
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY: POOL Review	DATE 12-7-59
PROBLEM: HIERARCHIAL A of V				TRACK 02

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		0200	x B	6359		$\sum \pi_{ijk} \dots$	FOR j, k... FIXED
		001	C	[L(y)+1]			
		002	x C	6360			$\sum \sum y = 0$
		003	x Z	0001	<input checked="" type="checkbox"/>		DELAY
		004	x P	1654			
		005	x C	6359			$\sum \pi_{ijk} \dots = 0$
		006	B	0201			
		007	A	0429	<input checked="" type="checkbox"/>	1 @ 29	
		008	Y	0163			
		009	x Z	0001			DELAY
		100	A	0646		1 @ 29	
		101	Y	0201	<input checked="" type="checkbox"/>		
		102	B	0114		A[L(m; k...)]	
		103	A	0656		1 @ 29	
		104	Y	0114			
		105	S	0641	<input checked="" type="checkbox"/>	A[L(m; k...)]	
		106	T	0113			
		107	B	[]		N @ 29	
		108	x S	1532			NUMBER OF $\pi_{ijk} \dots$
		109	C	[6300]	<input checked="" type="checkbox"/>	d.f. @ 29	
		200	B	0656			
		201	D	[6300]			→ 1/d.f. @ 0
		202	M	[9301]			SOS @ 30
		203	C	[6302]	<input checked="" type="checkbox"/>		MEAN SQ @ 30
		204	B	0653		40336	
		205	C	0123			
		206	B	0655			
		207	x C	6349	<input checked="" type="checkbox"/>		LEVEL COUNTER
		208	B	0223			
		209	A	0644		1 @ 29	
		300	Y	0425		L(d.f.)	
		301	A	0646	<input checked="" type="checkbox"/>	1 @ 29	

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL			PAGE OF 6 / (14)
JOB NO.	PROGRAM NO. FL-165	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY: POOL Review
PROBLEM: HIERARCHIAL A OF V			DATE 12-7-59
			TRACK 02

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		0.2		Y0431		CL(SOS)	
		3 3		A0655		1@29	
		3 4		Y0435		CL(MS)	
		3 5		B0641		XALo(M..KL..)	
		3 6		Y0308			
		3 7		Y0309			
		3 8		B0103		xA1533	
		3 9		Y0423		X	
		4 0		A0655		1@29	
		4 1		Y0263			
		4 2		U0538			BEGIN OUTER LOOP
		4 3		xR1900		X	} (19.0)
		4 4		xU1900			
y0.0000.0.5		4 5		18103F08			
		4 6		4F72327F			MEANS: LEVEL -
		4 7		101A060J		X	
		4 8		084F3A4F			
		4 9		0J06VQ00			
		5 0		xB6349			LEVEL CTR.
		5 1		xR1056		X	} INTEGER
		5 2		xU1000			
		5 3		xR1900			} (19.0)
		5 4		xU1900			
y0.0000.0.1		5 5		202018VQ		X	CR., CR., C.S
		5 6		xB1563			Lo(y)
		5 7		Y0315			
		5 8		Y0402			
		5 9		A0645		X	1@29
		6 0		Y0311			
		6 1		Y0404			
		6 2		B0308			
		6 3		A1534		X	

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PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL				PAGE OF 7 / (14)
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY: POOL Review	DATE 12-7-59
PROBLEM: HIERARCHIAL A OF V				TRACK 03

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		0300	Y	0459		AL 3	TEST FOR MIDDLE LOOP
		01	x B	6356		Σ RL	
		02	x C	6238		Σ YL	
		03	x B	6357	☒	Σ RH	
		04	x C	6248		Σ YH	
		05	x C	6357			Σ RH = 0
		06	x C	6356			Σ RL = 0
		07	B	0315	☒		BEGIN MIDDLE LOOP
		08	A	$L(n-k)$			
		09	A	$L(n-k)$			
		10	Y	0458		BL 3	TEST FOR INNER LOOP
		11	B	$L(y)+1$	☒	Σ $n_{ijk} @ 29$	BEGIN INNER LOOP
		12	x H	6363		TEMP. ST.	
		13	x A	6359			} Σ...Σ $n_{ijk} @ 29$
		14	x C	6359			
		15	B	$L(y)$	☒		
		16	x H	6252			
		17	x H	6249			
		18	x A	6360			} Σ...Σ $y @ 30$
		19	x C	6360	☒		
		20	x B	6363			TEMP STORE Σ...Σ n_{ijk}
		21	M	0657		1 @ 1	
		22	x H	6253		Σ...Σ $n_{ijk} @ 30$	
		23	D	0663	☒	1 @ 19	
		24	x H	6362		Σ...Σ $n_{ijk} @ 11$	Temp. STORE
		25	x B	6249		Σ...Σ $y @ 30$	
		26	x D	6362			
		27	x H	6363	☒	9 @ 19	
		28	x R	1305			} DATA OUTPUT # 2 PRINT MEAN
		29	x U	1300			
		30	x Z	0119			
		31	x B	6255	☒	1 @ 30	

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL			PAGE OF 8 / (14)
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY R.A.L.	PROGRAM CHECKED BY: POOL Review
PROBLEM: HIERARCHIAL A of V			DATE 12-7-59
			TRACK 03

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		<input checked="" type="checkbox"/>					
		0,3,3,2	x	D,6,2,5,3			
		3,3	x	C,6,2,5,9		1/n @ 0	
		3,4	x	R,6,2,3,5			} ΣXY - R _n
		3,5	x	U,6,1,1,1	<input checked="" type="checkbox"/>		(DPS050P)
		3,6	x	B,6,2,6,2		DLb	
		3,7	T	O,3,5,3			→ MAKE DLb "+", REDUCE
		3,8	x	C,6,2,3,8		ΣXYL	DHb
		3,9	x	B,6,2,6,1	<input checked="" type="checkbox"/>	DHb	
		4,0	x	C,6,2,4,8		ΣXYH	
		4,1	x	B,6,2,5,0		RL	
		4,2	x	A,6,3,5,6			ΣRL
		4,3	x	H,6,3,5,8	<input checked="" type="checkbox"/>	Temp STORE	
		4,4	E	O,6,5,9		3uuuuuuuu	
		4,5	x	C,6,3,5,6			ΣRL
		4,6	x	B,6,3,5,8		T.S.	
		4,7	E	O,6,6,2	<input checked="" type="checkbox"/>	40000000	
		4,8	M	O,4,1,1		1 @ 29	
		4,9	x	A,6,2,5,1		RH	
		5,0	x	A,6,3,5,7			} ΣRH
		5,1	x	C,6,3,5,7	<input checked="" type="checkbox"/>		
		5,2	U	O,3,5,8			
		5,3	A	O,6,5,4		1 @ 1	HERE FOR NEG. DLb
		5,4	x	C,6,2,3,8			
		5,5	x	B,6,2,6,1	<input checked="" type="checkbox"/>	DHb	
		5,6	x	S,6,2,5,5		1 @ 30	
		5,7	U	O,3,4,0			
		5,8	B	O,3,1,1		B[2(6)+1]	
		5,9	A	O,6,4,5	<input checked="" type="checkbox"/>	1 @ 29	
		6,0	Y	O,3,1,5			
		6,1	A	O,6,4,7		1 @ 29	
		6,2	Y	O,3,1,1			
		6,3	S	O,4,5,8	<input checked="" type="checkbox"/>		

LGP-30 CODING SHEET

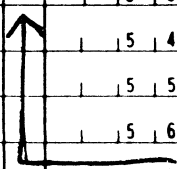
PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL				PAGE OF 9 / (14)
JOB NO.	PROGRAM NO. FL-165	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY: POOL Review	DATE 12-7-59
PROBLEM: HIERARCHIAL A of V				TRACK 04

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		0400	T	0311			END INNER LOOP
		001	x B	6360		$\Sigma \dots \Sigma y$	
		002	C	$[L_0(y)]$			
		003	x B	6359			
		004	C	$[L_0(y)+1]$		$\Sigma \dots \Sigma n_{ijk} \dots$	
		005	x P	1655			CARR. RET.
		006	x C	6359			} CLEAR SUMMATION REGISTERS
		007	x C	6360			
		008	B	0404			
		009	A	0645		1@29	
		100	Y	0402			
		101	x Z	0001			DELAY
		102	x P	1662			CARR. RET.
		103	A	0656		1@29	
		104	Y	0404			
		105	B	0308			
		106	A	0645			
		107	Y	0308			
		108	x Z	0000			DELAY
		109	Y	0309			
		200	S	0459		AL]	TEST FOR MIDDLE LOOP
		201	T	0307			END MIDDLE LOOP
		202	B	$[1532]$			
		203	S	$[1533]$			
		204	x H	6362		d.f. @29	TEMP. ST.
		205	C	$[6303]$			d.f. for A of V
		206	x B	6248		ΣXYH	
		207	x S	6255		1@30	
		208	T	0430			
		209	x Z	0001			- ERROR HALT - $SOS \geq 2^{30}$
		300	x B	6238			
		301	C	$[6304]$			SOS of A of V

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL			PAGE OF 10/(14)
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY: POOL Review
PROBLEM: HIERARCHIAL A of V			DATE 12-7-59
			TRACK 04

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		04,3,2		U,0,6,3,4			→ Test for d.f. = 1
		3,3	x	D,6,3,6,2			d.f. + 29
		3,4	x	M,6,2,3,8			SOS @ 30
		3,5		C[6,3,0,5]	×		MEAN SQ @ 30 FIN
		3,6		B,0,4,3,5			
		3,7		A,0,2,0,9		1 @ 29	
		3,8		Y,0,4,2,5			
		3,9		A,0,4,1,1	×	1 @ 29	
		4,0		Y,0,4,3,1			
		4,1		A,0,6,5,6		1 @ 29	
		4,2		Y,0,4,3,5			
		4,3		B,0,4,2,3	×		
		4,4		Y,0,4,2,2			
		4,5		Y,0,4,5,1			
		4,6		A,0,4,1,1		1 @ 29	
		4,7		Y,0,4,2,3	×		
		4,8		B,0,2,6,3			
		4,9		A,0,2,0,9		1 @ 29	
		5,0		Y,0,2,6,3			
		5,1		B[1,5,3,3]	×		
		5,2		S,0,6,5,0		2 @ 29	
		5,3		T,0,5,1,7			→ PRINT A of V
		5,4	x	B,6,3,4,9			} INCREMENT LEVEL COUNTER
		5,5		A,0,2,0,3	×	1 @ 29	
		5,6	x	C,6,3,4,9			
		5,7		U,0,2,4,3			END OUTER LOOP
		5,8		B[]			TEST FOR LOOP
		5,9		A[]	×		TEST FOR LOOP
		6,0	x	C,6,3,4,6		SOS @ 30	
		6,1		B,0,1,2,2		2 @ 29	
		6,2		S,0,6,4,8		1 @ 29	
		6,3	x	H,6,3,4,2	×	d.f. @ 29	



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PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL			PAGE OF 11 / (14)
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY: POOL Review
PROBLEM: HIERARCHIAL A OF V			DATE 12-7-59
			TRACK 05

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		05.0.0	S	06.50		2 @ 29	
		0.1	T	06.60			→ d.f. ≤ 1
		0.2	B	06.45		1 @ 29	
		0.3	x D	63.42	☒	d.f. @ 29	→ 1/2 d.f. @ 0
		0.4	x M	63.46		SOS @ 30	
		0.5	x C	63.55		MEAN SQUARE @ 30	
		0.6	x B	63.46		SOS @ 30	
		0.7	A	[3.0.1]	☒	Σ SOS @ 30	
		0.8	U	01.25			
		0.9	x P	12.59			COLOR SHIFT
		1.0	x B	63.55		M.S. @ 30	
		1.1	x Z	00.00	☒		DELAY
		1.2	x R	26.51			} OUTPUT "30"
		1.3	x U	25.00			
		1.4	x P	12.00			C.S.
		1.5	B	01.20	☒		
		1.6	U	01.53			
		1.7	B	02.03		1 @ 29	} RESTORE DPSOSOP CALLING SEQ.
		1.8	C	01.23			
		1.9	x R	19.00	☒		} (19.0)
		2.0	x U	19.00			
0.0.0.0.1.6		2.1	2.0.2.0.3.0.1.8				
		2.2	1.0.7.2.3.2.7.2				
		2.3	0. J. 1.2.7. F. 2.2	☒			ANALYSIS OF VARIANCE
		2.4	7. F. 0.6. 4.6. 5.4				
		2.5	0.6. 3. A. 7. 2. 1. F				
		2.6	2.2. 7. 2. 3. 2. 6. F				
		2.7	4. F. 2.0. 2.0. 0. J	☒			LEVEL d.f.
		2.8	0.8. 4. F. 3. A. 4. F				"SOS" MEAN SQUARE
		2.9	0. J. 3.0. 2. F. 2. A				
		3.0	5.4. 2. A. 3.0. 1.0				
		3.1	7. F. 0.6. 4.6. 0.6	☒			

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL				PAGE OF 12 / (14)
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY: POOL Review	DATE 12-7-59
PROBLEM: HIERARCHIAL A of V				TRACK 05

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		<input checked="" type="checkbox"/>					
		0532	7F	303F08			
		33	4F	723206			
		34	10	7F0874			
		35	52	721F4F	<input checked="" type="checkbox"/>		
		36	20	2018VQ			
		37		U0541			
		38		B0101			
		39		Y0422	<input checked="" type="checkbox"/>		
		40		U0243			
		41		B0425			
		42		S0203		1@29	INITIALIZE A of V
		43		Y0559	<input checked="" type="checkbox"/>		
		44		S0209		1@29	PRINTOUT
		45		Y0555			
		46		S0411		1@29	
		47		Y0552	<input checked="" type="checkbox"/>		
		48	x	B6349			LEVEL COUNTER
		49	x	H6344			A of V LINE CTR.
		50	x	R1056			INTEGER PRINTOUT
		51	x	U1000	<input checked="" type="checkbox"/>		
		52		B[63 * *]		d.f.@29	
		53	x	R1056			INTEGER PRINTOUT
		54	x	U1000			
		55		B[63 * *]	<input checked="" type="checkbox"/>	S05@30	
		56	x	R2651			OUTPUT "30"
		57	x	U2500			
		58		U0559			
		59		B[63 * *]	<input checked="" type="checkbox"/>	M.S.@30	
		60	x	R2651			OUTPUT "30"
		61	x	U2500			
		62		U0563			
		63	x	P1649	<input checked="" type="checkbox"/>		CARR RET.

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PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL			PAGE OF 13 / (14)
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY: POOL Review
PROBLEM: HIERARCHIAL A of V			DATE 12-7-59
			TRACK 06

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		0600	B	0552			
		001	S	0644		1@29	
		002	Y	0559			
		003	S	0646	☒	1@29	
		004	xZ	0000			DELAY
		005	Y	0555			
		006	S	0656		1@29	
		007	Y	0552	☒		
		008	x	B6344			A of V LINE CTR.
		009	S	0645		1@29	
		100	T	0663			→ TO BKPT 16
		101	U	0549	☒		
		102	Y	0616			HERE FOR LOG
		103	x	B1563			TRANSFORMATION
		104	Y	0618			
		105	Y	0624	☒		
		106	A	[15**]		N@29	
		107	Y	0633			
		108	B	[L(x)]			
		109	x	R1724	☒		} LOG ₁₀ X (18.0)
		200	x	U1700			
		201	x	Z0030			
		202	x	Z0002			
		203	M	0652	☒	1000@24	
		204	C	[L(y)]			y = TRANS X
		205	B	0618			
		206	A	0655		1@29	
		207	Y	0618	☒		
		208	Y	0624			
		209	S	0633		B[L ₁ (y)]	
		300	T	0618			
		301	B	0616	☒		

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PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL			PAGE 14 OF (14)
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY: R.A.L.	PROGRAM CHECKED BY: POOL Review
PROBLEM: HIERARCHIAL A of V			DATE 12-7-59
			TRACK 06

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		0632	U	0028			
		33	B	[]			TEST FOR LOOP
		34	x B	6362		d.f.@29	
		35	S	0650		2@29	
		36	T	0639			
		37	B	0209		1@29	
		38	U	0433			
		39	x B	6238			SOS = M.S. @ 30
		40	U	0435			
		41	A	[]			TEST OF LOOP
		42	x C	6300		(SEE 0042)	Lo of A of V STORAGE
30000010		43		2000			1@18
		44		4			} 1@29
		45		4			
		46		4			
		47		4			
		48		4			
		49					
		50		8			2@29
		51	3	WWWWWQ			MASK
		52	1	W400			1000@24
		53	U	0336			
30000006		54	4	00000000			1@1 (MASK)
		55		4			} 1@29
		56		4			
		57	4	00000000			1@1
		58					
		59	3	WWWWWQ			MASK
		60	x B	6346			SOS @ 30
		61	U	0505			
30000001		62	4	00000000			1@1
		63	x Z	1600			1@19 - BREAK POINT -

LGP-30 CODING SHEET

PREPARED FOR: LGP-30, RPC-4000 Users' Organization - POOL				PAGE OF 15 / 4
JOB NO.	PROGRAM NO. F4-165	PROGRAM PREPARED BY: R. A. Lamm	PROGRAM CHECKED BY: POOL Review	DATE 12-7-59
PROBLEM: STORAGE				TRACK 6300

PROGRAM INPUT CODES	STOP	LOCATION	INS. RUCTION		STOP	CONTENTS OF ADDRESS	NOTES
			OPERATION	ADDRESS			
		6300					} A of V RESULTS FOR PRINTOUT
	<input checked="" type="checkbox"/>	63 3 2					
		3 3					Uijk... @ 11 TEMP ST.
		3 4					
		3 5			<input checked="" type="checkbox"/>		
		3 6					
		3 7					
		3 8					
		3 9			<input checked="" type="checkbox"/>		
		4 0					
		4 1					
		4 2					(d.f. @ 29)
		4 3			<input checked="" type="checkbox"/>		
		4 4					A of V LINE CTR
		4 5					
		4 6					(S O S @ 30)
		4 7			<input checked="" type="checkbox"/>		Acc Σ..Σ Uijk...
		4 8					
		4 9					LEVEL COUNTER
		5 0					TEMP. STOR.
		5 1			<input checked="" type="checkbox"/>		
		5 2					
		5 3					
		5 4					
		5 5			<input checked="" type="checkbox"/>		(MEAN SQ. @ 30)
		5 6					Σ R L
		5 7					Σ R H
		5 8					TEMP STOR.
		5 9			<input checked="" type="checkbox"/>		Σ Uijk...
		6 0					Σ...Σ y
		6 1					
		6 2					T.S. Σ Uijk... @ 11, d.f. @ 29
		6 3			<input checked="" type="checkbox"/>		T.S. y FOR PRINTOUT

CARRIAGE RETURN

= CONDITIONAL STOP CODE

