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Multivariate Analysis, Retrieval, and Storage System (MARS)

Vol. VI MARS System – A Sample Problem

(Gross Weight of Subsonic Transports)

JULY 1975

Developed under
CONTRACT No. NAS 2-7627

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PREFACE

This report was prepared under Task II of Contract NAS2-7627, "Further Flight Mechanics and Vehicle Synthesis Research", in the period from June 1973 to May 1974. Mr. Michael J. Tauber was the NASA technical monitor for this study which was done for the Advanced Concepts Branch of the Aeronautics Division of National Aeronautics and Space Administration's Ames Research Center. Mr. Donald S. Hague, of Aerophysics Research Corporation, served as project leader for this study.

In the aerospace vehicle preliminary design process the estimation of subsystem component weights and costs are based on formulae obtained by multivariate correlation-regression analyses of historical data. While many groupings of such formulae have been presented in the past, there exists a need for a rapid method of verifying and improving these formulae in specific applications. The Multivariable Data Analysis, Retrieval, and Storage System (MARS) fulfills this function. In the MARS system selected vehicle characteristics information has been stored in a computerized data base. The data can be displayed, retrieved, or analyzed for functional relationships by multivariable statistical correlation-regression analyses using any specified subset of characteristics and vehicles.

This report, Volume VI of the Task II documentation, presents the detailed results for a typical aircraft wieght regression analysis. The particular example involves development of a gross weight estimation relationship for subsonic transport aircraft. The body of the report consists of actual computer printout.

INTRODUCTION

The Multivariate Analysis, Retrieval, and Storage System (MARS) and its associated data bases of aircraft and engine characteristics has been described in References 1 through 4. Basically the MARS system is a tool for rapid prediction of aircraft or engine characteristics based on correlation-regression analysis of past designs stored in the data bases. Figure 1 illustrates program operation. Figure 2 illustrates the parts of MARS used in the present report. The present report is an example of output obtained from the MARS system. The example involves derivation of an expression for gross weight of subsonic transport aircraft in terms of nine independent variables. Independent variables for the example were:

L_B = Body length, ft.

S_W = Wing area, $ft.^2$

D_B = Body depth, ft.

Λ = Quarter chord sweep, degrees

S_H = Horizontal tail area, $ft.^2$

T_R = Root thickness, ft.

S_V = Vertical tail area, $ft.^2$

N = Ultimate load factor, "g"

AR = Wing aspect ratio

An expression for gross weight, W_T, was sought in the exponential form

$$W_T = a_0 X_1^{a_1} X_2^{a_1} \ldots\ldots\ldots X_n^{a_n}$$

Aircraft used in the correlation-regression analysis are listed in Tables I and II where the transport data base and its contents are listed. The resulting equation is:

$$W_T = 9.46\, L_B^{.587}\, S_W^{.308}\, D_B^{.264}\, \Lambda^{.037}\, S_H^{.287}\, T_R^{-.335}\, S_V^{.143}\, N^{.155}\, AR^{-.111}$$

Note that the equation predicts that empty weight will fall with decreasing root thickness. This statistical anomaly reveals that thin wings have been more carefully (and expensively) designed than thicker wings rather than a true weight sensitivity to root thickness. This type of behavior is frequently encountered in "blind" statistical analysis. The example illustrates the need for careful selection of correlation variables and the need for continual review of the resulting estimation equations. There is also a need to have the ability to bound the variation of the coefficients to prevent such an anomaly. This last capability is now available in the latest version of MARS, Reference 5.

The remainder of this report consists of the actual computer output for the selected problem. The "goodness-of-fit" obtained by the final equation is illustrated in Figure .

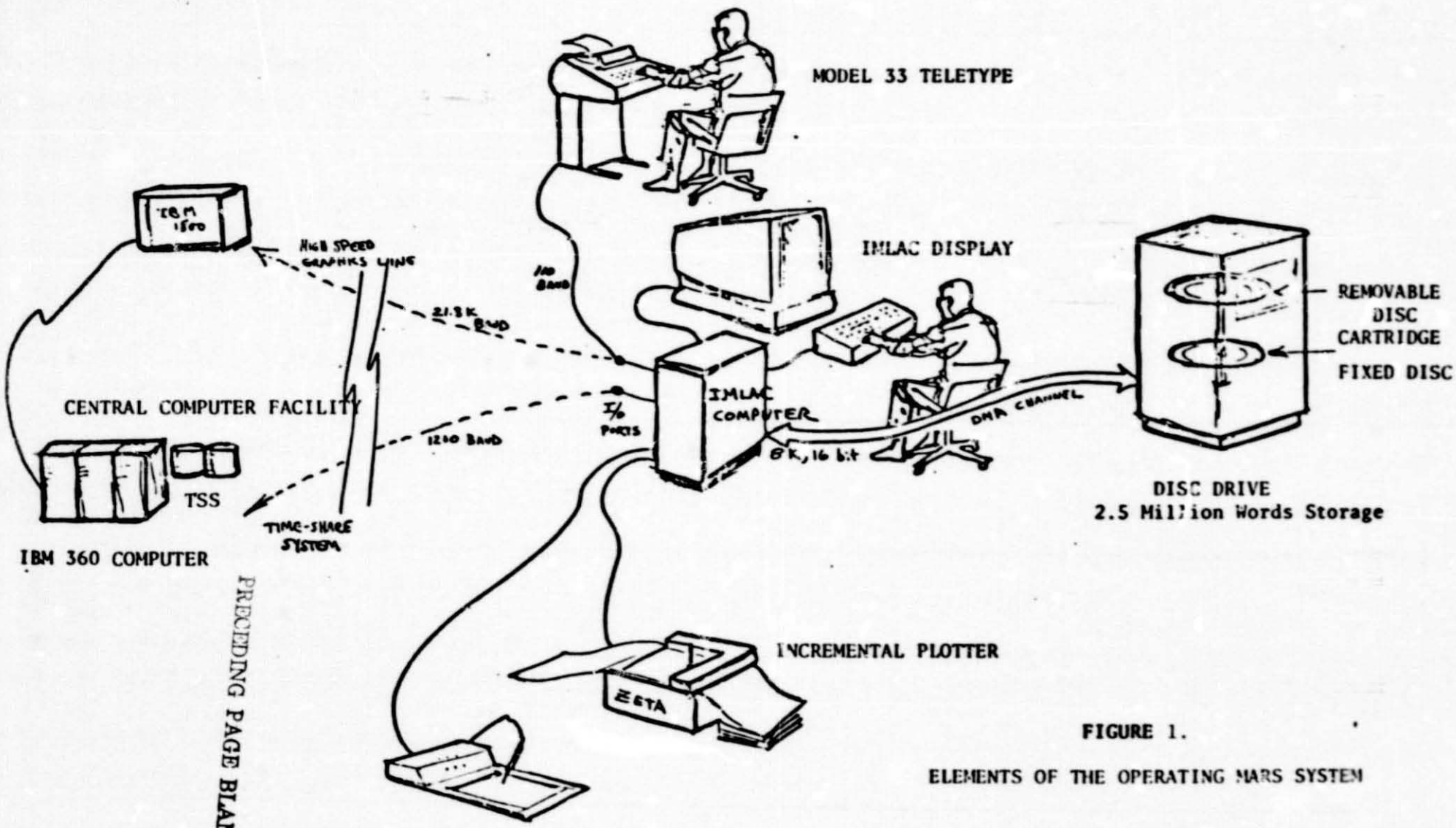

FIGURE 1.

ELEMENTS OF THE OPERATING MARS SYSTEM

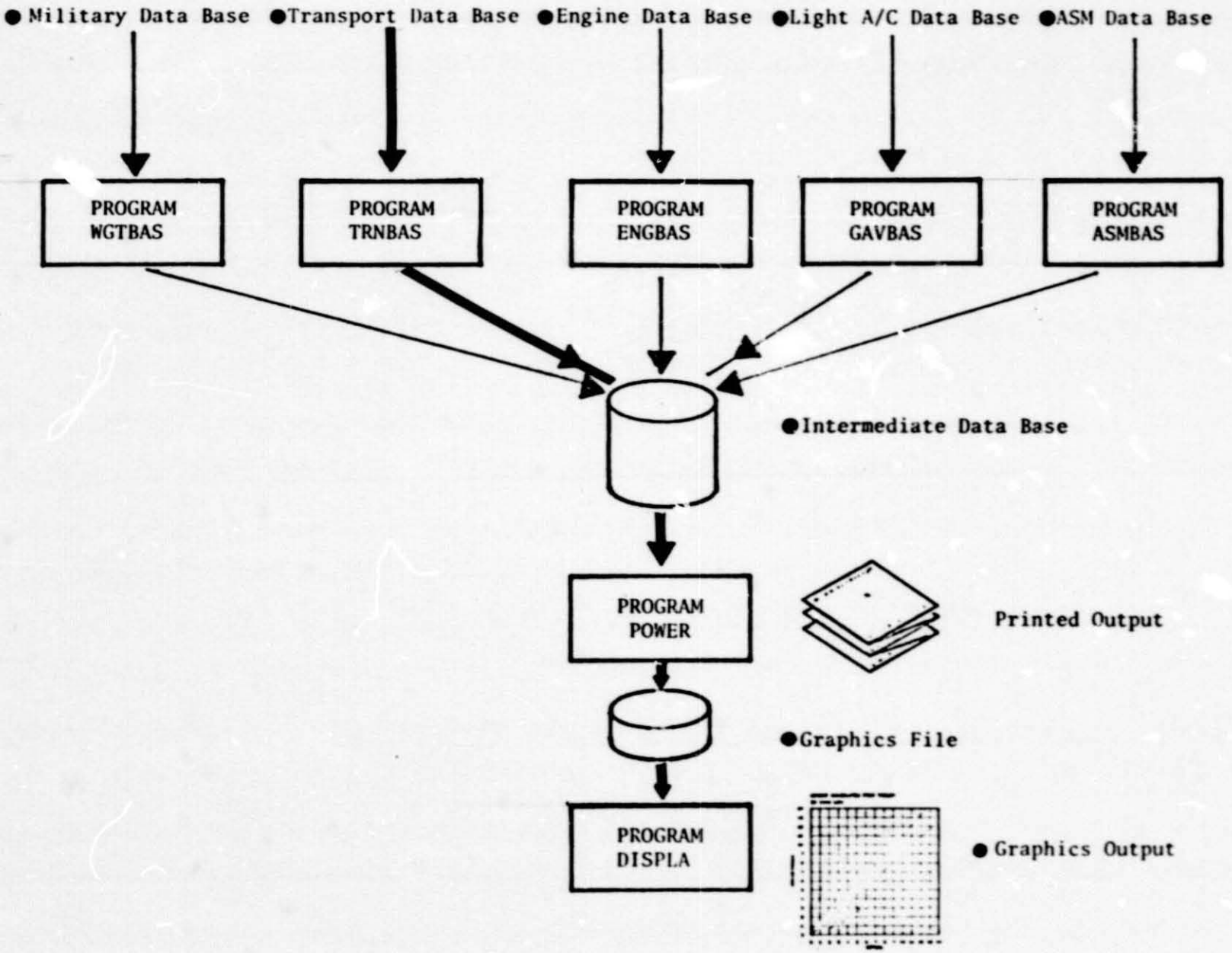

FIGURE 2. SCHEMATIC OF MARS PROGRAM OPERATIONS

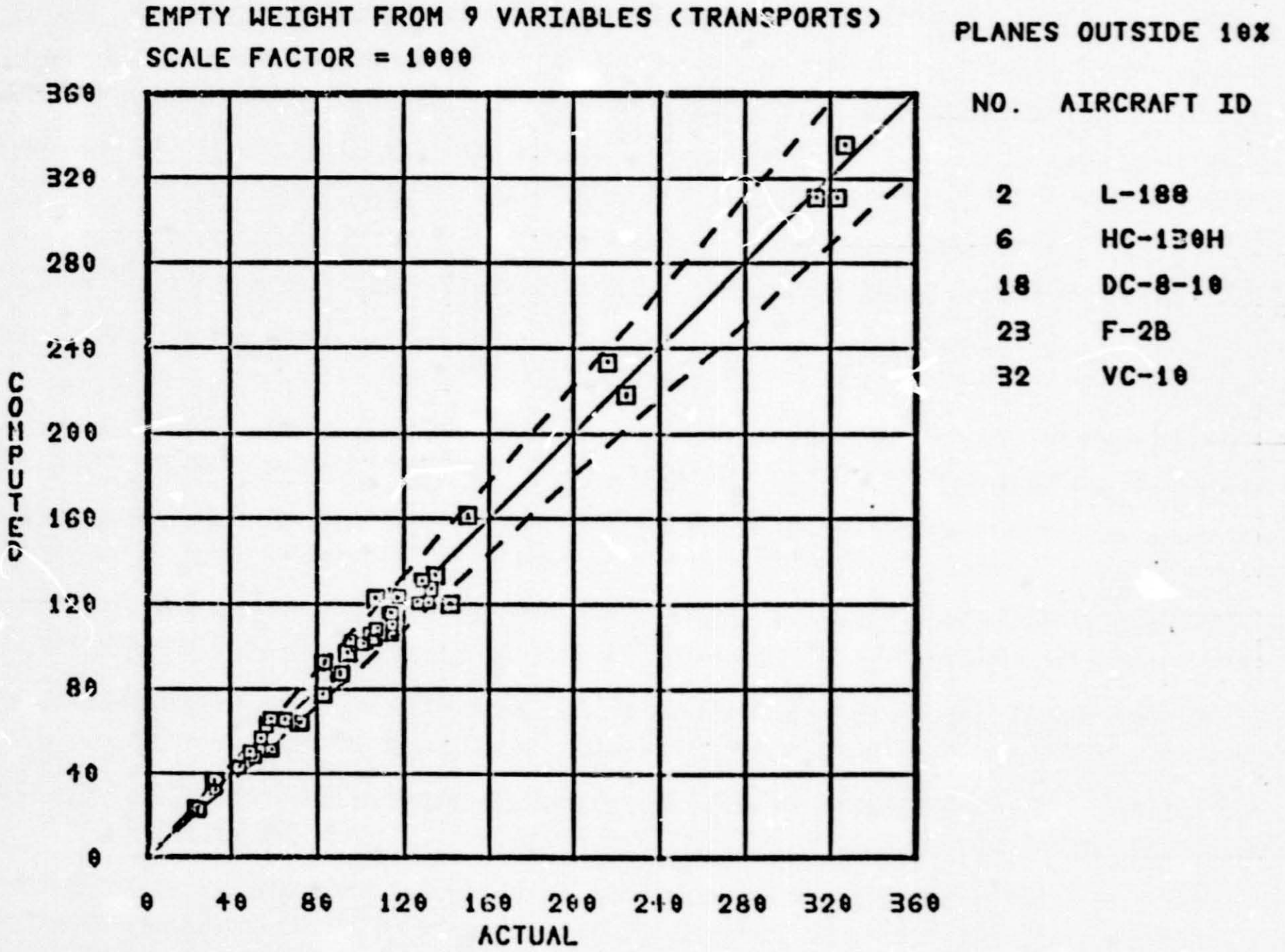

FIGURE 3. TYPICAL GRAPHICAL OUTPUT

TABLE I.

VEHICLES IN THE TRANSPORT DATA BASE, M^2

1. F-27	21. 880
2. L-188, Electra	22. 990
3. C-130A	23. F-2B
4. C-130A	24. DC-9-10
5. C-130B	25. DC-9-30
6. HC-130H	26. DC-9-30
7. C-133A	27. 727-100
8. C-133A	28. 727-200
9. SE210-6N, Caravelle	29. 737-100
10. 707-120	30. 737-200
11. 707-020	31. 737-200
12. 707-320	32. VC-10
13. 707-320B	33. VC-105
14. 720	34. G141-2
15. C-135A	35. C-5A
16. KC-135A	36. DC-10-10
17. C-135B	37. 747-27
18. DC-8-10	38. 747F
19. DC-8F-54	39. L1011
20. DC-8-62	40. C-141-1

TABLE II.

VEHICLES CHARACTERISTICS IN THE TRANSPORT DATA BASE, M^2

1. Gross Weight
2. Design Load Factor
3. Wing Area
4. Aspect Ratio
5. Wing Span
6. t/c Root
7. t/c Tip
8. Taper Ratio C_t/C_R
9. Quarter Chord Sweep
10. Fuselage Length
11. Fuselage Maximum Depth
12. Fuselage Maximum Width
13. Tail Type
14. Horizontal Tail Area
15. Vertical Tail Area
16. Empty Weight
17. Sink Speed
18. Wing Group Weight
19. Wing Basic Structure Weight
20. Wing Secondary Structure Weight
21. Aileron Weight
22. Leading Edge Flap Weight
23. Trailing Edge Flap Weight
24. Slats Weight
25. Spoiler Weight
26. Total Tail Group Weight
27. Stabilizer Weight
28. Elevator Weight
29. Fin Weight
30. Rudder Weight
31. Body Group Weight
32. Fuselage Basic Structure Weight
33. Alighting Gear Group Weight
34. Main Landing Gear Weight
35. Nose Landing Gear Weight
36. Surface Control Group Weight
37. Cockpit Controls
38. Auto Pilot Weight
39. System Controls Weight
40. A.P.U. Group Weight
41. Instruments & Navigation Group Weight
42. Hydraulic Pneumatic Group Weight
43. Hydraulic System Weight
44. Pneumatic System Weight
45. Electrical Group Weight
46. Avionics Group Weight
47. Avionics Equipment Weight
48. Avionics Installation Weight
49. Furnishings Group Weight
50. Personnel Accommodations Weight
51. Personnel Furnishings Weight
52. Misc. Equipment Weight
53. Emergency Equipment Weight
54. Air Conditioning Group Weight
55. Air Conditioning System Weight
56. De-Ice System Weight
57. Number in Crew
58. Number of Stewardesses
59. Number of 1st Class Passengers
60. Number of Tourist Passengers
61. Aileron Area
62. Leading Edge Flap Area
63. Trailing Edge Flap Area
64. Slat Area
65. Spoiler Area
66. Stabilizer Area
67. Elevator Area
68. Fin Area
69. Rudder Area
70. Number of Engines
71. Engine Make
72. Engine Thrust
73. Nacelle Group Weight
74. Inboard Nacelle Weight
75. Outboard Nacelle Weight
76. Fuselage Wetted Area
77. Inboard Nacelle Length
78. Inboard Nacelle Depth
79. Inboard Nacelle Width
80. Outboard Nacelle Length
81. Outboard Nacelle Length
82. Outboard Nacelle Width
83. Total Aileron Area
84. Total Leading Edge Flap Area
85. Total Trailing Edge Flap Area
86. Total Slat Area
87. Total Spoiler Area
88. Maximum Dynamic Pressure
89. Altitude for Maximum g
90. Maximum Mach number
91. Cruise Speed Mach Number
92. Cruise Speed, Miles per Hour
93. Cruise Altitude

[illegible]

[11]. ULTIMATE LOAD FACTOR, G.
[2]. WING AREA,FT**2
[3]. WING ASPECT RATIO
[4]. VAC AT DIVE
[5]. CRUISE(MACH .78 CHORD LINE)
[6]. FUSELAGE LENGTH, FEET
[7]. FUSELAGE MAX. DEPTH,FT
[8]. HORIZONTAL TAIL AREA,FT**2
[9]. VERTICAL TAIL AREA,FT**2

PROGRAM OUTPUT

THE BAD DATA MESSAGE MEANS A VALUE WAS NOT ENTERED OR THE VALUE WAS NEGATIVE,FOR THIS PARTICULAR OBSERVATION. THE NUMBER OF TIMES REPEATED INDICATES HOW MANY VALUES HAVE BEEN OMITTED.

BAD DATA FOR VEHICLE ID. 737-200 NUMBER 30

ARRAY OF SAMPLE WEIGHTINGS USED

LOC	1	2	3	4	5	6	7	8	9	10
1	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1
21	1	1	1	1	1	1	1	1	1	0
31	1	1	1	1	1	1	1	1	1	1
41	0	0	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0
81	0	0	0	0	0	0	0	0	0	0
91	0	0	0	0	0	0	0	0	0	0

THE DEPENDENT VARIABLE IS PRINTED OUT AS X10

INPUT VARIABLE X1C IS PRINTED OUT AS X 1

SUMS OF VARIABLES

X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
2.754445E 02	5.161796E 01	2.690229E 02	4.357895E 01	-7.470646E 01	1.056998E 02	1.893446E 02	1.030761E 02	2.429888E 02	4.470226

RAW SUMS OF SQUARES AND CROSS PRODUCTS

X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
1.312108E 03									
2.979054E 02	6.862720E 01								
1.717285E 03	2.953529E 02	2.307C4E 03							
4.65414E 02	1.06841E 02	6.164529E 02	1.67721E 02						
-4.314518E 02	-6.867172E 01	-5.729169E 02	-1.641111E 02	1.443995E 02					
8.179891E 02	1.370021E 02	8.177537E 02	2.101038E 02	-2.064772E 02	3.603229E 02				
1.068986E 03	2.503330E 02	1.458882E 03	3.904745E 02	-3.631108E 02	5.182588E 02	9.22740E 02			
5.093545E 02	1.367068E 02	7.034CCE 02	2.129388E 02	-1.974C0E 02	2.814465E 02	5.02314E 02	2.740995E 02		
1.413115E 03	3.313405E 02	1.877149E 03	5.017435E 02	-4.650158E 02	6.607966E 02	1.18420E 03	6.457922E 02	1.523337E 03	
2.558878E 03	5.973064E 02	3.445402E 03	9.236535E 02	-8.588564E 02	1.224866E 03	2.18064E 03	1.198C0E 03	2.900892E 03	5.157398E

VARIANCE-COVARIANCE MATRIX

X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
2.275[illegible]E-01									
-1.[illegible]E-01	8.[illegible]E-01								
2.[illegible]E-01	-8.[illegible]E-[illegible]	2.[illegible]E-01							
-[illegible].75664E-01	3.44781E-05	-3.[illegible]E-01	1.17097E-02						
2.[illegible]E-02	-2.[illegible]E-05	1.[illegible]E-02	1.[illegible]E-02	3.[illegible]E-03					
7.[illegible]E-02	-1.[illegible]E-02	2.[illegible]E-01	-2.01217E-01	-1.[illegible]E-01	1.920[illegible]E 00				
1.[illegible]E-01	-7.[illegible]E-03	1.[illegible]E-01	-1.9E497E-02	-6.[illegible]E-05	1.55451E-01	7.[illegible]E-02			
8.[illegible]E-02	-2.70176E-01	8.95535E-02	-9.43914E-03	6.[illegible]E-03	6.[illegible]E-02	4.[illegible]E-02	4.27530E-02		
2.17545E-01	-5.[illegible]E-03	2.[illegible]E-01	-3.04815E-02	2.[illegible]E-02	9.12100E-02	1.12046E-01	9.18109E-02	2.41585E-01	
3.[illegible]E-01	-1.[illegible]E-02	2.[illegible]E-01	-4.[illegible]E-02	1.[illegible]E-03	3.41225E-01	1.47641E-01	1.06436E-01	2.57[illegible]E-01	3.31073E-01

MEAN VALUES OF VARIABLES

X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
5.78063E 00	1.32341E 00	7.66722E 00	2.06611E 00	-1.01755E 00	2.70482E 00	4.85549E 00	2.64297E 00	6.23047E 00	1.14852E 0[illegible]

STANDARD DEVIATIONS OF VARIABLES

X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
4.77475E-01	9.01594E-02	5.15817E-01	1.78072E-01	1.59453E-01	1.38579E 00	2.67167E-01	3.06768E-01	4.91919E-01	5.75390E-01

FINAL MATRIX

X1	X2	X3	X4	X5	X6	X7	X8	X9	X
21.49858	1.83654	-17.81226	-4.70673	-0.12978	-0.00433	3.98590	-8.06966	-4.29769	0
1.83654	1.49035	-1.42976	-0.00861	0.21395	0.17486	1.63361	-1.09754	-0.69571	0
-17.81226	-1.42976	17.80620	3.69296	-0.37449	0.82321	-7.75846	5.72172	-2.09378	0
-4.70673	-0.00861	3.69296	4.73731	0.03051	3.30929	-0.96562	0.24849	2.26008	-0
-0.12978	0.21395	-0.37449	0.03051	1.66078	0.75779	1.37097	-0.16487	-1.13291	-0
-0.00433	0.17486	0.82321	3.30929	0.75779	4.55463	-1.49708	-1.28815	2.49097	0
3.98590	1.63361	-7.75846	-0.96562	1.37097	-1.49708	11.50883	-3.52218	-2.60648	0
-8.06966	-1.09754	5.72172	0.24849	-0.16487	-1.28815	-3.52218	10.04707	-3.64549	0
-4.29769	-0.69571	-2.09378	2.26008	-1.13291	2.49097	-2.60648	-3.64549	12.84797	0
-0.11864	-0.02417	-0.27603	0.03445	0.05783	-0.00865	-0.27235	-0.09497	-0.74537	0

FINAL VARIANCE CONTRIBUTIONS FINAL F-LEVELS

X 1	-4.547144E-04	-1.548974E 00
X 2	-4.111955E-04	-5.663742E-01
X 3	-4.278066E-03	-1.026085E 01
X 4	-2.504736E-04	-6.004230E-01
X 5	-4.637455E-03	-1.110451E 01
X 6	-1.742778E-03	-4.178003E 00
X 7	-6.444567E-03	-1.545477E 01
X 8	-8.950416E-04	-2.146766E 00
X 9	-4.784210E-03	-1.123751E 01

DEGREES OF FREEDOM= 29

F/P DONE

CORRELATION COEFFICIENTS

X1	X2	X3	X4	X5	X6	X7	X8	X9
1.00000								
-0.29535	1.00000							
0.01045	-0.13489	1.00000						
-0.11475	0.03464	-0.32489	1.00000					
0.98667	-0.00307	0.14485	0.36324	1.00000				
0.10866	-0.11957	0.20338	-0.81540	-0.51037	1.00000			
0.84756	-0.20427	0.41646	-0.41729	-0.00151	0.41997	1.00000		
0.71141	-0.16693	0.83966	-0.23920	0.19770	0.27661	0.84901	1.00000	
0.62620	-0.13469	0.80332	-0.23381	0.30339	0.13380	0.85245	0.90365	1.00000
0.80576	-0.19283	0.65697	-0.45193	0.01646	0.42794	0.96042	0.89467	0.91098

STEPWISE REGRESSION

STD. ERROR OF Y 0.592911

STEP NO. 1

VARIABLE ENTERING IS X 7

F LEVEL 439.855254

STD. ERROR OF Y 0.164544

MULTIPLE R 0.960479

CONSTANT TERM 1.442

VARIABLE	COEFFICIENT	STD. ERR. OF COEF.
X 7	2.048434	0.098622

STEP NO. 7

VARIABLE ENTERING IS X 3

F LEVEL 99.511937

STD. ERROR OF Y 0.120277

MULTIPLE R 0.979404

CONSTANT TERM 1.916

VARIABLE	COEFFICIENT	STD. ERR. OF COEF.
X 3	0.534947	0.093818
X 7	1.121905	0.191 33

STEP NO. 8

VARIABLE ENTERING IS X 8

F LEVEL 10.866745

STD. ERROR OF Y 0.107129

MULTIPLE R 0.984327

CONSTANT TERM 2.155

VARIABLE	COEFFICIENT	STD. ERR. OF COEF.
X 3	0.451574	0.086883
X 7	0.913990	0.172427
X 8	0.341061	0.164133

STEP NO. 4

VARIABLE ENTERING IS X 8

F LEVEL 19.276553

STD. ERROR OF Y 0.072215

MULTIPLE R 0.988741

CONSTANT TERM 2.606

VARIABLE	COEFFICIENT	STD. ERR. OF COEF.
X 3	0.498607	0.075807
X 6	0.044716	0.012791
X 7	0.668630	0.149025
X 9	0.444923	0.144139

STEP NO. 5

VARIABLE ENTERING IS X 9

F LEVEL 8.285617

STD. ERROR OF Y 0.069684

MULTIPLE R 0.991010

CONSTANT TERM 2.804

VARIABLE	COEFFICIENT	STD. ERR. OF COEF.
X 3	0.373416	0.081019
X 6	0.058770	0.013175
X 7	0.639550	0.143787
X 8	0.363585	0.143284
X 9	0.255637	0.088810

STEP NO. 6

VARIABLE ENTERING IS X 5

F LEVEL 12.721443

STD. ERROR OF Y 0.072790

MULTIPLE R 0.993501

CONSTANT TERM 2.150

VARIABLE	COEFFICIENT	STD. ERR. OF COEF.
X 3	0.305024	0.070241
X 5	-0.342284	0.097008
X 6	0.043309	0.011513
X 7	0.512387	0.133161
X 8	0.397090	0.141315
X 9	0.324054	0.079239

STEP NO. 7

VARIABLE ENTERING IS X 1

F LEVEL 0.482291

STD. ERROR OF Y 0.072982

MULTIPLE R 0.993603

CONSTANT TERM 2.197

VARIABLE	COEFFICIENT	STD. ERR. OF COEF.
X 1	0.044647	0.063050
X 3	0.364800	0.083137
X 5	-0.347054	0.098049
X 6	0.045709	0.012547
X 7	0.517101	0.134252
X 8	0.370583	0.171263
X 9	0.315808	0.083219

STEP NO. 8

VARIABLE ENTERING IS X 2

F LEVEL 0.054173

STD. ERROR OF Y 0.073885

MULTIPLE R 0.993809

CONSTANT TERM 1.941

VARIABLE	COEFFICIENT	STD. ERR. OF COEF.
X 1	0.101700	0.100741
X 2	0.153854	0.155304
X 3	0.337865	0.087423
X 5	-0.333945	0.099827
X 6	0.946987	0.012614
X 7	0.571739	0.146984
X 8	0.269179	0.178986
X 9	0.106171	0.091359

STEP NO. 9

VARIABLE ENTERING IS X 4

F LEVEL 0.600624

STD. ERROR OF Y 0.073379

MULTIPLE R 0.993935

CONSTANT TERM 2.247

VARIABLE	COEFFICIENT	STD. ERR. OF COEF.
X 1	0.142969	0.114103
X 2	0.154253	0.155143
X 3	0.307910	0.094124
X 4	-0.111305	0.143619
X 5	-0.334986	0.100307
X 6	0.938992	0.013095
X 7	0.586551	0.149302
X 8	0.294151	0.183364
X 9	0.286944	0.095618

EXPLAINED TERM EMPTY WEIGHT, POUNDS
[redacted]
CONSTANT MULTIPLIER, A= 0.52200E 01

EXPONENTIAL CONSTANTS [illegible] — VARIABLE: FUSELAGE LENGTH, FEET

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
1	F-27	23575.000	[illegible]	0.10331E 05	43.82 %
2	L-100	58012.031	0.63529E 05	0.55169E 04	9.51 %
3	C-130E	59162.037	0.52978E 05	-0.61847E 04	-10.45 %
4	C-130A	57407.027	0.52336E 05	-0.50716E 04	-8.83 %
5	C-130H	67578.063	0.55297E 05	-0.12238E 05	-18.18 %
6	HC-130H	72036.063	0.55300E 05	-0.16745E 05	-23.25 %
7	C-133A	116913.063	0.14031E 06	0.23561E 05	20.17 %
8	C-133B	113419.063	0.14017E 06	0.26561E 05	23.36 %
9	SC.210-60	58566.027	0.64109E 05	0.56424E 04	9.65 %
10	707-120	108160.000	0.11474E 06	0.59863E 04	5.44 %
11	707-020	101600.000	0.10035E 06	-0.13578E 04	-1.07 %
12	707-320	122600.000	0.12508E 06	0.32803E 04	2.68 %
13	707-320B	131560.125	0.12513E 06	-0.56709E 04	-4.32 %
14	720	101630.063	0.10051E 06	-0.11178E 04	-1.10 %
15	C-135A	99350.063	0.97556E 05	-0.18011E 04	-1.81 %
16	KC-135A	94100.063	0.97870E 05	0.37629E 04	4.01 %
17	C-135B	105800.063	0.97556E 05	-0.82441E 04	-7.79 %
18	DC-8-10	106800.000	0.10989E 06	0.30897E 04	2.89 %
19	DC-8F-54	129160.000	0.12732E 06	-0.18430E 04	-1.43 %
20	DC-8-62	134620.125	0.13967E 06	0.50515E 04	3.75 %
21	880	83014.063	0.90734E 05	0.77200E 04	9.30 %
22	990	113520.125	0.10749E 06	-0.60367E 04	-5.32 %
23	F-28	31887.016	0.37003E 05	0.51155E 04	16.04 %
24	DC-9-10	49890.027	0.48993E 05	-0.89693E 03	-1.80 %
25	DC-9-20	55267.017	0.66785E 05	0.11520E 05	20.84 %
26	DC-9-30	55950.004	0.66790E 05	0.10839E 05	19.37 %
27	727-100	82797.000	0.71917E 05	-0.10880E 05	-13.14 %
28	727-200	90907.063	0.10976E 06	0.18855E 05	20.74 %
29	737-100	53800.023	0.47229E 05	-0.65708E 04	-12.21 %
31	737-200	54828.027	0.54323E 05	-0.50506E 03	-0.92 %
32	VC-10	141690.125	0.10563E 06	-0.36062E 05	-25.45 %
33	VC-105	149800.125	0.23394E 06	0.84143E 05	56.17 %
34	G141-2	130360.125	0.10338E 06	-0.26975E 05	-20.69 %

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
35	C-5A	327000.125	0.32631E 06	-0.69531E 03	-0.21 %
36	DC-10-10	224470.125	0.17474E 06	-0.49730E 05	-22.15 %
37	747-27	323070.250	0.31062E 06	-0.12449E 05	-3.85 %
38	747F	313210.188	0.31062E 06	-0.25888E 04	-0.83 %
39	L1011	215990.063	0.19035E 06	-0.25642E 05	-11.87 %
40	C-141-1	127640.063	0.10338E 06	-0.24255E 05	-19.00 %

[illegible] EMPTY WEIGHT, POUNDS
[illegible] REGRESSION
CONSTANT MULTIPLIER, A= 0.79329E 01

EXPONENTIAL CONSTANTS
1.171905
0.534967

VARIABLE
FUSELAGE LENGTH, FEET
WING AREA, FT**2

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
1	F-27	23576.031	0.31454E 05	0.79778E 04	33.41 %
2	L-188	58012.031	0.59174E 05	0.11620E 04	2.00 %
3	C-130A	59162.027	0.62767E 05	0.36059E 04	6.09 %
4	C-130A	52607.027	0.62364E 05	0.49577E 04	8.64 %
5	C-130B	67579.063	0.64254E 05	-0.33344E 04	-4.94 %
6	HC-130H	72039.063	0.64742E 05	-0.77994E 04	-10.83 %
7	C-133A	115810.063	0.13317E 06	0.16059E 05	14.52 %
8	C-133A	113810.063	0.13377E 06	0.19959E 05	17.54 %
9	SE210-6N	58466.023	0.65994E 05	0.75142E 04	12.86 %
10	707-120	103160.000	0.11375E 06	0.55124E 04	5.00 %
11	707-320	101670.000	0.10612E 06	0.45218E 04	4.45 %
12	707-320	122600.000	0.17152E 06	0.89152E 04	7.27 %
13	707-320B	131560.125	0.13434E 06	0.27990E 04	2.13 %
14	720	101630.063	0.10612E 06	0.44938E 04	4.42 %
15	C-135A	59350.063	0.10432E 06	0.50631E 04	5.09 %
16	KC-135A	54190.063	0.10460E 06	0.10501E 05	11.16 %
17	C-135B	105800.063	0.10447E 06	-0.13400E 04	-1.31 %
18	DC-8-10	106800.000	0.11545E 06	0.86506E 04	8.10 %
19	DC-8F-54	129160.000	0.13211E 06	0.29536E 04	2.29 %
20	DC-8-62	134620.125	0.14004E 06	0.54173E 04	4.07 %
21	880	83014.063	0.90401E 05	0.73870E 04	8.90 %
22	990	113520.125	0.10555E 06	-0.79741E 04	-7.02 %
23	F-28	31887.016	0.34540E 05	0.26524E 04	8.32 %
24	DC-9-10	49890.027	0.43071E 05	-0.68198E 04	-13.67 %
25	DC-9-30	55262.012	0.52962E 05	-0.24098E 04	-4.36 %
26	DC-9-30	55550.004	0.52860E 05	-0.30498E 04	-5.52 %
27	727-100	82797.000	0.71901E 05	-0.10896E 05	-13.16 %
28	727-200	90900.063	0.91836E 05	0.98569E 03	1.08 %
29	737-100	53800.023	0.42459E 05	-0.11350E 05	-21.10 %
31	737-200	54820.027	0.47365E 05	-0.74627E 04	-13.61 %
32	VC-10	141690.125	0.10704E 06	-0.34651E 05	-24.46 %
33	VC-10S	149800.125	0.18542E 06	0.35619E 05	23.78 %

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
34	C141-2	130360.125	0.12536E 06	-0.50046E 04	-3.84 %
35	C-5A	327000.125	0.33153E 06	0.45295E 04	1.39 %
36	DC-10-10	224470.125	0.18339E 06	-0.41083E 05	-18.30 %
37	747-27	323070.250	0.30183E 06	-0.21237E 05	-6.57 %
38	747F	313210.188	0.30183E 06	-0.11377E 05	-3.63 %
39	L1011	215990.063	0.19036E 06	-0.25630E 05	-11.87 %
40	C-141-1	127640.063	0.12536E 06	-0.22845E 04	-1.79 %

[illegible] EMPTY WEIGHT, POUNDS
[illegible] REGRESSION =

[illegible]

EXPONENTIAL CONSTANTS
0.[illegible]
0.451524
0.541641

VARIABLE
FUSELAGE LENGTH, FEET
WING AREA, [illegible]
FUSELAGE MAX. PERIM, FT

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
1	F-27	[illegible]	[illegible]	0.660390E 04	29.03 %
2	L-188	59619.031	[illegible]	-0.[illegible]E 03	-1.94 %
3	C-130A	59167.937	[illegible]	[illegible]	11.10 %
4	C-130B	57607.937	[illegible]	[illegible]	13.99 %
5	C-130E	62578.063	[illegible]	[illegible]	-0.84 %
6	HC-130H	72034.063	[illegible]	[illegible]	-7.07 %
7	C-133A	119813.063	0.136190E 06	0.193937E 05	16.59 %
8	C-133A	113813.063	0.136190E 06	0.233937E 05	19.67 %
9	SE210-6N	59666.023	[illegible]	0.180136 04	3.08 %
10	707-120	108343.000	0.111758E 06	0.321308E 04	2.97 %
11	707-020	101603.000	0.105462E 06	0.381918E 04	3.76 %
12	707-320	123403.000	0.125489E 06	0.379186E 04	2.69 %
13	707-320B	131563.125	0.128190E 06	-0.337446E 04	-2.56 %
14	720	101633.063	0.105462E 06	0.378903E 04	3.73 %
15	C-135A	99353.063	0.102337E 06	0.300481E 04	3.03 %
16	KC-135A	94103.063	0.102516E 06	0.861266E 04	8.94 %
17	C-135B	105903.063	0.102337E 06	-0.343596E 04	-3.24 %
18	DC-8-10	166803.000	0.160946E 06	0.314640E 04	2.94 %
19	DC-8F-54	179163.000	0.172791E 06	-0.625108E 04	-4.96 %
20	DC-8-62	134420.125	0.128991E 06	-0.571098E 04	-4.74 %
21	880	83014.063	0.[illegible]E 05	0.2[illegible]E 04	3.04 %
22	990	113523.125	[illegible]	-0.[illegible]E 05	-[illegible] %
23	F-28	71987.016	[illegible]	0.391228E 04	12.27 %
24	DC-9-10	49893.027	0.458041E 05	-0.[illegible]E 04	-9.72 %
25	DC-9-30	55269.312	0.532768E 05	-0.199318E 04	-3.61 %
26	DC-9-30	55650.004	0.532768E 05	-0.[illegible]E 04	-4.78 %
27	727-100	83707.000	0.731158E 05	-0.[illegible]E 04	-11.69 %
28	727-200	90500.063	0.893378E 05	-0.[illegible]E 04	-1.73 %
29	737-100	53803.023	0.471798E 05	-0.[illegible]E 04	-12.31 %
30	737-200	54628.027	0.516[illegible]	-0.[illegible]E 04	-5.82 %
31	VC-10	141690.125	[illegible]	-0.[illegible]E 05	-25.47 %

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
33	VC-10B	149803.125	0.165[illegible]	0.[illegible]E 05	10.67 %
34	G141-?	130363.125	0.120[illegible]	-0.[illegible]E 04	-7.29 %
35	C-5A	327003.125	0.381[illegible]	0.[illegible]E 05	16.70 %
36	DC-10-10	224471.125	0.[illegible]	-0.[illegible]E 05	-11.87 %
37	747-27	[illegible]	[illegible]	-0.[illegible]E 04	-1.09 %
38	747F	713210.188	0.[illegible]	0.[illegible]E 04	2.03 %
39	L1011	215593.063	0.203[illegible]	-0.[illegible]E 05	-5.73 %
40	C-141-1	127640.063	0.120[illegible]	-0.[illegible]E 04	-5.31 %

[illegible] EMPTY WEIGHT, [illegible]

[illegible]

EXPONENTIAL CONSTANTS

[illegible]	
[illegible]	
[illegible]	
0.044718	

VARIABLE

FUSELAGE LENGTH, FEET
WING AREA,FT**2
FUSELAGE MAX. DEPTH,FT
[illegible] (INF)

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
1	F-27	23536.039	0.27663E 05	0.41715E 04	17.77 %
2	F-28	59719.391	0.51057E 05	-0.69569E 04	-11.99 %
3	C-130A	59167.039	0.63666E 05	0.74030E 04	6.20 %
4	C-130B	59627.039	0.61611E 05	0.49044E 04	4.98 %
5	C-130E	67573.063	0.62553E 05	-0.50763E 04	-7.51 %
6	KC-130H	72639.063	0.62553E 05	-0.99369E 04	-13.24 %
7	C-131A	11693.063	0.11534E 06	0.15980E 04	1.33 %
8	C-131B	11381.063	0.11946E 06	0.45580E 04	4.00 %
9	SF210-A/N	5966.024	0.61304E 05	0.29283E 04	5.01 %
10	707-120	108946.031	0.11645E 06	0.61773E 04	5.70 %
11	707-320	131403.031	0.10838E 06	0.83763E 04	8.15 %
12	707-320C	127463.031	0.12374E 06	0.61567E 04	5.02 %
13	707-320B	131563.125	0.13136E 06	-0.22075E 03	-0.17 %
14	720	101743.063	0.11091E 06	0.83641E 04	8.11 %
15	C-135A	99359.063	0.10674E 06	0.77825E 04	7.43 %
16	KC-135A	84103.063	0.10688E 06	0.13753E 05	13.55 %
17	C-135B	105803.063	0.10674E 06	0.94150E 03	0.89 %
18	DC-8-10	166903.031	0.11335E 06	0.55803E 04	5.20 %
19	DC-8F-54	129140.000	0.12413E 06	-0.50553E 04	-3.91 %
20	DC-8-62	134620.125	0.12888E 06	-0.57394E 04	-4.30 %
21	B36	83014.063	0.88170E 05	0.51558E 04	6.21 %
22	990	113423.125	0.98769E 05	-0.14778E 05	-13.02 %
23	F-28	31887.016	0.37543E 05	0.56553E 04	17.74 %
24	DC-9-10	46893.027	0.47223E 05	-0.26869E 04	-5.35 %
25	DC-9-30	55269.719	0.54058E 05	-0.17109E 04	-3.19 %
26	DC-9-30	5553.034	0.54058E 05	-0.18919E 04	-3.38 %
27	727-100	82707.000	0.76973E 05	-0.54241E 04	-7.03 %
28	727-200	90903.063	0.89541E 05	-0.13387E 04	-1.47 %
29	737-100	53803.023	0.50352E 05	-0.34485E 04	-6.41 %
31	737-200	54824.027	0.54354E 05	-0.47418E 03	-0.86 %

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
32	VC-10	141493.125	0.16879E 06	-0.33904E 05	-23.27 %
33	VC-10C	145800.125	0.15407E 06	0.71774E 04	4.79 %
34	G141-2	132762.125	0.12514E 06	-0.51709E 04	-3.97 %
35	C-5A	327300.125	0.37045E 06	0.53450E 05	16.10 %
36	DC-10-10	224473.125	0.23304E 06	-0.20506E 05	-9.14 %
37	747-27	323073.250	0.31750E 06	-0.53775E 04	-1.66 %
38	747F	313713.188	0.31749E 06	0.44826E 04	1.43 %
39	L1011	219593.063	0.20758E 06	-0.84086E 04	-3.89 %
40	C-141-1	127643.063	0.12514E 06	-0.24598E 04	-1.93 %

EMPTY WEIGHT,POUNDS

NUMBER OF REGRESSION = 5

EXPONENTIAL CONSTANTS

1.655980	
0.333416	
0.663585	
0.259770	
0.296697	

VARIABLE

FUSELAGE LENGTH, FEET
WING AREA,FT**2
FUSELAGE MAX. DEPTH,FT
0.25*(FT.SWEEP + TR CHORD LINE)
HORIZONTAL TAIL AREA,FT**2

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
1	F-27	29576.000	0.26[illegible]E 05	0.33360E 04	11.58 %
2	F-28	28612.371	0.29[illegible]E 05	-0.83[illegible]4E 04	-14.71 %
3	C-130A	59162.000	0.63[illegible]E 05	0.43[illegible]4E 04	7.38 %
4	C-130A	57407.027	0.61[illegible]E 05	0.43812E 04	7.63 %
5	C-130B	62578.063	0.66[illegible]E 05	-0.33077E 04	-4.75 %
6	KC-135A	72039.063	0.68[illegible]E 05	-0.79607E 04	-11.02 %
7	C-135	116810.063	0.11[illegible]E 06	0.24064E 04	2.06 %
8	C-135A	113813.063	0.11[illegible]E 06	0.54330E 04	4.77 %
9	SR71-6N	58466.039	0.61[illegible]E 05	0.26776E 04	4.57 %
10	707-120	103740.000	0.11[illegible]E 06	0.45616E 04	4.21 %
11	707-220	101600.000	0.10[illegible]E 06	0.49309E 04	4.81 %
12	707-320	127600.000	0.13[illegible]E 06	0.87813E 04	7.16 %
13	707-320A	131600.125	0.13316E 06	0.17980E 04	1.37 %
14	720	101430.063	0.10852E 06	0.68009E 04	6.78 %
15	C-135A	99359.063	0.10636E 06	0.70016E 04	7.05 %
16	KC-135A	96100.063	0.10647E 06	0.12376E 05	13.14 %
17	C-135B	105803.063	0.10837E 06	0.29598E 04	2.77 %
18	DC-8-10	102800.000	0.11449E 06	0.74881E 04	7.20 %
19	DC-8F-54	123160.000	0.12665E 06	-0.45082E 04	-3.49 %
20	DC-8-62	134423.125	0.12890E 06	-0.56279E 04	-4.18 %
21	880	83014.063	0.87470E 05	0.44561E 04	5.37 %
22	990	113523.125	0.98234E 05	-0.15204E 05	-13.47 %
23	F-28	31887.016	0.36718E 05	0.48308E 04	15.15 %
24	DC-9-10	46893.027	0.47715E 05	-0.21745E 04	-4.36 %
25	DC-9-30	55269.012	0.53937E 05	-0.13319E 04	-2.41 %
26	DC-9-40	55550.034	0.53837E 05	-0.20129E 04	-3.60 %
27	727-100	87797.000	0.76059E 05	-0.67780E 04	-8.13 %
28	727-200	90903.063	0.87662E 05	-0.32379E 04	-3.56 %
29	737-100	53800.023	0.50947E 05	-0.28531E 04	-5.30 %

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
31	737-200	54831.027	0.54465E 05	-0.36343E 03	-0.66 %
32	VC-10	141693.125	0.11492E 06	-0.26770E 05	-18.89 %
33	VC-10C	140803.125	0.15058E 06	0.97813E 04	6.53 %
34	0141-2	130363.125	0.11796E 06	-0.12403E 05	-9.51 %
35	C-5A	327003.125	0.32272E 06	-0.32825E 04	-1.00 %
36	DC-10-10	224473.125	0.22156E 06	-0.29143E 04	-1.30 %
37	747-27	323073.750	0.32455E 06	0.14796E 04	0.46 %
38	747F	313213.188	0.32455E 06	0.11340E 05	3.62 %
39	L1011	215693.063	0.22339E 06	0.74038E 04	3.43 %
40	C-141-1	127643.063	0.11796E 06	-0.96824E 04	-7.59 %

[illegible] EMPTY WEIGHT,EQUATION

[illegible] OF REGRESSION = 6

[illegible] AT 0.[illegible]E-01

EXPONENTIAL CONSTANTS

0.512767
0.395036
0.337390
0.339399
0.476454
-0.342264

VARIABLE

FUSELAGE LENGTH, FEET
WING AREA,FT**2
FUSELAGE MAX. DEPTH,FT
FUSELAGE WIDTH ,75 CHORD LINE)
HORIZONTAL TAIL AREA,FT**2
T/C AT ROOT

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
1	F-27	24574.000	0.233138E 05	-0.267638E 03	-1.11 %
2	L-188	59013.031	0.517236E 05	-0.628868E 04	-10.84 %
3	C-135A	99162.027	0.842746E 05	0.811218E 04	8.64 %
4	C-135A	92437.027	0.821566E 05	0.674918E 04	8.27 %
5	C-135A	67979.063	0.649598E 05	-0.261968E 04	-3.88 %
6	KC-135A	72038.063	0.646308E 05	-0.743028E 04	-10.31 %
7	C-135A	115813.063	0.120156E 06	0.333968E 04	2.86 %
8	C-135A	113813.063	0.120136E 06	0.633736E 04	5.60 %
9	SE210-6N	98466.023	0.936766E 05	0.821028E 04	8.91 %
10	707-120	108340.000	0.107538E 06	-0.807538E 03	-0.75 %
11	707-320	101800.000	0.104148E 06	0.356768E 04	3.44 %
12	707-320	127400.000	0.124809E 06	0.620098E 04	5.43 %
13	707-320B	131560.125	0.133932E 06	-0.274018E 04	-2.08 %
14	720	101633.063	0.104188E 06	0.256468E 04	2.51 %
15	C-135A	99350.063	0.100598E 06	0.121818E 04	1.23 %
16	KC-135A	94103.063	0.100644E 06	0.655738E 04	6.97 %
17	C-135A	105900.063	0.103943E 06	-0.236668E 04	-2.24 %
18	DC-8-10	105803.000	0.121438E 06	0.148398E 05	13.89 %
19	DC-8F-54	129160.000	0.129458E 06	0.285698E 03	0.22 %
20	DC-8-62	134620.125	0.133748E 06	-0.138438E 04	-1.03 %
21	880	83014.063	0.904658E 05	0.748598E 04	8.98 %
22	990	113520.125	0.103978E 06	-0.954918E 04	-8.41 %
23	F-28	31987.016	0.362048E 05	0.431668E 04	13.54 %
24	DC-9-10	45990.027	0.456378E 05	-0.253408E 03	-0.51 %
25	DC-9-30	55969.312	0.542298E 05	-0.104048E 04	-1.88 %
26	DC-9-30	55650.304	0.542298E 05	-0.172148E 04	-3.08 %
27	727-100	82757.000	0.732748E 05	-0.952288E 04	-11.50 %
28	727-200	60000.063	0.637998E 05	-0.230108E 04	-3.83 %

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
29	737-100	53800.023	0.523398E 05	-0.141148E 04	-2.62 %
31	737-200	54824.027	0.559318E 05	0.114288E 04	2.12 %
32	VC-10	141690.125	0.119878E 06	-0.218198E 05	-15.40 %
33	VC-10S	149800.125	0.159278E 06	0.947448E 04	6.32 %
34	G141-2	130360.125	0.121998E 06	-0.840738E 04	-6.45 %
35	C-5A	327000.125	0.336628E 06	0.962338E 04	2.94 %
36	DC-10-10	224470.125	0.215768E 06	-0.687448E 04	-3.06 %
37	747-27	323073.250	0.308738E 06	-0.143378E 05	-4.44 %
38	747F	313913.188	0.309738E 06	-0.447718E 04	-1.43 %
39	L1011	215993.063	0.234928E 06	0.188298E 05	8.72 %
40	C-141-1	127443.063	0.121958E 06	-0.568738E 04	-4.46 %

[illegible] EMPTY WEIGHT, PROPS
[illegible]

EXPONENT CONSTANTS == VARIABLE
C.[illegible]E 01 FUSELAGE LENGTH, FEET
C.[illegible] WING AREA,FT**2
C.[illegible] FUSELAGE MAX. DEPTH,FT
C.[illegible] ENGINE (NO. ,TF CHOICE)
C.[illegible] HORIZONTAL TAIL AREA,FT**2
-C.[illegible] TOC AT SPOT
C.[illegible] VERTICAL TAIL AREA,FT**2

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
1	F-27	29574.063	0.29616E 05	-0.13969E 03	-0.59 %
2	L-188	58619.063	0.58778E 05	-0.71956E 04	-12.30 %
3	C-130A	58167.027	0.63965E 05	0.47836E 04	8.09 %
4	C-130A	57407.027	0.61847E 05	0.44604E 04	7.77 %
5	C-130A	62578.063	0.66626E 05	-0.29571E 04	-4.37 %
6	HS-130H	72039.063	0.64283E 05	-0.77655E 04	-10.77 %
7	C-133A	116810.063	0.12212E 06	0.53114E 04	4.55 %
8	C-133A	113913.063	0.12716E 06	0.83468E 04	7.33 %
9	SE210-AN	56668.023	0.60351E 05	0.46851E 04	7.85 %
10	737-120	100343.000	0.10284E 06	-0.15050E 04	-1.39 %
11	737-220	101409.000	0.10350E 06	0.19078E 04	1.87 %
12	737-320	122400.000	0.12580E 06	0.32035E 04	2.61 %
13	707-320B	131560.125	0.12756E 06	-0.39079E 04	-2.97 %
14	720	101433.063	0.10356E 06	0.22618E 04	2.03 %
15	C-135A	99350.063	0.10127E 06	0.19449E 04	1.91 %
16	KC-135A	94103.063	0.10035E 06	0.64351E 04	6.84 %
17	C-135B	105803.063	0.10408E 06	-0.17150E 04	-1.62 %
18	DC-8-10	104363.031	0.12219E 06	0.15390E 05	14.41 %
19	DC-8F-54	129160.000	0.12962E 06	0.45731E 03	0.35 %
20	DC-8-62	136420.125	0.13335E 06	-0.12697E 04	-0.94 %
21	880	83014.063	0.91334E 05	0.83903E 04	9.99 %
22	990	113520.125	0.10456E 06	-0.80419E 04	-7.89 %
23	F-28	31987.016	0.35857E 05	0.40696E 04	12.76 %
24	DC-9-10	49893.027	0.49484E 05	-0.40829E 03	-0.81 %
25	DC-9-30	55263.047	0.53979E 05	-0.13302E 04	-2.41 %
26	DC-9-30	55650.004	0.53930E 05	-0.23112E 04	-3.59 %
27	727-100	82797.000	0.74910E 05	-0.79870E 04	-9.53 %

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
28	727-200	90903.063	0.86913E 05	-0.39874E 04	-4.39 %
29	737-100	93803.031	0.92923E 05	-0.87319E 03	-1.43 %
30	737-200	94828.027	0.96469E 05	0.16411E 04	2.99 %
31	VC-10	141600.125	0.12036E 06	-0.21060E 05	-14.86 %
32	VC-10S	149803.125	0.15970E 06	0.93992E 04	6.27 %
33	6141-2	133363.125	0.12366E 06	-0.77096E 04	-5.91 %
34	F-5A	127300.125	0.13466E 06	0.76191E 04	2.33 %
35	DC-10-10	224473.125	0.21730E 06	-0.74730E 04	-3.33 %
36	747-27	323371.250	0.30817E 06	-0.14903E 05	-4.61 %
37	747F	312210.188	0.30317E 06	-0.50433E 04	-1.61 %
38	L1011	215563.063	0.23315E 06	0.17159E 05	7.94 %
40	C-141-1	127640.063	0.12265E 06	-0.49586E 04	-3.91 %

[illegible] EMPTY WEIGHT, POUNDS

[illegible]

EXPONENTIAL CONSTANTS

0.478330
0.333965
0.965135
0.464893
0.494171
-0.333569
0.191760
0.159894

VARIABLE

FUSELAGE LENGTH, FEET
WING AREA, FT**2
FUSELAGE MAX. DEPTH, FT
FUSELAGE AT .25 CHORD LINE
HORIZONTAL TAIL AREA, FT**2
T/C AT ROOT
VERTICAL TAIL AREA, FT**2
ULTIMATE LOAD FACTOR, G.

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
1	F-27	33576.000	0.29610E 05	0.34035E 03	0.14 %
2	L-188	99017.031	0.90469E 05	-0.75627E 04	-13.04 %
3	C-130A	59163.027	0.64858E 05	0.56964E 04	9.63 %
4	C-130A	57407.027	0.62839E 05	0.54029E 04	9.41 %
5	C-130B	67578.063	0.64841E 05	-0.27331E 04	-4.05 %
6	KC-130H	72534.063	0.64511E 05	-0.75268E 04	-10.45 %
7	C-133A	116810.063	0.12391E 06	0.71491E 04	6.11 %
8	C-133A	113813.063	0.11649E 06	0.26771E 04	2.35 %
9	SR71-A5	58465.023	0.62503E 05	0.40370E 04	6.90 %
10	707-120	108340.000	0.10695E 06	-0.14824E 04	-1.38 %
11	707-020	101600.000	0.10319E 06	0.15334E 04	1.51 %
12	707-320	122600.000	0.12556E 06	0.29591E 04	2.41 %
13	707-320B	131540.125	0.12727E 06	-0.43041E 04	-3.26 %
14	720	101430.063	0.10343E 06	0.14031E 04	1.77 %
15	C-135A	99359.063	0.10169E 06	0.23306E 04	2.35 %
16	KC-135A	94105.063	0.97127E 05	0.30271E 04	3.22 %
17	C-135A	105800.063	0.10441E 06	-0.13916E 04	-1.32 %
18	DC-8-10	104800.000	0.12217E 06	0.15377E 05	14.39 %
19	DC-8F-54	129160.000	0.12937E 06	0.71106E 03	0.55 %
20	DC-8-62	134620.125	0.13391E 06	-0.70643E 03	-0.52 %
21	880	83014.063	0.91724E 05	0.87104E 04	10.49 %
22	990	113593.125	0.10500E 06	-0.85152E 04	-7.50 %
23	F-28	31887.016	0.35593E 05	0.36959E 04	11.59 %
24	DC-9-10	46893.027	0.46994E 05	0.10407E 03	0.21 %
25	DC-9-30	55269.012	0.53904E 05	-0.13650E 04	-2.47 %
26	DC-9-30	55553.004	0.53904E 05	-0.20460E 04	-3.66 %

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
27	727-100	83297.000	0.75706E 05	-0.70912E 04	-8.56 %
28	727-200	80600.063	0.87137E 05	-0.37776E 04	-4.15 %
29	737-100	53803.023	0.52724E 05	-0.10719E 04	-1.99 %
30	737-200	54824.027	0.56314E 05	0.15563E 04	2.84 %
32	VC-10	141500.125	0.12041E 06	-0.21076E 05	-14.87 %
33	VC-10S	146800.125	0.16170E 06	0.17104E 05	8.08 %
34	G141-?	130363.125	0.12284E 06	-0.78193E 04	-6.00 %
35	C-5A	327300.125	0.33561E 06	0.86089E 04	2.63 %
36	DC-10-10	224470.125	0.21617E 06	-0.83034E 04	-3.70 %
37	747-27	323073.250	0.31058E 06	-0.12490E 05	-3.86 %
38	747F	313210.188	0.31058E 06	-0.76196E 04	-0.84 %
39	L1011	215560.063	0.23140E 06	0.15611E 05	7.23 %
40	C-141-1	127640.063	0.12254E 06	-0.53692E 04	-3.99 %

[illegible] [illegible] EMPTY WEIGHT,POUNDS

[illegible]

[illegible] CONSTANTS	VARIABLE
[illegible]	FUSELAGE LENGTH, FEET
[illegible]	WING AREA,FEET2
[illegible]	FUSELAGE MAX. WIDTH,FT
[illegible]	FUSELAGE WETTED AREA (NO CARGO LINER)
[illegible]	HORIZONTAL TAIL AREA,FT**2
[illegible]	TAPER RATIO
[illegible]	VERTICAL TAIL AREA,FT**2
[illegible]	ULTIMATE LOAD FACTOR, G.
[illegible]	WING SURFACE RATIO

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
1	F-27	71574.000	0.[illegible]E 05	-0.[illegible]E 03	-0.38 %
2	F-28	58017.031	0.[illegible]E 05	-5.[illegible]E 04	-10.45 %
3	F-100A	80162.027	0.[illegible]E 05	0.551358E 04	9.32 %
4	F-100A	87407.027	0.[illegible]E 05	0.583337E 04	9.36 %
5	F-100B	67574.063	0.[illegible]E 05	-0.290311E 04	-4.29 %
6	DC-10B	77031.063	0.[illegible]E 05	-0.787758E 04	-10.44 %
7	F-111A	111913.063	0.123022E 06	0.660871E 04	5.49 %
8	F-111A	117813.063	0.119188E 06	0.176866E 04	1.73 %
9	SST[illegible]	58665.223	0.618617E 05	0.315135E 04	5.39 %
10	707-120	104343.930	0.[illegible]E 06	-0.159066E 04	-1.47 %
11	707-320	111401.332	0.107386E 06	0.134666E 04	1.32 %
12	707-320	122403.930	0.[illegible]E 06	0.218978E 04	1.79 %
13	707-320B	119169.125	0.[illegible]E 06	-0.522122E 04	-3.97 %
14	720	101493.063	0.[illegible]E 06	0.173009E 04	1.70 %
15	F-135A	99369.063	0.[illegible]E 06	0.287685E 04	2.90 %
16	DC-135A	94103.063	0.971505E 05	0.[illegible]E 04	3.24 %
17	F-135B	105033.063	0.[illegible]E 06	-0.[illegible]E 04	-0.95 %
18	DC-8-10	101903.000	0.[illegible]E 06	0.158[illegible]E 05	14.82 %
19	DC-8F-54	121161.000	0.[illegible]E 06	0.[illegible]E 03	0.61 %
20	DC-8-62	134423.125	0.[illegible]E 06	-0.160705E 04	-1.19 %
21	880	83014.063	0.921[illegible]E 05	0.[illegible]E 04	11.05 %
22	880	113523.125	0.[illegible]E 06	-0.[illegible]E 04	-5.89 %
23	F-28	31897.016	0.[illegible]E 05	0.[illegible]E 04	13.74 %
24	DC-9-10	41991.027	0.[illegible]E 05	-0.[illegible]E 03	-0.76 %
25	DC-9-30	55269.012	0.[illegible]E 05	-0.[illegible]E 04	-3.62 %

SAMPLE NO.	VEHICLE ID.	INPUT VALUE	CALCULATED VALUE	DIFF.	RATIO
26	DC-9-30	55053.004	0.[illegible]E 05	-0.[illegible]E 04	-4.80 %
27	727-100	82707.000	0.[illegible]E 05	-0.[illegible]E 04	-6.70 %
28	727-200	91533.363	0.[illegible]E 05	-0.[illegible]E 04	-3.53 %
29	737-100	83300.023	0.[illegible]E 05	-0.[illegible]E 04	-2.75 %
30	737-200	94934.027	0.[illegible]E 05	0.[illegible]E 04	2.68 %
31	VC-10	141699.125	0.[illegible]E 06	-0.[illegible]E 05	-15.70 %
32	VC-10S	141703.125	0.[illegible]E 06	0.[illegible]E 05	7.91 %
33	G141-2	130743.125	0.[illegible]E 06	-0.[illegible]E 04	-6.67 %
34	F-5A	227301.125	0.[illegible]E 06	0.[illegible]E 04	2.58 %
35	DC-10-10	224673.125	0.[illegible]E 06	-0.[illegible]E 04	-2.90 %
36	747-27	323073.250	0.[illegible]E 06	-0.[illegible]E 05	-3.86 %
37	747	313213.188	0.[illegible]E 06	-0.[illegible]E 04	-0.83 %
38	L[illegible]-1	215993.063	0.[illegible]E 06	0.[illegible]E 05	7.83 %
40	F-141-1	127640.063	0.[illegible]E 06	-0.[illegible]E 04	-4.68 %

REFERENCES

1. Hague, D.S., Vanderberg, J.D., and Woodbury, N.W. Multivariate Analysis, Retrieval, and Storage System (MARS). Vol. I, MARS System and Analysis Techniques. NASA CR-137671. May 1975.

2. Hague, D.S., Vanderberg, J.D., and Woodbury, N.W. Multivariate Analysis, Retrieval, and Storage System (MARS). Vol. II, Military Flight Vehicle Data Base (By Vehicle). NASA CR-137672. May 1975.

3. Hague, D.S., Vanderberg, J.D., and Woodbury, N.W. Multivariate Analysis, Retrieval, and Storage System (MARS). Vol. III, Transport Vehicle Data Base (By Vehicle). NASA CR-137673. May 1975.

4. Hague, D.S., Vanderberg, J.D., and Woodbury, N.W. Multivariate Analysis, Retrieval, and Storage System (MARS). Vol. IV, Turbojet and Turbofan Data Base (By Engine). NASA CR-137674. May 1975.

5. Woodbury, N.W. and Hague, D.S. Multivariate Analysis, Retrieval, and Storage System (MARS). Vol. V, User's Manual for MARS System Interactive Graphics Version. July 1975. (To be published as a NASA high number CR.)