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PROBABILISTIC SYSTEMS MODELING AND COST/PERFORMANCE METHODOLOGIES FOR OPTIMIZATION OF VEHICLE ASSIGNMENT

FINAL REPORT

VOLUME 2

PROGRAMMER'S MANUAL
ASSIGNMENT AND SMOOTHING MODEL

31 MARCH 1971

PREPARED UNDER CONTRACT NAS2-5202

FOR

ADVANCED CONCEPTS AND MISSIONS DIVISION
OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AMES RESEARCH CENTER
MOFFETT FIELD, CALIFORNIA

BY

LOCKHEED MISSILES & SPACE COMPANY
SUNNYVALE, CALIFORNIA

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FOREWORD

This report volume is the programmer's manual developed during a study of probabilistic systems modeling and cost/performance methodologies for optimal assignment of space vehicles and other program elements to advanced space missions. This study is being performed for the National Aeronautics and Space Administration under Contract NAS2-5202, and is monitored by Mr. R. E. Slye and Mr. Harold Hornby of the Advanced Concepts and Missions Division of the Office of Advanced Research and Technology.

Individuals of Lockheed Missiles & Space Company who contributed to this study are L. F. Fox, project leader; C. J. Golden, key technical member; and W. T. Lew.

CONTENTS

SUMMARY

This document is Volume 2 of a two volume series entitled Probabilistic Systems Modeling and Cost/Performance Methodologies for Optimization of Vehicle Assignment. This volume is a programmer's manual for the probabilistic optimal assignment and budget smoothing model described in Volume 1.

This volume contains appendixes that provide model input requirements, a sample case, flow charts, and a program listing. At the beginning of each appendix, descriptive details and technical comments are provided to indicate any special instructions applicable to the use of that appendix. In addition, the program listing of Appendix D includes comment cards that state the purpose of each subroutine in the complete program and describe operations performed within that subroutine.

Appendix A, Input Requirements, provides details on the many options that adapt the program to the specific needs of the analyst for a particular problem.

Appendix A

INPUT REQUIREMENTS
STATISTICAL ASSIGNMENT/SMOOTHING PROGRAM

A.1 GENERAL

A complete glossary of input terms and detailed format requirements are included in this appendix. Variable names are listed by order of input in corresponding sections of use to make the glossary easier to use than an alphabetical listing. Comments are also included which describe either external or internal restrictions associated with the variable.

Figure A-1 illustrates the basic data deck layout for this program. Any section may be eliminated if there are no associated data. However, either a blank card must be inserted in place of the section or the control card must reflect no input for that section. If the control card is coded so no data are input for some section, then values input for the preceding case are automatically supplied. Otherwise, if no data are desired for any one section, then a blank card must be input to replace that section. Stage performance data to be used in the stage-matching screen may be eliminated entirely, including the final blank card, if the stage-matching screen is not to be used. If this screen is used, then the stage cards must be ordered so that all stages in Class 1 precede those in Class 2, which precede those in Class 3, which precede those in Class 4. Stages not included in the matching screen follow those in the above classifications. If the matching screen is not used, the order of cards within each section is unimportant.

Constraint and budget level cards are input to the SMOTHS subroutine of this integrated program. The last data card input in this BUDGET Section is followed by a card containing only an asterisk in the first column.

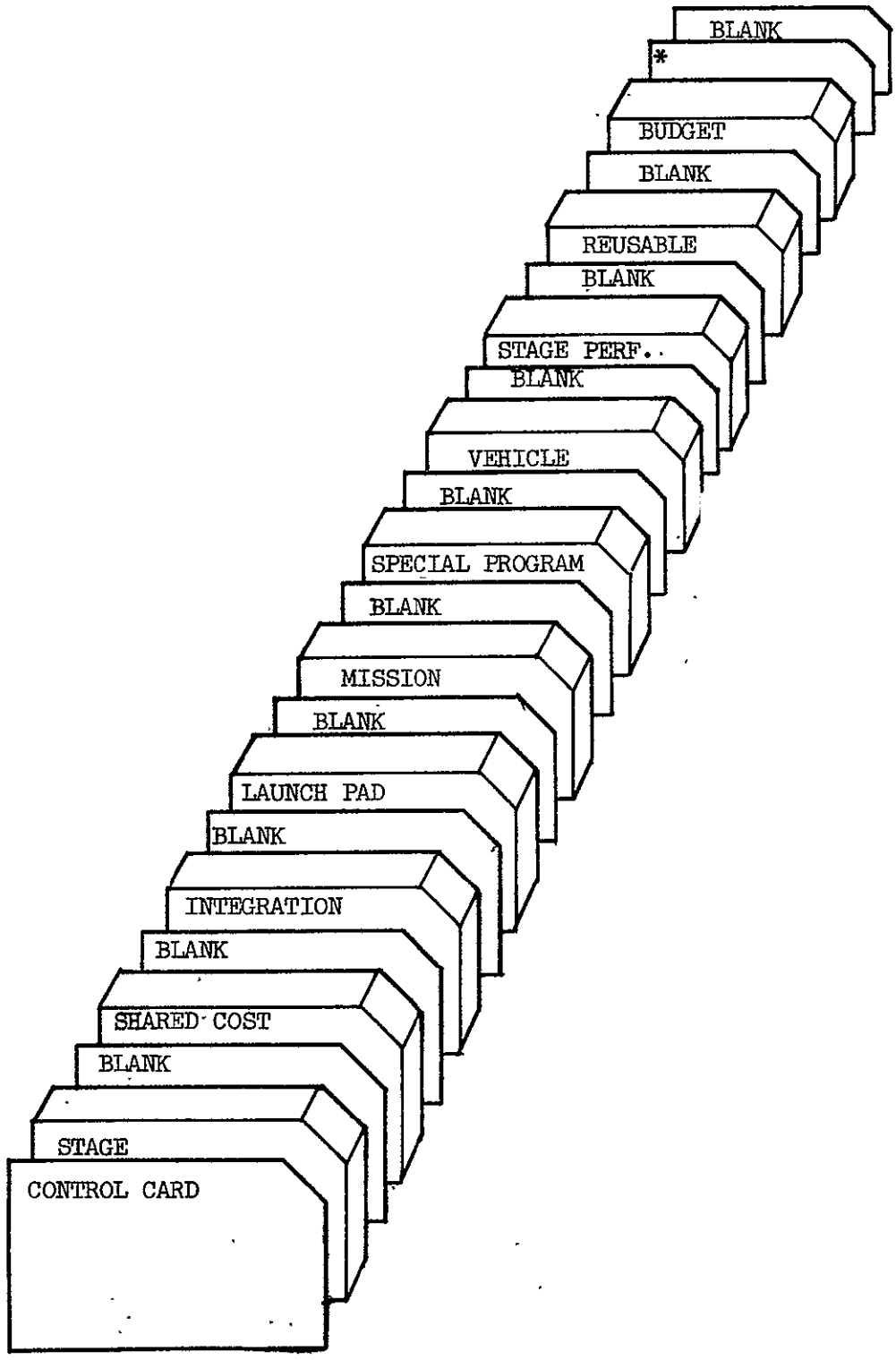

Figure A-1 Data Deck Layout

Then the control card for the next set of data appears unless there are no more data cases to follow. In this latter case, a blank card follows the asterisk card in order to terminate the run under normal circumstances.

A.2 INPUT FORM AND DEFINITIONS

Card Column	Variable Name	Format	Description and Comments
Control Card			
1 - 3	LP	I3	Code for logic printout If LP $\geq$ 2 Print decision numbers for each vehicle If LP $\geq$ 1 Print logic associated with algorithm If LP = 0 No logic output
4 - 6	NOPT	I3	Code for mission/vehicle compatibility screen 1 - ΔV vs. payload weight + availability + a priori assignment 2 - Code 1 plus use stage-matching screen 3 - All criteria
7 - 9	MOS	I3	Method of solution desired MOS = 0 Optimize assignment and smooth resulting budget MOS = 1 Input assignment and smooth resulting budget MOS = 2 Optimize assignment and output associated costs MOS = 3 Input assignment and print out associated costs
10 - 12	NSOL	I3	Number of solutions to be output in ascending order of total program cost

Card Column	Variable Name	Format	Description and Comments
13 - 15	MSOL	I3	MSOL = 1 bypasses time-saving feature in algorithm
16 - 18	MITR	I3	Maximum number of allowed iterations between SMOTHS and ASIGNS
19 - 21	ILY	I3	Last two digits of initial calendar launch year of mission model
22 - 24	MYRS	I3	Mission model duration in years
25 - 29	TREF	F5.1	Last 2 digits of calendar year for SMOTHS
30 - 41	GUESS	F12.2	Upper bound for total launch vehicle program (saves storage space if realistic value). If GUESS = 0.0, then GUESS is assigned a value 1.0 E15
42 - 44	GRØ	F3.1	Annual economic growth factor, e.g., 7% inflation/year; GRØ = 7 .
45 - 49	SLØ	F5.1	Annual Sustaining Costs less than SLØ are left out of the basic algorithm and treated later in determining the optimal assignment. MSØL = 0 option must be specified for implementation
67 - 68	IP	I2	Code for pad input*
69 - 70	IG	I2	Code for stage input*
71 - 72	IFM	I2	Code for shared cost group input*
73 - 74	II	I2	Code for integration cost input*
75 - 76	IM	I2	Code for mission input*
77 - 78	ISD	I2	Code for special program data*
79 - 80	IV	I2	Code for vehicle input*

* If ≥ 0, new input for this case

If < 0, use data from previous case

Card Columns	Variable Name	Format	Description and Comments
Stage Information (Input only if IG $\geq$ 0) I = 1, NSTG < 50			
1 - 2	KODS(I)	I2	Reference number of stage on card I
4 - 7	STG(I)	A4	Name of stage on card I
8 - 13	SR(I,J)	3F6.3	Recurring cost for first unit of stage on card I
14 - 19	J = 1,3		J = 1 Hardware
20 - 25			J = 2 ETR launch support
			J = 3 WTR launch support
26 - 30	PLC(I,J)	3F5.3	Recurring cost learning curve percent for stage on card I in decimal form (e.g., .95)†
31 - 35	J = 1,3		J = 1 Hardware
36 - 40			J = 2 ETR launch support
			J = 3 WTR luanch support
44 - 49	SNR(I)	F6.3	Development cost of stage on card I
50 - 55	STS(I)	F6.3	Sustaining cost of stage on card I
59 - 61	LSA(I)	I3	Last year stage on card I is available*+
62 - 64	NBY(I)	I3	Batching duration in years for stage recurring cost
65 - 67	NFS(I,J)	4I3	KODEF of the shared cost groups (up to 4) to which stage belongs
68 - 70	J = 1,4		
71 - 73			
74 - 76			

† If percent is 100, then input zero for more efficient program operation

* 1 corresponds to year I_{LY}

\+ If available through mission model, any number $\geq$ MYRS may be input. If number < MYRS is input then this termination date is maintained through all iterations.

Card Column	Variable Name	Format	Description and Comments
78 79 80	MODE(I,J) J = 1,3	3I1	Code to indicate type of input for recurring cost of stage on card I* J = 1 Hardware J = 2 ETR launch support J = 3 WTR launch support

Second Stage Card

5 - 9 10 - 14	SUSLS(I,J) J = 1,2	2F5.0	Sustaining cost at launch facility for Stage I, not to be duplicated at each pad. J = 1 ETR J = 2 WTR
15 - 17	NU(I)	I3	Number of reusable units in initial investment of component I NU = 0 unit is expendable NU > 0 estimate used by program directly NU ≤ -2 estimate used by program for first iteration, then subroutine REUSE calculates estimate for NU
18 - 23	UPP(I)	F6.2	Unit purchase price
24 - 29 30 - 32	UPPXX PXX	F6.1 F3.2	PXX% tail such that using the lognormal distribution, prob.(UPP(I) ≥ UPPXX) = PXX (e.g., PXX = .05)
33 - 38	RPLO(I)	F6.0	Return payload weight in lbs for this component.** (Vehicle return payload = orbiter return payload)
39 - 40	YDS(I)	F2.0	Duration in years over which β function distributes development cost for stage on card I. (Leave blank if SNR(I) = 0. Input necessary if SNR ≠ 0)

* If = 0, learning curve type input
If = 0, jump type input

** Any value ≥ 1.0 may be input to indicate payload return capability besides crew.

Card Column	Variable Name	Format	Description and Comments
41 - 42	IST(I)	I2	Last 2 digits of calendar start date for Stage Development Program
43 - 44	NSFX(NSDC*)	I2	Duration in years $\leq$ 12 for any miscellaneous (fixed or development) program associated with stage on card I (e.g., Run out costs). (Standard Development costs are distributed by a Beta function - any other development distribution may be input under this special category.)
45 - 49 50 - 54 55 - 59	SRXX(J) J = 1,3	3F5.1	XX% tail such that prob.(SR(J) $\geq$ SRXX(J)) = XX(1) for J = 1,3
60 - 62	XX(1)	F3.2	Percent tail above in decimal form (e.g., .05)
63 - 68 69 - 71	SNRXX XX(2)	F6.1 F3.2	XX% tail such that prob. (SNR(I) $\geq$ SNRXX) = XX(2)
72 - 77 78 - 80	STSXX XX(3)	F6.1 F3.2	XX% tail such that prob. (STS(I) $\geq$ STSXX) = XX(3)

If MODE(I,J) $\neq$ 0 for some J, require following Jump Type Input Card for Each such J.

5 - 14	SRJ(LX,1)	F10.3	Total recurring cost for up to POJ number of stages
15 - 24	SRJ(LX,2)	F10.3	Slope of line defining total recurring cost for over POJ number of stages
25 - 34	SRJ(LX,3)	F10.3	Y-intercept of line defining total recurring cost for over POJ number of stages
35 - 44	POJ(LX)	F10.3	Number of stages at which function defining total recurring cost changes slope

* NSDC = Number of special development costs $\leq$ 50

Card Column	Variable Name	Format	Description and Commments
45 - 54	SRJXX	F10.3	PXX% tail such that
55 - 57	PXX	F3.2	prob. (SRJ(LX,1) $\geq$ SRJXX) = PXX

If NSFX(NSDC) $\neq$ 0 read in following card.

1 - 3	NRFX(NSDC)	I3	Start date for special development cost associated with stage on card I. (Referenced to IST(I))
4 - 8 9 - 13 14 - 18 19 - 23 24 - 28 29 - 33 34 - 38 39 - 43 44 - 48 49 - 53 54 - 58 59 - 63	RXD(J,NSDC) J = 1,12	12F5.2	Special development cost to be spent in calendar year 1900 + IST(I) + NRFX(NSDC) - 2 + J (Input distribution)
64 - 69	RXDXX	F6.1	PXX% tail such that
70 - 72	PXX	F3.2	prob($\sum_{j=1}^{12}$ RXD(J,NSDC) $\geq$ RXDXX) = PXX

Last Stage Card must be followed by a blank card.

Shared Cost Group Cards (Input only if IFM $\geq$ 0) I = 1, NFAM < 40

1 - 2	KODEF(J)=I	I2	Reference Number of group on card J
4 - 7	FAM(I)	A4	Name of group I
8 - 17	FMNR(I)	F10.0	Development cost of group I
18 - 27	FMSUS(I)	F10.0	Sustaining cost of group I

Card Column	Variable Name	Format	Description and Comments
28 - 31	YDF(I)	F4.1	Duration in years of Development Program cost distribution (β Function). (Leave blank if FMNR(I) = 0.)
32 - 34	JST(I)	I3	Last 2 digits of calendar start date for group Development Program - necessary if FMNR or FMSUS ≠ 0
35 - 37	NSFX(NSDC)	I3	Duration in years for any miscellaneous fixed or development program distribution associated with group I. (Distribution input on following card.)
38 - 47	FMSLS(I,J)	2F10.0	Sustaining cost at launch site for group I not to be duplicated at each pad.
48 - 57	J = 1,2		J = 1 ETR J = 2 WTR
58 - 64	FMNRXX	F7.0	XX% tail such that prob.(FMNR(I) ≥ FMNRXX) = XX(1)
65 - 67	XX(1)	F3.2	
68 - 74	FMSSXX	F7.0	XX% tail such that prob.(FMSUS(I) ≥ FMSSXX) = XX(2)
75 - 77	XX(2)	F3.2	

If (NSFX(NSDC) ≠ 0) read following card.

1 - 3	NRFX(NSDC)	I3	Start date for special Development cost associated with group I. (Referenced to JST(I)).
4 - 8 9 - 13 14 - 18 ⋮ 59 - 63	RXD(J,NSDC) J = 1,12	12F5.2	Special Development cost to be spent in calendar year 1900 + JST(I) + NRFX(NSDC) - 2 + J (Input distribution)
64 - 69	RXDXX	F6.1	PXX% tail such that $\text{prob.}\left(\sum_{j=1}^{12} \text{RXD}(J,\text{NSDC}) \geq \text{RXDXX}\right) = \text{PXX}$
70 - 72	PXX	F3.2	

Card Column	Variable Name	Format	Description and Comments
Last Group card must be followed by a blank card.			
Integration Cost Cards (Input only if II $\geq$ 0) I = 1, NCI < 30			
3 - 5	NFML(I)	I3	KODEF of shared cost group which is lower member of integration pair I
6 - 8	NFMU(I)	I3	KODEF of shared cost group which is upper member of integration pair I
9 - 18	RINT(I)	F10.0	Recurring cost for first unit of integration I
19 - 28	PLCINT(I)	F10.0	Recurring cost learning curve percent for integration I
29 - 38	DINT(I)	F10.0	Development cost of integration I
39 - 48	SINT(I)	F10.0	Sustaining cost of integration I
49 - 52	YDI(I)	F4.1	Development duration in years for β distribution (Leave blank if DINT(I) = 0.)
53 - 55	KST(I)	I3	Last 2 digits of calendar start date for integration development program - input necessary if DINT or SINT $\neq$ 0
56 - 58	NSFX(NSDC)	I3	Duration in years for any miscellaneous fixed or development program associated with integration I. (Distribution input on following card).
59 - 68 69 - 78	SINTLS(I,J) J = 1,2	2F10.0	Sustaining cost at launch facility for integration I not to be duplicated at each pad. J = 1 ETR J = 2 WTR
Second Integration Card			
1 - 10 11 - 13	RINTXX XX(1)	F10.0 F3.2	XX(1)% tail such that prob.(RINT(I) $\geq$ RINTXX) = XX(1)

Card Column	Variable Name	Format	Description and Comments
14 - 23	DINTXX	F10.0	XX(2)% tail such that prob.(DINT(I) $\geq$ DINTXX) = XX(2)
24 - 26	XX(2)	F3.2	
27 - 36	SINTXX	F10.0	XX(3)% tail such that prob.(SINT(I) $\geq$ SINTXX) = XX(3)
37 - 39	XX(3)	F3.2	

IF NSFX(NSDC) $\neq$ 0 read following card.

1 - 3	NRFX(NSDC)	I3	Start date for Special Development cost associated with integration I. (Referenced to KST(I))
4 - 8 9 - 13 14 - 18 ⋮ 59 - 63	RXD(J,NSDC) J = 1,12	12F5.2	Special Development cost to be spent in calendar year 1900 + KST(I) + NRFX(NSDC) - 2 + J (Input distribution)
64 - 69	RXDXX	F6.1	PXX% tail such that $\text{prob}\left(\sum_{j=1}^{12} \text{RXD}(J,\text{NSDC}) \geq \text{RXDXX}\right) = \text{PXX}$
70 - 72	PXX	F3.2	

Last Integration card must be followed by a blank card.

Pad Cards (Input only if IP $\geq$ 0) I = 1, NP $\leq$ 30

1 - 4	KODEP(I)	I4	Number of pad complex on card I
7 - 10	PAD(I)	A4	Name of complex on card I
11 - 15	NPERPD(I)	F5.0	Maximum number of launches/year/pad possible at complex I

2nd - 6th cards needed for each pad complex (stage cost data, 2/card) (J = 1,10)

3 - 4 43 - 44	NPSTG(I,J)	I2	KODE corresponding to Jth stage costs of complex I

Card Column	Variable Name	Format	Description and Comments
5 - 9 45 - 49	PSTGD(I,J,1)	F5.0	J^{th} stage development cost of first pad in complex I
10 - 12 50 - 52	YDPS(I,J)	F3.0	Development duration in years for β distribution
13 - 15 53 - 55	MST(I,J)	I3	Last 2 digits of calendar start date of PSTGD
16 - 20 56 - 60	PSTGS(I,J,1)	F5.0	J^{th} stage sustaining cost of first pad in complex I
21 - 25 61 - 65	PSTGD(I,J,2)	F5.0	J^{th} stage development cost of second pad in complex I
26 - 30 66 - 70	PSTGS(I,J,2)	F5.0	J^{th} stage sustaining cost of second pad in complex I
31 - 35 71 - 75	PSTGD(I,J,3)	F5.0	J^{th} stage development cost of third pad in complex I
36 - 40 76 - 80	PSTGS(I,J,3)	F5.0	J^{th} stage sustaining cost of third pad in complex I

7th - 9th cards needed for each pad complex (family cost data, 2/card)(J = 1,5

3 - 4 43 - 44	NPFAM(I,J)	I2	KODEF corresponding to J^{th} family costs of complex I
5 - 9 45 - 49	PFAMD(I,J,1)	F5.0	J^{th} family development cost of first pad in complex I
10 - 12 50 - 52	YDPF(I,J)	F3.0	Development duration in years for β distribution
13 - 15 53 - 55	LST(I,J)	I3	Last 2 digits of calendar start date of PFAMD
16 - 20 56 - 60	PFAMS(I,J,1)	F5.0	J^{th} family sustaining cost of first pad in complex I

Card Column	Variable Name	Format	Description and Comments
21 - 25 61 - 65	PFAMD(I,J,2)	F5.0	J^{th} family development cost of second pad in complex I
26 - 30 66 - 70	PFAMS(I,J,2)	F5.0	J^{th} family sustaining cost of second pad in complex I
31 - 35 71 - 75	PFAMD(I,J,3)	F5.0	J^{th} family development cost of third pad in complex I
36 - 40 76 - 80	PFAMS(I,J,3)	F5.0	J^{th} family sustaining cost of third pad in complex I

10th and 11th cards needed for each pad complex (integration cost data, 3/card) (J = 1,5)

9 - 11 33 - 35 57 - 59	NPINTL(I,J)	I3	KODEF of lower group corresponding to J^{th} integration cost of comple:
12 - 14 36 - 38 60 - 62	NPINTU(I,J)	I3	KODEF of upper group corresponding to J^{th} integration cost of comple:
15 - 32 39 - 56 63 - 80	PINTS(I,J,K) K = 1,3	3F6.0	J^{th} integration sustaining cost of K^{th} pad in complex I

Last Pad Card must be followed by Blank Card.

Mission Data Card - (Input only if IM $\geq$ 0) I = 1, NMIS < 50

1 - 2	KODEM(I)	I2	Reference number of mission on card I
3 - 8	NAME(I)	A6	Name of mission on card I
9 - 12	PB(I)	F4.2	Priority of mission on card I
15 - 16	NSYR(I)	I2	Number of sustaining years required for SUS(I) after last launch year

Card Column	Variable Name	Format	Description and Comments
17 - 18	NYRSFX(I)	I2	Duration in years of any fixed or special development cost distribution associated with mission KODEM(I)
19 - 25	VLR(I)	F7.0	Characteristic velocity required in fps to accomplish mission on card I
26 - 28	RPLM(I)	F3.0	Return payload weight in lbs required by mission on card I*
29 - 31	TAMT(I)	F3.0	Number of days orbiter required for mission completion (only required if NU < 0 for some reusable stage).
32 - 38	WPR(I)	F7.0	Payload weight in lbs required for mission on card I
39 - 40	NTRIP(I)	I2	Maximum number of launches allowed to carry WPR(I) lbs into orbit. NTRIP(I) = 0 is same as 1.
41 - 80	MISN(I,J) J = 1,MYRS	20I2	Number of launches for mission on card I in calendar year J + 1900 + ILY - 1 with WPR payload at each launch

Second Mission Card

3 - 12	PLR(I)	F10.2	Payload recurring cost for mission KODEM(I).
13 - 22	SUS(I)	F10.2	Payload sustaining cost
23 - 32	C(I)	F10.2	Payload development cost
33 - 37	YDPL(I)	I5	Duration in years over which development cost is to be distributed by Beta Function
38 - 42 43 - 47 48 - 52 53 - 57	RDIST(I,L) L = 1,4	4F5.3	Input recurring cost distribution for PLR in decimal form (e.g., RDIST(I,1) = .05)

* Currently, any value $\geq$ 1.0 indicates that mission I is to be performed only by vehicles whose upper stage has RPLO > 1.0 .

Card Column	Variable Name	Format	Description and Comments
58 - 67	PLMD(I)	F10.2	Maximum diameter of payload for mission on card I
68 - 69	NPLS(I)	I2	Code for payload stabilization requirement 0 - No requirement 1 - Must be spin stabilized 2 - Must not be spin stabilized
70 - 71	MR(I)	I2	Code for man-rating requirement for mission on card I 0 - No requirement 1 - Must be man-rated
72 - 73	LTR(I)	I2	Code for launch site of mission 1 - ETR 2 - WTR
74 - 75	NRR(I)	I2	Number of restarts required for mission
76 - 77	IS(I)	I2	Last 2 digits of calendar start year for development cost PLD(I)
78 - 80	IVEHLA(I)	I3	A priori vehicle assignment for mission on card I If no vehicle assigned - 0 input; KODEV of vehicle input otherwise

Third Mission Card

1 - 10	PLRXX	F10.0	XX(1)% tail such that prob(PLR(I) $\geq$ PLRXX) = XX(1)
11 - 13	XX(1)	F3.2	
14 - 23	CXX	F10.0	Same for C(I)
24 - 26	XX(2)	F3.2	
27 - 36	SUSXX	F10.0	Same for SUS(I)
37 - 39	XX(3)	F3.2	

Card Column	Variable Name	Format	Description and Comments
If NYRSFX(I) ≠ 0 read following card.			
1 - 3	NSTRFX(I)	I3	Start date for special development cost associated with mission KODEM(I) referenced to IS(I)
4 - 8 9 - 13 14 - 18 ⋮ 59 - 63	RFIXD(J,I) J = 1, 12	12F5.2	Special Development cost to be spent in calendar year 1900 + IS(I) + NSTRFX(I) - 2 + J (Input distribution)
64 - 69	RXDXX	F6.1	PXX% tail such that $\text{Prob}\left(\sum_{j=1}^{12} \text{RFIXD}(J,I) \geq \text{RXDXX}\right) = \text{PXX}$
70 - 72	PXX	F3.2	
Last mission card must be followed by a blank card.			
Special Program Data Card (No launch associated with program) - Input only if ISD ≥ 0, I = 1, NSPR ≤ 6			
1 - 3	KODESP(I)	I3	Code number for Special Program (must be larger than 100)
4 - 9	NAME(I)	A6	Name of Special Program on card I
10 - 19	C(I)	F10.2	Development cost associated with program (distributed by β Function)
20 - 24	YDPL(I)	I5	Duration in years of Development program
25 - 26	IS(I)	I2	Last 2 digits of start year for development cost C(I)
27 - 36	SUS(I)	F10.2	Annual sustaining cost associated with program
37 - 38	NYRSST(I)	I2	Duration in years of sustaining program

Card Column	Variable Name	Format	Description and Comments
39 - 40	NYRSFX(I)	I2	Duration in years of any fixed cost which does not have a β distribution
41 - 50	CXX	F10.2	XX(1)% tail such that Prob(C(I) ≥ CXX) = XX(1)
51 - 53	XX(1)	F3.2	
54 - 63	SUSXX	F10.2	XX(2)% tail such that Prob(SUS(I) ≥ SUSXX) = XX(2)
64 - 66	XX(2)	F3.2	

If NYRSFX(I) ≠ 0 read following card.

1 - 3	NSTRFX(I)	I3	Start date for fixed cost referenced to IS(I)
4 - 8 9 - 13 14 - 18 ⋮ 59 - 63	RFIXD(J,I) J = 1,12	12F5.2	Fixed Cost to be spent in calendar year 1900 + IS(I) + NSTRFX(I) - 2 + J
64 - 69	RXDXX	F6.1	PXX% tail such that
70 - 72	PXX	F3.2	$\text{Prob}\left(\sum_{j=1}^{12} \text{RFIXD}(J,I) \geq \text{RXDXX}\right) = \text{PXX}$

Last Special Program Data card must be followed by a blank card.

Vehicle Data Card (Input only if IV ≥ 0) J = 1, NV ≤ 60

1 - 8	VEH(I,J) I = 1,4	4I2	KODS of stage in I^{th} position, where I = 1 corresponds to booster, for vehicle on card J
9 - 21	B1(J)	E13.6	Payload vs. characteristic velocity curve constants for performance evaluation of vehicle on card J. PL = EXP(B1 - B2*V - B3/(B4 - V)) and V = Excess Velocity = Total Characteristic Velocity-Circular Velocity at 100 n.m.
22 - 34	B2(J)	E13.6	
35 - 47	B3(J)	E13.6	
48 - 60	B4(J)	E13.6	

Card Column	Variable Name	Format	Description and Comments
79 - 80	KODEV(J)	I2	Reference number of vehicle on card J

2nd Card needed for each vehicle.

4 - 5	NVS(J)	I2	Code for stabilization of vehicle on card J 1 - Is spin stabilized 2 - Is not spin stabilized
6 - 7	MRV(J)	I2	Code for man-rating of vehicle on card J 0 - Is not man-rated 1 - Is man-rated
8 - 9	NRP(J)	I2	Number of restarts possible for vehicle on card J
10 - 12	NPAD(1,J)	I3	KODEP of pad complex at ETR from which vehicle J can be launched
13 - 15	NPAD(2,J)	I3	KODEP of pad complex at WTR from which vehicle J can be launched
16 - 18	NYP(1,J)	I3	1st year J^{th} vehicle can be flown from ETR
19 - 21	NYP(2,J)	I3	1st year J^{th} vehicle can be flown from WTR
80	JKEY	I1	Code for recurring cost distribution for vehicle on card J JKEY = 0 - standard distribution is used 1st year of distribution = .05 Recurring cost 2nd year of distribution = .20 Recurring cost 3rd year of distribution = .50 Recurring cost

(Continued on following page)

Card Column	Variable Name	Format	Description and Comments
			4th year of distribution = .25 Recurring cost = Launch year generating this recurring cost JKEY = 1 - Distribution is to be input on following card

Optional 3rd card for each vehicle (Input only if JKEY ≠ 0).

4 - 8 9 - 13 14 - 18 19 - 23	ALPI(I,J) I = 1,4	4F5.2	Input Recurring cost distribution for vehicle on card J in year I where I = 4 corresponds to year of launch

Last vehicle card must be followed by blank card.

Stage Performance Cards (Input only if NOPT = 2 on control card) I ≤ NSTG ≤ 40

1 - 4	KODE(I)	I4	Reference number of stage on card I (used to check order of cards)
5 - 9	NST(I)	I5	Classification of stage on card I
10 - 19	THRT(I)	F10.0	Stage thrust
20 - 29	DIAM(I)	F10.0	Stage diameter
30 - 39	TSL(I)	F10.0	Stage sea-level thrust
40 - 49	LENT(I)	F10.0	Interstage length required to clear engines
50 - 59	WTFU(I)	F10.0	Stage fuel weight
60 - 69	WTIN(I)	F10.0	Stage total inert weight
70 - 79	ISP(I)	F10.0	Stage vacuum specific impulse

Last Performance card must be followed by a blank card. Eliminate blank card if NOPT ≠ 2.

Reusable Stage Cards (One card required for each stage I with input negative NU(I)). (No special order required)

1 - 2	KODE(I)	I2	Stage code number of corresponding reusable stage

Card Column	Variable Name	Format	Description and Comments
5 - 6	NOB(I)	I2	Code to identify type of stage NOB = 1: BOOSTER NOB = 2: ORBITER
7 - 12	XLT(I)	F6.1	Amortization Lifetime (number of launches per unit before replacement)
13 - 18	TAT(I)	F6.1	Land to launch turn-around-time for first refurbishment (days)
19 - 24	PLCT(I)	F6.3	Learning curve percent for TAT in decimal form calculated from reference year (if zero is input, then PLCT is assumed to be 100)

Last Reusable Stage card must be followed by blank card. (Blank card required even if no data are input in this section.)

Budget Smoothing Data is input in subroutine SMOTHS using a CALL INPUT statement. The following variables may be input at this time.

Variable Name	Description and Comments
TITLE(I)	Output page HEADING - if no input blanks are output. 40 characters are allocated for storage, e.g., TITLE = 'LUNAR OPTION'
LEVEL(J)	YEARLY DESIRED FUNDING LEVEL (20 year maximum), e.g., LEVEL = 300., 375., 18 x 300.
ISTRT	FIRST YEAR of smoothing interval - referenced to TREF = 1
IFIN	Last year of smoothing interval - referenced to TREF
MAXITR	Maximum number of iterations allowed per case in SMOTHS subroutine
NCSTR	Number of constraints on mission programs $\leq$ 90
NPROG(K)	The reference number (KODEM or KODESP) of the mission being constrained

Variable Name	Description and Comments
KPROG(K)	The reference number (KODEM or KODESP) of the constraining program or mission
KODE(K)	Code number for type of constraint $\leq$ 11
CS(K)	Constant associated with each constraint
FIXED(I)	Yearly total fixed overhead costs (I = 1,20) If no input, is set to zero
PMAX, PMIN	Constants associated with PLOT2 - if no input they are set to 5000. and 1500. respectively
ACCL	Code for use of acceleration option - if no input it is set = TRUE
EXT	Code for use of extension option - if no input it is set = TRUE. If FALSE is input, these options will not be used.

The next card contains an * in the first column.

The next card is either a new control card for the next case of data or a blank card so that the run is terminated under normal circumstances.

Appendix B
SAMPLE CASE

B.1 DESCRIPTION

The output from a sample case is presented in this Appendix. Data are synthesized in order to test logical sequences. No significance should be attached to the values used. The listing includes a module map so that storage requirements are defined for each subroutine and common block. The program first prints out input data for easy reference and to provide a check on punched data. If probabilistic data are input, then two lines of output are provided for each item; the first line represents the most likely values input while the subsequent line represents the expected values calculated by the program.

Each section of output is described in detail:

(1) STAGE COST DATA include stage title or identifying name, recurring cost of first unit and learning curve (LC) factor for hardware, ETR, and WTR recurring cost, respectively. If any stage has jump – discontinuous form of recurring cost for any of the above three types – then the following line provides relevant information. Development and sustaining cost for each stage are listed along with years of availability referenced to the initial launch year. Each stage may belong to at most four "shared cost groups," whose reference numbers are listed on the output. Each group number is referenced to the "Shared Cost Data" number which follow this section. "Batch Fact" defines the number of years over which vehicles may be considered as produced in one period of time for learning curve purposes. A a reusable stage is designated as such and its expected unit purchase price is given with the input most likely value in parenthesis.

(2) SHARED COST DATA include data on each shared cost group which was referenced in (1) above. These groups may be families such as the Titan family or they may be subsystems, such as a guidance system shared by several stages. Total development cost for any vehicle equals the sum of the development costs for each of its component stages plus any development costs for any shared groups associated with these stages plus any integration development costs required. As mentioned above, the first line represents the most likely value while the second line (if appropriate) represents the expected value calculated by the program.

(3) INTEGRATION COST DATA are always between "families." If a specific stage-to-stage integration cost is desired, each stage must be put in a shared cost group by itself. Thus, many shared cost groups in (2) above will have no associated non-recurring costs. These groups will, however, be integrated with other shared cost groups, and this combination does have an integration non-recurring cost.

(4) PAD COST DATA would normally be the section which follows. For simplicity, no pad costs were included with this test run, but this section would list the complex reference number, identifying name and location, e.g. TITE represents Titan ETR complex, and the next entry would show the maximum number of launches per year per pad at this complex. All possible combinations of pad-related costs are listed with their respective values for each pad.

(5) MISSION MODEL DATA include mission internal reference number, identifying name, total ΔV required, payload required in lb, priority value, launch site identification, (1 = ETR, 2 = WTR), and launch rate schedule by year.

The following page lists all most likely costs (modal) associated with each mission and then lists all the corresponding calculated expected costs. Payload recurring costs (PLR) are distributed over a 4-year period by the following four fractions, where the last year is the year of launch. Development

costs (DEV) are included along with the development period and starting year. Sustaining costs (SUST) and total miscellaneous fixed costs (FIXED) are included for future reference.

(6) SPECIAL PROGRAMS are listed by internal reference number and name. Development cost (DEV), start year and duration are included along with sustaining costs (SUST). Fixed costs, if any are input, are output by year. Both modal (input) and expected (calculated) values are output.

(7) INPUT DATA TOTALS include total number of each input item along with other pertinent information from control card.

(8) QUANTITIES BRANCHED UPON lists every non-zero, non-recurring cost or "budget option" which the algorithm will consider in the optimization process along with its availability status. The reference number listed is used in the optional logic output described in (11).

(9) VEHICLE/MISSION CAPABILITY is a matrix of final vehicle-to-mission compatibility presenting the results of subroutines CAPBLI and AVAILI. Each vehicle is listed by stage components and internal reference number. The vehicle/mission number on the top line represents the mission-year combination number (NM) while the mission number only is given on the following line at the top of the matrix.

(10) CHANGED QUANTITIES BRANCHED UPON is a section included only if reusable stages appear in the input. The number of units purchased is indicated and multiplied by the unit purchase price in order to determine the estimated investment cost for each reusable stage for that iteration. This investment cost is added to the actual development cost for use by the algorithm. In general, these "budget option" quantities are the only ones from the list in (8) that will vary from iteration to iteration.

(11) BRANCH AND BOUND NODE VALUES present optional information which enables the user to check the internal logic of the algorithm. Each node is given a reference number which it keeps until its associated total bound exceeds the value of a known solution. (****represents a very large number, denoting an unfeasible combination). The node number from which branching

is taking place is provided in the second column. The last new node to be generated at each branch is given the reference number of its parent node for continuity. The reference number of the cost item under consideration [see (8)] is listed in the next column along with the appropriate sustaining year for that node. (0 represents no development or sustaining for that cost item). The recurring, non-recurring, and total lower bounds are then provided so that each branch in the decision tree is represented.

When a final solution has been found, it is designated a POSSIBLE SOLUTION. If it is identically the same as a previous possible solution, this fact is printed out and the newly found solution is discarded. Otherwise, if some pad costs and small sustaining costs were ignored by the algorithm, these extra costs are computed and added to the lower bound of the corresponding node. The values of these costs are printed out below the node information for the possible solution under consideration. When the optimal solution has been found – the least cost possible solution already investigated – this fact is designated on the following page.

(12) SOLUTION NUMBER 1 – the optimal launch vehicle for each mission-year combination is printed out as well as an array of mission information for easy reference. The "Number of Launches" represents the launch rate by year multiplied by the priority factor and the number of trips required by the associated vehicle to satisfy the mission payload requirements.

Following the first solution is a description of the uncertainties associated with the total cost of this assignment. The lognormal parameters μ and σ^2 are output along with the lognormal densities at selected points. The numbers in parenthesis are the corresponding normal densities. The 50 percent uncertainty interval, with lower bound taken as the most likely value (mode), is also output.

(13) Sections (11) and (12) are repeated until NSOL = 3 assignments have been found. The second and third assignments have added information output since the probability that those assignments cost more than preceding

assignments is output for various levels of correlation. The proper level of correlation is determined by the analyst since he can determine how much increase in technology is required by each program. Two programs requiring approximately the same technological advance will have a high degree of correlation.

(14) THE OPTIMUM SOLUTION HAS BEEN DETERMINED signifies the successful completion of the algorithm. If no significantly different second and third best solutions can be found, this fact will be output here and the program will continue using the optimal solution found.

(15) Following the above selection of an optimal assignment, any input to subroutine SMOTHS is automatically output as it appears on the data cards. The program constraints are then output – first the input constraints, then the calculated constraints. "Average" recurring cost data for each of the vehicles in the optimum assignment are calculated in VEHRC and output on the following page. Each vehicle is assigned a key number which is used internally and output with the associated stage component names defining the vehicle.

(16) The breakdown of costs by program and type, and by program and year on the following pages, is essentially the same as for the original budget smoothing model. For example, Program 2 (PN = Program Number) has NAME MAPLSU for Manned Planetary Support. The development start date is 1984. The program has no development (DEVL) costs and hence no development duration (YRS). Sustaining costs (SUST) start in year 1984 (= START + SS - 1.). They are spent for 0 (SD) years. Recurring costs start in year 1987 (= START + RS - 1.) and last for 4 (RD) years. The distribution follows on the same line (e.g., $130 M in 1987, $399 M in 1988, $456 M in 1989, and $409 M in 1990). On the following line fixed miscellaneous costs are similarly listed if any have been input for that program [e.g., fixed costs start in year 1971 (= START + RS - 1.) and last for 5 years (RD) for Program Number 13]. The distribution follows on the same line of output.

More complete data on these entries are provided in reference 1. Programs associated with missions are output first. For the selected sample case Programs 1 through 12 are mission related. Program 13 is a miscellaneous program having no associated launches, and the remaining programs are development or sustaining costs associated with launch vehicles. (There is only one such program for this test case.) These last programs are identified by the decision number used in the ASIGNS algorithm. A list of decision numbers, their associated values, and types of expenditure has been output previously for reference.

(17) The section "Total Program Costs and Launch Vehicle Schedule" is output as in the original smoothing program with the following modification. Instead of printing the launch vehicle key name under its associated program and year of launch, the key number already output with each corresponding vehicle name is substituted for simplicity. Total program costs are output by year as they would actually be spent.

(18) A plot follows this tabulated data showing actual yearly totals (*) and desired yearly level of spending (0). The modal value is plotted as an M while the upper value of the 50 percent uncertainty interval is designated by a U. Fixed costs are plotted by an F. Normally under options MOS = 0 or 1, the smoothed data are then output using the same formats. Only data input to SMOTHS directly from ASIGNS and the final smoothed data are output. Intermediate output is supressed. For this sample run, MOS = 2 was specified so no smoothing was performed. If no new case data are input, then the normal termination of the run is designated by END OF DATA – JOB COMPLETE.

Any discrepancies in input data are noted and printed out as a warning to the user. The flow diagrams in Appendix C define all non-normal exits from the algorithm in CHOOZS. Each non-normal termination of a case is denoted by a printout of the qualifying reason. The program then reads in new case data, if available, and proceeds as normal.

The sample case included in this Appendix required 0.69 minutes on the 360/67 computer available at Ames Research Center, Moffett Field, California. Estimating run time is quite difficult for a new set of data since the number of solutions "close to" the optimum solution determines how large the decision tree will be and, as a consequence, how much computer time must be expended. As a general rule, the computer time increases linearly with the number of missions in the mission model and exponentially with the number of decision items determined by the stage, shared group, integration, and pad cost input.

B.2 SAMPLE CASE PRINTOUT

The computer printout for the sample case discussed above follows:

```
//MOX02DD  JOB  (R3582,TEST,1,1),'GOLDEN'          STOP 4
IEF236I ALLOC. FOR MOX02DD  LKED
IEF237I SYSLIB   ON 1C0
IEF237I SYSLMOD  ON 235
IEF237I DECKS    ON 236
IEF237I          ON 230
IEF237I          ON 230
IEF237I SYSPRINT ON 0A5
IEF237I SYSUT1   ON 235
IEF237I SYSLIN   ON 063
IEF285I   SYS1.FORTLIB                                  KEPT
IEF285I   VOL SER NOS= SYSLB1.
IEF285I   SYS71084.T134035.RF000.MOX02DD.GOSET          PASSED
IEF285I   VOL SER NOS= USER02.
IEF285I   SYS1.USERLIB                                  KEPT
IEF285I   VOL SER NOS= USERC1.
IEF285I   SYS1.USERLIB2                                 KEPT
IEF285I   VOL SER NOS= 222222.
IEF285I   SYS1.USERLIB3                                 KEPT
IEF285I   VOL SER NOS= 222222.
IEF285I   SYS71084.T134035.RF000.MOX02DD.R0001556       DELETED
IEF285I   VOL SER NOS=       .
IEF285I   SYS71084.T134035.RF000.MOX02DD.R0001557       DELETED
IEF285I   VOL SER NOS= USER02.
IEF285I   SYS71084.T134035.RF000.MOX02DD.R0001558       DELETED
IEF285I   VOL SER NOS=       .
IEF236I ALLOC. FOR MOX02DD  GO
IEF237I PGM=*.DD ON 235
IEF237I FT05F001 ON 066
IEF237I FT06F001 ON 0A2
IEF237I GOSET    ON 235
IEF285I   SYS71084.T134035.RF000.MOX02DD.GOSET          PASSED
IEF285I   VOL SER NOS= USER02.
IEF285I   SYS71084.T134035.RF000.MOX02DD.R0001560       DELETED
IEF285I   VOL SER NOS=       .
IEF285I   SYS71084.T134035.RF000.MOX02DD.R0001559       DELETED
IEF285I   VOL SER NOS=       .
IEF285I   SYS71084.T134035.RF000.MOX02DD.GOSET          DELETED
IEF285I   VOL SER NOS= USER02.
```

```
F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,OVLY,MAP
          VARIABLE OPTIONS USED - SIZE=(126976,24576)          DEFAULT OPTION(S) USED
IEW0000     INCLUDE DECKS(MOX02MN,MOX01PK)
IEW0000     INCLUDE DECKS(MOX02NI,MOX02NR)
IEW0000     ENTRY MAIN
IEW0000       OVERLAY A
IEW0000     INCLUDE DECKS(MOX02AS)
IEW0000       OVERLAY B
IEW0000     INCLUDE DECKS(MOX02DS)
IEW0000       OVERLAY C
IEW0000     INCLUDE DECKS(MOX02EX)
IEW0000     OVERLAY B
IEW0000     INCLUDE DECKS(MOX02CI)
IEW0000       OVERLAY C
IEW0000     INCLUDE DECKS(MOX02MI,MOX02PI,MOX02ME)
IEW0000       OVERLAY B
IEW0000     INCLUDE DECKS(MOX02DN,MOX02MH,MOX02PN,MOX02AL)
IEW0000       OVERLAY B
IEW0000     INCLUDE DECKS(MOX02SM,MOX02RS,MOX02VC)
IEW0000       OVERLAY B
IEW0000     INCLUDE DECKS(MOX02CH)
IEW0000       OVERLAY C
IEW0000     INCLUDE DECKS(MOX02LD,MOX02OI)
IEW0000       OVERLAY C
IEW0000     INCLUDE DECKS(MOX02CM)
IEW0000       OVERLAY C
IEW0000     INCLUDE DECKS(MOX02PC)
IEW0000       OVERLAY A
IEW0000     INCLUDE DECKS(MOX02SS,MOX02RV,MOX02CR,ALINPT,MOX01UP,MOX02AT)
IEW0000     INCLUDE DECKS(MOX02TC)
IEW0000     INCLUDE DECKS(MOX02SH,MOX02LC)
```

MODULE MAP

CONTROL SECTION				ENTRY						
NAME	ORIGIN	LENGTH	SEG. NO.	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	N
$SEGTAB	00	4C	1							
MAIN	50	1914	1							
PACK	1968	F8	1							
				UNPACK	198A	ITEM	19FE			
NDTRI	1A50	2A6	1							

NDTR	1CF8	1DC	1
IHCSLOG *	1ED8	18A	1
IHCSSCN *	2098	1E0	1
IHCSEXP *	2288	180	1
IHCFRXPI*	2438	141	1
IHCFRXPR*	2580	183	1

ALOG10	1ED8	ALOG	1EF4
COS	2098	SIN	2084
EXP	2288		
FRXPI=	2438		

NAME	ORIGIN	LENGTH	SEG. NO.
IHCFCOMH*	2708	F31	1
IHCCOMH2*	3640	545	1
IHCFMAXI*	3888	C9	1
IHCSSQRT*	3C58	149	1
IHCFCVTH*	3DA8	1175	1
IHCEFNTH*	4F20	512	1
FIOCS= *	5438	160	1
IHCEFIOS*	5598	111C	1
IHCERRM *	6688	5AC	1
IHCUOPT *	6C68	398	1
IHCETRCH*	7000	28E	1
IHCUATBL*	7290	638	1
SAVER	78C8	FC0	1
SAVDMP	8888	148C	1
SAVSAR	9D48	A58	1
SAVE1	A7A0	FC4	1
SAV2	B768	FE0	1
SAV3	C748	9E4	1
SAV4	D130	3188	1
SVACAV	10288	848	1
SAVALL	10E00	3A1C	1
VARNCE	14820	ADC	1
SCRACH	15300	6A60	1
$ENTAB	18D60	24	1
ASIGNS	18D88	88A	2
TEMP	1C648	4110	2
$ENTAB	20758	54	2

NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION*
FRXPR*	2580						
IBCOM*	2708	FDIOCS*	27C4	INTSWTCH	3626		
SEQDASD	3840						
MAXO	3888	MINO	389E	AMAXO	3884	AMINO	38CA
SQRT	3C58						
ADCON*	3DA8	FCVAOUTP	3E52	FCVLOUTP	3EE2	FCVZOUTP	4032
FCVIOUTP	438E	FCVEOUTP	48C0	FCVCOUTP	4ADA	INT6SWCH	4DC3
ARITH*	4F20	ADJSWTCH	528C				
SET899	54C4	RES899	54DE				
FIOCSBEP	559E						
ERRMON	6688	IHCERRE	6600				
IHCTRCH	7000	ERRTRA	7008				

DATINS	20780	3E60	3
$ENTAB	24610	18	3
MEAN	24628	226	4
CAPBLI	20780	B30	5
$ENTAB	212E0	18	5

NAME	ORIGIN	LENGTH	SEG. NO.	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION
MISMTI	212F8	466	6								
PERFI	21760	48C	6								
MATEI	21C20	A68	6								
DECSMI	20780	10C8	7								
MATCHI	21878	1984	7								
PRINTI	23200	108A	7								
AVAILI	24290	718	7								
STGMMI	20780	2328	8								
REUSEI	22AD8	4D8	8								
VEHRC	22FB0	3CE	8								
CHOOZS	20780	20CE	9								
$ENTAB	22880	3C	9								
LBOWDI	228C0	A50	10								
OUTPTI	23310	58C	10								
COMPAR	228C0	160C	11								
POCSTI	228C0	18C2	12								
SMUTHS	18D88	228C	13								
REVLUS	1E048	662	13								
CONSTR	1E6B0	4F2	13								
ALINPT	1E8A8	81A	13								
				INPUT	1E8A8						
UMPLOT	1F6C8	F68	13								
				PLOT1	1F6FA	PLOT2	1F916	PLOT3	1FADA	PLOT4	1FC2A
				OMIT	1FE8E	PLTAPE	1FEC4				
AFRMT	20630	40	13								
TCOSTS	20670	16E6	13								
SHIFTS	21D58	754	13								

```
 LISTC       224B0      7B4     13
 SAVRT       22C68      FA0     13

ENTRY ADDRESS        50
TOTAL LENGTH      249A8

****MAIN       DOES NOT EXIST BUT HAS BEEN ADDED TO DATA SET
```

STAGE COST DATA

TITLE	RECURRING (HARDWARE)	LC	RECURRING (ETR ONLY)	LC	RECURRING (WTR ONLY)	LC	DEVELOPMENT	SUSTAINING	AVAILABLE FROM	TO	SHARED COST GROUPS				BATCH FACT
S-1B	38.00	0.0	0.0	0.0	0.0	0.0	95.00	90.00	4	20	0	0	0	0	1
S-1B	38.90	0.0	0.0	0.0	0.0	0.0	96.89	91.97	4	20	0	0	0	0	1
S-1C	55.00	0.0	0.0	0.0	0.0	0.0	110.00	147.00	4	20	14	17	0	0	1
S-1C	56.39	0.0	0.0	0.0	0.0	0.0	112.40	150.32	4	20	14	17	0	0	1
S-11	41.00	0.0	0.0	0.0	0.0	0.0	0.0	90.00	4	20	14	0	0	0	1
S-11	41.86	0.0	0.0	0.0	0.0	0.0	0.0	91.97	4	20	14	0	0	0	1
FIXED COSTS =	65.00		65.00	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0		0.0	0.0
FIXED COSTS =	66.42		66.42	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0		0.0	0.0
S-4B	21.00	0.0	0.0	0.0	0.0	0.0	60.00	65.00	4	20	14	0	0	0	1
S-4B	21.42	0.0	0.0	0.0	0.0	0.0	61.31	66.61	4	20	14	0	0	0	1
LS4B	14.30	0.0	0.0	0.0	0.0	0.0	45.00	15.00	5	20	13	0	0	0	1
LS4B	18.20	0.0	0.0	0.0	0.0	0.0	57.78	19.03	5	20	13	0	0	0	1
1200	27.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	20	12	18	20	0	1
1200	29.85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	20	12	18	20	0	1
1565	26.50	0.0	0.0	0.0	0.0	0.0	220.00	20.00	5	20	11	0	0	0	1
1565	33.87	0.0	0.0	0.0	0.0	0.0	282.32	25.60	5	20	11	0	0	0	1
R25B	3.39	0.0	0.0	0.0	0.0	0.0	3199.00	244.70	8	20	0	0	0	0	1
R25B	6.53	0.0	0.0	0.0	0.0	0.0	6143.29	470.11	8	20	0	0	0	0	1

REUSABLE STAGE UNIT PURCHASE PRICE= 325.09 (169.40)

R250	2.31	0.0	0.0	0.0	0.0	0.0	3739.00	178.20	8	20	21	0	0	0		1
R250	4.46	0.0	0.0	0.0	0.0	0.0	7179.91	341.83	8	20	21	0	0	0		1
REUSABLE STAGE	UNIT PURCHASE PRICE= 223.10 (116.10)															
R1.5	6.60	0.0	0.0	0.0	0.0	0.0	4578.00	280.00	8	20	0	0	0	0		1
R1.5	12.75	0.0	0.0	0.0	0.0	0.0	8791.04	537.84	8	20	0	0	0	0		1
REUSABLE STAGE	UNIT PURCHASE PRICE= 268.52 (140.00)															
FIXED COSTS =	10.00	10.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
FIXED COSTS =	12.47	12.47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
SSTO	2.42	0.0	0.0	0.0	0.0	0.0	3000.00	284.60	8	20	0	0	0	0		1
SSTO	4.46	0.0	0.0	0.0	0.0	0.0	5501.34	522.22	8	20	0	0	0	0		1
REUSABLE STAGE	UNIT PURCHASE PRICE= 263.91 (144.00)															
S/C	2.00	0.0	0.0	0.0	0.0	0.0	1900.00	110.00	5	20	0	0	0	0		1
S/C	2.49	0.0	0.0	0.0	0.0	0.0	2368.69	137.13	5	20	0	0	0	0		1
REUSABLE STAGE	UNIT PURCHASE PRICE= 106.30 (85.00)															
CSM	40.00	0.0	0.0	0.0	0.0	0.0	150.00	85.00	5	20	0	0	0	0		1
CSM	40.87	0.0	0.0	0.0	0.0	0.0	153.28	87.04	5	20	0	0	0	0		1

SHARED COST DATA

NO.	TITLE	DEVELOPMENT	SUSTAINING
14	SATN	0.0	110.00
14	SATN	0.0	112.40
17	SIVB	0.0	0.0

11	156	0.0	0.0
12	120	18.00	23.00
12	120	19.67	25.27
13	LS4B	0.0	0.0
18	1205	47.00	0.0
18	1205	51.50	0.0
20	1200	60.00	0.0
20	1200	65.57	0.0
21	R250	0.0	0.0

INTEGRATION COST DATA

LOWER GROUP	UPPER GROUP	RECURRING	LC	DEVELOPMENT	SUSTAINING
156	LS4B	0.0	0.0	80.00	0.0
156	LS4B	0.0	0.0	102.42	0.0
120	LS4B	0.0	0.0	80.00	0.0
120	LS4B	0.0	0.0	102.42	0.0
156	R250	0.0	0.0	50.00	0.0
156	R250	0.0	0.0	80.18	0.0

MISSION MODEL

	MISSION	VELOCITY	PAYLOAD	PRIORITY	TR	LAUNCH SCHEDULE																	
						71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
1	MANPLA	29000.	25000.	1.00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	
2	MAPLSU	29000.	25000.	1.00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
3	MANLUN	29000.	25000.	1.00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0
4	MALUSU	29000.	25000.	1.00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12	12	12	12
5	SPBASE	29000.	25000.	1.00	1	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0
6	SPBASU	29000.	25000.	1.00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12	12	12	12	12	12
7	MEDU	29000.	25000.	1.00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0
8	MEDSUP	29000.	25000.	1.00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10	10	10	10
9	MEDU	29000.	25000.	1.00	1	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0
10	MEDSUP	29000.	25000.	1.00	1	0	0	0	0	0	0	0	0	0	0	0	8	8	8	0	0	0	0	0	0
11	MEDU	29000.	25000.	1.00	1	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0
12	MEDSUP	28000.	25000.	1.00	1	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0

1	MANPLA	PLR=	90.0	DIST	BY.15, .35, .25, .25,	DEV=	17500.0	FOR	6	YRS	STARTING	1984	SUST=	800.0	FIXED=	0.0
1	MANPLA	PLR=	144.3	DIST	BY.15, .35, .25, .25,	DEV=	28063.7	FOR	6	YRS	STARTING	1984	SUST=	1282.9	FIXED=	0.0
2	MAPLSU	PLR=	50.0	DIST	BY.10, .30, .30, .30,	DEV=	0.0	FOR	0	YRS	STARTING	1984	SUST=	0.0	FIXED=	0.0
2	MAPLSU	PLR=	80.2	DIST	BY.10, .30, .30, .30,	DEV=	0.0	FOR	0	YRS	STARTING	1984	SUST=	0.0	FIXED=	0.0
3	MANLUN	PLR=	90.0	DIST	BY.15, .35, .25, .25,	DEV=	17500.0	FOR	6	YRS	STARTING	1980	SUST=	800.0	FIXED=	0.0
3	MANLUN	PLR=	144.3	DIST	BY.15, .35, .25, .25,	DEV=	28063.7	FOR	6	YRS	STARTING	1980	SUST=	1282.9	FIXED=	0.0
4	MALUSU	PLR=	50.0	DIST	BY.10, .30, .30, .30,	DEV=	0.0	FOR	0	YRS	STARTING	1980	SUST=	0.0	FIXED=	0.0
4	MALUSU	PLR=	80.2	DIST	BY.10, .30, .30, .30,	DEV=	0.0	FOR	0	YRS	STARTING	1980	SUST=	0.0	FIXED=	0.0
5	SPBASE	PLR=	80.0	DIST	BY.15, .35, .25, .25,	DEV=	10000.0	FOR	7	YRS	STARTING	1977	SUST=	550.0	FIXED=	0.0
5	SPBASE	PLR=	99.7	DIST	BY.15, .35, .25, .25,	DEV=	12466.8	FOR	7	YRS	STARTING	1977	SUST=	685.7	FIXED=	0.0
6	SPBASU	PLR=	45.0	DIST	BY.10, .30, .30, .30,	DEV=	0.0	FOR	0	YRS	STARTING	1977	SUST=	0.0	FIXED=	0.0
6	SPBASU	PLR=	72.2	DIST	BY.10, .30, .30, .30,	DEV=	0.0	FOR	0	YRS	STARTING	1977	SUST=	0.0	FIXED=	0.0
7	MEDU	PLR=	85.0	DIST	BY.15, .35, .25, .25,	DEV=	3690.0	FOR	7	YRS	STARTING	1979	SUST=	217.3	FIXED=	0.0
7	MEDU	PLR=	151.6	DIST	BY.15, .35, .25, .25,	DEV=	4600.2	FOR	7	YRS	STARTING	1979	SUST=	270.9	FIXED=	0.0
8	MEDSUP	PLR=	40.0	DIST	BY.10, .30, .30, .30,	DEV=	0.0	FOR	0	YRS	STARTING	1979	SUST=	-0.0	FIXED=	0.0
8	MEDSUP	PLR=	49.9	DIST	BY.10, .30, .30, .30,	DEV=	0.0	FOR	0	YRS	STARTING	1979	SUST=	0.0	FIXED=	0.0
9	MEDU	PLR=	85.0	DIST	BY.15, .35, .25, .25,	DEV=	3690.0	FOR	7	YRS	STARTING	1975	SUST=	217.3	FIXED=	0.0
9	MEDU	PLR=	151.6	DIST	BY.15, .35, .25, .25,	DEV=	4600.2	FOR	7	YRS	STARTING	1975	SUST=	270.9	FIXED=	0.0
10	MEDSUP	PLR=	40.0	DIST	BY.10, .30, .30, .30,	DEV=	0.0	FOR	0	YRS	STARTING	1975	SUST=	0.0	FIXED=	0.0
10	MEDSUP	PLR=	49.9	DIST	BY.10, .30, .30, .30,	DEV=	0.0	FOR	0	YRS	STARTING	1975	SUST=	0.0	FIXED=	0.0
11	MEDU	PLR=	85.0	DIST	BY.15, .35, .25, .25,	DEV=	3690.0	FOR	7	YRS	STARTING	1973	SUST=	217.3	FIXED=	0.0
11	MEDU	PLR=	151.6	DIST	BY.15, .35, .25, .25,	DEV=	4600.2	FOR	7	YRS	STARTING	1973	SUST=	270.9	FIXED=	0.0

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12 MEOSUP  PLR=  40.0 DIST BY.10, .30, .30, .30,  DEV=     0.0  FOR    0 YRS  STARTING  1973  SUST=     0.0   FIXED=     0.0
12 MEOSUP  PLR=  49.9 DIST BY.10, .30, .30, .30,  DEV=     0.0  FOR    0 YRS  STARTING  1973  SUST=     0.0   FIXED=     0.0
```

SPECIAL PROGRAMS

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  1 PLANED   DEV =     0.0     SUST =     0.0     DEV STARTS  1971    FOR     0 YEARS
FIXED COSTS =   1380.00  1400.00   800.00    41.00     1.00     0.0      0.0      0.0      0.0      0.0
FIXED COSTS =   1410.11  1430.54   817.45    41.89     1.02     0.0      0.0      0.0      0.0      0.0
```

NUMBER OF STAGES	13
NUMBER OF VEHICLES	8
NUMBER OF FAMILIES	8
NUMBER OF INTEGRATION COSTS	3
NUMBER OF PAD COMPLEXES	0
NUMBER OF MISSIONS	12
NUMBER OF YEARS	20
LAUNCH BASE YEAR	71
TOTAL ESTIMATE	300000.00
OPTION NUMBER	3
NUMBER OF SOLUTIONS	3
INFLATION FACTOR	.0

QUANTITIES BRANCHED UPON

NUMBER	DEVELOPMENT	SUSTAINING		YEAR AVAIL	LAST YEAR	DEV START	DEV DURATION
1	96.89	91.97	S-IB STAGE HARDWARE	4	20	1974	1.
2	112.40	150.32	S-IC STAGE HARDWARE	4	20	1974	1.
3	132.84	91.97	S-II STAGE HARDWARE	4	20	1974	1.
4	61.31	66.61	S-4B STAGE HARDWARE	4	20	1974	1.
5	57.78	19.03	LS4B STAGE HARDWARE	5	20	1973	3.
6	282.32	25.60	1565 STAGE HARDWARE	5	20	1973	3.
7	6143.29	470.11	R25B STAGE HARDWARE	8	20	1972	7.
8	7179.91	341.83	R250 STAGE HARDWARE	8	20	1972	7.
9	8815.96	537.84	R1.5 STAGE HARDWARE	8	20	1972	7.
10	5501.34	522.22	SS10 STAGE HARDWARE	8	20	1972	7.
11	2368.69	137.13	S/C STAGE HARDWARE	5	20	1973	3.
12	153.28	87.04	CSM STAGE HARDWARE	5	20	1974	2.
13	0.0	112.40	S4TN SHARED HARDWARE	4	20	1971	0.
14	19.67	25.27	120 SHARED HARDWARE	3	20	1971	3.
15	51.50	0.0	1205 SHARED HARDWARE	3	20	1971	3.
16	65.57	0.0	1200 SHARED HARDWARE	3	20	1971	3.
17	102.42	0.0	INTEGRATION OF 156 AND LS4B HARDWARE	5	20	1971	3.
18	102.42	0.0	INTEGRATION OF 120 AND LS4B HARDWARE	5	20	1971	3.
19	80.18	0.0	INTEGRATION OF 156 AND R250 HARDWARE	8	20	1971	3.

VEHICLE / MISSION CAPABILITY
(1 = POSSIBLE, 0 = IMPOSSIBLE)

VEHICLE / MISSION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
MISSION NUMBER	1	2	3	4	4	4	4	4	5	6	6	6	6	6	6	6	7	8	8	8	8	8	9	10	10	10	11	12													
1 S-IB S-4B CSM	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	1													
2 S-IC S-II S-4B CSM	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													
3 1200 LS4B CSM	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													
4 1565 LS4B S/C	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													
5 1565 R250	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													
6 R1.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													
7 SSTO S/C	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													
8 R258 R250	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1													

CHANGED QUANTITIES BRANCHED UPON

NUMBER	DEVELOPMENT	SUSTAINING		YEAR AVAIL	LAST YEAR
7	8093.84	470.11	R258 STAGE HARDWARE	8	20
	NUMBER OF UNITS PURCHASED = 6.0				
8	8518.52	341.83	R250 STAGE HARDWARE	8	20
	NUMBER OF UNITS PURCHASED = 6.0				
9	10427.10	537.84	R1.5 STAGE HARDWARE	8	20
	NUMBER OF UNITS PURCHASED = 6.0				
10	7084.79	522.22	SSTO STAGE HARDWARE	8	20
	NUMBER OF UNITS PURCHASED = 6.0				
11	3006.48	137.13	S/C STAGE HARDWARE	5	20
	NUMBER OF UNITS PURCHASED = 6.0				

BRANCH AND BOUND NODE VALUES

NODE NO.	BRANCHED FROM	COST NO.	YEARS SUSTAIN	RECURRING BOUND	NON-RECURRING BOUND	TOTAL BOUND
2	1	10	0	3122.70	497.79	3620.49
3	1	10	8	3122.70	8104.79	11227.49
4	1	10	10	3070.21	9126.45	12196.66
5	1	10	12	3009.64	10144.61	13154.25
6	1	10	14	2864.28	11125.95	13990.23
7	1	10	16	2617.98	12289.49	14907.47
8	1	10	18	2343.42	13608.50	15951.92
1	1	10	20	1975.98	15020.38	16996.36
9	2	8	0	3620.49	11502.77	15123.25
10	2	8	8	3620.49	20363.11	23983.60
11	2	8	10	3597.71	20898.45	24496.15
12	2	8	12	3571.41	20981.18	24552.59
13	2	8	14	3508.31	20222.63	23730.95
14	2	8	16	3401.39	18462.55	21863.94
15	2	8	18	3282.20	16422.03	19704.23
2	2	8	20	3122.70	13460.06	16582.76
16	3	8	0	3620.49	19109.77	22730.26
17	3	8	8	3620.49	27970.11	31590.60
18	3	8	10	3597.71	28505.45	32103.15
19	3	8	12	3571.41	28588.19	32159.60
20	3	8	14	3508.31	27829.64	31337.95
21	3	8	16	3401.39	26069.55	29470.95
22	3	8	18	3282.20	24029.03	27311.23
3	3	8	20	3122.70	21067.07	24189.76
23	4	8	0	3545.22	20058.38	23603.60
24	4	8	8	3545.22	28918.73	32463.94
25	4	8	10	3545.22	29579.60	33124.81
26	4	8	12	3518.92	29636.04	33154.96
27	4	8	14	3455.82	28851.30	32307.12
28	4	8	16	3348.90	27091.21	30440.12
29	4	8	18	3229.71	25050.69	28280.40
4	4	8	20	3070.21	22088.72	25158.93
30	5	8	0	3458.36	20562.48	24020.83
31	5	8	8	3458.36	29422.82	32881.18
32	5	8	10	3458.36	30083.69	33542.05
33	5	8	12	3458.36	30741.05	34199.41
34	5	8	14	3395.26	29919.41	33314.66
35	5	8	16	3288.34	28109.37	31397.70
36	5	8	18	3169.15	26068.84	29237.99
5	5	8	20	3009.64	23106.88	26116.52
37	6	8	0	3249.90	20310.08	23559.97
38	6	8	8	3249.90	29170.42	32420.32
39	6	8	10	3249.90	29831.29	33081.19
40	6	8	12	3249.90	30488.66	33738.55
41	6	8	14	3249.90	31109.21	34359.11
42	6	8	16	3142.98	29242.21	32385.18
43	6	8	18	3023.79	27082.50	30106.28
6	6	8	20	2864.28	24088.22	26952.50
44	7	8	0	2896.68	19157.08	22053.76
45	7	8	8	2896.68	28017.43	30914.10
46	7	8	10	2896.68	28678.29	31574.97
47	7	8	12	2896.68	29335.66	32232.34
48	7	8	14	2896.68	29956.21	32852.89
49	7	8	16	2896.68	30532.95	33429.62
50	7	8	18	2777.49	28373.23	31150.72
7	7	8	20	2617.98	25251.77	27869.75
51	9	9	0	15495.77	3448.99	18944.77
52	9	9	8	15495.77	14413.92	29909.70
53	9	9	10	14952.18	15489.59	30441.78
54	9	9	12	14324.96	16565.27	30890.23
55	9	9	14	12819.64	17640.93	30460.58
56	9	9	16	10268.96	18716.61	28985.57
57	9	9	18	7425.59	19469.46	26895.05
9	9	9	20	3620.49	17418.95	21039.44
58	8	8	0	2502.92	17751.92	20254.84
59	8	8	8	2502.92	26612.26	29115.18
60	8	8	10	2502.92	27273.13	29776.05
61	8	8	12	2502.92	27930.50	30433.41
62	8	8	14	2502.92	28551.05	31053.96
63	8	8	16	2502.92	29127.79	31630.70
64	8	8	18	2502.92	29692.25	32195.16
8	8	8	20	2343.42	26570.78	28914.19
65	2	7	0	3620.49	20229.18	23849.66
66	2	7	8	3620.49	28793.13	32413.61
67	2	7	10	3597.71	29400.70	32998.41
68	2	7	12	3571.41	29957.11	33528.52
69	2	7	14	3508.31	29976.17	33484.48
70	2	7	16	3401.39	29355.54	32756.93
71	2	7	18	3282.20	28555.79	31837.98
2	2	7	20	3122.70	27167.51	30290.20
72	1	11	0	3122.70	14371.46	17494.16
1	1	11	20	1975.98	16880.15	18856.13
73	72	8	0	3620.49	25376.44	28996.93
74	72	8	8	3620.49	34236.78	37857.27
75	72	8	10	3597.71	34943.22	38540.93

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 76       72        8        12        3571.41        35653.17        39224.58
 77       72        8        14        3508.31        36399.92        39908.23
 78       72        8        16        3401.39        37190.50        40591.89
 79       72        8        18        3282.20        33421.88        36704.07
 72       72        8        20        3122.70        27333.73        30456.43

************ POSSIBLE SOLUTION    1  ************
  1                                   1975.98        16880.15        18856.13

EXTRA PAD COSTS =       0.0
   11     10      5      16.00     137.13    2194.15

EXTRA PAD & SMALL SUST COSTS =    2194.15
NEW VALUE =     21050.28
 80       51        5         0        45238.25         1082.17        46320.42
 51       51        5        20        15495.77         3448.99        18944.77
 80       51       11         0        25252.25          450.21        25702.46
 51       51       11        20        15495.77         3448.99        18944.77
 81       51        6         0        25252.25         3456.69        28708.94
 51       51        6        20        15495.77         3448.99        18944.77
 82       51       17         0        25252.25         3739.01        28991.26
 51       51       17        20        15495.77         3448.99        18944.77

************ POSSIBLE SOLUTION    2  ************
 51                                   15495.77         3448.99        18944.77

EXTRA PAD COSTS =       0.0
    5     10      5      16.00      19.03     304.55
    6     10      5      16.00      25.60     714.21
   11     10      5      16.00     137.13    2908.36

EXTRA PAD & SMALL SUST COSTS =    2908.36
NEW VALUE =     21853.12
 83       15        9         0         7087.30        20681.53        27768.83
 84       15        9         8         7087.30        31646.46        38733.76
 85       15        9        10         7087.30        32389.49        39476.79
 86       15        9        12         7087.30        33081.34        40168.64
 87       15        9        14         7087.30        33235.86        40323.16
 88       15        9        16         7087.30        32750.68        39837.97
 89       15        9        18         7087.30        32086.37        39173.67
 15       15        9        20         3282.20        30035.86        33318.05
 90       58        9         0         6308.03        15955.41        22263.44
 91       58        9         8         6308.03        26920.34        33228.37
 92       58        9        10         6308.03        27996.01        34304.04
 93       58        9        12         6308.03        29071.68        35379.71

 94       58        9        14         6308.03        30147.35        36455.38
 95       58        9        16         6308.03        31223.02        37531.05
 96       58        9        18         6308.03        32298.69        38606.72
 58       58        9        20         2502.92        31365.75        33868.66

************ POSSIBLE SOLUTION    3  ************
  9                                   3620.49        17418.95        21039.44

EXTRA PAD COSTS =       0.0

EXTRA PAD & SMALL SUST COSTS =       0.0
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********** S O L U T I O N N U M B E R 1**********

9 3620.49 17418.95 21039.44

MISSION TITLE	CHARACTERISTIC VELOCITY(FT/SEC)	PAYLOAD (LBS)	RETURN PAYLOAD	LAUNCH YEAR	NUMBER OF LAUNCHES	OPTIMUM LAUNCH VEHICLE	LAUNCH SITE
MANPLA	29000.	25000.	0.	1989	8.00	R1.5	E
MAPLSU	29000.	25000.	10.	1990	15.00	R1.5	E
MANLUN	29000.	25000.	0.	1985	8.00	R1.5	E
MALUSU	29000.	25000.	10.	1986	12.00	R1.5	E
				1987	12.00	R1.5	E
				1988	12.00	R1.5	E
				1989	12.00	R1.5	E
				1990	12.00	R1.5	E
SPBASE	29000.	25000.	0.	1983	8.00	R1.5	E
SPBASU	29000.	25000.	10.	1984	12.00	R1.5	E
				1985	12.00	R1.5	E
				1986	12.00	R1.5	E
				1987	12.00	R1.5	E
				1988	12.00	R1.5	E
				1989	12.00	R1.5	E
				1990	12.00	R1.5	E
MEOO	29000.	25000.	0.	1985	7.00	R1.5	E
MEOSUP	29000.	25000.	10.	1986	10.00	R1.5	E
				1987	10.00	R1.5	E
				1988	10.00	R1.5	E
				1989	10.00	R1.5	E
				1990	10.00	R1.5	E
MEOO	29000.	25000.	0.	1981	7.00	R1.5	E
MEOSUP	29000.	25000.	10.	1982	8.00	R1.5	E
				1983	8.00	R1.5	E
				1984	8.00	R1.5	E
MEOO	29000.	25000.	0.	1979	7.00	R1.5	E
MEOSUP	28000.	25000.	10.	1980	6.00	R1.5	E

SULUTION 1 HAS EXPECTED L V COST 21039.44 (21039.45) MODE = 16521.73 STD. DEV. = 8797.81

PARAMETERS MU AND SIGMASQ = 9.87 AND 0.16

PROB (COST LE 16522.) =0.25 DENSITY = 1.1676 (0.37)

PROB (COST LE 25356.) =0.75 50 PERCENT UNCERTAINTY INTERVAL = 16522. TO 25356. DENSITY = 0.6[illegible]

PROB (COST LE 11603.) =0.10 DENSITY = 0.7925 (0.18)

PROB (COST LE 15728.) =0.30 DENSITY = 1.1588 (0.35)

PROB (COST LE 19411.) =0.50 DENSITY = 1.0772 (0.40)

PROB (COST LE 23955.) =0.70 DENSITY = 0.7609 (0.35)

PROB (COST LE 32471.) =0.90 DENSITY = 0.2832 (0.18)

9	1	9	0	*********	19074.30	*********
97	1	9	8	*********	30039.23	*********
98	1	9	10	*********	31114.90	*********
99	1	9	12	*********	32190.57	*********
100	1	9	14	*********	33266.24	*********
101	1	9	16	*********	34341.91	*********
102	1	9	18	*********	35417.58	*********
1	1	9	20	3620.49	36493.25	40113.74

********** S O L U T I O N N U M B E R 2**********

51			15495.77		6357.35	21853.12	
MISSION TITLE	CHARACTERISTIC VELOCITY(FT/SEC)	PAYLOAD (LBS)	RETURN PAYLOAD	LAUNCH YEAR	NUMBER OF LAUNCHES	OPTIMUM LAUNCH VEHICLE	LAUNCH SITE
MANPLA	29000.	25000.	0.	1989	8.00	1565 LS4B S/C	E
MAPLSU	29000.	25000.	10.	1990	15.00	1565 LS4B S/C	E
MANLUN	29000.	25000.	0.	1985	8.00	1565 LS4B S/C	E
MALUSU	29000.	25000.	10.	1986	12.00	1565 LS4B S/C	E
				1987	12.00	1565 LS4B S/C	E
				1988	12.00	1565 LS4B S/C	E
				1989	12.00	1565 LS4B S/C	E
				1990	12.00	1565 LS4B S/C	E
SPBASE	29000.	25000.	0.	1983	8.00	1565 LS4B S/C	E
SPBASU	29000.	25000.	10.	1984	12.00	1565 LS4B S/C	E
				1985	12.00	1565 LS4B S/C	E
				1986	12.00	1565 LS4B S/C	E
				1987	12.00	1565 LS4B S/C	E
				1988	12.00	1565 LS4B S/C	E
				1989	12.00	1565 LS4B S/C	E
				1990	12.00	1565 LS4B S/C	E
MEOO	29000.	25000.	0.	1985	7.00	1565 LS4B S/C	E
MEOSUP	29000.	25000.	10.	1986	10.00	1565 LS4B S/C	E
				1987	10.00	1565 LS4B S/C	E
				1988	10.00	1565 LS4B S/C	E
				1989	10.00	1565 LS4B S/C	E
				1990	10.00	1565 LS4B S/C	E
MEOO	29000.	25000.	0.	1981	7.00	1565 LS4B S/C	E
MEOSUP	29000.	25000.	10.	1982	8.00	1565 LS4B S/C	E
				1983	8.00	1565 LS4B S/C	E
				1984	8.00	1565 LS4B S/C	E
MEOO	29000.	25000.	0.	1979	7.00	1565 LS4B S/C	E
MEOSUP	28000.	25000.	10.	1980	6.00	1565 LS4B S/C	E

```
SOLUTION  2  HAS EXPECTED L V COST  21853.12  (  21853.17)     MODE =  20366.09   STD.-DEV. =   4792.54
PARAMETERS MU AND SIGMASQ =       9.97   AND       0.05
 PROB (COST LE    20366. )  =0.31   DENSITY =    1.9291   ( 0.39 )
PROB (COST LE    25769. )  =0.81    90 PERCENT UNCERTAINTY INTERVAL =    20366.  TO    25769.   DENSITY =      1.07
 PROB (COST LE    16168. )  =0.10   DENSITY =    1.0941   ( 0.18 )
 PROB (COST LE    19054. )  =0.30   DENSITY =    1.8402   ( 0.35 )
 PROB (COST LE    21346. )  =0.50   DENSITY =    1.8843   ( 0.40 )
 PROB (COST LE    23913. )  =0.70   DENSITY =    1.4662   ( 0.35 )
 PROB (COST LE    28182. )  =0.90   DENSITY =    0.6277   ( 0.18 )
 PROB ( ASSIGNMENT  2 COST GE ASSIGNMENT  1 COST) =0.69  IF CORRELATION =0.0

 PROB ( ASSIGNMENT  2 COST GE ASSIGNMENT  1 COST) =0.70  IF CORRELATION =0.3

 PROB ( ASSIGNMENT  2 COST GE ASSIGNMENT  1 COST) =0.72  IF CORRELATION =0.6

 PROB ( ASSIGNMENT  2 COST GE ASSIGNMENT  1 COST) =0.76  IF CORRELATION =0.9
```

102	14	9	0	10049.85	18461.54	28511.39
101	14	9	8	10049.85	29426.46	39476.32
100	14	9	10	10049.85	30169.50	40219.35
99	14	9	12	10049.85	30861.35	40911.20
98	14	9	14	10049.85	31015.86	41065.71
97	14	9	16	10049.85	30530.67	40580.52
51	14	9	18	7206.48	31283.53	38490.02
14	14	9	20	3401.39	29233.02	32634.41
9	44	9	0	9545.16	15233.77	24778.93
103	44	9	8	9545.16	26198.70	35743.86
104	44	9	10	9545.16	27274.38	36819.54
105	44	9	12	9545.16	28350.05	37895.21
106	44	9	14	9545.16	29425.71	38970.88
107	44	9	16	9545.16	30501.39	40046.55
108	44	9	18	6701.78	31254.25	37956.03
44	44	9	20	2896.68	29927.55	32824.22
109	90	11	0	25252.25	13279.43	38531.68
90	90	11	20	6308.03	16278.21	22586.24
110	90	5	0	15952.27	16820.98	32773.24
90	90	5	20	6308.03	16278.21	22586.24
111	90	6	0	9434.21	16285.91	25720.12
90	90	6	20	6308.03	16278.21	22586.24
112	90	17	0	9434.21	16568.23	26002.44
90	90	17	20	6308.03	16278.21	22586.24

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************ POSSIBLE SOLUTION   3  ************
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90			6308.03	16278.21	22586.24

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EXTRA PAD COSTS =       0.0
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5	10	5	16.00	19.03	304.55
6	10	5	16.00	25.60	714.21
11	10	5	16.00	137.13	2908.36

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EXTRA PAD & SMALL SUST COSTS =   2908.36
NEW VALUE =     25494.60
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113	16	9	0	15495.77	11056.00	26551.77
114	16	9	8	15495.77	22020.93	37516.70
115	16	9	10	14952.18	23096.60	38048.78
116	16	9	12	14324.96	24172.27	38497.23
117	16	9	14	12819.64	25247.94	38067.58
118	16	9	16	10268.96	26323.61	36592.57
119	16	9	18	7425.59	27076.47	34502.06
16	16	9	20	3620.49	25025.96	28646.45
120	37	9	0	12449.06	14189.33	26638.39

121	37	9	8	12449.06	25154.26	37603.32
122	37	9	10	12449.06	26229.93	38678.99
123	37	9	12	12449.06	27305.61	39754.66
124	37	9	14	12449.06	28381.27	40830.33
125	37	9	16	9898.38	29456.95	39355.32
126	37	9	18	7055.00	30209.80	37264.80
37	37	9	20	3249.90	28529.88	31779.78
127	23	9	0	14876.91	12100.44	26977.35
128	23	9	8	14876.91	23065.37	37942.28
129	23	9	10	14876.91	24141.04	39017.95
130	23	9	12	14249.69	25216.71	39466.41
131	23	9	14	12744.37	26292.38	39036.75
132	23	9	16	10193.69	27368.05	37561.74
133	23	9	18	7350.32	28120.91	35471.23
23	23	9	20	3545.22	26145.68	29690.89
134	13	9	0	12707.46	16110.10	28817.56
135	13	9	8	12707.46	27075.03	39782.49
136	13	9	10	12707.46	27818.06	40525.52
137	13	9	12	12707.46	28509.91	41217.37
138	13	9	14	12707.46	28664.42	41371.88
139	13	9	16	10156.77	29740.09	39896.87
140	13	9	18	7313.40	30492.95	37806.36
13	13	9	20	3508.31	28442.44	31950.75
141	65	9	0	10887.42	13324.77	24212.20
142	65	9	8	10887.42	24289.70	35177.13
143	65	9	10	10554.78	25365.38	35920.15
144	65	9	12	10170.96	26441.05	36612.00
145	65	9	14	9249.79	27516.71	36766.51
146	65	9	16	7688.94	28592.39	36281.32
147	65	9	18	5948.96	29668.05	35617.02
65	65	9	20	3620.49	30381.23	34001.71
148	10	9	0	15495.77	12309.34	27805.11
149	10	9	8	15495.77	23274.27	38770.04
150	10	9	10	14952.18	24349.94	39302.12
151	10	9	12	14324.96	25425.61	39750.57
152	10	9	14	12819.64	26501.28	39320.92
153	10	9	16	10268.96	27576.95	37845.91
154	10	9	18	7425.59	28329.81	35755.40
10	10	9	20	3620.49	26279.30	29899.79
155	30	9	0	14162.84	13144.89	27307.72
156	30	9	8	14162.84	24109.82	38272.65
157	30	9	10	14162.84	25185.49	39348.32
158	30	9	12	14162.84	26261.16	40424.00
159	30	9	14	12657.52	27336.83	39994.34
160	30	9	16	10106.83	28412.50	38519.33
161	30	9	18	7263.46	29165.36	36428.82
30	30	9	20	3458.36	27276.98	30735.34
162	3	7	0	3620.49	27836.18	31456.67
163	3	7	8	3620.49	36400.13	40020.62
164	3	7	10	3597.71	37007.71	40605.41
165	3	7	12	3571.41	37564.11	41135.52
166	3	7	14	3508.31	37583.18	41091.49
167	3	7	16	3401.39	36962.55	40363.94
168	3	7	18	3282.20	36162.79	39444.99
3	3	7	20	3122.70	34774.51	37897.21
169	141	6	0	25252.25	13412.48	38664.73
141	141	6	20	10887.42	13324.77	24212.19
170	141	19	0	15495.77	16411.27	31907.04
141	141	19	20	10887.42	13324.77	24212.19

********** POSSIBLE SOLUTION 4 **********

141			10887.42	13324.77	24212.19

EXTRA PAD COSTS = 0.0

6 10 5 16.00 25.60 409.66

EXTRA PAD & SMALL SUST COSTS = 409.66

NEW VALUE = 24621.85

171	11	9	0	14929.39	13348.42	28277.82
172	11	9	8	14929.39	24313.35	39242.75
173	11	9	10	14929.39	25056.38	39985.77
174	11	9	12	14302.18	26132.05	40434.23
175	11	9	14	12796.86	27207.72	40004.57
176	11	9	16	10246.17	28283.39	38529.56
177	11	9	18	7402.80	29036.25	36439.05
11	11	9	20	3597.71	26985.74	30583.44
178	12	9	0	14275.88	14442.19	28718.07
179	12	9	8	14275.88	25407.12	39683.00
180	12	9	10	14275.88	26150.14	40426.03
181	12	9	12	14275.88	26842.00	41117.88
182	12	9	14	12770.56	27917.67	40688.23
183	12	9	16	10219.88	28993.34	39213.22
184	12	9	18	7376.51	29746.20	37122.71
12	12	9	20	3571.41	27695.69	31267.10

********** S O L U T I O N N U M B E R 3**********

141 10887.42 13734.43 24621.85

MISSION TITLE	CHARACTERISTIC VELOCITY(FT/SEC)	PAYLOAD (LBS)	RETURN PAYLOAD	LAUNCH YEAR	NUMBER OF LAUNCHES	OPTIMUM LAUNCH VEHICLE	LAUNCH SITE
MANPLA	29000.	25000.	0.	1989	8.00	1565 R250	E
MAPLSU	29000.	25000.	10.	1990	15.00	1565 R250	E
MANLUN	29000.	25000.	0.	1985	8.00	1565 R250	E
MALUSU	29000.	25000.	10.	1986	12.00	1565 R250	E
				1987	12.00	1565 R250	E
				1988	12.00	1565 R250	E
				1989	12.00	1565 R250	E
				1990	12.00	1565 R250	E
SPBASE	29000.	25000.	0.	1983	8.00	1565 R250	E
SPBASU	29000.	25000.	10.	1984	12.00	1565 R250	E
				1985	12.00	1565 R250	E
				1986	12.00	1565 R250	E
				1987	12.00	1565 R250	E
				1988	12.00	1565 R250	E
				1989	12.00	1565 R250	E
				1990	12.00	1565 R250	E
MEOO	29000.	25000.	0.	1985	7.00	1565 R250	E
MEOSUP	29000.	25000.	10.	1986	10.00	1565 R250	E
				1987	10.00	1565 R250	E
				1988	10.00	1565 R250	E
				1989	10.00	1565 R250	E
				1990	10.00	1565 R250	E
MEOO	29000.	25000.	0.	1981	7.00	1565 R250	E
MEOSUP	29000.	25000.	10.	1982	8.00	1565 R250	E
				1983	8.00	1565 R250	E
				1984	8.00	1565 R250	E
MEOO	29000.	25000.	0.	1979	7.00	1565 R250	E
MEOSUP	28000.	25000.	10.	1980	6.00	1565 R250	E

SOLUTION 3 HAS EXPECTED L V COST 24621.85 (24621.88) MODE = 21507.69 STD. DEV. = 7562.95

PARAMETERS MU AND SIGMASQ = 10.07 AND 0.09

PROB (COST LE 21508.) =0.28 DENSITY = 1.4541 (0.38)

PROB (COST LE 29661.) =0.78 50 PERCENT UNCERTAINTY INTERVAL = 21508. TO 29661. DENSITY = 0.82

PROB (COST LE 16018.) =0.10 DENSITY = 0.8983 (0.18)

PROB (COST LE 20110.) =0.30 DENSITY = 1.4181 (0.35)

PROB (COST LE 23537.) =0.50 DENSITY = 1.3900 (0.40)

PROB (COST LE 27547.) =0.70 DENSITY = 1.0353 (0.35)

PROB (COST LE 34584.) =0.90 DENSITY = 0.4160 (0.18)

PROB (ASSIGNMENT 3 COST GE ASSIGNMENT 1 COST) =0.75 IF CORRELATION =0.0

PROB (ASSIGNMENT 3 COST GE ASSIGNMENT 1 COST) =0.77 IF CORRELATION =0.3

PROB (ASSIGNMENT 3 COST GE ASSIGNMENT 1 COST) =0.81 IF CORRELATION =0.6

PROB (ASSIGNMENT 3 COST GE ASSIGNMENT 1 COST) =0.90 IF CORRELATION =0.9

PROB (ASSIGNMENT 3 COST GE ASSIGNMENT 2 COST) =0.71 IF CORRELATION =0.0

PROB (ASSIGNMENT 3 COST GE ASSIGNMENT 2 COST) =0.72 IF CORRELATION =0.3

PROB (ASSIGNMENT 3 COST GE ASSIGNMENT 2 COST) =0.75 IF CORRELATION =0.6

PROB (ASSIGNMENT 3 COST GE ASSIGNMENT 2 COST) =0.83 IF CORRELATION =0.9

THE OPTIMUM SOLUTION HAS BEEN DETERMINED

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TITLE = 'TEST CASE',    LEVEL = 3180.,3500.,3850.,4230.,4650.,5110.,
5620.,6180.,6800.,7480.,8130.,8940.,9830.,10810.,11890.,13080.,14390.,
15830.,17410.,19150.,
    ISTRT = 2,   IFIN = 20,
MAXITR = 10,                    FIXED =1800.,1650.,1500.,1540.,1590.,
1630.,1680.,1740.,1800.,1870.,1930.,2010.,2100.,2200.,2310.,2430.,
2560.,2700.,2860.,3140.,
    PMAX = 15500.,  PMIN  = 1500.,
    NCSTR = 11,     NPROG = 101,73,74,71,72,75,76,80,81,84,85,
    KODE = 8,10X6,
   KPROG = 0,74,73,72,71,76,75,81,80,85,84,
    CS = 0.,0.,-1.,0.,-1.,0.,-1.,0.,-1.,0.,-1.,
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23 CONSTRAINTS

KODE								
8	13 PLANED FIXED							
6	TARGET DATE	11 MEOO	NO LATER THAN	0.	YEARS AFTER	12	MEOSUP	
6	TARGET DATE	12 MEOSUP	NO LATER THAN	1.	YEARS AFTER	11	MEOO	
6	TARGET DATE	9 MEOO	NO LATER THAN	0.	YEARS AFTER	10	MEOSUP	
6	TARGET DATE	10 MEOSUP	NO LATER THAN	1.	YEARS AFTER	9	MEOO	
6	TARGET DATE	7 MEOO	NO LATER THAN	0.	YEARS AFTER	8	MEOSUP	
6	TARGET DATE	8 MEOSUP	NO LATER THAN	1.	YEARS AFTER	7	MEOO	
6	TARGET DATE	5 SPBASE	NO LATER THAN	0.	YEARS AFTER	6	SPBASU	
6	TARGET DATE	6 SPBASU	NO LATER THAN	1.	YEARS AFTER	5	SPBASE	
6	TARGET DATE	1 MANPLA	NO LATER THAN	0.	YEARS AFTER	2	MAPLSU	
6	TARGET DATE	2 MAPLSU	NO LATER THAN	1.	YEARS AFTER	1	MANPLA	
11	PROGRAM DEV	14	COMPLETED BY FIRST LAUNCH OF PROGRAM			1	MANPLA	
11	PROGRAM DEV	14	COMPLETED BY FIRST LAUNCH OF PROGRAM			2	MAPLSU	
11	PROGRAM DEV	14	COMPLETED BY FIRST LAUNCH OF PROGRAM			3	MANLUN	
11	PROGRAM DEV	14	COMPLETED BY FIRST LAUNCH OF PROGRAM			4	MALUSU	
11	PROGRAM DEV	14	COMPLETED BY FIRST LAUNCH OF PROGRAM			5	SPBASE	
11	PROGRAM DEV	14	COMPLETED BY FIRST LAUNCH OF PROGRAM			6	SPBASU	
11	PROGRAM DEV	14	COMPLETED BY FIRST LAUNCH OF PROGRAM			7	MEOO	
11	PROGRAM DEV	14	COMPLETED BY FIRST LAUNCH OF PROGRAM			8	MEOSUP	
11	PROGRAM DEV	14	COMPLETED BY FIRST LAUNCH OF PROGRAM			9	MEOO	
11	PROGRAM DEV	14	COMPLETED BY FIRST LAUNCH OF PROGRAM			10	MEOSUP	
11	PROGRAM DEV	14	COMPLETED BY FIRST LAUNCH OF PROGRAM			11	MEOO	
11	PROGRAM DEV	14	COMPLETED BY FIRST LAUNCH OF PROGRAM			12	MEOSUP	

RECURRING COST DATA

KEY	NAME	UNIT COST
6	R1.5	12.75

REFERENCE YEAR 1971. TEST CASE

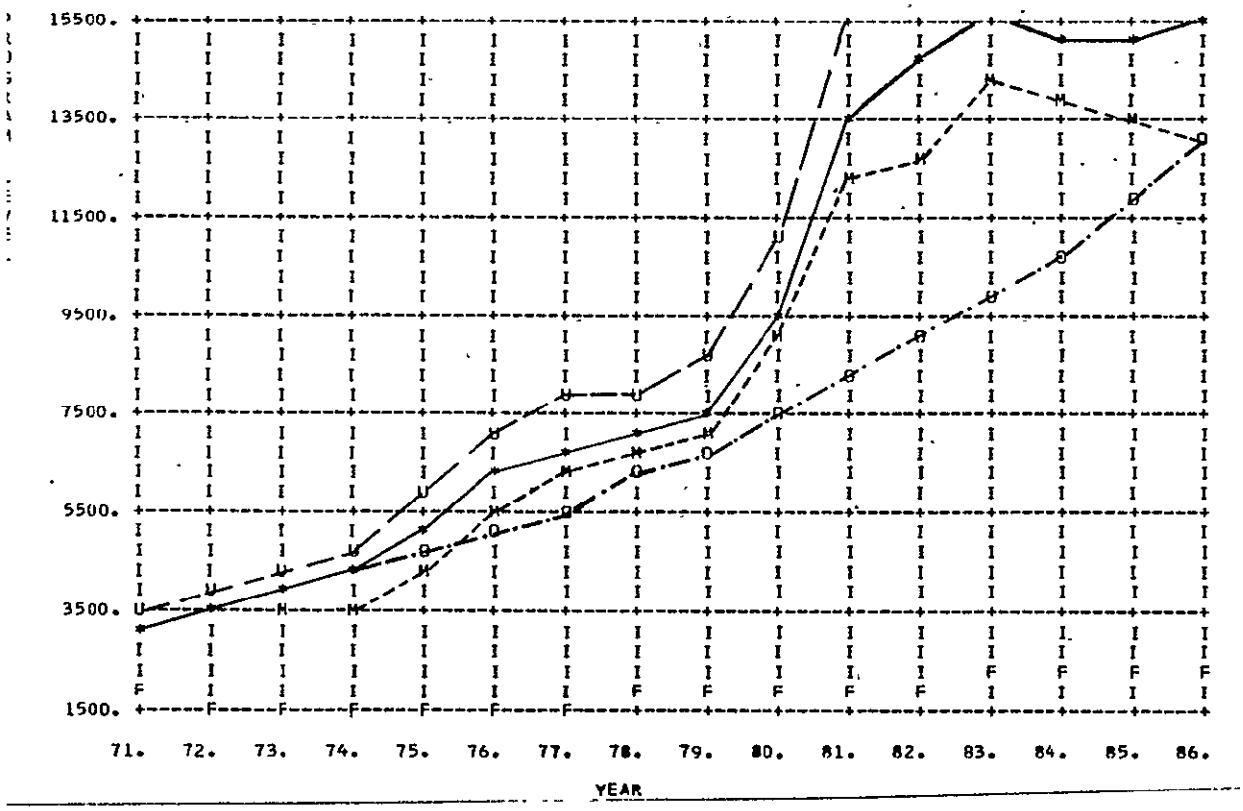
PN	NAME	START	DEVL	YRS	SUST	SS	SD	RS	RD	RECURRING OR FIXED ITEMS								
1	MANPLA	1984.	28064.	6.	1283.	4	13	3	4	178.	425.	340.	314.					
2	MAPLSU	1984.	0.	0.	0.	1	0	4	4	130.	399.	456.	409.					
3	MANLUN	1980.	28064.	6.	1283.	4	13	3	4	178.	425.	340.	314.					
4	MALUSU	1980.	0.	0.	0.	1	0	4	8	104.	423.	788.	1115.	1115.	1011.	692.	327.	
5	SPBASE	1977.	12467.	7.	686.	5	13	4	4	125.	300.	250.	225.					
6	SPBASU	1977.	0.	0.	0.	1	0	5	10	94.	385.	721.	1019.	1019.	1019.	1019.	925.	634.	298.
7	MEOO	1979.	4600.	7.	271.	5	8	4	4	164.	389.	310.	288.					
8	MEOSUP	1979.	0.	0.	0.	1	0	5	8	56.	231.	445.	626.	626.	570.	395.	181.	
9	MEOO	1975.	4600.	7.	271.	5	6	4	4	164.	389.	310.	288.					
10	MEOSUP	1975.	0.	0.	0.	1	0	5	6	45.	185.	356.	456.	316.	145.			
11	MEOO	1973.	4600.	7.	271.	5	5	4	4	164.	389.	310.	288.					
12	MEOSUP	1973.	0.	0.	0.	1	0	5	4	34.	105.	128.	109.					
13	PLANED	1971.	0.	0.	0.	1	0	0	0	0.								
								1	5	1410.	1431.	817.	42.	1.				
14	DEV 9	1972.	10402.	7.	538.	5	15	0	0									
								2	2	12.	12.							
	TOTAL		92797.		55485.													

TOTAL PROGRAM COSTS AND LAUNCH VEHICLE SCHEDULE

YEAR	1971.	1972.	1973.	1974.	1975.	1976.	1977.	1978.	1979.	1980.	1981.	1982.	1983.	1984.	1985.	1986.	1987.	1988.	1989.	1990.
PROGRAM																				
1 MANPLA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1803.	5009.	7392.	8921.	6632.	3400. 6*	1283.
2 MAPLSU	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	130.	399.	456.	409. 6*
3 MANLUN	0.	0.	0.	0.	0.	0.	0.	0.	0.	1803.	5009.	7392.	8921.	6632.	3400. 6*	1283.	1283.	1283.	1283.	1283.
4 MALUSU	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	104.	423.	788. 6*	1115. 6*	1115. 6*	1011. 6*	692. 6*	327. 6*
5 SPBASE	0.	0.	0.	0.	0.	0.	559.	1644.	2568.	3047.	3553.	2580.	1470. 6*	686.	686.	686.	686.	686.	686.	686.
6 SPBASU	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	94.	385.	721. 6*	1019. 6*	1019. 6*	1019. 6*	1019. 6*	925. 6*	634. 6*	298. 6*
7 MEDU	0.	0.	0.	0.	0.	0.	0.	0.	206.	606.	948.	1242.	1608.	1187.	765. 6*	271.	271.	271.	271.	271.
8 MEDSUP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	56.	231.	445.	626. 6*	626. 6*	570. 6*	395. 6*	181. 6*
9 MEDU	0.	0.	0.	0.	206.	606.	948.	1242.	1608.	1187.	765. 6*	271.	271.	271.						
10 MEDSUP	0.	0.	0.	0.	0.	0.	0.	0.	45.	185.	356.	456. 6*	316. 6*	145. 6*						
11 MEDU	0.	0.	206.	606.	948.	1242.	1608.	1187.	765. 6*	271.	271.									
12 MEDSUP	0.	0.	0.	0.	0.	0.	34.	185.	128. 6*	109. 6*										
13 PLANED	1410.	1431.	817.	42.	1.															
14 DEV 9	0.	467.	1384.	2155.	2438.	2681.	1909.	1004.	538.	538.	538.	538.	538.	538.	538.	538.	538.	538.	538.	538.
SUM	1410.	1897.	2408.	2804.	3593.	4529.	5058.	5182.	5858.	7747.	11534.	12862.	14004.	12935.	12650.	12929.	14588.	12314.	8355.	5275.
FIXED	1800.	1650.	1500.	1540.	1590.	1630.	1680.	1740.	1808.	1870.	1930.	2010.	2100.	2208.	2310.	2438.	2560.	2700.	2868.	3140.
TOTAL	3210.	3547.	3908.	4344.	5183.	6159.	6738.	6922.	7658.	9617.	13464.	14872.	16104.	15135.	14960.	15359.	17148.	15014.	11215.	8415.
LEVEL	3180.	3500.	3850.	4230.	4650.	5110.	5620.	6180.	6880.	7480.	8130.	8940.	9830.	10810.	11890.	13080.	14390.	15830.	17410.	19150.
MODE	3180.	3436.	3379.	3377.	4123.	5340.	6297.	6641.	7295.	9885.	12187.	12827.	14148.	13859.	13647.	13247.	15164.	13718.	10677.	7988.
50 PER CENT CONFID.	3379.	3873.	4400.	4801.	5844.	7104.	7703.	7790.	8680.	11008.	15777.	17556.	19002.	17674.	17468.	18059.	20159.	17462.	12689.	9405.

RMS = 4018. SMOOTHING INTERVAL 1972. THRU 1990.

ITERATION 1



END OF DATA - JOB COMPLETE

JOB NO.	JOB TYPE	NAME	CP NO.	JOB ORDER	TIME ON MIN.	LINES PRINTED	JOB TIME MIN.	DATE
A263	TEST	GOLDEN	MOX02DD	R3582	1024.75	1007	0.69	03/25/71

Appendix C
FLOW CHARTS

C.1 DESCRIPTION

Flow charts are provided in this section for each of the major subroutines and the main program MASTER. They appear in alphabetical order by subroutine name. A short description of the purpose of each subroutine is provided in the program listing in Appendix D. Subroutines AFRMT, INPUT, PLOT, and PACK were written in 360 Assembler Language so a description of each subroutine appears in this section rather than a flow chart.

C.2 MAJOR SUBROUTINE CHARTS

The subroutine flow charts follow.

SUBROUTINE AFRMT

IDENTIFICATION

Subroutine AFRMT
Deck Name MOX02AT
Fortran IV subroutine coded in 360 Assembler Language
Written by R. E. Slye

PURPOSE

This subroutine converts a variable from integer to A format

USAGE

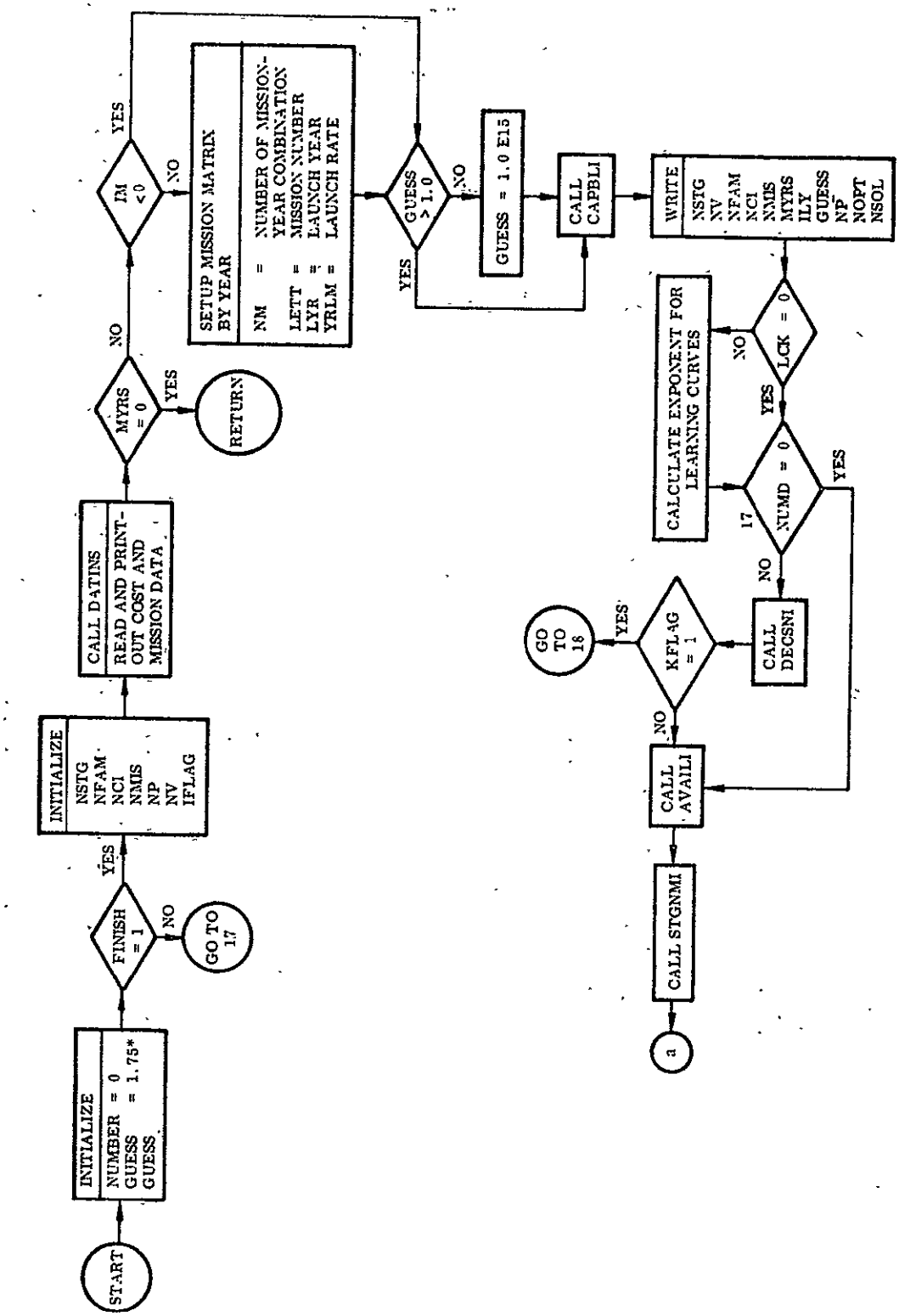
CALL AFRMT (I, X)

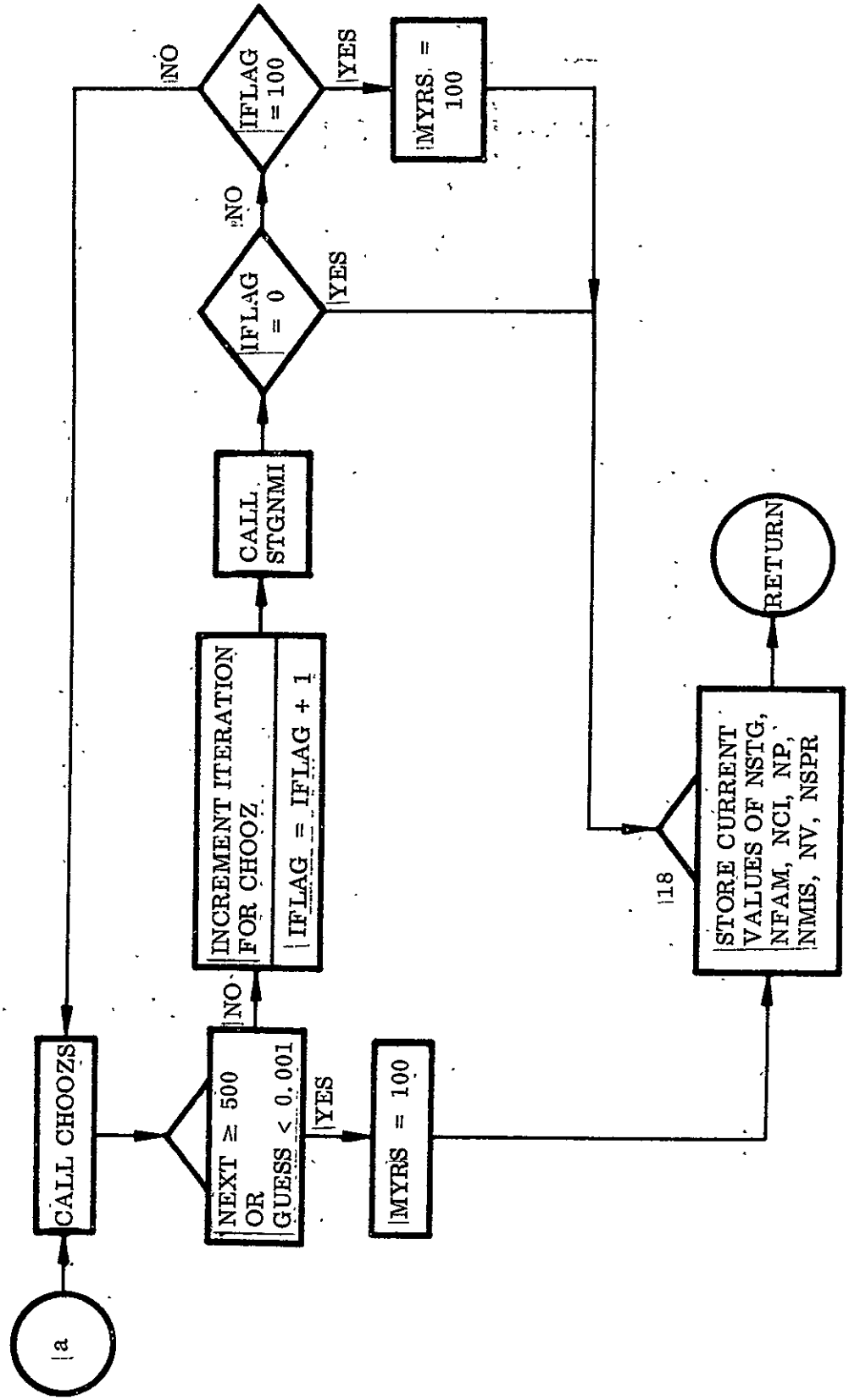
where

I is the name of the variable (may be one element of an array) in integer format

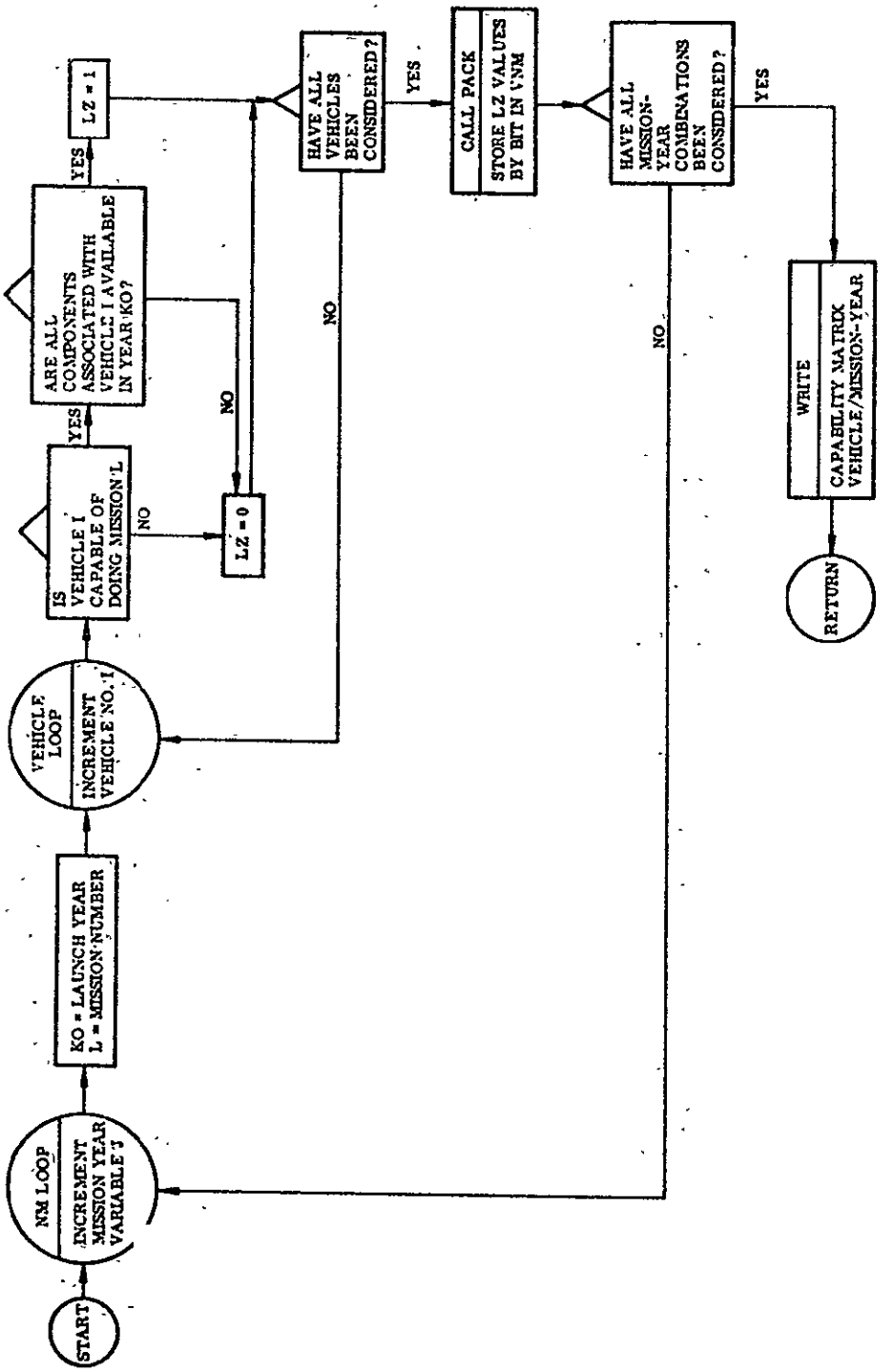
X is the name of the result returned in A4 format

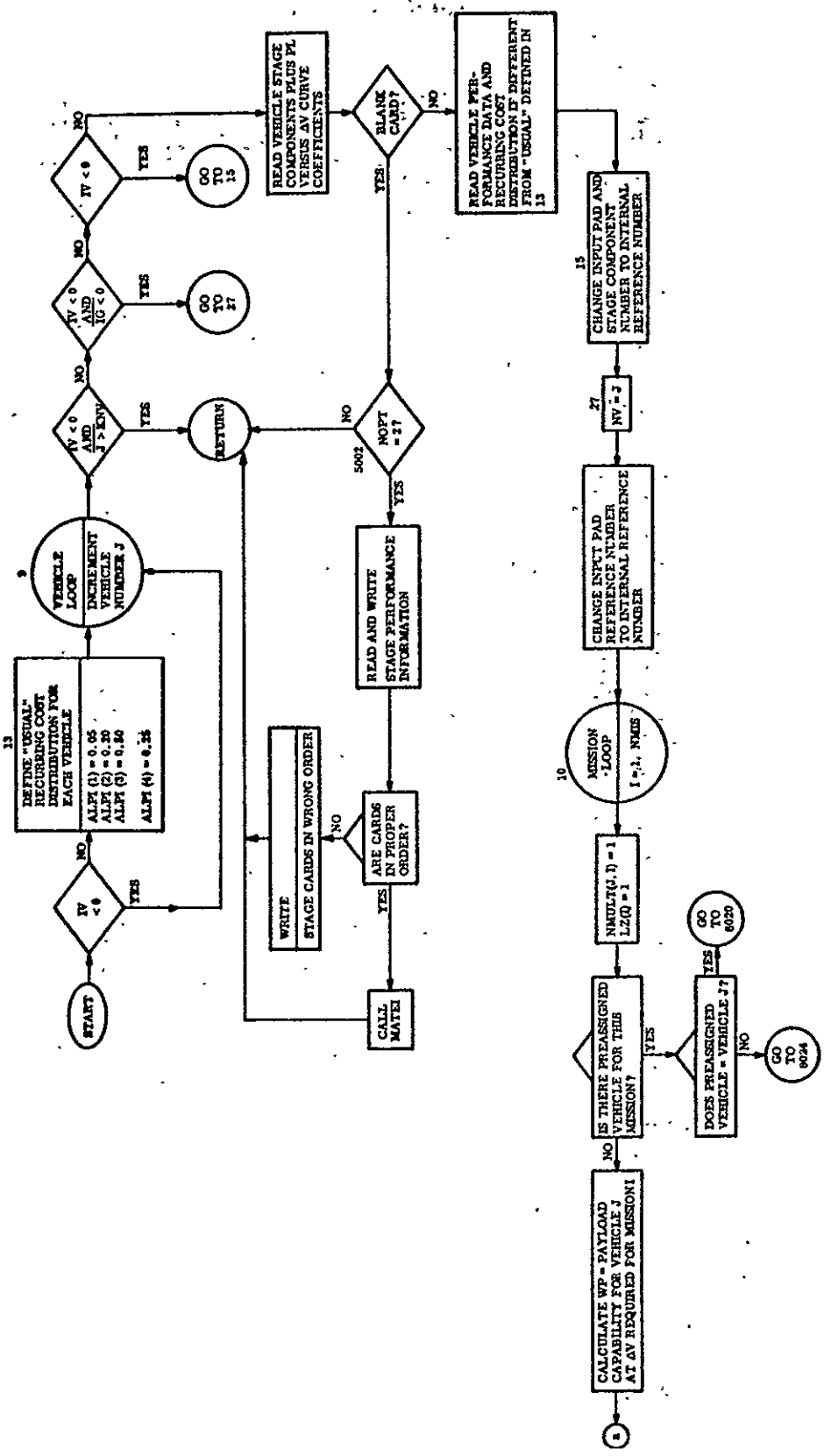
SUBROUTINE ASIGNS



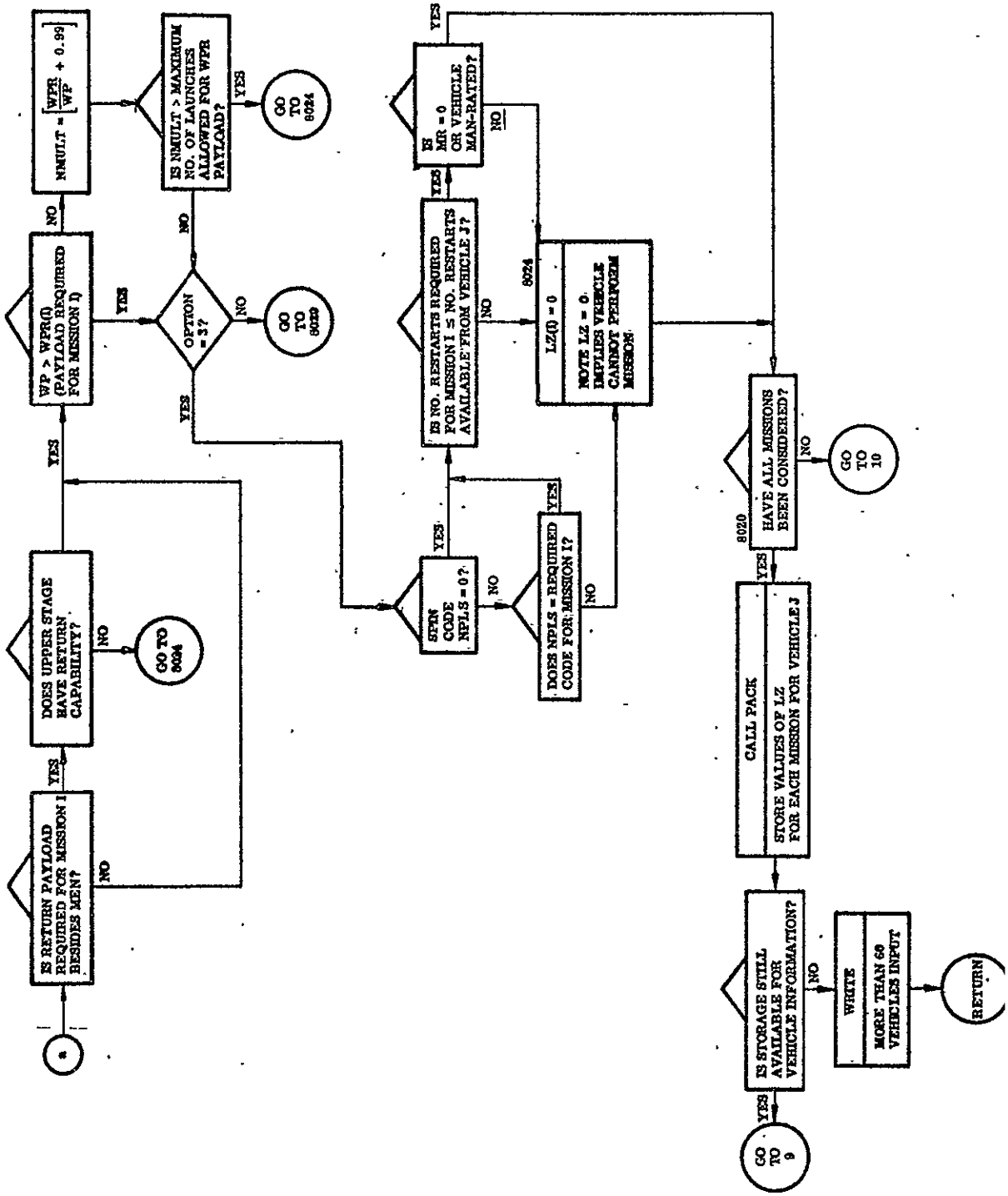

a
CALL CHOOZS
NEXT ≥ 500
OR
GUESS < 0.001
NO
YES
MYRS = 100
INCREMENT ITERATION FOR CHOOZ
IFLAG = IFLAG + 1
CALL STGNMI
IFLAG = 0
NO
YES
IFLAG = 100
NO
YES
MYRS = 100
18
STORE CURRENT VALUES OF NSTG, NFAM, NCL, NP, NMIS, NV, NSPR
RETURN

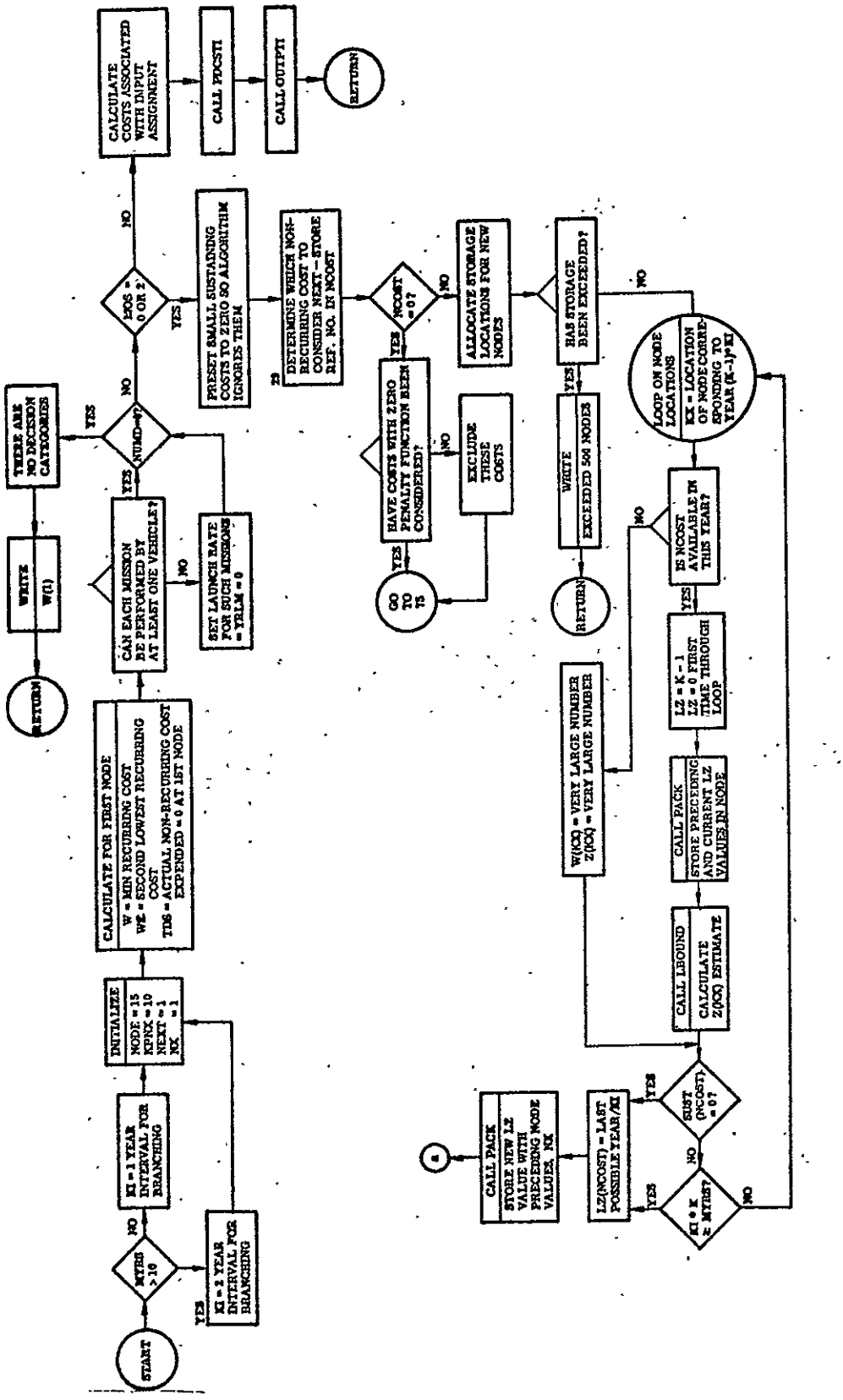
SUBROUTINE AVAILI

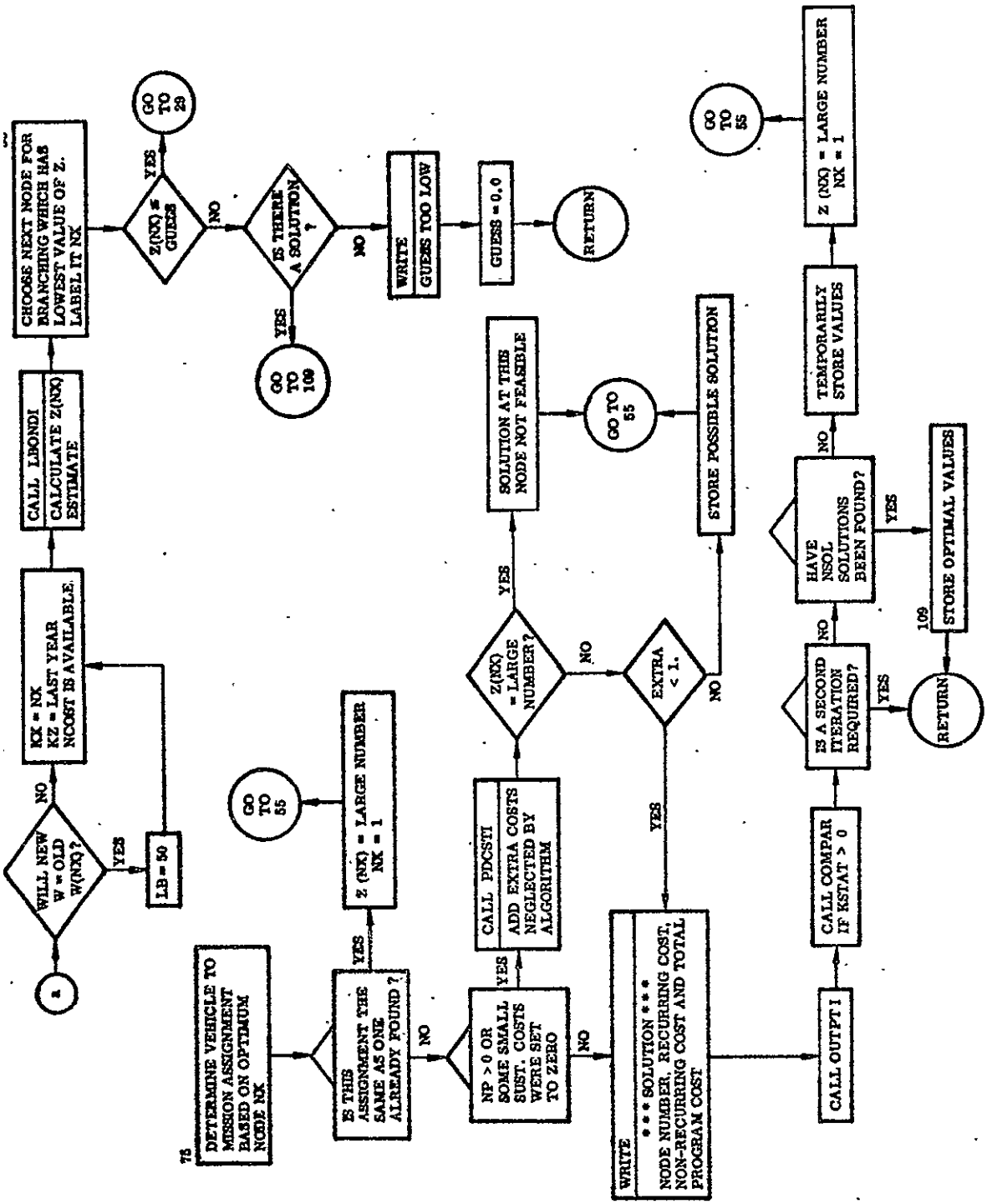



START
IV < 0
YES
NO
13
DEFINE "USUAL" RECURRING COST DISTRIBUTION FOR EACH VEHICLE
ALPI (1) = 0.05
ALPI (2) = 0.20
ALPI (3) = 0.50
ALPI (4) = 0.25
9
VEHICLE LOOP
INCREMENT VEHICLE NUMBER J
IV < 0 AND J > ENV
RETURN
IV < 0 AND IO < 0
GO TO 27
IV < 0
GO TO 13
READ VEHICLE STAGE COMPONENTS PLUS PL VERSUS ΔV CURVE COEFFICIENTS
BLANK CARD?
READ VEHICLE PERFORMANCE DATA AND RECURRING COST DISTRIBUTION IF DIFFERENT FROM "USUAL" DEFINED IN 13
NOPT = 27
5002
READ AND WRITE STAGE PERFORMANCE INFORMATION
ARE CARDS IN PROPER ORDER?
WRITE STAGE CARDS IN WRONG ORDER
CALL MATEI
15
CHANGE INPUT PAD AND STAGE COMPONENT NUMBER TO INTERNAL REFERENCE NUMBER
27
NV = 3
CHANGE INPUT PAD REFERENCE NUMBER TO INTERNAL REFERENCE NUMBER
10
MISSION LOOP
I = 1, NMIS
NMDLT(J, I) = 1
LZ(I) = 1
IS THERE PREASSIGNED VEHICLE FOR THIS MISSION?
DOES PREASSIGNED VEHICLE = VEHICLE J?
GO TO 6020
GO TO 9024
CALCULATE WP = PAYLOAD CAPABILITY FOR VEHICLE J AT ΔV REQUIRED FOR MISSION I
a

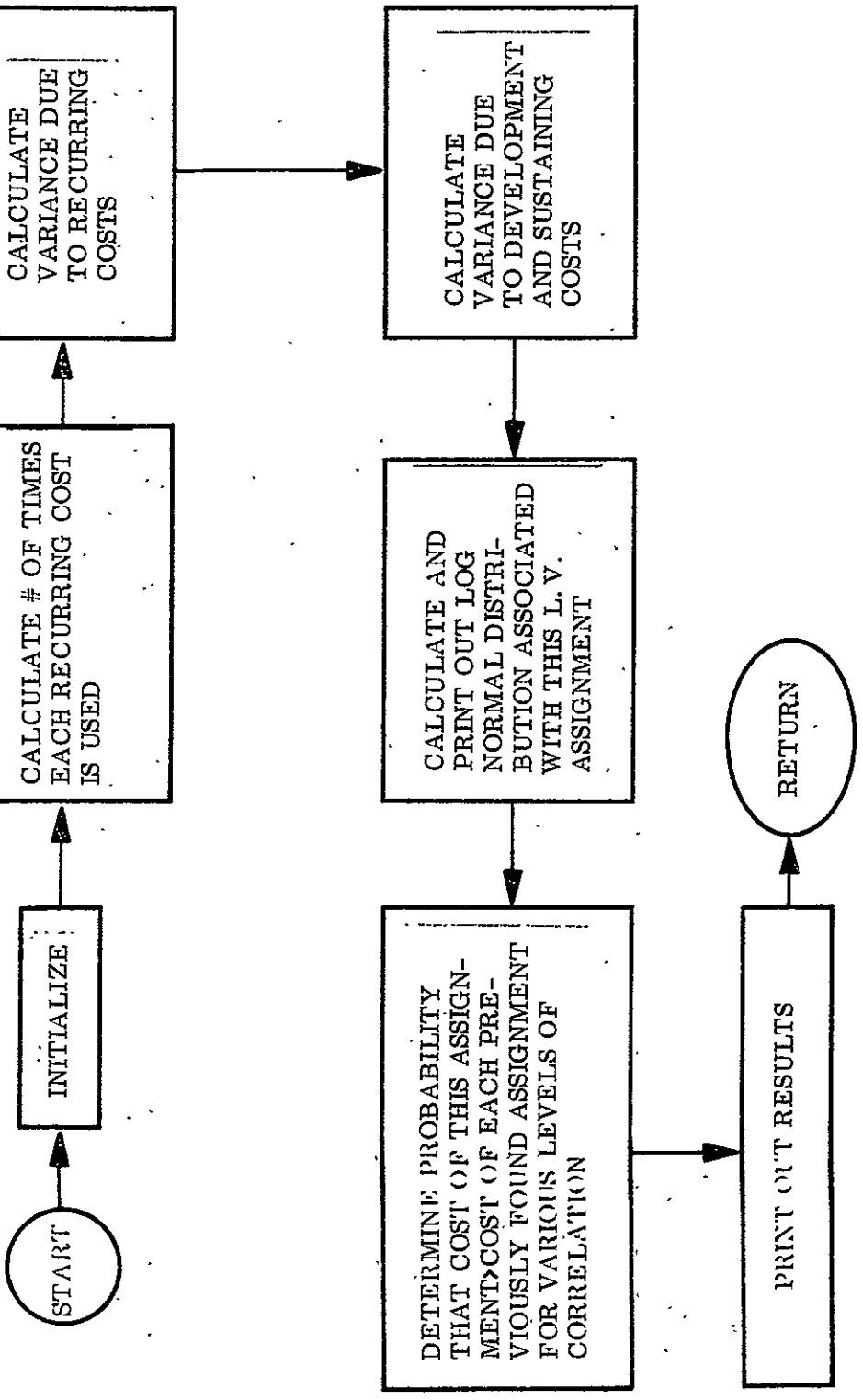
SUBROUTINE CAPBLI (Cont.)



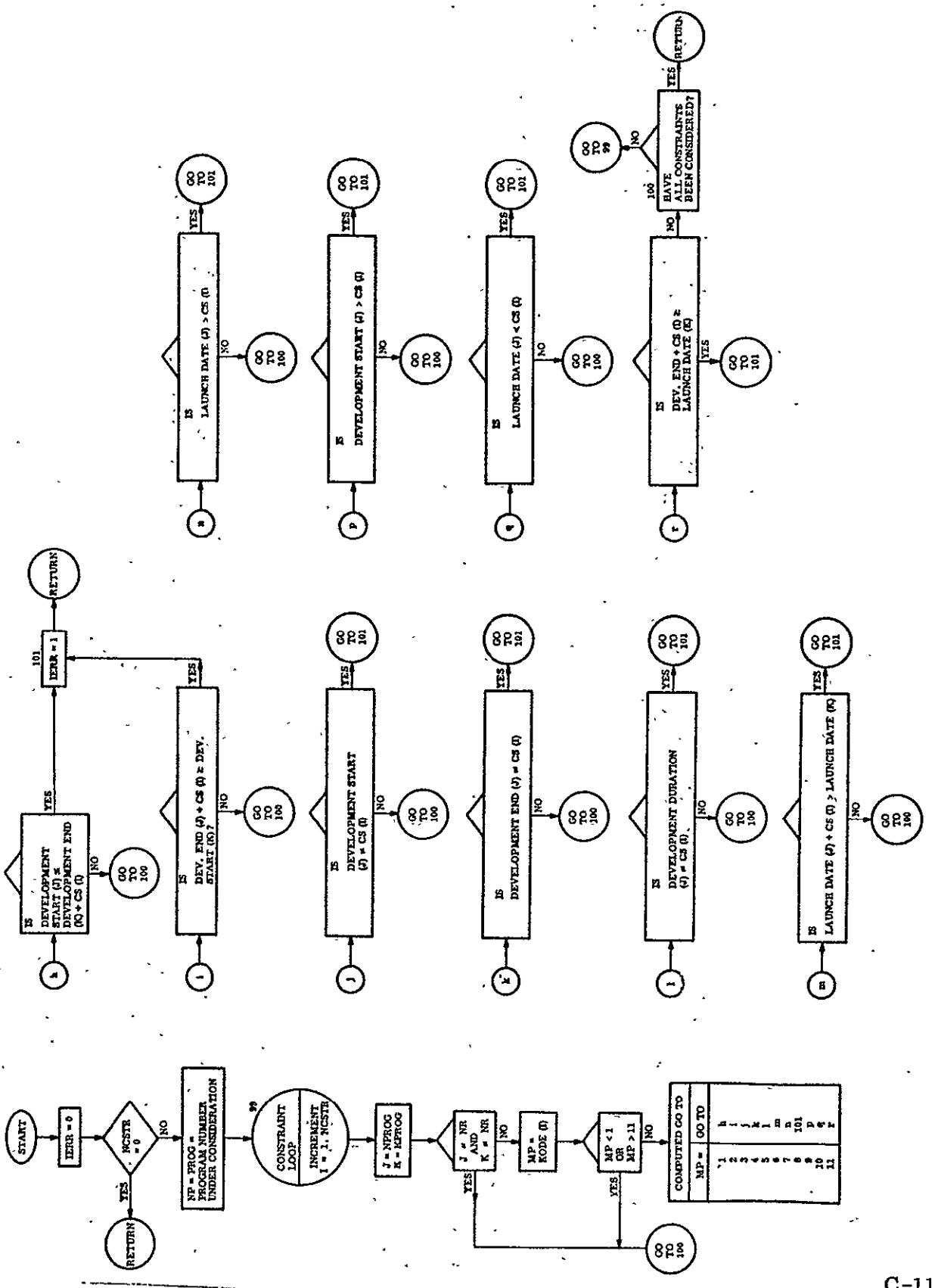

START
MYRS > 10
NO
YES
KI = 1 YEAR INTERVAL FOR BRANCHING
KI = 2 YEAR INTERVAL FOR BRANCHING
INITIALIZE
NODE = 15
KPNX = 10
NEXT = 1
NX = 1
CALCULATE FOR FIRST NODE
W = MIN RECURRING COST
WZ = SECOND LOWEST RECURRING COST
TDS = ACTUAL NON-RECURRING COST EXPENDED = 0 AT 1ST NODE
CAN EACH MISSION BE PERFORMED BY AT LEAST ONE VEHICLE?
SET LAUNCH RATE FOR SUCH MISSIONS = YRLM = 0
NUMD=0?
THERE ARE NO DECISION CATEGORIES
WRITE W(I)
RETURN
LSOS = 0 OR 2
PRESET SMALL SUSTAINING COSTS TO ZERO SO ALGORITHM IGNORES THEM
DETERMINE WHICH NON-RECURRING COST TO CONSIDER NEXT – STORE REF. NO. IN NCOST
NCOST = 0?
HAVE COSTS WITH ZERO PENALTY FUNCTION BEEN CONSIDERED?
EXCLUDE THESE COSTS
GO TO 75
ALLOCATE STORAGE LOCATIONS FOR NEW NODES
HAS STORAGE BEEN EXCEEDED?
WRITE EXCEEDED 500 NODES
RETURN
LOOP ON NODE LOCATIONS KX = LOCATION OF NODE CORRESPONDING TO YEAR (K-1)+KI
IS NCOST AVAILABLE IN THIS YEAR?
LZ = K - 1 LZ = 0 FIRST TIME THROUGH LOOP
CALL PACK STORE PRECEDING AND CURRENT LZ VALUES IN NODE
CALL LBOUND CALCULATE Z(KX) ESTIMATE
SUST (NCOST) = 0?
IS K ≥ MYRST
W(KX) = VERY LARGE NUMBER Z(KX) = VERY LARGE NUMBER
LZ(NCOST) = LAST POSSIBLE YEAR/KI
CALL PACK STORE NEW LZ VALUE WITH PRECEDING NODE VALUES, KX
A
CALCULATE COSTS ASSOCIATED WITH INPUT ASSIGNMENT
CALL FOCSTI
CALL OUTPTI
RETURN

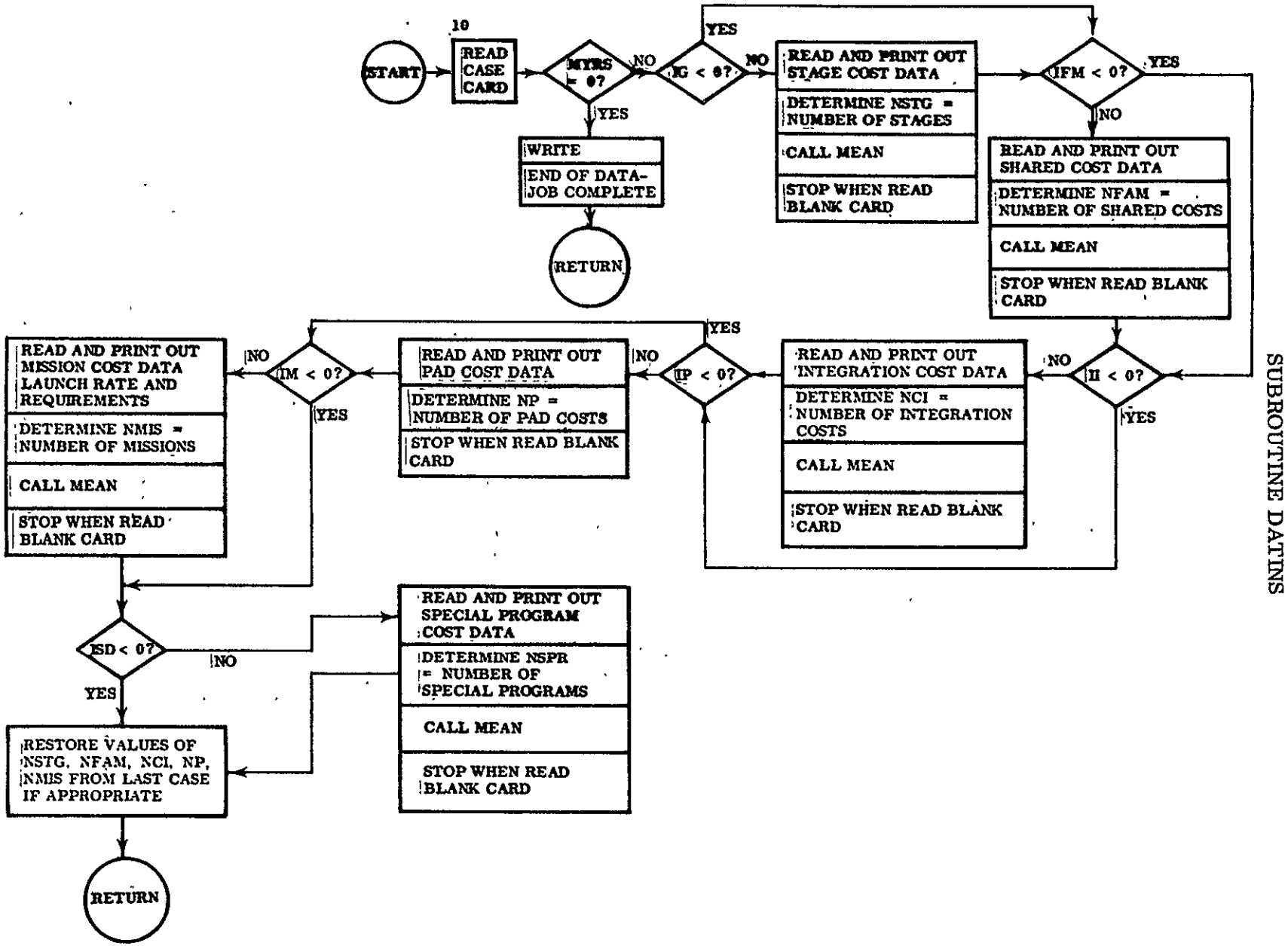

CHOOSE NEXT NODE FOR BRANCHING WHICH HAS LOWEST VALUE OF Z. LABEL IT NX
Z(NX) = GUESS
YES
GO TO 29
NO
IS THERE A SOLUTION ?
YES
GO TO 109
NO
WRITE
GUESS TOO LOW
GUESS = 0.0
RETURN
CALL LBONDI
CALCULATE Z(NX) ESTIMATE
KX = NX
KZ = LAST YEAR
NCOST IS AVAILABLE
WILL NEW W = OLD W(NX) ?
YES
LB = 50
NO
1
75
DETERMINE VEHICLE TO MISSION ASSIGNMENT BASED ON OPTIMUM NODE NX
IS THIS ASSIGNMENT THE SAME AS ONE ALREADY FOUND ?
YES
GO TO 55
Z (NX) = LARGE NUMBER NX = 1
NO
NP > 0 OR SOME SMALL SUST. COSTS WERE SET TO ZERO
YES
CALL PDCSTI
ADD EXTRA COSTS NEGLECTED BY ALGORITHM
NO
Z(NX) = LARGE NUMBER ?
YES
SOLUTION AT THIS NODE NOT FEASIBLE
GO TO 55
NO
EXTRA < 1.
YES
STORE POSSIBLE SOLUTION
NO
WRITE
*** SOLUTION ***
NODE NUMBER, RECURRING COST, NON-RECURRING COST AND TOTAL PROGRAM COST
CALL OUTPT I
CALL COMPAR IF KSTAT > 0
IS A SECOND ITERATION REQUIRED?
NO
HAVE NSOL SOLUTIONS BEEN FOUND?
NO
TEMPORARILY STORE VALUES
Z (NX) = LARGE NUMBER NX = 1
GO TO 55
YES
109
STORE OPTIMAL VALUES
RETURN
YES

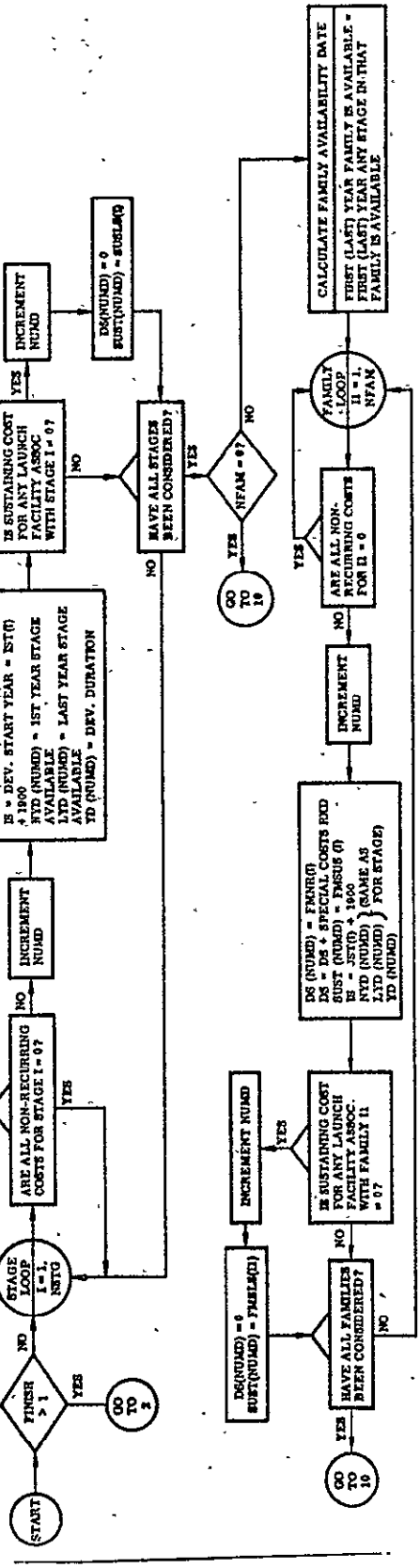
SUBROUTINE COMPAR

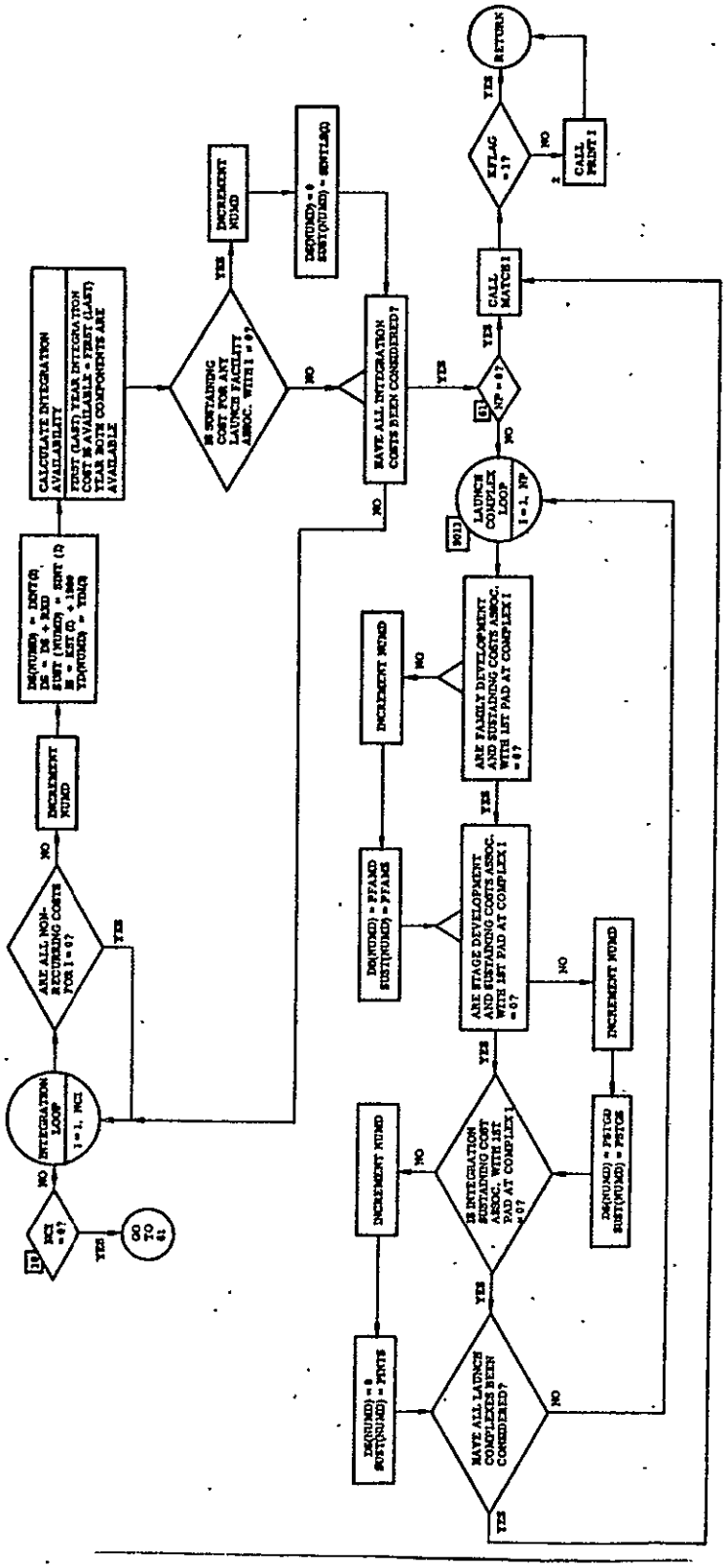


SUBROUTINE CONSTR




SUBROUTINE DATINS
START
10
READ CASE CARD
MYRS = 0?
NO
YES
WRITE
END OF DATA-JOB COMPLETE
RETURN
IG < 0?
YES
NO
READ AND PRINT OUT STAGE COST DATA
DETERMINE NSTG = NUMBER OF STAGES
CALL MEAN
STOP WHEN READ BLANK CARD
IFM < 0?
YES
NO
READ AND PRINT OUT SHARED COST DATA
DETERMINE NFAM = NUMBER OF SHARED COSTS
CALL MEAN
STOP WHEN READ BLANK CARD
II < 0?
NO
YES
READ AND PRINT OUT INTEGRATION COST DATA
DETERMINE NCI = NUMBER OF INTEGRATION COSTS
CALL MEAN
STOP WHEN READ BLANK CARD
IP < 0?
NO
YES
READ AND PRINT OUT PAD COST DATA
DETERMINE NP = NUMBER OF PAD COSTS
STOP WHEN READ BLANK CARD
IM < 0?
NO
YES
READ AND PRINT OUT MISSION COST DATA LAUNCH RATE AND REQUIREMENTS
DETERMINE NMIS = NUMBER OF MISSIONS
CALL MEAN
STOP WHEN READ BLANK CARD
ISD < 0?
NO
YES
READ AND PRINT OUT SPECIAL PROGRAM COST DATA
DETERMINE NSPR = NUMBER OF SPECIAL PROGRAMS
CALL MEAN
STOP WHEN READ BLANK CARD
RESTORE VALUES OF NSTG, NFAM, NCI, NP, NMIS FROM LAST CASE IF APPROPRIATE
RETURN


START
FINISH > 1
YES
GO TO 2
NO
STAGE LOOP I = 1, NSTG
ARE ALL NON-RECURRING COSTS FOR STAGE I = 0?
YES
NO
INCREMENT NUMD
DS (NUMD) = SNR(I)
DS = DS + SPECIAL COSTS RDD
SUST (NUMD) = STS(I)
ES = DEV. START YEAR - ST(0) + 1900
FYD (NUMD) = 1ST YEAR STAGE AVAILABLE
LYD (NUMD) = LAST YEAR STAGE AVAILABLE
YD (NUMD) = DEV. DURATION
IS SUSTAINING COST FOR ANY LAUNCH FACILITY ASSOC WITH STAGE I = 0?
YES
NO
INCREMENT NUMD
DS(NUMD) = 0
SUST(NUMD) = SUSLA(I)
HAVE ALL STAGES BEEN CONSIDERED?
YES
NO
NFAM = 0?
YES
GO TO 10
NO
CALCULATE FAMILY AVAILABILITY DATE
FIRST (LAST) YEAR FAMILY IS AVAILABLE = FIRST (LAST) YEAR ANY STAGE IN THAT FAMILY IS AVAILABLE
FAMILY LOOP I1 = 1, NFAM
ARE ALL NON-RECURRING COSTS FOR I1 = 0
YES
NO
INCREMENT NUMD
DS (NUMD) = FNNR(I)
DS = DS + SPECIAL COSTS RDD
SUST (NUMD) = FMSUS (I)
ES = JST(I) + 1900
FYD (NUMD) } (SAME AS
LYD (NUMD) } FOR STAGE)
YD (NUMD)
IS SUSTAINING COST FOR ANY LAUNCH FACILITY ASSOC WITH FAMILY I1 = 0?
YES
NO
INCREMENT NUMD
DS(NUMD) = 0
SUST(NUMD) = FMSLA(I1)
HAVE ALL FAMILIES BEEN CONSIDERED?
YES
NO
GO TO 10


RETURN
YES
KFLAG = 1?
NO
CALL PRINT 1
CALL MATCH 1
YES
NP = 0?
NO
LAUNCH COMPLEX LOOP I = 1, NP
M13
ARE FAMILY DEVELOPMENT AND SUSTAINING COSTS ASSOC. WITH 1ST PAD AT COMPLEX I = 0?
NO
INCREMENT M2MD
YES
ARE STAGE DEVELOPMENT AND SUSTAINING COSTS ASSOC. WITH 1ST PAD AT COMPLEX I = 0?
NO
INCREMENT M2MD
YES
IS INTEGRATION SUSTAINING COST ASSOC. WITH 1ST PAD AT COMPLEX I = 0?
NO
INCREMENT M2MD
YES
HAVE ALL LAUNCH COMPLEXES BEEN CONSIDERED?
NO
YES
HAVE ALL INTEGRATION COSTS BEEN CONSIDERED?
NO
YES
IS SUSTAINING COST FOR ANY LAUNCH FACILITY ASSOC. WITH I = 0?
NO
YES
INCREMENT M2MD
CALCULATE INTEGRATION AVAILABILITY
FIRST (LAST) YEAR INTEGRATION COST IS AVAILABLE = FIRST (LAST) YEAR BOTH COMPONENTS ARE AVAILABLE
INCREMENT M2MD
ARE ALL NON-RECURRING COSTS FOR I = 0?
NO
YES
INTEGRATION LOOP I = 1, NC1
M12
NC1 = 0?
YES
NO
M13

SUBROUTINE INPUT

IDENTIFICATION

AL INPT Generalized Data Input Subroutine
360/Assembler Language
Written by R. E. Slye

PURPOSE

This subroutine provides for input of single-precision fixed and floating point numbers and Hollerith information. Usage is particularly convenient inasmuch as no format statements are required, and data may be loaded in any order irrespective of the order in the calling statement.

USAGE

The calling statement is

CALL INPUT (5HALPHA, ALPHA, 4BETA, BETA, ...)

In the above, the Hollerith literals represent the external names of variables or arrays as they should appear on data cards. The other arguments are the internal names of the variables and arrays as referenced in the source program. It will become apparent that by using the external names in addition to the symbolic location names, it is possible to enter data for a variable on an input card without regard to its relative location in the calling sequence of the program.

ACCEPTABLE INPUT DATA FORMS

A. Floating Point General Form

Examples

Up to 9 decimal digits, with a decimal point permitted at the beginning, at the end or between two digits. A preceding plus or minus sign is optional. A decimal exponent preceded by E+ or + or - if negative may follow. If no decimal point appears, the exponent is mandatory. The magnitude of the number must be between the approximate limits of 10^{-75} and 10^{75}.

17.
5.0
-.0003
5.0E3 (5.0×10^{3})
5.0E+3 (5.0×10^{3})
5.0E-7 (5.0×10^{-7})

B. Decimal Integers General Form

Examples

The magnitude of the number must be less than 2^{31}. A preceding plus or minus sign is optional.

3
+1
-28987

C. Hollerith Information General Form

Examples

Any number of characters, including blanks. The number of characters is specified by writing nH preceding the Hollerith information. n is the number of characters in the block following nH.

14HTHIS IS A TEST
6HALPHA

RULES FOR PREPARATION OF DATA CARDS

Blanks are ignored except within Hollerith data fields.

Data must be contained within card columns 1 through 72.

It is not necessary that variable names on the data cards appear in the same order as those in the calling sequence. The routine will search the list for the name and its core location.

Individual data items are separated by commas.

An equal sign separates the name of a variable and its first data item.

A comma separates the end of a data set and the next variable name.

A data input record is terminated by an asterisk (*).

It is not necessary to input a data set for each name in the calling sequence.

Elements of an array may be skipped by writing consecutive commas — i.e., no data between the commas; or by singly subscripting the array name. Double subscripting is illegal. Thus, if it is desired to input data into a three-element vector V, one could write:

```
V = 2.79,,1.32
```

No data would be entered into V(2). What was originally there remains there. Alternatively, the above could be written:

```
V(1) = 2.79, V(3) = 1.32
```

Special Feature. The card image is normally written on the system output unit, tape 6, prior to being processed by the routine. If an N is punched in column 73, the card will not be listed. If column 73 contains a C, the card is treated as a comment only; i.e., it is not scanned for data. If the card contains CE in columns 73—74, the card will be treated as a comment card, and a page will be ejected.

EXAMPLE

If the following call statement appeared in a FORTRAN program,

CALL INPUT (1HA, A, 1HB, B, 1HC, C, 1HD, D, 1HP, P, 1HR, R, 1HS, S)

the input cards could be punched as follows:

```
A    = 3.14159265, B = 707, C = 1870,        1st card
D    = 1., 2., 3., 4., 5., 6., 7., 8., 9.,   2nd card
R(2) = 3, R(5) = 74., 42,                    3rd card
F    = 22HTHIS IS A CHECKOUT RUN*            4th card
```

Note that D must be dimensioned at least 9, R dimensioned at least 7 and P at least 6.

Also R(1), R(3), R(4), and R(6) are unchanged.

Even though S appears in the CALL statement, it is not necessary that it appear on one of the input cards. The * on card 4 signifies the end of the data record. This means that the routine will return control to the calling program.

RESTRICTIONS

The following errors will be detected by the subroutine. A diagnostic message and the card in error will be permited on the system output unit, tape 6.

1. Name on data card exceeds six characters.
2. Name on data card does not appear in the calling sequence.
3. Punctuation errors.
4. Name on data card begins with a non-alphabetic character.
5. Decimal or integer data out of range.

This subroutine may be used for reading double precision numbers; however, only the high order part of the number will be loaded. To clear the low order part of the number, write

```
DWORD = 1., 0,
```

ADDITIONAL INFORMATION

1. A slash (/) on a data card (not in an H field) indicates that information to the right of the slash is not to be scanned for data. Therefore, these columns may be used for comments.
2. In addition to the above means for entering Hollerith information, Hollerith may also be entered by enclosing it in apostrophes, i.e., P = 'THIS IS A CHECKOUT RUN'
3. Floating point and integer data may be repeated into consecutive locations by use of the letter X followed by the data; i.e.,

   D = 1., 4X2., 3.,

   is equivalent to

   D = 1., 2., 2., 2., 2., 3.,

4. Alphanumeric data may also be repeated. The use of the letter X is optional. For example, to set an array dimensioned 18 to blanks, write

   TITLE = 18' ',

   If the alphanumeric field exceeds 4 characters, only the last word will be repeated. For example,

   DATA = 3'ABCDEF', will result in
   ABCDEF EF EF

5. If a name on a data card is not followed by an equal sign, it will be retrieved from the calling program. For example, if in the calling program, X and ALPHA are dimensioned at least 2, then the following data card

   X = 3.1, ALPHA(2),

   will result in the current value of ALPHA(2) being stored in X(2).

As an additional example, suppose that the calling FORTRAN program has the following sequence:

```
      LOGICAL
     .  .  .
     .  .  .
      TRUE = .TRUE.
      FALSE = .FALSE.
     .  .  .
     .  .  .
      CALL INPUT (. . ., 'OK', OK, 'TRUE', TRUE,
                         'FALSE', FALSE, . . .)
```

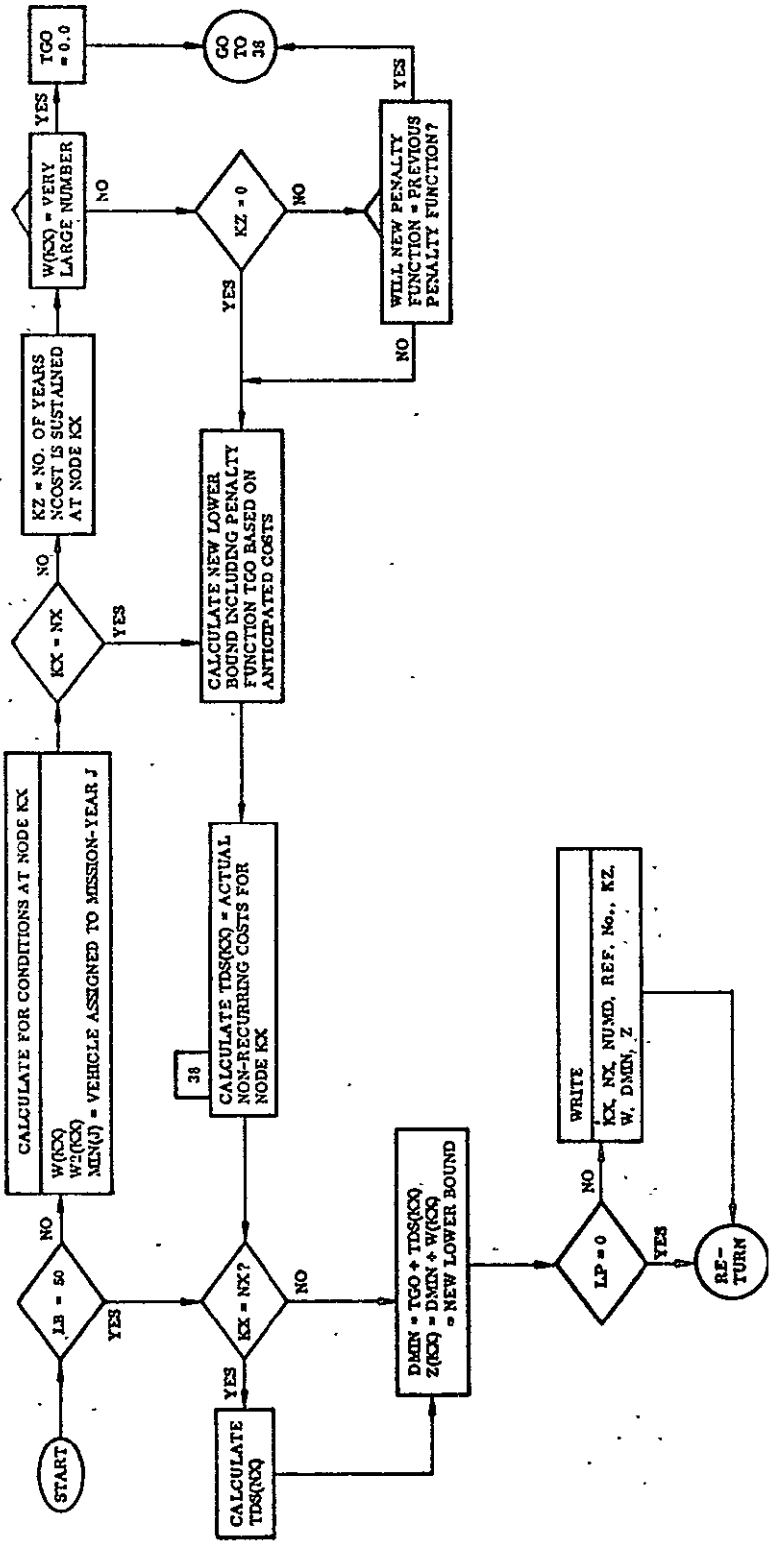
Then a data card written as follows,

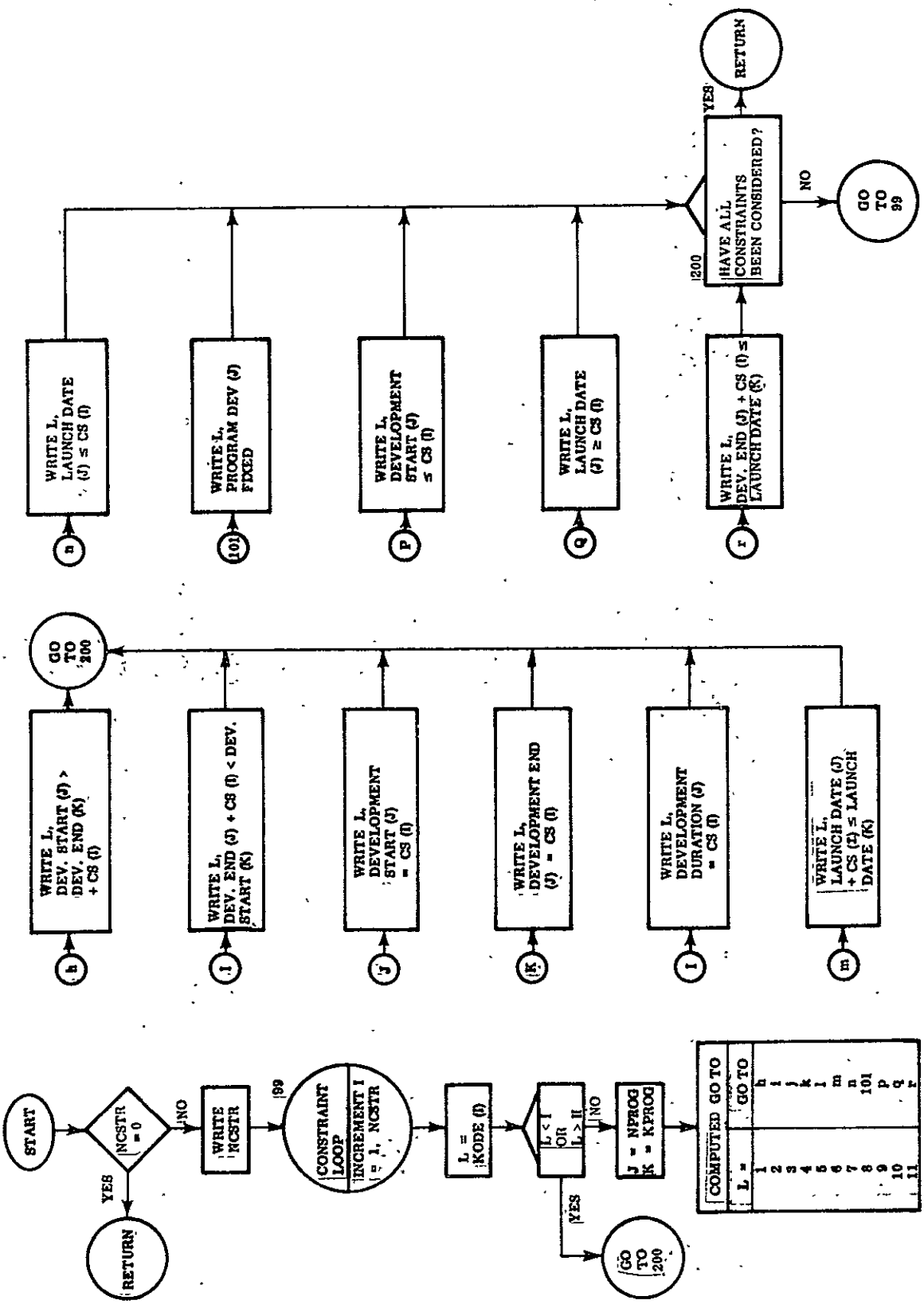
```
OK = TRUE,
```

will result in the input of logical data to the program.

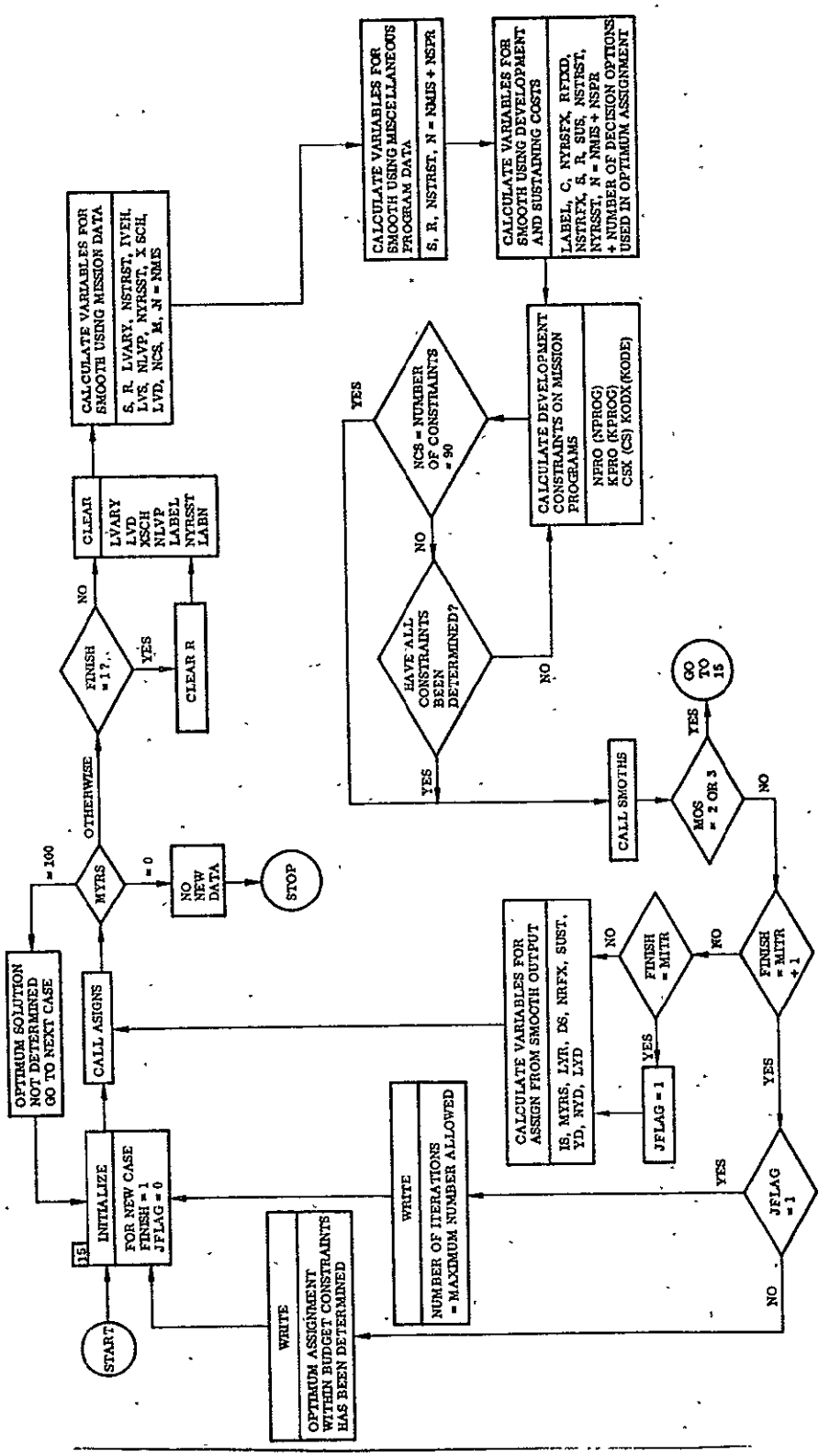
6. If a comma is omitted from a data card, a warning will be written on the system output unit and execution will continue. However, for any other type of error, execution will be suppressed, and the remaining data cards will be scanned for errors.
7. This subroutine will accept data cards punched on either a 026 for 029 keypunch.

SUBROUTINE LBONDI

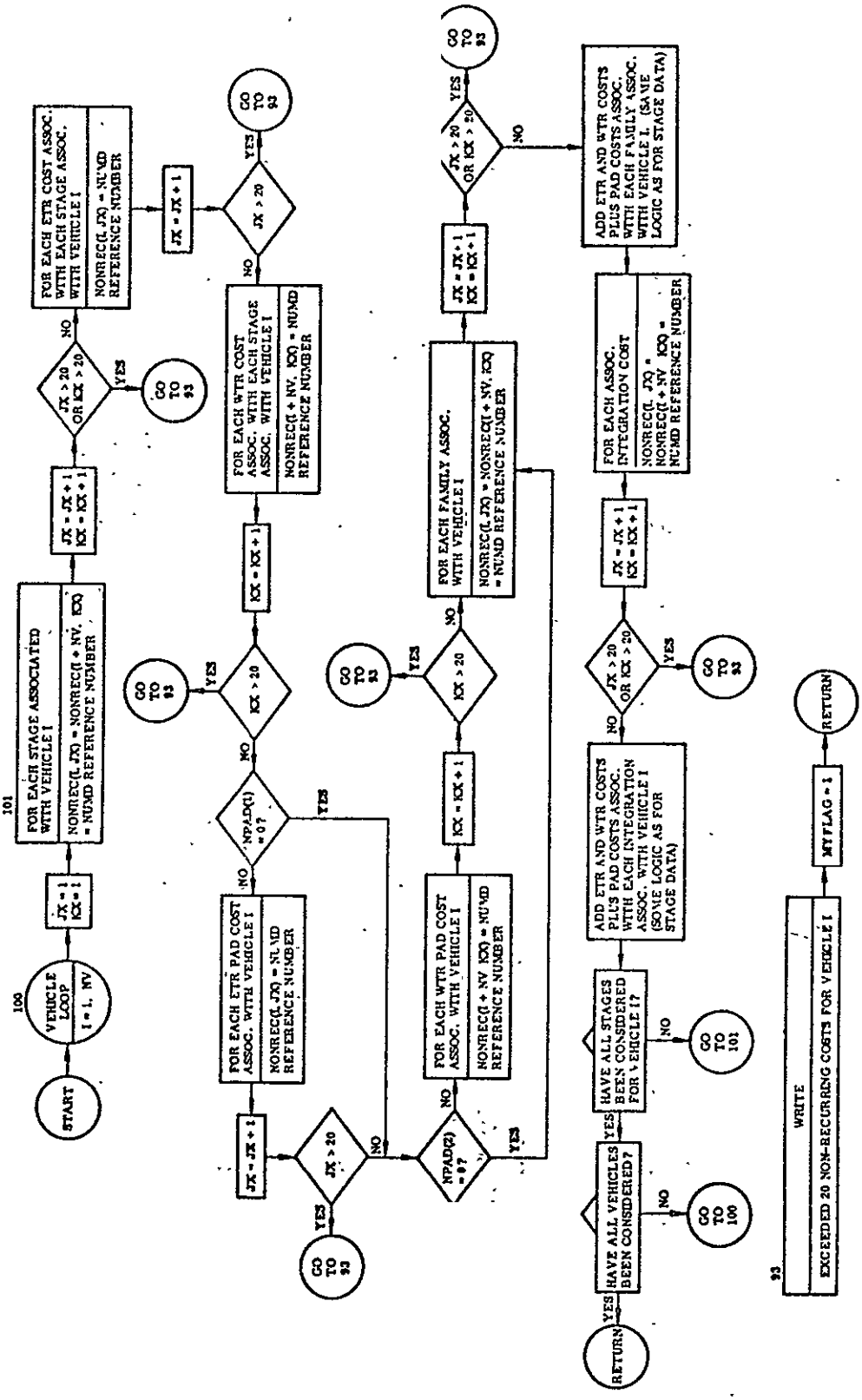



START
NCSTR = 0
YES
RETURN
NO
WRITE NCSTR
99
CONSTRAINT LOOP
INCREMENT I (= 1, NCSTR)
L = KODE (I)
L < 1 OR L > 11
NO
YES
GO TO 200
J = NPROG
K = KPROG
COMPUTED GO TO
L =
GO TO
1 h
2 i
3 j
4 k
5 l
6 m
7 n
8 101
9 p
10 q
11 r
WRITE L, DEV. START (J) > DEV. END (K) + CS (I)
WRITE L, DEV. END (J) + CS (I) < DEV. START (K)
WRITE L, DEVELOPMENT START (J) = CS (I)
WRITE L, DEVELOPMENT END (J) = CS (I)
WRITE L, DEVELOPMENT DURATION (J) = CS (I)
WRITE L, LAUNCH DATE (J) + CS (I) ≤ LAUNCH DATE (K)
GO TO 200
WRITE L, LAUNCH DATE (J) ≤ CS (I)
WRITE L, PROGRAM DEV (J) FIXED
WRITE L, DEVELOPMENT START (J) ≤ CS (I)
WRITE L, LAUNCH DATE (J) ≥ CS (I)
WRITE L, DEV. END (J) + CS (I) ≤ LAUNCH DATE (K)
200
HAVE ALL CONSTRAINTS BEEN CONSIDERED?
YES
RETURN
NO
GO TO 99

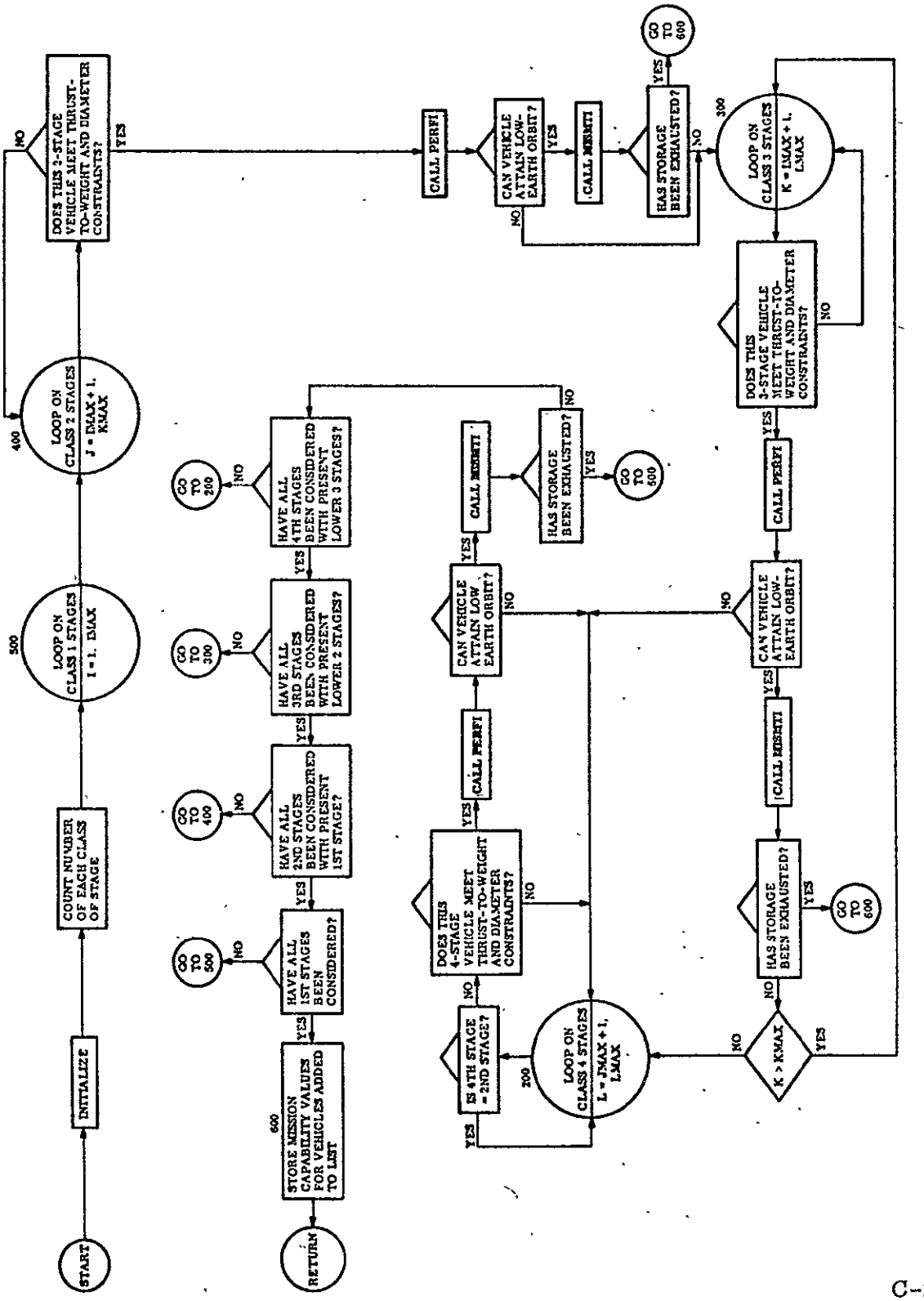
SUBROUTINE MASTER



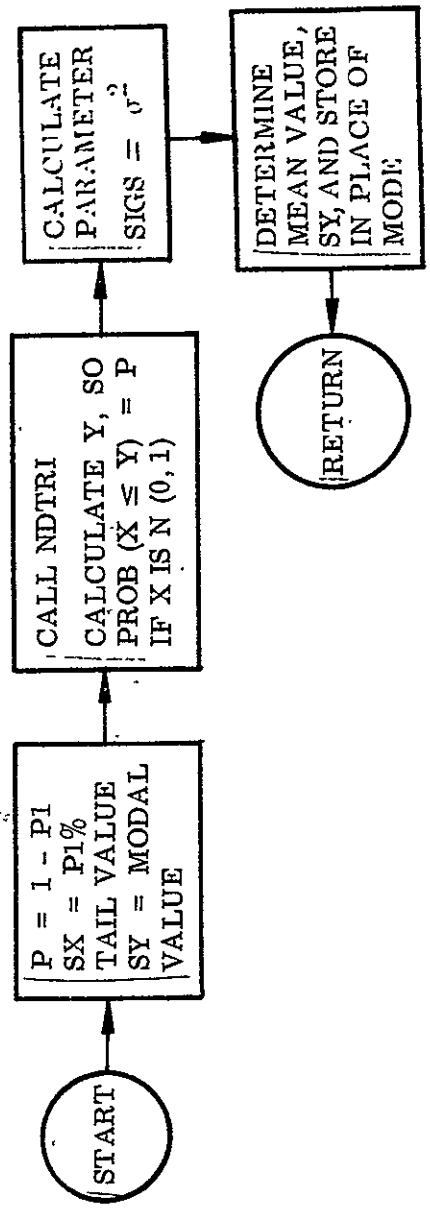
SUBROUTINE MATCH



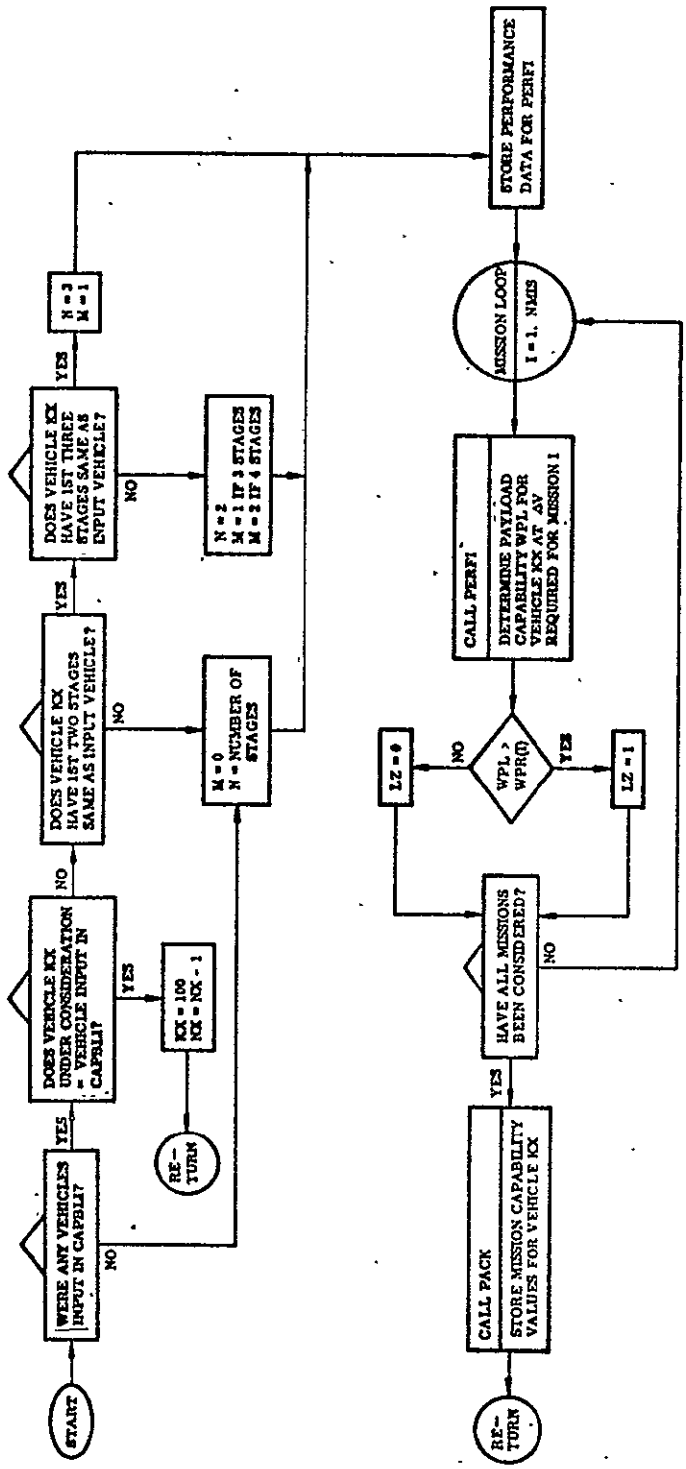
SUBROUTINE MATEI



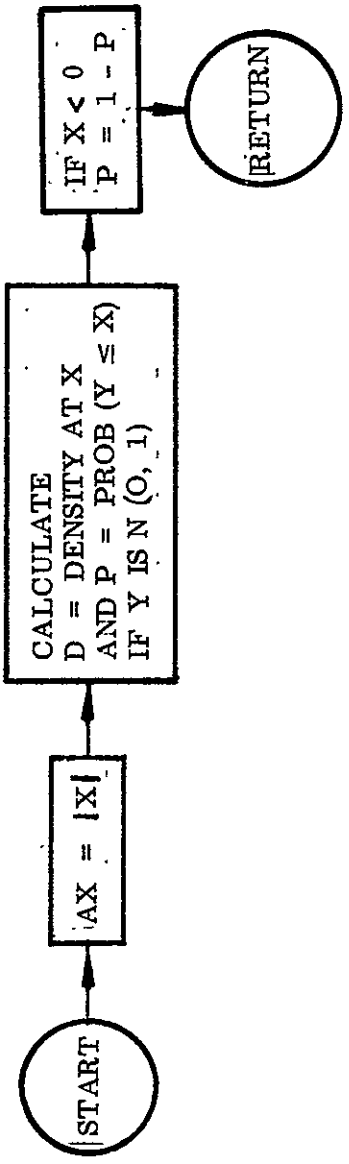
SUBROUTINE MEAN (P1, KSTAT, SIGS, SX, SY



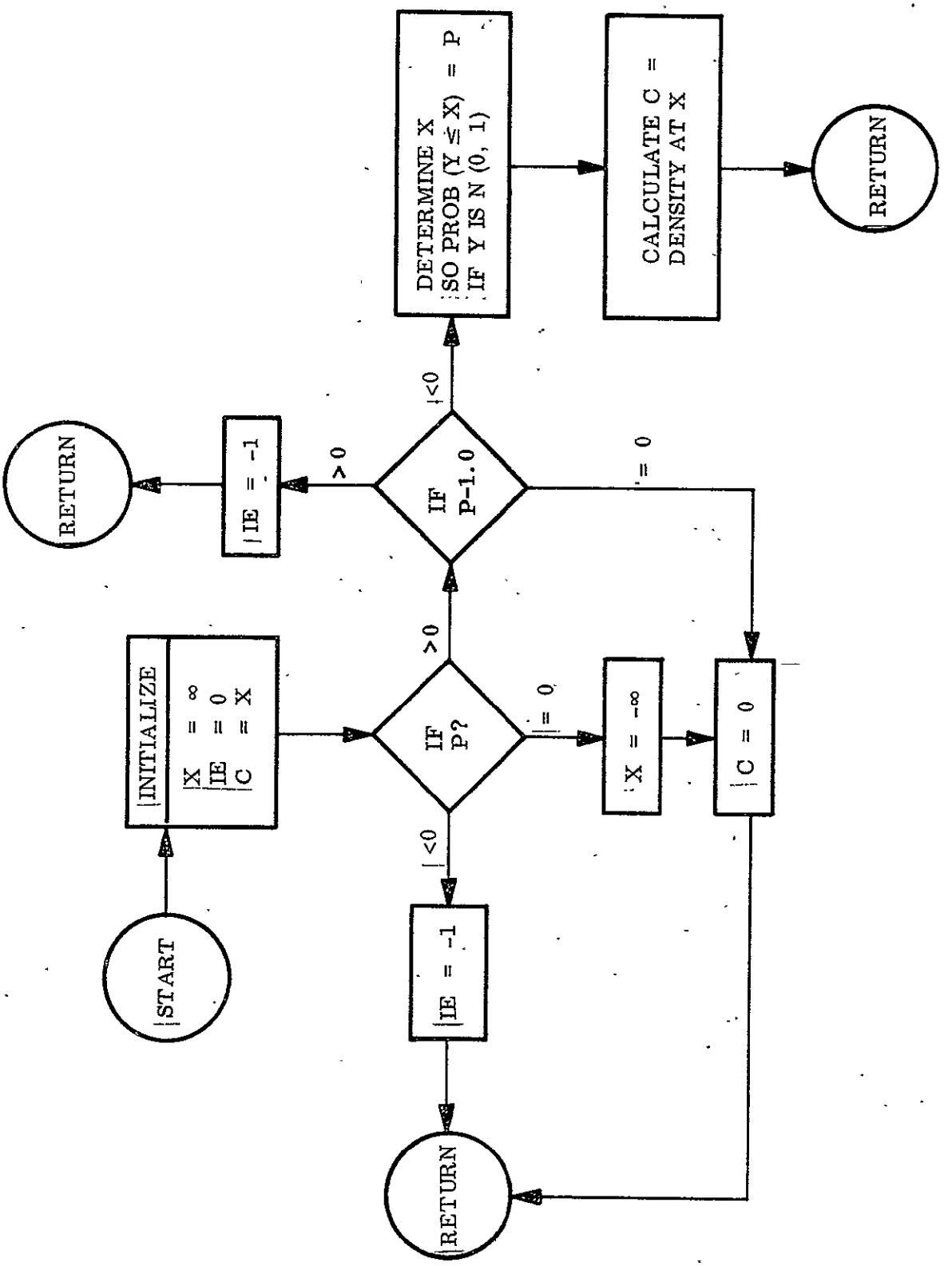
SUBROUTINE MISMTI



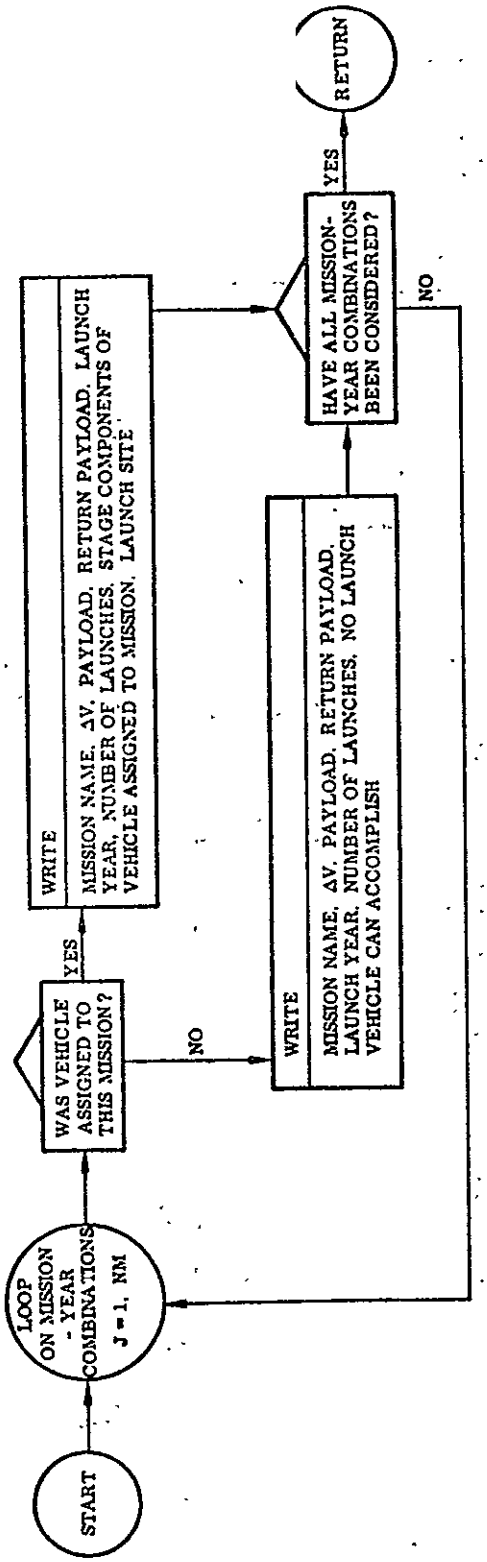
SUBROUTINE NDTR (X, P, D)



SUBROUTINE NDTRI (P, X, C, IE)



SUBROUTINE OUTPTI



SUBROUTINE PACK

IDENTIFICATION

Subroutine PACK
Deck Name MOX01PK
Fortran IV subroutine coded in 360 Assembler Language (also COMPASS coded for the CDC). Written by R. E. Slye

PURPOSE

This subroutine is used to pack an array of integer or logical data into a smaller array in a packed binary format.

METHOD

The unpacked (source) data is treated as an array of unsigned integers. The integer words are truncated on the left and only the N low order bits are retained. The N low order bits are then placed sequentially, left adjusted, in a packed array word until that word is filled. Packing then continues into the next word, etc., until the source data is exhausted.

Since a storage word contains 32 bits, a packed word may contain 32/N data items. Note that since only the N low order bits are retained, the largest integer item that will be represented correctly is $2^N - 1$. For example, if N = 4, the packed items will represent digits from 0 to 15. For a larger integer, the packed item will in effect be the modulus of the source item.

USAGE

This subroutine has three entry points. The three entries are PACK, UNPACK, and ITEM. To pack data, the Fortran call statement is

CALL PACK (L, M, I, N)

where

L is the name of the array containing the source data.
M is the name of the array containing the packed data.
I is the number of data items in L.
N is the number of low order bits to be retained.

The array L should be dimentioned I.
The array M should be dimentioned $\lfloor (I-1)/[32/N] \rfloor + 1$, where [ ] denotes integer part
To unpack data, the Fortran call statement is

CALL UNPACK (L, M, I, N)

where the arguments are as listed above.

I may be less than the actual number of items in the packed array.

Packed data in the array M is unpacked and placed right adjusted in the array L. (The unused high order part of the word is cleared.)

The third entry point to the routine may be used to recover a single item from the packed array M. It is called by the Fortran statement

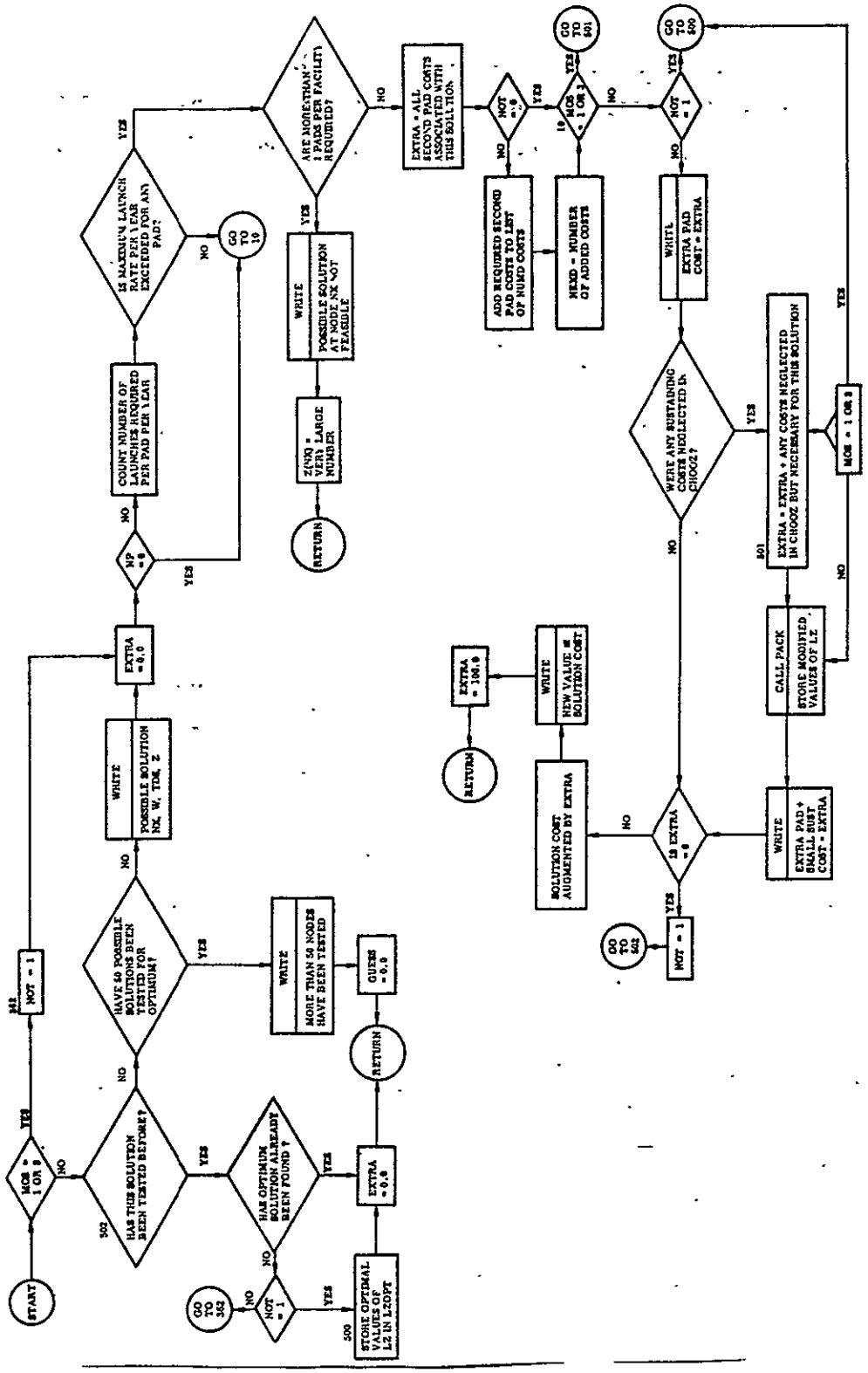
J = ITEM (M, I, N)

The Ith item in the packed array M is returned to the calling program.

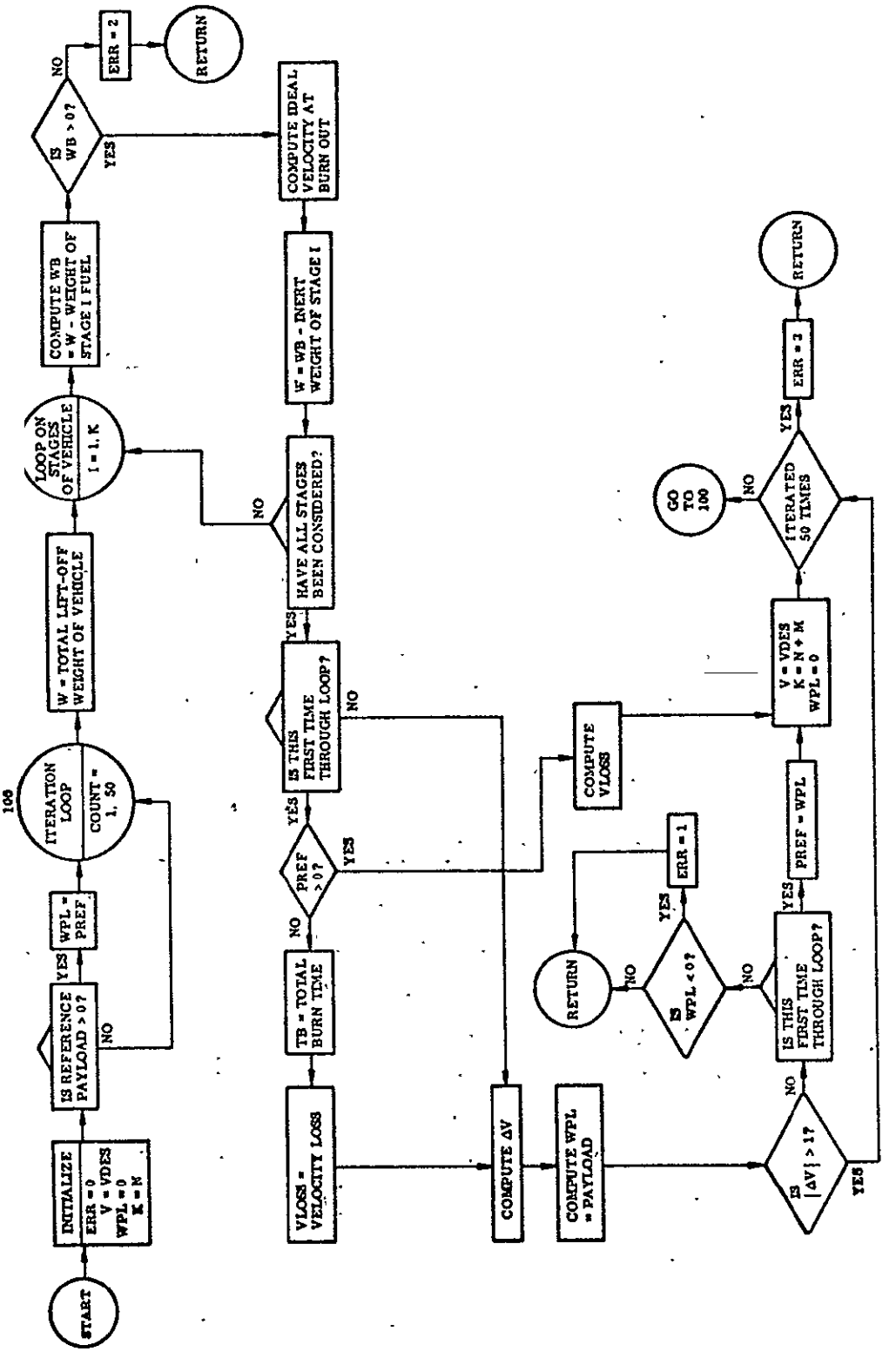
ADDITIONAL INFORMATION

If [32/N] is not an even integer, some low order bits in a packed word are unused. For example, if N = 6 the word may contain 5 items and the last 2 bits are unused. The 6th item will then start at the beginning of the 2nd word.

SUBROUTINE PDCSTI



SUBROUTINE PERFI



SUBROUTINE PLOT

IDENTIFICATION

UM PLOT, Drawing of Graphs by Use of the Printer
360/Assembler Language
Ames Modification of SHARE Library Routine UM PLOT

PURPOSE

This subroutine is used for the purpose of drawing plots, along with the printing of the usual type of numerical output, by use of the printer.

PRELIMINARY REMARKS

Several changes have been incorporated in the FORTRAN IV version of UM PLOT. The maximum width of the plot has been increased from 101 columns to 119 columns. The original program included entries for use in SAP and MAD coded routines, whereas the present version may be entered only from FORTRAN IV or MAP coded programs.

METHOD

A region of core is treated here much as a piece of graph paper. This region of core is called the "image region." The image region is cleared, and then a grid, consisting of I's and -'s, with +.s at grid intersection points, is formed. The program will place any given BCD character at the appropriate place in the image region, corresponding to an ordinate -- abscissa pair. Each point is written in the image region independently of those previously written, and so data to be plotted need not be sorted. Any number of points (consistent with the specified size of the image) may be plotted, with any Hollerith plotting character whatever. Points which fall on previously plotted points replace the latter, and points which fall on a grid line replace the grid line character.

Points which lie outside of the specified grid limits are not plotted. When all desired points have been placed in the image region, the latter is written out onto a standard BCD tape (i.e., tape 6, 7, 9, or 11) for subsequent printing.

USAGE

This subroutine has four main entries and two auxiliary entries. The four main entires are PLOT 1, PLOT 2, PLOT 3, and PLOT 4. Each performs a specific function, and normally they are taken in the order listed above. Exceptions to the normal sequence are discussed below. The two auxiliary entries are OMIT and PLTAPE. The first of these is used for the purpose of causing portions of the grid to be deleted, and the second is used if it is desired to output on a tape other than logical tape 6.

Each of the entries is discussed below in detail, following which the calling sequence arguments are defined. It may be noted that the four main entries can be taken by use of either a standard CALL statement [e.g., CALL PLOT 1( )] or an arithmetic statement [e.g., R = PLOT1( )]. The advantage of the latter is that if certain error conditions arise, they can be detected by interrogation of R, whereas the programmer has no way to detect an error condition if the CALL type entry is used. The details concerning error conditions and the interrogation of R will be found in Section D to follow.

A. The Four Main Entries

```
CALL PLOT 1 (NSCALE, NHL, NSBH, NBL, NSBV)
```

or

```
R = PLOT 1 (NSCALE, NHL, NSBH, NBL, NSBV)
```

This entry is used to set up grid spacing and the total length and width of the graph. The location of decimal points, and the scale factors (powers of 10) for values of the ordinate and abscissa to be printed along the axes of the plot are also specified. If both standard grid and standard scale factors are desired (to be described subsequently), then this entry need not be taken. If several plots are to be printed, all having the same scale factors and grid specifications, then this entry need only be taken one time.

CALL PLOT 2 (IMAGE, XMAX, XMIN, YMAX, YMIN, IDIM)

or

R = PLOT 2 (IMAGE, XMAX, XMIN, YMAX, YMIN, IDIM)

This entry clears the image region and prepares the grid lines of I's and -'s, with +'s at grid line intersection points. It establishes internally formula for computing the location in the image region that corresponds to a given abscissa – ordinate (X_i, Y_i) pair, based on maximum and minimum values as entered through the calling sequence.

CALL PLOT 3 (BCD, X, Y, NDATA)

or

R = PLOT 3(BCD, X, Y, NDATA)

This entry causes a specified Hollerith plotting character to be placed in the appropriate place in the image region for each of the abscissa – ordinate pairs, which are stored in arrays X and Y. This entry may not be taken unless entry PLOT 2 has been taken previously. This entry may be taken repeatedly, if desired, in order to write several sets of data in the image region before it is read out on tape.

CALL PLOT 4 (NCHAR, LABEL)

or

R = PLOT 4(NCHAR, LABEL)

This entry causes the contents of the image region to be written out on logical tape 6 (unless a different tape has been specified by use of the entry PLTAPE, discussed later). The topmost line of the graph will appear one space below the last line previously printed. The ordinate label is specified, and it will appear to the left of the graph. Abscissa labels may be printed above or below the graph by use of standard printout statments. The entry PLOT 4 can be taken repeatedly to obtain several copies of the same graph, if desired. The entry PLOT 2 must have been taken at least once prior to the entry PLOT 4. It is permissible to alter a graph (in the image region) by use of the entry PLOT 3 and then print the result using PLOT 4, without returning to the entry PLOT 2.

B. The Arguments For The Four Main Entries Are Described Here

Note that certain of them may be either integers or floating point quantities, as for example NHL (integer) or HL (floating equivalent of NHL).

NSCALE is an array of dimension 5 that supplies the subroutine with grid and scale factor information

NSCALE(1) = 0, standard grid and scale factors (see note (a), to follow)
≠ 0, grid and scale factors are as defined in NSCALE (2) - NSCALE (5)

NSCALE(2) = I, scale factor such that printed values of the ordinate are 10^I times the actual values

NSCALE(3) = J, J digits will appear to the right of the decimal point in printed ordinate values (J < 8)

NSCALE(4) = K, scale factor such that printed values of the abscissa are 10^K times the actual values

NSCALE(5) = M, M digits will appear to the right of the decimal point in printed abscissa values ($M < 8$)

NHL (or HL) is the number of horizontal grid lines ($NHL > 0$)

NSBH (or BH) is the number of spaces between horizontal grid lines ($NSBH > 0$)

NVL (or VL) is the number of vertical grid lines ($NVL > 0$)

NSBV (or SBV) is the number of spaces between vertical grid lines ($NSBV > 0$, and $NSVB*NVL \leq 119$)

Note (a). Standard scale factors correspond to values of I, J, K, and M of 0, 3, 0, 3, respectively. A standard grid is available which is 101 columns wide starting at column 13, and 51 lines long. It has 10 vertical grid lines and 5 horizontal grid lines, with 10 spaces between both horizontal and vertical grid lines. If both the standard scale factors and standard grid are desired, then the PLOT 1 entry need not be taken. It should be noted, however, that if PLOT 1 has been entered for the purpose of setting up nonstandard conditions, then the latter prevail until PLOT 1 is reentered with different arguments.

Any combination of vertical and horizontal grid lines may be specified, but the vertical grid always starts at column 13. It may extend as far to the right as column 132. The length of the grid is limited only by the dimensions of the image region in core.

Note (b). Integers are printed for the ordinate and/or abscissa scales if $J \leq -1$ and/or $M \leq -1$.

Note (c). If a scale factor is such that overflow or underflow would occur, then the scale factor is treated as zero. The subroutine may shift abscissa scale printout in order to accommodate all of the desired numbers. If the value of an ordinate or abscissa is too large to be printed in the allowed space to the left of the graph it will be truncated from the left.

IMAGE (or AIMAGE) is an array, dimensioned IDIM, which is used as the image region by the subroutine

XMAX is the value of the abscissa at the rightmost grid line

XMIN is the value of the abscissa at the leftmost grid line (XMIN < XMAX)

YMAX is the value of the ordinate at the uppermost grid line

YMIN is the value of the ordinate at the lowermost grid line (YMIN < YMAX)

IDIM is the dimension of the array IMAGE, where IDIM = N*(NSBH*NHL+1) and

$$N = \frac{K}{6} \text{ rounded up for the IBM 7094, or}$$

$$N = \frac{K}{4} \text{ rounded up for the IBM 360}$$

and where

$$K = NSBV*NVL+1$$

(The square brackets in the formula for N signify "integral value.")

Note (d). Set IDIM equal to at least 867 for the standard grid. (1326 for 360).

BCD is the Hollerith plotting character, any character whatever (see note (e), to follow)

X is the array (or single location) that contains the abscissa of the points to be plotted

Y is the array (or single location) that contains the ordinates of the points to be plotted

NDATA (or DATA) is the number of points to be plotted (NDATA > 0)

Note (e). The plotting character may be loaded into cell BCD by use of a DATA statement, that is,

```
DATA BCD/1H*/
```

or, alternatively, it may be entered as a Hollerith literal in the PLOT 3 entry statement, for example,

```
CALL PLOT 3 (1H*, X, Y, NDATA)
```

(The arithmetic statement entry R = PLOT 3 ( ) may not be used in the latter case.)

Note (f). If it is desired to write a single point at a time into the image array, set NDATA equal to 1.

N CHAR (or CHAR) is the number of Hollerith characters, including blanks, in the ordinate label (N CHAR ≤ NHL*NSBH+1)

LABEL is an array which contains the Hollerith characters that constitute the ordinate lable to be printed along the leftmost grid line. (See note (g), below)

Note (g). The ordinate label can be entered in array LABEL by use of the DATA statement, that is,

```
DATA (LABEL (J), J = 1, 3)/17HbbbORDINATEbLABEL/
```

Alternatively, it can be loaded as a Hollerith literal in the PLOT 4 entry statement, for example,

```
CALL PLOT 4 (17, 17HbbbORDINATEbLABEL)
```

(The arithmetic statement entry, R = PLOT 4 ( ), may not be used in the latter case.)

R (See Section D, to follow)

C. The Two Auxiliary Entries and Their Arguments

CALL PLTAPE (NTAPE)

This entry is used, prior to PLOT 4, if it is desired that the output be on a tape other than tape 6. Here, NTAPE is the tape number upon which the output is to take place (7, 9, or 11). The output tape number remains as set by this entry until PLTAPE is called again with a different value for NTAPE.

CALL OMIT (NARG)

This entry causes certain portions of the graph to be deleted. It is taken prior to the entry PLOT 4. The settings for NARG are tabulated below.

NARG	Effect
1	Numerical values of the abscissa are not printed
2	Numerical values of the ordinate are not printed
3	Combines the effect of NARG = 1 and NARG = 2
4	The complete bottom horizontal grid line is deleted
5	Combines the effect of NARG = 1 and NARG = 4
6	Combines the effect of NARG = 2 and NARG = 4
7	Combines the effect of NARG = 1 NARG = 2, and NARG = 4

D. Error Conditions

If arguments are incompatible with certain restrictions, then the message

$$\text{IMPROPER ARGUMENT} \begin{cases} \text{PLOT 1, or} \\ \text{PLOT 2,} \\ \text{etc.} \end{cases}$$

is printed, thus indicating the entry where the improper entry appears. If such errors occur in PLOT 1 or PLOT 2, subsequent entries into PLOT 3 and PLOT 4 are deleted with no further comment. The argument restrictions are

$$\begin{aligned} &\text{NHL} > 0 \\ &\text{NSBH} > 0 \\ &\text{NVL} > 0 \\ &\text{NSBV} > 0 \\ &\text{NSBV} * \text{NVL} \leq 119 \\ &\text{XMAX} > \text{XMIN} \\ &\text{YMAX} > \text{YMIN} \end{aligned}$$

BCD must be a single left-adjusted Hollerith character

If the user attempts to execute PLOT 3 or PLOT 4 without having previously executed PLOT 2, (or without execution of PLOT 2 subsequent to the execution of PLOT 1), the comment

NO PREVIOUS PLOT 2

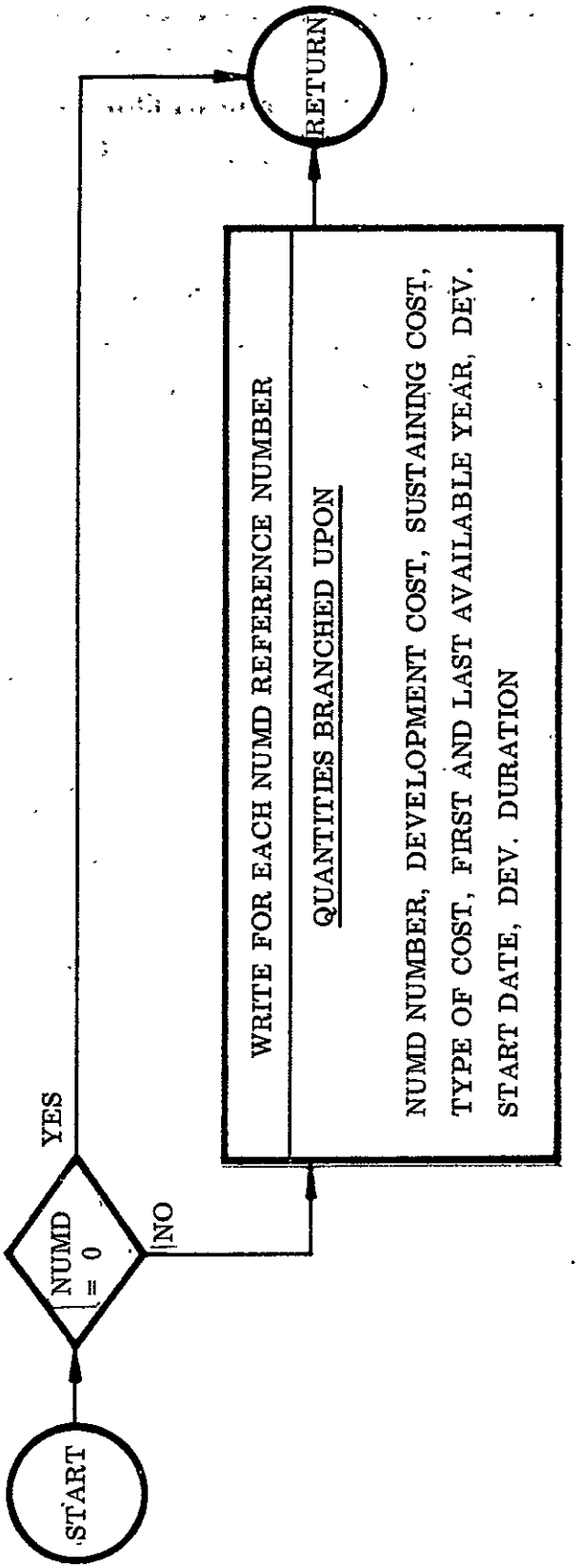
will be printed.

If the arithmetic statement (rather than the CALL statement) is used for the four main entries, then the user may take appropriate action in the case of such errors as would lead to the printouts described above. An error in the arguments, or one due to the

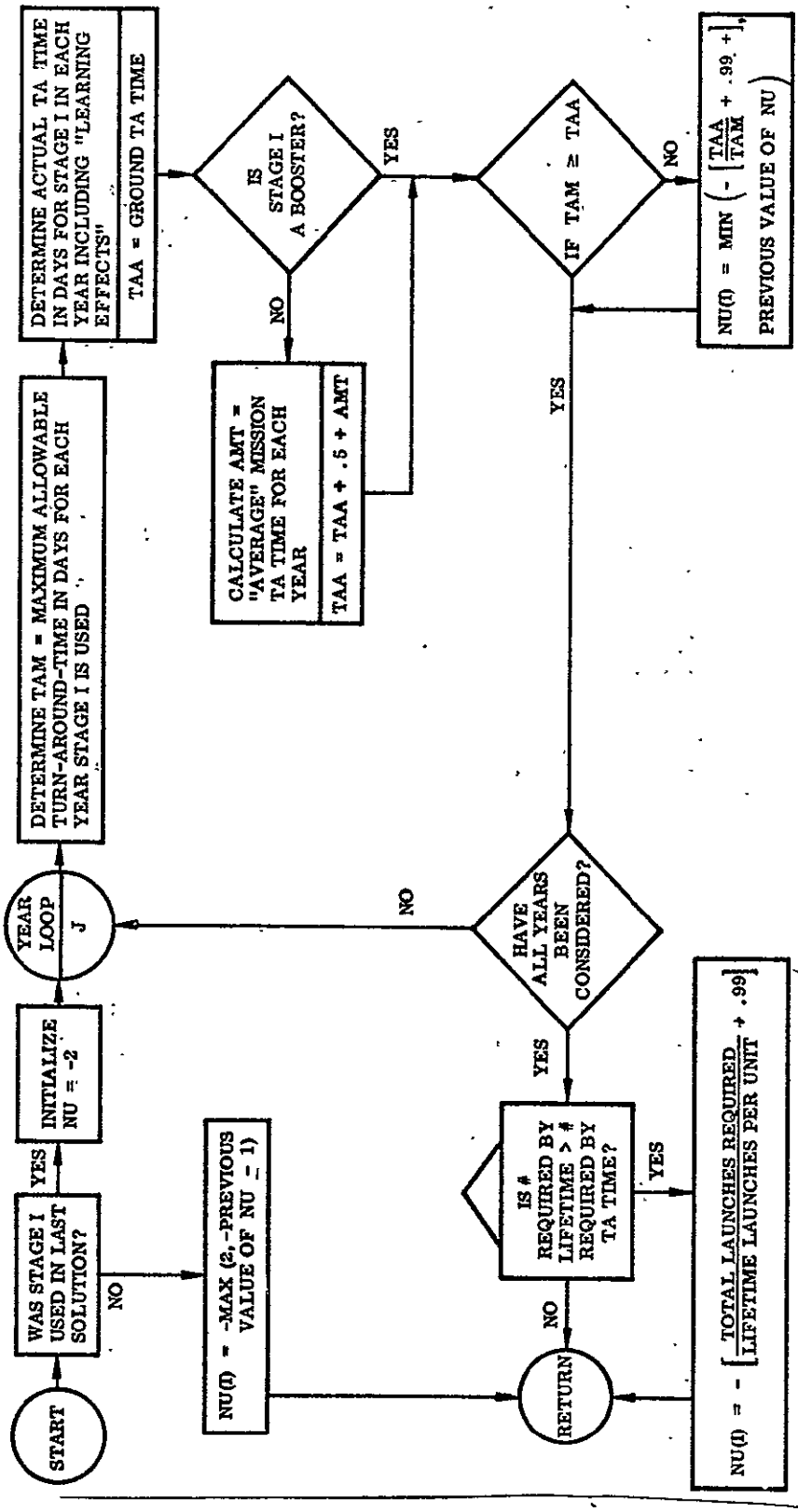
unsuccessful completion of an earlier entry, will cause a + 1.0, + 2.0, + 3.0, or + 4.0 to be loaded in cell R for entries PLOT 1, PLOT 2, PLOT 3, or PLOT 4, respectively. Cell R contains + 0.0 if no error condition arises. The user simply tests R following each attempt to enter the subroutine via PLOT 1, PLOT 2, PLOT 3, or PLOT 4.

If any points are not plotted by PLOT 3, then the number - 3.0 will be found in R . This might arise if points lie outside the stated minimum and maximum limits of the ordinate and abscissa, and need not be considered an error.

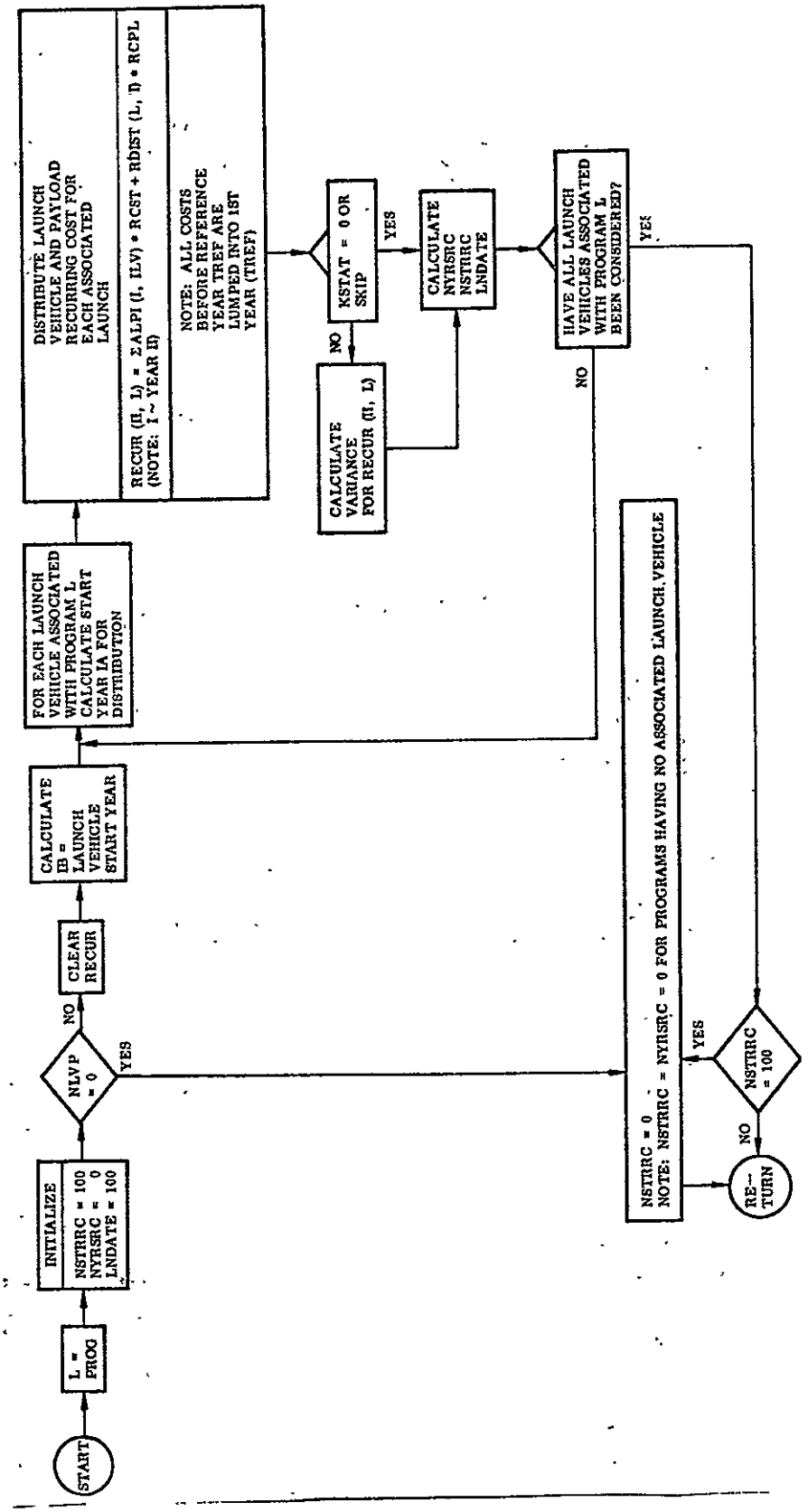
SUBROUTINE PRINTI

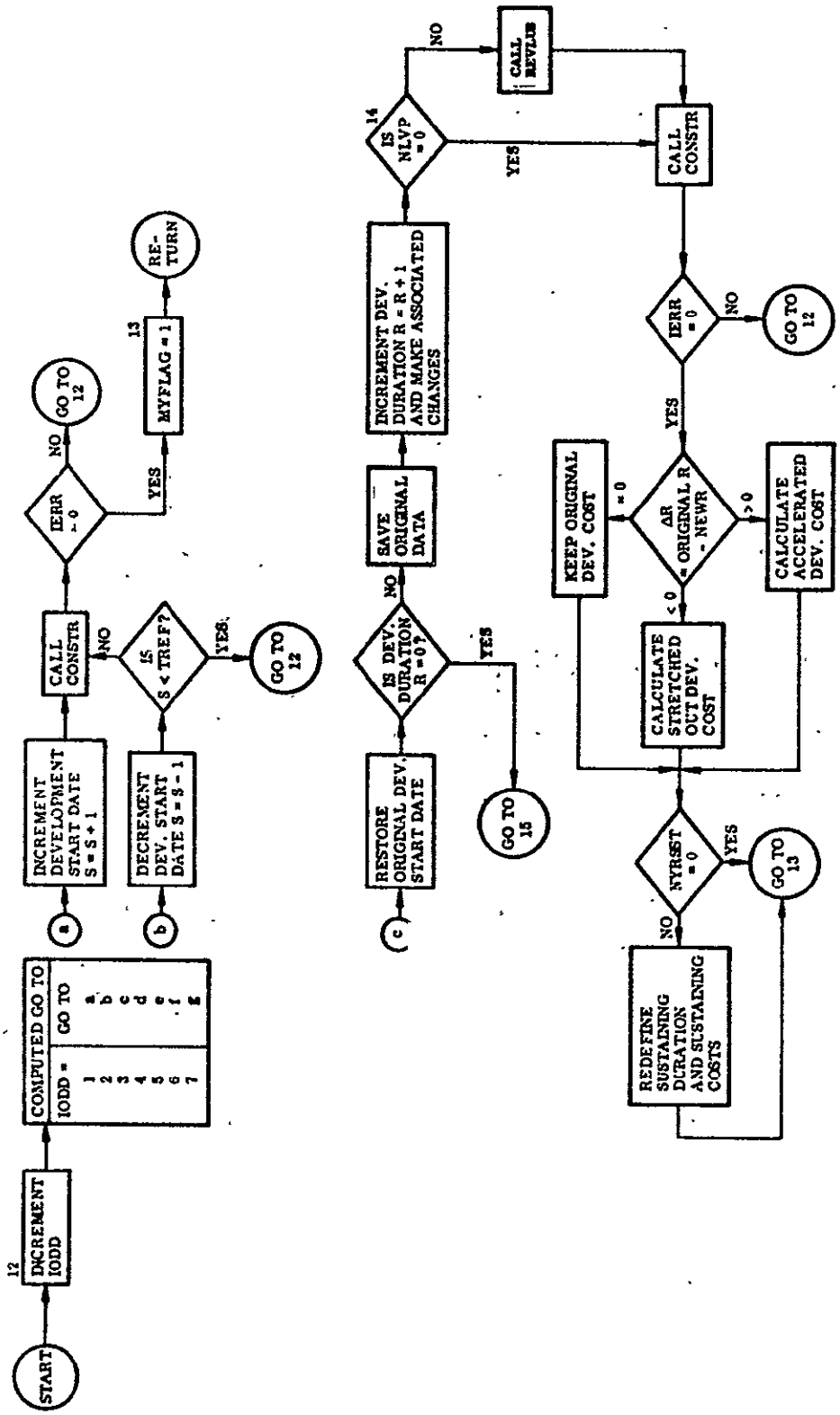


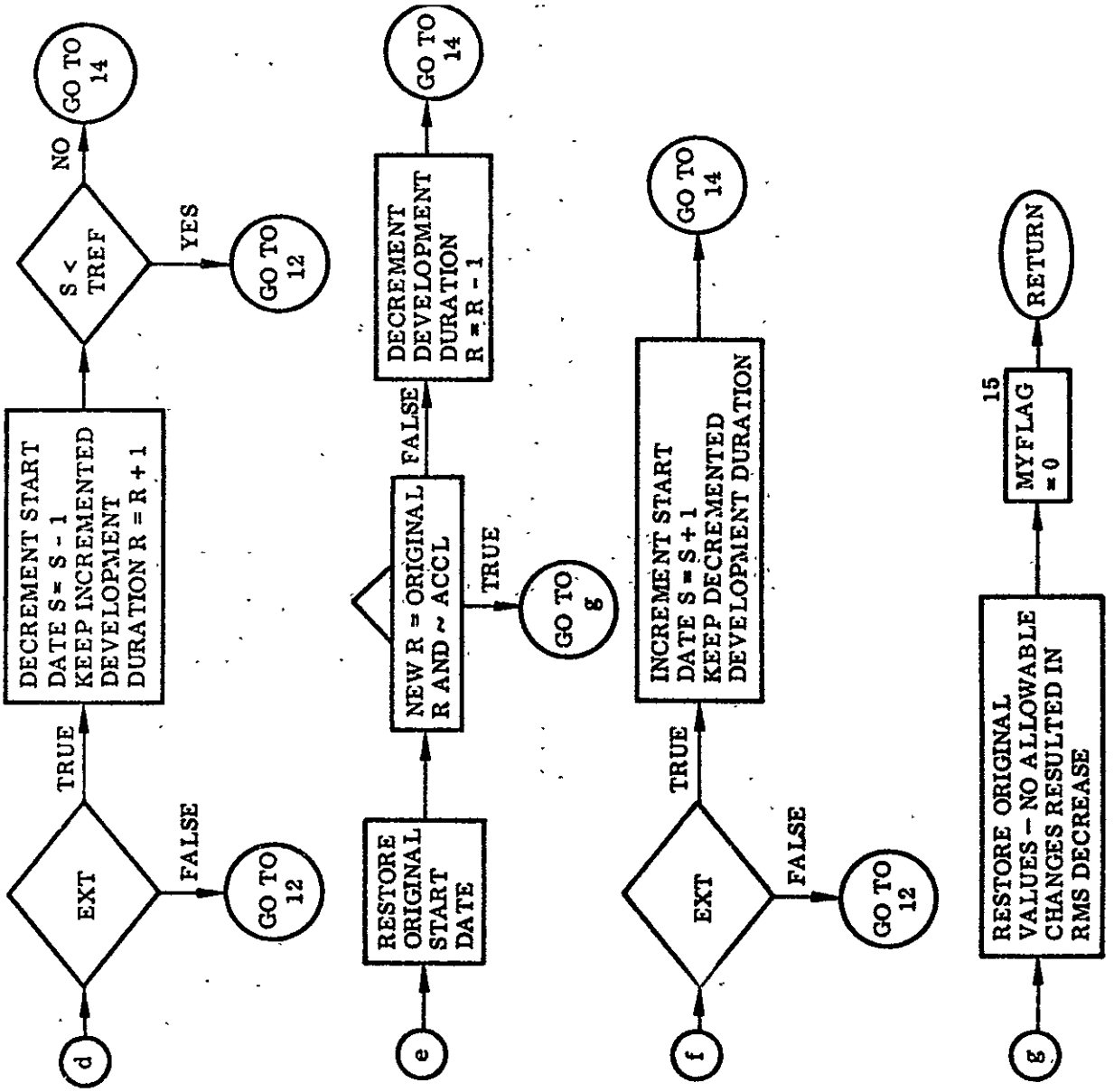
SUBROUTINE REUSEI



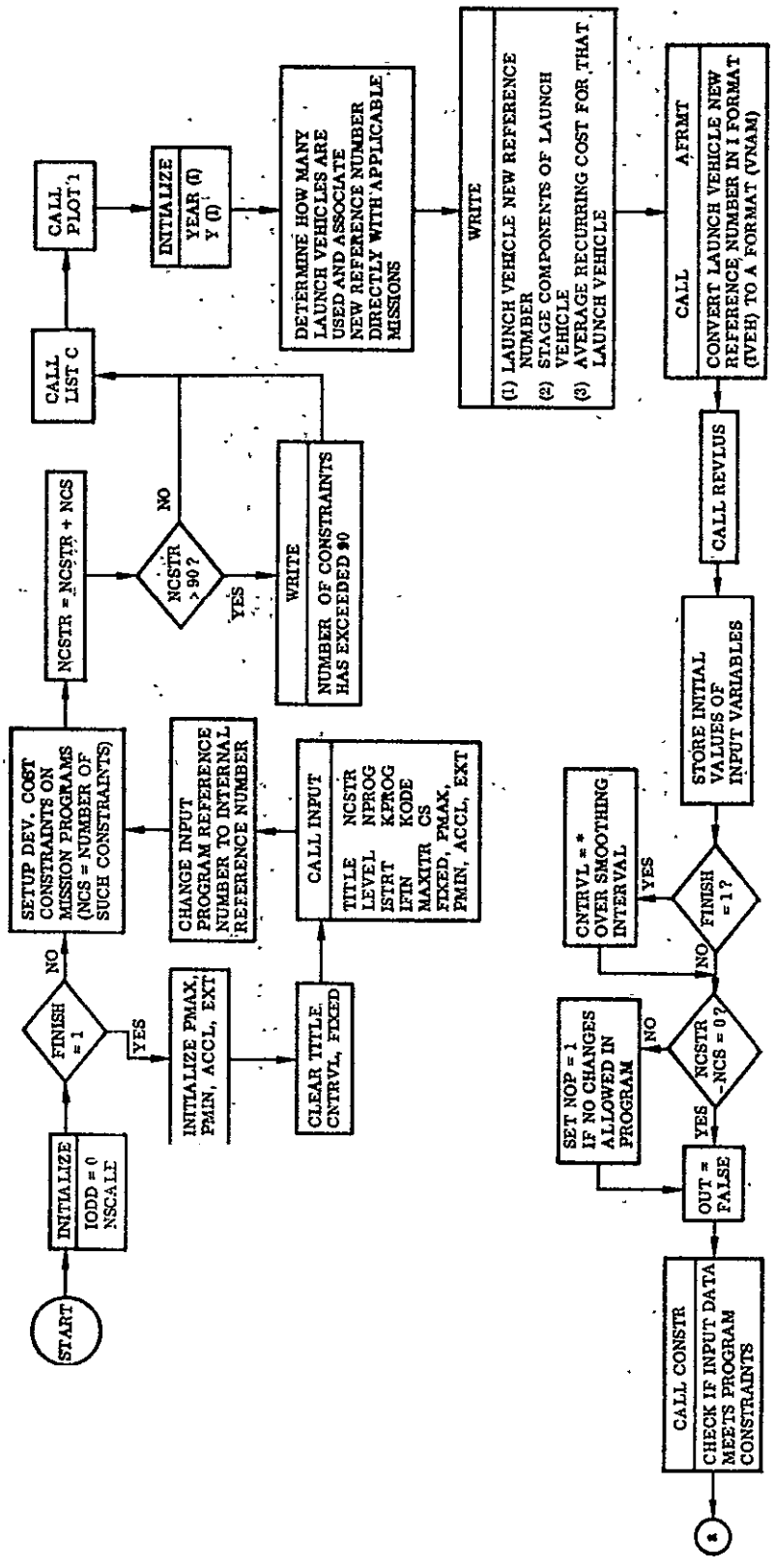
SUBROUTINE REVLUS

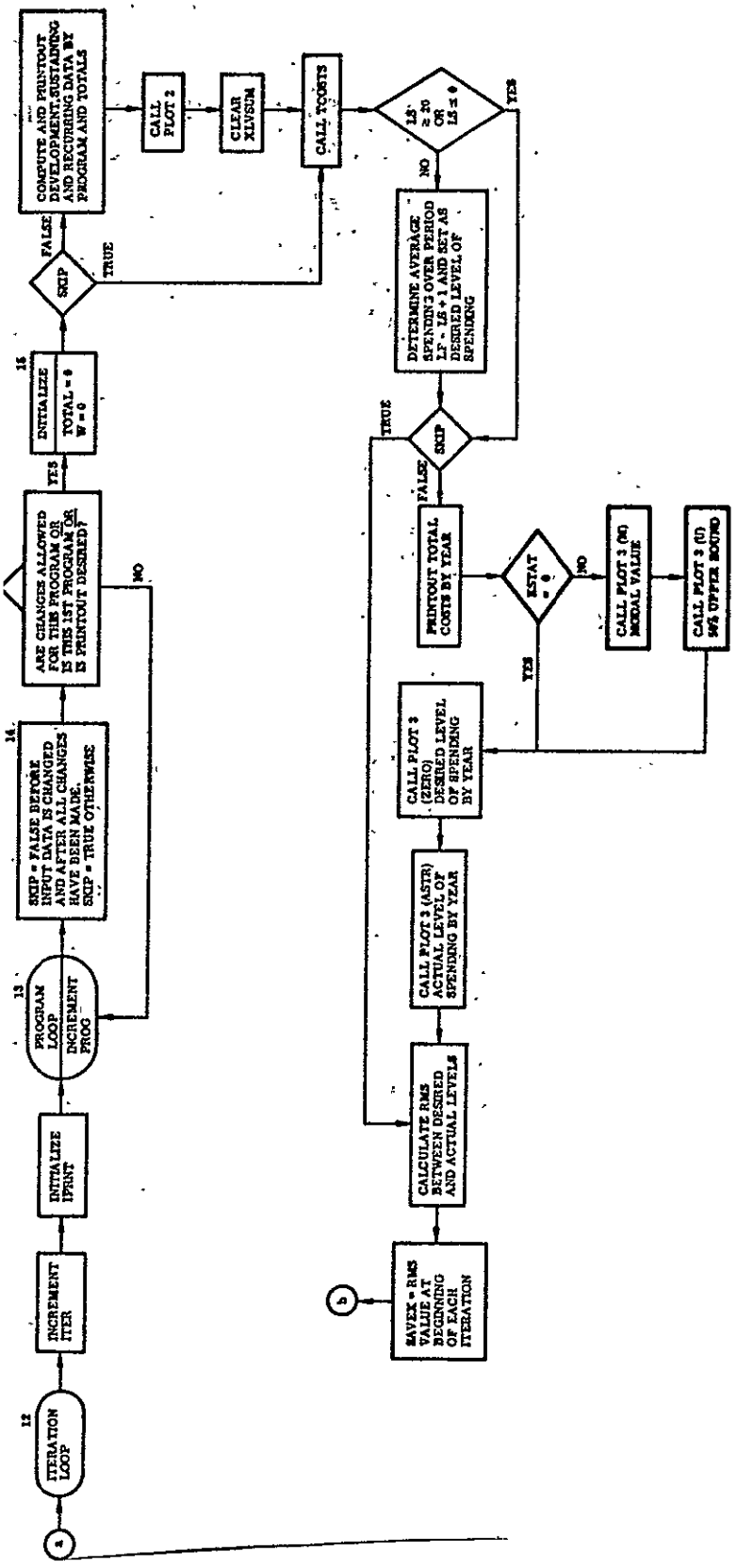


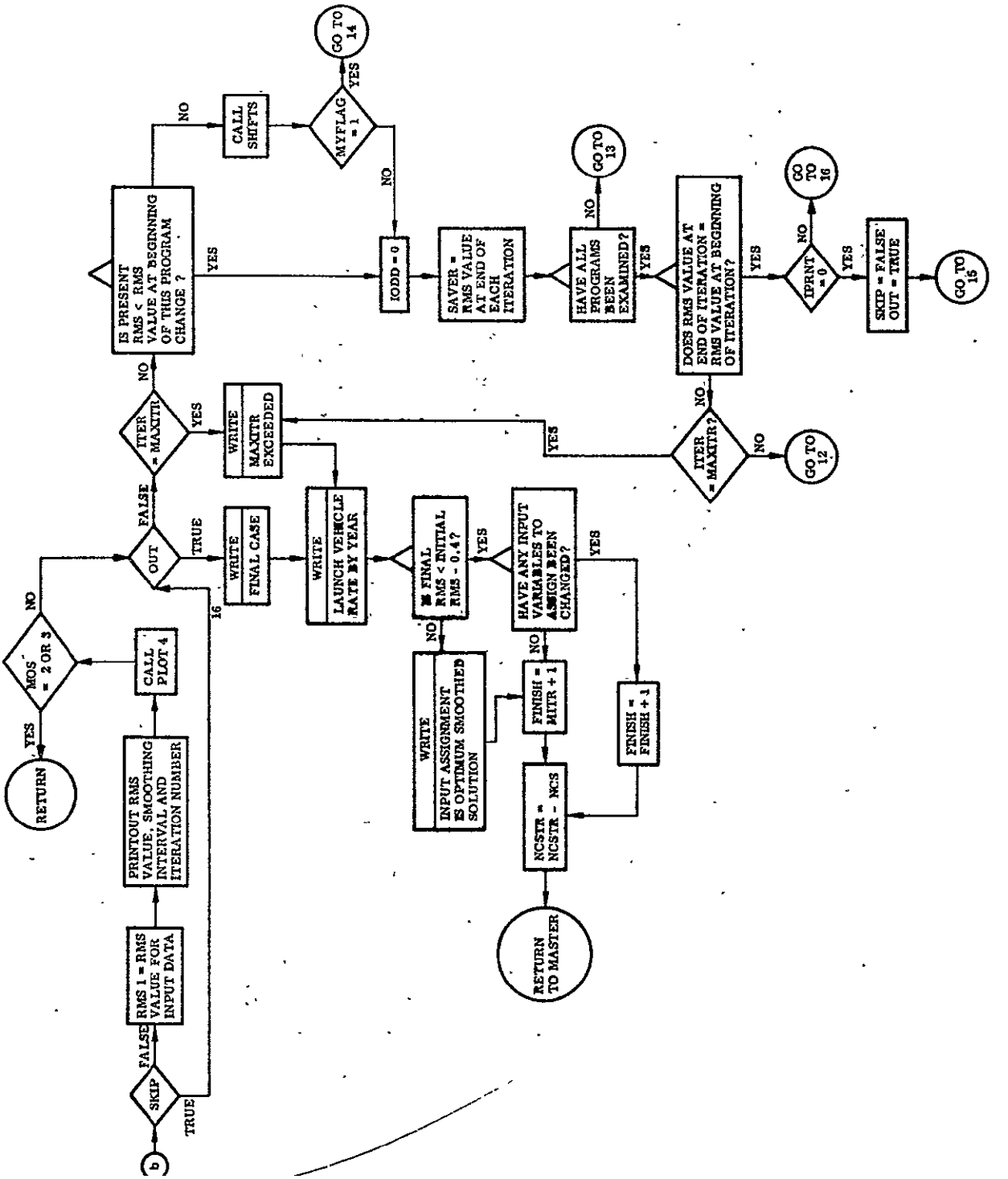

START
12
INCREMENT IODD
COMPUTED GO TO
IODD =
GO TO
1 a
2 b
3 c
4 d
5 e
6 f
7 g
a
INCREMENT DEVELOPMENT START DATE S = S + 1
CALL CONSTR
15
S < TREF?
YES
GO TO 12
NO
IERR = 0
YES
13
MYFLAG = 1
RE-TURN
NO
GO TO 12
b
DECREMENT DEV. START DATE S = S - 1
c
RESTORE ORIGINAL DEV. START DATE
IS DEV. DURATION R = 0?
YES
GO TO 15
NO
SAVE ORIGINAL DATA
INCREMENT DEV. DURATION R = R + 1 AND MAKE ASSOCIATED CHANGES
14
IS NLVP = 0
YES
NO
CALL REVLIS
CALL CONSTR
IERR = 0
NO
GO TO 12
YES
ΔR = ORIGINAL R - NEWR
= 0
KEEP ORIGINAL DEV. COST
< 0
CALCULATE STRETCHED OUT DEV. COST
> 0
CALCULATE ACCELERATED DEV. COST
NYRSST = 0
YES
GO TO 13
NO
REDEFINE SUSTAINING DURATION AND SUSTAINING COSTS


d
EXT
TRUE
FALSE
GO TO 12
DECREMENT START DATE S = S - 1
KEEP INCREMENTED DEVELOPMENT DURATION R = R + 1
S < TREF
YES
GO TO 12
NO
GO TO 14
e
RESTORE ORIGINAL START DATE
NEW R = ORIGINAL R AND ~ ACCL
TRUE
GO TO g
FALSE
DECREMENT DEVELOPMENT DURATION R = R - 1
GO TO 14
f
EXT
TRUE
FALSE
GO TO 12
INCREMENT START DATE S = S + 1
KEEP DECREMENTED DEVELOPMENT DURATION
GO TO 14
g
RESTORE ORIGINAL VALUES – NO ALLOWABLE CHANGES RESULTED IN RMS DECREASE
15
MYFLAG = 0
RETURN

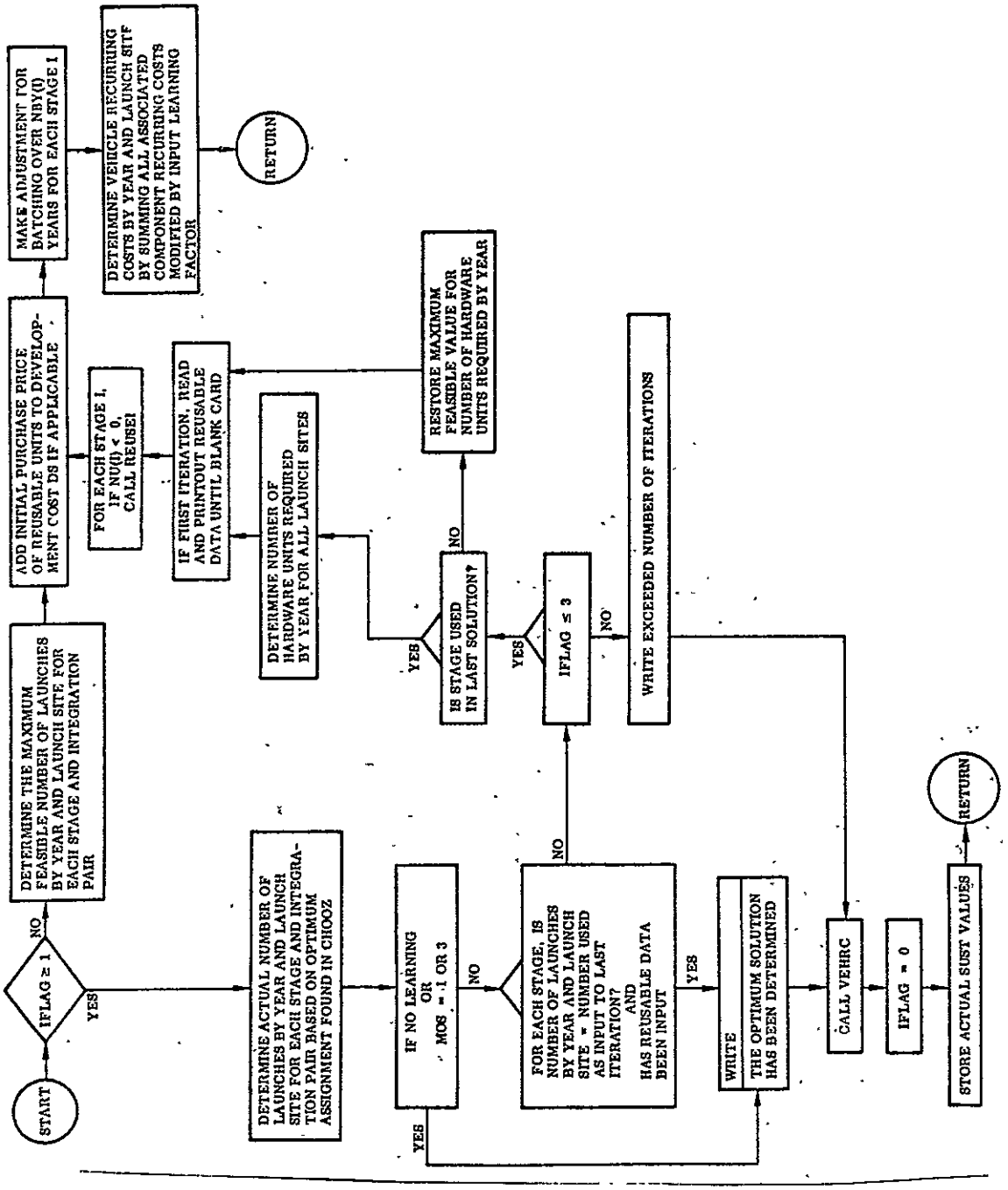
SUBROUTINE SMOTHS



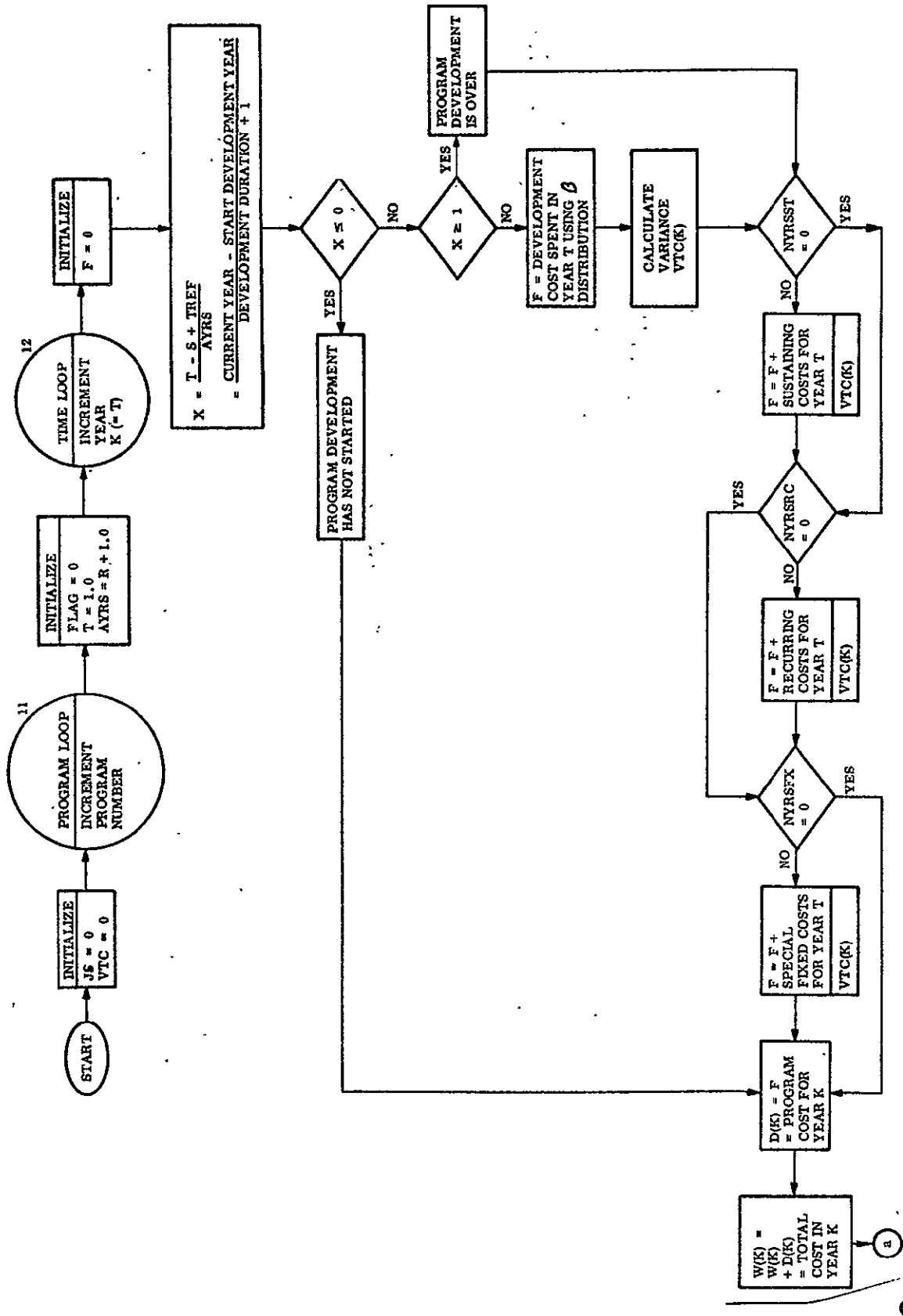

12
ITERATION LOOP
INCREMENT ITER
INITIALIZE IPRNT
13
PROGRAM LOOP
INCREMENT PROG
SKIP = FALSE BEFORE INPUT DATA IS CHANGED AND AFTER ALL CHANGES HAVE BEEN MADE. SKIP = TRUE OTHERWISE
ARE CHANGES ALLOWED FOR THIS PROGRAM OR IS THIS 1ST PROGRAM OR IS PRINTOUT DESIRED?
YES
NO
15
INITIALIZE
TOTAL = 0
W = 0
SKIP
FALSE
TRUE
COMPUTE AND PRINTOUT DEVELOPMENT-SUSTAINING AND RECURRING DATA BY PROGRAM AND TOTALS
CALL PLOT 2
CLEAR XLVSEM
CALL TCOSTS
LS ≥ 20 OR LS = 0
YES
NO
DETERMINE AVERAGE SPENDING OVER PERIOD LF - LS + 1 AND SET AS DESIRED LEVEL OF SPENDING
SKIP
TRUE
FALSE
PRINTOUT TOTAL COSTS BY YEAR
ESTAT = 0
NO
YES
CALL PLOT 3 (M) MEDIAL VALUE
CALL PLOT 3 (U) 95% UPPER BOUND
CALL PLOT 3 (ZERO) DESIRED LEVEL OF SPENDING BY YEAR
CALL PLOT 3 (ASTR) ACTUAL LEVEL OF SPENDING BY YEAR
CALCULATE RMS BETWEEN DESIRED AND ACTUAL LEVELS
SAVEX = RMS VALUE AT BEGINNING OF EACH ITERATION
a
a

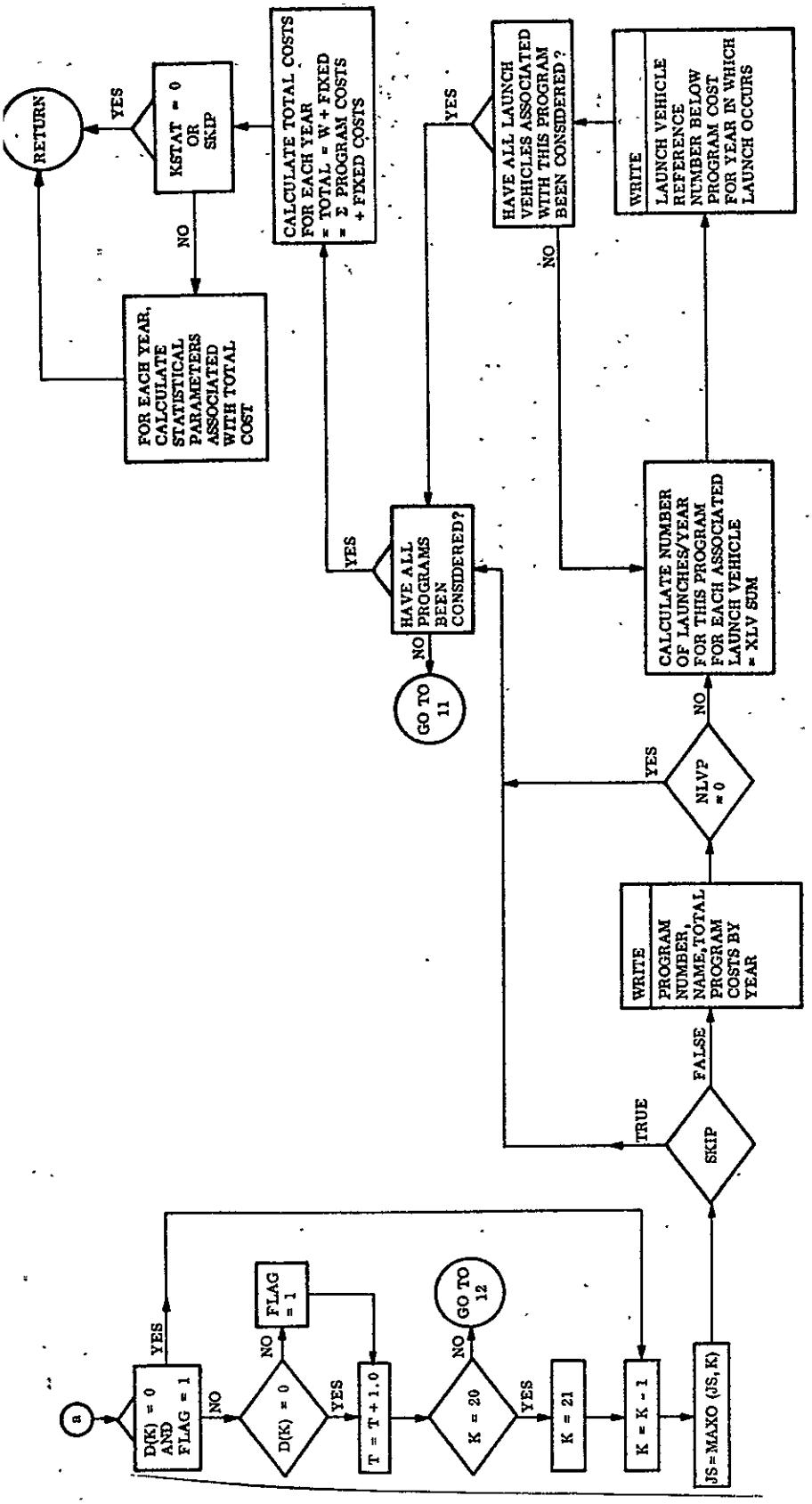

SKIP
FALSE
TRUE
RMS 1 = RMS VALUE FOR INPUT DATA
PRINTOUT RMS VALUE, SMOOTHING INTERVAL AND ITERATION NUMBER
CALL PLOT 4
MOS = 2 OR 3
YES
NO
RETURN
OUT
FALSE
TRUE
WRITE FINAL CASE
WRITE LAUNCH VEHICLE RATE BY YEAR
ITER = MAXITR
YES
NO
WRITE MAXITR EXCEEDED
IS PRESENT RMS < RMS VALUE AT BEGINNING OF THIS PROGRAM CHANGE ?
NO
YES
CALL SHIFTS
MYFLAG = 1
YES
NO
GO TO 14
IODD = 0
SAVER = RMS VALUE AT END OF EACH ITERATION
HAVE ALL PROGRAMS BEEN EXAMINED?
NO
YES
GO TO 13
DOES RMS VALUE AT END OF ITERATION = RMS VALUE AT BEGINNING OF ITERATION?
YES
NO
IPRNT = 0
NO
YES
GO TO 16
SKIP = FALSE
OUT = TRUE
GO TO 15
ITER = MAXITR?
NO
YES
GO TO 12
IS FINAL RMS < INITIAL RMS - 0.4?
YES
NO
HAVE ANY INPUT VARIABLES TO ASSIGN BEEN CHANGED?
YES
NO
WRITE INPUT ASSIGNMENT IS OPTIMUM SMOOTHED SOLUTION
FINISH = MITR + 1
FINISH = FINISH + 1
NCSTR = NCSTR - NCS
RETURN TO MASTER
16

SUBROUTINE STGNMI

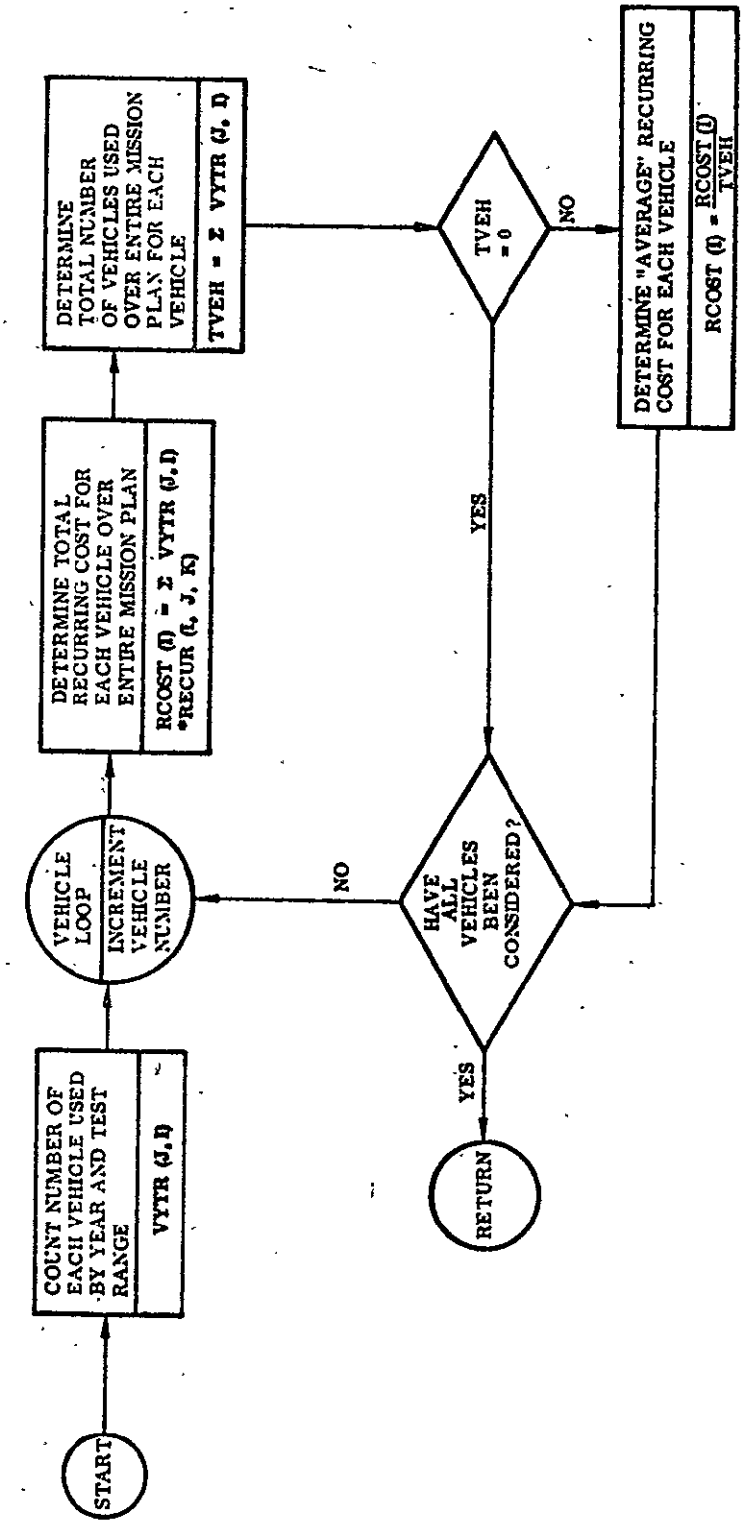


SUBROUTINE TCOSTS




a
D(K) = 0 AND FLAG = 1
YES
NO
D(K) = 0
NO
FLAG = 1
YES
T = T + 1.0
K = 20
NO
GO TO 12
YES
K = 21
K = K - 1
JS = MAXO (JS, K)
SKIP
TRUE
FALSE
WRITE PROGRAM NUMBER, NAME, TOTAL PROGRAM COSTS BY YEAR
NLV? ≠ 0
YES
NO
CALCULATE NUMBER OF LAUNCHES/YEAR FOR THIS PROGRAM FOR EACH ASSOCIATED LAUNCH VEHICLE = XLV SUM
WRITE LAUNCH VEHICLE REFERENCE NUMBER BELOW PROGRAM COST FOR YEAR IN WHICH LAUNCH OCCURS
HAVE ALL LAUNCH VEHICLES ASSOCIATED WITH THIS PROGRAM BEEN CONSIDERED?
YES
NO
HAVE ALL PROGRAMS BEEN CONSIDERED?
YES
NO
GO TO 11
CALCULATE TOTAL COSTS FOR EACH YEAR = TOTAL = W + FIXED = Σ PROGRAM COSTS + FIXED COSTS
KSTAT = 0 OR SKIP
YES
NO
RETURN
FOR EACH YEAR, CALCULATE STATISTICAL PARAMETERS ASSOCIATED WITH TOTAL COST

SUBROUTINE VEHRC



Appendix D
PROGRAM LISTING

D.1 DESCRIPTION

A compile-and-save Fortran listing of each major subroutine in the optimal assignment/budget smoothing program is included in this section. Storage requirements for each subroutine are listed on the output along with the code name under which the subroutine was saved. Total storage requirements are listed at the beginning of the sample case presented in Appendix B. Comment cards describing the logical function of each subsection and defining any variables whose names are not mnemonic are liberally distributed throughout the deck so that new users may readily become familiar with the programs.

Subroutines INPUT and PLOT are stored for general NASA use. Therefore, no listing is included here; however, a description of each is provided in Appendix C for completeness. Subroutines AFRMT and PACK are written in 360 assembler language, so the listings are provided in that language.

Labeled common blocks were used for storage whenever possible to avoid long argument lists for each subroutine. These blocks are found at the beginning of each listing. Subroutine ASIGNS lists all subroutines in which each common block appears. The block labeled SCRACH stores variables only required in that subroutine or related subroutines, so the same storage locations may be used for storing new variables in the next subroutine. All other labeled common blocks contain variables used in several subroutines.

The listings are presented in alphabetical order according to subroutine name for easy reference.

D.2 COMPILE-AND-SAVE LISTING

The compile-and-save listing follows.

```
                                                EXTERNAL SYMBOL DICTIONARY
SYMBOL   TYPE ID  ADDR   LENGTH LD ID

AFRMT     SD  01 000000 000040
```

```
 LOC  OBJECT CODE    ADDR1 ADDR2  STMT   SOURCE STATEMENT

000000                              1 AFRMT   CSECT
000000                              2         USING  *,15          REG 15 FOR BASE
000000 5020 D01C              0001C 3         ST     2,28(0,13)    SAVE REG 2
000004 9812 1000              00000 4         LM     1,2,0(1)      LOAD ADDRESSES OF ARGS TO REGS 1-2
000008 5810 1000              00000 5         L      1,0(0,1)      DATA TO REG 1
00000C 4E10 F038              00038 6         CVD    1,WORK        CONVERT TO DECIMAL
000010 F332 2000 F03D 00000 0003D   7         UNPK   0(4,2),WORK+5(3)   UNPACK 4 DIGITS
000016 96F0 2003      00003         8         OI     3(2),X'F0'    INSERT ZONES
00001A 4110 0004              00004 9         LA     1,4
00001E 95F0 2000      00000        10 LOOP    CLI    0(2),C'0'     SCAN OUT LEADING ZEROS
000022 4770 F032              00032 11        BNE    RETURN
000026 9240 2000      00000        12         MVI    0(2),C' '     INSERT BLANK
00002A 4120 2001              00001 13        LA     2,1(0,2)      BUMP POINTER
00002E 4610 F01E              0001E 14        BCT    1,LOOP        LIMIT TO 4 CHARACTERS
000032 5820 D01C              0001C 15 RETURN  L      2,28(0,13)    RESTORE REG 2
000036 07FE                        16         BR     14            RETURN
000038                             17 WORK    DS     D
                                   18         END
```

```
                                CROSS-REFERENCE

 SYMBOL     LEN   VALUE  DEFN     REFERENCES

 AFRMT      00001 000000 0001
 LOOP       00004 00001E 0010     0014
 RETURN     00004 000032 0015     0011
 WORK       00008 000038 0017     0006  0007


 NO STATEMENTS FLAGGED IN THIS ASSEMBLY
    32 PRINTED LINES
```

```
  F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,NCAL
            VARIABLE OPTIONS USED - SIZE=(126976,24576)          DEFAULT OPTION(S) USED
 IEW0000      NAME MOXO2AT(R)
 ****MOXO2AT   NOW REPLACED IN DATA SET
```

```
FORTRAN IV G LEVEL 1, MOD 4            ASIGNS          DATE = 71084        15/15/24          PAGE 00

0001                SUBROUTINE ASIGNS
                C
                C     THIS PROGRAM GENERATES THE LEAST COST ASSIGNMENT OF LAUNCH
                C     VEHICLES TO SPACE MISSIONS.  A BRANCH AND BOUND TECHNIQUE IS USED
                C     TO REDUCE THE COMBINATORIAL COMPLEXITY OF THE PROBLEM. SEVERAL BRANCHE
                C     ARE CREATED AT EACH NODE.  ONE OF THE BRANCHES EXCLUDES THE NEXT
                C     COST AND THE OTHERS    ASSUME EXPENDITURE OF A NON-RECURRING COST
                C     WITH 1-2 YEARS OF SUSTANING COST ADDED AT EACH NODE.
                C     PENALTY FUNCTIONS ARE USED TO SHARPEN THE LOWER BOUND.
                C ****THIS VERSION USES RATE EFFECTS IN RECURRING COSTS****
                C*****THIS VERSION INCORPORATES PAD COSTS AND REUSABLE PARAMETERS******
                C
0002                DOUBLE PRECISION NAME
0003                REAL NPERPD
0004                LOGICAL EXT,ACCL
0005                INTEGER*2   YDPL,NSYR,NSFX,NRFX,NYRSST,NSTRFX,NPROG,KPROG,KODE,
                   1 NYRSFX,KODEM,KODESP,NU,NBY,MODE,NOB,FINISH,NSTG,NFML,NFMU,KODS,
                   2  MAS,LABS,LABF,LABI,LSA,NYS,KODEF,LST,MST,IST,JST,KST,VEH,NYD,
                   3  NMULT,NONREC,IS,MAT,LYR,LETT,LYD,MIN,NVS,MRV,NRP,NYP,KODEP,
                   4  IVEHA,NTRIP,NPLS,NRR,MR,NPSTG,NPAD,NPFAM,NFS,NPINTL,NPINTU,MAPS,
                   5 MAPF,MAPI,KOUT,LTR,KODEV,NINTYR,NTGYTR,MAF,MAIC
                C
                C' STORAGE FOR TCOST, ASSIGN, AND MASTER AND SMOOTH,DATINS
0006                COMMON/SAVER/  RFIXD(12,84)
                C  STORAGE FOR DECISN, MATCH, PRINT AND ASSIGN,DATINS
0007                COMMON/SAVDMP/ NFAM,KFLAG,FAM(30),KODEF(30),FMNR(30),FMSUS(30),
                   1JST(30),YDF(30),LSA(40),SNR(40),NYS(40),DINT(40),SINT(40),KST(40),
                   2  YDI(40),YDS(40),IST(40),FMSLS(30,2),SUSLS(40,2),SINTLS(40,2),
                   3  LST(30,5),YDPF(30,5),MST(30,10),YDPS(30,10)
                C  STORAGE FOR ASSIGN, STGNUM, AND REUSE,DATINS, COMPARE
0008                COMMON/SAVSAR/ POJ(3),SRJ(3,3),NU(40),NBY(40),NOB(40),RINT(40),
                   1   PLCINT(40),XLT(40), PLCT(40),UPP(40),TAT(40),TAMT(50),SR(40,3),
                   2   MODF(40,3),PLC(40,3)
                C   STORAGE FOR MASTER,ASSIGN,DECISN,STGNUM,SMOOTH,AVAIL,MATCH,PRINT,CAPABL,
                C       AND OUTPUT AND PDCSTI,DATINS, COMPARE,TCOSTS
0009                COMMON/SAVE1/ FINISH,NSTG,NCI,ILY,LABF(30),LABS(40),LABI(40),
                   1 NFML(40),NFMU(40),KODS(40),STS(41),STG(40),VLR(50),WPR(50),
                   2  RPLM(50),MAS(40,3), RXD(12,50)
                C  STORAGE FOR MASTER,ASSIGN,SMOOTH,TCOST,OUTPUT,SHIFT,CONSTR,DATINS
0010                COMMON/SAV2/EXT,ACCL,KNSTG,KNFAM,KNCI,KNP,KNMIS,JFLAG,TREF,NCSTR,
                   1 PMAX,PMIN,ISTRT,IFIN,MAXITR,MITR,KODESP(6),TITLE(10),LEVEL(20),
                   2  CNTRVL(20),FIXED(20),KODEM(50),NSYR(50),NSFX(50),NAME(56),
                   3  YDPL(56),NRFX(50),NYRSST(84),NSTRFX(84),NYRSFX(84),SUS(84),C(84)

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                   4,  R(84), S(84),CS(90),NPROG(90),KPROG(90), KODE(90)
                C   STORAGE FOR ASSIGN,CHOOZ,LBOUND,DECISN,PADCST,CAPABL,STGNUM,MASTER,SMOOTH,
                C       PRINT, REVALU,TCOST, VEHREC ,MATCH1,DATINS, COMPARE
0011                COMMON/SAV3/GRO,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                   1   PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
                C   STORAGE FOR ASSIGN,PDCST,CAPABL,DECISN,MATCH,PRINT,STGNUM,DATINS,COMPARE
0012                COMMON/SAV4/  MAF(30,3), MAIC(40,3),
                   *                NPAD(2,60),NPFAM(30,5),NPINTL(30,5),NPINTU(30,5),
                   1  NFS(40,4),NPSTG(30,10),MAPS(30,10),MAPF(30,10),MAPI(30,10),
                   2  PFAMD(30,5,2),PFAMS(30,5,2),PINTS(30,5,2),PSTGD(30,10,2),
                   3   PSTGS(30,10,2)
                C   STORAGE FOR ASSIGN,CAPABL, AND AVAIL,DATINS
0013                COMMON/SVACAV/  KNV,NOPT,KODEP(30),RPLO(40),IVEHA(50),NTRIP(50),
                   1  NPLS(50),NRR(50),MR(50),NVS(60),MRV(60),NRP(60),B1(60),B2(60),
                   2  B3(60),B4(60),KODEV(60),NYP(2,60),VM(2,60)
                C    STORAGE FOR MASTER,CHOOZ,ASSIGN,STGNUM,PADCST,LBOUND,REUSE,VEHREC,
                C   OUTPUT,AVAIL,CAPABL,MATCH,SMOOTH,DECISN,PRINT,DATINS,COMPARE,REVALU,TCOSTS
0014                COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                   1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                   2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
                C   TEMPORARY STORAGE FOR ASSIGN,CHOOZ,STGNUM,LBOUND,VEHREC,AVAIL,PADCST
                C  DATINS, COMPARE
0015                COMMON/TEMP/VNM(2,250),IFLAG,KI,NEXT,LOUT,SAVS(40),KOUT(40),
                   1  NINTYR(40,20),NTGYTR(40,20,2),RECUR(60,20,2)
                C  OVERLAY STORAGE
0016                COMMON/SCRACH/  IP,IV,IG,MODX(3),NFX(4),NPFAX(5),LSX(5),NPINXL(5),
                   1  NPINXU(5),NPSTX(10),MSX(10),LZ(20),PB(50),MISN(50,20),DUM(1382),
                   2  RCOST(60),RXM(50),II,KNSP,KLCK,IM,DUMM(4192)
                C
0017                NEXD = 0
0018                IFLAG = 0
0019                KFLAG = 0
0020                IF(FINISH.GT.1)  GUESS = 1.75*GUESS
0021                IF(FINISH.GT.1)  GO TO 17
0022                KNV = 100
0023               11 NSTG = 0
0024                NFAM = 0
0025                NCI = 0
0026                NMIS = 0
0027                NSPR = 0
0028                NUMD = 1
0029                NP = 0
0030                NV = 0
```

```
            C  LCK = LEARNING CURVE KODE: = 1 IF HAVE LEARNING CURVE EFFECTS; =0 IF NONE
0031                LCK = 0
            C
0032                CALL DATINS
            C
0033                IF(MYRS.EQ.0)  RETURN
0034                IF(IM.LT.0)  GO TO 3000
            C
            C       ***SET UP MISSION MATRIX BY YEAR***
0035                NM = 0
0036                DO 4 I = 1,NMIS
0037                DO 4 J=1,MYRS
0038                IF(MISN(I,J).EQ.0) GO TO 4
0039                NM = NM + 1
0040                YRLM(NM)= FLOAT(MISN(I,J)) * PB(I)
0041                LETT(NM)= I
0042                LYR(NM) = J
0043              4 CONTINUE
            C
0044           3000 IF(GUESS.GT.1.0)  GO TO 3005
0045                GUESS = 1.0E15
            C
0046           3005 CALL CAPBLI
            C
0047             16 WRITE(6,2001) NSTG,NV,NFAM,NCI,NP,NMIS,MYRS,ILY,GUESS,NOPT,NSOL,
                    1  GRO
0048                IF(LCK.EQ.0)  GO TO 17
            C       CALCULATE EXPONENT FOR LEARNING CURVE
0049                ALOG2 = ALOG(2.)
0050                IF (IG.LT.0) GO TO 8030
0051                DO 660 I=1,NSTG
0052                DO 660 J=1,3
0053                IF (MODE(I,J).EQ.0.AND.PLC(I,J).GT..001)
                   1PLC(I,J) = ALOG(PLC(I,J))/ALOG2
0054             660 CONTINUE
0055            8030 IF(I1.LT.0.OR.NCI.EQ.0)  GO TO 17
0056                DO 680 I=1,NCI
0057                IF(PLCINT(I).GT..001)
                   1PLCINT(I) = ALOG(PLCINT(I))/ALOG2
0058             680 CONTINUE
            C
0059              17 IF(NUMD.EQ.0)  GO TO 305
            C
```



```
0060                CALL DECSNI
            C
0061                IF(KFLAG.EQ.1)  GO TO 1
            C
0062             305 CALL AVAILI
            C
            C
0063                CALL STGNMI
            C
0064                GUESS1 = GUESS
            C
0065             620 CALL CHOOZS
            C
0066                IF(NEXT.GE.500.OR.GUESS.LT..001)  GO TO 2
            C         IFLAG = NUMBER OF TIMES CHOOZ HAS BEEN CALLED
0067                IFLAG = IFLAG + 1
            C
0068                CALL STGNMI
            C
0069                GUESS = GUESS1
0070                IF(IFLAG.EQ.0)  GO TO 1
0071                IF(IFLAG.EQ.100)  GO TO 2
0072                GO TO 620
0073              2 MYRS = 100
0074              1 KNSTG = NSTG
0075                KNFAM = NFAM
0076                KNCI = NCI
0077                KNP = NP
0078                KLCK = LCK
0079                KNMIS = NMIS
0080                KNV = NV
0081                KNSP = NSPR
0082                RETURN
0083           2001 FORMAT (17H1NUMBER OF STAGES,8X,I5/19HONUMBER OF VEHICLES,6X,I5/
                    1  19HONUMBER OF FAMILIES,6X,I5/28HONUMBER OF INTEGRATION COSTS,I2/
                    X  24HONUMBER OF PAD COMPLEXES,4X,I2/
                    2  19HONUMBER OF MISSIONS,6X,I5/16HONUMBER OF YEARS,9X,I5/
                    3  17HOLAUNCH BASE YEAR,8X,I5/15HOTOTAL ESTIMATE,F17.2/14HOOPTION N
                   4UMBER,   11X,I5/  20HONUMBER OF SOLUTIONS,5X,I5/ 17HOINFLATION FAC
                   5TOR,12X,F4.3)
0084                END
```

```
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  TOTAL MEMORY REQUIREMENTS 00088A BYTES


 F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,NCAL,MAP
          VARIABLE OPTIONS USED - SIZE=(126976,24576)          DEFAULT OPTION(S) USED
IEW0000       NAME MOX02AS(R)
IEW0461  DATINS
IEW0461  CAPBLI
IEW0461  IBCOM=
IEW0461  DECSNI
IEW0461  AVAILI
IEW0461  STGNMI
IEW0461  CHOOZS
IEW0461  ALOG

                                                  MODULE MAP

  CONTROL SECTION                    ENTRY
    NAME     ORIGIN  LENGTH            NAME   LOCATION     NAME   LOCATION     NAME   LOCATION     NAME
  ASIGNS        00     88A
  SAVER        8C0     FC0
  SAVOMP      1880    148C
  SAVSAR      2040     A58
  SAVE1       3798     FC4
  SAV2        4760     FE0
  SAV3        5740     980
  SAV4        60C0    3188
  SVACAV      9248     B48
  SAVALL      9D90    3A1C
  TEMP        D7B0    4110
  SCRACH     118C0    6A60

 ENTRY ADDRESS       00
 TOTAL LENGTH     18320

****MOX02AS   NOW REPLACED IN DATA SET

                                          DIAGNOSTIC MESSAGE DIRECTORY

   IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.
```

```
(17)          OS/360  FORTRAN H                              DATE  71.084/15.16.42

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
   ISN 0002            SUBROUTINE AVAILI
                  C    *** ADD AVAILABILITY TO VEHICLE CAPABILITY MATRIX***
   ISN 0003            REAL NPERPD
   ISN 0004            INTEGER*2 NVS,MRV,NRP,NYP,KODEP,IVEHA,NTRIP,NPLS,NRR,MR,KODEV,
                      1 FINISH,NSTG,NFML,NFMU,KODS,MAS,LABS,LABF,LABI,VEH,NMULT,NONREC,
                      2  NYD,IS,MAT,LYR,LETT,LYD,MIN,LTR
   ISN 0005            COMMON/SAVE1/ FINISH,NSTG,NCI,ILY,LABF(30),LABS(40),LABI(40),
                      1 NFML(40),NFMU(40),KODS(40),STS(41),STG(40),VLR(50),WPR(50),
                      2  RPLM(50),MAS(40,3), RXD(12,50)
   ISN 0006            COMMON/SAV3/GRO,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPO(30),
                      1   PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
   ISN 0007            COMMON/SVACAV/  KNV,NOPT,KODEP(30),RPLO(40),IVEHA(50),NTRIP(50),
                      1  NPLS(50),NRR(50),MR(50),NVS(60),MRV(60),NRP(60),B1(60),B2(60),
                      2  B3(60),B4(60),KODEV(60),NYP(2,60),VM(2,60)
   ISN 0008            COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                      1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                      2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
   ISN 0009            COMMON/TEMP/ VNM(2,250),IFLAG,LZ(60),DUM(3603)
                  C
   ISN 0010                DO 39 J = 1,NM
   ISN 0011                KO = LYR(J)
   ISN 0012                L = LETT(J)
   ISN 0013                DO 35 I = 1,NV
   ISN 0014                LZ(I) = 0
   ISN 0015                IF(ITEM(VM(1,I),L,1).EQ.0)  GO TO 35
   ISN 0017                K = I
   ISN 0018                IF(LTR(L).EQ.2)  K = I & NV
   ISN 0020                DO 36 M = 1,20
   ISN 0021                IF(NONREC(K,M).EQ.0)  GO TO 37
   ISN 0023                NO = NONREC(K,M)
   ISN 0024                IF(KO.LT.NYD(NO))  GO TO 35
   ISN 0026                IF(KO.GT.LYD(NO))  GO TO 35
   ISN 0028             36 CONTINUE
   ISN 0029             37 LZ(I) = 1
   ISN 0030             35 CONTINUE
   ISN 0031                CALL PACK(LZ,VNM(1,J),NV,1)
   ISN 0032             39 CONTINUE
                  C    NM LESS THAN 136 FOR PRESENT FORMATS
   ISN 0033            284 WRITE (6,4000)
   ISN 0034                DO 421 ITER = 1,3
   ISN 0035                KNM = MIND(ITER*45,NM)
   ISN 0036                K = 1 & (ITER - 1)*45

   ISN 0037            285 WRITE(6,4002)  (LETT(J), J = K,KNM)
   ISN 0038                DO 420 I = 1,NV
   ISN 0039                IA=VEH(1,I)
   ISN 0040                IB=VEH(2,I)
   ISN 0041                IC=VEH(3,I)
   ISN 0042                ID=VEH(4,I)
   ISN 0043                DO 286 J = K,KNM
   ISN 0044                L = J-K&1
   ISN 0045            286 LZ(L)      = ITEM(VNM(1,J),I ,1)
   ISN 0046                WRITE(6,4100)I,STG(IA),STG(IB),STG(IC),STG(ID),(LZ(J), J=1,L)
   ISN 0047            420 CONTINUE
   ISN 0048                IF(NM.LE.KNM)  RETURN
   ISN 0050                IF(ITER.EQ.1)  WRITE(6,4001)
   ISN 0052                IF(ITER.EQ.2)  WRITE(6,4003)
   ISN 0054            421 CONTINUE
   ISN 0055                RETURN
   ISN 0056           4000 FORMAT (1H1,34X,51HV E H I C L E / M I S S I O N   C A P A B I L I
                      1 T Y/46X,30H(1 = POSSIBLE, 0 = IMPOSSIBLE)/1H0,43X,10(2H1 ),
                      2  10(2H2 ),10(2H3 ),6(2H4 )/18H VEHICLE / MISSION,9X,4(20H1 2 3 4
                      35 6 7 8 9 0 ),9H1 2 3 4 5//)
   ISN 0057           4001 FORMAT(1H0/ 1H0,26X,4(2H4 ),10(2H5 ),10(2H6 ),10(2H7 ),10(2H8 ),
                      1  2H9 /18H VEHICLE / MISSION,9X,9H6 7 8 9 0,4(20H 1 2 3 4 5 6 7 8
                      29 0)//)
   ISN 0058           4002 FORMAT (1H0,7X,14HMISSION NUMBER,   4X,45I2)
   ISN 0059           4003 FORMAT(1H0/ 1H0,44X,36(2H1 )/ 27X,9(2H9 ),10(2H0 ),10(2H1 ),
                      1 10(2H2 ),6(2H3 )/
                      2   18H VEHICLE / MISSION, 9X,4(20H1 2 3 4 5 6 7 8 9 0 ),
                      3     9H1 2 3 4 5//)
   ISN 0060           4100 FORMAT (1H ,I2,1X,4(A4,1X), 2X,       45I2)
   ISN 0061                END

****** END OF COMPILATION ******
```

```
F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
          VARIABLE OPTIONS USED - SIZE=(126976,24576)                    DEFAULT OPTION(S) USED
IEW0000      NAME MOX02AL(R)
IEW0461  ITEM
IEW0461  PACK
IEW0461  IBCOM=

                                        CROSS REFERENCE TABLE

  CONTROL SECTION                          ENTRY
    NAME    ORIGIN  LENGTH                  NAME   LOCATION     NAME   LOCATION     NAME   LOCATION     NAME
  AVAILI         00     718
  SAVE1         718     FC4
  SAV3        16E0     980
  SVACAV      2060     B48
  SAVALL      2BA8    3A1C
  TEMP        65C8    4110

  LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION          LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION
      2E8           SAVE1          SAVE1                     2EC          SAV3           SAV3
      2F0           SVACAV         SVACAV                    2F4          SAVALL         SAVALL
      2F8           SAVALL         SAVALL                    2FC          TEMP           TEMP
      300           ITEM           $UNRESOLVED               304          PACK           $UNRESOLVED
      308           IBCOM=         $UNRESOLVED               258          TEMP           TEMP
      260           SAVALL         SAVALL
  ENTRY ADDRESS     00
  TOTAL LENGTH    A6D8

****MOX02AL   NOW REPLACED IN DATA SET

                                        DIAGNOSTIC MESSAGE DIRECTORY

   IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.

(17)          OS/360  FORTRAN H                                DATE  71.084/15.17.53

         COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
ISN 0002            SUBROUTINE CAPBLI
                    C   VEHICLE DATA IS INPUT
                    C  THE ORIGINAL CAPABILITY MATRIX BETWEEN VEHICLE AND MISSION IS SET UP
                    C
ISN 0003                REAL ISP,LENT,NPERPD
ISN 0004                INTEGER*2 LTR,KODEV,NVS,MRV,NRP,NYP,KODEP,IVEHA,NTRIP,NPLS,NRR,
                       1  MR,NPSTG,NPAD,NPFAM,NFS,NPINTL,NPINTU,MAPS,MAPF,MAPI,FINISH,
                       2  NSTG,NFML,NFMU,KODS,MAS,LABS,LABF,LABI,VEH,NMULT,NONREC,NYD,
                       3  IS,MAT,LYR,LETT,LYD,MIN,MAF,MAIC
ISN 0005                COMMON/SAVE1/ FINISH,NSTG,NCI,ILY,LABF(30),LABS(40),LABI(40),
                       1 NFML(40),NFMU(40),KODS(40),STS(41),STG(40),VLR(50),WPR(50),
                       2  RPLM(50),MAS(40,3), RXD(12,50)
ISN 0006                COMMON/SAV3/GRO,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                       1   PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
ISN 0007                COMMON/SAV4/  MAF(30,3), MAIC(40,3),
                       *            NPAD(2,60),NPFAM(30,5),NPINTL(30,5),NPINTU(30,5),
                       1  NFS(40,4),NPSTG(30,10),MAPS(30,10),MAPF(30,10),MAPI(30,10),
                       2  PFAMD(30,5,2),PFAMS(30,5,2),PINTS(30,5,2),PSTGD(30,10,2),
                       3   PSTGS(30,10,2)
ISN 0008                COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                       1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                       2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
ISN 0009                COMMON/SVACAV/  KNV,NOPT,KODEP(30),RPLO(40),IVEHA(50),NTRIP(50),
                       1  NPLS(50),NRR(50),MR(50),NVS(60),MRV(60),NRP(60),B1(60),B2(60),
                       2  B3(60),B4(60),KODEV(60),NYP(2,60),VM(2,60)
ISN 0010                COMMON/SCRACH/IP,IV,IG,NPAX(2),NEH(4),NST(41),THRT(41),DIAM(41),
                       1  TSL(41),LENT(41),WTFU(41),WTIN(41),ISP(41),MZ(50),LZ(50),
                       2  NYPX(2),DUM(6369)
                    C
ISN 0011                IF(IV.LT.0)  GO TO  14
ISN 0013                DO 2 I = 1,60
ISN 0014                ALPI(1,I) = .05
ISN 0015                ALPI(2,I) = .20
ISN 0016                ALPI(3,I) = .50
ISN 0017              2 ALPI(4,I) = .25
ISN 0018             14 DO 281 J = 1,61
ISN 0019                IF(IV.LT.0.AND.J.GT.KNV) RETURN
ISN 0021                IF(IV.LT.0.AND.IG.LT.0)  GO TO 27
ISN 0023                IF(IV.LT.0)  GO TO 15
ISN 0025                READ(5,106) (NEH(I), I=1,4),B1(J),B2(J),B3(J),B4(J),KOV
ISN 0026                IF(KOV.EQ.0)  GO TO 5002
ISN 0028                KODEV(J) = KOV
```

```
ISN 0029            DO 16 K = 1,4
ISN 0030          16 VEH(K,J) = NEH(K)
ISN 0031            READ(5,108) NSX,MVX,NPX, (NPAX(I), I=1,2),(NYPX(I), I=1,2), JKEY
ISN 0032            DO 17  I = 1,2
ISN 0033            NPAD(I,J) = NPAX(I)
ISN 0034          17 NYP(I,J) = NYPX(I)
ISN 0035            NVS(J) = NSX
ISN 0036            MRV(J) = MVX
ISN 0037            NRP(J) = NPX
ISN 0038            IF (JKEY.EQ.0) GO TO 15
ISN 0040            READ (5,114) (ALPI(I,J),I=1,4)
ISN 0041          15 DO 26 I = 1,4
ISN 0042            IF(VEH(I,J).EQ.0)  GO TO 27
ISN 0044            DO 25 K = 1,NSTG
ISN 0045            IF(VEH(I,J).NE.KODS(K))  GO TO 25
ISN 0047            VEH(I,J)  = K
ISN 0048            GO TO 26
ISN 0049          25 CONTINUE
ISN 0050          26 CONTINUE
ISN 0051          27 NV = J
ISN 0052            IF(IV.LT.0.AND.(IP.LT.0.OR.NP.EQ.0))  GO TO 9007
ISN 0054            DO 9008 I = 1,2
ISN 0055            IF (NPAD(I,J).EQ.0) GO TO 9008
ISN 0057            DO 9009 K = 1,NP
ISN 0058            IF (NPAD(I,J).NE.KODEP(K)) GO TO 9009
ISN 0060            NPAD(I,J) = K
ISN 0061            GO TO 9008
ISN 0062         9009 CONTINUE
ISN 0063         9008 CONTINUE
ISN 0064         9007 C1 = B1(J)
ISN 0065            C2 = B2(J)
ISN 0066            C3 = B3(J)
ISN 0067            C4 = B4(J)
ISN 0068            DO 28 I=1,NMIS
ISN 0069            NMULT(J,I) = 1
ISN 0070            LZ(I) = 1
ISN 0071            IF (IVEHA(I).EQ.0) GO TO 21
ISN 0073            IF (IVEHA(I).NE.KODEV(J)) GO TO 8024
ISN 0075            GO TO 28
ISN 0076          21 VLX=VLR(I)-25573.
ISN 0077            IF(VLX.GE.C4-.01)  GO TO 8024
ISN 0079            WP=EXP(C1-C2*VLX-C3/(C4-VLX))

ISN 0080            IF(RPLM(I).LT.1.0)  GO TO 23
ISN 0082            DO 22 JJ = 1,4
ISN 0083            JJJ = 5-JJ
ISN 0084            IF(VEH(JJJ ,J).EQ.0)  GO TO 22
ISN 0086            LL = VEH(JJJ ,J)
ISN 0087            IF(RPLO(LL).LT..001)  GO TO 8024
ISN 0089            GO TO 23
ISN 0090          22 CONTINUE
ISN 0091          23 IF(WP.GE.WPR(I))    GO TO 24
ISN 0093            IF(WP.LE..001.OR.WPR(I)/WP.GE.100.)   GO TO 8024
ISN 0095            NMULT(J,I) = INT(WPR(I)/WP & .99)
ISN 0096            IF(NMULT(J,I).GT.NTRIP(I))  GO TO 8024
ISN 0098          24 IF (NOPT.NE.3) GO TO 28
ISN 0100            IF(NPLS(I).EQ.0)  GO TO 8023
ISN 0102            IF(NPLS(I).NE.NVS(J))   GO TO 8024
ISN 0104         8023 IF (NRR(I).GT.NRP(J)) GO TO 8024
ISN 0106            IF (MR(I).EQ.0.OR.MRV(J).EQ.1)  GO TO 28
ISN 0108         8024 LZ(I) = 0
ISN 0109          28 CONTINUE
ISN 0110.           CALL PACK(LZ,VM(1,J),NMIS,1)
ISN 0111         281 CONTINUE
ISN 0112            WRITE(6,113)
ISN 0113          99 RETURN
ISN 0114        5002 IF(NOPT.NE.2)  RETURN
ISN 0116            WRITE(6,111)
                C   CARDS MUST BE IN SAME ORDER AS INPUT STAGE CARDS
                C   ALL STAGES NOT TO BE USED IN MATCHING SCREEN MUST BE AT END OF DATA SET
ISN 0117            NTG = NSTG & 1
ISN 0118            DO 30 I = 1,NTG
ISN 0119            READ(5,109) J,NST(I),THRT(I),DIAM(I),TSL(I),LENT(I),WTFU(I),
                   1  WTIN(I),ISP(I)
ISN 0120            IF(J.EQ.0)  GO TO 31
ISN 0122            WRITE(6,112) I,NST(I),THRT(I),DIAM(I),TSL(I),LENT(I),WTFU(I),WTIN
                   1(I),ISP(I)
ISN 0123            IF(J.NE.KODS(I))   GO TO 5005
ISN 0125          30 CONTINUE
ISN 0126          31 CALL MATEI
ISN 0127        5004 RETURN
ISN 0128        5005 WRITE(6,110)
ISN 0129            RETURN
ISN 0130         106 FORMAT (4I2,4E13.6,18X,I2)
ISN 0131         108 FORMAT(3X,3I2,4I3,58X,I1)
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ISN 0132        109 FORMAT(I4,I5,7F10.0)
ISN 0133        110 FORMAT(27HOSTAGE CARDS IN WRONG ORDER)
ISN 0134        111 FORMAT(1H1,8H STG NST,9X,4HTHRT,9X,4HDIAM,9X,4H TSL,9X,4HLENT,9X,
                   1   4HWTFU,9X,4HWTIN,10X,3HISP//)
ISN 0135        112 FORMAT(1H0,2I4,7F13.2)
ISN 0136        113 FORMAT (28HOMORE THAN 60 VEHICLES INPUT)
ISN 0137        114 FORMAT (3X,4F5.2)
ISN 0138            END

****** END OF COMPILATION ******
```

```
 F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
           VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000      NAME MOX02CI(R)
IEW0461  PACK
IEW0461  MATEI
IEW0461  EXP
IEW0461  IBCOM=
```

CROSS REFERENCE TABLE

CONTROL SECTION NAME	ORIGIN	LENGTH
CAPBLI	00	B30
SAVE1	B30	FC4
SAV3	1AF8	980
SAV4	2478	3188
SAVALL	5600	3A1C
SVACAV	9020	B48
SCRACH	9868	6A60

ENTRY

NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME

LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION	LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION
220	SAVE1	SAVE1	224	SAV3	SAV3
228	SAV4	SAV4	22C	SAV4	SAV4
230	SAV4	SAV4	234	SAVALL	SAVALL
238	SAVALL	SAVALL	23C	SVACAV	SVACAV
240	SCRACH	SCRACH	244	PACK	$UNRESOLVED
248	MATEI	$UNRESOLVED	24C	EXP	$UNRESOLVED
250	IBCOM=	$UNRESOLVED	140	SCRACH	SCRACH
148	SAV3	SAV3			

ENTRY ADDRESS 00
TOTAL LENGTH 105C8

****MOX02CI NOW REPLACED IN DATA SET

DIAGNOSTIC MESSAGE DIRECTORY

```
0001              SUBROUTINE CHOOZS
                C  DETERMINE OPTIMUM VEHICLE TO MISSION ASSIGNMENT
                C
0002              INTEGER*2  KOUT,LTR,VEH,NMULT,NONREC,NYD,IS,MAT,LYR,LETT,LYD,MIN,
                 1  MINOPT,MORE,NSAVE,NADD,  NX,NINTYR,NTGYTR
0003              REAL NPERPD
                C
0004              COMMON/SAV3/GRO,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                 1   PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
0005              COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                 1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                 2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
0006              COMMON/VARNCE/KSTAT,VARI(40),VARF(50),VARM(56),FMVAR(2,30),
                 1  FIVAR(3,40),PLVAR(3,56),SVAR(5,40)
0007              COMMON/TEMP/VNM(2,250),IFLAG,KI,NEXT,LOUT,SAVS(40),KOUT(40),
                 1  NINTYR(40,20),NTGYTR(40,20,2),RECUR(60,20,2)
0008              COMMON/SCRACH/EXTRA,NADD,NX,MORE(50),LZ(46),W(500),W2(500),
                 1 TDS(500),WR(499),Z(500),COST(2,250),MINOPT(246,9),NODE(5,500),
                 2  NPOS,SIGSQ(9),ETC(9),
                 4  NCOST,LB,KX,KZ,NSAVE(10),KEEP(40),MZ(60),DUM
                C
                C
0009              IF(MYRS.GT.10) GO TO 2
0010              KI = 1
0011              KNEX = MYRS
0012              GO TO 7
0013            2 KI = 2
0014              KNEX = (MYRS + 1)/2
                C
                C     ***   INITIALIZE FUNCTIONS   ***
0015            7 NEXT=1
0016              NX=1
0017              KPNX = 10
0018              NADD = 0
0019              NPOS = 0
0020              DO 16 I = 1,NUMD
0021           16 LZ(I) = 15
0022              CALL PACK(LZ,NODE(1,1),NUMD,4)
0023              DO 17 I = 1,8
0024           17 LZOPT(I) = 0
0025              DO 400 I = 1,50
0026          400 MORE(I) = 0
0027              IF(LP.GT.0)  WRITE (6,205)
```



```
                C
                C     ***   FIND W(1) = SUM OF COLUMN MINIMUMS OF FIRST CASE   ***
0028              W(1)=0.0
0029              W2(1) = 0.0
0030              TDS(1) = 0.0
0031              DO 19 J=1,NM
0032              COST(1,J) = 1.0E30
0033              COST(2,J) = 1.0E30
0034              IY = LYR(J)
0035              IF(IY.GT.MYRS)  GO TO 325
0036              JX = LETT(J)
0037              ITR = LTR(JX)
0038              CALL UNPACK(MZ,VNM(1,J),NV ,1)
0039              DO 18 I=1,NV
0040              IF(MZ(I).EQ.0)  GO TO 18
0041              X = NMULT(I ,JX)
0042              CX = YRLM(J)*RECUR(I ,IY,ITR)*X
0043              IF(CX.GE.COST(2,J))  GO TO 18
0044              IF(CX.LT.COST(1,J))  GO TO 176
0045              COST(2,J) = CX
0046              GO TO 18
0047          176 COST(2,J) = COST(1,J)
0048              COST(1,J)  = CX
0049              MIN(J) = I
0050           18 CONTINUE
0051              IF(COST(1,J).LT.1.0E25)  GO TO 20
0052          325 YRLM(J)=0.0
0053              MIN(J) = 0
0054              COST(1,J) = 0.0
0055              COST(2,J) = 0.0
0056           20 W2(I) = W2(I) + COST(2,J)
0057           19 W(I) = W(I) + COST(1,J)
0058              IF(NUMD.NE.0)  GO TO 25
0059              WRITE(6,211)  W(I)
0060          211 FORMAT(1H1//25H PROGRAM RECURRING COST =, F12.2)
0061              RETURN
                C
                C  PRESET SMALL SUST COSTS TO ZERO SO ALGORITHM IGNORES THEM IF MSOL.NE.1
                C   LOUT = NUMBER OF SUST COSTS GT 0 WHICH HAVE BEEN SET TO 0
                C
0062            25 IF(IFLAG.EQ.0)  LOUT = 0
0063              IF(MOS.EQ.0.OR.MOS.EQ.2)  GO TO 26
0064              CALL UNPACK(LZ,NODE(1,1),NUMD,4)
```

```
0065              DO 401 I = 1,NUMD
0066            401 KOUT(I) = I
0067              CALL PDCSTI
0068              WRITE(6,211)  W(1)
                C
0069              CALL OUTPTI
                C
0070              RETURN
0071             26 IF(MSOL.EQ.1)  GO TO 29
0072            177 IF(NSOL.LE.1)  CALL UNPACK(LZ,NODE(1,1),NUMD,4)
0073              IF(IFLAG.GT.0)  GO TO 22
0074              DO 21 I = 1,NUMD
0075             21 KOUT(I) = 0
0076              X = MYRS
0077              G = 8.0/X
0078              IF(GUESS.LT.1.0E14) G = GUESS/(150.0*X)
0079              IF(SLO.GT.0.001)  G = SLO
0080              DO 27 I = 1,NUMD
0081              IF(SUST(I).LT..001)  GO TO 27
0082              IF(SUST(I).GT.G)  GO TO 27
0083              LOUT = LOUT + 1
0084              KOUT(I) = LOUT
0085              SAVS(LOUT) = SUST(I)
0086              SUST(I) = 0.0
0087              IF(DS(I).GE.1.)  GO TO 27
0088              IF(NSOL.LE.1)  LZ(I) = KNEX
0089              IF(NSOL.LE.1)  GO TO 27
0090              KOUT(I) = 0
0091              SUST(I) = SAVS(LOUT)
0092              LOUT = LOUT - 1
0093             27 CONTINUE
0094             28 IF(LOUT.GT.0.AND.NSOL.LE.1)  CALL PACK(LZ,NODE(1,1),NUMD,4)
0095              GO TO 29
0096             22 IF(LOUT.EQ.0.OR.NSOL.GT.1)  GO TO 29
0097              DO 23 I = 1,NUMD
0098              IF(KOUT(I).EQ.0.OR.DS(I).GE.1.)  GO TO 23
0099              LZ(I) = KNEX
0100             23 CONTINUE
0101              CALL PACK(LZ,NODE(1,1),NUMD,4)
                C
                C     ***   PICK COST TO CONSIDER NEXT   ***
0102             29 NCOST = 0
0103              NKEY = 0
```



```
0104              FMAX = -1.0E35
0105              IF (KPNX.NE.NX)
                 1CALL UNPACK (LZ,NODE(1,NX),NUMD,4)
0106             30 DO 35 NIC = 1,NUMD
0107              IF(LZ(NIC).LT.15) GO TO 35
0108              NKEY = NKEY + 1
0109              IF(KPNX.EQ.NX)  GO TO 300
0110              WR(NIC) = 0.0
0111              DO 33 J= 1,NM
0112              IF(YRLM(J).LT..001)  GO TO 33
0113              CALL UNPACK(MZ,VNM(1,J),NV ,1)
0114              CMIN = 1.0E30
0115              KO = LYR(J)
0116              JX = LETT(J)
0117              ITR = LTR(JX)
0118              DO 32 I1 = 1,NV
0119              IF(MZ(I1).EQ.0)   GO TO 32
0120              I = I1
0121              IF(ITR.EQ.2)  I = I1 + NV
0122              DO 31 M = 1, 20
0123              IF(NONREC(I,M).EQ.0)  GO TO 315
0124              NO = NONREC(I,M)
0125              IF(NO.EQ.NIC)  GO TO 32
0126              IF(KI*LZ(NO).LT.KO)  GO TO 32
0127             31 CONTINUE
0128            315 X = NMULT(I1,JX)
0129              CX = YRLM(J)*RECUR(I1,KO,ITR)*X
0130              IF(CX.LT.CMIN)  CMIN = CX
0131             32 CONTINUE
0132              WR(NIC) = WR(NIC) + CMIN
0133             33 CONTINUE
0134            300 PF = WR(NIC) - W(NX)
0135              IF(PF.LT..001)   GO TO 35
0136            301 IF(SUST(NIC).GE..001) DF = DS(NIC)*0.5 + SUST(NIC) + PF
                   1  -1.0E4/(SUST(NIC)**4)
0137              IF(SUST(NIC).LT..001)  DF = 0.5*DS(NIC) + 4.0 + PF
0138              IF(SUST(NIC).LT..001.AND.PF.GT.1.0E10)   DF = 1.0E34
0139              IF(DF.LE.FMAX)  GO TO 35
0140              FMAX = DF
0141              NCOST = NIC
0142             35 CONTINUE
0143             36 IF(NCOST.EQ.0)  GO TO 73
                C
```

```
C     ALLOCATE SPACE FOR NEW NODES
C
0144   295 IF(SUST(NCOST).GE..001)  J=0 + (NYD(NCOST) - 1)/KI
0145       IF(SUST(NCOST).LT..001)   J = KNEX - 1
0146       IF(NEXT.EQ.1)  GO TO 41
0147       DO 40  I = 2,NEXT
0148       K = NEXT + 2 - I
0149       IF(Z(K).LE.GUESS)  GO TO 40
0150       J=J+1
0151       IF(SUST(NCOST).GE..001)  NSAVE(J) = K
0152       IF(SUST(NCOST).LT..001)  NSAVE(1) = K
0153       IF(J.EQ.KNEX) GO TO 44
0154    40 CONTINUE
0155    41 IF(J.EQ.KNEX)  GO TO 44
0156       J=J+1
0157       NEXT=NEXT+1
0158       IF(NEXT.EQ.500) GO TO 74
0159       IF(SUST(NCOST).GE..001)  NSAVE(J) = NEXT
0160       IF(SUST(NCOST).LT..001)  NSAVE(1) = NEXT
0161       GO TO 41
C
C     ***   BRANCH WITH VARYING YEARS OF SUSTAINING COST   ***
0162    44 DO 52 K=1,10
0163       IF(SUST(NCOST).GE..001.AND.K.LT.1+(NYD(NCOST)-1)/KI)  GO TO 52
0164       KX=NSAVE(K)
0165       IF((K-1)*KI.LT.LYD(NCOST)) GO TO 45
0166       W(KX) = 1.0E30
0167       Z(KX) =20.0E30
0168       GO TO 509
0169    45 DO 46 I=1,5
0170    46 NODE(I,KX)=NODE(I,NX)
0171       LZ(NCOST)=K-1
0172       IF(K.EQ.1 + (NYD(NCOST)-1)/KI)   LZ(NCOST) = 0
0173       CALL PACK(LZ,NODE(1,KX),NUMD,4)
0174       LB = K-1
C
0175       CALL LBOND1
C
0176   509 IF(SUST(NCOST).LT..001) GO TO 53
0177       IF(KI*K.GE.MYRS) GO TO 53
0178    52 CONTINUE
C
C     ***   BRANCH INCLUDING NCOST AND ALL SUSTAINING - PUT IN NODE NX   ***
```



```
0179    53 LZ(NCOST) = (LYD(NCOST) + KI - 1)/KI
0180       CALL PACK (LZ,NODE(1,NX),NUMD,4)
0181       IF(W(NX).GT.W(KX)-.0001.AND.W2(NX).GT.W2(KX)-0.0001)  LB= 50
0182       IF(W(NX).GT.W(KX)-.0001.AND.W2(NX).GT.1.0E25.AND.W2(KX)-W2(NX).LT.
          1  1.0E25)  LB= 50
0183       KX = NX
0184       KZ = LYD(NCOST)
C
0185       CALL LBOND1
C
C
C     PICK NEXT NODE FOR BRANCHING AS THE ONE WITH LEAST LOWER BOUND Z
0186    55 KPNX = NX
0187       NX = 1
0188       DO 59  I=2,NEXT
0189       IF(Z(NX).GT.Z(I))  NX = I
0190    59 CONTINUE
0191       IF(Z(NX).LE.GUESS)  GO TO 29
0192       IF(NADD.GT.0)  GO TO 60
0193       WRITE(6,202)
0194       GUESS = 0.0
0195       RETURN
0196    60 WRITE(6,206) Z(NX)
0197       GO TO 109
0198    74 WRITE(6,203)
0199       RETURN
C
0200    73 IF(NKEY.EQ.0)  GO TO 75
0201       DO 37 I = 1,NUMD
0202       IF(LZ(I).EQ.15)  LZ(I) = 0
0203    37 CONTINUE
0204       CALL PACK(LZ,NODE(1,NX),NUMD,4)
C
C              ASSIGN VEHICLE TO MISSION
0205    75 DO 80 J=1,NM
0206       IF(YRLM(J).LT.0.0001)  GO TO 79
0207       CALL UNPACK(MZ,VNM(1,J),NV ,1)
0208       CMIN=1.0E30
0209       KO = LYR(J)
0210       JX = LETT(J)
0211       ITR = LTR(JX)
0212       DO 78 I1 = 1,NV
0213       IF(MZ(I1).EQ.0)  GO TO 78
```

```
0214              I = I1
0215              IF(ITR.EQ.2)  I = I1 + NV
0216              DO 77 K=1,20
0217              IF(NONREC(I,K).EQ.0) GO TO 775
0218              NO =NONREC(I,K)
0219              IF(KI*LZ(NO).LT.KO)      GO TO 78
0220           77 CONTINUE
0221          775 X = NMULT(I1,JX)
0222              CX=YRLM(J)*RECUR(I1,KO,ITR)*X
0223              IF(CX.GE.CMIN) GO TO 78
0224              CMIN=CX
0225              MIN(J)=I1
0226           78 CONTINUE
0227              GO TO 80
0228           79 MIN(J) = 0
0229           80 CONTINUE
0230              IF(NPOS.EQ.0)   GO TO 85
0231              DO 355 I = 1,50
0232              IF(MORE(I).EQ.0)  GO TO 356
0233              IF(MORE(I).EQ.NX)   GO TO 354
0234          355 CONTINUE
0235          356 DO 82 NA = 1,NPOS
0236              DO 81 J = 1,NM
0237              IF(MIN(J).NE.MINOPT(J,NA))  GO TO 82
0238           81 CONTINUE
0239              IF(LP.GT.0)
                 1WRITE(6,204) NX,Z(NX), NA
0240              GO TO 103
0241           82 CONTINUE
0242           85 IF(NP.EQ.0.AND.LOUT.EQ.0)  GO TO 86
               C
0243          354 CALL PDCSTI
               C
0244              IF(GUESS.LT..001)  GO TO 109
0245              IF(Z(NX).GT.19.0E30)  GO TO 55
0246              IF(EXTRA.LT.1.0)  GO TO 86
0247              IF(NPOS.GE.9)   GO TO 55
0248              GUESS = 2.0*Z(NX)
0249              NPOS = 1 + NPOS
0250              DO 319 I = 1,NM
0251          319 MINOPT(I,NPOS) = MIN(I)
0252              GO TO 55
0253           86 NADD = NADD + 1
```



```
0254              NBDD = NADD
0255              NPOS = MAXO(NBDD,NPOS)
0256              DMIN = Z(NX) - W(NX)
0257              WRITE(6,201) NADD,NX,W(NX), DMIN, Z(NX)
               C
0258              CALL OUTPTI
               C
0259              ETC(NADD) = Z(NX)
0260              IF(KSTAT.GT.0)  CALL COMPAR
0261              IF(IFLAG.EQ.0.AND.LCK.EQ.1)  RETURN
0262              IF(NADD.LT.NSOL)  GO TO 101
0263              IF(NADD.EQ.1)  RETURN
0264          109 DO 110 I = 1,NM
0265          110 MIN(I) = MINOPT(I,1)
0266              RETURN
               C
               C   STORE OPTIMAL VALUES
0267          101 DO 102 I = 1,NM
0268          102 MINOPT(I,NADD) = MIN(I)
0269          103 Z(NX) = 1.0E30
0270              NX = 1
0271              GO TO 55
0272          201 FORMAT (1H1,13(1H*),32H S O L U T I O N   N U M B E R  ,I2,12(1H*)
                 1  /1H ,I3,29X,3(F9.2,5X))
0273          202 FORMAT(14H1GUESS TOO LOW)
0274          203 FORMAT (19H1EXCEEDED 500 NODES)
0275          204 FORMAT (23HOTHE ASSIGNMENT AT NODE,I4,3X,16HWITH LOWER BOUND,F10.2
                 1,  3X,35HIS THE SAME AS SOLUTION/POSSIBILITY, I4)
0276          205 FORMAT (1H1,55H8 R A N C H   A N D   B O U N D   N O D E  V A L U
                 1 E S/58HONODE  BRANCHED  COST   YEARS   RECURRING   NON-RECURRING
                 2,5X,5HTOTAL/13H  NO.    FROM,5X,12HNO.  SUSTAIN,5X,3(5HBOUND,9X)/)
0277          206 FORMAT(28HONEXT SOLUTION HAS VALUE GT ,F10.2)
0278          207 FORMAT (23HOTHE ASSIGNMENT AT NODE,I4,3X,16HWITH LOWER BOUND,F10.2
                 1, 3X, 32HIS THE SAME AS PREVIOUS SOLUTION)
0279              END
```

TOTAL MEMORY REQUIREMENTS 0020F6 BYTES

```
 F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,NCAL,MAP
           VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000       NAME MOX02CH(R)
IEW0461   PACK
IEW0461   IBCOM=
IEW0461   UNPACK
IEW0461   PDCSTI
IEW0461   OUTPTI
IEW0461   LBOUNDI
IEW0461   COMPAR
IEW0461   MAXO
```

MODULE MAP

CONTROL SECTION NAME	ORIGIN	LENGTH	ENTRY NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME
CHOOZS	00	20F6							
SAV3	20F8	980							
SAVALL	2A78	3A1C							
VARNCE	6498	ADC							
TEMP	6F78	4110							
SCRACH	B088	6A60							

ENTRY ADDRESS 00
TOTAL LENGTH 11AE8

****MOX02CH NOW REPLACED IN DATA SET

DIAGNOSTIC MESSAGE DIRECTORY

IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.

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(17)          OS/360  FORTRAN H                                        DATE  71.084/15.23.51

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
ISN 0002            SUBROUTINE COMPAR
                C  STATISTICALLY COMPARE ASSIGNMENTS FOUND
                C
ISN 0003            INTEGER*2NU,NBY,NOB,     MODE,FINISH,NSTG,LABF,LABS,LABI,NFML,NFMU,
                   1  KODS,MAS,LTR,MAF,MAIC,NPAD,NPFAM,NPINTL,NPINTU,NFS,NPSTG,MAPS,
                   2  MAPF,MAPI,NYD,MAT,LYD,IS,LYR,LETT,MIN,VEH,NONREC,NMULT,KOUT,
                   3  NINTYR,NTGYTR,MINOPT,MORE,NADD,NX
ISN 0004            COMMON/SAVSAR/ POJ(3),SRJ(3,3),NU(40),NBY(40),NOB(40),RINT(40),
                   1  PLCINT(40),XLT(40), PLCT(40),UPP(40),TAT(40),TAMT(50),SR(40,3),
                   2   MODE(40,3),PLC(40,3)
ISN 0005            COMMON/SAVE1/ FINISH,NSTG,NCI,ILY,LABF(30),LABS(40),LABI(40),
                   1 NFML(40),NFMU(40),KODS(40),STS(41),STG(40),VLR(50),WPR(50),
                   2  RPLM(50),MAS(40,3), RXD(12,50)
ISN 0006            COMMON/SAV3/GRO,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                   1   PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
ISN 0007            COMMON/SAV4/  MAF(30,3), MAIC(40,3),
                   *          NPAD(2,60),NPFAM(30,5),NPINTL(30,5),NPINTU(30,5),
                   1  NFS(40,4),NPSTG(30,10),MAPS(30,10),MAPF(30,10),MAPI(30,10),
                   2  PFAMD(30,5,2),PFAMS(30,5,2),PINTS(30,5,2),PSTGD(30,10,2),
                   3   PSTGS(30,10,2)
ISN 0008            COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                   1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                   2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
ISN 0009            COMMON/VARNCE/KSTAT,VARI(40),VARF(50),VARM(56),FMVAR(2,30),
                   1  FIVAR(3,40),PLVAR(3,56),SVAR(5,40)
ISN 0010            COMMON/TEMP/VNM(2,250),IFLAG,KI,NEXT,LOUT,SAVS(40),KOUT(40),
                   1  NINTYR(40,20),NTGYTR(40,20,2),RECUR(60,20,2)
ISN 0011            COMMON/SCRACH/EXTRA,NADD,NX,MORE(50),LZ(46),W(500),W2(500),
                   1 TDS(500),WR(499),Z(500),COST(2,250),MINOPT(246,9),NODE(5,500),
                   2  NPOS,SIGSQ(9),ETC(9),
                   3 TSTG(40,2),DUM(30)
ISN 0012            DIMENSION TRINT(40)
                C
ISN 0013            DO 50 I = 1,NSTG
ISN 0014            TSTG(I,1) = 0.0
ISN 0015           50 TSTG(I,2) = 0.0
ISN 0016            IF(NCI.EQ.0)  GO TO 70
ISN 0018            DO 60 I = 1,NCI
ISN 0019           60 TRINT(I) = 0.0
                C
                C    CALCULATE NUMBER OF TIMES EACH RECURRING COST IS USED
ISN 0020           70 DO 100 J = 1,NM


ISN 0021            IF(YRLM(J).LT..001)  GO TO 100
ISN 0023            I = MIN(J)
ISN 0024            JX = LETT(J)
ISN 0025            ITR = LTR(JX)
ISN 0026            X = NMULT(I,JX)
ISN 0027            DO 99 MS = 1,4
ISN 0028            L = VEH(MS,I)
ISN 0029            IF(L.EQ.0)  GO TO 100
ISN 0031            TSTG(L,ITR) = TSTG(L,ITR) & YRLM(J)*X
ISN 0032            IF(NCI.EQ.0)  GO TO 99
ISN 0034            IF(MS.EQ.4)  GO TO 100
ISN 0036            IF(VEH(MS&1,I).EQ.0)  GO TO 100
ISN 0038            L1 = VEH(MS&1,I)
ISN 0039            DO 98 MI = 1,NCI
ISN 0040            DO 96 KY = 1,4
ISN 0041            IF(NFML(MI).NE.NFS(L,KY))   GO TO 96
ISN 0043            DO 95 KZ = 1,4
ISN 0044            IF(NFMU(MI).EQ.NFS(L1,KZ))  GO TO 97
ISN 0046           95 CONTINUE
ISN 0047           96 CONTINUE
ISN 0048            GO TO 98
ISN 0049           97 TRINT(MI) = TRINT(MI) & YRLM(J)*X
ISN 0050           98 CONTINUE
ISN 0051           99 CONTINUE
ISN 0052          100 CONTINUE
ISN 0053            TOT = 0.0
ISN 0054            VTC = 0.0
                C
                C   CALCULATE VARIANCE DUE TO RECURRING COSTS
ISN 0055            DO 200 L = 1,NSTG
ISN 0056            TSR = SR(L,1)*(TSTG(L,1)&TSTG(L,2))
ISN 0057            TOT = TOT & TSR
ISN 0058            IF(TSR.LT..001.OR.SVAR(1,L).LT..001)  GO TO 110
ISN 0060            TTSR = TSR*TSR*(EXP(SVAR(1,L)) - 1.0)
ISN 0061            VTC = VTC & TTSR
ISN 0062          110 TSR = SR(L,2)*TSTG(L,1)
ISN 0063            TOT = TOT & TSR
ISN 0064            IF(TSR.LT..001.OR.SVAR(2,L).LT..001)  GO TO 111
ISN 0066            TTSR = TSR*TSR*(EXP(SVAR(2,L)) - 1.0)
ISN 0067            VTC = VTC & TTSR
ISN 0068          111 TSR = SR(L,3)*TSTG(L,2)
ISN 0069            TOT = TOT & TSR
```

```
ISN 0070          IF(TSR.LT..001.OR.SVAR(3,L).LT..001)  GO TO 200
ISN 0072          TTSR = TSR * TSR*(EXP(SVAR(3,L)) - 1.0)
ISN 0073          VTC = VTC & TTSR
ISN 0074        200 CONTINUE
ISN 0075          IF(NCI.EQ.0)  GO TO 400
ISN 0077          DO 300 I = 1,NCI
ISN 0078          TSR = RINT(I)*TRINT(I)
ISN 0079          TOT = TOT & TSR
ISN 0080          IF(TSR.LT..001.OR.FIVAR(1,I).LT..001)  GO TO 300
ISN 0082          TTSR = TSR*TSR*(EXP(FIVAR(1,I)) - 1.0)
ISN 0083          VTC = VTC & TTSR
ISN 0084        300 CONTINUE
                C
                C  CALCULATE VARIANCE DUE TO DEV. AND  SUST COSTS
ISN 0085        400 DO 500 I = 1,NUMD
ISN 0086          IF(LZ(I).EQ.0)  GO TO 500
ISN 0088          IF(NADD.GT.1)  LZ(I) = LZ(I)*KI
ISN 0090          XX = LZ(I) - NYD(I) & 1
ISN 0091          SU = SUST(I)
ISN 0092          IF(KOUT(I).EQ.0)  GO TO 402
ISN 0094          LT = KOUT(I)
ISN 0095          SU = SAVS(LT)
ISN 0096        402 TOT = TOT & DS(I) & XX*SU
ISN 0097          J = MAT(I)
ISN 0098          IF(J.GT.1000)  J = J - 2000
ISN 0100          IF(J.LT.-200)  GO TO 500
ISN 0102          IF(J.LT.-100)  GO TO 440
ISN 0104          IF(J.LT.0)  GO TO 470
ISN 0106          IF(MAS(J,1).NE.I)  GO TO 500
ISN 0108          DTM = 0.0
ISN 0109          IF(LABS(J).EQ.0)  GO TO 410
ISN 0111          L = LABS(J)
ISN 0112          DO 405 K = 1,12
ISN 0113        405 DTM = DTM & RXD(K,L)
ISN 0114          IF(VARF(L).LT..001)  GO TO 410
ISN 0116          TTSR = DTM*DTM*(EXP(VARF(L)) - 1.0)
ISN 0117          VTC = VTC & TTSR
ISN 0118        410 DTM = DS(I) - DTM
ISN 0119          IF(NU(J).EQ.0)  GO TO 420
ISN 0121          X = NU(J)*NU(J)
ISN 0122          IF(VARI(J).LT..001)   GO TO 411
ISN 0124          TTSR = X*UPP(J)*UPP(J)*(EXP(VARI(J)) - 1.0)

ISN 0125          VTC = VTC & TTSR
ISN 0126        411 X = SQRT(X)
ISN 0127          DTM = DTM - X*UPP(J)
ISN 0128        420 IF(SVAR(4,J).LT..001)  GO TO 421
ISN 0130          TTSR = DTM*DTM*(EXP(SVAR(4,J)) - 1.0)
ISN 0131          VTC = VTC & TTSR
ISN 0132        421 IF(SVAR(5,J).LT..001.OR.SU      .LT..001)  GO TO 500
ISN 0134          TTSR = XX*XX*SU      *SU      *(EXP(SVAR(5,J)) - 1.0)
ISN 0135          VTC = VTC & TTSR
ISN 0136          GO TO 500
ISN 0137        440 JX = -J -100
ISN 0138          IF(MAI(JX,1).NE.I)  GO TO 500
ISN 0140          DTM = 0.0
ISN 0141          IF(LABI(JX).EQ.0)  GO TO 450
ISN 0143          L = LABI(JX)
ISN 0144          DO 445  K = 1,12
ISN 0145        445 DTM = DTM & RXD(K,L)
ISN 0146          IF(VARF(L).LT..001)  GO TO 450
ISN 0148          TTSR = DTM*DTM*(EXP(VARF(L)) - 1.0)
ISN 0149          VTC = VTC & TTSR
ISN 0150        450 DTM = DS(I) - DTM
ISN 0151          IF(FIVAR(2,JX).LT..001)  GO TO 451
ISN 0153          TTSR = DTM*DTM*(EXP(FIVAR(2,JX)) - 1.0)
ISN 0154          VTC = VTC & TTSR
ISN 0155        451 IF(SU      .LT..001.OR.FIVAR(3,JX).LT..001)  GO TO 500
ISN 0157          TTSR = SU      *SU      *XX*XX*(EXP(FIVAR(3,JX)) - 1.0)
ISN 0158          VTC = VTC & TTSR
ISN 0159          GO TO 500
ISN 0160        470 JX = -J
ISN 0161          IF(MAF(JX,1).NE.I)  GO TO 500
ISN 0163          DTM = 0.0
ISN 0164          IF(LABF(JX).EQ.0)  GO TO 480
ISN 0166          L = LABF(JX)
ISN 0167          DO 475 K = 1,12
ISN 0168        475 DTM = DTM & RXD(K,L)
ISN 0169          IF(VARF(L).LT..001)  GO TO 480
ISN 0171          TTSR = DTM*DTM*(EXP(VARF(L)) - 1.0)
ISN 0172          VTC = VTC & TTSR
ISN 0173        480 DTM = DS(I) - DTM
ISN 0174          IF(FMVAR(1,JX).LT..001)  GO TO 481
ISN 0176          TTSR = DTM*DTM*(EXP(FMVAR(1,JX)) - 1.0)
ISN 0177          VTC = VTC & TTSR
```

```
ISN 0178        481 IF(SU      .LT..001.OR.FMVAR(2,JX).LT..001)  GO TO 500
ISN 0180            TTSR = SU      *SU      *XX*XX*(EXP(FMVAR(2,JX)) - 1.0)
ISN 0181            VTC = VTC & TTSR
ISN 0182        500 CONTINUE
ISN 0183            SIGSQ(NADD) = ALOG(ETC(NADD)*ETC(NADD) & VTC) - ALOG(ETC(NADD)*
                   *  ETC(NADD))
ISN 0184            XMODE = ETC(NADD)*(EXP(-1.5*SIGSQ(NADD)))
ISN 0185            TP = SQRT(SIGSQ(NADD))
ISN 0186            XMU = ALOG(ETC(NADD)) - .5*SIGSQ(NADD)
ISN 0187            VTC = SQRT(VTC)
ISN 0188            XMD = (ALOG(XMODE) - XMU)/TP
ISN 0189            CALL NDTR(XMD,P2,D)
ISN 0190            XDUM = (ETC(NADD)/TP)*(1.00/2.5066)
ISN 0191            C = (XDUM/XMODE)*EXP(-.5*XMD**2)
ISN 0192            WRITE(6,900) NADD,ETC(NADD),TOT,XMODE,VTC,XMU,SIGSQ(NADD)
ISN 0193        900 FORMAT ('1SOLUTION',I3,'  HAS EXPECTED L V COST', F10.2,'  (',
                   *  F10.2,')  ', 3X,'MODE =',F10.2,3X,'STD. DEV. =',F10.2//
                   *  ' PARAMETERS MU AND SIGMASQ =',F10.2,3X,'AND',F10.2)
ISN 0194            WRITE(6,910) XMODE,P2,C,D
ISN 0195        910 FORMAT (1HO, ' PROB (COST LE', F10.0,' )  =', F4.2,3X,'DENSITY =',
                   *   F10.4,3X,'( ',F4.2,' )')
ISN 0196             P2 = P2 & .5
ISN 0197             CALL NDTRI(P2,Y2,C,IE)
ISN 0198             Z2 = EXP(TP*Y2 & XMU)
ISN 0199             C = (XDUM/Z2)*EXP(-.5*Y2**2)
ISN 0200             WRITE(6,905) Z2,P2,XMODE,Z2,C
ISN 0201        905 FORMAT('0PROB (COST LE', F10.0,' )  =',F4.2,3X,
                   *' 50 PERCENT UNCERTAINTY INTERVAL =',F10.0,2X,'TO', F10.0,3X,
                   *  'DENSITY =',F10.2)
ISN 0202             P = .1
ISN 0203             DO 520 I = 1,5
ISN 0204             CALL NDTRI(P,Y,C,IE)
ISN 0205             X5 = EXP(TP*Y & XMU)
ISN 0206             D = (XDUM/X5)*EXP(-.5*Y**2)
ISN 0207             WRITE(6,910) X5,P,D,C
ISN 0208        520 P = P & .2
ISN 0209             IF(NADD.LE.1)  GO TO 700
ISN 0211             NT = NADD - 1
ISN 0212             DO 600 I = 1,NT
ISN 0213             RHO = -.3
ISN 0214             TP1 = SQRT(SIGSQ(I))
ISN 0215             XMU1 = ALOG(ETC(I)) - .5*SIGSQ(I)

ISN 0216             DO 590 J = 1,4
ISN 0217             RHO = RHO & .3
ISN 0218             Y =(XMU - XMU1)/(SQRT(SIGSQ(I) & SIGSQ(NADD) - 2.0*RHO*TP*TP1))
ISN 0219             CALL NDTR(Y,P,D)
ISN 0220             WRITE(6,901) NADD,I,P,RHO
ISN 0221        901 FORMAT( '0 PROB ( ASSIGNMENT',I3,' COST GE ASSIGNMENT',I3,' COST)
                   *=', F4.2,'  IF CORRELATION =', F3.1//)
ISN 0222        590 CONTINUE
ISN 0223        600 CONTINUE
ISN 0224        700 WRITE(6,906)
ISN 0225        906 FORMAT(1H1)
ISN 0226            RETURN
ISN 0227            END.

****** END OF COMPILATION ******
```

```
F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
          VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000      NAME MOXO2CM(R)
IEW0461  NDTR
IEW0461  NDTRI
IEW0461  ALOG
IEW0461  SQRT
IEW0461  EXP
IEW0461  IBCOM=
```

CROSS REFERENCE TABLE

CONTROL SECTION NAME	ORIGIN	LENGTH	ENTRY NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME
COMPAR	00	160C							
SAVSAR	1610	A58							
SAVE1	2068	FC4							
SAV3	3030	980							
SAV4	39B0	3188							
SAVALL	6838	3A1C							
VARNCE	A558	ADC							
TEMP	B038	4110							
SCRACH	F148	6A60							

LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION	LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION
488	SAVSAR	SAVSAR	48C	SAVE1	SAVE1
490	SAV3	SAV3	494	SAV4	SAV4
498	SAV4	SAV4	49C	SAV4	SAV4
4A0	SAVALL	SAVALL	4A4	SAVALL	SAVALL
4A8	VARNCE	VARNCE	4AC	TEMP	TEMP
4B0	SCRACH	SCRACH	4B4	SCRACH	SCRACH
4B8	SCRACH	SCRACH	4BC	SCRACH	SCRACH
4C0	SCRACH	SCRACH	4C4	NDTR	$UNRESOLVED
4C8	NDTRI	$UNRESOLVED	4CC	ALOG	$UNRESOLVED
4D0	SQRT	$UNRESOLVED	4D4	EXP	$UNRESOLVED
4D8	IBCOM=	$UNRESOLVED			

ENTRY ADDRESS 00
TOTAL LENGTH 15BA8

****MOXO2CM NOW REPLACED IN DATA SET

DIAGNOSTIC MESSAGE DIRECTORY

IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.

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(17)          OS/360  FORTRAN H                                DATE  71.084/15.24.29

         COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
   ISN 0002            SUBROUTINE CONSTR
                  C    DETERMINE IF ANY PROGRAM CONSTRAINTS HAVE BEEN VIOLATED
   ISN 0003            DOUBLE PRECISION NAME
   ISN 0004            INTEGER PROG
   ISN 0005            LOGICAL SKIP,EXT,ACCL
   ISN 0006            INTEGER*2  NSYR,NSFX,NRFX,NYRSST,NSTRFX,NPROG,KPROG,KODE,NYRSFX,
                      1  YDPL,KODEM,KODESP
                  C
   ISN 0007            COMMON/SAV2/EXT,ACCL,KNSTG,KNFAM,KNCI,KNP,KNMIS,JFLAG,TREF,NCSTR,
                      1 PMAX,PMIN,ISTRT,IFIN,MAXITR,MITR,KODESP(6),TITLE(10),LEVEL(20),
                      2  CNTRVL(20),FIXED(20),KODEM(50),NSYR(50),NSFX(50),NAME(56),
                      3  YDPL(56),NRFX(50),NYRSST(84),NSTRFX(84),NYRSFX(84),SUS(84),C(84)
                      4,  R(84), S(84),CS(90),NPROG(90),KPROG(90), KODE(90)
   ISN 0008            COMMON/SCRACH/M,N,NCS,PROG,IODD,IERR,SKIP,MYFLAG,JS,NSCALE(5),
                      1  NSL(10),TOTAL(20),W(20),D(20),XOUT(20),VOUT(20),RRR(20),YEAR(20)
                      2,  Y(20),KVEHI(50),LABEL(50),LVARY(70),LVD(70),IVEH(70),LVS(70),
                      3  LVSF(80),VNAM(80),NDP(86),RF(86),CF(86),SF(86),FLAGR(86),
                      4  FLAGS(86),NSSF(86),NSRF(86),NSXF(86),NDSF(86),SUSTF(86),NLVP(86)
                      5,  NSTRRC(86),NYRSRC(86),LNDF(86),NSTRST(86),LNDATE(86),NPRO(90),
                      6  KPRO(90),CSX(90),LZ(46),RCOST( 60), KVEH( 60),IMAGE(830),
                      7  XSCH(10,70),XLVSUM(20,50),RECUR(20,50),DUM(656)
                  C
   ISN 0009            IERR = 0
   ISN 0010            IF (NCSTR.EQ.0) RETURN
   ISN 0012            NR = PROG
   ISN 0013            DO 100 I=1,NCSTR
   ISN 0014            J = NPROG(I)
   ISN 0015            K = KPROG(I)
   ISN 0016            IF (J.NE.NR.AND.K.NE.NR)  GO TO 100
   ISN 0018            MP= KODE(I)
   ISN 0019            IF (MP.LT.1.OR.MP.GT.11)  GO TO 100
   ISN 0021            GO TO (10,20,30,40,50,60,70,110,90,91,92),  MP
   ISN 0022          10 DT = CS(I)
   ISN 0023             IF (S(J).LT.(S(K)&R(K) & DT)) GO TO 110
   ISN 0025             GO TO 100
   ISN 0026          20 DT = CS(I)
   ISN 0027             IF ((S(J)&R(J)&DT).GT.S(K))  GO TO 110
   ISN 0029             GO TO 100
   ISN 0030          30     IF(S(J).NE.CS(I)) GO TO 110
   ISN 0032             GO TO 100
   ISN 0033          40 IF((S(J) & R(J) - 1.0).NE.CS(I))  GO TO 110
   ISN 0035             GO TO 100



   ISN 0036          50      IF (R(J).NE.CS(I)) GO TO 110
   ISN 0038             GO TO 100
   ISN 0039          60 DT = LNDATE(J)
   ISN 0040             ET = LNDATE(K)
   ISN 0041             IF((S(J)&DT&CS(I)).GT.(S(K)&ET).AND.(S(J) & DT & CS(I)).LT.(TREF &
                       1   20.))
                       1  GO TO 110
   ISN 0043             GO TO 100
   ISN 0044          70 DT = LNDATE(J) - 1
   ISN 0045             IF ((S(J) & DT).GT.CS(I))   GO TO 110
   ISN 0047             GO TO 100
   ISN 0048          90  IF(S(J).LT.CS(I))  GO TO 110
   ISN 0050             GO TO 100
   ISN 0051          91 DT = LNDATE(J) - 1
   ISN 0052             IF ((S(J) & DT).LT.CS(I))  GO TO 110
   ISN 0054             GO TO 100
   ISN 0055          92 DT = LNDATE(K) -1
   ISN 0056             IF ((S(J)&R(J)&CS(I)).GT.(S(K)&DT))  GO TO 110
   ISN 0058         100 CONTINUE
   ISN 0059             RETURN
   ISN 0060         110 IERR = 1
   ISN 0061         120 RETURN
   ISN 0062             END

****** END OF COMPILATION ******
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F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
         VARIABLE OPTIONS USED - SIZE=(126976,245760)              DEFAULT OPTION(S) USED
IEW0000    NAME MOXO2CR(R)


                                        CROSS REFERENCE TABLE

  CONTROL SECTION                        ENTRY

    NAME     ORIGIN  LENGTH              NAME   LOCATION     NAME   LOCATION     NAME   LOCATION     NAME

  CONSTR         00     4F2
  SAV2          4F8     FE0
  SCRACH       14D8    6A60


  LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION          LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION

      100           SAV2          SAV2                       104        SCRACH          SCRACH
      108           SCRACH        SCRACH                     10C        SCRACH          SCRACH
      110           SCRACH        SCRACH                     114        SCRACH          SCRACH

 ENTRY ADDRESS       00
 TOTAL LENGTH      7F38

****MOXO2CR   NOW REPLACED IN DATA SET
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FORTRAN IV G LEVEL 1, MOD 4          DATINS          DATE = 71084        15/24/56          PAGE 00

 0001              SUBROUTINE DATINS
                C  ALL COST DATA ASSOCIATED WITH VEHICLES IS INPUT - ALSO MISSION DATA
 0002               DOUBLE PRECISION NAME
 0003               REAL NPERPD,LEVEL
 0004               LOGICAL EXT,ACCL
 0005               INTEGER*2   YDPL,NSYR,NSFX,NRFX,NYRSST,NSTRFX,NPROG,KPROG,KODE,
                   1 NYRSFX,KODEM,KODESP,NU,NBY,MODE,NOB,FINISH,NSTG,NFML,NFMU,KODS,
                   2  MAS,LABS,LABF,LABI,LSA,NYS,KODEF,LST,MST,IST,JST,KST,VEH,NYD,
                   3  NMULT,NONREC,IS,MAT,LYR,LETT,LYD,MIN,NVS,MRV,NRP,NYP,KODEP,
                   4  IVEHA,NTRIP,NPLS,NRR,MR,NPSTG,NPAD,NPFAM,NFS,NPINTL,NPINTU,MAPS,
                   5 MAPF,MAPI,KOUT,LTR,KODEV,NINTYR,NTGYTR,MAF,MAIC
                C
 0006               COMMON/SAVER/  RFIXD(12,84)
 0007               COMMON/SAVDMP/ NFAM,KFLAG,FAM(30),KODEF(30),FMNR(30),FMSUS(30),
                   1JST(30),YDF(30),LSA(40),SNR(40),NYS(40),DINT(40),SINT(40),KST(40),
                   2  YDI(40),YDS(40),IST(40),FMSLS(30,2),SUSLS(40,2),SINTLS(40,2),
                   3  LST(30,5),YDPF(30,5),MST(30,10),YDPS(30,10)
 0008               COMMON/SAVSAR/ PDJ(3),SRJ(3,3),NU(40),NBY(40),NOB(40),RINT(40),
                   1    PLCINT(40),XLT(40), PLCT(40),UPP(40),TAT(40),TAMT(50),SR(40,3),
                   2    MODE(40,3),PLC(40,3)
 0009               COMMON/SAVE1/ FINISH,NSTG,NCI,ILY,LABF(30),LABS(40),LABI(40),
                   1 NFML(40),NFMU(40),KODS(40),STS(41),STG(40),VLR(50),WPR(50),
                   2  RPLM(50),MAS(40,3), RXD(12,50)
 0010               COMMON/SAV2/EXT,ACCL,KNSTG,KNFAM,KNCI,KNP,KNMIS,JFLAG,TREF,NCSTR,
                   1 PMAX,PMIN,ISTRT,IFIN,MAXITR,MITR,KODESP(6),TITLE(10),LEVEL(20),
                   2  CNTRVL(20),FIXFD(20),KODEM(50),NSYR(50),NSFX(50),NAME(56),
                   3  YDPL(56),NRFX(50),NYRSST(84),NSTRFX(84),NYRSFX(84),SUS(84),C(84)
                   4,  R(84),  S(84),CS(90),NPROG(90),KPROG(90),  KODE(90)
 0011               COMMON/SAV3/GRO,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                   1   PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
 0012               COMMON/SAV4/  MAF(30,3), MAIC(40,3),
                   *             NPAD(2,60),NPFAM(30,5),NPINTL(30,5),NPINTU(30,5),
                   1  NFS(40,4),NPSTG(30,10),MAPS(30,10),MAPF(30,10),MAPI(30,10),
                   2  PFAMD(30,5,2),PFAMS(30,5,2),PINTS(30,5,2),PSTGD(30,10,2),
                   3   PSTGS(30,10,2)
 0013               COMMON/SVACAV/  KNV,NOPT,KODEP(30),RPLO(40),IVEHA(50),NTRIP(50),
                   1  NPLS(50),NRR(50),MR(50),NVS(60),MRV(60),NRP(60),B1(60),B2(60),
                   2  B3(60),B4(60),KODEV(60),NYP(2,60),VM(2,60)
 0014               COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                   1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                   2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
 0015               COMMON/VARNCE/KSTAT,VARI(40),VARF(50),VARM(56),FMVAR(2,30),
                   1  FIVAR(3,40),PLVAR(3,56),SVAR(5,40)
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0016              COMMON/TEMP/VNM(2,250),IFLAG,KI,NEXT,LOUT,SAVS(40),KOUT(40),
                 1  NINTYR(40,20),NTGYTR(40,20,2),RECUR(60,20,2)
0017              COMMON/SCRACH/  IP,IV,IG,MODX(3),NFX(4),NPFAX(5),LSX(5),NPINXL(5),
                 1  NPINXU(5),NPSTX(10),MSX(10),LZ(20),PB(50),MISN(50,20),DUM(1382),
                 2  RCOST(60),RXM(50),II,KNSP,KLCK,IM,DUMM(3962),SRXX(3),XX(3),
                 3  PX(56),CX(56),SX(56),TRX(56)
            C
0018              READ(5,100) LP,NOPT,MOS,NSOL,MSOL,MITR,ILY,MYRS,TREF,GUESS,GRO,
                 1  SLO,IP,IG,IFM,II,IM,ISD,IV
            C     ***IG IFM II IM ISD AND IV ARE VARIABLES FOR BATCHING ONLY ***
0019              IF (MYRS.EQ.0) GO TO 806
0020              WRITE (6,104)
0021              GRO = GRO/100.0
0022              IF(IG.LT.0)  GO TO 12
0023              WRITE(6,213)
0024              LX = 0
            C  NSOC = NUMBER OF SPECIAL DEVELOPMENT COSTS
            C       WARNING - DON'T USE NSOC WHILE BATCHING
0025              NSOC = 0
0026              DO 8000 I = 1,40
0027              READ(5,101)  KODX,   STG(I),(SR(I,J),J=1,3),(PLC(I,J),J=1,3),
                 1  SNR(I),STS(I),LXX,NBX,(NFX(J),J=1,4),(MODX(J), J=1,3)
0028              IF(KODX.EQ.0)  GO TO 12
0029              KODS(I) = KODX
0030              LSA(I) = LXX
0031              NBY(I) = NBX
0032              DO 8010  J = 1,3
0033              NFS(I,J) = NFX(J)
0034           8010 MODE(I,J) = MODX(J)
0035              NFS(I,4) = NFX(4)
0036              IF(LCK.NE.1.AND.(PLC(I,1).GT..001.OR.PLC(I,2).GT..001.OR.PLC(I,3).
                 1GT..001))   LCK = 1
            C  INPUT NU(I) LE -2 IF WANT PROGRAM TO CALCULATE ESTIMATE FOR NU
0037              READ (5,111)  (SUSLS(I,J),J=1,2),NUX,UPP(I),UPPXX,PXX,RPLO(I),
                 1  YDS(I),ISX,NSXF,(SRXX(J),J=1,3),XX(1),SNRXX,XX(2),STSXX,XX(3)
0038              NU(I) = NUX
0039              IST(I) = ISX
0040              NSTG = NSTG + 1
0041              LABS(I) = 0
0042              NDS = YDS(I)
0043              NYS(I) = MAXO(IST(I) - ILY + NDS, 1)
0044              WRITE(6,112)
0045              WRITE (6,8001) STG(I),(SR(I,J),PLC(I,J),J=1,3),SNR(I),STS(I),
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                 1  NYS(I),LSA(I),(NFS(I,J),J=1,4),NBY(I)
0046              IF(XX(1).GT..0001)  CALL MEAN(XX(1),KSTAT,SVAR(1,I),SRXX(1),
                 1  SR(I,1))
0047              IF(XX(1).GT..0001.AND.SR(I,2).GT..0001)
                 1  CALL MEAN(XX(1),KSTAT,SVAR(2,I),SRXX(2),SR(I,2))
0048              IF(XX(1).GT..0001.AND.SR(I,3).GT..0001)
                 1  CALL MEAN(XX(1),KSTAT,SVAR(3,I),SRXX(3),SR(I,3))
0049              IF(XX(2).GT..0001)  CALL MEAN(XX(2),KSTAT,SVAR(4,I),SNRXX,SNR(I))
0050              IF(XX(3).GT..0001) CALL MEAN(XX(3),KSTAT,SVAR(5,I),STSXX,STS(I))
0051              UP = UPP(I)
0052              IF(PXX.GT..0001) CALL MEAN(PXX,KSTAT,VARI(I),UPPXX,UPP(I))
0053              IF(XX(1).GT..001.OR.XX(2).GT..001.OR.XX(3).GT..001)
                 *WRITE (6,8001) STG(I),(SR(I,J),PLC(I,J),J=1,3),SNR(I),STS(I),
                 1  NYS(I),LSA(I),(NFS(I,J),J=1,4),NBY(I)
0054              DO 8002 J = 1,3
0055              IF (MODE(I,J).EQ.0) GO TO 8002
0056              LX = LX + 1
0057              MODE(I,J) = LX
0058              READ(5,8003) (SRJ(LX,K), K = 1,3), POJ(LX),SRJXX,PXX
0059              IF(PXX.GT..0001) CALL MEAN(PXX,KSTAT,SVAR(J,I),SRJXX,SRJ(LX,1))
0060              IF(PXX.GT..0001) SRJ(LX,2) = SRJ(LX,2)*EXP(1.5*SVAR(J,I))
0061              IF(PXX.GT..0001) SRJ(LX,3) = SRJ(LX,3)*EXP(1.5*SVAR(J,I))
0062              WRITE(6,8004) J,POJ(LX),SRJ(LX,1),POJ(LX),(SRJ(LX,K),K=2,3)
0063           8002 CONTINUE
0064              IF(NU(I).NE.0)  WRITE(6,8005) UPP(I),UP
0065              IF(NSXF.EQ.0)   GO TO 8000
0066              NSOC = NSOC + 1
0067              READ(5,110) NRXF, (RXD(J,NSOC), J = 1,12),RXDXX,PXX
0068              NRFX(NSOC) = NRXF
0069              NSFX(NSOC) = NSXF
0070              NX = NRFX(NSOC) + NSFX(NSOC) - ILY
0071              NDS = NYS(I)
0072              NYS(I) = MAXO(NDS,NX)
0073              LABS(I) = NSOC
0074              WRITE(6,113) (RXD(J,NSOC), J = 1,12)
0075              IF(PXX.LT..0001)  GO TO 8000
0076              RX = 0.0
0077              DO 500 J = 1,12
0078           500 RX = RX + RXD(J,NSOC)
0079              CALL MEAN(PXX,KSTAT,VARF(NSOC),RXDXX,R)
0080              DO 501 J = 1,12
0081           501 RXD(J,NSOC) = RXD(J,NSOC)*EXP(1.5*VARF(NSOC))
0082              WRITE(6,113) (RXD(J,NSOC), J = 1,12)
```

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0083        8000 CONTINUE
0084          12 IF(IFM.LT.0)  GO TO 14
0085             DO 13 J = 1,30
0086             READ(5,102) I,FAM(I),FMNR(I),FMSUS(I),YDF(I),JX,NSXF,
                1  (FMSLS(I,K),K=1,2),FMNRXX,XX(1),FMSSXX,XX(2)
0087             IF(I.EQ.0)  GO TO 14
0088             IF(J.EQ.1)  WRITE(6,214)
0089             NFAM = NFAM + 1
0090             JST(I) = JX
0091             LABF(I) = 0
0092             KODEF(J) = I
0093             WRITE(6,112)
0094             WRITE(6,2141)KODEF(J), FAM(I),FMNR(I),FMSUS(I)
0095             IF(XX(1).GT..0001)  CALL MEAN(XX(1),KSTAT,FMVAR(1,I),FMNRXX,
                1    FMNR(I))
0096             IF(XX(2).GT..0001) CALL MEAN(XX(2),KSTAT,FMVAR(2,I),FMSSXX,FMSUS(I
                1))
0097             IF(XX(1).GT..001.OR.XX(2).GT..001)
                1WRITE(6,2141)KODEF(J), FAM(I),FMNR(I),FMSUS(I)
0098             IF(NSXF.EQ.0)  GO TO 13
0099             NSDC = NSDC + 1
0100             READ(5,110)   NRXF,     (RXD(J1,NSDC),  J1=1,12),RXDXX,PXX
0101             NSFX(NSDC) = NSXF
0102             NRFX(NSDC) = NRXF
0103             LABF(I) = NSDC
0104             WRITE(6,113) (RXD(J1,NSDC), J1 = 1,12)
0105             IF(PXX.LT..0001)  GO TO 13
0106             RX = 0.0
0107             DO 504 J1 = 1,12
0108         504 RX = RX + RXD(J1,NSDC)
0109             CALL MEAN(PXX,KSTAT,VARF(NSDC),RXDXX,RX)
0110             DO 505 J1 = 1,12
0111         505 RXD(J1,NSDC) = RXD(J1,NSDC)*EXP(1.5*VARF(NSDC))
0112             WRITE(6,113) (RXD(J1,NSDC), J1 = 1,12)
0113          13 CONTINUE
0114          14 IF(II.LT.0)  GO TO 1716
0115             DO 1715 I = 1,40
0116             READ(5,103)  J,K,RINT(I),PLCINT(I),DINT(I),SINT(I),YDI(I),KX,NSXF,
                1    (SINTLS(I,L),  L=1,2)
0117             IF(J.EQ.0)  GO TO 1716
0118             IF(I.EQ.1)   WRITE(6,215)
0119             READ(5,108) RINTXX,XX(1),DINTXX,XX(2),SINTXX,XX(3)
0120             IF(LCK.NE.1.AND.PLCINT(I).GT..001)  LCK = 1
```



```
0121             NCI = NCI + 1
0122             LABI(I) = 0
0123             KST(I) = KX
0124             NFML(I) = J
0125             NFMU(I) = K
0126             WRITE(6,112)
0127             WRITE(6,216) FAM(J),FAM(K),RINT(I),PLCINT(I),DINT(I),SINT(I)
0128             IF(XX(1).GT..0001)  CALL MEAN(XX(1),KSTAT,FIVAR(1,I),RINTXX,
                1   RINT(I))
0129             IF(XX(2).GT..0001)  CALL MEAN(XX(2),KSTAT,FIVAR(2,I),DINTXX,
                1  DINT(I))
0130             IF(XX(3).GT..00001)  CALL MEAN(XX(3),KSTAT,FIVAR(3,I),SINTXX,
                1  SINT(I))
0131             IF(XX(1).GT..001.OR.XX(2).GT..001.OR.XX(3).GT..001)
                1WRITE(6,216) FAM(J),FAM(K),RINT(I),PLCINT(I),DINT(I),SINT(I)
0132             IF(NSXF.EQ.0)   GO TO 1715
0133             NSDC = NSDC + 1
0134             READ(5,110)  NRXF,      (RXD(J,NSDC), J = 1,12),RXDXX,PXX
0135             NRFX(NSDC) = NRXF
0136             NSFX(NSDC) = NSXF
0137             LABI(I) = NSDC
0138             WRITE(6,113) (RXD(J,NSDC), J = 1,12)
0139             IF(PXX.LT..0001)  GO TO 1715
0140             RX = 0.0
0141             DO 502 J = 1,12
0142         502 RX = RX + RXD(J,NSDC)
0143             CALL MEAN(PXX,KSTAT,VARF(NSDC),RXDXX,RX)
0144             DO 503 J = 1,12
0145         503 RXD(J,NSDC) = RXD(J,NSDC)*EXP(1.5*VARF(NSDC))
0146             WRITE(6,113) (RXD(J,NSDC), J = 1,12)
0147        1715 CONTINUE
0148        1716 IF (IP.LT.0) GO TO 9002
0149             DO 9004 I = 1,30
0150             READ(5,9005)  J1, PAD(I),NPERPD(I)
0151             IF(J1.EQ.0)  GO TO 9002
0152             IF(I.EQ.1)  WRITE (6,9003)
0153             KODEP(I) = J1
0154             WRITE (6,9006) KODEP(I),PAD(I),NPERPD(I)
0155             NP = NP + 1
0156             READ(5,5000)  (NPSTX(J),PSTGD(I,J,1),YDPS(I,J),MSX(J),PSTGS(I,J,1)
                1,  PSTGD(I,J,2),PSTGS(I,J,2),  J=1,10)
0157             DO 700 J = 1,10
0158             MST(I,J) = MSX(J)
```

```
0159          700 NPSTG(I,J) = NPSTX(J)
0160              READ(5,5000)  (NPFAX(J),PFAMD(I,J,1),YDPF(I,J),LSX(J),PFAMS(I,J,1)
                 1,   PFAMD(I,J,2),PFAMS(I,J,2),  J=1,5)
0161              READ(5,5002) (NPINXL(J),NPINXU(J),(PINTS(I,J,K),K=1,2),J=1,5)
0162              DO 701 J = 1,5
0163              LST(I,J) = LSX(J)
0164              NPFAM(I,J) = NPFAX(J)
0165              NPINTL(I,J) = NPINXL(J)
0166          701 NPINTU(I,J) = NPINXU(J)
0167              DO 9022 J = 1,10
0168              IF (NPSTG(I,J).EQ.0) GO TO 5009
0169              DO 9023 L = 1,NSTG
0170              IF (NPSTG(I,J).NE.KODE(L)) GO TO 9023
0171              NPSTG(I,J) = L
0172              WRITE(6,5003) STG(L),(PSTGD(I,J,K),PSTGS(I,J,K),K=1,3)
0173              GO TO 9022
0174         9023 CONTINUE
0175         9022 CONTINUE
0176         5009 DO 5006 J = 1,5
0177              IF (NPFAM(I,J).EQ.0) GO TO 5007
0178              L = NPFAM(I,J)
0179         5006 WRITE(6,5004) FAM(L),(PFAMD(I,J,K),PFAMS(I,J,K),K=1,3)
0180         5007 DO 5008 J = 1,5
0181              IF (NPINTL(I,J).EQ.0) GO TO 9004
0182              L = NPINTL(I,J)
0183              LX = NPINTU(I,J)
0184         5008 WRITE(6,5005) FAM(L),FAM(LX),(PINTS(I,J,K),K = 1,3)
0185         9004 CONTINUE
0186         9002 IF(IM.LT.0)  GO TO 19
0187              DO 1719 I=1,MYRS
0188         1719 LZ(I)=ILY+I-1
0189              WRITE(6,217) (LZ(I),I=1,MYRS)
0190         1717 DO 1718 I=1,50
0191              READ(5,105)  KM,NAME(I),PB(I),NSYX,NYRSXF,VLR(I),RPLM(I),TAMT(I),
                1  WPR(I),NTP,(MISN(I,J), J=1,MYRS)
0192              IF(KM.EQ.0)   GO TO 1720
0193              KODEM(I) = KM
0194              NSYR(I) =  NSYX
0195              NYRSFX(I) = NYRSXF
0196              NTRIP(I) = NTP
0197              NMIS = NMIS + 1
0198              READ(5,107) PLR(I),SUS(I),C(I),NDPL,(RDIST(I,L),L=1,4),NPS,MRX,
                 1    LRX,NR,IIS,IVAX
```



```
0199              YDPL(I) = NDPL
0200              NPLS(I) = NPS
0201              MR(I) = MRX
0202              LTR(I) = MAXO(LRX,1)
0203              NRR(I) = NR
0204              IS(I) = 1900 + IIS
0205              IVEHA(I) = IVAX
0206              WRITE(6,219) I,NAME(I),  VLR(I),WPR(I),PB(I),LTR(I),
                 1  (MISN(I,J),J=1,MYRS)
0207              PX(I) = PLR(I)
0208              CX(I) = C(I)
0209              SX(I) = SUS(I)
0210              READ(5,108) PLRXX,XX(1),CXX,XX(2),SUSXX,XX(3)
0211              IF(XX(1).GT..0001) CALL MEAN(XX(1),KSTAT,PLVAR(1,I),PLRXX,PLR(I))
0212              IF(XX(2).GT..0001) CALL MEAN(XX(2),KSTAT,PLVAR(2,I),CXX,C(I))
0213              IF(XX(3).GT..0001) CALL MEAN(XX(3),KSTAT,PLVAR(3,I),SUSXX,SUS(I))
0214              RXM(I)  = 0.0
0215              IF(NYRSFX(I).EQ.0)  GO TO 1718
0216              READ(5,110)  NSTRXF,  (RFIXD(J,I),  J=1,12),RXDXX,PXX
0217              NSTRFX(I) = NSTRXF
0218              DO 520 J = 1,12
0219          520 RXM(I) = RXM(I) + RFIXD(J,I)
0220              TRX(I) = RXM(I)
0221              IF(PXX.LT..0001)  GO TO 1718
0222              CALL MEAN(PXX,KSTAT,VARM(I),RXDXX,RXM(I))
0223              DO 522 J = 1,12
0224          522 RFIXD(J,I) = RFIXD(J,I)*EXP(1.5*VARM(I))
0225         1718 CONTINUE
0226         1720 WRITE(6,104)
0227              DO 1721 I = 1,NMIS
0228              WRITE(6,112)
0229              IF(KSTAT.GT.0)  WRITE(6,109) I,NAME(I),PX(I), (RDIST(I,L),L=1,4),
                 *  CX(I),YDPL(I),IS(I),SX(I),TRX(I)
0230         1721 WRITE(6,109) I,NAME(I),PLR(I),(RDIST(I,L),L=1,4),C(I),YDPL(I),
                 1  IS(I),SUS(I),RXM(I)
0231           19 IF(ISD.LT.0)  GO TO 20
               C   INPUT SPECIAL PROGRAMS HAVING NO ASSOCIATED LAUNCHES
               C   KODESP GT 100
0232              DO 1725 I = 1,6
0233              K = NMIS + I
0234              READ(5,106)  KO,NAME(K),C(K),NDPL,IIS,SUS(K),NST,NYRSXF,CXX,XX(1),
                 1  SUSXX,XX(2)
0235              IF(KO.EQ.0.)  GO TO 20
```

```
0236              KODESP(I) = KO
0237              YDPL(K) = NDPL
0238              IS(K)       = 1900 + IIS
0239              NYRSST(K)       = NST
0240              NYRSFX(K)       = NYRSXF
0241              NSPR = NSPR + 1
0242              IF(I.EQ.1)  WRITE(6,114)
0243              WRITE(6,112)
0244              WRITE(6,115) I,NAME(K),C(K),SUS(K),IS(K),NDPL
0245              IF(XX(1).GT..0001) CALL MEAN(XX(1),KSTAT,PLVAR(2,K),CXX,C(K))
0246              IF(XX(2).GT..0001)  CALL MEAN(XX(2),KSTAT,PLVAR(3,K),SUSXX,SUS(K))
0247              IF(XX(1).GT..001.OR.XX(2).GT..001)
                 *WRITE(6,115) I,NAME(K),C(K),SUS(K),IS(K),NDPL
0248              IF(NYRSXF.EQ.0)  GO TO 1725
0249              READ(5,110)  NSTRXF,  (RFIXD(J,K),      J=1,12),RXDXX,PXX
0250              NSTRFX(K)       = NSTRXF
0251              WRITE(6,113)  (RFIXD(J,K), J = 1,12)
0252              IF(PXX.LT..0001)   GO TO 1725
0253              RX = 0.0
0254              DO 521 J = 1,12
0255           521 RX = RX + RFIXD(J,K)
0256              CALL MEAN(PXX,KSTAT,VARM(K),RXDXX,RX)
0257              DO 523 J = 1,12
0258           523 RFIXD(J,K) = RFIXD(J,K)*EXP(1.5*VARM(K))
0259              WRITE(6,113)  (RFIXD(J,K), J = 1,12)
0260          1725 CONTINUE
0261            20 IF(IG.LT.0)  NSTG = KNSTG
0262               IF(IG.LT.0)  LCK = KLCK
0263               IF(IFM.LT.0)  NFAM = KNFAM
0264               IF(II.LT.0)  NCI = KNCI
0265               IF (IP.LT.0) NP=KNP
0266               IF(ISD.LT.0)  NSPR=KNSP
0267               IF(IM.LT.0)  NMIS = KNMIS
0268              RETURN
0269           806 WRITE(6,4102)
0270            99 RETURN
0271           100 FORMAT (8I3,F5.1,F12.2,F3.1,F5.1,17X,7I2)
0272           101 FORMAT (I2,1X,A4,3F6.3,3F5.3,3X,  2F6.3,3X,6I3,1X,3I1)
0273           102 FORMAT(I2,1X,A4,2F10.0,F4.1,2I3,2F10.0,F7.0,F3.2,F7.0,F3.2)
0274           103 FORMAT (2X,2I3,4F10.0,F4.1,2I3,2F10.0)
0275           104 FORMAT (1H1)
0276           105 FORMAT (I2,A6,F4.2,2X,2I2,F7.0,2F3.0,F7.0,I2,20I2)
0277           106 FORMAT(I3,   A6,F10.2,I5,I2,F10.2,2I2,F10.2,F3.2,F10.2,F3.2)
```



```
0278           107 FORMAT (2X,3F10.2,I5,  4F5.3,  10X,512,I3)
0279           108 FORMAT (3(F10.0,F3.2))
0280           109 FORMAT(1X,I2,1X,A6,2X,4HPLR=,F6.1,8H DIST BY,4(F3.2,2H, ),5H DEV=,
                  1  F8.1,
                  2 5H  FOR,I5,14H YRS  STARTING,I6,2X,5HSUST=,F8.1,3X,6HFIXED=,F8.1)
0281           110 FORMAT (I3,12F5.2,F6.1,F3.2)
0282           111 FORMAT (4X,2F5.0,I3,F6.2,F6.1,F3.2,F6.0,F2.0,2I2,3F5.1,F3.2,F6.1,
                 *F3.2,F6.1,F3.2)
0283           112 FORMAT (1HO)
0284           113 FORMAT (14H FIXED COSTS =, 12F9.2)
0285           114 FORMAT (1H1,4X,'SPECIAL PROGRAMS'//)
0286           115 FORMAT(1H ,I3,1X,A6,3X,'DEV =',F8.2,3X,'SUST =',F8.2,3X,
                 *  'DEV STARTS', I6,3X,'FOR ',I4,1X,'YEARS')
0287           213 FORMAT (16H STAGE COST DATA/6HOTITLE,3(16H  RECURRING  LC ),68H  D
                  1EVELOPMENT  SUSTAINING  AVAILABLE  SHARED COST GROUPS  BATCH FACT/
                  2  10X,10H(HARDWARE),
                  3        6X,10H(ETR ONLY),6X,10H(WTR ONLY),30X,8HFROM  TO//)
0288           214 FORMAT (1HO///17HOSHARED COST DATA/37HONO. TITLE   DEVELOPMENT   S
                  1USTAINING//)
0289           215 FORMAT (1HO///22HOINTEGRATION COST DATA/59HOLOWER   UPPER    RECUR
                  1RING   LC   DEVELOPMENT   SUSTAINING/14H GROUP   GROUP//)
0290           216 FORMAT (2X,A4,4X,A4,F11.2,F7.3,2F13.2)
0291           217 FORMAT (14H1MISSION MODEL/48HO   MISSION   VELOCITY   PAYLOAD    P
                  1RIORITY  TR, 17X, 15HLAUNCH SCHEDULE//50X,20I4/1H /)
0292           219 FORMAT (1X,I2,1X,A6,2X,2F10.0,F10.2,4X,I2,2X,20I4)
0293          2141 FORMAT (1X,I2,2X,A4,2X,2F13.2)
0294          4102 FORMAT (1HO///5X,26HEND OF DATA - JOB COMPLETE)
0295          5000 FORMAT(2(2X,I2,F5.0,F3.0,I3,3F5.0,10X))
0296          5002 FORMAT(8X,2I3,2F6.0,6X,2I3,2F6.0,6X,2I3,2F6.0,6X)
0297          5003 FORMAT (27X,A4,1X,5HSTAGE,17X,3(F9.2,F8.2))
0298          5004 FORMAT (27X,A4,1X,6HSHARED,16X,3(F9.2,F8.2))
0299          5005 FORMAT (27X,15HINTEGRATION OF ,A4,5H AND ,A4,8X,F8.2,2(9X,F8.2))
0300          8001 FORMAT
                 1  (1X,A4,1X,3(F9.2,F7.3),F13.2,F12.2,2X,I4,1X,I4,2X,4I4,I9)
0301          8003 FORMAT (4X,5F10.3,F3.2)
0302          8004 FORMAT (3X,19HRECURRING COST TYPE,I2,22H  FOR X LESS THAN OR =,
                 1 F6.2,14H, TOTAL COST =,F6.2,19H,FOR X GREATER THAN,F6.2,
                 2 14H, TOTAL COST =,F6.2,4H X +,F6.2)
0303          8005 FORMAT(16HO REUSABLE STAGE, 4X,20HUNIT PURCHASE PRICE=,F7.2,'  (',
                 *  F7.2, ')')
0304          9003 FORMAT(1HO///14HOPAD COST DATA/12HONO. COMPLEX,2X,11HLAUNCHES/YR,
                 1  37X,5HPAD 1,12X,
                 2  5HPAD 2,12X,5HPAD 3/59X,3(11HDEV    SUST,6X)//)
```

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0305          9005 FORMAT (I4,2X,A4,F5.0)
0306          9006 FORMAT (1X,I2,2X,A4,5X,F6.2)
0307               END
```

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TOTAL MEMORY REQUIREMENTS 003E60 BYTES

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F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,NCAL,MAP
        VARIABLE OPTIONS USED - SIZE=(126976,24576)                    DEFAULT OPTION(S) USED
IEW0000      NAME MOX02DS(R)
IEW0461  IBCOM=
IEW0461  MEAN
IEW0461  MAXO
IEW0461  EXP


                                                    MODULE MAP

  CONTROL SECTION                          ENTRY

    NAME     ORIGIN   LENGTH                 NAME   LOCATION     NAME   LOCATION     NAME   LOCATION     NAME

  DATINS       00     3E60
  SAVER       3E60     FC0
  SAVDMP      4E20     148C
  SAVSAR      62E0      A58
  SAVE1       6D38     FC4
  SAV2        7D00     FE0
  SAV3        8CE0     980
  SAV4        9660    3188
  SVACAV      C7E8     B48
  SAVALL      D330    3A1C
  VARNCE     10D50     ADC
  TEMP       11830    4110
  SCRACH     15940    6A60


  ENTRY ADDRESS       00
  TOTAL LENGTH     1C3A0

****MOX02DS   NOW REPLACED IN DATA SET

                                        DIAGNOSTIC MESSAGE DIRECTORY

   IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.

(17)          OS/360  FORTRAN H                                    DATE  71.084/15.27.43

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
 ISN 0002            SUBROUTINE DECSNI
                C
                C  THIS SUBROUTINE SETS UP DS COSTS, CALCULATES AVAILABILITY OF EACH DECISION
                C   COST, AND MATCHES THESE COSTS WITH EACH VEHICLE THEN PRINTS THEM OUT
                C
 ISN 0003            REAL NPERPD
 ISN 0004            INTEGER*2 LTR,NPSTG,NPAD,NPFAM,NFS,NPINTL,NPINTU,MAPS,MAPF,MAPI,
                    1  FINISH,NSTG,NFML,NFMU,KODS,MAS,LABS,LABF,LABI,LSA,NYS,KODEF,
                    2  LST,MST,IST,JST,KST,VEH,NMULT,NONREC,NYD,IS,MAT,LYR,LETT,LYD,
                    3  MIN,MAF,MAIC
 ISN 0005            COMMON/SAVDMP/ NFAM,KFLAG,FAM(30),KODEF(30),FMNR(30),FMSUS(30),
                    1JST(30),YDF(30),LSA(40),SNR(40),NYS(40),DINT(40),SINT(40),KST(40),
                    2  YDI(40),YDS(40),IST(40),FMSLS(30,2),SUSLS(40,2),SINTLS(40,2),
                    3  LST(30,5),YDPF(30,5),MST(30,10),YDPS(30,10)
 ISN 0006            COMMON/SAVE1/ FINISH,NSTG,NCI,ILY,LABF(30),LABS(40),LABI(40),
                    1 NFML(40),NFMU(40),KODS(40),STS(41),STG(40),VLR(50),WPR(50),
                    2  RPLM(50),MAS(40,3), RXD(12,50)
 ISN 0007            COMMON/SAV3/GRO,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                    1   PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
 ISN 0008            COMMON/SAV4/  MAF(30,3), MAIC(40,3),
                    *            NPAD(2,60),NPFAM(30,5),NPINTL(30,5),NPINTU(30,5),
                    1  NFS(40,4),NPSTG(30,10),MAPS(30,10),MAPF(30,10),MAPI(30,10),
                    2  PFAMD(30,5,2),PFAMS(30,5,2),PINTS(30,5,2),PSTGD(30,10,2),
                    3   PSTGS(30,10,2)
 ISN 0009            COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                    1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                    2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
 ISN 0010            COMMON/SCRACH/LYF(30),NYF(30),DUM(6748)
                C
 ISN 0011            IF(FINISH.GT.1)  GO TO 2
                C
                C     ***SET UP DS  COSTS FOR BRANCH AND BOUND PROCEDURE***
                C     CALCULATE AVAILABILITY OF EACH DECISION COST
                C
 ISN 0013            NUMD = 0
 ISN 0014            DO 3 I = 1,NSTG
 ISN 0015            NX = LSA(I)
 ISN 0016            LSA(I) = MINO(NX,MYRS)
 ISN 0017            MAS(I,1) = 0
 ISN 0018            X = LABS(I)
 ISN 0019            IF(SNR(I)&STS(I)&X.LT..01)  GO TO 9024
 ISN 0021            NUMD = NUMD & 1
```

```
ISN 0022            DS (NUMD)=SNR(I)
ISN 0023            IF(LABS(I).EQ.0)  GO TO 302
ISN 0025            L = LABS(I)
ISN 0026            DO 301 K = 1,12
ISN 0027          301 DS(NUMD) = DS(NUMD) & RXD(K,L)
ISN 0028          302 SUST (NUMD)=STS(I)
ISN 0029            MAT(NUMD) = I
ISN 0030            MAS(I,1) = NUMD
                  C  NYD = FIRST YEAR COMPONENTS DEPENDENT ON DEV COST NUMD ARE AVAILABLE
ISN 0031            NYD(NUMD) = NYS(I)
                  C  LYD = LAST YEAR COMPONENTS DEPENDENT ON DEV COST NUMD ARE AVAILABLE
ISN 0032            LYD(NUMD) = LSA(I)
ISN 0033            YD(NUMD) = YDS(I)
ISN 0034            NDUM = NUMD & NMIS & NSPR
ISN 0035            IS(NDUM) = IST(I) & 1900
ISN 0036         9024 DO 9025 J = 1,2
ISN 0037            MAS(I,J&1) = 0
ISN 0038            IF(SUSLS(I,J).LT..01.OR.NP.EQ.0)    GO TO 9025
ISN 0040            NUMD = NUMD & 1
ISN 0041            DS(NUMD) = 0.0
ISN 0042            SUST(NUMD) = SUSLS(I,J)
ISN 0043            MAT(NUMD) = I & 2000
ISN 0044            MAS(I,J&1) = NUMD
ISN 0045            NYD(NUMD) = NYS(I)
ISN 0046            LYD(NUMD) = LSA(I)
ISN 0047            YD(NUMD) = 0.0
ISN 0048            NDUM = NUMD & NMIS & NSPR
ISN 0049            IS(NDUM) = ILY & 1900
ISN 0050         9025 CONTINUE
ISN 0051            3 CONTINUE
ISN 0052            IF(NFAM.EQ. 0) GO TO 601
                  C     CALCULATE FAMILY AVAILABILITY DATE
                  C FIRST YR. FAMILY IS AVAIL. = 1ST YR. ANY STAGE IN THAT FAMILY IS AVAIL.
ISN 0054            DO 422 II = 1,NFAM
ISN 0055            I = KODEF(II)
ISN 0056            LYF(I) = 0
ISN 0057          422 NYF(I) = MYRS
ISN 0058            DO 423 J = 1,NSTG
ISN 0059            DO 424 MS = 1,4
ISN 0060            I = NFS(J,MS)
ISN 0061            IF(I.EQ.0)  GO TO 423
ISN 0063            NX = NYS(J)

ISN 0064            NYF(I) = MINO(NYF(I),NX)
ISN 0065            NX = LSA(J)
ISN 0066            LYF(I) = MAXO(LYF(I),NX)
ISN 0067          424 CONTINUE
ISN 0068          423 CONTINUE
ISN 0069            DO 6 II = 1,NFAM
ISN 0070            I = KODEF(II)
ISN 0071            MAF(I,1) = 0
ISN 0072            X = LABF(I)
ISN 0073            IF(FMNR(I)&FMSUS(I)&X.LT..01)  GO TO 9026
ISN 0075            NUMD = NUMD & 1
ISN 0076            DS (NUMD) = FMNR(I)
ISN 0077            IF(LABF(I).EQ.0)  GO TO 304
ISN 0079            L = LABF(I)
ISN 0080            DO 303 K = 1,12
ISN 0081          303 DS(NUMD) = DS(NUMD) & RXD(K,L)
ISN 0082          304 SUST (NUMD)=FMSUS(I)
ISN 0083            MAT(NUMD) = -I
ISN 0084            MAF(I,1) = NUMD
ISN 0085            NX = YDF(I) & .9
ISN 0086            NX = JST(I) - ILY & NX
ISN 0087            NYD(NUMD) = MAXO (NYF(I),NX)
ISN 0088            LYD(NUMD) = LYF(I)
ISN 0089            YD(NUMD) = YDF(I)
ISN 0090            NDUM = NUMD & NMIS & NSPR
ISN 0091            IS(NDUM) = JST(I) & 1900
ISN 0092         9026 DO 9027 J = 1,2
ISN 0093            MAF(I,J&1) = 0
ISN 0094            IF (FMSLS(I,J).LT..01.OR.NP.EQ.0)   GO TO 9027
ISN 0096            NUMD = NUMD & 1
ISN 0097            DS(NUMD) = 0.0
ISN 0098            SUST(NUMD) = FMSLS(I,J)
ISN 0099            MAT(NUMD) = -I & 2000
ISN 0100            MAF(I,J&1) = NUMD
ISN 0101            NYD(NUMD) = NYF(I)
ISN 0102            LYD(NUMD) = LYF(I)
ISN 0103            YD(NUMD) = 0.0
ISN 0104            NDUM = NUMD & NMIS & NSPR
ISN 0105            IS(NDUM) = ILY & 1900
ISN 0106         9027 CONTINUE
ISN 0107            6 CONTINUE
ISN 0108          601 IF(NCI.EQ.0) GO TO 61
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ISN 0110           DO 60 I = 1,NCI
ISN 0111           JF = NFML(I)
ISN 0112           KF = NFMU(I)
ISN 0113           MAIC(I,1) = 0
ISN 0114           X = LABI(I)
ISN 0115           IF(DINT(I)&SINT(I)&X.LT..01)  GO TO 9028
ISN 0117           NUMD = NUMD & 1
ISN 0118           DS (NUMD) = DINT(I)
ISN 0119           IF(LABI(I).EQ.0)  GO TO 306
ISN 0121           L = LABI(I)
ISN 0122           DO 305 K = 1,12
ISN 0123       305 DS(NUMD) = DS(NUMD) & RXD(K,L)
ISN 0124       306 SUST (NUMD)=SINT(I)
ISN 0125           MAT(NUMD) = -100 -I
ISN 0126           MAIC(I,1) = NUMD
                C FIRST YR. INT. COST IS AVAIL. = 1ST YR. BOTH FAMS. ARE AVAIL.
ISN 0127           NYD(NUMD) = MAXO(NYF(JF),NYF(KF))
ISN 0128           LYD(NUMD) = MINO(LYF(JF),LYF(KF))
ISN 0129           YD(NUMD) = YDI(I)
ISN 0130           NDUM = NUMD & NMIS & NSPR
ISN 0131           IS(NDUM) = KST(I) & 1900
ISN 0132       9028 DO 9029 J = 1,2
ISN 0133           MAIC(I,J&1) = 0
ISN 0134           IF (SINTLS(I,J).LT..01.OR.NP.EQ.0)    GO TO 9029
ISN 0136           NUMD = NUMD & 1
ISN 0137           DS(NUMD) = 0.0
ISN 0138           SUST(NUMD) = SINTLS(I,J)
ISN 0139           MAT(NUMD) = -100 - I & 2000
ISN 0140           MAIC(I,J&1) = NUMD
ISN 0141           NX = YDI(I) & .9
ISN 0142           NX = KST(I) & NX - ILY
ISN 0143           NYD(NUMD) = MAXO(NYF(JF),NYF(KF),NX)
ISN 0144           LYD(NUMD) = MINO(LYF(JF),LYF(KF))
ISN 0145           YD(NUMD) = 0.0
ISN 0146           NDUM = NUMD & NMIS & NSPR
ISN 0147           IS(NDUM) = ILY & 1900
ISN 0148       9029 CONTINUE
ISN 0149         60 CONTINUE
ISN 0150         61 IF (NP.EQ.0) GO TO 9010
ISN 0152           DO 9011 I = 1,NP
ISN 0153           DO 9030 J = 1,5
ISN 0154           MAPF(I,J) = 0

ISN 0155           IF(PFAMD(I,J,1) & PFAMS(I,J,1) .LT. .01) GO TO 9030
ISN 0157           NUMD = NUMD & 1
ISN 0158           DS(NUMD) = PFAMD(I,J,1)
ISN 0159           SUST(NUMD) = PFAMS(I,J,1)
ISN 0160           MAT(NUMD) = -200 - I & 2000
ISN 0161           MAPF(I,J) = NUMD
ISN 0162           NX = YDPF(I,J) & .9
ISN 0163           NX = NX & LST(I,J) - ILY
ISN 0164           NYD(NUMD) = MAXO (NX,1)
ISN 0165           LYD(NUMD) = MYRS
ISN 0166           YD(NUMD) = YDPF(I,J)
ISN 0167           NDUM = NUMD & NMIS & NSPR
ISN 0168           IS(NDUM) = LST(I,J) & 1900
ISN 0169       9030 CONTINUE
ISN 0170           DO 9031 J = 1,10
ISN 0171           MAPS(I,J) = 0
ISN 0172           IF (PSTGD(I,J,1) & PSTGS(I,J,1).LT..01 ) GO TO 9031
ISN 0174           NUMD = NUMD & 1
ISN 0175           DS(NUMD) = PSTGD(I,J,1)
ISN 0176           SUST(NUMD) = PSTGS(I,J,1)
ISN 0177           MAT(NUMD) = -300 - I & 2000
ISN 0178           MAPS(I,J) = NUMD
ISN 0179           NX = YDPS(I,J) & .9
ISN 0180           NX = NX & MST(I,J) - ILY
ISN 0181           NYD(NUMD) = MAXO (NX,1)
ISN 0182           LYD(NUMD) = MYRS
ISN 0183           YD(NUMD) = YDPS(I,J)
ISN 0184           NDUM = NUMD & NMIS & NSPR
ISN 0185           IS(NDUM) = MST(I,J) & 1900
ISN 0186       9031 CONTINUE
ISN 0187           DO 9032 J = 1,5
ISN 0188           MAPI(I,J) = 0
ISN 0189           IF (PINTS(I,J,1) .LT. .01) GO TO 9032
ISN 0191           NUMD = NUMD & 1
ISN 0192           DS(NUMD) = 0.0
ISN 0193           SUST(NUMD) = PINTS(I,J,1)
ISN 0194           MAT(NUMD) = -400 - I & 2000
ISN 0195           MAPI(I,J) = NUMD
ISN 0196           JF = NPINTL(I,J)
ISN 0197           KF = NPINTU(I,J)
ISN 0198           NYD(NUMD) = MAXO(NYF(JF),NYF(KF))
ISN 0199           LYD(NUMD) = MYRS
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```
ISN 0200            YD(NUMD) = 0.0
ISN 0201            NDUM = NUMD & NMIS & NSPR
ISN 0202          . IS(NDUM) = ILY & 1900
ISN 0203       9032 CONTINUE
ISN 0204       9011 CONTINUE
               C
ISN 0205       9010 CALL MATCHI
               C
ISN 0206            IF(KFLAG.EQ.1)  RETURN
               C
ISN 0208          2 CALL PRINTI
               C
ISN 0209            RETURN
ISN 0210            END

****** END OF COMPILATION ******
```

```
 F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
           VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000      NAME MOX02DN(R)
IEW0461  MATCHI
IEW0461  PRINTI


                                        CROSS REFERENCE TABLE

  CONTROL SECTION                       ENTRY
    NAME     ORIGIN  LENGTH              NAME   LOCATION     NAME   LOCATION     NAME   LOCATION     NAME

  DECSNI        00    10C8
  SAVDMP      10C8    14BC
  SAVE1       2588     FC4
  SAV3        3550     980
  SAV4        3ED0    3188
  SAVALL      7058    3A1C
  SCRACH      AA78    6A60


  LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION          LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION

       120          SAVDMP        SAVDMP                     124          SAVE1         SAVE1
       128          SAV3          SAV3                       12C          SAV4          SAV4
       130          SAV4          SAV4                       134          SAV4          SAV4
       138          SAVALL        SAVALL                     13C          SAVALL        SAVALL
       140          SCRACH        SCRACH                     144          MATCHI        $UNRESOLVED
       148          PRINTI        $UNRESOLVED
 ENTRY ADDRESS      00
 TOTAL LENGTH    114D8

****MOX02DN   NOW REPLACED IN DATA SET


                                        DIAGNOSTIC MESSAGE DIRECTORY

  IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.
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(17)          OS/360  FORTRAN H                              DATE  71.084/15.28.24

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
ISN 0002            SUBROUTINE LBOND1
                C   THIS SUBROUTINE CALCULATES THE RECURRING AND NON-RECURRING LOWER
                C     BOUND WITH A PENALTY FUNCTION INCLUDED IF W NE 1.E30
                C
ISN 0003            REAL NPERPD
ISN 0004            INTEGER*2  NSAVE,NADD,NX,MINOPT,MORE,NTGYTR,
                   1  VEH,NMULT,NONREC,NYD,IS,MAT,LYR,LETT,LYD,MIN,KOUT,LTR,NINTYR
                C
ISN 0005            COMMON/SAV3/GRO,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                   1  PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
ISN 0006            COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                   1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                   2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
ISN 0007            COMMON/TEMP/VNM(2,250),IFLAG,KI,NEXT,LOUT,SAVS(40),KOUT(40),
                   1  NINTYR(40,20),NTGYTR(40,20,2),RECUR(60,20,2)
ISN 0008            COMMON/SCRACH/EXTRA,NADD,NX,MORE(50),LZ(46),W(500),W2(500),
                   1 TDS(500),WR(499),Z(500),COST(2,250),MINOPT(246,9),NODE(5,500),
                   2  NPOS,SIGSQ(9),ETC(9),
                   4  NCOST,LB,KX,KZ,NSAVE(10),KEEP(40),MZ(60),DUM
                C
ISN 0009            IF(L8.EQ.50)  GO TO 54
                C       ***FIND NEW RECURRING LOWER BOUND***
ISN 0011          49 W(KX)=0.
ISN 0012             W2(KX) = 0.0
ISN 0013             DO 50 J=1,NM
ISN 0014             IF(YRLM(J).LT..001)   GO TO 50
ISN 0016             CALL UNPACK(MZ,VNM(1,J),NV ,1)
ISN 0017             COST(1,J) = 1.0E30
ISN 0018             COST(2,J) = 1.0E30
ISN 0019             KO = LYR(J)
ISN 0020             JX = LETT(J)
ISN 0021             ITR = LTR(JX)
ISN 0022             DO 48 I1 = 1,NV
ISN 0023             IF(MZ(I1).EQ.0)  GO TO 48
ISN 0025             I = I1
ISN 0026             IF(ITR.EQ.2)  I = I1 & NV
ISN 0028             DO 47 M=1,20
ISN 0029             IF(NONREC(I,M).EQ.0) GO TO 475
ISN 0031             NO = NONREC(I,M)
ISN 0032             IF(KI*LZ(NO).LT.  KO  ) GO TO 48
ISN 0034          47 CONTINUE
ISN 0035         475 X = NMULT(I1,JX)

ISN 0036             CX=YRLM(J)*RECUR(I1,KO,ITR)*X
ISN 0037             IF(CX.GE.COST(2,J))  GO TO 48
ISN 0039             IF(CX.LT.COST(1,J))  GO TO 43
ISN 0041             COST(2,J) = CX
ISN 0042             GO TO 48
ISN 0043          43 COST(2,J) = COST(1,J)
ISN 0044             COST(1,J) = CX
ISN 0045             MIN(J) = I1
ISN 0046          48 CONTINUE
ISN 0047             W(KX)=W(KX)&COST(1,J)
ISN 0048             W2(KX) = W2(KX) & COST(2,J)
ISN 0049          50 CONTINUE
ISN 0050             IF(KX.EQ.NX)  GO TO 510
ISN 0052             KZ = KI*LZ(NCOST)
ISN 0053             IF(W(KX).LT.1.0E20)  GO TO 508
ISN 0055             TGO = 0.0
ISN 0056             GO TO 38
ISN 0057         508 IF(KZ.EQ.0)  GO TO 510
ISN 0059             KY = NSAVE(LB)
ISN 0060         512 IF(W(KX).GT.W(KY)-.0001.AND.W2(KX).GT.W2(KY)-.0001)  GO TO 38
ISN 0062             IF(W(KX).GT.W(KY)-.0001.AND.W2(KX).GT.1.0E25.AND.W2(KY)-W2(KX).LT.
                    1 1.0E25)  GO TO 38
                C
                C       CALCULATE LOWER BOUND USING PENALTY FUNCTION BASED ON VEHICLES
ISN 0064         510 DO 350 NIC = 1,NUMD
ISN 0065             KEEP(NIC) = 1
ISN 0066             IF(LZ(NIC).LT.15)  KEEP(NIC) = 0
ISN 0068         350 CONTINUE
ISN 0069         355 TGO = 0.0
ISN 0070             IV = 0
ISN 0071             TG = 0.0
ISN 0072         354 DO 351 IX = 1,NV
ISN 0073             IF(IX.EQ.IV)  GO TO 351
ISN 0075             VGO = 0.0
ISN 0076         330 DO 90 J = 1,NM
ISN 0077             IF(YRLM(J).LT..001)  GO TO 90
ISN 0079             IF(MIN(J).EQ.IX)  GO TO 91
ISN 0081          90 CONTINUE
ISN 0082             GO TO 351
ISN 0083          91 PF = 0.0
ISN 0084             KTV = 0
ISN 0085             I1 = IX
```

```
ISN 0086            JX = LETT(J)
ISN 0087           ,IF(LTR(JX).EQ.2)  I1 = IX & NV
ISN 0089            DO 341 M = 1,20
ISN 0090            IF(NONREC(I1,M).EQ.0)  GO TO 3415
ISN 0092            NO = NONREC(I1,M)
ISN 0093           . IF(KEEP(NO).EQ.0)  GO TO 341
ISN 0095            VGO = VGO &DS(NO) & FLOAT(KI)*SUST(NO)
ISN 0096            KTV = 1
ISN 0097          341 CONTINUE
ISN 0098         3415 IF(KTV.EQ.0)  GO TO 351
ISN 0100            DO 331  J = 1,NM
ISN 0101            IF(YRLM(J).LT.0.001.OR.MIN(J).NE.IX)  GO TO 331
ISN 0103            PF = PF & COST(2,J) - COST(1,J)
ISN 0104          331 CONTINUE
ISN 0105            VGO = AMIN1(VGO,PF)
ISN 0106            IF(VGO.LT.TG)  GO TO 351
ISN 0108            IV = IX
ISN 0109            TG = VGO
ISN 0110            I2 = I1
ISN 0111          351 CONTINUE
ISN 0112            TGO = TG & TGO
ISN 0113            IF(TG.LT.GUESS*.01)  GO TO 38
ISN 0115            TG = 0.0
ISN 0116            DO 352 M = 1,20
ISN 0117            IF(NONREC(I2,M).EQ.0)  GO TO 354
ISN 0119            NO = NONREC(I2,M)
ISN 0120            KEEP(NO) = 0
ISN 0121          352 CONTINUE
ISN 0122            GO TO 354
ISN 0123           38 IF(KZ.EQ.0)  TDS(KX) = TDS(NX)
ISN 0125              IF(KZ.GT.0.AND.KX.NE.NX)  TDS (KX) = TDS(NX)
                     1          & DS(NCOST) & FLOAT(   LB*KI-NYD(NCOST)&1)*SUST(NCOST)
ISN 0127           54 IF (KX.EQ.NX) TDS(NX) = TDS(NX) &
                      1          DS(NCOST) & FLOAT(LYD(NCOST)-NYD(NCOST)&1)*SUST(NCOST)
ISN 0129              DMIN = TGO & TDS(KX)
                    C
ISN 0130          507 Z(KX) = DMIN & W(KX)
ISN 0131            IF(LP.GT.0) WRITE(6,204)  KX,NX,NCOST,KZ,W(KX),DMIN,Z(KX)
ISN 0133            RETURN
ISN 0134          204 FORMAT (1H ,4(I3,5X),3(F9.2,5X))
ISN 0135            END

***** END OF COMPILATION ******


  F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
            VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000       NAME MOX02LD(R)
IEW0461   IBCOM=
IEW0461 . UNPACK

                                                CROSS REFERENCE TABLE

  CONTROL SECTION                          ENTRY

    NAME     ORIGIN  LENGTH                 NAME   LOCATION     NAME   LOCATION     NAME   LOCATION     NAME

  LBONDI         00     A50
  SAV3          A50     980
  SAVALL       13D0    3A1C
  TEMP         4DF0    4110
  SCRACH       8F00    6A60


  LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION          LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION

       168          SAV3          SAV3                      16C          SAVALL          SAVALL
       170          SAVALL        SAVALL                    174          TEMP            TEMP
       178          SCRACH        SCRACH                    17C          SCRACH          SCRACH
       180          SCRACH        SCRACH                    184          SCRACH          SCRACH
       188          SCRACH        SCRACH                    18C          IBCOM=         $UNRESOLVED
       190          UNPACK       $UNRESOLVED                 8C          SCRACH          SCRACH
        94          SAVALL        SAVALL
 ENTRY ADDRESS      00
 TOTAL LENGTH     F960

 ****MOX02LD   NOW REPLACED IN DATA SET

                                          DIAGNOSTIC MESSAGE DIRECTORY

   IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.
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(17)          OS/360  FORTRAN H                              DATE  71.084/15.28.56

         COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
  ISN 0002            SUBROUTINE LISTC
  ISN 0003            DOUBLE PRECISION NAME,NAMEN,NAMEK
  ISN 0004            INTEGER*2 KODESP,KODEM,NSYR,NSFX,NRFX,NYRSST,NSTRFX,NYRSFX,NPROG,
                     1  KPROG,KODE,LTR,YDPL
  ISN 0005            REAL LEVEL,NPERPD
  ISN 0006            COMMON/SAV2/EXT,ACCL,KNSTG,KNFAM,KNCI,KNP,KNMIS,JFLAG,TREF,NCSTR,
                     1 PMAX,PMIN,ISTRT,IFIN,MAXITR,MITR,KODESP(6),TITLE(10),LEVEL(20),
                     2  CNTRVL(20),FIXED(20),KODEM(50),NSYR(50),NSFX(50),NAME(56),
                     3  YDPL(56),NRFX(50),NYRSST(84),NSTRFX(84),NYRSFX(84),SUS(84),C(84)
                     4,  R(84), S(84),CS(90),NPROG(90),KPROG(90), KODE(90)
  ISN 0007            COMMON/SAV3/GRD,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                     1   PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
  ISN 0008            IF(NCSTR.EQ.0)   RETURN
  ISN 0010            WRITE (6,1)  NCSTR
  ISN 0011           1 FORMAT (1H1,25X,I2,' CONSTRAINTS'/6X,'KODE')
  ISN 0012            DO 200 I = 1,NCSTR
  ISN 0013            L = KODE(I)
  ISN 0014            IF(L.LT.1.OR.L.GT.11)   GO TO 200
  ISN 0016            J = NPROG(I)
  ISN 0017            K = KPROG(I)
  ISN 0018            IF(J.LE.NMIS & NSPR)  NAMEN = NAME(J)
  ISN 0020            NAMEK = NAME(K)
  ISN 0021            Z = CS(I)
  ISN 0022            GO TO (10,20,30,40,50,60,70,80,90,100,110),  L
  ISN 0023           10 WRITE(6,11) L,J,NAMEN,K,NAMEK,Z
  ISN 0024           11 FORMAT(6X,I3,3X,'START ',I3,1X,A6,' AFTER END ',I3,1X,A6,' &',F3.0
                       *)
  ISN 0025            GO TO 200
  ISN 0026           20 WRITE(6,21) L,J,NAMEN,Z,K,NAMEK
  ISN 0027           21 FORMAT (6X,I3,3X,'END ',I3,1X,A6,' &',F3.0,' BEFORE START ',I3,1X,
                      * A6)
  ISN 0028            GO TO 200
  ISN 0029           30 WRITE(6,31) L,J,NAMEN,Z
  ISN 0030           31 FORMAT (6X,I3,3X,'START ',I3,1X,A6,'  IN',F6.0)
  ISN 0031            GO TO 200
  ISN 0032           40 WRITE (6,41) L,J,NAMEN,Z
  ISN 0033           41 FORMAT (6X,I3,3X,'END DEVL ',I3,1X,A6,' IN',F6.0)
  ISN 0034            GO TO 200
  ISN 0035           50 WRITE (6,51) L,J,NAMEN,Z
  ISN 0036           51 FORMAT (6X,I3,3X,I3,1X,A6,F3.0,' YEARS DEVELOPMENT')
  ISN 0037            GO TO 200
  ISN 0038           60 IF (Z.LE.0.) GO TO 64

  ISN 0040              WRITE (6,61) L,J,NAMEN,Z,K,NAMEK
  ISN 0041           61 FORMAT (6X,I3,3X,'TARGET DATE ',I3,1X,A6,' NO LATER THAN',F4.0,
                      *  ' YEARS BEFORE ',I3,1X,A6)
  ISN 0042            GO TO 200
  ISN 0043           64 Z = ABS (Z)
  ISN 0044              WRITE (6,65) L,J,NAMEN,Z,K,NAMEK
  ISN 0045           65 FORMAT (6X,I3,3X,'TARGET DATE ',I3,1X,A6,' NO LATER THAN',F4.0,
                      *  ' YEARS AFTER  ',I3,1X,A6)
  ISN 0046            GO TO 200
  ISN 0047           70 WRITE (6,71) L,J,NAMEN,Z
  ISN 0048           71 FORMAT (6X,I3,3X,'TARGET DATE ',I3,1X,A6,' NO LATER THAN',F6.0)
  ISN 0049            GO TO 200
  ISN 0050           80 IF(J.LE.NMIS & NSPR)  WRITE (6,81) L,J,NAMEN
  ISN 0052           81 FORMAT (6X,I3,3X,I3,1X,A6,' FIXED')
  ISN 0053              IF(J.GT.NMIS & NSPR) WRITE(6,82) L,J
  ISN 0055           82 FORMAT (6X,I3,3X,'PROGRAM DEV  ', I3,'  FIXED')
  ISN 0056            GO TO 200
  ISN 0057           90 WRITE (6,91) L,J,NAMEN,Z
  ISN 0058           91 FORMAT (6X,I3,3X,'START ',I3,1X,A6,' NO EARLIER THAN',F6.0)
  ISN 0059            GO TO 200
  ISN 0060          100 WRITE (6,101) L,J,NAMEN,Z
  ISN 0061          101 FORMAT (6X,I3,3X,'TARGET DATE ',I3,1X,A6,' NO EARLIER THAN ',F6.0)
  ISN 0062            GO TO 200
  ISN 0063          110 WRITE( 6,111) L,J,K,NAMEK
  ISN 0064          111 FORMAT(6X,I3,3X, 'PROGRAM DEV  ',I3, '  COMPLETED BY FIRST LAUNCH
                       1OF PROGRAM ',I3,1X,A6)
  ISN 0065          200 CONTINUE
  ISN 0066              RETURN
  ISN 0067              END

****** END OF COMPILATION ******
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F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
        VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000      NAME MOX02LC(R)
IEW0461  IBCOM=


                                        CROSS REFERENCE TABLE

  CONTROL SECTION                       ENTRY
    NAME     ORIGIN  LENGTH             NAME   LOCATION     NAME   LOCATION     NAME   LOCATION     NAME

  LISTC          00     7B4
  SAV2          7B8     FE0
  SAV3         1798     980


  LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION          LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION

      370           SAV2           SAV2                      374           SAV3           SAV3
      378           IBCOM=         $UNRESOLVED
 ENTRY ADDRESS      00
 TOTAL LENGTH     2118

****MOX02LC   NOW REPLACED IN DATA SET

                                        DIAGNOSTIC MESSAGE DIRECTORY

   IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.


FORTRAN IV G LEVEL 1        MASTER     (MAIN)          DATE = 71084        16/06/46

            C  SPACE PROGRAM ECONOMIC EVALUATION MODEL
            C   COST UNCERTAINTIES ARE DISPLAYED QUANTITATIVELY
            C
            C  A PROGRAM EITHER EQUALS A MISSION WITH LAUNCH SCHEDULE OR A
            C  DEVELOPMENT OR SUSTAINING PROGRAM OR A MISC. PROGRAM
            C  A MISSION MUST HAVE AT LEAST ONE AND NO MORE THAN 10 LAUNCH YEARS
            C
 0001             DOUBLE PRECISION NAME
 0002             LOGICAL SKIP,EXT,ACCL
 0003             REAL NPERPD
 0004             INTEGER PROG
            C  CARDS 3,4,65 ARE NOT NEEDED ON TSS
 0005             INTEGER*2 YDPL,NSYR,NSFX,NRFX,NYRSST,NSTRFX,NPROG,KPROG,KODE,
                 1  NYRSFX,KODEM,KODESP,VEH,NMULT,NONREC,NYD,IS,MAT,LYR,LETT,LYD,
                 2  MIN,FINISH,NSTG,NFML,NFMU,KODS,MAS,LABS,LABF,LABI,LTR,NU,NBY,
                 3          MODE,NOB,LSA,NYS,KODEF,LST,MST,IST,JST,KST,NVS,MRV,NRP,
                 4  NYP,KODEP,IVEHA,NTRIP,NPLS,NRR,MR,NPSTG,NPAD,NPFAM,NFS,NPINTL,
                 5  NPINTU,MAPS,MAPF,MAPI,KODEV,MAF,MAIC
 0006             COMMON/SAVER/  RFIXD(12,84)
 0007             COMMON/SAVDMP/ NFAM,KFLAG,FAM(30),KODEF(30),FMNR(30),FMSUS(30),
                1JST(30),YDF(30),LSA(40),SNR(40),NYS(40),DINT(40),SINT(40),KST(40),
                 2  YDI(40),YDS(40),IST(40),FMSLS(30,2),SUSLS(40,2),SINTLS(40,2),
                 3  LST(30,5),YDPF(30,5),MST(30,10),YDPS(30,10)
 0008             COMMON/SAVSAR/ POJ(3),SRJ(3,3),NUI(40),NBY(40),NOB(40),RINT(40),
                1    PLCINT(40),XLT(40), PLCT(40),UPP(40),TAT(40),TAMT(50),SR(40,3),
                2    MODE(40,3),PLC(40,3)
 0009             COMMON/SAVE1/ FINISH,NSTG,NCI,ILY,LABF(30),LABS(40),LABI(40),
                1 NFML(40),NFMU(40),KODS(40),STS(41),STG(40),VLR(50),WPR(50),
                2  RPLM(50),MAS(40,3), RXD(12,50)
 0010             COMMON/SAV2/EXT,ACCL,KNSTG,KNFAM,KNCI,KNP,KNMIS,JFLAG,TREF,NCSTR,
                1 PMAX,PMIN,ISTRT,IFIN,MAXITR,MITR,KODESP(6),TITLE(10),LEVEL(20),
                2  CNTRVL(20),FIXED(20),KODEM(50),NSYR(50),NSFX(50),NAME(56),
                3  YDPL(56),NRFX(50),NYRSST(84),NSTRFX(84),NYRSFX(84),SUS(84),C(84)
                4,  R(84),  S(84),CS(90),NPROG(90),KPROG(90),  KODE(90)
 0011             COMMON/SAV3/GRO,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                1    PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
 0012             COMMON/SAV4/  MAF(30,3), MAIC(40,3),
                *              NPAD(2,60),NPFAM(30,5),NPINTL(30,5),NPINTU(30,5),
                1  NFS(40,4),NPSTG(30,10),MAPS(30,10),MAPF(30,10),MAPI(30,10),
                2  PFAMD(30,5,2),PFAMS(30,5,2),PINTS(30,5,2),PSTGD(30,10,2),
                3   PSTGS(30,10,2)
 0013             COMMON/SVACAV/  KNV,NOPT,KODEP(30),RPLO(40),IVEHA(50),NTRIP(50),
                1  NPLS(50),NRR(50),MR(50),NVS(60),MRV(60),NRP(60),B1(60),B2(60),
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                2  B3(60),B4(60),KODEV(60),NYP(2,60),VM(2,60)
0014             COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
0015             COMMON/VARNCE/KSTAT,VARI(40),VARF(50),VARM(56),FMVAR(2,30),
                1  FIVAR(3,40),PLVAR(3,56),SVAR(5,40)
0016             COMMON/SCRACH/M,N,NCS,PROG,IODD,IERR,SKIP,MYFLAG,JS,NSCALE(5),
                1  NSL(10),TOTAL(20),W(20),D(20),XOUT(20),VOUT(20),RRR(20),YEAR(20)
                2,  Y(20),KVEHI(50),LABEL(50),LVARY(70),LVD(70),IVEH(70),LVS(70),
                3  LVSF(80),VNAM(80),NOP(86),RF(86),CF(86),SF(86),FLAGR(86),
                4  FLAGS(86),NSSF(86),NSRF(86),NSXF(86),NDSF(86),SUSTF(86),NLVP(86)
                5,  NSTRRC(86),NYRSRC(86),LNDF(86),NSTRST(86),LNDATE(86),NPRO(90),
                6  KPRO(90),CSX(90),LZ(46),RCOST( 60), KVEH( 60),IMAGE(830),
                7  XSCH(10,70),XLVSUM(20,50),RECUR(20,50),KODX(90),LABN(46),DM(520)
0017             DIMENSION PRGLV(4)
0018             DATA BLANK /1H /
0019             DATA PRGLV /4HPROG, 4HRAM , 4HLEVE, 4HL   /
0020             STS(41) = BLANK
0021             LYR(252) = 0
0022           9 FINISH = 1
0023             KSTAT = 0
0024             JFLAG = 0
0025             DO 3 I = 1, 40
0026             DO 2 J = 1,3
0027             FIVAR(J,I) = 0.0
0028           2 SVAR(J,I) = 0.0
0029             VARI(I) = 0.0
0030             SVAR(4,I) = 0.0
0031           3 SVAR(5,I) = 0.0
0032             DO 4 I = 1,30
0033             FMVAR(1,I) = 0.0
0034           4 FMVAR(2,I) = 0.0
0035             DO 5 I = 1,56
0036             VARM(I) = 0.0
0037             DO 5 J = 1,3
0038           5 PLVAR(J,I) = 0.0
0039             DO 6 I = 1,50
0040           6 VARF(I) = 0.0
0041          10 CALL ASIGNS
0042             IF(MYRS.EQ.0)  GO TO 99
0043             IF(MYRS.EQ.100)  GO TO 9
0044             IF(FINISH.GT.1) GO TO 12
0045             NNH = NMIS + 1 + NSPR
```



```
0046             TREF = 1900.0 + TREF
0047             DO 8 I = 1,84
0048           8 R(I) = 0.0
0049          12 DO 13 I = 1,70
0050             LVARY(I) = 0
0051             LVD(I) = 0
0052             DO 131 J = 1,10
0053         131 XSCH(J,I) = 0.0
0054          13 CONTINUE
0055             DO 132 I = 1,86
0056         132 NLVP(I) = 0
0057             DO 133 I = 1,50
0058         133 LABEL(I) = 0
0059             DO 134 I = 1,NMIS
0060         134 NYRSST(I) = 0
0061             NUMD = NUMD + NEXD
0062             DO 14 I = 1, NUMD
0063          14 LABN(I) = 0
               C
               C  CALCULATE VARIABLES FOR SMOOTH FROM MISSION DATA
               C
0064             M = 1
0065             DO 120 K = 1,NM
0066             IF(MIN(K).EQ.0)  GO TO 120
0067             I = LYR(K)
0068             J = LETT(K)
0069             IF(J.EQ.LETT(K-1))  GO TO 105
0070             IF(FINISH.GT.1)  GO TO 104
0071             S(J) = IS(J)
0072             R(J) = YDPL(J)
0073         104 LVARY(J) = M
0074             NSTRST(J) =  INT(2.0*R(J)/3.0 + .999)
0075             IF(R(J).EQ.0)  NSTRST(J)=1
0076             GO TO 108
0077         105 L1 = LVARY(J)
0078             MO = M-1
0079             DO 106 L = L1,MO
0080             IF(MIN(K).NE.IVEH(L))  GO TO 106
0081             M1 = L
0082             GO TO 110
0083         106 CONTINUE
0084         108 IVEH(M) = MIN(K)
0085             LVS(M) = I - IS(J) + 1900 + ILY
```

```
0086              NLVP(J) = NLVP(J) + 1
0087              M1 = M
0088              M = M + 1
0089            110 M3 = IS(J)
0090              IF(SUS(J).LE..001)  GO TO 111
0091              NX = NYRSST(J)
0092              M4 = NSTRST(J)
0093              M5 = NSYR(J)
0094              NYRSST(J) = MAXO(NX,I - M4 - M3 + 1900 + ILY + M5 + 1)
0095            111 M2 = LVS(M1)
0096              K1 = MIN(K)
0097              X = NMULT(K1,J)
0098              NDUM = I - M2 - M3 + 1900 + ILY + 1
0099              XSCH(NDUM,M1) = YRLM(K)*X
0100              NX = LVD(M1)
0101              LVD(M1) = MAXO(NX,NDUM)
0102            120 CONTINUE
0103              M = M - 1
0104              NCS = 0
0105              N = NMIS
0106              IF(NSPR.EQ.0)  GO TO 170
0107              DO 150 I = 1,NSPR
0108              N = N + 1
0109              IF(FINISH.GT.1)  GO TO  140
0110              S(N) = IS(N)
0111              R(N) = YDPL(N)
0112            140 NSTRST(N) = INT(2.0*R(N)/3.0 + .999)
0113              IF(R(N).EQ.0)  NSTRST(N) = 1
0114            150 CONTINUE
                C
                C  CONTINUE TO CALCULATE VARIABLES FOR SMOOTH USING DEV. AND SUST. COSTS
                C
0115            170 IF(NUMD.EQ.0)  GO TO 260
0116              CALL UNPACK(LZ,LZOPT(1),NUMD,5)
0117              DO 210 I = 1,NUMD
0118              IF(LZ(I).EQ.0)  GO TO 210
0119              N = N + 1
0120              NDUM = N - NMIS - NSPR
0121              LABEL(NDUM) = I
0122              LABN(I) = N
0123              C(N) = DS(I)
0124              NYRSFX(N) = 0
0125              L = MAT(I)
```



```
0126              IF(L.GT.1000)  GO TO 206
0127              IF(L.LT.-100)  NDUM = -L -100
0128              IF(L.LT.-100)  J = LABI(NDUM)
0129              IF(L.LT.0.AND.L.GE.-100)  NDUM = -L
0130              IF(L.LT.0.AND.L.GE.-100)  J = LABF(NDUM)
0131              IF(L.GT.0)  J = LABS(L)
0132              IF(J.EQ.0)  GO TO 206
0133              DO 205  K = 1,12
0134              RFIXD(K,N) = RXD(K,J)
0135            205 C(N) = C(N) - RXD(K,J)
0136              NYRSFX(N) = NSFX(J)
0137              NSTRFX(N) = NRFX(J)
0138            206  NDUM = I + NMIS + NSPR
0139              S(N) = IS(NDUM)
0140              R(N) = YD(I)
0141              SUS(N) = SUST(I)
0142              NSTRST(N) = INT(2.0*R(N)/3.0 + .999)
0143              IF(R(N).EQ.0)  NSTRST(N)=1
0144              NYRSST(N) = LZ(I) - NYD(I) + INT(YD(I)) - NSTRST(N) + 1
0145              IF(SUS(N).LT..0001)  NYRSST(N) = 0
0146            210 CONTINUE
                C
                C  CALCULATE DEVELOPMENT CONSTRAINTS ON MISSION PROGRAMS
0147              DO 250  K = 1,NM
0148              IF(MIN(K).EQ.0)   GO TO 250
0149              J = LETT(K)
0150              IF(NLVP(J).EQ.1.AND.J.EQ.LETT(K-1))  GO TO 250
0151              IV = MIN(K)
0152              DO 211 I = 1,10
0153              NDM = K - I
0154              IF(J.NE.LETT(NDM)) GO TO 215
0155              IF (IV.EQ.MIN(NDM)) GO TO 250
0156            211 CONTINUE
0157            215 X = LYR(K) - LYR(NDM+1)
0158              I1 = IV
0159              IF(LTR(J).EQ.2)  I1 = IV + NV
0160              DO 220 K1 = 1,20
0161              IF(NONREC(I1,K1).EQ.0)  GO TO 250
0162              NO = NONREC(I1,K1)
0163              J1 = LABN(NO)
0164              NCS = NCS + 1
0165              NPRO(NCS) = J1
0166              CSX(NCS) = -1.0 -X
```

```
0167              IF(C(J1).LT..0001)  GO TO 216
0168              KPRO (NCS) = J
0169              KODX(NCS) = 11
0170              GO TO 217
0171            216 IF(NCS.EQ.1)  GO TO 219
0172              NCS = NCS - 1
0173              DO 218 I = 1,NCS
0174              IF(J1.EQ.NPRD(I))  GO TO 220
0175            218 CONTINUE
0176              NCS = NCS + 1
0177            219 KPRO(NCS) = 0
0178              KODX(NCS) = 8
0179           217  IF(NCS.GE.90)  GO TO 255
0180            220 CONTINUE
0181            250 CONTINUE
0182              GO TO 260
0183            255 WRITE(6,1002)
0184           1002 FORMAT(52HONUMBER OF DEVELOPMENT CONSTRAINTS HAS BEEN EXCEEDED)
               C
0185            260 CALL SMOTHS(PRGLV,BLANK)
               C
0186              IF(MOS.EQ.2.OR.MOS.EQ.3)  GO TO 9
0187              IF(FINISH.EQ.MITR + 1.AND.JFLAG.EQ.1)  GO TO 401
0188              IF(FINISH.EQ.MITR + 1)  GO TO 402
0189              IF(FINISH.EQ.MITR)   JFLAG = 1
               C
               C  CALCULATE VARIABLES FOR ASSIGN FROM SMOOTH VARIABLES
               C
0190              MXRS = MYRS
0191              DO 300  K = 1,NM
0192              I = LYR(K)
0193              J = LETT(K)
0194              IF(J.EQ.LETT(K-1))  GO TO 305
0195              IS(J) = S(J)
0196              IX = IS(J) + LNDATE(J) - 1900 - ILY
0197              IDIFF = IX - I
0198            305 IF (IDIFF.EQ.0)  GO TO 300
0199              MYRS = MAX0(MYRS,IDIFF + I)
0200              LYR(K) = I + IDIFF
0201            300 CONTINUE
0202              MYRS = MIN0 (MYRS,20)
0203              IF(N.EQ.NMIS+NSPR)  GO TO 10
0204              DO 350 I = NNM , N
```



```
0205              NDUM = I - NMIS - NSPR
0206              J = LABEL(NDUM)
0207              DS(J) = C(I)
0208              L = MAT(J)
0209              IF(L.GT.1000)  GO TO 320
0210              IF(L.LT.-100)  NDM = -L -100
0211              IF(L.LT.-100)  J1 = LABI(NDM)
0212              IF(L.LT.0.AND.L.GE.-100)  NDM = -L
0213              IF(L.LT.0.AND.L.GE.-100)  J1 = LABF(NDM)
0214              IF(L.GT.0)  J1 = LABS(L)
0215              IF(J1.EQ.0)  GO TO 320
0216              DO 310 K = 1,12
0217            310 DS(J) = DS(J) + RFIXD(K,I)
0218              NRFX(J1) = NSTRFX(I)
0219            320 SUST(J) = SUS(I)
0220              YD(J) = R(I)
0221              NYD(J) = INT(S(I) + R(I)) - 1900 - ILY
0222              IF(NYD(J).LE.0)   NYD(J) = 1
0223              NDUM = J + NMIS + NSPR
0224              IS(NDUM) = S(I)
0225            350 CONTINUE
0226              NUMD = NUMD - NEXD
0227              DO 349 I = 1,NUMD
0228              IF(LYD(I).EQ.MXRS)   LYD(I) = MYRS
0229            349 CONTINUE
0230              GO TO 10
0231            401 WRITE(6,500)
0232              GO TO 9
0233            402 WRITE(6,501)
0234              GO TO 9
0235            500 FORMAT (58HOMAXIMUM NUMBER OF ITERATIONS COMPLETED - END OF THIS C
                   *ASE)
0236            501 FORMAT ( 65HOOPTIMUM ASSIGNMENT WITHIN BUDGET CONSTRAINTS HAS BEEN
                   1 DETERMINED)
0237             99 STOP
0238              END
```

TOTAL MEMORY REQUIREMENTS 001914 BYTES

```
F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,NCAL,MAP
          VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000       NAME MOXO2MN(R)
IEW0461  ASIGNS
IEW0461  UNPACK
IEW0461  IBCOM=
IEW0461  SMOTHS
IEW0461  MAXO
IEW0461  MINO
```

MODULE MAP

CONTROL SECTION NAME	ORIGIN	LENGTH	ENTRY NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME
MAIN	00	1914							
SAVER	1918	FC0							
SAVDMP	28D8	148C							
SAVSAR	3D98	A58							
SAVE1	47F0	FC4							
SAV2	57B8	FE0							
SAV3	6798	980							
SAV4	7118	3188							
SVACAV	A2A0	B48							
SAVALL	ADE8	3A1C							
VARNCE	E808	ADC							
SCRACH	F2E8	6A60							

```
ENTRY ADDRESS       00
TOTAL LENGTH     15D48

****MOXO2MN   NOW REPLACED IN DATA SET
```

DIAGNOSTIC MESSAGE DIRECTORY

IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.

```
0001                SUBROUTINE MATCHI
                C   ***MATCH DECISION COSTS WITH EACH VEHICLE***
                C
0002                INTEGER*2  LSA,NYS,KODEF,LST,MST,IST,JST,KST,VEH,NMULT,NONREC,NYD,
                   1  IS,MAT,LYR,LETT,LYD,MIN,NPSTG,NPAD,NPFAM,NFS,NPINTL,NPINTU,MAPS,
                   2  MAPF,MAPI,FINISH,NSTG,NFML,NFMU,KODS,MAS,LABS,LABF,LABI,MAIC,MAF
                C
0003                COMMON/SAVDMP/ NFAM,KFLAG,FAM(30),KODEF(30),FMNR(30),FMSUS(30),
                   1JST(30),YDF(30),LSA(40),SNR(40),NYS(40),DINT(40),SINT(40),KST(40),
                   2  YDI(40),YDS(40),IST(40),FMSLS(30,2),SUSLS(40,2),SINTLS(40,2),
                   3  LST(30,5),YDPF(30,5),MST(30,10),YDPS(30,10)
0004                COMMON/SAVE1/ FINISH,NSTG,NCI,ILY,LABF(30),LABS(40),LABI(40),
                   1 NFML(40),NFMU(40),KODS(40),STS(41),STG(40),VLR(50),WPR(50),
                   2  RPLM(50),MAS(40,3), RXD(17,50)
0005                COMMON/SAV3/GRD,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                   1    PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
0006                COMMON/SAV4/  MAF(30,3), MAIC(40,3),
                   *                NPAD(2,60),NPFAM(30,5),NPINTL(30,5),NPINTU(30,5),
                   1  NFS(40,4),NPSTG(30,10),MAPS(30,10),MAPF(30,10),MAPI(30,10),
                   2  PFAMD(30,5,2),PFAMS(30,5,2),PINTS(30,5,2),PSTGD(30,10,2),
                   3    PSTGS(30,10,2)
0007                COMMON/SAVALL/LCK,SLO,NM,NEXO,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                   1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                   2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
                C
0008                IF(LP.GE.2)  WRITE(6,251)
0009              4 DO 66 I = 1,NV
0010                I2 = I + NV
0011                JX = 0
0012                KX = 0
0013                DO 64 J = 1,20
0014                NONREC(I2,J) = 0
0015             64 NONREC(I,J) = 0
0016             25 DO 65 MS= 1,4
0017                K = VEH(MS,I)
0018                IF(K.EQ.0) GO TO 66
0019                IF (MAS(K,1) .EQ. 0) GO TO 9050
0020                JX = JX + 1
0021                NONREC(I,JX) = MAS(K,1)
0022                KX = KX + 1
0023                NONREC(I2  ,KX) = MAS(K,1)
0024                IF(LP.GE.2)  WRITE(6,250)  I,  MAS(K,1)
0025                IF(LP.GE.2)  WRITE(6,250) I2, MAS(K,1)
```



```
0026                IF(JX.GT.20.OR.KX.GT.20)  GO TO 93
0027             9050 IF(NP.EQ.0)  GO TO 63
0028                IF (MAS(K,2).EQ.0) GO TO 9051
0029                DO 302 L = 1,JX
0030                IF(MAS(K,2).EQ.NONREC(I,L))   GO TO 9051
0031              302 CONTINUE
0032                JX = JX + 1
0033                NONREC(I,JX) = MAS(K,2)
0034                IF(LP.GE.2)  WRITE(6,250)  I,  MAS(K,2)
0035                IF (JX.GT.20) GO TO 93
0036             9051 IF (MAS(K,3).EQ.0) GO TO 9052
0037                DO 303 L = 1,KX
0038                IF(MAS(K,3).EQ.NONREC(I2,L))   GO TO 9052
0039              303 CONTINUE
0040                KX = KX + 1
0041                NONREC(I2  ,KX) = MAS(K,3)
0042                IF(LP.GE.2)  WRITE(6,250)  I2, MAS(K,3)
0043                IF (KX.GT.20) GO TO 93
0044             9052 IF (NPAD(1,I).EQ.0) GO TO 9053
0045                N1 = NPAD(1,I)
0046                DO 9054 J = 1,10
0047                IF (NPSTG(N1,J) .NE.K) GO TO 9054
0048                IF (MAPS(N1,J).EQ.0) GO TO 9053
0049                DO 304 L = 1,JX
0050                IF(MAPS(N1,J).EQ.NONREC(I,L))   GO TO 9053
0051              304 CONTINUE
0052                JX = JX +. 1
0053                NONREC(I,JX) = MAPS(N1,J)
0054                IF(LP.GE.2)  WRITE(6,250)  I,  MAPS(N1,J)
0055                IF (JX.GT.20) GO TO 93
0056                GO TO 9053
0057             9054 CONTINUE
0058             9053 IF (NPAD(2,I).EQ.0) GO TO 63
0059                N1 = NPAD(2,I)
0060                DO 9055 J = 1,10
0061                IF (NPSTG(N1,J).NE.K) GO TO 9055
0062                IF (MAPS(N1,J).EQ.0) GO TO 63
0063                DO 305 L = 1,KX
0064                IF(MAPS(N1,J).EQ.NONREC(I2,L))   GO TO 63
0065              305 CONTINUE
0066                KX = KX + 1
0067                NONREC(I2  ,KX) = MAPS(N1,J)
0068                IF(LP.GE.2)  WRITE(6,250)  I2, MAPS(N1,J)
```

```
0069              IF (KX.GT.20) GO TO 93
0070              GO TO 63
0071           9055 CONTINUE
               C     ***   PICK UP SHARED COSTS   ***
0072             63 IF(NFAM.EQ.0)  GO TO 21
0073                DO 885 KY=1,4
0074                KZ=NFS(K,KY)
0075                IF(KZ.EQ.0) GO TO 885
0076                IF (MAF(KZ,1).EQ.0) GO TO 9056
0077                DO 306 L = 1,JX
0078                IF(MAF(KZ,1).EQ.NONREC(I,L))  GO TO 401
0079            306 CONTINUE
0080                JX=JX+1
0081                NONREC(I,JX) = MAF(KZ,1)
0082                IF(LP.GE.2)  WRITE(6,250)  I,  MAF(KZ,1)
0083            401 DO 307 L = 1,KX
0084                IF(MAF(KZ,1).EQ.NONREC(I2,L))   GO TO 9056
0085            307 CONTINUE
0086                KX = KX + 1
0087                NONREC(I2  ,KX) = MAF(KZ,1)
0088                IF(LP.GE.2)  WRITE(6,250)  I2, MAF(KZ,1)
0089                IF(JX.GT.20.OR.KX.GT.20)    GO TO 93
0090           9056 IF(NP.EQ.0) GO TO 885
0091                IF (MAF(KZ,2).EQ.0) GO TO 9057
0092                DO 308 L = 1,JX
0093                IF(MAF(KZ,2).EQ.NONREC(I,L))    GO TO 9057
0094            308 CONTINUE
0095                JX = JX + 1
0096                NONREC(I,JX) = MAF(KZ,2)
0097                IF(LP.GE.2)  WRITE(6,250)  I,  MAF(KZ,2)
0098                IF(JX.GT.20) GO TO 93
0099           9057 IF (MAF(KZ,3).EQ.0) GO TO 9058
0100                DO 309 L = 1,KX
0101                IF(MAF(KZ,3).EQ.NONREC(I2,L))   GO TO 9058
0102            309 CONTINUE
0103                KX = KX + 1
0104                NONREC(I2  ,KX) = MAF(KZ,3)
0105                IF(LP.GE.2)  WRITE(6,250)  I2, MAF(KZ,3)
0106                IF (KX.GT.20) GO TO 93
0107           9058 IF (NPAD(1,I).EQ.0) GO TO 9059
0108                N1 = NPAD(1,I)
0109                DO 9060 J = 1,5
0110                IF (NPFAM(N1,J).NE.KZ) GO TO 9060
```



```
0111                IF (MAPF(N1,J).EQ.0) GO TO 9059
0112                DO 310 L = 1,JX
0113                IF(MAPF(N1,J).EQ.NONREC(I,L))  GO TO 9059
0114            310 CONTINUE
0115                JX = JX + 1
0116                NONREC(I,JX) = MAPF(N1,J)
0117                IF(LP.GE.2)  WRITE(6,250)  I,  MAPF(N1,J)
0118                IF (JX.GT.20) GO TO 93
0119                GO TO 9059
0120           9060 CONTINUE
0121           9059 IF (NPAD(2,I).EQ.0) GO TO 885
0122                N1 = NPAD(2,I)
0123                DO 9061 J = 1,5
0124                IF (NPFAM(N1,J).NE.KZ) GO TO 9061
0125                IF (MAPF(N1,J).EQ.0) GO TO 885
0126                DO 311 L = 1,KX
0127                IF(MAPF(N1,J).EQ.NONREC(I2,L))   GO TO 885
0128            311 CONTINUE
0129                KX = KX + 1
0130                NONREC(I2  ,KX) = MAPF(N1,J)
0131                IF(LP.GE.2)  WRITE(6,250)  I2, MAPF(N1,J)
0132                IF (KX.GT.20) GO TO 93
0133                GO TO 885
0134           9061 CONTINUE
0135            885 CONTINUE
               C     ***   PICK UP INTEGRATION COSTS   ***
0136             21 IF(MS.EQ.4) GO TO 65
0137                IF(VEH(MS+1,I).EQ.0) GO TO 65
0138                K1=VEH(MS+1,I)
0139                IF(NCI.EQ.0) GO TO 9062
0140                DO 89 J=1,NCI
0141                DO 887 KY=1,4
0142                IF(NFML(J).NE.NFS(K,KY)) GO TO 887
0143                DO 886 KZ=1,4
0144                IF(NFMU(J).EQ.NFS(K1,KZ)) GO TO 888
0145            886 CONTINUE
0146            887 CONTINUE
0147                GO TO 89
0148            888 IF (MAIC(J,1).EQ.0) GO TO 9063
0149                DO 312 L = 1,JX
0150                IF(MAIC(J,1).EQ.NONREC(I,L))   GO TO 402
0151            312 CONTINUE
0152                JX = JX + 1
```

```
0153              NONREC(I,JX) = MAIC(J,1)
0154              IF(LP.GE.2)  WRITE(6,250)  I,  MAIC(J,1)
0155           402 DO 313 L = 1,KX
0156              IF(MAIC(J,1).EQ.NONREC(I2,L))  GO TO 9063
0157           313 CONTINUE
0158              KX = KX + 1
0159              NONREC(I2  ,KX) = MAIC(J,1)
0160              IF(LP.GE.2)  WRITE(6,250)  I2, MAIC(J,1)
0161              IF(JX.GT.20.OR.KX.GT.20)    GO TO 93
0162          9063 IF(NP.EQ.0)   GO TO 89
0163              IF (MAIC(J,2).EQ.0) GO TO 9064
0164              DO 314 L = 1,JX
0165              IF(MAIC(J,2).EQ.NONREC(I,L))  GO TO 9064
0166           314 CONTINUE
0167              JX = JX + 1
0168              NONREC(I,JX) = MAIC(J,2)
0169              IF(LP.GE.2)  WRITE(6,250)  I,  MAIC(J,2)
0170              IF(JX.GT.20) GO TO 93
0171          9064 IF (MAIC(J,3).EQ.0) GO TO 89
0172              DO 315 L = 1,KX
0173              IF(MAIC(J,3).EQ.NONREC(I2,L))   GO TO 89
0174           315 CONTINUE
0175              KX = KX + 1
0176              NONREC(I2  ,KX) = MAIC(J,3)
0177              IF(LP.GE.2)  WRITE(6,250)  I2, MAIC(J,3)
0178              IF (KX.GT.20) GO TO 93
0179            89 CONTINUE
0180          9062 IF(NP.EQ.0)  GO TO 65
0181              DO 9065 M = 1,2
0182              IF (NPAD(M,I).EQ.0) GO TO 9065
0183              N1 = NPAD(M,I)
0184              DO 9066 J = 1,4
0185              IF (NFS(K,J).EQ.0) GO TO 9065
0186              DO 9067 KY = 1,5
0187              IF(NPINTL(N1,KY).EQ.0)   GO TO 9066
0188              IF (NPINTL(N1,KY).NE.NFS(K,J)) GO TO 9067
0189              DO 9068 KZ = 1,4
0190              IF (NPINTU(N1,KY).EQ.NFS(K1,KZ)) GO TO 9069
0191          9068 CONTINUE
0192              GO TO 9067
0193          9069 IF (MAPI(N1,KY).EQ.0) GO TO 9067
0194              IF (M.EQ.2) GO TO 9070
0195              DO 316 L = 1,JX
```



```
0196              IF(MAPI(N1,KY).EQ.NONREC(I,L))  GO TO 9067
0197           316 CONTINUE
0198              JX = JX + 1
0199              NONREC(I,JX) = MAPI(N1,KY)
0200              IF(LP.GE.2)  WRITE(6,250)  I,  MAPI(N1,KY)
0201              IF (JX.GT.20) GO TO 93
0202              GO TO 9067
0203          9070 DO 317  L = 1,KX
0204              IF(MAPI(N1,KY).EQ.NONREC(I2,L))  GO TO 9067
0205           317 CONTINUE
0206              KX = KX + 1
0207              NONREC(I2  ,KX) = MAPI(N1,KY)
0208              IF(LP.GE.2)  WRITE(6,250)  I2, MAPI(N1,KY)
0209              IF (KX.GT.20) GO TO 93
0210          9067 CONTINUE
0211          9066 CONTINUE
0212          9065 CONTINUE
0213            65 CONTINUE
0214            66 CONTINUE
0215               RETURN
0216            93 WRITE(6,220) I
0217               KFLAG = 1
0218            99 RETURN
0219           220 FORMAT(45H0EXCEEDED 20  NON-RECURRING COSTS FOR VEHICLE,I4)
0220           250 FORMAT(I5, 16X,I4)
0221           251 FORMAT (8H1VEHICLE,10X,15HDECISION NUMBER)
0222               END
```

TOTAL MEMORY REQUIREMENTS 001984 BYTES

```
 F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,NCAL,MAP
         VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000      NAME MOX02MH(R)
IEW0461  I8COM=
```

MODULE MAP

CONTROL SECTION			ENTRY						
NAME	ORIGIN	LENGTH	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME
MATCHI	00	1984							
SAVDMP	1988	14BC							
SAVE1	2E48	FC4							
SAV3	3E10	9E4							
SAV4	47F8	3188							
SAVALL	7980	3A1C							

```
 ENTRY ADDRESS       00
 TOTAL LENGTH      83A0

****MOX02MH   NOW REPLACED IN DATA SET
```

DIAGNOSTIC MESSAGE DIRECTORY

IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.

```
(17)          OS/360  FORTRAN H                          DATE  71.084/16.09.54

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
   ISN 0002            SUBROUTINE MATEI
                     C  DETERMINE IF VARIOUS STAGE COMBINATIONS MAKE A FEASIBLE VEHICLE
   ISN 0003            REAL ISP,ISPA,LENT
   ISN 0004            INTEGER*2 FINISH,NSTG,NFML,NFMU,KODS,MAS,LABS,LABF,LABI,VEH,NYD,
                      1  NMULT,NONREC,IS,MAT,LYR,LETT,LYD,MIN,NVS,MRV,NRP,NYP,KODEP,
                      2  IVEHA,NTRIP,NPLS,NRR,MR,KODEV
                     C
   ISN 0005            COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                      1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                      2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
   ISN 0006            COMMON/SAVE1/ FINISH,NSTG,NCI,ILY,LABF(30),LABS(40),LABI(40),
                      1 NFML(40),NFMU(40),KODS(40),STS(41),STG(40),VLR(50),WPR(50),
                      2  RPLM(50),MAS(40,3), RXD(12,50)
   ISN 0007            COMMON/SVACAV/  KNV,NOPT,KODEP(30),RPLO(40),IVEHA(50),NTRIP(50),
                      1  NPLS(50),NRR(50),MR(50),NVS(60),MRV(60),NRP(60),B1(60),B2(60),
                      2  B3(60),B4(60),KODEV(60),NYP(2,60),VM(2,60)
   ISN 0008            COMMON/SCRACH/IP,IV,IG,NPAX(2),NEH(4),NST(41),THRT(41),DIAM(41),
                      1  TSL(41),LENT(41),WTFU(41),WTIN(41),ISP(41),MZ(50),LZ(50),
                      2          WINT(3,60),KX,NX,WGHT(40),WF(4),WT(4),ISPA(4),
                      3  THUT(4),PRT(60),M,VDES,WPL,PR,K1,IERR,DUM(6067)
                     C
   ISN 0009            DATA PI,N,VREF,CLI/3.1416,2,25573.,28.5/
   ISN 0010            NV1 = NV & 1
   ISN 0011            DO 34 I = NV1,60
   ISN 0012            VEH(1,I)=0
   ISN 0013            DO 34 J=1,3
   ISN 0014            VEH(J&1,I)=0
   ISN 0015         34 WINT(J,I)=0.0
   ISN 0016            NX = 0
   ISN 0017            IMAX=0
   ISN 0018            JMAX=0
   ISN 0019            KMAX=0
   ISN 0020            LMAX=0
   ISN 0021            DO 35 I=1,NSTG
   ISN 0022            IF(NST(I).EQ.0)   GO TO 36
   ISN 0024         33 WGHT(I)=WTFU(I)&WTIN(I)
   ISN 0025            IF(NST(I).EQ.1) IMAX=I
   ISN 0027            IF(NST(I).EQ.2) JMAX=I
   ISN 0029            IF(NST(I).EQ.3) KMAX=I
   ISN 0031            IF(NST(I).EQ.4) LMAX=I
   ISN 0033         35 CONTINUE
   ISN 0034         36 IF(IMAX.EQ.0) GO TO 600

   ISN 0036            IF(JMAX.EQ.0) JMAX=IMAX
   ISN 0038            IF(KMAX.EQ.0) KMAX=JMAX
   ISN 0040            IF(LMAX.EQ.0) LMAX=KMAX
   ISN 0042            IM1=IMAX&1
   ISN 0043            JM1=JMAX&1
   ISN 0044            DO 500 I=1,IMAX
   ISN 0045            K1 = I
   ISN 0046            WF(1)=WTFU(I)
   ISN 0047            WT(1)=WTIN(I)
   ISN 0048            ISPA(1)=ISP(I)
   ISN 0049            THUT(1)=THRT(I)
   ISN 0050            DO 400 J=IM1,KMAX
   ISN 0051            WINX=PI*(DIAM(I)&DIAM(J))*(SQRT((LENT(J))**2&((DIAM(I)-DIAM(J))*
                      1  0.5)**2))*5.0*0.5
   ISN 0052            IF (THRT(I).LT.1.2*(WGHT(I)&WGHT(J)&WINX)) GO TO 400
   ISN 0054            IF (THRT(I).GT.3.5*(WGHT(I)&WGHT(J)&WINX)) GO TO 400
   ISN 0056            IF (DIAM(J).GT.1.2*DIAM(I)) GO TO 400
   ISN 0058            IF (DIAM(I).GT.3.5*DIAM(J)) GO TO 400
   ISN 0060            WF(2)=WTFU(J)
   ISN 0061            WT(2)=WTIN(J)
   ISN 0062            ISPA(2)=ISP(J)
   ISN 0063            THUT(2)=THRT(J)
   ISN 0064            M=0
   ISN 0065            PR=0.
   ISN 0066            VDES=0.
   ISN 0067            CALL PERFI(CLI,N,VREF)
   ISN 0068            IF (IERR.NE.0) GO TO 60
   ISN 0070            NX = NX & 1
   ISN 0071            KX = NV & NX
   ISN 0072            NJ=J
   ISN 0073            VEH(1,KX)=I
   ISN 0074            VEH(2,KX)=J
   ISN 0075            WINT(1,KX)=WINX
   ISN 0076            PRT(KX)=WPL
                     C
   ISN 0077            CALL MISMTI
                     C
   ISN 0078            IF(KX.EQ.100)  GO TO 60
   ISN 0080            IF(KX.GE.60)  GO TO 600
   ISN 0082         60 DO 300 K=IM1,LMAX
   ISN 0083            WINY=PI*(DIAM(J)&DIAM(K))*(SQRT((LENT(K))**2&((DIAM(J)-DIAM(K))
                      1  *0.5)**2))*5.0*0.5
```

```
ISN 0084          IF (THRT(J).LT.0.37*(WGHT(J)&WGHT(K)&WINY)) GO TO 300
ISN 0086          IF (THRT(J).GT.1.25*(WGHT(J)&WGHT(K)&WINY)) GO TO 300
ISN 0088          IF (THRT(I).LT.1.2*(WGHT(I)&WGHT(J)&WGHT(K)&WINX&WINY)) GO TO 300
ISN 0090          IF (THRT(I).GT.3.0*(WGHT(I)&WGHT(J)&WGHT(K)&WINX&WINY)) GO TO 300
ISN 0092          IF (DIAM(K).GT.1.2*DIAM(J)) GO TO 300
ISN 0094          IF (DIAM(J).GT.3.5*DIAM(K)) GO TO 300
ISN 0096          WF(3)=WTFU(K)
ISN 0097          WT(3)=WTIN(K)
ISN 0098          ISPA(3)=ISP(K)
ISN 0099          THUT(3)=THRT(K)
ISN 0100          M=1
ISN 0101          PR=0.
ISN 0102          VDES=0.
ISN 0103          CALL PERFI(CLI,N,VREF)
ISN 0104          IF (IERR.NE.0) GO TO 70
ISN 0106          NX = NX & 1
ISN 0107          KX = NV & NX
ISN 0108          VEH(1,KX)=I
ISN 0109          VEH(2,KX)=J
ISN 0110          VEH(3,KX)=K
ISN 0111          WINT(1,KX)=WINX
ISN 0112          WINT(2,KX)=WINY
ISN 0113          PRT(KX)=WPL
                C
ISN 0114          CALL MISMTI
                C
ISN 0115          IF(KX.EQ.100)  GO TO 69
ISN 0117          IF(KX.GE.60)  GO TO 600
ISN 0119       69 IF(K.GT.KMAX) GO TO 300
ISN 0121       70 DO 200 L=JM1,LMAX
ISN 0122          IF(L.EQ.NJ) GO TO  200
ISN 0124          WINZ=PI*(DIAM(K)&DIAM(L))*(SQRT((LENT(L))**2&((DIAM(K)-DIAM(L))
                1  *0.5)**2))*5.0*0.5
ISN 0125          IF(THRT(K).LT.0.30*(WGHT(K)&WGHT(L)&WINZ)) GO TO 200
ISN 0127          IF(THRT(K).GT.1.25*(WGHT(K)&WGHT(L)&WINZ)) GO TO 200
ISN 0129          IF(THRT(J).LT.0.32*(WGHT(J)&WGHT(K)&WGHT(L)&WINY&WINZ)) GO TO 200
ISN 0131          IF(THRT(J).GT.1.50*(WGHT(J)&WGHT(K)&WGHT(L)&WINY&WINZ)) GO TO 200
ISN 0133          IF(THRT(I).LT.1.20*(WGHT(I)&WGHT(J)&WGHT(K)&WGHT(L)&WINX&WINY&WINZ
                1  )) GO TO 200
ISN 0135          IF(THRT(I).GT.3.00*(WGHT(I)&WGHT(J)&WGHT(K)&WGHT(L)&WINX&WINY&WINZ
                1  )) GO TO 200
ISN 0137          IF(DIAM(L).GT.1.2*DIAM(K)) GO TO 200

ISN 0139          IF(DIAM(K).GT.4.0*DIAM(L)) GO TO 200
ISN 0141          WF(4)=WTFU(L)
ISN 0142          WT(4)=WTIN(L)
ISN 0143          ISPA(4)=ISP(L)
ISN 0144          THUT(4)=THRT(L)
ISN 0145          M=2
ISN 0146          PR=0.
ISN 0147          VDES=0.
ISN 0148          CALL PERFI(CLI,N,VREF)
ISN 0149          IF(IERR.NE.0) GO TO 200
ISN 0151          NX = NX & 1
ISN 0152          KX = NV & NX
ISN 0153          VEH(1,KX)=I
ISN 0154          VEH(2,KX)=J
ISN 0155          VEH(3,KX)=K
ISN 0156          VEH(4,KX)=L
ISN 0157          WINT(1,KX)=WINX
ISN 0158          WINT(2,KX)=WINY
ISN 0159          WINT(3,KX)=WINZ
ISN 0160          PRT(KX)=WPL
                C
ISN 0161          CALL MISMTI
                C
ISN 0162          IF(KX.EQ.100)  GO TO 200
ISN 0164          IF(KX.GE.60)  GO TO 600
ISN 0166       200 CONTINUE
ISN 0167       300 CONTINUE
ISN 0168       400 CONTINUE
ISN 0169       500 CONTINUE
ISN 0170       600 NV = NV & NX
ISN 0171           RETURN
ISN 0172           END

****** END OF COMPILATION ******
```

```
F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
         VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000      NAME MOX02ME(R)
IEW0461  PERFI
IEW0461  SQRT
IEW0461  MISMTI

                                        CROSS REFERENCE TABLE

  CONTROL SECTION                       ENTRY

    NAME     ORIGIN   LENGTH              NAME   LOCATION     NAME   LOCATION     NAME   LOCATION     NAME

  MATEI          00     A68
  SAVALL         A68    3A1C
  SAVE1         4488     FC4
  SVACAV        5450     B48
  SCRACH        5F98    6A60


  LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION          LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION

      140           SAVALL          SAVALL                   144           SAVALL          SAVALL
      148           SAVE1           SAVE1                    14C           SVACAV          SVACAV
      150           SCRACH          SCRACH                   154           PERFI           $UNRESOLVED
      158           SQRT            $UNRESOLVED              15C           MISMTI          $UNRESOLVED

 ENTRY ADDRESS        00
 TOTAL LENGTH       C9F8

****MOX02ME   NOW REPLACED IN DATA SET

                                    DIAGNOSTIC MESSAGE DIRECTORY

   IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.
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```
(17)          OS/360  FORTRAN H                                  DATE  71.084/16.10.37

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
   ISN 0002            SUBROUTINE MEAN (P1,KSTAT,SIGS,SX,SY)
                     C  FROM MODAL VALUE AND X PERCENT TAIL VALUE, CALCULATE MEAN AND SIGMA-SQUARE
                     C
   ISN 0003                KSTAT = 1
   ISN 0004                P = 1.0 - P1
   ISN 0005                CALL NDTRI(P,Y,C,IE)
   ISN 0006                SIGS = -.5*Y & .5*SQRT(Y*Y & 4.0*ALOG(SX/SY))
   ISN 0007                SIGS = SIGS*SIGS
   ISN 0008                SY = SY*EXP(1.5*SIGS)
   ISN 0009                RETURN
   ISN 0010                END

****** END OF COMPILATION ******
```

```
 F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
           VARIABLE OPTIONS USED - SIZE=(126976,24576)          DEFAULT OPTION(S) USED
IEW0000      NAME MOX02EX(R)
IEW0461  NDTRI
IEW0461  EXP
IEW0461  SQRT
IEW0461  ALOG

                                        CROSS REFERENCE TABLE

  CONTROL SECTION                    ENTRY
    NAME     ORIGIN  LENGTH           NAME   LOCATION     NAME   LOCATION     NAME   LOCATION     NAME
  MEAN          00     226

  LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION      LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION
       D8           NDTRI          $UNRESOLVED            DC           EXP            $UNRESOLVED
       E0           SQRT           $UNRESOLVED            E4           ALOG           $UNRESOLVED
 ENTRY ADDRESS       00
 TOTAL LENGTH       228
****MOX02EX   NOW REPLACED IN DATA SET

                                        DIAGNOSTIC MESSAGE DIRECTORY

   IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.


(17)          OS/360  FORTRAN H                              DATE  71.084/16.11.06

         COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
  ISN 0002            SUBROUTINE MISMTI
                    C  DETERMINE PERFORMANCE OF NEW VEHICLE IN TERMS OF MISSION MODEL INPUT
  ISN 0003            REAL LENT,ISP,ISPA,NPERPD
  ISN 0004            INTEGER*2 VEH,NMULT,NONREC,NYD,IS,MAT,LYR,LETT,LYD,MIN,LTR,NVS,
                     1  MRV,NRP,NYP,KODEP,IVEHA,NTRIP,NPLS,NRR,MR,KODEV,FINISH,NSTG,
                     2  NFML,NFMU,KODS,MAS,LABS,LABF,LABI
                    C
  ISN 0005            COMMON/SAVE1/ FINISH,NSTG,NCI,ILY,LABF(30),LABS(40),LABI(40),
                     1 NFML(40),NFMU(40),KODS(40),STS(41),STG(40),VLR(50),WPR(50),
                     2  RPLH(50),MAS(40,3), RXD(12,50)
  ISN 0006            COMMON/SVACAV/  KNV,NOPT,KODEP(30),RPLO(40),IVEHA(50),NTRIP(50),
                     1  NPLS(50),NRR(50),MR(50),NVS(60),MRV(60),NRP(60),B1(60),B2(60),
                     2  B3(60),B4(60),KODEV(60),NYP(2,60),VM(2,60)
  ISN 0007            COMMON/SAV3/GRO,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                     1   PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
  ISN 0008            COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                     1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                     2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
  ISN 0009            COMMON/SCRACH/IP,IV,IG,NPAX(2),NEH(4),NST(41),THRT(41),DIAM(41),
                     1  TSL(41),LENT(41),WTFU(41),WTIN(41),ISP(41),MZ(50),LZ(50),
                     2          WINT(3,60),KX,NX,WGHT(40),WF(4),WT(4),ISPA(4),
                     3  THUT(4),PRT(60),M,VDES,WPL,PR,K1,IERR,DUM(6067)
  ISN 0010            DATA VREF,CLI/25573.,28.5/
                    C
  ISN 0011            CF1=0.
  ISN 0012            KNS = 1
  ISN 0013            IF(NV.EQ.0)  GO TO 101
  ISN 0015            DO 100 MJ=1,NV
  ISN 0016            IF(VEH(1,KX).NE.VEH(1,MJ))  GO TO 100
  ISN 0018            IF(VEH(2,KX).NE.VEH(2,MJ))   GO TO 100
  ISN 0020            IF(VEH(3,KX).NE.VEH(3,MJ))   GO TO 20
  ISN 0022            IF(VEH(4,KX).NE.VEH(4,MJ))  GO TO 30
  ISN 0024            KX = 100
  ISN 0025            NX = NX - 1
  ISN 0026            RETURN
  ISN 0027         20 IF(VEH(3,MJ).NE.0)  GO TO 100
  ISN 0029            IF(KNS.EQ.3)  GO TO 100
  ISN 0031            CF1 = EXP(B1(MJ))
  ISN 0032            KNS = 2
  ISN 0033            GO TO 100
  ISN 0034         30 IF(VEH(4,MJ).NE.0)  GO TO 100
  ISN 0036            CF1 = EXP(B1(MJ))
```

```
ISN 0037            KNS = 3
ISN 0038          100 CONTINUE
ISN 0039          101 GO TO (200,300,400), KNS
ISN 0040          200 M=0
ISN 0041              N=2
ISN 0042              IF(VEH(3,KX).NE.0) N=3
ISN 0044              IF(VEH(4,KX).NE.0) N=4
ISN 0046              GO TO 500
ISN 0047          300 N=2
ISN 0048              M=1
ISN 0049              IF(VEH(4,KX).NE.0) M=2
ISN 0051              GO TO 500
ISN 0052          400 N=3
ISN 0053              M=1
ISN 0054          500 K1=VEH(1,KX)
ISN 0055              DO 501 I=1,4
ISN 0056              IF(VEH(I,KX).EQ.0) GO TO 502
ISN 0058              K=VEH(I,KX)
ISN 0059              WF(I)=WTFU(K)
ISN 0060              WT(I)=WTIN(K)
ISN 0061              ISPA(I)=ISP(K)
ISN 0062              THUT(I)=THRT(K)
ISN 0063          501 CONTINUE
ISN 0064          502 DO 503 I=1,NMIS
ISN 0065              LZ(I) = 0
ISN 0066              PR=CF1
ISN 0067              VDES=VLR(I)
ISN 0068              CALL PERFI(CLI,N,VREF)
ISN 0069              IF(WPL.GT.WPR(I).AND.IERR.EQ.0) LZ(I) = 1
ISN 0071          503 CONTINUE
ISN 0072              CALL PACK(LZ,VM(1,KX),NMIS,1)
ISN 0073              RETURN
ISN 0074              END

****** END OF COMPILATION ******
```

```
 F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
          VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000      NAME MOX02MI(R)
IEW0461  PACK
IEW0461  PERFI
IEW0461  EXP
```

CROSS REFERENCE TABLE

CONTROL SECTION NAME	ORIGIN	LENGTH
MISMTI	00	466
SAVE1	468	FC4
SVACAV	1430	B48
SAV3	1F78	980
SAVALL	28F8	3A1C
SCRACH	6318	6A60

ENTRY NAME	LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION	LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION
	108	SAVE1	SAVE1	10C	SVACAV	SVACAV
	110	SAV3	SAV3	114	SAVALL	SAVALL
	118	SAVALL	SAVALL	11C	SCRACH	SCRACH
	120	PACK	$UNRESOLVED	124	PERFI	$UNRESOLVED
	128	EXP	$UNRESOLVED	98	SCRACH	SCRACH
	A0	SAV3	SAV3			
ENTRY ADDRESS	00					
TOTAL LENGTH	CD78					

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****MOX02MI   NOW REPLACED IN DATA SET
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DIAGNOSTIC MESSAGE DIRECTORY

IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.

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(17)          OS/360  FORTRAN H                                DATE  71.084/16.11.38

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
   ISN 0002            SUBROUTINE NDTR(X,P,D)
                     C
                     C  THIS SUBROUTINE COMPUTES Y = P(X) = PROB THAT THE RANDOM VARIABLE U,
                     C   DISTRIBUTED NORMALLY(0,1) IS LESS THAN OR EQUAL TO X.  F(X) = THE
                     C ORDINATE OF THE NORMAL DENSITY AT X, IS ALSO COMPUTED.
                     C  DESCRIPTION OF PARAMETERS   X - - INPUT SCALAR FOR WHICH P(X) IS COMPUTED
                     C   P - - OUTPUT PROBABILITY,   D - - OUTPUT DENSITY.
                     C  METHOD - - BASED ON APPROX IN C. HASTINGS, APPROXIMATION FOR DIGITAL
                     C   COMPUTERS, PRINCETON UNIV. PRESS, PRINCETON, N.J., 1955.  SEE EQN. 26.2.17,
                     C   HANDBOOK OF MATHEMATICAL FUNCTIONS, ABRAMOWITZ AND STEGUN, DOVER PUBL., INC.
                     C
   ISN 0003            AX = ABS(X)
   ISN 0004            T = 1.0/(1.0 & .2316419*AX)
   ISN 0005            D = 0.3989423*EXP(-X*X/2.0)
   ISN 0006            P = 1.0 - D*T*((((1.330274*T - 1.821256)*T &1.781478)*T
                      *  -0.3565638)*T & .03193815)
   ISN 0007            IF(X) 1,2,2
   ISN 0008           1 P = 1.0 - P
   ISN 0009           2 RETURN
   ISN 0010            END

****** END OF COMPILATION ******
```

```
  F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
            VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000       NAME MOX02NR(R)
IEW0461  EXP

                                        CROSS REFERENCE TABLE

  CONTROL SECTION                    ENTRY
    NAME     ORIGIN  LENGTH            NAME   LOCATION     NAME   LOCATION     NAME   LOCATION     NAME
  NDTR          00     1DC

  LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION        LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION

       C8          EXP          $UNRESOLVED
 ENTRY ADDRESS     00
 TOTAL LENGTH     1E0

****MOX02NR   NOW REPLACED IN DATA SET

                                        DIAGNOSTIC MESSAGE DIRECTORY

   IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.
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(17)          OS/360  FORTRAN H                                  DATE  71.084/16.12.08

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
   ISN 0002            SUBROUTINE NDTRI(P,X,C,IE)
                     C
                     C     COMPUTES X = P**(-1)(Y), THE ARGUMENT X SUCH THAT Y = P(X) =
                     C    THE PROB THAT THE RANDOM VARIABLE U, DISTRIBUTED NORMALLY(0,1), IS
                     C     LESS THAN OR EQUAL TO X.   F(X), THE ORDINATE O F THE NORMAL DENSITY,AT X,
                     C     IS ALSO COMPUTED
                     C
                     C   P  -  INPUT PROBABILITY
                     C   X  -  OUTPUT ARGUMENT SUCH  THAT P = Y = THE PROB THAT U, THE RANDOM
                     C         VARIABLE, IS LESS THAN OR EQUAL TO X
                     C   C  -  OUTPUT DENSITY, F(X)
                     C   IER - OUTPUT ERROR CODE
                     C      MAXIMUM ERROR IS 0.00045
                     C
   ISN 0003            IE = 0
   ISN 0004            X = .99999E&74
   ISN 0005            C = X
   ISN 0006            IF (P) 1,4,2
   ISN 0007          1 IE = -1
   ISN 0008            RETURN
   ISN 0009          2 IF (P-1.0) 7,5,1
   ISN 0010          4 X = -.999999E&74
   ISN 0011          5 C = 0.0
   ISN 0012            RETURN
                     C
   ISN 0013          7 C = P
   ISN 0014            IF(C - 0.5) 9,9,8
   ISN 0015          8 C = 1.0 - C
   ISN 0016          9 T2 = ALOG(1.0/(C*C))
   ISN 0017            T = SQRT(T2)
   ISN 0018            X = T-(2.51551780.802853*T&0.010328*T2)/(1.0&1.432788*T&
                     1    0.189269*T2 & 0.001308*T*T2)
   ISN 0019            IF(P-0.5) 10,10,11
   ISN 0020         10 X = -X
   ISN 0021         11 C = 0.3989423*EXP(-X*X/2.0)
   ISN 0022            RETURN
   ISN 0023            END

****** END OF COMPILATION ******


   F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
             VARIABLE OPTIONS USED - SIZE=(126976,24576)                DEFAULT OPTION(S) USED
   IEW0000       NAME MOX02NI(R)
   IEW0461  EXP
   IEW0461  SQRT
   IEW0461  ALOG

                                          CROSS REFERENCE TABLE

    CONTROL SECTION                       ENTRY

      NAME     ORIGIN  LENGTH              NAME   LOCATION     NAME   LOCATION     NAME   LOCATION     NAME

    NDTRI          00     2A6


    LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION          LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION

         E0           EXP          $UNRESOLVED                E4           SQRT          $UNRESOLVED
         E8           ALOG         $UNRESOLVED
    ENTRY ADDRESS     00
    TOTAL LENGTH     2A8

   ****MOX02NI   NOW REPLACED IN DATA SET

                                          DIAGNOSTIC MESSAGE DIRECTORY

      IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.
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(17)          OS/360  FORTRAN H                                   DATE  71.084/16.12.38

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
   ISN 0002            SUBROUTINE OUTPTI
                  C    ***  PRINT OUT BEST ASSIGNMENT  ***
                  C
   ISN 0003            DOUBLE PRECISION NAME
   ISN 0004            REAL NPERPD,LEVEL
   ISN 0005            LOGICAL EXT,ACCL
   ISN 0006            INTEGER*2  YDPL,NSYR,NSFX,NRFX,NYRSST,NSTRFX,NPROG,KPROG,KODE,
                      1  NYRSFX,KODEM,KODESP,FINISH,NSTG,NFML,NFMU,KODS,MAS,LABS,LABF,
                      2   LABI,VEH,NMULT,NONREC,NYD,IS,MAT,LYR,LETT,LYD,MIN,LTR
                  C
   ISN 0007            COMMON/SAVE1/ FINISH,NSTG,NCI,ILY,LABF(30),LABS(40),LABI(40),
                      1 NFML(40),NFMU(40),KODS(40),STS(41),STG(40),VLR(50),WPR(50),
                      2  RPLM(50),MAS(40,3), RXD(12,50)
   ISN 0008            COMMON/SAV2/EXT,ACCL,KNSTG,KNFAM,KNCI,KNP,KNMIS,JFLAG,TREF,NCSTR,
                      1 PMAX,PMIN,ISTRT,IFIN,MAXITR,MITR,KODESP(6),TITLE(10),LEVEL(20),
                      2  CNTRVL(20),FIXED(20),KODEM(50),NSYR(50),NSFX(50),NAME(56),
                      3  YDPL(56),NRFX(50),NYRSST(84),NSTRFX(84),NYRSFX(84),SUS(84),C(84)
                      4,  R(84), S(84),CS(90),NPROG(90),KPROG(90), KODE(90)
   ISN 0009            COMMON/SAV3/GRD,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                      1   PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
   ISN 0010            COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                      1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                      2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
                  C
   ISN 0011            DATA ETR/1HE/
   ISN 0012            DATA WTR/1HW/
                  C
   ISN 0013            WRITE (6,4010)
   ISN 0014            DO 805 J=1,NM
   ISN 0015            L=LETT(J)
   ISN 0016            K=LYR(J)
   ISN 0017            M=1899&ILY&K
   ISN 0018            IF(YRLM(J).GT..001)  GO TO 804
   ISN 0020            IF(LETT(J-1).NE.L) WRITE(6,206) NAME(L),VLR(L),WPR(L),RPLM(L),M,
                      1   YRLM(J)
   ISN 0022            IF(LETT(J-1).EQ.L) WRITE(6,2061) M,YRLM(J)
   ISN 0024            GO TO 805
   ISN 0025         804 I = MIN(J)
   ISN 0026            IA=VEH(1,I)
   ISN 0027            IB=VEH(2,I)
   ISN 0028            IC=VEH(3,I)
   ISN 0029            ID=VEH(4,I)

   ISN 0030            X = NMULT(I,L)
   ISN 0031            X = YRLM(J)*X
   ISN 0032            TR = ETR
   ISN 0033            IF(LTR(L).EQ.2)  TR = WTR
   ISN 0035            IF(LETT(J-1).NE.L)  WRITE(6,202)NAME(L),VLR(L),WPR(L),RPLM(L),M,
                      1 X,STG(IA),STG(IB),STG(IC),STG(ID),TR
   ISN 0037            IF(LETT(J-1).EQ.L) WRITE(6,2021) M,X,        STG(IA),STG(IB),
                      1  STG(IC),STG(ID),TR
   ISN 0039         805 CONTINUE
   ISN 0040            RETURN
   ISN 0041         202 FORMAT (1X,A6,6X,F10.0,4X,F10.0,F10.0,5X,I4,4X,F5.2,9X,5(A4,1X))
   ISN 0042         206 FORMAT (1X,A6,6X,F10.0,4X,F10.0,   F10.0,5X,I4,4X,F5.2,9X,
                      1 32HNO LAUNCH VEHICLE CAN ACCOMPLISH)
   ISN 0043        2021 FORMAT (52X,I4,4X,F5.2,9X,5(A4,1X))
   ISN 0044        2061 FORMAT (52X,I4,4X,F5.2,9X,32HNO LAUNCH VEHICLE CAN ACCOMPLISH)
   ISN 0045        4010 FORMAT(8HOMISSION,4X,14HCHARACTERISTIC,4X,7HPAYLOAD,4X,6HRETURN,
                      1 4X,6HLAUNCH,4X,6HNUMBER,10X,7HOPTIMUM,8X,6HLAUNCH/7H  TITLE,4X,
                      2 16HVELOCITY(FT/SEC),4X,5H(LBS),4X,7HPAYLOAD,5X,4HYEAR,3X,11HOF LA
                      3UNCHES,4X,14HLAUNCH VEHICLE,5X,4HSITE//)
   ISN 0046            END

****** END OF COMPILATION ******
```

```
F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
         VARIABLE OPTIONS USED - SIZE=(126976,24576)          DEFAULT OPTION(S) USED
IEW0000      NAME MOX020I(R)
IEW0461  IBCOM=
```

CROSS REFERENCE TABLE

CONTROL SECTION NAME	ORIGIN	LENGTH
OUTPTI	00	58C
SAVE1	590	FC4
SAV2	1558	FE0
SAV3	2538	980
SAVALL	2EB8	3A1C

ENTRY

NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME

LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION	LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION
270	SAVE1	SAVE1	274	SAV2	SAV2
278	SAV3	SAV3	27C	SAVALL	SAVALL
280	SAVALL	SAVALL	284	IBCOM=	$UNRESOLVED

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ENTRY ADDRESS       00
TOTAL LENGTH      6BD8

****MOX020I   NOW REPLACED IN DATA SET
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DIAGNOSTIC MESSAGE DIRECTORY

IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.

EXTERNAL SYMBOL DICTIONARY

SYMBOL	TYPE	ID	ADDR	LENGTH	LD ID
PACK	SD	01	000000	0000E8	
UNPACK	LD		000052		01
ITEM	LD		000096		01

```
 LOC  OBJECT CODE    ADDR1 ADDR2  STMT   SOURCE STATEMENT

                                   1 *       SUBROUTINE  PACK ( L, M, I, N )
                                   2 *
                                   3 *             THIS ROUTINE PACKS I WORDS IN THE L ARRAY  TO THE
                                   4 *             ARRAY M.  DATA ITEMS L ARE TRUNCATED ON THE LEFT
                                   5 *             AND ONLY THE N LOW ORDER BITS ARE RETAINED.
                                   6 *             PACKED DATA IN M IS LEFT JUSTIFIED WITH 32/N ITEMS
                                   7 *             PER WORD.
                                   8 *
000000                             9 PACK    CSECT
000000                            10          USING  *,15          USE REG 15 FOR BASE
000000 9027 D01C          0001C   11          STM    2,7,28(13)    SAVE REGS
000004 9825 1000          00000   12          LM     2,5,0(1)      LOAD ADDRESSES OF ARGUMENTS
000008 5844 0000          00000   13          L      4,0(4)        I TO REG 4 - NO. OF ITEMS TO BE PACKED
00000C 5875 0000          00000   14          L      7,0(5)        N TO REG 7 - NO. OF BITS/ITEM
000010 4270 F029          00029   15          STC    7,SHIFT+3     MODIFY SHIFT INST WITH NO. OF BITS
000014 1367                       16          LCR    6,7           NO. OF BITS SHIFT FOR DECREMENT
000016 0670                       17          BCTR   7,0           N-1 FOR COMPARAND
000018 1B11                       18          SR     1,1           ZERO REG 1
00001A 4150 0020          00020   19 WORD     LA     5,32          LOAD A 32 TO REG 5 FOR COUNT
00001E 5013 0000          00000   20          ST     1,0(3)        ZERO STORAGE AREA
000022 5802 0000          00000   21 LOOP     L      0,0(2)        LOAD DATA TO REG 0
000026 8C00 0000          00000   22 SHIFT    SRDL   0,0           SHIFT DATA TO REG 1
00002A 1800                       23          SR     0,0           TRUNCATE ON LEFT FOR MOD 2**N
00002C 8D00 5000          00000   24          SLDL   0,0(5)        SHIFT BACK TO PROPER POSITION
000030 5603 0000          00000   25          O      0,0(3)        OR PACKED WORD TO REG 0
000034 5003 0000          00000   26          ST     0,0(3)        STORE BACK TO PACKED AREA
000038 4122 0004          00004   27          LA     2,4(2)        INCREMENT DATA ADDRESS
00003C 4640 F046          00046   28          BCT    4,NEXT        COUNT DOWN ON NO. OF ITEMS
000040 9827 D01C          0001C   29          LM     2,7,28(13)    RESTORE REGS
000044 07FE                       30          BR     14            RETURN
000046 8656 F022          00022   31 NEXT     BXH    5,6,LOOP      BRANCH BACK IF SPACE LEFT
00004A 4133 0004          00004   32          LA     3,4(3)        OTHERWISE INCREMENT STORAGE ADDRESS
00004E 47F0 F01A          0001A   33          B      WORD          AND CONTINUE
```

```
 LOC  OBJECT CODE    ADDR1 ADDR2  STMT   SOURCE STATEMENT

                                  35 *       SUBROUTINE  UNPACK ( L, M, I, N )
                                  36 *
                                  37 *             THIS ROUTINE UNPACKS I WORDS OF DATA FROM THE M
                                  38 *             ARRAY TO THE L ARRAY.  WORDS IN L ARE ZEROED AND N
                                  39 *             BITS ARE PLACED RIGHT JUSTIFIED FROM THE PACKED
                                  40 *             ARRAY M.
                                  41 *
                                  42          ENTRY  UNPACK
000052                            43          USING  *,15          USE REG 15 FOR BASE
000052 9027 D01C          0001C   44 UNPACK   STM    2,7,28(13)    SAVE REGS
000056 9825 1000          00000   45          LM     2,5,0(1)      LOAD ADDRESSES OF ARGUMENTS
00005A 5844 0000          00000   46          L      4,0(4)        I TO REG 4 - NO. OF ITEMS TO BE PACKED
00005E 5875 0000          00000   47          L      7,0(5)        N TO REG 7 - NO. OF BITS/ITEM
000062 4270 F025          00077   48          STC    7,LEFT+3      MODIFY SHIFT INST WITH NO. OF BITS
000066 1367                       49          LCR    6,7           NO. OF BITS SHIFT FOR DECREMENT
000068 0670                       50          BCTR   7,0           N-1 FOR COMPARAND
00006A 4150 0020          00020   51 DATA     LA     5,32          LOAD A 32 TO REG 5 FOR COUNT
00006E 5813 0000          00000   52          L      1,0(3)        LOAD PACKED DATA TO REG 1
000072 1800                       53 BACK     SR     0,0           ZERO REG 0
000074 8D00 0000          00000   54 LEFT     SLDL   0,0           SHIFT N BITS TO REG 0
000078 5002 0000          00000   55          ST     0,0(2)        STORE IN L
00007C 4122 00C4          00004   56          LA     2,4(2)        INCREMENT STORAGE ADDRESS
000080 4640 F038          0008A   57          BCT    4,MORE        COUNT DOWN ON NO. OF ITEMS
000084 9827 D01C          0001C   58          LM     2,7,28(13)    RESTORE REGS
000088 07FE                       59          BR     14            RETURN
00008A 8656 F020          00072   60 MORE     BXH    5,6,BACK      BRANCH BACK IF MORE DATA
00008E 4133 0004          00004   61          LA     3,4(3)        OTHERWISE INCREMENT DATA ADDRESS
000092 47F0 F018          0006A   62          B      DATA          AND CONTINUE
```

```
 LOC  OBJECT CODE    ADDR1 ADDR2  STMT   SOURCE STATEMENT

                                   64 *        FUNCTION  ITEM ( M, I, N )
                                   65 *
                                   66 *              THIS ROUTINE RETRIEVES THE I TH ITEM FROM THE PACKED
                                   67 *              ARRAY M.
                                   68 *
                                   69          ENTRY  ITEM
000096                             70          USING  *,15
000096 9025 D01C          0001C    71 ITEM     STM    2,5,28(13)     SAVE REGS
00009A 9824 1000          00000    72          LM     2,4,0(1)       LOAD ADDRESSES OF ARGS TO REGS 2,3,4.
00009E 5833 0000          00000    73          L      3,0(3)         LOAD I TO REG 3
0000A2 0630                        74          BCTR   3,0            SUBTRACT 1 FOR I-1
0000A4 4100 0020          00020    75          LA     0,32           LOAD A 32 TO REG 0
0000A8 8E00 0020          00020    76          SRDA   0,32           SHIFT TO REG 1
0000AC 5D04 0000          00000    77          D      0,0(4)         DIVIDE BY N
0000B0 5010 F04E          000E4    78          ST     1,TEMP         NO. OF ITEMS/WORD
0000B4 1803                        79          LR     0,3            I-1 TO REG 0
0000B6 8E00 0020          00020    80          SRDA   0,32           SHIFT TO REG 1
0000BA 5D00 F04E          000E4    81          D      0,TEMP         DIVIDE I-1 BY NO. ITEMS/WORD
0000BE 1851                        82          LR     5,1            SAVE IN REG 5 TO INDEX ARRAY M
0000C0 8B50 0002          00002    83          SLA    5,2            MULTIPLY BY 4
0000C4 8E00 0020          00020    84          SRDA   0,32           REMAINDER TO REG 1
0000C8 5C04 0000          00000    85          M      0,0(4)         MULTIPLY BY N
0000CC 1831                        86          LR     3,1            LOAD TO REG 3 TO INDEX SHIFT
0000CE 5815 2000          00000    87          L      1,0(5,2)       LOAD DATA FROM M ARRAY
0000D2 8910 3000          00000    88          SLL    1,0(3)         LEFT ADJUST PROPER ITEM
0000D6 5844 0000          00000    89          L      4,0(4)         LOAD N TO REG 4
0000DA 8D00 4000          00000    90          SLDL   0,0(4)         SHIFT N BITS TO REG 0
0000DE 9825 D01C          0001C    91          LM     2,5,28(13)     RESTORE REGS
0000E2 07FE                        92          BR     14             RETURN
0000E4                             93 TEMP     DS     F
                                   94          END
```

CROSS-REFERENCE

```
SYMBOL    LEN  VALUE  DEFN     REFERENCES

BACK      00002 000072 0053     0060
DATA      00004 00006A 0051     0062
ITEM      00004 000096 0071     0069
LEFT      00004 000074 0054     0048
LOOP      00004 000022 0021     0031
MORE      00004 00008A 0060     0057
NEXT      00004 000046 0031     0028
PACK      00001 000000 0009
SHIFT     00004 000026 0022     0015
TEMP      00004 0000E4 0093     0078  0081
UNPACK    00004 000052 0044     0042
WORD      00004 00001A 0019     0033


NO STATEMENTS FLAGGED IN THIS ASSEMBLY
  120 PRINTED LINES
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```
F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,NCAL                    DEFAULT OPTION(S) USED
         VARIABLE OPTIONS USED - SIZE=(126976,24576)
IEW0000      NAME MOX01PK(R)
****MOX01PK   NOW REPLACED IN DATA SET
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```
FORTRAN IV G LEVEL 1, MOD 4          PDCSTI          DATE = 71084          16/56/06          PAGE 00

0001              SUBROUTINE PDCSTI
                C DETERMINE IF MORE THAN ONE PAD NEEDED AT EACH COMPLEX AND IF PREVIOUSLY
                C    UNCONSIDERED COSTS ARE TO BE ADDED TO TOTAL COST FOUND IN ALGORITHM
                C
0002              REAL NPERPD,NPUSED
0003              INTEGER*2 KOUT,LTR,VEH,NMULT,NONREC,NYD,IS,MAT,LYR,LETT,LYD,MIN,
                 1  NVEH,MATCH,JF,JL,NADD,NX,MINOPT,MORE,NPSTG,NPAD,NPFAM,NFS,
                 2  NPINTL,NPINTU,MAPS,MAPF,MAPI,NINTYR,NTGYTR,MAF,MAIC,FINISH,NSTG,
                3LABF,LABS,LABI,NFML,NFMU,KODS,MAS
                C
0004              COMMON/SAVE1/ FINISH,NSTG,NCI,ILY,LABF(30),LABS(40),LABI(40),
                 1 NFML(40),NFMU(40),KODS(40),STS(41),STG(40),VLR(50),WPR(50),
                 2  RPLM(50),MAS(40,3), RXD(12,50)
0005              COMMON/SAV3/GRD,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                 1    PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
0006              COMMON/SAV4/  MAF(30,3), MAIC(40,3),
                 *              NPAD(2,60),NPFAM(30,5),NPINTL(30,5),NPINTU(30,5),
                 1  NFS(40,4),NPSTG(30,10),MAPS(30,10),MAPF(30,10),MAPI(30,10),
                 2  PFAMD(30,5,2),PFAMS(30,5,2),PINTS(30,5,2),PSTGD(30,10,2),
                 3    PSTGS(30,10,2)
0007              COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                 1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                 2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
0008              COMMON/TEMP/VNM(2,250),IFLAG,KI,NEXT,LOUT,SAVS(40),KOUT(40),
                 1  NINTYR(40,20),NTGYTR(40,20,2),RECUR(60,20,2)
0009              COMMON/SCRACH/EXTRA,NADD,NX,MORE(50),LZ(46),W(500),W2(500),
                 1 TDS(500),WR(499),Z(500),COST(2,250),MINOPT(246,9),NODE(5,500),
                 2  NPDS,SIGSQ(9),ETC(9),
                 4 JF(20),JL(20),MATCH(20),NPUSED(20),NVEH(20,6)
                C
0010              IF(MOS.EQ.1.OR.MOS.EQ.3)  GO TO 362
0011              NOT = 0
                C   MORE = NUMBER OF NODE WHICH HAS BEEN CONSIDERED AS OPT. SOLN.
0012            502 DO 355 I = 1,50
0013              IF (MORE(I).EQ.NX) GO TO 360
0014              IF(MORE(I).NE.0) GO TO 355
0015              MORE(I) = NX
0016              NTEM = NPDS + 1
0017              IF(LP.GT.0) WRITE(6,404) NTEM,NX,W(NX),TDS(NX),Z(NX)
0018              GO TO 356
0019            355 CONTINUE
0020            357 WRITE (6,358)
0021              GUESS = 0.0
```

```
0022              RETURN
0023          325 WRITE(6,401) NX,PAD(I),J
0024              Z(NX) = 20.0E30
0025              RETURN
0026          360 DO 361 J = I,49
0027              IF(MORE(J).EQ.0)  GO TO 354
0028          361 MORE(J) = MORE(J+1)
0029              MORE(50) = 0
0030          354 IF(NADD.GE.1.OR.(LCK.EQ.1.AND.IFLAG.EQ.0))  GO TO 359
0031              NEXD = 0
0032              IF(NOT.EQ.1)   GO TO 500
0033          362 NOT = 1
0034          356 EXTRA = 0.0
0035              IF(NP.EQ.0)  GO TO 1
0036              DO 320 I = 1,NP
0037              DO 322 K = 1,MYRS
0038              NPUSED(K) = 0.0
0039              DO 322 J = 1,6
0040          322 NVEH(K,J) = 0
            C  COUNT NUMBER OF LAUNCHES REQUIRED PER PAD PER YEAR
0041              DO 321 J = 1,NM
0042              IF(YRLM(J).LT..001)  GO TO 321
0043              K1= MIN(J)
0044              JA = LETT(J)
0045              L = LTR(JA)
0046              IF (NPAD(L,K1).NE.I) GO TO 321
0047              M = LYR(J)
0048              X = NMULT(K1,JA)
0049              X = YRLM(J)*X
0050              NPUSED(M) = NPUSED(M) + X
0051              DO 323 ME = 1,6
0052              IF(NVEH(M,ME).EQ.K1) GO TO 321
0053              IF (NVEH(M,ME).NE.0) GO TO 323
0054              NVEH(M,ME) = K1
0055              GO TO 321
0056          323 CONTINUE
0057          321 CONTINUE
            C   SEE IF SECOND PAD IS REQUIRED AT ANY FACILITY
0058              DO 331 J = 1,20
0059          331 MATCH(J) = 0
0060              DO 324 J = 1,MYRS
0061              IF (NPUSED(J).GT.2.0*NPERPD(I)) GO TO 325
0062              IF (NPUSED(J).LE.NPERPD(I)) GO TO 324
```



```
0063              DO 326 K = 1,10
0064              IF (NPSTG(I,K).EQ.0) GO TO 329
0065              IF (PSTGD(I,K,2) + PSTGS(I,K,2).LT..001) GO TO 326
0066              DO 327 L = 1,6
0067              IF (NVEH(J,L).EQ.0) GO TO 326
0068              LA = NVEH(J,L)
0069              DO 328 LB = 1,4
0070              IF(VEH(LB,LA).EQ.0) GO TO 327
0071              IF (VEH(LB,LA).NE.NPSTG(I,K)) GO TO 328
0072              DO 330 LC = 1,20
0073              IF (MATCH(LC).EQ.0) GO TO 332
0074              IF (MATCH(LC).EQ.K) GO TO 333
0075              GO TO 330
0076          332 MATCH(LC) = K
0077              JF(LC) = J
0078          333 JL(LC) = J
0079              GO TO 326
0080          330 CONTINUE
0081          328 CONTINUE
0082          327 CONTINUE
0083          326 CONTINUE
0084          329 DO 334 K = 1,5
0085              IF (NPFAM(I,K).EQ.0) GO TO 335
0086              IF (PFAMD(I,K,2) + PFAMS(I,K,2).LT..001) GO TO 334
0087              DO 336 L = 1,6
0088              IF (NVEH(J,L).EQ.0) GO TO 334
0089              LA = NVEH(J,L)
0090              DO 337 LB = 1,4
0091              IF (VEH(LB,LA).EQ.0) GO TO 336
0092              LD = VEH(LB,LA)
0093              DO 338 LC = 1,4
0094              IF (NFS(LD,LC).EQ.0) GO TO 337
0095              IF (NFS(LD,LC).NE.NPFAM(I,K)) GO TO 338
0096              K1 = -K
0097              DO 339 LE = 1,20
0098              IF (MATCH(LE).EQ.0) GO TO 340
0099              IF (MATCH(LE).EQ.K1) GO TO 341
0100              GO TO 339
0101          340 MATCH(LE) = K1
0102              JF(LE) = J
0103          341 JL(LE) = J
0104              GO TO 334
0105          339 CONTINUE
```

```
0106          338 CONTINUE
0107          337 CONTINUE
0108          336 CONTINUE
0109          334 CONTINUE
0110          335 DO 342 K = 1,5
0111              IF (NPINTL(I,K).EQ.0) GO TO 324
0112              IF (PINTS(I,K,2).LT..001) GO TO 342
0113              DO 343 L = 1,6
0114              IF (NVEH(J,L).EQ.0) GO TO 342
0115              LA = NVEH(J,L)
0116              DO 344 LB = 1,3
0117              IF (VEH(LB+1,LA).EQ.0) GO TO 343
0118              LC = VFH(LB,LA)
0119              DO 345 LD = 1,4
0120              IF (NFS(LC,LD).EQ.0) GO TO 344
0121              IF (NFS(LC,LD).NE.NPINTL(I,K)) GO TO 345
0122              LE = VFH(LB+1,LA)
0123              DO 346 LF = 1,4
0124              IF (NFS(LE,LF).EQ.0) GO TO 345
0125              IF (NFS(LE,LF).EQ.NPINTU(I,K)) GO TO 347
0126          346 CONTINUE
0127              GO TO 345
0128          347 K1 = -100 - K
0129              DO 348 LG = 1,20
0130              IF (MATCH(LG).EQ.0) GO TO 349
0131              IF (MATCH(LG).EQ.K1) GO TO 350
0132              GO TO 348
0133          349 MATCH(LG) = K1
0134              JF(LG) = J
0135          350 JL(LG) = J
0136              GO TO 342
0137          348 CONTINUE
0138          345 CONTINUE
0139          344 CONTINUE
0140          343 CONTINUE
0141          342 CONTINUE
0142          324 CONTINUE
            C     ADD EXTRA PAD COSTS ASSOCIATED WITH THIS SOLUTION
0143              DO 351 J = 1,20
0144              IF (MATCH(J).EQ.0) GO TO 320
0145              IF (MATCH(J).LT.-100) GO TO 352
0146              IF (MATCH(J).LT.0) GO TO 353
0147              K = MATCH(J)
```



```
0148              EXTRA = EXTRA + PSTGD(I,K,2) + PSTGS(I,K,2) * FLOAT(JL(J)-JF(J)+1)
0149              IF(NOT.EQ.0)  GO TO 351
0150              IF(PSTGD(I,K,2) + PSTGS(I,K,2).LT..01)  GO TO 351
0151              NEXD = NEXD + 1
0152              NDUM = NUMD + NEXD
0153              DS(NDUM)          = PSTGD(I,K,2)
0154              SUST(NDUM)          = PSTGS(I,K,2)
0155              MAT(NDUM)         = -300 - I + 2000
0156              MAPS(I,K) = NDUM
0157              NYD(NDUM)         = JF(J)
0158              LYD(NDUM)         = JL(J)
0159              YD(NDUM)          = 1.0
0160              LZ(NDUM)          = JL(J) - JF(J) + 1
0161              NDUM = NDUM + NSPR + NMIS
0162              IS(NDUM)    = JF(J) - 2 + 1900 + ILY
0163              GO TO 351
0164          353 K = -MATCH(J)
0165              EXTRA = EXTRA + PFAMD(I,K,2) + PFAMS(I,K,2)*FLOAT(JL(J)-JF(J)+1)
0166              IF(NOT.EQ.0)  GO TO 351
0167              IF(PFAMD(I,K,2) + PFAMS(I,K,2).LT..01)  GO TO 351
0168              NEXD = NEXD + 1
0169              NDUM = NUMD + NEXD
0170              DS(NDUM)          = PFAMD(I,K,2)
0171              SUST(NDUM)          = PFAMS(I,K,2)
0172              MAT(NDUM)         = -200 - I + 2000
0173              MAPF(I,K) = NDUM
0174              NYD(NDUM)         = JF(J)
0175              LYD(NDUM)         = JL(J)
0176              YD(NDUM)          = 1.0
0177              LZ(NDUM)          = JL(J) - JF(J) + 1
0178              NDUM = NDUM + NSPR + NMIS
0179              IS(NDUM)    = JF(J) - 2 + 1900 + ILY
0180              GO TO 351
0181          352 K = -MATCH(J) - 100
0182              EXTRA = EXTRA + PINTS(I,K,2) * FLOAT(JL(J)-JF(J)+1)
0183              IF(NOT.EQ.0)  GO TO 351
0184              IF(PINTS(I,K,2).LT..001)  GO TO 351
0185              NEXD = NEXD + 1
0186              NDUM = NUMD + NEXD
0187              DS(NDUM)          = 0.0
0188              SUST(NDUM)          = PINTS(I,K,2)
0189              MAT(NDUM)         = -400 -I + 2000
0190              MAPI(I,K) = NDUM
```

```
0191              NYD(NDUM)          = JF(J)
0192              LYD(NDUM)          = JL(J)
0193              YD(NDUM)           = 1.0
0194              LZ(NDUM)           = JL(J) - JF(J) + 1
0195              NDUM = NDUM + NSPR + NMIS
0196              IS(NDUM)    = JF(J) - 2 + 1900 + ILY
0197            351 CONTINUE
0198            320 CONTINUE
0199              1 IF(MOS.EQ.1.OR.MOS.EQ.3)  GO TO 501
0200                IF(NOT.EQ.1)   GO TO 500
0201                IF(LP.GT.0)
                   1WRITE(6,403) EXTRA
                C
                C   ADD PREVIOUSLY NEGLECTED SUSTAINING COSTS
0202                IF(LOUT.EQ.0)  GO TO 11
0203            501 DO 10 I = 1,NUMD
0204                IF(KOUT(I).EQ.0.OR.LZ(I).EQ.0)  GO TO 10
0205                LZ(I) = 0
0206                LT = KOUT(I)
0207                DO 8 J = 1,NM
0208                LM = MIN(J)
0209                IF(LM.EQ.0)  GO TO 8
0210                LY = LYR(J)
0211                IF(KI.EQ.2)  LY = (LYR(J) + 1)/KI
0212                L1 = LM
0213                LX = LETT(J)
0214                IF(LTR(LX).EQ.2)  L1 = LM + NV
0215                DO 6 KK = 1,20
0216                IF(NONREC(L1,KK).EQ.0)  GO TO 8
0217                IF(NONREC(L1,KK).NE.I)  GO TO 6
0218                IF(LY.GE.LZ(I))  LZ(I) = LY
0219              6 CONTINUE
0220              8 CONTINUE
0221                IF(MOS.EQ.1.OR.MOS.EQ.3.OR.LZ(I).EQ.0)   GO TO 10
0222                XX = LZ(I)*KI - NYD(I) + 1
0223                EXTRA = EXTRA + XX*SAVS(LT)
0224                WRITE(6,410) I,LZ(I),NYD(I),XX,SAVS(LT),EXTRA
0225            410 FORMAT (3I6,3F10.2)
0226                IF(DS(I).LT.1.0.AND.NSOL.LE.1)
                   1EXTRA = EXTRA + DS(I)
0227             10 CONTINUE
0228                IF(MOS.EQ.1.OR.MOS.EQ.3)  GO TO 500
0229                CALL PACK(LZ,NODE(1,NX),NUMD,4)
```



```
0230                IF(LP.GT.0)
                   1WRITE (6,405) EXTRA
0231             11 IF(EXTRA.LT..001)  NOT = 1
0232                IF(EXTRA.LT..001)  GO TO 502
0233                TDS(NX) = TDS(NX) + EXTRA
0234                Z(NX) = Z(NX) + EXTRA
0235                IF(LP.GT.0)
                   1WRITE(6,210) Z(NX)
0236             55 EXTRA = 100.0
0237                RETURN
0238            500 DO 76 NO = 1,NUMD
0239             76 LZ(NO) = LZ(NO)*KI
0240                CALL PACK(LZ,LZOPT(1),  NUMD+NEXD,5)
0241            359 EXTRA = 0.0
0242                RETURN
0243            210 FORMAT (12H NEW VALUE =, F12.2)
0244            358 FORMAT(36HOMORE THAN 50 NODES HAVE BEEN TESTED)
0245            401 FORMAT (26HOPOSSIBLE SOLUTION AT NODE,I4,49H NOT FEASIBLE. MORE TH
                   1AN 2 PADS NEEDED AT COMPLEX,1X,A4,8H IN YEAR, I3)
0246            403 FORMAT (18HOEXTRA PAD COSTS =, F10.2)
0247            404 FORMAT (1HO,12(1H*),19H POSSIBLE SOLUTION ,I3,2X,12(1H*)/1H ,I3,
                   1   29X,3(F9.2,5X))
0248            405 FORMAT (31HOEXTRA PAD & SMALL SUST COSTS =, F10.2)
0249                END
```

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FORTRAN IV G LEVEL 1, MOD 4            PDCSTI          DATE = 71084        16/56/06          PAGE 00

  TOTAL MEMORY REQUIREMENTS 001BC2 BYTES
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  F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,NCAL,MAP
            VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000       NAME MOXO2PC(R)
IEW0461   IBCOM=
IEW0461   PACK
```

MODULE MAP

CONTROL SECTION NAME	ORIGIN	LENGTH	ENTRY NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME
PDCSTI	00	1BC2							
SAVE1	1BC8	FC4							
SAV3	2B90	980							
SAV4	3510	3188							
SAVALL	6698	3A1C							
TEMP	A0B8	4110							
SCRACH	E1C8	6A60							

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 ENTRY ADDRESS       00
 TOTAL LENGTH     14C28

****MOXO2PC   NOW REPLACED IN DATA SET
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DIAGNOSTIC MESSAGE DIRECTORY

IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.

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(17)          OS/360  FORTRAN H                                    DATE  71.084/16.15.14

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
   ISN 0002            SUBROUTINE PERFI(INCL,N,VREF)
   ISN 0003            REAL LENT,ISP,ISPA,INCL
   ISN 0004            INTEGER COUNT
   ISN 0005            COMMON/SCRACH/IP,IV,IG,NPAX(2),NEH(4),NST(41),THRT(41),DIAM(41),
                      1  TSL(41),LENT(41),WTFU(41),WTIN(41),ISP(41),MZ(50),LZ(50),
                      2          WINT(3,60),KX,NX,WGHT(40),WF(4),WT(4),ISPA(4),
                      3  THUT(4),PRT(60),M,VDES,WPL,PR,K1,IERR,DUM(6067)
   ISN 0006            DATA PI,G /3.141593,32.174/
   ISN 0007            K = N
   ISN 0008            TLS = TSL(K1)
   ISN 0009            DIA = DIAM(K1)
   ISN 0010            KODE = 0
   ISN 0011            IERR = 0
   ISN 0012            V = VDES
   ISN 0013            WPL = 0.
   ISN 0014            IF(PR.LE.0.)   GO TO 30
   ISN 0016       10   WPL = PR
   ISN 0017       30   DO 100 COUNT = 1,50
   ISN 0018            W = WPL
   ISN 0019            DO 40 I=1,K
   ISN 0020       40   W = W&WF(I)&WT(I)
   ISN 0021            WLO = W
   ISN 0022            VIDL = 0.
   ISN 0023            DO 50 I=1,K
   ISN 0024            WB = W-WF(I)
   ISN 0025            IF(WB.GT.0.)  GO TO 48
   ISN 0027       45   IERR = 2
   ISN 0028            RETURN
   ISN 0029       48   VIDL = VIDL & G*ISPA(I)*ALOG(W/WB)
   ISN 0030       50   W = WB-WT(I)
   ISN 0031            IF (KODE) 90,55,90
   ISN 0032       55   IF(PR)  70,70,60
   ISN 0033       60   VLOSS = VIDL-VREF
   ISN 0034            GO TO 97
   ISN 0035       70   TB = 0.
   ISN 0036            DO 80 I=1,K
   ISN 0037       80   TB = TB & WF(I)*ISPA(I)/THUT(I)
   ISN 0038            WX = WB * EXP (VDES/ISPA(K)/G)
   ISN 0039            TB = TB - (WX-WB)*ISPA(K)/THUT(K)
   ISN 0040            TOW = TLS/WLO
   ISN 0041            IF (TOW.GT.1.5) TOW = 1.5
   ISN 0043            VLOSS = 6800.*(2.-TOW)  &  2800.*(THUT(1)/TLS-1.)
                      *  &.5E6*PI*DIA**2/WLO&4.1* EXP(TB/125.)  -1530.*COS(INCL/57.296)
   ISN 0044       90   DELV = VIDL-VLOSS-VREF-V
   ISN 0045            WPL = WPL&(WPL&WT(K))*DELV/ISPA(K)/G*(1.&WB/(WB&WF(K)))
   ISN 0046            IF(ABS(DELV).GT.1.)   GO TO 100
   ISN 0048       95   IF(KODE.EQ.0)  GO TO 96
   ISN 0050       110  IF (WPL.LT.0.) IERR = 1
   ISN 0052       120  RETURN
   ISN 0053       96   PR  = WPL
   ISN 0054       97   V = VDES
   ISN 0055            K = N&M
   ISN 0056            KODE = 1
   ISN 0057            WPL = 0.
   ISN 0058       100  CONTINUE
   ISN 0059            IERR = 3
   ISN 0060            RETURN
   ISN 0061            END

****** END OF COMPILATION ******
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F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
         VARIABLE OPTIONS USED - SIZE=(126976,24576)                DEFAULT OPTION(S) USED
IEW0000      NAME MOX02PI(R)
IEW0461  COS
IEW0461  EXP
IEW0461  ALOG

                                        CROSS REFERENCE TABLE

  CONTROL SECTION                       ENTRY
    NAME     ORIGIN  LENGTH              NAME   LOCATION     NAME   LOCATION     NAME   LOCATION     NAME
  PERFI          00     4BC
  SCRACH        4C0    6A60

  LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION            LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION
     120            SCRACH          SCRACH                    124            COS          $UNRESOLVED
     128            EXP          $UNRESOLVED                  12C            ALOG         $UNRESOLVED

 ENTRY ADDRESS       00
 TOTAL LENGTH      6F20

****MOX02PI   NOW REPLACED IN DATA SET

                                        DIAGNOSTIC MESSAGE DIRECTORY

   IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.
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(17)          OS/360  FORTRAN H                                DATE  71.084/16.16.19

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
  ISN 0002            SUBROUTINE PRINTI
                C     ***PRINT OUT DECISION COST CATEGORIES***
                C
  ISN 0003            REAL NPERPD
  ISN 0004            INTEGER*2 LSA,NYS,KODEF,LST,MST,IST,JST,KST,VEH,NMULT,NONREC,NYD,
                     1  IS,MAT,LYR,LETT,LYD,MIN,LTR,NPSTG,NPAD,NPFAM,NFS,NPINTL,NPINTU,
                     2  MAPS,MAPF,MAPI,FINISH,NSTG,NFML,NFMU,KODS,MAS,LABS,LABF,LABI,
                     3  MAF,MAIC
  ISN 0005            COMMON/SAVDMP/ NFAM,KFLAG,FAM(30),KODEF(30),FMNR(30),FMSUS(30),
                    1JST(30),YDF(30),LSA(40),SNR(40),NYS(40),DINT(40),SINT(40),KST(40),
                     2  YDI(40),YDS(40),IST(40),FMSLS(30,2),SUSLS(40,2),SINTLS(40,2),
                     3  LST(30,5),YDPF(30,5),MST(30,10),YDPS(30,10)
  ISN 0006            COMMON/SAVE1/ FINISH,NSTG,NCI,ILY,LABF(30),LABS(40),LABI(40),
                    1 NFML(40),NFMU(40),KODS(40),STS(41),STG(40),VLR(50),WPR(50),
                     2  RPLM(50),MAS(40,3), RXD(12,50)
  ISN 0007            COMMON/SAV3/GRO,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                    1   PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
  ISN 0008            COMMON/SAV4/ MAF(30,3), MAIC(40,3),
                     *          NPAD(2,60),NPFAM(30,5),NPINTL(30,5),NPINTU(30,5),
                     1  NFS(40,4),NPSTG(30,10),MAPS(30,10),MAPF(30,10),MAPI(30,10),
                     2  PFAMD(30,5,2),PFAMS(30,5,2),PINTS(30,5,2),PSTGD(30,10,2),
                     3   PSTGS(30,10,2)
  ISN 0009            COMMON/SAVALL/LCK,SLO,NM,NEXO,NV,NUMO,MYRS,LZOPT(8),NYD(46),MAT(46
                    1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                     2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
                C
  ISN 0010          2 IF(NUMO.EQ.0)  RETURN
  ISN 0012            WRITE(6,211)
  ISN 0013            DO 925 I = 1,NUMO
  ISN 0014            J=MAT(I)
  ISN 0015            IF(J.GT.1000)  J = J - 2000
  ISN 0017            IF (J.LT.-400) GO TO 9071
  ISN 0019            IF (J.LT.-300) GO TO 9072
  ISN 0021            IF (J.LT.-200) GO TO 9018
  ISN 0023            IF(J.LT.-100) GO TO 345
  ISN 0025            IF(J.LT.0) GO TO 340
  ISN 0027            DO 9073 K = 1,3
  ISN 0028            IF (MAS(J,K).NE.I) GO TO 9073
  ISN 0030            IF(K.EQ.1)  WRITE(6,208)  I,DS(I),SUST(I),STG(J),NYD(I),LYD(I),
                     1  IS(I&NMIS&NSPR),  YD(I)
  ISN 0032            IF(K.EQ.2)  WRITE(6,9074) I,DS(I),SUST(I),STG(J),NYD(I),LYD(I),
                     1  IS(I&NMIS&NSPR),  YD(I)
```

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ISN 0034            IF(K.EQ.3)  WRITE(6,9075) I,DS(I),SUST(I),STG(J),NYD(I),LYD(I),
                   . 1  IS(I&NMIS&NSPR),  YD(I)
ISN 0036            GO TO 925
ISN 0037          9073 CONTINUE
ISN 0038           340 JX=-J
ISN 0039               DO 9076 K = 1,3
ISN 0040               IF (MAF(JX,K).NE.I) GO TO 9076
ISN 0042               IF(K.EQ.1)  WRITE(6,209)  I,DS(I),SUST(I),FAM(JX),NYD(I),LYD(I),
                      1   IS(I&NMIS&NSPR), YD(I)
ISN 0044               IF(K.EQ.2)  WRITE(6,9077) I,DS(I),SUST(I),FAM(JX),NYD(I),LYD(I),
                      1   IS(I&NMIS&NSPR), YD(I)
ISN 0046               IF(K.EQ.3)  WRITE(6,9078) I,DS(I),SUST(I),FAM(JX),NYD(I),LYD(I),
                      1   IS(I&NMIS&NSPR), YD(I)
ISN 0048               GO TO 925
ISN 0049          9076 CONTINUE
ISN 0050           345 JX=-J-100
ISN 0051               JY=NFML(JX)
ISN 0052               JZ=NFMU(JX)
ISN 0053               DO 9079 K = 1,3
ISN 0054               IF (MAIC(JX,K).NE.I) GO TO 9079
ISN 0056               IF(K.EQ.1)  WRITE(6,210)   I,DS(I),SUST(I),FAM(JY),FAM(JZ),NYD(I),
                      1   LYD(I), IS(I&NMIS&NSPR),  YD(I)
ISN 0058               IF(K.EQ.2)  WRITE(6,9080)  I,DS(I),SUST(I),FAM(JY),FAM(JZ),NYD(I),
                      1   LYD(I), IS(I&NMIS&NSPR),  YD(I)
ISN 0060               IF(K.EQ.3)  WRITE(6,9081)  I,DS(I),SUST(I),FAM(JY),FAM(JZ),NYD(I),
                      1   LYD(I), IS(I&NMIS&NSPR),  YD(I)
ISN 0062               GO TO 925
ISN 0063          9079 CONTINUE
ISN 0064          9018 JX = -J - 200
ISN 0065               DO 9082 K = 1,5
ISN 0066               IF (MAPF(JX,K).NE.I) GO TO 9082
ISN 0068               KX = NPFAM(JX,K)
ISN 0069               WRITE(6,9083) I,DS(I),SUST(I),FAM(KX),PAD(JX),NYD(I),LYD(I),
                      1    IS(I&NMIS&NSPR),   YD(I)
ISN 0070               GO TO 925
ISN 0071          9082 CONTINUE
ISN 0072          9072 JX = -J - 300
ISN 0073               DO 9084 K = 1,10
ISN 0074               IF (MAPS(JX,K).NE.I) GO TO 9084
ISN 0076               KX = NPSTG(JX,K)
ISN 0077               WRITE(6,9085) I,DS(I),SUST(I),STG(KX),PAD(JX),NYD(I),LYD(I),
                      1    IS(I&NMIS&NSPR),   YD(I)


ISN 0078               GO TO 925
ISN 0079          9084 CONTINUE
ISN 0080          9071 JX = -J - 400
ISN 0081               DO 9086 K = 1,5
ISN 0082               IF (MAPI(JX,K).NE.I) GO TO 9086
ISN 0084               KX = NPINTL(JX,K)
ISN 0085               KY = NPINTU(JX,K)
ISN 0086               WRITE(6,9087)I,DS(I),SUST(I),FAM(KX),FAM(KY),PAD(JX),NYD(I),LYD(I)
                      1 ,  IS(I&NMIS&NSPR),   YD(I)
ISN 0087               GO TO 925
ISN 0088          9086 CONTINUE
ISN 0089           925 CONTINUE
ISN 0090               RETURN
ISN 0091           208 FORMAT (I4,6X,2F12.2,5X,A4,1X,14HSTAGE HARDWARE,29X,I3,9X,I3,8X,
                      1   I5,7X,F5.0)
ISN 0092           209 FORMAT (I4,6X,2F12.2,5X,A4,1X,15HSHARED HARDWARE,28X,I3,9X,I3,8X,
                      1    I5,7X,F5.0)
ISN 0093           210 FORMAT(I4,6X,2F12.2,5X,15HINTEGRATION OF ,A4,5H AND ,A4,
                      1  9H HARDWARE,11X,I3,9X,I3,8X,I5,7X,F5.0)
ISN 0094           211 FORMAT(25H1QUANTITIES BRANCHED UPON/1H0,6HNUMBER,5X,11HDEVELOPMENT
                     *, 2X, 10HSUSTAINING,50X,10HYEAR AVAIL,2X,9HLAST YEAR,2X,9HDEV STAR
                     *T, 2X, 12HDEV DURATION//)
ISN 0095          9074 FORMAT (I4,6X,2F12.2,5X,A4,1X,9HSTAGE ETR,34X,I3,9X,I3,8X,I5,7X,
                     *    F5.0)
ISN 0096          9075 FORMAT (I4,6X,2F12.2,5X,A4,1X,9HSTAGE WTR,34X,I3,9X,I3,8X,I5,7X,
                     *    F5.0)
ISN 0097          9077 FORMAT (I4,6X,2F12.2,5X,A4,1X,10HSHARED ETR,33X,I3,9X,I3,8X,I5,
                     *      7X, F5.0)
ISN 0098          9078 FORMAT (I4,6X,2F12.2,5X,A4,1X,10HSHARED WTR,33X,I3,9X,I3,8X,I5,7X,
                     *    F5.0)
ISN 0099          9080 FORMAT (I4,6X,2F12.2,5X,15HINTEGRATION OF ,A4,5H AND ,A4,4H ETR,
                      1  16X,I3,9X,I3,8X,I5,7X,F5.0)
ISN 0100          9081 FORMAT (I4,6X,2F12.2,5X,15HINTEGRATION OF ,A4,5H AND ,A4,4H WTR,
                      1  16X,I3,9X,I3,8X,I5,7X,F5.0)
ISN 0101          9083 FORMAT (I4,6X,2F12.2,5X,A4,1X,14HSHARED AT PAD ,A4,25X,I3,9X,I3,
                     *    8X,I5,7X,F5.0)
ISN 0102          9085 FORMAT (I4,6X,2F12.2,5X,A4,1X,13HSTAGE AT PAD ,A4,26X,I3,9X,I3,8X,
                     *   I5,7X,F5.0)
ISN 0103          9087 FORMAT (I4,6X,2F12.2,5X,15HINTEGRATION OF ,A4,5H AND ,A4,1X,
                      1  7HAT PAD ,A4,8X,I3,9X,I3,8X,I5,7X,F5.0)
ISN 0104               END

****** END OF COMPILATION ******
```

```
F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
          VARIABLE OPTIONS USED - SIZE=(126976,24576)                DEFAULT OPTION(S) USED
IEW0000      NAME MOX02PN(R)
IEW0461   IBCOM=

                                                CROSS REFERENCE TABLE

  CONTROL SECTION                    ENTRY

    NAME     ORIGIN   LENGTH            NAME   LOCATION     NAME   LOCATION     NAME   LOCATION     NAME

  PRINTI         00     108A
  SAVDMP       1090     14BC
  SAVE1        2550      FC4
  SAV3         3518      980
  SAV4         3E98     3188
  SAVALL       7020     3A1C


  LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION          LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION

      410           SAVDMP          SAVDMP                   414          SAVE1           SAVE1
      418           SAV3            SAV3                     41C          SAV4            SAV4
      420           SAV4            SAV4                     424          SAV4            SAV4
      428           SAVALL          SAVALL                   42C          SAVALL          SAVALL
      430           IBCOM=        $UNRESOLVED
 ENTRY ADDRESS      00
 TOTAL LENGTH     AA40

****MOX02PN   NOW REPLACED IN DATA SET

                                          DIAGNOSTIC MESSAGE DIRECTORY

  IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.


(17)          OS/360  FORTRAN H                                DATE  71.084/16.17.16

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
  ISN 0002            SUBROUTINE REUSEI
                   C ESTIMATE NUMBER OF INITIAL UNITS TO PURCHASE
                   C
  ISN 0003            INTEGER*2 NU,NBY,MODE,NOB,VEH,NMULT,NONREC,NYD,IS,MAT,LYR,LETT,
                     1 LYD,MIN
  ISN 0004            COMMON/SAVSAR/ POJ(3),SRJ(3,3),NU(40),NBY(40),NOB(40),RINT(40),
                     1   PLCINT(40),XLT(40), PLCT(40),UPP(40),TAT(40),TAMT(50),SR(40,3),
                     2   MODE(40,3),PLC(40,3)
  ISN 0005            COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                     1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                     2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
  ISN 0006            COMMON/SCRACH/  II,NUS(40),MSAVE(40),ISAVE(40),KLUE(40),
                     1STGYHW(40,20),RINTMX(40,20),STGMAX(40,20,2),STGYTR(40,20,2),
                     2  RINTYR(40,20),OUM(1047)
                   C
  ISN 0007            I = II
  ISN 0008            IF(KLUE(I).GT.0)  GO TO 100
  ISN 0010            NU(I) = -  MAXO (2,-NUS(I) -1)
  ISN 0011            RETURN
  ISN 0012       100  TL = 0.0
  ISN 0013            YY = TAT(I)
  ISN 0014            NU(I) = -2
  ISN 0015            DO 200 J = 1,MYRS
  ISN 0016            IF(STGYHW(I,J).LT..001)  GO TO 200
  ISN 0018            TAM = 365./STGYHW(I,J)
                   C   TAM = MAX ALLOWABLE AVERAGE TA TIME IN DAYS FOR YEAR J
  ISN 0019            XX = YY
  ISN 0020            TL = TL & STGYHW(I,J)
  ISN 0021            YY = TAT(I)*(TL)**PLCT(I)
  ISN 0022            YY = 2.0 *YY - TAT(I)
  ISN 0023            TAA = .5*(XX & YY)
  ISN 0024            IF(NOB(I).EQ.1)  GO TO 120
                   C  CALCULATE AVERAGE MISSION TA TIME FOR ORBITER ONLY
  ISN 0026            COUNT = 0.0
  ISN 0027            TOT = 0.0
  ISN 0028            DO 110 K = 1,NM
  ISN 0029            IF(LYR(K).NE.J)  GO TO 110
                   C  CHECK IF STAGE I IS TOP STAGE OF VEHICLE MK
  ISN 0031            MK = MIN(K)
  ISN 0032            DO 105 I1 = 1,4
  ISN 0033            I11 = 5-I1
  ISN 0034            IF(VEH(I11 ,MK).EQ.0)  GO TO 105
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   ISN 0036            IF(VEH(I11 ,MK).EQ.1)  GO TO 106
   ISN 0038            GO TO 110
   ISN 0039        105 CONTINUE
   ISN 0040        106 NETT = LETT(K)
   ISN 0041            XN = NMULT(MK,NETT)
   ISN 0042            COUNT = COUNT & YRLM(K)*XN
   ISN 0043            TOT = TOT & TAMT(NETT)*XN*YRLM(K)
   ISN 0044        110 CONTINUE
   ISN 0045            TAA = TAA  & .5 & TOT/COUNT
   ISN 0046        120 IF(TAM.GE.TAA)  GO TO 200
   ISN 0048            NRQY = TAA/TAM & .9999
   ISN 0049            NX = NU(I)
   ISN 0050            NU(I) = MINO(-NRQY,NX)
   ISN 0051        200 CONTINUE
                 C     COMPARE NUMBER REQUIRED BY LIFETIME TO NUMBER REQUIRED BY TAT
   ISN 0052            X = - NU(I)
   ISN 0053            IF((X*XLT(I)).LT.TL)  NU(I) = - INT(TL/XLT(I) & .9999)
   ISN 0055            RETURN
   ISN 0056            END

****** END OF COMPILATION ******
```

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 F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
           VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000      NAME MOX02RS(R)
IEW0461  FRXPR=


                                        CROSS REFERENCE TABLE

  CONTROL SECTION                       ENTRY

    NAME     ORIGIN  LENGTH              NAME   LOCATION     NAME   LOCATION     NAME   LOCATION     NAME

  REUSEI         00     4D8
  SAVSAR        4D8     A58
  SAVALL        F30    3A1C
  SCRACH       4950    6A60


  LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION          LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION

      128           SAVSAR          SAVSAR                   12C           SAVALL          SAVALL
      130           SAVALL          SAVALL                   134           SCRACH          SCRACH
      138           SCRACH          SCRACH                   13C           SCRACH          SCRACH
      140           FRXPR=         $UNRESOLVED
 ENTRY ADDRESS       00
 TOTAL LENGTH      B3B0

****MOX02RS   NOW REPLACED IN DATA SET

                                        DIAGNOSTIC MESSAGE DIRECTORY

   IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.
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(17)          OS/360  FORTRAN H                                    DATE  71.084/16.17.50

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
   ISN 0002            SUBROUTINE REVLUS
                     CTHIS SUBROUTINE RECALCULATES THE APPROPRIATE VALUES FOR RECURRING COSTS
   ISN 0003            INTEGER H,PROG
   ISN 0004            INTEGER*2  LTR,VEH,NMULT,NONREC,NYD,IS,MAT,LYR,LETT,LYD,MIN
   ISN 0005            LOGICAL SKIP
   ISN 0006            REAL NPERPD
   ISN 0007            COMMON/SAVRT/RVAK(20,50)
   ISN 0008            COMMON/SAV3/GRO,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                      1   PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
   ISN 0009            COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                      1),SUST(46),OS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                      2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
   ISN 0010            COMMON/VARNCE/KSTAT,VARI(40),VARF(50),VARM(56),FMVAR(2,30),
                      1  FIVAR(3,40),PLVAR(3,56),SVAR(5,40)
   ISN 0011            COMMON/SCRACH/M,N,NCS,PROG,IODD,IERR,SKIP,MYFLAG,JS,NSCALE(5),
                      1  NSL(10),TOTAL(20),W(20),D(20),XOUT(20),VOUT(20),RRR(20),YEAR(20)
                      2,  Y(20),KVEHI(50),LABEL(50),LVARY(70),LVD(70),IVEH(70),LVS(70),
                      3  LVSF(80),VNAM(80),NOP(86),RF(86),CF(86),SF(86),FLAGR(86),
                      4  FLAGS(86),NSSF(86),NSRF(86),NSXF(86),NDSF(86),SUSTF(86),NLVP(86)
                      5,  NSTRRC(86),NYRSRC(86),LNDF(86),NSTRST(86),LNDATE(86),NPRD(90),
                      6  KPRO(90),CSX(90),LZ(46),RCOST( 60), KVEH( 60),IMAGE(830),
                      7  XSCH(10,70),XLVSUM(20,50),RECUR(20,50),DUM(616),RVX(20),RPLX(20)
                C
   ISN 0012            DO 33 II = 1,20
   ISN 0013            RVX(II) = 0.0
   ISN 0014         33 RPLX(II) = 0.0
   ISN 0015            L = PROG
   ISN 0016            NSTRRC(L) = 100
   ISN 0017            NYRSRC(L) = 0
   ISN 0018            LNDATE(L) = 100
   ISN 0019            IF (NLVP(L).EQ.0) GO TO 21
   ISN 0021            DO 34 LC = 1,20
   ISN 0022         34 RECUR(LC,L) = 0.0
   ISN 0023            IJ = NLVP(L)
   ISN 0024            H = LVARY(L)
   ISN 0025            IB = LVS(H)
   ISN 0026            IF (IB.LT.4) IB = 4
   ISN 0028            DO 38 K=1,IJ
   ISN 0029            IF (LVD(H).EQ.0) GO TO 38
   ISN 0031            IA = LVS(H)-3
   ISN 0032            IF (IA.LT.1) IA=1
   ISN 0034            IK = LVD(H)

   ISN 0035            ILV = IVEH(H)
   ISN 0036            DO 37 J=1,IK
                C  RCST = VEH. RECURRING COST/YR. BY MISSION
   ISN 0037            RCST = XSCH(J,H)*RCOST(ILV)
                C RCPL = PAYLOAD RECURRING COST/YR.
   ISN 0038            RCPL = XSCH(J,H)*PLR(L)
   ISN 0039            DO 36 I=1,4
   ISN 0040            II = LVS(H)-IB&I&J-1
   ISN 0041            IF (II.LT.1) II=1
   ISN 0043            IF(KSTAT.EQ.0.OR.SKIP)  GO TO 36
   ISN 0045            RVX(II) = RVX(II) & RCST
   ISN 0046            RPLX(II) = RPLX(II) & RCPL
                C  DISTRIBUTE RECURRING COST BY YEAR
   ISN 0047         36 RECUR(II,L) = RECUR(II,L)&ALPI(I,ILV)*RCST & RDIST(L,I)*RCPL
   ISN 0048         37 CONTINUE
   ISN 0049            IF(KSTAT.EQ.0.OR.SKIP)  GO TO 42
   ISN 0051            VTOT = 0.0
   ISN 0052            DO 39 JX = 1,4
   ISN 0053            KX = VEH(JX,ILV)
   ISN 0054            IF(KX.EQ.0)  GO TO 40
   ISN 0056         39 VTOT = VTOT & SVAR(1,KX)
   ISN 0057            JX = JX & 1
   ISN 0058         40 XJX = JX - 1
   ISN 0059            DO 41 IX = 1,20
   ISN 0060            RVAR(IX,L) = (VTOT*RVX(IX))/XJX      & PLVAR(1,L)*RPLX(IX)
   ISN 0061            IF(RVAR(IX,L).GT..001)RVAR(IX,L) = RVAR(IX,L)/(RVX(IX) & RPLX(IX))
   ISN 0063         41 CONTINUE
   ISN 0064         42 NYRSRC(L) = MAXO (NYRSRC(L),II)
   ISN 0065            NSTRRC(L) = MINO (NSTRRC(L),IA)
   ISN 0066            LSUB = LNDATE(L)
   ISN 0067            LVSUB = LVS(H)
   ISN 0068            LNDATE(L) = MINO(LSUB,LVSUB)
   ISN 0069         38 H = H & 1
                C  NYRSRC & NSTRRC = 0 FOR DEVELOPMENT PROGRAM
   ISN 0070         21 IF (NSTRRC(L).EQ.100) NSTRRC(L) = 0
   ISN 0072         99 RETURN
   ISN 0073            END

****** END OF COMPILATION ******
```

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F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
          VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000     NAME MOX02RV(R)


                                        CROSS REFERENCE TABLE

  CONTROL SECTION                       ENTRY

    NAME     ORIGIN   LENGTH             NAME   LOCATION     NAME   LOCATION     NAME   LOCATION     NAME

  REVLUS       00      662
  SAVRT       668      FA0
  SAV3       1608      980
  SAVALL     1F88     3A1C
  VARNCE     59A8      ADC
  SCRACH     6488     6A60


  LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION          LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION

      128          SAVRT          SAVRT                     12C          SAV3           SAV3
      130          SAVALL         SAVALL                    134          SAVALL         SAVALL
      138          VARNCE         VARNCE                    13C          SCRACH         SCRACH
      140          SCRACH         SCRACH                    144          SCRACH         SCRACH
      148          SCRACH         SCRACH                    14C          SCRACH         SCRACH
      150          SCRACH         SCRACH
ENTRY ADDRESS      00
TOTAL LENGTH     CEE8

****MOX02RV   NOW REPLACED IN DATA SET
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(17)          OS/360  FORTRAN H                              DATE  71.084/16.40.54

        COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NI
   ISN 0002            SUBROUTINE SHIFTS
                     C  THIS SUBROUTINE SHIFTS THE DEVELOPMENT START DATES AND DURATION IN ORDER
                     C    TO ACHIEVE A SMOOTHER LEVEL OF SPENDING
                     C
   ISN 0003            DOUBLE PRECISION NAME
   ISN 0004            LOGICAL SKIP,ACCL,EXT
   ISN 0005            REAL LEVEL
   ISN 0006            INTEGER H,PROG
   ISN 0007            INTEGER*2     YDPL,NSYR,NSFX,NRFX,NYRSST,NSTRFX,NPROG,KPROG,
                      1  KODE,NYRSFX,KODEM,KODESP
   ISN 0008            COMMON/SAV2/EXT,ACCL,KNSTG,KNFAM,KNCI,KNP,KNMIS,JFLAG,TREF,NCSTR,
                      1 PMAX,PMIN,ISTRT,IFIN,MAXITR,MITR,KODESP(6),TITLE(10),LEVEL(20),
                      2  CNTRVL(20),FIXED(20),KODEM(50),NSYR(50),NSFX(50),NAME(56),
                      3  YDPL(56),NRFX(50),NYRSST(84),NSTRFX(84),NYRSFX(84),SUS(84),C(84)
                      4,  R(84), S(84),CS(90),NPROG(90),KPROG(90), KODE(90)
   ISN 0009            COMMON/SCRACH/M,N,NCS,PROG,IODD,IERR,SKIP,MYFLAG,JS,NSCALE(5),
                      1  NSL(10),TOTAL(20),W(20),D(20),XOUT(20),VOUT(20),RRR(20),YEAR(20)
                      2,  Y(20),KVEHI(50),LABEL(50),LVARY(70),LVD(70),IVEH(70),LVS(70),
                      3  LVSF(80),VNAM(80),NOP(86),RF(86),CF(86),SF(86),FLAGR(86),
                      4  FLAGS(86),NSSF(86),NSRF(86),NSXF(86),NDSF(86),SUSTF(86),NLVP(86)
                      5,  NSTRRC(86),NYRSRC(86),LNDF(86),NSTRST(86),LNDATE(86),NPRO(90),
                      6  KPRO(90),CSX(90),LZ(46),RCOST( 60), KVEH( 60),IMAGE(830),
                      7  XSCH(10,70),XLVSUM(20,50),RECUR(20,50),DUM(656)
                     C
   ISN 0010          110 IODD = IODD & 1
   ISN 0011              GO TO (140,150,160,168,170,178,180),  IODD
   ISN 0012          140 STR = S(PROG)
   ISN 0013              S(PROG) = STR & 1.0
   ISN 0014          145 CALL CONSTR
   ISN 0015              IF (IERR.NE.0) GO TO 110
   ISN 0017           14 MYFLAG = 1
   ISN 0018              RETURN
   ISN 0019          150 S(PROG) = STR - 1.0
   ISN 0020              IF (S(PROG).LT.TREF) GO TO 110
   ISN 0022              GO TO 145
   ISN 0023          160 S(PROG) =  STR
   ISN 0024              IF(R(PROG).LE..0001.OR.CF(PROG).LE..0001)    GO TO 190
   ISN 0026              CKR = R(PROG)
   ISN 0027              CKC = C(PROG)
   ISN 0028              CKS = SUS (PROG)
   ISN 0029              NDS = NYRSST(PROG)
   ISN 0030              NSS = NSTRST(PROG)
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ISN 0031            NSR = NSTRRC(PROG)
ISN 0032            NYRC = NYRSRC(PROG)
ISN 0033            NSX = NSTRFX(PROG)
ISN 0034            NSO = LNDATE(PROG)
ISN 0035            R(PROG) = CKR & 1.0
ISN 0036            NSTRST(PROG) = INT(2.0*R(PROG)/3.0 & .999)
ISN 0037            NSTRRC(PROG) = NSR & 1
ISN 0038            NSTRFX(PROG) = NSX & 1
ISN 0039            LNDATE(PROG) = NSO & 1
ISN 0040            IF (NLVP(PROG).EQ.0) GO TO 165
ISN 0042            IJ = NLVP(PROG)
ISN 0043            H = LVARY(PROG)
ISN 0044            DO 162 I=1,IJ
ISN 0045            NSL(I) = LVS(H)
ISN 0046            LVS(H) = LVS(H) & 1
ISN 0047          162 H = H & 1
ISN 0048            DO 34 LC = 1,20
ISN 0049           34 RRR(LC) = RECUR(LC,PROG)
ISN 0050          164 CALL REVLUS
ISN 0051          165 CALL CONSTR
ISN 0052            IF (IERR.NE.0) GO TO 110
ISN 0054            IF(RF(PROG) - R(PROG)) 9010,9020,9030
                  C  DEVELOPMENT DURATION IS STRETCHED OUT
ISN 0055         9010 C(PROG) = (.8 & .2*R(PROG)/RF(PROG)) * CF(PROG)
ISN 0056            GO TO 9050
ISN 0057         9020 C(PROG) = CF(PROG)
ISN 0058            GO TO 9050
                  C  DEVELOPMENT DURATION IS ACCELERATED - CRASH PROGRAM
ISN 0059         9030 X = AINT (.5*RF(PROG) & .99)
ISN 0060            IF(R(PROG).LT.X)  R(PROG) = X
ISN 0062            C(PROG) = CF(PROG) * EXP ((1. -R(PROG)/RF(PROG))/ (R(PROG)/
                   1  RF(PROG) - .4))
ISN 0063         9050 IF (NYRSST(PROG).EQ.0) GO TO 14
ISN 0065            NYRSST(PROG) = NDSF(PROG) - LNDF(PROG) & LNDATE(PROG) -
                   1   NSTRST(PROG) & NSSF(PROG)
                  C  THE FOLLOWING DEFN. OF NYRSST IS THE ORIGINAL
                  C     NYRSST(PROG) = R(PROG)/RF(PROG)*FLOAT(NDSF(PROG))&.001
ISN 0066            X = NDSF(PROG)
ISN 0067            X1 = NYRSST(PROG)
ISN 0068            SUS (PROG) = C(PROG)/CF(PROG)*SUSTF(PROG)*X/X1
ISN 0069            GO TO 14
ISN 0070          168 IF(.NOT.EXT)  GO TO 110


ISN 0072            S(PROG) = STR - 1.0
ISN 0073            IF(S(PROG).LT.TREF)  GO TO 110
ISN 0075            IF(NLVP(PROG).EQ.0)  GO TO 165
ISN 0077            GO TO 164
ISN 0078          170 S(PROG) = STR
ISN 0079            IF (CKR.EQ.RF(PROG).AND..NOT.ACCL)  GO TO 180
ISN 0081            R(PROG) = CKR - 1.0
ISN 0082            NSTRST(PROG) = INT(2.0*R(PROG)/3.0 & .999)
ISN 0083            NSTRRC(PROG) = NSR - 1
ISN 0084            NSTRFX(PROG) = NSX - 1
ISN 0085            LNDATE(PROG) = NSO - 1
ISN 0086            IF (NLVP(PROG).EQ.0) GO TO 165
ISN 0088            IJ = NLVP(PROG)
ISN 0089            H = LVARY(PROG)
ISN 0090            DO 172 I=1,IJ
ISN 0091            LVS(H) = NSL(I) - 1
ISN 0092          172 H = H & 1
ISN 0093          175 GO TO 164
ISN 0094          178 IF(.NOT.EXT)  GO TO 110
ISN 0096            S(PROG) = STR & 1.0
ISN 0097            IF(NLVP(PROG).EQ.0)  GO TO 165
ISN 0099            GO TO 164
ISN 0100          180 S(PROG) = STR
ISN 0101            R(PROG) = CKR
ISN 0102            C(PROG) = CKC
ISN 0103            SUS (PROG) = CKS
ISN 0104            NYRSST(PROG) = NDS
ISN 0105            NSTRST(PROG) = NSS
ISN 0106            NSTRRC(PROG) = NSR
ISN 0107            NYRSRC(PROG) = NYRC
ISN 0108            NSTRFX(PROG) = NSX
ISN 0109            LNDATE(PROG) = NSO
ISN 0110            IF (NLVP(PROG).EQ.0) GO TO 190
ISN 0112            IJ = NLVP(PROG)
ISN 0113            H = LVARY(PROG)
ISN 0114            DO 182 I=1,IJ
ISN 0115            LVS(H) = NSL(I)
ISN 0116          182 H = H & 1
ISN 0117            DO 36 LC = 1,20
ISN 0118           36 RECUR(LC,PROG) = RRR(LC)
ISN 0119          190 MYFLAG = 0
ISN 0120            RETURN
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   ISN 0121            END
****** END OF COMPILATION ******
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```
 F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
          VARIABLE OPTIONS USED - SIZE=(126976,24576)                DEFAULT OPTION(S) USED
IEW0000       NAME MOX02SH(R)
IEW0461  EXP
IEW0461  CONSTR
IEW0461  REVLUS
```

CROSS REFERENCE TABLE

CONTROL SECTION NAME	ORIGIN	LENGTH	ENTRY NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME
SHIFTS	00	754							
SAV2	758	FE0							
SCRACH	1738	6A60							

LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION	LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION
130	SAV2	SAV2	134	SCRACH	SCRACH
138	SCRACH	SCRACH	13C	SCRACH	SCRACH
140	SCRACH	SCRACH	144	SCRACH	SCRACH
148	EXP	$UNRESOLVED	14C	CONSTR	$UNRESOLVED
150	REVLUS	$UNRESOLVED			

ENTRY ADDRESS 00
TOTAL LENGTH 8198

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***MOX02SH   NOW REPLACED IN DATA SET
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DIAGNOSTIC MESSAGE DIRECTORY

IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.

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0001              SUBROUTINE SMOTHS(PRGLV,BLANK)
                  C     BUDGET SMOOTHING PROGRAM - R.E. SLYE
                  C     MODIFIED BY C.J. GOLDEN
0002              DOUBLE PRECISION NAME
0003              LOGICAL SKIP,OUT,ACCL,EXT
0004              REAL LEVEL,NPERPD
0005              INTEGER PROG,H
0006              INTEGER*2  LTR,YDPL,NSYR,NSFX,NRFX,NYRSST,NSTRFX,NPROG,KPROG,
                 1  KODF,NYRSFX,KODEM,KODESP,FINISH,NSTG,NFML,NFMU,KODS,MAS,LABS,
                 2  LABF,LABI,VEH,NMULT,NONREC,NYD,IS,MAT,LYR,LETT,LYD,MIN
0007              COMMON/SAVER/  RFIXD(12,84)
0008              COMMON/SAVE1/ FINISH,NSTG,NCI,ILY,LABF(30),LABS(40),LABI(40),
                 1 NFML(40),NFMU(40),KODS(40),STS(41),STG(40),VLR(50),WPR(50),
                 2  RPLM(50),MAS(40,3), RXD(12,50)
0009              COMMON/SAV2/EXT,ACCL,KNSTG,KNFAM,KNCI,KNP,KNMIS,JFLAG,TREF,NCSTR,
                 1 PMAX,PMIN,ISTRT,IFIN,MAXITR,MITR,KODESP(6),TITLE(10),LEVEL(20),
                 2  CNTRVL(20),FIXED(20),KODEM(50),NSYR(50),NSFX(50),NAME(56),
                 3  YDPL(56),NRFX(50),NYRSST(84),NSTRFX(84),NYRSFX(84),SUS(84),C(84)
                 4,  R(84), S(84),CS(90),NPROG(90),KPROG(90), KODE(90)
0010              COMMON/SAV3/GRO,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                 1    PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
0011              COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                 1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                 2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
0012              COMMON/VARNCE/KSTAT,VARI(40),VARF(50),VARM(56),FMVAR(2,30),
                 1  FIVAR(3,40),PLVAR(3,56),SVAR(5,40)
0013              COMMON/SCRACH/M,N,NCS,PROG,IODD,IERR,SKIP,MYFLAG,JS,NSCALE(5),
                 1  NSL(10),TOTAL(20),W(20),D(20),XOUT(20),VOUT(20),RRR(20),YEAR(20)
                 2,  Y(20),KVEHI(50),LABEL(50),LVARY(70),LVD(70),IVEH(70),LVS(70),
                 3  LVSF(80),VNAM(80),NOP(86),RF(86),CF(86),SF(86),FLAGR(86),
                 4  FLAGS(86),NSSF(86),NSRF(86),NSXF(86),NDSF(86),SUSTF(86),NLVP(86)
                 5,  NSTRRC(86),NYRSRC(86),LNDF(86),NSTRST(86),LNDATE(86),NPRO(90),
                 6  KPRO(90),CSX(90),LZ(46),RCOST(60),KVEH(60),IMAGE(830),
                 7  XSCH(10,70),XLVSUM(20,50),RECUR(20,50),KODX(90),NPROD(90),
                 8  KPROD(90),KODD(90),XMODE(20),UB(20),DUM(256)
0014              DIMENSION PRGLV(4)
0015              EQUIVALENCE (LS,LEVEL(1)),(LF,LEVEL(2))
0016              DATA ASTR /1H*/
0017              DATA ZERO /1HO/
0018              DATA FLET /1HF/
0019              DATA MLFT /1HM/
0020              DATA ULET /1HU/
                  C
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```
0021              IODD = 0
0022              NSCALE(1) = 1
0023              NSCALE(2) = 0
0024              NSCALE(3) = 0
0025              NSCALE(4) = 0
0026              NSCALE(5) = 0
0027              IF(FINISH.GT.1)  GO TO 18
0028              PMAX = 5000.
0029              PMIN = 1500.
                  C    ACCL = TRUE  IMPLIES USE ACCELERATION OPTION
0030                ACCL = .TRUE.
                  C     EXT = TRUE   IMPLIES USE EXTENSION OPTION
0031                EXT = .TRUE.
0032                DO 5 I=1,10
0033              5 TITLE (I) = BLANK
0034                DO 6  I = 1,20
0035                CNTRVL(I) = BLANK
0036              6 FIXED(I) = 0.0
0037                WRITE(6,399)
0038             16 CALL INPUT (6HTITLE , TITLE, 6HLEVEL ,LEVEL, 6HISTRT ,ISTRT,
                   X  6HIFIN  ,IFIN, 6HMAXITR,MAXITR,6HNCSTR ,NCSTR,6HNPROG ,NPROD,
                   X   6HKPROG ,KPROD,6HKODE  ,KODD,6HCS    ,CS,6HFIXED ,FIXED,
                   X   6HPMAX  ,PMAX, 6HPMIN  ,PMIN, 6HACCL  , ACCL, 6HEXT   ,EXT)
0039                DO 550 I = 1,NCSTR
0040                NPROG(I) = NPROD(I)
0041                KPROG(I) = KPROD(I)
0042            550 KODE(I) = KODD(I)
0043                DO 79 I = 1,20
0044             79 FIXED(I) = FIXED(I)*(1. + GRO)**(I-1)
0045                IF(NCSTR.EQ.0)  GO TO 18
0046                DO 8 I = 1,NCSTR
0047                DO 2 I1 = 1,NMIS
0048                IF(NPROG(I).EQ.KODEM(I1))  GO TO 3
0049              2 CONTINUE
0050                GO TO 36
0051              3  NPROG(I) = I1
0052             36 IF(KPROG(I).EQ.0)  GO TO 8
0053                DO 1 I1 = 1,NMIS
0054                IF(KPROG(I).EQ.KODEM(I1))  GO TO 4
0055              1 CONTINUE
0056                GO TO 8
0057              4 KPROG(I) = I1
0058              8 CONTINUE
```

```
0059              IF(NSPR.EQ.0)  GO TO 18
0060              DO 510 I = 1,NCSTR
0061              DO 502 I1 = 1,NSPR
0062              IF(NPROG(I).EQ.KODESP(I1))  GO TO 503
0063          502 CONTINUE
0064              GO TO 37
0065          503 NPROG(I) = I1 + NMIS
0066           37 IF(KPROG(I).EQ.0)   GO TO 510
0067              DO 501 I1 = 1,NSPR
0068              IF(KPROG(I).EQ.KODESP(I1))  GO TO 504
0069          501 CONTINUE
0070              GO TO 510
0071          504 KPROG(I) = I1 + NMIS
0072          510 CONTINUE
0073           18 IF(NCS.EQ.0)  GO TO 20
0074              IF(NCSTR + NCS.LE.90)  GO TO 35
0075         1000 WRITE(6,1001)
0076         1001 FORMAT(38HONUMBER OF CONSTRAINTS HAS EXCEEDED 90)
0077              NCS = 90 - NCSTR
0078           35 DO 19 I = 1,NCS
0079              NCSTR = NCSTR + 1
0080              KODE(NCSTR) = KODX(I)
0081              CS(NCSTR) = CSX(I)
0082              NPROG(NCSTR) = NPRO(I)
0083              KPROG(NCSTR) = KPRO(I)
0084           19 CONTINUE
0085           20 CALL LISTC
0086              CALL PLOT1 (NSCALE,7,5,15,6)
0087              T = 1.0
0088              DO 17 I=1,20
0089              YEAR(I) = TREF + T - 1.
0090              Y(I) = AMOD(YEAR(I),100.)
0091           17 T = T + 1.0
0092              WRITE (6,903)
0093              NLV = 0
0094              DO 33 I = 1,NV
0095              DO 31 J = 1,M
0096              IF(IVEH(J).NE.I)   GO TO 31
0097              NLV = NLV + 1
0098              KVEH(I)  = NLV
0099              KVEHI(NLV) = I
0100              GO TO 32
0101           31 CONTINUE
```



```
0102              GO TO 33
0103           32 IA = VEH(1,I)
0104              IB = VEH(2,I)
0105              IC = VEH(3,I)
0106              ID = VEH(4,I)
0107              WRITE(6,905) I,STG(IA),STG(IB),STG(IC),STG(ID),RCOST(I)
0108           33 CONTINUE
0109              DO 335 I = 1,M
0110              NX = IVEH(I)
0111          335 CALL AFRMT (NX,VNAM(I))
0112              DO 39 PROG = 1,N
0113           39 CALL REVLUS
0114           22 DO 23 I=1,N
0115              NOP(I) = 0
0116              RF(I) = R(I)
0117              SF(I) = S(I)
0118              CF(I) = C(I)
0119              SUSTF(I) = SUS (I)
0120              NDSF(I) = NYRSST(I)
0121              NSSF(I) = NSTRST(I)
0122              NSXF(I) = NSTRFX(I)
0123              LNDF(I) = LNDATE(I)
0124           23 NSRF(I) = NSTRRC(I)
0125              DO 24 I=1,M
0126           24 LVSF(I) = LVS(I)
0127              IF(FINISH.GT.1)  GO TO 21
0128              DO 25 I=ISTRT,IFIN
0129           25 CNTRVL(I) = ASTR
               C  NOP = 1 IF NO CHANGES ARE ALLOWED IN PROGRAM VARIABLES
0130           21 DO 26 I = 1,NCSTR
0131              J = NPROG(I)
0132              IF (KODE(I).EQ.8) NOP(J) = 1
0133           26 CONTINUE
0134           27 OUT = .FALSE.
0135              DO 61 PROG = 1,N
0136              IF(NOP(PROG).EQ.1)  GO TO 61
0137              CALL CONSTR
0138              IF (IERR.NE.0) WRITE (6,91) PROG
0139           61 CONTINUE
0140           91 FORMAT('0WARNING - CONSTRAINT VIOLATED IN PROGRAM NUMBER',I3)
0141              DO 300 ITER = 1,MAXITR
0142              IPRNT = 0
0143              IF (ITER.EQ.MAXITR)  IPRNT = 1
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0144              DO 200 PROG = 1,N
                C  IODD INDICATES WHAT TYPE OF CHANGE IS BEING MADE- IODD=0 INITIALLY
0145              14 SKIP = (IPRNT.EQ.0.AND.ITER.GT.1).OR.PROG.NE.1.OR.IODD.NE.0
0146                 IF (SKIP.AND.NOP(PROG).EQ.1.AND.PROG.NE.1) GO TO 195
0147              15 DO 30 J=1,20
0148                 TOTAL(J) = 0.
0149              30 W(J) = 0.
0150                 IF (SKIP) GO TO 55
0151              40 XT = 0.
0152                 ST = 0.
0153                 DO 50 I=1,N
                C  FLAGR = * INDICATES A CHANGE IN DEVELOPMENT DURATION
0154                 FLAGR(I) = BLANK
                C  FLAGS = * INDICATES A CHANGE IN START DATE OF DEVELOPMENT
0155                 FLAGS(I) = BLANK
0156                 IF (R(I).NE.RF(I)) FLAGR(I) = ASTR
0157                 IF (S(I).NE.SF(I)) FLAGS(I) = ASTR
0158                 X = NYRSST(I)
0159                 ST = ST + SUS(I)*X
0160              50 XT = XT + C(I)
0161                 WRITE (6,90) TREF,TITLE
0162                 WRITE (6,92)
0163                 DO 53 I=1,N
0164                 IF(I.GT.NMIS+NSPR)   GO TO 52
0165                 K = NYRSRC(I)
0166                 IF(K.EQ.0.OR.I.GT.NMIS)  RECUR(1,I) = 0.0
0167                 WRITE (6,94) I,NAME(I),S(I),FLAGS(I),C(I),R(I),FLAGR(I),SUS (I),
                    X  NSTRST(I),NYRSST(I),NSTRRC(I),NYRSRC(I),(RECUR(J,I),J=1,K)
0168                 GO TO 51
0169              52 NDM = I - NMIS - NSPR
0170                 WRITE(6,93) I,LABEL(NDM),S(I),FLAGS(I),C(I),R(I),FLAGR(I),SUS(I),
                    X  NSTRST(I),NYRSST(I),NSTRRC(I),NYRSRC(I)
0171              51 K = NYRSFX(I)
0172                 IF (K.EQ.0) GO TO 53
0173                 WRITE (6,98) NSTRFX(I),NYRSFX(I),(RFIXD(J,I),J=1,K)
0174              53 CONTINUE
0175                 WRITE (6,95) XT,ST
0176                 IF (ITER.NE.1) WRITE (6,902)
0177                 WRITE(6,96) YEAR
0178                 WRITE (6,97)
0179                 CALL PLOT2 (IMAGE,Y(16),Y(1),PMAX,PMIN)
0180                 DO 54 I=1,1000
0181              54 XLVSUM(I,1) = 0.0
```



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                C
0182              55 CALL TCOSTS (BLANK,ASTR)
                C
0183                 IF(LS.GT.20.OR.LS.LE.0)  GO TO 78
0184                 XL = 0.
                C  IF LEVEL(1) AND (2) ARE INPUT AS INTEGER YEARS, THEN THE PROGRAM
                C  TAKES THE AVERAGE SPENDING OVER THE PERIOD ENCOMPASSED BY THESE
                C  YEARS AS THE DESIRED BUDGET LEVEL
0185                 DO 76 I=LS,LF
0186              76 XL = XL+TOTAL(I)
0187                 XL = XL/FLOAT(LF-LS+1)
0188                 DO 77 I=1,20
0189              77 LEVEL(I) = XL
0190              78 IF (SKIP) GO TO 80
0191                 WRITE (6,99) (W(I),I=1,JS)
0192                 WRITE (6,990) (FIXED(I),I=1,JS)
0193                 WRITE (6,991) (TOTAL(I),I=1,JS)
0194                 WRITE (6,993) CNTRVL
0195                 WRITE (6,992) (LEVEL(I),I=1,JS)
0196                 IF(KSTAT.GT.0) WRITE(6,994) (XMODE(I),I = 1,JS)
0197                 IF(KSTAT.GT.0)  WRITE(6,995) (UB(I), I = 1,JS)
0198                 CALL PLOT3(FLET,Y,FIXED,JS)
0199                 IF(KSTAT.GT.0)  CALL PLOT3(ULET,Y,UB,JS)
0200                 IF(KSTAT.GT.0) CALL PLOT3(MLET,Y,XMODE,JS)
0201                 CALL PLOT3 (ZERO,Y,LEVEL,IFIN)
0202                 CALL PLOT3 (ASTR,Y,TOTAL,JS)
0203              80 SQD = 0
0204                 DO 100 I=ISTRT,IFIN
0205                 SQD = (TOTAL(I)-LEVEL(I))**2 + SQD
0206             100 CONTINUE
0207                 RMS = SQRT (SQD/FLOAT(IFIN-ISTRT+1))
                C   SAVEX = RMS VALUE AT BEGINNING OF ITERATION
0208                 IF (PROG.EQ.1.AND.IODD.EQ.0) SAVEX = RMS
0209                 IF (SKIP) GO TO 110
                C  RMS1 = VALUE OF RMS USING INPUT DATA
0210                 IF(ITER.EQ.1)  RMS1 = RMS
0211                 WRITE (6,199) RMS,YEAR(ISTRT),YEAR(IFIN)
0212                 WRITE (6,298) ITER
0213                 WRITE (6,399)
0214                 CALL PLOT4 (13,PRGLV)
0215                 WRITE (6,499)
0216                 IF(MOS.EQ.2.OR.MOS.EQ.3)  RETURN
0217             110 IF (OUT) GO TO 400
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0218              IF (ITER.EQ.MAXITR) GO TO 300
                C  SAVER = RMS VALUE AT BEGINNING OF PROGRAM CHANGE CONSIDERATIONS
0219              IF(IODD.EQ.0)  SAVER = RMS
0220              IF(RMS.LT.SAVER)  GO TO 190
                C
0221              CALL SHIFTS
                C
0222              IF(MYFLAG.EQ.1)  GO TO 14
0223            190 IODD = 0
                C   SAVER  = VALUE OF RMS AT END OF ITERATION
0224              IF(RMS.LT.SAVER.AND.PROG.EQ.N)  SAVER = RMS
0225            195 IF(PROG.LT.N)   GO TO 200
0226              IF (SAVEX.NE.SAVER) GO TO 300
0227              IF (IPRNT.NE.0) GO TO 400
0228              SKIP = .FALSE.
0229              OUT = .TRUE.
0230              GO TO 15
0231            200 CONTINUE
0232            300 CONTINUE
0233              WRITE (6,390)
0234              GO TO 403
0235            400 WRITE (6,299)
0236            403 WRITE (6,906) (YEAR(I),I=1,JS)
0237              WRITE (6,907)
0238              DO 402 I=1,NLV
0239              XLVTOT = 0.0
0240              DO 401 II=1,JS
0241            401 XLVTOT = XLVTOT + XLVSUM(II,I)
                C  XLVSUM(II,I) = NUMBER OF LAUNCHES IN YEAR II FOR VEH. KVEHI(I)
0242            402 WRITE (6,908) KVEHI(I),XLVTOT,(XLVSUM(II,I),II=1,JS)
0243              IF(SAVER.LT.RMS1 - .4)  GO TO 404
0244              WRITE(6,909)
0245            909 FORMAT (46HOINPUT ASSIGNMENT IS OPTIMUM SMOOTHED SOLUTION)
0246              GO TO 7
0247            404 NNMI = NMIS + NSPR
0248              DO 9 I = 1,NNMI
0249              IF(ABS(S(I) + R(I) - SF(I) - RF(I)).GE..01) GO TO 13
0250              IF(NYRSST(I).NE.NDSF(I))  GO TO 13
0251              IF(NLVP(I).EQ.0)  GO TO 9
0252              IF(LNDATE(I).NE.LNDF(I))  GO TO 13
0253              IJ = NLVP(I)
0254              H = LVARY(I)
0255              DO 11 II = 1,IJ
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0256              X = LVS(H)
0257              IF(ABS(S(I)+X-SF(I)-FLOAT(LVSF(H))).GE..01)  GO TO 13
0258             11 H = H + 1
0259              9 CONTINUE
0260              IF(N.EQ.NNMI)   GO TO 7
0261              NNMI = NNMI + 1
0262              DO 10 I = NNMI,N
0263              IF(ABS(S(I) + R(I) - SF(I) - RF(I)).GE.01)  GO TO 13
0264              IF(NYRSST(I).NE.NDSF(I))  GO TO 13
0265              IF(ABS(CF(I)-C(I)).GE..001)  GO TO 13
0266              IF(ABS(SUS(I) - SUSTF(I)).GE..001)  GO TO 13
0267             10 CONTINUE
0268              7 FINISH = MITR + 1
0269              GO TO 12
0270             13 FINISH = FINISH + 1
0271             12 NCSTR = NCSTR - NCS
0272              RETURN
0273             90 FORMAT (1H1,15X,14HREFERENCE YEAR,F7.0,5X,10A4)
0274             92 FORMAT (78HOPN  NAME  START    DEVL  YRS    SUST  SS  SD  RS  RD  R
                  XECURRING OR FIXED ITEMS  /1H )
0275             93 FORMAT (I3,1X,4HDEV ,I2,F6.0,1X,A1,F7.0,F4.0,1X,A1,F5.0,4I4)
0276             94 FORMAT (I3,1X,A6,F6.0,1X,A1,F7.0,F4.0,1X,A1,F5.0,4I4,12F6.0)
0277             95 FORMAT (20X,4H----,8X,4H----/2X,5HTOTAL,12X,F6.0,F11.0)
0278             96 FORMAT (1H1,30X,47HTOTAL PROGRAM COSTS AND LAUNCH VEHICLE SCHEDULE
                  *  /6HOYEAR ,4X,20F6.0)
0279             97 FORMAT (8HOPROGRAM)
0280             98 FORMAT(44X,2I4,12F6.0)
0281             99 FORMAT (6HOSUM  ,4X,20F6.0)
0282            107 FORMAT (44X,2I4,12F6.1)
0283            199 FORMAT (6HORMS =,F8.0,5X,18HSMOOTHING INTERVAL,F6.0,5H THRU,F6.0)
0284            298 FORMAT (1OHOITERATION, I3)
0285            299 FORMAT (11X,11H FINAL CASE)
0286            390 FORMAT (11X,16H MAXITR EXCEEDED )
0287            399 FORMAT (1H1)
0288            499 FORMAT (1HO,50X,4HYEAR)
0289            902 FORMAT (1HO,40X,34H* INDICATES CHANGE FROM INPUT DATA)
0290            903 FORMAT (1H1,30X,19HRECURRING COST DATA  /1HO,8X,3HKEY,10X,
                  *  4HNAME,24X,9HUNIT COST  /1H )
0291            905 FORMAT (10X,I2,10X,4A4,10X,F10.2)
0292            906 FORMAT (1H1,30X,35HLAUNCH VEHICLE REQUIREMENTS BY YEAR  /
                  *  6HOYEAR ,6X,20F6.0)
0293            907 FORMAT (11HOLV   TOTAL)
0294            908 FORMAT (1X,I2,F8.2,20F6.1)
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0295          990 FORMAT (6H FIXED,4X,20F6.0)
0296          991 FORMAT (6H TOTAL,4X,20F6.0)
0297          992 FORMAT (6H LEVEL,4X,20F6.0)
0298          993 FORMAT (8X,20(5X,A1))
0299          994 FORMAT(6H0 MODE,4X,20F6.0)
0300          995 FORMAT(12H 50 PER CENT/8H CONFID.,2X,20F6.0)
0301              END
```


TOTAL MEMORY REQUIREMENTS 00228C BYTES

```
F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,NCAL,MAP
          VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000      NAME MOX02SS(R)
IEW0461  IBCOM=
IEW0461  INPUT
IEW0461  FRXPI=
IEW0461  LISTC
IEW0461  PLOT1
IEW0461  AFRMT
IEW0461  REVLUS
IEW0461  CONSTR
IEW0461  PLOT2
IEW0461  TCOSTS
IEW0461  PLOT3
IEW0461  PLOT4
IEW0461  SHIFTS
IEW0461  SQRT
```

MODULE MAP

CONTROL SECTION			ENTRY							
NAME	ORIGIN	LENGTH	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME	
SMOTHS	00	22BC								
SAVER	22C0	FC0								
SAVE1	3280	FC4								
SAV2	4248	FE0								
SAV3	5228	980								
SAVALL	5BA8	3A1C								
VARNCE	95C8	ADC								
SCRACH	A0A8	6A60								

```
ENTRY ADDRESS       00
TOTAL LENGTH     10808

****MOX02SS   NOW REPLACED IN DATA SET
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DIAGNOSTIC MESSAGE DIRECTORY

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FORTRAN IV G LEVEL 1, MOD 4          STGNMI          DATE = 71084      16/52/21          PAGE 00

0001            SUBROUTINE STGNMI
              C DETERMINE NUMBER OF COMPONENTS ACTUALLY USED AND ASSOCIATED
              C   RECURRING COSTS
              C
0002            REAL NPERPD
0003            INTEGER*2  NU,NBY,MODE,NOB,FINISH,NSTG,NFML,NFMU,KODS,MAS,LABS,
               1  LABE,LABI,NPSTG,NPAD,NPFAM,NFS,NPINTL,NPINTU,MAPS,MAPF,MAPI,VEH,
               2  NMULT,NONREC,NYD,IS,MAT,LYR,LETT,LYD,MIN,KOUT,LTR,NINTYR,NTGYTR,
               3   MAF,MAIC
0004            COMMON/SAVSAR/ POJ(3),SRJ(3,3),NU(40),NBY(40),NOB(40),RINT(40),
               1   PLCINT(40),XLT(40), PLCT(40),UPP(40),TAT(40),TAMT(50),SR(40,3),
               2   MODE(40,3),PLC(40,3)
0005            COMMON/SAVE1/ FINISH,NSTG,NCI,ILY,LABF(30),LABS(40),LABI(40),
               1 NFML(40),NFMU(40),KODS(40),STS(41),STG(40),VLR(50),WPR(50),
               2  RPLM(50),MAS(40,3), RXD(12,50)
0006            COMMON/SAV3/GRO,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
               1   PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
0007            COMMON/SAV4/  MAF(30,3), MAIC(40,3),
              *            NPAD(2,60),NPFAM(30,5),NPINTL(30,5),NPINTU(30,5),
               1  NFS(40,4),NPSTG(30,10),MAPS(30,10),MAPF(30,10),MAPI(30,10),
               2  PFAMD(30,5,2),PFAMS(30,5,2),PINTS(30,5,2),PSTGD(30,10,2),
               3   PSTGS(30,10,2)
0008            COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
               1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
               2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
0009            COMMON/TEMP/VNM(2,250),IFLAG,KI,NEXT,LOUT,SAVS(40),KOUT(40),
               1  NINTYR(40,20),NTGYTR(40,20,2),RECUR(60,20,2)
0010            COMMON/SCRACH/  II,NUS(40),MSAVE(40),ISAVE(40),KLUE(40),
               1STGYHW(40,20),RINTMX(40,20),STGMAX(40,20,2),STGYTR(40,20,2),
               2  RINTYR(40,20),DUM(1047)
              C
0011            IF (IFLAG.GE.1) GO TO 621
              C     FIND MAX NUM OF EACH STAGE AND INTEGRATION POSSIBLE
0012            DO 661 I = 1,NSTG
0013            NUS(I) = 0
0014            DO 661 J=1,MYRS
0015            STGYTR(I,J,1) = 0.0
0016          661 STGYTR(I,J,2) = 0.0
0017            IF(NCI.EQ.0)  GO TO 665
0018            DO 662 I = 1,NCI
0019            DO 662 J = 1,MYRS
0020          662 RINTYR(I,J) = 0.0
0021          665 DO 6500  I = 1,NM
```

```
0022              IF(YRLM(I).LT..001)  GO TO 6500
0023              J = LYR(I)
0024              JX = LETT(I)
0025              K = LTR(JX)
                C   MSAVE & ISAVE INDICATE IF THAT STAGE OR INTEGRATION HAS ALREADY BEEN
                C     COUNTED FOR MISSION NM
0026              DO 9003 IZ = 1,40
0027              MSAVE(IZ) = 0
0028           9003 ISAVE(IZ) = 0
0029              DO 650 I1 = 1,NV
0030              IF(ITEM(VNM(1,I),I1,1).EQ.0)  GO TO 650
0031              X = NMULT(I1,JX)
0032              DO 649 MS = 1,4
0033              IA = VEH(MS,I1)
0034              IF(IA.EQ.0)  GO TO 650
0035              IF(MSAVE(IA).EQ.1)  GO TO 644
0036              STGYTR(IA,J,K) = YRLM(I)*X + STGYTR(IA,J,K)
0037              MSAVE(IA) = 1
0038            644 IF(NCI.EQ.0)  GO TO 649
0039              IF(MS.EQ.4)  GO TO 650
0040              IF(VEH(MS+1,I1).EQ.0)  GO TO 650
0041              L1 = VEH(MS+1,I1)
0042              DO 645 MI = 1,NCI
0043              IF(ISAVE(MI).EQ.1)  GO TO 645
0044              DO 646 KY = 1,4
0045              IF(NFML(MI).NE.NFS(IA,KY))  GO TO 646
0046              DO 647 KZ = 1,4
0047              IF(NFMU(MI).EQ.NFS(L1,KZ))   GO TO 648
0048            647 CONTINUE
0049            646 CONTINUE
0050              GO TO 645
0051            648 RINTYR(MI,J) = RINTYR(MI,J) + YRLM(I)*X
0052              ISAVE(MI) = 1
0053            645 CONTINUE
0054            649 CONTINUE
0055            650 CONTINUE
0056           6500 CONTINUE
0057              DO 668 J = 1,MYRS
0058              DO 668 I = 1,NSTG
0059            668 STGYHW(I,J) = STGYTR(I,J,1) + STGYTR(I,J,2)
0060              GO TO 673
                C
                C DETERMINE NUMBER OF EACH STAGE AND INTEGRATION USED IN LAST ITERATION BY YEAR
```



```
                C              FOR FUTURE PRINT OUT
0061            621 DO 623 K=1,2
0062              DO 623 J=1,MYRS
0063              DO 623 I=1,NSTG
0064              STGMAX(I,J,K) = NTGYTR(I,J,K)
0065              STGMAX(I,J,K) = STGMAX(I,J,K)/10.0
0066            623 STGYTR(I,J,K) = 0.0
0067              IF(NCI.EQ.0)  GO TO 9000
0068              DO 624 J=1,MYRS
0069              DO 624 I=1,NCI
0070              RINTMX(I,J) = NINTYR(I,J)
0071              RINTMX(I,J) = RINTMX(I,J)/10.0
0072            624 RINTYR(I,J) = 0.0
0073           9000 DO 622 J=1,NM
0074              IF(YRLM(J).LT..001)  GO TO 622
0075              I = MIN(J)
0076              K = LYR(J)
0077              JX = LETT(J)
0078              ITR = LTR(JX)
0079              X = NMULT(I,JX)
0080              DO 625 MS = 1,4
0081              L = VEH(MS,I)
0082              IF (L.EQ.0) GO TO 622
0083              STGYTR(L,K,ITR) = STGYTR(L,K,ITR) + YRLM(J)*X
0084              IF (NCI.EQ.0) GO TO 625
0085              IF (MS.EQ.4) GO TO 622
0086              IF (VEH(MS+1,I).EQ.0) GO TO 622
0087              L1 = VEH(MS+1,I)
0088              DO 626 MI=1,NCI
0089              DO 627 KY=1,4
0090              IF(NFML(MI).NE.NFS(L,KY)) GO TO 627
0091              DO 628 KZ = 1,4
0092              IF (NFMU(MI).EQ.NFS(L1,KZ)) GO TO 629
0093            628 CONTINUE
0094            627 CONTINUE
0095              GO TO 626
0096            629 RINTYR(MI,K) = RINTYR(MI,K) + YRLM(J)*X
0097            626 CONTINUE
0098            625 CONTINUE
0099            622 CONTINUE
0100              IF(NCI.EQ.0)  GO TO 9001
0101              DO 691 I=1,NCI
0102              DO 691 J=1,MYRS
```

```
0103          691 IF(RINTYR(I,J).LT..001)  RINTYR(I,J) = RINTMX(I,J)
              C  CHECK NUMBER OF LAUNCHES CALCULATED VS. NUMBER OF LAUNCHES USED IN LAST
              C                ITERATION
0104          9001 IF(LCK.EQ.0.OR.MOS.EQ.1.OR.MOS.EQ.3)     GO TO 4100
0105               DO 676 K = 1,2
0106               DO 676 J = 1,MYRS
0107               DO 676 I = 1,NSTG
0108               IF(ABS(STGYTR(I,J,K) - STGMAX(I,J,K)).GT.0.001.AND.STGYTR(I,J,K).
                  1GT.0.001.OR.(IFLAG.LE.1.AND.NU(I).LT.0))   GO TO 677
0109           676 CONTINUE
0110          4100 WRITE(6,4101)
0111          4101 FORMAT (1H0,4X, 40HTHE OPTIMUM SOLUTION HAS BEEN DETERMINED)
              C
0112           678 CALL VEHRC
              C
0113               IFLAG = 0
0114               IF(LOUT.EQ.0)  RETURN
0115               DO 112 I = 1,NUMD
0116               IF(KOUT(I).EQ.0)  GO TO 112
0117               LT = KOUT(I)
0118               SUST(I) = SAVS(LT)
0119           112 CONTINUE
0120               RETURN
              C
0121           677 IF(IFLAG.LE.3)  GO TO 679
0122               WRITE(6,8005)
0123          8005 FORMAT(49HOMAXIMUM NUMBER OF ASSIGNMENT ITERATIONS EXCEEDED)
0124               GO TO 678
              C      DETERMINE HARDWARE COSTS BY YEAR BASED ON LAST ITERATION
0125           679 DO 8013 I = 1,NSTG
0126               KLUE(I) = 0
0127               DO 8014 J = 1,MYRS
0128               IF(STGYTR(I,J,1).GT.0.01.OR.STGYTR(I,J,2).GT..01)  KLUE(I) = 1
0129          8014 STGYHW(I,J) = STGYTR(I,J,1) + STGYTR(I,J,2)
0130               IF(KLUE(I).EQ.1)  GO TO 8013
0131               DO 8016 J = 1,MYRS
0132               STGYTR(I,J,1) = STGMAX(I,J,1)
0133               STGYTR(I,J,2) = STGMAX(I,J,2)
0134          8016 STGYHW(I,J) = STGYTR(I,J,1) + STGYTR(I,J,2)
0135          8013 CONTINUE
              C
              C   ADD INITIAL REUSABLE PURCHASE PRICE TO DEV. COST DS
0136           672 IF(IFLAG.GT.1.OR.FINISH.GT.1)  GO TO 673
```



```
0137               NX = NSTG + 1
0138               DO 674 II = 1,NX
0139               READ(5,5000) J,NX2, X3,X4,X5
0140               IF(J.EQ.0)  GO TO 6735
0141               IF(II.EQ.1)  WRITE(6,5003)
0142               DO 675 I = 1,NSTG
0143               IF(J.EQ.KODS(I))  GO TO 6755
0144           675 CONTINUE
0145               WRITE(6,5001) II
0146               IFLAG = 100
0147               GO TO 674
0148          6755 NOB(I) = NX2
0149               XLT(I) = X3
0150               TAT(I) = X4
0151               IF(X5.GT..001)  PLCT(I) = ALOG(X5)/ALOG(2.)
0152               IF(X5.LE..001)  PLCT(I) = 0.0
0153               WRITE(6,5002) J,I,NU(I),UPP(I),NOB(I),XLT(I),TAT(I),PLCT(I)
0154           674 CONTINUE
0155          6735 IF(IFLAG.EQ.100) RETURN
0156           673 K = 0
0157               DO 710 I = 1,NSTG
0158               IF((NU(I).EQ.0).OR.(IFLAG.GE.1.AND.NU(I).GE.0))  GO TO 710
0159               IF(IFLAG.EQ.0)  GO TO 709
0160               NUS(I) = NU(I)
0161               II = I
              C      ITERATES ON INITIAL QUANTITY TO BE PURCHASED
              C
0162               CALL REUSEI
              C
0163           709 NI = MAS(I,1)
0164               IF(NU(I).LT.0)  LCK = 1
0165               X = NU(I)
0166               IF(X.LT.0)  X = -X
0167               Y = NUS(I)
0168               DS(NI) = DS(NI) + (X+Y) * UPP(I)
0169               IF(K.EQ.0)  WRITE (6,211)
0170               K = 1
0171               WRITE(6,208) NI,DS(NI),STS(I),STG(I),NYD(NI),LYD(NI)
0172               WRITE (6,209)  X
0173           710 CONTINUE
              C      MAKE ADJUSTMENT FOR BATCHING OVER YEARS
0174               DO 663 I = 1,NSTG
0175               IF (NBY(I).EQ.1) GO TO 663
```

```
0176              IA = 2
0177              IB = NBY(I)
0178              IC = 1
0179           666 DO 664 J= IA,IB
0180              IF (J.GT.MYRS) GO TO 700
0181           664 STGYHW(I,IC) = STGYHW(I,IC) + STGYHW(I,J)
0182           700 DO 667 J = IA,IB
0183              IF (J.GT.MYRS) GO TO 663
0184           667 STGYHW(I,J) = STGYHW(I,IC)
0185              IA = IA + NBY(I)
0186              IB = IB + NBY(I)
0187              IC = IC + NBY(I)
0188              GO TO 666
0189           663 CONTINUE
0190              IF(IFLAG.EQ.0)  GO TO 9006
0191              DO 9005 I = 1,NSTG
0192              IF(KLUE(I).EQ.0)  GO TO 9005
0193              DO 9002 J = 1,MYRS
0194              IF(STGYTR(I,J,1).LT..01) STGYTR(I,J,1) = STGMAX(I,J,1)
0195              IF (STGYTR(I,J,2).LT..01) STGYTR(I,J,2) = STGMAX(I,J,2)
0196              IF(STGYHW(I,J).LT..01)  STGYHW(I,J) = STGYTR(I,J,1)+STGYTR(I,J,2)
0197           9002 CONTINUE
0198           9005 CONTINUE
0199           9006 DO 9007 K = 1,2
0200              DO 9007 J = 1,MYRS
0201              DO 9007 I = 1,NSTG
0202           9007 NTGYTR(I,J,K) = STGYTR(I,J,K)*10.0
0203              IF(NCI.EQ.0)  GO TO 9009
0204              DO 9008  J = 1,MYRS
0205              DO 9008 I = 1,NCI
0206           9008 NINTYR(I,J) = RINTYR(I,J)*10.0
                  C
                  C  DETERMINE VEHICLE RECURRING COSTS BY YEAR AND LAUNCH SITE
0207           9009 DO 632 I=1,NV
0208              DO 635 J=1,MYRS
0209              RECUR(I,J,1) = 0.0
0210            635 RECUR(I,J,2) = 0.0
0211              DO 633 MS = 1,4
0212              K = VEH(MS,I)
0213              IF (K.EQ.0) GO TO 632
0214           9004 DO 634 J= 1,MYRS
0215              IF(STGYHW(K,J).LT.0.001)  GO TO 634
0216              IF(MODE(K,1).NE.0)  GO TO 8015
```



```
0217              HDWR = SR(K,1)*STGYHW(K,J)**PLC(K,1)
0218              GO TO 8010
0219           8015 LX = MODE(K,1)
0220              IF(STGYHW(K,J).LE.POJ(LX))   HDWR = SRJ(LX,1)/STGYHW(K,J)
0221              IF(STGYHW(K,J).GT.POJ(LX))  HDWR = SRJ(LX,2)+SRJ(LX,3)/STGYHW(K,J)
0222           8010 DO 692 L = 1,2
0223              IF(STGYTR(K,J,L).LT..001)   GO TO 692
0224              M = L + 1
0225              IF(MODE(K,M).NE.0)  GO TO 8011
0226              RECUR(I,J,L)=RECUR(I,J,L)+HDWR+SR(K,M)*STGYTR(K,J,L)**PLC(K,M)
0227              GO TO 692
0228           8011 LX = MODE(K,M)
0229              IF(STGYTR(K,J ,L).LE.POJ(LX)) RECUR(I,J ,L) = RECUR(I,J ,L)
                 1  + SRJ(LX,1)/STGYTR(K,J ,L) + HDWR
0230              IF (STGYTR(K,J ,L).GT.POJ(LX)) RECUR(I,J ,L) = RECUR(I,J ,L) +
                 1         SRJ(LX,2) + SRJ(LX,3)/STGYTR(K,J ,L) + HDWR
0231            692 CONTINUE
0232            634 CONTINUE
0233              IF(NCI.EQ.0)  GO TO 633
0234              IF (MS.EQ.4) GO TO 632
0235              IF(VEH(MS+1,I).EQ.0) GO TO 632
0236              K1 = VEH(MS+1,I)
0237              DO 636 L=1,NCI
0238              DO 637 KY=1,4
0239              IF (NFNL(L).NE.NFS(K,KY)) GO TO 637
0240              DO 638 KZ = 1,4
0241              IF (NFNU(L).EQ.NFS(K1,KZ)) GO TO 639
0242            638 CONTINUE
0243            637 CONTINUE
0244              GO TO 636
0245            639 DO 640 J = 1,MYRS
0246              IF(RINTYR(L,J).LT..0001)  GO TO 640
0247              HDWR = RINT(L)*RINTYR(L,J)**PLCINT(L)
0248              RECUR(I,J,1) = RECUR(I,J,1) + HDWR
0249              RECUR(I,J,2) = RECUR(I,J,2) + HDWR
0250            640 CONTINUE
0251            636 CONTINUE
0252            633 CONTINUE
0253            632 CONTINUE
0254             99 RETURN
0255            208 FORMAT (I4,6X,2F12.2,5X,A4,1X,14HSTAGE HARDWARE,29X,I3,9X,I3)
0256            209 FORMAT (6X, 27HNUMBER OF UNITS PURCHASED =,  F5.1)
0257            211 FORMAT (33H1CHANGED QUANTITIES BRANCHED UPON/1HO,6HNUMBER, 5X,
```

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     1  11HDEVELOPMENT, 2X, 10HSUSTAINING, 50X, 10HYEAR AVAIL, 2X,
     2  9HLAST YEAR//)
0258      5000 FORMAT (I2,2X,I2,2F6.1,F6.3)
0259      5001 FORMAT (45HOKODE NUMBER INCORRECT ON REUSABLE STAGE CARD, I6)
0260      5002 FORMAT (I4,I6, I8, F10.1, I6, F11.0, F10.0, F8.2)
0261      5003 FORMAT (22H1  REUSABLE STAGE DATA//5H KODE,3X,5HORDER,3X,5HUNITS,
     2   3X,5HPRICE,3X,4HTYPE,3X,8HLIFETIME,3X,7HTA TIME,3X,2HLC)
0262       END
```


TOTAL MEMORY REQUIREMENTS 002328 BYTES

```
F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,NCAL,MAP
          VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000      NAME MOX02SM(R)
IEW0461  ITEM
 EW0461  IBCOM=
.EW0461  VEHRC
IEW0461  REUSEI
IEW0461  FRXPR=
IEW0461  ALOG

                                                    MODULE MAP

 CONTROL SECTION                          ENTRY

   NAME     ORIGIN  LENGTH                NAME   LOCATION     NAME   LOCATION     NAME   LOCATION     NAME

 STGNMI         00    2328
 SAVSAR       2328     A58
 SAVE1        2D80     FC4
 SAV3         3D48     980
 SAV4         46C8    3188
 SAVALL       7850    3A1C
 TEMP         B270    4110
 SCRACH       F380    6A60


 ENTRY ADDRESS        00
 TOTAL LENGTH      15DE0

****MOX02SM   NOW REPLACED IN DATA SET

                                              DIAGNOSTIC MESSAGE DIRECTORY

  IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.

 FORTRAN IV G LEVEL 1, MOD 4            TCOSTS            DATE = 71084          16/53/01          PAGE 00

  0001                 SUBROUTINE TCOSTS (BLANK,ASTR)
                  C    CALCULATE TOTAL COSTS
                  C
  0002                 DOUBLE PRECISION NAME
  0003                 LOGICAL SKIP,EXT,ACCL
  0004                 REAL NPERPD
  0005                 INTEGER H,PROG
  0006                 INTEGER*2  LTR,YDPL,NSYR,NSFX,NRFX,NYRSST,NSTRFX,NPROG,KPROG,KODE,
                      1  NYRSFX,KODEM,KODESP,VEH,NMULT,NONREC,NYD,IS,MAT,LYR,LETT,LYD,MIN
                      2,FINISH,NSTG,NFML,NFMU,KODS,MAS,LABS,LABF,LABI
  0007                 COMMON/SAVRT/RVAR(20,50)
  0008                 COMMON/VARNCE/KSTAT,VARI(40),VARF(50),VARM(56),FMVAR(2,30),
                      1  FIVAR(3,40),PLVAR(3,56),SVAR(5,40)
  0009                 COMMON/SAVE1/ FINISH,NSTG,NCI,ILY,LABF(30),LABS(40),LABI(40),
                      1 NFML(40),NFMU(40),KODS(40),STS(41),STG(40),VLR(50),WPR(50),
                      2  RPLM(50),MAS(40,3), RXD(12,50)
  0010                 COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                      1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                      2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
  0011                 COMMON/SAVER/  RFIXD(12,84)
  0012                 COMMON/SAV2/EXT,ACCL,KNSTG,KNFAM,KNCI,KNP,KNMIS,JFLAG,TREF,NCSTR,
                      1 PMAX,PMIN,ISTRT,IFIN,MAXITR,MITR,KODESP(6),TITLE(10),LEVEL(20),
                      2  CNTRVL(20),FIXED(20),KODEH(50),NSYR(50),NSFX(50),NAME(56),
                      3  YDPL(56),NRFX(50),NYRSST(84),NSTRFX(84),NYRSFX(84),SUS(84),C(84)
                      4,  R(84),  S(84),CS(90),NPROG(90),KPROG(90),  KODE(90)
  0013                 COMMON/SAV3/GRO,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                      1    PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
  0014                 COMMON/SCRACH/M,N,NCS,PROG,IODD,IERR,SKIP,MYFLAG,JS,NSCALE(5),
                      1  NSL(10),TOTAL(20),W(20),D(20),XOUT(20),VOUT(20),RRR(20),YEAR(20)
                      2,  Y(20),KVEHI(50),LABEL(50),LVARY(70),LVD(70),IVEH(70),LVS(70),
                      3  LVSF(80),VNAM(80),NOP(86),RF(86),CF(86),SF(86),FLAGR(86),
                      4  FLAGS(86),NSSF(86),NSRF(86),NSXF(86),NDSF(86),SUSTF(86),NLVP(86)
                      5,  NSTRRC(86),NYRSRC(86),LNDF(86),NSTRST(86),LNDATE(86),NPRO(90),
                      6  KPRO(90),CSX(90),LZ(46),RCOST( 60), KVEH( 60),IMAGE(830),
                      7  XSCH(10,70),XLVSUM(20,50),RECUR(20,50),DUM(360),XMODE(20),UB(20)
                      8, VTC(20),DUMMY(236)
                  C
  0015                 DO 55 I = 1,20
  0016              55 VTC(I) = 0.0
  0017                 JS= 0
  0018                 DO 70 L=1,N
  0019                 FLAG = 0.
  0020                 T = 1.0
```

```
0021              AYRS = R(L) + 1.0
0022              IF(L.LE.NMIS + NSPR) GO TO 30
0023              NDUM = L - NMIS - NSPR
0024              LX = LABEL(NDUM)
0025              JX = MAT(LX)
0026              IF(JX.GT.1000) JX = JX - 2000
0027           30 DO 60 K=1,20
0028              F = 0.
0029              IT = T - S(L) + TREF
0030              X = (T - S(L) + TREF) / AYRS
                C  X.LE.0 PROGRAM DEV. HASN'T STARTED YET - X.GE.1 PROGRAM DEV. IS OVER
0031              IF (X.LE.0.) GO TO 59
0032              IF (X.GE.1.) GO TO 56
                C  BETA DISTRIBUTION FOR C(L)
0033              F = ((X*(1.-X))**2) * 30. * C(L) / AYRS
0034              IF(KSTAT.EQ.0.OR.SKIP.OR.F.LT..0001)  GO TO 56
0035              IF(L.LE.NMIS + NSPR) GO TO 31
0036              IF(JX.LT.-200) GO TO 56
0037              IF(JX.LT.-100)  GO TO 41
0038              IF(JX.LT.0)  GO TO 42
0039              IF(SVAR(4,JX).GT..001)  VTC(K) = VTC(K) + F*F*(EXP(SVAR(4,JX)) -
                 1   1.0)
0040              GO TO 56
0041           41 KX = -JX - 100
0042              IF(FIVAR(2,KX).GT..001)                    VTC(K) = VTC(K) +
                 1   F*F*(EXP(FIVAR(2,KX     )) - 1.0)
0043              GO TO 56
0044           42 KX = - JX
0045                          IF(FMVAR(1, KX).GT..001)  VTC(K) = VTC(K) + F*F*
                 1  (EXP(FMVAR(1, KX)) - 1.0)
0046              GO TO 56
0047           31 IF(PLVAR(2,L).LT..0001) GO TO 56
0048              TTSR = F*F*(EXP(PLVAR(2,L)) - 1.0)
0049              VTC(K) = VTC(K) + TTSR
0050           56 IF (NYRSST(L).EQ.0) GO TO 57
0051              I = IT - NSTRST(L)
0052              IF(I.LT.0.OR.I.GE.NYRSST(L))  GO TO 57
0053              F = F + SUS(L)
0054              IF(KSTAT.EQ.0.OR.SKIP.OR.SUS(L).LT..0001)  GO TO 57
0055              IF(L.LE.NMIS + NSPR)  GO TO 32
0056              IF(JX.LT.-200)  GO TO 57
0057              IF(JX.LT.-100)  GO TO 43
0058              IF(JX.LT.0)  GO TO 44
```



```
0059              IF(SVAR(5,JX).GT..001)  VTC(K) = VTC(K) + SUS(L)*SUS(L)*
                 1  (EXP(SVAR(5,JX)) - 1.0)
0060              GO TO 57
0061           43 KX = -JX -100
0062                          IF(FIVAR(3, KX    ).GT..001)  VTC(K) = VTC(K) +
                 1    SUS(L)*SUS(L)*(EXP(FIVAR(3,  KX   )) - 1.0)
0063              GO TO 57
0064           44 KX = -JX
0065                          IF(FMVAR(2, KX).GT..001)  VTC(K) = VTC(K) +
                 1  SUS(L)*SUS(L)*(EXP(FMVAR(2, KX)) - 1.0)
0066              GO TO 57
0067           32 IF(PLVAR(3,L).LT..0001)  GO TO 57
0068              TTSR = SUS(L)*SUS(L)*(EXP(PLVAR(3,L)) - 1.0)
0069              VTC(K) = VTC(K) + TTSR
0070           57 IF (NYRSRC(L).EQ.0) GO TO 58
0071              I = IT - NSTRRC(L)
0072              IF(I.LT.0.OR.I.GE.NYRSRC(L))  GO TO 58
0073              F = F + RECUR(I+1,L)
0074              IF(KSTAT.EQ.0.OR.SKIP.OR.RECUR(I+1,L).LT..01)    GO TO 58
0075              VTC(K) = VTC(K) + RECUR(I+1,L)*RECUR(I+1,L)*(EXP(RVAR(I+1,L))
                 1  - 1.0)
0076           58 IF (NYRSFX(L).EQ.0) GO TO 59
0077              I = IT - NSTRFX(L)
0078              IF(I.LT.0.OR.I.GE.NYRSFX(L))  GO TO 59
0079              F = F + RFIXD(I+1,L)
0080              IF(KSTAT.EQ.0.OR.SKIP.OR.RFIXD(I+1,L).LT..0001)  GO TO 59
0081              IF(L.LE.NMIS + NSPR)  GO TO 39
0082              IF(JX.LT.-200)  GO TO 59
0083              IF(JX.LT.-100)  GO TO 37
0084              IF(JX.LT.0)  GO TO 35
0085              LXX = LABS(JX)
0086              IF(VARF(LXX).GT..001)  VTC(K) = VTC(K) + RFIXD(I+1,L)*
                 1   RFIXD(I+1,L)*(EXP(VARF(LXX)) - 1.0)
0087              GO TO 59
0088           35 LXX = LABF(-JX)
0089              IF(VARF(LXX).GT..001)  VTC(K) = VTC(K) + RFIXD(I+1,L)*
                 1   RFIXD(I+1,L)*(EXP(VARF(LXX)) - 1.0)
0090              GO TO 59
0091           37 LXX = LABI(-JX - 100)
0092              IF(VARF(LXX).GT..001)  VTC(K) = VTC(K) + RFIXD(I+1,L)*
                 1   RFIXD(I+1,L)*(EXP(VARF(LXX)) - 1.0)
0093              GO TO 59
0094           39 IF(VARM(L).GT..001)  VTC(K) = VTC(K) + RFIXD(I+1,L)*RFIXD(I+1,L)*
```

```
                1   (EXP(VARM(L)) - 1.0)
0095           59 D(K) = F
          C    W(K) IS TOTAL COST IN YEAR K
0096              W(K) = W(K) + D(K)*(GRO +1.)**(K-1)
0097              IF (D(K).EQ.0..AND.FLAG.EQ.1.) GO TO 65
0098              IF (D(K).NE.0.) FLAG = 1.
0099           60 T = T + 1.0
0100              K = 21
0101           65 K = K-1
0102              JS = MAXO (JS,K)
0103              IF (SKIP) GO TO 70
0104              IF(L.LF.NMIS+NSPR)
                 1WRITE (6,98)  L,NAME(L),(D(I),I=1,K)
0105              IF(L.GT.NMIS+NSPR)  WRITE(6,89) L,LABEL(NDUM),(D(I),I=1,K)
0106              IF (NLVP(L).EQ.0) GO TO 70
0107              IJ = NLVP(L)
0108              H = LVARY(L)
0109              DO 69 II=1,IJ
0110              DO 67 I=1,20
0111              XOUT(I) = BLANK
0112           67 VOUT(I) = BLANK
0113              XSUB = LVS(H)
0114              IA = S(L) - TREF + XSUB
0115              IB = IA+LVD(H)-1
0116              DO 68 I=IA,IB
0117              IF (I.LT.1) GO TO 68
0118              IF (I.GT.20) GO TO 68
0119              IC = I-IA+1
0120              XOUT(I) = ASTR
0121              VOUT(I) = VNAM(H)
0122              KK = IVEH(H)
0123              ILV = KVEH(KK)
0124              XLVSUM(I,ILV) = XLVSUM(I,ILV) + XSCH(IC,H)
0125           68 CONTINUE
0126              WRITE (6,901) (VOUT(I),XOUT(I),I=1,K)
0127           69 H = H + 1
0128           70 CONTINUE
0129              DO 75 I=1,JS
0130              VTC(I) = VTC(I)*(1.0 + GRO)**(2*(I-1))
0131           75 TOTAL(I) = W(I) + FIXED(I)
0132              IF(KSTAT.EQ.0.OR.SKIP)  RETURN
0133              DO 80 I = 1,JS
0134              IF(W(I).LT..0001)  GO TO 79
```



```
0135              IF(VTC(I).LT..01)  GO TO 78
0136              SIG = ALOG(W(I)*W(I) + VTC(I)) - ALOG(W(I)*W(I))
0137              TP = SQRT(SIG)
0138              XMODE(I) = W(I)*(EXP(-1.5*SIG))
0139              XMU = ALOG(W(I)) - .5*SIG
0140              XMD = (ALOG(XMODE(I)) - XMU)/TP
0141              CALL NDTR(XMD,P2,DD)
0142              P2 = P2 + .5
0143              CALL NDTRI(P2,Y2,DD,IE)
0144              UB(I) = EXP(TP*Y2 + XMU)
0145              XMODE(I) = XMODE(I) + FIXED(I)
0146              UB(I) = UB(I) + FIXED(I)
0147              GO TO 80
0148           73 XMODE(I) = TOTAL(I)
0149              UB(I) = TOTAL(I)
0150              GO TO 80
0151           79 XMODE(I) = 0.0
0152              UB(I) = 0.0
0153           80 CONTINUE
0154              RETURN
0155           89 FORMAT(I3,1X,4HDEV ,I2,20F6.0)
0156           98 FORMAT (I3,1X,A6,20F6.0)
0157          901 FORMAT (11X,20(A4,A2))
0158              END
```

```
 TOTAL MEMORY REQUIREMENTS 0016E6 BYTES
```

```
 F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,NCAL,MAP
          VARIABLE OPTIONS USED - SIZE=(126976,24576)          DEFAULT OPTION(S) USED
IEW0000      NAME MOX02TC(R)
IEW0461  FRXPI=
IEW0461  IBCOM=
IEW0461  NDTR
IEW0461  NDTRI
IEW0461  EXP
IEW0461  MAXO
IEW0461  ALOG
IEW0461  SQRT
```

MODULE MAP

CONTROL SECTION NAME	ORIGIN	LENGTH	ENTRY NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME
TCOSTS	00	16E6							
SAVRT	16E8	FA0							
VARNCE	2688	ADC							
SAVE1	3168	FC4							
SAVALL	4130	3A1C							
SAVER	7B50	FC0							
SAV2	8B10	FE0							
SAV3	9AF0	980							
SCRACH	A470	6A60							

```
 ENTRY ADDRESS       00
 TOTAL LENGTH     10EDO

****MOX02TC   NOW REPLACED IN DATA SET
```

DIAGNOSTIC MESSAGE DIRECTORY

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    IEW0461 WARNING - SYMBOL PRINTED IS AN UNRESOLVED EXTERNAL REFERENCE, NCAL WAS SPECIFIED.
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(17)          OS/360  FORTRAN H                                   DATE  71.084/16.53.36

          COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=44,SOURCE,BCD,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NO
   ISN 0002            SUBROUTINE VEHRC
                     C     DETERMINE 'AVERAGE' RECURRING COST OF EACH VEHICLE
                     C
   ISN 0003            REAL NPERPD
   ISN 0004            INTEGER*2  VEH,NMULT,NONREC,NYD,IS,MAT,LYR,LETT,LYD,MIN,KOUT,
                      1  NINTYR,NTGYTR,LTR
   ISN 0005            COMMON/SAV3/GRO,GUESS,LP,NSOL,MSOL,NP,MOS,NMIS,NSPR,NPERPD(30),
                      1    PAD(30),LTR(50),PLR(50),RDIST(56,4),ALPI(4,60)
   ISN 0006            COMMON/SAVALL/LCK,SLO,NM,NEXD,NV,NUMD,MYRS,LZOPT(8),NYD(46),MAT(46
                      1),SUST(46),DS(46),LYD(46),YD(46),IS(102),LYR(252),LETT(250),
                      2  MIN(250),YRLM(250),VEH(4,60),NONREC(120,20),NMULT(60,50)
   ISN 0007            COMMON/TEMP/VNM(2,250),IFLAG,KI,NEXT,LOUT,SAVS(40),KOUT(40),
                      1  NINTYR(40,20),NTGYTR(40,20,2),RECUR(60,20,2)
   ISN 0008            COMMON/SCRACH/ VYTR(20,120),DUMM(102),RCOST(60),DUM(4246)
                     C     COUNT NUMBER OF EACH VEHICLE USED BY YEAR AND TEST RANGE
   ISN 0009            NV2 = 2*NV
   ISN 0010            DO 8032 I = 1,NV2
   ISN 0011            DO 8032 J = 1,MYRS
   ISN 0012         8032 VYTR(J,I) = 0.0
   ISN 0013            DO 8033 L = 1,NM
   ISN 0014            IF(YRLM(L).LT..0001)  GO TO 8033
   ISN 0016            I1= MIN(L)
   ISN 0017            M = LETT(L)
   ISN 0018            I = I1
   ISN 0019            IF(LTR(M).EQ.2)  I = I1 & NV
   ISN 0021            X = NMULT(I1,M)
   ISN 0022            J = LYR(L)
   ISN 0023            VYTR(J,I) = VYTR(J,I) & YRLM(L)*X
   ISN 0024         8033 CONTINUE
                     C     DETERMINE 'AVERAGE' RECURRING COST OF EACH VEHICLE
   ISN 0025            DO 8034 I = 1,NV
   ISN 0026            RCOST(I) = 0.0
   ISN 0027            TVEH = 0.0
   ISN 0028            II = I  & NV
   ISN 0029            DO 8035 J = 1,MYRS
   ISN 0030            RCOST(I) = RCOST(I) & VYTR(J,I)*RECUR(I,J,1) & VYTR(J,II)*
                      1   RECUR(I,J,2)
   ISN 0031            TVEH = TVEH & VYTR(J,I) & VYTR(J,II)
   ISN 0032         8035 CONTINUE
   ISN 0033            IF(TVEH.LT..0001)  GO TO 8034
   ISN 0035            RCOST(I) = RCOST(I)/TVEH
   ISN 0036         8034 CONTINUE

   ISN 0037         99 RETURN
   ISN 0038            END

****** END OF COMPILATION ******
```

```
F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,XREF,MAP,NCAL
          VARIABLE OPTIONS USED - SIZE=(126976,24576)              DEFAULT OPTION(S) USED
IEW0000      NAME MOX02VC(R)

                                        CROSS REFERENCE TABLE

  CONTROL SECTION                       ENTRY

    NAME     ORIGIN  LENGTH              NAME  LOCATION     NAME  LOCATION     NAME  LOCATION     NAME

  VEHRC          00     3CE
  SAV3          3D0     980
  SAVALL        D50    3A1C
  TEMP         4770    4110
  SCRACH       8880    6A60


  LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION          LOCATION  REFERS TO SYMBOL  IN CONTROL SECTION

       E0           SAV3          SAV3                       E4           SAVALL          SAVALL
       E8           SAVALL        SAVALL                     EC           TEMP            TEMP
       F0           SCRACH        SCRACH                     F4           SCRACH          SCRACH

 ENTRY ADDRESS       00
 TOTAL LENGTH      F2E0

****MOX02VC   NOW REPLACED IN DATA SET
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