AN ANALYSIS OF FORECASTING MODELS
APPLICABLE TO REQUIREMENTS DETERMINATION
FOR DEPARTMENT OF DEFENSE
PETROLEUM PRODUCTS

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DEPARTMENT OF THE AIR FORCE
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The current DOD petroleum requirements determination process involves manual computation and analysis by the services in determining forecast quantities for procurement by the Defense Fuel Supply Center (DFSC). However, these forecast requirements have not been as accurate as DFSC would like. The purpose of this thesis was twofold: to provide a general description of the requirements generation process and to propose an alternative forecasting method that would more accurately represent and predict future requirements. The alternative forecasting method analyzed was a computerized program named SIBYL-RUNNER. Past JP4 and JP5 consumption data from several Air Force and Navy locations was collected and subsequently analyzed using SIBYL-RUNNER to produce annual forecasts. These computer-generated forecasts were then compared with the initial forecasts provided by the services to determine which method more accurately predicted actual consumption. The overall results indicated that SIBYL-RUNNER provided more accurate results in a majority of the locations and time periods analyzed. Several recommendations were subsequently made by the authors to enhance the services' forecasting capabilities.

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A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force University of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

By

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Edward W. Pinion, LCDR, USN
COMMITTEE CHAIRMAN

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INTRODUCTION

Background

Petroleum has rapidly become one of the most expensive and politically sensitive sources of energy in the world. Over the past decade, crude oil prices have increased by over 300 percent in inflation adjusted terms and, until recently, allowed OPEC to establish itself as a dominant political force in the marketplace (6:4-1). Faced with strategic mobility systems that are petroleum dependent, the Department of Defense (DOD) relies heavily on petroleum derived products for most of its energy requirements. As a result, petroleum accounted for nearly 70% of all energy consumed by DOD activities in 1981. This was an expenditure of $13.254 billion and represented 71 percent of the DLA procurement budget (9). Projections through the year 2000 indicate that the military will experience increasing consumption and costs (20:13,25).

The Defense Logistics Agency's Defense Fuel Supply Center (DFSC) acts as DOD's integrated material manager (IMM) for wholesale bulk petroleum products in this volatile environment (23:I-1-2). As such, DFSC's responsibilities include the procurement and distribution of petroleum products for DOD organizations (17:11). Based on projected requirements provided by each of the individual services, DFSC develops and awards contracts for each product requested. With the tremendous amount of capital invested in petroleum and its strategic importance, accurate forecasting of requirements has become a major item of interest to DFSC. Under the present system, DFSC relies entirely upon each of the services for forecasted requirements.

Future requirements submitted to DFSC by the services are currently being derived from a manual analysis of projected mission changes, anticipated exercises, scheduled special events, and past consumption. The heavy reliance on estimated activity results in an attempt by the services to ensure every contingency has been adequately covered. As a result, contracts have been let that obligated contractors to excess quantities that were never lifted. This not only tied up valuable fuel resources but also had a detrimental effect on supplier relationships (19).

Problem Statement

Using present procedures, the services have been unable to provide initial purchase requests that predict future petroleum consumption as accurately as desired by DFSC. The following graphs depict the percent errors obtained between initial forecasts and actual consumption.

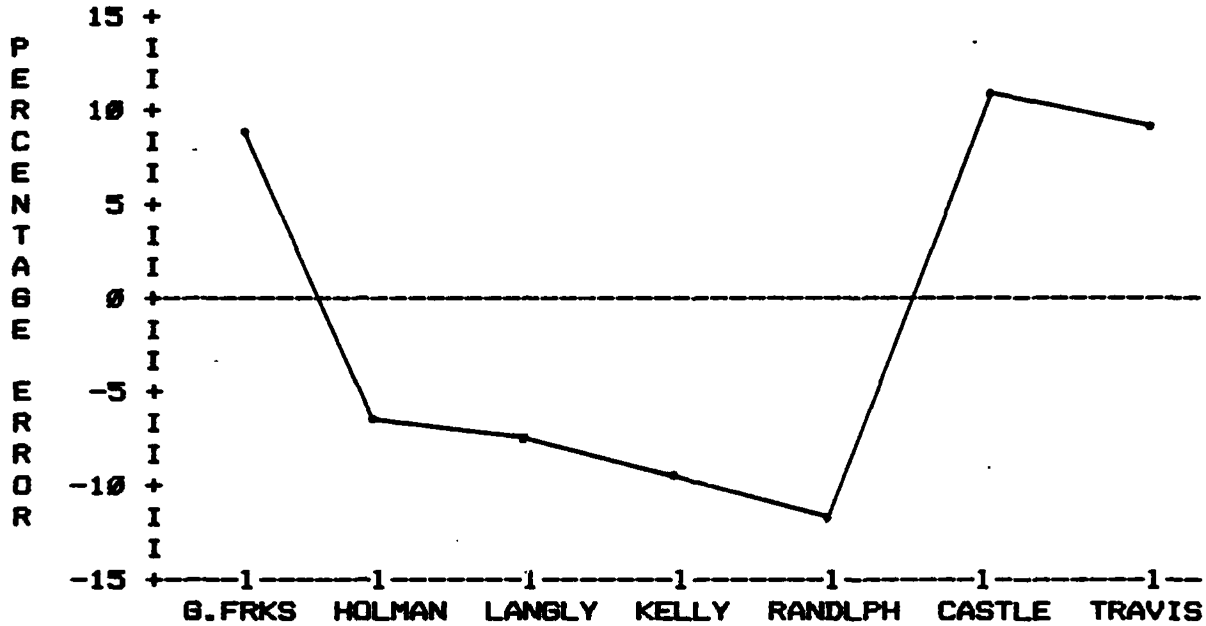

Figure 1-1

Air Force FY '81 Initial Forecast Accuracy - JP4

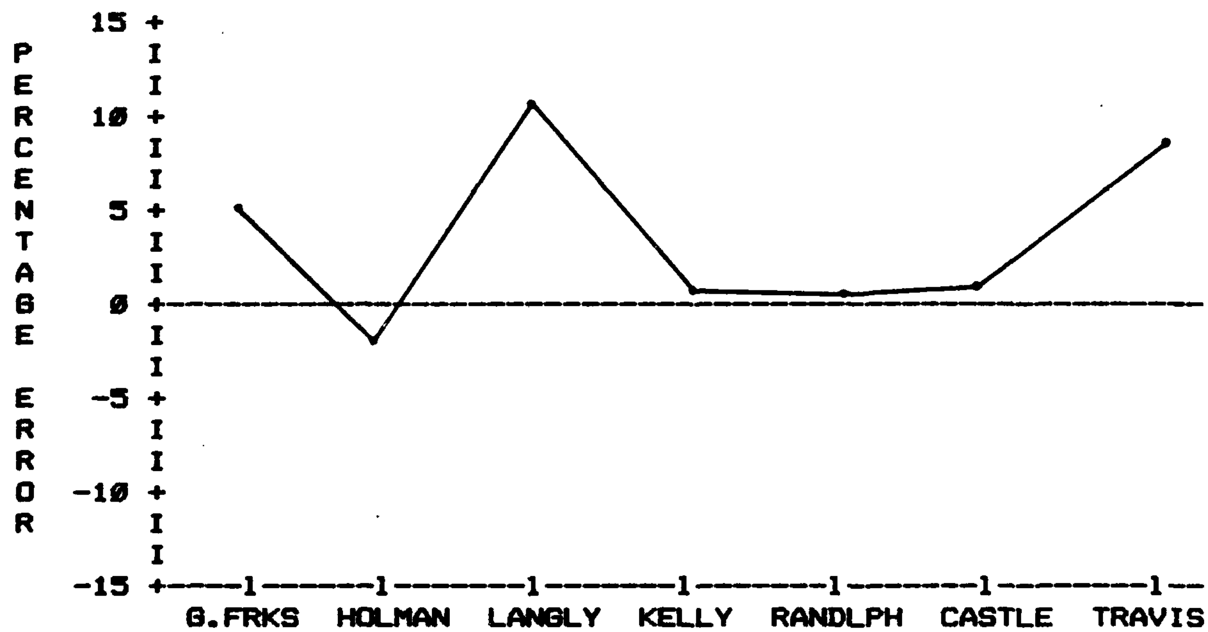

Figure 1-2

Air Force FY '82 Initial Forecast Accuracy - JP4

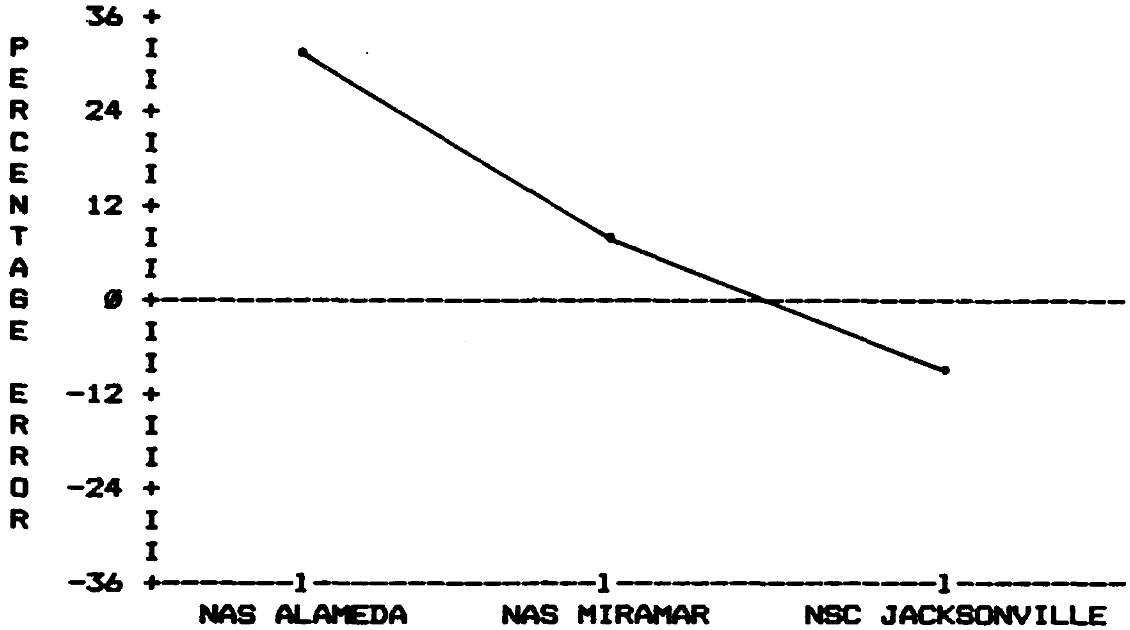

Figure 1-3

Navy FY '81 Initial Forecast Accuracy - JP5

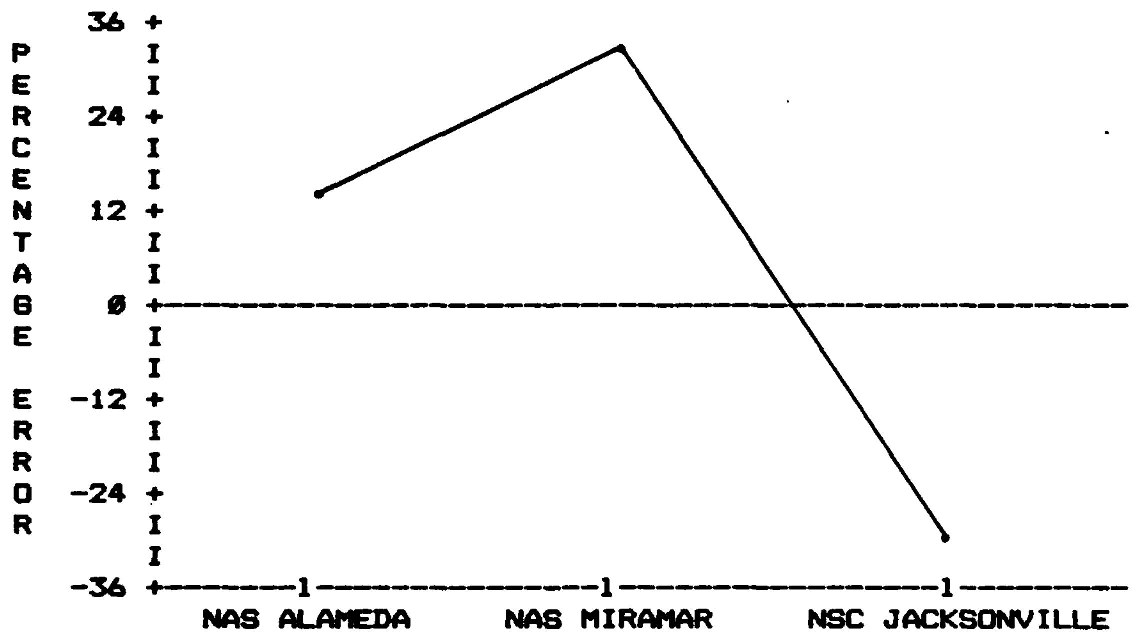

Figure 1-4

Navy FY '82 Initial Forecast Accuracy - JP5

Justification of Research

DOD purchasing of petroleum in a highly volatile market and complex political arena requires a thorough understanding of the requirements process. Presently, no document exists which explains the entire system from service computations to the awarding of contracts by DFSC. This research takes such a systems perspective and explains the overall procedure and its interrelated processes.

DFSC has become concerned with the difference between projected requirements and actual consumption. Because the services base their anticipated requirements on estimates of future activities which can be up to 18 months old, developing an accurate forecast becomes extremely difficult (14). The use of manual calculations and analysis compounds this problem since it limits the use of past consumption data and any sophisticated forecasting techniques that may apply. These two factors may contribute to the differences observed between projected requirements and actual consumption. The use of computer-based forecasting models and their capability to perform numerous calculations on large sets of data should help to improve the requirements determination process and significantly reduce these differences. This research study will attempt to make such an assessment.

Research Question

Can a computer-aided forecasting approach based on historical consumption data be utilized to provide better predictions for future petroleum requirements than the present system?

Research Objectives

The primary objectives of this research are to provide a detailed description of the current requirements generation process, examine the accuracy and merits of the present system, and propose a forecasting approach that will accurately represent and predict future requirements. These objectives will be pursued according to the following methodology:

1. Gain a thorough understanding of the present requirements determination process used by each of the services.

2. Obtain the initial service forecasts and actual consumption quantities for the locations being analyzed.

3. Determine the accuracy of the service forecasts by location and time period.

4. For each submission period, obtain the most appropriate forecasting models and select the model which provides the best results for that period.

5. By location, compare the service forecasts with the "Best" model's forecasts for each submission period and

determine which provides the most accurate results.

Purpose

The purpose of this study is to describe the current requirements determination system and provide the services with alternative methods for determining future petroleum requirements.

Scope

As mentioned previously, a thorough review and understanding of the present requirements determination process used by the individual services and the forecasting models available to assist in this process will constitute the major portion of the literature review. The requirements determination process for each service will be pursued from the lowest level and proceed through to the letting of individual contracts at DFSC. Because of the limited amount of written material in this area, a substantial portion of the literature review will be based on telephone and personal interviews. It is intended that the systems perspective gained from this review will provide a better understanding of how the overall requirements determination and contracting process works.

This study addresses only forecasting for peacetime operating stock (POS) and will be applied independently of war reserve material (WRM) planning. The requirements for WRM are based on threat analysis while this study concentrates on applying historical consumption patterns to future projections.

To further limit the scope of the problem and keep it within a feasible range, the petroleum products that will be addressed in this research are JP4 and JP5. These are the major aviation fuels used by the services, accounting for nearly two-thirds of DOD's total petroleum usage. Together, they constitute the bulk of DFSC's contract requirements. Also, since the Air Force and the Navy are the primary users of JP4 and JP5 respectively, only their bases and stations will be utilized in this analysis.

Although the results of this research pertain mostly to the respective service submission offices, they may provide insights and interrelationships for petroleum managers at all levels. This study should provide each service with an indication of how accurately its requirements determination system operates and may provide methods to improve the effectiveness of this process.

Summary

With the problem defined, the scope limited, and the objectives established, Chapter II consists of a comprehensive review of the present requirements determination process and its impact on the DFSC contracting process. General forecasting models and their applications are also covered. Taking into consideration any limitations or assumptions that have to be made, Chapter III concentrates on the research question and the methodology utilized to achieve the research objectives. Chapter IV contains a discussion of the data used in the forecasting model and an analysis of the results. Chapter V completes the research by providing a summary of the research effort and any conclusions or recommendations that resulted from the study.

CHAPTER II

LITERATURE REVIEW

The literature review for this thesis was conducted by using the various manuals, regulations and policies that comprise the fuels requirements determination process and the texts and user's guides that address the forecasting techniques that were used in the research portion. Because the written literature does not sufficiently cover the requirements determination process and provides only general guidelines, liberal use of personal and telephone interviews of key personnel associated with the requirements and contracting processes were made. This review covers the following major areas:

1. Expanded background of DFSC and its internal and external relationships;

2. The current requirements determination process used by the Air Force and Navy;

3. The procurement and distribution processes and their impact on the present requirements determination process; and

4. Forecasting models and their applications.

DFSC Background and Relationships

The Defense Fuel Supply Center has been in existence for nearly 40 years. Originating from a need to coordinate petroleum purchases for the DOD, it was initially established in 1945 as the Joint Army-Navy Petroleum Purchasing Agency under the direction of the War Department. Its name was changed twice during the next 12 years and in 1962 was changed to the Defense Petroleum Supply Center when it became a charter member of the Defense Supply Agency (presently known as the Defense Logistics Agency). Two years later it was renamed the Defense Fuel Supply Center (DFSC), the name by which it is known today. In 1973, DFSC's mission was expanded from primarily a procurement activity to that of Integrated Materiel Manager for bulk petroleum worldwide (6:ii).

Internally, DFSC is comprised of three directorates: the Directorate of Supply Operations, the Directorate of Procurement and Production, and the Directorate of Technical Operations (24:I-1-19). Based on the scope of this research, the areas of concern were limited to the Directorate of Supply Operations and the Directorate of Procurement and Production as they were the only departments directly affected by the service requirements projections. In addition, DFSC oversees ten Defense Fuel Regions (DFRs) which serve as DFSC's field representatives on fuels related matters in particular locations, both CONUS and overseas.

As mentioned previously, each of the military services calculates its own requirements and forwards them to DFSC for consolidation and contracting action. To facilitate the compilation of these requirements, the individual services have established their own Service Control Point (SCP) to act as a central focal point in this process. Both the Air Force and the Navy maintain their SCP offices at DFSC while the Army maintains their SCP office at the New Cumberland Army Depot in New Cumberland, Pennsylvania (24:I-1-3).

Requirements Determination Process

Each of the services uses slightly different methods for determining its future fuel requirements. Keeping in mind that this research was limited to the two major fuels by consumption, JP4 and JP5, only those processes involved in determining their requirements were reviewed. The Air Force is the primary user of JP4 while the Navy is the primary user of JP5. The Army is a major user of ground fuels but was given only cursory notice in this research as the major focus was placed on the bulk requirements for the major aviation fuels that DFSC is charged with procuring.

The Air Force requirements determination process begins at the Air Force SCP, Detachment 29 (Det 29), SA-ALC, Cameron Station, Virginia. The Air Force consumes about 55 percent of the DOD's total petroleum requirement; aircraft operations account for 92 percent of the Air Force total (21:1). Based on experience, judgement and past years consumption figures, the item manager at Det 29 formulates tentative JP4 requirements for each CONUS Air Force location and distributes these figures to the Major Commands (MAJCOMs) for review and comment. The MAJCOMs, in turn, relay the computations to the appropriate base for review and coordination. Any comments or adjustments are returned to the MAJCOMs where they are reviewed and consolidated before returning to Det 29. The item manager reviews the responses and makes adjustments as are deemed appropriate. Once the requirements receive coordinated approval by the using MAJCOMs, Det 29 consolidates them and fills out a Military Interdepartmental Purchase Request (MIPR), which is forwarded on to DFSC for subsequent contracting action (10). This system appears to work smoothly with the exception that the entire process is done manually, making the process slow and cumbersome and limiting the amount of analysis that can be performed in formulating future requirements. Overseas requirements are handled in a slightly different manner, with the Fuels Management Officer (FMO) at the particular overseas location submitting an AF Form 62, "Overseas Petroleum Requirements," to the appropriate MAJCOM fuels office for subsequent review and submission through the item manager at Det 29 to DFSC (22:1-26).

The Navy bulk requirements consolidation for JP5 is handled by their respective SCP, the Navy Petroleum Office, which is also located at Cameron Station, Virginia. General guidelines for submitting these requirements are contained in NAVSUP Manual, "Supply Ashore", Vol II. However, in an effort to clarify and standardize requirements submissions from using activities, the Navy Petroleum Office (NAVPETOFF) recently issued a NAVPETOFF Instruction implementing interim reporting instructions pending revision of NAVSUP Manual, Vol II (5). Under the new guidelines, Fleet Commanders, CONUS shore activities, and Navy bulk fuel terminals (Defense Fuel Support Points) are directed to submit their projected requirements, by quarter, for two fiscal years to the NAVPETOFF for subsequent consolidation and submission by MIPR to DFSC (15). General guidance for calculating these projections based on past consumption data is also provided; specifying that judgement and experience should be used in determining future requirements. Knowledge of exercises, overhaul schedules, budget constraints, turn-ins, etc., are to be used to modify submissions based on historical consumption/usage figures.

As was mentioned at the beginning of this chapter, the Army has virtually no requirement for the products we have focused on in this research. In fact, of the total JP4 and JP5 consumed by the DOD, the Army accounts for less than five percent (6:22). Because the Army has such an insignificant requirement for these products, what quantities they do use are generally purchased locally and are rarely included in the bulk contracts that DFSC is responsible for administering. For this reason, the Army's requirements determination process will not be reviewed.

Procurement Process

Once the total requirements for these fuels have been determined and consolidated by the respective services, the SCPs formulate MIPRs to cover the requirements and forward them to DFSC for contract action (24:II-1-2). The MIPR is reviewed and checked for accuracy and completeness by the Supply Operations Directorate before submission to the Procurement and Production Directorate for actual contract bid solicitation (24:II-1-6). Prior to award of the contract to a particular contractor, all bids are fed into a computer linear programming package that takes into account transportation costs and locations to arrive at the lowest laid down price (total cost from supplier to user) to serve a particular area (19). This serves a dual purpose: ensuring that the DOD gets the best possible price while conserving transportation resources to the greatest extent possible.

After the contracts have been awarded, the contracting officer summarizes the award data into a Distribution Plan (DP). The DP is published by DFSC to advise the CONUS and overseas fuel regions of how the requirements for a specified procurement program and delivery period will be supported. Also from this data, a Distribution Plan Authorization (DPA) is prepared by DFSC to furnish the fuel region with the authority to order and establish a maximum ordering quantity limit (24:II-4-1). This, in turn, is used by the respective DFR to prepare the Source Identification and Ordering Authorization (SIOATH), DFSC Form 21.1, which is distributed to the base or activity as the sole authorization for requisitioning of bulk aviation products from commercial sources (22:27-19).

This completes a general description of the present requirements determination process. As can be seen, the entire process involves manual manipulation of available data with little statistical or automated analysis. Several computerized analytical techniques are available which should facilitate this process. These are described in the following section.

Forecasting

Forecasts provide managers with the critical link between their organization and the environment. They provide the information required for management decisions throughout an organization. In an increasingly complex and volatile environment, forecasts become even more vital and indispensible as a tool for decision-making (7:432).

Management faces a wide variety of forecasting techniques to choose from. The methods vary in complexity from the extremely simplistic "naive" approach to the very complex Box-Jenkins technique. Although each method attempts to reduce the amount of uncertainty involved, no one approach works best in all circumstances (20:34). As a result, the researcher must select that technique which works best for his particular requirements.

> The selection of a method depends on many factors - the context of the forecast, the relevance and availability of historical data, the degree of accuracy desirable, the time period to be forecast, the cost/benefit of the forecast to the company, and the time available for making the analysis [3:45].

Forecasting methods fall into three major categories: qualitative, causal, and time series analysis and projection (3:49). The first uses mostly expert opinion and the knowledge of special events. In the second grouping, highly refined and specific information is used to explain relationships between factors which can be used to predict future conditions. The last category concentrates on the use of patterns and pattern changes to predict the future. The last two categories are often grouped together under the general heading of quantitative techniques.

Qualitative Methods

The use of qualitative or subjective techniques has not been well specified (1:211). In most instances, the forecaster carries out the process in his head, subjectively weighing many different factors. Although this approach may yield highly accurate results, depending upon the individual involved, the results are not reproducible and do not lend themselves well to research or use by others (16:2).

Causal Techniques

In contrast to qualitative techniques, quantitative methods such as time series or causal models provide reproducible results and are readily computer programmable (1:211). These techniques can be applied when three conditions exist:

1. There is information about the past.
2. This information can be quantified in the form of data.
3. It can be assumed that the pattern of the past will continue into the future [11:7].

Causal techniques provide forecasts based on the relationships between two or more variables. This approach requires the availablity of sufficient historical data to determine the relationships between factors. It also assumes that the conditions affecting the relationship continue on into the future (11:146). Models falling into this category include regression and correlation analysis, econometric models, input-output models, and systems dynamics (7:442).

Time Series Analysis

Time series analysis predicts the future based on past data or patterns (20:34). The time series data used to make these forecasts consists of values of some variable taken at equally spaced time intervals (7:445). In each instance, the observation is a realization of a joint random distribution making it a stochastic process (16:8).

Time series data usually consists of five components: the average, trends in the average, seasonal variation, cyclical variation, and random variation (20:34). The trend component refers to the long term growth or decline in the average of the variable (7:446). Cyclical variations represent the recurrent undulations of the variable over a period of years (20:34). The seasonal component refers to the annually repetitive demand fluctuations that occur (7:447). And, the random component is the irregular deviation found in the data due to complex random elements in the environment. These components may appear singularly or in any combination.

Time series analysis does not concern itself with the relationships between dependent and independent variables. Instead, it concentrates only on the outputs of the generating process. This provides two advantages: first, it reduces the need for expertise or the need to research the relationships , and second, it allows the forecaster to concern himself only with recording observations and making predicitions (11:17).

An important step in time series analysis is to determine which of these patterns are present. Different models are appropriate for different patterns. There are generally four patterns that will appear: horizontal, seasonal, cyclical, and trend (11:8-11).

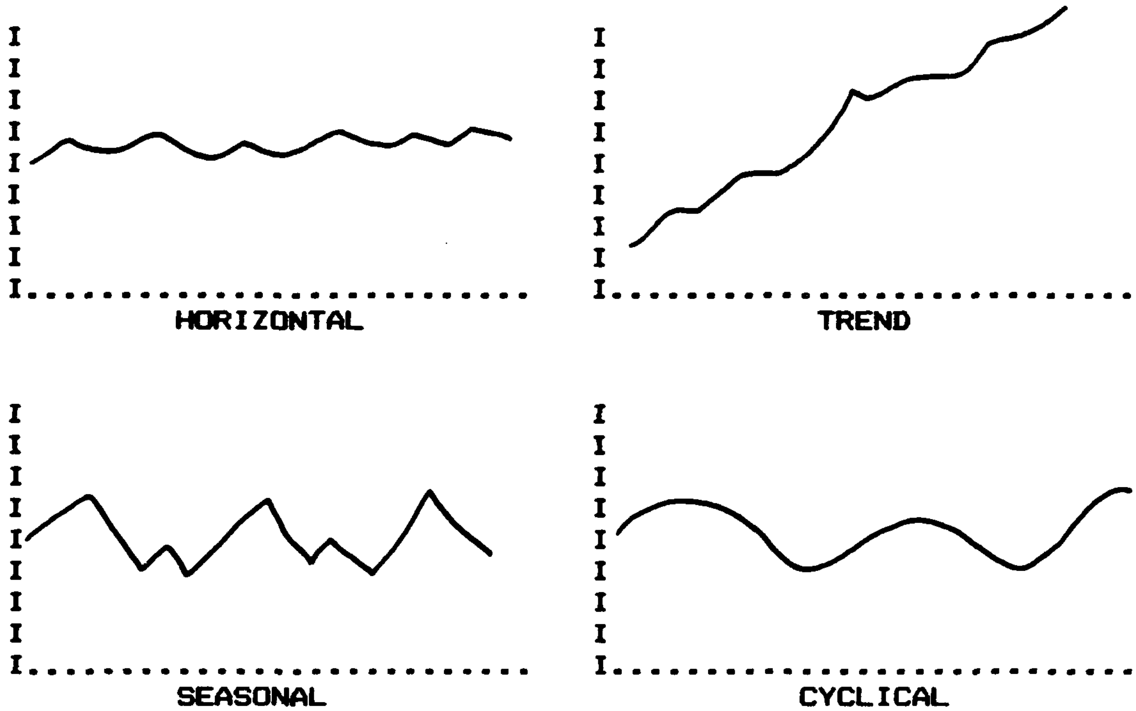

Figure 2-1

Data Patterns

In each pattern some random error will occur. The critical task of forecasting is to separate the pattern from the error (11:18).

data = pattern + randomness

The forecast will be the expected value provided by the pattern. The error follows a random pattern with a mean equal to zero (16:8-10). Thus, the procedure of estimating the pattern consists of fitting some functional form which minimizes the error component of the equation. This can be measured by the mean square error (11:20–21).

$$MSE = \Sigma e^2/n$$

where e_i is the error at each observation and n is the number of observations.

The researcher will also wish to obtain several additional statistics in order to determine the best pattern. These include the variance, covariance, and correlation. These aid the forecaster in determining the pattern and relationships between different time periods (11:35).

The variance describes the dispersion of the errors about their mean. When n is sufficiently large, the central limit theorem can be invoked allowing the distribution to be described as normal. Thus with the mean and variance the distribution specifies the errors completely (11:29). The variance can be computed as follows:

$$s^2 = \Sigma(X_i - \bar{X})^2/n-1$$

where s^2 is the variance, X_i is the ith observation, and $\bar{X}$ is the mean.

The covariance describes how observations vary in relation to each other (11:32). The larger the covariance, the stronger the relationship. The covariance between two variables, X and Y, can be computed as follows:

$$\text{covariance} = \Sigma(Y_i - \bar{Y})(X_i - \bar{X})/n-1$$

The term autocovariance is used to describe the relationship between different observations in the same series (16:21).

Although covariance can determine if a relationship exists, it does not show the magnitude. To overcome this problem the covariances can be standardized by dividing the covariances by the variance of the time series (16:25-26). This term is the correlation or the autocorrelation of the time series.

autocorrelation = covariance/variance

The autocorrelation aids tremendously in determining the appropriate model to be fit to the data.

Two further concepts require discussion before proceeding to the descriptions of forecasting models. These are the concepts of stationarity and nonstationarity. A stationary time series consists of a pattern where the first two moments of the joint distribution are constant (16:19-25). This means that the pattern may deviate from the mean but it will eventually return to the mean.

Nelson describes stationarity as a very strong condition to impose on a time series, one which is probably never true of all time series. In instances of nonstationarity, the researcher must transform the nonstationary time series into a stationary one. This can be accomplished through differencing or log transformations (16:56-67).

Makridakis and Wheelwright divide time series techniques into three categories: smoothing, decomposition, and the autoregressive-moving average model (12:43). These models are the most appealing and empirically based of those in use today.

Smoothing Models. These models weight or smooth past observations in order to obtain a forecast. These techniques attempt to average out the random error (12:43). These models cost little to operate and can be accomplished in short periods of time.

The moving average models attempt to provide forecasts by averaging out the last L period's observations to obtain a forecast:

$$\hat{Z}_t = \sum Z_{t-L}/L$$

where $\hat{Z}_t$ is the forecasted value and Z_{t-L} is the observed value (10:47). The moving average model becomes more sophisticated as all past observations are exponentially weighted to provide a forecast (11:49).

$$\hat{Z}_t = \alpha Z_{t-1} + (1-\alpha)\hat{Z}_{t-1}$$

where alpha (α) is the weighting factor. Both of these models require small amounts of data to be stored and little computational work; however, they work well only with stationary time series data (11:47-53).

The adaptive response rate models attempt to accomplish the same effect as the moving average models except it does not require establishing a smoothing coefficient (11:53). Instead it attempts to automatically determine the smoothing factor and vary it according to the conditions in the observations. It too only works well in a stationary time series.

Several models attempt to account for trended data which the previous models do not. Representative models of this category include the linear moving average models, Brown's one-parameter linear exponential smoothing model, and Holt's two parameter linear exponential smoothing model (11:55-66). These models attempt to determine the trend factor and add it to the forecast. These models can be used for trended time series observations but do not handle seasonal and cyclical fluctuations well.

Another class of smoothing models attempt to break out the five time series components and smooth them out individually. This class of models includes Brown's quadratic exponential and Winter's linear and seasonal exponential smoothing models (11:66-74).

<u>Decomposition Models</u>. These models apply some of the smoothing concepts but also attempt to break a time series into its major subcomponents (11:43). Instead of attempting to determine one pattern it attempts to predict the seasonal, cyclical, and trend patterns while smoothing out the random error (11:88).

data = f(trend, cycle, seasonality) + error

All of the decomposition techniques use a similiar methodology. The steps include:

1. Obtain tne seasonality and random error factor.

2. Subtract out this factor to obtain trend and cycle functions.

3. Isolate the seasonal factor through averaging.

4. Identify the appropriate form of the trend.

5. Obtain the cycle factor by subtracting out the seasonal trend factors.

6. Separate out all the factors to isolate the randomness.

Models falling into this category include the ratio-to-moving averages model, census II model, and several moving average models (11:88-138).

Box-Jenkins Technique. Box-Jenkins Autoregressive Moving Average (ARMA) techniques incorporate both the smoothing and decomposition methods along with a regression equation to form forecast (11:253). This allows the ARMA to smooth out the randomness , break down the time series into its component parts, and incorporate some explanatory methods.

The moving average (MA) portion of the ARMA model appears as follows:

$$\hat{Z}_t = \mu + U_t + \psi_1 U_{t-1} + \ldots \psi_q U_{t-q}$$

which is a moving average of q periods (16:33). Thus, the "memory" of this portion is only q periods long (16:37).

The moving average portion can take on differing orders of magnitude depending upon the number of periods in the moving average and seasonality. The order of the moving average component can be determined by the correlogram (16:74-75). Significant spikes, greater than two standard deviations, in the correlogram or autocorrelation function (ACF) and a sloping partial autocorrelation function (PACF) indicate an MA model.

The autoregressive component (AR) is a regressive equation in which the forecast is related to its own past values (16:38):

$$\hat{Z}_t = \phi_1 Z_{t-1} + \ldots . \phi_p Z_{t-p} + \delta + U_t$$

Autoregressive functions are not necessarily stationary. Stationarity can be achieved by comparing the ϕ weights to specified values (16:39-43). To determine whether a time series contains an AR component, one would look for a sloping ACF and significant spikes occuring in the PACF (16:40).

Both the AR and MA components can be combined to form an ARMA model (16:57):

$$\hat{Z}_t = \phi Z_{t-1} + \ldots + \phi_p Z_{t-p} + \delta + U_t - \theta_1 U_{t-1} - \ldots . \quad \theta_q U_{t-q}$$

In an ARMA model, time lags one thru q would be affected by the MA portion while the remaining time lags would be influenced by the AR portion (16:52).

The ARMA model functions for a stationary time series only. In instances of nonstationarity, differencing or log transformations are required (16:57). Differencing forms the autoregressive integrated moving average (ARIMA) model.

Differencing can be thought of as a sequence of differences (16:57). Thus:

$$W_t = Z_t - Z_{t-1}$$

where,

$$\hat{Z}_t = W_t + W_{t-1} + W_{t-2} + \ldots\ldots$$

The process of using the Box-Jenkins ARMA model consists of:

1. Postulate general class of models.
2. Identify model to be tentatively entertained.
3. Estimate parameters in tentatively entertained model.
4. Diagnostic checking (Is model adequate?).
5. Use model to forecast [11:329].

The Box-Jenkins ARMA model does possess some advantages and disadvantages. Statisticians prefer the model since it provides a wide variety of models which theoretically can fit any model (12:198). It also provides more information than is obtainable in other techniques. The main drawback to the model lies in its complexity (12:198). Many practioners find it much too difficult to understand or work with.

Summary

This chapter provided a description of the process presenty used by the SCPs to determine and forecast petroleum requirements for submission to DFSC. It also provided a review of several forecasting methods that could be applied to that process. The next chapter describes the methodology this research will use to meet the research objectives and answer the research question.

CHAPTER III

METHODOLOGY

Overview

This chapter addresses the methodology used to answer the research question: *Can a computer-aided forecasting model based on historical consumption data be developed that will provide better predictions for future petroleum requirements than the system presently in use?*

The two objectives developed to answer this question were to propose forecasting models to predict future bulk petroleum requirements and to determine if these models provided better results than the methodology currently used by the Air Force and Navy service control points (SCPs). The steps involved in achieving these research objectives included:

1. Obtain the initial service forecasts and actual consumption quantities for the locations being analyzed.

2. Determine the accuracy of the individual service forecasts by location and time period.

3. For each submission period, obtain the most appropriate forecasting models and select the model which provides the best results for that period.

4. By location, compare the service forecasts with the "Best" model's forecasts for each submission period and

determine which provides the most accurate results.

The remainder of this chapter expands on each step of the methodology. By following this process, the overall objective of answering the research question was achieved. The results of each of these steps are included in Chapter IV.

Data Collection and Validation

This research focuses on two of the major bulk petroleum products purchased by DFSC: JP4 and JP5. The data of interest concerning these products are the forecasted and issued quantities of each product by service.

The figures themselves consist of the monthly and annual forecasted and issued quantities of JP4 and JP5 that have been recorded since 1974. The amount of data available for each location varied depending on the record keeping requirements for that location. This time frame was selected based on the availability of data and because it was representative of the peacetime environment being modeled. The measured quantities are expressed in barrels, with a barrel being equivalent to 42 gallons.

The JP4 requirements were obtained from the following Air Force Bases: Kelly AFB (AFLC), Grand Forks AFB (SAC), Holloman AFB (TAC), Randolph AFB (ATC), Travis AFB (MAC), Langley AFB (TAC), and Castle AFB (SAC). Only Air Force locations were used for JP4 consumption since the Air

Force is the primary user of JP4. These locations were selected to represent the various types of missions flown by each of the MAJCOMs. In addition, these locations experienced no major mission changes which might distort the findings and provided sufficient quantities of data for the required computer analysis.

The JP5 requirements were derived entirely from Naval Air Stations and terminals. The initial MIPR quantities were provided by the Navy Petroleum Office while the actual consumption figures were obtained from the respective operating locations. Again, these locations were selected to represent the various types of missions flown by the Navy and availability of data required for this research. The locations included: Miramar NAS, Alameda NAS, and NSC Jacksonville.

The data collection process entailed the extraction of these figures from reports and documents maintained by the individual SCPs and service locations. Because the results obtained were not derived from a statistical sample, they can only be applied to these specific locations. However, as more data becomes available, these findings may prove to be generalizable throughout the services.

Several assumptions are necessary concerning this data:

1. The reports and documents maintained by the SCPs and service locations are accurate.

2. The consumption figures exhibit a pattern that will allow prediction of future requirements through the use of some quantitative forecasting technique.

Accuracy of Present Techniques

This step looked at the effectiveness or accuracy of the forecasting techniques presently employed by the services. This was accomplished for each location by first determining the forecasting errors associated with each submission period, converting these figures to percent errors (PE), and finally, determining the overall accuracy for the location by calculating the mean absolute percent error (MAPE).

The forecasting errors were obtained by comparing actual usage with the initial forecasted usage. This figure was calculated by subtracting the actual usage from the forecasted quantity (12:19).

The percent errors were calculated by dividing the forecast errors by the actual consumption during that time period. Thus, the PE is expressed as a percentage of the actual usage and provided an indication of the magnitude of the forecast error. This, in turn, was used as a measure of accuracy for comparing the results of different forecasting techniques.

The mean absolute percent error was derived by taking the mean of the absolute values of the percent errors. This figure provided an overall indication of the accuracy of the service forecasts. The MAPE was selected as a comparison measure since it eliminates the potential canceling of positive and negative errors, gives equal emphasis to both large and small errors, and allows for comparisons among different series of data (12:19).

These techniques provide a basis for determining how effectively the present methods utilized by the services predict future requirements.

Model Selection

As discussed in the literature review, several analytical forecasting methods exist. This step assessed the capability of these techniques by:

1. Selecting those models that were most appropriate for a given consumption pattern.

2. Generating forecasts for each of the models initially selected.

3. Choosing the model which provided the lowest forecasting errors and best overall results.

The forecasting models were analyzed using an interactive forecasting system known as SIBYL-RUNNER. This computerized analysis program consists of two sequential steps. The SIBYL portion provides the user with a preliminary analysis of the data in order to identify appropriate forecasting techniques for specific demand patterns. To do this, it requires relevant information concerning the characteristics of the forecasting situation. These include: time horizon, pattern of the data, type of model, value of forecast accuracy, complexity, and availability of data. Based on this information and the actual data, it recommends the most appropriate models for use with a given demand pattern (12:4-8).

The RUNNER portion represents the second half of this system. It contains several subroutines representing different forecasting models which can be applied to the data. This portion also provides calculations of each forecasting technique's accuracy in terms of mean percent error (MPE), mean absolute percent error (MAPE), and mean square error (MSE). The MPE is simply the mean of the PEs discussed in the previous section while the MSE is the mean of the squared forecast errors. RUNNER also has the capability of comparing several forecasting techniques on the same set of historical data. By using SIBYL-RUNNER, one should obtain:

1. A general analysis of the data.
2. A screening of available techniques.
3. A detailed examination of a few of the most appropriate techniques.
4. Final selection of a technique for the situation [12:8].

In addition, RUNNER provides a Chi-square statistic which aids in determining the most accurate model. The Chi-square value indicates whether the residuals or error terms still contain information which can aid in the forecast, or whether they are attributable to random errors or white noise. This test compares the computed Chi-square value with the Chi-square value from a statistical table based on the confidence level and the degrees of freedom (12:39). The test is as follows:

Ho: The residuals are not due to random fluctuations.

Ha: The residuals are due to random error.

The decision rule is to reject Ho if the computed Chi-square value is less than the table value at a specified level of confidence. If the computed value is lower than the table value, it can be concluded that the errors or differences are due simply to randomness or white noise.

Using the SIBYL portion of the program, appropriate forecasting models were identified for each MIPR submission period by location. This was accomplished for each submission period for which the initial MIPR quantity was known. As a result, SIBYL could generate a new set of appropriate forecasting models for each period. The RUNNER portion of the program was then used to produce the forecasts and their associated forecasting errors for each of the selected models. The most appropriate model, hereafter referred to as the final model, was then chosen according to the following criteria: lowest statistical measures of forecast error, the chi-square test, an analysis of the residual autocorrelations, and the realism of that forecast when compared with the past consumption pattern.

The realism of the forecast was subjectively determined by comparing the forecasted quantity provided by the model with past consumption trends. After the model was selected, its forecast was compared to the actual consumption for that time period to obtain a PE for comparison with the service forecast PE.

Selection of the "Best" Approach

This step of the methodology compared the forecast results generated by SIBYL-RUNNER with the SCP forecasts. The PEs for each fiscal year's forecasts were evaluated to determine which method provided a better approximation of the actual consumption. As a result, the forecast with the lowest PE was selected as the "Best" approach for that forecast period.

To determine which approach provided the most accurate results for each location, MAPEs were calculated for all submission periods by approach. These figures were then compared, and the method with the lowest MAPE value was selected as the "Best" approach for use at that location.

Chapter IV contains the results of this study and Chapter V summarizes the findings, recommendations, and conclusions.

CHAPTER IV

RESULTS AND ANALYSIS

Overview

This chapter contains the results obtained from the methodology described in Chapter Three. To aid in the analysis process, the results are provided in tabular form in the order of the methodology listed below:

1. Obtain the initial service forecasts and actual consumption quantities for the locations being analyzed.

2. Determine the accuracy of the individual service forecasts by location and time period.

3. For each submission period, obtain the most appropriate forecasting models and select the model which provides the best results for that period.

4. By location, compare the service forecasts with the "Best" model's forecasts for each submission period and determine which provides the most accurate results.

The results are discussed by location starting with a table listing the initial service MIPR estimates and actual consumption quantities. This table also completes the second step of the methodology by comparing the two values and obtaining a percent error (PE) figure. The PE was calculated by subtracting the actual consumption for a specific period from the initial forecast MIPR submission and dividing the difference by the actual consumption quantity. This figure provides a measure of accuracy for the service forecast. Each row in the table depicts the fiscal year under analysis, and the columns provide the forecast and consumption quantities and the percent error. Additionally, a mean absolute percent error (MAPE) was calculated for the service forecasts for the overall test discussed in step four of the methodology.

The following tables depict by fiscal year the results obtained from step three of the methodology. The models identified by SIBYL and applicable for mid-range forecasting are listed in the first column. The next three columns of these tables provide the results obtained from RUNNER: the mean squared error (MSE), the mean percentage error (MPE), and the mean absolute percentage error (MAPE). These statistics were discussed in Chapter III. The last column provides the forecast obtained from each model under consideration. Each table provides the results for a particular submission period.

Immediately following these tables, a discussion and determination of the most appropriate forecasting model for each location by forecast period is given, providing the rationale for selection of a particular model. The forecasts for each period were then compared with the actual consumption to develop the percent errors. This comparison is provided in a table similar to the one used to compare the service forecasts with actual consumption.

The last part of this analysis completes step four by conducting an overall comparison to determine whether the SIBYL-RUNNER forecasting models provided more accurate forecasts than the initial service MIPRs. Forecast MAPEs from both methods for each location were compared, and the lowest MAPE was selected as indicative of the "Best" method.

Throughout this analysis, references are made to additional information provided by the RUNNER portion of the program. The RUNNER printouts from which this information was extracted are provided in the appendices. In addition, the number of forecast comparisons for different locations varied. This was a result of the differing amounts of consumption data maintained at each location and the availability of past MIPR information that could be provided by the SCPs.

This chapter concludes with a summary section which restates the conclusions made from these tests and provides any general conclusions that can be made.

Model	Description
MEAN	Mean Averaging Model
EXPO	Exponential Smoothing Model
EXPOTL	Trigg and Leach Adaptive Smoothing Model
DECOMP	Classical Decomposition Model
CENSUS	Census II Decomposition Model
GAF	Generalized Adaptive Filtering Model
BOXJEN	Box-Jenkins ARMA Model

Table 4-1

Explanation of Forecasting Terms

Analysis

This section begins with an analysis of the Air Force locations. All quantities are expressed in gallons.

Castle AFB

After analyzing all the data for Castle AFB, the following results were obtained:

FY	FORECAST	CONSUMPTION	PE
1980	112,000,000	103,273,345	8.74
1981	112,000,000	99,714,040	13.13
1982	104,000,000	102,491,345	1.96

MAPE: 7.94

Table 4-2

Comparison of Initial Service Estimates
with Actual Consumption Quantities
Castle AFB

METHOD	MSE	MPE	MAPE	FORECAST
MEAN	852.2	-1.49	10.1	114,090,000
EXPO	1041.7	2.63	9.6	114,150,000
EXPOTL	1145.9	2.62	10.1	113,730,000

Table 4-3

FY 1980 SIBYL-RUNNER Results
Castle AFB

METHOD	MSE	MPE	MAPE	FORECAST
DECOMP	810.6	-1.68	10.7	103,600,000
CENSUS	522.1	-.94	8.8	86,312,000
GAF	494.8	-1.21	7.9	141,350,000
BOXJEN	863.3	-2.66	9.1	105,390,000

Table 4-4

FY 1981 SIBYL-RUNNER Results
Castle AFB

METHOD	MSE	MPE	MAPE	FORECAST
DECOMP	826.1	-1.79	11.0	97,191,360
CENSUS	619.8	-1.23	9.9	118,270,000
GAF	538.7	-1.14	8.7	101,730,000
BOXJEN	929.7	-3.18	10.8	128,320,000

Table 4-5

FY 1982 SIBYL-RUNNER Results
Castle AFB

Of the models selected by SIBYL for FY 1980, the MEAN technique was chosen as "Best" for that period. This choice was based on an examination of the statistics provided by the RUNNER portion of the program. The MEAN provided the lowest MSE and a MAPE that did not appear to be significantly different from the other models. In addition, a review of the RUNNER output showed that past consumption data were stationary, indicating that although observations might deviate from the mean, the tendency would be to return to the mean value. The autocorrelation analysis of the residuals and the chi-square test also provided evidence that the MEAN was an acceptable model. No significant autocorrelations were present and the computed chi-square value (12.1922) was less than the table value (15.5).

The SIBYL-RUNNER results for FY 1981 provided a different set of proposed models due to the presence of seasonality in the data. However, the program indicated that the past consumption pattern was still stationary. Of these models, the GAF was selected because it provided the lowest MSE and MAPE of the models under consideration.

Also, a review of the residual autocorrelations and chi-square test indicated that the residuals held no significant information that would contribute to a better forecast.

For FY 1982, the SIBYL-RUNNER program provided the same results as for 1981. The GAF model had the lowest MSE and MAPE of the models selected by SIBYL. The residual autocorrelations also indicated no significant autocorrelations or presence of any additional information that would provide a better forecast.

The following table provides a comparison of the selected model forecasts with actual consumption:

FY	MODEL	FORECAST	CONSUMPTION	PE
1980	MEAN	114,090,000	103,273,345	10.47
1981	GAF	95,714,040	99,714,040	-4.28
1982	GAF	102,491,345	102,491,345	-.74
MAPE: 5.16				

Table 4-6

Comparison of Forecast Model Results
with Actual Consumption Quantities
Castle AFB

The overall results for this location indicated that the SIBYL-RUNNER models provided more accurate forecasts than the SCP. A comparison of the MAPEs calculated for both methods revealed that the SIBYL-RUNNER models yielded a lower MAPE than the SCP method, 5.16 versus 7.94. The only year that the service was able to provide a more accurate forecast was FY 1980.

Grand Forks AFB

The following tables depict the results obtained for Grand Forks AFB:

FY	FORECAST	CONSUMPTION	PE
1980	33,000,000	28,844,118	14.41
1981	34,000,000	30,966,493	9.79
1982	31,000,000	29,308,087	5.77
MAPE: 9.99			

Table 4-7

Comparison of Initial Service Estimates
with Actual Consumption Quantities
Grand Forks AFB

METHOD	MSE	MPE	MAPE	FORECAST
MEAN	98.9	-2.11	11.6	33,647,040
EXPO	111.8	-.99	12.3	33,686,520
EXPOTL	120.8	-3.77	14.4	35,637,420

Table 4-8

FY 1980 SIBYL-RUNNER Results
Grand Forks AFB

METHOD	MSE	MPE	MAPE	FORECAST
MEAN	122.1	-3.14	14.0	32,044,320
EXPO	130.8	-5.68	15.6	30,643,620
EXPOTL	139.0	-5.83	16.8	30,995,580

Table 4-9

FY 1981 SIBYL-RUNNER Results
Grand Forks AFB

METHOD	MSE	MPE	MAPE	FORECAST
DECOMP	131.3	-3.29	14.5	29,863,260
CENSUS	112.6	-2.67	14.0	50,701,980
GAF	92.8	-2.63	13.1	34,228,740
BOXJEN	154.8	-2.25	16.0	45,746,400

Table 4-10

FY 1982 SIBYL-RUNNER Results
Grand Forks AFB

The MEAN technique was selected as the "Best" from those identified by SIBYL for FY 1980. This decision was based on the statistics provided by RUNNER. The MEAN provided both the lowest MSE and MAPE and, of the three identified, was the only model that did not exhibit a pattern in the autocorrelations of the residuals. With SIBYL identifying the data pattern as being stable and stationary, the MEAN technique was considered appropriate.

For FY 1981, the MEAN technique was again selected as appropriate for the same reasons as listed for FY 1980. The statistics provided by RUNNER showed that the MEAN resulted in the lowest MSE and MAPE of the candidate models selected by SIBYL.

The models selected as appropriate by SIBYL in FY 1982 changed as seasonality became apparent in the data pattern; however, the series did remain stationary. The GAF model was selected because it yielded the lowest MSE and MAPE of the four candidate models. In addition, a review of the residual autocorrelation analysis for this model revealed no visible pattern or autocorrelation was present in the residuals.

FY	MODEL	FORECAST	CONSUMPTION	PE
1980	MEAN	33,647,040	28,844,118	16.65
1981	MEAN	32,044,320	30,966,493	3.48
1982	GAF	34,228,740	29,308,087	16.97
MAPE: 12.31				

Table 4-11

Comparison of Forecast Model Results
with Actual Consumption Quantities
Grand Forks AFB

The overall results for Grand Forks AFB indicated that the SCP's forecasts provided more accurate results than could be achieved through the SIBYL-RUNNER program. The MAPE for the service forecast was 9.99 compared with the 12.31 achieved by SIBYL-RUNNER. Only in FY 1981 did SIBYL-RUNNER provide a closer forecast than the SCP.

Holloman AFB

The results for Holloman AFB are provided in the following tables:

FY	FORECAST	CONSUMPTION	PE
1980	42,000,000	45,260,721	-7.20
1981	44,800,000	47,897,862	-6.47
1982	48,200,000	48,943,405	1.52
MAPE: 5.06			

Table 4-12

Comparison of Initial Service Estimates
with Actual Consumption Quantities
Holloman AFB

METHOD	MSE	MPE	MAPE	FORECAST
MEAN	233.44	-3.53	16.17	40,168,800
EXPO	215.34	3.56	14.54	41,524,140
EXPOTL	269.86	4.68	16.25	41,023,920

Table 4-13

FY 1980 SIBYL-RUNNER Results
Holloman AFB

METHOD	MSE	MPE	MAPE	FORECAST
DECOMP	157.20	-2.13	12.18	51,204,720
CENSUS	134.01	-1.74	11.34	61,368,300
GAF	166.94	-1.86	12.42	45,665,760
BOXJEN	165.90	1.83	11.70	46,611,600

Table 4-14

FY 1981 SIBYL-RUNNER Results
Holloman AFB

METHOD	MSE	MPE	MAPE	FORECAST
DECOMP	210.21	-2.72	13.82	52,376,646
CENSUS	171.11	-2.27	12.85	26,257,560
GAF	215.24	-2.26	13.73	47,613,720
BOXJEN	229.20	.92	13.20	46,267,200

Table 4-15

FY 1982 SIBYL-RUNNER Results
Holloman AFB

The results obtained from RUNNER for FY 1980 indicated that the "Best" model of those selected by SIBYL was exponential smoothing. It had the lowest MSE and MAPE of those selected and also showed no remaining pattern or significant autocorrelations of the residuals.

The results for both FY 1981 and FY 1982 indicated that the CENSUS model was the "Best" of those selected by

SIBYL. However, to use this technique would imply an expected increase in consumption of 48 percent in FY 1981 and then a decrease of 57 percent in 1982. Based on past consumption patterns, this magnitude of fluctuation was unrealistic. It was evident that either the smoothing or moving average component of this model had become distorted resulting in the fluctuating forecasts. As a result, the next best model was selected, the BOXJEN model. Although this model had a higher MSE than the DECOMP model, both the MPE and MAPE were lower, making it the more appropriate model.

FY	MODEL	FORECAST	CONSUMPTION	PE
1980	EXPO	41,524,140	45,260,721	-8.26
1981	BOXJEN	46,611,600	47,897,862	-2.68
1982	BOXJEN	46,267,200	48,943,405	-5.47
MAPE: 5.47				

Table 4-16

Comparison of Forecast Model Results
with Actual Consumption Quantities
Holloman AFB

The overall results for Holloman AFB indicated that the SCP provided more accurate forecasts with a MAPE of 5.06 compared to the 5.47 achieved by SIBYL-RUNNER. Because these figures were very similar, the SIBYL-RUNNER model did provide a better forecast for the FY 1981 period.

Kelly AFB

An additional year of data had been maintained for Kelly AFB. As a result, four comparisons were possible for this location. The following tables reflect the results obtained with the additional data:

FY	FORECAST	CONSUMPTION	PE
1979	22,500,000	21,509,208	4.61
1980	23,000,000	24,162,952	-4.81
1981	23,000,000	24,712,389	-6.93
1982	25,000,000	24,706,989	1.19
MAPE: 4.39			

Table 4-17

Comparison of Initial Service Estimates with Actual Consumption Quantities Kelly AFB

METHOD	MSE	MPE	MAPE	FORECAST
MEAN	38.56	-1.61	10.00	23,859,360
EXPO	43.65	1.49	10.40	32,552,100
EXPOTL	50.30	4.66	10.62	32,387,880

Table 4-18

FY 1979 SIBYL-RUNNER Results Kelly AFB

METHOD	MSE	MPE	MAPE	FORECAST
MEAN	40.50	-1.81	10.90	23,567,040
EXPO	51.34	2.09	11.82	23,327,640
EXPOTL	55.30	3.23	12.10	22,996,680

Table 4-19

FY 1980 SIBYL-RUNNER Results Kelly AFB

METHOD	MSE	MPE	MAPE	FORECAST
MEAN	69.45	-3.14	13.70	23,688,000
EXPO	82.13	0.04	14.57	25,275,600
EXPOTL	93.56	1.01	14.92	25,144,560

Table 4-20

FY 1981 SIBYL-RUNNER Results
Kelly AFB

METHOD	MSE	MPE	MAPE	FORECAST
MEAN	64.01	-2.91	12.99	23,889,600
EXPO	74.49	0.02	13.65	24,882,900
EXPOTL	86.36	1.45	14.17	25,445,780

Table 4-21

FY 1982 SIBYL-RUNNER Results
Kelly AFB

The SIBYL-RUNNER results for Kelly AFB indicated that the MEAN technique was the "Best" model to use for each of the years studied. The MEAN technique had the lowest MSE and MAPE of any of the models selected as appropriate by SIBYL. Also, the residual autocorrelations revealed no significant autocorrelations or pattern remained in the data. The data were stable and stationary over the entire time period making the MEAN the most appropriate forecasting model to use.

FY	MODEL	FORECAST	CONSUMPTION	PE
1979	MEAN	23,859,360	21,509,208	10.92
1980	MEAN	23,567,040	24,162,952	-2.47
1981	MEAN	23,688,000	24,712,389	-4.15
1982	MEAN	23,889,600	24,706,989	-3.31

MAPE: 5.21

Table 4-22

Comparison of Forecast Model Results
with Actual Consumption Quantities
Kelly AFB

The overall results for Kelly AFB indicated that the SCP approach provided better results than the SIBYL-RUNNER method. The service MAPE of 4.39 was lower than the 5.21 provided by using SIBYL-RUNNER. However, SIBYL-RUNNER did provide a more accurate forecast for two of the fiscal years studied, FY 1980 and FY 1981.

Langley AFB

The following tables and explanations provide the results obtained for Langley AFB:

FY	FORECAST	CONSUMPTION	PE
1980	36,000,000	35,939,975	0.16
1981	33,000,000	36,153,055	-8.72
1982	47,000,000	41,919,186	12.12

MAPE: 7.00

Table 4-23

Comparison of Initial Service Estimates
with Actual Consumption Quantities
Langley AFB

METHOD	MSE	MPE	MAPE	FORECAST
MEAN	178.63	-3.84	16.85	35,587,440
EXPO	248.60	-8.46	19.80	38,115,420
EXPOTL	342.58	-13.54	24.32	38,487,120

Table 4-24

FY 1980 SIBYL-RUNNER Results
Langley AFB

METHOD	MSE	MPE	MAPE	FORECAST
DECOMP	181.04	-3.71	16.26	34,243,440
CENSUS	148.56	-2.93	13.99	23,272,200
GAF	79.60	-2.18	11.40	36,030,540
BOXJEN	162.10	-4.04	15.60	25,347,000

Table 4-25

FY 1981 SIBYL-RUNNER Results
Langley AFB

METHOD	MSE	MPE	MAPE	FORECAST
DECOMP	165.50	-3.52	15.80	35,547,540
CENSUS	156.50	-2.86	15.30	53,056,500
GAF	110.00	-2.41	12.90	35,632,380
BOXJEN	137.80	-6.71	14.80	35,977,200

Table 4-26

FY 1982 SIBYL-RUNNER Results
Langley AFB

The results from RUNNER for FY 1980 indicated that the most appropriate model to use was the MEAN. Of the candidate models selected by SIBYL, it had both the lowest MSE and MAPE. Also, a review of the residual autocorrelations revealed no significant autocorrelations or pattern remaining in the residuals that would suggest that a different model would be more appropriate.

The results provided by RUNNER for both FY 1981 and FY 1982 indicated that the GAF model was the "Best" technique of those selected by SIBYL. For both periods it obtained the lowest MSE and MAPE and the autocorrelation function revealed that the remaining residuals exhibited no autocorrelation or pattern that hadn't been accounted for by the model.

FY	MODEL	FORECAST	CONSUMPTION	PE
1980	MEAN	35,587,440	35,939,975	1.05
1981	GAF	36,030,540	36,153,055	0.34
1982	GAF	35,632,380	41,919,186	-14.99
MAPE: 5.46				

Table 4-27

Comparison of Forecast Model Results
with Actual Consumption Quantities
Langley AFB

The overall results for Langley AFB revealed that SIBYL-RUNNER provide more accurate forecasts than the SCP. The MAPE for the SIBYL-RUNNER models was 5.46 compared with the SCP MAPE of 7.00. However, an increase in consumption not evident from the past consumption pattern in 1982 enabled the SCP to make a better forecast for that period.

Randolph AFB

The following tables and discussion describe the results and analysis for Randolph AFB:

FY	FORECAST	CONSUMPTION	PE
1980	17,000,000	15,615,458	8.87
1981	16,500,000	14,642,190	12.69
1982	15,000,000	14,875,528	0.84

MAPE: 7.47

Table 4-28

Comparison of Initial Service Estimates
with Actual Consumption Quantities
Randolph AFB

METHOD	MSE	MPE	MAPE	FORECAST
MEAN	34.60	-3.46	14.70	16,112,880
EXPO	50.20	-8.36	17.80	19,540,080
EXPOTL	60.70	-10.49	20.80	18,763,920

Table 4-29

FY 1980 SIBYL-RUNNER Results
Randolph AFB

METHOD	MSE	MPE	MAPE	FORECAST
MEAN	32.30	-3.42	14.10	15,946,560
EXPO	44.70	-8.85	17.50	15,902,460
EXPOTL	57.30	-11.67	21.30	16,826,600

Table 4-30

FY 1981 SIBYL-RUNNER Results
Randolph AFB

METHOD	MSE	MPE	MAPE	FORECAST
DECOMP	967.20	100.00	100.00	00,000,000
CENSUS	15.80	-1.57	10.30	16,649,640
GAF	8.10	-1.11	7.40	14,016,240
BOXJEN	25.60	-4.24	12.40	14,158,200

Table 4-31

FY 1982 SIBYL-RUNNER Results
Randolph AFB

The results provided by SIBYL-RUNNER indicated that the MEAN method was the most appropriate forecasting technique for FY 1980 and FY 1981. In both years, the MEAN provided the lowest MSE and MAPE of those models selected by SIBYL. The residual autocorrelations revealed no additional forecasting information could be derived from the data, indicating that the MEAN was an appropriate forecasting model for this location.

The results for FY 1982 differed from the previous two periods as the SIBYL-RUNNER program detected a seasonal pattern in the additional data. Of the candidate models selected by SIBYL, the GAF was chosen as the "Best" model. Although the residual autocorrelations revealed one spike that had not been accounted for, the GAF model still provided a lower MSE and MAPE than the other models.

FY	MODEL	FORECAST	CONSUMPTION	PE
1980	MEAN	16,112,880	15,615,458	3.19
1981	MEAN	15,946,560	14,6[illegible]2,190	8.91
1982	GAF	14,016,240	14,875,528	-5.78
MAPE: 5.96				

Table 4-32

Comparison of Forecast Model Results
with Actual Consumption Quantities
Randolph AFB

A comparison of the SIBYL-RUNNER results with those of the forecasts submitted by the SCP indicated that the SIBYL-RUNNER forecasts were more accurate. The MAPE for the SIBYL-RUNNER models was 5.96 compared with the 7.47 MAPE for the SCP forecasts over the same time period.

Travis AFB

The results for Travis AFB are included in the tables and analysis discussion that follows:

FY	FORECAST	CONSUMPTION	PE
1980	85,000,000	86,379,592	-1.59
1981	90,000,000	81,342,057	10.64
1982	88,000,000	80,166,701	9.77
MAPE: 7.33			

Table 4-33

Comparison of Initial Service Estimates
with Actual Consumption Quantities
Travis AFB

METHOD	MSE	MPE	MAPE	FORECAST
MEAN	646.40	-2.20	12.70	85,438,080
EXPO	709.70	2.22	11.60	93,953,160
EXPOTL	705.90	2.16	11.60	93,793,980

Table 4-34

FY 1980 SIBYL-RUNNER Results
Travis AFB

METHOD	MSE	MPE	MAPE	FORECAST
DECOMP	517.50	-1.70	11.40	99,234,660
CENSUS	416.20	-1.15	9.60	66,089,940
GAF	392.50	-1.16	8.70	85,739,640
BOXJEN	461.80	0.17	9.50	85,738,800

Table 4-35

FY 1981 SIBYL-RUNNER Results
Travis AFB

METHOD	MSE	MPE	MAPE	FORECAST
DECOMP	520.20	-1.76	11.70	84,708,540
CENSUS	450.20	-1.44	10.30	84,183,960
GAF	452.60	-1.34	9.80	78,880,620
BOXJEN	609.40	-0.44	11.50	83,445,600

Table 4-36

FY 1982 SIBYL-RUNNER Results
Travis AFB

The results for FY 1980 indicated that the EXPOTL was the most appropriate model. It gave the lowest MPE and MAPE of those models selected by SIBYL. A review of the residual autocorrelation analysis also supported the use of the EXPOTL model. There was no visible pattern left in the residual autocorrelations indicating that there was no additional information left in the data that had not been accounted for.

The GAF model was chosen as the "Best" technique for both FY 1981 and FY 1982. In both instances, this model provided the lowest combination of error measures of those methods selected by SYBIL as appropriate. Although the CENSUS model provided a slightly lower MSE in FY 1982 than the GAF model, both the MPE and MAPE for the GAF were lower indicating less percentage error. As a result, the GAF was chosen over the CENSUS for this forecast period.

FY	MODEL	FORECAST	CONSUMPTION	PE
1980	EXPOTL	93,793,980	86,379,592	8.58
1981	GAF	85,739,640	81,342,057	5.41
1982	GAF	78,880,620	80,166,701	1.60
MAPE: 2.69				

Table 4-37

Comparison of Forecast Model Results
with Actual Consumption Quantities
Travis AFB

Based on an overall MAPE of 5.19 as compared with a MAPE of 7.33, the SIBYL-RUNNER models provided more accurate forecasts for Travis AFB than the SCP manual techniques.

For the Navy locations that follow, forecast and consumption data was provided on a quarterly and annual basis allowing additional comparisons to be made. However, because of the unavailability of past data, SIBYL-RUNNER forecasts could only be made for two fiscal years. In addition, all quantities are expressed in thousands of barrels. The tables and discussions that follow reflect these changes.

Alameda NAS

The results obtained for Alameda NAS are depicted in the tables and analysis that follow:

FY AND QTR	FORECAST	CONSUMPTION	PE
81Q1	74	59.402	24.57
81Q2	96	68.264	40.68
81Q3	96	69.713	37.71
81Q4	96	71.423	34.41
82Q1	66	60.266	9.51
82Q2	81	69.136	17.16
82Q3	88	64.887	35.62
82Q4	74	78.715	-5.99
FY81	362	268.802	34.67
FY82	309	273.004	13.19

MAPE: 23.93

Table 4-38

Comparison of Initial Service Estimates
with Actual Consumption Quantities
Alameda NAS

METHOD	MSE	MPE	MAPE	FORECAST
DECOMP	26.50	-2.79	14.30	238.11
CENSUS	13.40	-1.43	10.00	202.74
GAF	20.10	-2.19	13.30	247.15
BOXJEN	36.50	-8.91	17.90	278.30

Table 4-39

FY 1981 SIBYL-RUNNER Results
Alameda NAS

METHOD	MSE	MPE	MAPE	FORECAST
DECOMP	25.40	-2.84	14.00	213.90
CENSUS	17.30	-1.72	11.40	373.90
GAF	16.60	-1.85	11.80	274.19
BOXJEN	31.50	-7.53	16.60	269.60

Table 4-40

FY 1982 SIBYL-RUNNER Results
Alameda NAS

The SIBYL-RUNNER results for FY 1981 indicated that the CENSUS model was the most appropriate technique to use for that period. It yielded the lowest MSE and MAPE of the candidate models selected by SIBYL.

The GAF model was chosen as the "Best" forecasting technique for FY 1982. For this period, it provided the lowest MSE and the second lowest MAPE next to the CENSUS model. Based on past consumption patterns, however, the CENSUS model provided a forecast that was much higher than could be expected. In addition, the residual autocorrelation analysis and chi-square test both indicated that the GAF model exhibited a better fit to the data than any of the other models. For these reasons, the GAF was selected as the model of choice.

FY AND QTR	MODEL	FORECAST	CONSUMPTION	PE
81Q1	CENSUS	56.84	59.402	-4.31
81Q2	CENSUS	53.48	68.264	-21.66
81Q3	CENSUS	52.45	69.713	-24.76
81Q4	CENSUS	39.97	71.423	-44.04
82Q1	GAF	64.32	60.266	6.73
82Q2	GAF	67.85	69.136	1.86
82Q3	GAF	71.85	64.887	6.96
82Q4	GAF	70.17	78.715	-10.86
FY81	CENSUS	202.74	268.802	-24.57
FY82	GAF	274.19	273.004	0.43

MAPE: 12.50

Table 4-41

Comparison of Forecast Model Results
with Actual Consumption Quantities
Alameda NAS

Overall, the SIBYL-RUNNER models provided more accurate forecasts than the Navy SCP. The MAPE of 12.50 that was achieved by using SIBYL-RUNNER was lower than the 23.93 MAPE that the SCP obtained. On a quarterly basis, SIBYL-RUNNER also provided more accurate results, yielding a MAPE of 15.14 as compared with the SCP MAPE of 25.70.

Miramar NAS

The SIBYL-RUNNER results for Miramar NAS are provided in the tables and analysis that follow:

FY AND QTR	FORECAST	CONSUMPTION	PE
81Q1	321	316.296	1.49
81Q2	333	304.172	9.48
81Q3	333	254.915	30.63
81Q4	333	264.888	25.71
82Q1	321	211.616	51.69
82Q2	357	276.889	28.93
82Q3	381	283.483	34.39
82Q4	369	293.252	25.83
FY81	1320	1191.679	10.77
FY82	1428	1062.240	34.43

MAPE: 22.60

Table 4-42

Comparison of Initial Service Estimates
with Actual Consumption Quantities
Miramar NAS

METHOD	MSE	MPE	MAPE	FORECAST
DECOMP	303.70	-1.45	9.00	1088.00
CENSUS	220.10	-1.01	7.80	1304.19
GAF	306.50	-1.30	10.00	1216.29
BOXJEN	370.40	-5.38	11.00	1239.00

Table 4-43

FY 1981 SIBYL-RUNNER Results
Miramar NAS

METHOD	MSE	MPE	MAPE	FORECAST
DECOMP	291.01	-1.60	10.37	1213.02
CENSUS	338.28	-1.66	11.04	1105.56
GAF	291.12	-1.25	9.94	1130.39
BOXJEN	331.40	-4.60	10.80	1465.30

Table 4-44

FY 1982 SIBYL-RUNNER Results
Miramar NAS

The results provided by SIBYL-RUNNER for FY 1981 indicated that the CENSUS model was the most appropriate for the forecast period. This model provided both the lowest MSE and MAPE of any of the candidate models selected by SIBYL.

For FY 1982, the GAF model was chosen as the "Best" model as it yielded the lowest MSE and MAPE for this time period. The residual autocorrelation analysis and chi-square values also indicated that these models were the most appropriate for their respective forecast periods.

FY AND QTR	MODEL	FORECAST	CONSUMPTION	PE
81Q1	CENSUS	295.68	316.296	-6.52
81Q2	CENSUS	328.71	304.172	8.07
81Q3	CENSUS	341.34	254.915	33.90
81Q4	CENSUS	339.09	264.888	28.01
82Q1	GAF	295.47	211.616	39.63
82Q2	GAF	284.13	276.889	2.62
82Q3	GAF	277.92	283.483	-1.96
82Q4	GAF	273.27	293.252	-6.81
FY81	CENSUS	1304.19	1191.679	9.44
FY82	GAF	1130.39	1062.240	6.42

MAPE: 7.93

Table 4-45

Comparison of Forecast Model Results
with Actual Consumption Quantities
Miramar NAS

A comparison of the percent errors of the SCP forecasts with the SIBYL-RUNNER forecasts indicated that the latter approach provided more accurate forecasts. Only in three of the quarters analyzed did the SCP forecasts outperform those provided by the SIBYL-RUNNER model. On an annual basis, the CENSUS model provided more accurate forecasts for FY 1981. The GAF model used for FY 1982 provided much better results than the SCP forecasts. Its PE of 6.42 was much lower than the PE of 34.43 achieved by the service forecasts. The MAPEs for each approach also reflect this difference. The MAPE for SIBYL-RUNNER was 7.93 while the MAPE for the Navy SCP was 22.60.

<u>NSC Jacksonville</u>

The results obtained for NSC Jacksonville are provided in the tables and analysis that follow:

FY AND QTR	FORECAST	CONSUMPTION	PE
81Q1	336.43	314.000	7.14
81Q2	336.43	373.000	9.80
81Q3	284.57	347.000	-17.99
81Q4	284.57	364.000	-21.82
82Q1	270.29	385.000	-29.79
82Q2	284.57	515.000	-44.74
82Q3	282.19	438.000	-35.57
82Q4	286.95	260.000	10.37
FY81	1242.00	1398.000	-11.16
FY82	1124.00	1598.000	-29.66

MAPE: 20.41

Table 4-46

Comparison of Initial Service Estimates
with Actual Consumption Quantities
NSC Jacksonville

METHOD	MSE	MPE	MAPE	FORECAST
MEAN	884.00	-4.51	18.89	1719.72
EXPO	983.00	-9.31	19.38	1260.90
EXPOTL	1236.60	-13.36	21.19	1229.99

Table 4-47

FY 1981 SIBYL-RUNNER Results
NSC Jacksonville

METHOD	MSE	MPE	MAPE	FORECAST
MEAN	882.77	-4.86	19.42	1646.28
EXPO	862.72	-7.39	18.78	1291.13
EXPOTL	1049.39	-10.40	20.61	1353.96

Table 4-48

FY 1982 SIBYL-RUNNER Results
NSC Jacksonville

The results obtained for FY 1981 indicated that the MEAN technique was the most appropriate model of those selected as suitable by SIBYL. It had the lowest MSE and MAPE of those models under consideration and a review of the residual autocorrelation analysis revealed no remaining pattern in the data that had not been accounted for.

The EXPO model was chosen as the most appropriate for FY 1982 as it achieved the lowest MSE and MAPE of those models selected by SIBYL. It also provided the lowest MSE and MAPE and revealed no remaining pattern in the residuals.

FY AND QTR	MODEL	FORECAST	CONSUMPTION	PE
81Q1	MEAN	429.93	314.000	36.92
81Q2	MEAN	429.93	373.000	15.26
81Q3	MEAN	429.93	347.000	23.89
81Q4	MEAN	429.93	364.000	18.11
82Q1	EXPO	348.57	385.000	-9.46
82Q2	EXPO	321.46	515.000	-37.58
82Q3	EXPO	312.15	438.000	-28.73
82Q4	EXPO	308.95	260.000	18.83
FY81	MEAN	1719.72	1398.000	23.01
FY82	EXPO	1291.13	1598.000	-19.20

MAPE: 21.11

Table 4-49

Comparison of Forecast Model Results
with Actual Consumption Quantities
NSC Jacksonville

The overall results for NSC Jacksonville indicated that the SCP forecast provided almost consistently better forecasts by quarter than the SIBYL-RUNNER forecasts. The fiscal year results indicated the same outcome for FY 1981 but SIBYL-RUNNER was more accurate in FY 1982. The overall MAPE for the Navy SCP was 20.41 which was slightly lower than the 21.11 that was achieved by SIBYL-RUNNER over the same forecast periods. As a result, it was concluded that the Navy SCP was able to provide more accurate forecasts over these forecast periods than SIBYL-RUNNER for this location.

Summary

For the locations analyzed, SIBYL-RUNNER tended to provide more accurate forecasts than the Air Force or Navy SCPs. Overall, SIBYL-RUNNER provided lower MAPEs at 60 percent of the locations studied. For the Air Force, it provided better forecasts at 57 percent of the locations while for the Navy it provided better forecasts at 67 percent.

In terms of forecast periods, fiscal years and quarters, SIBYL-RUNNER provided more accurate forecasts 59.6 percent of the time. For the Air Force, it provided better results 59 percent of the time while for the Navy it achieved better results in 60 percent of the forecast periods.

Chapter V discusses these findings in more detail and provides the conclusions and recommendations derived from them.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The research question addressed in this study was: *Can a computer-aided forecasting approach based on historical consumption data be utilized to provide better predictions for future petroleum requirements than the present system?*

Conclusions

The results of this research indicated that a computer-aided approach does provide more accurate forecasts of petroleum consumption than the forecasts provided by the service control points. However, because this is not a statistically generalizable conclusion, it can only be applied to the locations analyzed in this study and their respective time periods. The resultant analysis of this fuel consumption data suggests several other conclusions which correspond with the research objectives outlined in Chapter I.

Objective One

The first objective was to provide a description of the current requirements generation process. The description provided in Chapter II discussed this process in general terms and outlined the procedures that are followed in developing forecasts. This description identified the key players in forecasting petroleum requirements as the Service Control Points (SCPs), Air Force Detachment 29 and the Navy Petroleum Office. They are responsible for generating forecasts which are submitted by Military Interdepartmental Purchase Request (MIPR) to the Defense Fuels Supply Center (DFSC) for procurement and distribution action. The accuracy of these forecasts is crucial to ensuring that all requirements are satisfied while maintaining good working relationships with suppliers. Should the SCPs provide inaccurate forecasts, DFSC may very well procure quantities in excess or short of actual requirements. The inability to accurately forecast requirements for a particular location requires continual updates of contracted quantities. This not only degrades relationships with the supplier but also requires additional time and effort to make the necessary changes.

It should be noted that this description was not intended to be a detailed, indepth look at this process. It would be impossible to describe the intricate details and workings of a system of this magnitude and scope. Instead, an attempt was made to provide a general overview of the steps and processes involved in generating a requirement and then getting it filled. The major emphasis was placed on the data used to generate the requirement, the major players responsible for forecasting and procuring the required quantities, and the interaction required between the players.

Objective Two

The second objective was to examine the accuracy and merits of the present system. This was accomplished by comparing the initial SCP forecast with the actual consumption for a given forecast period. For the locations analyzed during this study, it was observed that the SCP forecasts both under and overstated actual requirements. The tendency, however, appeared to be towards overstatement rather than understatement. Although no guidance had been established to determine if the under or overstatements were within acceptable limits, it appeared that some were obviously in a questionable category.

The manual methods employed by the SCPs and the limited amount of past consumption data that is currently being maintained by the services restricted the depth of analysis that was available to the SCPs for making forecasts. However, it appeared that the SCPs were doing everything within their capabilities to develop accurate forecasts. It was also recognized that the forecasting environment that the SCPs operate under is and has been in a constant state of flux. As a result, past forecasting performance does not necessarily indicate how accurate their current forecasts are or how accurate they will be in future forecasts. Many new procedural requirements and innovations have recently been implemented by the SCPs in an attempt to improve their forecasting accuracy.

Objective Three

The third and final objective was to propose a forecasting approach that would accurately represent and predict future requirements for the services. This was accomplished by utilizing a computerized forecasting program, SIBYL-RUNNER, to analyze past consumption data and provide forecasts for comparison with actual consumption. The intent of this objective was to provide an acceptable alternative to the manual methods presently used in making initial forecasts. Although no statistical inference could be drawn to make a general conclusion, the results indicated that the forecasting techniques available in SIBYL-RUNNER provided more accurate forecasts for a majority of the locations and forecast periods analyzed.

Recommendations

A final objective of this research effort is to recommend further actions based upon the results and observations formulated from this analysis. The following recommendations are considered important to further evaluate the results and extend the applicability of this thesis.

1. Additional research should be conducted to determine if factors other than past consumption provide more information for future requirements. In particular, the relationship between flying hours and consumption should be explored through the use of causal forecasting techniques.

2. A computerized forecasting system should be procured for use by the SCPs. Although there was no statistical evidence that an interactive system such as SIBYL-RUNNER would provide more accurate forecasts as a general rule, the ability to expand analysis capability and eliminate much of the manual work would greatly enhance the SCPs' flexibility and reliability. The system should be user friendly and designed around the Decision Support System (DSS) concept to be of optimum value and use. In addition, it should have the capability to provide forecasts on a month by month basis so updates can be incorporated as changes occur.

3. Historical consumption data should be retained by month for a minimum of five years. One of the major problems encountered during this research effort was obtaining sufficient historical data from which forecasts could be made for comparison. The forecasting models used to analyze this data require a minimum of two years of monthly data, or 24 data points, before a forecast can be

made. Even more data points are required to identify seasonality or trend factors that may be present. The more information obtained about the historical demand pattern, the more accurate the forecast is likely to be. If the SCPs implement the previous recommendation, this requirement will have a definite impact on the accuracy of their forecasts.

4. A means for information transfer should be instituted to inform the SCPs of planned or unplanned activities that will have an impact on present consumption or future requirements. At the present time, the SCPs are often left uninformed of mission changes or special exercises. As a result, the SCPs are forced to seek information on their own that often should have been provided to them. To the extent possible, every effort should be made by all involved parties to get this type of information to the SCPs.

Summary

This research focused on determining whether a computer-aided forecasting approach could provide more accurate forecasts than the techniques currently utilized by the services. After determining the processes used by the Air Force and Navy, data was collected from several of their locations. This data was analyzed through an interactive forecasting program named SIBYL-RUNNER. This program reviewed past petroleum consumption for seasonality or cycles and proposed several forecasting models determined to be suitable for the data pattern observed. The candidate models were then used to generate forecasts and statistical measures of accuracy. By loration and forecast period, a most appropriate model was selected. After this analysis had been completed for all periods and locations, the results were compared to actual consumption to obtain statistical measures of percent error. The percent errors for each approach were then compared and a "Best" approach was determined by forecast period and location. The final results of this research, although not statistically generalizable beyond the locations studied, indicated that the approach using SIBYL-RUNNER provided more accurate forecasts in a majority of the locations and forecast periods analyzed. Based on the results of this study, several recommendations were proposed which should enhance the SCPs' capability to produce more accurate forecasts for future petroleum requirements.

APPENDICES

APPENDIX A

CASTLE AFB DATA AND RESULTS

CASTLE AFB

MONTHLY JP4 ISSUES - OCT 77 THRU APR 83

(THOUSANDS OF BARRELS)

*** DATAFILE LISTING FUNCTION ***

PERIOD	OBSERVATION	PERIOD	OBSERVATION	PERIOD	OBSERVATION
1	206.03	25	190.46	49	191.17
2	224.56	26	252.08	50	174.61
3	195.43	27	150.27	51	151.57
4	227.25	28	168.12	52	188.75
5	207.24	29	258.63	53	200.77
6	277.21	30	199.14	54	210.05
7	216.90	31	185.40	55	250.85
8	212.07	32	238.26	56	201.15
9	267.60	33	197.05	57	191.19
10	209.15	34	176.34	58	241.42
11	215.38	35	236.31	59	197.16
12	281.72	36	206.83	60	241.57
13	206.02	37	218.80	61	198.34
14	198.99	38	183.21	62	180.77
15	208.42	39	158.62	63	208.41
16	193.30	40	195.89	64	178.57
17	211.45	41	186.49	65	191.89
18	295.32	42	183.30	66	197.37
19	211.61	43	191.31	67	268.17
20	209.70	44	221.84	68	0.
21	255.93	45	189.84	69	0.
22	211.69	46	229.09	70	0.
23	265.21	47	175.62	71	0.
24	224.81	48	240.13	72	0.
				73	0.

CASTLE AFB

FY 1980 MEAN RESULTS

```
MEAN SQUARED ERROR (MSE)          =  852.2
MEAN ABSOLUTE PC ERROR (MAPE)     =   10.1%
MEAN PC ERROR OR BIAS  (MPE)      =  -1.49%
```

PERIOD	FORECAST
25	226.37
26	226.37
27	226.37
28	226.37
29	226.37
30	226.37
31	226.37
32	226.37
33	226.37
34	226.37
35	226.37
36	226.37

```
                  *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                   AUTOCORRELATION
 10                    .   *   I       .                      -0.18
  9                    .       I  *    .                       0.14
  8                    .   *   I       .                      -0.20
  7                    .  *    I       .                      -0.24
  6                    .       I     * .                       0.31
  5                    .      *I       .                      -0.05
  4                    . *     I       .                      -0.32
  3                    .       I    *  .                       0.25
  2                    .    *  I       .                      -0.14
  1                    .  *    I       .                      -0.26
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                    0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   12.1922
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

CASTLE AFB

FY 1980 EXPO RESULTS

MEAN SQUARED ERROR (MSE)	=	1041.7
MEAN ABSOLUTE PC ERROR (MAPE)	=	9.6%
MEAN PC ERROR OR BIAS (MPE)	=	2.63%

PERIOD	FORECAST
25	227.62
26	227.34
27	227.09
28	226.86
29	226.65
30	226.47
31	226.30
32	226.15
33	226.02
34	225.90
35	225.79
36	225.69

```
                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                   AUTOCORRELATION
 10                 .   *   I       .                          -0.19
  9                 .       I  *    .                           0.15
  8                 .    *  I       .                          -0.16
  7                 .   *   I       .                          -0.21
  6                 .       I     * .                           0.32
  5                 .       *       .                          -0.01
  4                 . *     I       .                          -0.31
  3                 .       I     * .                           0.28
  2                 .    *  I       .                          -0.16
  1                 .*      I       .                          -0.33
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
       -1                   0                  +1
```

CHI-SQUARE COMPUTED (8 DEGREES OF FREEDOM) = 13.0487
CHI-SQUARE FROM TABLE (8 DEGREES OF FREEDOM) = 15.50

CASTLE AFB

FY 198Ø EXPOTL RESULTS

```
MEAN SQUARED ERROR (MSE)           = 1145.9
MEAN ABSOLUTE PC ERROR (MAPE)      =   10.1%
MEAN PC ERROR OR BIAS  (MPE)       =   2.62%
```

PERIOD	FORECAST
25	229.19
26	227.29
27	226.22
28	225.61
29	225.26
30	225.07
31	224.96
32	224.89
33	224.86
34	224.84
35	224.83
36	224.82

FINAL ALPHA = 0.432

```
                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                 AUTOCORRELATION
 10                 .    *  I       .                        -0.17
  9                 .       I   *   .                         0.20
  8                 .    *  I       .                        -0.15
  7                 .  *    I       .                        -0.24
  6                 .       I     * .                         0.32
  5                 .       *       .                        -0.02
  4                 .*      I       .                        -0.35
  3                 .       I      *.                         0.34
  2                 .   *   I       .                        -0.18
  1                 .*      I       .                        -0.37
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
       -1                   0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   15.6486
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS

CASTLE AFB

FY 1981 DECOMP RESULTS

```
MEAN SQUARED ERROR (MSE)            =  810.6
MEAN ABSOLUTE PC ERROR (MAPE)       =   10.7%
MEAN PC ERROR OR BIAS  (MPE)        =  -1.68%
```

```
***  FORECAST  ***
PERIOD   FORECAST
 37        190.64
 38        217.39
 39        216.29
 40        189.08
 41        215.61
 42        214.51
 43        187.52
 44        213.83
 45        212.74
 46        185.97
 47        212.05
 48        210.96
```

```
                 *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                              AUTOCORRELATION
 10                   .    * I      .                    -0.11
  9                   .    * I      .                    -0.12
  8                   .     *I      .                    -0.06
  7                   .  *   I      .                    -0.18
  6                   .      I   *  .                     0.21
  5                   .     *I      .                    -0.05
  4                   .*     I      .                    -0.32
  3                   .      I     *.                     0.31
  2                   .   *  I      .                    -0.17
  1                   .   *  I      .                    -0.17
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I...I
       -1                    0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   13.1457
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS

CASTLE AFB

FY 1981 CENSUS RESULTS

```
MEAN SQUARED ERROR (MSE)          =  522.1
MEAN ABSOLUTE PC ERROR (MAPE)     =    8.8%
MEAN PC ERROR OR BIAS  (MPE)      =  -0.94%


DO YOU WANT TO INPUT YOUR ESTIMATES OF THE TREND CYCLE (Y OR N)
=N
```

PERIOD	FORECAST
37	171.32
38	189.01
39	152.03
40	157.26
41	185.07
42	200.30
43	158.16
44	170.35
45	180.01
46	145.71
47	176.83
48	168.39

CASTLE AFB

FY 1981 GAF RESULTS

```
MEAN SQUARED ERROR (MSE)           =  494.8
MEAN ABSOLUTE PC ERROR (MAPE)      =    7.9%
MEAN PC ERROR OR BIAS  (MPE)       =  -1.21%


DO YOU WANT TO CONTINUE THE TRAINING (Y OR N)
=N

PERIOD              FORECAST
 37                  197.16
 38                  207.27
 39                  163.53
 40                  194.59
 41                  194.57
 42                  180.47
 43                  211.26
 44                  183.63
 45                  169.61
 46                  200.94
 47                  187.37
 48                  181.95

                *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                 AUTOCORRELATION
 10                    .       *      .                      -0.02
  9                    . *     I      .                      -0.24
  8                    .       I*     .                       0.06
  7                    .      *I      .                      -0.03
  6                    . *     I      .                      -0.27
  5                    .       I*     .                       0.06
  4                    .       I   *  .                       0.14
  3                    .       I   *  .                       0.17
  2                    . *     I      .                      -0.24
  1                    .       I*     .                       0.06
         I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
        -1                     0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    8.9741
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

CASTLE AFB

FY 1981 BOXJEN RESULTS

```
MEAN SQUARED ERROR (MSE)              =   863.3
MEAN ABSOLUTE PC ERROR (MAPE)         =     9.1%
MEAN PC ERROR OR BIAS  (MPE)          =   -2.66%
```

PER	FORECAST	95 PC. BOUNDS	
37	183.2	120.1	246.2
38	240.5	148.2	332.9
39	203.8	91.1	316.5
40	182.8	37.6	328.1
41	240.7	68.7	412.8
42	203.6	8.6	398.7
43	182.9	-44.6	410.5
44	240.7	-16.0	497.4
45	203.7	-78.8	486.1
46	182.9	-134.0	499.8
47	240.7	-107.7	589.1
48	203.7	-173.4	580.7

*** RESIDUAL AUTOCORRELATION COEFFICIENTS ***

```
STANDARD ERROR =  0.174         CHI SQUARE =          6.58
       DEGREES OF FREEDOM =  8

TIME LAG                                                AUTOCORRELATION
  11                 .      I*      .                        0.04
  10                 .      I*      .                        0.04
   9                 . *    I       .                       -0.25
   8                 .    * I       .                       -0.09
   7                 .     *I       .                       -0.07
   6                 . *    I       .                       -0.25
   5                 .      *       .                        0.02
   4                 .  *   I       .                       -0.19
   3                 .      I  *    .                        0.13
   2                 .      *       .                       -0.01
   1                 .      *       .                        0.01
      I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
     -1                   0                  +1
```

CASTLE AFB

FY 1982 DECOMP RESULTS

```
MEAN SQUARED ERROR (MSE)            =  826.1
MEAN ABSOLUTE PC ERROR (MAPE)       =   11.0%
MEAN PC ERROR OR BIAS  (MPE)        =  -1.79%
```

*** FORECAST ***

PERIOD	FORECAST
49	187.19
50	200.96
51	199.83
52	185.19
53	198.80
54	197.68
55	183.19
56	196.65
57	195.53
58	181.19
59	194.49
60	193.38

```
                        *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                          AUTOCORRELATION
 10                          *     I     .                             -0.28
  9                          .   * I     .                             -0.09
  8                          .     I*    .                              0.04
  7                          .*    I     .                             -0.25
  6                          .     I   * .                              0.18
  5                          .    *I     .                             -0.03
  4                          *     I     .                             -0.28
  3                          .     I    *.                              0.26
  2                          .    *I     .                             -0.07
  1                          . *   I     .                             -0.20
              I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
             -1                    0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   17.8175
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

CASTLE AFB

FY 1982 CENSUS RESULTS

```
MEAN SQUARED ERROR (MSE)           =  619.8
MEAN ABSOLUTE PC ERROR (MAPE)      =    9.9%
MEAN PC ERROR OR BIAS  (MPE)       =  -1.23%
```

DO YOU WANT TO INPUT YOUR ESTIMATES OF THE TREND CYCLE (Y OR N)
=N

PERIOD	FORECAST
49	203.61
50	216.26
51	177.66
52	201.33
53	240.42
54	247.22
55	222.91
56	261.19
57	250.11
58	245.39
59	270.95
60	278.91

CASTLE AFB

FY 1982 GAF RESULTS

```
MEAN SQUARED ERROR (MSE)          =  538.7
MEAN ABSOLUTE PC ERROR (MAPE)     =    8.7%
MEAN PC ERROR OR BIAS  (MPE)      =  -1.14%


DO YOU WANT TO CONTINUE THE TRAINING (Y OR N)
=N

PERIOD            FORECAST
 49                226.43
 50                183.32
 51                196.29
 52                203.04
 53                178.56
 54                200.50
 55                203.79
 56                194.30
 57                207.99
 58                202.69
 59                198.18
 60                227.17

                  *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                 AUTOCORRELATION
 10                       .    *I    .                      -0.07
  9                       .   * I    .                      -0.08
  8                       .     I *  .                       0.10
  7                       .     I*   .                       0.03
  6                       . *   I    .                      -0.21
  5                       .     I*   .                       0.04
  4                       .     I   * .                      0.19
  3                       .     I*   .                       0.05
  2                       .  *  I    .                      -0.17
  1                       .   * I    .                      -0.11
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
       -1                       0                       +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   6.9518
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

CASTLE AFB

FY 1982 BOXJEN RESULTS

```
MEAN SQUARED ERROR (MSE)            =  929.7
MEAN ABSOLUTE PC ERROR (MAPE)       =   10.8%
MEAN PC ERROR OR BIAS  (MPE)        =  -3.18%
```

PER	FORECAST	95 PC. BOUNDS	
49	202.9	138.9	267.0
50	198.8	112.2	285.4
51	207.2	102.6	311.8
52	205.8	72.4	339.2
53	198.6	42.7	354.5
54	207.2	31.6	382.7
55	205.8	1.3	410.3
56	198.6	-30.3	427.5
57	207.2	-43.8	458.2
58	205.8	-75.5	487.1
59	198.6	-109.2	506.4
60	207.2	-125.1	539.4

*** RESIDUAL AUTOCORRELATION COEFFICIENTS ***

STANDARD ERROR = 0.149   CHI SQUARE =   14.94
DEGREES OF FREEDOM = 12

```
TIME LAG                                           AUTOCORRELATION
 15               .   * I     .                        -0.12
 14               .     I    *.                         0.24
 13               .     I*    .                         0.07
 12               .     I   * .                         0.22
 11               .     I     *                         0.31
 10               . *   I     .                        -0.18
  9               . *   I     .                        -0.19
  8               .    *I     .                        -0.04
  7               .   * I     .                        -0.09
  6               .     I *   .                         0.09
  5               .     *     .                        -0.01
  4               .   * I     .                        -0.12
  3               .     I *   .                         0.10
  2               .     *     .                        -0.02
  1               .     I*    .                         0.04
    I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
   -1                   0                   +1
```

APPENDIX B

GRAND FORKS AFB DATA AND RESULTS

GRAND FORKS AFB

MONTHLY JP4 ISSUES - OCT 77 THRU APR 83

(THOUSANDS OF BARRELS)

*** DATAFILE LISTING FUNCTION ***

PERIOD	OBSERVATION	PERIOD	OBSERVATION	PERIOD	OBSERVATION
1	66.34	23	88.38	45	45.20
2	51.14	24	64.69	46	90.60
3	73.80	25	57.93	47	50.96
4	53.08	26	76.03	48	80.20
5	67.97	27	51.79	49	58.45
6	81.49	28	48.00	50	52.75
7	65.09	29	39.03	51	57.65
8	59.72	30	49.83	52	55.83
9	68.82	31	52.47	53	52.61
10	58.82	32	64.20	54	51.96
11	65.52	33	65.72	55	74.53
12	82.69	34	49.11	56	64.16
13	62.66	35	72.11	57	45.26
14	58.21	36	60.54	58	64.45
15	60.51	37	62.51	59	56.00
16	65.55	38	57.82	60	64.17
17	59.22	39	47.23	61	61.46
18	79.31	40	51.32	62	38.86
19	63.09	41	62.00	63	66.06
20	65.96	42	55.07	64	61.47
21	85.02	43	63.08	65	41.58
22	55.11	44	71.25	66	51.98
				67	76.07

GRAND FORKS AFB

FY 1980 MEAN RESULTS

```
MEAN SQUARED ERROR (MSE)          =   98.9
MEAN ABSOLUTE PC ERROR (MAPE)     =   11.6%
MEAN PC ERROR OR BIAS  (MPE)      =  -2.11%
```

PERIOD	FORECAST
25	66.76
26	66.76
27	66.76
28	66.76
29	66.76
30	66.76
31	66.76
32	66.76
33	66.76
34	66.76
35	66.76
36	66.76

```
                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                AUTOCORRELATION
 10                 .  *    I        .                     -0.23
  9                 .       I  *     .                      0.15
  8                 .   *   I        .                     -0.19
  7                 .      *I        .                     -0.07
  6                 .       I   *    .                      0.20
  5                 .       I*       .                      0.07
  4                 . *     I        .                     -0.31
  3                 .       I  *     .                      0.15
  2                 .       I*       .                      0.06
  1                 .*      I        .                     -0.37
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                 0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   10.0258
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

GRAND FORKS AFB

FY 1980 EXPO RESULTS

```
MEAN SQUARED ERROR (MSE)          =  111.8
MEAN ABSOLUTE PC ERROR (MAPE)     =   12.3%
MEAN PC ERROR OR BIAS  (MPE)      =  -0.99%
```

PERIOD	FORECAST
25	68.28
26	67.92
27	67.60
28	67.31
29	67.05
30	66.81
31	66.60
32	66.41
33	66.24
34	66.08
35	65.94
36	65.82

```
                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                   AUTOCORRELATION
 10                 .  *    I       .                          -0.23
  9                 .       I  *    .                           0.16
  8                 .   *   I       .                          -0.18
  7                 .      *I       .                          -0.06
  6                 .       I   *   .                           0.20
  5                 .       I *     .                           0.09
  4                 . *     I       .                          -0.32
  3                 .       I *     .                           0.12
  2                 .       I*      .                           0.07
  1                *.       I       .                          -0.43
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
        -1                  0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   11.2219
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.

GRAND FORKS AFB

FY 1980 EXPOTL RESULTS

```
MEAN SQUARED ERROR (MSE)            =  120.8
MEAN ABSOLUTE PC ERROR (MAPE)       =   14.4%
MEAN PC ERROR OR BIAS  (MPE)        =  -3.77%
```

PERIOD	FORECAST
25	73.98
26	73.21
27	72.50
28	71.85
29	71.25
30	70.70
31	70.20
32	69.74
33	69.32
34	68.93
35	68.58
36	68.25

FINAL ALPHA = 0.083

```
                  *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                AUTOCORRELATION
 10                 .  *    I       .                        -0.23
  9                 .       I   *   .                         0.19
  8                 .   *   I       .                        -0.18
  7                 .     * I       .                        -0.09
  6                 .       I   *   .                         0.22
  5                 .       I *     .                         0.10
  4                 *       I       .                        -0.38
  3                 .       I  *    .                         0.17
  2                 .       *       .                        -0.01
  1                *.       I       .                        -0.45
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
       -1                   0                  +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   13.4906
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.

GRAND FORKS AFB

FY 1981 MEAN RESULTS

```
MEAN SQUARED ERROR (MSE)           =  122.1
MEAN ABSOLUTE PC ERROR (MAPE)      =   14.0%
MEAN PC ERROR OR BIAS  (MPE)       =  -3.14%
```

PERIOD	FORECAST
37	63.58
38	63.58
39	63.58
40	63.58
41	63.58
42	63.58
43	63.58
44	63.58
45	63.58
46	63.58
47	63.58
48	63.58

```
                     *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                               AUTOCORRELATION
 10                  .  *  I     .                         -0.20
  9                  .     I*    .                          0.05
  8                  . *   I     .                         -0.24
  7                  .    *I     .                         -0.12
  6                  .     *     .                         -0.00
  5                  .     I *   .                          0.10
  4                  .  *  I     .                         -0.21
  3                  .     I    *.                          0.26
  2                  .     I   * .                          0.21
  1                  .     *     .                          0.00
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
       -1                  0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   10.0952
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS

GRAND FORKS AFB

FY 1981 EXPO RESULTS

```
MEAN SQUARED ERROR (MSE)          =  130.8
MEAN ABSOLUTE PC ERROR (MAPE)     =   15.6%
MEAN PC ERROR OR BIAS  (MPE)      =  -5.68%
```

PERIOD	FORECAST
37	60.96
38	60.92
39	60.88
40	60.85
41	60.82
42	60.79
43	60.77
44	60.74
45	60.72
46	60.70
47	60.69
48	60.67

```
                         *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                         AUTOCORRELATION
 10                     .  *   I      .                               -0.18
  9                     .      I *    .                                0.08
  8                     . *    I      .                               -0.26
  7                     .    * I      .                               -0.15
  6                     .     *I      .                               -0.04
  5                     .      I*     .                                0.04
  4                     .*     I      .                               -0.30
  3                     .      I    * .                                0.22
  2                     .      I   *  .                                0.13
  1                     .     *I      .                               -0.07
           I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
          -1                   0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   10.5067
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

GRAND FORKS AFB

FY 1981 EXPOTL RESULTS

```
MEAN SQUARED ERROR (MSE)            =  139.0
MEAN ABSOLUTE PC ERROR (MAPE)       =   16.8%
MEAN PC ERROR OR BIAS  (MPE)        =  -5.83%
```

PERIOD	FORECAST
37	61.75
38	61.70
39	61.65
40	61.60
41	61.55
42	61.51
43	61.47
44	61.43
45	61.39
46	61.35
47	61.31
48	61.28

FINAL ALPHA = 0.044

```
                        *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                        AUTOCORRELATION
 10                         .  *   I      .                        -0.18
  9                         .      I  *   .                         0.15
  8                         . *    I      .                        -0.23
  7                         .     * I     .                        -0.12
  6                         .      *      .                        -0.01
  5                         .      I*     .                         0.05
  4                         *      I      .                        -0.36
  3                         .      I  *   .                         0.17
  2                         .      I*     .                         0.07
  1                         .   *  I      .                        -0.15
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
       -1                  0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   11.2084
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.

GRAND FORKS AFB

FY 1982 DECOMP RESULTS

```
MEAN SQUARED ERROR (MSE)            =  131.3
MEAN ABSOLUTE PC ERROR (MAPE)       =   14.5%
MEAN PC ERROR OR BIAS  (MPE)        =  -3.29%


DO YOU WANT TO ESTIMATE THE  12 CYCLICAL FACTORS FOR YOUR
FORECASTS? (IF NOT, A VALUE OF 100 WILL BE ASSIGNED TO EACH)
=N

***  FORECAST  ***
PERIOD   FORECAST
 49        59.39
 50        60.38
 51        59.14
 52        60.13
 53        58.89
 54        59.87
 55        58.63
 56        59.62
 57        58.38
 58        59.36
 59        58.13
 60        59.11

                 *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                  AUTOCORRELATION
 10                       .   * I     .                     -0.12
  9                       .     I*    .                      0.07
  8                       .  *  I     .                     -0.17
  7                       .  *  I     .                     -0.16
  6                       .    *I     .                     -0.05
  5                       .     I*    .                      0.07
  4                       . *   I     .                     -0.21
  3                       .     I *   .                      0.12
  2                       .     I    *.                      0.27
  1                       .  *  I     .                     -0.17
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
      -1                    0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   11.7512
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

GRAND FORKS AFB

FY 1982 CENSUS RESULTS

```
MEAN SQUARED ERROR (MSE)          =  112.6
MEAN ABSOLUTE PC ERROR (MAPE)     =   14.0%
MEAN PC ERROR OR BIAS  (MPE)      =  -2.67%
```

DO YOU WANT TO INPUT YOUR ESTIMATES OF THE TREND CYCLE (Y OR N)
=N

PERIOD	FORECAST
49	73.58
50	81.63
51	72.87
52	77.29
53	80.78
54	96.58
55	98.95
56	116.77
57	115.06
58	120.23
59	135.94
60	137.51

GRAND FORKS AFB

FY 1982 GAF RESULTS

```
MEAN SQUARED ERROR (MSE)           =   92.8
MEAN ABSOLUTE PC ERROR (MAPE)      =   13.1%
MEAN PC ERROR OR BIAS  (MPE)       =  -2.63%


DO YOU WANT TO CONTINUE THE TRAINING (Y OR N)
=N

PERIOD             FORECAST
  49                 65.51
  50                 64.12
  51                 67.00
  52                 63.45
  53                 66.20
  54                 60.51
  55                 72.97
  56                 63.28
  57                 74.57
  58                 71.95
  59                 71.39
  60                 74.02

                *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                          AUTOCORRELATION
 10                   .     *     .                  -0.00
  9                   .     I *   .                   0.11
  8                   .    *I     .                  -0.03
  7                   .     *     .                   0.02
  6                   . *   I     .                  -0.20
  5                   .     I*    .                   0.06
  4                   .     I*    .                   0.03
  3                   .     *     .                   0.00
  2                   .     I   * .                   0.19
  1                   .    *I     .                  -0.03
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
       -1                   0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    4.5816
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

GRAND FORKS AFB

FY 1982 BOXJEN RESULTS

MEAN SQUARED ERROR (MSE) = 154.8
MEAN ABSOLUTE PC ERROR (MAPE) = 16.0%
MEAN PC ERROR OR BIAS (MPE) = -2.25%

PER	FORECAST	95 PC. BOUNDS	
49	53.0	27.5	78.6
50	76.2	39.3	113.1
51	52.8	-6.8	112.3
52	76.8	0.7	152.8
53	52.8	-45.6	151.2
54	76.8	-40.1	193.6
55	52.8	-87.8	193.3
56	76.8	-84.3	237.9
57	52.8	-133.7	239.3
58	76.8	-132.2	285.8
59	52.8	-183.3	288.8
60	76.8	-183.7	337.2

*** RESIDUAL AUTOCORRELATION COEFFICIENTS ***

STANDARD ERROR = 0.147 CHI SQUARE = 20.98
DEGREES OF FREEDOM = 12

```
TIME LAG                                         AUTOCORRELATION
 15              .     I  *  .                        0.17
 14              .     I   * .                        0.19
 13              . *   I     .                       -0.18
 12              .     I *   .                        0.10
 11              .     I  *  .                        0.13
 10              .    *I     .                       -0.05
  9              .     I  *  .                        0.14
  8              .  *  I     .                       -0.16
  7              *     I     .                       -0.29
  6              .     I  *  .                        0.15
  5              .     I*    .                        0.07
  4              *     I     .                       -0.30
  3              .     I   * .                        0.21
  2              .   * I     .                       -0.11
  1              . *   I     .                       -0.18
     I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
    -1                 0                   +1
```

APPENDIX C

HOLLOMAN AFB DATA AND RESULTS

HOLLOMAN AFB

MONTHLY JP4 ISSUES - OCT 77 THRU APR 83

(THOUSANDS OF BARRELS)

*** DATAFILE LISTING FUNCTION ***

PERIOD	OBSERVATION	PERIOD	OBSERVATION	PERIOD	OBSERVATION
1	59.34	23	106.49	45	96.15
2	62.12	24	79.11	46	116.71
3	74.40	25	86.09	47	79.93
4	65.39	26	100.05	48	64.28
5	69.93	27	79.80	49	102.20
6	93.25	28	78.58	50	113.76
7	69.19	29	114.46	51	102.51
8	85.01	30	81.48	52	106.98
9	84.52	31	81.22	53	90.03
10	59.75	32	99.92	54	86.38
11	63.91	33	74.27	55	109.48
12	86.06	34	85.18	56	87.00
13	69.93	35	113.26	57	92.53
14	63.42	36	83.31	58	116.28
15	84.44	37	98.45	59	77.76
16	72.58	38	96.94	60	80.42
17	77.83	39	91.61	61	87.52
18	108.15	40	79.51	62	75.86
19	104.86	41	79.48	63	116.61
20	75.98	42	110.32	64	85.49
21	108.37	43	128.56	65	109.74
22	88.86	44	98.50	66	102.23
				67	95.75

HOLLOMAN AFB

FY 1980 MEAN RESULTS

```
MEAN SQUARED ERROR (MSE)          =  233.4
MEAN ABSOLUTE PC ERROR (MAPE)     =   16.2%
MEAN PC ERROR OR BIAS  (MPE)      =  -3.53%
```

PERIOD	FORECAST
25	79.70
26	79.70
27	79.70
28	79.70
29	79.70
30	79.70
31	79.70
32	79.70
33	79.70
34	79.70
35	79.70
36	79.70

```
AUTOCORRELATIONS OF THE RESIDUALS (ERRORS)...
HOW MANY TIME LAGS DO YOU WANT TO SEE GRAPHED (0 = NONE)
=10

                  *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                   AUTOCORRELATION
 10                   .       *       .                        0.01
  9                   .       I *     .                        0.08
  8                   .  *    I       .                       -0.23
  7                   .     * I       .                       -0.13
  6                   .       I  *    .                        0.15
  5                   .      *I       .                       -0.10
  4                   .       I *     .                        0.10
  3                   .       I       *                        0.39
  2                   .       I   *   .                        0.22
  1                   .       I     * .                        0.26
             I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
            -1                0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    9.1862
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

HOLLOMAN AFB

FY 1980 EXPO RESULTS

```
MEAN SQUARED ERROR (MSE)            =  215.3
MEAN ABSOLUTE PC ERROR (MAPE)       =   14.5%
MEAN PC ERROR OR BIAS  (MPE)        =   3.56%
```

PERIOD	FORECAST
25	91.08
26	87.49
27	84.97
28	83.22
29	81.98
30	81.12
31	80.52
32	80.10
33	79.80
34	79.59
35	79.45
36	79.35

```
AUTOCORRELATIONS OF THE RESIDUALS (ERRORS)...
HOW MANY TIME LAGS DO YOU WANT TO SEE GRAPHED (0 = NONE)
=10

                  *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                    AUTOCORRELATION
 10                      .       I *     .                      0.10
  9                      .       I *     .                      0.09
  8                      .*      I       .                     -0.34
  7                      .    *  I       .                     -0.14
  6                      .       I  *    .                      0.13
  5                      .*      I       .                     -0.33
  4                      .      *I       .                     -0.04
  3                      .       I    *  .                      0.24
  2                      .     * I       .                     -0.10
  1                      .  *    I       .                     -0.24
         I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
        -1                       0                    +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    9.7977
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

HOLLOMAN AFB

FY 198Ø EXPOTL RESULTS

```
MEAN SQUARED ERROR (MSE)          =  269.9
MEAN ABSOLUTE PC ERROR (MAPE)     =   16.3%
MEAN PC ERROR OR BIAS  (MPE)      =   4.68%
```

PERIOD	FORECAST
25	86.17
26	84.41
27	83.09
28	82.10
29	81.36
30	80.80
31	80.38
32	80.06
33	79.82
34	79.65
35	79.51
36	79.41

FINAL ALPHA = 0.249

AUTOCORRELATIONS OF THE RESIDUALS (ERRORS)...
HOW MANY TIME LAGS DO YOU WANT TO SEE GRAPHED (0 = NONE)
=10

```
                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                AUTOCORRELATION
 10                     .       I *     .                    0.10
  9                     .       I  *    .                    0.13
  8                     .  *    I       .                   -0.27
  7                     .    *  I       .                   -0.15
  6                     .       I *     .                    0.12
  5                     .     * I       .                   -0.08
  4                     .      *I       .                   -0.03
  3                     .       I    *  .                    0.24
  2                     .  *    I       .                   -0.24
  1                     .  *    I       .                   -0.27
         I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
        -1                      0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    7.9231
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

HOLLOMAN AFB

FY 1981 DECOMP RESULTS

```
MEAN SQUARED ERROR (MSE)          =  157.2
MEAN ABSOLUTE PC ERROR (MAPE)     =   12.2%
MEAN PC ERROR OR BIAS  (MPE)      =  -2.13%
```

DO YOU WANT TO ESTIMATE THE 12 CYCLICAL FACTORS FOR YOUR FORECASTS? (IF NOT, A VALUE OF 100 WILL BE ASSIGNED TO EACH)
=N

*** FORECAST ***

PERIOD	FORECAST
37	90.51
38	101.04
39	102.83
40	92.66
41	103.43
42	105.24
43	94.81
44	105.81
45	107.64
46	96.96
47	108.19
48	110.04

```
                         *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                    AUTOCORRELATION
 10                       .     I *    .                         0.08
  9                       .    *I      .                        -0.07
  8                       . *   I      .                        -0.25
  7                       .   * I      .                        -0.15
  6                       .     I   *  .                         0.18
  5                       .*    I      .                        -0.29
  4                       .    *I      .                        -0.07
  3                       .     I      .*                        0.42
  2                       .   * I      .                        -0.10
  1                       .   * I      .                        -0.09
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                     0                  +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   14.8201
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.

HOLLOMAN AFB

FY 1981 CENSUS RESULTS

MEAN SQUARED ERROR (MSE)	=	134.0
MEAN ABSOLUTE PC ERROR (MAPE)	=	11.3%
MEAN PC ERROR OR BIAS (MPE)	=	-1.74%

DO YOU WANT TO INPUT YOUR ESTIMATES OF THE TREND CYCLE (Y OR N)
=N

PERIOD	FORECAST
37	88.19
38	94.17
39	104.68
40	97.37
41	122.74
42	136.62
43	127.40
44	133.65
45	140.97
46	122.96
47	154.89
48	137.51

HOLLOMAN AFB

FY 1981 GAF RESULTS

```
MEAN SQUARED ERROR (MSE)          =  166.9
MEAN ABSOLUTE PC ERROR (MAPE)     =   12.4%
MEAN PC ERROR OR BIAS  (MPE)      =  -1.86%


DO YOU WANT TO CONTINUE THE TRAINING (Y OR N)
=N

PERIOD            FORECAST
 37                 84.60
 38                 97.82
 39                 84.32
 40                 91.35
 41                 94.59
 42                 87.59
 43                 92.05
 44                 90.04
 45                 88.86
 46                 95.26
 47                 88.06
 48                 92.74

                  *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                 AUTOCORRELATION
 10                 . *     I      .                        -0.24
  9                 .      *I      .                        -0.07
  8                 .      *I      .                        -0.03
  7                 .       *      .                        -0.02
  6                 .    *  I      .                        -0.13
  5                 .       I *    .                         0.11
  4                 .       I *    .                         0.08
  3                 .       *      .                        -0.01
  2                 .       *      .                         0.00
  1                 .      *I      .                        -0.06
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
       -1                   0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    3.7332
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

HOLLOMAN AFB

FY 1981 BOXJEN RESULTS

```
MEAN SQUARED ERROR (MSE)            =  165.9
MEAN ABSOLUTE PC ERROR (MAPE)       =   11.7%
MEAN PC ERROR OR BIAS  (MPE)        =   1.83%
```

PER	FORECAST	95 PC.	BOUNDS
37	86.2	59.5	112.9
38	110.8	70.4	151.1
39	81.2	28.1	134.4
40	85.5	10.4	160.6
41	110.5	17.2	203.9
42	81.2	-28.9	191.4
43	85.5	-48.8	219.8
44	110.5	-45.5	266.5
45	81.2	-95.2	257.6
46	85.5	-117.6	288.6
47	110.5	-117.3	338.4
48	81.2	-170.1	332.6

*** RESIDUAL AUTOCORRELATION COEFFICIENTS ***

```
STANDARD ERROR =  0.174       CHI SQUARE =        4.37
       DEGREES OF FREEDOM =  8

TIME LAG                                          AUTOCORRELATION
  11              .       I *    .                     0.12
  10              .       I   *  .                     0.13
   9              .    *  I      .                    -0.16
   8              .     * I      .                    -0.12
   7              .     * I      .                    -0.08
   6              .       I*     .                     0.05
   5              .   *   I      .                    -0.19
   4              .       I *    .                     0.12
   3              .       *      .                     0.00
   2              .       *      .                     0.01
   1              .       *      .                    -0.01
    I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
   -1                     0                  +1
```

HOLLOMAN AFB

FY 1982 DECOMP RESULTS

```
MEAN SQUARED ERROR (MSE)          =  210.2
MEAN ABSOLUTE PC ERROR (MAPE)     =   13.8%
MEAN PC ERROR OR BIAS  (MPE)      =  -2.72%
```

DO YOU WANT TO ESTIMATE THE 12 CYCLICAL FACTORS FOR YOUR FORECASTS? (IF NOT, A VALUE OF 100 WILL BE ASSIGNED TO EACH)
=N

*** FORECAST ***

PERIOD	FORECAST
49	97.82
50	102.09
51	103.82
52	99.56
53	103.89
54	105.64
55	101.29
56	105.69
57	107.46
58	103.03
59	107.49
60	109.28

```
                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                    AUTOCORRELATION
 10                       .   * I     .                        -0.08
  9                       .     *     .                        -0.02
  8                       .     I*    .                         0.07
  7                       .     *     .                        -0.02
  6                       .     I *   .                         0.09
  5                       *     I     .                        -0.31
  4                       .  *  I     .                        -0.13
  3                       .     I     *                         0.28
  2                       . *   I     .                        -0.19
  1                       .     *     .                         0.02
           I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
          -1                    0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   11.7518
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.

HOLLOMAN AFB

FY 1982 CENSUS RESULTS

```
MEAN SQUARED ERROR (MSE)           =  171.1
MEAN ABSOLUTE PC ERROR (MAPE)      =   12.8%
MEAN PC ERROR OR BIAS  (MPE)       =  -2.27%
```

DO YOU WANT TO INPUT YOUR ESTIMATES OF THE TREND CYCLE (Y OR N)
=N

PERIOD	FORECAST
49	79.46
50	75.95
51	69.06
52	56.71
53	60.77
54	59.51
55	54.51
56	44.77
57	38.22
58	35.44
59	31.03
60	19.75

HOLLOMAN AFB

FY 1982 GAF RESULTS

```
MEAN SQUARED ERROR (MSE)          =  215.2
MEAN ABSOLUTE PC ERROR (MAPE)     =   13.7%
MEAN PC ERROR OR BIAS  (MPE)      =  -2.26%


DO YOU WANT TO CONTINUE THE TRAINING (Y OR N)
=N

PERIOD              FORECAST
  49                  95.36
  50                  92.58
  51                  89.40
  52                 101.76
  53                  96.12
  54                  91.09
  55                  93.50
  56                  93.16
  57                  95.50
  58                  92.13
  59                  95.17
  60                  97.89

                *** RESIDUAL AUTOCORRELATIONS ***
 TIME LAG                                              AUTOCORRELATION
  10                  .   * I     .                       -0.11
   9                  .    *I     .                       -0.07
   8                  .     I*    .                        0.04
   7                  .     I*    .                        0.07
   6                  .   * I     .                       -0.12
   5                  .     I*    .                        0.07
   4                  .    *I     .                       -0.06
   3                  .   * I     .                       -0.11
   2                  .     *     .                       -0.01
   1                  .    *I     .                       -0.03
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                   0                   +1
 CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    2.8899
 CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

 THE MODEL YOU USED IS CORRECT BECAUSE THERE
 IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

HOLLOMAN AFB

FY 1982 BOXJEN RESULTS

MEAN SQUARED ERROR (MSE) = 229.2
MEAN ABSOLUTE PC ERROR (MAPE) = 13.2%
MEAN PC ERROR OR BIAS (MPE) = 0.92%

PER	FORECAST	95 PC. BOUNDS	
49	107.2	76.1	138.4
50	87.1	38.1	136.1
51	79.3	17.8	140.7
52	109.9	27.9	192.0
53	86.8	-13.7	187.3
54	79.3	-36.6	195.1
55	109.9	-28.0	247.9
56	86.8	-71.9	245.5
57	79.3	-97.6	256.2
58	109.9	-91.0	310.9
59	86.8	-137.2	310.9
60	79.3	-165.5	324.1

*** RESIDUAL AUTOCORRELATION COEFFICIENTS ***

STANDARD ERROR = 0.149 CHI SQUARE = 6.99
DEGREES OF FREEDOM = 12

```
TIME LAG                                              AUTOCORRELATION
 15                 .    *I     .                        -0.06
 14                 .     I  *  .                         0.14
 13                 .     I *   .                         0.09
 12                 .   * I     .                        -0.08
 11                 .     *     .                        -0.01
 10                 .     I*    .                         0.07
  9                 .   * I     .                        -0.11
  8                 .     I *   .                         0.08
  7                 .     I*    .                         0.05
  6                 .     I*    .                         0.03
  5                 *     I     .                        -0.30
  4                 .     *     .                         0.02
  3                 .     I*    .                         0.03
  2                 .     *     .                        -0.01
  1                 .     *     .                         0.00
     I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
    -1                    0                  +1
```

APPENDIX D

KELLY AFB DATA AND RESULTS

KELLY AFB

MONTHLY JP4 ISSUES - JAN 76 THRU DEC 82

(THOUSANDS OF BARRELS)

*** DATAFILE LISTING FUNCTION ***

PERIOD	OBSERVATION	PERIOD	OBSERVATION	PERIOD	OBSERVATION
1	39.67	29	35.02	57	46.39
2	51.90	30	54.56	58	54.94
3	48.35	31	41.28	59	47.65
4	59.19	32	52.20	60	46.14
5	46.10	33	54.48	61	46.89
6	39.63	34	38.19	62	46.48
7	46.67	35	39.43	63	50.92
8	40.67	36	51.80	64	49.73
9	38.80	37	48.38	65	60.43
10	45.00	38	44.77	66	45.19
11	41.76	39	45.76	67	52.20
12	43.40	40	44.40	68	40.73
13	37.88	41	26.32	69	49.46
14	48.20	42	77.61	70	44.69
15	54.08	43	49.29	71	46.24
16	51.11	44	58.15	72	50.72
17	51.16	45	46.92	73	50.08
18	46.25	46	37.82	74	49.83
19	53.00	47	55.55	75	61.65
20	46.86	48	37.04	76	59.71
21	49.97	49	35.43	77	46.77
22	44.08	50	50.57	78	63.89
23	44.24	51	54.36	79	63.75
24	45.32	52	49.92	80	52.47
25	49.91	53	62.11	81	42.94
26	48.89	54	51.97	82	43.08
27	66.07	55	35.03	83	47.61
28	39.48	56	50.97	84	52.61

KELLY AFB

FY 1979 MEAN RESULTS

```
MEAN SQUARED ERROR (MSE)            =   38.6
MEAN ABSOLUTE PC ERROR (MAPE)       =   10.0%
MEAN PC ERROR OR BIAS  (MPE)        =  -1.61%
```

PERIOD	FORECAST
28	47.34
29	47.34
30	47.34
31	47.34
32	47.34
33	47.34
34	47.34
35	47.34
36	47.34
37	47.34
38	47.34
39	47.34

```
                 *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                              AUTOCORRELATION
 10                  .       I*      .                     0.06
  9                  .   *   I       .                    -0.20
  8                  .       *       .                    -0.02
  7                  .     * I       .                    -0.11
  6                  .     * I       .                    -0.10
  5                  .      *I       .                    -0.05
  4                  .     * I       .                    -0.08
  3                  .      *I       .                    -0.07
  2                  .       I   *   .                     0.16
  1                  .       I    *  .                     0.19
         I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
        -1                   0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    3.8130
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

KELLY AFB

FY 1979 EXPO RESULTS

```
MEAN SQUARED ERROR (MSE)           =   43.6
MEAN ABSOLUTE PC ERROR (MAPE)      =   10.4%
MEAN PC ERROR OR BIAS  (MPE)       =   1.49%
```

PERIOD	FORECAST
28	57.17
29	61.62
30	63.85
31	64.96
32	65.51
33	65.79
34	65.93
35	66.00
36	66.04
37	66.05
38	66.06
39	66.07

```
                   *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                    AUTOCORRELATION
 10                   .       *       .                         -0.01
  9                   .   *   I       .                         -0.21
  8                   .     * I       .                         -0.08
  7                   .   *   I       .                         -0.21
  6                   .     * I       .                         -0.12
  5                   .   *   I       .                         -0.20
  4                   .   *   I       .                         -0.21
  3                   .       I*      .                          0.03
  2                   .       I *     .                          0.12
  1                   .       I  *    .                          0.14
         I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
        -1                    0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    6.1005
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

KELLY AFB

FY 1979 EXPOTL RESULTS

```
MEAN SQUARED ERROR (MSE)            =   50.3
MEAN ABSOLUTE PC ERROR (MAPE)       =   10.6%
MEAN PC ERROR OR BIAS  (MPE)        =   4.66%
```

PERIOD	FORECAST
28	51.11
29	61.42
30	64.62
31	65.62
32	65.93
33	66.03
34	66.06
35	66.07
36	66.07
37	66.07
38	66.07
39	66.07

FINAL ALPHA = 0.689

```
                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                  AUTOCORRELATION
 10                       .    * I       .                    -0.09
  9                       .  *   I       .                    -0.19
  8                       .    * I       .                    -0.11
  7                       .   *  I       .                    -0.14
  6                       .  *   I       .                    -0.21
  5                       .    * I       .                    -0.12
  4                       .   *  I       .                    -0.14
  3                       .     *I       .                    -0.03
  2                       .      I*      .                     0.04
  1                       .      I    *  .                     0.27
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                      0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    6.1104
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS

KELLY AFB

FY 1980 MEAN RESULTS

```
MEAN SQUARED ERROR (MSE)            =   40.5
MEAN ABSOLUTE PC ERROR (MAPE)       =   10.9%
MEAN PC ERROR OR BIAS  (MPE)        =  -1.81%
```

PERIOD	FORECAST
40	46.76
41	46.76
42	46.76
43	46.76
44	46.76
45	46.76
46	46.76
47	46.76
48	46.76
49	46.76
50	46.76
51	46.76

```
                      *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                   AUTOCORRELATION
 10                      .       *      .                     0.00
  9                      .     * I      .                    -0.11
  8                      . *     I      .                    -0.18
  7                      .  *    I      .                    -0.16
  6                      .       I  *   .                     0.15
  5                      .       I*     .                     0.03
  4                      . *     I      .                    -0.19
  3                      .       I*     .                     0.07
  2                      .  *    I      .                    -0.15
  1                      .       *      .                    -0.01
         I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
        -1                       0                    +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    6.0073
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS

KELLY AFB

FY 1980 EXPO RESULTS

```
MEAN SQUARED ERROR (MSE)          =   51.3
MEAN ABSOLUTE PC ERROR (MAPE)     =   11.8%
MEAN PC ERROR OR BIAS  (MPE)      =   2.09%
```

PERIOD	FORECAST
40	46.64
41	46.55
42	46.47
43	46.40
44	46.33
45	46.28
46	46.23
47	46.18
48	46.14
49	46.10
50	46.07
51	46.03

```
                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                   AUTOCORRELATION
 10                     .      I*    .                         0.04
  9                     .    * I     .                        -0.09
  8                     .   *  I     .                        -0.14
  7                     .   *  I     .                        -0.14
  6                     .      I *   .                         0.12
  5                     .      *     .                         0.02
  4                     . *    I     .                        -0.19
  3                     .      I*    .                         0.03
  2                     .   *  I     .                        -0.13
  1                     .      *     .                         0.01
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                    0                  +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    4.5337
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS

KELLY AFB

FY 1980 EXPOTL RESULTS

```
MEAN SQUARED ERROR (MSE)          =   55.3
MEAN ABSOLUTE PC ERROR (MAPE)     =   12.1%
MEAN PC ERROR OR BIAS  (MPE)      =   3.23%
```

PERIOD	FORECAST
40	45.07
41	45.37
42	45.54
43	45.63
44	45.69
45	45.72
46	45.74
47	45.75
48	45.75
49	45.76
50	45.76
51	45.76

FINAL ALPHA = 0.431

```
                        *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                  AUTOCORRELATION
 10                      .     *     .                        0.02
  9                      .  *  I     .                       -0.13
  8                      .  *  I     .                       -0.15
  7                      .  *  I     .                       -0.16
  6                      .     I   * .                        0.18
  5                      .     I*    .                        0.05
  4                      . *   I     .                       -0.20
  3                      .     I *   .                        0.08
  2                      .*    I     .                       -0.23
  1                      .    *I     .                       -0.09
          I.I.I.I.I.I.I.I.I.?.I.I.I.I.I.I.? ?  .I.I.I
        -1                     0                    +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    8.1138
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS

KELLY AFB

FY 1981 MEAN RESULTS

```
MEAN SQUARED ERROR (MSE)          =   69.4
MEAN ABSOLUTE PC ERROR (MAPE)     =   13.7%
MEAN PC ERROR OR BIAS  (MPE)      =  -3.14%
```

PERIOD	FORECAST
52	47.00
53	47.00
54	47.00
55	47.00
56	47.00
57	47.00
58	47.00
59	47.00
60	47.00
61	47.00
62	47.00
63	47.00

```
                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                 AUTOCORRELATION
 10                       .     *      .                      0.01
  9                       .     *      .                      0.00
  8                       .   * I      .                     -0.08
  7                       .   * I      .                     -0.10
  6                       .     I*     .                      0.03
  5                       .     I*     .                      0.07
  4                       . *   I      .                     -0.22
  3                       .     *      .                      0.00
  2                       .    *I      .                     -0.06
  1                       .  *  I      .                     -0.16
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                     0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    4.9820
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

KELLY AFB

FY 1981 EXPO RESULTS

```
MEAN SQUARED ERROR (MSE)           =   82.1
MEAN ABSOLUTE PC ERROR (MAPE)      =   14.6%
MEAN PC ERROR OR BIAS  (MPE)       =   0.04%
```

PERIOD	FORECAST
52	47.32
53	48.02
54	48.66
55	49.23
56	49.74
57	50.20
58	50.62
59	50.99
60	51.33
61	51.63
62	51.91
63	52.15

```
                         *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                     AUTOCORRELATION
 10                       .      I*     .                         0.03
  9                       .      *      .                         0.02
  8                       .    * I      .                        -0.09
  7                       .    * I      .                        -0.12
  6                       .      I*     .                         0.03
  5                       .      I*     .                         0.04
  4                       . *    I      .                        -0.22
  3                       .      I*     .                         0.07
  2                       .      *      .                        -0.02
  1                       .    * I      .                        -0.09
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                      0                 +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =     4.3460
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

KELLY AFB

FY 1981 EXPOTL RESULTS

```
MEAN SQUARED ERROR (MSE)           =   93.6
MEAN ABSOLUTE PC ERROR (MAPE)      =   14.9%
MEAN PC ERROR OR BIAS  (MPE)       =   1.01%
```

PERIOD	FORECAST
52	47.17
53	47.83
54	48.43
55	48.98
56	49.47
57	49.92
58	50.33
59	50.70
60	51.03
61	51.34
62	51.61
63	51.87

FINAL ALPHA = 0.092

```
                        *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                        AUTOCORRELATION
 10                           .       I *    .                        0.08
  9                           .       *      .                       -0.00
  8                           .     * I      .                       -0.09
  7                           .     * I      .                       -0.12
  6                           .       I*     .                        0.03
  5                           .       I *    .                        0.12
  4                           . *     I      .                       -0.22
  3                           .       *      .                       -0.00
  2                           .      *I      .                       -0.07
  1                           . *     I      .                       -0.22
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
          -1                  0                  +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    7.6166
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS

KELLY AFB

FY 1982 MEAN RESULTS

```
MEAN SQUARED ERROR (MSE)           =    64.0
MEAN ABSOLUTE PC ERROR (MAPE)      =    13.0%
MEAN PC ERROR OR BIAS  (MPE)       =   -2.91%
```

PERIOD	FORECAST
64	47.40
65	47.40
66	47.40
67	47.40
68	47.40
69	47.40
70	47.40
71	47.40
72	47.40
73	47.40
74	47.40
75	47.40

```
                        *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                  AUTOCORRELATION
 10                       .    I*   .                         0.03
  9                       .    I*   .                         0.06
  8                       .  * I    .                        -0.11
  7                       .  * I    .                        -0.08
  6                       .    I *  .                         0.08
  5                       .    I*   .                         0.05
  4                       *    I    .                        -0.25
  3                       .    *    .                        -0.00
  2                       .   *I    .                        -0.06
  1                       . *  I    .                        -0.13
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                    0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =     7.3929
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.

KELLY AFB

FY 1982 EXPO RESULTS

```
MEAN SQUARED ERROR (MSE)              =   74.5
MEAN ABSOLUTE PC ERROR (MAPE)         =   13.7%
MEAN PC ERROR OR BIAS  (MPE)          =   0.02%
```

PERIOD	FORECAST
64	48.33
65	48.59
66	48.82
67	49.03
68	49.22
69	49.39
70	49.54
71	49.68
72	49.80
73	49.92
74	50.02
75	50.11

```
                          *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                          AUTOCORRELATION
 10                              .      I*     .                       0.04
  9                              .      I*     .                       0.06
  8                              .    * I      .                      -0.10
  7                              .    * I      .                      -0.08
  6                              .      I*     .                       0.07
  5                              .      I*     .                       0.04
  4                              *      I      .                      -0.27
  3                              .     *I      .                      -0.03
  2                              .     *I      .                      -0.06
  1                              .  *   I      .                      -0.13
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                             0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    7.4926
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.

KELLY AFB

FY 1982 EXPOTL RESULTS

```
MEAN SQUARED ERROR (MSE)           =    86.4
MEAN ABSOLUTE PC ERROR (MAPE)      =    14.2%
MEAN PC ERROR OR BIAS  (MPE)       =    1.45%
```

PERIOD	FORECAST
64	48.30
65	49.68
66	50.34
67	50.65
68	50.79
69	50.86
70	50.89
71	50.91
72	50.91
73	50.92
74	50.92
75	50.92

FINAL ALPHA = 0.529

```
                          *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                   AUTOCORRELATION
  10                   .    *    .                              0.02
   9                   .    I*   .                              0.03
   8                   . *  I    .                             -0.15
   7                   .  * I    .                             -0.09
   6                   .    I *  .                              0.11
   5                   .    I *  .                              0.10
   4                   *    I    .                             -0.24
   3                   .    *    .                             -0.01
   2                   .  * I    .                             -0.09
   1                   .*   I    .                             -0.22
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
       -1                   0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   10.5858
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS

APPENDIX E

LANGLEY AFB DATA AND RESULTS

LANGLEY AFB

MONTHLY JP4 ISSUES - APR 78 THRU SEP 82

(THOUSANDS OF BARRELS)

*** DATAFILE LISTING FUNCTION ***

PERIOD	OBSERVATION	PERIOD	OBSERVATION	PERIOD	OBSERVATION
1	100.34	19	66.77	37	87.10
2	79.98	20	64.21	38	68.70
3	70.80	21	82.10	39	50.14
4	84.67	22	46.83	40	57.17
5	51.99	23	64.06	41	85.87
6	81.75	24	77.33	42	62.20
7	51.26	25	63.17	43	75.47
8	56.77	26	91.25	44	73.18
9	79.03	27	71.10	45	77.17
10	51.08	28	62.85	46	67.95
11	61.24	29	89.50	47	77.40
12	90.45	30	67.61	48	78.45
13	62.05	31	72.94	49	93.82
14	66.73	32	90.09	50	88.33
15	73.28	33	59.64	51	58.33
16	70.30	34	50.84	52	84.81
17	81.66	35	90.68	53	107.60
18	80.00	36	46.09	54	49.60

LANGLEY AFB

FY 1980 MEAN RESULTS

```
MEAN SQUARED ERROR (MSE)           =  178.6
MEAN ABSOLUTE PC ERROR (MAPE)      =   16.8%
MEAN PC ERROR OR BIAS  (MPE)       =  -3.84%
```

PERIOD	FORECAST
25	70.61
26	70.61
27	70.61
28	70.61
29	70.61
30	70.61
31	70.61
32	70.61
33	70.61
34	70.61
35	70.61
36	70.61

```
                  *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                  AUTOCORRELATION
 10                    .  *    I       .                       -0.23
  9                    .      *I       .                       -0.03
  8                    .       I*      .                        0.05
  7                    . *     I       .                       -0.29
  6                    .      *I       .                       -0.04
  5                    .       *       .                       -0.01
  4                    .*      I       .                       -0.33
  3                    .       I      *.                        0.35
  2                    .       *       .                       -0.02
  1                    .     * I       .                       -0.17
            I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
           -1                  0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    9.6006
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

LANGLEY AFB

FY 1980 EXPO RESULTS

```
MEAN SQUARED ERROR (MSE)             =  248.6
MEAN ABSOLUTE PC ERROR (MAPE)        =   19.8%
MEAN PC ERROR OR BIAS  (MPE)         =  -8.46%
```

PERIOD	FORECAST
25	69.13
26	72.41
27	74.38
28	75.56
29	76.27
30	76.69
31	76.95
32	77.10
33	77.19
34	77.25
35	77.28
36	77.30

```
                        *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                       AUTOCORRELATION
 10                       . *      I        .                      -0.31
  9                       .        I *      .                       0.11
  8                       .        *        .                      -0.00
  7                       .    *   I        .                      -0.22
  6                       .        I    *   .                       0.23
  5                       .        *        .                       0.01
  4                       .       *I        .                      -0.12
  3                       .        I        *                       0.42
  2                       .        I*       .                       0.04
  1                       .    *   I        .                      -0.19
            I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
           -1                      0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    10.5975
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.

LANGLEY AFB

FY 1980 EXPOTL RESULTS

```
MEAN SQUARED ERROR (MSE)          =  342.6
MEAN ABSOLUTE PC ERROR (MAPE)     =   24.3%
MEAN PC ERROR OR BIAS  (MPE)      = -13.54%
```

PERIOD	FORECAST
25	73.40
26	74.72
27	75.60
28	76.18
29	76.57
30	76.82
31	76.99
32	77.11
33	77.18
34	77.23
35	77.27
36	77.29

FINAL ALPHA = 0.336

```
                      *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                    AUTOCORRELATION
 10                  .   *   I       .                          -0.22
  9                  .       I*      .                           0.07
  8                  .       I*      .                           0.05
  7                  .   *   I       .                          -0.19
  6                  .       I    *  .                           0.24
  5                  .       *       .                           0.02
  4                  .  *    I       .                          -0.25
  3                  .       I     * .                           0.30
  2                  .      *I       .                          -0.05
  1                  . *     I       .                          -0.32
         I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                  0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    9.7751
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS

LANGLEY AFB

FY 1981 DECOMP RESULTS

```
MEAN SQUARED ERROR (MSE)          =  181.0
MEAN ABSOLUTE PC ERROR (MAPE)     =   16.3%
MEAN PC ERROR OR BIAS  (MPE)      =  -3.71%


DO YOU WANT TO ESTIMATE THE  12 CYCLICAL FACTORS FOR YOUR
FORECASTS? (IF NOT, A VALUE OF 100 WILL BE ASSIGNED TO EACH)
=N

***  FORECAST  ***
PERIOD   FORECAST
 37         61.70
 38         71.57
 39         72.19
 40         61.37
 41         71.19
 42         71.81
 43         61.05
 44         70.81
 45         71.43
 46         60.72
 47         70.43
 48         71.05

                 *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                              AUTOCORRELATION
 10                   .  *  I     .                      -0.20
  9                   .    *I     .                      -0.07
  8                   .     I*    .                       0.04
  7                   .*    I     .                      -0.30
  6                   .     *     .                      -0.00
  5                   .     *     .                       0.01
  4                   *     I     .                      -0.33
  3                   .     I     *                       0.37
  2                   .     *     .                       0.00
  1                   .  *  I     .                      -0.21
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                 0                  +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   15.0536
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN
THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME
LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.
```

LANGLEY AFB

FY 1981 CENSUS RESULTS

```
MEAN SQUARED ERROR (MSE)          =  148.6
MEAN ABSOLUTE PC ERROR (MAPE)     =   14.0%
MEAN PC ERROR OR BIAS  (MPE)      =  -2.93%


DO YOU WANT TO INPUT YOUR ESTIMATES OF THE TREND CYCLE (Y OR N)
=N
```

PERIOD	FORECAST
37	62.38
38	66.34
39	57.30
40	55.06
41	55.35
42	51.63
43	40.77
44	41.11
45	39.41
46	23.83
47	32.79
48	28.13

LANGLEY AFB

FY 1981 GAF RESULTS

```
MEAN SQUARED ERROR (MSE)            =    79.6
MEAN ABSOLUTE PC ERROR (MAPE)       =    11.4%
MEAN PC ERROR OR BIAS  (MPE)        =   -2.18%


DO YOU WANT TO CONTINUE THE TRAINING (Y OR N)
=N

PERIOD              FORECAST
  37                  65.39
  38                  82.52
  39                  54.45
  40                  80.07
  41                  82.28
  42                  58.28
  43                  85.08
  44                  79.76
  45                  58.29
  46                  84.93
  47                  71.47
  48                  55.35

                ***  RESIDUAL AUTOCORRELATIONS  ***
 TIME LAG                                                AUTOCORRELATION
  10                      .       *I       .                  -0.03
   9                      .       *I       .                  -0.04
   8                      .     *  I       .                  -0.14
   7                      .        I*      .                   0.04
   6                      .        I *     .                   0.08
   5                      .        *       .                   0.01
   4                      .       *I       .                  -0.03
   3                      .       *I       .                  -0.05
   2                      .     *  I       .                  -0.13
   1                      .      * I       .                  -0.12
         I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
        -1                     0                    +1
 CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    2.2848
 CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

 THE MODEL YOU USED IS CORRECT BECAUSE THERE
 IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

LANGLEY AFB

FY 1981 BOXJEN RESULTS

```
MEAN SQUARED ERROR (MSE)            =  162.1
MEAN ABSOLUTE PC ERROR (MAPE)       =   15.6%
MEAN PC ERROR OR BIAS  (MPE)        =  -4.04%
```

PER	FORECAST	95 PC. BOUNDS	
37	50.9	26.3	75.4
38	88.8	52.8	124.9
39	46.1	-1.5	93.7
40	50.9	-22.3	124.1
41	88.8	-4.3	181.9
42	46.1	-65.8	158.0
43	50.9	-90.7	192.5
44	88.8	-78.2	255.8
45	46.1	-145.2	237.4
46	50.9	-173.8	275.5
47	88.8	-165.7	343.3
48	46.1	-237.1	329.3

*** RESIDUAL AUTOCORRELATION COEFFICIENTS ***

```
STANDARD ERROR =  0.174       CHI SQUARE =        2.22
       DEGREES OF FREEDOM =  8

TIME LAG                                               AUTOCORRELATION
 11               .   *  I        .                       -0.14
 10               .    * I        .                       -0.10
  9               .    * I        .                       -0.09
  8               .      *        .                       -0.01
  7               .     *I        .                       -0.06
  6               .    * I        .                       -0.12
  5               .      I*       .                        0.05
  4               .    * I        .                       -0.08
  3               .     *I        .                       -0.06
  2               .      *        .                       -0.02
  1               .      *        .                       -0.02
    I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
   -1                    0                  +1
```

LANGLEY AFB

FY 1982 DECOMP RESULTS

```
MEAN SQUARED ERROR (MSE)            =  165.5
MEAN ABSOLUTE PC ERROR (MAPE)       =   15.8%
MEAN PC ERROR OR BIAS  (MPE)        =  -3.52%
```

```
DO YOU WANT TO ESTIMATE THE  12 CYCLICAL FACTORS FOR YOUR
FORECASTS? (IF NOT, A VALUE OF 100 WILL BE ASSIGNED TO EACH)
=N
```

*** FORECAST ***

PERIOD	FORECAST
49	65.85
50	73.94
51	72.05
52	65.80
53	73.88
54	71.99
55	65.75
56	73.83
57	71.93
58	65.70
59	73.77
60	71.88

```
                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                   AUTOCORRELATION
 10                   .*      I       .                       -0.25
  9                   .      *I       .                       -0.06
  8                   .       I  *    .                        0.09
  7                 * .       I       .                       -0.41
  6                   .       I   *   .                        0.14
  5                   .       I*      .                        0.03
  4                  *.       I       .                       -0.33
  3                   .       I       *                        0.31
  2                   .       *       .                        0.02
  1                   .*      I       .                       -0.27
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
          -1                  0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   26.0689
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.

LANGLEY AFB

FY 1982 CENSUS RESULTS

```
MEAN SQUARED ERROR (MSE)          =  156.5
MEAN ABSOLUTE PC ERROR (MAPE)     =   15.3%
MEAN PC ERROR OR BIAS  (MPE)      =  -2.86%
```

DO YOU WANT TO INPUT YOUR ESTIMATES OF THE TREND CYCLE (Y OR N)
=N

PERIOD	FORECAST
49	90.49
50	98.25
51	86.40
52	89.49
53	121.89
54	104.22
55	108.08
56	118.00
57	115.05
58	89.84
59	128.69
60	112.94

LANGLEY AFB

FY 1982 GAF RESULTS

```
MEAN SQUARED ERROR (MSE)          =  110.0
MEAN ABSOLUTE PC ERROR (MAPE)     =   12.9%
MEAN PC ERROR OR BIAS  (MPE)      =  -2.41%


DO YOU WANT TO CONTINUE THE TRAINING (Y OR N)
=N

PERIOD            FORECAST
 49                 70.66
 50                 71.99
 51                 66.78
 52                 66.83
 53                 76.14
 54                 64.74
 55                 66.89
 56                 75.23
 57                 69.16
 58                 71.50
 59                 77.98
 60                 71.96

                *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                               AUTOCORRELATION
 10                        .     *     .                    0.01
  9                        .   * I     .                   -0.08
  8                        .  *  I     .                   -0.13
  7                        .    *I     .                   -0.04
  6                        .     I   * .                    0.18
  5                        .    *I     .                   -0.06
  4                        .     *     .                   -0.00
  3                        .   * I     .                   -0.10
  2                        .    *I     .                   -0.07
  1                        . *   I     .                   -0.19
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                      0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    5.3974
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

LANGLEY AFB

FY 1982 BOXJEN RESULTS

```
MEAN SQUARED ERROR (MSE)             =  137.8
MEAN ABSOLUTE PC ERROR (MAPE)        =   14.8%
MEAN PC ERROR OR BIAS  (MPE)         =  -6.71%
```

PER	FORECAST	95 PC. BOUNDS	
49	64.3	37.4	91.1
50	76.9	44.5	109.2
51	71.7	33.1	110.2
52	66.5	22.5	110.5
53	76.1	27.4	124.9
54	71.9	18.7	125.1
55	66.4	8.8	124.0
56	76.2	14.5	137.8
57	71.9	6.5	137.3
58	66.4	-3.0	135.8
59	76.2	3.2	149.2
60	71.9	-4.6	148.4

```
*** RESIDUAL AUTOCORRELATION COEFFICIENTS ***

STANDARD ERROR =  0.149       CHI SQUARE =       16.80
       DEGREES OF FREEDOM = 12

TIME LAG                                         AUTOCORRELATION
 15              .     I*    .                       0.04
 14              .     I   * .                       0.18
 13              .     *     .                       0.01
 12              .     I*    .                       0.07
 11              .     I *   .                       0.09
 10              .*    I     .                      -0.23
  9              .    *I     .                      -0.03
  8              .     *     .                      -0.02
  7             *.     I     .                      -0.35
  6              .     I  *  .                       0.17
  5              .     *     .                       0.01
  4              . *   I     .                      -0.22
  3              .     I    *.                       0.27
  2              .     I*    .                       0.03
  1              .     *     .                      -0.02
   I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
  -1                   0                   +1
```

APPENDIX F

RANDOLPH AFB DATA AND RESULTS

RANDOLPH AFB

MONTHLY JP4 ISSUES - APR 78 THRU SEP 82

(THOUSANDS OF BARRELS)

*** DATAFILE LISTING FUNCTION ***

PERIOD	OBSERVATION	PERIOD	OBSERVATION	PERIOD	OBSERVATION
1	42.26	19	30.43	37	30.44
2	31.36	20	26.38	38	31.90
3	24.47	21	31.21	39	26.85
4	39.44	22	21.57	40	26.86
5	32.11	23	25.94	41	35.40
6	36.71	24	40.42	42	28.83
7	29.91	25	30.12	43	33.30
8	31.84	26	31.61	44	23.98
9	28.87	27	31.71	45	24.75
10	22.80	28	27.44	46	27.47
11	27.37	29	40.28	47	27.38
12	42.20	30	31.76	48	31.66
13	32.91	31	30.80	49	43.82
14	33.13	32	37.54	50	34.00
15	32.78	33	19.97	51	29.25
16	30.90	34	24.14	52	40.65
17	29.92	35	34.29	53	27.23
18	41.41	36	32.14	54	40.89

RANDOLPH AFB

FY 1980 MEAN RESULTS

```
MEAN SQUARED ERROR (MSE)           =   34.6
MEAN ABSOLUTE PC ERROR (MAPE)      =   14.7%
MEAN PC ERROR OR BIAS  (MPE)       =  -3.46%
```

PERIOD	FORECAST
25	31.97
26	31.97
27	31.97
28	31.97
29	31.97
30	31.97
31	31.97
32	31.97
33	31.97
34	31.97
35	31.97
36	31.97

```
                  *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                AUTOCORRELATION
 10                  .    * I     .                        -0.12
  9                  .  *   I     .                        -0.19
  8                  .    * I     .                        -0.08
  7                  .     *I     .                        -0.03
  6                  .      I   * .                         0.24
  5                  .    * I     .                        -0.11
  4                  .  *   I     .                        -0.21
  3                  .      I*    .                         0.06
  2                  . *    I     .                        -0.25
  1                  .     *I     .                        -0.04
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                 0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    5.7832
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS

RANDOLPH AFB

FY 1980 EXPO RESULTS

```
MEAN SQUARED ERROR (MSE)            =   50.2
MEAN ABSOLUTE PC ERROR (MAPE)       =   17.8%
MEAN PC ERROR OR BIAS  (MPE)        =  -8.36%
```

PERIOD	FORECAST
25	31.75
26	34.65
27	36.68
28	38.10
29	39.10
30	39.79
31	40.28
32	40.62
33	40.86
34	41.03
35	41.15
36	41.23

```
                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                  AUTOCORRELATION
 10                  .    *  I      .                        -0.17
  9                  .      *I      .                        -0.07
  8                  .       *      .                         0.01
  7                  .       *      .                         0.02
  6                  .       I     *.                         0.35
  5                  .     * I      .                        -0.09
  4                  .    *  I      .                        -0.14
  3                  .       *      .                        -0.02
  2                  .     * I      .                        -0.08
  1                  .       I*     .                         0.07
           I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
          -1                 0                    +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    4.7096
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS

RANDOLPH AFB

FY 1980 EXPOTL RESULTS

```
MEAN SQUARED ERROR (MSE)            =   60.7
MEAN ABSOLUTE PC ERROR (MAPE)       =   20.8%
MEAN PC ERROR OR BIAS  (MPE)        = -10.49%
```

PERIOD	FORECAST
25	36.81
26	36.89
27	36.97
28	37.05
29	37.12
30	37.20
31	37.27
32	37.35
33	37.42
34	37.49
35	37.56
36	37.63

FINAL ALPHA = 0.018

```
                      *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                         AUTOCORRELATION
 10                     .     *  I        .                          -0.17
  9                     .  *     I        .                          -0.24
  8                     .     *  I        .                          -0.15
  7                     .        I *      .                           0.10
  6                     .        I      * .                           0.23
  5                     .     *  I        .                          -0.16
  4                     .    *   I        .                          -0.19
  3                     .     *  I        .                          -0.13
  2                     .     *  I        .                          -0.13
  1                     .        I     *  .                           0.22
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                      0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    7.5279
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

RANDOLPH AFB

FY 1981 MEAN RESULTS

```
MEAN SQUARED ERROR (MSE)           =   32.3
MEAN ABSOLUTE PC ERROR (MAPE)      =   14.1%
MEAN PC ERROR OR BIAS  (MPE)       =  -3.42%
```

PERIOD	FORECAST
37	31.64
38	31.64
39	31.64
40	31.64
41	31.64
42	31.64
43	31.64
44	31.64
45	31.64
46	31.64
47	31.64
48	31.64

```
                     *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                   AUTOCORRELATION
 10                   .  *  I     .                            -0.19
  9                   .*    I     .                            -0.28
  8                   .     *     .                             0.02
  7                   .   * I     .                            -0.13
  6                   .     I  *  .                             0.21
  5                   .     *     .                             0.01
  4                   .*    I     .                            -0.31
  3                   .     I *   .                             0.12
  2                   . *   I     .                            -0.24
  1                   .    *I     .                            -0.08
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
       -1                   0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   12.5689
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

RANDOLPH AFB

FY 1981 EXPO RESULTS

```
MEAN SQUARED ERROR (MSE)            =   44.7
MEAN ABSOLUTE PC ERROR (MAPE)       =   17.51
MEAN PC ERROR OR BIAS  (MPE)        =  -8.85%
```

PERIOD	FORECAST
37	30.63
38	30.93
39	31.17
40	31.36
41	31.52
42	31.64
43	31.74
44	31.82
45	31.89
46	31.94
47	31.98
48	32.01

```
                        *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                     AUTOCORRELATION
 10                      .  *   I      .                        -0.20
  9                      .   *  I      .                        -0.17
  8                      .      I *    .                         0.09
  7                      .     *I      .                        -0.05
  6                      .      I     *.                         0.31
  5                      .      I*     .                         0.05
  4                      .  *   I      .                        -0.18
  3                      .      I *    .                         0.09
  2                      .     *I      .                        -0.07
  1                      .      I*     .                         0.07
            I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
           -1                   0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    8.3173
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

RANDOLPH AFB

FY 1981 EXPOTL RESULTS

```
MEAN SQUARED ERROR (MSE)          =   57.3
MEAN ABSOLUTE PC ERROR (MAPE)     =   21.3%
MEAN PC ERROR OR BIAS  (MPE)      = -11.67%
```

PERIOD	FORECAST
37	32.01
38	32.05
39	32.08
40	32.10
41	32.12
42	32.12
43	32.13
44	32.13
45	32.14
46	32.14
47	32.14
48	32.14

FINAL ALPHA = 0.341

```
                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                    AUTOCORRELATION
 10                      .*      I       .                      -0.30
  9                      *       I       .                      -0.34
  8                      .       *       .                       0.01
  7                      .     * I       .                      -0.09
  6                      .       I       *                       0.36
  5                      .       I*      .                       0.07
  4                      .*      I       .                      -0.31
  3                      .       I*      .                       0.04
  2                      .  *    I       .                      -0.23
  1                      .      *I       .                      -0.06
         I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
        -1                       0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   17.9038
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.

RANDOLPH AFB

FY 1982 DECOMP RESULTS

```
MEAN SQUARED ERROR (MSE)          =  967.2
MEAN ABSOLUTE PC ERROR (MAPE)     =  100.0%
MEAN PC ERROR OR BIAS  (MPE)      = 100.00%


DO YOU WANT TO ESTIMATE THE  12 CYCLICAL FACTORS FOR YOUR
FORECASTS? (IF NOT, A VALUE OF 100 WILL BE ASSIGNED TO EACH)
=N

***  FORECAST  ***
PERIOD   FORECAST
 49         0.
 50         0.
 51         0.
 52         0.
 53         0.
 54         0.
 55         0.
 56         0.
 57         0.
 58         0.
 59         0.
 60         0.

                      *** RESIDUAL AUTOCORRELATIONS ***
 TIME LAG                                                  AUTOCORRELATION
  10                        .  *  I     .                      -0.16
   9                        .     I*    .                       0.04
   8                        .    *I     .                      -0.06
   7                        . *   I     .                      -0.20
   6                        .     I     *                       0.30
   5                        .     *     .                       0.00
   4                       *.     I     .                      -0.34
   3                        .     I *   .                       0.11
   2                        . *   I     .                      -0.21
   1                        .     *     .                       0.01
         I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                   0                   +1
 CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   15.8363
 CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

 THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN
 THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME
 LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.
```

RANDOLPH AFB

FY 1982 CENSUS RESULTS

MEAN SQUARED ERROR (MSE) = 15.8
MEAN ABSOLUTE PC ERROR (MAPE) = 10.3%
MEAN PC ERROR OR BIAS (MPE) = -1.57%

DO YOU WANT TO INPUT YOUR ESTIMATES OF THE TREND CYCLE (Y OR N)
=N

PERIOD	FORECAST
49	31.03
50	32.11
51	30.38
52	29.93
53	37.65
54	36.07
55	34.42
56	33.01
57	27.94
58	28.46
59	34.27
60	41.15

RANDOLPH AFB

FY 1982 GAF RESULTS

```
MEAN SQUARED ERROR (MSE)          =     8.1
MEAN ABSOLUTE PC ERROR (MAPE)     =     7.4%
MEAN PC ERROR OR BIAS  (MPE)      =   -1.11%


DO YOU WANT TO CONTINUE THE TRAINING (Y OR N)
=N

PERIOD             FORECAST
 49                  31.83
 50                  25.59
 51                  26.57
 52                  28.33
 53                  29.56
 54                  30.51
 55                  29.63
 56                  24.11
 57                  24.83
 58                  25.00
 59                  27.46
 60                  30.30

                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                  AUTOCORRELATION
 10                     .     *     .                          0.01
  9                     .  *  I     .                         -0.13
  8                     .     *     .                          0.01
  7                     .     I*    .                          0.07
  6                     .   * I     .                         -0.09
  5                     .     I*    .                          0.04
  4                     .   * I     .                         -0.11
  3                     .     I    *.                          0.26
  2                     .    *I     .                         -0.03
  1                    *.     I     .                         -0.41
            I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
           -1                   0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   13.2896
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.

RANDOLPH AFB

FY 1982 BOXJEN RESULTS

MEAN SQUARED ERROR (MSE) = 25.6
MEAN ABSOLUTE PC ERROR (MAPE) = 12.4%
MEAN PC ERROR OR BIAS (MPE) = -4.24%

PER	FORECAST	95 PC. BOUNDS	
49	31.8	20.7	42.8
50	26.0	13.6	38.4
51	21.6	7.6	35.5
52	36.8	21.2	52.4
53	26.3	9.4	43.1
54	30.3	12.1	48.4
55	26.1	6.8	45.4
56	23.2	2.8	43.7
57	27.0	5.5	48.5
58	23.3	0.8	45.7
59	32.9	9.4	56.3
60	31.8	-1.5	65.2

*** RESIDUAL AUTOCORRELATION COEFFICIENTS ***

STANDARD ERROR = 0.164 CHI SQUARE = 9.41
DEGREES OF FREEDOM = 9

```
TIME LAG                                      AUTOCORRELATION
 12              .    I   * .                      0.21
 11              .  * I     .                     -0.09
 10              .    *     .                     -0.01
  9             *.    I     .                     -0.36
  8              .  * I     .                     -0.08
  7              .    I *   .                      0.11
  6              .    I  *  .                      0.16
  5              .    I*    .                      0.06
  4              .    *     .                     -0.02
  3              .    I*    .                      0.07
  2              .    I*    .                      0.04
  1              .    I *   .                      0.12
    I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
   -1                 0                   +1
```

APPENDIX G

TRAVIS AFB DATA AND RESULTS

TRAVIS AFB

MONTHLY JP4 ISSUES - OCT 77 THRU APR 83

(THOUSANDS OF BARRELS)

*** DATAFILE LISTING FUNCTION ***

PERIOD	OBSERVATION	PERIOD	OBSERVATION	PERIOD	OBSERVATION
1	145.09	23	227.14	45	150.82
2	150.90	24	185.34	46	188.16
3	170.58	25	161.71	47	136.67
4	143.69	26	226.16	48	185.00
5	143.33	27	155.68	49	164.54
6	194.78	28	138.13	50	161.87
7	178.65	29	199.51	51	132.99
8	161.40	30	152.78	52	154.90
9	200.60	31	154.30	53	160.83
10	166.86	32	190.79	54	168.36
11	161.29	33	164.97	55	193.37
12	202.37	34	150.52	56	143.04
13	135.20	35	198.17	57	145.50
14	137.95	36	162.94	58	180.01
15	156.95	37	172.82	59	137.85
16	130.49	38	156.34	60	165.48
17	152.30	39	153.82	61	149.91
18	214.10	40	152.08	62	134.36
19	174.12	41	152.21	63	189.80
20	163.63	42	154.99	64	125.61
21	183.67	43	140.74	65	157.27
22	188.05	44	193.06	66	148.32
				67	186.27

TRAVIS AFB

FY 1980 MEAN RESULTS

```
MEAN SQUARED ERROR (MSE)          =  646.4
MEAN ABSOLUTE PC ERROR (MAPE)     =   12.7%
MEAN PC ERROR OR BIAS  (MPE)      =  -2.20%
```

PERIOD	FORECAST
25	169.52
26	169.52
27	169.52
28	169.52
29	169.52
30	169.52
31	169.52
32	169.52
33	169.52
34	169.52
35	169.52
36	169.52

```
                 *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                             AUTOCORRELATION
 10                   .    *  I       .                  -0.17
  9                   .       I*      .                   0.04
  8                   . *     I       .                  -0.29
  7                   *       I       .                  -0.42
  6                   .       I *     .                   0.08
  5                   .    *  I       .                  -0.14
  4                   .   *   I       .                  -0.19
  3                   .       I     * .                   0.31
  2                   .      *I       .                  -0.04
  1                   .       I   *   .                   0.20
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                   0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   11.6564
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.

TRAVIS AFB

FY 1980 EXPO RESULTS

```
MEAN SQUARED ERROR (MSE)            =  709.7
MEAN ABSOLUTE PC ERROR (MAPE)       =   11.6%
MEAN PC ERROR OR BIAS  (MPE)        =   2.22%
```

PERIOD	FORECAST
25	188.91
26	187.94
27	187.24
28	186.73
29	186.35
30	186.08
31	185.88
32	185.73
33	185.63
34	185.55
35	185.49
36	185.45

```
                        *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                      AUTOCORRELATION
 10                     .  *    I        .                        -0.25
  9                     .       I *      .                         0.09
  8                     .   *   I        .                        -0.21
  7                     *       I        .                        -0.38
  6                     .       I   *    .                         0.19
  5                     .      *I        .                        -0.09
  4                     .  *    I        .                        -0.23
  3                     .       I       *.                         0.34
  2                     .   *   I        .                        -0.18
  1                     .      *I        .                        -0.03
            I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
           -1                   0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   11.9570
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS

TRAVIS AFB

FY 1980 EXPOTL RESULTS

```
MEAN SQUARED ERROR (MSE)          =  705.9
MEAN ABSOLUTE PC ERROR (MAPE)     =   11.6%
MEAN PC ERROR OR BIAS  (MPE)      =   2.16%
```

PERIOD	FORECAST
25	189.60
26	187.61
27	186.55
28	185.99
29	185.68
30	185.52
31	185.44
32	185.39
33	185.37
34	185.35
35	185.35
36	185.34

FINAL ALPHA = 0.466

```
                *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                        AUTOCORRELATION
 10                 .  *    I       .               -0.26
  9                 .       I  *    .                0.15
  8                 .    *  I       .               -0.16
  7                 *       I       .               -0.42
  6                 .       I   *   .                0.22
  5                 .       *       .                0.00
  4                 .   *   I       .               -0.22
  3                 .       I      *.                0.33
  2                 . *     I       .               -0.28
  1                 .    *  I       .               -0.13
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
       -1                   0                  +1
```

CHI-SQUARE COMPUTED (8 DEGREES OF FREEDOM) =   14.2915
CHI-SQUARE FROM TABLE (8 DEGREES OF FREEDOM) = 15.50

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.

TRAVIS AFB

FY 1981 DECOMP RESULTS

```
MEAN SQUARED ERROR (MSE)          =  517.5
MEAN ABSOLUTE PC ERROR (MAPE)     =   11.4%
MEAN PC ERROR OR BIAS  (MPE)      =  -1.70%
```

```
DO YOU WANT TO ESTIMATE THE  12 CYCLICAL FACTORS FOR YOUR
FORECASTS? (IF NOT, A VALUE OF 100 WILL BE ASSIGNED TO EACH)
=N
```

*** FORECAST ***

PERIOD	FORECAST
37	163.75
38	184.98
39	188.44
40	165.00
41	186.39
42	189.88
43	166.26
44	187.81
45	191.32
46	167.52
47	189.23
48	192.76

```
                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                 AUTOCORRELATION
 10                        .  *   I      .                    -0.20
  9                        .    * I      .                    -0.11
  8                        . *    I      .                    -0.23
  7                        *      I      .                    -0.33
  6                        .      I*     .                     0.06
  5                        . *    I      .                    -0.24
  4                        .  *   I      .                    -0.18
  3                        .      I      . *                   0.43
  2                        .    * I      .                    -0.11
  1                        .      I*     .                     0.06
           I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
          -1                      0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   18.2047
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.

TRAVIS AFB

FY 1981 CENSUS RESULTS

```
MEAN SQUARED ERROR (MSE)           =  416.2
MEAN ABSOLUTE PC ERROR (MAPE)      =    9.6%
MEAN PC ERROR OR BIAS  (MPE)       =  -1.15%


DO YOU WANT TO INPUT YOUR ESTIMATES OF THE TREND CYCLE (Y OR N)
=N
```

PERIOD	FORECAST
37	130.11
38	147.19
39	135.55
40	113.37
41	135.00
42	147.44
43	129.57
44	129.75
45	133.00
46	117.61
47	134.36
48	120.62

TRAVIS AFB

FY 1981 GAF RESULTS

```
MEAN SQUARED ERROR (MSE)          =  392.5
MEAN ABSOLUTE PC ERROR (MAPE)     =    8.7%
MEAN PC ERROR OR BIAS  (MPE)      =  -1.16%


DO YOU WANT TO CONTINUE THE TRAINING (Y OR N)
=N

PERIOD            FORECAST
 37                173.80
 38                192.15
 39                163.59
 40                174.65
 41                175.57
 42                159.17
 43                176.41
 44                166.98
 45                155.89
 46                177.60
 47                164.34
 48                161.27

               *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                        AUTOCORRELATION
 10                .     *I     .                   -0.05
  9                .     *I     .                   -0.04
  8                .      I *   .                    0.09
  7                .      I *   .                    0.12
  6                .    * I     .                   -0.10
  5                .      I   * .                    0.19
  4                .      I *   .                    0.10
  3                .     *I     .                   -0.03
  2                .   *  I     .                   -0.14
  1                .      *     .                   -0.02
         I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
        -1                0                  +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    3.7287
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

TRAVIS AFB

FY 1981 BOXJEN RESULTS

MEAN SQUARED ERROR (MSE) = 461.8
MEAN ABSOLUTE PC ERROR (MAPE) = 9.5%
MEAN PC ERROR OR BIAS (MPE) = 0.17%

PER	FORECAST	95 PC. BOUNDS	
37	147.9	103.5	192.3
38	198.5	118.5	278.4
39	162.9	62.3	263.6
40	149.6	17.4	281.7
41	198.2	33.8	362.6
42	162.9	-26.9	352.8
43	149.6	-74.6	373.8
44	198.2	-61.7	458.0
45	162.9	-127.0	452.9
46	149.6	-178.2	477.4
47	198.2	-168.9	565.2
48	162.9	-238.3	564.2

*** RESIDUAL AUTOCORRELATION COEFFICIENTS ***

STANDARD ERROR = 0.174 CHI SQUARE = 5.76
DEGREES OF FREEDOM = 8

```
TIME LAG                                                 AUTOCORRELATION
 11                  .       I*      .                        0.04
 10                  .      *I       .                       -0.07
  9                  .  *    I       .                       -0.22
  8                  .   *   I       .                       -0.15
  7                  .  *    I       .                       -0.19
  6                  .   *   I       .                       -0.17
  5                  .     * I       .                       -0.08
  4                  .      *I       .                       -0.07
  3                  .       I *     .                        0.11
  2                  .       I*      .                        0.07
  1                  .       *       .                       -0.00
       I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
      -1                   0                  +1
```

TRAVIS AFB

FY 1982 DECOMP RESULTS

```
MEAN SQUARED ERROR (MSE)            =  520.2
MEAN ABSOLUTE PC ERROR (MAPE)       =   11.7%
MEAN PC ERROR OR BIAS  (MPE)        =  -1.76%


DO YOU WANT TO ESTIMATE THE  12 CYCLICAL FACTORS FOR YOUR
FORECASTS? (IF NOT, A VALUE OF 100 WILL BE ASSIGNED TO EACH)
=N

***  FORECAST  ***
PERIOD   FORECAST
 49        158.35
 50        171.56
 51        174.24
 52        158.37
 53        171.57
 54        174.26
 55        158.38
 56        171.59
 57        174.27
 58        158.39
 59        171.60
 60        174.29
```

```
                     *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                  AUTOCORRELATION
 10                       .*    I     .                       -0.23
  9                       .     *     .                        0.02
  8                       .   * I     .                       -0.12
  7                       .*    I     .                       -0.26
  6                       .     I*    .                        0.07
  5                       .  *  I     .                       -0.14
  4                       .   * I     .                       -0.10
  3                       .     I     *                        0.32
  2                       .     I*    .                        0.06
  1                       .     *     .                       -0.01
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                     0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   13.2844
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN
THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME
LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.
```

TRAVIS AFB

FY 1982 CENSUS RESULTS

```
MEAN SQUARED ERROR (MSE)          =  450.2
MEAN ABSOLUTE PC ERROR (MAPE)     =   10.3%
MEAN PC ERROR OR BIAS  (MPE)      =  -1.44%
```

DO YOU WANT TO INPUT YOUR ESTIMATES OF THE TREND CYCLE (Y OR N)
=N

PERIOD	FORECAST
49	150.16
50	165.86
51	151.89
52	139.26
53	166.68
54	172.65
55	157.65
56	186.44
57	170.44
58	176.49
59	185.95
60	180.91

TRAVIS AFB

FY 1982 GAF RESULTS

```
MEAN SQUARED ERROR (MSE)          =  452.6
MEAN ABSOLUTE PC ERROR (MAPE)     =    9.8%
MEAN PC ERROR OR BIAS  (MPE)      =  -1.34%


DO YOU WANT TO CONTINUE THE TRAINING (Y OR N)
=N
```

PERIOD	FORECAST
49	167.58
50	158.16
51	153.44
52	159.24
53	149.31
54	143.23
55	165.42
56	142.79
57	165.18
58	156.17
59	157.84
60	159.75

```
                         *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                 AUTOCORRELATION
 10                   .   * I     .                         -0.10
  9                   .     I*    .                          0.03
  8                   .     I*    .                          0.04
  7                   .     I *   .                          0.08
  6                   .    *I     .                         -0.07
  5                   .     I*    .                          0.07
  4                   .     I   * .                          0.17
  3                   .    *I     .                         -0.06
  2                   .    *I     .                         -0.03
  1                   .    *I     .                         -0.06
         I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
        -1                  0                  +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    3.1796
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

TRAVIS AFB

FY 1982 BOXJEN RESULTS

```
MEAN SQUARED ERROR (MSE)              =   609.4
MEAN ABSOLUTE PC ERROR (MAPE)         =    11.51
MEAN PC ERROR OR BIAS  (MPE)          =   -0.44%
```

PER	FORECAST	95 PC. BOUNDS	
49	169.7	119.1	220.2
50	160.2	85.7	234.6
51	168.0	75.6	260.4
52	168.1	47.8	288.4
53	160.2	16.3	304.0
54	168.0	4.0	332.0
55	168.1	-24.6	360.8
56	160.2	-58.4	378.7
57	168.0	-73.6	409.6
58	168.1	-104.1	440.2
59	160.2	-140.2	460.6
60	168.0	-158.2	494.2

*** RESIDUAL AUTOCORRELATION COEFFICIENTS ***

STANDARD ERROR = 0.149 CHI SQUARE = 11.16
DEGREES OF FREEDOM = 12

```
TIME LAG                                        AUTOCORRELATION
  15                .     I*    .                    0.04
  14                .     I  *  .                    0.17
  13                .     I  *  .                    0.14
  12                .     I*    .                    0.03
  11                .     I    *.                    0.20
  10                . *   I     .                   -0.17
   9                .    *I     .                   -0.07
   8                .*    I     .                   -0.19
   7                . *   I     .                   -0.16
   6                .   * I     .                   -0.12
   5                . *   I     .                   -0.13
   4                .     I*    .                    0.03
   3                .     I *   .                    0.09
   2                .     I  *  .                    0.15
   1                .     *     .                    0.01
     I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
    -1                    0                   +1
```

APPENDIX H

ALAMEDA NAS DATA AND RESULTS

ALAMEDA NAS

MONTHLY JP5 ISSUES - JAN 76 THRU JUN 83

(THOUSANDS OF BARRELS)

*** DATAFILE LISTING FUNCTION ***

PERIOD	OBSERVATION	PERIOD	OBSERVATION	PERIOD	OBSERVATION
1	24.14	31	24.46	61	18.50
2	32.62	32	33.39	62	21.01
3	44.98	33	23.72	63	23.11
4	29.37	34	18.94	64	24.72
5	32.91	35	26.14	65	23.91
6	51.82	36	28.22	66	20.83
7	22.94	37	25.59	67	27.02
8	40.08	38	22.69	68	21.92
9	31.85	39	24.31	69	20.16
10	32.68	40	24.14	70	27.54
11	39.69	41	33.88	71	18.15
12	32.69	42	23.71	72	19.58
13	26.42	43	20.88	73	20.91
14	39.31	44	29.48	74	21.98
15	43.08	45	21.07	75	28.33
16	30.29	46	19.82	76	17.78
17	35.79	47	27.98	77	20.14
18	42.18	48	22.73	78	26.40
19	34.99	49	19.91	79	16.93
20	44.87	50	23.35	80	28.43
21	27.28	51	25.60	81	32.74
22	30.58	52	22.01	82	18.77
23	35.09	53	31.10	83	22.39
24	25.09	54	24.41	84	25.69
25	24.95	55	24.72	85	15.84
26	34.01	56	19.84	86	21.29
27	40.15	57	17.65	87	24.55
28	30.79	58	20.94	88	17.67
29	27.13	59	20.58	89	16.19
30	39.82	60	17.46	90	24.72

ALAMEDA NAS

FY 1981 DECOMP RESULTS

```
MEAN SQUARED ERROR (MSE)          =   26.5
MEAN ABSOLUTE PC ERROR (MAPE)     =   14.3%
MEAN PC ERROR OR BIAS  (MPE)      =  -2.79%


DO YOU WANT TO ESTIMATE THE  12 CYCLICAL FACTORS FOR YOUR
FORECASTS? (IF NOT, A VALUE OF 100 WILL BE ASSIGNED TO EACH)
=N

*** FORECAST  ***
PERIOD   FORECAST
 58        18.62
 59        23.05
 60        21.67
 61        17.88
 62        22.12
 63        20.79
 64        17.15
 65        21.20
 66        19.91
 67        16.41
 68        20.28
 69        19.03

                     *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                  AUTOCORRELATION
 10                       .    I*    .                         0.03
  9                       .    I*    .                         0.03
  8                       .    I*    .                         0.06
  7                       .    *     .                        -0.02
  6                       *    I     .                        -0.23
  5                       .    I*    .                         0.03
  4                       .    *     .                         0.01
  3                       .    I*    .                         0.07
  2                       .    *     .                        -0.01
  1                       .   *I     .                        -0.07
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                    0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    4.1774
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

ALAMEDA NAS

FY 1981 CENSUS RESULTS

```
MEAN SQUARED ERROR (MSE)          =   13.4
MEAN ABSOLUTE PC ERROR (MAPE)     =   10.0%
MEAN PC ERROR OR BIAS  (MPE)      =  -1.43%

DO YOU WANT TO INPUT YOUR ESTIMATES OF THE TREND CYCLE (Y OR N)
=N
```

PERIOD	FORECAST
58	16.85
59	21.58
60	18.41
61	16.35
62	17.84
63	19.29
64	16.03
65	19.46
66	16.96
67	13.72
68	15.32
69	10.93

ALAMEDA NAS

FY 1981 GAF RESULTS

```
MEAN SQUARED ERROR (MSE)          =   20.1
MEAN ABSOLUTE PC ERROR (MAPE)     =   13.3%
MEAN PC ERROR OR BIAS  (MPE)      =  -2.19%


DO YOU WANT TO CONTINUE THE TRAINING (Y OR N)
=N

PERIOD             FORECAST
 58                  22.09
 59                  21.41
 60                  19.21
 61                  21.06
 62                  21.71
 63                  21.84
 64                  21.39
 65                  23.21
 66                  19.32
 67                  21.02
 68                  18.17
 69                  16.74

                 *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                  AUTOCORRELATION
 10                          .    I  * .                      0.14
  9                          .    *    .                     -0.02
  8                          .    I*   .                      0.03
  7                          .    I*   .                      0.04
  6                          .    *    .                      0.00
  5                          . *  I    .                     -0.13
  4                          . *  I    .                     -0.13
  3                          . *  I    .                     -0.17
  2                          . *  I    .                     -0.15
  1                          .    I*   .                      0.06
         I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
        -1                  0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    6.4641
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

ALAMEDA NAS

FY 1981 BOXJEN RESULTS

```
MEAN SQUARED ERROR (MSE)            =    36.5
MEAN ABSOLUTE PC ERROR (MAPE)       =    17.9%
MEAN PC ERROR OR BIAS  (MPE)        =  -8.91%
```

PER	FORECAST	95 PC. BOUNDS	
58	22.9	10.5	35.3
59	24.8	7.4	42.3
60	21.5	0.3	42.8
61	22.8	-4.7	50.3
62	24.8	-7.7	57.4
63	21.5	-15.4	58.4
64	22.8	-20.5	66.1
65	24.8	-23.9	73.6
66	21.5	-32.2	75.3
67	22.8	-37.7	83.3
68	24.8	-41.7	91.4
69	21.5	-50.5	93.6

```
*** RESIDUAL AUTOCORRELATION COEFFICIENTS ***

STANDARD ERROR =  0.136       CHI SQUARE =       20.00
       DEGREES OF FREEDOM = 15

TIME LAG                                                    AUTOCORRELATION
   18                         .  *  I    .                     -0.14
   17                         .    I *  .                       0.12
   16                         .    *    .                       0.01
   15                         .  * I    .                      -0.09
   14                         .    I   *.                       0.20
   13                         .    I*   .                       0.03
   12                         .    I    .  *                    0.38
   11                         .    I*   .                       0.05
   10                         .    I  * .                       0.15
    9                         .    I  * .                       0.16
    8                         .    I *  .                       0.11
    7                         .    I*   .                       0.04
    6                         .*   I    .                      -0.19
    5                         .    I *  .                       0.11
    4                         .    I  * .                       0.15
    3                         .    *    .                       0.01
    2                         .    I *  .                       0.11
    1                         .    *    .                      -0.01
               I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
              -1                   0                   +1
```

ALAMEDA NAS

FY 1982 DECOMP RESULTS

```
MEAN SQUARED ERROR (MSE)          =   25.4
MEAN ABSOLUTE PC ERROR (MAPE)     =   14.0%
MEAN PC ERROR OR BIAS  (MPE)      =  -2.84%
```

DO YOU WANT TO ESTIMATE THE 12 CYCLICAL FACTORS FOR YOUR FORECASTS? (IF NOT, A VALUE OF 100 WILL BE ASSIGNED TO EACH)
=N

*** FORECAST ***

PERIOD	FORECAST
70	17.36
71	20.44
72	19.14
73	16.67
74	19.61
75	18.35
76	15.98
77	18.78
78	17.56
79	15.28
80	17.95
81	16.78

```
                        *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                  AUTOCORRELATION
 10                           .    *    .                       0.01
  9                           .    I*   .                       0.07
  8                           .    I*   .                       0.03
  7                           .  * I    .                      -0.10
  6                           .*   I    .                      -0.18
  5                           .    *    .                       0.01
  4                           .    *    .                       0.00
  3                           .    I  * .                       0.15
  2                           .    *    .                       0.00
  1                           .   *I    .                      -0.05
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                        0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    5.2674
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS

ALAMEDA NAS

FY 1982 CENSUS RESULTS

```
MEAN SQUARED ERROR (MSE)          =   17.3
MEAN ABSOLUTE PC ERROR (MAPE)     =   11.4%
MEAN PC ERROR OR BIAS  (MPE)      =  -1.72%
```

```
DO YOU WANT TO INPUT YOUR ESTIMATES OF THE TREND CYCLE (Y OR N)
=N
```

PERIOD	FORECAST
70	20.90
71	26.79
72	24.90
73	24.82
74	28.37
75	32.61
76	32.57
77	41.31
78	34.68
79	37.30
80	37.30
81	31.64

ALAMEDA NAS

FY 1982 GAF RESULTS

```
MEAN SQUARED ERROR (MSE)          =   16.6
MEAN ABSOLUTE PC ERROR (MAPE)     =   11.8%
MEAN PC ERROR OR BIAS  (MPE)      =  -1.85%


DO YOU WANT TO CONTINUE THE TRAINING (Y OR N)
=N

PERIOD           FORECAST
 70                21.87
 71                21.13
 72                21.32
 73                22.03
 74                22.12
 75                23.70
 76                25.17
 77                24.02
 78                22.66
 79                25.06
 80                22.53
 81                22.58

                  *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                AUTOCORRELATION
 10                          .    I *  .                     0.12
  9                          .   *I    .                    -0.03
  8                          .    *    .                     0.01
  7                          .    I *  .                     0.08
  6                          .    I*   .                     0.04
  5                          .  * I    .                    -0.08
  4                          .   *I    .                    -0.07
  3                          . *  I    .                    -0.15
  2                          . *  I    .                    -0.14
  1                          .    I *  .                     0.08
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                   0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    5.6752
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

ALAMEDA NAS

FY 1982 BOXJEN RESULTS

```
MEAN SQUARED ERROR (MSE)              =    31.5
MEAN ABSOLUTE PC ERROR (MAPE)         =    16.6%
MEAN PC ERROR OR BIAS  (MPE)          =   -7.53%
```

PER	FORECAST	95 PC.	BOUNDS
70	24.1	12.6	35.6
71	22.6	5.9	39.2
72	20.7	0.0	41.4
73	24.1	-2.5	50.8
74	22.6	-9.0	54.2
75	20.7	-15.2	56.6
76	24.1	-17.8	66.1
77	22.6	-24.8	69.9
78	20.7	-31.4	72.9
79	24.1	-34.4	82.6
80	22.6	-41.8	86.9
81	20.7	-49.0	90.4

```
*** RESIDUAL AUTOCORRELATION COEFFICIENTS ***

STANDARD ERROR =  0.125        CHI SQUARE =        28.64
      DEGREES OF FREEDOM = 19

TIME LAG
                                                        AUTOCORRELATION
 12                   .     I     .   *                     0.39
 11                   .     I*    .                         0.03
 10                   .     I   * .                         0.15
  9                   .     I   * .                         0.14
  8                   .     I*    .                         0.06
  7                   .     *     .                        -0.01
  6                   .*    I     .                        -0.22
  5                   .     I  *  .                         0.09
  4                   .     I   * .                         0.15
  3                   .     *     .                         0.02
  2                   .     I  *  .                         0.12
  1                   .    *I     .                        -0.03
   I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
  -1                        0                   +1
```

APPENDIX I

MIRAMAR NAS DATA AND RESULTS

MIRAMAR NAS

MONTHLY JP5 ISSUES - JAN 74 THRU JUN 83

(THOUSANDS OF BARRELS)

PERIOD	OBSERVATION	PERIOD	OBSERVATION	PERIOD	OBSERVATION
1	142.42	39	156.46	77	138.53
2	137.53	40	114.17	78	135.93
3	175.09	41	133.11	79	129.00
4	192.92	42	125.98	80	129.05
5	139.68	43	123.21	81	96.66
6	147.65	44	110.06	82	114.84
7	155.81	45	119.00	83	101.99
8	181.35	46	110.63	84	98.95
9	135.04	47	109.22	85	129.48
10	176.05	48	92.77	86	88.07
11	156.59	49	116.95	87	100.14
12	155.01	50	112.07	88	86.93
13	175.13	51	106.70	89	77.42
14	149.61	52	118.87	90	102.16
15	165.13	53	120.86	91	94.56
16	166.89	54	135.45	92	99.39
17	161.25	55	107.19	93	82.84
18	130.85	56	114.76	94	73.47
19	153.29	[illegible]	108.20	95	68.98
20	189.80	58	106.19	96	76.29
21	165.27	59	110.16	97	88.79
22	151.43	60	93.59	98	97.77
23	155.88	61	122.86	99	99.42
24	134.56	62	99.45	100	96.63
25	222.78	63	104.06	101	85.24
26	110.67	64	109.76	102	111.75
27	145.04	65	96.43	103	107.04
28	127.91	66	102.90	104	110.39
29	123.89	67	104.93	105	89.39
30	134.93	68	111.33	106	95.54
31	99.13	69	89.76	107	95.61
32	148.31	70	108.11	108	114.92
33	147.30	71	104.06	109	131.42
34	127.58	72	89.03	110	103.69
35	138.57	73	110.44	111	90.64
36	121.81	74	120.70	112	75.94
37	134.32	75	128.69	113	78.68
38	112.38	76	132.48	114	90.52

MIRAMAR NAS

FY 1981 DECOMP RESULTS

```
MEAN SQUARED ERROR (MSE)          =  303.7
MEAN ABSOLUTE PC ERROR (MAPE)     =    9.0%
MEAN PC ERROR OR BIAS  (MPE)      =  -1.45%


DO YOU WANT TO ESTIMATE THE  12 CYCLICAL FACTORS FOR YOUR
FORECASTS? (IF NOT, A VALUE OF 100 WILL BE ASSIGNED TO EACH)
=N

***  FORECAST  ***
PERIOD   FORECAST
 70        95.18
 71        97.06
 72        93.05
 73        94.87
 74        90.92
 75        92.67
 76        88.80
 77        90.48
 78        86.67
 79        88.29
 80        84.54
 81        86.09

                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                               AUTOCORRELATION
 10                        .    *    .                     -0.00
  9                        .    I*   .                      0.05
  8                        .  * I    .                     -0.11
  7                        .    I *  .                      0.11
  6                       *.    I    .                     -0.29
  5                        .    I  * .                      0.16
  4                        .    I*   .                      0.03
  3                        .    I*   .                      0.07
  2                        .    I*   .                      0.07
  1                        *    I    .                     -0.25
               I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
              -1                  0                  +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   14.6633
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN
THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME
LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.
```

MIRAMAR NAS

FY 1981 CENSUS RESULTS

MEAN SQUARED ERROR (MSE) = 220.1
MEAN ABSOLUTE PC ERROR (MAPE) = 7.8%
MEAN PC ERROR OR BIAS (MPE) = -1.01%

DO YOU WANT TO INPUT YOUR ESTIMATES OF THE TREND CYCLE (Y OR N)
=N

PERIOD	FORECAST
70	99.47
71	104.40
72	91.18
73	116.70
74	99.36
75	112.65
76	110.11
77	111.92
78	119.31
79	110.77
80	117.84
81	110.48

MIRAMAR NAS

FY 1981 GAF RESULTS

```
MEAN SQUARED ERROR (MSE)          =  306.5
MEAN ABSOLUTE PC ERROR (MAPE)     =   10.0%
MEAN PC ERROR OR BIAS  (MPE)      =  -1.30%


DO YOU WANT TO CONTINUE THE TRAINING (Y OR N)
=N
```

PERIOD	FORECAST
69	102.70
70	101.63
71	106.50
72	99.17
73	106.08
74	99.16
75	100.63
76	102.62
77	98.67
78	100.58
79	97.58
80	100.97

```
                     *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                   AUTOCORRELATION
 10                         .   *I    .                      -0.05
  9                         .  * I    .                      -0.11
  8                         .    I*   .                       0.05
  7                         .  * I    .                      -0.11
  6                         .  * I    .                      -0.08
  5                         .    *    .                      -0.02
  4                         .   *I    .                      -0.05
  3                         .   *I    .                      -0.07
  2                         .    *    .                      -0.02
  1                         . *  I    .                      -0.15
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                  0                  +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    4.6534
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

MIRAMAR NAS

FY 1981 BOXJEN RESULTS

```
MEAN SQUARED ERROR (MSE)            =  370.4
MEAN ABSOLUTE PC ERROR (MAPE)       =   11.0%
MEAN PC ERROR OR BIAS  (MPE)        =  -5.38%
```

PER	FORECAST	95 PC. BOUNDS	
70	101.9	63.6	140.3
71	104.6	45.3	163.8
72	101.9	22.5	181.3
73	104.6	5.3	203.9
74	101.9	-18.1	222.0
75	104.6	-36.5	245.7
76	101.9	-61.2	265.1
77	104.6	-81.2	290.3
78	101.9	-107.3	311.2
79	104.6	-128.8	337.9
80	101.9	-156.5	360.4
81	104.6	-179.4	388.5

```
*** RESIDUAL AUTOCORRELATION COEFFICIENTS ***

STANDARD ERROR =  0.122       CHI SQUARE =       29.93
      DEGREES OF FREEDOM = 19

TIME LAG                                                 AUTOCORRELATION
 12                 .    I    .*                          0.28
 11                 . *  I    .                          -0.14
 10                 .    I *  .                           0.09
  9                 .    I *  .                           0.09
  8                 .    *    .                           0.01
  7                 .    I *  .                           0.12
  6                 .*   I    .                          -0.21
  5                 .    I   *.                           0.21
  4                 .    I*   .                           0.07
  3                 .    *    .                           0.02
  2                 .    I *  .                           0.12
  1                 *    I    .                          -0.23
   I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
   -1                    0                   +1
```

MIRAMAR NAS

FY 1982 DECOMP RESULTS

```
MEAN SQUARED ERROR (MSE)            =  291.0
MEAN ABSOLUTE PC ERROR (MAPE)       =   10.4%
MEAN PC ERROR OR BIAS  (MPE)        =  -1.60%


DO YOU WANT TO ESTIMATE THE  12 CYCLICAL FACTORS FOR YOUR
FORECASTS? (IF NOT, A VALUE OF 100 WILL BE ASSIGNED TO EACH)
=N

***  FORECAST  ***
PERIOD   FORECAST
 82       105.07
 83       103.90
 84        90.99
 85       116.32
 86        94.21
 87       106.39
 88       101.92
 89       101.96
 90       101.46
 91        93.94
 92       103.62
 93        93.24

                 *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                AUTOCORRELATION
 10                         .   *   .                         0.02
  9                         .   I*  .                         0.05
  8                         .   I*  .                         0.06
  7                         .   *   .                        -0.02
  6                         .   *   .                         0.02
  5                         .   I   *                         0.18
  4                         .   I   .*                        0.27
  3                         .   I   .*                        0.27
  2                         .   I   .  *                      0.33
  1                         .   I   .  *                      0.36
           I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
          -1                    0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =  34.3293
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN
THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME
LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.
```

MIRAMAR NAS

FY 1982 CENSUS RESULTS

```
MEAN SQUARED ERROR (MSE)            =  338.2
MEAN ABSOLUTE PC ERROR (MAPE)       =   11.0%
MEAN PC ERROR OR BIAS  (MPE)        =  -1.66%
```

DO YOU WANT TO INPUT YOUR ESTIMATES OF THE TREND CYCLE (Y OR N)
=N

PERIOD	FORECAST
82	115.16
83	111.22
84	90.88
85	109.73
86	96.97
87	96.30
88	93.85
89	88.17
90	87.86
91	77.60
92	76.78
93	61.04

MIRAMAR NAS

FY 1982 GAF RESULTS

```
MEAN SQUARED ERROR (MSE)           =  291.1
MEAN ABSOLUTE PC ERROR (MAPE)      =    9.9%
MEAN PC ERROR OR BIAS  (MPE)       =  -1.25%


DO YOU WANT TO CONTINUE THE TRAINING (Y OR N)
=N

PERIOD            FORECAST
 73                102.97
 74                 94.04
 75                 98.46
 76                 95.49
 77                 93.14
 78                 95.50
 79                 91.46
 80                 97.64
 81                 88.82
 82                 92.26
 83                 92.66
 84                 87.95

                  *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                              AUTOCORRELATION
 10                       .   *I    .                    -0.04
  9                       .  * I    .                    -0.10
  8                       .    I*   .                     0.03
  7                       .  * I    .                    -0.12
  6                       .  * I    .                    -0.08
  5                       .    *    .                    -0.02
  4                       .   *I    .                    -0.06
  3                       .   *I    .                    -0.07
  2                       .    *    .                    -0.01
  1                       . *  I    .                    -0.15
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                    0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    4.7751
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

MIRAMAR NAS

FY 1982 BOXJEN RESULTS

MEAN SQUARED ERROR (MSE)	=	331.4
MEAN ABSOLUTE PC ERROR (MAPE)	=	10.8%
MEAN PC ERROR OR BIAS (MPE)	=	-4.60%

PER	FORECAST	95 PC. BOUNDS	
82	113.6	73.2	154.0
83	114.2	42.5	185.9
84	101.0	-3.2	205.1
85	131.8	-5.7	269.3
86	113.1	-58.1	284.3
87	131.2	-73.8	336.1
88	130.6	-107.9	369.1
89	127.1	-144.5	398.7
90	128.0	-176.1	432.1
91	122.3	-213.7	458.3
92	135.6	-231.6	502.8
93	116.8	-280.8	514.5

*** RESIDUAL AUTOCORRELATION COEFFICIENTS ***

STANDARD ERROR = 0.120 CHI SQUARE = 16.64
DEGREES OF FREEDOM = 20

```
TIME LAG                                                  AUTOCORRELATION
   12                   .   I * .                               0.10
   11                   .   *   .                               0.02
   10                   .   *   .                               0.00
    9                   .   I*  .                               0.07
    8                   .   I  *.                               0.16
    7                   . * I   .                              -0.09
    6                   . * I   .                              -0.09
    5                   .   I*  .                               0.07
    4                   .   I  *.                               0.13
    3                   .   *   .                               0.02
    2                   .   I*  .                               0.04
    1                   *   I   .                              -0.20
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
       -1                   0                  +1
```

APPENDIX J

NSC JACKSONVILLE DATA AND RESULTS

NSC JACKSONVILLE

MONTHLY JP5 ISSUES - OCT 78 THRU SEP 82

(THOUSANDS OF BARRELS)

*** DATAFILE LISTING FUNCTION ***

PERIOD	OBSERVATION	PERIOD	OBSERVATION	PERIOD	OBSERVATION
1	195.32	21	171.00	41	109.59
2	160.54	22	113.54	42	124.25
3	120.26	23	137.65	43	130.33
4	150.58	24	187.69	44	111.18
5	160.75	25	157.72	45	133.08
6	193.37	26	165.28	46	162.63
7	143.59	27	116.98	47	118.34
8	129.52	28	96.79	48	102.43
9	173.72	29	147.93	49	134.14
10	149.34	30	151.38	50	113.92
11	192.36	31	160.57	51	145.28
12	157.10	32	121.59	52	179.11
13	110.58	33	123.34	53	156.18
14	110.55	34	96.27	54	218.87
15	121.89	35	112.80	55	163.82
16	102.68	36	101.55	56	116.77
17	116.62	37	129.93	57	114.19
18	197.39	38	76.96	58	86.12
19	164.08	39	97.44	59	135.20
20	146.92	40	129.53	60	31.33

NSC JACKSONVILLE

FY 1981 MEAN RESULTS

```
MEAN SQUARED ERROR (MSE)          =  884.0
MEAN ABSOLUTE PC ERROR (MAPE)     =   18.9%
MEAN PC ERROR OR BIAS  (MPE)      =  -4.51%
```

PERIOD	FORECAST
37	143.31
38	143.31
39	143.31
40	143.31
41	143.31
42	143.31
43	143.31
44	143.31
45	143.31
46	143.31
47	143.31
48	143.31

```
                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                  AUTOCORRELATION
 10                     .  *  I      .                         -0.15
  9                     .   * I      .                         -0.09
  8                     .    *I      .                         -0.05
  7                     .     I*     .                          0.04
  6                     .     I   *  .                          0.17
  5                     .     I *    .                          0.10
  4                     . *   I      .                         -0.18
  3                     .    *I      .                         -0.07
  2                     .    *I      .                         -0.04
  1                     .     I     *.                          0.30
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                   0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =    7.2810
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

NSC JACKSONVILLE

FY 1981 EXPO RESULTS

```
MEAN SQUARED ERROR (MSE)            =  983.0
MEAN ABSOLUTE PC ERROR (MAPE)       =   19.4%
MEAN PC ERROR OR BIAS  (MPE)        =  -9.31%
```

PERIOD	FORECAST
37	114.42
38	110.56
39	107.86
40	105.97
41	104.64
42	103.71
43	103.06
44	102.61
45	102.29
46	102.07
47	101.91
48	101.80

```
                        *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                      AUTOCORRELATION
 10                         .   *  I       .                       -0.14
  9                         .     *I       .                       -0.06
  8                         .   *  I       .                       -0.16
  7                         .      I*      .                        0.06
  6                         .      I    *  .                        0.25
  5                         .      I*      .                        0.05
  4                         .*     I       .                       -0.32
  3                         .  *   I       .                       -0.18
  2                         .     *I       .                       -0.12
  1                         .      I   *   .                        0.21
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
          -1                      0                 +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   10.9265
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

NSC JACKSONVILLE

FY 1981 EXPOTL RESULTS

```
MEAN SQUARED ERROR (MSE)            = 1236.6
MEAN ABSOLUTE PC ERROR (MAPE)       =   22.0%
MEAN PC ERROR OR BIAS  (MPE)        = -13.36%
```

PERIOD	FORECAST
37	106.42
38	103.09
39	102.04
40	101.71
41	101.60
42	101.57
43	101.55
44	101.55
45	101.55
46	101.55
47	101.55
48	101.55

FINAL ALPHA = 0.683

```
                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                AUTOCORRELATION
 10                     .   * I     .                      -0.14
  9                     .     *     .                       0.01
  8                     .    * I    .                      -0.11
  7                     .     I*    .                       0.05
  6                     .     I   * .                       0.26
  5                     .     I*    .                       0.04
  4                     *     I     .                      -0.34
  3                     .  *  I     .                      -0.18
  2                     .  *  I     .                      -0.22
  1                     .     I *   .                       0.11
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
       -1                    0                    +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   11.1508
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.

NSC JACKSONVILLE

FY 1982 MEAN RESULTS

```
MEAN SQUARED ERROR (MSE)            =  882.8
MEAN ABSOLUTE PC ERROR (MAPE)       =   19.4%
MEAN PC ERROR OR BIAS  (MPE)        =  -4.86%
```

PERIOD	FORECAST
49	137.19
50	137.19
51	137.19
52	137.19
53	137.19
54	137.19
55	137.19
56	137.19
57	137.19
58	137.19
59	137.19
60	137.19

```
                          *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                       AUTOCORRELATION
 10                          .      *      .                        0.02
  9                          .      I*     .                        0.03
  8                          .      *      .                       -0.02
  7                          .      I *    .                        0.09
  6                          .      I      *                        0.28
  5                          .      I     *.                        0.24
  4                          .      I*     .                        0.05
  3                          .      I  *   .                        0.15
  2                          .      I *    .                        0.08
  1                          .      I      .*                       0.36
                    I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
                   -1               0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   14.6155
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED CAN BE IMPROVED BECAUSE THERE IS SOME PATTERN IN THE RESIDUALS WHICH CAN BE FORCASTED. SPECIFICALLY, THE FOLLOWING TIME LAGS AND AUTOCORRELATIONS DO NOT SEEM TO BE RANDOM.

NSC JACKSONVILLE

FY 1982 EXPO RESULTS

```
MEAN SQUARED ERROR (MSE)          =  862.7
MEAN ABSOLUTE PC ERROR (MAPE)     =   18.8%
MEAN PC ERROR OR BIAS  (MPE)      =  -7.39%
```

PERIOD	FORECAST
49	121.28
50	115.62
51	111.67
52	108.90
53	106.96
54	105.60
55	104.65
56	103.98
57	103.52
58	103.19
59	102.96
60	102.80

```
                        *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                     AUTOCORRELATION
 10                    .  * I    .                                -0.10
  9                    .   *I    .                                -0.07
  8                    . *  I    .                                -0.22
  7                    .    *    .                                -0.02
  6                    .    I   *.                                 0.24
  5                    .    I*   .                                 0.03
  4                    .*   I    .                                -0.25
  3                    .  * I    .                                -0.11
  2                    .  * I    .                                -0.12
  1                    .    I  * .                                 0.18
          I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
         -1                 0                     +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   11.6820
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS
```

NSC JACKSONVILLE

FY 1982 EXPOTL RESULTS

```
MEAN SQUARED ERROR (MSE)             = 1049.4
MEAN ABSOLUTE PC ERROR (MAPE)        =   20.6%
MEAN PC ERROR OR BIAS  (MPE)         = -10.40%
```

PERIOD	FORECAST
49	115.33
50	114.81
51	114.32
52	113.84
53	113.38
54	112.94
55	112.52
56	112.11
57	111.72
58	111.35
59	110.99
60	110.65

FINAL ALPHA = 0.040

```
                    *** RESIDUAL AUTOCORRELATIONS ***
TIME LAG                                                  AUTOCORRELATION
 10                       .   * I     .                      -0.09
  9                       .     *     .                      -0.02
  8                       .  *  I     .                      -0.13
  7                       .     *     .                       0.01
  6                       .     I    *.                       0.27
  5                       .     I*    .                       0.05
  4                       .*    I     .                      -0.26
  3                       .   * I     .                      -0.11
  2                       . *   I     .                      -0.18
  1                       .     I *   .                       0.11
        I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I
       -1                       0                   +1
CHI-SQUARE COMPUTED (  8 DEGREES OF FREEDOM) =   10.7741
CHI-SQUARE FROM TABLE (  8 DEGREES OF FREEDOM) =  15.50
```

THE MODEL YOU USED IS CORRECT BECAUSE THERE
IS NO SIGNIFICANT PATTERN LEFT IN THE RESIDUALS

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