MAINTENANCE OF SUPPLIES AND EQUIPMENT

TECHNIQUES FOR DETERMINING OPTIMAL OPERATIONAL READINESS FLOAT

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PREFACE

The techniques presently in use for calculating operational readiness float levels do not take into consideration the random nature of failures or the desirability to allocate stock levels to minimize the associated costs. A more sophisticated mathematical model taking these important points into account is presented herein. This procedure determines stock levels required to meet a desirea float-availability goal at a minimum cost by using past demand data or appropriate estimates. To assist the reader in understanding the techniques presented in this pamphlet, it is suggested that he read appendix E. Definition of Terms and Phrases, before reading the rest of the pamphlet.

CHAPTER 1

INTRODUCTION

1-1. <u>Purpose</u>. a. This pamphlet presents techniques for determining the optimum allocation for operational readiness float. The float is optimized on the basis of achieving a desired float-availability at a minimum cost. The procedure may be divided into two separate parts. One part is used for calculating float levels based on estimated parameters. The other part is used for calculating float levels based on estimated on historical float demands. The procedure provides the user with a dual capability: (i) he is able to determine initial float allocation levels for systems with little or no usage data, and (i) when historical data become available, he is able to modify initial float levels to reflect past occurrences. To assist the user in obtainment of the optimal float allocation.

b. This model is formulated to determine the operational readiness float allocations for a set of identical end items. However, the formulation is still valid if applied to a group of different end item types. The float-availability resulting from such application will be applicable to the group of end item types. The respective float-availabilities of each end item type comprising the group will be greater than the floatavailability of the group.

1-2. <u>Scope</u>. This pamphlet applies to Headquarters, U.S. Army Materiel Command (AMC); AMC major subordinate commands; project/product managers; and separate installations and activities reporting directly to Headquarters, AMC.

1-3. <u>General</u>. a. The analytical derivation of the procedure is detailed in chapters 2 and 3. Chapter 2 presents the general procedure including the optimizing technique, and chapter 3 discusses the procedure's formulation with and without historical demand information. Chapter 4 presents the coding formats for each part of the procedure.

b. The appendixes contain the computer program and sample input and output data for the two parts of the procedure. Possible model variations are also briefly discussed in the appendixes.

c. The source deck for the operational readiness float allocation procedures (appendix C) is available upon request from the AMC Maintenance Support Center, Applied Science Division. Letterkenny Army Depot, Chambersburg, Pennsylvania 17201 (AUTOVON 242-7739).

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GENERAL PROCEDURE

2.1. Ceneral. The model presented in this pamphlet is used to determine component-end-item-float levels for operational readiness float. The objective of this model is to determine float levels which enable operational readiness float to meet a prespecified float availability goal at a minimum cost. 1

2-2. Assumptions. a. Assumptions which are inherent in the general formulation of this model are listed below.

(1) The end item can be subdivided into mission essential component end items.

(2) Component end item failures are independent.

(3) The failure rate of a component end item in float is negligible compared to its operational failure rate.

(4) The float demands for each component end item follow a Poisson process.

(5) The float cost of any component end item is directly proportional to the quantity of that end item in float.

b. Assumptions in a(1) and (1) above are inhorent in AP 750-10. These assumptions require that a maintenance analysis be performed to segment the end item into component end items which are mission essential and that fail independently. The determination of mission essentiality is made in reference to an overall mission objective of the end items to be supported, not just one particular field mission.

c. The Poisson demand assumption specifies that the occurrence of a failure of a component end item of type I, from a population of M component end items of type I, is described by a Poisson process. This is not stipulating that any one component end item fails exponentially, i.e., by a Poisson process.

2-3. Overview of Computation Procedures. a. The first step in obtaining the optimum float levels is to determine for each component end item the probability that the quantity of that component end item in the repair/resupply channel is less than or equal to the quantity of that end item in float. The quantity of component end items in float may vary from zero to a predetermined float stock level limit. Calculation of the probability can be performed by two methods. The choice of methods is

The cost is a minimum for the calculated float-availability which may be equal to or greater than the float-availability goal. ANCP /50-6

dependent upon the existence of historical demand information. If demand data on component end items are unavailable, as in the case of a new end item, estimated component end item reliability and maintainability parameters will be used in conjunction with the Poisson distribution to arrive at the float-availability associated with the various float levels of each component end item. If sufficient demand data are available, they are utilized through application of Baysian inference and the foisson distribution to arrive at the float-availability. These two methods are individually discussed in chapter 3.

b. The float-availability for a particular set of float levels is represented by the product of the component-end-item floatavailabilities of the appropriate component end items. The componentend-item-float-availability increases as the float level of that component end item is increased, thus increasing float-availability.

c. There are numerous float level combinations that enable the operational readiness float to meet a prespecified float-avail bility. The problem is to find the least expensive combination based upon the unit cost of the component end items.

d. The minimum cost float allocation is determined by an incremental process. Beginning with no component end items in float, the float-availability is calculated. If this value is below the floatavailability goal, an additional component end item for float is selected on the basis of utility, i.e., having the greatest increase in the floatavailability per dollar expended. For each component end item, the utility differs with the quantity of that component end item in float. This process is repeated until the desired float-availability is achieved. The optimum float allocation is that allocation first encountered in the process which achieves the desired float-availability.

2-4. Incremental Process Example. a. To help illustrate the incremental process, an example is included below. The end item considered for this example consists of two component end items, unit A and unit B. The component-end-item-float-availability calculated for each component end item relative to its respective float level and unit costs is listed in table 2-1. (See chapter β , equations (1) and (3) for calculation procedures.)

Component			Componen	t End It	ems In F	loat		Unit
End Item	0	1	2	3	4	5	6	Cost
A	0.368	0.736	0.920	0.981	0.996	0.999	≈1.000	\$1,000
В	0.607	0.910	0.986	0.998	≃1.000	≃1.000	≈1.000	\$5,000

Table 2-1. Component-End-Item-Float-Availabilities Relative to Float Levels

2-2

b. The steps and example results of the incremental process are as follows.

(1) Compute the natural logarithms for each component end item's set of float availabilities, corresponding to the various float levels (table (-)).

Component			Compone	ent End I	tems In F	loat	
End Item	0	1	2	3	4	5	6
Α	-0.999	-0.307	-0.083	-0.019	-0.004	-0.001	0.000
В	-0.499	-0.094	-0.014	-0.002	U.000	0.000	0.000

Table 2-2. Natural Logarithm of Component-End-Item-Float-Availabilities

(2) For each component end item, successively compute the change in the natural logarithm of its component-end-item-float-availability resulting from the addition of one more unit of that component end item to float. This is the marginal increase. (See table 2-3 for results.)

Table 2-3. Marginal Increase in Natural Logarithm of Component-End-Item-Float-Availability

Component		Com	onent End	Items In 1	Float	
End Item	1	2	3	4	5	6
A	0.692	J.224	0.064	0.015	0.003	0.001
В	0.405	0.080	0.012	0.002	0.000	0.000

(3) Divide the marginal increase by the unit cost to obtain the marginal utility resulting from the addition of each unit to float. (See table 2-4 for results.)

Table 2-4. Marginal Utility

Com	onen	t	Compo	nent End It	ems In Floa	t	
End	Item	1	2	3	4	5	6
	A	6.93×10^{-4}	$2,23 \times 10^{-4}$	6.42x10-5	1.52x10-5	3.01x10-6	1.0x10-6
	В	8.10x10 ⁻⁵	1.60×10^{-5}	2.42x10-6	4.00x10-7	-	-

(4) For each component end item order the marginal utilities from the largest to the smallest.

(5) Compute the natural logarithm of the float-availability goal. (No goal is presented in the example.)

(6) Allocate component end item float stockage in an optimal manner by adding a float, a unit of the component end item with the greatest marginal utility, until the float-availability goal is achieved or exceeded (table -5).

(7) Optimal component end item float stockage levels are those that result in the calculated float-availability being equal to or greater than the float-availability goal.

c. The two methods used to calculate the probability of adequate float are discussed in phases 3.

Cost	Float-Availability	Unit B	Unit A
\$ C	.224	0	0
1,000	. 446	0	1
2,000	.560	0	2
7,000	. 839	1	2
8,000	. 892	1	3
13,000	.968	2	3
14,000	.981	2	4
15,000	.985	2	5
20,000	.997	3	ç
21,000	.998	3	ъ́
26,000	≈1,000	4	6

Table 2-5. Allocations

CHAPTER 3

DEVELOPMENT OF FLOAT MODELS

3-1. <u>General</u>. This chapter presents the underlying principles and the development of the two float level calculation methods presented and discussed in this pamphlet. The understanding of the derivations is not essential for the successful use of either model. The derivations are short and briefly discussed. They'are presented to aid in understanding the approach taken for calculating operational readiness float levels.

3-2. Method 1 - Operational Readiness Float Without Prior Data. a. Introduction and formulation of problem. In the absence of any past demand data it is necessary to derive a model which will allow the use of engineering judgment and past experience with like end items in the formulation of demand estimates. This situation can occur with new end items or with older end items that lack appropriate or meaningful data. This procedure is an application of Palm's Theorem and follows closely work done by G. J. Fenney and C. C. Sherbrooke.

b. Additional assumptions.

(1) Assumptions used in this model, in addition to those already presented are:

(a) The mean-time-between-railures, the mean-time-to-repair, the mean-transportation-time, and the mean-time-awaiting-repair are constant, at least over the interval of time for which float levels are being computed.

(b) A prior maintenance engineering analysis of failure rates and repair/resupply data has been conducted; thus all data required for this analysis are available.

(2) The first assumption is not restrictive, providing that the time between recalculations is not large, and that it describes a representative portion of the useful life of the end item(s). AR 750-19 stipulates such float factor calculations be made once a year.

(3) The second assumption is implicit in AR 750-19.

c. Development of model.

(1) The development of this model is based on a queuing theorem developed by Palm, which states that if input of a process is Poisson, then the quantity of units in the service cycle in the steady state is also Poisson for any distribution of service. The Poisson-state probabilities depend on the mean of the resupply distribution, but not on the distributional form.

(2) Stated simply, using the Poisson demand assumption, it is possible to calculate the probability of having X component end items of type I in the repair/resupply cycle at any random point in time.

Thus, the probability of having at least one unit of component end item type I available from float (probability of having X or less component end items of type I in the repair/resupply cycle) can be related to the respective float level X of component end item type I.

Define:

N	= Quantity of end items assigned to the using unit.
М	= Total number of types of component end items which are candidates for float stock.
X(I)	= Quantity of component end items, of type I in repair/resupply at any random point in time.
$^{MTBF}f^{(1)}$	<pre>= Mean-time-between-failures requiring float for component end item type I. (In calendar time.)</pre>
MTTR _f (I)	<pre>= Mean-time-to-repair/resupply for component end item type I. (In calendar time)</pre>
T(I)	= Mean-transportation-time for component end item type I.
B(I)	Mean-time-awaiting-repair/resupply for component end item type I.
W(I)	= Mean-repair/resupply-time for component end item type I (MTTK _f (I) + T(I) + B(I)).
F(I)	= Float stock level for component end item type I.
C(I)	= Unit cost to purchase, stock, and maintain in float, component end item type I.
R[F(I) MTBF _f (I), W(I), N]	= Component-end-item-float-availability for component end item type I when float stock equals F(I), given parameters MTBF(I), W(I), and N.
RG	= Float-availability goal.
F{X(I) MTBF _f (I), W(I), N}	= Probability of having X units of component end item type I in the repair/resupply channel.
SL	Maximum quantity of any component end item type which can be stocked in float.

· 3-2

(3) The probability that, at a random point in time, none of the end items are inoperable for the lack of float for component end item type I, is simply the component-end-item-float-availability of component end item type I.

This is given as:

$$R[F(I) | MTBF_{f}(I), W(I), N] = \sum_{X(I)=0}^{F(I)} F\{X(I) | MTBF_{f}(I), W(I), N\}$$
(1)
$$X(I)=0$$
For I=1, 2, 3, ---, M.

(4) The float-availability of the complement of end items is the probability that, at a random point in time, no end item is inoperable for lack of float for any component end item. This is given by:

Float availability =
$$\prod_{I=1}^{M} R[F(I) | MTBF_{I}(I), W(I), N]$$
(2)

(5) Under the Poisson demand assumption and Palm's theorem,

$$F\{X(I) | MTBF_{f}(I), W(I), N\} = \frac{\left[\frac{N \times W(I)}{MTBF_{f}(I)}\right]^{X(I)} e^{-\left[\frac{N \times W(I)}{MTBF_{f}(I)}\right]}}{X(I)!}$$
(3)
For I=1, 2, 3, ---, M, and
X(I)=0, 1, 2, ---, SL;

otherwise the total expression = 0.

(6) For convenience, let:

 $A(I) = \frac{N \times W(I)}{M^{TBF} f(I)} = in the repair/resupply cycle from the N end items assigned to the user.$

3-3

(7) Substituting equations (1) and (3) into equation (2) yields:

Float availability =
$$\frac{M}{I=1} \begin{bmatrix} F(I) & A(I) & -A(I) \\ \Sigma & ---- \\ X(I) = 0 & X(I) \end{bmatrix}$$
(4)

(8) Therefore, the problem is to minimize:

(9) Satisfying the constraint:

$$M$$

$$\Pi R[F(I) | A(I)] \ge RG$$

$$I=1$$
For F(I) \le SL, and
(6)

I =1, 2, 3, ---, M.

(10) The procedure used to solve the above objective function, subject to the one constraint, is described in section II.

3-3. <u>Method 2-- Operational Readiness Float Using Prior Data</u>. a. <u>Introduction and formulation of problem</u>. This technique uses the demand over a fixed past interval of time to estimate the float-availability resulting from operational readiness float, by allocating float levels to minimize float stock cost. The problem can be formulated as follows:

It is desired to choose float stock levels for component end items, F(I), for each of M different types of component end items which have experienced specific demands (D(I)) from a group of N end items over some fixed past interval of time so that the float-availability shall be greater than or equal to a prespecified float-availability requirement. The solution will also yield a minimum float stock cost.

b. Additional assumptions.

(1) Assumptions used in this model in addition to those already presented are:

(a) The mean-demand for any component end item during a fixed interval of time is a gamma¹ distributed random variable θ given by $f(\theta, \alpha, \beta)$; where α and β are parameters of the gamma distribution.

¹This gamma distribution of mean demands is referred to as the prior gamma distribution in the latter discussion.

(b) Historical demand data over a fixed interval of time are available for each candidate component end item for which float stock is to be established.

(2) The first assumption is supported by work done by Sherbrooke. The failure of any particular component end item in an end item composed of many such component end items is a random variable. The mean-demand of any one component end item is an unknown constant, but the mean-demand of all component end items in an end item will form a distribution of meandemands. This is the reasoning behind the mean-demand distribution assumption. The use of the log-normal distribution as well as the gamma distribution has been suggested for such applications. Although both methods are available for computer application, the gamma distribution is used in the discussion.

(3) Historical demand data necessary to satisfy the second assumption above are available by proper application of the documentation of float usage procedures specified in AR 750-19. The demand data must represent the total demands, from all end items being supported by float, for a float component end item type.

(4) The necessity of having past demand data available eliminates the use of this procedure for new end items or for end items with no failure data. This procedure will yield a result for float requirements even if all demands are zero for the inputs, providing the prior distribution parameters are estimated. However, unless it is known that zero demands really resulted from zero failures requiring float and not because of a lack of proper data collection procedures, or because the component end item is relatively new, this procedure should not be used with such inputs.

c. <u>Development of model</u>.

(1) The derivation of this model uses the principles of Bayesian statistics in estimating future demands for component end items. Bayesian statistics is primarily concerned with predicting a future state of nature based on assumptions about past states, or knowledge gained on past states of nature through some experiment, or by means of a set of data tied to past experience. By assuming a distributional form for the past mean-demand for float of all component end items in an end item, it is possible to use the assumption to calculate the probabilities of X demands in the future. Instead of trying to give a point estimate of true demand for float for the component end item, this approach estimates the probability that the mean-demand for float for the component end item,

3-5

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Define:

м	= Total number of types of component end items which are candidates for float stock.
D(I)	= Total quantity of past demands from all end items for component end item type I over some fixed interval of time.
C(I)	- Unit cost of component end item type I.
α	Shape parameter of the prior gamma distribution of mean-demands for component end item type I.
β	= Scale parameters of the prior gamma distribution of mean-demands for component end item type I.
P	= The number of cells into which the prior gamma distribution of mean-demands for component end item type I is divided. ²
Γ(α)	= Gamma function with argument α , $\Gamma(\alpha) = (\alpha - 1)$;
θ _k	= Mean of the kth cell, where $k=1, 2, 3, \dots, P$.
$\Pr[D(I) \theta_k]$	= Conditional probability of D(I) demands given a mean-demand of θ_k .
т	= The fixed past interval of time over which component end item demands were observed.
λ	= (AT/T) the ratio of the weighted average repair/resupply time (AT) for all component end item types, to the fixed past demand observation time (T).
$\Pr[X(I) \lambda \theta_k]$	= Conditional probability of X demands during a mean-repair/resupply time given a mean-demand of $\lambda \theta_{k}$.
F(1)	= Float stock level for component end item type I.
R[F(Ι) λθ _k]	= Conditional component-end-item-float-availability for component end item type I for float leve: $F(I)$, given a mean-demand $(\lambda \theta_k)$ during a mean- repair/resupply time.

²The division of the distribution of mean-demands into P cells is mathematically necessary for numerical integration involved in the calculation of the Bayesian inverse probabilities. The actual number of cells is determined through a trade-off. As the number increases, the accuracy, computation time, and core requirements increase. For component end items with mean-demands of less than ten, it was found that twenty cells operate effectively and efficiently.

R[F(I) D(I)]	 Conditional component-end-item-float-availability for component end item type I for float level F(I), given that the component end item experienced P(I) demands during some fixed past interval of time.
2	 Factor to reflect anticipated changes in usage or end item density.
SL	 Maximum quantity of any component end item type which can be stocked in float.
RG	= Float-availability goal.

(2) By the method of moments, the parameters of the prior gamma distribution can be determined as such:

Expected value of
$$\theta = \alpha\beta = \sum_{\substack{\Sigma \\ I=1}}^{M} D(I)/M$$

Var $(\theta) = \alpha\beta^2 = \frac{\left[\sum_{\substack{I=1 \\ I=1}}^{M} D^2(I) \right] - \frac{1}{M} \left[\sum_{\substack{I=1 \\ I=1}}^{M} D(I) \right]^2}{M-1}$

Therefore,

$$\hat{\alpha} = \left[\frac{M}{\Sigma} - \frac{D(I)}{M} \right]^2 / \frac{1}{M-I} \left\{ \left[\frac{M}{\Sigma} - D^2(I) \right] - \frac{1}{M} \left[\frac{M}{\Sigma} - D(I) \right]^2 \right\}$$
(7)
$$\hat{\alpha} = \frac{\left[\frac{M}{N\Sigma} - D^2(I) \right] - \left[\frac{M}{I=1} - D(I) \right]^2 }{\left(\frac{M}{I=1} - D(I) \right]^2 }$$
(8)
$$\hat{\alpha} = \frac{\left[\frac{M}{N\Sigma} - D^2(I) \right] - \left[\frac{M}{\Sigma} - D(I) \right]^2 }{\left(\frac{M}{I=1} - D(I) \right]^2 }$$
(8)

(3) Once $\hat{\alpha}$ and $\hat{\beta}$ are obtained from equations (7) and (8), the prior gamma distribution defining the past mean-demands for all component end items is described. However, the data available concern past demands

for each component end item and not mean-demands. The objective is to use these past demands to calculate the float-availability for each type of component end item in light of the past demand data.

(4) It is convenient to subdivide the prior gamma distribution into P cells. This essentially says that, for computational purposes, the prior gamma distribution is composed of P cells which generate a mean-demand of $\theta_{\rm L}$ (mean for the kth cell). This makes it possible to calculate the probability of the occurrence of a particular mean-demand $\theta_{\rm L}$ given that a past demand D has occurred.

(5) The mean of the first and last cell (θ_1 and θ_p , respectively) must be calculated at some percentile point, since it is obvicusly impossible to subdivide an infinite scale into P parts. The .01 and .99 percentile levels are used here, but any other level could be used. The result of narrowing the limits (e.g., .05 and .95 levels) would be to weight the extremes of the distribution by moving the extreme estimates of the mean-demands corresponding to the .05 and .95 percentile levels toward the center of the distribution. This narrowing would have little effect on the stock levels calculated. If carried too far, it would tend to decrease the calculated float levels, because cells representing high demands would not be weighted proportionally. Therefore, with the range from the .01 to the .99 percentile included within the distribution, the results should be of sufficient accuracy for most applications.

(6) The mean-demands, θ_1 and θ_2 at the lower and upper limits, for the .01 and .99 percentiles respectively, are calculated from the following equations.

$$.01 = \int_{0}^{\theta} \left[\frac{y (\alpha - 1) e^{-(y/\beta)}}{\Gamma(\alpha)\beta^{\alpha}} \right] dy \qquad (9)$$

$$.99 = \int_{0}^{\theta} \left[\frac{y (\alpha - 1) e^{-(y/\beta)}}{\Gamma(\alpha)\beta^{\alpha}} \right] dy \qquad (10)$$

(7) The computer program presented herein evaluates equations (9) and (10) by transforming the gamma distribution into a chi-square distribution,³ since chi-square tables are more readily available and easier to use.

³ The transformation is $y=2X/\beta$ where X is a chi-square distributed random variable.

(8) With θ , and θ calculated, the other means are calculated by equation (11). P

$$\theta_{k} = \theta_{1} + (k-1) \begin{bmatrix} \theta_{p} - \theta_{1} \\ -P-1 \end{bmatrix}$$
For k=1, 2, 3, ---, P.
(11)

(9) The upper and lower limits $L_{(k-1)}$ and L_k respectively, of each of the P cells are obtained from the following equation:

$$L_{k} = \theta_{k} + \left[\frac{\theta_{p} - \theta_{1}}{2(P-1)}\right]$$
For k=1, 2, 3, ---, (P-1);
with $L_{c} = 0$ and $L_{p} = \infty$.
(12)

(10) With these values, the probability of occurrence of a mean-demand of $\theta_{\mu} is\colon$

$$\Pr(\theta_{k}) = \int_{k}^{L} \left[\frac{y^{(\alpha-1)} e^{-(y/\beta)}}{\Gamma(\alpha)\beta^{\alpha}} \right] dy \qquad (13)$$

For k=1, 2, 3, ---, P.

(11) Using the Poisson demand generation assumption, the probability of observing a particular demand D(I) given the occurrence of a mean-demand of θ_{k} is:

$$\Pr[D(I) | \theta_k] = \begin{bmatrix} \theta_k^{D(I)} & e^{-(\theta_k)} \\ \vdots \\ D(I) \end{bmatrix}$$
(14)

This probability is calculated for each type of component end item for all $\boldsymbol{\theta}_k$'s.

(12) Using Bayesian inference, the probability of any θ_k occurring, given an occurrence of D(I) is:

$$\Pr[\theta_{k} | D(I)] = \begin{bmatrix} \Pr[D(I)|\theta_{k}] & \Pr(\theta_{k}) \\ \hline \\ \hline \\ P \\ \sum_{k=1}^{p} \Pr[D(I)|\theta_{k}] & \Pr(\theta_{k}) \end{bmatrix}$$
(15)

(13) The demand data used in this method is that obtained over a fixed post interval of time T. The float problem is concerned with supplying enough float of component end items to protect against supply shortages over the repair/resupply time interval. Therefore, the historical values need adjustment to convert to the projected values θ' , over the required time scale. This yields:

$$\theta_{k} = Z_{\lambda} \theta_{k}$$
(16)

For k=1, 2, 3, ---, P.

(14) The Z value is a factor which allows the analyst to adjust the data to fit future operational needs which may not be compatible with the usage that generated the demand data. Possible applications of the Z factor may reflect changes in environmental and/or usage conditions. If conditions have changed so that twice as many demands for float are expected, the value of Z would be equated to 2.0. With the new mean demands, the probability of a demand of size X arising for each component end item type I, given the mean demand of θ'_k is:

$$\Pr[X(I)|\theta_{k}'] = \begin{bmatrix} \theta_{k}' X(I) & -\theta_{k}' \\ \frac{\theta_{k}'}{2} & e \\ \hline X(I)! \end{bmatrix}$$

For X(I)=0, 1, 2, ---, F(I). (17)

(15) Using equation (17), the probability of having demands for F(I) or less component end items of type I is:

$$R[F(I) | \theta' | = \sum_{k} Pr[X(I) | \theta']$$

$$K = X(I) = 0$$
For F(I) = 0, 1, 2, ---, SL. (18)

3-10

(16) With equations (15) and (18), the weighted average utility of each additional float of component end item type I, given that the component end item had a demand of D(I) in the past, is:

$$R[F(I)|D(I)] = \sum_{k=1}^{p} R[F(I)|\theta'] Pr[\theta'_{k}|D(I)]$$
(19)

(17) Equation (19) gives the float-availability of component end item I given a particular float stock level of F(I). The float-availability of a complement of end items is:

Float-availability =
$$\prod_{I=1}^{M} R[F(I)|D(I)]$$
 (20)

(18) The problem is then reduced to finding the set of stock levels F(I) which minimizes the cost of float stock and yields the desired float-availability goal. Therefore, the problem is to minimize

$$\Sigma$$
 C(I)F(I), satisfying:
I=1

$$M = R[F(I) | A(I)] \ge RG$$

$$I=1$$
(21)

(19) The number of end items being supported with component end items stocked in float does not enter into the calculations of this method. Demand data are generated by all end items; using such data in this method accounts for all end items, regardless of the actual number. If there is an anticipated change in the number of end items in use, the value of the Z must reflect the percentage of change.

3-4. Conclusion. a. These methods provide the user the capability to:

(1) Allocate operational readiness float to achieve a floatavailability goal.

(2) Perform the allocation in a manner which minimizes the cost to achieve a float-availability goal.

(3) Perform allocations which consider the random nature of end item failure and component end item failures.

b. These important considerations are not available to the user in present methods of allocating operational readiness float.

CHAPTER 4

USER'S GUIDE

4-1. General. A computer program was developed to perform the calculation inherent in the previously discussed float allocation procedure.
The coding procedures required for the utilization of this computer program are presented in the following chapter. The presentation consists of two parts which coincide with the two procedures for float allocation:
(i) without and (i) with historical demand data.

4-2. Float Allocation Without Historical Data. a. Data inputs. The following set of data is necessary to utilize this method.

(i) The code number -- the value is 1 for this method.

(2) The number of float-availability goals and their values, for which float allocation is desired. (Maximum number is 10.)

(3) Float stock level limit -- the maximum number of any type of component end item to be stocked in float.

(4) The quantity of end items assigned to the user.

(5) For each floatable component end item:

(a) Description or user-distinguishable code.

(b) Unit cost to float each component end item.

(c) ' $\Pi BF_f(I)$ -- the mean-time-between-failures for each component end item of type I which requires float.

(d) W(I) -- the mean-time-between-float-replenishment for each commonent end item of type I. This value is the mean interval between the time that a failed end item generates a float demand and the time that the floated component end item is replaced or returned to float status. This time period may be subdivided into: the mean-time-to-repair/resupply, the mean-transportation-time, and the mean-time-awaiting-repair/resupply.

b. <u>Coding procedure</u>. The data inputs are discussed in four parts, each of which contains an example coded data card. The data positions on the card and the inclusion or exclusion of decimal points must be strictly followed. The specific formats are illustrated on the sample data cards.

(1) Initialization card 1:

(a) The code number value of 1 is entered in column 4.

4-1

(b) The number of float-availability goals to be used in the float calculation is right justified in columns 5-8. (Maximum number is 10.)

(c) The float stock level limit is right justified in columns 9-12.

(d) The number of different floatable component end items is right justified in columns 13-16.

(e) An example coded initialization card 1 is shown below.

6 . 10 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 77 79 30 31 32 33 34 54 36 37 38 39 40 41 42 43 44 5 5 7 5 6 7 7 6 10 11 12 13 14 15 16 17 5 19 0 71 72 13 74 5 8 27 78 2 **ato a ntato a oto a oto**

(2) Initialization card 2:

(a) Enter the values of the desired float-availability goals in descending order (highest value first) from left to right on the card in consecutive ten column fields. Each value must be less than 1.0 and must contain a decimal point. For the computer program in this pamphlet, a maximum of four decimal places can be used.

(b) An example coded initialization card 2 is shown below.

0.5000 0.3700 0.9900 0.9000 0.7500 0.9500 2 3 4 5 6 7 8 9 10 11 12 13 14 .5 15 17 18 19 20 21 23 21 75 77 27 76 78 30 31 32 33 34 75 16 37 48 39 (1)27 47 47 43 45 46 17 48 49 (5) 57 51 43 55 46 17 58 59 (6) 61 6 32 32 33 14 35 36 3' 38 33 43 11 42 43 44 45 7 28 29 2 6 7 8 9 10 11 12 13 14 15 16 17 18 19 29 21 22 23 2 10 11 12 13 14 15 16 17 18 19 29 71 77 73

(3) Initialization card 3:

(a) Quantity of end items assigned to the user. This number must be right justified in columns 1-4.

(b) An example coded initialization card is shown below.

/	1 + 26 5 51 + 31		16 55 13	<u>M2 2</u>	4.57	21 78 2	9 <u> </u>	<u>7 39</u> 1	<u>()5 %</u> [37 JE 19	<u>ole e</u>	<u>ala .</u>	5 15 1-	19 19	<u>র্বার্</u> র	<u>.</u>	<u>35 %</u> †		icit
Ĺ	. 2 3 6 5 6 7	9 10 1.	11	15 16 17	18 19 1	10 21	22 21	74 35	26 21	<u>1</u> 4 14	36 N	2 14	31 15	yh j	14 1	27	1. 15	41 54	15 4
		171	6 <u>)</u>	12 13	11 12	16	n i	4 19	7	21 22				~				- Y	24

- (4) Item characteristics card:
- (a) For each floatable component end item, enter the identification

code (the FSN or other identification) in columns 1-40. A short description can also be included.

(b) The unit cost to float each component end item is entered in columns 41-50, in dollars and cents. (Maximum is 99999999.99.)

- (c) The W(I) is entered in columns 51-60.
- (d) The MTBF, (I) is entered in columns 61-70.

The unit cost, $MTBF_f(I)$, and the W(I) must each contain a decimal point; the dimensional units for $MTBF_f(I)$ and W(I) must be identical for all component end items, i.e., Cost = \$1000.00, W(I) = 5.00 hours, $MTBF_f = 245.00$ hours.

(e) An example item characteristics card is shown below.

FSN, XXXXX, XX1 1000.0 245.0 1 : 5 6 7 3 9 10 11 12 1314 1 25 76 27 28 29 30 31 32 33 34 35 36 37 38 39 22 23 60 41 62 43 48 45

c. Data deck sequence. The set of data cards must be ordered as shown below.



4-3. Float Allocation With Historical Demand Data. a. Data inputs. The following set of data is required as input for the second method.

(1) The code number -- the value is 2 for this method.

(2) The number of float-availability goals and their values, for which float allocation is desired. (Maximum number is 10.)

(3) Float stock level limit -- the maximum number of any type of component end item to be stocked in float.

(4) The quantity of component end items assigned to the user.

(5) For each floatable component end item:

(a) Description or user-distinguishable code.

(b) Unit cost to float each component end item.

(c) The number of past demands for float of each component end item, accumulated over some interval of time.

(6) A projected usage/density factor. This factor is used to bias the input data whenever it is known that float is being computed for end items that will have different usage rates and/or different quantities than the end items that generated the original data.

(7) The mean-repair/resupply time for component end items being floated.

(8) The interval of time over which the demand data was obtained.

b. <u>Coding procedure</u>. The data inputs are discussed in four parts, each of which contains an example coded data card. The data positions on the card and the inclusion or exclusion of decimal points must be strictly followed. The specific formats are illustrated on the sample data cards.

(1) Initialization card 1:

(a) The code number value of 2 is entered in column 4.

(b) The number of float-availability goals to be used in the float calculation is right justified in columns 5-8. (Maximum number is 10.)

(c) The float stock level limit is right justified in columns 9-12.

(d) The number of different floatable component end items is right justified in columns 13-16.

4-4

(e) An example coded initialization card 1 is shown below.

10 6 4 1 21 25 26 2 28 29 20 11 17 33 14 25 36 37 48 29 40 41 42 19 44 45 25 47 45 19 50 51 52 53 5 18 19 .0. 3 4 5 6 / A 9 10 11 12 13 14 15 15 11 4 5 6 7 8 5 10 11 12 13 14 15 16 17 18 19 20 21 27 23 24 25 26 27 28 29 30 31 32

(2) Initialization card 2:

(a) Enter the values of the desired float-availability goals in descending order (highest value first) from left to right on the card in consecutive ten column fields. Each value must be less than 1.0 and must contain a decimal point. For the computer program in this pamphlet, a maximum of four decimal places can be used.

(b) An example coded initialization card 2 is shown below.

/		0.	990	ρ		_ (٥.	9	50	ρ						ρ		_ 1		•7							50				0	•3	370	00				1	7
1	1 7 3	456	78	9 [10]1	1 12	13 14	15 1	6] : /	<u>17</u> 19	10	_22_3	37	<u>ð.</u>	27	<u>.</u>	9]10	31 32	313	5	8 17	83	140	4] 4	<u>7 0</u>	<u> († 45</u>	Æ	сц	49] 50	FT 5	2 53	54 55	56 5		9 60	61 6.	63	61 65	SF /	,
	12	3 4	5 6	1 8	9	10		2 13	14	15	16 1	7 µ	19	20	21	2	3 24	Z	ð	<u>n 1</u>	8 23	30	31	12	33 3	4 3	5 36	31	38 3	9 40	41	Q (3 4	45	46	47 1	18 4	4	
				-	7	1	6	10	u	12	- (3	1		5	16	ß	18	19	70	21	77	2	3	<u>74</u>	75	26	27	78	3	30	31	v	33	ч	3		5		

(3) Item characteristics card:

(a) For each floatable component end item, enter the identification code (the FSN or other identification) in columns 1-40. A short description can also be included.

(b) The unit cost to float each component end item is entered in columns 41-50, in dollars and cents. (Maximum is 9999999.99.)

(c) The past demand is entered in columns 51-55. The demand must be read in as a real number, for computational purposes only to one decimal place.

(d) An example coded item characteristics card is shown below.



(4) Data characteristics card:

(a) The usage/density factor is entered in columns 1-10 with a maximum of three decimal places.

(b) The mean-repair/resupply time is entered in columns 11-20 with a maximum of three decimal places.

(c) The time interval over which the data were collected is entered in columns 21-30 with a maximum of three decimal places. The dimensional units must be the same as for (b) above (e.g., both hours, or days, etc.).

(d) An example coded data characteristics card is shown below.



c. Data deck sequence. The set of data cards must be ordered as shown below.



Appendix A

MODEL VARIATIONS

This appendix is used to discuss situations which deviate from those idealized in the formulation of this model.

- A-1. <u>Condition</u> An item is a component end item, and it is impossible or undesirable to allocate that item as float.
 - <u>Action</u> Such an item may be disregarded when applying this model. However, the float-availability indicated by the float allocation must be modified by the user to reflect the float-availability of the nonfloatable component end item.

Two modifications are possible that permit the model to obtain a floatavailability which includes the effect of the nonfloatable component end item.

a. The unit cost of stocking the component end item in float may be assigned a large value, i.c., \$99999999.99.

b. Alternatively and preferably, the float-availability goal can be divided by the float-availability of the nonfloatable component end item (the probability of zero demands on the nonfloatable component end item). This new value can then be input into the model as the floatavailability goal.

- A-2. Condition The float limit varies with component end item.
 - Action The model assumes the maximum float limit is the same for each floatable component end item. It is possible that variable float limits will have no effect on the presently formulated model. The effect can be determined by setting the maximum float limit to a high value (less than 100). This value should allow the float-availability goals to be achieved without reaching this limit. If, upon reviewing the model allocation, it is found that the actual float limits of the respective component end items are not exceeded, the solution has been reached. However, if float limits are exceeded, computer program modification will be necessary.
- A-3. <u>Condition</u> The incremental cost of float for one or more component end items is not constant.
 - <u>Action</u> The average incremental cost can be used, if the associated error is acceptable to the user.

Model redefinition is necessary to arrive at an optimal solution if the inclusion of variable incremental costs of float is desired.

- A-4. <u>Condition</u> It is necessary to maximize float-availability constrained to a fixed amount of funds.
 - Action This problem is a slight variation of the problem addressed in this pamphlet (obtain a floatavailability goal at a minimum cost). Only minor modification of the computer program is required.

Appendix B

SAMPLE INPUT DATA AND OPTIMAL FLOAT LEVEL ALLOCATIONS

This appendix contains two examples to illustrate the dual usage of the model as well as the output format of the computer adaption. The first example gives a float allocation for an end item without demand data. The second example gives an allocation for an end item with demand data.

B-1. System Without Prior Data. a. The end item under consideration is to meet a float-availability goal of 0.95 at a minimum cost. The failure and repair related data and the cost for the four component end items are as follows.

Component End Items	W(hours)	MTBF (hours)	Cost/Unit
FSN (XXXXX.XX1)	5.0	245.0	\$1,000.00
FSN (XXXXX.XX2)	6.0	194.0	\$2,000.00
FSN (XXXXX.XX3)	5.0	445.0	\$5,000.00
FSN (XXXXX.XX4)	5.0	120.0	\$ 500.00

The number of end items authorized float support is 50.

b. The computer inputs and outputs for this example are shown on table B-1. An output has been included which shows the float stock levels required to meet a float-availability goal of 0.99 for comparison purposes. The total cost for float stock to meet the 0.95 float availability goal is seen to be \$25,000. The float-availability goal of 0.99 can be obtained for \$33,500. Therefore, the float-availability can be increased by another 4% with the expenditure of \$8,500. This illustrates the importance of computing the float levels for a number of float-availability goals instead of merelv one. The achieved floatavailabilities for the float levels calculated are 0.96 and 0.99, which are the closest values obtained that meet or exceed the requirements of 0.95 and 0.99. This is not saying that a system of float levels cannot be computed that yields a lower float-availability closer to the desired value even at a slightly smaller cost. It simply means that on a dollar/ float-availability basis, a float-availability of 0.96 is the best rate that exceeds specifications.

B-2. System With Prior Data. a. The operational readiness float for the end items under consideration is to meet a float-availability goal of 0.95 at a minimum cost. Each end item is composed or four component end items. The historical demand data for a fixed interval of time and the cost per unit are listed below.

B-1

AMCP 750-6

Component End Items	Demands/Period	Cost/Julit
FSN (XXXXX.XX1)	1.0	\$1,000.00
FSN (XXXXX.XX2)	2.0	\$2,000.00
FSN (XXXXX.XX3)	0.0	\$5,000.00
FSN (XXXXX.XX4)	2.0	\$ 500.00

It was assumed the condition of usage, number of end items in the group, and period for float allocation are equal to the condition of the past demand period.

b. The computer inputs and outputs for this example are shown on table B-2. The output for the 0.99 float-availability goal is included for comparison purposes.

B--2

Table B-1. Float Allocations Without Prior Data

INPUT LISTING TABLE

NUMBER OF END ITEMS FIELDED= 50

ITEM	COST UNIT	MTTR	MTBF
FSN XXXXX.XX1	1000.00	5.00	245.00
FSN XXXXX.XX2	2000.00	6.00	194.00
FSN XXXXX,XX3	5000.00	5.00	445.00
FSN XXXXXXX4	500.00	5.00	120.00

REQD FLOAT-AVAILABILITY - 0.9500

ACTUAL FLOAT AVAILABILITY -- 0.9509

FLOAT AND ASSOCIATED COST TO OBTAIN THE ACTUAL FLOAT-AVAILABILITY

ITEM ID.NO. AND DESCRIPTION	REQUIRED ITEM FLOAT	TOTAL ITEM COST
FSN XXXXXXX1	4	4000.00
FSN XXXXXX2	4	8000.00
FSN XXXXXXXX	2	10000.00
FSN XXXXX.XX4	6	3000.00

TOTAL COST OF FLOAT STOCKAGE 25000.00

REQD FLOAT-AVAILABILITY--0.9900

ACTUAL FLOAT-AVAILABILITY--0.9902

FLOAT AND ASSOCIATED COST TO OBTAIN THE ACTUAL FLOAT-AVAILABILITY

ITEM ID.NO. AND DESCRIPTION	REQUIRED ITEM FLOAT	TOTAL ITEM COST
FSN XXXXX.XX1	5	5000.00
FSN /XXXX.XX2	5	10000.00
FSN XXXXXX3	3	15000.00
FSN XX XXX.XX4	7	3500.00
TOTAL COST OF FLOAT STOCKAGE 33500.00		

B-3

Table B-2. Float Allocations With Prior Data

INPUT LISTING

ITEM	COST/UNIT	DEMAND
FSN XXXXXXX1	1000.00	1.0
FSN XXXXXXX2	2000.00	2.Ø
FSN XXXXX.XX3	5000.00	Ø. •
FSN XXXXXX4	500.00	2.Ø

USAGE FACTOR: 1.00 AVERAGE REPAIR/RESUPPLY TIME: 1.00 DATA COLLECTION PERIOD: 1.00

REQD FLOAT-AVAILABILITY--0.9500

ACTUAL FLOAT-AVAILABILITY--Ø.9597

FLOAT AND ASSOCIATED COST TO OBTAIN THE ACTUAL FLOAT-AVAILABILITY

ITEM ID.NO. AND DESCRIPTION	REQUIRED ITEM FLOAT	TOTAL ITEM COST
FSN XXXXXXX1	5	5000.00
F5N XXXXXXX2	6	12000.00
FSN XXXXXXX3	3	1 5000.00
FSN XXXXX.XX4	7	3500.00
	a	

TOTAL COST OF FLOAT STOCKAGE 35500.00

REQD FLOAT-AVAILABILITY - 0.9900

ACTUAL FLOAT-AVAILABILITY--Ø.9931

FLOAT AND ASSOCIATED COST TO OBTAIN THE ACTUAL FLOAT-AVAILABILITY

ITEM ID.NO. AND DESCRIPTION	REQUIRED ITEM FLOAT	TOTAL ITEM COST
FSN XXXXXXX1	7	7000.00
FSN XXXXXXX2	7	1 4000.00
FSN XXXXXXX3	5	25000.00
FSN XXXXXXX4	9	4500.00
TOTAL COST OF FLOAT STOCKAGE 5050	ଷ. ହଡ଼	

B-4

Appendix C

FORTRAN PROGRAM FOR FLOAT ALLOCATION PROCEDURE

This appendix contains a FORTRAN IV computer program which can be used to determine operational readiness float based on the two methods previously discussed. Coding procedures for this program are discussed in chapter 4. This computer program was structured to handle low demand items. High demand data will cause the logarithm and exponential functions to overflow and underflow. If such application is desired, modification of the computer program is necessary.

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		7.63,36.2,8.26,				
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2822		READIS.1010) IFC				
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0874		DU BO 1=1, NOCST				
6025		IF(PG(1)-1.0)80	•82•81			
6:25		W#ITE16,1001)RG	(1)			
2777		C1=1.∂				
8228	80	CONTINUE	a . a			
2029 6632	5	1F (01-1.7)82.60 50 TC (800.900				
2632		READ(5,1224)N	r re fru			
2032		WRITE(6.1025) N				
0033		WRITE(6,1026)				
6034		DU 100 I=1.NI				
6435		READ(5,1011)(10				
2436		WRITE(0,1027)(1	D([+J]+J=1+10)+(C(E),W(E),MT8	111	
6837		E=4	E / 1 \			
6434 2039		A([]=E*W([)/MTB Ll=L+I				
,						

PAGE 2021

FURTRAN I	V G LEVEL	13	MAIN	DATE = 70296	20134105	PANE 0002
2048		DO 100 J=1.L	1			
6241		J1=J-1				
w#42		18(31)93+11+	93			
2843	93	CALL FACTIJI	L.FAC)			
2344		SUM1=J1+ALOG	51A(1))-A(1)-FAC			
1345		LNRIF(1,J)=C	XPISUM1)			
2246		LNRIF(1,J)=L	NRIF(I+J)+TERM			
0247		GO TO 12				
: 148		LNR1F([,J)=E				
6344	15	TERM=LNR[F[]				
18252			ALOG(ENPIF(I+J))			
8651		CONTINUE	_			
3852	141	DU ZEN IST.N				
3053		LO 549 7=1*1	-			
1254		R=J+1				
2055		-	(LNKIFIT,K)-LNRIF(T,	J///////		
2050	200	CONTINUE				
2857		00 210 1=1.1	N 1			
4629		JELOAT(I)=0 CONTINUE				
2259	110	GO TO 392				
2362	25.7	MAX=2.3				
2361 2662	200	00 302 1=1.4	N Ť			
8463		00 322 3*1.1				
2264			L)-MAX1300,300,32			
2:65	3.5	MAX=MARGUII				
2260		1164=1				
1367		IFLUAT=J				
6208	120	CONTINUE				
3261		IF (MAX-D.L)	341,610,301			
2010	301	MARGUETEN.				
0071		JFLOAT(ITEM) = TFLPAT			
2272	398	LPRBT=2./				
2273		PO 400 I=1.	NI			
6174		J=JFL(AT{1)				
8275		JL = J+1				
6216			+LNKTF(I,JL)			
2211	422	CENTINUE	- * * .			
2074		PRAT=EXPLEP				
8:74		06 522 1=1,0				
2282	6.33		8)481+258+258 1))507+517+518			
2281 2282			a) RG([),PRBT			
2047 2043	510	100051=0.0				
2284		DU 50 J=1.N	r			
2207		COSTJ=C(J)+.				
いまれた		THEAST=EAST				
2287		WRITE (6.184)	2) (ID(J.K),K=1,10),	JFLUAT(J).CUSTJ		
283	50	CONTINUE				
2089		WRITE 16.184	SITACOST			
2843		1F(1-1)611,				
28.21	51	RG(1)=2.8				
0292		GO TU 257				
6393	500	CONTINUE				
1144		GO TO 252				
8895	610	WRITE 16,105	Ø 1			
2846		GO TO e11				
0037	9899	WRITE15+111.	71			

No. No. Operation 100 000 100	FURTR	AN EV C	G LEVEL	18	. MAEN	DATE	= 10296	23/34/23	PAGE 0003
0439 READIS_11111011.011.01.011.011 0419 RESDIS_1110101.01.01.01.01.011 0419 RESDIS_1110101.01.01.01.01.011 0419 RESDIS_1110101.01.01.01 0419 SUDI=0.* 0419 SUDI=0.* 0419 SUDI=0.* 0419 SUDI=0.* 0419 SUDI=0.11 0419 SUDI=0.11 0419 SUDI=0.11 0419 SUDI=0.11 0411 SUDI=0.11 0419 SUDI=0.11 0411 SUDI=0.11 0412 SUDI=0.11 0413 SUDI=0.11 0414 SUDI=0.11 0415 SUDI=0.11 0416 SUDI=0.11 0417 SUDI=0.11 0418 S	88 98	1		NO 9001 (=)	• N [
eisi eisio(s,iiiii); A,T,THE eisi unze iiii unze iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii	6499)				(),D([)			
0102 ukTrE(0,1114)2,AT,TTHE 013 114-20 014 SUMD1-0,1 015 SOUT=0.0 016 00 130 [-1,4,4] 017 SUMD1-0,11 018 SUMD1-0,11 019 A.→ 011 SUMD1-0,11 011 CALL GAMALAPHA,YE1 0114 COLLGANALAPHA,YE1 0115 IFE00F-1,019,92,22,202 0116 IOS1-2,004PHA 0117 OIN=COS1 0118 COLCARS 0119 IFE00F-1,011,0071 0111 SUMD1-0,011 0122 OIC-11*(00F-10F1+0,01+0F2,-0) 0123 OIC-2-011*(00F-10F1+0,01+0) 0124 OIC-11*(00F1 0125 OSUM1+0,011 0126 <th>#10a</th> <th>1</th> <th>9001</th> <th>WRITE(6,111</th> <th>(3)(1D(1,J),J=1,10),C</th> <th>1),0(1)</th> <th></th> <th></th> <th></th>	#10a	1	9001	WRITE(6,111	(3)(1D(1,J),J=1,10),C	1),0(1)			
$ \begin{array}{c} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 $									
etc SumDimeter etc SumDimeter SumDimeter etc					L4}Z;AT;T1ME				
uiss SQDT=2.8 uiss SQDT=2.8 <t< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></t<>									
0 130 1=1+N1 0 130 1=1+N1 0 130 1=1+N1 0 1=1+N1 1=1+N1 1=1+N1 1=1+N1 1=1+N1 1=1+1 1=1+N1 1=1+N1 1=1+1 1=1+N1 1=1+N1 1=1+1 1=1+N1 1=1+N1 1									
e17 SUMD(+0)(1) e188 SQ(+SQ)(+O)(1)+*2 e188 SQ(+SQ)(+O)(1)+*2 e118 CANTINUE e111 BETA=TANT=SQ(/SUMD1)/(ANT=1.2) e112 ALPAASUMD(/ANT=9TA) e113 CALL GAMMALAPAAY(E) e114 D0F=2.0*ALPAA e115 IF(DOF=1.3)199,202,202 e116 199 (1)=CH1SQ(2,1) e117 O11=CH1SQ(2,1) e118 CO TO 233 e119 D0T=1.00F(+1) e120 D0F=1.00F(+1) e121 D0T=1.00F(+1) e122 O1T=1.00F(+1) e123 O2=CH1 e124 O2=CH1 e125 O3=CH1SQ(2,1)OF7) e126 O4=CH1SQ(2,1)OF7) e127 O(1)M = (10A=01) + (0) + 00F +									
0100 SQD1=SQD1=D(1)+*2 0100 ANT=N1 0111 BETA=(ANT=SQD1/SQMP1=SQMP1)/(ANT=L-B) 0112 ALPMA=SQMD1/(ANT=GTA) 0113 CALL GAMAKALPHAY-E1 0114 D0F=2-BPALPHA 0115 CALL GAMAKALPHAY-E1 0114 D0F=2-BPALPHA 0115 CALL GAMAKALPHAY-E1 0116 D0F=2-BPALPHA 0117 CALL GAMAKALPHAY-E1 0118 D0F=2-BPALPHA 0119 COTO 0119 COTO 0110 COTO 0111 COTO 0119 COTO 0119 COTO 0119 COTO 0111 COTO 0111 COTO 0111 COTO 0111 COTO 0111 COTO 0111 COTO 112 COTO 113 COTO 114 COTO 115 COTO 116 COTO 117 COTO 118 COTO									
100 A → 100 100 111 BETA-TANT-SUDT/SUMPT-SUMDT//(ANT-1-0) 111 BETA-TANT-SUDT/SUMPT-SUMDT//(ANT-1-0) 111 BETA-TANT-SUDT/SUMPT-SUMDT//(ANT-1-0) 111 BETA-TANT-SUDT/SUMPT-SUMDT//(ANT-1-0) 111 BETA-TANT-SUDT/SUMPT-SUMDT//(ANT-1-0) 112 CALL GAMMALALPHA Y.E1 113 CALL GAMMALALPHA Y.E1 114 D07-2.0+ALPHA 115 IF100F-1.00199,202,202 116 195 117 OTIN-FCHSQ12,10 118 CG TO 283 119 202 110 DDF2-100F1+1 112 DDF2-100F1+1 112 OTF1-100F1 112 DDF2-100F1+1 113 DCTN+1(10-CDF) 114 <									
e110 ATT-N1 e111 BETA-TANT-SUDDT/SUMPT-SUMDTT/ANT-L-D) e112 ALPHA-SUNDT/TANT-SUDDTT/ANT-L-D) e113 CALL GAMMALALPHA,YLE) e114 DDF-2:20+ALPHA e115 FF100F-L-D199,722,722 e116 199 011-ENISOIL.1) e117 O11N=ENISOI2.1) e118 G0 TO 283 e119 202 TOPEI=FOFF e122 OOFL=TOPEI+1 e123 OQECHT(1:TOPE1) e124 OOFL=TOPEI+1 e125 C3=EHISO(2:TOPEI) e126 OGT=C100FL+10F-1 e127 OITN=EINED-EINET e128 OQECHT(1:TOPE-DOFL)+01+#EETA/2.0 e129 TEMP2TOPEIN+01+01+01+01+01+01+01+01+01+01+01+01+01+			- 130						
2112 ALPHA-SUMDI/IANTEGTA) 2113 CALL GAMARALPHA,Y.E) 8114 DGF-2.20+ALPHA 115 IF (DOF-1.3) 199,722,722 8116 199.011=CHISCIL.1) 1117 OIIN=CHISCI2.1) 1118 GO TO 283 119 202 TOFI=DOFA 1122 TOF2=TDFI+1 1123 O2=CHF(1:TOF1) 1124 OIDF2=TDFI+1 1125 O3=CHISCI2.TDGF1+ 1126 O3=CHISCI2.TDGF1+ 1127 OIIN=CHISCI2.TDGF1+ 1128 O2=CHF(1:TDGF2-TDGF1)+Q1)+RETA/2.40 1129 O2=CHF(1:TDGF2-TDGF1)+Q1)+RETA/2.40 1120 O3=CHISCI2.TDGF1 1124 O110=CHISCI2.TDGF1 1125 C3=CHISCI2.TDGF1 1126 O4=CHISCI2.TDGF1 1127 OIIN= 1128 CA=CHISCI2.TDGF1 1129 TIM=IN 1200 TIM=IN 1210 DI*A=COF-OFT1)+Q3+*BETA/2.40 1211 OIIN= 1229 TIM=IN 1230 DI*IN=COF-OFT1)+Q3+*BETA/2.40 1241 <th></th> <th></th> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>									
C113 CALL GAMMA(ALPMA,Y.E) B114 DDF-2,894.DFAA C115 IF 100F-1,31199,202,202 C116 109 0(1)=CH1S0(2,1) C117 0(1)=CH1S0(2,1) C118 G0 TC 283 C119 202 100F1=DDF C120 D0F1=100F1 C121 D0F2=100F1+1 C121 D0F2=100F1+1 C122 01=CH1S0(1,100F1) C123 02=CH1.4(1,100F1) C124 0(1)=(102-01)=C0F-D0F1+01)+RETA/2.0 C125 03=CH1S0(2,100F2) C126 04=CH1S0(2,100F2) C127 0(1)=(102-03)=(D0F-D0F1+03)+BETA/2.0 C128 C33 T1N=1N C129 TEMP2+10(1N)=C11)/(T1N-1.0) C129 TEMP2+10(1N)=C11)/(T1N-1.0) C129 TEMP2+10(1N)=C11)/(T1N-1.0) C129 TEMP2+10(1N)=C11)/(T1N-1.0) C129 TEMP2+10(1N)=C11)/(T1N-1.0) C120 C38 K=1.NT C133 0(X)=O119+(K-1)=TEMP2 C135 235 C0NTINUE C135 C35 C0NTINUE C136 C33 C0NTINUE C137 L1K(K)=C(K)+TEMP2/7.0 C135 C35 C0NTINUE C138 C138 L1=KK C141 J=K-1 C141 J=K-1	ø111			BETA=(ANI+S	SUDI/SUMPI-SUMDI//CAN	(-1.0)			
Blis D0F=2,894LPKA El15 IF (D0F=1:0199,202,202 Blis 109 Oll N=CHISO(1,1) Blis G0 TC 285 Control Contonte Control Contro Control Control Control C	2112	2		ALPHA= SUMD	I/LANI+BFTA)				
c115 IF FOOF-1.#3199,202,202 6116 195 Q111-CH15012,1) 0117 Q111-CH15012,1) 0118 C0 T0 283 119 202 100F1+00F 111 DOF2-100F1 1121 DOF2-100F1 1122 Q1-CH15017,1(),100F1 1123 Q2-CH7,4(),100F-00F1+Q11*RETA/2.8 1124 Q11=(1Q2-Q11*(00F-00F1)*Q11*RETA/2.8 1125 Q3-CH15Q12,100F1 1126 Q4-CH15Q12,100F-10 1127 Q11N=(1Q0-Q3)*BLTA/2.8 1128 Q11=(1Q2-Q11*(01F-00F1)*Q1*RETA/2.8 1129 Q110+Q-Q3*100F-00F1+Q1*RETA/2.8 1120 Q1N=(1Q0-Q3*100F-00F1)*Q3*RETA/2.8 1121 Q1N=(1Q0-Q3*100F-00F1)*Q3*RETA/2.8 1122 Q1N=(1Q0-Q3*100F-00F1)*Q3*RETA/2.8 1121 Q1N=(1Q0-Q3*100F-00F1)*Q3*RETA/2.8 1122 Q1N=(1Q0-Q3*100F-00F1)*Q3*RETA/2.8 1129 TIN=N 1201 Q1N=(1Q0-Q3*100F-00F1)*Q3*RETA/2.8 1212 Q1N=(1Q0-Q3*100F-00F1)*Q3*RETA/2.8 1213 Q1N=(1Q0-Q3*100F-00F1)*Q3*RETA/2.8 1214 Z2************************************	6113	1		CALL GAMMA	(ALPHA,Y,E)				
4116 195 Q111=Ch1SQ12.1) 9117 Q11N1=Ch1SQ12.1) 9118 GD TO 283 9119 202 DOF1=DOF4 9121 DOF2=DOF1+ 9122 Q1=Ch1SQ11+TOF1 9123 Q2=Ch1-x(1+TOF2) 9124 Q1=Ch1-x(1+TOF2) 9125 Q2=Ch1-x(1+TOF2) 9126 Q1=Ch1-x(1+TOF2) 9127 Q1=Ch1-x(1+TOF2) 9128 Q2=Ch1-x(1+TOF2) 9129 Q2=Ch1-x(1+TOF2) 9120 Q2=Ch1-x(1+TOF2) 9121 Q1=Ch1-x(1+TOF2) 9122 Q1=Ch1-x(1+TOF2) 9123 Q2=Ch1-x(1+x(1+C)) 9124 Q1=Ch1-x(1+TOF2) 9125 Q3 9136 Z1=XEETA*ALPMA 9130 Z1=XEETA*ALPMA 9131 Y1=N=1 9132 Cu1N1=Ch1+1+FEP2 9133 Y1=N=1 9134 Y1=N=1 9135 CuNTINUE 9136 CU X1=NT 9137 L1M(N1=Ch1N) 9138 J1=X=1 9139	0114	,		DOF=2.0+ALF	РКА				
0117 01191=CH1SQ12+11 0118 GO TO 203 0119 202 0011=100F1 0122 01=CH1SQ11+100F1 0123 02=CH1,41+100F1 0124 01=CH1SQ11+100F-00F1+Q11+RETA/2.0 0125 02=CH1,41+100F-00F1+Q11+RETA/2.0 0126 01=CH1SQ12+100F-10 0127 011N=1(02-Q11+01)+RETA/2.0 0128 203 0129 04=CH1SQ12+100F1 0120 04=CH1SQ12+100F1 0121 011N=1(10+Q3)+100F-00F1)+Q3)+8ETA/2.0 0128 203 011N=1(10+Q3)+100F-00F1)+Q3)+8ETA/2.0 0128 203 011N=1(10+Q3)+100F-00F1)+Q3)+8ETA/2.0 0128 203 0139 72=*4ETA*ALPHA 0130 72=*4ETA*ALPHA 0131 NT=N=1 0132 00 0133 01K3=Q11)+(K=1)*1EMP2 0134 L1M(K)=Q1K1=EMP2/7.0 0135 236 0136 J14=1N=1 0137 CUNT+N=1 0138 J14=1N=1 0140 SUMP=-0.1 <th>-</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>	-								
0118 G0 TC 203 0119 202 INDF1=DDFF 0121 ID0F2=ID0F1+1 0122 Q1=C+15N(1,100F1) 0123 Q2=CH1(1,100F2) 0111=(1Q2-Q1)*(00F-D0F1)*Q1)*8ETA/2.0 0124 O(1)=(1Q2-Q1)*(00F-D0F1)*Q1)*8ETA/2.0 0125 Q3=CH1SQ(2,100F2) 0126 Q4=CH1SQ(2,100F2) 0127 O(1N)=(1Q4-Q1)*(00F-D0F1)*Q3)*8ETA/2.0 0128 C33 *(100-D0F1)*Q3)*8ETA/2.0 0129 TEMP2=1Q(1N)-C(1))/(TIN-1.0) 0120 Z03 *(1-N) 0120 Z03 *(1-N) 0120 Z03 *(1-N) 0121 O(1)+(1Q4-Q3)*(100-D0F1)*Q3)*8ETA/2.0 0122 Q3 *(1-N) 0123 Q2=CH1 0120 Z2*976ETA*ALPHA 0121 Q2=CH1 0122 TEMP2:1(D1N)-C(1)//TIN-1 0133 OEN 0134 L1+KEN 0135 Z35 0236 K=1.NT 0135 Z35 0136 J1*4.1. 0137 L1+KEM 0138 J1*4.1.			199		-				
c119 202 DOF1=DOF1 d120 DOF1=1DOF1+1 d121 IDOF2=1DOF1+1 d122 Q1=CH1Sr11+1DOF1 d123 Q2=CH1-x(1+1DOF1) d124 O11>=(1Q2-Q1)*(OOF-DOF1)*Q1)*BETA/2.0 d125 Q3=CH1SQ(2+1DOF1) d126 Q4=CH1SQ(2+1DOF1) d127 Q1+N=(1Q4-Q3)*(DOF-DOF1)*Q3)*BETA/2.0 d128 203 d129 T1M=1N d120 Q2=VH1-x(1)+(V1+1N-1.0) d131 Y1=N=1 d132 OU 230 K=1+NT d133 OIX)=Q11+(K+1+IPTP2 d134 U1*(K+1+IPTP2)*0 d135 Z35 d136 J1/4=IN+1 d137 U1MINI=Q1(N) d138 J1/4=IN+1 d139 CU 336 K=1+IN d130 J1/4=IN+1 d131 Y1=IN+1 d133 OIX)=Q1+K+1=P77*.0 d135 Z35 d146 J1/4 d147 U1*(K+1=N=1**********************************					2(2+1)				
4120 OPTI=100F1 4121 ID0F2=1DFF1+1 9122 OI=CHTSOT1+100F1 9123 O2=CHT_s(1+100F2) 9124 OIII=1(Q2-QI)*(OOF-DOF1)*QI)*RETA/2.0 9125 C3=CHTSQT2+100F1 9126 O4=CHTSQT2+100F1 9127 O(INI=1(Q0-QI)*(OOF-DOF1)*GI)*BETA/2.0 9128 203 9127 O(INI=1(Q0-QI)*(INI=1.0) 9128 203 9129 TEMP2=1Q(INI-C(I))/(TIN-1.0) 9120 O2 230 K=1,NT 9131 YT=IN-1 9132 O103 K=1,NT 9133 O(K)=O(I)+(K-1)*TEMP2 9134 UI (K-1)*TEMP2 * 0 9135 SUMPT=4.2 9136 SUMPT=4.2 9137 LIMI(N)=O(IN) 9138 J1*1N*1 9139 CUNTINUE 9139 SUMPT=4.2 9139 J1*1N*1 9130 J1*1N*1 9131 J1*1N*1 9132 SUMP-8.0 9139 SUMPT=5.0 9140 SUMP=8.0 9140 SUMPT=5.									
ni21 1D0F2=1D0F1+1 0122 01=(H150F1) 0123 02=CH1,J(1,1D0F2) 0124 011=(1Q2-Q1)*(D0F-D0F1)*Q1)*RETA/2.0 0125 03=CH15Q(2,1D0F2) 0126 Q4=CH15Q(2,1D0F-D0F1)*Q1)*RETA/2.0 0127 01(N1*1(Q4-Q3)*(D0F-D0F1)*Q3)*8ETA/2.0 0128 203 0130 Z2=YEETA*ALPHA 0131 Yf=1N-1 129 12M(Q4-Q3)*(D0F-D0F1)*Q3)*8ETA/2.0 0131 Yf=1N-1 129 12M(Q4-Q3)*(D0F-D0F1)*Q3)*8ETA/2.0 0131 Yf=1N-1 129 12M(Q4-Q3)*(D0F-D0F1)*Q3)*8ETA/2.0 0131 Yf=1N-1 129 12M(Q4-Q3)*(D0F-D0F1)*Q3)*8ETA/2.0 0133 Yf=1N-1 129 12M(Q4-Q3)*(D0F-D0F1)*Q3)*8ETA/2.0 0133 Yf=1N-1 129 0230 K=1,NT 133 01N+1 <p1*emp2< td=""> 134 01N+1<p1*emp2< td=""> 135 235 136 J1N=1<n4< td=""> 137 L1M(IN)=0(1N) 138 J1N=1<n4< td=""> 139 CU 332 139 <td< td=""><th></th><th></th><td>202</td><td></td><td></td><td></td><td></td><td></td><td></td></td<></n4<></n4<></p1*emp2<></p1*emp2<>			202						
0122 01-CH1Sr(1,100F1) 0123 02-CH1,d(1,100F2) 0124 011)=(102-01)+(00F-00F1)+(01+RETA/2.0 0125 03-CH1SQ(2,100F2) 0126 04-CH1SQ(2,100F2) 0127 011N1=(104-03)+(00F-00F1)+(03)+8ETA/2.0 0128 203 TIN=1 0127 011N1=(104-03)+(00F-00F1)+(03)+8ETA/2.0 0128 203 TIN=1 0129 TEMP2-10(11)-(11)/(TIN-1.0) 0130 Z2*9*ETA+*ALPHA 0131 V1=IN-1 132 00 Z30 K=1=NT 0133 0(K)=0(1)+(K-1)+TEMP2 0134 LINK(K)=0(K)+TEMP2/7.0 0135 23x: CUNTINUE 0136 SUMPT=0.7 0137 LIN(K)=0(K)+TEMP2/7.0 0138 J14=1N+1 0139 CU 320 K=1,NN 0136 SUMPT=0.7 0137 LIN(K)=0(K)+K 0138 J14=N+1 0139 CU 320 K=1,NN 0130 J14=N+1 0131 LIN(K)=0(K) 0132 SUMPT=0.7 0133 J14=N+1 0139 CU 320 K=1									
#123 Q2-CH1(1,1D0F2) #124 Q11)=(Q2-Q1)+(Q0F-00F1)+Q1)*RETA/2.0 #125 Q3=CH1SQ12,1D0F1) #126 Q4=CH1SQ12,1D0F1) #127 Q1(N)=(Q4-Q3)*(D0F-00F1)+Q3)*BETA/2.0 #128 203 T[N=1N #129 TEMP2=1Q(1N)-Q11)/(TIN-1.0) #130 ZZ=Y*EETA**ALPHA #131 Y1=IN-1 #132 Q0 Z30 K=1.NT #133 Q1(X)=Q11)+(K-1)*TEMP2 #133 Q1(X)=Q11)+(K-1)*TEMP2 #133 Q1(X)=Q11)+(K-1)*TEMP2 #134 L1M(K)=Q1(X)+TEMP2/7.0 #135 Z35 CDNTINUE #136 SUMPT=d.7 #137 L1M(K)=Q1(X)+TEMP2/7.0 #138 J1'4=1N+1 #139 Q1 X #138 J1'4=1N+1 #139 Q2 X K=1.[N #149 K = J1N-KK #149 L1M(K)=Q1(X) #149 K = J1N-KK #149 L1M(K)=Q1(X) #149 K = J1N-KK #141 J4K #144 TEKK=N33,310,33 #144 TEKK=N1									
#124 0(1)=((Q2-Q))*(OOF-DOF)+Q1)*BETA/2.d %125 Q3=CHISQ(2,100F) #127 0(1N)=((Q4-Q3)*(DOF-DOF))*Q3)*BETA/2.0 #128 203 T(M*1N %129 TEMP2=(Q(1N)-C(1))/(TIN-1.0) %130 ZZ=**ECTA**ALPHA %131 Vf=1N-1 %132 C0 230 K=1,NT %133 OIX)=Q(1)+(K-1)*TEMP2 %134 L1K(K)=Q(K)+TEMP2/7.0 %135 Z35 CONTINUE %136 SUMPT=0.7 %137 L1M(K)=Q(K)+TEMP2/7.0 %138 J1%=1N=1 %136 SUMPT=0.7 %137 L1M(K)=Q(K)+TEMP2/7.0 %138 J1%=1N=1 %139 C0 30 K=1,NN %139 C0 30 K=1,NN %130 SUMPT=0.7 %131 L1M(K)=Q(K)+TEMP2/7.0 %133 J1%=1N=1 %134 L1M(K)=Q(K)+TEMP2/7.0 %135 C0 30 K=1,NN %138 J1%=1N=1 %139 SUMPT=0.7 %140 L1M(K)=Q(K) %1414 J=K-1 %145 TEMP2=TEMP5/2.0									
k125 03=CHISq12,ID0F11 0126 04=CHISq12,ID0F21 011N1=(104-03)*(D0F-D0F1)+03)*8ETA/2.0 0128 203 TIN=IN 129 TEMP2+IQ1N1-0(1))/(TIN-1.0) 0130 72=Y*0ETA*ALPHA 0131 NT=IN-1 0122 C0 230 K=1,NT 0133 OIK)=011)+(K-1)*TEMP2 0134 LIM(K)=0(K)+EMP2/7.0 0135 230 CONTINUE 0136 JIM=K 0137 LIM(K)=0(K)+EMP2/7.0 0138 JIM=K 0139 CU 330 KK=1,NT 0130 SUMPTe0.7 0131 UIM(IN=QUIN) 0136 SUMPTe0.7 0137 LIM(K)=QUIN) 0138 JIM=KK 0140 K=JIN-KK 0141 JK 0142 IF(K-INI33,310,33 0143 312 SUMP2.01 0144 TEMP27EMP5/2.00 0145 TEMP5/2.00 0146 GO TO 305 0147 33 SUMP2.00 0148 TEMP27EMP5/2.00 0149 TEMP27EMP5/2.00						FA/2.4			
0126 Q4=CHISQ12,IDUF71 0127 Q1IN1=(1Q4-Q3)*(DDF-DDF1)+Q3)*BETA/7.0 0128 203 0130 TIN=IN 0131 NT=IN-1 0132 C0 0133 Q1(K)=C1(F)/(TIN-1.0) 0134 NT=IN-1 0135 C0 0136 Q2=Y*ETA**ALPHA 0131 NT=IN-1 0132 C0 0133 Q1(K)=TEMP2 0134 L1M(K)=Q(K)*TEMP2/*.0 0135 23b 0136 SUMPT=0.7 0137 L1M(K)=Q(K)*TEMP2/*.0 0138 J1Y=IN+1 0139 C1 0130 SUMPT=0.7 0131 J1Y=IN+1 0130 J1Y=IN+1 0131 J1Y=IN+1 0132 SUMPT=0.7 0131 L1M(K)=Q(K)*TEMP2/*.0 0132 SUMPT=0.1 0133 J1Y=IN+1 0140 K=_JIN-KK 0141 JK=-1 0141 JK=-1 0142 TE(K-1N)33,310,33									
0127 0(1N)=(104-03)*(DOF-DOF1)+(3)*BETA/2.0 0128 203 TIN=IN 129 TEMP2=1(01N)-0(1))/(TIN-1.0) 0130 Z=**EETA**ALPMA 0131 NT=IN-1 132 00 230 K=1.NT 0133 OIK)=0(1)*(K-1)*TEMP2 0141 LIN(K)-1(K)+1EMP27.00 0153 23: CUNTINUE 0134 LIN(K)-0(K)+TEMP27.00 0135 23: CUNTINUE 0136 SUMPT=0.7 0137 LIM(IN)=0(IN) 0138 J14=IN+1 0139 CU 320 KK=1, IN 0130 SUMPT=0.7 0131 LIM(IN)=0(IN) 0138 J14=IN+1 0139 CU 320 KK=1, IN 0130 CU 320 KK=1, IN 0140 K=JIN-KK 0141 J=K-1 0142 IF(K-IN33, 310, 33 0143 SUMP=0.01 0144 TEMP5=TEMP2 0145 TEMP2=TEMP5/2.0 0145 TEMP2=TEMP5 0146 CU 3205 0147 33 SUMP=0.20 0148 TEM									
0120 203 TIN=IN 0120 TEMP2=1Q(IN)-O(I))/(TIN-1.0) 0130 ZZ=Y*EETA**ALPHA 0131 VI=IN=I 0132 OD 230 K=I,NT 0133 OIK)=Q(I)+(K-1)*TEMP2 0134 LIM(K)=Q(K)+TEMP2/7.0 0135 Z35 CUNTINUE 0136 SUMPI=0.7 0137 LIM(K)=Q(IN) 0138 J1%=IN=I 0139 CU 332 KK=L,IN 0130 CU 332 KK=L,IN 0131 J=K-L 0132 LIM-KK 0143 J=K-L 0144 J=K-L 0145 TEMP2.4 0146 K=JIM-KK 0147 IF(K-IN)33,310,33 0148 TEMP2.4 0144 TEMP2.4 0145 TEMP2.4 0146 CU TO 305 0145 TEMP2.4 0146 CU TO 305 0147 35 SUMP4.6 0148 TEMP2.4 0150 AP=LIMELDA-1.0 *EXP(-LIM(J)/ELTA)/ZZ 0151 AP=LIMELDA-1.0 *EXP(-LIM(J)/ELTA)/ZZ						ETA/2.0			
0130 ZZ=Y*EETA**ALPHA 0131 NT=IN-1 c132 CO 230 K=1,NT 0133 OIK)=QII)+(K-1)*TEMP2 0134 LIM(K)=Q(K)+TEMP2/*.0 0135 236 CUNTINUE 0136 SUMPT=0.7 0137 LIM(IN)=QIIN) 0138 J14=IN+1 0139 CU 332 KK=1,IN 0140 KK=1,IN 0137 LIM(IN)=QIIN) 0148 J14=IN+1 0139 CU 332 KK=1,IN 0140 K=1,IN 0141 J=K-1 0142 IF(K-IN)3,310,33 0143 J12 SUMP=.01 0144 TEMP5=TEMP2 0145 TEMP5/2.0 0146 GO TC 305 0145 TEMP5.12C.0 0146 GO TC 305 0147 3 SUMP=0.2 0146 TEMP5.12C.0 0147 SUMP2.2.0 0158 AP=1 [M] ()*ELTAP5.2 0149 IF (K-1)375.322.305 0140 TEMP2.2 0150 AP=1 [M] ()*ELAPA-1.2.0 *EXP(-L [M[K]/2L			203						
d131 Vf=IN-1 c132 C0 230 K=1,NT d133 C1K1=Q11)+(K-1)+TEMP2 d134 LIM(K)=Q(K)+TEMP2/?.0 c135 230 CUNTINUE u136 SUMPT=0.7 c137 L(M(IN)=Q(IN) d138 J1'u=IN+1 u139 C'0' 320 KK=1,IN d140 K=JIN-KK u141 J=K-1 d140 K=JIN-KK u141 J=K-1 d142 IF (K-IN'33,310,33 c143 312 SUMP=0.01 d144 TEMP5=TEMP2 d145 TEMP5=TEMP2 d146 GO TC 305 g146 GO TC 305 g147 33 SUMP=0.0 g148 TEMP2=TEMP5/2.0 g149 IF (K-1)375,322,395 g146 GO TC 305 g147 33 SUMP=0.02 g148 TEMP2=TEMP5/2.0 g150 305 AP=LIPH3)************************************					N)-Q(1))/(TIN-1.0)				
c132 CO 230 K=1.NT c133 O(K)=O(1)+(K-1)*TEMP2 d134 L(K)=O(1)+(K-1)*TEMP2/7.0 c135 230 CUNTINUE u136 SUMPT=0.7 u137 L(M(N)=O(1N) u138 J1*=1*4 u139 CU 330 KK=1, IN u138 J1*=1*4 u139 CU 330 KK=1, IN u140 K=JN*KK u141 J=K-1 u142 If(K-IN)33, 310, 33 u143 312 SUMP=.01 u144 TEMP5=TEMP2 u145 TEMP5=2 u145 TEMP5=2.0 u146 GO TC 305 u146 GO TC 305 u147 IF(K-I)375,322,305 u148 TEMP2=TEMP5 u149 IF(K-I)375,322,305 u148 TEMP2=TEMP5 u150 305 AP=1[M])*(ALPHA-1.0)*EXP(-LIM(J)/ELTA)/22 u151 R=LIM'K)**(ALPHA-1.0)*EXP(-LIM(J)/ELTA)/22 u151 R=LIM'K)**(ALPHA-1.0)*EXP(-LIM(K)/BETA)/22 u152 PA(K)=1(TEMP2/2.0)*1AP&BP)+SUMP u153 SUMPT=SU*PT+PR(K) u154	0136	•		ZZ=Y*EETA*	*ALPHA				
6133 O(K)=Q(L)+(K-1)+TEMP2 0134 LIM(K)=Q(K)+TEMP2/7.0 0135 23x CONTINUE 0136 SUMPT=0.7 137 LIM(K)=Q(IN) 0138 J1Y=1N+1 0139 CU 330 KK=1, IN 0140 K=JIN-KK 0141 J=K-1 0142 IF(K-IN)33, 310, 33 0143 310 SUMP=.01 0144 TEMP5=TEMP2 0145 TEMP5/2.0 0146 GO TC 305 0146 GO TC 305 0146 GO TC 305 0147 J=(K-I)325,322,305 0148 TEMP2=TEMP5 0149 I=(K-I)325,322,305 0140 TEMP2=TEMP5 0150 396 AP=1[M[1])**(IAPHA=1.0]*EXP(-LIM(J)/ELTA)/22 0151 RP=LIM'N)**(ALPHA=1.0]*EXP(-LIM(J)/ELTA)/22 0151 RP=LIM'N)**(ALPHA=1.0]*EXP(-LIM(J)/ELTA)/22 0151 RP=LIM'N)**(ALPHA=1.0]*EXP(-LIM(K)/BETA)/22 0152 PQ(K)=(TEMP2/2.0)*(AP+8P)*SUMP 0153 SUMPT=SUMPT+PR(K) 0154 GO TO 330	ø13.	l		NT=IN-1					
0134 L1M(K)=Q(K)+TEMP2/?.0 0135 230 CUNTINUE 0136 SUMPT=0.7 .137 L1M(IN)=Q(IN) 0138 J14=IN+1 0139 CU 330 KK=1, IN 0140 K=JIN*KK 0141 J=K-1 0142 IF(K-IN)33,310,33 0143 310 SUMP=.01 0144 TEMP5=TEMP2 0145 TEMP5=TEMP2 0146 G0 TC 305 0147 35 SUMP=.02 0148 TEMP2=TEMP5/2.0 0149 TEMP2=TEMP5/2.0 0146 G0 TC 305 0147 35 SUMP=.02 0148 TEMP2=TEMP5 0149 IF(K-1)375,320,305 0140 TEMP2=TEMP5 0150 305 AP=LIMI)**(ALPHA-1.0)*EXP(-LIM(J)/ELTA)/22 0151 RP=LIMIX1**(ALPHA-1.0)*EXP(-LIM(J)/ELTA)/22 0151 RP=LIMIX1**(ALPHA-1.0)*EXP(-LIM(J)/ELTA)/22 0152 PQ(K)=LTEMP2/2.0)*(AP+BP)*SUMP 0153 SUMPT=SUMPT*PR(K) 0154 G0 T0 330									
C135 23C CUNTINUE U136 SUMPT=0.7 c137 LIM(IN)=C(IN) Ø138 J14=IN+1 Ø139 CU 330 KK=1,IN Ø140 K=JIN-KK 0140 K=JIN-KK 0141 J=K-1 Ø147 If(K-IN)33,310,33 Ø143 312 SUMP=.01 Ø144 TEMP2=TEMP2 Ø145 TEMP2=TEMP2 Ø146 GO TC 305 Ø147 33 SUMP=0.0 Ø148 TEMP2=TEMP5 Ø149 If(K-I)325,320,305 Ø150 305 AP=LIMIJ)**(ALPHA-1.0)*EXP(-LIMIJ)/ELTA)/22 Ø151 AP=LIMIX)**(ALPHA-1.0)*EXP(-LIMIJ)/ELTA)/22 Ø152 Pq(K)=TEMP2/2.0)*IAP+BP)+SUMP Ø153 SUMPT=SUMPT+PR(K) Ø154 GO TO 330									
U136 SUMPT=d.7 .137 L[M(IN)=Q(IN) Ø138 J1%=IN+1 Ø139 C0 308 KK=1,IN Ø140 K=JIN*KK G141 J=K-1 Ø142 If (K-IN)33,310,33 Ø143 312 Ø144 TEMPS=TEMP2 Ø145 TEMPS=TEMP5/2.0 Ø146 GO TC 305 Ø147 33 Ø146 GO TC 305 Ø147 33 SUMP=0.0 Ø146 GO TC 305 Ø147 33 Ø146 GO TC 305 Ø147 B3 SUMP=0.0 Ø148 TEMP2=TEMP5 Ø149 IF (K-I)375,320,305 Ø150 305 AP=1[M'N]**(ALPHA-1.0)*EXP(-LIM(J)/ELTA)/22 Ø150 305 AP=1[M'N]**(ALPHA-1.0)*EXP(-LIM(J)/ELTA)/22 Ø151 AP=LIM'N]**(ALPHA-1.0)*EXP(-LIM(K)/0ETA)/22 Ø152 PQ(K)=1TEMP2/2.0)*1AP+0D)+SUMP Ø153 SUMPT=SUMPT+PR(K) Ø154 GO TO 330) + TEMP 2/ 3.0				
<pre>cl37 L[M(IN)=O(IN) 0138 J1'y=IN+1 0139 C'y 330 KK=1,IN 0140 K=JIN~KK cl41 J=K-1 0147 IF(K-IN133,310,33 c143 312 SUMP=.01 0146 TEMP2=TEMP5/2.0 0146 GO TC 305 c147 33 SUMP=0.0 0146 GO TC 305 c147 J3 SUMP=0.0 c149 IF(K-I)325,320,305 c149 IF(K-I)325,320,305 c149 IF(K-I)325,320,305 c149 JF(K-I)325,320,305 c150 305 Ap=LIMIJ)**(ALPHA-1.0)*EXP(-LIM(J)/EETA)/22 d151 Ap=LIM'K)**(ALPHA-1.0)*EXP(-LIM(K)/BETA)/22 d152 Pq(K)=(TEMP2/2.0)*1Ap+Bp)+SUMP d153 SUMPT=SUMPT+Pq(K) c154 GO TO 330</pre>			236						
0138 J1Y=IN+1 0139 C9 330 KK=1,IN 0140 K=JIN+KK 0141 J=K-1 0142 IF(K-IN133,310,33 0143 312 SUMP=.01 0144 TEMPS=TEMP2 0145 TEMP2=TEMP5/2.0 0146 GO TC 305 0147 33 SUMP=0.0 0146 GO TC 305 0147 33 SUMP=0.0 0146 GO TC 305 0147 33 SUMP=0.0 0148 TEMP2=TEMP5 0149 IF(K-I)375,320,305 0150 305 AP=LIMIJ)**(ALPHA-1.0)*EXP(-LIM(J)/ELTA)/22 0151 AP=LIM*(N)**(ALPHA-1.0)*EXP(-LIM(K)/BETA)/22 0152 Pq(K)=1TEMP2/2.0)*EXP(-LIM(K)/BETA)/22 0153 SUMPT=SUMPT+PR(K) 0153 SUMPT=SUMPT+PR(K) 0154 GO TO 330					T N 1				
0139 CU 336 KK=1, IN 0140 K=JIN-KK 0141 J=K-1 0142 IF(K-IN133,310,33 0143 312 SUMP=.01 0144 TEMPS=TEMP2 0145 TEMPS=TEMP2/2.0 0146 GO TC 305 0147 33 SUMP=0.0 0146 GO TC 305 0147 33 SUMP=0.0 0148 TEMP2=TEMP5 0149 IF(K-I)375,320,305 0150 305 AP=LIMIJ)**(ALPHA-1.0)*EXP(-LIM(J)/ELTA)/22 0151 AP=LIM'K)**(ALPHA-1.0)*EXP(-LIM(K)/8ETA)/22 0151 AP=LIM'K)**(ALPHA-1.0)*EXP(-LIM(K)/8ETA)/22 0152 Pq(K)=1TEMP2/2.0)*1AP+8D)+SUMP 0153 SUMPT=SUMPT+PR(K) 0154 GO TO 330					1.47				
0140 K = JIN+KK 0141 J=K-1 0142 IF(K-IN)33,310,33 0143 312 SUMP = .01 0144 TEMPS=TEMP2 0145 TEMPS=TEMP2 0146 GO TC 305 0147 33 SUMP=C.0 0146 GO TC 305 0147 33 SUMP=C.0 0148 TEMP2=TEMP5/2.0 0149 IF(K-1)3P5,320,305 0150 305 AP=L[M'(1)] **(ALPHA-1.0)*EXP(-L]M(J)/ELTA)/22 0150 305 AP=L[M'(1)] **(ALPHA-1.0)*EXP(-L]M(J)/ELTA)/22 0151 RP=L[M'(K)] **(ALPHA-1.0)*EXP(-L]M(K)/0ETA)/22 0152 Pq(K) = (TEMP2/2.0)*EXP(-L]M(K)/0ETA)/22 0153 SUMPT=SUMPT+PR(K) 0153 SUMPT+PR(K) 0154 GO TO 330					L - TN				
0141 J=K-1 0147 IF(K-IN133,310,33) 0143 312 0144 TEMP5=TEMP2 0145 TEMP2=TEMP5/2.0 0146 GO TC 305 0147 33 0148 TEMP2=TEMP5 0147 33 0148 TEMP2=TEMP5 0149 IF(K-I)325,322,305 0150 305 0151 AP=LIMIJ)**(ALPHA-1.0)*EXP(-LIM(J)/EETA)/22 0151 AP=LIM'K)**(ALPHA-1.0)*EXP(-LIM(K)/BETA)/22 0152 Pq(K)=(TEMP2/2.0)*1AP+BP)+SUMP 0153 SUMPT=SUMPT+PR(K) 0154 GO TO 330					••••				
d147 IF (K-IN133,310,33 d143 312 d144 TEMP5=TEMP2 d145 TEMP2=TEMP5/2.0 d146 GO TC 305 d147 33 SUMP=0.0 d148 TEMP2=TEMP5/2.0 d145 GO TC 305 d147 33 SUMP=0.0 d148 TEMP2=TEMP5 d149 f(K-I)325.320,305 d150 305 Ap=LIMIJ)+*(ALPHA-1.0)*EXP(-LIM(J)/ELTA)/22 J151 Ap=LIM*(N)**(ALPHA-1.0)*EXP(-LIM(K)/BETA)/22 y152 Pq(K)=TEMP2/2.0)*EXP(-LIM(K)/BETA)/22 y153 SUMPT=SUMPT+PR(K) d153 SUMPT=SUMPT+PR(K) d154 GO TO 330									
d144 TEMPS=TEMP2 d145 TEMP2=TEMP5/2.0 d146 GD TC 305 d147 33 SUMP=0.0 d148 TEMP2=TEMP5 d149 IF(K-1)3P5,320,305 d150 305 AP=LIMIJ)**(ALPHA-1.0)*EXP(-LIM(J)/EETA)/22 d151 RP=LIM'X)**(ALPHA-1.0)*EXP(-LIM(K)/BETA)/22 4152 Pq(K)=TEMP2/2.0)*TAP+80)+SUMP d153 SUMPT=SUMPT+PR(K) d154 GO TO 330				IF (K-IN) 33	, 310, 33				
d145 TEMP2=TEMP5/2.0 d146 GO TC 305 d147 33 SUMP=0.0 d148 TEMP2=TEMP5 d149 IF(K-1)325,320,305 d150 305 AP=L1M1J)**(ALPHA-1.0)*EXP(-L1M(J)/0ETA)/22 d151 AP=L1M*K)**(ALPHA-1.0)*EXP(-L1M(K)/0ETA)/22 d151 AP=L1M*K)**(ALPHA-1.0)*EXP(-L1M(K)/0ETA)/22 d153 SUMPT=SUMPT+PR(K) d154 GO TO 330	614	3	312	SUMP=.01					
0146 GO TC 305 0147 33 SUMP=0.0 0148 TEMP2=TEMP5 0149 TF(K-1)325,320,305 0150 305 AP=L1M1J)**(ALPHA-1.0)*EXP(-L1M(J)/EETA)/22 0151 AP=LIM*K)**(ALPHA-1.0)*EXP(-L1M(K)/BETA)/22 0152 Pq(K)=*(ALPHA-1.0)*EXP(-L1M(K)/BETA)/22 0153 SUMPT=SUMPT+PR(K) 0154 GO TO 330	0144	•		TEMP5=TEMP	2				
8147 33 SUMP=0.0 6148 TEMP2=TEMP5 6149 IF(K-1)3P5,320,305 6150 305 AP=LIM(J)**(ALPHA-1.0)*EXP(-LIM(J)/0LTA)/22 5151 RP=LIM(K)**(ALPHA-1.0)*EXP(-LIM(K)/0LTA)/22 9152 Pq(K)=(TEMP2/2.0)*EXP(-LIM(K)/0LTA)/22 9153 SUMPT=SUMPT+PR(K) 8154 GO TO 330	014	5		TEMP2=TEMP	512.0				
2148 TEMP2=TEMP5 2149 IF(K-1)325,328,305 2150 305 AP=LIM(J)**(ALPHA-1.0)*EXP(-LIM(J)/2ETA)/22 J151 AP=LIM'K)**(ALPHA-1.0)*EXP(-LIM(K)/BETA)/22 9152 PR(K)*(TEMP2/2.8)*TAP+8DP)+SUMP 2153 SUMPT=SUMPT+PR(K) 2154 GQ TQ 330	0140	5							
2149 IF (K-1)325,322,305 2150 305 AP=LIMIJ)**(ALPHA-1,0)*EXP(-LIM(J)/ELTA)/22 2151 AP=LIM'K)**(ALPHA-1,0)*EXP(-LIM(K)/BETA)/22 4152 Pq(K)=(TEMP2/2,0)*(AP+BP)+SUMP 4153 SUMPT=SUMPT+PR(K) 6154 GO TO 330	614	7	33		_				
0150 305 AP=L1MIJ)++(ALPHA-1.0)+EXP(-LIM(J)/ELTA)/22 0151 AP=LIM*K)++(ALPHA-1.0)+EXP(-LIM(K)/BETA)/22 9152 Pq(K)=(TEMP2/2.0)+1AP+BP)+SUMP 0153 SUMPT=SUMPT+PR(K) 0154 GO TO 330									
J151 RP=LIM*K)**(ALPHA-1.0)*EXP(-LIM(K)/BETA)/22 4152 PR(K)=(TEMP2/2.0)*1AP+BP)+SUMP J153 SUMPT=SUMPT+PR(K) 6154 GQ TQ 330									
4152 PR(K)=(TEMP2/2+8)+1AP+8P)+SUMP 4153 SUMPT=SUMPT+PR(K) 8154 GO TO 338			505						
0153 SUMPT=SUMPT+PR(K) 0154 GO TO 330									
els4 GO TO 330									
	-								
			320		SUMPT				
		-							

C-4

FURTRAN	IV G L	EVEL	18	MAIN	DATE =	72295	20/34/03	PANE 0
6156			TE (PR(K)-0.0	1331.330.330				
0157		331	PR(K)=0.0					
¥158			CONTINUE					
6159	B	,,,,	DU 438 1+1.M	1				
016¢	_		SUMP #0.0	•				
0161			IXX=D(1)					
Ø162			CALL FACTURE	X.FAC)				
0163			00 43 K=1.IN					
6164			PRUGQ(1,K)=E	XP(D(I)+ALOG(Q(K))-G	(K)-FAC)			
0165			SUMP=SUMP+PR	UGQ(I,K)*PR(K)				
r166		43	CONTINUE					
2167			DU 430 J=1.1	N				
ø168			PRQGU(I,J)=P	RUGQ(I+J)*PR(J)/SUMP	>			
0169		430	CONTINUE					
6176			DD 550 K≠1+1					
E171			Q{K}={AT/TIM	E)+Z+Q(K)				
£172			Ll=L+l					
ə173			DO 550 I=1,L	1				
8174			J=I-1					
J175			CALL FACT(J.					
0176				XP(J+ALOG(Q(K))-Q(K)	FAC)			
0:77		550	CUNTINUE					
e178			DU 601 K=1,1	N				
2179			TEMP3=0.2					
6180			00 601 IS±1,					
9181				TEMP3+PRXGQ(K, (S)				
2187			TEMP3=PRXGQ(K+15)				
9183		001	CONTINUE					
0184			PO 700 I=1.N					
2185 £185			DU 700 IS=1. TEMP4=0.0	LI				
6187			DU 699 K=1.1					
6188				TEMP4+PRXGQ(K+15)*PH	00001.00			
J189			TEMP4=LNRIF((WOUTIEK)			
6198		004	CUNTINUE	14137				
0191		077		ALOG(LNR1F(1,IS))				
8192		722	CONTINUE	200124811111111				
0193			GO TO 101					
0194		611	CONTINUE					
0195			STOP					
· #196			END					

, and a second

Appendix D

FORTRAN SEGMENT FOR PRIOR DATA USING LOG-NORMAL DISTRIBUTION

D-1. If the demand data indicate that the distribution of means follows a log-normal distribution, another program segment must be substituted into the source deck to allow for a log-normal representation. The lognormal segment shown on table D-1 must be substituted for the segment between markers $A \rightarrow$ and $B \rightarrow$ in the source program which is contained in appendix C.

D-2. To use the log-normal segment, it is necessary to include, following the data elements required by chapter 4, data for the standardized normal distribution. This data set is shown in table D-2 and must be entered in ascending order.

Ø129

Ø13Ø

B

► 13Ø CONTINUE ØØ95 A TIN = INØØ96 ØØ97 ANI = NIAP = SUMDI/ANI ØØ98 $\begin{array}{l} AF = 30M01/(111) \\ B = (SQD1-AN1*AP**2.0) / (AN1-1.0) \\ VAR = ALOG (1.0+B/AP**2.0) \end{array}$ 0097 0100 AMEAN = ALOG (1.0+D/AP $^{-2.0}$) AMEAN = ALOG (AP)-VAR/2.0 SDEV = SQRT (VAR) Z01 = -2.33 Ø1Ø1 Ø1Ø2 Ø1Ø3 XØ1 = EXP (ZØ1*SDEV+AMEAN) X99 = EXP ((-ZØ1)*SDEV+AMEAN) Ø1Ø4 Ø1Ø5 SUMP = .01 2106 TEMP 2 = (X99-XØ1)/TIN 0:97 NT = IN-1Øiee DO 23% K = 1,IN Q(K) = X%1 + (K-1)*TEMP 2 23% LIM (K) = Q (K) + TEMP 2/2.%0109 ØIIØ ์ดี่าาา SUMPT = Ø.Ø Ø112 SUMP 1 = 0.0 READ (5,1012) (ZN (I), I = 1,234) 1012 FORMAT (10F8.5) DO 1 K = 1, NT JZ = ((A LOG (LI M (K)) - AMEAN)*100.0/SDEV) Ø113 Ø114 Ø115 ø116 IF (JZ-Ø) 4, 7, 7 Ø117 $\begin{array}{l} \text{IF} (JZ - \psi) 4, 7, 7 \\ 4 JZ = -1^* JZ + 1 \\ \text{ZN} (JZ) = 1.0^{\circ} \text{ZN} (JZ) \\ \text{IF} (K-1) 8, 8, 9 \\ \text{$6 PR} (K) = \text{ZN} (JZ) \\ \text{URP} = \text{ZN} (JZ) \\ \text{URP} = \text{ZN} (JZ) \\ \end{array}$ Ø118 Ø119 Ø12Ø ø121 Ø122 GO TO 1 Ø123 7 JZ = JZ + 1Ø124 9 PR (K) = ZN (JZ)-URP URP = ZN (JZ) !F (K-NT) 1, 3, 1 Ø125 Ø126 Ø127 3 PR (IN) = 1.0-ZN (JZ) 1 CONTINUE Ø128

DO 4361 = 1, NI

Table D-1. Log-normal Segment

Table D-2. Normal Table Data for Log-normal Program Segment

· · · · · · · · · · · · · · · · · · ·
5000 5040 5080 5120 5160 5199 5239 5279 5319 5359
.6179 .6217 .6255 .6293 .6331 .6368 .6406 .5443 .6480 .6517
1.5.17931 - 5.5832 - 5.871 - 5.9101 - 5.948 - 5.987 - 60.26 - 60.64 - 61.03 - 61.41
<u>5898: 5438 5478 5517</u> 5557 5596 5636 5675 5714 5753
6736 6772 6808 6844 6879
<u>66915</u> 6950 .0985 .07019 .7054 .7088 .7123 .7157 .7190 .7224
.7257 .7291 .7324 .7357 .7389 .7422 .7454 .7486 .7517 .7549
7680 17611 7642 17673 17704 7734 7764 7794 7893 7893 7852 17704 7893
- 7881 - 7910 - 7939 - 7357 - 7395 - 8023
.8159, .8186, .8212, .8238, .8264, .8289, .8315, .8340, .8365, .8389
.8413; -8438 .8461 .88485; 8508 .8531 .8554 .3577 .8699
1.2.14.5.17.4.31200.000000.00000000000000000000000000
9192 9207 9222 9236 9251 9265 9279 9292 9306 9310
<u>া হয় হলত বিজিপের বিজেপির প্রথম বিজেপির প্রথম বিজেপির প্রথম বিজেপের সংগ্রম বিজেপির ব্যাপির বিজেপির বিজেপির বিজ</u>
17月4日18月16月1月1日日本19月1日日期18月2日3月1日1月1日日日日1日日日日日日日日日日日日日日日日日日日日日日日日日
9452 9463 9474 9484 9495 9505 9515 9525 9535 9545 1 1 2 2 1 1 1 2 2 1 1 1 2 2 1 2 2 2 2 2
<u>9554</u> <u>19564</u> <u>9573</u> <u>9582</u> <u>9593</u> <u>9593</u> <u>9628</u> <u>9625</u> <u>9633</u>
<u></u>
9713: 9719 9726 9732 9738 9744 9750 9756 9761 9761 9867
<u>9773</u> <u>9778</u> <u>9783</u> <u>9788</u> <u>9798</u> <u>9798</u> <u>9803</u> <u>9808</u> <u>9812</u> <u>9817</u>
<u>.9821</u> <u>.9826</u> .9830 .9834 .9838 .9842 .9846 .9850 .9854 .9857
<u>.9861</u> .9864 .9868 .9871 .9875 .9878 .9881 .9884 .9887 .9890

Appendix E

DEFINITION OF TERMS AND PHRASES

Mean-time-awaiting-repair -- Mean time a failed component end item spends in a queue awaiting repair.

- <u>Mean-transportation time</u> -- Mean time spent in transporting a component end item to the repair facility from the location of failure, plus transportation time from the repair facility to the float stock location.
- <u>Component end itsm</u> -- A group of assemblies, subassemblies, and parts, which, although part of a larger end item, are connected together in such a manner as to be capable of operating independently of the larger end item, e.g., transmitter, receiver, power supply unit, etc. These are also called end items of equipment.
- <u>Component-end-item-float-availability</u> (as applied to operational readiness float) -- The probability that, at a random point in time, none of the end items supported by operational readiness float are inoperable for lack of operational readiness float for that component end item.
- <u>Component end item float level</u> -- The quantity of a specific component end item which is stocked in operational readiness float.
- Demand data -- Historical information describing the quantity of each component end item requested from operational readiness float during a specific interval of time.
- End item (JCS) -- A final combination of end products, component parts, and/or materials which is ready for its intended use, e.g., ship, tank, mobile machine shop, aircraft, etc.
- Float-availability (as applied to operational readiness float) -- The probability that, at a random point in time, none of the end items supported by operational readiness float are inoperable for lack of any item which is authorized operational readiness float.
- Float-availability goal -- The float-availability desired for the end items supported by operational readiness float.
- Float item -- A term used collectively to denote a component end item which is to be stocked for use as operational readiness float.
- Float stock cost -- The total cost of buying, stocking, and maintaining a component end item ellocated to operational readiness float.

- Operational readiness float -- Per AR 750-19, "End items of mission essential, maintenance significant equipment authorized for stockage by maintenance support units or activities to replace unserviceable repairable equipment to meet operational commitments."
- Optimal float allocation -- An allocation, such that no other ellocation can meet or exceed the float-availability achieved by that allocation, at less cost.
- Utility -- A measure of the increase in float-availability per dollar expended which corresponds to increasing by one unit the quantity of a component end item kept in float.

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