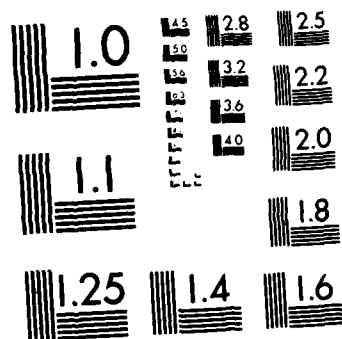


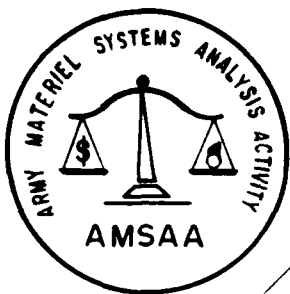
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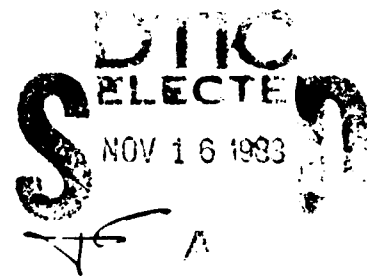
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AMSAA

**SORTIE DURATION AND
HELICOPTER COMPONENT
FAILURES (AN EMPIRICAL STUDY)**

**INVENTORY
RESEARCH
OFFICE**

May 1983



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US Army Materiel Systems Analysis Activity
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SUMMARY

1. Background

The purpose of this study was to investigate the effects that sorties^{*} have on component failures for Army aircraft. The underlying hypothesis was that the stresses occurring during take off and/or landing cause more failures of aircraft components than does continuous flying. Under this hypothesis an increase in the number of sorties for a given flying hour program results in an increase in demand for spare parts. The Army's current method of forecasting demand is based solely on flying hours and past experience and thus is inconsistent with this hypothesis.

The scope of the study was limited to appraising the implications of the hypothesis as applied to forecasting demands for repair parts at the wholesale level. The referenced studies done on fixed wing jet aircraft gave various models to be evaluated while analyzing the data. These studies suggested other variables; some of these were also considered in this work.

2. Findings

The analysis was done primarily on aggregate information. The direction of the study was dictated by the availability of data and many of the suggested models developed by others could not be directly tested. By looking at worldwide (peacetime) and Vietnam (wartime) data, it was apparent that sorties for Army aircraft were quite a bit shorter in duration^{**} and less variable in absolute terms for both peacetime and wartime than those observed in earlier work done on fixed wing-jet aircraft. This short duration of sorties made it impossible to detect any failure time pattern (i.e. time to fail within a sortie).

Analysis of about 20 years of flying hour records (DA Form 1352) for five types of aircraft showed a consistently high correlation between sorties and flying hours. This finding was corroborated using three months of Sample Data Collection (SDC) data on Blackhawk helicopters collected during the Bright Star Exercise.

Comparison of peacetime and wartime data (1352 records) showed both a higher utilization rate (flying hours : hours available) and longer duration sorties for the wartime environment. Based on the referenced studies for fixed wing aircraft, both of these factors may cause lower failure rates per flying hour for wartime planning when one ignores combat produced damage.

* Sortie is defined as a flight determined by a takeoff and a corresponding landing.

** Sortie length or duration is defined as the flying time between the takeoff and landing.

Since little actual failure data could be obtained, several indirect methods were used to try to find the relationship between failures and sorties and between failures and flying hours. The 1352 records contain aircraft availability and other related data. The Bright Star data contain maintenance events and man-hours. Regressions of these variables against sorties and flying hours resulted in low correlations. The IRO wholesale demand data did show increased demands for increases in flying hours, but the causes of the increase in demands were confounded with wartime effects. Several other IRO studies indicated that the use of flying hour data improved the forecast for individual item demand at the wholesale level.

3. Conclusions

This study was not able to show any relationship between failures and flying hours, sorties, or utilization. The data were limited in that other causal effects could not be removed from the analysis, nor could the explanatory variables be controlled adequately to statistically quantify the study's findings. Other IRO studies did demonstrate the favorable use of flying hours in making demand forecasts and the lack of results of this study should not be construed as negating these findings. This report was written to document the work done even though there were no positive conclusions. It includes many graphs in the appendix depicting 20 years of 1352 data which may be useful in other research work.

CHAPTER I

INTRODUCTION

1.1 Background

The Army currently invests several hundreds of millions of dollars in safety level stock at the wholesale level to guard against the errors made when forecasting demand for repair parts in the supply system. In an effort to impact this investment, the Army Inventory Research Office (IRO) has conducted several research studies [4], [8], [11] with the intent of improving the forecast method used in the wholesale management inventory system known as the Commodity Command Standard System (CCSS).

These studies considered various demand models and forecast schemes and used the IRO demand data base for empirical investigation and evaluation. The IRO data base [6] includes 15 years of requisitions and demand for aviation parts by quarter accumulated from the Troop Support and Aviation Readiness Command (TSARCOM) Demand Return and Disposal (DRD) files from 1967 thru 1982. Actual flying hour history is also included in this data base.

In each study, program dependent forecast methods performed best (see [10] for evaluation methods) when evaluated using a simulated supply system. The program variable, flying hours, was applied to the data in a "straight line" fashion, i.e. a forecast for demand per flying hour was made, then this forecast was multiplied by the number of flying hours scheduled for the forecast horizon to determine the forecasted demand. This straight line method is what is currently being used in CCSS. Similarly the straight line assumption is being considered by the wartime planners, i.e. if we double flying hours during war, we will also double requirements for repair parts.

Maurice Shurman of the Boeing Corporation has shown [14], [15], using data from fixed wing, jet aircraft that this straight line assumption may be incorrect and that the effect of takeoffs should be considered. He claims that a large portion of the failures occur early in a flight and that these failures are caused by the stress of takeoff. Hence a unit flying short sorties (flying time between takeoffs) over a fixed flying hour program will generate more failures than a similar unit flying longer sorties for the same program.

Others, [1], [3], [13] have followed Shurman's lead and have supported his finding that the straight line assumption is incorrect. These studies

were all performed on fixed wing aircraft and may not apply to helicopters the way they are employed by the Army. Details of these findings will be cited in the next chapter.

1.2 Problem

It is felt that if Shurman's findings are applicable to Army aircraft (primarily helicopters) a sortie dependent model can be formulated and an improved demand forecast algorithm developed.

1.3 Objectives

The following is a list of objectives which describe the anticipated course of the study.

a. Determine if data are available to measure the variability of sortie lengths. Flying hours per sortie is a major consideration of the study and should vary enough between time frames, aircraft, etc., to make the variable meaningful at the wholesale (aggregated) level of demand. Wartime vs peacetime scenarios should be considered.

b. Determine if failure or demand data are available to relate failures to sortie length. Time to failure within a sortie would be the principal data element but other data types may be considered. Aggregate data may be used and experimental design layouts may be useful.

c. Analyze the data and determine the relationship between failures and sorties. Consider the findings from cited reports in developing the relationship.

d. Develop a forecast algorithm capturing the sortie/flying hour relationship.

e. Add sortie length and/or the number of sorties flown to the IRO demand history file.

f. Test the sortie dependent forecast model using the IRO demand history file comparing it with the current forecast method.

g. Determine the feasibility of extending the results to other weapon systems.

1.4 Methodology

The methodology follows the list of objectives. First an intense literature review was done including site visits and telephone calls to a few of the referenced authors. Some of their findings are summarized in the next

chapter. Next several discussions were held with TSARCOM and with the Reliability, Availability and Maintainability Division of AMSAA to identify availability of data.

At the outset it was apparent that helicopter sorties were quite a bit shorter in duration than those flown by fixed wing Army aircraft. To get a better feel for the magnitude and variability of helicopter sorties a request was made to TSARCOM to derive quarterly statistics on five aircraft (OV-1, AH-1, CH-47, UH-1, OH-58) from the 1352 flying hour report. A description and analysis of the data are found in Chapter III. Since this was the first time a historical survey was made of the 1352 data, all the time series graphs made from the data are included in Appendix C. This data represents actual field usage information as opposed to developmental data which is commonly used for reliability estimation.

The 1352 analysis showed that, in the aggregate, sorties were highly correlated with flying hours. The direction of the study was then shifted to determine a failure rate/flying hour relationship. Chapter III describes the attempts at relating 1352 reliability/availability statistics to flying hours.

A continuation of the failure rate analysis is given in Chapter IV where Sample Data Collection data and demand data were considered. Alternative causal variables are also discussed in this chapter. The conclusions and recommendations are found in Chapter V.

CHAPTER II

RELATED STUDIES

2.1 Inventory Research Office

The Army as well as the other Services have in the past assumed a direct proportional relationship between component failures for aircraft and flying hours. This relationship has been indirectly tested by IRO in several previously mentioned studies by comparing forecast algorithms with and without program (flying hour) adjustments using actual demand and flying hour history. In each case the program dependent algorithm worked best. Additional attempts at IRO to statistically compare flying hours with demands using regression techniques have not been very successful due to a problem of relating demands to specific usage and aircraft.

2.2 Boeing

Maurice Shurman of the Boeing Corporation [13-15] studied failure data on various fixed wing jet aircraft. His initial work included time to failure analysis on six aircraft (F-106, E-3A, B-52, F-4, C-141, 707) where he noted that a high percentage of the failures occurred early in the flight or sortie. By plotting these data with a common format relating percent of total failures per sortie against time to fail as a percent of the nominal sortie length for each system he generated a family of curves whose bounds were similar to those shown in Figure 1.

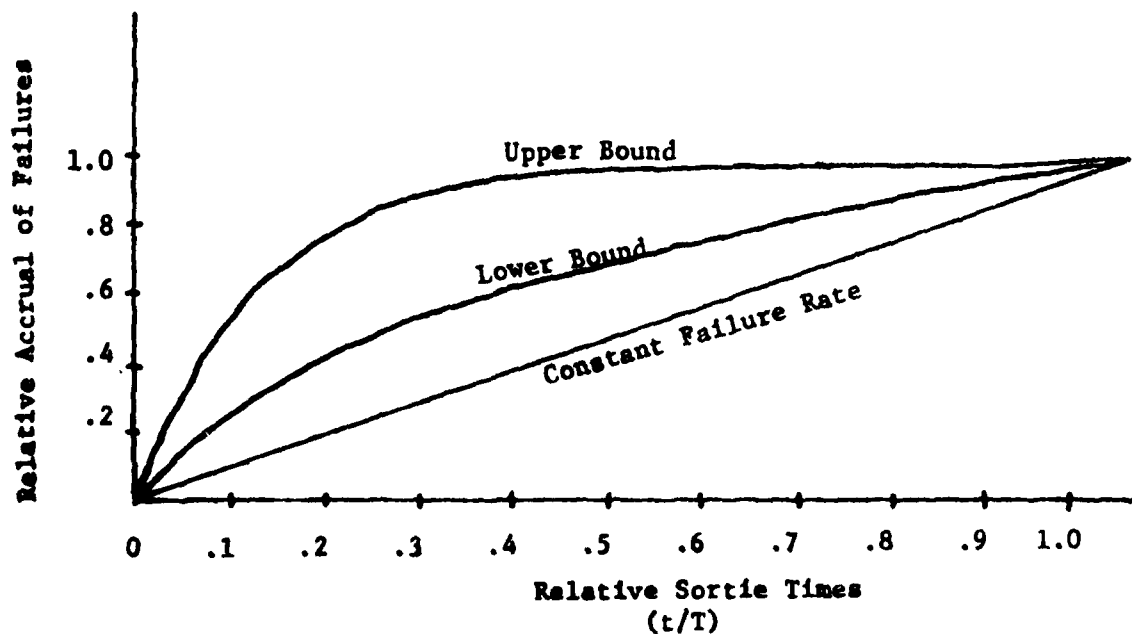


Figure 1. Common Plot

Using these curves he generated reliability equations. He confirmed his findings with other jet aircraft including the C5-A, C141-A.

His results indicate that sortie length should be considered when developing failure estimates, i.e., an increase in sorties per flying hour would result in an increase in failures per flying hour. This conjecture if true for Army helicopters would impact many areas such as contingency planning, reliability estimates and demand forecasting.

2.3 Air Force

COL Chris Shaw of the Air Force [13], in his analysis of C-5, C-130, C-141, and P-3C aircraft, claims that both sorties and flying hours affect failures. His model combines the failures due to start up, landing, and steady state flight in the following linear manner:

$$Y = A + B (X-1) + C$$

where

Y = failures per sortie

A = failures due to start up of the sortie

B = steady state failure rate during cruise (failures per flying hour)

C = failures due to landing of the sortie

X = sortie length in hours

He confirmed his model by plotting and regressing average failures per sortie against sortie length. He deleted short sorties (less than one hour) from the regression and made a point estimate of these observations. His data did show a non zero intercept indicating the sortie effect. Figure 2 compares Shaw's finding with Shurman's.

2.4 Institute for Defense Analyses

P. B. Buck of the Institute for Defense Analyses [1] has compared maintenance man-hours to utilization rates for the 6th and 7th fleets for the A-6E, A-7E, F-4J, and F-14 aircraft. He used multiple regression analysis which included the explanatory variables: utilization, flying hours, sorties, and dummy variables indicating different groups. His preliminary findings indicate that utilization rate (hours flown/hours available) has a much greater impact on failures than do sorties. This relationship is hyperbolic in function with failures per flying hour decreasing with an increase in flying hours per month for the aircraft. Hence the assumption of a constant failure rate (failures per flying hour) is incorrect

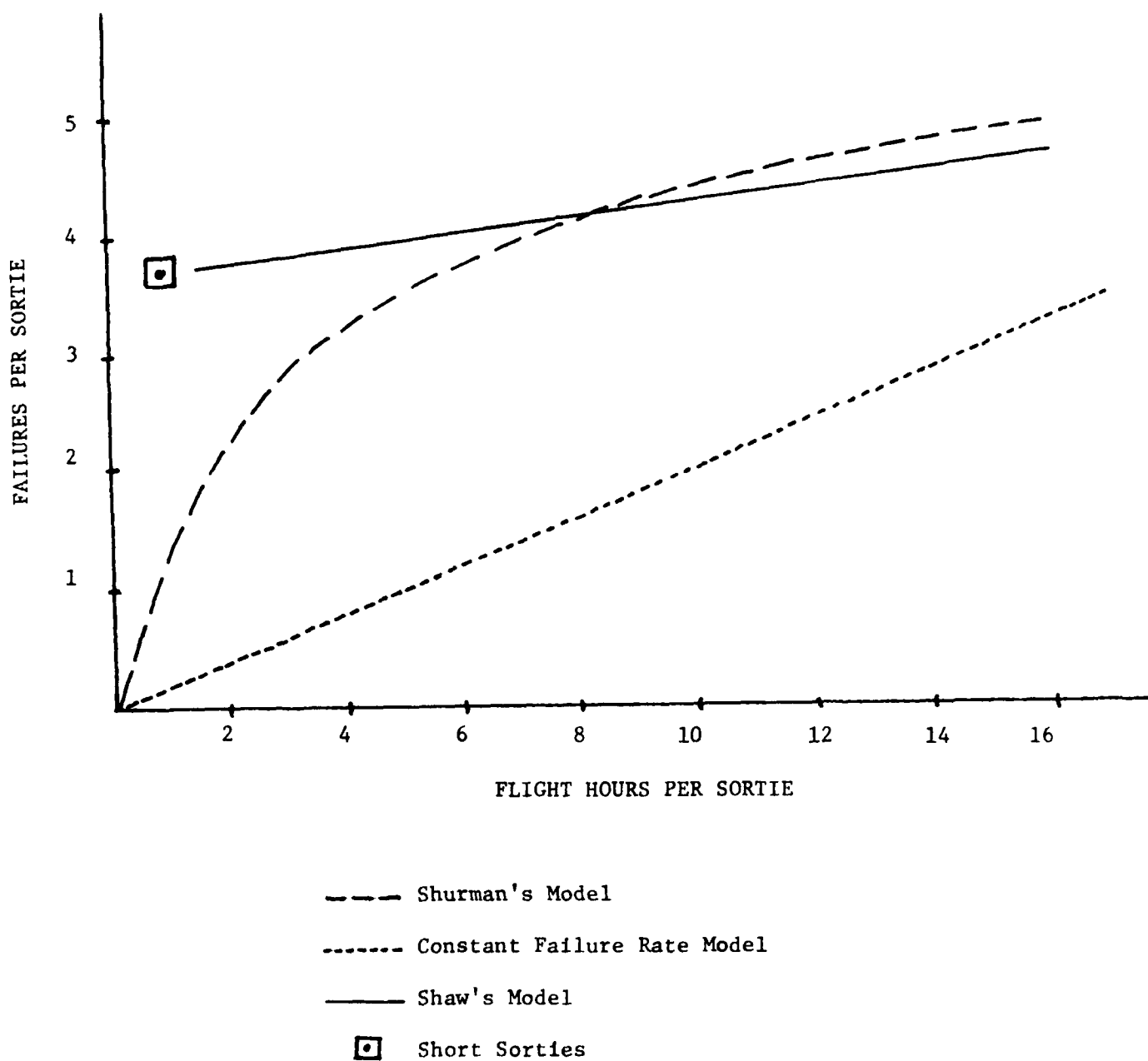


Figure 2. Comparison of Failure Models

and should be adjusted to reflect the utilization of the aircraft. This implies that a small peacetime utilization would generate a larger failure rate estimate (failures per flying hour) than would be expected during wartime where the utilization would be greater.

2.5 Others

Linda Cavalluzzo of the Center for Naval Analyses [3] has demonstrated in her preliminary work using F14-A data that the number of sorties and the number of flying hours flown in given periods were highly correlated. She developed a linear relationship between failures and flying hours using an econometric method (two stage least square). (This method eliminates the secondary dependency that failures have on flying hours.) Her equations show a more severe slope on flying hour (approximately 1) than did the normal least squares estimate.

H. Campbell of the Rand Corporation [2] considered seven other operational variables and concluded that only flying hours should be used to explain demand variation.

T. S. Donaldson and A. F. Sweetland of the Rand Corporation [5] studied the relationship between maintenance manhours and aircraft flying hours. Their findings were mixed across the various systems studied and the analysis was confounded by mission type variables.

G. Walker, D. Wilson, and D. Hindes [19] of the Boeing Corporation did an extensive study for the Air Force Human Resources Laboratory where they estimated the maintenance impacts of various characteristic parameters of the design, operational, and natural environments of the subsystems of various aircraft. Separate models were developed using multiple regression techniques for 29 equipment types. Thirteen of these models included a sortie variable.

Martin Cohen in [4] cites other references, all who have had various degrees of success in relating failures to operational variables.

2.6 Model Consideration

The work done by Shurman, Shaw, Buck, and IRO had the major impact on the conduct of the study. Each model was indirectly considered and each explanatory variable was investigated. The mode of evaluation was dictated by the availability of the data and the conclusions were somewhat subjective using data analysis inferences.

CHAPTER III

SORTIE VARIABILITY

3.1 Basic Questions

Since the referenced studies relating sorties to failures were all done using fixed wing aircraft data, a preliminary analysis was done to investigate the statistical characteristics of sorties as applied to helicopters and other Army aircraft. The basic questions of concern were as follows:

- a. How long are typical sorties for helicopters as compared to fixed wing aircraft?
- b. Does sortie length vary between aircraft, time, units, and scenario?
- c. Is sorties variation sufficiently large to consider it as an explanatory variable?
- d. Is there a difference between wartime and peacetime sortie lengths?
- e. Are sorties correlated with flying hours?
- f. Is utilization (flying hours flown/hours available) correlated with flying hours and/or sorties?
- g. Is reliability or maintainability affected by sorties?

3.2 Data Description

To help answer these basic data questions, TSARCOM went into their archives and retrieved "1352 - Army Aircraft Inventory Status and Flying Time" records from the early 1960s to 1982 for five systems: AH-1, CH-47, OH-58, OV-1, UH-1. (Three years of UH-60 Blackhawk data were also collected.) These data are collected routinely on a monthly basis for each tail number by unit at organization level. The data contain flying hour and sortie information as well as maintenance and availability statistics. Appendix A contains sketches of these aircraft.

Since the study deals mainly with failures (demands) as seen at the whole-sale level, the data were collected in terms of quarterly aggregate statistics which are described in the next section. During the war years, the data were separated into Vietnam and Non-Vietnam (worldwide) categories.

3.3 Data Variables

To determine a profile of usage for each system, 16 variables or statistics were computed for each quarter of available data. These statistics give the number of system and units fielded, the gross number of flying hours and sorties,

the average and standard deviation of usage (utilization) per aircraft (tail number), the average and standard deviation of sortie length, and attempts at reliability and availability measurements. The definition of each variable is found in Appendix B.

3.4 Time Series Analysis

The initial analysis consisted of time series plots of each variable with Vietnam data superimposed on the world wide (excluding Vietnam) series. These graphs are found in Appendix C and will be referred to as "time series plots" throughout this report. Averages and standard deviations of the plotted (non-zero) quarters are included for both Vietnam and worldwide data.

The following is a list of observations gleaned from the time series statistics:

a. The average and coefficient of variation of the two sortie length variables (average duration of sorties, average duration of sorties by aircraft - refer to Appendix B for definition) over the time series are given in Table 1.

TABLE 1. SORTIE DURATION (HRS)

		AH-1		CH-42		OH-58		OV-1		UH-1	
		AVG	COEF-V	AVG	COEF-V	AVG	COEF-V	AVG	COEF-V	AVG	COEF-V
AVERAGE DURATION OF SORTIES	WORLDWIDE	.33	.20	.30	.19	.33	.16	.86	.14	.32	.16
	VIETNAM	.57	.23	.34	.12	.38	.28	1.66	.15	.34	.12
AVERAGE DURATION OF SORTIES BY AIRCRAFT	WORLDWIDE	.30	.35	.31	.19	.37	.76	.79	.21	.34	.20
	VIETNAM	.56	.32	.34	.30	.39	.32	1.56	.20	.38	.15

From these data we see that the sortie durations are quite a bit shorter for the Army aircraft than those experienced for the fixed wing/jet aircraft cited in the referenced studies. The coefficient of variation (ratio of standard deviation to average) is approximately .20 between the quarterly averages which give a range of ± 60 percent (3 Std. Dev.) of the reported average of averages. Thus for a typical average sortie length average of .30 hours, the actual quarterly average may range from .12 to .48 hours. For a given 1000 flying hour program, the actual range of the number of sorties per 1000 hours may be between 2083 and 5555 and may

have significant impact on the number of failures per flying hour. This table also points out that the average sortie during Vietnam was longer for each aircraft than that experienced on the Non-Vietnam worldwide average and quite a bit larger for the AH-1 and OV-1.

b. Table 2 compares the average quarterly (averaged over all non-zero quarters) flying hour program for each type of aircraft. These data are non stationary and follow trend lines and hence maximum values will be given with each average as opposed to standard deviations. Minimums are not given since they are quite low and indicate the initial build up of density.

TABLE 2. FLYING HOURS (PER 3 MONTHS)

	AH-1		CH-47		OH-58		OV-1		UH-1	
	AVG	MAX	AVG	MAX	AVG	MAX	AVG	MAX	AVG	MAX
WORLDWIDE	13,908	35,000	10,517	16,000	60,913	120,000	5,706	7,000	166,923	250,000
VIETNAM	46,686	90,000	31,661	60,000	21,943	45,000	10,301	20,000	298,648	500,000

Except for the OH-58, the hours flown in Vietnam are two to three times greater than those flown during worldwide non Vietnam wartime missions. Thus if the straight line assumption about failures and flying hours is correct, then we will need two to three times more spare parts to support a conflict similar to Vietnam than to support peacetime activities. Note also the maximum Vietnam flying hours were on the magnitude of from four to six times the peacetime average.

c. The flying hour program reflects to some extent the density of items fielded. The density comparisons are shown in Table 3. Again maximum values are given instead of standard deviations.

TABLE 3. DENSITY

	AH-1		CH-47		OH-58		OV-1		UH-1	
	AVG	MAX	AVG	MAX	AVG	MAX	AVG	MAX	AVG	MAX
WORLDWIDE	569	1100	296	500	1569	2300	151	230	2668	4800
VIETNAM	317	560	227	325	159	300	63	100	1539	2500

The averages are somewhat misleading due to the density buildup over time. The comparison of maximums can be used to determine how much of the total density was fielded in Vietnam during its peak period. (Note World maximum occurred after the Vietnam war and reflects total density of equipment.) Hence for the AH-1, CH-47,

OV-1, and UH-1 approximately 50 percent of the total density was deployed in Vietnam at the peak but these aircraft flew three to six times the normal peacetime flying hour program. (Note: worldwide does not include Vietnam during the war years.)

d. Usage or utilization rate combines the flying hour program with density. It compares by tail numbers the total hours reported on the unit's property book with the number of hours flown (ratio) during the same period. Thus from the last two remarks it is not surprising to see that the Vietnam utilization is much greater than peacetime. Table 4 shows these differences.

TABLE 4. UTILIZATION - USAGE

	AH-1		CH-47		OH-58		OV-1		OH-1	
	AVG	MAX	AVG	MAX	AVG	MAX	AVG	MAX	AVG	MAX
WORLDWIDE	.01	.02	.02	.03	.02	.07	.02	.03	.03	.05
VIETNAM	.07	.10	.06	.09	.07	.08	.07	.10	.09	.11

The peacetime utilization is relatively constant at about 2 percent but the Vietnam data reflected a build up from 6 percent to about 10 percent. If Buck's findings are true for Army aircraft then the failures per flying hour rate for Vietnam (excluding combat damage) should be much smaller than those experienced during peacetime. Unfortunately we don't have data to test this hypothesis.

e. Even though our main interest in the study dealt with aggregate variability we also measured the variability between aircraft (tail numbers) by computing standard deviations within each quarter for a few of the variables. The time series of these standard deviations are found in Appendix C. Table 5a relates the average standard deviation to the estimated overall mean by giving the coefficient of variation for each system for usage and sortie duration.

TABLE 5a

AVERAGE COEFFICIENT OF VARIATION OF USAGE

	AH-1	CH-47	OH-58	OV-1	UH-1
WORLDWIDE	2.00	1.00	1.00	1.00	1.00
VIETNAM	.60	.70	1.60	.60	.55

AVERAGE COEFFICIENT OF VARIATION OF SORTIE DURATION

	AH-1	CH-47	OH-58	OV-1	UH-1
WORLDWIDE	1.20	.93	1.00	.90	1.0
VIETNAM	.67	1.1	.60	.50	.76

These high coefficients of variation indicate that the individual helicopter's experience may be quite different from that reported by the quarterly averages. Presently the variability within the aggregate is not considered when forecasting wholesale demands. If this variability as shown in the table is attributed to causal differences such as unit, mission, geography, then forecasting separately for homogeneous subgroups may be worth considering.

3.5 Regression Analysis

The analysis of the time series data indicated that utilization, flying hours, and sortie lengths exhibit enough variation to be considered as explanatory variables when predicting failures. Since these variables are associated with each other, regression analysis (ordinary least squares) was performed to determine if these variables are sufficiently pairwise independent to be considered simultaneously in a failure rate model. The author considers for this study variables with correlation coefficients of greater than .85 to be statistically the same (i.e. each variable contains the same information). The regressions considered are as follows:

Total Sorties vs Total Flying Hours

Total Flying Hours vs Density

Average Use vs Total Flying Hours

The scatter diagrams of these data are found in Appendix D and E. Table 5.b. contains the estimated correlation coefficients. It should be noted that all lines were fitted with an assumed zero intercept.

TABLE 5.b. ESTIMATED CORRELATION COEFFICIENTS

		AH-1	CH-47	OH-58	OV-1	UH-1
SORTIES	WORLDWIDE	.92	.86	.98	.86	.88
VS						
FLYING HRS	VIETNAM	.97	.97	.99	.98	.98
FLYING HRS	WORLDWIDE	.87	.65	.82	.38	.61
VS						
DENSITY	VIETNAM	.96	.95	.97	.95	.98
USAGE	WORLDWIDE	-.43	-.05	-.09	.61	.06
FLYING HRS	VIETNAM	.94	.91	.73	.56	.93

The following is a list of inferences drawn from the analysis.

a. The total number of sorties flown is highly correlated with total hours flown for the data sets considered. The estimated slopes of the regression lines are given in Table 6.

TABLE 6. SLOPE ESTIMATES SORTIES VS FLYING HOURS

	AH-1	CH-47	OH-58	OV-1	UH-1
WORLDWIDE	2.9	3.2	2.9	1.2	3.1
VIETNAM	1.6	3.0	2.8	.57	3.0

This table is consistent with Table 1 where the average sortie lengths were compared. (Note: Total Sorties = Slope x Total Flying Hours

Avg Sortie Length = $1 : \text{Slope}$)

Longer duration sorties are flown during wartime conditions particularly for the AH-1 and OV-1. Within each class sorties and flying hours are the same predictor variables due to the high correlations but the effects of flying hours on failures may be different between the data classes because of the various slopes found between the classes. Shurman's model would project different failure rates (per flying hour) for those cells with different slopes.

b. Density is currently being used as a program factor in forecasting failures for other than aircraft systems. Appendix D shows a high correlation within each data class between total flying hours and density. The estimated slopes of the regression lines are given in Table 7.

TABLE 7. SLOPE ESTIMATES FLYING HOURS VS DENSITY

	AH-1	CH-47	OH-58	OV-1	UH-1
WORLDWIDE	23	30	37	32	51
VIETNAM	156	140	143	150	182

There are extreme differences between the slopes for worldwide and Vietnam data. For the AH-1 we would expect to fly seven times the number of peacetime hours for the same density. Hence if the straight time flying hour model is correct, but density were used instead of flying hours to forecast demand, the wartime estimate would be too low.

c. Utilization did not correlate well with flying hours using worldwide data; the plot was nearly horizontal. The Vietnam data did show a higher correlation which probably reflects the different intensities of the war. Table 4 from the previous section shows the differences in utilization between the data cells. Utilization as a variable may capture the effect of a wartime scenario and should be considered in the failure rate model.

In an attempt to get a picture of failures from the 1352 data, quarterly availability and reliability variables as defined in Appendix B were computed from the maintenance and supply down times. The reliability (inherent availability) variable measures the percentage of time each aircraft would have been available if only maintenance time was considered when computing down time. Similarly the availability variable measures the percentage of time each aircraft was actually available with both maintenance and supply down time being considered.

These failure related measures were regressed against total flying hours, sortie length and usage. The scattergrams and statistics are included in Appendix E. The OV-1 was the only fixed wing aircraft in the analysis and was also the only aircraft with a consistent (but relatively low) positive correlation between the failure measures and both usage and sortie length. Hence it is questionable whether the findings from the fixed wing aircraft studies are applicable to helicopters.

Additional regression analysis was done between sortie length^{*} vs flying hours, sortie length vs usage, and usage vs flying hours. These statistics are found in Appendix F. In each case the correlations were low for all the data sets implying the pair wise independence between these variables.

3.6 Findings

Within each data subset of the 1352 analysis (system and scenario) the number of sorties flown was highly correlated with the total flying hours (statistically this implies the two variables contain the same information). The estimated slopes which reflect sortie length did differ between a few of the data cells and this difference should be considered in the model building as a cell effect.

The other variables, sortie length and usage, were shown to be individually uncorrelated with flying hours and with each other. These variables could be included in the model without causing any multi collinearity problems. (Note sortie length and cell effect are related and including both may cause problems with the model structure).

Failures in terms of reliability and availability as defined in this study did not correlate well with the explanatory variables, and this lack of correlation raises questions about the credibility of a failure rate model.

Additional failure rate analysis is given in the next chapter.

*Sortie length should not be confused with the number of sorties which was evaluated in Section 3.4.

CHAPTER IV

FAILURE RATE ANALYSIS

4.1 Introduction

Since the model would be used at the wholesale level, aggregate failures were of main concern. The 1352 data files contain maintenance down time but this included scheduled maintenance which is done on a flying hour basis and would confound any analysis done with it. Other aggregate data sources were not found.

Another source of data was Sample Data Collection (SDC). This might be considered micro data in that it gives historical information on a few selected aircraft from particular units. The data contain only unscheduled maintenance along with monthly flying hours and sorties. It does not contain the aggregate dimension of variability that would be needed for an experimental design analysis. An analysis of SDC, Blackhawk, data is given in Section 2 of this chapter.

An indirect way of measuring aggregate failures is to look at the demands for repair parts at the wholesale level. The IRO has a history of this wholesale data for Army aircraft. The data were of limited use because of the problems encountered when trying to relate the demands to specific aircraft types. Further discussion and analysis of this data is given in Section 3.

In discussing this project with aircraft engineers, maintenance personnel, and data collectors, it was of consistent opinion that sorties do have some effect on failures. They also mentioned many other causal variables that they felt may have a greater impact. A synopsis of these discussions is given in Section 4.

Section 5 contains a subjective summary of the failure rate analysis.

4.2 Sample Data Collection

In an effort to determine if SDC data as "Micro data" could contribute to the "macro analysis," data collected during the Bright Star Exercise were analyzed. The data consisted of monthly non-scheduled maintenance events, maintenance hours, flying hours and sorties for each of fourteen Blackhawk helicopters for three months yielding approximately 42 observations. The analysis was similar to the regression experiments done with the 1352 data.

The scattergram of the number of sorties against flying hours is found in Appendix C. The correlation was high and the slope of 3.7 was of the same gross

magnitude as the slopes observed (worldwide - peacetime) with the 1352 data. Appendix G also contains scattergrams made in an attempt to relate failures to sorties or flying hours. The variables considered were: events per flying hour, number of maintenance events, and total maintenance hours. In each case the correlation of the variable with sorties and flying hours was extremely low. This analysis does not support the failure rate/flying hour - sortie model.

Additional work was done with quarterly SDC data taken from the summary reports. The analysis not presented here gave additional evidence that sorties are correlated with flying hours with a slope of approximately 1/3. Again there was no evidence to support the failure rate vs flying hour or sortie model.

4.3 IRO Demand Data

Since the results of the study are to be applied to demand forecasting, the most natural data base for the failure rate analysis is the IRO TSARCOM demand data file. As mentioned in Chapter 1, these data have been used in previous forecasting studies where the results indicated the favorable use of flying hours when predicting demand for replacement parts.

The file consists of quarterly demands for approximately 22,000 items from the years 1967 to 1982. Martin Cohen [4] describes the first use of the data base and gives a subjective analysis of the relationship between flying hours and demands. In [6], Sally Frazza gives a comprehensive description of the data along with the processing decisions that had to be made in creating the data file.

There are several problems with the data that precludes its use for model building. The 1352 data indicated that the biggest difference in sortie length occurred between the wartime and peacetime periods. The demand file also shows a substantial difference in demands but these demands are for both combat damage and failures hence confounding the analysis. Another consideration is that the data contain many "common items," i.e. items that are common to several systems. Identification of demand to a particular system is not given in the data base. In Cohen's study he picked selected items unique to particular systems and with these groups of items showed a definite relationship between demands and flying hours.

Figure 3 shows a time series of aggregate demand for 12,148 actually demanded items from the years 1967 to 1977. This compares the magnitude of demands between the peacetime and wartime periods. Since the demands during war were three to four times that during peacetime, these data do not conflict with the failure rate model but further detailed analysis and model building is not possible due to the previously mentioned constraints of the data. Thus the best we can say is that the demand data file is consistent with the flying hour/sortie models but does not support rigorous model testing experiments.

4.4 Other Variables

In discussing this project with Army helicopter experts (engineers, pilots, maintenance experts, data collectors) it became quite apparent that other variables would have to be considered when evaluating the effects of sorties and flying hours on failures.

First off, the notion of sortie would have to be qualified by the types of takeoffs and landings. Takeoffs may be classified in the following ways:

- a. Vertical and angular (to various degrees).
- b. Full power and constrained power.
- c. Maximum payload and minimum payload (crew and fuel).
- d. Cold startup and continuation of mission.

Similarly landings may be classified as:

- a. Autorotations (emergency landings with the engines stalled - these are practiced as part of the training program).
- b. Hovering (where the aircraft doesn't quite touch the ground but stays in one location for loading or unloading).
- c. Running (where the aircraft comes in from less than vertical descent).

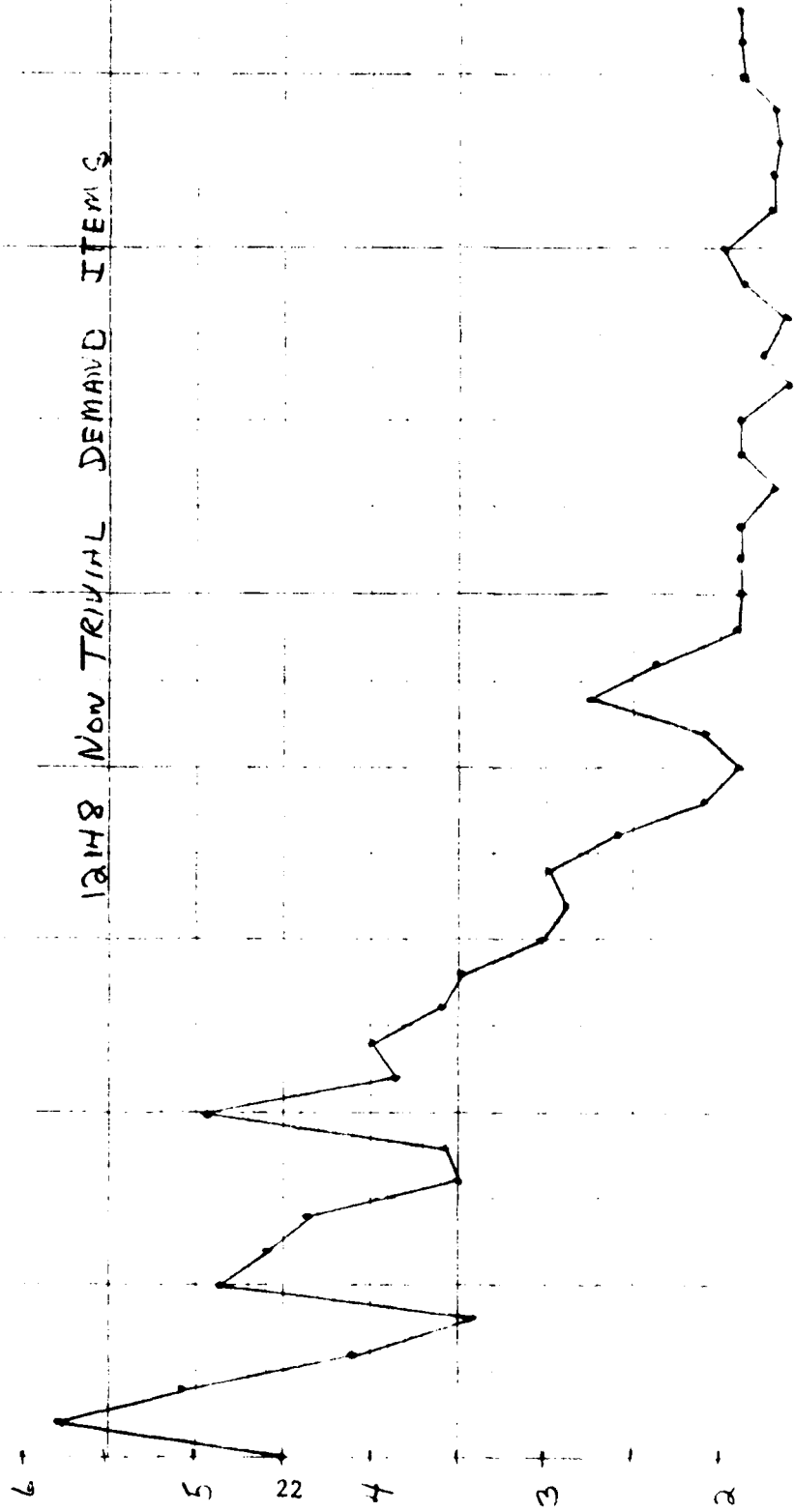
Flying hours would also have to be classified according to the types of mission as follows:

- a. Nappe of the Earth (where the aircraft flies at tree level with extreme power surges to lift over obstacles).
- b. Contour/low level flight (various altitudes).
- c. Weight variation.
- d. Special considerations.

Other conditions would affect failures. These include geographic conditions such as: sand, alkaline, ice, and snow, along with environmental conditions such as moisture, rain, heat, cold, and volcanic ash.

12148 Non TRIVIAL DEMAND ITEMS

12148	NON TRIVIAL	DEMAND	ITEMS



3

Subsystems react differently to the mentioned classes (e.g. nappe of the earth flying would impact the engine system differently than it would the electrical systems) and should be considered separately when developing a failure rate model. The failures themselves are inherently different. They may be caused by age, malfunction, accident, improper use, stress, combat damage, or neglect. Each of these factors may confound the effects of sorties and flying hours and should be appraised during the analysis.

Another problem in dealing with failures is the association of the failure with a specific sortie or mission. Very seldom are failures detected in flight; most of them are observed during inspection (daily, pre-flight, post-flight) or during routine or scheduled maintenance. In either case the specific time into a flight or sortie of a failure is not observed and is lost for the analysis. Hence stress of takeoff and landing cannot be directly measured.

The mentioned considerations lend themselves to a classical experimental design where each of the factors would be controlled or blocked during the experiment. Such an experiment would be extremely expensive and is beyond the scope of this study. The lack of such a control of the environment precludes the development of a failure rate model per se and puts emphasis on developing general relationships gleaned subjectively from the aggregate data. The next section summarizes these subjective observations concerning failures.

4.5 Findings

As mentioned in the previous section there are many variables that may affect failures in addition to sorties and flying hours. Many of these are related to the variable in question and their effects would be difficult to differentiate without an extensive experimental design effort. Since the results of this study are to be applied to demand forecasting at the wholesale level, the environmental variables in terms of the aggregation may not vary much over time except possibly between peacetime and wartime periods.

The 1352 failure data (reliability/availability) as analyzed in the previous chapter did not correlate well with sorties, flying hours, or utilization. Similar analysis using SDC data for a single unit resulted in the same finding.

The IRO demand history file showed more demands during the Vietnam era than during peacetime. This corresponded to an increased flying hour program but the relationship was confounded due to the fact that many of the demands were generated from combat damage and other wartime conditions not directly related to flying hours.

CHAPTER V

CONCLUSIONS/RECOMMENDATIONS

5.1 Summary of Findings

The analysis presented in this study was done primarily on aggregate information. The direction of the study was dictated by the availability of data and many of the suggested models developed by others could not be directly tested. By looking at worldwide (peacetime) and Vietnam (wartime) data it was apparent that sorties for Army aircraft were quite a bit shorter in duration and less variable in absolute terms than those observed in earlier work done on fixed wing jet aircraft. This short duration of helicopter sorties made it impossible to detect any failure time pattern as demonstrated by Shurman.

Analysis of about 20 years of 1352 flying hour records for five aircraft consistently showed a high correlation between the number of sorties and flying hours. This finding was corroborated using three months of SDC data on Blackhawk helicopters collected during the Bright Star exercise.

The correlation analysis of the 1352 data was done separately for the wartime and peacetime data. For each of the four helicopters tested, the slope was estimated as approximately 3 (assuming a zero intercept, Slope = number of sorties

flying hours) except for the AH-1 wartime data where the slope was estimated as 1.6 (longer sorties during wartime). For the OV-1 (the only fixed wing aircraft) the slope was 1.2 for peacetime and .57 for war also indicating longer sorties during war. These differences in slopes between systems and scenario indicate that if sorties do have an impact on failures then a different flying hour model should be used for different aircraft and scenarios, or sorties should be included in the model.

Another difference seen between the wartime and peacetime data was utilization. The utilization rate for wartime was three to six times that of peacetime. This difference in utilization should be considered for contingency planning.

Due to the paucity of failure data per se, several indirect methods of relating failures to flying hours and sorties were investigated. Using both 1352 reliability and availability statistics, there was no correlation found between these variables and sorties, flying hours or utilization. Similar findings were demonstrated using the SDC Bright Star data where maintenance events and maintenance manhours were regressed against sorties and flying hours. The IRO wholesale demand data did show increased demands for increases in flying hours but the

causes of increase in demand were confounded by wartime effects. Several other IRO studies indicated that the use of flying hour data improved the forecast for individual item demand at the wholesale level.

During the course of the study several Army aircraft experts were contacted and they all suggested that other factors such as mission, environment, and geographic location may have a greater effect on failures than do sorties and flying hours. The Boeing study [19] addressed these factors using Air Force data. These results suggested 29 different models to be used separately for different high failure equipment. Each model considered (multiple regression) as many as 54 explanatory variables. Results of this complexity would not be useful in the context of forecasting demand at the wholesale level. No additional analysis was performed on this topic.

5.2 Conclusions

This study was not able to show any relationship between failures and flying hours, sorties, or utilization. The data were limited in that other causal effects could not be removed from the analysis nor could the explanatory variables be controlled adequately to statistically quantify the study's findings. Other IRO studies did demonstrate the favorable use of flying hours in making demand forecasts and the lack of results of this study should not be construed as negating these findings.

5.3 Recommendations

The following is a list of recommendations based on the findings of this study:

- a. Until stronger evidence is found to support the study findings, continue to use flying hours as a program variable for demand forecasting.
- b. Continue to search for failure data where sortie, flying hour, and utilization effects can be statistically appraised and a failure rate model developed.
- c. Contingency planners should be aware of the large differences in utilization observed between the wartime and peacetime data. Additional work should be considered where a usage model similar to Buck's [1] could be studied.

BIBLIOGRAPHY

- 1 Buck, Pierpont, "Projection of Peacetime Maintenance Data from Naval Aircraft to Obtain Wartime Requirements for Spare Parts and Manpower," Paper given at 47th Symposium of Military Operations Research Society, 8 July 81, Institute for Defense Analyses, Confidential.
- 2 Campbell, H., "The Relationship of Resource Demands to Airbase Operations," The Rand Corporation, Santa Monica, CA, January 1963, LD#05415.
- 3 Cavalluzzo, Linda, "The Effect of Operational Factors on Aircraft Failures," Memorandum 82-1639, Center for Naval Analyses, 19 October 82, Confidential.
- 4 Cohen, Martin, "Demand Forecasting With Program Factors," AMC Inventory Research Office, September 1975, ADA017858.
- 5 Donaldson, T. S. and A. F. Sweetland, "The Relationship of Flight-Line Maintenance Man-Hours to Aircraft Flying Hours," The Rand Corporation, Santa Monica, CA, August 1968, LD#18672.
- 6 Frazza, Sally, "Data Base for NICP Oriented Problems," US Army Inventory Research Office, February 1980, ADA082171.
- 7 Gotwals, E. P. and A. Hutchison, "Use of End Item Age in Demand Forecasting," DRC Inventory Research Office, December 1976, ADA037585.
- 8 Gotwals, E. P., "Integrated Forecasting Techniques for Secondary Item Classes - Part I, Active Items," US Army Inventory Research Office, September 1980, ADA097024.
- 9 Gotwals, E. P., "Integrated Forecasting Techniques for Secondary Item Classes - Part II, Inactive Items," US Army Inventory Research Office, September 1980, ADA097025.
- 10 Gotwals, E. P., "Evaluation of Forecast Methods in an Inventory Management System (An Empirical Study)," US Army Inventory Research Office, August 1981, TR81-5, ADA107894.
- 11 Orr, Donald, "Demand Forecasts Using Process Models and Item Class Parameters: Application of Ancillary Variables," DRC Inventory Research Office, April 1976, ADA026081.
- 12 Orr, Donald, "Kalman and Moving Average Filters for Forecasting: Systematics of Demand Processes and Extension," DRC Inventory Research Office, October 1976, ADA032476.

- 13 Shaw, COL Christopher C., "Saber Sustainer," Briefing, Air Force Studies and Analysis, March 1981.
- 14 Shurman, Maurice, "Time Dependent Failures Rates for Jet Aircraft," Proceedings 1978 Annual Reliability and Maintainability Symposium, pp 198-203, Boeing Company, Seattle.
- 15 Shurman, Maurice, "Development of In Flight Steady State Failures Rates," Proceedings 1979 Annual Reliability and Maintainability Symposium, pp 323-325, Boeing Company, Seattle.
- 16 Shurman, Maurice, "Time Dependent Failure Rates for Jet Aircraft," Briefing, Boeing Company, Seattle, WA, 1980.
- 17 Slowik, William, "CV Manpower Readiness Study," Naval Air Development Center, Systems Directorate, July 1982.
- 18 Smiley, William A, CPT, and Oscar A. Goldfarb, "An Evaluation of Program Activity as a Demand Prediction Tool," The School of Systems and Logistics, Air Force Institute of Technology, Wright-Patterson AFB, OH, August 1967, LD#17040.
- 19 Walker, Gary D, David H. Wilson, and D. Kent Hindes, "Maintenance Metrics to Forecast Resource Demands of Weapon System," Vol I - User Guide for Cargo/Transport Aircraft, Draft Technical Report, Boeing Aerospace Company, Product Support Experience Analysis Center, Seattle, WA, 1983, D194-30046-1.

APPENDIX A
AIRCRAFT USED IN STUDY

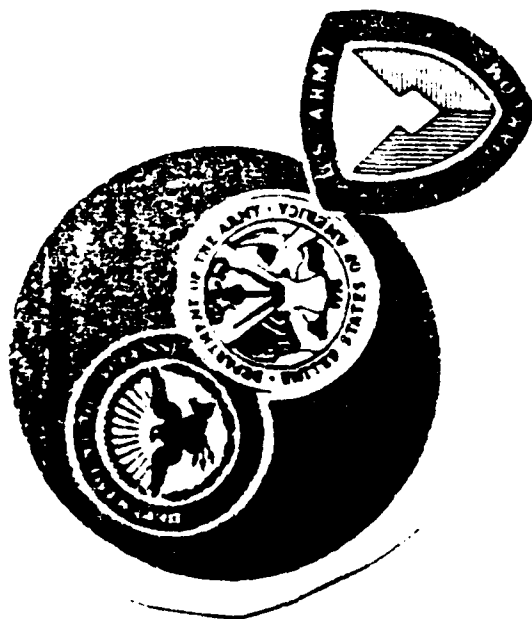
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AND LOGISTIC MANAGEMENT QUARTERLY SUMMARY (PART B)

CH-47B/C, HELICOPTER

1 July - 31 December 1981



RCS DRCNM-156

PART A & B

DA CIR 750-37 - 49

CH-47



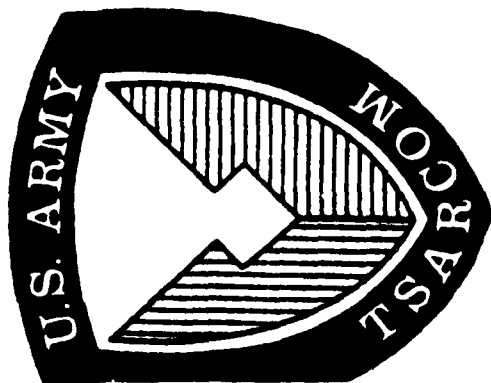
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A-2

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US ARMY TROOP SUPPORT & A TION MATERIAL READINESS COMMAND DIRECTORATE FOR PRODUCT ASSURANCE
SYSTEM PERFO. NCE ASSESSMENT DIVISION

/ COBRO CORPORATION

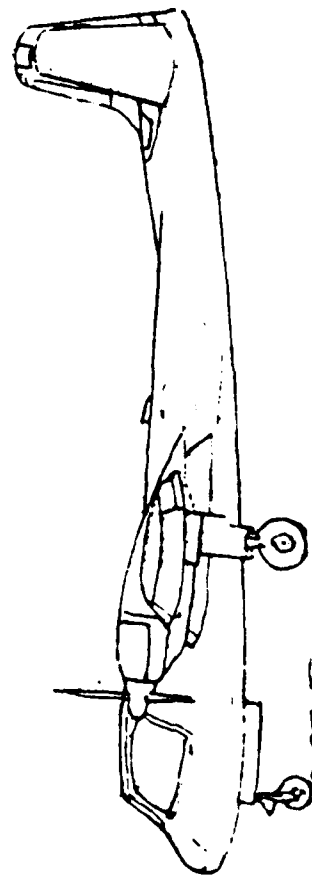
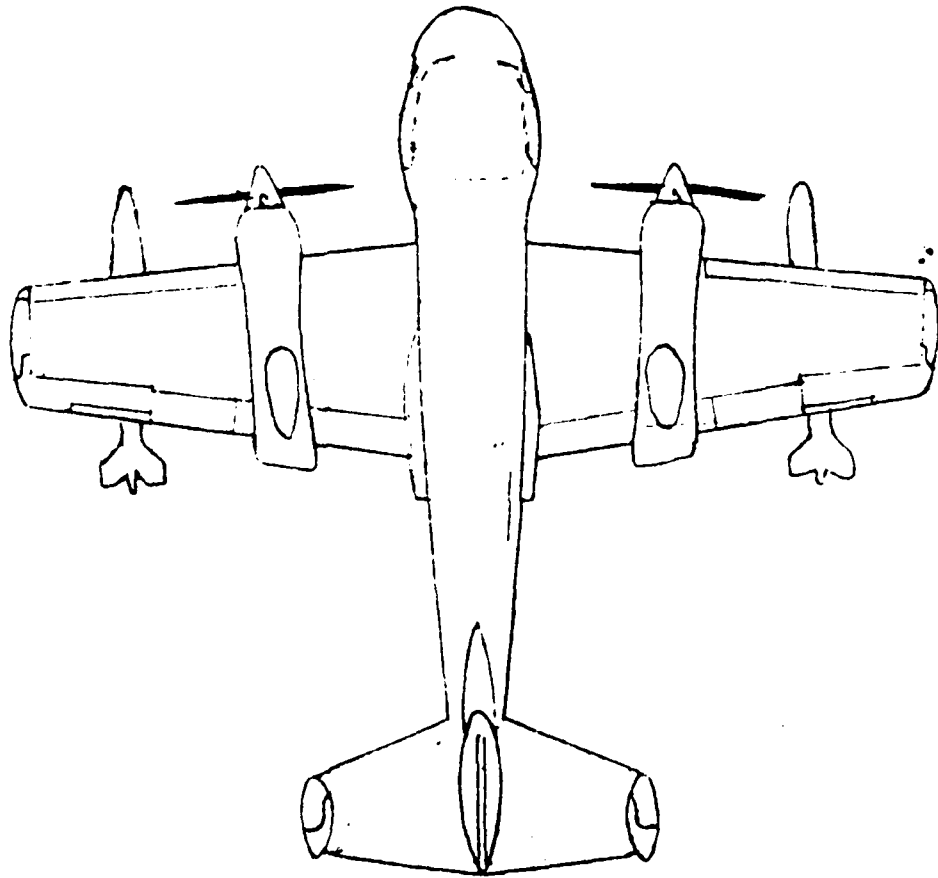


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OV-1D AIRCRAFT 1 JUL 80 - 30 SEP 80

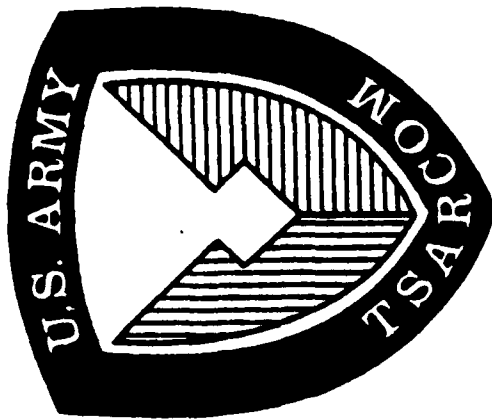
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PART A & B
DA CIR 750-37-49

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BY COBRO CORPORATION Apr 81

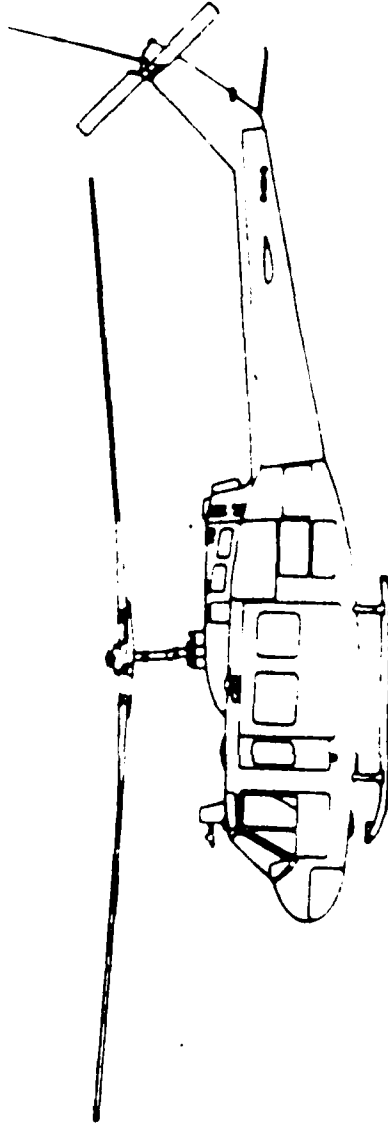
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LOGISTIC MANAGEMENT ANALYSIS QUARTERLY SUMMARY (PART A)
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UH-1H HELICOPTER
1 JUL 80 - 30 SEP 80

RCS DRCMM-156
PART A & B
DA CIR 750-37-49

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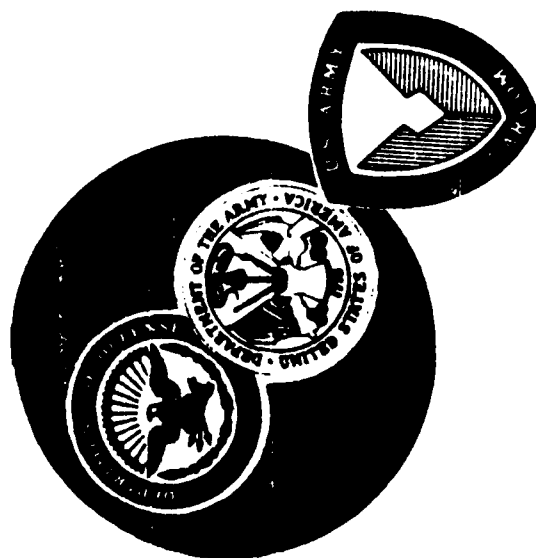
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BY COBRO CORPORATION 15 APR 81

DEPARTMENT OF THE ARMY SAMPLE DATA COLLECTION

LOGISTIC MANAGEMENT ANALYSIS QUARTERLY SUMMARY (PART A)
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UH-60A, HELICOPTER

1 SEP 80 - 30 NOV 80

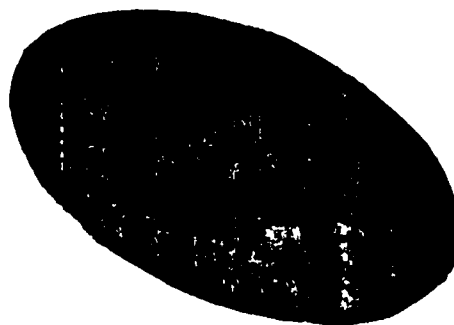
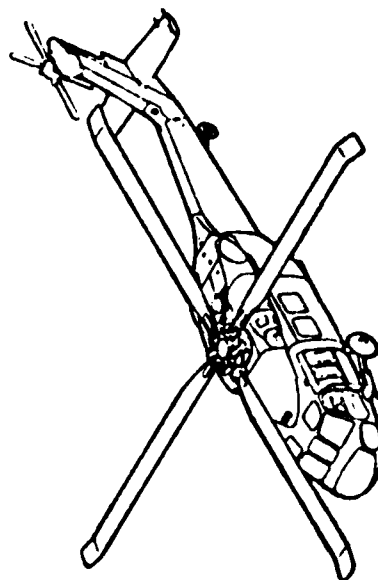


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PART A & B

DA CIR 750-37-57

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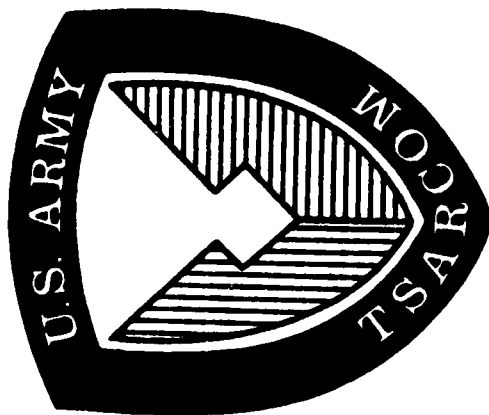
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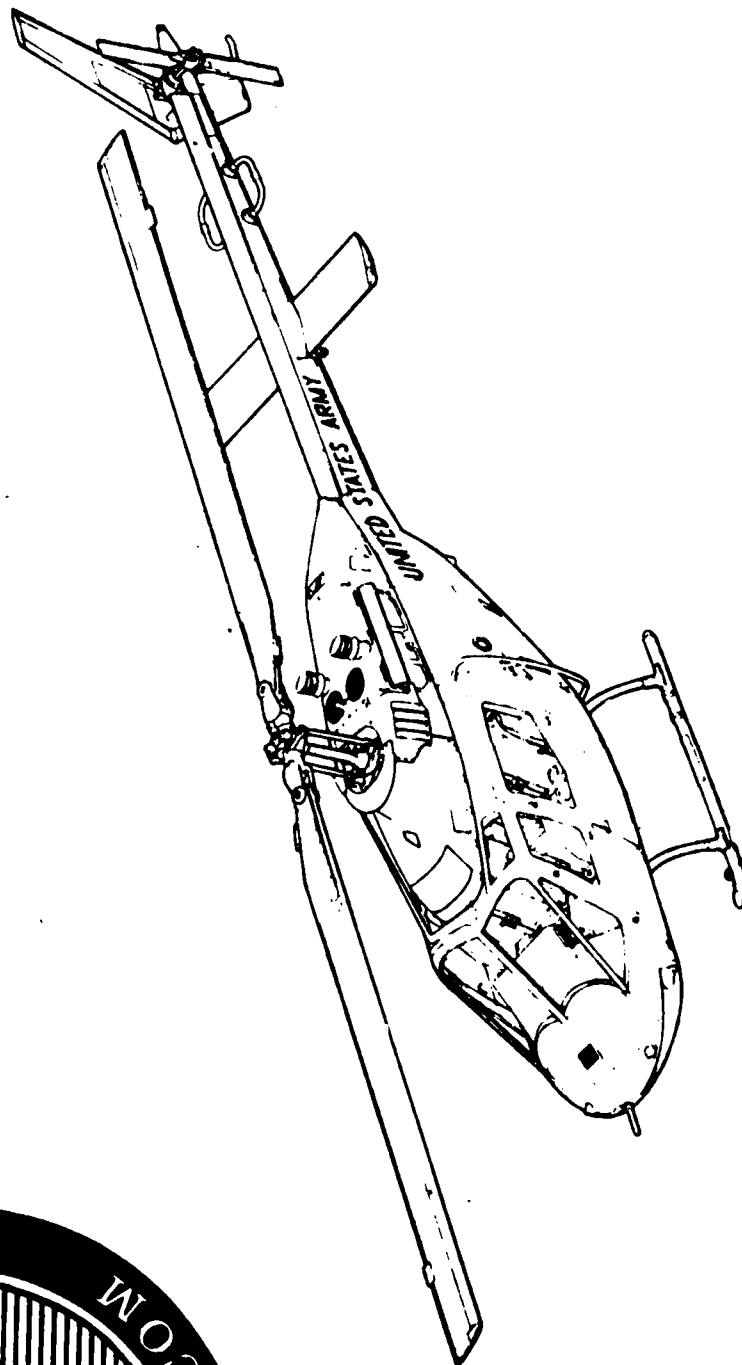
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OH-58A/C HELICOPTER

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PART A & B
DA CIR 750-37-49

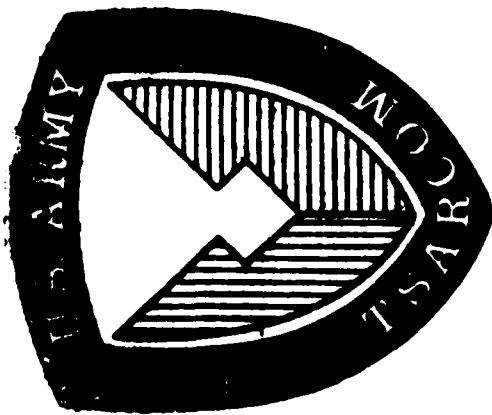


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SYSTEM PERFORMANCE ASSESSMENT DIVISION

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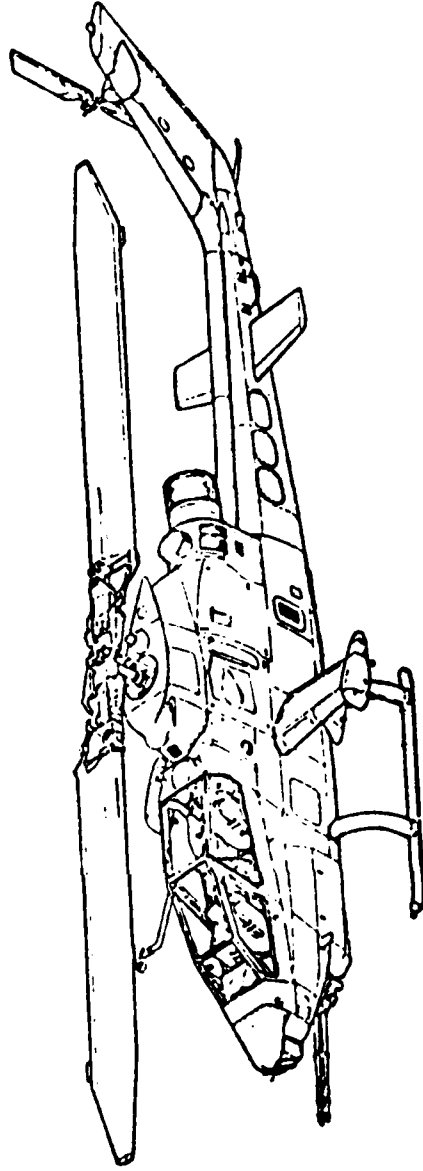


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DA CIR 750-37-49

DEPARTMENT OF THE ARMY SAMPLE DATA COLLECTION

LOGISTIC MANAGEMENT ANALYSIS QUARTERLY SUMMARY (PART A)
AND LOGISTIC MANAGEMENT QUARTERLY SUMMARY (PART B)

AH-1 HELICOPTER
01 JUL 80 - 30 SEP 80



A-7

US ARMY TROOP SUPPORT & AVIATION MATERIAL READINESS COMMAND DIRECTORATE FOR PRODUCT ASSURANCE
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APPENDIX B

DEFINITION - 1352 VARIABLES

<u>Data Elements</u>	<u>Definitions</u>
a. Density	The number of aircraft reporting data within the quarter.
b. Number of Reporting Units	The number of units reporting data within quarter.
c. Total Flying Hours	The sum of all hours flown within the quarter.
d. Avg Hours On Hand	The average hours on hand per aircraft for the quarter.
e. Standard Deviation of Hours On Hand	Standard Deviation of (d).
f. Avg Usage	The average (flying hours ÷ hours on hand) per aircraft for the quarter.
g. Standard Deviation of Usage	Standard Deviation of (f).
h. Total Number of Sorties	The sum of all landings reported within the quarter.
i. Avg Length of Sortie(Duration)	$c \div h$ (Total Flying Hours ÷ Total Sorties)*
j. Avg Length of Sortie by Aircraft (Duration)	The average (flying hours ÷ number of landings) per aircraft for the quarter.**
k. Standard Deviation of Length of Sortie by Aircraft	The standard deviation of (j).
L. Avg Reliability	The average ((hours on hand - hours not mission capable due to maintenance) ÷ hours on hand) per aircraft for the quarter.
m. Std Dev of Reliability	Standard deviation of (L).
n. Avg Availability	The average ((partial mission capable + full mission capable ÷ hrs on hand) per aircraft for the quarter.
o. Standard Deviation of Availability	Standard deviation of (n).
p. Number of Autorotations	The sum of all autorotations reported within the quarter.

* Fleet Ratio

** Average Ratio of Each Tail Number

APPENDIX C

1352 DATA TIME SERIES

Variables

Density

Number of Reporting Units

Total Flying Hours

Avg Hours on Hand

Standard Deviation of Hours On Hand

Avg Usage

Standard Deviation of Usage

Total Number of Sorties

Avg Length of Sortie

Avg Length of Sortie by Aircraft

Standard Deviation of Length of Sortie by Aircraft

Avg Reliability

Std Dev of Reliability

Avg Availability

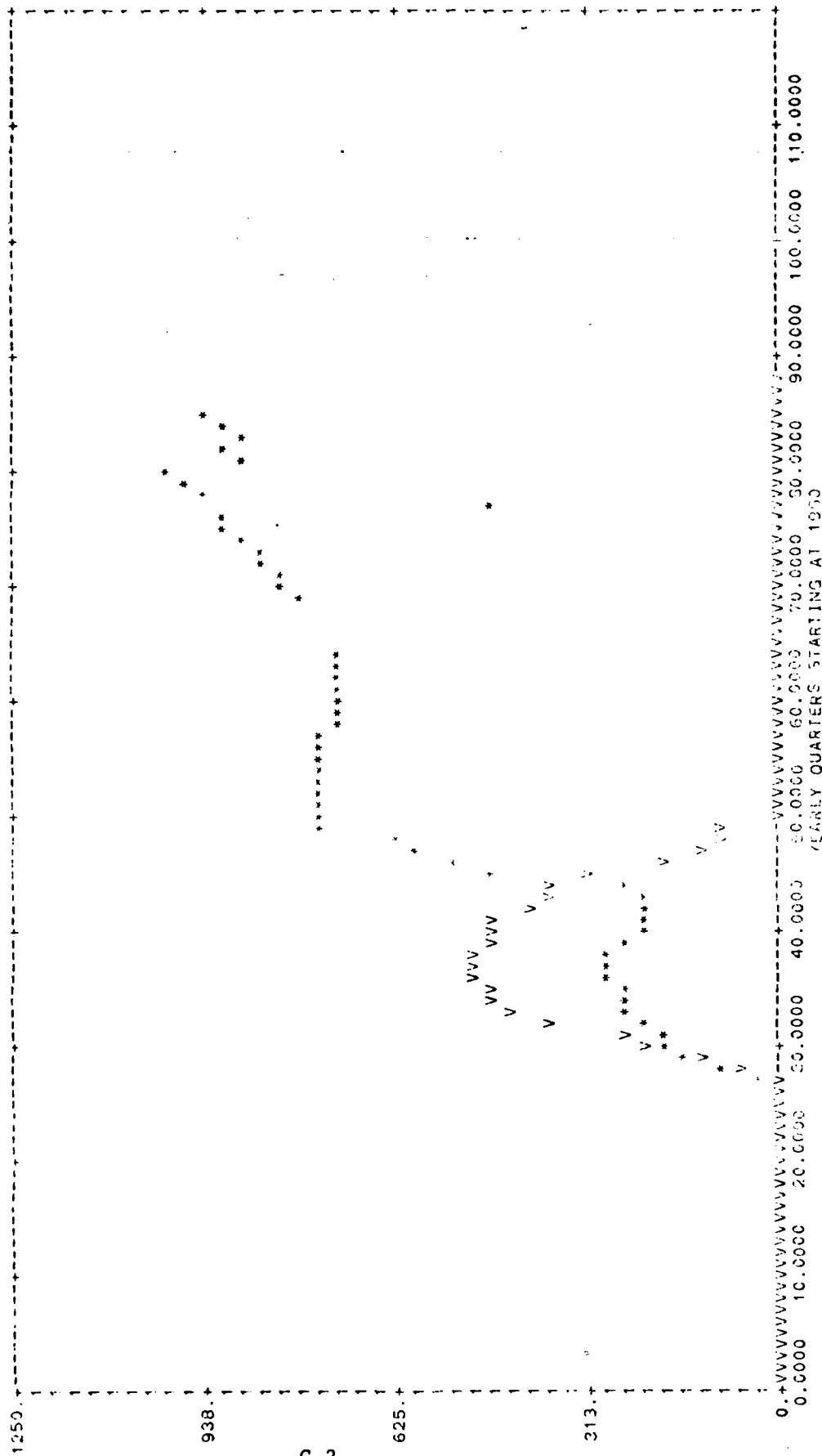
Standard Deviation of Availability

Number of Autorotations

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SYSTEM-101
YVARIABLE

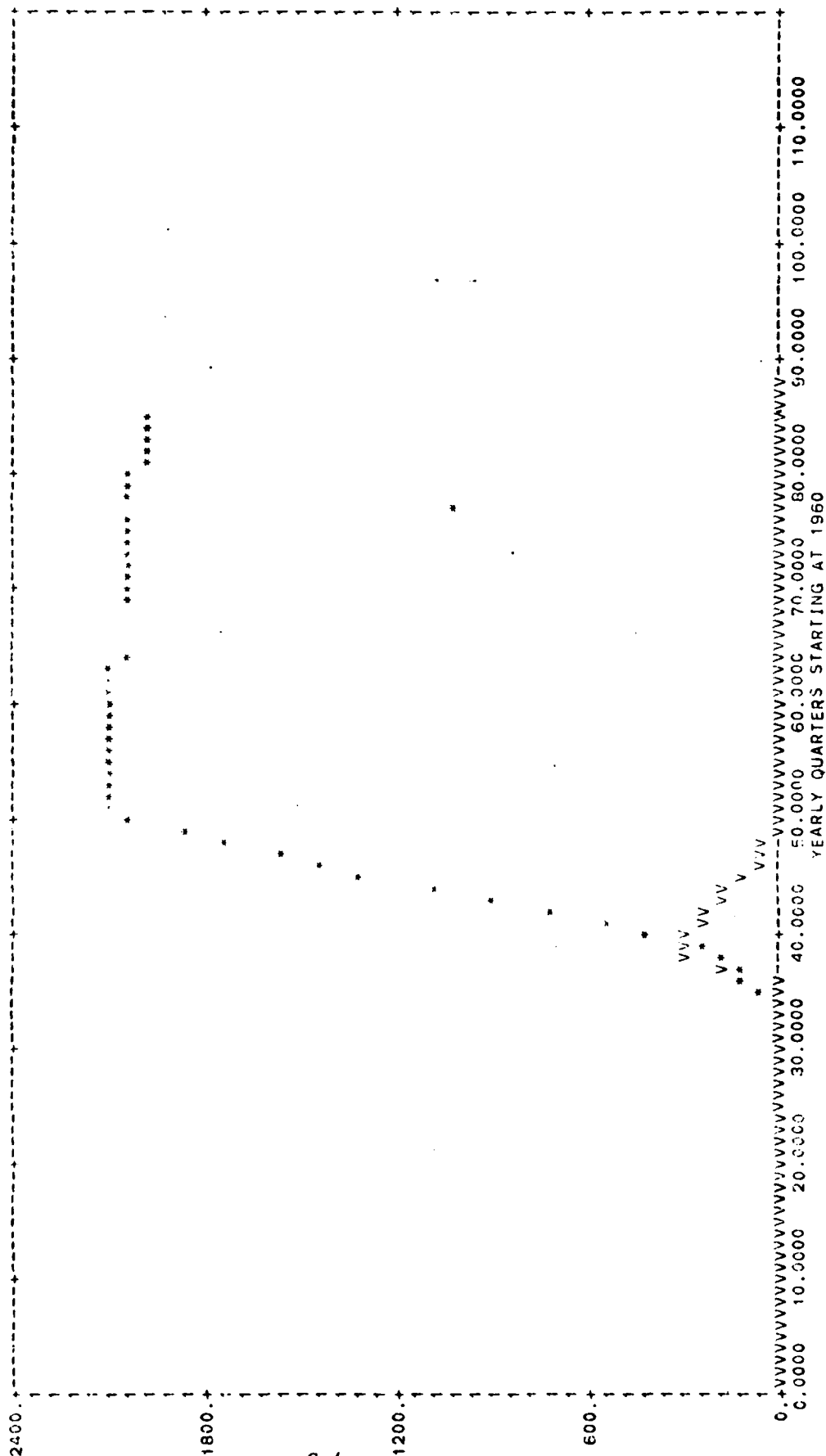
DENSITY



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VIETNAM AVERAGE = 317.09 STANDARD DEVIATION = 150.0170 NUMBER OF OBSERVATIONS = 23

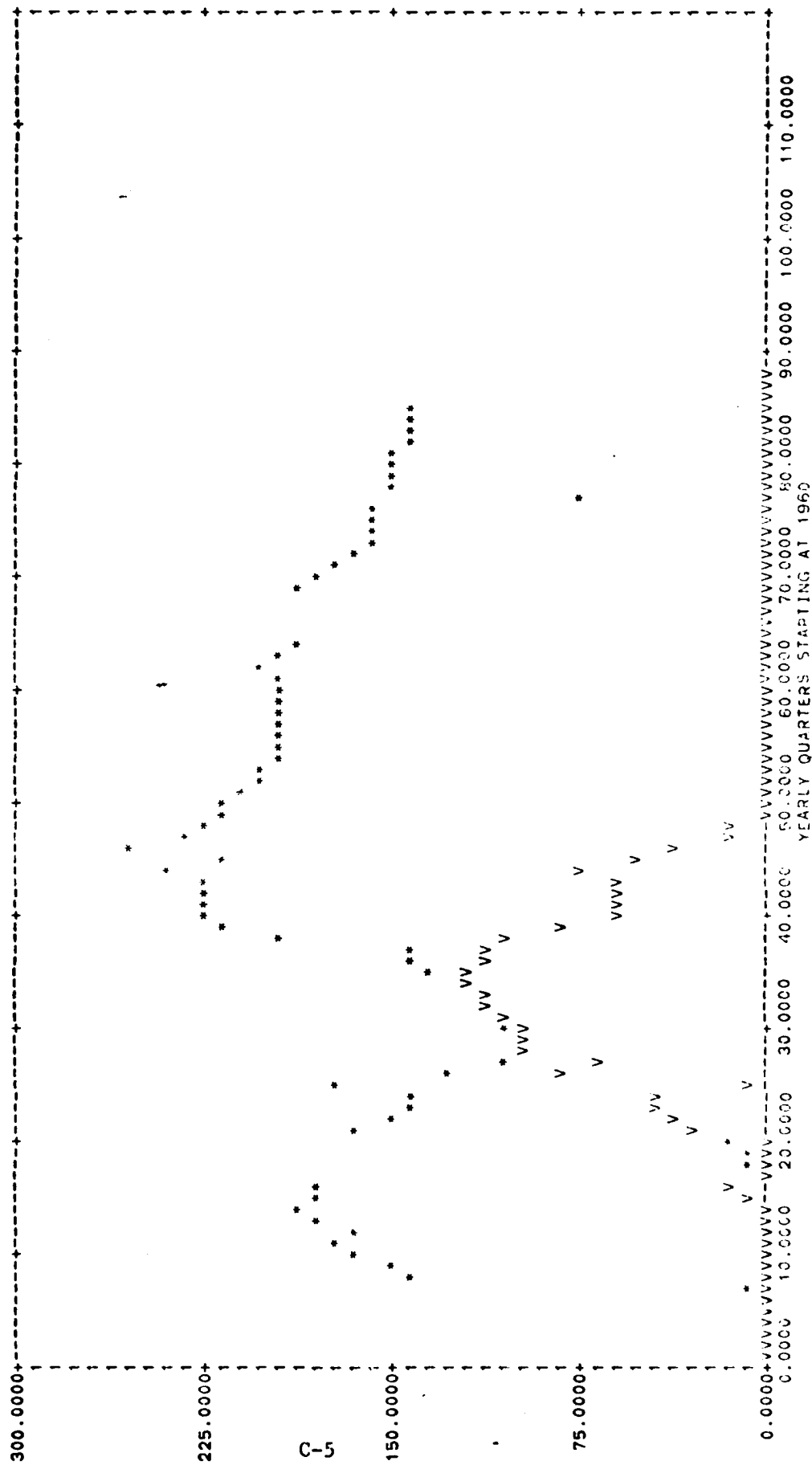
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DENSITY



WORLDWIDE AVERAGE= 1569.98 STANDARD DEVIATION= 744.1725 NUMBER OF OBSERVATIONS= 49
VIETNAM AVERAGE= 159.50 STANDARD DEVIATION= 103.3104 NUMBER OF OBSERVATIONS= 14

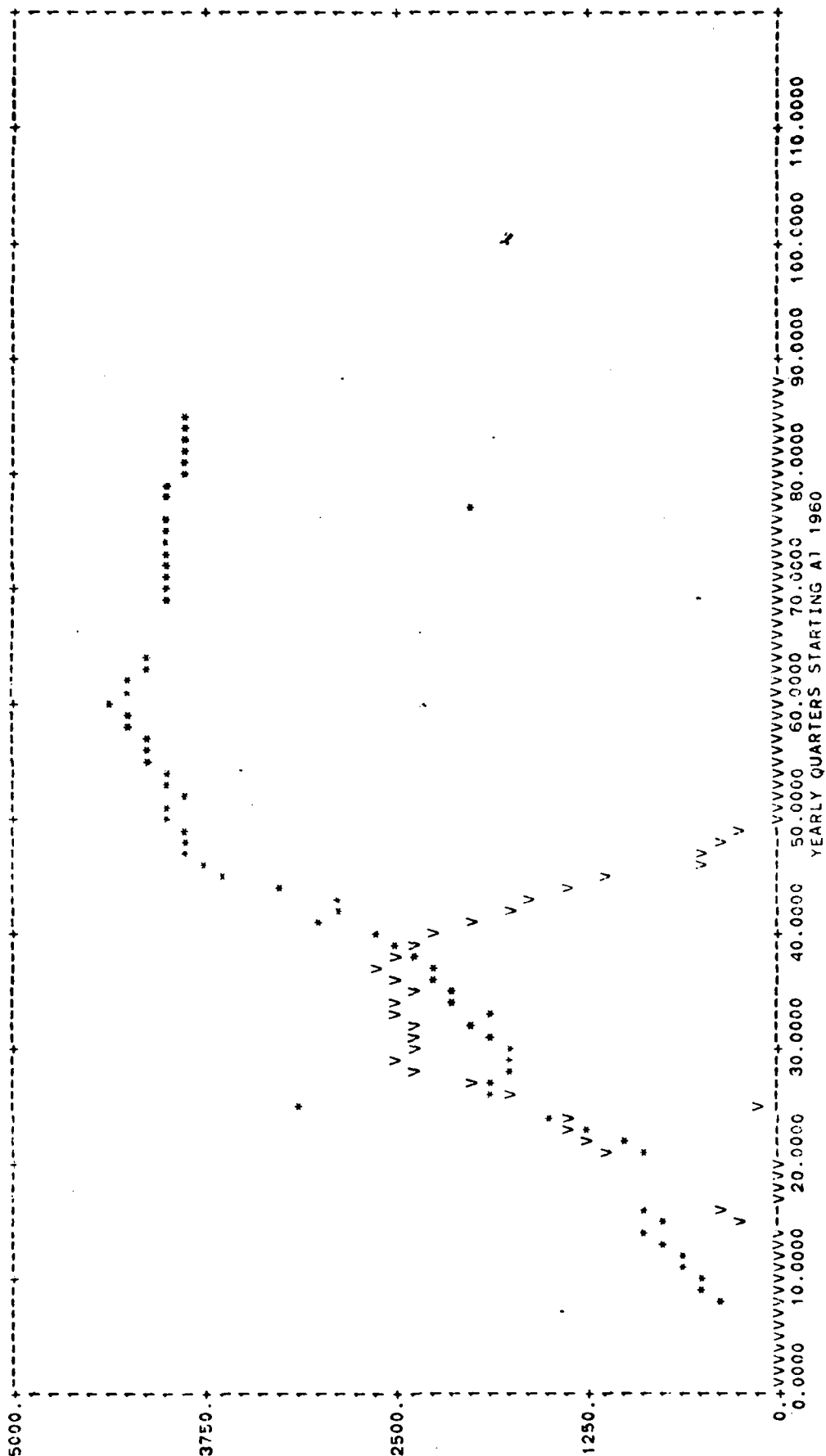
DENSITY



WORLDWIDE AVERAGE =	151.71	STANDARD DEVIATION =	64.8112	NUMBER OF OBSERVATIONS =	79
VIETNAM AVERAGE =	63.81	STANDARD DEVIATION =	39.0256	NUMBER OF OBSERVATIONS =	32

SYSTEM=UH-1
VARIABLE=

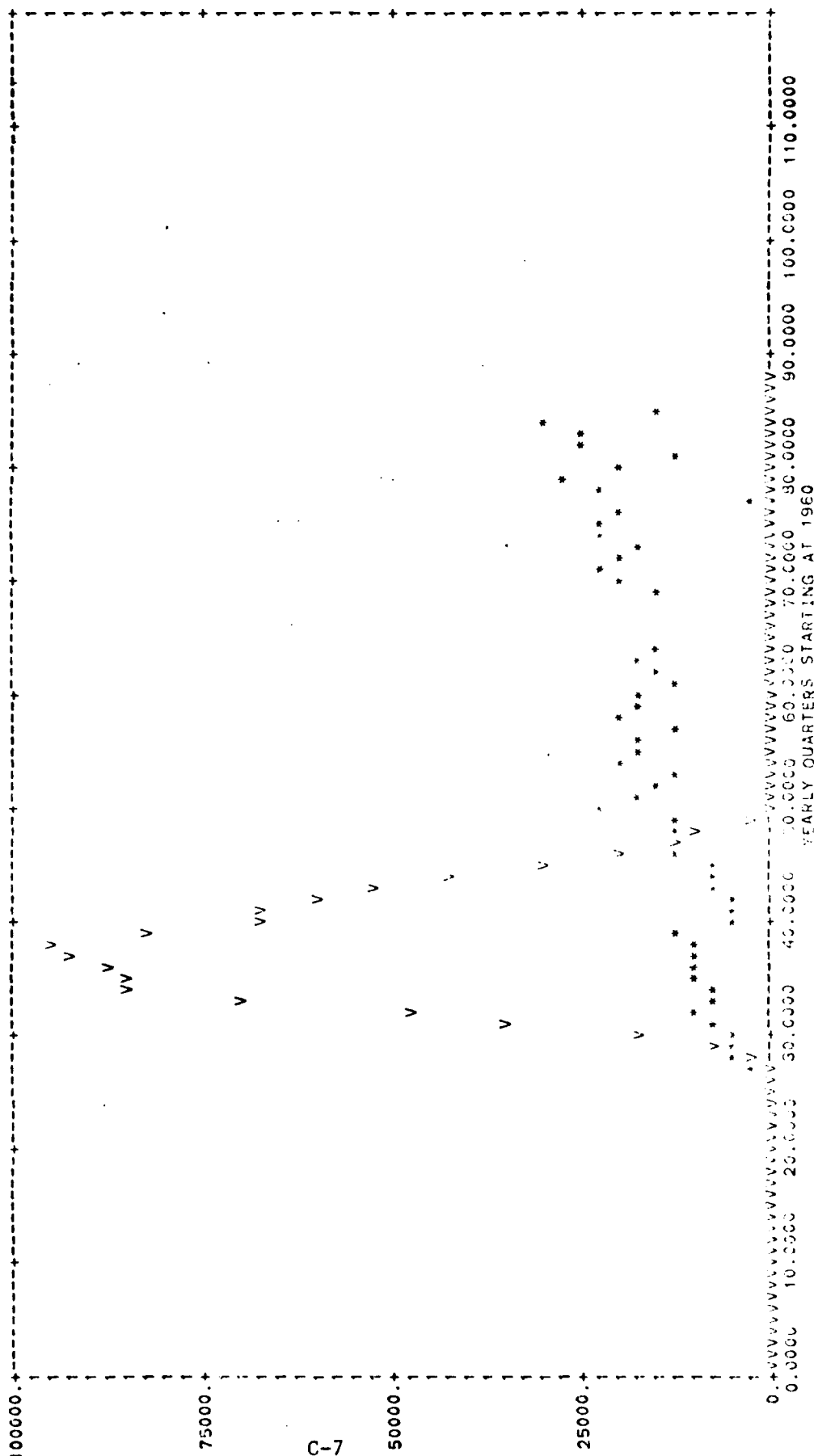
DENSITY



WORLDWIDE AVERAGE= 2669.21 STANDARD DEVIATION= 1464.4305 NUMBER OF OBSERVATIONS= 76
VIETNAM AVERAGE= 1539.00 STANDARD DEVIATION= 905.1690 NUMBER OF OBSERVATIONS= 33

SYSTEM=AH-1
YVARIABLE=

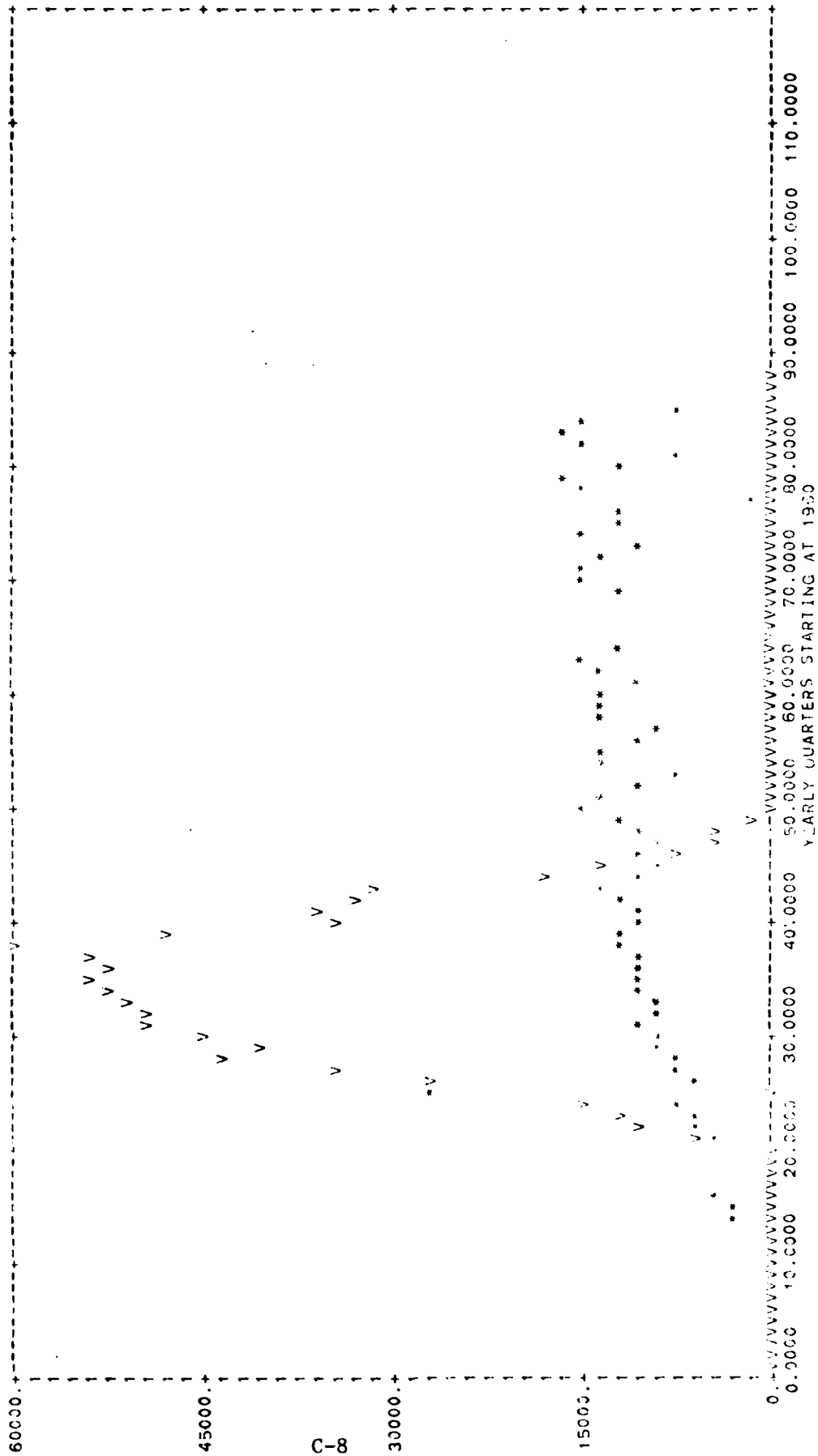
TOTAL FLYING HOURS



WORLDWIDE AVERAGE= 10009.02 STANDARD DEVIATION= 6967.4035 NUMBER OF OBSERVATIONS= 56
VIETNAM AVERAGE= 60180.43 STANDARD DEVIATION= 33069.4069 NUMBER OF OBSERVATIONS= 23

SYSTEM: CH-17
Y-VARIABLE=

TOTAL FLYING HOURS

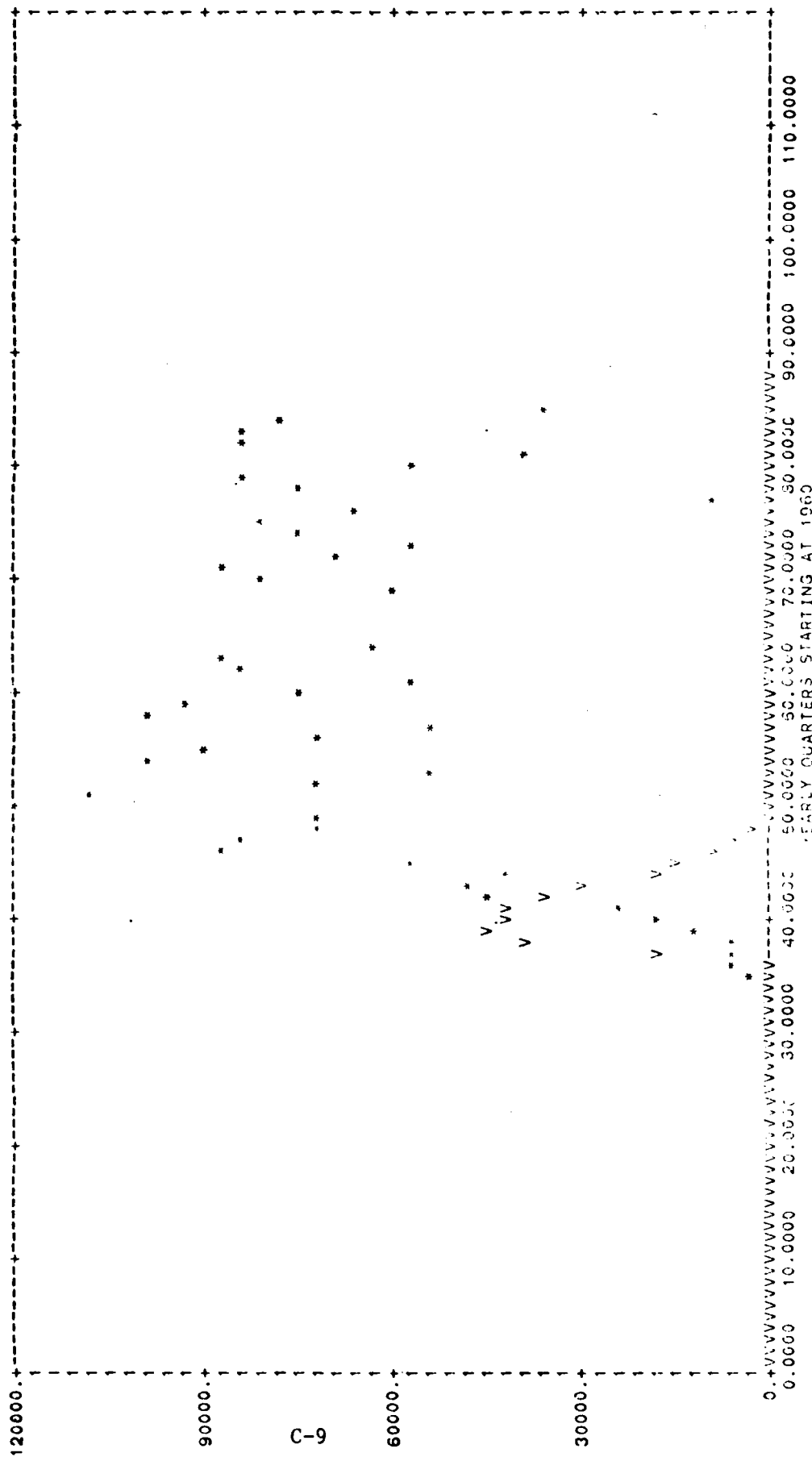


WORLDWIDE AVERAGE=	10517.82	STANDARD DEVIATION=	4314.8347	NUMBER OF OBSERVATIONS=	66
VIETNAM AVERAGE=	31661.46	STANDARD DEVIATION=	18935.0252	NUMBER OF OBSERVATIONS=	28

YEARLY QUARTERS STARTING AT 1950

SYSTEM=OH58
YVARIABLE=

TOTAL FLYING HOURS



WORLDWIDE AVERAGE= 30013.02
VIETNAM AVERAGE= 21313.43

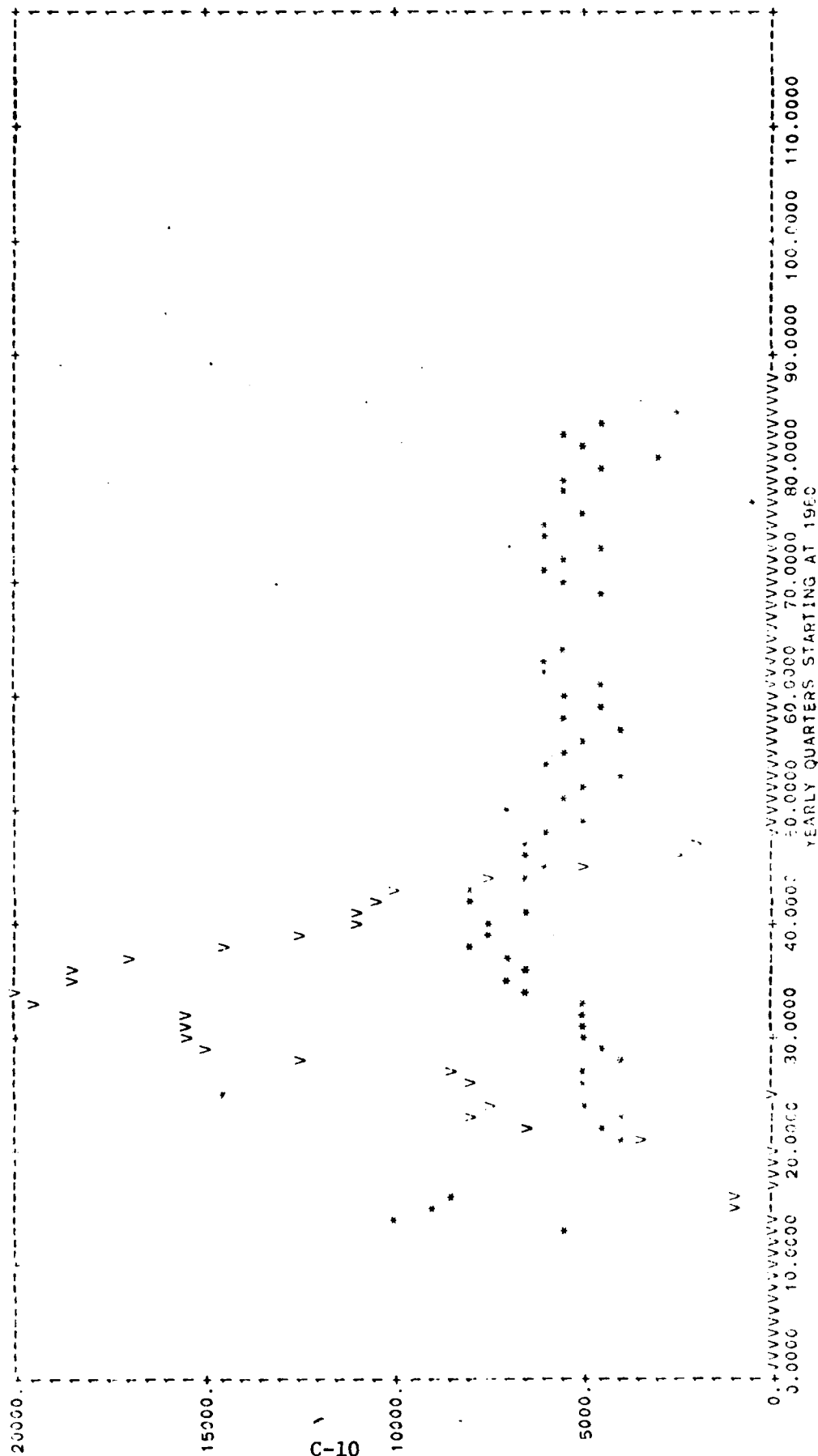
STANDARD DEVIATION= 30794.2305
STANDARD DEVIATION= 16750.2009

NUMBER OF OBSERVATIONS= 48
NUMBER OF OBSERVATIONS= 14

GRAPH-CUTLIER * AT 10. YVALUE= 120.000

SYSTEM-00-1
VARIABLES

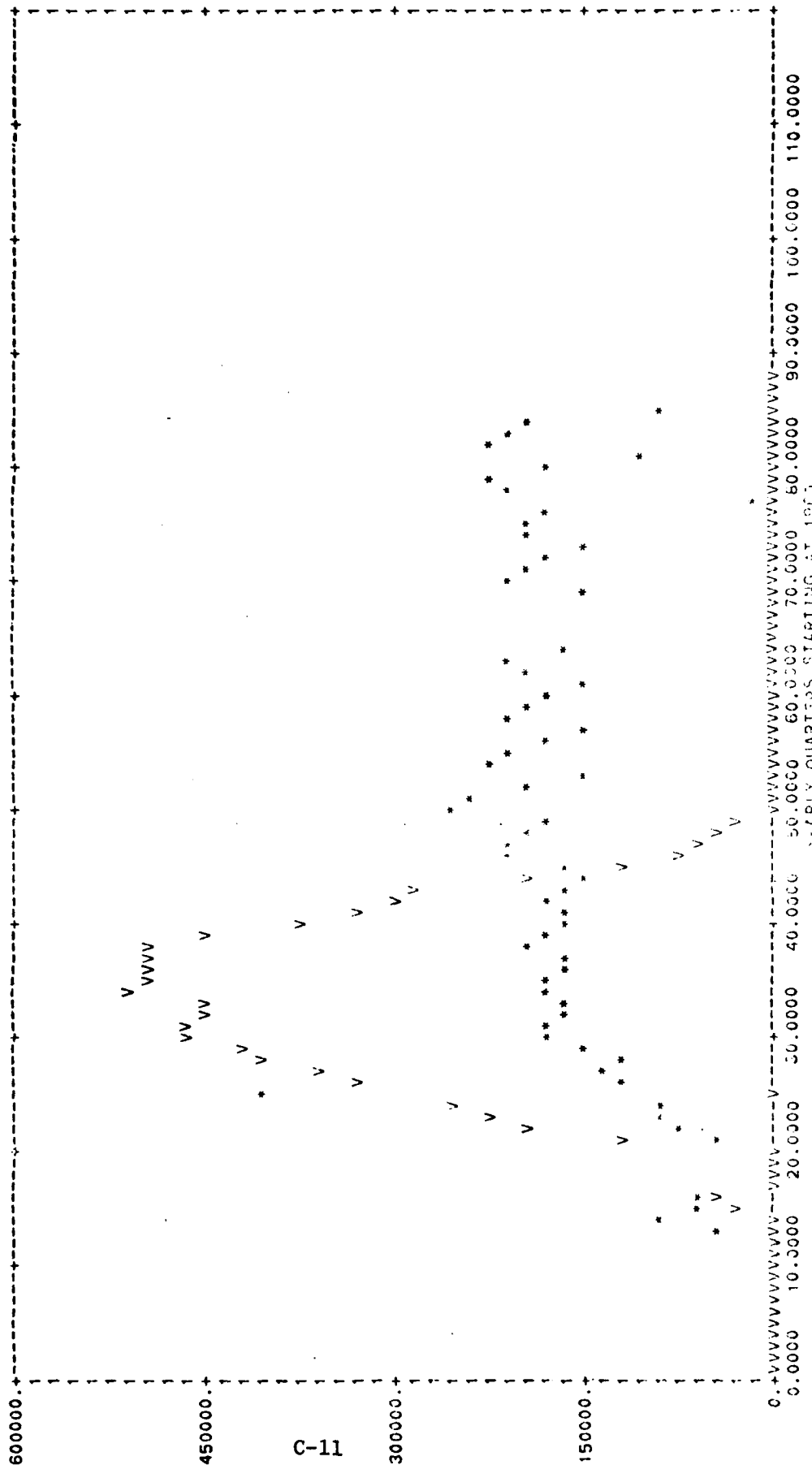
TOTAL FLYING HOURS



WORLDWIDE AVERAGE= 5706.32 STANDARD DEVIATION= 1843.9858 NUMBER OF OBSERVATIONS= 65
VIETNAM AVERAGE= 10301.45 STANDARD DEVIATION= 6027.2362 NUMBER OF OBSERVATIONS= 29

SYSTEM=UH-1
VARIABLE=

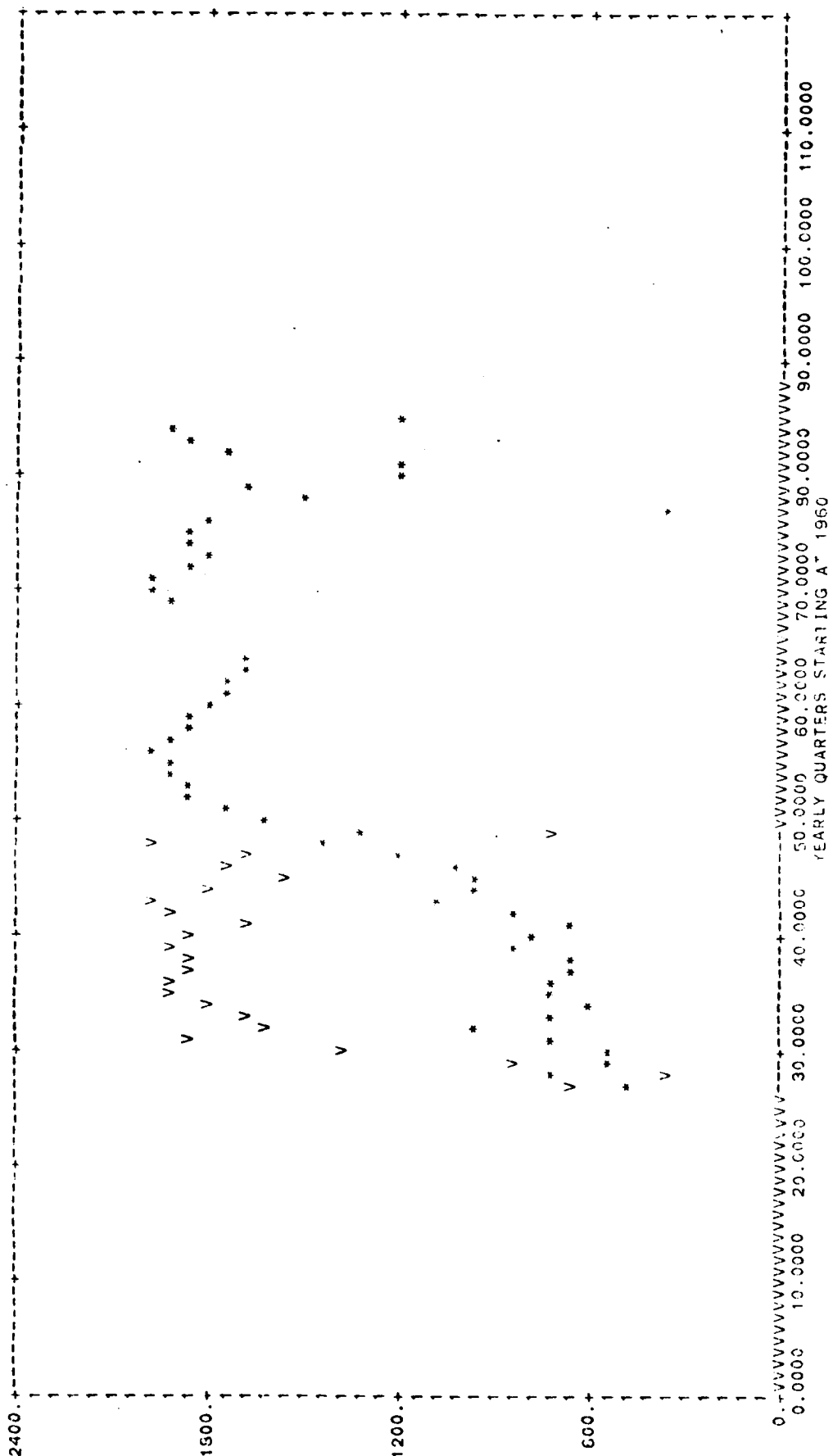
TOTAL FLYING HOURS



WORLDWIDE AVERAGE= 16923.37 STANDARD DEVIATION= 59266.4534 NUMBER OF OBSERVATIONS= 65
VIETNAM AVERAGE= 292542.87 STANDARD DEVIATION= 169784.4533 NUMBER OF OBSERVATIONS= 30

SYSTEM=3H-1
YVARIABLE=

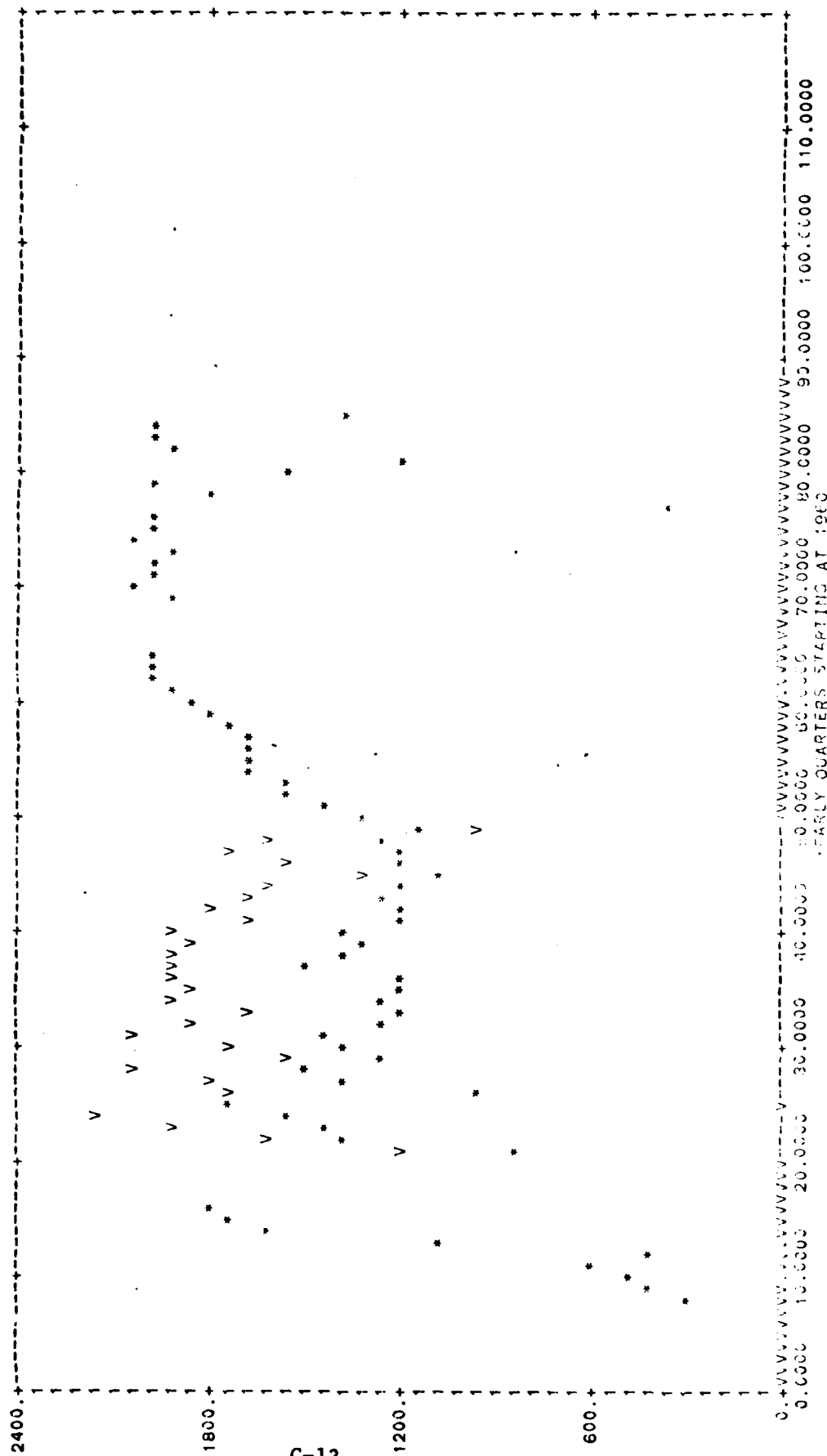
AVG HOURS ON HAND



WORLDWIDE AVERAGE= 1345.65 STANDARD DEVIATION= 533.1166 NUMBER OF OBSERVATIONS= 55
VIETNAM AVERAGE= 1590.82 STANDARD DEVIATION= 472.0006 NUMBER OF OBSERVATIONS= 23

SYSTEM=CH47
YVARIABLE=

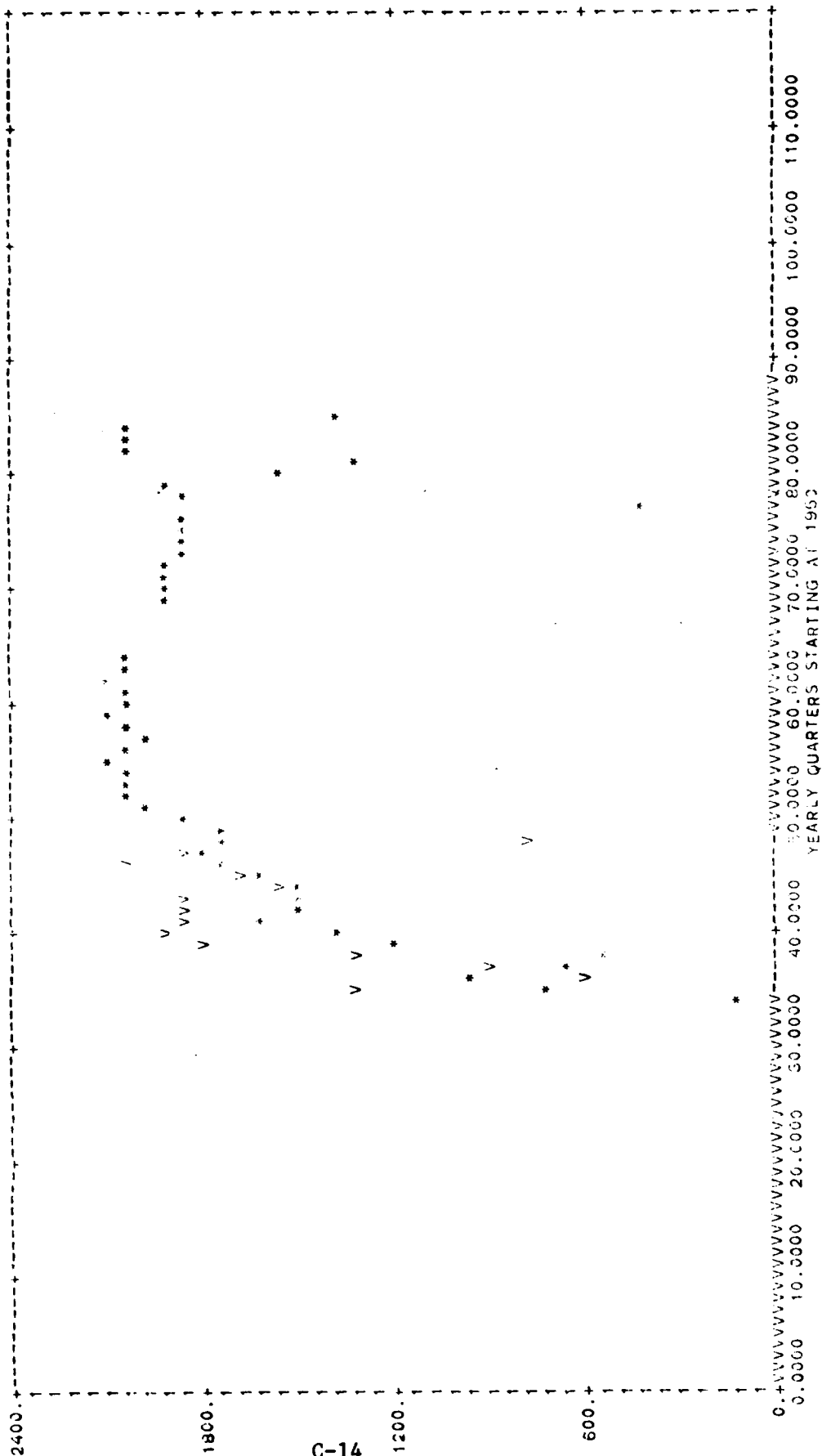
AVG HOURS ON HAND



WORLDWIDE AVERAGE= 1451.47
VIETNAM AVERAGE= 1753.18
STANDARD DEVIATION= 440.9849
STANDARD COEFFICIENT= 257.9447
NUMBER OF OBSERVATIONS= 70
NUMBER OF OBSERVATIONS= 28

SYSTEM-OPS
YARIABLE=

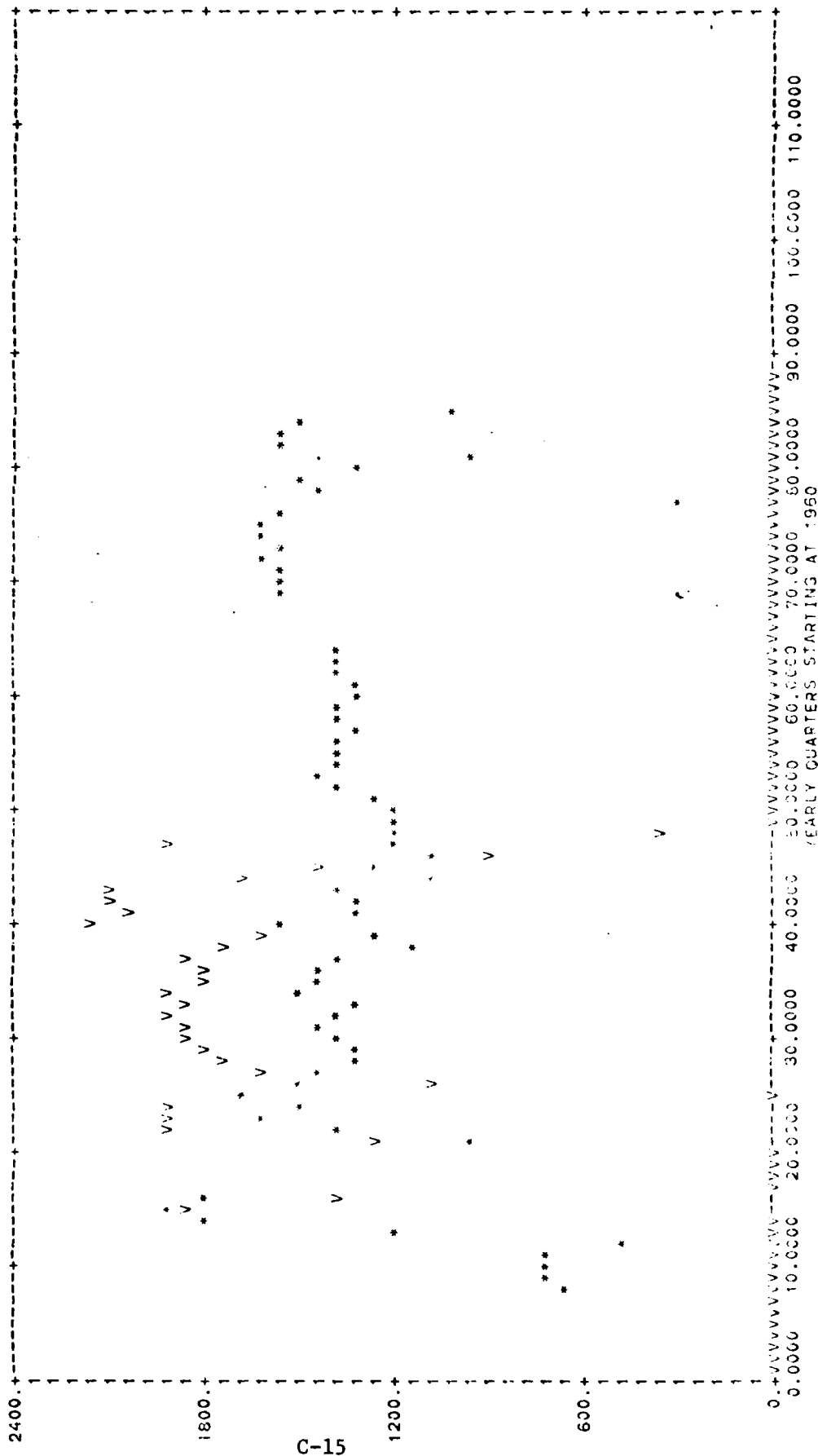
AVG HOURS ON HAND



WORLDWIDE AVERAGE= 1674.65 STANDARD DEVIATION= 493.0352 NUMBER OF OBSERVATIONS= 48
VIETNAM AVERAGE= 1525.02 STANDARD DEVIATION= 472.2517 NUMBER OF OBSERVATIONS= 14

SYSTEM=OV-1
YVARIABLE=

AVG HOURS ON HAND

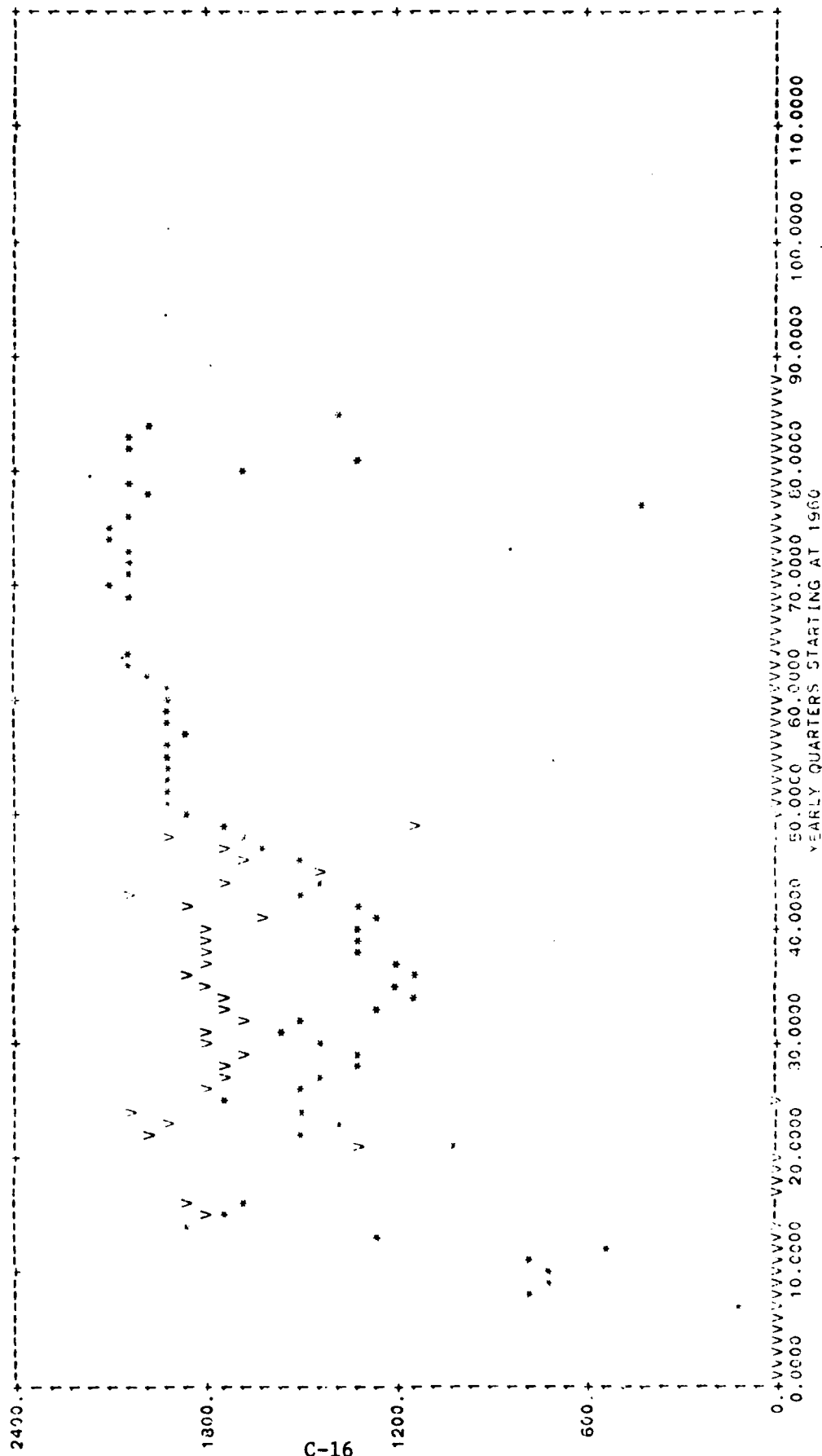


WORLDWIDE AVERAGE= 1332.69 STANDARD DEVIATION= 293.3083 NUMBER OF OBSERVATIONS= 70
VIETNAM AVERAGE= 1002.09 STANDARD DEVIATION= 538.5353 NUMBER OF OBSERVATIONS= 29

(EARLY QUARTERS STARTING AT 1960)

SYSTEM=H-1
YVARIABLE=

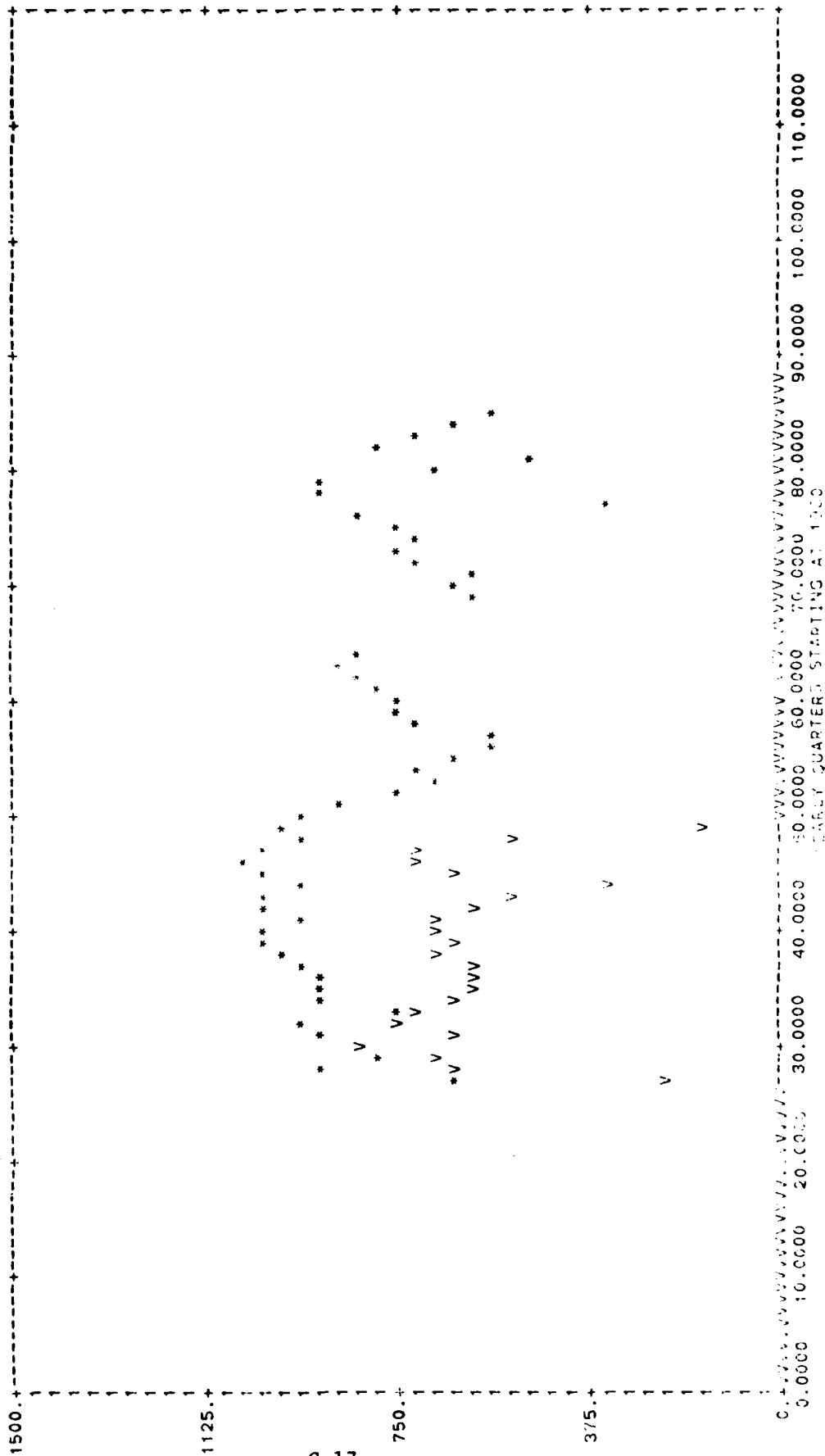
AVG HOURS ON WING



WORLDWIDE AVERAGE= 1503.50 STANDARD DEVIATION= 445.2417 NUMBER OF OBSERVATIONS= 71
VIETNAM AVERAGE= 1754.13 STANDARD DEVIATION= 187.7075 NUMBER OF OBSERVATIONS= 30

SYSTEM=AH-1
VARIABLE=

STANDARD DEVIATION OF HOURS ON HAND

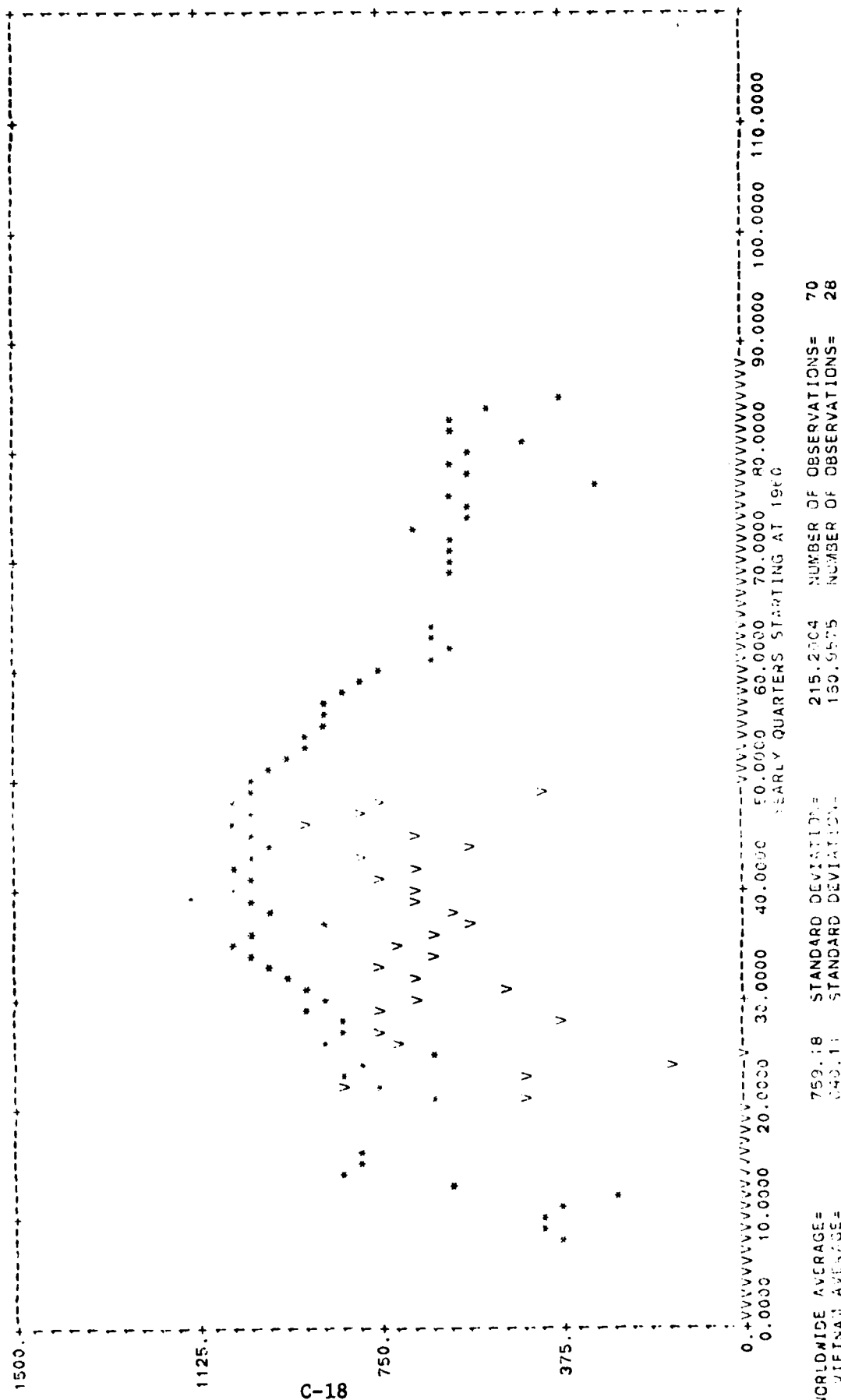


WORLDWIDE AVERAGE= 802.41 STANDARD DEVIATION= 159.0027 NUMBER OF OBSERVATIONS= 55
VIETNAM AVERAGE= 559.84 STANDARD DEVIATION= 162.4461 NUMBER OF OBSERVATIONS= 23

EARLY QUARTERS STARTING AT 1960

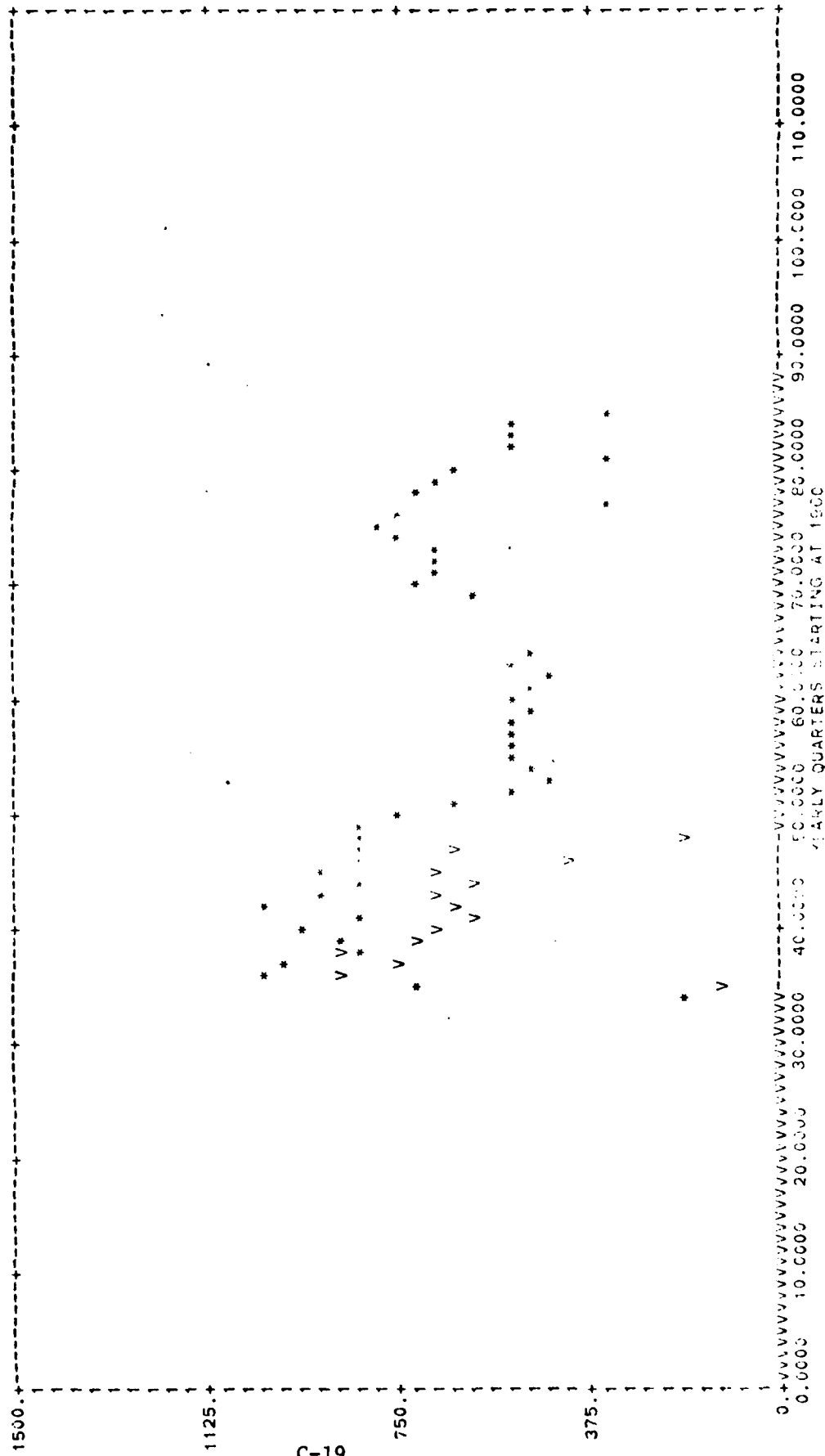
SYSTEM CMM7
YVARIABLE

STANDARD DEVIATION OF HOURS ON HAND



SYSTEM=OH58
YVARIABLE=

STANDARD DEVIATION OF HOURS ON HAND

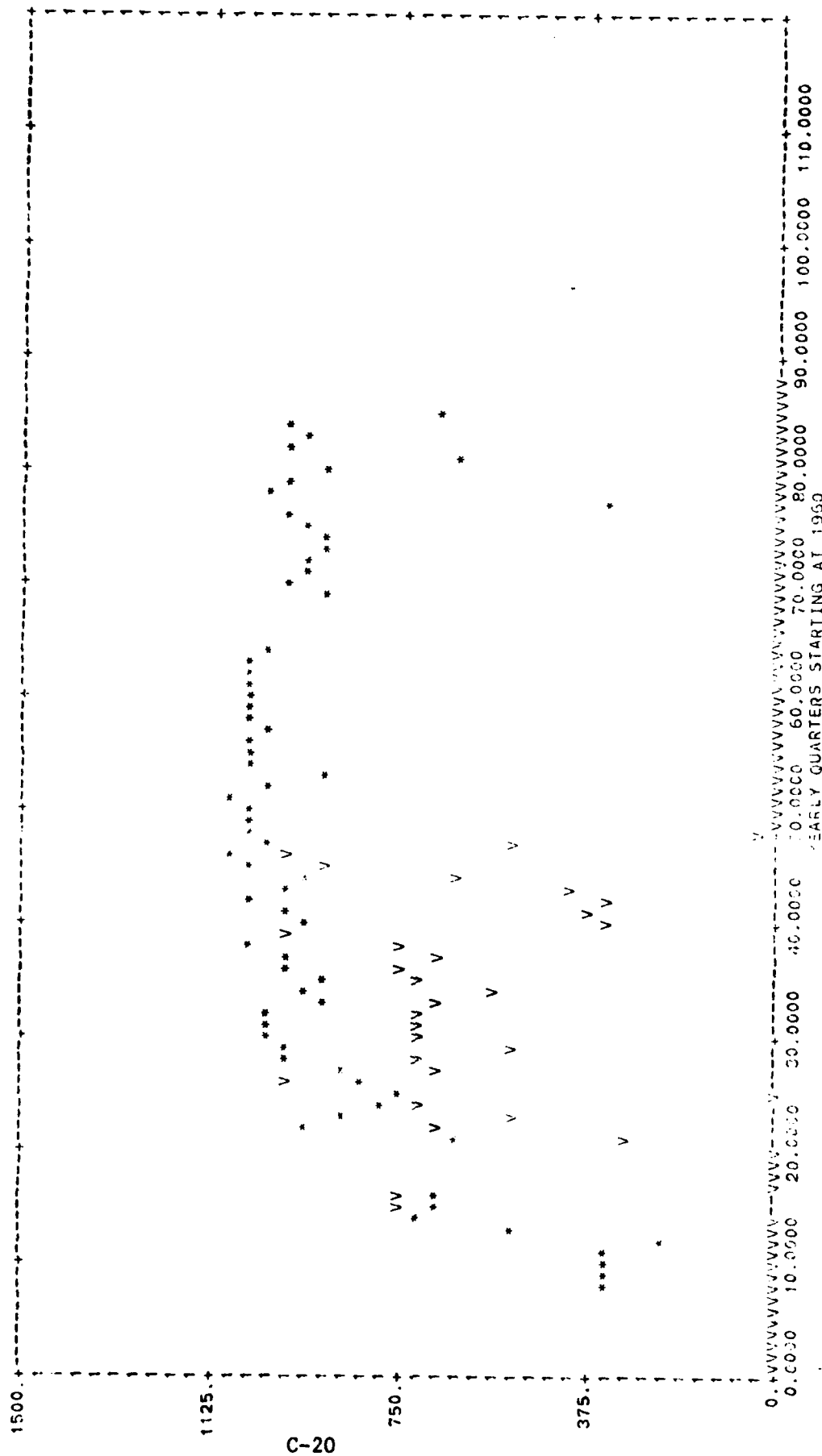


C-19

WORLDWIDE AVERAGE= 653.93 STANDARD DEVIATION= 191.9156 NUMBER OF OBSERVATIONS= 48
VIETNAM AVERAGE= 544.67 STANDARD DEVIATION= 216.0129 NUMBER OF OBSERVATIONS= 14

SYSTEM CV-1
VARIABLE=

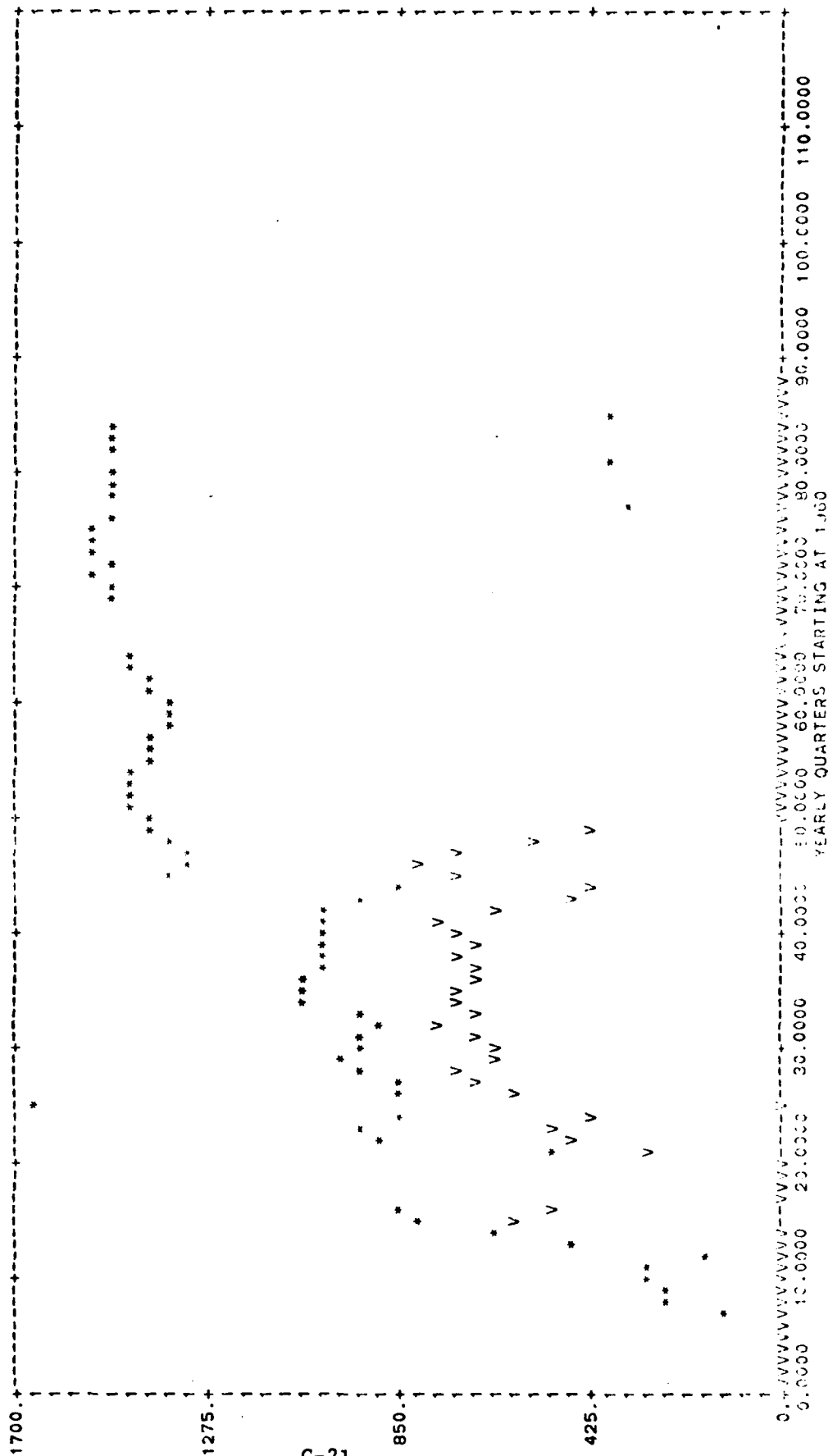
STANDARD DEVIATION OF HOURS ON HAND



WORLDWIDE AVERAGE= 985.57 STANDARD DEVIATION= 212.0140 NUMBER OF OBSERVATIONS= 70
VIETNAM AVERAGE= 633.13 STANDARD DEVIATION= 216.1561 NUMBER OF OBSERVATIONS= 29

SYSTEM=UH-1
VARIABLE=

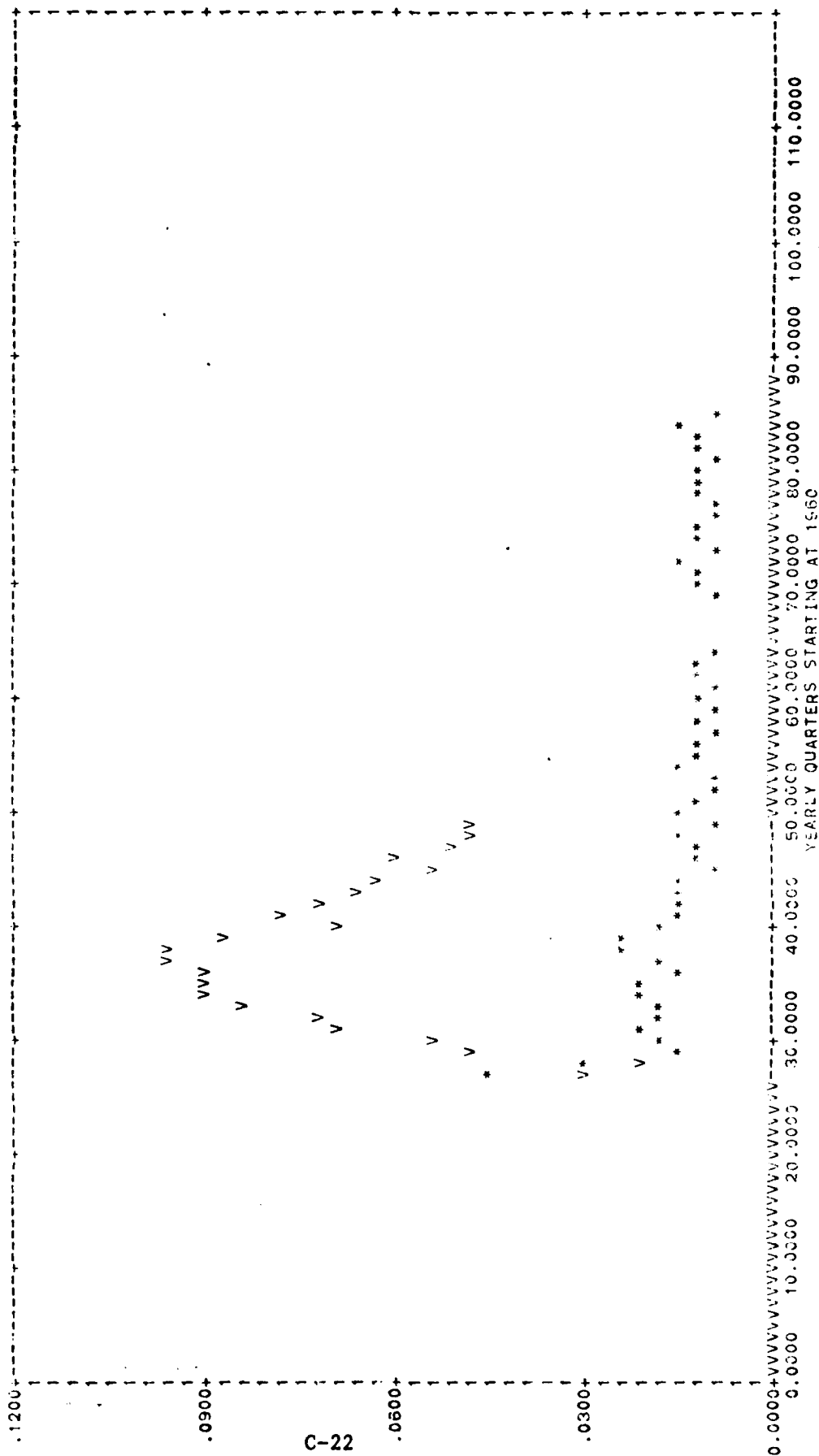
STANDARD DEVIATION OF HOURS ON HAND



WORLDWIDE AVERAGE= 1089.60 STANDARD DEVIATION= 416.0741 NUMBER OF OBSERVATIONS= 71
VIETNAM AVERAGE= 613.19 STANDARD DEVIATION= 126.0114 NUMBER OF OBSERVATIONS= 30

SYSTEM=NH-1
VARIABLE=

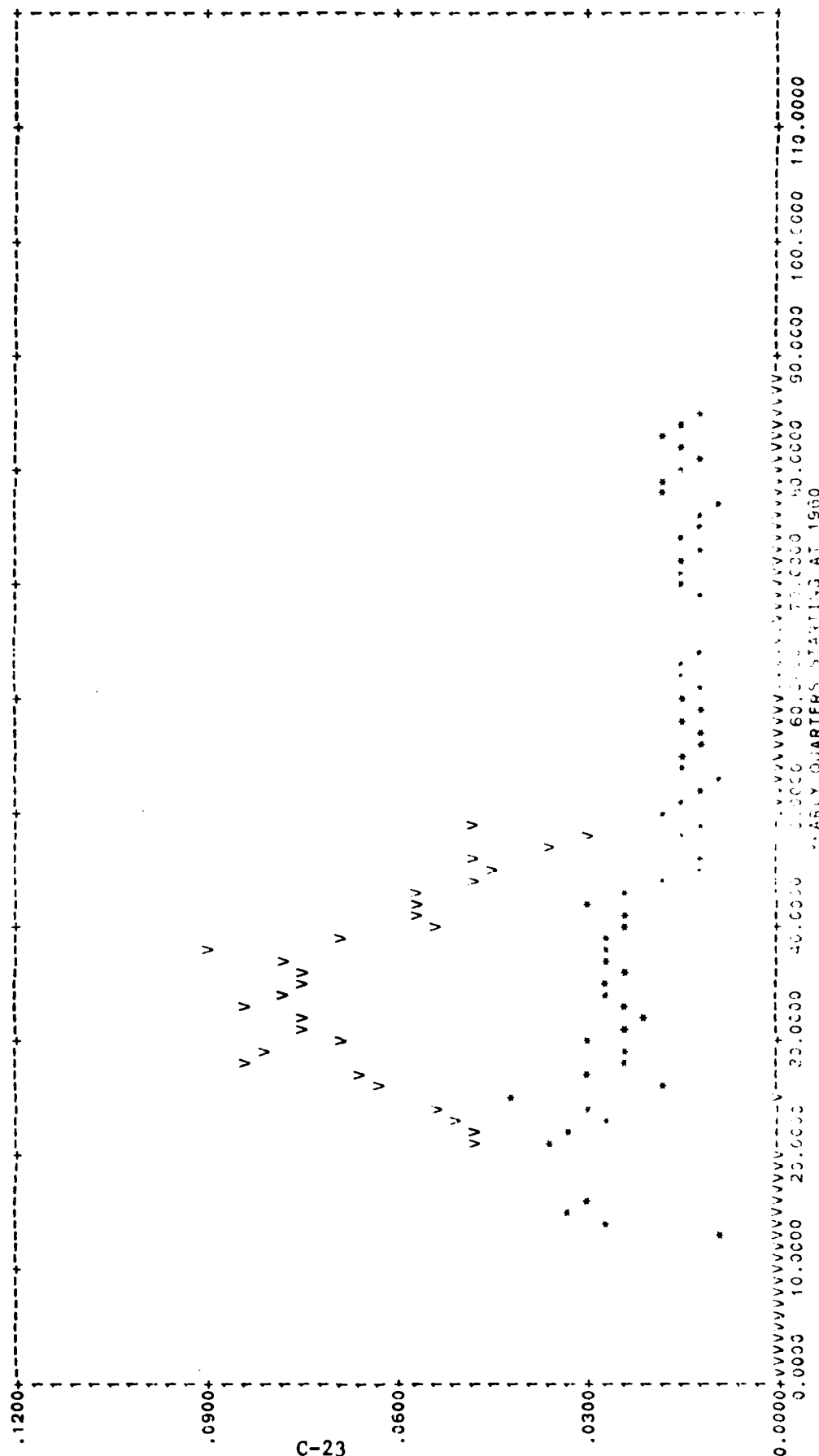
AVERAGE USAGE



WORLDWIDE AVERAGE= .01 STANDARD DEVIATION= .0063 NUMBER OF OBSERVATIONS= 55
VIETNAM AVERAGE= .07 STANDARD DEVIATION= .0208 NUMBER OF OBSERVATIONS= 23

SYSTEM=CH47
VARIABLE=

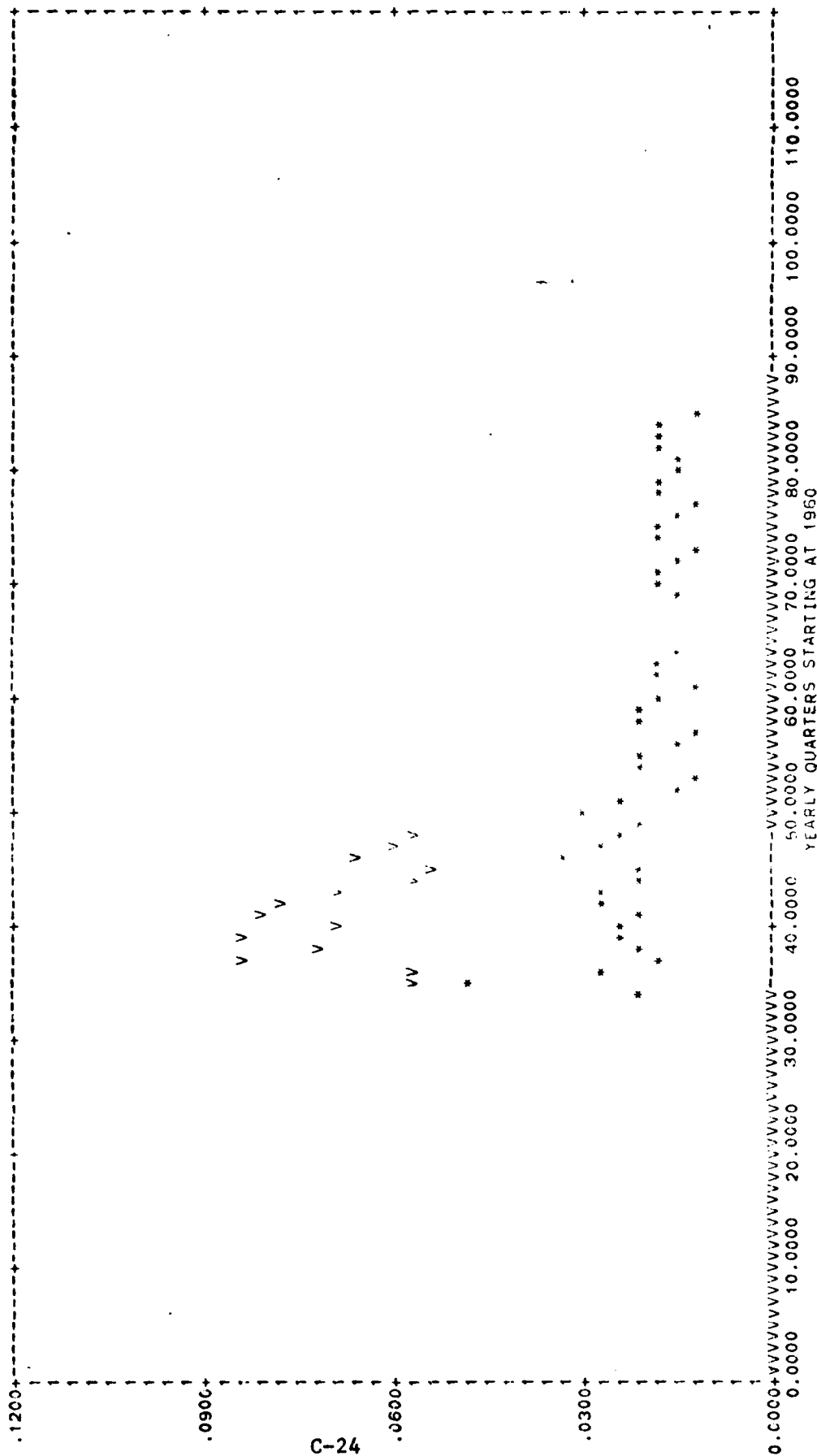
AVERAGE USAGE



WORLDWIDE AVERAGE = .02 NUMBER OF OBSERVATIONS = 65
VIETNAM AVERAGE = .02 NUMBER OF OBSERVATIONS = 28

SYSTEM:CHE9
VARIABLE=

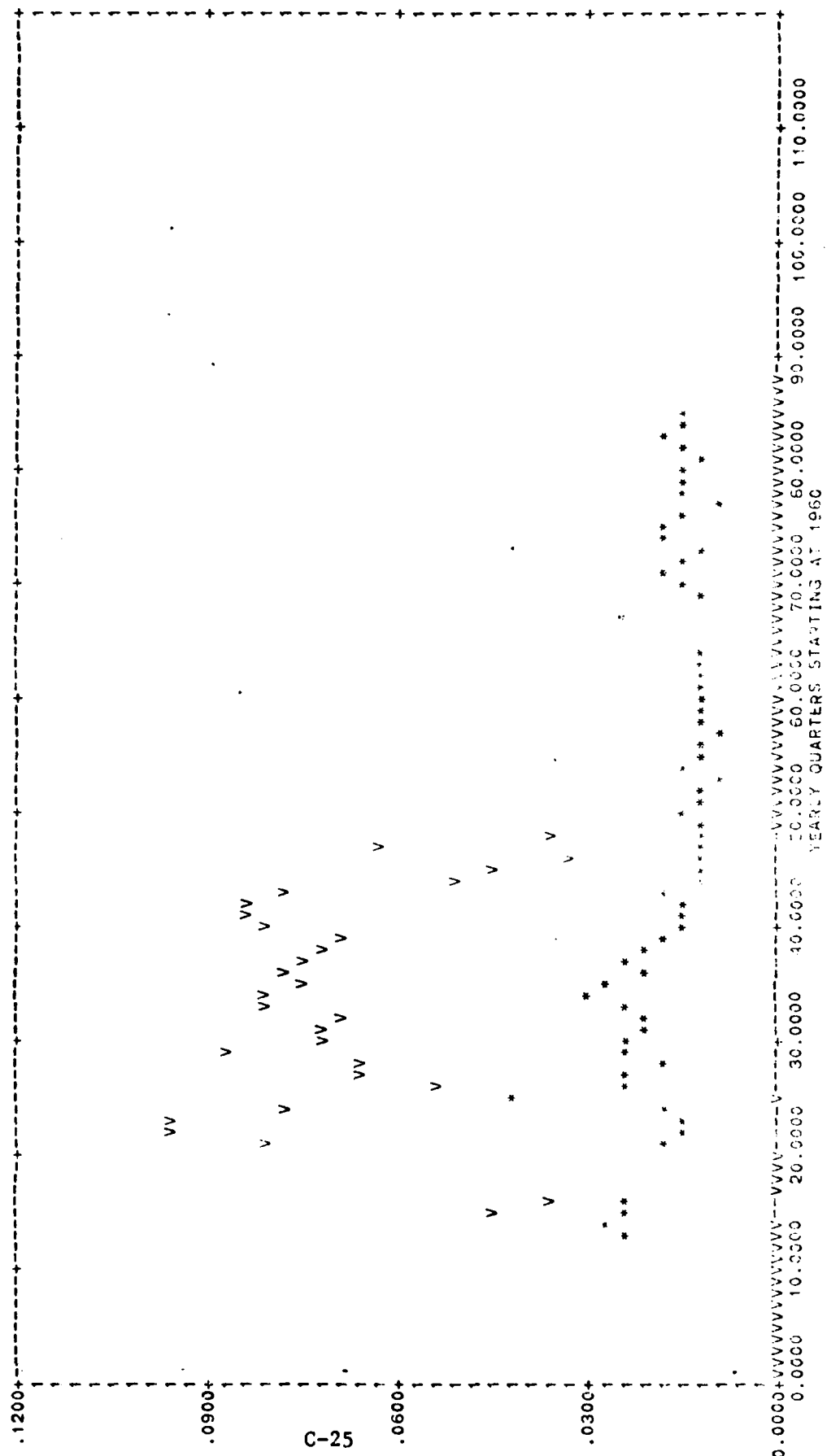
AVERAGE US\$100



WORLDWIDE AVERAGE= .02 STANDARD DEVIATION= .0065 NUMBER OF OBSERVATIONS= 48
VIETNAM AVERAGE= .07 STANDARD DEVIATION= .0110 NUMBER OF OBSERVATIONS= 14

SYSTEM=QV-1
YVARIABLE=

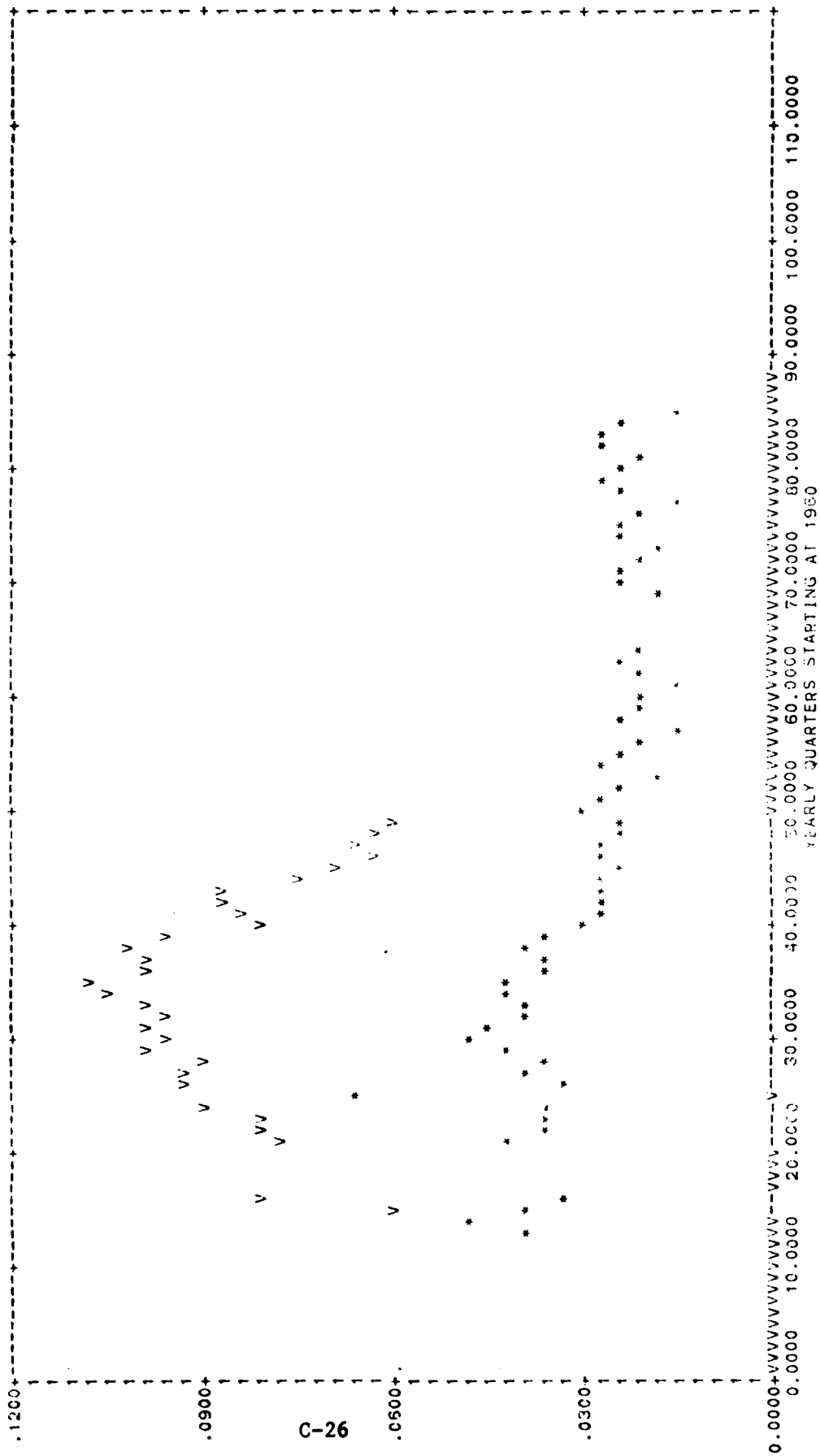
AVERAGE USAGE



WORLDWIDE AVERAGE= .02 STANDARD DEVIATION= .0006 NUMBER OF OBSERVATIONS= 65
VIETNAM AVERAGE= .07 STANDARD DEVIATION= .0173 NUMBER OF OBSERVATIONS= 29

SYSTEM-1
VARIABLE

AVERAGE US-1

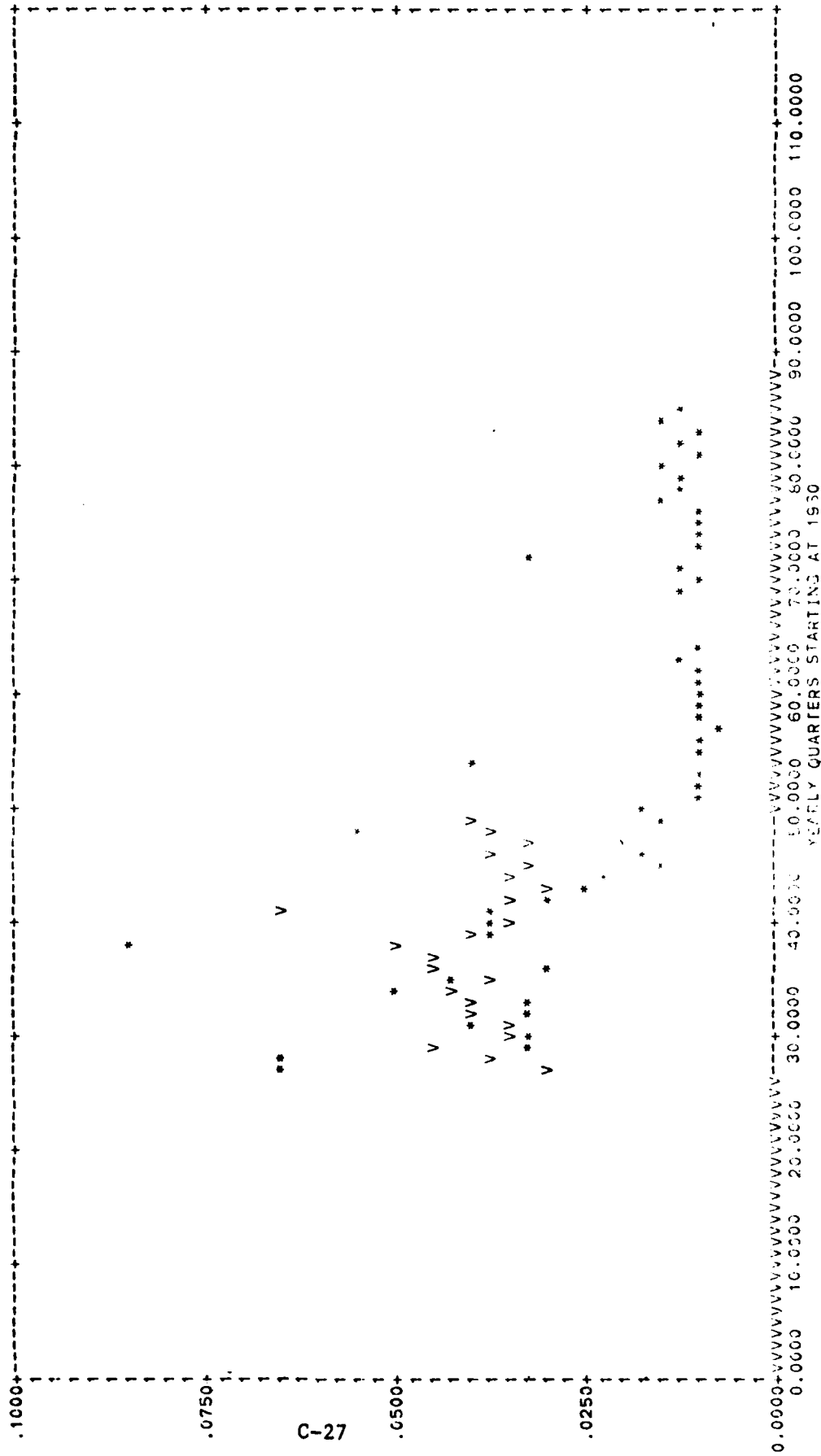


C-26

WORLDWIDE AVERAGE = .03 STANDARD DEVIATION = .0099 NUMBER OF OBSERVATIONS = 65
VIETNAM AVERAGE = .09 STANDARD DEVIATION = .0139 NUMBER OF OBSERVATIONS = 30

SYSTEM=AH-1
YVARIABLE=

STANDARD DEVIATION OF USAGE



WORLDWIDE AVERAGE=
VIETNAM AVERAGE=

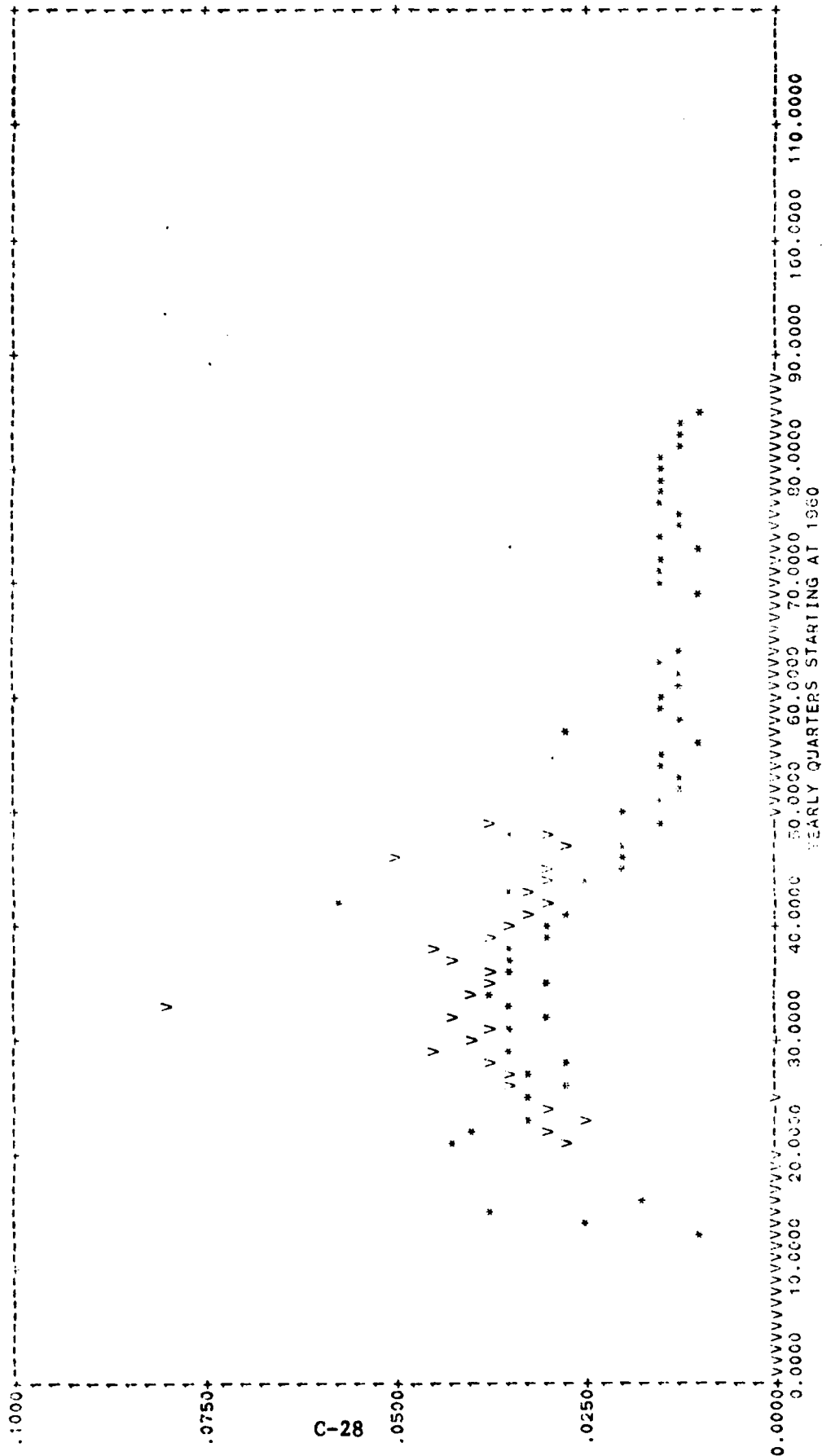
.02 STANDARD DEVIATION=
.04 STANDARD DEVIATION=

.0172 NUMBER OF OBSERVATIONS=
.0073 NUMBER OF OBSERVATIONS=

55
23

SYSTEM=C-47
VARIABLE=

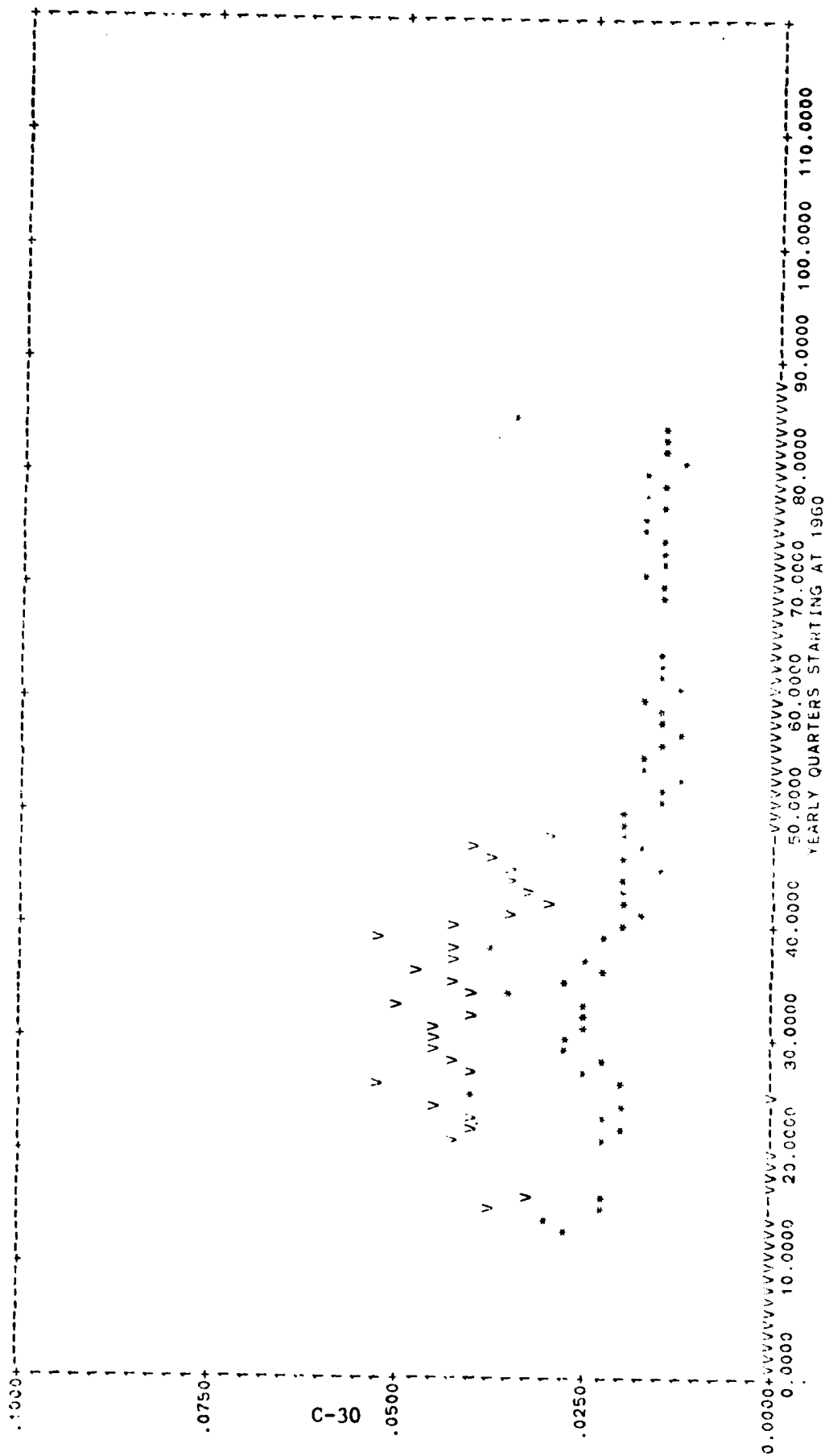
STANDARD DEVIATION OF USAGE



WORLDWIDE AVERAGE= .02 STANDARD DEVIATION= .0110 NUMBER OF OBSERVATIONS= 66
VIETNAM AVERAGE= .04 STANDARD DEVIATION= .0103 NUMBER OF OBSERVATIONS= 28

SYSTEM:GV-1
VARIABLE=

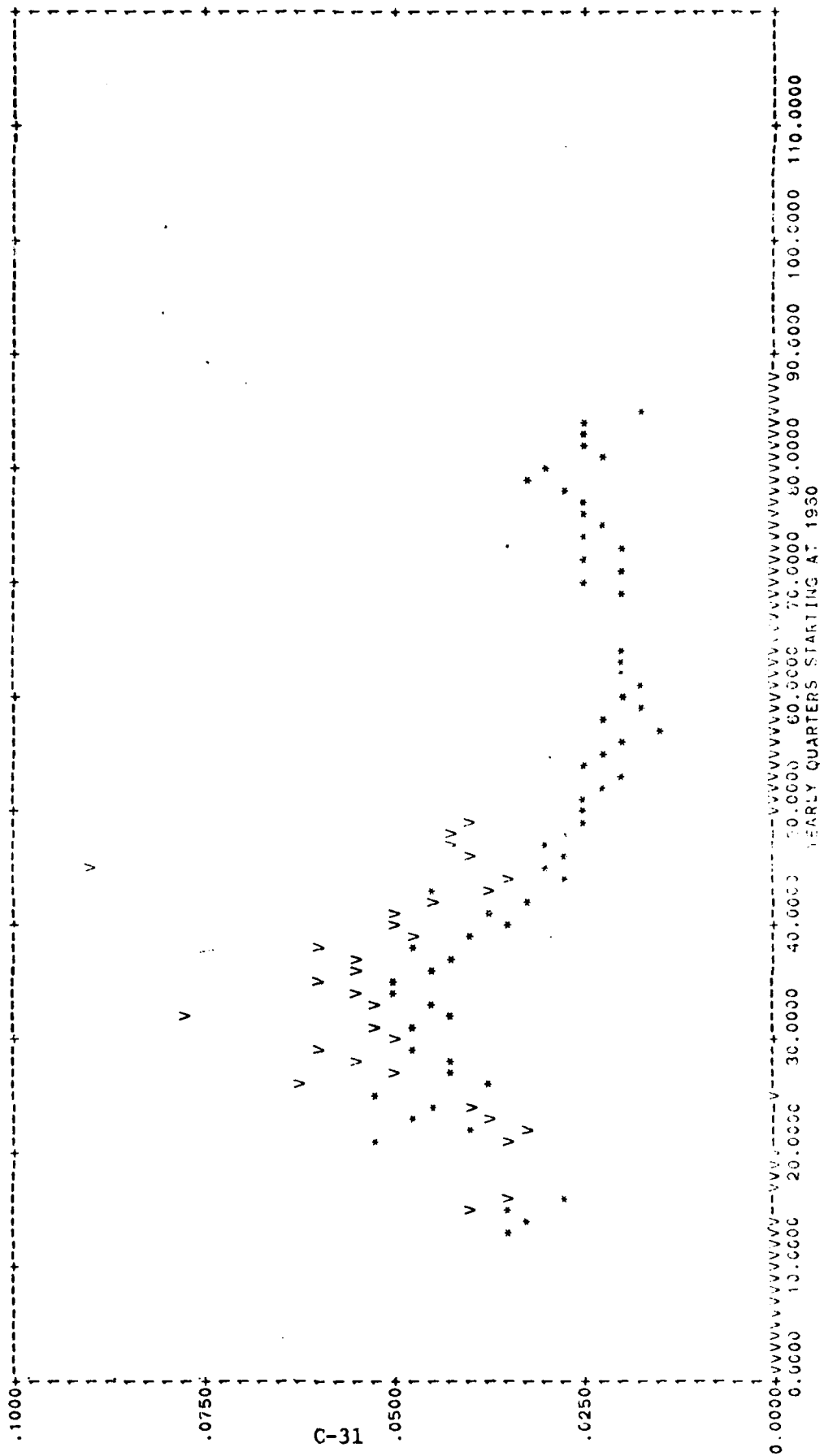
STANDARD DEVIATION OF USAGE



WORLDWIDE AVERAGE= .02 STANDARD DEVIATION= .0060 NUMBER OF OBSERVATIONS= 65
VIETNAM AVERAGE= .04 STANDARD DEVIATION= .0038 NUMBER OF OBSERVATIONS= 29

SYSTEM=UH-1
VARIABLE=

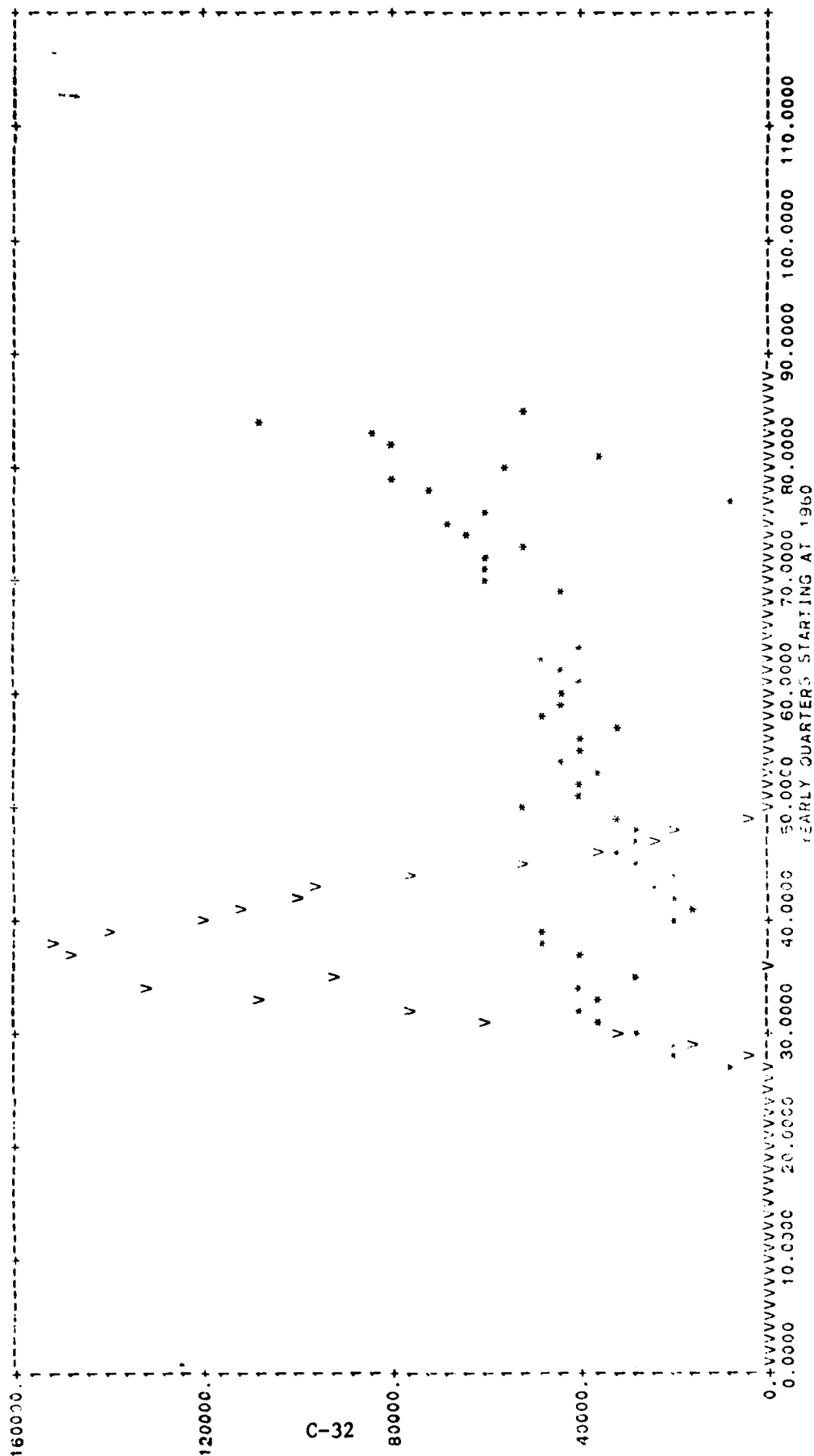
STANDARD DEVIATION OF USAGE



WORLDWIDE AVERAGE= .03 STANDARD DEVIATION= .0100 NUMBER OF OBSERVATIONS= 65
VIETNAM AVERAGE= .03 STANDARD DEVIATION= .0107 NUMBER OF OBSERVATIONS= 30

SYSTEM-1
VARIABLE:

TOTAL NUMBER OF SORTIES

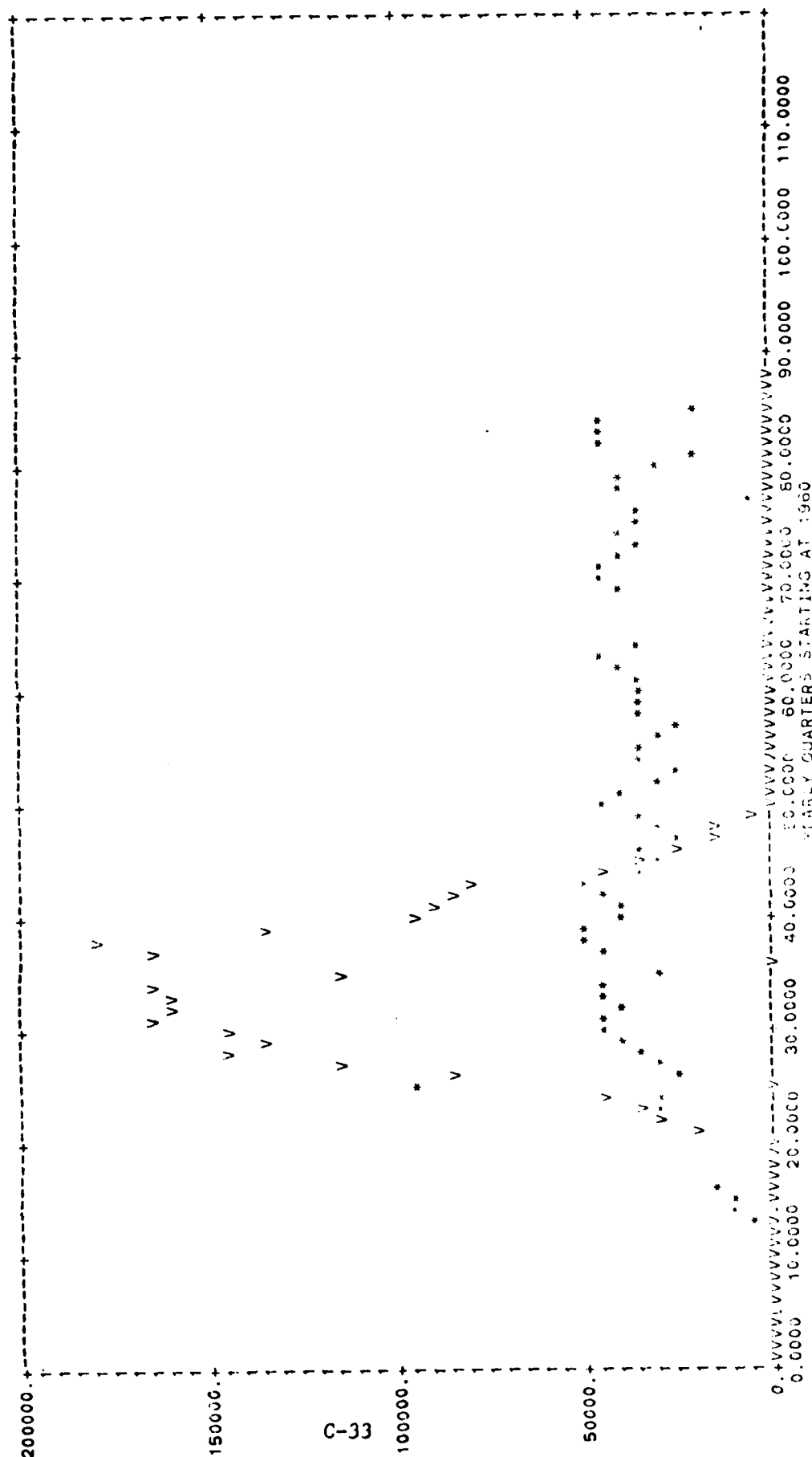


WORLDWIDE AVERAGE= 41972.50 STANDARD DEVIATION= 20104.2462 NUMBER OF OBSERVATIONS= 55
VIETNAM AVERAGE= 72526.50 STANDARD DEVIATION= 50350.0673 NUMBER OF OBSERVATIONS= 22

EARLY QUARTERS STARTING AT 1960

SYSTEM=CH47
VARIABLE=

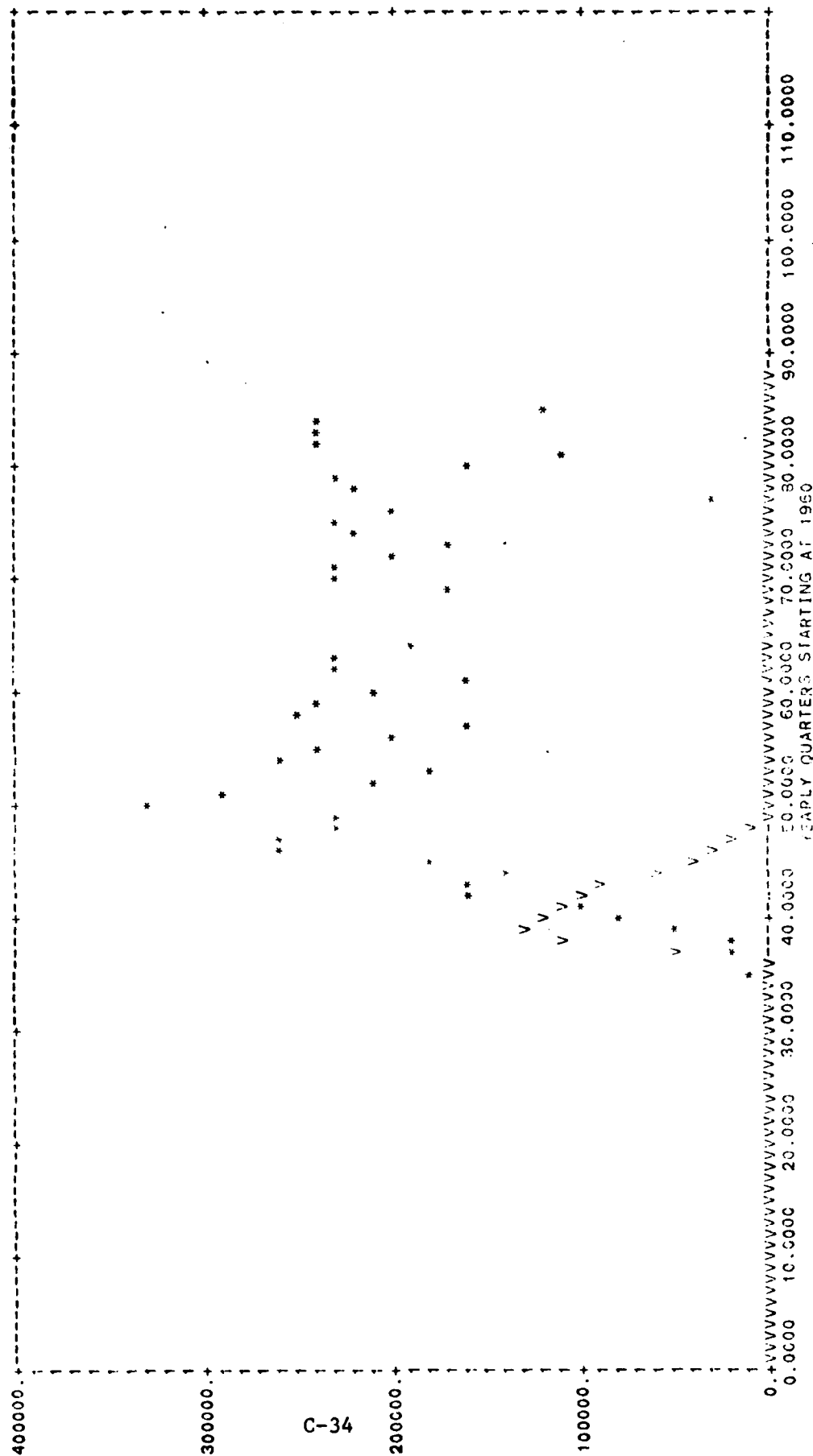
TOTAL NUMBER OF SORTIES



WORLDWIDE AVERAGE= 35283.75 STANDARD DEVIATION= 12849.8028 NUMBER OF OBSERVATIONS= 64
VIETNAM AVERAGE= 91023.11 STANDARD DEVIATION= 58184.8538 NUMBER OF OBSERVATIONS= 27

SYSTEM: C-59
VARIABLE:

TOTAL NUMBER OF SORTIES

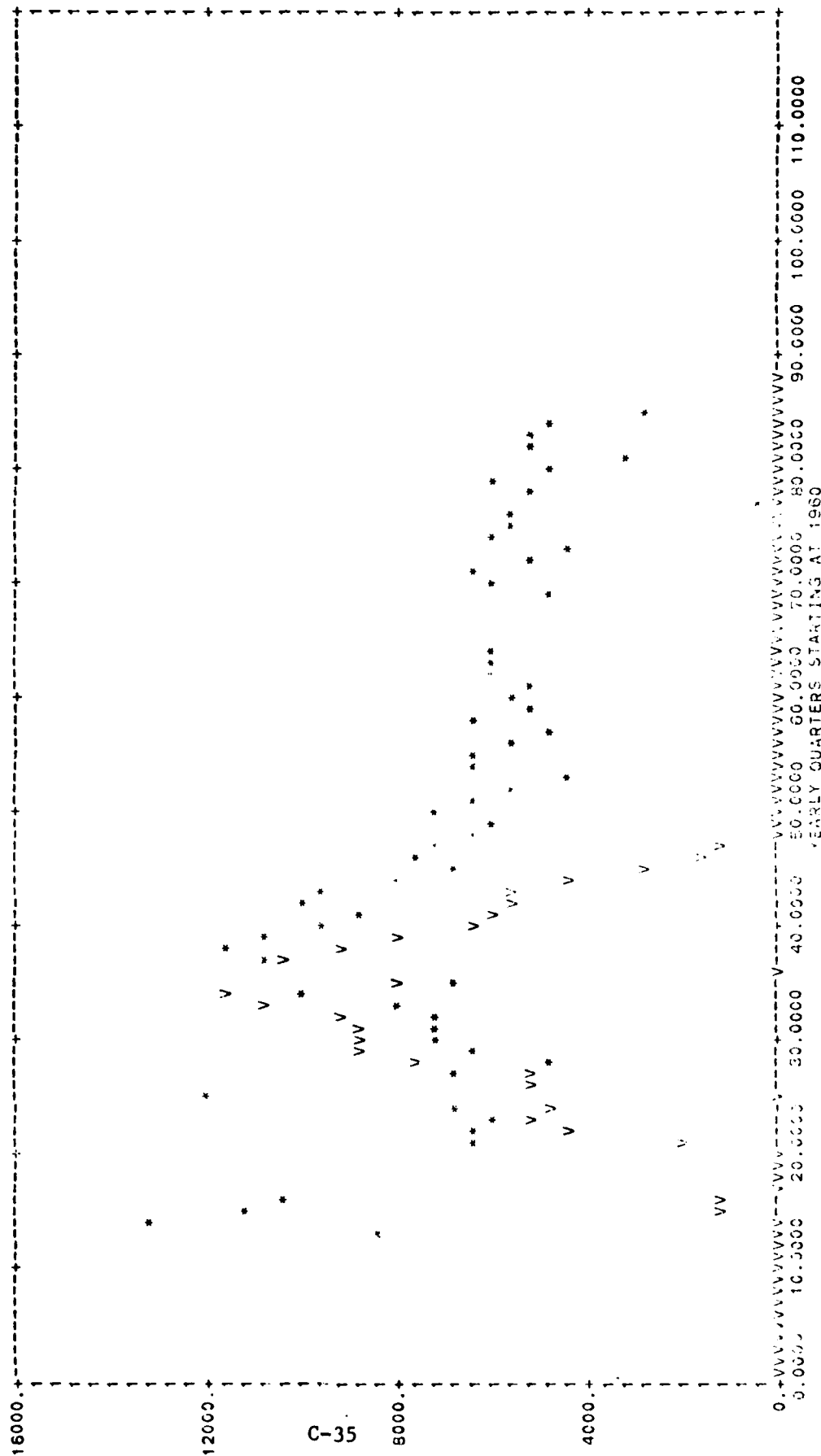


WORLDWIDE AVERAGE= 180845.79 STANDARD DEVIATION= 78536.4151 NUMBER OF OBSERVATIONS= 47
VIETNAM AVERAGE= 66556.77 STANDARD DEVIATION= 45214.7484 NUMBER OF OBSERVATIONS= 13

REAPLY QUARTERS STARTING AT 1960

SYSTEM=OV-1
YVARIABLE=

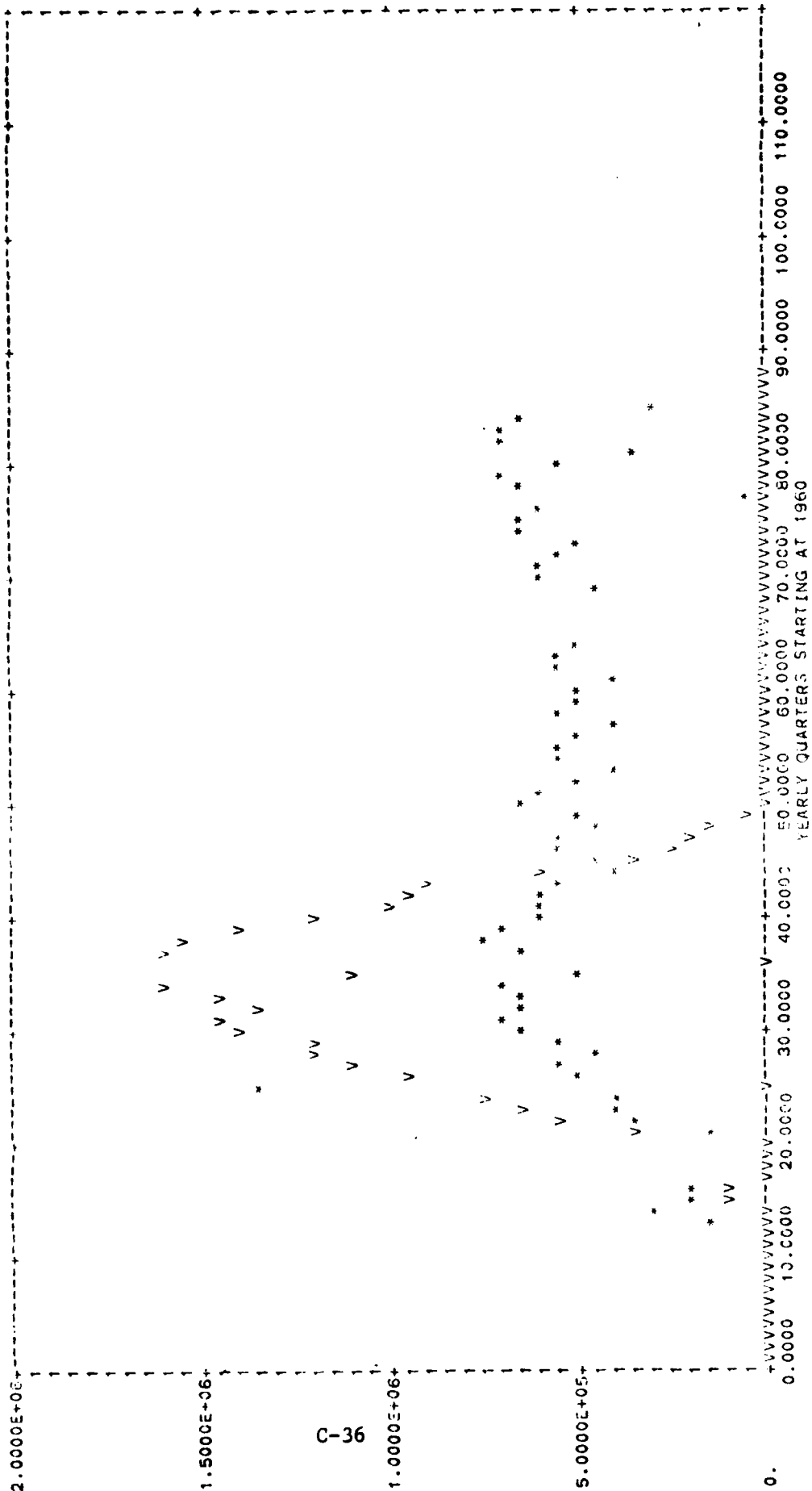
TOTAL NUMBER OF SORTIES



WORLDWIDE AVERAGE= 6563.18 STANDARD DEVIATION= 2550.0021 NUMBER OF OBSERVATIONS= 66
VIETNAM AVERAGE= 5874.57 STANDARD DEVIATION= 2291.9599 NUMBER OF OBSERVATIONS= 28

SYSTEM-1
VARIABLE=

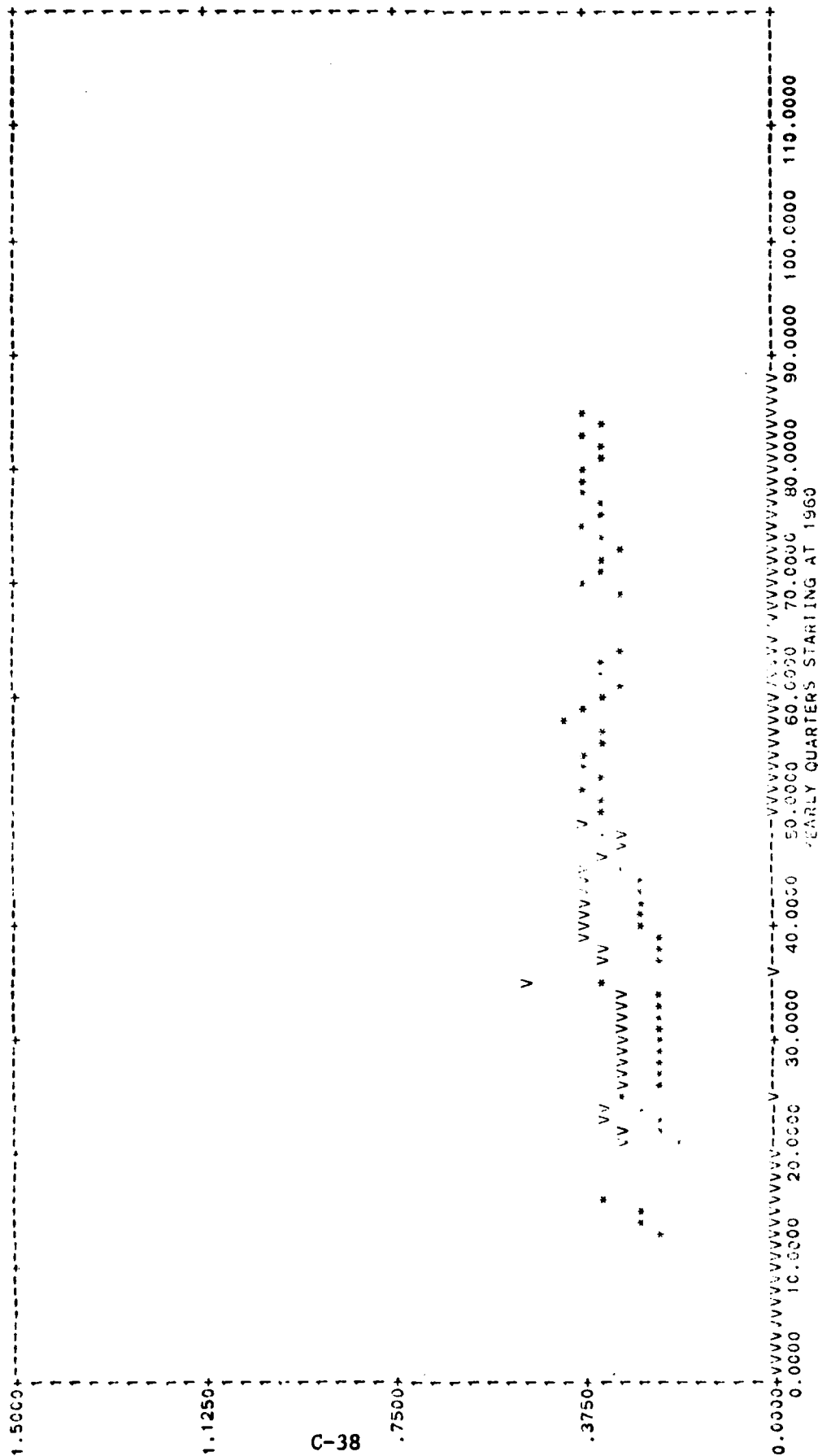
TOTAL NUMBER OF SERIES



WORLDWIDE AVERAGE= 486193.52 STANDARD DEVIATION= 222193.6360 NUMBER OF OBSERVATIONS= 69
VIETNAM AVERAGE= 879062.14 STANDARD DEVIATION= 515704.9097 NUMBER OF OBSERVATIONS= 29

SYSTEM-0047
VARIABLE=

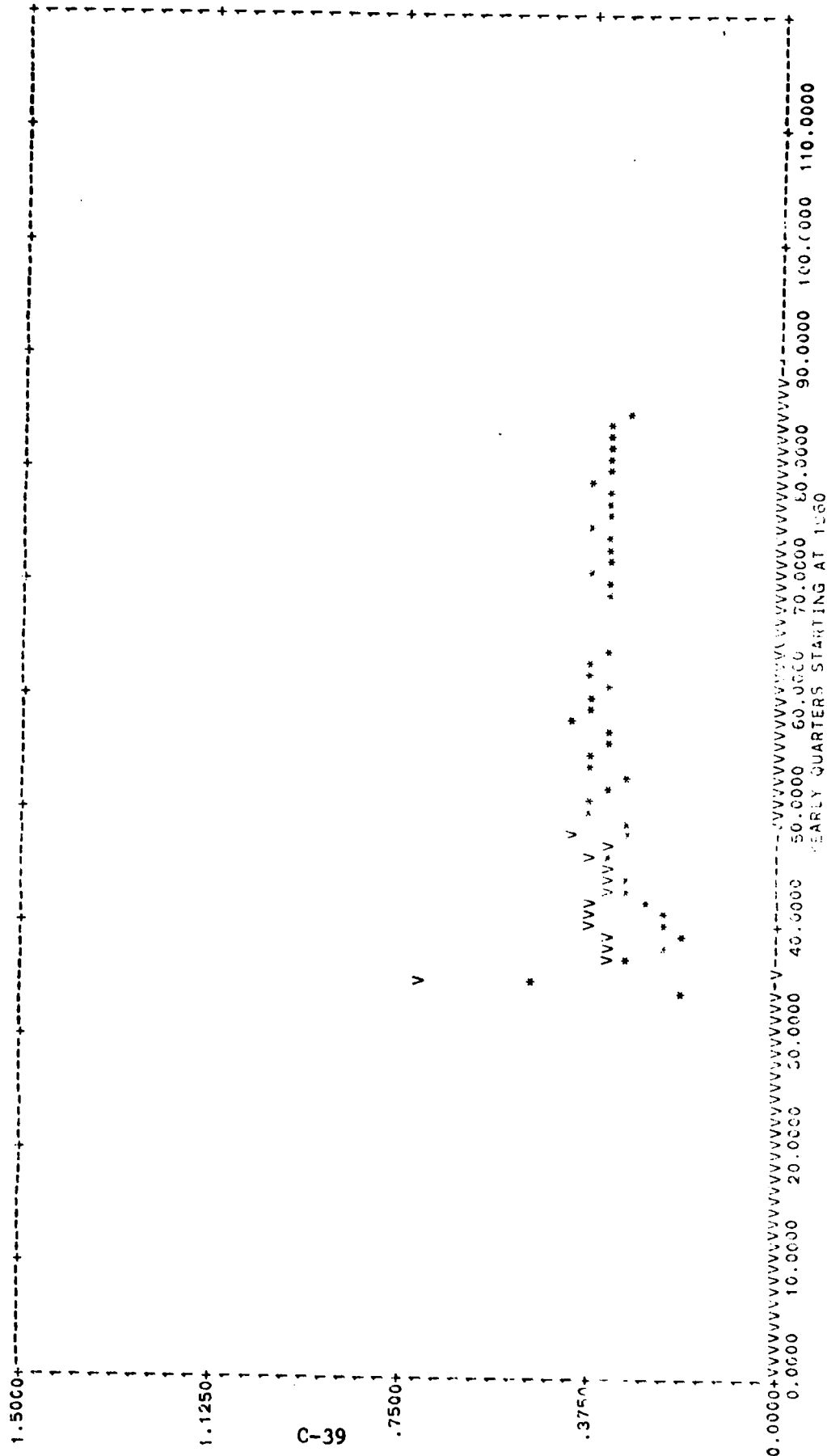
AVERAGE LENGTH OF SERIES



WORLDWIDE AVERAGE= .30 STANDARD DEVIATION= .0531 NUMBER OF OBSERVATIONS= 64
VIETNAM AVERAGE= .34 STANDARD DEVIATION= .0412 NUMBER OF OBSERVATIONS= 27

SYSTEM-0458
VARIABLE=

AVERAGE LENGTH OF SORTIES



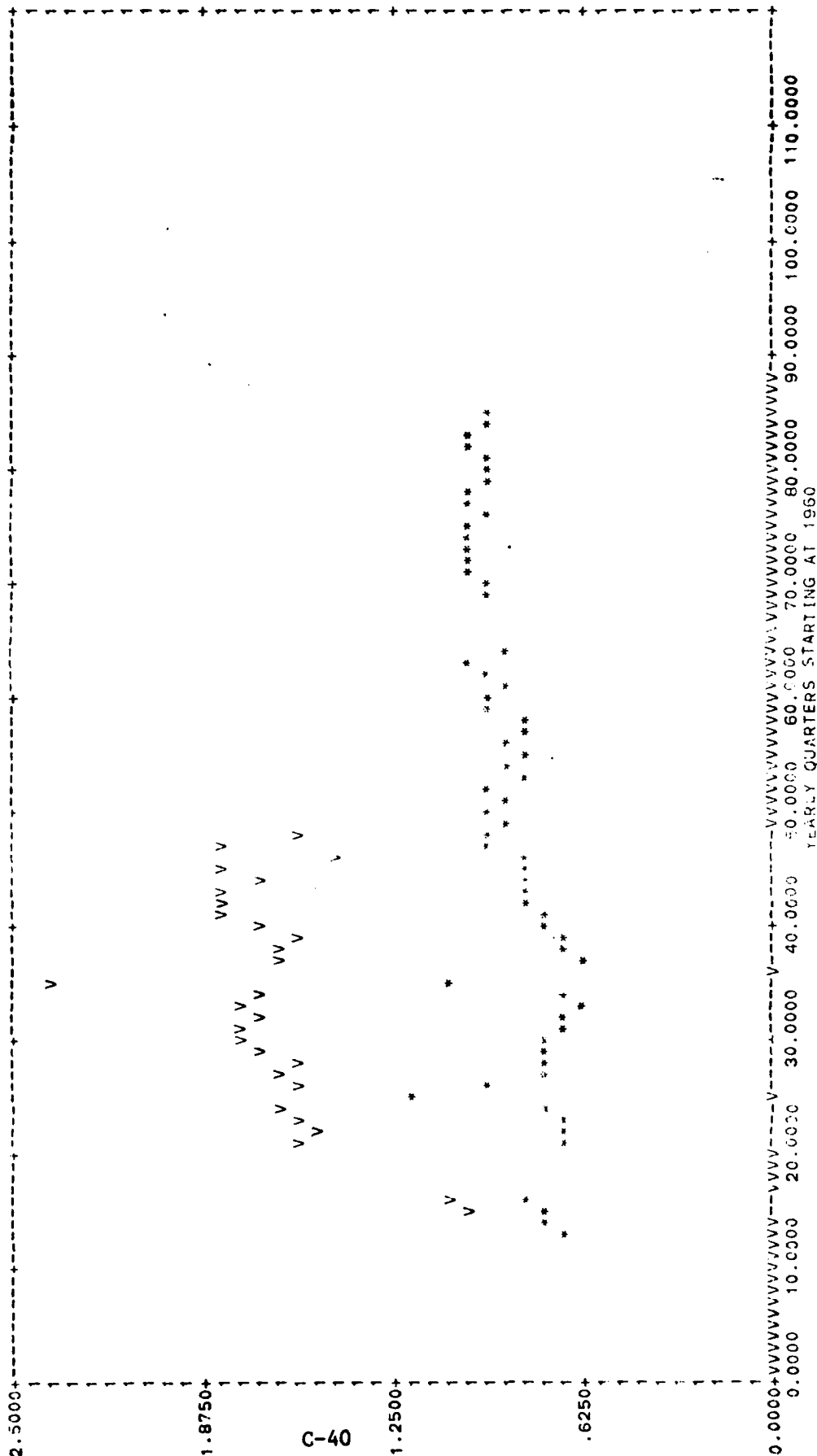
WORLDWIDE AVERAGE= .33
VIETNAM AVERAGE= .33

STANDARD DEVIATION= .0528
STANDARD DEVIATION= .1004

NUMBER OF OBSERVATIONS= 47
NUMBER OF OBSERVATIONS= 13

SYSTEM=C-40
YVARIABLE=

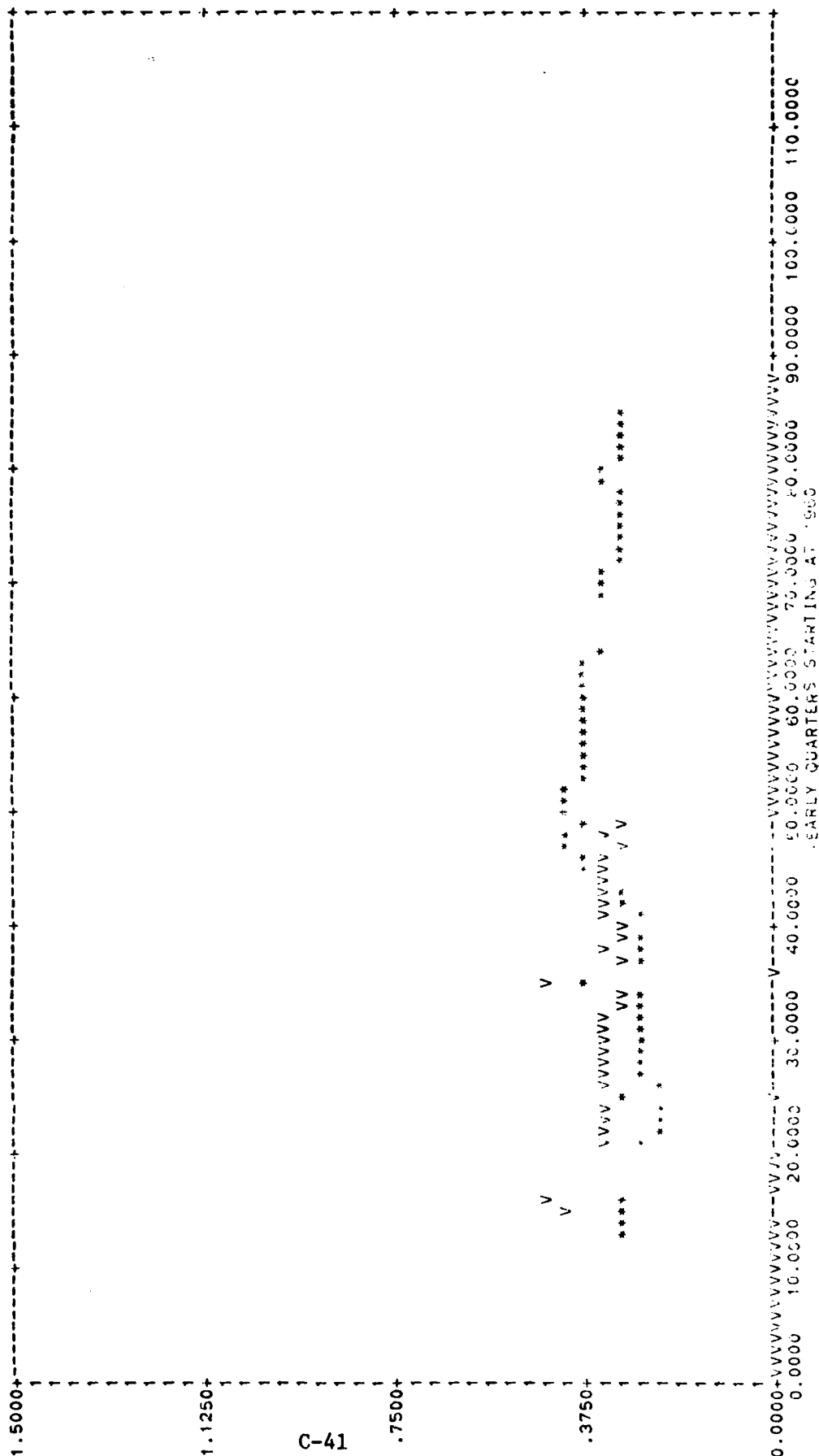
AVERAGE LENGTH OF SORTIES



WORLDWIDE AVERAGE= .86 STANDARD DEVIATION= .1215 NUMBER OF OBSERVATIONS= 64
VIETNAM AVERAGE= 1.65 STANDARD DEVIATION= .2393 NUMBER OF OBSERVATIONS= 28

SYSTEM=UH-1
YVARIABLE=

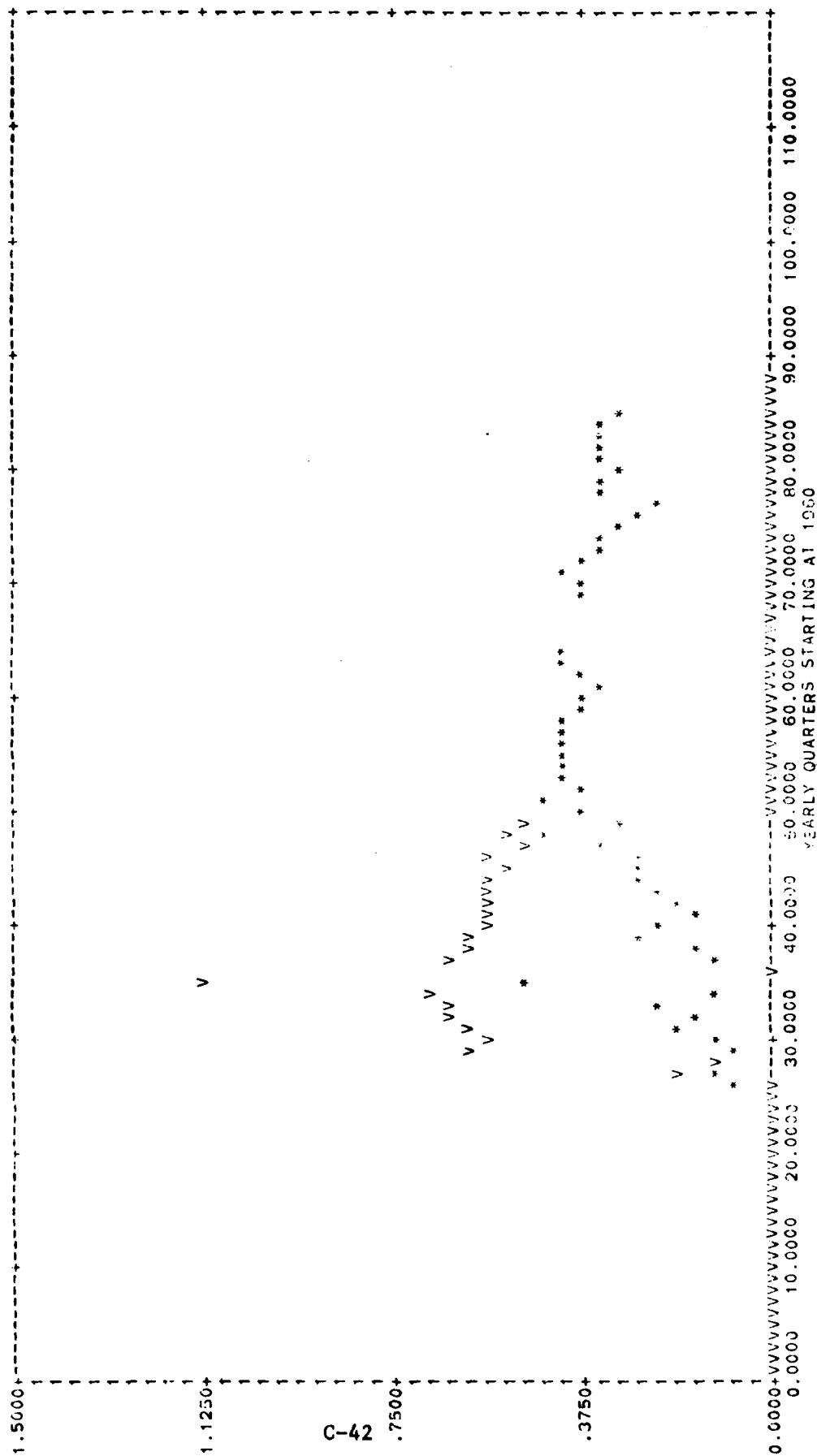
AVERAGE LENGTH OF SORTIES



WORLDWIDE AVERAGE= .32 STANDARD DEVIATION= .0525 NUMBER OF OBSERVATIONS= 64
VIETNAM AVERAGE= .34 STANDARD DEVIATION= .0400 NUMBER OF OBSERVATIONS= 29

SYSTEMATIC
VARIABLE=

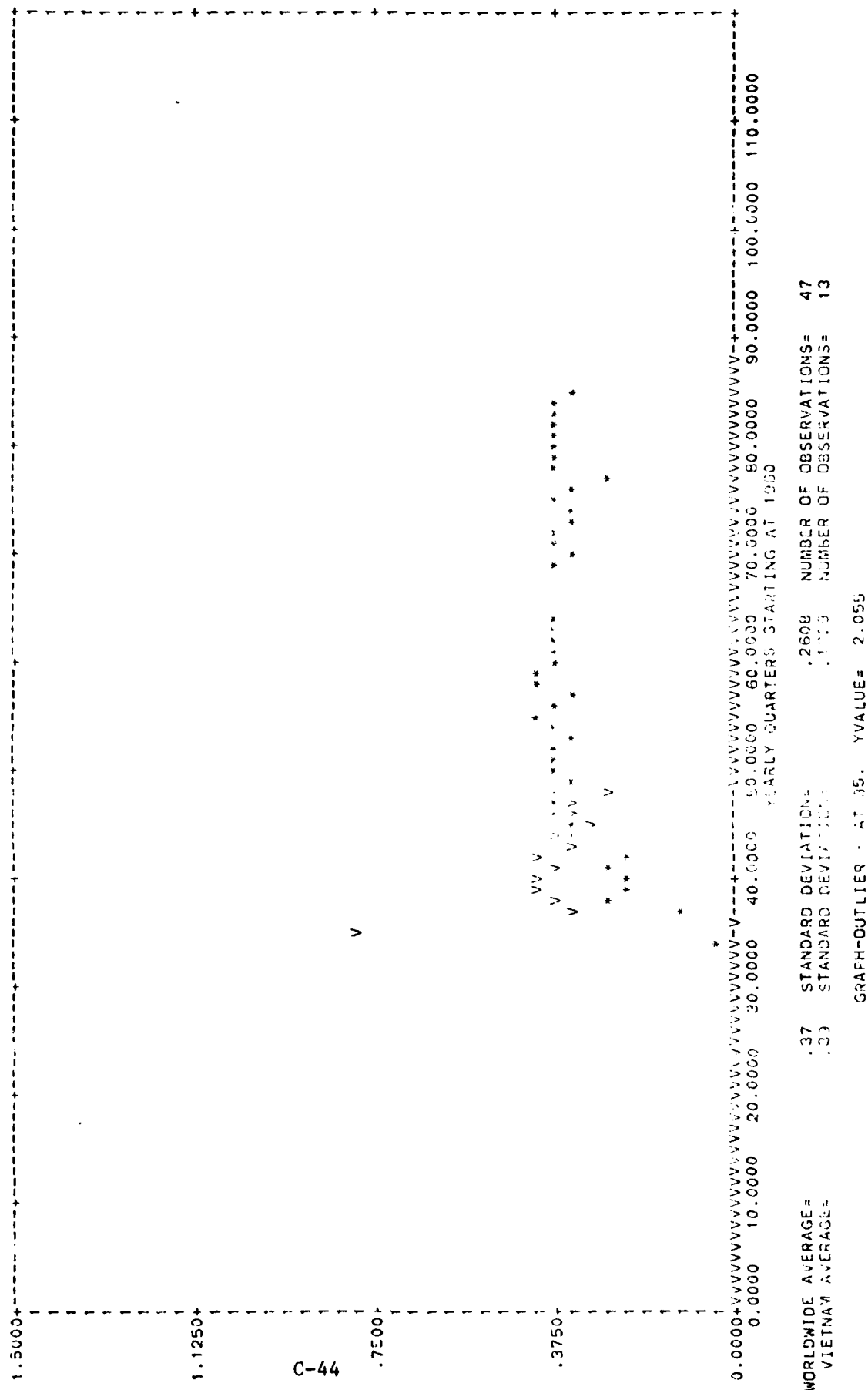
AVERAGE LENGTH OF SORTIES BY AIRCRAFT



WORLDWIDE AVERAGE= .30 STANDARD DEVIATION= .1079 NUMBER OF OBSERVATIONS= 55
VIETNAM AVERAGE= .56 STANDARD DEVIATION= .1341 NUMBER OF OBSERVATIONS= 22

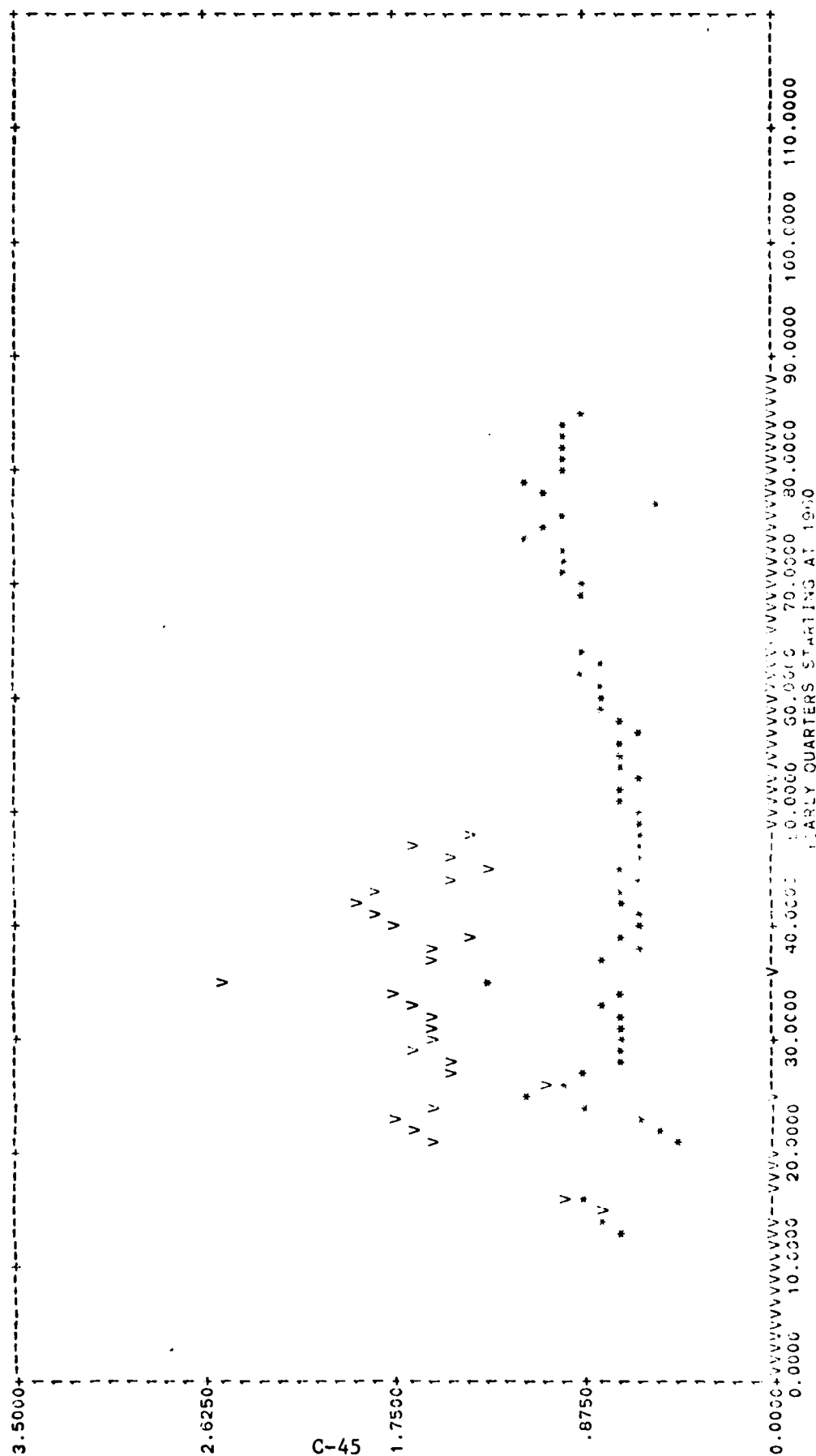
YEARLY QUARTERS STARTING AT 1960

AVERAGE LENGTH OF FLIGHTS BY AIRCRAFT



SYSTEM=OV-1
YVARIABLE=

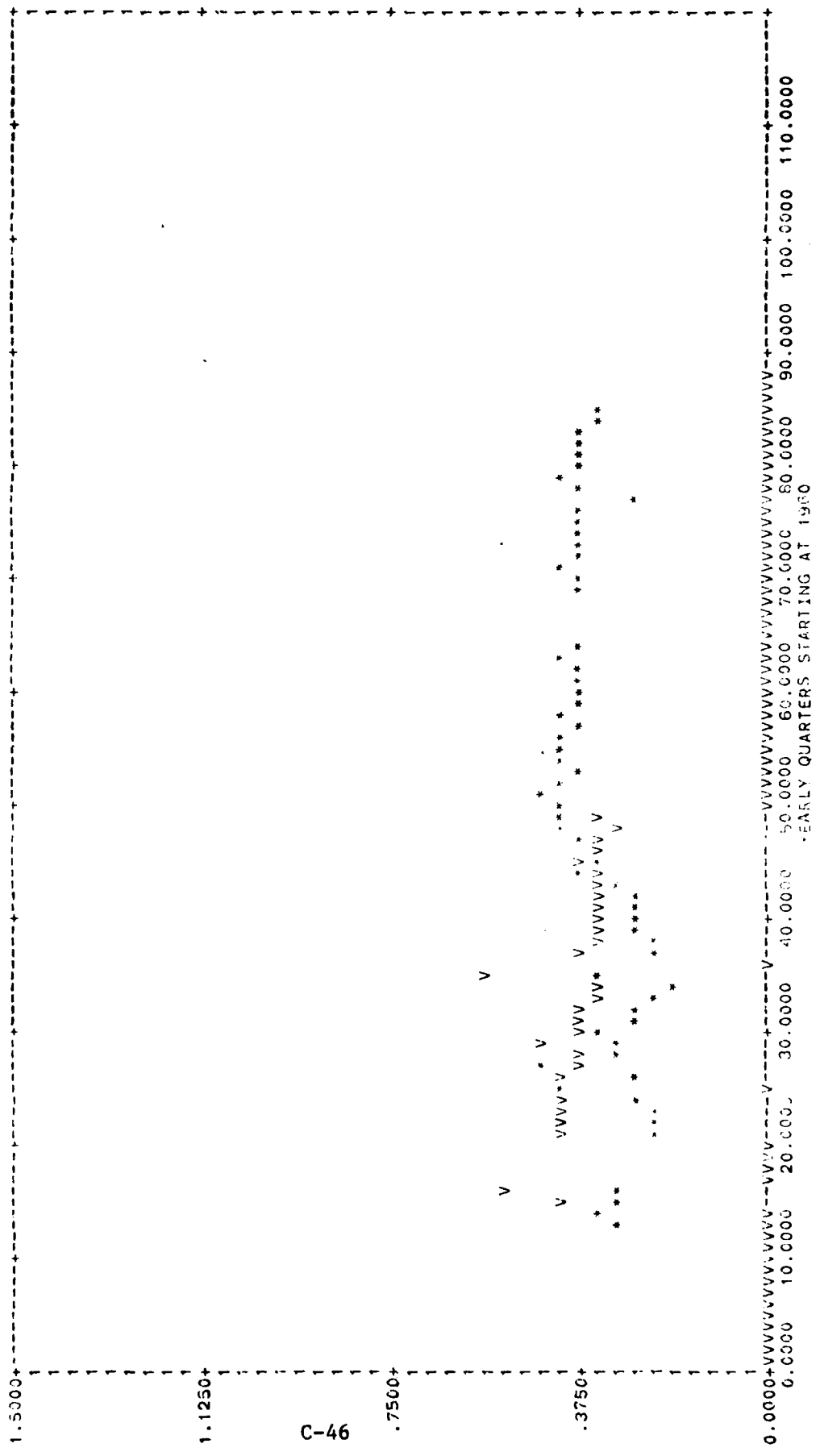
AVERAGE LENGTH OF SORTIES BY AIRCRAFT



WORLDWIDE AVERAGE= .79 STANDARD DEVIATION= .1703 NUMBER OF OBSERVATIONS= 64
VIETNAM AVERAGE= 1.56 STANDARD DEVIATION= .3102 NUMBER OF OBSERVATIONS= 26

SYSTEM UNIT
VARIABLES

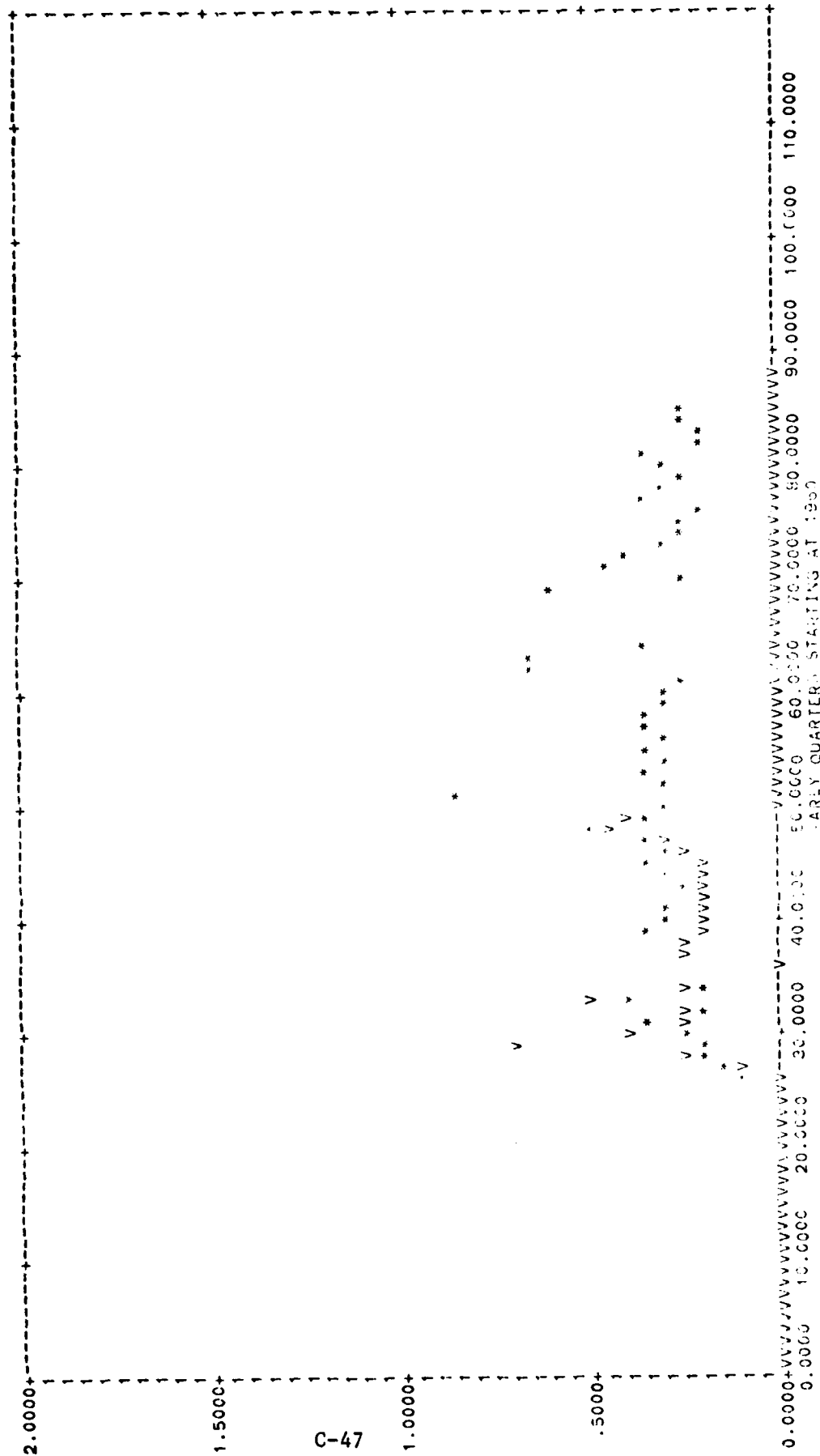
AVERAGE NUMBER OF SORTIES BY AIRCRAFT



WORLDWIDE AVERAGE= .34 STANDARD DEVIATION= .0576 NUMBER OF OBSERVATIONS= 64
VIETNAM AVERAGE= .28 STANDARD DEVIATION= .0562 NUMBER OF OBSERVATIONS= 29

SYSTEM=AH-1
YVARIABLE=

STANDARD DEVIATION OF LENGTH OF SORTIE BY AIRCRAFT



WORLDWIDE AVERAGE= .37 STANDARD DEVIATION= .1410 NUMBER OF OBSERVATIONS= 55
VIETNAM AVERAGE= .30 STANDARD DEVIATION= .1478 NUMBER OF OBSERVATIONS= 22
GRAPH-OUTLIER : AT .25. YVALUE= 3.446
GRAPH-OUTLIER : AT .25. YVALUE= 2.421

STANDARD DEVIATION OF LENGTH OF STAKE BY AIRCRAFT

1.5000-

1.0000-

.5000

9.0000

50.0000 60.0000 70.0000 80.0000 90.0000 100.0000 110.0000

YEARLY QUARTERS STARTING AT 1950

WORLDWIDE AVERAGE =
VIETNAM AVERAGE =

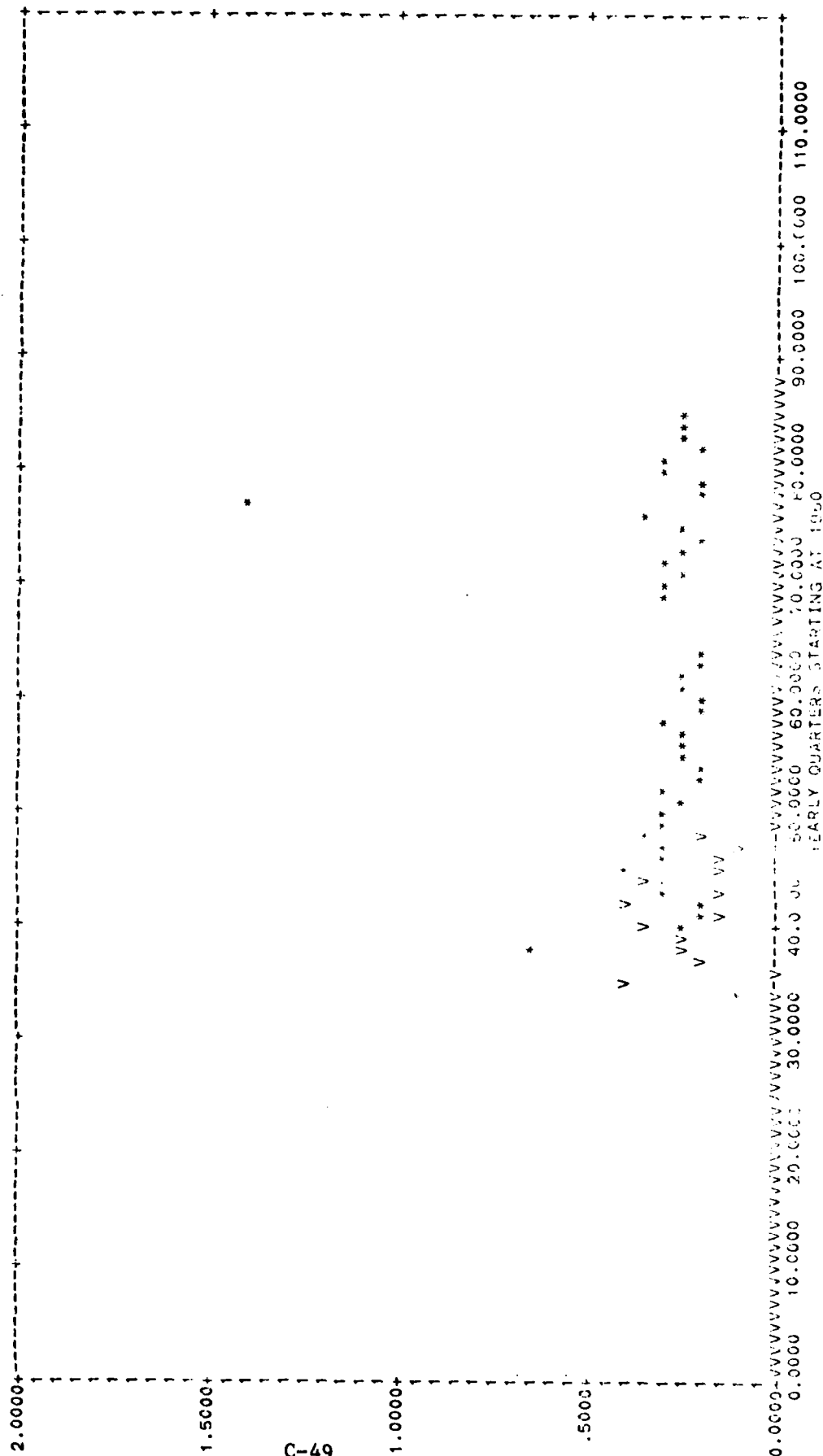
STANDARD DEVIATION=

.0918	NUMBER OF OBSERVATIONS=	64
.9986	NUMBER OF OBSERVATIONS=	27

GRAPH-OUTLIER V AT 35. YVALUE= 5.31

SYSTEM=OH58
YVARIABLE=

STANDARD DEVIATION OF LENGTH OF SORTIE BY AIRCRAFT

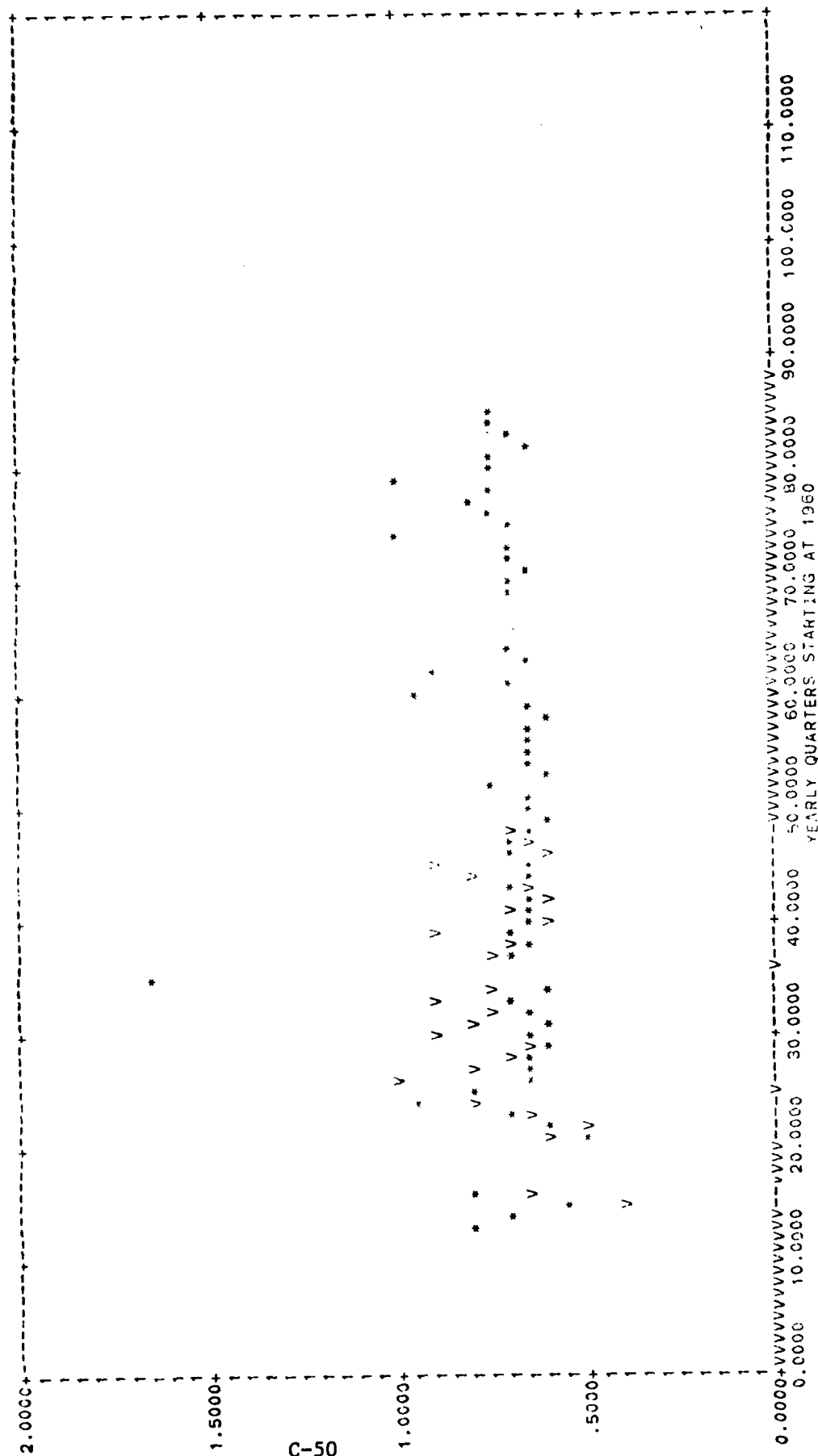


WORLDWIDE AVERAGE= .39 STANDARD DEVIATION= .7366 NUMBER OF OBSERVATIONS= 47
VIETNAM AVERAGE= .24 STANDARD DEVIATION= .6093 NUMBER OF OBSERVATIONS= 13

GRAPH-OUTLIER = AT 85. YVALUE= 5.195

SYSTEM=OV-1
YVARIABLE=

STANDARD DEVIATION OF LENGTH OF SORTIE BY AIRCRAFT

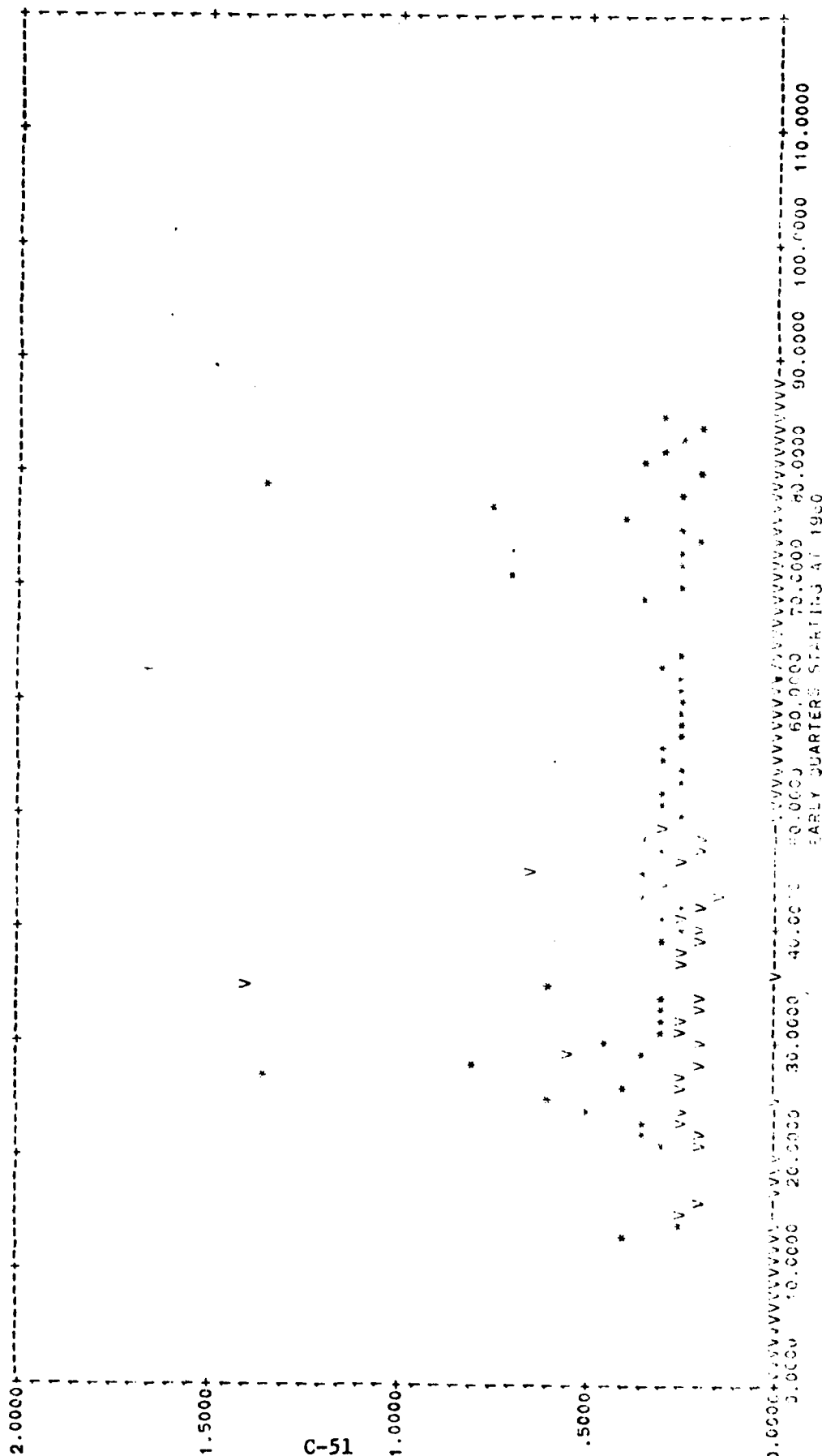


WORLDWIDE AVERAGE= .71 STANDARD DEVIATION= .1550 NUMBER OF OBSERVATIONS= 64
VIETNAM AVERAGE= .79 STANDARD DEVIATION= .3517 NUMBER OF OBSERVATIONS= 28

GRAPH-OUTLIER V AT 35. YVALUE= 2.616

SYSTEM=UH-1
VARIABLE=

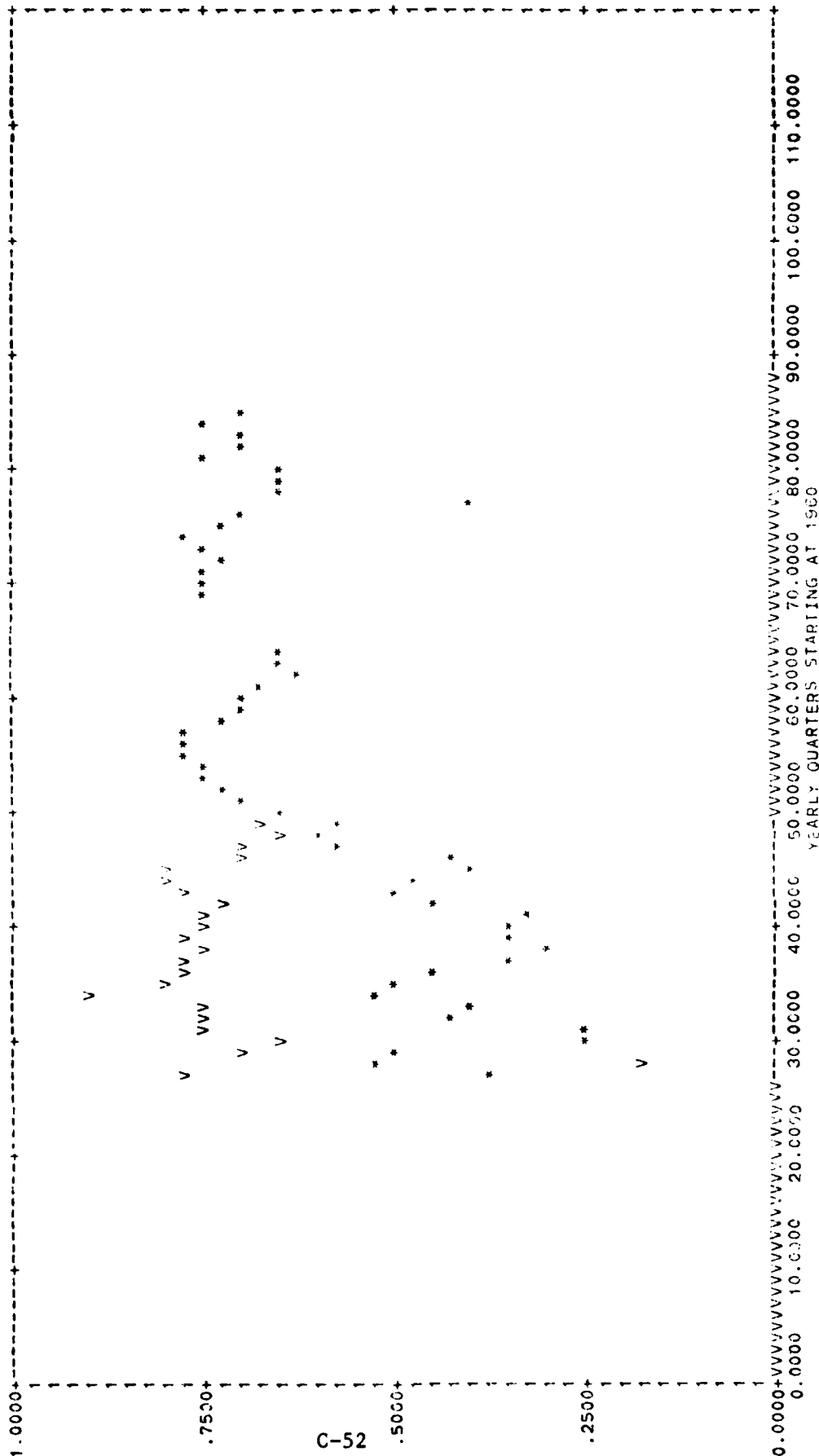
STANDARD DEVIATION OF LENGTH OF SORTIE BY AIRCRAFT



C-51

SYSTEM=AH-1
YVARIABLE=

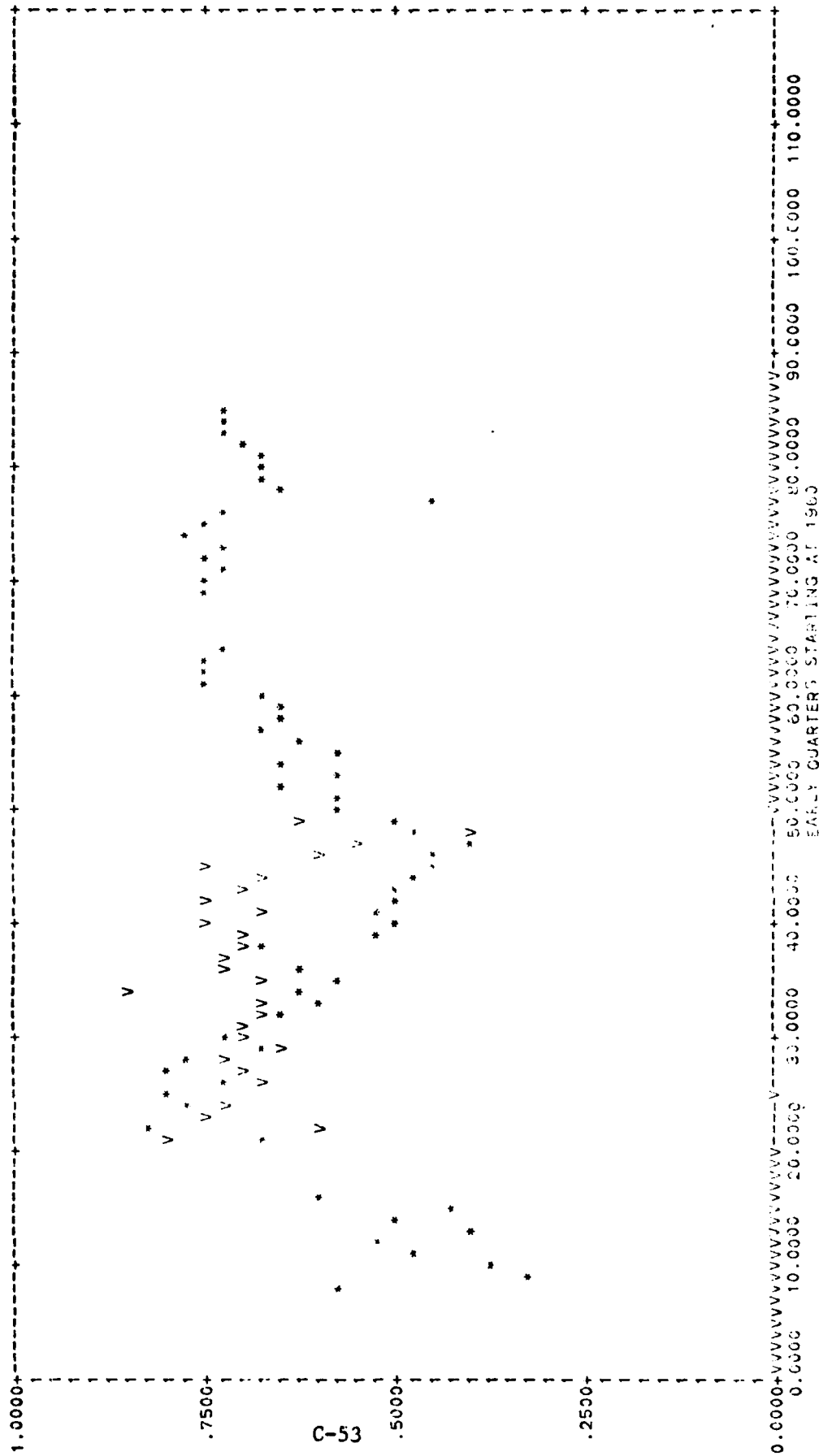
AVERAGE RELIABILITY



WORLDWIDE AVERAGE= .59 STANDARD DEVIATION= .1598 NUMBER OF OBSERVATIONS= 55
VIETNAM AVERAGE= .72 STANDARD DEVIATION= .1300 NUMBER OF OBSERVATIONS= 23

SYSTEM=CH47
YVARIABLE=

AVERAGE RELIABILITY



WORLDWIDE AVERAGE=
VIETNAM AVERAGE=

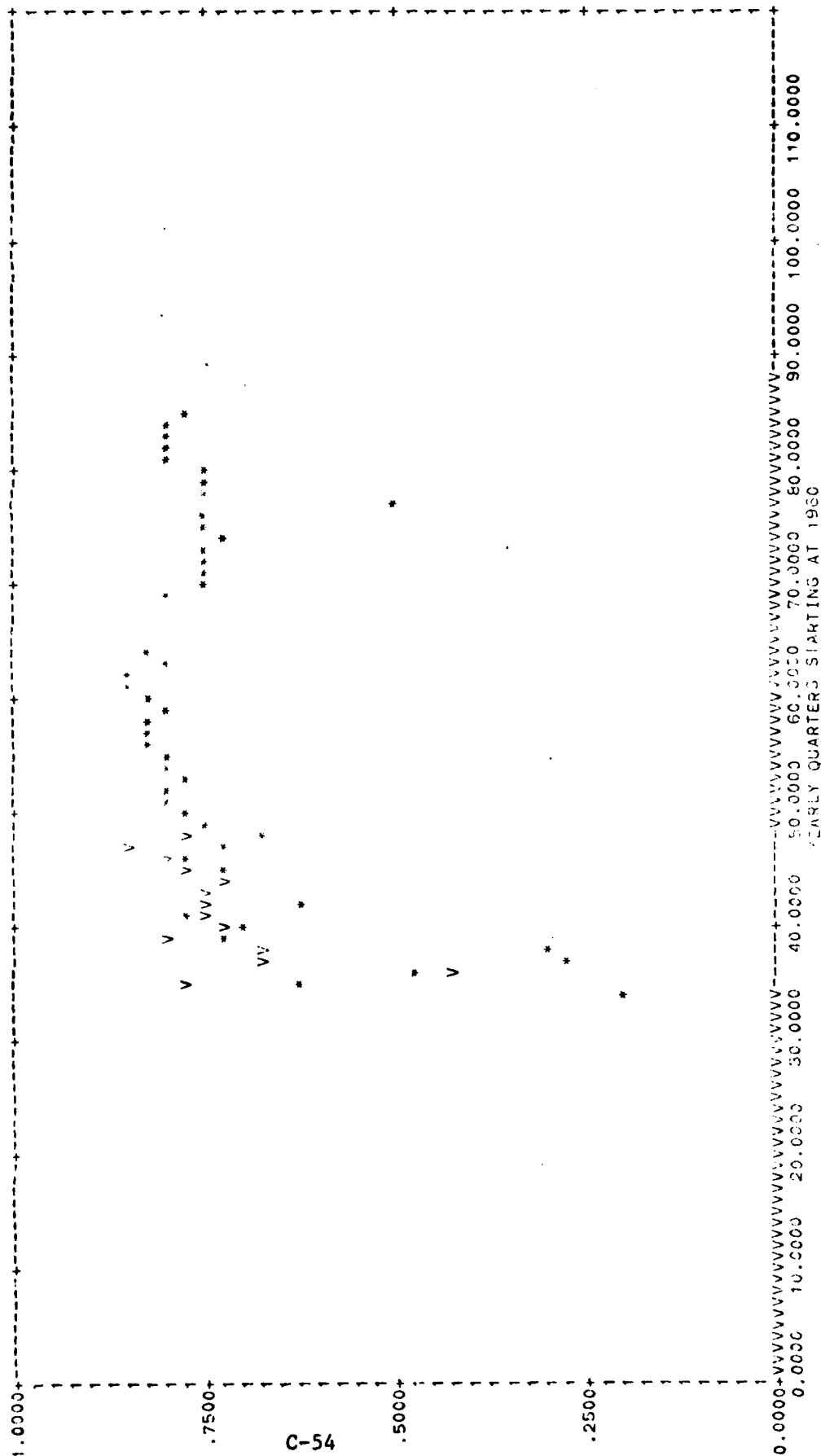
.69 STANDARD DEVIATION=
.69 STANDARD DEVIATION=

.1189 NUMBER OF OBSERVATIONS=
.0423 NUMBER OF OBSERVATIONS=

70
28

SYSTEM CHANGES
VARIABLE=

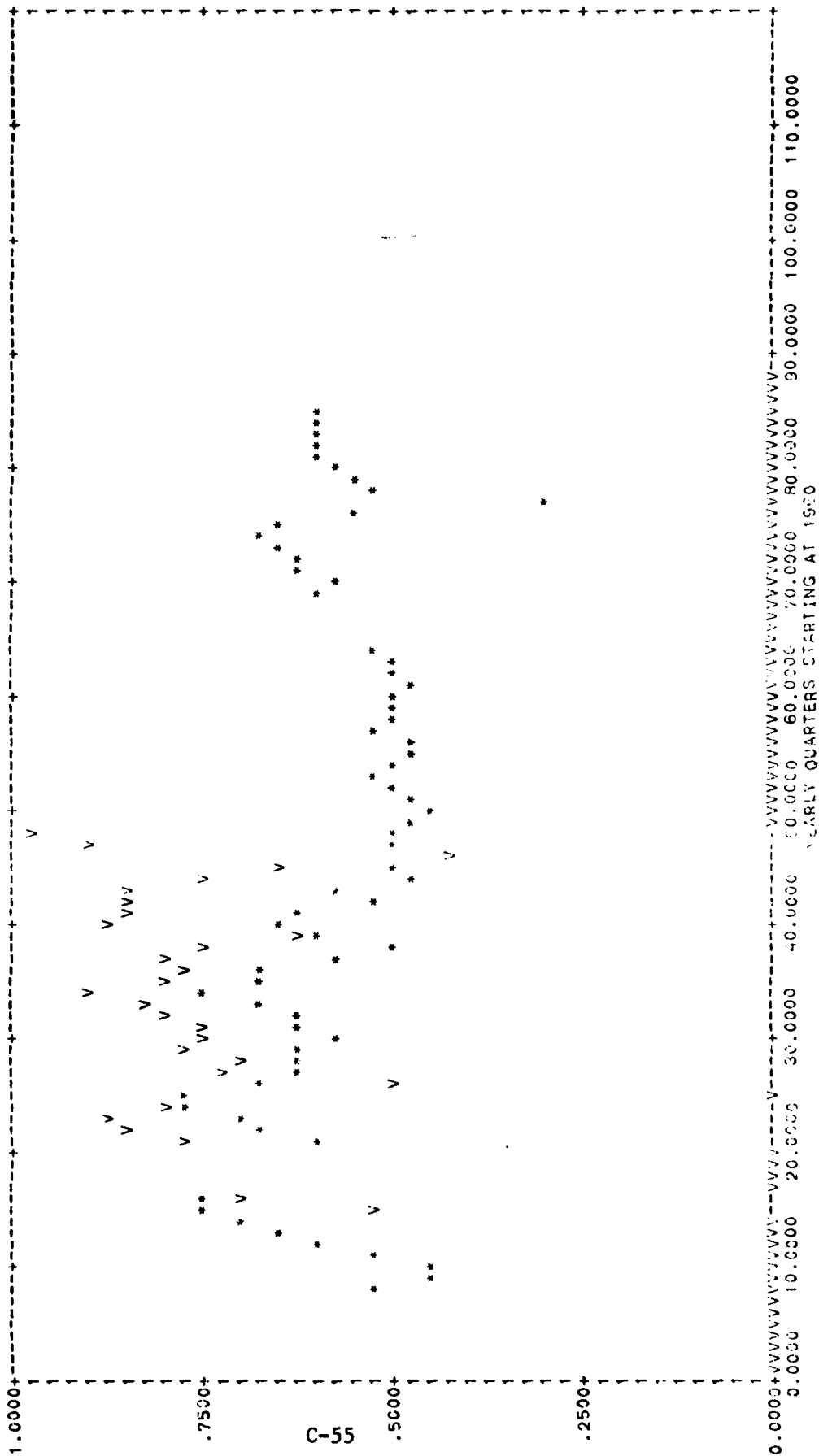
AVERAGE RELIABILITY



WORLDWIDE AVERAGE= .72 STANDARD DEVIATION= .1419 NUMBER OF OBSERVATIONS= 48
VIETNAM AVERAGE= .73 STANDARD DEVIATION= .1004 NUMBER OF OBSERVATIONS= 14

SYSTEM=OV-1
YVARIABLE=

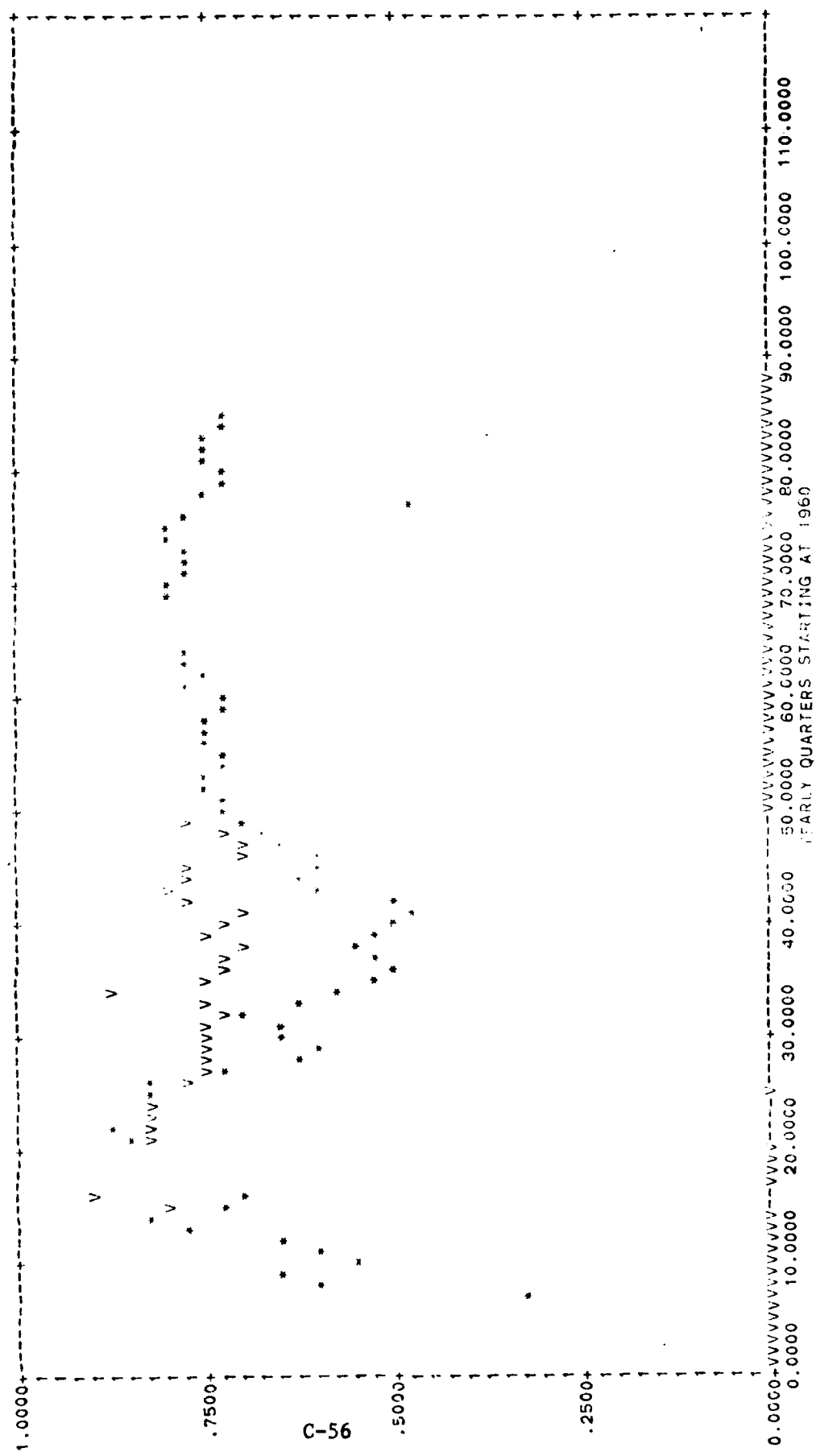
AVERAGE RELIABILITY



WORLDWIDE AVERAGE= .50 STANDARD DEVIATION= .0026 NUMBER OF OBSERVATIONS= 70
VIETNAM AVERAGE= .76 STANDARD DEVIATION= .1130 NUMBER OF OBSERVATIONS= 29

SYSTEM=UM-1
YVARIABLE=

AVERAGE RELIABILITY



WORLDWIDE AVERAGE=	.69	STANDARD DEVIATION=	.1092	NUMBER OF OBSERVATIONS=	71
VIETNAM AVERAGE=	.77	STANDARD DEVIATION=	.0511	NUMBER OF OBSERVATIONS=	30

AD-A134 745

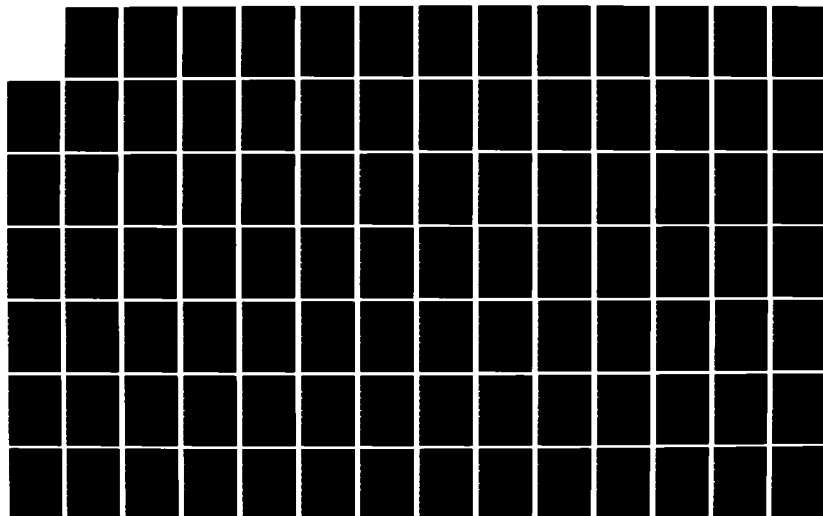
SORTIE DURATION AND HELICOPTER COMPONENT FAILURES (AN
EMPIRICAL STUDY)(U) ARMY INVENTORY RESEARCH OFFICE
PHILADELPHIA PA E GOWALS MAY 83 USAIRO-TR-83/3

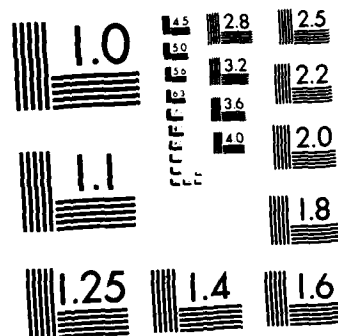
2/3

UNCLASSIFIED

F/G 1/3

NL

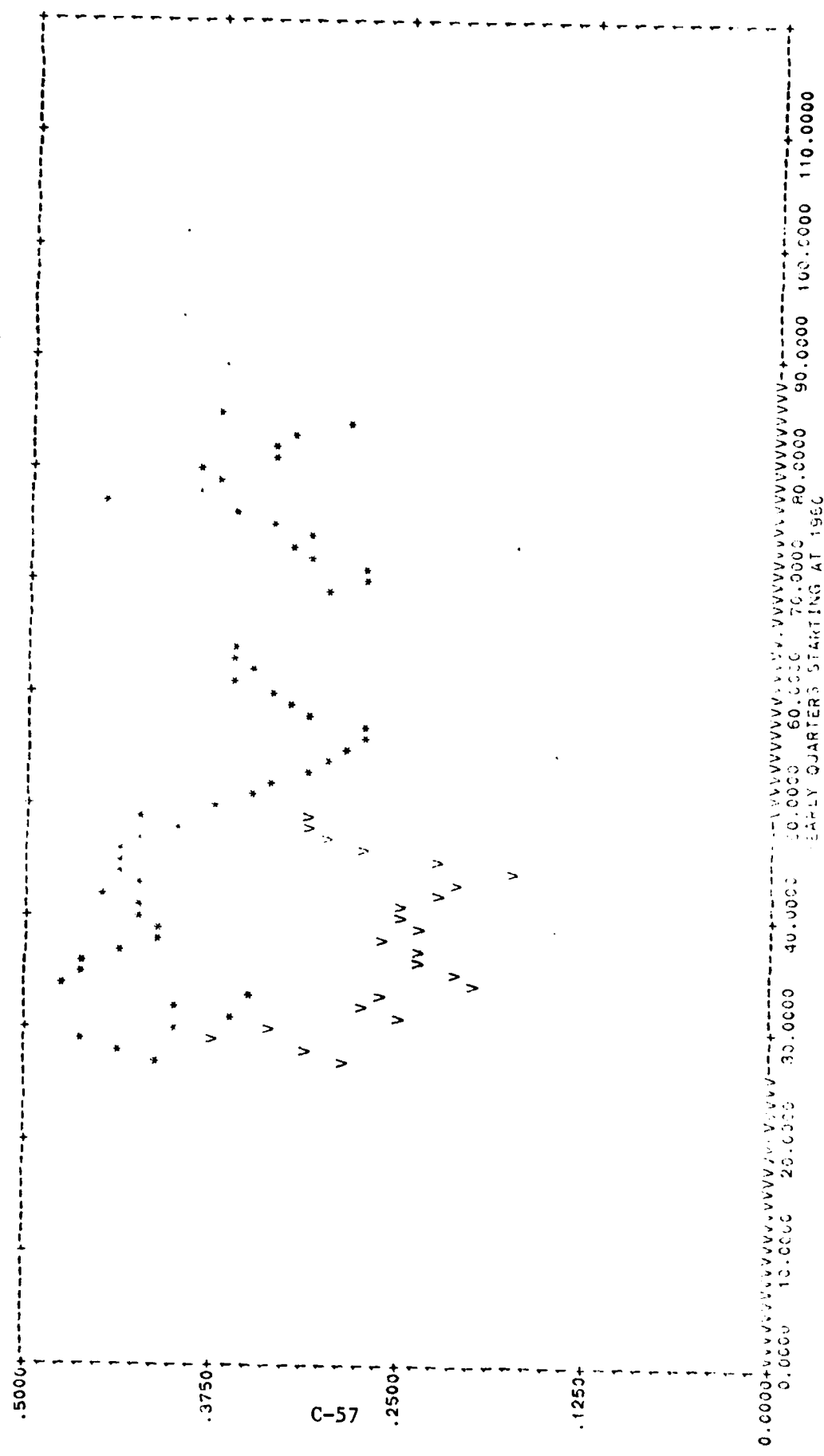




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

SYSTEM 4H-1
YVARIABLE=

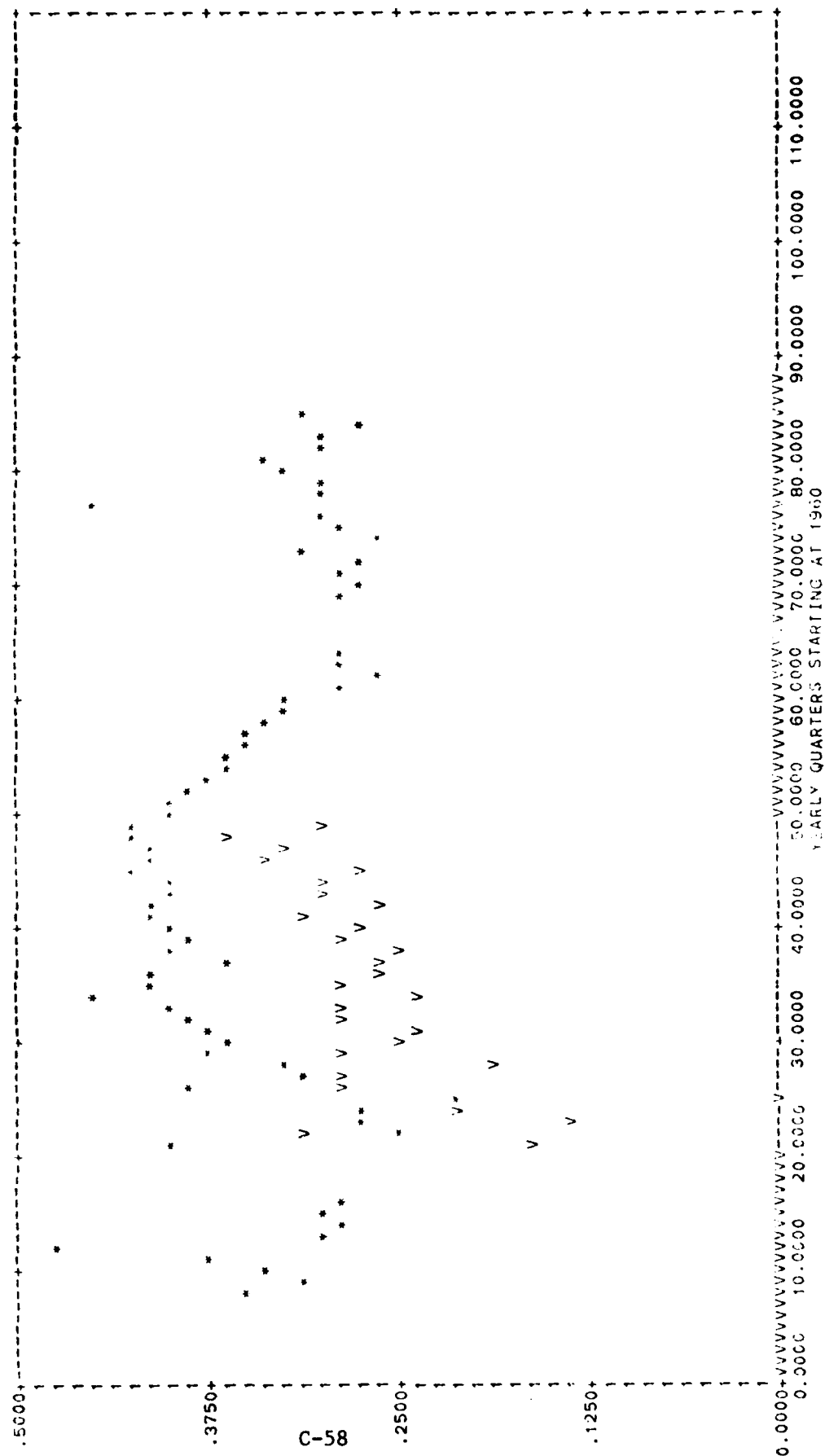
STANDARD DEVIATION OF RELIABILITY



WORLDWIDE AVERAGE= .0000
VIETNAM AVERAGE= .0000
STANDARD DEVIATION= .0000
NUMBER OF OBSERVATIONS= 55
EARLY QUARTERS STARTING AT 1960
NUMBER OF OBSERVATIONS= 23

SYSTEM-CHIN7
VARIABLE-

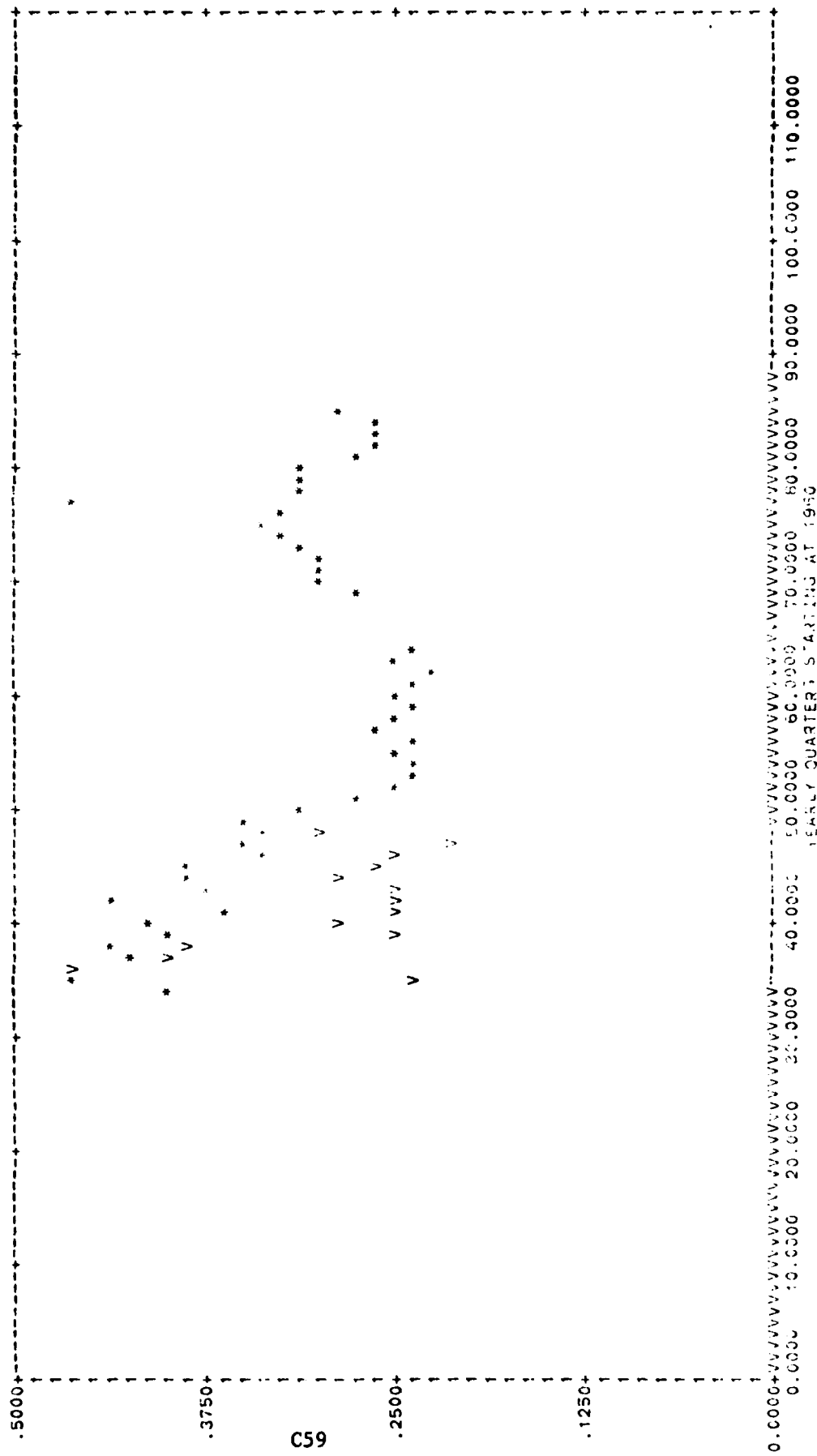
STANDARD DEVIATION OF RELIABILITY



WORLDWIDE AVERAGE= .35 STANDARD DEVIATION= .0580 NUMBER OF OBSERVATIONS= 70
VIETNAM AVERAGE= .27 STANDARD DEVIATION= .0603 NUMBER OF OBSERVATIONS= 28

SYSTEM-0458
YVARIABLE=

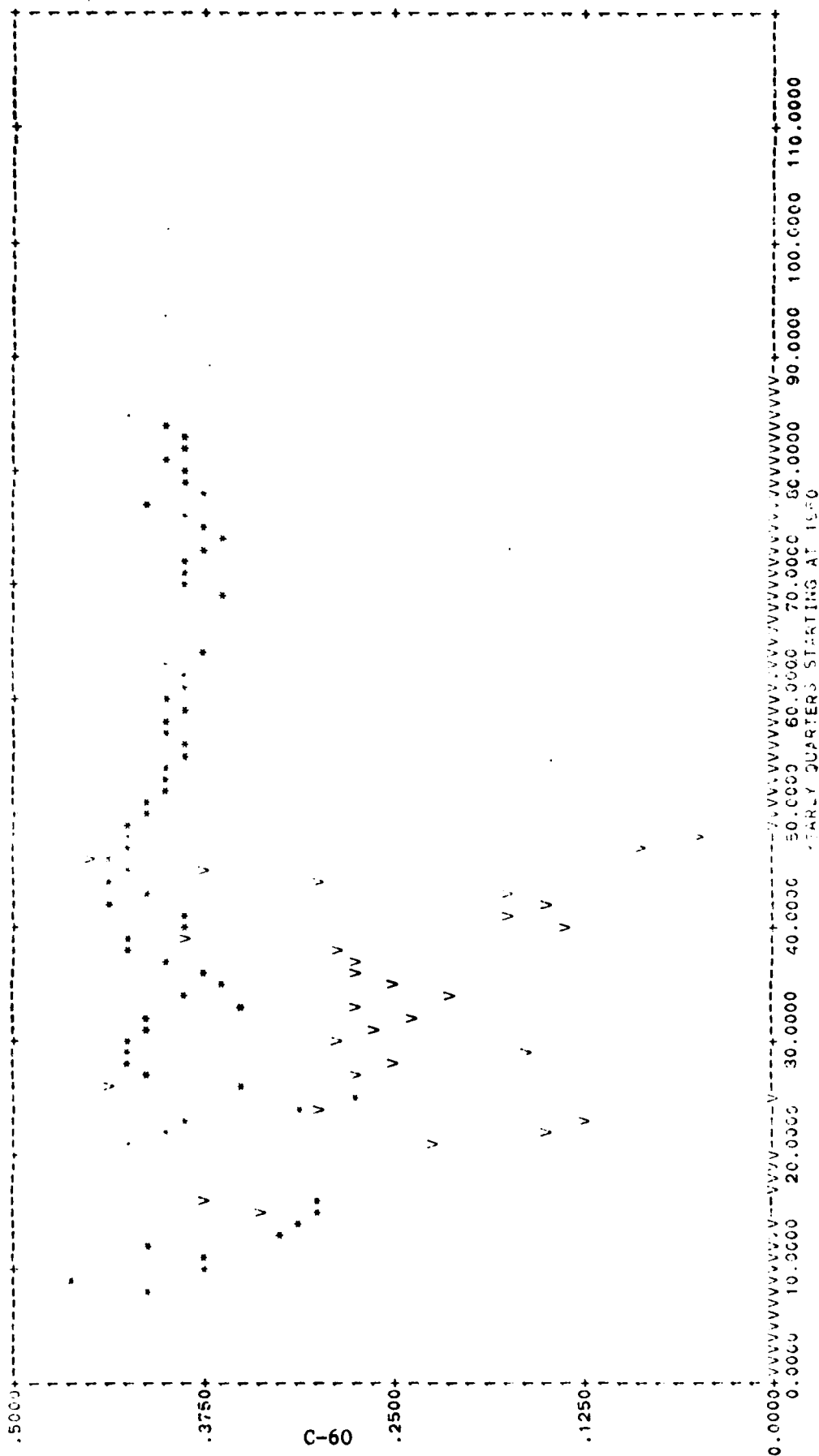
STANDARD DEVIATION OF RELIABILITY



WORLDWIDE AVERAGE= .32 STANDARD DEVIATION= .0097 NUMBER OF OBSERVATIONS= 48
VIETNAM AVERAGE= .29 STANDARD DEVIATION= .0012 NUMBER OF OBSERVATIONS= 14

SYSTEM=OV-1
VARIABLE=

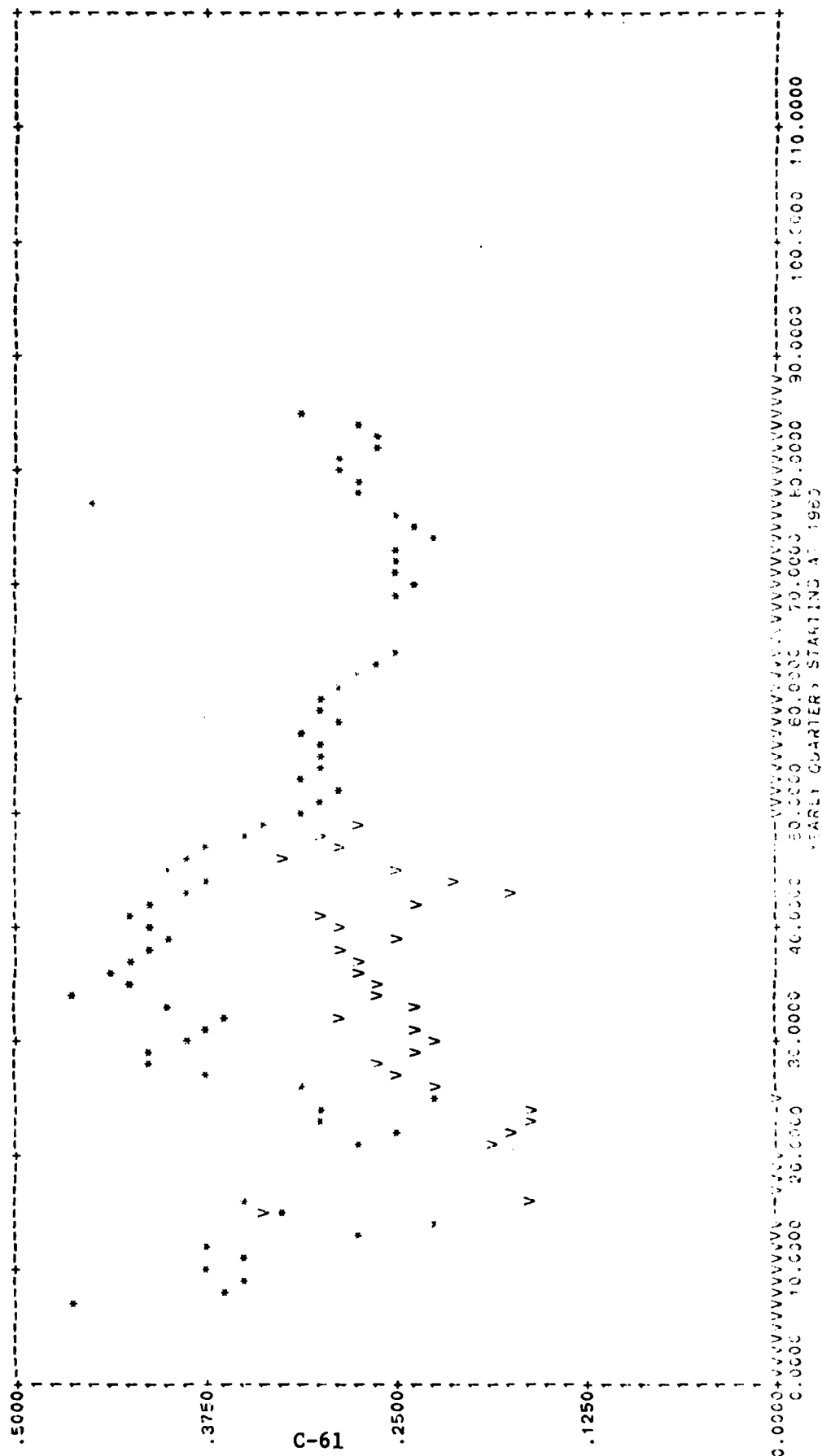
STANDARD DEVIATION OF RELIABILITY



WORLDWIDE AVERAGE= .0315 NUMBER OF OBSERVATIONS= 70
VIETNAM AVERAGE= .0098 NUMBER OF OBSERVATIONS= 29

SYSTEM=UH-1
VARIABLE=

STANDARD DEVIATION OF RELIABILITY



WORLDWIDE AVERAGE=
VIETNAM AVERAGE=

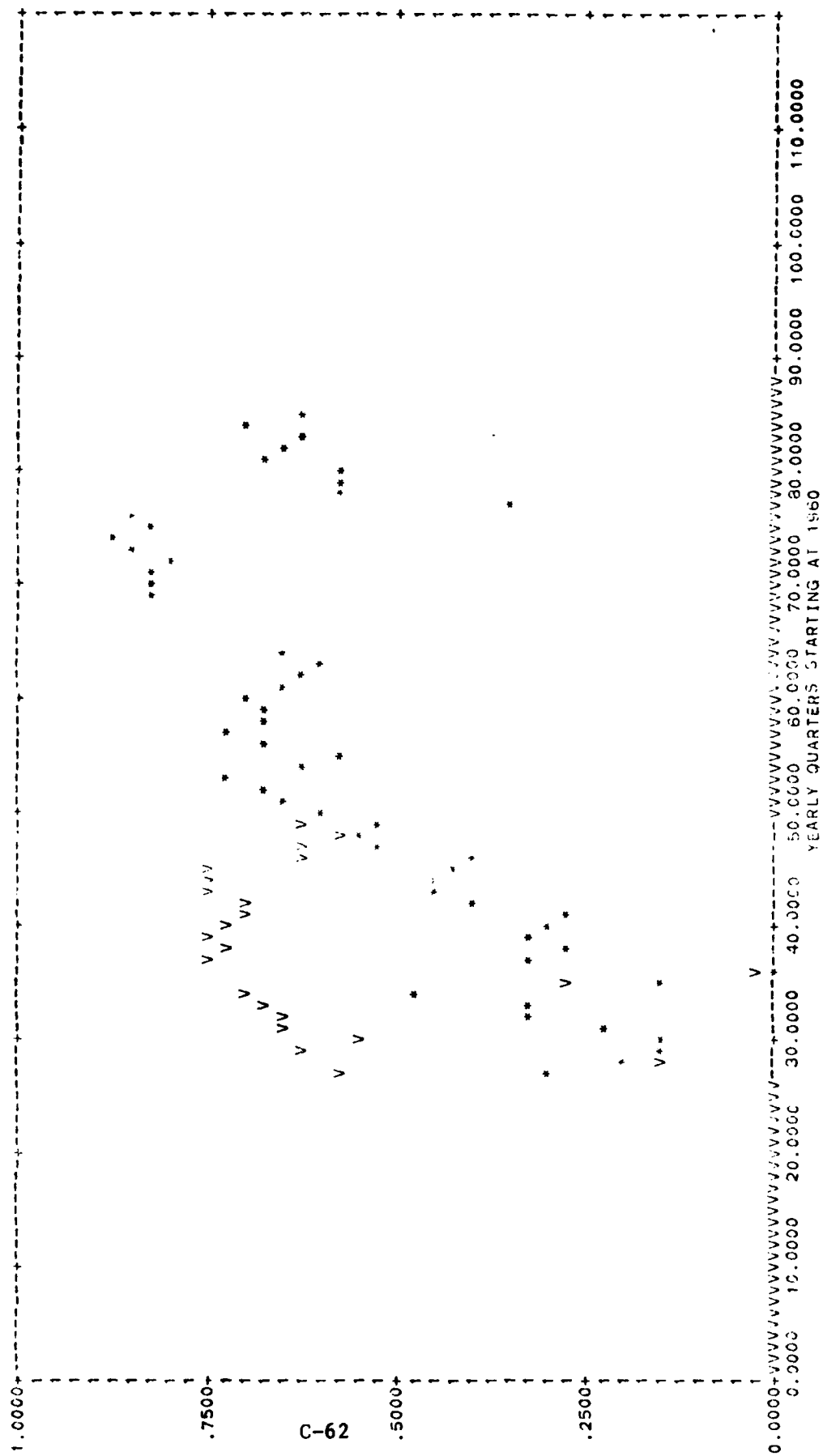
.33 STANDARD DEVIATION=
.25 STANDARD DEVIATION=

.0007 NUMBER OF OBSERVATIONS=
.0400 NUMBER OF OBSERVATIONS=

YEARLY QUARTERS STARTING AT 1960

SYSTEM NO=1
VARIABLE=

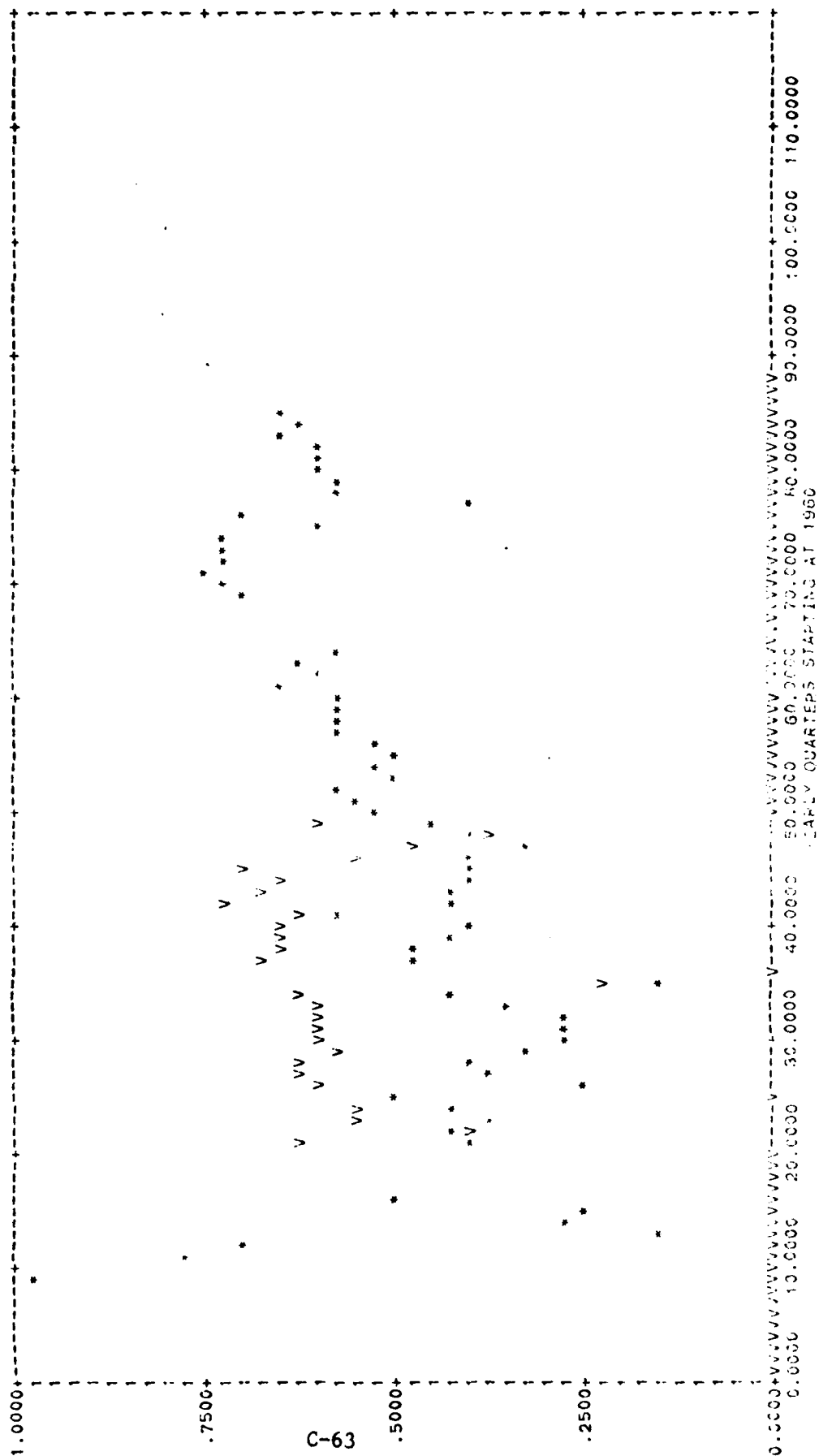
AVERAGE AVAILABILITY



WORLDWIDE AVERAGE= .55 STANDARD DEVIATION= .2042 NUMBER OF OBSERVATIONS= 54
VIETNAM AVERAGE= .60 STANDARD DEVIATION= .1934 NUMBER OF OBSERVATIONS= 23

SYSTEM=CH47
YVARIABLE=

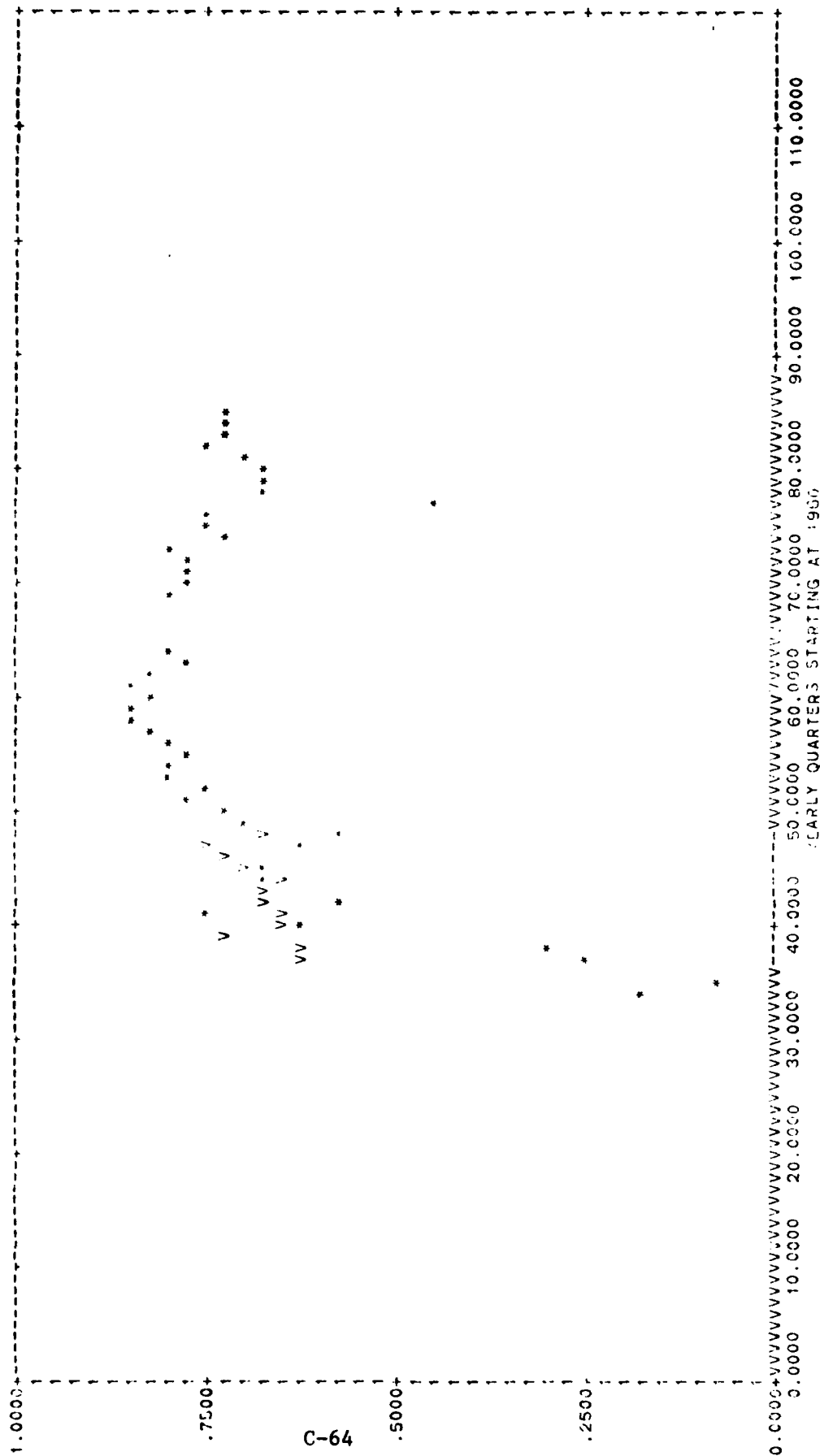
AVERAGE AVAILABILITY



*OR-DAVE AVERAGE= .54 STANDARD DEVIATION= .2024 NUMBER OF OBSERVATIONS= 69
VIETNAM AVERAGE= .56 STANDARD DEVIATION= .2119 NUMBER OF OBSERVATIONS= 28
GRAPH-OUTLIER AT 10. VALUE= 1.00
GRAPH-OUTLIER AT 10. VALUE= 1.00

SYSTEM-JOB
VARIABLE

AVERAGE A.V.A. = .0000

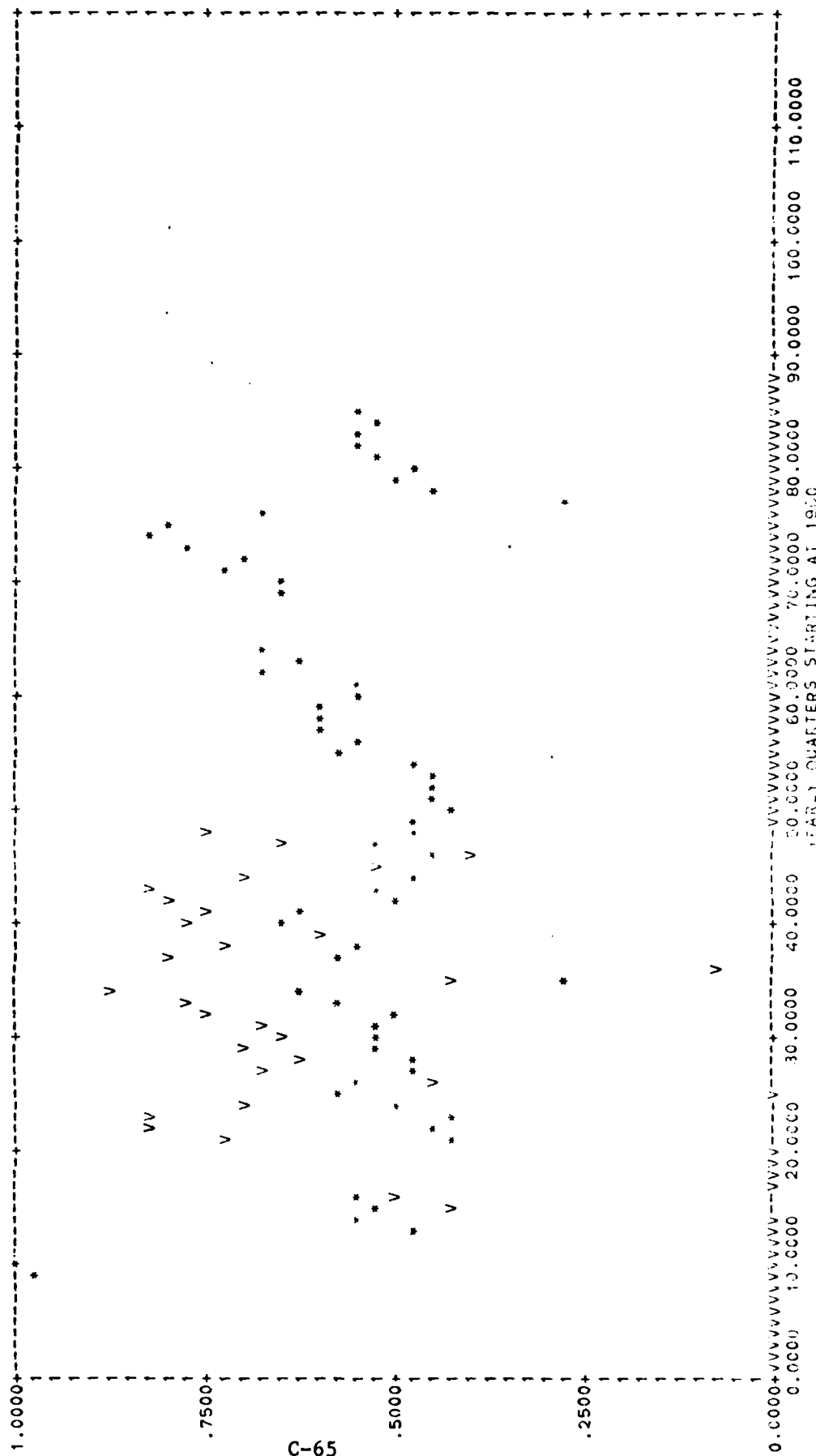


C-64

WORLDWIDE AVERAGE= .69 STANDARD DEVIATION= .1725 NUMBER OF OBSERVATIONS= 47
VIETNAM AVERAGE= .05 STANDARD DEVIATION= .0406 NUMBER OF OBSERVATIONS= 12

SYSTEM=OV-1
VARIABLE=

AVERAGE AVAILABILITY



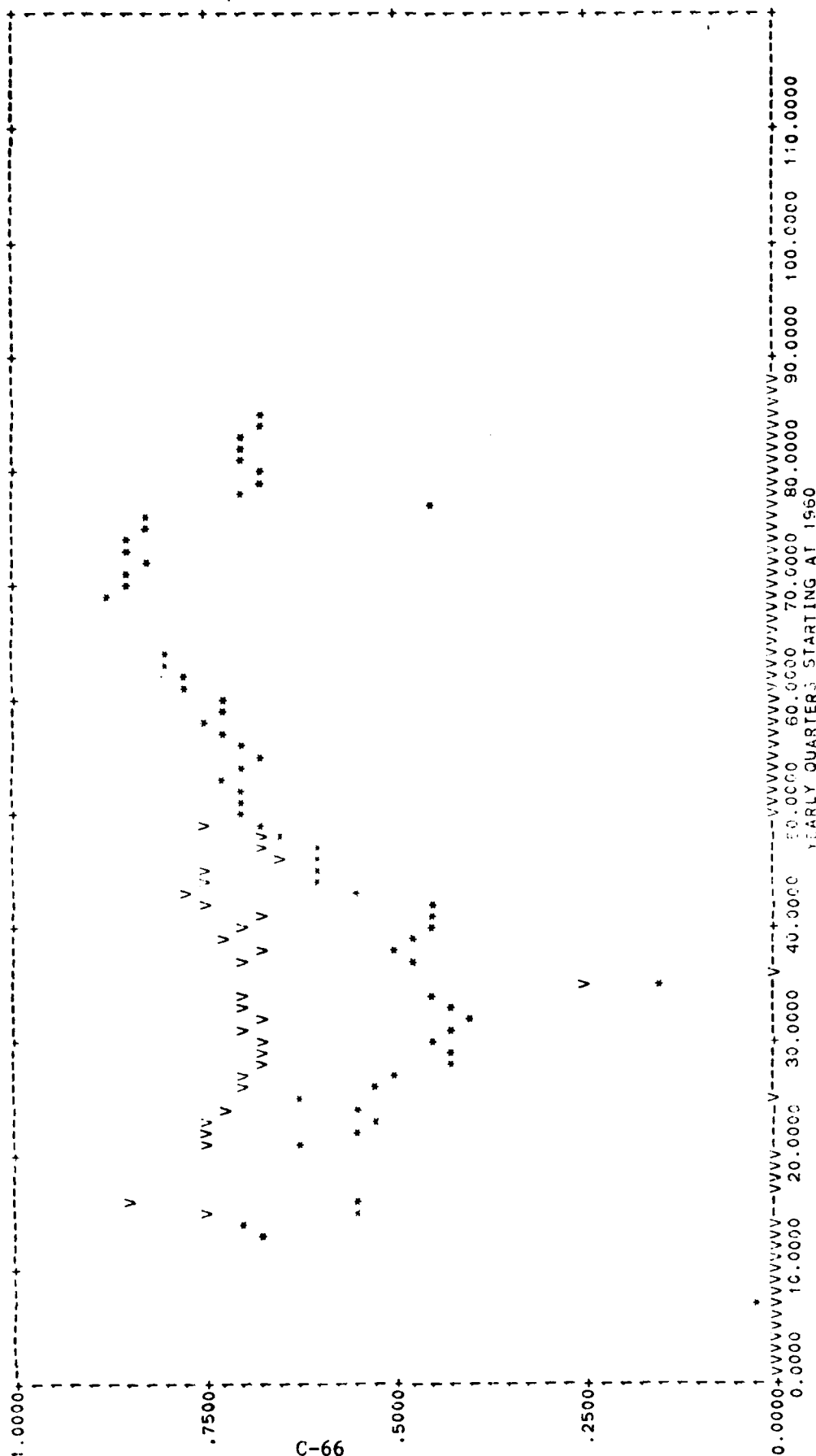
C-65

WORLDWIDE AVERAGE= .58 STANDARD DEVIATION= .1756 NUMBER OF OBSERVATIONS= 70
VIETNAM AVERAGE= .66 STANDARD DEVIATION= .1728 NUMBER OF OBSERVATIONS= 29

GRAPH-OUTLIER * AT 10: YVALUE= 1.128
GRAPH-OUTLIER * AT 10: YVALUE= 1.000
GRAPH-OUTLIER * AT 11: YVALUE= 1.073
GRAPH-OUTLIER * AT 12: YVALUE= 1.089

SYSTEM=007-1
YVARIABLE=

AVERAGE AVAILABILITY

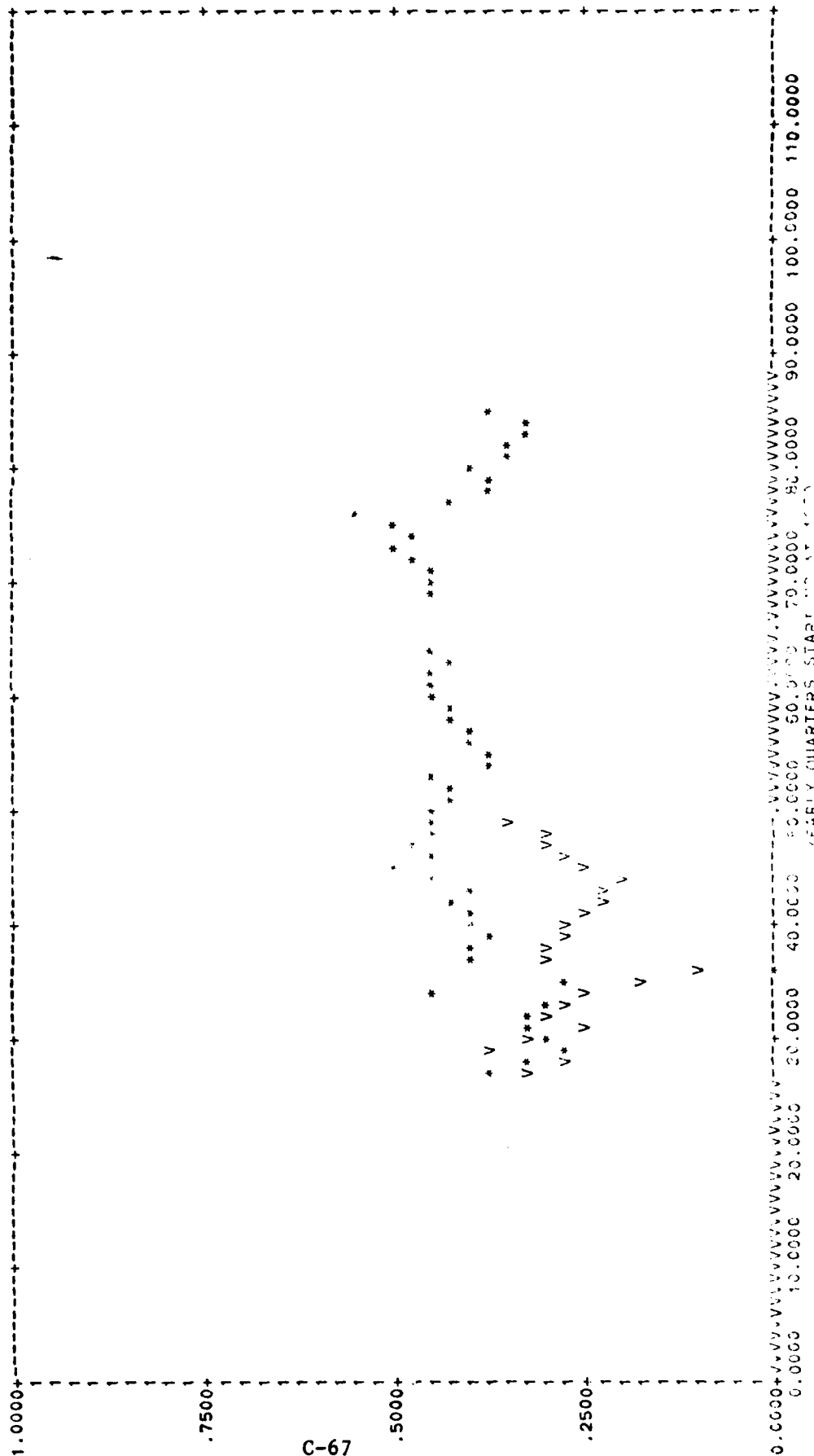


WORLDWIDE AVERAGE= .66 STANDARD DEVIATION= .2613 NUMBER OF OBSERVATIONS= 71
VIETNAM AVERAGE= .68 STANDARD DEVIATION= .1577 NUMBER OF OBSERVATIONS= 30

GRAPH-OUTLIER : AT 8. YVALUE= 1.228
GRAPH-OUTLIER : AT 9. YVALUE= 1.535
GRAPH-OUTLIER : AT 10. YVALUE= 1.113
GRAPH-OUTLIER : AT 11. YVALUE= 1.402

SYSTEM=AH-1
VARIABLE=

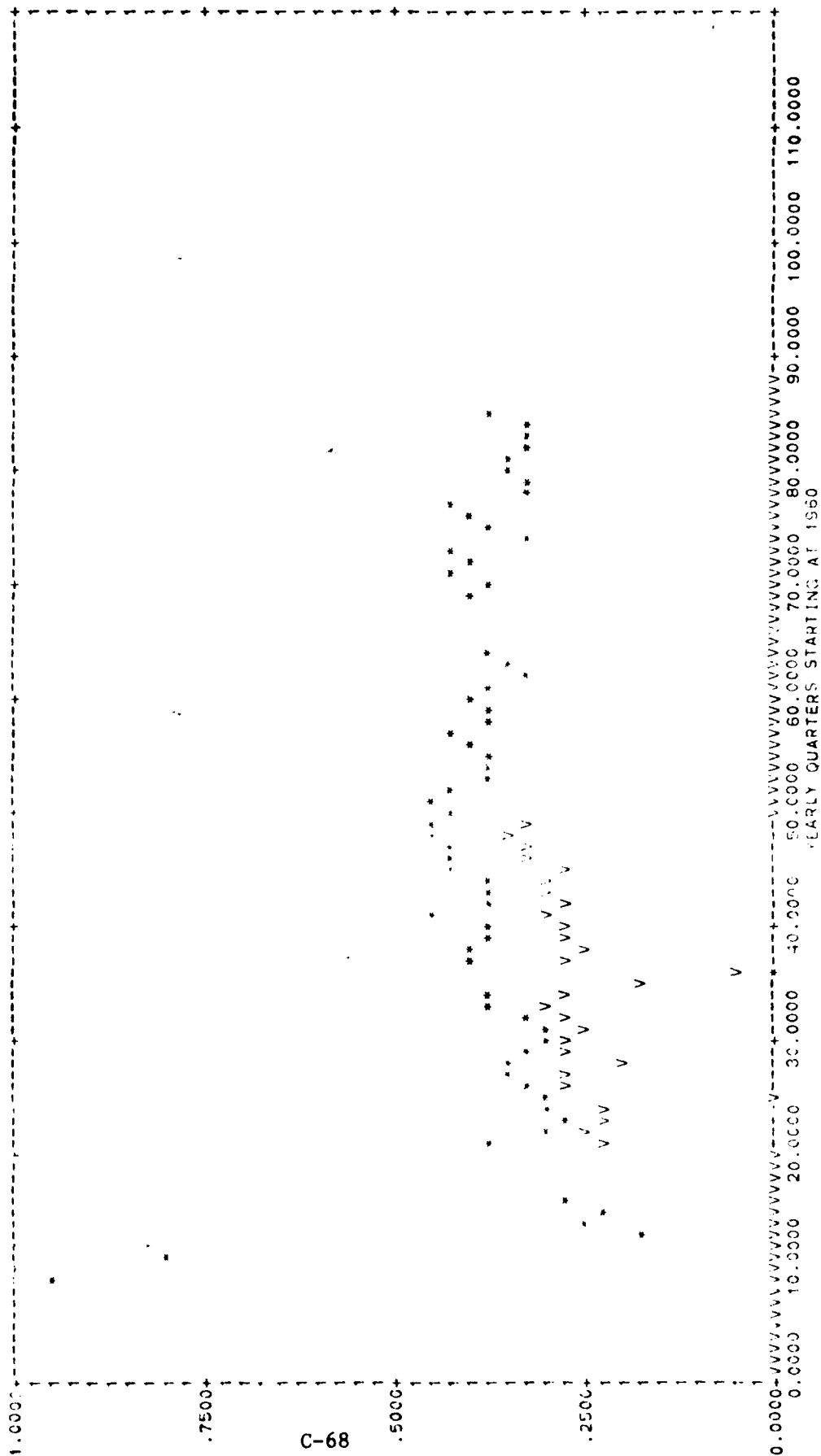
STANDARD DEVIATION OF AVAILABILITY



WORLDWIDE AVERAGE= .41 STANDARD DEVIATION= .0006 OBSERVATIONS= 54
VIETNAM AVERAGE= .27 STANDARD DEVIATION= .0007 OBSERVATIONS= 23

SYSTEM OF
VARIABLES

STANDARD DEVIATION OF AVAILABILITY

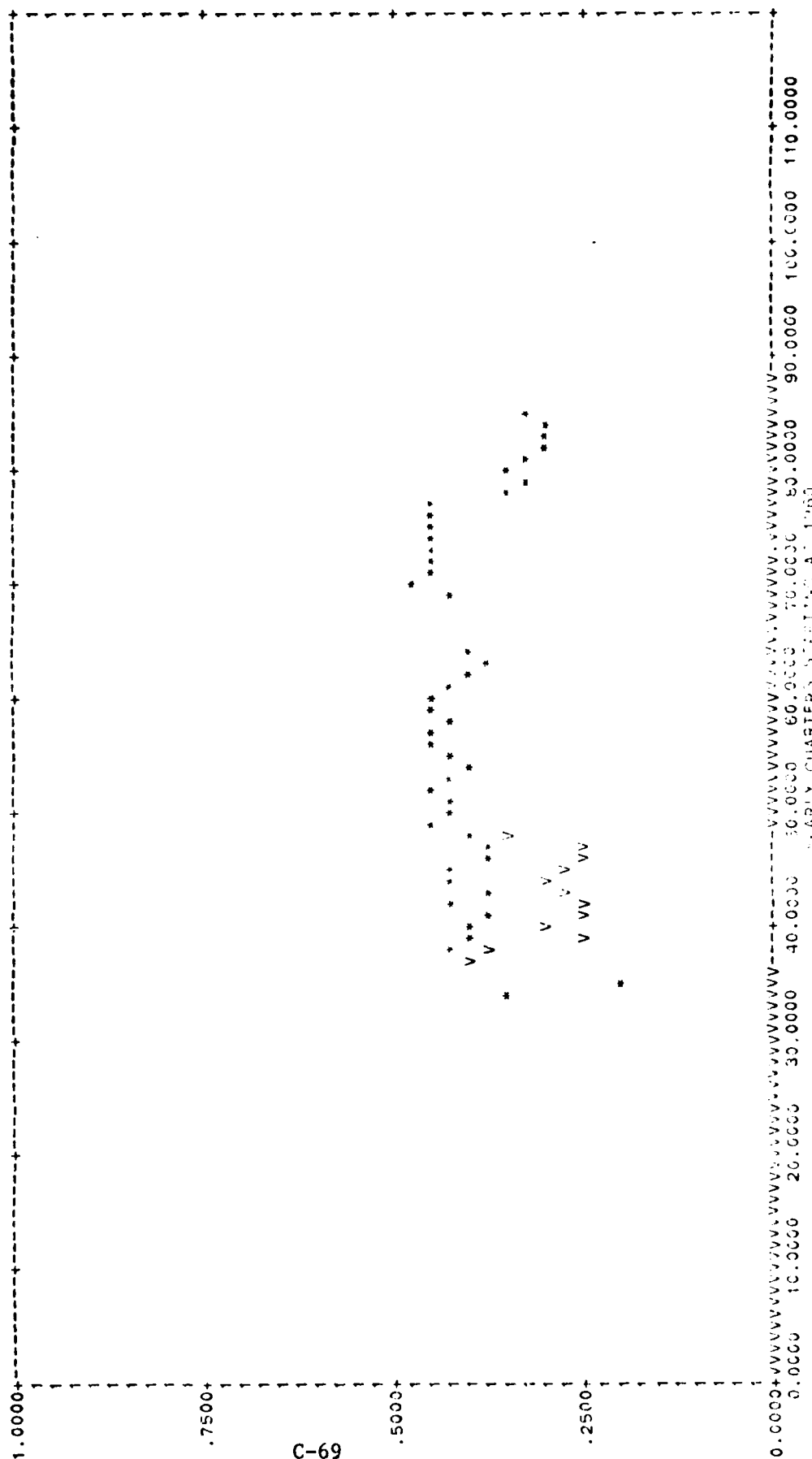


C-68

WORLDWIDE AVERAGE= .41 STANDARD DEVIATION= .1840 NUMBER OF OBSERVATIONS= 69
VIETNAM AVERAGE= .26 STANDARD DEVIATION= .0553 NUMBER OF OBSERVATIONS= 28
GRAPH-OUTLIER * AT 8. YVALUE= 1.291
GRAPH-OUTLIER * AT 10. YVALUE= 1.132

SYSTEM=OH5R
YVARIABLE=

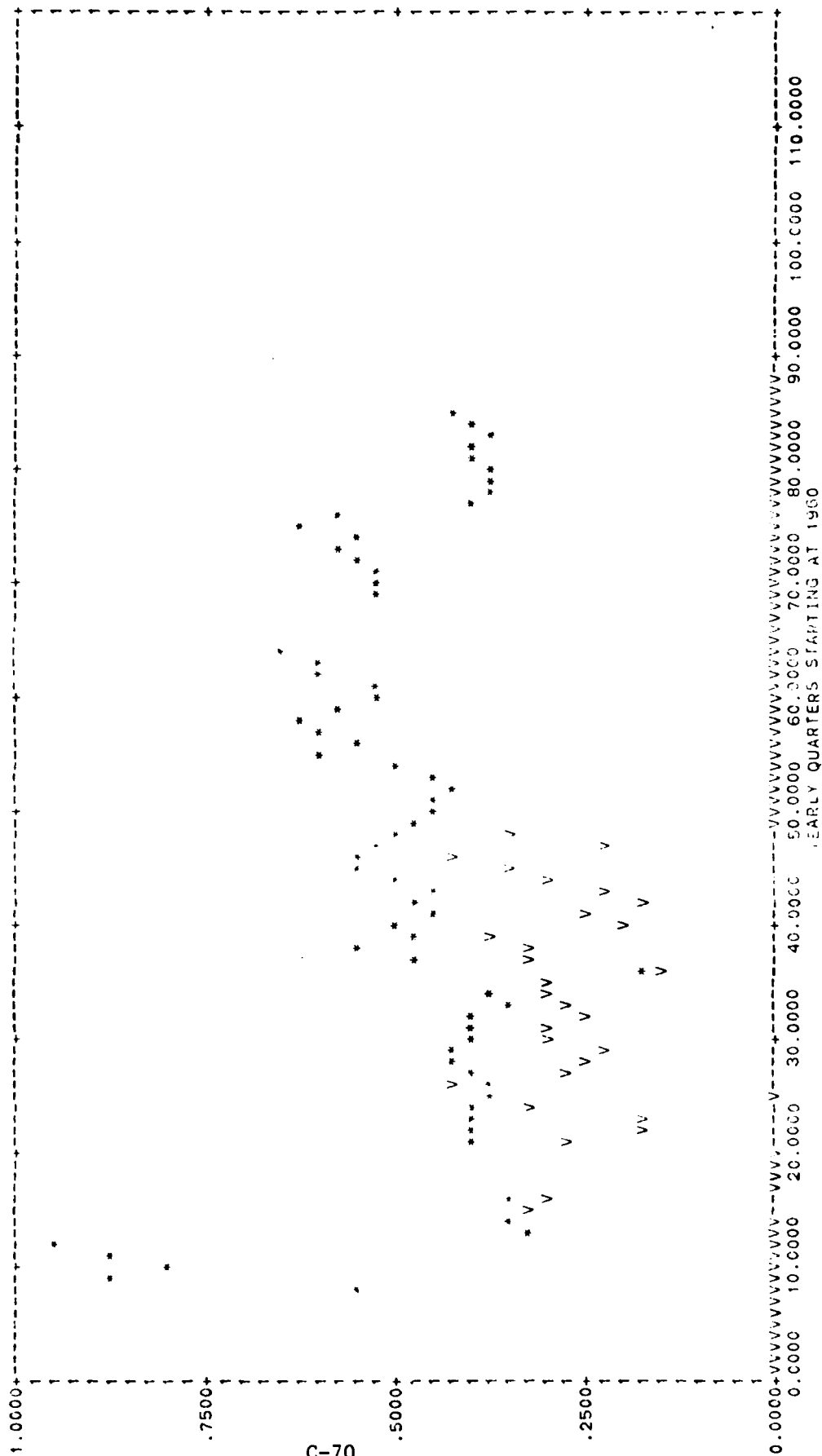
STANDARD DEVIATION OF AVAILABILITY



WORLDWIDE AVERAGE= .40 STANDARD DEVIATION= .0000 NUMBER OF OBSERVATIONS= 47
VIETNAM AVERAGE= .129 STANDARD DEVIATION= .0000 NUMBER OF OBSERVATIONS= 12

SYSTEM:CV-1
VARIABLE=

STANDARD DEVIATION OF AVAILABILITY

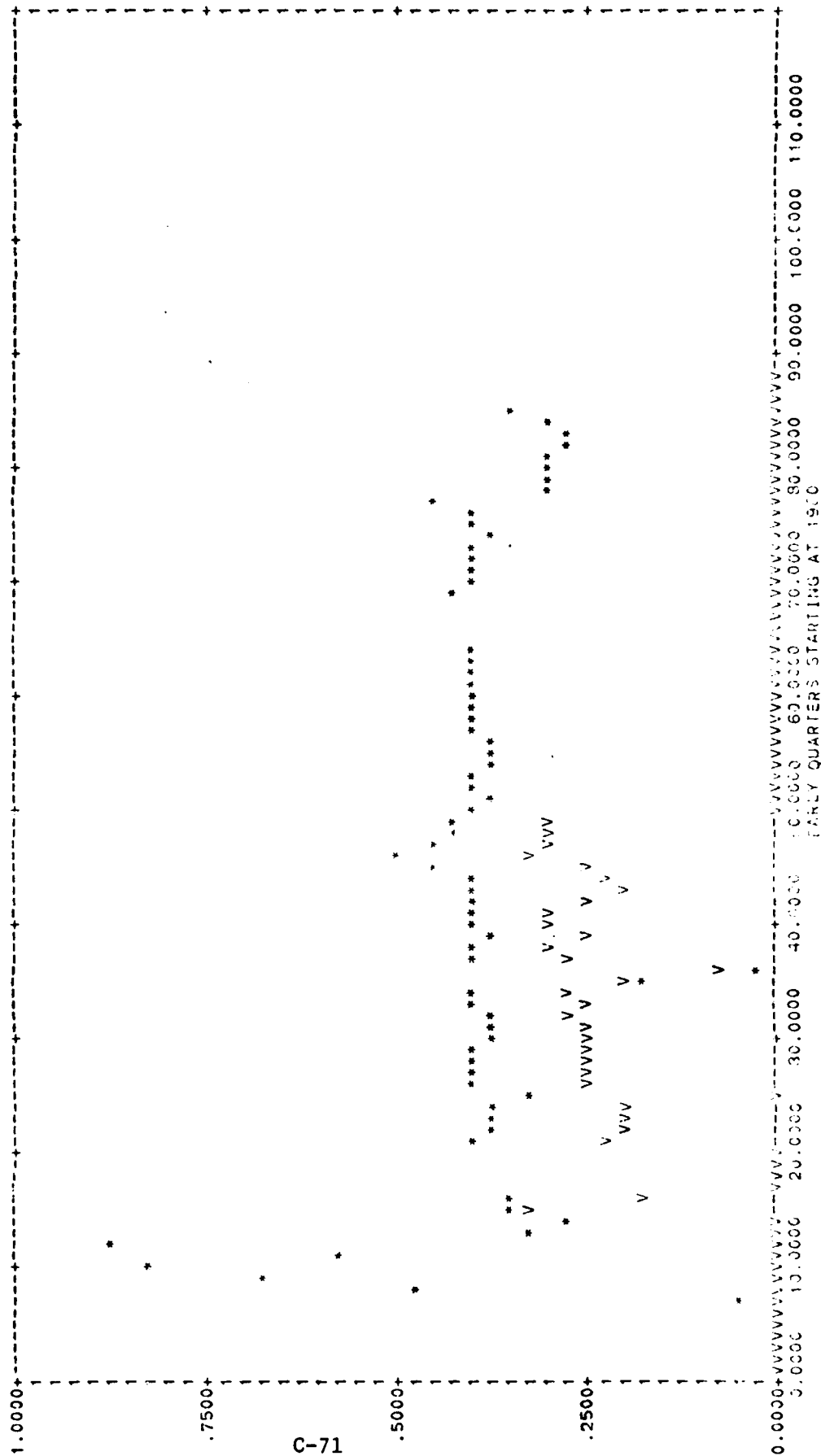


C-70

WORLDWIDE AVERAGE= .49 STANDARD DEVIATION= .1345 NUMBER OF OBSERVATIONS= 70
VIETNAM AVERAGE= .28 STANDARD DEVIATION= .0795 NUMBER OF OBSERVATIONS= 29

SYSTEM=UH-1
YVARIABLE=

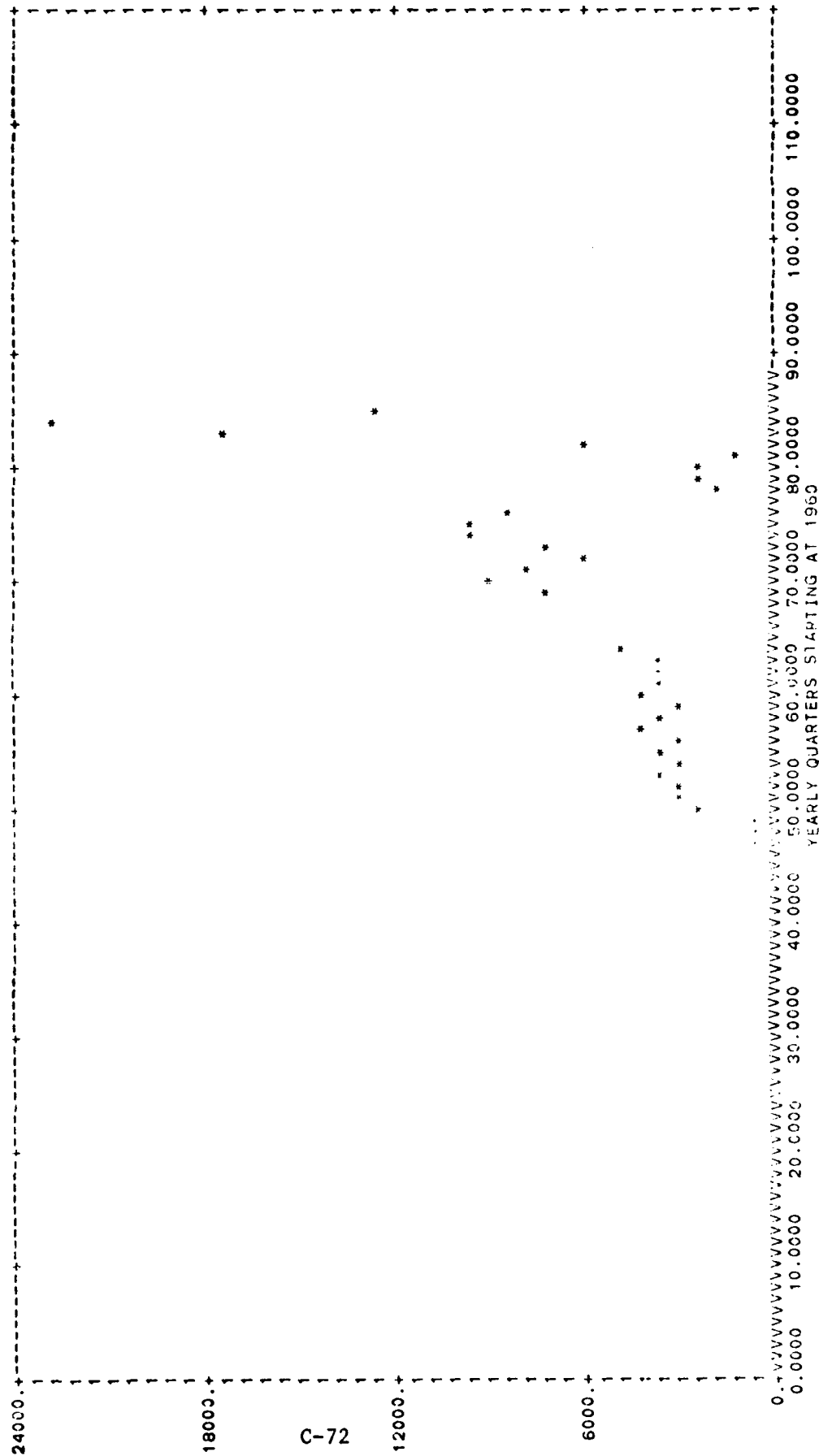
STANDARD DEVIATION OF AVAILABILITY



WORLDWIDE AVERAGE= .39 STANDARD DEVIATION= .1109 NUMBER OF OBSERVATIONS= 71
VIETNAM AVERAGE= .25 STANDARD DEVIATION= .0935 NUMBER OF OBSERVATIONS= 30

SYSTEM-H-1
YVARIABLE=

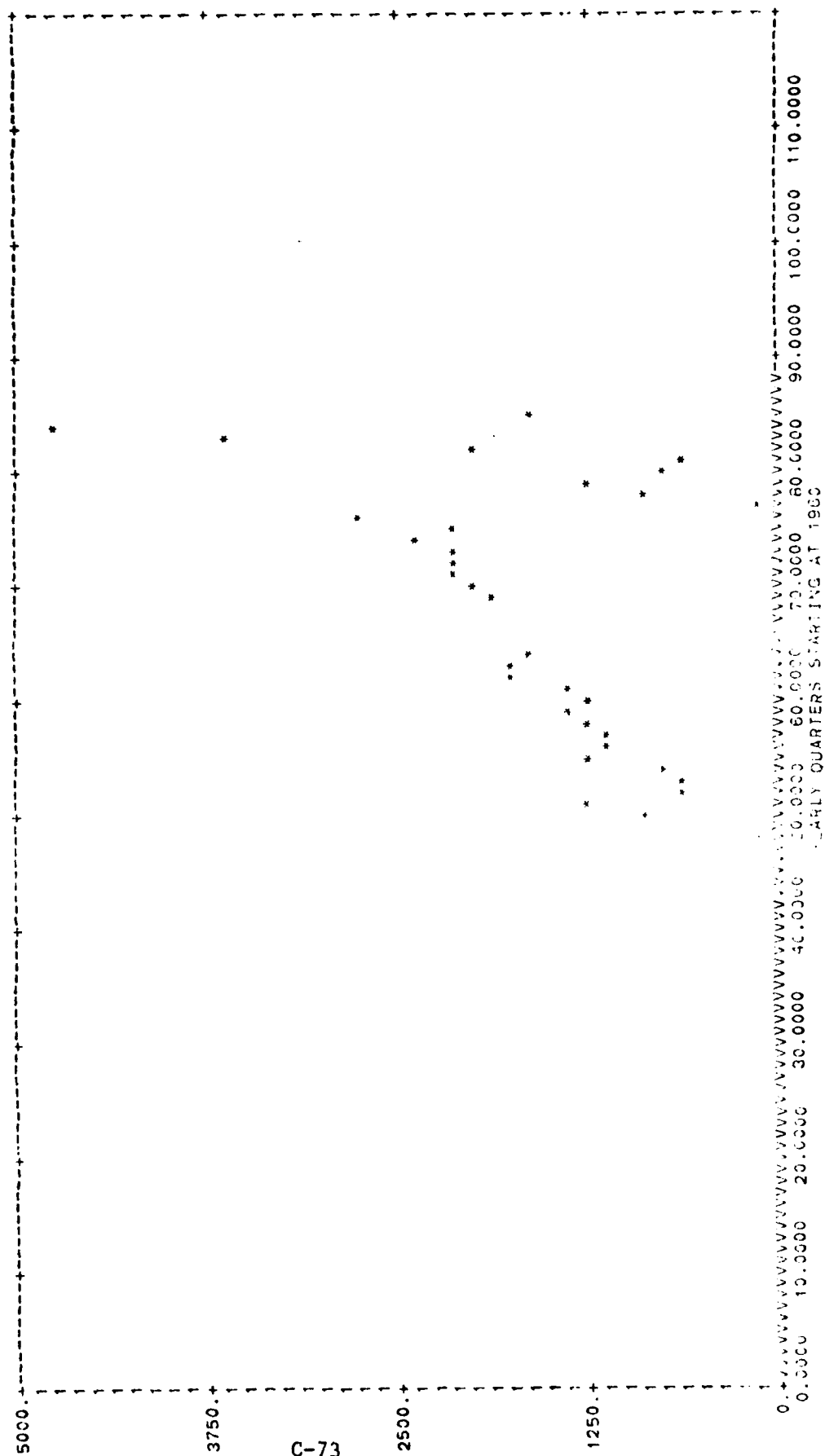
NUMBER OF AUTOCORRELATIONS



WORLDWIDE AVERAGE= 5290.57 STANDARD DEVIATION= 4795.2372 NUMBER OF OBSERVATIONS= 35

SYSTEM=CH47
VARIABLE=

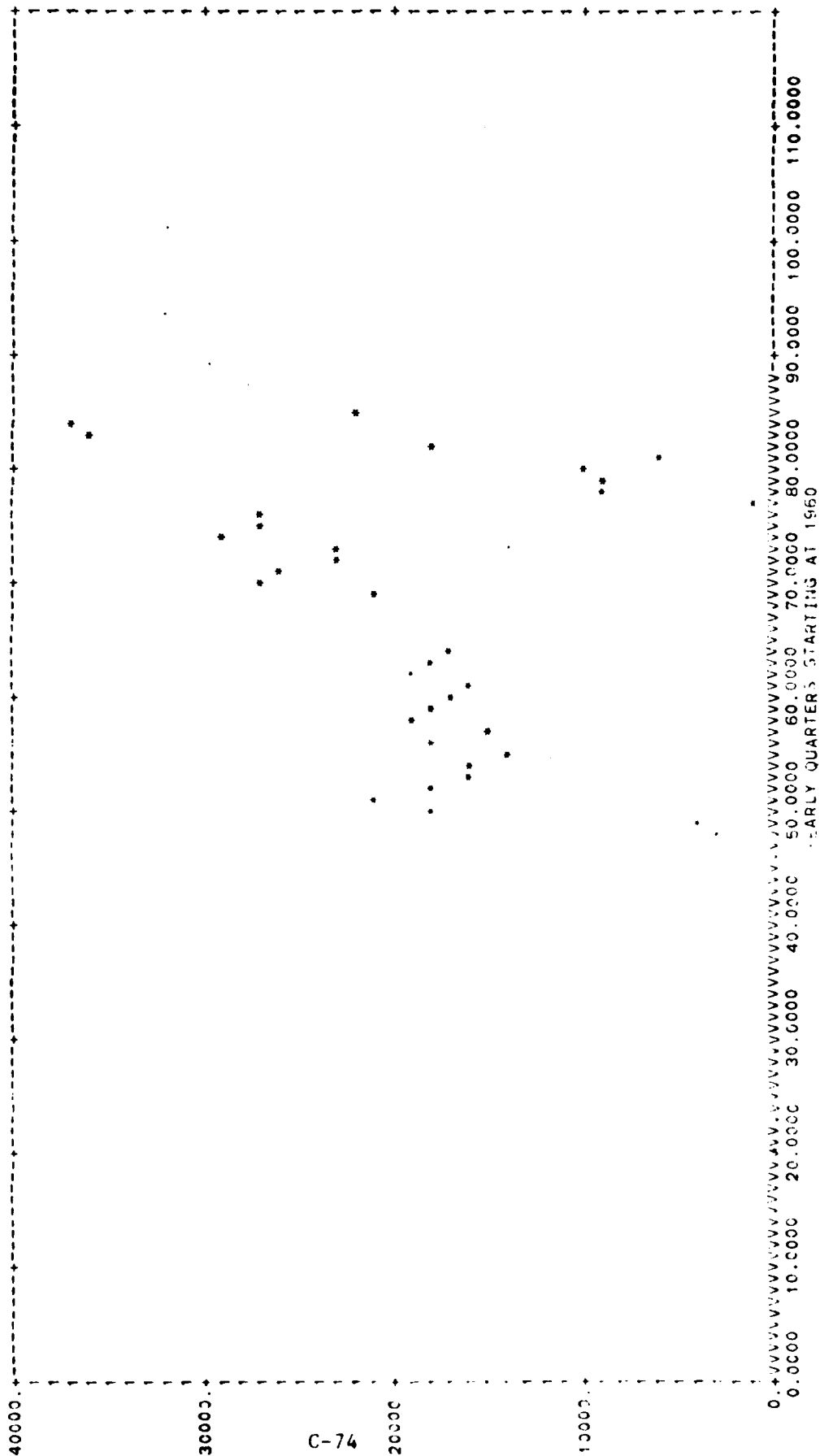
NUMBER OF AUTOROTATIONS



WORLDWIDE AVERAGE= 1454.37 STANDARD DEVIATION= 975.0099 NUMBER OF OBSERVATIONS= 35

SYSTEM=OH58
VARIABLE=

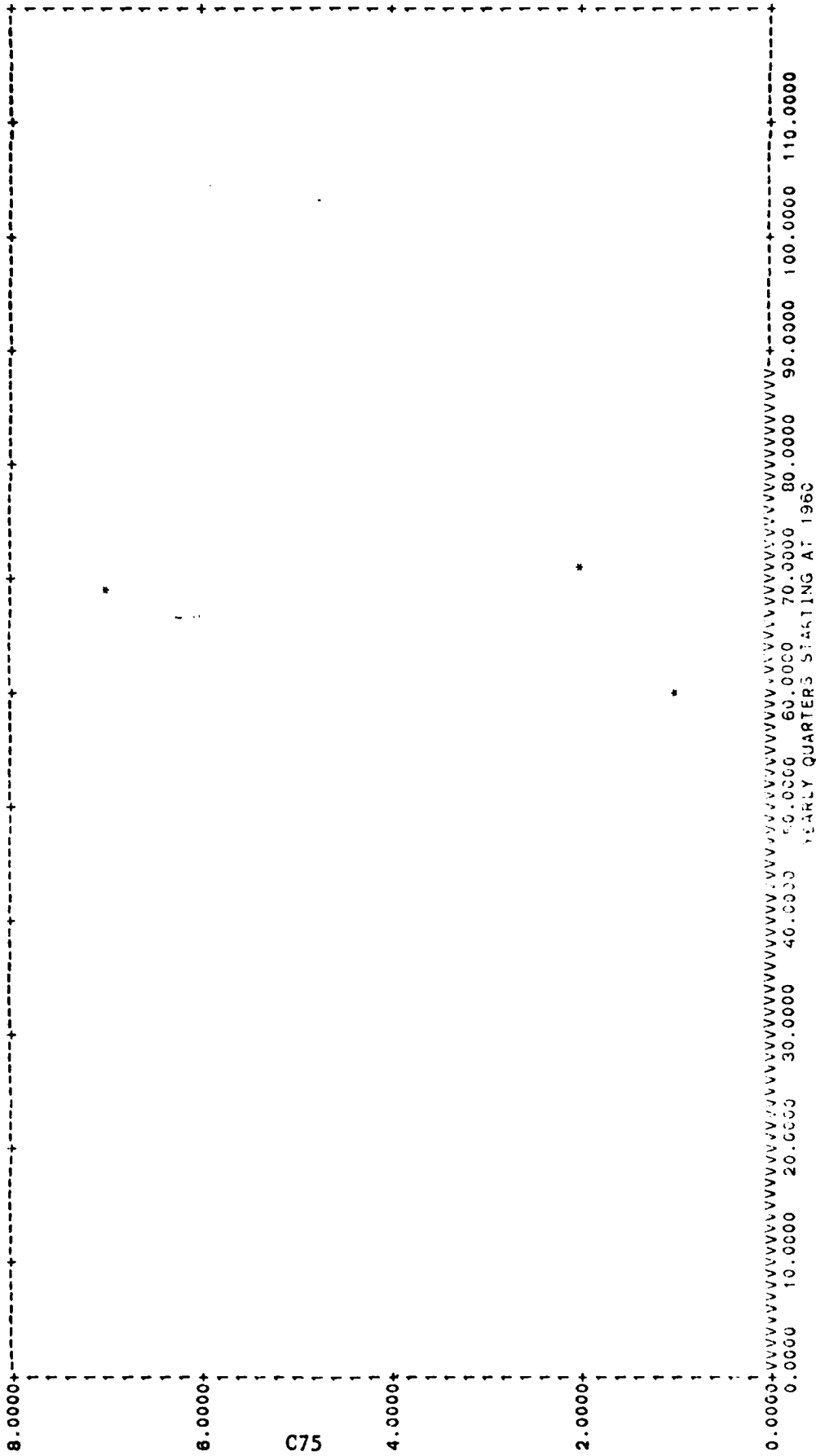
NUMBER OF OBSERVATIONS



WORLDWIDE AVERAGE= 17710.63 STANDARD DEVIATION= 8827.8916 NUMBER OF OBSERVATIONS= 35

SYSTEM=OV-1
VARIABLE=

NUMBER OF AUTOPOTATIONS



WORLDWIDE AVERAGE=

3.35

STANDARD DEVIATION=

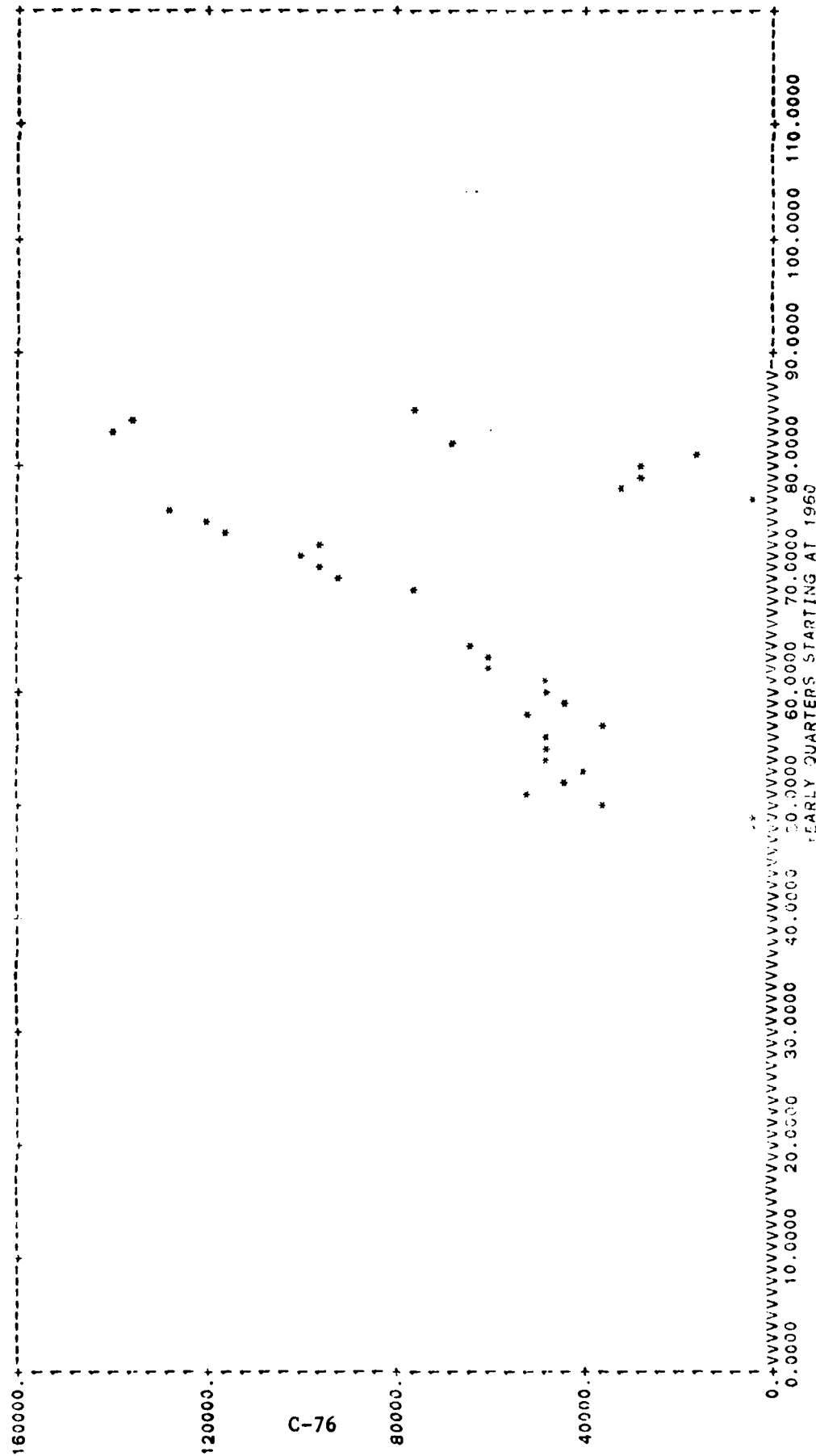
3.2146

NUMBER OF OBSERVATIONS=

3

SYSTEM-1
VARIABLE=

NUMBER OF OPERATIONS



WORLDWIDE AVERAGE= 60120.26 STANDARD DEVIATION= 38414.2533 NUMBER OF OBSERVATIONS= 35

APPENDIX D

1352 PROGRAM DATA

REGRESSION ANALYSIS

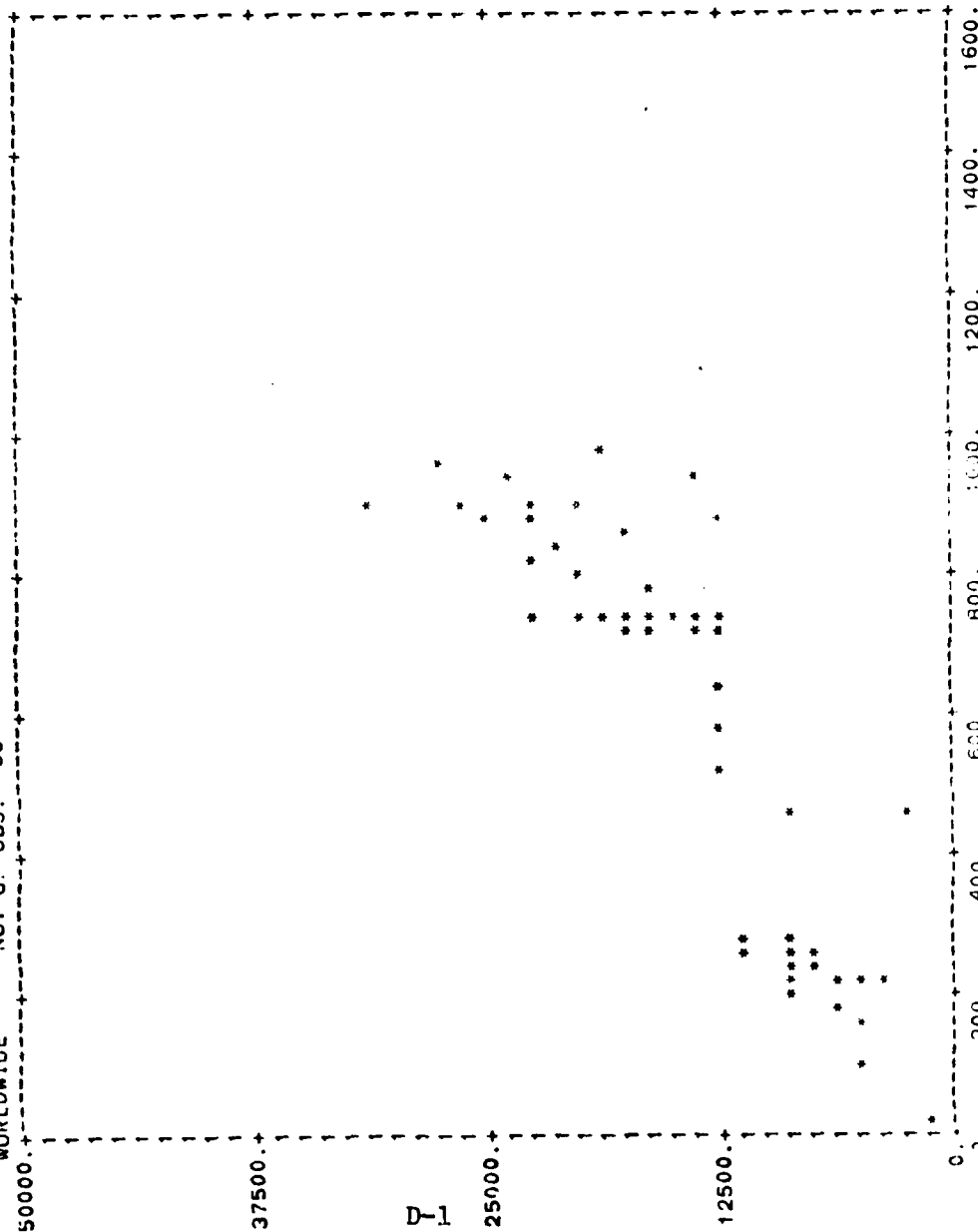
Y VARIABLE
(DEPENDENT)

TOTAL FLYING HOURS
TOTAL NUMBER OF SORTIES

X VARIABLE
(INDEPENDENT)

DENSITY
TOTAL FLYING HOURS

SYSTEM=AH-1
 YVARIABLE= TOTAL FLYING HOURS
 XVARIABLE= DENSITY
 WORLDWIDE NO. OF OBS. =56

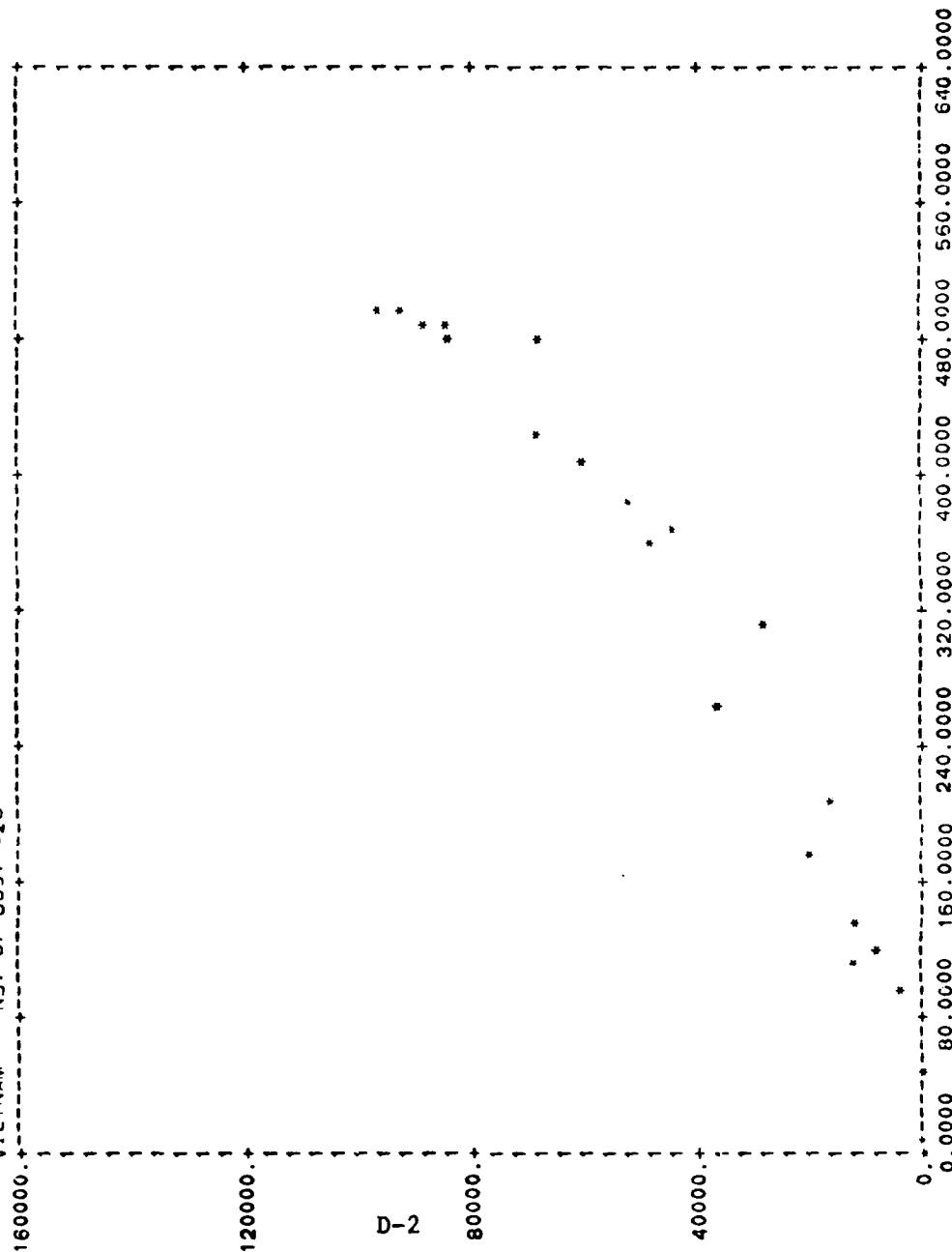


ANOVA TABLE

REGRESSION	DF	SS	MS	F	PROB > F
1	1	1.283593444801E+10	1.283593444801E+10	1.283593444801E+10	0.000000E+00
RESIDUAL	55	681843642.9419	1.239352078076E+07		
TOTAL	56	1.3517578091E+10			

F-TEST = 1035.69717331
 R**2 = 0.95735376298
 B(1) EST = 23.3386310762

SYSTEM=AM-1
YVARIABLE=
XVARIABLE=
VIETNAM NO. OF OBS. =23



ANOVA TABLE

REGRESSION	DF=	SS=	MS=
RESIDUAL	22	2.552751319349E+9	116034150.8795
TOTAL	23	7.4190352008E+10	

F-TEST= 617.3837628463
R**2= 96.55918694243
B(1) EST= 156.268830561

SYSTEM=CH47

YVARIABLE=

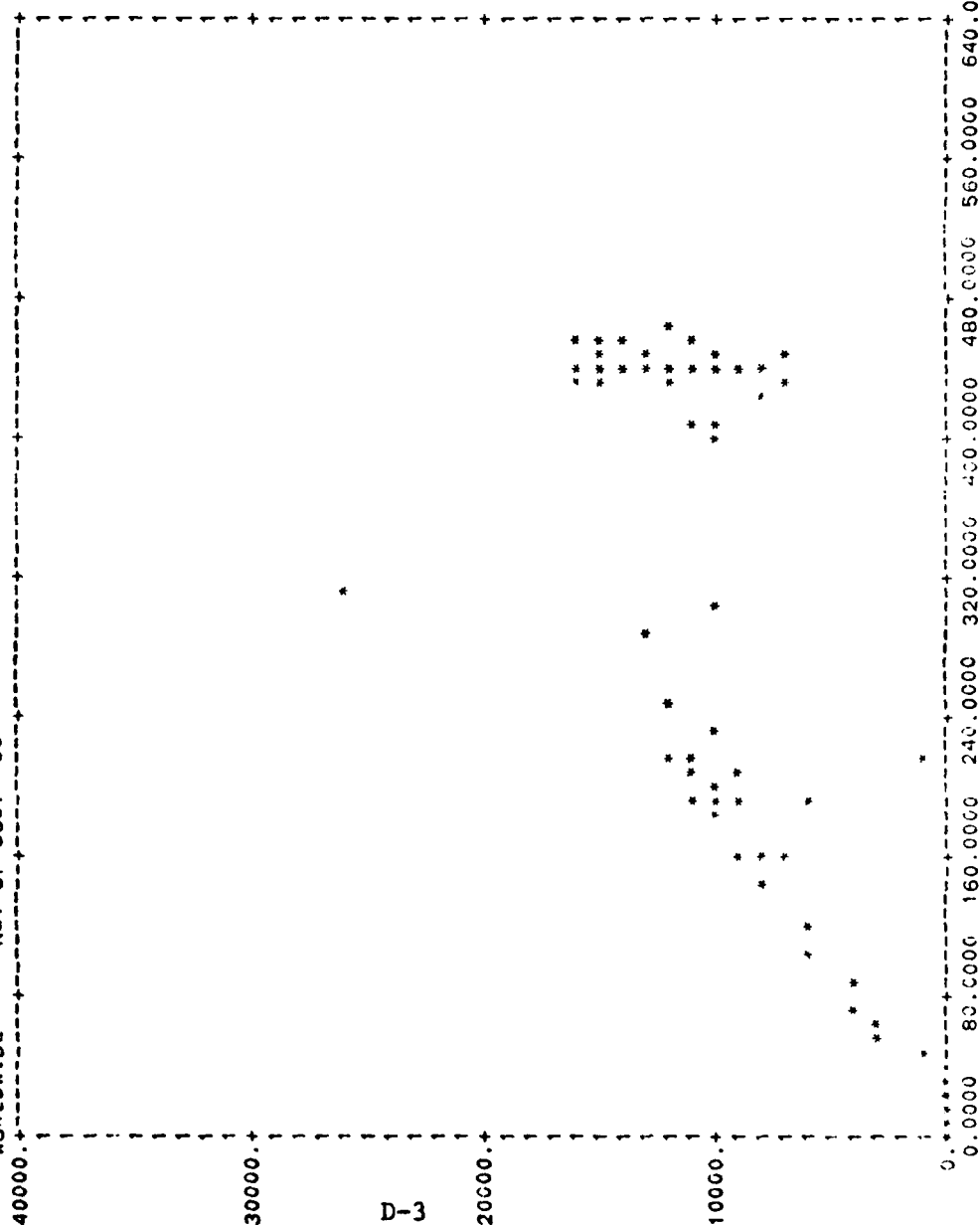
XVARIABLE=

WORLDWIDE

NO. OF OBS. =66

TOTAL FLYING HOURS

DENSITY



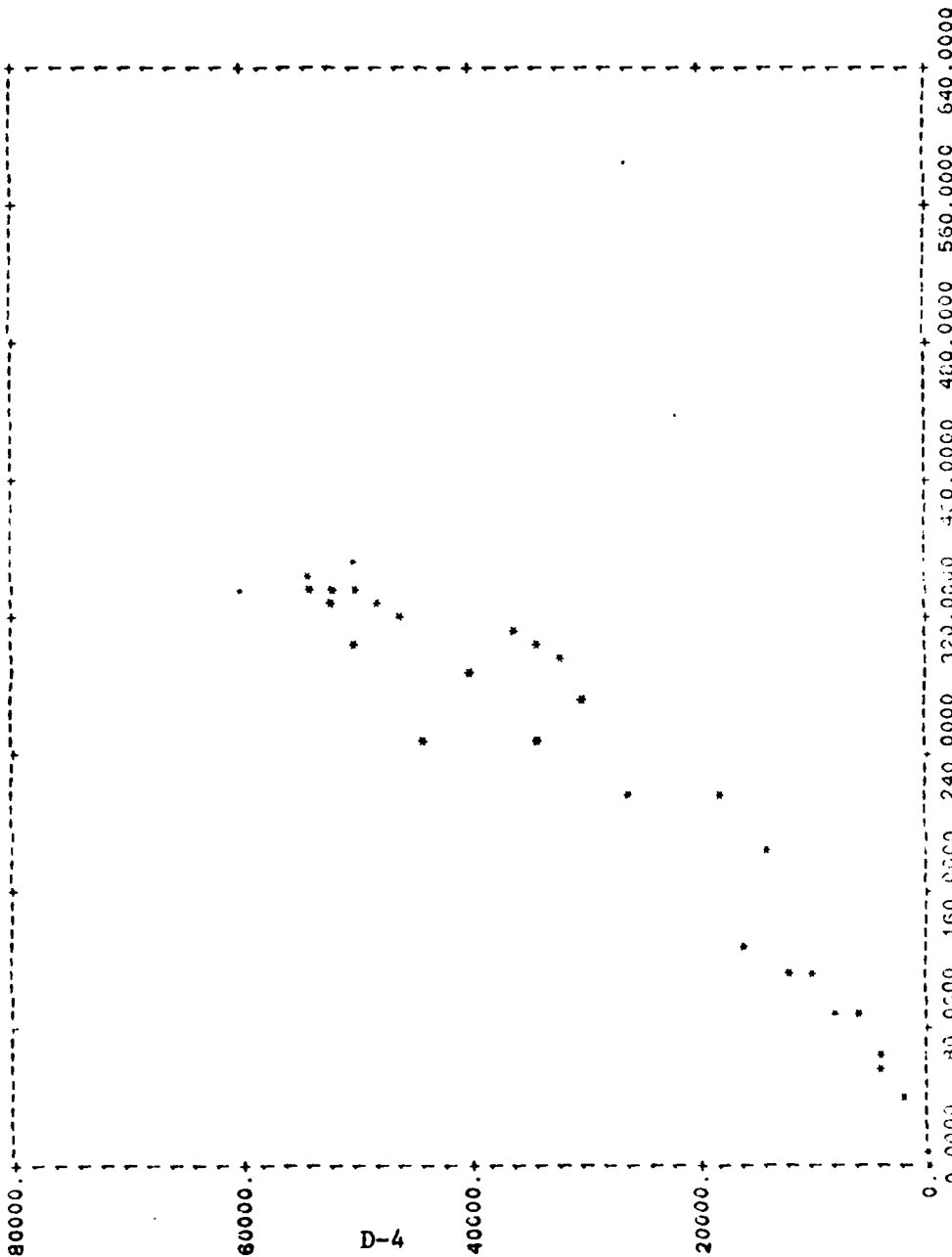
D-3

0.0000 80.0000 160.0000 240.0000 320.0000 400.0000 480.0000 560.0000 640.0000

ANOVA TABLE

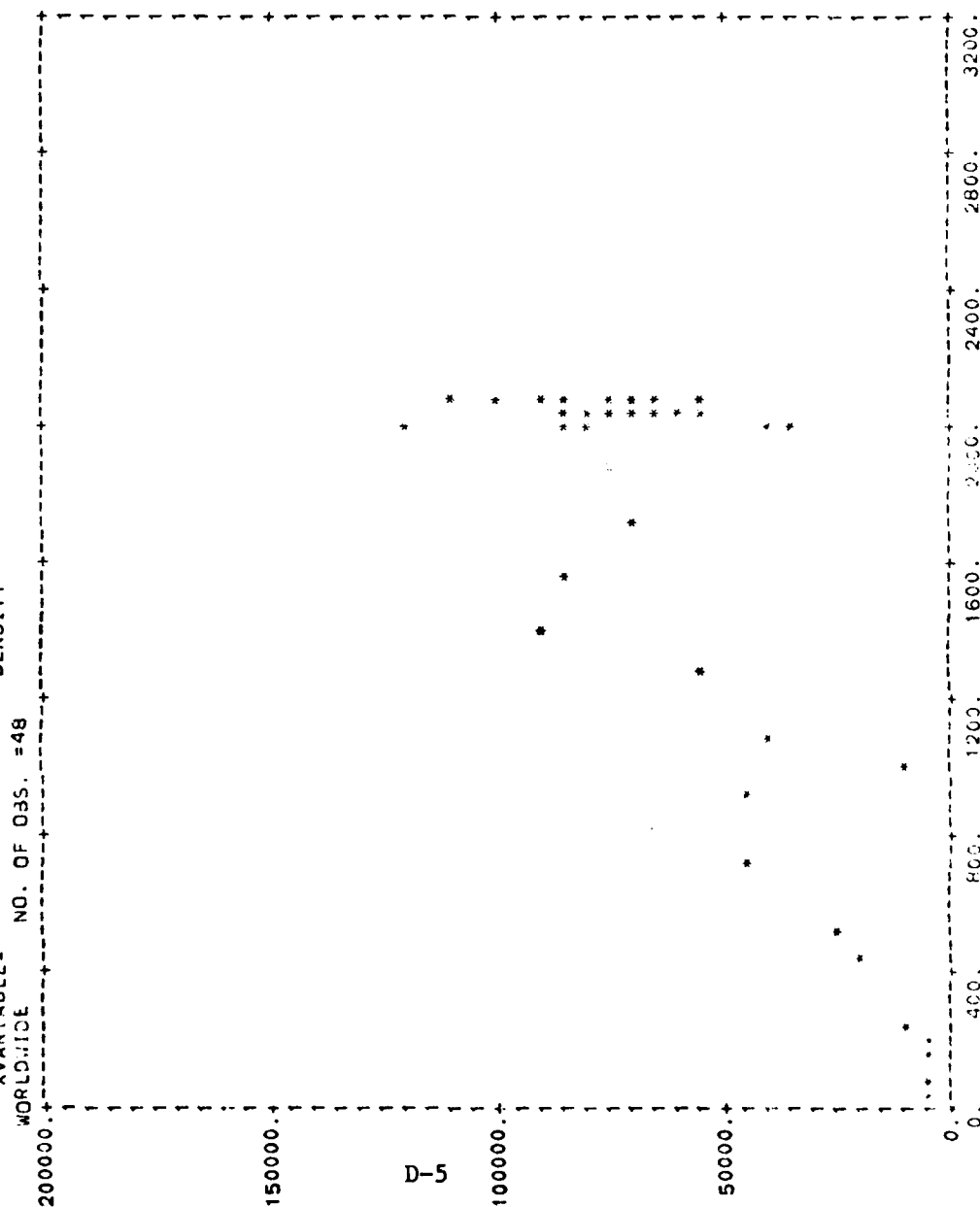
REGRESSION DF= 1. SS= 7.407059179486E+9 MS= 7.407059179486E+9
RESIDUAL DF= 65. SS= 904314688.5144 MS= 13912533.66945
TOTAL DF= 66. SS= 8.311373868E+9
F-TEST= 546.7774138213
R-SQ=2= 89.37522070421 S= 3729.950893705 CORR F=1= .6474563932268
3(1) EST= 30.85705836895

SYSTEM C047
 YVARIABLE=
 X VARIABLE=
 VIETNAM NO. OF OBS. = 28
 TOTAL FLYING HOURS
 DENSITY



ANOVA TABLE
 REGRESSION DF= 1. SS= 3.654775875019E+10 F= 3.654775875019E+10
 RESIDUAL DF= 27. SS= 1.201244086814E+9 F= 44490521.73387
 TOTAL DF= 28. SS= 3.7749002837E+10
 F-TEST= 821.472918509
 R-SQ= 96.81781240156 S= 6670.121568148 CORR EST= .9549990969963
 B(1) EST= 140.5169801332

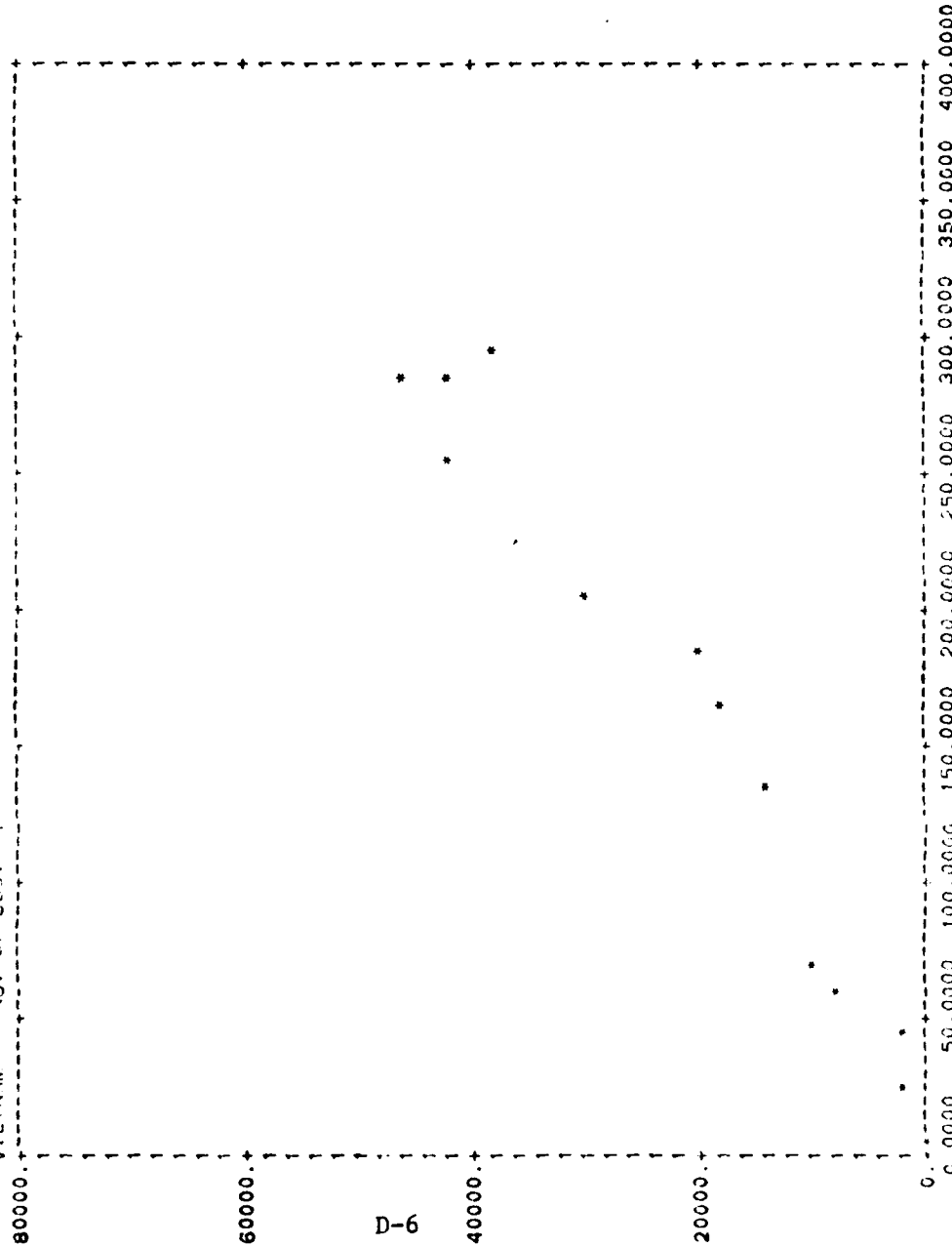
SYSTEM: OH58
YVARIABLE=
XVARIABLE=
WORLDWIDE NO. OF OBS. = 48



ANOVA TABLE

REGRESSION	DF	SS	MS	F	EST
RESIDUAL	47	1.514008316862E+10	3.2212761E+08	1.05	2.085283250004E+11
TOTAL	48	2.22668408189E+11			300852033.3749
F-TEST	693.1240120789				
R-2	03.6371231504				
B(1) EST	07.6176670972				

SYSTEM=CHS
Y-VARIABLE=
X-VARIABLE=
VIETNAM NO. OF OBS. =14



ANOVA TABLE

SOURCE	SS	DF	MS
REGRESSION	1.015602400786E+10	1	1.015602400786E+10
RESIDUAL	2.2598926141	13	17892225.08777
TOTAL	1.0395522934E+10	14	

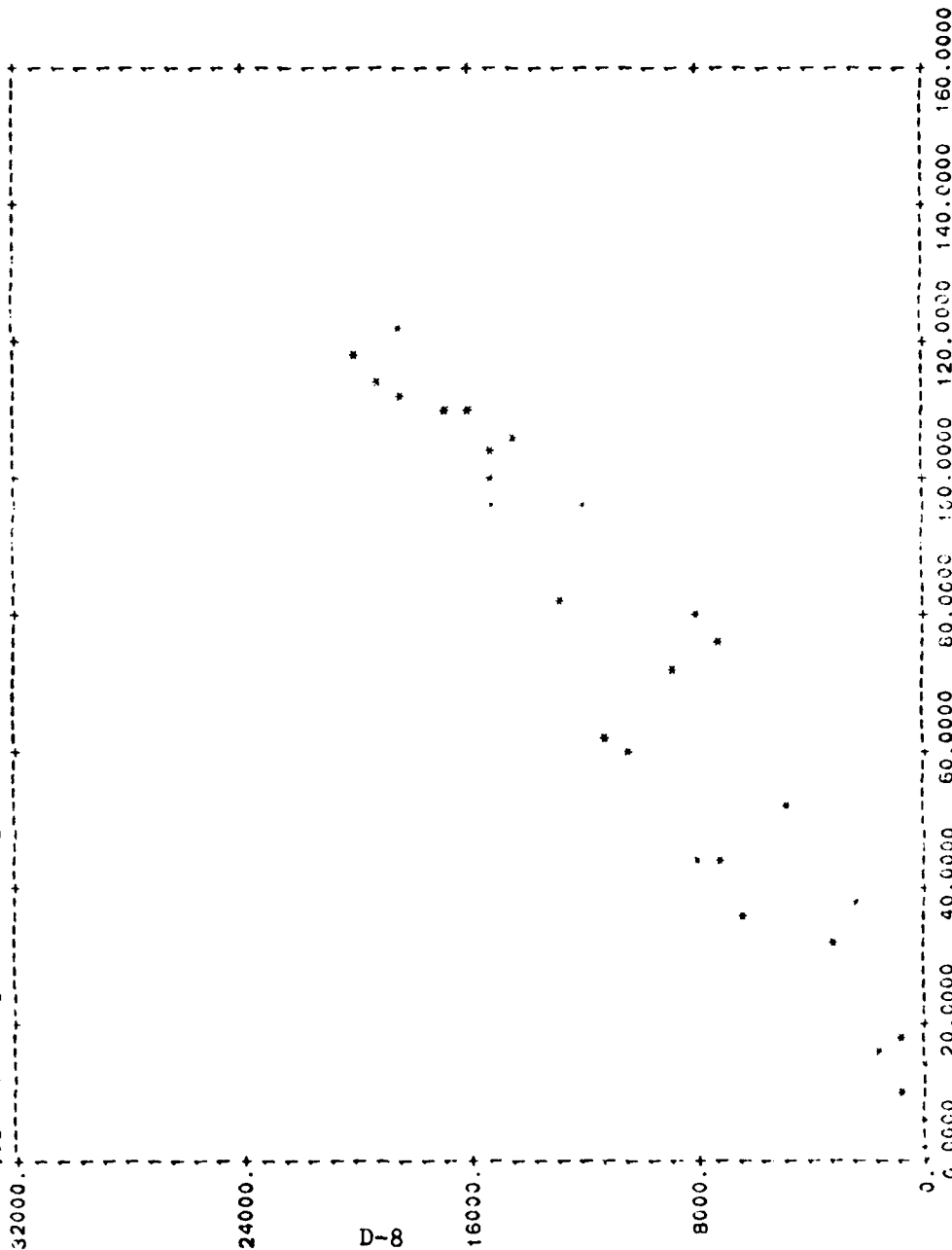
F-TEST = 507.3421910936
R-SQ = 97.76102253785
B(1) EST = 143.2509228895

CORR EJT = .9733678581256

A scatter plot titled "D-7" showing a distribution of data points. The x-axis is labeled "D-7" and ranges from 0 to 20,000. The y-axis is labeled "D-7" and ranges from 0 to 20,000. The data points are clustered in the upper right quadrant, with a peak density around (10,000, 10,000).

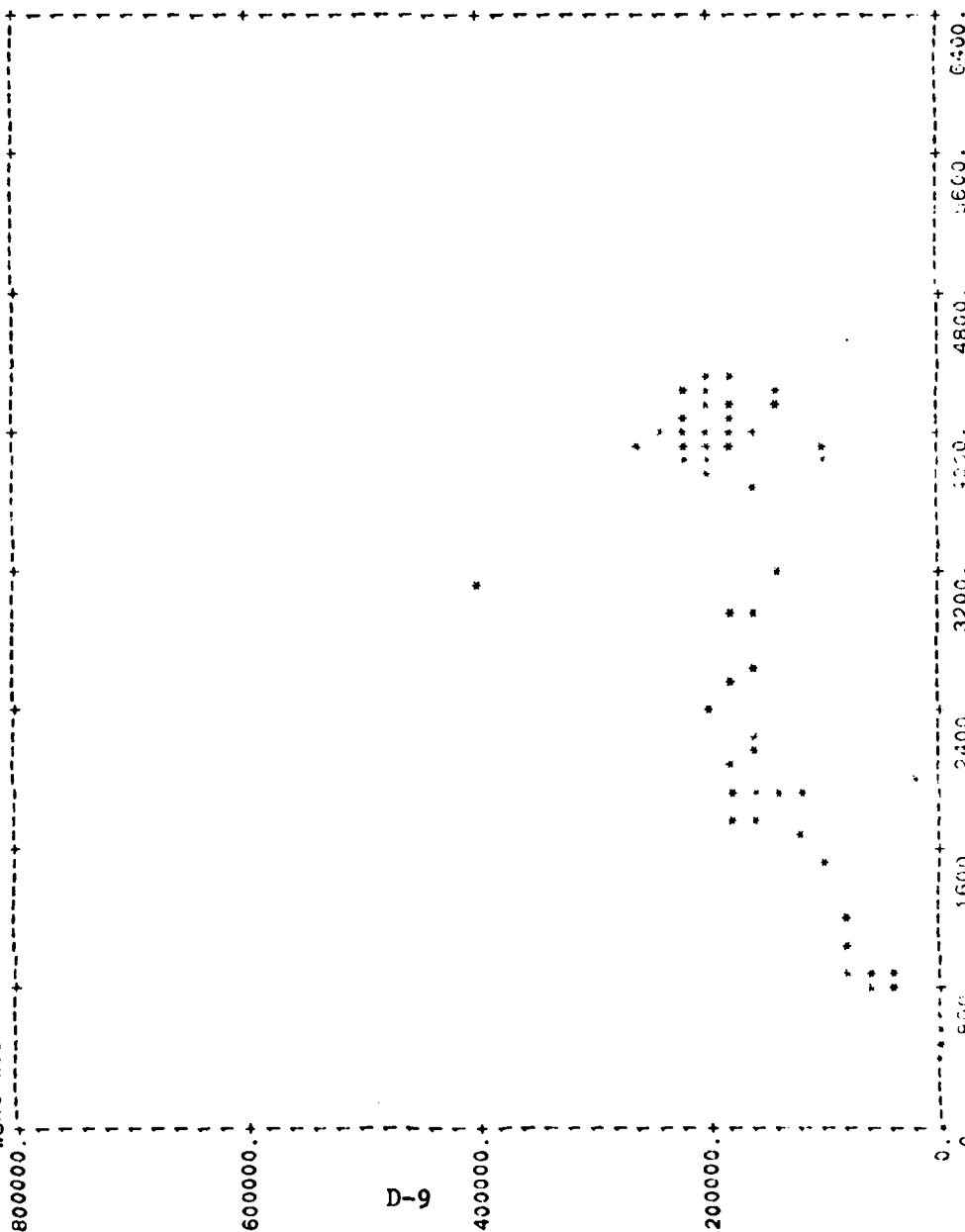
ANOVA TABLE			
REGRESSION	DF=	1.	SS=
RESIDUAL	DF=	64.	SS=
TOTAL	DF=	65.	SS=
F=	MS=	110.950002	
R=	R ² =	0.9362019275	
		32.11309238	

SYSTEM: D-8
 Y-VARIABLE: TOTAL FLYING HOURS
 X-VARIABLE: DENSITY
 VIETNAM NO. OF OBS. = 29



ANOVA TABLE
 REGRESSION DF= 1. SS= 3.399349905294E+9 MS= 3.399349905294E+9
 RESIDUAL DF= 28. SS= 95317742.70572 MS= 3404205.096633
 TOTAL DF= 29. SS= 4.09466764E+9
 F-TEST= 1174.826366734
 R-SQ= 97.0721494660 S= 1045.04880603 CORR EST= .9557291223106
 B(1) EST= 150.1114685748

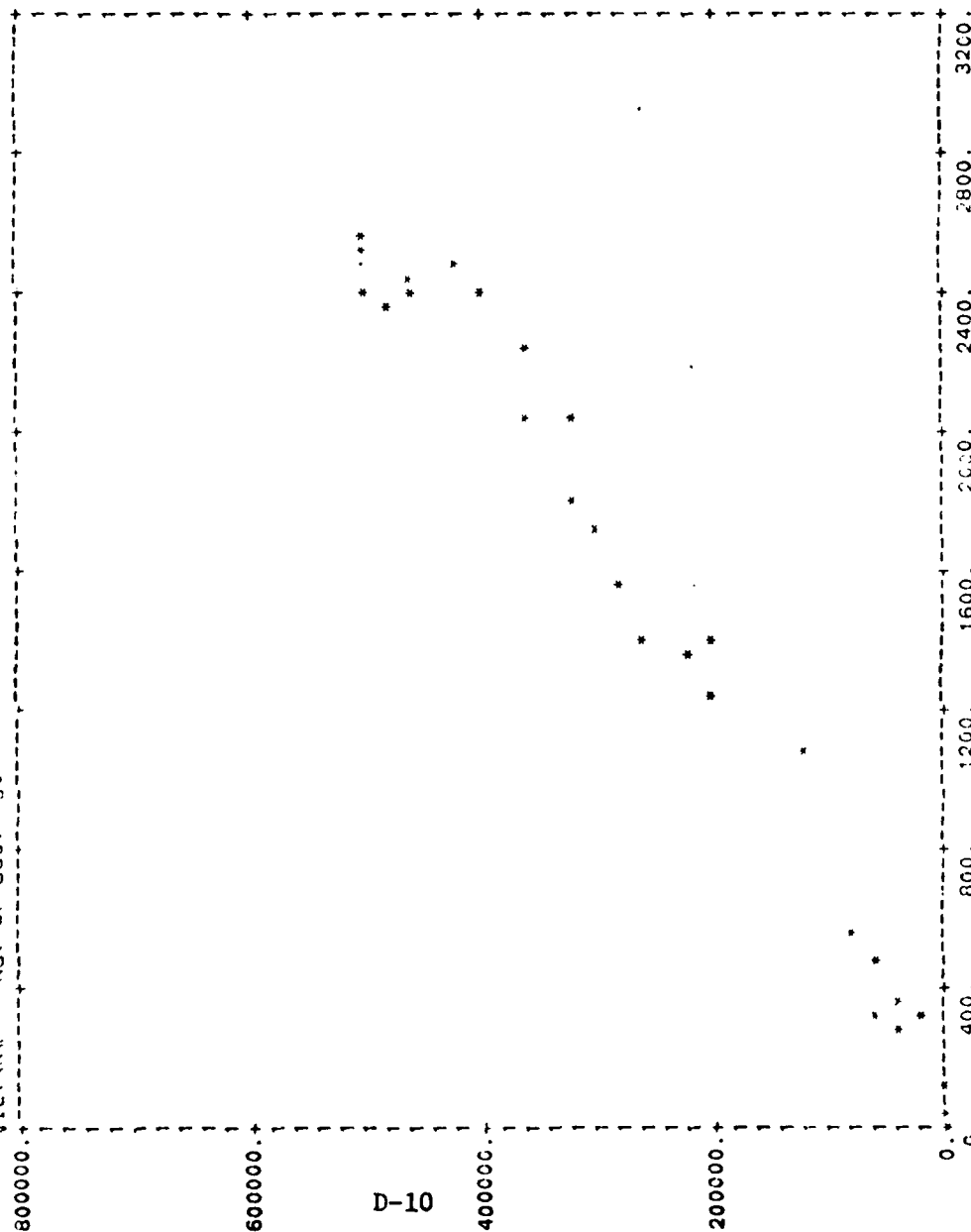
SYSTEM=UH-1
 YVARIABLE= TOTAL FLYING HOURS
 XVARIABLE= DENSITY
 WORLDWIDE NO. OF OBS. =65



REGRESSION
 DF= 1 SS= 1.857356874739E+12 MS= 1.85735687473 E+12
 RESIDUAL DF= 63 SS= 1.73335859790E+11 MS= 2.73335859790E+9
 TOTAL DF= 64 SS= 2.03592252731E+12
 F-TEST= 66.820850194
 S=2= 31.231724379 S= 52916.54031493 COR= .974 .6125005581107
 B(1) EST= 51.4354783159

SYSTEM-001
 VARIABLE= TOTAL FLYING HOURS
 AVAILABLE= DENSITY

VIETNAM NO. OF OBS. = 30



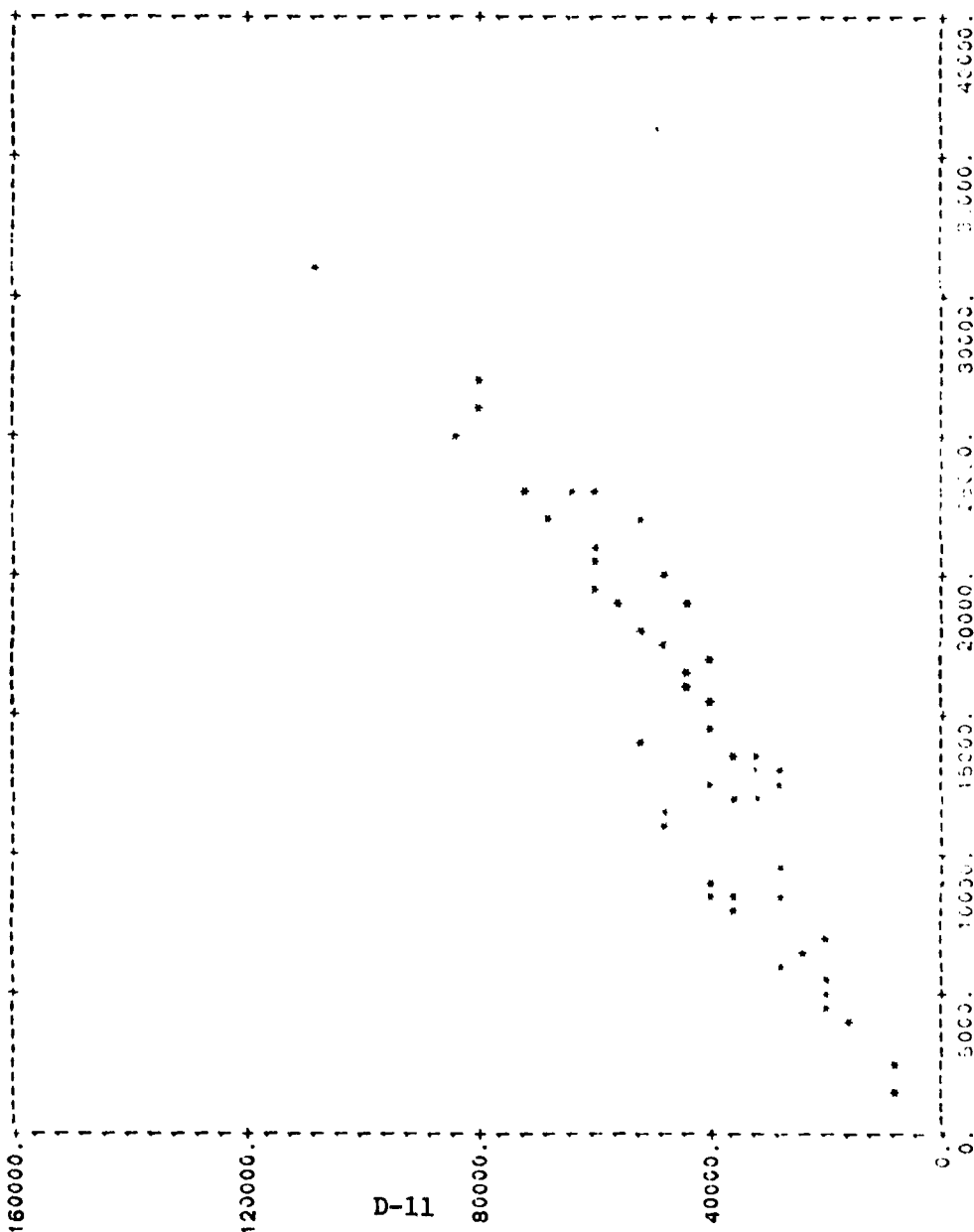
ANOVA TABLE

REGRESSION	DF=	SS=	MS=
RESIDUAL	29	4.041274547978E+10	1.393542947579E+9
TOTAL	30	3.511710512425E+12	

F-TEST= 2490.987287454
 R**2= 98.84920054381 S= 37330.18815354 CORR EST= .9939467562707
 B(1) EST= 182.3761934004

SYSTEM=AI-1
 YVARIABLE= TOTAL NUMBER OF SORTIES
 XVARIABLE= TOTAL FLYING HOURS

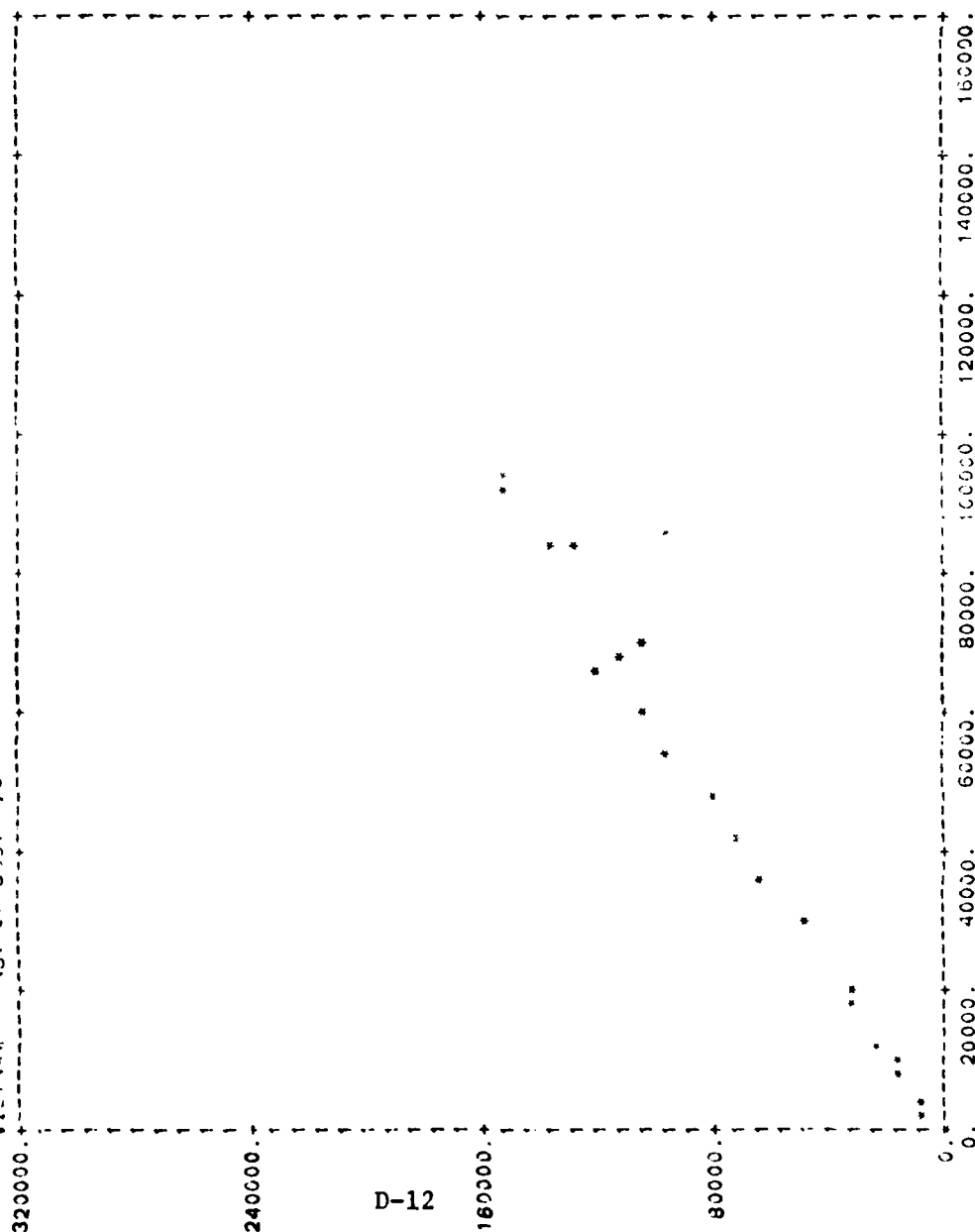
WORLDWIDE NO. OF OBS. =55



ANOVA TABLE

0.	5000.	10000.	15000.	20000.	25000.	30000.	35000.	40000.
REGRESSION	DF= 1.	SS= 1.15440828919E+11	MS= 1.15440828919E+11					
RESIDUAL	DF= 54.	SS= 3.233734970025E+9	MS= 59899502.03751					
TOTAL	DF= 55.	SS= 1.18720563939E+11						
F-TEST	1924.63790100							
R**2=	97.271233004							
B(1) EST=	2.9318015493							

SYSTEM=AH-1
 Y VARIABLE= TOTAL NUMBER OF SORTIES
 X VARIABLE= TOTAL FLYING HOURS
 VIETNAM NO. OF OBS. =22



ANOVA TABLE

Source	SS	DF	MS	F	EST
Regression	1.665550778453E+11	1	1.665550778453E+11		
Residual	2.404688421736E+9	21	114508972.4636		
Total	1.68959766267E+11	22			
F-TEST	1454.515521901				
R**2	98.57676861468				
B(1) EST	1.563709173628				

SYSTEM=CH47

YVARIABLE=

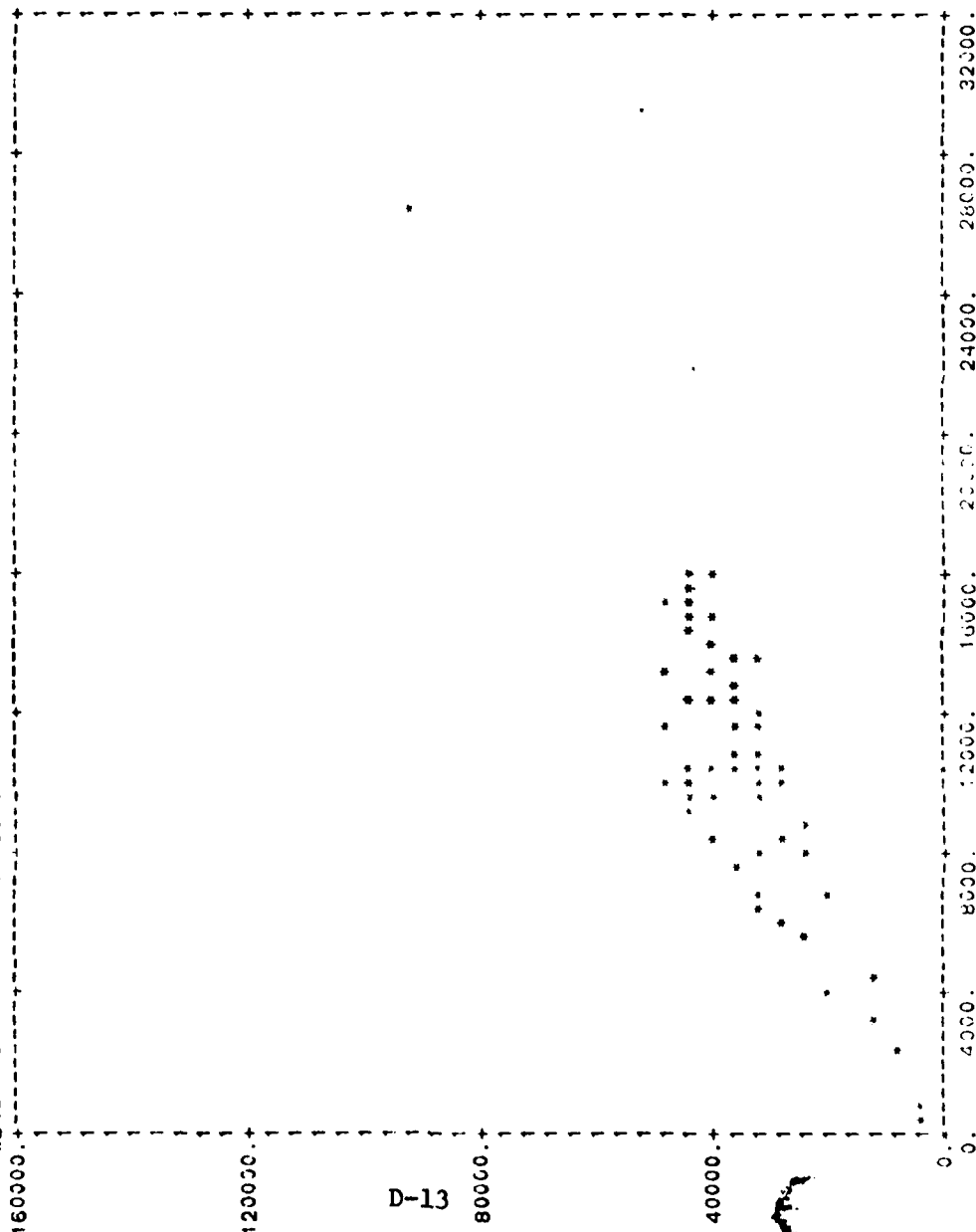
XVARIABLE=

WORLDWIDE

NO. OF OBS. = 64

TOTAL NUMBER OF SORTIES

TOTAL FLYING HOURS



D-13

ANOVA TABLE

	DF	SS	MS	F	P	TOTAL
REGRESSION	1	55	55	8.708460418611E+10	0.000000000000E+00	8.708460418611E+10
RESIDUAL	63	53	0.841270000000E+9	0.000000000000E+00	4.75303051092	4.75303051092
TOTAL	64	108	1.691270000000E+10			
F-TEST=	1832.101125902					
R-SQ=	0.000000000000					
S(1) LST=	0.219355881822					

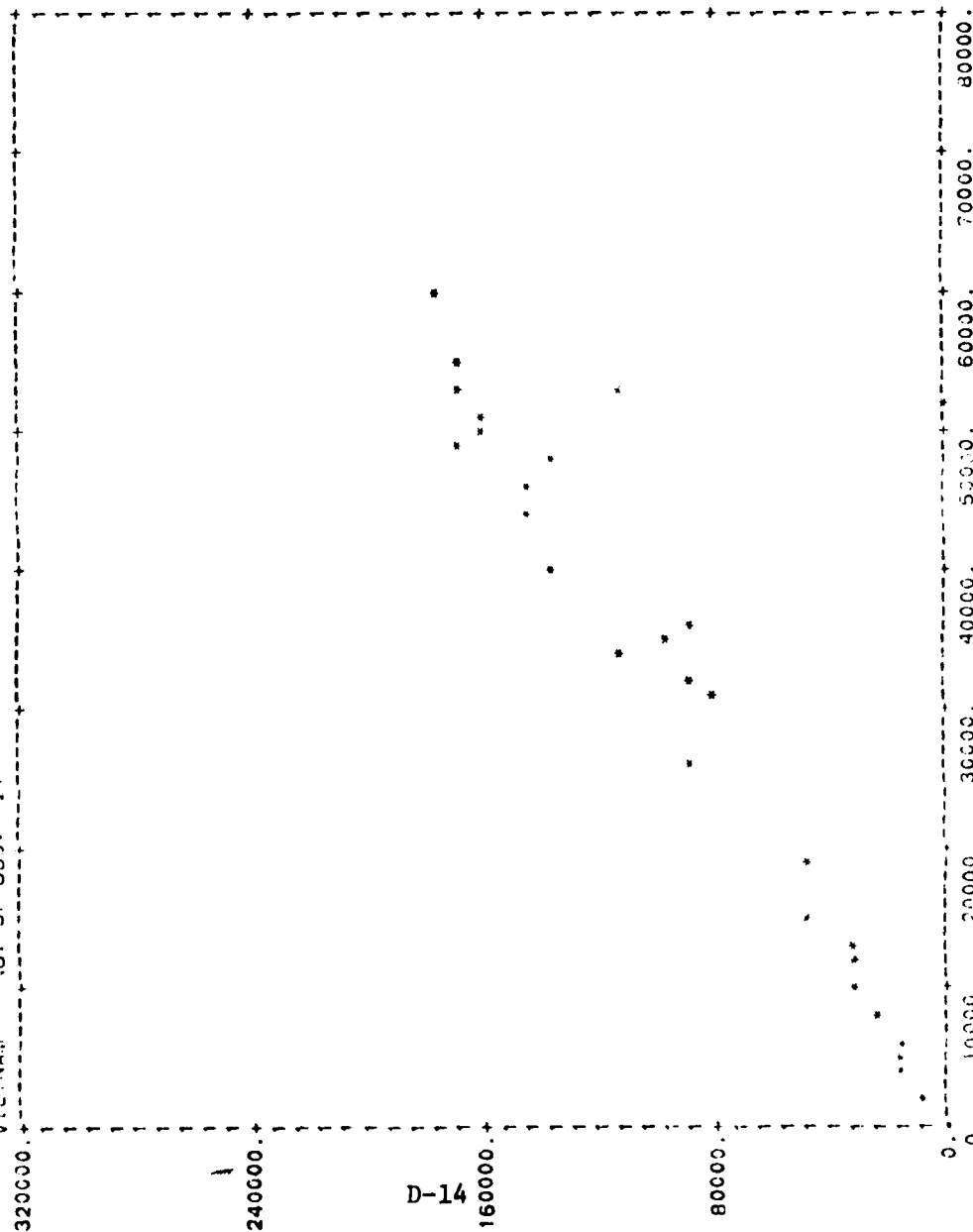
SYSTEM: GRANT

YVARIABLE=

XVARIABLE=

VIETNAM NO. OF OBS. = 27

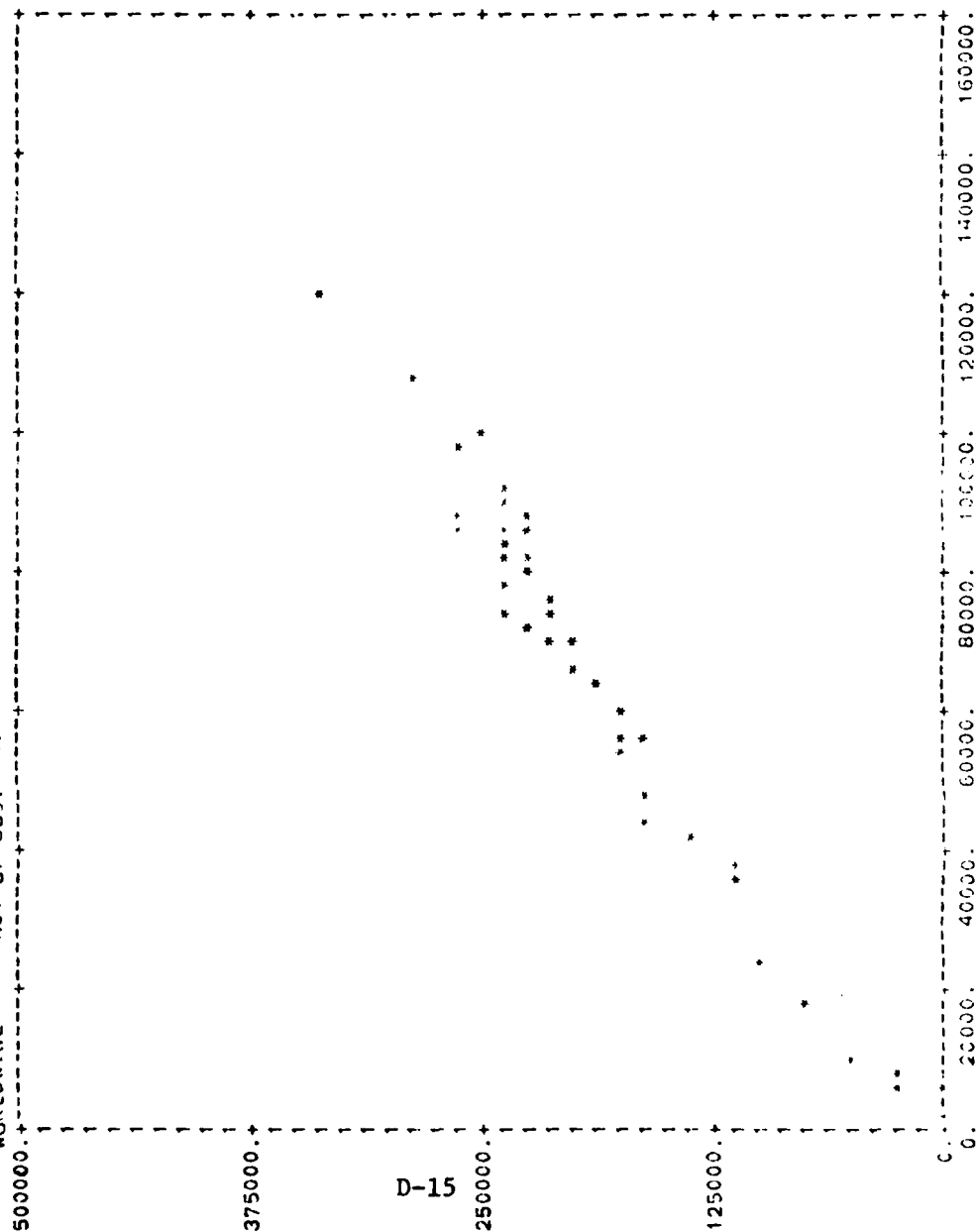
TOTAL NUMBER OF SORTIES
TOTAL FLYING HOURS



ANOVA TABLE

	10000.	20000.	30000.	40000.	50000.	60000.	70000.	80000.
REGRESSION	DF= 1.	SS= 3.14442630492E+11	MS= 3.14442630492E+11					
RESIDUAL	DF= 26.	SS= 4.239611768973E+9	MS= 163061991.1143					
TOTAL	DF= 27.	SS= 3.186832242261E+11						
F-TEST=	1.2736251013							
R*2=	98.05064292115	S= 12769.57286343	CORR EST=	.9756337256976				
B(1) EST=	2.994669915067							

SYSTEM=Q158
YVARIABLE=
XVARIABLE=
WORLDWIDE NO. OF Q35. =47



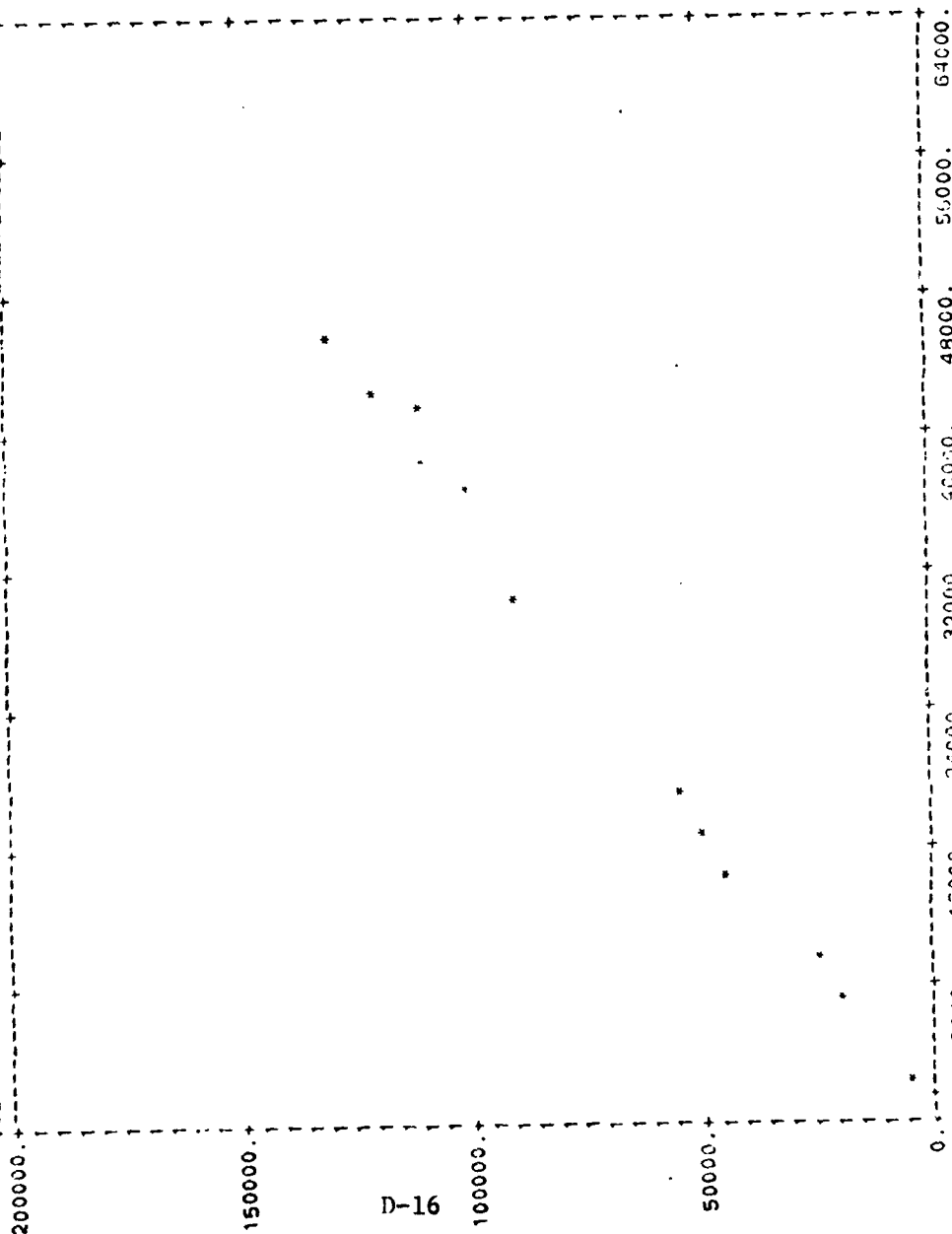
0. 20000. 40000. 60000. 80000. 100000. 120000. 140000. 160000.

ATCVA TABLE

REGRESSION: DF= 1. SS= 1.809011507445E+12 MS= 1.809011507445E+12
RESIDUAL: DF= 46. SS= 1.10693647725E+10 MS= 257812727.7563
TOTAL: DF= 47. SS= 1.820670892922E+12
F-TEST= 7016.763708052
R-SQ= 99.94 99.99999
B(1) EST= 2.050504773112

SYSTEM-CHINA
VARIABLE= TOTAL NUMBER OF SORTIES
VARIABLE= TOTAL FLYING HOURS

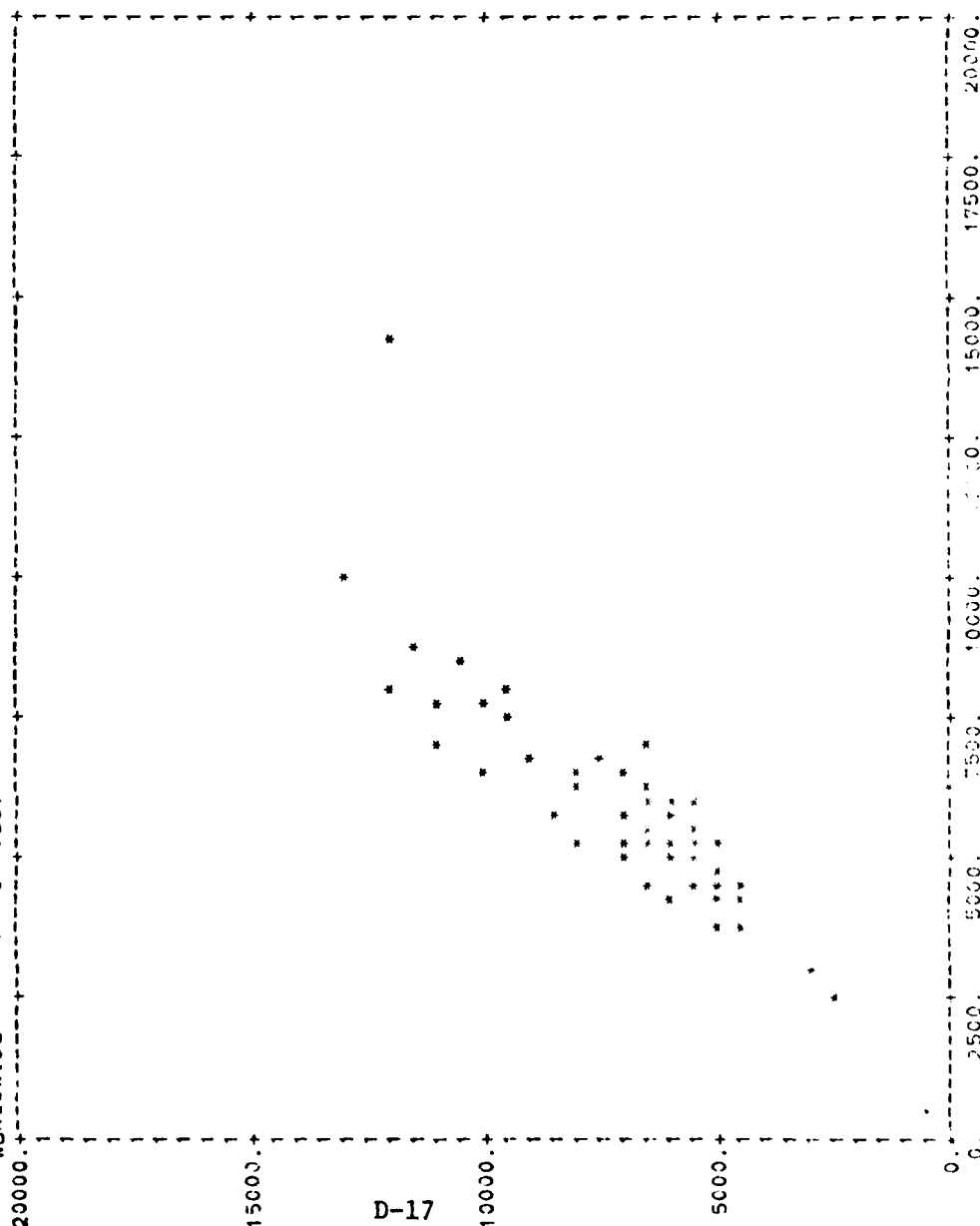
VIETNAM NO. OF OBS. = 13



ANOVA TABLE
REGRESSION 1. SS= 8.201810206719E+10 MS= 8.201810206719E+10
RESIDUAL 12. SS= 101825480.812 MS= 8.485455.734334
TOTAL 13. SS= 8.2119927548E+10
F-TEST= 9665.72629668 S= 2912.580730169 CORR EST= .9980967093891
R**2= 99.87600393248
B(1) EST= 2.810059791951

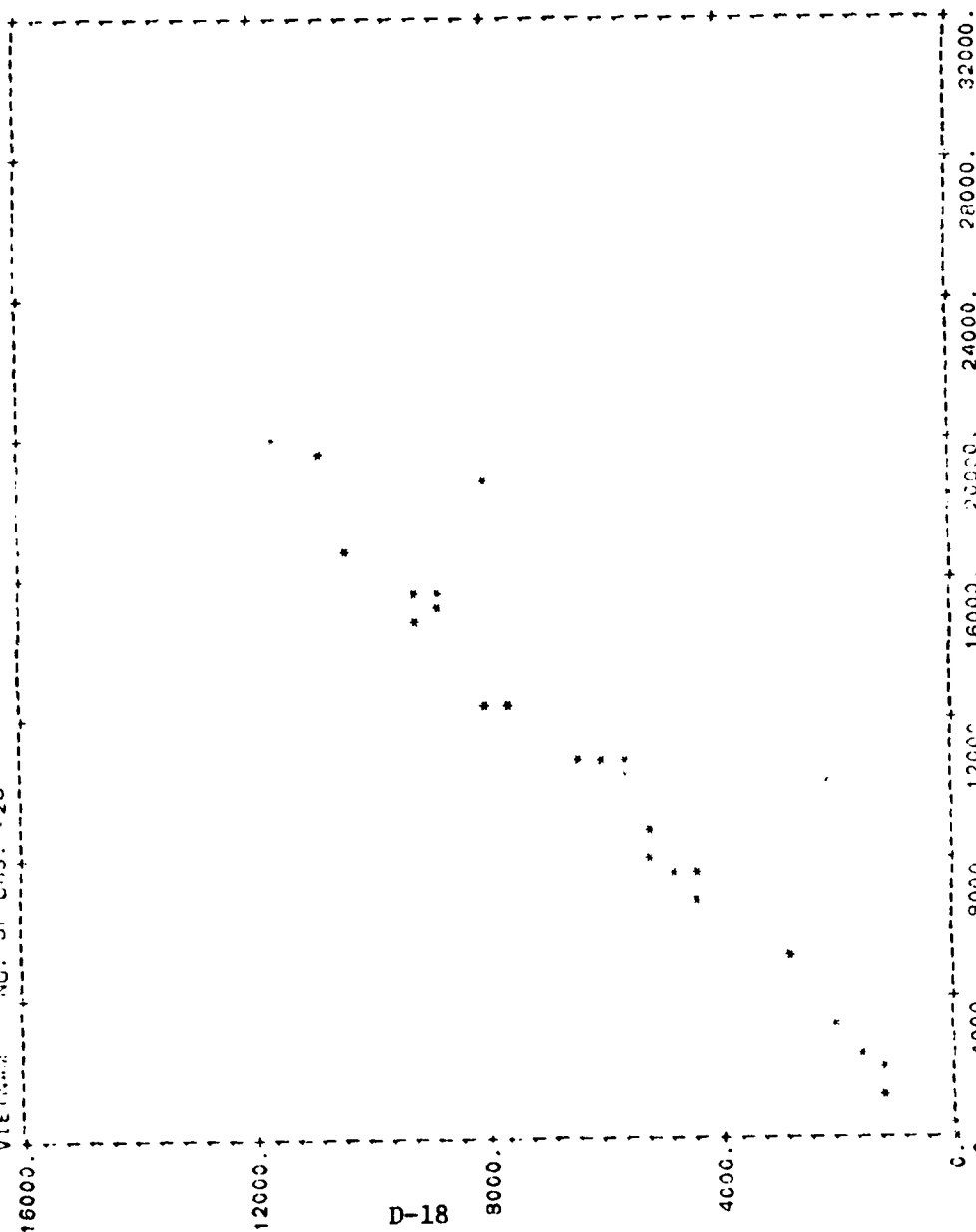
SYSTEM=DV-1
 VARIABLE=
 WORLDWIDE

NO. OF OBS. = 64



ANOVA TABLE
 REGRESSION DF= 1. SS= 3.1830E+09 MS= 3.1830E+09
 RESIDUAL DF= 63. SS= 1.2450E+09 MS= 1.9762E+07
 TOTAL DF= 64. SS= 3.2075E+09
 F-TEST= 161.00000000
 R+2= 0.9999999999
 B(1) EST= 1.1778E+07

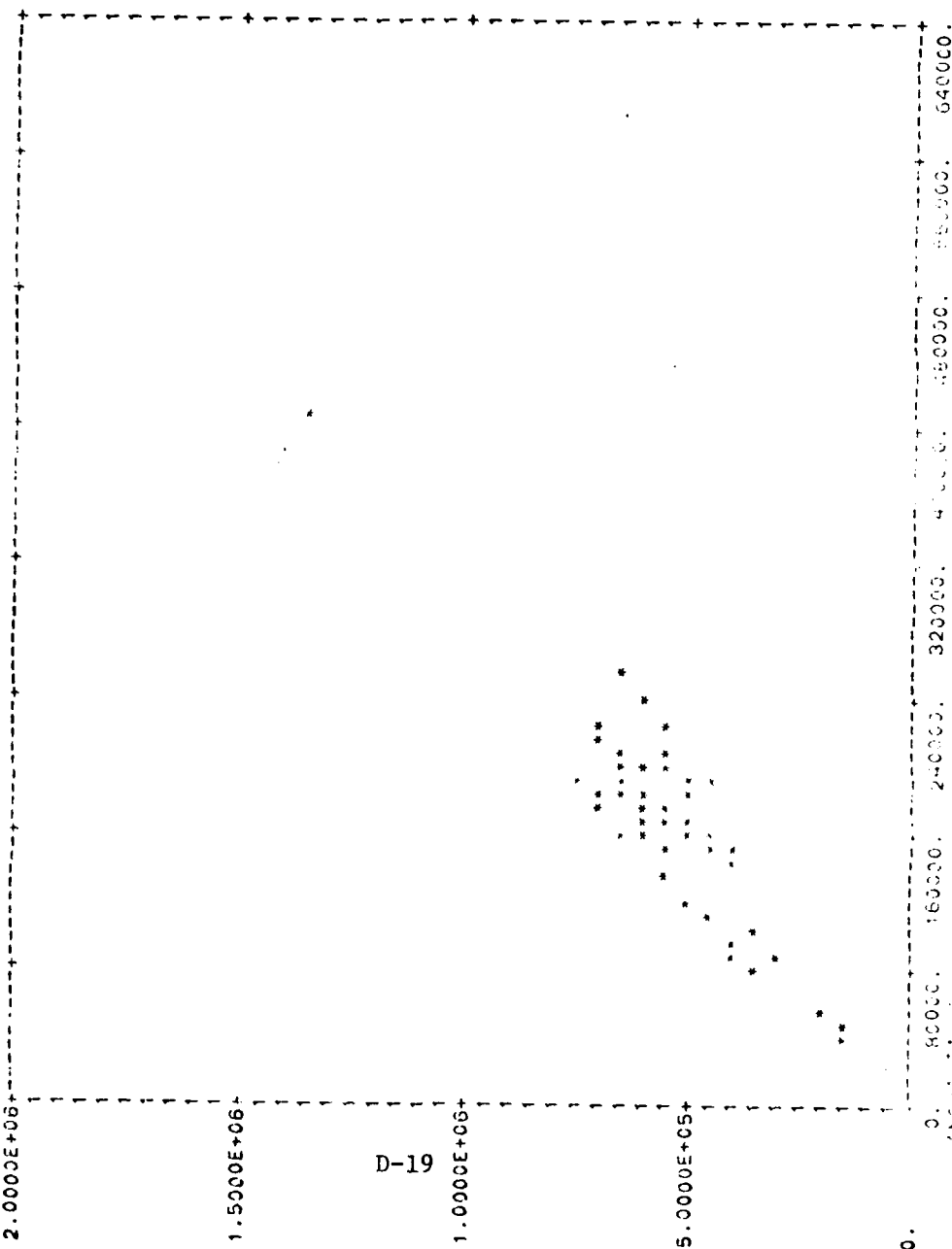
SYSTEM=OV-1
 VARIABLE= TOTAL NUMBER OF SORTIES
 X VARIABLE= TOTAL FLYING HOURS
 VIETNAM NO. OF OBS. = 28



D-18

ANOVA TABLE
 REGRESSION DF= 1. SS= 1.247096783214E+9 MS= 1.247096783214E+9
 RESIDUAL DF= 27. SS= 11786092.78561 MS= 436521.9550225
 TOTAL DF= 28. SS= 1.258882876E+9
 F-TEST= 2856.893608364
 R*2= 99.60376573943 S= 660.6980815944 CORR EST= .9817831508631
 B(1) EST= .5763007378894

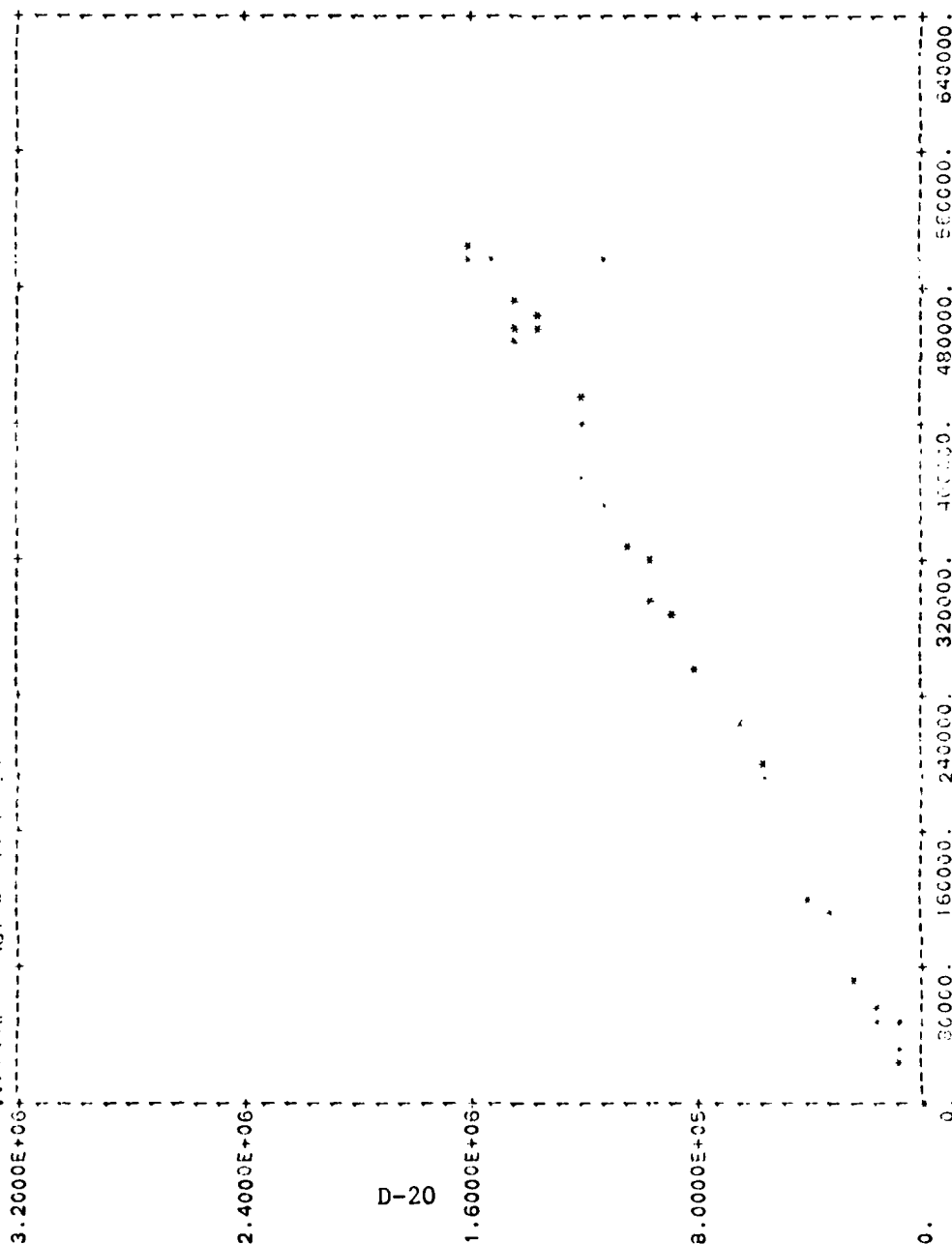
SYSTEM=UN-1
 YVARIABLE=
 XVARIABLE=
 WORLDWIDE
 NO. OF OBS. =64
 TOTAL NUMBER OF SORTIES
 TOTAL FLYING HOURS



REGRESSION
 RESIDUAL
 TOTAL
 F-TEST
 S+2
 B(1) 50%

DF= 1. SS= 1.41869274703E+13
 DF= 63. SS= 1.200132004501E+13
 DF= 64. SS= 1.000166150748E+13
 2004.99276530
 1.75.59004221
 1.087948494810

SYSTEM=011
 VARIABLE= TOTAL NO. OF CASUALTIES
 AVAILABLE= TOTAL FLYING HOURS
 VIETNAM NO. OF CASUALTIES



D-20

ANOVA TABLE
 REGRESSION DF= 1, SS= 2.963747129927E+13 MS= 2.963747129927E+13
 RESIDUAL DF= 28, SS= 2.189592390125E+11 MS= 7.818901393304E+9
 TOTAL DF= 29, SS= 2.935640053828E+13
 F-TEST= 3700.49044009
 R**2= 59.207259464 S= 63424.55198249 CORR EST= .9851907323035
 B(1) EST= 3.01320000918

APPENDIX E

1352 FAILURE DATA

REGRESSION ANALYSIS

Y VARIABLE
(DEPENDENT)

RELIABILITY
AVAILABILITY
RELIABILITY

AVAILABILITY

RELIABILITY
AVAILABILITY
AVAILABILITY

X VARIABLE
(INDEPENDENT)

USAGE
USAGE
LENGTH OF SORTIES
(BY AIRCRAFT)
LENGTH OF SORTIES
(BY AIRCRAFT)
TOTAL FLYING HOURS
TOTAL FLYING HOURS
RELIABILITY

SYSTEM=AH-1

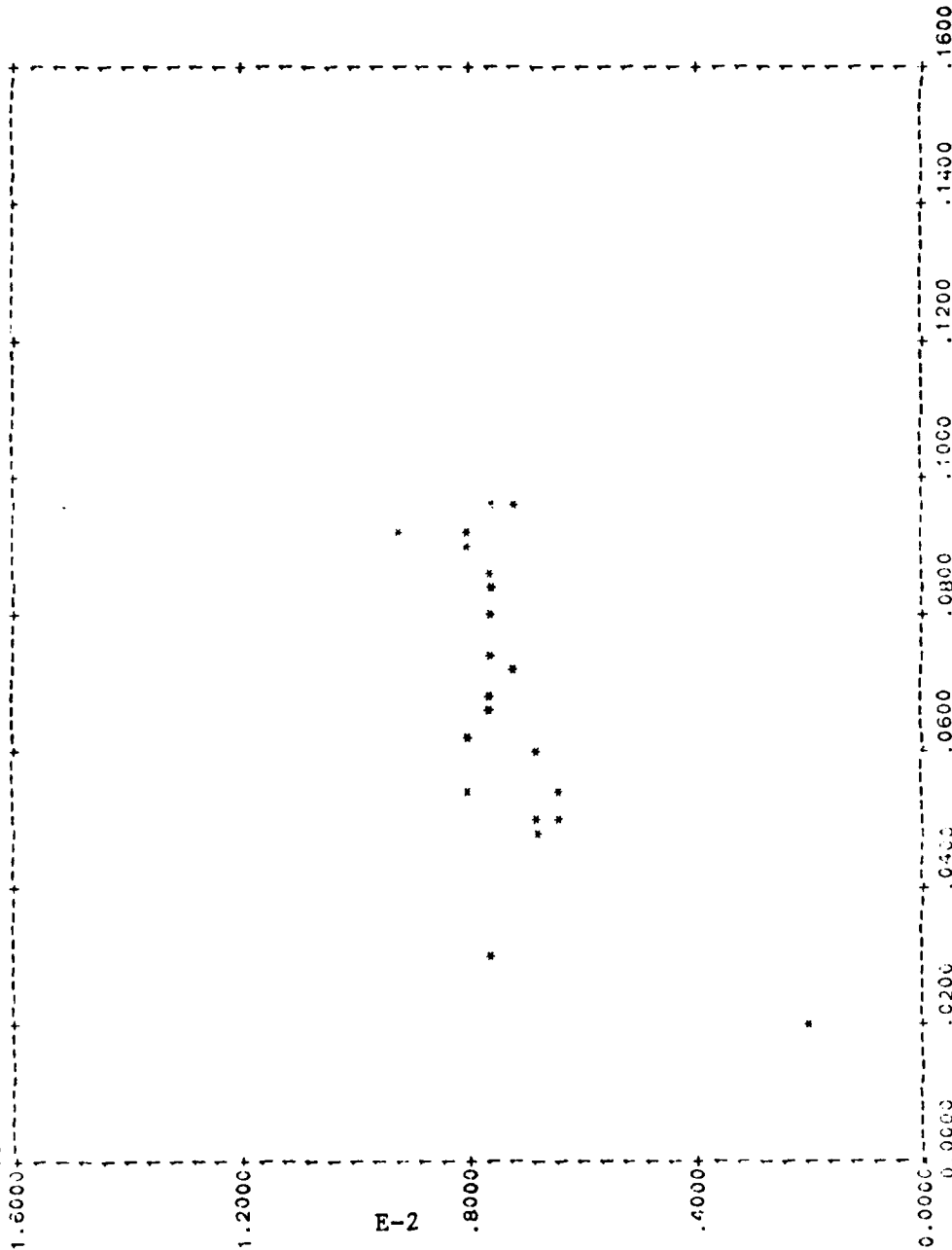
Y VARIABLE=

AVERAGE RELIABILITY

X VARIABLE=

AVERAGE USAGE

VIETNAM NO. OF OBS. = 23



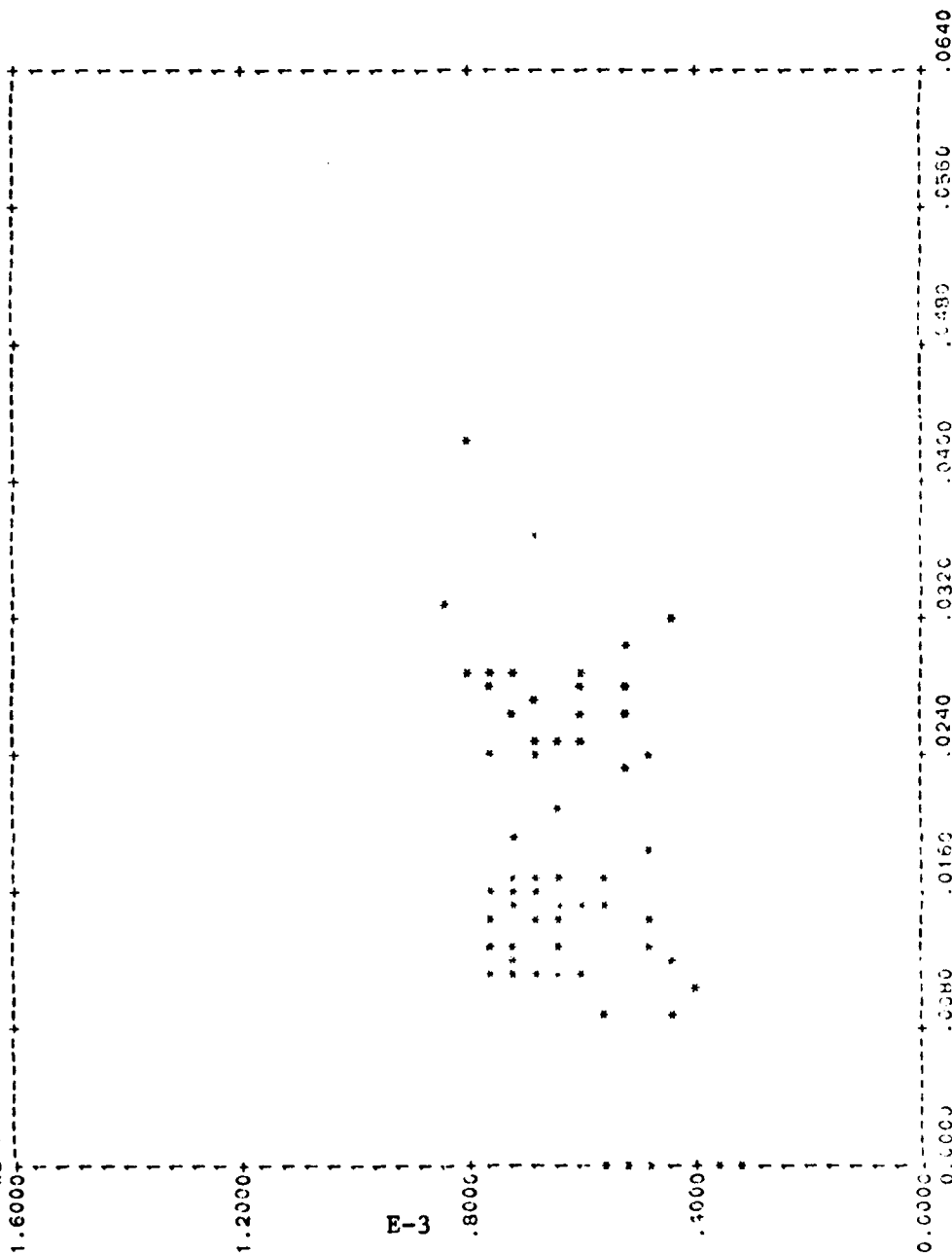
E-2

ANOVA TABLE

REGRESSION	DF=	SS=	MS=
1.	1.	.1505375538597	.1505375538597
RESIDUAL	DF=	SS=	MS=
21.	21.	.2215376635316	.01054941254913
TOTAL	DF=	SS=	
22.	22.	.3720752173913	
F-TEST=	14.26975702757		
R-squared=	.40143890369026		
S=	.1027103332149		
SLOPE EST=	5.93455607167		
INTERCEPT EST=	.4592430669305		

SYSTEM=CH47
YVARIABLE=
XVARIABLE=
WORLDWIDE

NO. OF OBS. = 65



E-3

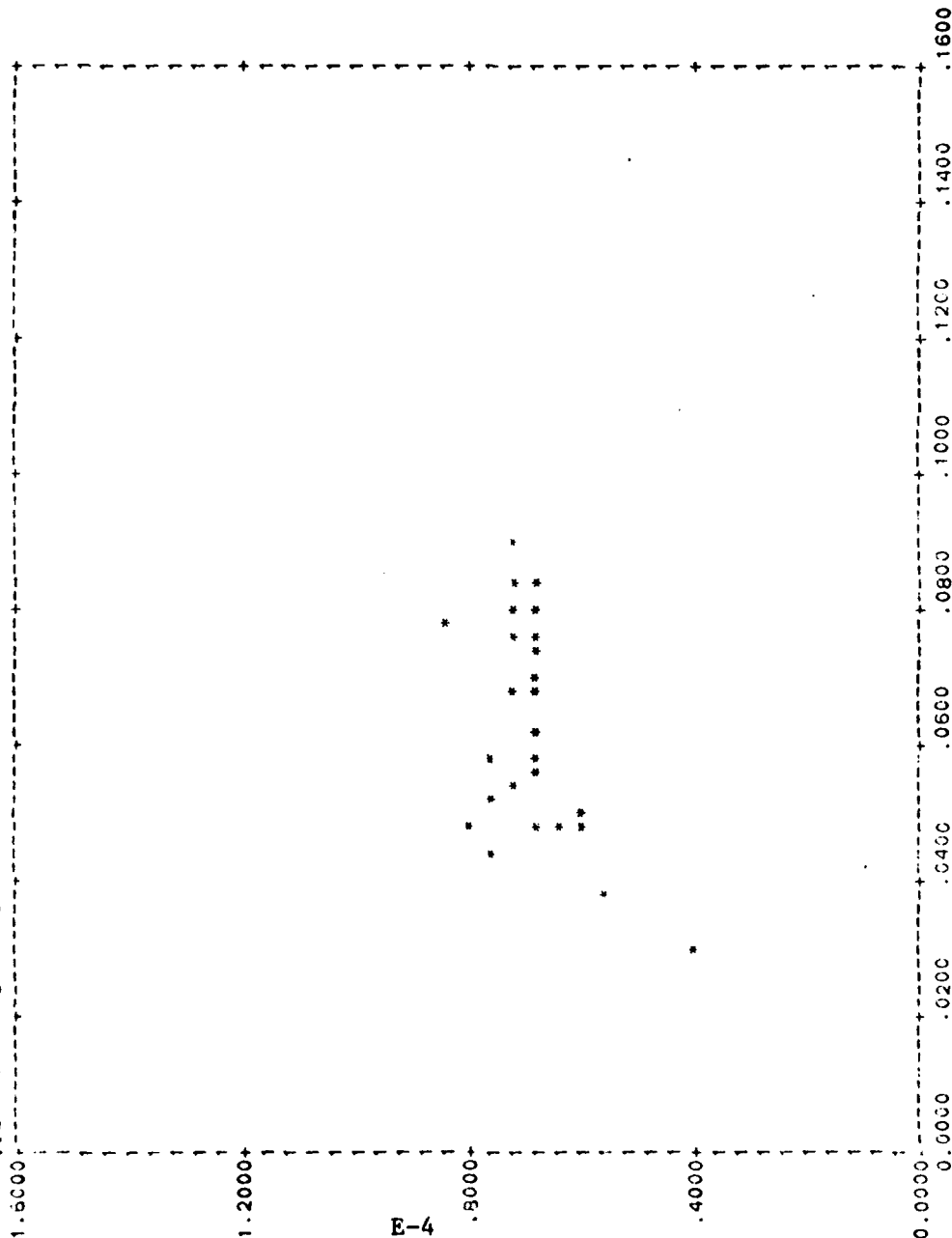
ANOVA TABLE
REGRESSION DF= 1 SS= .01325886296601 MS= .01325886296601
RESIDUAL DF= 63 SS= .702339216494 MS= .01130703599367
TOTAL DF= 64 SS= .715598079460
F-TEST= 1.09548127451
R-SQ= .0186600000000000
SLOPE EST= 1.855739018400 INTERCEPT EST= .0000000000000000

SYSTEM-047

ANALYSIS
TABLE

AVERAGE RELIABILITY
AVERAGE USAGE

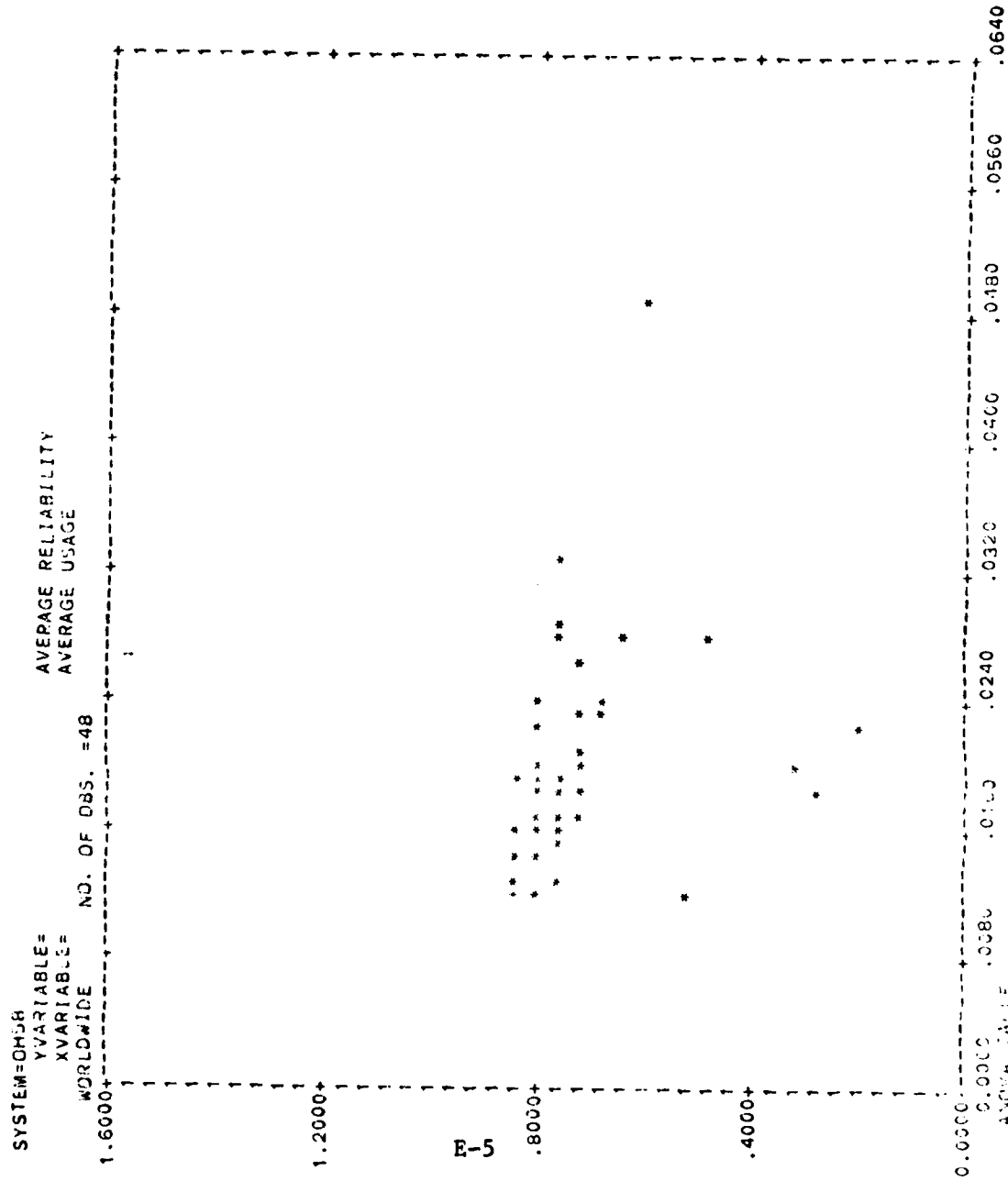
NO. OF OBS. = 28



E-4

ANOVA TABLE

REGRESSION	DF	SS	MS
RESIDUAL	26	.03671936898963	.00139305269191
TOTAL	27	.0460014881532	.00170373647497
F-TEST	0.533394059566		
R**2	20.0958262875		
S	.07193625122152		
SLOPE EST	2.041028861589		
INTERCEPT EST	.5405329209117		



ANOVA TABLE
REGRESSION DF= 1 SS= .0396838622620 MS= .0396838622620
RESIDUAL DF= 46 SS= .9201898697737 MS= .019791019269373
TOTAL DF= 47 SS= .960873725
F-TEST= 2.01410420048
R=12= 4.494818261757 CORRELATION EST= -.234310340339
S= .1403049537331
SLOPE EST= -4.401294273542 INTERCEPT EST= .8770565

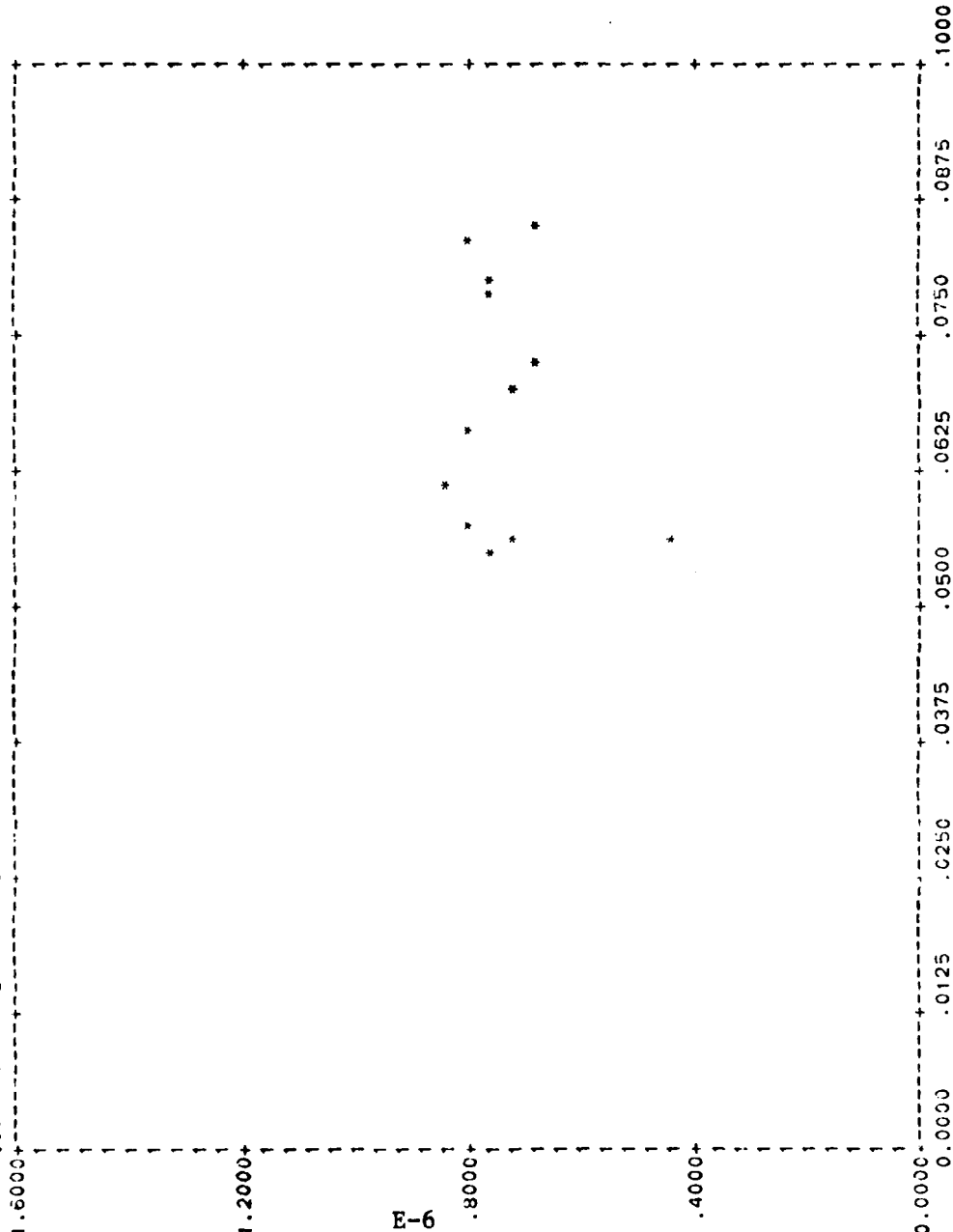
SYSTEM-ORIG

Y-VARIABLE=

X-VARIABLE=

VIEW=NO. OF OBS. =14

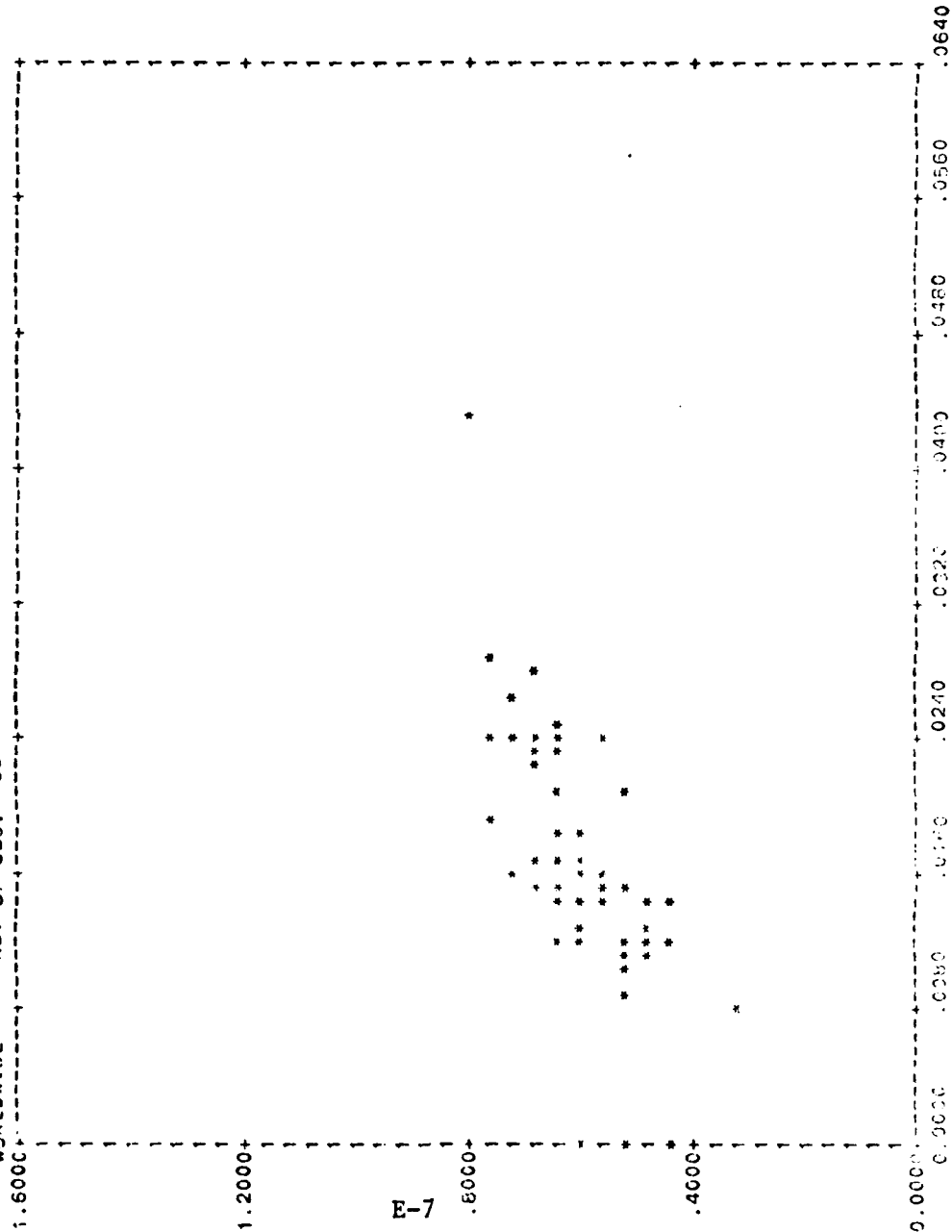
AVERAGE RELIABILITY
AVERAGE USAGE



E-6

0.0000	.0125	.0250	.0375	.0500	.0625	.0750	.0875	.1000
ANOVA TABLE								
REGRESSION	DF= 1.	SS= .00114403413217	MS= .00114403413217					
RESIDUAL	DF= 12.	SS= .1298410965868	MS= .01082009138223					
TOTAL	DF= 13.	SS= .1309855						
F-TEST=	.1057665201512							
R*2=	.8736870975926	CORRELATION EST=	.09347123073933					
S=	.1040196582471							
SLOPE EST=	.8527596223675	INTERCEPT EST=	.6736341684822					

SYSTEM=OV-1
 YVARIABLE=
 XVARIABLE=
 WORLDWIDE
 NO. OF OBS. = 65
 AVERAGE RELIABILITY
 AVERAGE USAGE

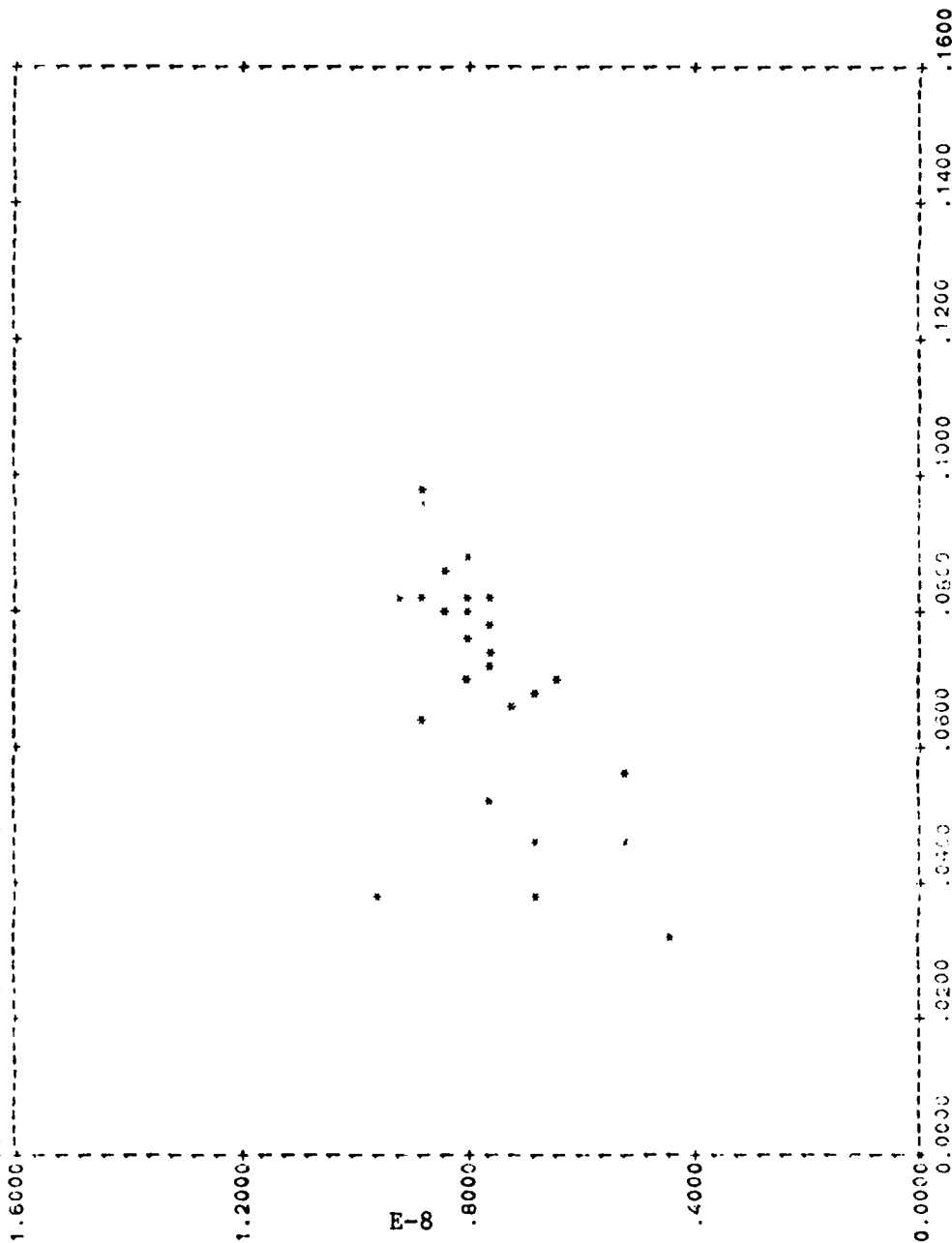


E-7

ANOVA TABLE
 REGRESSION Df= 1 SS= .2910378275901 MS= .2910378275901
 RESIDUAL Df= 63 SS= .2642186399484 MS= .004197121173754
 TOTAL Df= 64 SS= .5552564675385
 F-TEST= 69.10699159347
 R-SQ= .52312965532 CORRELATION EST= .7232596348115
 S= .0672517251334
 SLOPE EST= .111331590480 INTERCEPT EST= .000130634472

SYSTEM CUMULATIVE
 AVERAGE RELIABILITY
 AVERAGE USAGE

VIETNAM NO. OF OBS. = 29

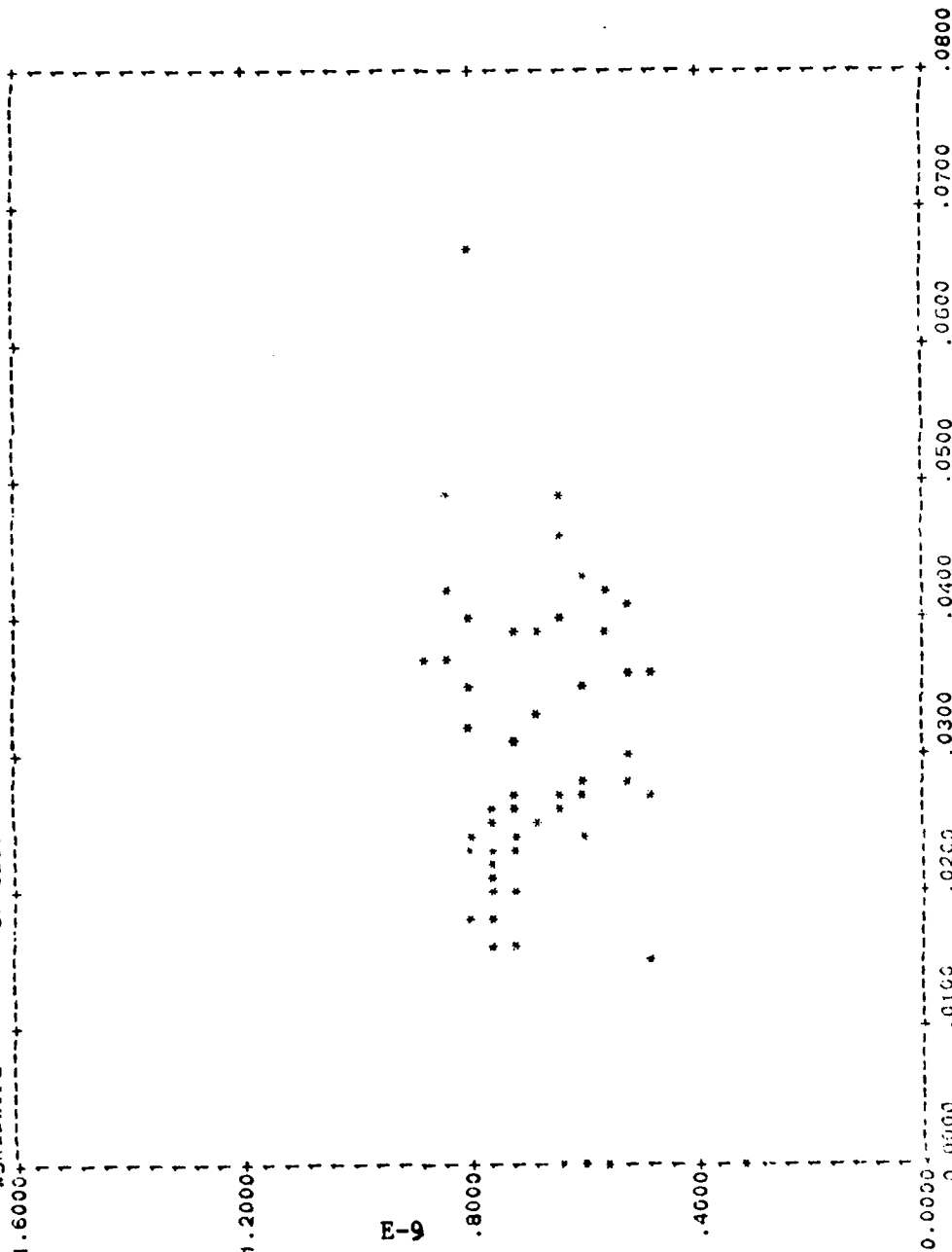


ANOVA TABLE

REGRESSION	DF=	1.	SS=	.1416639089608	MS=	.1416639089608
RESIDUAL	DF=	27.	SS=	.2812653324185	MS=	.01043945675624
TOTAL	DF=	28.	SS=	.4235292413793		
F-TEST=	13.57001605399					
R**2=	33.44343040535					
S=	.1021736597936					
SLOPE EST=	4.103425913752					
INTERCEPT EST=	.4784513131081					

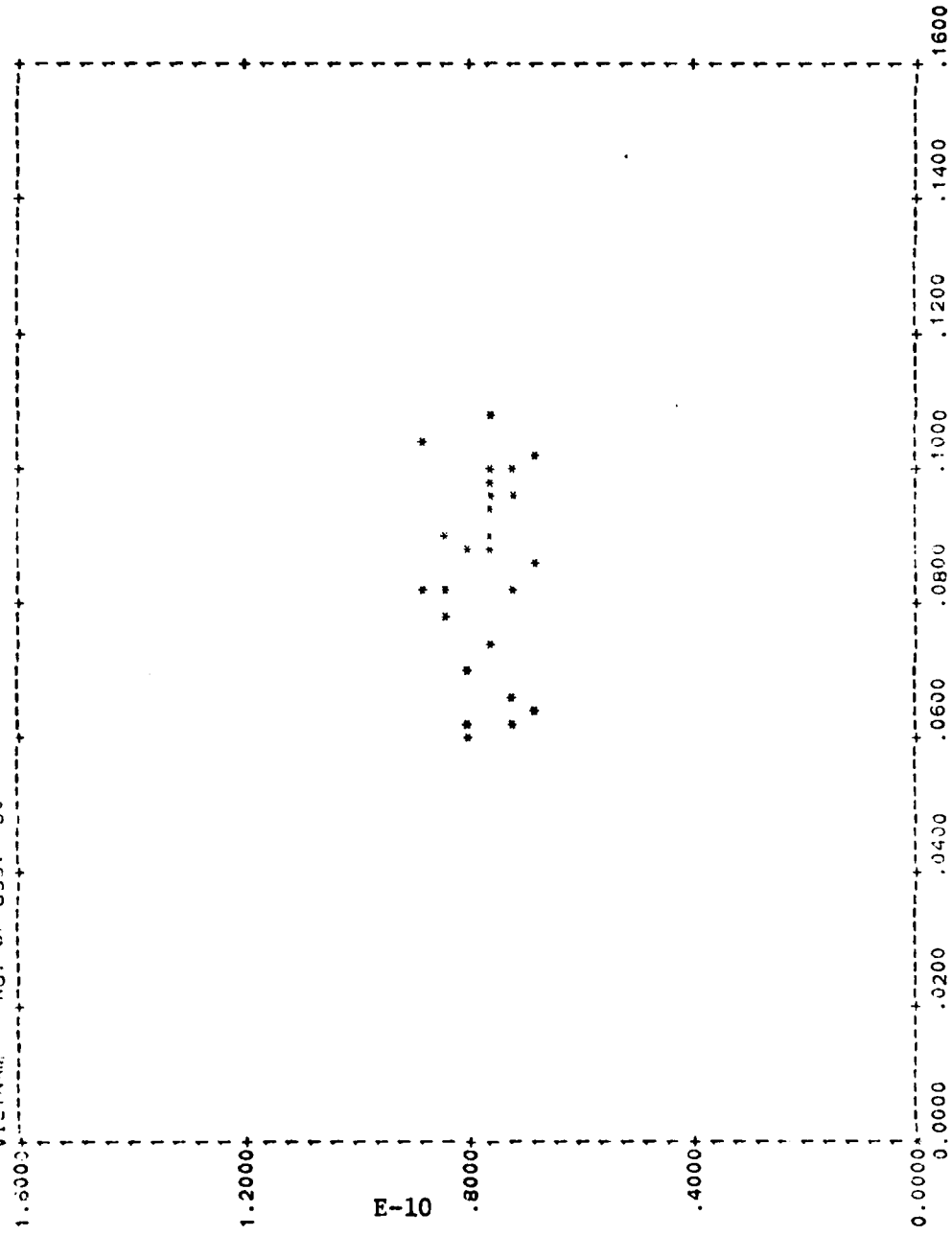
SYSTEM=UH-1
YVARIABLE=
XVARIABLE=
WORLDWIDE NO. OF OJS. =65

AVERAGE RELIABILITY
AVERAGE USAGE



ANOVA TABLE
REGRESSION DF= 1. SS= .01116961907045 MS= .01116961907045
RESIDUAL DF= 63. SS= .0435613963142 MS= .01025335549705
TOTAL DF= 64. SS= .0547310153843
F-TEST= 1.080562213092 CORRELATION EST= -.130334628321
R-SQ= .016975627096
S= .01218559123 INTERCEPT EST= .740650955683
SLOPE EST= -1.306200657

SYSTEM-1
 VARIABLE=
 X VARIABLE=
 VIETNAM NO. OF CBS. #30

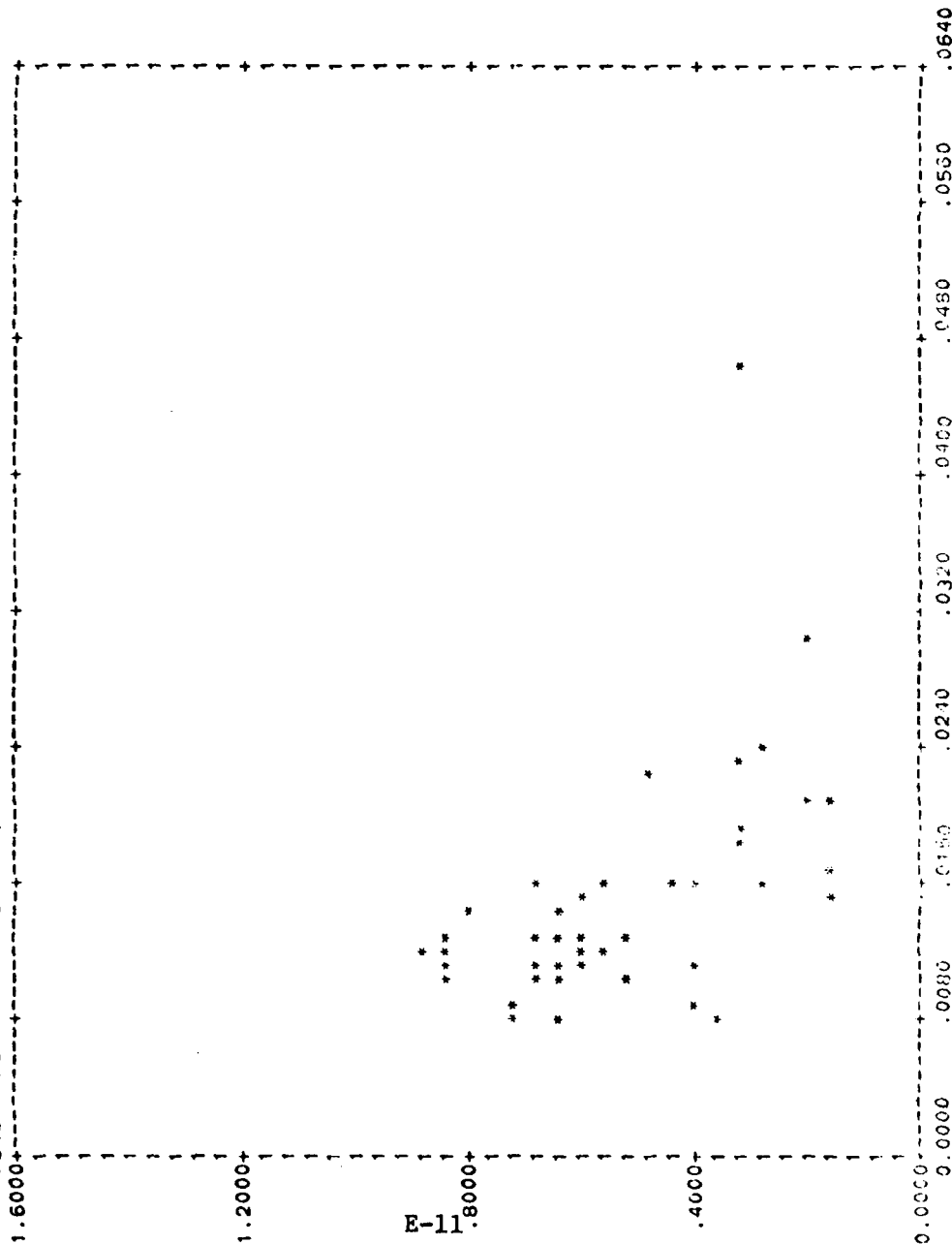


ANOVA TABLE

REGRESSION	DF=	SS=	MS=
1.	1.	.00007445057542885	.00007445057542885
RESIDUAL	DF=	SS=	MS=
28.	28.	.07552291009124	.002697246788973
TOTAL	DF=	SS=	
29.	29.	.07559736666667	
F-TEST=	.02760165810234		
R**2=	.09849096431778		
S=	.05193502468440		
SLOPE EST=	-.115639742331		
INTERCEPT EST=	.770503975191		
CORRELATION EST=	-.03139527011600		

SYSTEM=AH-1
YVARIABLE=
XVARIABLE=
WORLDWIDE
AVERAGE AVAILABILITY
AVERAGE USAGE

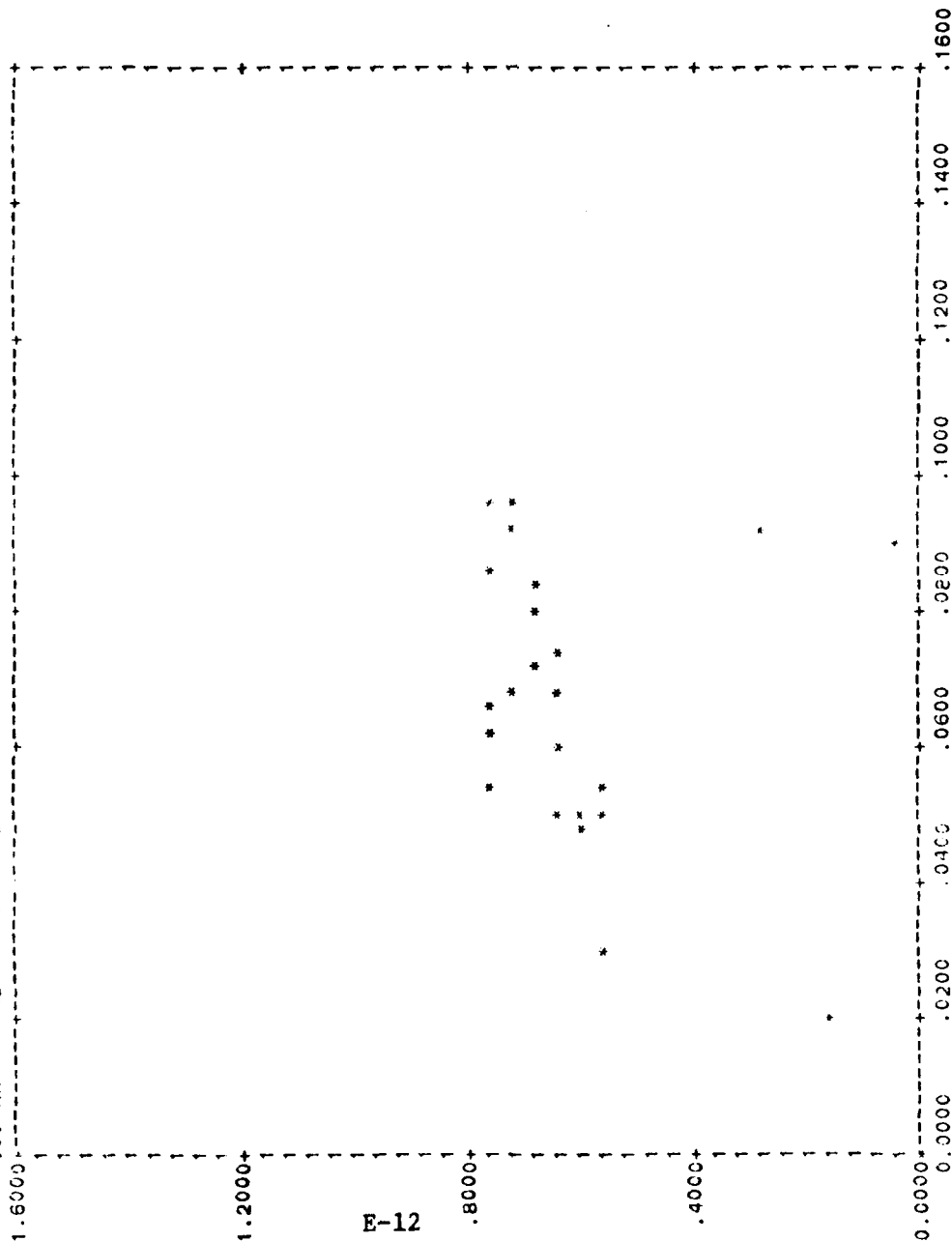
NO. OF OBS. =54



ANOVA TABLE

REGRESSION	DF=	1	SS=	.7661190139064	MS=	.7661190139064
RESIDUAL	DF=	53	SS=	1.744026319427	MS=	.0272456245624
TOTAL	DF=	54	SS=	2.51014533333		
F-TEST=	27.5729040004					
R ² =	34.0511300739					
S=	.167838764597					
SLOPE EST=	-19.02183287154					
INTERCEPT EST=	.0272456245624					

SYSTEM: 00-1
 VARIABLE: AVERAGE WAIVERABILITY
 VARIABLE: AVERAGE USAGE
 VIETNAM NO. OF DES. 123



E-12

ANOVA TABLE

REGRESSION	DF=	1.	SS=	.02184320639643	MS=	.02184320639643
RESIDUAL	DF=	21.	SS=	.8010634022992	MS=	.03814682868092
TOTAL	DF=	22.	SS=	.8229266086957		
F-TEST=			.5726087109139			
R**2=			2.654332253402			.1629212157272
S=			.1953121314228			
SLOPE EST=			1.517819639205			
INTERCEPT EST=			.5020304483799			

SYSTEM-CH17

YVARIABLE=

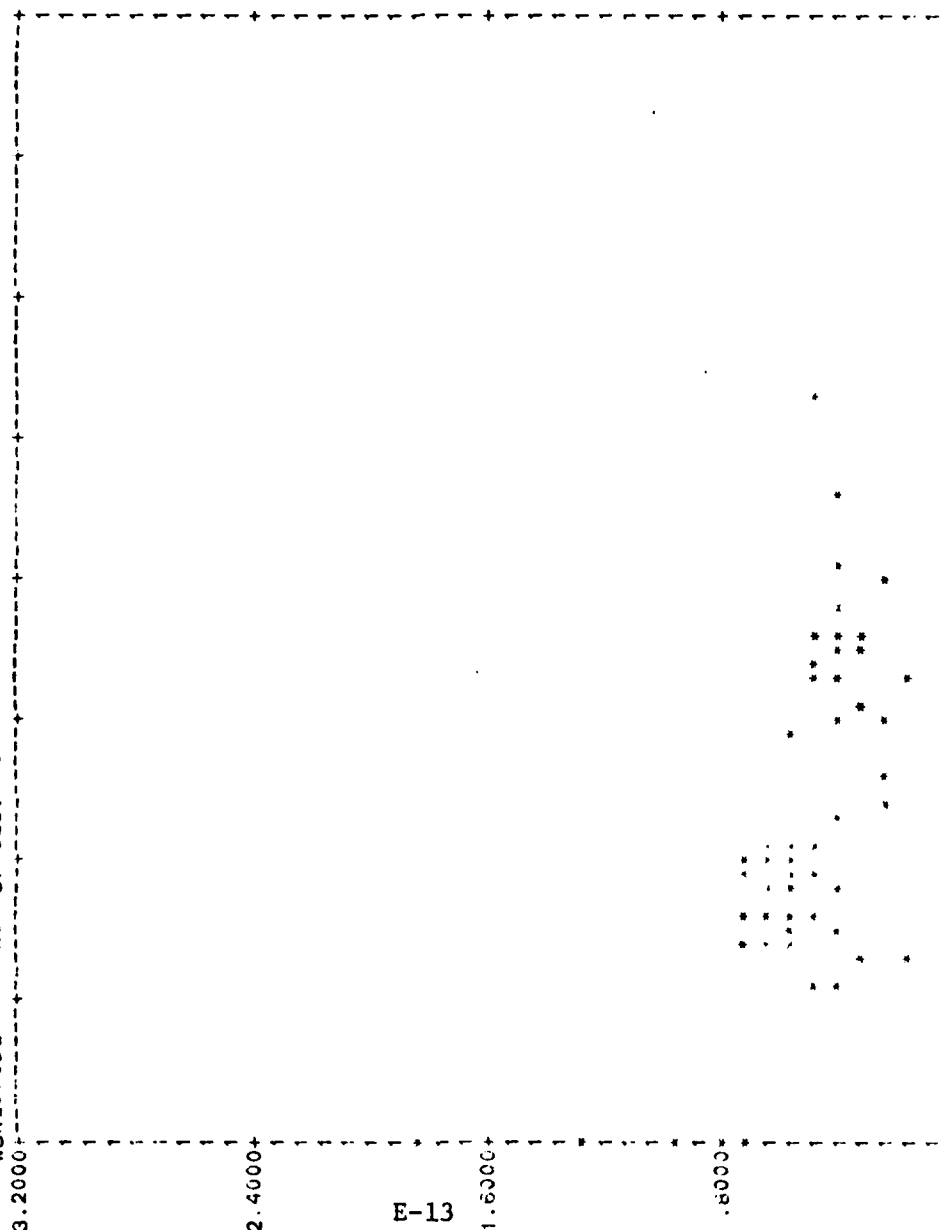
XVARIABLE=

WORLDWIDE

NO. OF OBS. =64

AVERAGE AVAILABILITY

AVERAGE USAGE



F-13

0.0000 0.0800 0.1600 0.2400 0.3200 0.4000 0.4800 0.5600 0.6400

AVERAGE

REGRESSION

RESIDUAL

FOR

F-TEST

S=

SLOPE EST

INTERCEPT EST

SS= 1.258276414527 MS= 1.258276414527

DF= 62.00000000 MS= 1.0179160295924

DF= 63.00000000 MS= 1.0179160295924

DF= 64.00000000 MS= 1.0179160295924

REGRESSION EST= -1.465405E-01474

S= 1.322600000000

SLOPE EST= -8.443420000000

INTERCEPT EST= 1.0179160295924

SYSTEM COUNT

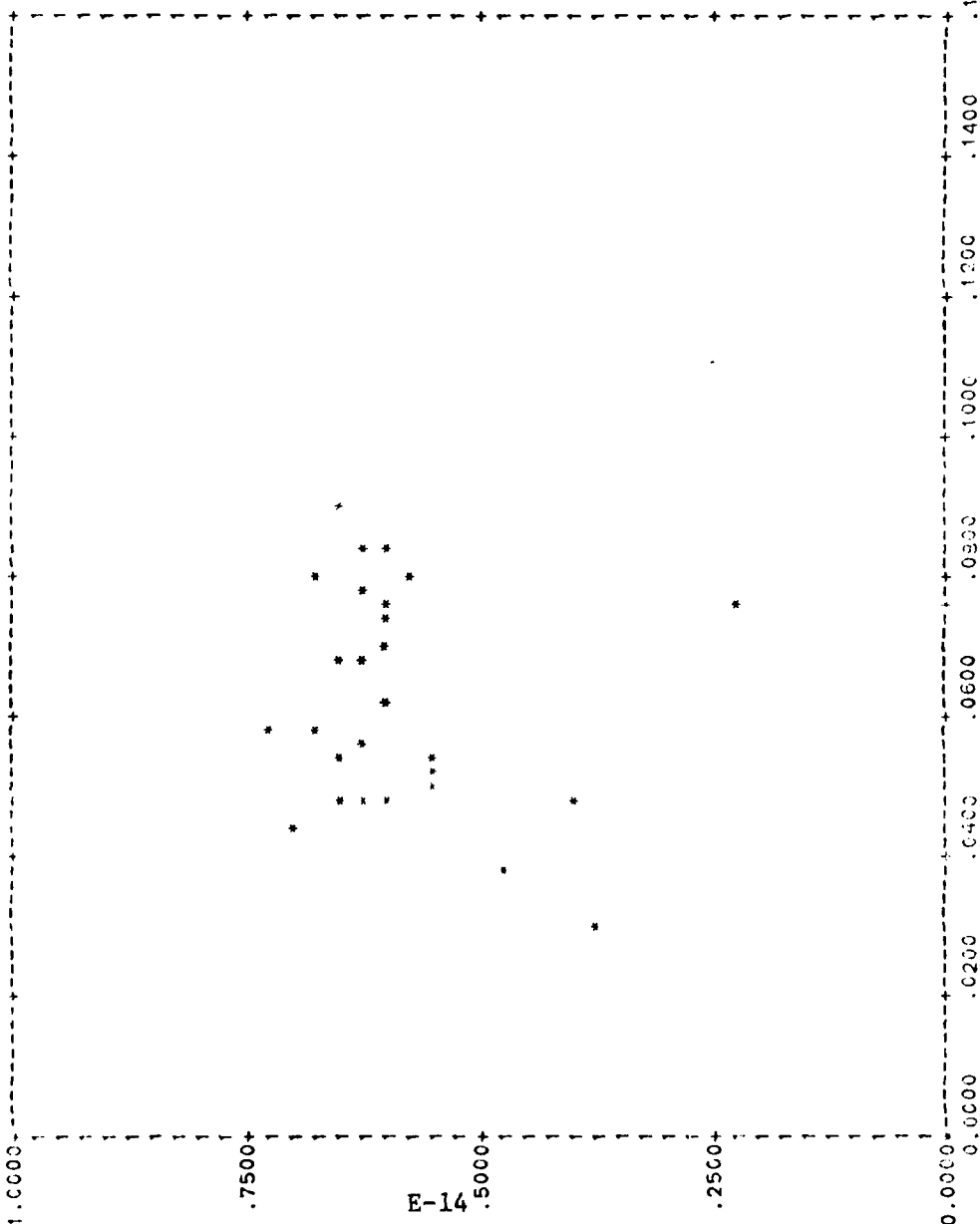
INDEPENDENT

DEPENDENT

VIETNAM % OF GDS. 198

AVERAGE AVERAGE

AVERAGE USAGE



ANOVA TABLE

REGRESSION: DF= 1, SS= .0005179970791284, MS= .0005179970791284

RESIDUAL: DF= 26, SS= .6223946814923, MS= .02393825698017

TOTAL: DF= 27, SS= .6229126785714

F-TEST= .02163836337257, CORRELATION EST= .02870039951974

R**2= .0015725413012, S= .1547199307797

SLOPE EST= .2780492245748, INTERCEPT EST= .5475543886292

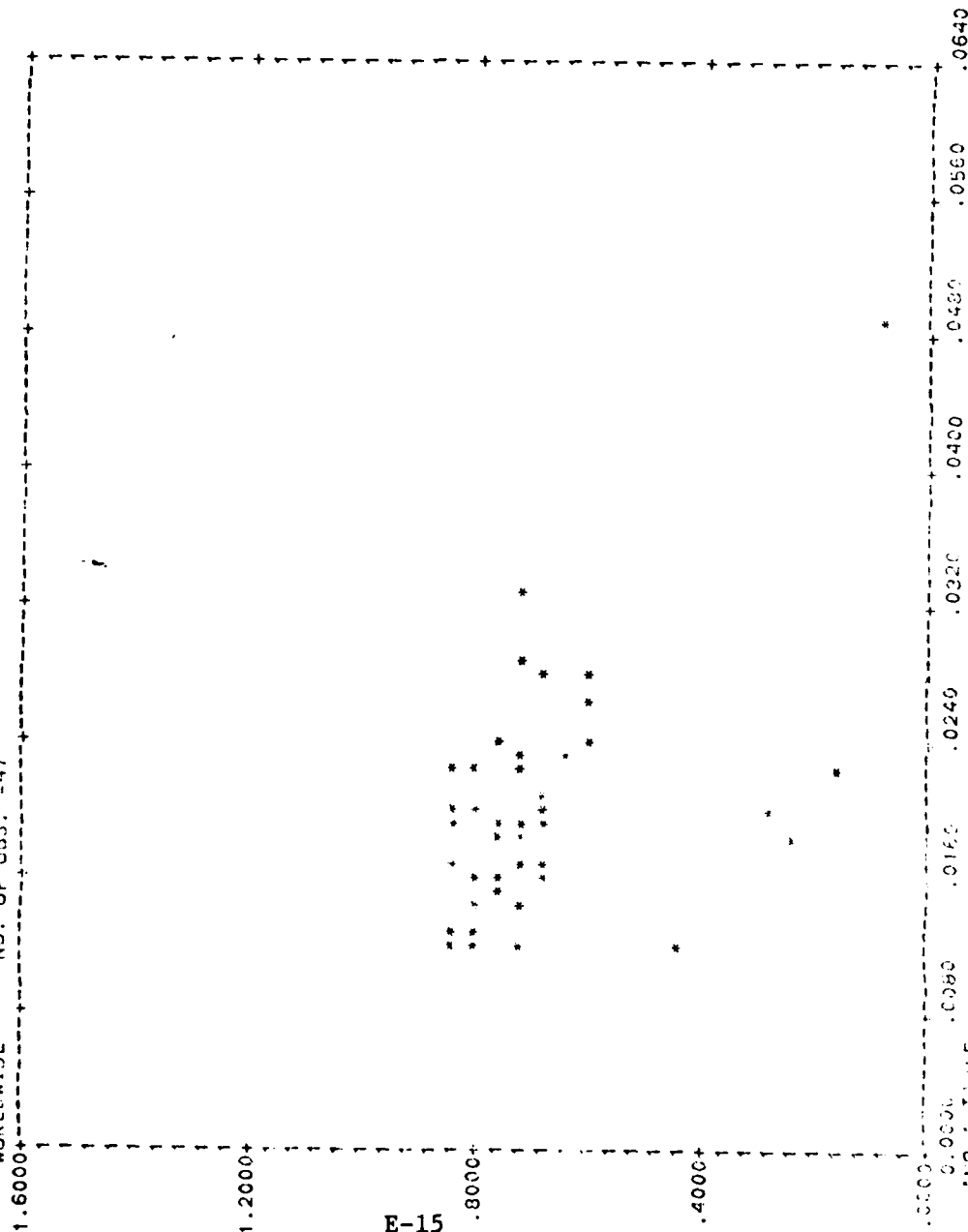
SYSTEM=CH58

YVARIABLE=
XVARIABLE=

AVERAGE AVAILABILITY
AVERAGE USAGE

NO. OF OBS. =47

WORLDWIDE



E-15

ANOVA TABLE

REGRESSION	DF	SS	MS
RESIDUAL	45	.0065806978179	.0001462377316
TOTAL	46	.006994338352	.0001520507468
F-TEST	13.0878490769		
R-SQ	22.03121100		
S	.000000000000		
SLOPE EST	.000000000000		
INTERCEPT EST	.000000000000		

SYSTEM=OH59

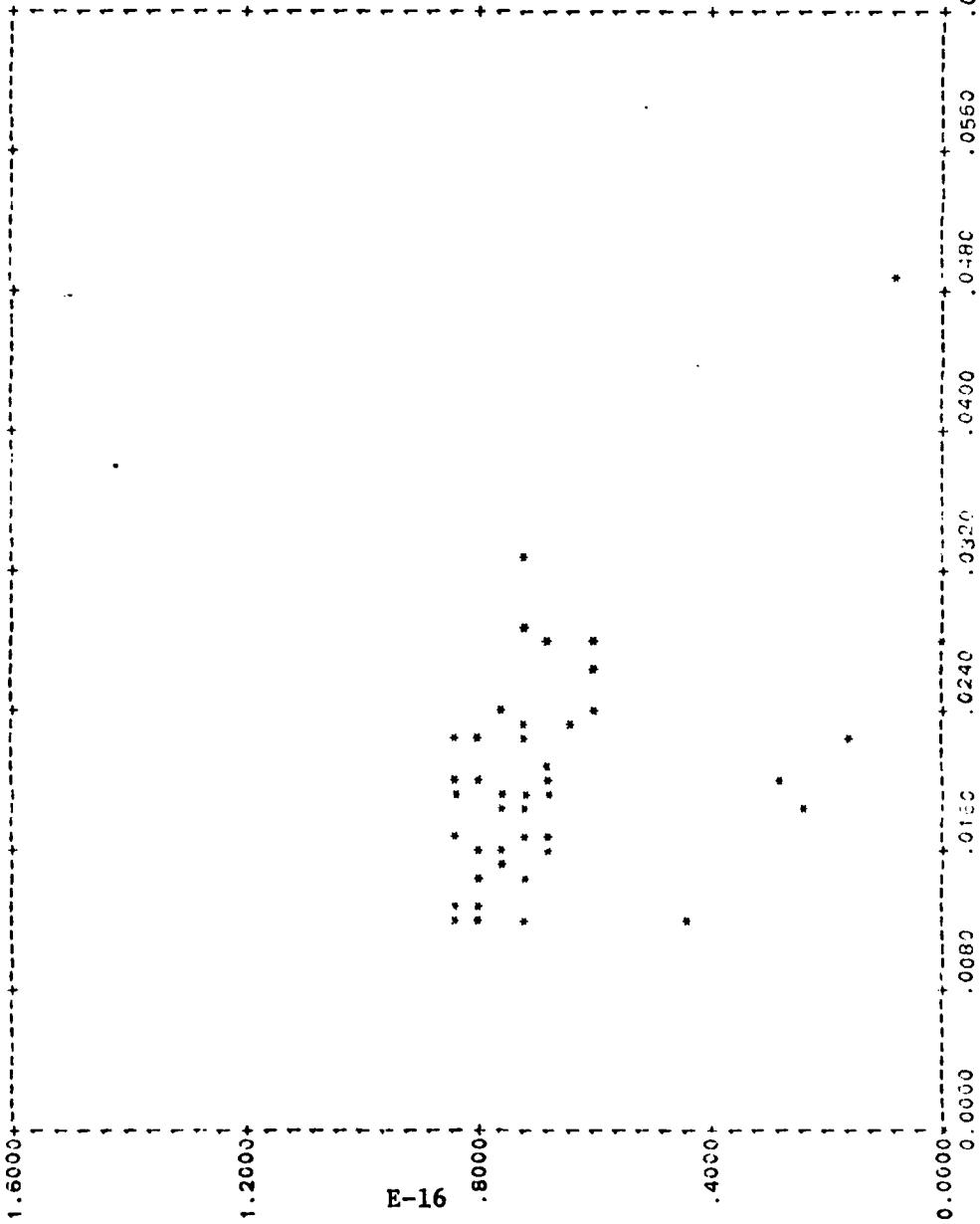
YVARIABLE=

XVARIABLE=

WORLDWIDE

NO. OF OBS. =47

AVERAGE AVAILABILITY
AVERAGE USAGE



E-16

ANGVA TABLE
REGRESSION DF= 1. SS= .2085806978179 MS= .3085806978179
RESIDUAL DF= 45. SS= 1.000994238352 MS= .02357764974116
TOTAL DF= 46. SS= 1.36957493617
F-TEST= 13.08734807669
R**2= .223311747046 CORRELATION EST= -.4714666057726
S= .155501532268
SLOPE EST= -12.6310178512 INTERCEPT EST= .9381073311897

[illegible]

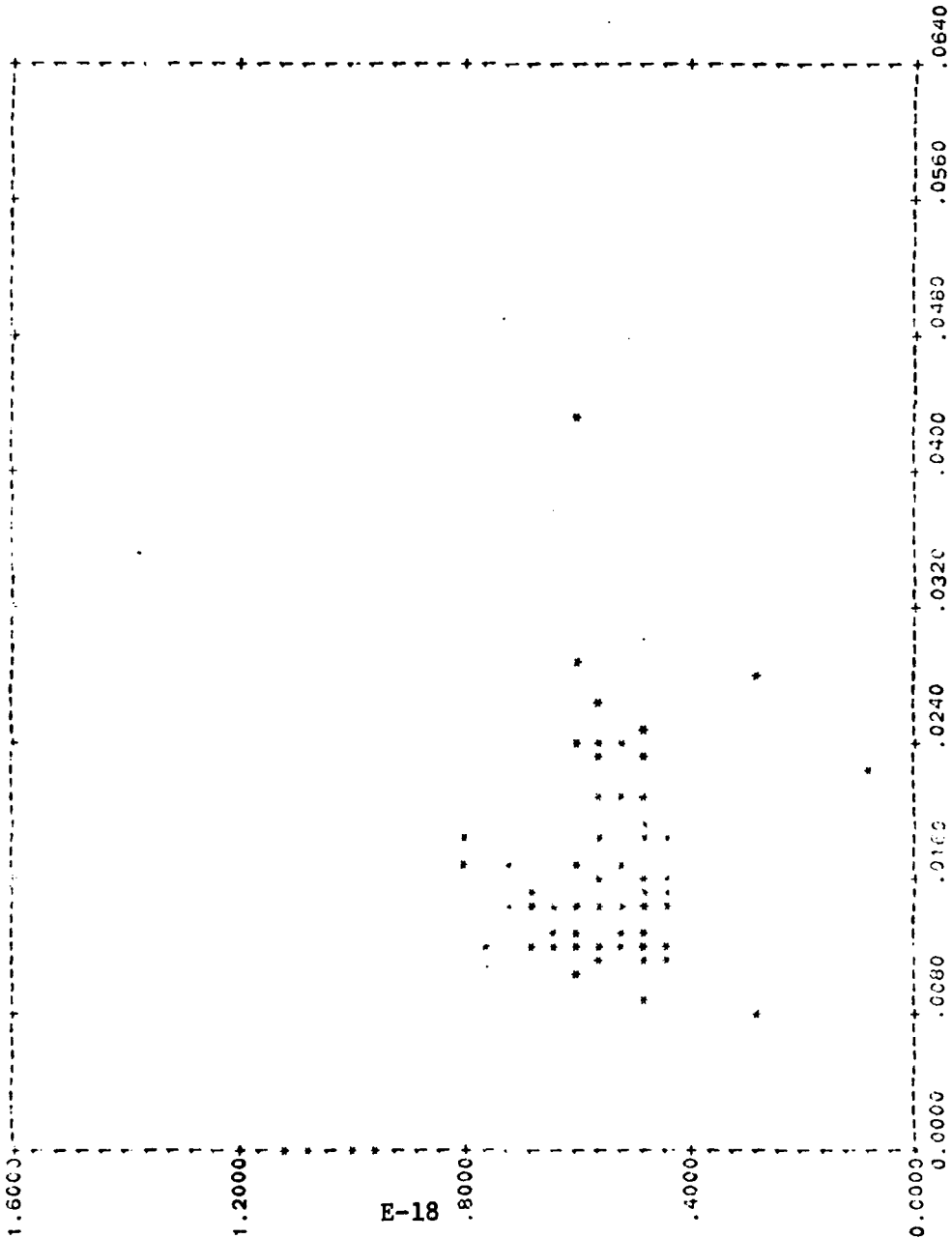
SYSTEM 00-1

INDEPENDENT
VARIABLE

AVERAGE AVAILABILITY
AVERAGE USAGE

NO. OF OBS. = 65

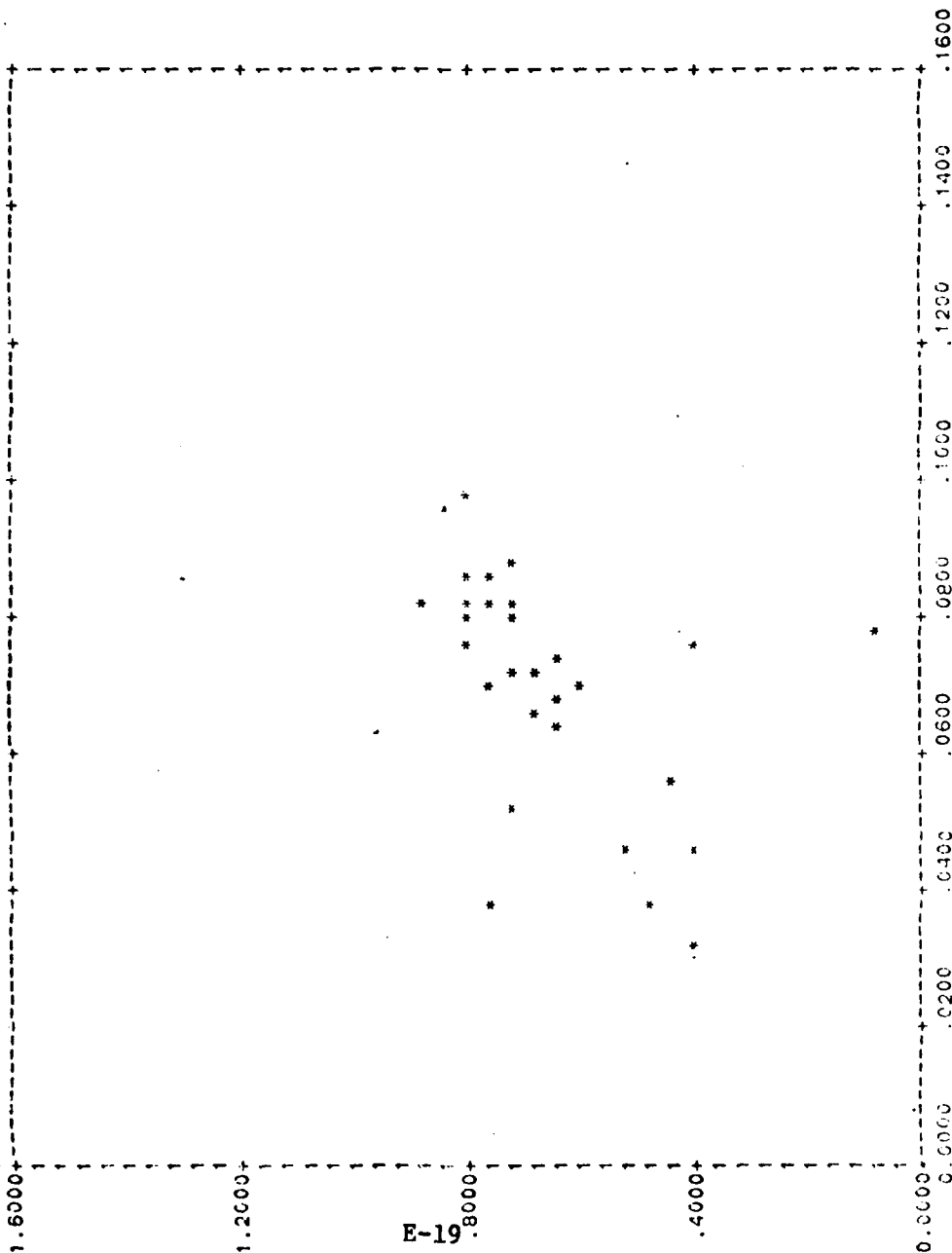
ADJUSTED



ANOVA TABLE

	0.0000	.0080	.0160	.0240	.0320	.0400	.0480	.0560	.0640
REGRESSION	DF=	1.	SS=	.004873414639440	MS=	.004873414639440			
RESIDUAL	DF=	63.	SS=	.8683279099759	MS=	.01378298365041			
TOTAL	DF=	64.	SS=	.8732013846154					
F-TEST=		.355819392264							
R**2=		.558106899587							
S=		.1174009525107							
SLOPE EST=		-1.451052204778							
INTERCEPT EST=		.5629037661354							

SYSTEM=OV-1
 YVARIABLE=
 XVARIABLE=
 VIETNAM NO. OF OBS. =29
 AVERAGE AVAILABILITY
 AVERAGE USAGE



ANCOVA TABLE
 REGRESSION SS= 1.802563623546 MS= 1802563623546
 RESIDUAL SS= 1.5539260062631 MS= 15539260062631
 TOTAL SS= 3.3564896298091 MS= 33564896298091
 F-TEST= 7.421550050467
 R-SQ= 21.56633491305 CORRELATION EST= .46121074312
 S= .15539260062631
 SLOPE EST= 4.63440047331 INTERCEPT EST= .335648962981

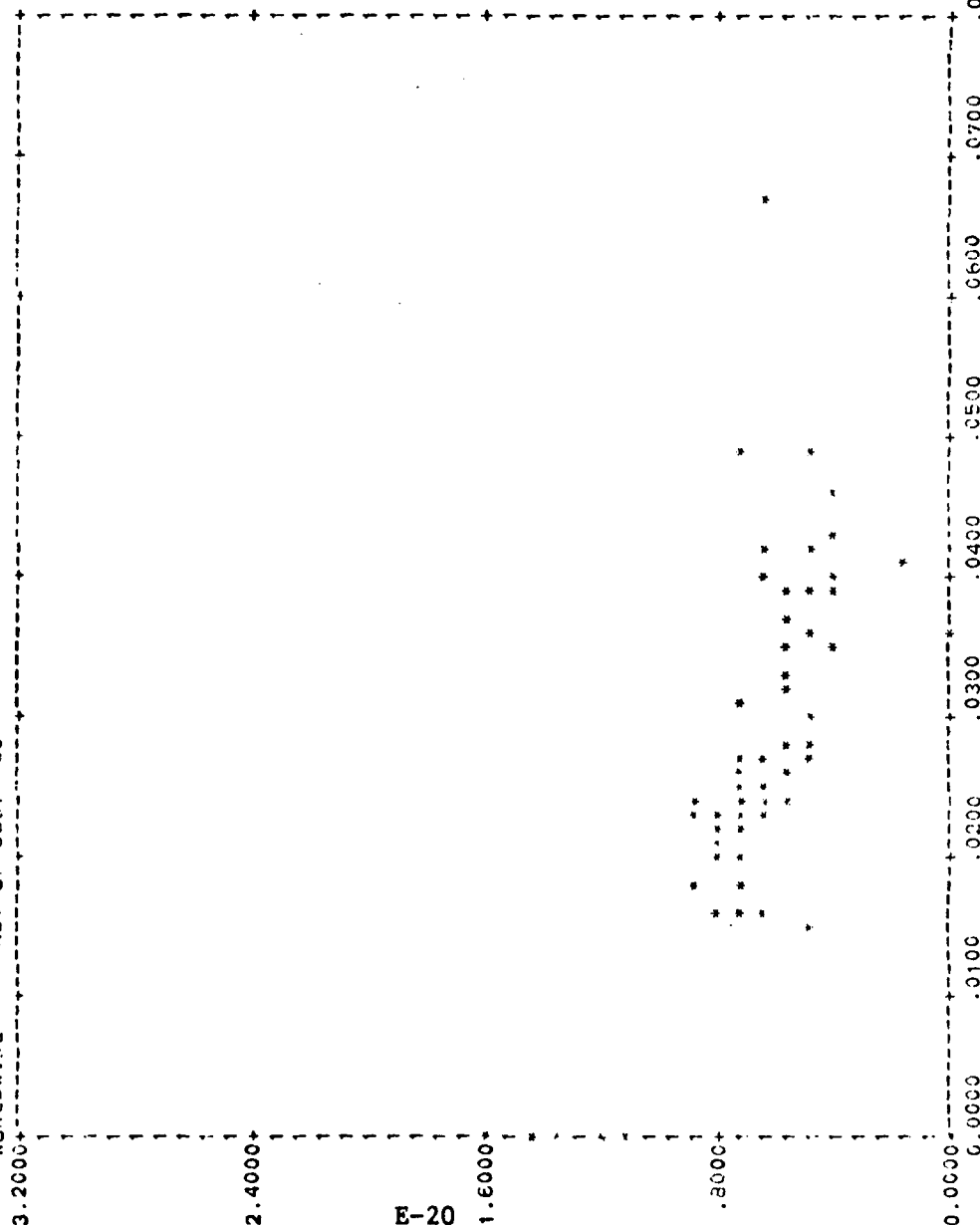
SYSTEM OUTPUT

Y VARIABLER
X VARIABLER

AVERAGE AVAILABILITY
AVERAGE USAGE

NO. OF OBS. = 65

AGROWIDE



E-20

0.0000 .0100 .0200 .0300 .0400 .0500 .0600 .0700 .0800

ANOVA TABLE

REGRESSION DF= 1. SS= .504647438468 MS= .504647438468
RESIDUAL DF= 63. SS= 1.214145546147 MS= .01927215152615
TOTAL DF= 64. SS= 1.748792984615

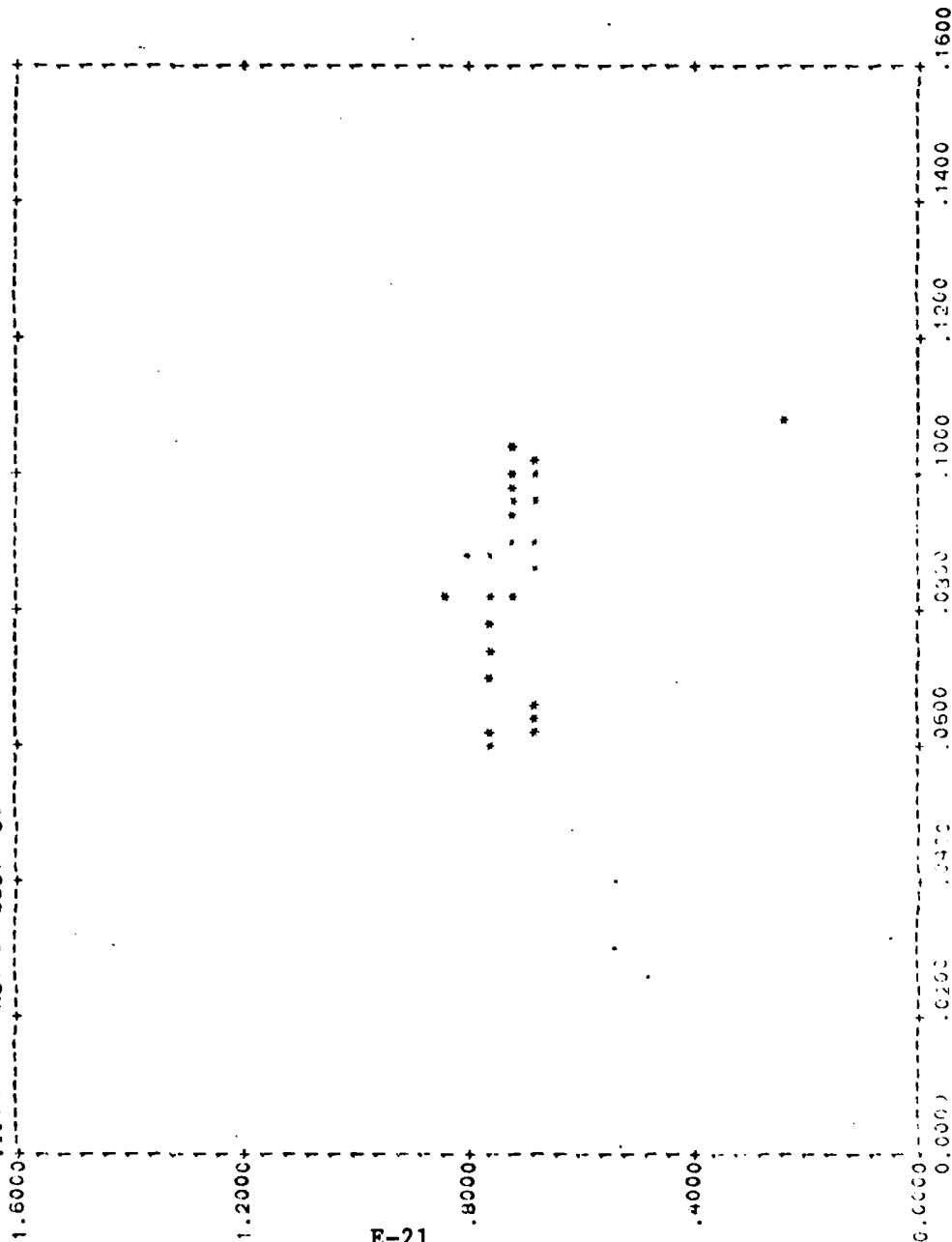
F-TEST= 27.74130942693

R**2= 30.57236356636 CORRELATION EST= -.5529226577872

S= .130241743621

SLOPE EST= -.9.205254708412 INTERCEPT EST= .800395784966

SYSTEM=UH-1
YVARIABLE=
XVARIABLE=
VIETNAM NO. OF OBS. =30
AVERAGE AVAILABILITY
AVERAGE USAGE



E-21

ANOVA TABLE
REGRESSION SS= .09618402410339 MS= .09618402410339
RESIDUAL SS= .02237055152012 MS= .02237055152012
TOTAL SS= .11855457562351
F-TEST= 4.309210307016
R-SQ= .149400009529
SLOPE EST= .415830135513
INTERCEPT EST= 1.13612961217
CORRELATION EST= -.3302042410407

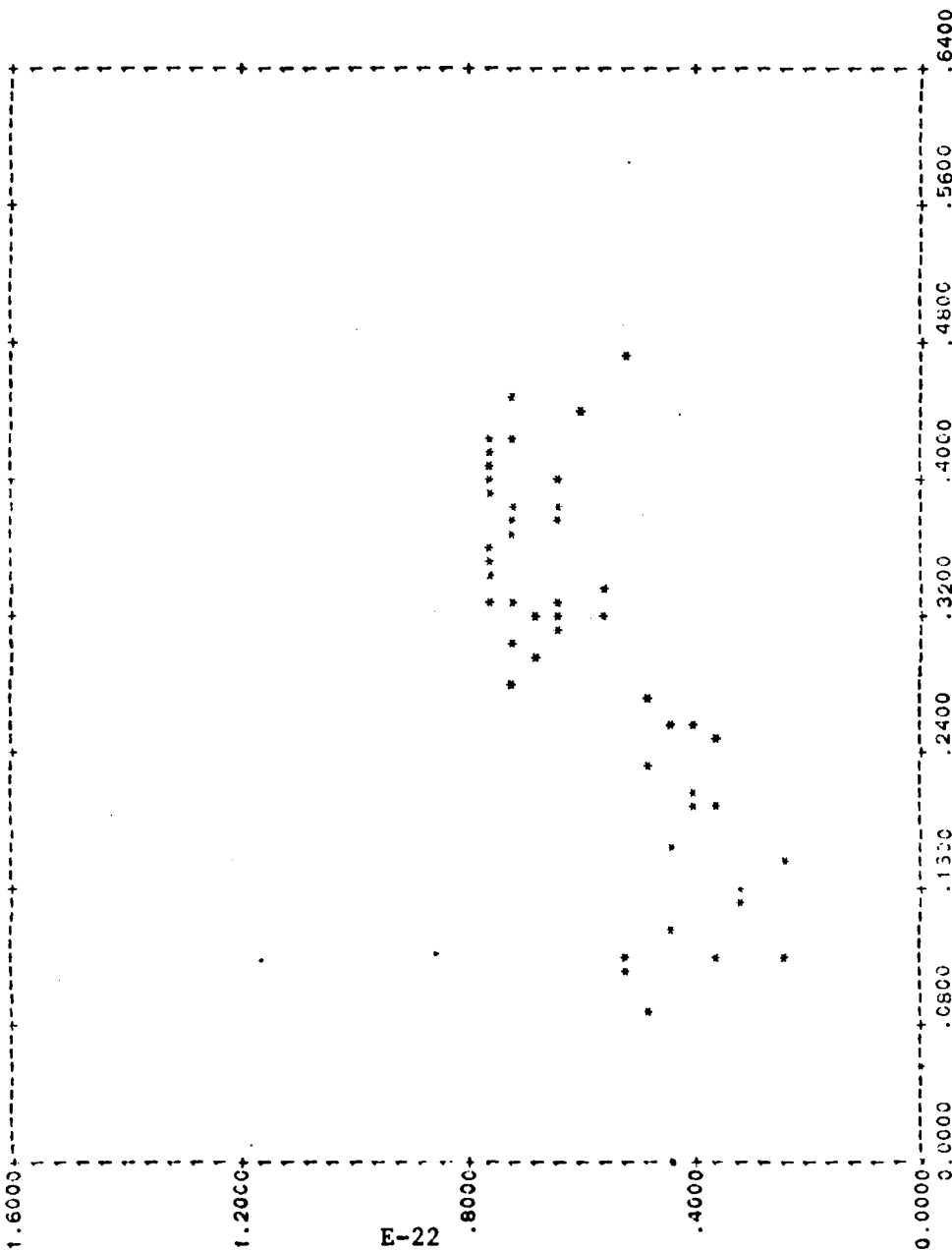
SYSTEM=1

YVARIABLE=

XVARIABLE=

NOROWIDE NO. OF OBS. =54

AVERAGE RELIABILITY
AVERAGE LENGTH OF SORTIES BY AIRCRAFT

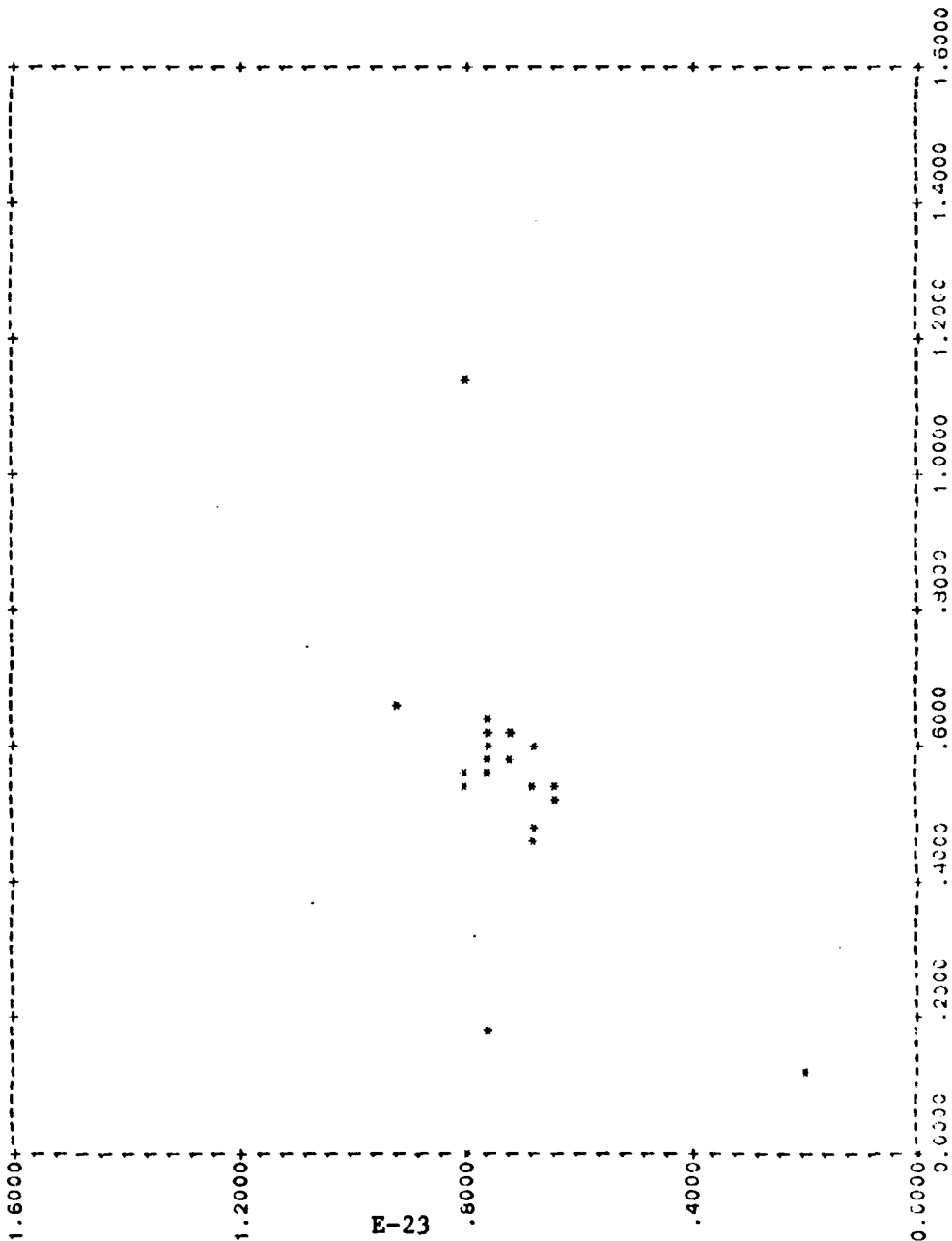


E-22

ANOVA TABLE

REGRESSION	DF= 1.	SS= .025262092846	MS= .025262092846
RESIDUAL	DF= 52.	SS= .533293891968	MS= .01025575748455
TOTAL	DF= 53.	SS= 1.258561481481	
F-TEST=	R0.16817541537		
R+2=	60.7452865669		
S=	.1012707138543		
SLOPE EST=	1.202047546351		
INTERCEPT EST=	.2303117378555		

SYSTEM: AH-1
 YVARIABLE= AVERAGE RELIABILITY
 XVARIABLE= AVERAGE LENGTH OF SORTIES BY AIRCRAFT
 VIETNAM NO. OF OBS. = 22



E-23

ANOVA TABLE
 REGRESSION DF= 1. SS= .1231598514781 MS= .1231598514781
 RESIDUAL DF= 20. SS= .240450321249 MS= .01222254606246
 TOTAL DF= 21. SS= .3636101727273
 F-TEST= 10.07543813518 CORRELATION EST= .5730159143125
 R**2= .33700249623615
 S= .1103006242814
 SLOPE EST= .473914969305 INTERCEPT EST= .484787450704

SYSTEM=CH47

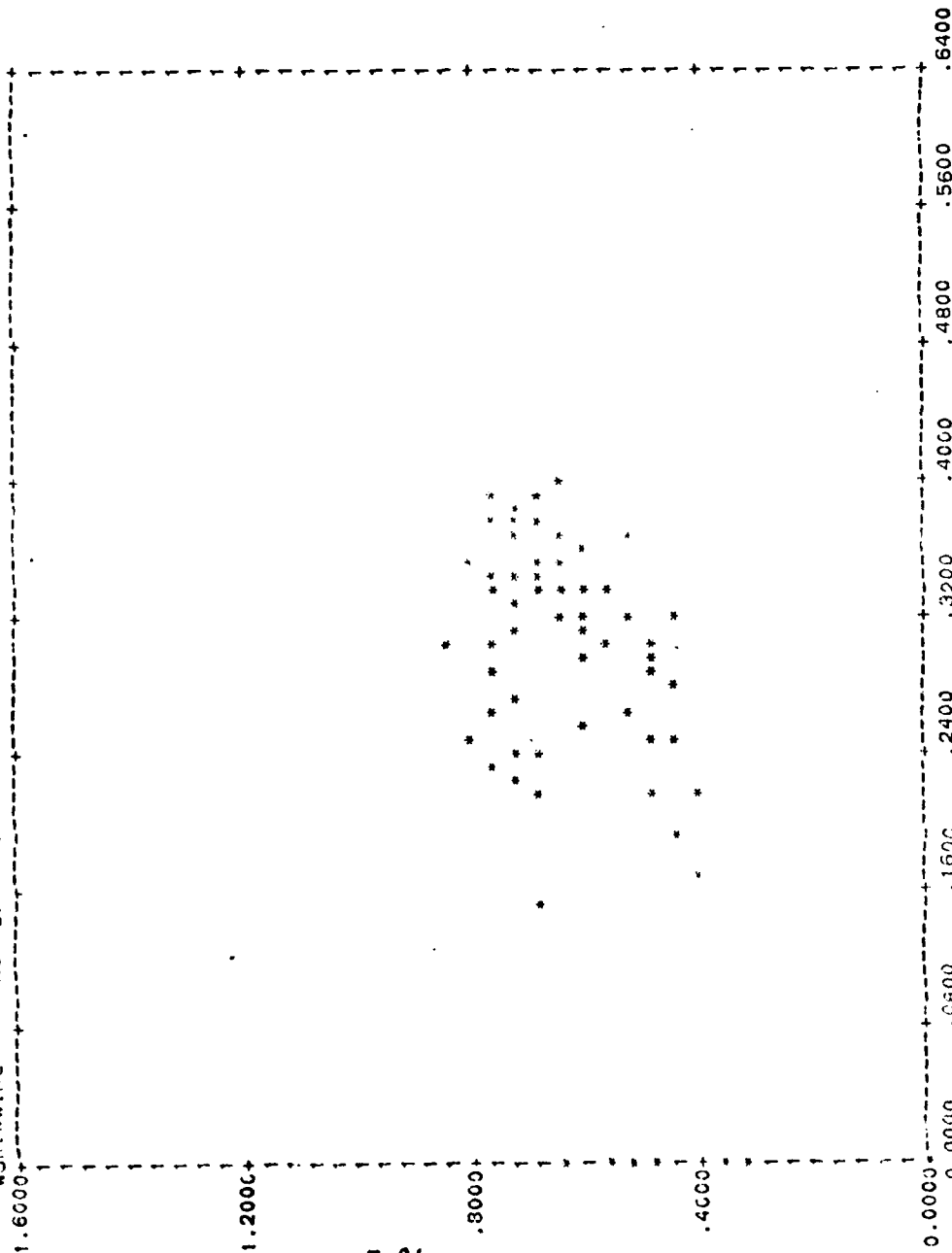
VARIABLE=

VARIABLE=

WORLDWIDE

NO. OF OBS. = 64

AVERAGE RELIABILITY
AVERAGE LENGTH OF SORTIES BY AIRCRAFT



E-24

ANOVA TABLE

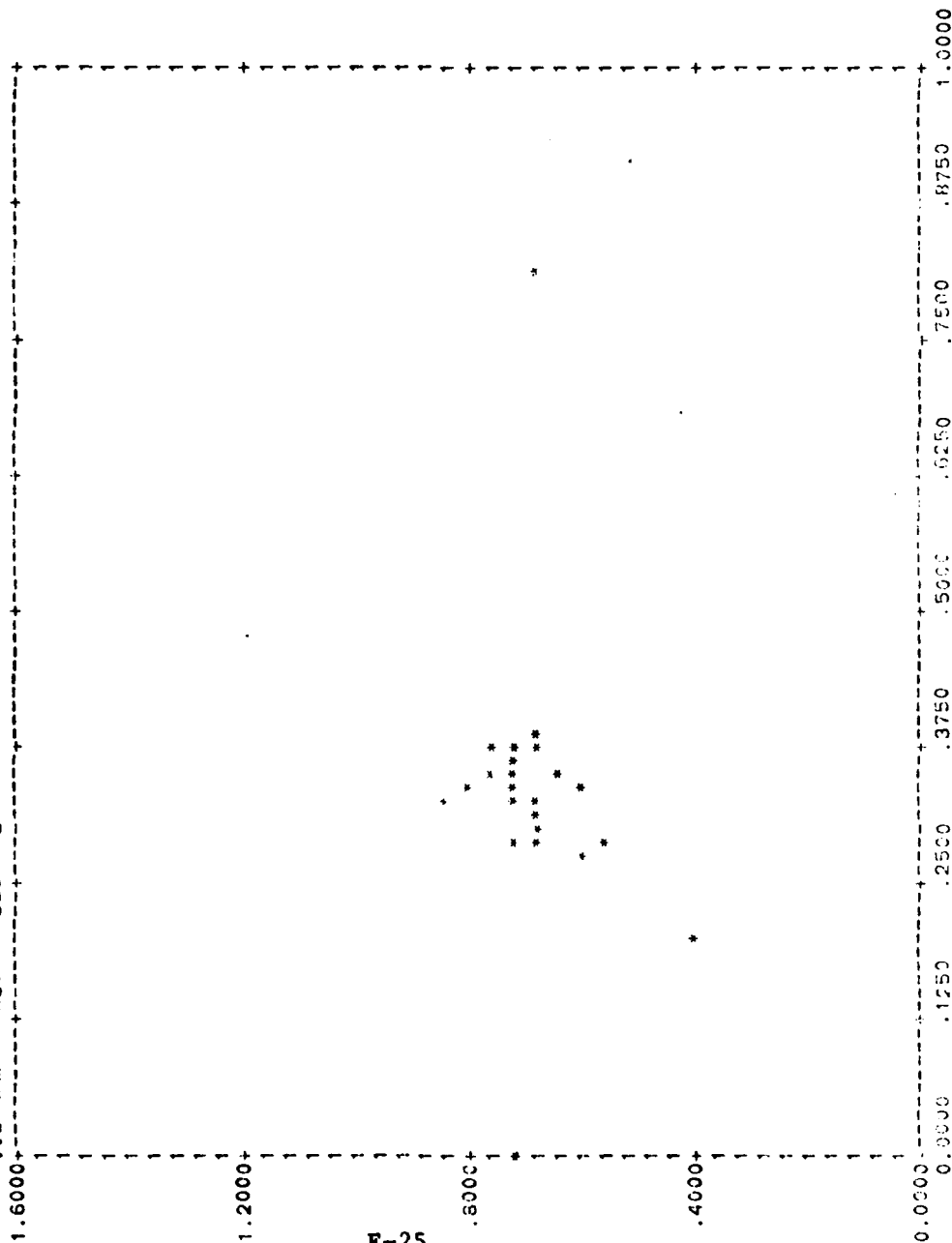
REGRESSION	DF=	SS=	MS=
RESIDUAL	62	.6834128503173	.01102278790634
TOTAL	63	.77526375	
F-TEST=	8.33281928732		
R**2=	11.84769095251		
SLOPE EST=	.6540753331643		
INTERCEPT EST=	.440192970531		

SYSTEM=CH47

Y-VARIABLE=
X-VARIABLE=

AVERAGE RELIABILITY
AVERAGE LENGTH OF SORTIES BY AIRCRAFT

VIETNAM NO. OF OBS. = 27



E-25

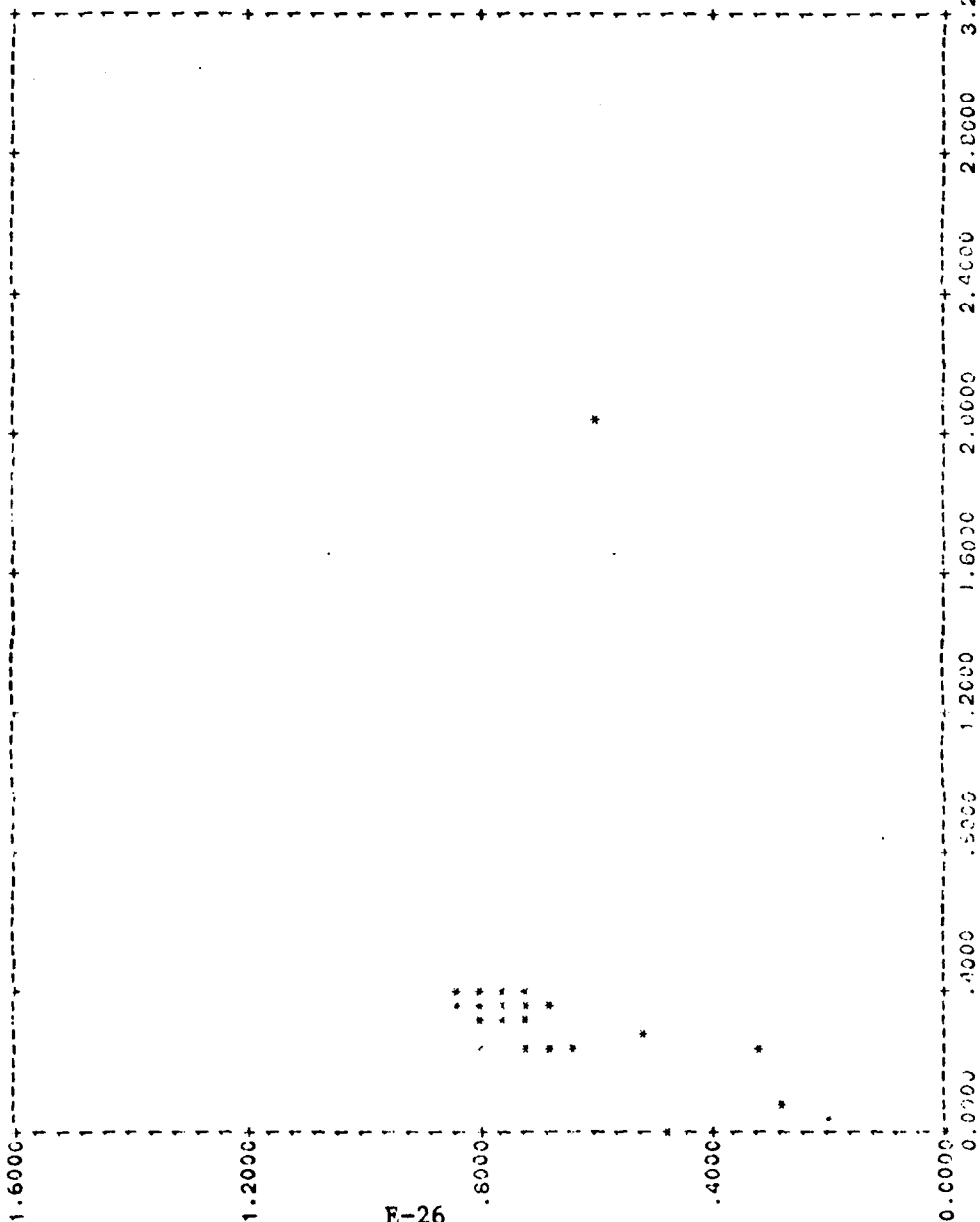
ANOVA TABLE
REGRESSION DF= 1. SS= .00876255549868 R^2= .00876255549868
RESIDUAL DF= 25. SS= .172828111808 R^2= .000000000000
TOTAL DF= 26. SS= .181590666307
F-TEST= 1.27186423098
R+2= .181590666307
S= .053112100401
SLOPE EST= .1753150274207 CORRELATION EST= .22121075772 INTERCEPT EST= .6231148746500

SYSTEM FORMER

WORLDWIDE

NO. OF OBS. = 47

AVERAGE RELIABILITY
AVERAGE LENGTH OF SORTIES BY AIRCRAFT



E-26

ANOVA TABLE

REGRESSION DF= 1. SS= .012300659575877 MS= .012300659575877
RESIDUAL DF= 45. SS= .805221351676 MS= .0182271413706
TOTAL DF= 46. SS= .8775279574468

F-TEST= .040063727184 CORRELATION EST= .118423521124
R*2= 1.402410375811
S= .1386819680036 INTERCEPT EST= .7095303957492
SLOPE EST= .06271990636553

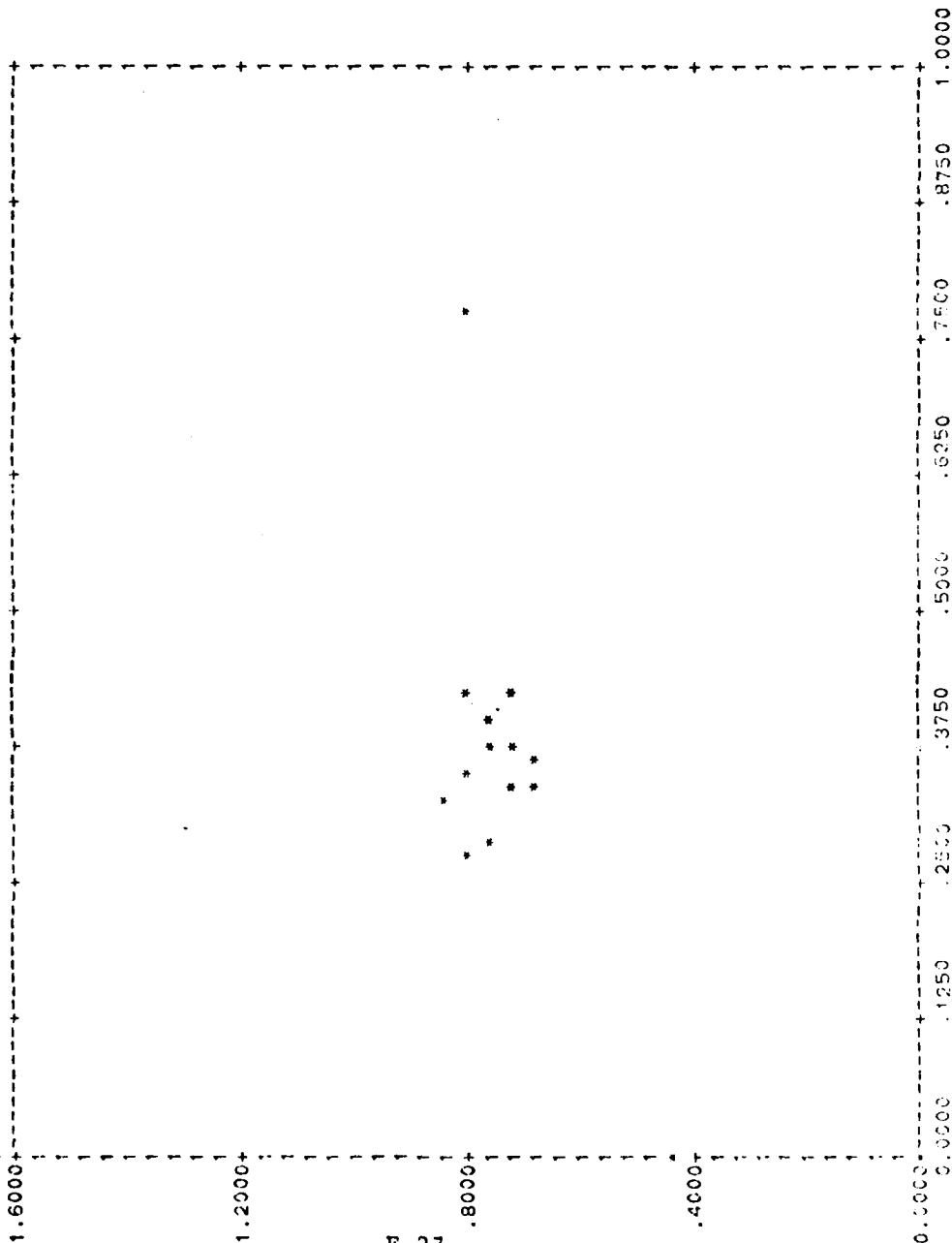
SYSTEM=0458

YVARIABLE=

XVARIABLE=

VIE NAM NO. OF OBS. =13

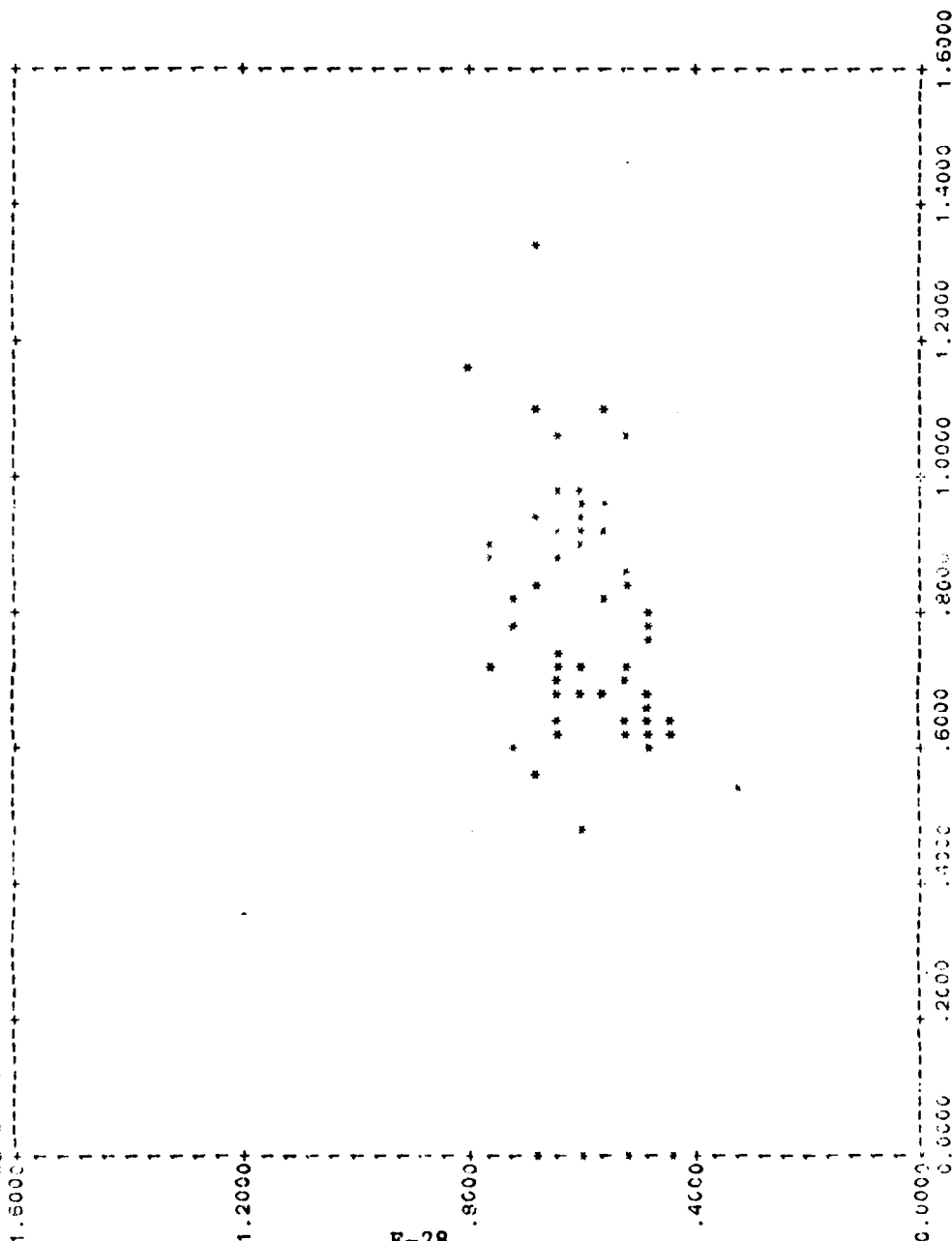
AVERAGE RELIABILITY
AVERAGE LENGTH OF SORTIES BY AIRCRAFT



E-27

REGRESSION OF= 1. SS= .0001345264162464 RS= .0031945264162464
 RESIDUAL OF= 11. SS= .03168316589145 RS= .002872105990131
 TOTAL OF= 12. SS= .03178769230769
 F-TEST= .0007205354861 CORRELATION EST= .073277149475
 R**2= .01060107416 INTERCEPT EST= .74107390157
 SLOPE EST= .03075000000000 INTERCEPT EST= .74107390157

SYSTEM-CV-1
 VARIABLE= AVERAGE RELIABILITY
 VARIABLE= AVERAGE LENGTH OF SORTIES BY AIRCRAFT
 AVERAGE LENGTH OF SORTIES BY AIRCRAFT
 NO. OF OBS= 604
 AVERAGE LENGTH OF SORTIES BY AIRCRAFT

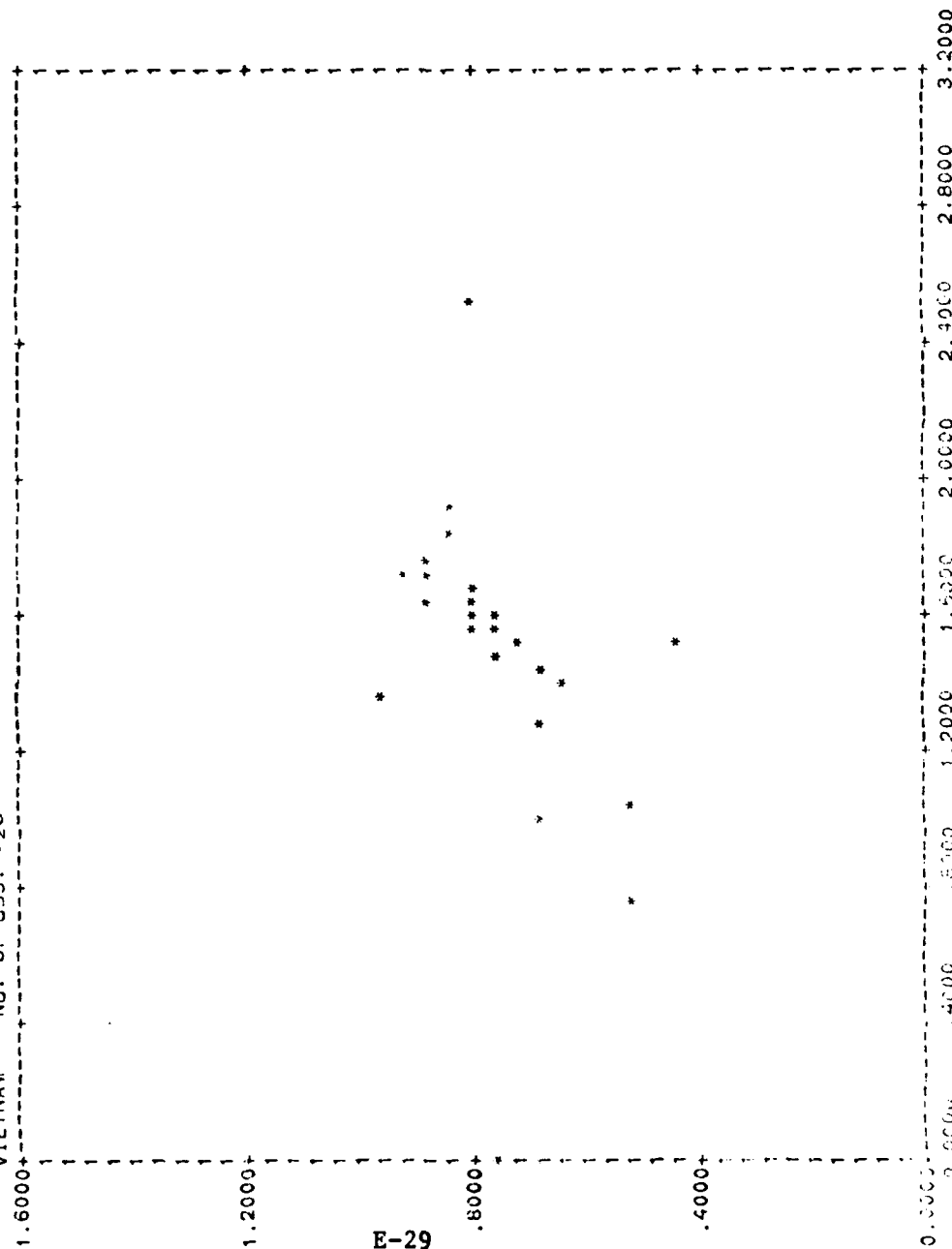


E-28

ANOVA TABLE

REGRESSION	CF=	1.	SS=	.09746137253908	MS=	.09746137253908
RESIDUAL	DF=	62.	SS=	.4198550649609	MS=	.007255726854208
TOTAL	DF=	63.	SS=	.5173164375		
F-TEST=		13.423375621				
R*2=		17.867134227				
S=		.0853056443761				
SLOPE EST=		.230796019736				
INTERCEPT EST=		.3978577120566				

SYSTEM=OV-1
 YVARIABLE= AVERAGE RELIABILITY
 XVARIABLE= AVERAGE LENGTH OF SORTIES BY AIRCRAFT
 VIETNAM NO. OF OBS. = 28



E-29

ADJUSTED R-SQUARE = .4233
 REGRESSION DF= 1, SS= .1401677146707 MS= .1401677146707
 RESIDUAL DF= 26, SS= .28313249615 MS= .01089012498519
 TOTAL DF= 27, SS= .4233109642857
 F-TEST= 12.921641165
 R-SQ= .4233109642857
 SLOPE EST= .2276830649718 INTERCEPT EST= .407364464485

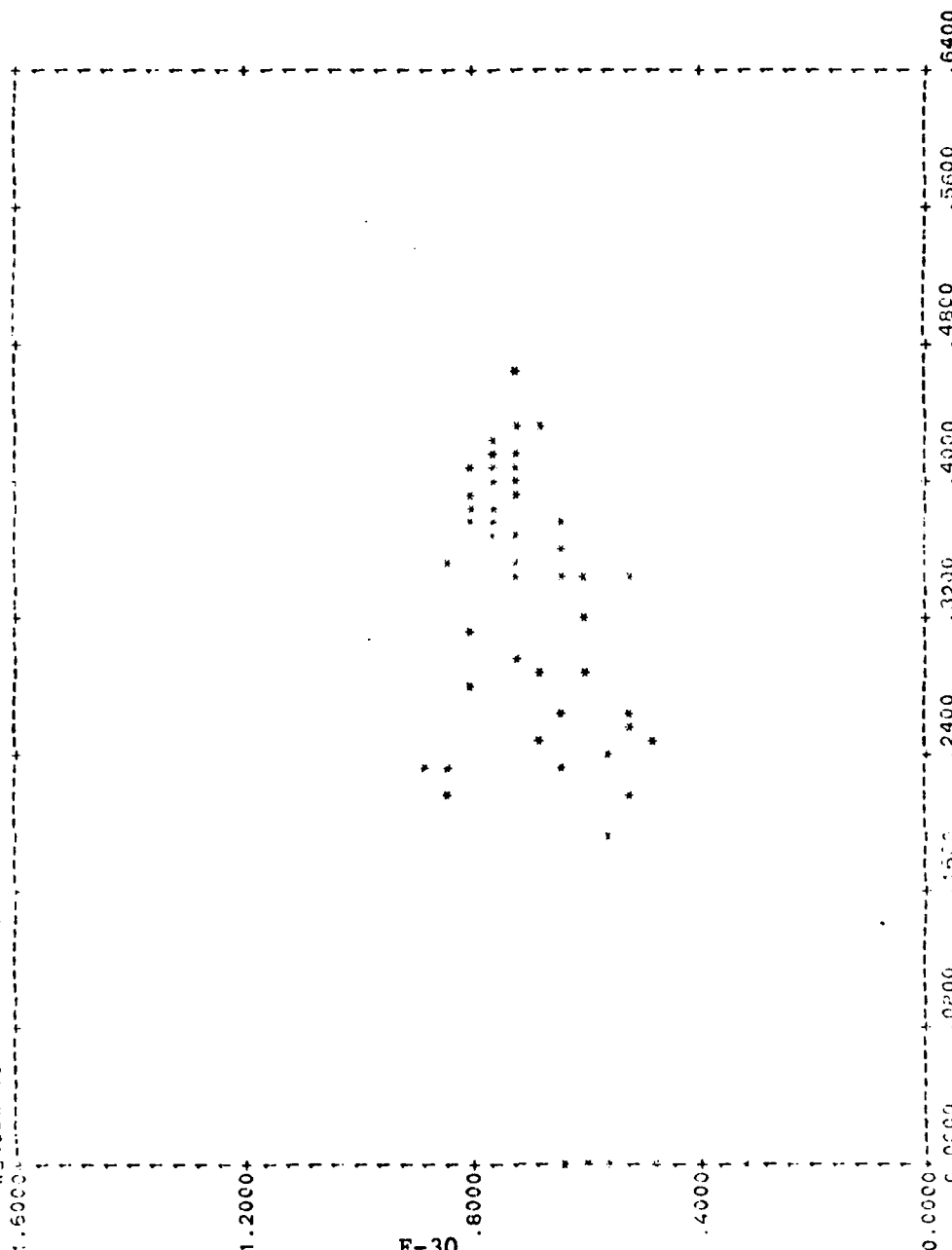
SYSTEM=04-1

NO. TABLES=

NO. OF OBS. FOR

NO. OF OBS. FOR

AVERAGE RELIABILITY
AVERAGE LENGTH OF SORTIES BY AIRCRAFT



E-30

0.0000 .0200 .0400 .0600 .0800 .1000 .1200 .1400 .1600 .1800 .2000 .2200 .2400 .2600 .2800 .3000 .3200 .3400 .3600 .3800 .4000 .4200 .4400 .4600 .4800 .5000 .5200 .5400 .5600 .5800 .6000 .6200 .6400

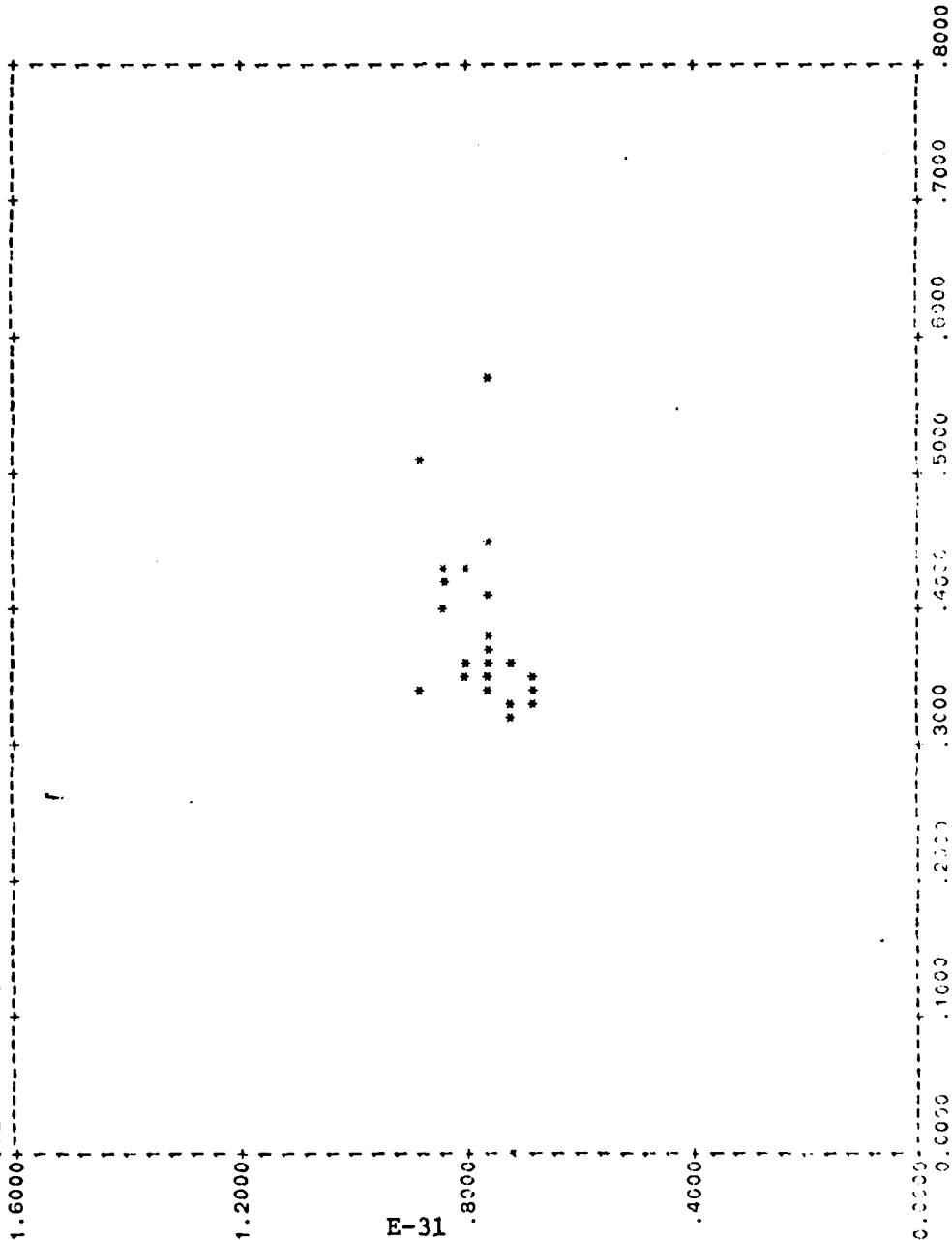
ANOVA TABLE

REGRESSION DF= 1 SS= .1226267080826 MS= .1226267080826
RESIDUAL DF= 62 SC= .4904812294174 MS= .007910987571218
TOTAL DF= 63 SS= .6133079375

F-TEST= 15.52609000112 CORRELATION EST= .4475145019674
R**2= .2030322949

S= .08994373261365 INTERCEPT EST= .4613697324421
SLOPE EST= .6530468217394

SYSTEM=UH-1
 YVARIABLE=
 XVARIABLE=
 VIETNAM NO. OF OBS. =29
 AVERAGE RELIABILITY
 AVERAGE LENGTH OF SORTIES BY AIRCRAFT



ANOVA TABLE
 REGRESSION DF= 1 SS= .01593816663458 MSF .01593816663458
 RESIDUAL DF= 27 SS= .00330266095162 MSF .002173802257468
 TOTAL DF= 28 SS= .0192408275861
 F-TEST= 7.311930000000000
 R-SQ= .2129000000000000
 S.E. ESTIMATE= .0044000000000000
 SLOPE EST= .4211154000000000
 INTERCEPT EST= .0000000000000000
 CORRELATION EST= .4621200000000000

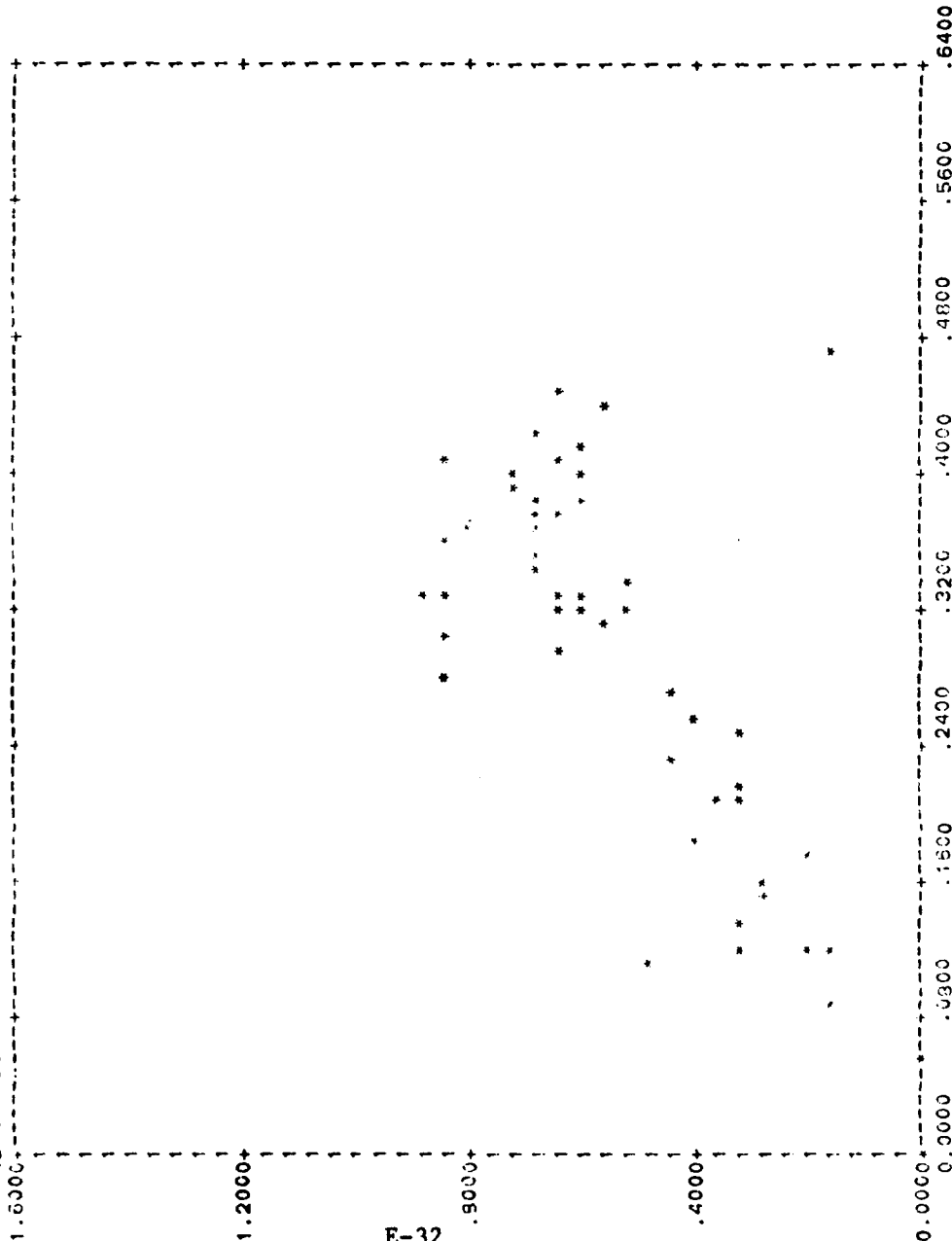
SYSTEM=44-1

Y-VARIABLE
X-VARIABLE

AVERAGE AVAILABILITY
AVERAGE LENGTH OF SORTIES BY AIRCRAFT

NO. OF OBS. = 54

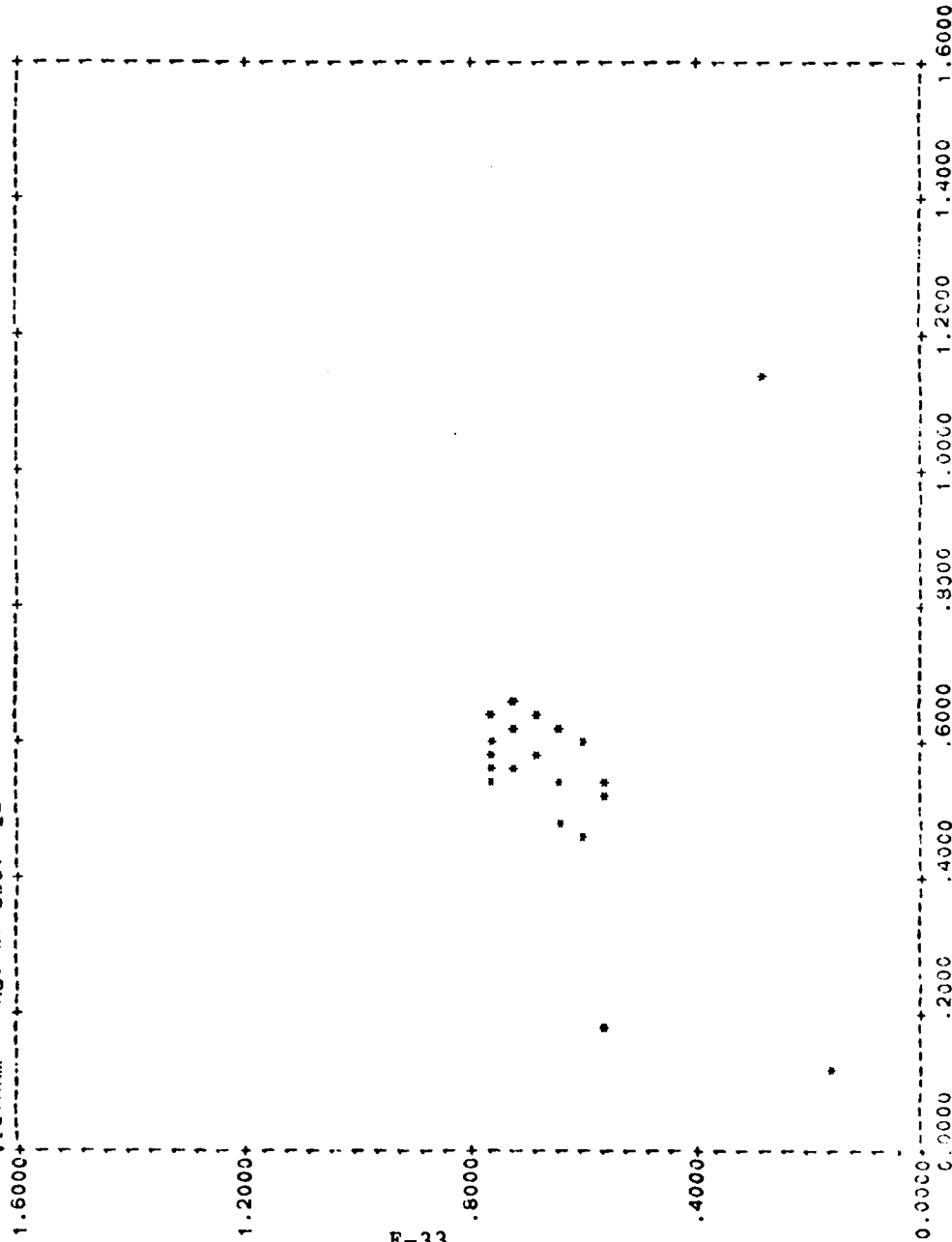
MORQUIDE



E-32

ANOVA TABLE
REGRESSION DF= 1. SS= 1.051825677008 MS= 1.051825677008
RESIDUAL DF= 52. SS= 1.152119656326 MS= .02215614723703
TOTAL DF= 53. SS= 2.213945333333
F-TEST= 47.78925079709
R*2= 47.89017895753 CORRELATION EST= .6920272041401
S= .1488494112754
SLOPE EST= 1.361523593112 INTERCEPT EST= .1366924014587

SYSTEM=AH-1
 YVARIABLE=
 XVARIABLE=
 VIETNAM NO. OF OBS. =22
 AVERAGE AVAILABILITY
 AVERAGE LENGTH OF SORTIES BY AIRCRAFT



E-33

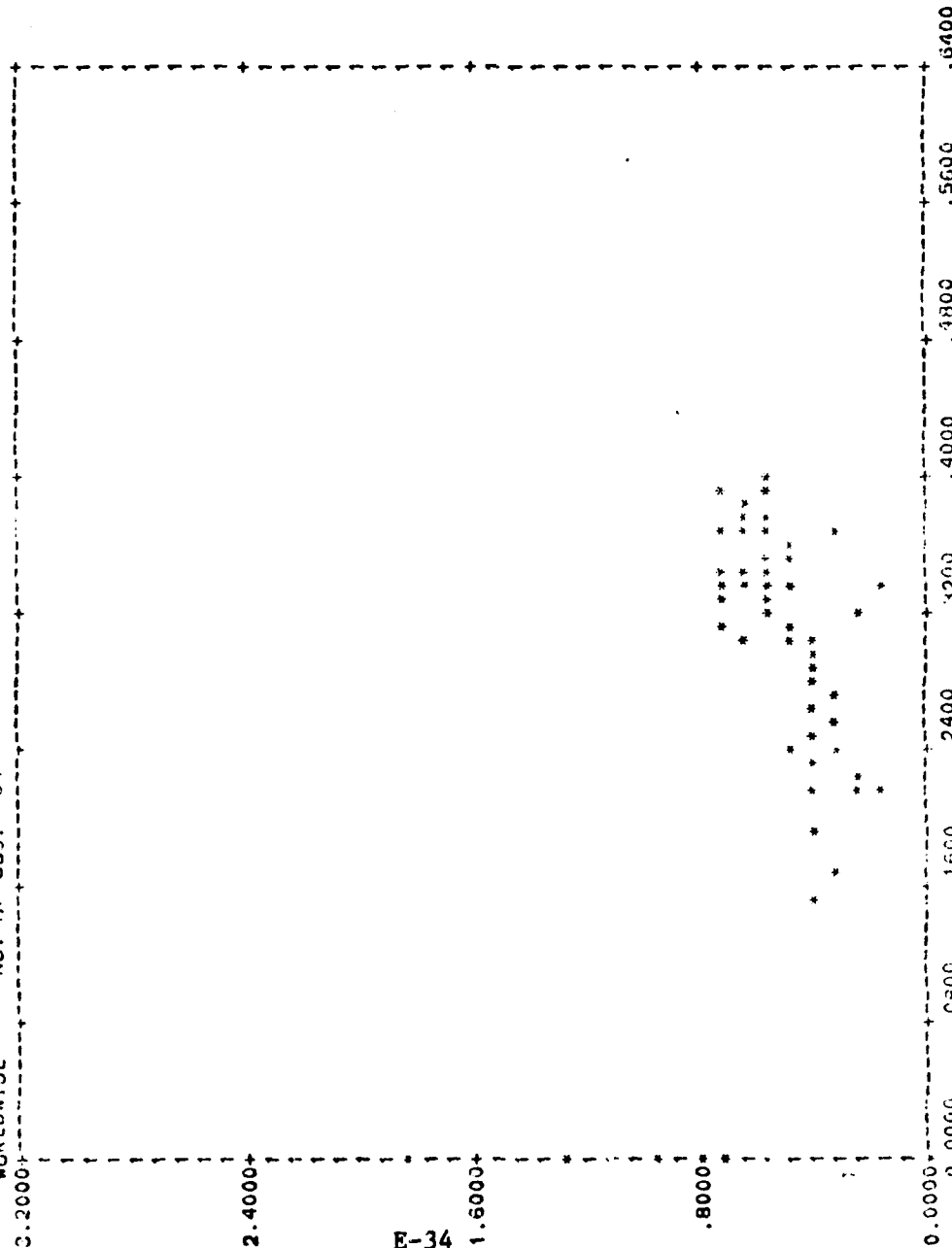
ANOVA TABLE
 REGRESSION DF= 1 SS= .000278512180105 MS= .000278512180105
 RESIDUAL DF= 20 SS= .0744397605472 MS= .00372193802736
 TOTAL DF= 21 SS= .0747182727273
 F-TEST= .1970506777109
 R-SQ= .02712223009 CORRELATION EST= .0937707220297
 S= .15401411361
 SLOPE EST= .03100321040701 INTERCEPT EST= .083511260865

SYSTEM-CH47

YVARIABLE=
XVARIABLE=

AVERAGE AVAILABILITY
AVERAGE LENGTH OF SORTIES BY AIRCRAFT

WORLDWIDE NO. OF OBS. = 64



E-34

ANOVA TABLE

REGRESSION	DF= 1.	SS= .5239691161834	MS= .5239691161834
RESIDUAL	DF= 62.	SS= .8288926338166	MS= .0133692360293
TOTAL	DF= 63.	SS= 1.35286175	
F-TEST=	39.19215092284	CORRELATION EST=	.622337562358
R**2=	38.73042579431	SLOPE EST=	1.562208183765
S=	.1150254125584	INTERCEPT EST=	.01213687267024

E-35

	0.0000	.1250	.2500	.3750	.5000	.6250	.7500	1.0000
ANOVA TABLE								
REGRESSION	DF = 1.	SS = .05014361726346	MS = .05014361726346					
RESIDUAL	DF = 25.	SS = .24535201236602	MS = .009814080496547					
TOTAL	DF = 26.	SS = .2954956296296						
F-TEST =	9.10935459422							
R-SQ =	16.000000000000							
CORRELATION EST = -.471144000109								
SE =	.000000000000							
INTERCEPT EST =	-.445831922765							
SLOPE EST =	.000000000000							

AVERAGE AVAILABILITY
AVERAGE LENGTH OF SORT

.8020+

ANNOVA TABLE

REGRESSION	DF =	1.	SS =	.142652082684	MS =	.142652082684
RESIDUAL	DF =	45.	SS =	1.226322847902	MS =	.02726495217559
TOTAL	DF =	46.	SS =	1.36957493617		

F-TEST= 5.232068:63909

10.415792349

S# .1651210228:54

2135331620033

INTERCEPT EST =

.7678:6948239

SYSTEM-OH58

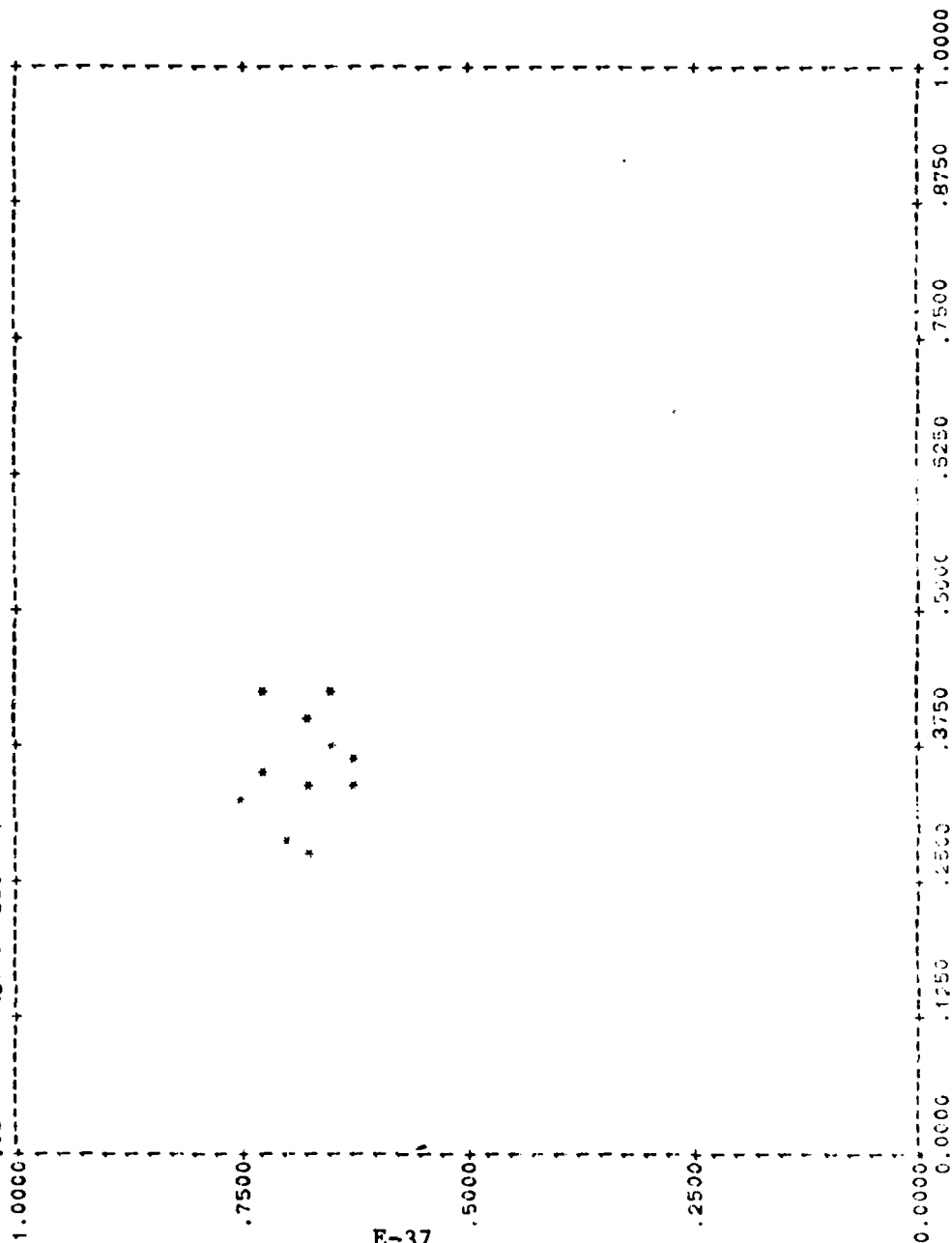
YVARIABLE=

XVARIABLE=

NO. OF OBS. =12

VIEINAM

AVERAGE AVAILABILITY
AVERAGE LENGTH OF SORTIES BY AIRCRAFT



E-37

0.0000 0.0000 0.1250 0.2500 0.3750 0.5000 0.6250 0.7500 0.8750 1.0000

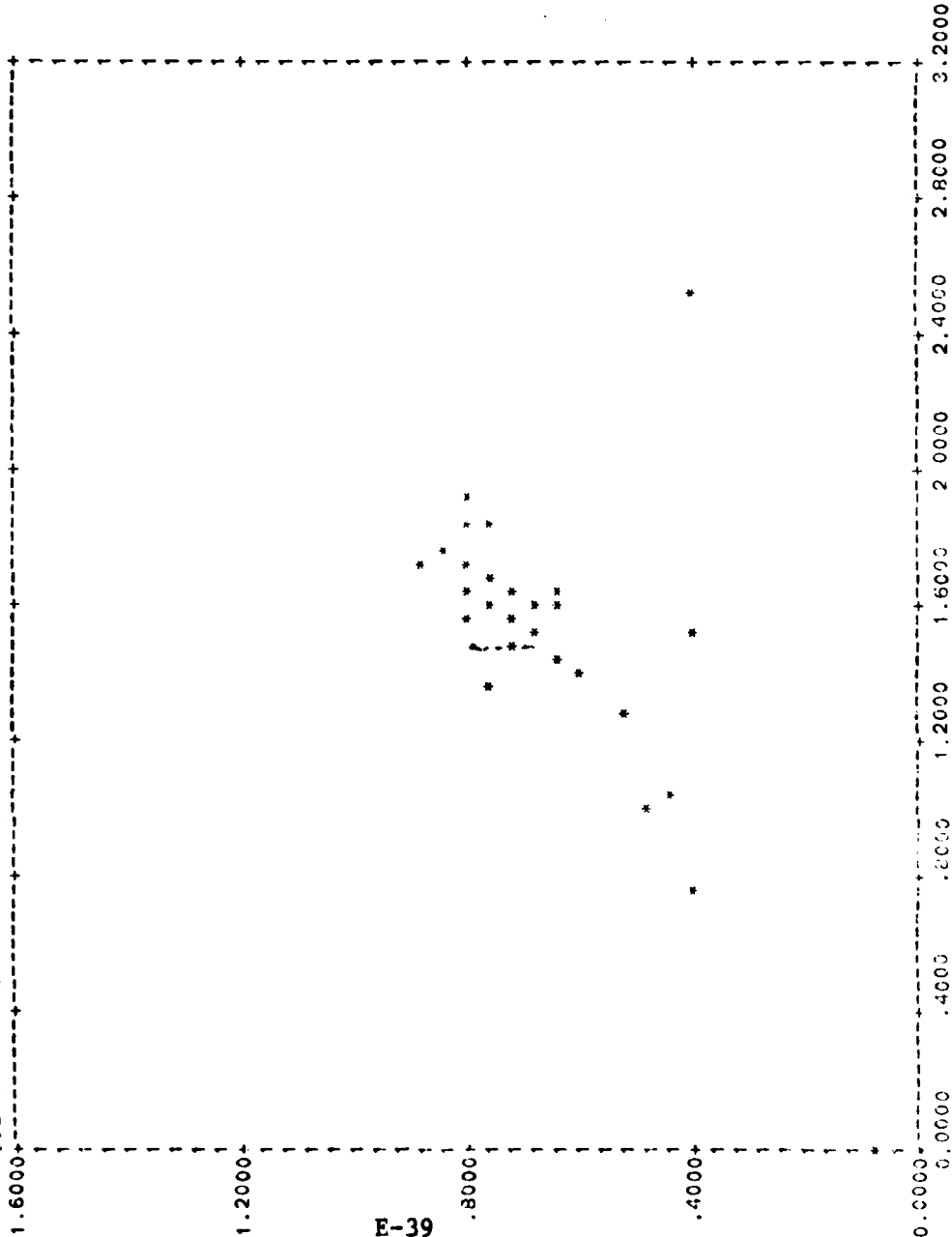
ANOVA TABLE

REGRESSION	DF= 1.	SS= .0005318743072549	MS= .0005318743072549
RESIDUAL	DF= 10.	SS= .01759612569275	MS= .001759612569275
TOTAL	DF= 11.	SS= .018128	
F-TEST=	.013170070008		
R+2=	3.09452304521		
S=	.0413077301632		
SLOPE EST=	-.1433155214302		
INTERCEPT EST=	.7334300707625		

AVERAGE AVAILABLE
AVERAGE LENGTH OF SORTIES BY AIRCRAFT

3946306161281

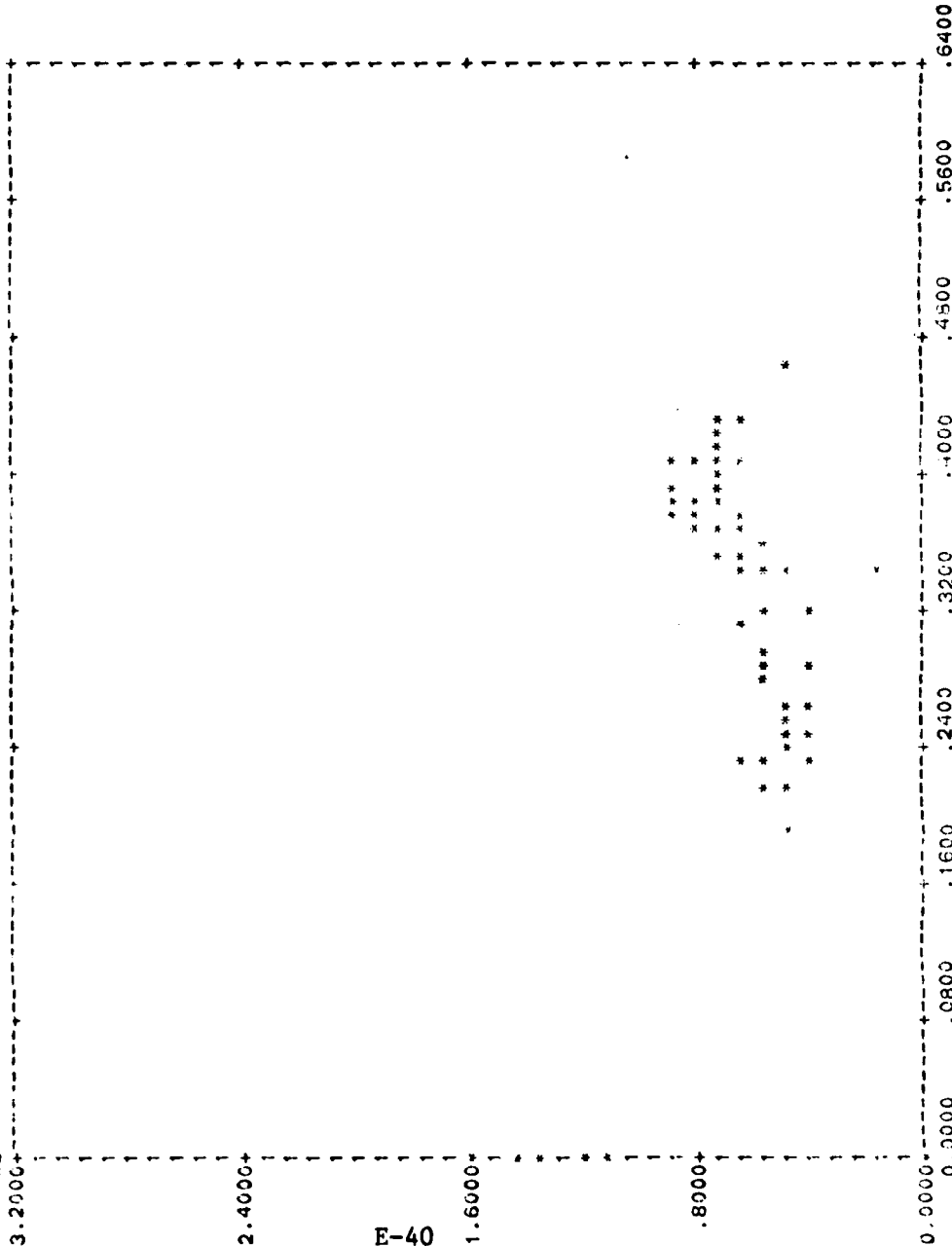
SYSTEM=OV-1
YVARIABLE=
XVARIABLE=
VIETNAM NO. OF OBS. =28
AVERAGE AVAILABILITY
AVERAGE LENGTH OF SORTIES BY AIRCRAFT



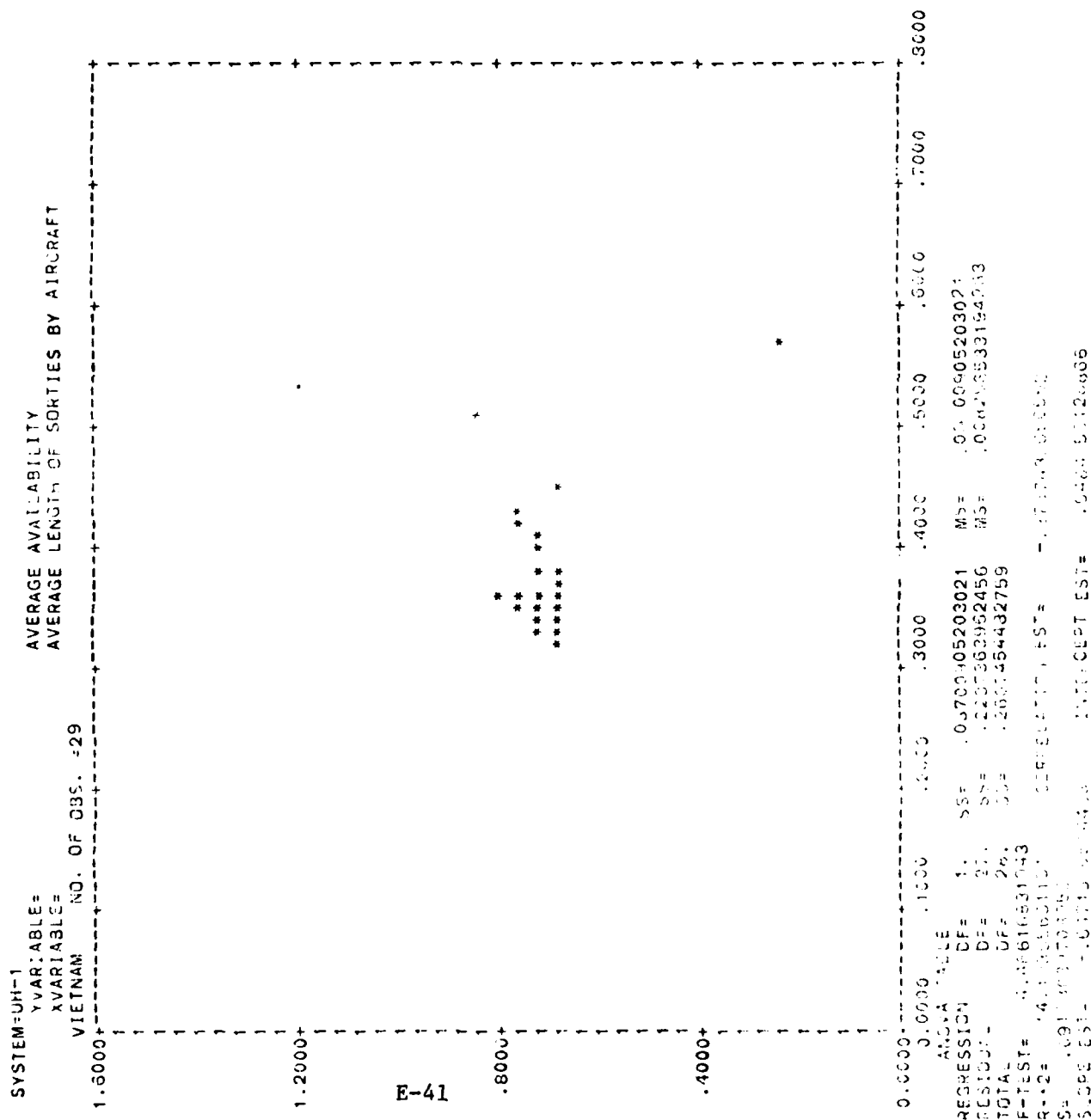
F-39

ANOVA TABLE
REGRESSION DF= 1 SS= .00692760159961 MS= .00692760159961
RESIDUAL DF= 26 SS= .06305131126861 MS= .002425054312187
TOTAL DF= 27 SS= .0699789128606
F-TEST= 4.041961990096
R-SQ= .13453875369 CORRELATION EST= .365022295000
S= .129678056122 INTERCEPT EST= .421736589759
SLOPE EST= .1574769723133

SYSTEM: GIFT
 YVARIABLE= AVERAGE AVAILABILITY
 XVARIABLE= AVERAGE LENGTH OF SORTIES BY AIRCRAFT
 WORLDWIDE NO. OF OBS. 104



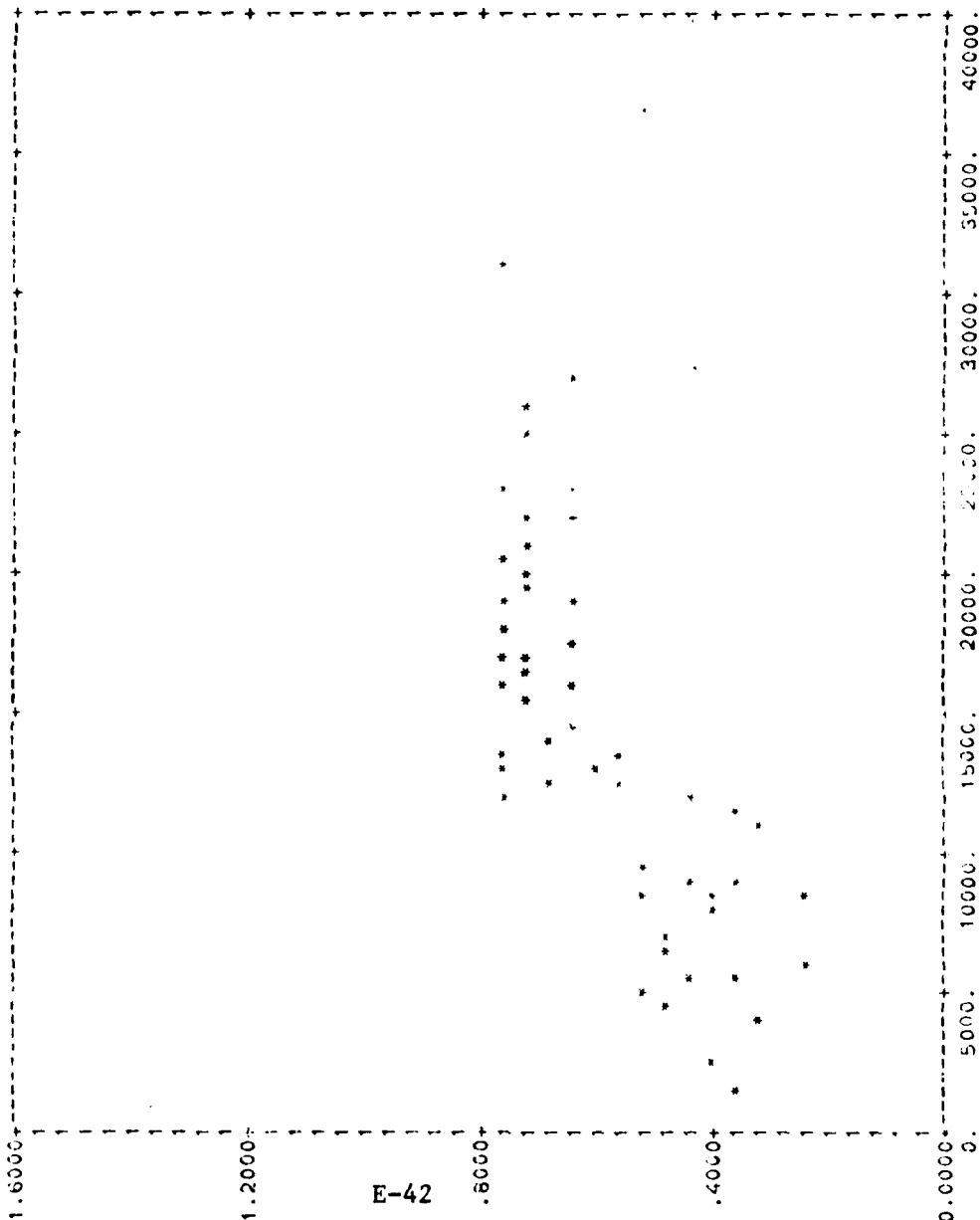
ANGVA TABLE
 REGRESSION: CR= 1. SS= .6004624692565 MS= .6004624692565
 RESIDUAL DF= 62. SS= .7591632807435 MS= .01224456904425
 TOTAL DF= 63. SS= 1.35962575
 F-TEST= 49.03068558744 CORRELATION EST= .6045585-00552
 R+2= 44.16380531602
 S= .110551808288
 SLOPE EST= 1.443913228334 INTERCEPT EST= .135165547498



SYSTEM NO. 1
 VARIABLE
 AVERAGE RELIABILITY
 TOTAL FLYING HOURS

NO. OF OBS. = 55

WORLDWIDE

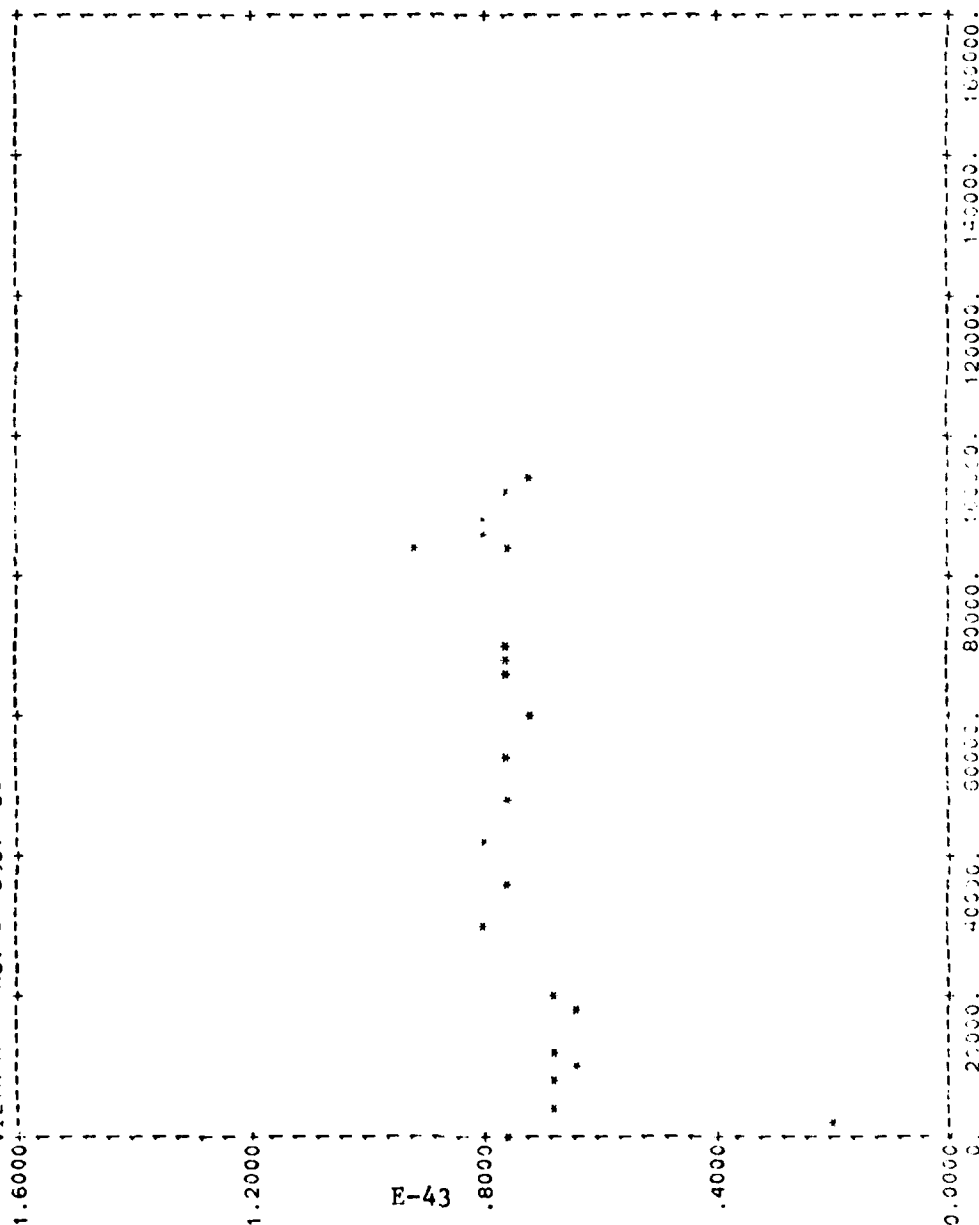


E-42

ANOVA TABLE
 REGRESSION DF= 1. SS= 18.72633079407 MS= 18.72633079407
 RESIDUAL DF= 54. SS= 1.724853205933 MS= .03194172603579
 TOTAL DF= 55. SS= 20.451184
 F-TEST= 588.2654027081
 R**2= 91.55599830145 S= .1787224832966 CORR ED= .7596658391052
 B(1) EST= .00003722004334527

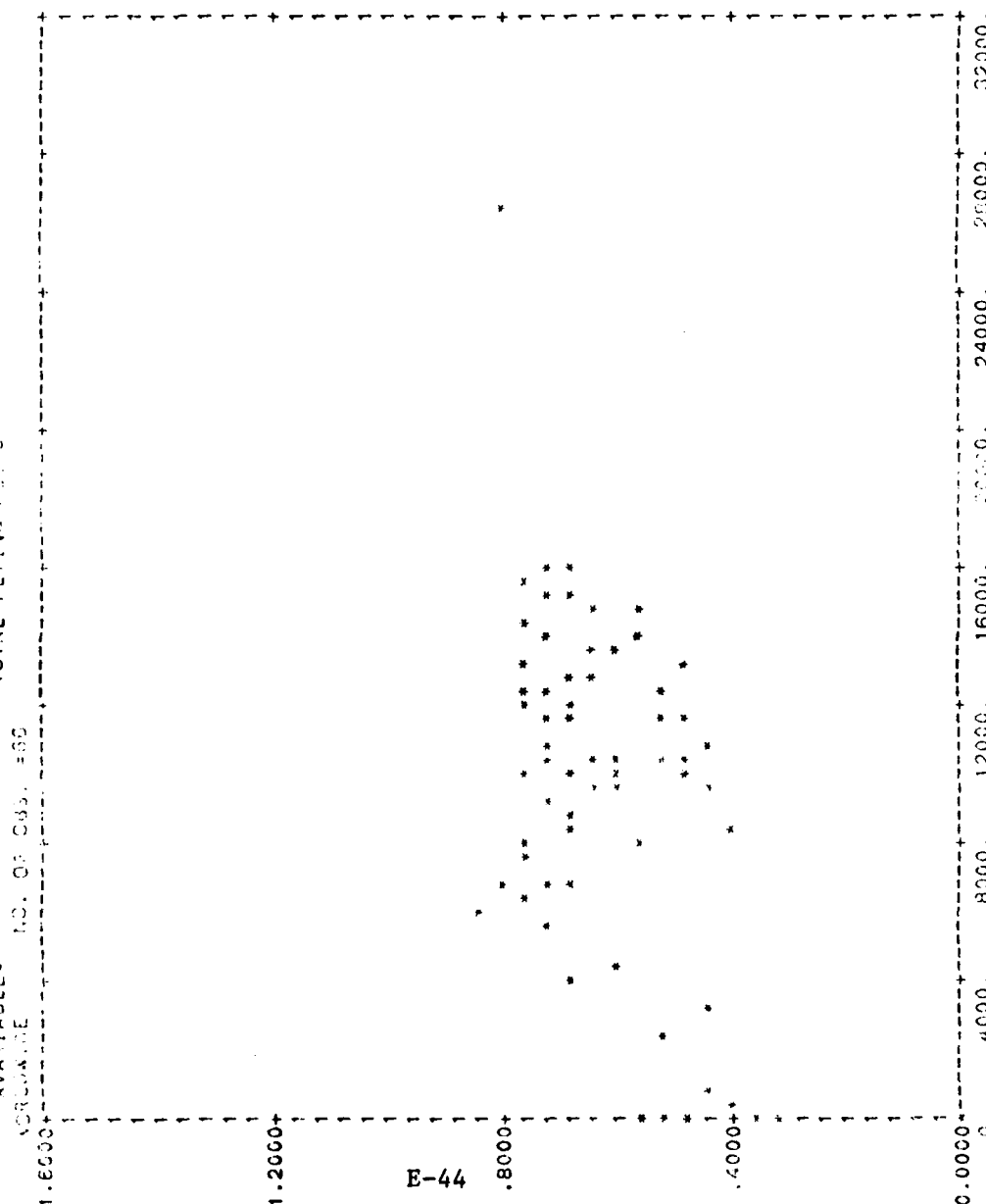
SYSTEM=AH-1
 YVARIABLE=
 XVARIABLE=
 VIETNAM NO. OF OBS. =23

AVERAGE RELIABILITY
 TOTAL FLYING HOURS



0. 2000. 4000. 6000. 8000. 10000. 12000. 14000. 16000.
 A.D.J.A. TABLE
 REGRESSION DF= 1. SS= 9.149862760964 MS 9.149862760964
 RESIDUAL DF= 22. SS= 3.200195239036 V = 1.456634195562
 TOTAL DF= 23. SS= 12.350058
 F-TEST= 62.63143372471
 R**2= 73.0875046584
 B(1) EST= .000011053834919

SYSTEM=0117
 VARIABLE= AVERAGE RELIABILITY
 VARIABLE= TOTAL FLYING HOURS
 CORRELATION= .00000000



E-44

ANOVA TABLE
 REGRESSION DF= 1. SS= 24.25010472067 MS= 24.25010472067
 RESIDUAL DF= 65. SS= 3.41746279325 MS= .05258071198962
 TOTAL DF= 66. SS= 27.667851
 F-TEST= 461.1977244709
 R**2= 87.64722898311 S= .2293048451072 CORR EST= .3665464355012
 B(1) EST= .0000537734599572

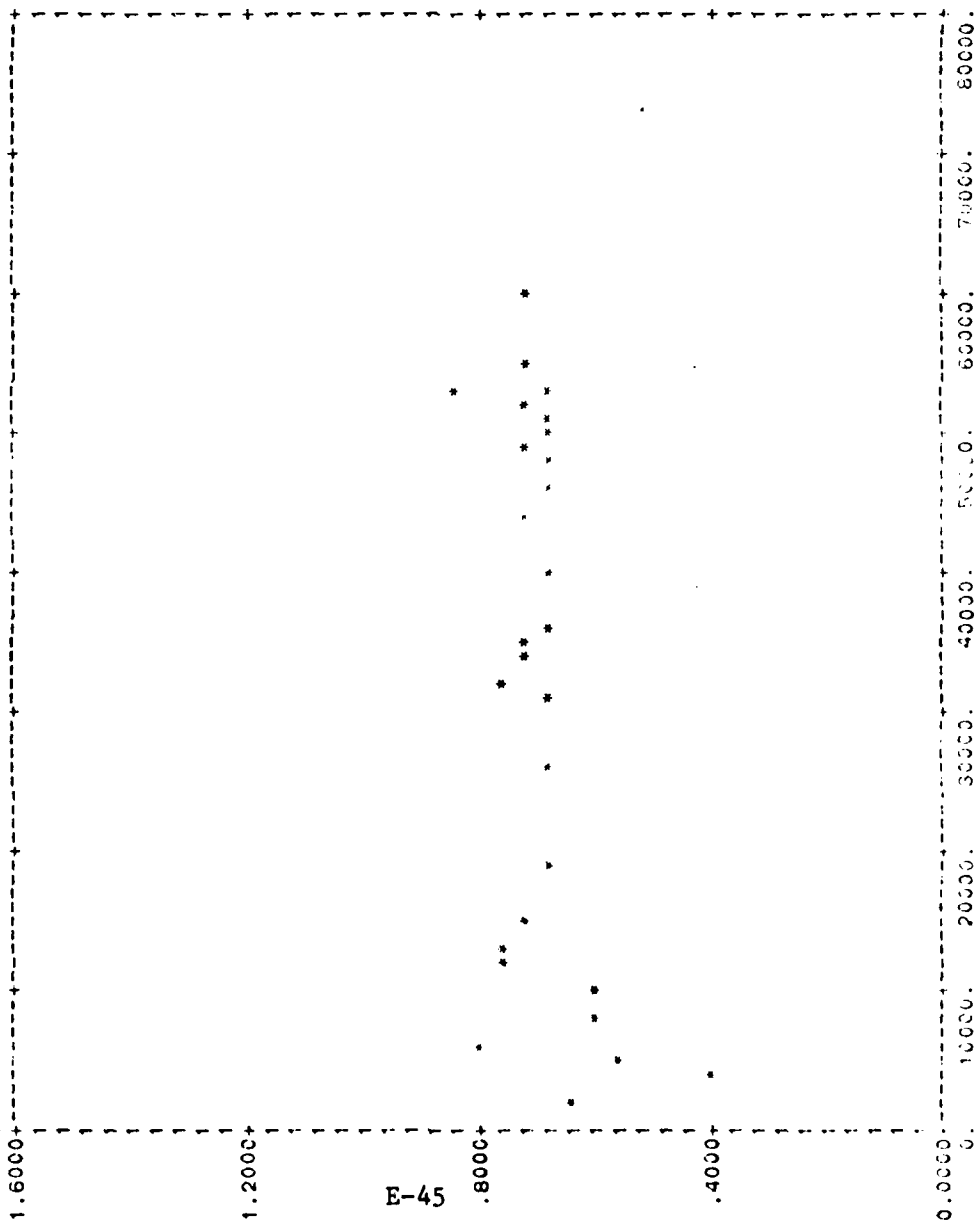
SYSTEM=CH47

YVARIABLE=

XVARIABLE=

VIETNAM NO. OF OBS. =28

AVERAGE RELIABILITY
TOTAL FLYING HOURS



ANOVA TABLE

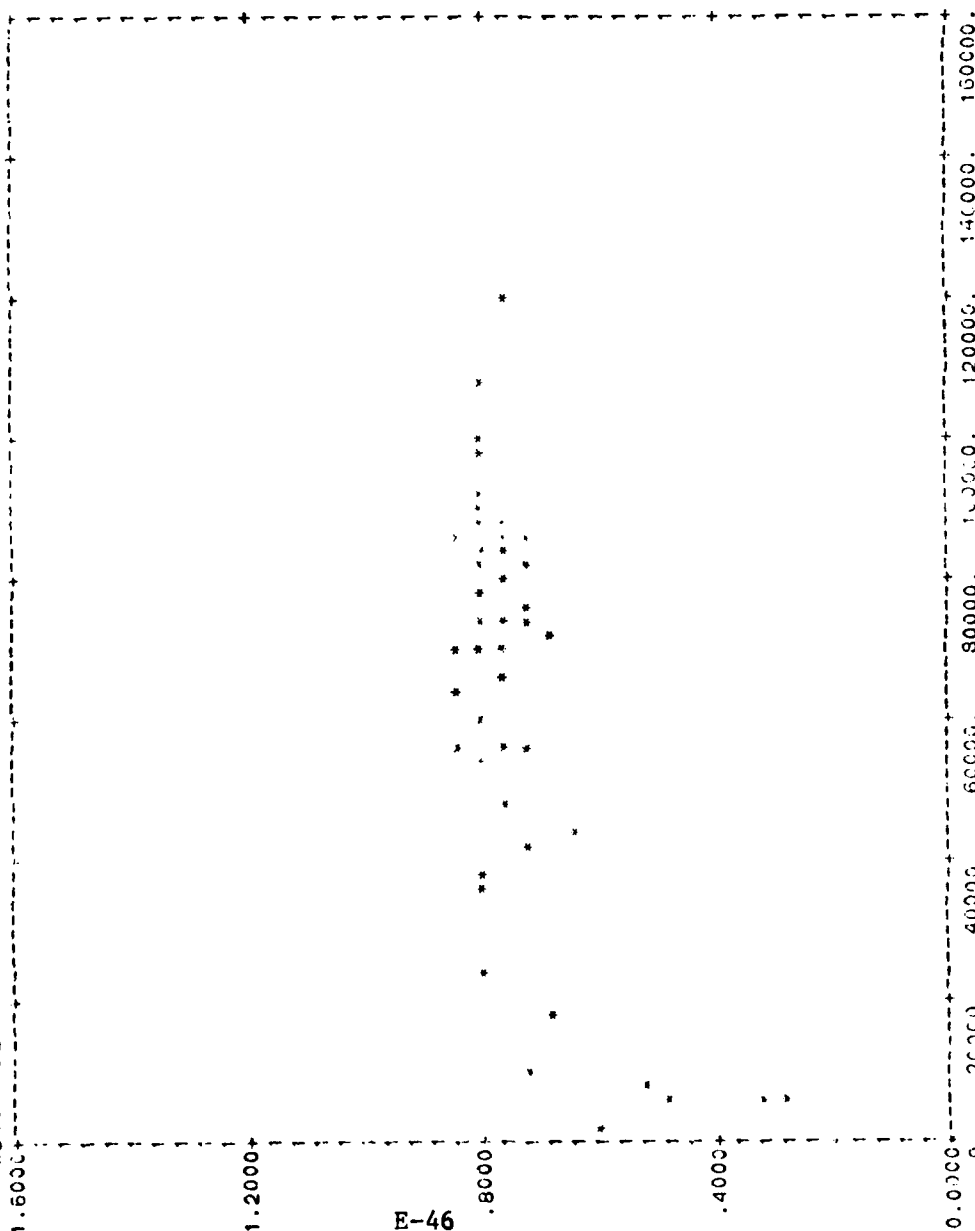
SOURCE	SS	DF	MS
REGRESSION	0.35107266403	1	0.35107266403
RESIDUAL	3.024053597	26	0.11631013835
TOTAL	3.375126261	27	

F-TEST = 3.024053597 / 0.11631013835 = 26.03

R-SQ = 0.1042

B(1) EST = 0.35107266403

SYSTEM 501
 INDEPENDENT VARIABLE= AVERAGE YIELD PER
 HECTARE
 DEPENDENT VARIABLE= TOTAL FLYING HOURS
 NO. OF OBS. = 48



E-46

ANOVA TABLE

Source	DF	SS	MS
REGRESSION	1	22.63335909156	22.63335909156
RESIDUAL	47	3.177978908437	.06761657251993
TOTAL	48	25.811338	

F-TEST = 337.66379788
 R-SQ = 87.7823520437
 B(1) EST = .0000101261121894
 CORR EST = .691431925088

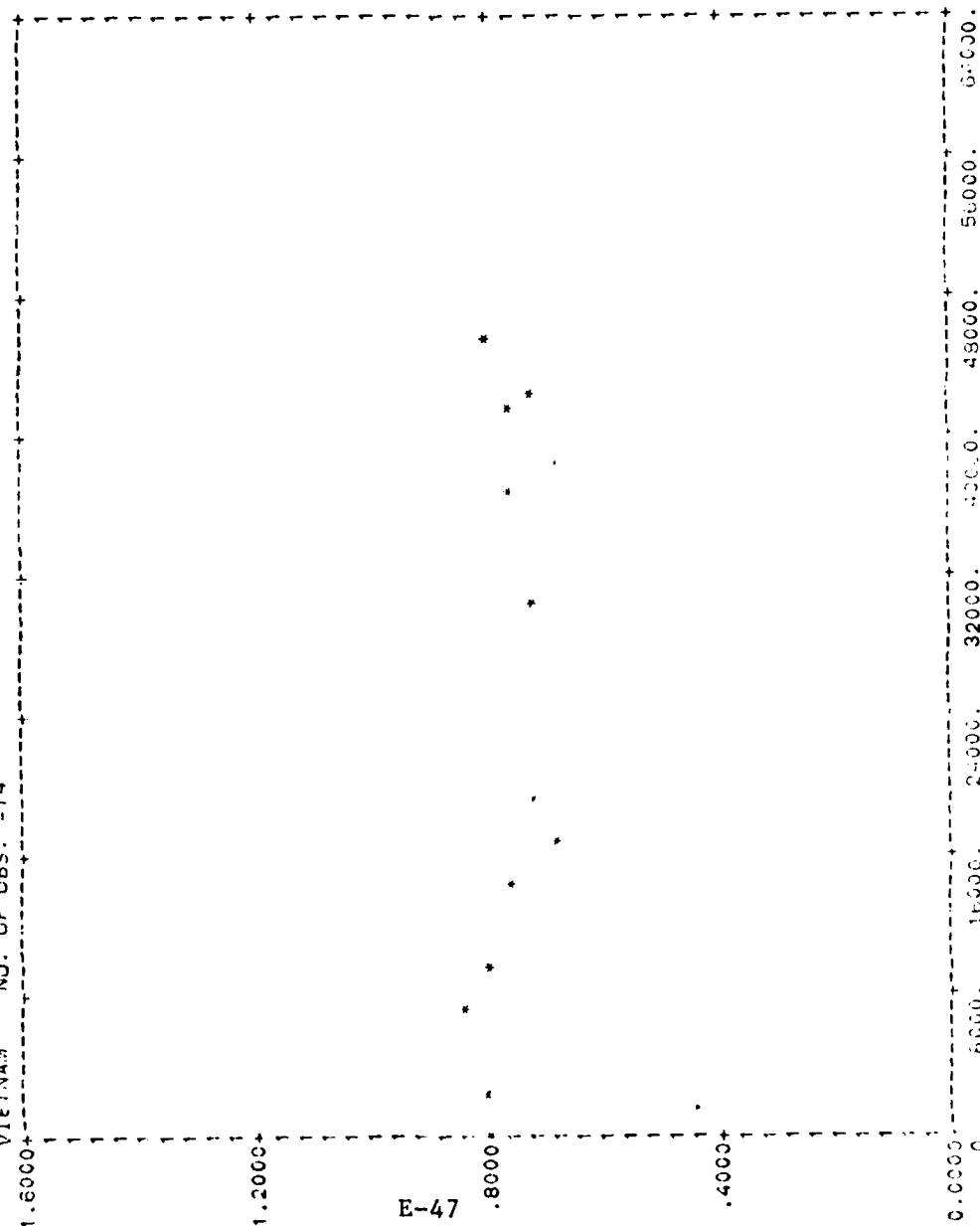
SYSTEM=OH58

YVARIABLE=

XVARIABLE=

VIETNAM NO. OF OBS. =14

AVERAGE RELIABILITY
TOTAL FLYING HOURS



E-47

0.000+ 0.400+ 0.800+ 1.200+ 1.600+

0. 8000. 16000. 24000. 32000. 40000. 48000. 56000. 64000.

AVOYA TABLE

REGRESSION OF = 1.581 5578402 VS = 0.087625578402

RESIDUAL OF = 1.03451421530 VS = 0.20245433399

TOTAL OF = 7161277

F-TEST = 24.61013704201

R-SQ = 0.14 50.17007

9(1) EST = 0.0002 0.1100 0.122

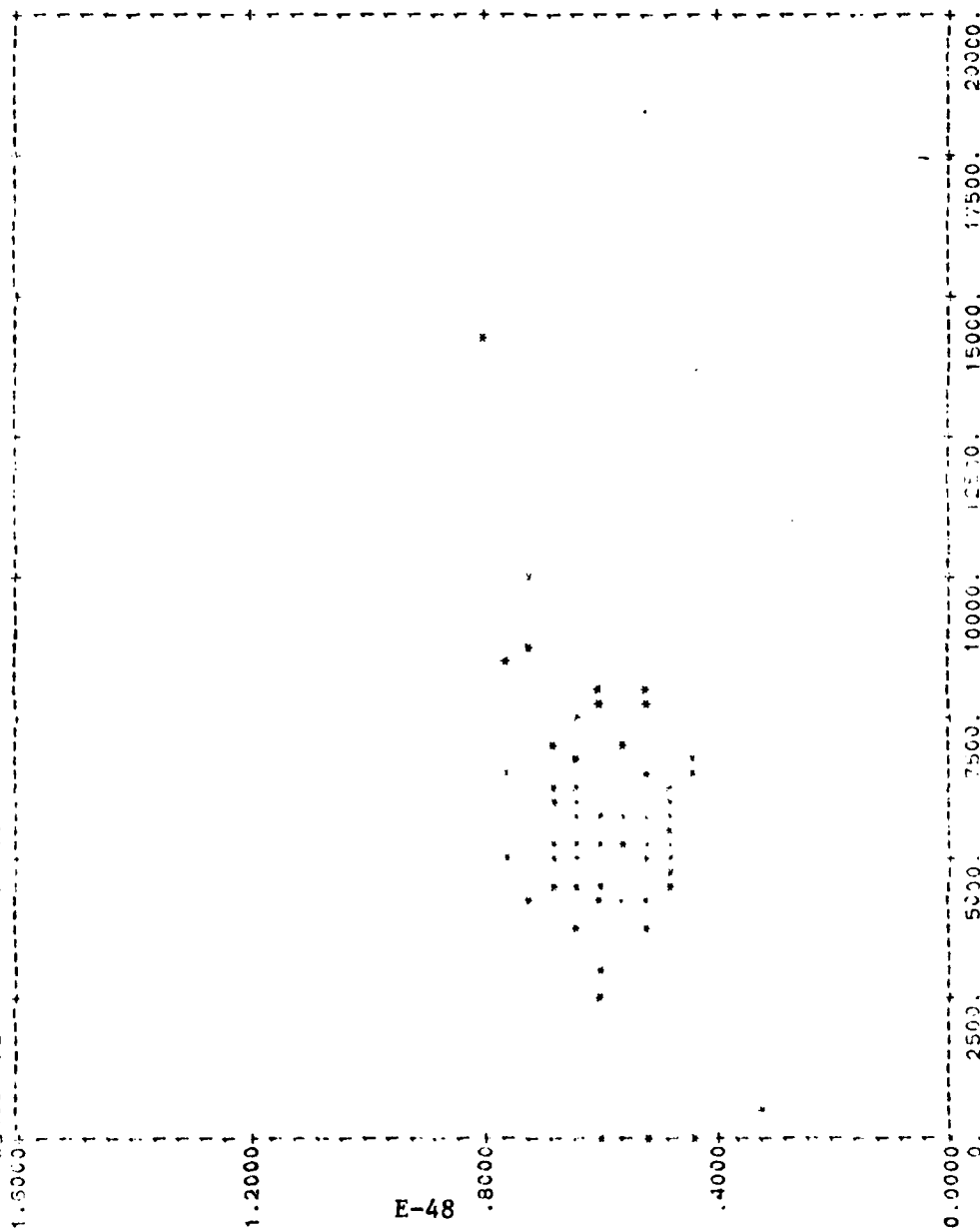
132925442170F

SYSTEM-001

INDEPENDENT
VARIABLE=

ADJ. R. SQUARED=

AVERAGE VALUE
TOTAL FLYING HOURS

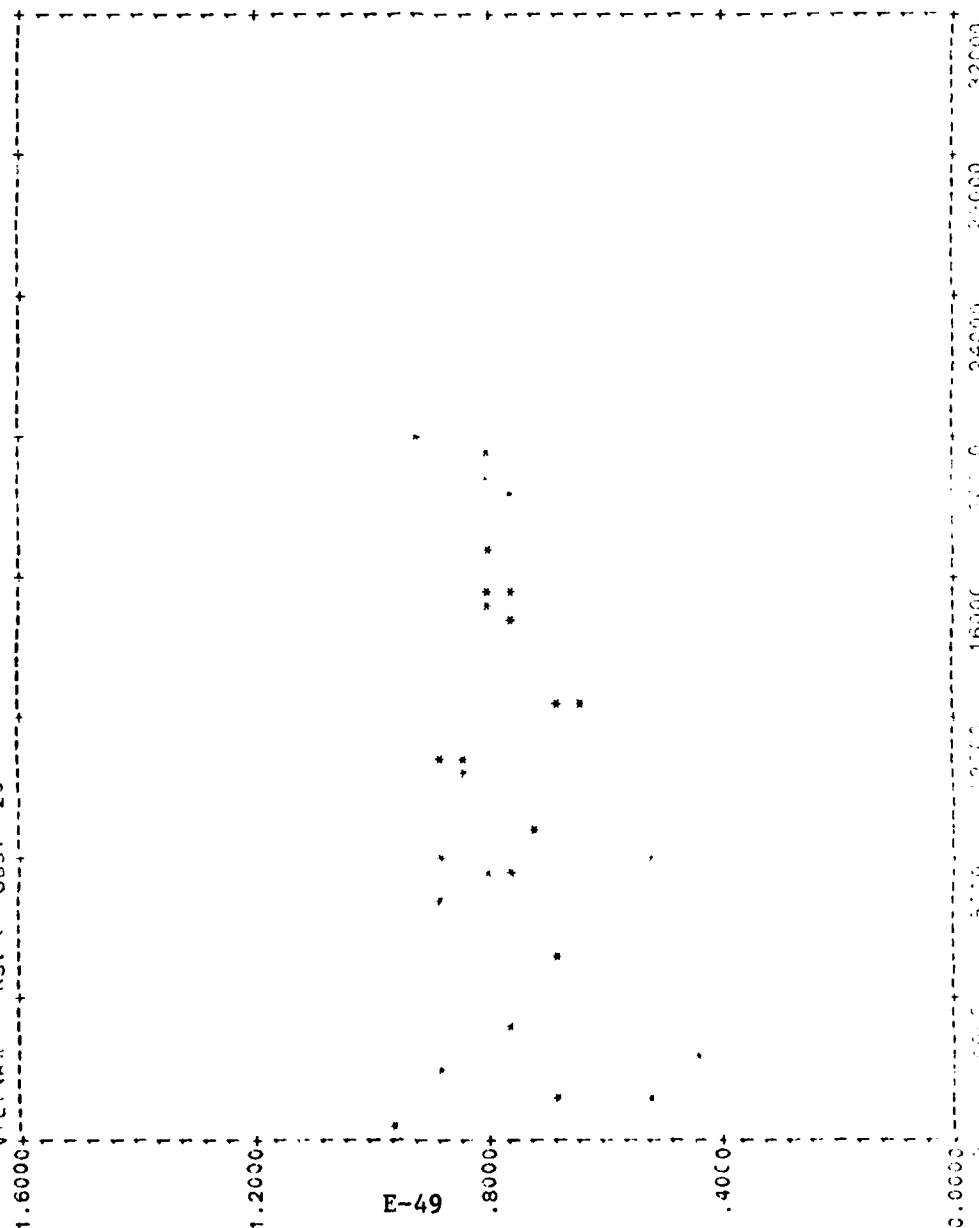


ANOVA TABLE

REGRESSION	DF	SS	MS
RESIDUAL	DF	SS	MS
TOTAL	DF	SS	MS
F-TEST=	729.170145003		
R**2=	91.9311216063		
B(1) EST=	.00039431019453029		

ADJ. R. SQUARED= .3830365504250

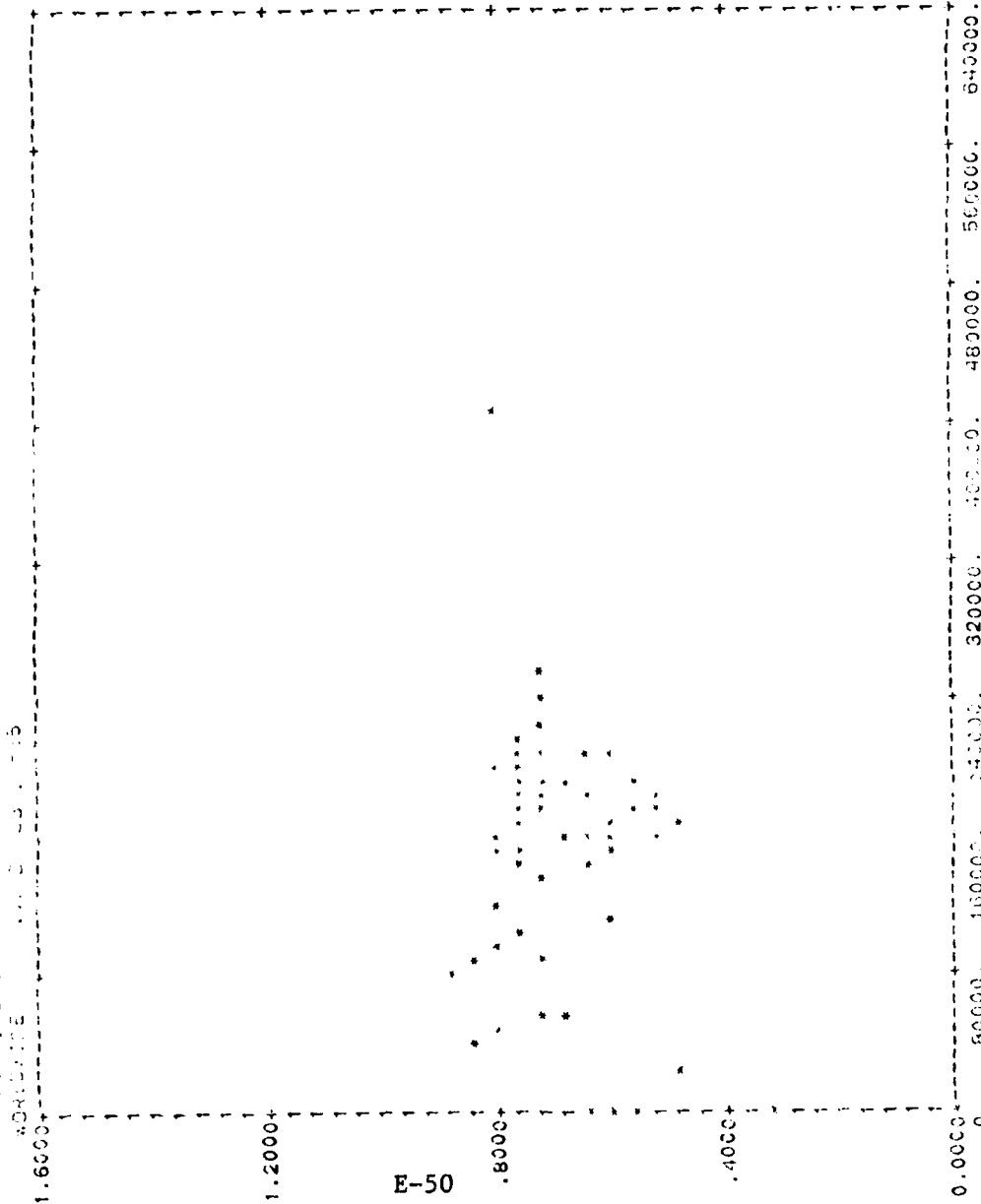
SYSTEM=OV-1
 VARIABLE=
 AVA. TABLE=
 VIETNAM NO. OF OBS. =29
 AVERAGE RELIABILITY
 TOTAL FLYING HOURS



REGRESSION
 RESIDUAL
 TOTAL
 F-TEST
 R-SQ
 B(1) EST

Variable	Sum of Squares	D.F.	Mean Square	F-Value	P-Value
REGRESSION	10.2603116	1	10.2603116	16.324	0.0001
RESIDUAL	4.0013003	27	0.1481963		
TOTAL	14.2616119	28			
F-TEST	10.2603116	1	10.2603116	16.324	0.0001
R-SQ	0.7161				
B(1) EST	0.0000000				

SYSTEM VARIABLE
AVERAGE RESIDUAL
TOTAL FLYING HOURS

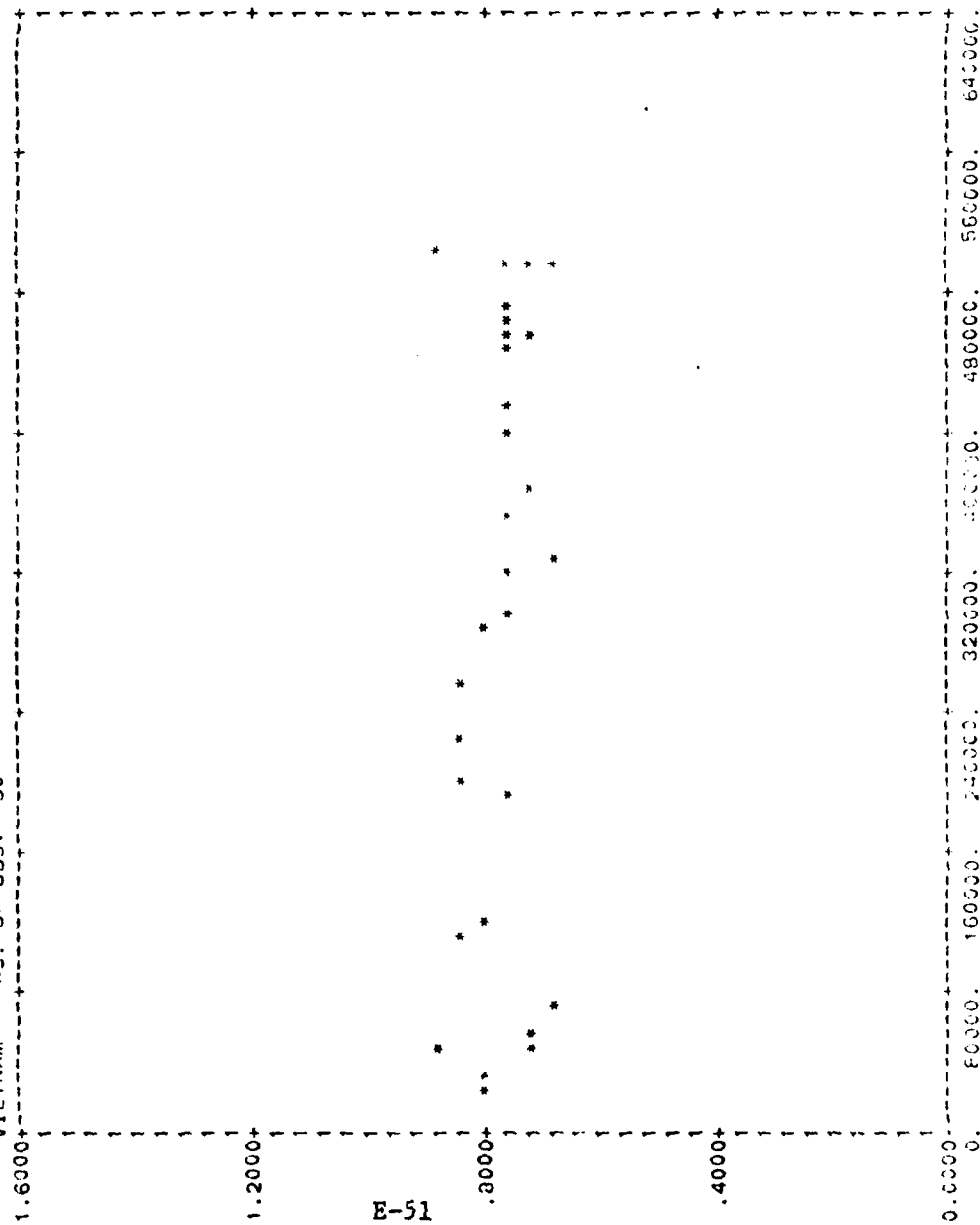


E-50

ANCOVA TABLE
REGRESSION DF= 1. SS= 29.47343043339 MS= 29.47343043339
RESIDUAL DF= 64. SS= 4.18569351661 MS= .0654014619703
TOTAL DF= 65. SS= 32.659124
F-TEST= 435.450278033
R**2= 87.12565507341 S= .2537370933012 CORR EST= .001933390722054
B(1) EST= .0000003740049340912

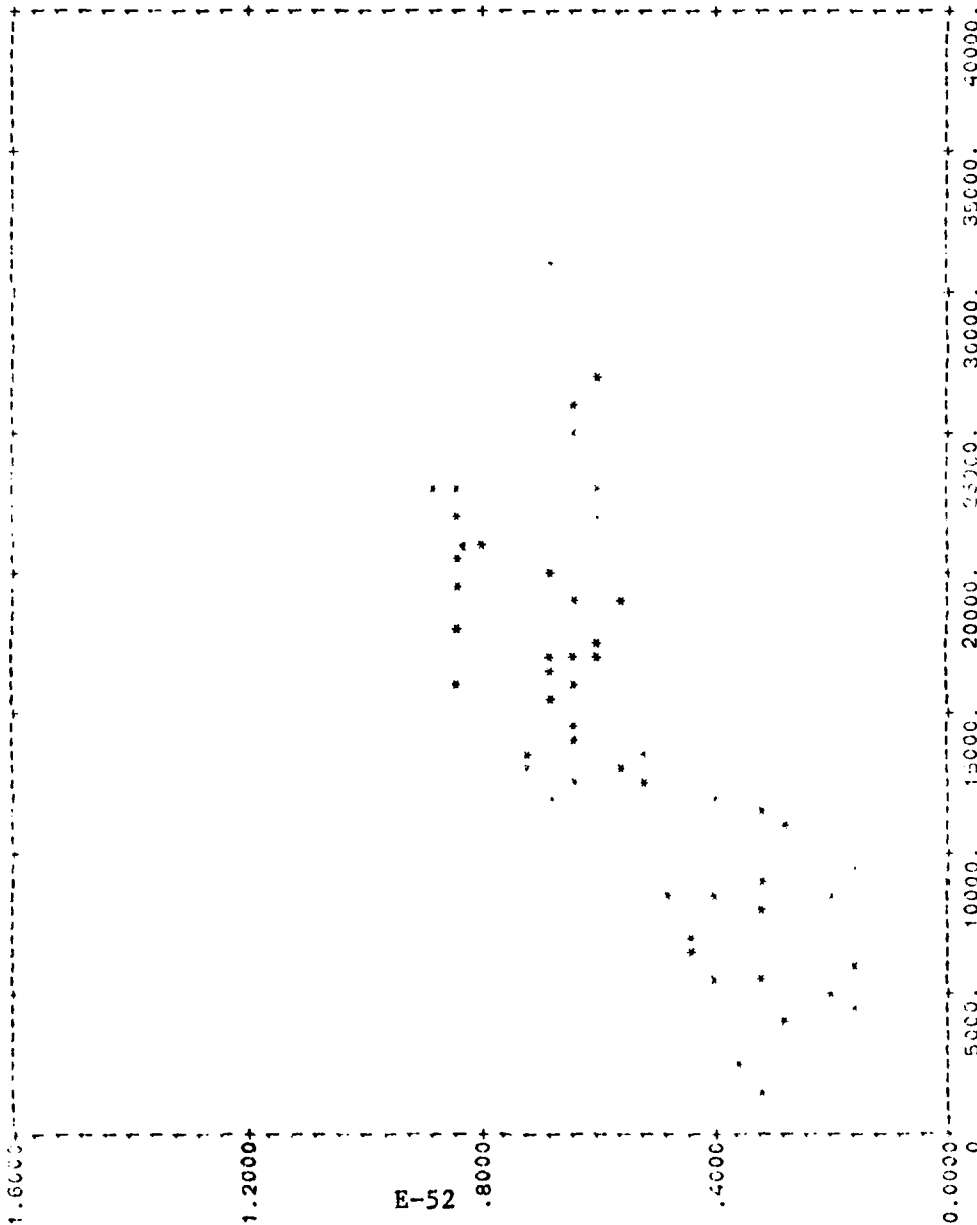
SYSTEM=UH-1
YVARIABLE=
XVARIABLE=
VIETNAM NO. OF OBS. =30

AVERAGE RELIABILITY
TOTAL FLYING HOURS



E-51

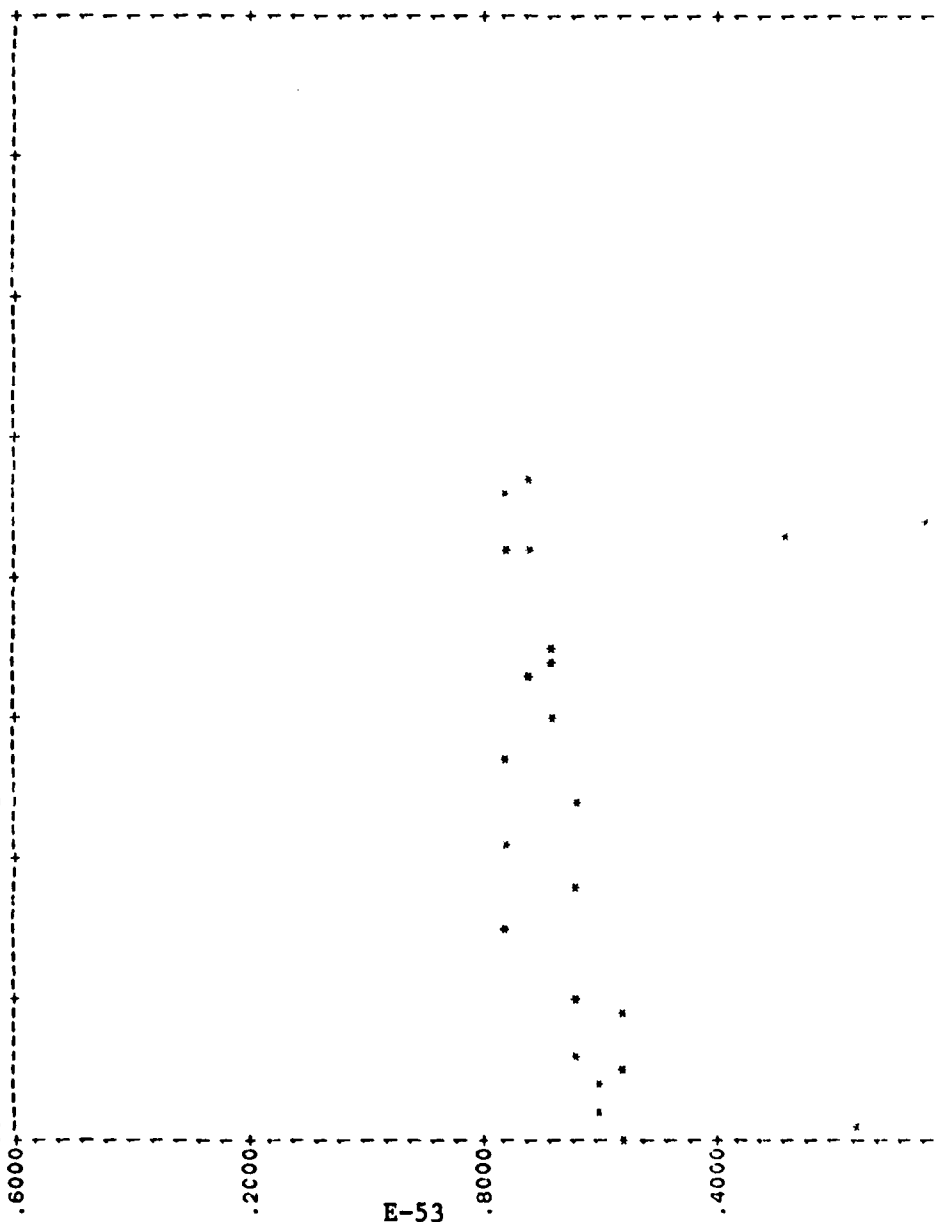
ANOVA TABLE
REGRESSION DF= 1. SS= 13.18035892886 MS= 13.18035892886
RESIDUAL DF= 29. SS= 4.52337207141 MS= .155978350586935
TOTAL DF= 30. SS= 17.7042931
F-TEST= 84.8000000000000
R-SQ= .427777777777778
S.E. EST= .000000000000000



ANOVA TABLE			
REGRESSION	DF= 1.	SS= 16.81737736367	MS= 16.81737736367
RESIDUAL	DF= 53.	SS= 1.439458636328	MS= .0271559691193
TOTAL	DF= 54.	SS= 18.256836	
F-TEST=	619.205705381		
R**2=	92.11560275339		
B(1) EST=	.000035380072387		
			COR? EST= .7554270063635

SYSTEM=AH-1
 YVARIABLE=
 XVARIABLE=
 VIETNAM NO. OF OBS. =23

1.6000+
 1.2000+
 .8000+
 .4000+
 0.0000



0.0000	0.	20000.	40000.	60000.	80000.	100000.	120000.	140000.	160000.
ANOVA TABLE									
REGRESSION	DF=	1.	SS=	5.841959544619	MS=	5.841959544619			
RESIDUAL	DF=	22.	SS=	3.347582455381	MS=	.152162838803			
TOTAL	DF=	23.	SS=	9.189552					
F-TEST=	26.2920736467								
R**2=	63.671834539								
B(1) EST=	.000006573724240166								

E-53

SYSTEM=CRAT

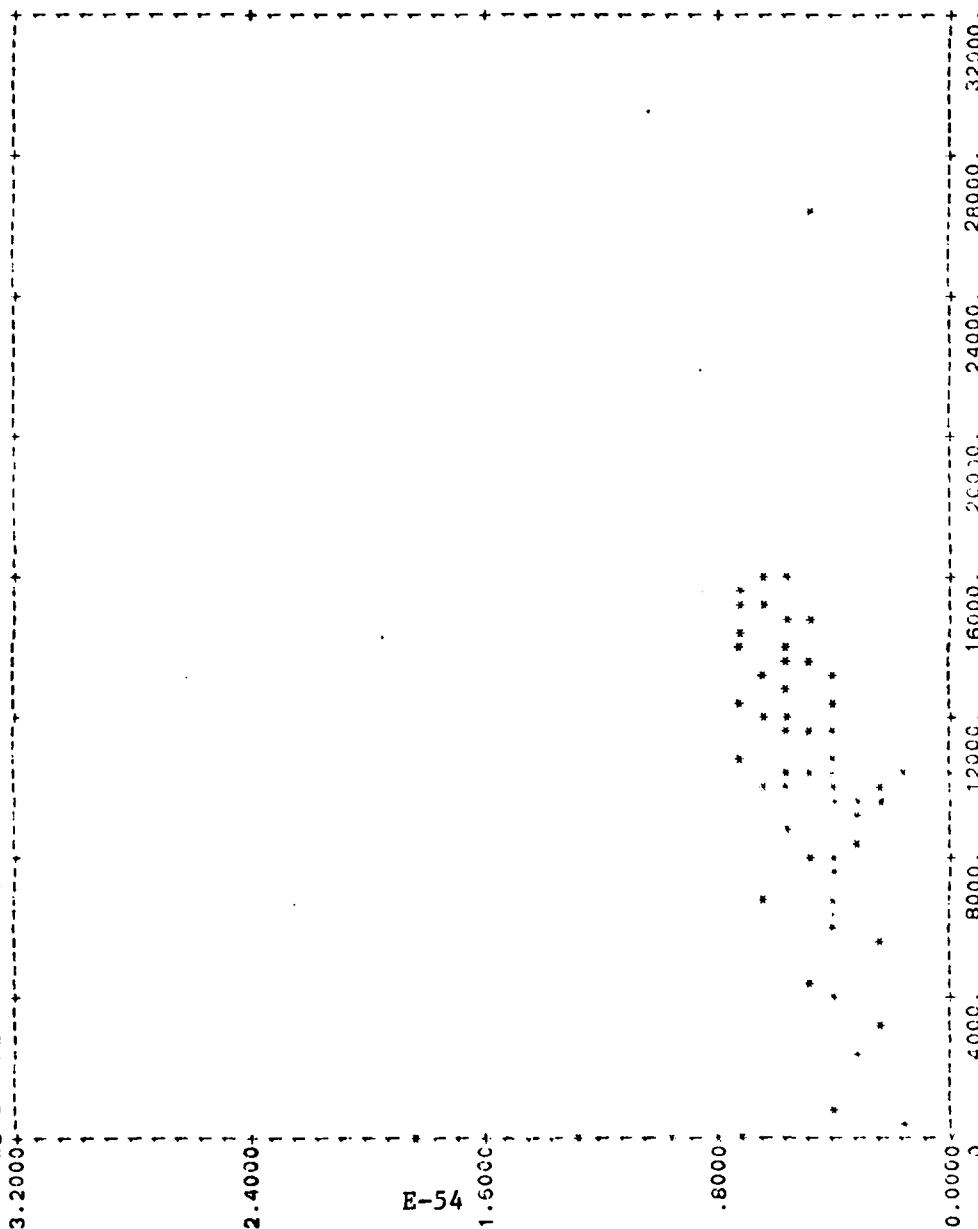
YVARIABLE=

XVARIABLE=

WORLDWIDE

AVERAGE AVERAGE CITY
TOTAL FLYING OF CR

NO. OF OBS. = 65



ANOVA TABLE

REGRESSION	DF=	1.	SS=	15.18615290735	MS=	15.18615290735
RESIDUAL	DF=	64.	SS=	2.211345092647	MS=	.03455226707261
TOTAL	DF=	65.	SS=	17.397498		
F-TEST=		439.5124291843				
R*2=		87.2822024511	S=	.1855824011912	CORR EST=	.4412046615905
B(1) EST=		.00004251204165923				

HD-A134 745

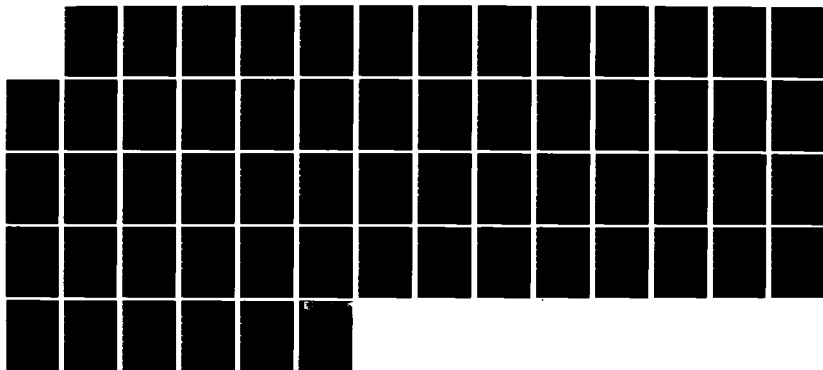
SORTIE DURATION AND HELICOPTER COMPONENT FAILURES (AN
EMPIRICAL STUDY)(U) ARMY INVENTORY RESEARCH OFFICE
PHILADELPHIA PA E GOWALS MAY 83 USAIRO-TR-83/3

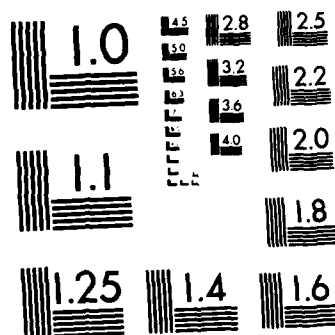
3/3

UNCLASSIFIED

F/G 1/3

NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

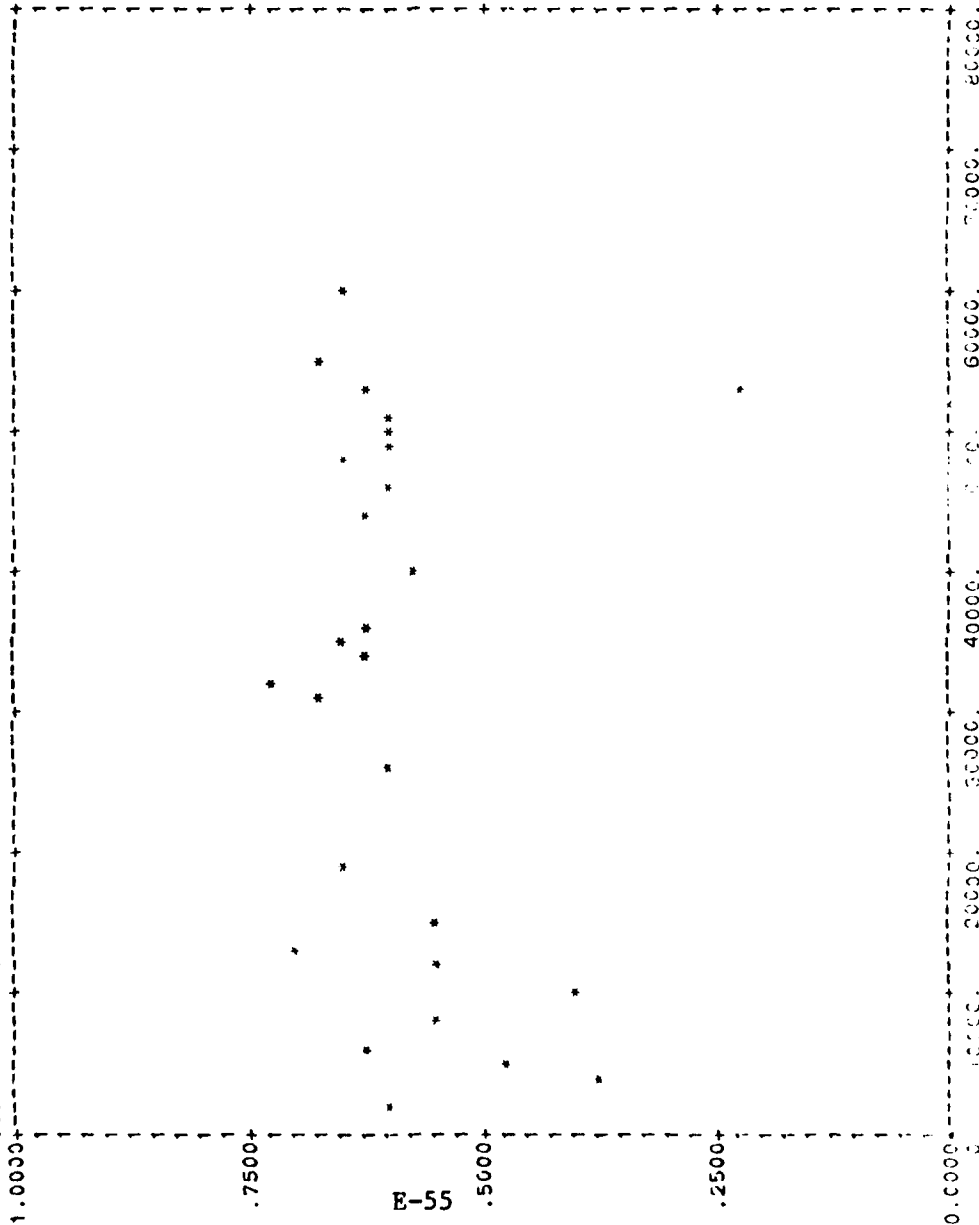
SYSTEM=CH47

YVARIABLE=

XVARIABLE=

VIETNAM NO. OF OBS. =28

AVERAGE AVAILABILITY
TOTAL FLYING HOURS



	0.0000	10000	20000	30000	40000	50000	60000	70000	80000
ATCVA TABLE									
RECEIVED	0	1	55	510015	5619349	MS	561855	519349	
RECEIVED	0	2	55	210000	96738065	VS	56000	1022463	
TOTAL	0	28	55	9.557323					
F-105	0	1	55	5624165					
R-2	0	1	55	5624165					
R(1) EST	0	1	55	5624165					

1
 2
 3
 4
 5

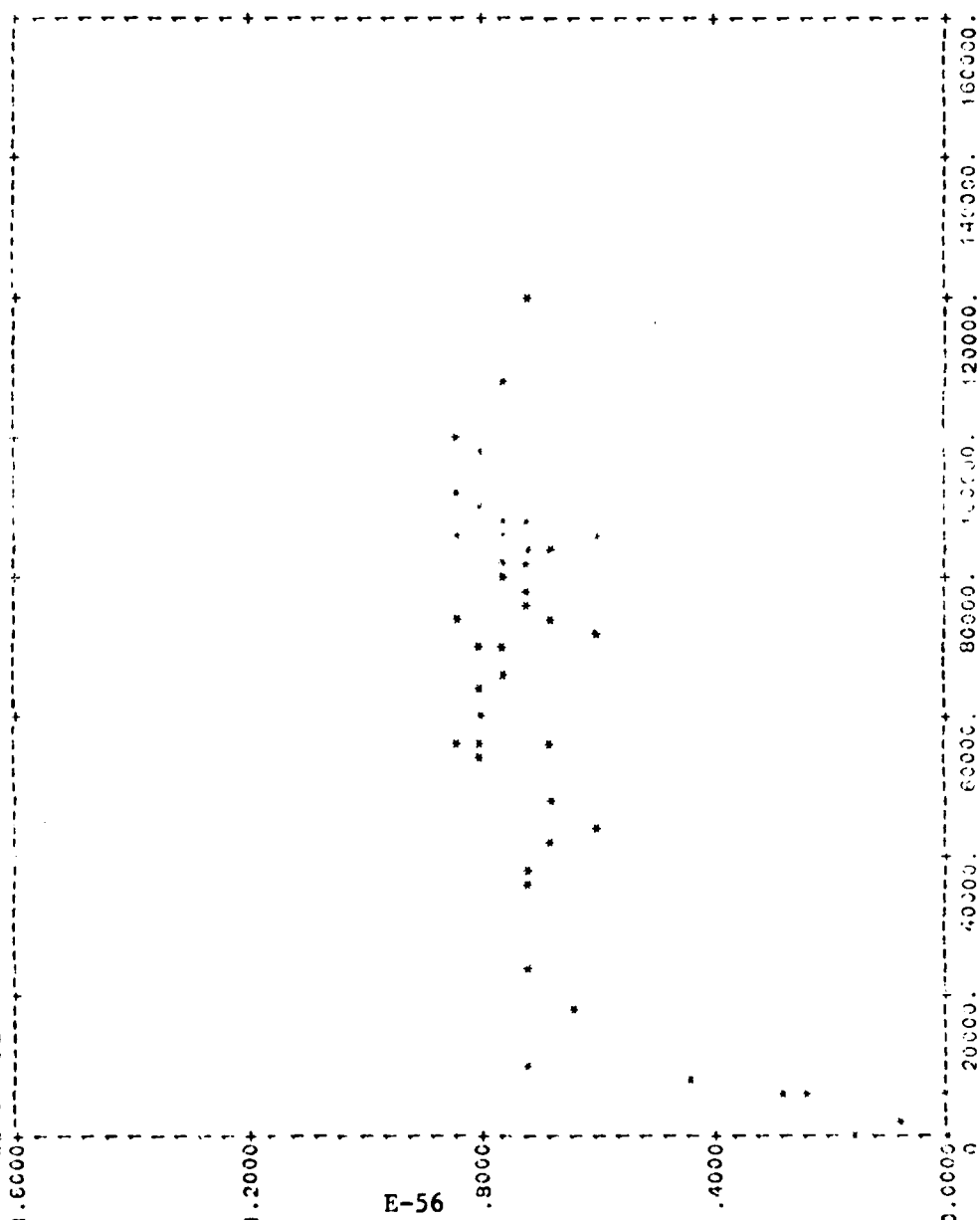
XVARIABLE=

[illegible]

AVERAGE AVAILABLE
TOTAL FLYING HOURS

三三三

一、
 二、
 三、
 四、
 五、
 六、
 七、
 八、
 九、
 十、



	0	20000.	40000.	60000.	80000.	100000.	120000.	140000.	160000.
ANOVA TABLE									
REGRESSION		1.	SS=	21.18451062147	MS=	21.18451062147			
RESIDUAL		46.	SS=	2.41542337853	MS=	.05250920388108			
TOTAL		47.	SS=	23.60000000000					
F-TEST=	403	444	727715						
R ² =	39.7652566558	S=	.2291436883827	CORR	LOF=	.6915324177336			
B(1) EST=	.0000097546	98093657							

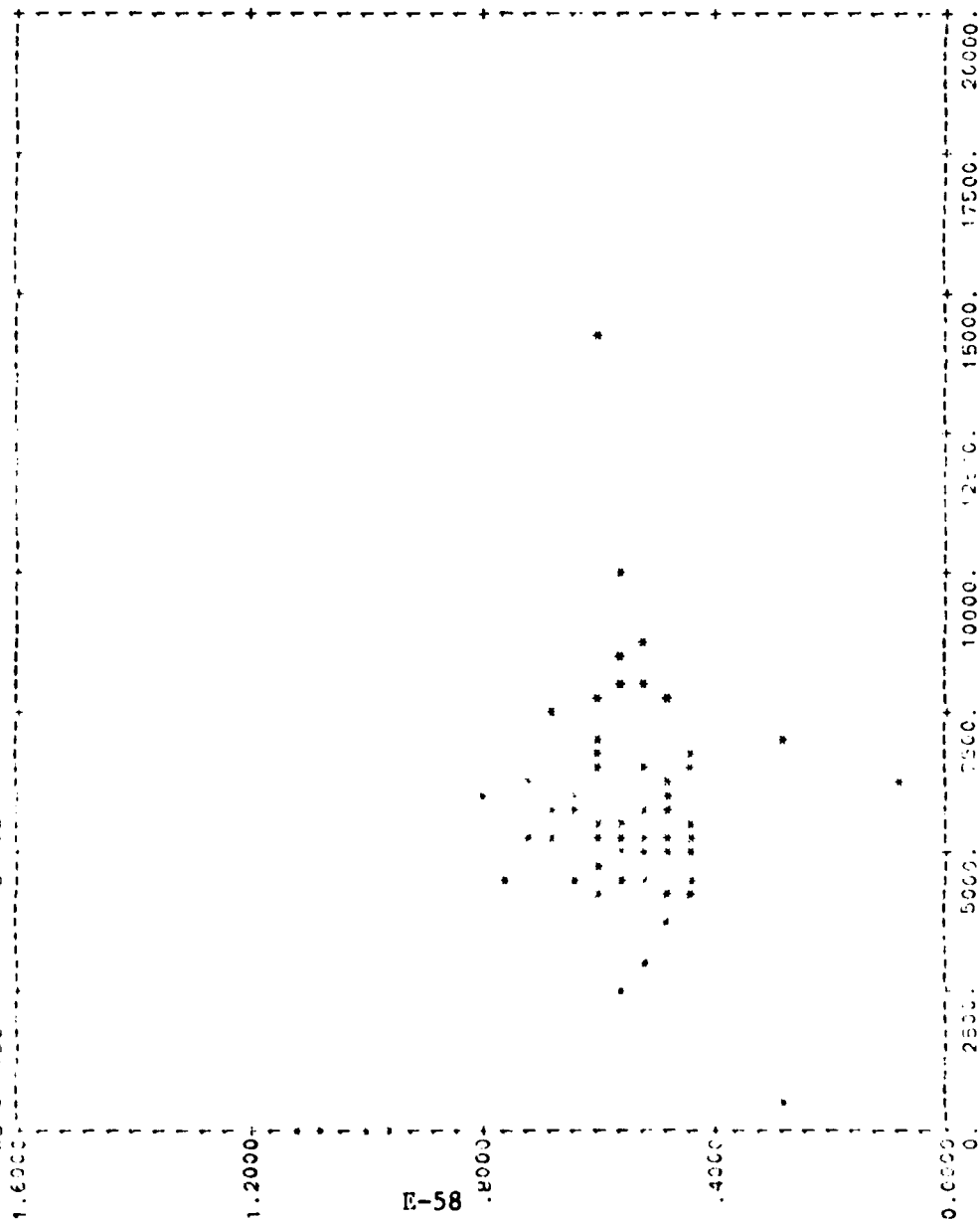
SYSTEM 10-1

AVAILABLE
VARIABLES

AVERAGE A.V.A. TOTAL PLIN. 10000

CS

10000



E-58

ANOVA TABLE				2500.	5000.	7500.	10000.	12500.	15000.	17500.	20000.
REGRESSION	DF=	1.	SS=	17.42079909556	MS=	17.42079909556					
RESIDUAL	DF=	64.	SS=	2.309326904142	MS=	.0360832328219					
TOTAL	DF=	65.	SS=	19.730126							
F-TEST=				482.7942524617							
R**2=				.9049542749768	SE	.1939558708803	COV	EST=	.13579983	.1603	
B(1) EST=				.0000859111157547							

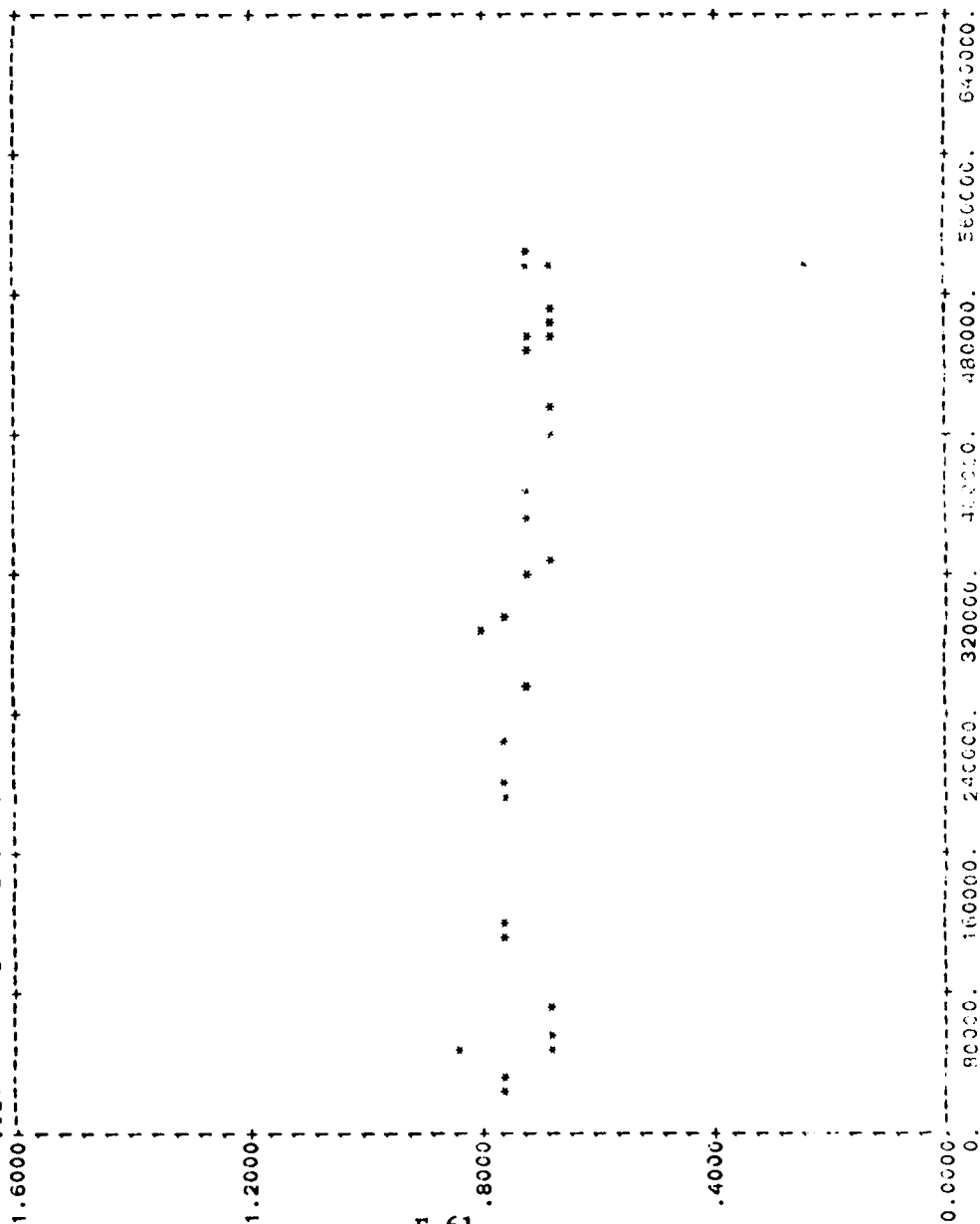
VIETNAM NO. OF OBS. = 29

A scatter plot showing the relationship between E-58 (X-axis) and E-59 (Y-axis). The plot contains 1000 data points, represented by asterisks (*). The X-axis (E-58) ranges from 0 to 32000, and the Y-axis (E-59) ranges from 0 to 16000. The data points are distributed across the plot, showing a general positive correlation, with a higher density of points in the lower-left region (E-58 < 16000, E-59 < 8000).

[illegible]

[illegible]

SYSTEM=UH-1
 YVARIABLE=
 XVARIABLE=
 VIETNAM NO. OF OBS. =30
 AVERAGE AVAILABILITY
 TOTAL FLYING HOURS



E-61

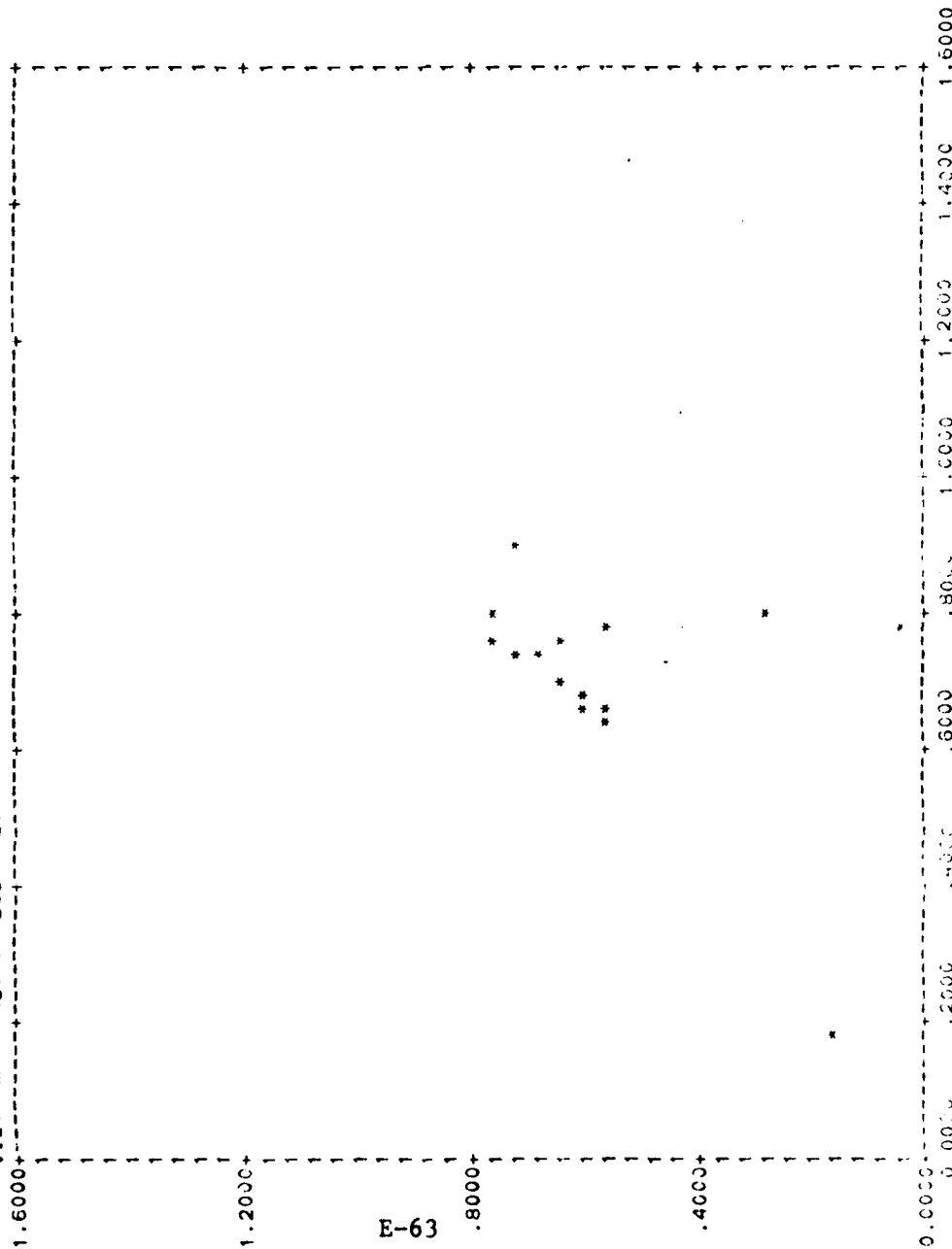
0.0000. 80000. 160000. 240000. 320000. 400000. 480000. 560000. 640000.
 ANOVA TABLE
 REGRESSION DF= 1. SS= 9.438405438304 MS= 9.438405438304
 RESIDUAL DF= 28. SS= 57.01020661046 MS= 2.036078124319
 TOTAL DF= 29. SS= 66.44861204876
 F-TEST= 46.3520450797
 R+2= 0.9201147125
 B(1) EST= .0000015406989321192

AVERAGE AVAILABILITY
AVERAGE RELIABILITY

A scatter plot showing the relationship between E-62 (Y-axis) and an unlabeled X-axis. The Y-axis ranges from 0.0000 to 1.6000 with major ticks every 0.2000. The X-axis ranges from 0.0000 to 1.0000 with major ticks every 0.1250. The data points are concentrated in two main regions: a large cluster between X=1.2500 and X=1.5000, and a smaller cluster between X=1.7500 and X=1.8750. The points in the first cluster show a general upward trend, while the points in the second cluster are more scattered.

ANOVA TABLE					
REGRESSION	DF=	1.	SS=	17.76221859054	MS=
RESIDUAL	DF=	53.	SS=	.4946174094563	MS=
TOTAL	DF=	54.	SS=	18.256836	
F-TEST=		1003.28427151			
R-SQ=		97.20078242551			
(1) EST=		.930649348457			

SYSTEM-AH-1
 YVARIABLE=
 XVARIABLE=
 VIETNAM NO. OF OBS. =23
 AVERAGE AVAILABILITY
 AVERAGE RELIABILITY

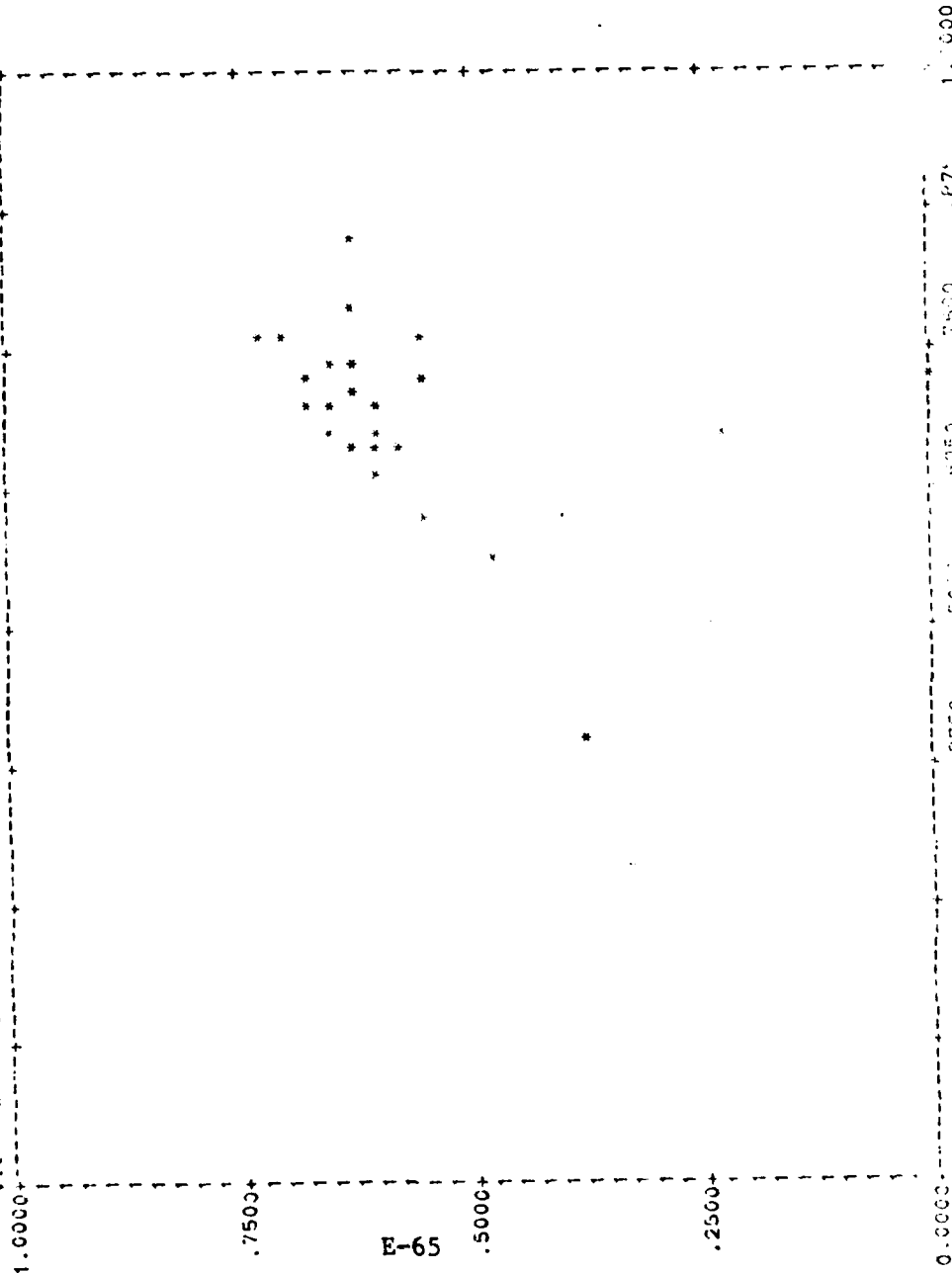


E-63

0.0000 0.2000 0.4000 0.6000 0.8000 1.0000 1.2000 1.4000 1.6000
 RESREG= 1. SEE 3.5400041178744 MS 1.5400041178744
 RESIDUAL OF= 21. SEE 3.5400041178744 MS 1.5400041178744
 TOTAL OF= 24. SEE 3.5400041178744 MS 1.5400041178744
 F-TEST= 24. SEE 3.5400041178744 MS 1.5400041178744
 S=2= 21. SEE 3.5400041178744 MS 1.5400041178744
 B(1) EST= 1631000000000

SYSTEM=CH47
YVARIABLE=
XVARIABLE=
VIETNAM

NC. OF OBS. = 28



0.0000	.1250	.2500	.3750	.5000	.6250	.7500	.8750	1.0000
ANOVA TABLE								
REGRESSION	DF=	1	SS=	9.932937386469	MS=	9.932937386469		
RESIDUAL	DF=	26	SS=	16.00050115308	MS=	.615399984618		
TOTAL	DF=	27	SS=	25.933438499549				
F-TEST=	MSR/MSR			16.132937386469	COV=			
R-SQ=				.382937386469				
B(1) 500				16.132937386469				

15

0.0000	.1250	.2500	.3750	.5000	.6250	.7500	.8750	1.0000
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ANOVA TABLE		SS	DF	MS
REGRESSION	DF= 1	23.26151008461	1	23.26151008461
RESIDUAL	DF= 46	3387289150935	46	73636720654.25
TOTAL	DF= 47	33.600234	47	7149000894.59574
F=155.1	3159.601816121			
R^2= .6955874332299				
B(1) EST=	1.0498566743105			
		1.0851120776519	1	1.0851120776519

SYSTEM=CH56

VARIABLE:

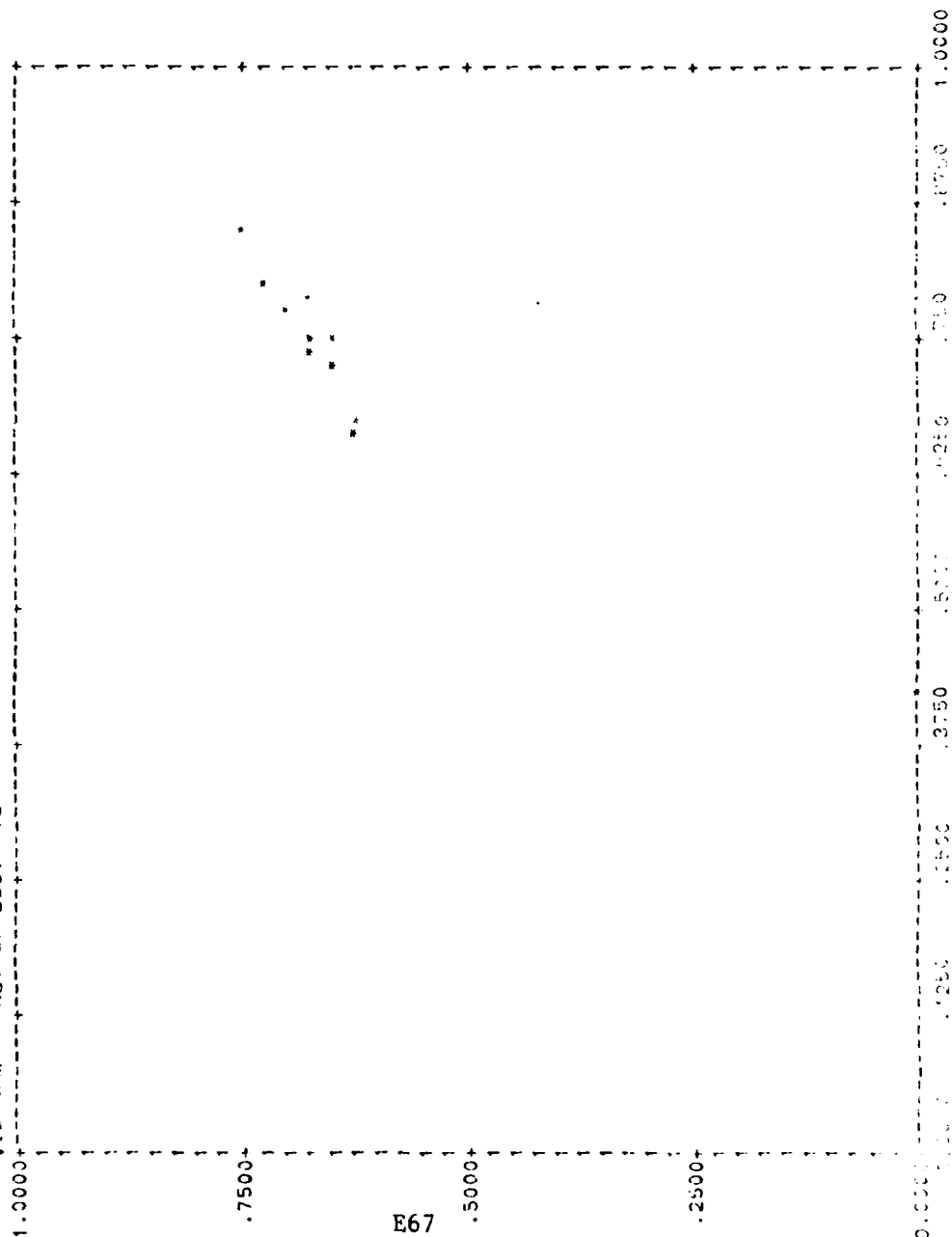
AVERAGE AVAILABILITY

AVAR:ABLE=

AVERAGE RELIABILITY

NO. OF OBS. = 12

WILLIAM

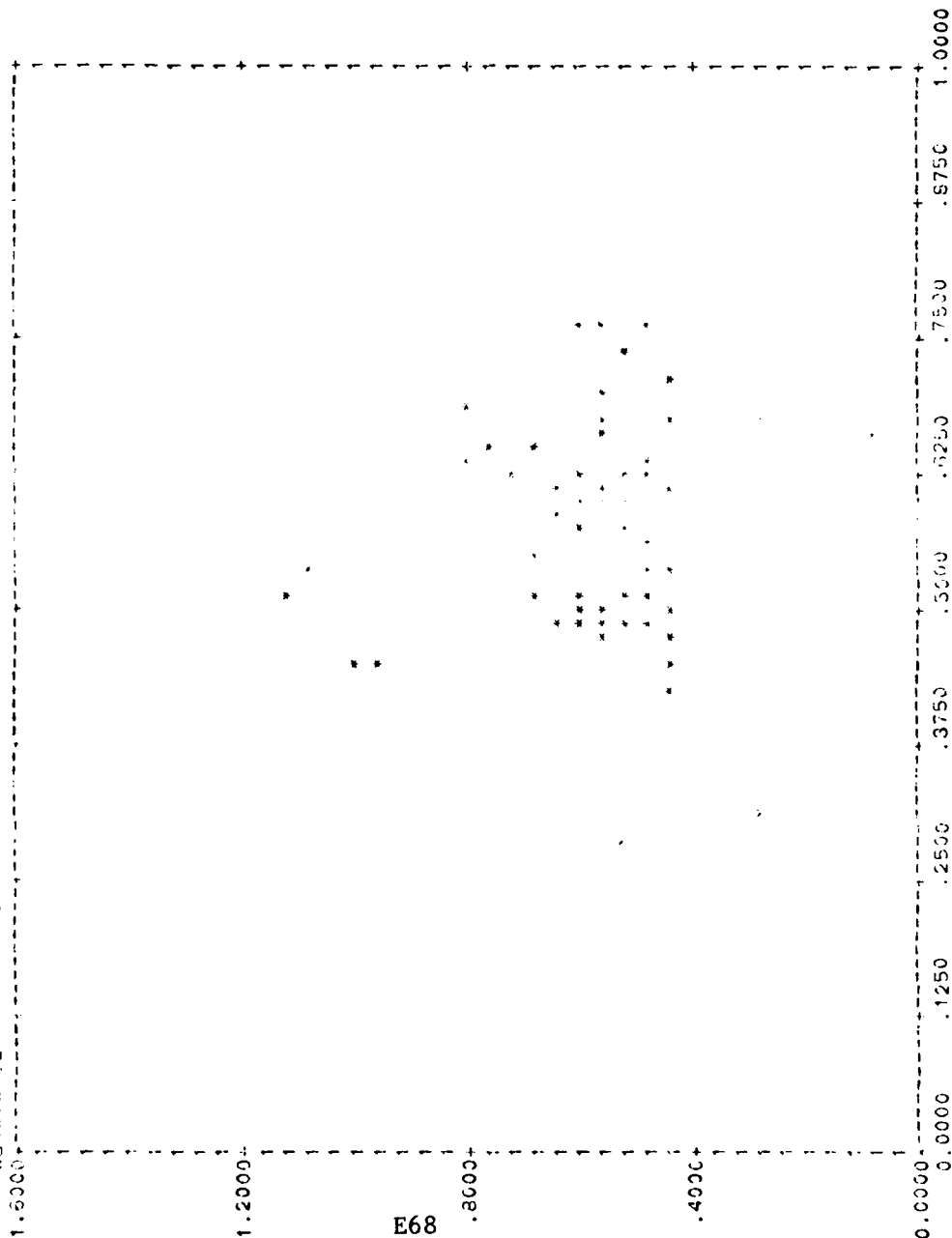
[illegible]

SYSTEM

EXPLANATION

NO. 3 CORR. 870

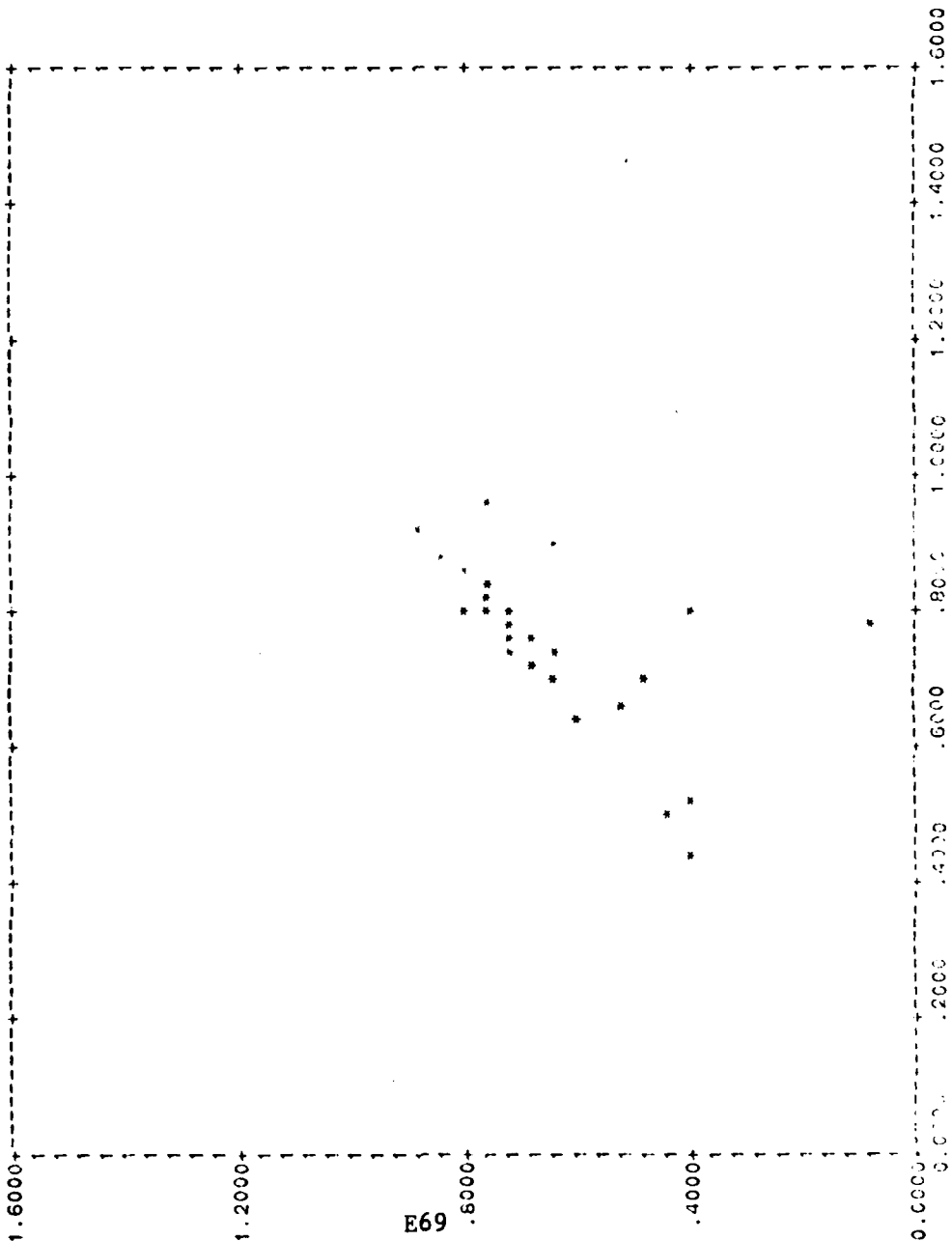
AVERAGE AVERAGE
AVERAGE RESIDUAL



ANOVA TABLE

REGR	DF	SS	MS	MS
REGR	1	22.5118049718	22.5118049718	22.5118049718
RESIDUAL	99	21.77867502823	21.77867502823	21.77867502823
TOTAL	100	44.2904800000	44.2904800000	44.2904800000
F-TEST	100	2540010757	2540010757	2540010757
R**2	100	18181184	18181184	18181184
9(1) EST	100	1704207934151	1704207934151	1704207934151

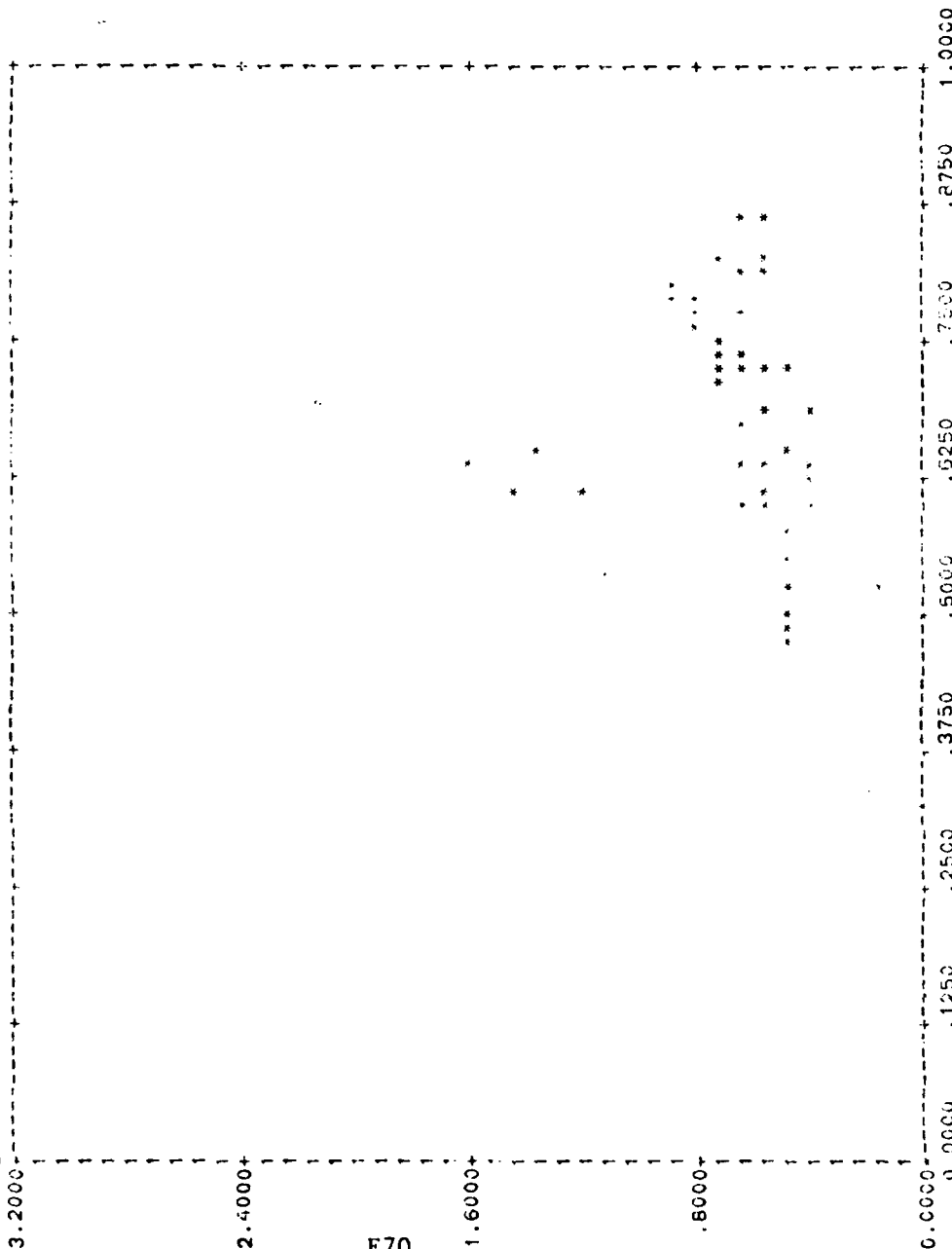
SYSTEM=OV-1
 VARIABLE=
 AVERAGE AVAILABILITY
 AVERAGE RELIABILITY
 VIETNAM
 NO. OF OBS. =29



E69

REGRESSION DE= 1.0000 SE= 1.0000 MS= 12.77972102647
 RESIDUAL DE= 20.0000 SE= 1.0000 MS= 10.38089191172
 TOTAL DE= 20.0000 SE= 1.0000 MS= 10.38089191172
 F=15.75 MS= 10.38089191172 SE= 1.0000 MS= 10.38089191172
 R=2.21 MS= 10.38089191172 SE= 1.0000 MS= 10.38089191172
 B(1) EST= 10.38089191172

SYSTEM UNIT
 AVAILABLE= AVERAGE AVERAGE
 AVAILABLE= RELATIVE
 WORKLOAD NO. 3- 055- 571



ANOVA TABLE
 REGRESSION DF= 1. SS= 31.79355727494 MS= 31.79355727494
 RESIDUAL DF= 70. SS= 4.178141725058 MS= .0596877389294
 TOTAL DF= 71. SS= 35.971699
 F-TEST= 532.664790064
 R+2= 86.3849155974 S= .2443107425583 CORR EST= .3570731975215
 9(1) EST= .9589050353259

APPENDIX F

CAUSAL VARIABLES

REGRESSION ANALYSIS

Y VARIABLE

(DEPENDENT)

USAGE

LENGTH OF SORTIES
(BY AIRCRAFT)

LENGTH OF SORTIES
(BY AIRCRAFT)

X VARIABLE

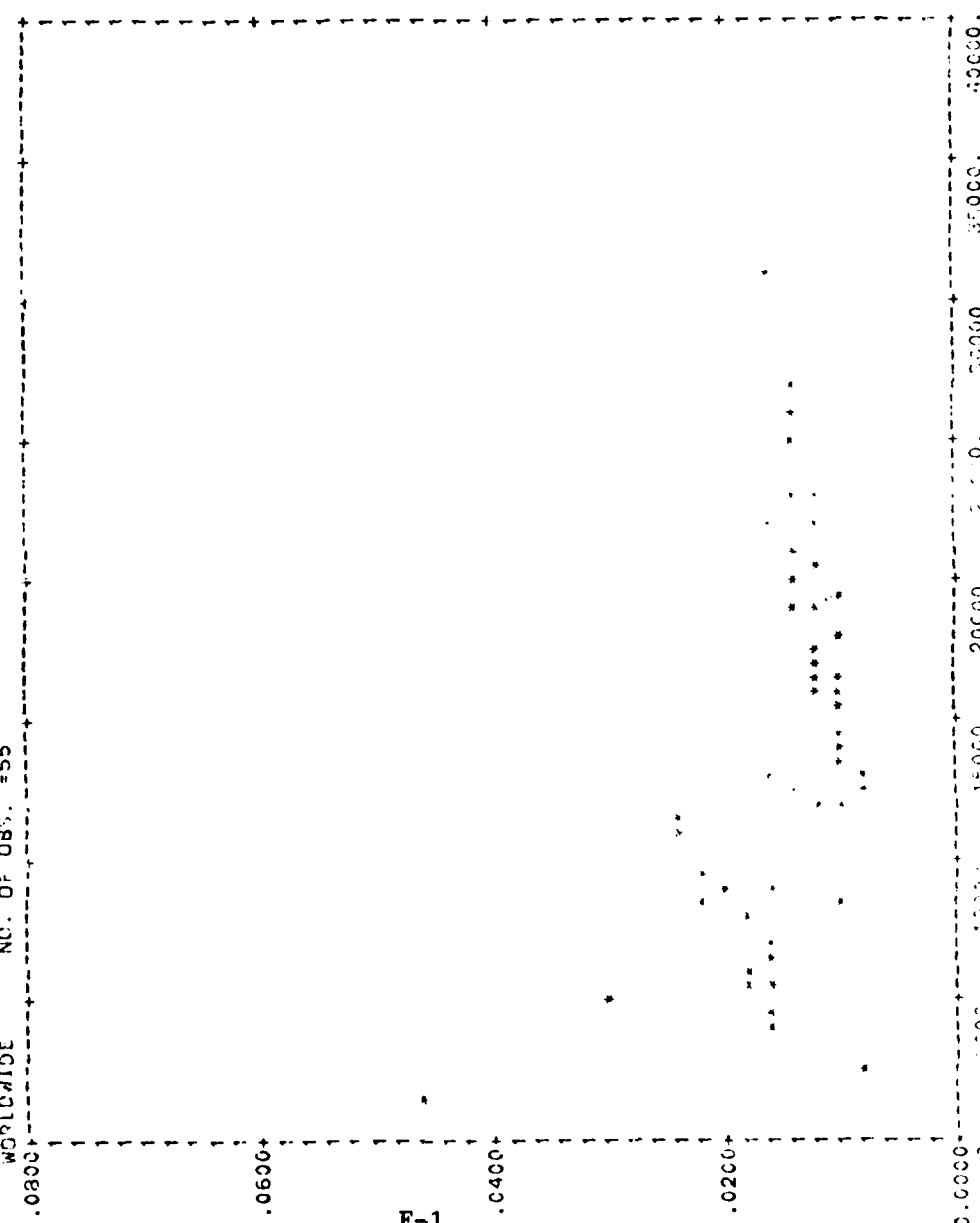
(INDEPENDENT)

TOTAL FLYING HOURS

TOTAL FLYING HOURS

USAGE

SYSTEM=AT-1
 YVARIABLE= AVERAGE USAGE
 XVARIABLE= TOTAL FLYING HOURS
 WORLDWIDE NO. OF OBS. =55



F-1

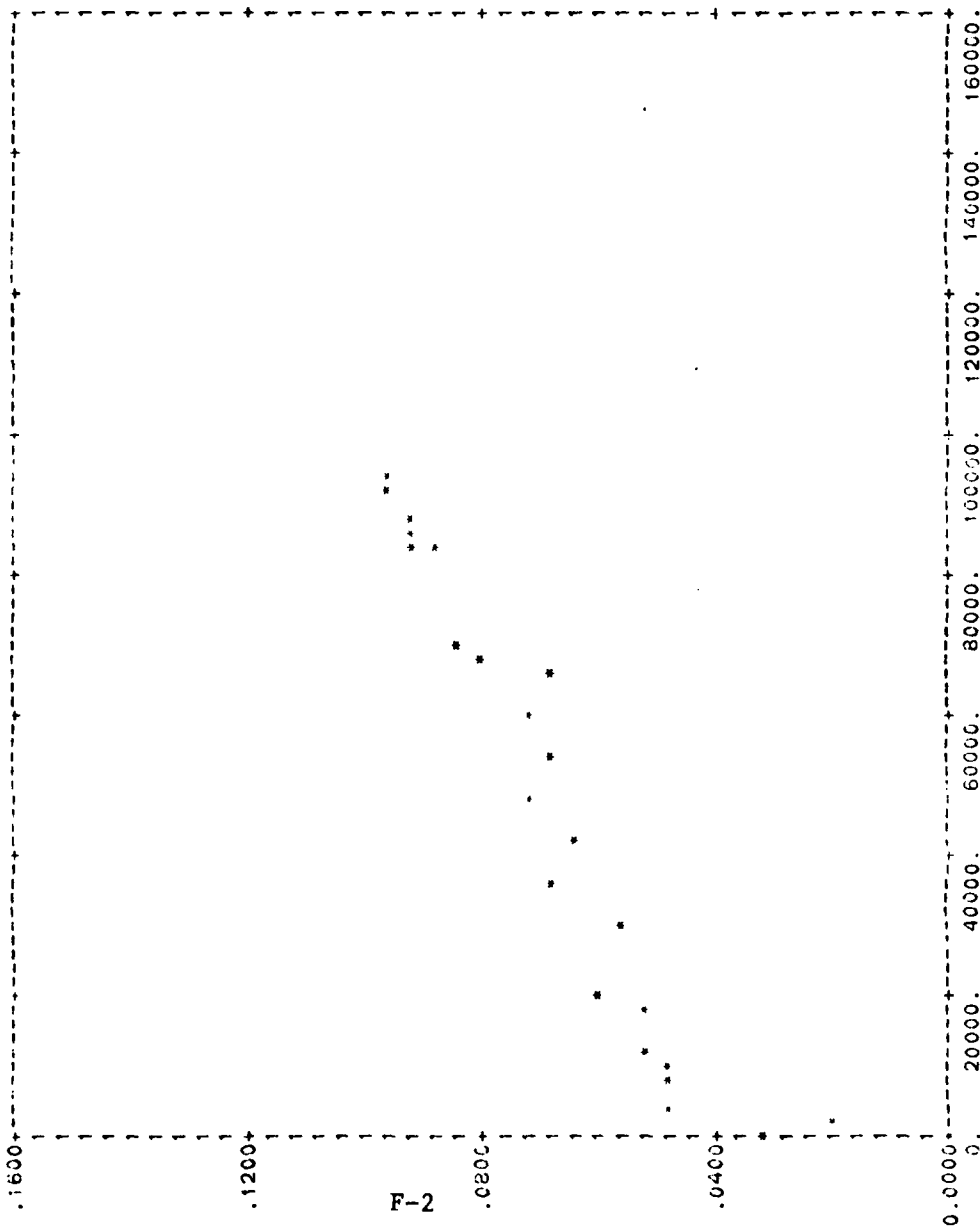
ANOVA TABLE
 REPRESSION OF= 1. 55- .007891776676513 MS= .007891776676543
 RESIDUAL OF= 54. 55- .005507223323486 MS= .005507223323486
 TOTAL OF= 55. 55- .01339899 MS= .01339899
 F-TEST= 1.339899/0.007891776676513= 169.16
 R-SQ= .007891776676513/0.01339899= .5900
 S(1) EST= 0.007891776676513

SYSTEM-20-1

Y-Axis Label
AVERAGE US F-2
TOTAL FLYING HOURS

X-Axis Label
VIETNAM NO. OF OBS. = 23

VIETNAM NO. OF OBS. = 23



F-2

0.0000 0.0400 0.0800 0.1200 0.1600

ANOVA TABLE
REGRESSION DF= 1. SS= .09937229556408 MS= .09937229556408
RESIDUAL DF= 22. SS= .0121537043592 MS= .000552441107237
TOTAL DF= 23. SS= .111528
F-TEST= 179.8785311866
R**2= .8916235780363 S= .02350406583389 CORR EST= .9494134050422
B(1) EST= .000001157334622037

A scatter plot showing the relationship between F-2 (X-axis) and F-3 (Y-axis) for 1,000,000 iterations. The X-axis ranges from 0 to 24,000 with major ticks every 2,000 units. The Y-axis ranges from 0.000 to 0.0800 with major ticks every 0.0200 units. The data points form a dense triangular cluster with its base on the X-axis (F-3 ≈ 0) and its apex at approximately (10,000, 0.025). There are several outliers at higher F-2 values, notably one near (24,000, 0.045) and another near (24,000, 0.055).

[illegible]

ANOVA TABLE			
REGRESSION	DF=	1.	SS=
RESIDUAL	DF=	27.	SS=
TOTAL	DF=	28.	SS=
F-TEST=	244.3501512537		
RR-2=	90.0508575029	S=	
RR(1) EST=	.00000165954810972		
		MS=	.1039548146268
		MS=	.01148638537322
			.115451
		CORR EST=	.9184814032692

SYSTEM=OR58

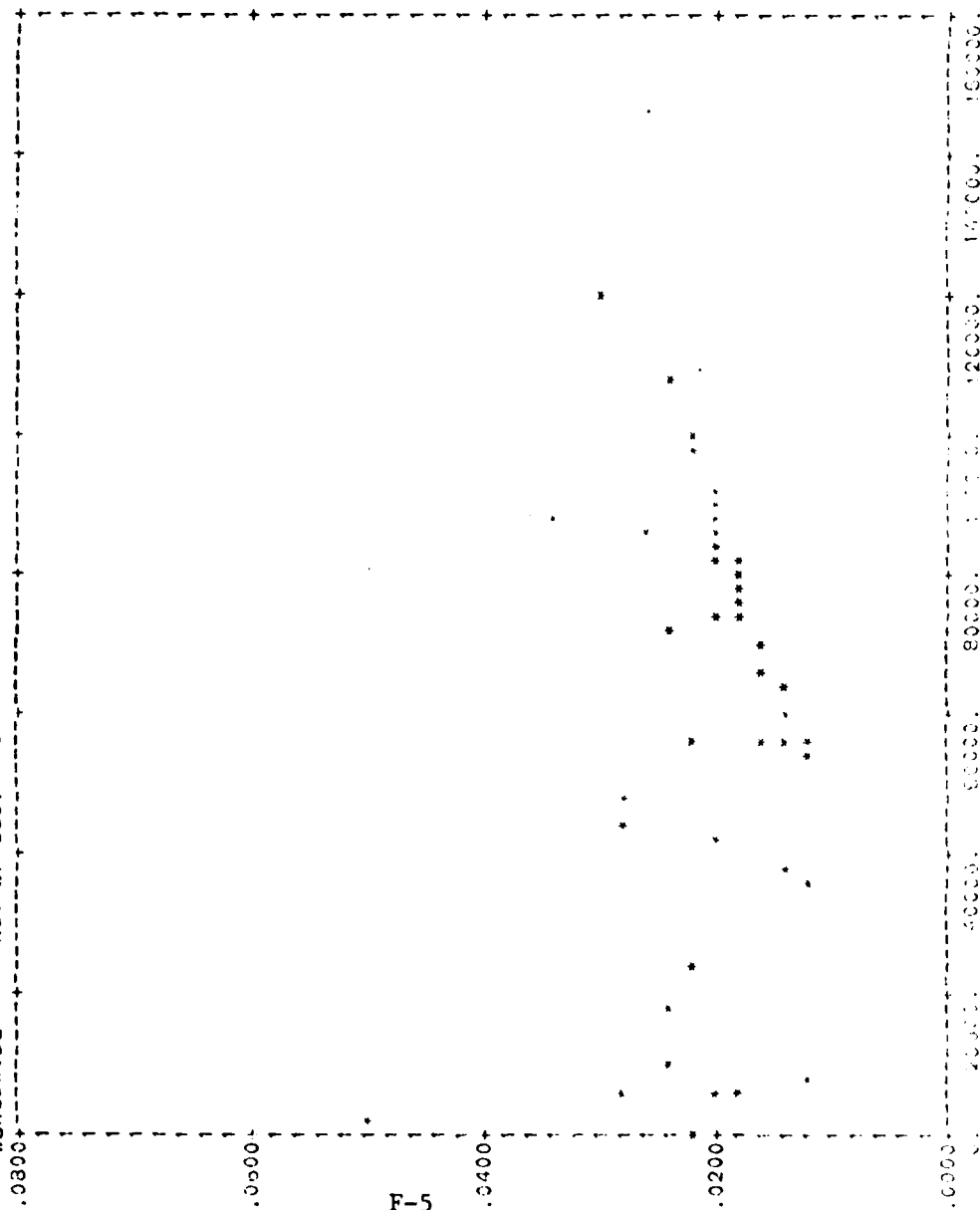
YVARIABLE=

XVARIABLE=

WORLDWIDE

NO. OF OBS. = 48

AVERAGE USAGE
TOTAL FLYING HOURS



F-5

REGRESSION
SSE 1.55
R2 0.71
F 10.17
T 2.17
P 0.0001
S 0.0001
C 0.0001
D 0.0001
E 0.0001
F 0.0001
G 0.0001
H 0.0001
I 0.0001
J 0.0001
K 0.0001
L 0.0001
M 0.0001
N 0.0001
O 0.0001
P 0.0001
Q 0.0001
R 0.0001
S 0.0001
T 0.0001
U 0.0001
V 0.0001
W 0.0001
X 0.0001
Y 0.0001
Z 0.0001

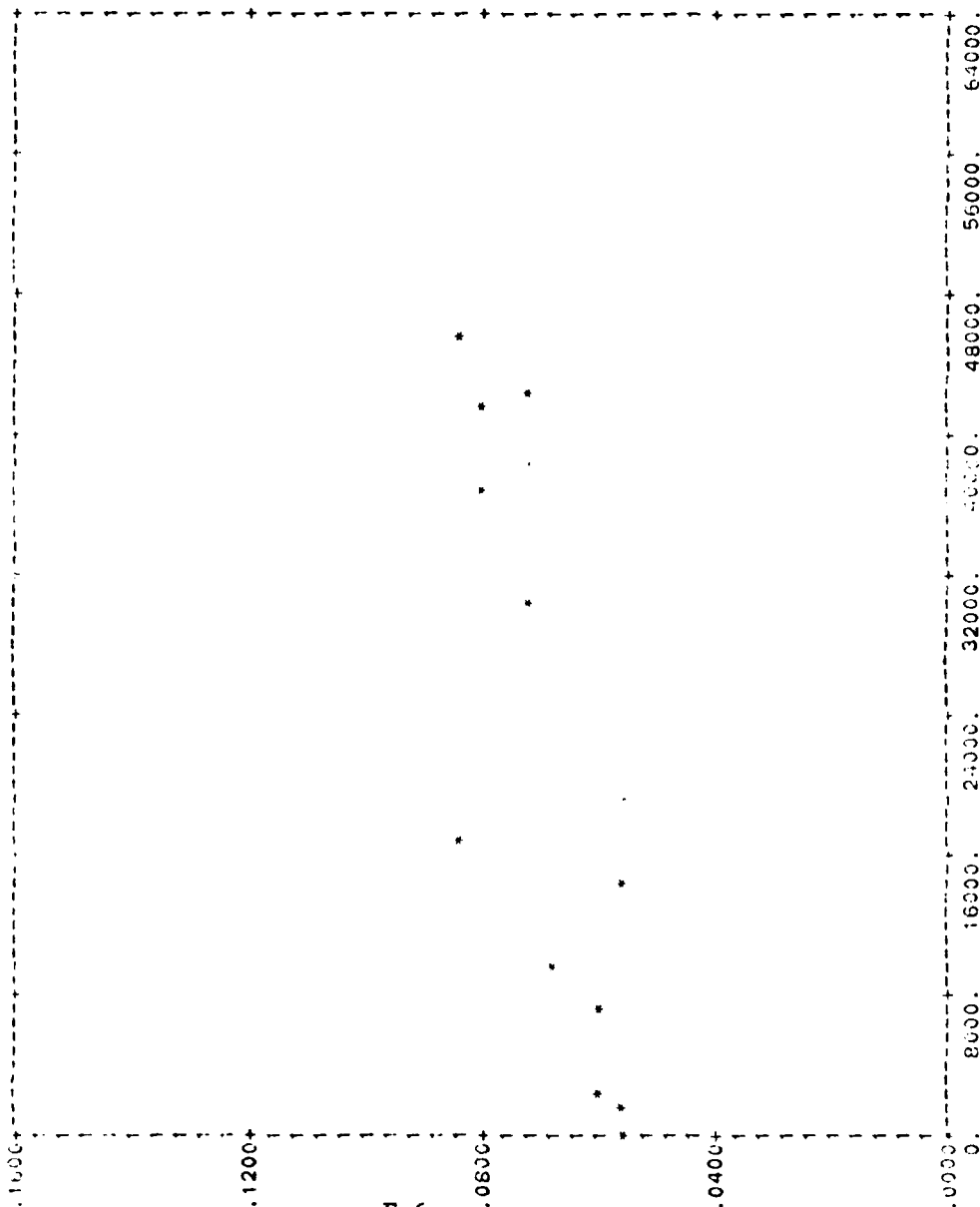
SYSTEM OVER

TABLE

AVARIABLE

VIETNAM NO. OF OBS. 104

AVERAGE 104
TOTAL 104



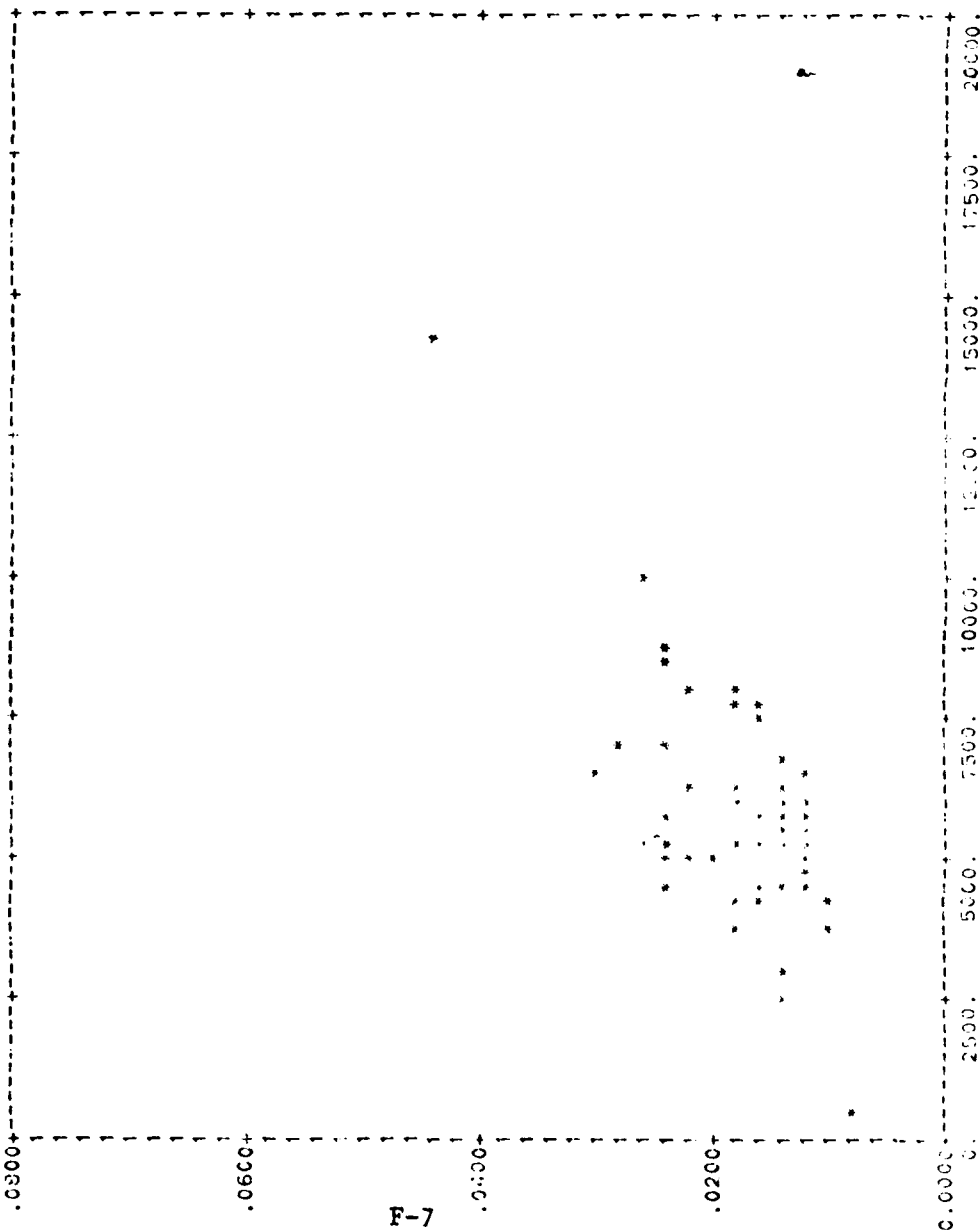
F-6

ANOVA TABLE

REGRESSION	DF	SS	MS
1.	1.	.04924336997991	.04924336997991
RESIDUAL	13.	.01679463002009	.00129189461693
TOTAL	14.	.066038	

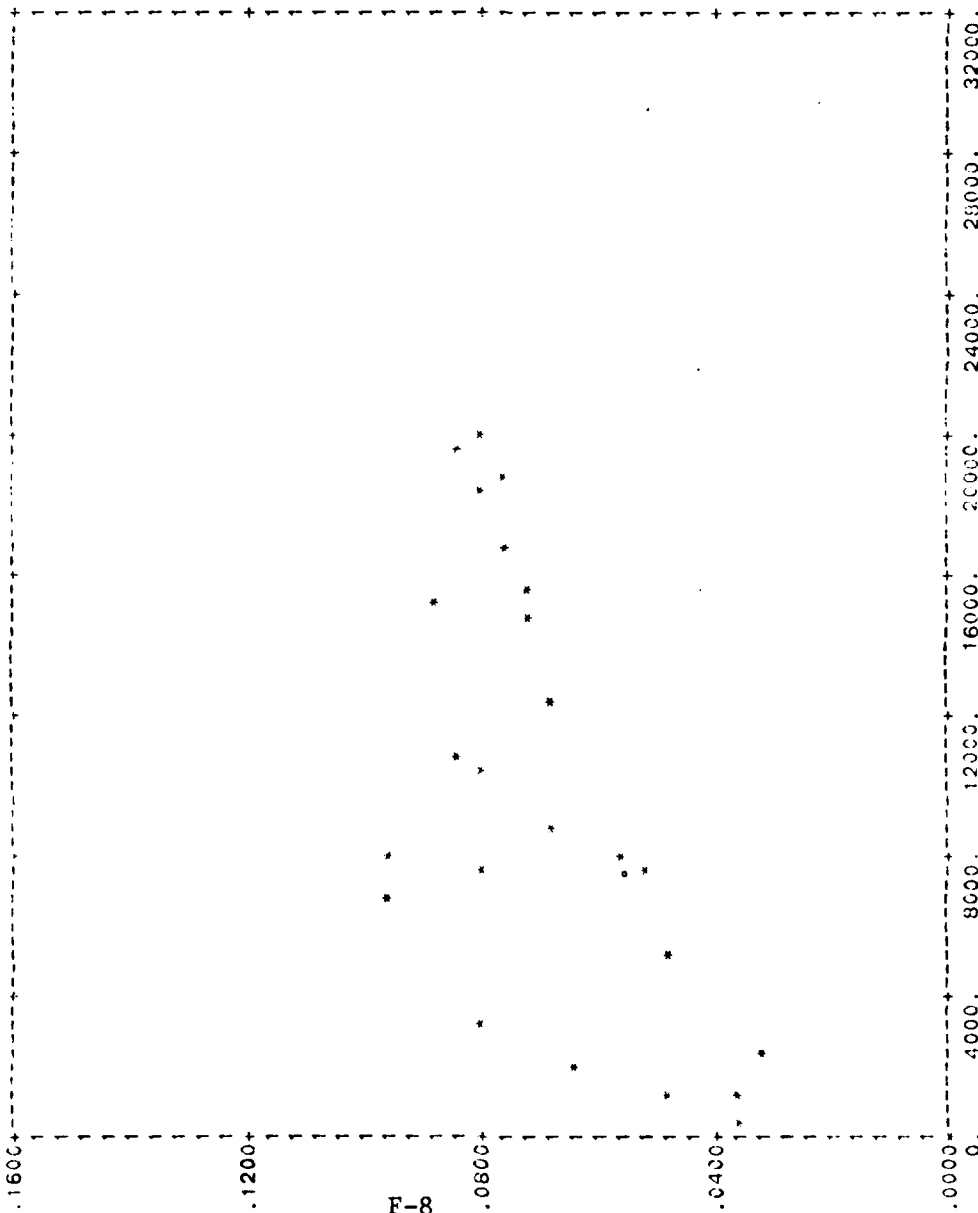
F-TEST = 38.11717251128
 S = .03504293556361
 CORR EST = .7354819549034
 S(1) EST = .00000217718278083

SYSTEM=QV-1
 YVARIABLE=
 YVARIABLE=
 WORLDWIDE NO. OF OBS. =65
 AVERAGE USAGE
 TOTAL FLYING HOURS



ANOVA TABLE
 REGRESSION D.F. 1. SSE .0139041308531 MS= .0189041308531
 RESIDUAL D.F. 63. SS= .00171809145002 MS= .00002534170542045
 TOTAL D.F. 64. SS= .0156222
 F=115.14
 R=2
 S(1) 534

SYSTEM DATA
 Y-Axis: AVERAGE
 X-Axis: TOTAL
 VARIATION: NO. OF DATA

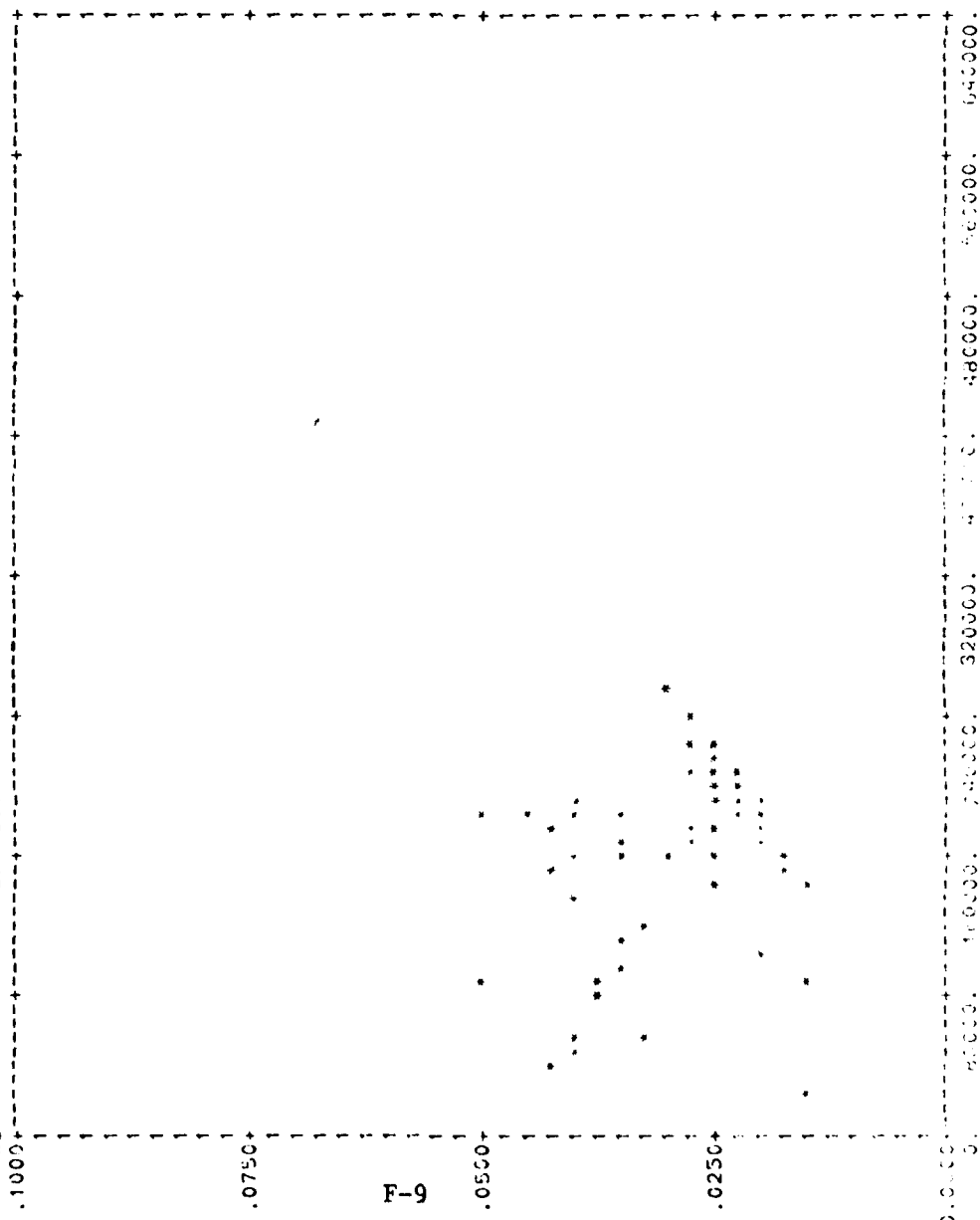


ANOVA TABLE			
REGRESSION	DF=	1.	SS=
RESIDUAL	DF=	28.	SS=
TOTAL	DF=	29.	SS=
F-TEST=	134.1472103349	S=	.03031022151249
R**2=	82.73067610934	S=	.03031022151249
B(1) EST=	.000005485982485297	CORR EST=	.5697278955262

SYSTEM=UH-1
YVARIABLE= AVERAGE USAGE
XVARIABLE= TOTAL FLYING HOURS

NJ. OF OBS. =65

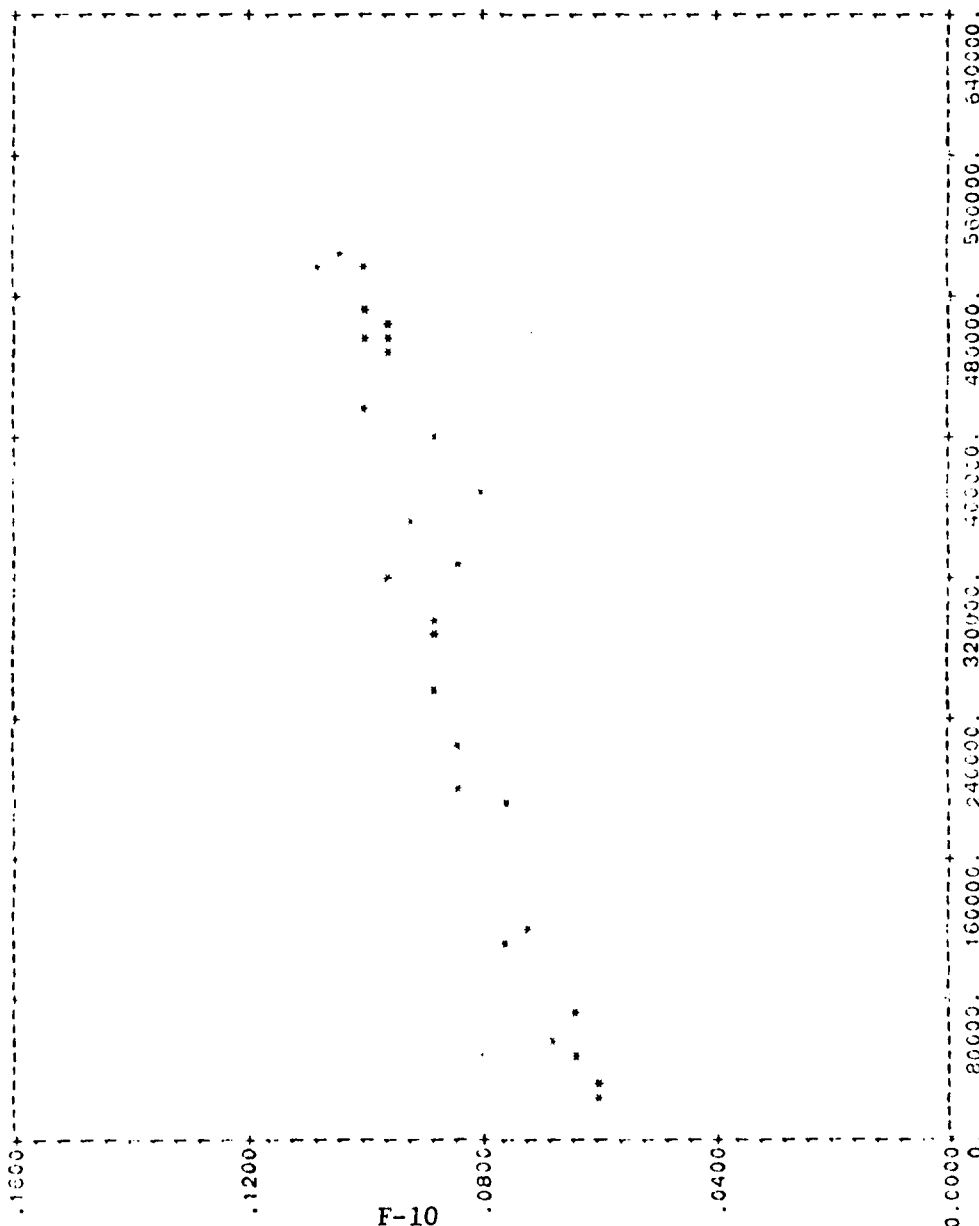
WORLDWIDE



REGRESSION
RESD. ST.
TOTAL
WORLDWIDE
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AVG. X

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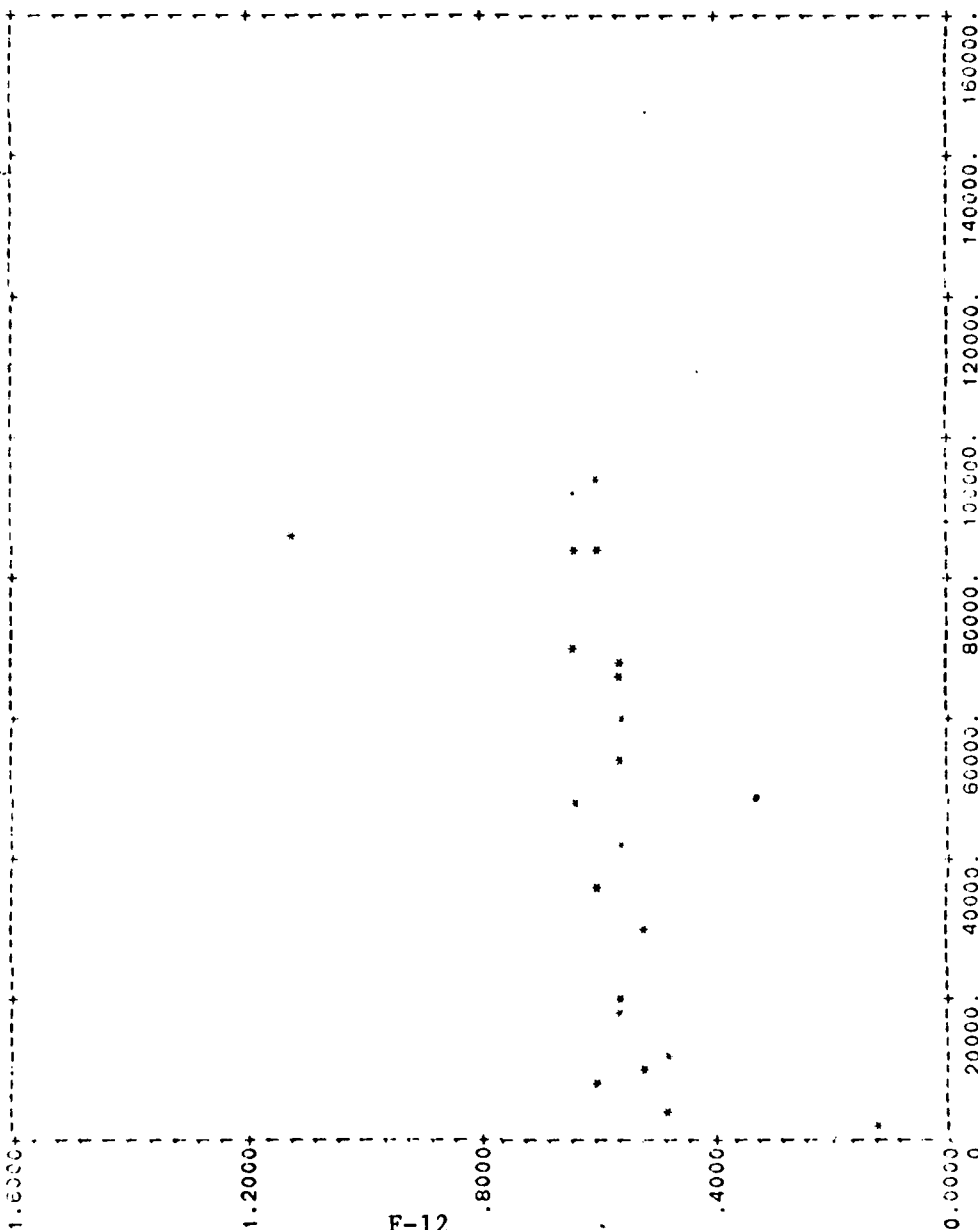
AVERAGE 30.000000
TOTAL FLYING 100.000000



ANOVA TABLE			
REGRESSION	DF=	1.	SS= .1960210569371
RESIDUAL	DF=	29.	SS= .029038294306294
TOTAL	DF=	30.	SS= .027104
F-TEST=		197.4563110325	
R-SQ=		87.19099727633	
B(1) EST=		2.374632094675E-7	
			CORR EST= .9378613874642

SYSTEM PART I
 VARIABLE
 AVERAGE LENGTH OF JOURNIES BY AIRCRAFT
 TOTAL FLYING HOURS

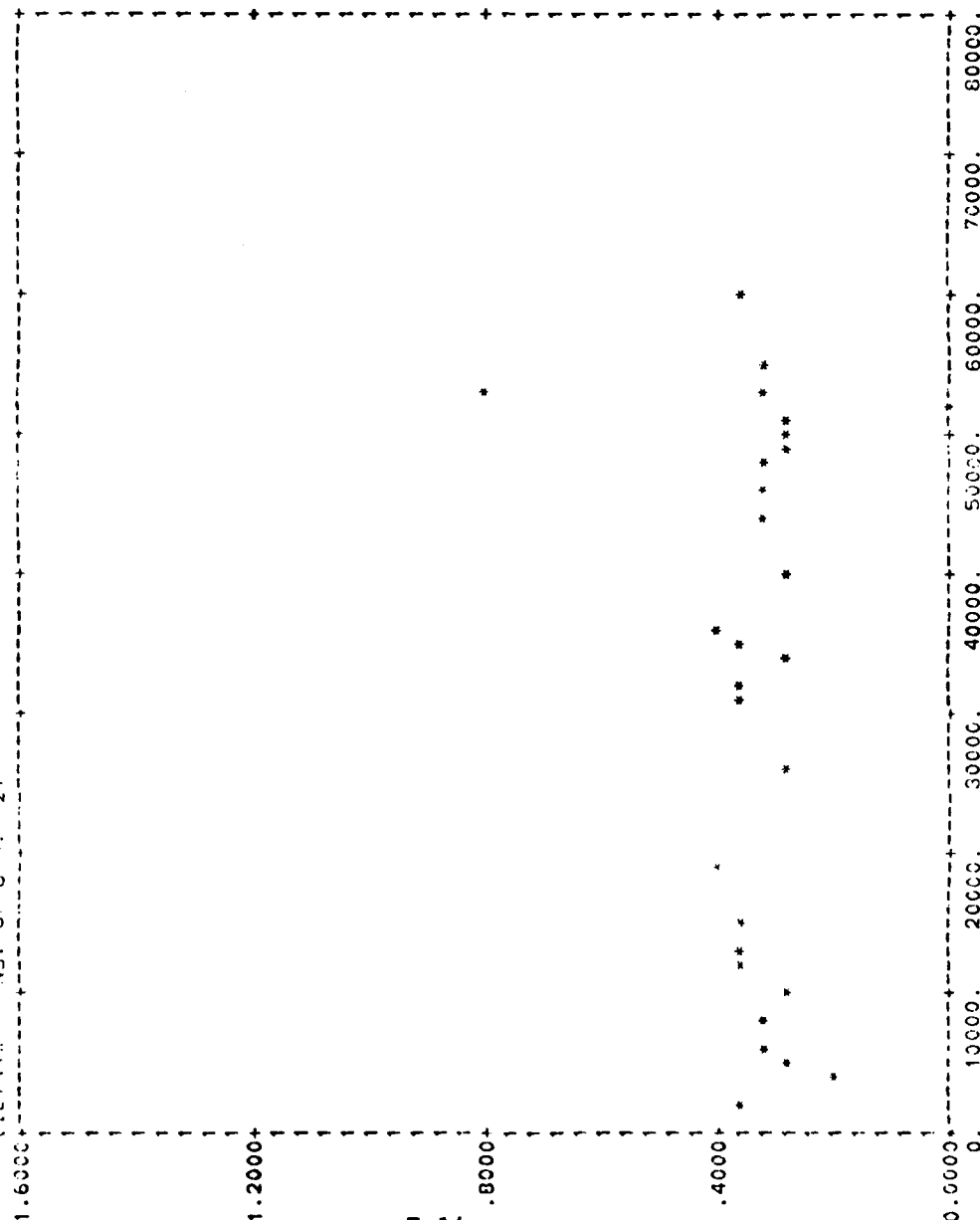
VIETNAM NO. OF OBS. = 22



F-12

ANOVA TABLE
 REGRESSION DF= 1. SS= .238977179623 MS= .238977179623
 RESIDUAL DF= 20. SS= .4229901385588 MS= .02114950692794
 TOTAL DF= 21. SS= .7119673181818
 F-TEST= 12.66354216236 CORRELATION EST= .6370914033337
 R**2= .4059454560361
 S= .145428700403
 SLOPE EST= .000003603765295747 INTERCEPT EST= .4009741654907

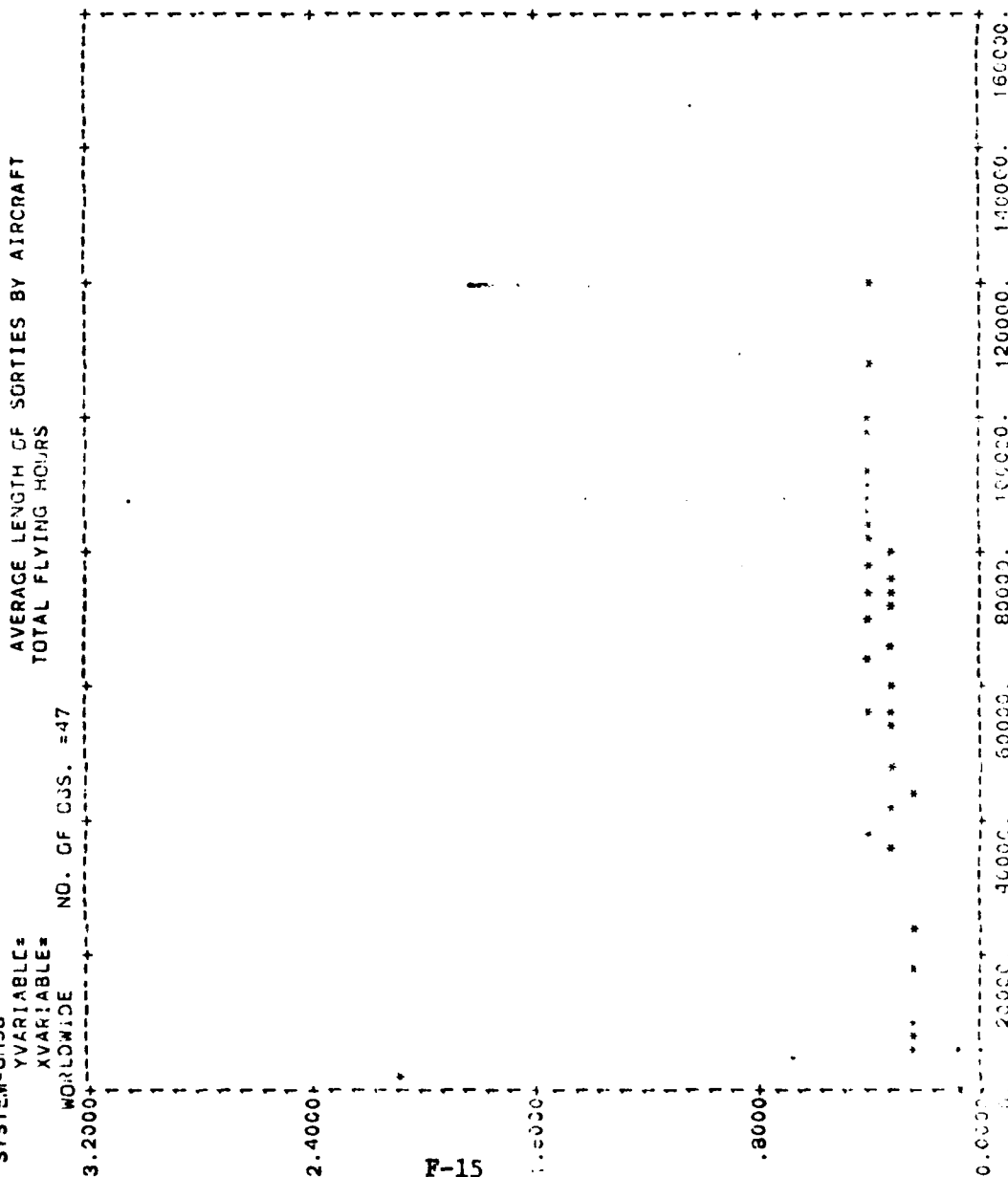
SYSTEMECH47
 Y-Variable: AVERAGE LENGTH OF NOTICES BY AIRCRAFT
 X-Variable: TOTAL FLYING HOURS
 VIETNAM NO. OF OBS. 127



F-14

ANOVA TABLE
 REGRESSION DF= 1. SS= .01641566536497 MS= .01641566536497
 RESIDUAL DF= 25. SS= .2631124087091 MS= .01040449634836
 TOTAL DF= 26. SS= .2795280740741
 F-TEST= 1.5777472369
 R*2= 5.936346753703 CORRELATION EST= .2436461934795
 S= .1020024330512
 SLOPE EST= .000001331549224489 INTERCEPT EST= .3036507102893

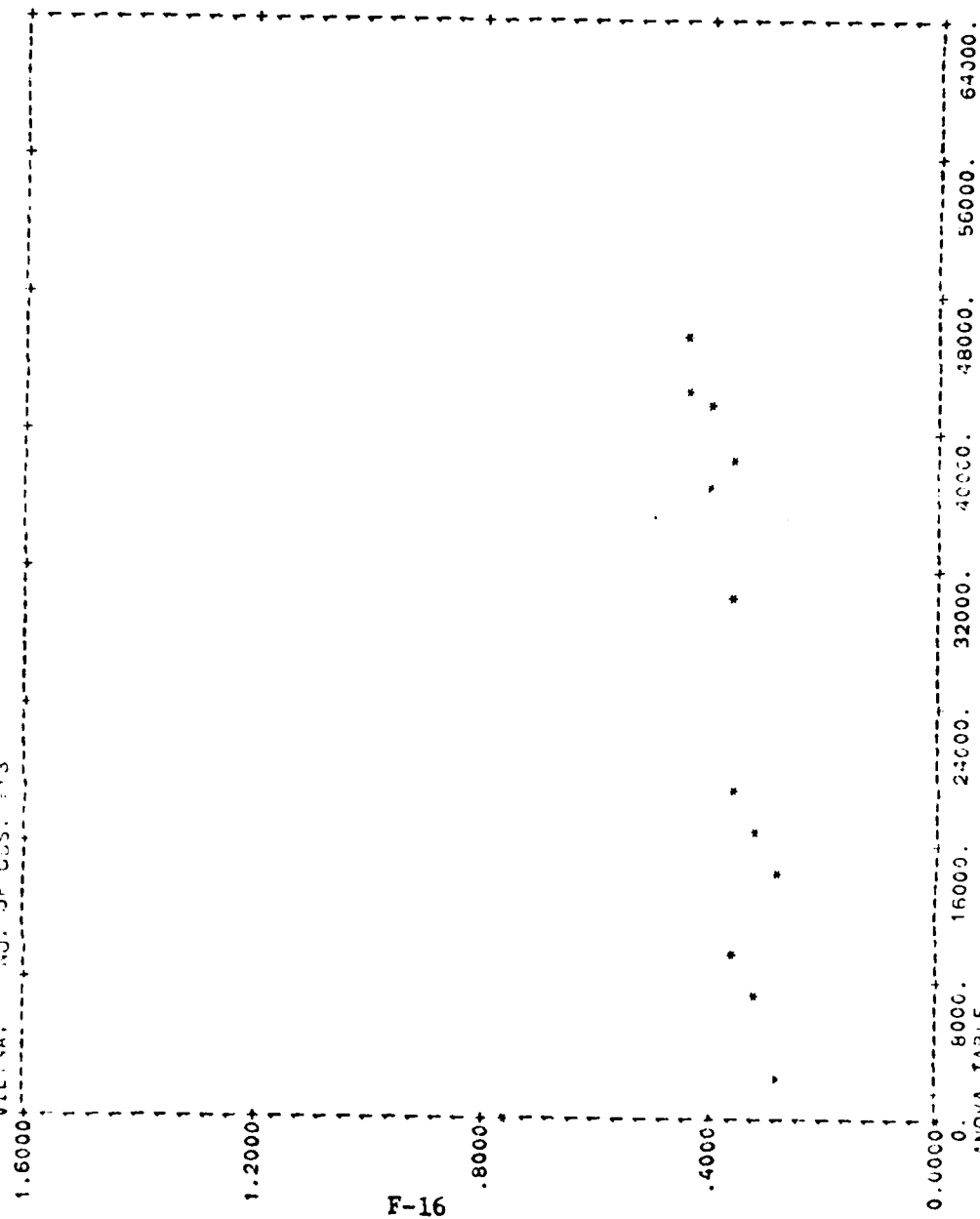
SYSTEM=OH58
YVARIABLE=
XVARIABLE=
WORLDWIDE NO. OF CJS. =47



F-15

REGRESSION: DE 1. 35. 01258473341963 MS= .01258473341963
 RESIDUAL DE 40. 35. 0113550245304 MS= .0042411656231
 TOTAL DE 40. 35. 31125034978723
 F-TEST= 19175034978723
 R**2= .002092977359 CORRELATION EST= -.0034170321215
 S= .2631374830127
 SLOPE EST= -5.510571201044E-7 INTERCEPT EST= .001030394501

SYSTEM=OVER
 YVARIABLE= AVERAGE LENGTH OF JOURNIES BY AIRCRAFT
 XVARIABLE= TOTAL FLYING HOURS
 VIETNAM NO. OF OBS. = 13



F-16

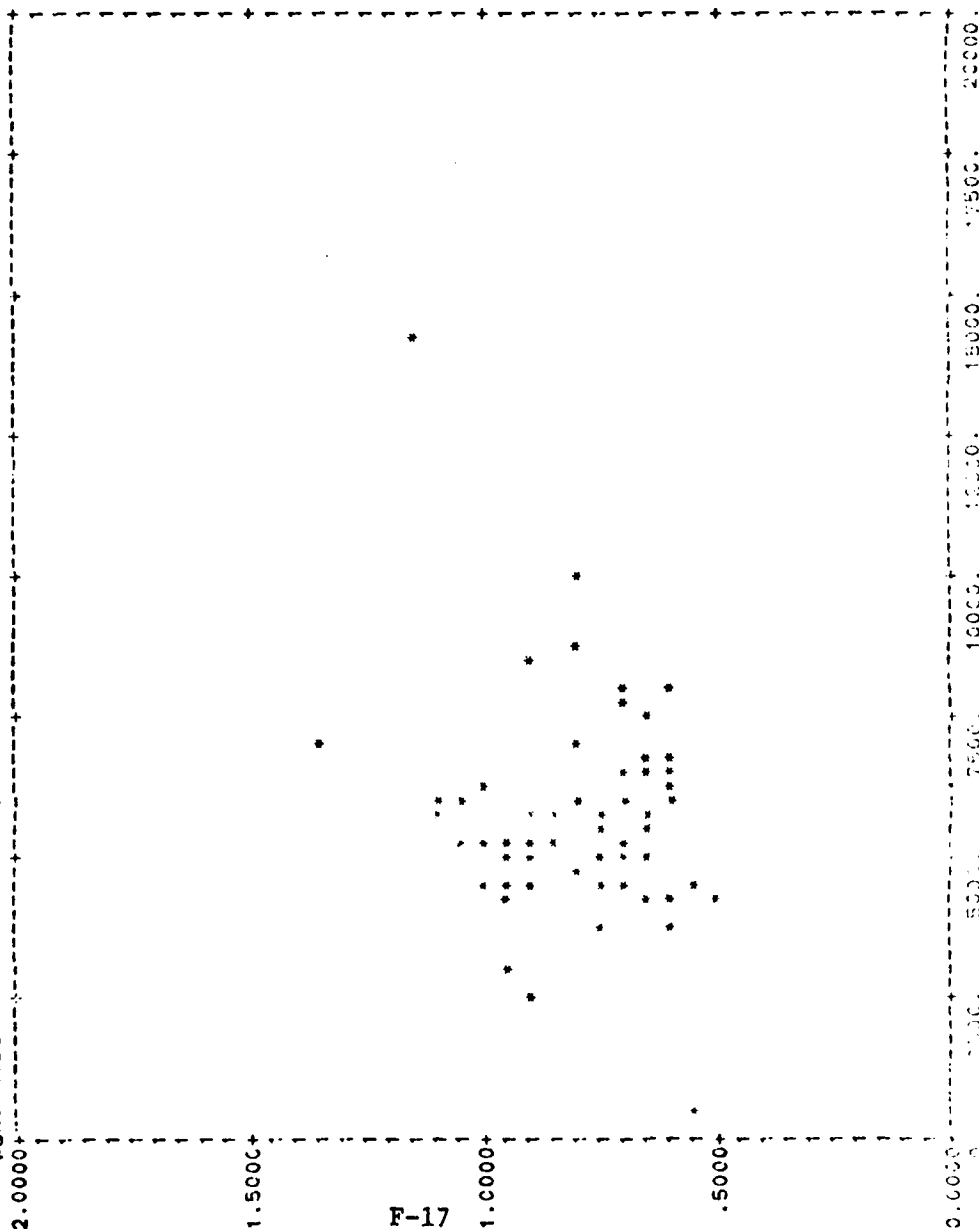
ANOVA TABLE

	0.	8000.	16000.	24000.	32000.	40000.	48000.	56000.	64000.
REGRESSION	DF=	1.	SS=	.002243247356163	MS=	.002243247356163			
RESIDUAL	DF=	11.	SS=	.1790119834131	MS=	.01627381667392			
TOTAL	DF=	12.	SS=	.1812552307692					
F-TEST=		.1378439613222							
R**2=		1.23761796812							
S=		.1275636703168							
SLOPE EST=		-8.383206352965E-7							
INTERCEPT EST=		.4091833539379							

SYSTEM=OV-1
Y VARIABLE=
X VARIABLE=
WOR(L/WIDE

NO. OF OBS. =64

AVERAGE LENGTH OF SORTIES BY AIRCRAFT
TOTAL FLYING HOURS

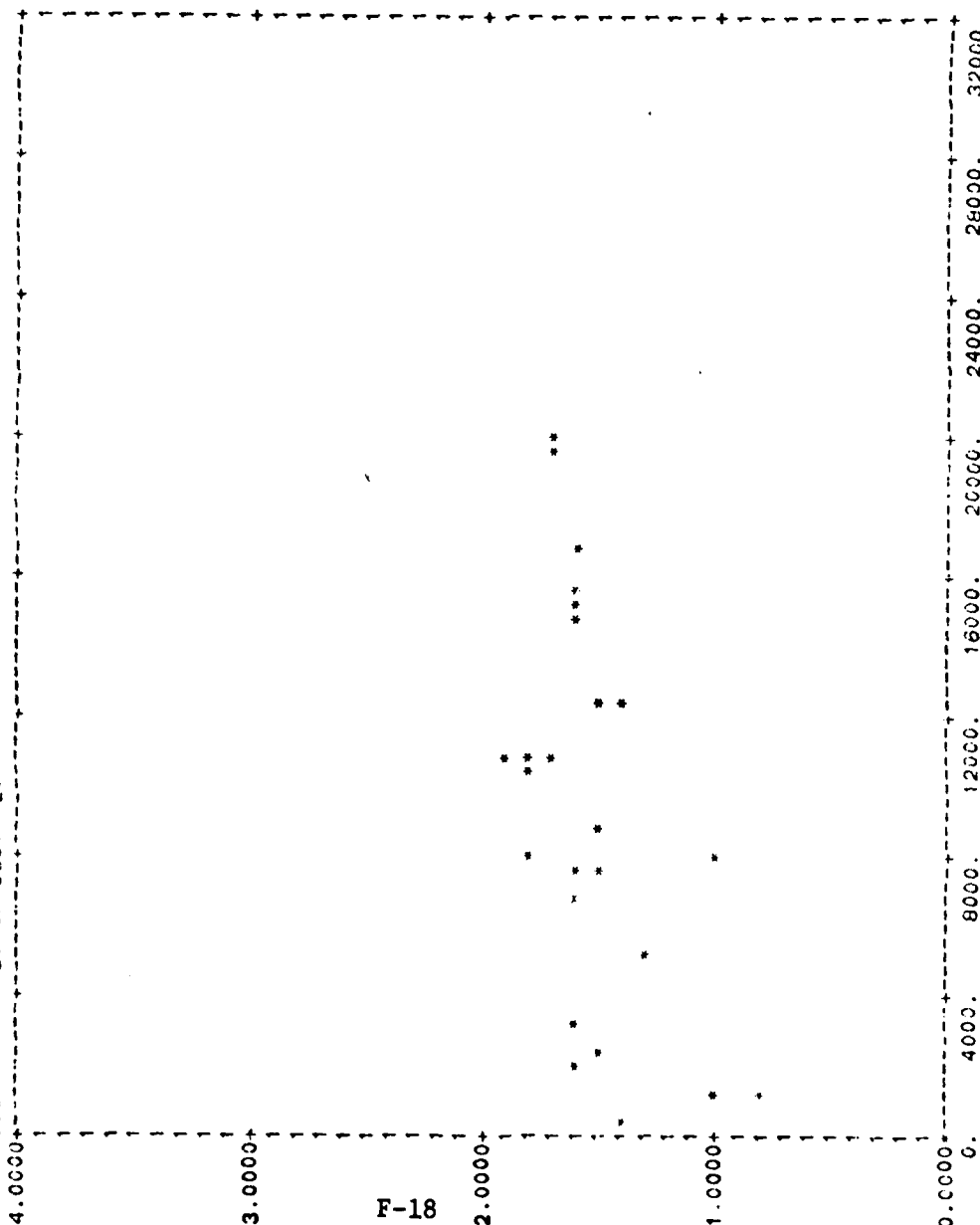


F-17

REGRESSION OF= 1. S54 .00587676979553 MS= .00587676979553
RESIDUAL OF= 61. 1.7789015464575 MS= .01843191136472
TOTAL OF= 63. 1.804992234375
F-TOTAL= 2.31424481618
P-A2= 2.000000000000 CORRELATION EST= .98710020636
S= .000000000000 INTERCEPT EST= .000000000000
SLOPE EST= .174123271124

SYSTEM: Q-1
 Y-VARIABLE= AVERAGE LENGTH OF SORTIES BY AIRCRAFT
 X-VARIABLE= TOTAL FLYING HOURS

VIETNAM NO. OF OBS. = 28

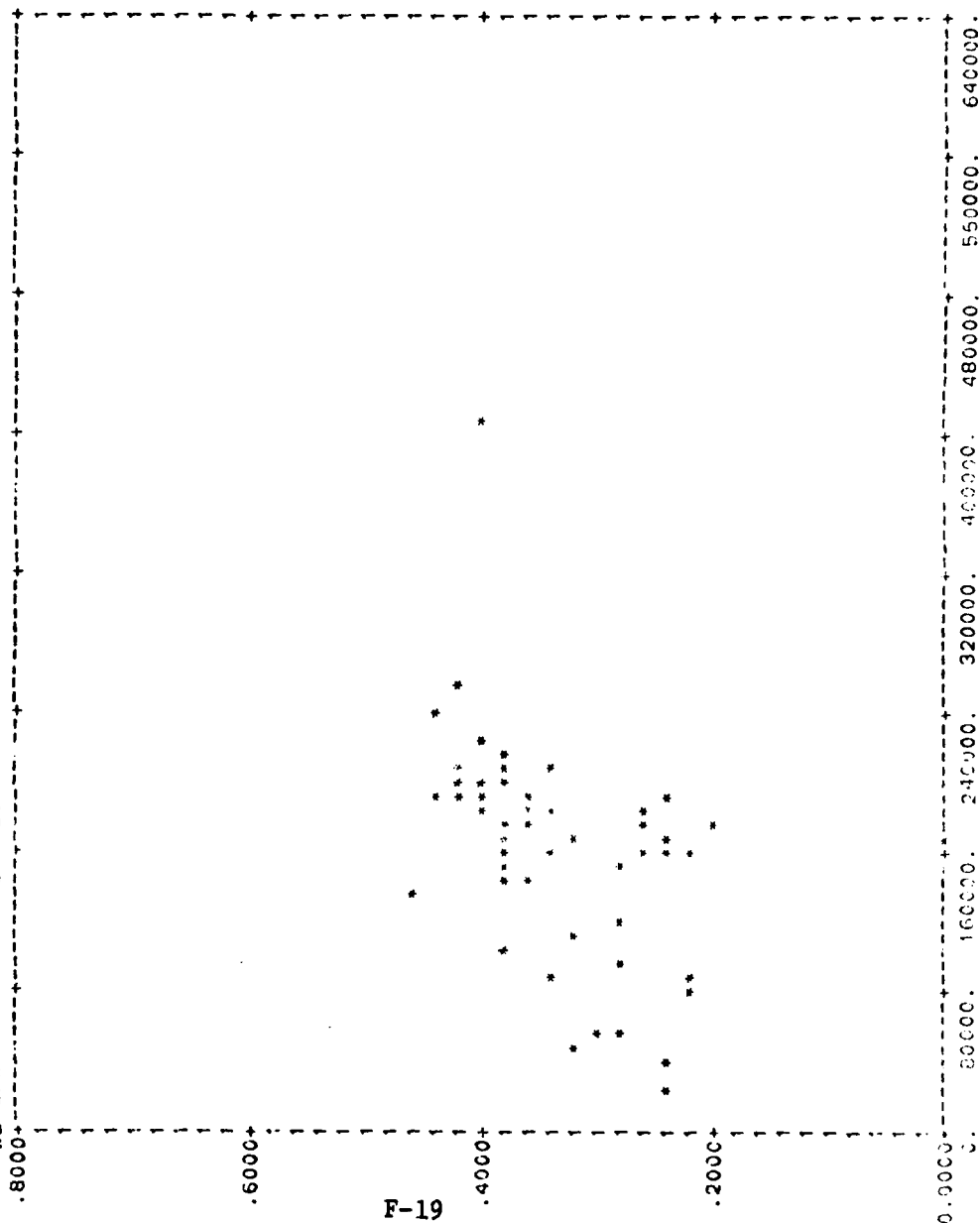


ANOVA TABLE
 REGRESSION DF= 1. SS= .8176599611137 MS= .8176599611137
 RESIDUAL DF= 26. SS= 1.881142753172 MS= .07235164435277
 TOTAL DF= 27. SS= 2.698802714286
 F-TEST= 11.30119389031
 R**2= 30.29713720034 CORRELATION EST= .5504283531972
 S= .269922609759
 SLOPE EST= .00002935729642757 INTERCEPT EST= 1.270877228

SYSTEM=UH-1
 YVARIABLE= AVERAGE LENGTH OF SORTIES BY AIRCRAFT
 XVARIABLE= TOTAL FLYING HOURS

NO. OF OBS. = 64

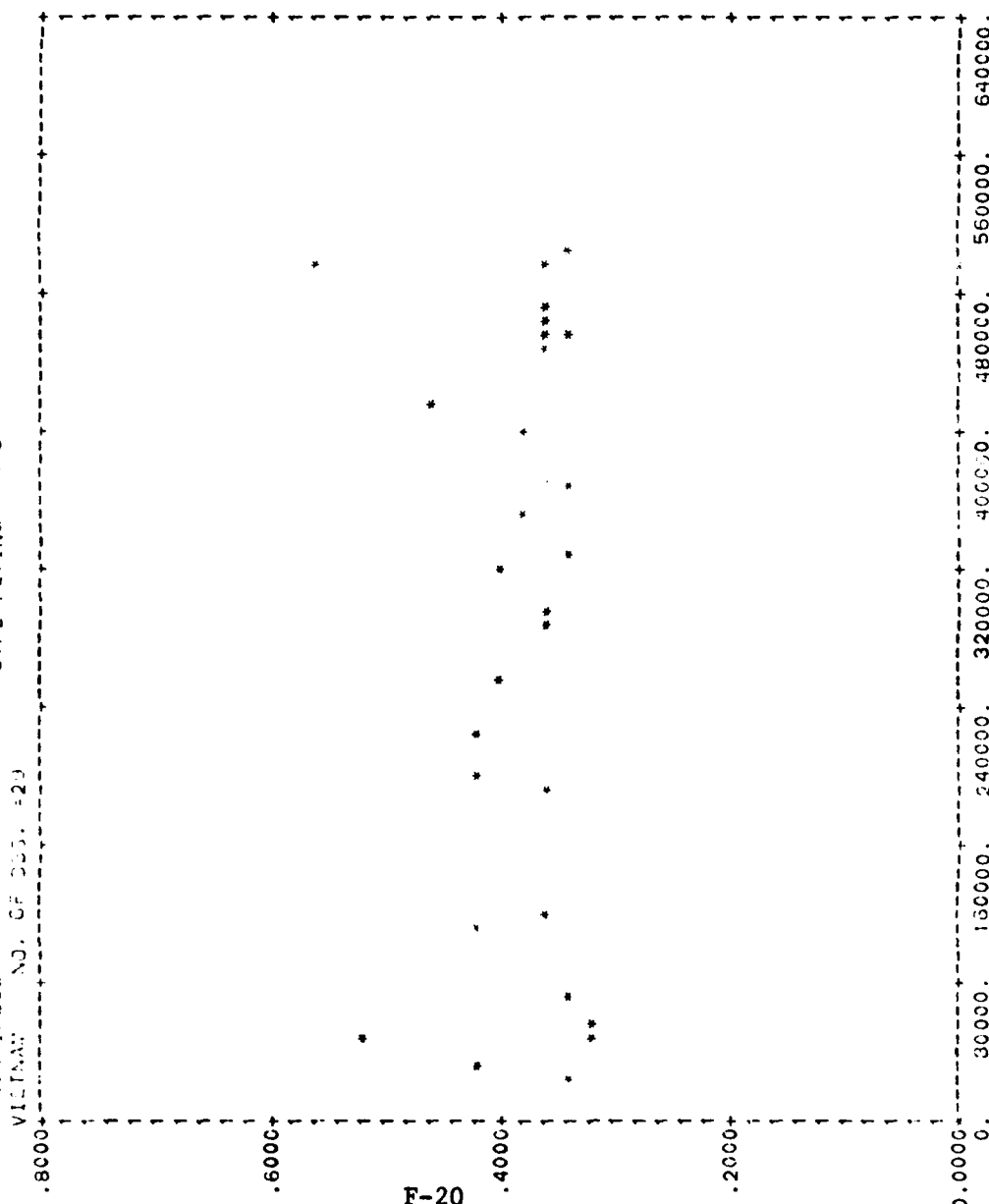
FOR LOW FIDELITY



F-19

REGRESSION DF= 1. SS= .073183946512 MS= .073183946512
 RESIDUAL DF= 62. SS= .210822037863 MS= .003404371578435
 TOTAL DF= 63. SS= .283815984375 MS= .0045002531190476
 F-TEST= 21.12160090105
 R= .42= .210822037863
 S= .0518631197728
 SLOPE EST= 5.705712621151E-7 INTERCEPT EST= .0002342014258

SYSTEM UNIT
 IVARIABLES
 X VARIABLE
 Y VARIABLE
 NO. OF OBS. = 29
 VIETNAM



0.0000 30000. 160000. 240000. 320000. 400000. 480000. 560000. 640000.

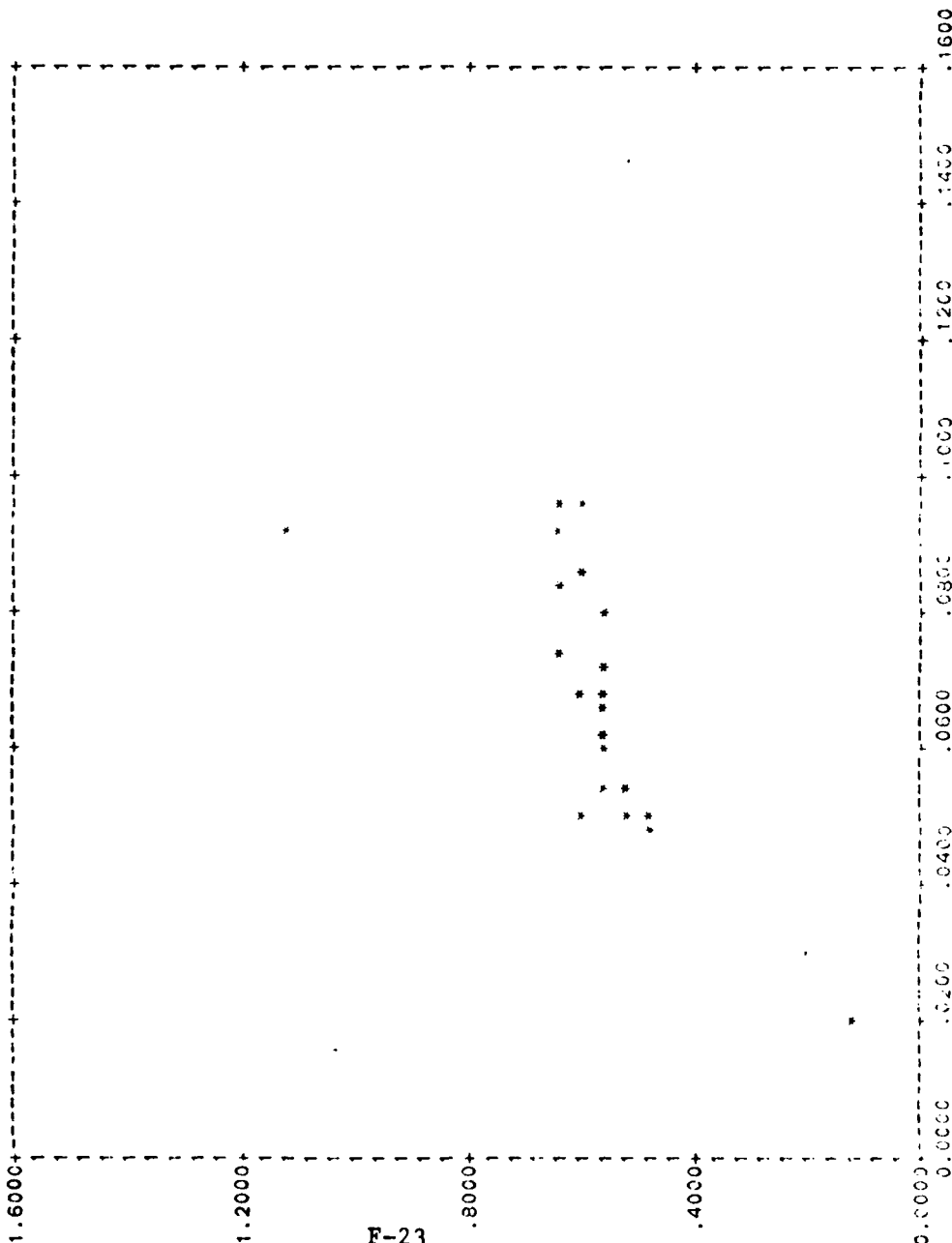
ANOVA TABLE

REGRESSION	DF=	1.	SS=	5.961631981299E-8	MS=	5.961631981299E-8
RESIDUAL	DF=	27.	SS=	.08835718176299	MS=	.003272488213444
TOTAL	DF=	28.	SS=	.08835724137931		
F-TEST=		.00001821742842895				
R+2=		.0006747191161963				
S=		.05720566592082				
SLOPE EST=	2.738373610879E-10					
INTERCEPT EST=	.3804373389423					

100

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SYSTEM=AH-1
 YVARIABLE=
 XVARIABLE=
 VIETNAM NO. OF OBS. =22
 AVERAGE LENGTH OF SORTIES BY AIRCRAFT
 AVERAGE USAGE

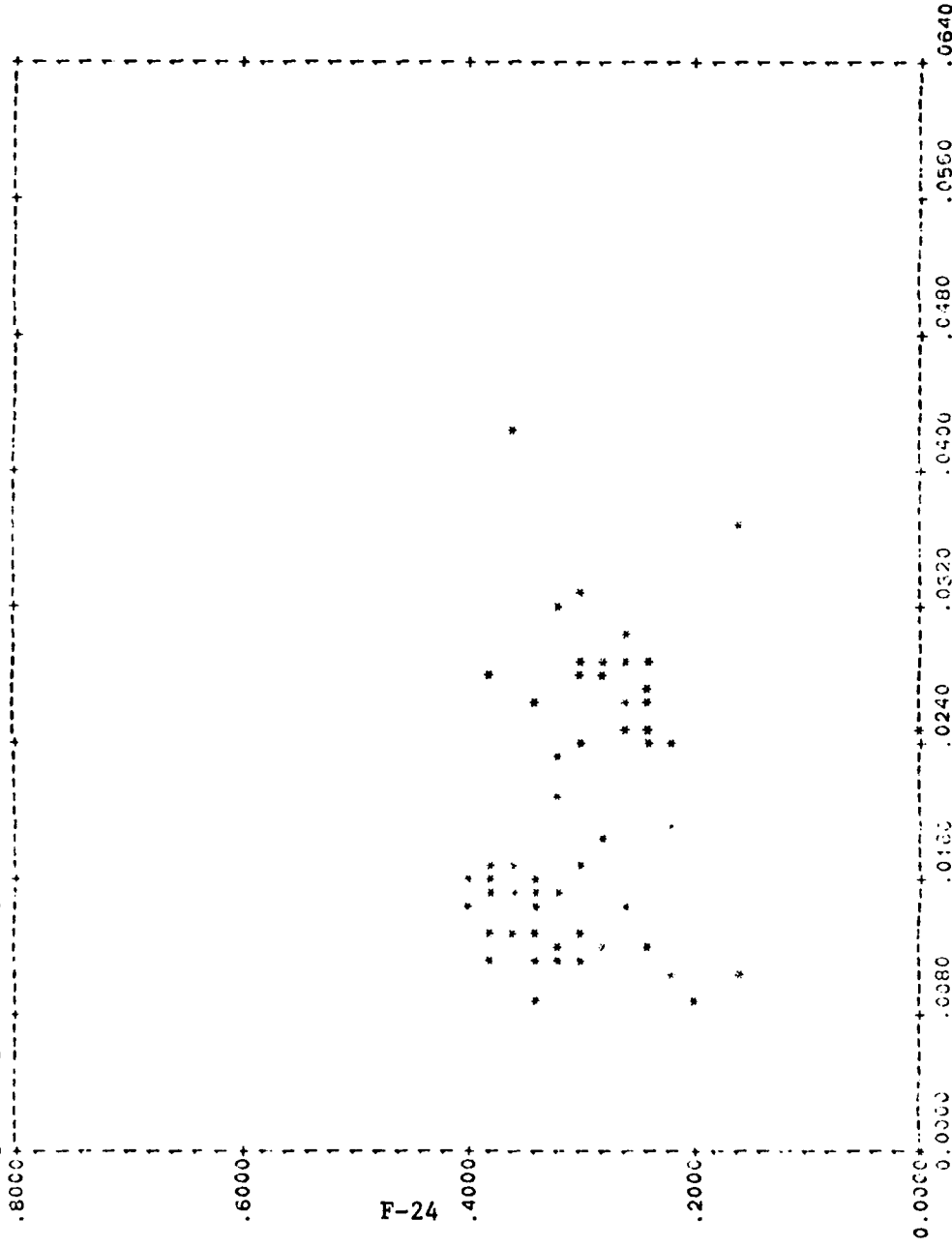


F-23

REGRESSION
 DE= 1. SS= .41115 2765712 MS= .41115 12785712
 RESIDUAL DE= 20. SS= .00000 00000 MS= .00000 00000
 TOTAL DE= 21. SS= .41115 2765712 MS= .41115 12785712
 F-TEST= 27.00000 2245
 R=2= .91477 1217
 CORRELATION EST= .91477 1217
 SLOPE EST= .00000 00000
 INTERCEPT EST= .00000 00000

SYSTEM
 AVERAGE LENGTH F-24
 AVERAGE USAGE

NO. OF OBS. 164



F-24

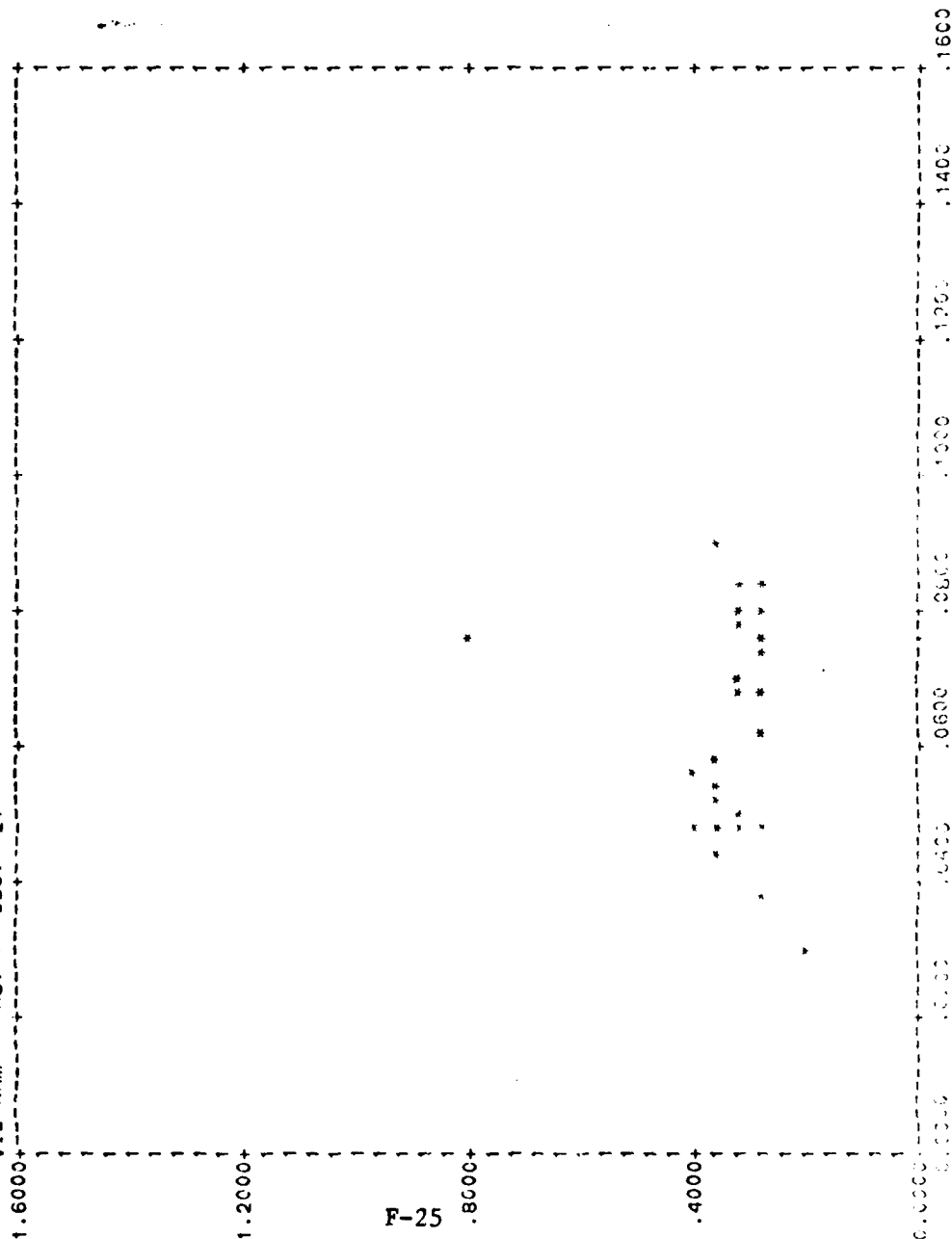
ANOVA TABLE

REGRESSION	DF= 1.	SS= .01682351318404	MS= .01682351318404
RESIDUAL	DF= 62.	SS= .197868424316	MS= .003191426198845
TOTAL	DF= 63.	SS= .2146979375	

F-TEST= 5.27351829714
 R-SQ= 7.83869359287
 S= .05849270925212

CORRELATION EST= -.2799765679437
 INTERCEPT EST= .3415021507807

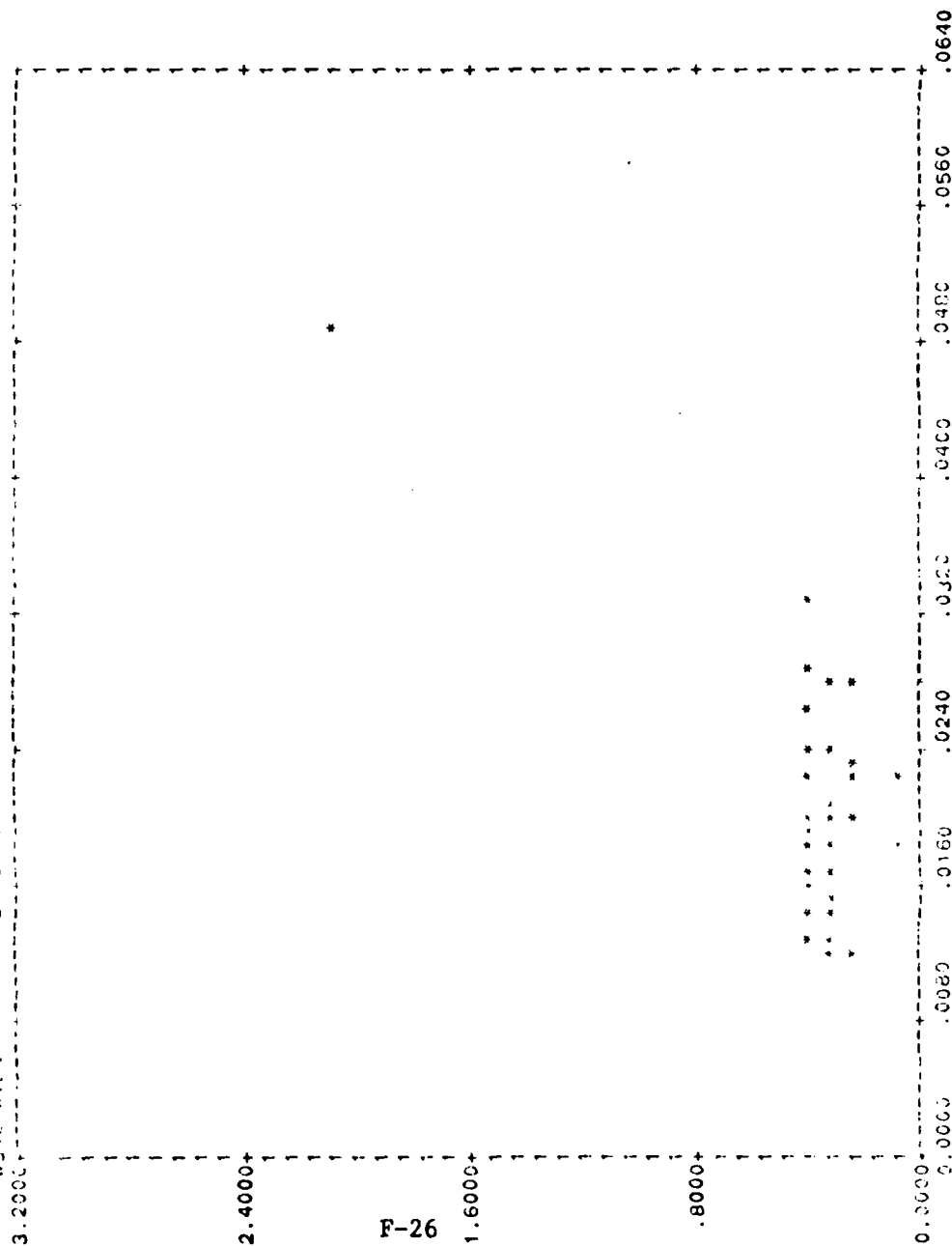
SYSTEM=CH47
 YVARIABLE=
 XVARIABLE=
 VIETNAM NO. OF OBS. =27
 AVERAGE LENGTH OF SORTIES BY AIRCRAFT
 AVERAGE USAGE



REGRESSION
 DF= 25
 SS= .008503748697218
 MS= .000339748697218
 REGSTAT
 SS= .0076543253709
 MS= .00029824301567
 F= 12.85280740741
 R-SQ= .83733447704
 CORRELATION EST= .91744
 S.E. OF EST= .0000000000
 S.E. OF EST= .0000000000
 INTERCEPT EST= .0000000000

SYSTEM ONE
Y VARIABLE
X VARIABLE
CORRELATION

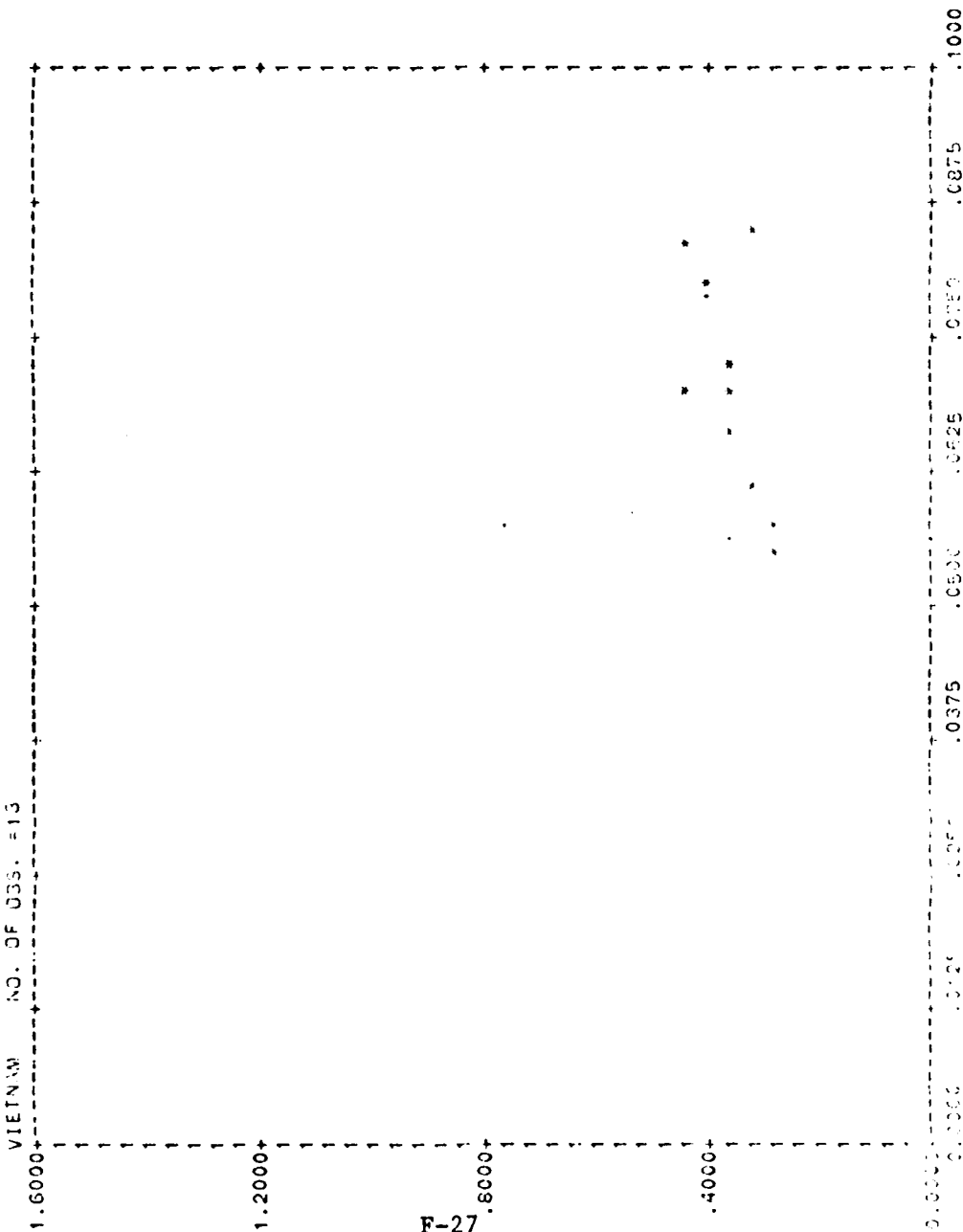
NO. OF OBS = 47



ANOVA TABLE

REGRESSION	DF= 1	SS= 1.241058931645	MS= 1.241058931645
RESIDUAL	DF= 45 <td>SS= 1.887376147078 <td>MS= .0419416921573 </td></td>	SS= 1.887376147078 <td>MS= .0419416921573 </td>	MS= .0419416921573
TOTAL	DF= 46 <td>SS= 3.128434978723 <td></td> </td>	SS= 3.128434978723 <td></td>	
F-TEST=	29.59004120226		
R-SQ=	36.6702731391		
S=	.20473070942		
SLOPE EST=	25.4311453598		
INTERCEPT EST=	-1.127151254019		
CORRELATION EST=	.621843451295		

SYSTEM=OH58
YVARIABLE=
XVARIABLE=
VIETNAM NO. OF O39. =13
AVERAGE LENGTH OF SORTIES BY AIRCRAFT
AVERAGE USAGE

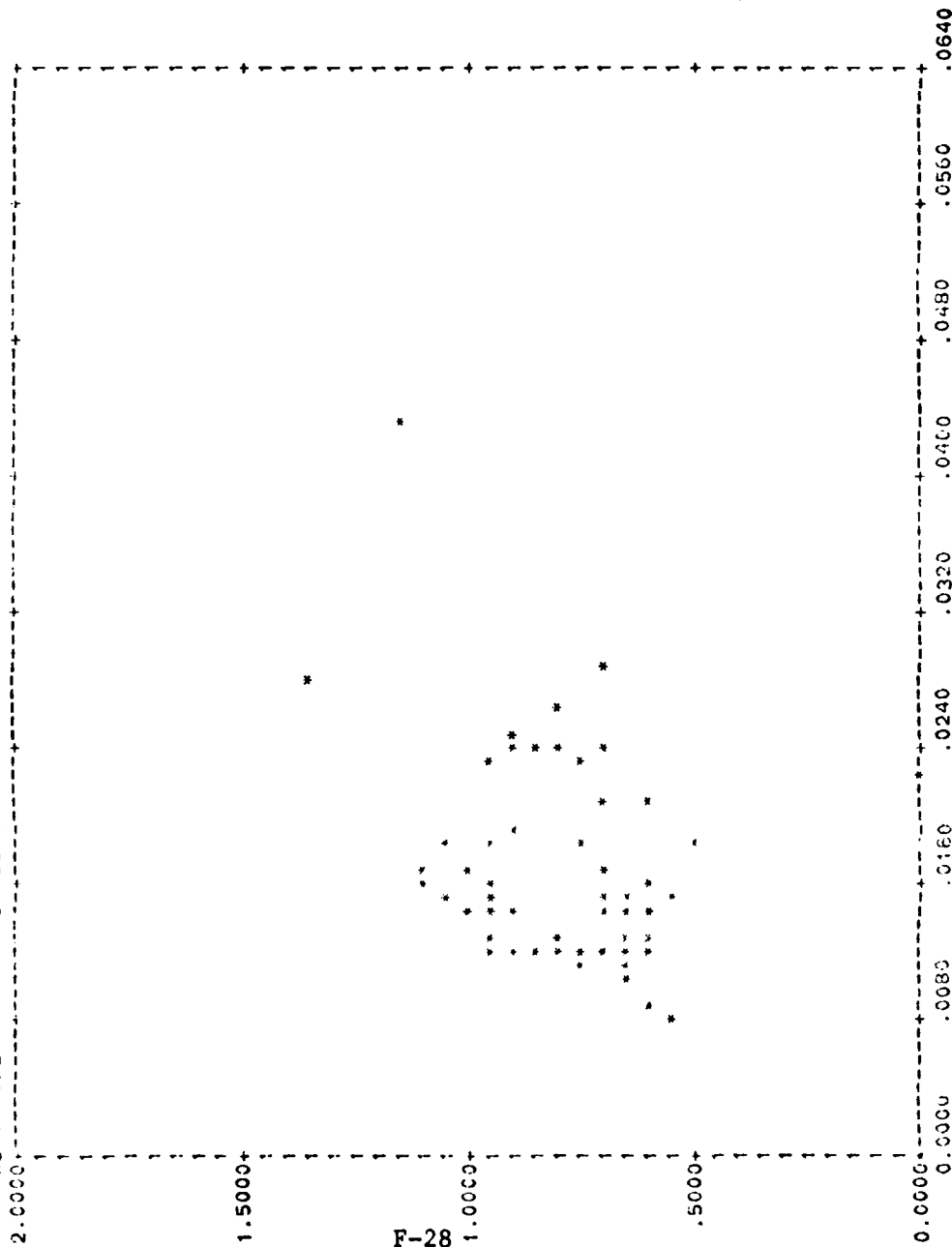


F-27

REGRESSION OF = 1.001543396101843 VS = .001543396101343
RESIDUAL OF = 1.001543396101843 VS = .001543396101343
TOTAL OF = 1.001543396101843 VS = .001543396101343
F-TEST OF = 1.001543396101843 VS = .001543396101343
SE OF ESTIMATE = 1.001543396101843 VS = .001543396101343
SCORE OF = 1.001543396101843 VS = .001543396101343
INTERCEPT EST = 1.001543396101843 VS = .001543396101343

SYSTEM CV-1
 VARIABLE= AVERAGE LENGTH OF SERVICES BY AIRCRAFT
 DEPENDENT VARIABLE= AVERAGE USAGE

NO. OF OBS. = 64



F-28

0.0000+ .0080 .0160 .0240 .0320 .0400 .0480 .0560 .0640

ANOVA TABLE

REGRESSION	DF=	SS=	MS=
RESIDUAL	62	1.597119412965	.02575999053169
TOTAL	63	1.830892234375	

F-TEST= 9.075038222039

R**2= 12.76824583235

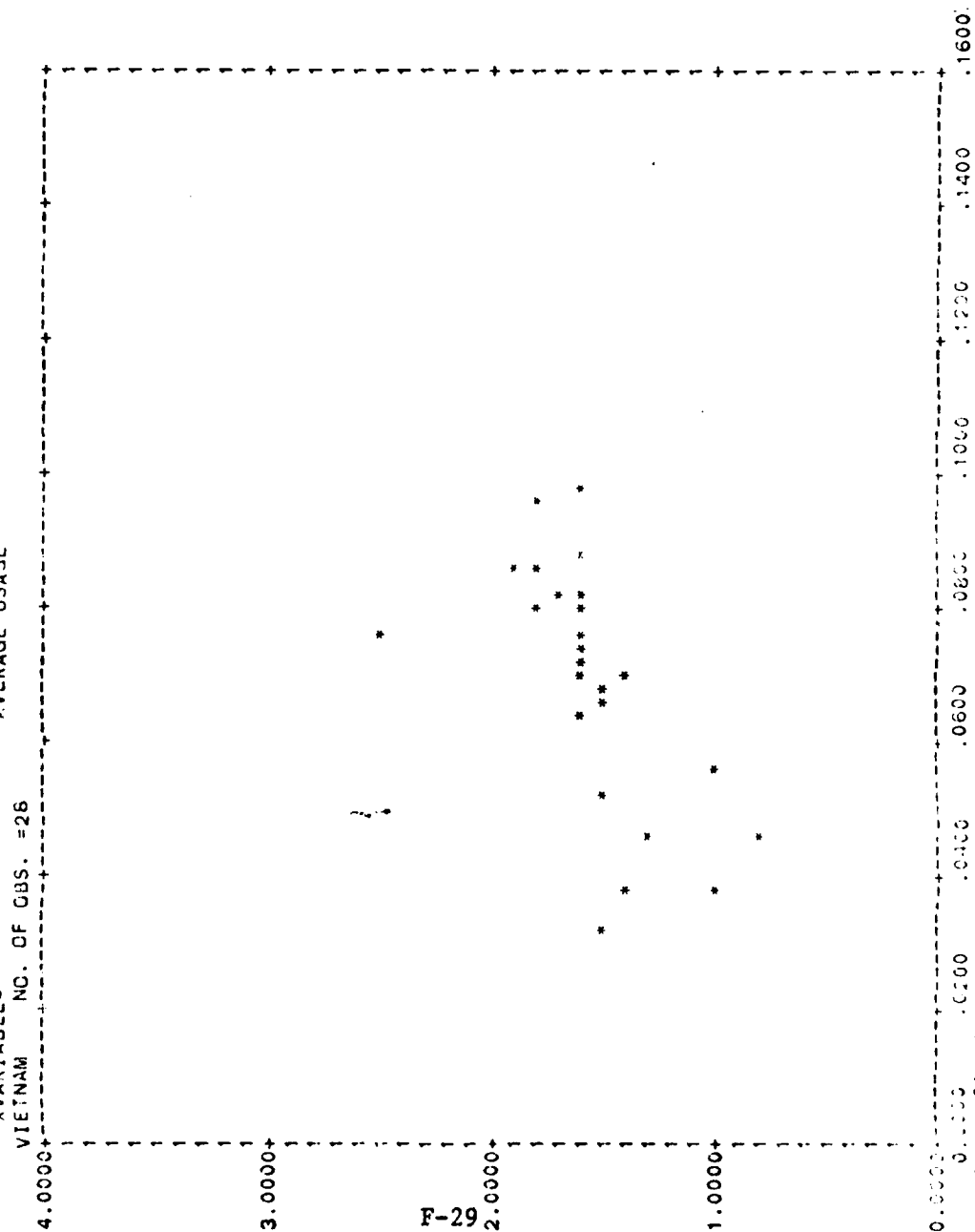
S= .1604991916855

CORRELATION EST= .3573260228433

SLOPE EST= 10.11154087364

INTERCEPT EST= .6240390222234

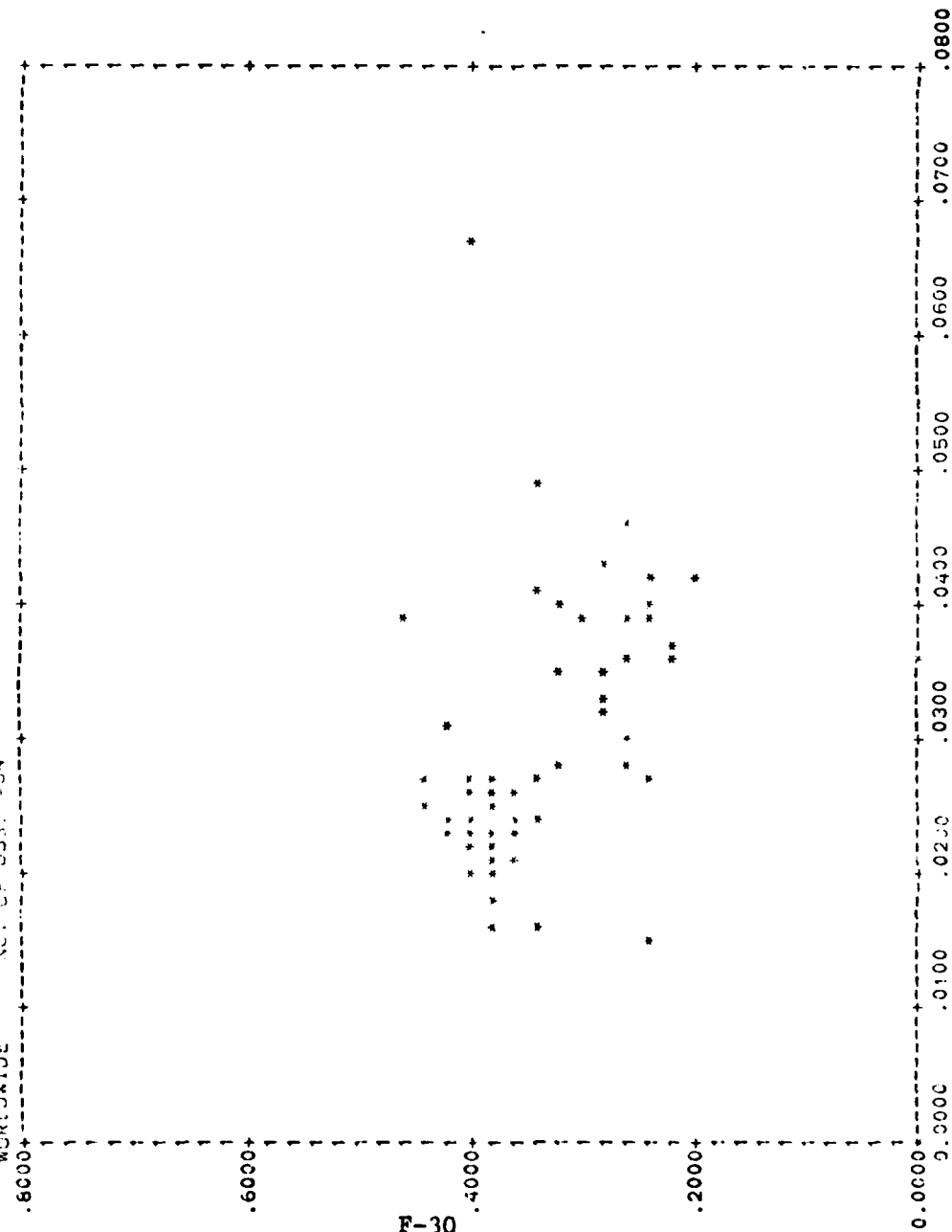
SYSTEM=OV-1
Y VARIABLE= AVERAGE LENGTH OF SORTIES BY AIRCRAFT
X VARIABLE= AVERAGE USAGE
VIETNAM NO. OF OBS. =26



REGRESSION TABLE
DEGREES OF FREEDOM: 1
SS: 1.015215256432 MS: 1.015215256432
RESIDUALS: 25
SS: 1.015215256432 MS: 1.015215256432
TOTAL: 26
SS: 2.030430512864 MS: 2.030430512864
F-TEST: 1.015215256432
P-VALUE: 0.0000000000
CORRELATION: .774
INTERCEPT EST: .784
SLOPE EST: 1.015215256432

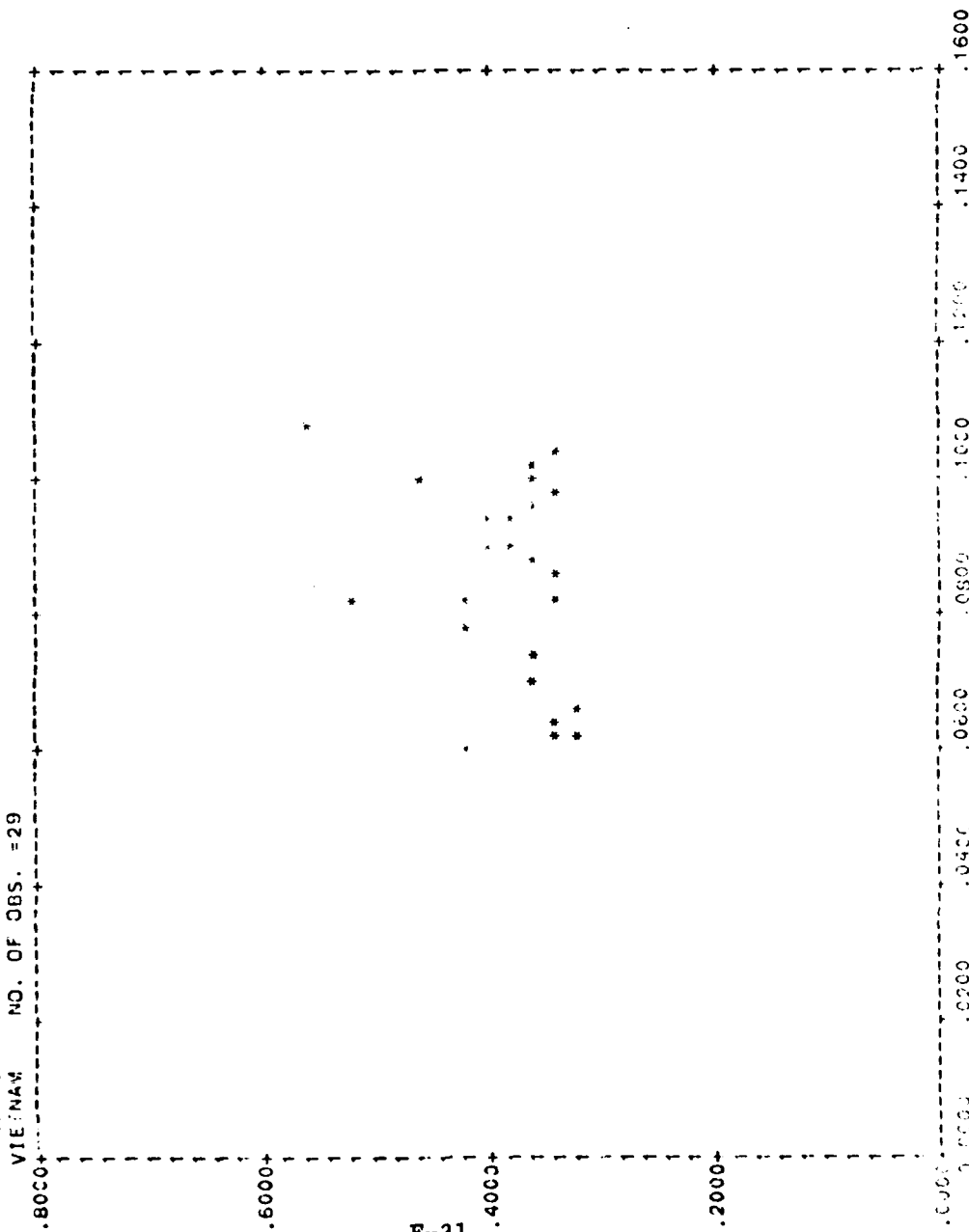
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93	93
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95	95
96	96
97	97
98	98
99	99
100	100

AVERAGE NUMBER OF SEATLINES BY AIRCRAFT
AVERAGE USAGE



ANOVA TABLE			
REGRESSION	DF= 1.	SS= .05096671192717	MS= .05096671192717
RESIDUAL	DF= 62.	SS= .2370372724478	MS= .003823181813675
TOTAL	DF= 63.	SS= .288005984375	
F-TEST=	13.3149647342	CORRELATION EST=	-.4230792327851
W*2=	17.62710168967		
S*2=	.06183188237184	INTERCEPT EST=	.4230792327851
SLOPE EST=	-2.952857312052		

SYSTEM=UII-1
 YVARIABLE=
 XVARIABLE=
 VIE: NAM NO. OF OBS. =29
 AVERAGE LENGTH OF SORTIES BY AIRCRAFT
 AVERAGE USAGE



F-31

REGRESSION: D.F. 1, SS= .0000475996629 MS= .00500475996629
 RESIDUAL: D.F. 27, SS= .0000248141302 MS= .0000919041659700
 TOTAL: D.F. 28, SS= .0000724137931
 F-TEST: F(1,27)=0.023073
 Y=42= .0000000000
 S= .0000000000
 SLOPE EST= .001100110227 INTERCEPT EST= .0000000000

APPENDIX G

SAMPLE DATA COLLECTION - BRIGHT STAR EXERCISE

UH-60 - BLACKHAWK

REGRESSION ANALYSIS

Y VARIABLE
(DEPENDENT)

TOTAL SORTIES
MAINTENANCE EVENTS
PER FLYING HOUR
MAINTENANCE EVENTS
MAINTENANCE SORTIES
MAINTENANCE MANHOURS
MAINTENANCE MANHOURS

X VARIABLE
(INDEPENDENT)

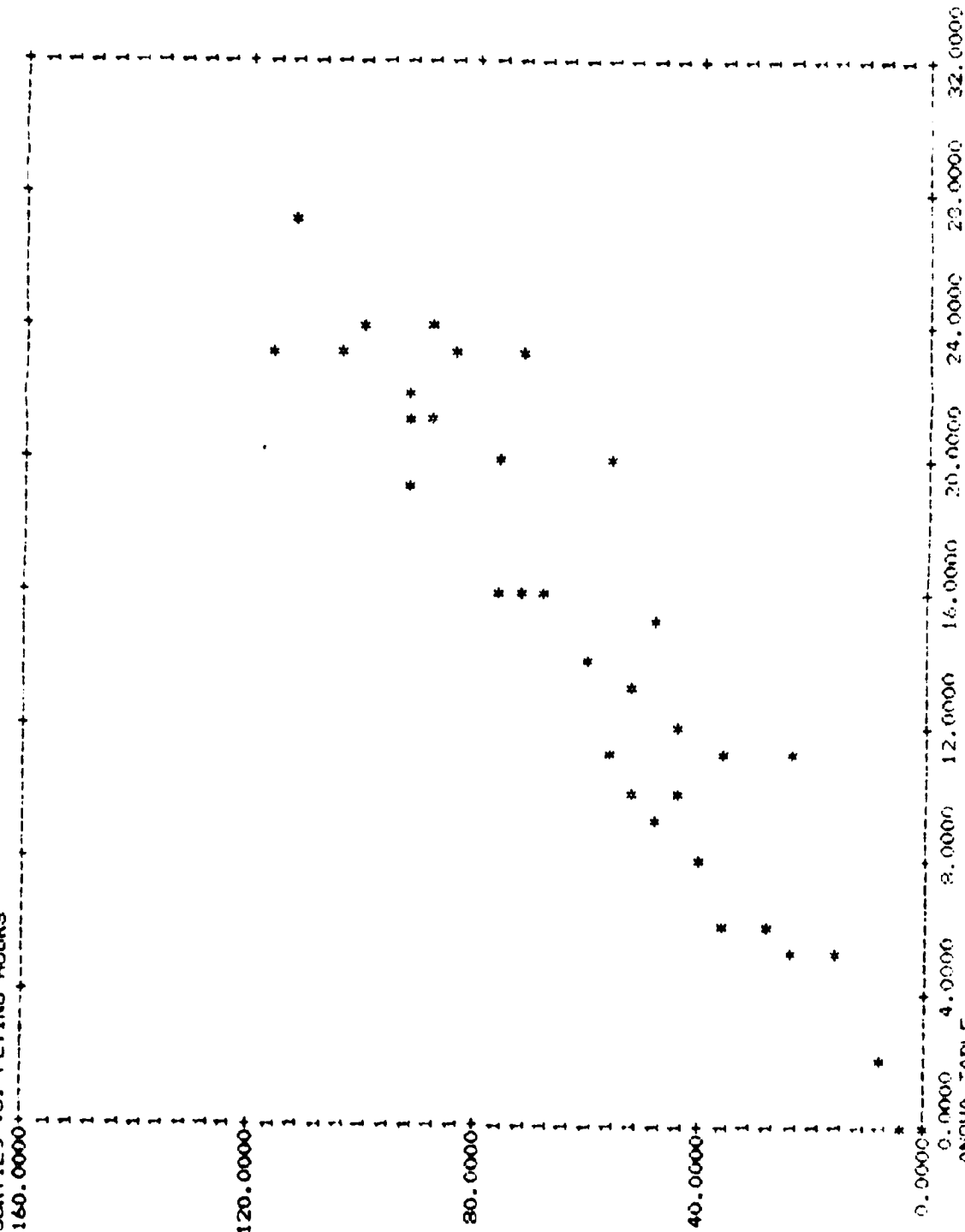
TOTAL FLYING HOURS
SORTIE LENGTH

FLYING HOURS
SORTIES
SORTIE LENGTH
FLYING HOURS

SYSTEM= UH-60 BLACKHAWK

SAMPLE DATA COLLECTION DATA BRIGHT STAR-EXERCISE

SORTIES VS. FLYING HOURS



G-1

REGRESSION

RESIDUAL

TOTAL

MS=

22984.38251525

22984.38251525

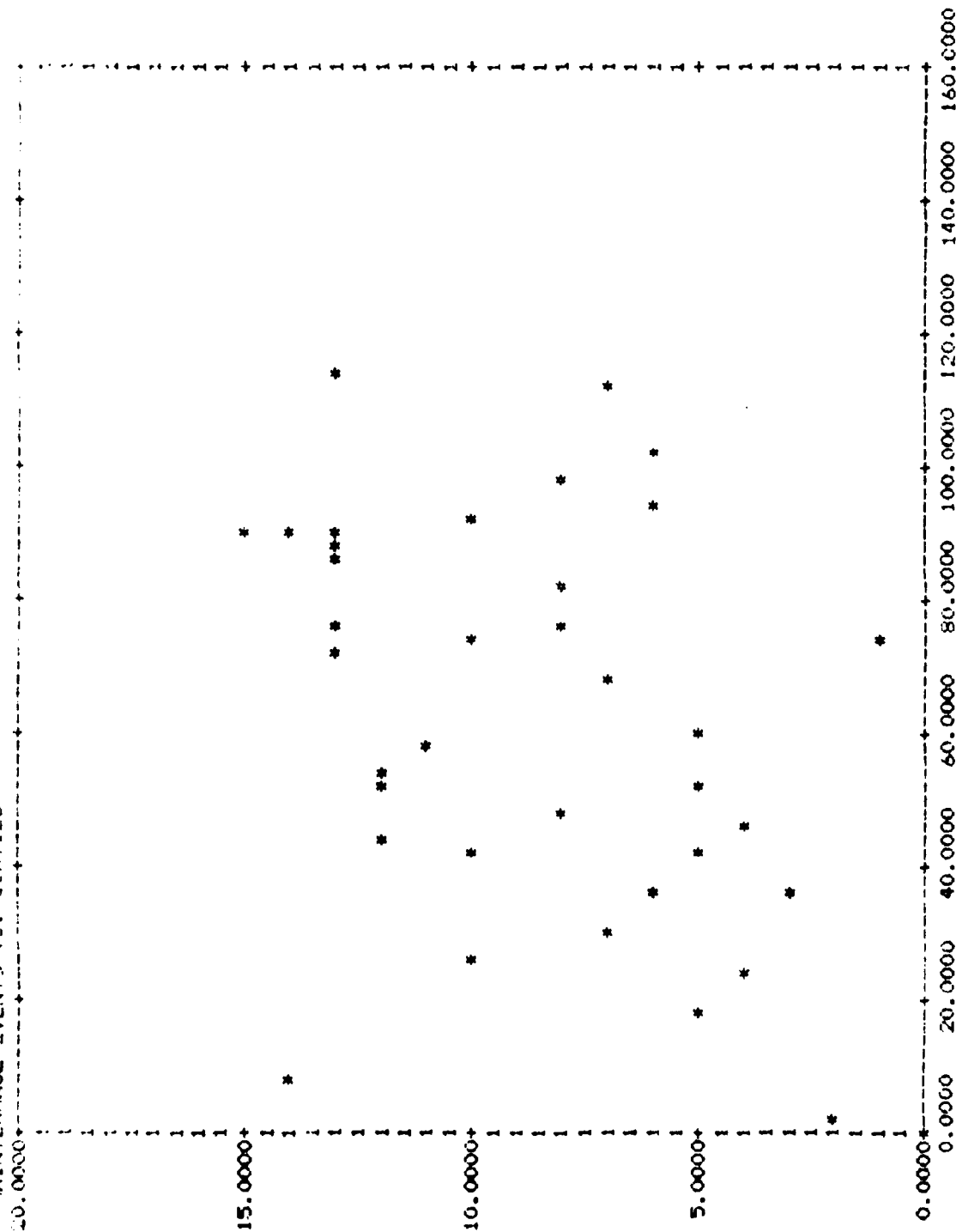
22984.38251525

SYSTEM= UH-60. BLACKHAWK

SAMPLE DATA COLLECTION DATA

BRIGHT STAR EXERCISE

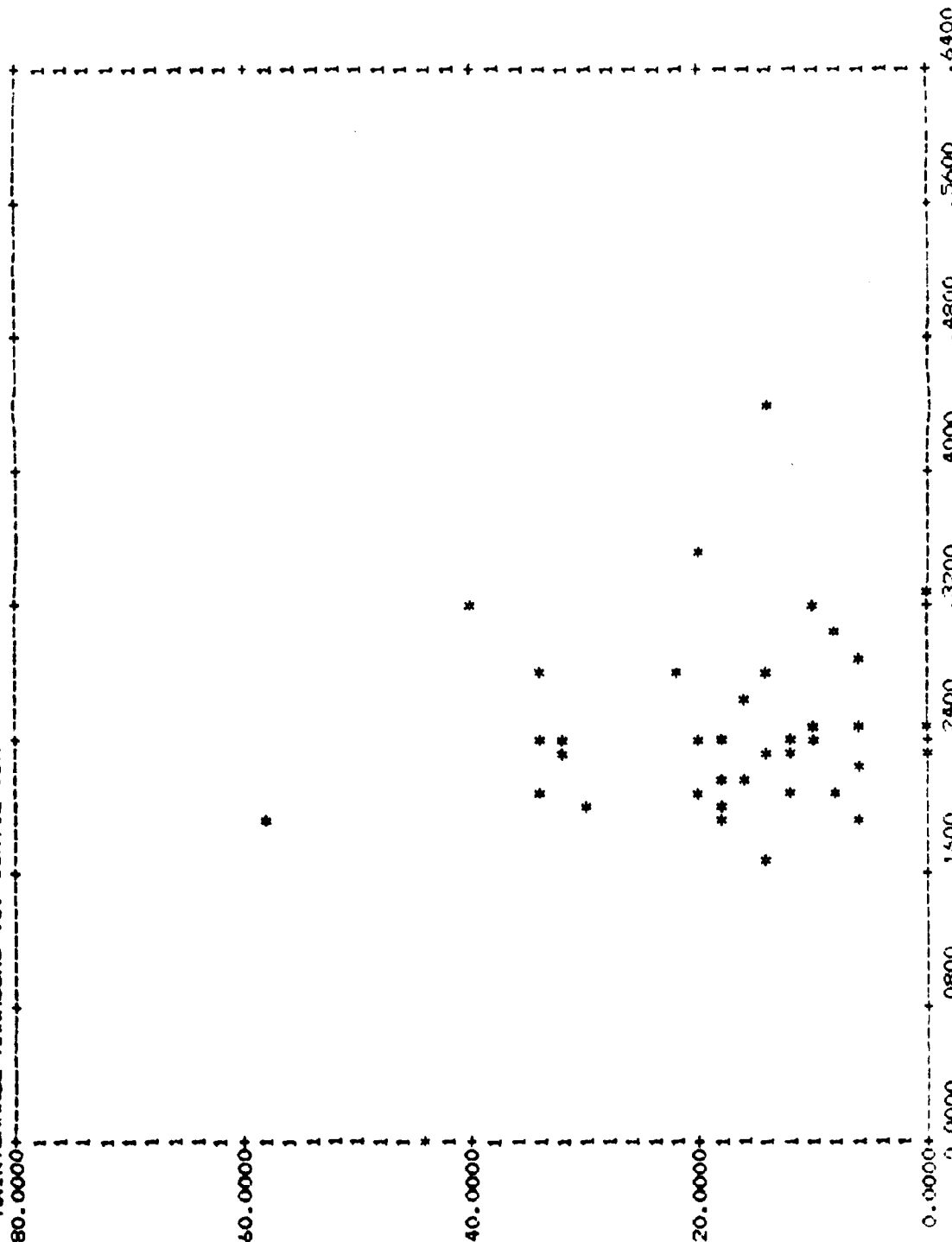
MAINTENANCE EVENTS VS. SORTIES



SYSTEM= UH-60, BLACKHAWK

SAMPLE DATA COLLECTION DATA BRIGHT STAR-EXERCISE

MAINTENANCE MANHOURS VS. SORTIE LENGTH



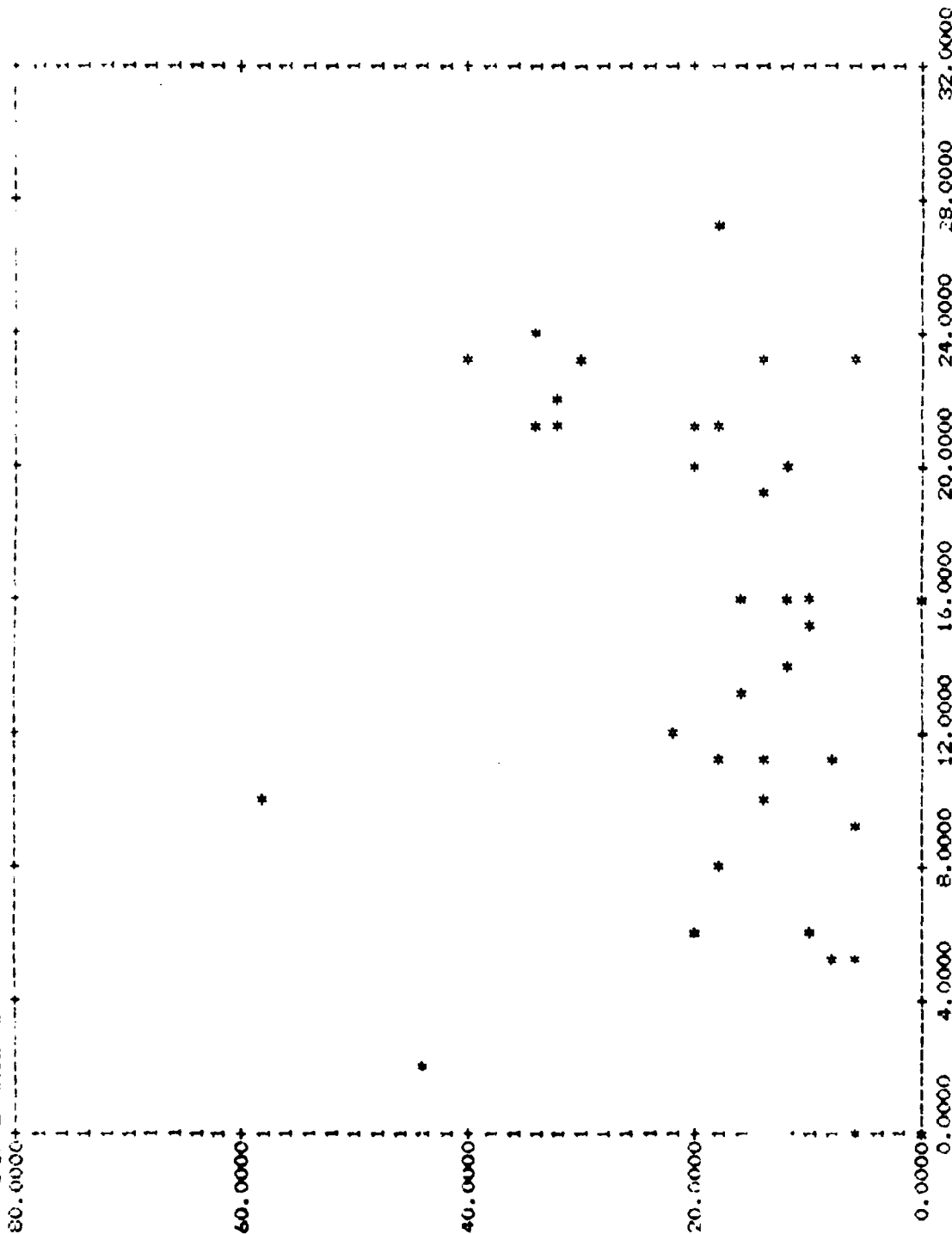
ANOVA TABLE

REGRESSION	DF= 1.	SS= 44.24535155002	MS= 44.24535155002
RESIDUAL	DF= 33.	SS= 4960.893505593	MS= 150.3301062301
TOTAL	DF= 34.	SS= 5005.138857142	
F TEST= 294.3212950459			
R**2= .882928476171	CORR EST= .9402110049472		
S(1) EST= -31.34035189063	R(0) EST= 23.4516720099		

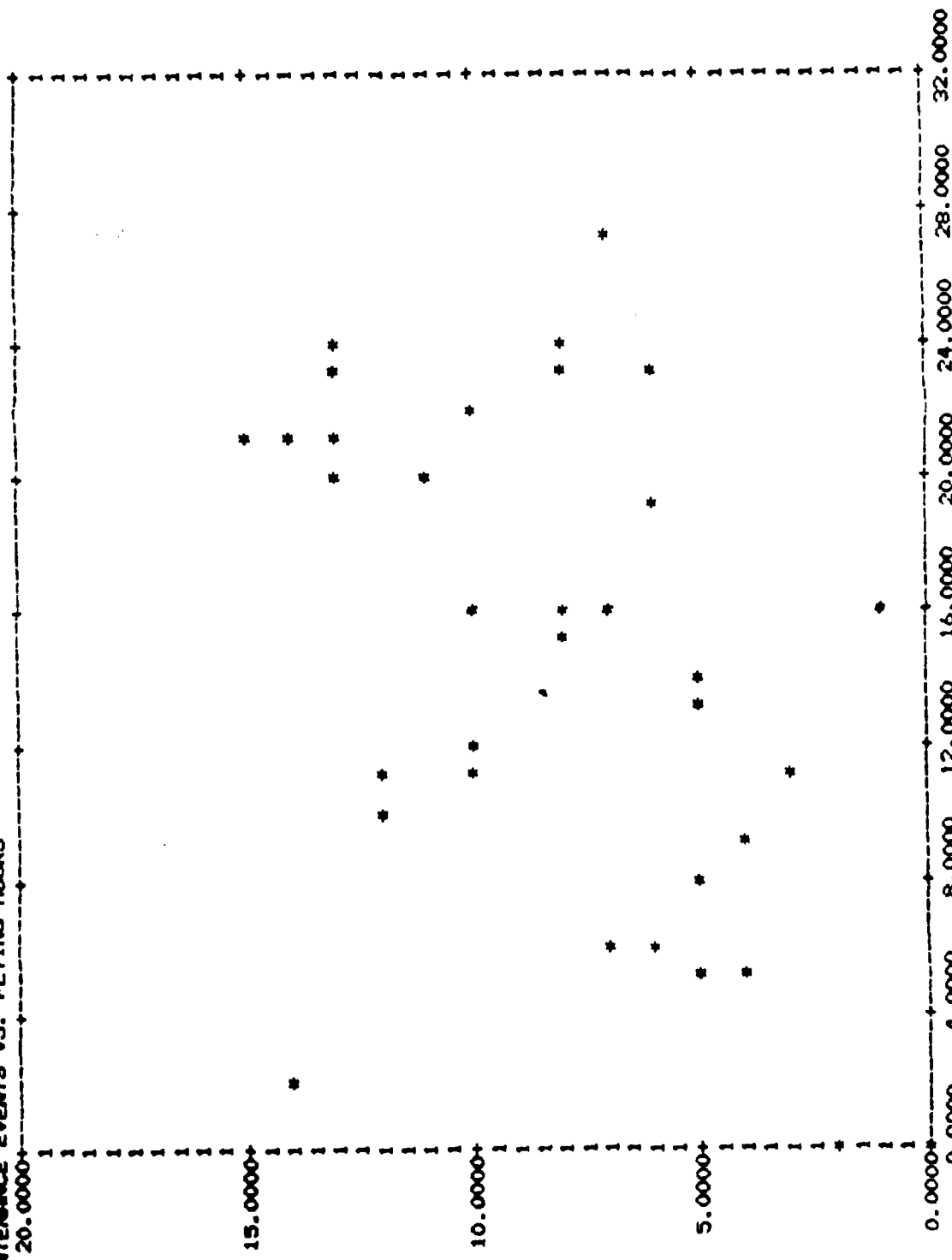
SYSTEM= UH-60, BLACKHAWK

SAMPLE DATA COLLECTION DATA BRIGHT STAR-EXERCISE

MAINTENANCE MANHOURS VS. FLIGHT HOURS



MAINTENANCE EVENTS VS. FLYING HOURS



G-5

ANOVA TABLE

REGRESSION	DF= 1.	SS= 51.24658348282	MS= 51.24658348282
RESIDUAL	DF= 33.	SS= 422.29627366	MS= 12.79685677758
TOTAL	DF= 34.	SS= 473.5428571429	

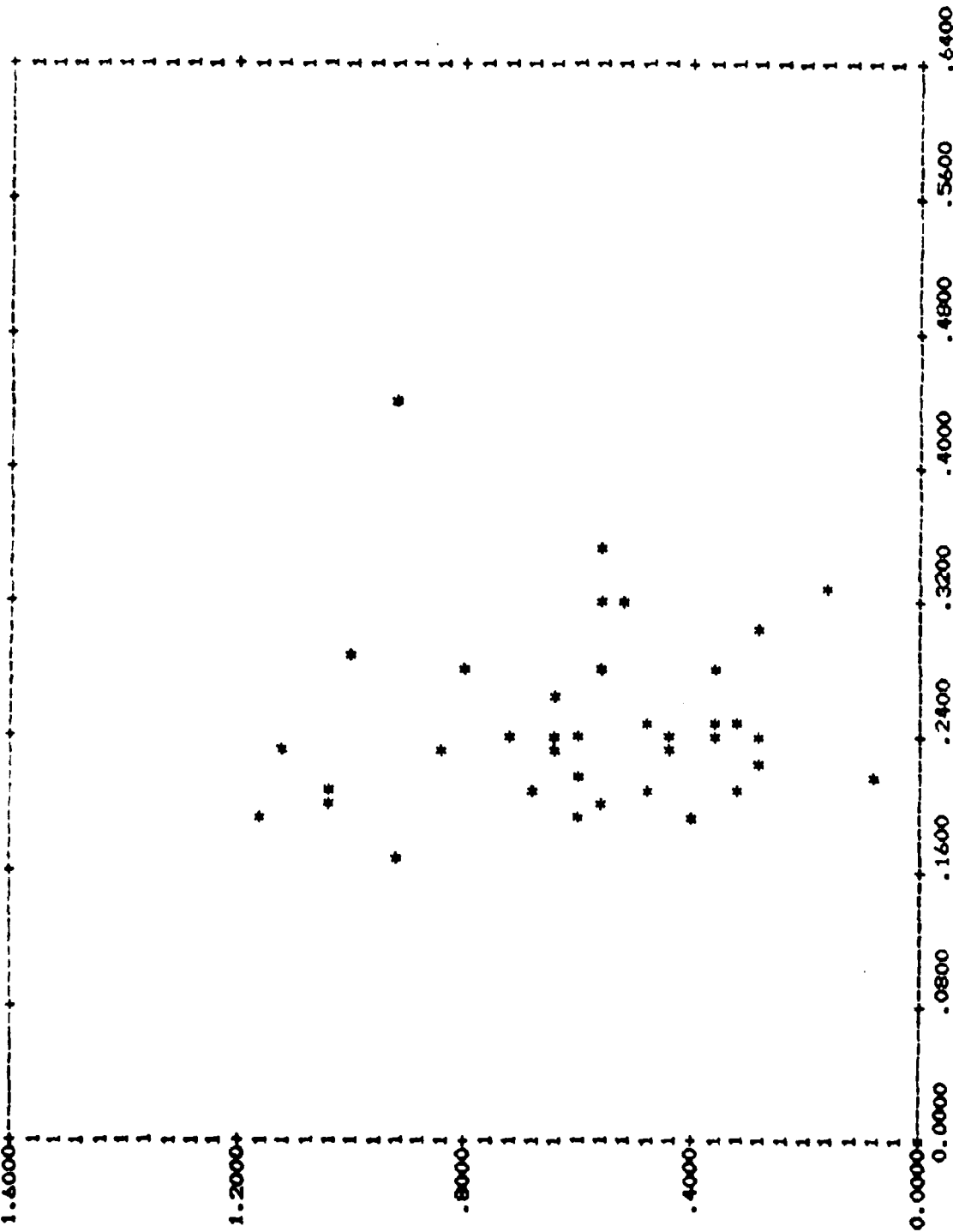
F-TEST= 4.004622726779
R**2= 10.82195258778
B(1) EST= .1822609919621
CORR EST= .3289673629371
R(0) EST= 6.052857724932

SYSTEM= UH-60, BLACKHAWK

SAMPLE DATA COLLECTION DATA BRIGHT STAR-EXERCISE

EVENTS/FLYING HOURS VS. AVG.

SORTIE LENGTH



ANOVA TABLE

REGRESSION	DF=	SS=	MS=
RESIDUAL	35.	2.721530690765	0.07775801973616
TOTAL	36.	2.742589189189	

F-TEST= .2708209197608
R**2= .7678327657212
B(1) EST= -.4524370360757
CORR EST= -.08762606722438
B(0) EST= .6930750822434

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