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EMERGENCY EVACUATION COMPUTER SIMULATION - PROGRAM DESCRIPTION --ETC(U)
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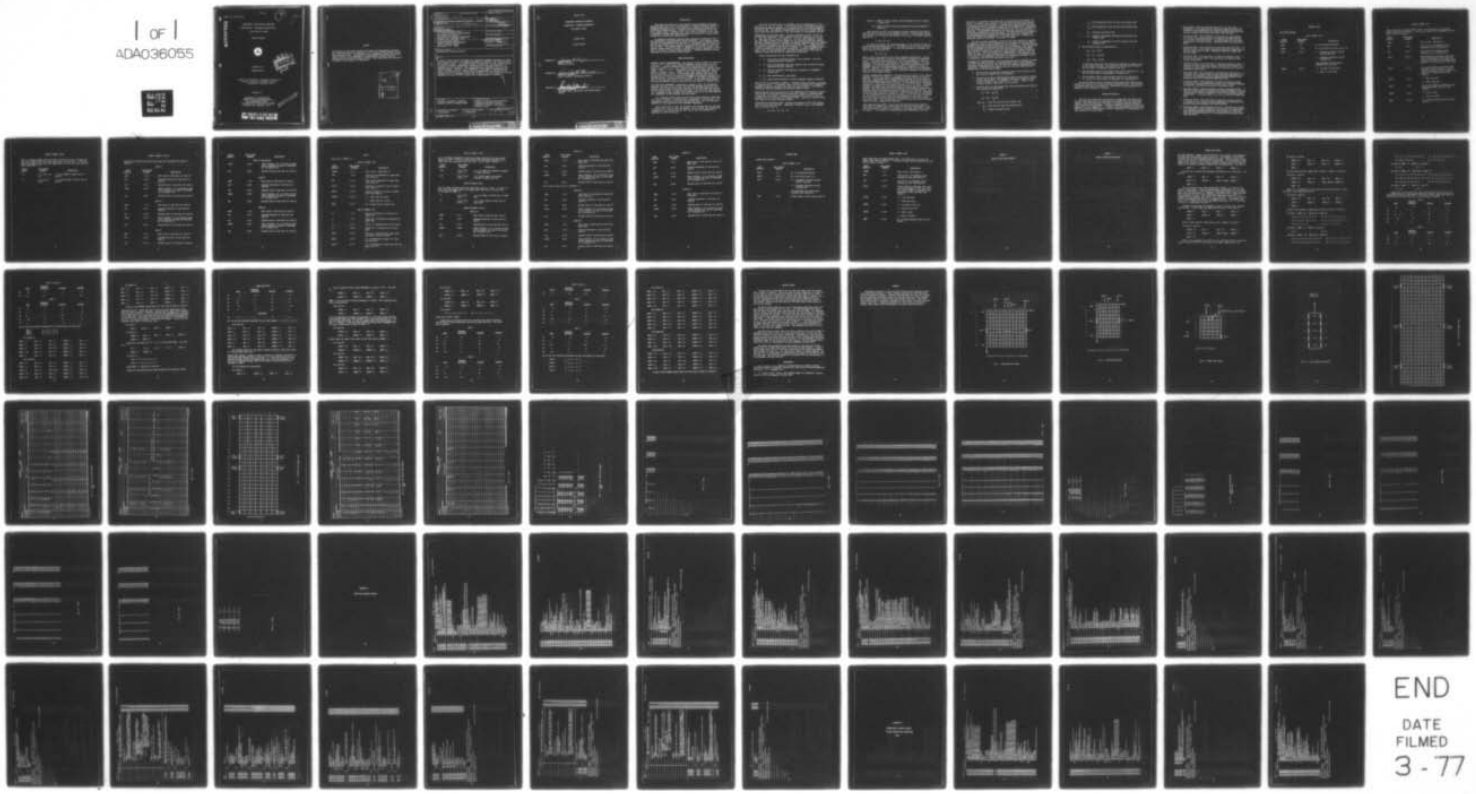

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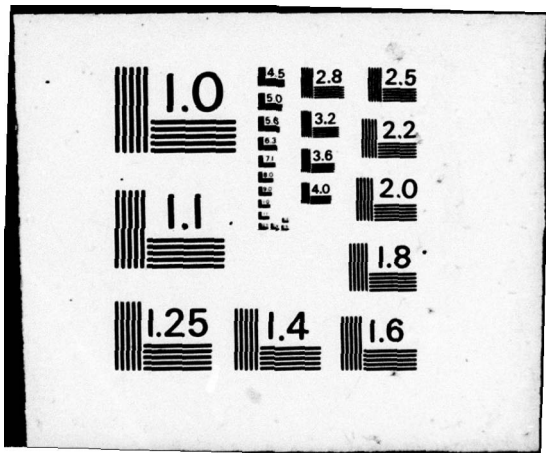
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EMERGENCY EVACUATION COMPUTER SIMULATION - PROGRAM DESCRIPTION AND USER'S GUIDE

JAMES GILLESPIE

OCTOBER 1976

INTERIM REPORT

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Prepared by

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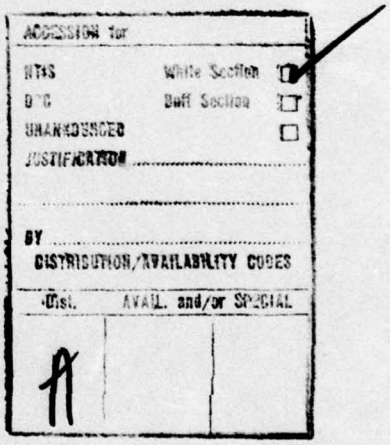

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16. Abstract

A computer model has been developed that simulates emergency evacuation in transport category aircraft. Two computer programs are available that model wide and narrow body aircraft. The computer model is statistical in that a gamma function is assumed to obtain a probability distribution for time path segments of a passenger during evacuation. The program has been successfully run on an IBM 370/155 computer. Running time is dependent on the number of passengers and number of simulations run. Running time is approximately one minute for five evacuations of a 80 passenger narrow body aircraft. For 100 evacuations of a 389 passenger wide body aircraft running time is approximately 90 minutes.

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EMERGENCY EVACUATION COMPUTER SIMULATION - PROGRAM DESCRIPTION AND USER'S GUIDE

October 1976

Interim Report

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INTRODUCTION

High costs and injuries to test subjects during emergency evacuation demonstrations have led to the development of computer simulation models of emergency evacuations with a long-range goal of eventually replacing the certification demonstrations. Besides the obvious advantages of low cost and no human injury, a computer model can be used to simulate a wide range of emergencies rather than those done under the restrictive criteria established for a certification demonstration.

An emergency evacuation computer model described in Reference 1 has been developed by FAA Aeronautical Center personnel. This computer program is based on the assumption that the door is a bottleneck and passenger movement in the interior of the aircraft is not considered except as a queue at the exit door. The computer model in Reference 1 is written in GPSS. The present computer model is written in FORTRAN and traces a passenger from his seat to the exit he selects during evacuation. Separate programs have been developed for wide and narrow body aircraft.

MODEL DESCRIPTION

AIRCRAFT INTERIOR REPRESENTATION - The interior of the aircraft is treated as a matrix of I, J values that identify passenger seating, aisle, and exit locations. A general representation of wide and narrow body aircraft is shown in figures 1 and 2. The I denotes row number and the J denotes column number. Thus, I = 1, J = 1 represents the seat of the upper left hand passenger in figures 1 and 2. Figures 1 and 2 show input parameters, which will be discussed in detail in the program input section, that allow the program user to specify the seating arrangement and passenger assigned to a particular exit. Further flexibility is added to the model by allowing the user to identify empty seats in the aircraft. In the narrow body program the user can identify seats in exit rows that are common in overwing exits.

EXIT PATH TIME COMPONENTS - Referring to figures 1 and 2, in evacuating a passenger must get out of his seat and move through boxes where seats are present, move through aisle boxes, and then move through boxes which may or may not contain seats, to reach the exit door. Let T_1 be the time required for a passenger to move through a box without seats and T_2 the time required for a passenger to move through a box with seats.

As a passenger moves toward the exit door he may encounter a delay due to a line at the door. This delay will be dependent on the movement of the passengers in front of him and the door opening time. Let T_3 be the time required for door opening and exit equipment deployment.

When a door exit is free, the passenger goes through the door and down a slide or off a wing to reach the ground. Let T_4 be the time required for a passenger to go through the exit door and T_5 the time required for a passenger to reach the ground.

The total evacuation time of a passenger can be represented as a function of T_1, T_2, T_3, T_4, and T_5. First the individual time components must be determined and then be combined in a suitable manner to determine passenger evacuation time. The computer programs have been written to accept time component input for each open exit. All times except T_3 are passenger related.

DETERMINATION OF EXIT PATH TIMES - The same mathematical model is used for all five time components. Each passenger is given a unique T_1, T_2, T_4 and T_5. Each open exit is given a unique T_3. For each time component, evacuation test data suitable to that segment of the evacuation path are required. The mean, standard deviation, minimum, and maximum component times are required for a group of passengers or exit doors as program input. A gamma function is fitted to this data by the Method of Moments (2). From the gamma function a table of probability versus time is generated. A random probability between 0 and 1 is then determined. The random probability is then used to generate a time from the table of probability versus time.

Factors influencing the time components are:

1. T_1 - aisle width, aircraft attitude, aisle blockage, visibility, passenger physical condition
2. T_2 - seat configuration, seat belt removal time, aircraft attitude, passenger physical condition
3. T_3 - door and equipment configuration, passenger or crewmember opening door
4. T_4 - door configuration, crew effort
5. T_5 - type of path followed to ground, passenger physical condition.

This list is not necessarily complete. Passenger mental attitude is certainly an important factor. A systematic small scale test program will probably be required to generate suitable input data for these functions. The factors cited above must be considered in obtaining ranges of data.

Because the data used to generate the time components are statistical, provision is made in the program to allow the user to generate a desired number of emergency evacuations. Average data obtained from a series of runs is probably more representative of evacuation tests. Generally, similar evacuation tests will produce different results.

CALCULATION OF EVACUATION TIME - Consider the movement of the first passenger to a given open exit door. Referring to figures 1 and 2, the passenger time to the door (T_D) is:

$$T_D = N_1 \cdot T_1 + N_2 \cdot T_2 \qquad 1$$

where N_1 = number of boxes without seats passenger must move through to reach exit

N_2 = number of boxes with seats passenger must move through to reach exit

Upon reaching the door the passenger is either delayed by the time it takes the door to open or he goes through the door. The time spent inside the aircraft (T_A) is taken as the greater of T_3 or T_D. The total evacuation time (T) is:

$$T = T_A + T_4 + T_5 \qquad 2$$

If there is no delay, the second passenger to exit reaches the door in the time determined from equation 1. Note that N_1, T_1, N_2, and T_2 are different for the second passenger. If the second passenger is delayed, his time to the door is given by:

$$T_D = T_A + T_4 \qquad 3$$

where T_A and T_4 are values for the first passenger preceding him. The T_A for the second passenger is taken as the greater T_D computed by equations 1 and 3. The total evacuation time for the second passenger is given by equation 2 using T_4 and T_5 appropriate to the second passenger. For each passenger, T_A is used to keep a record of the delays encountered by that passenger or is the time determined by equation 1 depending on which is greater. Equation 2 is used to compute evacuation time for each passenger. Thus, the door may not necessarily be a bottleneck throughout the evacuation process in this computer model.

INITIAL PASSENGER EXIT SELECTION - Two options are available in the computer programs. In the first option, a passenger evacuates through the nearest open exit. The nearest exit is determined by counting the total number of boxes the passenger must move through to reach each open exit and selecting the exit with the smallest total of boxes. In the second option, passengers assigned to a given exit must evacuate through it if it is open. Passengers assigned to blocked exits evacuate through the nearest open exit in both options. The second option has been included in the computer model because passengers may not necessarily evacuate through the exit nearest them. This gives the program user some flexibility in selecting an exit for a passenger if this has been observed in evacuation tests. In both options, the passenger exit selection is an initial one and passengers at the ends of lines of exits with long evacuation times are redistributed to exits with shorter evacuation times. The redistribution is based on exit flow rates determined from the initial passenger exit selection.

UPPER DECK WIDE BODY MODEL - Since wide body aircraft may have upper or lower decks in addition to the main deck, provision has been added in the wide body program to handle this situation. The upper deck model is shown in figure 3. It consists of a passenger seating configuration with one

aisle only, a staircase to the main deck, and one exit to the outside. By using I, J notation, the location of the staircase and exit may be varied. It should be noted that the same I, J values can be used for upper and main deck passengers since the program handles the decks separately. The program user can assign any combination of passengers to the exit to the outside and staircase. For passengers assigned to the staircase, the user must also select their escape exit on the main deck. The escape path and time segments for passengers exiting directly are handled the same as lower deck exits using time segment data appropriate to the upper deck exit. However, for passengers using the staircase, a new model is needed.

The time it takes a passenger to move to the stair entrance is similar to equation 1 using T_1 and T_2 appropriate to the upper deck and the boxes a passenger must move through to reach the stair entrance. A new time function T_6 must be defined for passenger movement on the staircase. This function is the same mathematically as the five time functions previously discussed. Upon reaching the main deck a passenger moves through a number of boxes to reach the exit. This time segment is T_2 appropriate to the main deck exit times the number of boxes the passenger moves through. The passenger time to the exit is thus composed of his time to the staircase entrance, time on the staircase, and time from staircase to exit door.

PASSENGER EXIT REDISTRIBUTION - The aircraft exits must be numbered as shown in figure 4 in order for the exit redistribution logic to work properly. After the initial evacuation, the exit with the greatest evacuation time is determined. Passengers at the end of this exit line are redistributed to another exit in the following manner:

1. The exit with the shortest evacuation time in the vicinity of the exit with the longest time is determined.

2. Vicinity of an exit is defined as any exit one exit away on either side of the aircraft. For example, referring to figure 4, exits in the vicinity of exit 1 are exits 2, 3, and 4. Exits in the vicinity of exit 3 are exits 1, 2, 4, 5 and 6.

3. The flow rates for the longest exit time and shortest exit time in the vicinity are computed by:

$$R_L = (T_L - T_{3_L})/N_L \qquad 4$$

$$R_S = (T_S - T_{3_S})/N_S \qquad 5$$

where R_L = flow rate for exit with longest time

R_S = flow rate for exit with shortest time

T_L = longest evacuation time

T_{3_L} = exit preparation time for exit with longest time

T_{3_S} = exit preparation time for exit with shortest time

T_S = shortest evacuation time

N_L = number of passengers evacuating through exit with longest time

N_S = number of passengers evacuating through exit with shortest time

4. The following values are determined by:

$$T_{AV} = (T_L + T_S)/2 \quad (6)$$

$$\Delta N_L = (T_L - T_{AV})/R_L \quad (7)$$

$$\Delta N_S = (T_{AV} - T_S)/R_S \quad (8)$$

It should be noted that ΔN_L and ΔN_S are truncated to integer values in the computer program. The smallest of ΔN_L and ΔN_S is taken as the net change in passengers between exits (ΔN).

5. The evacuation time for the longest time exit is reduced by $\Delta N \cdot R_L$ and the total amount of passengers is reduced by ΔN.

6. The evacuation time for the shortest time exit is increased by $\Delta N \cdot R_S$ and the total amount of passengers is increased by ΔN.

The same procedure is again repeated reducing evacuation time and passengers for the exit now having the greatest evacuation time. The procedure is repeated until ΔN_L or ΔN_S equals 0. Experience to date indicates that a maximum of five iterations is required.

PROGRAM DESCRIPTION

Both wide and narrow body programs use the same names for subroutines. The wide body program has one more subroutine (UDECK) than the narrow body program. The main program and subroutine PATH contain slightly different logic between the two programs. A complete FORTRAN listing of the wide body program is given in Appendix I. A listing of the main program and subroutine PATH for the narrow body program is given in Appendix II. A description of each subroutine is given below:

1. Main program - The main program reads in all the input data. It determines initial passenger exit selection using two options described in the paragraph entitled INITIAL PASSENGER EXIT SELECTION. The main program calls subroutines GAMF, PATH, and OPTIM.

2. Subroutine GAMF - This subroutine is called by the main program. It acts as a controlling program to establish the gamma function fit to input time segment data. It returns tables of time versus probability to the main program. Subroutine GAMF calls subroutine CDTR.

3. Subroutine CDTR - This subroutine is called by subroutine GAMF. It computes tables of time versus probability based on a gamma function fit and returns them to GAMF. Subroutine CDTR calls subroutines NDTR and DLGAM.

4. Subroutine NDTR - This subroutine is called by subroutine CDTR. It is used by subroutine CDTR in the calculation of tables of probability versus time.

5. Subroutine DLGAM - This subroutine is called by subroutine CDTR. It computes the double precision natural logarithm of the gamma function and is used by subroutine CDTR in the calculation of tables of probability versus time.

6. Subroutine PATH - This subroutine is called by the main program. It calculates the evacuation time for each individual passenger as described in the paragraph entitled CALCULATION OF EVACUATION TIME. Subroutine PATH calls subroutines RANDU and LININ.

7. Subroutine RANDU - This subroutine is called by subroutine PATH. It generates a random probability between 0 and 1 for each passenger and open exit door which is returned to subroutine PATH.

8. Subroutine LININ - This subroutine is called by subroutine PATH. It uses the random probability generated by subroutine RANDU to linearly interpolate the tables of probability versus time generated by subroutine GAMF. It returns times T_1, T_2, T_3, T_4, and T_5 to subroutine PATH.

9. Subroutine OPTIM - This subroutine is called by the main program. It changes the exit route of certain passengers as described in the paragraph entitled PASSENGER EXIT REDISTRIBUTION.

10. Subroutine UDECK - This subroutine is only in the wide body program. It is called by the main program if the aircraft has an upper deck. This subroutine simulates evacuation from an upper or lower deck using the procedure described in the paragraph entitled upper deck wide body model.

PROGRAM INPUT

WIDE BODY PROGRAM

CARD A FORMAT (4I5)

INPUT QUANTITY	CARD COLUMN NUMBERS	DESCRIPTION
NRUN	1-5	No. of simulations desired
NEXIT	6-10	No. of main deck aircraft exits $\leq$ 10
NOPT	11-15	= 0 Passenger evacuates through nearest open exit
		= 1 Passenger evacuates through assigned exit
		(See paragraph entitled initial passenger exit selection)
NDECK	16-20	= 0 No upper or lower deck
		= 1 Upper or lower deck

CARDS B FORMAT (9I5)

These cards must be repeated NEXIT times. The cards must be in the exit number order shown in Figure 4. The aircraft seats must be numbered for each exit as shown in Figure 1.

INPUT QUANTITY	CARD COLUMN NUMBERS	DESCRIPTION
IROWE	1-5	Exit row No. (See Figure 1)
NRF	6-10	First row No. of passenger seats assigned to exit (See Figure 1)
NRL	11-15	Last row No. of passenger seats assigned to exit (See Figure 1)
NCOL1	16-20	Column number of passenger seats nearest aisle assigned to left side exit. Lowest column number of passenger seats assigned to right side exit (See Figure 1)
NCOL2	21-25	Last column number of passenger seats assigned to left side exit. Column number of passenger seats nearest aisle assigned to right side exit (See Figure 1)
NSIDE	26-30	= 0 Left side exit = 1 Right side exit
NCOL3	31-35	Last column number of passenger seats assigned to right side exit (See Figure 1)
NOPEN	36-40	= 0 Exit is open = 1 Exit is closed
NEMP	41-45	No. of empty passenger seats in exit section.

CARDS C FORMAT (16I5)

The I, J values of empty seats are input 8 pairs to a card. If there are more than 8 empty seats to an exit continue on the next card. A new card must be started for each exit with empty seats. Do not input any cards for exits where NEMP = 0.

INPUT QUANTITY	CARD COLUMN NUMBERS	DESCRIPTION
IV	1-5, 11-15, 21, 25, ...	I or row number of empty seat in section
JV	6-10, 16-20, 26-30, ...	J or column number of empty seat in section

CARDS D FORMAT (5F 10.0)

Five sets of cards are input for each open exit following the order of Figure 4.

CARD D1

INPUT QUANTITY	CARD COLUMN NUMBERS	DESCRIPTION
XMN1	1-10	Mean value of time data for time T1.
SD1	11-20	Standard deviation of time data for time T1.
XU1	21-30	Maximum value of time data for time T1.
XINT1	31-40	Table interval. No. of points in time versus probability table is XU1/XINT1. No. of points $\leq$ 50.
XL1	41-50	Minimum value of time data for time T1.

CARD D2

XMN2	1-10	Mean value of time data for time T2.
SD2	11-20	Standard deviation of time data for time T2.
XU2	21-30	Maximum value of time data for time T2.
XINT2	31-40	Table interval. No. of points in time versus probability table is XU2/XINT2. No. of points $\leq$ 50.
XL2	41-50	Minimum value of time data for time T2.

CARD D3

XMN3	1-10	Mean value of time data for time T3.
SD3	11-20	Standard deviation of time data for time T3.
XU3	21-30	Maximum value of time data for time T3.

INPUT QUANTITY	CARD COLUMN NUMBERS	DESCRIPTION
		CARD D3 (Continued)
XINT3	31-40	Table interval. No. of points in time versus probability table is XU3/XINT3. No. of points $\leq$ 50.
XL3	41-50	Minimum value of time data for time T3.
		CARD D4
XMN4	1-10	Mean value of time data for time T4.
SD4	11-20	Standard deviation of time data for time T4.
XU4	21-30	Maximum value of time data for time T4.
XINT4	31-40	Table interval. No. of points in time versus probability table is XU4/XINT4. No. of points $\leq$ 50.
XL4	41-50	Minimum value of time data for time T4.
		CARD D5
XMN5	1-10	Mean value of time data for time T5.
SD5	11-20	Standard deviation of time data for time T5.
XU5	21-30	Maximum value of time data for time T5.
XINT5	31-40	Table interval. No. of points in time versus probability table is XU5/XINT5. No. of points $\leq$ 50.
XL5	41-50	Minimum value of time data for time T5.

CARDS E

Input only if NDECK = 1.

CARD E1 FORMAT (7I5)

INPUT QUANTITY	CARD COLUMN NUMBERS	DESCRIPTION
IROWE	1-5	Exit row No. (See Figure 3)
NRF	6-10	First row of passengers in upper deck (See Figure 3)
NRL	11-15	Last row of passengers in upper deck (See Figure 3)
NCOL1	16-20	Column No. of seats on left of aisle (See Figure 3)
NCOL2	21-25	Largest column No. of seats in upper deck (See Figure 3)
NOPEN	26-30	= 0 Upper deck exit open = 1 Upper deck exit closed
NEMP	31-35	No. of empty seats in upper deck

CARD E2 FORMAT (7I5)

IU	1-5	Row No. of entrance to staircase in upper deck
JU	6-10	Column No. of entrance to staircase in upper deck
IL	11-15	Row No. of staircase exit on main deck
JL	16-20	Column No. of staircase exit on main deck
NOUT	21-25	Exit No. on main deck that upper deck passengers evacuate through
NNOUT	26-30	No. of passengers on upper deck that use staircase
NUOUT	31-35	No. of passengers on upper deck that use upper deck exit

CARD E3 FORMAT (16I5)

The I,J values of passengers that use the upper deck exit are input eight pairs to a card. If there are more than eight passengers assigned to the upper deck exit continue on the next card. Do not input if NUOUT = 0.

INPUT QUANTITY	CARD COLUMN NUMBERS	DESCRIPTION
IUD	1-5, 11-15, 21-25, ...	I or row number of passenger assigned to upper deck exit
JUD	6-10, 16-20, 26-30, ...	J or column number of passenger assigned to upper deck exit

CARD E4 FORMAT (16I5)

The I,J values of empty seats are input eight pairs to a card. If there are more than eight empty seats in the upper deck continue on the next card. Do not input if NEMP = 0.

IV	1-5, 11-15, 21-25, ...	I or row number of empty seat in upper deck
JV	6-10, 16-20, 26-30, ...	J or column number of empty seat in upper deck

CARDS E5 FORMAT (5F10.0)

CARD E5.1

XMN1	1-10	Mean value of time data for time T1
SD1	11-20	Standard deviation of time data for time T1
XU1	21-30	Maximum value of time data for time T1
XINT1	31-40	Table interval. No. of points in time versus probability table is XU1/XINT1. No. of points $\leq$ 50.
XL1	41-50	Minimum value of time data for time T1

CARD E5.2

INPUT QUANTITY	CARD COLUMN NUMBERS	DESCRIPTION
XMN2	1-10	Mean value of time data for time T2 on upper deck
SD2	11-20	Standard deviation of time data for time T2
XU2	21-30	Maximum value of time data for time T2
XINT2	31-40	Table interval. No. of points in time versus probability table is XU2/XINT2. No. of points $\leq$ 50.
XL2	41-50	Minimum value of time data for time T2

Do not input cards E5.3-5.5 if NOPEN = 1.

CARD E5.3

XMN3	1-10	Mean value of time data for time T3 of upper deck exit
SD3	11-20	Standard deviation of time data for time T3
XU3	21-30	Maximum value of time data for time T3
XINT3	31-40	Table interval. No. of points in time versus probability table is XU3/XINT3. No. of points $\leq$ 50.
XL3	41-50	Minimum value of time data for time T3

CARD E5.4

XMN4	1-10	Mean value of time data for time T4 of upper deck
SD4	11-20	Standard deviation of time data for time T4
XU4	21-30	Maximum value of time data for time T4
XINT4	31-40	Table interval. No. of points in time versus probability table is XU4/XINT4. No. of points $\leq$ 50.
XL4	41-50	Minimum value of time data for time T4

CARD E5.5

INPUT QUANTITY	CARD COLUMN NUMBERS	DESCRIPTION
XMN5	1-10	Mean value of time data for time T5 of upper deck
SD5	11-20	Standard deviation of time data for time T5
XU5	21-30	Maximum value of time data for time T5
XINT5	31-40	Table interval. No. of points in time versus probability table is XU5/XINT5. No. of points $\leq$ 50.
XL5	41-50	Minimum value of time data for time T5

CARD E5.6

XMN6	1-10	Mean value of time data for time T6 of staircase
SD6	11-20	Standard deviation of time data for time T6
XU6	21-30	Maximum value of time data for time T6
XINT6	31-40	Table interval. No. of points in time versus probability table is XU6/XINT6. No. of points $\leq$ 50.
XL6	41-50	Minimum value of time data for time T6

PROGRAM INPUT

NARROW BODY PROGRAM

CARD A FORMAT (4I5)

INPUT QUANTITY	CARD COLUMN NUMBERS	DESCRIPTION
NRUN	1-5	No. of simulations desired
NEXIT	6-10	No. of aircraft exits $\leq$ 10
NOPT	11-15	= 0 Passenger evacuates through nearest open exit = 1 Passenger evacuates through assigned exit (See paragraph entitled initial passenger exit selection)
JEMP	16-20	Column number of aisle (See Figure 2)

CARDS B FORMAT (8I5)

These cards must be repeated NEXIT times. The cards must be in the exit number order shown in Figure 4. The aircraft seats must be numbered for each exit as shown in Figure 2.

INPUT QUANTITY	CARD COLUMN NUMBERS	DESCRIPTION
IROWE	1-5	Exit row No. (See Figure 2)
NRF	6-10	First row No. of passenger seats assigned to exit (See Figure 2)
NRL	11-15	Last row No. of passenger seats assigned to exit (See Figure 2)
NCOL1	16-20	Column number of passenger seats nearest aisle assigned to left side exit. Last column number of passenger seats assigned to right side exit (See Figure 2)
NSIDE	21-25	= 0 Left side exit = 1 Right side exit
NSEAT	26-30	= 0 No seats in exit row = 1 Seats in exit row
NOPEN	31-35	= 0 Exit is open = 1 Exit is closed
NEMP	41-45	No. of empty passenger seats in exit section

CARDS C

(Same as Wide Body Program)

CARDS D

(Same as Wide Body Program)

SAMPLE CASE INPUT

WIDE BODY PROGRAM - Assume an evacuation test has occurred on the hypothetical wide body configuration shown in Figure 5. The numbers in the seats indicate the exit that passengers used in the test. Since we wish to duplicate the test option 1 will be used in the program. For the purpose of this sample case, we will do only one run although a number such as ten might be better if we wished to actually compare test and program data. For card A:

NRUN = 1 NEXIT = 6 NOPT = 1 NDECK = 0

We wish now to assign the passengers who used exit 1 to that exit. For card B1:

IROWE = 3 NRF = 1 NRL = 9 NCOL1 = 3

NCOL1 = 12 NSIDE = 0 NCOL 3 (blank) NOPEN = 0

NEMP = 21

The only quantity that needs explanation is NEMP = 21, which is the number of empty seats. Since we have assigned the passengers on the right side of the aircraft to a left hand exit, the program logic cannot determine where the right hand aisle is. However, if we make column 9 empty, we will have simulated an aisle. This totals eight empty seats since row 3 is assumed empty by program logic since it is a row exit. For row 8 we wish to ignore any passengers who use an exit different from 1. The number using exit 3 is 5. Similarly for row 9 the number using exit 3 is 8. This gives a total of 21 empty seats for exit 1.

Although no passengers are assigned to exit 2, program logic requires input values. We will input one empty seat for exit 2. For card B2:

IROWE = 3 NRF = 1 NRL = 1 NCOL1 = 7

NCOL2 = 7 NSIDE = 1 NCOL3 = 7 NOPEN = 1

NEMP = 1

We will later specify 1 empty seat in row 1, column 7 for exit 2.

For exit 3, card B3:

IROWE = 14 NRF = 8 NRL = 20 NCOL1 = 3

NCOL2 = 12 NSIDE = 0 NCOL3 (blank) NOPEN = 0

NEMP = 28

NEMP = 28 is composed of 12 seats for the right hand aisle, 5 seats for row 8, 2 seats for row 9, 2 seats for row 19, and 7 seats for row 20.

For exit 4, card B4:

IROWE = 14 NRF = 10 NRL = 10 NCOL1 = 7

NCOL2 = 7 NSIDE = 1 NCOL3 = 7 NOPEN = 1

NEMP = 1

We will later specify 1 empty seat in row 10, column 7 for exit 4.

For exit 5, card B5:

IROWE = 25 NRF = 19 NRL = 30 NCOL1 = 3

NCOL2 = 12 NSIDE = 0 NCOL3 (Blank) NOPEN = 0

NEMP = 22

NEMP = 22 is composed of 11 seats for the right hand aisle, 8 seats for row 19, and 3 seats for row 20.

For exit 6, card B6:

IROWE = 25 NRF = 20 NRL = 20 NCOL1 = 7

NCOL2 = 7 NSIDE = 1 NCOL3 = 7 NOPEN = 1

NEMP = 1

We will later specify 1 empty seat in row 20, column 7 for exit 6.

For exit 1, NEMP = 21. There are 3 cards C1:

IV = 1, 2, 4, 5, 6, 7, 8, 9 JV = 9, 9, 9, 9, 9, 9, 9, 9

IV = 8, 8, 8, 8, 8, 9, 9, 9 JV = 1, 5, 8, 11, 12, 1, 2, 5

IV = 9, 9, 9, 9, 9 JV = 6, 7, 8, 11, 12

For exit 2, NEMP = 1. There is 1 card C2:

IV = 1 JV = 7

For exit 3, NEMP = 28. There are 4 cards C3:

IV = 8, 9, 10, 11, 12, 13, 15, 16 JV = 9, 9, 9, 9, 9, 9, 9, 9

IV = 17, 18, 19, 20, 8, 8, 8, 8 JV = 9, 9, 9, 9, 2, 3, 6, 7

IV = 8, 9, 9, 19, 19, 20, 20, 20 JV = 10, 3, 10, 6, 10, 1, 2, 6

IV = 20, 20, 20, 20 JV = 7, 8, 11, 12

For exit 4, NEMP = 1. There is 1 card C4:

IV = 10 JV = 7

For exit 5, NEMP = 22. There are 3 cards C5:

IV = 19, 20, 21, 22, 23, 24, 26, 27 JV = 9, 9, 9, 9, 9, 9, 9, 9

IV = 28, 29, 30, 19, 19, 19, 19, 19 JV = 9, 9, 9, 1, 2, 3, 5, 7

IV = 19, 19, 19, 20, 20, 20 JV = 8, 11, 12, 3, 5, 10

For exit 6, NEMP = 1. There is 1 card C6:

IV = 20 JV = 7

Assume that the following data have been obtained for each exit from the evacuation test or from similar small scale tests. Note that input are required only for each open exit. All times are in seconds.

EXIT 1

	MEAN	STANDARD DEVIATION	MAXIMUM	MINIMUM
T1	.6	.6	3.	.3
T2	1.	1.	4.	.5
T3	8.	2.	18.	6.
T4	.75	.5	2.	.5
T5	3.	1.	5.	1.

EXIT 3

	MEAN	STANDARD DEVIATION	MAXIMUM	MINIMUM
T1	.6	.6	3.	.3
T2	1.	1.	4.	.5
T3	8.	2.	18.	6.

EXIT 3 (Cont'd.)

	MEAN	STANDARD DEVIATION	MAXIMUM	MINIMUM
T4	.75	.5	2.	.5
T5	4.5	2.	7.	1.5

EXIT 5

	MEAN	STANDARD DEVIATION	MAXIMUM	MINIMUM
T1	.6	.6	3.	.3
T2	1.	1.	4.	.5
T3	8.	2.	18.	6.
T4	.75	.5	2.	.5
T5	3.	1.	5.	1.

Let us use the following intervals for the time tables for each exit:

EXIT 1 .1, .1, 1., .1, .2
EXIT 3 .1, .1, 1., .1, .5
EXIT 5 .1, .1, 1., .1, .2

For cards D1:

XMN1 = .6 SD1 = .6 XU1 = 3. XINT1 = .1 XL1 = .3

XMN2 = 1. SD1 = 1. XU2 = 4. XINT2 = .1 XL2 = .5

XMN3 = 8. SD3 = 2. XU3 = 18. XINT3 = 1. XL3 = 6.

XMN4 = .75 SD4 = .5 XU4 = 2. XINT4 = .1 XL4 = .5

XMN5 = 3. SD5 = 1. XU5 = 5. XINT5 = .2 XL5 = 1.

For cards D2:

XMN1 = .6 SD1 = .6 XU1 = .3 XINT1 = .1 XL1 = .3

XMN2 = .1 SD2 = 1. XU2 = 4. XINT2 = .1 XL2 = .5

XMN3 = 8. SD3 = 2. XU3 = 18. XINT3 = 1. XL3 = 6.

XMN4 = .75 SD4 = .5 XU4 = 2. XINT4 = .1 XL4 = .5

XMN5 = 4.5 SD5 = 2. XU5 = 7. XINT5 = .5 XL5 = 1.5

For cards D3:

XMN1 = .6	SD1 = .6	XU1 = 3.	XINT1 = .1	XL1 = .3
XMN2 = 1.	SD2 = 1.	XU2 = 4.	XINT2 = .1	XL2 = .5
XMN3 = 8.	SD3 = 2.	XU3 = 18.	XINT3 = 1.	XL3 = 6.
XMN4 = .75	SD4 = .5	XU4 = 2.	XINT4 = .1	XL4 = .5
XMN5 = 3.	SD5 = 1.	XU5 = 5.	XINT5 = .2	XL5 = 1.

A copy of the FORTRAN coding sheet for this case is shown in Figure 6.

UPPER DECK OPTION - Assume now that we wish to add an upper deck to the wide body case previously discussed. Assume that the upper deck configuration is given by Figure 3. Let us assign the eight passengers at the rear of the upper deck to the upper deck exit and the remaining eight passengers to the staircase. When they reach the main deck they will be assigned to exit No. 1 to evacuate through. Card A must be changed. Cards E are then inserted after cards D for the main deck.

For card A:

NRUN = 1 NEXIT = 6 NOPT = 1 NDECK = 1

For card E1:

IROWE = 6 NRF = 2 NRL = 5 NCOL1 = 2 NCOL2 = 5

NOPEN = 0 NEMP = 0

Assume the staircase is at I = 3, J = 6 on the main deck. For card E2:

IU = 1 JU = 3 IL = 3 JL - 6 NOUT = 1

NNOUT = 8 NUOUT = 8

For card E3:

IUD = 4, 4, 4, 4, 5, 5, 5, 5

JUD = 1, 2, 4, 5, 1, 2, 4, 5

Since NEMP = 0, there is no card E4.

Assume the following data has been obtained from evacuation tests:

UPPER DECK EXIT

	MEAN	STANDARD DEVIATION	MAXIMUM	MINIMUM
T1	.6	.6	3.	.3
T2	1.	1.	4.	.5
T3	12.	4.	20.	6.
T4	1.5	.5	4.	.75
T5	5.	1.	10.	2.

STAIRCASE

T6	4.	1.	8.	1.

Let us use the following intervals for the time tables: .1, .1, .2, .2, .5, .2

For cards E5:

XMN1 = .6	SD1 = .6	XU1 = 3.	XINT1 = .1	XL1 = .3
XMN2 = 1.	SD2 = 1.	XU2 = 4.	XINT2 = .1	XL2 = .5
XMN3 = 12.	SD3 = 4.	XU3 = 20.	XINT3 = 2.	XL3 = 6.
XMN4 = 1.5	SD4 = .5	XU4 = 4.	XINT4 = .2	XL4 = .75
XMN5 = 5.	SD5 = 1.	XU5 = 10.	XINT5 = .5	XL5 = 2.
XMN6 = 4.	SD6 = 1.	XU6 = 8.	XINT6 = .2	XL6 = 1.

The FORTRAN coding for this case is shown in Figure 6 after the coding for the main deck only case.

NARROW BODY PROGRAM - Assume we wish to simulate an emergency evacuation in the narrow body aircraft shown in Figure 7. In this case we will let passengers evacuate through the nearest open exit. Seating assignment to an exit is not important except that all the seats in the aircraft must be assigned to exits.

Let us simulate ten evacuations.

For card A:

NRUN = 10	NEXIT = 8	NOPT = 0	JEMP = 4

Let us assign the first class passengers to exits 1 and 2. For card B1:

IROWE = 1 NRF = 2 NRL = 8 NCOL1 = 3

NSIDE = 0 NSEAT = 0 NOPEN = 0 NEMP = 7

NEMP = 7 will be used to delete passengers in column 1 thus simulating the first class seating.

For card B2:

IROWE = 1 NRF = 2 NRL = 8 NCOL1 = 6

NSIDE = 1 NSEAT = 0 NOPEN = 1 NEMP = 0

It is not necessary to delete any passengers on this side of the aircraft since program logic will take columns 5 and 6 only because NCOL1 = 6. For the left side exit NCOL1 = 3 and the program logic will take columns 1, 2, and 3. If NCOL1 = 2 had been input there would have been a mismatch with the aisle column which is input as JEMP = 4.

For card B3:

IROWE = 12 NRF = 9 NRL = 14 NCOL1 = 3

NSIDE = 0 NSEAT = 1 NOPEN = 1 NEMP = 0

Notice there are seats in the exit row for this exit so NSEAT = 1.

For card B4:

IROWE = 12 NRF = 9 NRL = 14 NCOL1 = 7

NSIDE = 1 NSEAT = 1 NOPEN = 0 NEMP = 0

For card B5:

IROWE = 15 NRF = 15 NRL = 20 NCOL1 = 3

NSIDE = 0 NSEAT = 1 NOPEN = 1 NEMP = 0

For card B6:

IROWE = 15 NRF = 15 NRL = 20 NCOL1 = 7

NSIDE = 1 NSEAT = 1 NOPEN = 0 NEMP = 0

For card B7:

IROWE = 27 NRF = 21 NRL = 26 NCOL1 = 3

NSIDE = 0 NSEAT = 0 NOPEN = 0 NEMP = 0

For card B8:

IROWE = 27 NRF = 21 NRL = 26 NCOL1 = 7

NSIDE = 1 NSEAT = 0 NOPEN = 1 NEMP = 0

For card C1:

IV = 2, 3, 4, 5, 6, 7, 8 JV = 1, 1, 1, 1, 1, 1, 1

There are no more C cards.

Assume that the following data are available from previous testing. There are four sets of this data, one set for each open exit. All times are in seconds.

EXIT 1

	MEAN	STANDARD DEVIATION	MAXIMUM	MINIMUM
T1	.6	.6	3.	.3
T2	1.	1.	4.	.5
T3	10.	2.	20.	6.
T4	1.	1.	3.	.5
T5	2.5	1.	4.	1.

EXIT 4

	MEAN	STANDARD DEVIATION	MAXIMUM	MINIMUM
T1	.6	.6	3.	.3
T2	1.	1.	4.	.5
T3	6.	2.	12.	6.
T4	1.5	1.5	4.	.5

EXIT 4 Cont'd.

	MEAN	STANDARD DEVIATION	MAXIMUM	MINIMUM
T5	4.	1.	6.	3.

EXIT 6

	MEAN	STANDARD DEVIATION	MAXIMUM	MINIMUM
T1	.6	.6	3.	.3
T2	1.	1.	4.	.5
T3	6.	2.	12.	6.
T4	1.5	1.5	4.	.5
T5	4.	1.	6.	3.

EXIT 7

	MEAN	STANDARD DEVIATION	MAXIMUM	MINIMUM
T1	.6	.6	3.	.3
T2	1.	1.	4.	.5
T3	10.	2.	20.	6.
T4	1.	1.	3.	.5
T5	2.5	1.	4.	1.

Let us use the following intervals for the time tables for each exit:

EXIT 1	.1, .1, 2., .1, .2
EXIT 3	.1, .1, 1., .1, .2
EXIT 6	.1, .1, 1., .1, .2
EXIT 7	.1, .1, 2., .1, .2

For cards D1:

XMN1 = .6	SD1 = .6	XU1 = 3.	XINT1 = .1	XL1 = .3
XMN2 = 1.	SD2 = 1.	XU2 = 4.	XINT2 = .1	XL2 = .5
XMN3 = 10.	SD3 = 2.	XU3 = 20.	XINT3 = 2.	XL3 = 6.
XMN4 = 1.	SD4 = 1.	XU4 = 3.	XINT4 = .1	XL4 = .5
XMN5 = 2.5	SD5 = 1.	XU5 = 4.	XINT5 = .2	XL5 = 1.

For cards D2:

XMN1 = .6	SD1 = .6	XU1 = 3.	XINT1 = .1	XL1 = .3
XMN2 = 1.	SD2 = 1.	XU2 = 4.	XINT2 = .1	XL2 = .5
XMN3 = 6.	SD3 = 2.	XU3 = 12.	XINT3 = 1.	XL3 = 6.
XMN4 = 1.5	SD4 = 1.5	XU4 = 4.	XINT4 = .1	XL4 = .5
XMN5 = 4.	SD5 = 1.	XU5 = 6.	XINT5 = .2	XL5 = 3.

For cards D3:

XMN1 = .6	SD1 = .6	XU1 = 3.	XINT2 = .1	XL1 = .3
XMN2 = 1.	SD2 = 1.	XU2 = 4.	XINT2 = .1	XL2 = .5
XMN3 = 6.	SD3 = 2.	XU3 = 12.	XINT3 = 1.	XL3 = 6.
XMN4 = 1.5	SD4 = 1.5	XU4 = 4.	XINT4 = .1	XL4 = .5

For cards D4:

XMN1 = .6	SD1 = .6	XU1 = 3.	XINT1 = .1	XL1 = .3
XMN2 = 1.	SD2 = 1.	XU2 = 4.	XINT2 = .1	XL2 = .5
XMN3 = 10.	SD3 = 2.	XU3 = 20.	XINT3 = 2.	XL3 = 6.
XMN4 = 1.	SD4 = 1.	XU4 = 3.	XINT4 = .1	XL4 = .5
XMN5 = 2.5	SD5 = 1.	XU5 = 4.	XINT5 = .2	XL5 = 1.

A copy of the FORTRAN coding sheet for this case is shown in Figure 8.

PROGRAM OUTPUT

A copy of the program output for the wide body sample case with upper deck is shown in Figure 9. The first page of output consists of a print out of the input aircraft configuration data in the same format as the input. This allows the user an easy check to make sure input data is correct. The aircraft configuration data are followed by the time segment input data. The exit appropriate to the time data is identified in the last column of this output. Next are the input data for the upper deck if this option is used in the program.

The first output consists of a list of passengers identifying seat row, seat column, exit assigned, and exit out. For each passenger his time to the exit door, door delay time, and evacuation time are given. By comparing time to the exit door and door delay time the user can determine if a bottleneck is occurring at the door. If time to the exit door is greater than door delay time for any passenger, this indicates that the door is not always a bottleneck. A new page is started for each exit that is used in the evacuation. The first exit listed is the upper deck exit if the upper deck option is used. This exit number is set equal to NEXIT + 1. This, passengers on the upper deck that use a main deck exit may be identified by looking for NEXIT + 1 in their exit assigned column. The remaining exit data is in the order of main deck exit numbers.

The next page of output starts out with a summary of the total number of passengers that used an exit, the total evacuation time for that exit, and the exit's number for the initial evacuation. Passengers are then redistributed to exits with shorter lines and the next line of output indicates where passengers were taken from and where they went. The new passenger totals and evacuation times for all the exits are then listed. This is repeated until logic is not able to redistribute any more passengers between exits.

The narrow body program has the same output as the wide body program except there is no upper deck output for the narrow body program. A copy of the program output for one of the ten simulations of the narrow body sample case is shown in Figure 10. All times are in seconds in these programs. The CPU time for five evacuations is approximately one minute on the IMB 370/155 for this case. CPU time has ranged up to 90 minutes for 100 evacuations of a 389 passenger wide body aircraft.

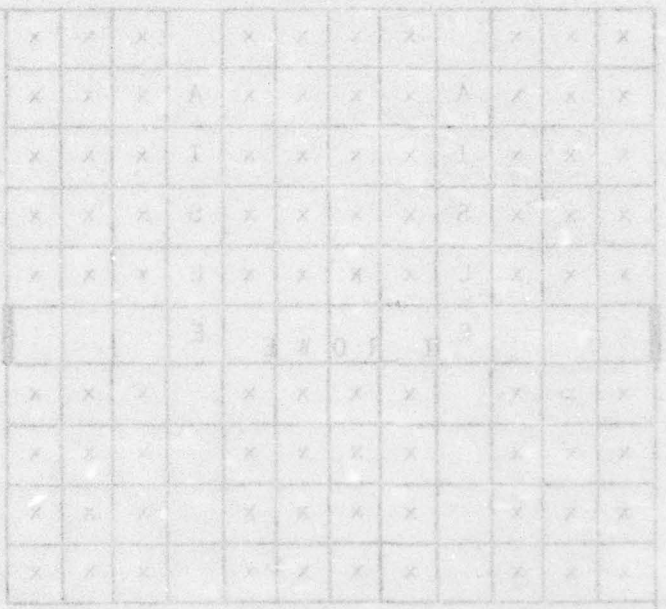
REFERENCES

1. Earl D. Folk, et al., GPSS/360 COMPUTER MODELS TO SIMULATE AIRCRAFT PASSENGER EMERGENCY EVACUATION, FAA-AM-72-30, FAA Office of Aviation Medicine, Washington, D.C., September 1972.

2. M.G. Kendall and A. Stuart, THE ADVANCED THEORY OF STATISTICS, Volume I, Charles Griffin and Company, Limited, 1958.

SUMMARY

Mathematical models for wide and narrow body aircraft emergency evacuations have been developed. Fortran computer programs have been developed from the mathematical models. Several cases have been run using all program options producing reasonable results for the wide and narrow body programs. The programs require evacuation path time segment input data. Some small scale testing will be required to generate a valid range of appropriate time segment input data. Correlation between full scale evacuation tests and program output should then be performed to provide program validation.



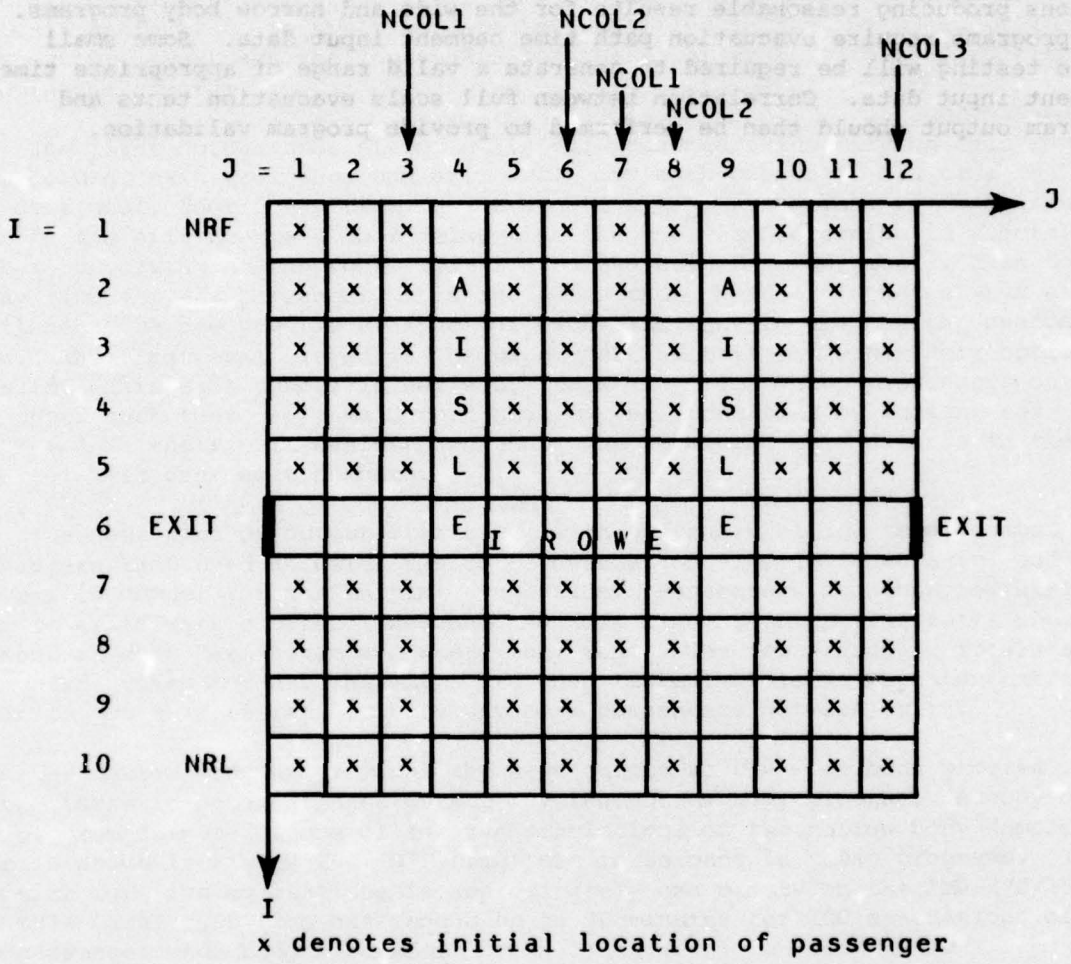
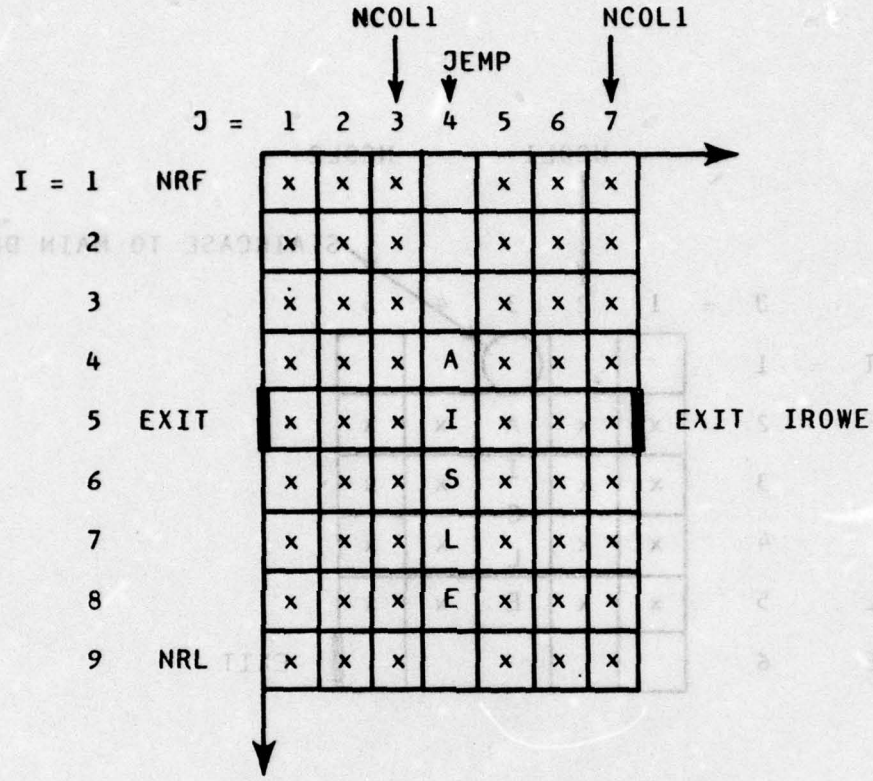
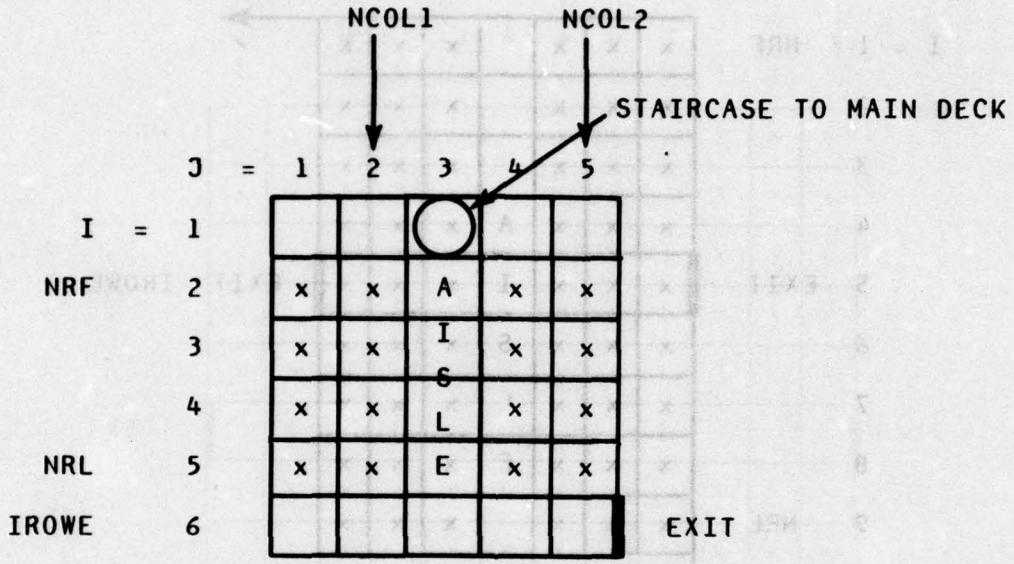


Fig. 1 - Wide body jet model



x denotes initial location of passenger

Fig. 2 - Narrow body model



x Denotes Passenger

Fig. 3 - Upper deck model

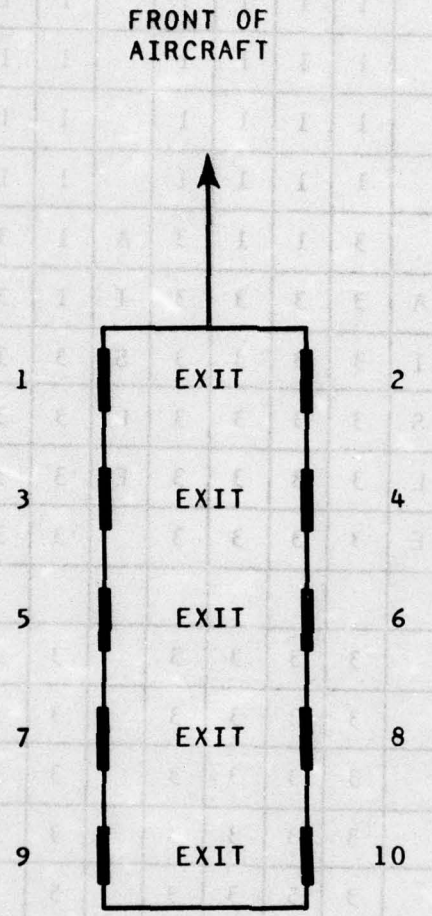


Fig. 4 - Exit numbering sequence

		1	2	3	4	5	6	7	8	9	10	11	12	
1		1	1	1		1	1	1	1		1	1	1	
2		1	1	1		1	1	1	1		1	1	1	
3	EXIT 1 OPEN													EXIT 2 CLOSED
4		1	1	1		1	1	1	1		1	1	1	
5		1	1	1		1	1	1	1		1	1	1	
6		1	1	1		1	1	1	1		1	1	1	
7		1	1	1		1	1	1	1		1	1	1	
8		3	1	1		3	1	1	3	A	1	3	3	
9		3	3	1	A	3	3	3	3	I	1	3	3	
10		3	3	3	I	3	3	3	3	S	3	3	3	
11		3	3	3	S	3	3	3	3	L	3	3	3	
12		3	3	3	L	3	3	3	3	E	3	3	3	
13		3	3	3	E	3	3	3	3		3	3	3	
14	EXIT 3 OPEN													EXIT 4 CLOSED
15		3	3	3		3	3	3	3		3	3	3	
16		3	3	3		3	3	3	3		3	3	3	
17		3	3	3		3	3	3	3		3	3	3	
18		3	3	3		3	3	3	3		3	3	3	
19		3	3	3		3	5	3	3		5	3	3	
20		5	5	3		3	5	5	5		3	5	5	
21		5	5	5		5	5	5	5		5	5	5	
22		5	5	5		5	5	5	5		5	5	5	
23		5	5	5		5	5	5	5		5	5	5	
24		5	5	5		5	5	5	5		5	5	5	
25	EXIT 5 OPEN													EXIT 6 CLOSED
26		5	5	5		5	5	5	5		5	5	5	
27		5	5	5		5	5	5	5		5	5	5	
28		5	5	5		5	5	5	5		5	5	5	
29		5	5	5		5	5	5	5		5	5	5	
30		5	5	5		5	5	5	5		5	5	5	

Fig. 5 - Wide body sample case

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"C" FOR COMMENTS

STATEMENT NUMBER	CONT	FORTRAN STATEMENT	IDENTIFICATION
10		8 0 4	
1		2 8 3 0 0 0 7	
1		2 8 6 1 0 1 0	
12		9 14 3 0 1 1 0	
12		9 14 7 1 1 0 0	
15		15 20 3 0 1 1 0	
15		15 20 7 1 1 0 0	
27		21 26 3 0 0 0 0	
27		21 26 7 1 0 1 0	
2		1 3 1 4 1 5 1 6 1 7 1 8 1	
		.6 .6 3. .1 .3	
		1. 1. 4. .1 .5	
		10. 2. 20. 2. 6.	
		1. 1. 3. .1 .5	
		2.5 1. 4. .1 1.	
		.6 .6 3. .1 .3	
		1. 1. 4. .1 .5	
		6. 2. 12. 1. 6.	
		1.5 1.5 4. .1 .5	
		4. 1. 6. .2 3.	
		.6 .6 3. .1 .3	
		1. 1. 4. .1 .5	
		6. 2. 12. 1. 6.	
		1.5 1.5 4. .1 .5	
		4. 1. 6. .2 3.	
		.6 .6 3. .1 .3	
		1. 1. 4. .1 .5	

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Fig. 6 - Input for wide body sample case

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"C" FOR COMMENTS

STATEMENT NUMBER	CONT	FORTRAN STATEMENT	IDENTIFICATION
		8. 2. 18. 1. 6.	
		.75 .5 2. .1 .5	
		4.5 2. 7. .5 1.5	
		.6 .6 3. .1 .3	
		1. 1. 4. .1 .5	
		8. 2. 18. 1. 6.	
		.75 .5 2. .1 .5	
		3. 1. 5. .2 1.	
		UPPER DECK CASE	
1		6 1 1 CARD A REPLACEMENT	
6		2 5 2 5 0 0 INSERT AFTER INPUT DATA FOR MAIN DECK	
1		3 3 6 1 8 8	
4		1 4 2 4 4 4 5 5 1 5 2 5 4 5 5	
		.6 .6 3. .1 .3	
		1. 1. 4. .1 .5	
		12. 4. 20. 2. 6.	
		1.5 .5 4. .2 .75	
		5. 1. 10. .5 2.	
		4. 1. 8. .2 1.	

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Fig. 6 - Cont.

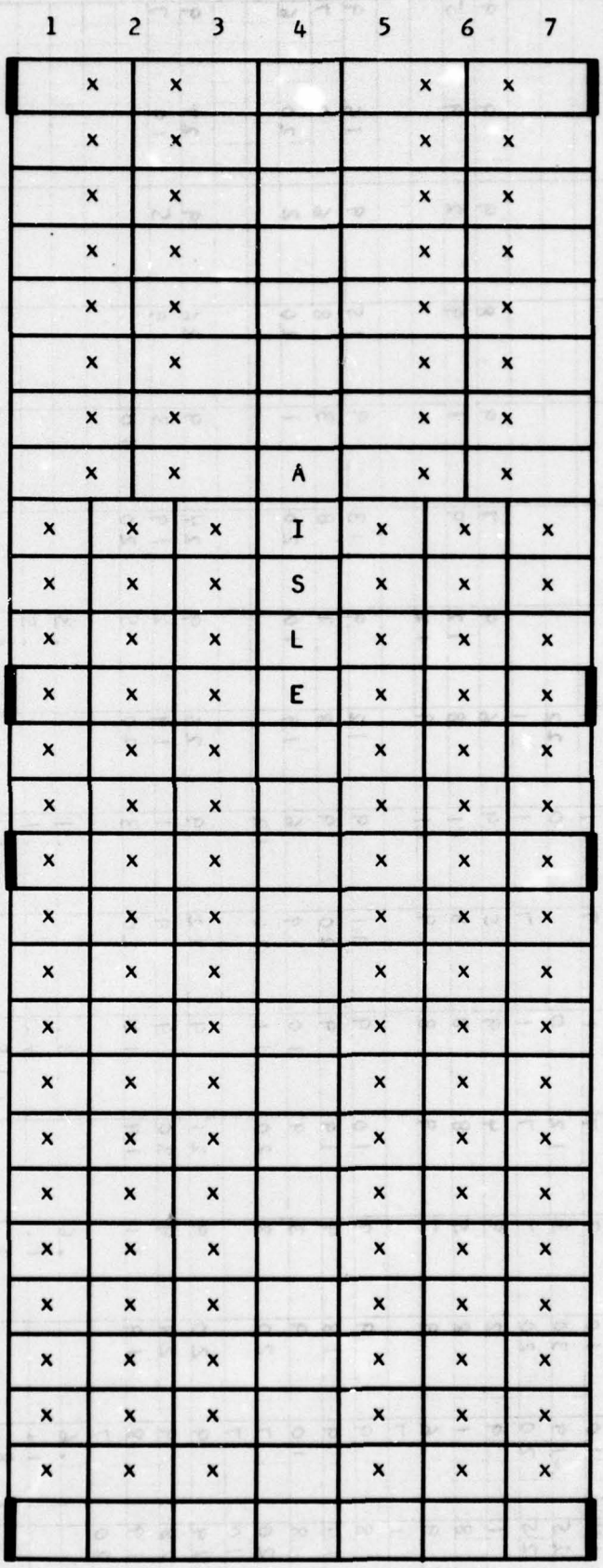

Fig. 7 - Narrow body sample case

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"C" FOR COMMENTS

STATEMENT NUMBER	CONT	FORTRAN STATEMENT	IDENTIFICATION
1		6 1 0	
3		1 9 3 12 0 0 21	
3		1 1 7 7 1 7 1 1	
14		8 20 3 12 0 0 28	
14		10 10 7 7 1 7 1 1	
25		19 30 3 12 0 0 22	
25		20 20 7 7 1 7 1 1	
1		9 2 9 4 9 5 9 6 9 7 9 8 9 9	9 9
8		1 8 5 8 8 8 11 8 12 9 1 9 2	9 5
9		6 9 7 9 8 9 11 9 12	
1		7	
8		9 9 9 10 9 11 9 12 9 13 9 15 9	16 9
17		9 18 9 19 9 20 9 8 2 8 3 8 6	8 7
8		10 9 3 9 10 19 6 19 10 20 1 20 2	20 6
20		7 20 8 20 11 20 12	
10		7	
19		9 20 9 21 9 22 9 23 9 24 9 26 9	27 9
28		9 29 9 30 9 19 1 19 2 19 3 19 5	19 7
19		8 19 11 19 12 20 3 20 5 20 10	
20		7	
		.6 .6 3. .1 .3	
		1. 1. 4. .1 .5	
		8. 2. 18. 1. 6.	
		.75 .5 2. .1 .5	
		3. 1. 5. .2 1.	
		.6 .6 3. .1 .3	
		1. 1. 4. .1 .5	

C

AC Form 8070-62 (9-68) C FAA AC 69-2847

Fig. 8 - Input for narrow body sample case

FORTRAN ☐ 360 ☐ 7040

PROGRAM | PROGRAMED BY | DATE | Page 2 of 2

"C" FOR COMMENTS

STATEMENT NUMBER | CONT | FORTRAN STATEMENT | IDENTIFICATION

```
      10.          2.          20.          2.          6.
       1.          1.           3.          .1          .5
      2.5          1.           4.          .1          1.
```

AC Form 8070-82 (9-88)

C FAA AC 00-2847

Fig. 8 - Cont.

AIRCRAFT CONFIGURATION INPUT DATA

```
 1    6    1    1
 3    1    9    3   12    0    0    0   21
 3    1    1    7    7    1    7    1    1
14    8   20    3   12    0    0    0   28
14   14   14    7    7    1    7    1    1
25   19   35    3   12    0    0    0   22
25   20   20    7    7    1    7    1    1
 1    9    2    9    4    9    5    9    6    9    7    9    8    9    9    9
 8    1    8    5    8    8    8   11    8   12    9    1    9    2    9    5
 9    6    9    7    9    8    9   11    9   12
 1    7
 8    9    9    9   10    9   11    9   12    9   13    9   15    9   16    9
17    9   18    9   15    9   21    9    8    2    8    3    8    6    8    7
 8   10    9    3    9   10   16    6   19   10   20    1   20    2   20    6
20    7   20    8   20   11   20   12
10    7
19    9   20    9   21    9   22    9   23    9   24    9   26    9   27    9
28    9   29    9   30    9   19    1   19    2   19    3   19    5   19    7
19    8   19   11   19   12   20    3   20    5   20   10
20    7
```

TIME SEGMENT INPUT DATA

```
 0.600    0.600    3.000    0.100    0.300    1
 1.000    1.000    4.000    0.100    0.500    1
 8.000    2.000   18.000    1.000    6.000    1
 0.750    0.500    2.000    0.100    0.500    1
 3.000    1.000    5.000    0.200    1.000    1
 0.600    0.600    3.000    0.100    0.300    3
 1.000    1.000    4.000    0.100    0.500    3
 8.000    2.000   18.000    1.000    6.000    3
 0.750    0.500    2.000    0.100    0.500    3
 4.500    2.000    7.000    0.500    1.500    3
 0.600    0.600    3.000    0.100    0.300    5
 1.000    1.000    4.000    0.100    0.500    5
 8.000    2.000   18.000    1.000    6.000    5
 0.750    0.500    2.000    0.100    0.500    5
 3.000    1.000    5.000    0.200    1.000    5
```

UPPER DECK INPUT DATA

```
 4    2    5    2    5    3    0
 1    3    3    6    1    8    8
 4    1    4    2    4    4    4    5    5    1    5    2    5    4    5    5
 0.000    0.000    3.000    0.100    0.300
 1.000    1.000    4.000    0.100    0.500
12.000    5.000   20.000    2.000    6.000
 1.500    0.500    4.000    0.200    0.750
 5.000    1.000   10.000    0.500    2.000
 4.000    1.000    8.000    0.200    1.000
```

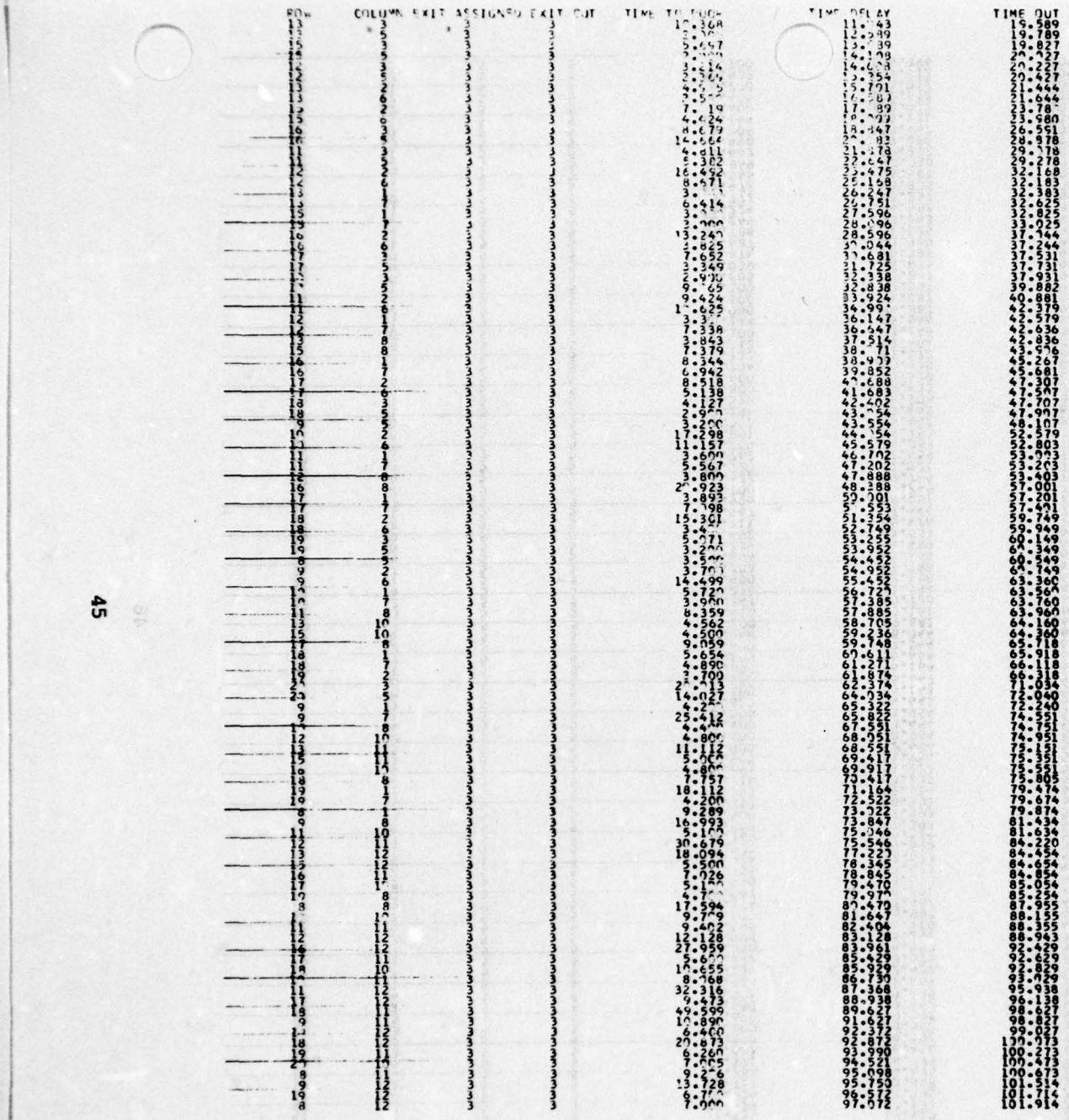
Fig. 9 - Output for wide body sample case

R	COLUMN	EXIT ASSIGNED	EXIT OUT	TIME TO DOOR	ME DELAY	TIME OUT
	2	7	7	3.154	12.671	19.460
	4	7	7	2.102	14.249	20.479
4	2	7	7	14.198	15.645	25.323
4	4	7	7	3.057	18.233	25.523
5	1	7	7	5.729	19.721	27.057
5	5	7	7	8.026	21.432	29.458
4	1	7	7	8.431	23.474	31.304
4	5	7	7	3.229	25.410	31.696

Fig. 9 - Cont.

ROW	COLUMN	EXIT ASSIGNED	EXIT OUT	TIME TO DOOR	TIME DELAY	TIME OUT
2	3	1	1	9.224	13.712	16.472
2	5	1	1	2.000	12.134	16.672
4	3	1	1	2.000	12.634	16.872
4	5	1	1	12.423	13.134	19.785
1	3	1	1	3.439	14.896	19.985
1	5	1	1	2.300	15.569	20.185
3	2	1	1	3.829	16.068	20.385
2	6	1	1	2.500	16.751	20.585
4	2	1	1	2.500	17.251	20.785
4	6	1	1	4.987	17.751	21.790
5	3	1	1	2.300	18.559	21.990
5	5	1	1	2.300	19.059	22.190
1	2	1	1	20.193	19.559	27.161
1	6	1	1	7.151	22.161	27.361
2	1	1	1	3.000	23.110	27.561
2	7	1	1	12.337	23.611	29.072
4	1	1	1	5.403	24.921	29.272
4	7	1	1	3.000	25.678	29.472
5	2	1	1	26.000	26.178	33.178
5	6	1	1	4.939	28.178	33.378
6	3	1	1	12.079	28.925	34.705
6	5	1	1	4.188	30.355	34.905
1	1	1	1	17.980	31.060	37.290
1	7	1	1	19.646	32.659	39.164
2	8	1	1	10.699	34.366	39.364
4	8	1	1	26.724	35.436	42.436
5	1	1	1	3.300	37.436	42.636
5	7	1	1	3.300	37.936	42.836
6	2	1	1	3.654	38.436	43.036
6	6	1	1	3.667	39.117	43.236
7	3	1	1	4.603	39.599	43.303
7	5	1	1	2.900	40.297	43.503
1	8	1	1	7.207	40.797	44.756
5	8	1	1	11.273	41.578	46.317
6	1	1	1	8.845	42.628	47.010
6	7	1	1	10.034	43.553	48.164
7	2	1	1	3.400	44.557	48.364
7	6	1	1	3.400	45.057	48.564
8	3	1	1	6.512	45.557	49.627
2	10	1	1	4.500	46.376	49.827
4	10	1	1	4.500	46.876	50.027
6	8	1	1	4.150	47.376	50.227
7	1	1	1	5.583	47.876	51.447
7	7	1	1	8.848	48.531	52.776
8	2	1	1	3.778	49.479	52.976
8	6	1	1	13.605	49.943	55.138
9	3	1	1	3.500	51.157	55.338
1	10	1	1	4.800	51.657	55.538
2	11	1	1	15.395	52.157	56.969
4	11	1	1	18.699	53.232	58.464
5	10	1	1	4.800	54.460	58.664
7	8	1	1	9.224	54.960	59.077
8	7	1	1	10.819	55.795	60.263
1	11	1	1	5.300	56.750	60.463
2	12	1	1	7.179	57.250	60.707
4	12	1	1	6.488	57.869	61.207
5	11	1	1	11.544	58.450	62.630
6	12	1	1	5.1	59.376	62.830
1	12	1	1	6.48	59.806	63.082
5	12	1	1	10.239	61.369	64.226
6	11	1	1	5.600	61.117	64.426
7	10	1	1	44.103	61.617	68.617
6	12	1	1	18.379	63.517	68.817
7	11	1	1	19.147	64.678	69.595
8	10	1	1	5.700	65.791	69.795
7	12	1	1	6.400	66.291	69.995
9	11	1	1	6.500	66.791	70.195
2	2	7	1	15.077	67.291	72.477
2	4	7	1	8.121	68.501	72.677
2	1	7	1	10.168	69.301	72.877
2	5	7	1	6.146	69.683	73.077
3	2	7	1	31.968	70.183	77.183
3	4	7	1	21.468	72.183	77.979
3	1	7	1	11.977	72.619	78.179
3	5	7	1	21.14	74.337	81.184

Fig. 9 - Cont.



ROW	COLUMN	EXIT ASSIGNED	EXIT OUT	TIME TO FOOT	TIME DELAY	TIME OUT
13	3	3	3	10.368	11.143	19.589
13	5	3	3	8.10[illegible]	12.289	19.789
15	3	3	3	5.457	13.[illegible]39	19.827
14	5	3	3	3.[illegible]00	14.[illegible]28	20.027
14	3	3	3	3.514	14.[illegible]28	20.227
12	5	3	3	2.[illegible]89	15.[illegible]54	20.427
13	2	3	3	4.[illegible]15	15.701	21.444
13	6	3	3	2.[illegible]52	16.[illegible]92	21.644
12	2	3	3	7.[illegible]19	17.[illegible]89	23.78
15	3	3	3	4.[illegible]24	18.[illegible]99	23.980
16	3	3	3	8.679	18.847	26.591
15	4	3	3	14.[illegible]66	20.[illegible]82	28.978
11	3	3	3	4.611	21.[illegible]78	29.178
11	5	3	3	5.382	22.647	29.278
12	2	3	3	16.492	23.475	32.168
14	6	3	3	8.971	25.158	32.183
13	1	3	3	3.[illegible]	26.267	32.383
15	1	3	3	6.414	26.751	32.625
15	1	3	3	3.[illegible]19	27.596	32.825
13	1	3	3	5.[illegible]00	28.096	33.025
16	2	3	3	13.240	28.596	37.144
16	6	3	3	8.825	30.044	37.244
17	5	3	3	7.652	30.681	37.531
17	5	3	3	5.349	31.725	37.731
17	5	3	3	2.930	32.338	37.931
11	5	3	3	9.[illegible]65	32.838	39.882
11	5	3	3	9.624	33.924	40.881
12	6	3	3	1[illegible].625	34.99[illegible]	42.379
12	1	3	3	3.[illegible]39	36.147	42.579
14	7	3	3	7.338	36.647	42.636
13	8	3	3	3.843	37.514	42.836
15	8	3	3	7.379	38.[illegible]71	43.996
14	1	3	3	8.344	38.[illegible]99	45.267
16	7	3	3	6.942	39.852	45.681
17	2	3	3	8.518	40.688	47.307
17	6	3	3	5.138	41.683	47.507
18	3	3	3	4.277	42.402	47.707
18	5	3	3	2.[illegible]50	43.[illegible]54	47.907
18	5	3	3	3.200	43.554	48.107
10	2	3	3	17.298	44.[illegible]54	52.579
11	4	3	3	11.157	45.579	52.803
11	1	3	3	3.600	46.702	53.093
11	7	3	3	5.567	47.202	53.203
12	8	3	3	3.800	47.888	53.403
16	8	3	3	20.923	48.388	57.001
17	1	3	3	3.893	50.301	57.201
17	7	3	3	7.198	50.[illegible]53	57.401
18	2	3	3	15.301	51.354	59.749
18	6	3	3	3.[illegible]27	52.749	59.949
19	3	3	3	5.771	53.255	60.149
19	5	3	3	3.2[illegible]0	53.952	60.349
8	9	3	3	3.5[illegible]0	54.452	60.549
9	2	3	3	3.70[illegible]	54.952	60.749
9	6	3	3	14.499	55.452	63.360
10	1	3	3	5.720	56.[illegible]20	63.560
10	7	3	3	3.[illegible]00	57.385	63.760
11	8	3	3	8.359	57.885	63.960
13	10	3	3	4.562	58.705	64.160
15	10	3	3	4.500	59.236	64.360
14	8	3	3	9.059	59.748	65.718
18	1	3	3	5.654	60.611	65.918
18	7	3	3	4.890	61.271	66.118
19	2	3	3	3.[illegible]00	61.874	66.318
2	5	3	3	2.[illegible]13	62.374	71.034
23	5	3	3	14.027	64.034	72.040
9	1	3	3	4.2[illegible]	65.322	72.240
9	7	3	3	25.412	65.822	74.551
12	8	3	3	4.[illegible]	67.551	74.751
12	10	3	3	4.80[illegible]	68.051	74.951
13	11	3	3	11.112	68.551	75.151
15	11	3	3	5.[illegible]	69.417	75.351
14	11	3	3	4.[illegible]	69.917	75.551
18	8	3	3	7.757	70.417	75.805
19	1	3	3	18.112	71.164	79.474
19	7	3	3	4.200	72.522	79.674
8	1	3	3	9.289	73.022	79.874
9	8	3	3	16.993	73.847	81.434
11	10	3	3	5.1[illegible]	75.046	81.634
12	11	3	3	30.679	75.546	84.220
13	12	3	3	18.094	77.223	84.454
13	12	3	3	5.500	78.345	84.654
16	11	3	3	7.026	78.845	84.854
17	12	3	3	5.[illegible]	79.470	85.054
12	8	3	3	4.[illegible]	79.9[illegible]	85.254
18	8	3	3	17.594	80.470	87.955
11	12	3	3	9.[illegible]9	81.647	88.155
11	11	3	3	9.402	82.404	88.355
12	12	3	3	12.128	83.128	88.943
10	12	3	3	27.959	83.961	92.429
11	11	3	3	5.6[illegible]0	85.429	92.629
10	10	3	3	10.455	85.929	92.829
11	11	3	3	8.168	86.730	93.029
11	12	3	3	32.316	87.368	95.938
11	12	3	3	9.473	88.938	96.138
10	11	3	3	49.599	89.627	98.627
11	11	3	3	10.890	91.627	98.827
12	12	3	3	6.400	92.372	99.027
10	12	3	3	20.873	92.872	100.173
11	11	3	3	6.260	93.990	100.273
14	14	3	3	7.[illegible]05	94.521	100.473
11	11	3	3	9.2[illegible]6	95.098	100.673
12	12	3	3	13.728	95.750	101.514
12	12	3	3	6.[illegible]	96.572	101.714
12	12	3	3	7.000	97.072	101.914

Fig. 9 - Cont.

ROW	COLUMN	EXIT ASSIGNED	EXIT OUT	TIME TO DECR	TIME DELAY	TIME OUT
24	3	5	5	5.501	9.256	13.841
24	5	5	5	15.919	10.251	22.919
26	3	5	5	2.000	17.919	23.119
26	5	5	5	5.498	18.419	23.319
23	3	5	5	3.841	19.419	23.519
23	5	5	5	16.539	19.133	27.096
24	2	5	5	4.936	22.496	27.296
24	6	5	5	15.711	22.898	29.589
24	2	5	5	11.286	24.675	30.376
26	6	5	5	4.371	26.173	30.576
27	3	5	5	9.087	26.816	32.183
27	7	5	5	2.300	28.292	32.383
22	3	5	5	2.600	28.592	32.583
22	5	5	5	2.600	29.092	32.783
23	2	5	5	11.063	29.592	34.966
23	6	5	5	5.501	30.875	35.166
24	1	5	5	5.428	31.669	35.561
24	7	5	5	10.134	32.429	37.437
26	1	5	5	7.372	33.575	37.958
26	7	5	5	5.856	34.547	38.503
27	2	5	5	8.003	35.296	39.957
27	6	5	5	4.146	36.318	40.157
28	3	5	5	2.600	36.987	40.357
28	5	5	5	6.174	37.487	41.808
21	3	5	5	11.887	38.391	43.676
21	5	5	5	8.440	39.638	44.336
22	2	5	5	23.753	41.673	47.673
22	6	5	5	22.424	42.873	49.645
23	1	5	5	22.379	44.645	51.524
23	7	5	5	7.369	46.524	51.724
24	8	5	5	3.500	47.393	51.924
26	8	5	5	3.500	47.893	52.124
27	1	5	5	11.367	48.393	53.443
27	7	5	5	3.885	49.554	53.643
28	2	5	5	9.716	50.135	54.980
28	6	5	5	5.291	51.222	55.030
29	3	5	5	2.900	51.954	55.230
29	5	5	5	2.900	52.454	55.430
21	2	5	5	3.400	52.954	55.795
21	6	5	5	3.400	53.454	56.951
22	1	5	5	5.595	53.954	57.630
22	7	5	5	3.600	54.643	57.830
23	8	5	5	3.800	55.143	58.229
23	0	5	5	5.800	55.647	58.773
28	1	5	5	3.600	56.164	58.973
28	7	5	5	8.199	56.664	60.915
29	2	5	5	3.400	57.544	61.115
29	6	5	5	19.068	58.044	64.369
30	3	5	5	3.200	59.681	64.569
30	5	5	5	3.416	61.181	64.769
20	2	5	5	8.247	60.728	64.963
20	6	5	5	16.236	61.596	66.199
21	1	5	5	3.900	62.598	66.399
21	7	5	5	4.203	63.098	66.599
22	8	5	5	8.694	63.649	67.783
24	10	5	5	13.239	64.489	69.211
26	10	5	5	10.492	65.533	69.823
28	8	5	5	11.711	66.426	71.087
29	1	5	5	4.967	67.448	71.287
29	7	5	5	13.906	68.057	73.183
30	2	5	5	3.700	69.245	73.383
30	6	5	5	14.622	69.745	75.112
19	6	5	5	18.724	71.021	76.821
20	1	5	5	26.762	72.459	79.194
20	7	5	5	4.200	74.253	79.394
21	8	5	5	6.841	74.753	79.594
23	10	5	5	41.442	75.442	82.442
24	11	5	5	7.296	77.442	82.642
26	11	5	5	30.328	78.196	84.677
27	10	5	5	5.800	79.838	84.877
29	8	5	5	5.400	80.338	85.077
30	1	5	5	5.204	80.838	85.277
30	7	5	5	8.732	81.572	85.675
20	8	5	5	8.212	82.401	86.243
22	10	5	5	5.100	83.144	86.443
23	11	5	5	29.144	83.644	88.917
24	12	5	5	47.000	84.887	91.887
26	12	5	5	5.500	86.887	92.087
27	11	5	5	5.300	87.387	92.287
28	10	5	5	9.805	87.887	92.487
30	8	5	5	28.039	88.675	95.188
21	10	5	5	5.874	90.385	95.338
22	11	5	5	6.687	90.939	95.588
23	12	5	5	34.788	91.525	98.058
27	12	5	5	22.249	93.243	98.537
28	11	5	5	18.224	94.493	98.737
29	10	5	5	5.772	95.257	98.937
21	11	5	5	13.472	95.895	100.661
22	12	5	5	29.565	96.687	102.196
28	12	5	5	21.969	98.116	103.165
29	11	5	5	8.663	99.212	103.365
30	10	5	5	6.498	99.878	104.165
19	10	5	5	9.208	100.447	104.107
20	11	5	5	14.144	101.131	105.385
21	12	5	5	6.400	102.012	105.585
29	12	5	5	6.400	102.512	105.785
30	11	5	5	6.200	103.012	105.985
20	12	5	5	32.832	103.512	109.436
30	12	5	5	6.700	104.996	109.636

Fig. 9 - Cont.

NO. PASS.	TIME	EXIT NO.
75	81.184	1
124	131.914	3
99	109.636	5
3 PASS. FROM EXIT 5 GO TO EXIT 3		
75	81.184	1
127	134.535	3
96	106.594	5
1 PASS. FROM EXIT 5 GO TO EXIT 3		
75	81.184	1
108	105.409	3
95	105.580	5
1 PASS. FROM EXIT 5 GO TO EXIT 3		

Fig. 9 - Cont.

AIRCRAFT CONFIGURATION INPUT DATA

1	8	0	4				
1	2	8	3	0	0	0	7
1	4	8	6	1	0	1	0
12	9	14	3	0	1	1	0
12	9	14	7	1	1	0	0
15	15	20	3	0	1	1	0
15	15	20	7	1	1	0	0
27	21	26	3	0	0	0	0
27	21	26	7	1	0	1	0
2	1	3	1	4	1	5	1	6	1	7	1	8	1

TIME SEGMENT INPUT DATA

0.600	0.600	3.000	0.100	0.300	1
1.000	1.000	4.000	0.100	0.500	1
10.000	2.000	20.000	2.000	6.000	1
1.500	1.500	3.000	0.100	0.500	1
2.500	1.000	4.000	0.200	1.000	1
0.600	0.600	3.000	0.100	0.300	4
1.000	1.000	4.000	0.100	0.500	4
6.000	2.000	12.000	1.000	6.000	4
1.500	1.500	4.000	0.100	0.500	4
4.000	1.000	6.000	0.200	3.000	4
0.600	0.600	3.000	0.100	0.300	6
1.000	1.000	4.000	0.100	0.500	6
6.000	2.000	12.000	1.000	6.000	6
1.500	1.500	4.000	0.100	0.500	6
4.000	1.000	6.000	0.200	3.000	6
0.600	0.600	3.000	0.100	0.300	7
1.000	1.000	4.000	0.100	0.500	7
10.000	2.000	20.000	2.000	6.000	7
1.500	1.500	3.000	0.100	0.500	7
2.500	1.000	4.000	0.200	1.000	7

Fig. 10 - Output for narrow body sample case

COLUMN	EXIT ASSIGNED	EXIT OUT	TIME TO DOCK	TIME DELAY	TIME OUT
3	1	1	3.711	12.488	14.245
5	2	1	2.473	11.412	14.371
2	1	1	17.746	12.429	24.746
3	1	1	3.516	20.746	24.946
6	2	1	6.511	21.509	25.815
5	2	1	8.360	22.811	28.697
2	1	1	9.443	24.634	29.667
3	1	1	3.359	26.320	29.667
6	2	1	6.550	26.965	31.011
5	2	1	4.934	28.132	31.735
2	1	1	5.598	29.179	32.565
3	1	1	2.960	29.980	32.765
6	2	1	9.192	31.480	35.133
5	2	1	13.[illegible]	31.962	38.011
2	1	1	7.686	34.214	38.165
3	1	1	3.260	35.343	38.365
6	2	1	15.68[illegible]	35.843	41.989
5	2	1	3.4[illegible]	38.148	42.169
2	1	1	3.7[illegible]	38.648	42.369
6	2	1	22.982	39.148	46.148

Fig. 10 - Cont.

ROW	COLUMN	EXIT ASSIGNED	EXIT OUT	TIME TO DOCK	TIME DELAY	TIME OUT
12	7	4	4	[illegible]	[illegible]	11.251
12	6	4	4	1.[illegible]	7.117	11.457
12	5	4	4	[illegible]	[illegible]	[illegible]
12	4	3	4	[illegible]	[illegible]	[illegible]
11	3	3	4	[illegible]	[illegible]	[illegible]
12	2	3	4	[illegible]	[illegible]	[illegible]
13	3	3	4	[illegible]	11.320	[illegible]
11	5	4	4	[illegible]	11.053	[illegible]
13	5	4	4	10.744	12.353	20.744
10	3	3	4	7.[illegible]	[illegible]	29.182
11	2	3	4	[illegible]	24.656	[illegible]
12	1	3	4	13.[illegible]	29.[illegible]	33.455
13	2	3	4	[illegible]	28.345	[illegible]
10	5	4	4	[illegible]	29.092	[illegible]
11	6	4	4	20.[illegible]	34.192	40.192
13	6	4	4	[illegible]	34.192	40.[illegible]
9	3	3	4	14.067	[illegible]	[illegible]
10	2	3	4	5.465	[illegible]	[illegible]
11	1	3	4	17.6[illegible]	[illegible]	[illegible]
13	1	3	4	21.[illegible]	44.252	[illegible]
9	5	4	[illegible]	9.782	[illegible]	[illegible]
10	6	4	[illegible]	25.[illegible]	[illegible]	[illegible]
11	7	4	[illegible]	[illegible]	54.492	[illegible]
13	7	4	4	[illegible]	54.992	[illegible]
8	3	1	4	3.421	[illegible]	[illegible]
8	5	2	4	3.433	[illegible]	[illegible]
9	2	3	4	5.865	57.257	[illegible]
[illegible]	1	3	4	[illegible]	[illegible]	[illegible]
9	6	4	4	7.[illegible]	[illegible]	[illegible]
1[illegible]	7	4	4	11.[illegible]	[illegible]	[illegible]
7	3	1	4	7.[illegible]	[illegible]	[illegible]
8	4	1	4	[illegible]	[illegible]	[illegible]
7	5	2	4	[illegible]	[illegible]	[illegible]
8	6	2	4	[illegible]	[illegible]	[illegible]
9	1	3	4	[illegible]	[illegible]	[illegible]
9	7	4	4	[illegible]	[illegible]	[illegible]
7	2	1	4	[illegible]	[illegible]	[illegible]
7	6	2	4	[illegible]	[illegible]	[illegible]

Fig. 10 - Cont.

	COLUMN	EXIT ASSIGNED	EXIT CUT	TIME TO DOOR	TIME DELAY	TIME OUT
	7	6	6	0.714	6.900	11.614
13	6	6	6	2.267	7.071	13.161
15	5	6	6	1.531	8.770	13.206
15	3	5	6	8.459	9.536	17.282
14	3	3	6	2.000	12.293	17.462
14	5	4	6	2.6[illegible]	12.968	17.662
15	2	5	6	8.620	13.514	20.575
16	3	5	6	9.723	15.822	23.636
16	5	6	6	2.600	18.624	23.836
14	2	3	6	6.496	19.143	25.919
14	6	4	6	7.979	20.713	27.176
15	1	5	6	5.300	22.040	27.376
16	2	5	6	4.047	23.140	27.583
17	3	5	6	3.422	24.117	28.782
16	6	6	6	6.749	25.001	30.582
17	5	6	6	2.900	28.633	31.182
14	1	3	0	4.020	27.133	31.706
14	7	4	0	6.353	27.969	33.427
16	1	5	6	3.600	29.291	33.627
17	2	5	0	27.538	29.791	39.791
18	3	5	6	9.641	33.791	40.778
16	7	6	6	11.680	36.051	43.302
17	6	6	0	3.4[illegible]	38.483	43.502
18	5	6	0	3.260	39.1[illegible]	43.702
17	1	5	6	3.9[illegible]	39.6[illegible]	43.5[illegible]
18	2	5	6	13.552	42.[illegible]07	47.837
19	3	5	6	3.5[illegible]	42.[illegible]54	48.[illegible]37
17	7	6	6	5.946	43.354	48.454
18	6	6	0	3.70[illegible]	44.496	48.654
19	5	6	6	31.[illegible]00	44.996	54.596
18	1	5	6	19.638	48.956	57.652
19	2	5	0	6.626	52.[illegible]51	58.[illegible]52
20	3	5	0	25.146	53.743	63.711
18	7	6	6	21.761	57.743	67.156
19	6	6	6	4.[illegible]00	61.628	67.350
20	5	6	0	10.826	62.128	68.916
19	1	5	0	4.500	64.261	69.116
20	2	5	6	6.[illegible]62	64.761	69.7[illegible]0
19	7	6	6	4.633	65.807	70.[illegible]55
21	6	6	6	8.435	66.379	72.290
21	3	7	0	3.500	68.[illegible]49	72.490
21	5	8	0	9.832	68.627	75.367
20	1	5	0	8.469	71.73[illegible]	76.192
20	7	6	6	18.1[illegible]4	72.[illegible]55	79.[illegible]06
21	2	7	0	25.5[illegible]2	74.[illegible]82	84.780
21	6	8	0	7.4[illegible]	78.[illegible]82	84.58[illegible]
21	1	7	0	9.313	80.[illegible]65	86.111
21	7	8	0	26.5[illegible]6	31.816	91.562

Fig. 10 - Cont.

ROW	COLUMN	EXIT ASSIGNED	EXIT CUT	TIME TO DOOR	TIME DELAY	TIME OUT
26	3	7	7	6.194	11.647	16.421
26	5	8	7	2.[illegible]	13.194	16.621
25	3	7	7	4.920	13.694	17.541
26	2	7	7	2.500	14.762	17.741
25	5	8	7	2.300	15.262	17.941
26	6	8	7	11.821	15.762	22.213
24	3	7	7	3.552	18.126	22.213
25	2	7	7	8.240	18.8[illegible]	23.440
26	1	7	7	3.863	[illegible].279	23.640
24	5	8	7	2.600	20.923	23.640
25	6	8	7	8.750	21.423	26.224
26	7	8	7	9.119	22.984	27.705
23	3	7	7	9.942	24.503	29.585
24	2	7	7	3.100	26.216	29.785
25	1	7	7	7.338	26.716	30.645
23	5	8	7	3.188	27.826	30.649
24	6	8	7	6.539	28.374	32.153
25	7	8	7	8.344	29.428	33.661
22	3	7	7	6.735	3[illegible].691	34.565
23	2	7	7	9.342	31.742	36.188
24	1	7	7	5.967	33.115	36.471
22	5	8	7	4.554	33.944	37.041
23	6	8	7	3.[illegible]00	34.053	37.241
24	7	8	7	3.600	33.153	37.441
22	2	7	7	18.825	35.653	42.156
23	1	7	7	12.796	38.196	43.146
22	6	8	7	3.700	39.837	43.346
23	7	8	7	6.032	40.337	43.[illegible]70
22	1	7	7	4.200	41.108	43.770
22	7	8	7	23.128	41.608	48.360

Fig. 10 - Cont.

```
NO. PASS.     TIME        EXIT NO.
      [illegible]   46.148          1
      38      73.920          4
      48      91.562          6
      30      48.369          7
12 PASS. FROM EXIT [illegible] GO TO EXIT 7
      20      46.148          1
      38      73.920          4
      36      70.172          6
      42      63.046          7
 7 PASS. FROM EXIT 4 GO TO EXIT 1
      27      58.629          1
      31      61.408          4
      36      70.172          6
      42      63.046          7
 2 PASS. FROM EXIT 6 GO TO EXIT 4
      27      58.629          1
      33      64.983          4
      34      66.617          6
      42      63.046          7
 8 PASS. FROM EXIT 8 GO TO EXIT 7
```


Fig. 10 - Cont.

APPENDIX I

WIDE BODY PROGRAM LISTING

```
LEVEL 2     JUN 74 )                    OS/360  FORTRAN H                    DATE  75.337/18.29.29

          OMPILER OPTIONS - NAME=  MAIN,OPT=00,LINECNT=74,SIZE=00
                            SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF
  ISN 0002          COMMON P1(50),P2(50),P3(50),P4(50),P5(50)
  ISN 0003          COMMON XX1(50),XX2(50),XX3(50),XX4(50),XX5(50)
  ISN 0004          COMMON NN1,NN2,NN3,NN4,NN5
  ISN 0005          COMMON NCOL1(11),NCOL3(11),NCOUNT(10),LOLD,TOLD,NEXIT
  ISN 0006          COMMON XL1(11),XL2(11),XL3(11),XL4(11),XL5(11)
  ISN 0007          DIMENSION N(30,15,10,10)
  ISN 0008          DIMENSION                    NSAV1(10),NSAV2(10),IROWE(10),NRF(10)
  ISN 0009          DIMENSION NRL(10),NCOL2(10),NSIDE(10),NOPEN(10),NEMP(10)
  ISN 0010          DIMENSION IV(10,30),JV(10,30),IIU(20),JJU(20),T(10),T3(10
                   1)
  ISN 0011          DIMENSION XMN1(10),SD1(10),XU1(10),XINT1(10)
  ISN 0012          DIMENSION XMN2(10),SD2(10),XU2(10),XINT2(10)
  ISN 0013          DIMENSION XMN3(10),SD3(10),XU3(10),XINT3(10)
  ISN 0014          DIMENSION XMN4(10),SD4(10),XU4(10),XINT4(10)
  ISN 0015          DIMENSION XMN5(10),SD5(10),XU5(10),XINT5(10)
  ISN 0016          DO 90 I=1,10
  ISN 0017       90 NCOUNT(I)=0
  ISN 0018          LOLD=0
  ISN 0019          TOLD=0.
  ISN 0020          NX=0
  ISN 0021          DO 15 L=1,10
  ISN 0022          DO 15 K=1,10
  ISN 0023          DO 15 I=1,30
  ISN 0024          DO 15 J=1,15
  ISN 0025       15 N(I,J,K,L)=0
  ISN 0026          WRITE(6,205)
  ISN 0027          READ(5,200)NRUN,NEXIT,NOPT,NDECK
  ISN 0028          WRITE(6,200)NRUN,NEXIT,NOPT,NDECK
  ISN 0029          READ(5,201)(IROWE(I),NRF(I),NRL(I),NCOL1(I),NCOL2(I),NSIDE(I),NOJL
                   1I(I),NOPEN(I),NEMP(I),I=1,NEXIT)
  ISN 0030          WRITE(6,201)(IROWE(I),NRF(I),NRL(I),NCOL1(I),NCOL2(I),NSIDE(I),NCO
                   1L3(I),NOPEN(I),NEMP(I),I=1,NEXIT)
  ISN 0031          DO 1 I=1,NEXIT
  ISN 0032          IF(NEMP(I).EQ.0)GO TO 1
  ISN 0034          NM=NEMP(I)
  ISN 0035          READ(5,203)(IV(I,K),JV(I,K),K=1,NM)
  ISN 0036          WRITE(6,203)(IV(I,K),JV(I,K),K=1,NM)
55ISN 0037        1 CONTINUE
  ISN 0038          WRITE(6,206)
  ISN 0039          DO 4 I=1,NEXIT
  ISN 0040          IF(NOPEN(I).EQ.1)GO TO 4
  ISN 0042          READ(5,202)XMN1(I),SD1(I),XU1(I),XINT1(I),XL1(I)
  ISN 0043          READ(5,202)XMN2(I),SD2(I),XU2(I),XINT2(I),XL2(I)
  ISN 0044          READ(5,202)XMN3(I),SD3(I),XU3(I),XINT3(I),XL3(I)
  ISN 0045          READ(5,202)XMN4(I),SD4(I),XU4(I),XINT4(I),XL4(I)
  ISN 0046          READ(5,202)XMN5(I),SD5(I),XU5(I),XINT5(I),XL5(I)
  ISN 0047          WRITE(6,207)XMN1(I),SD1(I),XU1(I),XINT1(I),XL1(I),I
  ISN 0048          WRITE(6,207)XMN2(I),SD2(I),XU2(I),XINT2(I),XL2(I),I
  ISN 0049          WRITE(6,207)XMN3(I),SD3(I),XU3(I),XINT3(I),XL3(I),I
  ISN 0050          WRITE(6,207)XMN4(I),SD4(I),XU4(I),XINT4(I),XL4(I),I
  ISN 0051          WRITE(6,207)XMN5(I),SD5(I),XU5(I),XINT5(I),XL5(I),I
  ISN 0052        4 CONTINUE
  ISN 0053          DO 2 I=1,NEXIT
  ISN 0054          IF(NSIDE(I).EQ.0)GO TO 2
  ISN 0056          IF(NX.GT.0)GO TO 5
  ISN 0058          NSAV1(I)=NCOL1(I)
  ISN 0059          NSAV2(I)=NCOL2(I)
  ISN 0060        5 NCOL1(I)=NCOL3(I)-NSAV2(I)-1
  ISN 0061          NCOL2(I)=NCOL3(I)-NSAV1(I)+1
  ISN 0062        2 CONTINUE
  ISN 0063          DO 80 I=1,NEXIT
  ISN 0064          IF(NEMP(I).EQ.0)GO TO 80
  ISN 0066          IF(NSIDE(I).EQ.0)GO TO 81
  ISN 0068          N9=NEMP(I)
  ISN 0069          DO 81 K=1,N9
  ISN 0070       81 JV(I,K)=NCOL3(I)-JV(I,K)+1
  ISN 0071       80 CONTINUE
  ISN 0072       79 DO 10 K=1,NEXIT
  ISN 0073          N1=NRF(K)
  ISN 0074          N2=NRL(K)
```

```
ISN 0075            N3=NCOL2(K)
ISN 0076            DO 10 I=N1,N2
ISN 0077            DO 10 J=1,N3
ISN 0078            IF(I.EQ.IROWE(K))GO TO 10
ISN 0080            JEMP=NCOL1(K)+1
ISN 0081            IF(J.EQ.JEMP)GO TO 10
ISN 0083            IF(NEMP(K).EQ.0)GO TO 12
ISN 0085            NP=NEMP(K)
ISN 0086            DO 20 L=1,NP
ISN 0087            IF(I.EQ.IV(K,L).AND.J.EQ.JV(K,L))GO TO 10
ISN 0089         20 CONTINUE
ISN 0090         12 IF(J.LE.NCOL1(K))NJ=JEMP-J
ISN 0092            NA=NCOL1(K)+2
ISN 0093            IF(J.GE.NN)NJ=J-JEMP
ISN 0095            IF(NOPT.EQ.2)GO TO 5
ISN 0097            IF(NOPEN(K).EQ.1)GO TO 9
ISN 0099            N(I,J,K,K)=JEMP+IABS(I-IROWE(K))+NJ
ISN 0100            GO TO 10
ISN 0101         9  DO 6 L=1,NEXIT
ISN 0102            IF(NOPEN(L).EQ.1)GO TO 6
ISN 0104            IF(NSIDE(L).EQ.NSIDE(K))GO TO 7
ISN 0106            IF(NSIDE(K).EQ.0)GO TO 8
ISN 0108            N(I,J,K,L)=NCOL3(K)-NCOL1(L)+IABS(I-IROWE(L))+NJ
ISN 0109            GO TO 6
ISN 0110         8  N(I,J,K,L)=NCOL3(L)-NCOL1(K)+IABS(I-IROWE(L))+NJ
ISN 0111            GO TO 6
ISN 0112         7  N(I,J,K,L)=JEMP+IABS(I-IROWE(L))+NJ
ISN 0113         6  CONTINUE
ISN 0114            KK=1000
ISN 0115            DO 13 L=1,NEXIT
ISN 0116            IF(NOPEN(L).EQ.1)GO TO 13
ISN 0118            IF(N(I,J,K,L).LT.KK)GO TO 14
ISN 0120            GO TO 13
ISN 0121         14 KK=N(I,J,K,L)
ISN 0122            LL=L
ISN 0123         13 CONTINUE
ISN 0124            DO 16 L=1,NEXIT
ISN 0125         16 N(I,J,K,L)=KK
ISN 0126            N(I,J,K,LL)=KK
ISN 0127         10 CONTINUE
ISN 0128            IF(NDECK.EQ.1)CALL UDECK(IIL,JJU,TIU,IL,JL,NOUT,NNOUT)
ISN 0130            L=0
ISN 0131         53 L=L+1
ISN 0132            IF(L.GT.NEXIT)GO TO 51
ISN 0134            IF(NOPEN(L).EQ.1)GO TO 53
ISN 0136            WRITE(6,208)
ISN 0137            CALL GAMF(XMN1(L),SD1(L),XU1(L),XINT1(L),P1,XX1,NN1)
ISN 0138            CALL GAMF(XMN2(L),SD2(L),XU2(L),XINT2(L),P2,XX2,NN2)
ISN 0139            CALL GAMF(XMN3(L),SD3(L),XU3(L),XINT3(L),P3,XX3,NN3)
ISN 0140            CALL GAMF(XMN4(L),SD4(L),XU4(L),XINT4(L),P4,XX4,NN4)
ISN 0141            CALL GAMF(XMN5(L),SD5(L),XU5(L),XINT5(L),P5,XX5,NN5)
ISN 0142         50 KK=1000
ISN 0143            DO 30 K=1,NEXIT
ISN 0144            N1=NRF(K)
ISN 0145            N2=NRL(K)
ISN 0146            N3=NCOL2(K)
ISN 0147            DO 30 I=N1,N2
ISN 0148            DO 30 J=1,N3
ISN 0149            IF(N(I,J,K,L).LT.KK)GO TO 31
ISN 0151            GO TO 30
ISN 0152         31 KK=N(I,J,K,L)
ISN 0153            II=I
ISN 0154            JJ=J
ISN 0155            K4=K
ISN 0156            LL=L
ISN 0157         30 CONTINUE
ISN 0158            IF(N(II,JJ,K4,LL).EQ.1000)GO TO 52
ISN 0160            N(II,JJ,K4,LL)=1000
ISN 0161            CALL PATH(KK,II,JJ,K4,LL,NSIDE(K4),T,T3,TIU,J)
ISN 0162            GO TO 50
ISN 0163         52 IF(NDECK.EQ.0)GO TO 53
ISN 0165            IF(L.NE.NOUT)GO TO 53
```

```
ISN                     IF(NSIDE(L).EQ.0)KK=IABS(IRCWE(L)-IL)+NCOLI      .+IABS(JL-NCOL1(L)+
                       11)
ISN 0169                IF(NSIDE(L).EQ.1)KK=IABS(IROWF(L)-IL)+NCOL1(L)+1+IABS(JL-NSAV2(L)+
                       11)
ISN 0171                NL=NEXIT+1
ISN 0172                DO 95 I=1,NNOUT
ISN 0173             95 CALL PATH(KK,IIU(I),JJU(I),AL,L,0,T,T3,TIU(I),1)
ISN 0174                GO TO 53
ISN 0175             51 NX=NX+1
ISN 0176                CALL OPTIM(T,ACCUNT,NEXIT,NOPEN,NSIDE,T3)
ISN 0177                IF(NX.LT.NRUN)GO TO 79
ISN 0179            200 FORMAT(4I5)
ISN 0180            201 FORMAT(5I5)
ISN 0181            202 FORMAT(5F10.0)
ISN 0182            203 FORMAT(16I5)
ISN 0183            205 FORMAT(5X,33HAIRCRAFT CONFIGURATION INPUT DATA)
ISN 0184            206 FORMAT(1H1,9X,23HTIME SEGMENT INPUT DATA)
ISN 0185            207 FORMAT(5F10.3,I5)
ISN 0186            208 FORMAT(1H1,7X,3HROW,5X,6HCOLUMN,1X,13HEXIT ASSIGNED,1X,8HEXIT OUT,
                       13X,12HTIME TO DOOR,10X,13HTIME DELAY,12X,8HTIME OUT)
ISN 0187                STOP
ISN 0188                END

*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=00,LINECNT=74,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      187 ,PROGRAM SIZE =   19130

*STATISTICS*  NO  DIAGNOSTICS GENERATED

******* END OF COMPILATION ******                                    55K BYTES OF CORE NOT USED
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LEVEL 21.8 ( JUN 74 )                    OS/360  FORTRAN H                    DATE  75.337/18.29.41

          COMPILER OPTIONS - NAME=  MAIN,OPT=00,LINECNT=74,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF
    ISN 0002            SUBROUTINE PATMIN(I,J,K,L,M,T,T3,TIU,NFLAG)
    ISN 0003            COMMON P1(50),P2(50),P3(50),P4(50),P5(50)
    ISN 0004            COMMON XX1(50),XX2(50),XX3(50),XX4(50),XX5(50)
    ISN 0005            COMMON NN1,NN2,NN3,NN4,NN5
    ISN 0006            COMMON NCOL1(11),NCOL3(10),NCOUNT(10),LOLD,TOLD,NEXIT
    ISN 0007            COMMON XL1(11),XL2(11),XL3(11),XL4(11),XL5(11)
    ISN 0008            DIMENSION T(10),T3(10)
    ISN 0009            CALL RANDU(YFL)
    ISN 0010            CALL LININ(P1,XX1,YFL,T1,NN1,XL1(L))
    ISN 0011            CALL LININ(P2,XX2,YFL,T2,NN2,XL2(L))
    ISN 0012            IF(LOLD.EQ.L)GO TO 4
    ISN 0014            CALL LININ(P3,XX3,YFL,T3(L),NN3,XL3(L))
    ISN 0015          4 CALL LININ(P4,XX4,YFL,T4,NN4,XL4(L))
    ISN 0016            CALL LININ(P5,XX5,YFL,T5,NN5,XL5(L))
    ISN 0017            IF(NFLAG.EQ.1)GO TO 10
    ISN 0019            IF(J.LE.NCOL1(K))NJJ=NCOL1(K)+1-J
    ISN 0021            NK=NCOL1(K)+2
    ISN 0022            IF(J.GE.NN)NJJ=J-NCOL1(K)-1
    ISN 0024            TTOD=T1*(N-NJJ)+T2*NJJ
    ISN 0025            GO TO 5
    ISN 0026         10 TTOD=TIU+N*T1
    ISN 0027          5 IF(LOLD.NE.L)GO TO 1
    ISN 0029          2 IF(NCOUNT(L).EQ.0)TSUM=T3(L)
    ISN 0031            TSAVE=TSUM
    ISN 0032            IF(TSUM.LT.TTOD)TSUM=TTOD
    ISN 0034            T(L)=TSUM+T4+T5
    ISN 0035            IF(TOLD.GE.T(L))T(L)=TOLD+.2
    ISN 0037            IF(M.EQ.1)J=NCOL3(K)-J+1
    ISN 0039            WRITE(6,100)I,J,K,L,TTOD,TSAVE,T(L)
    ISN 0040            NCOUNT(L)=NCOUNT(L)+1
    ISN 0041            TSUM=TSUM+T4
    ISN 0042            LOLD=L
    ISN 0043            TOLD=T(L)
    ISN 0044            GO TO 3
    ISN 0045          1 IF(LOLD.EQ.0)GO TO 2
    ISN 0047            TOLD=0.
    ISN 0048            NCOUNT(L)=0
    ISN 0049            GO TO 2
    ISN 0050          3 CONTINUE
    ISN 0051        100 FORMAT(4I10,3(10X,F10.3))
    ISN 0052            RETURN
    ISN 0053            END

*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=0),LINECNT=74,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =       52 ,PROGRAM SIZE =      1676

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                          95K BYTES OF CORE NOT USED
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```
COMPILER OPTIONS - NAME= MAIN,OPT=00,LINECNT=74,SIZE=0000K,
                   SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF
ISN 0002            SUBROUTINE UOPCK(IIU,JJU,TIU,IL,JL,NOUT,NNOUT)
ISN 0003            COMMON P1(50),P2(50),P3(50),P4(50),P5(50)
ISN 0004            COMMON XX1(50),XX2(50),XX3(50),XX4(50),XX5(50)
ISN 0005            COMMON NN1,NN2,NN3,NN4,NN5
ISN 0006            COMMON NCOL1(11),NCOL3(10),NCOUNT(10),LOLD,TOLD,NEXIT
ISN 0007            COMMON XL1(11),XL2(11),XL3(11),XL4(11),XL5(11)
ISN 0008            DIMENSION N(10,7),IUD(20),JUD(20),P6(50),XX6(50),TIU(20),IIU(20),
                   1JJU(20),IV(20),JV(20),T(10),T3(10)
ISN 0009            DATA NC/7/
ISN 0010            DO 15 I=1,10
ISN 0011            DO 15 J=1,7
ISN 0012         15 N(I,J)=100
ISN 0013            LL=NEXIT+1
ISN 0014            IF(NC.EQ.1)GO TO 2
ISN 0016            WRITE(6,103)
ISN 0017            READ(5,100)IROWE,NRF,NRL,NCOL1(LL),NCOL2,NOPEN,NEMP
ISN 0018            JEMP=NCOL1(LL)+1
ISN 0019            WRITE(6,100)IROWE,NRF,NRL,NCOL1(LL),NCOL2,NOPEN,NEMP
ISN 0020            READ(5,100)IU,JU,IL,JL,NOUT,NNOUT,NUOUT
ISN 0021            WRITE(6,100)IU,JU,IL,JL,NOUT,NNOUT,NUOUT
ISN 0022            IF(NOPEN.EQ.1)GO TO 1
ISN 0024            READ(5,101)(IUD(I),JUD(I),I=1,NUOUT)
ISN 0025            WRITE(6,101)(IUD(I),JUD(I),I=1,NUOUT)
ISN 0026         1  IF(NEMP.EQ.0)GO TO 5
ISN 0028            READ(5,101)(IV(I),JV(I),I=1,NEMP)
ISN 0029            WRITE(6,101)(IV(I),JV(I),I=1,NEMP)
ISN 0030         5  READ(5,102)XMN1,SD1,XU1,XINT1,XL1(LL)
ISN 0031            READ(5,102)XMN2,SD2,XU2,XINT2,XL2(LL)
ISN 0032            WRITE(6,104)XMN1,SD1,XU1,XINT1,XL1(LL)
ISN 0033            WRITE(6,104)XMN2,SD2,XU2,XINT2,XL2(LL)
ISN 0034            IF(NOPEN.EQ.1)GO TO 6
ISN 0036            READ(5,102) XMN3,SD3,XU3,XINT3,XL3(LL)
ISN 0037            READ(5,102)XMN4,SD4,XU4,XINT4,XL4(LL)
ISN 0038            READ(5,102)XMN5,SD5,XU5,XINT5,XL5(LL)
ISN 0039            WRITE(6,104)XMN3,SD3,XU3,XINT3,XL3(LL)
ISN 0040            WRITE(6,104)XMN4,SD4,XU4,XINT4,XL4(LL)
ISN 0041            WRITE(6,104)XMN5,SD5,XU5,XINT5,XL5(LL)
ISN 0042         6  IF(NNOUT.EQ.0)GO TO 2
ISN 0044            READ(5,102)XMN6,SD6,XU6,XINT6,XL6
ISN 0045            WRITE(6,104)XMN6,SD6,XU6,XINT6,XL6
ISN 0046         2  CALL GAMF(XMN1,SD1,XU1,XINT1,P1,XX1,NN1)
ISN 0047            CALL GAMF(XMN2,SD2,XU2,XINT2,P2,XX2,NN2)
ISN 0048            IF(NOPEN.EQ.1)GO TO 7
ISN 0050            CALL GAMF(XMN3,SD3,XU3,XINT3,P3,XX3,NN3)
ISN 0051            CALL GAMF(XMN4,SD4,XU4,XINT4,P4,XX4,NN4)
ISN 0052            CALL GAMF(XMN5,SD5,XU5,XINT5,P5,XX5,NN5)
ISN 0053         7  IF(NNOUT.EQ.0)GO TO 8
ISN 0055            CALL GAMF(XMN6,SD6,XU6,XINT6,P6,XX6,NN6)
ISN 0056         8  IF(NOPEN.EQ.1)GO TO 61
ISN 0058            DO 10 I=NRF,NRL
ISN 0059            DO 10 J=1,NCOL2
ISN 0060            DO 30 L=1,NUOUT
ISN 0061            IF(I.EQ.IUD(L).AND.J.EQ.JUD(L))GO TO 31
ISN 0063         30 CONTINUE
ISN 0064            GO TO 10
ISN 0065         31 IF(J.LE.NCOL1(LL))NJ=JEMP-J
ISN 0067            IF(J.GT.NCOL1(LL))NJ=J-JEMP
ISN 0069            N(I,J)=JEMP+IABS(I-IROWE)+NJ
ISN 0070         10 CONTINUE
ISN 0071            WRITE(6,208)
ISN 0072         50 KK=1000
ISN 0073            DO 40 I=NRF,NRL
ISN 0074            DO 40 J=1,NCOL2
ISN 0075            IF(N(I,J).LT.KK)GO TO 41
ISN 0077            GO TO 40
ISN 0078         41 KK=N(I,J)
ISN 0079            II=I
ISN 0080            JJ=J
ISN 0081         40 CONTINUE
ISN 0082            IF(N(II,JJ).EQ.100)GO TO 61
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ISN 0084            N(II,JJ)=1
ISN 0085            CALL PATH(KK,II,JJ,LL,LL,T,T3,
ISN 0086            GO TO 5
ISN 0087         60 IF(NNOUT.EQ.1)GO TO 95
ISN 0089            DO 70 I=NRF,NRL
ISN 0090            DO 70 J=1,NCOL2
ISN 0091            IF(I.EQ.IRO)GO TO 70
ISN 0093            IF(J.EQ.JEMP)GO TO 72
ISN 0095            IF(NEMP.EQ.1)GO TO 72
ISN 0097            DO 80 L=1,NEMP
ISN 0098            IF(I.EQ.IV(L).AND.J.EQ.JV(L))GO TO 7
ISN 0100         80 CONTINUE
ISN 0101         72 DO 85 L=1,NUOUT
ISN 0102            IF(I.EQ.IUD(L).AND.J.EQ.JUD(L))GO TO 70
ISN 0104         85 CONTINUE
ISN 0105            IF(J.LE.NCOL1(LL))NJ=JEMP-J
ISN 0107            IF(J.GT.NCOL1(LL))NJ=J-JEMP
ISN 0109            N(I,J)=NJ+IABS(I-IU)+IABS(JEMP-JU)
ISN 0111         70 CONTINUE
ISN 0111            M=1
ISN 0112         75 KK=1000
ISN 0113            DO 9  I=NRF,NRL
ISN 0114            DO 9  J=1,NCOL2
ISN 0115            IF(N(I,J).LT.KK)GO TO 91
ISN 0117            GO TO 9
ISN 0118         91 KK=N(I,J)
ISN 0119            IIU(M)=I
ISN 0120            JJU(M)=J
ISN 0121         9  CONTINUE
ISN 0122            I=IIU(M)
ISN 0123            J=JJU(M)
ISN 0124            IF(N(I,J).EQ.1000)GO TO 95
ISN 0126            N(I,J)=1000
ISN 0127            CALL RANDU(YFL)
ISN 0128            CALL LININ(P1,XX1,YFL,T1,NN1,XL1(LL))
ISN 0129            CALL LININ(P2,XX2,YFL,T2,NN2,XL2(LL))
ISN 0130            CALL LININ(P6,XX6,YFL,T6,NN6,XL6)
ISN 0131            IF(J.LE.NCOL1(LL))NJ=JEMP-J
ISN 0133            IF(J.GT.NCOL1(LL))NJ=J-JEMP
ISN 0135            TIU(M)=T1*(KK-NJ)+T2*NJ+T6
ISN 0136            M=M+1
ISN 0137            GO TO 75
ISN 0138         95 NC=1
ISN 0139        100 FORMAT(7I5)
ISN 0140        101 FORMAT(16I5)
ISN 0141        102 FORMAT(5F10.0)
ISN 0142        103 FORMAT(1H0,9X,21HUPPER DECK INPUT DATA)
ISN 0143        104 FORMAT(5F10.3)
ISN 0144        200 FORMAT(1H1,7X,3HROW,5X,6HCOLUMN,1X,13HEXIT ASSIGNED,1X,8HEXIT OUT,
                   13X,12HTIME TO DOOR,10X,10HTIME DELAY,12X,8HTIME OUT)
ISN 0145            RETURN
ISN 0146            END
```

OPTIONS IN EFFECT NAME= MAIN,OPT=00,LINECNT=74,SIZE=0000K,

OPTIONS IN EFFECT SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF

STATISTICS SOURCE STATEMENTS = 145 ,PROGRAM SIZE = 5898

STATISTICS NO DIAGNOSTICS GENERATED

****** END OF COMPILATION ****** 67K BYTES OF CORE NOT USED

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LEVEL  8 ( JUN 74 )                    OS/360  FORTRAN                    DATE  75.337/18.30.02

      COMPILER OPTIONS - NAME=  MAIN,OPT=00,LINECNT=74,SIZE=    K,
                         SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF
ISN 0002            SUBROUTINE OPTIM(T,NCOUNT,NEXIT,NOPEN,NSIDE,T3)
ISN 0003            DIMENSION T(10),NCOUNT(10),NOPEN(10),NSIDE(10),K(5),T3(10)
ISN 0004            WRITE(6,105)
ISN 0005            DO 40 I=1,NEXIT
ISN 0006            IF(NOPEN(I).EQ.1)GO TO 40
ISN 0008            WRITE(6,101)NCOUNT(I),T(I),I
ISN 0009         40 CONTINUE
ISN 0010          8 TT=0.
ISN 0011            DO 1 I=1,NEXIT
ISN 0012            IF(NOPEN(I).EQ.1)GO TO 1
ISN 0014            IF(T(I).GT.TT)GO TO 2
ISN 0016            GO TO 1
ISN 0017          2 TT=T(I)
ISN 0018            II=I
ISN 0019          1 CONTINUE
ISN 0020            IF(NSIDE(II).EQ.0)GO TO 5
ISN 0022            K(1)=II-3
ISN 0023            K(2)=II-2
ISN 0024            K(3)=II-1
ISN 0025            K(4)=II+1
ISN 0026            K(5)=II+2
ISN 0027            T1=1000.
ISN 0028            DO 3 J=1,5
ISN 0029            IF(K(J).LE.0)GO TO 3
ISN 0031            IF(K(J).GT.NEXIT)GO TO 3
ISN 0033            K1=K(J)
ISN 0034            IF(NOPEN(K1).EQ.1)GO TO 3
ISN 0036            IF(T(K1).LT.T1)GO TO 4
ISN 0038            GO TO 3
ISN 0039          4 T1=T(K1)
ISN 0040            K2=K1
ISN 0041          3 CONTINUE
ISN 0042            GO TO 10
ISN 0043          5 K(1)=II-2
ISN 0044            K(2)=II-1
ISN 0045            K(3)=II+1
ISN 0046            K(4)=II+2
ISN 0047            K(5)=II+3
ISN 0048            T1=1000.
ISN 0049            DO 6 J=1,5
ISN 0050            IF(K(J).LE.0)GO TO 6
ISN 0052            IF(K(J).GT.NEXIT)GO TO 6
ISN 0054            K1=K(J)
ISN 0055            IF(NOPEN(K1).EQ.1)GO TO 6
ISN 0057            IF(T(K1).LT.T1)GO TO 7
ISN 0059            GO TO 6
ISN 0060          7 T1=T(K1)
ISN 0061            K2=K1
ISN 0062          6 CONTINUE
ISN 0063         10 DELT=(TT-T1)/2
ISN 0064            R1=(T1-T3(K2))/NCOUNT(K2)
ISN 0065            R2=(TT-T3(II))/NCOUNT(II)
ISN 0066            N1=DELT/R1
ISN 0067            N2=DELT/R2
ISN 0068            IF(N1.GT.N2)GO TO 11
ISN 0070            NCOUNT(II)=NCOUNT(II)-N1
ISN 0071            T(II)=T(II)-N1*R2
ISN 0072            NCOUNT(K2)=NCOUNT(K2)+N1
ISN 0073            T(K2)=T(K2)+N1*R1
ISN 0074            NSAVE=N1
ISN 0075            GO TO 12
ISN 0076         11 NCOUNT(II)=NCOUNT(II)-N2
ISN 0077            T(II)=T(II)-N2*R2
ISN 0078            NCOUNT(K2)=NCOUNT(K2)+N2
ISN 0079            T(K2)=T(K2)+N2*R1
ISN 0080            NSAVE=N2
ISN 0081         12 WRITE(6,107)NSAVE,II,K2
ISN 0082            IF(NSAVE.EQ.0)GO TO 35
ISN 0084            DO 20 I=1,NEXIT
ISN 0085            IF(NOPEN(I).EQ.1)GO TO 20
```

```
ISN 0087            WRITE(6,101)NCOUNT(I),T(I),I
ISN 0088         20 CONTINUE
ISN 0089            GO TO 8
ISN 0090         30 CONTINUE
ISN 0091        101 FORMAT(20X,I10,F10.3,I10)
ISN 0092        105 FORMAT(1H1,23X,9HNO. PASS.,3X,4HTIME,6X,8HEXIT NO.)
ISN 0093        107 FORMAT(20X,I5,16H PASS. FROM EXIT,I2,11H GO TO EXIT,I2)
ISN 0094            RETURN
ISN 0095            END
*OPTIONS IN EFFECT*       NAME= MAIN,OPT=00,LINECNT=74,SIZE=0000K,
*OPTIONS IN EFFECT*       SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF
*STATISTICS*      SOURCE STATEMENTS =       94 ,PROGRAM SIZE =      2520
*STATISTICS*  NO  DIAGNOSTICS GENERATED
****** END OF COMPILATION ******                                  87K BYTES OF CORE NOT USED
```

```
LEVEL 2  (  JUN 74 )                    OS/360  FORTRAN H                    DATE  75.337/18.30.14
          COMPILER OPTIONS - NAME=  MAIN,OPT=00,LINECNT=74,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF
   ISN 0002                  SUBROUTINE RANDU(YFL)
   ISN 0003                  DATA IX,NX/39,0/
   ISN 0004                1 NX=NX+1
   ISN 0005                  IY = IX * 65549
   ISN 0006                  IF(IY)5,6,6
   ISN 0007                5 IY=IY + 2147483647 + 1
   ISN 0008                6 YFL = IY
   ISN 0009                  YFL = YFL * .4656613E-9
   ISN 0010                  IX = IY
   ISN 0011                  IF(NX.LE.2)GO TO 1
   ISN 0013                  RETURN                                          PL009000
   ISN 0014                  END

*OPTIONS IN EFFECT*       NAME=  MAIN,OPT=00,LINECNT=74,SIZE=0000K,

*OPTIONS IN EFFECT*       SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      13 ,PROGRAM SIZE =      386

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                          99K BYTES OF CORE NOT USED
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```
      COMPILER OPTIONS - NAME=  MAIN,OPT=00,LINECNT=74,SIZE=     K,
                         SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF
  ISN 0002            SUBROUTINE LININ(P,XX,R,T,NN,XL)
  ISN 0003            DIMENSION P(100),XX(100)
  ISN 0004            IF(R.GE.P(NN))GO TO 2
  ISN 0006            DO 3 I=2,NN
  ISN 0007          3 IF(R.LE.P(I))GO TO 4
  ISN 0009          4 T=XX(I)-((XX(I)-XX(I-1))*(P(I)-R))/(P(I)-P(I-1))
  ISN 0010            IF(T.LT.XL)T=XL
  ISN 0012            RETURN
  ISN 0013          2 T=XX(NN)
  ISN 0014            RETURN
  ISN 0015            END
*OPTIONS IN EFFECT*     NAME=  MAIN,OPT=00,LINECNT=74,SIZE=    K,
*OPTIONS IN EFFECT*     SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF
*STATISTICS*    SOURCE STATEMENTS =      14 ,PROGRAM SIZE =      628
*STATISTICS*  NO  DIAGNOSTICS GENERATED
****** END OF COMPILATION ******                              99K BYTES OF CORE NOT USED
```

```
LEVEL 21     JUN 74 )                    OS/360  FORTRAN H                    DATE  75.337/18.30.16

     MPILER OPTIONS - NAME=  MAIN,OPT=00,LINECNT=74,SIZE=00
                      SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMA   DIT,ID,NOXREF
ISN 0002              SUBROUTINE GAMF(XMN,SD,XU,XINT,P,XX,NN)
ISN 0003              DIMENSION P(100),XX(100)
ISN 0004        60    BETA=SD*SD/XMN
ISN 0005              ALPA = XMN/BETA - 1.)
ISN 0006              G = 2.0*ALPA & 2.0
ISN 0007              NN = XU/XINT
ISN 0008              DO 30 I = 1,NN
ISN 0009              XX(I) = I * XINT
ISN 0010              X     = 2.0   * XX(I)/BETA
ISN 0011              CALL CDTR(X,G,P(I),D,IER)
ISN 0012        30    CONTINUE
ISN 0013              RETURN
ISN 0014              END

*OPTIONS IN EFFECT*       NAME=  MAIN,OPT=00,LINECNT=74,SIZE=0000K,
*OPTIONS IN EFFECT*       SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =      13 ,PROGRAM SIZE =      650

*STATISTICS*  NO  DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                          99K BYTES OF CORE NOT USED
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```
COMPILER OPTIONS - NAME= MAIN,OPT=00,LINECNT=74,SIZE=0000K,
                   SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF
C     ******************************************************************  CDTR  10
C                                                                           CDTR  20
C        SUBROUTINE CDTR                                                    CDTR  30
C                                                                           CDTR  40
C        PURPOSE                                                            CDTR  50
C           COMPUTES P(X) = PROBABILITY THAT THE RANDOM VARIABLE U,          CDTR  60
C           DISTRIBUTED ACCORDING TO THE CHI-SQUARE DISTRIBUTION WITH G      CDTR  70
C           DEGREES OF FREEDOM, IS LESS THAN OR EQUAL TO X.  F(G,X), THE     CDTR  80
C           ORDINATE OF THE CHI-SQUARE DENSITY AT X, IS ALSO COMPUTED.       CDTR  90
C                                                                           CDTR 100
C        USAGE                                                              CDTR 110
C           CALL CDTR(X,G,P,D,IER)                                          CDTR 120
C                                                                           CDTR 130
C        DESCRIPTION OF PARAMETERS                                          CDTR 140
C           X   - INPUT SCALAR FOR WHICH P(X) IS COMPUTED.                  CDTR 150
C           G   - NUMBER OF DEGREES OF FREEDOM OF THE CHI-SQUARE            CDTR 160
C                 DISTRIBUTION.  G IS A CONTINUOUS PARAMETER.               CDTR 170
C           P   - OUTPUT PROBABILITY.                                       CDTR 180
C           D   - OUTPUT DENSITY.                                           CDTR 190
C           IER - RESULTANT ERROR CODE WHERE                                CDTR 200
C                 IER= 0 --- NO ERROR                                       CDTR 210
C                 IER=-1 --- AN INPUT PARAMETER IS INVALID.  X IS LESS      CDTR 220
C                            THAN 0.0, OR G IS LESS THAN 0.5 OR GREATER     CDTR 230
C                            THAN 2*10**(+5).  P AND D ARE SET TO -1.E75.   CDTR 240
C                 IER=+1 --- INVALID OUTPUT.  P IS LESS THAN ZERO OR        CDTR 250
C                            GREATER THAN ONE, OR SERIES FOR T1 (SEE        CDTR 260
C                            MATHEMATICAL DESCRIPTION) HAS FAILED TO        CDTR 270
C                            CONVERGE.  P IS SET TO 1.E75.                  CDTR 280
C                                                                           CDTR 290
C        REMARKS                                                            CDTR 300
C           SEE MATHEMATICAL DESCRIPTION.                                   CDTR 310
C                                                                           CDTR 320
C        SUBROUTINES AND FUNCTION SUBPROGRAMS REQUIRED                      CDTR 330
C           DLGAM                                                           CDTR 340
C           NDTR                                                            CDTR 350
C                                                                           CDTR 360
C        METHOD                                                             CDTR 370
C           REFER TO R.E. BARGMANN AND S.P. GHOSH, STATISTICAL              CDTR 380
C           DISTRIBUTION PROGRAMS FOR A COMPUTER LANGUAGE,                  CDTR 390
C           IBM RESEARCH REPORT RC-1094, 1963.                              CDTR 400
C                                                                           CDTR 410
C     ******************************************************************  CDTR 420
C                                                                           CDTR 430
ISN 0002        SUBROUTINE CDTR(X,G,P,D,IER)                                CDTR 440
ISN 0003        DOUBLE PRECISION XX,DLXX,X2,DLX2,GG,G2,DLT3,THETA,THPI,     CDTR 450
               1GLG2,DD,T11,SER,CC,XI,FAC,TLOG,TERM,GTH,A2,A,B,C,DT2,DT3,THPI CDTR 460
C                                                                           CDTR 470
C       TEST FOR VALID INPUT DATA                                           CDTR 480
C                                                                           CDTR 490
C                                                                           CDTR 500
ISN 0004        IF(G-(.5-1.E-5)) 59,10,10                                   CDTR 510
ISN 0005     10 IF(G-2.E+5) 20,20,59                                        CDTR 520
ISN 0006     20 IF(X) 50,30,30                                              CDTR 530
C                                                                           CDTR 540
C       TEST FOR X NEAR 0.0                                                 CDTR 550
C                                                                           CDTR 560
ISN 0007     30 IF(X-1.E-8) 40,40,80                                        CDTR 570
ISN 0008     40 P=0.0                                                       CDTR 580
ISN 0009        IF(G-2.) 50,60,70                                           CDTR 590
ISN 0010     50 D=1.E75                                                     CDTR 600
ISN 0011        GO TO 610                                                   CDTR 610
ISN 0012     60 D=0.5                                                       CDTR 620
ISN 0013        GO TO 610                                                   CDTR 630
ISN 0014     70 D=0.0                                                       CDTR 640
ISN 0015        GO TO 610                                                   CDTR 650
C                                                                           CDTR 660
C       TEST FOR X GREATER THAN 1.E+6                                       CDTR 670
C                                                                           CDTR 680
ISN 0016     80 IF(X-1.E+6) 100,100,90                                      CDTR 690
ISN 0017     90 D=0.0                                                       CDTR 700
```

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ISN                     P=1.0                                                   CDTR 710
ISN                     GO TO 610                                               CDTR 720
                C                                                               CDTR 730
                C       SET PROGRAM PARAMETERS                                  CDTR 740
                C                                                               CDTR 750
ISN 0020          100   XX=DBLE(X)                                              CDTR 760
ISN 0021                DLXX=DLOG(XX)                                           CDTR 770
ISN 0022                X2=XX/2.D0                                              CDTR 780
ISN 0023                DLX2=DLOG(X2)                                           CDTR 790
ISN 0024                GG=DBLE(G)                                              CDTR 800
ISN 0025                G2=GG/2.D0                                              CDTR 810
                C                                                               CDTR 820
                C       COMPUTE ORDINATE                                        CDTR 830
                C                                                               CDTR 840
ISN 0026                CALL DLGAM(G2,GLG2,IOK)                                 CDTR 850
ISN 0027                DD=(G2-1.D0)*DLXX-X2-G2*.69314718055994530 -GLG2        CDTR 860
ISN 0028                IF(DD-1.68D02) 110,110,120                              CDTR 870
ISN 0029          110   IF(DD+1.68D02) 130,130,140                              CDTR 880
ISN 0030          120   D=1.E75                                                 CDTR 890
ISN 0031                GO TO 150                                               CDTR 900
ISN 0032          130   D=0.0                                                   CDTR 910
ISN 0033                GO TO 150                                               CDTR 920
ISN 0034          140   DD=DEXP(DD)                                             CDTR 930
ISN 0035                D=SNGL(DD)                                              CDTR 940
                C                                                               CDTR 950
                C       TEST FOR G GREATER THAN 1000.0                          CDTR 960
                C       TEST FOR X GREATER THAN 2000.0                          CDTR 970
                C                                                               CDTR 980
ISN 0036          150   IF(G-1000.) 160,160,18)                                 CDTR 990
ISN 0037          160   IF(X-2000.) 190,190,170                                 CDTR1000
ISN 0038          170   P=1.0                                                   CDTR1010
ISN 0039                GO TO 610                                               CDTR1020
ISN 0040          180   A=DLOG(XX/GG)/3.D0                                      CDTR1030
ISN 0041                A=DEXP(A)                                               CDTR1040
ISN 0042                B=2.00/(9.D0*GG)                                        CDTR1050
ISN 0043                C=(A-1.D0+B)/DSQRT(B)                                   CDTR1060
ISN 0044                SC=SNGL(C)                                              CDTR1070
ISN 0045                CALL NDTR(SC,P,DUMMY)                                   CDTR1080
ISN 0046                GO TO 490                                               CDTR1090
                C                                                               CDTR1100
                C       COMPUTE THETA                                           CDTR1110
                C                                                               CDTR1120
ISN 0047          190   K= IDINT(G2)                                            CDTR1130
ISN 0048                THETA=G2-DFLOAT(K)                                      CDTR1140
ISN 0049                IF(THETA-1.D-8) 200,200,210                             CDTR1150
ISN 0050          200   THETA=0.D0                                              CDTR1160
ISN 0051          210   THP1=THETA+1.D0                                         CDTR1170
                C                                                               CDTR1180
                C       SELECT METHOD OF COMPUTING T1                           CDTR1190
                C                                                               CDTR1200
ISN 0052                IF(THETA) 230,230,220                                   CDTR1210
ISN 0053          220   IF(XX-10.D0) 260,260,320                                CDTR1220
                C                                                               CDTR1230
                C       COMPUTE T1 FOR THETA EQUALS 0.0                         CDTR1240
                C                                                               CDTR1250
ISN 0054          230   IF(X2-1.68D02) 250,240,240                              CDTR1260
ISN 0055          240   T1=1.0                                                  CDTR1270
ISN 0056                GO TO 400                                               CDTR1280
ISN 0057          250   T11=1.D0-DEXP(-X2)                                      CDTR1290
ISN 0058                T1=SNGL(T11)                                            CDTR1300
ISN 0059                GO TO 400                                               CDTR1310
                C                                                               CDTR1320
                C       COMPUTE T1 FOR THETA GREATER THAN 0.0 AND               CDTR1330
                C       X LESS THAN OR EQUAL TO 10.0                            CDTR1340
                C                                                               CDTR1350
ISN 0060          260   SER=X2*(1.D0/THP1 -X2/(THP1+1.D0))                      CDTR1360
ISN 0061                J=1                                                     CDTR1370
ISN 0062                CC=DFLOAT(J)                                            CDTR1380
ISN 0063                DO 270 IT1=3,30                                         CDTR1390
ISN 0064                XI=DFLOAT(IT1)                                          CDTR1400
ISN 0065                CALL DLGAM(XI,FAC,IOK)                                  CDTR1410
ISN 0066                TLOG= XI*DLX2-FAC-DLOG(XI+THETA)                        CDTR1420
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ISN 0067            TERM=DEXP(TLOG)                                                 CDTR1430
ISN 0068            TERM=DSIGN(TERM,CC)                                             CDTR1440
ISN 0069            SER=SER+TERM                                                    CDTR1450
ISN 0070            CC=-CC                                                          CDTR1460
ISN 0071            IF(DABS(TERM)-1.D-9) 280,270,270                                CDTR1470
ISN 0072        270 CONTINUE                                                        CDTR1480
ISN 0073            GO TO 600                                                       CDTR1490
ISN 0074        280 IF(SER) 600,600,290                                             CDTR1500
ISN 0075        290 CALL DLGAM(THP1,GTH,IOK)                                        CDTR1510
ISN 0076            TLOG=THETA*DLX2+DLOG(SER)-GTH                                   CDTR1520
ISN 0077            IF(TLOG+1.68D02) 300,300,310                                    CDTR1530
ISN 0078        300 T1=0.0                                                          CDTR1540
ISN 0079            GO TO 400                                                       CDTR1550
ISN 0080        310 T11=DEXP(TLOG)                                                  CDTR1560
ISN 0081            T1=SNGL(T11)                                                    CDTR1570
ISN 0082            GO TO 400                                                       CDTR1580
                C                                                                   CDTR1590
                C     COMPUTE T1 FOR THETA GREATER THAN 0.0 AND                     CDTR1600
                C     X GREATER THAN 10.0 AND LESS THAN 2000.0                      CDTR1610
                C                                                                   CDTR1620
ISN 0083        320 A2=0.D0                                                         CDTR1630
ISN 0084            DO 340 I=1,25                                                   CDTR1640
ISN 0085            XI=DFLOAT(I)                                                    CDTR1650
ISN 0086            CALL DLGAM(THP1,GTH,IOK)                                        CDTR1660
ISN 0087            T11=-(13.D0*XX)/XI +THP1*DLOG(13.D0*XX/XI) -GTH-DLOG(XI)        CDTR1670
ISN 0088            IF(T11+1.68D02) 340,340,330                                     CDTR1680
ISN 0089        330 T11=DEXP(T11)                                                   CDTR1690
ISN 0090            A2=A2+T11                                                       CDTR1700
ISN 0091        340 CONTINUE                                                        CDTR1710
ISN 0092            A=1.91282051+THETA/156.D0-XX/312.D0                             CDTR1720
ISN 0093            B=DABS(A)                                                       CDTR1730
ISN 0094            C= -X2+THP1*DLX2+DLOG(B)-GTH-3.951243718581427                  CDTR1740
ISN 0095            IF(C+1.68D02) 370,370,350                                       CDTR1750
ISN 0096        350 IF (A) 360,370,380                                              CDTR1760
ISN 0097        360 C=-DEXP(C)                                                      CDTR1770
ISN 0098            GO TO 390                                                       CDTR1780
ISN 0099        370 C=0.D0                                                          CDTR1790
ISN 0100            GO TO 390                                                       CDTR1800
ISN 0101        380 C=DEXP(C)                                                       CDTR1810
ISN 0102        390 C=A2+C                                                          CDTR1820
ISN 0103            T11=1.D0-C                                                      CDTR1830
ISN 0104            T1=SNGL(T11)                                                    CDTR1840
                C                                                                   CDTR1850
                C     SELECT PROPER EXPRESSION FOR P                                CDTR1860
                C                                                                   CDTR1870
ISN 0105        400 IF(G-2.) 420,410,410                                            CDTR1880
ISN 0106        410 IF(G-4.) 450,460,460                                            CDTR1890
                C                                                                   CDTR1900
                C     COMPUTE P FOR G GREATER THAN ZERO AND LESS THAN 2.0           CDTR1910
                C                                                                   CDTR1920
ISN 0107        420 CALL DLGAM(THP1,GTH,IOK)                                        CDTR1930
ISN 0108            DT2=THETA*DLXX-X2-THP1*.6931471805599453 -GTH                   CDTR1940
ISN 0109            IF(DT2+1.68D02) 430,430,440                                     CDTR1950
ISN 0110        430 P=T1                                                            CDTR1960
ISN 0111            GO TO 490                                                       CDTR1970
ISN 0112        440 DT2=DEXP(DT2)                                                   CDTR1980
ISN 0113            T2=SNGL(DT2)                                                    CDTR1990
ISN 0114            P=T1+T2+T2                                                      CDTR2000
ISN 0115            GO TO 490                                                       CDTR2010
                C                                                                   CDTR2020
                C     COMPUTE P FOR G GREATER THAN OR EQUAL TO 2.0                  CDTR2030
                C     AND LESS THAN 4.0                                             CDTR2040
                C                                                                   CDTR2050
ISN 0116        450 P=T1                                                            CDTR2060
ISN 0117            GO TO 490                                                       CDTR2070
                C                                                                   CDTR2080
                C     COMPUTE P FOR G GREATER THAN OR EQUAL TO 4.0                  CDTR2090
                C     AND LESS THAN OR EQUAL TO 100.0                               CDTR2100
                C                                                                   CDTR2110
ISN 0118        460 DT3=0.D0                                                        CDTR2120
ISN 0119            DO 480 I3=2,K                                                   CDTR2130
ISN 0120            THPI=DFLOAT(I3)+THETA                                           CDTR2140
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```
ISN 0121            CALL DLGAM(THPI,GTH,IOK)                                    CDTR2150
ISN 0122            DLT3=THPI*DLX2-DLXX-X2-GTH                                  CDTR2160
ISN 0123            IF(DLT3+1.68D02) 480,480,470                                CDTR2170
ISN 0124        470 DT3=DT3+DEXP(DLT3)                                          CDTR2180
ISN 0125        480 CONTINUE                                                    CDTR2190
ISN 0126            T3=SNGL(DT3)                                                CDTR2200
ISN 0127            P=T1-T3-T3                                                  CDTR2210
                C                                                               CDTR2220
                C     SET ERROR INDICATOR                                       CDTR2230
                C                                                               CDTR2240
ISN 0128        490 IF(P) 500,520,520                                           CDTR2250
ISN 0129        500 IF(ABS(P)-1.E-7) 510,510,600                                CDTR2260
ISN 0130        510 P=0.0                                                       CDTR2270
ISN 0131            GO TO 610                                                   CDTR2280
ISN 0132        520 IF(1.-P) 530,550,550                                        CDTR2290
ISN 0133        530 IF(ABS(1.-P)-1.E-7) 540,540,600                             CDTR2300
ISN 0134        540 P=1.0                                                       CDTR2310
ISN 0135            GO TO 610                                                   CDTR2320
ISN 0136        550 IF(P-1.E-8) 560,560,570                                     CDTR2330
ISN 0137        560 P=0.0                                                       CDTR2340
ISN 0138            GO TO 610                                                   CDTR2350
ISN 0139        570 IF((1.0-P)-1.E-8) 580,580,610                               CDTR2360
ISN 0140        580 P=1.0                                                       CDTR2370
ISN 0141            GO TO 610                                                   CDTR2380
ISN 0142        590 IER=-1                                                      CDTR2390
ISN 0143            D=-1.E75                                                    CDTR2400
ISN 0144            P=-1.E75                                                    CDTR2410
ISN 0145            GO TO 620                                                   CDTR2420
ISN 0146        600 IER=+1                                                      CDTR2430
ISN 0147            P= 1.E75                                                    CDTR2440
ISN 0148            GO TO 620                                                   CDTR2450
ISN 0149        610 IER=0                                                       CDTR2460
ISN 0150        620 RETURN                                                      CDTR2470
ISN 0151            END

*OPTIONS IN EFFECT*      NAME= MAIN,OPT=00,LINECNT=74,SIZE=0000K,
*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF
*STATISTICS*  SOURCE STATEMENTS =     150 ,PROGRAM SIZE =     3554
*STATISTICS*  NO  DIAGNOSTICS GENERATED
****** END OF COMPILATION ******                                  79K BYTES OF CORE NOT USED
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          COMPILER OPTIONS - NAME=  MAIN,OPT=00,LINECNT=74,SIZE=0000K,
                             SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF
                             C*********************************************************************  NDTR  10
                             C                                                                       NDTR  20
                             C          SUBROUTINE NDTR                                              NDTR  30
                             C                                                                       NDTR  40
                             C          PURPOSE                                                      NDTR  50
                             C             COMPUTES Y = P(X) = PROBABILITY THAT THE RANDOM VARIABLE J NDTR  60
                             C             DISTRIBUTED NORMALLY(0,1), IS LESS THAN OR EQUAL TO X.    NDTR  70
                             C             F(X), THE ORDINATE OF THE NORMAL DENSITY AT X, IS ALSO    NDTR  80
                             C             COMPUTED.                                                 NDTR  90
                             C                                                                       NDTR 100
                             C          USAGE                                                        NDTR 110
                             C             CALL NDTR(X,P,D)                                          NDTR 120
                             C                                                                       NDTR 130
                             C          DESCRIPTION OF PARAMETERS                                    NDTR 140
                             C             X--INPUT SCALAR FOR WHICH P(X) IS COMPUTED.               NDTR 150
                             C             P--OUTPUT PROBABILITY.                                    NDTR 160
                             C             D--OUTPUT DENSITY.                                        NDTR 170
                             C                                                                       NDTR 180
                             C          REMARKS                                                      NDTR 190
                             C             MAXIMUM ERROR IS 0.0000007.                               NDTR 200
                             C                                                                       NDTR 210
                             C          SUBROUTINES AND SUBPROGRAMS REQUIRED                         NDTR 220
                             C             NONE                                                      NDTR 230
                             C                                                                       NDTR 240
                             C          METHOD                                                       NDTR 250
                             C             BASED ON APPROXIMATIONS IN C. HASTINGS, APPROXIMATIONS FOR NDTR 260
                             C             DIGITAL COMPUTERS, PRINCETON UNIV. PRESS, PRINCETON, N.J., NDTR 270
                             C             1955.  SEE EQUATION 26.2.17, HANDBOOK OF MATHEMATICAL     NDTR 280
                             C             FUNCTIONS, ABRAMOWITZ AND STEGUN, DOVER PUBLICATIONS, INC., NDTR 290
                             C             NEW YORK.                                                 NDTR 300
                             C                                                                       NDTR 310
                             C*********************************************************************  NDTR 320
                             C                                                                       NDTR 330
   ISN 0002                        SUBROUTINE NDTR(X,P,D)                                            NDTR 340
                             C                                                                       NDTR 350
   ISN 0003                        AX=ABS(X)                                                         NDTR 360
   ISN 0004                        T=1.0/(1.0+.2316419*AX)                                           NDTR 370
   ISN 0005                        D=0.3989423*EXP(-X*X/2.0)                                         NDTR 380
   ISN 0006                        P = 1.0 - D*T*((((1.330274*T - 1.821256)*T + 1.781478)*T -        NDTR 390
                                  1  0.3565638)*T + 0.3193815)                                       NDTR 400
   ISN 0007                        IF(X)1,2,2                                                        NDTR 410
   ISN 0008                      1 P=1.0-P                                                           NDTR 420
   ISN 0009                      2 RETURN                                                            NDTR 430
   ISN 0010                        END                                                               NDTR 440
*OPTIONS IN EFFECT*       NAME=  MAIN,OPT=00,LINECNT=74,SIZE=0000K,
*OPTIONS IN EFFECT*       SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF
*STATISTICS*     SOURCE STATEMENTS =       9 ,PROGRAM SIZE =      486
*STATISTICS*  NO  DIAGNOSTICS GENERATED
****** END OF COMPILATION ******                                  99K BYTES OF CORE NOT USED
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COMPILER OPTIONS - NAME= MAIN,OPT=00,LINECNT=74,SIZE=    ,
                   SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NO    ODEDIT,ID,NOXREF
C                                                                       DLGA  10
C     ..................................................................DLGA  20
C                                                                       DLGA  30
C        SUBROUTINE DLGAM                                               DLGA  40
C                                                                       DLGA  50
C        PURPOSE                                                        DLGA  60
C           COMPUTES THE DOUBLE PRECISION NATURAL LOGARITHM OF THE      DLGA  70
C           GAMMA FUNCTION OF A GIVEN DOUBLE PRECISION ARGUMENT.        DLGA  80
C                                                                       DLGA  90
C        USAGE                                                          DLGA 100
C           CALL DLGAM(XX,DLNG,IER)                                     DLGA 110
C                                                                       DLGA 120
C        DESCRIPTION OF PARAMETERS                                      DLGA 130
C           XX   - THE DOUBLE PRECISION ARGUMENT FOR THE LOG GAMMA      DLGA 140
C                  FUNCTION.                                            DLGA 150
C           DLNG - THE RESULTANT COUBLE PRECISION LOG GAMMA FUNCTION    DLGA 160
C                  VALUE.                                               DLGA 170
C           IER  - RESULTANT ERROR CODE WHERE                           DLGA 180
C                  IER= 0----NO ERROR.                                  DLGA 190
C                  IER=-1----XX IS WITHIN 10**(-9) OF BEING ZERO OR XX  DLGA 200
C                            IS NEGATIVE.  DLNG IS SET TO -1.0075.      DLGA 210
C                  IER=+1----XX IS GREATER THAN 10**70. DLNG IS SET TO  DLGA 220
C                            +1.0075.                                   DLGA 230
C                                                                       DLGA 240
C        REMARKS                                                        DLGA 250
C           NONE                                                        DLGA 260
C                                                                       DLGA 270
C        SUBROUTINES AND FUNCTION SUBPROGRAMS REQUIRED                  DLGA 280
C           NONE                                                        DLGA 290
C                                                                       DLGA 300
C        METHOD                                                         DLGA 310
C           THE EULER-MCLAURIN EXPANSION TO THE SEVENTH DERIVATIVE TERM  DLGA 320
C           IS USED, AS GIVEN BY M. ABRAMOWITZ AND I.A. STEGUN,         DLGA 330
C           'HANDBOOK OF MATHEMATICAL FUNCTIONS', U. S. DEPARTMENT OF   DLGA 340
C           COMMERCE, NATIONAL BUREAU OF STANDARDS APPLIED MATHEMATICS  DLGA 350
C           SERIES, 1966, EQUATION 6.1.41.                              DLGA 360
C                                                                       DLGA 370
C     ..................................................................DLGA 380
C                                                                       DLGA 390
      SUBROUTINE DLGAM(XX,DLNG,IER)                                     DLGA 400
      DOUBLE PRECISION XX,ZZ,TERM,RZZ,DLNG                              DLGA 410
      IER=0                                                             DLGA 420
      ZZ=XX                                                             DLGA 430
      IF(XX-1.D10) 2,2,1                                                DLGA 440
    1 IF(XX-1.D70) 8,9,9                                                DLGA 450
C                                                                       DLGA 460
C        SEE IF XX IS NEAR ZERO OR NEGATIVE                             DLGA 470
C                                                                       DLGA 480
    2 IF(XX-1.D-9) 3,3,4                                                DLGA 490
    3 IER=-1                                                            DLGA 500
      DLNG=-1.D75                                                       DLGA 510
      GO TO 10                                                          DLGA 520
C                                                                       DLGA 530
C        XX GREATER THAN ZERO AND LESS THAN OR EQUAL TO 1.D+10          DLGA 540
C                                                                       DLGA 550
    4 TERM=1.D0                                                         DLGA 560
    5 IF(ZZ-18.D0) 6,6,7                                                DLGA 570
    6 TERM=TERM*ZZ                                                      DLGA 580
      ZZ=ZZ+1.D0                                                        DLGA 590
      GO TO 5                                                           DLGA 600
    7 RZZ=1.D0/ZZ**2                                                    DLGA 610
      DLNG =(ZZ-0.5D0)*DLOG(ZZ)-ZZ +0.9189385332046727 -DLOG(TERM)+     DLGA 620
     1(1.D0/ZZ)*(.83333333333333D-1 -(RZZ*(.27777777777777D-2 +(RZZ*    DLGA 630
     2(.79365079365079D-3 -(RZZ*(.59523809523809D-3)))))))              DLGA 640
      GO TO 10                                                          DLGA 650
C                                                                       DLGA 660
C        XX GREATER THAN 1.D+10 AND LESS THAN 1.D+70                    DLGA 670
C                                                                       DLGA 680
    8 DLNG=ZZ*(DLOG(ZZ)-1.D0)                                           DLGA 690
      GO TO 10                                                          DLGA 700
```

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                C
                C       XX GREATER THAN OR EQUAL TC 1.D+70                      DLGA 710
                C                                                               DLGA 720
                                                                                DLGA 730
   ISN 0022           9 IER=+1                                                  DLGA 740
   ISN 0023             DLNG=1.D75                                              DLGA 750
   ISN 0024          10 RETURN                                                  DLGA 760
   ISN 0025             END                                                     DLGA 770

*OPTIONS IN EFFECT*       NAME=  MAIN,OPT=00,LINECNT=74,SIZE=0000K,
*OPTIONS IN EFFECT*       SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF
*STATISTICS*     SOURCE STATEMENTS =      24 ,PROGRAM SIZE =      810
*STATISTICS*  NO  DIAGNOSTICS GENERATED
****** END OF COMPILATION ******                          99K BYTES OF CORE NOT USED
*STATISTICS*  NO  DIAGNOSTICS THIS STEP
```

APPENDIX II

NARROW BODY PROGRAM LISTING

OF MAIN PROGRAM AND SUBROUTINE

PATH

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          COMPILER OPTIONS - NAME=  MAIN,OPT=00,LINECNT=74,SIZE=00K,
                             SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF
   ISN 0002            COMMON P1(50),P2(50),P3(50),P4(50),P5(50)
   ISN 0003            COMMON XX1(50),XX2(50),XX3(50),XX4(50),XX5(50)
   ISN 0004            COMMON NN1,NN2,NN3,NN4,NN5
   ISN 0005            COMMON NCOL1(10),NCOUNT(10),LCLD,TOLD,NSAV1(10),IROWE(10)
   ISN 0006            COMMON XL1(10),XL2(10),XL3(10),XL4(10),XL5(10)
   ISN 0007            DIMENSION N(30,4,10,10),NSEAT(10),NRF(10)
   ISN 0008            DIMENSION NRL(10),NSIDE(10),NOPEN(10),NEMP(10)
   ISN 0009            DIMENSION IV(10,20),JV(10,20),T(10),T5(10)
   ISN 0010            DIMENSION XMN1(10),SD1(10),XU1(10),XINT1(10)
   ISN 0011            DIMENSION XMN2(10),SD2(10),XU2(10),XINT2(10)
   ISN 0012            DIMENSION XMN3(10),SD3(10),XU3(10),XINT3(10)
   ISN 0013            DIMENSION XMN4(10),SD4(10),XU4(10),XINT4(10)
   ISN 0014            DIMENSION XMN5(10),SD5(10),XU5(10),XINT5(10)
   ISN 0015            DO 90 I=1,10
   ISN 0016         90 NCOLN1(I)=0
   ISN 0017            TOLD=0.
   ISN 0018            LCLD=0
   ISN 0019            NX=0
   ISN 0020            DO 15 L=1,10
   ISN 0021            DO 15 K=1,10
   ISN 0022            DO 15 I=1,30
   ISN 0023            DO 15 J=1,4
   ISN 0024         15 N(I,J,K,L)=100
   ISN 0025            WRITE(6,205)
   ISN 0026            READ(5,203)NRUN,NEXIT,NOPT,JEMP
   ISN 0027            WRITE(6,203)NRUN,NEXIT,NOPT,JEMP
   ISN 0028            READ(5,201)(IROWE(I),NRF(I),NRL(I),NCOL1(I),NSIDE(I),NSEAT(I),NOPE
                      1N(I),NEMP(I),I=1,NEXIT)
   ISN 0029            WRITE(6,201)(IROWE(I),NRF(I),NRL(I),NCOL1(I),NSIDE(I),NSEAT(I),NOP
                      1EN(I),NEMP(I),I=1,NEXIT)
   ISN 0030            DO 1 I=1,NEXIT
   ISN 0031            IF(NEMP(I).EQ.0)GO TO 1
   ISN 0033            NM=NEMP(I)
   ISN 0034            READ(5,200)(IV(I,K),JV(I,K),K=1,NM)
   ISN 0035            WRITE(6,200)(IV(I,K),JV(I,K),K=1,NM)
   ISN 0036          1 CONTINUE
   ISN 0037            WRITE(6,206)
   ISN 0038            DO 4 I=1,NEXIT
   ISN 0039            IF(NOPEN(I).EQ.1)GO TO 4
   ISN 0041            READ(5,202)XMN1(I),SD1(I),XU1(I),XINT1(I),XL1(I)
   ISN 0042            READ(5,202)XMN2(I),SD2(I),XU2(I),XINT2(I),XL2(I)
   ISN 0043            READ(5,202)XMN3(I),SD3(I),XU3(I),XINT3(I),XL3(I)
   ISN 0044            READ(5,202)XMN4(I),SD4(I),XU4(I),XINT4(I),XL4(I)
   ISN 0045            READ(5,202)XMN5(I),SD5(I),XU5(I),XINT5(I),XL5(I)
   ISN 0046            WRITE(6,207)XMN1(I),SD1(I),XU1(I),XINT1(I),XL1(I),I
   ISN 0047            WRITE(6,207)XMN2(I),SD2(I),XU2(I),XINT2(I),XL2(I),I
   ISN 0048            WRITE(6,207)XMN3(I),SD3(I),XU3(I),XINT3(I),XL3(I),I
   ISN 0049            WRITE(6,207)XMN4(I),SD4(I),XU4(I),XINT4(I),XL4(I),I
   ISN 0050            WRITE(6,207)XMN5(I),SD5(I),XU5(I),XINT5(I),XL5(I),I
   ISN 0051          4 CONTINUE
   ISN 0052            DO 2 I=1,NEXIT
   ISN 0053            IF(NSIDE(I).EQ.0)GO TO 2
   ISN 0055            IF(NX.GT.0)GO TO 5
   ISN 0057            NSAV1(I)=NCOL1(I)
   ISN 0058          5 NCOL1(I)=NSAV1(I)-JEMP
   ISN 0059          2 CONTINUE
   ISN 0060            DO 80 I=1,NEXIT
   ISN 0061            IF(NEMP(I).EQ.0)GO TO 80
   ISN 0063            IF(NSIDE(I).EQ.0)GO TO 80
   ISN 0065            NR=NEMP(I)
   ISN 0066            DO 81 K=1,NR
   ISN 0067         81 JV(I,K)=NSAV1(I)-JV(I,K)+1
   ISN 0068         80 CONTINUE
   ISN 0069            DO 10 K=1,NEXIT
   ISN 0070            N1=NRF(K)
   ISN 0071            N2=NRL(K)
   ISN 0072            N3=NCOL1(K)
   ISN 0073            DO 10 I=N1,N2
   ISN 0074            DO 10 J=1,N3
   ISN 0075            IF(I.EQ.IROWE(K).AND.NSEAT(K).EQ.0)GO TO 10
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ISN 0077            IF(NEMP(K).EQ.0)GO TO 12
ISN 0079            NP=NEMP(K)
ISN 0080            DO 20 L=1,NP
ISN 0081            IF(I.EQ.IV(K,L).AND.J.EQ.JV(K,L))GO TO 10
ISN 0083         20 CONTINUE
ISN 0084         12 IF(NSIDE(K).EQ.0)NJ=JEMP-J
ISN 0086            IF(NSIDE(K).EQ.1)NJ=NSAV1(K)-JEMP-J+1
ISN 0088            IF(NOPT.EQ.0)GO TO 9
ISN 0090            IF(NOPEN(K).EQ.1)GO TO 9
ISN 0092            N(I,J,K,K)=NCCL1(K)+1+IABS(I-IRCWE(K))+NJ
ISN 0093            IF(I.EQ.IRCWE(K).AND.NSEAT(K).EQ.1)N(I,J,K,K)=J
ISN 0095            GO TO 10
ISN 0096          9 DO 6 L=1,NEXIT
ISN 0097            IF(NOPEN(L).EQ.1)GO TO 6
ISN 0099            IF(I.EQ.IRCWE(L).AND.NSEAT(L).EQ.1)GO TO 3
ISN 0101            N(I,J,K,L)=NCCL1(L)+1+IABS(I-IRCWE(L))+NJ
ISN 0102            GO TO 6
ISN 0103          3 IF(NSIDE(K).EQ.0)JS=J
ISN 0105            IF(NSIDE(K).EQ.1)JS=NSAV1(K)+1-J
ISN 0107            IF(NSIDE(L).EQ.0)N(I,J,K,L)=JS
ISN 0109            IF(NSIDE(L).EQ.1)N(I,J,K,L)=NSAV1(L)+1-JS
ISN 0111          6 CONTINUE
ISN 0112            KK=1000
ISN 0113            DO 13 L=1,NEXIT
ISN 0114            IF(NOPEN(L).EQ.1)GO TO 13
ISN 0116            IF(N(I,J,K,L).LT.KK)GO TO 14
ISN 0118            GO TO 13
ISN 0119         14 KK=N(I,J,K,L)
ISN 0120            LL=L
ISN 0121         13 CONTINUE
ISN 0122            IF(NSIDE(K).EQ.0)GO TO 17
ISN 0124            IF(NSIDE(LL).EQ.1)GO TO 17
ISN 0126            LLL=LL+1
ISN 0127            IF(NOPEN(LL).EQ.0.AND.NOPEN(LLL).EQ.0)GO TO 18
ISN 0129            GO TO 17
ISN 0130         18 IF(N(I,J,K,LL).EQ.N(I,J,K,LLL))LL=LL+1
ISN 0132         17 DO 16 L=1,NEXIT
ISN 0133         16 N(I,J,K,L)=100
ISN 0134            N(I,J,K,LL)=KK
ISN 0135         10 CONTINUE
ISN 0136            L=0
ISN 0137         52 L=L+1
ISN 0138            IF(L.GT.NEXIT)GO TO 51
ISN 0140            IF(NOPEN(L).EQ.1)GO TO 52
ISN 0142            WRITE(6,208)
ISN 0143            CALL GAMF(XMN1(L),SD1(L),XU1(L),XINT1(L),P1,XX1,NN1)
ISN 0144            CALL GAMF(XMN2(L),SD2(L),XU2(L),XINT2(L),P2,XX2,NN2)
ISN 0145            CALL GAMF(XMN3(L),SD3(L),XU3(L),XINT3(L),P3,XX3,NN3)
ISN 0146            CALL GAMF(XMN4(L),SD4(L),XU4(L),XINT4(L),P4,XX4,NN4)
ISN 0147            CALL GAMF(XMN5(L),SD5(L),XU5(L),XINT5(L),P5,XX5,NN5)
ISN 0148         50 KK=1000
ISN 0149            DO 30 K=1,NEXIT
ISN 0150            N1=NRF(K)
ISN 0151            N2=NRL(K)
ISN 0152            N3=NCCL1(K)
ISN 0153            DO 30 I=N1,N2
ISN 0154            DO 30 J=1,N3
ISN 0155            IF(N(I,J,K,L).LT.KK)GO TO 31
ISN 0157            GO TO 30
ISN 0158         31 KK=N(I,J,K,L)
ISN 0159            II=I
ISN 0160            JJ=J
ISN 0161            K4=K
ISN 0162            LL=L
ISN 0163         30 CONTINUE
ISN 0164            IF(N(II,JJ,K4,LL).EQ.1000)GO TO 52
ISN 0166            N(II,JJ,K4,LL)=1000
ISN 0167            CALL PATH(KK,II,JJ,K4,LL,NSIDE(K4),NSEAT(K4),T,T3)
ISN 0168            GO TO 50
ISN 0169         51 NX=NX+1
ISN 0170            CALL OPTIM(T,NCOUNT,NEXIT,NOPEN,NSIDE,T3)
ISN 0171            IF(NX.LT.NRUN)GO TO 5
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ISN 0173        200 FORMAT(1615)
ISN 0174        201 FORMAT(8I5)
ISN 0175        202 FORMAT(5F10.0)
ISN 0176        203 FORMAT(4I5)
ISN 0177        205 FORMAT(5X,33HAIRCRAFT CONFIGURATION INPUT DATA)
ISN 0178        206 FORMAT(1H0,9X,23HTIME SEGMENT INPUT DATA)
ISN 0179        207 FORMAT(5F10.3,I5)
ISN 0180        208 FORMAT(1H1,7X,3HROW,5X,6HCOLUMN,1X,13HEXIT ASSIGNED,1X,8HEXIT OUT,
                   13X,12HTIME TO DOOR,10X,10HTIME DELAY,12X,8HTIME OUT)
ISN 0181            STOP
ISN 0182            END

*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=00,LINECNT=74,SIZE=0000K,

*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF

*STATISTICS*     SOURCE STATEMENTS =     181 ,PROGRAM SIZE =    57516

*STATISTICS*  NO DIAGNOSTICS GENERATED

****** END OF COMPILATION ******                                  59K BYTES OF CORE NOT USED
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LEVE    8 ( JUN 74 )                    OS/360  FORTRAN                         DATE  75.335/17.25.39
          COMPILER OPTIONS - NAME=  MAIN,OPT=00,LINECNT=74,SIZE    0K,
                             SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF
   ISN 0002            SUBROUTINE PATH(N,I,J,K,L,M,NR,T,T3)
   ISN 0003            COMMON P1(50),P2(50),P3(50),P4(50),P5(50)
   ISN 0004            COMMON XX1(50),XX2(50),XX3(50),XX4(50),XX5(50)
   ISN 0005            COMMON NN1,NN2,NN3,NN4,NN5
   ISN 0006            COMMON NCOL1(10),NCOUNT(10),LCLD,TOLD,NSAV1(10),IROWE(10)
   ISN 0007            COMMON XL1(10),XL2(10),XL3(10),XL4(10),XL5(10)
   ISN 0008            DIMENSION T(10),T3(10)
   ISN 0009            CALL RANDU(YFL)
   ISN 0010            CALL LININ(P1,XX1,YFL,T1,NN1,XL1(L))
   ISN 0011            CALL LININ(P2,XX2,YFL,T2,NN2,XL2(L))
   ISN 0012            IF(LOLD.EQ.L)GO TO 6
   ISN 0014            CALL LININ(P3,XX3,YFL,T3(L),NN3,XL3(L))
   ISN 0015          6 CALL LININ(P4,XX4,YFL,T4,NN4,XL4(L))
   ISN 0016            CALL LININ(P5,XX5,YFL,T5,NN5,XL5(L))
   ISN 0017            NJJ=NCOL1(K)+1-J
   ISN 0018            IF(NN.EQ.1)GO TO 5
   ISN 0020            TTOD=T1*(N-NJJ)+T2*NJJ
   ISN 0021            GO TO 4
   ISN 0022          5 TTOD=T1*(N-NJJ-NCOL1(K))+T2*(NJJ+NCOL1(K))
   ISN 0023            IF(I.EQ.IROWE(L).AND.K.EQ.L)TTOD=T2*N
   ISN 0025            IF(I.EQ.IROWE(L).AND.K.NE.L)TTOD=T2*(N-1)+T1
   ISN 0027          4 IF(LOLD.NE.L)GO TO 1
   ISN 0029          2 IF(NCOUNT(L).EQ.0)TSUM=T3 (L)
   ISN 0031            TSAVE=TSUM
   ISN 0032            IF(TSUM.LT.TTOD)TSUM=TTOD
   ISN 0034            T(L)=TSUM+T4+T5
   ISN 0035            IF(TOLD.GE.T(L))T(L)=TOLD+.2
   ISN 0037            IF(M.EQ.1)J=NSAV1(K)-J+1
   ISN 0039            WRITE(6,100)I,J,K,L,TTOD,TSAVE,T(L)
   ISN 0040            NCOUNT(L)=NCOUNT(L)+1
   ISN 0041            TSUM=TSUM+T4
   ISN 0042            LCLD=L
   ISN 0043            TOLD=T(L)
   ISN 0044            GO TO 3
   ISN 0045          1 IF(LOLD.EQ.0)GO TO 2
   ISN 0047            TOLD=0.
   ISN 0048            NCOUNT(L)=0
   ISN 0049            GO TO 2
   ISN 0050          3 CONTINUE
   ISN 0051        100 FORMAT(4I10,3(10X,F10.3))
   ISN 0052            RETURN
   ISN 0053            END
*OPTIONS IN EFFECT*      NAME=  MAIN,OPT=00,LINECNT=74,SIZE=0000K,
*OPTIONS IN EFFECT*      SOURCE,EBCDIC,NOLIST,NODECK,LOAD,NOMAP,NOEDIT,ID,NOXREF
*STATISTICS*     SOURCE STATEMENTS =      52 ,PROGRAM SIZE =     1844
*STATISTICS*  NO  DIAGNOSTICS GENERATED
****** END OF COMPILATION ******                                  95K BYTES OF CORE NOT USED
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