THE DETERMINATION OF OPERATIONAL AND SUPPORT REQUIREMENTS AND COSTS DURING THE CONCEPTUAL DESIGN OF SPACE SYSTEMS

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Prepared by

Charles Ebeling
Kenneth Beasley

University of Dayton

Engineering Management and Systems Department

300 College Park

Dayton, Ohio 45469-0236

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Chapter I

Introduction

A. Background

This report documents the first year of research conducted by the University of Dayton for the National Aeronautics and Space Administration (NASA) Langley Research Center (LaRC) under NASA research grant NAG-1-1327. The purpose of the grant is to provide support to NASA in predicting operational and support parameters and costs of proposed space systems. Specific research objectives include: (1) the development of a methodology for deriving reliability and maintainability parameters and based upon their estimates determine operational capability and support costs, and (2) the identification of data sources and the establishment of an initial data base to implement the methodology. Implementation of the methodology is accomplished through the development of a comprehensive computer model. A third objective, not documented in this report, is to assist NASA in the development of a simulation model which will provide an integrated view of the operations and support of proposed space transportation systems.

B. Related Efforts

Several previous studies provide insight and motivation for this research. These studies are discussed briefly below.

The Supportability Assessment Model (SAM) developed by Rockwell International [21] provided much of the motivation for the development of the parametric equations as part of this research. SAM projects maintenance action rates as a function of the dry (empty) weight of a vehicle. Dry weight is considered a surrogate for complexity. This projection is then modified by factors which consider the environment (e.g. space vs. ground), technology (development year) and reliability procurement policies (high or low reliability specifications). Using Air Force Maintenance Data Collection (MDC) data (AFM 66-1) pertaining to the C-9A, C-141A and the C-5A, Rockwell derived a regression equation with maintenance actions per flying hour as a dependent variable and empty weight as an independent variable. Predictions from this equation for estimating spacecraft reliability are then adjusted by an environmental factor derived from MIL-HDBK-217, Reliability Prediction of Electronic Equipment and a technology factor related to the development year.

An enhancement to the original Rockwell SAM model is the Reliability/Maintainability (R/M) Analysis Methodology used by Rockwell in assessing the R&M of the Personnel Launch System, Advanced Manned Launch System (PLS/AMLS). [19] This analysis established regression equations between unscheduled maintenance actions and vehicle dry weight for several aircraft subsystems such as avionics, powerplants, electrical, hydraulic, structural and landing gear. Eight different aircraft including a bomber, fighters and airlift (cargo) are used to generate examples of the correlations obtained between subsystem weight and maintenance actions per

flying hour or per landings. Component removals are computed as a percent of the component maintenance actions in order to determine requirements for spares. Both a bottom-up and a top-down analysis is performed using Air Force, airline and orbiter data.

In a discussion on life cycle costing, Earles [7] presents one of the first successful parametric models for estimating maintenance manhours per flying hour (MH/FH). An estimate of the MH/FH for on-aircraft propulsion is obtained from a regression equation with the thrust/engine and number of engines as independent variables. Five tactical aircraft and the T-38 provided the source of data.

Another early study by Harmon, Pates, and Gregor [9] developed maintenance manhours per flying hour (MH/FH) estimates for tactical aircraft for use during conceptual and development design phases. Again, using AFM 66-1 data, MH/FH estimating relationships were derived using aircraft design and performance parameters. Using ten tactical aircraft, a data base covering maintenance manhours over a 6 month period was developed at the two-digit work unit code (WUC). Different independent variables were selected for each subsystem. For example, landing gear maintenance manhours was assumed to be related to kinetic energy and aircraft weight while the fuel system maintenance manhours was related to weight, number of engines and fuel quantity. Correlations above .90 were reported for each of the examples, however, only 5 to 7 data points (aircraft) were used in the analysis. Technology improvement factors are given for each WUC but details on their derivations are not provided.

Norris and Timmins [16] present another early study which focused on spacecraft performance during its orbital life. Component failure rates over time of 57 unmanned spacecraft were analyzed. Both a Duane reliability growth curve and a Weibull hazard rate function provided an adequate fit to the data. A decreasing failure rate over time and a four-fold increase in failures during the first day following launch were observed from the data.

Decreasing failure rates were also reported in a study by Hecht and Florentino [10] and Hecht and Hecht [11] which focused on electronic systems of over 300 spacecraft. The study concluded that design and environmental causes of failures contributed the most to a decreasing failure rate. They computed Weibull shape and scale parameters for each of several failure classifications. Causes of spacecraft failures, their distribution by subsystem and criticality and mission type are also presented. A reliability prediction method is developed for electronic equipment operating in a space environment which is consistent with MIL-HDBK-217.

Peacore [18] discusses some reliability results pertaining to the Air Force's AWACS (E-3A) system. In flight failure rates were found to be decreasing with flight time which he believes to be characteristic of large multi-engine transport type aircraft. A model, developed by Boeing Aerospace Corporation and based upon B-52 data, has high early failure rates which decrease to a relatively constant rate after 10 hours of flight. The high early failures are attributed to environmental stresses during takeoff, failures occurring when initiating (e.g. turning on) and stabilizing equipment, failures undetected during testing, and
maintenance induced failures.

One of the few papers addressing failure time and repair time probability distributions is presented by Ostrofsky [17]. However, only graphical examples of these distributions are provided with no results on fitted theoretical distributions reported.

A comprehensive report prepared for the Goddard Space Flight Center (NASA) by Bloomquist and Graham [5] describes the study of 44 unmanned orbital spacecraft. In fact, this study is an update of earlier studies conducted by the Planning Research Corporation (PRC) which addressed 350 spacecraft. In addition to providing an extensive data base of the 44 spacecraft, the report classified anomalies by satellite mission, subsystem, effect, and incident type (e.g. electrical or mechanical). Subsystem survival times were also computed in units of the spacecraft design life.

A report prepared by Hughes Aircraft for the Rome Air Development Center [14] addresses differences between predicted and demonstrated reliability and the observed field values (primarily MTBF). Prediction models for estimating the field MTBF were derived. The study contains a detailed description of the Air Force's MDC (AFM 66-1) and D056 data systems. The relationship between predicted and observed MTBF was established using multiple regression techniques. Of interest in this report is the derivation of a "K" factor (equipment use factor) to account for the differences between equipment flying hours and equipment operating hours. Equipment operating hours varied from 1.2 to 2.4 times the flying hours depending upon the aircraft.

Maintenance policies may have a significant effect on the maintenance manhours expended in supporting a space vehicle. Barnard and Matteson [4] describe a test conducted by the Navy to perform aircraft maintenance similar to that of the commercial airlines. Both scheduled maintenance manhours and aircraft downtime were significantly reduced while the quality of maintenance increased. Similar changes in maintenance policies may be contemplated as NASA transitions from the Shuttle to the next generation of space transportation vehicles.

C. Scope of Research

This initial effort is limited to the prediction of reliability and maintainability (R&M) parameters and their effect on the operations and support of space transportation vehicles. The focus is on the failure and repair of major subsystems and their impact on vehicle turn times, maintenance manpower, and repairable spares requirements. Other system components such as booster rockets, expendables (e.g. fuels and oxygen), ground support facilities, software development and maintenance, and overhead staff would be subjects for future research activities.

Chapter II discusses various sources of R&M data and documents the data utilized in this study. Chapter III develops the general methodology for estimating R&M parameters and for relating these parameters to the logistics support requirements of the proposed vehicle. Chapter IV presents the analysis and results of applying the methodology to the initial data base while Chapter V describes the implementation of the methodology through the use of a computer model and provides some validation of the model. The report concludes with a summary of the research findings and results.

Chapter II.

Data Sources

The principle approach to be used in establishing R&M estimates of new space systems is based upon comparability with existing systems. In this regard, many of the subsystems defined for manned space vehicles may be favorably compared to corresponding aircraft systems. Therefore, a primary source of data to support this analysis are commercial and military aircraft failure and repair data.

A. Reliability and Maintainability Data

Data requirements consist of the following R&M data pertaining to all relevant aircraft subsystems.

The primary R&M data are:

(1) Mean time between maintenance (MTBM). This is defined to be the length of time in flying hours between maintenance actions on a particular subsystem or component. Only unscheduled maintenance actions are included. A distinction is made between maintenance actions and failures. Maintenance actions include inherent failures (internal subsystem failures), induced failures (external failure causes) and no defect.

(2) Maintenance manhours per maintenance action (MH/MA). This is the primary measure of maintainability used in this study. Along with the number of maintenance actions per mission (obtained from the MTBM), it becomes the basis of the maintenance cost estimates.

(3) Maintenance Task Times. The length of time (usually in hours) to perform a particular task such as troubleshoot, remove and replace, perform minor maintenance, etc. This maintainability parameter is usually summarized at the subsystem or component level as the Mean Time to Repair (MTTR). In this study, task times are obtained by dividing the MH/MA by an average crew size. Task Times include both on and off vehicle times.

(4) Maintenance crew sizes. The number of maintenance personnel required to perform a particular task. This number may vary depending upon the task, the particular component involved and the skill level of the personnel. An average crew size was determined by subsystem.

(5) Removal rates (RR). This is the percent of maintenance actions which results in a removal and replacement of a component from the aircraft. It is the basis for establishing demand rates for spare components.

(6) Abort rates (AB). This is the percent of maintenance actions as a result of a ground or air abort. This rate is used to establish a critical failure rate which in turn is used to compute a mission reliability.

(7) Percent off equipment (POFF). This is the percent of the total unscheduled maintenance manhours performed on components removed from the aircraft. These hours do not delay processing the vehicle. Therefore 1-POFF, or the percent of on-aircraft work, is used in determining the vehicle turnaround time.

Secondary R&M data which were collected and documented include:

(1) Maintenance manhours per flying hours (MH/FH). This is sometimes referred to as the maintenance index (MI) and may be broken down into off-equipment (aircraft) and on-equipment (aircraft) manhours. When it differs from flying hours, subsystem operating hours should be used.

(2) Mean sorties between maintenance actions (MSBMA). This is the average number of sorties flown between unscheduled maintenance actions.

B. Military R&M Data Systems

(1) US Air Force data systems

Reliability and maintainability data for USAF aircraft originates with the Maintenance Data Collection (MDC) system as described in AFM 66-1. This data is collected at the base (squadron/wing) level (AFTO Form 349) and transmitted periodically to AF Logistics Command (AFLC). AFR 65-110 data (aircraft status reporting) reports flying hours and sorties for the same bases monthly. The D056 Product Performance System processes this data producing several R&M reports. D056 also provides data to the Maintenance and Operational Data Access System (MODAS) for on-line viewing and retrieval. AFALD Pamphlet 800-4, Aircraft Historical Reliability and Maintainability Data summarizes the worldwide R&M data at the two-digit work unit code (WUC) in 6-month intervals (see Appendix A for an example of AFALDP 800-4 data). Currently Volumes I through VI covering the years 1972 through 1989 have been published.

The current Office of Primary Responsibility (OPR) for AFALDP 800-4 is ALD(AFLC)/LSR, Wright-Patterson AFB, Ohio. However, with the consolidation of AFLC and the Air Force Systems Command (AFSC) scheduled for July 1992, this office may no longer exist. With the eventual implementation of REMIS (Reliability and Maintainability Information System), the D056 system along with MODAS will also be eliminated. It is not certain at this time what the final configuration and capabilities of REMIS will be.

The MODAS system (G063) is currently sponsored by AFLC/MMES, Wright-Patterson AFB, Ohio 45433. MODAS provides the user with access to various data bases through an interactive menu driven system. It is a Data Base Management System (DBMS) with some automated analytical capability. R&M information may be displayed by aircraft (MDS), WUC, level of WUC, base and by month. Examples of MODAS reports may be found in Appendix B.

In addition, to the above systems, a unique representation of aircraft R&M data exist in the form of Logistics Composite Model (LCOM) data bases. LCOM is a computer simulation model which simulates the operation of a squadron or wing of aircraft with random failures times and repair times of aircraft subsystems and components. LCOM data bases exist for most of the aircraft in the Air Force inventory although many of these data bases are several years old. This data is unique in that the failure times may be based upon several years of (AFM 66-1) data and repair times and crew sizes are often based upon field audits conducted at the unit's themselves. This data, which is usually collected at the 3 or 4 digit WUC level, is a refinement of the MDC data. LCOM data bases may be obtained from ASD/ENSSC, Wright-Patterson AFB, Ohio. LCOM data bases were not used in developing the parametric equations because of the more readily available and more relevant MODAS and AFALDP 800-4 data.

(2) US Navy

The primary source of R&M data pertaining to Navy aircraft is the Aviation 3-M Information reports. The Navy Maintenance Support Office (NAMSO), is the central data bank for Aviation 3-M data (Maintenance and Material Management system). NAMSO is part of the Naval Sea Logistics Center. Although preformatted reports are published monthly, quarterly and annually, and are available on request, a potential user may also request the development of a new report. Most reports can be obtained on either hard copy or microfiche. Magnetic tape may be obtained under a special request.

The following R&M reports have been identified as relevant to this research. Examples of each report may be found in Appendix C.

Report Title	Report Number
Reliability and Maintainability Summary	NAMSO 4790.A7142-01
WUC System R&M Summary	NAMSO 4790.A7142-02
R&M Summary for selected WUCs	NAMSO 4790.A7142-03
R&M Trend Analysis Summary	NAMSO 4790.A7142-04
5-Digit WUC R&M Trend Analysis Summary	NAMSO 4790.A7142-05
R&M Summary for Selected Equipments	NAMSO 4790.A7298-01

The R&M Summary Report provides data similar to that available from the MODAS system. Summary statistics are reported by aircraft type at the 5-digit WUC and include mean flying hours between maintenance actions, maintenance manhours per flying hour, maintenance manhours per maintenance action, and elapsed maintenance time per maintenance action.

Of particular interest in this research is the WUC System R&M Summary. This report provides mean flying hours between maintenance actions, maintenance manhours per flying hour, maintenance manhours per maintenance action, and elapsed maintenance time per maintenance action by system level WUC (2-digit) for all appropriate aircraft. Similar R&M information is provided in the R&M Summary for selected WUCs. However, this report is at the 4-digit WUC and pertains only to engines and avionic components.

The two trend analysis reports provide MTBF and MH/FH information at the 4-digit and 5-digit WUC respectively. Multiple time periods may be displayed to produce trend data, and a comparative failure ranking of the WUC relative to all WUCs for the aircraft is computed.

The final report, R&M Summary for Selected Equipments, allows for R&M data to be presented at the 2nd and 4th level WUC by activity. This report would not add any new information not already available on the other reports other than the activity breakdown.

(3) Reliability Analysis Center

The Reliability Analysis Center (RAC) is one of 21 DOD Information Analysis Centers (IAC). It is operated by IIT Research Institute in Rome, New York. As an IAC, RAC maintains data bases and studies concerning component reliability particularly that of electronic systems. The Center also conducts special studies, publishes newsletters, and offers training courses. In general, the items contained in RAC's data bases are individual parts rather than an entire component. Therefore, this data was not used in this research.

C. Commercial Aircraft R&M Data

Commercial data sources were investigated but not used in developing the initial data base for reasons discussed below. However, examples of the reports and types of data available from these sources is documented in Attachment 8.

(1) Federal Aviation Agency (FAA)

Commercial sources of R&M data include both the airlines and the aerospace contractors. In addition, the Federal Aviation Agency (FAA) in Oklahoma City maintains a data base consisting of component failures by Airline Transport Association (ATA) code which corresponds to the military's WUC. The data base is very detailed with significant variability in reporting by the individual airlines. A narrative on each incident is included, but there is no quantitative data for estimating MTBF or MTTR. This data is of limited use since there is no practical way to obtain failure rates or times of failure without additional information.

(2) Commercial Airlines

Each airline maintains R&M data in a form useful to them. However, they only measure reliability in terms of failures which cause schedule delays (usually of 15 minutes or more) or aborts. Therefore total maintenance activities are generally not captured in their data systems. R&M reports from three different carriers were obtained and analyzed for their relevance to this research. Because of major differences in reporting compared to the military data systems, it was concluded that this data would be of very limited use. For example, USAir produces a monthly reliability assurance program report [22] which focus schedule departure delays and cancellations. Flying hours between events and maintenance hours are not reported.

(3) Aerospace Contractors

Examples of the type of data maintained by the major aerospace corporations may be found in Attachment 7. These contractors are dependent upon the airlines for reporting failures and, as a result, their reports focus on those events which significantly affect scheduled flights resulting in delays (again exceeding 15 minutes), cancellations, diversions, and air turn backs. While this information is very useful in identifying problem areas, failure times cannot be computed from this report. For example, scheduled interruptions are Boeing's major measure of reliability. They maintain very little data on MTBF, MTTR or maintenance MH/FH. McDonnell Douglas maintains a Data Exchange Program which reports various reliability information which is then provided to commercial aircraft customers. Information contained in this report is obtained from participating airlines. Like the Boeing report, it focuses on events which result in excessive delays and cancellations. However, a component removal summary contains some MTBF information.

(4) Other Sources

A secondary source of reliability data consists of subcontractors involved in the manufacture of particular aircraft subsystems and components. For example, Hughes Corporation which, among other things, makes radar systems for various aircraft. We were able to obtain the system specifications and reliability test results on four of their radar systems. As additional information like this on other radar sets is obtained, a parametric estimation of MTBF is possible. We have requested similar input from other subcontractors including Harris Corporation (digital map generators, global positioning system) and E-Systems (electronic systems). This level of detail may be beneficial during the follow-on effort when component level R&M analysis is anticipated.

Other sources which had been pursued include Airbus Industries (Europe), The Society of Automotive Engineers (SAE) which has published a guidebook on rocket booster reliability, the Aeronautical Systems Division (Air Force Systems Command) concerning a comparative study on competing radar systems, and the Air Force Logistics Command's Reliability and Maintainability Information System (REMIS). Some of the information gathered is beyond the scope of this task and has not been incorporated into this report.

Various points of contact for the data sources identified above are summarized in Appendix D.

D. Aircraft Performance and Design Specifications.

In addition to R&M data, aircraft performance and design specifications (Table 1) were necessary to support the parametric analysis. A primary source of this data for military aircraft was a technical report titled "Modular Life Cycle Cost Model for Advanced Aircraft Systems Phase III," prepared by the Grumman Aerospace Corporation [15] for the Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio. This report documents the data base used in developing a life cycle cost model for the proposed aircraft.

Table 1
Aircraft Design/Performance Variables[1]
(Potential Drivers)

VEHICLE DRY WEIGHT	NUMBER INTERNAL FUEL TANKS
VEHICLE LENGTH	MISSION LENGTH
WETTED AREA	OPERATING CEILING
VEHICLE WING SPAN	NUMBER OF WHEELS
FUSELAGE VOLUME	NUMBER ACTUATORS
SUBSYSTEM WEIGHTS	NUMBER CONTROL SURFACES
FUSELAGE SURFACE AREA	MAXIMUM ELECTRICAL OUTPUT
LANDING DISTANCE	NUMBER HYDRAULICS SYSTEMS
CREW SIZE	NUMBER AVIONICS SYSTEMS
NUMBER PASSENGERS	BTU COOLING CAPACITY
NUMBER ENGINES	AVIONICS INSTALL WEIGHT

The primary source for subsystem weights used in this study was Design Branch of the Plans and Programs Directorate of the Wright Laboratories at Wright-Patterson AFB (WL/XPAD). Secondary data sources included all volumes of Jane's All The World's Aircraft [13], "*Aviation Week & Space Technology*" [3], and Observer's Directory of Military Aircraft [8].

E. Initial Data Base

The primary source of military R&M data is the Air Force AFM 66-1 Maintenance Data Collection (MDC) system and the Navy 3-M data system. The initial data base consisted of AF MDC data as reported in Volume V (October 1985 to September 1987) of AFALDP 800-4 and Navy data reported in the July 1990 - June 1991 R&M Summary Report. Volume VI of AFALDP 800-4 (October 1987-September 1989) and the MODAS on-line system (January 1990-December 1991) were secondary sources. AFALDP 800-4 summarizes R&M data at 6-month intervals. Four 6-month periods were averaged together in order to provide more accurate measures. The Navy data is presented by quarters. Four quarters were averaged together also to provide for more accurate MTBM's and manhours. Table 2 lists the 37 Air Force and Navy aircraft used in the study and Table 3 identifies the 26 major aircraft subsystems which were included. These subsystems are identified by two-digit work unit codes (WUC).

[1] Variable definitions of those used in the models are found in Appendix F.

Table 2
AF/NAVY Aircraft

TACTICAL	BOMBER	CARGO/TANKER	COMMAND/CONTROL /TRAINER
A-7D/E	B-1B	C-2A	E-2C
A-10A	B-52G	C-5A	E-3A
F-4C/D/E	FB-111A	C-9A	EA-6B
F-5E		KC-10A	T-38
F-14A		C130B/E/H	
F-15A/C		KC-135A	
F-16A/B		C-140A	
F-18A		C-141B	
F-106			
F-111A/D/F			

Table 3
Aircraft Subsystems
2-Digit Work Unit Codes (WUC)

WUC SYSTEM	SYSTEM NOUN
11	STRUCTURES/AIRFRAME
12	EQUIP/FURNGS/CREW COMPARTMENT
13	LANDING GEAR
14	FLIGHT CONTROLS
23	POWER PLANT SYSTEM
24	AIRBORNE AUXY PWR (APU)
41	AIR CONDITIONING/ENVIRONMENTAL CONTROL
42	ELECTRICAL POWER
44	LIGHTING SYSTEM
45	HYDRAULIC POWER
47	OXYGEN
49	FIRE PROTECTION/MISC UTILITIES
51	INSTRUMENTS
52	AUTO FLIGHT
55	MAL ANLY RECORDING
61	COMMUNICATIONS
62	VHF COMMUNICATIONS
63	UHF SYSTEM
64	PASS ADDRESS SYS
66	EMERG LOCT XMTR
71	NAVIGATION
72	RADAR NAVIGATION
91	EMERG EQUIP
93	DRAG CHUTE EQUIP
96	PERSONNEL EQUIP
97	EXP DEV & COMP

Figure 1
AF R&M Summary Format

OUTPUT RESULTS FOR F-15

TOT FLYING-HRS	172258
TOT SORTIES	130501
TOT LANDINGS	146896
AVG MISSION LENGTH	1.319975

WUC 13

TOTAL MAINTENANCE EVENTS	13223.61
TOTAL MAINTENANCE MANHOURS	125632
TOTAL ON-EQUIP MAINT	89678
TOTAL OFF-EQUIP MAINT	35954
PERCENT OFF EQUIPMENT HRS	.2861851
MEAN FLYING HR BTWN MAINT	13.02655
MEAN SORTIES BTWN MAINT	9.868786
MEAN LANDINGS BTWN MAINT	11.10861
MAN-HOURS PER FLY-HR	.7293246
MAN-HOURS PER SORTIE	.9626899
MAN-HOURS PER MAINT ACTION	9.500581
ON-EQUIP MAN-HRS/MAINT ACTION	6.781657
OFF-EQUIP MAN-HRS/MAINT ACTION	2.718924

ECHO CHECK OF INPUT DATA

PERIOD		MTBM	ON-EQUIP MH	OFF-EQUIP MH
	13			
1		9.276	30658	11548
2		13.707	28229	11707
3		14.368	16776	6976
4		16.831	14015	5723

VALIDATION CHECK

PERIOD		ON-EQUIP MH/FH	OFF-EQUIP MH/FH
	13		
1		.7647485	.2880591
2		.6180946	.2563334
3		.3967458	.1649797
4		.3169811	.1294386

Two computer programs, written in interactive Microsoft© BASIC, were utilized for processing the data. The data was aggregated into two years (AF) or one year (Navy) and various R&M parameters computed as illustrated in Figures 1 and 2. These programs are listed in Appendix E; the AF processed data is in Attachment 1; and the Navy processed data is in Attachment 2. These data provided the MTBM and MH/MA dependent variable values used in the subsequent regression analysis.

Values for the independent variables (Table 1) and subsystem weights used in the analysis are found in Appendix G. R&M (Dependent) variable values are summarized in Appendix H.

Figure 2
Navy R&M Summary Format

```
                    OUTPUT RESULTS FOR F-14A
                           WUC 45XXX


TOT FLYING-HRS 92011
TOT MAINT ACTIONS    8943
TOT MAN-HRS          56868
TOT ELAPSED TIME     32224.9

     MEAN FLYING HR BTWN MAINT      10.28861
     MAN-HOURS PER FLY-HR           .6180566
     AVG ELAPSED MAIN TIME          3.603366
     AVE CREW SIZE                  1.764722
     MAN-HOURS PER MAINT ACTION     6.35894


SUMMARY STATS FOR 45XXX HYDRAULICS/PNEUMATIC PWR

          AVG TASK TIME        3.38761
          AVG CREW SIZE        1.747144
```

Chapter III

Methodology

A. Parametric Analysis

The primary objective is to develop a methodology for estimating reliability and maintainability parameters for use in life cycle costing, supportability requirements determination and the assessment of operational capabilities and constraints of proposed space vehicles. This methodology utilizes the available data sources identified in the previous chapter. The approach is based upon a comparability analysis with similar aircraft subsystems. By estimating aircraft equipment failure and repair parameters as a function of performance and design specifications, then, with suitable adjustments to account for the differences in operating environment, the R&M parameters of a conceptual space vehicle may be estimated based upon its design and operating specifications. Adjustments are also necessary to account for technological innovation over time. This chapter presents the mathematical foundation for the analysis performed on the data base and described in the following chapter.

Parametric R&M equations are derived using regression analysis. In general, let

$$Y = B_0 + B_1 X_1 + B_2 X_2 + \ldots + B_k X_k \qquad (1)$$

where Y = R&M parameter of interest (e.g. MTBF or MH/MA)

and X_j = jth design or performance specification (e.g. vehicle dry weight), $j = 1, 2, \ldots k$,

then

$B_0, B_1, \ldots, B_k$ are the regression coefficients.

These are estimated by performing a least-squares fit of the equation against known paired values for Y and the corresponding $X_1, X_2, \ldots, X_k$ obtained from the data base.

The following R&M parameters have been estimated using this approach:

MTBM - Mean Flying Hours between Maintenance Actions

MH/MA - Maintenance Manhours per Maintenance Actions

RR - Subsystem removal rate

POFF - Percent off-equipment (vehicle) manhours

CREW - Average crew size per maintenance task

AB - Abort Rates (Critical Failure Rate)

In addition to the above R&M parameters, regression equations were derived to estimate subsystem weights and design/performance variables (see Table 1) as functions of the vehicle **dry weight** (DRY WT) and **length + wing** span (LEN+WING). These variables are classified as secondary variables while the **dry weight** and **length + wing** span are classified as primary variables. Using these equations, it is possible to estimate all of the necessary R&M parameters using only a small number of primary (driver) variables. First subsystem weights are determined from the regression equations, then the secondary variables are computed from their equations, and finally the MTBM, MH/MA and other R&M parameters are estimated from their regression equations. The latter equations will include subsystem weights and those secondary variables which were found to significantly improve upon their prediction capability.

B. Computation of MTBM

An initial MTBM is obtained by subsystem from the derived parametric estimating equations. The MTBM is in units of operating (flying) hours between maintenance actions and reflects a subsystem operating in an aircraft (air/ground) environment.

(1) Technology Growth Factor

In order to account for increased reliability as a result of technological change over time, a growth factor was computed. First, the learning curve effect on the reliability of a subsystem over time was estimated. The learning curve accounts for engineering changes, modifications, and other reliability burn-in phenomena associated with a system maturing over time. This was accomplished by fitting an equation of the form:

$$MTBM = a\ T^b \tag{2}$$

where: T = cumulative calendar time or cumulative operating (flying) hours and "a" and "b" are parameters estimated using least-squares.

Next, a technology adjustment factor was found by averaging several pairwise comparisons between aircraft developed during different technology periods but having similar missions and requirements. An MTBM for both aircraft was obtained from the data set (generally a two-year average value). The MTBM of the newer aircraft was modified using the learning curve growth rate (b) to account for the differences in age between the two systems. That is,

$$\text{Mod MTBM} = a \times (1986 - \text{Dev YR Old ACFT})^b \tag{3}$$

where solving Equation (2) for "a" provides:

$$a = \text{NEW ACFT MTBM}/(1986\text{-DEV YR NEW ACFT})^b \tag{4}$$

The baseline year of the data is 1986 and the MTBM reflects the baseline year. The "a" parameter defines the units (e.g. operating hours or years) while the "b" parameter describes the rate of growth.

The adjustment factor was then found by solving the compound growth rate curve:

$$\text{MOD MTBM} = \text{OLD ACFT MTBM} \times (1+\text{ADJ FAC})^{\text{AGE DIFF}} \tag{5}$$

That is,

$$\text{ADJ FAC} = [\text{MOD MTBM}/\text{OLD ACFT MTBM}]^{(1/\text{AGE DIFF})} - 1 \tag{6}$$

This factor was then used in adjusting the initial MTBM to account for technological growth in reliability between the baseline year of the data and the expected development year of the proposed system. That is

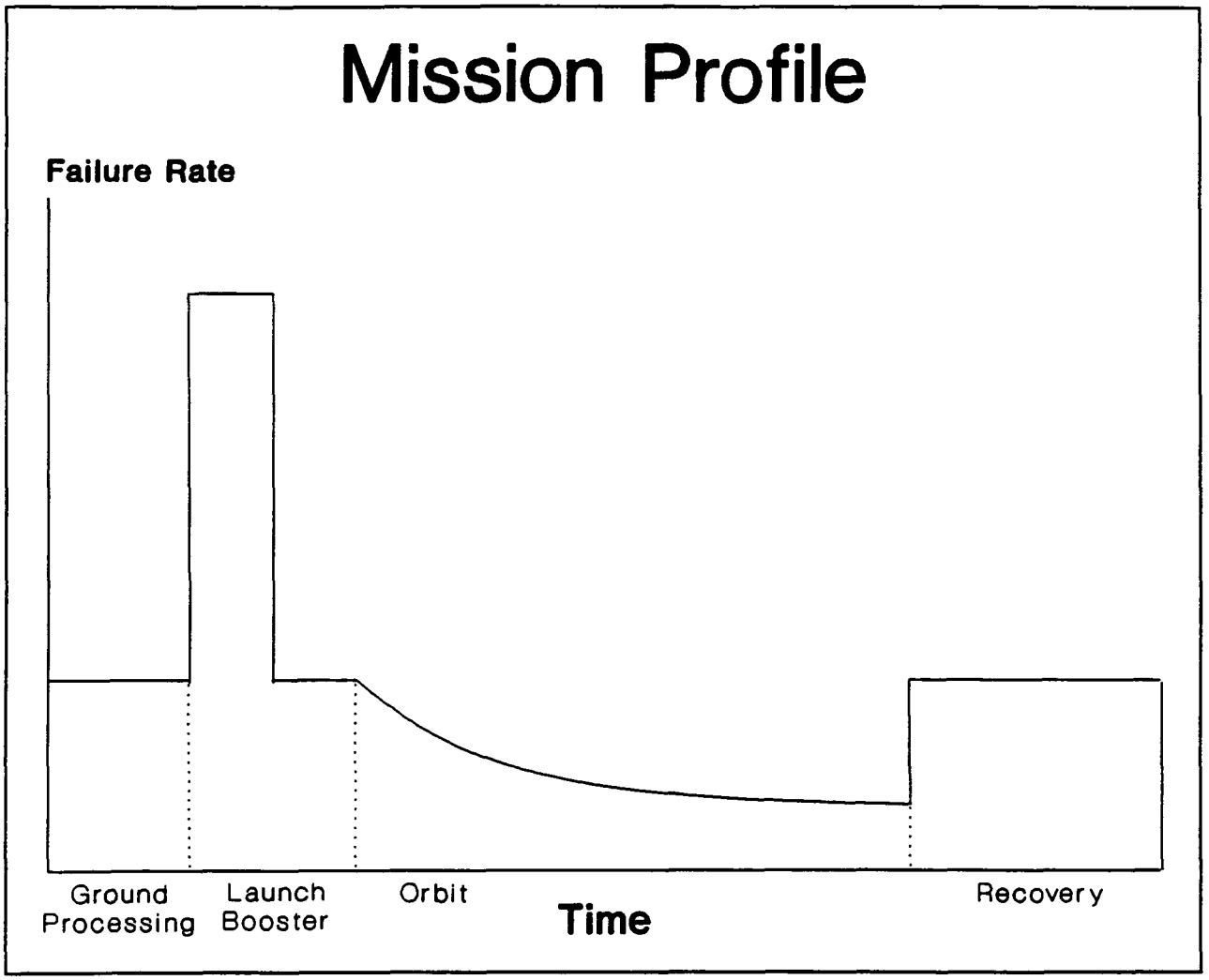
$$\text{ADJ MTBM} = \text{MTBM} \times (1+\text{ADJ FAC})^{(\text{yr}-1986)} \tag{7}$$

(2) Environmental Adjustment

A further adjustment to the MTBM was then made to account for the change in failure rates (from those of the aircraft air/ground environment) during launch and orbit. During the air (non-booster launch and re-entry phase) and ground phase, failure rates are assumed to be constant (exponential) with a MTBM based upon the ADJ MTBM defined above. However, during launch under booster rockets, the failure rate may increase dramatically as a result of the increased vibration and stresses. On the other hand, while in orbit, the failure rate is assumed to decrease over time based upon results found in related work cited in Chapter 1. A Weibull failure rate function was assumed for this portion of the mission. Previous studies have shown a decrease in component failure rates occurring in the somewhat more benign space environment. Two approaches have been identified to quantify this change. The first is to include an environmental factor in the regression model. This would require obtaining historical data on comparable components operating in space. This data is quite limited and may be explored during the follow-on effort. An alternate approach is to make use of the earlier research which concluded failure rates in space were decreasing with the Weibull failure distribution providing a reasonable model. This study utilizes the latter approach.

For each subsystem, a mission profile curve was assumed having the following form:

Figure 3
Mission Profile



This failure rate curve may be expressed mathematically as:

$$\lambda(t) = \begin{cases} \lambda & for \quad 0 \le t < t_0 \\ \kappa \times \lambda & for \quad t_0 \le t < t_1 \\ \lambda & for \quad t_1 \le t < t_2 \\ \frac{b}{a}\left(\frac{t}{a}\right)^{b-1} & for \quad t_2 \le t < t_3 \\ \lambda & for \quad t_3 \le t < t_4 \end{cases} \tag{8}$$

where:

$$\lambda = \frac{1}{ADJ\ MTBM}$$

κ = *LAUNCH FACTOR*

and a, and b are the Weibull scale and shape parameters respectively

Since, in general, a reliability function is given by

$$R(t) = e^{-\int_0^t \lambda(\xi)\, d\xi} \tag{9}$$

the reliability function may be obtained from (8) using (9):

$$R(t) = \begin{cases} e^{-\lambda t} & for \quad 0 \le t < t_0 \\ e^{-[\lambda t_0 + \kappa\lambda(t-t_0)]} & for \quad t_0 \le t < t_1 \\ e^{-\lambda[(t+t_0-t_1)+\kappa(t_1-t_0)]} & for \quad t_1 \le t < t_2 \\ e^{-\lambda(t_2+t_0-t_1)-\kappa\lambda(t_1-t_0)+\left(\frac{t}{a}\right)^b-\left(\frac{t_2}{a}\right)^b} & for \quad t_2 \le t < t_3 \\ e^{-\lambda(t_2+t_0-t_1)-\kappa\lambda(t_1-t_0)+\left(\frac{t_3}{a}\right)^b-\left(\frac{t_2}{a}\right)^b-\lambda(t-t_3)} & for \quad t_3 \le t < t_4 \end{cases} \tag{10}$$

Since the mission profile is repetitive over time, a steady-state MTBM may be computed from equation (11).

$$SS\ MTBM = \frac{\int_0^{t_4} R(t)\, dt}{1 - R(t_4)} \tag{11}$$

The use of the Weibull failure distribution in defining R(t) requires a numerical integration to compute the MTBM from Equation (11). In the implementation of the model discussed in Chapter V, Simpson's rule was used to perform the integration.

(3) Critical MTBM

Using aircraft air and ground abort rates (AB), subsystem regression equations were derived to provide estimates of critical failure rates. A critical MTBM was then obtained from

$$\text{CRIT MTBM} = \text{SS MTBM/AB} \tag{12}$$

A vehicle MTBM is calculated from the subsystem MTBM's using:

$$\text{VEH MTBM} = 1/[1/\text{MTBM}_1 + 1/\text{MTBM}_2 + \ldots + 1/\text{MTBM}_k] \tag{13}$$

where $1/\text{MTBM}_i$ is the failure rate of the ith subsystem.

With critical failure rates replacing 1/(ADJ MTBM), approximate mission reliabilities are found using Equation (10) for each subsystem. A Vehicle reliability is computed by multiplying subsystem reliabilities (R_i)

$$R_{veh} = R_1 \times R_2 \times \ldots \times R_k \tag{14}$$

Equation (14) assumes no explicit redundancy at the subsystem level. Some component redundancy may be implicitly taken into account by the critical MTBM.

C. Maintainability Estimates

The primary maintainability parameter used in this study is the maintenance manhours per maintenance action (MH/MA). This parameter is estimated from the parametric regression equations for each subsystem. Then using

$$\text{TOT MA} = 1/(\text{SS MTBM}) \times \text{OPER HRS} \tag{15}$$

total maintenance actions per mission is obtained and from

$$\text{TOT MANHRS} = \text{MH/MA} \times \text{TOT MA} \tag{16}$$

total maintenance manhours per mission is found. Manhours are then split into on-vehicle and off-vehicle manhours using the percent off-equipment hours (POFF) obtained from regression equations:

$$\text{TOT ON-VEH MH} = (1\text{-POFF}) \times \text{TOT MANHRS} \tag{17}$$

$$\text{TOT OFF-VEH MH} = \text{POFF} \times \text{TOT MANHRS} \tag{18}$$

Maintenance manpower requirements are determined by computing the total manhours of work per month and dividing this total by the number of hours per month available per technician to do direct maintenance work.

Let N = number of mission per month,

AV = available hours per month per individual

IND = percent of indirect work (work not included in the MH/MA)

then,

$$NBR\ PER = \frac{TOT\ MANHRS \times N}{(1 - IND)\ AV}\ (rounded\ up) \tag{19}$$

Scheduled maintenance manhours per mission are found by multiplying the unscheduled manhours by a percentage estimated from a regression equation giving scheduled maintenance as a percent of the unscheduled maintenance.

C. Spare Parts Requirements

In order to estimate spare parts requirements, it is necessary to distinguish between a failure resulting in a remove and (if a spare is available) replace action versus other maintenance actions such as on-aircraft troubleshoot and repair. The MODAS system identifies maintenance actions by an action taken code one of which is a removal code.

Using regression equations or an estimated mean value, a removal rate (RR) per maintenance action was determined and used to obtain the mean number of demands (failures) for spares (MFAIL) per mission as follows:

$$MFAIL = RR \times (TOT\ MA) \tag{20}$$

Under the common assumption that the number of failures in a given time period follows a Poisson process, a spare parts level can now be found which will satisfy demands a specified percent of the time. This is the frequently used fill rate criterion which represents the percent of time a demand (failure) can be immediately satisfied from the on-hand stock.

Let S = spare parts level to support a given mission and
p = desired percent of time demands are satisfied (fill rate), then find the smallest value for S such that F(S) > = p where

$$F(S) = \sum_{i=0}^{S} Exp(-MFAIL) \times MFAIL_i/i! \tag{21}$$

F(S) is the cumulative probability of demands not exceeding the spares level (S).

D. Vehicle Turn Times

In order to determine the time required to perform maintenance on the vehicle, estimates of average repair crew sizes for typical on-vehicle tasks by subsystem must first be obtained. Once the average crew size has been determined from regression equations or averages from the data base, an average repair time can be obtained by

$$\text{REPAIR TIME} = (1\text{-POFF}) \times (\text{MH/MA})/\text{AVG CREW} \tag{22}$$

Average on-vehicle subsystem repair time per mission may be found from

$$\text{MSN REPAIR TIME} = \frac{\text{TOT ON-VEH MH}}{\text{AVG CREW}} \tag{23}$$

Assuming all tasks are performed sequentially (a worst case), then total vehicle mission repair time is the sum of the subsystem repair times:

$$\text{VEH REPAIR TIME} = \sum_{\text{ALL SUBSYS}} \text{MSN REPAIR TIME} \tag{24}$$

Scheduled maintenance time may then be added to obtain a total vehicle maintenance time:

$$\text{TOT VEH TASK TIME} = \text{VEH REPAIR TIME} + \frac{\text{SCH MHRS}}{\text{AVG CREW SIZE}} \tag{25}$$

Mission time must be included in order to obtain a vehicle turn-around time. Therefore, vehicle turn-around time in working days is:

$$\text{VEH TURNAROUND} = \text{MSN TIME}/24 + \text{TOT VEH TASK TIME}/8 \tag{26}$$

Equation (26) assumes a single 8-hour maintenance shift per day. Dividing the vehicle turnaround time into the number of working days per month gives an estimate of the number of missions per month per vehicle:

$$\text{MSN/MO/VEH} = \frac{\text{WORKING DA/MO}}{\text{VEH TURNAROUND}} \tag{27}$$

Dividing the required number of mission per month by the number of missions per month per vehicle provides an estimate of the required fleet size:

$$\textit{FLEET SIZE} = \frac{\textit{RQD MSN/MO}}{\textit{MSN/MO/VEH}} \quad (\textit{rounded up}) \tag{28}$$

Chapter IV

Analysis and Results

A. Preliminaries

Both Navy and Air Force aircraft were initially selected for deriving the parametric equations. However, Air Force subsystem data was utilized primarily in the current model because it was more comprehensive and consistent. In many cases, there was a significant difference in failure times between Navy and Air Force systems due, in part, to the more stressful environment found on carrier based aircraft. The first set of R&M equations also contained variables such as mission length and maximum ceiling which could not accurately be extrapolated to values representative of space vehicles. Finally, these equation were not weight based making them difficult to use in those cases where vehicle design had not progressed much beyond the determination of subsystem weights. Nevertheless, many of these equations resulted in a good fit to the data (e.g. high R-squared values) and are presented in Attachment 3. The remainder of this chapter is based primarily upon the Air Force data base presented in Chapter II.

Table 4 identifies the subsystems by military aircraft work unit code (WUC) and shows the mapping of WUC's to NASA's Work Breakdown Structure (WBS) for space vehicle subsystems. The mapping in some cases is only approximate. For example, WUC 14XXX, flight controls, includes control surfaces whereas WBS 1.12, actuators, does not. Miscellaneous utilities (WUC 49XXX) and Personal Equipment (WUC 96XXX) may include oxygen masks, communications, goggles, maintenance crane, fire protection and warning devices, water systems, flashlights, ladder, cooler, toilets, etc., while WBS 1.15 personnel provisions includes food, water, waste management and seats.

Similarly, WBS 1.16, recovery and auxiliary systems, includes parachutes, escape systems, separation systems, docking system and manipulator system, which, in turn, is mapped to emergency equipment (survival kit, emergency oxygen system, emergency lights, search and rescue systems, parachute system, life raft, life vest, evacuation system, escape slide), drag chute, explosive devices (ejection seats devices, escape initiating systems, and canopy removal system). During implementation of the equations, adjustments can be made to the parameters to account for the approximate nature of the match between the WBS and WUC structure. To develop a complete match would involve developing equations at a much lower level of both the WBS and WUC structures.

Table 4
WUC to WBS Conversions

WBS		WUC	
1.1	Wing Group	11XXX	Airframe
1.2	Tail Group	12XXX	Crew Compartment
1.3	Body Group		
1.4	Thermal Protection System		
1.5	Landing Gear	13XXX	Landing Gear
1.6	Propulsion		
1.7	Propulsion, RCS	23XXX	Propulsion System
1.8	Propulsion, OMS		
1.9	Prime Power	24XXX	Aux Power Units-APU
1.10	Electrical	42XXX	Electrical
		44XXX	Lighting System
1.11	Hydraulics/Pneumatics	45XXX	Hydr/Pneumatics
1.12	Actuators	14XXX	Flight Controls
1.13	Avionics	51XXX	Instruments
		52XXX	Autopilot
		55XXX	Malfunc Anal Rec
		61XXX	HF Comm
		62XXX	VHF Comm
		63XXX	UHF Comm
		64XXX	Interphone
		66XXX	Emergency Comm
		71XXX	Radio Navigation
		72XXX	Radar Navigation
1.14	Environmental Control	41XXX	Environ Control
		47XXX	Oxygen System
1.15	Personnel Provisions	49XXX	Misc Utilities
		96XXX	Personnel Equipment
1.16	Recovery & Auxiliary Sys	91XXX	Emerg Equipment
		93XXX	Drag Chute Eqpt
		97XXX	Explosive Devices

WUC 11XXX (airframe) was mapped into WBS's 1.1 (wing group), 1.2 (tail group), 1.3 (body group), and 1.4 (TPS). The distribution of failures was based, in part, upon the breakdown of aircraft maintenance actions of WUC 11XXX to the wing, tail, and body using the data in Table 5. WUC 12XXX (crew compartment) was also mapped into the body group. The allocation of failures and manhours to the thermal protection system (TPS) was proportional to its weight to the total weight of WBS 1.1, 1.2, 1.3 and 1.4.

Table 5
WUC 11XXX Maintenance Actions

AIRCRAFT	TAIL	WING	BODY	TOTAL
B-52	417	7417	22,501	30,335
KC-10A	37	212	1,427	1676
F-15E	-	203	2,388	2591
F-4E	32	1225	5,575	6832
F-16C	787	2430	8,809	12,026
F-16A	272	2109	13,116	15,497
TOTAL	945	13,393	52,028	66,366
PERCENT	.014	.202	.784	1.000

In many cases, work unit codes were combined into a single WBS using Table 4 before deriving a regression equation. WUC's 42XXX (electrical) and 44XXX (lighting) were combined under WBS 1.10 (electrical distribution). WUC's 41XXX (environmental) and WUC's 47XXX (oxygen systems) were combined under WBS 1.14 (environmental control system). All avionics WUC's were combined under WBS 1.13 (avionics). WUC 23XXX (propulsion system) was computed separately for WBS 1.6 (propulsion), 1.7 (RCS), and 1.8 (OMS) using their corresponding weights.

B. Regression Analysis

Multiple linear regression procedures were used to develop each of the parametric equations. A "best fit" was defined as the simplest mathematical model having a significant F-value, a large R-squared value, and a small standard error. Generally, only independent variables which were significant (based upon a t-test) were included in the final model. Several models were marginally significant but retained nevertheless. A secondary criterion for model selection was

the practical test that the model would provide reasonable results over the anticipated range of independent variable values. Because of the difference between aircraft and space vehicle parameters, extrapolations outside the domain of the input data were expected. Nonlinear transformations of the independent variables were also included in the model if they significantly contributed to the prediction power of the equation. Generally these transformations consisted of squaring, taking logarithms or square roots of the variables.

An investigation of the residuals would, on occasion, identify one or more data points as outliers (two or more standard deviations from the mean). At times these outliers were deleted from the data base. This was based upon the strong possibility that the AFALDP 800-4 data was incomplete. This is particularly true for the Vol VI data which contains a warning to this effect. In processing AFM 66-1, the monthly tapes from the bases may not contain all of the failures logged for that month. On the other hand, the monthly flying hours and sorties reported through a different data system is almost always complete. The net result is an overstatement of the MTBF. This was normally the case when outliers were observed.

C. Analysis of Weights and Secondary Variables

Several variables were identified as primary or "driver" variables. These include (1) vehicle dry weight in pounds, (2) the sum of the vehicle length and wing span in feet, (3) crew size, and (4) number of passengers. Values for these independent variables were based upon references [8] and [13] and are found in Appendix G. Using these four driver variables, regression equations were derived to estimate subsystem weights and secondary variables. Table 6 displays the weight equations and Table 7 displays the secondary variable equations. As a conceptual vehicle becomes better defined, it is expected values for these variables will be obtained from the design specifications and will need not be estimated from the "driver" variables. With the exception of Prime Power (WBS 1.9) and Avionics (1.13), there are excellent least-squares fits to the data. The number of aircraft in the data base having an APU weight is quite small and its weight is not as dependent with vehicle size as are other subsystems. The engine weight equation was not used since aircraft engines are not comparable to spacecraft engines. Instead, a percentage of dry weight was allocated to each propulsion system and the TPS. Avionics weight is not as highly correlated with vehicle size as are the remaining subsystems. Observe that the secondary variable equations must be evaluated in a particular order since several of these equations require values derived from the previous secondary variable equations. Correlation of these equations vary from under 60 percent to over 99 percent.

Table 6
Subsystem Weight Equations[2]

WBS	SUBSYSTEM	EQUATION	R
1.1	WING	$-4485026.7 + 1351022\log(DRY\ WT) - 135432[\log(DRY\ WT)]^2 + 4522.4[\log(DRY\ WT)]^3$	.980
1.2	TAIL	$-290909.9 + 91929.4\log(DRY\ WT)$ $-9709.9[\log(DRY\ WT)]^2 + 343.5[\log(DRY\ WT)]^3$	.960
1.3	BODY	$3.971E8 + 1.4180E6\log(DRY\ WT) - 4.047E7/\sqrt{\log(DRY\ WT)}$ $-12993808.8\sqrt{\log(DRY\ WT)}$	.986
1.5	LANDING GEAR	$-49535 + 0.28256(DRY\ WT) + 6873.7\log(DRY\ WT) - 160.1\sqrt{DRY\ WT}$	.989
1.6-1.8	ENGINES	$-7141.9 + 89.1\sqrt{DRY\ WT}$	.958
1.9	APU (PRIME PWR)	$-910.4 + 100.2\log(DRY\ WT) + 1.3835\sqrt{DRY\ WT}$	.785
1.10	ELECTRICAL	$-757.97 + 11.22\sqrt{DRY\ WT}$	.872
1.11	HYDRAULICS	$575.3 + .02222(DRY\ WT) - 5.061\sqrt{DRY\ WT}$	.982
1.12	FLIGHT CONTROLS	$-9849.51 + 0.045967(DRY\ WT) + 1364.8\log(DRY\ WT) - 26.25\sqrt{DRY\ WT}$	.984
1.13	AVIONICS	$-10901.5 + 1261.5\log(DRY\ WT)$	.748
1.14	ENVIRONMENTAL	$-719.2 + 5.56(LEN + WING) + 56.88\sqrt{LEN + WING}$	.904
1.15	PERSONNEL PROV	$66255.6 - 14720.4\log(DRY\ WT) + 818.2(\log(DRY\ WT))^2$	.902

[2] NOTE: LOG is the natural logarithm.

Table 7
Secondary Variable Equations

Variable	Equation	R
FUSELAGE AREA	$-8833 + .0829(DRYWT) + 1275\log(DRYWT) - 32.46\sqrt{DRYWT}$	.980
FUSELAGE VOLUME	$-47619 + 22144\log(LEN + WING) - 5743\sqrt{LEN + WING} + .4262(LEN + WING)^2$	.893
WETTED AREA	$486.03 + .1510(LEN + WING)^2$	.997
NBR WHEELS	$2.1896 + 6.6630(DRYWT) - 1.3872(DRYWT)^2$	.912
NBR ACTUATORS	$-40.991 - .001425(DRYWT) + 2.0752E\text{-}9(DRYWT)^2 + .007467(WETAREA)$ $- 1.03767\sqrt{WETAREA} + .4828\sqrt{DRYWT} + 14.967\sqrt{CONTS} - .01781(CONTR)^2$	.978
NBR CONTROL SURFACES	$3.5887 + .000528(DRYWT) + .09493(LEN + WING) - .00517(WETAREA)$	.932
KVA MAX	$-214.812 + .001098(DRYWT) + 25.157\log(DRYWT)$	.940
NBR HYDR SUBSYS	$13.48 - .5685(LEN + WING) + .002409(WETAREA) + .4333\sqrt{DRYWT}$	.857
NBR FUEL TANKS	$-13.2236 + 1.85177\log(DRYWT)$	.569
TOT NBR AVIONICS SUBSYS	$-40.42 - 1.879(DRYWT) + 6.1928\log(DRYWT)$	.614
NBR DIFF AVIONICS SUBSYS	$9.674 - 1.85799\log(DRYWT) + .87684(TOTSUBS) + 1.45574\log(AVWT)$	.950
BTU COOLING	$-1114.5 - 12.0177(LEN + WING) + 9.40511(LEN + WING)^2 + 230.872\sqrt{LEN + WING}$	.779

Because the weight equations are generated from aircraft data, they may not reflect the distribution of the subsystem weights in a space vehicle. Therefore, an alternative estimator for subsystem weights is based upon the weight distribution given in Table 8. These percentages are an average obtained from data pertaining to several different proposed space vehicles (see Appendix I). These percentages are then applied to the primary driver variable - vehicle dry weight to obtain the subsystem weights.

Table 8
Weight Distribution

WBS	SUBSYSTEM	AVERAGE
1.1	WING	.091
1.2	TAIL	.003
1.3	BODY	.140
1.4	TPS	.099
1.5	LANDING GEAR	.053
1.6	PROPULSION	.019
1.7	PROPULSION, RCS	.029
1.8	PROPULSION, OMS	.017
1.9	APU (PRIME POWER)	.151
1.10	ELECTRICAL	.059
1.11	HYDRAULICS/PNEU	.021
1.12	ACTUATORS	.007
1.13	AVIONICS	.061
1.14	ECS	.083
1.15	PERSONNEL PROV	.070
1.16	RECOVERY & AUX	.097
	AVE VEHICLE	1.00

D. MTBM Equations

Based upon the "driver" variables, subsystem weights, and the secondary variables, regression equations were derived to estimate MTBM. These equations are summarized in the following table with the regression analysis provided in Appendix J. The estimated MTBM represents an unadjusted number and reflects aircraft reliability as captured in the data base. With the exception of Propulsion (WBS 1.6-1.8), acceptable correlations were obtained with the regression models. Aircraft engine failures were estimated exclusively from engine weight in order to utilize the equation for each Propulsion WBS and to provide a reasonable approach for extrapolating aircraft engine results to space vehicle propulsion systems. It is expected that this equation will be replaced as data on space propulsion systems becomes available.

Table 9[3]
MTBM Equations

WBS	SUBSYSTEM	EQUATION	R
1.1-1.3	WING,TAIL,BODY	$15.231 + .006057(TAIL\ WT) - .137575\sqrt{DRY\ WT} - .000723(WET\ AREA)$	.944
1.3	BODY (CREW COMP)	$3428.5 - .0142(DRY\ WT) - 423.96\log(DRY\ WT) + 11.050\sqrt{DRY\ WT} + 111.57(CREW) - 360.72\sqrt{CREW} + .01865(BODY\ WT) - 4.8357\sqrt{BODY\ WT} - .25785(CREW + PASS)$	.891
1.5	LANDING GEAR	$72.411 + 14.568(WHEELS) + .0994(WING\ LEN) - 12.410\log(DRY\ WT) - 65.6\sqrt{WHEELS} - .00568(WHEELS\ WT) + 18.598\log(WHEELS\ WT)$	.914
1.6-1.8	PROPULSION[4]	$34.104 + .0009853(ENG\ WT) - .31223\sqrt{ENG\ WT}$	.509
1.9	APU (PRIME POWER)	$4996.5 - 1.9061(KVA\ MAX) + 46.350\sqrt{KVA\ MAX} - 2.735(APU\ WT) + 284.5\sqrt{APU\ WT} - 1643\log(APU\ WT)$	.886
1.10	ELECTRICAL	$1193 - .0755(ELECT\ WT) + 6.7588\sqrt{ELECT\ WT} - .7156(WING\ LEN) - 167.2\log(DRY\ WT) + 2.2308\sqrt{DRY\ WT} + 29.1\log(KVA) - .00127(KVA)^2$	.955
1.11	HYDRAULICS	$396.3 - .00622(WET\ AREA) + 35.635(SUBSYS) - 779.8\sqrt{SUBSYS} + 975.6\log(SUBSYS) + 8.813\sqrt{HYD\ WT} - 105.7\log(HYD\ WT)$	.855
1.12	ACTUATORS	$26.29 - 1.114\sqrt{ACT\ WT} + .9516(ACT) - 1.899(CONTS) + .3505(WING\ LEN) - .00357(WET\ AREA)$	.913
1.13	AVIONICS	$-36.92 - 4.496(TOT\ SUBS) + 45.756\sqrt{TOT\ SUBS} - .1231(AVE\ WT/S) + .02360(AV\ WT) - 2.453\sqrt{AV\ WT}$	.884
1.14	ENVIRONMENT	$454.4 - .000547(DRY\ WT) + .8210(LEN + WING) - 107.5\log(LEN + WING)$	.840
1.14	ECS-OXYGEN	$6613 - 1.485(WING\ LEN) - 1358.3\log(DRY\ WT) + 73.58\log(DRY\ WT)^2 - .7259((DRY\ WT)/(LEN + WING)$	.720
1.15	PERSONNEL PROV	$17952.8 + .005793(DRY\ WT) + 169.96(CREW) - 10.136(WING\ LEN) + 21.15(CREW + PASS) - 461.3\sqrt{CREW + PASS} - 1.893(SUBS\ WT) + 421.8\sqrt{SUBS\ WT} - 4054.1\log(SUBS\ WT)$	.961
1.16	REC & AUX SYS	$7549.1 - .0165(DRY\ WT) + 4.002(WING\ LEN) - 999.8\log(DRY\ WT) + 16.85\sqrt{DRY\ WT} - 4.225(CREW + PASS)$	.925

[3]Variable names are defined in Appendix F.

[4] Used to compute small weight engines.

The estimated MTBM is adjusted for technological change. In deriving the adjustment factor, a learning curve of the form given by Equation (2) is determined by using least-squares. These curves are summarized by subsystem in Table 10. Three separate equations were derived using historical data from the F-16B, B-1, and F-15A. Appendix Q summarizes the results of the regression analysis and Table 10 depicts the average growth rate (b parameter) for each subsystem. Only statistically significant growth rates from among the three aircraft were averaged. A separate analysis was performed for the overall aircraft.

Table 10.
Learning Curve Results

WBS	SUBSYSTEM	AVE GROWTH RATE (b)
1.1	WING	.1534
1.2	TAIL	.1534
1.3	BODY	.1534
1.4	TPS	---
1.5	LANDING GEAR	.1480
1.6-1.8	PROPULSION	.2305
1.9	APU (PRIME POWER)	.1927
1.10	ELECTRICAL	.1333
1.11	HYDRAULICS/PNEU	.1703
1.12	ACTUATORS	.1608
1.13	AVIONICS	.2427
1.14	ECS	.1555
1.15	PERSONNEL PROV	.0683
1.16	RECOVERY & AUX	.3592
	VEHICLE	.1370

Using the methodology discussed in the previous chapter, technology adjustment factors were then derived. These factors, displayed in Table 11, represent an average annual growth rate based upon a compound growth curve derived from the pairwise comparisons shown in Appendix R. One subsystem, electrical, resulted in a negative growth rate which was set equal to zero. A combined avionics growth rate of .42 appeared to be excessive and was replaced with an adjusted rate obtained by deleting the F-4E - F-16A comparison which had a 0.978

annual growth rate. The rates shown in Table 11 represent the default values used in the implementation phase. In implementation, the TPS subsystem defaulted to the structural subsystems (WBS 1.1, 1.2, 1.3) growth rates. The APU growth rate was not computed because of insufficient data. The aircraft rate was used as a default value.

Table 11
Technology Growth Rates

WBS	SUBSYSTEM	AVERAGE
1.1	WING	.08184
1.2	TAIL	.08184
1.3	BODY	.08184
1.4	TPS	---
1.5	LANDING GEAR	.03352
1.6-1.8	PROPULSION	.01116
1.9	APU (PRIME POWER)	*.0557*
1.10	ELECTRICAL	-0.02090
1.11	HYDRAULICS/PNEU	.09222
1.12	ACTUATORS	.05622
1.13	AVIONICS	.41915 (.22)
1.14	ECS	.00617
1.15	PERSONNEL PROV	.03571
1.16	RECOVERY & AUX	.08358
	AVE TOTAL	.0557

Regression equations for subsystem critical failure rates were derived from MODAS obtained aircraft air/ground abort rates found in Appendix N and displayed in Table 12. For WUC's 24XXX, 49/96XXX, and 91/93/97XXX, averages were used since the number of data points were insufficient to properly fit a regression curve. Regression results may also be found in Appendix N. Because of the processing time required to obtain the abort rates, these equations are based upon a smaller sample size consisting of 13 aircraft. Each subsystem and each aircraft data point had to be retrieved separately from the MODAS ABORT SUMMARY REPORT. In general, there is a high correlation between vehicle size as measured by DRY WEIGHT or LENGTH plus WING SPAN and abort rates.

Table 12
Critical Failure Rate Equations

WBS	Equation	R
1.1 WING 1.2 TAIL 1.3 BODY	$3.1213E\text{-}2 + 1.956E\text{-}7(DRY\ WT) - 1.546E\text{-}4\sqrt{DRY\ WT}$	.802
1.3 BODY (CREW COMPARTMENT)	$.04232 + 3.8775E\text{-}7(DRY\ WT) - 2.5188E\text{-}4\sqrt{DRY\ WT}$	.914
1.5 LANDING GEAR	$-2.4321 + 5.9112E\text{-}3(LEN + WING) + 1.1457\log(LEN + WING) - .33925\sqrt{LEN + WING}$	.794
1.6-1.8 PROPULSION	$(4.8164E\text{-}2) - (1.2681E\text{-}4) \times (WING\,LEN)$	.777
1.9 PRIME PWR (APU)	AVERAGE = .064	---
1.10 ELECTRICAL	$-39.96 + 11.09\log(DRY\ WT) - 1.0178(\log(DRY\ WT))^2 + .030908(\log(DRY\ WT))^3$	.833
1.11 HYDRAULICS	$5000.3 - \frac{7578.2}{\sqrt{\log(DRY\,WT)}} - 453.6\log(DRY\,WT) + 24.6(\log(DRY\,WT))^2 - 0.5276(\log(DRY\,WT))^3$	.970
1.12 ACTUATORS (FLIGHT CONTROLS)	$.71195 - .18814\log(LEN + WING) + 2.0988E\text{-}2\sqrt{LEN + WING}$	.956
1.13 AVIONICS	$5.0275E\text{-}2 + 2.605E\text{-}7(DRY\ WT) - 2.2882E\text{-}4\sqrt{DRY\ WT}$	.909
1.14 ECS	$8.2199E\text{-}2 + 5.007E\text{-}7(DRY\ WT) - 4.0613E\text{-}4\sqrt{DRY\ WT}$	.888
1.15 PERSONNEL PROV	AVERAGE = .0185	---
1.16 REC AUX SYS	AVERAGE = .004678	---

E. MH/MA Equations

Predicted maintenance manhours per maintenance action were obtained from regression equations using primary, secondary and subsystem weight variables. These equations are presented in Table 13. Appendix K contains the regression analysis.

Marginal correlations were obtained for several subsystems including electrical, and oxygen subsystems. For those subsystems average manhours per maintenance action remains somewhat constant across aircraft. However, except for landing gear and oxygen, the fitted equations were significant at the 10 percent level and therefore partly explain the variation found in this parameter. In order to separate the on and off vehicle work being performed, the percent of off-equipment (POFF) manhours was also estimated from regression equations. These equations are identified in Table 14.

Table 13.
MH/MA Equations

WBS	Equation	R
1.1 - 1.3 WING,TAIL,BODY	$16.57 - .3512(FUSDENS) - .7546\log(DRYWT)$	.6672
1.3 BODY (CREW COMPARTMENT)	$7.0855 - \frac{1.6666}{\sqrt{CREW + PASS}} + .09878(CREW + PASS)^2$	.7414
1.5 LANDING GEAR	$-156.95 + 55.98\log(L.GEARWT) - 6.0952(\log(L.GEARWT))^2 + .2128(\log(L.GEARWT))^3$	.5243
1.6-1.8 PROPULSION	$52.632 + 9.12212E{-}4(ENGWT) - .3936\sqrt{ENGWT}$	.6506
1.9 PRIME PWR (APU)	$-451.4 + .09054(KVAMAX) - 2.9654\sqrt{KVAMAX} + .26570(APUWT) - 26.0995\sqrt{APUWT} + 150.5\log(APUWT)$	.8585
1.10 ELECTRICAL	$-95.161 + 20.316\log(DRYWT) - .9836(\log(DRYWT))^2$	.4704
1.10 ELECTRICAL-LIGHTING	$2300.0 + 474.1\log(DRYWT) - 452.3\log(LEN + WING) - \frac{.14629(DRYWT)}{LEN + WING} - 2769.9\sqrt{\log(DRYWT)} + 1788.39\sqrt{\log(LEN + WING)}$	.6084
1.11 HYDRAULICS	$2.4124\log(DRYWT) - .16307(\log(DRYWT))^2$	.9527
1.12 ACTUATORS (FLIGHT CONTROLS)	$26.238 - 1.1067(ACT) - 1.66585(CONTS) - .00328(WETAREA) + .0006018(DRYWT) - 6.2827\log(ACTWT) + 14.2891\sqrt{ACT}$	.7857
1.13 AVIONICS	$131.3954 + 1.0394(AVS) - 9.0352\sqrt{TSUB} - .0154(AVWT) + 2.8641\sqrt{AVWT} - 26.19323\log(AVWT)$	.8016
1.14 ECS	$.6886774\log(DRYWT)$	.9419
1.14 ECS-OXYGEN	$5.7432 + .018525\log(DRYWT) - .003366\sqrt{DRYWT}$	.2523
1.15 PERSONNEL PROV	$9.5132 + .03508(WINGLEN) - .000721(WT) - 4.52\sqrt{CREW}$	.7061
1.16 REC AUX SYS	$-57.9008 + 1.4639E{-}4(DRYWT) + 8.2373\log(DRYWT) - .15144\sqrt{DRYWT}$	.6412

Table 14.
Percent Off Equipment Equations

WBS	Equation	R
1.1 - 1.3 WING,TAIL,BODY	$MEDIAN = .0835$	
1.3 BODY (CREW COMPARTMENT)	$MEDIAN = .088$	
1.4 LANDING GEAR	$.02774 - 4.07E\text{-}6(DRYWT) - .00194(WINGLEN) + .19316\sqrt{WHEEL} + .007156\sqrt{L.GEARWT}$	.8146
1.6 - 1.8 PROPULSION	$1.14633 + 4.5721E\text{-}5(ENGWT) - .011456\sqrt{ENGWT}$	.6551
1.9 PRIME POWER(APU)	$-109.8302 - .1645\log(DRYWT) + .1427(KVAMAX) - 6.1518\sqrt{KVAMAX} + 15.75\log(KVAMAX) + .06602(APUWT) - 5.6832\sqrt{APUWT} + 29.0715\log(APUWT)$	.9974
1.10 ELECTRICAL	$-26.5654 - .00271(KVAMAX) + .005143(ELECWT) - .74878\sqrt{ELECWT} + 6.62114\log(ELECWT)$	.9274
1.10 LIGHTING	$3.0610 + 1.178E\text{-}5(DRYWT) - 1.27E\text{-}4(WETAREA) - .42392\log(DRYWT) + .13468\sqrt{LENWING}$	.7817
1.11 HYDRAULICS	$.07614 - .00181(LENGTH + WING) + .001543\sqrt{DRY\ WT}$	.5836
1.12 ACTUATORS (FLIGHT CONTROL)		.8034
1.13 AVIONICS	$7.166202 + .0209(AVS) - .00128(AVWT) + .177379\sqrt{AVWT} - 1.734\log(AVWT) + \frac{.0067(AVWT)}{AVS}$	.8705
1.14 ECS	$AVERAGE = .0932$	
1.14 ECS - OXYGEN	$23.85198 - .00902(LENGTH + WING) - 5.247019\log(DRYWT) + .300955(\log(DRYWT))^2 - \frac{.00212(DRYWT)}{LENGTH + WING}$	.8483
1.15 PERSONNEL PROV (MISC. UTILITIES)	$.198886 + 4.938E\text{-}6(DRYWT) - .00205\sqrt{DRY\ WT} + 4.877E\text{-}4(KVAMAX)$	.6620
1.15 PERSONNEL PROV (EQPT)	$-5.46864 + .168358(WINGLEN) - .00448(WETAREA) + .365211(CREW + PASS) - 4.152794\sqrt{CREW + PASS} + .17797\sqrt{SUBWT}$	.9869
1.16 REC AUX SYS (EMERGENCY EQUIP)	$4.653976 - .457186\log(DRY\ WT) + .002421\sqrt{DRY\ WT}$	.6285
1.16 DRAG CHUTE	$AVERAGE = .287$	
1.16 EXPLOSIVES	$AVERAGE = .01$	

F. Scheduled Maintenance

Limited data is maintained on military aircraft pertaining to scheduled maintenance. These tasks fall into two categories: preflight/postflight inspections and periodic maintenance. For AF aircraft, total maintenance manhours expended in both areas are recorded in AFALDP 800-4. Using this data pertaining to 27 different data points, a regression analysis was performed with the results summarized in Table 15. Scheduled maintenance manhours is predicted as a percent of the unscheduled maintenance manhours. Once total unscheduled maintenance is computed, then the predicted percentage is applied to obtain the total scheduled maintenance.

Table 15.
Scheduled Maintenance Manhours

As a percentage of UNSCHEDULED Maintenance Manhours:

%UNSCH = 0.844224 + .002638 x (LENGTH + WING)
+ .00003379 x (WETTED AREA) - .005231 SQRT (DRY WT)

(R = 0.922)

SCH MANHOURS = % UNSCH x UNSCH MANHOURS

G. Removal Rates

Removal rates were based on data pertaining to six aircraft: C-5A, C-130E, C-141B, F-15D, F-111A, and T-38A. Since it was not possible to obtain adequate least-square fits for WBS's 1.11 and 1.15, mean values were used. Results are depicted in Table 16 with the data and regression analysis found in Appendix M.

Table 16.
Removal Rate Equations

WBS	Equation	R
1.1 - 1.3 WING,TAIL,BODY	$.193413 - 6.308859E\text{-}7(BODYWT)$	.9233
1.3 BODY (CREW COMPARTMENT)	$.202678 + 5.880527E\text{-}4(BTUCOOL)$	.6574
1.5 LANDING GEAR	$.863902 - 2.962998E\text{-}2\sqrt{WINGLEN}$	.8404
1.6 - 1.8 PROPULSION	$.6211067 - 2.487229E\text{-}3\sqrt{ENGWGT}$	.9112
1.9 PRIME POWER (APU)	$.578976 - 7.511937E\text{-}4\sqrt{DRYWT}$	.9016
1.10 ELECTRICAL	$-.385331 - 1.006106E\text{-}3(LENGTH + WING) + .177148\log(LENGTH + WING)$	.7894
1.10 ELECT-LIGHTING	$2.365084 + 2.014026E\text{-}3(LENGTH + WING) - .411521\log(LENGTH + WING)$	.8649
1.11 HYDRAULICS	$AVERAGE = .368$	
1.12 ACTUATORS (FLIGHT CONTROLS)	$.453906 - 6.676835E\text{-}4(WINGLEN)$	.9154
1.13 AVIONICS	$.397347 - 4.265886E\text{-}7(DRYWT) + 2.163533E\text{-}4\sqrt{DRYWT}$	.8705
1.14 ECS	$.529437 - 8.913525E\text{-}5(ECSWT)$	.7484
1.14 ECS-OXYGEN	$.602614 - 6.758594E\text{-}4\sqrt{DRY\ WT}$	.9309
1.15 PERSONNEL PROV (MISC UTIL)	$AVERAGE = .274$	
1.16 REC & AUX SYS (EMERGENCY EQUIPMENT)	$2.348928 - .358519(WINGLEN)$	.9103
1.16 REC & AUX SYS (EXPLOSIVE)	$2.532197 - .228368\log(WETAREA)$	.8207

H. Crew Sizes

Average (mean) crew sizes for performing unscheduled maintenance are predicted from derived regression equations. The input data for this analysis was obtained from the MODAS maintenance summary reports which provided by aircraft and by subsystem total maintenance manhours and total elapsed time. The crew size analysis may be found in Appendix O and is summarized in Table 17. By dividing the maintenance manhours by elapsed time, an average crew size was obtained. For this analysis, crew sizes were estimated at the one digit (or higher) level. Because of the difficulty and time in extracting this data from MODAS, the data was obtained at the higher level. The resulting equations are in Table 18. No significant fit could be obtained for WUC's 2XXXX and avionics (5XXXX, 6XXXX and 7XXXX). Therefore the mean value was used. Neither propulsion repair crew size nor avionics repair crew size seem to be related to aircraft size.

Table 17
Repair Crew Size Data
(by WUC)

AIRCRAFT	1XXXX	2XXXX	4XXXX	AVIONICS	9XXXX
A7D	1.66	2.44	1.58	2.01	1.76
F111E	2.66	2.85	2.73	2.42	2.87
F4E	1.80	2.37	2.04	2.28	1.88
F15C	2.03	2.26	2.18	2.21	2.00
F16A	1.90	2.37	2.02	2.21	2.17
C130E	2.12	2.00	2.21	1.98	2.02
KC135	1.90	2.53	2.39	2.42	2.03
C141B	2.30	2.99	2.26	1.98	2.12
C5B	2.09	2.11	2.22	2.10	2.42

Table 18
Crew Size Regression Equations

WUC	WBS	EQUATION	R
1XXXX	1.1-1.5, 1.12	$1.5 - 3.1988E\text{-}5(WET\ AREA) + 9.1722E\text{-}3\sqrt{WET\ AREA}$	.737
2XXXX	1.6-1.9	AVE = 2.44	---
4XXXX	1.10, 1.11, 1.14	$-1.48 - 2.833E\text{-}3(LEN + WING) + .81466\,LOG(LEN + WING)$	.774
AVIONICS	1.13	AVE = 2.18	---
9XXXX	1.15, 1.16	$1.78933 + 9.8722E\text{-}4\sqrt{DRY\ WT}$	.759

An empirical crew size distribution was obtained from the MODAS Detail Maintenance Data report which identifies the start and stop time of each maintenance activity along with the assigned crew size. The crew size distribution and average (mean) crew size were found (Table 19). Since this distribution was based on over 130 individual maintenance tasks, it is assumed to be representative of the crew size requirements for this particular component (AC power system) on B-1B.

Table 19
Crew Size Probability Distribution

```
     AIRCRAFT IS                B-1B
     WORK UNIT CODE IS          42B**
     NOMENCLATURE IS            AC POWER SYSTEM

CREW SIZE  PROB  CUM PROB
  1.00     0.11    0.11
  2.00     0.52    0.63
  3.00     0.33    0.96
  4.00     0.03    0.99
  5.00     0.01    0.99
  6.00     0.01    1.00
  7.00     0.00    1.00
  8.00     0.00    1.00

          AVERAGE CREW SIZE IS    2.326485
```

I. Repair Distribution

Using August 1990 data from the B1-B bomber, MODAS provided start and stop maintenance times for each failure record in the system (see Table 20). Using the repair times computed from these values, a Chi-square goodness of fit test was conducted to determine a suitable distribution. Because of the tendency to report times in whole hours (or 30 minute periods), the data had to be aggregated into four intervals. A significant fit was obtained using either the Weibull or lognormal distributions (see Tables 21). Follow-on research will attempt to analyze repair distributions more fully.

Table 20
Repair Time[5] Data

Repair Time Observations

NASA B1-B WUC 42E TIME-TO-REPAIR

ORDERED ARRAY OF OBSERVATIONS

5	5	5	5	5
5	5	10	10	15
20	20	20	20	20
25	25	30	30	30
30	30	30	30	30
30	30	30	30	30
30	30	30	30	30
30	30	30	30	30
30	30	30	30	30
40	55	60	60	60
60	60	60	60	60
60	60	60	60	60
60	60	60	60	60
60	60	60	60	60
60	60	60	60	60
60	60	60	60	60
60	60	60	60	60
60	60	60	60	60
60	60	60	60	60
60	60	90	90	90
90	90	90	90	90
90	90	90	115	115
115	120	120	120	120
120	120	120	120	120
120	120	120	120	120
120	120	120	120	120
120	120	120	120	120
120	120	120	120	150
150	150	150	175	175
180	180	180	180	180
180	180	180	180	240
240	240	240	240	240
240	240	240	240	240
240	240	270	270	285
300	300	300	300	300
300	330	360	395	420
420	450	450	480	480

DESCRIPTIVE STATISTICS

SAMPLE SIZE	185	
MEAN	112.2432	
APPROX 80% CONF INTERVAL	100.8087	125.6778
MEDIAN	60	
VARIANCE	10570.67	
STANDARD DEVIATION	102.8138	
VARIANCE/MEAN RATIO	93.24486	
COEFFICIENT OF VARIATION	.9078022	
RANGE	475	
SKEWNESS-(B1)	1.868348	
10% CRITICAL VALUES FOR B1=0	-.2882482	.2882482
KURTOSIS-(B2)	5.288713	
10% CRIT VALUES FOR B2=3 (NORMAL)	2.467804	3.532497

[5]Time is in minutes.

Table 21
Goodness of Fit Tests

Repair Time Distributions

CHI-SQUARE COMPUTATION

WEIBULL WITH SCALE PARAMETER= 120 AND SHAPE PARAMETER= 1.17

CELL	LOWER	UPPER	OBS	EXP	(O-E)^2/E
1.00	0.00	41.37	46.00	46.25	0.00
2.00	41.37	87.73	51.00	46.25	0.49
3.00	87.73	158.64	46.00	46.25	0.00
4.00	158.64	9999.00	42.00	46.25	0.38

CHI-SQUARE STATISTIC= .8810811 DEGREES OF FREEDOM= 1
95% CRITICAL VALUE= 3.84 90% CRITICAL VALUE= 2.71
CANNOT REJECT AT 10% LEVEL

MEAN OF LOGNORMAL= 121.8989 WITH STND. DEV= .9832414

CELL	LOWER	UPPER	OBS	EXP	(O-E)^2/E
1.00	-9999.00	3.86	45.00	46.25	0.03
2.00	3.86	4.32	52.00	46.25	0.71
3.00	4.32	4.86	42.00	46.25	0.38
4.00	4.86	9999.00	46.00	46.25	0.00

CHI-SQUARE STATISTIC= 1.140841 DEGREES OF FREEDOM= 1
95% CRITICAL VALUE= 3.84 90% CRITICAL VALUE= 2.71
CANNOT REJECT AT 10% LEVEL

An attempt to derive a failure time distribution from the MODAS data was more difficult. MODAS provides the Julian date and time (although time does not appear to be very accurate) of each failure. However flying hours (and sorties) are reported monthly. Therefore it is impossible to determine from this data set the actual flying hours between failures. However, it may be possible to show in some cases that the number of failures per flying hour is Poisson by taking failures per month and converting to failures per flying hour. Therefore the time (flying hours) between failures would be exponential. This approach will be investigated in the follow-on effort.

CHAPTER V

Implementation

I. INTRODUCTION

This chapter describes the PC based model for evaluating the reliability and maintainability equations derived in the previous chapter. Because of the large number of equations to be evaluated and the large number of additional calculations, the only practical way to implement the results of this research is on a computer. This PC based model is completely menu driven with all parameters computed at the subsystem (WBS) level and then rolled up to reflect overall vehicle performance.

Flying hours between maintenance actions, maintenance manhours per maintenance action, critical failure (abort) rates, percent on/off vehicle hours, removal rates, and crew sizes are estimated using the multiple regression models derived from aircraft data. Lower bounds (and in some cases upper bounds) are set if the equations predict values outside the limits of the input data. In addition to predicting failures and repair manhours, estimates of mission reliability, spares support, manpower requirements, and fleet size are also made.

The computer model is design to evaluate all 16 major subsystems as defined by the NASA work breakdown structure (WBS). Upon execution of the model, the user may elect to delete any number of these subsystems from the analysis.

II. Modes of Operation

A. The model operates in one of three modes: PRECONCEPTUAL, WEIGHT DRIVEN, & WEIGHT/VARIABLE DRIVEN. In mode 1, PRECONCEPTUAL, the user must specify 4 driver variables and 10 system parameters. The driver variables are used to estimate subsystem weights and secondary variable values from the multiple regression models derived for this purpose. These 4 variables and the 10 system parameters are listed below as they appear on the first menu. When operating in Mode 1, the user will bypass the weight and secondary variable menus shown below. However, changes to the primary variables will result in both weights and secondary variables being recomputed. The user has the option of having weights computed by the regression (aircraft) equations or by the weight distribution presented in Table 8. The user must specify the average crew size for scheduled maintenance activity. However, the model will compute crew sizes for unscheduled maintenance based upon the regression equations in Table 18. The default value for the technology growth factor is the estimated factor (see Table 11) for the overall vehicle. The user may elect to replace a subsystem growth factor with this value on a subsequent menu. The Weibull shape parameter default value is based upon a previous study [11] and is used in determining the MTBM adjusted for the time in orbit. The launch factor applies to the booster phase of the mission. Available hours per month is the average number of working hours a month, and the percent indirect work

refers to all work accomplished by the individual which is not accounted for in the maintenance manhour equations.

Figure 4
Driver & System Variables

INPUT MODULE - PRIMARY INDEP VARIABLES

NBR	VARIABLE	CURRENT VALUE
	VEHICLE DRIVER VARIABLES	
1	DRY WGT (LBS)	9000
2	LENGTH+WING SPAN (FT)	100
3	CREW SIZE	2
4	NBR PASSENGERS	8
	SYSTEM PARAMETER VALUES	
5	TECHNOLOGY YR	1994
6	DEFAULT TECH GROWTH FACTOR	.0557
7	WIEBULL SHAPE PARAMETER	.28
8	LAUNCH FACTOR	20
9	AVAIL MANHRS/MONTH	144
10	PERCENT INDIRECT WORK	.15
11	SPARE FILL RATE OBJ	.95
12	AVG CREW SIZE-SCHD MAINT	1.8
13	PLANNED MISSIONS/MONTH	1
14	WGT IND 0-PCT/1-EQS	1

B. In Mode 2, WEIGHT DRIVEN, the user may input/change subsystem weights. This should result in more accurate estimates. Secondary variables may be recomputed from these weights, however, the secondary menu will not be displayed and the user cannot update it. As subsystem weights are updated, the total weight is recomputed. The overall vehicle dry-weight is set equal to this new total weight regardless of the initial value on the first menu. The subsystem weight menu is shown below:

Figure 5
Weight Menu

SUBSYSTEM WEIGHTS

NBR	SUBSYSTEM	WEIGHT IN LBS
1	1.1 WING GROUP	1846.976
2	1.2 TAIL GROUP	364.9596
3	1.3 BODY GROUP	2319.57
4	1.4 TPS	849.7662
5	1.5 LANDING GEAR	347.2477
6	1.6 PROPULSION	77.25148
7	1.7 PROPULSION-RCS	309.0059
8	1.8 PROPULSION-OMS	154.503
9	1.9 PRIME POWER	114.4622
10	1.10 ELECTRIC CONV/DISTR	263.2065
11	1.11 HYDRAULICS/PNEUMATICS	253.3027
12	1.12 ACTUATORS	429.6665
13	1.13 AVIONICS	501.8043
14	1.14 ENVIRONMENTAL CONTROL	348.4342
15	1.15 PERSONNEL PROVISIONS	47.32994
16	1.16 RECOVERY & AUX SYSTEMS	772.5147
TOTAL WGT		9000

C. Mode 3, WEIGHT/VARIABLE DRIVEN, allows the user to specify and change both subsystem weights and 12 secondary variables. These secondary variables provide for more accurate regression equations as measured by the R value (Multiple Correlation coefficient) and the standard error of the estimate (a measure of the variability of the estimated value. This mode, therefore, should result in the most accurate assessments. However, the vehicle must be sufficiently defined to enable the user to assign values to these variables. Definitions of these variables may be found in Appendix F. Default values are computed values from the regression equations. These are the same values which would be used in Modes 1 and 2. The user may run the model in Mode 3, and by not changing the weight or secondary variable values, generate the same results as Mode 1.

Figure 6
Secondary Variable Menu

SECONDARY INDEP VARIABLES

NBR	VARIABLE	CURRENT VALUE
1	FUSELAGE AREA	478
2	FUSELAGE VOLUME	1185.183
3	WETTED AREA	1996.191
4	NBR WHEELS	3
5	NBR ACTUATORS	5
6	NBR CONTR SURFACES	7
7	KVA MAX	24.12491
8	NBR HYDR SUBSYS	8
9	NBR FUEL TANKS (INTERNAL)	4
10	TOT NBR AVIONICS SUBSYS	16
11	NBR DIFF AVIONICS SUBSYS	16
12	BTU COOLING	86.46997

III. Additional Input Parameters

A. Subsystem Calibration

To provide sufficient flexibility to transition from the aircraft system to the space vehicle system, a calibration factor is included. This factor is used in modifying the aircraft computed MTBM AND MH/MA where CALIBRATED MTBM = CAL FACTOR x AIRCRAFT MTBM and CALIBRATED MH/MA = CAL FACTOR x MH/MA. The default value is one. With these two factors, the R&M parameters may be calibrated by subsystem based upon non-aircraft

data (e.g. Shuttle data) in order to account for those differences between aircraft and space vehicles which are not accounted for by the variables in the aircraft generated equations.

Figure 7
Calibration Menu - MTBM

SUBSYSTEM MTBM CALIBRATION FACTOR
SPACE VEH-MTBM = CAL FAC x ACFT-MTBM

NBR	SUBSYSTEM	CAL FACTOR
1	1.1 WING GROUP	1
2	1.2 TAIL GROUP	1
3	1.3 BODY GROUP	1
4	1.4 TPS	1
5	1.5 LANDING GEAR	1
6	1.6 PROPULSION	1
7	1.7 PROPULSION-RCS	1
8	1.8 PROPULSION-OMS	1
9	1.9 PRIME POWER	1
10	1.10 ELECTRIC CONV/DISTR	1
11	1.11 HYDRAULICS/PNEUMATICS	1
12	1.12 ACTUATORS	1
13	1.13 AVIONICS	1
14	1.14 ENVIRONMENTAL CONTROL	1
15	1.15 PERSONNEL PROVISIONS	1
16	1.16 RECOVERY & AUX SYSTEMS	1

Figure 8
Calibration Menu - MH/MA

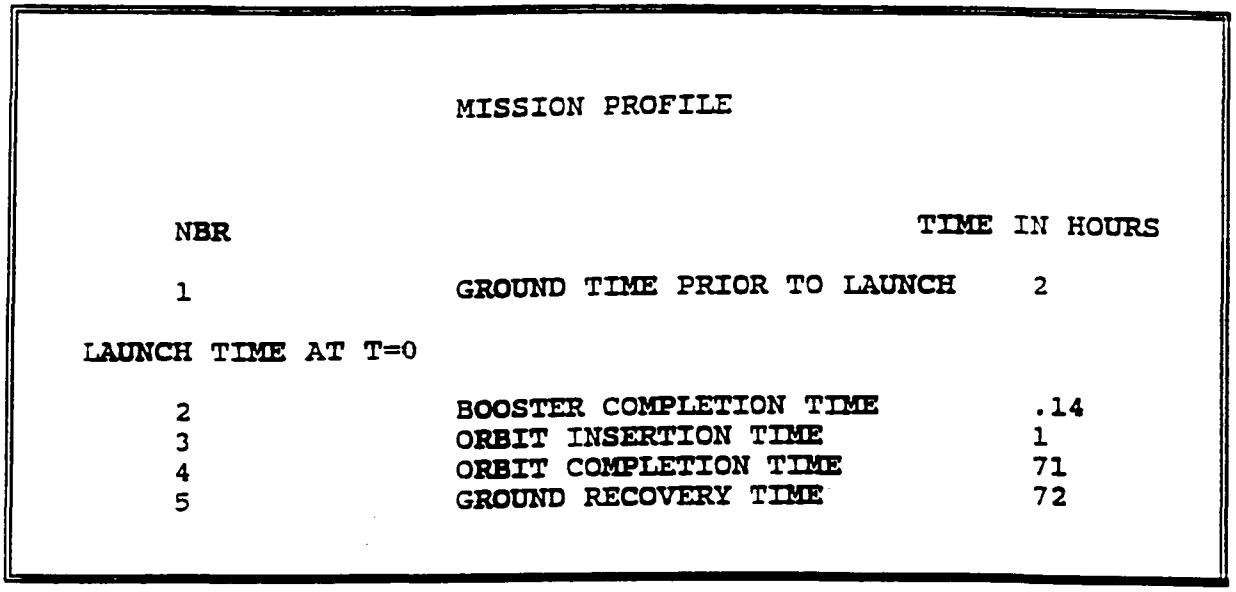
SUBSYSTEM MH/MA CALIBRATION FACTOR
CAL MH/MA = CAL FAC x COMPUTED-MH/MA

NBR	SUBSYSTEM	CAL FACTOR
1	1.1 WING GROUP	1
2	1.2 TAIL GROUP	1
3	1.3 BODY GROUP	1
4	1.4 TPS	1
5	1.5 LANDING GEAR	1
6	1.6 PROPULSION	1
7	1.7 PROPULSION-RCS	1
8	1.8 PROPULSION-OMS	1
9	1.9 PRIME POWER	1
10	1.10 ELECTRIC CONV/DISTR	1
11	1.11 HYDRAULICS/PNEUMATICS	1
12	1.12 ACTUATORS	1
13	1.13 AVIONICS	1
14	1.14 ENVIRONMENTAL CONTROL	1
15	1.15 PERSONNEL PROVISIONS	1
16	1.16 RECOVERY & AUX SYSTEMS	1

B. Mission Profile and Subsystem Operating Hours

In order to adjust for the time spent in space and to account for ground operating times, the following mission profile menu is provided (see Figure 4):

Figure 9
Mission Profile Menu



MISSION PROFILE

NBR		TIME IN HOURS
1	GROUND TIME PRIOR TO LAUNCH	2
LAUNCH TIME AT T=0		
2	BOOSTER COMPLETION TIME	.14
3	ORBIT INSERTION TIME	1
4	ORBIT COMPLETION TIME	71
5	GROUND RECOVERY TIME	72

From the selected profile, subsystem operating times are determined and displayed in the following manner:

Figure 10
Subsystem Operating Times

SUBSYSTEM OPERATING TIMES

NBR	SUBSYSTEM	MAX GROUND TIME 2 HRS GROUND TIME	BOOSTER TIME	REM TIME TO-ORBIT	ORBIT TIME	RECOVERY TIME
1	1.1 WING GROUP	2	.14	.86	70	1
2	1.2 TAIL GROUP	2	.14	.86	70	1
3	1.3 BODY GROUP	2	.14	.86	70	1
4	1.4 TPS	2	.14	.86	70	1
5	1.5 LANDING GEAR	2	.14	.86	70	1
6	1.6 PROPULSION	2	.14	.86	70	1
7	1.7 PROPULSION-RCS	2	.14	.86	70	1
8	1.8 PROPULSION-OMS	2	.14	.86	70	1
9	1.9 PRIME POWER	2	.14	.86	70	1
10	1.10 ELECTRIC CONV/DISTR	2	.14	.86	70	1
11	1.11 HYDRAULICS/PNEUMATICS	2	.14	.86	70	1
12	1.12 ACTUATORS	2	.14	.86	70	1
13	1.13 AVIONICS	2	.14	.86	70	1
14	1.14 ENVIRONMENTAL CONTROL	2	.14	.86	70	1
15	1.15 PERSONNEL PROVISIONS	2	.14	.86	70	1
16	1.16 RECOVERY & AUX SYSTEMS	2	.14	.86	70	1

The user may then uniquely adjust each subsystem based upon its mission profile. In computing space adjusted MTBM's, the ground segment, non-booster time to orbit, and recovery segments have constant failure rates based upon the calibrated MTBM as adjusted for technology and the steady-state ground/air/space environment. During the launch (booster) segment, the failure rate is increased by the launch factor (system parameter number 8). During the orbit segment, the failure rate is assumed to be decreasing based upon the Weibull shape parameter (system parameter number 7).

C. Technology Factor

The default technology factors used by the model are those presented in Table 11. The user may replace any one of these with the system value displayed on the first menu.

Figure 11
Technology Factor Display Menu

OPTION TO USE DEFAULT RATE
FOR ANNUAL RELIABILITY GROWTH FACTOR

NBR	SUBSYSTEM	ANNUAL GROWTH RATE
1	1.1 WING GROUP	.082
2	1.2 TAIL GROUP	.082
3	1.3 BODY GROUP	.082
4	1.4 TPS	.082
5	1.5 LANDING GEAR	.033
6	1.6 PROPULSION	.011
7	1.7 PROPULSION-RCS	.011
8	1.8 PROPULSION-OMS	.011
9	1.9 PRIME POWER	.054
10	1.10 ELECTRIC CONV/DISTR	0
11	1.11 HYDRAULICS/PNEUMATICS	.092
12	1.12 ACTUATORS	.056
13	1.13 AVIONICS	.22
14	1.14 ENVIRONMENTAL CONTROL	.0062
15	1.15 PERSONNEL PROVISIONS	.036
16	1.16 RECOVERY & AUX SYSTEMS	.083

IV. Computations

A. MTBM (mean operating hours between maintenance actions)

An aircraft MTBM is first computed by evaluating the regression equations. Then the calibration factor is applied to obtain the calibrated MTBM. A technology adjustment to account for increases in reliability in obtained by:

$$\text{ADJ MTBM} = (1+\text{TECH GROWTH FAC})^{(\text{tech yr}-86)} \times \text{CAL MTBM}$$

where 86 reflects the baseline year of the input data.

The primary MTBM used in subsequent calculations is based upon the adjustment for operating in the launch and space environment (SS MTBM). This adjustment uses the subsystem mission profiles as previously discussed. As a result of the decreasing failure rate, a numerical integration must be performed for each subsystem. Therefore, this process may take several seconds to a minute to complete.

A critical MTBM is based upon a critical failure or abort rate and is found from:

CRIT MTBM = SS MTBM / ABORT RATE

Corresponding to and computed from the subsystem critical MTBM is a subsystem mission reliability. This reliability may be interpreted as the probability the subsystem will complete the mission without a critical failure. This reliability also depends upon the subsystem mission profiles (operating times). A vehicle mission reliability is obtained by multiplying the subsystem reliabilities.

B. Maintainability Parameters

The initial calculation is the determination of the subsystem maintenance manhour per maintenance action (MH/MA) obtained by evaluating the corresponding regression equations. This value is then adjusted by the maintainability calibration factor. Total maintenance actions per mission (TOT MA) is found by

TOT MA = TOT OPER HRS / SS MTBM

Then total manhours per mission (MH) is calculated by:

TOT MH = MH/MA x TOT MA

These manhours are then split into on-vehicle and off-vehicle manhours using the regression estimated percent of off/on-vehicle manhours. Scheduled maintenance manhours per mission is based upon a regression estimated percent of unscheduled maintenance applied to the total unscheduled maintenance manhours. Scheduled maintenance is also broken down into on and off-vehicle work.

To convert total manhours into manpower requirements, the following calculations are performed:

MANHRS/MO = TOT MH x MISSIONS/MO

Then

NBR PERSONNEL = MANHRS/MO / {AVAIL MANHRS/MO x (1-% INDIRECT)}

and NBR PERSONNEL is rounded up to the nearest integer if the fraction portion exceeds .001. This is done by subsystem.

C. Spares

Spares levels for each subsystem are determined using a single mission fill rate goal specified on the first menu. Fill rate refers to the percent of time a spare will be available when a demand (failure) is generated. The average number of demands (MFAIL) are determined from an estimated removal rate (RR) as follows:

$$MFAIL = RR \times TOT\ MA$$

This becomes the mean of a Poisson probability distribution. The spares level is iteratively increased by one unit until the probability of demands not exceeding the spares level reaches or exceeds the fill rate objective (system variable number 11). The achieved fill rate and computed spares level are then retained for display.

D. Vehicle Turn Time

For each subsystem, an average task time is found from:

$$AVG\ TASK\ TIME = MH/MA\ /\ AVG\ CREW\ SIZE$$

Average hours (clock time) on-vehicle time per mission becomes:

$$ON\text{-}VEH\ HRS/MSN = TOT\ ON\text{-}VEH\ MH\ /AVG\ CREW$$

The subsystem on-vehicle times are summed together in order to obtain a maximum vehicle turn time. This assumes each task must be accomplished sequentially. Since this is probably not the case, it provides an upper bound on vehicle turn time. On-vehicle scheduled maintenance is also added to this sum to obtain a total turn time. By adding the mission time (including ground processing time) to this total, a complete vehicle turnaround time is obtained. This is converted to days under the assumption that the mission time will occur on a 24 hour/day basis but the scheduled and unscheduled work would occur on a 8 hour/day basis. For a given vehicle, the number of missions per month is found by

$$VEH\ MSN/MO = (WORKING\ DAYS/MO)\ /TURNAROUND\ TIME\ IN\ DAYS$$

The fleet size is computed from:

$$FLEET\ SIZE = (MSN/MO)\ /\ (MSN/MO/VEH)$$

rounded up to the nearest integer.

V. Output Reports

The following figures are examples of the output displays resulting from running the model. Separate screen displays are found for the reliability calculations, maintainability calculations, spares levels, and vehicle turn time analysis.

Figure 12
Reliability Report

RELIABILITY REPORT

VEHICLE IS TEST VEH DATE: 06-11-1992 TIME: 16:25:32

WBS	CALIBRATED MTBM	TECH ADJ	SPACE ADJ
1.1 WING GROUP	34.72159	65.22554	333.5887
1.2 TAIL GROUP	500.9829	941.1113	5072.357
1.3 BODY GROUP	4.636185	8.709212	30.29372
1.4 TPS	37.40193	70.26064	360.7854
1.5 LANDING GEAR	6.255318	8.110579	27.23173
1.6 PROPULSION	31.43182	34.3067	166.8098
1.7 PROPULSION-RCS	28.91587	31.56063	152.0331
1.8 PROPULSION-OMS	30.37121	33.14908	160.5794
1.9 PRIME POWER	121.2774	184.716	979.6754
1.10 ELECTRIC CONV/DISTR	5.15	5.15	12.77312
1.11 HYDRAULICS/PNEUMATICS	46.95026	94.93341	494.1188
1.12 ACTUATORS	22.58846	34.92995	170.1649
1.13 AVIONICS	27.13062	133.1492	700.7554
1.14 ENVIRONMENTAL CONTROL	28.5382	29.98478	143.5583
1.15 PERSONNEL PROVISIONS	3259.32	4325.19	23383.49
1.16 RECOVERY & AUX SYSTEMS	253.802	480.311	2578.978
VEHICLE	1.140834	1.558437	5.248452

RELIABILITY REPORT - page 2

VEHICLE IS TEST VEH DATE: 06-11-1992 TIME: 16:25:43

WBS	CRITICAL FAIL RATE	CRITICAL MTBM	SUBSYS MSN RELIABILITY
1.1 WING GROUP	1.831055E-02	18218.39	.9992496
1.2 TAIL GROUP	1.831055E-02	277018.3	.9999506
1.3 BODY GROUP	1.895309E-02	1598.353	.9914805
1.4 TPS	1.831055E-02	19703.69	.9993061
1.5 LANDING GEAR	4.266358E-02	638.2898	.9788026
1.6 PROPULSION	.035484	4700.988	.9970951
1.7 PROPULSION-RCS	.035484	4284.554	.9968133
1.8 PROPULSION-OMS	.035484	4525.404	.9969826
1.9 PRIME POWER	.064	15307.43	.999107
1.10 ELECTRIC CONV/DISTR	.00248	5150.451	.9973483
1.11 HYDRAULICS/PNEUMATICS	.00084	588236.6	.9999768
1.12 ACTUATORS	5.542377E-02	3070.251	.9955556
1.13 AVIONICS	.02376	29493.07	.9995364
1.14 ENVIRONMENTAL CONTROL	4.817755E-02	2979.776	.9954211
1.15 PERSONNEL PROVISIONS	.0185	1263973	.9999891
1.16 RECOVERY & AUX SYSTEMS	.004678	551299.3	.9999752
VEHICLE		254.6037	.9477038

Figure 13
Maintainability Report

MAINTAINABILITY REPORT

VEHICLE IS TEST VEH DATE: 06-11-1992 TIME: 16:26:08

WBS	MANHR/MA	TOT MA	TOT MANHRS
1.1 WING GROUP	9.097628	.2218301	2.018128
1.2 TAIL GROUP	9.097628	1.458888E-02	.1327242
1.3 BODY GROUP	12.1892	2.442751	29.77517
1.4 TPS	9.097628	.2051081	1.865997
1.5 LANDING GEAR	4.576832	2.717419	12.43717
1.6 PROPULSION	49.24341	.443619	21.84531
1.7 PROPULSION-RCS	45.99536	.4867361	22.3876
1.8 PROPULSION-OMS	47.88092	.4608312	22.06502
1.9 PRIME POWER	5.2	7.553523E-02	.3927832
1.10 ELECTRIC CONV/DISTR	4.495022	5.793417	26.04154
1.11 HYDRAULICS/PNEUMATICS	8.446617	.1497616	1.264979
1.12 ACTUATORS	2.1	.4348724	.9132319
1.13 AVIONICS	5.440491	.1056003	.5745176
1.14 ENVIRONMENTAL CONTROL	6.123659	.5154701	3.156563
1.15 PERSONNEL PROVISIONS	6.5948	3.164626E-03	2.087008E-02
1.16 RECOVERY & AUX SYSTEMS	4.051671	2.869354E-02	.1162568
SCHEDULED			77.19669
TOTALS	14.35193 (AVG)	14.0994	222.2046

MAINTAINABILITY REPORT - page 2

VEHICLE IS TEST VEH DATE: 06-11-1992 TIME: 16:26:35

WBS	ON-VEH MH	OFF-VEH MH	PERCENT ON-VEH
1.1 WING GROUP	1.849614	.1685136	.9165
1.2 TAIL GROUP	.1216417	1.108247E-02	.9165
1.3 BODY GROUP	27.22195	2.553221	.91425
1.4 TPS	1.710186	.1558107	.9165
1.5 LANDING GEAR	8.805834	3.631335	.7080256
1.6 PROPULSION	6.00746	15.83785	.275
1.7 PROPULSION-RCS	6.156589	16.23101	.275
1.8 PROPULSION-OMS	6.06788	15.99714	.275
1.9 PRIME POWER	.3809997	.0117835	.97
1.10 ELECTRIC CONV/DISTR	20.12333	5.918207	.7727397
1.11 HYDRAULICS/PNEUMATICS	1.212454	5.252423E-02	.9584781
1.12 ACTUATORS	.6963355	.2168965	.7624958
1.13 AVIONICS	.4251539	.1493637	.740019
1.14 ENVIRONMENTAL CONTROL	2.912391	.2441722	.9226462
1.15 PERSONNEL PROVISIONS	1.783757E-02	3.032502E-03	.8546961
1.16 RECOVERY & AUX SYSTEMS	7.680828E-02	3.944849E-02	.660678
SCHEDULED	75.65276	1.543934	
TOTALS	159.4392	62.76532	.7399081 (AVG)

MAINTAINABILITY REPORT - page 3

VEHICLE IS TEST VEH DATE: 06-11-1992 TIME: 16:27:26

WBS	MANHRS/MSN	MANHRS/MO	NBR PERSONNEL
1.1 WING GROUP	2.018128	2.018128	1
1.2 TAIL GROUP	.1327242	.1327242	1
1.3 BODY GROUP	29.77517	29.77517	1
1.4 TPS	1.865997	1.865997	1
1.5 LANDING GEAR	12.43717	12.43717	1
1.6 PROPULSION	21.84531	21.84531	1
1.7 PROPULSION-RCS	22.3876	22.3876	1
1.8 PROPULSION-OMS	22.06502	22.06502	1
1.9 PRIME POWER	.3927832	.3927832	1
1.10 ELECTRIC CONV/DISTR	26.04154	26.04154	1
1.11 HYDRAULICS/PNEUMATICS	1.264979	1.264979	1
1.12 ACTUATORS	.9132319	.9132319	1
1.13 AVIONICS	.5745176	.5745176	1
1.14 ENVIRONMENTAL CONTROL	3.156563	3.156563	1
1.15 PERSONNEL PROVISIONS	2.087008E-02	2.087008E-02	0
1.16 RECOVERY & AUX SYSTEMS	.1162568	.1162568	0
SCHEDULED	77.19669	77.19669	1
TOTAL		145.0079	15

Figure 14
Subsystem Spares Report

SUBSYSTEM SPARES REPORT

VEHICLE IS TEST VEH DATE: 06-11-1992 TIME: 16:27:37

WBS	REM RATE	AVG DEMAND	SPARES RQMT	FILL RATE
1.1 WING GROUP	.1919366	4.257731E-02	0	0
1.2 TAIL GROUP	.1919366	2.800139E-03	0	0
1.3 BODY GROUP	.2227305	.5440751	2	.9820489
1.4 TPS	.194	3.979097E-02	0	.9820489
1.5 LANDING GEAR	.22	.5978321	2	.9770984
1.6 PROPULSION	.5992393	.2658339	1	.9703458
1.7 PROPULSION-RCS	.5773786	.281031	1	.9671848
1.8 PROPULSION-OMS	.5901843	.2719754	1	.9690837
1.9 PRIME POWER	.5077349	3.835187E-02	0	.9690837
1.10 ELECTRIC CONV/DISTR	.5007281	2.900927	6	.9712413
1.11 HYDRAULICS/PNEUMATICS	.368	5.511226E-02	1	.9985361
1.12 ACTUATORS	.38593	.1678303	1	.9873974
1.13 AVIONICS	.4140355	4.372229E-02	0	.9873974
1.14 ENVIRONMENTAL CONTROL	.5070317	.2613596	1	.9712519
1.15 PERSONNEL PROVISIONS	.274	8.671074E-04	0	.9712519
1.16 RECOVERY & AUX SYSTEMS	.747236	2.144084E-02	0	.9712519
TOTALS	.4057564 (AVG)	5.535527	16	

Figure 15
Vehicle Turn Time Report

VEHICLE TURN TIME REPORT

VEHICLE IS TEST VEH DATE: 06-11-1992 TIME: 16:28:03

WBS	AVG CREW SIZE	AVG (ON) TASK TIME (HRS)	AVG ON-VEH CLOCK HRS
1.1 WING GROUP	1.845915	4.516987	1.002004
1.2 TAIL GROUP	1.845915	4.516987	6.589777E-02
1.3 BODY GROUP	1.845915	6.037099	14.74713
1.4 TPS	1.845915	4.516987	.9264705
1.5 LANDING GEAR	1.845915	1.755505	4.770443
1.6 PROPULSION	2.43	5.572813	2.472206
1.7 PROPULSION-RCS	2.43	5.205235	2.533576
1.8 PROPULSION-OMS	2.43	5.418622	2.49707
1.9 PRIME POWER	2.43	2.07572	.15679
1.10 ELECTRIC CONV/DISTR	1.98833	1.746935	10.12072
1.11 HYDRAULICS/PNEUMATICS	1.98833	4.071708	.6097854
1.12 ACTUATORS	1.845915	.8674509	.3772304
1.13 AVIONICS	2.18	1.846819	.1950247
1.14 ENVIRONMENTAL CONTROL	1.98833	2.841566	1.464742
1.15 PERSONNEL PROVISIONS	1.935642	2.91198	9.215327E-03
1.16 RECOVERY & AUX SYSTEMS	1.882954	1.421622	4.079137E-02

VEHICLE TURN TIME REPORT - page 2

VEHICLE IS TEST VEH DATE: 06-11-1992 TIME: 16:28:36

	MAX TURN TIMES
AVG VEH TASK TIME	3.457753 HRS
SCHD MAINT MSN TASK TIME	42.02931 HRS
MAX TURN TIME NO SCH MAINT	41.9891 HRS
MAX TURN TIME WITH SCH MAINT	84.0184 HRS
MISSION TIME -INC GRND TIME	74 HRS
TOT VEHICLE TURNAROUND TIME	116.0293 HRS
TOT VEHICLE TURNAROUND TIME	8.336997 DAYS
MISSIONS/MONTH/VEHICLE	2.518893
FLEET SIZE	1

VI. Validation

Some model validation was accomplished by running the computer model for different aircraft having known R&M parameters. The R&M parameters were obtained from AFALDP 800-4 Volume VI, and therefore, were not part of the input data to the model. Since the average date of the data in Volume IV is 1988, this date was used for the technology year. The space adjusted feature of the model was not utilized since it obviously does not apply to aircraft. Mission profiles reflected the average mission of the aircraft.

The model was run in all three modes. Table 22 and 23 compare the results of the computed MTBM values in each model with reported values from Volume VI for the F-16A and C-141B respectively.

Table 22
Model Validation - F16

SUBSYSTEM	MODE 1	MODE 2	MODE 3	OCT 87 MAR 88	APR 88 SEP 88
STRUCTURAL	6.2	7.8	7.8	7.4	7.5
LANDING GEAR	14.0	14.2	14.2	11.4	10.1
PROPULSION	20.7	19.2	19.2	20.2	17.8
APU	22.8	37.0	50.4	23.4	21.5
ELECTRICAL	19.9	17.3	21.5	16.6	14.4
HYDRAULICS	96.8	84.9	100.3	58.7	64.8
ACTUATORS	17.4	14.1	13.3	13.7	15.2
AVIONICS	19.9	16.1	14.7	16.4	15.6
ECS	29.7	29.7	29.7	36.0	33.5
PERSON PROV	784	1539	1539	493	476
REC & AUX SYS	88.5	88.5	88.5	117	224
AIRCRAFT	1.8	1.9	1.9	1.8	1.7

Table 23
Model Validation - C141B

SUBSYSTEM	MODE 1	MODE 2	MODE 3	OCT 87 MAR 88	APR 88 SEP 88
STRUCTURAL	3.6	1.3	1.7	2.7	2.3
LANDING GEAR	1.5	3.6	7.8	6.8	6.3
PROPULSION	9.6	9.6	9.6	3.3	2.6
APU	147	60.7	54.1	41.5	32.0
ELECTRICAL	37.3	46.1	39.1	8.9	7.6
HYDRAULICS	5.6	5.6	5.6	15.6	14
ACTUATORS	11.1	3.1	5.0	4.9	4.5
AVIONICS	1.7	1.8	1.7	4.0	3.2
ECS	16.6	16.6	16.6	10.7	9.9
PERSON PROV	210	50.1	50.1	30.8	23.3
REC & AUX SYS	120.7	120.8	120.8	96.7	87.0
AIRCRAFT	.50	.43	.52	.57	.48

VII. User Options

At the conclusion of a run, the user has the option of repeating the analysis after changing one or more of the input parameters. Regardless of the mode, the primary variable screen will be displayed for update. If in mode 2 or 3, the subsystem weight menu will be available for update, and if in mode 3, the secondary variable menu will also appear. The calibration and mission/subsystem profile menu and technology growth rates will also be available for update.

The user may also save all of the current input menus for use at a later time. The calculated MTBMs (both space adjusted and critical operating hours between failures) may also be saved for a more detailed reliability calculation.

Chapter VI

Conclusion

This report describes the data, methodology, and results of a one year research effort to develop a model for predicting R&M parameters for conceptual space transportation systems for use in determining operational capabilities and support costs. While the model appears to work reasonable well when applied to aircraft systems, its accuracy when used for space systems has not as yet been demonstrated.

The model is dynamic and should be updated as new data becomes available. It is particularly important to integrate the current aircraft data base with data obtained from the Shuttle and other space systems. Subsystems unique to a space vehicle such as the TPS, propulsion systems, and docking systems require data not available from aircraft. Although this study has included these subsystems in a rationale way using comparability with aircraft subsystems, their uniqueness requires the use of R&M parameters obtained from similar subsystems in order to insure a higher degree of accuracy. As the model is used over time, those features which seem to work should be retained while those which do not provide reasonable results should be replaced. The model is modularized in the sense that any regression equation may be easily replaced without affecting other areas of the model.

Finally, this research addressed only the major subsystems on the vehicle. The space transportation system includes booster rockets, launch and recovery facilities, software, and expendable fuels, oxygen, etc. Therefore, follow-on research efforts should focus on these aspects of the system. Much work remains as well in refining the subsystem analysis. Better accuracy may be achieved by analyzing component (rather than subsystem) failures and repair. Subsystems may then be defined in terms of their individual components. This would also permit a more explicit determination of redundancy and its effect on mission reliability.

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APPENDIX A

AFALDP 800-4 Format

AIRCRAFT SYSTEM RELIABILITY AND MAINTAINABILITY SUMMARY

AIRCRAFT C009A REPORT PERIOD: 1 APR 86 TO 30 SEP 86

AVG. INVENTORY: 17 FLYING HOURS: 13126 SORTIES: 10726 LANDINGS: 14402

WUC SYS	SYSTEM NOUN	MEAN-TIME-BETWEEN-MAINTENANCE				NUMBER OF MAINTENANCE MANHOURS							
						INHERENT		INDUCED		NO DEFECT		TOTAL	
		INHERENT	INDUCED	NO DEFECT	TOTAL	ON EQ	OFF EQ	ON EQ	OFF EQ	ON EQ	OFF EQ	ON EQ	OFF EQ
03	*SCHED INSP LOOK PH	.00	.00	.00	.000	0	0	0	0	0	0	9965	0
04	*SPECIAL INSP	.00	.00	.00	.000	0	0	0	0	0	0	2464	11
11	AIRFRAME	20.70	20.01	97.96	9.141	3946	266	1485	38	997	14	6457	630
12	COCKPIT & FUS COMPT	27.29	12.66	75.01	7.618	1509	819	1878	139	797	96	4359	1689
13	LANDING GEAR SYS	21.14	64.03	93.09	13.818	3092	252	380	545	752	1249	4244	2132
14	FLIGHT CONTROLS	33.15	83.08	66.29	17.408	2745	76	807	2	1124	8	4474	224
23	TURBO FAN PWR PLANT	56.09	68.01	89.29	22.788	2121	100	804	29	1418	36	4360	441
24	AUXILIARY PWR PLANT	136.32	437.53	267.88	73.742	742	1	57	12	278	0	1094	24
41	AIR COND,PRES&ICE	60.49	111.24	89.29	27.232	1196	10	342	13	742	0	2280	65
42	ELECTL PWR SUPPLY	177.38	656.30	375.03	100.969	2534	362	81	0	194	0	2815	394
44	LIGHTING SYSTEM	28.17	112.19	336.56	20.868	973	5	189	2	132	0	1315	34
45	HYD & PNEU PR SUPLY	149.16	345.42	257.37	74.158	456	7	64	0	223	0	743	7
46	FUEL SYSTEM	128.69	570.70	172.71	64.980	1610	0	108	0	830	0	2578	2
47	OXYGEN	218.77	328.15	164.08	71.727	271	13	114	3	410	0	804	26
49	MISC UTILITIES	525.04	656.30	937.57	218.767	181	0	77	0	79	0	345	18
51	INSTRUMENTS	190.23	820.38	120.42	67.313	282	13	29	0	374	14	686	52
52	AUTOPILOT	144.24	2187.67	226.31	84.684	391	0	2025	0	285	0	2701	10
56	ALL WEATHER LND SYS	99.44	937.67	119.33	51.074	537	0	43	0	438	0	1021	0
61	HF COMMUNICATIONS	729.22	.00	4375.33	596.636	68	4	0	0	5	0	79	8
62	VHF COMMUNICATIONS	201.94	.00	1875.14	179.808	212	10	0	0	17	0	236	10
63	UHF COMMUNICATIONS	201.94	13126.00	2625.20	184.873	200	0	1	0	16	0	217	0
64	INTERPHONE G610 11	114.14	1458.44	1458.44	98.692	336	7	10	0	41	0	386	37
65	IFF/ATC APX 64	820.38	.00	423.42	278.277	62	0	0	0	46	0	108	0
66	EMERGENCY COMMUN	1193.27	13126.00	437.53	312.524	91	4	4	0	103	14	198	29
69	MISC COMM EQUIP	437.53	4375.33	6563.00	375.029	58	0	2	0	28	0	88	0
71	*RADIO NAVIGATION	125.01	1458.44	729.22	99.439	507	83	22	4	74	13	603	179
72	RADAR NAVIGATION	195.91	4375.33	604.85	136.729	354	221	29	0	97	0	479	221
91	EMERGENCY EQUIP	1312.60	4375.33	1875.14	656.300	15	0	20	0	11	44	46	44
97	*EXP DEV & COMP	.00	13126.00	.00	13126.000	0	0	1	0	0	0	1	0
	TOTAL SYSTEMS	3.08	4.82	7.72	1.495	24489	1953	8252	787	9511	1448	55149	6285

APPENDIX B

MODAS Report Format

Operational Summary

Date Range = January, 1990 TO December, 1991 , Base Code = ****

MDS/CMD = F004E /***

Date	Flight Hours	Poss. Hours	Sorties	Landings	Avg. Inv.	Percnt FMC	Percnt PMC	Percnt NMC
1 90	4832	164606	4039	4704	220	64.76	6.68	28.56
2 90	4607	179401	3757	4336	266	68.59	6.97	24.45
3 90	5185	139978	4153	4483	190	64.92	7.35	27.72
4 90	4974	186269	3927	4534	258	69.08	6.88	24.04
5 90	4995	194349	3986	4368	261	68.83	7.85	23.32
6 90	4932	167411	3950	4255	232	66.10	9.97	23.94
7 90	4459	249048	3617	4105	335	79.18	3.34	17.48
8 90	5434	246912	4481	4763	332	83.59	3.57	12.84
9 90	3392	237120	2925	3121	330	81.05	4.72	14.23
10 90	4429	243360	3737	4398	325	82.89	4.19	12.92
11 90	3968	234000	3399	3584	325	80.04	5.05	14.91
12 90	3003	241800	2586	2710	325	86.26	3.17	10.56
1 91	2702	241080	2365	2732	323	88.23	2.38	9.39
2 91	2777	217728	2342	2507	324	84.38	2.41	13.21
3 91	3374	238920	2561	2696	320	85.97	2.03	12.00
4 91	3381	227580	2384	2725	316	86.62	1.40	11.97
5 91	2658	229728	2095	2254	311	90.80	0.73	8.47
6 91	2096	221304	1720	1802	307	92.52	0.33	7.15
7 91	1930	226776	1507	1798	305	91.91	0.27	7.82
8 91	1674	211698	1205	1338	284	92.99	0.38	6.63
9 91	982	198336	739	792	276	95.98	0.16	3.86
10 91	1175	196536	847	1076	264	96.41	0.29	3.30
11 91	816	180888	607	724	252	97.24	0.23	2.53
12 91	619	181536	521	640	244	98.04	0.25	1.71
TOTAL	78394	5056364	63450	70445				

Summary Maintenance Data - Manhours

Date Range = January, 1990 TO December, 1991 , Base Code = ****

MDS/WUC = F004E /11***

Date	Flight Hours		Maintenance Manhours				On-Eq	
	Mo	Cum	On-Eq	Off-Eq	Sup	Total	Events	MMHTR
1 90	4832	4832	8905	259	0	9164	2203	3.56
2 90	4607	9439	5358	259	0	5617	1216	3.79
3 90	5185	14624	8248	509	0	8757	1827	4.22
4 90	4974	19598	8046	716	0	8762	1693	4.34
5 90	4995	24593	6444	550	0	6994	1521	3.86
6 90	4932	29525	4548	218	0	4766	1103	3.70
7 90	4459	33984	5332	340	0	5672	1131	4.28
8 90	5434	39418	4323	19	0	4342	938	3.70
9 90	3392	42810	4255	86	0	4341	985	4.03
10 90	4429	47239	5443	66	0	5509	971	4.94
11 90	3968	51207	7135	209	0	7344	1290	4.95
12 90	3003	54210	4906	229	0	5135	838	4.89
1 91	2702	56912	5933	177	0	6110	928	5.66
2 91	2777	59689	1961	63	0	2024	319	5.09
3 91	3374	63063	3082	17	0	3099	399	5.07
4 91	3381	66444	2903	90	0	2993	633	4.10
5 91	2658	69102	664	24	0	688	246	2.62
6 91	2096	71198	1127	17	0	1144	212	4.95
7 91	1930	73128	2525	133	0	2658	314	6.81
8 91	1674	74802	944	18	0	962	247	3.51
9 91	982	75784	1028	11	0	1039	254	3.72
10 91	1175	76959	1154	95	0	1249	342	3.44
11 91	816	77775	422	5	0	427	124	3.02
12 91	619	78394	550	17	0	567	141	3.64
TOTAL	78394		95236	4127	0	99363	19875	

Abort Summary - ON Equipment

Date Range = January, 1990 TO December, 1991 , Base Code = ****

MDS/WUC = F016A /11***

	Flight Hours		Abort Count				Sorties	
Date	Mo	Cum	Air	Ground	Total	Cum	Mo	Cum
1 90	11801	11801	1	8	9	9	8618	8618
2 90	10932	22733	0	3	3	12	7684	16302
3 90	12327	35060	0	7	7	19	8910	25212
4 90	11936	46996	0	5	5	24	8953	34165
5 90	11681	58677	0	3	3	27	8618	42783
6 90	12466	71143	1	8	9	36	9222	52005
7 90	10915	82058	4	17	21	57	7875	59880
8 90	12765	94823	1	4	5	62	9486	69366
9 90	10033	104856	2	2	4	66	7473	76839
10 90	11958	116814	1	5	6	72	8726	85565
11 90	10761	127575	0	5	5	77	7885	93450
12 90	9011	136586	2	7	9	86	6477	99927
1 91	9696	146282	1	10	11	97	6817	106744
2 91	12238	158520	1	4	5	102	8590	115334
3 91	11504	170024	0	0	0	102	8088	123422
4 91	11796	181820	4	5	9	111	7804	131226
5 91	11696	193516	0	2	2	113	8012	139238
6 91	9787	203303	2	3	5	118	7326	146564
7 91	9300	212603	4	5	9	127	7180	153744
8 91	10302	222905	1	4	5	132	7979	161723
9 91	9818	232723	1	3	4	136	7315	169038
10 91	10936	243659	0	3	3	139	8089	177127
11 91	8869	252528	0	5	5	144	6679	183806
12 91	7693	260221	2	8	10	154	5902	189708
TOTAL	260221		28	126	154		189708	

Summary Maintenance Data - Failures

Date Range = January, 1990 TO December, 1991 , Base Code = ****

MDS/WUC = F004E /11***

Date	Flight Hours		On-Equipment Failures				
	Mo	Cum	T1	T2	T6	Total	Removals
1 90	4832	4832	610	113	167	890	558
2 90	4607	9439	375	60	114	549	302
3 90	5185	14624	492	68	128	688	414
4 90	4974	19598	489	45	120	654	370
5 90	4995	24593	292	67	132	491	183
6 90	4932	29525	255	24	160	439	144
7 90	4459	33984	179	34	187	400	77
8 90	5434	39418	281	40	95	416	149
9 90	3392	42810	197	20	87	304	90
10 90	4429	47239	67	21	124	212	30
11 90	3968	51207	538	72	106	716	310
12 90	3003	54210	307	31	79	417	128
1 91	2702	56912	416	56	47	519	215
2 91	2777	59689	40	12	29	81	11
3 91	3374	63063	80	11	66	157	47
4 91	3381	66444	185	21	63	269	83
5 91	2658	69102	83	19	18	120	48
6 91	2096	71198	50	6	18	74	31
7 91	1930	73128	44	15	23	82	22
8 91	1674	74802	102	10	12	124	50
9 91	982	75784	58	13	19	90	23
10 91	1175	76959	53	3	14	70	20
11 91	816	77775	21	1	9	31	7
12 91	619	78394	41	4	3	48	10
TOTAL	78394		5255	766	1820	7841	3322

System Summary - Reliability

Date Range = July, 1991 TO July, 1991 , Base Code = ****
MDS/WUC = F015A /*****

System	Removal	MTBR	Failure Count				MTBM			
			T1	T2	T6	Total	T1	T2	T6	Total
2 =POWER PLAN	865	7	682	45	1317	2044	9	141	4	3
03=LOOK PH SC	0	0	0	0	0	0	0	0	0	0
04=SPECIAL IN	0	0	0	0	0	0	0	0	0	0
11=AIRFRAME	37	171	215	20	247	482	29	317	25	13
12=CKPT & FUS	46	137	43	3	96	142	147	2114	66	44
13=LANDING GE	302	21	306	17	119	442	20	373	53	14
14=FLIGHT CON	81	78	118	10	120	248	53	634	52	25
32=NOT DEFINE	0	0	0	0	8	8	0	0	792	792
41=AIR COND P	38	166	53	3	99	155	119	2114	64	40
42=ELECTRICAL	36	176	30	1	60	91	211	6343	105	69
43=NOT DEFINE	0	0	0	0	5	5	0	0	1268	1268
44=LIGHTING S	31	204	38	1	25	64	166	6343	253	99
45=HYD AN PNE	66	96	88	1	73	162	72	6343	86	39
46=FUEL SYSTE	85	74	77	3	147	227	82	2114	43	27
47=OXYGEN SYS	13	487	14	1	9	24	453	6343	704	264
49=MISC UTILI	19	333	11	1	36	48	576	6343	176	132
51=INSTRUMENT	149	42	150	3	162	315	42	2114	39	20
52=AUTOPILOT	39	162	39	0	59	98	162	0	107	64
53=NOT DEFINE	0	0	0	0	1	1	0	0	6343	6343
54=NOT DEFINE	1	6343	1	0	0	1	6343	0	0	6343
55=MALF ANAL	17	373	19	0	12	31	333	0	528	204
57=INTER GUID	18	352	66	4	31	101	96	1585	204	62
62=NOT DEFINE	0	0	1	0	0	1	6343	0	0	6343
63=UHF COMMUN	89	71	169	5	90	264	37	1268	70	24
65=IFF	89	71	174	8	91	273	36	792	69	23
71=RADIO NAVI	112	56	113	1	120	234	56	6343	52	27
74=FIRE CONTR	415	15	447	5	560	1012	14	1268	11	6
75=WPN DLVRY	91	69	90	2	373	465	70	3171	17	13
76=TAC ELEC W	116	54	163	0	116	279	38	0	54	22
91=EMERG EQUI	19	333	1	0	20	21	6343	0	317	302
92=TOW TARGET	0	0	0	0	0	0	0	0	0	0
97=EXPLOSIVE	123	51	3	1	124	128	2114	6343	51	49
TOTAL	2897		3111	135	4120	7366				

System Summary - Maintainability

Date Range = August, 1989 TO July, 1991 , Base Code = ****

MDS/WUC = F015B /***** F015A /*****

System	Maintenance Manhours				On Equip.		Off Equip.	
	On-eq	Off-eq	Supp	Total	MH/FH	MMHTR	MHTR	MHTC
01=NOT DEFINE	0	0	549874	549874	3.464	0.000	0	0
2 =POWER PLAN	599911	289764	173219	1062894	6.697	9.334	40376	0
03=LOOK PH SC	0	0	721345	721345	4.545	0.000	0	0
04=SPECIAL IN	0	0	544554	544554	3.431	0.000	0	0
05=NOT DEFINE	0	0	447	447	0.003	0.000	0	0
06=NOT DEFINE	0	0	77327	77327	0.487	0.000	0	0
07=NOT DEFINE	0	0	44412	44412	0.280	0.000	0	0
08=NOT DEFINE	0	0	1034	1034	0.007	0.000	0	0
09=NOT DEFINE	0	4	195225	195229	1.230	0.000	0	0
10=NOT DEFINE	6	0	0	6	0.000	0.600	0	0
11=AIRFRAME	268809	6427	0	275236	1.734	3.846	3817	0
12=CKPT & FUS	50057	4522	0	54579	0.344	5.778	3389	4
13=LANDING GE	70593	41831	0	112424	0.708	5.094	19236	0
14=FLIGHT CON	81141	9679	0	90820	0.572	6.670	5387	1
15=NOT DEFINE	53	22	0	75	0.000	4.417	11	0
16=NOT DEFINE	25	60	0	85	0.001	1.333	60	0
17=NOT DEFINE	9	21	0	30	0.000	2.250	0	0
18=NOT DEFINE	6	0	0	6	0.000	2.000	0	0
31=NOT DEFINE	76	0	0	76	0.000	3.455	0	0
32=NOT DEFINE	192	2	0	194	0.001	3.176	0	0
33=NOT DEFINE	33	4	0	37	0.000	5.200	0	0
34=NOT DEFINE	33	18	0	51	0.000	4.833	8	0
36=NOT DEFINE	5	0	0	5	0.000	5.000	0	0
39=NOT DEFINE	21	0	0	21	0.000	2.000	0	0
40=NOT DEFINE	3	0	0	3	0.000	0.000	0	0
41=AIR COND P	46537	8391	0	54928	0.346	5.945	6787	0
42=ELECTRICAL	31397	25912	0	57309	0.361	6.465	22499	0
43=NOT DEFINE	335	1	0	336	0.002	2.629	0	0
44=LIGHTING S	33792	5519	0	39311	0.248	3.126	4080	0
45=HYD AN PNE	53546	5627	0	59173	0.373	5.961	3510	0
46=FUEL SYSTE	138550	7347	0	145897	0.919	13.417	1660	0
47=OXYGEN SYS	6246	1316	0	7562	0.048	3.739	528	0
48=NOT DEFINE	1033	0	0	1033	0.007	13.800	0	0
49=MISC UTILI	13409	790	0	14199	0.089	8.214	317	0
50=NOT DEFINE	528	0	0	528	0.003	1.000	0	0
51=INSTRUMENT	43838	14741	0	58579	0.369	4.678	4711	0
52=AUTOPILOT	19660	11820	0	31480	0.198	7.998	7613	0
53=NOT DEFINE	4334	22	0	4356	0.027	6.414	7	0
54=NOT DEFINE	152	1	0	153	0.001	5.500	0	0
55=MALF ANAL	7908	5097	0	13005	0.082	4.224	2858	0
56=NOT DEFINE	2	0	0	2	0.000	0.000	0	0
57=INTER GUID	8441	5091	0	13532	0.085	3.471	3147	0
59=NOT DEFINE	1	0	0	1	0.000	1.000	0	0
61=NOT DEFINE	2	16	0	18	0.000	0.000	13	0
62=NOT DEFINE	6	19	0	25	0.000	2.000	12	0
63=UHF COMMUN	29126	25204	0	54330	0.342	3.316	16979	1
64=NOT DEFINE	77	43	0	120	0.001	4.714	41	0
65=IFF	26519	40602	0	67121	0.423	3.140	32205	0
66=NOT DEFINE	13	33	0	46	0.000	2.000	27	0
69=NOT DEFINE	11	0	0	11	0.000	0.000	0	0
70=NOT DEFINE	1	0	0	1	0.000	1.000	0	0
71=RADIO NAVI	34342	28190	0	62532	0.394	4.096	13382	0

```
Marcon Industries            *** M O D A S  II  ***
Record Type: A          Detail Maintenance Data Report
MDS: B001B

                                  Summary Report
                                      AUG 90

                                 Cum.                    Total
                       Total     Crew       Total        Units
                        Time     Size     Man-hours    Produced

                       214.8      247       520.8         101
Hit <RETURN> to continue, or "$" to end output:   Marcon Industries
  M O D A S  II  ***                      Page:    1
 Record Type: A          Detail Maintenance Data Report
 MDS: B001B

                                  Summary Report
                                      SEP 90

                                 Cum.                    Total
                       Total     Crew       Total        Units
                        Time     Size     Man-hours    Produced

                       162.0      180       306.8          88
Hit <RETURN> to continue, or "$" to end output:
 Marcon Industries            *** M O D A S  II  ***
 Record Type: A          Detail Maintenance Data Report
 MDS: B001B

                                  Summary Report
                                      OCT 90

                                 Cum.                    Total
                       Total     Crew       Total        Units
                        Time     Size     Man-hours    Produced

                       295.9      349       757.6         141
Hit <RETURN> to continue, or "$" to end output:
```

Failures selected are All Failures

Reliability - MTBM (by type)

Date Range = August, 1989 TO July, 1991 , Base Code = ****

MDS/WUC = F015A /74F** F015B /74F**

Date	Flight Hours Mo	Flight Hours Cum	Failure Count	Mean Time Between Maint. Monthly	Mean Time Between Maint. 3mo avg	Mean Time Between Maint. Cum
8 89	7782	7782	949	8.20	8.20	8.20
9 89	5327	13109	615	8.66	8.38	8.38
10 89	7402	20511	845	8.76	8.51	8.51
11 89	6066	26577	750	8.09	8.50	8.41
12 89	5394	31971	589	9.16	8.64	8.53
1 90	6587	38558	1112	5.92	7.36	7.93
2 90	6100	44658	625	9.76	7.77	8.14
3 90	7133	51791	919	7.76	7.46	8.09
4 90	7369	59160	553	13.33	9.82	8.50
5 90	6908	66068	897	7.70	9.04	8.41
6 90	6861	72929	794	8.64	9.42	8.43
7 90	5732	78661	1163	4.93	6.83	8.02
8 90	7428	86089	741	10.02	7.42	8.16
9 90	5127	91216	961	5.34	6.38	7.92
10 90	7004	98220	1092	6.41	7.00	7.79
11 90	6821	105041	703	9.70	6.88	7.89
12 90	5449	110490	726	7.51	7.65	7.87
1 91	6182	116672	955	6.47	7.74	7.78
2 91	6135	122807	792	7.75	7.18	7.78
3 91	7043	129850	830	8.49	7.51	7.82
4 91	6757	136607	936	7.22	7.79	7.79
5 91	7768	144375	916	8.48	8.04	7.82
6 91	6895	151270	691	9.98	8.42	7.90
7 91	7449	158719	707	10.54	9.56	7.99
TOTAL	158719		19861			

AIRCRAFT SYSTEM RELIABILITY AND MAINTAINABILITY SUMMARY

AIRCRAFT C009A REPORT PERIOD: 1 APR 86 TO 30 SEP 86

AVG. INVENTORY: 17 FLYING HOURS: 13126 SORTIES: 10726 LANDINGS: 14402

WUC SYS	SYSTEM NOUN	MEAN-TIME-BETWEEN-MAINTENANCE				NUMBER OF MAINTENANCE MANHOURS							
						INHERENT		INDUCED		NO DEFECT		TOTAL	
		INHERENT	INDUCED	NO DEFECT	TOTAL	ON EQ	OFF EQ	ON EQ	OFF EQ	ON EQ	OFF EQ	ON EQ	OFF EQ
03	*SCHED INSP LOOK PH	.00	.00	.00	.000	0	0	0	0	0	0	9965	0
04	*SPECIAL INSP	.00	.00	.00	.000	0	0	0	0	0	0	2484	11
11	AIRFRAME	20.70	20.01	97.96	9.141	3948	268	1485	38	997	14	6457	630
12	COCKPIT & FUS COMPT	27.29	12.66	78.01	7.618	1809	819	1878	139	787	56	4359	1669
13	LANDING GEAR SYS	21.14	64.03	93.09	13.818	3092	252	980	545	752	1249	4244	2132
14	FLIGHT CONTROLS	33.15	83.06	66.29	17.408	2745	76	807	2	1124	8	4474	224
23	TURBO FAN PWR PLANT	56.09	68.01	89.29	22.788	2121	100	804	29	1418	36	4360	441
24	AUXILIARY PWR PLANT	136.32	437.53	267.88	73.742	742	1	57	12	278	0	1094	24
41	AIR COND,PRES&ICE	60.49	111.24	89.28	27.232	1196	10	342	13	742	0	2280	69
42	ELECTL PWR SUPPLY	177.38	656.30	378.03	100.869	2534	362	81	0	194	0	2815	984
44	LIGHTING SYSTEM	28.17	112.19	336.56	20.868	973	9	169	2	132	0	1318	34
45	HYD & PNEU PR SUPLY	149.16	345.42	257.37	74.158	456	7	64	0	223	0	743	7
46	FUEL SYSTEM	128.69	570.70	172.71	64.980	1610	0	108	0	830	0	2678	2
47	OXYGEN	218.77	328.15	164.06	71.727	271	13	114	3	410	0	804	26
49	MISC UTILITIES	525.04	656.30	937.57	218.767	181	0	77	0	79	0	345	18
51	INSTRUMENTS	180.23	820.38	120.42	67.313	282	13	29	0	374	14	686	52
52	AUTOPILOT	144.24	2187.67	226.31	84.684	391	0	2025	0	285	0	2701	10
56	ALL WEATHER LND SYS	99.44	937.67	118.33	51.074	537	0	43	0	438	0	1021	0
61	HF COMMUNICATIONS	729.22	.00	4378.33	596.636	68	4	0	0	5	0	79	6
62	VHF COMMUNICATIONS	201.94	.00	1876.14	170.808	212	10	0	0	17	0	236	10
63	UHF COMMUNICATIONS	201.94	13126.00	2625.20	184.873	200	0	1	0	16	0	217	0
64	INTERPHONE G610 11	114.14	1458.44	1458.44	98.892	336	7	10	0	41	0	386	37
65	IFF/ATC APX 64	820.38	.00	423.42	278.277	62	0	0	0	46	0	108	0
66	EMERGENCY COMMUN	1193.27	13126.00	437.53	312.824	91	4	4	0	103	14	198	29
69	MISC COMM EQUIP	437.53	4378.33	6563.00	376.028	88	0	2	0	28	0	88	0
71	*RADIO NAVIGATION	125.01	1458.44	729.22	99.439	507	83	22	4	74	13	603	179
72	RADAR NAVIGATION	195.91	4378.33	804.65	136.729	354	221	29	0	97	0	479	221
91	EMERGENCY EQUIP	1312.60	4378.33	1875.14	656.300	15	0	20	0	11	44	46	44
97	*EXP DEV & COMP	.00	13126.00	.00	13126.000	0	0	1	0	0	0	1	0
	TOTAL SYSTEMS	3.08	4.82	7.72	1.495	24489	1953	8252	787	9511	1448	55149	6285

Narcon Industries *** M U D A S II *** Page: 1
Record Type: A Detail Maintenance Data Report TUE, SEP 24 1991
MDS: B001B 13:29:05

JCN (Julian Day)	JCN2 (Serial)	Day (Julian)	Year (1 digit)	Time	WUC	Type Maint	Action Taken	When Disco	How Mal	Failure (1,2 or 6)	Start Time	Stop Time	Crew Size	Tail No.	Base Id	Cmd
208	0262	211	0	00000	42BD0	C	X	F	002	6	1030	1630	2	6110	JFSD	0S
211	0120	211	0	00541	42BDA	B	R	F	721	1	0700	1330	3	6115	JFBD	0S
211	4151	211	0	00688	42BDA	B	T	D	799	6	1500	1530	3	6118	JFBD	0S
221	0230	221	0	00000	42B99	B	L	F	127	1	1420	1440	3	6115	JFBD	0S
221	0230	221	0	00000	42BA0	B	X	F	799	6	1440	1500	3	6115	JFBD	0S
221	0230	221	0	00000	42BA0	B	Y	F	242	1	1400	1420	3	6115	JFBD	0S
220	0357	222	0	00000	42BA0	B	H	C	799	6	0800	1600	2	5069	FNWZ	0S
221	0258	223	0	00000	42BD0	B	G	2	105	2	0700	1000	2	5080	PRQE	0S
223	0038	223	0	00000	42BDB	B	R	F	381	1	1730	1930	2	6115	JFBD	0S
225	4151	225	0	00000	42BAA	B	T	F	799	6	1400	1500	2	6129	PRQE	0S
225	4151	225	0	00000	42BAA	B	U	F	799	6	1500	1600	2	6129	PRQE	0S
225	0314	225	0	00000	42BD0	B	G	E	105	2	1930	2000	2	5070	FNWZ	0S
225	4052	225	0	00601	42BAC	B	R	F	450	1	1300	1600	3	6139	PRQE	0S
225	5553	226	0	00000	42BA0	B	X	D	799	6	0700	0800	2	6093	FXBM	0S
157	0199	226	0	00000	42BA0	B	X	B	799	6	1100	1200	2	6126	PRQE	0S
204	0326	226	0	00000	42BA0	B	X	F	799	6	0700	0900	2	6126	PRQE	0S
225	5553	226	0	00927	42BAA	B	R	D	255	1	0005	0200	2	6093	FXBM	0S
227	0559	227	0	00000	42BA0	B	H	F	799	6	0800	0900	2	3070	FNWZ	0S
227	0251	227	0	00000	42BA0	B	X	B	799	6	0700	0900	2	5062	FNWZ	0S
208	0031	227	0	00000	42BA0	B	X	F	799	6	2130	2400	3	6118	JFBD	0S
227	0299	227	0	00000	42BAA	B	R	B	721	1	1200	1300	2	4058	FNWZ	0S
207	0148	227	0	00000	42BE0	B	X	B	799	6	0000	0000	0	6113	JFBD	0S
211	4151	227	0	00688	42BDA	B	U	D	799	6	0200	0400	1	6118	JFSD	0S
227	4152	227	0	00874	42BDA	B	T	F	799	6	0005	0200	1	6113	JFSD	0S
227	0251	228	0	00000	42BA0	B	X	B	799	6	1400	1600	2	5062	FNWZ	0S
208	0031	228	0	00000	42BA0	B	X	F	799	6	0005	0045	3	6118	JFSD	0S
227	0109	228	0	00000	42BAH	B	H	F	799	6	0700	0800	1	6130	PRQE	0S
228	4519	228	0	00000	42BDA	B	T	F	799	6	1730	1900	5	3071	FNWZ	0S
228	0436	228	0	00000	42BDA	B	R	F	615	1	2200	2330	6	5071	FNWZ	0S
229	0222	229	0	00000	42BA0	B	X	D	799	6	2230	2300	3	6118	JFSD	0S
229	0222	229	0	00000	42BA0	B	Y	D	037	1	2130	2200	3	6118	JFSD	0S
229	0222	229	0	00694	42BAA	B	R	D	037	1	2200	2230	3	6118	JFSD	0S
226	9042	230	0	00000	42BA0	B	G	2	615	1	0700	1200	2	6135	PRQE	0S
232	0118	231	0	00626	42BAA	B	R	F	242	1	1200	1600	2	6126	PRQE	0S
232	0414	232	0	00000	42BEA	B	X	B	450	1	1500	1945	3	5079	FXBM	0S
233	4008	233	0	00000	42BA0	B	X	2	799	6	2000	2005	1	3065	FNWZ	0S
225	0314	233	0	00000	42BDD	B	X	E	799	6	2300	2400	2	5070	FNWZ	0S
232	0307	233	0	00000	42BE0	B	Y	D	615	1	2130	2300	3	6116	JFSD	0S
233	0213	233	0	00000	42BEA	B	P	F	800	6	2000	2030	3	6113	JFSD	0S
232	0307	233	0	00000	42BEA	B	G	D	105	2	2300	2400	3	6116	JFSD	0S
225	0314	234	0	00000	42B99	B	G	E	105	2	1600	1800	2	5070	FNWZ	0S
232	0307	234	0	00000	42BE0	B	X	D	799	6	0700	0730	3	6116	JFSD	0S
233	0213	234	0	00000	42BEA	B	S	F	800	6	0730	0800	3	6113	JFSD	0S
232	0307	234	0	00000	42BEA	B	G	D	105	2	2400	0700	3	6116	JFSD	0S
235	0252	235	0	00000	42BAA	B	R	F	721	1	1230	1630	2	6132	FNWZ	0S
219	0210	235	0	00595	42BDA	B	U	F	799	6	1000	1200	2	6129	PRQE	0S
235	0152	235	0	00874	42BAH	B	P	F	800	6	0900	1100	1	6113	JFSD	0S
235	0420	236	0	00000	42BA0	B	H	F	799	6	2000	2400	4	5074	FNWZ	0S
235	0252	236	0	00000	42BA0	B	H	F	799	6	1800	1900	4	6132	FNWZ	0S
236	0166	236	0	00000	42BAA	B	R	F	721	1	1400	1630	2	4058	FNWZ	0S
190	4211	236	0	00000	42BAH	B	Q	F	799	6	0445	0505	1	5077	FXBM	0S
235	4681	236	0	00000	42BDA	B	G	F	105	2	0300	0600	2	5070	FNWZ	0S
228	0324	236	0	00000	42BDE	B	G	B	105	2	0700	0900	3	4058	FNWZ	0S
235	0387	236	0	00000	42BEA	B	X	F	799	6	0335	0400	2	3068	FNWZ	0S

APPENDIX C

Navy 3-M Report Format

CATALOG

OF

3-M AVIATION INFORMATION REPORTS

REPORT TITLE - RELIABILITY AND MAINTAINABILITY SUMMARY

REPORT No. - NAMSO 4790.A7142-01

FREQUENCY OF DISTRIBUTION - QUARTERLY

HIGHLIGHTS OF REPORT - AIRCRAFT: BY TYPE/MODEL/SERIES BY TYCOM/TOTAL NAVY

- DEPICTS RELIABILITY AND MAINTAINABILITY STATISTICS BASED ON AIRFRAME FLIGHT HOURS.
  - TOTAL MAINTENANCE ACTIONS AND FAILURES.
  - MEAN FLIGHT HOURS BETWEEN MAINTENANCE ACTIONS (MFHBMA).
  - MEAN FLIGHT HOURS BETWEEN FAILURES (MFHBF).
  - MANHOUR EXPENDITURES.
  - ASSEMBLY AND SYSTEM SUMMARIES.
  - PRODUCED QUARTERLY ON THREE MONTH DATA BASE.

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NAVY MAINTENANCE SUPPORT OFFICE

Naval Sea Logistics Center

Mechanicsburg, PA 17055-0795

AIRCRAFT F/A 18A

WUC	NOMENCLATURE	COMMAND	TOTAL FLIGHT HOURS	TOTAL MAINT ACTIONS	MFHBMA	MLT REPAIR FAILURE	TOTAL FAILURE	MFHBF	UNSCH MAINT MAN HOURS	UNSCH MAINT MAN HRS PER F/H	M/H PER MAINT ACT	EMT PER MAINT ACT
754CD	BRU32/A AIRCRAFT BOMB EJECTOR RACK	CNAL	4,845	164	29.5	8	32	151.4	302	.062	1.8	1.4
		FMFLANT	2,595	11	235.9	0	2	1,297.5	69	.027	6.3	5.8
		CNAP	4,413	112	39.4	6	13	339.5	223	.051	2.0	1.8
		FMFPAC	2,853	20	142.7	0	10	285.3	87	.030	4.3	2.8
		NASC	570	35	16.3	0	0	-.-	114	.200	3.3	1.9
		NAVRES	681	24	28.4	0	4	170.3	60	.088	2.5	1.9
		TOTAL	16,296	366	44.5	14	61	267.1	854	.052	2.3	1.9
754CE	BRU33/A AIRCRAFT BOMB EJECTOR RACK	CNAL	4,845	24	201.9	9	11	440.5	39	.008	1.6	1.2
		CNAP	4,413	12	367.8	0	1	4,413.0	21	.005	1.7	.8
		FMFPAC	2,853	18	158.5	0	8	356.6	66	.023	3.6	2.8
		TOTAL	16,296	56	291.0	9	21	776.0	154	.009	2.8	2.0
	TOTAL 754CO EJECTOR ASSEMBLIES/BOMB	CNAL	4,845	194	25.0	17	44	110.1	362	.075	1.9	1.4
		FMFLANT	2,595	12	216.3	0	3	865.0	95	.037	7.9	7.6
		CNAP	4,413	132	33.4	10	18	245.2	252	.057	1.9	1.1
		FMFPAC	2,853	42	67.9	4	22	129.7	156	.055	3.7	2.6
		NASC	570	40	14.3	0	0	-.-	122	.215	3.1	1.0
		NAVRES	681	26	26.2	0	4	170.3	76	.111	2.9	1.6
		TOTAL	16,296	446	36.5	31	91	179.1	1,063	.065	2.4	1.6
75E50	AIRCRAFT PYLONS	CNAL	4,845	20	242.3	3	3	1,615.0	35	.007	1.8	1.3
		CNAP	4,413	22	200.6	13	13	339.5	43	.010	2.0	1.0
		TOTAL	16,296	55	296.3	19	19	857.7	88	.005	1.6	1.0
75E51	SUU63/A AIRCRAFT PYLON	CNAL	4,845	154	31.5	18	20	242.3	300	.062	1.9	1.0
		CNAP	4,413	71	62.2	5	5	882.6	139	.032	2.0	.8
		FMFPAC	2,853	16	178.3	1	3	951.0	41	.015	2.6	1.2
		NASC	570	22	25.9	1	1	570.0	66	.116	3.0	.8
		TOTAL	16,296	274	59.5	27	31	525.7	559	.034	2.0	.9

A	B	C	D	E	F	G	H	J	K	L	M

A	The work unit code and its corresponding nomenclature. Data for work unit codes are summarized at the system (2nd) and assembly/set (4th) levels.
B	The major command or Navy-wide total.
C	Number of flight hours reported for the period.
D	Number of unscheduled maintenance actions initiated.

E	Mean flight hours between maintenance actions.
F	Number of failures repaired at the organizational level.
G	Number of maintenance actions confirmed as failures by the action taken code (B,C,Z or 1 thru 9) and a malfunction code other than a conditional malfunction.

H	Mean flight hours between failures.
J	Number of unscheduled maintenance manhours reported on the VIDS/MAF source document.
K	Maintenance manhours per flight hour.
L	Maintenance manhours per maintenance action.
M	Elapsed maintenance time per maintenance action.

CATALOG

OF

3-M AVIATION INFORMATION REPORTS

REPORT TITLE - WORK UNIT CODE SYSTEM RELIABILITY AND MAINTAINABILITY SUMMARY

REPORT No. - NAMSO 4790.A7142-02

FREQUENCY OF DISTRIBUTION - QUARTERLY

HIGHLIGHTS OF REPORT

- COMPARES SYSTEM PERFORMANCE FOR AN AIRCRAFT.
- SUMMARIZES RELIABILITY AND MAINTAINABILITY DATA BY MAJOR COMMAND, SPECIFIED WORK UNIT CODE AND AIRCRAFT.
- PROVIDES WORK UNIT CODE PERCENT OF TOTAL AIRCRAFT ACTIONS.

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NAVY MAINTENANCE SUPPORT OFFICE

Naval Sea Logistics Center
Mechanicsburg, PA 17055-0795

PERIOD - APR 87 THROUGH JUN 87
DATE - 21 AUG 87

NAVY
WORK UNIT CODE SYSTEM
RELIABILITY AND MAINTAINABILITY SUMMARY

NAMSO 4790.A7142-01
PAGE 281

AIRCRAFT	TOTAL FLIGHT HOURS	TOTAL MAINT ACTIONS	MFHBMA	ML 1 REPAIR FAILURE	TOTAL FAILURE	MFHBF	UNSCH MAINT MAN HOURS	MAINT M/H PER F/H	M/H PER MAINT ACT	EMT PER MAINT ACT	WUC % OF TOTAL ACFT MAINT ACT	WUC % OF TOTAL ACFT ML 1 FAIL	WUC % OF TOTAL ACFT TOT FAIL	WUC % OF TOTAL ACFT MAN HOURS
A WUC - 65000 NOMENCLATURE - IFF SYSTEMS														
KA-6D	1,521	39	39.0	11	18	84.5	201	.132	5.2	3.0	.7	.7	.8	.6
A-6E	17,634	667	26.4	119	296	59.6	4,300	.244	6.4	3.7	.9	.6	.9	.9
TA-7C	2,670	57	46.8	9	30	89.0	691	.259	12.1	6.9	.9	.6	1.0	1.5
A-7E	14,784	348	42.5	59	158	93.6	2,113	.143	6.1	4.0	.8	.5	.9	.9
EA-7L	564	23	24.5	2	4	141.0	295	.523	12.8	5.1	2.1	.8	1.0	3.8
C-2A	691	14	49.4	1	3	230.3	56	.080	4.0	2.3	.6	.1	.3	.3
TC-4C	797	8	99.6	2	2	398.5	17	.021	2.1	1.4	.5	.5	.3	.1
KC-130F	2,742	97	28.3	7	55	49.9	2,149	.784	22.2	8.0	1.4	.3	1.6	3.9
EC-130Q	841	8	105.1	0	4	210.3	118	.141	14.8	8.6	.6	.0	.5	1.6
KC-130T	274	12	22.8	1	3	91.3	73	.265	6.0	4.9	2.1	.6	1.2	1.8
E-2C	3,163	120	26.4	15	47	67.3	862	.272	7.2	4.1	1.5	.6	1.3	1.5
F/A-18A	21,044	272	77.4	37	67	314.1	951	.045	3.5	2.0	.7	.5	.5	.4
F/A-18B	3,304	21	157.3	2	5	660.8	101	.030	4.8	2.6	.5	.3	.4	.3
F-4S	2,794	164	17.0	30	90	31.0	1,356	.485	8.3	5.9	1.6	1.5	2.0	1.6
F-14A	21,582	1,109	19.5	213	546	39.5	7,585	.351	6.8	4.0	1.3	1.0	1.6	1.5

B	C	D	E	F	G	H	J	K	L	M	N

A	System level work unit code and nomenclature.
B	The identification of the aircraft.
C	Total flight hours for the reporting period.
D	Total system level maintenance actions initiated.
E	Mean flight hours between maintenance actions.

F	Number of repair actions accomplished at the organizational level.
G	Number of maintenance actions confirmed as failures.
H	Mean flight hours between failures.
J	Manhours required for unscheduled maintenance.

K	Maintenance manhours divided by flight hours.
L	Manhours per maintenance action.
M	Elapsed maintenance time per maintenance action.
N	Percentage of effort performed on the WUC relative to that expended on the entire aircraft.

CATALOG

OF

3-M AVIATION INFORMATION REPORTS

REPORT TITLE - RELIABILITY AND MAINTAINABILITY SUMMARY FOR SELECTED WORK UNIT CODES

REPORT No. - NAMSO 4790.A7142-03

FREQUENCY OF DISTRIBUTION - QUARTERLY

HIGHLIGHTS OF REPORT -

- PERMITS COMPARATIVE ANALYSIS OF ENGINES AND AVIONICS EQUIPMENT PERFORMANCE WITHIN VARIOUS AIRCRAFT.
- PORTRAYS THE FOLLOWING INFORMATION FOR WORK UNIT CODES LISTED IN THIS REPORT:
  - AIRCRAFT APPLICATION.
  - RELIABILITY AND MAINTAINABILITY STATISTICS.
  - WUC PERCENT OF TOTAL AIRCRAFT MAINTENANCE ACTIONS, FAILURES AND MAN-HOURS.
- EXCLUDES WORK UNIT CODES HAVING SIX OR LESS MAINTENANCE ACTIONS.

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Naval Sea Logistics Center
Mechanicsburg, PA 17055-0795

NAVY

PERIOD - APR 87 THROUGH JUN 87 RELIABILITY AND MAINTAINABILITY SUMMARY NAMSO 4790.A7142-02
DATE - 21 AUG 87 FOR SELECTED WORK UNIT CODES PAGE

AIRCRAFT	TOTAL FLIGHT HOURS	TOTAL MAINT ACTIONS	MFHBMA	MLT REPAIR FAILURE	TOTAL FAILURE	MFHBF	UNSCH MAINT MAN HOURS	MAINT M/H PER F/H	M/H PER MAINT ACT	EMT PER MAINT ACT	WUC % OF TOTAL ACTY MAINT ACT	WUC % OF TOTAL ACTY MLT FAIL	WUC % OF TOTAL ACTY TOT FAIL	WUC % OF TOTAL ACTY MAN HOUR
WUC - 72360 NOMENCLATURE - AN/APN141(V) ELECTRONIC ALTIMETER SET														
EA-6B	5,164	24	215.2	10	12	430.3	56	.011	2.3	1.2	.1	.2	.1	.1
KA-6D	1,521	8	190.1	2	2	760.5	14	.009	1.7	1.1	.1	.1	.1	.1
A-6E	17,634	74	238.3	36	44	400.8	210	.012	2.8	1.6	.1	.2	.1	.1
TA-7C	2,670	134	19.9	9	55	48.5	634	.238	4.7	3.5	2.0	.6	1.9	1.4
A-7E	14,784	39	379.1	7	19	778.1	279	.019	7.1	4.3	.1	.1	.1	.1
C-2A	691	10	69.1	1	4	172.8	314	.454	31.4	5.1	.4	.1	.4	1.6
P-3B	7,691	7	1,098.7	4	4	1,922.8	31	.004	4.5	2.6	.0	.1	.1	.0
TOTAL	74,403	2,079	35.8	235	947	78.6	12,153	.163	5.8	3.6	1.0	.4	1.0	1.0
WUC - 72380 NOMENCLATURE - AN/APN153(V) DOPPLER RADAR NAV SET														
ERA-3B	455	18	25.3	1	7	65.0	268	.588	14.9	7.6	1.3	.2	1.1	1.9
A-4E	2,235	27	82.8											1.9
A-4F	1,146	32	35.8											3.1
EA-6A	831	60	13.9											4.1
EA-6B	5,164	163	31.7											1.2
A-6E	17,634	921	19.1											1.1
A-7E	14,784	13	1,137.2											.0
TC-4C	797	33	24.2											2.2
P-3A	730	10	73.0											1.8
P-3B	7,691	213	36.1	22	130	59.2	2,598	.338	12.2	9.3	1.4	.5	1.7	2.3
TOTAL	51,467	1,490	34.5	324	923	55.8	14,103	.274	9.5	6.1	.9	.7	1.3	1.4
WUC - 72390 NOMENCLATURE - AN/APN154( )(V) RADAR BEACON SET														
A-4M	3,616	11	328.7	3	5	723.2	78	.021	7.0	6.4	.1	.1	.1	.2
EA-6B	5,164	42	123.0	10	19	271.8	437	.085	10.4	4.6	.2	.2	.2	.4
KA-6D	1,521	17	89.5	3	7	217.3	70	.046	4.1	2.5	.3	.2	.3	.2
A-6E	17,634	192	91.8	49	85	207.5	1,291	.073	6.7	4.2	.2	.2	.3	.3
TA-7C	2,670	23	116.1	5	10	267.0	99	.037	4.3	2.1	.3	.3	.3	.2
A-7E	14,784	81	182.5	31	42	352.0	243	.016	3.0	2.0	.2	.3	.2	.1
F-14A	21,582	205	105.3	52	85	253.9	918	.043	4.5	2.7	.2	.3	.2	.2
TOTAL	66,971	571	117.3	153	253	264.7	3,136	.047	5.5	3.3	.2	.2	.2	.2

Please refer to NAMSO Report 4790.A7142-02 for format definitions. The difference between this report (NAMSO 4790.A7142-03) and the preceding (NAMSO 4790.A7142-02) is that data is given by the first four positions of the work unit code. In NAMSO Report 4790.A7142-02, the data is summarized by the first two positions of the work unit code. Additionally, this report is restricted to work unit codes identifying engine and avionic equipments.

CATALOG OF 3-M AVIATION INFORMATION REPORTS

REPORT TITLE - RELIABILITY AND MAINTAINABILITY TREND ANALYSIS SUMMARY

REPORT No. - NAMSO 4790.A7142-04

FREQUENCY OF DISTRIBUTION - QUARTERLY

HIGHLIGHTS OF REPORT -

- DEPICTS RELIABILITY AND MAINTAINABILITY STATISTICS FOR A 4-DIGIT WUC.
- PROVIDES FOR MULTIPLE TIME FRAMES FOR TREND ANALYSIS.
- INDICATES COMPARATIVE FAILURE RANKING OF THE WUC IN RELATION TO ALL WUCs FOR THE AIRCRAFT.

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NAVY MAINTENANCE SUPPORT OFFICE

Naval Sea Logistics Center
Mechanicsburg, PA 17055-0795

WUC	NOMENCLATURE	PERIOD	TOTAL FLIGHT HOURS	TOTAL MAINT ACTIONS	MFHBMA	MLI REPAIR FAILURE	TOTAL FAILURE	MFHBF	UNSCH MAINT MAN HOURS	UNSCH MAINT M/H PER F/H	M/H PER MAINT ACT	LMI PER MAINT ACT	FAIL RANK
736G1	C9535/ASQ155 COMPUTER CONTR	APR87-JUN87	5,768	190	30.4	25	84	68.7	1,086	.188	5.7	3.3	18
		JAN87-MAR87	6,340	226	28.1	37	106	59.8	1,733	.273	7.7	4.0	14
		OCT86-DEC86	7,015	208	33.7	42	112	62.6	1,512	.216	7.3	3.9	14
		JUL86-SEP86	6,934	183	38.0	35	81	85.9	1,341	.193	7.3	4.0	25
		APR86-JUN86	6,035	189	31.9	37	89	67.8	1,427	.236	7.5	4.1	17
		JAN86-MAR86	6,782	178	38.5	29	90	75.4	1,560	.230	8.9	4.2	23
		OCT85-DEC85	6,395	149	42.9	27	75	85.3	1,028	.161	6.9	3.6	23
		JUL85-SEP85	6,574	152	43.3	26	78	84.3	939	.143	6.2	3.4	28
736G2	CV3163/ASQ155 A-D/D-A CONVE	APR87-JUN87	5,768	232	24.9	12	117	49.3	2,130	.369	9.2	5.4	10
		JAN87-MAR87	6,340	221	28.7	9	110	57.6	2,274	.359	10.3	5.9	12
		OCT86-DEC86	7,015	283	24.8	18	138	50.8	3,043	.434	10.8	6.0	10
		JUL86-SEP86	6,934	353	19.7	9	167	41.6	3,978	.572	11.3	6.4	7
		APR86-JUN86	6,035	264	22.9	20	138	43.7	2,798	.464	10.6	5.9	6
		JAN86-MAR86	6,782	217	31.3	16	112	60.6	2,246	.331	10.3	5.6	12
		OCT85-DEC85	6,395	287	22.3	13	134	47.7	2,482	.388	8.6	4.9	7
		JUL85-SEP85	6,574	247	26.6	10	108	60.9	2,238	.340	9.1	4.9	18
736G3	CV3163/ASQ155 A-D/D-A CONV	APR87-JUN87	5,768	14	412.0	0	10	576.8	42	.007	3.0	2.6	262
		JAN87-MAR87	6,340	19	333.7	1	16	396.3	126	.020	6.6	6.1	181
		OCT86-DEC86	7,015	36	194.9	0	33	212.6	203	.029	5.6	4.4	85
		JUL86-SEP86	6,934	31	224.3	0	30	231.8	155	.022	5.0	4.0	108
		APR86-JUN86	6,035	17	355.0	0	17	355.0	76	.013	4.5	3.5	171
		JAN86-MAR86	6,782	20	339.1	0	19	356.9	3	.000	.2	.2	173
		OCT85-DEC85	6,395	25	255.8	0	18	355.3	4	.001	.2	.1	167
		JUL85-SEP85	6,574	26	252.8	0	26	252.8	289	.044	11.1	6.0	121

A	B	C	D

A	The first five positions of the work unit code and its corresponding nomenclature.
B	The reporting period selected for the report. Multiple time periods may be included in the report.

C	Please refer to NAMSO Report 4790.A7142-01 or 4790.A7142-02 for format definitions.

D	The comparative failure ranking of the work unit code for the specified period as compared with all work unit codes for the aircraft.

CATALOG OF 3-M AVIATION INFORMATION REPORTS

REPORT TITLE - FIVE DIGIT WUC RELIABILITY AND MAINTAINABILITY TREND ANALYSIS SUMMARY

REPORT No. - NAMSO 4790.A7142-05

FREQUENCY OF DISTRIBUTION - QUARTERLY

HIGHLIGHTS OF REPORT -

- DEPICTS RELIABILITY AND MAINTAINABILITY STATISTICS FOR A 5-DIGIT WUC.
- PROVIDES FOR MULTIPLE TIME FRAMES FOR TREND ANALYSIS.
- INDICATES COMPARATIVE FAILURE RANKING OF THE WUC IN RELATION TO ALL WUCs FOR THE AIRCRAFT.

Published by

NAVY MAINTENANCE SUPPORT OFFICE

Naval Sea Logistics Center

Mechanicsburg, PA 17055-0795

WUC	NOMENCLATURE	PERIOD	TOTAL FLIGHT HOURS	TOTAL MAINT ACTIONS	MFHBMA	MI REPAIR FAILURE	TOTAL FAILURE	MFHBF	UNSCH MAINT MAN HOURS	UNSCH MAINT M/H PER F/H	M/H PER MAINT ACT	EMT PER MAINT ACT	FAIL RANK
727H	AN/APS116( ) RADAR SET	OCT86-DEC86	14,253	718	19.9	129	429	33.2	8,455	.593	11.8	9.0	10
		JUL86-SEP86	13,823	714	19.4	146	409	33.8	7,664	.556	10.8	7.7	11
		APR86-JUN86	14,305	809	17.7	162	444	32.2	9,980	.698	12.3	7.8	12
		JAN86-MAR86	15,825	898	17.6	177	497	31.8	10,415	.658	11.6	8.1	11
		OCT85-DEC85	13,447	654	20.6	123	346	38.9	8,031	.597	12.3	8.1	13
		JUL85-SEP85	16,414	887	18.5	205	476	34.5	11,808	.719	13.3	8.5	11
729D	AN/APN202 RADAR BEACON SET	APR87-JUN87	11,020	47	234.5	14	19	580.0	197	.018	4.2	2.9	149
		JAN87-MAR87	8,305	52	159.7	14	26	319.4	354	.043	6.8	4.3	122
		OCT86-DEC86	14,253	72	198.0	21	34	419.2	442	.031	6.1	4.0	131
		JUL86-SEP86	13,823	70	197.5	18	30	460.8	426	.031	6.1	3.7	128
		APR86-JUN86	14,305	62	230.7	27	41	348.9	363	.023	5.9	3.2	122
		JAN86-MAR86	15,825	80	197.8	33	50	316.5	389	.025	4.9	3.3	117
		OCT85-DEC85	13,447	77	174.6	20	36	373.5	455	.034	5.9	3.7	127
		JUL85-SEP85	16,414	63	260.5	24	32	512.9	240	.015	3.8	2.3	140
729F	OU78( )/AP CONV CONT GROUP R	APR87-JUN87	11,020	229	48.1	39	136	81.0	2,618	.238	11.4	6.9	30
		JAN87-MAR87	8,305	185	44.9	48	127	65.4	1,962	.236	10.6	6.8	29
		OCT86-DEC86	14,253	347	41.1	57	234	60.9	4,740	.333	13.7	8.7	24
		JUL86-SEP86	13,823	280	49.4	59	182	76.0	3,483	.252	12.4	7.7	27
		APR86-JUN86	14,305	328	43.9	73	200	71.5	3,704	.259	11.4	6.9	27
		JAN86-MAR86	15,825	357	44.3	91	246	64.3	4,139	.262	11.6	7.1	24
		OCT85-DEC85	13,447	348	38.9	70	205	65.6	3,716	.276	10.7	6.6	26
		JUL85-SEP85	16,414	328	50.0	58	192	85.5	4,507	.275	13.7	8.2	35

A	B	C	D

A	The first four positions of the work unit code and its corresponding nomenclature.
B	The reporting period selected for the report. Multiple time periods may be included in the report.

C	Please refer to NAMSO Report 4790.A7142-01 or 4790.A7142-02 for format definitions.

D	The comparative failure ranking of the work unit code for the specified period as compared with all work unit codes for the aircraft.

CATALOG OF 3-M AVIATION INFORMATION REPORTS

REPORT TITLE - RELIABILITY AND MAINTAINABILITY SUMMARY FOR SELECTED EQUIPMENTS

REPORT No. - NAMSO 4790.A7298-01

FREQUENCY OF DISTRIBUTION - ON DEMAND

HIGHLIGHTS OF REPORT -

- ALLOWS RELIABILITY AND MAINTAINABILITY COMPARISON BY ACTIVITY, WORK UNIT CODE, AIRCRAFT OR OTHER VARIABLE PARAMETERS AS REQUESTED.
- CUSTOMER SELECTS AIRCRAFT, WORK UNIT CODES AND DATE RANGE.
- PROVIDES WUC ASSEMBLY AND SYSTEM SUMMARIES.

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Naval Sea Logistics Center
Mechanicsburg, PA 17055-0795

PERIOD - MAY 87 THROUGH JUL 87
DATE - 17 OCT 87

RELIABILITY AND MAINTAINABILITY SUMMARY
FOR SELECTED EQUIPMENTS

ACFT - SH-60B

AIRCRAFT - SH-60B [A]

WUC	NOMENCLATURE	ACTIVITY	TOTAL FLIGHT HOURS	TOTAL MAINT ACTIONS	MFHBMA	MI REPAIR FAILURE	TOTAL FAILURE	MFHBF	UNSCH MAINT MAN HOURS	MAINT M/H PER F/H	M/H PER MAINT ACT	EMT PER MAINT ACT
74191	C10486( )/ASQ164 CONTROL INDIC	HSL-41	2,136	15	142.4	0	4	534.0	52	.024	3.5	2.3
		HSL-43 DET 5	298	1	298.0	0	1	298.0	6	.021	6.4	3.2
		HSL-43 DET 8	707	2	353.5	1	1	707.0	1	.001	.5	.5
		HSL-45	518	3	172.7	2	2	259.0	10	.019	3.3	1.7
		NATC ROTARY WIN	176	1	176.0	1	1	176.0	1	.008	1.4	.7
		TOTAL	6,468	22	294.0	4	9	718.7	71	.011	3.2	2.0
74192	C10487( )/ASQ164 CONTROL INDIC	HSL-40	502	4	125.5	0	1	502.0	20	.040	5.1	2.6
		HSL-41	2,136	4	534.0	0	0	-.-	7	.003	1.6	1.1
		HSL-43 DET 11	387	2	193.5	1	2	193.5	56	.144	27.9	14.5
		HSL-43	245	1	245.0	0	1	245.0	11	.045	11.1	3.7
		HSL-43 DET 5	298	2	149.0	0	0	-.-	2	.006	.9	.9
		HSL-43 DET 8	707	1	707.0	1	1	707.0	0	.000	.3	.3
		NATC ROTARY WIN	176	3	58.7	0	0	-.-	4	.020	1.2	1.0
		TOTAL	6,468	17	380.5	2	5	1,293.6	99	.015	5.8	3.1
	TOT 74190 AN/ASQ164( ) CONTROL	HSL-40	502	4	125.5	0	1	502.0	20	.040	5.1	2.6
		HSL-44	276	1	276.0	0	0	-.-	1	.004	1.0	1.0
		HSL-41	2,136	19	112.4	0	4	534.0	59	.027	3.1	2.1
		HSL-43 DET 11	387	2	193.5	1	2	193.5	56	.144	27.9	14.5
		HSL-43	245	1	245.0	0	1	245.0	11	.045	11.1	3.7
		HSL-43 DET 5	298	3	99.3	0	1	298.0	8	.028	2.7	1.7
		HSL-43 DET 8	707	4	176.8	2	2	353.5	2	.003	.5	.5
		HSL-45	518	3	172.7	2	2	259.0	10	.019	3.3	1.7
		NATC ROTARY WIN	176	4	44.0	1	1	176.0	5	.028	1.2	.9
		TOTAL	6,468	41	157.8	6	14	462.0	172	.027	4.2	2.4

A	B	C	D	E	F	G	H	J	K	L

A	Aircraft and work unit codes as specified by the user. Data for work unit codes are summarized at the system (2nd) and assembly/set (4th) levels.
B	Variable data field as desired by user. Can include activity, BU/SER, time frame, constants, etc.
C	Number of flight hours reported.

D	Number of unscheduled maintenance actions initiated.
E	Mean flight hours between maintenance actions.
F	Number of failures repaired at the organizational level and total failures at all levels.
G	Mean flight hours between failures.

H	Number of unscheduled maintenance manhours reported on the VIDS/MAF source document.
J	Maintenance manhours per flight hour.
K	Maintenance manhours per maintenance action.
L	Elapsed maintenance time per maintenance action.

APPENDIX D

R&M Data Sources

Government:

FAA
Operations Systems Branch, AVN-120
PO Box 25082
Oklahoma City, Oklahoma 73125

US Air Force:

Rome Laboratory/ERSR (MIL HNDBK-217)
Griffiss AFB, NY 13441-5700

Aeronautical Systems Division/ENACR (System Reliability)
Wright-Patterson AFB, OH 45433

HQ Air Force Logistics Command/ENIS (MODAS & REMIS)
WPAFB, OH 45433

Acquisition Logistics Division (ALD Pamphlet 800-4)
WPAFB, OH 45433

Aeronautical Systems Division/ENSSC (LCOM)
WPAFB, OH 45433

Reliability Analysis Center (RAC)
PO Box 4700
Rome, NY 13440-8200

Naval Air Systems Command (AIR-4114)
Washington, DC 20361

Naval Maintenance Support Office
Naval Sea Logistics Center, Code 61
5450 Carlisle Pike
PO Box 2060
Mechanicsburg, PA 17055-0795

Commercial:

Airbus Industrie of North America
593 Herndon Parkway
Herndon, VA 22070

American Institute of Aeronautics and Astronautics (AIAA)
37 L'Enfant Promenade SW
Washington, DC 20024

Commercial (continued)

Boeing Commercial Air Planes
PO Box 3707
Seattle, WA 98124

Boeing Computer Services
7990 Boeing Court
Vienna, VA 22182-3999

Douglas Aircraft Company
3855 Lakewood Blvd.
Long Beach, CA 90846

E-Systems
PO Box 1056
Greenville, TX 75401

Harris Corporation
4141 Col. Glenn
Dayton, OH 45431

Harris Corporation
Government Aerospace Systems Division
PO Box 9400
Melbourne, FL 32902

Hughes Aircraft Company
Radar Systems Group
PO Box 92426
Los Angeles, CA 90009

Society of Automotive Engineers (SAE), Inc.
400 Commonwealth Dr.
Warrendale, PA 15096-0001

United Airlines
San Francisco International Airport (MOC/SF Airport)
San Francisco, CA 91428

US Air
173 Industry Dr.
Pittsburgh, PA 15275

APPENDIX E

Data Generation Programs (BASIC)

Basic Program for Data Analysis

AFALDP 800-4

```
10 'PROGRAM COMBINES 6 MONTH DATA FROM ALDP 800-4
20 'COMPUTES R&M STATS FOR VARIOUS 2-DIGIT WUC'S
30 KEY OFF:CLS:COLOR 3
40 PRINT TAB(20) "CALCULATION OF AIRCRAFT R&OOM PARAMETERS"
50 PRINT:PRINT
60 DIM MTBM(10,10),MMH(10,10),WUC$(10)
70 FOR J=1 TO 5
80 READ WUC$(J)
90 NEXT J
100 INPUT "ENTER AIRCRAFT";AC$
110 INPUT "ENTER NUMBER OF 6-MONTH INTERVALS";NUM
120 FOR I=1 TO NUM
130 PRINT "ENTER FLYING HOURS FOR ";I;"6-MONTH PERIOD"
140 INPUT FH(I)
150 PRINT "ENTER SORTIES FOR ";I;"6-MONTH PERIOD"
160 INPUT S(I)
170 PRINT "ENTER LANDINGS FOR ";I;"6-MONTH PERIOD"
180 INPUT L(I)
190 FOR J=1 TO 5
200 PRINT "ENTER MTBM FOR";WUC$(J)
210 INPUT MTBM(I,J)
220 PRINT "ENTER ON-EQUIP MMH FOR";WUC$(J)
230 INPUT MMH(I,J)
240 PRINT "ENTER OFF-EQUIP MMH FOR";WUC$(J)
250 INPUT OMMH(I,J)
260 PRINT
270 NEXT J
280 NEXT I
290 CLS:COLOR 2
300 PRINT TAB(20) "OUTPUT RESULTS FOR ";AC$
310 LPRINT TAB(20) "OUTPUT RESULTS FOR ";AC$
320 PRINT
330 LPRINT
340 FOR I=1 TO NUM
350 TFH=TFH+FH(I)
360 TS=TS+S(I)
370 TL=TL+L(I)
375 NEXT I
380 PRINT TAB(10) "TOT FLYING-HRS";TAB(40) TFH
390 LPRINT TAB(10) "TOT FLYING-HRS";TAB(40) TFH
400 PRINT TAB(10) "TOT SORTIES";TAB(40) TS
410 LPRINT TAB(10) "TOT SORTIES";TAB(40) TS
420 PRINT TAB(10) "TOT LANDINGS";TAB(40) TL
430 LPRINT TAB(10) "TOT LANDINGS";TAB(40) TL
440 PRINT:LPRINT
450 FOR J=1 TO 5
460 FOR I=1 TO NUM
```

```
470 TMAINT(J)=TMAINT(J)+(1/MTBM(I,J))*FH(I)
480 TMMH(J)=TMMH(J)+MMH(I,J)
490 TOMMH(J)=TOMMH(J)+OMMH(I,J)
500 NEXT I
510 TOTMH(J)=TMMH(J)+TOMMH(J)
520 MFHBM(J)=TFH/TMAINT(J)
530 MSBM(J)=TS/TMAINT(J)
540 MLBM(J)=TL/TMAINT(J)
550 MHFH(J)=TOTMH(J)/TFH
560 MHS(J)=TOTMH(J)/TS
570 PRINT:PRINT
580 LPRINT:LPRINT
590 PRINT TAB(10) "WUC ";WUC$(J):PRINT
600 LPRINT TAB(10) "WUC ";WUC$(J):LPRINT
610 PRINT TAB(15) "TOTAL MAINTENANCE EVENTS"; TAB(50) TMAINT(J)
620 LPRINT TAB(15) "TOTAL MAINTENANCE EVENTS"; TAB(50) TMAINT(J)
630 PRINT TAB(15) "TOTAL MAINTENANCE MANHOURS";TAB(50) TOTMH(J)
640 LPRINT TAB(15) "TOTAL MAINTENANCE MANHOURS";TAB(50) TOTMH(J)
650 PRINT TAB(20) "TOTAL ON-EQUIP MAINT";TAB(50) TMMH(J)
660 LPRINT TAB(20) "TOTAL ON-EQUIP MAINT";TAB(50) TMMH(J)
670 PRINT TAB(20) "TOTAL OFF-EQUIP MAINT";TAB(50) TOMMH(J)
680 LPRINT TAB(20) "TOTAL OFF-EQUIP MAINT";TAB(50) TOMMH(J)
690 PRINT:COLOR 12
700 LPRINT
710 PRINT TAB(15) "MEAN FLYING HR BTWN MAINT";TAB(50) MFHBM(J)
720 LPRINT TAB(15) "MEAN FLYING HR BTWN MAINT";TAB(50) MFHBM(J)
730 PRINT TAB(15) "MEAN SORTIES BTWN MAINT";TAB(50) MSBM(J)
740 LPRINT TAB(15) "MEAN SORTIES BTWN MAINT";TAB(50) MSBM(J)
750 PRINT TAB(15) "MEAN LANDINGS BTWN MAINT";TAB(50) MLBM(J)
760 LPRINT TAB(15) "MEAN LANDINGS BTWN MAINT";TAB(50) MLBM(J)
770 PRINT TAB(15) "MAN-HOURS PER FLY-HR";TAB(50) MHFH(J)
780 LPRINT TAB(15) "MAN-HOURS PER FLY-HR";TAB(50) MHFH(J)
790 PRINT TAB(15) "MAN-HOURS PER SORTIE";TAB(50) MHS(J)
800 LPRINT TAB(15) "MAN-HOURS PER SORTIE";TAB(50) MHS(J)
810 PRINT:LPRINT
820 MHPF(J)=TOTMH(J)/TMAINT(J)
830 MHPFON(J)=TMMH(J)/TMAINT(J)
840 OMHPF(J)=TOMMH(J)/TMAINT(J)
850 PRINT TAB(15) "MAN-HOURS PER MAINT ACTION";TAB(50) MHPF(J)
860 LPRINT TAB(15) "MAN-HOURS PER MAINT ACTION";TAB(50) MHPF(J)
870 PRINT TAB(20) "ON-EQUIP MAN-HRS/MAINT ACTION";TAB(50) MHPFON(J)
880 LPRINT TAB(20) "ON-EQUIP MAN-HRS/MAINT ACTION";TAB(50) MHPFON(J)
890 PRINT TAB(20) "OFF-EQUIP MAN-HRS/MAINT ACTION";TAB(50) OMHPF(J)
900 LPRINT TAB(20) "OFF-EQUIP MAN-HRS/MAINT ACTION";TAB(50) OMHPF(J)
910 PRINT
915 LPRINT:LPRINT
920 NEXT J
930 COLOR 3
935 GOSUB 1000
940 END
```

```
10 'PROGRAM COMBINES 4 QUARTERS OF DATA FROM NAVY 3M SYSTEM
20 'COMPUTES R&M STATS FOR A PARTICULAR 2-DIGIT WUC
30 KEY OFF:CLS:COLOR 3
40 PRINT TAB(20) "CALCULATION OF AIRCRAFT R&M PARAMETERS"
50 PRINT:PRINT
60 DIM MTBM(10),MMH(10),ACFT$(10)
70 FOR I=1 TO 9
80 READ ACFT$(I)
90 NEXT I
100 INPUT "ENTER WUC";WUC$
105 LPRINT TAB(10) "NAVY 3M DATA SYSTEM - R&M SUMMARY REPORT COMPOSITE"
106 LPRINT:LPRINT
110 LPRINT TAB(10) "WUC ";WUC$:LPRINT
120 NUM=4
130 FOR J=1 TO 9
135 TFH=0:TMA=0:TMMH=0:TET=0:TFAIL=0
140 PRINT TAB(5) "FOR AIRCRAFT  ";ACFT$(J)
145 LPRINT:PRINT
150 FOR I=1 TO NUM
160 PRINT "ENTER DATA FOR QTR";I
170 READ FH(I)
180 INPUT "ENTER MAINT ACTIONS FOR QTR";MA(I)
190 INPUT "ENTER UNSCH MAINT MAN-HRS - QTR";MMH(I)
210 INPUT "ENTER ELASPSED MAINT TIME";EMT(I)
220 PRINT
230 NEXT I
240 CLS:COLOR 2
250 PRINT TAB(20) "OUTPUT RESULTS FOR ";ACFT$(J)
260 LPRINT TAB(20) "OUTPUT RESULTS FOR ";ACFT$(J)
270 PRINT
280 LPRINT
290 FOR I=1 TO NUM
300 TFH=TFH+FH(I)
310 TMA=TMA+MA(I)
320 TMMH=TMMH+MMH(I)
330 TET=TET+MA(I)*EMT(I)
350 NEXT I
360 PRINT TAB(10) "TOT FLYING-HRS";TAB(40) TFH
370 LPRINT TAB(10) "TOT FLYING-HRS";TAB(40) TFH
380 PRINT TAB(10) "TOT MAINT ACTIONS";TAB(40) TMA
390 LPRINT TAB(10) "TOT MAINT ACTIONS";TAB(40) TMA
400 PRINT TAB(10) "TOT MAN-HRS";TAB(40) TMMH
410 LPRINT TAB(10) "TOT MAN-HRS";TAB(40) TMMH
440 PRINT TAB(10) "TOT ELAPSED TIME";TAB(40) TET
450 LPRINT TAB(10) "TOT ELAPSED TIME";TAB(40) TET
460 PRINT:LPRINT
470 MFHBMA=TFH/TMA
480 MMHFH=TMMH/TFH
490 AVEMT=TET/TMA
500 AVCREW=TMMH/TET
520 PRINT:PRINT
540 PRINT:COLOR 12
550 LPRINT
560 PRINT TAB(15) "MEAN FLYING HR BTWN MAINT";TAB(50) MFHBMA
570 LPRINT TAB(15) "MEAN FLYING HR BTWN MAINT";TAB(50) MFHBMA
580 PRINT TAB(15) "MAN-HOURS PER FLY-HR";TAB(50) MMHFH
590 LPRINT TAB(15) "MAN-HOURS PER FLY-HR";TAB(50) MMHFH
600 PRINT TAB(15) "AVG ELAPSED MAIN TIME";TAB(50) AVEMT
610 LPRINT TAB(15) "AVG ELAPSED MAIN TIME";TAB(50) AVEMT
620 PRINT TAB(15) "AVG CREW SIZE";TAB(50) AVCREW
630 LPRINT TAB(15) "AVG CREW SIZE";TAB(50) AVCREW
```

```
660 PRINT TAB(15) "MAN-HOURS PER MAINT ACTION";TAB(50) TMMH/TMA
670 LPRINT TAB(15) "MAN-HOURS PER MAINT ACTION";TAB(50) TMMH/TMA
680 PRINT
690 LPRINT:LPRINT
691 SUM1=SUM1+TET:SUM2=SUM2+TMMH:SUM3=SUM3+TMA
695 NEXT J
700 COLOR 3
710 LPRINT:LPRINT TAB(10) "SUMMARY STATS FOR ";WUC$
711 LPRINT:LPRINT TAB(20) "AVG TASK TIME";TAB(40) SUM1/SUM3
712 LPRINT TAB(20) "AVG CREW SIZE";TAB(40) SUM2/SUM1
720 END
1000 DATA "A4-E","A-4F","EA-6B","A-6E","A-7E","C-2A","E-2C","F-18A","F-14A"
1010 DATA 1579,1598,1770,1398
1020 DATA 2335,2384,2625,2527
1030 DATA 7444,6080,8517,5982
1040 DATA 17022,14906,16840,15328
1050 DATA 4624,5404,4989,556
1060 DATA 2751,3794,3871,1777
1070 DATA 7341,9143,9738,6036
1080 DATA 17856,15592,17214,15184
1090 DATA 21649,19976,30652,19734
```

```
10 'PROGRAM COMBINES 6 MONTH DATA FROM ALDP 800-4
20 'COMPUTES SCHEDULED MAINT AS A PERCENT OF TOTAL MAINT
30 KEY OFF:CLS:COLOR 3
40 PRINT TAB(20) "CALCULATION OF AIRCRAFT SCHEDULED MAINT"
50 PRINT:PRINT
60 INPUT "ENTER AIRCRAFT TYPE";AC$
70 INPUT "ENTER TIME PERIOD";TIM$
80 INPUT "ENTER NUMBER OF TIME PERIODS";NUM
90 FOR I=1 TO NUM
100 PRINT
110 PRINT "FOR TIME PERIOD";I
112 INPUT "ENTER TOT FLY HRS";FLY(I)
113 INPUT "ENTER TOT SORTIES";SORT(I)
120 INPUT "ENTER SCHED INSP-03 HRS";SCH3(I)
130 INPUT "ENTER SCHED INSP-03 HRS OFF";OSCH3(I)
140 INPUT "ENTER SCHED INSP-04 HRS ON";SCH4(I)
150 INPUT "ENTER SCHED INSP-04 OFF HRS";OSCH4(I)
160 INPUT "ENTER TOT ON EQ MHRS";TOTON(I)
170 INPUT "ENTER TOT OFF EQ MHRS";TOTOFF(I)
180 SUM1=SUM1+SCH3(I)+OSCH3(I)+SCH4(I)+OSCH4(I)
190 SUM2=SUM2+TOTON(I)+TOTOFF(I)
200 SUM3=SUM3+SCH3(I)+SCH4(I)
210 SUM4=SUM4+OSCH3(I)+OSCH4(I)
220 SUM5=SUM5+TOTON(I)
230 SUM6=SUM6+TOTOFF(I)
231 TFLY=TFLY+FLY(I)
232 TSORT=TSORT+SORT(I)
240 NEXT I
250 PERSCH=SUM1/SUM2
260 PERON=SUM3/SUM5
270 PEROFF=SUM4/SUM6
280 CLS:COLOR 3
290 LOCATE 5,10:PRINT TAB(20) "AIRCRAFT TYPE";TAB(45) AC$
300 PRINT TAB(20) "TIME PERIOD IS";TAB(45) TIM$
310 PRINT
320 PRINT TAB(10) "SCHEDULED MAINTENANCE PERCENTS"
330 PRINT TAB(10) "OF TOTAL MAINTENANCE";TAB(40) PERSCH
340 PRINT TAB(10) "OF ON-EQ MAINTENANCE";TAB(40) PERON
350 PRINT TAB(10) "OF OFF-EQ MAINTENANCE";TAB(40) PEROFF
360 PRINT
370 PRINT TAB(10) "AS A PERCENT OF UNSCHEDULED MAINTENANCE"
380 PRINT
390 PRINT TAB(10) "TOTAL";TAB(40) SUM1/(SUM2-SUM1)
400 PRINT TAB(10) "ON-EQ";TAB(40) SUM3/(SUM5-SUM3)
410 PRINT TAB(10) "OFF-EQ";TAB(40) SUM4/(SUM6-SUM4)
420 PRINT
430 PRINT TAB(10) "SCH MAINT HRS PER FLY HR";TAB(40) SUM1/TFLY
440 PRINT TAB(10) "SCH MAINT HRS PER SORTIE";TAB(40) SUM1/TSORT
450 PRINT TAB(10) "% SCHED ON-EQUIP";TAB(40) SUM3/SUM1
460 PRINT TAB(10) "% SCHED OFF-EQUIP";TAB(40) SUM4/SUM1
500 END
```

APPENDIX F

Variable Definitions

INDEPENDENT VARIABLE

Variable Name	Definition
ACT	Total number of actuators to operate all vehicle movable flight surfaces.
ACT WT	Weight of the actuator subsystem in pounds.
AV INSTA	Weight in pounds of brackets, shelves, wiring and plugs used on avionics equipment.
AV WT	Weight in pounds of avionics equipment uninstalled (does not include wiring, shelves, ducts, fasteners, etc.).
AVS	Total number of avionics (AN nomenclature) subsystems.
BODY WT	Weight of the body (fuselage) in pounds.
BTU COOL	Total cooling capacity of air conditioning equipment used for personnel and equipment cooling. Measured in BTU/HR/1000.
CONTS	Total number of control surfaces - ailerons, rudders, elevator tabs, flaps, spoilers and slats.
CREW	Total number of crew members (repair or flying depending upon context).
DIF SUBS	Total number of different avionics subsystems (two or more identical units count as one).
DRY WT	Empty weight (without fuel) of vehicle in pounds.
ECS WT	Total weight of the environmental control system including heating, cooling and anti-icing equipment in pounds.
ELECT WT	Weight of electrical subsystems in pounds.

ENG	Number of primary engines.
ENG WT	Weight of the engine in pounds.
FUEL TK	Number of separate internal fuel cells, bladders and tanks.
FUS AREA	External area of fuselage including canopy in square feet.
FUS DENS	Fuselage density (weight/volume).
FUS VOL	Total volume of fuselage, excluding any engine inlet duct volume, in cubic feet.
HYD WT	Weight of Hydraulic subsystems in pounds.
KVA MAX	Total electrical power of engines, motors, and APU driven generators/alternators in kVA (thousands of volt amps).
L.GEAR WT	Landing gear weight in pounds.
LEN+WING	Aircraft length plus wing span in feet.
MSN LEN	Mission length in hours. May be adjusted by/for subsystem utilization.
PASS	Maximum number of passengers.
SUB WT	Total subsystem weight in pounds.
SUBS	Total number of aircraft subsystems requiring use of hydraulic or pneumatic power.
WET AREA	Total external surface area of vehicle in square feet.
WHEELS	Total number of wheels.
WING LEN	Length of the wing in feet.

APPENDIX G

Design/Performance/Weight Values

	DRY_WGT	LEN_WING	WETAREA	FUS VOL
A-4E	9624	69	1072	571
A-4F	10169	69	1094	581
A-6E	25558	108	2180	1231
A-7D	17792	85	1703	813
A-7E	18546	85	1703	813
A-10A	20822	111	2600	793
B-52G	152293	344	17645	12447
FB-111A	47480	144	3164	1889
F-106A	24000	108	2230	1321
F-111A	43032	137	3117	1889
F-111D	44341	137	3117	1889
F-111F	44341	137	3101	1889
F-4C	28545	97	1989	1270
F-4D	28702	97	1989	1270
F-4E	29663	101	1989	1270
F-5E	9459	75	947	660
F-14A	39037	126	3105	1822
F-15A	26768	107	2632	1495
F-15C	27425	107	2643	1716
F-16A	14447	80	1385	596
F-16B	14447	82	1398	596
F-18A	23050	94	2050	964
C-130B	67100	231	8899	9060
C-130E	71990	231	8899	9060
C-130H	73962	232	8899	9060
KC-135A	97030	267	10954	11550
C-140A	21450	114	2734	1710
C-141B	140882	328	15350	19678
C-2A	31369	138	3729	2712
C-5A	320083	471	33712	86610
C-9A	61790	212	6248	7647
KC-10A	240613	347	21101	41300
E-2C	37498	138	3150	1346
EA-6B	32162	112	2295	1361
T-38A	6673	72	971	806
E-3A	188000	299		

	FUS AREA	CREWSIZE	PASSENGR	ENGINES
A-4E	478	1		1.00
A-4F	498	1		1.00
A-6E	898	2		2.00
A-7D	749	1		1.00
A-7E	749	1		1.00
A-10A	711	1		2.00
B-52G	4942	6		8.00
FB-111A	958	2		2.00
F-106A	985	1		1.00
F-111A	961	2		2.00
F-111D	961	2		2.00
F-111F	961	2		2.00
F-4C	1000	2		2.00
F-4D	1000	2		2.00
F-4E	961	2		2.00
F-5E	583	1		2.00
F-14A	1647	2		2.00
F-15A	1405	1		2.00
F-15C	1468	1		2.00
F-16A	735	1		1.00
F-16B	551	2		1.00
F-18A	890	1		2.00
C-130B	3460	4	92	4.00
C-130E	3460	4	92	4.00
C-130H	3460	4	92	4.00
KC-135A	4420	4	80	4.00
C-140A	1050	4	0	4.00
C-141B	6683	5	209	4.00
C-2A	1336	3	28	2.00
C-5A	16646	5	360	4.00
C-9A	3221	3	40	2.00
KC-10A	9115	4	75	3.00
E-2C	1043	5	0	2.00
EA-6B	1017	4		2.00
T-38A	533	2		2.00
E-3A		23	0	

	MSN LEN	WHEELS	ACTUATOR	CONT SUR
A-4E	2.50	3	14.00	13.00
A-4F	2.50	3	14.00	13.00
A-6E	4.10	4	23.00	19.00
A-7D	1.50	4	26.00	12.00
A-7E	4.00	4	26.00	12.00
A-10A	1.70	3	23.00	14.00
B-52G	6.70	8	42.00	32.00
FB-111A	3.20	4	31.00	28.00
F-106A	1.50	4	9.00	6.00
F-111A	2.20	4	31.00	28.00
F-111D	2.30	4	31.00	28.00
F-111F	2.40	4	31.00	28.00
F-4C	1.20	4	24.00	17.00
F-4D	1.30	4	27.00	17.00
F-4E	1.20	4	27.00	17.00
F-5E	0.90	3	19.00	12.00
F-14A	3.70	4	41.00	23.00
F-15A	1.30	3	9.00	9.00
F-15C	1.30	3	9.00	8.00
F-16A	1.30	3	14.00	11.00
F-16B	1.30	3	14.00	11.00
F-18A	2.40	4	12.00	11.00
C-130B	2.40	6	15.00	14.00
C-130E	2.40	6	15.00	14.00
C-130H	2.80	6	15.00	14.00
KC-135A	3.00	10	29.00	24.00
C-140A	1.90	6		16.00
C-141B	3.30	10	29.00	
C-2A		4	25.00	18.00
C-5A	3.90	28	115.00	43.00
C-9A	1.20	6	24.00	20.00
KC-10A	4.40	10	39.00	52.00
E-2C	5.10	4	25.00	18.00
EA-6B	3.10	4	24.00	19.00
T-38A	1.20	3	0.00	
E-3A	8.20			

	ECSWT	KVA MAX	SUBSYS	FUEL TK	AV WGT
A-4E	63.00	11.00	17.00	2.00	
A-4F	63.00	11.00	17.00	2.00	
A-6E	420.00	65.00	34.00	6.00	
A-7D	263.00	27.50	38.00	7.00	1178.00
A-7E	263.00	27.50	38.00	7.00	
A-10A	210.00	60.00	20.00		1153.00
B-52G	670.00	160.00	76.00		8823.00
FB-111A	631.00	130.00	38.00	4.00	
F-106A	407.00	28.30	25.00	7.00	
F-111A	631.00	130.00	38.00	4.00	
F-111D	631.00	62.40	22.00	6.00	
F-111F	631.00	57.40	35.00	4.00	
F-4C	392.00	63.00	39.00	9.00	
F-4D	397.00	63.00	33.00	9.00	2135.00
F-4E	403.00	63.00	33.00	9.00	
F-5E	143.00	55.00	16.00	3.00	303.00
F-14A	1048.00	126.50	45.00		
F-15A	669.00	50.00	28.00	5.00	1910.00
F-15C	669.00	130.00	30.00	5.00	1938.00
F-16A	230.00	50.00	20.00	7.00	1103.00
F-16B	23.00	50.00	20.00	4.00	1103.00
F-18A		80.00	14.00	8.00	
C-130B	1526.00	190.00	20.00	6.00	
C-130E	1836.00	190.00	20.00	6.00	3249.00
C-130H	1836.00	190.00	20.00	6.00	3249.00
KC-135A	1473.00	120.00	12.00	10.00	
C-140A	608.00	28.00	8.00	6.00	2323.00
C-141B	2648.00	252.00	33.00	12.00	4240.00
C-2A	656.00	123.00	31.00	2.00	
C-5A	3636.00	484.00	72.00	12.00	4015.00
C-9A	1538.00	112.00	12.00		2143.00
KC-10A	2186.00	360.00	30.00	15.00	4181.00
E-2C	510.00	123.00	27.00		
EA-6B	585.00	92.00	34.00	6.00	
T-38A	325.00	16.00	14.00	4.00	493.00
E-3A					2353.00

	TOTSUBS	AV INSTA	DIF SUBS	BTU COOL
A-4E	14.00	203.00	14.00	25.00
A-4F	15.00	70.00	15.00	25.00
A-6E	27.00	663.00	21.00	130.00
A-7D	31.00	523.00	31.00	75.00
A-7E	37.00	506.00	37.00	75.00
A-10A	16.00	203.00	16.00	15.80
B-52G	19.00	2949.00	19.00	180.00
FB-111A	26.00	1080.00	22.00	127.40
F-106A	16.00	801.00	14.00	95.00
F-111A	26.00	874.00	24.00	95.50
F-111D	28.00	1089.00	23.00	142.20
F-111F	25.00	992.00	25.00	95.50
F-4C	14.00	434.00	14.00	40.00
F-4D	27.00	496.00	27.00	40.00
F-4E	28.00	626.00	28.00	40.00
F-5E	10.00	207.00	10.00	35.00
F-14A	33.00	619.00	31.00	174.00
F-15A	25.00	393.00	25.00	153.00
F-15C	25.00	364.00	25.00	155.00
F-16A	18.00	250.00	18.00	40.00
F-16B	18.00	336.00	18.00	40.00
F-18A	16.00	329.00	14.00	106.00
C-130B	23.00	658.00	22.00	78.00
C-130E	27.00	851.00	25.00	105.00
C-130H	30.00	800.00	25.00	78.00
KC-135A	22.00	654.00	22.00	130.00
C-140A	20.00	556.00	20.00	34.00
C-141B	25.00	1241.00	18.00	118.00
C-2A	18.00	425.00	17.00	50.00
C-5A	33.00	1377.00	25.00	318.00
C-9A	18.00	800.00	15.00	200.00
KC-10A	36.00	1389.00	25.00	145.00
E-2C	29.00	965.00	27.00	195.00
EA-6B	26.00		23.00	130.00
T-38A	9.00	59.00	5.00	
E-3A				

	WGT WING	WGT TAIL	WGT BODY
A-4E			
A-4F			
A-6E			
A-7D	3269	832	3302
A-7E			
A-10A	5107	967	4745
B-52G	37369	6030	26731
FB-111A			
F-106A			
F-111A			
F-111D			
F-111F			
F-4C	4688	913	4801
F-4D	4688	913	4801
F-4E	4688	913	4801
F-5E	1349	328	2617
F-14A			
F-15A	3399	1098	6160
F-15C	3642	1104	6245
F-16A	1808	719	3118
F-16B			
F-18A			
C-130B	11626	3410	14338
C-130E	11626	3410	14338
C-130H	11626	3410	14338
KC-135A	25305	5565	20732
C-140A	2954	880	3736
C-141B	35092	5907	36822
C-2A			
C-5A	100012	12719	121259
C-9A	11392	2791	11822
KC-10A	59202	14636	46987
E-2C			
EA-6B			
T-38A	795	302	2140
E-3A	32654	6310	35193

	WGT13	WGT14	ENG WGT	WGT24
A-4E				
A-4F				
A-6E				
A-7D	1267	1196.00	4497	
A-7E				
A-10A	1486	836.00	4283	157.00
B-52G	12992	2591.00	36554	
FB-111A				
F-106A				
F-111A				
F-111D				
F-111F				
F-4C	1962	1001.00	9968	
F-4D	1962	1001.00	9968	
F-4E	1962	1001.00	9968	
F-5E	768	422.00	2247	
F-14A				
F-15A	1305	800.00	6049	481.00
F-15C	1343	810.00	6091	482.00
F-16A	924	718.00	3671	164.00
F-16B	1067	718.00		170.40
F-18A				
C-130B	4873	1693.00		451.00
C-130E	4873	1693.00	16696	460.00
C-130H	4873	1693.00	16696	460.00
KC-135A	11023	2287.00	23386	945.00
C-140A	1081	939.00	3804	
C-141B	10850	3701.00	25471	535.00
C-2A				367.00
C-5A	38282	7263.00	39091	1080.00
C-9A	4295	1639.00	10535	832.00
KC-10A	26211	5773.00	43162	1486.00
E-2C				
EA-6B				
T-38A	527	394.00	1767	
E-3A	13330	3214.00	23321	500.00

	WGT42	WGT45	WGT51/72
A-4E			
A-4F			
A-6E			
A-7D	1094.00	210.00	1178.00
A-7E			
A-10A	732.00	373.00	1153.00
B-52G	6047.00	1915.00	8823.00
FB-111A			
F-106A			
F-111A			
F-111D			
F-111F			
F-4C	536.00		
F-4D	536.00	601.00	2135.00
F-4E	536.00	601.00	
F-5E	310.00	159.00	303.00
F-14A			
F-15A	583.00	431.00	1910.00
F-15C	607.00	433.00	1938.00
F-16A	441.00	309.00	1103.00
F-16B	441.00	309.00	1103.00
F-18A			
C-130B	2299.00	666.00	
C-130E	2299.00	666.00	3249.00
C-130H	2299.00	666.00	3249.00
KC-135A	4152.00	880.00	
C-140A	1937.00	338.00	2323.00
C-141B	2823.00	1605.00	4240.00
C-2A			
C-5A	4046.00	4484.00	4015.00
C-9A	1766.00	756.00	2143.00
KC-10A	4862.00	4170.00	4181.00
E-2C			
EA-6B			
T-38A	327.00	147.00	493.00
E-3A			2353.00

APPENDIX H

Dependent Variable Values

	FHBMA11	MH/MA11
A-4E		
A-4F		
A-6E		
A-7D	10.00	5.80
A-7E		
A-10A	11.30	5.20
B-52G	3.00	6.90
FB-111A	1.10	3.90
F-106A	10.10	7.40
F-111A	2.90	4.30
F-111D	2.50	4.40
F-111F	2.30	4.30
F-4C	5.10	6.20
F-4D	3.60	5.40
F-4E	4.20	6.70
F-5E	7.90	7.60
F-14A		
F-15A	3.00	5.70
F-15C	2.68	9.00
F-16A	8.32	5.20
F-16B	6.50	4.10
F-18A		
C-130B	3.40	5.70
C-130E	5.30	8.10
C-130H	4.70	9.80
KC-135A	4.00	6.00
C-140A	9.40	9.20
C-141B	3.63	6.30
C-2A		
C-5A	1.37	5.40
C-9A	10.30	4.40
KC-10A	41.90	5.10
E-2C		
EA-6B		
T-38A	6.20	7.70
E-3A	4.80	2.90

	%OFF12	FHBMA12	MH/MA12
A-4E			
A-4F			
A-6E			
A-7D	0.06	46.00	7.60
A-7E			
A-10A	0.07	22.80	4.50
B-52G	0.04	15.30	4.20
FB-111A	0.06	9.10	4.00
F-106A	0.00	41.30	3.20
F-111A	0.04	11.00	5.00
F-111D	0.04	18.40	5.30
F-111F	0.01	28.10	6.00
F-4C	0.13	5.60	5.40
F-4D	0.09	6.20	5.20
F-4E	0.07	6.20	4.70
F-5E	0.05	32.50	3.80
F-14A			
F-15A	0.10	18.50	8.50
F-15C	0.05	26.40	10.00
F-16A	0.10	28.80	7.00
F-16B	0.11	14.90	6.50
F-18A			
C-130B	0.18	13.60	6.40
C-130E	0.30	14.70	8.80
C-130H	0.09	21.40	11.90
KC-135A	0.27	24.90	10.20
C-140A	0.44	20.80	7.30
C-141B	0.39	10.00	10.40
C-2A			
C-5A	0.18	1.90	7.70
C-9A	0.29	8.90	5.00
KC-10A	0.05		7.70
E-2C			
EA-6B			
T-38A	0.16	29.40	4.60
E-3A		8.90	7.90

	FHBMA13	MH/MA13	%OFF EQP
A-4E			
A-4F			
A-6E			
A-7D	14.40	9.90	0.34
A-7E			
A-10A	18.50	8.50	0.39
B-52G		6.20	0.14
FB-111A		6.40	0.34
F-106A	11.20	6.80	0.26
F-111A	8.70	10.10	0.34
F-111D	10.70	11.50	0.30
F-111F		9.60	0.27
F-4C	11.30	11.50	0.54
F-4D	8.40	7.30	0.31
F-4E	12.00	10.60	0.41
F-5E	18.00	11.90	0.50
F-14A			
F-15A	13.00	9.50	0.29
F-15C	15.30	13.60	0.28
F-16A	12.40	6.00	0.45
F-16B	10.30	4.30	0.29
F-18A			
C-130B	12.80	10.90	0.32
C-130E	13.30	9.40	0.23
C-130H	12.30	11.70	0.13
KC-135A	6.20	9.10	0.49
C-140A	10.60	10.90	0.47
C-141B	7.50	6.60	0.19
C-2A			
C-5A	1.40	5.90	0.23
C-9A	15.70	5.90	0.31
KC-10A		4.80	
E-2C			
EA-6B			
T-38A	12.70	6.60	0.33
E-3A		7.90	

	FHBMA14	MH/MA14	%OFF EQP
A-4E	3.93		
A-4F	2.76		
A-6E	4.28		
A-7D	14.56	10.60	0.15
A-7E	7.28		
A-10A	17.14	6.00	0.13
B-52G	7.08	5.70	0.18
FB-111A	4.36	6.00	
F-106A	22.49	9.70	0.08
F-111A	6.02	9.90	0.16
F-111D	7.21	9.30	0.14
F-111F	9.61	9.60	0.07
F-4C	9.35	11.30	0.04
F-4D	9.80	9.80	0.06
F-4E	9.65	11.90	0.13
F-5E	21.70	11.40	0.22
F-14A	4.48		
F-15A	12.95	10.90	0.08
F-15C	14.35	15.10	0.08
F-16A	15.53	7.30	0.20
F-16B	14.34	5.80	0.16
F-18A	7.47		
C-130B	14.38	6.60	
C-130E	18.94	7.30	0.04
C-130H	18.32	9.40	0.03
KC-135A	6.60	6.30	0.19
C-140A	11.80	7.70	0.12
C-141B	6.80	6.50	0.06
C-2A	8.57		
C-5A	3.80	6.30	0.09
C-9A	21.98	3.90	0.09
KC-10A		6.10	0.05
E-2C	6.70		
EA-6B	4.24		
T-38A	17.53	8.90	0.29
E-3A	4.78	2.10	0.07

	FHBMA23	MHMA23	%OFF EQP
A-4E			
A-4F			
A-6E			
A-7D	21.70	22.60	0.54
A-7E			
A-10A	20.40	29.80	0.73
B-52G	4.60	13.70	0.62
FB-111A	6.20	19.30	0.66
F-106A	13.20	24.20	0.45
F-111A	5.70	17.20	0.43
F-111D	5.20	13.70	0.36
F-111F	9.30	24.70	0.63
F-4C	16.50	25.50	0.45
F-4D	20.50	31.50	0.52
F-4E	16.50	41.90	0.63
F-5E	22.10	58.80	0.82
F-14A			
F-15A	11.20	36.00	0.62
F-15C	11.00	31.50	0.56
F-16A	22.00	32.90	0.69
F-16B	20.50	11.70	0.21
F-18A			
C-130B	7.60	10.20	0.24
C-130E	6.80	12.80	0.42
C-130H	6.40	13.90	0.20
KC-135A	5.00	14.10	0.58
C-140A	7.10	12.20	0.34
C-141B	4.40	14.20	0.55
C-2A			
C-5A	1.40	11.40	0.64
C-9A	26.20	6.40	
KC-10A	28.40	10.70	
E-2C			
EA-6B			
T-38A	20.20	25.00	0.68
E-3A	8.60	4.10	0.00

	FMA41/47	MHMA4147	%OFF EQP-41	%OFF EQP-47
A-4E				
A-4F				
A-6E				
A-7D	29.20	6.50	0.22	0.12
A-7E				
A-10A	17.50	4.50	0.17	0.08
B-52G	18.30	6.20	0.04	
FB-111A	5.90	5.20		
F-106A	22.10	7.20	0.12	0.05
F-111A	8.80	6.50	0.26	0.33
F-111D	9.90	10.40	0.31	0.23
F-111F	10.00	10.80	0.24	0.32
F-4C	16.60	6.90	0.03	0.10
F-4D	19.90	9.20	0.03	0.17
F-4E	19.40	9.20	0.04	0.20
F-5E	35.80	6.70	0.47	
F-14A				
F-15A	17.70	8.60	0.19	0.15
F-15C	19.40	12.50	0.25	
F-16A	28.60	4.90	0.16	
F-16B	21.10	4.40	0.16	0.13
F-18A				
C-130B	11.00	6.10	0.07	0.05
C-130E	12.80	6.60	0.06	0.05
C-130H	11.10		0.07	0.02
KC-135A	28.50	8.20	0.15	0.07
C-140A	19.80	7.00	0.19	0.06
C-141B	9.30	5.30	0.14	0.11
C-2A				
C-5A	4.20	5.90	0.10	0.02
C-9A		5.00		0.04
KC-10A	38.70	5.20		
E-2C				
EA-6B				
T-38A	41.60	7.30	0.34	0.12

	FMA42/44	MHMA4244	%OFF EQP - 42	%OFF EQP - 44
A-4E				
A-4F				
A-6E				
A-7D	26.30	6.40	0.38	0.22
A-7E				
A-10A	24.40	6.50	0.48	0.17
B-52G	9.00	6.10	0.30	0.04
FB-111A	9.00	7.30	0.31	
F-106A	18.80	4.60	0.20	0.12
F-111A	7.90	6.80	0.15	0.26
F-111D	9.40	9.90	0.16	0.31
F-111F	17.90	5.20	0.30	0.24
F-4C	16.00	9.40	0.33	0.03
F-4D	15.70	6.70	0.35	0.03
F-4E	16.30	8.20	0.31	0.04
F-5E	36.30	7.90		0.47
F-14A				
F-15A	12.60	6.10	0.23	0.19
F-15C	14.90		0.16	0.25
F-16A	14.50	5.70	0.52	0.16
F-16B	13.20	4.90	0.53	0.16
F-18A				
C-130B	12.80	4.50	0.11	0.07
C-130E	14.40	5.80	0.15	0.06
C-130H	12.40	8.30	0.05	0.07
KC-135A	10.00	7.30	0.36	0.15
C-140A	20.20	5.70	0.25	0.19
C-141B	39.80		0.28	0.14
C-2A				
C-5A	2.50	4.10	0.29	0.10
C-9A	20.70	4.40	0.19	
KC-10A	81.70	4.70		
E-2C				
EA-6B				
T-38A	31.20	6.60	0.47	0.34
E-3A	8.50	4.60		

	FHBMA45	MH/MA45	%OFFEQP
A-4E			
A-4F			
A-6E			
A-7D	44.40	9.10	0.13
A-7E			
A-10A	95.80	9.80	0.18
B-52G	9.60	4.60	0.08
FB-111A	12.30	6.00	0.29
F-106A	35.20	8.30	0.12
F-111A	20.50	8.20	0.11
F-111D	18.50	8.60	0.13
F-111F	28.20	7.10	0.14
F-4C	30.40	8.70	0.07
F-4D	26.30	8.30	0.09
F-4E	44.70	11.90	0.19
F-5E	183.00	9.50	0.11
F-14A			
F-15A	19.70	8.90	0.08
F-15C	25.40		0.09
F-16A	75.70	4.50	0.10
F-16B	62.70	4.00	0.17
F-18A			
C-130B	17.00	5.40	0.07
C-130E	18.70	5.80	0.05
C-130H	19.40	9.00	0.03
KC-135A	14.30	6.20	0.11
C-140A	27.30	4.50	0.04
C-141B	16.00	5.00	0.04
C-2A			
C-5A	4.70	4.90	0.05
C-9A	73.80	4.10	0.01
KC-10A	60.50	5.70	0.33
E-2C			
EA-6B			
T-38A	91.60	5.90	0.18
E-3A	17.60	2.40	0.17
E-3A			

	FMA49/96	MHMA4996	%OFF EQP-96	%OFF EQP-49
A-4E				
A-4F				
A-6E				
A-7D	234.00	8.50	0.98	0.09
A-7E				
A-10A	235.00	7.60	0.98	0.06
B-52G	55.50	7.60		0.08
FB-111A	40.10	3.60	0.47	0.01
F-106A	60.30	13.80		0.08
F-111A	95.00	5.30		0.05
F-111D	108.40	10.50		0.00
F-111F	121.80	5.70		0.05
F-4C	236.60	5.00		0.02
F-4D	236.80	4.90		0.00
F-4E	262.10			0.00
F-5E	610.80	6.40		0.00
F-14A				
F-15A	83.60	7.20		0.03
F-15C	131.10	13.20		0.02
F-16A	561.10	7.70	0.96	0.15
F-16B	492.70	4.00	0.24	
F-18A				
C-130B	34.70	4.00	0.23	0.05
C-130E	48.80	7.10	0.57	0.08
C-130H	34.20	6.60	0.72	0.04
KC-135A	46.70	3.40	0.31	0.13
C-140A	70.50	4.10		0.05
C-141B	34.60	8.70		0.45
C-2A				
C-5A	10.00	6.40		
C-9A	201.40	5.70		0.03
KC-10A	175.90	4.30		
E-2C				
EA-6B				
T-38A	331.50	4.50	0.69	0.00
E-3A	45.30	2.20	0.14	0.13

AVIONICS

	FHBMA	MH/MA	%OFF EQP
A-4E			
A-4F			
A-6E			
A-7D	13.80	7.30	0.40
A-7E			
A-10A	11.70	7.80	0.31
B-52G	3.60	6.80	0.29
FB-111A	3.20	10.20	0.52
F-106A	5.30	5.70	0.28
F-111A	5.70	13.80	0.36
F-111D	4.50	13.00	0.41
F-111F	6.50	11.20	0.48
F-4C	4.60	8.70	0.38
F-4D	3.00	9.00	0.43
F-4E	2.30	8.80	0.36
F-5E	13.40	8.20	0.35
F-14A			
F-15A	7.20	12.60	0.40
F-15C	6.80	13.60	0.46
F-16A	17.10	4.70	0.29
F-16B	10.90	4.90	0.19
F-18A			
C-130B	4.70	8.70	0.41
C-130E	4.40	9.60	0.44
C-130H	3.20	11.00	0.23
KC-135A	2.60	8.00	0.35
C-140A	11.30	11.80	0.53
C-141B	4.40	7.00	0.31
C-2A			
C-5A	1.50	8.00	0.29
C-9A		5.00	
KC-10A	9.60	5.30	
E-2C			
EA-6B			
T-38A	14.40	4.60	0.23
E-3A	4.80	8.50	0.29

NASA - WBS SUBSYSTEM ROLL-UP

	FLY HRS	ME42	MH42	ME44	MH44	FHBMA	MH/MA	ME41
A-7D	150,924	2,490	21,328	3,252	15,301	26.3	6.4	4,212
A-10	442,398	11,115	92,786	7,023	24,573	24.4	6.5	17,156
B-52G	136,040	8,357	62,352	6,788	30,305	9.0	6.1	5,070
FB-111A	40,127	2,005	12,677	2,474	19,837	9.0	7.3	5,950
F-106A	21,836	519	3,616	644	1,772	18.8	4.6	536
F-111A	16,149	629	4,220	1,413	9,641	7.9	6.8	1,578
F-111D	40,114	1,952	18,390	2,301	23,849	9.4	9.9	3,487
F-111F	31,048	607	4,508	1,127	4,553	17.9	5.2	2,666
F-4C	30,998	920	13,427	1,014	4,672	16.0	9.4	1,144
F-4D	153,424	3,717	39,744	6,067	26,083	15.7	6.7	4,785
F-4E	204,993	4,795	62,772	7,789	40,977	16.3	8.2	7,009
F-5E	47,034	633	5,893	662	4,336	36.3	7.9	1,093
F-15A	172,258	4,606	41,376	9,078	42,654	12.6	6.1	8,239
F-15C	103,690	2,157	37,844	4,780	46,705	14.9	12.2	4,632
F-16A	350,102	13,672	112,957	10,501	25,724	14.5	5.7	8,614
F-16B	67,002	2,627	18,909	2,454	5,900	13.2	4.9	2,123
C-130B	88,133	3,732	18,797	3,138	12,052	12.8	4.5	6,379
C-130E	514,595	17,216	118,821	18,643	90,800	14.4	5.8	32,261
C-130H	42,802	1,707	19,013	1,731	9,476	12.4	8.3	2,711
KC-135A	278,012	13,331	128,443	14,335	73,488	10.0	7.3	2,711
C-140A	5,783	119	930	167	689	20.2	5.7	237
C-141B	572,817	13,382	100,299	1,014	157,424	39.8	17.9	48,923
C-5A	109,290	17,043	91,017	27,203	88,938	2.5	4.1	19,972
C-9A	40,070	352	4,632	1,583	3,804	20.7	4.4	1,132
KC-10A	67,738	829	3,869			81.7	4.7	983
T-38	460,850	6,757	50,917	8,003	46,256	31.2	6.6	8,028
E-3A	32,693	2,165	13,129	1,672	4,614	8.5	4.6	4,389
NAVY A/C								
A4-E	6,345	1,141	5,655	1,040	2,722	2.9	3.8	312
A-4F	9,871	9,871	5,582	834	2,636	0.9	0.8	123
EA-6B	28,023	7,548	46,800	4,195	10,042	2.4	4.8	2,213
A-6E	64,096	28,550	163,801	13,474	36,832	1.5	4.8	5,539
A-7E	15,573	1,432	8,481	1,552	4,867	5.2	4.5	769
C-2A	12,193	1,246	8,315	1,997	4,277	3.8	3.9	1,076
E-2C	32,258	4,374	21,301	5,483	9,247	3.3	3.1	4,956
F-18A	65,846	3,270	26,994	2,742	11,929	11.0	6.5	4,510
F-14A	92,011	13,954	96,743	14,216	40,522	3.3	4.9	9,695

	MH41	ME47	MH47	FHBMA	MH/MA	ME49	MH49	ME96	MH96	FHBMA	MH/MA
A-7D	28,254	951	5,265	29.2	6.5	628	3,940	17	1,549	234.0	8.5
A-10	83,967	8,184	30,982	17.5	4.5	1,841	9,675	42	4,631	234.9	7.6
B-52G	34,123	2,376	12,170	18.3	6.2	2,452	18,576			55.5	7.6
FB-111A	33,600	876	2,080	5.9	5.2	987	3,611	14	40	40.1	3.6
F-106A	5,594	450	1,460	22.1	7.2	160	909	202	4,078	60.3	13.8
F-111A	10,554	266	1,395	8.8	6.5	170	839		63	95.0	5.3
F-111D	38,546	559	3,553	9.9	10.4	359	3,838	11	34	108.4	10.5
F-111F	30,908	440	2,497	10.0	10.8	255	1,373		77	121.8	5.7
F-4C	9,977	725	2,934	16.6	6.9	131	623		30	236.6	5.0
F-4D	53,379	2,906	17,204	19.9	9.2	648	3,029		159	236.8	4.9
F-4E	66,431	3,564	30,872	19.4	9.2	782	6,267		2,661	262.1	11.4
F-5E	7,143	219	1,594	35.8	6.7	77	482		10	610.8	6.4
F-15A	76,389	1,480	7,119	17.7	8.6	2,060	14,870			83.6	7.2
F-15C	61,708	722	5,255	19.4	12.5	791	10,422			131.1	13.2
F-16A	44,539	3,618	15,535	28.6	4.9	578	2,642	46	2,154	561.1	7.7
F-16B	10,883	1,051	3,080	21.1	4.4	115	450	21	96	492.7	4.0
C-130B	38,827	1,645	9,833	11.0	6.1	2,534	10,095	8	39	34.7	4.0
C-130E	218,207	8,070	46,153	12.8	6.6	10,427	73,915	128	713	48.8	7.1
C-130H	112,940	1,142	8,699	11.1	31.6	1,217	7,820	35	487	34.2	6.6
KC-135A	48,834	7,051	31,158	28.5	8.2	5,917	20,440	40	70	46.7	3.4
C-140A	1,728	55	307	19.8	7.0	82	339			70.5	4.1
C-141B	264,346	12,809	61,812	9.3	5.3	16,579	144,805			34.6	8.7
C-5A	125,125	6,143	29,388	4.2	5.9	11,047	71,029			9.9	6.4
C-9A	5,901	453	2,085	25.3	5.0	199	1,129			201.4	5.7
KC-10A	6,143	769	2,939	38.7	5.2	385	1,637			175.9	4.3
T-38	59,693	3,042	20,774	41.6	7.3	1,377	6,199	13	78	331.5	4.5
E-3A	16,598	569	1,507	6.6	3.7	631	1,492	91	118	45.3	2.2

NAVY A/C

A4-E	1,772	460	1,006	8.2	3.6
A-4F	406	148	476	36.4	3.3
EA-6B	8,156	1,720	5,263	7.1	3.4
A-6E	18,818	2,478	8,259	8.0	3.4
A-7E	2,979	262	1,180	15.1	4.0
C-2A	5,429	649	2,528	7.1	4.6
E-2C	20,960	1,484	5,628	5.0	4.1
F-18A	24,310	736	2,439	12.6	5.1
F-14A	52,846	2,108	7,914	7.8	5.1

NASA - AVIONICS SUBSYSTEM ROLL-UP

	FLY HRS	ME51	MH51	OMH51	ME52	MH52	OMH52	ME55
A-7D	150,924	2,901	14,231	12,130				
A-10	442,398	16,636	127,100	97,617	2,759	31,026	20,634	2,108
B-52G	136,040	16,062	89,032	80,309	5,976	43,136	29,842	897
FB-111A	40,127	3,825	29,184	20,193	2,506	43,979	16,586	556
F-106A	21,836	829	3,264	2,771	886	8,110	5,890	391
F-111A	16,149	938	11,008	8,503	779	16,999	9,047	98
F-111D	40,114	2,344	20,548	16,062	2,848	52,300	27,019	88
F-111F	31,048	1,372	13,650	9,552	1,489	22,900	10,403	
F-4C	30,998	1,510	15,110	9,224	604	9,176	6,699	125
F-4D	153,424	7,629	71,919	40,052	3,125	33,218	25,015	1,560
F-4E	204,993	11,678	110,667	65,896	4,159	75,104	50,584	4,087
F-5E	47,034	1,544	11,423	7,239	404	4,925	3,309	141
F-15A	172,258	5,914	59,543	49,310	1,380	24,959	12,312	
F-15C	103,690	2,619	33,119	20,647	1,132	24,917	13,875	1,238
F-16A	350,102	5,515	30,894	22,630				1,763
F-16B	67,002	1,652	9,366	7,978				231
C-130B	88,133	2,895	14,689	12,071	2,412	19,299	14,000	120
C-130E	514,595	13,375	77,149	67,103	14,725	99,807	82,100	918
C-130H	42,802	1,353	14,944	14,113	1,494	17,797	15,390	85
KC-135A	278,012	39,657	230,067	199,714	18,767	136,080	96,870	
C-140A	5,783	84	428	393	78	406	324	
C-141B	572,817	31,309	189,631	155,418	20,235	160,470	113,106	4,800
C-5A	109,290	9,869	68,871	52,376	12,900	116,122	98,948	25,744
C-9A	40,070	470	1,875	1,698	368	3,823	3,805	
KC-10A	67,738	858	3,014	3,000	1,497	9,520	9,520	
T-38	460,850	19,736	75,463	62,897	2,576	17,710	11,636	154
E-3A	32,693	1,358	7,374	7,255	458	3,903	3,903	86

MH55	OMH55	ME61	MH61	OMH61	ME62	MH62	OMH62	ME63	MH63	OMH63
					1,410	13,928	5,349	1,971	15,137	9,277
16,058	10,215				5,770	42,925	27,071	5,442	39,039	21,329
2,787	2,551	1,027	12,026	8,019				3,871	30,589	14,837
2,923	1,518	867	12,161	3,870				2,922	25,120	9,943
1,807	1,672							505	2,084	1,584
920	857	274	4,026	2,035				248	1,752	1,329
380	357	1,321	21,053	7,794				1,011	9,058	6,236
678	508	641	8,769	3,367				634	4,157	1,990
447	385							829	5,713	3,487
10,566	9,004							7,023	37,631	25,045
25,765	14,259							10,645	73,916	54,727
888	729				17	122	78	623	4,833	2,945
17,867	11,570							6,815	63,649	36,555
15,818	11,907							4,219	48,262	27,053
3,314	3,193				3,622	16,519	11,157	6,286	28,966	19,238
407	391				998	4,010	2,906	1,080	6,160	3,559
766	690	1,350	15,060	6,967	441	4,141	2,185	498	3,966	2,428
4,813	4,583	5,332	66,100	28,334	2,378	18,712	11,058	5,161	27,885	16,507
854	825	777	9,274	4,551	1,533	4,083	3,302	243	1,977	1,454
		2,811	33,875	19,617	382	1,411	762	5,459	58,092	26,523
		34	783	276	22	421	135	27	293	174
17,950	17,672	9,362	116,661	51,049	6,493	42,731	29,717	5,412	28,173	17,850
163,369	127,165	3,097	32,479	22,939	523	3,285	2,570	1,060	7,076	4,759
		87	276	267	187	611	576	173	434	434
		171	937	937	100	452	359	399	2,069	2,069
447	388				18	56	53	3,158	16,229	10,167
753	749	590	6,445	4,229	102	1,018	633	944	11,673	7,174

NASA - AVIONICS SUBSYSTEM ROLL-UP

ME64	MH64	OMH64	ME66	MH66	OMH66	ME71	MH71	OMH71	ME72	MH72
726	5,645	4,258				2,415	18,200	10,107	1,552	13,125
1,257	7,380	4,372				3,755	30,730	20,688	109	276
5,777	41,505	25,619				2,490	19,864	10,955	1,341	14,745
1,309	9,636	7,286				617	5,929	2,369	122	831
						1,472	8,194	5,062		
303	2,300	1,626				201	2,327	1,843		
710	5,479	5,073				576	6,848	5,107		
466	1,903	1,433				198	1,889	904		
						3,470	22,413	15,995	215	5,677
						30,714	290,204	157,034	1,779	24,165
						55,240	468,872	300,342	3,505	32,417
201	1,218	1,218				571	5,365	3,084		
						9,813	134,911	69,530		
						6,088	86,665	38,737		
917	4,795	4,464				2,314	10,700	7,004		
477	2,457	2,365				1,695	7,886	7,252		
2,214	13,036	10,363	288	953	867	2,772	27,985	15,595	5,879	63,358
12,259	68,764	54,963	1,317	3,978	3,723	14,051	253,857	88,679	47,312	503,196
1,431	16,403	14,716	166	697	626	1,985	22,039	16,027	4,228	58,478
7,678	66,147	35,042				3,641	44,472	23,258	28,430	280,361
62	653	370				110	1,513	720	94	1,555
18,658	74,723	65,856	1,729	7,024	5,984	20,005	161,366	101,091	10,868	98,934
5,556	35,931	25,396	1,994	23,704	14,227	2,464	29,045	16,450	8,594	96,180
384	1,119	1,001	165	674	556	347	1,680	1,326	246	1,525
1,333	5,138	5,133	27	117	117	2,177	13,876	13,876	458	2,198
1,894	11,025	10,090				4,408	24,533	16,232		
1,337	9,714	5,804	101	1,281	853	1,377	12,192	8,156	450	3,508

OMH72	TOT ME	TOT MH	TOT OMH	FHBMA	MH/MA	%OFF EQ	MH/FH
6,705	10,975	80,266	47,826	13.8	7.3	0.404	0.53
262	37,836	294,534	202,188	11.7	7.8	0.314	0.67
7,947	37,441	253,684	180,079	3.6	6.8	0.290	1.86
599	12,724	129,763	62,364	3.2	10.2	0.519	3.23
	4,083	23,459	16,979	5.3	5.7	0.276	1.07
	2,841	39,332	25,240	5.7	13.8	0.358	2.44
	8,898	115,666	67,648	4.5	13.0	0.415	2.88
	4,800	53,946	28,157	6.5	11.2	0.478	1.74
715	6,753	58,536	36,505	4.6	8.7	0.376	1.89
8,619	51,830	467,703	264,769	3.0	9.0	0.434	3.05
17,397	89,314	786,741	503,205	2.3	8.8	0.360	3.84
	3,501	28,774	18,602	13.4	8.2	0.354	0.61
	23,922	300,929	179,277	7.2	12.6	0.404	1.75
	15,296	208,781	112,219	6.8	13.6	0.463	2.01
	20,417	95,188	67,686	17.1	4.7	0.289	0.27
	6,133	30,286	24,451	10.9	4.9	0.193	0.45
31,958	18,869	163,253	97,124	4.7	8.7	0.405	1.85
277,554	116,828	1,124,261	634,604	4.4	9.6	0.436	2.18
41,376	13,295	146,546	112,380	3.2	11.0	0.233	3.42
152,334	106,825	850,505	554,120	2.6	8.0	0.348	3.06
443	511	6,052	2,835	11.3	11.8	0.532	1.05
65,541	128,871	897,663	623,284	4.4	7.0	0.306	1.57
46,843	71,801	576,062	411,673	1.5	8.0	0.285	5.27
1,253	2,427	12,017	10,916	16.5	5.0	0.092	0.30
2,197	7,020	37,321	37,208	9.6	5.3	0.003	0.55
	31,944	145,463	111,463	14.4	4.6	0.234	0.32
2,567	6,803	57,861	41,323	4.8	8.5	0.286	1.77

APPENDIX I

Subsystem Weight Percentage

WEIGHT DISTRIBUTION ANALYSIS

	PLS	%	AMLS	%	AVG
WING	1,869	0.096	1,739	0.100	0.098
TAIL	69	0.004	62	0.004	0.004
BODY	2,238	0.115	2,907	0.168	0.141
TPS	2,124	0.109	1,555	0.090	0.100
LANDING	1,161	0.060	829	0.048	0.054
PROP 6,7,8	1,366	0.070	1,138	0.066	0.068
PRIME PWR	2,872	0.148	2,720	0.157	0.152
ELECTRIC	1,216	0.063	999	0.058	0.060
ACTUATORS	173	0.009	123	0.007	0.008
AVIONICS	1,337	0.069	956	0.055	0.062
ECS	1,599	0.082	1,478	0.085	0.084
PERS ACCOM	1,434	0.074	1,195	0.069	0.071
RECOV & AUX	1,961	0.101	1,634	0.094	0.098
TOTAL	19,419	1.000	17,335	1.00	1.00

APPENDIX J

MTBM Regression Analysis

----------Multiple Regression----------

Date/Time 04-01-1992 15:05:42
Data Base Name C:\NASA\WUC11
Description Backup of NASAMSTR created 12-18-1991

Multiple Regression Report

Dependent Variable: FHBMA11

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	15.23085	0.0000	3.994154	3.81	0.0015		
WGT TAIL	.6057E-02	2.8217	.5551E-03	10.91	0.0000	0.2439	0.2439
SQR TW	-.1375748	-1.7464	.5844E-01	-2.35	0.0317	0.8836	0.0446
WETAREA	-.723E-03	-0.7205	.6747E-03	-1.07	0.2997	0.8914	0.0343

Analysis of Variance Report

Dependent Variable: FHBMA11

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	1114.525	1114.525		
Model	3	1254.958	418.3195	43.77	0.000
Error	16	152.9258	9.557861		
Total	19	1407.884	74.09917		

Root Mean Square Error	3.091579
Mean of Dependent Variable	7.465
Coefficient of Variation	.4141432
R Squared	0.8914
Adjusted R Squared	0.8710

----------Multiple Regression----------

Date/Time 04-01-1992 15:06:00
Data Base Name C:\NASA\WUC11
Description Backup of NASAMSTR created 12-18-1991

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	.	.	.	.	.
2	.	.	.	.	.	.
3	.	.	.	.	.	.
4	10	7.201859	.8609902	5.376893	9.026825	2.798142
5	.	.	.	.	.	.
6	11.3	4.898123	.8715137	3.050851	6.745395	6.401877
7	3	2.562452	1.713773	-1.070084	6.194987	.4375482
8	1.1	.	.	.	.	.
9	10.1	.	.	.	.	.
10	2.9	.	.	.	.	.
11	2.5	.	.	.	.	.
12	2.3	.	.	.	.	.
13	5.1	5.291407	1.027527	3.113447	7.469368	-.1914072
14	3.6	5.291407	1.027527	3.113447	7.469368	-1.691407
15	4.2	5.291407	1.027527	3.113447	7.469368	-1.091407
16	7.9	7.517668	1.150616	5.078806	9.95653	.3823323
17	.	.	.	.	.	.
18	3	5.776029	.836188	4.003634	7.548424	-2.776029
19	2.68	5.583581	.8619595	3.75656	7.410602	-2.903581
20	8.32	8.247961	1.022725	6.08018	10.41574	.7204E-01
21	6.5	.	.	.	.	.
22	.	.	.	.	.	.
23	3.4	5.871576	.8064643	4.162183	7.580968	-2.471576
24	5.3	5.871576	.8064643	4.162183	7.580968	-.5715756
25	4.7	5.871576	.8064643	4.162183	7.580968	-1.171576
26	4	9.766043	1.391922	6.815705	12.71638	-5.766043
27	9.4	6.614183	1.103623	4.27493	8.953437	2.785816
28	3.63	1.53145	1.63013	-1.923795	4.986695	2.09855
29	.	.	.	.	.	.
30	1.37	1.344041	2.476408	-3.904985	6.593067	.0259589
31	10.3	5.43271	1.149304	2.99663	7.868791	4.86729
32	41.9	40.8043	3.042678	34.355	47.2536	1.095703
33	.	.	.	.	.	.
34	.	.	.	.	.	.
35	6.2	8.530637	1.529309	5.289094	11.77218	-2.330637

Durbin - Watson Statistic 1.213496

----------Multiple Regression----------

Date/Time 04-02-1992 14:43:23
Data Base Name C:\NASA\WUC12A
Description Merge of WUC11 and WUC12 created 04-01-1992

Multiple Regression Report

Dependent Variable: FHBMA12

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	3428.487	0.0000	889.042	3.86	0.0027		
DRY_WGT	-.142E-01	-99.4395	.4057E-02	-3.50	0.0050	0.2665	0.2665
LN DRYWT	-423.9594	-49.6111	112.3514	-3.77	0.0031	0.3194	0.3123
SQR WGT	11.05028	125.8885	3.053272	3.62	0.0040	0.3395	0.3178
CREWSIZE	111.5669	48.0205	29.20304	3.82	0.0028	0.3689	0.1151
SQR CREW	-360.7212	-28.1205	91.78398	-3.93	0.0024	0.5711	0.1975
WGT BODY	.1865E-01	44.7105	.5565E-02	3.35	0.0065	0.5852	0.2126
SQRWTBOD	-4.835661	-31.1615	1.462995	-3.31	0.0070	0.7243	0.2711
CREW+TRP	-.2578509	-2.1322	.1338993	-1.93	0.0804	0.7938	0.1739

Analysis of Variance Report

Dependent Variable: FHBMA12

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	6581.192	6581.192		
Model	8	1873.412	234.1765	5.29	0.007
Error	11	486.516	44.22873		
Total	19	2359.928	124.2067		

Root Mean Square Error	6.650468
Mean of Dependent Variable	18.14
Coefficient of Variation	.366619
R Squared	0.7938
Adjusted R Squared	0.6439

----------Multiple Regression----------

Date/Time 04-02-1992 14:43:48
Data Base Name C:\NASA\WUC12A
Description Merge of WUC11 and WUC12 created 04-01-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	.	.	.	.	.
2	.	.	.	.	.	.
3	.	.	.	.	.	.
4	46	35.40208	4.578885	25.33262	45.47154	10.59792
5	.	.	.	.	.	.
6	22.8	18.02934	3.334961	10.6954	25.36328	4.77066
7	15.3	14.40029	6.470281	.1714525	28.62913	.8997078
8	9.1	.	.	.	.	.
9	41.3	.	.	.	.	.
10	11	.	.	.	.	.
11	18.4	.	.	.	.	.
12	28.1	.	.	.	.	.
13	5.6	8.198369	3.428157	.6594849	15.73725	-2.598369
14	6.2	8.774358	3.362468	1.379931	16.16879	-2.574358
15	6.2	12.26911	3.176613	5.283397	19.25482	-6.069109
16	32.5	39.88201	3.990315	31.10688	48.65714	-7.382008
17	.	.	.	.	.	.
18	18.5	20.57762	3.828342	12.15869	28.99656	-2.077622
19	26.4	22.01048	3.785872	13.68494	30.33601	4.389523
20	28.8	29.78044	3.131097	22.89483	36.66606	-.9804421
21	14.9	.	.	.	.	.
22	.	.	.	.	.	.
23	13.6	16.12783	3.214599	9.058584	23.19708	-2.52783
24	14.7	19.4407	3.221416	12.35646	26.52493	-4.740697
25	21.4	20.35781	3.556437	12.53683	28.1788	1.042189
26	24.9	20.19248	3.847112	11.73227	28.65269	4.70752
27	20.8	10.50898	4.839775	-.1342001	21.15216	10.29102
28	10	7.176239	6.234165	-6.533356	20.88583	2.823762
29	.	.	.	.	.	.
30	1.9	2.424153	6.641927	-12.18216	17.03046	-.5241526
31	8.9	15.85721	2.948073	9.374085	22.34034	-6.957213
32	.	-282.9091	89.58411	-479.9141	-85.90405	.
33	.	.	.	.	.	.
34	.	.	.	.	.	.
35	29.4	31.935	5.370606	20.12446	43.74554	-2.535002
36	8.9	9.461346	6.644016	-5.149556	24.07225	-.5613461

Durbin - Watson Statistic .5828236

----------Multiple Regression----------

Date/Time 04-12-1992 19:23:26
Data Base Name B:WUC13
Description Backup of WUC13 created 03-27-1992

Multiple Regression Report

Dependent Variable: FHBMA13

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	72.41159	0.0000	17.39141	4.16	0.0013		
WHEELS	14.5682	20.6183	4.177294	3.49	0.0045	0.5762	0.5762
LEN_WING	.9942E-01	2.6360	.2670E-01	3.72	0.0029	0.5780	0.4303
LN DRYWT	-12.41028	-2.9632	4.370507	-2.84	0.0149	0.6106	0.3896
SQRWHEEL	-65.6	-13.8090	16.95416	-3.87	0.0022	0.6747	0.6015
WGT13	-.568E-02	-12.0906	.1661E-02	-3.42	0.0051	0.7200	0.5508
LOGWGT13	18.59791	5.0203	6.412072	2.90	0.0133	0.8354	0.4365

Analysis of Variance Report

Dependent Variable: FHBMA13

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	2690.59	2690.59		
Model	6	248.1326	41.35543	10.15	0.000
Error	12	48.88739	4.073949		
Total	18	297.02	16.50111		

Root Mean Square Error	2.018403
Mean of Dependent Variable	11.9
Coefficient of Variation	.1696137
R Squared	0.8354
Adjusted R Squared	0.7531

----------Multiple Regression----------

Date/Time 04-12-1992 19:23:27
Data Base Name B:WUC13
Description Backup of WUC13 created 03-27-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	.	.	.	.	.
2	.	.	.	.	.	.
3	.	.	.	.	.	.
4	14.4	12.13839	.8063493	10.38218	13.89459	2.261614
5	.	11.62329	.7845961	9.914456	13.33212	.
6	18.5	17.50248	1.167702	14.95926	20.04571	.9975166
7	.	-8.098694	6.455153	-22.15785	5.960466	.
8	.	.	.	.	.	.
9	11.2	.	.	.	.	.
10	8.7	.	.	.	.	.
11	10.7	.	.	.	.	.
12	.	.	.	.	.	.
13	11.3	11.63141	.9716528	9.515175	13.74764	-.3314095
14	8.4	11.56334	.9720188	9.446307	13.68037	-3.163341
15	12	11.62189	.8982958	9.665422	13.57835	.3781118
16	18	15.52705	1.127848	13.07063	17.98348	2.472947
17	.	.	.	.	.	.
18	13	12.5797	1.230238	9.90027	15.25912	.4203033
19	15.3	12.5968	1.223564	9.931908	15.26169	2.7032
20	12.4	13.28172	.7411884	11.66743	14.89601	-.8817177
21	10.3	13.56009	.7361409	11.95679	15.16339	-3.260091
22	.	.	.	.	.	.
23	12.8	14.376	.9899314	12.21995	16.53204	-1.575998
24	13.3	13.50301	.8845586	11.57647	15.42956	-.2030125
25	12.3	13.32671	.8913186	11.38544	15.26798	-1.026712
26	6.2	5.20037	1.642939	1.622091	8.77865	.9996295
27	10.6	10.49421	1.90281	6.349935	14.63848	.105792
28	7.5	7.232115	1.476327	4.016712	10.44752	.2678852
29	.	.	.	.	.	.
30	1.4	1.537934	2.015474	-2.851719	5.927587	-.137934
31	15.7	14.52365	1.049495	12.23788	16.80943	1.176345
32	.	-68.25033	22.92037	-118.1703	-18.33034	.
33	.	.	.	.	.	.
34	.	.	.	.	.	.
35	12.7	13.90354	1.488036	10.66263	17.14444	-1.203537

Durbin - Watson Statistic 1.1842

----------Sum of Functions Regression----------

Date/Time 05-18-1992 15:20:40
Data Base Name C:\NASA\WUC23
Description Merge of WUC11 and WUC51 created 04-27-1992

Estimation Summary Report

Y: FHBMA23 X: ENG WGT
Model: A+B*(X)+C*(SQR(X))

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	34.10401387922342	10.23731	3.3	0.0040	0.25947618
B	9.853047097031215D-04	7.461445E-04	1.3	0.2042	
C	-.3122318101760727	.1872512	-1.7	0.1137	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	2	338.017	169.0085	13.00033	3.0	0.0778
Error	17	964.673	56.74547	7.532959		
Total	19	1302.69	68.56263	8.280255		

----------Sum of Functions Regression----------

Date/Time 05-18-1992 15:20:49
Data Base Name C:\NASA\WUC23
Description Merge of WUC11 and WUC51 created 04-27-1992

Residual Analysis

Row	Actual X	Actual Y	Predicted Y	Lower95% Value	Upper95% Value	Residual
1	.	.	.	.	.	.
2	.	.	.	.	.	.
3	.	.	.	.	.	.
4	4497	21.7	17.59677	.9983463	34.19518	4.103235
5	.	.	.	.	.	.
6	4283	20.4	17.89018	1.253127	34.52723	2.509822
7	36554	4.6	10.42493	-7.081947	27.9318	-5.824929
8	.	6.2	.	.	.	.
9	.	13.2	.	.	.	.
10	.	5.7	.	.	.	.
11	.	5.2	.	.	.	.
12	.	9.3	.	.	.	.
13	9968	16.5	12.75235	-3.882895	29.38759	3.747653
14	9968	20.5	12.75235	-3.882895	29.38759	7.747653
15	9968	16.5	12.75235	-3.882895	29.38759	3.747653
16	2247	22.1	21.51742	3.922633	39.1122	.582585
17	.	.	.	.	.	.
18	6049	11.2	15.78019	-.6974329	32.25782	-4.580194
19	6091	11	15.73742	-.7396602	32.2145	-4.737417
20	3671	22	18.80332	2.009699	35.59695	3.196676
21	.	20.5	.	.	.	.
22	.	.	.	.	.	.
23	.	7.6	.	.	.	.
24	16696	6.8	10.21025	-6.638539	27.05904	-3.410251
25	16696	6.4	10.21025	-6.638539	27.05904	-3.810252
26	23386	5	9.398357	-7.390118	26.18683	-4.398357
27	3804	7.1	18.59472	1.841787	35.34766	-11.49472
28	25471	4.4	9.369648	-7.407126	26.14642	-4.969648
29	.	.	.	.	.	.
30	39091	1.4	10.88782	-7.082106	28.85775	-9.487823
31	10535	26.2	12.43668	-4.230335	29.10369	13.76332
32	43162	28.4	11.76412	-7.23429	30.76253	16.63588
33	.	.	.	.	.	.
34	.	.	.	.	.	.
35	1767	20.2	22.72017	4.610004	40.83033	-2.520164
36	23321	8.6	9.400715	-7.388428	26.18986	-.8007144

Residual Plot

----------Multiple Regression----------

Date/Time 04-02-1992 17:08:31
Data Base Name A:WUC24
Description Backup of WUC24 created 03-13-1992

Multiple Regression Report

Dependent Variable: FHBMA24

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	4996.525	0.0000	1764.139	2.83	0.0253		
KVA MAX	-1.906061	-4.2720	.5968567	-3.19	0.0152	0.0151	0.0151
SQR KVA	46.34963	3.7415	17.27203	2.68	0.0314	0.1201	0.0041
WGT24	-2.735048	-18.4110	1.063313	-2.57	0.0369	0.5197	0.1360
SQR WT24	284.5488	38.6879	102.2125	2.78	0.0271	0.5338	0.1340
LOG WT24	-1642.986	-20.2179	575.155	-2.86	0.0245	0.7847	0.1154

Analysis of Variance Report

Dependent Variable: FHBMA24

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	54639.37	54639.37		
Model	5	32075.44	6415.087	5.10	0.027
Error	7	8798.53	1256.933		
Total	12	40873.97	3406.164		

Root Mean Square Error	35.45325
Mean of Dependent Variable	64.83077
Coefficient of Variation	.5468584
R Squared	0.7847
Adjusted R Squared	0.6310

----------Multiple Regression----------

Date/Time 04-02-1992 17:08:41
Data Base Name A:WUC24
Description Backup of WUC24 created 03-13-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	.	.	.	.	.
2	.	.	.	.	.	.
3	.	.	.	.	.	.
4	.	.	.	.	.	.
5	.	.	.	.	.	.
6	100	69.82757	22.92636	15.78379	123.8713	30.17243
7	.	.	.	.	.	.
8	.	.	.	.	.	.
9	.	.	.	.	.	.
10	.	.	.	.	.	.
11	.	.	.	.	.	.
12	.	.	.	.	.	.
13	.	.	.	.	.	.
14	.	.	.	.	.	.
15	.	.	.	.	.	.
16	.	.	.	.	.	.
17	.	.	.	.	.	.
18	27.1	7.185519	33.36948	-71.47559	85.84663	19.91448
19	31.6	55.7631	14.63838	21.2564	90.26981	-24.1631
20	22.6	45.40957	20.49519	-2.903259	93.72239	-22.80956
21	24	35.4301	19.86587	-11.39926	82.25946	-11.4301
22	.	.	.	.	.	.
23	52.5	41.59393	17.04385	1.416855	81.77101	10.90607
24	49.6	44.51074	16.72573	5.083572	83.93791	5.089256
25	44.1	44.51074	16.72573	5.083572	83.93791	-.4107437
26	233	181.7857	26.3202	119.7417	243.8297	51.21433
27	98	.	.	.	.	.
28	53.2	48.68216	18.10141	6.012123	91.35219	4.517845
29	.	21.10454	19.34587	-24.49903	66.70811	.
30	14.5	15.26921	34.75413	-66.65589	97.19431	-.7692118
31	99.7	158.4855	23.50973	103.0666	213.9044	-58.78552
32	90.9	94.35203	35.24929	11.25969	177.4444	-3.452026
33	.	.	.	.	.	.
34	.	.	.	.	.	.
35	.	.	.	.	.	.

Durbin - Watson Statistic 1.276503

----------Multiple Regression----------

Date/Time 04-07-1992 14:35:52
Data Base Name A:WUC42
Description Backup of WUC42 created 03-27-1992

Multiple Regression Report

Dependent Variable: FMA42/44

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	1193.127	0.0000	117.0389	10.19	0.0000		
WGT42	-.755E-01	-7.6982	.9180E-02	-8.22	0.0000	0.0233	0.0233
SQR WT42	6.758773	7.6694	.8034786	8.41	0.0000	0.0363	0.0170
LEN WING	-.7155964	-5.0081	.8059E-01	-8.88	0.0000	0.0384	0.0094
LN DRYWT	-167.2401	-10.6606	16.50279	-10.13	0.0000	0.0391	0.0091
SQR WGT	2.2308	17.6804	.2085312	10.70	0.0000	0.3664	0.0320
LOG KVA	29.10236	1.5538	4.96025	5.87	0.0001	0.4321	0.0100
KVA SQD	-.127E-02	-4.2703	.1504E-03	-8.46	0.0000	0.9126	0.0290

Analysis of Variance Report

Dependent Variable: FMA42/44

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	9425.524	9425.524		
Model	7	5013.717	716.2453	19.40	0.000
Error	13	480.0486	36.92682		
Total	20	5493.766	274.6883		

Root Mean Square Error	6.076744
Mean of Dependent Variable	21.18571
Coefficient of Variation	.2868321
R Squared	0.9126
Adjusted R Squared	0.8656

----------Multiple Regression----------

Date/Time 04-07-1992 14:36:04
Data Base Name A:WUC42
Description Backup of WUC42 created 03-27-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	.	.	.	.	.
2	.	.	.	.	.	.
3	.	.	.	.	.	.
4	26.3	29.8017	3.488953	22.26824	37.33516	-3.501701
5	.	.	.	.	.	.
6	24.4	14.95013	1.740427	11.19215	18.70812	9.449867
7	9	6.211584	5.541101	-5.752943	18.17611	2.788416
8	9	.	.	.	.	.
9	18.8	.	.	.	.	.
10	7.9	.	.	.	.	.
11	9.4	.	.	.	.	.
12	17.9	.	.	.	.	.
13	16	16.70531	2.848549	10.55463	22.85599	-.705307
14	15.7	16.82314	2.872824	10.62004	23.02623	-1.123136
15	16.3	14.22686	2.972956	7.807555	20.64616	2.07314
16	36.3	33.83958	4.143581	24.89262	42.78654	2.460419
17	.	.	.	.	.	.
18	12.6	6.691128	2.937948	.3474145	13.03484	5.908873
19	14.9	18.09532	3.458087	10.6285	25.56213	-3.195318
20	14.5	21.83239	2.183244	17.11826	26.54652	-7.332394
21	13.2	19.82873	2.184684	15.11149	24.54597	-6.628732
22	.	.	.	.	.	.
23	12.8	4.73493	3.232978	-2.245821	11.71568	8.065071
24	14.4	13.65659	2.758887	7.699511	19.61367	.7434092
25	12.4	16.13459	2.651955	10.4084	21.86078	-3.734589
26	10	19.80948	2.971453	13.39343	26.22554	-9.809485
27	20.2	17.44753	4.498868	7.733433	27.16164	2.752466
28	39.8	39.02169	4.757357	28.74945	49.29393	.7783089
29	.	.	.	.	.	.
30	2.5	5.149785	5.956206	-7.71105	18.01062	-2.649785
31	20.7	22.96551	3.21715	16.01893	29.91208	-2.265505
32	81.7	77.70444	5.775562	65.23366	90.17522	3.99556
33	.	.	.	.	.	.
34	.	.	.	.	.	.
35	31.2	29.27219	4.585095	19.37191	39.17248	1.927809

Durbin - Watson Statistic .9728374

----------Multiple Regression----------

Date/Time 04-03-1992 14:10:20
Data Base Name A:WUC45
Description Backup of WUC45 created 03-13-1992

Multiple Regression Report

Dependent Variable: FHBMA45

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	396.2586	0.0000	158.0882	2.51	0.0263		
WETAREA	-.622E-02	-1.2534	.2952E-02	-2.11	0.0552	0.1895	0.1895
SUBSYS	35.63519	14.9205	13.60838	2.62	0.0212	0.2126	0.1606
SQR SUBS	-779.8318	-27.5569	293.7664	-2.65	0.0198	0.2190	0.1578
LOG SUBS	975.5665	12.8481	372.1557	2.62	0.0211	0.3287	0.1377
SQR WT45	8.812898	3.1624	2.214499	3.98	0.0016	0.3724	0.1646
LOG WT45	-105.7279	-2.3344	25.46246	-4.15	0.0011	0.7302	0.2943

Analysis of Variance Report

Dependent Variable: FHBMA45

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	43300.82	43300.82		
Model	6	25232.66	4205.443	5.86	0.004
Error	13	9321.665	717.0512		
Total	19	34554.32	1818.648		

Root Mean Square Error	26.77781
Mean of Dependent Variable	46.53
Coefficient of Variation	.5754956
R Squared	0.7302
Adjusted R Squared	0.6057

----------Multiple Regression----------

Date/Time 04-03-1992 14:10:30
Data Base Name A:WUC45
Description Backup of WUC45 created 03-13-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	.	.	.	.	.
2	.	.	.	.	.	.
3	.	.	.	.	.	.
4	44.4	43.68098	18.99137	2.674194	84.68777	.7190208
5	.	.	.	.	.	.
6	95.8	71.94819	9.017187	52.47798	91.4184	23.85181
7	9.6	7.946936	23.73618	-43.30499	59.19886	1.653065
8	12.3	.	.	.	.	.
9	35.2	.	.	.	.	.
10	20.5	.	.	.	.	.
11	18.5	.	.	.	.	.
12	28.2	.	.	.	.	.
13	30.4	.	.	.	.	.
14	26.3	30.67701	13.32979	1.894903	59.45912	-4.377014
15	44.7	30.67701	13.32979	1.894903	59.45912	14.02299
16	183	121.2529	15.21319	88.40407	154.1017	61.74712
17	.	.	.	.	.	.
18	19.7	43.58819	8.864145	24.44844	62.72794	-23.88819
19	25.4	37.19875	9.746329	16.15415	58.24334	-11.79875
20	75.7	84.11586	9.813308	62.92664	105.3051	-8.415863
21	62.7	84.03505	9.798325	62.87819	105.1919	-21.33505
22	.	.	.	.	.	.
23	17	28.79477	11.82984	3.251391	54.33815	-11.79477
24	18.7	28.71986	11.83429	3.166882	54.27284	-10.01986
25	19.4	28.71986	11.83429	3.166882	54.27284	-9.319861
26	14.3	23.15324	14.23642	-7.586506	53.89299	-8.853242
27	27.3	33.6419	24.34888	-18.93301	86.21681	-6.3419
28	16	-19.23709	16.0961	-53.99232	15.51813	35.23709
29	.	.	.	.	.	.
30	4.7	8.607842	22.39445	-39.74698	56.96266	-3.907842
31	73.8	49.35373	14.39855	18.26391	80.44355	24.44627
32	60.5	68.67876	24.75348	15.23025	122.1273	-8.178764
33	.	.	.	.	.	.
34	.	.	.	.	.	.
35	91.6	125.0493	16.28075	89.89542	160.2033	-33.44935

Durbin - Watson Statistic .7553009

----------Multiple Regression----------

Date/Time 04-02-1992 16:26:05
Data Base Name A:WUC14
Description Backup of WUC14 created 03-27-1992

Multiple Regression Report

Dependent Variable: FHBMA14

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	26.29027	0.0000	5.516686	4.77	0.0006		
SQR WT14	-1.11361	-3.1267	.2823322	-3.94	0.0023	0.3119	0.3119
ACTUATOR	.9516068	4.4096	.2070737	4.60	0.0008	0.3665	0.3635
CONT SUR	-1.899484	-3.2112	.3542125	-5.36	0.0002	0.4257	0.4177
LEN WING	.3505284	7.4989	.0697234	5.03	0.0004	0.5870	0.1962
WETAREA	-.357E-02	-5.6737	.8842E-03	-4.04	0.0019	0.8338	0.2781

Analysis of Variance Report

Dependent Variable: FHBMA14

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	3124.495	3124.495		
Model	5	368.186	73.63719	11.04	0.001
Error	11	73.38562	6.67142		
Total	16	441.5716	27.59822		

Root Mean Square Error	2.582909
Mean of Dependent Variable	13.55706
Coefficient of Variation	.1905213
R Squared	0.8338
Adjusted R Squared	0.7583

----------Multiple Regression----------

Date/Time 04-02-1992 15:26:14
Data Base Name A:WUC14
Description Backup of WUC14 created 03-27-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	3.93	.	.	.	.	.
2	2.76	.	.	.	.	.
3	4.28	.	.	.	.	.
4	14.56	13.36487	1.540009	9.978226	16.75151	1.19513
5	7.28	.	.	.	.	.
6	17.14	18.93295	1.272004	16.13568	21.73022	-1.792948
7	7.08	6.314134	2.212739	1.448084	11.18018	.7658658
8	4.36	.	.	.	.	.
9	22.49	.	.	.	.	.
10	6.02	.	.	.	.	.
11	7.21	.	.	.	.	.
12	9.61	.	.	.	.	.
13	9.35	8.357595	1.360307	5.366136	11.34906	.9924049
14	9.8	11.21242	1.154889	8.672692	13.75214	-1.412416
15	9.65	12.8599	1.145179	10.34153	15.37827	-3.209903
16	21.7	21.57082	2.105001	16.9417	26.19994	.129179
17	4.48	.	.	.	.	.
18	12.95	14.22219	1.201421	11.58014	16.86425	-1.272195
19	14.35	15.88612	1.210335	13.22446	18.54778	-1.536119
20	15.53	11.79617	1.177666	9.206356	14.38598	3.733831
21	14.34	12.73119	1.058403	10.40365	15.05873	1.608809
22	7.47	.	.	.	.	.
23	14.38	17.14578	1.270408	14.35202	19.93954	-2.765779
24	18.94	17.14578	1.270408	14.35202	19.93954	1.794222
25	18.32	17.70663	1.29922	14.8495	20.56375	.6133728
26	6.6	9.488832	1.438714	6.324945	12.65272	-2.888832
27	11.8	.	.	.	.	.
28	6.8	.	.	.	.	.
29	8.57	.	.	.	.	.
30	3.8	3.590492	2.552406	-2.022521	9.203505	.2095082
31	21.98	18.14413	1.81661	14.14921	22.13905	3.835873
32	.	-73.75688	15.50723	-107.8589	-39.65482	.
33	6.7	.	.	.	.	.
34	4.24	.	.	.	.	.

Durbin - Watson Statistic 1.453594

----------Multiple Regression----------

Date/Time 04-05-1992 14:10:02
Data Base Name B:AVIONICS
Description Backup of AVIONICS created 03-27-1992

Multiple Regression Report

Dependent Variable: FHBMA

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	-36.91729	0.0000	27.71737	-1.33	0.2124		
TOTSUBS	-4.496016	-7.2132	1.798985	-2.50	0.0315	0.3061	0.3061
SQR TSUB	45.75636	8.1287	18.14795	2.52	0.0303	0.3499	0.3269
AVG WT/S	-.1230886	-2.2612	.4387E-01	-2.81	0.0186	0.5039	0.1876
WGT51/72	.2360E-01	10.1898	.7750E-02	3.05	0.0124	0.5524	0.4244
SQR51/72	-2.453409	-9.6786	.7582701	-3.24	0.0089	0.7813	0.5377

Analysis of Variance Report

Dependent Variable: FHBMA

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	1161.106	1161.106		
Model	5	277.7397	55.54793	7.15	0.004
Error	10	77.7247	7.77247		
Total	15	355.4644	23.69763		

Root Mean Square Error	2.787915
Mean of Dependent Variable	8.51875
Coefficient of Variation	.3272681
R Squared	0.7813
Adjusted R Squared	0.6720

----------Multiple Regression----------

Date/Time 04-05-1992 14:10:02
Data Base Name B:AVIONICS
Description Backup of AVIONICS created 03-27-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	.	.	.	.	.
2	.	.	.	.	.	.
3	.	.	.	.	.	.
4	13.8	11.47413	2.163948	6.654596	16.29367	2.325869
5	.	.	.	.	.	.
6	11.7	13.2958	1.391816	10.19595	16.39564	-1.595797
7	3.6	3.321389	2.734361	-2.768568	9.411346	.2786114
8	3.2	.	.	.	.	.
9	5.3	.	.	.	.	.
10	5.7	.	.	.	.	.
11	4.5	.	.	.	.	.
12	6.5	.	.	.	.	.
13	4.6	.	.	.	.	.
14	3	3.347025	1.895034	-.8735862	7.567636	-.3470249
15	2.3	.	.	.	.	.
16	13.4	14.37355	2.05159	9.804258	18.94284	-.9735508
17	.	.	.	.	.	.
18	7.2	9.215006	.9867181	7.017392	11.41262	-2.015006
19	6.8	8.969621	.9692566	6.810897	11.12834	-2.169621
20	17.1	13.69418	1.421032	10.52927	16.8591	3.405816
21	10.9	12.69238	1.256933	9.892949	15.49182	-1.792384
22	.	.	.	.	.	.
23	4.7	.	.	.	.	.
24	4.4	4.35442	1.118757	1.862731	6.846109	.4558E-01
25	3.2	6.210011	1.03621	3.902168	8.517853	-3.010011
26	2.6	.	.	.	.	.
27	11.3	5.770187	1.547329	2.323983	9.216392	5.529813
28	4.4	5.542498	1.320705	2.601031	8.483965	-1.142498
29	.	.	.	.	.	.
30	1.5	2.12689	1.636726	-1.51842	5.772199	-.6268895
31	.	-.3224168	3.293402	-7.657466	7.012632	.
32	9.6	7.683124	2.278235	2.609049	12.7572	1.916876
33	.	.	.	.	.	.
34	.	.	.	.	.	.
35	14.4	14.22974	2.211951	9.303292	19.15619	.1702614

Durbin - Watson Statistic 1.486022

----------Multiple Regression----------

Date/Time 03-17-1992 15:46:03
Data Base Name C:\NASA\PRECON
Description Merge of WUC12 and WUC11 created 03-17-1992

Multiple Regression Report

Dependent Variable: ECS FHMA

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	454.3876	0.0000	73.06644	6.22	0.0000		
DRY_WGT	-.547E-03	-2.7882	.1174E-03	-4.66	0.0001	0.2268	0.2268
LEN_WING	.8210209	6.3884	.1587219	5.17	0.0000	0.2412	0.2399
LN LENTH	-107.5185	-4.3668	18.67703	-5.76	0.0000	0.7057	0.3295

Analysis of Variance Report

Dependent Variable: ECS FHMA

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	15876	15876		
Model	3	2878.971	959.6572	16.78	0.000
Error	21	1200.849	57.18326		
Total	24	4079.82	169.9925		

Root Mean Square Error	7.561962
Mean of Dependent Variable	25.2
Coefficient of Variation	.3000779
R Squared	0.7057
Adjusted R Squared	0.6636

----------Multiple Regression----------

Date/Time 03-17-1992 15:46:20
Data Base Name C:\NASA\PRECON
Description Merge of WUC12 and WUC11 created 03-17-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	50.7493	4.118218	42.1861	59.31249	.
2	.	50.45108	4.085465	41.95599	58.94617	.
3	.	25.69216	1.828852	21.88935	29.49497	.
4	35.8	36.86065	2.3857	31.89995	41.82134	-1.060646
5	.	36.44805	2.36965	31.52073	41.37537	.
6	25.8	27.79544	1.74072	24.17588	31.41499	-1.995438
7	26.8	25.50905	3.895484	17.40899	33.6091	1.290951
8	6.7	12.25799	2.913207	6.20043	18.31556	-5.557993
9	40.7	26.45771	1.779617	22.75727	30.15815	14.24229
10	10.2	14.31453	2.695768	8.709101	19.91996	-4.114533
11	11.5	13.59828	2.802119	7.771712	19.42486	-2.098285
12	11.6	13.59828	2.802119	7.771712	19.42486	-1.998284
13	27.1	26.65697	2.11557	22.25797	31.05597	.4430351
14	32.1	26.57109	2.123911	22.15475	30.98743	5.52891
15	29.2	24.79607	2.100431	20.42855	29.16359	4.403929
16	43	46.63979	3.487054	39.389	53.89058	-3.639786
17	.	16.48271	2.533746	11.21418	21.75124	.
18	20.9	25.24841	1.886233	21.32628	29.17054	-4.34841
19	22.4	24.88891	1.916442	20.90397	28.87386	-2.488913
20	40.6	41.27864	2.843852	35.36529	47.19199	-.6786423
21	31.6	39.85584	2.647759	34.35024	45.36145	-8.255842
22	.	30.62558	1.996451	26.47427	34.77689	.
23	13.8	21.98905	2.961403	15.83127	28.14683	-8.189052
24	15.9	19.31327	2.714297	13.66931	24.95723	-3.413271
25	15.8	18.80413	2.682354	13.22659	24.38167	-3.004132
26	34.1	19.77402	2.826684	13.89637	25.65167	14.32598
27	24.4	26.99358	1.749175	23.35644	30.63072	-2.593578
28	11.7	23.88553	3.557813	16.48761	31.28345	-12.18553
29	.	20.73655	2.040279	16.49411	24.97899	.
30	5.5	3.885876	7.251264	-11.192	18.96375	1.614124
31	35.4	18.79546	2.621801	13.34383	24.24709	16.60454
32	.	-21.289	8.379209	-38.71227	-3.865732	.
33	.	17.40764	2.290914	12.64404	22.17124	.
34	.	21.40354	2.152125	16.92853	25.87855	.
35	57.4	50.23156	3.978719	41.95843	58.50468	7.168446

Durbin - Watson Statistic 1.564765

----------Multiple Regression----------

Date/Time 03-18-1992 16:24:35
Data Base Name C:\NASA\PRECON
Description Merge of WUC12 and WUC11 created 03-17-1992

Multiple Regression Report

Dependent Variable: FHBMA47

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	6613.119	0.0000	2618.338	2.53	0.0186		
LEN_WING	-1.484938	-3.7671	.824043	-1.80	0.0841	0.1844	0.1844
LN DRY	-1358.298	-31.4055	574.8234	-2.36	0.0266	0.3888	0.3131
LDRY SQD	73.58044	36.8273	32.95623	2.23	0.0352	0.4523	0.2908
WGT/LEN	-.7258523	-2.5758	.3997296	-1.82	0.0819	0.5185	0.2127

Analysis of Variance Report

Dependent Variable: FHBMA47

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	157445.3	157445.3		
Model	4	24456.88	6114.22	6.46	0.001
Error	24	22715.22	946.4675		
Total	28	47172.1	1684.718		

Root Mean Square Error	30.76471
Mean of Dependent Variable	73.68276
Coefficient of Variation	.4175293
R Squared	0.5185
Adjusted R Squared	0.4382

----------Multiple Regression----------

Date/Time 03-18-1992 16:24:54
Data Base Name C:\NASA\PRECON
Description Merge of WUC12 and WUC11 created 03-17-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	141.1113	14.8278	110.5091	171.7135	.
2	.	135.1058	13.73957	106.7495	163.4621	.
3	.	74.50274	7.388289	59.25449	89.75098	.
4	.	89.13271	8.856916	70.85345	107.412	.
5	59.4	86.20551	8.97948	67.67329	104.7377	-26.8055
6	54	81.1097	9.006599	62.52152	99.69788	-27.1097
7	57.3	50.2059	13.07486	23.22149	77.19032	7.094097
8	45.8	65.38286	9.373751	46.03693	84.72878	-19.58286
9	48.5	76.77922	7.535839	61.22646	92.33199	-28.27922
10	60.7	65.54992	8.589679	47.8222	83.27764	-4.849918
11	71.8	65.01151	8.994681	46.44792	83.57509	6.788498
12	70.6	65.01151	8.994681	46.44792	83.57509	5.588493
13	42.8	64.57682	10.69242	42.50937	86.64427	-21.77682
14	52.8	64.22317	10.80014	41.93341	86.51292	-11.42317
15	57.5	65.46734	9.715715	45.41566	85.51902	-7.967339
16	215	142.0901	15.25339	110.6095	173.5706	72.90994
17	43.6	65.17923	8.394764	47.85378	82.50468	-21.57923
18	116.4	72.50864	7.562007	56.90186	88.11541	43.89137
19	143.6	71.52433	7.679718	55.67462	87.37404	72.07568
20	96.8	103.5267	9.627464	83.65718	123.3963	-6.726723
21	63.8	103.8566	9.612676	84.01761	123.6957	-40.05664
22	89.5	75.70082	8.69736	57.75086	93.65078	13.79918
23	53.6	52.13289	11.7856	27.80928	76.4565	1.46711
24	63.8	56.5951	11.05877	33.77158	79.41863	7.204895
25	37.5	57.45002	11.07085	34.60156	80.29848	-19.95002
26	39.4	57.72341	11.89523	33.17355	82.27326	-18.32341
27	105	79.31601	9.222612	60.28201	98.35001	25.68399
28	44.7	52.84816	12.59733	26.84928	78.84703	-8.148155
29	.	67.65247	8.162927	50.8055	84.49945	.
30	17.8	26.02779	27.49129	-30.70984	82.76541	-8.227787
31	88.5	56.84679	10.56459	35.04317	78.65041	31.65321
32	88.1	61.15994	19.6937	20.51528	101.8046	26.94006
33	.	67.13113	7.37101	51.91855	82.34372	.
34	.	66.90881	8.17968	50.02726	83.79037	.
35	151	183.7776	24.31625	133.5927	233.9624	-32.77757
36	57.5	69.05804	19.9642	27.85511	110.261	-11.55804

Durbin - Watson Statistic 1.776327

----------Multiple Regression----------

Date/Time 04-06-1992 11:25:48
Data Base Name C:\NASA\WUC96
Description Merge of WUC47 and WUC12 created 02-11-1992

Multiple Regression Report

Dependent Variable: FMA49/96

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	17952.78	0.0000	2610.109	6.88	0.0000		
DRY_WGT	.5793E-02	2.6703	.1051E-02	5.51	0.0002	0.2448	0.2448
CREWSIZE	169.962	1.5299	34.79977	4.88	0.0005	0.4510	0.4508
LEN_WING	-10.13568	-6.6007	1.493222	-6.79	0.0000	0.5271	0.4064
PERSONS	21.14998	10.7670	3.980229	5.31	0.0002	0.5287	0.2572
SQR_PER	-461.3385	-13.7798	86.43541	-5.34	0.0002	0.5324	0.3662
WGT49/96	-1.892708	-37.9819	.3154611	-6.00	0.0001	0.5328	0.3246
SQRWT49/	421.831	71.9834	68.4356	6.16	0.0001	0.6250	0.4239
LOGWT49/	-4054.064	-29.7305	615.4006	-6.59	0.0000	0.9242	0.5188

Analysis of Variance Report

Dependent Variable: FMA49/96

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	770752.3	770752.3		
Model	8	584015.3	73001.91	16.76	0.000
Error	11	47919.77	4356.342		
Total	19	631935	33259.74		

Root Mean Square Error	66.00259
Mean of Dependent Variable	196.31
Coefficient of Variation	.3362162
R Squared	0.9242
Adjusted R Squared	0.8690

----------Multiple Regression----------

Date/Time 04-06-1992 11:26:00
Data Base Name C:\NASA\WUC96
Description Merge of WUC47 and WUC12 created 02-11-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	.	.	.	.	.
2	.	.	.	.	.	.
3	.	.	.	.	.	.
4	234	296.2767	23.31404	245.0067	347.5468	-62.27673
5	.	.	.	.	.	.
6	235	213.7676	36.67631	133.1125	294.4228	21.23238
7	55.5	47.42839	65.27004	-96.10739	190.9642	8.07161
8	40.1	.	.	.	.	.
9	60.3	.	.	.	.	.
10	95	.	.	.	.	.
11	108.4	.	.	.	.	.
12	121.8	.	.	.	.	.
13	236.6	258.4744	36.76332	177.628	339.3209	-21.87442
14	236.8	259.3846	36.80959	178.4363	340.3328	-22.58458
15	262.1	217.3143	34.72522	140.9498	293.6787	44.78574
16	610.8	454.2334	28.79348	390.9134	517.5533	156.5666
17	.	.	.	.	.	.
18	83.6	129.978	36.88562	48.86253	211.0934	-46.37795
19	131.1	132.4468	36.62774	51.8985	212.9951	-1.346802
20	561.1	630.444	46.66964	527.8124	733.0755	-69.34399
21	492.7	452.9334	40.21066	364.5058	541.3609	39.76666
22	.	.	.	.	.	.
23	34.7	.3676592	32.37596	-70.83053	71.56585	34.33234
24	48.8	26.36375	31.55152	-43.0214	95.74891	22.43625
25	34.2	21.57078	31.59287	-47.90533	91.0469	12.62922
26	46.7	73.33378	63.0208	-65.2557	211.9232	-26.63378
27	70.5	78.93259	53.74566	-39.25987	197.125	-8.432587
28	34.6	84.06072	49.07781	-23.86664	191.9881	-49.46072
29	.	.	.	.	.	.
30	10	-7.931614	64.03231	-148.7455	132.8823	17.93161
31	201.4	.	.	.	.	.
32	175.9	179.8266	65.26067	36.31137	323.3418	-3.926575
33	.	.	.	.	.	.
34	.	.	.	.	.	.
35	331.5	376.9937	33.91124	302.4193	451.5682	-45.49371

Durbin - Watson Statistic .8255058

----------Multiple Regression----------

Date/Time 04-20-1992 12:59:29
Data Base Name B:WUC97
Description Backup of WUC97 created 03-13-1992

Multiple Regression Report

Dependent Variable: FMA91397

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	7549.095	0.0000	2040.461	3.70	0.0021		
DRY_WGT	-.165E-01	-4.8461	.7514E-02	-2.20	0.0442	0.1183	0.1183
LEN_WING	4.00187	2.6090	1.085099	3.69	0.0022	0.2945	0.1860
LN DRYWT	-999.7649	-6.7243	276.4095	-3.62	0.0025	0.3054	0.0831
SQR WGT	16.8468	10.9600	6.396186	2.63	0.0188	0.6256	0.1214
PERSONS	-4.224915	-2.1475	.862487	-4.90	0.0002	0.8560	0.0506

Analysis of Variance Report

Dependent Variable: FMA91397

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	603369.1	603369.1		
Model	5	205508.5	41101.7	17.83	0.000
Error	15	34579.43	2305.295		
Total	20	240087.9	12004.4		

Root Mean Square Error	48.01349
Mean of Dependent Variable	169.5048
Coefficient of Variation	.2832575
R Squared	0.8560
Adjusted R Squared	0.8080

----------Multiple Regression----------

Date/Time 04-20-1992 12:59:29
Data Base Name B:WUC97
Description Backup of WUC97 created 03-13-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	143.8382	25.82817	88.8058	198.8705	.
2	.	125.925	24.46182	73.80399	178.0461	.
3	.	97.26936	16.04484	63.08246	131.4563	.
4	104	53.57728	18.02652	15.16798	91.98658	50.42272
5	.	46.76052	17.89455	8.632401	84.88863	.
6	122.4	134.2292	26.72573	77.28436	191.174	-11.82916
7	.	1031.059	205.2035	593.8298	1468.288	.
8	249.2	237.2138	21.50652	191.3896	283.038	11.98621
9	41	108.7047	18.68796	68.88611	148.5234	-67.70474
10	146.8	204.3625	17.87317	166.2799	242.4451	-57.5625
11	175.2	205.5599	19.5112	163.9872	247.1326	-30.35989
12	199	205.5599	19.5112	163.9872	247.1326	-6.559891
13	72.1	45.68945	20.27456	2.490231	88.88867	26.41055
14	74.8	45.43245	20.51974	1.710815	89.15409	29.36755
15	96.9	62.84465	18.44202	23.55004	102.1393	34.05535
16	125.4	174.4325	25.88182	119.2859	229.5792	-49.03252
17	.	159.9037	16.51369	124.7178	195.0896	.
18	58	93.49603	14.80389	61.95322	125.0388	-35.49603
19	109.5	92.03338	14.53774	61.05767	123.0091	17.46662
20	.	73.55019	19.23756	32.56052	114.5399	.
21	.	80.53036	19.6367	38.69023	122.3705	.
22	.	53.35607	16.50855	18.18113	88.53101	.
23	189.9	211.3269	29.46412	148.5473	274.1064	-21.42686
24	281.2	212.3031	26.63475	155.5521	269.054	68.89696
25	140.8	220.6398	25.46201	166.3876	274.892	-79.83978
26	452.8	425.0218	35.31642	349.7728	500.2709	27.77817
27	128.5	93.45365	25.04482	40.09039	146.8169	35.04635
28	96	104.5069	46.28212	5.893059	203.1207	-8.506867
29	.	88.02855	22.05599	41.03361	135.0235	.
30	.	-533.9526	436.0255	-1462.997	395.0914	.
31	385.3	339.3272	25.87459	284.1959	394.4584	45.97281
32	.	505.0987	327.4009	-192.498	1202.695	.
33	.	194.9878	15.92005	161.0668	228.9089	.
34		95.26366	15.42128	62.40537	128.1219	.
..	.	289.9013	41.4184	201.6507	378.152	20.89865

Durbin - Watson Statistic 1.804476

APPENDIX K

MHMA Regression Analysis

----------Multiple Regression----------

Date/Time 04-01-1992 15:46:03
Data Base Name C:\NASA\WUC11
Description Backup of NASAMSTR created 12-18-1991

Multiple Regression Report

Dependent Variable: MH/MA11

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	16.57323	0.0000	3.446548	4.81	0.0001		
FUS DENS	-.3511567	-0.7189	.8338E-01	-4.21	0.0003	0.2926	0.2926
LN DRYWT	-.7455627	-0.4292	.2965363	-2.51	0.0194	0.4451	0.0172

Analysis of Variance Report

Dependent Variable: MH/MA11

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	982.1554	982.1554		
Model	2	30.41182	15.20591	9.22	0.001
Error	23	37.9128	1.648383		
Total	25	68.32462	2.732985		

Root Mean Square Error	1.283894
Mean of Dependent Variable	6.146154
Coefficient of Variation	.2088938
R Squared	0.4451
Adjusted R Squared	0.3969

----------Multiple Regression----------

Date/Time 04-01-1992 15:46:19
Data Base Name C:\NASA\WUC11
Description Backup of NASAMSTR created 12-18-1991

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	7.568937	.530663	6.471285	8.666588	.
2	.	7.565148	.5209367	6.487615	8.642681	.
3	.	5.972121	.2885803	5.375207	6.569036	.
4	5.8	6.118094	.339687	5.415467	6.82072	-.3180933
5	.	6.087148	.3332928	5.397748	6.776549	.
6	5.2	4.110045	.6046	2.859458	5.360631	1.089955
7	6.9	5.151078	.4670056	4.185099	6.117057	1.748922
8	3.9	4.251517	.5098779	3.196859	5.306176	-.3515172
9	7.4	6.81138	.3165508	6.15661	7.46615	.5886202
10	4.3	4.630466	.4368744	3.726812	5.53412	-.3304658
11	4.4	4.608125	.4402585	3.697471	5.518779	-.2081251
12	4.3	4.608125	.4402585	3.697471	5.518779	-.308125
13	6.2	6.016082	.2735671	5.450222	6.581943	.1839175
14	5.4	6.001486	.2736548	5.435444	6.567528	-.6014857
15	6.7	5.918314	.2748418	5.349816	6.486811	.7816863
16	7.6	7.37484	.5128313	6.314073	8.435608	.2251596
17	.	5.097078	.3557626	4.361199	5.832956	.
18	5.7	6.46717	.280771	5.886409	7.047932	-.7671704
19	9	6.771715	.3012482	6.148597	7.394833	2.228285
20	5.2	5.764346	.40291	4.930945	6.597746	-.5643458
21	4.1	5.764346	.40291	4.930945	6.597746	-1.664346
22	.	5.805303	.3146783	5.154405	6.4562	.
23	5.7	7.168776	.393468	6.354906	7.982646	-1.468776
24	8.1	7.142027	.3987096	6.317315	7.96674	.957973
25	9.8	7.121879	.3993941	6.295751	7.948007	2.678121
26	6	6.415567	.3622405	5.66629	7.164845	-.4155674
27	9.2	7.362902	.397073	6.541575	8.184229	1.837098
28	6.3	6.25459	.4301723	5.364799	7.144382	.4541E-01
29	.	6.744976	.290952	6.143156	7.346797	.
30	5.4	6.251603	.6268806	4.954929	7.548276	-.8516026
31	4.4	7.008264	.3578876	6.26799	7.748538	-2.608264
32	5.1	6.011143	.5460897	4.881582	7.140704	-.9111433
33	.	5.594174	.2865999	5.001356	6.186993	.
34	.	5.358382	.3272913	4.681395	6.035368	.
35	7.7	8.696106	.7472628	7.150428	10.24178	-.9961062

Durbin - Watson Statistic 1.591353

----------Sum of Functions Regression----------

Date/Time 04-02-1992 15:39:30
Data Base Name C:\NASA\WUC12A
Description Merge of WUC11 and WUC12 created 04-01-1992

Estimation Summary Report

Y: MH/MA12 X: LOG PERS
Model: A+B*(1/SQR(X))+C*(X*X)

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	7.085547889120501	2.554192	2.8	0.0130	0.54960626
B	-1.66660693023797	2.257151	-0.7	0.4704	
C	.0987784700042235	7.185552E-02	1.4	0.1871	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	2	52.45333	26.22666	5.121198	10.4	0.0011
Error	17	42.98468	2.52851	1.590129		
Total	19	95.438	5.023053	2.241217		

----------Sum of Functions Regression----------

Date/Time 04-02-1992 15:39:39
Data Base Name C:\NASA\WUC12A
Description Merge of WUC11 and WUC12 created 04-01-1992

Residual Analysis

Row	Actual X	Actual Y	Predicted Y	Lower95% Value	Upper95% Value	Residual
1	0	.	.	.	.	.
2	0	.	.	.	.	.
3	.6931472	.	5.131208	1.596899	8.665516	.
4	0	7.6	.	.	.	.
5	0	.	.	.	.	.
6	0	4.5	.	.	.	.
7	1.791759	4.2	6.157598	2.453058	9.862137	-1.957598
8	.6931472	4	5.131208	1.596899	8.665516	-1.131207
9	0	3.2	.	.	.	.
10	.6931472	5	5.131208	1.596899	8.665516	-.1312074
11	.6931472	5.3	5.131208	1.596899	8.665516	.1687928
12	.6931472	6	5.131208	1.596899	8.665516	.8687926
13	.6931472	5.4	5.131208	1.596899	8.665516	.2687927
14	.6931472	5.2	5.131208	1.596899	8.665516	.0687924
15	.6931472	4.7	5.131208	1.596899	8.665516	-.4312076
16	0	3.8	.	.	.	.
17	.6931472	.	5.131208	1.596899	8.665516	.
18	0	8.5	.	.	.	.
19	0	10	.	.	.	.
20	0	7	.	.	.	.
21	.6931472	6.5	5.131208	1.596899	8.665516	1.368793
22	0	.	.	.	.	.
23	4.564348	6.4	8.363339	4.840035	11.88664	-1.963338
24	4.564348	8.8	8.363339	4.840035	11.88664	.4366619
25	4.564348	11.9	8.363339	4.840035	11.88664	3.536661
26	4.430817	10.2	8.233025	4.714607	11.75144	1.966975
27	2.397895	7.3	6.577252	2.839643	10.31486	.7227482
28	5.365976	10.4	9.210281	5.483817	12.93675	1.189718
29	3.433987	.	7.351009	3.732269	10.96975	.
30	5.899898	7.7	9.837771	5.766802	13.90874	-2.137771
31	3.7612	5	7.62358	4.054166	11.19299	-2.62358
32	4.369448	7.7	8.174137	4.655851	11.69242	-.4741375
33	1.609438	.	6.027713	2.355306	9.70012	.
34	1.386294	.	5.859896	2.240462	9.47933	.
35	.6931472	4.6	5.131208	1.596899	8.665516	-.5312075
36	3.135494	7.9	7.115475	3.450584	10.78037	.7845255

----------Sum of Functions Regression----------

Date/Time 04-02-1992 16:08:13
Data Base Name C:\NASA\WUC13
Description Backup of NASAMSTR created 12-20-1991

Estimation Summary Report

Y: MH/MA X: LOGWGT13
Model: A+B*(X)+C*(X*X)+D*(X^3)

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	-156.9462781443671	175.3195	-0.9	0.3825	0.27491117
B	55.98411332035852	63.68528	0.9	0.3909	
C	-6.095157233287962	7.631809	-0.8	0.4349	
D	.2128174813014896	.3017441	0.7	0.4897	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	3	39.06438	13.02146	3.608526	2.3	0.1146
Error	18	103.0338	5.7241	2.392509		
Total	21	142.0982	6.76658	2.601265		

----------Sum of Functions Regression----------

Date/Time 04-02-1992 16:08:18
Data Base Name C:\NASA\WUC13
Description Backup of NASAMSTR created 12-20-1991

Residual Analysis

Row	Actual X	Actual Y	Predicted Y	Lower95% Value	Upper95% Value	Residual
1	.	.	.	.	.	.
2	.	.	.	.	.	.
3	.	.	.	.	.	.
4	7.144407	9.9	9.522524	4.266597	14.77845	.3774756
5	.	.	.	.	.	.
6	7.303843	8.5	9.720329	4.451412	14.98925	-1.220329
7	9.472089	6.2	7.340721	1.897937	12.78351	-1.140721
8	.	6.4	.	.	.	.
9	.	6.8	.	.	.	.
10	.	10.1	.	.	.	.
11	.	11.5	.	.	.	.
12	.	9.6	.	.	.	.
13	7.58172	11.5	9.894126	4.605783	15.18247	1.605874
14	7.58172	7.3	9.894126	4.605783	15.18247	-2.594126
15	7.58172	10.6	9.894126	4.605783	15.18247	.7058744
16	6.64379	11.9	8.370622	2.906784	13.83446	3.529378
17	.	.	.	.	.	.
18	7.173958	9.5	9.56492	4.307173	14.82267	-.649E-01
19	7.202661	13.6	9.603564	4.34368	14.86345	3.996436
20	6.828712	6	8.895804	3.592491	14.19912	-2.895804
21	6.972606	4.3	9.221945	3.961608	14.48228	-4.921945
22	.	.	.	.	.	.
23	8.491465	10.9	9.252911	3.950193	14.55563	1.647089
24	8.491465	9.4	9.252911	3.950193	14.55563	.1470894
25	8.491465	11.7	9.252911	3.950193	14.55563	2.44709
26	9.307739	9.1	7.700285	2.269283	13.13129	1.399715
27	6.985642	10.9	9.248073	3.989399	14.50675	1.651927
28	9.291921	6.6	7.734547	2.305128	13.16397	-1.134547
29	.	.	.	.	.	.
30	10.55274	5.9	5.174696	-1.452819	11.80221	.7253048
31	8.365207	5.9	9.43036	4.138935	14.72179	-3.53036
32	10.17393	4.8	5.845793	.1736933	11.51789	-1.045793
33	.	.	.	.	.	.
34	.	.	.	.	.	.
35	6.267201	6.6	6.900555	.404545	13.39656	-.3005549
36	9.497772	7.9	7.284155	1.840164	12.72815	.6158446

----------Sum of Functions Regression----------

Date/Time 05-18-1992 15:22:42
Data Base Name C:\NASA\WUC23
Description Merge of WUC11 and WUC51 created 04-27-1992

Estimation Summary Report

Y: MHMA23 X: ENG WGT
Model: A+B*(X)+C*(SQR(X))

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	52.6323670458033	14.94758	3.5	0.0026	0.42330867
B	9.122120994236714D-04	1.089452E-03	0.8	0.4140	
C	-.393600323202448	.273407	-1.4	0.1681	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	2	1509.608	754.8038	27.47369	6.2	0.0093
Error	17	2056.602	120.9766	10.99894		
Total	19	3566.21	187.6953	13.70019		

----------Sum of Functions Regression----------

Date/Time 05-18-1992 15:22:51
Data Base Name C:\NASA\WUC23
Description Merge of WUC11 and WUC51 created 04-27-1992

Residual Analysis

Row	Actual X	Actual Y	Predicted Y	Lower95% Value	Upper95% Value	Residual
1	.	.	.	.	.	.
2	.	.	.	.	.	.
3	.	.	.	.	.	.
4	4497	22.6	30.33987	6.104384	54.57537	-7.739875
5	.	.	.	.	.	.
6	4283	29.8	30.78034	6.488446	55.07224	-.9803435
7	36554	13.7	10.72453	-14.83741	36.28647	2.975473
8	.	19.3	.	.	.	.
9	.	24.2	.	.	.	.
10	.	17.2	.	.	.	.
11	.	13.7	.	.	.	.
12	.	24.7	.	.	.	.
13	9968	25.5	22.42829	-1.860969	46.71755	3.071708
14	9968	31.5	22.42829	-1.860969	46.71755	9.071709
15	9968	41.9	22.42829	-1.860969	46.71755	19.47171
16	2247	58.8	36.02446	10.33417	61.71475	22.77554
17	.	.	.	.	.	.
18	6049	36	27.53795	3.478826	51.59707	8.462052
19	6091	31.5	27.47017	3.41185	51.52849	4.029831
20	3671	32.9	32.13334	7.612824	56.65385	.7666664
21	.	11.7	.	.	.	.
22	.	.	.	.	.	.
23	.	10.2	.	.	.	.
24	16696	12.8	17.00438	-7.596682	41.60544	-4.204381
25	16696	13.9	17.00438	-7.596682	41.60544	-3.104381
26	23386	14.1	13.7741	-10.73889	38.2871	.325899
27	3804	12.2	31.8265	7.365395	56.28761	-19.6265
28	25471	14.2	13.05014	-11.44577	37.54605	1.14986
29	.	.	.	.	.	.
30	39091	11.4	10.47118	-15.76686	36.70923	.9288171
31	10535	6.4	21.84333	-2.492323	46.17897	-15.44333
32	43162	10.7	10.23296	-17.50677	37.9727	.4670366
33	.	.	.	.	.	.
34	.	.	.	.	.	.
35	1767	25	37.69898	11.25618	64.14178	-12.69898
36	23321	4.1	13.79851	-10.71545	38.31248	-9.698515

Residual Plot

----------Multiple Regression----------

Date/Time 04-02-1992 17:09:45
Data Base Name A:WUC24
Description Backup of WUC24 created 03-13-1992

Multiple Regression Report

Dependent Variable: MH/MA24

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	-451.3954	0.0000	118.7124	-3.80	0.0089		
KVA MAX	.9054E-01	3.4559	.4055E-01	2.23	0.0670	0.0072	0.0072
SQR KVA	-2.965429	-4.0027	1.175478	-2.52	0.0451	0.0166	0.0101
WGT24	.265695	30.0350	.7173E-01	3.70	0.0100	0.0412	0.0025
SQR WT24	-26.09953	-58.2119	6.889591	-3.79	0.0091	0.0749	0.0043
LOG WT24	150.5043	29.6631	38.72723	3.89	0.0081	0.7370	0.0098

Analysis of Variance Report

Dependent Variable: MH/MA24

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	1164.27	1164.27		
Model	5	95.68211	19.13642	3.36	0.086
Error	6	34.1479	5.691316		
Total	11	129.83	11.80273		

Root Mean Square Error	2.385648
Mean of Dependent Variable	9.85
Coefficient of Variation	.2421977
R Squared	0.7370
Adjusted R Squared	0.5178

----------Multiple Regression----------

Date/Time 04-02-1992 17:10:05
Data Base Name A:WUC24
Description Backup of WUC24 created 03-13-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	.	.	.	.	.
2	.	.	.	.	.	.
3	.	.	.	.	.	.
4	.	.	.	.	.	.
5	.	.	.	.	.	.
6	8.7	6.741755	1.770797	2.411969	11.07154	1.958245
7	.	.	.	.	.	.
8	.	.	.	.	.	.
9	.	.	.	.	.	.
10	.	.	.	.	.	.
11	.	.	.	.	.	.
12	.	.	.	.	.	.
13	.	.	.	.	.	.
14	.	.	.	.	.	.
15	.	.	.	.	.	.
16	.	.	.	.	.	.
17	.	.	.	.	.	.
18	17.2	17.04953	2.276696	11.48277	22.61629	.1504726
19	13.8	11.43404	.9869653	9.020807	13.84727	2.365959
20	7	9.051776	1.656509	5.001438	13.10211	-2.051776
21	.	10.05459	1.613951	6.108312	14.00087	.
22	.	.	.	.	.	.
23	7.9	10.29294	1.146999	7.488411	13.09748	-2.392944
24	7.5	10.15497	1.125487	7.403035	12.9069	-2.654969
25	12.7	10.15497	1.125487	7.403035	12.9069	2.545031
26	7	6.877838	1.776137	2.534996	11.22068	.1221623
27	12	.	.	.	.	.
28	9	8.317269	1.221766	5.329924	11.30462	.6827307
29	.	13.1504	1.322275	9.9173	16.3835	.
30	7.7	7.649233	2.33862	1.931061	13.3674	.5077E-01
31	6.7	7.560628	1.585665	3.68351	11.43775	-.8606281
32	13	12.91464	2.372941	7.112551	18.71673	.8536E-01
33	.	.	.	.	.	.
34	.	.	.	.	.	.
35	.	.	.	.	.	.

Durbin - Watson Statistic 1.731521

----------Sum of Functions Regression----------

Date/Time 03-20-1992 16:11:05
Data Base Name C:\NASA\PRECON2
Description Merge of WUC12 and PRECON created 03-19-1992

Estimation Summary Report

Y: MH/MA42 X: LN DRY
Model: A+B*(X)+C*(X*X)

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	-95.16097482423832	57.21129	-1.7	0.1093	0.22130247
B	20.31584606137617	10.63598	1.9	0.0681	
C	-.983565860822489	.4916664	-2.0	0.0569	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	2	52.37164	26.18582	5.117208	3.4	0.0497
Error	24	184.2802	7.678342	2.770982		
Total	26	236.6519	9.101995	3.016951		

----------Sum of Functions Regression----------

Date/Time 03-20-1992 16:11:14
Data Base Name C:\NASA\PRECON2
Description Merge of WUC12 and PRECON created 03-19-1992

Residual Analysis

Row	Actual X	Actual Y	Predicted Y	Lower95% Value	Upper95% Value	Residual
1	9.172015	.	8.432947	2.118108	14.74779	.
2	9.227099	.	8.555184	2.304271	14.8061	.
3	10.14871	.	9.714996	3.837769	15.59222	.
4	9.786504	8.6	9.458464	3.547251	15.36968	-.8584635
5	9.82801	.	9.500953	3.598363	15.40354	.
6	9.943766	8.3	9.601545	3.715425	15.48767	-1.301545
7	11.93356	7.5	7.209922	1.198005	13.22184	.2900778
8	10.76806	6.3	9.555716	3.653239	15.45819	-3.255715
9	10.08581	7	9.688965	3.811125	15.5668	-2.688964
10	10.6697	6.7	9.631414	3.732719	15.53011	-2.931413
11	10.69967	9.4	9.610364	3.710418	15.51031	-.2103646
12	10.69967	7.4	9.610364	3.710418	15.51031	-2.210364
13	10.25924	14.6	9.741886	3.862651	15.62112	4.858114
14	10.26472	10.7	9.742595	3.863181	15.62201	.9574055
15	10.29766	13.1	9.745605	3.865008	15.6262	3.354396
16	9.154722	9.3	8.393341	2.057032	14.72965	.9066593
17	10.57227	.	9.687634	3.793509	15.58176	.
18	10.19496	9	9.729173	3.851511	15.60683	-.7291723
19	10.21921	17.5	9.734923	3.856787	15.61306	7.765077
20	9.578242	8.3	9.194108	3.211594	15.17662	-.8941078
21	9.578242	7.2	9.194108	3.211594	15.17662	-1.994108
22	10.04542	.	9.668145	3.789035	15.54726	.
23	11.11394	5	9.138396	3.229833	15.04696	-4.138396
24	11.18428	6.9	9.024733	3.115607	14.93386	-2.124732
25	11.21131	11.1	8.978465	3.069075	14.88786	2.121535
26	11.48278	9.6	8.434091	2.515919	14.35226	1.16591
27	9.97348	7.8	9.623115	3.739674	15.50656	-1.823115
28	11.85568	7.5	7.449983	1.466471	13.43349	.5002E-01
29	10.35358	.	9.745828	3.862843	15.62881	.
30	12.67634	5.3	4.320797	-2.464639	11.10623	.9792036
31	11.0315	13.2	9.259225	3.351353	15.1671	3.940775
32	12.39095	4.7	5.559242	-.7975169	11.916	-.8592423
33	10.53204	.	9.705401	3.813326	15.59747	.
34	10.37854	.	9.743942	3.859775	15.62811	.
35	8.805825	7.5	7.468602	.5409592	14.39624	.3140E-01
36	12.1442	6.1	6.500862	.3732426	12.62848	-.4008624

----------Multiple Regression----------

Date/Time 06-08-1992 12:05:32
Data Base Name C:\NASA\PRECON2
Description Merge of WUC12 and PRECON created 03-19-1992

Multiple Regression Report

Dependent Variable: MH/MA44

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	2300.043	0.0000	900.3793	2.55	0.0185		
LN DRY	474.1092	231.8082	165.1477	2.87	0.0091	0.0274	0.0274
LN LENTH	-452.2954	%-125.2645					
			148.6725	-3.04	0.0062	0.0588	0.0418
WGT/LEN	-.1462855	-11.0183	.5235E-01	-2.79	0.0109	0.0979	0.0312
SQRLGDRY	-2769.85	%-206.6015					
			966.0448	-2.87	0.0092	0.0983	0.0253
SQRLGLEN	1788.391	109.4917	593.9519	3.01	0.0067	0.3702	0.0393

Analysis of Variance Report

Dependent Variable: MH/MA44

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	630.75	630.75		
Model	5	38.57628	7.715257	2.47	0.066
Error	21	65.62372	3.124939		
Total	26	104.2	4.007692		

Root Mean Square Error	1.76775
Mean of Dependent Variable	4.833334
Coefficient of Variation	.3657413
R Squared	0.3702
Adjusted R Squared	0.2203

----------Multiple Regression----------

Date/Time 06-08-1992 12:05:53
Data Base Name C:\NASA\PRECON2
Description Merge of WUC12 and PRECON created 03-19-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	4.476142	1.033574	2.326984	6.6253	.
2	.	4.279973	1.061601	2.072538	6.487408	.
3	.	5.161638	.4341575	4.258875	6.064402	.
4	4.7	4.367497	.7106825	2.889743	5.845252	.3325024
5	.	4.389714	.749886	2.830442	5.948986	.
6	3.5	3.653058	.8042564	1.980731	5.325384	-.1530578
7	4.5	5.035193	.9830074	2.991182	7.079205	-.5351934
8	8	6.920512	.7419165	5.377812	8.463213	1.079488
9	2.8	4.812259	.4654595	3.844408	5.78011	-2.012259
10	6.8	6.681951	.6717756	5.285097	8.078804	.1180496
11	10.3	6.787664	.7033455	5.325166	8.250161	3.512337
12	4	6.787664	.7033455	5.325166	8.250161	-2.787664
13	4.6	5.106588	.7295298	3.589644	6.623532	-.506588
14	4.3	5.099264	.7355821	3.569735	6.628793	-.7992635
15	5.3	5.446658	.6352148	4.125827	6.767489	-.1466579
16	6.5	4.505446	.8628373	2.711309	6.299583	1.994554
17	.	6.476019	.6235349	5.179475	7.772564	.
18	4.7	5.392233	.4540576	4.448091	6.336375	-.6922331
19	9.8	5.474997	.469175	4.49942	6.450573	4.325004
20	2.4	4.134334	.7652015	2.543216	5.725452	-1.734334
21	3.3	4.150309	.6651328	2.767269	5.53335	-.8503091
22	.	4.92256	.6141115	3.64561	6.19951	.
23	3.8	3.376757	.8575392	1.593637	5.159877	.4232426
24	4.9	4.448046	.656988	3.081942	5.814151	.4519539
25	5.5	4.667245	.6337518	3.349456	5.985034	.8327551
26	5.1	5.186151	.6777176	3.776942	6.59536	-.862E-01
27	4.1	3.481111	.8803259	1.65061	5.311612	.6188891
28	4.4	5.179641	.9178398	3.271135	7.088146	-.7796407
29	.	4.21546	.747825	2.660474	5.770447	.
30	3.3	1.861427	1.275647	-.7910823	4.513937	1.438573
31	2.4	4.157676	.7184562	2.663758	5.651594	-1.757676
32	3.3	2.849757	1.251661	.2471228	5.452392	.4502428
33	.	5.78718	.5418295	4.660529	6.91383	.
34	.	5.928824	.5377628	4.81063	7.047019	.
35	5.4	6.106457	1.519221	2.947473	9.265441	-.7064567
36	2.8	4.827341	1.041613	2.661469	6.993213	-2.027341

Durbin - Watson Statistic 2.458488

----------Multiple Regression----------

Date/Time 03-18-1992 20:48:06
Data Base Name C:\NCSS\FILES\precon
Description Backup of PRECON created 03-18-1992

Multiple Regression Report

Dependent Variable: MH/MA45

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	0						
LN DRY	2.412351	3.4617	.4730937	5.10	0.0000	0.8557	0.8557
LDRY SQD	-.1630653	-2.5469	.0434658	-3.75	0.0009	0.9077	0.8116

Analysis of Variance Report

Dependent Variable: MH/MA45

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	0	0	0		
Model	2	1365.137	682.5685	122.87	0.000
Error	25	138.883	5.555321		
Total	27	1504.02	55.70445		

Root Mean Square Error	2.356973
Mean of Dependent Variable	7.022222
Coefficient of Variation	.3356449
R Squared	0.9077
Adjusted R Squared	0.9040

----------Multiple Regression----------

Date/Time 03-18-1992 20:48:06
Data Base Name C:\NCSS\FILES\precon
Description Backup of PRECON created 03-18-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	8.408112	.7703225	6.821725	9.994497	.
2	.	8.375729	.7559537	6.818934	9.932524	.
3	.	7.687117	.5271578	6.601499	8.772736	.
4	9.1	7.990798	.6106086	6.733323	9.248272	1.109203
5	.	7.958168	.6002989	6.721925	9.194411	.
6	9.8	7.864206	.5723715	6.685476	9.042936	1.935794
7	4.6	5.565836	.7595165	4.001703	7.129969	-.9658361
8	6	7.068747	.4573211	6.126949	8.010544	-1.068747
9	8.3	7.742929	.5403237	6.630198	8.85566	.5570712
10	8.2	7.175302	.4587896	6.23048	8.120123	1.024698
11	8.6	7.143155	.4578761	6.200214	8.086095	1.456846
12	7.1	7.143155	.4578761	6.200214	8.086095	-.432E-01
13	8.7	7.585934	.5059632	6.543963	8.627904	1.114066
14	8.3	7.580823	.5049864	6.540865	8.620782	.7191773
15	11.9	7.549824	.4992655	6.521647	8.578001	4.350176
16	9.5	8.418076	.7748201	6.822427	10.01372	1.081924
17	.	7.277736	.4644312	6.321296	8.234176	.
18	8.9	7.645278	.5179666	6.578588	8.711968	1.254722
19	13.2	7.623048	.5133272	6.565912	8.680183	5.576952
20	4.5	8.14603	.6638971	6.778813	9.513246	-3.64603
21	4	8.14603	.6638971	6.778813	9.513246	-4.14603
22	.	7.778087	.5491371	6.647205	8.908968	.
23	5.4	6.668953	.4888824	5.662159	7.675748	-1.268953
24	5.8	6.582885	.5022931	5.548473	7.617297	-.7828851
25	9	6.549364	.5080413	5.503115	7.595614	2.450636
26	6.2	6.199637	.5824589	5.000133	7.399141	.3629E-03
27	4.5	7.839382	.5654381	6.674931	9.003834	-3.339382
28	5	5.680065	.7250962	4.186817	7.173313	-.6800647
29	.	7.496412	.4902212	6.486861	8.505963	.
30	4.9	4.376877	1.14514	2.018599	6.735155	.5231233
31	4.1	6.767777	.4761021	5.787303	7.748252	-2.667778
32	5.7	4.854976	.986229	2.823956	6.885995	.8450241
33	.	7.319152	.4678913	6.355587	8.282718	.
34	.	7.472254	.4864747	6.470419	8.474091	.
35	5.9	8.598242	.8634986	6.819971	10.37651	-2.698242
36	2.4	5.246937	.8591117	3.477701	7.016174	-2.846937

Durbin - Watson Statistic 1.444019

----------Multiple Regression----------

Date/Time 04-02-1992 16:29:08
Data Base Name A:WUC14
Description Backup of WUC14 created 03-27-1992

Multiple Regression Report

Dependent Variable: MH/MA14

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	26.23825	0.0000	16.15215	1.62	0.1326		
ACTUATOR	-1.106748	-8.9169	.5413623	-2.04	0.0656	0.0925	0.0925
CONT SUR	-1.66585	-6.7252	.6519315	-2.56	0.0267	0.2150	0.2121
WETAREA	-.328E-02	-9.7412	.1091E-02	-3.01	0.0119	0.2555	0.2139
DRY_WGT	.6018E-03	17.3149	.2159E-03	2.79	0.0177	0.4589	0.1855
LOG WG14	-6.282692	-1.5498	3.429373	-1.83	0.0941	0.4688	0.2522
SQR ACT	14.28908	8.4616	6.916294	2.07	0.0632	0.6173	0.1272

Analysis of Variance Report

Dependent Variable: MH/MA14

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	1278.494	1278.494		
Model	6	91.62071	15.27012	2.96	0.057
Error	11	56.7954	5.163218		
Total	17	148.4161	8.730359		

Root Mean Square Error	2.272272
Mean of Dependent Variable	8.427778
Coefficient of Variation	.2696169
R Squared	0.6173
Adjusted R Squared	0.4086

----------Multiple Regression----------

Date/Time 04-02-1992 16:29:30
Data Base Name A:WUC14
Description Backup of WUC14 created 03-27-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	.	.	.	.	.
2	.	.	.	.	.	.
3	.	.	.	.	.	.
4	10.6	10.92807	1.527894	7.568065	14.28807	-.3280668
5	.	.	.	.	.	.
6	6	7.714234	.937169	5.653299	9.775168	-1.714234
7	5.7	3.419895	1.746283	-.420368	7.260158	2.280105
8	6	.	.	.	.	.
9	9.7	.	.	.	.	.
10	9.9	.	.	.	.	.
11	9.3	.	.	.	.	.
12	9.6	.	.	.	.	.
13	11.3	8.60483	.966235	6.479976	10.72968	2.69517
14	9.8	9.625388	1.013047	7.397589	11.85319	.174612
15	11.9	10.20372	1.063192	7.865646	12.54179	1.69628
16	11.4	12.11051	1.982511	7.750756	16.47026	-.7105103
17	.	.	.	.	.	.
18	10.9	9.627027	1.331217	6.699538	12.55452	1.272973
19	15.1	11.57412	1.263872	8.794729	14.35351	3.525882
20	7.3	8.715774	1.00266	6.510818	10.92073	-1.415773
21	5.8	8.673118	1.009739	6.452595	10.89364	-2.873117
22	.	.	.	.	.	.
23	6.6	6.128696	1.222941	3.439318	8.818075	.4713035
24	7.3	9.071507	1.236983	6.351249	11.79176	-1.771506
25	9.4	10.25826	1.474821	7.014971	13.50155	-.8582592
26	6.3	4.962518	1.105857	2.53062	7.394416	1.337482
27	7.7	.	.	.	.	.
28	6.5	.	.	.	.	.
29	.	.	.	.	.	.
30	6.3	6.709926	2.263569	1.732096	11.68776	-.4099255
31	3.9	6.540598	1.002121	4.336826	8.744371	-2.640598
32	6.1	6.831707	2.216654	1.957047	11.70637	-.7317071
33	.	.	.	.	.	.
34	.	.	.	.	.	.

Durbin - Watson Statistic 1.432175

----------Multiple Regression----------

Date/Time 04-05-1992 14:14:45
Data Base Name B:AVIONICS
Description Backup of AVIONICS created 03-27-1992

Multiple Regression Report

Dependent Variable: MH/MA

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	131.3954	0.0000	45.66148	2.88	0.0150		
DIF SUBS	1.039403	2.3979	.2646763	3.93	0.0024	0.2156	0.2156
SQR TSUB	-9.035161	-2.6722	2.627782	-3.44	0.0055	0.3066	0.0918
WGT51/72	-.154E-01	-10.9945	.4954E-02	-3.11	0.0099	0.3066	0.0000
SQR51/72	2.864137	18.6286	.9554125	3.00	0.0121	0.4087	0.0079
LOG5172	-26.19323	-7.6260	9.767558	-2.68	0.0213	0.6425	0.0289

Analysis of Variance Report

Dependent Variable: MH/MA

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	1107.285	1107.285		
Model	5	84.03074	16.80615	3.95	0.027
Error	11	46.76455	4.251323		
Total	16	130.7953	8.174706		

Root Mean Square Error	2.061874
Mean of Dependent Variable	8.070588
Coefficient of Variation	.25548
R Squared	0.6425
Adjusted R Squared	0.4799

----------Multiple Regression----------

Date/Time 04-05-1992 14:14:45
Data Base Name B:AVIONICS
Description Backup of AVIONICS created 03-27-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	.	.	.	.	.
2	.	.	.	.	.	.
3	.	.	.	.	.	.
4	7.3	8.218063	1.581274	4.740672	11.69545	-.9180632
5	.	.	.	.	.	.
6	7.8	6.690749	.9269202	4.652352	8.729146	1.109251
7	6.8	6.7421	2.056123	2.220465	11.26373	.5790E-01
8	10.2	.	.	.	.	.
9	5.7	.	.	.	.	.
10	13.8	.	.	.	.	.
11	13	.	.	.	.	.
12	11.2	.	.	.	.	.
13	8.7	.	.	.	.	.
14	9	11.1196	.8945798	9.152324	13.08688	-2.1196
15	8.8	.	.	.	.	.
16	8.2	8.73908	1.940782	4.471093	13.00707	-.5390806
17	.	.	.	.	.	.
18	12.6	10.03277	.7545902	8.373344	11.69219	2.567232
19	13.6	10.13388	.7599139	8.462744	11.80501	3.466125
20	4.7	6.377603	.8949887	4.409427	8.345779	-1.677603
21	4.9	6.377603	.8949887	4.409427	8.345779	-1.477602
22	.	.	.	.	.	.
23	8.7	.	.	.	.	.
24	9.6	11.77641	1.044804	9.478772	14.07404	-2.176407
25	11	9.236857	.7690271	7.545684	10.92803	1.763144
26	8	.	.	.	.	.
27	11.8	10.97905	1.104018	8.551194	13.4069	.8209524
28	7	7.258468	1.111545	4.814061	9.702875	-.2584677
29	.	.	.	.	.	.
30	8	7.689709	1.030331	5.4239	9.955519	.3102908
31	5	7.288274	1.084899	4.902466	9.674082	-2.288274
32	5.3	5.474031	1.464335	2.253802	8.694262	-.1740313
33	.	.	.	.	.	.
34	.	.	.	.	.	.
35	4.6	3.066015	1.443832	-.1091256	6.241155	1.533985

Durbin - Watson Statistic 1.204315

----------Multiple Regression----------

Date/Time 03-20-1992 15:55:14
Data Base Name C:\NASA\PRECON2
Description Merge of WUC12 and PRECON created 03-19-1992

Multiple Regression Report

Dependent Variable: MH/MA41

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	0						
LN DRY	.6886774	0.9419	.4914E-01	14.01	0.0000	0.8871	0.8871

Analysis of Variance Report

Dependent Variable: MH/MA41

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	0	0	0		
Model	1	1409.219	1409.219	196.41	0.000
Error	25	179.3709	7.174834		
Total	26	1588.59	61.09961		

Root Mean Square Error	2.678588
Mean of Dependent Variable	7.442308
Coefficient of Variation	.3599137
R Squared	0.8871
Adjusted R Squared	0.8871

----------Multiple Regression----------

Date/Time 03-20-1992 15:55:28
Data Base Name C:\NASA\PRECON2
Description Merge of WUC12 and PRECON created 03-19-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	6.31656	.4507101	5.388377	7.244743	.
2	.	6.354496	.4534169	5.420738	7.288253	.
3	.	6.989185	.4987044	5.962163	8.016207	.
4	6.7	6.739745	.4809059	5.749377	7.730113	-.397E-01
5	.	6.768329	.4829455	5.773761	7.762897	.
6	4.5	6.848047	.4886337	5.841765	7.85433	-2.348047
7	6.7	8.218374	.5864117	7.01073	9.426019	-1.518374
8	5.6	7.415723	.5291395	6.326024	8.505422	-1.815723
9	10.4	6.945869	.4956136	5.925212	7.966526	3.454131
10	6.7	7.347982	.5243059	6.268237	8.427726	-.6479816
11	11	7.368618	.5257784	6.285841	8.451395	3.631382
12	11.6	7.368618	.5257784	6.285841	8.451395	4.231382
13	8.7	7.065305	.5041359	6.027098	8.103512	1.634695
14	11.1	7.069083	.5044054	6.030321	8.107844	4.030918
15	9.5	7.091764	.5060238	6.049669	8.133859	2.408237
16	6.5	6.304651	.4498603	5.378218	7.231084	.1953492
17	.	7.280881	.519518	6.210996	8.350765	.
18	9.3	7.021041	.5009774	5.989338	8.052744	2.278959
19	13.3	7.03774	.502169	6.003584	8.071897	6.26226
20	5.2	6.59632	.470672	5.627028	7.565612	-1.39632
21	5.1	6.59632	.470672	5.627028	7.565612	-1.49632
22	.	6.918055	.493629	5.901485	7.934624	.
23	6.1	7.65392	.5461357	6.529219	8.778621	-1.55392
24	6.7	7.702363	.5495923	6.570544	8.834182	-1.002363
25	.	7.720974	.5509203	6.58642	8.855528	.
26	7.2	7.907929	.5642602	6.745903	9.069955	-.7079291
27	7.3	6.868511	.4900939	5.859222	7.877801	.431489
28	5.4	8.164738	.5825845	6.964975	9.3645	-2.764738
29	.	7.130274	.5087717	6.082521	8.178028	.
30	6.3	8.729906	.6229114	7.447095	10.01272	-2.429906
31	5.2	7.597143	.5420845	6.480785	8.713501	-2.397143
32	6.2	8.533365	.6088874	7.279435	9.787295	-2.333365
33	.	7.253181	.5175415	6.187367	8.318995	.
34	.	7.147467	.5099984	6.097187	8.197747	.
35	7.4	6.064374	.4327157	5.173248	6.955499	1.335627
36	3.8	8.363435	.5967622	7.134475	9.592395	-4.563435

Durbin - Watson Statistic 1.144088

----------Sum of Functions Regression----------

Date/Time 03-20-1992 16:45:57
Data Base Name C:\NASA\PRECON2
Description Merge of WUC12 and PRECON created 03-19-1992

Estimation Summary Report

Y: MH/MA47 X: DRY_WGT
Model: A+B*(LOG(X))+C*(SQR(X))

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	5.743205009617056	10.81172	0.5	0.6002	0.06366295
B	1.852806289238006D-02	1.216017	0.0	0.9880	
C	-3.36575286114062D-03	9.676912E-03	-0.3	0.7310	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	2	4.087586	2.043793	1.429613	0.8	0.4541
Error	24	60.11908	2.504962	1.582707		
Total	26	64.20667	2.469487	1.57146		

----------Sum of Functions Regression----------

Date/Time 03-20-1992 16:46:06
Data Base Name C:\NASA\PRECON2
Description Merge of WUC12 and PRECON created 03-19-1992

Residual Analysis

Row	Actual X	Actual Y	Predicted Y	Lower95% Value	Upper95% Value	Residual
1	9624	.	5.582958	1.995398	9.170517	.
2	10169	.	5.574758	2.016322	9.133193	.
3	25558	.	5.393162	2.042842	8.743483	.
4	17792	5.5	5.475584	2.096881	8.854286	.2442E-01
5	18546	.	5.466939	2.094282	8.839595	.
6	20822	3.8	5.441772	2.081785	8.801758	-1.641771
7	152293	5.1	4.650835	1.222065	8.079604	.4491653
8	47480	2.4	5.209322	1.836588	8.582056	-2.809322
9	24000	3.2	5.408655	2.05687	8.760441	-2.208655
10	43032	5.2	5.242697	1.875322	8.610072	-.427E-01
11	44341	6.4	5.232712	1.863689	8.601735	1.167288
12	44341	5.7	5.232712	1.863689	8.601735	.4672875
13	28545	4	5.364636	2.014288	8.714984	-1.364636
14	28702	5.9	5.363176	2.012752	8.7136	.5368242
15	29663	8.7	5.354319	2.003306	8.705331	3.345681
16	9459	7.3	5.58548	1.988315	9.182645	1.71452
17	39037	.	5.27409	1.912002	8.636179	.
18	26768	4.8	5.38143	2.031468	8.731391	-.5814293
19	27425	7.3	5.375162	2.025169	8.725155	1.924838
20	14447	4.3	5.516122	2.093327	8.938917	-1.216122
21	14447	2.9	5.516122	2.093327	8.938917	-2.616122
22	23050	.	5.418331	2.064947	8.771715	.
23	67100	6	5.077272	1.689793	8.464749	.9227287
24	71990	5.7	5.047365	1.658048	8.436682	.6526353
25	73962	7.6	5.03558	1.645656	8.425504	2.56442
26	97030	4.4	4.907539	1.513019	8.302058	-.5075386
27	21450	5.6	5.435052	2.077402	8.792703	.1649477
28	140882	4.8	4.699558	1.283092	8.116023	.1004426
29	31369	.	5.338918	1.986443	8.691394	.
30	320083	4.8	4.073869	.8264E-01	8.065102	.7261315
31	61790	4.6	5.110952	1.726151	8.495752	-.5109522
32	240613	3.8	4.321806	.6805212	7.96309	-.5218055
33	37498	.	5.286585	1.926579	8.646591	.
34	32162	.	5.331893	1.978597	8.685188	.
35	6673	6.8	5.631417	1.792076	9.470758	1.168583
36	188000	2.6	4.508858	1.019374	7.998342	-1.908858

----------Multiple Regression----------

Date/Time 04-06-1992 12:01:58
Data Base Name C:\NASA\WUC96
Description Merge of WUC47 and WUC12 created 02-11-1992

Multiple Regression Report

Dependent Variable: MHMA4996

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	9.513174	0.0000	1.68657	5.64	0.0000		
LEN WING	.3508E-01	1.7971	.1022E-01	3.43	0.0037	0.0031	0.0031
WGT49/96	-.721E-03	-1.1406	.2665E-03	-2.70	0.0163	0.2029	0.0600
SQR CREW	-4.520094	-0.9904	1.519629	-2.97	0.0095	0.4986	0.1043

Analysis of Variance Report

Dependent Variable: MHMA4996

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	773.1284	773.1284		
Model	3	49.7196	16.5732	4.97	0.014
Error	15	49.99197	3.332798		
Total	18	99.71158	5.539532		

Root Mean Square Error	1.825595
Mean of Dependent Variable	6.378947
Coefficient of Variation	.2861907
R Squared	0.4986
Adjusted R Squared	0.3984

----------Multiple Regression----------

Date/Time 04-06-1992 12:02:07
Data Base Name C:\NASA\WUC96
Description Merge of WUC47 and WUC12 created 02-11-1992

Residual Analysis

Row	Actual Y	Predicted Value	Std Err of Pred	Lower95% Mean	Upper95% Mean	Residual
1	.	.	.	.	.	.
2	.	.	.	.	.	.
3	.	.	.	.	.	.
4	8.5	7.669556	.6735326	6.234453	9.104659	.8304439
5	.	.	.	.	.	.
6	7.6	8.643637	.7730332	6.996527	10.29075	-1.043637
7	7.6	8.664033	1.549436	5.362634	11.96543	-1.064033
8	3.6	.	.	.	.	.
9	13.8	.	.	.	.	.
10	5.3	.	.	.	.	.
11	10.5	.	.	.	.	.
12	5.7	.	.	.	.	.
13	5	5.843669	.5503315	4.671073	7.016266	-.8436694
14	4.9	5.843669	.5503315	4.671073	7.016266	-.9436693
15	.	6.008549	.5307801	4.87761	7.139488	.
16	6.4	7.366797	.6628822	5.954387	8.779207	-.9667969
17	.	.	.	.	.	.
18	7.2	8.435759	.7450752	6.848219	10.0233	-1.235759
19	13.2	8.435038	.7449992	6.84766	10.02242	4.764962
20	7.7	7.57732	.667131	6.155857	8.998783	.1226802
21	4	5.767948	.604834	4.479221	7.056674	-1.767948
22	.	.	.	.	.	.
23	4	5.031277	.5793074	3.796941	6.265614	-1.031277
24	7.1	5.031277	.5793074	3.796941	6.265614	2.068723
25	6.6	5.087407	.5731291	3.866234	6.308579	1.512593
26	3.4	3.177409	1.143138	.7417119	5.613105	.2225916
27	4.1	3.383024	1.089339	1.061958	5.704089	.7169764
28	8.7	6.748656	.7755465	5.096191	8.401121	1.951344
29	.	.	.	.	.	.
30	6.4	6.771239	1.310955	3.977974	9.564504	-.3712387
31	5.7	.	.	.	.	.
32	4.3	6.378088	.8124059	4.647086	8.10909	-2.078087
33	.	.	.	.	.	.
34	.	.	.	.	.	.
35	4.5	5.344202	.6632126	3.931088	6.757316	-.8442016

Durbin - Watson Statistic 1.490154

Sum of Functions Regression

Date/Time 04-20-1992 13:05:05
Data Base Name B:WUC97
Description Backup of WUC97 created 03-13-1992

Estimation Summary Report

Y: MHMA9137 X: DRY_WGT
Model: A+B*(X)+C*(LOG(X))+D*(SQR(X))

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	-57.900849445138	20.62665	-2.8	0.0109	0.41108948
B	1.4638806795145O9D-04	4.060194E-05	3.6	0.0018	
C	8.237320943745208	2.634379	3.1	0.0053	
D	-.1514356975659418	4.433468E-02	-3.4	0.0027	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	3	18.66346	6.221154	2.494224	4.7	0.0126
Error	20	26.73654	1.336827	1.156212		
Total	23	45.4	1.973913	1.40496		

----------Sum of Functions Regression----------

Date/Time 04-20-1992 13:05:06
Data Base Name B:WUC97
Description Backup of WUC97 created 03-13-1992

Residual Analysis

Row	Actual X	Actual Y	Predicted Y	Lower95% Value	Upper95% Value	Residual
1	9624	.	4.20468	1.479104	6.930256	.
2	10169	.	4.323351	1.631893	7.014809	.
3	25558	.	5.228855	2.714802	7.742908	.
4	17792	6.4	5.118762	2.587104	7.650419	1.281238
5	18546	.	5.147458	2.619209	7.675707	.
6	20822	5	5.205316	2.683981	7.726651	-.2053158
7	152293	4.8	3.596225	.9631841	6.229265	1.203776
8	47480	4.4	4.751958	2.25468	7.249236	-.3519578
9	24000	2.7	5.232194	2.716236	7.74815	-2.532193
10	43032	3.9	4.874202	2.37556	7.372845	-.9742023
11	44341	5.1	4.838446	2.340366	7.336525	.2615545
12	44341	4.1	4.838446	2.340366	7.336525	-.7384455
13	28545	.	5.200963	2.690131	7.711795	.
14	28702	6.8	5.198863	2.688194	7.709533	1.601137
15	29663	5.7	5.184861	2.675177	7.694546	.5151388
16	9459	4	4.165978	1.428768	6.903187	-.1659774
17	39037	.	4.980506	2.479411	7.481602	.
18	26768	5.2	5.220557	2.70785	7.733264	-.206E-01
19	27425	5.2	5.214257	2.702254	7.72626	-.143E-01
20	14447	.	4.911157	2.350274	7.47204	.
21	14447	.	4.911157	2.350274	7.47204	.
22	23050	.	5.229442	2.71216	7.746725	.
23	67100	5.6	4.243475	1.733176	6.753775	1.356525
24	71990	5.5	4.134512	1.616941	6.652083	1.365488
25	73962	4.7	4.093051	1.572236	6.613867	.6069483
26	97030	1.7	3.718819	1.153953	6.283685	-2.018819
27	21450	5.3	5.214932	2.694923	7.734942	.8507E-01
28	140882	4.5	3.541364	.9148228	6.167904	.9586363
29	31369	.	5.155697	2.647732	7.663662	.
30	320083	8	7.698452	4.475865	10.92104	.3015485
31	61790	3.6	4.371178	1.867238	6.875117	-.7711777
32	240613	5	5.107493	2.418397	7.796589	-.107493
33	37498	.	5.019613	2.517318	7.521908	.
34	32162	.	5.140531	2.633351	7.64771	.
35	6673	3.3	3.241859	.1636122	6.320105	.5814E-01
36	188000	2.3	3.994804	1.35635	6.633258	-1.694804

APPENDIX L

POFF Regression Analysis

----------Descriptive Statistics----------

Date/Time 02-06-1992 16:47:28
Data Base Name C:\NASA\WUC11
Description Backup of NASAMSTR created 12-18-1991

Detail Report

Variable: %OFF EQU

Mean - Average	8.916666E-02	No. observations	35
Lower 95% c.i.limit	.068566	No. missing values	11
Upper 95% c.i.limit	.1097673	Sum of frequencies	24
Adj sum of squares	5.475333E-02	Sum of observations	2.14
Standard deviation	4.879119E-02	Std.error of mean	9.959459E-03
Variance	2.38058E-03	T-value for mean=0	8.952963
Coef. of variation	.5471909	T prob level	0.0000
Skewness	1.064671	Kurtosis	1.951067
Normality Test Value	1.178617	Reject if > 1.182(10%)	1.289(5%)
K.S. Normality Test	0.11352	Reject if > 0.162(10%)	0.178(5%)
√b1 1.00 Skew-Z	2.18 Pr 0.0291	b2 4.33 Kurt-Z	1.78 Pr 0.0751
D'Agostino-Pearson Omnibus K² Normality Test		7.9	Pr 0.0189
100-%tile (Maximum)	.235	90-%tile	.14
75-%tile	.1245	10-%tile	.042
50-%tile (Median)	.0835	Range	.222
25-%tile	.052	75th-25th %tile	.0725
0-%tile (Minimum)	.013	C.L. Median(95%)	.053, .124

.013----------Line Plot / Box Plot----------.235
1 1 12 1111 1 1 2 1 11 1 2 2 11 1

Distribution & Histogram

Variable: %OFF EQU

Bin	Lower	Upper	Count	Prcnt	Total	Prcnt	Histogram
1	.013	3.318E-02	1	4.2	1	4.2	:*
2	3.318E-02	5.336E-02	6	25.0	7	29.2	:******
3	5.336E-02	7.354E-02	4	16.7	11	45.8	:****
4	7.354E-02	9.372E-02	3	12.5	14	58.3	:***
5	9.372E-02	.1139091	3	12.5	17	70.8	:***
6	.1139091	.1340909	3	12.5	20	83.3	:***
7	.1340909	.1542727	3	12.5	23	95.8	:***
8	.1542727	.1744545	0	0.0	23	95.8	:
9	.1744545	.1946364	0	0.0	23	95.8	:
10	.1946364	.2148182	0	0.0	23	95.8	:
11	.2148182	.235	1	4.2	24	100.0	:*

----------Descriptive Statistics----------

Date/Time 02-06-1992 17:03:16
Data Base Name C:\NASA\WUC12
Description Data base created at 16:18:28 on 12-19-1991

Detail Report

Variable: %OFF EQP

Mean - Average	.1287692	No. observations	35
Lower 95% c.i.limit	8.176091E-02	No. missing values	9
Upper 95% c.i.limit	.1757775	Sum of frequencies	26
Adj sum of squares	.3386806	Sum of observations	3.348
Standard deviation	.1163925	Std.error of mean	2.282646E-02
Variance	1.354722E-02	T-value for mean=0	5.641227
Coef. of variation	.9038848	T prob level	0.0000
Skewness	1.39201	Kurtosis	1.175161
Normality Test Value	2.053402	Reject if > 1.169(10%)	1.265(5%)
K.S. Normality Test	0.21790	Reject if > 0.156(10%)	0.171(5%)
√b1 1.31 Skew-Z	2.79 Pr 0.0052	b2 3.74 Kurt-Z	1.33 Pr 0.1835
D'Agostino-Pearson Omnibus K² Normality Test		9.6	Pr 0.0083
100-%tile (Maximum)	.438	90-%tile	.298
75-%tile	.178	10-%tile	.037
50-%tile (Median)	.088	Range	.436
25-%tile	.049	75th-25th %tile	.129
0-%tile (Minimum)	.002	C.L. Median(95%)	.05, .16

.002----------Line Plot / Box Plot----------.438
1 1 12212 11 11111 1 1 11 1 1 1 1 1

Distribution & Histogram

Variable: %OFF EQP

Bin	Lower	Upper	Count	Prcnt	Total	Prcnt	Histogram
1	.002	4.163E-02	3	11.5	3	11.5	:***
2	4.163E-02	8.127E-02	9	34.6	12	46.2	:*********
3	8.127E-02	.1209091	5	19.2	17	65.4	:*****
4	.1209091	.1605455	2	7.7	19	73.1	:**
5	.1605455	.2001818	2	7.7	21	80.8	:**
6	.2001818	.2398182	0	0.0	21	80.8	:
7	.2398182	.2794545	1	3.8	22	84.6	:*
8	.2794545	.3190909	2	7.7	24	92.3	:**
9	.3190909	.3587273	0	0.0	24	92.3	:
10	.3587273	.3983636	1	3.8	25	96.2	:*
11	.3983636	.438	1	3.8	26	100.0	:*

----------Multiple Regression----------

Date/Time 04-16-1992 12:01:35
Data Base Name C:\NASA\WUC13
Description Backup of NASAMSTR created 12-20-1991

Multiple Regression Report

Dependent Variable: %OFF EQP

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	.2774E-01	0.0000	.1396931	0.20	0.8453		
DRY WGT	-.407E-05	-2.5518	.1497E-05	-2.72	0.0159	0.2263	0.2263
LEN WING	-.194E-02	-1.8514	.6558E-03	-2.96	0.0097	0.3259	0.3037
SQRWHEEL	.1931569	1.3771	.8535E-01	2.26	0.0389	0.5679	0.1079
SQRW13	.7156E-02	2.5413	.3463E-02	2.07	0.0565	0.6636	0.1937

Analysis of Variance Report

Dependent Variable: %OFF EQP

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	2.203816	2.203816		
Model	4	.1751109	4.377772E-02	7.40	0.002
Error	15	8.875405E-02	5.916937E-03		
Total	19	.263865	1.388763E-02		

Root Mean Square Error	7.692163E-02
Mean of Dependent Variable	.33195
Coefficient of Variation	.2317265
R Squared	0.6636
Adjusted R Squared	0.5739

----------Sum of Functions Regression----------

Date/Time 04-27-1992 13:42:16
Data Base Name C:\NASA\WUC23
Description Merge of WUC11 and WUC51 created 04-27-1992

Estimation Summary Report

Y: %OFF EQP X: ENG WGT
Model: A+B*(X)+C*(SQR(X))

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	1.146330127496948	.1905965	6.0	0.0000	0.42921925
B	4.572100568624601D-05	1.54087E-05	3.0	0.0109	
C	-1.145581687278943D-02	3.70415E-03	-3.1	0.0086	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	2	.1518611	7.593055E-02	.275555	4.9	0.0261
Error	13	.2019466	1.553436E-02	.1246369		
Total	15	.3538078	2.358718E-02	.1535812		

----------Multiple Regression----------

Date/Time 04-16-1992 12:38:01
Data Base Name A:WUC24
Description Backup of WUC24 created 03-13-1992

Multiple Regression Report

Dependent Variable: %OFF EQP

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	-109.8302	0.0000	24.7688	-4.43	0.0473		
LN DRYWT	-.1645163	-1.0364	.4566E-01	-3.60	0.0691	0.1403	0.1403
KVA MAX	.1426994	80.9389	.2812E-01	5.07	0.0367	0.4907	0.3695
SQR KVA	-6.151774	%-159.2671					
			1.26376	-4.87	0.0397	0.5106	0.3729
LOG KVA	15.75077	78.4592	3.377648	4.66	0.0430	0.5125	0.3674
WGT24	.6602E-01	118.1754	.1467E-01	4.50	0.0460	0.9286	0.0362
SQR WT24	-5.683191	%-247.6460					
			1.273395	-4.46	0.0467	0.9439	0.0200
LOG WT24	29.07148	133.8745	6.480136	4.49	0.0463	0.9949	0.0089

Analysis of Variance Report

Dependent Variable: %OFF EQP

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	.2614689	.2614689		
Model	7	.154171	2.202443E-02	56.11	0.018
Error	2	7.851048E-04	3.925524E-04		
Total	9	.1549561	1.721735E-02		

Root Mean Square Error	1.981294E-02
Mean of Dependent Variable	.1617
Coefficient of Variation	.122529
R Squared	0.9949
Adjusted R Squared	0.9772

----------Multiple Regression----------

Date/Time 04-16-1992 13:06:22
Data Base Name C:\NASA\WUC42
Description Merge of WUC41 and WUC13 created 12-27-1991

Multiple Regression Report

Dependent Variable: %OFF EQP

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	-26.56543	0.0000	5.705455	-4.66	0.0016		
KVA MAX	-.271E-02	-2.1024	.1020E-02	-2.66	0.0288	0.1454	0.1454
WGT42	.5143E-02	36.0501	.8676E-03	5.93	0.0004	0.2036	0.1952
SQR WT42	-.7487788	-64.7482	.1349785	-5.55	0.0005	0.4231	0.2289
LOG WT42	6.621144	30.6361	1.325087	5.00	0.0011	0.8600	0.2395

Analysis of Variance Report

Dependent Variable: %OFF EQP

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	1.055355	1.055355		
Model	4	.2494558	6.236395E-02	12.29	0.002
Error	8	4.060512E-02	5.07564E-03		
Total	12	.2900609	2.417175E-02		

Root Mean Square Error	7.124353E-02
Mean of Dependent Variable	.2849231
Coefficient of Variation	.2500448
R Squared	0.8600
Adjusted R Squared	0.7900

----------Multiple Regression----------

Date/Time 04-16-1992 13:10:12
Data Base Name A:WUC44
Description Backup of WUC44 created 03-13-1992

Multiple Regression Report

Dependent Variable: %OFF EQP

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	3.061047	0.0000	.6213115	4.93	0.0001		
DRY_WGT	.1178E-04	7.3057	.3256E-05	3.62	0.0020	0.1100	0.1100
WETAREA	-.127E-03	-8.7046	.3581E-04	-3.56	0.0023	0.1460	0.1241
LN DRYWT	-.4239174	-3.5260	.0959754	-4.42	0.0003	0.3359	0.2655
SQR WING	.1346839	4.4295	.3769E-01	3.57	0.0022	0.6115	0.1742

Analysis of Variance Report

Dependent Variable: %OFF EQP

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	.6311348	.6311348		
Model	4	.1681584	4.203959E-02	7.08	0.001
Error	18	.1068569	5.936492E-03		
Total	22	.2750152	1.250069E-02		

Root Mean Square Error	7.704864E-02
Mean of Dependent Variable	.1656522
Coefficient of Variation	.465123
R Squared	0.6115
Adjusted R Squared	0.5251

----------Multiple Regression----------

Date/Time 04-16-1992 13:17:33
Data Base Name A:WUC45
Description Backup of WUC45 created 03-13-1992

Multiple Regression Report

Dependent Variable: %OFFEQP

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	.7614E-01	0.0000	.0283886	2.68	0.0130		
LEN_WING	-.181E-02	-2.6037	.5151E-03	-3.52	0.0018	0.0119	0.0119
SQR_WGT	.1543E-02	2.5598	.4460E-03	3.46	0.0020	0.3406	0.0005

Analysis of Variance Report

Dependent Variable: %OFFEQP

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	.3719467	.3719467		
Model	2	4.866481E-02	.0243324	6.20	0.007
Error	24	9.420949E-02	3.925395E-03		
Total	26	.1428743	5.495166E-03		

Root Mean Square Error	6.265298E-02
Mean of Dependent Variable	.1173704
Coefficient of Variation	.5338057
R Squared	0.3406
Adjusted R Squared	0.2857

Residual Plot

----------Multiple Regression----------

Date/Time 04-16-1992 12:33:56
Data Base Name A:WUC14
Description Backup of WUC14 created 03-27-1992

Multiple Regression Report

Dependent Variable: %OFF EQP

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	5.512466	0.0000	1.372817	4.02	0.0013		
ACTUATOR	.2663E-02	0.8745	.1111E-02	2.40	0.0311	0.0293	0.0293
WGT14	-.566E-03	-14.4189	.1722E-03	-3.29	0.0054	0.1397	0.1041
LOG WG14	-1.193089	-13.1531	.3157466	-3.78	0.0020	0.3424	0.2322
SQR WT14	.1055595	25.9373	.3051E-01	3.46	0.0038	0.6455	0.1545

Analysis of Variance Report

Dependent Variable: %OFF EQP

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	.2719226	.2719226		
Model	4	6.115096E-02	1.528774E-02	6.37	0.004
Error	14	3.358546E-02	2.398961E-03		
Total	18	9.473642E-02	5.263134E-03		

Root Mean Square Error	4.897919E-02
Mean of Dependent Variable	.1196316
Coefficient of Variation	.4094169
R Squared	0.6455
Adjusted R Squared	0.5442

CLS
Ok

----------Multiple Regression----------

Date/Time 04-16-1992 11:34:54
Data Base Name A:AVIONICS
Description Backup of AVIONICS created 03-27-1992

Multiple Regression Report

Dependent Variable: %OFF EQP

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	7.166202	0.0000	1.777114	4.03	0.0030		
DIF SUBS	.2090E-01	1.4599	.4766E-02	4.39	0.0018	0.1874	0.1874
WGT51/72	-.128E-02	-28.0442	.2910E-03	-4.40	0.0017	0.2205	0.0064
SQR51/72	.1773785	35.2005	.4246E-01	4.18	0.0024	0.2212	0.0000
LOG5172	-1.734067	-15.3826	.4300031	-4.03	0.0030	0.2358	0.0091
WGT/TSUB	.6700E-02	7.2109	.1521E-02	4.40	0.0017	0.7578	0.0131

Analysis of Variance Report

Dependent Variable: %OFF EQP

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	1.782616	1.782616		
Model	5	.1003	2.006001E-02	5.63	0.013
Error	9	3.204889E-02	3.560988E-03		
Total	14	.1323489	9.453496E-03		

Root Mean Square Error	5.967401E-02
Mean of Dependent Variable	.3447333
Coefficient of Variation	.1731019
R Squared	0.7578
Adjusted R Squared	0.6233

----------Descriptive Statistics----------

Date/Time 02-10-1992 12:35:07
Data Base Name C:\NASA\WUC41
Description Merge of WUC42 and WUC11 created 02-05-1992

Detail Report

Variable: %OFF EQP

Mean - Average	.0932	No. observations	35
Lower 95% c.i.limit	6.419662E-02	No. missing values	10
Upper 95% c.i.limit	.1222034	Sum of frequencies	25
Adj sum of squares	.118494	Sum of observations	2.33
Standard deviation	7.026557E-02	Std.error of mean	1.405311E-02
Variance	4.93725E-03	T-value for mean=0	6.631982
Coef. of variation	.7539224	T prob level	0.0000
Skewness	1.07983	Kurtosis	.4710465
Normality Test Value	1.124025	Reject if > 1.176(10%)	1.276(5%)
K.S. Normality Test	0.19816	Reject if > 0.159(10%)	0.174(5%)

(b1 1.01 Skew-Z 2.24 Pr 0.0249 b2 3.15 Kurt-Z 0.74 Pr 0.4604
D'Agostino-Pearson Omnibus K) Normality Test 5.6 Pr 0.0615

100-%tile (Maximum)	.27	90-%tile	.2
75-%tile	.13	10-%tile	.026
50-%tile (Median)	.08	Range	.255
25-%tile	.03	75th-25th %tile	9.999999E-02
0-%tile (Minimum)	.015	C.L. Median(95%)	.035, .11

.015----------Line Plot / Box Plot----------.27
1 11131 1 1 4 12 1 2 1 2 1 1

Distribution & Histogram

Variable: %OFF EQP

Bin	Lower	Upper	Count	Prcnt	Total	Prcnt	Histogram
1	.015	3.818E-02	8	32.0	8	32.0	:********
2	3.818E-02	6.136E-02	1	4.0	9	36.0	:*
3	6.136E-02	8.454E-02	5	20.0	14	56.0	:*****
4	8.454E-02	.1077273	3	12.0	17	68.0	:***
5	.1077273	.1309091	3	12.0	20	80.0	:***
6	.1309091	.1540909	1	4.0	21	84.0	:*
7	.1540909	.1772727	0	0.0	21	84.0	:
8	.1772727	.2004546	2	8.0	23	92.0	:**
9	.2004546	.2236364	0	0.0	23	92.0	:
10	.2236364	.2468182	1	4.0	24	96.0	:*
11	.2468182	.27	1	4.0	25	100.0	:*

Residual Plot

----------Multiple Regression----------

Date/Time 04-16-1992 12:59:43
Data Base Name C:\NASA\WUC47B
Description Merge of WUC47 and WUC47 created 04-16-1992

Multiple Regression Report

Dependent Variable: %OFF EQP

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	23.85198	0.0000	6.959501	3.43	0.0037		
LEN_WING	-.902E-02	-10.1204	.2212E-02	-4.08	0.0010	0.1748	0.1748
LN DRYWT	-5.247019	-50.4282	1.523853	-3.44	0.0036	0.3474	0.0560
LDWGTSQD	.3009554	62.2695	.8677E-01	3.47	0.0034	0.6096	0.0637
WGT/LEN	-.212E-02	-2.7734	.8730E-03	-2.42	0.0284	0.7196	0.0097

Analysis of Variance Report

Dependent Variable: %OFF EQP

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	.2930621	.2930621		
Model	4	.1118034	2.795085E-02	9.62	0.000
Error	15	4.357554E-02	2.905036E-03		
Total	19	.155379	8.177839E-03		

Root Mean Square Error	5.389838E-02
Mean of Dependent Variable	.12105
Coefficient of Variation	.4452572
R Squared	0.7196
Adjusted R Squared	0.6448

Residual Plot

Multiple Regression

Date/Time 04-16-1992 14:07:39
Data Base Name C:\NASA\WUC49
Description Merge of WUC24 and WUC13 created 02-12-1992

Multiple Regression Report

Dependent Variable: %OFF EQP

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	.1988856	0.0000	.114326	1.74	0.0981		
DRY WGT	.4938E-05	2.0439	.2131E-05	2.32	0.0318	0.3304	0.3304
SQR WGT	-.205E-02	-1.7743	.1098E-02	-1.87	0.0771	0.4032	0.2606
KVA MAX	.4877E-03	0.3383	.4481E-03	1.09	0.2900	0.4382	0.2504

Analysis of Variance Report

Dependent Variable: %OFF EQP

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	.0936584	.0936584		
Model	3	8.434577E-02	2.811526E-02	4.94	0.011
Error	19	.1081273	5.690911E-03		
Total	22	.1924731	8.748776E-03		

Root Mean Square Error	7.543813E-02
Mean of Dependent Variable	6.381305E-02
Coefficient of Variation	1.182174
R Squared	0.4382
Adjusted R Squared	0.3495

Residual !

----------Multiple Regression----------

Date/Time 04-16-1992 14:11:10
Data Base Name C:\NASA\WUC96
Description Merge of WUC47 and WUC12 created 02-11-1992

Multiple Regression Report

Dependent Variable: %OFF EQP

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	-5.46864	0.0000	1.728256	-3.16	0.0507		
LEN_WING	.1683579	44.4755	.3631E-01	4.64	0.0189	0.2583	0.2583
WETAREA	-.448E-02	-59.8242	.9387E-03	-4.77	0.0175	0.2815	0.2633
PERSONS	.3652105	56.9495	.4935E-01	7.40	0.0051	0.2901	0.2636
SQR PER	-4.152794	-59.6224	.5515564	-7.53	0.0049	0.7208	0.2901
SQRWT49/	.1779732	17.9140	.3293E-01	5.40	0.0124	0.9740	0.3109

Analysis of Variance Report

Dependent Variable: %OFF EQP

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	3.584711	3.584711		
Model	5	.7633067	.1526613	22.47	0.014
Error	3	2.038224E-02	6.794081E-03		
Total	8	.7836889	9.796111E-02		

Root Mean Square Error	8.242621E-02
Mean of Dependent Variable	.6311111
Coefficient of Variation	.1306049
R Squared	0.9740
Adjusted R Squared	0.9306

Data Base Name C:\NASA\WUC91
Description Backup of WUC49 created 02-13-1992

Multiple Regression Report

Dependent Variable: %OFF EQP

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	4.653976	0.0000	2.156753	2.16	0.0476		
LN DRYWT	-.4571863	-2.0304	.2379916	-1.92	0.0739	0.3140	0.3140
SQR WGT	.2421E-02	1.4973	.1709E-02	1.42	0.1770	0.3950	0.2461

Analysis of Variance Report

Dependent Variable: %OFF EQP

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	1.664096	1.664096		
Model	2	.3243408	.1621704	4.90	0.023
Error	15	.4968562	3.312375E-02		
Total	17	.821197	4.830571E-02		

Root Mean Square Error	.1819993
Mean of Dependent Variable	.3040555
Coefficient of Variation	.5985725
R Squared	0.3950
Adjusted R Squared	0.3143

----------Descriptive Statistics----------

Date/Time 02-14-1992 14:38:09
Data Base Name C:\NASA\WUC93
Description Data base created at 17:14:42 on 02-13-1992

Detail Report

Variable: %OFF EQP

Mean - Average	.2877375	No. observations	8
Lower 95% c.i.limit	.1127736	No. missing values	0
Upper 95% c.i.limit	.4627014	Sum of frequencies	8
Adj sum of squares	.3085063	Sum of observations	2.3019
Standard deviation	.2099341	Std.error of mean	7.422291E-02
Variance	4.407232E-02	T-value for mean=0	3.876667
Coef. of variation	.7296028	T prob level	0.0061
Skewness	.5445296	Kurtosis	-.7486194
Normality Test Value	1.0736	Reject if > 1.548(10%)	2.421(5%)
K.S. Normality Test	0.18167	Reject if > 0.264(10%)	0.288(5%)
√b1 0.44 Skew-Z	0.73 Pr 0.4631	b2 1.98 Kurt-Z	-0.41 Pr 0.6818
D'Agostino-Pearson Omnibus K² Normality Test		0.7	Pr 0.7024
100-%tile (Maximum)	.644	90-%tile	.5625
75-%tile	.44	10-%tile	.0464
50-%tile (Median)	.265	Range	.5976
25-%tile	.10075	75th-25th %tile	.33925
0-%tile (Minimum)	.0464	C.L. Median(95%)	.0464, .644

.0464----------Line Plot / Box Plot----------.644
1 1 1 1 1 1 1 1
-------[XXXXXXXXXXXXXXXXXXXXmXaXXXXXXXXXXXXXXXXXXX]----------

Distribution & Histogram

Variable: %OFF EQP

Bin	Lower	Upper	Count	Prcnt	Total	Prcnt	Histogram
1	.0464	.1317714	3	37.5	3	37.5	:***
2	.1317714	.2171429	0	0.0	3	37.5	:
3	.2171429	.3025143	2	25.0	5	62.5	:**
4	.3025143	.3878857	0	0.0	5	62.5	:
5	.3878857	.4732572	1	12.5	6	75.0	:*
6	.4732572	.5586286	1	12.5	7	87.5	:*
7	.5586286	.644	1	12.5	8	100.0	:*

----------Descriptive Statistics----------

Date/Time 02-14-1992 15:16:51
Data Base Name C:\NASA\WUC97
Description Backup of WUC91 created 02-14-1992

Detail Report

Variable: %OFF EQP

Mean - Average	1.003704E-02	No. observations	36
Lower 95% c.i.limit	-9.861112E-04	No. missing values	9
Upper 95% c.i.limit	2.106019E-02	Sum of frequencies	27
Adj sum of squares	.0201892	Sum of observations	.271
Standard deviation	2.786589E-02	Std.error of mean	5.362793E-03
Variance	7.765078E-04	T-value for mean=0	1.871606
Coef. of variation	2.776306	T prob level	0.0726
Skewness	4.268697	Kurtosis	19.66771
Normality Test Value	192.5925	Reject if > 1.164(10%)	1.254(5%)
K.S. Normality Test	0.35238	Reject if > 0.153(10%)	0.168(5%)
√b1 4.03 Skew-Z	5.70 Pr 0.0000	b2 19.00 Kurt-Z	4.83 Pr 0.0000
D'Agostino-Pearson Omnibus K² Normality Test		55.8	Pr 0.0000
100-%tile (Maximum)	.14	90-%tile	.033
75-%tile	.0048	10-%tile	0
50-%tile (Median)	.0013	Range	.14
25-%tile	0	75th-25th %tile	.0048
0-%tile (Minimum)	0	C.L. Median(95%)	0, .0047

0----------Line Plot / Box Plot----------.14
D422 11 1 1 1 1

Distribution & Histogram

Variable: %OFF EQP

Bin	Lower	Upper	Count	Prcnt	Total	Prcnt	Histogram
1	0	1.272E-02	23	85.2	23	85.2	:**********
2	1.272E-02	2.545E-02	1	3.7	24	88.9	:*
3	2.545E-02	3.818E-02	1	3.7	25	92.6	:*
4	3.818E-02	5.090E-02	1	3.7	26	96.3	:*
5	5.090E-02	6.363E-02	0	0.0	26	96.3	:
6	6.363E-02	7.636E-02	0	0.0	26	96.3	:
7	7.636E-02	8.909E-02	0	0.0	26	96.3	:
8	8.909E-02	.1018182	0	0.0	26	96.3	:
9	.1018182	.1145455	0	0.0	26	96.3	:
10	.1145455	.1272727	0	0.0	26	96.3	:
11	.1272727	.14	1	3.7	27	100.0	:*

APPENDIX M

Removal Rate Data & Regression

REMOVAL RATE

ANALYSIS SUMMARY								
WUC		MEAN	C-5A	C-130E	C-141B	F-15D	F-111A	T-38A
11	1	0.194	0.116	0.168	0.177	0.207	0.309	0.185
12	2	0.319	0.398	0.225	0.362	0.235	0.000	0.377
13	3	0.442	0.220	0.314	0.344	0.663	0.620	0.490
14	4	0.304	0.131	0.247	0.263	0.390	0.429	0.363
24	5	0.321	0.187	0.306	0.269	0.521	0.000	0.000
41	6	0.385	0.168	0.313	0.378	0.345	0.636	0.468
42	7	0.344	0.230	0.305	0.332	0.381	0.539	0.275
44	8	0.716	0.767	0.530	0.696	0.694	0.872	0.734
45	9	0.368	0.234	0.257	0.308	0.593	0.515	0.303
46	10	0.272	0.178	0.199	0.164	0.366	0.389	0.359
47	11	0.415	0.237	0.375	0.313	0.514	0.535	0.517
49	12	0.274	0.150	0.313	0.389	0.368	0.138	0.288
51	13	0.507	0.453	0.414	0.445	0.510	0.726	0.494
52	14	0.458	0.375	0.483	0.514	0.345	0.708	0.322
61	15	0.299	0.317	0.307	0.539	0.000	0.330	0.000
62	16	0.245	0.275	0.327	0.388	0.000	0.000	0.235
63	17	0.368	0.299	0.306	0.275	0.405	0.546	0.375
64	18	0.456	0.518	0.443	0.521	0.000	0.507	0.292
65	19	0.472	0.382	0.551	0.445	0.350	0.422	0.680
66	20	0.396	0.309	0.557	0.322	0.000	0.000	0.000
69	21	0.455	0.000	0.295	0.419	0.000	0.652	0.000
71	22	0.442	0.395	0.411	0.424	0.426	0.433	0.560
72	23	0.475	0.455	0.542	0.427	0.000	0.000	0.000
91	24	0.461	0.179	0.189	0.392	0.658	0.000	0.887
97	25	0.555	0.192	0.707	0.128	0.911	0.421	0.968

REMOVAL RATE

WUC	MEAN	MEDIAN	STD DEV	VARIANCE	VAR/MEAN RATIO	COEFF VAR
11	0.194	0.181	6.407E-2	4.105E-3	2.119E-2	0.3308
12	0.319	0.362	.0826818	6.836E-3	2.14E-2	0.25887
13	0.442	0.417	.1778206	3.162E-2	7.1566E-2	0.40246
14	0.304	0.313	.1107797	1.227E-2	4.0391E-2	0.3646
24	0.321	0.2875	.1424603	2.03E-2	6.327E-2	0.44415
41	0.385	0.3615	.1573603	2.476E-2	6.4373E-2	0.40908
42	0.344	0.3185	.1084576	1.176E-2	3.4228E-2	0.31559
44	0.716	0.715	.1120169	1.255E-2	1.7537E-2	0.1566
45	0.368	0.3055	.1486499	2.207E-2	5.991E-2	0.4033
46	0.272	0.279	.101439	1.029E-2	3.7784E-2	0.37248
47	0.415	0.4445	.1251341	1.566E-2	3.77163E-2	0.3014
49	0.274	0.3005	.1073773	1.153E-2	4.2029E-2	0.39141
51	0.507	0.4735	.1127367	1.271E-2	2.5068E-2	0.22236
52	0.458	0.429	.1445094	2.088E-2	4.56126E-2	0.315638
61	0.299	0.317	.1926806	3.709E-2	0.1242	0.64495
62	0.245	0.275	.1484907	.02205	8.9998E-2	0.60606
63	0.368	0.3405	.1003549	.01007	2.73919E-2	0.27295
64	0.456	0.507	9.713E-2	9.434E-3	2.0679E-2	0.2129
65	0.472	0.4335	.1230586	1.514E-2	3.2106E-2	0.2609
66	0.396	0.322	.1396815	1.948E-2	4.91995E-2	0.35248
69	0.455	0.419	.1812522	3.285E-2	7.215E-2	0.398
71	0.442	0.425	5.959E-2	3.551E-3	8.04246E-3	0.13497
72	0.475	0.455	5.997E-2	3.596E-3	7.57649E-3	0.12634
91	0.461	0.392	.3076337	9.464E-2	0.2052895	0.66732
97	0.555	0.564	.3612372	.13049	0.23533	0.65147

REMOVAL RATE ANALYSIS - WUC 23

	REMOVALS	MISSIONS ACCOMPLISHED	PERCENT
F-4E	1,988	5,921	0.3358
F-15C	8,653	16,891	0.5123
F-16C	16,978	39,635	0.4284
C-5A	6,845	43,508	0.1573
C-130E	12,205	36,836	0.3313
KC-135	1,787	10,354	0.1726
TOTALS	48,456	153,145	0.3164

----------Sum of Functions Regression----------

Date/Time 06-04-1992 15:34:59
Data Base Name C:\nasa\WUC11
Description Backup of NASAMSTR created 12-18-1991

Estimation Summary Report

Y: REMRAT11 X: WGT BODY
Model: A+B*(X)

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	.1934133385777032	8.649185E-03	22.4	0.0002	0.85260957
B	-6.308858923946157D-07	1.514432E-07	-4.2	0.0252	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	1	3.888923E-03	3.888923E-03	6.236123E-02	17.4	0.0252
Error	3	6.722772E-04	2.240924E-04	1.496972E-02		
Total	4	.0045612	.0011403	3.376833E-02		

----------Sum of Functions Regression----------

Date/Time 06-04-1992 15:13:20
Data Base Name C:\nasa\WUC11
Description Backup of NASAMSTR created 12-18-1991

Estimation Summary Report

Y: REMRAT13 X: LEN_WING
Model: A+B*(SQR(X))

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	.8639022023186406	.1440472	6.0	0.0039	0.70322806
B	-2.962998410898014D-02	9.624203E-03	-3.1	0.0370	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	1	.1111809	.1111809	.3334381	9.5	0.0370
Error	4	4.691989E-02	1.172997E-02	.108305		
Total	5	.1581008	3.162017E-02	.1778206		

----------Sum of Functions Regression----------

Date/Time 06-04-1992 15:17:11
Data Base Name C:\nasa\WUC11
Description Backup of NASAMSTR created 12-18-1991

Estimation Summary Report

Y: REMRAT14 X: LEN_WING
Model: A+B*(X)

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	.453905563751608	3.872833E-02	11.7	0.0003	0.83791083
B	-6.676834926788542D-04	1.468313E-04	-4.5	0.0104	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	1	5.185439E-02	5.185439E-02	.2277156	20.7	0.0104
Error	4	1.003094E-02	2.507735E-03	5.007729E-02		
Total	5	6.188534E-02	1.237707E-02	.1112523		

----------Sum of Functions Regression----------

Date/Time 06-04-1992 15:23:55
Data Base Name C:\nasa\WUC11
Description Backup of NASAMSTR created 12-18-1991

Estimation Summary Report

Y: REMRAT24 X: DRY_WGT
Model: A+B*(SQR(X))

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	.5789757975531332	9.536927E-02	6.1	0.0261	0.81294072
B	-7.51193706208044D-04	2.547987E-04	-2.9	0.0984	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	1	4.949569E-02	4.949569E-02	.2224763	8.7	0.0984
Error	2	1.138906E-02	5.694529E-03	.0754621		
Total	3	6.088475E-02	2.029492E-02	.1424602		

----------Sum of Functions Regression----------

Date/Time 04-27-1992 14:28:07
Data Base Name C:\NASA\WUC23
Description Merge of WUC11 and WUC51 created 04-27-1992

Estimation Summary Report

Y: REM RATE X: ENG WGT
Model: A+B*(SQR(X))

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	.6211067449067929	7.217704E-02	8.6	0.0010	0.83032542
B	-2.487228698927137D-03	5.62173E-04	-4.4	0.0115	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	1	7.983025E-02	7.983025E-02	.2825425	19.6	0.0115
Error	4	1.631308E-02	4.07827E-03	6.386133E-02		
Total	5	9.614334E-02	1.922867E-02	.1386675		

----------Sum of Functions Regression----------

Date/Time 06-04-1992 16:03:23
Data Base Name C:\nasa\WUC41
Description Merge of WUC42 and WUC11 created 02-05-1992

Estimation Summary Report

Y: REMRAT12 X: BTU COOL
Model: A+B*(X)

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	.2026788301027799	9.232288E-02	2.2	0.1593	0.43220529
B	5.880527005587363D-04	4.765976E-04	1.2	0.3426	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	1	.0100263	.0100263	.1001314	1.5	0.3426
Error	2	.0131717	6.585851E-03	8.115325E-02		
Total	3	.023198	7.732667E-03	8.793558E-02		

----------Sum of Functions Regression----------

Date/Time 06-04-1992 16:06:33
Data Base Name C:\nasa\WUC41
Description Merge of WUC42 and WUC11 created 02-05-1992

Estimation Summary Report

Y: REMRAT41 X: ECSWT
Model: A+B*(X)

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	.529437162022918	7.991302E-02	6.6	0.0027	0.56002885
B	-8.913524598640413D-05	3.950266E-05	-2.3	0.0870	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	1	6.933792E-02	6.933792E-02	.263321	5.1	0.0870
Error	4	5.447341E-02	1.361835E-02	.1166977		
Total	5	.1238113	2.476227E-02	.1573603		

----------Sum of Functions Regression----------

Date/Time 05-03-1992 11:11:02
Data Base Name C:\NCSS\REMAV
Description Data base created at 10:48:48 on 05-03-1992

Estimation Summary Report

Y: REM42 X: LEN+WING
Model: A+B*(X)+C*(LOG(X))
Filter: REM42

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	-.3853306486485544	.5520891	-0.7	0.5574	0.6231614
B	-1.006105783537246D-03	6.318003E-04	-1.6	0.2523	
C	.1771478107273882	.1326407	1.3	0.3134	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F
Model	2	8.119295E-03	4.059648E-03	6.371536E-02	1.7	0.3768
Error	2	4.909905E-03	2.454952E-03	4.954748E-02		
Total	4	.0130292	.0032573	5.707276E-02		

----------Sum of Functions Regression----------

Date/Time 05-03-1992 11:12:43
Data Base Name C:\NCSS\REMAV
Description Data base created at 10:48:48 on 05-03-1992

Estimation Summary Report

Y: REM44 X: LEN+WING
Model: A+B*(X)+C*(LOG(X))
Filter: REM42

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	2.365083753788492	.7221055	3.3	0.0819	0.74813032
B	2.0140263171312260-03	8.263639E-04	2.4	0.1351	
C	-.4115210829205226	.1734875	-2.4	0.1411	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	2	2.494925E-02	1.247462E-02	.1116899	3.0	0.2519
Error	2	8.399552E-03	4.199776E-03	6.480568E-02		
Total	4	.0333488	.0083372	9.130827E-02		

----------Sum of Functions Regression----------

Date/Time 06-04-1992 16:16:45
Data Base Name C:\nasa\WUC47
Description Merge of WUC45 and WUC42 created 01-03-1992

Estimation Summary Report

Y: REMRAT47 X: DRY_WGT
Model: A+B*(SQR(X))

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	.6026214260605686	4.229213E-02	14.2	0.0001	0.86652279
B	-6.758594018545932D-04	1.326294E-04	-5.1	0.0070	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	1	6.784252E-02	6.784252E-02	.260466	26.0	0.0070
Error	4	1.045031E-02	2.612577E-03	5.111338E-02		
Total	5	7.829283E-02	1.565857E-02	.1251342		

----------Sum of Functions Regression----------
Date/Time 06-04-1992 16:23:15
Data Base Name C:\nasa\AVIONICS
Description Merge of WUC71 and WUC61 created 03-25-1992

Estimation Summary Report

Y: REMRAT91 X: LEN_WING
Model: A+B*(LOG(X))

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	2.348927831791845	.4999144	4.7	0.0182	0.82869887
B	-.3585188334562223	9.410941E-02	-3.8	0.0318	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	1	.3137073	.3137073	.5600958	14.5	0.0318
Error	3	6.484672E-02	2.161557E-02	.1470224		
Total	4	.378554	.0946385	.3076337		

----------Sum of Functions Regression----------
Date/Time 06-04-1992 16:31:52
Data Base Name C:\nasa\WUC42
Description Merge of WUC41 and WUC13 created 12-27-1991

Estimation Summary Report

Y: REMRAT97 X: WETAREA
Model: A+B*(LOG(X))

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	2.532197071458078	.6949638	3.6	0.0219	0.67346829
B	-.2283679845742844	7.950773E-02	-2.9	0.0454	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	1	.4394121	.4394121	.6628817	8.2	0.0454
Error	4	.2130494	5.326235E-02	.2307864		
Total	5	.6524615	.1304923	.3612372		

----------Sum of Functions Regression----------

Date/Time 05-03-1992 11:00:51
Data Base Name C:\NCSS\REMAV
Description Data base created at 10:48:48 on 05-03-1992

Estimation Summary Report

Y: REMAV X: DRY WGT
Model: A+B*(X)+C*(SQR(X))
Filter: REMAV

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	.3973471291561014	.0219378	18.1	0.0030	0.75776649
B	-4.265886102584761D-07	2.39473E-07	-1.8	0.2168	
C	2.163532620527512D-04	1.603619E-04	1.3	0.3097	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	2	1.121494E-03	5.607472E-04	.0236801	3.1	0.2422
Error	2	3.585056E-04	1.792528E-04	1.338853E-02		
Total	4	.00148	.00037	1.923538E-02		

APPENDIX N

Abort Rate Data & Regression

ABORT RATES - ABORTS PER MAINTENANCE ACTION

	F-4D-A	F-4D-F	F-4D	B-52G-A	B-52G-F	B-52G	B-52H-A	B-52H-F
WUC11	16	775	0.02065	39	30,437	0.00128	23	20,234
WUC12	11	1,154	0.00953	22	5,850	0.00376	4	3,933
WUC13	17	758	0.02243	48	25,000	0.00192	12	15,326
WUC14	24	405	0.05926	13	20,649	0.00063	10	13,144
WUC41	4	207	0.01932	7	3,284	0.00213	7	2,734
WUC42	16	217	0.07373	16	6,620	0.00242	8	6,023
WUC44	6	218	0.02752	6	2,248	0.00267	3	1,507
WUC45	23	281	0.08185	18	21,306	0.00084	2	10,481
WUC47	1	102	0.00980	4	1,719	0.00233	0	1,324
WUC51	10	388	0.02577	22	11,280	0.00195	23	9,941
WUC52	12	144	0.08333	4	1,681	0.00238	0	1,054
WUC61								
WUC62		2	0.00000	0	22	0.00000	0	3
WUC63	13	233	0.05579	1	2,428	0.00041	4	1,787
WUC64				4	2,024	0.00198	2	1,991
WUC71	6	971	0.00618	0	2,251	0.00000	0	1,720
WUC72	0	54	0.00000	0	712	0.00000	0	645

	KC-10A-A	KC-10A-F	KC-10	C-130A-A	C-130A-F	C-130B-A	C-130B-F	C-130B	C-130E-A
WUC11	5	1,695	0.00295	7	1,329	27	11,395	0.00237	77
WUC12	0	2,041	0.00000	1	169	5	2,663	0.00188	28
WUC13	19	6,016	0.00316	17	746	50	5,087	0.00983	154
WUC14	10	2,056	0.00486	6	422	29	3,394	0.00854	62
WUC41	3	1,280	0.00234	10	282	30	1,718	0.01746	86
WUC42	5	1,011	0.00495	14	379	58	1,397	0.04152	101
WUC44	7	3,105	0.00225	0	132	6	580	0.01034	10
WUC45	17	1,707	0.00996	3	348	28	2,380	0.01176	60
WUC47	3	884	0.00339	0	67	2	382	0.00524	9
WUC51	6	956	0.00628	1	262	12	2,063	0.00582	44
WUC52	3	1,990	0.00151	1	228	12	1,802	0.00666	37
WUC61									
WUC62	0	196	0.00000	0	43	3	421	0.00713	8
WUC63	0	473	0.00000	0	30	2	255	0.00784	3
WUC64	1	1,231	0.00081	3	105	10	105	0.09524	24
WUC71	2	2,509	0.00080	3	226	2	1,130	0.00177	10
WUC72	2	529	0.00378	2	477	5	2,244	0.00223	80

legend:

A - aborts

F - maintenance actions

ABORT RATES - ABORTS PER MAINTENANCE ACTION

C-130E-F	C-130E	C-130H-A	C-130H-F	C-130H	F-4D-A	F-4D-F	F-4D	F-4G-A	F-4G-F
40,515	0.00190	40	14,504	0.00276	94	7,841	0.01199	40	2,563
12,250	0.00229	13	6,167	0.00211	78	7,917	0.00985	69	3,396
18,711	0.00823	85	9,350	0.00909	196	5,115	0.03832	120	1,239
12,004	0.00516	51	6,734	0.00757	363	4,727	0.07679	142	1,776
10,445	0.00823	41	4,008	0.01023	56	2,127	0.02633	23	956
6,188	0.01632	84	3,055	0.02750	206	1,164	0.17698	100	492
4,777	0.00209	6	1,884	0.00318	48	1,176	0.04082	31	456
10,763	0.00557	45	4,990	0.00902	431	3,570	0.12073	233	1,309
2,215	0.00406	6	1,247	0.00481	18	732	0.02459	14	292
9,289	0.00474	12	3,016	0.00398	50	3,033	0.01649	41	1,514
7,416	0.00499	29	3,715	0.00781	134	1,449	0.09248	61	645
2,399	0.00333	4	1,938	0.00206	0	1	0.00000		
2,133	0.00141	2	1,303	0.00153	106	2,571	0.04123	48	1,730
3,611	0.00665	6	2,032	0.00295	0	0		1	0
6,630	0.00151	2	2,647	0.00076	96	10,965	0.00876	24	5,681
19,270	0.00415	25	7,244	0.00345	1	787	0.00127	2	485

F-16A-A	F-16A-F	F-16A	F-16C-A	F-16C-F		F-15A-A	F-15A-F	F-15A	F-15B-A
154	15,844	0.00972	162	11,841	0.01368	203	13,088	0.01551	22
125	9,856	0.01268	153	7,754	0.01973	52	4,153	0.01252	31
737	23,831	0.03093	1,060	26,310	0.04029	243	8,137	0.02986	62
1,200	17,654	0.06797	1,051	12,930	0.08128	236	6,677	0.03535	79
191	5,719	0.03340	486	7,572	0.06418	215	4,271	0.05034	41
884	11,654	0.07585	919	10,511	0.08743	289	2,696	0.10720	42
108	5,168	0.02090	149	6,143	0.02426	95	3,236	0.02936	19
375	4,300	0.08721	386	3,146	0.12270	560	4,293	0.13044	115
28	1,907	0.01468	51	2,712	0.01881	6	924	0.00649	3
173	5,297	0.03266	255	6,996	0.03645	196	7,108	0.02757	35
0	5	0.00000	0	9	0.00000	158	2,239	0.07057	19
26	2,368	0.01098	14	2,099	0.00667	0	2	0.00000	
134	5,557	0.02411	178	9,895	0.01799	51	6,489	0.00786	13
30	896	0.03348	42	891	0.04714	0	8	0.00000	0
12	2,301	0.00522	22	3,568	0.00617	53	6,451	0.00822	11
0	4	0.00000	1	18	0.05556	0			0

ABORT RATES - ABORTS PER MAINTENANCE ACTION

F-15B-F	F-15C-A	F-15C-F	F-15C	F-15D-A	F-15D-F	F-15E-A	F-15E-F	F-111E-A
2,810	142	15,325	0.00927	21	2,773	32	2,397	29
1,346	74	4,238	0.01746	16	1,017	20	1,257	7
1,331	270	7,283	0.03707	56	1,363	90	2,355	60
1,271	274	7,518	0.03645	39	1,174	115	1,528	147
761	210	6,343	0.03311	31	1,087	111	1,622	59
361	279	3,251	0.08582	36	558	64	795	59
803	96	4,948	0.01940	21	750	12	976	15
641	521	4,950	0.10525	67	851	64	421	74
253	15	1,424	0.01053	2	288	3	565	2
1,760	336	7,661	0.04386	32	1,674	69	2,305	62
419	150	2,594	0.05783	19	385	162	2,053	98
								0
				0				0
1,516	40	8,506	0.00470	11	1,478	21	2,072	8
								10
1,359	63	7,636	0.00825	7	1,217	7	1,303	0
						0	185	

ABORT RATES - ABORTS PER MAINTENANCE ACTION

F-111E-F	F-111E	KC-135A-A	KC-135A-F	KC-135A	KC-135R-A	KC-135R-F
5,557	0.00522	41	30,065	0.00136	34	22,601
1,173	0.00597	5	4,657	0.00107	7	5,780
752	0.07979	41	22,160	0.00185	30	33,012
3,468	0.04239	32	21,413	0.00149	33	24,694
2,641	0.02234	6	4,238	0.00142	15	4,859
1,345	0.04387	57	8,464	0.00673	13	4,438
1,136	0.01320	13	3,849	0.00338	14	3,801
1,822	0.04061	25	11,361	0.00220	9	9,490
911	0.00220	4	2,326	0.00172	3	2,546
2,791	0.02221	37	17,086	0.00217	51	15,263
2,244	0.04367	4	6,911	0.00058	8	5,606
308	0.00000	0	911	0.00000	1	707
9	0.00000	1	207	0.00483	2	405
1,120	0.00714	2	2,013	0.00099	4	1,812
608	0.01645	7	2,326	0.00301	3	2,068
411	0.00000	0	1,301	0.00000	1	1,153
		17	10,650	0.00160	15	10,140

ABORTS PER MAINTENANCE ACTION - ROLL-UPS

	F-4D-A	F-4D-F	F-4D		B-52G-A	B-52G-F	B-52G		B-52H-A	B-52H-F	KC-10A-A	KC-10A-F	KC-10		C-130A-A	C-130A-F	C-130B-A	C-130B-F	C-130B		C-130E-A
WUC42	16	217	0.07373		16	6,620	0.00242		8	6,023	5	1,011	0.00495		14	379	58	1,397	0.04152		101
WUC44	6	218	0.02752		6	2,248	0.00267		3	1,507	7	3,105	0.00225		0	132	6	580	0.01034		10
WBS 10	22	435	0.05057		22	8,866	0.00248		11	7,530	12	4,118	0.00292		14	511	64	1,977	0.03237		111
WUC45	23	281	0.08185		18	21,306	0.00084		2	10,481	17	1,707	0.00996		3	348	28	2,380	0.01176		60
WUC47	1	102	0.00980		4	1,719	0.00233		0	1,324	3	884	0.00339		0	67	2	382	0.00524		9
WUC51	10	388	0.02577		22	11,280	0.00195		23	9,941	6	956	0.00628		1	262	12	2,063	0.00582		44
WUC52	12	144	0.08333		4	1,681	0.00238		0	1,054	3	1,990	0.00151		1	228	12	1,802	0.00666		37
WUC61																					
WUC62		2	0.00000		0	22	0.00000		0	3	0	196	0.00000		0	43	3	421	0.00713		8
WUC63	13	233	0.05579		1	2,428	0.00041		4	1,787	0	473	0.00000		0	30	2	255	0.00784		3
WUC64					4	2,024	0.00198		2	1,991	1	1,231	0.00081		3	105	10	105	0.09524		24
WUC71	6	971	0.00618		0	2,251	0.00000		0	1,720	2	2,509	0.00080		3	226	2	1,130	0.00177		10
WUC72	0	54	0.00000		0	712	0.00000		0	645	2	529	0.00378		2	477	5	2,244	0.00223		80
AVIONICS ROLL-UP	41	1,792	0.02288		31	20,398	0.00152		29	17,141	14	7,884	0.00178		10	1,371	46	8,020	0.00574		206

	C-130E-F	C-130E		C-130H-A	C-130H-F	C-130H		F-4D-A	F-4D-F	F-4D		F-4G-A	F-4G-F		F-16A-A	F-16A-F	F-16A		F-16C-A	F-16C-F		F-15A-A	F-15A-F	F-15A		F-15B-A
	6,188	0.01632		84	3,065	0.02750		206	1,164	0.17698		100	492		884	11,654	0.07585		919	10,511	0.08743		289	2,696	0.10720		42
	4,777	0.00209		6	1,884	0.00318		48	1,176	0.04082		31	456		108	5,168	0.02090		149	6,143	0.02426		95	3,236	0.02936		19
	10,965	0.01012		90	4,939	0.01822		254	2,340	0.10855		131	948		992	16,822	0.05897		1,068	16,664	0.06413		384	5,932	0.06473		61
	10,763	0.00557		45	4,990	0.00902		431	3,570	0.12073		233	1,309		375	4,300	0.08721		386	3,148	0.12270		560	4,293	0.13044		115
	2,215	0.00406		6	1,247	0.00481		18	732	0.02459		14	292		28	1,907	0.01468		51	2,712	0.01881		6	924	0.00649		3
	9,289	0.00474		12	3,016	0.00398		50	3,033	0.01649		41	1,514		173	5,297	0.03266		255	6,996	0.03645		198	7,108	0.02757		35
	7,416	0.00499		29	3,715	0.00781		134	1,449	0.09248		61	645		0	5	0.00000		0	9	0.00000		158	2,239	0.07057		19
	2,399	0.00333		4	1,938	0.00206		0	1	0.00000					26	2,368	0.01098		14	2,099	0.00667		0	2	0.00000		
	2,133	0.00141		2	1,303	0.00153		106	2,571	0.04123		48	1,730		134	5,557	0.02411		178	9,895	0.01799		51	6,489	0.00786		13
	3,611	0.00665		6	2,032	0.00295		0	0			1	0		30	896	0.03348		42	891	0.04714		0	8	0.00000		0
	6,630	0.00151		2	2,647	0.00076		96	10,965	0.00876		24	5,681		12	2,301	0.00522		22	3,568	0.00617		53	6,451	0.00822		11
	19,270	0.00415		25	7,244	0.00345		1	787	0.00127		2	485		0	4	0.00000		1	18	0.05556		0				0
	50,748	0.00406		80	21,895	0.00365		387	18,806	0.02058		177	10,055		375	16,428	0.02283		512	23,476	0.02181		158	22,297	0.02054		78
						0.0071																				

ABORTS PER MAINTENANCE ACTION - ROLL-UPS

F-15B-F	F-15C-A	F-15C-F	F-15C	F-15D-A	F-15D-F	F-15E-A	F-15E-F	F-111E-A
361	279	3,251	0.08582	36	558	64	795	59
803	96	4,948	0.01940	21	750	12	976	15
1,164	375	8,199	0.14197	87	1,308	76	1,771	74
641	521	4,950	0.10525	67	851	64	421	74
253	15	1,424	0.01053	2	288	3	565	2
1,760	336	7,661	0.04386	32	1,674	69	2,305	62
419	150	2,594	0.05783	19	385	162	2,053	98
								0
				0				0
1,516	40	8,506	0.00470	11	1,478	21	2,072	8
								10
1,359	63	7,636	0.00825	7	1,217	7	1,303	0
						0	185	
5,054	589	26,397	0.02231	69	4,754	259	7,918	178

ABORTS PER MAINTENANCE ACTION - ROLL-UPS

F-111E-F	F-111E	KC-135A-A	KC-135A-F	KC-135A
1,345	0.04387	57	8,464	0.00673
1,136	0.01320	13	3,849	0.00338
2,481	0.02983	70	12,313	0.00569
1,822	0.04061	25	11,361	0.00220
911	0.00220	4	2,326	0.00172
2,791	0.02221	37	17,086	0.00217
2,244	0.04367	4	6,911	0.00058
308	0.00000	0	911	0.00000
9	0.00000	1	207	0.00483
1,120	0.00714	2	2,013	0.00099
608	0.01645	7	2,326	0.00301
411	0.00000	0	1,301	0.00000
		17	10,650	0.00160
7,491	0.02376	68	41,405	0.00164

ABORTS & MAINTENANCE ACTION DATA

	F-4E	B-52G	C-5B	KC-10A	C-130E	F-16C	KC-135R	F-15C	TOT	RATE
WUC 23										
ABORTS	323	47		23		812			1,205	
MA	5,921	36,181		3,926		39,635			85,663	0.0141
WUC 49										
ABORTS	62	4		3	48		2		119	
MA	261	1,738		570	2,732	631	1,032		6,333	0.0188
WUC 91										
ABORTS	0	1		3	1	1	4		10	
MA	30	500		342	741	43	267		1,923	0.0052
WUC 93										
ABORTS	2	1							3	
MA	276	580							856	0.0035
WUC 96										
ABORTS	1				0	4	0		5	
MA	15				138	72	142		367	0.0136
WUC 97										
ABORTS	0	0		1	0	0	0			
MA	902	1,306		227	575	1,888	737			
WUC 24										
ABORTS				4	15	949	12	781	1,761	
MA				1,057	4,514	10,828	5,235	5,854	27,488	0.0641

----------Sum of Functions Regression----------
Date/Time 03-21-1992 13:18:31
Data Base Name C:\NCSS\FILES\ABORT
Description Data base created at 12:22:06 on 03-21-1992

Estimation Summary Report

Y: AWUC11 X: DRY WT
Model: A+B*(X)+C*(SQR(X))

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	3.1212954054979310-02	7.319232E-03	4.3	0.0017	0.6424076
B	1.9560107501036660-07	9.48912E-08	2.1	0.0662	
C	-1.5455839037814190-04	5.629948E-05	-2.7	0.0206	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F
Model	2	3.120985E-04	1.560493E-04	1.249197E-02	9.0	0.0058
Error	10	1.737278E-04	1.737278E-05	4.168066E-03		
Total	12	4.858263E-04	4.048552E-05	6.362824E-03		

----------Sum of Functions Regression----------
Date/Time 03-21-1992 13:23:44
Data Base Name C:\NCSS\FILES\ABORT
Description Data base created at 12:22:06 on 03-21-1992

Estimation Summary Report

Y: AWUC12 X: DRY WT
Model: A+B*(X)+C*(SQR(X))
Filter: AWUC12

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	.0423204002592303	7.036862E-03	6.0	0.0002	0.8357789
B	3.8774914729865470-07	1.259424E-07	3.1	0.0132	
C	-2.5188293779246770-04	6.22464E-05	-4.0	0.0029	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F
Model	2	3.755805E-04	1.877903E-04	1.370366E-02	22.9	0.0003
Error	9	7.379731E-05	8.199701E-06	2.863512E-03		
Total	11	4.493778E-04	4.085253E-05	6.391598E-03		

----------Sum of Functions Regression----------

Date/Time 03-21-1992 13:31:13
Data Base Name C:\NCSS\FILES\ABORT
Description Data base created at 12:22:06 on 03-21-1992

Estimation Summary Report

Y: AWUC13 X: LEN+WING
Model: A+B*(X)+C*(LOG(X))+D*(SQR(X))

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	-2.432076284094683	1.385685	-1.8	0.1131	0.630021
B	5.911218731680826D-03	3.564697E-03	1.7	0.1316	
C	1.145696021259627	.6458694	1.8	0.1098	
D	-.3392548733540112	.1946242	-1.7	0.1153	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F
Model	3	3.731493E-03	1.243831E-03	3.526799E-02	5.1	0.0246
Error	9	2.191311E-03	2.43479E-04	1.560381E-02		
Total	12	5.922804E-03	4.93567E-04	2.221637E-02		

----------Sum of Functions Regression----------

Date/Time 05-06-1992 15:15:57
Data Base Name C:\NASA\WUC23
Description Merge of WUC11 and WUC51 created 04-27-1992

Estimation Summary Report

Y: ABTRATE X: LEN_WING
Model: A+B*(X)

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	4.816425031610672D-02	1.836541E-02	2.6	0.1198	0.60345060
B	-1.268146378348553D-04	7.269126E-05	-1.7	0.2232	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	1	1.050443E-03	1.050443E-03	3.241054E-02	3.0	0.2232
Error	2	6.902844E-04	3.451422E-04	.018578		
Total	3	1.740727E-03	5.802425E-04	2.408822E-02		

----------Sum of Functions Regression----------

Date/Time 03-22-1992 10:27:44
Data Base Name C:\NCSS\FILES\ABORT
Description Data base created at 12:22:06 on 03-21-1992

Estimation Summary Report

Y: AWBS10 X: LN DRY
Model: A+B*(X)+C*(X*X)+D*(X^3)

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	-39.95984549060828	17.15776	-2.3	0.0448	0.6941617
B	11.09214143900919	4.735571	2.3	0.0439	
C	-1.017822607855107	.4341715	-2.3	0.0437	
D	3.090758729469949D-02	1.322297E-02	2.3	0.0442	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F
Model	3	1.531093E-02	5.103644E-03	.0714398	6.8	0.0108
Error	9	6.74579E-03	7.495322E-04	2.737758E-02		
Total	12	2.205672E-02	1.83806E-03	.0428726		

----------Sum of Functions Regression----------

Date/Time 03-21-1992 13:44:33
Data Base Name C:\NCSS\FILES\ABORT
Description Data base created at 12:22:06 on 03-21-1992

Estimation Summary Report

Y: AWUC45 X: LN DRY
Model: A+B*(1/SQR(X))+C*(X)+D*(X*X)+E*(X^3)
Filter: AWUC45

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	5000.25349948818	2535.252	2.0	0.0892	0.94124711
B	-7578.183026428647	3806.867	-2.0	0.0868	
C	-453.6120878012779	234.4657	-1.9	0.0943	
D	24.60056275019885	12.97183	1.9	0.0997	
E	-.5276227079707911	.2839331	-1.9	0.1055	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	4	.0281919	7.047974E-03	8.395221E-02	28.0	0.0002
Error	7	1.759745E-03	2.513922E-04	1.585535E-02		
Total	11	2.995164E-02	2.722876E-03	5.218119E-02		

----------Sum of Functions Regression----------
Date/Time 03-21-1992 13:37:30
Data Base Name C:\NCSS\FILES\ABORT
Description Data base created at 12:22:06 on 03-21-1992

Estimation Summary Report

Y: AWUC14 X: LEN+WING
Model: A+B*(LOG(X))+C*(SQR(X))

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	.7119536461928977	.1846638	3.9	0.0032	0.913044
B	-.1881388279494333	5.986314E-02	-3.1	0.0105	
C	2.098824012629048D-02	9.148882E-03	2.3	0.0447	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F)
Model	2	1.015222E-02	5.076109E-03	7.124681E-02	52.5	0.0000
Error	10	9.66868E-04	9.66868E-05	9.832945E-03		
Total	12	1.111908E-02	9.265904E-04	3.043995E-02		

----------Sum of Functions Regression----------
Date/Time 03-22-1992 10:24:15
Data Base Name C:\NCSS\FILES\ABORT
Description Data base created at 12:22:06 on 03-21-1992

Estimation Summary Report

Y: AWUCAV X: DRY WT
Model: A+B*(X)+C*(SQR(X))

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	5.027494869365081D-02	7.988421E-03	6.3	0.0001	0.826693
B	2.605132300912917D-07	1.03567E-07	2.5	0.0306	
C	-2.288197493912551D-04	6.144687E-05	-3.7	0.0039	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F
Model	2	9.871627E-04	4.935814E-04	2.221669E-02	23.9	0.0002
Error	10	2.069475E-04	2.069475E-05	4.549148E-03		
Total	12	1.19411E-03	9.950918E-05	9.975429E-03		

----------Sum of Functions Regression----------

Date/Time 03-22-1992 10:45:38
Data Base Name C:\NCSS\FILES\ABORT
Description Data base created at 12:22:06 on 03-21-1992

Estimation Summary Report

Y: AWBS14 X: DRY WT
Model: A+B*(X)+C*(SQR(X))

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	8.219898653084546D-02	1.398155E-02	5.9	0.0002	0.7892753
B	5.007204471814113D-07	1.812657E-07	2.8	0.0200	
C	-4.061250903579635D-04	1.07546E-04	-3.8	0.0036	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F
Model	2	2.374444E-03	1.187222E-03	3.445609E-02	18.7	0.0004
Error	10	6.339409E-04	6.339409E-05	7.962041E-03		
Total	12	3.008385E-03	2.506987E-04	1.583347E-02		

APPENDIX O

Crew Size Data & Regression

----------Descriptive Statistics----------

Date/Time 05-03-1992 08:56:17
Data Base Name C:\NCSS\CREW
Description Data base created at 07:48:02 on 05-03-1992

Detail Report

Variable: CREW1

Mean - Average	2.051111	No. observations	9
Lower 95% c.i.limit	1.823704	No. missing values	0
Upper 95% c.i.limit	2.278518	Sum of frequencies	9
Adj sum of squares	.7010889	Sum of observations	18.46
Standard deviation	.296034	Std.error of mean	9.867799E-02
Variance	8.763611E-02	T-value for mean=0	20.7859
Coef. of variation	.1443286	T prob level	0.0000
Skewness	.984818	Kurtosis	1.348314
Normality Test Value	1.187607	Reject if > 1.482(10%)	2.151(5%)
K.S. Normality Test	0.18577	Reject if > 0.252(10%)	0.275(5%)

√b1 0.81 Skew-Z 1.39 Pr 0.1653 b2 3.11 Kurt-Z 1.05 Pr 0.2948
D'Agostino-Pearson Omnibus K² Normality Test 3.0 Pr 0.2207

100-%tile (Maximum)	2.66	90-%tile	2.48
75-%tile	2.12	10-%tile	1.66
50-%tile (Median)	2.03	Range	1
25-%tile	1.9	75th-25th %tile	.2199999
0-%tile (Minimum)	1.66	C.L. Median(95%)	1.8, 2.3

1.66----------Line Plot / Box Plot----------2.66
1 1 2 1 1 1 1 1
----------[XXXXXXXXXmXaXXXX]----------

Detail Report

Variable: CREW2

Mean - Average	2.435556	No. observations	9
Lower 95% c.i.limit	2.189136	No. missing values	0
Upper 95% c.i.limit	2.681975	Sum of frequencies	9
Adj sum of squares	.8232222	Sum of observations	21.92
Standard deviation	.3207846	Std.error of mean	.1069282
Variance	.1029028	T-value for mean=0	22.77748
Coef. of variation	.131709	T prob level	0.0000
Skewness	.5811442	Kurtosis	-.213162
Normality Test Value	1.059425	Reject if > 1.482(10%)	2.151(5%)
K.S. Normality Test	0.16200	Reject if > 0.252(10%)	0.275(5%)

√b1 0.48 Skew-Z 0.83 Pr 0.4077 b2 2.29 Kurt-Z 0.02 Pr 0.9819
D'Agostino-Pearson Omnibus K² Normality Test 0.7 Pr 0.7096

100-%tile (Maximum)	2.99	90-%tile	2.92
75-%tile	2.53	10-%tile	2
50-%tile (Median)	2.37	Range	.99
25-%tile	2.26	75th-25th %tile	.27
0-%tile (Minimum)	2	C.L. Median(95%)	2.11, 2.85

2----------Line Plot / Box Plot----------2.99
1 1 1 2 1 1 1 1
----------[XXXXXXXXmXXXXaXXXXXXX]----------

----------Descriptive Statistics----------

Date/Time 05-03-1992 08:56:18
Data Base Name C:\NCSS\CREW
Description Data base created at 07:48:02 on 05-03-1992

Detail Report

Variable: CREW4

Mean - Average	2.181111	No. observations	9
Lower 95% c.i.limit	1.944235	No. missing values	0
Upper 95% c.i.limit	2.417987	Sum of frequencies	9
Adj sum of squares	.7606889	Sum of observations	19.63
Standard deviation	.3083604	Std.error of mean	.1027868
Variance	9.508611E-02	T-value for mean=0	21.21976
Coef. of variation	.1413776	T prob level	0.0000
Skewness	-.2693298	Kurtosis	2.075035
Normality Test Value	1.244826	Reject if > 1.482(10%)	2.151(5%)
K.S. Normality Test	0.17682	Reject if > 0.252(10%)	0.275(5%)
{b1 -0.22 Skew-Z	-0.39 Pr 0.6998	b2 3.49 Kurt-Z	1.41 Pr 0.1580
D'Agostino-Pearson Omnibus K} Normality Test		2.1	Pr 0.3427
100-%tile (Maximum)	2.73	90-%tile	2.56
75-%tile	2.26	10-%tile	1.58
50-%tile (Median)	2.21	Range	1.15
25-%tile	2.04	75th-25th %tile	.22
0-%tile (Minimum)	1.58	C.L. Median(95%)	2.02, 2.39

1.58----------Line Plot / Box Plot----------2.7
1 11 1 2 1 1
----------[XXXXXXXXXaXmXX]----------

Detail Report

Variable: CREW567

Mean - Average	2.178889	No. observations	9
Lower 95% c.i.limit	2.045203	No. missing values	0
Upper 95% c.i.limit	2.312574	Sum of frequencies	9
Adj sum of squares	.2422889	Sum of observations	19.61
Standard deviation	.1740291	Std.error of mean	5.800968E-02
Variance	3.028611E-02	T-value for mean=0	37.56078
Coef. of variation	7.987055E-02	T prob level	0.0000
Skewness	.2465188	Kurtosis	-1.403731
Normality Test Value	1.071084	Reject if > 1.482(10%)	2.151(5%)
K.S. Normality Test	0.16743	Reject if > 0.252(10%)	0.275(5%)
{b1 0.20 Skew-Z	0.35 Pr 0.7241	b2 1.66 Kurt-Z	-1.14 Pr 0.2528
D'Agostino-Pearson Omnibus K} Normality Test		1.4	Pr 0.4886
100-%tile (Maximum)	2.42	90-%tile	2.42
75-%tile	2.28	10-%tile	1.98
50-%tile (Median)	2.21	Range	.4400001
25-%tile	2.01	75th-25th %tile	.27
0-%tile (Minimum)	1.98	C.L. Median(95%)	1.98, 2.42

1.98----------Line Plot / Box Plot----------2.42
2 1 1 2 1 2
-----[XXXXXXXXXXXXXXXXXXXXXXXXXXXXXaXXXXXmXXXXXXXXXXX]----------

----------Descriptive Statistics----------

Date/Time 05-03-1992 08:56:18
Data Base Name C:\NCSS\CREW
Description Data base created at 07:48:02 on 05-03-1992

Detail Report

Variable: CREW9

Mean - Average	2.141111	No. observations	9
Lower 95% c.i.limit	1.887686	No. missing values	0
Upper 95% c.i.limit	2.394536	Sum of frequencies	9
Adj sum of squares	.8706889	Sum of observations	19.27
Standard deviation	.3299032	Std.error of mean	.1099677
Variance	.1088361	T-value for mean=0	19.47036
Coef. of variation	.1540804	T prob level	0.0000
Skewness	1.476357	Kurtosis	2.547503
Normality Test Value	1.967954	Reject if > 1.482(10%)	2.151(5%)
K.S. Normality Test	0.24289	Reject if > 0.252(10%)	0.275(5%)
{b1 1.22 Skew-Z	2.04 Pr 0.0415	b2 3.74 Kurt-Z	1.62 Pr 0.1048
D'Agostino-Pearson Omnibus K} Normality Test	6.8		Pr 0.0336
100-%tile (Maximum)	2.87	90-%tile	2.645
75-%tile	2.17	10-%tile	1.76
50-%tile (Median)	2.03	Range	1.11
25-%tile	2	75th-25th %tile	.1700001
0-%tile (Minimum)	1.76	C.L. Median(95%)	1.88, 2.42

1.76----------Line Plot / Box Plot----------2.87
1 1 111 1 1 1 1
----------[XmXXXXXXXaX]----------

----------Sum of Functions Regression----------

Date/Time 05-03-1992 08:23:49
Data Base Name C:\NCSS\CREW
Description Data base created at 07:48:02 on 05-03-1992

Estimation Summary Report

Y: CREW1 X: WET AREA
Model: A+B*(X)+C*(SQR(X))
Filter: CREW1

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	1.500658209569604	.2436676	6.2	0.0016	0.5434855
B	-3.198838553665343D-05	2.614986E-05	-1.2	0.2757	
C	9.172174012957018D-03	5.589843E-03	1.6	0.1617	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F
Model	2	.1543499	7.717495E-02	.2778038	3.0	0.1408
Error	5	.1296501	2.593002E-02	.161028		
Total	7	.284	4.057143E-02	.2014235		

Residual Analysis

Row	Actual X	Actual Y	Predicted Y	Lower95% Value	Upper95% Value	Residual
1	1703	1.66	1.824694	1.359004	2.290384	-.164694
2	.	.	.	.	.	.
3	1989	1.8	1.846096	1.387503	2.304689	-.461E-01
4	2643	2.03	1.887655	1.437904	2.337406	.1423445
5	1385	1.9	1.797702	1.320582	2.274822	.1022978
6	8899	2.12	2.081246	1.608878	2.553614	.3875E-01
7	10954	1.9	2.11023	1.632421	2.588038	-.2102297
8	15350	2.3	2.146024	1.666436	2.625612	.1539759
9	33712	2.09	2.106353	1.525632	2.687073	-.164E-01

----------Sum of Functions Regression----------

Date/Time 05-03-1992 08:32:04
Data Base Name C:\NCSS\CREW
Description Data base created at 07:48:02 on 05-03-1992

Estimation Summary Report

Y: CREW4 X: LEN+WING
Model: A+B*(X)+C*(LOG(X))
Filter: CREW4

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	-1.48042021491415	1.898606	-0.8	0.4708	0.5991441(
B	-2.832923203920881D-03	2.211458E-03	-1.3	0.2564	
C	.8146558480412586	.4565359	1.8	0.1344	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F
Model	2	.252689	.1263445	.3554497	3.7	0.1017
Error	5	.169061	.0338122	.1838809		
Total	7	.42175	.06025	.2454588		

Residual Analysis

Row	Actual X	Actual Y	Predicted Y	Lower95% Value	Upper95% Value	Residual
1	85	1.58	1.898013	1.358883	2.437143	-.3180131
2	.	.	.	.	.	.
3	101	2.04	1.993189	1.474824	2.511555	.0468105
4	107	2.18	2.023204	1.506564	2.539845	.1567957
5	80	2.02	1.86279	1.309979	2.4156	.1572104
6	231	2.21	2.298872	1.745391	2.852353	-.0888719
7	267	2.39	2.314874	1.769078	2.86067	.7513E-01
8	328	2.26	2.309693	1.776217	2.843169	-.0496934
9	471	2.22	2.199364	1.547251	2.851477	.2064E-01

----------Sum of Functions Regression----------

Date/Time 05-03-1992 08:52:24
Data Base Name C:\NCSS\CREW
Description Data base created at 07:48:02 on 05-03-1992

Estimation Summary Report

Y: CREW9 X: DRY WGT
Model: A+B*(SQR(X))
Filter: CREW9

Term	Coefficient Estimate	Std. Error	T-Value	Prob(|t|>T)	R-Squared
A	1.789334628455685	.1035151	17.3	0.0000	0.5768083
B	9.872173912348861D-04	3.452152E-04	2.9	0.0288	

Source	df	Sum-Sqr	Mean Square	SQR(M.S.)	F-Ratio	Prob(f>F
Model	1	.1574687	.1574687	.3968232	8.2	0.0288
Error	6	.1155313	1.925522E-02	.1387632		
Total	7	.273	.039	.1974842		

Residual Analysis

Row	Actual X	Actual Y	Predicted Y	Lower95% Value	Upper95% Value	Residual
1	17792	1.76	1.921016	1.544625	2.297407	-.1610163
2	.	.	.	.	.	.
3	29663	1.88	1.959363	1.591241	2.327484	-.794E-01
4	27425	2	1.952823	1.583483	2.322162	.4718E-01
5	14447	2.17	1.907994	1.528191	2.287797	.2620062
6	71990	2.02	2.054215	1.694324	2.414105	-.342E-01
7	97030	2.03	2.096849	1.734755	2.458944	-.668E-01
8	140882	2.12	2.159879	1.787946	2.531812	-.0398794
9	320083	2.42	2.347862	1.90699	2.788734	.7214E-01

APPENDIX P

Scheduled Maintenance Data

SCHEDULED MAINTENANCE DATA BASE
REGRESSION FUNCTION & ANOVA FOR % OF UNSCH

% OF UNSCH = 0.844224 + 0.002638 LGTH+WING
+ 3.379129E-05 WET AREA
- 0.005231 SQR DRY WT

R-Squared = 0.849869
Adjusted R-Squared = 0.830287
Standard error of estimate = 0.048856
Number of cases used = 27

Analysis of Variance

Source	SS	df	MS	F Value	Sig Prob
Regression	0.31077	3	0.10359	43.39986	0.000000
Residual	0.05490	23	0.00239		
Total	0.36567	26			

SCHEDULED MAINTENANCE DATA BASE
REGRESSION COEFFICIENTS FOR % OF UNSCH

Variable	Coefficient	Std Error	t Value	Two-Sided Sig Prob
Constant	0.84422	0.04774	17.68267	0.000000
LGTH+WING	0.00264	5.41478E-04	4.87191	0.000064
WET AREA	3.37913E-05	4.82356E-06	7.00547	0.000000
SQR DRY WT	-0.00523	5.44648E-04	-9.60423	0.000000

Standard error of estimate = 0.048856
Durbin-Watson statistic = 2.325117

SCHEDULED MAINTENANCE DATA BASE
STANDARDIZED RESIDUALS TABLE FOR % OF UNSCH

Case	Actual % OF UNSCH	Predicted % OF UNSCH	Residual	Std Dev	Std Residual
A-7D	0.4840	0.4277	0.0563	0.0462	1.2168
A-10A	0.4660	0.4696	-3.562E-03	0.0466	-7.641E-02
B-52G	0.2590	0.3066	-4.760E-02	0.0459	-1.037
B-52G-2	0.3300	0.3066	0.0234	0.0459	0.5097
FB-111A	0.1700	0.1901	-2.015E-02	0.0442	-0.456
F-106A	0.4880	0.3949	0.0931	0.0472	1.9708
F-111A	0.2360	0.2245	0.0115	0.0452	0.2536
F-111D	0.2520	0.2082	0.0438	0.0446	0.9826
F-111F	0.1810	0.2076	-2.661E-02	0.0446	-0.597
F-4E	0.2580	0.2777	-1.975E-02	0.0452	-0.437
F-5E	0.6320	0.5651	0.0669	0.0438	1.5287
F-15A	0.2790	0.3585	-7.955E-02	0.0468	-1.701
F-15C	0.3490	0.3485	5.1859E-04	0.0466	0.0111
F-16A	0.4720	0.4720	-1.384E-05	0.0458	-3.020E-04
C-130B	0.3840	0.3980	-1.400E-02	0.0464	-0.302
C-130B-2	0.4700	0.3980	0.0720	0.0464	1.5514
C-130E	0.3210	0.3495	-2.849E-02	0.0471	-0.605
C-130H	0.2880	0.3346	-4.662E-02	0.0471	-0.989
C-130H-2	0.4020	0.3346	0.0674	0.0471	1.4295
KC-135A	0.2960	0.2893	6.6864E-03	0.0465	0.1437
C-140A-2	0.3910	0.4718	-8.076E-02	0.0466	-1.733
C-141B	0.2510	0.2656	-1.460E-02	0.0455	-0.321
C-141B-2	0.3030	0.2656	0.0374	0.0455	0.8221
C-5A	0.2570	0.2651	-8.147E-03	0.0356	-0.229
C05A-2	0.2720	0.2652	6.8484E-03	0.0356	0.1926
C-9A	0.2730	0.3151	-4.212E-02	0.0461	-0.914
T-38A	0.5850	0.6389	-5.388E-02	0.0404	-1.333

Durbin-Watson statistic = 2.325117
PRESS statistic = 0.07127

----------Descriptive Statistics----------

Date/Time 03-23-1992 13:50:42
Data Base Name C:\NASA\MAINT
Description Merge of WUC51 and WUC11 created 02-21-1992

Detail Report

Variable: %UNSCH

Mean - Average	.3731923	No. observations	35
Lower 95% c.i.limit	.3193155	No. missing values	9
Upper 95% c.i.limit	.4270691	Sum of frequencies	26
Adj sum of squares	.444882	Sum of observations	9.703
Standard deviation	.133399	Std.error of mean	2.616169E-02
Variance	1.779528E-02	T-value for mean=0	14.26484
Coef. of variation	.3574537	T prob level	0.0000
Skewness	.5888664	Kurtosis	-.3560498
Normality Test Value	1.015485	Reject if > 1.169(10%)	1.265(5%)
K.S. Normality Test	0.12370	Reject if > 0.156(10%)	0.171(5%)
√b1 0.55 Skew-Z	1.33 Pr 0.1846	b2 2.49 Kurt-Z	-0.25 Pr 0.8000
D'Agostino-Pearson Omnibus K² Normality Test		1.8	Pr 0.4016
100-%tile (Maximum)	.665	90-%tile	.585
75-%tile	.472	10-%tile	.236
50-%tile (Median)	.3515	Range	.495
25-%tile	.272	75th-25th %tile	.2
0-%tile (Minimum)	.17	C.L. Median(95%)	.273, .466

```
.17----------Line Plot / Box Plot----------.665
1 1       1  12 21  11  1   11    11 1  1      1111  1           1       1    1
```

Distribution & Histogram

Variable: %UNSCH

Bin	Lower	Upper	Count	Prcnt	Total	Prcnt	Histogram
1	.17	.215	2	7.7	2	7.7	:**
2	.215	.26	4	15.4	6	23.1	:****
3	.26	.305	5	19.2	11	42.3	:*****
4	.305	.35	2	7.7	13	50.0	:**
5	.35	.395	3	11.5	16	61.5	:***
6	.395	.44	2	7.7	18	69.2	:**
7	.44	.485	3	11.5	21	80.8	:***
8	.485	.53	2	7.7	23	88.5	:**
9	.53	.5750001	0	0.0	23	88.5	:
10	.5750001	.62	1	3.8	24	92.3	:*
11	.62	.665	2	7.7	26	100.0	:**

APPENDIX Q

Learning Curve Data & Regression

----------Multiple Regression----------

Date/Time 01-08-1992 16:07:40
Data Base Name C:\NASA\learn
Description Data base created at 15:46:10 on 01-08-1992

Aircraft: F-16B

Multiple Regression Report

Dependent Variable: LOG MTBM

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simpl R-Sqr
Intercept	-1.826819	0.0000	.2906916	-6.28	0.0000		
LOG CUM	.1441237	0.7799	.2726E-01	5.29	0.0001	0.6082	0.608

Analysis of Variance Report

Dependent Variable: LOG MTBM

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	1.973916	1.973916		
Model	1	1.468497	1.468497	27.95	0.000
Error	18	.9458253	5.254585E-02		
Total	19	2.414322	.1270696		

Root Mean Square Error	.2292288
Mean of Dependent Variable	-.3141589
Coefficient of Variation	-.7296589
R Squared	0.6082
Adjusted R Squared	0.5865

Row	MTBM	FLY HRS	LOG MTBM	CUM	LOG CUM
1	.315	106	-1.155183	106	4.663439
2	.459	1387	-.7787051	1493	7.308543
3	.587	2984	-.5327305	4477	8.406709
4	.651	4735	-.4292457	9212	9.128263
5	.801	5428	-.2218943	14640	9.591513
6	.679	6133	-.3871342	20773	9.941409
7	.953	8907	-4.81E-02	29680	10.29823
8	.724	9831	-.3229639	39511	10.58433
9	.48	9369	-.7339692	48880	10.79712
10	.574	10044	-.5551259	58924	10.984
11	.63	12787	-.4620355	71711	11.1804
12	.687	15531	-.375421	87242	11.37644
13	.633	15775	-.4572849	103017	11.54265
14	.825	16248	-.1923719	119265	11.6891
15	.779	15975	-.2497442	135240	11.81481
16	.939	16424	-.0629398	151664	11.92942
17	1.172	17726	.1587117	169390	12.03996
18	1.112	16877	.1061602	186267	12.13494
19	1.41	16481	.3435897	202748	12.21972
20	1.076	12657	7.325E-02	215405	12.28028

----------Multiple Regression----------

Date/Time 01-08-1992 16:14:52
Data Base Name C:\NASA\learn
Description Data base created at 15:46:10 on 01-08-1992

Aircraft: B-1

Multiple Regression Report

Dependent Variable: LOG MTBM

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	-2.229546	0.0000	.2569398	-8.68	0.0003		
LOG CUM	.1271822	0.8949	.2836E-01	4.49	0.0065	0.8009	0.800

Analysis of Variance Report

Dependent Variable: LOG MTBM

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	8.427293	8.427293		
Model	1	.3213427	.3213427	20.12	0.006
Error	5	7.987001E-02	.015974		
Total	6	.4012127	6.686879E-02		

Root Mean Square Error	.1263883
Mean of Dependent Variable	-1.097223
Coefficient of Variation	-.1151892
R Squared	0.8009
Adjusted R Squared	0.7611

Row	MTBM	FLY HRS	LOG MTBM	CUM	LOG CUM
1	.236	367	-1.443923	367	5.905362
2	.266	1167	-1.324259	1534	7.335634
3	.288	2786	-1.244795	4320	8.371011
4	.396	6515	-.9263411	10835	9.290537
5	.339	8304	-1.081755	19139	9.859484
6	.238	11000	.	30139	10.31358
7	.498	12427	-.6971552	42566	10.65881
8	.382	11676	-.9623347	54242	10.90121

----------Multiple Regression----------

Date/Time 01-08-1992 16:25:06
Data Base Name C:\NASA\learn
Description Data base created at 15:46:10 on 01-08-1992 Aircraft: F-15A

Multiple Regression Report

Dependent Variable: LOG MTBM

Independent Variable	Parameter Estimate	Stndized Estimate	Standard Error	t-value (b=0)	Prob. Level	Seq. R-Sqr	Simple R-Sqr
Intercept	-2.517107	0.0000	.2322152	-10.84	0.0000		
LOG CUM	.1403061	0.8265	.1912E-01	7.34	0.0000	0.6830	0.6830

Analysis of Variance Report

Dependent Variable: LOG MTBM

Source	df	Sums of Squares (Sequential)	Mean Square	F-Ratio	Prob. Level
Constant	1	18.84179	18.84179		
Model	1	2.070925	2.070925	53.87	0.000
Error	25	.9610558	3.844223E-02		
Total	26	3.031981	.1166146		

Root Mean Square Error .1960669
Mean of Dependent Variable -.8353705
Coefficient of Variation -.2347065

R Squared 0.6830
Adjusted R Squared 0.6703

Row	MTBM	FLY HRS	LOG MTBM	CUM	LOG CUM
1	.23	422	-1.469676	422	6.045005
2	.186	1579	-1.682009	2001	7.601402
3	.242	3610	-1.418818	5611	8.632484
4	.343	8974	-1.070025	14585	9.587749
5	.217	8317	-1.527858	22902	10.03898
6	.484	20886	-.7256704	43788	10.68711
7	.43	26762	-.8439701	70550	11.16408
8	.521	36022	-.6520053	106572	11.57658
9	.491	40281	-.7113112	146853	11.89719
10	.482	48396	-.7298112	195249	12.18203
11	.499	45993	-.6951492	241242	12.39356
12	.5	40349	-.6931472	281591	12.54821
13	.483	42101	-.7277386	323692	12.68755
14	.449	40427	-.8007324	364119	12.80524
15	.424	39126	-.8580218	403245	12.9073
16	.475	41960	-.7444405	445205	13.00629
17	.423	42960	-.8603831	488165	13.09841
18	.38	41694	-.967584	529859	13.18037
19	.438	42925	-.8255364	572784	13.25826
20	.496	44157	-.7011793	616941	13.33253
21	.404	40778	-.9063404	657719	13.39653
22	.492	40198	-.7092766	697917	13.45586
23	.514	40089	-.665532	738006	13.51171
24	.687	45671	-.375421	783677	13.57175
25	.704	42284	-.3509769	825961	13.6243
26	.74	44214	-.3011051	870175	13.67645
27	1	38817	.	908992	13.72009
28	.582	37366	-.5412849	946358	13.76038
29	1.073	42941	.	989299	13.80475

SUMMARY OF REGRESSION ANALYSIS OF WUC FOR F15A

WUC	R-SQUARED	F-RATIO	PROB(f>F)	A	B
11	.4986	26.8	.0000	-1.91537	.207678
12	.2419	8.6	.0067	2.058404	6.85051D-2
13	.6682	54.4	.0000	-.126513	.198581
14	.0051	0.1	.7135	2.320406	1.35424D-2
23	.8615	168.0	.0000	-1.15716	.260454
24	.1733	5.7	.0247	2.083529	7.37557D-2
41	.3939	17.5	.0003	1.475740	.111258
42	.5006	27.1	.0000	1.628790	.132691
44	.0571	1.6	.2209	3.469018	-3.5174D-2
45	.5544	32.2	.0000	.7148762	.158111
46	.0484	1.3	.2604	2.035695	4.59528D-2
47	.2858	10.4	.0034	3.169316	.114194
49	.1241	3.7	.0660	3.582417	6.83186D-2
51	.7441	75.6	.0000	.4074346	.217907
52	.5637	33.6	.0000	.8766071	.246037
55	.8064	108.3	.0000	.4810699	.304793
57	.5747	35.1	.0000	1.836396	.186201
63	.6388	46.0	.0000	5.783D-2	.218141
65	.0588	1.6	.2139	2.294958	3.60766D-2
71	.7474	76.9	.0000	-.280821	.227016
74	.6896	57.8	.0000	-1.37103	.221936
75	.0001	0.0	.9573	2.010836	-2.5339
76	.0347	0.9	.3424	3.701741	-4.7932D-2
91	.0043	0.1	.7405	6.556656	-3.1327D-2
97	.0849	2.4	.1325	1.856478	.186038

SUMMARY OF REGRESSION ANALYSIS OF WUC FOR F16B

WUC	R-SQUARED	F-RATIO	PROB(f>F)	A	B
11	.1059	2.3	.15	1.06010	6.46444D-02
12	.36829	11.1	.0035	.895870	.165848
13	.32299	9.1	.0072	1.18406	9.746065D-2
14	.52673	21.1	.0002	.68128	.160767
23	.60731	29.4	.0000	.52739	.200457
24	.61054	29.8	.0000	.143243	.244629
41	.51493	20.2	.0003	1.096176	.205497
42	.142337	3.2	.0918	2.352841	6.748413D-2
44	.000168	0.0	.9555	3.301224	-3.30773D-2
45	.596262	28.1	.0000	1.905543	.182393
46	.383556	11.8	.0028	1.116509	.145248
47	.006646	0.1	.7254	4.080491	1.689806D-2
49	.003831	0.1	.7955	6.461357	-2.79783D-2
51	.006221	0.1	.7340	3.417607	1.448673D-2
55	.152934	3.2	.0882	7.750761	-.182029
62	.295669	7.6	.0132	7.048922	-.242943
63	.391082	12.2	.0024	2.140883	.1653402
64	.694946	41.0	.0000	1.189182	.3180727
65	.009315	0.2	.6773	4.475461	-2.87638D-2
71	.380828	11.7	.0029	2.109804	.133664
74	.733988	52.4	.0000	-1.15588	.280784
75	.705648	45.5	.0000	-.348929	.258164
76	.249363	6.3	.0212	2.196688	.101590
91	.167479	3.6	.0732	4.336979	.293534
93	.861299	31.0	.0026	4.379366	.424908
96	.012051	0.2	.6450	7.112811	6.728099D-2
97	.007545	0.1	.7081	4.651410	3.790276

SUMMARY OF REGRESSION ANALYSIS OF WUC FOR B1B

WUC	R-SQUARED	F-RATIO	PROB(f>F)	A	B
11	.3889	3.8	.0985	-.481398	.107564
12	.5187	6.5	.0439	1.339757	.218297
13	.0437	0.3	.6194	1.627507	3.24288D-2
14	.0128	0.1	.7895	1.856759	-1.8648D-2
16	.5717	8.0	.0300	-1.28814	.533732
19	.2123	1.3	.2981	2.964628	.159060
23	.2637	2.1	.1931	.514386	7.03474D-2
24	.7642	19.4	.0045	.702416	.259668
27	.0458	0.3	.6109	3.885255	-.07045
39	.1926	1.4	.2767	2.423009	.158599
41	.2466	2.0	.2106	1.040726	8.32289D-2
42	.3047	2.6	.1560	.986220	8.57397D-2
43	.1248	0.9	.3907	3.072291	.104326
44	.6880	13.2	.0109	.597645	.199826
45	.0114	0.1	.8012	1.887197	.016278
46	.1802	1.3	.2945	2.817722	-.09968
47	.4963	5.9	.0511	1.859626	.191071
48	.2795	2.3	.1780	2.679096	.142582
49	.6084	9.3	.0224	5.960521	-.20272
51	.5936	8.8	.0253	1.015608	.415428
52	.3803	3.7	.1035	4.465351	-.10694
55	.6044	9.2	.0232	1.255066	.177114
59	.2483	2.0	.2089	1.752438	8.51324
73	.6457	10.9	.0163	-.609565	.169980
75	.1214	0.8	.3977	1.739776	.082262
76	.2454	2.0	.2119	1.127913	7.49415
97	.3654	3.5	.1124	7.623481	-.22974

AVERAGE SLOPE FROM SUMMARY OF REGRESSION ANALYSIS OF WUC

PLANES USED:
F15A
F16B
B1B

WUCs	AVERAGE SLOPE	NUMBER OF VALUES AVERAGED
11 & 12	.153578	5
13	.148021	2
14	.160767	1
23	.230456	2
41 & 47	.155505	4
42 & 44	.133334	3
45	.170252	2
49 & 96	.068319	1
51 - 72*	.242701	8
91, 93, & 97	.359221	2

51 - 72 IS COMPOSED OF 51, 52, 61, 62, 63, 64, 69, 71, & 72

APPENDIX R

Technology Growth Data

TECHNOLOGY ADJUSTMENT FACTOR DATA

ATD MTBM CALCULATIONS

	10/85-3/86	4/86-9/86	10/86-3/87	4/87-9/87	10/85-9/87
FLT HOURS	4,200	40,164	36.027	40.533	120,924
MTBM/PERIOD					
WUC 11	7.678	8.535	12.936	12.384	10.7404
WUC 12	38.82	40.488	50.247	58.405	48.1541
WUC 13	11.867	13.774	16.302	16.181	15.1443
WUC 14	11.032	12.939	17.523	19.227	15.8115
WUC 23	17.962	19.098	27.355	24.791	22.8638
WUC 41	29.765	29.253	44.478	46.060	37.7405
WUC 42	43.019	58.293	73.375	78.705	67.4562
WUC 44	36	48.566	46.971	57.250	49.9961
WUC 45	34.721	44.936	46.188	54.774	47.7059
WUC 47	136.225	168.050	164.507	167.492	165.4609
WUC 49	195.429	218.283	259.187	311.792	254.8499
WUC 51	39.265	52.571	60.754	60.227	56.5869
WUC 52					
WUC 61					
WUC 62	83.824	89.452	133.929	142.722	114.9352
WUC 63	65.019	69.972	86.396	89.280	80.1036
WUC 64	156.381	193.096	251.937	258.172	226.1225
WUC 69	3,109.091	2,868.857	1,896.158	2,533.313	2.401.6267
WUC 71	51.429	60.671	65.743	75.061	66.0188
WUC 72	83.824	96.317	103.229	107.230	101.2675
WUC 91	152.679	161.952	232.432	268.43	207.9488
WUC 93					
WUC 96					
WUC 97	183.871	196.882	184.754	455.427	236.7149

GROUPED WUCs		
11 & 12	8.7817	
13	15.1443	
14	15.8115	
23	22.8638	
41 & 47	30.7310	
42 & 44	28.7142	
45	47.7059	
49	254.8499	
51 - 72 *	14.5524	WUCs 51, 62, 63, 64, 69, 71, & 72
91 & 97	110.7007	

A10A MTBM CALCULATIONS

	10/85-3/86	4/86-9/86	10/86-3/87	4/87-9/87	10/85-9/87
FLY HOURS	106,021	113,267	104,537	118,573	442,398
MTBM/PERIOD					
WUC 11	8.475	6.965	6.489	8.185	7.4517
WUC 12	24.882	20.122	20.275	27.467	22.8478
WUC 13	20.338	16.366	15.829	22.860	18.4911
WUC 14	18.594	15.501	14.709	20.802	17.1365
WUC 23	25.029	18.496	17.745	21.661	20.3636
WUC 41	29.167	22.994	22.124	30.639	25.7869
WUC 42	45.897	37.907	33.303	44.277	39.8021
WUC 44	65.083	60.441	51.931	78.681	62.9925
WUC 45	113.879	94.468	77.723	103.648	95.7781
WUC 47	58.285	47.792	43.179	75.332	54.0563
WUC 49	285.771	230.686	188.695	278.995	240.3030
WUC 51	28.960	23.876	24.054	30.521	26.5931
WUC 52	220.418	143.014	138.276	162.429	160.3472
WUC 61					
WUC 62	96.470	64.835	64.890	90.307	76.6722
WUC 63	91.793	69.660	70.112	101.344	81.2932
WUC 64	391.221	337.104	313.925	374.047	351.9473
WUC 69	2,255.766	845.276	1,005.163	513.303	857.3603
WUC 71	153.210	106.354	95.468	131.310	117.8159
WUC 72	9,638.273	3,146.306	3,167.788	4,088.724	4,058.6975
WUC 91	302.054	207.069	244.245	334.008	263.1751
WUC 93					
WUC 96	10,602.100	7,079.188	17,422.833	11,857.300	10,533.2860
WUC 97	199.663	203.718	234.915	296.433	228.9848

GROUPED WUCs		
11 & 12	5.6191	
13	18.4911	
14	17.1365	
23	20.3636	
41 & 47	17.4585	
42 & 44	24.3907	
45	95.7781	
49 & 96	234.9431	
51 - 72 *	12.2062	WUCs 51, 52, 62, 63, 64, 69, 71, & 72
91 & 97	122.4462	

F4E MTBM CALCULATIONS

	10/85-3/86	4/86-9/86	10/86-3/87	4/87-9/87	10/85-9/87
FLY HOURS	51,567	54,718	49,583	491,240	647,108
MTBM/PERIOD					
WUC 11	3.316	2.676	3.364	3.187	3.1585
WUC 12	6.962	5.859	6.021	6.208	6.2155
WUC 13	11.459	11.687	12.578	12.253	12.1601
WUC 14	10.338	8.457	10.102	10.083	9.9423
WUC 23	17.924	15.598	15.558	17.140	16.9256
WUC 41	33.792	25.653	31.968	27.306	27.8923
WUC 42	45.878	39.911	41.488	43.357	43.0824
WUC 44	25.290	26.434	25.585	28.200	27.5754
WUC 45	47.440	42.916	44.629	43.979	44.1927
WUC 47	59.069	57.841	51.703	62.499	60.8301
WUC 49	334.851	279.173	245.460	213.583	226.8965
WUC 51	18.563	16.847	17.086	17.863	17.7639
WUC 52	51.006	46.808	49.533	50.229	49.9273
WUC 61					
WUC 62					
WUC 63	23.145	16.032	18.412	21.257	20.5800
WUC 64					
WUC 69					
WUC 71	4.144	3.374	3.338	4.190	4.0254
WUC 72	62.963	46.371	58.817	74.094	68.3182
WUC 91	991.673	816.687	708.329	1,116.455	1,028.7890
WUC 93	170.188	144.757	156.413	156.446	156.3819
WUC 96	2,242.043	2,379.043		MTBM NOT CALCULATED	
WUC 97	537.156	353.019	378.496	261.298	286.0779

GROUPED WUCs		
11 & 12	2.0943	
13	12.1601	
14	9.9423	
23	16.9256	
41 & 47	19.1236	
42 & 44	16.8136	
45	44.1927	
49	226.8965	
51 - 72 *	2.5775	WUCs 51, 52, 63, 71, & 72
91, 93, & 97	92.0627	

F15A MTBM CALCULATIONS

	10/85-3/86	4/86-9/86	10/86-3/87	4/87-9/87	10/85-9/87
FLY HOURS	40,089	45,671	42,284	44,214	172,258
MTBM/PERIOD					
WUC 11	1.916	2.659	2.736	3.097	2.5395
WUC 12	12.575	20.262	22.697	22.263	18.5404
WUC 13	9.276	13.707	14.368	16.831	13.0265
WUC 14	9.802	14.048	14.170	14.832	12.9459
WUC 23	9.833	10.897	11.818	12.381	11.1731
WUC 41	15.934	20.226	23.768	26.224	20.9076
WUC 42	29.917	42.643	36.483	42.678	37.3985
WUC 44	15.162	20.128	19.459	22.196	18.9753
WUC 45	15.593	24.984	20.506	19.350	19.6957
WUC 47	99.476	135.926	120.467	113.369	116.3904
WUC 49	59.216	83.494	107.048	100.032	83.5801
WUC 51	25.024	31.849	27.245	33.344	29.1272
WUC 52	120.387	153.774	126.599	73.081	109.7883
WUC 61					
WUC 62					
WUC 63	20.633	28.349	25.094	28.055	25.2764
WUC 64					
WUC 69					
WUC 71	15.077	23.713	16.263	16.824	17.5541
WUC 72					
WUC 91	331.314	496.424	671.175	566.846	486.6045
WUC 93					
WUC 96					
WUC 97	41.934	84.420	127.746	56.180	65.8729

GROUPED WUCs		
11 & 12	2.2336	
13	13.0265	
14	12.9459	
23	11.1731	
41 & 47	17.7238	
42 & 44	12.5882	
45	19.6957	
49	83.5801	
51 - 71 *	7.1444	WUCs 51, 52, 63, 69, & 71
91 & 97	58.0187	

F16A MTBM CALCULATIONS

	10/85-3/86	4/86-9/86	10/86-3/87	4/87-9/87	10/85-9/87
FLY HOURS	83,341	85,027	89,041	92,693	350,102
MTBM/PERIOD					
WUC 11	6.882	8.350	9.250	8.655	8.3255
WUC 12	25.699	26.521	34.459	29.690	28.8032
WUC 13	12.757	11.210	13.489	12.348	12.4037
WUC 14	14.362	15.766	18.010	14.470	15.5285
WUC 23	21.309	25.008	23.432	19.315	22.0051
WUC 41	38.637	35.019	51.469	40.319	40.6432
WUC 42	22.124	22.943	30.619	28.166	25.6072
WUC 44	30.833	34.410	37.085	31.679	33.3399
WUC 45	75.014	74.324	79.359	74.333	75.7139
WUC 47	80.757	90.551	102.938	118.533	96.7670
WUC 49	641.085	488.661	706.675	626.304	605.7130
WUC 51	50.571	64.610	76.627	66.734	63.4818
WUC 52					
WUC 61					
WUC 62	85.742	78.511	88.422	73.449	80.9672
WUC 63	52.219	51.500	61.535	58.224	55.6955
WUC 64	324.284	397.322	418.033	397.824	381.7905
WUC 69					
WUC 71	150.707	140.773	170.250	146.203	151.2970
WUC 72					
WUC 91	2,604.406	5,001.588	1,141.551	648.203	1,296.6742
WUC 93	7,576.455	28,342.333	22,260.250	92,693.000	18,426.4217
WUC 96	11,905.857	5,314.188	8,094.636	7,724.417	7,610.9133
WUC 97	213.695	228.567	57.483	50.159	84.1798

GROUPED WUCs		
11 & 12	6.4587	
13	12.4037	
14	15.5285	
23	22.0051	
41 & 47	28.6218	
42 & 44	14.4832	
45	75.7139	
49 & 96	561.0610	
51 - 72 *	18.0875	WUCs 51, 62, 63, 64, & 71
91, 93, & 97	78.7103	

F4C MTBM CALCULATIONS

	10/85-3/86	4/86-9/86	10/86-3/87	4/87-9/87	10/85-9/87
FLY HOURS		18,421	12,577	9.944	40,942
MTBM/PERIOD					
WUC 11		5.4820	4.557	6.395	5.3343
WUC 12		5.6130	5.483	9.489	6.1812
WUC 13		11.6960	10.695	15.489	12.0668
WUC 14		9.7830	8.777	12.477	9.9545
WUC 23		17.0720	15.624	19.652	17.1305
WUC 41		25.6560	29.523	38.996	29.2650
WUC 42		33.4320	34.084	50.222	36.6208
WUC 44		29.6160	32.084	43.614	32.9646
WUC 45		33.0130	27.341	31.974	30.8066
WUC 47		46.2840	38.462	54.339	45.0905
WUC 49		224.6460	256.673	621.500	278.5166
WUC 51		21.7490	18.970	28.991	22.0952
WUC 52		51.4550	51.126	60.634	53.3097
WUC 61					
WUC 62					
WUC 63		39.959	34.177	44.995	38.9925
WUC 64					
WUC 69					
WUC 71		8.536	9.586	12.864	9.6492
WUC 72		139.553	151.530	284.114	163.7679
WUC 91		877.190	483.731	904.000	705.8966
WUC 93		214.198	196.516	320.774	226.1992
WUC 96		708.500			
WUC 97		103.489	228.673	261.684	151.0777

GROUPED WUCs		
11 & 12	2.8633	
13	12.0668	
14	9.9545	
23	17.1305	
41 & 47	17.7468	
42 & 44	17.3483	
45	30.8066	
49	278.5166	
51 - 72 *	5.0149	WUCs 51, 52, 63, 71, & 72
91, 93, & 97	80.2785	

B52G MTBM CALCULATIONS

	10/85-3/86	4/86-9/86	10/86-3/87	4/87-9/87	10/85-9/87
FLY HOURS	32,742	34,536	33,863	34,899	136,040
MTBM/PERIOD					
WUC 11	3.327	2.877	2.872	3.074	3.0238
WUC 12	14.137	16.260	15.392	19.795	16.1893
WUC 13	5.243	5.025	4.107	4.742	4.7364
WUC 14	7.174	7.322	6.636	7.231	7.0817
WUC 23	3.588	4.851	5.132	5.148	4.5925
WUC 41	23.969	25.357	28.266	30.939	26.9172
WUC 42	14.016	17.285	17.242	16.949	16.2783
WUC 44	19.606	21.504	17.555	22.046	20.0412
WUC 45	9.210	9.956	8.968	10.449	9.6210
WUC 47	55.307	56.990	50.542	68.699	57.2559
WUC 49	59.639	51.623	54.972	56.471	55.4810
WUC 51	7.920	8.619	8.517	8.846	8.4696
WUC 52	19.443	22.543	22.819	27.350	22.7644
WUC 61	134.741	124.679	132.277	139.040	132.4636
WUC 62					
WUC 63	39.401	36.088	30.729	35.575	35.1436
WUC 64	24.674	25.227	22.234	22.400	23.5485
WUC 69					
WUC 71	40.125	85.274	52.017	56.471	54.6346
WUC 72	83.739	101.279	109.235	116.719	101.4466
WUC 91	696.638	986.743	891.132	1,125.774	900.9271
WUC 93	84.170	100.104	103.874	192.812	109.6212
WUC 96					
WUC 97	85.712	54.994	159.731	51.933	71.8270

GROUPED WUCs		
11 & 12	2.5479	
13	4.7364	
14	7.0817	
23	4.5925	
41 & 47	18.3095	
42 & 44	8.9824	
45	9.6210	
49	55.4810	
51 - 72 *	3.7226	WUCs 51, 52, 61, 63, 64, 71, & 72
91, 93, & 97	41.3999	

B1B MTBM CALCULATIONS

	10/87-3/88	4/88-9/88	10/88-3/89	4/89-9/89	10/87-9/89
FLY HOURS	8,304	11,001	12,427	11,676	43,408
MTBM/PERIOD					
WUC 11	1.905	1.235	2.428	1.900	1.7696
WUC 12	23.794	21.571	69.425	51.893	34.3693
WUC 13	6.452	4.584	11.056	7.965	6.9156
WUC 14	5.607	3.459	7.610	5.894	5.2454
WUC 23	3.007	2.475	4.672	3.429	3.2708
WUC 41	6.101	4.094	8.312	6.876	5.9945
WUC 42	5.085	4.367	9.372	7.330	6.1388
WUC 44	12.194	8.893	19.883	17.479	13.5184
WUC 45	7.152	4.779	11.318	8.681	7.3498
WUC 47	35.038	22.871	68.280	69.089	40.6061
WUC 49	51.900	28.426	46.894	43.567	40.1923
WUC 51	159.692	60.445	225.945	353.818	134.8073
WUC 52	43.937	22.314	34.329	19.299	26.3237
WUC 61					
WUC 62					
WUC 63					
WUC 64					
WUC 69					
WUC 71					
WUC 72					
WUC 91					
WUC 93					
WUC 96					
WUC 97	296.571	139.253	203.721	93.408	148.1501

GROUPED WUCs	
11 & 12	1.6829
13	6.9156
14	5.2454
23	3.2708
41 & 47	5.2234
42 & 44	4.2217
45	7.3498
49	40.1923
51 & 52	22.0232
97	148.1501

Technology Growth Factors

WUCs	A7D-A10A	F4E-F15A	F4E-F16A	F4C-F16A	B52G-B1B	AVERAGE
11 & 12	-0.0837	0.0235	0.3299	0.1357	0.0038	0.08184
13	0.0668	0.0242	0.0131	0.0120	0.0515	0.03352
14	0.0321	0.0752	0.0974	0.0665	0.0098	0.05622
23	-0.0141	-0.0583	0.0636	0.0448	0.0198	0.01116
41 & 47	-0.1023	-0.0056	0.0868	0.0713	-0.0193	0.00617
42 & 44	-0.0304	-0.0440	-0.0120	-0.0081	-0.0099	-0.02090
45	0.2739	-0.1061	0.1218	0.1587	0.0129	0.09222
49 & 96	-0.0155	-0.1248	0.2217	0.1005	-0.0033	0.03571
51 - 72	-0.0271	0.3970	0.9779	0.2931	0.4549	0.41915
91 - 97	0.0527	-0.0593	0.0012	0.0217	0.4017	0.08358
51 - 72	-0.0271	0.3970	DELETED	0.2931	0.4549	0.22357

TECHNOLOGY ADJUSTMENT FACTOR
Overall Aircraft

Perform pairwise comparison between similar aircraft developed at different times (i.e. different technologies).

Determine the annual growth rate in reliability (FHBMA).

Average annual growth rate over several comparisons.

Model: Compound Growth Curve

$$\text{ADJ FHBMA} = \text{FHBMA} \times (1+\text{ADJ FAC})^{yr-86}$$

ACFT	FHBMA	DEV YR	DISCOUNTED FHBMA[2]	ADJ FAC[3]
A-7D	1.27	68	1.27	
A-10A	1.34	72	1.387	.0220
F-4E	.507	67	.507	
F-15A	.652	72	.680	.0604
F-4E	.507	67		
F-16A	1.110	74	1.182	.128
F-4C	.656	63		
F-16A	1.110	74	1.224	.058
B-52G	.406	58		
B-1	.338	85	.534	.0102
			AVERAGE =	.0557

Notes:

1. 86 represents the baseline year of the data
2. Discounted $FHBMA_2 = A \times (86-yr_1+yr_2)^B$

   where $B = .137$ and $A = FHBMA_2 / (86-YR_2)^B$

   (based upon reliability growth curve)
3. $ADJ\ FAC = (DISC\ FHBMA_2 / FHBMA_1)^{1/(yr2-yr1)} - 1$

   (by solving for the ADJ FAC in the compound growth curve)

APPENDIX S

R & M Model - BASIC Program Listing

```
10 'NASA, LANGLEY RESEARCH CENTER
20 'MTBM COMPUTATIONAL MODEL - NASA RESEARCH GRANT -
30 'DEVELOPED BY C. EBELING, UNIV OF DAYTON  2/10/92
35 '   ******** COMBINED PRE/CONCEPTUAL MODEL **********
40 '
50 'SAVE AS "MTB3.BAS"    Mean Time Between Maintenance - MODIFIED
60 '
70 DIM WBS$(25),X(100),NAM$(100),THRS(20),MHMA(20),MH(20),MP(20),OMH(20),FMH(20)
72 DIM GOH(20),LOH(20),TOH(20),OOH(20),ROH(20),R(20),TSKT(20)
73 DIM V(15),SNAM$(15),FMAT(20),FMAC(20),FMAS(20),S(20)
74 DIM MW(20),C(20),CM(20),OP$(20),TG(20),PWTS(20)
75 DIM FMA(20),PF(20),PA(25),Z(500),Y(500),RR(20),W(20),NR(20),FR(20)
76 RFLG=0  'REPEAT FLAG
80 '
85 GOSUB 1000 'OPENING BANNER
87 INPUT "DO YOU WISH TO INPUT FROM A FILE-(Y/N)";ANS$
88 IF ANS$="Y" OR ANS$="y" THEN GOSUB 1700:GOTO 100
90 GOSUB 500 'INITIALIZATION
95 GOSUB 12300  'OPTION TO DELETE SUBSYSTEMS
100 GOSUB 1050 'INPUT MODULE
102 IF RFLG=0 OR MODE=0 THEN GOSUB 1500 ELSE GOSUB 1400 'SUBSYS WGTS
103 IF RFLG=0 OR MODE=0 OR MODE=1 THEN GOSUB 11120 ELSE GOSUB 11000  'SECONDARY VARIABLES
104 GOSUB 1200  'ESTABLISH SUBSYSTEM MTBM CALIBRATION FACTORS
105 GOSUB 1600 'DETERMINE MISSION PROFILE
110 GOSUB 1300 'DETERMINE SUBSYSTEM HRS
111 GOSUB 12400 'ESTABLISH TECH GROWTH FACTORS
112 CLS:LOCATE 10,20:PRINT "COMPUTING MTBM'S ....."
113 P1=.202:P2=.014:P3=.784
114 'ADD=W(1)+W(2)+W(3):P1=W(1)/ADD:P2=W(2)/ADD:P3=W(3)/ADD
115 GOSUB 3000 'EVALUATE REGRESSION EQS;  DETERMINE UNADJUSTED MTBM & MH/MA
120 GOSUB 2500  'PERFORM TECHNOLOGY ADJUSTMENT
130 GOSUB 2000 'DETERMINE SPACE ADJUSTMENT
140 GOSUB 2700 'DETERMINE CRITICAL FAILURES-MTBM
145 GOSUB 2800 'DETERMINE CRIT FAIL RELIABILITY
150 GOSUB 9000 'DISPLAY RELIABILITY PARAMETERS
160 GOSUB 7000 'COMPUTE MANPOWER REQUIREMENTS
170 GOSUB 7500 'DISPLAY MAINTAINABILITY PARAMETERS
175 CLS:LOCATE 10,20:PRINT "COMPUTING SPARES ....."
180 GOSUB 8000 'COMPUTE SPARES REQUIREMENTS
190 GOSUB 8500 'DISPLAY SPARES REQUIREMENTS
200 GOSUB 9700  'DISPLAY VEHICLE TURN-TIME
310 'FMA12=2257.4-687.44*LOG(W(3))+70.118*LOG(W(3))^2-2.38*LOG(W(3))^3
400 CLS
405 LOCATE 10,20:INPUT "DO YOU WISH ANOTHER ANALYSIS-(Y/N)";ANS$
408 IF ANS$="Y" OR ANS$="y" THEN RFLG=1:GOTO 100
409 CLS
410 LOCATE 10,10:INPUT "DO YOU WISH TO SAVE FHBMA'S FOR RELIABILITY ANALYSIS - (Y/N)";ANS$
420 IF ANS$="Y" OR ANS$="y" THEN GOSUB 9500
430 CLS
435 LOCATE 10,10:INPUT "DO YOU WISH TO SAVE INPUT FOR LATER USE - (Y/N)";ANS$
440 IF ANS$="Y" OR ANS$="y" THEN GOSUB 9600
470 LOCATE 15,25:PRINT "HAVE A NICE DAY"
480 COLOR 3
490 END
500 ' INITIALIZATION MODULE
520 FOR I=1 TO 16
525 MW(I)=1
526 CM(I)=1
527 OP$(I)="COMPUTE"
```

```
530 READ WBS$(I)
540 NEXT I
580 FOR I=1 TO 14
590 READ NAM$(I)
600 NEXT I
610 FOR I=1 TO 12
620 READ SNAM$(I)
630 NEXT I
640 FOR I=1 TO 16:READ TG(I):NEXT I  'TECH GROWTH RATES
650 FOR I=1 TO 16:READ PWTS(I):NEXT I  'WGT DISTR PERCENTS
690 '              **** DEFAULT VALUES ******
700 X(1)=90001  'DRY WEIGHT - LBS
710 X(2)=100    'LENGTH + WING SPAN - FT
720 X(3)=2  'CREW SIZE
730 X(4)=8  'NBR PASSENGERS
750 X(5)=1994   'TECHNOLOGY YR
760 X(6)=.0557  'DEFAULT TECH GROWTH FACTOR
770 X(7)=.28  'WEIBULL SHAPE PARAMETER
780 X(8)=20     'LAUNCH FAILURE RATE FACTOR
790 X(9)=144    ' AVAIL HRS PER MONTH
800 X(10)=.15   'PERCENT INDIRECT WORK
810 X(11)=.95   'SPARES FILL RATE GOAL
815 X(12)=1.8   ' AVG CREW SIZE
816 X(13)=1  'PLANNED MSN PER MONTH
817 X(14)=1 'WGHT INDICATOR
820 T(0)=2:T(1)=.14:T(2)=1:T(3)=71:T(4)=72
830 'P1=.39:P2=.01:P3=.6    'PRORATION FACTORS FOR WUC11 (WBS 1,2,3)

900 'INITIALIZE SUBSYSTEM MSN PROFILES
910 FOR I=1 TO 16
920 GOH(I)=T(0):LOH(I)=T(1):TOH(I)=T(2)-T(1):OOH(I)=T(3)-T(2):ROH(I)=T(4)-T(3)
921 NEXT I
922 'FOR I=1 TO 3:OOH(I)=0:NEXT I
923 'GOH(5)=0:OOH(5)=0
924 'OOH(12)=0

999 '
1000 'INPUT MODULE
1010 KEY OFF:CLS:COLOR 11
1015 IF RFLG$="YES" THEN GOTO 1050
1020 LOCATE 6,15:PRINT "VEHICLE RELIABILITY/MAINTAINABILITY MODEL"
1030 PRINT:PRINT TAB(20) "NASA - LANGLEY RESEARCH CENTER"
1040 LOCATE 14,20:INPUT "ENTER VEHICLE NAME";VNAM$
1042 PRINT:PRINT TAB(20) "ANALYSIS MODE"
1043 PRINT:PRINT TAB(20) "PRECONCEPTUAL.....1"
1044 PRINT TAB(20) "SUBSYSTEM WEIGHT DRIVEN....2"
1045 PRINT TAB(20) "WEIGHT/VARIABLE DRIVEN.....3"
1046 PRINT:INPUT "ENTER CHOICE";MODE

1049 'PRIMARY MENU
1050 CLS:PRINT TAB(5) "INPUT MODULE - PRIMARY INDEP VARIABLES"
1060 PRINT TAB(1) "NBR";TAB(10) "VARIABLE";TAB(35) "CURRENT VALUE"
1065 PRINT:PRINT TAB(5) "VEHICLE DRIVER VARIABLES":PRINT
1070 FOR I=1 TO 14
1075 IF I=5 THEN PRINT:PRINT TAB(5) "SYSTEM PARAMETER VALUES":PRINT
1080 PRINT TAB(1) I;TAB(7) NAM$(I);TAB(35) X(I)
1090 NEXT I
1100 PRINT:INPUT "ENTER NBR OF VARIABLE TO BE CHANGED - 0 IF NONE";NBR
1110 IF NBR=0 THEN GOTO 1135
1120 INPUT "ENTER NEW VALUE";X(NBR)
1130 GOTO 1050
1135 YR=X(5):B=X(7):LF=X(8):X1=X(1):X2=X(2)
```

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1137 '
1200 'MODULE TO INPUT MOD FACTOR
1205 CLS:PRINT TAB(20) "SUBSYSTEM MTBM CALIBRATION FACTOR"
1206 PRINT TAB(20) "SPACE VEH-MTBM = CAL FAC x ACFT-MTBM"
1210 PRINT TAB(3) "NBR  SUBSYSTEM";TAB(45) "CAL FACTOR"
1220 PRINT
1230 FOR I=1 TO 16
1235 IF OP$(I)="DELETE" THEN GOTO 1250
1240 PRINT TAB(3) I;TAB(10) WBS$(I) TAB(45) MW(I)
1250 NEXT I
1260 PRINT:INPUT "ENTER NBR OF SUBSYSTEM TO BE CHANGED - 0 IF NONE";NBR
1265 IF NBR>16 THEN GOTO 1205
1270 IF NBR=0 THEN GOTO 1295
1280 INPUT "ENTER NEW FACTOR";MW(NBR)
1290 GOTO 1205
1295 GOSUB 12200  'ESTABLISH CAL FACTOR FOR MAINT

1300 'DISPLAY SUBSYSTEM OPERATING TIMES
1301 CLS:PRINT:PRINT TAB(5) "SUBSYSTEM OPERATING TIMES"
1305 PRINT TAB(1) "TOTAL MISSION TIME";TAB(20) T(4);" HRS";TAB(30) "MAX GROUND TIME";TAB(50) T(0);" HRS"
1306 PRINT TAB(1) "NBR  SUBSYSTEM";TAB(30) "GROUND";TAB(38) "BOOSTER";TAB(46) "REM TIME";TAB(55)
"ORBIT";TAB(65) "RECOVERY"
1310 PRINT TAB(31) "TIME";TAB(40) "TIME";TAB(46) "TO-ORBIT";TAB(56) "TIME";TAB(65) "TIME"
1320 PRINT
1330 FOR I=1 TO 16
1335 IF OP$(I)="DELETE" THEN GOTO 1350
1340 PRINT TAB(1) I;TAB(7) WBS$(I) TAB(35) GOH(I);TAB(42) LOH(I);TAB(50) TOH(I);TAB(58) OOH(I);TAB(65) ROH(I)
1350 NEXT I
1360 PRINT:INPUT "ENTER NBR OF SUBSYSTEM TO BE CHANGED - 0 IF NONE";NBR
1365 IF NBR>16 THEN GOTO 1301
1370 IF NBR=0 THEN GOTO 1395
1380 INPUT "ENTER NEW VALUES SEPARATED BY COMMAS";GOH(NBR),LOH(NBR),TOH(NBR),OOH(NBR),ROH(NBR)
1390 GOTO 1300

1400 'WEIGHT MENU MODULE
1402 IF MODE=1 THEN RETURN
1405 CLS:PRINT TAB(20) "SUBSYSTEM WEIGHTS"
1410 PRINT TAB(3) "NBR  SUBSYSTEM";TAB(45) "WEIGHT IN LBS"
1420 PRINT
1430 FOR I=1 TO 16
1435 IF OP$(I)="DELETE" THEN GOTO 1450
1440 PRINT TAB(3) I;TAB(10) WBS$(I) TAB(45) W(I)
1450 NEXT I
1455 PRINT:PRINT TAB(3) "TOTAL WGT";TAB(45) ADD:PRINT
1460 PRINT:INPUT "ENTER NBR OF SUBSYSTEM TO BE CHANGED - 0 IF NONE";NBR
1465 IF NBR>16 THEN GOTO 1405
1470 IF NBR=0 THEN GOTO 1495
1480 INPUT "ENTER NEW WEIGHT";W(NBR)
1484 ADD=0
1485 FOR I=1 TO 16:ADD=ADD+W(I):NEXT I
1486 X1=ADD:X(1)=ADD
1490 GOTO 1405

1500 ' MODULE TO COMPUTE SUBSYSTEM WEIGHTS
1505 IF X(14)=0 THEN GOTO 1567
1510 W(1)=-4485026.7#+1351022.5#*LOG(X1)-135432!*(LOG(X1))^2+4522.4*(LOG(X1))^3
1511 IF W(1)<=0 THEN W(1)=795
1515 W(2)=-290909.9+91929.4*LOG(X1)-9709.901*(LOG(X1))^2+343.5*(LOG(X1))^3
1516 IF W(2)<=0 THEN W(2)=302
1520 W(3)=39713145.2#+1417950.4#*LOG(X1)-40472209#/SQR(LOG(X1))-12993808.8#*SQR(LOG(X1))
1523 IF W(3)<=0 THEN W(3)=2140
1525 W(5)=-49535!+.282563*X1+6873.7*LOG(X1)-160.1*SQR(X1)
```

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1526 IF W(5)<=0 THEN W(5)=527
1530 W(12)=-9849.5+.0459666*X1+1364.8*LOG(X1)-26.248*SQR(X1)
1531 IF W(12)<=0 THEN W(12)=100
1535 W(9)=-910.4+100.22*LOG(X1)+1.3835*SQR(X1)
1536 IF W(9)<=0 THEN W(9)=157
1540 W(14)=-719.15+5.56265*X2+56.882*SQR(X2)
1541 IF W(14)<=0 THEN W(14)=63
1545 W(10)=-757.97+11.222*SQR(X1)
1546 IF W(10)<=0 THEN W(10)=310
1550 W(11)=575.27+.022216*X1-5.0608*SQR(X1)
1551 IF W(11)<=0 THEN W(11)=147
1555 W(15)=66255.6-14720.4*LOG(X1)+818.19*(LOG(X1))^2
1556 IF W(15)<=0 THEN W(15)=284
1560 W(13)=-10901.5+1261.52*LOG(X1)
1561 IF W(13)<=0 THEN W(13)=303
1563 W(4)=.11*X1:W(6)=.01*X1:W(7)=.04*X1:W(8)=.02*X1:W(16)=.1*X1
1564 WENG=-7141.92+89.1053*SQR(X1)
1565 'W(6)=WENG
1567 FOR I=1 TO 16
1568 IF OP$(I)="DELETE" THEN W(I)=1
1569 NEXT I
1570 'WEIGHT RECONCILIATION
1572 ADD=0
1575 FOR I=1 TO 16:ADD=ADD+W(I):NEXT I
1580 PCT=X1/ADD
1586 TX1=X1
1587 SM1=0
1588 FOR I=1 TO 16
1589 IF OP$(I)="DELETE" THEN GOTO 1592
1590 IF X(14)=1 THEN W(I)=PCT*W(I) ELSE W(I)=PWTS(I)*TX1
1591 SM1=SM1+W(I)
1592 NEXT I
1593 DIF=X1-SM1
1594 IF DIF>1 AND X(14)=0 THEN TX1=TX1+DIF:GOTO 1587
1595 ADD=SM1
1596 GOSUB 1400

1599 '
1600 'MODULE TO ESTABLISH MISSION PROFILE
1615 CLS:COLOR 10:KEY OFF
1630 NBR=0
1635 LOCATE 3,25:PRINT "MISSION PROFILE"
1640 LOCATE 7,10:PRINT "NBR";TAB(50) "TIME IN HOURS"
1645 LOCATE 9,10:PRINT "1" ;TAB(25) "GROUND TIME PRIOR TO LAUNCH";TAB(55) T(0)
1650 LOCATE 11,5:PRINT "LAUNCH TIME AT T=0"
1655 LOCATE 13,10:PRINT "2" ;TAB(25) "BOOSTER COMPLETION TIME";TAB(55) T(1)
1660 LOCATE 14,10:PRINT "3" ;TAB(25) "ORBIT INSERTION TIME";TAB(55) T(2)
1665 LOCATE 15,10: PRINT "4" ;TAB(25) "ORBIT COMPLETION TIME";TAB(55) T(3)
1670 LOCATE 16,10:PRINT "5" ;TAB(25) "GROUND RECOVERY TIME";TAB(55) T(4)
1675 PRINT:PRINT
1680 INPUT "ENTER NUMBER TO BE CHANGED OR 0 IF NONE";NBR
1685 IF NBR>16 THEN GOTO 1615
1690 IF NBR>0 THEN NBR=NBR-1:INPUT "ENTER NEW TIME";T(NBR):GOTO 1615
1694 IF RFLG=0 THEN GOSUB 900

1699 '
1700 'MODULE TO READ FROM A FILE
1705 INPUT "ENTER FILE NAME";DNAM$
1707 LOCATE 5,10:PRINT "INPUT DATA WILL BE READ FROM AN FILE"
1708 PRINT
1710 OPEN DNAM$ FOR INPUT AS #3
1720 FOR I=1 TO 16
```

```
1725 INPUT #3,WBS$(I),W(I),MW(I),CM(I)
1730 INPUT #3,GOH(I),LOH(I),TOH(I),OOH(I),ROH(I)
1731 INPUT #3,OP$(I)
1735 NEXT I
1740 FOR I=1 TO 13
1745 INPUT #3,NAM$(I),X(I),SNAM$(I),V(I)
1750 NEXT I
1755 FOR I=0 TO 4
1760 INPUT #3,T(I)
1765 NEXT I
1770 CLOSE #3
1780 LOCATE 15,10:PRINT "DATA SUCCESSFULLY READ"
1785 RFLG=1

1999 '
2000 'MODULE TO DETERMINE SPACE ADJ MTBM
2010 YZ=0:YX=1
2020 FOR J=1 TO 16
2030 T0=GOH(J):T1=T0+LOH(J):T2=T1+TOH(J)
2040 T3=T2+OOH(J):T4=T3+ROH(J)
2050 IF OP$(J)="DELETE" THEN GOTO 2100
2060 L1=1/FMAT(J):L2=LF*L1
2070 GOSUB 2200
2080 FMAS(J)=MEAN
2090 YZ=YZ+1/MEAN
2095 YX=YX*RT4
2100 NEXT J
2110 SVFMA=1/YZ:VR=YX

2200 'MODULE TO COMPUTE SPACE ADJUSTED MTBM
2210 A=(B*T(2)^(B-1)/L1)^(1/B)
2220 A1=(1-EXP(-L1*T0))/L1
2230 A2=EXP(-L1*T0)*(1-EXP(-L2*(T1-T0)))/L2
2240 A3=EXP(-L2*(T1-T0))*(EXP(-L2*T0)/L2-EXP(-L2*(T2+T0-T1)))/L2)
2255 GOSUB 2320 'FIND A4 USING SIMPSON'S RULE
2260 A4=EXP(-L1*(T2+T0-T1)-L2*(T1-T0)+(T2/A)^B)*AREA
2270 A5=EXP(-L1*(T2+T0-T1)-L2*(T1-T0)-(T3/A)^B+(T2/A)^B)*(1-EXP(-L1*(T4-T3)))/L1
2280 MEAN=A1+A2+A3+A4+A5
2290 RT4=EXP(-L1*(T2+T0-T1)-L2*(T1-T0)-(T3/A)^B+(T2/A)^B-L1*(T4-T3))
2300 MEAN=MEAN/(1-RT4)

2320 N=INT((T3-T2)/.5)
2330 IF N=0 THEN AREA=0

2340 DX=(T3-T2)/N
2350 FX=4
2360 Z(0)=T2:Y(0)=EXP(-(Z(0)/A)^B):SUM=Y(0)
2370 FOR I=1 TO N
2380 Z(I)=Z(I-1)+DX
2390 Y(I)=EXP(-(Z(I)/A)^B)
2400 IF I=N THEN FX=1
2410 SUM=SUM+FX*Y(I)
2420 IF FX=4 THEN FX=2 ELSE FX=4
2430 NEXT I
2440 AREA=DX*SUM/3

2500 'TECHNOLOGY ADJUSTMENT MODULE
2510 Y=0
2520 FOR I=1 TO 16
2530 IF OP$(I)="DELETE" THEN GOTO 2560
2540 FMAT(I)=FMA(I)*(1+TG(I))^(YR-1986)
2550 Y=Y+1/FMAT(I)
```

```
2560 NEXT I
2570 TVFMA=1/Y

2700 'DETERMINE CRITICAL FMA
2710 YY=0
2720 FOR I=1 TO 16
2730 IF OP$(I)="DELETE" THEN GOTO 2760
2740 FMAC(I)=FMAS(I)/PA(I)
2750 YY=YY+1/FMAC(I)
2760 NEXT I
2770 CVFMA=1/YY

2800 'MODULE TO DETERMINE RELIABILITIES - CRITICAL FAILURES ONLY
2810 VR=1
2820 FOR J=1 TO 16
2830 T0=GOH(J):T1=T0+LOH(J):T2=T1+TOH(J)
2840 T3=T2+OOH(J):T4=T3+ROH(J)
2850 IF OP$(J)="DELETE" THEN R(J)=1:GOTO 2900
2860 L1=1/FMAC(J):L2=LF*L1
2870 A=(B*T(2)^(B-1)/L1)^(1/B)
2880 R(J)=EXP(-L1*(T2+T0-T1)-L2*(T1-T0)-(T3/A)^B+(T2/A)^B-L1*(T4-T3))
2890 VR=VR*R(J)
2900 NEXT J

3000 'MTBM CALCULATIONS BY WUC
3005 PROR=W(4)/(W(1)+W(2)+W(3)+W(4)):PP=1-PROR
3010 'WBS 1,2 & 3  AIRFRAME      ***********
3020 FMA11=15.231+.006057*W(2)-.137575*SQR(W(1)+W(2)+W(3)+W(4))-.000723*V(3)
3022 IF FMA11<1.4 THEN FMA11=1.4
3025 FMA(1)=FMA11/(PP*P1):FMA(2)=FMA11/(PP*P2)
3030 MH11=16.5732-.3511567*W(3)/V(2)-.74556*LOG(X1)
3031 IF MH11<3.9 THEN MH=3.9
3032 MHMA(1)=MH11:MHMA(2)=MH11
3040 AB11=.031213+1.956E-07*X1-1.5456E-04*SQR(X1)
3041 IF AB11<=0 THEN AB11=.00128
3042 IF AB11>.02065 THEN AB11=.02065
3045 PA(1)=AB11:PA(2)=AB11
3050 PF(1)=.0835:PF(2)=.0835:PF(3)=(.0835+.088)/2
3054 R11=.1934-6.309E-07*W(3)
3055 R12=.20268+.000588*V(12)
3060 RR(1)=R11:RR(2)=R11:RR(3)=(R11+R12)/2
3100 'WUC12  AIRCREW COMPARTMENT      *************
3                                    1                                   1                                   0
FMA12=3428.49-.0142*X1-423.96*LOG(X1)+11.05*SQR(X1)+111.567*X(3)-360.72*SQR(X(3))+.01865*W(3)-4.83566*SQR(W(3))-.25
785*(X(3)+X(4))
3112 IF FMA12<5.6 THEN FMA12=5.6  ' 25TH PERCENTILE RANGE
3115 TP=P3*PP/FMA11+1/FMA12:FMA(3)=1/TP   'CHECK LINE 3715 FOR FMA(3)
3120 MH12=7.0855-1.6667/SQR(X(3)+X(4))+.098778*(X(2)+X(4))
3121 IF MH12<3.2 THEN MH12=3.2
3123 MHMA(3)=((1/FMA11)*MH11+(1/FMA12)*MH12)/(1/FMA11+1/FMA12)
3130 AB12=.04232+3.8775E-07*X1-2.51883E-04*SQR(X1)
3131 IF AB12>.02 THEN AB12=.02
3135 PA(3)=(AB11/FMA11+AB12/FMA12)/(1/FMA11+1/FMA12)
3200 'WUC13/WBS5  LANDING GEAR SYSTEMS      ***************
3210 SMA13=22.2723-.00313*V(3)+.19511*X2-5.47476*SQR(V(4))+.003161*W(5)-.5171441*SQR(W(5))
3211 'FMA(5)=SMA13*(GOH(5)+LOH(5)+TOH(5)+OOH(5)+ROH(5))
3212 'IF SMA12<.4 THEN SMA12=.4
3213 FMA(5)=72.4+14.568*V(4)+.0994*X2-12.41*LOG(X1)-65.6*SQR(V(4))-.00568*W(5)+18.598*LOG(W(5))
3214 IF FMA(5)<1.4 THEN FMA(5)=1.4
3215 'FMA(5)=SMA13*(GOH(5)+LOH(5)+TOH(5)+OOH(5)+ROH(5))
3220 MHMA(5)=-156.95+55.984*LOG(W(5))-6.095*(LOG(W(5)))^2+.212817*(LOG(W(5)))^3
3221 IF MHMA(5)<1.9 THEN MHMA(5)=1.9
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3230 AB13=-2.4321+.0059112*X2+1.1457*LOG(X2)-.33925*SQR(X2)
3231 IF AB13<0 THEN PA(5)=.00185 ELSE PA(5)=AB13
3232 IF PA(5)>.08 THEN PA(5)=.08
3250 PF(5)=.02774-4.07E-06*X1-.00194*X2+.19316*SQR(V(4))+.007156*SQR(W(13))
3251 IF PF(5)<.134 THEN PF(5)=.134
3252 IF PF(5)>.54 THEN PF(5)=.54
3260 RR(5)=.8639-.02963*X2
3261 IF RR(5)<.22 THEN RR(5)=.22
3300 'WUC14  WBS 12 FLIGHT CONTROLS          **************
3310 FMA(12)=26.29-1.1136*SQR(W(12))+.9516*V(5)-1.9*V(6)+.3505*X2-.00357*V(3)
3312 IF FMA(12)<2.8 THEN FMA(12)=2.8
3320 MHMA(12)=26.238-1.1067*V(5)-1.6658*V(6)-.00328*V(3)+.0006018*X2-6.2827*LOG(W(12))+14.289*SQR(V(5))
3321 IF MHMA(12)<2.1 THEN MHMA(12)=2.1
3330 AB14=.711953-.1881388*LOG(X2)+.0209882*SQR(X2)
3331 IF AB14<0 THEN PA(12)=6.000001E-04 ELSE PA(12)=AB14
3332 IF PA(12)>.08128 THEN PA(12)=.08128
3350 PF(12)=5.51246+.002663*V(5)-.000566*W(12)-1.193*LOG(W(12))+.10556*SQR(W(12))
3351 IF PF(12)<.04 THEN PF(12)=.04
3352 IF PF(12)>.29 THEN PF(12)=.29
3360 RR(12)=.4527-.0006677*X2
3361 IF RR(12)<0 THEN RR(12)=.07
3400 'WUC24    APU                  ***************
3410 FMA(9)=4996.525-1.906*V(7)+46.35*SQR(V(7))-2.735*W(9)+284.549*SQR(W(9))-1642.99*LOG(W(9))
3411 IF FMA(9)<14.5 THEN FMA(9)=14.5
3420 MHMA(9)=-451.4+.09054*V(7)-2.9654*SQR(V(7))+.2657*W(9)-26.1*SQR(W(9))+150.5*LOG(W(9))
3421 IF MHMA(9)<5.2 THEN MHMA(9)=5.2
3440 PA(9)=.064
3                                   4                                   5                                   0
PF(9)=-109.83-.1645*LOG(X1)+.1427*V(7)-6.1517*SQR(V(7))+15.751*LOG(V(7))+.066*W(9)-5.6832*SQR(W(9))+29.071*LOG(W(9))
3451 IF PF(9)<.03 THEN PF(9)=.03
3452 IF PF(9)>.29 THEN PF(9)=.29
3460 RR(9)=.579-.0007512*SQR(X1)
3461 IF RR(9)<0 THEN RR(9)=.01
3500 'WUC41/47 WBS14   ENVIRONMENTAL CONTROL  **************
3510 'FMA(14)=34.08071-.42487*W(14)^2
3511 FH41=454.387-.000547*X1+.821*X2-107.5185*LOG(X2)
3512 FH47=6613.12-1.485*X2-1358.3*LOG(X1)+73.58*(LOG(X1))^2-.725852*X1/X2
3513 Z=1/FH41+1/FH47:FMA(14)=1/Z
3515 IF FMA(14)<7.68 THEN FMA(14)=7.68
3520 MH41=.6886774*LOG(X1)
3521 MH47=5.7432+.018525*LOG(X1)-3.36575E-03*SQR(X1)
3522 MHMA(14)=(MH41/FH41+MH47/FH47)/(1/FH41+1/FH47)
3523 IF MHMA(14)<1! THEN MHMA(14)=1!
3530 PA(14)=.082199+5.0072E-07*X1-4.0612E-04*SQR(X1)
3531 IF PA(14)<0 THEN PA(14)=.00152
3532 IF PA(14)>.05222 THEN PA(14)=.05222
3550 PF47=23.852-.00902*X2-5.247*LOG(X1)+.301*LOG(X1)^2-.00212*X1/X2
3551 IF PF47<.02 THEN PF47=.02
3552 IF PF47>.33 THEN PF47=.33
3553 PF(14)=(.0932/FH41+PF47/FH47)/(1/FH41+1/FH47)
3555 R41=.5294-8.914E-05*W(14)
3556 IF R41<0 THEN R41=.168
3557 R47=.6026-.0006758*SQR(X1)
3560 RR(14)=(R41/FH41+R47/FH47)/(1/FH41+1/FH47)
3600 'WUC 42/44   WBS 10  *** ELECTRICAL SYS ******
3                                   6                                   1                                   0
FMA(10)=1193.13-.0755*W(10)+6.758773*SQR(W(10))-.715596*X2-167.24*LOG(X1)+2.2308*SQR(X1)+29.10236*LOG(V(7))-.00127*
V(7)^2
3611 FH44=1
3613 FH42=1
3614 IF FMA(10)<5.15 THEN FMA(10)=5.15
3620 'MHMA(10)=-18392.3+1694.6*LOG(X1)-92.8412*(LOG(X1))^2+27629/SQR(LOG(X1))+2*LOG(X1)^3
```

```
3621 MH42=-95.161+20.3158*LOG(X1)-.98356*(LOG(X1))^2
3622 MH44=2300.04+474.11*LOG(X1)-452.295*LOG(X2)-.146285*X1/X2-2769.85*SQR(LOG(X1))+1788.4*SQR(LOG(X2))
3623 MHMA(10)=(MH42+MH44)/2
3624 IF MHMA(10)<1! THEN MHMA(10)=4.1
3630 PA(10)=-39.95984+11.09214*LOG(X1)-1.0178226#*LOG(X1)^2+.0309075*LOG(X1)^3
3631 IF PA(10)<=0 THEN PA(10)=.00248
3632 IF PA(10)>.142 THEN PA(10)=.142
3650 PF42=-26.565-.00271*V(7)+.005143*W(10)-.74878*SQR(W(10))+6.621*LOG(W(10))
3651 IF PF42<.054 THEN PF42=.054
3652 IF PF42>.53 THEN PF42=.53
3653 PF44=3.061+1.178E-05*X1-.000127*V(3)-.42392*LOG(X1)+.13468*SQR(X2)
3654 IF PF44<.03 THEN PF44=.03
3655 IF PF44>.47 THEN PF44 =.47
3656 PF(10)=(PF42/FH42+PF44/FH44)/(1/FH42+1/FH44)
3660 RR42=-.38533-.001*X2+.17715*LOG(X2)
3661 IF RR42<.23 THEN RR42=.23:IF RR42>.539 THEN RR42=.539
3662 RR44=2.3651+.00201*X2-.41152*LOG(X2)
3663 IF RR44<.53 THEN RR44=.53:IF RR44>.872 THEN RR44=.872
3665 RR(10)=(RR42/FH42+RR44/FH44)/(1/FH42+1/FH44)
3700 '****WBS 4   THERMAL PROTECTION SYSTEM *********
3710 FMA(4)=FMA11/PROR
3720 MHMA(4)=MH11
3730 PA(4)=AB11:PF(4)=.0835:RR(4)=.194
3800 'WUC45 WBS11  HYDRAULICS SYS     ******************
3810FMA(11)=396.258-.00622*V(3)+35.635*V(8)-779.83*SQR(V(8))+975.56*LOG(V(8))+8.812899*SQR(W(11))-105.728*LOG(W(11))
3812 IF FMA(11)<4.7 THEN FMA(11)=4.7
3820 MH45=2.41235*LOG(X1)-.16306*LOG(X1)^2
3821 MHMA(11)=MH45
3822 IF MHMA(11)<2.4 THEN MHMA(11)=2.4
3830 PA(11)=5000.2535#-7578.183/SQR(LOG(X1))-453.612*LOG(X1)+24.6005*LOG(X1)^2-.5276227*LOG(X1)^3
3831 IF PA(11)<=0 THEN PA(11)=.00084
3832 IF PA(11)>.1304 THEN PA(11)=.1304
3850 PF(11)=.07614-.00181*X2+.001543*SQR(X1)
3851 IF PF(11)<.014 THEN PF(11)=.014
3852 IF PF(11)>.33 THEN PF(11)=.33
3860 RR(11)=.368
3900 ' WBS 13   AVIONICS ******************
3910 FMA(13)=-36.917-4.5*V(10)+45.756*SQR(V(10))-.123088*W(13)/V(10)+.0236*W(13)-2.4534*SQR(W(13))
3912 IF FMA(13)<1.5 THEN FMA(13)=1.5
3920 MHMA(13)=131.395+1.0394*V(11)-9.035*SQR(V(10))-.0154*W(13)+2.864*SQR(W(13))-26.193*LOG(W(13))
3921 IF MHMA(13)<4.6 THEN MHMA(13)=4.6
3930 PA(13)=.0502749+2.605132E-07*X1-2.288197E-04*SQR(X1)
3931 IF PA(13)<0 THEN PA(13)=.00152
3932 IF PA(13)>.02376 THEN PA(13)=.02376
3950 PF(13)=7.1662+.0209*V(11)-.00128*W(13)+.1774*SQR(W(13))-1.734*LOG(W(13))+.0067*W(13)/V(10)
3951 IF PF(13)<.193 THEN PF(13)=.193
3952 IF PF(13)>.532 THEN PF(13)=.532
3960 RR(13)=.39735-4.2659E-07*X1+2.1635E-04*SQR(X1)
3961 IF RR(13)<0 THEN RR(13)=.235
3962 IF RR(13)>.726 THEN RR(13)=.726
4000 'WUC49   MISC UTILITIES     ************************
4010 ' WUC49/96  WBS15   PERSONNEL PROVISIONS ****************
4                    0                    2                    0
FMA(15)=17952.8+.00579*X1+170*X(3)-10.136*X2+21.15*(X(3)+X(4))-461.34*SQR(X(3)+X(4))-1.893*W(15)+421.8*SQR(W(15))-4
054*LOG(W(15))
4021 'FH49=58226.97+.0168*X1-42.358*X2-27480.6*LOG(X2)+79.598*LOG(X1)^2+3131.24*LOG(X2)^2-8.6965*X1/X2
4023 IF FMA(15)<46.7 THEN FMA(15)=46.7
4030 MHMA(15)=9.51317+.03508*X2-.000721*W(15)-4.52*SQR(X(3))
4031 'MH49=.0831*LOG(X1)^2-.0116*X1/X2
4033 IF MHMA(15)<2.2 THEN MHMA(15)=2.2
4040 PA(15)=.0185
4050 PF49=.19888+4.938E-06*X1-.00205*SQR(X1)+.0004877*V(7)
```

```
4051 IF PF49<.002 THEN PF49=.002
4052 IF PF49>.45 THEN PF49=.45
4053 PF96=-5.4686+.16835*X2-.00448*V(3)+.36521*X(4)-4.1528*SQR(X(4))+.178*SQR(W(15))
4054 IF PF96<.23 THEN PF96=.23
4055 IF PF96>.98 THEN PF96=.98
4057 PF(15)=(PF49+PF96)/2
4060 RR(15)=.274
4100 '*******WUC23 PROPULSION SYSTEM **** WBS 6, 7 & 8 ********
4160 FOR I=6 TO 8
4161 RR(I)=.6211-.0024872*SQR(W(I))
4162 IF RR(I)<.157 THEN RR(I)=.157
4163 'IF RR(I)>.5120001 THEN RR(I)=.5120001
4165 PF(I)=1.14633+4.572E-05*W(I)-.011456*SQR(W(I))
4166 IF PF(I)<.2 THEN PF(I)=.2
4167 IF PF(I)>.725 THEN PF(I)=.725
4170 FMA(I)=34.1+9.853001E-04*W(I)-.312232*SQR(W(I))
4171 IF FMA(I)<1.4 THEN FMA(I)=1.4
4175 MHMA(I)=52.6324+.0009122*W(I)-.3936*SQR(W(I))
4176 IF MHMA(I)<4.1 THEN MHMA(I)=4.1
4178 PA(I)=.048164-.0001268*X2
4179 IF PA(I)<.0013 THEN PA(I)=.0013
4180 NEXT I
4200 ' WUC91/93/97  WBS 16  ***** RECOVERY & AUX SYS ********
4210 FMA(16)=7549.1-.0165*X1+4*X2-999.76*LOG(X1)+16.847*SQR(X1)-4.225*(X(3)+X(4))
4211 IF FMA(16)<17.9 THEN FMA(16)=17.9
4220  MHMA(16)=-57.9+1.4639E-04*X1+8.23732*LOG(X1)-.151436*SQR(X1)
4221 IF MHMA(16)<1.7 THEN MHMA(16)=1.7
4230 PA(16)=.004678
4253 PF91=4.654-.45718*LOG(X1)+.00242*SQR(X1)
4254 IF PF91<.011 THEN PF91=.011
4255 IF PF91>.84 THEN PF91=.84
4256 R97=2.532-.22837*LOG(V(3))
4257 PF(16)=(PF91+.287+.01)/3
4258 IF R97<0 THEN R97=.128
4260 R91=2.3489-.35852*LOG(X(2))
4261 IF R91<0 THEN R91=.461    'SET EQUAL TO MEAN VALUE
4262 IF R91>1 THEN R91=.461
4263 IF R97>1 THEN R97=.968
4265 RR(16)=(R91+R97)/2
4300 'APPLY MTBM & MHMA CALIBRATION FACTORS
4310 FOR I=1 TO 16
4320 FMA(I)=MW(I)*FMA(I)
4325 MHMA(I)=CM(I)*MHMA(I)
4330 NEXT I
5500 'SCHEDULED MAINTENANCE MODULE
5540 SCHP=-3.861213-.0449*X2+3.2794*LOG(X1)+.02297*SQR(X1)-.0176*LOG(X1)^3-7.289*LOG(X2)+2.36973*SQR(X2)
5550 IF SCHP<.17 THEN SCHP=.17
5560 IF SCHP>.665 THEN SCHP=.665
5569 '
5570 'VEHICLE ROLL-UP   - UNADJUSTED MTBM
5575 Y=0
5580 FOR I=1 TO 16
5590 IF OP$(I)="DELETE" THEN GOTO 5610
5600 Y=Y+1/FMA(I)
5610 NEXT I
5620 VFMA=1/Y

6999 '
7000 'MANPOWER COMPUTATION MODULE ******
7005 TMA=0:VMH=0:AMHMA=0:KK=0:TOMH=0:TFMH=0:APF=0:TMP=0
7010 MANF=(4.348*5*8)/(X(9)*(1-X(10)))  'HRLY AVAIL FACTOR
7020 FOR I=1 TO 16
```

```
7030 IF OP$(I)="DELETE" THEN GOTO 7140
7035 KK=KK+1
7040 THRS(I)=GOH(I)+LOH(I)+TOH(I)+OOH(I)+ROH(I)
7045 MA=THRS(I)/FMAS(I)
7046 TMA=TMA+MA
7050 MH(I)=MA*MHMA(I)
7055 AMHMA=AMHMA+MHMA(I)
7060 VMH=VMH+MH(I)
7070 MEN=(MH(I)*X(13))/(X(9)*(1-X(10)))
7080 MP(I)=INT(MEN+.999)
7085 TMP=TMP+MP(I)
7090 OMH(I)=(1-PF(I))*MH(I)
7100 FMH(I)=PF(I)*MH(I)
7110 TOMH=TOMH+OMH(I)
7120 TFMH=TFMH+FMH(I)
7130 APF=APF+1-PF(I)
7135 VMOH=VMOH+MH(I)*X(13)
7140 NEXT I
7150 APF=APF/KK
7160 AMHMA=AMHMA/KK
7170 SMP=(SCHP*VMH*X(13))/(X(9)*(1-X(10)))
7180 SMP=INT(SMP+.99)
7190 TMP=TMP+SMP

7499 '
7500 ' DISPLAY MODULE FOR MAINTAINABILITY REPORT
7510 CLS:COLOR 14
7520 PRINT TAB(25) "MAINTAINABILTY REPORT"
7530 PRINT TAB(1) "VEHICLE IS ";VNAM$;TAB(35) "DATE: ";DATE$;TAB(60) "TIME: ";TIME$
7548 COLOR 7
7550 PRINT TAB(1) "WBS";TAB(32) "MANHR/MA";TAB(50) "TOT MA";TAB(65) "TOT MANHRS"
7555 PRINT
7570 FOR I=1 TO 16
7580 IF OP$(I)="DELETE" THEN GOTO 7592
7590 PRINT TAB(1) WBS$(I);TAB(32) MHMA(I);TAB(50) THRS(I)/FMAS(I);TAB(65) MH(I)
7592 NEXT I
7593 PRINT:COLOR 11
7594 PRINT TAB(5) "SCHEDULED";TAB(65) SCHP*VMH
7595 COLOR 15
7600 PRINT TAB(5) "TOTALS";TAB(32) AMHMA;"(AVG)";TAB(50) TMA;TAB(65) VMH+SCHP*VMH
7610 COLOR 14
7620 INPUT "ENTER RETURN TO CONTINUE...";RET
7640 CLS:COLOR 14
7650 PRINT TAB(25) "MAINTAINABILTY REPORT - page 2"
7660 PRINT TAB(1) "VEHICLE IS ";VNAM$;TAB(35) "DATE: ";DATE$;TAB(60) "TIME: ";TIME$
7680 COLOR 7
7690 PRINT TAB(1) "WBS";TAB(32) "ON-VEH MH";TAB(47) "OFF-VEH MH";TAB(60) "PERCENT ON-VEH"
7700 PRINT
7710 FOR I=1 TO 16
7720 IF OP$(I)="DELETE" THEN GOTO 7740
7730 PRINT TAB(1) WBS$(I);TAB(32) OMH(I);TAB(50) FMH(I);TAB(65) 1-PF(I)
7740 NEXT I
7750 PRINT:COLOR 7
7755 PRINT TAB(5) "SCHEDULED";TAB(32) .98*SCHP*VMH;TAB(50) .02*SCHP*VMH
7760 COLOR 15
7770 PRINT TAB(5) "TOTALS";TAB(32) TOMH+.98*SCHP*VMH;TAB(50) TFMH+.02*SCHP*VMH;TAB(65) APF;"(AVG)"
7780 COLOR 14
7790 INPUT "ENTER RETURN TO CONTINUE...";RET
7800 CLS:COLOR 14
7810 PRINT TAB(25) "MAINTAINABILTY REPORT - page 3"
7820 PRINT TAB(1) "VEHICLE IS ";VNAM$;TAB(35) "DATE: ";DATE$;TAB(60) "TIME: ";TIME$
7830 'PRINT TAB(1) "MNHR ADJ FAC";MANF
```

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7840 COLOR 7
7850 PRINT TAB(1) "WBS";TAB(30) "MANHRS/MSN";TAB(45) "MANHRS/MO";TAB(60) "NBR PERSONNEL"
7860 PRINT
7870 FOR I=1 TO 16
7880 IF OP$(I)="DELETE" THEN GOTO 7900
7890 PRINT TAB(1) WBS$(I);TAB(30) MH(I);TAB(45) X(13)*MH(I);TAB(60) MP(I)
7900 NEXT I
7910 PRINT:COLOR 11
7915 PRINT TAB(5) "SCHEDULED";TAB(30) SCHP*VMH;TAB(45) X(13)*SCHP*VMH;TAB(60) SMP
7920 COLOR 15
7930 PRINT TAB(5) "TOTAL";TAB(45) VMOH;TAB(60) TMP:COLOR 14
7932 'PRINT TAB(5) "AVAIL HRS/MO=";X(9);TAB(40) "INDIRECT WORK=";X(10)
7940 COLOR 14
7950 INPUT "ENTER RETURN TO CONTINUE...";RET

7999 '
8000 'SPARES CALCULATIONS
8010 ARR=0:TS=0:KK=0:TNR=0
8020 FOR I=1 TO 16
8030 IF OP$(I)="DELETE" THEN GOTO 8180
8040 NR(I)=RR(I)*(THRS(I)/FMAS(I))  ' MEAN NBR REMOVALS
8045 MN=NR(I)
8050 GOSUB 8300  'COMPUTE FILL RATE RQMT - POISSON DISTR
8055 S(I)=STK:FR(I)=F
8060 TNR=TNR+NR(I)
8150 ARR=ARR+RR(I)
8160 TS=TS+S(I)
8170 KK=KK+1
8180 NEXT I
8190 ARR=ARR/KK

8300 ' COMPUTE SPARES USING POISSON DIST
8310 P=EXP(-MN)
8320 IF P>=X(11) THEN JD=1:GOTO 8370
8330 JD=1:F=P
8340 P=P*MN/JD
8350 JD=JD+1:F=F+P
8360 IF F<X(11) THEN GOTO 8340
8370 STK=JD-1

8499 '
8500 ' DISPLAY SPARES RESULTS
8510 CLS:COLOR 14
8520 PRINT TAB(25) "SUBSYSTEM SPARES REPORT"
8530 PRINT TAB(1) "VEHICLE IS ";VNAM$;TAB(35) "DATE: ";DATE$;TAB(60) "TIME: ";TIME$
8545 COLOR 7
8550 PRINT TAB(1) "WBS";TAB(25) "REM RATE";TAB(38) "AVG DEMAND";TAB(50) "SPARES RQMT";TAB(65) "FILL RATE"
8555 PRINT
8570 FOR I=1 TO 16
8580 IF OP$(I)="DELETE" THEN GOTO 8600
8590 PRINT TAB(1) WBS$(I);TAB(30) RR(I);TAB(41) NR(I);TAB(56) S(I);TAB(65) FR(I)
8600 NEXT I
8610 PRINT
8620 COLOR 15
8630 PRINT TAB(5) "TOTALS";TAB(27) ARR;"(AVG)";TAB(43) TNR;TAB(55) TS
8640 INPUT "ENTER RETURN TO CONTINUE...";RET

8999 '
9000 '***** DISPLAY MODULE FOR RELIABILITY REPORT *******
9010 CLS:COLOR 14
9020 PRINT TAB(25) "RELIABILITY REPORT"
9030 PRINT TAB(1) "VEHICLE IS ";VNAM$;TAB(35) "DATE: ";DATE$;TAB(60) "TIME: ";TIME$
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9048 COLOR 7
9050 PRINT:PRINT TAB(1) "WBS";TAB(25) "CALIBRATED MTBM";TAB(48) "TECH ADJ";TAB(61) "SPACE ADJ"
9055 PRINT
9070 FOR I=1 TO 16
9080 IF OP$(I)="DELETE" THEN GOTO 9092
9090 PRINT TAB(1) WBS$(I);TAB(35) FMA(I);TAB(48) FMAT(I);TAB(61) FMAS(I)
9092 NEXT I
9093 PRINT
9095 COLOR 15
9100 PRINT TAB(5) "VEHICLE";TAB(35) VFMA;TAB(48) TVFMA;TAB(61) SVFMA
9105 COLOR 14
9110 INPUT "ENTER RETURN TO CONTINUE...";RET
9120 CLS:COLOR 14
9130 PRINT TAB(20) "RELIABILITY REPORT - page 2"
9140 PRINT TAB(1) "VEHICLE IS ";VNAM$;TAB(35) "DATE: ";DATE$;TAB(60) "TIME: ";TIME$
9160 COLOR 7
9170 PRINT TAB(1) "WBS";TAB(33) "CRITICAL";TAB(48) "CRITICAL";TAB(65) "SUBSYS"
9171 PRINT TAB(33) "FAIL RATE";TAB(48) "MTBM";TAB(65) "MSN RELIABILITY"
9180 PRINT
9190 FOR I=1 TO 16
9200 IF OP$(I)="DELETE" THEN GOTO 9220
9210 PRINT TAB(1) WBS$(I);TAB(33) PA(I);TAB(48) FMAC(I);TAB(65) R(I)
9220 NEXT I
9230 PRINT
9240 COLOR 15
9250 PRINT TAB(5) "VEHICLE";TAB(48) CVFMA;TAB(65) VR
9260 COLOR 14
9270 INPUT "ENTER RETURN TO CONTINUE...";RET

9500 'MODULE TO WRITE FHBMA TO A FILE
9520 INPUT "ENTER FILE NAME";DNAM$
9530 OPEN DNAM$ FOR OUTPUT AS #1
9540 FOR I=1 TO 16
9550 WRITE #1,FMAT(I),FMAS(I),FMAC(I)
9560 NEXT I
9570 CLOSE #1

9600 'MODULE TO WRITE INPUT DATA TO A FILE
9605 INPUT "ENTER FILE NAME";DNAM$
9610 OPEN DNAM$ FOR OUTPUT AS #2
9615 FOR I=1 TO 16
9620 WRITE #2,WBS$(I),W(I),MW(I),CM(I)
9621 WRITE #2,GOH(I),LOH(I),TOH(I),OOH(I),ROH(I)
9622 WRITE #2,OP$(I)
9625 NEXT I
9630 FOR I=1 TO 13
9635 WRITE #2,NAM$(I),X(I),SNAM$(I),V(I)
9640 NEXT I
9645 FOR I=0 TO 4
9650 WRITE #2,T(I)
9655 NEXT I
9690 CLOSE #2

9700 'MODULE TO DISPLAY VEHICLE TURN TIME
9703 GOSUB 12000   'COMPUTE CREW SIZES
9705 TT=0
9706 SUM=0:CT=0
9710 FOR I=1 TO 16
9715 IF OP$(I)="DELETE" THEN GOTO 9735
9716 CT=CT+1
9720 TSKT(I)=(1-PF(I))*MHMA(I)/C(I)  'ON-EQUIP TASK TIME
9730 TT=TT+(THRS(I)/FMAS(I))*TSKT(I)
```

```
9733 SUM=SUM+TSKT(I)
9735 NEXT I
9740 SCHT=.98*SCHP*VMH/X(12)
9750 GTT=TT+SCHT:ATSK=SUM/CT
9800 ' DISPLAY VEHICLE TURN TIME
9810 CLS:COLOR 14
9820 PRINT TAB(25) "VEHICLE TURN TIME REPORT"
9830 PRINT TAB(1) "VEHICLE IS ";VNAM$;TAB(35) "DATE: ";DATE$;TAB(60) "TIME: ";TIME$
9840 PRINT
9845 COLOR 7
9850 PRINT TAB(1) "WBS";TAB(22) "AVG CREW SIZE";TAB(40) "AVG (ON) TASK TIME (HRS)";TAB(57) "AVG ON-VEH CLOCK
HRS"
9855 PRINT
9870 FOR I=1 TO 16
9880 IF OP$(I)="DELETE" THEN GOTO 9900
9885 TEMP=(THRS(I)/FMAS(I))*TSKT(I)
9890 PRINT TAB(1) WBS$(I);TAB(30) C(I);TAB(45) TSKT(I);TAB(59) TEMP
9900 NEXT I
9910 PRINT:INPUT "ENTER RETURN.....";RET
9920 CLS:COLOR 14
9921 PRINT TAB(25) "VEHICLE TURN TIME REPORT - page 2"
9922 PRINT TAB(1) "VEHICLE IS ";VNAM$;TAB(35) "DATE: ";DATE$;TAB(60) "TIME: ";TIME$
9923 PRINT
9924 COLOR 15:PRINT:PRINT TAB(52) "MAX TURN TIMES":PRINT
9925 PRINT TAB(5) "AVG VEH TASK TIME";TAB(55) ATSK;"HRS"
9930 PRINT TAB(5) "SCHD MAINT MSN TASK TIME";TAB(55) SCHT;"HRS"
9931 PRINT TAB(5) "MAX TURN TIME NO SCH MAINT";TAB(55) TT;"HRS"
9932 PRINT TAB(5) "MAX TURN TIME WITH SCH MAINT";TAB(55) TT+SCHT;"HRS"
9940 PRINT TAB(5) "MISSION TIME -INC GRND TIME";TAB(55) T(0)+T(4);"HRS"
9945 VTT=T(0)+T(4)+OTT+SCHT
9946 DVTT=(T(0)+T(4))/24+(OTT+SCHT)/8
9950 PRINT TAB(5) "TOT VEHICLE TURNAROUND TIME";TAB(55) VTT;"HRS"
9951 PRINT TAB(5) "TOT VEHICLE TURNAROUND TIME";TAB(55) DVTT;"DAYS"
9955 PRINT TAB(5) "MISSIONS/MONTH/VEHICLE";TAB(55) 21/DVTT
9960 PRINT TAB(5) "FLEET SIZE ";TAB(55) INT(X(13)/(21/DVTT)+.99)
9985 LOCATE 21,10:INPUT "ENTER RETURN TO CONTINUE...";RET

10000 'INPUT DATA
10005 DATA 1.1 WING GROUP,1.2 TAIL GROUP,1.3 BODY GROUP,1.4 TPS
10010 DATA 1.5 LANDING GEAR,1.6 PROPULSION,1.7 PROPULSION-RCS
10020 DATA 1.8 PROPULSION-OMS,1.9 PRIME POWER,1.10 ELECTRIC CONV/DISTR
10030 DATA 1.11 HYDRAULICS/PNEUMATICS,1.12 ACTUATORS,1.13 AVIONICS
10040 DATA 1.14 ENVIRONMENTAL CONTROL,1.15 PERSONNEL PROVISIONS
10050 DATA 1.16 RECOVERY & AUX SYSTEMS
10150 DATA DRY WGT (LBS),LENGTH+WING SPAN (FT),CREW SIZE,NBR PASSENGERS
10152 DATA TECHNOLOGY YR
10155 DATA DEFAULT TECH GROWTH FACTOR, WIEBULL SHAPE PARAMETER
10160 DATA LAUNCH FACTOR,AVAIL MANHRS/MONTH,PERCENT INDIRECT WORK
10170 DATA SPARE FILL RATE OBJ,AVG CREW SIZE-SCHD MAINT,PLANNED MISSIONS/MONTH
10180 DATA WGT IND 0-PCT/1-EQS
11000 CLS:PRINT:PRINT TAB(5) "SECONDARY INDEP VARIABLES":PRINT
11005 IF MODE=1 OR MODE=2 THEN RETURN
11010 PRINT TAB(1) "NBR";TAB(10) "VARIABLE";TAB(35) "CURRENT VALUE"
11020 PRINT
11040 FOR I=1 TO 12
11050 PRINT TAB(1) I;TAB(7) SNAM$(I);TAB(35) V(I)
11060 NEXT I
11070 PRINT:INPUT "ENTER NBR OF VARIABLE TO BE CHANGED - 0 IF NONE";NBR
11075 IF NBR>16 THEN GOTO 11000
11080 IF NBR=0 THEN RETURN
11090 INPUT "ENTER NEW VALUE";V(NBR)
11100 GOTO 11000
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11110 '
11120 'SUBROUTINE TO COMPUTE SECONDARY VARIABLES
11122 'WETTED AREA
11123 V(3)=486.026+.1510165*X(2)^2
11130 'NBR WHEELS
11140 V(4)=2.189572+6.66297E-05*X(1)-1.38718E-10*X(1)^2
11150 V(4)=CINT(V(4))
11160 IF V(4)<3 THEN V(4)=3
11170 'NBR CONTROL SURFACES
11180 V(6)=3.588737+.0005281*X(1)+.09493*X(2)-.00517*V(3)
11190 IF V(6)<6 THEN V(6)=6
11200 V(6)=INT(V(6))
11210 'NBR ACTUATORS
11220 V(5)=-41-.001425*X1+2.0752E-09*X1^2+.007467*V(3)-1.0377*SQR(V(3))+.4828*SQR(X1)+14.97*SQR(V(6))-.017811*V(6)^2
11230 IF V(5)<5 THEN V(5)=5
11240 V(5)=INT(V(5))
11280 'KVA MAX
11290 V(7)=-214.812+.001098*X(1)+25.1571*LOG(X(1))
11300 IF V(7)<11 THEN V(7)=11
11340 'NBR AVIONICS SYSTEMS  (TOTSUBS)
11350 V(10)=-40.4242-1.879E-05*X(1)+6.192823*LOG(X(1))
11360 IF V(10)<9 THEN V(10)=9
11370 V(10)=CINT(V(10))
11420 'NBR DIFFERENT AVIONICS SUBSYSTEMS
11430 V(11)=9.674-1.858*LOG(X(1))+.87684*V(10)+1.4557*LOG(W(13))
11440 IF V(11)<5 THEN V(11)=5:IF V(11)>V(10) THEN V(11)=V(10)
11450 V(11)=CINT(V(11))
11460 'BTU COOLING
11470 V(12)=-1114.52-12.0178*X2+.009405*X2^2+230.872*SQR(X2)
11480 IF V(12)<25 THEN V(12)=25
11490 'MAX PERSONS = CREW + PASSENGERS
11500 X(62)=X(7)+X(8)
11510 'NBR HYDRAULICS SUBSYSTEMS
11520 V(8)=13.48-.56854*X2+.002409*V(3)+.433276*SQR(X1)
11530 IF V(8)<8 THEN V(8)=8
11540 V(8)=CINT(V(8))
11550 'NBR INTERNAL FUEL TANKS
11560 V(9)=-13.2236+1.851772*LOG(X(1))
11570 IF V(9)<2 THEN V(9)=2
11580 IF V(9)>12 THEN V(9)=12
11590 V(9)=CINT(V(9))
11620 'FUSELAGE AREA
11630 V(1)=-8832.74+.082862*X(1)+1274.76*LOG(X(1))-32.456*SQR(X(1))
11640 IF V(1)<478 THEN V(1)=478
11650 'FUSELAGE VOLUME
11660 V(2)=-47618.5+22143*LOG(X(2))-5743.09*SQR(X(2))+.42623*X(2)^2
11670 IF V(2)<571 THEN V(2)=571
11680 GOSUB 11000  'DISPLAY MENU

11700 DATA FUSELAGE AREA,FUSELAGE VOLUME,WETTED AREA
11710 DATA NBR WHEELS,NBR ACTUATORS,NBR CONTR SURFACES,KVA MAX
11720 DATA NBR HYDR SUBSYS,NBR FUEL TANKS (INTERNAL)
11730 DATA TOT NBR AVIONICS SUBSYS
11740 DATA NBR DIFF AVIONICS SUBSYS,BTU COOLING
11750 'TECH GROWTH RATES
11760 DATA .082,.082,.082,.082,.033,.011,.011,.011,.054,0,.092,.056
11770 DATA .22,.0062,.036,.083
11780 'WGT DISTRIBUTION PERCENTAGES
11790 DATA .091,.003,.140,.099,.053,.019,.029,.017,.151,.059
11800 DATA .021,.007,.061,.083,.070,.097
12000 'CREW SIZE CALCULATIONS
12110 C(1)=1.5-.000032*V(3)+.009172*SQR(V(3))
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12120 C(2)=C(1):C(3)=C(1):C(4)=C(1)
12130 C(12)=C(1):C(5)=C(1)
12140 C(6)=2.43:C(7)=2.43:C(8)=2.43
12150 C(9)=2.43
12160 C(10)=-1.48-.002833*X2+.814656*LOG(X2)
12170 C(11)=C(10):C(14)=C(10)
12180 C(13)=2.18
12190 C(16)=1.7893+9.871999E-04*SQR(X1)
12195 C(15)=(C(10)+C(16))/2

12199 '
12200 'MODULE TO INPUT MOD FACTOR FOR MAINTENANCE
12202 COLOR 9
12205 CLS:PRINT TAB(20) "SUBSYSTEM MH/MA CALIBRATION FACTOR"
12206 PRINT TAB(20) "CAL MH/MA = CAL FAC x COMPUTED-MH/MA"
12210 PRINT TAB(3) "NBR  SUBSYSTEM";TAB(45) "CAL FACTOR"
12220 PRINT
12230 FOR I=1 TO 16
12235 IF OP$(I)="DELETE" THEN GOTO 12250
12240 PRINT TAB(3) I;TAB(10) WBS$(I) TAB(45) CM(I)
12250 NEXT I
12260 PRINT:INPUT "ENTER NBR OF SUBSYSTEM TO BE CHANGED - 0 IF NONE";NBR
12270 IF NBR=0 THEN GOTO 12295
12280 INPUT "ENTER NEW FACTOR";CM(NBR)
12290 GOTO 12205

12300 ' MENU TO DELETE A SUBSYSTEM
12305 CLS:PRINT TAB(20) "OPTION TO DELETE A SUBSYSTEM":PRINT
12310 PRINT TAB(3) "NBR  SUBSYSTEM";TAB(45) "OPTION"
12320 PRINT
12330 FOR I=1 TO 16
12335 IF OP$(I)="DELETE" THEN COLOR 4 ELSE COLOR 3
12340 PRINT TAB(3) I;TAB(10) WBS$(I) TAB(45) OP$(I)
12350 NEXT I
12360 PRINT:INPUT "ENTER NBR OF SUBSYSTEM TO BE DELETED - 0 IF NONE";NBR
12365 IF NBR>16 THEN GOTO 12305
12370 IF NBR=0 THEN GOTO 12395
12380 OP$(NBR)="DELETE"
12390 GOTO 12305

12400 ' MENU TO DEFAULT ON TECH GROWTH FACTOR
12403 COLOR 13
12405 CLS:PRINT TAB(25) "OPTION TO USE DEFAULT RATE"
12406 PRINT TAB(20) "FOR ANNUAL RELIABILITY GROWTH FACTOR":PRINT
12410 PRINT TAB(3) "NBR  SUBSYSTEM";TAB(45) "ANNUAL GROWTH RATE"
12420 PRINT
12430 FOR I=1 TO 16
12435 IF OP$(I)="DELETE" THEN GOTO 12450
12440 PRINT TAB(3) I;TAB(10) WBS$(I) TAB(45) TG(I)
12450 NEXT I
12460 PRINT:INPUT "ENTER NBR OF SUBSYSTEM TO BE CHANGED - 0 IF NONE";NBR
12465 IF NBR>16 THEN GOTO 12405
12470 IF NBR=0 THEN GOTO 12495
12480 TG(NBR)=X(6)
12490 GOTO 12405
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