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SCHEDULING ALGORITHM FOR MISSION PLANNING AND LOGISTICS EVALUATION
USERS' GUIDE

JOB ORDER 81-197

Prepared by

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Contract NAS 9-12200

For

MISSION PLANNING AND ANALYSIS DIVISION

National Aeronautics and Space Administration
LYNDON B. JOHNSON SPACE CENTER
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SCHEDULING ALGORITHM FOR MISSION PLANNING AND LOGISTICS EVALUATION
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TECHNICAL REPORT INDEX/ABSTRACT

(See instructions on reverse side.)

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13. ABSTRACT

The Scheduling Algorithm for Mission Planning and Logistics Evaluation (SAMPLE) program is a mission planning tool composed of three subsystems; the Mission Payloads Subsystem (MPLS), which generates a list of feasible combinations from a payload model for a given calendar year; GREEDY, which is a heuristic model used to find the best traffic model; and the Operations Simulation and Resources Scheduling Subsystem (OSARS), which determines traffic model feasibility for available resources. The SAMPLE provides the user with options to allow the execution of MPLS, GREEDY, GREEDY-OSARS, or MPLS-GREEDY-OSARS.

14. SUBJECT TERMS

FOREWORD

This document is the User's Guide for the seventh baseline version (SA7) of the Scheduling Algorithm for Mission Planning and Logistics Evaluation (SAMPLE).

CONTENTS

TABLE

FIGURE

1. INTRODUCTION

The Scheduling Algorithm for Mission Planning and Logistics Evaluation (SAMPLE) is an interactive computer program for automatically generating traffic models and flight schedules for the Shuttle Transportation System (STS). The SAMPLE is composed of three major subsystems: the Mission Payloads (MPLS) program; the Set Covering Program (SCP), and the Operations Simulation and Resource Scheduling (OSARS) program. The MPLS program determines a set of payload combinations which satisfy various STS constraints, such as: the maximum weight-to-orbit capability, cargo bay capacity, Reaction Control System (RCS) and Orbital Maneuvering System (OMS) fuel capacities, etc. The SCP forms a subset (traffic model) of the feasible payload combinations from MPLS such that a minimum number of Shuttle flights will transport all the specified payloads without redundancies. The OSARS program uses the traffic model produced by the SCP and assigns resources to each of the flights to produce an STS flight schedule. References 1, 2, and 3 of Section 6 describe the MPLS program, SCP, and OSARS program in detail.

The SAMPLE was written in FORTRAN V and was designed to execute on the UNIVAC 1100 series computers using the EXEC 8 operating system. The program was written to be used primarily in a demand (interactive) mode, but it may also be run in the batch mode.

The purpose of this document is to describe how to use the SAMPLE. Information concerning run stream construction, input data, and output data is provided. The flow of the interactive data stream is described. Error messages are specified, along with suggestions for remedial action. In addition, formats and parameter definitions for the payload data set (payload model), feasible combination file, and traffic model are documented.

2. EXEC 8 CONTROL CARDS

The EXEC 8 control cards required to execute the SAMPLE program must be specified by the user as follows:

```
@RUN  JWLXI, 1230B........        The run card
@XQT  FM3-L71194*SAMPLE. SAMPLE   Starts program execution
.
.
.
INPUT
DATA
.
.
.
@FIN                              Signs off of EXEC 8
```

3. INPUT DATA DESCRIPTION

3.1 GENERAL

The input to the SAMPLE is generally represented as data card images and in certain circumstances also requires nonformatted input. Large blocks of format-restricted input, specifically the payload model, are generally retained in a data element and added (@ADD) to the data stream at the appropriate place.

An optional input technique, used to suppress user tutorials, is available for the SAMPLE. This method is operational for Steps 2, 3, 4, 6, 7, and 10 identified in section 3.2. Note that integers requiring two or more digits must be surrounded by a slash. It is assumed that the input is ordered as the program expects the data; therefore, a user should become well acquainted with the input options before using this method.

The units of measure used for the SAMPLE may be English or metric.

A sample program logic flow is presented in figure B-1 to stress the major steps involved in using the SAMPLE. It should be pointed out that the major steps are not contiguous in their order. The omitted steps are options or steps supporting a previous option(s). A detailed description of each step entitled Interactive Data Flow is given in section 3.2.

3.2 INTERACTIVE DATA FLOW

The following steps identify the interactive data flow of the SAMPLE program. The user may optionally input a zero to list all the available options at each step following the input of a payload model.

Step 1

The program uses units 1 and 2 to write the feasible combinations, thus the program internally assigns two temporary files at the beginning of the execution. The file names are LA and LX and are assigned to units 1 and 2, respectively. The program execution runstream is:

```
@XQT SAMPLE.SAMPLE
```

At this point the program will print:

```
INPUT TUG CHARACTERISTICS AND MISSION MODEL DATA:
(FOR EXAMPLE @ADD SAMPLE.DATA99)
```

The user should add the payload model data; refer to section 3.3 for a more detailed discussion of this input. After reading the data, the control proceeds to Step 2.

Step 2

At this point the program will print:

```
SELECT AN OPTION: (5 TO TERMINATE)
```

The user has the following five options for selection:

```
1: DISPLAY OPTIONS
2: SELECTION OF ANALYSIS TYPE
3: PAYLOAD VARIATION OPTIONS
4: OUTPUT DISPLAY OF FEASIBLE MISSIONS IN MKS
5: TERMINATE
```

If the user selects option 1, control goes to Step 3. If he selects option 2, control goes to Step 4. If he selects option 3, control goes to Step 5.

If he selects option 4, control goes to Step 6. If he selects option 5, the program terminates via Step 18.

Step 3

When the user selects option 1 in Step 2, the program prints:

SELECT DISPLAY OPTIONS: (7 FOR ALL & 8 FOR NONE)

At this point, the following nine options are available to user:

1: PAYLOAD MODEL DISPLAY
2: STATISTICAL ANALYSIS OF MISSIONS
3: DISCIPLINE MIX DISPLAY
4: OCCURRENCE TABLE
5: FEASIBLE COMBINATIONS
6: INFEASIBLE COMBINATIONS
7: DISPLAY ALL (1 TO 6)
8: NONE OF THE ABOVE
9: MPLS DEBUG PRINT

Different options are available for printing the information about the mission payload data. If the user wishes to select options 1, 3, and 6, he should input 136. He may choose any order. To choose all the display options, the user can input 7; and, for not printing any display, the user can input 8. Option 9 is used for programmer checkout. After printing the results for the selected options, the control returns to Step 2. Note: The user will need much patience to see all the displays on the terminal; therefore, it is advisable to select these options under break point print (@BRKPT PRINT$) command only.

Step 4

When the user selects option 2 in Step 2, the program prints:

SELECT AN ANALYSIS TYPE: (4 FOR NONE)

The user has four options available to him:

1: GENERATE FEASIBLE COMBINATIONS (MPLS ONLY)
2: TRAFFIC MODEL (MPLS+SCA)
3: FLIGHT SCHEDULE (MPLS+SCA+OSARS)
4: NONE OF THE ABOVE

Option 1 is selected if the user is interested only in generating feasible combinations. If the user desires the traffic model, option 2 is required. To get a complete flight schedule, option 3 should be selected. Option 4 can be selected if none of the above options are desired; in which case, control will return to Step 2. If option 1, 2, or 3 is selected, the control goes to Step 7.

Step 5

When the user selects option 3 in Step 2, the program prints:

INPUT THE PAYLOAD VARIATION OPTIONS
15 FOR NONE

The user has 15 options available to him:

OPTION # 0 HAS BEEN SELECTED **

IOP=1;	A 50% INCREASE IN NON-NASA AUTOMATED
IOP=2;	A 50% REDUCTION IN NASA AUTOMATED
IOP=3;	A 25% INCREASE IN NON-NASA AUTOMATED
IOP=4;	A 25% REDUCTION IN NASA AUTOMATED
IOP=5;	A 100% INCREASE IN NON-NASA SORTIES
IOP=6;	A 50% INCREASE IN NASA SORTIES
IOP=7;	A 100% INCREASE IN NON-NASA PAYLOADS
IOP=8;	A 50% INCREASE IN NON-NASA PAYLOADS
IOP=9;	DECREASE LENGTHS BY 20% & ADD 30% TO WEIGHT
IOP=10;	DECREASE LENGTHS BY 15% & ADD 25% TO WEIGHT
IOP=11;	INCREASE LENGTHS BY 15% & SUBTRACT 20% FROM WEIGHT
IOP=12;	RANDOMIZE LENGTHS, MINIMUM OF 5 FT.
IOP=13;	RANDOM DELETION OF PAYLOADS-SPECIFY A %
IOP=14;	REGENERATE THE PAYLOAD MODEL
IOP=15;	FINISHED OPTIONS OR NONE, WHICHEVER IS APPLICABLE

The user is required to select options until option 15 is chosen. In other words, the user may select all options at his discretion.

Options 1 to 8 cause the flight frequency of the payloads to be modified. In order to determine the actual change, a message is printed as

OPTION #8 HAS BEEN SELECTED **
THE PERCENT CHANGE IS nn.nnnn

where nn.nnnn is the percent change.

If the user selects options 9, 10, or 11, the payload lengths and weights are changed. The modified payload length cannot exceed 60 feet nor can the weight exceed 65,000 pounds.

Option 12 specifies that the payload lengths be computed as the payload length multiplied by a random number in the interval from zero to one. The minimum value of the length parameter is 5 feet.

Option 13 allows the user to specify a percentage of payloads to be deleted from the model. The user is prompted as:

INPUT THE PERCENTAGE OF THE PAYLOADS TO BE DELETED

The actual percentage is then printed as:

THE ACTUAL PERCENTAGE DELETED IS nn.nnnn

Option 14 permits the user to save the modified payload model on mass storage.

A message is then printed indicating the name of the file that contains the model, i.e.,

THE OUTPUT PAYLOAD MODEL IS CONTAINED ON FILE <MODEL>.

(Refer to section 4 for a description of the internal file assignment.)

Selection of option 15 returns control to Step 2.

Step 6

If the user selects option 4 at Step 2, the printed output for feasible missions will be displayed in the mks system instead of the fps system. Control returns to Step 2.

Step 7

After selection of the analysis type, the program prints:

INPUT YEAR FOR ANALYSIS: (79 to 91)

The user should select the year for analysis in range of 79 to 91. If option 1 was selected at Step 4, the control goes to Step 10; otherwise, the control goes to Step 8.

Step 8

After obtaining the correct year for analysis, the message reads as:

SELECT INTERACTIVE OPTIONS: (3 FOR NONE)

The available options are:

1: USE PREVIOUSLY DEFINED FEASIBLE MISSIONS
2: USE INTERACTIVE FEATURE IN TRAFFIC MODELING
3: NONE OF THE ABOVE

If the user desires to use the previously defined feasible missions, he should select option 1. Option 2 should be selected if the interactive feature is desired in traffic modeling. The user may like to select both options 1 and 2; to do so, he should input 12. If the user desires not to select option 1 or 2, he can input 3. If option 1 is being selected, the control goes to Step 9; otherwise, control goes to Step 10.

Step 9

If the previously defined feasible mission option is selected, the program prints:

INPUT PREVIOUSLY DEFINED FEASIBLE MISSION DATA:
(SPECIFY THE FILE NAME, FOR EXAMPLE > FILEN.)

The user should use a previously defined feasible mission data file which has been saved from some previous run of the SIMPLE program. The input file name, including the period, is restricted to six columns left-adjusted in column 1. After reading the previously defined data, control goes to Step 13.

Step 12

At this point the program will print:

SELECT PERSONAL DATA BASE TO GENERATE FEASIBLE MISSION:
(8 FOR NONE)

The following eight options are available:

1: TUG PERFORMANCE DATA
2: PAYLOAD MODEL DATA
3: YEARS AVAILABILITY OF TUG
4: AVAILABILITY YEAR FOR WTR
5: MAXIMUM NUMBER OF PAYLOADS
6: MISSION TYPES
7: DISCIPLINE MIX
8: NONE OF THE ABOVE

Any number of options can be selected to change the data base. To select options 2, 6, 7, and 4, the input should be 2674. In other words, the user is required to specify a minimum of one option and may specify a maximum of seven.

Option 1 causes the third stage vehicle (TSV) performance data described in section 3.3 to be input again. This allows for a data override (reference Step 1). The user is prompted for input as:

INPUT TUG PERFORMANCE DATA:

Option 2 causes the payload model data described in section 3.3 to be input again. The user is prompted for input as

INPUT PAYLOAD MODEL DATA:

Option 3 causes the years of availability of the TSV to be input. The user is prompted for input as:

INPUT YEARS AVAILABILITY OF TUG:

The user is required to input in free field form 10 two-digit years specifying when the TSV's input at option 1 are available. The range of usable TSV's are from 1979 to 1991, therefore 1999 indicates the particular TSV is unavailable. A sample input might be

84, 99, 99, 99, 99, 79, 81, 99, 99, 99

Option 4 causes the availability of the western test range (WTR) to be specified. The users is prompted for input as:

INPUT AVAILABILITY YEAR FOR WTR:

A typical user response might be

83

Option 5 causes the maximum number of payloads which can be grouped on a flight to be reset. It should be pointed out that a maximum of six payloads may be flown regardless of the user input. The user is prompted as:

INPUT MAXIMUM NUMBER OF PAYLOADS ALLOWED IN ONE COMBINATION:

A typical user response might be

4

Assuming options 6 and 7 were chosen and set to a -1, at this stage the program prints:

INPUT 1 TO PRINT MISSION CLASS CODE LIST: OTHERWISE SKIP A LINE

If user desires to see the mission class code list, he should input 1; otherwise, skip a line.

At this stage the program prints:

INPUT 1 TO PRINT DISCIPLINE MIX LIST; OTHERWISE SKIP A LINE

If the user desires to see the discipline mix list, he should input 1. The chuice of option 8 transfers control to Step 11.

Step 11

At this stage, the program is ready to go through the MPLS part of the program to generate all the feasible missions for the selected data base. After generating the feasible missions, the statistical analysis for the year under consideration is printed along with the analysis of time elapsed.

If in Step 4 option 1 was selected (i.e., only MPLS analysis was desired), the control goes to Step 18; otherwise, control goes to Step 12.

Step 12

If the user selects option 3 at Step 4, the resource data found in data element DATA2 of SAMPLE is required for the analysis. The program logic necessary to use the input has been established. However, OSARS should be used with care, as it sometimes returns misleading results. The following program user prompt is given for completeness.

INPUT RESOURCE DATA: (FOR EXAMPLE @ADD SAMPLE.DATA2)

The user inputs the resource data element and control goes to Step 13.

Step 13

In Step 8, if the user had not selected option 2, which means the user is not interested in the interactive feature in traffic modeling, the traffic model will be printed out and the control returns to Step 2. Otherwise, a message is printed:

ALTERNATE TRAFFIC MODEL OPTION
DO YOU WANT ANOTHER SCHEDULE?

1: YES.

0: NO.

If the user desires to have another traffic model, he should input 1 and the control goes to Step 14. Otherwise, when 0 is input, the control goes to Step 18.

Step 14

CRITERIA FOR FLIGHT/COMBINATION SELECTION OPTION

CHOOSE CRITERIA FOR FLIGHT/COMBINATION SELECTION:

1: MAXIMUM NUMBER OF PAYLOADS

2: MAXIMUM PRIORITY

3: MINIMUM COST

4: MINIMUM COST PER PAYLOAD

5: NONE OF THE ABOVE

The user can select any number of options. If he desires to select options 2 and 4, the input should be 24. As per the selections of options, the user will get the display of the best five combinations in those modes. At the end of the display, or if the user selects option 5, control goes to Step 15.

Step 15

WHICH MISSIONS DO YOU WANT OMITTED?

(ENTER 0 TO END)

At this time, the user should enter the missions to be omitted one at a time. The last entry should be zero in order to transfer control to Step 16.

Step 16

WHICH MISSION DO YOU WANT TO ENTER?

(ENTER 0 TO END)

The user should enter the mission to be specified in the traffic model one at a time. The last entry should be zero in order to transfer control to Step 17.

Step 17

At this stage, the program completes the traffic modeling as the user specified and prints out the results. Then a message is printed:

DO YOU WISH TO SEE INFORMATION ON THESE MISSIONS?

0: NONE

-1: PRINT ALL

-2: PRINT ALL AND SAVE ON SCRATCH FILE

-3: SAVE ON SCRATCH FILE ONLY

N: ENTER MISSION "N"

If the user is not interested in seeing the information about the flights, he should input zero. In this case, statistics for the current traffic model will be printed; then control returns to Step 2. If the user wishes to see the information about the missions selected for the traffic model, he should input -1. If he wishes flight information and wishes to save the traffic model on a scratch file, he should enter -2. If he wishes to save it on scratch file only, the user should enter -3. The saved traffic model is written on logical unit 1 (LA).

If the user desires to have the information about specific flights, he should input the number he desires. The information for that flight will be printed. Then the user can enter another flight number. The control returns to Step 2 when he enters zero.

Step 18

In case of normal termination, a temporary file (LX), assigned by the program can be saved for future use. This temporary file will have feasible mission data for the year under consideration (the final selection in case another year was selected for analysis). To save this data for future use, it should be copied to a secured file. Assuming that SECURE is a cataloged file and the data are saved as an element, the run stream would be:

```
@COPY LX.,SECURE.
```

This saved data can be used in the future as previously defined feasible mission data and can be added in Step 9. By saving the data for future use, the user does not have to go through the generation of feasible mission data (i.e., MPLS program) repeatedly for the same set of payload data.

3.3 PAYLOAD MODEL DATA

The input data required at Step 1 of the previous section is described in table I. Any reference made to free field input means that the input data are separated by commas and are not restricted to a particular set of card columns.

TABLE I.- PAYLOAD MODEL CARDS

The first set of cards in the payload model identifies the solid-propellant Interim Upper Stage (IUS) data. The second set of cards pertains to the Liquid-Propellant Upper Stage (LUS) data, and the remaining cards identify individual payload characteristics.

SET ONE

Card	Word	Symbol	Type	Units	Format	Column	Description
1	1	N	I	-	Free	-	Number of unique stages in the model
2-L $(L \leq 15)$	1	TISP	R	sec	F10.0	1-10	Specific impulse of the stage
	2	TTSVWT	R	lb	F10.0	11-20	Total weight of the stage
	3	FUEL	R	lb	F10.0	21-30	Total fuel available for the stage
	4	TSVLN	R	ft	F10.0	31-40	Length of the stage
L+1	1	NTSVS	I	-	Free	-	Number of IUS vehicles to be used $(NTSVS \leq 10)$
L+2	1	N	I	-	Free	-	Number of stages on the IUS $(1 \leq N \leq S)$
	2	NUNQS(NSTVS$_1$1)	I	-	Free	-	First stage identified by the first set of cards
	3	NUNQS(NSTVS$_1$2) :	I	-	Free	-	Second stage number
	N+1	NUNQS(NSTVS$_1$N)	I	-	Free		Last stage number
	N+2	YRAVAL	I	-	Free	-	A two-digit number which represents the year of availability of this vehicle

TABLE I.- CONTINUED

The second set of cards pertains to the LUS vehicles. The order in which the data are input is the order each LUS is considered. For simplicity, the next card in the sequence is denoted as "k".

SET TWO

Card	Word	Symbol	Type	Units	Format	Column	Description
k	1	N1	I	-	Free	-	Number of LUS vehicles to be input
k+1	1	TUGLN	R	ft	F10.3	1-10	Length of the LUS
	2	TUGWT	R	lb	F10.3	11-20	Weight of the LUS
to	3	TUGCAP	R	lb	F10.3	21-30	Capacity of the LUS
	4	TUGISP	R	sec	F10.3	31-40	Specific impulse of the LUS
k+N1	5	TUGTYP	I	-	I2	44-45	The LUS type =1, expendable =3, reusable
	6	YRAVAL	I	-	I2	47-48	First year available for the LUS
k+N1+1	1	NUMPL	I	-	Free field	-	Number of payloads in the model
	2	MKS	I	-	Free	-	A flag specifying the internal units of the payload model =1, the units are in mks =2, the units are in fps

TABLE I.- CONTINUED

The rest of the cards are identified in sets of three, and identify individual payload characteristics.

Card	Word	Symbol	Type	Units	Format	Column	Description
1	1	NUMB	A	-	2A6	4-15	Payload alphanumeric identification label
	2	NDISP	A	-	2A6	16-27	Payload discipline
	3	NAME	A	-	6A6	28-63	Payload description
	4	LEN	R	ft	F5.0	64-68	Total payload length, including the pallet and/or lab
	5	WT	R	lb	F6.0	69-74	Total weight of the payload at lift-off, including the pallet and/or lab, if applicable
	6	WT1	R	lb	F6.0	75-80	Total weight of the payload at landing, including the pallet and/or lab, if applicable
2	1	DIAM	R	ft	F4.1	4-7	Diameter of the payload
	2	HA	R	n.mi.	F9.0	8-16	Desired circular altitude
	3	INCL	R	deg	F5.1	17-21	Desired inclination
	4	C3	R	ft^2/sec^2	F5.0	22-26	C3 energy, this number will be multiplied by 100,000.

TABLE I. - CONTINUED

Card	Word	Symbol	Type	Units	Format	Column	Description
2	5	PMT	I	-	I2	27-28	Payload mission type flag =1, attached =2, servicing =3, deploy =4, retrieved
	6	FLTPYR	I	-	1323	29-67	Flight frequency for 1979 to 1991. Each word contains a flag and denotes the number of times a payload goes up and/or down in a given year. The word is entered as XYZ, where X=1 The up and down trips for this payload can be combined on a flight X=2 The up and down trips for this payload cannot be combined on a flight X is ignored if the mission type is 1 or 2, or if the payload is always deployed or retrieved. In these situations, X is set to zero (or blank) If X is nonzero, Y is the number of deployments ($Y \leq 9$) and Z is the number of retrievals If X is zero, YZ is the number of deploys, retrieves, sorties, or services
	7	IRPT	I	-	I3	68-70	A flag which indicates the repeat conditions of a payload =0 Payloads to be repeated in a given year cannot be flown on the same flight =1 Payloads flown can be repeated in a given year on the same flight

TABLE I.- CONCLUDED

Card	Word	Symbol	Type	Units	Format	Column	Description
2	8	PLDUR	R	hrs	F3.1	71-73	Desired time on-orbit
	9	OPTIME	R	hrs	F3.1	74-76	Nominal duration of payload operation/ day of time onboard the orbiter
	10	IFREQ	I	-	I3	77-79	Number of times/day the payload is operated while onboard the orbiter
	11	MODE	I	-	I1	80	Preferred delivery mode (attached payloads only) =1 lab =2 pallet =3 lab and pallet
3	1	RCS	R	lb	F6.1	4-9	Reaction Control System (RCS) fuel requirements based on individual payload requirements
	2	OXEPS	R	lb	F6.1	10-15	Electrical Power System (EPS) O_2 requirements based on individual payload demands
	3	HEPS	R	lb	F5.1	16-20	EPS H_2 requirements based on individual payload demands
	4	CGPOS		ft	F4.1	21-24	Distance of the payload center of gravity from the front end of the payload
	5	FTSV	R	-	I1	25	A flag when set nonzero forces the use of a TSV

4. OUTPUT DESCRIPTION

4.1 NORMAL OUTPUT

The output from the SAMPLE program can be classified into the following four basic types.

4.1.1 PAYLOAD MODEL

This output is written on a formatted mass storage file, logical unit 7, and is optional. It has the same information and format as the input mission model. The reader is referred to section 3.3 for a detailed description.

4.1.2 FEASIBLE COMBINATION FILE

Two mass storage files (logical units 1 and 2) are assigned to retain the information of feasible combinations. The complete set of feasible combinations from the MPLS is stored on logical unit 1. Logical unit 2 is used to keep the input information for the SCP. The information on logical unit 1 is always transferred to logical unit 2, either totally or partially. The reasons are:

a. Since the SCP is designed to handle a maximum of 2000 combinations, whenever the combinations in logical unit 1 exceed that limit, logical unit 2 can store a randomly chosen subset of those combinations of which the total number will be within 2000.

b. By transferring the information to logical unit 2, logical unit 1 can be reused to retain the traffic model.

Both logical unit 1 and logical unit 2 contain fixed length records. The user is referred to Appendix A for description of the feasible combination file.

4.1.3 TRAFFIC MODEL FILE

The traffic model output is written on a formatted file which is logical unit 1. It is initiated by the first card image "n*CASE* m" where n is the number of missions in the traffic model and m is the number of the traffic model. The rest of the cards are identified in sets of six. The format of the traffic model file is described in Appendix B.

4.1.4 DISPLAY

The display output of the SAMPLE can be differentiated into the following six types, any of which are optional.

a. Payload model display

   This is the initial output of the SAMPLE and it consists of approximately three pages of information pertaining to the payload model. This information is displayed in four different sets. The first set prints the following parameters for each payload.

   - Payload discipline
   - Payload ID
   - Payload name

   The second set prints out the following parameters for each payload.

   - Payload diameter
   - Weight of the H_2 for EPS
   - Weight of the O_2 for EPS
   - Height of apogee
   - Payload duration
   - Operation time
   - C3 energy

   The third set of information consists of the following parameters for each payload.

   - Inclination
   - RCS fuel supply
   - Center of gravity
   - Launch length
   - Launch weight including adapter
   - Landing weight
   - Payload mission type

The fourth set of information provides the flight frequencies for each payload in every year from 1979 through 1991.

b. Mission class and discipline mix display

This display contains two lists of payload parameters. The first one is called 'MISSION CLASS CODE LIST,' and prints out the payload number and the mission type associated with that payload. The second one is called 'PAYLOAD DISCIPLINE MIX LIST,' and includes the payload number and its discipline mix.

c. Occurrence table

This optional print is a list of each payload and all feasible combinations which include that payload. The title of the table is displayed as "n OCCURRENCE TABLE," where n is the year in which the particular case is executed. This is immediately followed by "PAYLOAD" and "FEASIBLE COMBINATIONS." Under the column of "PAYLOAD" are printed out the payload ID's. Under the column of "FEASIBLE COMBINATIONS" are combination numbers which carry that payload.

d. Feasible combinations

This display prints the following parameters for the feasible combinations.

- Flight number
- Launch site
- Payload identification number/name
- Orbiter sequence
- Inclination
- Total weight up/down
- Up/down length
- TSV name
- TSV sequence
- Altitude
- Payload type
- Orbiter and TSV ΔV

- Number of orbital maneuvering system (OMS) kits
- Load factor
- Payload margin
- Percentage used of the first kit

e. Infeasible combinations

This option will give a list of infeasible combinations. For each combination, the following information will be printed out.

- Payload ID's and their disciplines
- One of the following messages will be displayed to indicate the reason that the combination fails.

(1) DOWN WEIGHT CONSTRAINT VIOLATED

(2) MISSION TYPE NOT ALLOWED

(3) NO FEASIBLE SEQUENCE FOUND

(4) NO TUGS SATISFY LENGTH AND WEIGHT CONSTRAINTS

(5) NUMBER OF PAYLOADS ON A TUG GREATER THAN 3

(6) PAYLOAD iii CAN ONLY BE A DEDICATED TUG

(7) PAYLOAD DISCIPLINE MIX NOT ALLOWED

(8) THE RCS WEIGHT IS GREATER THAN THE CAPACITY IN THIS CASE

(9) TOTAL LENGTH GREATER THAN BAY LENGTH, DOWN TOTAL LENGTH = rrrr.r

(10) UPWEIGHT CONSTRAINT VIOLATED

f. Traffic model data

These data give the total number of missions in the traffic model, the mission identifications, and the total cost of this traffic model.

4.2 ABNORMAL OUTPUT

Diagnostic messages from subroutines of SAMPLE are listed below.

Diagnostic message	Subroutine	Description
STORING ERROR	LOAD5	The program writes more data on a file than it can hold. The user can either reassign a larger file or contact the responsible programmer for help.
TABLE ERROR***INPUT TO GREEDY IS CLOBBERED**	TABLE	This message implies that more than one payload in a combination have the same ID; a responsible programmer should be contacted.
GREEDY ERROR	GREEDY	This display indicates either a certain payload is not covered or is overlapped in the traffic model. A responsible programmer should be contacted.
THE NUMBER ENTERED IS TOO LARGE, PLEASE ENTER A NUMBER LESS THAN XX	RESCH	In the mission omit option, the user inputs the mission ID, which is larger than any existing mission ID.
MISSION XX CANNOT BE OMITTED, BECAUSE PAY-LOAD YY WOULD BE UNCOVERED	RESCH	The user wants to omit some missions that will cause some payloads not to be contained in the traffic model. He should refer to the occurrence table and be sure all payloads can be included.
MISSION XX IS UNACCEPTABLE	RESCH	In the mission addition option, the user entered more than one mission which contains the same payload.

5. SAMPLE INPUT AND OUTPUT

This section contains two run streams and a typical printed output from SAMPLE.

COMPACT RUN STREAM FOR SAMPLE

@RUN	Run card
@USE S.,FD3-L78486*SAMPLE.	Specifies an internal file name for an external file name
@XQT S.SAMPLE	Starts execution.
@ADD S.DATA	Adds the mission model to the run
1722/80/38	This string of input specifies the following options in the order given: (1) The "1" specifies the display option (2) The "7" specifies all displays (3) The "2" specifies that an analysis type is to be chosen (4) The second "2" specifies GREEDY and MPLS are to be executed (5) The "/80/" denotes that a two-digit number 80 was input to specify the year under analysis (6) The "3" specifies no interactive options are to be chosen (7) The "8" specifies that no data base options are chosen
1	The cost coefficient to be used by the GREEDY program
5	Terminate analysis

COMPACT RUN STREAM FOR GREEDY ONLY

@RUN JWLXIA	Run card
@USE S.,FD3-L78486*SAMPLE	Specifies an internal file name for an external file name
@XQT S.SAMPLE	Starts execution
@ADD S.DATA	Adds the mission model to the run
22/80/1	This string of input specifies the following options in the order given: (1) The first "2" specifies that an analysis type is to be chosen (2) The second "2" specifies that the MPLS and GREEDY programs are to be executed (3) The "/80/" specifies that the year of analysis is 1980 (4) The "1" indicates that a previously defined feasible mission file is to be used
DATA.	This input specifies that the feasible mission file is named DATA
1	The cost coefficient for the GREEDY program
5	Terminate analysis

PRINTED OUTPUT FOR THE SAMPLE

```
@XQT SAMPLE
 INPUT TUG CHARACTERISTICS AND MISSION MODEL DATA:
 (FOR EXAMPLE @ADD SAMPLE.DATA99)


 SELECT AN OPTION: ( 5 TO TERMINATE )


************************  MISSION MODEL DISPLAY  ************************
```

NO.	PAYLOAD DISCIPLINE	PAYLOAD ID		NAME
1	ASTRONOMY	AS-1A CDR	A	LOW EARTH ORBIT EXPLORER
2	ASTRONOMY	AS-03 CDR	A	SOLAR PHYSICS SATELLITE
3	PHYSICS	PH-1A CDR	A	EXPLORER-UPPER ATMOSPHERE
4	PHYSICS	PH-1B CDR	A	EXPLORER-MEDIUM ALTITUDE
5	PHYSICS	PH-04 CDR	A	HELIO AND INTERSTEL. SPACECRAFT
6	PHYSICS	PH-5V CDR	A	REVISIT
7	LUNAR	LU-03 CDE	A	LUNAR ROVER
8	LIFE SCI.	LS-01 LCR	A	LIFE SCIENCE RESEARCH MODULE
9	EARTH OBS.	EO-5D LCE	A	SPECIAL PURPOSE SATELLITE-D
10	N NASA/DOD	NN-01 CDR	A	INTEL SAT.
11	N NASA/DOD	NN-05 CDR	A	FOREIGN COMMUNICATIONS
12	N NASA/DOD	NN-09 CDR	A	FOREIGN SYN. MET. SATELLITE
13	N NASA/DOD	NN-11 LCR	A	LOW ORBIT EARTH RES.
14	ASTRONOMY	AS-10K30	S	STELLAR
15	PHYSICS	PH-6D	S	HIGH ENERGY ASTROPHYSICS

NO.	DIAM	HEPS	OXEPS	HA	PLOUR	OPTIME	C3
1	0.	150.	2000.	297.	0.	0.	.0000
2	0.	150.	2000.	270.	0.	0.	.0000
3	0.	150.	2000.	846.	0.	0.	.0000
4	0.	150.	2000.	4028.	0.	0.	.0000
5	0.	150.	2000.	0.	0.	0.	.7710+09
6	0.	150.	2000.	200.	0.	0.	.0000
7	0.	150.	2000.	0.	0.	0.	.7710+09
8	0.	150.	2000.	300.	0.	0.	.0000
9	0.	150.	2000.	400.	0.	0.	.0000
10	0.	150.	2000.	19323.	0.	0.	.0000
11	0.	150.	2000.	19323.	0.	0.	.0000
12	0.	150.	2000.	19323.	0.	0.	.0000
13	0.	150.	2000.	300.	0.	0.	.0000
14	0.	150.	2000.	162.	0.	0.	.0000
15	0.	150.	2000.	120.	0.	0.	.0000

NO.	INCL	RCS	CG	LAUNCH LENGTH, FT.	LAUNCH WT.INCL. ADAPTER	ADAPTER WT.,LB.	PMT
1	28.5	1800.0	.0	12.2	640.0	640.0	3
2	28.5	1800.0	.0	13.1	4146.0	4146.0	3
3	90.0	1800.0	.0	13.3	1046.0	1046.0	3
4	28.5	1800.0	.0	12.6	852.0	852.0	3
5	28.5	1800.0	.0	10.5	635.0	635.0	3
6	28.5	1800.0	.0	5.0	3500.0	3500.0	2
7	28.5	1800.0	.0	24.0	8700.0	8700.0	3
8	28.5	1800.0	.0	13.0	682.0	682.0	3
9	90.0	1800.0	.0	9.7	676.0	676.0	3
10	.0	1800.0	.0	12.2	4498.0	4498.0	3
11	.0	1800.0	.0	12.2	982.0	982.0	3
12	.0	1800.0	.0	10.3	807.0	807.0	3
13	97.0	1800.0	.0	36.0	6213.0	6213.0	3
14	28.5	1800.0	.0	55.0	42702.0	31190.0	1
15	28.5	1800.0	.0	27.0	20720.0	18138.0	1

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FLIGHTS PER YEAR

NO.	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	0-0	1-1	1-2	1-1	1-0	1-0	1-0	1-0	1-1	1-1	1-1	1-1	1-1
2	0-0	1-1	0-0	1-1	0-0	1-1	0-0	1-1	0-0	1-1	0-0	1-1	0-0
3	0-0	0-0	0-0	0-0	0-0	1-1	0-0	0-0	0-0	1-0	1-1	1-1	1-1
4	0-0	0-0	1-0	0-0	0-0	1-1	0-0	0-0	0-0	1-0	1-1	1-1	1-1
5	0	0	0	0	0	0	0	0	0	1	0	0	0
6	0	0	0	0	0	0	0	0	0	1	1	1	1
7	0	0	0	0	0	0	0	0	1	1	0	0	0
8	0-0	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2	2-2
9	0	0	0	0	0	0	1	0	0	1	0	0	1
10	0-0	0-0	0-0	0-0	2-0	3-0	2-0	2-0	0-1	0-1	2-2	3-3	2-0
11	0-0	0-0	1-0	1-0	1-0	1-3	1-1	1-0	1-0	1-1	1-1	1-1	1-1
12	0-0	0-0	1-0	1-0	0-0	1-1	0-1	1-1	0-0	1-1	0-0	1-1	0-0
13	0-0	0-0	0-0	0-0	1-2	1-1	1-1	1-1	1-1	1-1	1-1	1-1	1-1
14	0	0	0	0	0	0	0	0	0	1	1	1	1
15	0	0	1	1	1	1	1	1	1	1	1	1	1

SEQUENCE NO.,PAYLOAD ID,PMT
1 1-3 2 1-4 3 2-3 4 2-4 5 8-3 6 8-4

DUPLICATED PAYLOADS
PAYLOAD ID,TIMES DUPLICATED
6 2 8 2
SEQ,PAYLOAD NO,TUG
1 1 0 2 1 0 3 2 0 4 2 0 5 8 0
6 8 0

FLT. NO. 1 LAUNCH SITE: ETR

PAYLOADS: AS-1A CCR A
1000
SHUTTLE SEQUENCE 1-D
ALTITUDE 297.
INCLINATION 28.5
TOTAL LENGTH UP: 12. TOTAL WEIGHT UP: 5851.7
PAYLOAD MARGIN: 28938. LOAD FACTOR: .09568
SHUTTLE DELTAV: 1241.

FLT. NO. 2 LAUNCH SITE: ETR

PAYLOADS: AS-1A CCR A
1050
SHUTTLE SEQUENCE 1-R
ALTITUDE 297.
INCLINATION 28.5
TOTAL LENGTH DOWN: 12. TOTAL WEIGHT DOWN: 3701.7
PAYLOAD MARGIN: 28298. LOAD FACTOR: .11568
SHUTTLE DELTAV: 1261.

FLT. NO. 3 LAUNCH SITE: ETR

PAYLOADS: AS-03 CCR A
2000
SHUTTLE SEQUENCE 2-D
ALTITUDE 270.

```
 INCLINATION               28.5
 TOTAL LENGTH UP:  13.        TOTAL WEIGHT UP:  9357.7
 PAYLOAD MARGIN: 28938.     LOAD FACTOR:  .14396
 SHUTTLE DELTAV:  1113.

FLT. NO.    4     LAUNCH SITE: ETR

 PAYLOADS:    AS-03    CDR  A
                 2050
 SHUTTLE SEQUENCE          2-R
 ALTITUDE                  270.
 INCLINATION               28.5
 TOTAL LENGTH DOWN:  13.      TOTAL WEIGHT DOWN:  7207.7
 PAYLOAD MARGIN: 24792.     LOAD FACTOR:  .22524
 SHUTTLE DELTAV:  1133.

FLT. NO.    5     LAUNCH SITE: ETR

 PAYLOADS:    LS-01    LCP  A
                 8001
 SHUTTLE SEQUENCE          8-D
 ALTITUDE                  300.
 INCLINATION               28.5
 TOTAL LENGTH UP:  13.        TOTAL WEIGHT UP:  5893.7
 PAYLOAD MARGIN: 28938.     LOAD FACTOR:  .09568
 SHUTTLE DELTAV:  1255.

FLT. NO.    6     LAUNCH SITE: ETR

 PAYLOADS:    LS-01    LCP  A
                 8002
 SHUTTLE SEQUENCE          8-D
 ALTITUDE                  300.
 INCLINATION               28.5
 TOTAL LENGTH UP:  13.        TOTAL WEIGHT UP:  5893.7
 PAYLOAD MARGIN: 28938.     LOAD FACTOR:  .09568
 SHUTTLE DELTAV:  1255.

FLT. NO.    7     LAUNCH SITE: ETR

 PAYLOADS:    LS-01    LCP  A
                 8051
 SHUTTLE SEQUENCE          8-R
 ALTITUDE                  300.
 INCLINATION               28.5
 TOTAL LENGTH UP:    5.       TOTAL LENGTH DOWN:  18.
 TOTAL WEIGHT UP:   7950.9     TOTAL WEIGHT DOWN:  6093.7
 NO. OF KITS NEEDED: 1         % USE OF FIRST KIT:   3.26
 PAYLOAD MARGIN: 25906.     LOAD FACTOR:  .19043
 SHUTTLE DELTAV:  1275.

FLT. NO.    8     LAUNCH SITE: ETR

 PAYLOADS:    LS-01    LCP  A
                 8052
 SHUTTLE SEQUENCE          8-R
 ALTITUDE                  300.
```

```
 INCLINATION                28.5
 TOTAL LENGTH UP:    5.       TOTAL LENGTH DOWN:  18.
 TOTAL WEIGHT UP:  7950.9     TOTAL WEIGHT DOWN:  6093.7
 NO. OF KITS NEEDED: 1        % USE OF FIRST KIT:    3.26
 PAYLOAD MARGIN: 25906.     LOAD FACTOR:  .19043
 SHUTTLE DELTAV:  1275.

FLT. NO.    9      LAUNCH SITE: ETR

 PAYLOADS:    AS-03     CDR  A    AS-1A     CDR  A
                 2000       1000
 SHUTTLE SEQUENCE        2-D          1-D
 ALTITUDE                270.         297.
 INCLINATION             28.5         28.5
 TOTAL LENGTH UP:  25.        TOTAL WEIGHT UP: 14085.7
 PAYLOAD MARGIN: 27000.     LOAD FACTOR:  .21670
 SHUTTLE DELTAV:  1241.

FLT. NO.   10      LAUNCH SITE: ETR

 PAYLOADS:    AS-03     CDR  A    AS-1A     CDR  A
                 2050       1000
 SHUTTLE SEQUENCE        2-R          1-D
 ALTITUDE                270.         297.
 INCLINATION             28.5         28.5
 TOTAL LENGTH UP:  17.        TOTAL LENGTH DOWN:  18.
 TOTAL WEIGHT UP: 13064.5     TOTAL WEIGHT DOWN: 11495.7
 NO. OF KITS NEEDED: 1        % USE OF FIRST KIT:    6.48
 PAYLOAD MARGIN: 20504.     LOAD FACTOR:  .35924
 SHUTTLE DELTAV:  1261.

FLT. NO.   11      LAUNCH SITE: ETR

 PAYLOADS:    AS-1A     CDR  A    LS-01     LCR  A
                 1000       8001
 SHUTTLE SEQUENCE        1-D          8-D
 ALTITUDE                297.         300.
 INCLINATION             28.5         28.5
 TOTAL LENGTH UP:  30.        TOTAL LENGTH DOWN:    5.
 TOTAL WEIGHT UP: 13314.4     TOTAL WEIGHT DOWN:   7349.7
 NO. OF KITS NEEDED: 1        % USE OF FIRST KIT:    2.87
 PAYLOAD MARGIN: 24650.     LOAD FACTOR:  .22968
 SHUTTLE DELTAV:  1255.

FLT. NO.   12      LAUNCH SITE: ETR

 PAYLOADS:    AS-1A     CDR  A    LS-01     LCR  A
                 1000       8051
 SHUTTLE SEQUENCE        1-D          8-R
 ALTITUDE                297.         300.
 INCLINATION             28.5         28.5
 TOTAL LENGTH UP:  17.        TOTAL LENGTH DOWN:  18.
 TOTAL WEIGHT UP: 13162.5     TOTAL WEIGHT DOWN:   8031.7
 NO. OF KITS NEEDED: 1        % USE OF FIRST KIT:    7.30
 PAYLOAD MARGIN: 23968.     LOAD FACTOR:  .25099
 SHUTTLE DELTAV:  1275.
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```
FLT. NO.   13      LAUNCH SITE: ETR

 PAYLOADS:    AS-03     CDR  A    AS-1A     CDR  A
                2000      1050
 SHUTTLE SEQUENCE        2-D          1-R
 ALTITUDE                270.         297.
 INCLINATION             28.5        28.5
 TOTAL LENGTH UP:   18.      TOTAL LENGTH DOWN:  17.
 TOTAL WEIGHT UP: 16601.3    TOTAL WEIGHT DOWN:  7989.7
 NO. OF KITS NEEDED: 1       % USE OF FIRST KIT:   6.74
 PAYLOAD MARGIN: 24010.     LOAD FACTOR:  .25540
 SHUTTLE DELTAV:  1261.

FLT. NO.   14      LAUNCH SITE: ETR

 PAYLOADS:    AS-03     CDR  A    AS-1A     CDR  A
                2050      1050
 SHUTTLE SEQUENCE        2-R          1-R
 ALTITUDE                270.         297.
 INCLINATION             28.5        28.5
 TOTAL LENGTH UP:    5.      TOTAL LENGTH DOWN:  30.
 TOTAL WEIGHT UP: 12966.4    TOTAL WEIGHT DOWN: 12135.7
 NO. OF KITS NEEDED: 1       % USE OF FIRST KIT:  11.02
 PAYLOAD MARGIN: 19864.     LOAD FACTOR:  .37924
 SHUTTLE DELTAV:  1281.

FLT. NO.   15      LAUNCH SITE: ETR

 PAYLOADS:    AS-1A     CDR  A    LS-01     LCR  A
                1050      8002
 SHUTTLE SEQUENCE        1-R          8-D
 ALTITUDE                297.         300.
 INCLINATION             28.5        28.5
 TOTAL LENGTH UP:   18.      TOTAL LENGTH DOWN:  17.
 TOTAL WEIGHT UP: 13211.2    TOTAL WEIGHT DOWN:  7989.7
 NO. OF KITS NEEDED: 1       % USE OF FIRST KIT:   7.36
 PAYLOAD MARGIN: 24010.     LOAD FACTOR:  .24968
 SHUTTLE DELTAV:  1275.

FLT. NO.   16      LAUNCH SITE: ETR

 PAYLOADS:    AS-1A     CDR  A    LS-01     LCR  A
                1050      8052
 SHUTTLE SEQUENCE        1-R          8-R
 ALTITUDE                297.         300.
 INCLINATION             28.5        28.5
 TOTAL LENGTH UP:    5.      TOTAL LENGTH DOWN:  30.
 TOTAL WEIGHT UP: 13064.1    TOTAL WEIGHT DOWN:  8671.7
 NO. OF KITS NEEDED: 1       % USE OF FIRST KIT:  11.84
 PAYLOAD MARGIN: 23328.     LOAD FACTOR:  .27099
 SHUTTLE DELTAV:  1295.

FLT. NO.   17      LAUNCH SITE: ETR

 PAYLOADS:    AS-03     CDR  A    LS-01     LCR  A
                2030      8001
 SHUTTLE SEQUENCE        2-D          8-D
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```
 ALTITUDE                   270.        300.
 INCLINATION                28.5        28.5
 TOTAL LENGTH UP:   31.      TOTAL LENGTH DOWN:    5.
 TOTAL WEIGHT UP: 17040.6     TOTAL WEIGHT DOWN:  7349.7
 NO. OF KITS NEEDED: 1         % USE OF FIRST KIT:   4.71
 PAYLOAD MARGIN: 24650.     LOAD FACTOR:  .26216
 SHUTTLE DELTAV:  1255.

FLT. NO.   18      LAUNCH SITE: ETR

 PAYLOADS:    AS-03    CDR  A    LS-01    LCR  A
               2000       8051
 SHUTTLE SEQUENCE           2-D         8-R
 ALTITUDE                   270.        300.
 INCLINATION                28.5        28.5
 TOTAL LENGTH UP:   18.      TOTAL LENGTH DOWN:  18.
 TOTAL WEIGHT UP: 16888.7     TOTAL WEIGHT DOWN:  8031.7
 NO. OF KITS NEEDED: 1         % USE OF FIRST KIT:   9.15
 PAYLOAD MARGIN: 23968.     LOAD FACTOR:  .25983
 SHUTTLE DELTAV:  1275.

FLT. NO.   19      LAUNCH SITE: ETR

 PAYLOADS:    AS-03    CDR  A    LS-01    LCR  A
               2050       8002
 SHUTTLE SEQUENCE           2-R         8-D
 ALTITUDE                   270.        300.
 INCLINATION                28.5        28.5
 TOTAL LENGTH UP:   18.      TOTAL LENGTH DOWN:  18.
 TOTAL WEIGHT UP: 13400.2     TOTAL WEIGHT DOWN: 11495.7
 NO. OF KITS NEEDED: 1         % USE OF FIRST KIT:   8.94
 PAYLOAD MARGIN: 20504.     LOAD FACTOR:  .35924
 SHUTTLE DELTAV:  1275.

FLT. NO.   20      LAUNCH SITE: ETR

 PAYLOADS:    AS-03    CDR  A    LS-01    LCR  A
               2050       8052
 SHUTTLE SEQUENCE           2-R         8-R
 ALTITUDE                   270.        300.
 INCLINATION                28.5        28.5
 TOTAL LENGTH UP:    5.      TOTAL LENGTH DOWN:  31.
 TOTAL WEIGHT UP: 13261.0     TOTAL WEIGHT DOWN: 12177.7
 NO. OF KITS NEEDED: 1         % USE OF FIRST KIT:  13.48
 PAYLOAD MARGIN: 19822.     LOAD FACTOR:  .38055
 SHUTTLE DELTAV:  1295.

FLT. NO.   21      LAUNCH SITE: ETR

 PAYLOADS:    AS-03    CDR  A    AS-1A    CDR  A    LS-01    LCR  A
               2000       1000       8001
 SHUTTLE SEQUENCE           2-D         1-D         8-D
 ALTITUDE                   270.        297.        300.
 INCLINATION                28.5        28.5        28.5
 TOTAL LENGTH UP:   43.      TOTAL LENGTH DOWN:    5.
 TOTAL WEIGHT UP: 21516.1     TOTAL WEIGHT DOWN:  8641.7
 NO. OF KITS NEEDED: 1         % USE OF FIRST KIT:   8.00
```

```
 PAYLOAD MARGIN: 23358.    LOAD FACTOR:  .33102
 SHUTTLE DELTAV:  1255.

FLT. NO.   22      LAUNCH SITE: ETR

 PAYLOADS:     AS-C3     CDP  A    AS-1A    CDP  A   LS-01    LCP  A
                  2000       1000       8051
 SHUTTLE SEQUENCE          2-D          1-D          8-R
 ALTITUDE                  270.         297.         300.
 INCLINATION               28.5         28.5         28.5
 TOTAL LENGTH UP:   30.       TOTAL LENGTH DOWN:   18.
 TOTAL WEIGHT UP: 21367.1      TOTAL WEIGHT DOWN:   9323.7
 NO. OF KITS NEEDED: 1         % USE OF FIRST KIT:   12.46
 PAYLOAD MARGIN: 22676.    LOAD FACTOR:  .32873
 SHUTTLE DELTAV:  1275.

FLT. NO.   23      LAUNCH SITE: ETR

 PAYLOADS:     AS-03     CDP  A    AS-1A    CDP  A   LS-01    LCP  A
                  2050       1000       8002
 SHUTTLE SEQUENCE          2-R          1-D          8-D
 ALTITUDE                  270.         297.         300.
 INCLINATION               28.5         28.5         28.5
 TOTAL LENGTH UP:   30.       TOTAL LENGTH DOWN:   18.
 TOTAL WEIGHT UP: 17884.7      TOTAL WEIGHT DOWN: 12787.7
 NO. OF KITS NEEDED: 1         % USE OF FIRST KIT:   12.31
 PAYLOAD MARGIN: 19212.    LOAD FACTOR:  .39962
 SHUTTLE DELTAV:  1275.

FLT. NO.   24      LAUNCH SITE: ETR

 PAYLOADS:     AS-03     CDP  A    AS-1A    CDP  A   LS-01    LCP  A
                  2050       1000       8052
 SHUTTLE SEQUENCE          2-R          1-D          8-R
 ALTITUDE                  270.         297.         300.
 INCLINATION               28.5         28.5         28.5
 TOTAL LENGTH UP:   17.       TOTAL LENGTH DOWN:   31.
 TOTAL WEIGHT UP: 17748.3      TOTAL WEIGHT DOWN: 13469.7
 NO. OF KITS NEEDED: 1         % USE OF FIRST KIT:   16.88
 PAYLOAD MARGIN: 18530.    LOAD FACTOR:  .42093
 SHUTTLE DELTAV:  1295.

FLT. NO.   25      LAUNCH SITE: ETR

 PAYLOADS:     AS-03     CDP  A    AS-1A    CDP  A   LS-01    LCP  A
                  2000       1050       8001
 SHUTTLE SEQUENCE          2-D          1-R          8-D
 ALTITUDE                  270.         297.         300.
 INCLINATION               28.5         28.5         28.5
 TOTAL LENGTH UP:   31.       TOTAL LENGTH DOWN:   17.
 TOTAL WEIGHT UP: 21415.9      TOTAL WEIGHT DOWN:   9281.7
 NO. OF KITS NEEDED: 1         % USE OF FIRST KIT:   12.52
 PAYLOAD MARGIN: 22718.    LOAD FACTOR:  .32947
 SHUTTLE DELTAV:  1275.

FLT. NO.   26      LAUNCH SITE: ETR
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 PAYLOADS:    AS-03     CDR  A    AS-1A     CDR  A    LS-01     LCR  A
             2000      1050      8051
 SHUTTLE SEQUENCE       2-D          1-R           8-R
 ALTITUDE               270.         297.         300.
 INCLINATION            28.5         28.5         28.5
 TOTAL LENGTH UP:  18.      TOTAL LENGTH DOWN:  30.
 TOTAL WEIGHT UP: 21271.6    TOTAL WEIGHT DOWN:  9963.7
 NO. OF KITS NEEDED: 1       % USE OF FIRST KIT:  17.02
 PAYLOAD MARGIN: 22036.     LOAD FACTOR:  .32726
 SHUTTLE DELTAV:  1295.

FLT. NO.   27      LAUNCH SITE: ETR

 PAYLOADS:    AS-03     CDR  A    AS-1A     CDR  A    LS-01     LCR  A
             2050      1050      8002
 SHUTTLE SEQUENCE       2-R          1-R           8-D
 ALTITUDE               270.         297.         300.
 INCLINATION            28.5         28.5         28.5
 TOTAL LENGTH UP:  18.      TOTAL LENGTH DOWN:  30.
 TOTAL WEIGHT UP: 17797.1    TOTAL WEIGHT DOWN: 13427.7
 NO. OF KITS NEEDED: 1       % USE OF FIRST KIT:  16.93
 PAYLOAD MARGIN: 18572.     LOAD FACTOR:  .41962
 SHUTTLE DELTAV:  1295.

FLT. NO.   28      LAUNCH SITE: ETR

 PAYLOADS:    AS-03     CDR  A    AS-1A     CDR  A    LS-01     LCR  A
             2050      1050      8052
 SHUTTLE SEQUENCE       2-R          1-R           8-R
 ALTITUDE               270.         297.         300.
 INCLINATION            28.5         28.5         28.5
 TOTAL LENGTH UP:   5.      TOTAL LENGTH DOWN:  43.
 TOTAL WEIGHT UP: 19465.5    TOTAL WEIGHT DOWN: 14109.7
 NO. OF KITS NEEDED: 1       % USE OF FIRST KIT:  36.60
 PAYLOAD MARGIN: 17890.     LOAD FACTOR:  .44093
 SHUTTLE DELTAV:  1315.
*******************  STATISTICAL ANALYSIS FOR 1980  *******************
TOTAL NUMBER OF COMBINATIONS GENERATED:        66
       NUMBER OF FEASIBLE COMBINATIONS:        28
       NUMBER OF INFEASIBLE COMBINATIONS:      38

TOTAL ELAPSED TIME:          551
       (ALL TIMES ARE IN MILLISECONDS)
       AVERAGE TIME PER FEASIBLE COMBINATION:      19
       AVERAGE TIME PER GENERATED COMBINATION:      8
* TIME IN FEACOM *          41
```

```
 MISSION TYPE ANALYSIS

CHOOSE COST COEFFICIENT FOR EACH FLIGHT:

1980      OCCURRENCE TABLE
     PAYLOAD     FEASIBLE COMBINATIONS
  1)   1000      1    9    10   11   12   21   22   23   24
  2)   1050      2   13    14   15   16   25   26   27   28
  3)   2000      3    9    13   17   18   21   22   25   26
  4)   2050      4   10    14   19   20   23   24   27   28
  5)   8001      5   11    17   21   25
  6)   8002      6   15    19   23   27
  7)   8051      7   12    18   22   26
  8)   8052      8   16    20   24   28
  ** MAX NO. SINGLES =     8

OCCURRENCE TABLE AND GREEDY INTERFACE REQUIRED    79 MILLISECONDS
TIME IN GREEDY =         24 MILLISECONDS
TRAFFIC MODEL CONTAINS THE FOLLOWING  4 MISSIONS
         5         6         22         26
THE TRAFFIC MODEL COST IS      4
SELECT AN OPTION: ( 5 TO TERMINATE )
 RUN FINISHED NORMALLY


6BRKPT PRINTS
```

2345678901234567890123456789012345678901234567890123456789012345678901234567

6. REFERENCES

1. Williams, J.: Mission Payloads Subsystem Description, LEC-7390, Dec. 11, 1975.

2. Chang, H.: The GREEDY Algorithm, A Subprogram of the Scheduling Algorithm for Mission Planning Logic Evaluation, LEC-7621, Jan. 9, 1976.

3. Kirtley, R. P., and Glendenning, M. G.: Design, Description, and User Information for the Operations Simulation and Resource Scheduling Processor, TRW Note No. 73-FMT-914, Sept. 24, 1973.

APPENDIX A

FORMAT OF THE FEASIBLE COMBINATION FILE

The feasible combination file is unformatted and contains one record for each feasible combination generated by the program. Each record contains the following information.

Word no.	Symbol	Dimension	Type	Description
1	MM	1	I	Flight number
2	M	1	I	Number of payloads on this flight
3 - 8	IC	6	I	Payload numbers
9 - 14	IB	6	I	Optimal payload sequence
15 - 20	NAME1	6	A	Alphanumeric mission type
21	LAUNCH	1	I	A flag set to 1 or 2, indicating the eastern or western test range
22	NTUGPL	1	I	Number of TSV payloads
23	IFTUG	1	I	TSV number used for this mission
24 - 29	ICTUG	6	I	Payload numbers of the TSV payloads
30	NOKITS	1	I	Number of OMS kits used
31	PWMARG	1	R	Additional payload weight the Orbiter could carry on this flight
32	PCTUSE	1	R	Percentage of the first OMS kit that is used
33	FLOAD	1	R	Load factor

Word no.	Symbol	Dimension	Type	Description
34	POINC	1	R	Inclination of the first orbit
35	POALT	1	R	Altitude of the first orbit
36 - 41	ALT	6	R	Orbital altitude of each payload
42 - 47	XINC	6	R	Orbital inclination of each payload
48	TOTLU	1	R	Total length up
49	TOTLD	1	R	Total length down
50	TOTWU	1	R	Total weight up
51	TOTWD	1	R	Total weight down
52	TUGDV	1	R	Total TSV ΔV used
53	ORBDV	1	R	Total Orbiter ΔV used
54 - 59	IG	6	A	Array of alphabetic mission types
60 - 71	ICC	12	I	Cost coefficients
72 - 83	IDENT	12	A	An array of two-word alphanumeric payload names

APPENDIX B

FORMAT OF THE TRAFFIC MODEL FILES

The traffic model file is formatted and contains seven unique card images. The format below identifies the data required to process one traffic model.

CARD 1

Word no.	Symbol	Format	Columns	Dimension	Type	Description
1	LENGTH	I6	1 - 6	1	I	Number of missions in this traffic model
2	FLAG	A6	7 - 12	1	I	Hollerith word "*CASE*"
3	CASE	I6	13 - 18	1	I	Number of the traffic model

CARD 2 TO 7

The next set of cards is in groups of six; the number of sets for the traffic model is identified by the word "LENGTH" of the first card.

Card no.	Word no.	Symbol	Format	Columns	Dimension	Type	Description
2	1	RECORD	I4	1 - 4	83	I	Flight number
2	2		I4	5 - 8		I	Number of payloads on this flight
2	3		6I6	9 - 44		I	Payload numbers
2	4		6I4	45 - 68		I	Optimal payload sequence
2	5		2A6	69 - 80		A	Alphanumeric mission type
3	1		4A6	1 - 24		A	

Card no.	Word no.	Symbol	Format	Columns	Dimension	Type	Description
3	2		I2	25 - 26		I	A flag set to 1 or 2, indicating the eastern or western test range
3	3		I2	27 - 28		I	Number of TSV payloads
3	4		I2	29 - 30		I	TSV number used for this mission
3	5		6I4	31 - 54		I	Payload numbers of the TSV payloads
3	6		I2	55 - 56		I	Number of OMS kits used
3	7		F10.0	57 - 66		R	Additional payload weight the Orbiter can carry on this flight
3	8		F5.0	67 - 71		R	Percentage of the first OMS kit that is used
3	9		F5.0	72 - 76		R	Load factor
4	1		F7.1	1 - 7		R	Inclination of the first orbit
4	2		F7.1	8 - 14		R	Altitude of the first orbit
4	3 - 8		6 F7.1	15 - 56		R	Orbital altitude of each payload
4	9 - 10		2 F7.1	57 - 70		R	Orbital inclination of each payload
5	1 - 4		4 F7.1	1 - 28		R	

Card no.	Word no.	Symbol	Format	Columns	Dimension	Type	Description
5	5		F7.1	29 - 35		R	Total length up
5	6		F7.1	36 - 42		R	Total length down
5	7		F7.1	43 - 49		R	Total weight up
5	8		F7.1	50 - 56		R	Total weight down
5	9		F7.1	57 - 63		R	Total TSV ΔV used
5	10		F7.0	64 - 70		R	Total Orbiter ΔV used
5	11 - 16		6A1	71 - 76		A	Array of alphabetic mission types
6	1 - 12		12I6	1 - 72		I	Cost coefficients
7	1 - 12		12A6	1 - 72		A	An array of two-word alphanumeric payload names

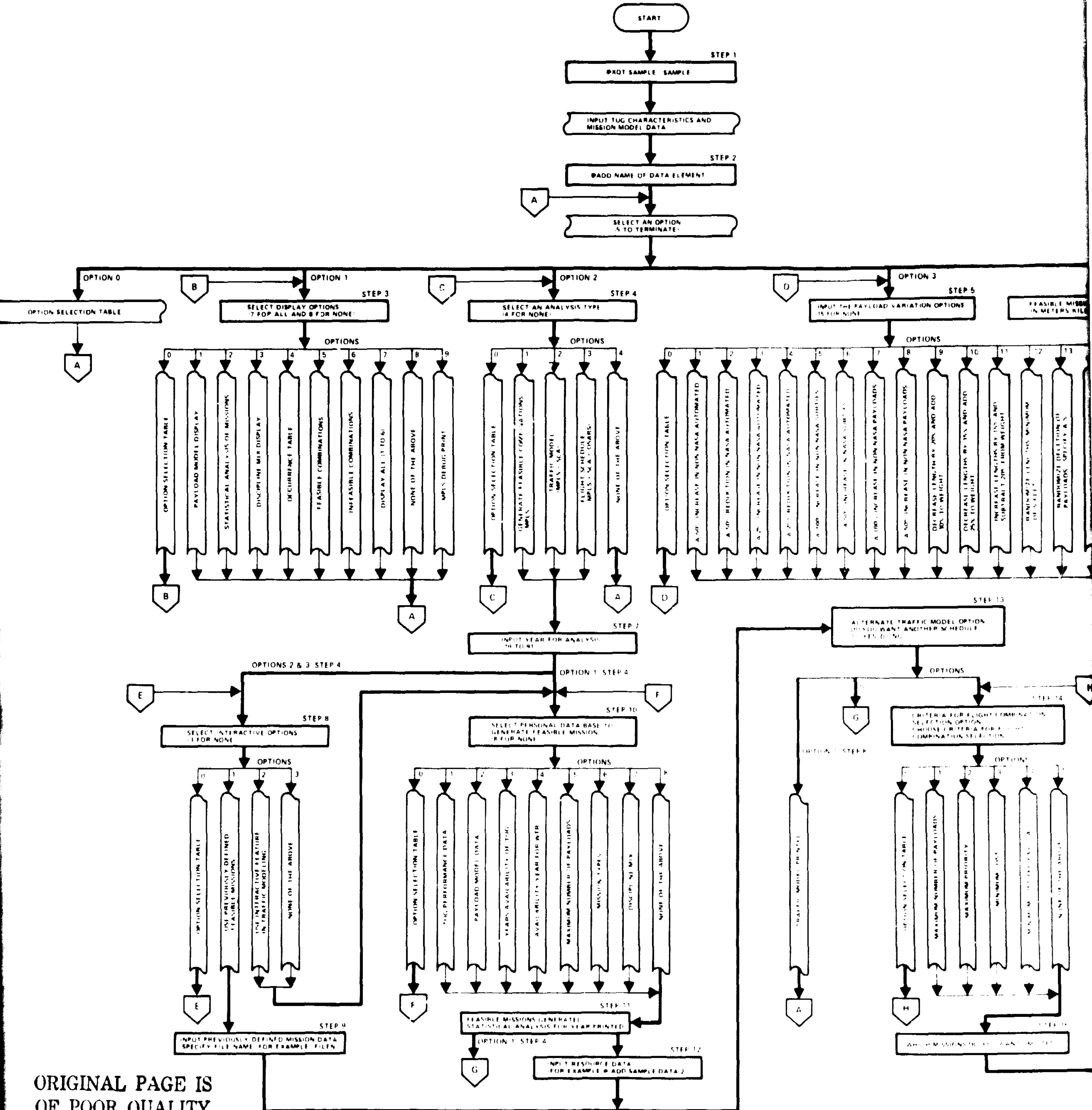

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Figure B-1.- Program logic flow.

FOLDOUT FRAME

SAMPLE PROGRAM LOGIC FLOW