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SIMULATION UTILITY MANAGEMENT SYSTEM (SUMS): USER'S MANUAL

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This research project produced a multi-job/force-level analysis model with supporting software. Incorporated in the Simulation Utility Management System (SUMS) are the abilities to: a) consider the allocation of personnel within a dynamic multi-job system, b) assess the interdependencies among utility estimates in the multi-job system, c) investigate potential tradeoffs between single job and overall force-level utilities, and d) perform sensitivity analyses of the effects of changes in enlistment standards and other personnel policies on single and total system utilities. SUMS provides the user with the capability to affect personnel programs such as: enlistment standards, job classification standards, promotion policies, and force-downsizing policies. These policies can be evaluated in terms of single and total system costs, values and productive capacities.

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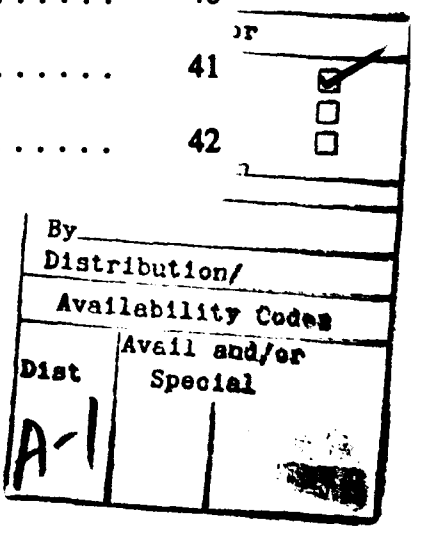

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PREFACE

This research and development effort was conducted as task order number 51 under Contract F41689-88-D-0251 (SBA 68822004) by Metrica, Inc. for the Manpower and Personnel Research Division of the Armstrong Laboratory's Human Resources Directorate. The purpose of this effort was to develop a multiple Air Force Specialty (AFS) force analysis model and supporting software package.

The authors wish to thank Dr. Brian Deuermeyer and Mrs. LeAnn Coleman for their valuable technical contributions to this effort. In addition, the authors would like to express appreciation to Ms. Barbara Randall (computer programmer), Mr. Kevin Borden (computer programmer), and Mr. Darryl Hand (computer programmer).

SIMULATION UTILITY MANAGEMENT SYSTEM (SUMS): USER'S MANUAL

SUMMARY

The Simulation Utility Management System (SUMS) and supporting software was developed in an effort to provide Air Force policy makers a tool to model a multi-job/force-level personnel system. This manual guides the user through the SUMS software package with input and output examples and explanations of options and parameters available.

Incorporated into SUMS is a enlisted personnel simulation model which begins with an initial inventory of personnel categorized by job, aptitude, grade, and experience, which SUMS then ages, separates, promotes, and accesses. The user specifies the job(s) to be included in the simulation. The user may choose from eight Air Force Specialties (AFSs) or two alternative force-level clusterings of AFSs. The user may specify one of two alternative promotion methodologies, as well as the minimum years of service (YOS) requirements for promotion from one grade to the next. The user may also specify one of eight methodologies to be used in allocating accessions to the jobs of a simulation.

The user is provided with the ability to affect personnel programs such as: enlistment standards, job classification standards, and force-downsizing policies. The user may affect enlistment standards for entering accession by specifying minimum General score and overall composite scores (Mechanical + Administrative + General + Electronic). The user may affect job classification standards by specifying the selector aptitude index (AI) and the minimum selector AI score for any job in the simulation. Force-downsizing policies may be simulated through the specification of manning levels for jobs.

SUMS provides the user with a variety of output with which alternative programs and policies can be evaluated. Evaluation criteria provided to the user include: productive capacity, costs, values, and ending force levels. The output also provides the user with a year-by-year summary for each job of manning levels, personnel inventories, promotions, separation, force-outs, accessions, and average productive capacity.

INTRODUCTION

The Simulation Utility Management System (SUMS) user interface provides a user friendly, DOS Windows environment for performing various personnel and management policy analyses and updating and/or modifying the data/parameters supporting the simulation scenarios of SUMS. SUMS was developed to use computer simulation modeling (CSM) in conjunction

with utility analysis to analyze the flow of Air Force enlisted personnel. In addition, cost and productive value estimates developed in the Value of Air Force Experience (VAFE) research (Stone, Rettenmaier, Saving, & Looper, 1989a and Stone, Grossman, Looper, & Engquist, 1991) provided the basis to assess dollar-valued utility payoffs for alternative human resource management (HRM) programs (Stone, Turner, Fast, Curry, Looper, & Engquist, 1992). The user of SUMS is assumed to have some knowledge of Air Force programs used to access, train, promote, reenlist, and separate enlisted personnel.

SUMS includes all eight 5-digit Air Force Specialties (AFSs) from the Air Force's job performance measurement program, on which Walk Through Performance Test (WTPT) data were collected. These form the basis of the productive capacity estimates for personnel with particular aptitude attributes at various stages in their career path (Stone et al., 1992). SUMS also allows for multiple AFS groupings, referred to as clusters. Presently, SUMS provides the option to use two different clusterings of AFSs (see Appendix A). These force-level groupings of AFSs provide flexibility for a wide range of analyses of personnel policy and program review. SUMS also includes analysis at the grade level (grades E1 through E9).

SUMS provides several options for promotion methodologies. These include constant promotion across AFSs/Clusters and promote-to-fill. Several methods of allocating accessions are also included in SUMS. These include maximizing total value, productive capacity, or net return, and minimizing total cost. SUMS also includes a method of allocating accessions which simulates applicants randomly arriving at the Military Entrance Processing Stations (MEPS).

Getting Started

SUMS presently operates on an IBM-compatible 386 PC with a minimum of 8 megabytes of internal memory. The larger the internal memory of the machine, the faster SUMS will process its simulations. A minimum of 25 megabytes of disk space is required to house the data supporting SUMS' operation. The user interface for SUMS has been implemented under Windows (Version 3.0). A mouse is necessary for movement within the SUMS user interface. Before beginning the installation of SUMS, the user should read the READ.ME file provided on the installation disks for SUMS.

To initiate access to the user interface and SUMS from Windows, the user must select SUMS from the Windows menu. The **SUMS Main Menu Screen**, Figure 1, will then appear. This menu will allow the user to access the primary functions of SUMS for the purpose of defining, executing, and saving a desired scenario as well as specify output files and access the on-line Help for Windows. More specifically, this menu will allow the user to access the following pull-down menus:

- **Scenario Menu,**
- **AFS Menu,**
- **File Menu,**

- **Execute Menu,**
- **Exit Menu,**
- **Print Menu,** and
- **Help Menu.**

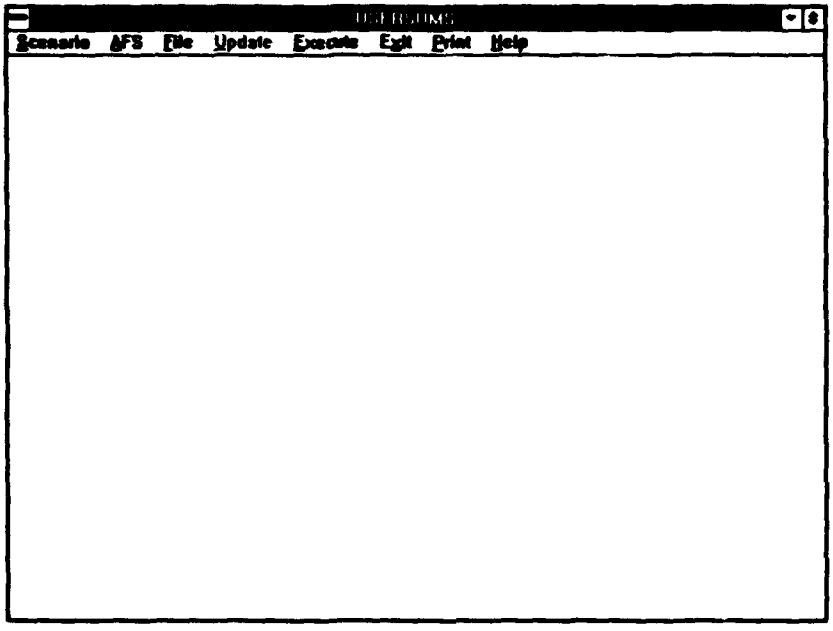

Figure 1. SUMS Main Menu Screen

The **Scenario Menu** allows the user to set the parameters of a scenario which are not AFS/Cluster specific, as well as to specify the AFSs/Clusters to be included in the simulation. The **AFS Menu** allows the user to specify the AFS/Cluster specific parameters of the scenario. The **File Menu** allows the user to specify the name of the output file to which SUMS will write the results of the simulation. The **Execute Menu** allows the user to execute a simulation using SUMS. The **Exit Menu** allows the user to exit SUMS. The **Print Menu** allows the user to print the output of an executed simulation. The **Help Menu** allows the user access general operating information about Windows.

Movement in the SUMS user interface is controlled using a mouse. The user selects a menu in order to access the parameters or options listed under that menu. Upon entering the SUMS user interface, the only menus which the user may initially choose from are (Figure 2):

- **Scenario,**
- **Exit,** and
- **Help.**

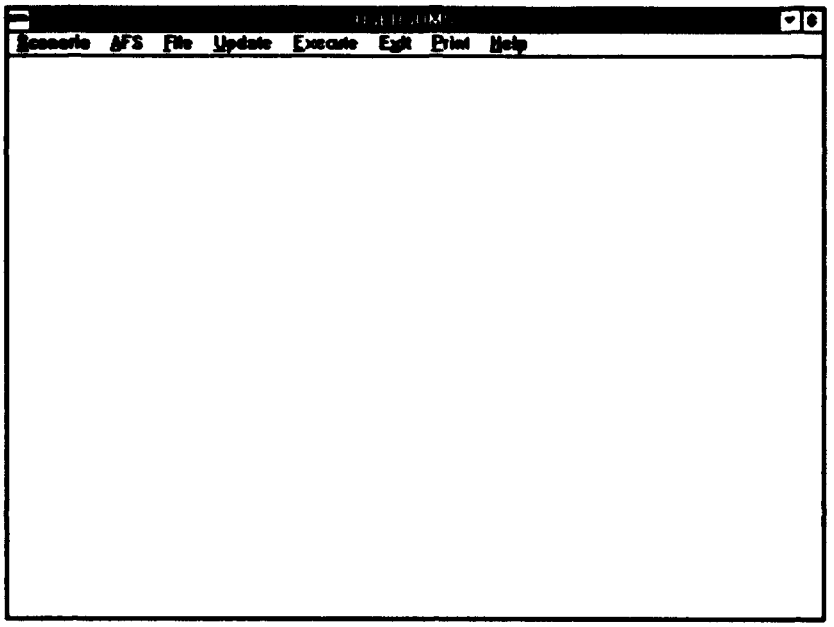

Figure 2. SUMS Menu Screen

In order to continue in SUMS, the user must select the **Scenario Menu** and choose the population for the simulation. The process of defining the population will be discussed in detail. After the user has defined the population for SUMS, the user may then access the all menus in any order (Figure 2). If the user executes SUMS without accessing any of the parameters of the **Scenario** or **AFS** menus, SUMS will execute the simulation using the settings from the Default parameter file. Appendix B contains information relating to the settings of the Default parameter file.

User Screens in SUMS

Screens in the SUMS user interface will present the user with several options. The user may alter the parameter by using the mouse to select the parameter screen and the keyboard to enter the new parameter value, or using the mouse to select various parameter options offered in the screen. Each parameter screen will also contain two additional options:

- **OK** and,
- **Cancel.**

To exit the parameter screen, the user may select one of these two options.

The **OK** option will keep any changes made by the user to the parameter. The user will then be returned to the **SUMS Main Menu Screen**. For example, the user in Figure 3 selected

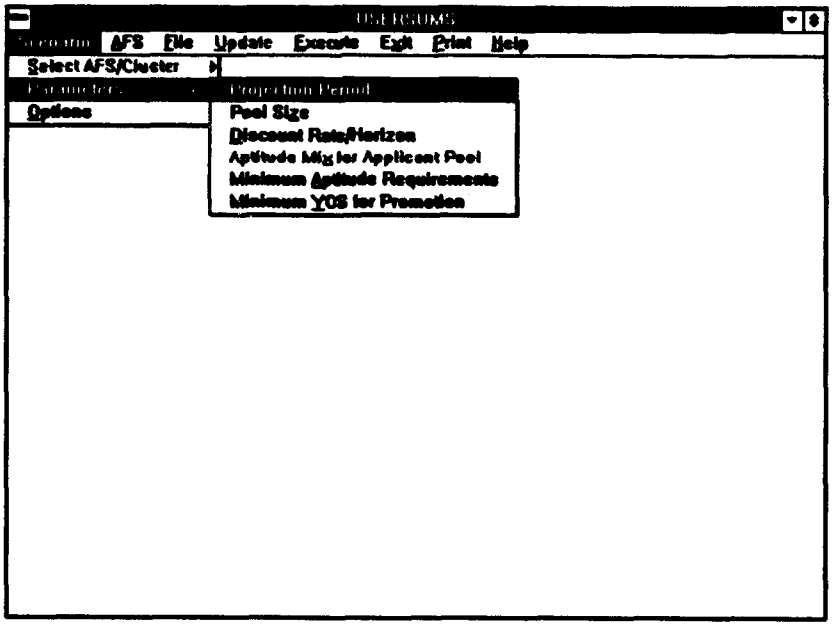

Figure 3. Example: Scenario Menu/Parameters Menu

the **Scenario Menu** and then the **Parameters Menu**. Then if in Figure 4, the user selected the parameter **Projection Period** and entered a new value at the **Projection Period Screen**, selecting the **OK** option at the **Projection Period Screen** would return the user to the **SUMS Main Menu Screen** (Figure 1). The revised parameter specified by the user would than be used in the simulation. If the user had not made any changes to the parameters in the **Projection Period Screen**, selecting the **OK** option would also have returned the user to the **SUMS Main Menu Screen**, maintaining the default settings in the simulation for that parameter.

The **Cancel** option will return the user to the original menu, the **SUMS Main Menu Screen**, as the **OK** option above does, but will not keep any changes the user has made to the parameter. Selecting the **Cancel** option will reset the parameter to the default settings for that parameter.

To enter new values at parameter screens, the user selects the box corresponding to the value to be altered. For example, if the user had selected the **Projection Period Screen** shown in Figure 3, to enter a new value for the projection period, the user would first click on the projection period box using the mouse. Next, the user would use the Delete or Backspace key on the keyboard to delete the value already in the box. Once the previous value was completely deleted, the user may then enter the new value using the number keys on the keyboard. The user would then select either the **OK** or **Cancel** option.

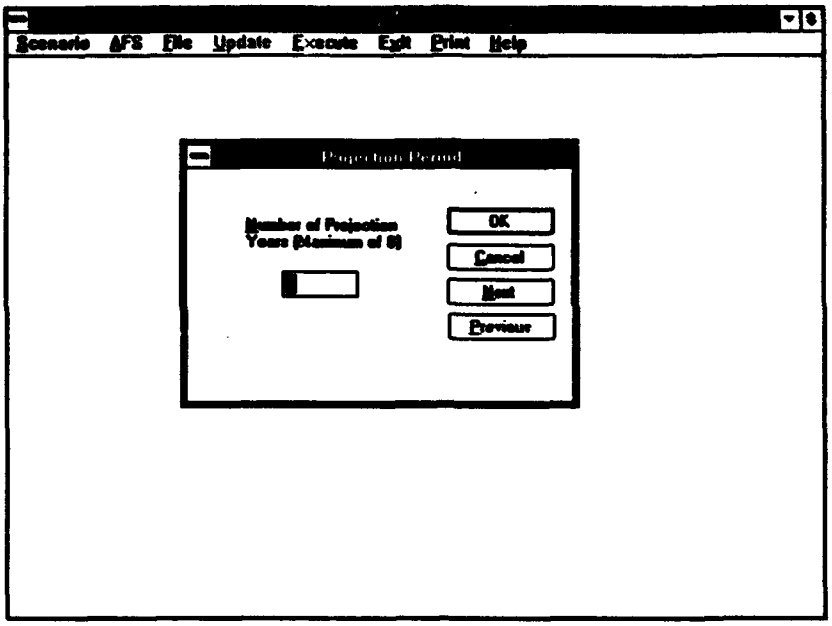

Figure 4. Example: Projection Period Screen

Some parameter and option screens will contain more than one value that the user may edit. For example, the **Costs/Values** screens under the **Options Menu** in the **Scenario Menu** (Figure 5). Costs and value in SUMS may be changed by year or across years. If the user had selected **Service State Value** as the parameter to edit, and chosen to edit those years using the **% By Year** option, the screen shown in Figure 6 would appear. To edit a percent for a particular year, the user would select that year using the mouse. The corresponding value for that year will then appear in the small box. The user may then select that small box, erase the contents of that box, and enter the new percentage change. This process may be repeated as many time as necessary. After all changes have been made, the user would use the **OK** or **Cancel** option to exit that screen.

The parameter **Service State Value** could vary only by year. Other parameters or options may vary by AFS/Cluster only, or by AFS/Cluster and by year. The procedure for editing these parameters or options will be similar to that outlined for **Service State Value**. The user will select the AFS for the value to be edited. Then at the small edit box, the user may enter the new values. If the parameter varies by AFS/Cluster and by year, values for the parameter for the AFS/Cluster selected will appear in small edit boxes for each projection year. The user may edit values for any or all of the years of the projection period.

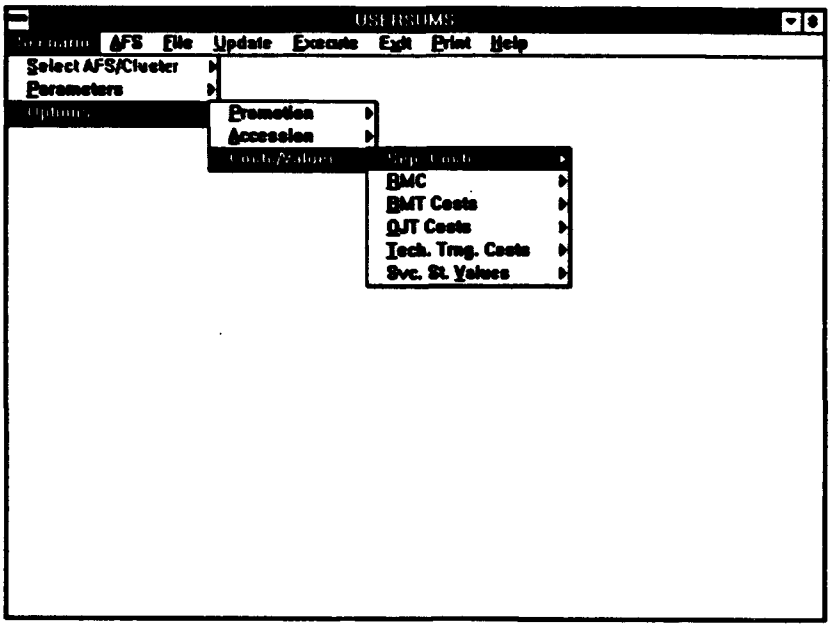

Figure 5. Example: Scenario Menu/Options Menu

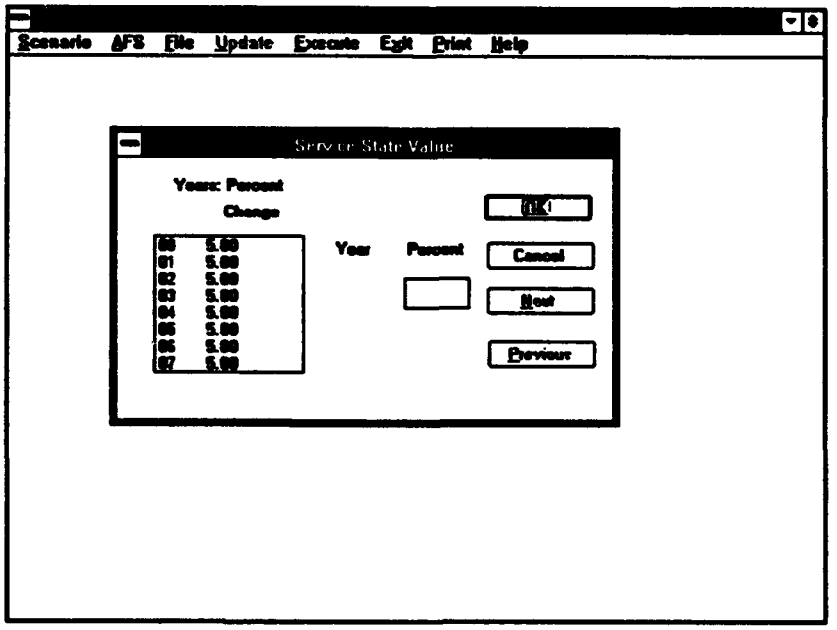

Figure 6. Example: Service State Value - By Year

DEFINING THE POPULATION

Before the user may execute SUMS, or access any of its parameters or options, the population for the simulation must first be defined. In defining the population, the user is specifying the AFSs or Clusters which SUMS will use in the simulation. Clusters are groupings of AFSs which allow the user to perform force-level analysis. Until a population has been defined for SUMS, the user will not be permitted to access any of the pull-down menus other than (Figure 2):

- **Scenario,**
- **Exit, and**
- **Help.**

The **Scenario Menu** will allow the user to specify the population for SUMS. The user may also exit SUMS by selecting the **Exit Menu** at this time. Help for Windows is also available to the user at this time by selecting the **Help Menu.**

In order to specify the population for a simulation, the user would select the **Scenario Menu** at the screen shown in Figure 2. The **Scenario Menu,** shown in Figure 7, would then allow the user to select the **Select AFSs/Clusters** option. At the next menu (Figure 8), the user may then select between using AFSs or Clusters for the simulation.

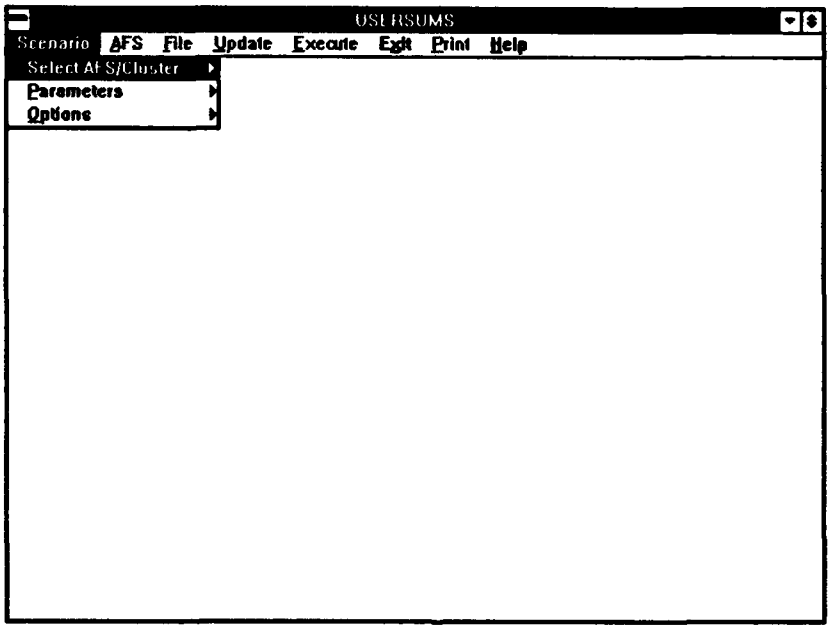

Figure 7. Scenario Menu: Define Population

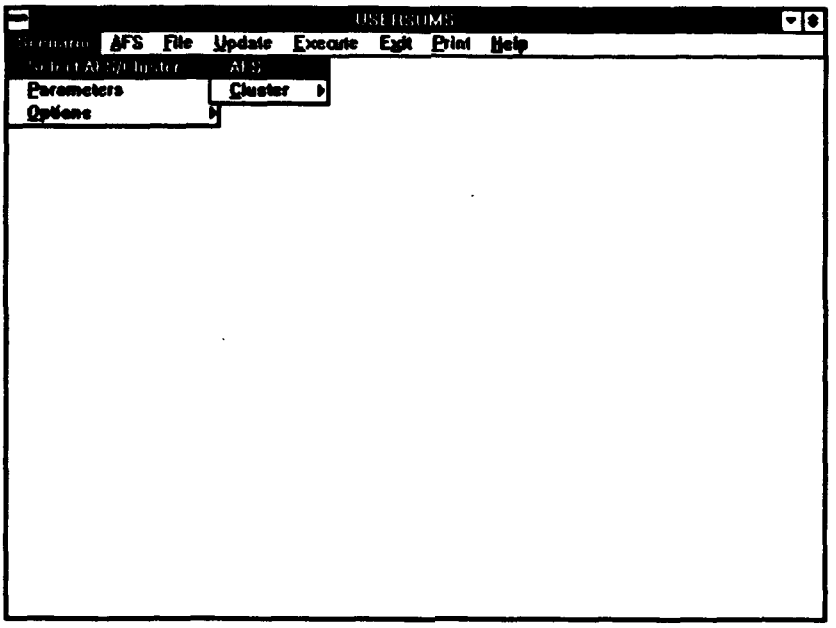

Figure 8. Select AFS/Cluster Menu

By selecting the AFS option (Figure 8), the user may then specify the AFSs to be used in the simulation. The user may specify any combination or all of the eight Walk Through Performance Test (WTPT) AFSs (Figure 9):

- **AFS 122x0** - Aircrew Life Support,
- **AFS 272x0** - Air Traffic Controller,
- **AFS 324x0** - Precision Measurement Equipment Laboratory,
- **AFS 328x0** - Communication and Navigation Systems,
- **AFS 423x5** - Aerospace Ground Equipment,
- **AFS 426x2** - Jet Engine Mechanic,
- **AFS 492x1** - Communication Systems Radio Operations, and
- **AFS 732x0** - Personnel Specialist.

To select an AFS, the user clicks on the desired AFS (Figure 9), highlighting that AFS. After selecting all the AFSs to be included in the population, the user then selects the OK option. The population for SUMS will now be defined as the selected AFSs.

To perform force-level analysis, the user would select the Cluster option at the menu in Figure 8. The next menu, shown in Figure 10, would allow the user to choose between two clustering of AFSs:

- **20 MAGE Clusters** or
- **51 AFS Clusters.**

The user may select between the two different clusterings by clicking on the desired clustering. This cluster will then be used as the population for SUMS. Appendix A presents the methodologies used to develop these clusters and the AFSs contained in each cluster.

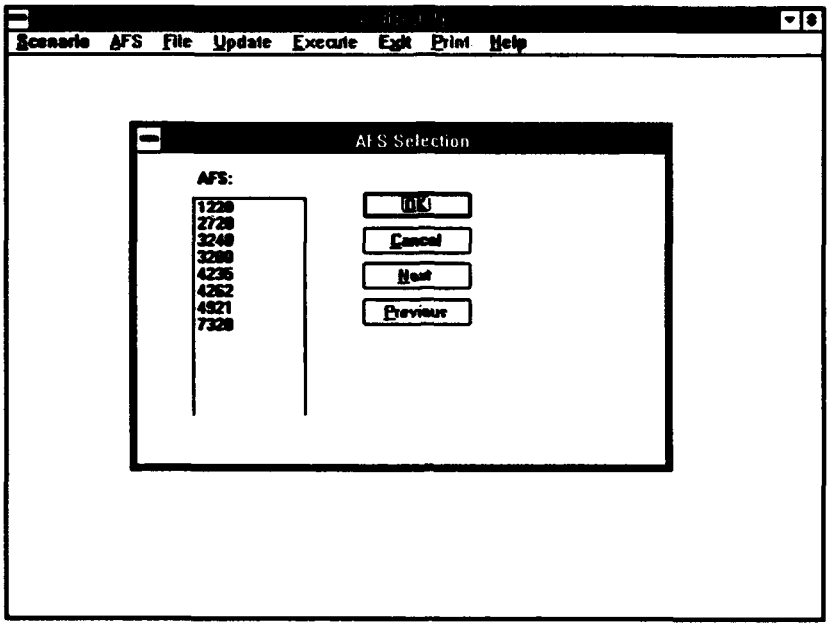

Figure 9. AFS Selection Screen

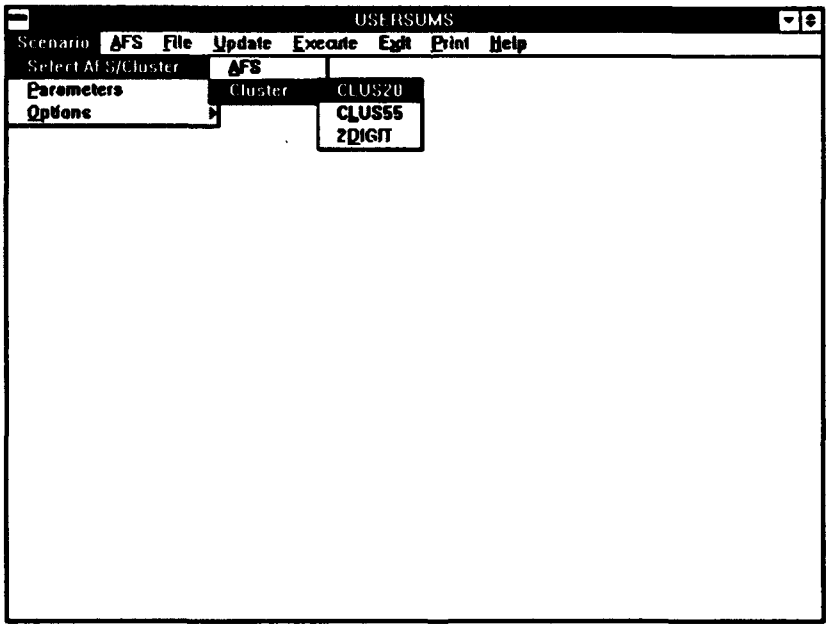

Figure 10. Cluster Selection Menu

Once the population for SUMS has been defined using AFSs or clusters, the user may not redefine the population. If the user has defined the population using AFSs, the number of AFSs included in the population may not be increased or decreased. Once the user has specified the AFSs or Clusters to be used in the simulation, the user then be able to access all the parameters and options of SUMS (Figure 1), as well as execute the simulation.

SCENARIO

The **Scenario Menu** allows the user to access the parameters of a simulation scenario which are not AFS/Cluster specific. If the user does not access the **Scenario Menu**, the simulation will use default values for all the parameters and options available under this menu (see Appendix B for default parameters). From the **Scenario Menu**, presented in Figure 11, the user is directed to a secondary menu which provides two additional options: **Parameters or Options**. The **Parameters Menu**, shown in Figure 12, allows the user to access the following screens for the purpose of changing or viewing parameter values:

- **Projection Period,**
- **Pool Size,**
- **Discount Rate/Horizon,**
- **Minimum Aptitude Requirements**, and
- **Minimum YOS for Promotion.**

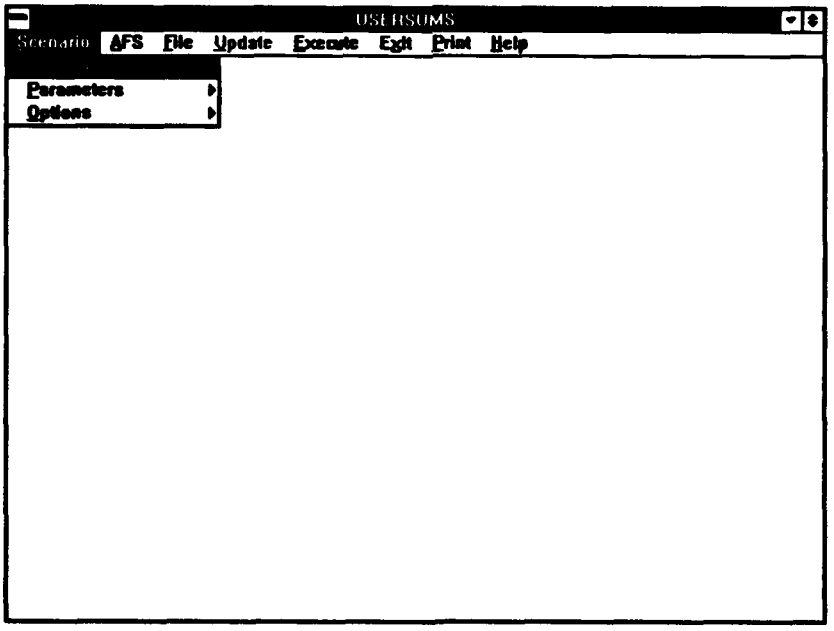

Figure 11. Scenario Menu

Each screen for these parameters will display the default values for the parameter. The user may view or revise any of the parameters shown on the menu presented in Figure 12. Each parameter screen will be discussed in detail.

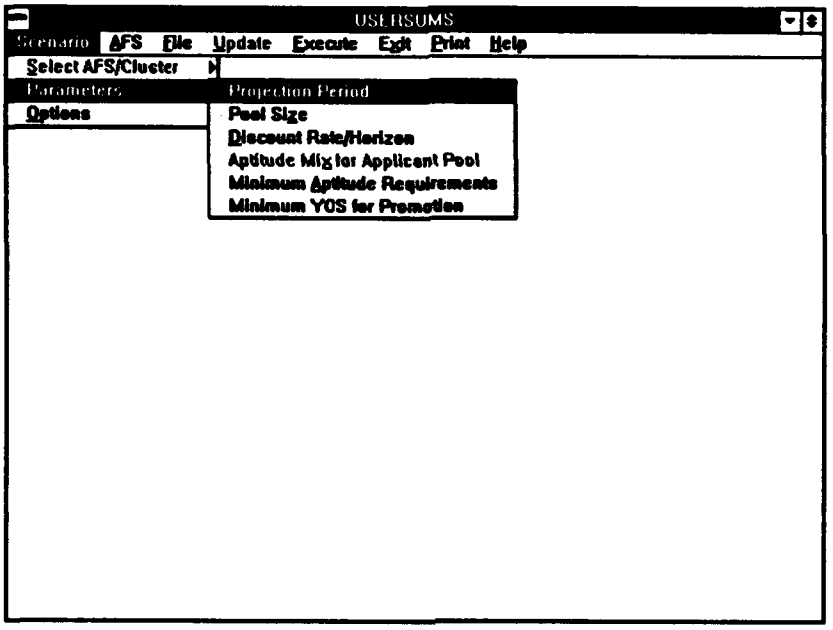

Figure 12. Parameters Menu

The **Options Menu**, displayed in Figure 13, allows the user access to different methodologies for allocating promotions and accessions. This menu also allows the user to view/revise the cost and value parameters to be used in the simulation. Specifically, the **Options Menu** allows the user to access the following options:

- **Promotion,**
- **Accession, and**
- **Costs/Values.**

Each screen or menu for these options/changes will display the default options/values. The user may view and/or revise any of the values accessible from the menu presented in Figure 13. Each option/value screen will be discussed in detail.

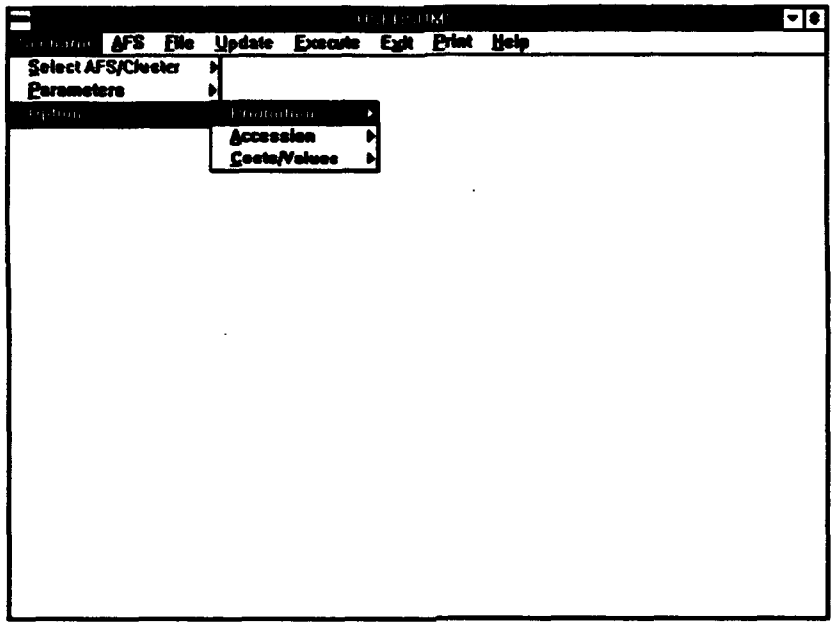

Figure 13. Options Menu

Parameters: Projection Period

The **Projection Period Screen**, shown in Figure 14, allows the user to specify the number of years to be projected in the simulation. The user may change the number of years to be projected by selecting the **Number of Projection Years** box and entering the new number of projection years. The minimum number of years allowed is one (1) and the maximum allowed is eight. The number of projection years must be entered in integer numbers, e.g. 1, 2, 3, ..., 8. By default the simulation will include eight projection years.

Parameters: Pool Size

The **Pool Size Screen** allows the user to specify the size of the applicant pool from which accession will be drawn for each projection year of the simulation (Figure 15). The user may specify the size of the applicant pool to be used for each of the projection years specified in the **Projection Period Screen**. The user may change any one of or all of the pool sizes. Applicant pools may vary in size for each year of a simulation. To change the size of an applicant pool, the user must select the year corresponding to the projection year to be changed from the box and then enter the new size of the new size of the applicant pool. This number must be an integer number greater than zero. By default, the size of the applicant pool will be 12,500 for each projection year of the simulation (for cluster analysis the size of the applicant pool 110,000). Pool sizes too large or too small relative to the number of authorized positions will

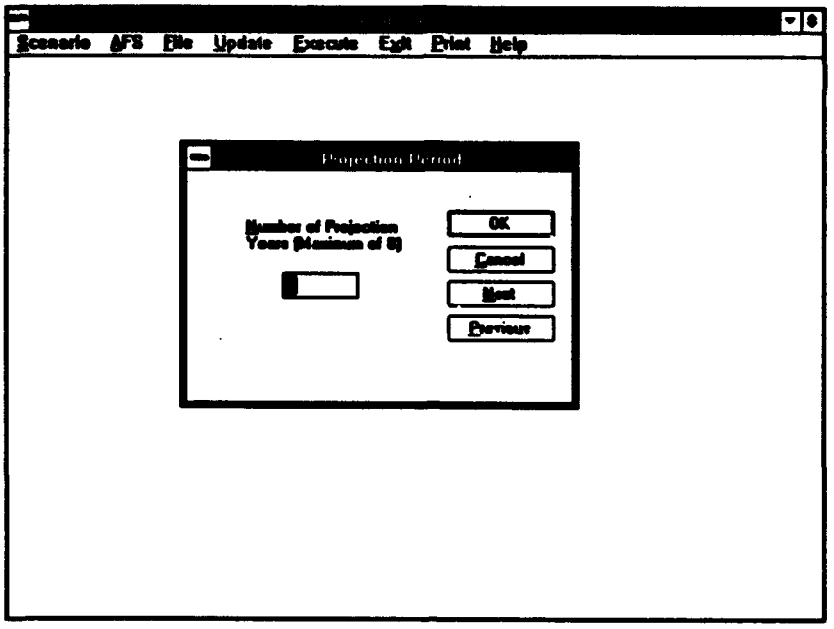

Figure 14. Projection Period Screen

affect the validity of the simulation. Default pool sizes were determined based on the minimum pool size necessary to meet all accession goals (given the default enlistment standards).

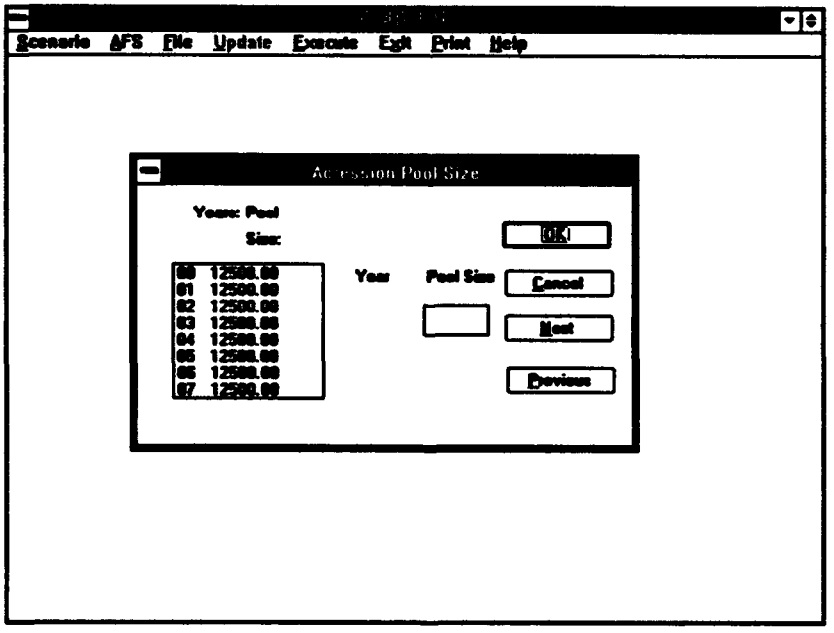

Figure 15. Pool Size Screen

Parameters: Discount Rate/Horizon

The Discount Rate/Horizon Screen allows the user to specify the discount rate to be used in the simulation and the horizon for applying that discount rate, Figure 16. The discount rate will be used in the computation of expected net return and any other expected values or costs that will be required in the simulation. The horizon is the number of years into the future to be used in the computation of expected net return and any other expected values or costs that will be required.

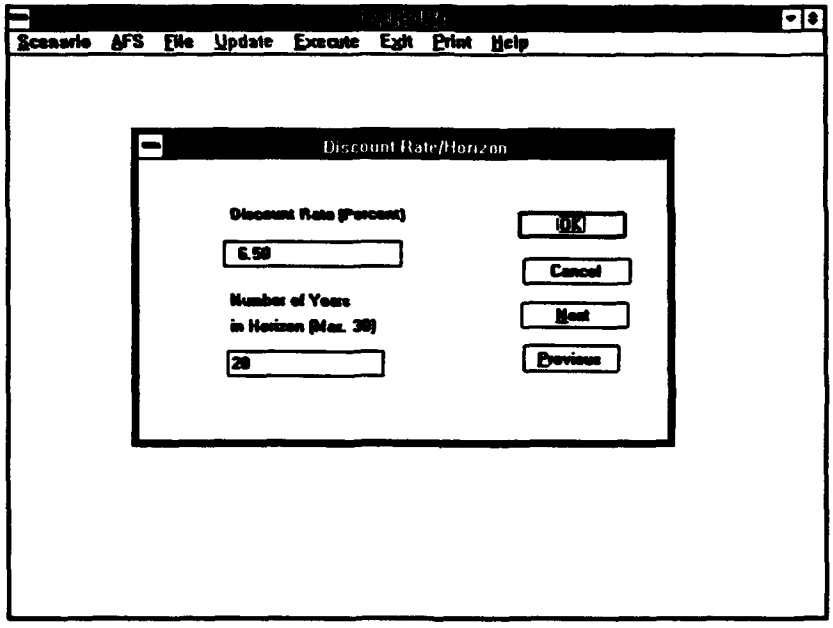

Figure 16. Discount Rate/Horizon Screen

The user may alter any one or both of these factors by selecting the appropriate box and entering the new value. The rate specified for the discount rate must be greater than or equal to 0.00%. The horizon must be entered in integer years greater than one year and less than or equal to 30 years. By default the discount rate is specified as 6.50% and the horizon is 20 years. The default discount rate is the 5-year certificate rate from the October 24, 1991, Wall Street Journal. A 20 year horizon is assumed based on the continuation rates from the Uniform Airman Records (UAR) file for June 1990. Based on the June 1990 UAR file, most retirements for enlisted personnel occurred by 20 year of service (YOS) point.

Parameters: Minimum Aptitude Requirements

The Minimum Aptitude Requirements Screen allows the user to specify the minimum aptitude requirements for all entering accessions, Figure 17. These minimum aptitude requirements are applied to all applicants in the specified applicant pool. An applicant not meeting the specified minimum aptitude requirements will not be considered as a possible entering accession by the simulation. These requirements effectively reduce the number of people in the available applicant pool from which accessions may be drawn. Overall minimum aptitude requirements do not vary by AFS/Cluster or by projection year.

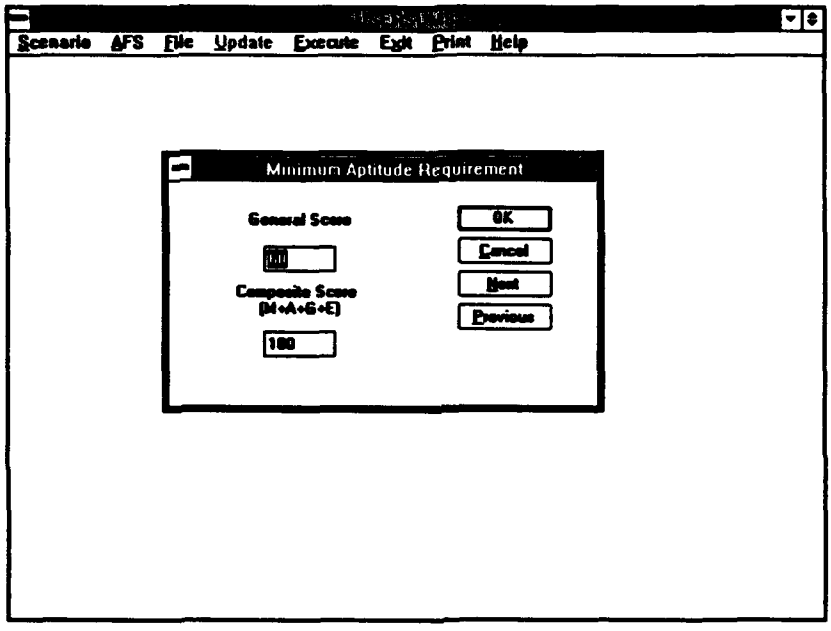

Figure 17. Minimum Aptitude Requirements Screen

The user may specify the minimum General (G) score allowed for any entering accession, as well as the minimum Composite score for any entering accession. The minimum Composite score is the sum of the Mechanical (M), Administrative (A), General (G), and Electronic (E) scores for any applicant (possible scores for each test range between 10 and 99). To change the minimum aptitude requirements, the user must select the appropriate box and enter the new minimum score. The score entered must be an integer number. The user may increase or decrease the requirements within the constraints that the G-score ranges between 10 and 99, and the Composite score ranges between 40 and 396. By default the minimum G-score for entering applicants is 60 and the minimum Composite score is 180.

Parameters: Minimum YOS for Promotion

The **Minimum YOS for Promotion Screen** allows the user to specify the minimum number of years of service (YOS) necessary in a particular grade to be eligible for promotion to the next grade, Figure 18. Only personnel satisfying the YOS requirement will be considered for promotion by the simulation. The minimum YOS for promotion requirement varies only by grade. It does not vary by AFS/Cluster or by projection year.

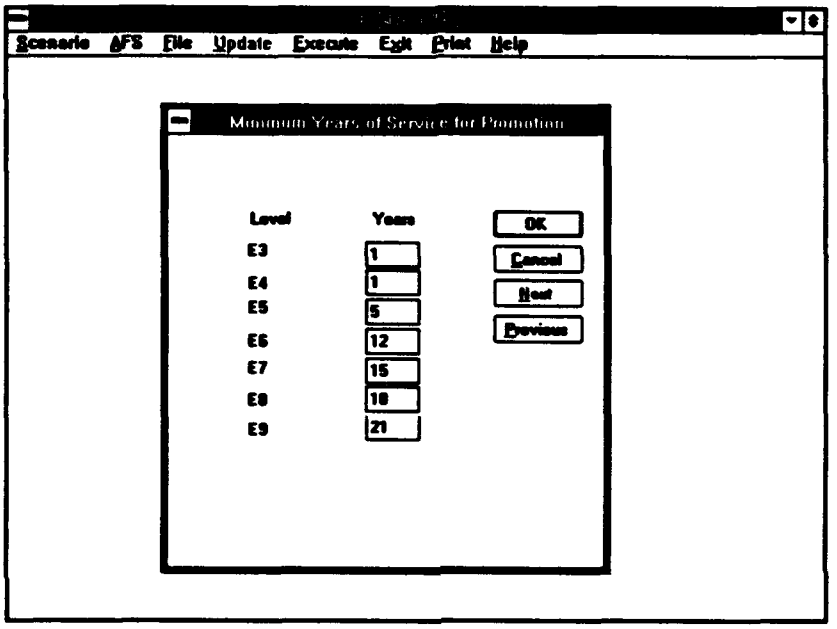

Figure 18. Minimum YOS for Promotion Screen

The user may change any or all of the YOS requirements for promotion. To change the YOS requirements, the user must select the box corresponding to the grade YOS requirement to be changed. The user may then enter the new YOS requirement. The new YOS requirement must be an integer number greater than or equal to zero. By default the minimum YOS for promotion by grade is:

- 1 YOS for promotion from grade E3 to grade E4,
- 5 YOS for promotion from grade E4 to grade E5,
- 12 YOS for promotion from grade E5 to grade E6,
- 15 YOS for promotion from grade E6 to grade E7,
- 18 YOS for promotion from grade E7 to grade E8, and
- 21 YOS for promotion from grade E8 to grade E9.

Average YOS for promotions were obtained from the Air Force Military Personnel Center (AFMPC). Minimum YOS for promotions from grades E1 to E2 and E2 to E3 are assumed to be zero, i.e., these promotions are always assumed to occur within the first YOS determined from the Uniform Airman Records (UAR) file for June of 1990. The minimum default values for promotion to grades E4 to E9 were determined from the average YOS for promotions adjusted for the distribution of grades from the UAR file for June of 1990.

Options: Promotion

The **Promotion Menu** allows the user to select the type of promotion system to be utilized by the simulation, Figure 19. There are two options for the methodology used to promote enlisted personnel listed under the Type of Promotion:

- **Promote to Fill**, and
- **Constant Promotion Rate.**

An explanation of each method of promotion is provided below. To specify the type of promotion to be used in the simulation, the user must select the desired method of promotion. By default the simulation will utilize the **Constant Promotion Rate** method.

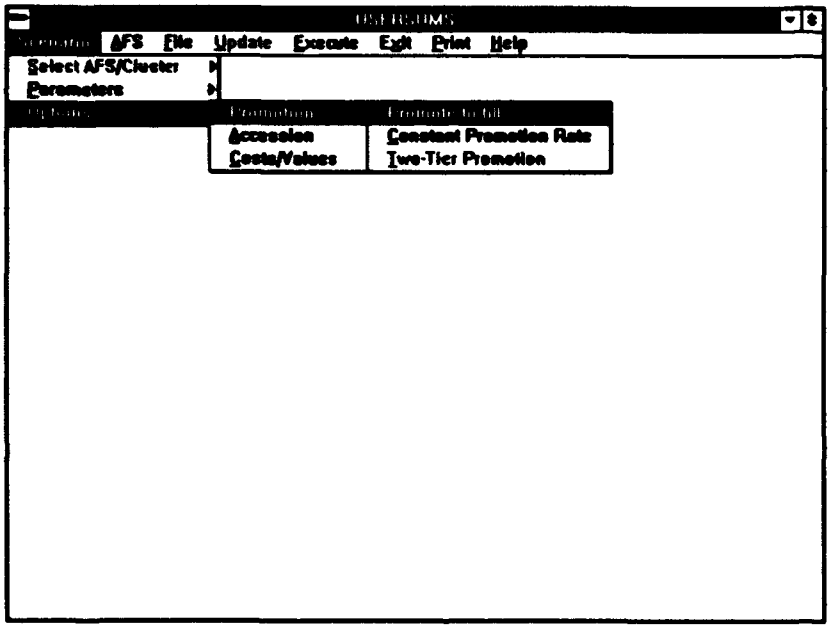

Figure 19. Promotion Menu

Promote to Fill method promotes personnel by AFS at a rate which will fill the openings created by natural attrition within the AFS/Cluster. This rate will vary by AFS/Cluster since the number of openings and the eligible promotion population vary by AFS/Cluster.

Constant Promotion Rate method promotes personnel across all AFSs/Clusters at a single rate. This rate will be the same across AFSs/Clusters by grade. This method does not necessarily insure that all needed promotions within AFSs/Clusters by grade will be met, resulting in potential shortages and overages. The single promotion rate represents the proportion of the total eligible population (sum of all eligible populations across AFSs/Clusters) necessary to fill all openings (sum of all openings across AFSs/Clusters). For example, if 1000 openings exist across AFSs/Clusters and the eligible population across AFSs/Clusters equals 1500, the single promotion rate applied each AFS/Cluster is equal to (1000/1500) or 0.67.

Options: Accession

The **Accession Menu** allows the user to select the methodology for allocating accessions which will be used by the simulation, Figure 20. The user may select from eight accession allocation methodologies:

- **Random Arrival,**
- **Maximize Expected Total Net Return,**
- **Maximize Total Productive Capacity,**
- **Maximize Total Value,**
- **Minimize Total Cost,**
- **Maximize Expected Total Productive Capacity,**
- **Maximize Expected Total Value,** and
- **Minimize Expected Total Cost.**

An explanation of each method of accession allocation is provided below and a more detailed explanation is provided in Appendix C. The user may specify any one of the eight methodologies by selecting that option from the **Accession Menu.** By default the simulation will use the **Maximize Expected Total Net Return** Method.

Random Arrival method uses a random procedure for determining when, and the order in which, applicants from the specified applicant pool become available to be considered as a possible accession. This method attempts to represent the way in which applicants appear at the Military Enlistment Processing Station (MEPS) as a random occurrence. Accessions are allocated to AFSs/Clusters as they randomly arrive at the MEPS on the relative basis of need by each AFS/Cluster, without regard to the aptitude distribution of future applicants.

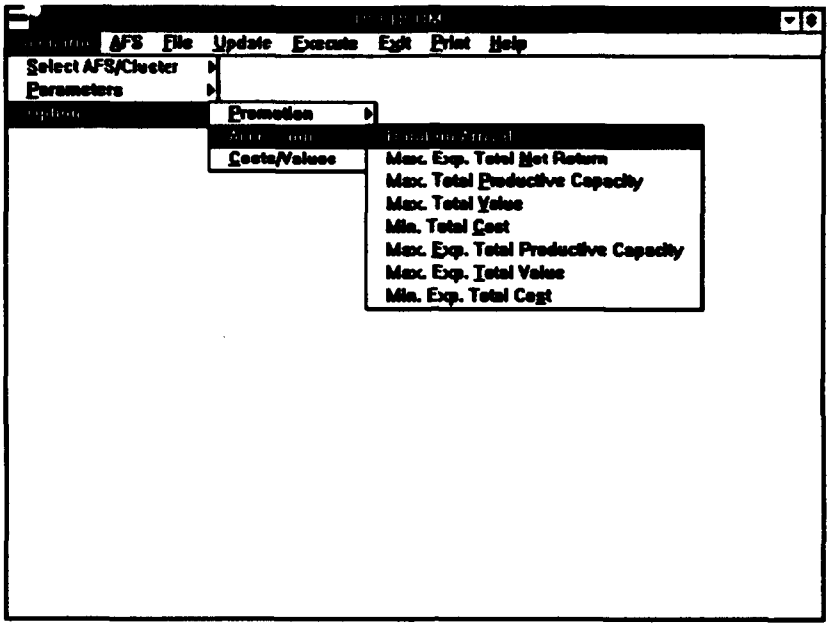

Figure 20. Accession Menu

Maximize Expected Total Net Return method uses the expected net return calculated for each aptitude cell (of the eligible applicant pool) for each AFS/Cluster to allocate accessions in order to maximize total system expected net return for each projection year. Total system expected net return is equal to the sum of expected net return across accessions across AFSs. The discount rate and horizon specified at the **Discount Rate/Horizon Screen** will be used in the calculation of expected net return. Expected net return is equal to the expected present discounted value of the flow of accruable value to the Air Force, net of cost, from an applicant entering a particular AFS/Cluster projected over a given horizon (Stone et al., 1992). The expected component of the expected net return calculation is derived from accounting for the probability of continuation from one YOS to the next over the given horizon.

Maximize Total Productive Capacity method uses the productive capacity calculated for each aptitude cell (of the eligible applicant pool) for each AFS/Cluster to allocate accessions in order to maximize total system productive capacity for each projection year. The productive capacity for an applicant is equal to the sum of the productive capacity to be accrued each year over a given horizon by entering a particular AFS/Cluster (Stone et al., 1992).

Maximize Total Value method uses the total value calculated for each aptitude cell (of the eligible applicant pool) for each AFS/Cluster to allocate accessions in order to maximize total system value for each projection year. The discount rate and horizon specified at the **Discount Rate/Horizon Screen** will be used in the calculation of total value. The total value for an applicant is equal to the discounted present value of the flow of value (or worth) to be accrued from each year service over a given horizon by entering a particular AFS/Cluster.

Minimize Total Cost method uses the total cost calculated for each aptitude cell (of the eligible applicant pool) for each AFS/Cluster to allocate accessions in order to minimize total system cost for each projection year. The discount rate and horizon specified at the **Discount Rate/Horizon Screen** will be used in the calculation of total cost. The total cost for an applicant is equal to the discounted present value of the flow of cost to be accrued from each year of service over a given horizon by entering a particular AFS/Cluster.

Maximize Expected Total Productive Capacity method uses the expected productive capacity calculated for each aptitude cell (of the eligible applicant pool) for each AFS/Cluster to allocate accessions in order to maximize total system expected productive capacity for each projection year. The total expected productive capacity for an applicant is equal to the sum of the expected productive capacity to be accrued over a given horizon by entering a particular AFS/Cluster. Expected productive capacity equals the product of the probability of remaining in service through the *n*th YOS times the productive capacity of the individual in the *n*th YOS (Stone et al., 1992).

Maximize Expected Total Value method uses the expected total value calculated for each aptitude cell (of the eligible applicant pool) for each AFS/Cluster to allocate accessions in order to maximize total system expected value for each projection year. The discount rate and horizon specified at the **Discount Rate/Horizon Screen** will be used in the calculation of the flow of expected value. The total expected value for an applicant is equal to the present discounted expected value of the flow of value (or worth) to be accrued from each year service over a given horizon by entering a particular AFS/Cluster. Expected value equals the product of the probability of remaining in service through the *n*th YOS times the value of the individual in the *n*th YOS.

Minimize Expected Total Cost method uses the expected total cost calculated for each aptitude cell (of the eligible applicant pool) for each AFS/Cluster to allocate accessions in order to minimize total expected system cost for each projection year. The discount rate and horizon specified at the **Discount Rate/Horizon Screen** will be used in the calculation of expected cost. The total expected cost for an applicant is equal to the present discounted expected value of the flow of cost to be accrued from each year service over a given horizon by entering a

particular AFS/Cluster. Expected cost for the *n*th YOS equals the product of the probability of remaining in service through the *n*th YOS times the cost of the individual in the *n*th YOS.

Options: Costs/Values

The **Costs/Values Menu** will allow the user to access the screens which provide the ability to specify the percentage change expected to occur in costs and values in each projection year of the simulation. Actual costs and values vary by AFS/Cluster, Figure 21. The percentage changes in these costs/values vary only by year of projection, and not by AFS/Cluster. The user may specify the percentage change in the following costs/values:

- **Separation Costs,**
- **Regular Military Compensation (RMC) Costs,**
- **Basic Military Training (BMT) Costs,**
- **On-the-Job Training (OJT) Costs,**
- **Technical Training (Trng) Costs,** and
- **Service State Values.**

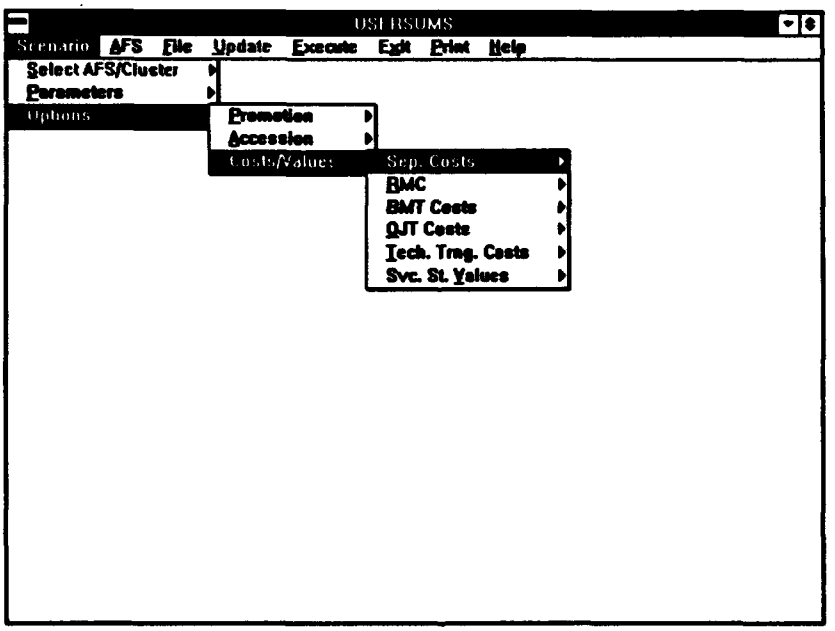

Figure 21. Costs/Values Menu

To view or revise the percentage change in any of these costs/values, the user must select the appropriate cost/value from the menu shown in Figure 21. The specific cost/value menu for that cost/value selected will then appear. Figure 22 shows an example of this type of menu for the parameter service state value, which will be the same for any cost/value selected. At this menu, the user may choose either to vary the percentage change by projection year or to set the percentage change the same across all projection years.

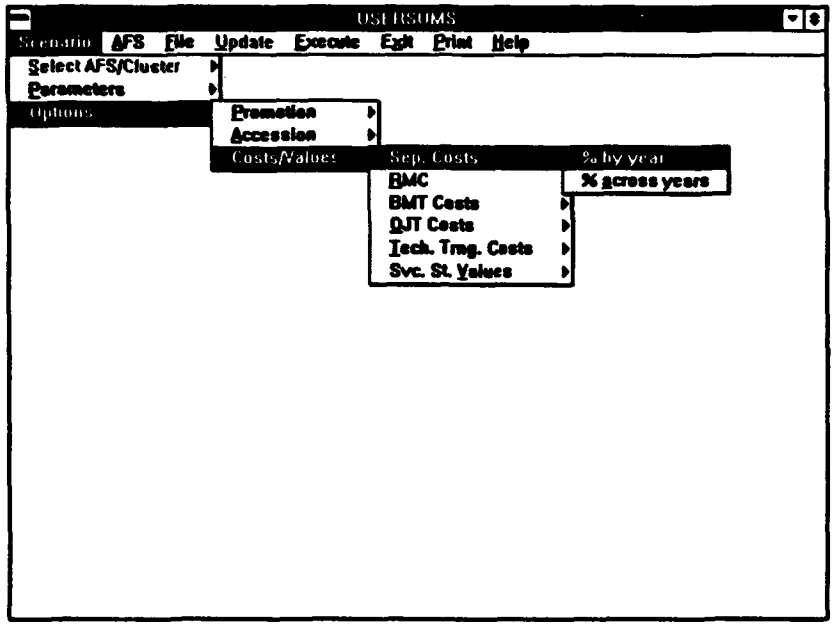

Figure 22. Costs/Values Menu: By or Across Years

To vary the percentage change by year, the user must select the **% By Year** option (Figure 22). The next screen to appear will display the values for the selected cost/value parameter by projection year. An example of this type of screen is shown in Figure 23 for the parameter service state value. The number of projection years shown at this screen will correspond to the number of projection years specified at the **Projection Period Screen**. By selecting the box for the appropriate projection year and entering the percentage change, the user may vary the percentage change in the cost/value by projection year.

To specify a percentage change across all years, the user must select the **% Across Years** option (Figure 22). At the next screen to appear, the user may then enter the new percentage change. An example of this type of screen is shown in Figure 24 for the parameter service state value.

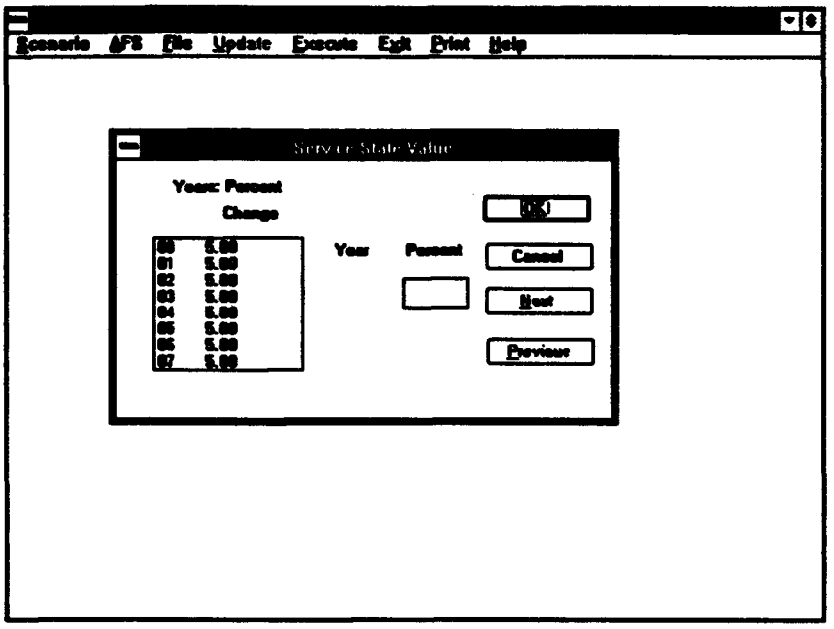

Figure 23. Service State Values Screen: By Year

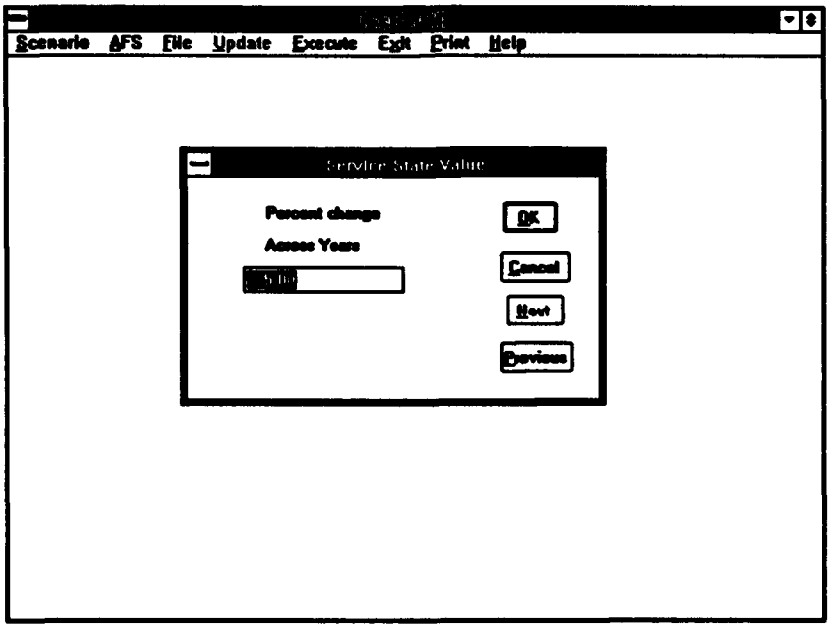

Figure 24. Service State Values Screen: Across Years

The percentage changes entered may reflect an increase or decrease in costs/values. An increase will be entered as a positive percentage and a decrease will be entered as a negative (-)

percentage. By default the simulation assumes the following percentage changes for all projection years.

- Separation Costs +2.5%,
- RMC +4.1%,
- BMT Costs +2.5%,
- OJT Costs +2.5%,
- Technical Trng Costs +2.5%, and
- Service State Values +5.0%.

Percentage increases for Separation, BMT, OJT, and Technical Training costs were taken from the FY90 Air Training Command (ATC) Cost Factors Manual. The percentage increase in RMC uses the authorized January 1991 increase in RMC (Enlisted Retention Report of 30 June 1990). The increase in service state values was assumed to follow the average increase in the earnings and compensation over the last 1979 to 1989 time period (Statistical Abstract of the United States, 1990).

AFS

The **AFS Menu**, shown in Figure 25, allows the user to specify AFS/Cluster parameters which are AFS/Cluster specific. The following parameters may be accessed from this menu:

- **Minimum Manning Requirements,**
- **Minimum Selector AI Requirements,**
- **Manning Requirements, and**
- **Maximum Force-out Requirements.**

The user may set the parameters only for the AFSs/Clusters specified in the population for SUMS. If the user does not access the **AFS Menu**, the simulation will use default values for all AFS/Cluster specific parameters (see Appendix B for default parameters).

Minimum Manning Requirements

The **Minimum Manning Requirements Menu**, shown in Figure 26, allows the user to set the minimum manning requirements by AFS/Cluster. Minimum manning requirements insure that each AFS/Cluster is able, at least partially, to meet its desired accession goals. Accessions are allocated to insure that minimum manning requirements for each AFS/Cluster are met based on the AFS/Cluster-specific demand for accessions and the availability of accessions to meet the minimum manning levels across AFSs/Clusters. These minimum manning requirements will be satisfied first by the simulation. The accession allocation methodology selected by the user on the **Accession Menu** will be used to allocate accessions subject to meeting the minimum manning requirements. Once the minimum manning

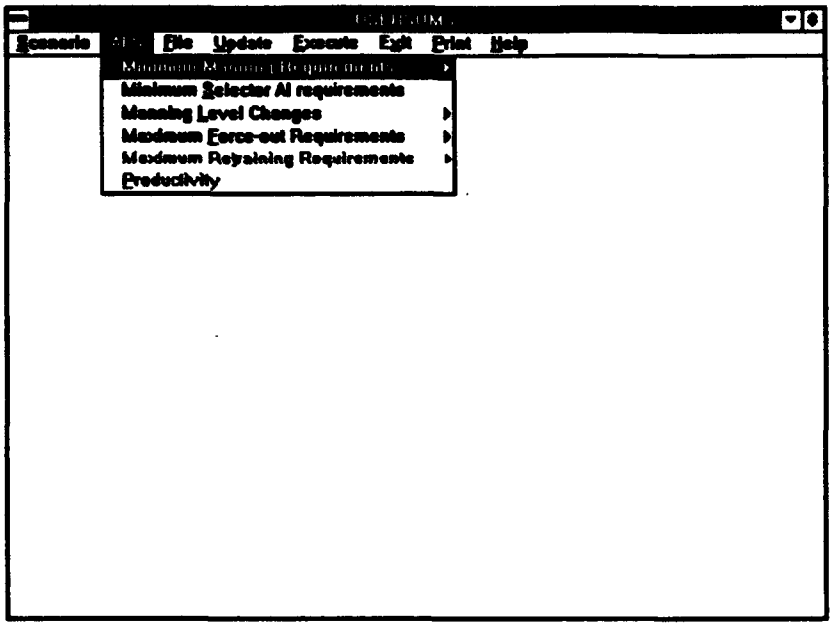

Figure 25. AFS Menu

requirements are satisfied, the residual applicant pool, if existing, will then be allocated using the unconstrained accession allocation methodology.

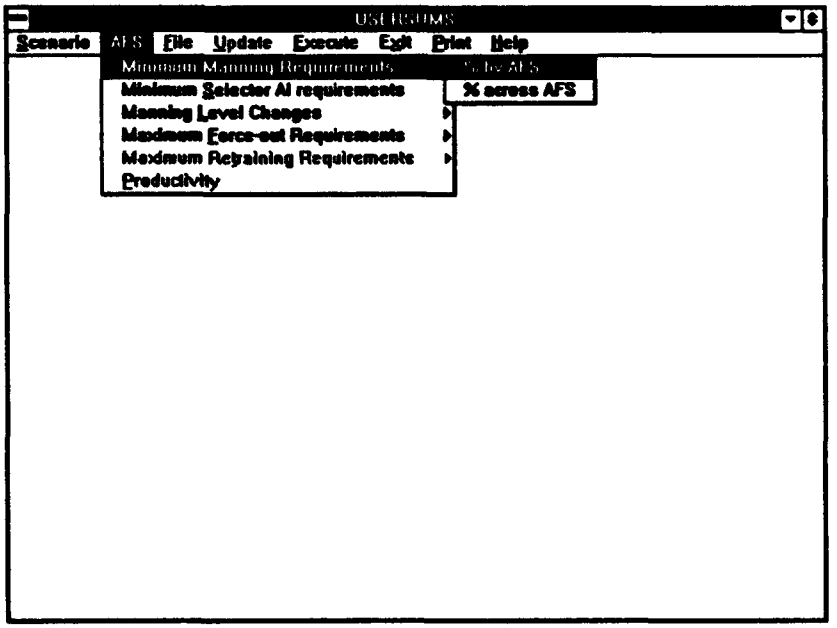

Figure 26. Minimum Manning Requirements: By or Across AFSs

Minimum manning requirements may vary by AFS/Cluster or may be set across AFSs/Clusters as displayed by the menu in Figure 26. To specify minimum manning requirements which vary by AFS/Cluster, the user must select the **% by AFS** option, and then at the next screen, shown in Figure 27, choose the appropriate AFS/Cluster and enter the new percent required for that AFS/Cluster. To change the minimum manning requirements across all AFSs/Clusters, the user must select the **% Across AFS** option. The screen in Figure 28 will then appear and from this screen the user may enter the new percent required. This will set the minimum manning requirements at that percentage across **all** AFSs/Clusters. This percentage must range between 0% and 100%. By default, minimum manning requirements are set at 100% across all AFSs/Clusters.

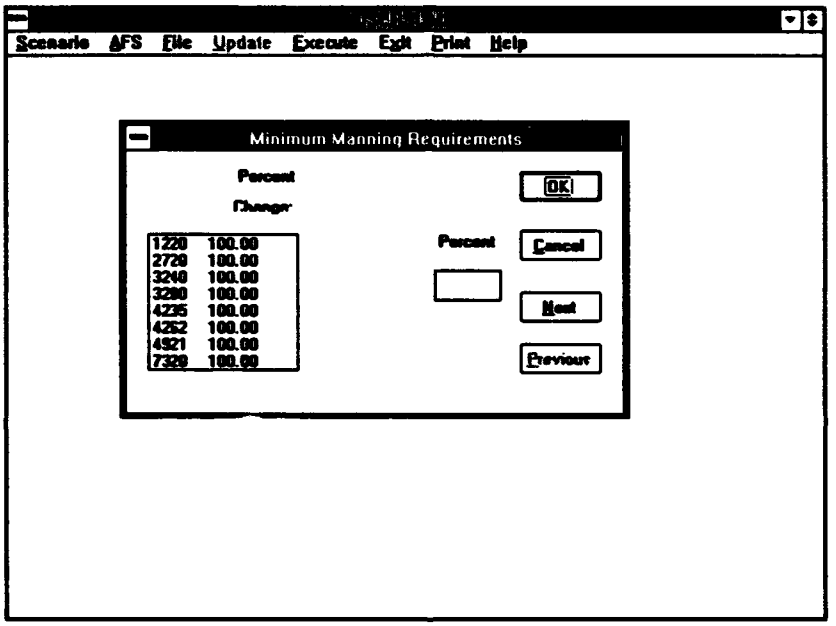

Figure 27. Min. Manning Requirements Screen: By AFS

Minimum Selector AI Requirements

The **Minimum Selector AI Requirements Screen**, shown in Figure 29, allows the user to specify the Minimum Selector Aptitude Index (AI) score for each AFS/Cluster of any entering accession. Only applicants meeting the minimum Selector AI for any AFS/Cluster will be considered as possible entering accessions for that AFS/Cluster by the simulation. The user may specify both the Selector AI for any AFS/Cluster and the minimum score for that Selector AI

for any entering accession. The minimum Selector AI requirements do not vary by projection year. The user may select between four Selector AIs:

- Mechanical (M),
- Administrative (A),
- General (G), and
- Electronic (E).

Scores for the Selector AIs may range between 10 and 99. The screen as shown in Figure 29 will display the default Selector AIs and minimum scores for the AFSs/Clusters specified by the user on the Select AFSs/Clusters screen. To change any Selector AI or its minimum score, the user must first select that AFS/Cluster from the box or enter the number of the AFS. The user may then enter the new Selector AI, or the new minimum score, or both.

SUMS will ignore a Selector AI requirement for a particular AFS/Cluster if the restriction is below the overall minimum aptitude requirement specified by the user on the **Minimum Aptitude Requirements Screen** from the **Scenario Menu**. For example, if the user had specified a minimum G-score of 60 for accessions at the **Minimum Aptitude Requirements Screen**, and then specified a minimum Selector AI of G-30 for any AFS/Cluster, the minimum

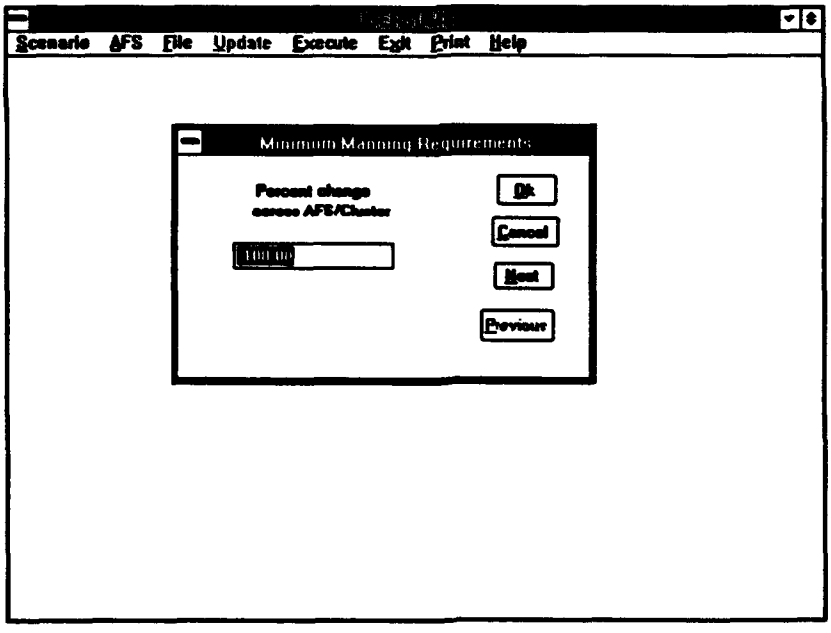

Figure 28. Minimum Manning Requirements Screen: Across AFSs

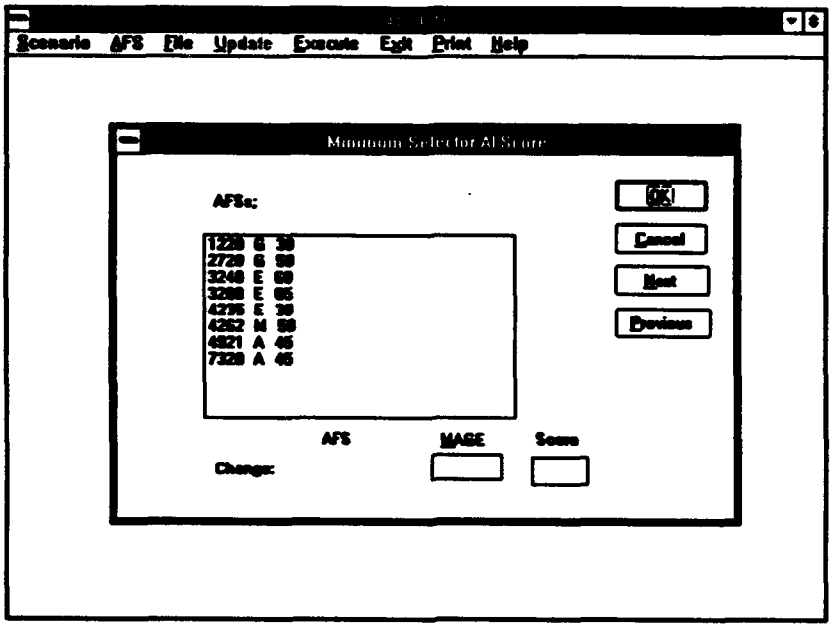

Figure 29. Minimum Selector AI Requirements Screen

Selector AI for that AFS/Cluster would be ignored by SUMS. By establishing a minimum entrance score of G-60, SUMS has eliminated all applicants from the pool with a G-score of less than 60. This effectively sets a minimum Selector AI for all AFSs/Clusters of G-60. Thus, specifying a minimum Selector AI of G-30 would be ineffective since any applicant with a score less than 60 had already been removed from the pool. The individual AFS/cluster aptitude restrictions must be above the overall minimums to be effective.

Manning Level Changes

The **Manning Level Changes Menu**, shown in Figure 30, allows the user to specify the percent change in manning levels by AFS/Cluster and by projection year. Manning levels represent the number of personnel required in each grade for each AFS/Cluster. For example, a 5% increase in the manning level for a particular AFS/Cluster will increase the maximum size of the inventory possible in that AFS/Cluster by 5%. Changes in manning levels may be specified by or across projection years, and by or across AFSs/Clusters. This gives the user four possible options for changing the minimum manning levels:

- **By AFS, By Year**
- **By AFS, Across Years**
- **Across AFSs, By Year**
- **Across AFSs, Across Years**

By default, a 0.00% change in manning level changes is assumed in the option across projection years, across all AFSs/Clusters. The specified percentage changes may reflect an increase or decrease in manning levels. An increase in inventories will be entered by the user as a positive percentage and a decrease will be entered as a negative (-) percentage.

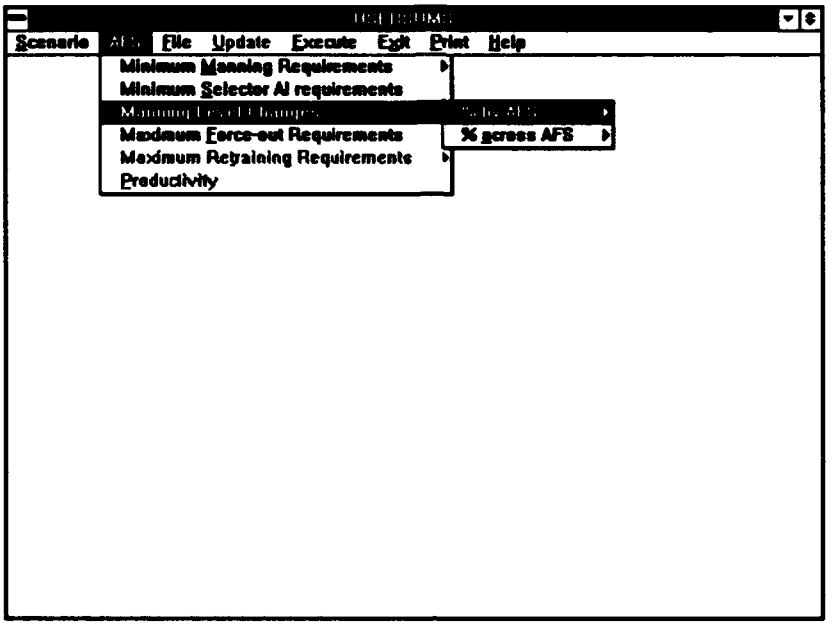

Figure 30. Manning Level Changes Menu: By or Across AFSs

To vary manning level changes **By AFS, By Year**, the user must select the **% by AFS** option (Figure 30). Next the user must select the **% by Year** option (Figure 31). At the next screen to appear (Figure 32), the user may then enter the new percent changes for each AFS for each projection year. These percentage changes may vary by AFSs/Clusters and by projection years.

To vary manning level changes **By AFS, Across Years**, the user must select the **% by AFS** option (Figure 30). Next the user must select the **% Across Year** option (Figure 31). At the next screen to appear (Figure 33), the user may then enter the percent changes for each AFS across all projection years. These percentage changes may vary only by AFSs/Clusters and not by projection years.

To vary manning level changes **Across AFSs, By Year**, the user must select the **% Across AFSs** option (Figure 30). Next the user must select the **% by Year** option (Figure 31). At the next screen to appear (Figure 34), the user may then enter the percent changes by

projection year. These percentage changes may vary only by projection year and not by AFS/Cluster.

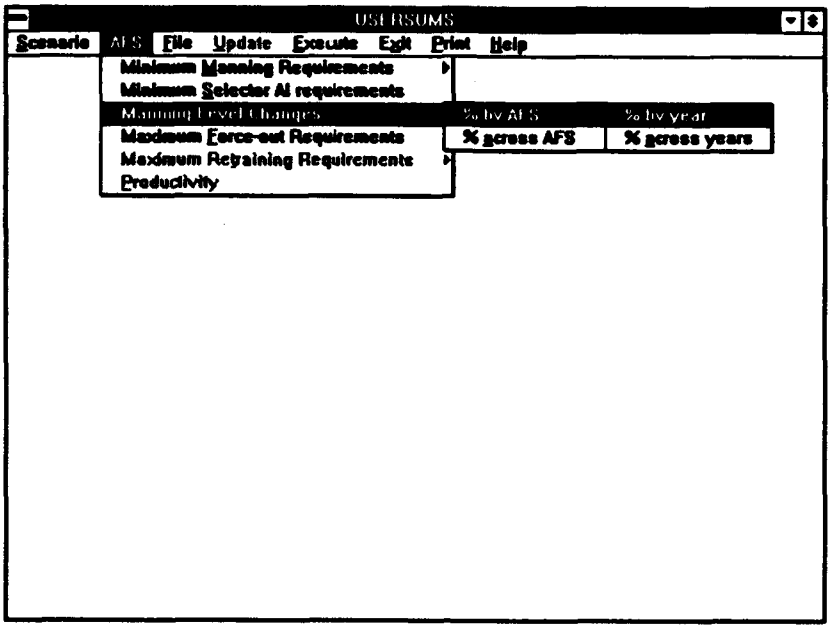

Figure 31. Manning Level Changes Menu: By or Across AFSs, By or Across Years

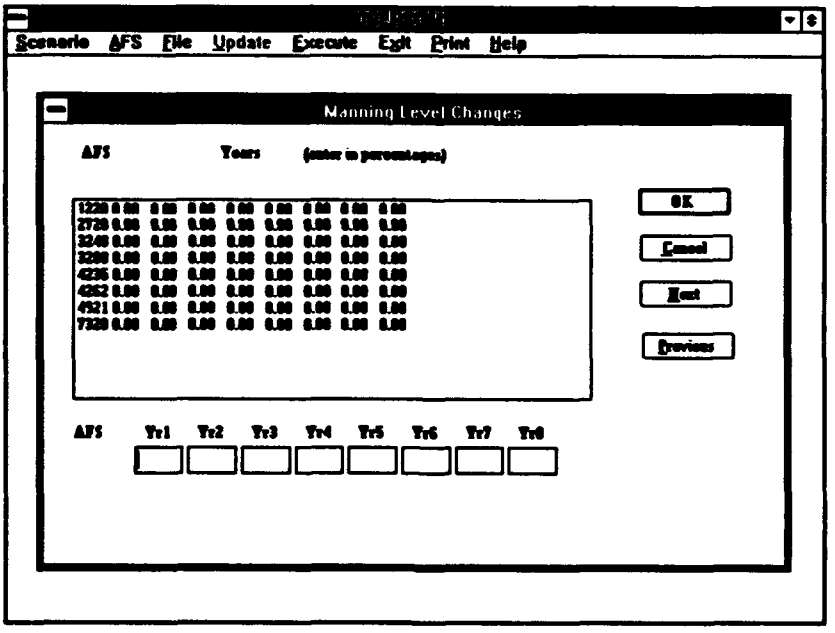

Figure 32. Manning Level Changes Screen: By AFS, By Year

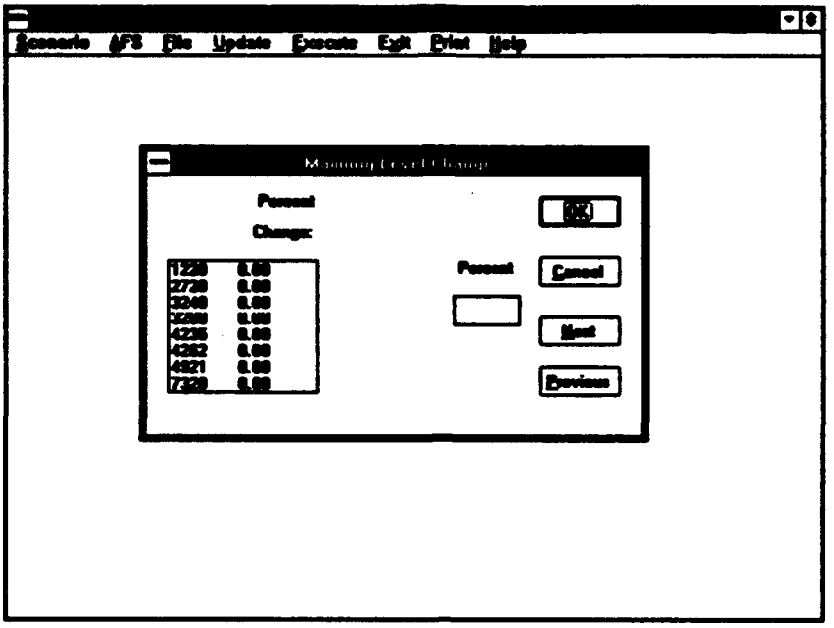

Figure 33. Manning Level Changes Screen: By AFS, Across Years

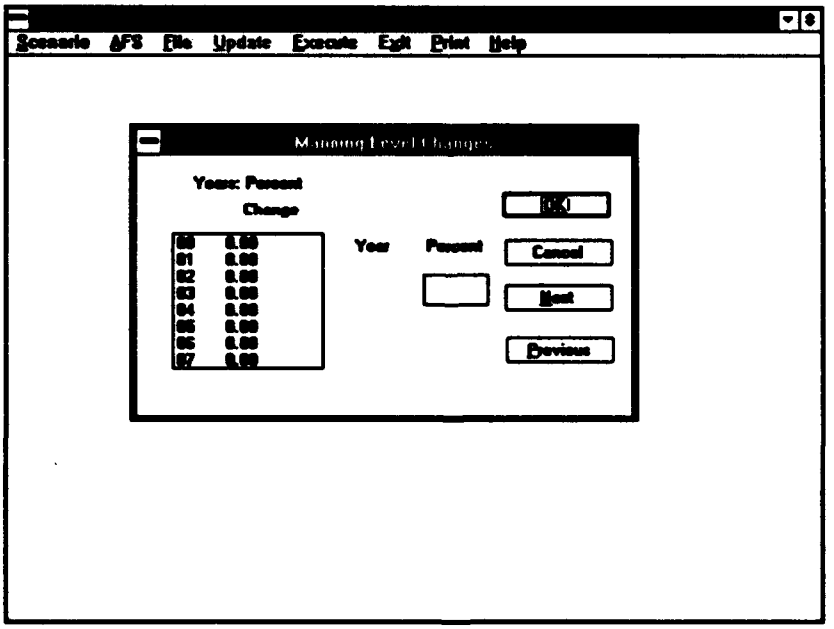

Figure 34. Manning Level Changes Screen: Across AFSs, By Year

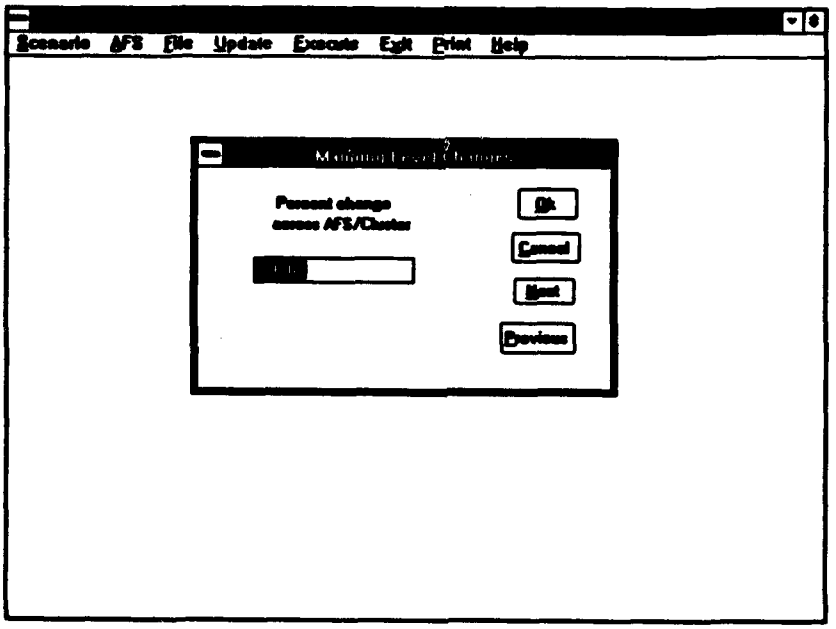

Figure 35. Manning Level Changes Screen: Across AFSs, Across Years

To vary manning level changes Across AFSs, Across Years, the user must select the **% Across AFSs** option (Figure 30). Next the user must select the **% Across Years** option (Figure 31). At the next screen to appear (Figure 35), the user may then enter the change in manning level changes for all years, for all AFSs/Clusters. This percentage may not vary by projection year or by AFS/Cluster.

Maximum Force-out Requirements

The **Maximum Force-out Requirements Menu**, shown in Figure 36, allows the user to specify the maximum proportion of an overage which will be forced-out, if force-outs are required to meet set manning levels by grade by AFS/Cluster or across AFSs/Clusters by projection year. The user has four possible options for changing the maximum force-out requirements:

- **By AFS, By Year**
- **By AFS, Across Years**
- **Across AFSs, By Year**
- **Across AFSs, Across Years**

By default, maximum force-out requirements are set at 100.00% across all projection years across all AFSs/Clusters. The percentage must range between 0.00% and 100.00%.

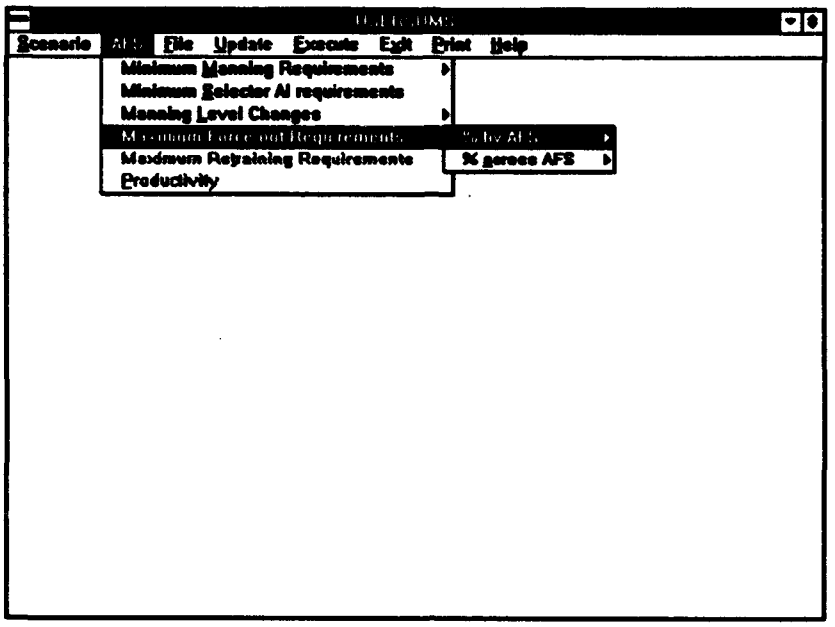

Figure 36. Maximum Force-out Requirements: By AFS or Across AFSs

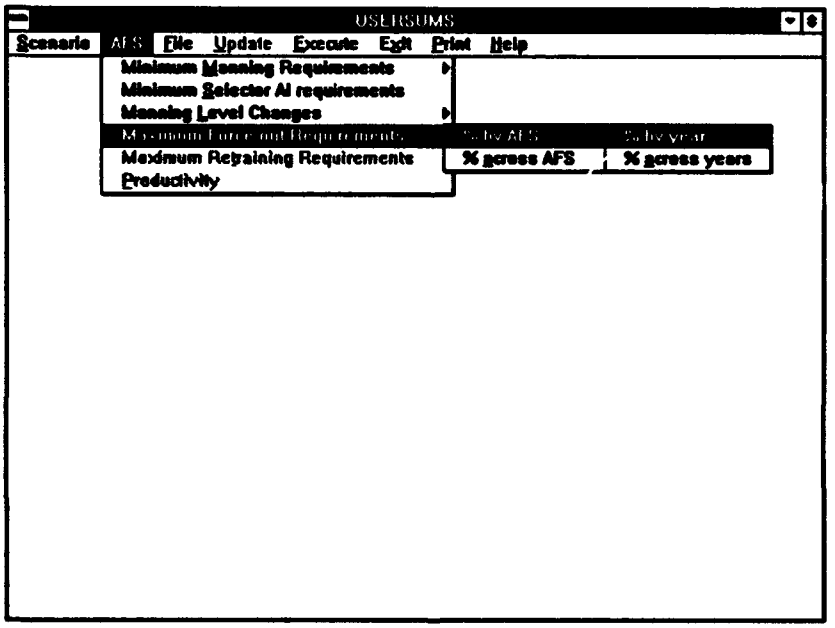

Figure 37. Maximum Force-out Requirements: By or Across AFSs, By or Across Years

To vary the maximum force-out requirements **By AFS, By Year**, the user must select the **% by AFS** option (Figure 36). Next the user must select the **% by Year** option (Figure 37). At the next screen to appear (Figure 38), the user may then enter the new percent force-out requirements for each AFS for each projection year. These percentage requirements may vary by AFSs/Clusters and by projection years.

To vary the maximum force-out requirements **By AFS, Across Years**, the user must select the **% by AFS** option (Figure 36). Next the user must select the **% Across Year** option (Figure 37). At the next screen to appear (Figure 39), the user may then enter the percent force-out requirements for each AFS/Cluster across all projection years. These percentage requirements may vary only by AFS/Cluster and not by projection years.

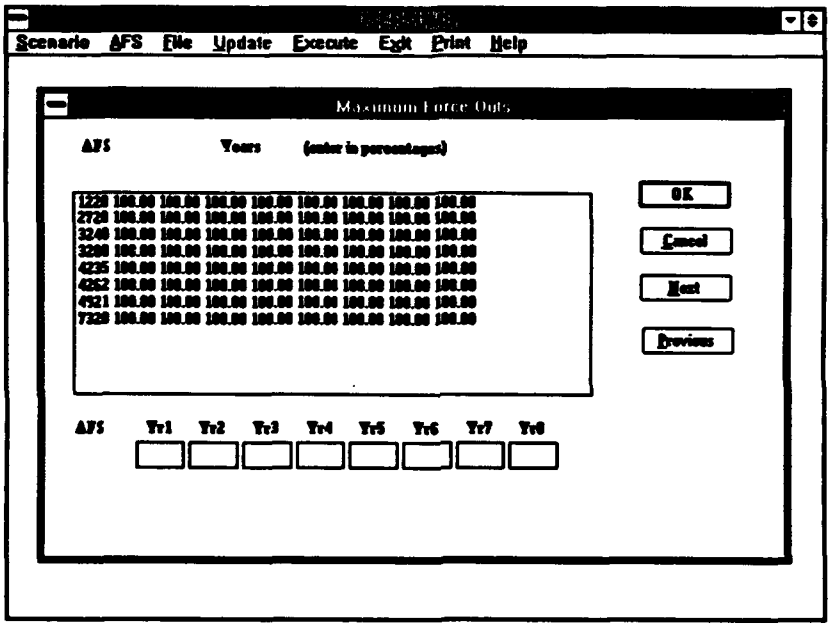

Figure 38. Maximum Force-out Requirements Screen: By AFS, By Year

To vary the maximum force-out requirements **Across AFSs, By Year**, the user must select the **% Across AFSs** option (Figure 36). Next the user must select the **% by Year** option (Figure 37). At the next screen to appear (Figure 40), the user may then enter the percent force-out requirements by projection year. These percentage requirements may vary only by projection year and not by AFS/Cluster.

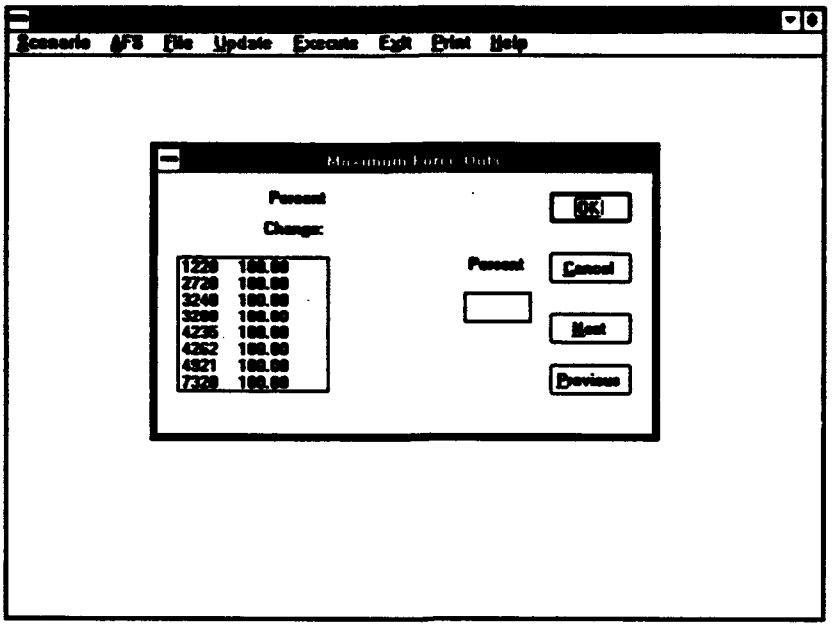

Figure 39. Maximum Force-out Requirements Screen: By AFS, Across Years

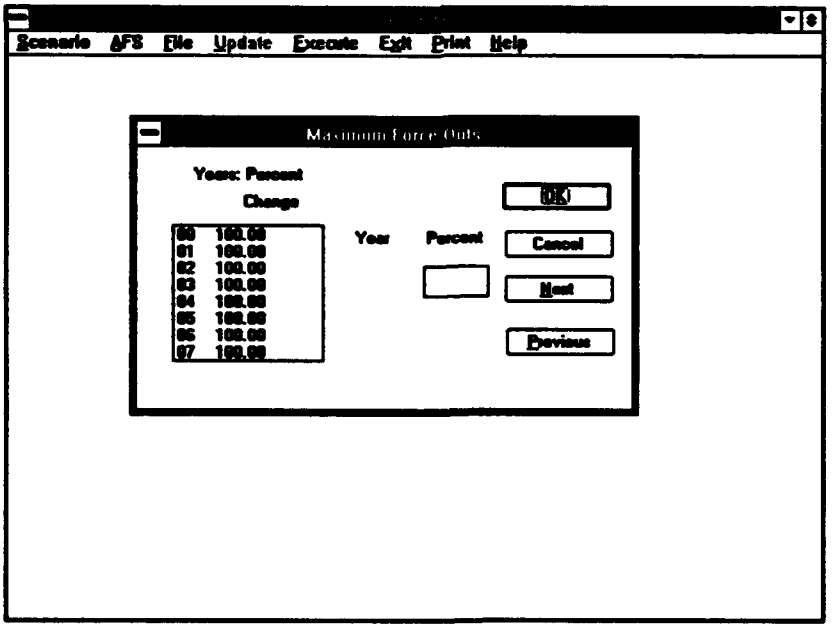

Figure 40. Maximum Force-out Requirements Screen: Across AFSs, By Year

To vary the maximum force-out requirements Across AFSs, Across Years, the user must select the **% Across AFSs** option (Figure 36). Next the user must select the **% Across Years** option (Figure 37). At the next screen to appear (Figure 41), the user may then enter the change in force-out requirements for all years, for all AFSs/Clusters. This percentage requirement may not vary by projection year or by AFS/Cluster.

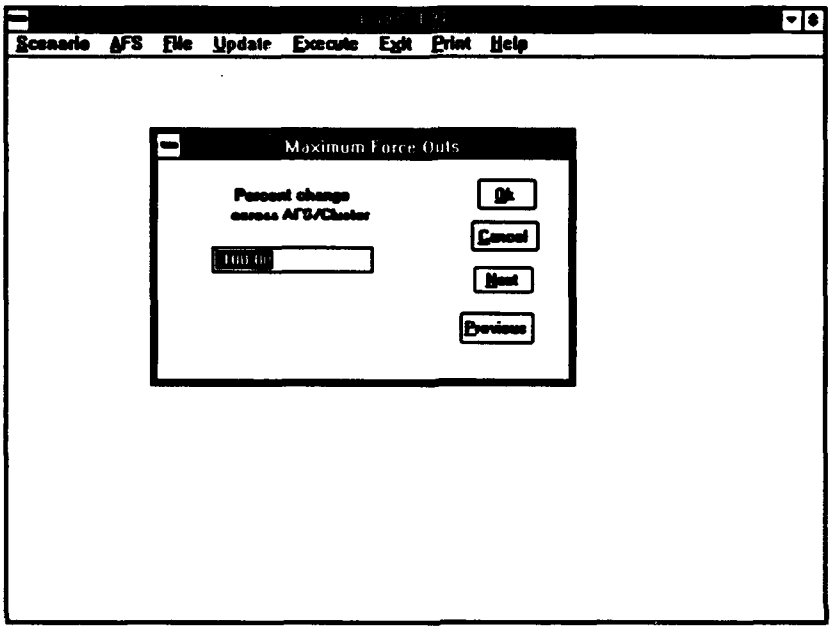

Figure 41. Maximum Force-out Requirements Screen: Across AFSs, Across Years

FILE

The **File Menu**, shown in Figure 42, allows the user to specify the name of the output file for the execution of SUMS. The option available under the **File Menu** is **Output File Name**. By selecting the **Output File Name** option, the user may specify the new output file name. To enter a new file name (Figure 43), the user clicks on the **Output File Name** box and then enters the new file name. When the user executes the simulation, the output from the simulation will be directed to this file. Appendix E contains a sample output file.

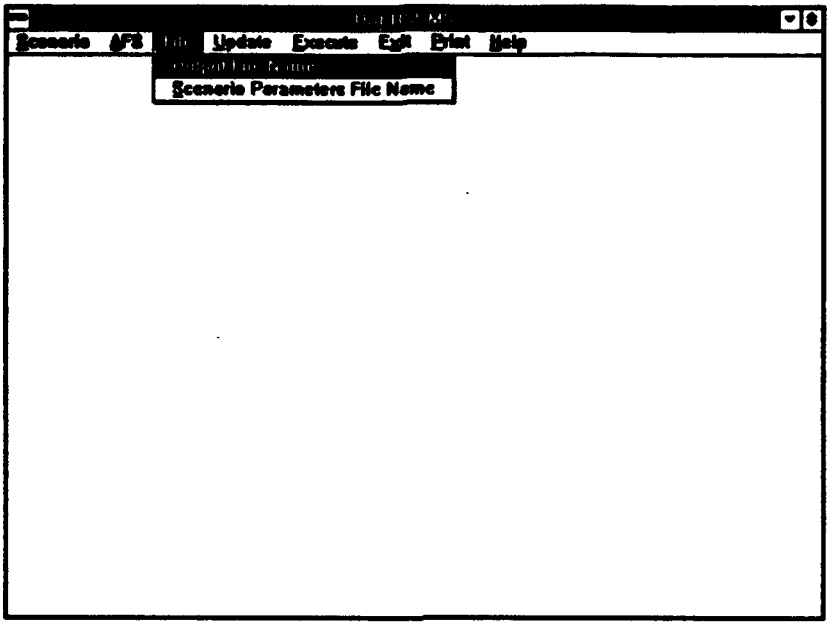

Figure 42. File Menu

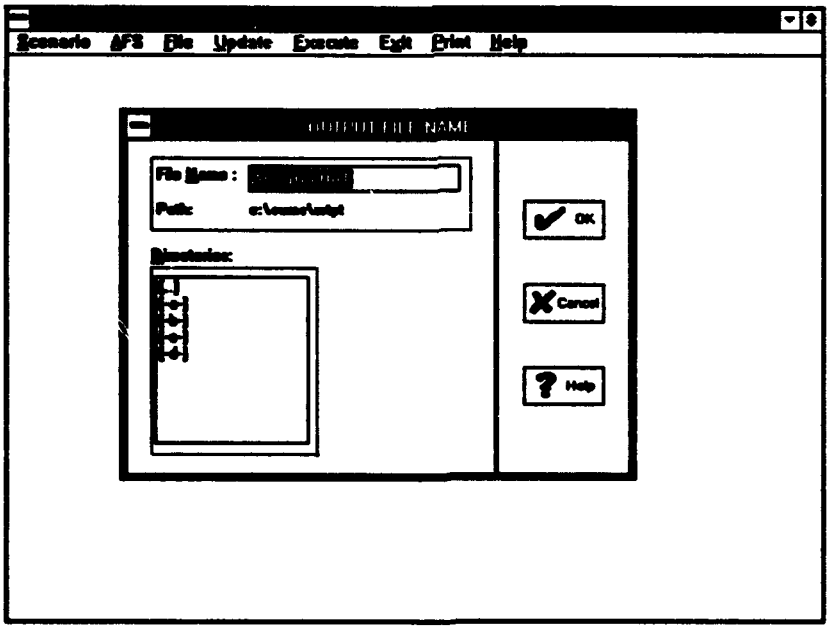

Figure 43. Output File Name Screen

EXECUTE

The **Execute Menu**, shown in Figure 44, will allow the user to execute a simulation in SUMS. This menu allows the user two options:

- **Run and Retain Parameters** and
- **Run and Restart.**

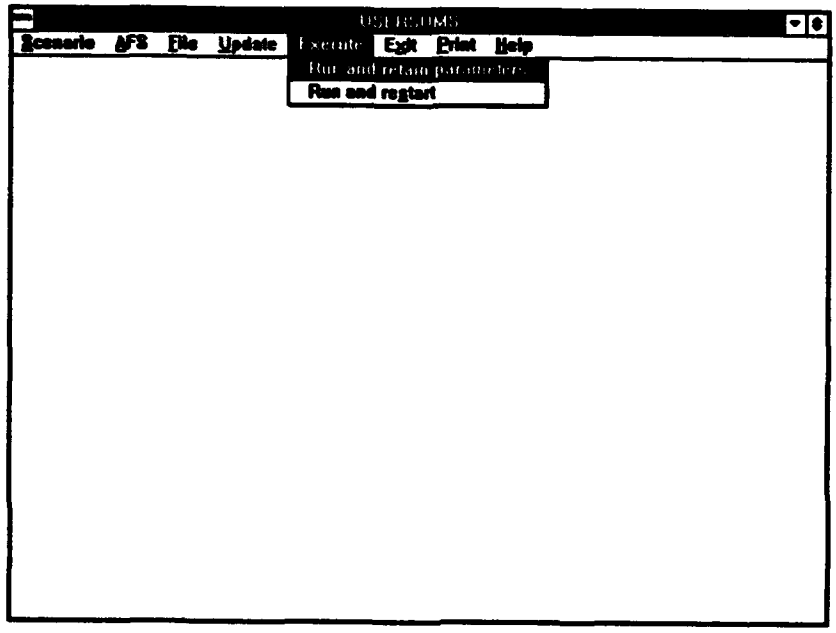

Figure 44. Execute Menu

If the user selects the **Run and Retain Parameters** option, SUMS will execute the simulation and direct the output from that simulation to the output file specified under the **Output File Name** option. Once the simulation is complete, SUMS will return the user to the **SUMS Main Menu Screen** (Figure 1). The population and all parameters and options will be those specified by the user before executing the simulation. The user once again has access to any of the menus in SUMS.

If the user selects the **Run and Restart** option, SUMS will execute the simulation and direct the output from that simulation to the output file specified under the **Output File Name** option. Once the simulation is complete, SUMS will return the user to the **SUMS Menu Screen**

shown in Figure 2. The population and parameter changes specified by the user will not be retained in SUMS if the user selects this option. The user must define a new population at the **Scenario Menu** shown in Figure 7. By selecting the **File Menu**, the user may specify the output file name of the simulation executed using the **Run and Restart** option. The user may then print that output using the **Print Menu**.

EXIT

The **Exit Menu**, shown in Figure 45, allows the user to end the session and exit SUMS to Windows.

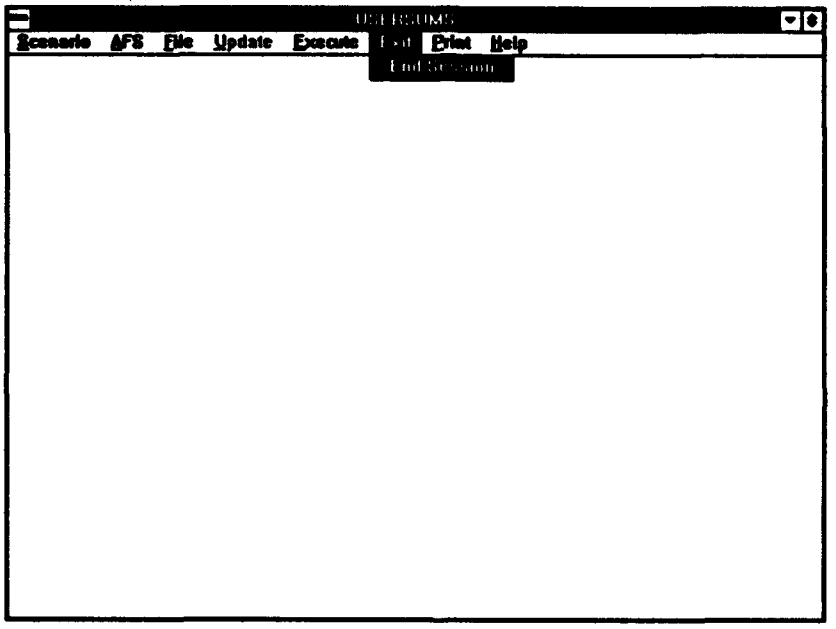

Figure 45. Exit Menu

PRINT

The **Print Menu**, shown in Figure 46, allows the user to print the output of an executed simulation. The file to be printed will be the file specified on the **Output File Name Screen** (Figure 43). The user may also view an output file from this menu. Appendix E contains a sample output file.

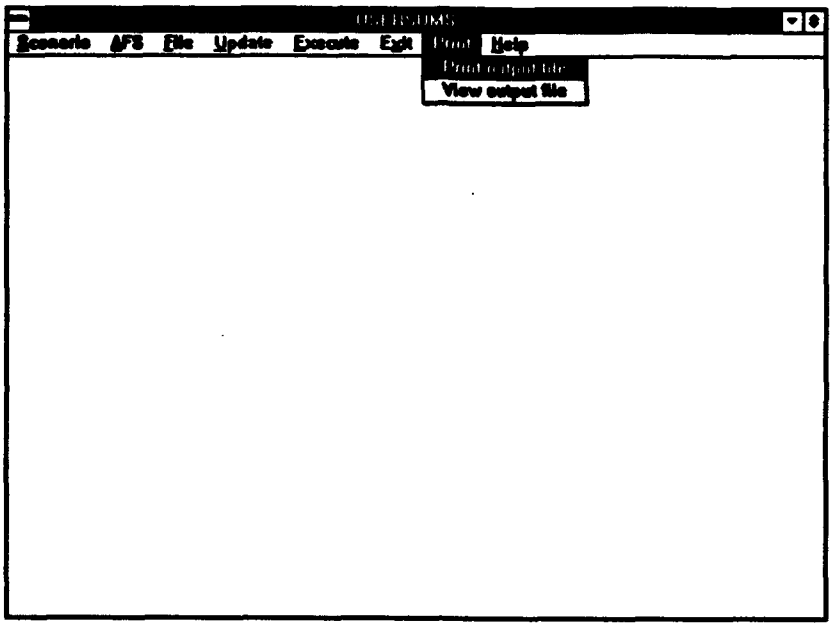

Figure 46. Print Menu

HELP

This menu, shown in Figure 47, will provide the user with information about operating within Windows.

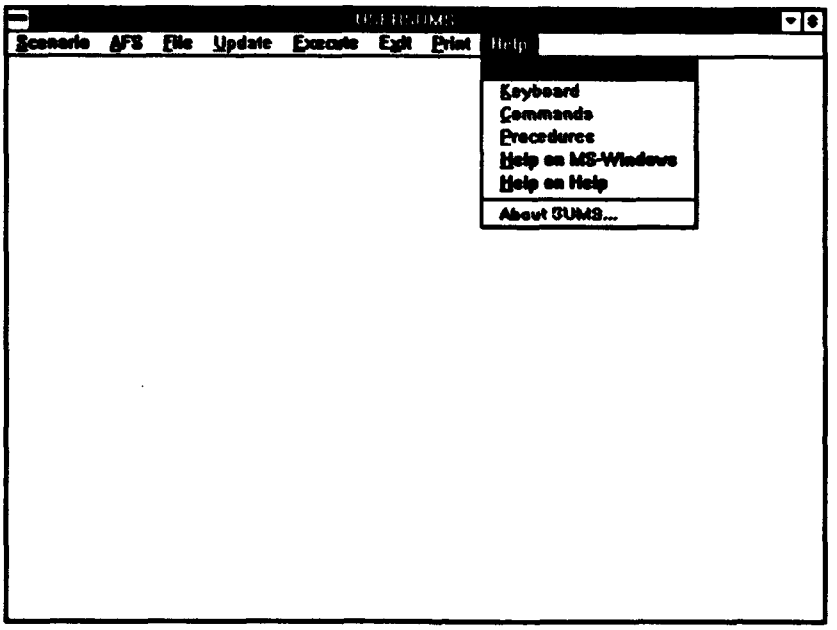

Figure 47. Help Menu

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APPENDIX A

Definition of Clusters

This appendix describes the methodologies used to create the two Clusters of AFSs available. The tables of Clusters that follow include listings of all AFSs included in each cluster, the Selector AI for each Cluster, and the minimum aptitude score for each Cluster.

MAGE Cluster

The following clusters are based on the minimum selector AI score, M, A, G, or E, required for admittance into the AFS. The clusters are comprised of those AFSs with the same designated aptitude requirements, M, A, G, or E, and similar minimum score requirements. For example, cluster 1 is comprised of those AFSs with a minimum mechanical (M) score requirement between 61 and 57, while cluster 2 includes those AFSs with a minimum mechanical (M) score requirement between 51 and 50. The range of scores within a cluster is arbitrary and could be larger or smaller depending on whether more or fewer clusters are desired. Other factors to be considered are the actual differences of the AFSs included in a cluster, as well as the difficulty of constructing parameters of the cluster to be used in SUMS. This methodology results in 20 clusters of AFSs.

Cluster No.	AFS	AI	Score	Description
(1)	454x2	M	58	Aircrew Egress Systems Mechanic
	454x4			Aircraft Pneudraulic Systems
	457x1			Helicopter Maintenance
	463x0			Nuclear Weapons
	472x3			Vehicle Body Mechanic
	753x1			Gunsmith
(2)	361x0	M	51	Antenna Systems Installation/Maintenance
	361x1			Communication Cable Systems Installation/Maintenance
	411x1			Missile Maintenance
	452x4			Tactical Aircraft Maintenance
	454x0			Aerospace Propulsion
	454x3			Aircraft Fuel Systems
	457x0			Strategic Aircraft Maintenance
	457x2			Airlift Aircraft Maintenance
	458x0			Aircraft Metals Technology
	458x2			Aircraft Structural Maintenance
	472x0			Special Purpose Vehicle & Equipment Mechanic
	472x2			General Purpose Vehicle Mechanic
	545x1			Liquid Fuel Systems Maintenance
	552x0			Structural
	552x5			Plumbing

(3)	458x3	M	44	Fabrication & Parachute
	472x1			Special Vehicle Mechanic
	551x0			Pavements Maintenance
	551x1			Construction Equipment
	552x2			Metal Fabricating
	566x1			Environmental Support
	591x0			Seaman
	591x1			Marine Engine
	603x0			Vehicle Operations/Dispatch
(4)	661x0	A	63	Logistics Plans
	672x1			Financial Management
	672x2			Financial Services
	673x0			Auditing
(5)	271x1	A	45	Airfield Management
	271x2			Operations Resource Management
	472x4			Vehicle Maintenance Control & Analysis
	492x1			Communications Systems Radio Operations
	602x0			Passenger & HHG
	602x1			Freight & Packaging
	645x2			Supply Systems Analysis
	732x0			Personnel
	732x1			Personnel Affairs
(5)	612x1	A	29	Subsistence Operations
	702x0			Information Management
	741x1			Fitness & Recreation
(7)	201x1	G	68	Target Intelligence
	205x0			Electronic Intelligence Operations
	206x0			Imagery Interpreter
	208x1			Germanic Cryptologic Linguist
	208x2			Romance Cryptologic Linguist
	208x3			Slavic Cryptologic Linguist
	208x4			Far East Cryptologic Linguist
	208x5			Mid East Cryptologic Linguist
	651x0			Contracting
	733x1			Manpower Management
	791x0			Public Affairs
	791x1			Radio & TV Broadcasting
	792x2			Historian
	982x0			Dental Laboratory

(8)	111x0	G	57	Defensive Aerial Gunner
	113x0			Flight Engineer
	114x0			Aircraft Loadmaster
	201x0			Intelligence Operations
	202x0			Radio Communications Analysis
	209x0			Defensive C3CM
	231x3			Visual Information Production-Documentation
	242x0			Disaster Preparedness
	496x0			Comm-Computer Systems Plan & Program Management
	751x1			Training Systems
	924x0			Medical Laboratory
(9)	112x0	G	53	In-Flight Refueling Operations
	117x0			Airborne Warning C&C Systems Operations
	121x0			Survival Training
	241x0			Safety
	272x0			Air Traffic Control
	276x0			Aerospace Control & Warning Systems
	391x0			Maintenance Data Systems Analysis
	491x2			Communications-Computer Systems Program
	674x0			Cost Analysis
	912x5			Optometry
	913x1			Occupational Therapy
	914x0			Mental Health
(10)	207x1	G	49	Morse Systems
	207x2			Printer Systems
	274x0			Command and Control
	275x0			Tactical Air Command & Control
	553x0			Engineering Assistant
	881x0			Paralegal
	913x0			Physical Therapy
(11)	115x0	G	43	Pararescue/Recovery
	116x0			Airborne Communications Systems Operations
	222x0			Geodetic
	231x0			Visual Information Media
	231x1			Graphics
	231x2			Still Photo
	233x0			Imagery Production
	273x0			Combat Control
	392x0			Maintenance Scheduling
	458x1			Nondestructive Inspection

	491x1			Communications-Computer Systems
	492x2			Communications Systems Electromagnetic Spectrum
	555x0			Production Control
	731x0			Personnel Systems Management
	753x0			Combat Arms Training & Maintenance
	821x0			Special Investigations
(12)	901x0	G	43	Aeromedical
	902x0			Medical Service
	902x2			Surgical Service
	903x0			Radiologic
	903x1			Nuclear Medicine
	904x0			Cardiopulmonary Laboratory
	905x0			Pharmacy
	906x0			Medical Administration
	907x0			Bioenvironmental Engineering
	908x0			Environmental Medicine
	911x0			Aerospace Physiology
	915x0			Medical Material
	919x0			Orthotic
	924x1			Histopathology
	925x0			Cytotechnology
	926x0			Diet Therapy
	981x0			Dental Assistant
(13)	122x0	G	34	Aircrew Life Support
	566x0			Pest Management
	571x0			Fire Protection
	612x0			Meatcutter
	623x0			Services
	645x1			Material Storage & Distribution
	703x0			Reprographic
	751x0			Education
	811x0			Security
	811x2			Law Enforcement
(14)	303x2	E	75	AC&W Radar
	303x3			Auto Tracking Radar
	455x0			Photo & Sensors Maintenance
	455x5			Avionics Support Equipment (SE)
(15)	118x0	E	67	Airborne Computer Systems
	118x1			Airborne C&C Communications Equipment

	118x2			Airborne Radar Systems
	303x1			Air Traffic Control Radar
	304x0			Wideband Communications Equipment
	304x2			Meteorological & Navigation
	304x4			Ground Radar Communications
	304x5			Television Systems
	304x6			Satellite Communications Systems Equipment
	305x4			Electronic Computer & Switching Systems
	306x6			Secure Communications Systems Maintenance
	309x0			Space Systems Equipment Maintenance
	316x3			Instrumentation
	324x0			Precision Measurement Equipment Laboratory
	341x2			Defensive Systems Trainer
	341x4			Flight Simulator
	341x6			Navigation/Tactics Training Devices
	341x7			Missile Trainer
	411x0			Missile Systems Maintenance
(16)	451x4	E	67	F-15 Avionics Test Station & Component
	451x5			F-16/A-10 Avionics Test Station & Component
	451x6			F/FB-111 Avionics Test Station & Component
	451x7			B-1B Avionics Test Station & Component
	452x1			F-15 Avionics Systems
	452x2			F-16 Avionics Systems
	452x3			F/FB-111 Avionics Systems
	455x1			Avionics Guidance & Control Systems
	455x2			Communication & Navigation Systems
	455x3			Weapon Control Systems
	455x4			Airborne Warning & Control Radar
	455x6			Airborne Command Post Communications
	456x0			Bomb-Navigation Systems
	456x1			Electronic Warfare Systems
	456x2			Defensive Fire Control Systems (DFCS)
	457x3			B-1B & B-2 Avionics Systems
	466x0			Air Launched Missile Systems
	493x0			Communications-Computer Systems Control
	918x0			Biomedical Equipment
(17)	277x0	E	42	Space Systems Operations
	362x1			Telephone Switching
	362x3			Missile Control Communications Systems
	362x4			Telephone & Data Circuitry Equipment
	404x0			Imagery Systems Maintenance
	411x2			Missile Facilities

	542x0			Electrician
	542x1			Electric Power Line
(18)	100x0	G	42	First Sergeant
	465x0			Munitions Operations
	645x0			Inventory Management
	734x0			Social Actions
	742x0			Open Mess Management
	871x0			Band
	872x0			Instrumentalist
	893x0			Chapel Management
(19)	452x5	E	45	Tactical Electrical & Environmental Systems
	454x1			Aerospace Ground Equipment
	454x5			Strategic Electrical & Environmental Systems
	454x6			Airlift Electrical & Environmental Systems
	461x0			Munitions Systems
	462x0			Aircraft Armament Systems
	464x0			Explosive Ordinance Disposal
	542x2			Electric Power Production
	545x0			Refrigeration & Air-Conditioning
	545x2			Heating Systems
	545x3			CE Controls Systems
(20)	251x0	G	40	Weather
	605x5			Air Transportation
	631x0			Fuels

AFS Cluster

The following clusters are based on the ordering of AFSs in the Airman Classification Structure Chart and the selector AI score, M, A, G, or E, designated for the AFS. This methodology results in 55 clusters of AFSs. An attempt was made in these clusterings to group AFSs with similar tasks into the same clustering, subject to the Selector AI for each AFS.

Cluster No.	AFS	AI	Score	Description
(1)	111xx	G	55	Defensive Aerial Gunner
	114xx			Aircraft Loadmaster
(2)	112xx	G	55	In-Flight Refueling
	113xx			Flight Engineer
(3)	115xx	G	40	Pararescue/Recovery
	121xx			Survival Training
	122xx			Aircrew Life Support
(4)	116xx	G	45	Airborne Command Systems
	117xx			Airborne Warning C&C Systems
(5)	201xx	G	60	Intelligence Operations & Targeting
	202xx			Radio Communications Analysis
	205xx			Electronic Intelligence Operations
	206xx			Imagery Interpreter
	207xx			Communication Collection Systems
	208xx			Cryptologic Linguist
	209xx			Defensive C3CM
(6)	222xx	G	43	Geodetic
	231xx			Visual Information Services
	233xx			Imagery Production
(7)	241xx	G	55	Safety
	242xx			Disaster Preparedness
	571xx			Fire Protection

(8)	251xx	G	64	Weather
(9)	271xx	A	45	Airfield Management
	472x4			Vehicle Maintenance Control & Analysis
	492x1			Communications Systems Radio Operations
(10)	272xx	G	50	Air Traffic Control
	273xx			Combat Control
	274xx			Command and Control
	275xx			Tactical Air Command & Control
	276xx			Aerospace Control & Warning Systems
(11)	277xx	E	58	Space Systems Operations
(12)	118xx	E	67	Airborne C&C Mission Electronic Systems
	303xx			Ground Radar
	304xx			Communications Systems
	305xx			Electronic Computer & Switching Maintenance
	306xx			Secure Communications Systems Maintenance
	309xx			Space Systems Equipment Maintenance
	362xx			Telephone & Missile Control Comm Systems
(13)	316xx	E	67	Instrumentation
	324xx			Precision Measurement Equipment Laboratory
	918xx			Biomedical Equipment
(14)	341xx	E	67	Training Devices
(15)	361xx	M	51	Antenna & Cable Systems Installation/Maintenance
(16)	391xx	G	48	Maintenance Data Systems Analysis
	392xx			Maintenance Scheduling
(17)	404xx	E	40	Imagery Systems Maintenance

(18)	411xx	G	50	Missile Systems Maintenance
(19)	451xx	E	67	Avionics Test Stations
	452x1			Avionics Systems
	452x2			Avionics Systems
	452x3			Avionics Systems
(20)	454x1	M	51	Aerospace Ground Equipment
(21)	454x0	M	51	Aerospace Propulsion
	454x2			Aircrew Egress Systems
	454x3			Aircraft Fuel Systems
	454x4			Aircraft Pneudraulic Systems
(22)	452x5	M	45	Tactical Electrical & Environmental Systems
	454x5			Strategic Electrical & Environmental Systems
	454x6			Airlift Electrical & Environmental Systems
(23)	455xx	E	67	Conventional Avionics Systems
	456xx			Offensive/Defensive Avionic Systems
	457x3			Advanced Avionic Systems
(24)	452x4	M	51	Tactical Aircraft Maintenance
	457x0			Strategic Aircraft Maintenance
	457x1			Helicopter Maintenance
	457x2			Airlift Aircraft Maintenance
	458xx			Aircraft Fabrication
(25)	461xx	M	61	Munitions Systems
	462xx			Aircraft Armament Systems
	464xx			Explosive Ordinance Disposal
(26)	463xx	M	61	Nuclear Weapons

(27)	465xx	A	45	Munitions Operations
(28)	466xx	E	67	Air Launched Missile Systems
(29)	472x0	M	50	Special Purpose & Base Maint Vehicle Equipment
	472x1			Special Vehicle Mechanic
	472x2			General Purpose Vehicle Mechanic
	472x3			Vehicle Body Mechanic
(30)	491x1	G	45	Communications-Computer Systems
	491x2			Communications-Computer Systems Programming
	492x2			Comm Systems Electromagnetic Spectrum Mgt
(31)	496x0	G	58	Comm-Computer Systems Plan & Program Mgt
(32)	542x0	E	33	Electrical
	542x1			Electric Power Line
(33)	542x2	M	51	Electric Power Production
	545x0			Refrigeration & Air-Conditioning
	545x2			Heating Systems
	545x3			CE Controls Systems
(34)	545x1	M	51	Liquid Fuel Systems Maintenance
(35)	551xx	M	44	Pavements & Construction Equipment
	552xx			Structural
	566x1			Environmental Support
(36)	553xx	G	48	Engineering Assistant
	555xx			Production Control

(37)	591xx	M	44	Vehicle Operations
	603xx			Marine
(38)	605xx	M	51	Air Transportation
(39)	612x1	A	27	Subsistence Operations
	741xx			Fitness & Recreation
(40)	566x0	G	30	Pest Management
	612x0			Meatcutter
	623x0			Services
	703xx			Reprographic
(41)	631xx	M	51	Fuels
(42)	645x0	A	45	Inventory Management
	742xx			Open Mess Management
(43)	645x1	E	30	Materiel Storage & Distribution
(44)	645x2	A	51	Supply Systems Analysis
	602xx			Traffic Management
	661xx			Logistics Plans
(45)	651xx	G	70	Contracting
	674xx			Cost Analysis
(46)	672xx	A	61	Financial Management & Services
	673xx			Auditing
(47)	702xx	A	32	Information Management
	732xx			Personnel

(48)	731x0	G	43	Personnel Systems Management
	733xx			Manpower Management
(49)	734xx	A	45	Social Actions
	893xx			Chapel Management
(50)	751xx	G	50	Education & Training
	753x0			Combat Arms Training & Maintenance
(51)	753x1	M	61	Gunsmith
(52)	791xx	G	69	Public Affairs
	792xx			Historian
	881xx			Paralegal
(53)	811xx	G	35	Security Police
	821xx			Special Investigations
(54)	871xx	A	27	Band
	872xx			Instrumentalist
(55)	901xx	G	43	Aeromedical
	902xx			Medical Service
	903xx			Radiologic
	904xx			Cardiopulmonary Laboratory
	905xx			Pharmacy
	906xx			Medical Administration
	907xx			Bioenvironmental Engineering
	908xx			Environmental Medicine
	911xx			Aerospace Physiology
	912xx			Optometry
	913xx			Biomedical Therapy
	914xx			Mental Health Service
	915xx			Medical Materiel
	919xx			Orthotic
	924xx			Medical Laboratory
	925xx			Cytotechnology
	926xx			Diet Therapy
	981xx			Dental
	982xx			Dental Laboratory

APPENDIX B

Default Parameter File Values

This appendix details the settings of the Default parameter file.

I. Scenario
- A. Parameters
  1. Projection Period = 8 years
  2. Pool Size
     - a. AFSs = 12,500 for all years
     - b. Clusters = 110,000 for all years
  3. Discount Rate/Horizon
     - a. Discount Rate = 6.50%
     - b. Horizon = 20 years
  4. Aptitude Mix for Applicant Pool = FY90 MEPS Applicant Pool
  5. Minimum Aptitude Requirements
     - a. Minimum G-score = 60
     - b. Minimum Composite Score = 180
  6. Minimum YOS for Promotion
     - a. E1 to E2 = 0 YOS
     - b. E2 to E3 = 0 YOS
     - c. E3 to E4 = 1 YOS
     - d. E4 to E5 = 5 YOS
     - e. E5 to E6 = 12 YOS
     - f. E6 to E7 = 15 YOS
     - g. E7 to E8 = 18 YOS
     - h. E8 to E9 = 21 YOS
- B. Options
  1. Promotion - Constant Promotion Rate Method
  2. Accession - Maximize Expected Net Return Method
  3. Costs/Values
     - a. Separation Costs - 2.5%
     - b. RMC Costs - 4.1%
     - c. BMT Costs - 2.5%
     - d. OJT Costs - 2.5%
     - e. Technical Trng Costs - 2.5%
     - f. Service State Values - 5.0%

II. AFS
- A. Minimum Manning Requirements - 100% for all AFSs/Clusters, for all years
- B. Minimum Selector AI Requirements
  1. For AFSs
     - a. AFS 122x0 - G-30
     - b. AFS 272x0 - G-50
     - c. AFS 324x0 - E-60
     - d. AFS 328x0 - E-65

e. AFS 423x5 - E-30
f. AFS 426x2 - M-50
g. AFS 492x1 - A-45
h. AFS 732x0 - A-45

2. For Clusters (see Appendix A)

C. Manning Level Changes - 0.00% change in requirements for all AFSs/Clusters, for all years

D. Maximum Force-out Requirements - 100.00% force-out requirement for all AFSs/Clusters, for all years

III. File

A. Output File Name AFSs - AFSGR8.OUT

B. Output File Name Clusters

1. 20 MAGE Clusters - CLUS20.OUT
2. 51 AFS Clusters - CLUS51.OUT

APPENDIX C

Allocation Methodologies

This appendix details the methodology used to estimate the quantitative factors which affect the allocation of enlisted personnel. SUMS allocates accessions to AFSs/Clusters in order to fill AFS/Cluster-specific manning vacancies caused by the attrition/promotion process and manning requirements. SUMS selects recruits from a given accession pool comprised of a given aptitude mix based on the four ASVAB composite scores (Mechanical, Administrative, General, and Electronic). The allocation of aptitude-specific accessions to AFSs/Clusters is performed using a methodology which maximizes or minimizes the total benefit resulting from an allocation of aptitude-specific accessions to multiple AFSs/Clusters. The user has been provided eight alternative methodologies for allocating accessions:

(1) Random Arrival,
(2) Maximize Expected Total Net Return,
(3) Maximize Total Productive Capacity,
(4) Maximize Total Value,
(5) Minimize Total Cost,
(6) Maximize Expected Total Productive Capacity,
(7) Maximize Expected Total Value, and
(8) Minimize Expected Total Cost.

Random Arrival

Random arrival represents a slightly different methodology for the allocation of aptitude-specific accessions from the other allocation alternatives. Random arrival uses a purely random procedure for determining the order in which aptitude-specific applicants from the applicant pool become available as possible accessions. Each applicant is randomly selected from the applicant pool with a given aptitude distribution. This method attempts to mirror the aptitude distribution of applicants which recruiters actually confront at Military Entrance Processing Station (MEPS). The Random Arrival allocation of each accession is performed without regard to the aptitude distribution of future applicants. Accessions are allocated to AFSs/Clusters as they randomly arrive at the MEPS on the basis of relative need by each AFS/Cluster. For example, if AFS_i needs two times as many accessions as AFS_j and the applicants that enter the MEPS are equally qualified for both AFS_i and AFS_j, then those available accessions will be allocated to AFS_i at a rate of 2 for 1 relative to AFS_j accessions. Thus, qualified applicants are randomly allocated to AFSs/Clusters based on the relative needs of the AFSs/Clusters. This method does not maximize or minimize total system welfare based on benefits, costs, or any other allocation criterion.

Alternative Methodologies

The other seven allocation alternatives use the same methodology differing only in terms of the allocation criterion employed to determine to which AFS/Cluster each accession will be allocated. Each of the alternatives (2) through (8) uses a different allocation criterion. The allocation criterion represents the single quantitative factor assignable to each aptitude group which is used to determine the "best" AFS/Cluster allocation of the recruits. Aptitude groups are based on the range of possible scores for the selector aptitude index (AI) of each AFS/Cluster. For example, an AFS/Cluster with a minimum selector AI of M-60 would consist of four aptitude groups comprised of applicants with M scores of 99 to 90, 89 to 80, 79 to 70, and 69 to 60. "Best" in this context refers to the allocation of a single accession to a specific AFS/Cluster making the greatest contribution to the overall welfare of the system as defined by the objective to be maximized or minimized. The objective is expressed in terms of one of seven allocation criterion: expected total net return, total productive capacity, total value, total cost, expected total productive capacity, expected total value, or expected total cost.

To determine the allocation of accessions across AFSs/Clusters for these seven alternatives, a linear programming routine (Seplo, Deo, & Kowalik, 1983) is used. This linear programming algorithm determines the number of qualified applicants from each aptitude group to be assigned to each AFS/Cluster across all AFSs/Clusters specified in the system. The allocation solution is obtained by maximizing (minimizing):

$$\sum_{k=1}^{K}\sum_{x=1}^{M}(V_{x,k}\times n_{x,k}) \qquad (1)$$

subject to the constraints:

$$\sum_{k=1}^{K} n_{x,k} \le a_x \quad \text{for all x} \qquad (2)$$

$$\sum_{x=1}^{M} n_{x,k} \le r_k \quad \text{for all k} \qquad (3)$$

$$n_{x,k} \ge 0 \quad \text{for all x and k} \qquad (4)$$

where,

K is the number of AFSs/Clusters,
M is the number of aptitude groups,
$V_{x,k}$ is the allocation criterion value to be accrued to the system from allocating an accession with aptitude x to AFS/Cluster k,
x is the aptitude group,
k is the kth AFS/Cluster,
$n_{x,k}$ is the number of accessions with aptitude x assigned to AFS/Cluster k,
a_x is the number of accessions of aptitude x, and
r_k is the accession requirement for AFS/Cluster k which is necessary to meet the desired manning level.

The objective function (Equation 1) is the total allocation criterion value of all accessions assigned to all AFSs/Clusters from all aptitude groups. The allocation problem is solved by finding the maximum (minimum) value for this function. If cost were selected as the allocation criterion, the objective function would be minimized versus the selection of productivity as the allocation criterion which would be maximized. Equation 2 constrains the number of accessions assigned from an aptitude group to the number of accessions available in the group. Equation 3 constrains the number of accessions assigned to an AFS/Cluster to be less than or equal to the established manning level for that AFS/Cluster. This constraint does not affect the allocation of accessions while the number of accessions allocated to an AFS/Cluster is below the established manning level for that AFS/Cluster. Equation 4 specifies that a negative number of accessions with aptitude x cannot be assigned to any AFS/Cluster.

Expected Total Net Return

The allocation criterion Expected Total Net Return, encompasses several important factors: productive capacity, value of services produced by personnel in the Air Force, probability of attrition, training costs, basic military training(BMT) costs, and personnel maintenance costs (regular military compensation). These factors are combined into a single measure called expected net return for any aptitude cohort in any AFS/Cluster. The expected net return for an individual with aptitude x is defined simply as the difference between expected value and expected cost over the specified horizon, T. Thus, the objective function to be maximized is the summation of expected net return across all accessions allocated to all AFSs/Clusters.

To allocate accessions to the AFSs, a measure of expected net return, $ETNR_{x,k}$, is required for the kth AFS/Cluster. This value is estimated in three steps: estimation of expected value, estimation of expected costs, and estimation of expected net return.

Estimation of Expected Value

The expected value for an individual with aptitude x equals the summation over the specified horizon T of the products of the probability that an individual with aptitude x will remain in service through YOS t multiplied by the value accruing to the Air Force of an individual with aptitude x in YOS t multiplied times the productive capacity (Faneuff et al., 1990) of an individual with aptitude x in YOS t. The expected value of an individual with aptitude x over the horizon T, $EV_{x,k}$, can be expressed as,

$$EV_{x,k}=\sum_{t=0}^{T}[S_{x,k,t}\times V_{x,k,t}\times PC_{x,k,t}] \quad (5)$$

where,

$EV_{x,k}$ is the expected value for an individual with aptitude x in AFS/Cluster k

$S_{x,k,t}$ is the probability that an individual with aptitude x in AFS/Cluster k will remain in service through YOS t,

$V_{x,k,t}$ is the value to the Air Force of the services provided by an individual of aptitude x in AFS/Cluster k in YOS t, and

$PC_{x,k,t}$ is the productive capacity of an individual with aptitude x in AFS/Cluster k in YOS t.

Estimation of Expected Cost

The expected cost of an individual with aptitude x over horizon T, EC_x, equals the summation over horizon T of the products of the probability that an individual with aptitude x will remain in service through YOS t multiplied by the cost to the Air Force of an individual with aptitude x in YOS t (Faneuff et al., 1990), which can be expressed as,

$$EC_{x,k}=\sum_{t=0}^{T}[S_{x,k,t}\times C_{x,k,t}] \quad (6)$$

where,

$EC_{x,k}$ is the expected cost for an individual with aptitude x in AFS/Cluster k

$C_{x,k,t}$ is the cost to the Air Force of maintaining and/or training an individual with aptitude x in AFS/Cluster k in YOS t and

$S_{x,k,t}$ is the same as in Equation 5.

Estimation of Expected Total Net Return

Thus, the expected total net return of an individual with aptitude x over horizon T, $ETNR_{x,k}$, is the difference between expected value and expected cost over horizon T and can be expressed as,

$$ETNR_{x,k}=EV_{x,k}-EC_{x,k} \tag{7}$$

or

$$ETNR_{x,k}=\sum_{t=0}^{T}[S_{x,k,t}\times V_{x,k,t}\times PC_{x,k,t}]-\sum_{t=0}^{T}[S_{x,k,t}\times C_{x,k,t}] \tag{8}$$

Thus, SUMS will allocate accessions in order to maximize the expected total net return, which can be expressed as (similar to Equation 1),

$$\sum_{k=1}^{K}\sum_{x=1}^{M}(ETNR_{x,k}\times n_{x,k}) \tag{9}$$

where,

$ETNR_{x,k}$ is the expected net return to the Air Force of maintaining and/or training an individual with aptitude x in AFS k over a user-specified time horizon and

$n_{x,k}$ is the number of accessions with aptitude x assigned to AFS/Cluster k.

Total Productive Capacity

Productive capacity, $PC_{x,k,t}$, is calculated for each aptitude group x of the eligible applicant pool for each YOS t that an applicant could serve for each AFS/Cluster k to which an applicant could be allocated. The allocation criterion, $TPC_{x,k}$, for an individual with aptitude x in a particular AFS/Cluster k is equal to the sum of the productive capacity to be attained each year of additional experience t over a given horizon T.

$$TPC_{x,k}=\sum_{t=0}^{T}PC_{x,k,t} \tag{10}$$

where,

$PC_{x,k,t}$ is the productive capacity of an individual with aptitude x in AFS/Cluster k in YOS t and

$TPC_{x,k}$ is the sum of the productive capacity attainable over a specified horizon T for an individual with aptitude x in AFS k.

Accessions are allocated by maximizing total system productivity for each projection year, which can be expressed as (similar to Equation 1),

$$\sum_{k=1}^{K}\sum_{x=1}^{M}(TPC_{x,k}\times n_{x,k}) \tag{11}$$

where,

$n_{x,k}$ is the number of accessions with aptitude x assigned to AFS/Cluster k and

$TPC_{x,k}$ is the sum of the productive capacity attainable over a specified horizon T for an individual with aptitude x in AFS/Cluster k.

Total Value

The allocation criterion total value (TV) is the value to the Air Force of the services provided by an individual with aptitude x in AFS k over a horizon T. Value, $V_{x,k,t}$, is calculated for each aptitude group x of the eligible applicant pool for each YOS t that an applicant could serve for each AFS/Cluster k to which an applicant could be allocated. The allocation criterion, $TV_{x,k}$, for an individual with aptitude x in a particular AFS/Cluster k is equal to the sum of the value to be attained each year of additional experience t over a given horizon T.

$$TV_{x,k}=\sum_{t=0}^{T}V_{x,k,t} \tag{12}$$

where,

$V_{x,k,t}$ is the value to the Air Force of services provided by an individual with aptitude x in AFS/Cluster k in YOS t and

$TV_{x,k}$ is the sum of the value attainable over a specified horizon T for an individual with aptitude x in AFS k.

Accessions are allocated by maximizing total system value for each projection year, which can be expressed as (similar to Equation 1),

$$\sum_{k=1}^{K}\sum_{x=1}^{M}(TV_{x,k}\times n_{x,k}) \tag{13}$$

where,

$n_{x,k}$ is the number of accessions with aptitude x assigned to AFS/Cluster k and

$TV_{x,k}$ is the sum of the value attainable over a specified horizon T for an individual with aptitude x in AFS/Cluster k.

Total Cost

The allocation criterion total cost (TC) is the cost to the Air Force of maintaining and/or training an individual with aptitude x in AFS k over horizon T. Cost, $C_{x,t}$, is calculated for each aptitude group x of the eligible applicant pool for each YOS t that an applicant could serve for each AFS/Cluster k to which an applicant could be allocated. The allocation criterion, $TC_{x,k}$, for an individual with aptitude x in a particular AFS/Cluster k is equal to the sum of the costs to be incurred each year of additional experience t over a given horizon T.

$$TC_{x,k}=\sum_{t=0}^{T} C_{x,k,t} \tag{14}$$

where,

$C_{x,k,t}$ is the cost to the Air Force of maintaining and/or/training an individual with aptitude x in AFS/Cluster k in YOS t and

$TC_{x,k}$ is the sum of the costs incurred over a specified horizon T for an individual with aptitude x in AFS k.

Accessions are allocated by minimizing total system cost for each projection year, which can be expressed as (similar to Equation 1),

$$\sum_{k=1}^{K}\sum_{x=1}^{M}(TC_{x,k}\times n_{x,k}) \tag{15}$$

where,

$n_{x,k}$ is the number of accessions with aptitude x assigned to AFS/Cluster k and

$TC_{x,k}$ is the sum of the costs incurred over a specified horizon T for an individual with aptitude x in AFS/Cluster k.

Expected Total Productive Capacity

Expected productive capacity is calculated for each aptitude group x of the eligible applicant pool for each YOS t that an applicant could serve for each AFS/Cluster k to which an applicant could be allocated considering the probability that an individual with aptitude x will remain in service through YOS t in AFS/Cluster k, $S_{x,k,t}$. The allocation criterion, $ETPC_{x,k}$, for an individual with aptitude x in a particular AFS/Cluster k is equal to the sum of the productive capacity to be attained each year of additional experience t over a given horizon T.

$$ETPC_{x,k}=\sum_{t=0}^{T}[S_{x,k,t}\times PC_{x,k,t}] \tag{16}$$

where,

$S_{x,k,t}$ is the probability that an individual with aptitude x will remain in service through YOS t in AFS k,

$P_{x,k,t}$ is the productive capacity of an individual with aptitude x in YOS t and AFS k, and

$ETPC_{x,k}$ is the sum of the expected productive capacity attainable over a specified horizon T for an individual with aptitude x in AFS k.

Accessions are allocated by maximizing total system expected productive capacity for each projection year, which can be expressed as (similar to Equation 1),

$$\sum_{k=1}^{K}\sum_{x=1}^{M}(ETPC_{x,k}\times n_{x,k}) \tag{17}$$

where,

$n_{x,k}$ is the number of accessions with aptitude x assigned to AFS/Cluster k and

$ETPC_{x,k}$ is the sum of the expected productive capacity attainable over a specified horizon T for an individual with aptitude x in AFS/Cluster k.

Expected Total Value

Expected value is calculated for each aptitude group x of the eligible applicant pool for each YOS t that an applicant could serve for each AFS/Cluster k to which an applicant could be allocated considering the probability that an individual with aptitude x will remain in service through YOS t, $S_{x,k,t}$. The allocation criterion value $ETV_{x,k}$ for an individual with aptitude x in a particular AFS/Cluster k is equal to the sum of the expected value to be attained each year of additional experience t over a given horizon T.

$$ETV_{x,k}=\sum_{t=0}^{T}[S_{x,k,t}\times V_{x,k,t}] \tag{18}$$

where,

$S_{x,k,t}$ is the probability that an individual with aptitude x will remain in service through YOS t in AFS k,

$V_{x,k,t}$ is the value to the Air Force of services provided by an individual with aptitude x in YOS t and AFS k, and

$ETV_{x,k}$ is the sum of the expected value attainable over a specified horizon T for an individual with aptitude x in AFS k.

Accessions are allocated by maximizing total system expected value for each projection year, which can be expressed as (similar to Equation 1),

$$\sum_{k=1}^{K}\sum_{x=1}^{M}(ETV_{x,k}\times n_{x,k}) \tag{19}$$

where,

$n_{x,k}$ is the number of accessions with aptitude x assigned to AFS/Cluster k and

$ETV_{x,k}$ is the sum of the expected value attainable over a specified horizon T for an individual with aptitude x in AFS/Cluster k.

Expected Total Cost

Expected total cost is calculated for each aptitude group x of the eligible applicant pool for each YOS t that an applicant could serve for each AFS/Cluster k to which an applicant could be allocated considering the probability that an individual with aptitude x will remain in service through YOS t, $S_{x,k,t}$. The allocation criterion value $ETC_{x,k}$ for an individual with aptitude x in a particular AFS/Cluster k is equal to the sum of the expected total cost to be incurred for each year of additional experience t over a given horizon T.

$$ETC_{x,k}=\sum_{t=0}^{T}[S_{x,k,t}\times C_{x,k,t}] \tag{20}$$

where,

$S_{x,k,t}$ is the probability that an individual with aptitude x will remain in service through YOS t in AFS k,

$C_{x,k,t}$ is the cost to the Air Force of maintaining and/or/training an individual with aptitude x in YOS t and AFS k, and

$ETC_{x,k}$ is the sum of the expected total cost incurred over a specified horizon T for an individual with aptitude x in AFS k.

Accessions are allocated by minimizing total system expected cost for each projection year, which can be expressed as (similar to Equation 1),

$$\sum_{k=1}^{K}\sum_{x=1}^{M}(ETC_{x,k}\times n_{x,k}) \tag{21}$$

where,

$n_{x,k}$ is the number of accessions with aptitude x assigned to AFS/Cluster k and

$ETC_{x,k}$ is the sum of the expected total cost incurred over a specified horizon T for an individual with aptitude x in AFS/Cluster k.

APPENDIX D

Data Sources

This appendix details the sources of data used for the implementation of SUMS. All costs and values are AFS/Cluster specific, with the exception of regular military compensation (RMC) and basic military training (BMT) costs. Costs and values for Clusters were calculated using a weighted average based on the number of personnel in each AFS within each Cluster.

Regular military compensation (RMC) is comprised of basic pay, basic allowance for quarters (BAQ), basic allowance for subsistence (BAS), and the tax advantage accruing from the nontaxable nature of BAQ and BAS. Values for RMC are taken from the FY90 enlisted personnel pay tables. RMC does not vary by AFS/Cluster. Basic military training (BMT) costs were taken from the Air Training Commands (ATC) FY90 Cost Factors Manual (1990). BMT costs also do not vary by AFS/Cluster.

Separation costs are derived from FY90 RMC and the Walk Through Performance Test(WTPT) data. Separation costs represent an estimate of an airman's tendency to reduce his/her level of productivity once the airman has made the decision to separate. The magnitude of the separation cost calculated was based on statistical differences between the measured productivity (Total WTPT scores) of airmen who indicated that they would reenlist versus airmen who did not. The percent difference in productivity was multiplied time RMC to determine the dollar amount of separation costs.

In the conduct of the WTPT surveys, enlisted personnel were questioned as to whether or not they would reenlist at the end of their current terms with their responses categorized accordingly. Productivity was estimated across all AFS's using ordinary least squares regression with Total WTPT score as the dependent variable, and YOS in months and a binary variable representing the reenlist/separate decision. The productivity equation was integrated over the range of values from 36 to 48 months of service. The area beneath the curve for those who did not reenlist was smaller than that for those who did reenlist. The difference between the two curves represents the loss in productivity. A detailed explanation of this method may be found in Stone, Grossmann, Looper, and Engquist (1991).

On-the-job training (OJT) and technical training costs were calculated using the ATC FY90 Cost Factors Manual (1990). The information provided in the ATC FY90 Cost Factors Manual (1990) provided technical training course costs for each AFS/Cluster. These costs were used in conjunction with information from the Occupational Research Data Bank (ORDB) concerning courses taken by airmen at specific stages of their career to estimate the costs of formal technical training for each AFS by year of service (YOS). The technical training costs allocated to each YOS within an AFS/Cluster were estimated as a weighted average based upon the proportion of airmen who had taken a course in each YOS of that AFS/Cluster (Stone et al., 1989a). OJT costs are estimated primarily for individuals in grades E2 through E5. Since minimal OJT occurs beyond these points, no OJT costs beyond those levels are included (Stone et al., 1992).

The basis of service states in SUMS is YOS. Each YOS 0 to 30 represents a service state. Service state values are calculated based on civilian earnings surveys administered monthly by the Bureau of the Census (U.S. Department of Commerce, 1986). Service state values represent the opportunity cost to the airman of remaining in the service (Stone et al., 1989a). Service state values are AFS/Cluster specific.

Continuation rates for each AFS/Cluster were calculated from data obtained from the Uniform Airman Records (UAR) files of the Historical Airman Data (HAD) base (Saving, Stone, Looper, & Taylor, 1985) for June 1983 and June 1984. The UAR files were used to estimate the probability of an airman with aptitude x continuing from one YOS to another. The June 1983 to June 1984 time period was selected because that time period was before enlisted force drawdowns had begun to reach sizeable numbers in fiscal year 1985 and 1986 (Stone, Saving, Turner, Looper & Engquist, 1991). The continuation rates should reflect market driven rates and not the influences of a force drawdown.

Initial manning levels for each AFS/Cluster were obtained from a June 1990 UAR snapshot. The aptitude distribution of the default applicant file is taken from the FY90 MEPS applicant pool. Aptitude cells for the applicant file are based on the four Selector AI scores for each applicant, Mechanical (M), Administrative (A), General (G), and Electronic (E).

APPENDIX E

Sample Output File

This appendix contains a sample output file. The simulation executed to create this output file included:

- Population = Four AFSs
  - AFS 272x0
  - AFS 324x0
  - AFS 426x2
  - AFS 732x0
- Projection Period = 2 Years
- 10% Decrease in Manning Levels in Year 2 for all AFSs (Force-downsizing)
- Default Values for all other Scenario and AFS parameters and options

Air Force Multiple AFS Scenario Analyses

——— Time = 0 ———
——— Time = 1 ———

afs	apt	evalue	ecost	return
u2720	90	451880.20	160520.23	291360.00
u2720	80	385073.44	146085.52	238987.97
u2720	70	345771.44	133981.78	211789.66
u2720	60	355221.44	136437.05	218784.38
u2720	50	379606.66	143893.09	235713.52
u3240	90	172908.09	127148.60	45759.46
u3240	80	164706.56	122011.05	42695.55
u3240	70	180886.26	131955.17	48931.10
u3240	60	164665.53	122944.05	41721.48
u4262	90	375851.25	143870.56	231980.61
u4262	80	361310.38	139968.39	221341.94
u4262	70	350732.20	137822.09	212910.05
u4262	60	348640.16	136896.97	211743.23
u4262	50	356259.12	140784.75	215474.38
u7320	90	137376.91	127101.55	10275.34
u7320	80	175861.83	143374.16	32487.66
u7320	70	181272.16	144819.20	36452.92
u7320	60	165125.94	139880.38	25245.57
u7320	50	192648.26	155560.86	37087.43

Scenario afs8
u2720

		Grade							
		3	4	5	6	7	8	9	Total
Manning Goals	:	836.0	1101.0	1273.0	827.0	584.0	133.0	77.0	4831.0
Initial Inventory	:	836.0	1101.0	1273.0	827.0	584.0	133.0	77.0	4831.0
Separations	:	64.3	212.4	72.9	43.4	81.1	21.4	14.6	510.1
Promotions	:	0.0	337.2	124.8	90.0	74.5	26.2	14.6	667.5
Accession Goal	:	510.1	0.0	0.0	0.0	0.0	0.0	0.0	510.1
Accession Minimum Goal	:	510.1	0.0	0.0	0.0	0.0	0.0	0.0	510.1
Accessions	:	510.1	0.0	0.0	0.0	0.0	0.0	0.0	510.1
Forced Outs	:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Overage (-Shortage)	:	108.5	-0.0	-38.1	-27.8	-33.0	-9.8	-0.0	-0.0
Ending Inventory	:	944.5	1101.0	1235.0	799.2	551.1	123.2	77.0	4831.0
Avg. Productivity	:	0.9068	1.0432	1.2007	1.3836	1.5191	1.6474	1.7439	1.2054

u3240

		Grade							
		3	4	5	6	7	8	9	Total
Manning Goals	:	550.0	842.0	486.0	251.0	184.0	44.0	21.0	2378.0
Initial Inventory	:	550.0	842.0	486.0	251.0	184.0	44.0	21.0	2378.0
Separations	:	41.5	160.5	27.8	18.3	23.8	3.5	4.6	280.1
Promotions	:	0.0	223.4	63.0	42.8	27.8	8.1	4.6	369.6
Accession Goal	:	280.1	0.0	0.0	0.0	0.0	0.0	0.0	280.1
Accession Minimum Goal	:	280.1	0.0	0.0	0.0	0.0	0.0	0.0	280.1
Accessions	:	280.0	0.0	0.0	0.0	0.0	0.0	0.0	280.0
Forced Outs	:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Overage (-Shortage)	:	15.1	0.0	-7.8	-3.3	-4.1	0.0	0.0	-0.1
Ending Inventory	:	565.1	842.0	478.2	247.7	180.0	44.0	21.0	2377.9
Avg. Productivity	:	0.9174	0.9826	1.1263	1.2888	1.3724	1.4581	1.5952	1.0760

u4262

		Grade							
		3	4	5	6	7	8	9	Total
Manning Goals	:	1308.0	3243.0	2929.0	1368.0	807.0	210.0	158.0	10023.0
Initial Inventory	:	1308.0	3243.0	2929.0	1368.0	807.0	210.0	292.0	10157.0
Separations	:	133.4	625.0	114.1	74.1	111.2	41.6	171.0	1270.4
Promotions	:	0.0	731.8	318.4	204.3	130.2	37.1	27.6	1449.4
Accession Goal	:	1136.4	0.0	0.0	0.0	0.0	0.0	0.0	1136.4
Accession Minimum Goal	:	1136.4	0.0	0.0	0.0	0.0	0.0	0.0	1136.4
Accessions	:	1136.4	0.0	0.0	0.0	0.0	0.0	0.0	1136.4
Forced Outs	:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Overage (-Shortage)	:	271.2	-211.6	0.0	-0.0	-18.1	-32.2	-9.4	-0.0
Ending Inventory	:	1579.2	3031.4	2929.0	1368.0	788.9	177.8	148.6	10023.0
Avg. Productivity	:	0.9198	1.0362	1.2135	1.3886	1.5191	1.6304	1.7662	1.1873

u7320

		Grade							
		3	4	5	6	7	8	9	Total
Manning Goals	:	1174.0	3312.0	2613.0	1450.0	640.0	13.0	10.0	9212.0
Initial Inventory	:	1174.0	3312.0	2613.0	1450.0	640.0	13.0	217.0	9419.0
Separations	:	141.3	546.4	240.8	148.8	150.1	1.2	72.5	1301.2
Promotions	:	0.0	643.4	363.7	222.9	151.3	1.2	0.0	1382.5
Accession Goal	:	1228.7	0.0	0.0	0.0	0.0	0.0	0.0	1228.7
Accession Minimum Goal	:	1228.7	0.0	0.0	0.0	0.0	0.0	0.0	1228.7
Accessions	:	1228.6	0.0	0.0	0.0	0.0	0.0	0.0	1228.6
Forced Outs	:	0.0	0.0	0.0	0.0	0.0	0.0	134.4	134.4
Overage (-Shortage)	:	444.0	-266.7	-100.0	-77.2	-0.0	0.0	0.0	-0.1
Ending Inventory	:	1618.0	3045.3	2513.0	1372.8	640.0	13.0	10.0	9211.9
Avg. Productivity	:	0.9337	1.0443	1.2251	1.4271	1.5504	1.6313	1.7913	1.1891

Accessions by Scenario afs8

AFS u2720

Year	90	80	70	60	50	40	30	20	10
1	510.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AFS u3240

Year	90	80	70	60	50	40	30	20	10
1	0.00	0.00	280.00	0.00	0.00	0.00	0.00	0.00	0.00

AFS u4262

Year	90	80	70	60	50	40	30	20	10
1	893.80	242.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AFS u7320

Year	90	80	70	60	50	40	30	20	10
1	0.00	0.00	765.00	0.00	463.60	0.00	0.00	0.00	0.00

——— Time = 2 ———

afs	apt	evalue	ecost	return
u2720	90	474474.22	166466.91	308007.31
u2720	80	404327.12	151454.45	252872.61
u2720	70	363060.03	138897.62	224162.36
u2720	60	372982.44	141456.41	231526.00
u2720	50	398586.91	149200.86	249386.00
u3240	90	181553.45	132156.67	49396.79
u3240	80	172941.89	126815.62	46126.28
u3240	70	189930.55	137155.16	52775.40
u3240	60	172898.80	127784.34	45114.42
u4262	90	394643.72	149305.38	245338.34
u4262	80	379375.81	145248.47	234127.34
u4262	70	368268.78	143011.26	225257.53
u4262	60	366072.16	142063.89	224008.26
u4262	50	374072.00	146100.72	227971.28
u7320	90	144245.73	131828.09	12417.64
u7320	80	184654.88	148781.66	35873.24
u7320	70	190335.70	150293.45	40042.27
u7320	60	173382.20	145137.06	28245.14
u7320	50	202280.66	161432.36	40848.33

Scenario afs8

u2720

		Grade							
		3	4	5	6	7	8	9	Total
Manning Goals	:	752.4	991.0	1145.7	744.3	525.6	119.7	69.3	4348.0
Initial Inventory	:	944.5	1101.0	1235.0	799.2	551.1	123.2	77.0	4831.0
Separations	:	96.0	192.7	68.7	31.8	58.4	22.4	19.0	489.1
Promotions	:	0.0	82.6	0.0	12.9	36.0	24.8	11.3	167.7
Accession Goal	:	13.6	0.0	0.0	0.0	0.0	0.0	0.0	13.6
Accession Minimum Goal	:	13.6	0.0	0.0	0.0	0.0	0.0	0.0	13.6
Accessions	:	13.6	0.0	0.0	0.0	0.0	0.0	0.0	13.6
Forced Outs	:	0.0	0.0	7.6	0.0	0.0	0.0	0.0	7.6
Overage (-Shortage)	:	27.1	-0.0	0.0	0.0	-21.7	-5.4	0.0	-0.0
Ending Inventory	:	779.5	991.0	1145.7	744.3	503.9	114.3	69.3	4348.0
Avg. Productivity	:	0.9106	1.0360	1.2168	1.4037	1.5358	1.6600	1.7681	1.2060

u3240

		Grade							
		3	4	5	6	7	8	9	Total
Manning Goals	:	495.0	757.8	437.4	226.0	165.6	39.6	20.0	2140.2
Initial Inventory	:	565.1	842.0	478.2	247.7	180.0	44.0	21.0	2377.9
Separations	:	87.6	153.7	28.5	21.7	21.7	5.3	5.5	324.0
Promotions	:	0.0	69.5	0.0	11.6	11.7	4.2	3.4	100.4
Accession Goal	:	87.0	0.0	0.0	0.0	0.0	0.0	0.0	87.0
Accession Minimum Goal	:	87.0	0.0	0.0	0.0	0.0	0.0	0.0	87.0
Accessions	:	86.9	0.0	0.0	0.0	0.0	0.0	0.0	86.9
Forced Outs	:	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.7
Overage (-Shortage)	:	-0.1	0.0	0.0	-0.0	-0.0	0.0	-0.0	-0.1
Ending Inventory	:	494.9	757.8	437.4	226.0	165.6	39.6	20.0	2140.1
Avg. Productivity	:	0.9039	0.9924	1.1311	1.3006	1.3838	1.4714	1.5844	1.0798

u4262

		Grade							
		3	4	5	6	7	8	9	Total
Manning Goals	:	1177.2	2918.7	2636.1	1231.2	726.3	189.0	142.2	9020.7
Initial Inventory	:	1579.2	3031.4	2930.0	1368.0	788.9	177.8	148.6	10023.0
Separations	:	203.0	463.6	111.8	70.5	93.3	30.8	82.0	1055.0
Promotions	:	0.0	289.2	0.0	0.0	56.7	41.5	41.3	428.7
Accession Goal	:	243.4	0.0	0.0	0.0	0.0	0.0	0.0	243.4
Accession Minimum Goal	:	243.4	0.0	0.0	0.0	0.0	0.0	0.0	243.4
Accessions	:	243.4	0.0	0.0	0.0	0.0	0.0	0.0	243.4
Forced Outs	:	0.0	0.0	181.1	9.6	0.0	0.0	0.0	190.6
Overage (-Shortage)	:	153.1	-61.6	0.0	0.0	-15.4	-41.7	-34.3	0.0
Ending Inventory	:	1330.3	2857.1	2636.1	1231.2	710.8	147.3	107.8	9020.7
Avg. Productivity	:	0.8979	1.0412	1.2264	1.4010	1.5323	1.6423	1.7815	1.1829

u7320

		Grade							
		3	4	5	6	7	8	9	Total
Manning Goals	:	1056.6	2980.8	2351.7	1305.0	576.0	11.7	9.0	8290.8
Initial Inventory	:	1618.0	3045.3	2513.0	1372.8	640.0	13.0	10.0	9211.9
Separations	:	191.7	438.4	182.2	125.0	113.8	2.2	3.2	1056.5
Promotions	:	0.0	299.7	87.2	75.9	53.0	3.1	2.2	521.2
Accession Goal	:	135.4	0.0	0.0	0.0	0.0	0.0	0.0	135.4
Accession Minimum Goal	:	135.4	0.0	0.0	0.0	0.0	0.0	0.0	135.4
Accessions	:	135.4	0.0	0.0	0.0	0.0	0.0	0.0	135.4
Forced Outs	:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Overage (-Shortage)	:	205.2	-161.4	-9.7	-34.2	0.0	0.0	0.0	-0.0
Ending Inventory	:	1261.8	2819.4	2342.0	1270.8	576.0	11.7	9.0	8290.8
Avg. Productivity	:	0.9052	1.0516	1.2264	1.4352	1.5590	1.6784	1.8103	1.1688

Accessions by Scenario afs8

AFS u2720

Year	90	80	70	60	50	40	30	20	10
2	13.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AFS u3240

Year	90	80	70	60	50	40	30	20	10
2	0.00	0.00	86.90	0.00	0.00	0.00	0.00	0.00	0.00

AFS u4262

Year	90	80	70	60	50	40	30	20	10
2	243.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AFS u7320

Year	90	80	70	60	50	40	30	20	10
2	0.00	0.00	0.00	0.00	135.40	0.00	0.00	0.00	0.00

Accessions by Scenario afs8

AFS u2720

Year	90	80	70	60	50	40	30	20	10	Net Return
1	510.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	148.6227
2	13.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.2000

AFS u3240

Year	90	80	70	60	50	40	30	20	10	Net Return
1	0.00	0.00	280.00	0.00	0.00	0.00	0.00	0.00	0.00	13.7007
2	0.00	0.00	86.90	0.00	0.00	0.00	0.00	0.00	0.00	4.5862

AFS u4262

Year	90	80	70	60	50	40	30	20	10	Net Return
1	893.80	242.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	261.0418
2	243.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	59.7154

AFS u7320

Year	90	80	70	60	50	40	30	20	10	Net Return
1	0.00	0.00	765.00	0.00	463.60	0.00	0.00	0.00	0.00	45.0802
2	0.00	0.00	0.00	0.00	135.40	0.00	0.00	0.00	0.00	5.5310

Total Accessions by Year for Scenario afs8

Year	Accessions
1	3155.1
2	479.3

Year	Total Net Return
1	468.4455
2	74.0213

Year	Total Avg. Productivity
0	1.1493
1	1.1813
2	1.1733

Total_Population	
0	26785.0000
1	26443.7617
2	23799.5000

Total_Cost	
1	680.0994
2	658.0196

Total_Value	
1	1595.3307
2	1603.8312

Net_Utility	
1	915.2312
2	945.8115