ROTATABLE POOL ALLOWANCE FORECASTING

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This report describes an analysis conducted to determine the relationship between number of aircraft deployed and repairs performed in support of these aircraft by an aviation maintenance activity. An assumption of the linearity of this relationship is basic to a recent proposal for forecasting requirements for items contained in rotatable pools. It was found that a direct linear relationship between number of aircraft and number of repairs does not exist, and thus any forecasting technique based on this assumption would be invalid.

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REPORT 88

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ABSTRACT

This report describes an analysis conducted to determine the relationship between number of aircraft deployed and repairs performed in support of these aircraft by an aviation maintenance activity. An assumption of the linearity of this relationship is basic to a recent proposal for forecasting requirements for items contained in rotatable pools. It was found that a direct linear relationship between number of aircraft and number of repairs does not exist, and thus any forecasting technique based on this assumption would be invalid.

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I. INTRODUCTION

The objective of this study is to validate the underlying assumption of a proposed rotatable pool allowance forecasting program. This program, as set forth at the Aviation Supply Officers Conference held at ASO (Navy Aviation Supply Office) in October 1971, was developed by NAS Oceana to compute the size of rotatable pools at the IMA (Intermediate Maintenance Activity) level. Basically, the proposed program: (1) relates IMA repairs, by item, for a given time frame to the particular type, model, and series of aircraft on which the item was installed; (2) multiplies this number of repairs by the ratio of the anticipated number of aircraft (carrying this item) to the number of aircraft supported at the time the repairs were effected; (3) translates this forecast to a monthly average; and (4) utilizes this monthly repair forecast in accordance with the ASO rotatable pool instruction (FASOINST 4700.25E of 10 March 1970) to arrive at the prescribed rotatable pool quantity.

The underlying assumption made in the program is that there is a direct, linear relationship between number of aircraft supported and repairs on installed equipments. Although it is inherent that this hypothesis is true for repairables which are scheduled for overhaul on a cyclic basis, the validity of the hypothesis is not evident when considering the universe of cyclic and routine repairs.

The purpose of this study is to determine the validity of the linearity assumption prior to devoting further resources to evaluation and documentation of the NAS Oceana proposal.

II. APPROACH

In testing the linear relationship between number of aircraft supported and repairs on installed equipments, a correlation analysis was employed. Correlation analysis indicates the degree of linear association between two variables. The measure of correlation, referred to as the correlation coefficient, lies between +1.0 and -1.0. If the value of this coefficient is positive, it indicates that as one variable increases, the other variable also increases. Conversely, if the correlation coefficient is negative, it implies that as one variable increases the other decreases.

If there is a perfect correlation between number of aircraft and number of repairs, the coefficient will be +1.0. As the coefficient moves from +1.0 toward zero, the strength of the linear association weakens. A negative coefficient indicates that the variables are inversely proportional.

Six master jet activities and all major aircraft assigned to these activities were selected for this analysis. These activities and the major types of aircraft at each activity are listed in Appendix A. The time frame used for the analysis was Calendar Year 1971.

The repair data utilized to perform the correlation analysis were obtained from the 3M (Maintenance and Material Management) data base at MSO (Maintenance Support Office). These data included all repairs performed on the major aircraft types deployed at the selected activities. Repair data for interchangeable items were consolidated under the FIIN designated as the prime or family head. Since an item must be repaired

at least once a month to qualify for a rotatable pool, all items with less than three repairs per quarter for a given activity/aircraft were not considered in this study. The repair data for each FIIN were summarized by quarter (four quarterly observations) for each activity/aircraft.

To test the linear relationship between the number of aircraft supported and the number of repairs performed, the summarized quarterly repair data for each FIIN were correlated with the number of supported aircraft on which the FIIN was installed. Thus, for each FIIN/activity/aircraft combination there are four observations on number of repairs performed and four observations on number of aircraft supported. A correlation coefficient was computed on the basis of these four pairs of observations for each item applicable to each activity/aircraft.

III. FINDINGS

A frequency distribution of the correlation coefficients for all FIIN/activity/aircraft combinations is shown in TABLE I. As used in TABLE I, the term "Observation" refers to a correlation coefficient for a given FIIN installed on a given aircraft at a given activity. For example, the correlation coefficient for FIIN A on an F-4J at NAS Oceana would represent one observation, while the correlation coefficient for FIIN A on an F-4J at NAS Miramar would represent a separate observation.

TABLE I

FREQUENCY DISTRIBUTION

CORRELATION RANGE	NO. OF OBSERVATIONS	% OF OBSERVATIONS	CUMULATIVE %
≤ 0	274	29.9%	29.9%
.01 - .50	205	22.4%	52.3%
.51 - .70	132	14.5%	66.8%
.71 - .80	84	9.2%	76.0%
.81 - .90	115	12.5%	88.5%
.91 - 1.00	105	11.5%	100.0%
TOTAL	915	100.0%	

Approximately 30% of the correlation coefficients are negative, indicating an inverse relationship between number of repairs and number of aircraft supported; i.e., as the number of aircraft increases, the number of repairs decreases and vice versa. Only 33% of the observations had a correlation coefficient greater than .70, indicating a reasonably strong positive linear correlation exists for these items.

Frequency distributions for each individual activity/aircraft combination are shown in Appendix B. Although the correlation coefficient distributions vary from activity to activity and even across aircraft at the same activity, none of the observed activities showed a strong linear correlation between number of repairs and number of aircraft supported.

IV. CONCLUSION

The purpose of this study was to validate the hypothesis that there is a direct linear relationship between the number of aircraft supported

and the number of repairs on installed equipments. This relationship was verified for only 33% of the cases observed. The study indicated that this relationship does exist for some items for each tested activity/aircraft combination, but these items are outnumbered by items for which a strong correlation does not exist.

APPENDIX A: Activities and Types of Aircraft

ACTIVITY	TYPE OF AIRCRAFT
NAS OCEANA	F-4B
NAS OCEANA	F-4J
NAS OCEANA	A-6A
NAS OCEANA	A-6B
NAS OCEANA	KA-6D
NAS CECIL FIELD	A-7A
NAS CECIL FIELD	A-7B
NAS CECIL FIELD	A-7E
NAS ALBANY	RA-5C
NAS MIRAMAR	F-4B
NAS MIRAMAR	F-4J
NAS MIRAMAR	F-8H
NAS MIRAMAR	F-8J
NAS MIRAMAR	RF-8G
NAS LEMOORE	A-7A
NAS LEMOORE	A-7B
NAS LEMOORE	A-7E
NAS LEMOORE	A-4F
NAS WHIDBEY ISLAND	A-6A
NAS WHIDBEY ISLAND	EA-6B

APPENDIX B: Frequency Distributions for Individual Activities/Aircraft

CORRELATION RANGE	NAS OCEANA F-4B	NAS OCEANA F-4J	NAS OCEANA A-6A	NAS OCEANA A-6B	NAS OCEANA KA-6D
≤ 0	4	25	52	0	2
.01 - .50	1	12	20	2	2
.51 - .70	5	13	13	0	2
.71 - .80	4	3	8	0	1
.81 - .90	5	3	9	0	1
.91 -1.00	7	1	3	0	0
Total FIINs	26	57	105	2	8

CORRELATION RANGE	NAS CECIL FIELD A-7A	NAS CECIL FIELD A-7B	NAS CECIL FIELD A-7E	NAS ALBANY RA-5C
≤ 0	1	2	15	72
.01 - .50	1	6	14	39
.51 - .70	2	3	8	14
.71 - .80	3	9	4	7
.81 - .90	5	9	7	8
.91 -1.00	10	10	2	1
Total FIINs	22	39	50	141

CORRELATION RANGE	NAS MIRAMAR F-4B	NAS MIRAMAR F-4J	NAS MIRAMAR F-8H	NAS MIRAMAR F-8J
≤ 0	3	16	0	19
.01 - .50	8	17	2	9
.51 - .70	5	12	1	2
.71 - .80	2	5	2	3
.81 - .90	2	12	4	6
.91 -1.00	9	15	0	1
Total FIINs	29	77	9	40

CORRELATION RANGE	NAS MIRAMAR RF-8G	NAS LEMOORE A-7A	NAS LEMOORE A-7B	NAS LEMOORE A-7E
≤ 0	2	1	2	8
.01 - .50	0	2	11	12
.51 - .70	2	4	4	19
.71 - .80	2	3	2	12
.81 - .90	1	7	2	7
.91 -1.00	2	8	6	9
Total FIINs	9	25	27	67

CORRELATION RANGE	NAS LEMOORE A-4F	NAS WHIDBEY ISLAND A-6A	NAS WHIDBEY ISLAND EA-6B
≤ 0	0	50	0
.01 - .50	2	45	0
.51 - .70	3	20	0
.71 - .80	0	14	0
.81 - .90	5	22	0
.91 -1.00	3	17	1
Total FIINs	13	168	1