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AN ANALYSIS OF SELECTED SURFACE SHIP OPTAR OBLIGATION PATTERNS AND THEIR DEPENDENCY ON OPERATING SCHEDULES AND OTHER FACTORS

by

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U.S. Navy ships receive their annual operating funds from their type commander in the form of an OPTAR (Operating Target). The ship's OPTAR can be viewed as the funding necessary to execute its annual budget. At present the type commander's budget office essentially divides each ship's annual OPTAR authorization into fourths and allocates to the unit one-fourth of its total annual amount authorized for each quarter of the fiscal year. No attempt is made to allocate the OPTAR on the basis of when the funds are likely to be most needed.

This thesis studies OPTAR spending patterns for two classes of Navy ships in the Pacific Fleet and attempts to draw conclusions as to

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the impact of operational scheduling and other factors on the OPTAR obligation rates for these ships. Parametric and non-parametric statistical methods were used to study potential relationships between OPTAR spending and operational employment. Based on the results of this analysis, it was found that there is no significant relationship between the operational employment of a ship and its OPTAR spending. Possible explanations for the lack of relationship between operational employment and OPTAR spending are offered and discussed.

An Analysis of Selected Surface Ship OPTAR Obligation Patterns and Their Dependency on Operating Schedules and Other Factors

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ABSTRACT

U.S. Navy ships receive their annual operating funds from their type commander in the form of an OPTAR (Operating Target). The ship's OPTAR can be viewed as the funding necessary to execute its annual budget. At present the type commander's budget office essentially divides each ship's annual OPTAR authorization into fourths and allocates to the unit one-fourth of its total annual amount authorized for each quarter of the fiscal year. No attempt is made to allocate the OPTAR on the basis of when the funds are likely to be most needed.

This thesis studies OPTAR spending patterns for two classes of Navy ships in the Pacific Fleet and attempts to draw conclusions as to the impact of operational scheduling and other factors on the OPTAR obligation rates for these ships. Parametric and non-parametric statistical methods were used to study potential relationships between OPTAR spending and operational employment. Based on the results of this analysis, it was found that there is no significant relationship between the operational employment of a ship and its OPTAR spending. Possible explanations for the lack of relationship between operational employment and OPTAR spending are offered and discussed.

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I. INTRODUCTION

A. PURPOSE

With increased Congressional attention being focused each year on the Defense budget due to deficits and the growing national debt, it has become imperative that military managers ensure each DOD dollar be spent as efficiently and effectively as possible. Within the Department of the Navy, this has meant streamlining operations and learning to "do more with less."

Annual operating costs for U.S. Navy ships are high. In order to ensure that the Operation and Maintenance funding appropriated by Congress for these ships is spent in the most efficient manner, while at the same time maintaining maximum readiness and meeting all operational commitments, it is important that these funds be properly budgeted and obligated. The scarcity of such funds demands that managers strive to achieve the most return for the dollar. Dollars need to be allocated where they are most needed, which in turn means that those responsible for allocating the dollars need to know who needs the dollars most and when they are needed.

The purpose of this thesis is to analyze the OPTAR spending rates for two classes of surface ships assigned to the U.S. Pacific fleet, and attempt to draw conclusions as to the impact that operational scheduling and other factors have on the OPTAR obligation rates for the two classes of ships. If spending patterns can be identified, and the causes of these patterns can be shown to be related to operational scheduling or other predictable factors, then budget personnel and other fiscal planners, given advance information about ship's schedules, might be better able to effectively allocate the scarce funding available.

The primary research question for this thesis is as follows:

- Are there readily identifiable spending patterns (patterns in the OPTAR obligation rates) for either of the two classes of ships examined?

The subsidiary research questions which will be examined and discussed are as follows:

- If patterns are evident in the spending rates, are these patterns dependent on the ship's operational schedule?
- If patterns are evident in the spending rates, are these patterns dependent on the current policy of "spending the allocated OPTAR before the funding expires in order to avoid the loss of funding in future periods?"

B. DISCUSSION

U.S. Navy ships receive annual operating funds from their respective type commander[1] in the form of an OPTAR (Operating Target). The ship's OPTAR can be viewed as the funding necessary to execute its annual "budget." At present, the type commander's budget office

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[1] The term "type commander" refers to the administrative superior in a ship's chain of command who is responsible for allocating the ship's OPTAR. The type commander is responsible to the fleet commander for the financial management of all ships, squadrons, and units under his command. The type commander for the Pacific fleet surface ships examined in this thesis is Commander Naval Surface Forces Pacific, commonly abbreviated COMNAVSURFPAC.

divides each ship's annual OPTAR authorization into fourths, and at the beginning of each quarter of the fiscal year, allocates to each ship one-fourth of its total annual amount authorized. No attempt is made to allocate the OPTAR funds on the basis of when the funds are likely to be most needed. Problems in budgeting can arise when ships do not obligate their funds at this constant rate from quarter to quarter. As shown in Appendix C, there are wide fluctuations in the rate at which individual ships obligate their OPTAR. Even within the same ship class, the obligation rates can vary dramatically from ship to ship.

This thesis will attempt to determine whether any discernable patterns in OPTAR obligation exist. Since a ship's operational employment normally tends to drive the ship's activities, particular emphasis will be placed on studying the relationship, if any, between the ship's schedule and its obligation rate.

C. SCOPE

Data collection for the thesis involved a random sample of Pacific fleet units from two different classes of ships—the KNOX (FF-1052) class frigate and the BELKNAP (CG-26) class cruiser. (Further information concerning sample selection will be discussed in Chapter III). Once the sample ships were selected, data concerning the ships' scheduling were collected, along with all available monthly obligation reports and other OPTAR, Budget, and obligation type reports. Two fiscal years of cost and schedule data were used in the analysis. This data was analyzed in an attempt to identify patterns and relationships in OPTAR spending in order to study the thesis questions previously stated.

D. ASSUMPTIONS

One overriding assumption made in the analysis of the data is that those personnel aboard the individual ship who are responsible for managing the allocated OPTAR resources (Commanding Officer, Supply Officer, Department Heads), do so in a rational manner, meaning that each ship conscientiously attempts to husband available financial resources, as opposed to spending in a haphazard manner and then "asking for more." While it might be argued that some ships are less than fiscally conservative when it comes to OPTAR management, this assumption is necessary in order to make certain judgments concerning spending patterns. Further discussions of this assumption, and its impact on the interpretation of the results of the data analysis are contained in later chapters.

E. ORGANIZATION OF THE THESIS

As discussed earlier, this thesis focuses on analyzing cost and schedule data for selected ships and attempts to draw conclusions about spending patterns and their causes. Prior to the actual analysis of data, some brief background information will be provided in Chapter II, including a comparison of the type commander's budgeting problem with the problem of cash management in private industry. Additionally, a review of the procedures for OPTAR budgeting at COMNAVSURFPAC will be provided.

Chapter III will discuss data collection procedures and the methodology used in the analysis, as well as present highlights of the data collected, including ship schedules and OPTAR obligation information.

Chapter IV contains an analysis of the data collected, and an initial interpretation of the analysis.

The final Chapter provides a brief summary of the findings with respect to the analysis of OPTAR obligation rates and their dependency on ships schedules and other factors.

Appendix A provides detailed information with respect to the ships studied in this thesis and their operating schedules for fiscal years 1985 and 1986. Appendix B provides detailed information with respect to these same ships' monthly OPTAR obligation rates as reported in monthly BOR's (Budget OPTAR Reports) from the ships. Appendix C contains OPTAR obligation graphs for each ship included in the thesis, for both fiscal years studied.

II. OVERVIEW OF CASH MANAGEMENT

A. CASH MANAGEMENT IN THE CIVILIAN SECTOR

The need for efficient budgeting in the Navy can be more easily understood if the concept of "cash management" is first examined from a civilian business perspective. The problem facing a Navy type commander in the area of OPTAR allocation most closely resembles the problem of cash management in the civilian sector. The following sections briefly describe the concept of cash management.

1. Cash Management Concepts

Cash has been described as the "oil that lubricates the wheels of business." (Brigham, 1985) Just as a machine fails to work efficiently without an adequate oil supply, and can be in danger of self-destruction, so too is a business that experiences inadequate cash flow. On the other hand, too much oil in a machine often serves no purpose. A company that carries an excessive cash balance is also being wasteful. By itself, cash is a non-earning asset. A firm that holds cash beyond its minimum requirements is lowering its potential earnings. In order to maximize earnings potential, the goal of any firm should be to minimize the amount of cash held without adversely affecting business activities (Brigham, 1985).

The discipline of cash management has evolved as one of the more critical areas of financial management within a company. Although the study of cash management escaped treatment in financial management and operations research literature for many years, the dramatic rise in interest rates over the past two decades has focused a renewed interest in properly managing cash assets.

Cash management is generally defined in financial literature as that area of financial management that encompasses those techniques used to collect and report financial data relevant to the management of the cash assets of a business (National Association of Accountants, 1961). These cash assets are generally defined as being composed of cash, marketable securities and other highly liquid or "near cash" assets.

The study of cash management is not completely new. As mentioned previously, the rise in interest rates over the years has increased managerial attention to this area, but the rise in interest rates alone is not the sole reason for the renewed emphasis by managers. Since World War II, the expansion of corporations into multi-divisional "profit center" structures has greatly increased the problems of funding corporate operations (Hill, 1970). Additionally, the Post-war Employment Act of 1946 had a major impact on the availability and cost of money. The twin objectives of reduced unemployment and a higher standard of living with minimal inflation produced a very strong consumer and social demand for goods and services that business and government had a hard time satisfying (Hill, 1970). This resulted in a dramatic rise in interest rates (from about 1% in 1945 to as high as 18% in the early 1980s). Finally, improvements in communications and transportation have facilitated innovations for faster movement and clearing of funds within the country's banking system (Hill, 1970).

2. Cash Management Objectives

There are several objectives associated with cash management that are often cited in financial literature. Cash is a "non-earning" asset and efficient management of a firm's cash assets involves all steps taken to achieve the following primary objectives of cash management:

- ensuring sufficient cash is available to the firm when it is needed
- accelerating net cash flows (by "speeding up" cash inflows and "slowing down" cash outflows)
- improving cash utilization through careful investment of excess or otherwise idle cash

"Cash flow" in a financial sense is often defined as the firm's net income after adding back expense items which do not use funds in the current period, such as depreciation. It may also involve the deduction of revenue items which do not currently provide funds, such as amortization of deferred income (Mason, 1961).[2] The concept of net cash flow as the amount of resources or funds made available after meeting current requirements of revenue earning operations is a valid and useful tool in the field of cash management. Cash flow analysis is useful in:

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[2] This is a somewhat simplified definition of cash flow. Investment and financing activities of a firm also contribute to a firm's net cash flow. More detailed coverage of the topic of measuring cash flows can be found in most accounting or financial management texts.

- determining debt retirement requirements of the firm.
- maintaining regular dividends to stockholders.
- financing replacement and expansion costs of the firm.

The overall objective of cash management is to provide for the adequate availability and safekeeping of corporate funds under varied economic conditions in order to help achieve desired corporate objectives. (Hill, 1970). In order to meet this objective, financial managers use various tools to measure and monitor the flow of cash within the firm. The development and use of these tools is what the study of cash management is all about.

3. Why Cash Management is Important

There are two major sources of capital employed in the operation of a business. First, there is the "cash fund," which is defined as capital in the form of cash or equivalent assets. Second, there is the "operating fund," which is defined as capital in the form of all other assets from which the company expects to derive its earnings, such as inventories, plant and equipment (National Association of Accountants, 1961). Since the "cash fund" is the most liquid and the least "fixed" of the two sources of capital, and since cash is a non-earning asset, increased efficiency in the management of cash accounts can result in greatly improved earnings for the firm, brought about by reduced operating costs (The Conference Board, Inc., 1961).

There are numerous other reasons cited in literature as to why efficient cash management is important to a firm. The three primary reasons cited are as follows:

- to ensure sufficient cash is available at the time and place needed in order to meet obligations. Failure to do so can impair the firm's credit standing, which in turn can result in the firm being forced to obtain financing on unfavorable terms, and can even result in the firm's bankruptcy (National Association of Accountants, pp. 2-3.).
- to maintain a rate of cash flow which enables the company to keep abreast of technological advances and growth within its industry.
- to provide management personnel the information needed to support decision making concerning the employment of the firm's assets. This type of information is not normally developed in the firm's accounting process of forecasting and measuring periodic income. This is due to the accrual accounting procedures used, wherein receipts and disbursements of cash do not necessarily take place in the same periods in which revenues and costs are recognized.

4. <u>Cash Management Techniques</u>

In order to achieve the objectives associated with efficient cash management, most companies have focused their attention on the following three areas: improved cash forecasts (cash budgeting), tightened control over sources and uses of funds, and sound investment of surplus cash resources (The Conference Board, Inc., 1961).

a. Improved Cash Forecasts

Most successful corporations have, over a period of time, developed their own plans for determining what funds will be needed to run their companies. In financial management literature, such plans are known as forecasts (Hill, 1970). In some literature, these forecasts are called cash budgets. Forecasts serve a variety of purposes in the management of cash within a company. Specifically, the cash forecasts can be useful in the following areas (National Association of Accountants, 1961):

- determining funds available for future growth and expansion.
- identifying ways of improving rate of return on assets.
- identifying funds available for temporary investment.
- determining working capital requirements.
- planning for payments to both shareholders and creditors.

There are two basic types of cash forecasts used in most corporations, short-term forecasts and long-term forecasts (Hill, 1970).

(1) Short-Term Forecasts. Short-term cash forecasts (cash budgets) are used primarily to determine short-term financing needs, and usually cover a period of not more than one year (The Conference Board, Inc., 1961). These forecasts are also used in determining cash operating requirements, short-term financing needs, cash availability for temporary investments, and high and low points in the corporate cash cycle (Hill, 1970). Although the detailed procedures for developing short-term cash budgets are beyond the scope of this thesis, financial literature cites two primary methods for developing these forecasts. The first is the Cash Receipts and Disbursement Method, and the second is the Adjusted Net Income method.

Under the Cash Receipts and Disbursements method, the financial manager attempts to project all cash items to be received or disbursed, including operational and non-operational items, items that arise from the projected purchase or sale of assets, and items that indicate increases or decreases in either creditor or equity investment in the corporation (Hill, 1970). This form of cash forecast tends to be most useful in managing the day-to-day control of cash.

The Adjusted Net Income method projects changes in the balance sheet, particularly in the working capital items. Estimated profit is adjusted for changes that affect cash such as receivables and inventory, and for non-operating changes such as capital expenditures. Further adjustments are made for non-cash items such as depreciation expenses to arrive at the final cash forecast figures. This method tends to be more accurate than the Cash Receipts and Disbursements method when estimating the cash position for forecasts of a quarter or longer (Hill, 1970).

(2) Long-Term Forecasts. Long-term or long-range forecasts are not as detailed as the short-term forecasts, and generally cover a period of time of anywhere from three to ten years (The Conference Board, Inc., 1961). They are used to forecast the effect of the company's long-range plans on the company's future balance sheets (The Conference Board, Inc., 1961). They tend to be very general in nature, and attempt to show only the more significant changes on the balance sheet caused by major acquisitions, the introduction of new products, and the long-term growth of the corporation (Hill, 1970).

b. Control Over Sources and Uses of Funds

Numerous ways of improving control over sources and uses of funds have been developed. These improved control techniques all contribute to a more efficient use of cash within the corporation. The following practices are used by the more efficient corporations in managing and conserving cash flows:

- speeding up collections
  - the use of lock boxes
  - area concentration banking
- tightening control over inventories and inventory policies
- scheduling of payables

c. Investing Surplus Cash

Most firms, after developing a cash management plan that minimizes the amount of cash that must be kept on hand, still experience seasonal peaks and valleys in demand for cash. At times these firms find that they have an excess of cash on hand. Sound investment of excess cash has become a standard practice in most larger firms. Normally this excess cash is invested in short term instruments—usually those that mature in less than one year (The Conference Board, Inc., 1961). The actual type of instrument used will normally depend on the length of time the securities are expected to be held, which in turn depends on the seasonal peaks and valleys in the firm's demand for cash. The financial manager will select those instruments whose liquidity and maturity patterns best suit the company's needs. The following are examples of the types of instruments often used by companies for investing excess cash (Brigham, 1986):

- U.S. Treasury Bills

- Commercial paper
- Negotiable certificates of deposit
- Money market mutual funds
- Floating rate preferred stock mutual funds
- Eurodollar market time deposits
- U.S. Treasury notes
- U.S. Treasury bonds
- Corporate bonds
- State/municipal obligations

B. CASH MANAGEMENT AND OPTAR ALLOCATION

Having looked at the concept of cash management in the civilian sector, parallels can be drawn between the problems faced by civilian managers in properly budgeting for cash outlays, and the problems faced by Navy budgeting personnel in allocating OPTAR funds to subordinate commands. Before looking at the similarities, a brief overview of OPTAR funds, including the general flow of these funds, is in order.

1. The Flow of Funding Within the Department of the Navy

This thesis focuses on the allocation of OPTAR funds to ships of the operating forces. The OPTAR monies allocated to individual ships originate from within the O&M,N (Operation and Maintenance, Navy) accounts of the Annual Budget of the United States, and a brief explanation of the flow of these funds follows. The explanation is somewhat simplified for greater ease in understanding the general flow.

Following appropriation of funding by Congress and apportionment of these funds to the Secretary of Defense by the President's Office of Management and Budget (OMB), all Navy O&M,N funds flow first through the Office of the Comptroller of the Navy (Assistant Secretary of the Navy for Financial Management), and are then allocated to the Chief of Naval Operations (CNO) Comptroller. The CNO's comptroller (OP-92) administers and reallocates the funds to the next levels of responsibility, known as "major claimants."

The "major claimants" are the higher echelon commanders within the Navy who are responsible for managing their forces within the prescribed limits of the assigned allocation. The allocation assigned represents a legally binding spending limitation that the major claimant must ensure is not exceeded. The Navy's fleet commanders, Commander in Chief Atlantic Fleet (CINCLANTFLT) and Commander in Chief Pacific Fleet (CINCPACFLT), are the major claimants for for all operating forces under their operational command. The major claimant for Pacific fleet surface ships is CINCPACFLT.

The next step in the flow of funds is the issuance of an "expense limitation" by the major claimant to the subordinate type commanders (Department of the Navy, 1974). For the ships studied in this thesis, the type commander is Commander Naval Surface Forces Pacific. Commander Naval Surface Forces Pacific (COMNAVSURFPAC) is responsible to CINCPACFLT for the financial management of all forces under his command.

From the expense limitation provided by the fleet commander, COMNAVSURFPAC assigns each ship under his administrative command an "Operating Target" (OPTAR). An OPTAR is an estimate of the amount of money which will be required by the ship to perform the tasks and functions assigned during the fiscal year (Department of the Navy, 1974). The ships are treated as cost centers and their OPTAR expenditures are monitored very closely by the type commander. Since the assigned OPTAR is an administrative spending limit and is not legally binding, by monitoring the expenditure of OPTAR by units under his command, COMNAVSURFPAC is able to redistribute available funds throughout the fiscal year in order to ensure that they are spent where they are most needed. Thus the term Operating Target is quite descriptive—the money figures provided to the individual ships are indeed only "target" amounts.[3]

At the type commander level, the fiscal and budget personnel are careful to ensure that the total amount of the expense limitation assigned by the major claimant for the operation and maintenance of assigned units is not exceeded. However, within this aggregate figure, they have the flexibility to use funds where they are most needed, and

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[3]Although a ship's OPTAR is not a legally binding limit on spending, most ships attempt to remain within the limits of the OPTAR figures imposed by the type commander. Failure to remain within these limits, or excessive requests by the ship for OPTAR augments or loans, are considered by superiors in the chain of command to be indicative of inefficient management of financial resources at the shipboard level.

are able to redistribute excess funds as necessary throughout the fiscal year to units having legitimate unfunded requirements.

2. OPTAR Allocation by COMNAVSURFPAC

The procedures used by COMNAVSURFPAC in allocating OPTAR amounts to assigned units is relatively straightforward. Using historical data on operating costs for the various classes of surface ships assigned, each ship is assigned an annual operating cost estimate. These estimated operating costs are generally the same for all units within a given ship class. The amounts assigned to ships within a class may vary somewhat when an individual unit has configuration differences (different weapons systems or electronics suites), or when other factors tend to differentiate the unit (overseas homeporting, need for habitability upgrade, etc). By and large, these differences in estimated annual operating costs are minor.

The estimated annual operating cost for the assigned ships becomes the basis for each ship's annual OPTAR amount. This annual OPTAR figure is divided into fourths and allocated to the ships on a quarterly basis. In general, there are no attempts made to allocate the annual OPTAR on the basis of anything other than a straight one-fourth per quarter basis.

Historical data has shown that the ships do not necessarily obligate their assigned OPTAR at such an even rate. The graphs contained in Appendix C show the uneven rate at which ships obligate their OPTAR funds. In any given quarter a ship may also experience funding needs that exceed their quarterly allocation. These situations are dealt with on a case basis by COMNAVSURFPAC budget personnel in one of two ways. First, a ship requiring excess funds may request an advance, or a redistribution of funds from next quarter's OPTAR allocation to this quarter. This is basically a "loan," and reduces the amount of OPTAR that the ship will receive in follow-on quarters without impacting on the overall annual OPTAR amount. Second, COMNAVSURFPAC has the option of granting the ship an OPTAR augment. An OPTAR augment is an increase in overall OPTAR allocation with no effect on succeeding quarter's OPTAR. The net effect is an increase in both the OPTAR allocation for the quarter, and an increase in the ship's annual OPTAR allocation. COMNAVSURFPAC normally uses OPTAR advances to help ships meet funding shortfalls when they occur. OPTAR augments are generally reserved for cases involving unidentified or short-fused requirements that the ships would have been unable to plan and budget for. Funding augments to a ship's OPTAR are made from an Augment Reserve fund maintained by COMNAVSURFPAC for just such contingencies.

At the end of the fiscal year, COMNAVSURFPAC redistributes excess funds as necessary and as available, in order to ensure that O&M,N funds granted by CINCPACFLT are used efficiently and effectively where they are most needed. Normally, any excess funds are used to augment ship's OPTARs in order to take care of high priority unfunded requirements still pending at the end of the fiscal year. If there are insufficient unfunded requirements, then excess funds remaining toward the end of the fiscal year may be returned by

COMNAVSURFPAC to CINCPACFLT for reprogramming or redistribution to other type commanders.

3. <u>The Cash Management Problem Revisited</u>

COMNAVSURFPAC manages the OPTAR accounts for over 160 assigned surface ships. In fiscal year 1986 the COMNAVSURFPAC Spending Plan Summary budgeted over $200 million dollars for ship operations and maintenance. Allocating and monitoring the expenditure of these funds is the responsibility of the COMNAVSURFPAC Force Comptroller, assisted by the Fiscal Officer and his budget staff. The problems facing these personnel are not unlike those problems facing civilian executives who must deal with cash management in large corporations. Certain aspects of managing these accounts are similar to the cash management problems encountered in a civilian firm.

The expense limitation provided to COMNAVSURFPAC by CINCPACFLT for the purpose of operating and maintaining the assigned ships can be viewed as the "cash" asset account.[4] This figure represents how much money is to be spent by all of the ships assigned to COMNAVSURFPAC over the entire fiscal year. How this money is allocated and budgeted for expenditure by the assigned ships is a problem faced by the COMNAVSURFPAC staff.

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[4]It should be pointed out that no cash is actually involved, rather funds are set aside into various "accounts." When funds are allocated to the type commander (COMNAVSURFPAC) by CINCPACFLT, or by COMNAVSURFPAC to individual ships, it is merely these accounts that change hands.

The primary objectives of cash management within a civilian firm are to ensure cash availability when and where needed throughout the fiscal year and to provide for the most efficient use of the firm's cash assets. These objectives apply equally as well to the management of the OPTAR accounts for the ships assigned to COMNAVSURFPAC. Proper allocation and budgeting of available OPTAR funds ensures the most efficient use of these assets, and also ensures that funding is available to ships when and where it is most needed.

Proper cash management procedures within civilian firms usually include provisions for providing management personnel with critical feedback information needed to support decision-making with respect to the firm's cash assets. At COMNAVSURFPAC this is accomplished through close monitoring of each ship's monthly Budget OPTAR Report (BOR). This report is discussed further in the next chapter, and is mentioned here only to point out that this report allows COMNAVSURFPAC budget personnel to monitor the OPTAR obligation rates for all the ships of the force in order to ensure that the funds are being used correctly and effectively.

Another cash management technique common to civilian firms is the strict control over the sources and uses of cash funds. While COMNAVSURFPAC has little control over the "source" of the OPTAR funds (the expense limitation is always received from CINCPACFLT in the form of annual and quarterly advance planning figures), the Force Comptroller is able to exercise some control over the "uses" of the funds. This is accomplished by controlling who gets what funds initially, and how they are spent throughout the fiscal year. Often funds are granted to a ship and are specifically designated to be spent on certain high-interest programs (like galley improvements and crew's berthing modifications). Additionally, such earmarked funds are often granted to ships during the fiscal year in the form of OPTAR augments. Ship's are also able to take advantage of what are known as "automatic take-up" funds. Automatic take-up funds allow a ship to automatically grant itself an OPTAR augment (without prior notification of or approval by COMNAVSURFPAC) when excessive amounts of money have been spent on pre-designated items such as expendable bathythermographs (XBT's), or tug services (items of operational necessity and high cost which are often difficult to budget for).

One final area in which similarities (and differences) between cash management and OPTAR management can be seen is in the area of budgeting. Cash budgets are an absolute necessity to ensure the most efficient use of a firm's cash assets. Businesses go to great pains to attempt to develop both long-term and short-term cash budgets. These budgets, particularly the short-term variety, are laid out in great detail. Every attempt is made to ensure that most accurate data possible is used in the cash budget. Firms attempt to be very exact as to when specific inflows and outflows of cash are going to occur.

COMNAVSURFPAC also budgets for the outlay of the OPTAR funds.[5] However, as mentioned earlier, no real attempt is make to predict precisely when funds will be needed by any specific unit. An annual estimate of operating costs is arrived at for each surface unit, and then this figure is basically "divided by four" and allocated to the unit on a quarterly basis. In looking at the spending data for various classes of ships (as shown in Appendix C and discussed in chapters three and four), it is apparent that ships do not obligate their OPTAR at such a steady, even rate. Unfortunately, there are no algorithms at present that allow budget personnel to accurately predict OPTAR obligation rates or patterns.

The potential problems associated with present budget practices should be obvious. Situations might occur wherein some ships have excess funds in a given quarter, while other ships are in dire need of additional money due to different operational commitments and other factors. This problem is discussed further in the next section.

4. <u>The Need for Efficient OPTAR Allocation</u>

If it were possible to accurately and reliably predict OPTAR obligation patterns for the ships assigned, numerous benefits might accrue to various participants in the budget process. First of all, it is almost certain that OPTAR money would be spent more efficiently.

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[5]COMNAVSURFPAC budgets are considered short term, as they are developed on a fiscal year basis only. Long-term budgets, similar to those used in civilian firms, are not used.

Consider the following hypothetical (and greatly simplified) example.

Assume ships A and B are both granted $1000 to spend this week, without regard to their actual needs. Ship A is recently out of overhaul, is in excellent material condition, and is not due to deploy for another six months. Ship B, on the other hand, has been out of overhaul for three years, is in fair material condition, and is deploying next week for a six month tour of duty overseas. In preparation for its upcoming operation, ship B immediately spends all its OPTAR funds on critical repair parts, but is still in need of an additional $500 to cover pre-deployment expenses. Ship A, which really only needs $500 this week, knows that if it fails to spend the assigned OPTAR funds, it may "lose" them (Ship A's superior might take back the surplus funds). Ship A therefore spends the money on items that may be needed six months from now when it deploys. Now ship B is forced to borrow against next week's OPTAR funds in order to pay for this weeks needs. The bottom line is that one ship runs a "deficit" for this week while the other "breaks even," even though it probably should have shown a surplus that would have covered the first ship's deficit. The inefficiency here is obvious. Given the two objectives of providing funds when and where they are most needed and ensuring that all funds are spent efficiently, it is easy to see that the method of budgeting used in the example above could easily preclude achievement of these objectives.

Although difficult to quantify, and of little significance to budget personnel at the COMNAVSURFPAC level, there is also the issue of interest payments that the United States government must pay on all borrowed money. When appropriated money is spent inefficiently at lower levels of government (or the military), the inefficiency contributes to increased government debt. Somewhere along the line the government must borrow to pay the obligations made by the hypothetical ships in the above example. Because Ship A spent its surplus $500 on items it did not immediately require, the additional $500 needed by ship B had to be borrowed. The borrowed funds mean higher interest payments by the government, and increased debt. With this in mind, it stands to reason that large sums of money might be saved each year by the federal government if all levels and branches of the government were able to more efficiently schedule their "cash" outflows.

It is with these ideas in mind that the following thesis study was undertaken. The remainder of this thesis focuses on attempting to determine whether or not there are discernable patterns in ship's OPTAR obligation rates, and if so, what factors influence these patterns.

III. DATA COLLECTION

A. SELECTION OF SHIP CLASSES TO BE EXAMINED

Two ship classes were selected for study in this thesis, the BELKNAP class cruiser and the KNOX class frigate. The two classes are representative of both ends of the maintenance cost spectrum.

The BELKNAP (CG-26) class cruisers represent the high end of the cost spectrum. These large and relatively complex steam powered warships are equipped with Standard surface-to-air missiles, Harpoon anti-surface missiles, guns, and various anti-submarine weapons. They are fitted with NTDS (Navy Tactical Data System) data link capabilities that allow them to inte-grate well into an aircraft carrier battle group. The primary mission of these ships is anti-air warfare (AAW), and they were specifically designed to operate in an AAW role in support of aircraft carrier battle groups.

The KNOX (FF-1052) class frigate represents the low end of the cost spectrum. These relatively small, steam powered warships are not as sophisticated as their cruiser counterparts. They are equipped with a single five inch gun, Harpoon anti-ship missiles, the close-in weapon system (CIWS), and various anti-submarine weapons and sensors. They are not equipped with any sort of data link capability, and thus do not integrate as well into a carrier battle group as do the cruisers. The primary missionof the frigate is anti-submarine warfare (ASW), and the ships were specifically designed as anti-submarine escorts for convoy operations. When operating in support of a carrier battle group, frigates are normally employed in an ASW role, and are assigned screening stations around the carrier for the purpose of detecting enemy submarines.

B. SPECIFIC SHIPS CHOSEN FOR STUDY

Information was obtained from the COMNAVSURFPAC staff for Pacific fleet units only. In the case of the BELKNAP class cruisers, only five such ships are assigned to Pacific fleet, and all five were included in this study. Table I lists pertinent data for the five cruisers studied.

TABLE I

SHIPS' GENERAL INFORMATION CRUISERS

Ship Name	Hull Number	Homeport	Unit Identification Code
USS Fox	CG-33	San Diego	52708
USS Horne	CG-30	San Diego	52705
USS Jouett	CG-29	San Diego	52704
USS W.H. Standley	CG-32	San Diego	52707
USS Sterett	CG-31	Subic Bay	52706

Source: Tab A to Appendix 15 to Annex C to COMNAVSURFPAC OPORD 201

Over 20 KNOX class frigates are assigned to Pacific fleet, so it was necessary to select a small sample of these ships for study. Ten frigates were chosen to be examined. The selection of these ships was random with the exception of the four ships homeported in Yokosuka, Japan. These ships were specifically included in the sample in order to collect data as to whether overseas homeporting has any effect on ship operating and maintenance costs. Table II contains a listing of the KNOX class frigates studied, along with pertinent data.

TABLE II

SHIPS' GENERAL INFORMATION FRIGATES

Ship Name	Hull Number	Homeport	Unit Identification Code
USS Badger	FF-1071	Pearl Harbor	54066
USS Cook	FF-1083	San Diego	20054
USS Downes	FF-1070	San Diego	54065
USS Fanning	FF-1076	San Diego	54071
USS F. Hammond	FF-1067	Yokosuka	54062
USS Kirk	FF-1087	Yokosuka	20058
USS Knox	FF-1052	Yokosuka	54047
USS Lockwood	FF-1064	Yokosuka	54059
USS Stein	FF-1065	San Diego	54060
USS Whipple	FF-1062	Pearl Harbor	54057

Source: Tab A to Appendix 15 to Annex C to COMNAVSURFPAC OPORD 201

C. DATA COLLECTION AND CONVERSION

All data and other information collected for this study was obtained from the COMNAVSURFPAC staff files. Two categories of information were collected. First, schedule information was obtained from the Current Operations Office (code N321). For each ship in the study, scheduling and employment data was gathered from the Quarterly Employment Schedules for the fiscal years 1985 and 1986. Next, OPTAR expenditure information was collected from the office of the COMNAVSURFPAC Force Comptroller (code N72). The monthly OPTAR obligation data was extracted from the monthly Budget OPTAR Reports (BOR's) for each of the ships in the study for the fiscal years 1985 and 1986.

In order to put the scheduling and OPTAR information in a format suitable for analysis, some conversion of the schedule data was necessary.

The monthly BOR provides a great deal of information concerning the obligation of each ship's OPTAR funds, including a breakdown of these expenditures in ten-day increments. Because the spending information was broken down into ten-day increments, it was necessary to break down the ships' employment information into ten-day periods as well. This was done by identifying the eight[6] most common ship employment categories, and then analyzing each ship's schedule to determine which of these employment categories was most appropriate for each ten-day period in the ship's schedule. The

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[6]Six of the eight employment categories used in this study are similar to the categories used by the COMNAVSURFPAC budget staff for their internal analysis of OPTAR expenditure data. They do not use the two categories of "Training" (TRNG) and "Overhaul" (OVHL) which are included above. Additionally, the COMNAVSURFPAC budget staff has a separate category for the ship's Operational Propulsion Plant Examination (OPPE) which for this study has been placed in the category of "Inspections" (INSP).

eight primary employment categories used in this analysis are described in Table III.

TABLE III

EIGHT MAJOR EMPLOYMENT CATEGORIES

Category	Code	Explanation/Remarks
Maintenance	MAINT	Tender Availability or other maintenance periods
Deployment	DEPL	Scheduled deployment periods overseas
Upkeep	UPKP	Routine inport periods in CONUS
Training	TRNG	Refresher and other Training periods
Exercises	EXER	At-sea exercise periods (Fleetex, COMPTUEX, etc.)
Inspections	INSP	All inspection periods (NTPI, OPPE, etc.)
Underway	U/W	At-sea periods for local ISE ops or transits
Overhaul	OVHL	Regularly scheduled ship overhaul periods

The converted ship scheduling information for each ship in the study is contained in Appendix A to this thesis. This appendix lists each ship's primary employment for each ten-day period for each month in both fiscal years studied (the three ten-day periods are referred to as "Period 1," "Period 2," and "Period 3"). In addition to the primary employment information, the appendix lists the total number of days each ship was underway during the month (under the column headed "DAYS U/W").

The OPTAR obligation information for each ship in the study is contained in Appendix B to this thesis. This appendix lists each ship's OPTAR expenditures for each month of the two fiscal years studied. Again, the information is broken down into three ten-day periods for each month. Monthly totals are contained in the final column, as are total annual expenditure figures.

Having collected the necessary data and converted it into a format useful for analysis, the next step was to conduct an analysis of the information in an attempt to determine what, if any, patterns exist in the OPTAR obligation rates for the ships examined, and what factors influence OPTAR expenditure.

IV. ANALYSIS OF DATA

A. DESCRIPTIVE STATISTICS

In analyzing the data contained in Appendices A and B, the first step was to conduct a brief overview of the appropriate descriptive statistics. The following sections describe the data for the two classes of ships involved.

1. KNOX (FF-1052) Class Frigates

Four of the ten frigates involved in the study were homeported overseas (in Yokosuka, Japan). As mentioned previously, these four ships were deliberately included in the sample in order to study the effect of overseas (foreign) homeporting on ship operating costs. The remaining six ships were homeported in U.S. ports, five in the continental United States, with the remaining unit in Pearl Harbor, Hawaii.

Over the two year period studied, each frigate obligated, on the average, approximately $1.095 million dollars in OPTAR funds in each fiscal year. Interestingly enough, the ships obligated more money in fiscal year 1985 than they did in fiscal year 1986. The mean annual OPTAR expenditure for fiscal year 1985 was $1.191 million dollars, while the mean for fiscal year 1986 was only $997,000 per ship. The data were widely spread about these means in both years, with a standard deviation in 1985 of over $68,000 and in 1986 exceeding $108,000.

The average monthly OPTAR obligation amount over the two years studied was $92,103. Again, however, the data were very widely dispersed about this mean, with a standard deviation of $50,380.

The monthly OPTAR obligations over the two-year period for the frigates studied appear to be fairly normally distributed. The histogram in Figure 1 shows the distribution for the monthly OPTAR obligations for the Frigates included in the study.

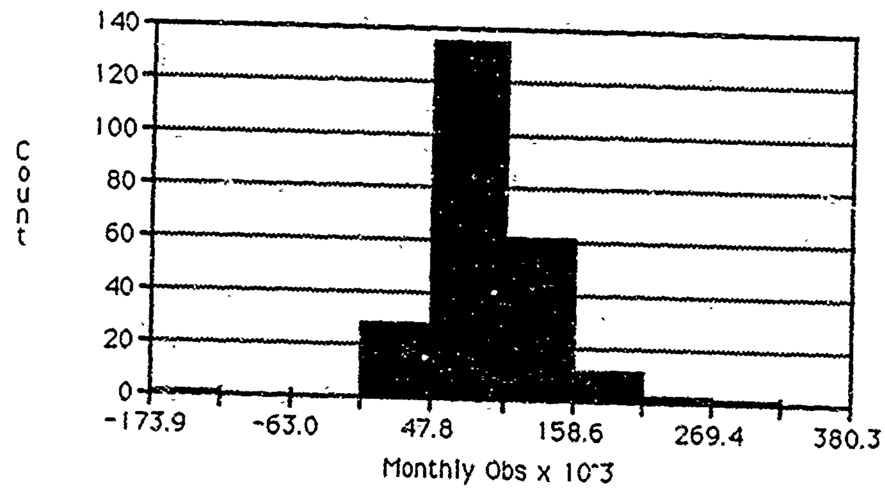

Figure 1

Histogram of Monthly OPTAR Obligations for Frigates

In analyzing the OPTAR obligation data, the monthly obligation amounts for each ship were also converted to percentages of total annual OPTAR obligated. The distribution patterns were, as expected, similar to the patterns observed for the aggregates (above). The average monthly percentage of total annual OPTAR expended was approximately 8.4% (with a rather large standard deviation of 4.5%). This mean of 8.4% is what would be expected for a normal distribution in which each ship is "on the average" obligating approximately one-twelfth (8.33%) of its annual OPTAR each month.

When the annual OPTAR obligations were initially examined, the distribution did not appear to be normally distributed. Figure 2 shows the histogram of annual OPTAR obligations for Frigates over the two years studied. Note the bi-modal distribution, and the appearance of a distinct "break" in the data in the $1 million region.

The apparent cause of this abnormal distribution, as well as the "break" in the data, is the fact that the levels of funding allocated to and obligated by the frigates differed over the two years studied. As previously mentioned, the amount of funding provided the ships actually went down between FY 1985 and 1986. The cause for this difference in funding levels is unknown, and is not important for purposes of data analysis.[7] The effects of this differential in funding can be accounted for in the analysis by using "percentage of annual OPTAR expended" as the dependent variable in certain calculations (discussed further in a later section). It is only important to recognize that the annual OPTAR obligations are not normally distributed when viewed over the two-year period as a whole (certain analysis techniques are only meaningful when data is normally distributed).

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[7]The apparent drop in obligation levels from fiscal year 1985 to 1986 was a function of budgetary constraints. The amount of OPTAR allocated to the ships was larger in 1985 than it was in 1986.

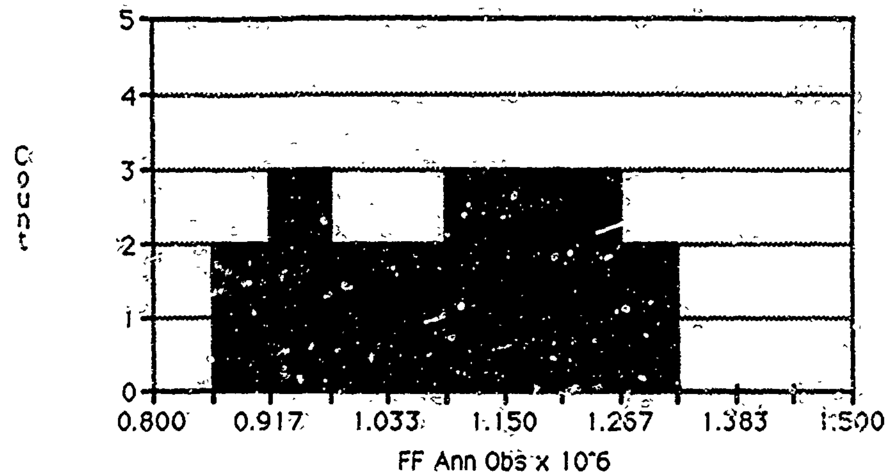

Figure 2

Histogram of Annual OPTAR Obligations Frigates (1985-1986)

When the histograms are observed for each year on an individual basis, different distribution patterns can be observed. Figures 3 and 4 are the histograms for the annual obligations for FY 1985 and Fy 1986.

Figure 3 shows that the distribution of annual OPTAR obligations for 1985 is somewhat closer to normal. The continued presence of distinct "breaks" in the data and the apparent outliers can be attributed to the fact that there is such a small sample size involved (only ten ships). Nonetheless, it is difficult to state for certain whether or not the data is or is not normally distributed.

Figure 4 shows that the annual OPTAR obligations for fiscal year 1986 also do not appear to be normally distributed. The presence of outliers is still evident, and the data is highly skewed to the right.

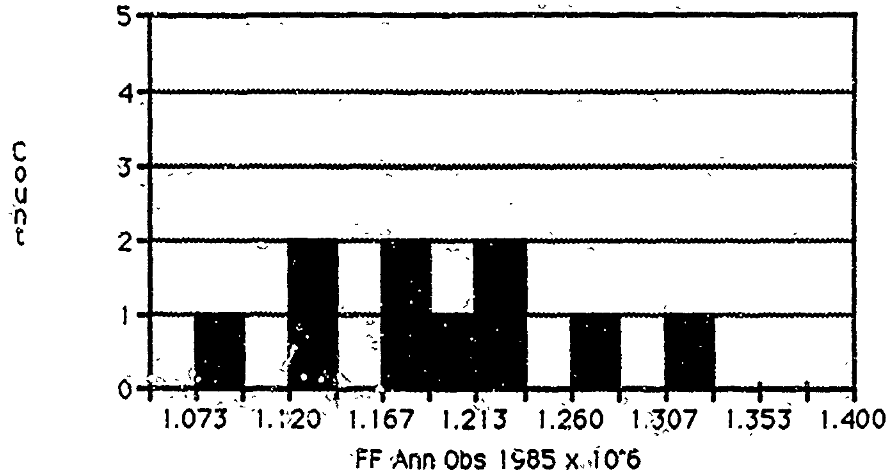

Figure 3

Histogram of Annual OPTAR Obligations Frigates—1985

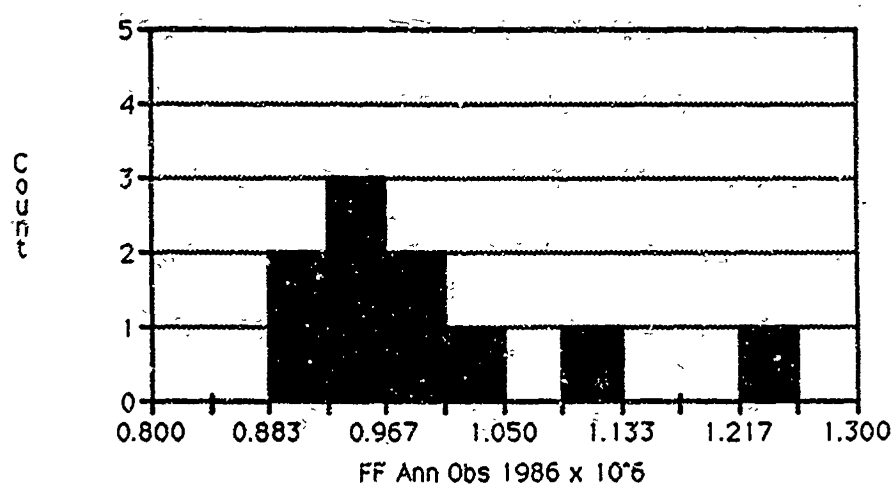

Figure 4

Histogram of Annual OPTAR Obligations Frigates—1986

The number of days underway per month was another variable examined in the analysis. Over the two-year period examined, each ship was underway approximately 11.4 days per month. Again, the standard deviation was relatively high at 8.8 days per month. Additionally, the data was not normally distributed. Figure 5 shows the histogram for the number of days underway per month for Frigates over the two year period studied. As can be seen, were it not for the large number of months in which the ships were underway zero days, the distribution would have appeared to approximate a normal distribution much more closely. With this in mind, an attempt was made to "normalize" the distribution by removing select groups of ships that did not get underway during a given month.

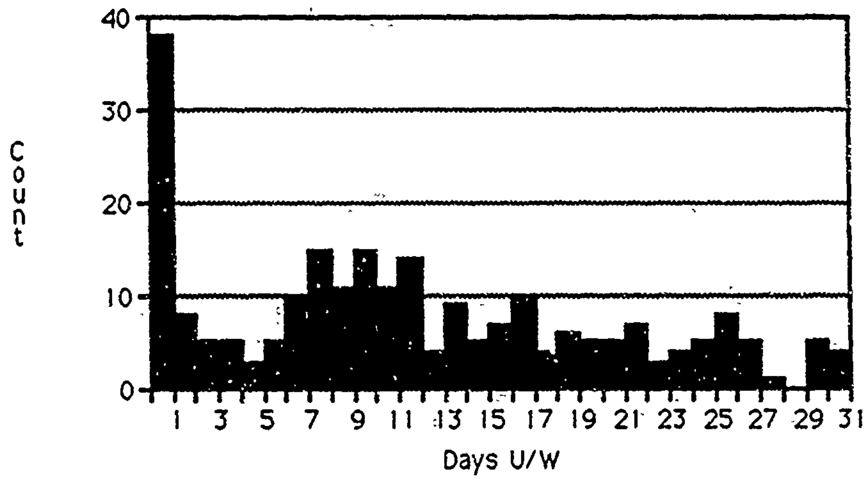

Figure 5

Histogram of Days U/W per month Frigates (1985-1986)

The first step was to remove all ships from the data set who were in overhaul for all or part of any month in which the ship did not get underway. When this was done, very little improvement was noted in the distribution in terms of making it more "normal." There were still a large number of months in whichships had zero days underway, so an additional step was taken in an attempt to smooth the data and obtain a more normal distribution.

This next step involved removing from the data set all ships that were either in regular overhaul or in a Selected Restricted Availability (SRA)[8] during any month in which the ship had zero days underway. As can be seen from the histogram below (Figure 6), removal of this data still had no appreciable effect on improving the normality of the distribution.

As a last resort, all data points for ships that had no underway days in a given month were removed from the data set, regardless of the reason the ship did not get underway during the month. The histogram for this data set (Figure 7) finally showed some improvement in normalizing the distribution.

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[8]Selected Restricted Availability (SRA) is a scheduled maintenance period in which the ship is normally in a repair status and unable to get underway for anywhere from two to three months. The maintenance period is normally conducted in the ship's homeport, and involves both tender and shore based maintenance support, often including local shipyard participation. The SRA is often viewed as a "mini-overhaul."

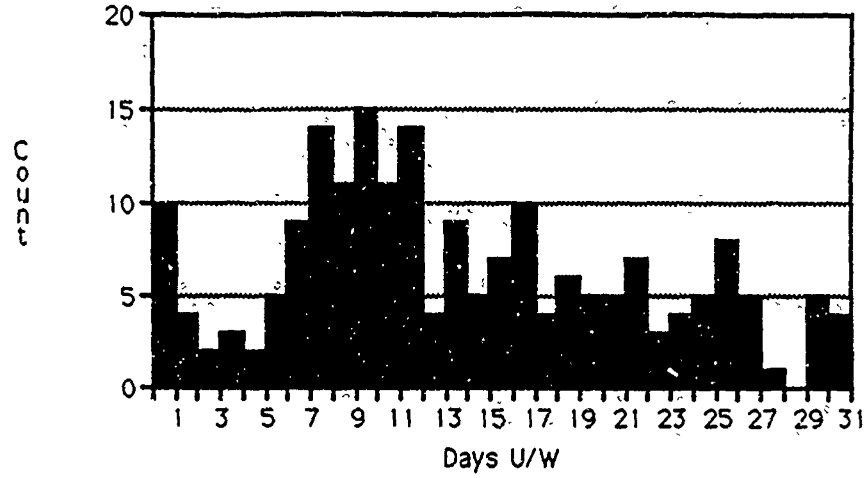

Figure 6

**Histogram of Days U/W per month
Frigates (1985-1986)
(less ships in Overhaul or SRA)**

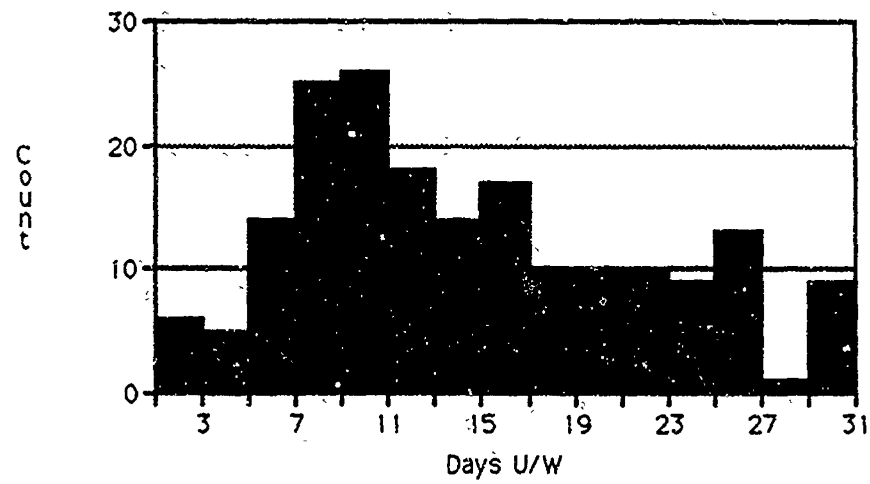

Figure 7

**Histogram of Days U/W per month
Frigates (1985-1986)
(less all ships with zero u/w days in a given month)**

The final variable examined in the analysis was the number of months since last regular scheduled overhaul. For the Frigates included in this study, the average number of months since last overhaul was 26, with a standard deviation of 19 months. The histogram of this variable is as shown in Figure 8. It should be noted that the distribution of months since last overhaul is non-normal and skewed right.

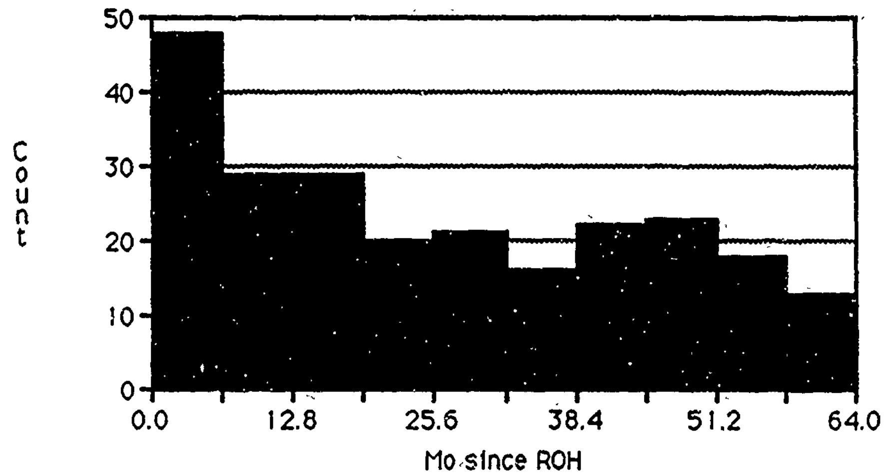

Figure 8

Histogram of Months since last Overhaul Frigates (1985-1986)

The skewness of the above distribution can be partially explained by the fact that within the data, there were several ships that were undergoing overhaul within the two-year period examined. During any given month in which a ship was undergoing a scheduled overhaul, the ship was assigned a value of zero for the variable "months since last overhaul." This had the effect of skewing the data somewhat to the right. Were it not for this induced skewness, the data would have been more normally distributed, but probably not enough to be considered a true normal distribution.

2. BELKNAP (CG-26) Class Cruisers

As stated previously, all five of the BELKNAP class cruisers assigned to the U.S. Pacific Fleet were included in the study. One of the cruisers was homeported overseas (Subic Bay, PI), while the remainder were assigned to homeports in the continental U.S.

As can be seen from the data in Appendix B, the cruisers were considerably more expensive to operate than the frigates. Over the two year period studied, each cruiser obligated, on the average, $2.87 million dollars per year for operations and maintenance expenses. Just as was the case for the frigates, the cruisers also obligated more in fiscal year 1985 than they did in fiscal year 1986. The mean annual OPTAR expenditure for fiscal year 1985 was $3.11 million dollars, while the mean for fiscal year 1986 was $2.63 million dollars per ship. The standard deviation was $430,000 in 1985 and $374,000 in 1986.

The average monthly OPTAR obligation for cruisers over the two year period studied was $239,436. The data were widely dispersed about this mean, with a standard deviation of over $116,000.

The monthly OPTAR obligations over the two year period for the cruisers studied appear to be fairly normally distributed. The histogram in Figure 9 shows the distribution for the monthly OPTAR obligations for cruisers in the study.

The monthly OPTAR obligation data for each cruiser was also converted to percentage of total annual OPTAR obligated. The average monthly percentage of total annual OPTAR expended was approximately 8.33% (with a standard deviation of 3.945%). The mean of 8.33% is what would be expected for a normal distribution in which each ship is "on the average" obligating approximately one-twelfth (8.33%) of its annual OPTAR each month.

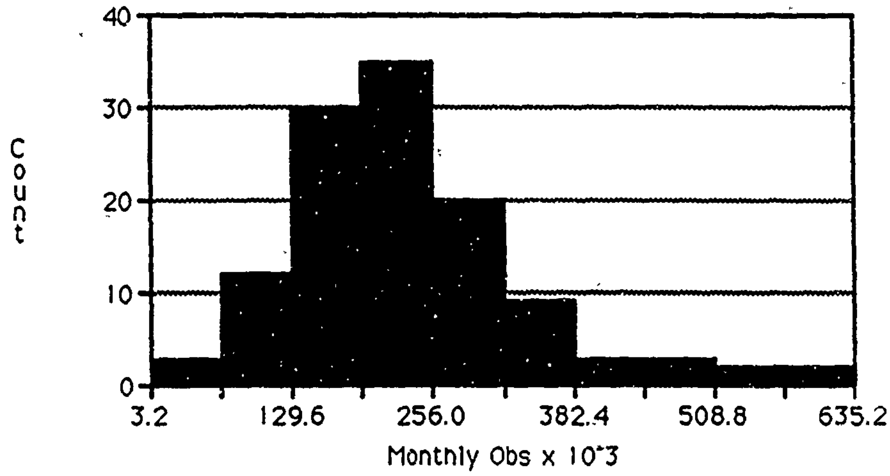

Figure 9

Histogram of Monthly OPTAR Obligations for Cruisers

As was the case with the frigates, when the annual OPTAR obligation totals were examined for the cruisers in the study, the distribution did not appear to be normal. However, with only five cruisers included in the study, there were not enough observations available to make any firm conclusions concerning the distribution of annual OPTAR.

The number of days underway per month was another variable examined in the analysis. Over the two year period, each cruiser was underway approximately 11.13 days per month. Again, the standard deviation was relatively high at 8.8 days per month. Additionally, the data was not normally distributed. Figure 10 shows the histogram for the number of days underway per month for Cruisers over the two year period. As can be seen, were it not for the large number of months in which the ships were underwayzero days, the distribution would have come closer to being normal. With this in mind, the same procedure as was used with the frigates was followed in order to attempt to "normalize" the distribution by removing select groups of ships that did not get underway during a given month.

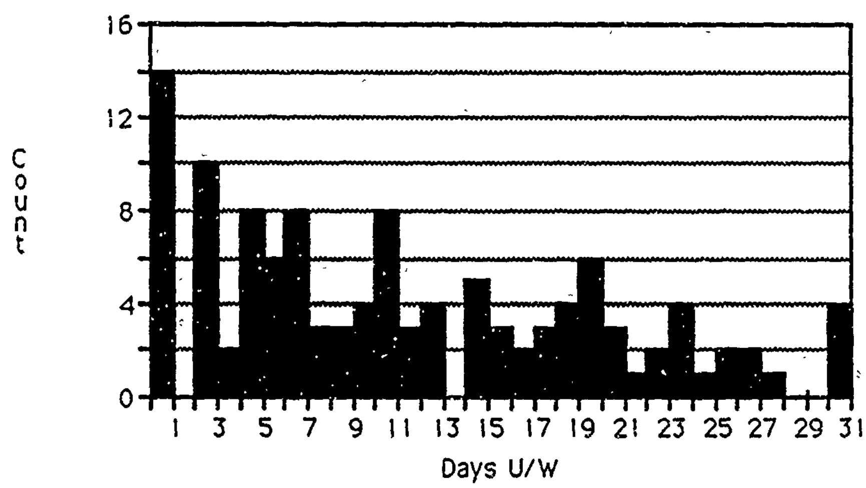

Figure 10

Histogram of Days U/W per Month
Cruisers (1985-1986)

The procedure followed resembled that used in the analysis of the frigates. All months in which a ship did not get underway due to being in an overhaul or SRA status were removed from the data set. The revised data set was more normally distributed, but still appeared to skewed slightly right. Figure 11 shows the histogram for this data set.

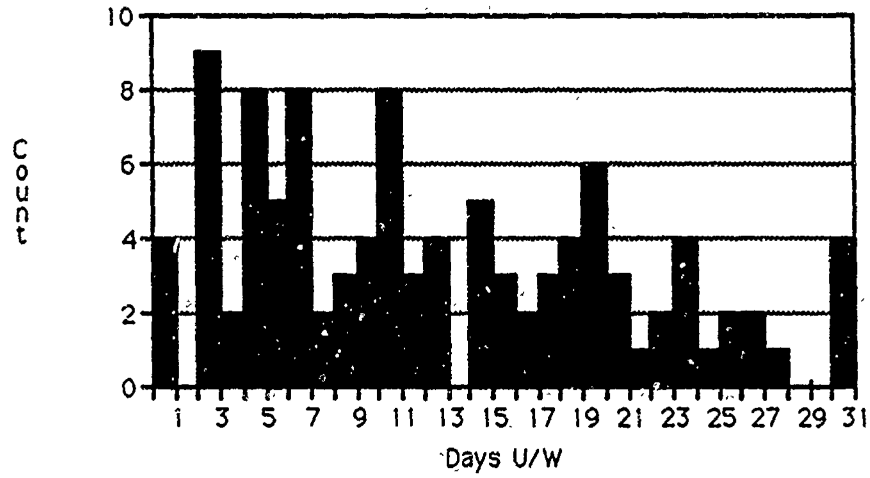

Figure 11

Histogram of Days U/W per Month
Cruisers (1985-1986)
(less Ships in Overhaul or SRA)

The final variable examined in the initial analysis of the cruiser data was the number of months since last regular scheduled overhaul. Figure 12 shows the histogram for this variable.

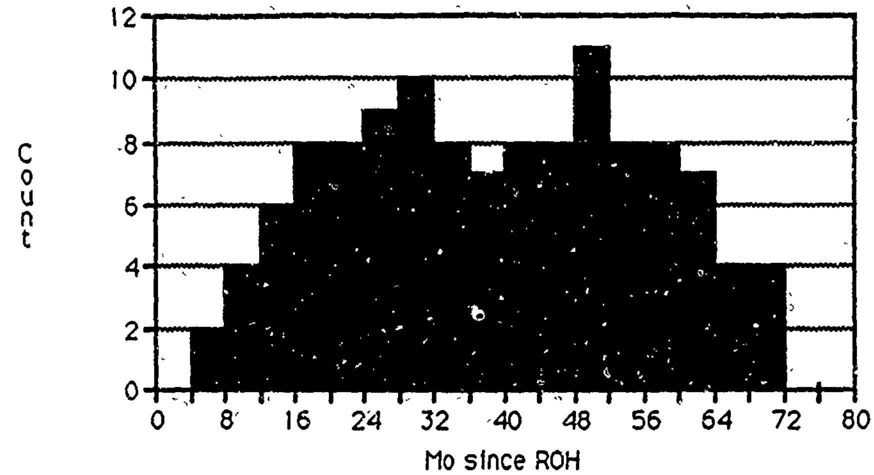

Figure 12

Histogram of Months since last Overhaul
Cruisers (1985-1986)

For the Cruisers included in this study, the average number of months since last overhaul was 38.3, with the standard deviation being 17 months. The data appears to be fairly normally distributed.

Having conducted a brief overview of the data collected for the thesis, the next step was to study the OPTAR obligation patterns and determine their degree of dependence on various employment variables that were available. The first portion of the study involved both simple and multiple regression analysis.

B. REGRESSION ANALYSIS

1. KNOX (FF-1052) Class Frigates

The initial analysis of the KNOX class frigate data revolved around attempting to determine what relationship, if any, exists between monthly OPTAR obligation and the number of days underway in a given month. Since a ship's schedule tends to revolve around its underway periods, it seemed only natural to investigate this relationship first.

First, a simple regression was carried out using "monthly OPTAR obligation" as the dependent variable, and "days underway" as the independent variable. Recall from the previous section that the dependent variable (monthly OPTAR obligation) was fairly normally distributed. The independent variable (days U/W) did not exhibit a normal distribution, but as a starting point in the analysis, this combination of variables was regressed. The following output resulted from this initial regression:

Dependent variable: Monthly OPTAR Obligations
Independent variable(s): Days U/W

Variable name	Coefficient	Std Error	t-ratio
Constant	89897.55	5345.50	16.82
Days U/W	193.67	372.20	0.52

F-Ratio: 0.271

Coefficient of Determination..........................	0.001
Coefficient of Correlation..............................	0.034
Standard Error of the Estimate.............	50461.763
Durbin-Watson Statistic................................	2.106

The above data seems to indicate that monthly OPTAR obligations are not dependent on how many days the ship is underway in a given month. First, the t-ratio for the independent variable is extremely low (as is the F ratio), indicating that this variable is not statistically significant in explaining monthly OPTAR obligations. When the plot of the above variables is examined, there appears to be little statistical relationship between the two variables used in the regression. Figure 13 shows the plot of the dependent versus the independent variable for this initial regression.

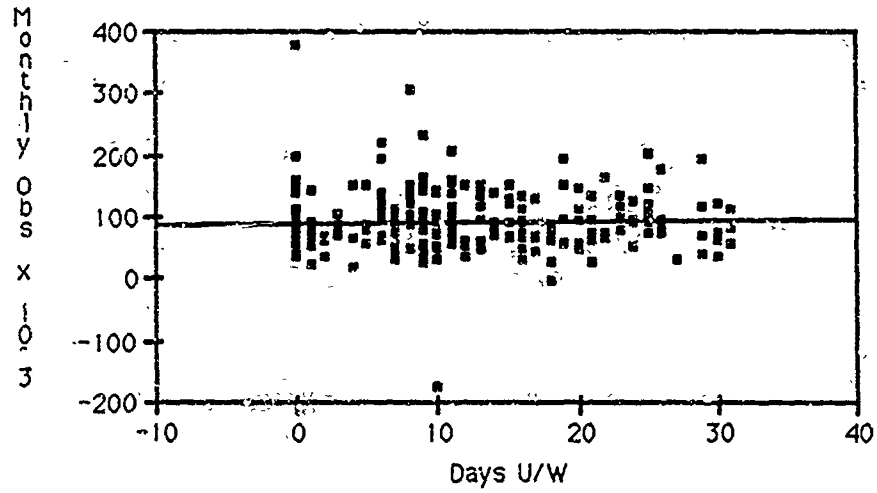

Figure 13

Plot of Monthly OPTAR vs. Days Underway

Note that the regression line resulting from this regression is nearly parallel to the X-axis of the graph. This would indicate that the mean of the dependent variable (Y-bar) is probably just as good a predictor as the regression equation—thus the reliability of the equation is extremely low. The resultant coefficients of determination and correlation support this conclusion.

The next step was to convert the monthly obligations into "percentage of total annual OPTAR obligated," in order to see if the relationship could be improved any by smoothing out any inflationary or deflationary effects of the change in OPTAR allocations over the two fiscal years in the study. When the percentage of total annual OPTAR obligated was regressed against days underway, the following output resulted:

Dependent variable: Percent of annual OPTAR obligated
Independent variable(s): Days Underway

Variable name	Coefficient	Std Error	t-ratio
Constant	8.13	.48	16.81
Days U/W	.02	.03	.70

F-Ratio: .502

Coefficient of Determination.............................. .002
Coefficient of Correlation................................ .046
Standard Error of the Estimate.................... 4.568
Durbin-Watson Statistic.................................. 2.178

As can be seen from the information above, there was no significant improvement in the regression as a result of converting the monthly OPTAR obligation into a percentage of annual OPTAR expended. The t-ratio still indicates that the independent variable (days underway) is not statistically significant in explaining the behavior of the dependent variable (percent of annual OPTAR obligated). The plot of the dependent versus independent variable of this regression is shown in Figure 14.

Again, the regression line shown is nearly parallel to the X-axis, indicating that the regression equation does not explain much of the variation in the dependent variable. The resulting coefficients of determination and correlation remain extremely low, as does the F-ratio.

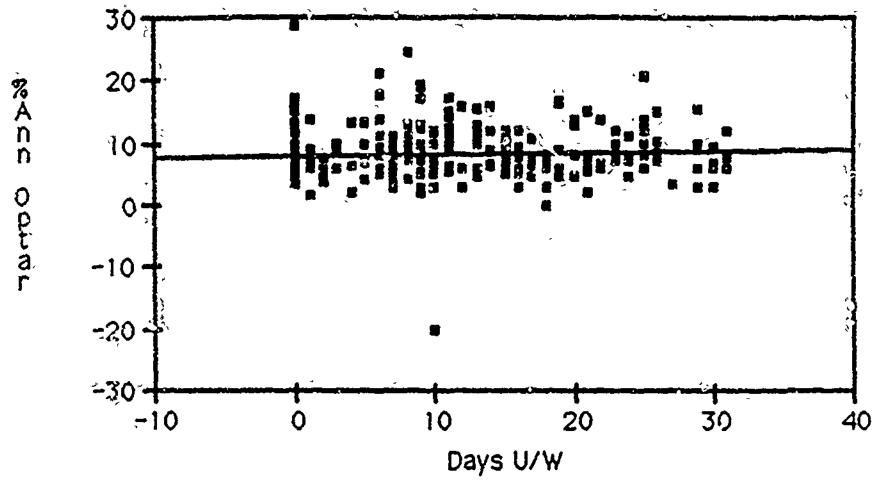

Figure 14

Percent of Annual OPTAR obligated vs. Days Underway

Recall that the independent variable (days underway) was not normally distributed. Attempts were made to normalize this variable in an earlier section of this analysis by removing data points for groups of ships that had zero days underway in a given month. First, the data points for those ships that were in overhaul during the two fiscal years studied were removed from the data set, then ships that were in either overhaul <u>or</u> SRA were removed, and finally, any data point for a ship having zero days underway in a given month was removed from the data set. This manipulation of the data set was done with the idea that perhaps ship spending was dependent on days underway, but only if the ship was in a true "operational" status, and not undergoing overhaul or maintenance which made it impossible for the ship to get underway in a particular month. This hypothesis also proved to be false. The next few iterations of the regression analysis attempted to regress both the "monthly OPTAR obligation" and the "percentage of annual OPTAR obligation" against the independent variable "days underway." The regression output for these iterations were as follows. First, the monthly OPTAR obligations were regressed against the days underway for all data points for which the ships were not in overhaul:

Dependent variable: Monthly OPTAR Obligations
Independent variable(s): Days Underway (less ships in overhaul)

Variable name	Coefficient	Std Error	t-ratio
Constant	87363.66	5812.66	15.03
Days U/W	339.93	384.20	0.88

F-Ratio: 0.78

Coefficient of Determination	0.004
Coefficient of Correlation	0.060
Standard Error of the Estimate	47506.174
Durbin-Watson Statistic	2.102

Again, the outcome of the regression failed to show that monthly OPTAR obligation was related in any way to days underway.

Next, the percent of annual OPTAR obligated was regressed against the days underway for all ships not in overhaul. The resulting regression output was as follows:

Dependent variable: Percent of annual OPTAR obligated
Independent variable(s): Days underway (less ships in overhaul)

Variable name	Coefficient	Std Error	t-ratio
Constant	8.08	0.54	14.90
Days U/W	0.02	0.03	0.76

F-Ratio: 0.58

Coefficient of Determination......................	**0.003**
Coefficient of Correlation..............................	**0.052**
Standard Error of the Estimate....................	**4.431**
Durbin-Watson Statistic..............................	**2.214**

The above output again shows that the dependent variable (percent of annual OPTAR obligated) is not statistically dependent on the independent variable (days underway).

Next, a regression of the same variables was conducted for the data set which excluded all data points for ships that were either in overhaul or undergoing SRA. The regression output (not shown here) also failed to show any relationship between the independent variable (days underway) and either of the two dependent variables (monthly OPTAR obligation and percent of annual OPTAR obligated).

Finally, all data points for ships that had zero days underway in any given month were removed from the data set, and the same simple regression attempts as those above were made. First, the dependent variable "monthly OPTAR obligation" was used, with the following regression output resulting:

Dependent variable: Monthly OPTAR obligation
Independent variable(s): Days U/W (less all data points which include zero-day u/w months)

Variable name	Coefficient	Std Error	t-ratio
Constant	**93928.04**	**7543.61**	**12.45**
Days U/W	**-15.05**	**467.98**	**-0.03**

F-Ratio: 0.001

Coefficient of Determination.........................	**0.000**
Coefficient of Correlation..............................	**0.000**
Standard Error of the Estimate............	**49081.90**
Durbin-Watson Statistic................................	**2.17**

From the above data, it can once again be seen that the independent variable (days underway) is not statistically significant as a predictor of monthly OPTAR obligation. Figure 15 shows the plot of the monthly OPTAR obligation versus the days underway for all data points except those with zero underway days in any given month. The plot shows fairly clearly that there does not appear to be any relationship between the two variables. The nearly horizontal slope of the regression line indicates that the mean of the dependent variable is just as good a predictor of OPTAR obligation as is this particular regression.

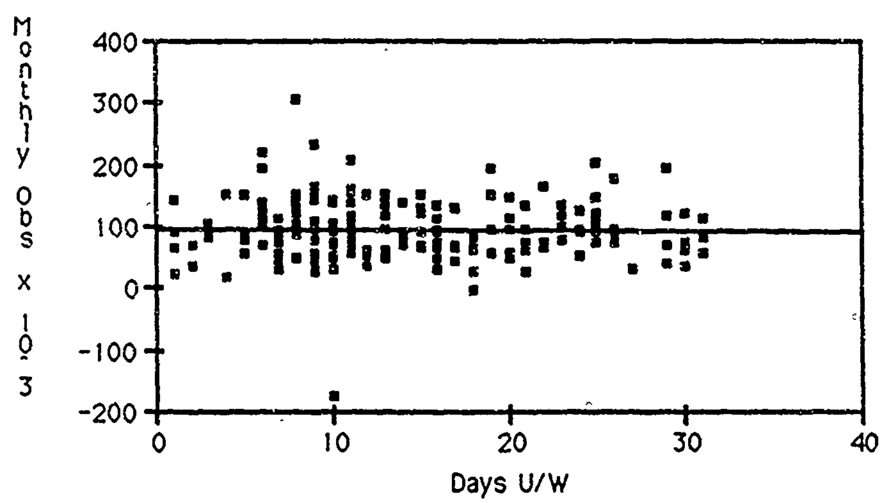

Figure 15

Plot of Monthly OPTAR vs. Days Underway (less data points with zero day u/w months)

When this same data file was used to regress percent of annual OPTAR against days underway, the results were similar to previous regression attempts. The resulting output below again shows no relationship between the two variables. Figure 16 shows the plot of these two variables, and confirms the lack of any firm relationship.

Dependent variable: Percent of Annual OPTAR obligated
Independent variable(s): Days U/W (less all data points which include zero-day u/w months)

Variable name	Coefficient	Std Error	t-ratio
Constant	8.60	.70	12.23
Days U/W	-0.001	.04	-0.03

F-Ratio: 0.001

Coefficient of Determination............................ 0.000
Coefficient of Correlation.............................. 0.002
Standard Error of the Estimate.................... 4.579
Durbin-Watson Statistic................................ 2.311

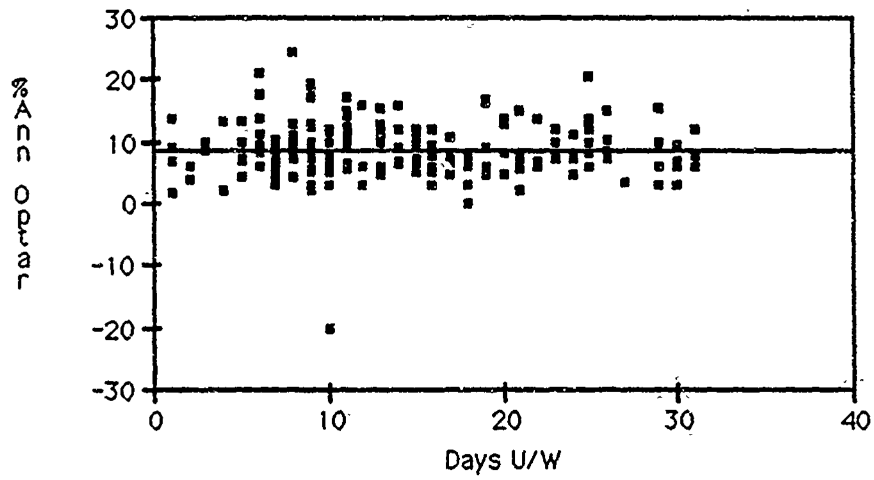

Figure 16

Percent of Annual OPTAR Obligated versus Days Underway (less data points with zero day u/w months)

One final quantitative variable whose relationship to OPTAR was examined was "months since last overhaul." It seemed natural to investigate this variable as it appeared reasonable to assume that the longer the time since a major overhaul, the more a ship might spend to keep equipment functioning and in otherwise maintaining operational readiness. Such proved not to be the case. When both "monthly OPTAR obligation" and "percent of annual OPTAR obligated" were regressed against the variable "months since last overhaul," neither of these two dependent variables could be shown to be statistically dependent on the time since last overhaul. The regression output below is representative of the type of output that resulted from all simple regression attempts when using "months since last overhaul" as the independent variable.

Dependent variable: Monthly OPTAR obligations
Independent variable(s): Months since last overhaul

Variable name	Coefficient	Std Error	t-ratio
Constant	90050.29	5484.18	16.42
Mo. since OVHL	78.68	169.11	0.46

F-Ratio: 0.216

Coefficient of Determination........................ 0.001
Coefficient of Correlation.............................. 0.030
Standard Error of the Estimate............ 50467
Durbin-Watson Statistic................................ 2.104

The plot of these two variables is as shown in Figure 17. Note the nearly horizontal slope of the regression line, again indicating that the mean of the dependent variable is probably as good a predictor as the resulting regression equation. The coefficients of determination and correlation above also bear out this conclusion. It can be safely stated that the amount of OPTAR obligated by a ship in a given month is not statistically dependent upon the number of months since last overhaul for that ship.

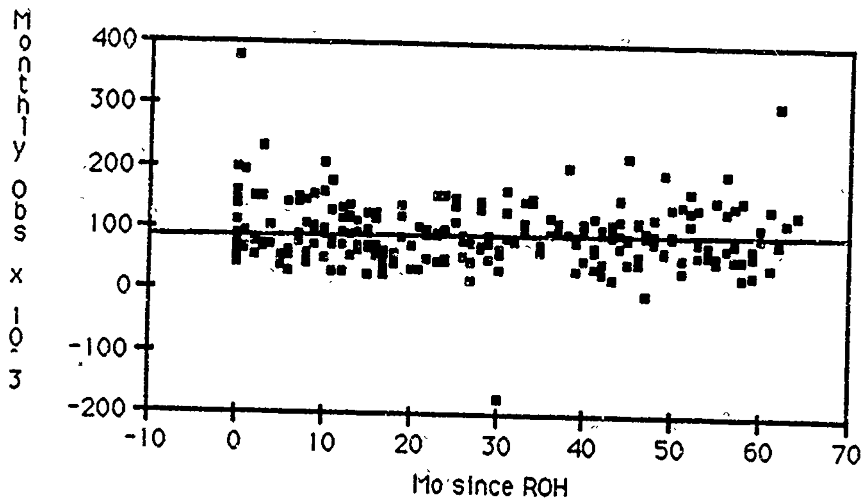

Figure 17

Monthly OPTAR Obligated vs. Months Since Overhaul

Although the variable "months since last overhaul" did not appear to be significant in explaining the behavior in OPTAR obligation when used alone in a simple regression, it was examined further in several multiple regression iterations. The multiple regression studies involved using both "months since last overhaul" and "days underway" as independent variables, with both "monthly OPTAR obligation" and "percent of annual OPTAR obligated" as dependent variables. The results from all multiple regression attempts using these two variables were disappointing, and failed to show a statistically significant relationship between OPTAR and these two explanatory variables. Of all the multiple regressions conducted, the one showing the strongest relationship between variables (although inconclusive) was when "monthly OPTAR obligations" for all ships other than those in an overhaul status were regressed against the two independent variables. This regression resulted in the following output:

Dependent variable: Monthly OPTAR obligation (all ships less those in overhaul)
Independent variable(s): Days underway
Months since last overhaul

Variable name	Coefficient	Std Error	t-ratio
Constant	82090.97	8328.27	9.965
Days U/W	384.46	387.51	0.992
Mo since OVHL	162.58	179.94	0.904

F-Ratio: 0.799

Coefficient of Determination........................ 0.007
Coefficient of Correlation............................ 0.086
Standard Error of the Estimate............ 47526
Durbin-Watson Statistic................................ 2.115

Although the above regression showed one of the strongest relationships for all the regressions conducted for the frigates (note the t-ratios approaching one (1) and the F statistic of .799), the relationships are still extremely weak. Again it can be stated that there is very little statistical relationship between OPTAR obligation and either "days underway" or "months since last overhaul" among the frigates studied.

2. BELKNAP (CG-26) Class Cruisers

The analysis of the BELKNAP class cruiser data followed much the same procedure as that for the frigates. Regression studies were carried out in order to study the relationship between the ships' OPTAR obligations and certain employment factors.

First, a simple regression was carried out using "monthly OPTAR obligation" as the dependent variable, and "days underway" as the independent variable. Recall from the previous section that the dependent variable (monthly OPTAR obligation) was fairly normally distributed. The independent variable (days U/W) did not exhibit a normal distribution, but as a starting point in the analysis of the cruiser data, this combination of variables was regressed. The following output resulted from this initial regression:

Dependent variable: Monthly OPTAR Obligations
Independent variable(s): Days U/W

Variable name	Coefficient	Std Error	t-ratio
Constant	208307.55	17109.84	12.17
Days U/W	2788.31	1207.91	2.31

F-Ratio: 5.33

Coefficient of Determination........................ 0.04
Coefficient of Correlation.............................. 0.21
Standard Error of the Estimate.......... 114870.65
Durbin-Watson Statistic................................ 1.72

The above data seems to indicate that for the cruisers in the study, monthly OPTAR obligations are somewhat more dependent on how many days the ship is underway in a given month than was the case for the frigates. First, the t-ratio for the independent variable is much higher than seen in the frigate studies (as is the F ratio), and appears to have some statistical significance in explaining monthly OPTAR obligations. When the plot of the above variables is examined, there appears to be more of a relationship between the two variables used in the regression than the similar plot for the frigates in the study. Figure 18 shows the plot of the dependent versus the independent variable for this initial regression. Of particular interest in this graph is the fact that while the observations are widely dispersed about the regression line, the variance appears to be constant and the regression line shown is not parallel to the X-axis, as was the case with the frigate regression.

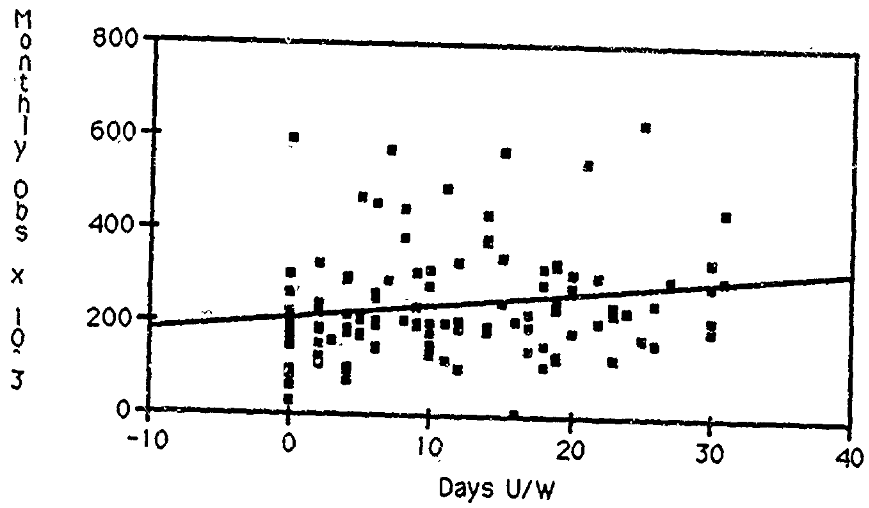

Figure 18

Plot of Monthly OPTAR vs. Days Underway

This indicates that there is at least some "advantage" to using the regression equation to explain the behavior of the OPTAR expenditures when compared to simply using the mean of the OPTAR obligations as a predictor. The resultant coefficients of determination and correlation bear this out as well, with both being considerably higher than similar statistics obtained in the studies of the frigate data. Further tests of the validity of this model were carried out by conducting an analysis of the residuals. The assumption of constant variance was confirmed via a plot of the residuals as shown in Figure 19.

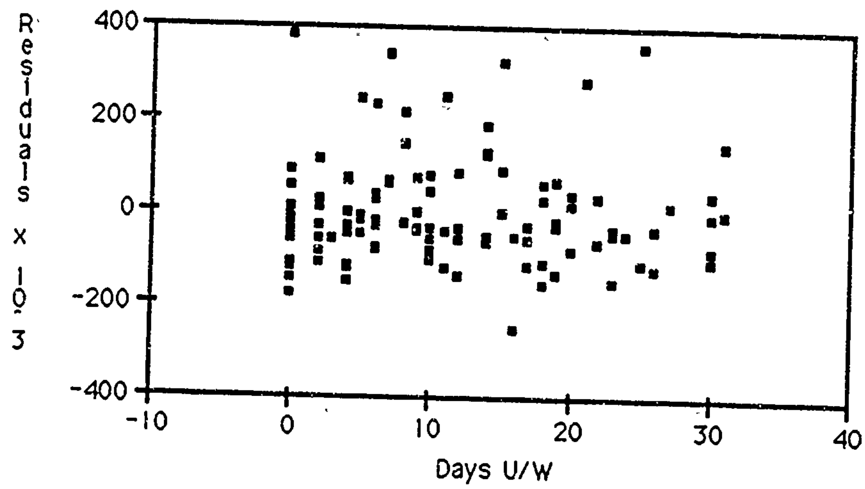

Figure 19

Plot of Residuals (initial regression)

As can be seen from the plot of the residuals versus the independent variable, the error terms are fairly randomly distributed and the constant variance assumption appears to be upheld. The normality of the residual terms is seen in Figure 20, a histogram of the residuals in this model.

The histogram shows the data to be skewed slightly to the right, indicating that the residuals are not as normally distributed as desired. Although the results of the initial regression of the cruiser data indicated a much stronger relationship between OPTAR and days underway than was the case for the frigates, the initial model was still weak. The coefficients of correlation and determination both indicate that the model still does not explain much of the variation of the dependent variable, and for this reason, the analysis continued.

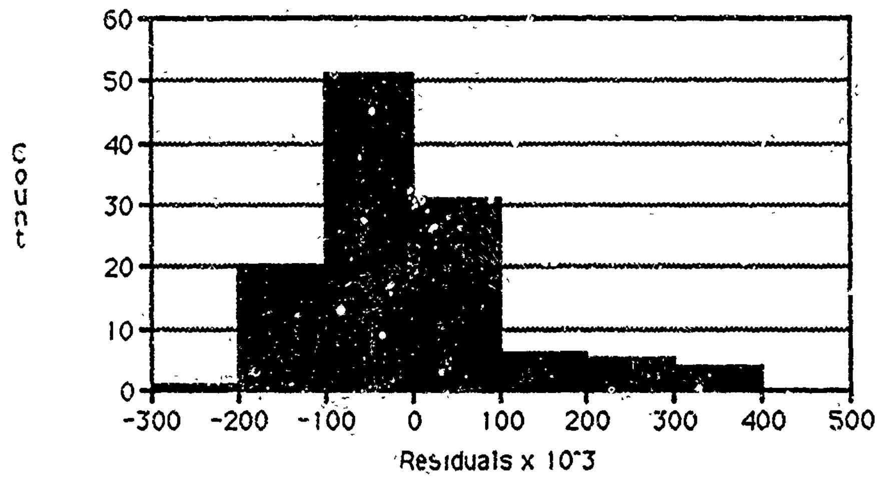

Figure 20

Histogram of Residuals (initial regression)

The next step was to convert the monthly obligations into "percentage of total annual OPTAR obligated," in order to see if the model could be improved by smoothing out any inflationary or deflationary effects of the change in OPTAR allocations over the two fiscal years in the study. When the percentage of total annual OPTAR obligated was regressed against days underway, the following output resulted:

Dependent variable: Percent of annual OPTAR obligated
Independent variable(s): Days Underway

Variable name	Coefficient	Std Error	t-ratio
Constant	7.41	0.58	12.701
Days U/W	0.08	0.04	1.976

F-Ratio: 3.906

Coefficient of Determination	**0.033**
Coefficient of Correlation	**0.180**
Standard Error of the Estimate	**3.921**
Durbin-Watson Statistic	**1.860**

As can be seen from the above, when the OPTAR obligations were converted to "percentage of total annual OPTAR" and regressed against "days underway," the resulting regression showed no improvement over the original regression. In fact, this new regression appears to be less valid than the original. The t-ratios and F statistics actually got worse, as did the coefficient of correlation and coefficient of determination. This decline alone is not alarming considering this new model on its own, but it does cause the original model to be somewhat questionable. The whole reason for converting the data from the aggregate figures to the percentages of annual OPTAR was to smooth out any effect of the differential in funding allocation for the two years studied (the ships were allocated more OPTAR in 1985 than they were in the following year 1986). One would have expected the new model to show some improvement over the original, since the effects of regressing essentially two populations against one variable would have been removed. Since the revised model actually appears to be less valid than the original, then the validity of the original model can also be considered somewhat questionable. Nonetheless, the analysis continued to explore other possible relationships.

Recall that the independent variable (days underway) was not normally distributed. Attempts were made to normalize this variable in an earlier section of this analysis by removing data points for groups of ships that had zero days underway in a given month. First, the data points for any ships that were in overhaul during the two fiscal years studied were removed from the data set, then ships that were in either overhaul <u>or</u> SRA were removed, and finally, any data point for a ship having zero days underway in a given month was removed from the data set. This manipulation of the data set was done with the idea that perhaps ship spending was dependent on days underway, but only if the ship was in a true "operational" status, and not undergoing overhaul or maintenance which made it impossible for the ship to get underway in a particular month. This hypothesis also proved to be false. The next few iterations of the regression analysis attempted to regress both the "monthly OPTAR obligation" and the "percentage of annual OPTAR obligation" against the independent variable "days underway." The results of these iterations were as follows:

None of the cruisers in this study were in overhaul during the two year period for which data was collected. Therefore, the removal of observations involves only those data points for ships that had zero days underway in a given month due to being in an SRA status. Using this revised data file, the monthly OPTAR obligations were regressed against the variable "days underway" with the following results:

Dependent variable: Monthly OPTAR obligations
Independent variable(s): Days U/W (less ships in ROH/SRA)

Variable name	Coefficient	Std Error	t-ratio
Constant	203810.65	18537.14	10.99
Days u/w	2944.09	1236.51	2.38

F-Ratio: 5.669

Coefficient of Determination.......................... 0.052
Coefficient of Correlation.............................. 0.228
Standard Error of the Estimate........... 107105.16
Durbin-Watson Statistic................................. 1.91

As can be seen from above, there was a slight improvement in the regression model (when compared to the initial regression) as a result of using the revised data file. The t-statistic increased from 2.31 to 2.38, the coefficient of determination increased from 0.04 to 0.052, and the coefficient of correlation increased from 0.21 to 0.228. Whether or not these slight increases are meaningful is questionable in light of the fact that the numbers are already so small. The plot of this revised model is as shown in Figure 21, and was not significantly different than the initial regression plot.

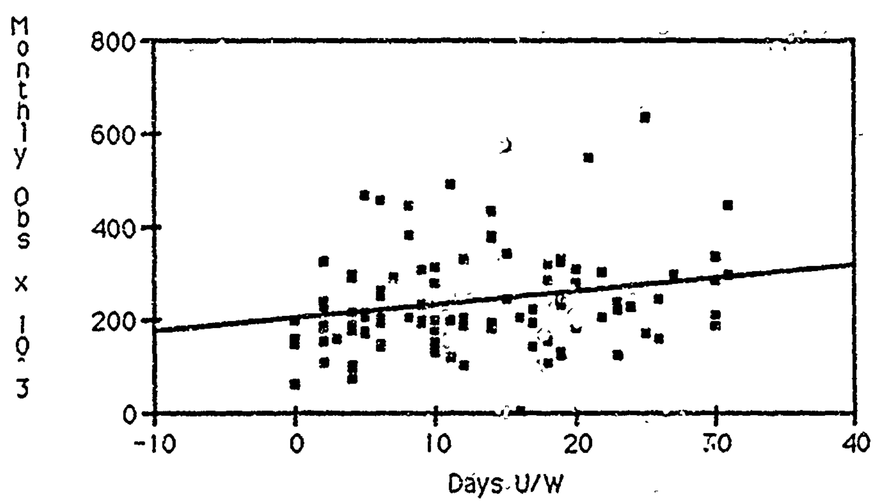

Figure 21

Plot of Monthly OPTAR vs. Days Underway (less Ships in Overhaul or SRA)

The analysis of residuals also did not result in any changes from the initial residual analysis. The residual plot of this regression is shown in Figure 22. The plot shows the error terms to be fairly randomly distributed, and supports the equal variance assumption necessary in regression analysis.

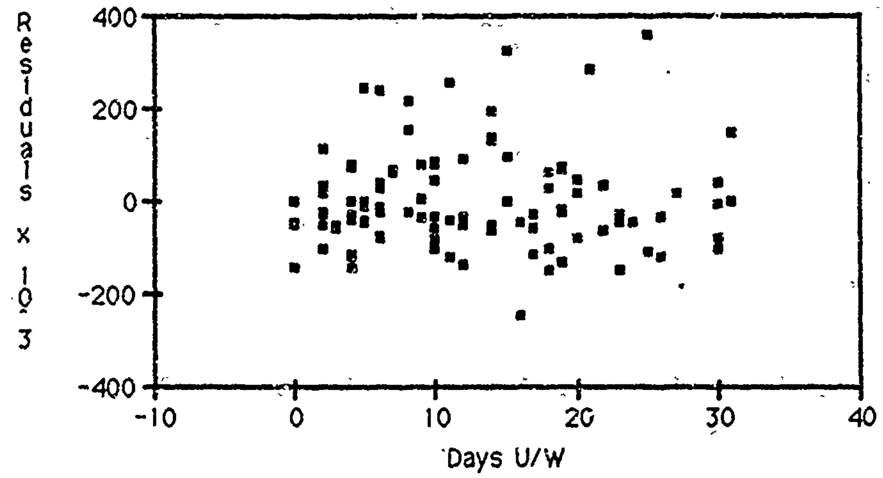

Figure 22

Plot of Residuals vs. Independent Variable (Days U/W)

The same regression analysis was conducted using "percent of total annual OPTAR obligated" as the dependent variable and "days underway" as the independent variable to determine if any improvement in the model resulted. As in the initial regression, there was no improvement in the regression as a result of using "percent of total annual OPTAR obligated" as the dependent variable. In fact there was again a decrease in the t-statistic, F-ratio, and coefficients of correlation and determination (because the model failed to show improvement, the actual output is not shown here).

The final simple regression involved revising the data set once again. This time, all data points with <u>any</u> zero day underway months, for whatever the reason, were removed from the data set. First, the dependent variable "monthly OPTAR obligation" was used, with the following regression output resulting:

Dependent variable: Monthly OPTAR obligation
Independent variable(s): Days U/W (less all data points which include zero-day u/w months)

Variable name	Coefficient	Std Error	t-ratio
Constant	212002.85	19925.23	10.64
Days U/W	2492.79	1303.54	1.91

F-Ratio: 3.65

Coefficient of Determination.......................... 0.036
Coefficient of Correlation.............................. 0.189
Standard Error of the Estimate........... 108008.311
Durbin-Watson Statistic................................ 1.861

Note from the above output that this final revision of the data set failed to improve the relation between OPTAR obligated and days underway. The removal of all zero-day underway months from the data set actually resulted in a decline in the t-statistic, the F-ratio, and the coefficients of correlation and determination. The plot of Monthly OPTAR obligation versus Days Underway is as shown in Figure 23. The plot is not significantly different from those of previous regressions. The conclusion to be drawn is that when all zero day underway months are removed from the data set, there is no improvement in the relationship between the monthly OPTAR obligated and the number of days during the month that the ship gets underway. Although not shown here, the results of the regression of "percent of total annual OPTAR obligated" against "days underway" yielded much the same results. When these two variables were regressed, the key statistics again decreased, indicating that the relationship was not improved by converting the aggregate figures to percentages.

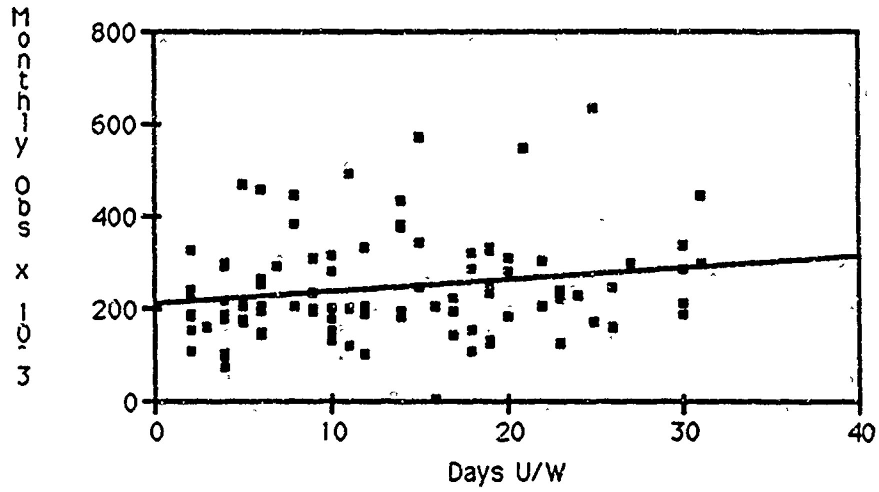

Figure 23

Plot of Monthly OPTAR vs. Days Underway (less data points with zero day u/w months)

Finally, as was done with the frigates, the variable "months since last overhaul" was examined to determine whether any relationship between this variable and the amount of OPTAR obligated exists for cruisers. When examined by itself in a simple regression, this variable failed to prove significant in explaining the behavior of cruiser OPTAR obligation patterns. When "monthly OPTAR obligated" was regressed against the variable "months since last overhaul," the following output resulted:

Independent variable(s): Months since last Overhaul

Variable name	Coefficient	Std Error	t-ratio
Constant	232562.77	26332.66	8.83
Mo since OVHL	179.48	628.79	0.28

F-Ratio: 0.081

Coefficient of Determination......................... 0.001
Coefficient of Correlation.............................. 0.026
Standard Error of the Estimate........... 116666.722
Durbin-Watson Statistic................................ 1.779

As can be seen from the above, the variable "months since last overhaul" is not statistically significant in explaining the behavior of the dependent variable "monthly OPTAR obligated." Figure 24 below is a plot of these two variables, and as can be seen from the nearly horizontal slope of the resulting regression line, the mean of the dependent variable (Y-bar) is probably as good a predictor of the monthly OPTAR obligated as is this particular independent variable (months since last overhaul).

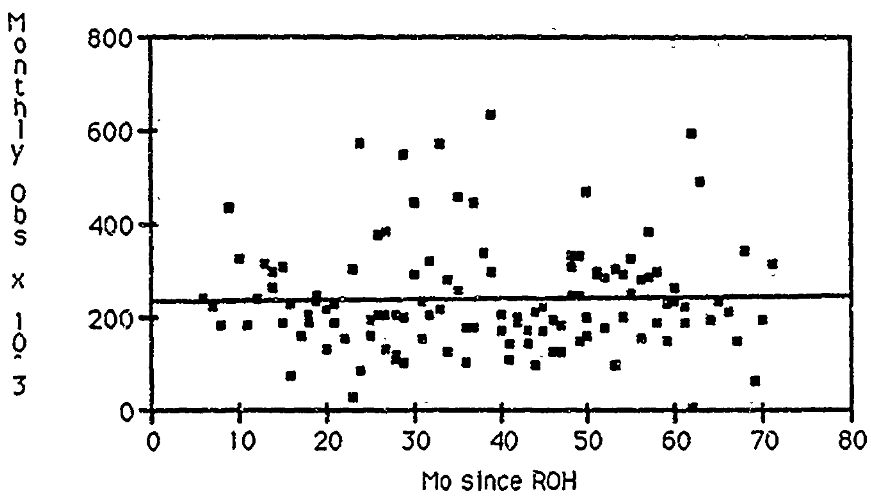

Figure 24

Monthly OPTAR Obligated vs. Months Since Overhaul

Although the variable "months since overhaul" was shown to not be a good predictor of monthly OPTAR when used alone in a simple regression, one final attempt was made at using this variable, this time in a multiple regression. Since the data file for cruisers which excluded all data points for ships in overhaul or SRA proved to result in the best simple regression when using "days underway" as the independent variable, this data file was again used in this multiple regression. When "monthly OPTAR obligated" was regressed against both "days underway" and "months since last overhaul," the following output resulted:

Dependent variable: Monthly OPTAR Obligated
Independent variable(s): Months since last Overhaul
Days Underway (less ships in overhaul or SRA)

Variable name	Coefficient	Std Error	t-ratio
Constant	206973.51	29512.65	7.013
Days U/W	2954.48	1244.71	2.374
Mo. since OVHL	-85.46	618.54	-0.138

F-Ratio: 2.817

Coefficient of Determination.............................. 0.052
Coefficient of Correlation.............................. 0.229
Standard Error of the Estimate........... 107618.844
Durbin-Watson Statistic.............................. 1.916

From the above output, it can be safely concluded that the variable "months since last overhaul" adds very little to the regression in terms of explaining the behavior of the dependent variable (monthly OPTAR obligated). First of all, it should be noted that the t-statistic for the variable "months since last overhaul" is extremely low, and is not statistically significant. Additionally, the addition of the new variable caused a significant decrease in the F-statistic (down from 5.669 in the original regression of this data file), confirming that the addition of this variable does not improve the regression.

To summarize briefly the results of the regression analysis for both the frigates and the cruisers in this study, the following key points can be made:

- In the case of frigates, OPTAR obligation is <u>not</u> statistically dependent upon either days underway or the number of months since last overhaul.
- In the case of cruisers, there <u>does</u> appear to be some relationship between OPTAR obligation and days underway, but not between OPTAR obligation and the number of months since last overhaul. Although the variable "days underway" is of some significance in explaining the behavior of monthly OPTAR obligations, there is not a strong enough relationship to justify using "days underway" as a predictor of monthly OPTAR spending.

C. VARIANCE ANALYSIS

Having been unable to develop a statistically significant parametric model for predicting monthly OPTAR obligations, the study of the data next focused on non-parametric analysis in an effort to examine potential relationships between operational employment and OPTAR obligation. The non-parametric studies involved variance analysis in order to determine if indeed there were differences in OPTAR spending that could be associated with the operational employment of a ship.

The first step in this analysis involved manipulating the data to allow comparisons of mean spending in each employment category (using an analysis of variance between various samples of data). As discussed in chapter three, the OPTAR spending data was broken down into ten-day increments, as shown in Appendix A. The employment data was also broken down into ten-day increments in order to make direct comparisons between the "ten-day spending" and the "ten-day employment." Appendix B contains the ships' employment data broken down into ten-day increments.[9]

The next step involved sorting the data for each class of ship into the various employment categories. The ten-day spending data for frigates were sorted into eight data files, one for each of the eight employment categories. For example, all data points for ten-day OPTAR obligations for Frigates who were in a deployed status were sorted into their own file entitled "deployment." The same procedure was then used to sort the Cruiser data, except that only seven of the eight employment categories were used, due to the fact that there were no cruisers in the "overhaul" employment category during the two years studied.

Once the data was sorted by employment category, the procedure followed was to conduct a one-way analysis of variance between the

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[9]The ten-day employment information contained in Appendix B was based upon the author's analysis of the detailed scheduling data provided by the COMNAVSURFPAC Operations Office. In any ten-day period a ship might have been employed in more than one primary activity. Because of this, a degree of subjective judgement was required on the part of the author (based upon seven years of sea duty in similar ships) in deciding which of the eight primary employment categories was "driving" the ship's routine during any given ten-day period.

various employment categories. The one-way analysis of variance would identify which of the categories, if any, were influential in driving OPTAR obligations during the two years studied. Prior to discussing the resulting variance studies, a brief overview of the data used in the analysis is provided.

On the basis of the breakdown of the raw data into the ten-day increments used in the analysis, certain trends in the data were noted. Figures 25 and 26 show graphically the breakdown of each class of ship's employment data in terms of the percentage of time spent in the various employment categories over the two years in the study (these graphs show the aggregated information for all the data points in the study—i.e., not all ships in the study spent time in an overhaul status).

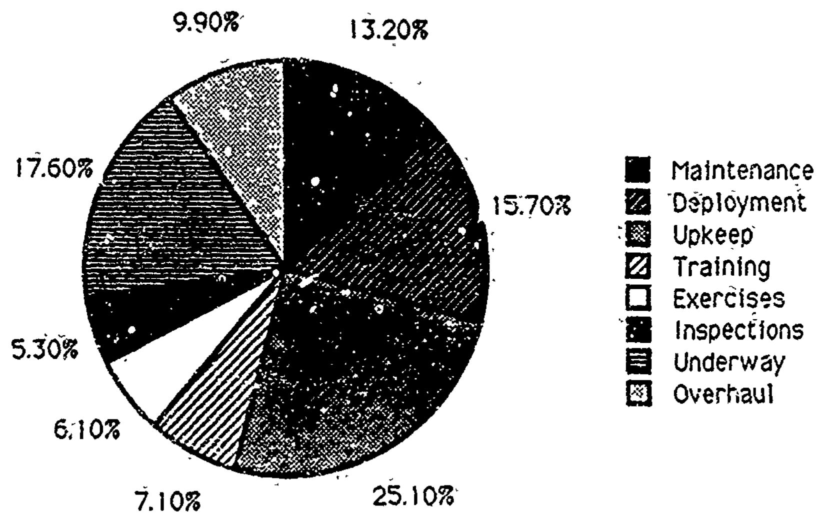

Figure 25

Percentage of Time Spent in Various Activities (Frigates, 1985-1986)

Figures 25 and 26 are in and of themselves of little value in the analysis other than for information purposes. The two graphs merely show what percentage of time each class of ship spent in the various employment categories. However, when these two graphs are compared with Figures 27 and 28, certain subjective (albeit preliminary) conclusions can be drawn.

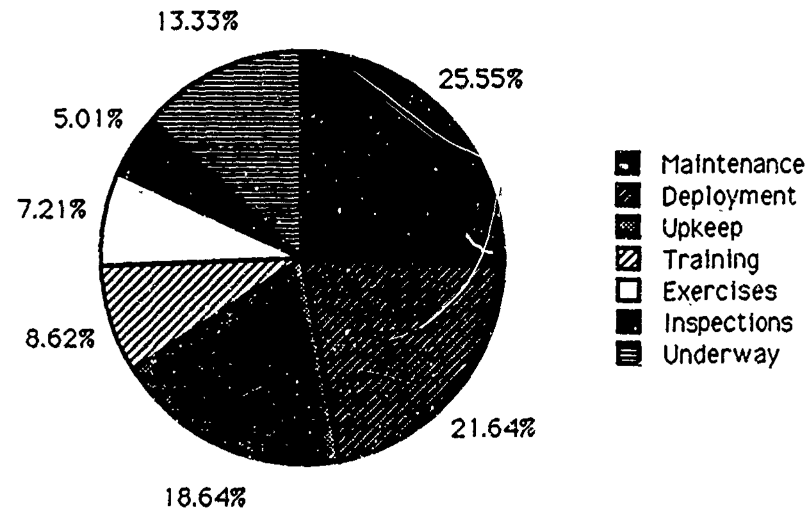

Figure 26

Percentage of Time Spent in Various Activities (Cruisers, 1985-1985)

First, an explanation of Figures 27 and 28 is in order so that a proper interpretation of the two graphs and a proper comparison with Figures 25 and 26 are possible. Figures 27 and 28 represent the percentage of the total OPTAR obligated, for each class of ship, broken down by the employment category the ships were in when the OPTAR funds were obligated. In other words, these graphs explain what percentage of the OPTAR was obligated, and "when" it was obligated.

For example, Figure 27 should interpreted as follows: the frigates in the study obligated 12.9% of their total OPTAR while in a maintenance category, 16.1% while in a deployed status, 23.3% while in upkeep, and so on. The remaining percentages are as shown along the perimeter of the pie chart in Figure 27.

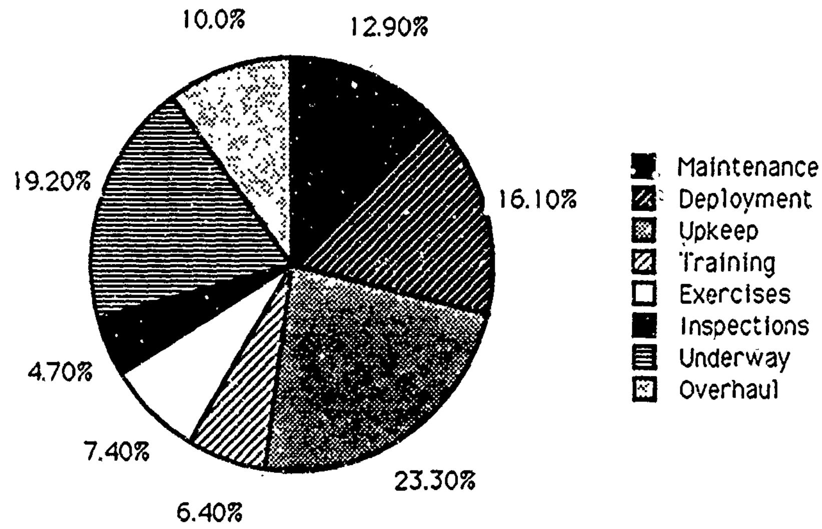

Figure 27

Percentage of Total OPTAR Obligated in Various Activities (Frigates, 1985-1986)

In the case of the cruiser data shown in Figure 28, the percentages differed somewhat. Cruisers obligated 22.5% of their OPTAR while in a maintenance status, 21.9% while deployed, 18.2% while in upkeep, and so on as shown in Figure 28. Note the presence of only seven employment categories for this chart since none of the cruisers were in overhaul during the period of the study.

When the two sets of pie charts are compared for each class of ship (i.e., Figure 25 versus Figure 27 and Figure 26 versus Figure 28), it would be expected that, if operational employment had a significant impact on OPTAR obligation, there should be significant differences in the way each chart looks. Conversely, if employment does <u>not</u> significantly impact on OPTAR obligation, then one would expect that the graphs for each class of ship would look similar, indicating that the ships are obligating their money at a somewhat even rate that is not affected by operational employment.

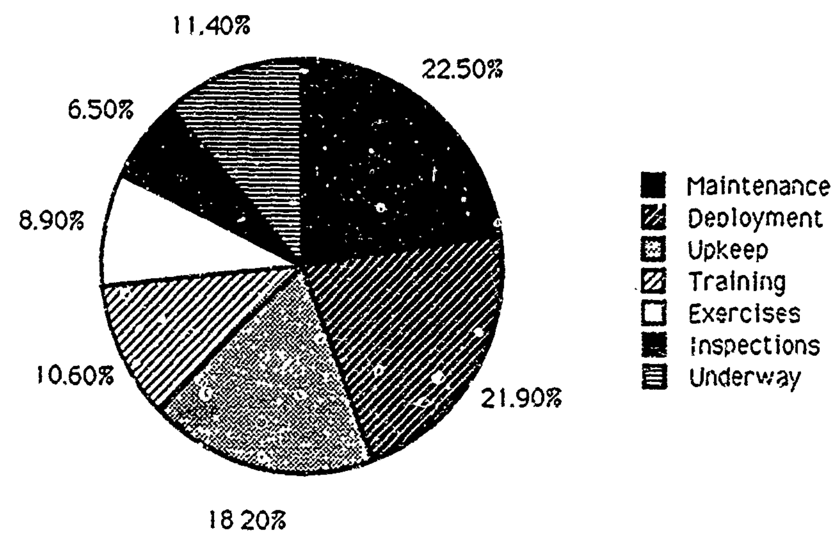

Figure 28

Percentage of Total OPTAR Obligated in Various Activities (Cruisers, 1985-1986)

For example, the frigates in the study spent 13.2% of their time in maintenance, and while in maintenance periods, obligated 12.9% of their total OPTAR. The frigates spent 9.9% of their time in overhaul, and obligated 10% of their OPTAR while in overhaul. They spent 16.1% of their time deployed, and while deployed, obligated 15.7% of their total OPTAR. The remaining comparisons can be made by reviewing Figures 25 and 27. The point to be made is that if employment _were_ a driving factor in the obligation of OPTAR, one would _not_ expect the OPTAR obligation percentages to be so similar to the percentages of time spent in each employment category. If operational employment tended to drive OPTAR obligation, then one would expect that during certain categories of employment, a larger percentage of total OPTAR would be obligated, while in other categories a smaller percentage of total OPTAR would be obligated. Given the charts shown in Figures 25 and 27, it would appear that the obligation of OPTAR tends to be fairly evenly distributed throughout the period studied, and does not appear to be dependent upon any specific employment category. A similar situation, although to a lesser extent, can be seen in the data for the cruisers in the study as shown by a comparison of Figures 26 and 28.

The above interpretation of Figures 25 through 28 is subjective in nature, but is supported by statistical analysis which shows that there is no significant difference between the two sets of data. To statistically test whether or not there was a significant difference between the proportions in Figures 25 and 26 and those in Figures 27 and 28, a Chi-square goodness of fit test was conducted for both the frigate and cruiser data.

In a Chi-square goodness of fit test, two sets of proportions are statistically compared to determine whether or not they differ significantly. The Chi-square goodness of fit test is used to test the hypothesis that several proportions have specified numerical values, or that two sets of proportions do not differ significantly.

In the case of the frigate data, a goodness of fit test was conducted to determine whether or not there was a significant difference between the proportions in Figure 27, representing the percentage of total OPTAR obligated while a ship is in the various employment categories, and the proportions contained in Figure 25, which represent the percentage of time the ships spent in the various employment categories. The results of the Chi-square test for goodness of fit were as follows:

Null Hypothesis: The proportions associated with Figure 25 do not differ significantly from the proportions found in Figure 27. (There is no significant difference between the percentage of OPTAR obligated by a frigate in any specific employment category and the percentage of time spent in that same category.)

Alternative Hypothesis: The proportions contained in Figures 25 and 27 differ significantly. (There is a significant difference between the percentage of OPTAR obligated by a frigate in any specific employment category and the percentage of time spent in that same category.)

Test Statistic: Chi-square

Computed value of Chi-square test statistic: 0.6563

Critical value of Chi-square = 14.0671 (alpha = 0.05, 7 d.f.)

As shown above, the computed value of Chi-square is extremely small, and is much lower than the critical value. Since the computed value of Chi-square is less than the critical value, the null hypothesis cannot be rejected. Acceptance of the null hypothesis supports the earlier conclusion that there is no significant difference between the two sets of proportions.

The same goodness of fit test was conducted with the cruiser data shown in Figures 26 and 28. The results from this test were similar to the above and were as follows:

Null Hypothesis: The proportions associated with Figure 26 do not differ significantly from the proportions found in Figure 28 (There is no significant difference between the percentage of OPTAR obligated by a cruiser in any specific employment category and the percentage of time spent in that same category).

Alternative Hypothesis: The proportions contained in Figures 26 and 28 differ significantly. (There is a significant difference between the percentage of OPTAR obligated by a cruiser in any specific employment category and the percentage of time spent in that same category.)

Test Statistic: Chi-square

Computed value of Chi-square test statistic: 1.9009

Critical value of Chi-square = 12.5916 (alpha = 0.05, 6 d.f.)

Although the value of the computed Chi-square is considerably larger for the cruisers than it was for the frigates, it is still not statistically significant. The computed value of Chi-square is less than its critical value, and the null hypothesis cannot be rejected. As before, acceptance of the null hypothesis supports the earlier conclusion that there is no significant difference between the sets of proportions in Figures 26 and 28.

The Chi-square tests seem to support the initial conclusion that there is no relationship between OPTAR obligation and the operational employment of a ship. To confirm this conclusion, further testing of the data was conducted. The next step in the study involved variance analysis of the OPTAR obligation data, and the following sections discuss the results of the variance analysis conducted for the two classes of ships involved.

1. <u>KNOX (FF-1052) Class Frigates</u>

The initial analysis of the KNOX class frigate data involved a one-way analysis of variance (ANOVA) of the eight operational employment categories. In conducting this initial analysis, the null and alternative hypotheses were as follows:

<u>Null Hypothesis</u>: The mean OPTAR obligation during any ten-day period does not vary on the basis of operational employment (the means of OPTAR obligated for each of the categories of employment are equal).

<u>Alternative Hypothesis</u>: The mean OPTAR obligation during any ten-day period <u>does</u> vary depending on operational employment (one or more of the means of each of the employment categories are <u>not</u> equal).

In conducting the analysis of variance, the objective was to either accept or reject the null hypothesis on the basis of a test statistic, in this case the resulting F-ratio. On the basis of either acceptance or rejection of the null hypothesis above, it would be possible to state whether or not operational employment is statistically significant as a determinant of OPTAR obligation rates. When the initial analysis of variance was conducted, the following output resulted:

Analysis of Variance: Frigate OPTAR Obligations by Employment

SOURCE	DF	SS	MS	F-RATIO
Employment	7	4.70 x10^9	671381760	0.81
ERROR	712	5.90 x10^11	828491776	
TOTAL	719	5.95 x10^11		

Employment Category	Number Observations	Mean OPTAR	Standard Deviation
Maintenance	95	$29446	$19087
Deployment	113	$30920	$22390
Upkeep	181	$27919	$22898
Training	51	$27053	$20099
Exercises	44	$36656	$24362
Inspections	38	$26515	$54184
Underway	127	$32706	$26331
Overhaul	71	$30399	$48317

From the information above, it can be seen that the F-ratio resulting from this one-way analysis of variance is extremely low, and can not be considered statistically significant. If the value of alpha (the probability of making a type I statistical error) for this analysis is set at 0.05 (in order to be 95% certain that we do not make a type I error and reject the null hypothesis when it is in fact true), then the critical value of F would be 2.01. Since the actual value of the F-ratio is 0.81, and does not exceed this critical value of F, we can safely accept the null hypothesis, and conclude that the means of the various employment categories are equal. This indicates that, for the Frigates in the study, there is no difference in the amount of OPTAR obligated from one employment category to another. In other words, OPTAR obligation does not depend on the employment of the ship. Because of the extremely low F-ratio computed for this initial analysis, no further analysis of the data was considered necessary for the Frigates. The null hypothesis would be accepted at almost all levels of alpha, and therefore the study moved on into an analysis of the cruiser data.

2. BELKNAP (CG-26) Class Cruisers

The initial analysis of the BELKNAP class cruiser data involved the same procedure as was used in the frigate analysis, a one-way analysis of variance for the seven employment categories used for the cruisers in the study. In conducting this analysis, the null and alternative hypotheses were identical to those used in the frigate analysis:

Null Hypothesis: The mean OPTAR obligation during any ten-day period does not vary on the basis of operational employment (the means of OPTAR obligated for each of the categories of employment are equal).

Alternative Hypothesis: The mean OPTAR obligation during any ten-day period does vary depending on operational employment (one or more of the means of each of the employment categories are not equal).

In conducting the analysis of variance, the objective was again to either accept or reject the null hypothesis on the basis of a test statistic, in this case the resulting F-ratio. When the initial ANOVA was conducted for the cruisers in the study, the following output resulted:

Analysis of Variance: Cruiser OPTAR Obligations by Employment

SOURCE	DF	SS	MS	F-RATIO
Employment	6	4.55 x10^10	7.58 x10^9	2.12
ERROR	353	1.26 x10^12	3.58 x10^9	
TOTAL	359	1.30 x10^12		

Employment Category	Number Observations	Mean OPTAR	Standard Deviation
Maintenance	92	$70752	$53575
Deployment	78	$81251	$60953
Upkeep	67	$78423	$57422
Training	31	$98540	$56907
Exercises	26	$98955	$85181
Inspections	18	$104753	$79398
Underway	48	$68527	$48711

Unlike the results of the initial frigate analysis, the value of the F-ratio resulting from this ANOVA can be considered statistically significant. Using an alpha value of 0.05, the critical value of F for this ANOVA would be 2.10. Since the F-ratio resulting from this analysis is greater than the critical value of F (at alpha = 0.05), the null hypothesis can be rejected (but just barely).[10] The resulting conclusion would be that for the cruisers in the study, at least one of the mean OPTAR expenditures involved in the comparison of the means for the various employment categories is not equal. This would indicate that, for cruisers, there is some relationship between operational employ-

[10]The null hypothesis cannot be rejected at an alpha of less than 0.05. For example, if the value of alpha is set at the 0.01 level of significance, the critical value of F is 2.80, a value considerably larger than the F-ratio resulting from this ANOVA. Therefore, if it were necessary to have a 99% probability of not making a type I statistical error, then the null hypothesis could be safely accepted.

ment and the amount of OPTAR obligated. The next steps in the analysis involved identifying which category or categories of employment did not have a mean that was equal to the other mean OPTAR obligations.

To accomplish this, the analysis of variance procedures were conducted on various combinations of the seven employment categories, in order to isolate which variable or variables differed significantly in terms of the sample means. To simplify this procedure (by reducing the number of iterations necessary), certain groupings of variables were analyzed first, in order to confirm that there was no significant differences in the means of these variables (thus effectively eliminating them from the analysis).

First, an analysis of variance was conducted for the three employment categories with the highest mean OPTAR obligation per ten-day period. As shown earlier in the output from the one-way analysis of variance previously conducted, these three employment variables were "training," "exercises," and "inspections." The following are the results of the analysis of variance for these three employment categories:

Null Hypothesis: The means of the ten-day OPTAR obligations for the three employment categories are equal.

Alternative Hypothesis: The means of these three employment categories are not equal (at least one of the means is significantly different from the others).

Analysis of Variance: Cruiser OPTAR Obligations by Employment (Variables used: "Training," "Exercises," "Inspections")

SOURCE	DF	SS	MS	F-RATIO
FACTOR	2	498816256	249408128	0.05
ERROR	72	3.86 x10^11	5.36 x10^9	
TOTAL	74	3.86 x10^11		

Employment Category	Number Observations	Mean OPTAR	Standard Deviation
Training	31	$98540	$56907
Exercises	26	$98955	$85181
Inspections	18	$104753	$79598

From the output above it can be safely concluded that there is no statistically significant difference in the means of the three categories of employment. The critical value of F (for an alpha of 0.05) is approximately 3.1, which is significantly larger than the computed F-ratio of 0.05. Thus, the null hypothesis (that the means of the three employment categories are equal) may be safely retained.

This same procedure was used for the four employment categories with the lowest mean OPTAR obligation per ten-day period. The results of this analysis were as follows:

Null Hypothesis: The means of the ten-day OPTAR obligations for the four employment categories are equal.

Alternative Hypothesis: The means of these four employment categories are not equal (at least one of the means is significantly different from the others).

Analysis of Variance: Cruiser OPTAR Obligations by Employment (Variables used: "Maintenance," "Deployment," "Upkeep," "U/W")

SOURCE	DF	SS	MS	F-RATIO
FACTOR	3	7.50 x10^9	2.50 x10^9	0.80
ERROR	281	8.76 x10^11	3.12 x10^9	
TOTAL	284	8.34 x10^11		

Employment Category	Number Observations	Mean OPTAR	Standard Deviation
Maintenance	92	$70752	$53575
Deployment	78	$81251	$60953
Upkeep	67	$78423	$57422
Underway	48	$68527	$48711

For the above analysis the critical value of F is approximately 2.60 (at an alpha value of 0.05). Since an F-ratio of 0.80 was calculated, it can be safely concluded that there is no significant difference in the mean OPTAR obligations per ten-day period between the four operational employment categories examined.

The two previous ANOVA tests found that the mean ten-day OPTAR obligations for the three highest cost employment categories did not differ significantly from one other, and that the mean ten-day OPTAR obligations for the four lowest cost employment categories also did not differ significantly from one other. The next step involved testing to confirm that the mean of the ten-day OPTAR obligations for the four low cost employment categories was significantly different from the mean of the ten-day OPTAR obligations for the three high cost employment categories. This ANOVA was conducted by consolidating the data for the high and low cost categories into two new categories, named "high cost" and "low cost." The following are the results of the analysis of variance for these two new categories:

Null Hypothesis: The mean of the ten-day OPTAR obligations for the high cost employment categories is not significantly different from the mean of the ten-day OPTAR obligations for the low cost employment categories.

Alternative Hypothesis: The means of these two categories do differ significantly from one another

Analysis of Variance: Cruiser OPTAR Obligations by Employment (Variables used: "High Cost," "Low Cost")

SOURCE	DF	SS	MS	F-RATIO
FACTOR	1	3.75 x10^10	3.75 x10^10	10.56
ERROR	358	1.27 x10^12	3.55 x10^9	
TOTAL	359	1.30 x10^12		

Employment Category	Number Observations	Mean OPTAR	Standard Deviation
Low Cost	285	$75054	$55789
High Cost	75	$100175	$72243

For the above analysis, the critical value of F is 3.84. Because the computed value of F (10.56) is significantly higher than the critical value, the null hypothesis can be safely rejected. This shows that there <u>is</u> a significant difference in the mean of the ten-day OPTAR obligations between the high cost employment categories and the low cost employment categories.

The above analysis confirmed the difference between the high and low cost "groupings" of employment categories, but did not identify any individual categories of employment that differed from one another. Obviously, based upon the results of the initial analysis of variance wherein it was found that the null hypothesis could be rejected, there is at least one of the seven employment categories that has a mean OPTAR obligation rate that is either more or less than the others. The remainder of this analysis of data focused on identifying the differing categories of employment through repeated analyses of variance for different combinations of variables.

The results of this analysis showed that the employment categories of "maintenance" and "underway" did not have the same mean OPTAR obligation per ten-day period as did the three higher cost categories of employment ("training," "exercise," and "inspection").[11] The mean ten-day expenditures for these two categories were found to be significantly lower than for the others. The following shows the results of the analysis of variance for the category of "maintenance" when included with the three high cost categories.

Null Hypothesis: The means of the ten-day OPTAR obligations for the four employment categories are equal.

Alternative Hypothesis: The means of these four employment categories are not equal (at least one of the means is significantly different from the others).

Analysis of Variance: Cruiser OPTAR Obligations by Employment (Variables: "Maintenance," "Training," "Exercise," "Inspection")

SOURCE	DF	SS	MS	F-RATIO
FACTOR	3	3.63 x10^10	1.20 x10^10	3.05
ERROR	163	6.47 x10^11	3.97 x10^9	
TOTAL	166	6.83 x10^11		

[11] Due to space considerations, only the relevant analysis of variance results are discussed in this section.

Employment Category	Number Observations	Mean OPTAR	Standard Deviation
Maintenance	92	$70752	$53575
Training	31	$98540	$56907
Exercises	26	$98955	$85151
Inspection	18	$104753	$79398

For the above analysis, the critical value of F is approximately 2.60. At the 0.05 level of significance then, the null hypothesis can safely be rejected and it can be concluded that the mean OPTAR obligation per ten-day period is different when a ship is in a maintenance period than when it is in any of the three remaining employment categories (they were previously shown to have equal means).

The same results were obtained when the category "underway" was examined in conjunction with the three higher cost categories. For example, when an analysis of variance was conducted using the categories "underway" and "high cost," the following output resulted:

Null Hypothesis: The means of the ten-day OPTAR obligations for the two employment categories are equal

Alternative Hypothesis: The means of these two employment categories are not equal

Analysis of Variance: Cruiser OPTAR Obligations by Employment (Variables: "Underway," "High Cost")

SOURCE	DF	SS	MS	F-RATIO
FACTOR	1	2.93 x10^10	2.93 x10^10	7.13
ERROR	121	4.97 x10^11	4.11 x10^9	
TOTAL	122	5.27 x10^11		

Employment Category	Number Observations	Mean OPTAR	Standard Deviation
Underway	48	$68527	$48711
High Cost	75	$100175	$72243

The critical value of F for the above analysis (at alpha = 0.05) is approximately 3.92. The computed value of F is significantly higher than this critical value of F, and the null hypothesis may be safely rejected. Thus it can be shown that the mean OPTAR obligation per ten-day period is different when a ship is underway than when it is in any one of the three higher cost categories of employment ("Training," "Exercise," and "Inspection").

Statistically then, only two firm conclusions can be drawn from the non-parametric analysis of the cruisers involving the analysis of variance between different employment categories. First, it can be seen that the cruisers in the study tended to obligate less money in any ten-day period in which the ship was employed in either an "underway" or a "maintenance" period than when the ship was in other "higher cost" employment categories. Second, two different levels of spending were evident in the analysis, into which the seven employment categories tended to group themselves. The categories of "training," "exercise," and "inspection" tended to fall into the "high cost" spending level, while the remaining four categories fell into the "low cost" spending level (based on the ten-day OPTAR obligation and employment data). Because of the non-parametric nature of variance analysis, these differences in spending levels cannot be quantified, only identified and shown to be statistically significant. Further discussion of the non-parametric studies will be offered in the next chapter.

3. The Impact of Overseas Homeporting on OPTAR Obligation

The final non-parametric studies of the data involved using variance analysis to determine whether or not there are differences in OPTAR obligation that can be attributable to the policy of homeporting select U.S. Navy ships in foreign overseas ports.

For economic and strategic military reasons, the U.S. Navy maintains a strong overseas presence in the Pacific Ocean area by homeporting select warships in certain foreign ports. The use of these foreign homeports provides for greater flexibility and faster response by Navy forces operating in the Western Pacific. Transit times from U.S. ports to operating areas in the Western Pacific and Indian Ocean are measured in weeks rather than days. In order to maintain a credible naval presence in certain areas, while at the same time reducing logistic support problems, the use of overseas homeports is essential. Homeporting U.S. Navy ships overseas does create problems for planners, however, including those involved with budgeting OPTAR to support such units.

Discussions with COMNAVSURFPAC budget personnel indicated an interest in the issue of OPTAR versus overseas homeporting. Commanding Officers of some ships in overseas homeports have occasionally claimed that operating and maintenance costs for their ships are higher than for ships homeported in the United States, and thus overseas units should be budgeted for a larger allocation of OPTAR funds. Using the OPTAR obligation data collected for this thesis, an attempt was made to study this problem.

A potential difficulty encountered in studying this problem resulted from the way in which OPTAR funds were (and are) allocated by the type commander. As discussed earlier in this thesis, all ships within a given class are allocated approximately the same amount of OPTAR each fiscal year. Over the two year period in this study, the ships were allocated OPTAR without regard to whether or not the unit was homeported overseas (ships homeported overseas did not automatically receive a larger initial OPTAR allocation at the beginning of the fiscal year). As mentioned in the last chapter, ships can only obligate OPTAR up to the total amount they are allocated in a given fiscal year. This being the case, unless the ships homeported overseas found it necessary to obtain OPTAR augments, and unless these OPTAR augments are reflected in the OPTAR obligation data collected, then it only stands to reason that they would not have obligated any more OPTAR in any fiscal year than the ships homeported in the U.S. Because of the this problem, it is necessary to interpret results of any statistical analysis in this area very carefully. The results of the analysis, and the interpretations of these results are discussed in the following paragraphs.

To analyze the data, a non-parametric procedure similar to the earlier variance analysis was followed. This time, however, the monthly OPTAR obligation data was used (rather than the ten-day expenditure data), broken down into two samples for each class of ship—the first sample including ships homeported in U.S. ports, the second sample including ships homeported overseas. After the data was separated in this manner, a two-sample, two-tailed, "t-test" was conducted for both the frigates and the cruisers in the study. The t-test used was similar to the variance analysis conducted earlier, except that instead of using the F-ratio as a test statistic to determine whether or not to accept or reject a null hypothesis, the t-test uses the "t-statistic" for the same purpose. The results of this analysis were as follows.

The frigate data was studied first. Recall that four of the ten ships included in the study were homeported overseas in Yokosuka, Japan. These included USS FRANCIS HAMMOND (FF-1067), USS KIRK (FF-1087), USS KNOX (FF-1052), and USS LOCKWOOD (FF-1064). The remaining units were homeported in U.S. ports, either in California or Hawaii. The OPTAR data for the frigates were broken down into two samples (U.S. Ports, Overseas Ports) and compared using the t-test. The results of the t-test were as follows:

Null Hypothesis: The mean monthly OPTAR obligation by frigates homeported in the United States is equal to the mean monthly OPTAR obligation by ships homeported overseas.

Alternative Hypothesis: The mean monthly OPTAR obligation by frigates homeported in the United States is not equal to the mean monthly OPTAR obligation for frigates homeported overseas (either one or the other is higher)

T-test For KNOX (FF-1052) Class Ships

Monthly OPTAR Obligation by Homeport

Categories:	**U.S. Ports**	**Overseas Ports**
Mean:	**$91936**	**$90131**
Std. Deviation	**$53757**	**$45519**
No.Observations:	**144**	**96**

T-statistic (computed) = 0.27
T-statistic (critical) = 1.96 (two tailed, alpha = 0.05)

From the information above, it can be seen that the null hypothesis cannot be rejected. The computed value of the t-statistic is significantly smaller than the critical value of the t-statistic. It is also interesting to note that the mean monthly OPTAR obligated by frigates homeported overseas was actually smaller than the mean for the ships homeported in the U.S.

The acceptance of the null hypothesis in this case calls for careful analysis in order to draw a meaningful conclusion, however. At first glance it might seem appropriate to conclude that it does not cost significantly more to homeport a frigate overseas than it does to homeport the same ship in the United States. This could be an incorrect conclusion. The validity of such a conclusion is dependent upon the assumption that the overseas units were in fact allocated all the OPTAR funding that was necessary and appropriate to keep them as operationally ready as their U.S. based counterparts. If the units homeported overseas were allocated approximately the same amount of annual OPTAR as the U.S. based units, then it only stands to reason that there would be no difference in mean monthly OPTAR obligations, since no ship can obligate more OPTAR than it is allocated. In this case, the results of the t-test above reflect exactly what should be reflected— that the overseas units obligate the same amount of OPTAR (on the average) as the U.S. based units, but only because they are allocated the same level of OPTAR as the U.S. based units.

If, and only if, it is correct to assume that the data used in the analysis does indeed reflect all OPTAR funding necessary and appropriate to maintain the overseas homeported frigates at a level of readiness comparable to the U.S. based frigates, then it can be safely concluded that it does not cost significantly more to operate and maintain frigates in overseas homeports.

The cruiser data was studied next, with essentially the same results. Only one of the BELKNAP class cruisers in the study was based overseas, USS STERETT (CG-31), homeported at Subic Bay in the Philippines. The remaining units were all homeported in San Diego, California. The t-test for the cruisers involved comparing the monthly OPTAR obligation data for USS STERETT with the monthly OPTAR obligation data for all the remaining units. The results of this analysis were as follows:

Null Hypothesis: The mean monthly OPTAR obligation by cruisers homeported in the United States is equal to the mean monthly OPTAR obligation by cruisers homeported overseas.

Alternative Hypothesis: The mean monthly OPTAR obligation by cruisers homeported in the United States is not equal to the mean monthly OPTAR obligation for cruisers homeported overseas (either one or the other is higher)

T-test For BELKNAP (CG-26) Class Ships

Monthly OPTAR Obligation by Homeport

Categories:	**U.S. Ports**	**Overseas Ports**
Mean:	**$232182**	**$268457**
Std. Deviation	**$117213**	**$109692**
No.Observations:	**96**	**24**

T-statistic (computed) = 1.37
T-statistic (critical) = 1.98 (two tailed, alpha = 0.05)

Although the computed value of the t-statistic is considerably higher than the corresponding t-statistic for the frigates studied, it is still not high enough to allow rejection of the null hypothesis. The critical value of the t-statistic is higher than the computed value, thus, the null hypothesis must be accepted. The conclusion to be drawn from the acceptance of the null hypothesis in this case is subject to the same assumption considerations as were discussed in the frigate analysis. If USS STERETT was allocated the same level of annual OPTAR funding as the other cruisers in the study, then it is again only logical that she would obligate the same as the other cruisers in the study. If, on the other hand, the obligation data does, in fact, reflect differences in obligation due to being homeported overseas, then acceptance of the null hypothesis allows one to conclude that it does not cost significantly more to homeport a cruiser overseas than it does in the U.S.

The importance of certain assumptions made in the analysis of the OPTAR obligation data, and the relationship between these assumptions and conclusions drawn regarding the analysis of the data are discussed further in the following chapter.

V. SUMMARY AND CONCLUSIONS

This thesis began with a discussion of the need for efficient allocation of OPTAR funds in order to maximize the benefits derived from such funding. The high cost of operating U.S. Navy ships coupled with the scarcity of funds in an age of deficit government spending make it absolutely essential that military fiscal and budget personnel ensure that OPTAR funds are used wisely and efficiently.

The problems of managing U.S. Navy OPTAR funds are not unlike the problems associated with cash management in the civilian sector. The similarities and differences between OPTAR management and cash management were discussed earlier in this thesis. One key area of cash management that receives much attention by civilian managers is the subject of cash budgeting. Ensuring the most efficient use of cash funds requires a firm to know <u>when</u> cash is most likely to be needed, and <u>how much</u> funding will be necessary. This requires that a firm establish a relatively detailed cash budget in order to plan for cash inflows and outflows. In managing OPTAR allocations for U.S. Navy ships, the cash "outflows" (obligations) are not budgeted for in the same manner as they are in the civilian business sector. Once a total annual OPTAR amount has been established for each ship, this total amount is allocated on the basis of one-fourth of the annual amount for each quarter of the fiscal year. No attempt is made to allocate the OPTAR on the basis of when the ships are most likely to need the funds. If budget personnel were better able to predict when OPTAR funds were likely to be obligated by the ships, then these cash outflows could be better planned for, resulting in more effective and efficient use of OPTAR funds.

The primary research question for this thesis was "are there readily identifiable patterns in the OPTAR obligation rates for the two classes of ships examined?". A key subsidiary research question was "if patterns are evident in the spending rates, are these patterns dependent on the ships' operational scheduling or employment?" The two questions are very closely related in that the first question cannot be answered without examining the impact of ship scheduling and employment on OPTAR obligation, which in turn serves to answer the second question. This thesis focused on a statistical analysis of the aggregated OPTAR and scheduling data collected for two classes of ships in an effort to answer the above questions. If patterns existed in the data that were readily predictable, then these patterns should have been identifiable through statistical analysis. The following sections summarize the findings of the analysis conducted, as well as offer some conclusions and a discussion of the analysis itself.

A. SUMMARY OF FINDINGS

The study of the data focused on attempting to establish whether any significant relationship existed between the amount of OPTAR obligated by a ship and certain operational employment factors specific to the ship at the time the OPTAR was obligated.

First, regression studies were conducted to analyze the relationship between OPTAR obligation and the number of days the ship was underway in a given month. For both classes of ships, it was found that monthly OPTAR obligations are not statistically dependent upon the number of days per month that the ship is underway. In the case of the frigates, there was almost no relationship between OPTAR and "days underway." For the cruisers in the study, there was some relationship found to exist, but not enough to be statistically significant in allowing prediction of OPTAR obligation based upon a knowledge of the independent variable "days underway."

Using regression, it was also determined that there is no relationship between the amount of OPTAR obligated by a ship and the amount of time that has elapsed since the ship's last overhaul. For both of the classes of ships examined, the variable "months since last overhaul" was of no significance in predicting or explaining OPTAR obligations. This variable also failed to prove significant when included in a multiple regression using both "days underway" and "months since last overhaul" as independent variables in predicting OPTAR obligation.

Next, variance analysis was used to study whether or not any relationship existed between the operational employment of a ship (using the eight employment categories discussed in chapter three), and the amount of OPTAR obligated by a ship in a given ten day period. The results showed fairly clearly that for the frigates in the study, there was no significant relationship between operational employment and OPTAR obligation. On the average, the frigates tended to obligate OPTAR fairly evenly throughout the year without regard to operational employment. There were no operational employment categories that stood out as being significantly different from the others in terms of the amount of OPTAR obligated.

For the cruisers in the study, some relationships were apparent, but none were significant enough to be used in predicting or explaining OPTAR obligations. The non-parametric nature of the variance analysis conducted did not quantify the relationships, but merely identified their existence. The results of the variance analysis showed that the cruiser employment categories tended to fall into two groups, high cost employment categories and low cost employment categories. Among the "high cost" group were the following employment categories:

1. Exercises—at-sea exercise periods (FLEETEX, COMPTUEX, READEX)
2. Inspections—all inspection periods (OPPE, NTPI, DNSI, ADMAT)
3. Training—refresher and other training periods

The "low cost" group of employment categories for the cruisers consisted of the following:

1. Maintenance—tender availability or other maintenance periods
2. Deployment—scheduled deployment periods overseas
3. Upkeep—routine inport periods, usually in homeport
4. Underway—at-sea periods for local operations or transits

The exact strength of the relationships could not be measured using non-parametric studies. The existence of the apparent "break" in the data between "high cost" and "low cost" employment categories could be of some use to budget personnel in OPTAR allocation, however. In budgeting and allocating annual OPTAR, planners could examine ships' schedules prior to allocation of the funds, and make use of high cost/low cost employment category averages in allocating OPTAR for a given period. While this method would not guarantee that OPTAR would be allocated where it is most needed, it might better approximate the needs of the ships than simply allocating one-fourth of the total annual OPTAR figure in each quarter.

The final operational factor studied was in the area homeport assignments, specifically whether or not overseas homeporting caused units to obligate more OPTAR than those units homeported in the United States. The statistical analysis of the data failed to show a significant relationship between the annual OPTAR obligated by a ship and whether or not the ship was homeported overseas. For the frigates in the study, there was no relationship between the amount of annual OPTAR obligated and the homeport assignment. For the cruiser data, the relationship between homeport and annual OPTAR obligated was stronger than for the frigates, however, this relationship was still weak, and could not be considered statistically significant. This interpretation of the homeport analysis called for particular care due to factors discussed later in this chapter.

B. DISCUSSION OF FINDINGS

The statistical analysis failed to identify patterns in the OPTAR obligation data that could be attributable to operational employment factors. The failure to establish a relationship between operational employment and OPTAR obligation was an unexpected outcome of the analysis.

Based on experience and intuitive logic, it would seem perfectly reasonable to expect some sort of relationship to exist between OPTAR obligation and operational employment. The higher a ship's operational tempo, the more stress is placed upon men, machinery and equipment. With this increased stress should come increased maintenance and repair requirements as well as increased usage of consumable materials such as paint, paper products, mooring lines, lubricants and other items. It would seem only appropriate that for any ship there would be some minimal amount of OPTAR obligation necessary to maintain a basic level of readiness. Above this minimal level, it would seem logical that increased OPTAR obligation would somehow be tied to the operational employment of the ship. Such was not the case, however, as shown in the preceding analysis. Possible explanations for the failure to establish a relationship between these two variables are discussed below.

First of all, this thesis focused only on total OPTAR obligations. This aggregate approach to the analysis was taken in order to take an initial "macro" look at the way OPTAR is obligated by ships. It is also from this "macro" viewpoint that OPTAR funds are allocated by the type commander's budget office. The total amount of OPTAR obligated by a ship for any period is actually broken down into numerous fund codes. Table IV below shows the primary fund codes applicable to Pacific fleet surface ships. The obligation of OPTAR is actually accounted for not only by total amount of OPTAR obligated but by individual fund code as well.

TABLE IV

FUND CODES APPLICABLE TO NAVSURFPAC UNITS

Fund Code	Explanation
NA	Reimbursable Work
NB	Non-aviation depot level repairables
NC	NSA consumable materials
ND	Rental or hire of passenger vehicle
NE	NSA equipment and equipage
NK	Charter and Hire services
NM	TAD training
NQ	TAD administrative travel
NR	Equipment maintenance and repair
NU	Other purchased services
NV	Orders for printing and publications
NY	Audiovisual products and costs
N2	Hull and Structural facilities maintenance
N3	Aviation depot level repairables
N7	Medical and Dental
N9	POL and lubricants (other than propulsion fuels)

It may well be that patterns and trends actually do exist in the OPTAR obligations, but that the trends and patterns were blurred somewhat by the aggregate approach taken in this analysis. For example, repair spending <u>may</u>, in fact, be highly correlated with the operational employment of the ship. A ship in overhaul might, in fact, obligate more repair and maintenance OPTAR (fund codes NB, NR and

N2) than a ship in an upkeep or training period. Identification of such trends would be possible only through a complete analysis, similar to the one conducted in this thesis, for each fund code. But even if this were the case, it still does not explain why the aggregate or total OPTAR obligations do not appear to be statistically dependent upon the operational employment of the ship, nor would such information prove very beneficial to budget personnel attempting to more accurately "schedule" the obligation of OPTAR.

Another possible explanation as to why there was no apparent relationship between OPTAR obligation and operational employment has to do with the way OPTAR funds are budgeted and allocated to the ships, and the traditional approach to spending that has had become prevalent within the U.S. Government. Within the federal government there often appears to be an unwritten "rule" of budgeting that essentially requires all agencies to spend (obligate) all allocated funds prior to the end of any fiscal year. Ensuring that allocated funds are "spent down to zero" prior to the end of the fiscal year tends to become a major goal of personnel responsible for OPTAR management aboard ship. The general line of reasoning used by most budget personnel to justify such seemingly irrational fiscal behavior revolves around the fear that "if the money is not spent, then next year it will become more difficult (if not impossible) to justify OPTAR funding at the existing (or any higher) level." This "use it or lose it" attitude tends to be prevalent within all branches of the federal government, including the Navy. Discussions with several U.S. Navy Supply Corps Officers indicate that whether or not this "rule" is actually codified in writing and enforced is not the issue. The fact is that most shipboard supply officers agree that the name of the game is to "spend all that is allocated to you." This attitude would no doubt skew any data collected for the purpose of analysis and make it difficult if not impossible to determine whether or not OPTAR obligation is indeed dependent upon operational employment factors.

Additionally, many supply officers queried by the author felt that if excess OPTAR funds <u>were</u> "left on the books" at the end of a fiscal year, that punitive measures would probably be taken against them. The "punitive" measures cited ranged from reprimand or damaging fitness reports from the Commanding Officer to an inability to justify and obtain future OPTAR requests (crippling the supply officer's ability to obtain emergency augments if needed). Discussions with COMNAVSURFPAC budget personnel indicate that most of the concerns of the shipboard supply officers were unfounded. As long as the type commander's budget office is informed in a timely manner (approximately one month prior to the end of the fiscal year) that excess OPTAR funds exist onboard any ship, then no such punitive measures actually exist. Any excess funds are merely "returned" by the ship to the type commander's budget office to be redistributed to other ships with high priority unfunded requirements or returned to the fleet commander for redistribution or reprogramming. When this established procedure for dealing with excess OPTAR at the end of a fiscal year was discussed with supply officers, most tended to feel that if faced with a choice of "spending the funds down to zero" at the ship level or returning excess funds to the type commander, then the choice would be to spend the funds at the shipboard level. More than one supply officer felt that although the type commander's office stated that no punitive action would be taken if excess OPTAR funds were returned prior to the end of the fiscal year, that such action would probably result in either a reduction of OPTAR allocation in the following year, or difficulties in obtaining augments at a later date if needed.

At any rate, the "spend all you get" attitude would no doubt tend to make any analysis of OPTAR obligation questionable. For example, in the analysis of homeport impact on OPTAR obligation it was found that there was no relationship between OPTAR obligation and homeport assignment. It was concluded that homeporting a ship overseas does not cost any more, in terms of OPTAR, than homeporting the same ship in a U.S. port. As alluded to earlier, such a conclusion is suspect when it is apparent that all ships, regardless of homeport, tend to obligate all OPTAR they are allocated, and since it seemed that all of the ships within a given class were allocated about the same amount of OPTAR. One could argue that if you were to give a ship homeported overseas a larger OPTAR allocation, then in all likelihood the ship would obligate all allocated funding. One could argue further that this same phenomenon would occur if a ship homeported in a U.S. port were allocated a larger share of OPTAR than the overseas units. If one accepts the "spend all you get" philosophy as being prevalent in the Navy, then the difficulties in analyzing OPTAR obligation data and drawing meaningful conclusions become obvious.

One final area of interest is the apparent difference between the two classes of ships studied with respect to the relationship that OPTAR obligation rates had with various operational employment factors. In almost every phase of the analysis, there tended to be a higher degree of correlation between OPTAR and employment factors for the cruisers than for the frigates. Although there may be numerous possible explanations for this phenomenon, the most obvious explanation as to why the cruisers show a higher degree of correlation may very well rest with the difference in experience levels of the supply officers assigned to the ships. The cruisers are normally assigned a more senior and experienced supply officer than the frigates. This difference in experience could account for the differences in the relationships found. The higher degree of correlation between OPTAR and scheduled employment for the cruisers might reflect a more sophisticated approach to managing OPTAR aboard cruisers, where not only the supply officer, but all of the senior officers assigned tend to be more seasoned and experienced than their contemporaries aboard the frigates. Although this conclusion can not be proven statistically from the data collected, it may be an area worthy of further study.

C. AREAS REQUIRING FURTHER STUDY

In addition to the above, there were several areas identified in the course of this study that could be pursued further in analyzing the relationships between OPTAR obligation and operational employment.

First, and perhaps most importantly, an analysis of the OPTAR patterns for each individual OPTAR fund code (as shown in Table IV) might prove to be beneficial. The repair parts fund codes (codes NB and NR) might show a higher degree of correlation with operational employment factors than did the aggregate OPTAR figures looked at in this thesis. Ships are not allowed to indiscriminately "stockpile" repair parts and are authorized to order repair items only when they are actually needed. This is not true of consumables which, in general, can be ordered at any time. If the repair part fund codes were isolated and studied by themselves, it is felt that spending patterns might be more readily identifiable. In any case, the rate at which a ship obligates OPTAR for repair parts probably more accurately reflects the actual needs of the ship.

The second area where further study would be appropriate relates to the "spend all that you are allocated" attitude that appears to be prevalent among most ships. To test this theory, an experiment could be conducted wherein certain ships in the study would be allocated a significantly larger OPTAR than normal for a given fiscal year, while others would be allocated somewhat less OPTAR than normal. The patterns in spending could then be monitored to determine whether the ships allocated the significantly larger OPTAR were in fact able to "come in under budget." If the "spend all that you are allocated" attitude is prevalent, then it would be expected that these ships (like most others) would "spend down to zero" rather than return excess OPTAR funds at the end of the fiscal year.

The next area where further study might be appropriate would merely be an extension of the above. A thorough study of the attitudes, practices, procedures and policies regarding the administration of OPTAR funds aboard ship might prove beneficial in identifying potential patterns in OPTAR obligation. Interviews with Commanding Officers, Supply Officers, Department Heads and other key personnel in the shipboard "fiscal" chain of command might be useful in explaining "the how and the why" of ships' OPTAR policies. It could also be useful in identifying any apparent myths regarding OPTAR that might be prevalent, such as the fear of "punishment" if not all OPTAR is obligated prior to the end of the fiscal year.

Another area for further analysis would be a study as to the feasibility of implementing a reward/incentive system within the framework of shipboard OPTAR management. Such a system would be designed to provide incentives and rewards to ships that were able to manage their OPTAR more efficiently (instead of being "punished" for having money left over at the end of a fiscal year, a ship would actually be rewarded in some fashion). The study could involve determining the appropriate measures of OPTAR efficiency, as well as proposals for providing incentives and rewards. Similar reward/incentive systems have been implemented in other Navy commands with a great deal of success.

Finally, further study as to the impact of seniority and experience on the attitudes and policies of supply officers might prove valuable. As discussed in a previous chapter, the relationship between operational employment and OPTAR obligation was much greater for the cruisers in the study than for the frigates. Since the seniority of the supply officer and other key personnel in the chain of command is the primary difference between the cruisers and the frigates (other than the inherent physical differences between the ships), it may just be that the experience and seniority of the cruiser supply officers is such that they are better able to manage their OPTAR, obligating funds in a more rational way and in a pattern that is more closely related to the employment of the ship.

Appendix A
MONTHLY SCHEDULE/EMPLOYMENT DATA
USS FOX (CG-33)

Fiscal Year 1985

	Period 1	Period 2	Period 3	DAYS U/W
OCT	MAINT	MAINT	MAINT	2
NOV	U/W	U/W	U/W	17
DEC	TRNG	INSP	UPKP	2
JAN	UPKP	U/W	TRNG	14
FEB	TRNG	U/W	INSP	19
MAR	TRNG	TRNG	TRNG	20
APR	U/W	EXER	U/W	23
MAY	MAINT	MAINT	EXER	10
JUN	EXER	INSP	UPKP	6
JUL	MAINT	UPKP	DEPL	9
AUG	DEPL	DEPL	DEPL	23
SEP	DEPL	DEPL	DEPL	26

Fiscal Year 1986

	Period 1	Period 2	Period 3	DAYS U/W
OCT	DEPL	DEPL	DEPL	30
NOV	DEPL	DEPL	DEPL	26
DEC	DEPL	DEPL	UPKP	19
JAN	UPKP	MAINT	TRNG	2
FEB	MAINT	U/W	MAINT	2
MAR	MAINT	MAINT	MAINT	0
APR	MAINT	MAINT	MAINT	0
MAY	UPKP	UPKP	U/W	3
JUN	INSP	TRNG	UPKP	5
JUL	U/W	INSP	MAINT	10
AUG	MAINT	UPKP	UPKP	2
SEP	U/W	EXER	EXER	21

Last regular overhaul completed: April 1984

Appendix A
MONTHLY SCHEDULE/EMPLOYMENT DATA
USS HORNE (CG-30)

Fiscal Year 1985

	Period 1	Period 2	Period 3	DAYS U/W
OCT	TRNG	INSP	UPKP	8
NOV	TRNG	U/W	MAINT	16
DEC	U/W	INSP	UPKP	11
JAN	MAINT	EXER	UPKP	8
FEB	U/W	TRNG	U/W	18
MAR	UPKP	MAINT	MAINT	8
APR	INSP	EXER	EXER	15
MAY	UPKP	TRNG	EXER	10
JUN	EXER	MAINT	MAINT	6
JUL	UPKP	UPKP	DEPL	12
AUG	DEPL	DEPL	DEPL	31
SEP	DEPL	DEPL	DEPL	30

Fiscal Year 1986

	Period 1	Period 2	Period 3	DAYS U/W
OCT	DEPL	DEPL	DEPL	31
NOV	DEPL	DEPL	DEPL	25
DEC	DEPL	DEPL	DEPL	18
JAN	MAINT	UPKP	UPKP	0
FEB	MAINT	INSP	U/W	5
MAR	TRNG	UPKP	MAINT	5
APR	MAINT	MAINT	MAINT	0
MAY	MAINT	MAINT	INSP	2
JUN	U/W	TRNG	EXER	14
JUL	EXER	U/W	U/W	20
AUG	MAINT	MAINT	MAINT	0
SEP	MAINT	TRNG	TRNG	5

Last regular overhaul completed: July 1982

Appendix A
MONTHLY SCHEDULE/EMPLOYMENT DATA
USS JOUETT (CG-29)

Fiscal Year 1985

	Period 1	Period 2	Period 3	DAYS U/W
OCT	DEPL	DEPL	DEPL	25
NOV	DEPL	DEPL	DEPL	22
DEC	DEPL	DEPL	DEPL	17
JAN	MAINT	MAINT	U/W	4
FEB	TRNG	MAINT	MAINT	6
MAR	MAINT	MAINT	MAINT	0
APR	MAINT	MAINT	MAINT	0
MAY	MAINT	INSP	TRNG	6
JUN	U/W	U/W	U/W	19
JUL	TRNG	U/W	EXER	15
AUG	U/W	UPKP	TRNG	12
SEP	MAINT	MAINT	MAINT	3

Fiscal Year 1986

	Period 1	Period 2	Period 3	DAYS U/W
OCT	INSP	UPKP	UPKP	7
NOV	UPKP	MAINT	MAINT	5
DEC	MAINT	MAINT	UPKP	4
JAN	UPKP	MAINT	MAINT	4
FEB	MAINT	U/W	UPKP	6
MAR	UPKP	UPKP	EXER	10
APR	EXER	MAINT	MAINT	14
MAY	MAINT	U/W	TRNG	12
JUN	EXER	EXER	EXER	24
JUL	UPKP	UPKP	UPKP	2
AUG	UPKP	DEPL	DEPL	23
SEP	DEPL	DEPL	DEPL	16

Last regular overhaul completed: July 1981

Appendix A

MONTHLY SCHEDULE/EMPLOYMENT DATA

USS WILLIAM H. STANDLEY (CG-32)

Fiscal Year 1985

	Period 1	Period 2	Period 3	DAYS U/W
OCT	DEPL	DEPL	DEPL	N/A*
NOV	DEPL	DEPL	DEPL	N/A*
DEC	U/W	UPKP	UPKP	4
JAN	UPKP	MAINT	MAINT	0
FEB	MAINT	MAINT	U/W	6
MAR	TRNG	TRNG	INSP	9
APR	MAINT	MAINT	U/W	5
MAY	UPKP	MAINT	MAINT	2
JUN	MAINT	MAINT	MAINT	0
JUL	UPKP	UPKP	UPKP	0
AUG	UPKP	UPKP	UPKP	7
SEP	U/W	U/W	UPKP	14

*info unavailable; ship assigned to CINCLANTFLT

Fiscal Year 1986

	Period 1	Period 2	Period 3	DAYS U/W
OCT	MAINT	TRNG	U/W	14
NOV	INSP	MAINT	TRNG	12
DEC	U/W	U/W	UPKP	11
JAN	MAINT	UPKP	UPKP	4
FEB	UPKP	U/W	UPKP	7
MAR	MAINT	INSP	UPKP	2
APR	EXER	EXER	EXER	18
MAY	UPKP	UPKP	TRNG	4
JUN	EXER	EXER	U/W	23
JUL	UPKP	UPKP	U/W	6
AUG	UPKP	MAINT	UPKP	4
SEP	U/W	DEPL	DEPL	10

Last regular overhaul completed: August 1983

Appendix A
MONTHLY SCHEDULE/EMPLOYMENT DATA
USS STERETT (CG-31)

Fiscal Year 1985

	Period 1	Period 2	Period 3	DAYS U/W
OCT	TRNG	TRNG	UPKP	19
NOV	U/W	EXER	EXER	19
DEC	U/W	UPKP	UPKP	9
JAN	DEPL	DEPL	DEPL	4
FEB	DEPL	DEPL	DEPL	18
MAR	DEPL	DEPL	DEPL	22
APR	UPKP	UPKP	EXER	10
MAY	UPKP	UPKP	INSP	2
JUN	DEPL	DEPL	DEPL	20
JUL	DEPL	DEPL	DEPL	30
AUG	DEPL	DEPL	DEPL	27
SEP	DEPL	U/W	MAINT	10

Fiscal Year 1986

	Period 1	Period 2	Period 3	DAYS U/W
OCT	MAINT	MAINT	MAINT	0
NOV	MAINT	MAINT	MAINT	0
DEC	MAINT	MAINT	MAINT	0
JAN	MAINT	MAINT	U/W	11
FEB	U/W	TRNG	U/W	17
MAR	DEPL	DEPL	DEPL	19
APR	DEPL	DEPL	DEPL	30
MAY	U/W	UPKP	UPKP	6
JUN	TRNG	U/W	U/W	15
JUL	MAINT	MAINT	MAINT	0
AUG	MAINT	U/W	TRNG	9
SEP	INSP	INSP	MAINT	10

Last regular overhaul completed: October 1980

Appendix A
MONTHLY SCHEDULE/EMPLOYMENT DATA
USS BADGER (FF-1071)

Fiscal Year 1985

	Period 1	Period 2	Period 3	DAYS U/W
OCT	UPKP	UPKP	EXER	9
NOV	EXER	DEPL	DEPL	24
DEC	DEPL	DEPL	UPKP	12
JAN	UPKP	U/W	UPKP	15
FEB	EXER	UPKP	MAINT	7
MAR	MAINT	INSP	U/W	9
APR	TRNG	U/W	MAINT	8
MAY	MAINT	EXER	EXER	18
JUN	EXER	U/W	TRNG	15
JUL	MAINT	U/W	UPKP	3
AUG	DEPL	DEPL	DEPL	21
SEP	DEPL	DEPL	DEPL	30

Fiscal Year 1986

	Period 1	Period 2	Period 3	DAYS U/W
OCT	DEPL	DEPL	DEPL	31
NOV	DEPL	DEPL	DEPL	25
DEC	DEPL	U/W	UPKP	10
JAN	MAINT	INSP	MAINT	0
FEB	EXER	EXER	UPKP	11
MAR	INSP	UPKP	UPKP	1
APR	INSP	DEPL	DEPL	12
MAY	DEPL	UPKP	EXER	14
JUN	MAINT	U/W	U/W	13
JUL	UPKP	U/W	U/W	14
AUG	U/W	UPKP	U/W	11
SEP	TRNG	TRNG	UPKP	2

Last regular overhaul completed: June 1982

Appendix A
MONTHLY SCHEDULE/EMPLOYMENT DATA
USS COOK (FF-1083)

Fiscal Year 1985

	Period 1	Period 2	Period 3	DAYS U/W
OCT	U/W	U/W	MAINT	16
NOV	TRNG	UPKP	UPKP	7
DEC	MAINT	INSP	UPKP	2
JAN	UPKP	MAINT	U/W	9
FEB	U/W	UPKP	TRNG	9
MAR	U/W	U/W	INSP	16
APR	TRNG	EXER	UPKP	15
MAY	UPKP	INSP	EXER	13
JUN	EXER	UPKP	UPKP	6
JUL	UPKP	UPKP	DEPL	8
AUG	DEPL	DEPL	DEPL	26
SEP	DEPL	DEPL	DEPL	29

Fiscal Year 1986

	Period 1	Period 2	Period 3	DAYS U/W
OCT	DEPL	DEPL	DEPL	31
NOV	DEPL	DEPL	DEPL	25
DEC	DEPL	DEPL	DEPL	18
JAN	MAINT	MAINT	U/W	7
FEB	UPKP	UPKP	TRNG	1
MAR	UPKP	U/W	UPKP	13
APR	UPKP	UPKP	UPKP	5
MAY	MAINT	MAINT	MAINT	2
JUN	MAINT	MAINT	MAINT	0
JUL	MAINT	MAINT	MAINT	1
AUG	MAINT	MAINT	MAINT	0
SEP	MAINT	U/W	U/W	9

Last regular overhaul completed: September 1984

Appendix A
MONTHLY SCHEDULE/EMPLOYMENT DATA
USS DOWNES (FF-1070)

Fiscal Year 1985

	Period 1	Period 2	Period 3	DAYS U/W
OCT	MAINT	MAINT	EXER	11
NOV	EXER	EXER	EXER	25
DEC	DEPL	DEPL	DEPL	13
JAN	DEPL	DEPL	DEPL	29
FEB	DEPL	DEPL	DEPL	20
MAR	DEPL	DEPL	DEPL	29
APR	DEPL	DEPL	DEPL	23
MAY	DEPL	DEPL	DEPL	21
JUN	UPKP	UPKP	MAINT	0
JUL	MAINT	TRNG	TRNG	10
AUG	UPKP	U/W	MAINT	7
SEP	MAINT	MAINT	MAINT	0

Fiscal Year 1986

	Period 1	Period 2	Period 3	DAYS U/W
OCT	MAINT	MAINT	INSP	7
NOV	TRNG	UPKP	TRNG	10
DEC	INSP	INSP	UPKP	8
JAN	UPKP	UPKP	U/W	14
FEB	MAINT	MAINT	MAINT	0
MAR	U/W	MAINT	MAINT	4
APR	U/W	U/W	UPKP	21
MAY	UPKP	UPKP	U/W	12
JUN	U/W	TRNG	INSP	10
JUL	MAINT	UPKP	TRNG	9
AUG	UPKP	MAINT	MAINT	3
SEP	UPKP	EXER	EXER	20

Last regular overhaul completed: December 1983

Appendix A

MONTHLY SCHEDULE/EMPLOYMENT DATA

USS FANNING (FF-1076)

Fiscal Year 1985

	Period 1	Period 2	Period 3	DAYS U/W
OCT	EXER	EXER	EXER	25
NOV	EXER	UPKP	UPKP	9
DEC	UPKP	EXER	UPKP	7
JAN	UPKP	UPKP	EXER	11
FEB	UPKP	UPKP	DEPL	8
MAR	DEPL	DEPL	DEPL	22
APR	DEPL	DEPL	DEPL	14
MAY	DEPL	DEPL	DEPL	22
JUN	DEPL	DEPL	DEPL	30
JUL	DEPL	DEPL	DEPL	24
AUG	DEPL	DEPL	UPKP	29
SEP	UPKP	UPKP	U/W	7

Fiscal Year 1986

	Period 1	Period 2	Period 3	DAYS U/W
OCT	U/W	U/W	U/W	25
NOV	UPKP	UPKP	MAINT	1
DEC	MAINT	MAINT	MAINT	0
JAN	MAINT	MAINT	MAINT	0
FEB	MAINT	UPKP	UPKP	7
MAR	UPKP	U/W	UPKP	10
APR	U/W	INSP	UPKP	12
MAY	UPKP	UPKP	EXER	11
JUN	EXER	U/W	INSP	10
JUL	MAINT	TRNG	INSP	10
AUG	MAINT	TRNG	MAINT	0
SEP	UPKP	EXER	EXER	18

Last regular overhaul completed: March 1984

Appendix A
MONTHLY SCHEDULE/EMPLOYMENT DATA
USS FRANCIS HAMMOND (FF-1067)

Fiscal Year 1985

	Period 1	Period 2	Period 3	DAYS U/W
OCT	OVHL	OVHL	OVHL	0
NOV	OVHL	OVHL	OVHL	0
DEC	OVHL	OVHL	OVHL	0
JAN	OVHL	OVHL	OVHL	0
FEB	OVHL	OVHL	OVHL	0
MAR	OVHL	OVHL	OVHL	0
APR	OVHL	OVHL	OVHL	0
MAY	OVHL	OVHL	OVHL	6
JUN	OVHL	OVHL	OVHL	3
JUL	U/W	U/W	U/W	24
AUG	U/W	U/W	UPKP	13
SEP	TRNG	TRNG	UPKP	9

Fiscal Year 1986

	Period 1	Period 2	Period 3	DAYS U/W
OCT	U/W	TRNG	INSP	16
NOV	TRNG	TRNG	UPKP	17
DEC	INSP	U/W	UPKP	7
JAN	UPKP	INPS	DEPL	13
FEB	DEPL	DEPL	DEPL	30
MAR	DEPL	DEPL	DEPL	26
APR	U/W	UPKP	UPKP	10
MAY	UPKP	UPKP	UPKP	3
JUN	U/W	U/W	U/W	27
JUL	UPKP	UPKP	U/W	8
AUG	UPKP	U/W	EXER	17
SEP	U/W	UPKP	UPKP	6

Last regular overhaul completed: June 1985

Appendix A
MONTHLY SCHEDULE/EMPLOYMENT DATA
USS KIRK (FF-1087)

Fiscal Year 1985

	Period 1	Period 2	Period 3	DAYS U/W
OCT	MAINT	INSP	U/W	8
NOV	U/W	U/W	EXER	24
DEC	U/W	UPKP	UPKP	7
JAN	MAINT	TRNG	TRNG	7
FEB	U/W	U/W	U/W	23
MAR	UPKP	U/W	UPKP	21
APR	INSP	U/W	UPKP	16
MAY	UPKP	U/W	U/W	15
JUN	UPKP	U/W	UPKP	18
JUL	DEPL	DEPL	DEPL	31
AUG	DEPL	DEPL	DEPL	25
SEP	DEPL	DEPL	DEPL	20

Fiscal Year 1986

	Period 1	Period 2	Period 3	DAYS U/W
OCT	UPKP	U/W	UPKP	17
NOV	TRNG	INSP	U/W	16
DEC	U/W	INSP	UPKP	11
JAN	U/W	U/W	U/W	25
FEB	MAINT	MAINT	MAINT	1
MAR	MAINT	MAINT	MAINT	0
APR	MAINT	MAINT	UPKP	4
MAY	UPKP	TRNG	TRNG	16
JUN	U/W	EXER	UPKP	15
JUL	TRNG	EXER	EXER	21
AUG	U/W	TRNG	U/W	20
SEP	UPKP	UPKP	TRNG	7

Last regular overhaul completed: November 1982

Appendix A
MONTHLY SCHEDULE/EMPLOYMENT DATA
USS KNOX (FF-1052)

Fiscal Year 1985

	Period 1	Period 2	Period 3	DAYS U/W
OCT	INSP	UPKP	U/W	15
NOV	UPKP	U/W	U/W	23
DEC	U/W	UPKP	MAINT	7
JAN	MAINT	MAINT	MAINT	0
FEB	MAINT	MAINT	MAINT	0
MAR	MAINT	INSP	U/W	9
APR	UPKP	INSP	UPKP	6
MAY	UPKP	U/W	U/W	16
JUN	UPKP	U/W	UPKP	18
JUL	DEPL	DEPL	DEPL	30
AUG	DEPL	DEPL	DEPL	29
SEP	DEPL	DEPL	DEPL	24

Fiscal Year 1986

	Period 1	Period 2	Period 3	DAYS U/W
OCT	UPKP	U/W	UPKP	9
NOV	INSP	U/W	INSP	16
DEC	U/W	UPKP	UPKP	11
JAN	UPKP	U/W	UPKP	5
FEB	U/W	U/W	UPKP	21
MAR	U/W	U/W	U/W	23
APR	TRNG	UPKP	U/W	5
MAY	TRNG	U/W	UPKP	9
JUN	U/W	INSP	U/W	16
JUL	U/W	UPKP	UPKP	11
AUG	UPKP	UPKP	EXER	11
SEP	U/W	U/W	UPKP	7

Last regular overhaul completed: July 1981

Appendix A
MONTHLY SCHEDULE/EMPLOYMENT DATA
USS LOCKWOOD (FF-1064)

Fiscal Year 1985

	Period 1	Period 2	Period 3	DAYS U/W
OCT	UPKP	U/W	UPKP	11
NOV	U/W	U/W	EXER	26
DEC	U/W	UPKP	UPKP	6
JAN	UPKP	UPKP	UPKP	5
FEB	U/W	U/W	UPKP	19
MAR	U/W	U/W	UPKP	20
APR	U/W	UPKP	UPKP	4
MAY	TRNG	U/W	OVHL	10
JUN	OVHL	OVHL	OVHL	0
JUL	OVHL	OVHL	OVHL	0
AUG	OVHL	OVHL	OVHL	0
SEP	OVHL	OVHL	OVHL	0

Fiscal Year 1986

	Period 1	Period 2	Period 3	DAYS U/W
OCT	OVHL	OVHL	OVHL	0
NOV	OVHL	OVHL	OVHL	3
DEC	OVHL	OVHL	OVHL	2
JAN	OVHL	OVHL	OVHL	0
FEB	UPKP	U/W	TRNG	6
MAR	U/W	EXER	UPKP	19
APR	UPKP	TRNG	TRNG	19
MAY	TRNG	UPKP	TRNG	16
JUN	UPKP	UPKP	INSP	13
JUL	TRNG	UPKP	U/W	11
AUG	UPKP	UPKP	TRNG	11
SEP	TRNG	U/W	UPKP	9

Last regular overhaul completed: June 1980

Appendix A
MONTHLY SCHEDULE/EMPLOYMENT DATA
USS STEIN (FF-1075)

Fiscal Year 1985

	Period 1	Period 2	Period 3	DAYS U/W
OCT	UPKP	MAINT	MAINT	8
NOV	MAINT	MAINT	INSP	8
DEC	UPKP	UPKP	UPKP	1
JAN	UPKP	MAINT	MAINT	0
FEB	UPKP	UPKP	U/W	8
MAR	U/W	UPKP	INSP	13
APR	MAINT	INSP	MAINT	6
MAY	MAINT	MAINT	MAINT	0
JUN	MAINT	MAINT	MAINT	0
JUL	MAINT	MAINT	TRNG	6
AUG	U/W	U/W	U/W	19
SEP	U/W	EXER	U/W	22

Fiscal Year 1986

	Period 1	Period 2	Period 3	DAYS U/W
OCT	U/W	MAINT	U/W	8
NOV	TRNG	INSP	INSP	13
DEC	TRNG	TRNG	UPKP	0
JAN	UPKP	UPKP	EXER	11
FEB	UPKP	TRNG	EXER	10
MAR	EXER	UPKP	UPKP	9
APR	UPKP	MAINT	MAINT	0
MAY	MAINT	MAINT	MAINT	0
JUN	UPKP	TRNG	U/W	7
JUL	UPKP	UPKP	TRNG	8
AUG	UPKP	UPKP	TRNG	6
SEP	INSP	UPKP	EXER	17

Last regular overhaul completed: May 1981

Appendix A
MONTHLY SCHEDULE/EMPLOYMENT DATA
USS WHIPPLE (FF-1062)

Fiscal Year 1985

	Period 1	Period 2	Period 3	DAYS U/W
OCT	OVHL	OVHL	OVHL	0
NOV	OVHL	OVHL	OVHL	0
DEC	OVHL	OVHL	OVHL	0
JAN	OVHL	OVHL	OVHL	0
FEB	OVHL	OVHL	OVHL	0
MAR	OVHL	OVHL	OVHL	2
APR	OVHL	TRNG	TRNG	1
MAY	UPKP	U/W	UPKP	15
JUN	UPKP	U/W	U/W	14
JUL	TRNG	U/W	U/W	21
AUG	UPKP	U/W	INSP	10
SEP	UPKP	UPKP	EXER	5

Fiscal Year 1986

	Period 1	Period 2	Period 3	DAYS U/W
OCT	UPKP	INSP	INSP	1
NOV	UPKP	U/W	UPKP	9
DEC	INSP	UPKP	UPKP	0
JAN	U/W	UPKP	EXER	11
FEB	UPKP	EXER	UPKP	6
MAR	UPKP	UPKP	DEPL	9
APR	DEPL	DEPL	DEPL	19
MAY	DEPL	DEPL	DEPL	26
JUN	DEPL	DEPL	DEPL	26
JUL	DEPL	DEPL	DEPL	25
AUG	DEPL	DEPL	DEPL	18
SEP	UPKP	UPKP	UPKP	0

Last regular overhaul completed: April 1985

Appendix B

MONTHLY OPTAR OBLIGATION DATA

USS FOX (CG-33)

Fiscal Year 1985

	Period 1	Period 2	Period 3	Total
OCT	34211	146562	61431	242205
NOV	131678	34702	58024	224405
DEC	32530	76902	74107	183540
JAN	251509	68245	116743	436498
FEB	66380	180657	80033	327070
MAR	42838	(37593)	176689	181934
APR	86687	93210	60213	240110
MAY	95069	142960	76156	314186
JUN	135330	75399	53378	264048
JUL	105009	147139	58120	310268
AUG	2767	40767	184491	228026
SEP	(19767)	80867	100682	161782

FY 85 Total $ 3114072

Fiscal Year 1986

	Period 1	Period 2	Period 3	Total
OCT	94969	38030	57657	190637
NOV	53947	89520	104253	247721
DEC	73384	20820	36603	130808
JAN	59435	152972	14881	227290
FEB	77545	31237	47028	155811
MAR	20443	39237	(29761)	29918
APR	31941	31557	23187	86687
MAY	46740	(7662)	121588	160666
JUN	75504	87685	41627	204818
JUL	38654	89435	3100	131191
AUG	10561	52066	44507	107134
SEP	68599	75202	406645	550448

FY 86 Total $ 2223129

Appendix B

MONTHLY OPTAR OBLIGATION DATA

USS HORNE (CG-30)

Fiscal Year 1985

	Period 1	Period 2	Period 3	Total
OCT	$122063	90161	168927	381151
NOV	128411	27755	47892	204058
DEC	56440	70177	72389	199008
JAN	126411	188278	130831	445522
FEB	72428	38967	41371	152768
MAR	49166	51709	105652	206498
APR	344060	145278	83990	573328
MAY	128524	153457	(1044)	280837
JUN	167443	198747	93377	459568
JUL	(11211)	164665	(50687)	102766
AUG	243575	146176	54562	444314
SEP	65725	88551	180131	334408
			FY 85 Total	$3784226

Fiscal Year 1986

	Period 1	Period 2	Period 3	Total
OCT	95561	116966	82512	295040
NOV	79370	35939	56310	171621
DEC	73171	37084	(4100)	106155
JAN	78044	48558	75259	201862
FEB	64644	104553	4505	173703
MAR	62787	101458	46260	210506
APR	54021	60857	58265	173144
MAY	49278	29343	48002	126624
JUN	42885	115247	24071	182204
JUL	45907	11888	248922	306717
AUG	24692	47604	79107	151403
SEP	92590	181525	192165	466281
			FY 86 Total	$2565260

Appendix B

MONTHLY OPTAR OBLIGATION DATA

USS JOUETT (CG-29)

Fiscal Year 1985

	Period 1	Period 2	Period 3	Total
OCT	127200	371985	136023	635209
NOV	91481	31113	83371	205966
DEC	122674	17508	859	141042
JAN	37254	84100	69773	188985
FEB	62756	41832	39377	143966
MAR	47733	35329	14454	97517
APR	93732	45106	81517	220356
MAY	66227	46235	84542	197006
JUN	71628	33415	22713	127758
JUL	70959	73794	102948	247702
AUG	40386	97120	192544	330051
SEP	57105	83495	16886	157487

FY 85 Total $ 2693045

Fiscal Year 1986

	Period 1	Period 2	Period 3	Total
OCT	167569	44423	82082	294075
NOV	81261	43656	51777	176694
DEC	59557	37531	777	97867
JAN	72525	116265	99843	288634
FEB	103508	59547	88517	251574
MAR	25364	110772	17438	153575
APR	195343	83353	102261	380958
MAY	111566	41324	33578	186469
JUN	109705	77268	41147	228121
JUL	82631	73746	107539	236916
AUG	112619	38517	74209	225346
SEP	14244	24305	41724	3194

FY 86 Total $ 2523423

Appendix B

MONTHLY OPTAR OBLIGATION DATA

USS WILLIAM H. STANDLEY (CG-32)

Fiscal Year 1985

	Period 1	Period 2	Period 3	Total
OCT	134998	94473	70418	299890
NOV	44191	58752	85477	188421
DEC	32795	26225	13099	72121
JAN	75927	25217	57260	158405
FEB	98445	39916	68958	207321
MAR	86946	128115	20069	235131
APR	167760	18540	30130	216430
MAY	63263	65308	59168	187740
JUN	52967	81309	21110	155388
JUL	56855	93915	151506	302277
AUG	220414	20206	330473	571094
SEP	100470	37663	55174	193308

FY 85 Total $ 2787526

Fiscal Year 1986

	Period 1	Period 2	Period 3	Total
OCT	103393	156732	114646	374772
NOV	98839	39073	69133	207046
DEC	22794	63733	31294	117822
JAN	3171	12251	87575	102999
FEB	85108	69128	134977	289214
MAR	122980	70124	43332	236437
APR	200624	68990	49306	318921
MAY	69241	29786	118743	217771
JUN	43522	36556	45611	125691
JUL	90180	67165	98443	255790
AUG	62617	36427	76590	175635
SEP	40265	113724	22695	176686

FY 86 Total $ 2598784

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MONTHLY OPTAR OBLIGATION DATA

USS STERETT (CG-31)

Fiscal Year 1985

	Period 1	Period 2	Period 3	Total
OCT	175994	64617	91286	331897
NOV	70611	126269	48153	245033
DEC	105722	60245	31644	197611
JAN	38591	45077	211190	294858
FEB	107802	87080	92811	287693
MAR	65797	133461	103446	302705
APR	63345	122721	15689	201757
MAY	77312	36639	212091	326043
JUN	149747	119244	10389	279381
JUL	55076	111545	117981	284603
AUG	107814	56770	135041	299627
SEP	60479	16573	68740	145792

FY 85 Total $ 3197000

Fiscal Year 1986

	Period 1	Period 2	Period 3	Total
OCT	108268	12592	142628	263489
NOV	16763	78385	92491	187641
DEC	134174	79900	377968	592041
JAN	157172	137512	197210	491895
FEB	68508	111235	17155	196899
MAR	67498	99711	66843	234053
APR	139966	43847	29115	212930
MAY	19789	67860	61085	148735
JUN	141109	127932	74994	344036
JUL	32928	8002	87781	62855
AUG	26180	100162	62977	194320
SEP	193679	22726	100673	317079

FY 86 Total $ 3245973

Appendix B

MONTHLY OPTAR OBLIGATION DATA

USS BADGER (FF-1071)

Fiscal Year 1985

	Period 1	Period 2	Period 3	Total
OCT	53055	50613	43871	147540
NOV	30743	27897	31524	90165
DEC	20705	14873	168	35747
JAN	27005	79496	25272	131776
FEB	41291	20940	26677	88909
MAR	33279	39423	27857	100560
APR	49606	59966	43262	152835
MAY	31300	20104	26585	77989
JUN	90298	21913	8710	120923
JUL	54962	43984	3200	102147
AUG	21747	62463	13581	97792
SEP	12894	10941	13531	37366

FY 85 Total $ 1183749

Fiscal Year 1986

	Period 1	Period 2	Period 3	Total
OCT	57803	32381	24345	114530
NOV	45953	21703	6990	74647
DEC	20172	4762	6582	31516
JAN	21132	21631	59534	102298
FEB	66391	46298	4467	117157
MAR	41764	17358	31524	90647
APR	36681	16410	7922	61014
MAY	41513	30658	19621	91792
JUN	35495	38826	20844	95166
JUL	19513	6705	41995	68214
AUG	46144	2196	48723	97064
SEP	17702	1699	17878	37281

FY 86 Total $ 981326

Appendix B

MONTHLY OPTAR OBLIGATION DATA

USS COOK (FF-1083)

Fiscal Year 1985

	Period 1	Period 2	Period 3	Total
OCT	20472	26979	20702	68153
NOV	49828	8392	21597	79818
DEC	34535	29822	7431	71790
JAN	32522	39802	30126	102451
FEB	18420	4824	15559	38805
MAR	26426	15457	23002	64886
APR	67296	73913	9761	150971
MAY	70326	60728	16520	147575
JUN	22394	22567	58303	103265
JUL	25037	51339	16700	93077
AUG	111988	33557	31506	177052
SEP	31899	18339	66939	117175

FY 85 Total $ 1215018

Fiscal Year 1986

	Period 1	Period 2	Period 3	Total
OCT	14283	29490	14239	57932
NOV	42678	47901	20188	110768
DEC	23457	3497	733	27688
JAN	23796	15028	19118	57944
FEB	16020	27581	22073	65675
MAR	14715	40719	2558	57992
APR	44319	34980	9984	89284
MAY	22403	5618	6072	34093
JUN	22403	5618	6072	34093
JUL	12029	19532	21903	53465
AUG	31821	59205	62733	153760
SEP	26872	35628	94872	157373

FY 86 Total $ 900067

Appendix B

MONTHLY OPTAR OBLIGATION DATA

USS DOWNES (FF-1070)

Fiscal Year 1985

	Period 1	Period 2	Period 3	Total
OCT	99193	31479	75028	205700
NOV	5026	39728	29215	73969
DEC	39463	20179	73143	132786
JAN	27118	36085	54807	118011
FEB	73313	21601	2677	97592
MAR	25704	(1620)	44809	68892
APR	88121	15320	15497	118939
MAY	11619	30869	(17016)	25472
JUN	21508	31440	8629	61578
JUL	60234	60609	16312	137155
AUG	1402	12086	20090	33579
SEP	15284	62689	25665	103638
			FY 85 Total	$ 1177311

Fiscal Year 1986

	Period 1	Period 2	Period 3	Total
OCT	24965	28154	45405	98524
NOV	51548	30642	9085	91276
DEC	40022	25940	33886	99849
JAN	37166	45833	56153	139153
FEB	3361	40459	12744	56564
MAR	5813	9598	5098	20509
APR	53684	64151	14969	132806
MAY	39293	14270	122	53686
JUN	(18523)	25143	(180495)	(173875)
JUL	64929	99635	184	164748
AUG	32003	17583	39642	89229
SEP	20195	54298	38387	112881
			FY 86 Total	$ 883350

Appendix B

MONTHLY OPTAR OBLIGATION DATA

USS FANNING (FF-1076)

Fiscal Year 1985

	Period 1	Period 2	Period 3	Total
OCT	20152	30120	39318	89590
NOV	30552	50577	29134	110264
DEC	23273	33231	17547	74052
JAN	32519	19623	107337	159479
FEB	85182	26562	17510	129255
MAR	44736	10449	20534	75720
APR	25719	75867	38786	140373
MAY	18030	19879	28706	66616
JUN	16334	39321	16974	72629
JUL	62717	38404	24138	125259
AUG	20687	9752	7945	38385
SEP	2523	39765	1564	43852

FY 85 Total $ 1125474

Fiscal Year 1986

	Period 1	Period 2	Period 3	Total
OCT	37838	56243	27451	121532
NOV	18274	36847	17722	72843
DEC	20148	12397	5252	37799
JAN	27937	25674	36063	89676
FEB	35717	23437	34640	93796
MAR	28062	10397	9324	47784
APR	84431	40095	27192	151718
MAY	48180	17883	17018	83082
JUN	25093	14862	8906	48862
JUL	34169	33484	2081	69735
AUG	33349	7347	38277	78974
SEP	33518	16513	10700	60732

FY 86 Total $ 956533

Appendix B

MONTHLY OPTAR OBLIGATION DATA

USS FRANCIS HAMMOND (FF-1067)

Fiscal Year 1985

	Period 1	Period 2	Period 3	Total
OCT	16686	51319	90788	158795
NOV	21588	14728	7493	43810
DEC	54756	5062	10362	70180
JAN	17833	12150	19858	49842
FEB	19940	10087	28352	58380
MAR	564	122593	14645	137803
APR	18123	26777	17121	62022
MAY	37497	19482	4624	61604
JUN	43151	13767	13749	70668
JUL	27310	34385	33099	94794
AUG	55733	27558	67495	150787
SEP	73955	53415	105290	232661

FY 85 Total $ 1191346

Fiscal Year 1986

	Period 1	Period 2	Period 3	Total
OCT	12905	18056	45065	76027
NOV	29305	11702	5345	46354
DEC	9837	8149	12655	30642
JAN	27021	88146	29335	144502
FEB	26686	17231	18956	62873
MAR	54522	21564	20503	96589
APR	25576	20073	8328	53977
MAY	12976	5291	65034	83303
JUN	(23146)	33796	22180	32830
JUL	39834	10441	70691	120967
AUG	15153	29060	24176	68390
SEP	30935	7240	89383	127559

FY 86 Total $ 944013

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MONTHLY OPTAR OBLIGATION DATA

USS KIRK (FF-1087)

Fiscal Year 1985

	Period 1	Period 2	Period 3	Total
OCT	7918	24806	15132	47856
NOV	25618	13520	13711	52851
DEC	27907	76567	8912	113386
JAN	30721	40168	21581	92471
FEB	22448	31448	22973	76871
MAR	6311	28951	37704	72967
APR	46253	28223	15119	89596
MAY	33430	15613	22188	71230
JUN	21210	51744	13957	86912
JUL	16714	30491	37004	84210
AUG	41366	65175	40960	147502
SEP	115542	20280	10802	146626

FY 85 Total $ 1082478

Fiscal Year 1986

	Period 1	Period 2	Period 3	Total
OCT	20451	23412	21551	65414
NOV	27655	35053	31303	94012
DEC	181044	(150091)	80182	111135
JAN	144939	32492	24619	202051
FEB	23262	19054	42361	84677
MAR	17331	33020	1702	52054
APR	6225	37904	19489	63620
MAY	9864	8031	32513	50409
JUN	29600	54348	8159	92107
JUL	26107	24966	22669	73743
AUG	61623	(18786)	4277	47114
SEP	34321	18216	4392	48145

FY 86 Total $ 984481

Appendix B

MONTHLY OPTAR OBLIGATION DATA

USS KNOX (FF-1052)

Fiscal Year 1985

	Period 1	Period 2	Period 3	Total
OCT	23682	36625	31978	92286
NOV	57458	22741	18084	98284
DEC	25323	6913	8162	40399
JAN	18738	19925	55150	93814
FEB	32955	51266	30333	114555
MAR	16754	65712	11791	94258
APR	30860	155765	34279	220905
MAY	32894	45101	33214	111210
JUN	9727	26111	(37941)	(2102)
JUL	44339	34790	40565	119695
AUG	98204	42177	55165	195546
SEP	(5560)	31151	65517	91108

FY 85 Total $ 1269958

Fiscal Year 1986

	Period 1	Period 2	Period 3	Total
OCT	95761	19987	25162	140911
NOV	77311	23668	33375	134356
DEC	38324	13285	10177	61787
JAN	14938	15169	46325	76433
FEB	20404	30274	9217	59895
MAR	65733	40040	28460	134234
APR	30054	22082	28658	80794
MAY	30351	10876	17021	58249
JUN	27792	(18228)	23773	33517
JUL	39412	40095	30963	110471
AUG	24917	82840	28909	136667
SEP	49346	13971	20233	83550

FY 86 Total $ 1110864

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MONTHLY OPTAR OBLIGATION DATA

USS LOCKWOOD (FF-1064)

Fiscal Year 1985

	Period 1	Period 2	Period 3	Total
OCT	39193	44713	29598	113505
NOV	19800	28567	35868	84235
DEC	39226	24033	8073	71332
JAN	28381	43034	80488	151904
FEB	(1903)	54806	140020	192923
MAR	7824	38092	9344	55262
APR	99425	8007	45143	152567
MAY	31822	31864	8906	72593
JUN	13655	29066	5342	48064
JUL	42517	15690	140	58348
AUG	40585	21360	27615	89561
SEP	1348	25553	24211	51113

FY 85 Total $ 1141407

Fiscal Year 1986

	Period 1	Period 2	Period 3	Total
OCT	39667	128747	33442	201857
NOV	16416	23914	12602	52934
DEC	5169	23686	586	29442
JAN	11143	15809	18358	45312
FEB	22714	25127	13634	61467
MAR	50882	23052	2733	76666
APR	16470	25592	33414	75477
MAY	12128	41165	16039	69333
JUN	11697	19841	9436	40975
JUL	41040	11649	8904	61594
AUG	27233	36592	4179	68005
SEP	26418	60657	57886	144962

FY 86 Total $ 928024

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MONTHLY OPTAR OBLIGATION DATA

USS STEIN (FF-1065)

Fiscal Year 1985

	Period 1	Period 2	Period 3	Total
OCT	47183	47797	26080	121058
NOV	50619	28792	26201	105614
DEC	13501	8817	654	22974
JAN	64232	16673	69963	150870
FEB	15451	56485	15431	87368
MAR	64058	36856	16864	117779
APR	66037	29907	4967	100912
MAY	20070	34422	26927	81419
JUN	39479	5610	21556	66646
JUL	36506	94943	5788	137238
AUG	23310	(8272)	41463	56501
SEP	49550	66893	47713	164158

FY 85 Total $ 1212537

Fiscal Year 1986

	Period 1	Period 2	Period 3	Total
OCT	50200	15759	70771	136732
NOV	28819	17387	13358	59565
DEC	23647	22807	5528	51984
JAN	16129	21617	37509	75255
FEB	60171	75673	9078	144923
MAR	(8917)	9173	25135	25392
APR	10472	14462	35869	60804
MAY	28273	24439	37953	90666
JUN	13856	12729	15560	42147
JUL	34567	21608	48556	304741
AUG	46683	18141	51482	116307
SEP	40792	21953	68573	131318

FY 86 Total $ 1239834

Appendix B

MONTHLY OPTAR OBLIGATION DATA

USS WHIPPLE (FF-1062)

Fiscal Year 1985

	Period 1	Period 2	Period 3	Total
OCT	156803	23561	17925	198288
NOV	28172	5230	12460	45864
DEC	8931	360102	11234	380269
JAN	18018	28804	37847	84670
FEB	26193	26571	14494	67258
MAR	13504	27066	20416	60986
APR	22355	54556	15498	92409
MAY	38184	7097	22258	67539
JUN	53473	8251	22596	84321
JUL	11176	21916	41303	74396
AUG	40979	17162	44198	102340
SEP	14813	15977	27234	58025

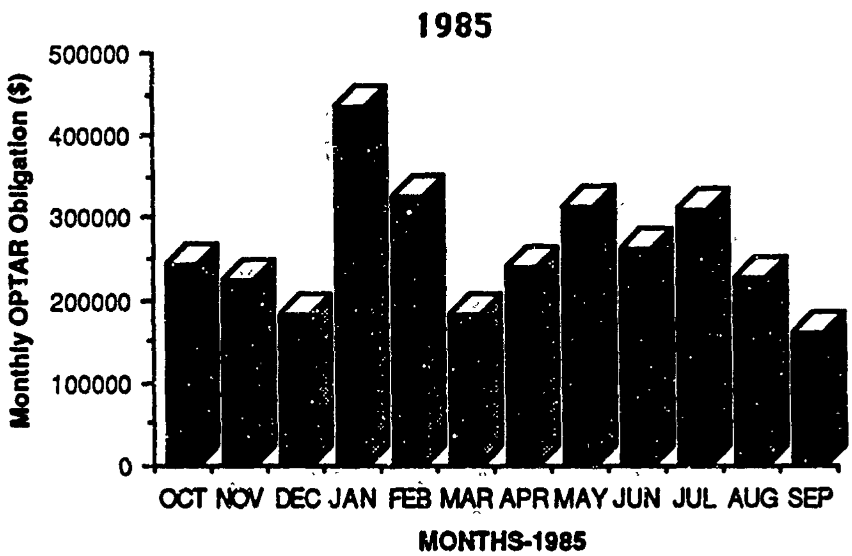
FY 85 Total $ 1316365

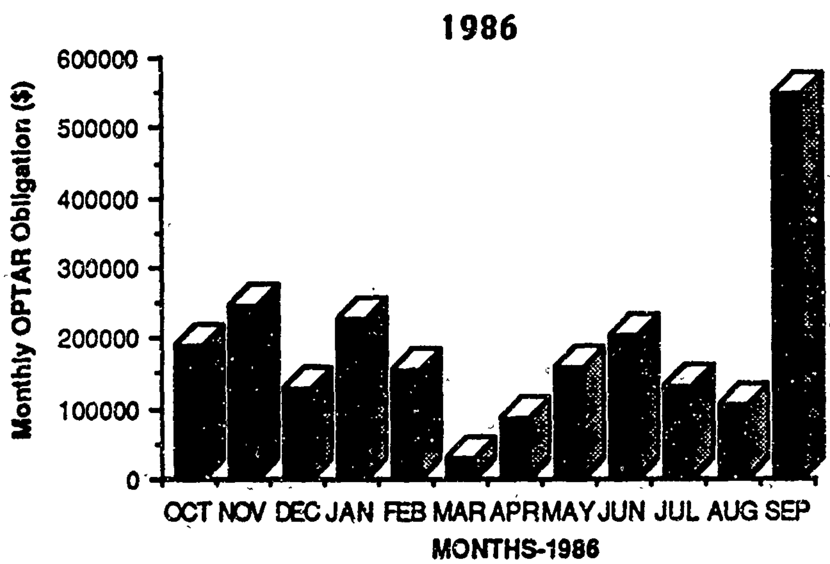
Fiscal Year 1986

	Period 1	Period 2	Period 3	Total
OCT	23738	54829	64401	142969
NOV	43696	21277	13029	78003
DEC	18503	3976	23386	45857
JAN	43098	25832	87299	156230
FEB	39888	27747	33126	100764
MAR	4959	2806	24320	32085
APR	34087	41840	17891	93818
MAY	43812	28853	17157	89823
JUN	25144	25144	25144	75433
JUL	52081	15966	32961	101008
AUG	23154	41037	11177	75369
SEP	1845	22127	29875	53848

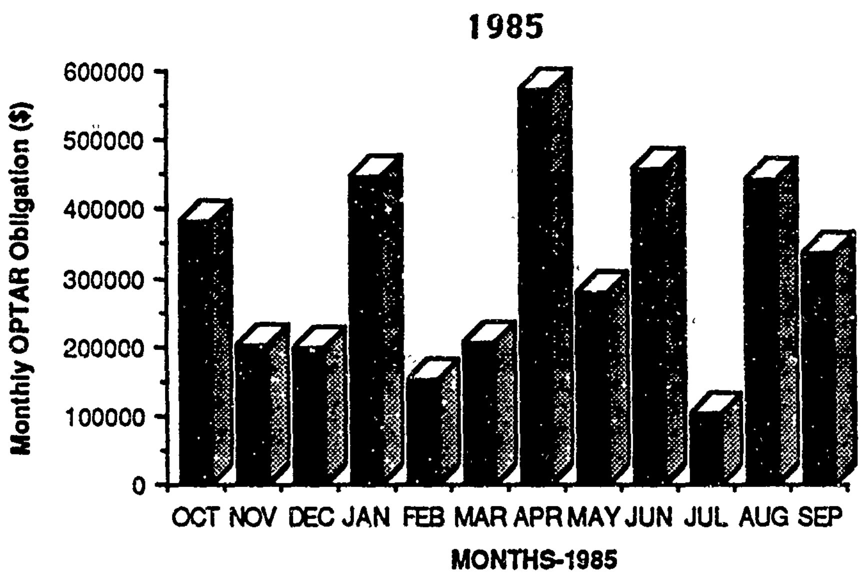
FY 86 Total $ 1045207

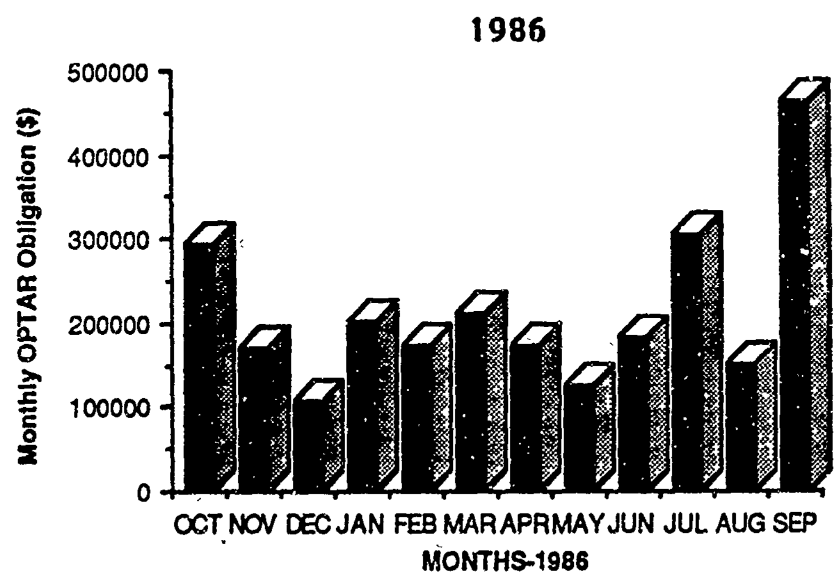
Appendix C
OPTAR OBLIGATION GRAPHS
USS FOX (CG-33)



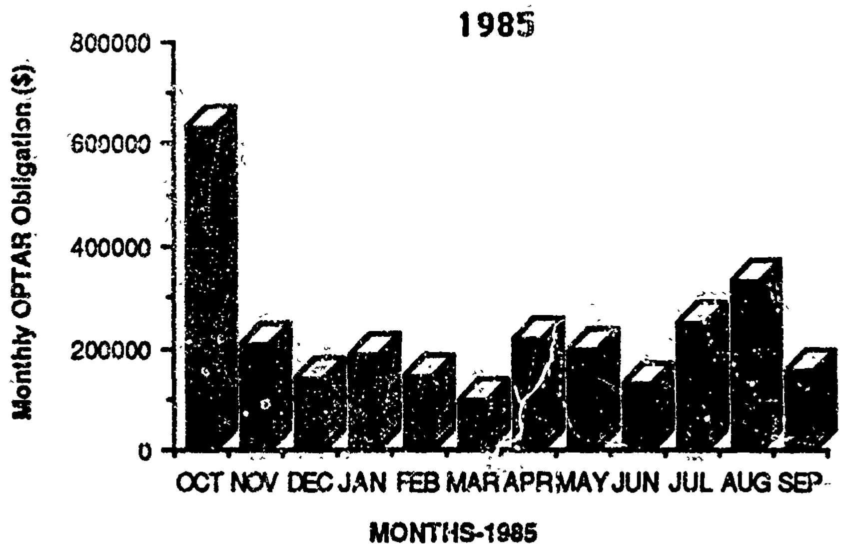


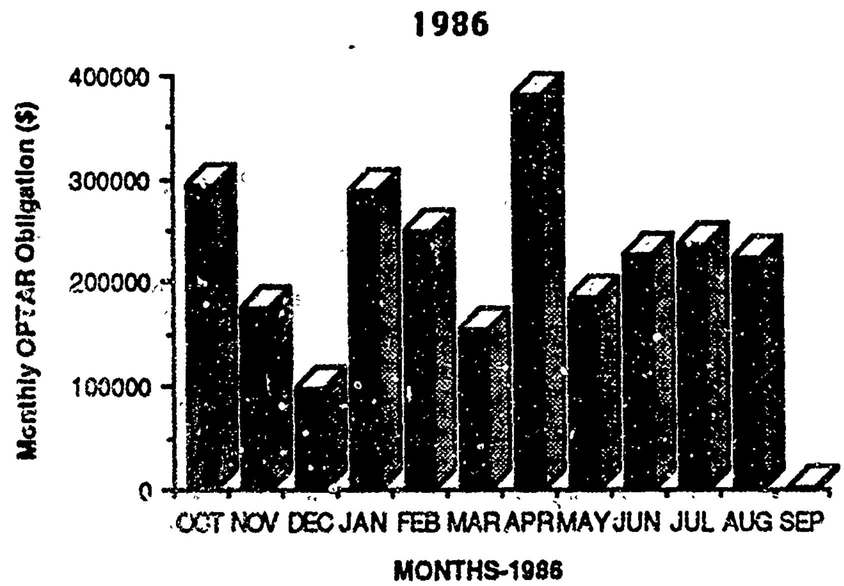
Appendix C
OPTAR OBLIGATION GRAPHS
USS HORNE (CG-30)



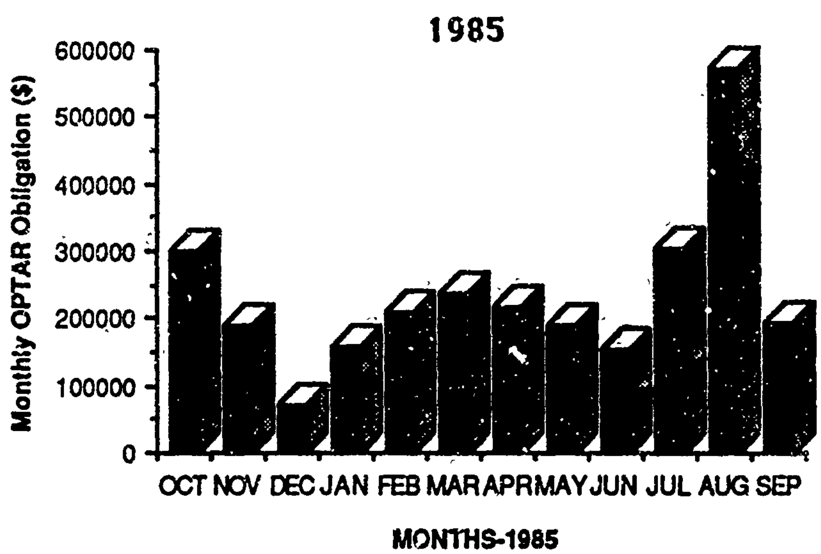


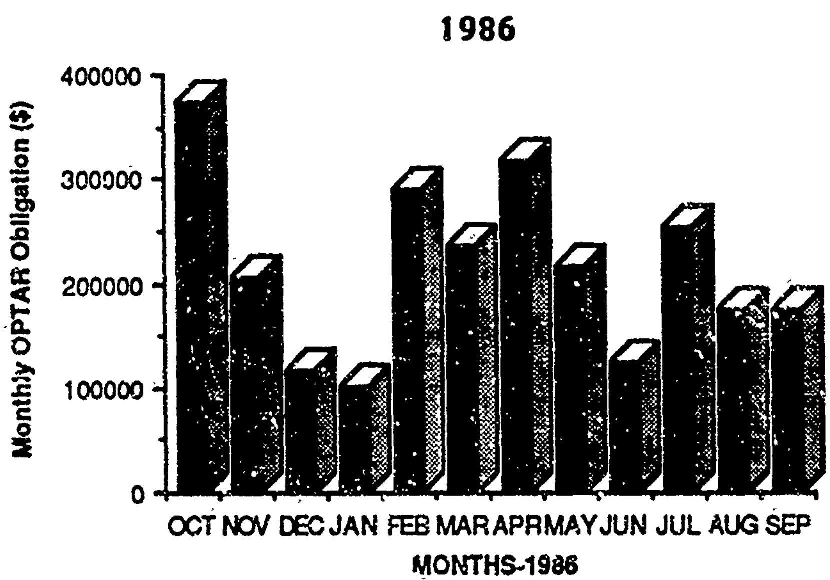
Appendix C
OPTAR OBLIGATION GRAPHS
USS JOUETT (CG-29)



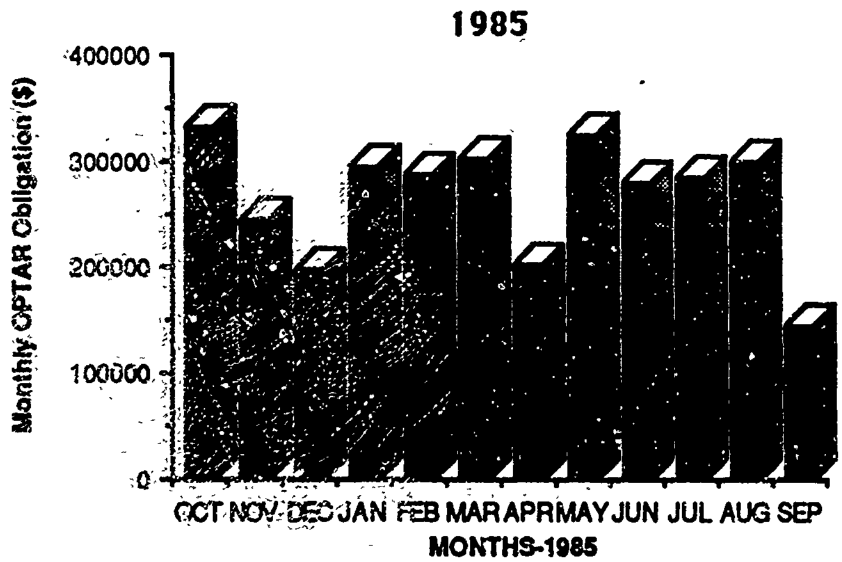


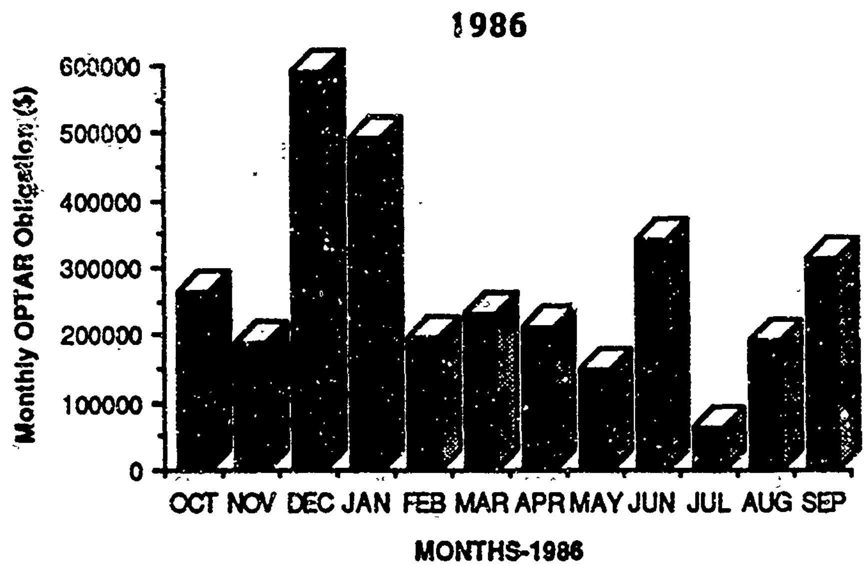
Appendix C
OPTAR OBLIGATION GRAPHS
USS WILLIAM H. STANDLEY (CG-32)



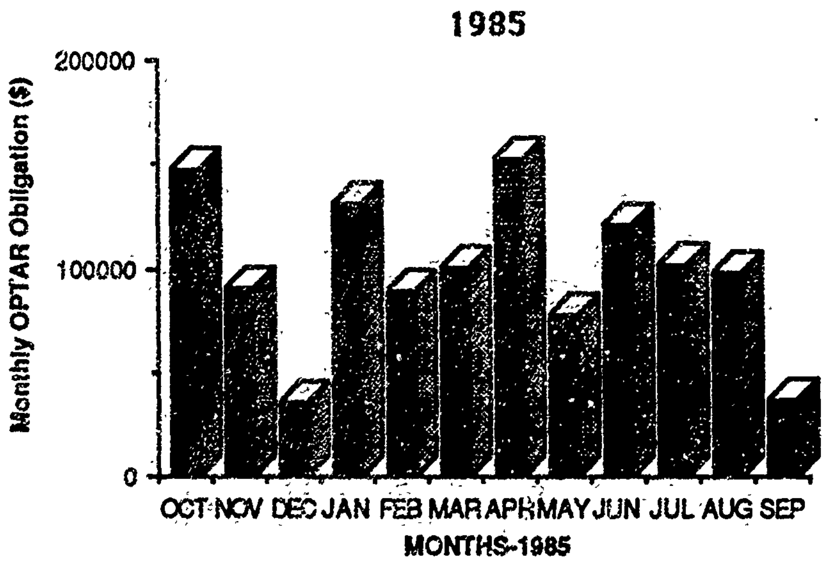


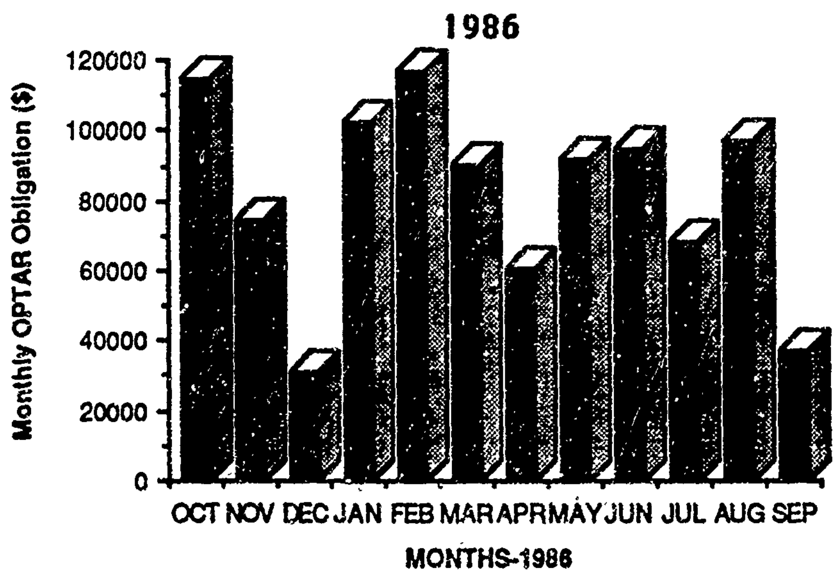
Appendix C
OPTAR OBLIGATION GRAPHS
USS STERETT (CG-31)



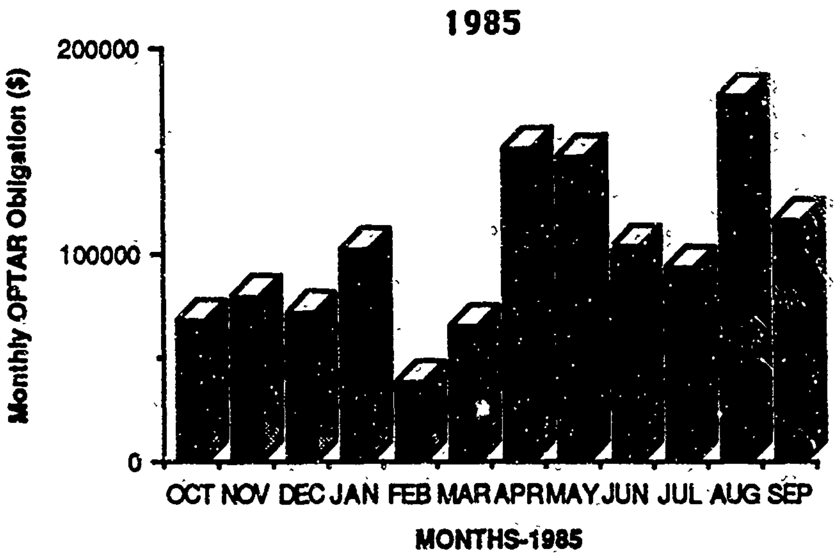


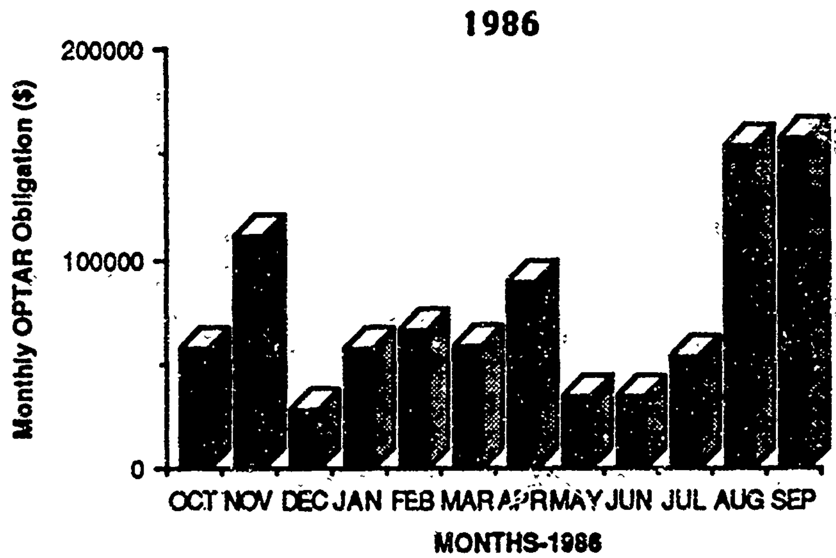
Appendix C
OPTAR OBLIGATION GRAPHS
USS BADGER (FF-1071)



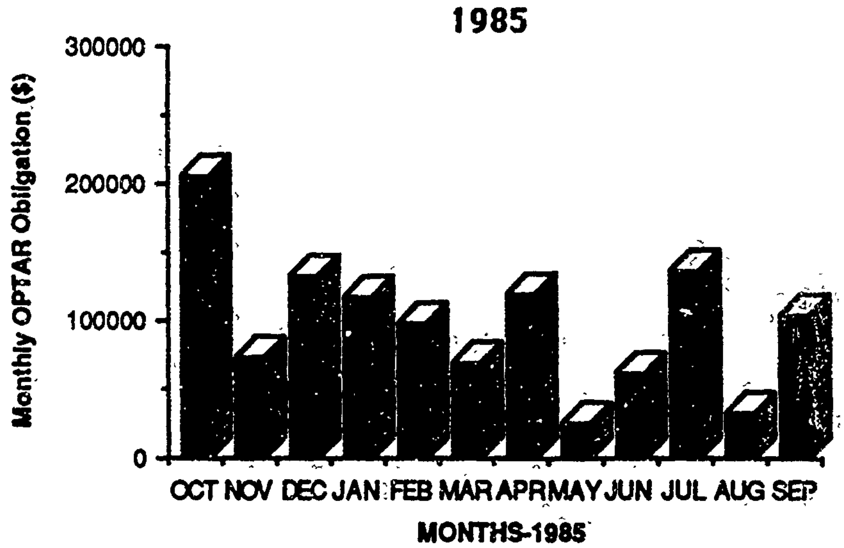


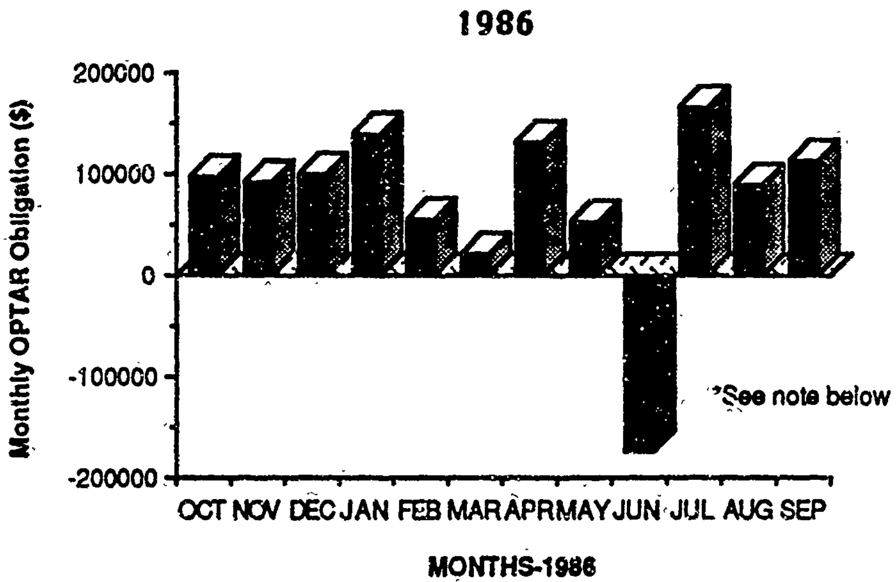
Appendix C
OPTAR OBLIGATION GRAPHS
USS COOK (FF-1083)





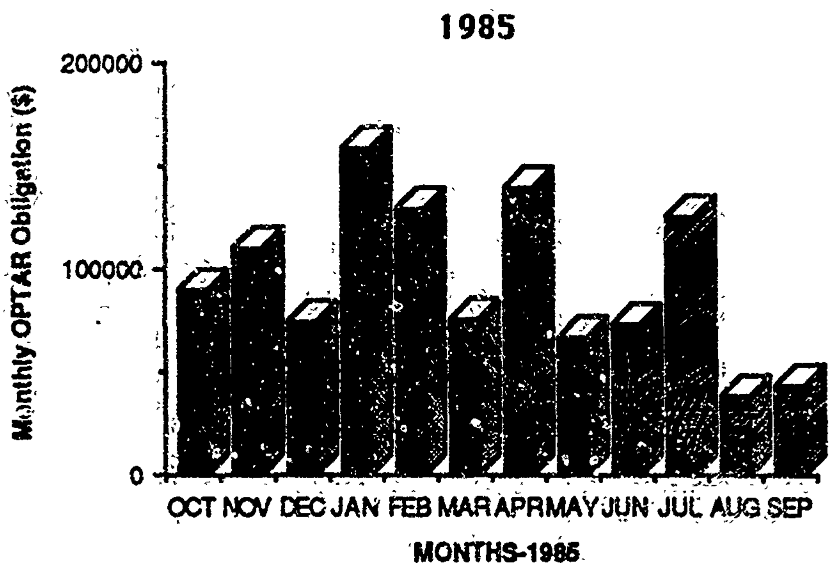
Appendix C
OPTAR OBLIGATION GRAPHS
USS DOWNES (FF-1070)

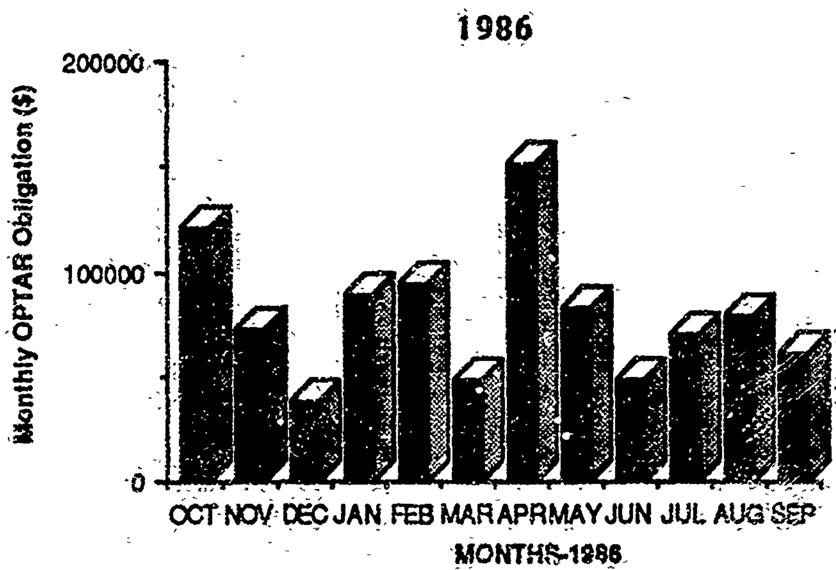




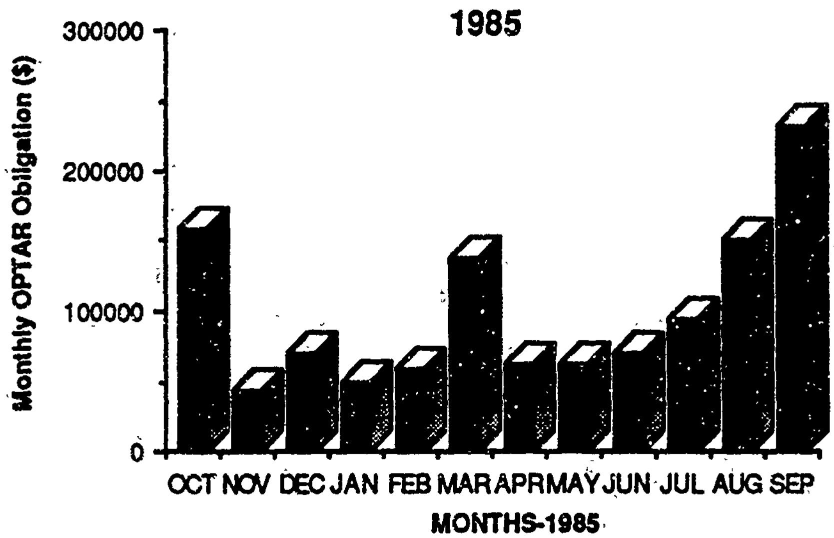
*Note: negative OPTAR obligation shown in June 1986 due to abnormally large adjustment of prior obligations (primarily cancellation of requisitions).

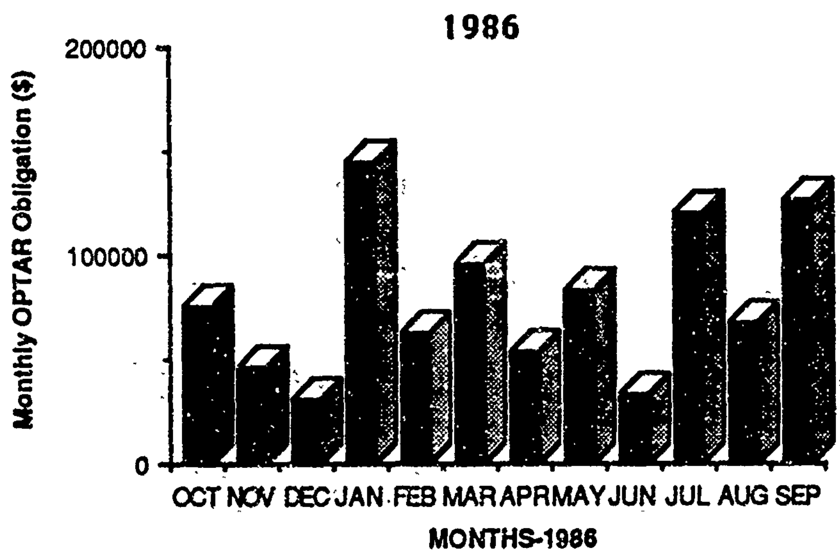
Appendix C
OPTAR OBLIGATION GRAPHS
USS FANNING (FF-1076)



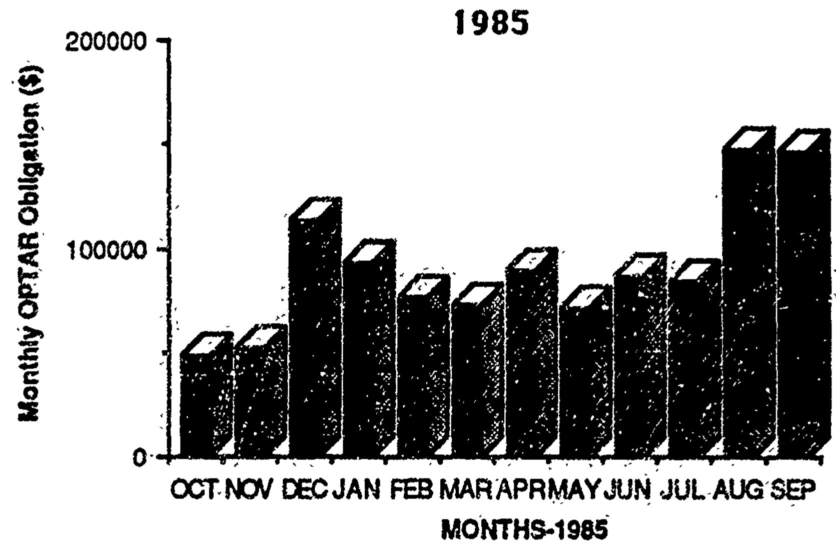


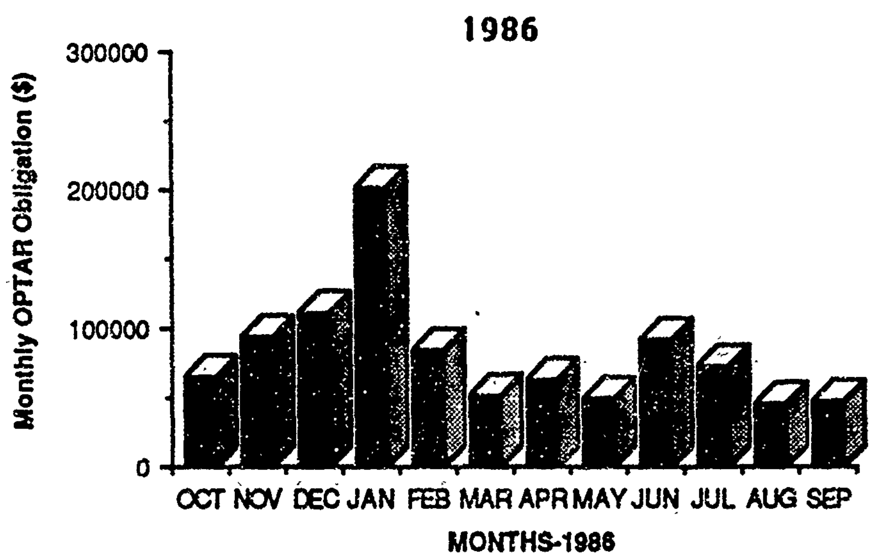
Appendix C
OPTAR OBLIGATION GRAPHS
USS FRANCIS HAMMOND (FF-1067)



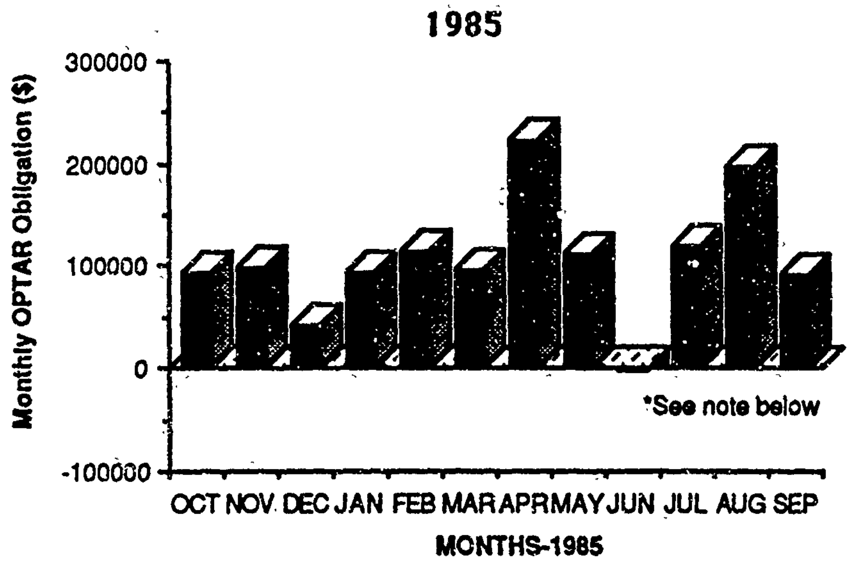


Appendix C
OPTAR OBLIGATION GRAPHS
USS KIRK (FF-1087)

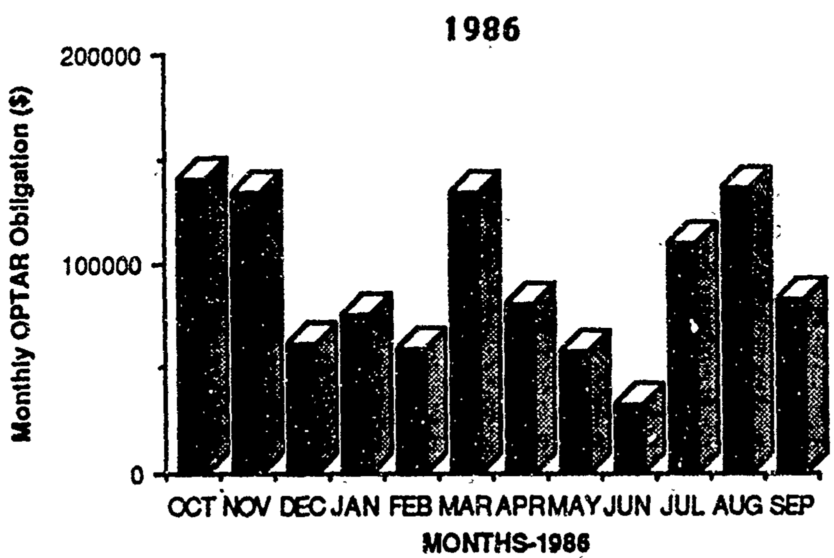




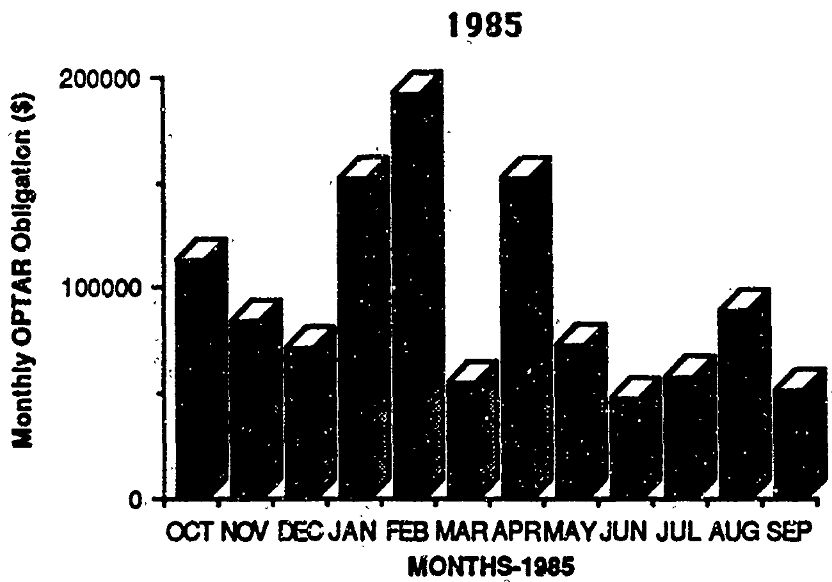
Appendix C
OPTAR OBLIGATION GRAPHS
USS KNOX (FF-1052)

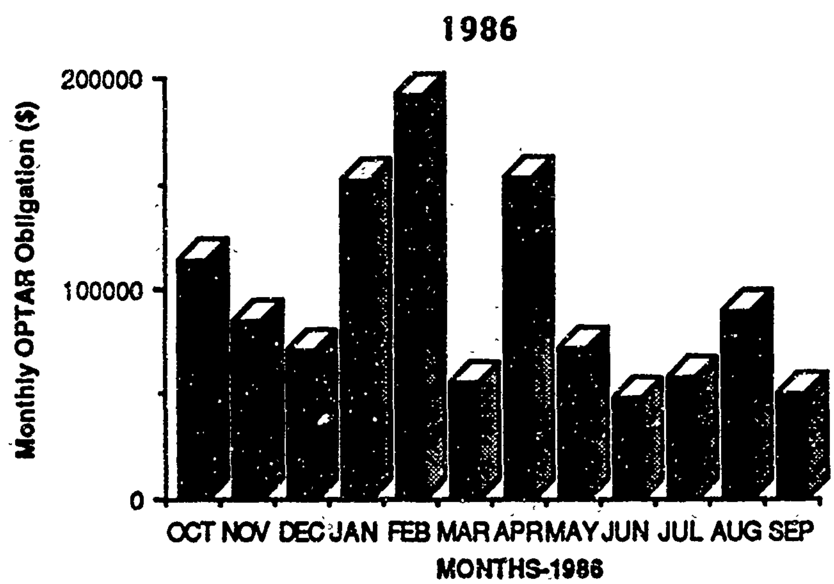


*Note: negative OPTAR obligation June 1985 due to adjustment of prior period obligations (cancellation of requisitions,etc.)

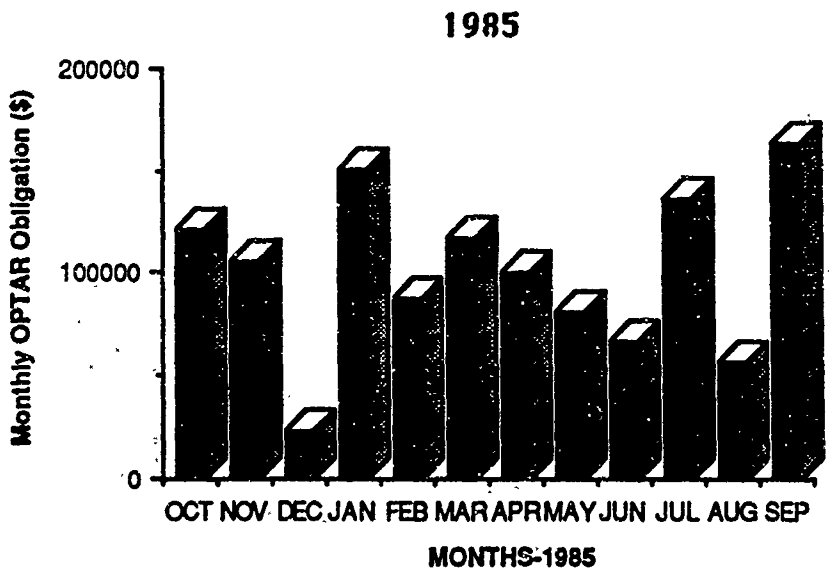


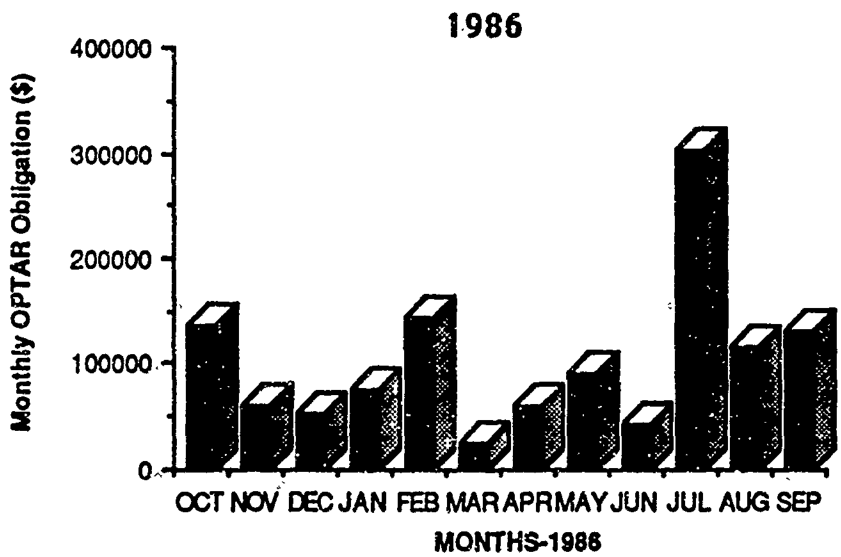
Appendix C
OPTAR OBLIGATION GRAPHS
USS LOCKWOOD (FF-1064)



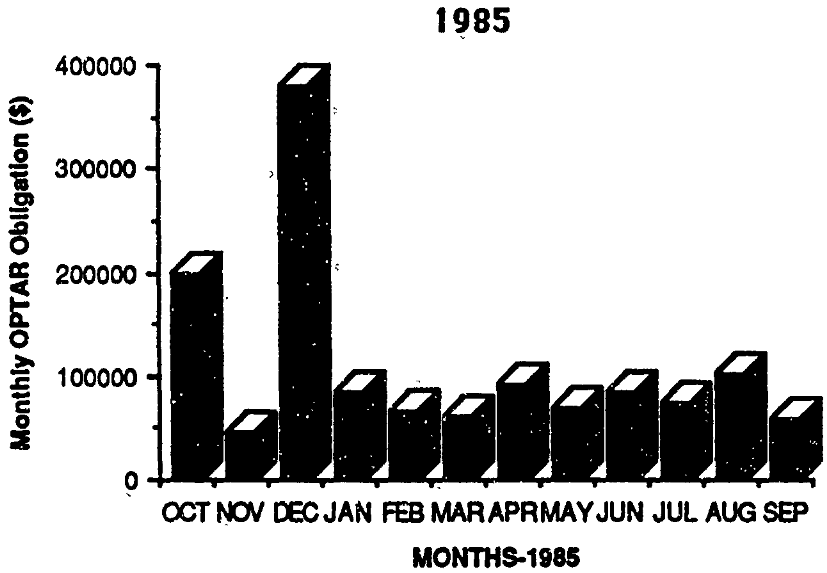


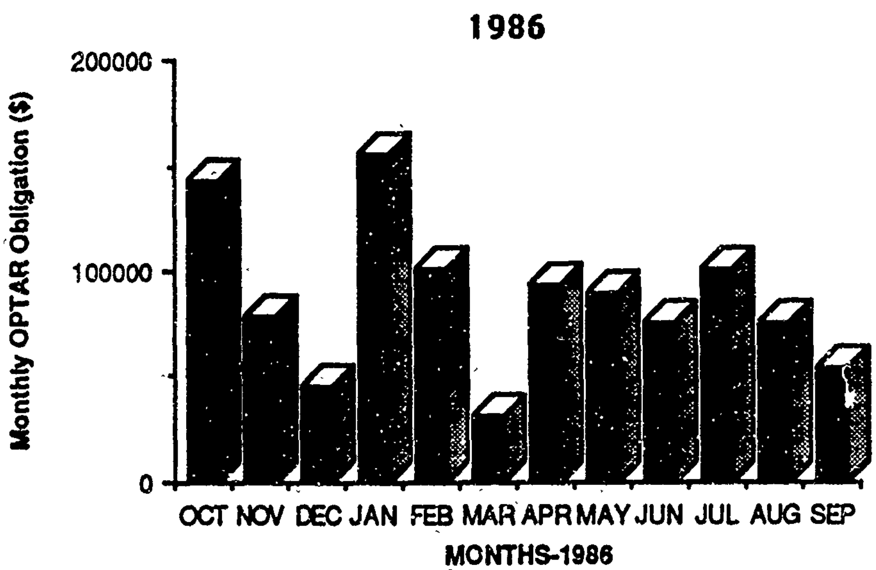
Appendix C
OPTAR OBLIGATION GRAPHS
USS STEIN (FF-1065)





Appendix C
OPTAR OBLIGATION GRAPHS
USS WHIPPLE (FF-1062)





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