A RAND NOTE

Short-Term Aggregate Model for Projecting Air Force Enlisted Personnel (SAM)

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RAND

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Prepared for the
United States Air Force

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PREFACE

RAND is helping to design an Enlisted Force Management System (EFMS) for the Air Force.[1] The EFMS is a decision support system designed to assist managers of the enlisted force in setting and meeting force targets. The system contains computer models that project the force resulting from given management actions, so actions that meet targets can be found. Some of those models analyze separate job specialties (disaggregate models), and others analyze the total enlisted force across all specialties (aggregate models); some models make annual projections (middle-term models) and others make monthly projections.

The Short-Term Aggregate Inventory Projection Model (SAM) is the component of the EFMS that makes monthly projections (for the rest of the current fiscal year) of the aggregate enlisted force. SAM can be used to analyze the total size, grade composition, and budget cost of the enlisted force during a fiscal year. It supports planning of management actions to achieve user specified end-of-year force levels (known as "end strengths") and user specified end-of-year grade levels (known as "grade strengths").

The overall model consists of five modules:

Module P: Preprocessor
Module 1: Separation Projection
Module 2: Inventory and Cost Projection
Module 3: Computer Aided Design
Module 4: Plan Comparison

The Preprocessor module assembles and transforms data on past enlisted force behavior into a form useful for predicting and reporting monthly flows and inventories. The Separation Projection module predicts monthly loss and reenlistment behavior. The Inventory and Cost Projection module combines the separation predictions with user specified management actions to project monthly inventories through the end of the current fiscal year and to estimate Military Personnel

[1]For an overview of the EFMS see Grace Carter, Jan Chaiken, Michael Murray, and Warren Walker, *Conceptual Design of an Enlisted Force Management System for the Air Force*, RAND, N-2005-AF, August 1983.

Account costs for the entire fiscal year. The Computer Aided Design module helps users find management actions that will achieve force size and grade composition goals for the fiscal year. The Plan Comparison module enables users to easily compare alternative plans for the fiscal year.

This Note describes the entire SAM model and gives detailed specifications for modules P and 2 through 4. Detailed specifications for alternative versions of Module 1 are presented in separate publications. These describe three methods of predicting the separations required from Module 1:

- Time series forecasting.
- Robust separation projection.
- Benchmark separation projection.

All three methods predict the monthly losses and reenlistment flows that are needed as inputs to Module 2. They predict "policy-free" flows--the losses and reenlistments that would occur in the absence of early release and early reenlistment programs. (Module 2 accounts for the effects of past and present management actions on losses and reenlistments.) However, in spite of having the same objectives, the three methods differ fundamentally in the way they accomplish those objectives.

The time series forecasting method uses models such as constant rate, regression, autoregression, and straight line running average. These models are documented in Marygail K. Brauner, Kevin L. Lawson, William T. Mickelson, Joseph Adams, and Jan M. Chaiken, *Time Series Models for Predicting Monthly Losses of Air Force Enlisted Personnel*, RAND, N-3167-AF, 1991.

The robust separation projection method uses data on past losses and reenlistments to estimate separation rates for a model that predicts loss and reenlistment flows one month at a time for each of a mutually exclusive set of about 500 cohorts. After these flows are predicted for a projection month, the inventory is updated and the models are applied to the updated inventories to predict the flows for the following month.

This process is repeated until the inventory for the last month of the fiscal year is projected. Thus, it applies separation rates to a series of different inventories. The robust method is specified in Marygail K. Brauner and Daniel A. Relles, *The Robust Separation Projection Method for Predicting Monthly Losses of Air Force Enlisted Personnel*, RAND, N-3169-AF, 1991.

The benchmark separation projection (BSP) method uses data on past losses and reenlistments to estimate a set of separation rates for each month of the fiscal year for a mutually exclusive set of about 280 "decision groups." Those separation rates are then applied to the current inventory to predict monthly loss and reenlistment flows for the rest of the fiscal year. Thus, the BSP method applies different sets of separation rates to a single inventory (that single inventory is the inventory at the start of the projection period). The BSP method is documented in C. Peter Rydell and Kevin L. Lawson, *The Benchmark Separation Projection Method for Predicting Monthly Losses of Air Force Enlisted Personnel*, RAND, N-3168-AF, 1991.

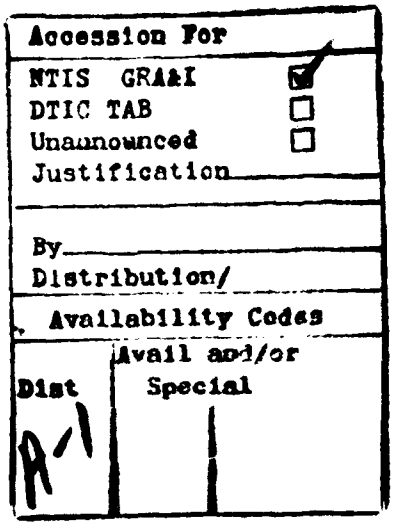
All three of these methods were presented to the Air Force as possible solutions to the problem of predicting the short-term behavior of airmen. The Air Force is using these specifications as the point of departure for developing a method for predicting monthly losses of enlisted personnel in Module 1 of SAM. As a consequence, the method for Module 1 that will be used in the EFMS is likely to differ considerably from that presented in any of the three Notes mentioned above.

This Note is primarily intended as a design specification for the Air Force members of the EFMP who are building SAM and as an introduction to SAM for its users. It should also be of interest to modelers and analysts who are involved in manpower and personnel research for other uniformed services.

The work described here is part of the Enlisted Force Management Project (EFMP), a joint effort of the Air Force (through the Deputy Chief of Staff for Personnel) and RAND. RAND's work falls within the Resource Management and Systems Acquisition Program of Project AIR FORCE. The EFMP is part of a larger body of work in that program that

is concerned with the effective utilization of human resources in the Air Force.

Peter Rydell is a RAND staff member. Kevin Lawson is a Major in the Air Force.



SUMMARY

The Short-Term Aggregate Inventory Projection Model (SAM) is the component of the Enlisted Force Management System (EFMS)[1] that projects the aggregate enlisted force from the current month to the end of the fiscal year. The projections depend upon planned management actions defining accession, promotion, and early-release policies. Interface screens show the performance of a given plan with respect to fiscal year goals for total force strength, force strengths by the top five grades, and personnel cost.

In addition to predicting the consequences of a given set of planned management actions, SAM can also help users design management actions. The user can specify desired force trajectories (monthly levels of the enlisted force, both total force and force by top five grades). Then SAM suggests accession and promotion policies that are predicted to achieve those force trajectories.

Finally, SAM has the capability to archive and then compare alternative plans. This capability is designed to enable users to consider many alternative plans, so that a superior plan is not overlooked. It also enables users to compare past plans with actual events so that ways of improving future planning can be discovered.

The SAM model consists of five modules:

Module P: Preprocessor.
Module 1: Separation Projection.
Module 2: Inventory and Cost Projection.
Module 3: Computer Aided Design.
Module 4: Plan Comparison.

The Preprocessor module assembles and transforms data on past enlisted force behavior into a form useful for predicting and reporting monthly flows and inventories. The Separation Projection module projects monthly loss and reenlistment behavior. The Inventory and Cost

[1]For an overview of the EFMS see Grace Carter, Jan Chaiken, Michael Murray, and Warren Walker, *Conceptual Design of an Enlisted Force Management System for the Air Force,* RAND, N-2005-AF, August 1983.

Projection module combines the separation projections with user specified management actions to project monthly inventories through the end of the current fiscal year and to estimate Military Personnel Account costs for the entire fiscal year. The Computer Aided Design module helps users find management actions that will achieve force size and grade composition goals for the fiscal year. The Plan Comparison module enables users to easily compare alternative plans for the fiscal year.

ACKNOWLEDGMENTS

Many years of research by a large number of people in the Air Force and at RAND lie behind the Short-Term Aggregate Inventory Projection Model (SAM). In general, the Air Force concentrated on issues related to data and accounting definitions and was responsible for programming and testing the model; RAND concentrated on the theory behind the model--what needed to be projected and how to structure the model to make the projections. There were many overlaps among these roles.

On the Air Force side, we were assisted by many members of the Washington Area Personnel Systems Division of the Air Force Military Personnel Center (AFMPC/DPMDW). Special thanks go to Tech. Sergeant Robbie Robertson, who programmed the model, and Jean Breeden, the model's primary end user, who worked closely with us from start to finish to help us define the model's user interface.

Warren Walker, project leader of the Enlisted Force Management Project, supported and guided the modeling effort. Allan Abrahamse provided helpful comments on an earlier version of this Note.

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I. INTRODUCTION TO SAM

PURPOSE

The Short-term Aggregate Inventory Projection Model (SAM) is the component of the Enlisted Force Management System (EFMS) that supports aggregate planning within a fiscal year. SAM will be used to analyze the size and grade composition of the enlisted force month by month during a fiscal year (October through the following September) and estimate the cost of enlisted personnel for the entire fiscal year. The force size and cost estimates are conditional upon the management actions users of the model choose.

SAM users can start the model during any month of the fiscal year. SAM will then recognize actual events between October to the start of the projection period, project future events for the remaining months of the fiscal year, accept inputs of possible management actions, and evaluate the ability of the management actions to achieve fiscal year goals.

SAM can be used to help fine tune a draft plan so that it achieves inventory goals exactly. It can also be used to compare the projected results from alternative plans.

MODULAR STRUCTURE

SAM has five modules, two of which are divided into submodules. Each module has a specific job to do, often requiring a module-specific accounting structure and information base.

Module P: Preprocessor

This module transforms information on past enlisted force behavior into variables needed in other modules.

P1: Early Release Programs.

P2: Events in Past 12 Months.

P3: Losses from Accessions.

P4: Forced Early Reenlistment Program.

Module 1: Separation Projection

This module projects attrition from inventory at start of projection period, policy-free ETS losses, retirements, reenlistments, and flows to retirement eligibility.

Module 2: Inventory and Cost Projection

This module projects monthly inventories and fiscal-year cost, conditional upon user choice of management actions that control the enlisted force.

2A: Inventory Projection.

2B: Cost Projection.

Module 3: Computer Aided Design

This module determines NPS accessions needed to achieve the end strength goal and promotions to top five grades needed to achieve the grade strength ceiling goals, conditional upon the user choices made for all other management actions.

Module 4: Plan Comparison

This module compares the alternative plans that have been produced by Module 2, with Module 3's help.

Interaction Among Modules

Figure 1 shows the relationships among the five modules. Users operate SAM by moving back and forth among modules. The simplest monthly analysis sequence is to run modules P, 1, 2, and 3, in that order, iterate Modules 2 and 3 until several plans have been constructed, and then run Module 4 to compare the alternative plans.

SAM is driven by user choices made in Modules 2 and 3. In Module 2 the user chooses short-term and background management actions. In Module 3 the user chooses force trajectories and the computer designs short-term management actions that achieve those trajectories.

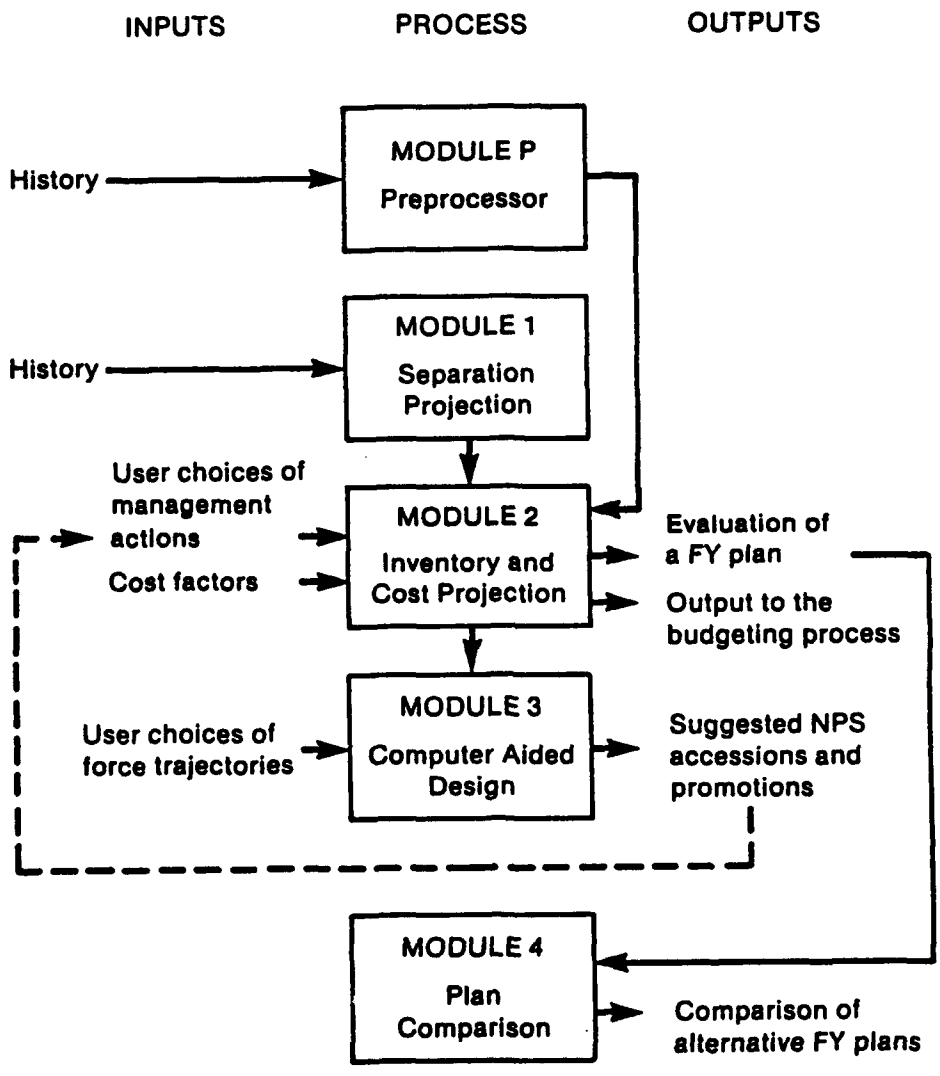

Fig. 1--Structure of SAM: Short-Term Aggregate Model for projecting Air Force enlisted personnel

If the user would like, Module 2 can use the short term management actions designed in Module 3. This feedback flow is shown by a dotted line in Fig. 1 to indicate that users decide whether to implement the feedback. Moreover, SAM is flexible enough for users to adopt some of the suggested management actions and not others.

USE OF POLICY-FREE PROJECTIONS

To project separation flows accurately, SAM needs to take account of early release programs. Three Air Force enlisted personnel programs release people before the end of their obligated service in the active force.

- **Palace Chase:** early release for the purpose of joining the Air Reserve Forces.
- **Early Out:** early release during a fiscal year of people who otherwise would have left the next fiscal year, for the purpose of reducing the first year's end strength.
- **Rollup:** early release during a fiscal year of people who otherwise would have left in a later month during the same fiscal year, for the purpose of reducing personnel cost during the fiscal year.

In the absence of early release programs, all the early release losses would have been "ETS losses" (but in a later month than the month in which the early release losses occurred).[1] ETS losses can most easily be defined negatively. They are losses that are not attrition, retirement, Rollup, Early Out, Palace Chase, Officer Training School (OTS), or miscellaneous losses. Rather, ETS losses are voluntary departures at the end of an enlisted person's contract to serve in the active force, or at the end of an extension of the contract.

"ETS losses" used in loss accounting should not be confused with "losses during the ETS year" used in loss modeling. The latter phrase

[1]"ETS" stands for Expiration of Term of Service.

means all the losses, including attrition, that occur during the 12 months before, and including, the expiration of term of service established at the start of the term of service. Losses that occur after the expiration of that original term of service are not included in "losses during the ETS year"; they are called "losses from extensions."

Three kinds of variables are needed to completely describe the effects of the early release programs:

- **Losses:** number of losses during a month due to each early release program.
- **Shifts:** number of losses that did not occur during a month due to each early release program (the number of losses that would have occurred in the month if they had not been shifted to earlier months by the early release program).
- **Inventory reductions:** inventory at the start of a month that does not exist because of each early release program (inventory that would have existed if losses after the inventory date had not been shifted to before the inventory date).

The shift counts are needed because they are used to define "Policy-Free ETS losses" (the ETS losses that would occur if there were no early release programs), and the inventory reductions are needed because they are used to define "Policy-Free inventories" (the inventories that would exist if there were no early release programs). Adding early release shifts to past ETS losses produces past policy-free ETS losses. Subtracting early release shifts from projected policy-free ETS losses yields projected ETS losses.

The reason for modeling policy-free ETS losses can be made clear by an example. Assume that in the absence of any early release programs there would be 1500 ETS losses during September and 1500 ETS losses during October. Further assume that 250 losses are shifted from October to September by one or more of the early release programs, making actual ETS losses 1500 in September and 1250 in October. (The 250 early

release losses in September are not called ETS losses, they are called early release losses; but the shifts out of October reduce the ETS losses there.)

Also assume that the inventory of enlisted personnel was 500,000 at the start of September, and that there were 1500 gains to the enlisted force during September.

Under these assumptions if one used the September loss experience to predict October's losses one would get an estimate of 1499 ETS losses:

September ETS loss proportion = 1500/500000
Start of October inventory = 500000 - 1750 + 1500 = 499750
Estimated October losses = (499750)(1500/500000) = 1499

The estimated October ETS loss is 1499. The actual October ETS loss is 1250. This estimate is off by 249 losses, which is a 20 percent error.

Adjusting losses and inventories into what they would have been without the early release program prevents the above error from occurring.

The "policy-free" calculation is done as follows:

1. **Historical Analysis**

a. *Estimate policy-free ETS losses*

September ETS losses	1500
+ Shifts to past	0
= September Policy-Free ETS losses	1500

b. *Estimate policy-free inventory*

Start of September inventory	500000
+ Inventory reduction due to early release programs	0
= Policy-free inventory	500000

c. *Policy-free loss rate*

Policy-free ETS loss rate = 1500/500000

2. **Projection**

a. *Estimate policy-free inventory*

Start of October inventory	499750
+ Inventory reduction due to early release programs	250
= Policy-free inventory	500000

b. *Estimate policy-free ETS losses*

Estimated policy-free ETS losses in October
= (500000)(1500/500000) = 1500

c. *Transform policy-free ETS losses into ETS losses*

October Policy-free ETS losses	1500
- Shifts to the past	250
= Actual ETS losses	1250

This estimate has no error because the example assumes that without the early release program the ETS losses in October and September would be the same.

The purpose of the example is to point out that ETS losses in the absence of early release shifts are more stable than those that occur with early release shifts. To take advantage of the greater stability, and hence greater predictability, of policy-free ETS losses, SAM models policy-free ETS losses (Module 1) and then uses early release shift counts to translate policy-free losses into actual losses (Module 2).

The following equations generalize the above example and also serve to introduce some of this document's notation. (The Glossary in App. A presents all the notation in a convenient format.) "PC" is Palace Chase, "EO" is Early Out, "RU" is Rollup, "LOSS" refers to losses, "SHIFT" is a loss that no longer exists (at the given time) because of an early release program, "INVRED" is an inventory reduction caused by an early release program, and "STARTINV" is the inventory of enlisted personnel at the start of a month.

The prefix "PF" stands for "policy-free" and indicates an inventory or flow that would have happened if the early release programs did not exist.

1. **Historical Analysis**

a. *Policy-free ETS losses*

```
PFETSLOSS = ETSLOSS
            + PCSHIFT
            + EOSHIFT
            + RUSHIFT
```

b. *Policy-free inventory*

```
PFSTARTINV  = STARTINV
              + PCINVRED
              + EOINVRED
              + RUINVRED
```

c. *Policy-free loss rate*

```
PFETSLOSSRATE = PFETSLOSS/PFSTARTINV
```

2. **Projection**

a. *Estimate policy-free inventory*

```
PFSTARTINV  = STARTINV
              + PCINVRED
              + EOINVRED
              + RUINVRED
```

b. *Estimate policy-free ETS losses*

```
PFETSLOSS = PFETSLOSSRATE * PFSTARTINV
```

c. *Transform policy-free ETS losses into ETS losses*

```
ETSLOSS = PFETSLOSS
          - PCSHIFT
          - EOSHIFT
          - RUSHIFT
```

ORGANIZATION AND SUGGESTIONS FOR READING

When users operate SAM, they will see the interface screens of Modules 2, 3, and 4. Modules P and 1 have no interface screens, because users do not interact with those modules.

Since the easiest way to understand a model is to start with its interface screens, this document describes Modules 2, 3, and 4 first. Then it describes Module P and provides an overview of Module 1.

(Various versions of Module 1 are specified in detail elsewhere.[2] This order of exposition ensures that the outputs Module P produces for the other modules are understood before the user turns to an explanation of how they are produced.

The description of most of the modules requires several sections and may be of interest to different types of readers. Separate sections present an overview of the module (which should be of interest to all readers); the interface screens (which should be of interest to SAM users and programmers); and an "action diagram" describing how the module works (which will primarily be of interest to the programmers). Action diagrams lie part way between prose and programming. They are primarily designed to show computer programmers how to write the computer code for the model. (Of course, the diagrams also are useful for showing model users how the model works.) The action diagrams present necessary inputs (by source), required calculations (in processing order), and outputs generated (by destination).

Thus, to obtain an overview of all of the modules of SAM, read Secs. II, VI, IX, and XVI; to understand how to use SAM, read Secs. III, VII, and X; and to program SAM, read Secs. IV, V, VIII, XI, XII, XIII, XIV, XV, and XVI.

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[2]Brauner, Lawson, and Mickelson, 1991; Brauner and Relles, 1991; Rydell and Lawson, 1991.

II. OVERVIEW OF MODULE 2: INVENTORY AND COST PROJECTION

Module 2 consists of two submodules. Module 2A projects the inventory that results from user choices of short-run management actions, and Module 2B projects the cost that results from those actions.

This section discusses each submodel in turn. Three topics provide an overview of the force projection submodel: inventory and flow accounting, variables that describe inventory and flow events, and analysis steps in doing force projections. The same three topics then provide an overview of the cost projection submodule: cost accounting, cost variables, and analysis steps in doing cost projections. This overview section concludes by defining notation used in the action diagrams in the following sections.

INVENTORY AND FLOW ACCOUNTING

Accounting Structure

The accounting structure for this module's calculations uses all combinations of three dimensions: grade, category of enlistment, and month during the fiscal year. Table 1 shows the grade and category of enlistment accounting cells. Replicating that table over all months during the fiscal year gives the complete set of accounting cells.

Accounting Identities

Several accounting identities (equations that are true by definition) are used in making the projections in Module 2. Construction of Module 2 basically involved choosing an appropriate set of accounting identities (and then finding ways to obtain all the components of the identities).

The accounting identities provide an overview of how Module 2 does its job. They apply to each cell in Module 2's inventory structure (see Table 1).

Table 1

ACCOUNTING STRUCTURE FOR MODULE 2A

	Category of Enlistment			
Grade	First	Second	Career	Retirement Eligible
E-1				
E-2				
E-3				
E-4				
E-5				
E-6				
E-7				
E-8				
E-9				

NOTE: Replicated for all months during the fiscal year (Oct. through Sept.)

Total attrition loss =

Attrition from accessions during projection months
+ Attrition from start-of-projection period inventory

Rollup shift =

ETS losses shifted from this month to earlier months in this fiscal year by the Rollup program

Early Out shift =

ETS losses shifted from this month to the previous fiscal year by the Early Out program

Palace Chase shift =

ETS losses shifted from this month to previous months in the projection period

+ ETS losses shifted from this month to months before the start of the projection period

ETS loss =

Policy-free ETS loss
- Rollup shift
- Early Out shift

- Palace Chase shift

Total gain to the enlisted force =

NPS accessions
+ PS accessions
+ OTS gain
+ Miscellaneous gain

Total loss to the enlisted force =

Attrition
+ ETS loss
+ Rollup loss
+ Early Out loss
+ Palace Chase loss
+ Retirement
+ OTS loss
+ Miscellaneous loss

Net change in inventory during a month =

Total gain to an accounting cell
- Total loss to an accounting cell
+ Reenlistment into an accounting cell
- Reenlistment out of an accounting cell
+ Flow into a cell because of becoming retirement eligible
- Flow out of a cell because of becoming retirement eligible
+ Promotion into an accounting cell
- Promotion out of an accounting cell
+ Demotion into an accounting cell
- Demotion out of an accounting cell

EVENT VARIABLES

Module 2A does its job of converting inputs specified by users into outputs users want to see by assembling the following items for each cell in its accounting structure:

- Start-of-month inventory for the cell.
- All flows out of the cell during the month.
- All flows into the cell during the month.
- End-of-month inventory for the cell.

Module 2A obtains these flows and inventories by combining inputs specified by users on Module 2 input screens with history and predictions from Module 1.

The event variables that describe the inventories and flows in Module 2 are listed below. The left column gives the computer name, the right column gives the definition.

All these variables have subscripts <Grade, Catenl, Month> in Module 2. The history of events during past months of the fiscal year comes into Module 2 with these dimensions, and the events during the current and future months of the fiscal year are projected with these dimensions during Module 2's calculations.

Change in Inventory

STARTINV	Inventory at the start of a month.
ENDINV	Inventory at the end of a month.
NETCHANGE	Change in inventory during a month.

Gains to the Enlisted Force

NPS4	Non-Prior Service (NPS) accessions for a 4-year term.
NPS6	NPS accessions for a 6-year term.
NPS	Total NPS accessions (NPS4 + NPS6).
PS	Prior Service accessions.
OTSGAIN	Gains scheduled to go to Officer's Training School.
MISCGAIN	Miscellaneous gains (recalls from the Reserves, returned dropped from rolls, delayed reenlistments, gain adjustments, and other gains).

TOTALGAIN	Total gain (NPS4 + NPS6 + PS + OTSGAIN + MISCGAIN).

Losses from the Enlisted Force

NPSATT	Attrition from NPS accessions during projection months.
PSATT	Attrition from PS accessions during projection months.
INVATT	Attrition from the inventory that existed at the start of the projection period.
ATTLOSS	Total attrition loss (NPSATT + PSATT + INVATT).
ETSLOSS	Expiration of term of service loss (losses that are not attrition, retirement, Rollup, Early Out Palace Chase, OTS, or miscellaneous, but rather are voluntary departures at the end of the enlisted person's contract to serve, or after an extension of that contract).
RULOSS	Rollup losses (ETS losses shifted to this month from later months in the fiscal year to reduce personnel costs in the fiscal year).
RULOSSBYORIGIN	Rollup losses by month from which the loss was shifted (the "origin month").
EOLOSS	Early Out losses (losses shifted to this month from months in the next fiscal year to reduce this fiscal year's end strength).
PCLOSS	Palace Chase losses (ETS losses shifted to this month from later months to send personnel to the Reserves before the end of their obligated active service).
RETIREMENT	Retirement losses.

OTSLOSS	Losses to Officer's Training School.
MISCLOSS	Miscellaneous losses (gain adjustment and other losses).
TOTALLOSS	Total losses (ATTLOSS + ETSLOSS + RULOSS + EOLOSS + PCLOSS + RETIREMENT + OTSLOSS + MISCLOSS).

Definition of Policy-Free ETS Losses

ETSLOSS	See definition under "Losses from the Enlisted Force" above.
RUSHIFT	Rollup shifts (ETS losses shifted to previous months by the Rollup program).
EOSHIFT	Early Out shifts (ETS losses shifted to previous months by the Early Out program).
PCSHIFT	Palace Chase shifts (ETS losses shifted to previous months by the Palace Chase program).
PFETSLOSS	ETS losses that would have occurred if there had been no early release programs. (ETSLOSS + RUSHIFT + EOSHIFT + PCSHIFT).

Changes in Grade

PROMIN	Promotions into a grade.
PROMOUT	Promotions out of a grade.
DEMOIN	Demotions into a grade.
DEMOOUT	Demotions out of a grade.

Changes in Category of Enlistment

REENLISTIN	Reenlistments into a category.
REENLISTOUT	Reenlistments out of a category.
RETELIGIN	Flow into the retirement-eligible category (category 4) from the career term category.
RETELIGOUT	Flow out of the career term category (category 3) to the retirement-eligibility category.

ANALYSIS STEPS IN MODULE 2A: INVENTORY PROJECTION

Past vs. Projection Months

SAM is designed to be used during every month of a fiscal year. For past months (the months in a fiscal year that have already happened) the inventory and flows come from historical data assembled in Modules P1 and P2. For projection months (the current and future months in the fiscal year), the inventory and flows come from the calculations specified below. Those calculations draw on user specified inputs, accession attrition proportions from Module P3, and the separation projections made by Module 1.

Module 2 makes projections only to the end of the fiscal year. This differs from Module 1 where projections are made 12 months into the future, no matter where in the fiscal year the analysis is done. Module 2 uses only those projections from Module 1 that are needed to reach the end of the fiscal year.

Overview of Projection Calculations

The user specified inputs are marginal totals (for example, NPS accessions come in as monthly totals, with no grade or category of enlistment detail). Distribution variables derived from historical patterns (by Module P2) allocate the marginal totals to the detail in the accounting structure.

The inventory projection calculations are done using the complete accounting structure--grade, category of enlistment, and month.

The output screens are then filled with various aggregations of detailed results. Doing the calculations at the detailed level, and then aggregating to generate output displays, guarantees that the output screens are internally consistent.

COST ACCOUNTING

SAM estimates the Military Personnel Account (MPA) cost of the enlisted force during the fiscal year.

Table 2 presents the items in the MPA budget. The bold face headings in the table show the aggregated cost items in SAM's cost accounts.

SAM makes its cost estimates using grade-specific cost factors for person-years worked by the enlisted force. This cost estimation method is designed to provide short-term force programmers with rapid feedback on the cost implications of management actions that increase or decrease the size of the force during a fiscal year. SAM's cost estimation method, however, is not a substitute for the budget models that estimate fiscal year costs in great detail. On the contrary, SAM is designed to provide inventory and flow details to those budget models so that detailed cost estimates can be made for a fiscal year.

Note also that SAM estimates only MPA account costs. The estimate does not include the costs of training (beyond the pay of military personnel), base operating support (equipment and supplies and civilian contractor labor), "rent" for military housing, or temporary duty (TDY) expenses.

COST VARIABLES

SAM disaggregates the total MPA cost into six categories:

BASICPAY	Basic pay.
RETIREPAY	Retired pay accrual (equal to a percentage of basic pay).

Table 2

MILITARY PERSONNEL ACCOUNT COST OF AIR FORCE
ENLISTED PERSONNEL

Basic Pay
1. Basic Pay

Retirement Accrual
2. Retired Pay Accrual

BAQ and VHA
3. Basic Allowance for Quarters (BAQ)
4. Variable Housing Allowance (VHA)

Incentive and Special Pay
6. Incentive Pay (e.g. flying pay)
7. Special Pays
   - Reenlistment Bonus
   - Other (many categories)

Miscellaneous
5. Subsistence
   a. Basic Allowance for Subsistence (BAS)
   b. Subsistence-In-Kind
8. Allowances
   a. Uniform or Clothing
   b. Station Allowance Overseas
   c. Family Separation Allowance
9. Separation Payments
10. Social Security Payments
12. Other Military Personnel Costs

Permanent Change in Station (PCS)
11. PCS Travel

Total MPA Cost

SOURCE: *Justification of Estimates for Fiscal Years 1988/1989, Submitted to Congress January 1987: Military Personnel, Air Force*, Department of the Air Force, Washington, D.C., 1987, pp. 11-13.

BAQVHA	Basic Allowance for Quarters and Variable Housing Allowance.
INCENTPAY	Incentive and special pays (an example of the former is flying pay, an example of the latter is reenlistment bonuses).
MISCPAY	Miscellaneous pays (subsistence, uniform or clothing allowance, station allowance overseas, family separation allowances, separation payments, Social Security payments, and other military personnel costs).
PCSCOST	Permanent Change of Station costs.
TOTALCOST	Total MPA costs (BASICPAY + RETIREPAY + BAQVHA + INCENTPAY + MISCPAY + PCSCOST).

ANALYSIS STEPS IN MODULE 2B: COST PROJECTION

The estimation of Military Personnel Account (MPA) costs for the fiscal year is accomplished by doing three calculations for each type of cost for each grade.

a. Estimate the number of person-months the enlisted force worked during each month,

$$\text{Person-Months} = \text{Start of month inventory} + (\text{Gain Weight})(\text{Gain}) - (\text{Loss Weight})(\text{Loss})$$

b. Estimate the number of person years the enlisted force worked during the entire fiscal year,

$$\text{Person-Years} = (\text{Person months in all months of the fiscal year})/12$$

c. Estimate the cost by applying grade-specific cost factors,

$$\text{Cost} = (\text{Person-Years}) * (\text{Cost per person-year}).$$

The "gain weight" is the fraction of a month that a gain works (since gains come in part way through the month). The "loss weight" is the fraction of a month that a loss works (since losses leave part way through a month).

SUBSCRIPTS AND PREFIXES

The following subscript and prefix notation is used in writing the Module 2 action diagrams. It is also used in specifying the variables obtained from input screens and those reported on output screens.

Subscripts

Grade	Pay grade (E-1 through E-9).
Botgrade	Bottom four grades (E-1 through E-4).
Topgrade	Top five grades (E-5 through E-9).
Catenl	Category of enlistment (1 = first term, 2 = second term, 3 = career terms, not retirement eligible, 4 = retirement eligible).
Month	Month in fiscal year (October through September).
Past	Month during the 12-month period before the start of the first projection month.
Origin	Month in fiscal year from which a Rollup loss was shifted.
Tfms	Total years of federal military service (count starts with 0 during the period when an enlisted person has been in the service for less than 12 months).
n	Number of months. Used to indicate the number of months after an early release that the shift occurs, and the number of months after an accession that an attrition loss occurs (the counting of "n" starts with 0 in the same month as the reference flow).

Prefixes

m	An "m" prefix on a variable indicates a marginal variable that is an input and has fewer subscripts than the stem variable will have inside the model.
d	A "d" prefix on a variable indicates a distribution variable that will be used to expand a marginal variable to full dimensionality; a "d" prefix on a subscript

inside a distribution variable indicates a dimension over which the distribution has been constructed.

t — A "t" prefix on a variable indicates summation over one or more dimensions to create a total; a "t" prefix on a subscript inside a total variable indicates a dimension over which the summation was done.

An example of the "d" notation is:

	Oct	Nov	Dec
NPS <Month>	50	100	50
dNPS <dMonth>	0.25	0.50	0.25

An example of the "t" notation is:

```
tNPS <tMonth> = 200.
```

Combining the two examples provides an illustration of how the distribution variables are estimated:

```
dNPS <dMonth> = NPS <Month> / tNPS <tMonth>.
```

An example of the "m" notation would occur if the user specified only the total NPS accessions on the input screen:

```
mNPS,
```

so that the model then had to distribute that total over months by multiplying by the appropriate distribution variable:

```
NPS <Month> = mNPS * dNPS <dMonth>.
```

III. USER INTERFACE SCREENS FOR MODULE 2

The following displays present the input and output screens that a user will see when operating Module 2 of SAM, referred to as "SAM2" for short. The computer program variables obtained from the input screens are down in the body of the input tables. The computer program variables used to construct the output screens are down in the display area of the output screens.

INPUT SCREENS

SAM2's input screens obtain user choices of budget, end-strength, and grade-strength goals, short-term management actions, and background management actions. Note that the goals can change during a fiscal year, so they have to be entered (or accepted anew) each month.

"Short-term" management actions are those that force programmers use to fine tune the aggregate enlisted force during a fiscal year (e.g., Rollups). "Background" management actions are those that force programmers must recognize when doing their fine tuning but that are rarely altered once a fiscal year has begun (e.g., Palace Chase program).

Users will enter inputs only for projected months. Historical data for previous months in the fiscal year will appear on the input screens but will be protected; the user will not be able to change them.

The SAM2 interface has been constructed to be user-friendly. It is programmed in the PC EXPRESS computer language and takes advantage of the power of that language to give the user some calculation assistance when entering inputs.

For example, the first input screen requires the user to enter grade strength ceilings. The user can either enter those goals directly or can enter various planning factors in the bottom of the table and have the computer compute the goals.

A second example occurs on all the remaining input screens. The user can either enter all the monthly counts and have the total computed automatically or can enter the total and have the computer spread the total evenly over all the months. (The spreading is done by subtracting the past months' data from the total and spreading the remainder over all the projection months.)

The following ten figures present the SAM2 screens that accept user inputs:

Figure 2. Fiscal year goals.

Figure 3. Short-term management actions: Accessions.

Figure 4. Short-term management actions: Rollups by category of enlistment.

Figure 5. Short-term management actions: Early outs.

Figure 6. Short-term management actions: Promotions into top grades.

Figure 7. Short-term management actions: Demotions from grade.

Figure 8. Background management actions: OTS and miscellaneous gains.

Figure 9. Background management actions: Palace Chase, OTS, and miscellaneous losses.

Figure 10. Forced early reenlistments from same fiscal year.

Figure 11. Forced early reenlistments from next fiscal year.

OUTPUT SCREENS

The output screens first present summaries of plan performance and short-term management actions. Then they give details of a plan's results. A complete report on a plan must include the input as well as the output screens.

The summary output screens show plan performance on the budget, grade-strength, and end-strength goals, and the short-term management actions (accessions, promotions, rollups, and early outs) that were used to achieve the performance.

SAM2 Input Screen 1
FISCAL YEAR GOALS

Item	Military Personnel Account FY Budget ($ millions)	Grade Strength Ceilings E-5	E-6	E-7	E-8	E-9	End Strength
		Goals					
Goal	BUDGET	GRADECEILING <Topgrade>					ENDSTRENGTH
		Computation of Grade Strength Ceilings					
End strength factor (%)		A					
Sliding scale constant		B					
Grade strength ceiling		B + (A/100)*(ENDSTRENGTH)					

Fig. 2--Fiscal year goals

SAM2 Input Screen 2
SHORT-TERM MANAGEMENT ACTIONS: ACCESSIONS

Month	NPS Accessions Total	4 Year Percent	4 Year Flow	6 Year Percent	6 Year Flow	PS Accessions Flow
Oct						
Nov						
Dec						
Jan						
Feb						
Mar			mNPS4 <Month>			
Mar					mNPS6 <Month>	
Apr						mPS <Month>
May						
Jun						
Jul						
Aug						
Sep						
Total						

Fig. 3--Short-term management actions: Accessions

SAM2 Input Screen 3
SHORT-TERM MANAGEMENT ACTIONS: ROLLUPS BY CATEGORY OF ENLISTMENT

Month in which Rollup occurs	Month in this FY in which rolled up losses would otherwise have occurred											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Oct												
Nov												
Dec												
Jan												
Feb												
Mar												
Apr	mRULOSSBYORIGIN <Catenl, Month, Origin >											
May												
Jun												
Jul												
Aug												
Sep												
Total												

NOTE: Repeat screen 4 times: for the four categories of enlistment

Fig. 4--Short-term management actions: Rollups by category of enlistment

SAM2 Input Screen 4
SHORT-TERM MANAGEMENT ACTIONS: EARLY OUTS

Month in which Early Out occurs	Category of Enlistment			
	First	Second	Career	Retirement-eligible
Oct				
Nov				
Dec				
Jan				
Feb				
Mar	mEOLOSS <Catenl, Month>			
Apr				
Mar				
Jun				
Jul				
Aug				
Sep				
Total				

Fig. 5--Short-term management actions: Early outs

SAM2 Input Screen 5
SHORT-TERM MANAGEMENT ACTIONS: PROMOTIONS INTO TOPGRADES

Item	Top Grade				
	E-5	E-6	E-7	E-8	E-9
Oct					
Nov					
Dec					
Jan					
Feb					
Mar	mPROMINTOP <Topgrade, Month>				
Apr					
May					
Jun					
Jul					
Aug					
Sep					
Total					

Fig. 6--Short-term management actions: Promotions into top grades

SAM2 Input Screen 6
SHORT-TERM MANAGEMENT ACTIONS: DEMOTIONS FROM GRADE

Item	Grade								
	E-1	E-2	E-3	E-4	E-5	E-6	E-7	E-8	E-9
Oct									
Nov									
Dec									
Jan									
Feb									
Mar	mDEMOOUT <Grade, Month>								
Apr									
May									
Jun									
Jul									
Aug									
Sep									
Total									

Fig. 7--Short-term management actions: Demotions from grade

SAM2 Input Screen 7
BACKGROUND MANAGEMENT ACTIONS: OTS AND MISCELLANEOUS GAINS

Month	OTS Gain	Miscellaneous Gain
Oct		
Nov	mOTSGAIN <Month>	
Dec		
Jan		
Feb		mMISCGAIN <Month>
Mar		
Apr		
May		
Jun		
Jul		
Aug		
Sep		
Total		

NOTE: "Miscellaneous gains" are recalls from the Reserves returned dropped from rolls, delayed reenlistments, gain adjustments, and other gains.

Fig. 8--Background management actions: OTS and miscellaneous gains

SAM2 Input Screen 8
BACKGROUND MANAGEMENT ACTIONS: PALACE CHASE, OTS, AND MISC. LOSSES

Month	Palace Chase Loss	OTS Loss	Miscellaneous Loss
Oct	mPCLOSS <Month>		
Nov			
Dec		mOTSLOSS <Month>	
Jan			
Feb			mMISCLOSS <Month>
Mar			
Apr			
May			
Jun			
Jul			
Aug			
Sep			
Total			

NOTE: "Miscellaneous losses" are loss adjustments and other losses.

Fig. 9--Background management actions: Palace Chase, OTS, and miscellaneous losses

SAM2 Input Screen 9
FORCED EARLY REENLISTMENTS FROM SAME FISCAL YEAR

Month in which reup occurs	Month in this FY in which early reenlistment would otherwise have occurred											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Oct												
Nov												
Dec												
Jan												
Feb												
Mar	FEROUT1POLICY <Catenl, Month, Origin>											
Apr												
May												
Jun												
Jul												
Aug												
Sep												

NOTE: Repeated 3 times: first, second, and career terms.

Fig. 10--Forced early reenlistments from same fiscal year

SAM2 Input Screen 10
FORCED EARLY REENLISTMENTS FROM NEXT FISCAL YEAR

Month in which reup occurs	Category of Enlistment		
	First	Second	Career
Oct			
Nov			
Dec			
Jan			
Feb			
Mar	FEROUT2POLICY <Catenl, Month>		
Apr			
May			
Jun			
Jul			
Aug			
Sep			

Fig. 11--Forced early reenlistments from next fiscal year

The detailed output screens work in pairs. The first pair shows inventory change by grade and by category of enlistment. The second pair shows details of gains and losses. The third pair analyzes the two largest types of losses (attrition losses and ETS losses). The fourth pair shows end-of-month inventories and fiscal-year costs.

Summary Output Screens

The following two figures are SAM2 summary output screens:

Figure 12. Summary of plan performance.

Figure 13. Summary of short-term management actions.

Detailed Output Screens

The following ten figures are SAM2 detailed output screens:

Figure 14. Inventory change by grade.

Figure 15. Inventory change by category of enlistment.

Figure 16. Gains by category of enlistment or grade.

Figure 17. Losses by category of enlistment or grade.

Figure 18. Attrition losses.

Figure 19. Policy-free ETS losses by category of enlistment or grade.

Figure 20. Inventory at end of month by category of enlistment.

Figure 21. Military personnel account costs for fiscal year.

Figure 22. Policy-free reenlistments.

Figure 23. Actual reenlistments.

SAM2 Summary Output Screen 1
SUMMARY OF PLAN PERFORMANCE

Item	Military Personnel Account FY Budget ($ Millions)	Grade Strength E-5	E-6	E-7	E-8	E-9	End Strength
Projected	TOTALCOST	ENDINV <Topgrade, tCatenl, Month=Sep>					
		ENDINV <tGrade, tCatenl, Month=Sep>					
Goal	BUDGET	GRADECEILING <Topgrade>					ENDSTRENGTH
Difference	DIFFBUDGET	DIFFGRADECEILING <Topgrade>					DIFFENDSTRENGTH

Fig. 12--Summary of plan performance

SAM2 Summary Output Screen 2
SUMMARY OF SHORT-TERM MANAGEMENT ACTIONS

	Accessions		Early Release		Promotions to Grade				
Month	NPS	PS	Rollup	Early Out	E-5	E-6	E-7	E-8	E-9
Oct	NPS <tGrade, tCatenl, Month>								
Nov		PS <tGrade, tCatenl, Month>							
Dec			RULOSS <tGrade, tCatenl, Month>						
Jan				EOLOSS <tGrade, tCatenl, Month>					
Feb					PROMIN <Grade=Topgrade, tCatenl, Month>				
Mar									
Apr									
May									
Jun									
Jul									
Aug									
Sep									
Total									

Fig. 13--Summary of short-term management actions

SAM2 Detailed Output Screen 1
INVENTORY CHANGE BY GRADE: _____

Month	Starting Inventory	Gain	Loss	Promotion In	Promotion Out	Demotion In	Demotion Out	Ending Inventory
Oct	STARTINV <Grade, tCatenl, Month>							
Nov	TOTALGAIN <Grade, tCatenl, Month>							
Dec	TOTALLOSS <Grade, tCatenl, Month>							
Jan	PROMIN <Grade, tCatenl, Month>							
Feb	PROMOUT <Grade, tCatenl, Month>							
Mar	DEMOIN <Grade, tCatenl, Month>							
Apr	DEMOOUT <Grade, tCatenl, Month>							
May	ENDINV <Grade, tCatenl, Month>							
Jul								
Aug								
Sep								
Total								

NOTE: Repeated 10 times: total, and 9 grades.

Fig. 14--Inventory change by grade

SAM2 Detailed Output Screen 2
INVENTORY CHANGE BY CATEGORY OF ENLISTMENT: _____

Month	Starting Inventory	Gain	Loss	Reenlist In	Reenlist Out	Flow to Ret. Elig In	Flow to Ret. Elig Out	Ending Inventory
Oct	STARTINV <tGrade, Catenl, Month>							
Nov	TOTALGAIN <tGrade, Catenl, Month>							
Dec	TOTALLOSS <tGrade, Catenl, Month>							
Jan	REENLISTIN <tGrade, Catenl, Month>							
Feb	REENLISTOUT <tGrade, Catenl, Month>							
Mar	RETELIGIN <tGrade, Catenl, Month>							
Apr	RETELIGOUT <tGrade, Catenl, Month>							
May	ENDINV <tGrade, Catenl, Month>							
Jun								
Jul								
Aug								
Sep								
Total								

NOTE: Repeated 5 times: total, and 4 categories of enlistment.

Fig. 15--Inventory change by category of enlistment

SAM2 Detailed Output Screen 3
GAINS BY CATEGORY OF ENLISTMENT: _____ OR GRADE: _____

Month	NPS Accessions			PS Accessions	OTS Gain	Misc. Gain	Total
	4 Year	6 Year	Total				
Oct	NPS4 <Grade, Catenl, Month>						
Nov		NPS6 <Grade, Catenl, Month>					
Dec			NPS <Grade, Catenl, Month>				
Jan				PS <Grade, Catenl, Month>			
Feb					OTSGAIN <Grade, Catenl, Month>		
Mar						MISCGAIN <Grade, Catenl, Month>	
Apr							TOTALGAIN <Grade, Catenl, Month>
May							
Jun							
Jul							
Aug							
Sep							
Total							

NOTE: Repeated 14 times: total, 4 categories of enlistment, and 9 grades.

Fig. 16--Gains by category of enlistment or grade

SAM2 Detailed Output Screen 4
LOSSES BY CATEGORY OF ENLISTMENT: _____ OR GRADE: _____

Month	Attrition		ETS Loss	Roll Up	Early Out	Palace Chase	Retirement	OTS Loss	Misc. Loss	Total
	BMT	STD								
Oct	BMTATTLOSS <Grade, Catenl, Month>									
Nov		STDATTLOSS <Grade, Catenl, Month>								
Dec			ETSLOSS <Grade, Catenl, Month>							
Jan				RULOSS <Grade, Catenl, Month>						
Feb					EOLOSS <Grade, Catenl, Month>					
Mar						PCLOSS <Grade, Catenl, Month>				
Apr							RETIREMENT <Grade, Catenl, Month>			
May								OTSLOSS <Grade, Catenl, Month>		
Jun									MISCLOSS <Grade, Catenl, Month>	
Jul										TOTALLOSS <Grade, Catenl, Month>
Aug										
Sep										
Total										

NOTE: Repeated 14 times: total, 4 categories of enlistment, and 9 grades.

Fig. 17--Losses by category of enlistment or grade

SAM2 Detailed Output Screen 5
ATTRITION LOSSES: _____

Month	Category of Enlistment				
	First		Second	Career	Retirement Eligible	Total
	BMT	STD				
Oct						
Nov						
Dec						
Jan						
Feb	BMTATTLOSS <tGrade, Catenl=1, Month>					
Mar		STDATTLOSS <tGrade, Catenl, Month>				
Apr			ATTLOSS <tGrade, tCatenl, Month>			
May						
Jun						
Jul						
Aug						
Sep						
Total						

Fig. 18--Attrition losses

SAM2 Detailed Output Screen 6
POLICY-FREE ETS LOSSES BY CATEGORY OF ENLISTMENT: _____ OR GRADE: _____

Month	ETS Loss	Rollup Shift	Early Out Shift	Palace Chase Shift	Policy-free ETS Loss
Oct	ETSLOSS <tGrade, Catenl, Month>				
Nov		RUSHIFT <tGrade, Catenl, Month>			
Dec			EOSHIFT <tGrade, Catenl, Month>		
Jan				PCSHIFT <tGrade, Catenl, Month>	
Feb					PFETSLOSS <tGrade, Catenl, Month>
Mar					
Apr					
May					
Jun					
Jul					
Aug					
Sep					
Total					

NOTE: Repeated 14 times: total, 4 categories of enlistment, and 9 grades.

Fig. 19--Policy-free ETS losses by category of enlistment or grade

SAM2 Output Screen 7
INVENTORY AT END OF MONTH BY CATEGORY OF ENLISTMENT: _____

	Grade									
Month	E-1	E-2	E-3	E-4	E-5	E-6	E-7	E-8	E-9	Total
Sep last FY	STARTINV	<Grade, Catenl, Month=Oct>								
				STARTINV	<tGrade, Catenl, Month=Oct>					
Oct										
Nov										
Dec										
Jan										
Feb										
Mar										
Apr	ENDINV	<Grade, Catenl, Month>								
Apr					ENDINV	<tGrade, Catenl, Month>				
May										
Jun										
Jul										
Aug										
Sep										

NOTE: Repeated 5 times: total, and 4 categories of enlistment.

Fig. 20--Inventory at end of month by category of enlistment

SAM2 Detailed Output Screen 8
MILITARY PERSONNEL ACCOUNT COSTS FOR FISCAL YEAR

Grade	Basic Pay	Retired Pay Accrual	BAQ and VHA	Incentive and Special Pay	Misc. Pay	PCS Cost	Total
E-1	BASICPAY <Grade>						
E-2		RETIREPAY <Grade>					
E-3			BAQVHA <Grade>				
E-4				INCENTPAY <Grade>			
E-5					MISCPAY <Grade>		
E-6						PCSCOST <Grade>	
E-7							TOTALCOST <Grade>
E-8							
E-9							
Total							

Fig. 21--Military personnel account costs for fiscal year

SAM2 Output Screen 9
POLICY-FREE REENLISTMENTS OUT BY CATEGORY OF ENLISTMENT OR GRADE

Month	ETS Reenlistments	Forced Early Reenlistments Shifted to: Same FY	Past FY	Policy-free Reenlistments
Oct				
Nov				
Dec				
Jan				
Feb	ETSREENLISTOUT	FERSHIFT1	FERSHIFT2	PFREENLISTOUT
Mar				
Apr				
May				
Jun				
Jul				
Aug				
Sep				

NOTE: Repeated 14 times: total, 4 catenl, and 9 grades.

Fig. 22--Policy-free reenlistments out by category of enlistment or grade

SAM2 Output Screen 10
ACTUAL REENLISTMENTS OUT BY CATEGORY OF ENLISTMENT OR GRADE

Month	ETS Reenlistments	Forced Early Reenlistments from: Same FY	Next FY	Total actual Reenlistments
Oct				
Nov				
Dec				
Jan				
Feb				
Mar	ETSREENLISTOUT	FEROUT1	FEROUT2	REENLISTOUT
Apr				
May				
Jun				
Jul				
Aug				
Sep				

NOTE: Repeated 14 times: total, 4 catenl, and 9 grades.

Fig. 23--Actual reenlistments out by category of enlistment or grade

IV. ACTION DIAGRAM FOR MODULE 2A: INVENTORY PROJECTION

All the submodules in Modules 2, 3 and 4 of SAM (and some of those in Module 1) are programmed in the EXPRESS computer language. One of the strengths of that language is that once data have been expressed in a multidimensional array, computations with those data become very easy. Consequently, most of the work of Module 2A consists of loading historical and projected information into the appropriate multidimensional array. Generating the output then becomes a simple matter of manipulating and aggregating that array.

Module 2A uses a 4-dimensional data array: grade, category of enlistment, month of the fiscal year, and variables. The array has 432 cells in it for each variable (9 grades times 4 categories of enlistment times 12 months).

In other words, SAM2A can be thought of as a collection of inventory and flow variables, each of which has the dimensions <Grade, Catenl, month>. In the course of assembling those variables other dimensions are sometimes used, but those other dimensions occur only in specific calculations and are not carried throughout the data structure.

INPUTS DESCRIBING PAST EVENTS IN FISCAL YEAR (FROM MODULES P1 AND P2)

The first step in running SAM2 each month is to get data on past events during the fiscal year into the module's data array.

All the inputs describing past events come in with subscripts <Grade, Catenl, Month>. However, since this step covers only past events, the month subscript ranges only over those months in the fiscal year that have already occurred.

Change in Inventory

STARTINV	Inventory at the start of a month.
ENDINV	Inventory at the end of a month.
NETCHANGE	Change in inventory during a month.

Gains to the Enlisted Force

NPS4	Non-Prior Service (NPS) accessions for a 4-year term.
NPS6	NPS accessions for a 6-year term.
NPS	Total NPS accessions (NPS4 + NPS6).
PS	Prior Service accessions.
OTSGAIN	Gains scheduled to go to Officer's Training School.
MISCGAIN	Miscellaneous gains (recalls from the Reserves, returned dropped from rolls, delayed reenlistments, gain adjustments, and other gains).
TOTALGAIN	Total gain (NPS4, NPS6, PS, OTSGAIN, and MISCGAIN).

Losses from the Enlisted Force

BMTATTLOSS	Attrition losses from BMT.
STDATTLOSS	Standard attrition losses.
ATTLOSS	Total attrition losses.
ETSLOSS	ETS losses (losses that are not attrition, retirement, Rollup, Early Out, Palace Chase, OTS, or miscellaneous, but rather are voluntary departures at the expiration of the enlisted person's contract to serve, or after an extension of that contract).
RULOSS	Rollup losses (ETS losses shifted to this month from later months in the fiscal year to reduce personnel costs in the fiscal year).
RULOSSBYORIGIN	Rollup losses by month from which the loss was shifted (the "origin" month).
EOLOSS	Early Out losses (losses shifted to this month from months in the next fiscal year to reduce this fiscal year's end strength).

PCLOSS	Palace Chase losses (ETS losses shifted to this month from later months to send personnel to the reserve forces before the end of their obligated active service).
RETIREMENT	Retirement losses.
OTSLOSS	Losses to Officer's Training School.
MISCLOSS	Miscellaneous losses (gain adjustments and other losses).
TOTALLOSS	Total losses (ATTLOSS + ETSLOSS + RULOSS + EOLOSS + PCLOSS + RETIREMENT + OTSLOSS + MISCLOSS).

Definition of Policy-Free ETS Losses

ETSLOSS	(See definition under "Losses from the Enlisted Force" above).
RUSHIFT	Rollup shifts (ETS losses shifted to previous months by the Rollup program).
EOSHIFT	Early Out shifts (ETS losses shifted to previous months by the Early Out program).
PCSHIFT	Palace Chase shifts (ETS losses shifted to previous months by the Palace Chase program).
PFETSLOSS	ETS losses that would have occurred if there had been no early release programs: sum of ETSLOSS, RUSHIFT, EOSHIFT, and PCSHIFT.

Changes in Grade

PROMIN	Promotions into a grade.
PROMOUT	Promotions out of a grade.
DEMOIN	Demotions into a grade.
DEMOOUT	Demotions out of a grade.

Changes in Category of Enlistment

REENLISTIN	Reenlistment into a category.
REENLISTOUT	Reenlistment out of a category.
RETELIGIN	Flow into the retirement-eligible category (category 4) from the career term category.

RETELIGOUT	Flow out of the career term category (category 3) to the retirement-eligible category.

AGGREGATION OF PAST EVENTS FOR INPUT SCREENS

Before users can be asked to fill in the Module 2 input screens for the projection months, those screens must contain the data for the months in the fiscal year that have already occurred.

Those past inputs are not user choices, but rather actual events. Therefore they can be obtained from the actual events for past months that have just been loaded into the Module 2 accounting structure.

Not only *can* the past inputs be obtained from the detailed accounting structure, but they *should* be gotten from there to guarantee that all the numbers used in Module 2 are internally consistent.

Filling in past events on the input screens requires doing the obvious aggregations of the detailed data on past events. For example, mNPS4 <Month> = tNPS4 <tGrade, tCaten1, Month>.

USER-SPECIFIED INPUTS

Once the data on past events have been loaded into Module 2A's data array and into the Module 2 input screens, the operation of the module can begin. Note that the setup work is done only once each month.

However, from this point on, the module's work will be repeated many times each month. The multiple runs will occur as users take advantage of the latest available information (just loaded into the model) to explore alternative revisions to the plan for achieving fiscal year goals. It is also possible that the goals themselves (a user specified input) have also changed, or that users will want to explore what would have to happen to achieve them if they did change.

The inputs obtained from users are listed below. The inputs in screen 1 are the fiscal year goals. As just mentioned, these may have changed since last month. So the goals have to be reentered each month. The inputs on the rest of the input screens are all flows.

The user specified flows are only for the projection months, of course. These inputs for past months have already been obtained above (and are entered on the input screens in a protected mode so the user cannot inadvertently alter them).

Input Screen 1

BUDGET
GRADECEILING <Topgrade>
ENDSTRENGTH

Input Screen 2

mNPS4 <Month>
mNPS6 <Month>
mPS <Month>

Input Screen 3

mRULOSSBYORIGIN <Catenl, Month, Origin>

Input Screen 4

mEOLOSS <Catenl, Month>

Input Screen 5

mPROMINTOP <Topgrade, Month>

Input Screen 6

mDEMOOUT <Grade, Month>

Input Screen 7

mOTSGAIN <Month>
mMISCGAIN <Month>

Input Screen 8

mPCLOSS <Month>
mOTSLOSS <Month>
mMISCLOSS <Month>

Input Screen 9

FEROUT1POLICY <Catenl, Month, Origin>

Input Screen 10

FEROUT2POLICY <Catenl, Month>

INTERMEDIATE VARIABLES FROM HISTORY (FROM MODULES P1, P2, AND P3)

From Module P1: Early Release Programs

PCLOSSPROP <Catenl, n>	Proportion of Palace Chase losses obtained from "n" months in the future (n = 0 if loss was obtained from the same month).
EOSHIFTHIST <Grade, Catenl, Month>	Early Out shifts during projection months caused by Early Out losses that occurred before the start of the projection period.
PCSHIFTHIST <Grade, Catenl, Month>	Palace Chase shifts during projection months caused by Palace Chase losses that occurred before the start of the projection period.

From Module P2: Events in Past 12 Months Distributions.

For Gains:

dNPS4 <dGrade>

dNPS6 <dGrade>

dPS <dGrade, dCatenl>

dOTSGAIN <dGrade, dCatenl>

dMISCGAIN <dGrade, dCatenl>

For Losses:

dATTLOSS <dGrade, Catenl>

dPFETSLOSS <dGrade, Catenl>

dRULOSS <dGrade, Catenl>

dEOLOSS <dGrade, Catenl>

dPCLOSS <dGrade, dCatenl>

dRETIREMENT <dGrade, Catenl>

dOTSLOSS <dGrade, dCatenl>

dMISCLOSS <dGrade, dCatenl>

For Shifts:

dRUSHIFT <dGrade, Catenl>

dPCSHIFT <dGrade, dCatenl>

For reenlistment and flow to retirement eligibility:

dREENLISTOUT <dGrade, Catenl>

dRETELIGOUT <dGrade, Catenl = 3>

For demotions out of a grade:

dDEMOOUT <Grade, dCatenl>

Historical Promotion Rates.

HISTPROMOUTRATE <Grade, Catenl>	Average monthly promotion rate out of a grade during the 12 months before the first projection month.

Past NPS Accessions.

mNPS4 <Past>	NPS4 accessions during the 12 months before the first projection month.
mNPS6 <Past>	NPS6 accessions during the 12 months before the first projection month.

Inputs from Module P3: Losses from Attrition

NPS4ATTPROP <Catenl, n>	Proportion of NPS4 accessions lost because of attrition in the nth month after accession (n = 0 in the same month as the accession).
NPS6ATTPROP <Catenl, n>	Proportion of NPS6 accessions lost because of attrition in the nth month after accession (n = 0 in the same month as the accession).
PSATTPROP <Catenl, n>	Proportion of PS accessions lost because of attrition in the nth month after accession (n = 0 in the same month as the accession).
NPS4BMTATTPROP <Catenl, n>	Proportion of NPS4 accessions lost because

	of attrition in the nth month after accession while the enlisted person was still in BMT.
NPS6BMTATTPROP <Catenl, n>	Proportion of NPS6 accessions lost because of attrition in the nth month after accession while the enlisted person was still in BMT.

Inputs from Module P4: Forced Early Reenlistments

FERSHIFTHIST <Grade, Catenl, Month>	Forced early reenlistment shifts during projection months caused by forced early reenlistments that occurred before the start of the fiscal year being analyzed.
dFEROUT <dGrade, Catenl>	Distribution of forced early reenlistments by grade within each category of enlistment.
dFERSHIFT <dGrade, Catenl>	Distribution of forced early reenlistment shifts within each category of enlistment.

SEPARATION PROJECTIONS (FROM MODULE 1)

The following inputs to Module 2 from Module 1 leave Module 1 with month named by FPM and PM (date of First Projection Month and Projection Month). That method of naming the month must be changed to the "Month" subscript used in Module 2. Appendix B discusses this transformation. The point is not that switching methods of naming months is difficult, but rather that care must be taken to make sure the separations get assigned to the correct month in the Module 2 accounts.

INVATT <Catenl, Month>

PFETSLOSS <Catenl, Month>

RETIREMENT <Catenl, Month>

PFREENLISTOUT <Catenl, Month>

RETELIGOUT <Catenl = 3, Month>

CALCULATIONS

The following calculations need be done only for the projection months. Information on events during the months of the fiscal year that have already happened has already been entered into the SAM2 accounts.

Gains

Allocation of user specified inputs to detailed cells:

```
If Catenl = 1
NPS4 <Grade, Catenl, Month> =  mNPS4 <Month> * dNPS4 <dGrade>
Else
NPS4 <Grade, Catenl, Month> =  0

If Catenl = 1
NPS6 <Grade, Catenl, Month> =  mNPS6 <Month> * dNPS4 <dGrade>
Else
NPS6 <Grade, Catenl, Month> =  0

PS <Grade, Catenl, Month> =  mPS <Month> * dPS <dGrade, dCatenl>

OTSGAIN <Grade, Catenl, Month> =
        mOTSGAIN <Month> * dOTSGAIN <dGrade, dCatenl>

MISCGAIN <Grade, Catenl, Month> =
        mMISCGAIN <Month> * dMISCGAIN <dGrade, dCatenl>
```

Losses

Attrition from Accessions. To find the attrition losses during a given month from accessions that occurred since the start of the projection period, multiply the accessions each month since the start of the projection period by the appropriate attrition proportion, and sum. The calculations below start that sum with the month for which attrition is being counted and work backward to the month that starts the projection period.

```
NPS4ATT <Catenl, Month> =
        NPS4ATTPROP <Catenl, 0> * mNPS4 <Month>
      + NPS4ATTPROP <Catenl, 1> * mNPS4 <Month - 1>
      + ...
      + NPS4ATTPROP <Catenl, n> * mNPS4 <Month - n>
        ...
        stop sum when Month - n = First Projection Month

NPS6ATT <Catenl, Month> =
        NPS6ATTPROP <Catenl, 0> * mNPS6 <Month>
      + NPS6ATTPROP <Catenl, 1> * mNPS6 <Month - 1>
      + ...
      + NPS6ATTPROP <Catenl, n> * mNPS6 <Month - n>
```

```
        ...
        stop sum when Month - n = First Projection Month

PSATT <Catenl, Month> =
        PSATTPROP <Catenl, 0> * mPS <Month>
      + PSATTPROP <Catenl, 1> * mPS <Month - 1>
      + ...
      + PSATTPROP <Catenl, n> * mPS <Month - n>
        ...
        stop sum when Month - n = First Projection Month
```

Attrition from Basic Military Training. To find the attrition losses during a given month from accessions that occurred since the start of the projection period and while the enlisted person was still in BMT, multiply the accessions each month since two months before the start of the projection period by the appropriate attrition proportion, and sum. The reason for starting two months before the start of the projection period is that BMT lasts six weeks, so attritions from BMT can occur in the calendar month in which the accession occurs and the two following calendar months.

The calculations below start that sum with the month for which attrition is being counted and work backward to two months before the start of the projection period. Note that when the first projection month is the first or second month of the fiscal year, reaching back two months means reaching into the previous fiscal year. That is why the mNPS4 <Past> and mNPS6 <Past> inputs to module 2A are needed.

```
NPS4BMTATT <Catenl, Month> =
        NPS4BMTATTPROP <Catenl, 0> * mNPS4 <Month>
      + NPS4BMTATTPROP <Catenl, 1> * mNPS4 <Month - 1>
      + ...
      + NPS4BMTATTPROP <Catenl, n> * mNPS4 <Month - n>
        ...
        stop sum when Month - n = First Projection Month - 2

NPS6BMTATT <Catenl, Month> =
        NPS6BMTATTPROP <Catenl, 0> * mNPS6 <Month>
      + NPS6BMTATTPROP <Catenl, 1> * mNPS6 <Month - 1>
      + ...
      + NPS6BMTATTPROP <Catenl, n> * mNPS6 <Month - n>
        ...
        stop sum when Month - n = First Projection Month - 2
```

Total Attrition.

```
ATTLOSS <Catenl, Month> =
        NPS4ATT <Catenl, Month>
      + NPS6ATT <Catenl, Month>
      + PSATT <Catenl, Month>
      + INVATT <Catenl, Month>
```

Adding the Grade Dimension to Attritions.

```
ATTLOSS <Grade, Catenl, Month> =
        ATTLOSS <Catenl, Month> * dATTLOSS <dGrade, Catenl>
```

Subdividing Total Attrition into BMT Attrition and Standard Attrition.

```
BMTATTLOSS <Grade = 1, Catenl, Month> =
        NPS4BMTATT <Catenl, Month>
      + NPS6BMTATT <Catenl, Month>

BMTATTLOSS <Grade = 2 through 9, Catenl, Month> = 0

STDATTLOSS <Grade, Catenl, Month> =
        ATTLOSS <Grade, Catenl, Month>
      - BMTATTLOSS <Grade, Catenl, Month>
```

Policy-free ETS Losses.

```
PFETSLOSS <Grade, Catenl, Month> =
        PFETSLOSS <Catenl, Month> * dPFETSLOSS <dGrade, Catenl>
```

Rollup Shifts.

```
RUSHIFT <Catenl, Month> = tRULOSSBYORIGIN <Catenl, tMonth, Origin = Month>

RUSHIFT <Grade, Catenl, Month> =
        RUSHIFT <Catenl, Month> * dRUSHIFT <dGrade, Catenl>
```

Early Release Shifts.

```
EOSHIFT <Grade, Catenl, Month> = EOSHIFTHIST <Grade, Catenl, Month>
```

Palace Chase Shifts.

```
PCSHIFTPROJ <Month> =
        PCLOSSPROP<Catenl, 0> * PCLOSS <Month>
      + PCLOSSPROP<Catenl, 1> * PCLOSS <Month - 1>
        ...
      + PCLOSSPROP<Catenl, n> * PCLOSS <Month - n>
        ...
```

```
        stop sum when Month - n = First Projection Month

PCSHIFTPROJ <Grade, Catenl, Month> =
        PCSHIFTPROJ <Month> * dPCSHIFT <dGrade, dCatenl>

PCSHIFT <Grade, Catenl, Month> =
        PCSHIFTHIST <Grade, Catenl, Month>
      + PCSHIFTPROJ <Grade, Catenl, Month>
```

ETS Losses.

```
ETSLOSS <Grade, Catenl, Month> =
        PFETSLOSS <Grade, Catenl, Month>
      - RUSHIFT <Grade, Catenl, Month>
      - EOSHIFT <Grade, Catenl, Month>
      - PCSHIFT <Grade, Catenl, Month>
```

Rollup Losses.

```
RULOSS <Catenl, Month> = tRULOSSBYORIGIN <Cetenl, Month, tOrigin>
                         Screen 3, for projection months

RULOSS <Grade, Catenl, Month> =
        RULOSS <Catenl, Month> * dRULOSS <dGrade, Catenl>
```

Early Out Losses.

```
EOLOSS <Grade, Catenl, Month> =
        mEOLOSS <Catenl, Month> * dEOLOSS <dGrade, Catenl>
```

Palace Chase Losses.

```
PCLOSS <Grade, Catenl, Month> =
        mPCLOSS <Month> * dPCLOSS <dGrade, dCatenl>
```

Retirements.

```
RETIREMENT <Grade, Catenl, Month> =
        RETIREMENT <Catenl, Month> * dRETIREMENT <Grade, Catenl>
```

OTS and Miscellaneous Losses.

```
OTSLOSS <Grade, Catenl, Month> =
        mOTSLOSS <Month> * dOTSLOSS <dGrade, dCatenl>

MISCLOSS <Grade, Catenl, Month> =
        mMISCLOSS <Month> * dMISCLOSS <dGrade, dCatenl>
```

Reenlistments

When projecting reenlistments, SAM must take account of any forced early reenlistments that users plan in current and future months, and it must take account of reenlistments that have been shifted away from current and future months by forced early reenlistments in past months.

The output screens reporting on the forced early reenlistment program require the following information:

FEROUT1 = Forced early reenlistments from a later month in the current fiscal year.

FEROUT2 = Forced early reenlistments from the next fiscal year.

FERSHIFT1 = Forced early reenlistment shifts to an earlier month in the current fiscal year.

FERSHIFT2 = Forced early reenlistment shifts to the previous fiscal year.

PFREENLISTOUT = Reenlistments-out that would have occurred if there were no forced early reenlistment program.

REENLISTOUT = Actual reenlistments-out.

ETSREENLISTOUT = Actual reenlistments-out less forced early reenlistments, or equivalently, policy-free reenlistments-out less forced early reenlistment shifts (analogous to ETS losses).

To do this estimating SAM starts with the policy-free reenlistments estimated by Module 1:

PFREENLISTOUT <Catenl, Month> = Policy-free reenlistments-out.

Then it uses additional inputs from historical data:

FERSHIFTHIST <Grade, Catenl, Month> = Forced early reenlistment shifts during projection months caused by forced early reenlistments that occurred before the start fiscal year being analyzed.

dFEROUT <dGrade, Catenl> = Distribution of forced early reenlistments by grade within each category of enlistment.

dFERSHIFT <dGrade, Catenl> = Distribution of forced early reenlistment shifts within each category of enlistment.

Finally, SAM uses the user specified inputs from the input screens that define the forced early reenlistment program:

FEROUT1POLICY <Catenl, Month, Origin> = Forced early reenlistments from same fiscal year.

FEROUT2POLICY <Catenl, Month, Origin> = Forced early reenlistments from next fiscal year.

With this information, SAM performs the following calculations:

```
FERSHIFT1 <Catenl, Month> =
            tFEROUT1POLICY <Catenl, tMonth, Origin = Month)
          * dFERSHIFT <dGrade, Month>

FERSHIFT2 <Grade, Catenl, Month> =
            FERSHIFTHIST <Grade, Catenl, Month>

FEROUT1 <Grade, Catenl, Month> =
            FEROUT1POLICY <Catenl, Month, tOrigin>
          * dFEROUT <dGrade, Month>

FEROUT2 <Grade, Catenl, Month> =
            FEROUT2POLICY <Catenl, Month, tOrigin>
          * dFEROUT <dGrade, Month>

ETSREENLISTOUT <Grade, Catenl, Month> =
            PFREENLISTOUT <Grade, Catenl, Month>
          - FERSHIFT1 <Grade, Catenl, Month>
          - FERSHIFT2 <Grade, Catenl, Month>

REENLISTOUT <Grade, Catenl, Month> =
            ETSREENLISTOUT <Grade, Catenl, Month>
          + FEROUT1 <Grade, Catenl, Month>
          + FEROUT2 <Grade, Catenl, Month>


REENLISTIN <Grade, Catenl = 1, Month> = 0

REENLISTIN <Grade, Catenl = 2, Month> =
        REENLISTOUT <Grade, Catenl = 1, Month>

REENLISTIN <Grade, Catenl = 3, Month> =
        REENLISTOUT <Grade, Catenl = 2, Month>
      + REENLISTOUT <Grade, Catenl = 3, Month>
```

REENLISTIN <Grade, Catenl = 4 Month> =
REENLISTOUT <Grade, Catenl = 4, Month>

Flow to Retirement Eligibility

RETELIGOUT <Grade, Catenl, Month> = 0 if Catenl = 1, 2, or 4

RETELIGOUT <Grade, Catenl = 3, Month> =
RETELIGOUT <Catenl = 3, Month> * dRETELILGOUT <dGrade, Catenl = 3>

RETELIGIN <Grade, Catenl, Month> = 0 if Catenl = 1, 2, or 3

RETELIGIN <Grade, Catenl = 4, Month> =
RETELIGOUT <Grade, Catenl = 3, Month>

Demotions

Demotions out of a Grade.

DEMOOUT <Grade, Catenl, Month> =
mDEMOOUT <Grade, Month> * dDEMOOUT <Grade, dCatenl>

Demotions into a Grade.

If Grade = 9

DEMOIN <Grade, Catenl, Month> = 0

If Grade < 9

DEMOIN <Grade, Catenl, Month> = DEMOOUT <Grade + 1, Catenl, Month>

Promotions and Inventory Change

Promotions and inventory change have to be done month by month, because modeling promotions during a month requires the start-of-month inventory. The inventory at the start of the first projection month equals the inventory at the end of the last month before the first projection month, or, where Month = First Projection Month:

STARTINV <Grade, Catenl, Month> = ENDINV <Grade, Catenl, Month - 1>

From this point on, under the "Projection and Inventory Change" heading, the following calculations must all be done for the first projection month, then for the second projection month, and so on until all the projection months have been completed.

For Grades 1 through 3.

PROMOUT <Grade, Catenl, Month> =
HISTPROMOUTRATE <Grade, Catenl>
* STARTINV <Grade, Catenl, Month>

For Grade 1.

```
PROMIN <Grade=1, Catenl, Month > = 0
```

For Grades 2 through 4.

To enable SAM to recognize that persons with a 6-year term of enlistment get promoted directly to E-3 from E-1, the model uses an intermediate variable PROM13, the count of direct promotions of 6-year persons from E-1 to E-3 during a month. This flow is estimated as half of NPS6 accessions from last month (the half that came in during the early part of that month) plus half of NPS6 accessions from two months ago (the half that came in during the late part of that month). The lags result from NPS6 accessions spending time as E-1s while they are in basic military training.

```
PROM13 <Catenl = 1, Month> = 0.5 * NPS6 <Catenl = 1, Month - 1>
                           + 0.5 * NPS6 <Catenl = 1, Month - 2>

PROMIN <Grade = 2, Catenl, Month> =
        PROMOUT <Grade = 1, Catenl, Month>
      - PROM13 <Catenl = 1, Month>

PROMIN <Grade = 3, Catenl, Month> =
        PROMOUT <Grade = 2, Catenl, Month>
      + PROM13 <Catenl = 1, Month>

PROMIN <Grade = 4, Catenl, Month> =
        PROMOUT <Grade = 3, Catenl, Month>
```

For Grades 5 through 9.

```
TRIALPROMIN <Grade, Catenl, Month> =
        HISTPROMOUTRATE <Grade - 1, Catenl>
      * STARTINV <Grade - 1, Catenl, Month>

PROMIN <Grade, Catenl, Month> =
        TRIALPROMIN <Grade, Catenl, Month>
      * mPROMIN <Topgrade, Month>
      / tTRIALPROMIN <Grade, tCatenl, Month>
```

For Grades 4 through 8.

```
PROMOUT <Grade, Catenl, Month> = PROMIN <Grade + 1, Catenl, Month>
```

For Grade 9.

```
PROMOUT <Grade, Catenl, Month> = 0
```

For all Grades.

```
TOTALGAIN <Grade, Catenl, Month> =
        NPS4 <Grade, Catenl, Month>
      + NPS6 <Grade, Catenl, Month>
      + PS <Grade, Catenl, Month>
      + OTSGAIN <Grade, Catenl, Month>
      + MISCGAIN <Grade, Catenl, Month>

TOTALLOSS <Grade, Catenl, Month> =
        ATTLOSS <Grade, Catenl, Month>
      + ETSLOSS <Grade, Catenl, Month>
      + RULOSS<Grade, Catenl, Month>
      + EOLOSS <Grade, Catenl, Month>
      + PCLOSS <Grade, Catenl, Month>
      + RETIREMENT <Grade, Catenl, Month>
      + OTSLOSS <Grade, Catenl, Month>
      + MISCLOSS <Grade, Catenl, Month>

NETCHANGE <Grade, Catenl, Month> =
      + TOTALGAIN <Grade, Catenl, Month>
      - TOTALLOSS <Grade, Catenl, Month>
      + REENLISTIN <Grade, Catenl, Month>
      - REENLISTOUT <Grade, Catenl, Month>
      + RETELIGIN <Grade, Catenl, Month>
      - RETELIGOUT <Grade, Catenl, Month>
      + PROMIN <Grade, Catenl, Month>
      - PROMOUT <Grade, Catenl, Month>
      + DOMOIN <Grade, Catenl, Month>
      - DEMOOUT <Grade, Catenl, Month>

ENDINV <Grade, Catenl, Month> =
        STARTINV <Grade, Catenl, Month>
      + NETCHANGE <Grade, Catenl, Month>

STARTINV <Grade, Catenl, Month + 1> = ENDINV <Grade, Catenl, Month>
```

Now the calculations under the "Promotion and Inventory Change" heading have been completed for one month, and a starting inventory for the next month has been obtained. All the calculations under the heading "Promotions and Inventory Change" must now be redone for the new month, and so on until the last month in the fiscal year has been analyzed.

OUTPUTS FOR SAM2 INTERFACE SCREENS

Module 2's Summary Output Screen 2 (Fig. 13) and Detailed Output Screens 1 through 7 (Figs. 14-20) can all be filled in by straightforward aggregations of the data in Module 2A's data array. Note that this aggregation must be done over the entire year, not just over the months for which projection calculations had to be performed.

Summary Output Screen 1 (Fig. 12) requires information on goals from Input Screen 1 (Fig. 2) and cost estimates from Module 2B. Once those items have been obtained, the bottom line of the screen can be filled in by subtracting performances from goals.

Detailed Output Screen 8 (Fig. 21), although listed below for completeness, cannot yet be filled in because it uses output from Module 2B.

Summary Output Screen 1.

COST
ENDINV <Topgrade, tCatenl, Month = Sep>
ENDINV <tGrade, tCatenl, Month = Sep>
BUDGET
GRADECEILING <Topgrade>
ENDSTRENGTH
DIFFBUDGET
DIFFGRADECEILING <Topgrade>
DIFFENDSTRENGTH

Summary Output Screen 2.

NPS <tGrade, tCatenl, Month>
PS <tGrade, tCatenl, Month>
RULOSS <tGrade, tCatenl, Month>
EOLOSS <tGrade, tCatenl, Month>
PROMIN <Grade = Topgrade, tCatenl, Month>

Detailed Output Screen 1.

GAIN <tGrade, Catenl, Month >
LOSS <tGrade, Catenl, Month>
PROMIN <tGrade, Catenl, Month>
PROMOUT <tGrade, Catenl, Month>
DEMOIN <tGrade, Catenl, Month>
DEMOOUT <tGrade, Catenl, Month>
NETCHANGE <tGrade, Catenl, Month>

Detailed Output Screen 2.

GAIN <Grade, tCatenl, Month >
LOSS <Grade, tCatenl, Month>
REENLISTIN <Grade, tCatenl, Month>
REENLISTOUT <Grade, tCatenl, Month>
RETELIGIN <Grade, tCatenl, Month>

RETELIGOUT <Grade, tCatenl, Month>
NETCHANGE <Grade, tCatenl, Month>

Detailed Output Screen 3.

NPS4 <Grade, Catenl, Month>
NPS6 <Grade, Catenl, Month>
PS <Grade, Catenl, Month>
OTSGAIN <Grade, Catenl, Month>
MISCGAIN <Grade, Catenl, Month>
TOTALGAIN <Grade, Catenl, Month>

Detailed Output Screen 4.

BMTATTLOSS <Grade, Catenl, Month>
STDATTLOSS <Grade, Catenl, Month>
ETSLOSS <Grade, Catenl, Month>
RULOSS <Grade, Catenl, Month>
EOLOSS <Grade, Catenl, Month>
PCLOSS <Grade, Catenl, Month>
RETIREMENT <Grade, Catenl, Month>
OTSLOSS <Grade, Catenl, Month>
MISCLOSS <Grade, Catenl, Month>
TOTALLOSS <Grade, Catenl, Month>

Detailed Output Screen 5.

ATTLOSS <tGrade, Catenl, Month>

Detailed Output Screen 6.

ETSLOSS <tGrade, Catenl, Month>
RUSHIFT <tGrade, Catenl, Month>
EOSHIFT <tGrade, Catenl, Month>
PCSHIFT <tGrade, Catenl, Month>
PFETSLOSS <tGrade, Catenl, Month>

Detailed Output Screen 7.

STARTINV <Grade, Catenl, Month = Oct>
STARTINV <tGrade, Catenl, Month = Oct>
ENDINV <Grade, Catenl, Month>
ENDINV <tGrade, Catenl, Month>

Detailed Output Screen 8.

BASICPAY <Grade>
RETIREPAY <Grade>
BAQVHA <Grade>
INCENTPAY <Grade>
MISCPAY <Grade>

PCSCOST <Grade>
TOTALCOST <Grade>

Detailed Output Screen 9.

ETSREENLISTOUT <Grade, Catenl, Month>
FERSHIFT1 <Grade, Catenl, Month>
FERSHIFT2 <Grade, Catenl, Month>
PFREENLISTOUT <Grade, Catenl, Month>

Detailed Output Screen 10.

ETSREENLISTOUT <Grade, Catenl, Month>
FEROUT1 <Grade, Catenl, Month>
FEROUT2 <Grade, Catenl, Month>
REENLISTOUT <Grade, Catenl, Month>

OUTPUTS TO MODULE 2B: COST PROJECTION

STARTINV <Grade, Catenl, Month>
ENDINV <Grade, Catenl, Month>
TOTALGAIN <Grade, Catenl, Month>
TOTALLOSS <Grade, Catenl, Month>

OUTPUTS TO MODULE 3: COMPUTER AIDED DESIGN

ENDSTRENGTH
GRADECEILING <Topgrade>

BEGINV <Grade, Catenl, Month = Oct>
ENDINV <Grade, Catenl, Month>

TOTALLOSS <Grade, Catenl, Month>
PROMIN <Grade, Catenl, Month>
PROMOUT <Grade, Catenl, Month>
DEMOIN <Grade, Catenl, Month>
DEMOOUT <Grade, Catenl, Month>
REENLISTIN <Grade, Catenl, Month>
REENLISTOUT <Grade, Catenl, Month>
RETELIGOUT <Grade, Catenl, Month>
RETELIGIN <Grade, Catenl, Month>

NPS <Grade, Catenl, Month>
PS <Grade, Catenl, Month>
OTSGAIN <Grade, Catenl, Month>
MISCGAIN <Grade, Catenl, Month>

OUTPUTS TO MODULE 4: PLAN COMPARISON

The outputs to Module 4 are the same as the outputs to the SAM2 interface screens. Any and all output that a user looks at to evaluate a fiscal-year plan should be available to compare alternative fiscal-year plans.

OUTPUTS TO BUDGETING PROCESS

These outputs are needed by the budgeting models that prepare detailed (and official) estimates of the personnel costs during a fiscal year. An additional output to the budgeting process is produced by Module 2B.

NPS4 <tGrade, tCatenl, Month>
NPS6 <tGrade, tCatenl, Month>
PS <tGrade, tCatenl, Month>
OTSGAIN <tGrade, tCatenl, Month>
MISCGAIN <tGrade, tCatenl, Month>
TOTALGAIN <tGrade, tCatenl, Month>

ATTLOSS <tGrade, tCatenl, Month>
ETSLOSS <tGrade, tCatenl, Month>
RULOSS <tGrade, tCatenl, Month>
EOLOSS <tGrade, tCatenl, Month>
PCLOSS <tGrade, tCatenl, Month>
RETIREMENT t<Grade, tCatenl, Month>
OTSLOSS <tGrade, tCatenl, Month>
MISCLOSS <tGrade, tCatenl, Month>
TOTALLOSS <tGrade, tCatenl, Month>

V. ACTION DIAGRAM FOR MODULE 2B: COST PROJECTION

This module projects the Military Personnel Account costs of the enlisted force for the fiscal year being analyzed. It estimates the following cost items by grade:

BASICPAY	Basic pay.
RETIREPAY	Retired pay accrual (equal to a percentage of basic pay).
BAQVHA	Basic Allowance for Quarters and Variable Housing Allowance.
INCENTPAY	Incentive and special pays (an example of the former is flying pay, an example of the latter is reenlistment bonuses).
MISCPAY	Miscellaneous pays (subsistence, uniform or clothing allowance, station allowance overseas, family separation allowances, separation payments, Social Security payments, and other military personnel costs).
PCSCOST	Permanent Change of Station costs.
TOTALCOST	Total MPA costs (BASICPAY + RETIREPAY + BAQVHA + INCENTPAY + MISCPAY + PCSCOST).

In addition to the above outputs for the SAM2 output screens, this module also estimates person-years by grade and total years of federal military service (Tfms), which is for the budgeting process that does detailed costing for the fiscal year.

INPUTS FROM MODULE 2A: INVENTORY PROJECTION

STARTINV <Grade, Catenl, Month>
ENDINV <Grade, Catenl, Month>
TOTALGAIN <Grade, Catenl, Month>
TOTALLOSS <Grade, Catenl, Month>

INPUTS ON FLOW WEIGHTS AND COST FACTORS

GAINWEIGHT <Grade, Month>	Fraction of a month that a gain works (gains come in part way through the month).
LOSSWEIGHT <Grade, Month>	Fraction of a month that a loss works (losses leave part way through a month).
BASICPAYFACTOR <Grade>	Basic pay per person-year.
RETIREPAYFACTOR <Grade>	Retired pay accrual per person-year.
BAQVHAFACTOR <Grade>	Basic allowance for quarters and variable housing allowance per person-year.
INCENTPAYFACTOR <Grade>	Incentive and special pay per person-year.
MISCPAYFACTOR <Grade>	Miscellaneous pay per person-year.
PCSCOSTFACTOR <Grade>	Permanent change of station cost per person-year.

INPUTS ON TFMS DISTRIBUTION

To estimate the person years during the fiscal year by Tfms, a recent inventory by Grade, Category, of Enlistment, and Tfms is needed. The inventory at the start of the fiscal year is a good choice.

INVENTORY <Grade, Catenl, Tfms>

CALCULATIONS

Calculations for SAM2 Output

```
PERSONMONTHS <Grade, Month> =
        STARTINV <Grade, Month>
      + GAINWEIGHT <Grade, Month> * TOTALGAIN <Grade, Catenl, Month>
      - LOSSWEIGHT <Grade, Month> * TOTALLOSS <Grade, Catenl, Month>

PERSONYEARS <Grade> = tPERSONMONTHS <Grade, tCatenl, tMonth>/12

BASICPAY <Grade> =
        PERSONYEARS <Grade> * BASICPAYFACTOR <Grade>

RETIREPAY <Grade> =
        PERSONYEARS <Grade> * RETIREPAYFACTOR <Grade>

BAQVHA <Grade> =
        PERSONYEARS <Grade> * BAQVHAFACTOR <Grade>
```

```
INCENTPAY <Grade> =
        PERSONYEARS <Grade> * INCENTPAYFACTOR <Grade>

MISCPAY <Grade> =
        PERSONYEARS <Grade> * MISCPAYFACTOR <Grade>

PCSCOST <Grade> =
        PERSONYEARS <Grade> * PCSCOSTFACTOR <Grade>

TOTALCOST <Grade> =
         BASICPAY <Grade>
        +RETIREPAY <Grade>
        +BAQVHA <Grade>
        +INCENTPAY <Grade>
        +MISCPAY <Grade>
        +PCSCOST <Grade>
```

Calculations for Budget Process

```
PERSONMONTHS <Grade, Tfms> =
        INVENTORY <Grade, Tfms>
      * tPERSONMONTHS <Grade, Catenl, tMonth>

PERSONYEARS <Grade, Tfms> =
        tPERSONMONTHS <Grade, tCatenl, Tfms>/12
```

OUTPUT TO SAM2 INTERFACE SCREENS

```
BASICPAY <Grade>
RETIREPAY <Grade>
BAQVHA <Grade>
INCENTPAY <Grade>
MISCPAY <Grade>
PCSCOST <Grade>
TOTALCOST <Grade>
```

OUTPUT TO MODULE 4: PLAN COMPARISON

The outputs to Module 4 are the same as the outputs to the SAM2 interface screens. Any and all outputs that a user looks at to evaluate a fiscal-year plan should be available to compare alternative fiscal-year plans.

OUTPUT TO BUDGETING PROCESS

This output joins other output from Module 2A in providing estimates that are needed by the budgeting process, which makes official estimates of personnel costs.

```
PERSONYEARS <Grade, Tfms>
```

VI. OVERVIEW OF MODULE 3: COMPUTER AIDED DESIGN

Module 3 of the Short-term Aggregate Inventory Projection Model (SAM3) helps users achieve the end-strength and grade-strength goals that they established for the fiscal year in SAM2. SAM3 accepts trajectories chosen by the user for the total number of airmen in the force and in each of the top five grades. These trajectories start in the first projection month and continue though the end of the fiscal year. Presumably (but not necessarily) users will choose trajectories that achieve the end-of-year grade strengths and total strengths specified in the fiscal-year goals. SAM3 then computes the monthly NPS accessions for the remainder of the fiscal year that will make the enlisted force inventory follow the desired force trajectory, and it computes promotions that make the inventory by grade follow the desired grade trajectories.

The suggested NPS accessions and promotion policy, together with the other short-term management actions (PS accessions and early releases) specified in SAM2, constitute a fiscal-year plan that "exactly" achieves the inventory goals for the fiscal year.[1] The actions suggested by SAM3 do not, however, necessarily achieve the third fiscal-year goal: personnel cost that equals the budget. Nevertheless, SAM3 can help achieve that goal. Bowing the trajectories up (holding onto personnel longer) will increase the cost of personnel during the fiscal year, and bowing them down (letting them leave sooner) will decrease the cost of personnel. Moreover, having found an accession and promotion policy that achieves the inventory goals, the next analysis done with SAM2 can focus on the budget goal (using the Rollup program, for example). Users can rerun SAM2 using the exact actions suggested by SAM3, or they can rerun SAM2 using the suggested actions as guidelines but modifying the suggestions to take account of factors not considered by SAM3.

---

[1]Since the projected losses of personnel are subject to uncertainty, the *actual* inventories cannot be expected to match the goals exactly.

One likely sequence of events is:

A. Users run SAM2 and find that their draft plan does not achieve fiscal-year goals.
B. Users send the draft plan to SAM3, choose force trajectories that lead to the desired year-end force levels, and obtain suggested NPS accession and promotion plans. Those plans, however, involve highly variable monthly actions (e.g., very unsmooth NPS accessions) and do not achieve the desired fiscal-year budget.
C. Users rerun SAM2 using the suggested NPS accessions and promotions as guidelines, but smoothing them somewhat. Users also modify some (or all) of the short-term management actions in a direction that adjusts fiscal-year cost toward the budget. Now users find that, while they are closer to achieving the fiscal-year goals, the goals are still not met exactly. Moreover, the force trajectories resulting from the smoothed NPS accession and promotion plans are erratic.
D. Users repeat steps B and C until an acceptable plan has been designed. An acceptable plan meets fiscal-year goals for end strength, grade strengths, and fiscal-year costs and has a satisfactory degree of smoothness in monthly NPS accessions, promotions to the top five grades, and force trajectories during the fiscal year.

VII. USER INTERFACE SCREENS FOR MODULE 3

Figures 24 and 25 present the input and output screens that a user will see when operating SAM3. The computer program variables obtained from the input screens or sent to the output screens are shown in the display area.

INPUT SCREEN

The input screen (Fig. 24) accepts user choices of force trajectories: the month by month inventories by the top five grades and total inventory at the end of a month. Those trajectories will presumably be chosen to reach the end-of-year goals obtained from Module 2 and reported at the bottom of the input screen.

OUTPUT SCREEN

The output screen (Fig. 25) shows the NPS accessions and promotions to the top five grades necessary to achieve the desired force trajectories (given the projected enlisted force behavior and other projected management actions specified for Module 3 by Module 2). If the trajectories have been chosen to reach the grade strength ceiling and end strength goals in September, then the output screen shows the NPS accessions and the promotions to the top five grades that will exactly achieve the grade strength ceiling and end strength goals. These suggested accession and promotion actions are conditional upon the other management actions specified in the latest Module 2 run. If those other management actions are altered (possibly to affect the fiscal year cost), then Module 3 will have to be rerun to find new accession and promotion plans that achieve the force size goals.

SAM3 Input Screen
FORCE TRAJECTORIES: INVENTORY AT END OF MONTH

Month	Force by Top Five Grades					Total Force
	E-5	E-6	E-7	E-8	E-9	
Oct						
Nov						
Dec						
Jan						
Feb						
Mar						
Apr	GRADETRAJECTORY <Topgrade, Month>					
May						FORCETRAJECTORY <month>
Jun						
Jul						
Aug						
Sep						
Sep Goal	GRADECEILING <Topgrade>					ENDSTRENGTH

Fig. 24--Force trajectories: Inventory at end of month

SAM3 Output Screen
SUGGESTED NPS ACCESSIONS AND PROMOTIONS INTO TOP FIVE GRADES

Item	NPS Accessions	Promotions into Grade				
		E-5	E-6	E-7	E-8	E-9
Oct						
Nov						
Dec						
Jan						
Feb	NPS <tGrade, tCatenl, Month>					
Mar		PROMIN <Grade=Topgrade, tCatenl, Month>				
Apr						
May						
Jun						
Jul						
Aug						
Sep						

Fig. 25--Suggested NPS accessions and promotions into top five grades

VIII. ACTION DIAGRAM FOR MODULE 3

End-of-year grade strength and end strength goals are obtained by Module 3 from Module 2 and placed at the bottom of the input screen where users enter their suggested trajectories. Given the user choice of trajectories and the management actions chosen in Module 2, Module 3 then calculates the revised NPS accessions and promotions to the top five grades necessary to achieve those trajectories.

INPUTS

Inputs from Module 2A: Inventory Projection

ENDSTRENGTH
GRADECEILING <Topgrade>

STARTINV <Grade, Catenl, Month = Oct>
ENDINV <Grade, Catenl, Month>

TOTALLOSS <Grade, Catenl, Month>
PROMIN <Grade, Catenl, Month>
PROMOUT <Grade, Catenl, Month>
DEMOIN <Grade, Catenl, Month>
DEMOOUT <Grade, Catenl, Month>
REENLISTIN <Grade, Catenl, Month>
REENLISTOUT <Grade, Catenl, Month>
RETELIGOUT <Grade, Catenl, Month>
RETELIGIN <Grade, Catenl, Month>

NPS <Grade, Catenl, Month>
PS <Grade, Catenl, Month>
OTSGAIN <Grade, Catenl, Month>
MISCGAIN <Grade, Catenl, Month>

Inputs from Interface Screens

GRADETRAJECTORY <Topgrade, Month>
FORCETRAJECTORY <Month>

Special Inputs to SAM3 from SAM2

NPS4ATTPROP <n> = Proportion of NPS4 accessions lost from attrition during the nth month after accession, n = 0 in the same month as the accessions.

NPS6ATTPROP <n> = Proportion of NPS6 accessions lost from attrition during the nth month after accession, n = 0 in the same month as the accessions.

These attrition proportions can be obtained from Module 2, or they can be obtained from Module P3, which is their original source.

DRAFTNPS4 <Month> = NPS4 accessions in current SAM2 plan.

DRAFTNPS6 <Month> = NPS6 accessions in current SAM2 plan.

These "draft" NPS accessions are a new name for the accessions in the plan currently being tested by SAM2, and revised by SAM3. Using "draft" in the name makes clear that Module 3 is going to revise this variable.

CALCULATIONS

The calculations part of the action diagram presents the algorithms that convert input variables into output variables. During the course of those calculations it is sometimes useful to compute internal variables, to make the logic easier to follow. Those internal variables do not appear on either the input or output list, but rather are listed at the start of the calculations.

Variables on the input, output, and internal variables lists have their subscript dimensions explicitly defined. However, to make formulas as compact as possible, those subscript dimensions are often left implicit when presenting the algorithms. To determine the subscript dimensions, find the variable on the input, output, or internal variable lists.

Internal Variables

These variables are used in calculations, but they are neither inputs to nor outputs from Module 3.

DRAFTNPS <Grade, Catenl, Month>	NPS accessions in draft plan received from Module 2.
REQNPS <Month>	NPS accessions required to achieve desired force trajectory.
DRAFTPROMIN <Grade, Catenl, Month>	Promotions into grade in draft plan from Module 2.
REQPROMIN <Grade, Month>	Promotions into grade required to achieve desired grade trajectory.
PARTGAIN <Grade, Catenl, Month>	All gains to enlisted force except NPS accessions.

Place Force Size Goals at Bottom of Input Screen

These goals, originally obtained from Module 2 inputs, are what the force trajectory and grade trajectory should equal in September for Module 3 to produce management actions that achieve the goals.

ENDSTRENGTH
GRADECEILING <Topgrade>

Estimation of NPS Accessions

Do for all months:

GAP <Month> = FORCETRAJECTORY <Month> - ENDINV <tGrade, tCatenl, Month>

Calculate the following survival proportions (all are fractions between zero and one):

SURVIVE <a,b> = Proportion of NPS accessions during month "a" that survive until the end of month "b"

Let n = number of projection month, with the count starting at 1 for the first projection month and ending in the last month of the fiscal year. The formulas below are for n = 1 through 12, because 12 is

the maximum needed. If the SAM projection starts during the fiscal year, then less than 12 months will be needed.

These formulas must be applied to specific starting months. If the first projection month is April, then NPS4 <1> means the NPS4 flow during April, NPS4 <2> means the NPS4 flow during May, and so on. We need to know survivors from all accession months to all months in the remainder of the projection year. So if there are "p" projection months we need p(1 - p)/2 SURVIVE ratios, as defined below.

Implement the following formulas for n = 1, then implement them again for n = 2, and so on until n = last month in the projection period. This will generate the desired p(1 - p)/2 SURVIVE ratios.

```
SURVIVE <n,n> = [  DRAFTNPS4 <n> * (1 - NPS4ATTPROP <0>)
                 + DRAFTNPS6 <n> * (1 - NPS6ATTPROP <0)) ]
              / [ DRAFTNPS4 <n> + DRAFTNPS6 <n> ]

SURVIVE <n,n+1> = [  DRAFTNPS4 <n> * (1 - NPS4ATTPROP <0>)
                                   - NPS4ATTPROP <1>) ]
                  + DRAFTNPS6 <n> * (1 - NPS6ATTPROP <0)) ]
                                   - NPS6ATTPROP <1)) ]
                / [ DRAFTNPS4 <n> + DRAFTNPS6 <n> ]

SURVIVE <n,n+2> = [  DRAFTNPS4 <n> * (1 - NPS4ATTPROP <0>)
                                   - NPS4ATTPROP <1>) ]
                                   - NPS4ATTPROP <2>) ]
                  + DRAFTNPS6 <n> * (1 - NPS6ATTPROP <0)) ]
                                   - NPS6ATTPROP <1)) ]
                                   - NPS6ATTPROP <2)) ]
                / [ DRAFTNPS4 <n> + DRAFTNPS6 <n> ]
```

These formulas keep on going until the second subscript reaches the end of the fiscal year. The general formula is:

```
SURVIVE <n,n+j> = [  DRAFTNPS4 <n> * (1 - NPS4ATTPROP <0>)
                                   - NPS4ATTPROP <1>) ]
                                   - NPS4ATTPROP <2>) ]
                                     (and so on with terms that have
                                      subscripts increasing by 1 until
                                      subscript j is reached)
                                   - NPS4ATTPROP <j>) ]
                  + DRAFTNPS6 <n> * (1 - NPS6ATTPROP <0)) ]
```

```
                                    - NPS6ATTPROP <1)) ]
                                    - NPS6ATTPROP <2)) ]
                                      (and so on with terms that have
                                       subscripts increasing by 1 until
                                       subscript j is reached)
                                    - NPS6ATTPROP <j)) ]
                    / [ DRAFTNPS4 <n> + DRAFTNPS6 <n> ]
```

Do separately for each month, n = 1 during first projection month, n = 2 during next month, and so on until the end of the fiscal year (the formulas go to month 12, but the calculations can stop when the last projection month in the fiscal year is reached):

```
ADDNPS <n> = Additional NPS accessions required in the nth projection
             month, n = 1 in first projection month

ADDNPS <1> = GAP <1> / SURVIVE <1,1>

ADDNPS <2> = [ GAP <2>
                 - ADDNPS <1> * SURVIVE <1,2> ]
           / SURVIVE <2,2>

ADDNPS <3> = [ GAP <3>
                 - ADDNPS <1> * SURVIVE <1,3> ]
                 - ADDNPS <2> * SURVIVE <2,3> ]
           / SURVIVE <3,3>

ADDNPS <4> = [ GAP <4>
                 - ADDNPS <1> * SURVIVE <1,4> ]
                 - ADDNPS <2> * SURVIVE <2,4> ]
                 - ADDNPS <3> * SURVIVE <3,4> ]
           / SURVIVE <4,4>
```

Repeat the following formula making the j subscript be 5, 6, and so on until the last month in the fiscal year is reached:

```
ADDNPS <j> = [ GAP <j>
                 - ADDNPS <1> * SURVIVE <1,j> ]
                 - ADDNPS <2> * SURVIVE <2,j> ]
```

```
            - ADDNPS <3> * SURVIVE <3,j> ]
              (keep subtracting terms with increasing subscripts until
               you reach the last projection month in the fiscal year)
            - ADDNPS <j-1> * SURVIVE <j-1,j> ]
        / SURVIVE <j,j>
```

Finally, add the further NPS accessions to the NPS accessions in the draft plan from SAM2 to get the total required to meet the end strengths specified in SAM3:

```
NPS <Month> = DRAFTNPS4 <Month> + ADDNPS4 <Month>
            + DRAFTNPS6 <Month> + ADDNPS6 <Month>
```

Achieving the Force Trajectories

```
+-- Do for Month = FPM through Sep
|
|
|     a. Beginning force equals last months ending force
|
|     +- If Month = October
|     |
|     |     STARTINV = STARTINV <Grade, Catenl, Month = Oct>
|     |
|     | Else
|     |
|     |     STARTINV = ENDINV <Month - 1>
|     |
|     +- End
|
|
|     b. Calculate total gain
|
|     +- Do for all dimensions, except where indicated otherwise
|     |
|     |     PARTGAIN =  PS + OTSGAIN + MISCGAIN
|     |
|     |     TOTALGAIN = PARTGAIN + NPS
|     |
|     +- End
|
|
|     c. The promotions into the top five grades from Module 2 are
|        "draft" promotions
```

```
|
|     +- Do for Grade = 5, 6, 7, 8, and 9
|     |
|     |       DRAFTPROMIN = PROMIN
|     |
|     +- End
|
|
|     d. Calculate promotions required to achieve desired grade trajectories
|
|     +- Do for all dimensions, except where indicated otherwise
|     |
|     |   +-D Do for Grade = 9
|     |   |
|     |   |         REQPROMIN <Grade, Month>  =
|     |   |                 GRADETRAJECTORY <Grade, Month>
|     |   |               - STARTINV <Grade, tCatenl, Month>
|     |   |               - TOTALGAIN <Grade, tCatenl, Month>
|     |   |               + TOTALLOSS <Grade, tCatenl, Month>
|     |   |               + DEMOIN <Grade, tCatenl, Month>
|     |   |
|     |   |         PROMIN <Grade, Catenl, Month>  =
|     |   |                 DRAFTPROMIN
|     |   |               * REQPROMIN <Grade, Month>
|     |   |               / DRAFTPROMIN <Grade, tCatenl, Month>
|     |   |
|     |   |         PROMOUT <Grade - 1>  =  PROMIN
|     |   |
|     |   |
|     |   +-D End
|     |
|     |
|     |   +-D Do for Grade = 8
|     |   |
|     |   |         REQPROMIN <Grade, Month>  =
|     |   |                 GRADETRAJECTORY <Grade, Month>
|     |   |               - STARTINV <Grade, tCatenl, Month>
|     |   |               - TOTALGAIN <Grade, tCatenl, Month>
|     |   |               + TOTALLOSS <Grade, tCatenl, Month>
|     |   |               + PROMOUT < Grade, tCatenl, Month>
|     |   |               - DEMOOUT <Grade, tCatenl, Month>
|     |   |               + DEMOIN <Grade, tCatenl, Month>
|     |   |
|     |   |         PROMIN <Grade, Catenl, Month>  =
|     |   |                 DRAFTPROMIN
|     |   |               * REQPROMIN <Grade, Month>
|     |   |               / DRAFTPROMIN <Grade, tCatenl, Month>
|     |   |
|     |   |         PROMOUT <Grade - 1>  =  PROMIN
|     |   |
|     |   |
|     |   |
```

```
|       |   +-D End
|       |
|       |   +-D Do for Grade = 7
|       |   |
|       |   |         REQPROMIN <Grade, Month>  =
|       |   |                 GRADETRAJECTORY <Grade, Month>
|       |   |               - STARTINV <Grade, tCatenl, Month>
|       |   |               - TOTALGAIN <Grade, tCatenl, Month>
|       |   |               + TOTALLOSS <Grade, tCatenl, Month>
|       |   |               + PROMOUT <Grade, tCatenl, Month>
|       |   |               - DEMOOUT <Grade, tCatenl,Month>
|       |   |               + DEMOIN <Grade, tCatenl, Month>
|       |   |
|       |   |         PROMIN <Grade, Catenl, Month>  =
|       |   |                 DRAFTPROMIN
|       |   |               * REQPROMIN <Grade, Month>
|       |   |               / DRAFTPROMIN <Grade, tCatenl, Month>
|       |   |
|       |   |         PROMOUT <Grade - 1>  =  PROMIN
|       |   |
|       |   |
|       |   +-D End
|       |
|       |   +-D Do for Grade = 6
|       |   |
|       |   |         REQPROMIN <Grade, Month>  =
|       |   |                 GRADETRAJECTORY <Grade, Month>
|       |   |               - STARTINV <Grade, tCatenl, Month>
|       |   |               - TOTALGAIN <Grade, tCatenl, Month>
|       |   |               + TOTALLOSS <Grade, tCatenl, Month>
|       |   |               + PROMOUT <Grade, tCatenl, Month>
|       |   |               - DEMOOUT <Grade, tCatenl,Month>
|       |   |               + DEMOIN <Grade, tCatenl, Month>
|       |   |
|       |   |         PROMIN <Grade, Catenl, Month>  =
|       |   |                 DRAFTPROMIN
|       |   |               * REQPROMIN <Grade, Month>
|       |   |               / DRAFTPROMIN <Grade, tCatenl, Month>
|       |   |
|       |   |         PROMOUT <Grade - 1>  =  PROMIN
|       |   |
|       |   |
|       |   +-D End
```

```
|       |
|       |   +-D Do for Grade = 5
|       |   |
|       |   |       REQPROMIN <Grade, Month>  =
|       |   |               GRADETRAJECTORY <Grade, Month>
|       |   |             - STARTINV <Grade, tCatenl, Month>
|       |   |             - TOTALGAIN <Grade, tCatenl, Month>
|       |   |             + TOTALLOSS <Grade, tCatenl, Month>
|       |   |             + PROMOUT <Grade, tCatenl, Month>
|       |   |             - DEMOOUT <Grade, tCatenl, Month>
|       |   |             + DEMOIN <Grade, tCatenl, Month>
|       |   |
|       |   |       PROMIN <Grade, Catenl, Month>  =
|       |   |               DRAFTPROMIN
|       |   |             * REQPROMIN <Grade, Month>
|       |   |             / DRAFTPROMIN <Grade, tCatenl, Month>
|       |   |
|       |   |
|       |   |
|       |   +-D End
|       |
|       +- End
|
|
|   e.  Project net change in force
|
|   +-D For all dimensions
|   |
|   |       NETCHANGE =
|   |                     TOTALGAIN
|   |                   - TOTALLOSS
|   |                   + PROMIN
|   |                   - PROMOUT
|   |                   + DEMOIN
|   |                   - DEMOOUT
|   |                   + REENLISTIN
|   |                   - REENLISTOUT
|   |                   - RETELIGIN
|   |                   - RETELIGOUT
|   |
|   |       ENDINV = STARTINV + NETCHANGE
|   |
|   +-D End
|
+-DD End
```

OUTPUTS TO SAM2A INTERFACE SCREENS

NPS <tGrade, tCatenl, Month>	NPS accessions
PROMIN <Grade tCatenl, Month>	Promotions into top 5 grades

IX. OVERVIEW OF MODULE 4: PLAN COMPARISON

Module 4 of the Short-term Aggregate Inventory Projection Model (SAM4) compares the projected results from two alternative plans for the same fiscal year. If the plans were made in different months, then at least part of the comparison will involve comparing projections with actual events.

Sending a plan made by SAM2 to SAM4 not only enables comparison with other plans, it also archives the plan for future reference and analysis. At a minimum, any plan that gets used in formal planning exercises, such as the Budget Estimate Submission or the President's Budget, should be archived. And the "official" plan at the end of each month (the one that guides management actions during the next month) should be archived.

It may also be useful to archive alternative plans that were considered but not adopted, so that evidence can be collected on their performance. Possibly in a future year a currently rejected strategy will prove attractive.

One possible use of SAM4 is to compare last month's plan for the fiscal year with this month's plan. The major difference between the two plans is likely to be projected vs. actual events during the preceding month. A second use is comparing plans made at various stages during the year with actual events for the whole year after the fiscal year is over. In both cases, the purpose of the comparisons will be to learn as much as possible about why plans have to be revised in order to make better plans in future years. An unambiguous, consistent, and easy-to-use convention for naming alternative plans is the key to making SAM4 work (together with database procedures that facilitate archiving and accessing a given plan).

The suggested naming convention is to label a plan with:

FF-YY-MMM-XXX

where FF = fiscal year (last 2 digits)

YY = calendar year (last 2 digits)

MMM = month (3 characters, e.g. APR)

XXX = number of alternative plan made in a given month

The inclusion of both fiscal year and calendar year is important. With both years in the name there should be no confusion caused by the fact that policy discussions usually use fiscal years, while databases usually use calendar years. The use of three letters instead of two digits to label months avoids potential confusion over whether months are numbered sequentially during a fiscal year or during a calendar year.

X. USER INTERFACE SCREENS FOR MODULE 4

The following six figures present the input and output screens that a user will see when operating SAM4. The computer program variables obtained from the input screens or sent to the output screens are shown in the display area.

INPUT SCREEN

The input screen (Fig. 26) specifies the two plans to be compared by SAM4--a "reference" plan and a "test" plan. An example of a reference plan is last month's plan for the rest of the fiscal year (with the projections for last month replaced by actual events, with last month's projections of losses and reenlistments for the rest of the fiscal year replaced by this month's projections, but with management actions unchanged from last month's choices). An example of a test plan is any plan made this month (presumably it represents an attempt to do better than the reference plan).

OUTPUT SCREENS

The output screens for SAM4 display various comparisons of the reference and test plans. The initial 13 output screens present a reference plan characteristic, the corresponding test plan characteristic, and the difference between the two on the same screen.

Subsequent output screens (not shown in this document) enable the user to access all the SAM2 output screens for the reference plan, for the test plan, and for the difference (test minus reference) between the two plans. No specification of these output screens is made in the following sections, since their contents are clear and programming them is simply a matter of database management: keeping track of all the SAM2 output screens for each plan and doing the subtractions that produce the screen-by-screen differences.

The output screens for SAM4 (and the related figure numbers) are:

Comparisons of Plan Performance

1. Total force (Fig. 27)
2. Grade E-5 strength (Fig. 28)
3. Grade E-6 strength (Fig. 28)
4. Grade E-7 strength (Fig. 28)
5. Grade E-8 strength (Fig. 28)
6. Grade E-9 strength (Fig. 28)
7. FY budget (Fig. 29)

Comparisons of Changes During the Fiscal Year

8. Total force (Fig. 30)
9. Grade E-5 strength (Fig. 31)
10. Grade E-6 strength (Fig. 31)
11. Grade E-7 strength (Fig. 31)
12. Grade E-8 strength (Fig. 31)
13. Grade E-9 strength (Fig. 31)

Comparison of all SAM2 output screens

For each SAM2 output screen in Sec. V:

- Reference plan output.
- Test plan output.
- Difference (test minus reference).

SAM4 Input Screen
CHOICE OF PLANS TO COMPARE

Component of Plan Identification	Reference Plan	Test Plan
Fiscal year (last 2 digits)		
Calendar year (last 2 digits)		
Month in which plan was made (3 characters)		
Identifier of specific plan in that month (3 characters)		

Fig. 26--Choice of plans to compare

SAM4 Output Screen 1
COMPARISON OF PLAN PERFORMANCE: TOTAL FORCE

Item	Reference Plan	Test Plan	Difference (Test - Ref)
Projected	ENDINV <tGrade, tCatenl, Month>		
Goal	ENDSTRENGTH		
Difference	DIFFENDSTRENGTH		

Fig. 27--Comparison of plan performance: Total force

SAM4 Output Screen 2
COMPARISON OF PLAN PERFORMANCE: GRADE E-5 STRENGTH

Item	Reference Plan	Test Plan	Difference (Test - Ref)
Projected	ENDINV <Grade = 5, tCatenl, Month = Oct>		
Goal	GRADECEILING <Topgrade = 5>		
Difference	DIFFGRADECEILING <Topgrade = 5>		

NOTE: SAM4 Output screens 3 through 6 are this screen for grades E-6 through E-9.

Fig. 28--Comparison of plan performance: Grades E-5, E-6, E-7, E-8, E-9

SAM4 Output Screen 7
COMPARISON OF PLAN PERFORMANCE: FY BUDGET

Item	Reference Plan	Test Plan	Difference (Test - Ref)
Projected	TOTALCOST		
Goal	BUDGET		
Difference	DIFFBUDGET		

Fig. 29--Comparison of plan performance: FY budget

SAM4 Output Screen 8
COMPARISON OF CHANGES DURING FISCAL YEAR: TOTAL FORCE

Flows During Fiscal Year	Reference Plan	Test Plan	Difference (Test - Ref)
Gain to enlisted force	TOTALGAIN <tGrade, tCatenl, tMonth>		
Loss from enlisted force	TOTALLOSS <tGrade, tCatenl, tMonth>		
Projected net change[a]	ENDINV <tGrade, tCatenl, Month = Sep> - STARTINV <tGrade, tCatenl, Month = Oct>		
Desired net change[b]	ENDSTRENGTH - STARTINV <tGrade, tCatenl, Month = Oct>		
Gap (proj. minus desired)	ENDINV <tGrade, tCatenl, Month = Sep> - ENDSTRENGTH		

[a]Gain minus loss.

[b]Goal for total force at end of FY minus total force at start of FY.

Fig. 30--Comparison of changes during fiscal year: Total force

SAM4 Output Screen 9
COMPARISON OF CHANGES DURING FISCAL YEAR:
GRADES E-5, E-6, E-7, E-8, E-9

Flows During Fiscal Year	Reference Plan	Test Plan	Difference (Test - Ref)
Gain to enlisted force	TOTALGAIN <Grade = 5, tCatenl, tMonth>		
Promotions into grade	PROMIN <Grade = 5, tCatenl, tMonth>		
Demotions into grade	DEMOIN <Grade = 5, tCatenlk, tMonth>		
Total additions to grade	TOTALGAIN + PROMIN +DOMOIN		
Loss from enlisted force	TOTALLOSS <Grade = 5, tCatenl, tMonth>		
Promotions out of grade	PROMOUT <Grade = 5, tCatenl, tMonth>		
Demotions out of grade	DEMOOUT <Grade = 5, tCatenl, tMonth>		
Total subtractions from grade	TOTALLOSS + PROMOUT + DEMOOUT		
Projected net change[a]	ENDINV <Grade = 5, tCatenl, Month = Sep> - STARTINV <Grade = 5, tCatenl, Month = Oct>		
Desired net change[b]	GRADECEILING <Topgrade = 5> - STARTINV <Grade = 5, tCatenl, Month = Oct>		
Gap (proj. minus desired)	ENDINV <Grade = 5, tCatenl, Month = Sep> - GRADECEILING <Topgrade = 5>		

NOTE: SAM4 Output screens 10 through 13 are this screen for grades E-6 through E-9.

[a]Total additions minus total subtractions.

[b]Goal for grade strength at end of FY minus grade strength at start of FY.

Fig. 31--Comparison of changes during fiscal year: Grades E-5, E-6, E-7, E-8, E-9

XI. ACTION DIAGRAM FOR MODULE 4

INPUTS FROM MODULE 2

The inputs from SAM2 to SAM4 are identical to the outputs from SAM2 to its output interface screens. This information must be available for each of the two plans compared by SAM4. The names of the two plans are obtained from an input interface screen (see end of this section).

INPUTS FROM INTERFACE SCREEN

Name of Reference Plan

FF	Fiscal year (last 2 digits).
YY	Calendar year (last 2 digits).
MMM	Month (3 characters, e.g, APR).
XXX	Number of specific plan made in the given month.

Name of Test Plan

FF	Fiscal year (last 2 digits).
YY	Calendar year (last 2 digits).
MMM	Month (3 characters, e.g, APR).
XXX	Number of specific plan made in the given month.

CALCULATIONS

The computer program for SAM4 must accomplish three tasks:

1. Access and keep track of the inputs defining the reference and test plans being compared.
2. Fill out the initial 13 output screens (see Sec. X).
3. Give the user access to any of the SAM2 output screens for either plan, and to the screen-by-screen difference between the two plans.

The first task is a database management problem and does not involve any calculations.

The second task does involve some calculations: summing monthly variables into fiscal-year totals and finding differences between the reference plan and the test plan. However, the calculations are sufficiently simple for them to be stated completely on the output screens (see Sec. X), using the "t" notation established in Sec. II.

The third task is so simple to define that neither the screens nor the calculations are shown. Giving the user access to the SAM2 output screens for each plan is a database management problem that does not involve calculations. The only calculations required are subtracting the items in a reference plan screen from those in a test plan screen to get a screen of differences between the plans.

The importance of finding a good solution to the database management problems posed by SAM4 can not be overemphasized. The success of SAM will depend on users finding plan comparisons to be easy, clear, and fast. Finding the "best" plan in a given month will require making and studying many alternative plans. If comparing and contrasting alternative plans are difficult, then fewer alternatives will be considered and a superior alternative may be missed.

OUTPUTS TO SAM4 INTERFACE SCREENS

Initial 13 Output Screens

tENDINV <tGrade, tCatenl, Month>
ENDSTRENGTH
DIFFENDSTRENGTH

tENDINV <Grade, tCatenl, Month = Oct>
GRADECEILING <Topgrade>
DIFFGRADECEILING <Topgrade>

COST
BUDGET
DIFFBUDGET

TOTALGAIN <tGrade, tCatenl, tMonth>
TOTALLOSS <tGrade, tCatenl, tMonth>
ENDINV <tGrade, tCatenl, Month = Sep>
  - STARTINV <tGrade, tCatenl, Month = Oct>

```
ENDSTRENGTH - STARTINV <tGrade, tCatenl, Month>
ENDINV <tGrade, tCatenl, Month = Sep> - ENDSTRENGTH

TOTALGAIN <Grade, tCatenl, tMonth>
PROMIN <Grade, tCatenl, tMonth>
DEMOIN <Grade, tCatenlk, tMonth>
TOTALGAIN + PROMIN +DOMOIN ]
TOTALLOSS <Grade, tCatenl, tMonth>
PROMOUT <Grade, tCatenl, tMonth>
DEMOOUT <Grade, tCatenl, tMonth>
TOTALLOSS + PROMOUT + DEMOOUT
ENDINV <Grade, tCatenl, Month = Sep>
  - STARTINV <Grade, tCatenl, Month = Oct>
GRADECEILING <Topgrade> - STARTINV <Grade, tCatenl, Month = Oct>
ENDINV <Grade, tCatenl, Month = Sep> - GRADECEILING <Topgrade = 5>
```

Comparison of SAM2 Input and Output Screens

The required outputs here are (1) the SAM2 input and output screens for the reference and test plans, which are inputs to SAM4 from SAM2, and (2) the differences for each of the variables on the two sets of screens.

XII. ACTION DIAGRAM FOR MODULE P1: EARLY RELEASE PROGRAMS

The purpose of this module is to produce information on early release programs required by Modules 2A and P2.

For Module 2A: Inventory Projection

PCLOSSPROP <Catenl, n>	Proportion of Palace Chase losses obtained from "n" months in the future (n = 0 if loss was obtained from the same month).
EOSHIFTHIST <Grade, Catenl, Month>	Early Out shifts during projection months caused by Early Out losses that occurred before the start of the projection period.
PCSHIFTHIST <Grade, Catenl, Month>	Palace Chase shifts during projection months caused by Palace Chase losses that occurred before the start of the projection period.

For Module P2: Events in Past Year

All the following variables are needed by <Grade, Catenl, Month>, where month ranges over the 12 months before the first projection month (FPM):

RULOSS	Rollup losses (ETS losses shifted to this month from later months in the fiscal year to reduce personnel costs in the fiscal year); equal to the sum of RULOSSFROMOCT though RULOSSFROMSEP, when controlling on given loss month.
RULOSSBYORIGIN	Rollup losses by month from which the loss was shifted (the "origin" month).
EOLOSS	Early Out losses (losses shifted to this month from months in the next fiscal year to reduce this fiscal year's end strength).
PCLOSS	Palace Chase losses (ETS losses shifted to this month from later months to send personnel to the Reserves before the end of their obligated active service).

RUSHIFT	Rollup shifts (ETS losses shifted to previous months by the Rollup program).
EOSHIFT	Early Out shifts (ETS losses shifted to previous months by the Early Out program).
PCSHIFT	Palace Chase shifts (ETS losses shifted to previous months by the Palace Chase program).

INPUTS

Assemble the following counts, where LM (loss month) ranges over the 48 months before the first projection month. That is, count all early release losses, by type, for LM = FPM - 48 through FPM - 1. The reason for the long reach into the past is that the Palace Chase program can shift losses from up to three years into the future. The dimensions are defined below.

RULOSS <Grade, Catenl, TOE, LMOS, LM, OETS, DOS>
EOLOSS <Grade, Catenl, TOE, LMOS, LM, OETS, DOS>
PCLOSS <Grade, Catenl, TOE, LMOS, LM, OETS, DOS>

When counting the early release losses, use the following categorization (i.e., create records that have loss counts with the following subscripts):[1]

Grade	Pay grade (E-1 through E-9)
Catenl	Category of enlistment (1 through 4)
TOE	Term of Enlistment (either 4 or 6 years)
LMOS	Months of Service at time of early release loss
LM	Loss month (month in which early release occurs)
OETS	Original Expiration of Term of Service
DOS	Date of Separation

Note that LM, OETS, and DOS should all be given by Sequential Month Number (see App. B).

[1]All this detail is not necessary for Module 2; however, this early release database will serve other purposes if it is made this general. Once the initial database has been built, updating it each month is simply a matter of adding records to reflect the new month's activity in the early release programs.

CALCULATIONS

For calculating the information needed by Modules 2A and P2, the records can be aggregated to the following level:

```
RULOSS <Grade, Catenl, LM, DOS>
EOLOSS <Grade, Catenl, LM, DOS>
PCLOSS <Grade, Catenl, LM, DOS>
```

For Module 2A: Inventory Projection

To get the proportions of Palace Chase losses that are shifted from months that are 0 to 11 months after the early release, two intermediate variables are needed: the sum of Palace Chase losses that are shifted from n months in the future (SUMPCLOSS(n)) and the sum of all Palace Chase losses (SUMPCLOSS).

```
+-  Do for n = 0 through 11
|
|    SUMPCLOSS <Catenl, n> =
|            Sum of PCLOSS record that match on Catenl
|            and that satisfy the condition
|            DOS - LM = n
|
|    SUMPCLOSS <Catenl> =
|            Sum of all PCLOSS records that match on Catenl
|
|    PCLOSSPROP <Catenl, n> =
|             SUMPCLOSS(n) <Catenl, n>
|           / SUMPCLOSS <Catenl>
+-- End
```

For a given first projection month, FPM:

```
EOSHIFTHIST <Grade, Catenl, Month> =
        Sum of all EOLOSS records that match on Grade and Catenl,
        and that satisfy the conditions
        LM < FPM
        DOS = Month

PCSHIFTHIST <Grade, Catenl, Month> =
        Sum of all PCLOSS records that match on Grade and Catenl,
        and that satisfy the conditions
        LM < FPM
        DOS = Month
```

For Module P2: Events in Past 12 Months

If no records satisfy the conditions specified in one or more of the following variables, then set that variable equal to zero.

RULOSS <Grade, Catenl, Month> =
Sum of all RULOSS records that match on Grade and Catenl, and that satisfy the conditions
LM ≥ FPM - 12
LM < FPM
LM = Month

RULOSSBYORIGIN <Grade, Catenl, Month, Origin> =
Sum of all RULOSS records that match on Grade and Catenl, and that satisfy the conditions
LM ≥ FPM-12
LM < FPM
LM = Month
DOS = Origin

The following variables are defined the same as the above variable, just changing the condition on DOS appropriately.

EOLOSS <Grade, Catenl, Month> =
Sum of all EOLOSS records that match on Grade and Catenl, and that satisfy the conditions
LM ≥ FPM - 12
LM < FPM
LM = Month

PCLOSS <Grade, Catenl, Month> =
Sum of all PCLOSS records that match on Grade and Catenl, and that satisfy the conditions
LM ≥ FPM - 12
LM < FPM
LM = Month

RUSHIFT <Grade, Catenl, Month> =
Sum of all RULOSS records that match on Grade and Catenl, and that satisfy the conditions
DOS ≥ FPM - 12
DOS < FPM
DOS = Month

EOSHIFT <Grade, Catenl, Month> =
Sum of all EOLOSS records that match on Grade and Catenl, and that satisfy the conditions
DOS ≥ FPM - 12
DOS < FPM
DOS = Month

PCSHIFT <Grade, Catenl, Month> =
Sum of all PCLOSS records that match on Grade and Catenl,
and that satisfy the conditions
DOS ≥ FPM - 12
DOS < FPM
DOS = Month

OUTPUTS TO MODULE 2A: INVENTORY PROJECTION

PCLOSSPROP <Catenl, n>
EOSHIFTHIST <Grade, Catenl, Month>
PCSHIFTHIST <Grade, Catenl, Month>

OUTPUTS TO MODULE P2: EVENTS IN THE PAST 12 MONTHS

All the following outputs have subscripts <Grade, Catenl, Month>.

RULOSS
EOLOSS
PCLOSS
RUSHIFT
EOSHIFT
PCSHIFT

One output has subscripts <Grade, Catenl, Month, Origin>

RULOSSBYORIGIN

XIII. ACTION DIAGRAM FOR MODULE P2: EVENTS IN PAST 12 MONTHS

The first step in running SAM2 each month is to get data on past events during the fiscal year into the module's data array. The required historical data are first pulled together in this preprocessor module. In addition, this module produces the distributions by Grade and Category of Enlistment, and the promotion rates, that Module 2 requires.

INPUTS FROM MODULE P1: EARLY RELEASE PROGRAMS

RULOSS	Rollup losses (ETS losses shifted to this month from later months in the fiscal year to reduce personnel costs in the fiscal year).
RULOSSBYORIGIN	Rollup losses by month from which the loss was shifted (the "origin" month).
EOLOSS	Early Out losses (losses shifted to this month from months in the next fiscal year to reduce this fiscal year's end strength).
PCLOSS	Palace Chase losses (ETS losses shifted to this month from later months to send personnel to the Reserves before the expiration of their obligated active service).
RUSHIFT	Rollup shifts (ETS losses shifted to previous months by the Rollup program).
EOSHIFT	Early Out shifts (ETS losses shifted to previous months by the Early Out program).
PCSHIFT	Palace Chase shifts (ETS losses shifted to previous months by the Palace Chase program).

INPUTS DESCRIBING OTHER EVENTS DURING THE PAST 12 MONTHS

All these outputs describing past events have subscripts <Grade, Catenl, Month>, where Month ranges over the past 12 months.

Change in Inventory

STARTINV	Inventory at the start of a month.
ENDINV	Inventory at the end of a month.
NETCHANGE	Change in inventory during a month.

Gains to the Enlisted Force

NPS4	NPS accessions for a 4-year term.
NPS6	NPS accessions for a 6-year term.
NPS	Total NPS accessions (NPS4 + NPS6).
PS	Prior service accessions.
OTSGAIN	Gains scheduled to go to Officer's Training School.
MISCGAIN	Miscellaneous gains (recalls from the Reserves, returned dropped from rolls, delayed reenlistments, gain adjustments, and other gains).
TOTALGAIN	Total gain (NPS4 + NPS6 + PS + OTSGAIN + MISCGAIN).

Losses from the Enlisted Force

BMTATTLOSS	Attrition from BMT.
STDATTLOSS	Standard attrition (after BMT).
ATTLOSS	Total attrition losses.
ETSLOSS	Expiration of Term of Service loss (losses that are not attrition, retirement, Rollup, Early Out Palace Chase, OTS, or miscellaneous, but rather are voluntary departures at the expiration of the enlisted person's contract to serve, or after an extension of that contract).
RETIREMENT	Retirement losses.
OTSLOSS	Loss to Officer's Training School.
MISCLOSS	Miscellaneous losses (gain adjustment and other loss).
TOTALLOSS	Total losses (ATTLOSS + ETSLOSS + RULOSS + EOLOSS + PCLOSS + RETIREMENT + OTSLOSS + MISCLOSS).

Changes in Grade

PROMIN	Promotions into a grade.
PROMOUT	Promotions out of a grade.
DEMOIN	Demotions into a grade.
DEMOOUT	Demotions out of a grade.

Changes in Category of Enlistment

REENLISTIN	Reenlistments into a category.
REENLISTOUT	Reenlistments out of a category.
RETELIGIN	Flow into the retirement-eligible category (category 4) from the career term category.
RETELIGOUT	Flow out of the career term category (category 3) to the retirement-eligibility category.

CALCULATIONS

Policy-Free ETS Loss

PFETSLOSS =	ETS losses that would have occurred if there had been no early release programs (ETSLOSS + RUSHIFT + EOSHIFT + PCSHIFT).

Distributions

For Gains:

```
dNPS4 <dGrade> =
        tNPS4 <Grade, tCaten1, tMonth>
      / tNPS4 <tGrade, tCaten1, tMonth>


dNPS6 <dGrade> =
        tNPS6 <Grade, tCaten1, tMonth>
      / tNPS6 <tGrade, tCaten1, tMonth>

dPS <dGrade, dCaten1> =
        tPS <Grade, Caten1, tMonth>
      / tPS <tGrade, tCaten1, tMonth>

dOTSGAIN <dGrade, dCaten1> =
        tOTSGAIN <Grade, Caten1, tMonth>
      / tOTSGAIN <tGrade, tCaten1, tMonth>

dMISCGAIN <dGrade, dCaten1> =
        tMISCGAIN <Grade, Caten1, tMonth>
      / tMISCGAIN <tGrade, tCaten1, tMonth>
```

For Losses:

```
dATTLOSS <dGrade, Catenl> =
        tATTLOSS <Grade, Catenl, tMonth>
      / tATTLOSS <tGrade, Catenl, tMonth>

dPFETSLOSS <dGrade, Catenl> =
        tPFETSLOSS <Grade, Catenl, tMonth>
      / tPFETSLOSS <tGrade, Catenl, tMonth>

dRULOSS <dGrade, Catenl> =
        tRULOSS <Grade, Catenl, tMonth>
      / tRULOSS <tGrade, Catenl, tMonth>

dEOLOSS <dGrade, Catenl> =
        tEOLOSS <Grade, Catenl, tMonth>
      / tEOLOSS <tGrade, Catenl, tMonth>

dPCLOSS <dGrade, dCatenl> =
        tPCLOSS <Grade, Catenl, tMonth>
      / tPCLOSS <tGrade, tCatenl, tMonth>

dRETIREMENT <dGrade, Catenl> =
        tRETIREMENT <Grade, Catenl, tMonth>
      / tRETIREMENT <tGrade, Catenl, tMonth>

dOTSLOSS <dGrade, dCatenl> =
        tOTSLOSS <Grade, Catenl, tMonth>
      / tOTSLOSS <tGrade, tCatenl, tMonth>

dMISCLOSS <dGrade, dCatenl> =
        tMISCLOSS <Grade, Catenl, tMonth>
      / tMISCLOSS <tGrade, tCatenl, tMonth>
```

For Shifts:

```
dRUSHIFT <dGrade, Catenl> =
        tRUSHIFT <Grade, Catenl, tMonth>
      / tRUSHIFT <tGrade, Catenl, tMonth>

dPCSHIFT <dGrade, dCatenl> =
        tPCSHIFT <Grade, Catenl, tMonth>
      / tPCSHIFT <tGrade, tCatenl, tMonth>
```

For reenlistment and flow to retirement eligibility:

```
dREENLISTOUT <dGrade, Catenl> =
        tREENLISTOUT <Grade, Catenl, tMonth>
      / tREENLISTOUT <tGrade, Catenl, tMonth>
```

```
dRETELIGOUT <dGrade, Catenl = 3> =
        tRETELIGOUT <Grade, Catenl = 3, tMonth>
      / tRETELIGOUT <tGrade, Catenl = 3, tMonth>
```

For demotions out of a grade:

```
dDEMOOUT <Grade, dCatenl> =
        tDEMOOUT <Grade, Catenl, tMonth>
      / tDEMOOUT <Grade, tCatenl, tMonth>
```

Promotion Rates

Module 2 requires the average monthly promotion rate out of a grade during the 12 months before the first projection month.

```
HISTPROMOUTRATE <Grade, Catenl> =
        PROMOUT <Grade, Catenl, tMonth>
      / STARTINV <Grade, Catenl, tMonth>
```

EVENT OUTPUTS TO MODULE 2A

All these outputs describing past events have subscripts <Grade, Catenl, Month>, where Month is month in the fiscal year being analyzed. In other words, although this module has assembled complete histories over the past 12 months so that it could calculate distributions and rates, only the events in the current fiscal year are needed as flow inputs to Module 2A.

Change in Inventory

STARTINV	Inventory at the start of a month.
ENDINV	Inventory at the end of a month.
NETCHANGE	Change in inventory during a month.

Gains to the Enlisted Force

NPS4	NPS accessions for a 4-year term.
NPS6	NPS accessions for a 6-year term.
NPS	Total NPS accessions (NPS4 + NPS6).
PS	Prior service accessions.

OTSGAIN	Gains scheduled to go to Officer's Training School
MISCGAIN	Miscellaneous gains (recalls from the Reserves, returned dropped from rolls, delayed reenlistments, gain adjustments, and other gains).
TOTALGAIN	Total gain (NPS4 + NPS6 + PS + OTSGAIN + MISCGAIN).

Losses from the Enlisted Force

BMTATTLOSS	Attrition from BMT.
STDATTLOSS	Standard attrition (after BMT).
ATTLOSS	Total attrition losses.
ETSLOSS	Expiration of term of service losses (losses that are not attrition, retirement, Rollup, Early Out Palace Chase, OTS, or miscellaneous, but rather are voluntary departures at the expiration of the enlisted person's contract to serve. or after an extension of that contract).
RULOSS	Rollup losses (ETS losses shifted to this month from later months in the fiscal year to reduce personnel costs in the fiscal year). Equal to the sum of RULOSSFROMOCT though RULOSSFROMSEP, when controlling on given loss month.
RULOSSBYORIGIN	Rollup losses by month from which the loss was shifted (the "origin" month).
EOLOSS	Early Out losses (losses shifted to this month from months in the next fiscal year to reduce this fiscal year's end strength).
PCLOSS	Palace Chase losses (ETS losses shifted to this month from later months to send personnel to the reserve forces before the end of their obligated active service).
RETIREMENT	Retirement losses.
OTSLOSS	Losses to Officer's Training School.
MISCLOSS	Miscellaneous losses (gain adjustments and other losses).
TOTALLOSS	Total losses (ATTLOSS + ETSLOSS + RULOSS + EOLOSS + PCLOSS + RETIREMENT + OTSLOSS + MISCLOSS).

Definition of Policy-Free ETS Loss

ETSLOSS	(See definition under "Losses from the Enlisted Force" above).
RUSHIFT	Rollup shifts (ETS losses shifted to previous months by the Rollup program).
EOSHIFT	Early Out shifts (ETS losses shifted to previous months by the Early Out program).
PCSHIFT	Palace Chase shifts (ETS losses shifted to previous months by the Palace Chase program).
PFETSLOSS	ETS losses that would have occurred if there had been no early release programs (ETSLOSS + RUSHIFT + EOSHIFT + PCSHIFT).

Changes in Grade

PROMIN	Promotions into a grade.
PROMOUT	Promotions out of a grade.
DEMOIN	Demotions into a grade.
DEMOOUT	Demotions out of a grade.

Changes in Category of Enlistment

REENLISTIN	Reenlistments into a category.
REENLISTOUT	Reenlistments out of a category.
RETELIGIN	Flow into the retirement-eligible category (category 4) from the career term category.
RETELIGOUT	Flow out of the career term category (category 3) to the retirement-eligible category.

DISTRIBUTION AND RATE OUTPUTS TO MODULE 2A

Distributions

For Gains:

dNPS4 <dGrade>
dNPS6 <dGrade>
dPS <dGrade, dCatenl>
dOTSGAIN <dGrade, dCatenl>
dMISCGAIN <dGrade, dCatenl>

For Losses:

dATTLOSS <dGrade, Catenl>

dPFETSLOSS <dGrade, Catenl>
dRULOSS <dGrade, Catenl>
dEOLOSS <dGrade, Catenl>
dPCLOSS <dGrade, dCatenl>
dRETIREMENT <dGrade, Catenl>
dOTSLOSS <dGrade, dCatenl>
dMISCLOSS <dGrade, dCatenl>

For Shifts:

dRUSHIFT <dGrade, Catenl>
dPCSHIFT <dGrade, dCatenl>

For reenlistments and flow to retirement eligibility:

dREENLISTOUT <dGrade, Catenl>
dRETELIGOUT <dGrade, Catenl = 3>

For demotions out of a grade:

dDEMOOUT <Grade, dCatenl>

Historical Promotion Rates

HISTPROMOUTRATE <Grade, Catenl>	Average monthly promotion rate out of a grade during the 12 months before the first projection month.

PAST NPS ACCESSIONS TO MODULE 2A

To calculate attrition from BMT, Module 2A needs accession data from before the start of the projection period.

mNPS4 <Past>	NPS4 Accessions during the 12 months before the first projection month.
mNPS6 <Past>	NPS6 accessions during the 12 months before the first projection month.

XIV. ACTION DIAGRAM FOR MODULE P3: LOSSES FROM ACCESSIONS

This module supplies accession attrition proportions to Module 2A. Separate proportions are needed for attrition from NPS4, NPS6, and PS accessions. Additional proportions are needed for attrition from NPS4 and NPS6 accessions that occur while the enlisted person is still in Basic Military Training (BMT). All the proportions are needed for each of the 12 months following the accession (n = 0 through 11).

NPS4ATTPROP <n>	Proportion of NPS4 accessions lost from attrition in the nth month after accession (n = 0 in the same month as the accession).
NPS6ATTPROP <n>	Proportion of NPS6 accessions lost from attrition in the nth month after accession (n = 0 in the same month as the accession).
PSATTPROP <n>	Proportion of PS accessions lost from attrition in the nth month after accession (n = 0 in the same month as the accession).
NPS4BMTATTPROP <n>	Proportion of NPS4 accessions lost from attrition in the nth month after accession, while the enlisted person was still in BMT.
NPS6BMTATTPROP <n>	Proportion of NPS6 accessions lost from attrition in the nth month after accession, while the enlisted person was still in BMT.

Note that the proportions are ratios with attrition losses in the numerator and the original number of accessions in the denominator. The proportions are not based on Makovian logic, where the denominator would be survived accessions.

The proportions are also specific to each category of enlistment. All the NPS accessions will be in the first term. Most of the PS accessions will be in the second term.

Finally, the proportion of accessions lost while the enlisted person is still in BMT is a subset of all losses from accessions. BMT lasts six weeks, so the only months that can have losses from BMT are those with n = 0, n = 1, and n = 2. In the n = 0 month, all losses will be from BMT, so the attrition proportion and the attrition from BMT proportion will be the same. In the n = 1 and n = 2 month some losses will be from BMT and others will be from after BMT, so the attrition proportion will be larger than the attrition from BMT proportion. In months where n > 2, the attrition from BMT proportion will be zero.

Notation needed for this action diagram includes:

AM Accession Month (given by Sequential Month Number, see App. B).

LM Loss Month, the month in which the attrition loss occurs (given by Sequential Month Number).

FPM First Projection Month (given by Sequential Month Number), the current month.

n Number of months after the accession that the attrition loss occurs, where the count starts with zero in the accession month. In other words, "n" is the same as Months of Service (MOS) of the accession.

INPUTS

Assemble the following counts, where AM and LM range over all 12 months before the first projection month (FPM). In other words, count all NPS accessions for AM = FPM - 12 through FPM - 1, then count all attritions from those accessions that occur in in months LM = FPM - 12 through FPM - 1, and finally count the subset of attritions that occur while the enlisted person is still in BMT.

Count accessions:

NPS4 <AM>	NPS accessions in month AM with TOE = 4.
NPS6 <AM>	NPS accessions in month AM with TOE = 6.
PS <AM>	PS accessions in month AM.

Count attrition from accessions:

NPS4ATT <AM, LM>	Attrition in month LM of NPS4 accessions that entered the enlisted force in month AM.
NPS6ATT <AM, LM>	Attrition in month LM of NPS6 accessions that entered the enlisted force in month AM.
PSATT <AM, LM>	Attrition in month LM of PS accessions that occurred in month AM.

Count attrition from accessions that are still in BMT:

NPS4BMTATT <AM, LM>	Attrition in month LM of NPS4 accessions that entered the enlisted force in month AM and that were still in Basic Military Training at the time of the attrition.
NPS6BMTATT <AM, LM>	Attrition in month LM of NPS6 accessions that entered the enlisted force in month AM and that were still in Basic Military Training at the time of the attrition.

CALCULATIONS

The required calculations are simply a matter of counting attritions and dividing them by the accessions from which the attritions came.

Do the following for n = 0 through 11:

NPS4ATTPROP <n> =
(Sum of NPS4ATT counts that have LM = AM + n)
/ (Sum of NPS4 counts that have AM ≤ FPM - 1 - n)

NPS6ATTPROP <n> =
(Sum of NPS6ATT counts that have LM = AM + n)
/ (Sum of NPS4 counts that have AM ≤ FPM - 1 - n)

PSATTPROP <n> =
(Sum of PSATT counts that have LM = AM + n)
/ (Sum of PS counts that have AM ≤ FPM - 1 - n)

NPS4BMTATTPROP <n> =
(Sum of NPS4BMTATT counts that have LM = AM + n)
/ (Sum of NPS4 counts that have AM ≤ FPM - 1 - n)

NPS6BMTATTPROP <n> =
(Sum of NPS6BMTATT counts that have LM = AM + n)
/ (Sum of NPS4 counts that have AM ≤ FPM - 1 - n)

These formulas assume that the database for these calculations contains accessions and attrition losses from accessions only for the 12 months before the first projection month (for months FPM - 12 through FPM - 1). Given that the database is set up that way, or that a select statement has limited a larger database to the desired 12 month subset, then the above formulas will give the correct numerators and denominators for the ratios.

For example, when n = 8 there are only four months in which accessions can occur and leave enough time to get to the eighth month following the accession: months FPM - 12, FPM - 11, FPM - 10, and FPM - 9. Or, using the above formula for the denominator, all months where AM $\leq$ FPM - 1 - 8.

OUTPUTS TO MODULE 2A: INVENTORY PROJECTION

For n = 0 through 11, and for Catenl = 1 through 4 (for definitions of the variables, see the preceding subsection):

NPS4ATTPROP <n>

NPS6ATTPROP <n>

PSATTPROP <n>

NPS4BMTATTPROP <n>

NPS6BMTATTPROP <n>

XV. ACTION DIAGRAM FOR MODULE P4: FORCED EARLY REENLISTMENT PROGRAM

The purpose of Module P4 is to produce information on the forced early reenlistment program required by Module 2A.

The forced early reenlistment program causes enlisted personnel to leave or reenlist early. The program began in FY86, and each year it has different details. For example, the details for the first three years of the program were:

Forced Early Reenlistments in FY86:

- First termers (CONUS, non-SRB specialties) with DOS in August or September 1986 had to either leave or reenlist in June or July 1986.
- First termers (CONUS, non-SRB specialties) with DOS in October, November, or December 1986 had to either leave or reenlist in September 1986.

Forced Early Reenlistments in FY87:

- First termers (CONUS) with DOS in May through September 1987 had to either leave or reenlist in April 1987.
- First termers (non-CONUS) with DOS in May through September 1987 had to either leave or reenlist in April or May 1987.

Forced Early Reenlistments in FY88:

- First and second termers with DOS in April through September 1988 had to either leave or reenlist in March 1988.

- First and second termers with DOS in October 1988 through March 1989 (with a few AFSCs excepted) had to either leave or reenlist in April 1988.

The purpose of this program is to force a larger number of early losses than could be obtained by making early losses voluntary. Note that, in addition to the exceptions stated explicitly, personnel managers could grant an extension that moved an individual's DOS out of the range that triggered this program.

SAM2's policy levers for early releases are used to specify the early losses caused by the forced early reenlistment program. Those policy levers are "Rollup losses" for the early losses that otherwise would have left in the same fiscal year, and "Early Out losses" for the early losses that would otherwise have left in the next fiscal year. Additional policy levers for early reenlistments enable users to specify the early reenlistments caused by this program. These early reenlistment policy levers were constructed analogous to those for early releases in that they distinguish between early reenlistments that would otherwise have occurred in the same fiscal year and those that would have occurred in the next fiscal year.

Unlike early losses, early reenlistments do not have a Separation Program Designator (SPD) code on airmen records. There is an SPD code for reenlistments, but no codes subdividing reenlistments into those caused by an early reenlistment program and all others. We needed to construct such a code to allow modeling of the early reenlistment program to be done analogously to the modeling of the early release programs.

The way to model the early reenlistment program that has evolved during extensive EFMP discussions can be summarized by two principles:

- Assign an SPD code for reenlistments that result from this management action by assuming that all reenlistments occurring in the specified month, having a DOS in the specified range of months, and satisfying the other conditions on category of

enlistment, location, and specialty, are reenlistments caused by this program.

- On historical files, assign the month of the forced reenlistment to be the month it occurred, and define a forced reenlistment shift based on the month that the reenlistments would have occurred if there had been no early reenlistment program (the shift months are either the OETS month or the DOS month, depending upon whether the forced reenlistment occurs before/at OETS or after OETS).

These principles involve approximations. For example, a few of the reenlistments receiving the early-reenlistment SPD code might have reenlisted in that month without the program. Also, not all unforced reenlistments occur exactly in the OETS or DOS month. However, these principles do a good job of using all available information on the program's effects.

Two variables are needed for months in the current fiscal year that have already occurred. These variables are used to fill in the user-input screens for the part of the fiscal year already past:

FEROUT1POLICY <Catenl, Month, Origin>	Forced early reenlistments from same fiscal year.
FEROUT2POLICY <Catenl, Month>	Forced early reenlistments from next fiscal year.

One variable is needed to count shifts from the remaining months in the current fiscal year that are caused by forced early reenlistments during the previous fiscal year:

FERSHIFTHIST <Grade, Catenl, Month>	Forced early reenlistment shifts during projection months caused by forced early reenlistments that occurred before the start of the fiscal year being analyzed.

The final two variables are distributions across grades estimated from data in the 12 months before the first projection month. If there were no forced early reenlistments during those months, then these distributions will have to be obtained from an earlier 12 month period that did have forced early reenlistments.

dFEROUT <dGrade, Catenl>	Distribution of forced early reenlistments by grade within each category of enlistment.
dFERSHIFT <dGrade, Catenl>	Distribution of forced early reenlistment shifts within each category of enlistment.

INPUTS

Assemble the following counts of forced early reenlistments:

FEROUT <Grade, Catenl, TOE, RMOS, RM, OETS, DOS>

where

Grade	Pay grade
Catenl	Category of enlistment
TOE	Term of enlistment
RMOS	Months of service at time of early reenlistment
RM	Month in which early reenlistment actually occurs
OETS	Original expiration of term of service
DOS	Date of separation

Then, using the principles stated in the introduction to this section, define the shift month, SM, of each record to be:

SM = OETS if RM $\leq$ OETS
= DOS if RM > OETS

Finally, allocate the FEROUT counts among two variables, FEROUT1 and FEROUT2, depending upon whether the reenlistment month (RM) and the shift month (SM) are in the same fiscal year or not.

FEROUT1 = FEROUT if RM and SM are in the same fiscal year

FEROUT2 = FEROUT if RM and SM are in different fiscal years (RM will be in one fiscal year and SM in the next)

CALCULATIONS

Build two variables for previous months in the current fiscal year (these are to fill in the input screens for past months):

FEROUT1POLICY <Catenl, Month, Origin>
Sum of all FEROUT1 records that match on Catenl
and satisfy the conditions
RM in the current fiscal year
RM = Month
SM = Origin

FEROUT2POLICY <Catenl, Month>
Sum of all FEROUT2 records that match on Catenl
and satisfy the conditions
RM in the previous fiscal year
RM = Month

Then build the following variables for the 12 months before the first projection month. These are needed to construct distribution variables:

FEROUT1 <Grade, Catenl, Month> =

Sum of all FEROUT1 records that match on Grade, Catenl,
and that satisfy the conditions
RM ≥ FPM - 12
RM < FPM
RM = Month

FERSHIFT1 <Grade, Catenl, Month> =

Sum of all FEROUT1 records that match on Grade and Catenl
and that satisfy the conditions
SM ≥ FPM - 12
SM < FPM
SM = Month

FEROUT2 <Grade, Catenl, Month> =

Sum of all FEROUT2 records that match on Grade, Catenl,
and that satisfy the conditions

```
        RM ≥ FPM - 12
        RM < FPM
        RM = Month

FERSHIFT2 <Grade, Catenl, Month> =

        Sum of all FEROUT2 records that match on Grade and Catenl
        and that satisfy the conditions
        SM ≥ FPM - 12
        SM < FPM
        SM = Month

FEROUT <Grade, Catenl, Month>
        FEROUT1 <Grade, Catenl, Month>
      + FEROUT2 <Grade, Catenl, Month>

FERSHIFT <Grade, Catenl, Month>
        FERSHIFT1 <Grade, Catenl, Month>
      + FERSHIFT2 <Grade, Catenl, Month>
```

Use these variables to construct the following distributions. The distributions are calculated using both kinds of forced early reenlistments because there is no reason for the grade distribution to vary by whether the reenlistment is shifted from a month in the current fiscal year or in the next fiscal year:

```
dFEROUT <dGrade, Catenl> =
        tFEROUT <Grade, Catenl, tMonth>/
        tFEROUT <tGrade, Catenl, tMonth>

dFERSHIFT <dGrade, Catenl> =
        tFERSHIFT <Grade, Catenl, tMonth>/
        tFERSHIFT <tGrade, Catenl, tMonth>
```

Finally, moving from the past 12 months to the next 12 months (FPM and the following 11 months), count the shifts that will occur during that projection period as a result of forced early reenlistments that occurred before the start of the current fiscal year.

```
FERSHIFTHIST <Grade, Catenl, Month> =

        Sum of all FEROUT2 records that match on Grade and Catenl
        and that satisfy the conditions
        RM in previous fiscal year
        SM = Month
```

OUTPUTS TO MODULE 2A

FEROUT1POLICY <Catenl, Month, Origin>

FEROUT2POLICY <Catenl, Month>

dFEROUT <dGrade, Catenl>

dFERSHIFT <dGrade, Catenl>

FERSHIFTHIST <Grade, Catenl, Month>

XVI. ALTERNATIVE SEPARATION PROJECTION MODELS FOR MODULE 1

PURPOSE OF MODULE 1

Module 1 of the Short-term Aggregate Model (SAM1) predicts policy-free separations (both losses and reenlistments) of active-duty enlisted personnel from the Air Force. The predictions are inputs to SAM2. They define the behavioral trends in the enlisted force. SAM2 then adds the effects of management actions (early releases, early reenlistments, and others) to predict actual separations from the Air Force.

Not only does Module 2 modify the loss and reenlistment predictions from Module 1 by shifting the separation month (to take account of early releases and early reenlistments), but it also adds losses. It adds the attrition losses from accessions made during the projection period, and it adds losses to OTS and any miscellaneous losses identified by model users.

In any given month during the projection period, the relationship between the behavioral inputs from Module 1 and Module 2's prediction of actual separations can be summarized as follows:

Module 2 loss prediction = Module 1 loss prediction
+ early release losses
- early release shifts
+ losses from accessions
+ OTS losses
+ Miscellaneous losses

Module 2 reenlistment prediction = Module 1 reenlistment prediction
+ early reenlistment losses
- early reenlistment shifts

Specifically, SAM1 projects three types of losses (inventory attrition, policy-free ETS losses, and retirement losses), policy-free reenlistments, and flows to retirement eligibility. SAM2 requires these predictions by category of enlistment and by month during the projection period (current month through the end of the fiscal year):

INVATT <Catenl, Month> — Attrition losses from inventory existing at the start of the projection period.

PFETSLOSS <Catenl, Month>	Policy-free ETS losses.
RETIREMENT <Catenl, Month>	Retirement losses.
PFREENLISTOUT <Catenl, Month>	Policy-free reenlistments out of each category of enlistment.
RETELIGOUT <Catenl = 3, Month>	Flow out of the career category into the retirement-eligible category of enlistment from becoming retirement eligible.

ROBUST VS. BENCHMARK PROJECTION

The EFMP has developed two promising methods of predicting the separations required of SAM1:

- Robust separation projection.
- Benchmark separation projection.

Both methods predict the monthly losses and reenlistment flows that are needed as inputs to SAM2. Both methods predict "policy-free" flows. (SAM2 accounts for the effect of past and present management actions on losses and reenlistments.) However, the two methods differ fundamentally in the way they accomplish that same objective.

The robust separation projection method uses data on past losses and reenlistments to estimate separation rates for a model that predicts monthly policy-free separation flows. That monthly model is then run for the rest of the fiscal year to predict monthly loss and reenlistment flows. The method applies one set of separation rates to different inventories. Each month's inventory is estimated from the previous month's inventory by a survival calculation. The method has been specified by Brauner and Relles, 1991.

Benchmark separation projection uses data on past losses and reenlistments to estimate separation rates for a model of monthly policy-free flows. Those separation rates are then applied to the current inventory to predict monthly loss and reenlistment flows for the rest of the fiscal year. The BSP method applies different sets of separation

rates to a single inventory (the inventory at the start of the projection period). The method has been specified by Rydell and Lawson, 1991.

The names "robust" and "benchmark" are historical artifacts. "Robust" refers to a particular method of averaging past separation rates that is not unduly influenced by outliers in the historical data. "Benchmark" refers to the method's original purpose: to serve as a standard of comparison for the accuracy (predictive ability when data collection and model operation go as planned), reliability (how often everything goes as planned), and runtime (time required each month to update databases and run the new projections) of alternative methods for SAM1. The benchmark method became an attractive alternative in its own right.

The Air Force is performing an extensive test and evaluation of the various approaches to producing the monthly separations required from SAM1 to determine which approach to use in the EFMS.

CONCLUSION

What combination of robust and benchmark predictions the Air Force will ultimately use in SAM remains an open question. Both models are currently operational. They are both undergoing extensive testing, and experience on their predictive capabilities and operating characteristics is being accumulated.

It may turn out that both methods are necessary because neither dominates the other. For example, the robust method may predict attrition losses best and the benchmark method may predict ETS losses best, so a mixture of the two approaches may be used. Or it may turn out that their performance depends upon circumstances that change over time, so that one method will be used to make predictions during years with certain characteristics and the other will be used in years with different characteristics.

Appendix A

GLOSSARY

SUBSCRIPTS	DEFINITIONS
AM	Accession month. Used to indicate the month in which an accession occurs (expressed as a Sequential Month Number (SMN), see App. B).
Botgrade	Bottom four grades (E-1 through E-4).
Catenl	Category of enlistment (1 = first term, 2 = second term, 3 = career terms, not retirement eligible, 4 = retirement eligible).
DOS	Date of separation, the month in which the enlisted person currently expects to separate (either leave or reenlist), which will be later than OETS if the enlisted person has extended or has announced plans to extend (expressed as SMN; see App. B).
FPM	First projection month. Used to indicate the sequential month (see App. B) during which projections start.
Grade	Pay grade (E-1 through E-9).
ID	Inventory date. Used to indicate the date on which inventory reductions due to early release programs are being counted (expressed as SMN; see App. B).
LM	Loss month. Used to indicate the month in which an early release loss occurs (expressed as SMN; see App. B).
MDOS	Months to DOS. MDOS = 1 if DOS occurs in the current month.
Month	Month in fiscal year (October through September).
MOS	Months of service (at the end of the first, partial, calendar month in the service enlisted persons have MOS = 0, meaning that they have not yet been in the service for a full month).

n	Number of months. Used to indicate the number of months after an early release loss that the shift occurs, and to indicate the number of months after an accession that an attrition loss occurs (the counting of "n" starts with 0 in the same month as the reference flow).
OETS	Date of the original Expiration of Term of Service (expressed as SMN; see App. B).
Origin	Month in fiscal year from which a Rollup loss was shifted.
Past	Month during the 12 month period before the first projection month.
PM	Projection month. Used to indicate the number of months after FPM, where PM = 1 during the FPM.
SMN	Sequential month number (see App. B).
Tfms	Total years of federal military service (count starts with 0 during the period when an enlisted person has been in the service for less than 12 months, and goes to 30 years).
TOE	Term of enlistment (4 years or 6 years).
Topgrade	Top five grades (E-5 through E-9).

PREFIXES

d	A "d" prefix on a variable indicates a distribution variable that will be used to expand a margin variable to full dimensionality; a "d" prefix on a subscript inside a distribution variable indicates a dimension over which the distribution has been constructed.
m	An "m" prefix on a variable indicates a marginal variable that is an input and has fewer subscripts than the stem variable will have inside the model.

t	A "t" prefix on a variable indicates summation over one or more dimensions to create a total; a "d" prefix on a subscript inside a total variable indicates a dimension over which the summation was done.

VARIABLES

Fiscal-Year Goals

BUDGET	Budget for MPA enlisted personnel costs during a fiscal year.
ENDSTRENGTH	Upper limit on the number of enlisted personnel across all grades at the end of the fiscal year.
GRADECEILING	Upper limit on the number of enlisted personnel in a grade at the end of the fiscal year (exists only for grades E-5 through E-9).

Performance Relative to Goals

DIFFBUDGET	Projected cost - BUDGET.
DIFFENDSTRENGTH	Projected total force - ENDSTRENGTH.
DIFFGRADECEILING	Projected force in grade - GRADECEILING.

Change in Inventory

ENDINV	Inventory at the end of a month.
NETCHANGE	Change in inventory during a month.
STARTINV	Inventory at the start of a month.

Gains to the Enlisted Force

MISCGAIN	Miscellaneous gains (recalls from the Reserves, returned dropped from rolls, delayed reenlistments, gain adjustments, and other gains).
NPS4	NPS accessions for a 4-year term.
NPS6	NPS accessions for a 6-year term.
NPS	Total NPS accessions (NPS4 + NPS6).
OTSGAIN	Gains scheduled to go to Officer's Training School.
PS	Prior service accessions.

TOTALGAIN	Total gain (NPS4 + NPS6 + PS + OTSGAIN + MISCGAIN).

Losses from the Enlisted Force

ATTLOSS	Total attrition (NPSATT + PSATT + INVATT).
BMTATTLOSS	Attrition from BMT.
EOLOSS	Early Out losses (losses shifted to this month from months in the next fiscal year to reduce this fiscal year's end strength).
ETSLOSS	ETS losses (losses that are not attrition, retirement, Rollup, Early Out Palace Chase, OTS, or miscellaneous, but rather are voluntary departures at the end of the enlisted person's contract to serve, or after an extension of that contract; not to be confused with "losses during the ETS year," which is an annual loss modeling concept meaning all the losses, including attrition, that occur during the 12 months before the OETS, therefore excluding losses that occur after an extension of the original term of service).
INVATT	Attrition from inventory that existed at the start of the projection period.
MISCLOSS	Miscellaneous losses--dropped from rolls (deserters), gain adjustment, and other loss.
NPSATT	Attrition from NPS accessions during the projection period.
NPSATTPROP(n)	Proportion of NPS accessions lost from attrition in the nth month after accession (n = 0 in the same month as the accession).
OTSLOSS	Losses to Officer's Training School.
PCLOSS	Palace Chase losses (ETS losses shifted to this month from later months to send personnel to the Reserves before the end of their obligated active service).
PSATT	Attrition from PS accessions during the projection period.
PSATTPROP(n)	Proportion of PS accessions lost from attrition in the nth month after accession (n = 0 in the same month as the accession).
RETIREMENT	Retirement losses.

RULOSS	Rollup losses (ETS losses shifted to this month from later months in the fiscal year to reduce personnel costs in the fiscal year).
RULOSSBYORIGIN	Rollup losses by month from which the loss was shifted (the "origin" month).
STDATTLOSS	Attrition after BMT.
TOTALLOSS	Total losses (ATTLOSS + ETSLOSS + RULOSS + EOLOSS + PCLOSS + RETIREMENT + OTSLOSS + MISCLOSS).

Definition of Policy-Free ETS Losses

EOSHIFT	Early Out shifts (ETS losses shifted to previous months by the Early Out program).
ETSLOSS	(See definition under "Losses from the Enlisted Force" above).
PCSHIFT	Palace Chase shifts (ETS losses shifted to previous months by the Palace Chase program).
PFETSLOSS	ETS losses that would have occurred if there had been no early release programs (ETSLOSS + RUSHIFT + EOSHIFT + PCSHIFT).
RUSHIFT	Rollup shifts (ETS losses shifted to previous months by the Rollup program).

Definition of Policy-Free Inventory

EOINVRED	Inventory reduction caused by the Early Out program having shifted losses from after to before the inventory date.
PCINVRED	Inventory reduction caused by the Palace Chase program having shifted losses from after to before the inventory date.
PFSTARTINV	Inventory that would have existed if there were no early release programs (STARTINV + PCINVRED + EOINVRED + RUINVRED).
RUINVRED	Inventory reduction caused by the Rollup program having shifted losses from after to before the inventory d[illegible] e.

STARTINV	Inventory at the start of the month.

Details of Early Release Shifts

EOSHIFTHIST	Early Out shifts in a given projection month caused by Early Out losses that occurred before the start of the projection period.
EOSHIFTPROJ	Early Out shifts in a given projection month caused by Early Out losses that occur during the projection period (this variable always equals zero, as Early Out losses in a given fiscal year are, by definition, shifted from the next fiscal year).
PCLOSSPROP(n)	Proportion of Palace Chase losses obtained from "n" months in the future (n = 0 if the loss was obtained from the same month).
PCSHIFTHIST	Palace Chase shifts in a given projection month caused by Palace Chase losses that occurred before the start of the projection period.
PCSHIFTPROJ	Palace Chase shifts in a given projection month caused by Palace Chase losses that occur during the projection period.
RUSHIFTHIST	Rollup shifts in a given projection month caused by Rollup losses that occurred before the start of the projection period.
RUSHIFTPROJ	Rollup shifts in a given projection month caused by Rollup losses that occur during the projection period.

Details of Forced Early Reenlistments

ETSREENLISTOUT	Actual reenlistments out less forced early reenlistments or, equivalently, policy-free reenlistments out less forced early reenlistment shifts (analogous to ETS losses).
FEROUT1	Forced early reenlistments from a later month in the current fiscal year.
FEROUT2	Forced early reenlistments from the next fiscal year.
FEROUT1POLICY	Forced early reenlistments from same fiscal year (user input).

FEROUT2POLICY	Forced early reenlistments from next fiscal year (user input).
FERSHIFT1	Forced early reenlistment shifts to an earlier month in the current fiscal year.
FERSHIFT2	Forced early reenlistment shifts to the previous fiscal year.
FERSHIFTHIST	Forced early reenlistment shifts during projection months caused by forced early reenlistments that occurred before the fiscal year being analyzed.
PFREENLISTOUT	Reenlistments out that would have occurred if there were no forced early reenlistment program.
REENLISTOUT	Actual reenlistments out.

Changes in Grade

DEMOIN	Demotions into a grade.
DEMOOUT	Demotions out of a grade.
HISTPROMOUTRATE	Historical monthly rate of promotion out of a grade (denominator is end of month inventory).
PROMIN	Promotions into a grade.
PROMOUT	Promotions out of a grade.

Changes in Category of Enlistment

REENLISTIN	Reenlistments into a category.
REENLISTOUT	Reenlistments out of a category.
RETELIGIN	Flow into the retirement-eligible category (category 4) from the careers category.
RETELIGOUT	Flow out of the careers category (category 3) to the retirement-eligibility category.

Military-Personnel-Account (MPA) Cost

BAQVHA	Basic allowance for quarters and variable housing allowance.
BASICPAY	Basic pay.
INCENTPAY	Incentive and special pays (an example of the former is flying pay, an example of the latter is reenlistment bonuses).

MISCPAY	Miscellaneous pays (subsistence, uniform or clothing allowance, station allowance overseas, family separation allowances, separation payments, social security payments, and other military personnel costs).
PCSCOST	Permanent change of station costs.
RETIREPAY	Retired pay accrual (equal to a percentage of basic pay).
TOTALCOST	Total MPA costs (BASICPAY + RETIREPAY + BAQVHA + INCENTPAY + MISCPAY + PCSCOST).

Cost Factors

BAQVHAFACTOR	Basic allowance for quarters and variable housing allowance per person-year.
BASICPAYFACTOR	Basic pay per person-year.
GAINWEIGHT	Fraction of a month that a gain works (gains come in part way through the month).
INCENTPAYFACTOR	Incentive and special pay per person-year.
LOSSWEIGHT	Fraction of a month that a loss works (losses leave part way through a month).
MISCPAYFACTOR	Miscellaneous pay per person-year.
PCSCOSTFACTOR	Permanent Change of Station cost per person-year.
RETIREPAYFACTOR	Retired pay accrual per person-year.

Appendix B

SEQUENTIAL MONTH NUMBER

The different modules of SAM must be able to transfer information on monthly inventories and flow without ever making an error in lining up the different systems of naming months. Those different naming systems include:

- Month in a calendar year.
- Month in a fiscal year.
- Month in a projection period.

To enable the different modules of SAM to communicate without error, a uniform method of numbering months is needed. The uniform method adopted is to number months sequentially, starting with "1" for January 1980. By numbering months sequentially, a simple "greater than" check enables a computer program to tell whether one month is later than another.

The following formula translates the standard YYMM date found on airman records into the sequential month number needed for SAM.

$$SMN = 12(YY - 80) + MM$$

where

SMN = Sequential Month Number, YY = last two digits of calendar year, MM = number of month in calendar year.

Suppose Module 1 of SAM has predicted policy-free ETS losses for 12 projection months starting with February 1987. This information must then be transferred to Module 2 and aligned correctly with fiscal-year time.

The above formula (or Table B.1) shows that the first projection month's number is 12(87 - 80) + 2 = 86, so the predictions are for months 86 through 97.

Then Table B.1 shows that the predictions begin in the fifth month of FY87 and only the predictions for months 86 through 93 are needed to fill out FY87 accounts.

To get the computer to translate a sequential month number into fiscal year and month in fiscal year, use the following formulas:

$$FY = \{\text{Integer Part of } [(SMN + 2)/12]\} + 80$$

$$NN = SMN - 12(FY - 80) + 3$$

where

SMN = Sequential Month Number,
FY = last two digits of fiscal year,
NN = month in fiscal year.

Table B.1

SEQUENTIAL MONTH NUMBER BY CALENDAR YEAR

Calendar Year	1 Jan	2 Feb	3 Mar	4 Apr	5 May	6 Jun	7 Jul	8 Aug	9 Sep	10 Oct	11 Nov	12 Dec
80	1	2	3	4	5	6	7	8	9	10	11	12
81	13	14	15	16	17	18	19	20	21	22	23	24
82	25	26	27	28	29	30	31	32	33	34	35	36
83	37	38	39	40	41	42	43	44	45	46	47	48
84	49	50	51	52	53	54	55	56	57	58	59	60
85	61	62	63	64	65	66	67	68	69	70	71	72
86	73	74	75	76	77	78	79	80	81	82	83	84
87	85	86	87	88	89	90	91	92	93	94	95	96
88	97	98	99	100	101	102	103	104	105	106	107	108
89	109	110	111	112	113	114	115	116	117	118	119	120
90	121	122	123	124	125	126	127	128	129	130	131	132
91	133	134	135	136	137	138	139	140	141	142	143	144

Table B.2

SEQUENTIAL MONTH NUMBER BY FISCAL YEAR

Fiscal Year	1 Oct	2 Nov	3 Dec	4 Jan	5 Feb	6 Mar	7 Apr	8 May	9 Jun	10 Jul	11 Aug	12 Sep
81	10	11	12	13	14	15	16	17	18	19	20	21
82	22	23	24	25	26	27	28	29	30	31	32	33
83	34	35	36	37	38	39	40	41	42	43	44	45
84	46	47	48	49	50	51	52	53	54	55	56	57
85	58	59	60	61	62	63	64	65	66	67	68	69
86	70	71	72	73	74	75	76	77	78	79	80	81
87	82	83	84	85	86	87	88	89	90	91	92	93
88	94	95	96	97	98	99	100	101	102	103	104	105
89	106	107	108	109	110	111	112	113	114	115	116	117
90	118	119	120	121	122	123	124	125	126	127	128	129
91	130	131	132	133	134	135	136	137	138	139	140	141
92	142	143	144	145	146	147	148	149	150	151	152	153

Appendix C

GAINS AND LOSSES FROM THE ENLISTED FORCE DURING FY86

Table C.1 presents the annual gains and losses from the enlisted force during FY86 in terms of SAM accounts. The data come from the Air Force's *Justification of Estimates for Fiscal Years 1988/1989*. These counts show which gain and loss flows are large and which are small.

The gain/loss accounts in SAM do not call the 62,408 reenlistments that occurred during FY86 a gain or a loss. SAM treats reenlistments as transfers between categories of enlistment. In contrast, the *Justification of Estimates* calls reenlistments both a gain and a loss (presumably because they are lost to one category of enlistment and gained by another). Consequently, the total losses and total gains reported by the *Justification of Estimates* are both 62,408 larger than those reported in Table C.1.

Several small gain categories in the *Justification of Estimates* are consolidated into "Miscellaneous Gains" in the SAM accounts and several small loss categories are consolidated into "Miscellaneous Losses".

Table C.1

ANNUAL GAINS AND LOSSES FROM THE ENLISTED FORCE
DURING FY86

DURING FY86

Item	FY86 Flows
Gains	
NPS Accessions	64400
PS Accessions	2110
OTS Gain	1886
Miscellaneous Gain	1889
Total	70285
Losses	
Attrition	25691
ETS Loss	20237
Normal Early Release (Early Out and Rollup)	3321
Programmed Early Release (Palace Chase)	2655
Retirement	9332
OTS Loss	2761
Miscellaneous Loss	228
Total	64225

SOURCE: *Justification of Estimates for Fiscal Years 1988/1989, Submitted to Congress January 1987: Military Personnel, Air Force*, Department of the Air Force, Washington, D.C., 1987, p. 9.

NOTE: Miscellaneous gains include recalls from the Reserves, returned dropped from rolls, gain adjustments, and other gains. Miscellaneous losses include dropped from rolls (deserters), loss adjustments, and other losses.

Appendix D

PROMOTION PHASE POINTS TO GRADES E-2 THROUGH E-4

For grades E-1 through E-4, promotion is based on fixed phase points. The entry grade for 4-year enlistees is E-1. The entry grade for 6-year enlistees is E-1 during basic military training, after which they are immediately promoted to E-3.

For 4-year enlistees, the E-2 phase point is 6 months, the E-3 phase is 16 months, and the E-4 phase point is 30 months "below the zone" and 36 months normally.

For 6-year enlistees, the E-4 phase point is 24 months "below the zone" and 30 months normally.

At the end of the first (partial) calendar month in service, enlisted personnel are "0 months in service" (MOS = 0). At the end of the second calendar month in service enlisted personnel are "1 months in service" (MOS = 1). At the end of the 13th calendar month in service enlisted personnel are "12 months in service" (MOS = 12) and "1 year in service" (YOS = 1).

Table D.1 shows how the fixed phase points for promotion to grades E-2 through E-4 line up on the MOS, YOS method of counting time in service.

Table D.1

GRADES E-1 THROUGH E-4 BY MONTHS IN SERVICE

	4-Year Enlistee				6-Year Enlistee			
MOS	E-1	E-2	E-3	E-4	E-1	E-2	E-3	E-4
				YOS = 0				
0	x				x			
1	x						x	
2	x						x	
3	x						x	
4	x						x	
5	x						x	
6		x					x	
7		x					x	
8		x					x	
9		x					x	
10		x					x	
11		x					x	
				YOS = 1				
12		x					x	
13		x					x	
14		x					x	
15		x					x	
16			x				x	
17			x				x	
18			x				x	
19			x				x	
20			x				x	
21			x				x	
22			x				x	
23			x				x	

Table D.1 (cont.)

MOS	4-Year Enlistee E-1	E-2	E-3	E-4	6-Year Enlistee E-1	E-2	E-3	E-4
			YOS = 2					
24			x				x	b
25			x				x	b
26			x				x	b
27			x				x	b
28			x				x	b
29			x				x	b
30			x	b				x
31			x	b				x
32			x	b				x
33			x	b				x
34			x	b				x
35			x	b				x
			YOS = 3					
36				x				x
37				x				x
38				x				x
etc.				x				x

NOTE: x = normal grade, b = grade resulting from a below-the-zone (BTZ) promotion to grade E-4.

Appendix E

MPA COSTS OF THE ENLISTED FORCE DURING FY86

SAM estimates the MPA cost of the enlisted force during the fiscal year. The bold face headings in Table E.1 show the aggregated cost items in SAM's cost accounts. The table also gives the FY86 cost of the enlisted force, so the relative size of items in the budget can be assessed.

SAM makes its cost estimates using grade-specific cost factors for person-years worked by the enlisted force.

This cost estimation method is designed to provide short-run force programmers with rapid feedback on the cost implications of management actions that increase or decrease the size of the force during a fiscal year. The method is adequate to indicate how much money is saved by the usual short-run management strategies:

- Fewer accessions during FY.
- Delayed accessions.
- Delayed promotions.
- Early releases.
  - Palace Chase
  - Early Out
  - Rollup

SAM's cost estimation method, however, is not a substitute for the budget models that estimate fiscal year costs in great detail. On the contrary, SAM is designed to provide inventory and flow detail to those budget models so that detailed cost estimates can be made for a fiscal year.

SAM estimates only MPA account costs. That account does not include the costs of training (beyond the pay of military personnel), base operating support (equipment and supplies and civilian contractor labor), "rent" for military housing, or temporary duty (TDY) expenses.

Finally, SAM's cost estimates are for only one fiscal year. They do not include estimates of future cost changes that result from management actions taken in the fiscal year analyzed.

Because of the approximate nature of the cost estimates and, even more important, because of the omitted cost items, SAM's cost estimates are not appropriate for making judgments about the cost effectiveness of alternative management actions.

Table E.1

MILITARY PERSONNEL ACCOUNT COST OF AIR FORCE
ENLISTED PERSONNEL DURING FY86

Item	FY86 Cost (Millions of $)	
Basic Pay		6232
1. Basic Pay	6232	
Retirement Accrual		3067
2. Retired Pay Accrual	3067	
BAQ & VHA		1001
3. Basic Allowance for Quarters (BAQ)	827	
4. Variable Housing Allowance (VHA)	174	
Incentive and Special Pay		126
6. Incentive Pay (e.g. flying pay)	28	
7. Special Pays	98	
Reenlistment Bonus	79	
Other (many categories)	19	
Miscellaneous		1675
5. Subsistence	889	
a. Basic Allow. for Sub. (BAS)	762	
b. Subsistence-In-Kind	126	
8. Allowances	260	
a. Uniform or Clothing	53	
b. Station Allowance Overseas	190	
c. Family Separation Allowance	16	
9. Separation Payments	49	
10. Social Security Payments	442	
12. Other Military Personnel Costs	35	
Permanent Change in Station (PCS)		666
11. PCS Travel	666	
Total	12767	12767

SOURCE: *Justification of Estimates for Fiscal Years 1988/1989, Submitted to Congress January 1987: Military Personnel, Air Force*, Department of the Air Force, Washington, D.C., 1987, pp. 11-13.

Appendix F

BUILDING SAM'S DATABASE FROM PDGL AND UAR FILES

PURPOSE

This appendix defines the methodology for using the Air Force's Promotion-Demotion-Gain-Loss (PDGL) and Uniform Airman Record (UAR) files to build the database for Module 2 of the Short-term Aggregate IPM (SAM2). Operationally, this will be done monthly during the week after the Airman Active K (AAK) file is posted.

Since the inputs for Modules 3 and 4 either come from Module 2 or are user inputs, this appendix defines the entire PDGL-UAR database required for all the modules specified in this document.

PDGL and UAR variables refer to monthly airman records. SAM2 variables are subscripted variables--n-dimensional arrays of numbers, where n = number of subscripts. This appendix defines the monthly PDGL and UAR variables and the subscripts for each SAM2 variable. The job of accumulating PDGL and UAR records into subscripted SAM2 variables is straightforward, but not explicitly defined here.

TYPES OF SAM2 VARIABLES

Three kinds of SAM2 variables must be constructed from PDGL or UAR data.

1. "Historical" variables (ones with an "h" prefix) that record actual events in the fiscal year being analyzed--events in the part of the fiscal year that has already occurred.

2. "Experience" variables (ones with an "e" prefix) that record events in the 12 months before the start of projections.

3. Variables from the fiscal year before the fiscal year being analyzed.

Variables in the first and third categories have subscripts of Grade, Catenl, Month, and (sometimes) Origin (see definitions below). Variables in the second category have subscripts of Grade, Catenl, and (sometimes) Tfms and Past (see definitions below).

This appendix does not put the prefixes on the variables.

INTERMEDIATE VARIABLES

Before SAM2 subscripts and variables on the PDGL and UAR files are defined, several intermediate variables need to be defined. These will be used to build SAM2 variables.

Intermediate Variables on the PDGL File

FYTRANS = Fiscal year in which transaction occurs (last two digits).

FYOFDOS = Fiscal year in which the airman's DOS is scheduled to occur (last two digits).

The value for FY of DOS should be obtained from the DOS-YR-MO variable, on the PDGL (position 036-039). Note that the "YR" portion of that variable is calendar year. One way to get the FY is:

If (DOS-YR-MO) - 100 * INT[(DOS-YR-MO)/100)] = 10, 11, or 12
Then FYOFDOS = INT[(DOS-YR-MO)/100] + 1
If (DOS-YR-MO) - 100 * INT[(DOS-YR-MO)/100)] = 1, 2, ... 9
Then FYOFDOS = INT[(DOS-YR-MO)/100]

CURTIME = YYMM of current month (last two digits of calendar year and two digit month within calendar year).

MOS = Months of service.

Use PDGL variable MO-TAFMSD-YR-MO-DA (position 013-018) to build the variable MOS:

X = INT[(MO-TAFMSD-YR-MO-DA)/100]

MOS = INT(12(A) + B - 12(C) - D)

where A = INT(CURTIME/100)
B = CURTIME - 100(A)
C = INT(X/100)
D = X - 100(C)

Note that the interpretation of these formulas is:

A = YY of CURTIME
B = MM of CURTIME
C = YY of MO-TAFMSD-YR-MO-DA
D = MM of MO-TAFMSD-YR-MO-DA

Intermediate Variables on the UAR File

Month = Current month (three character name, e.g., Jan, Feb, ... Dec).

CURTIME = YYMM of current month (last two digits of calendar year and two digit month within calendar year).

SUBSCRIPTS

Six SAM2 subscript variables are required:

1. Grade = Pay grade (E-1 through E-9).
2. Catenl = Category of enlistment (first, second, career, retirement eligible).
3. Month = Month in fiscal year (Oct through Sept).
4. Origin = Month from which rollups or early outs come.
5. Past = Past 12 months (1 = 12 months ago, 2 = 11 months ago, etc.).
6. Tfms = Total federal military service (in years).

Mappings for the first five variables are required for the PDGL file, while mappings for all but Origin are needed for the UAR file.

The mapping for Past is not given in this appendix. Past can be defined only when the start month of a projection period is known. Past runs from 1 to 12 over the 12 months before that start month.

The mappings for the other subscripts are as follows:

PDGL variable	REC-POSN	SAM2 subscript
gr-curr	029	Grade
= 1		= 1
= 2		= 2
= 3		= 3
= 4		= 4
= 5		= 5
= 6		= 6
= 7		= 7
= 8		= 8
= 9		= 9
cat-enlist	032	Catenl
= 1		= 1
= 2		= 2
= 4		= 3
= 5		= 3
as-of-month	062	Month
= A		= Jan
= B		= Feb
= C		= Mar
= D		= Apr
= E		= May
= F		= Jun
= G		= Jul
= H		= Aug
= I		= Sep
= J		= Oct
= K		= Nov
= L		= Dec
DOS-YR-MO	036-039	Origin
when MM part of YYMM is equal to		
= 01		= Jan
= 02		= Feb
= 03		= Mar
= 04		= Apr
= 05		= May
= 06		= Jun
= 07		= Jul
= 08		= Aug
= 09		= Sep
= 10		= Oct
= 11		= Nov
= 12		= Dec

UAR variable	REC-POSN	SAM2 subscript
gr-curr-2	064	Grade
= 1		= 1
= 2		= 2
= 3		= 3
= 4		= 4
= 5		= 5
= 6		= 6
= 7		= 7
= 8		= 8
= 9		= 9
cat-enlist	079	Catenl
= 1		= 1
= 2		= 2
= 4		= 3
= 5		= 3
month	new variable	Month
= Jan		= Jan
= Feb		= Feb
= Mar		= Mar
= Apr		= Apr
= May		= May
= Jun		= Jun
= Jul		= Jul
= Aug		= Aug
= Sep		= Sep
= Oct		= Oct
= Nov		= Nov
= Dec		= Dec

pay-date-yr-mo	075-078	Tfms
CURTIME	new variable	

Tfms = INT([12(A)+B - 12(C)-D]/12)

where A = INT(CURTIME/100)
B = CURTIME - 100(A)
C = INT((pay-date-yr-mo)/100)
D = (pay-date-yr-mo) - 100(C)

Note that the interpretation of these formulas is:

A = YY of CURTIME
B = MM of CURTIME
C = YY of pay-date-yr-mo
D = MM of pay-date-yr-mo

GAINS

The gain categories are as follows:

1. NPS accessions.
2. PS accessions.
3. Recalls from Reserves.
4. Returned from dropped from rolls.
5. Delayed Reenlistment Program.
6. OTS Gains.
7. Other Gains.

These variables are obtained directly from the Recoded ADN, spd-trans-code (REC-POSN 103-105) on the PDGL file.

PDGL Recode	SAM MODULE 2 VARIABLE
010	[NPS <Grade, Catenl, Month>]
020	[PS <Grade, Catenl, Month>]
040	[RECALLRES <Grade, Catenl, Month>]
045	[RETDROPROLL <Grade, Catenl, Month>]
055	[DELAYREEN <Grade, Catenl, Month>]
030	[OTSGAIN <Grade, Catenl, Month>]
050	[OTHERGAIN <Grade, Catenl, Month>]

The subscripts Grade (E-1 through E-9) and Catenl (first, second, and career) come from the PDGL. The subscript Month (Oct through Sept) will the be month (1 through 12) the transaction took place.

LOSSES

The loss categories are as follows:

1. Attrition (all categories).
2. ETS Losses.
3. Early outs taken from current Fiscal Year (Rollups).
4. Early outs taken from next fiscal year (Early Outs).
5. Retirements.
6. Losses to Reserves.
7. OTS Losses.
8. Other Losses.

Each of these variables is obtained for SAM2 by summing PDGL records over one or more values of the variable spd-trans-code (REC-POSN 103-105) on the PDGL file.

PDGL Recode	SAM MODULE 2 VARIABLE
700,705,710	[ATTRITION <Grade, Catenl, Month>]
715,720,725	
730,735,740	
745,750,755	
760,765,770	
775,780,785	
790,795,800	
810	
825	
830,835,840	
one of the following:	[ATTMOSZERO <Month>]
700,705,710	
715,720,725	
730,735,740	
745,750,755	
760,765,770	

775,780,785
790,795,800
810
825
830,835,840,
and MOS = 0

one of the following: [ATTMOSONE <Month>]
700,705,710
715,720,725
730,735,740
745,750,755
760,765,770
775,780,785
790,795,800
810
825
830,835,840,
and MOS = 1

one of the following: [ATTMOSTWO <Month>]
700,705,710
715,720,725
730,735,740
745,750,755
760,765,770
775,780,785
790,795,800
810
825
830,835,840,
and MOS = 2

```
500,510,520              [ ETSLOSS <Grade, Catenl, Month> ]

630,635,640              [ ROLLUPBYORIGIN <Grade, Catenl, Month,
if                                          Origin>]
FYOFDOS = FYTRANS


630,635,640              [ EARLYOUT <Grade, Catenl, Month> ]
if
FYOFDOS = FYTRANS + 1


630,635,640              [ LASTEARLYOUTBYORIGIN <Grade, Catenl, Month,
if                                          Origin> ]
FYOFDOS = FYTRANS + 1


 300                     [ RETIREMENT <Grade, Catenl, Month> ]

600,605,610              [ LOSSTORES <Grade, Catenl, Month> ]
615,620,625

 400                     [ OTSLOSS <Grade, Catenl, Month> ]

 410                     [ OTHERLOSS <Grade, Catenl, Month> ]
```

If more than one recode is listed for a SAM2 variable, then sum over all the recodes to obtain the SAM2 variable. The subscripts are obtained as with the gains.

REENLISTMENTS

Reenlistments are obtained from the UAR file. Reenlistments need to be counted in two ways:

1. Reenlistments into a term (second or career) to obtain the SAM2 variable [REENLISTIN <Grade, Catenl, Month>].

2. Reenlistments out of a term to obtain the SAM2 variable [REENLISTOUT <Grade, Catenl, Month>].

Each of these variables is obtained for SAM2 by summing PDGL records over the values of the variable spd-trans-code (REC-POSN 103-105) on the PDGL file. Reenlistments out of grade n are then set equal to reenlistments into grade n + 1.

PDGL Recode	SAM MODULE 2 VARIABLE
100, 120, 130 140, 150, 160	[REENLISTOUT <Grade, Catenl, Month>]

PROMOTIONS AND DEMOTIONS

Promotions are obtained from the PDGL file and need to be counted in two ways:

1. Promotions into a grade to get the SAM2 variable [PROMIN <Grade, Catenl, Month>].

2. Promotions out of a grade to get the SAM2 variable [PROMOUT <Grade, Catenl, Month>].

Demotions are obtained from the PDGL file and need to be counted in two ways:

1. Demotions into a grade to get the SAM2 variable [DEMOIN <Grade, Catenl, Month>].

2. Demotions out of a grade to get the SAM2 variable [DEMOOUT <Grade, Catenl, Month>].

Each of these variables is obtained for SAM2 by summing PDGL records over the values of the variable spd-trans-code (REC-POSN 103-105) on the PDGL file. Promotions out of grade n are then set equal to promotions into grade n + 1. Demotions out of grade n are set equal to demotions into grade n - 1.

PDGL Recode	SAM MODULE 2 VARIABLE
200	[PROMOUT <Grade, Catenl, Month>].
210	[DEMOOUT <Grade, Catenl, Month>].

INVENTORY

Inventories are broken out by Grade, Category of Enlistment, and Month within the fiscal year. The SAM2 variable ENDINV requires the inventory as of the end of the month, which will be equal to the SAM2 variable STARTINV for the beginning of the next month.

For example:

```
[ ENDINV <Grade, Catenl, Month = Oct> ]  =
                        [ STARTINV <Grade, Catenl, Month = Nov> ]
```

The inventories are obtained from the UAR file by counting the enlisted personnel by the three subscripts as defined in the subscript section of this appendix.

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