User Manual for Personnel Inventory Aging and Promotion Model

Robert Shuford

CIM D0020718.A1/Final
June 2009

CNA
ANALYSIS & SOLUTIONS

Approved for distribution: June 2009

Henry S. Griffis

Henry S. Griffis
Defense Workforce Analysis Team
Resource Analysis Division

Approved for Pubic Release; Distribution Unlimited. Specific authority: N00014-05-D-0500.
Copies of this document can be obtained through the Defense Technical Information Center at www.dtic.mil
or contact CNA Document Control and Distribution Section at 703-824-2123.

Contents

The Personnel Inventory Aging and Promotion (PIAP) model

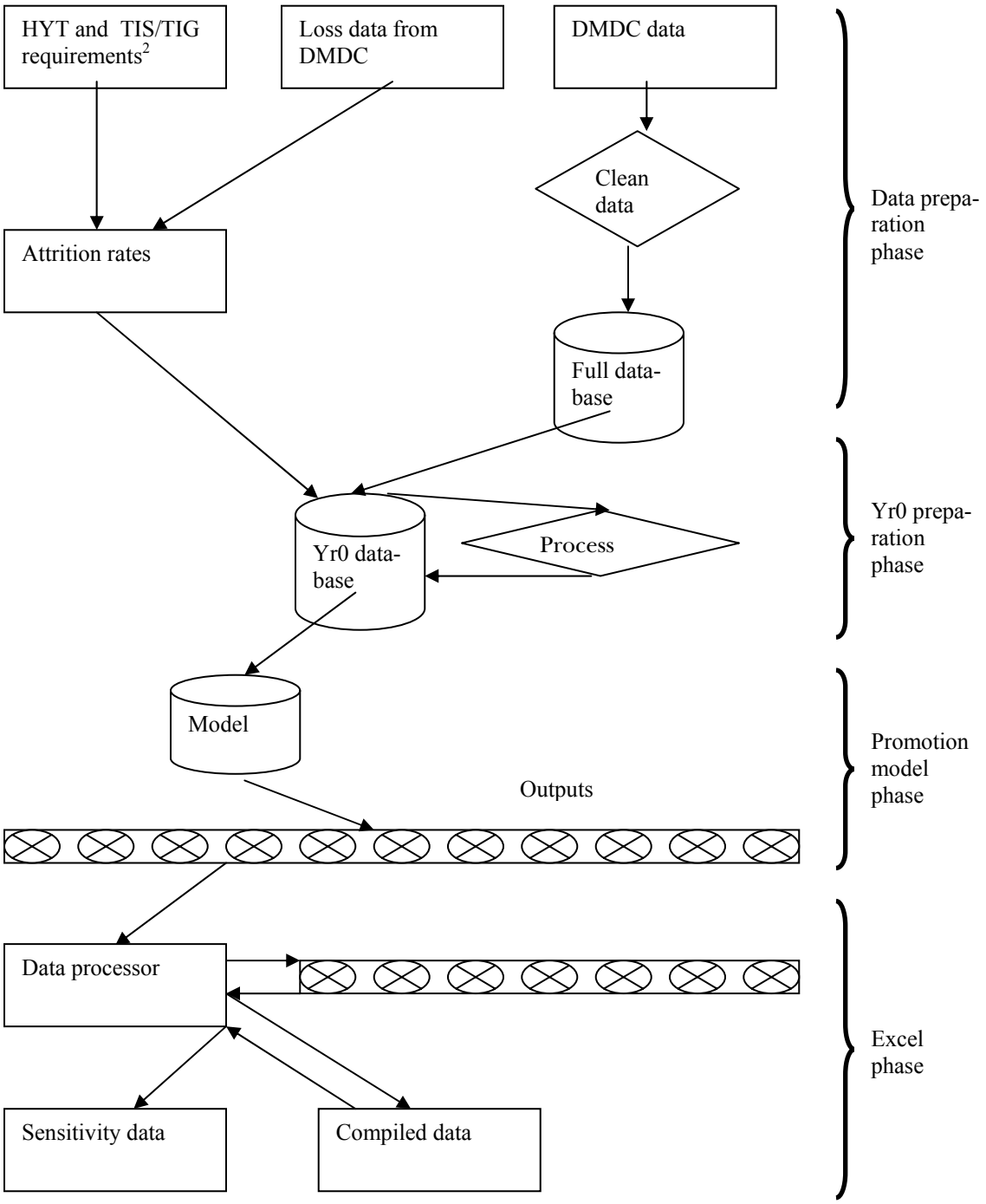
This manual describes not only how to use and maintain the PIAP model, but it also discusses its development, structure, usage, and outputs. Additionally, the manual provides guidance for interpreting the results.

The PIAP model can be used to examine the effect of various manpower policy implementations and their future consequences to the Navy's personnel profile. The user may analyze how policy changes will affect promotion tempo, promotion rates, likelihood of promotion, separation rates, and gaps between requirements and personnel.

The PIAP model incorporates several files in two different formats: Access and Excel[1]. The Access database, SourceData.mdb, contains the base data compiled from the original data from the Defense Manpower Data Center (DMDC). A second database, Yr0.mdb, links to SourceData.mdb and prepares the data for processing by the PIAP model, which is contained in a third Access file named PIAPM.mdb. The model generates numerous Excel outputs that are compiled by PIAPM.xls to produce statistics and charts describing the PIAP model's results. Figure 1, below, is a simple schematic that depicts the full process from input data to final results.

[1] We developed the model using Access 2000; its data processor was developed with Excel 2000. We tested both with the Office 2003 versions of these applications and found that they have full functionality.

Figure 1. Schematic of the PIAP model and data processor



[2] High Year Tenure and Time in Service/Time in Grade

SourceData.mdb

In the interest of limiting the model's file size, the base dataset, SourceData.mdb, contains the data from DMDC and should be held inviolate. It must contain the fields and data types as listed in table 1:

Table 1. Source Data Fields

Field	Type	Description
ssn	Text	Psuedo SSN for tracking individuals year by year
rate	Text	The two- or three-character rating
grade	Text	Paygrade
mos	Integer	Months of service
yos	Integer	Years of service
mig	Integer	Months in grade
yig	Integer	Years in grade

Note that the model only uses paygrades E3 to E9 and that all E1s and E2s have been "promoted" to E3. We believe this to be valid since promotion to E3 is virtually automatic after 1 year of service [1], and the model utilizes actual Time in Service and Time in Grade for promotions and separations. Since the model only handles the enlisted community, the grade field is of the form E03, E04, etc., but the actual format is irrelevant (it may be either numeric or text) as long the numeric part of the paygrade (i.e., 3, 4, etc.) is in the farthest right-hand position.

Yr0.mdb

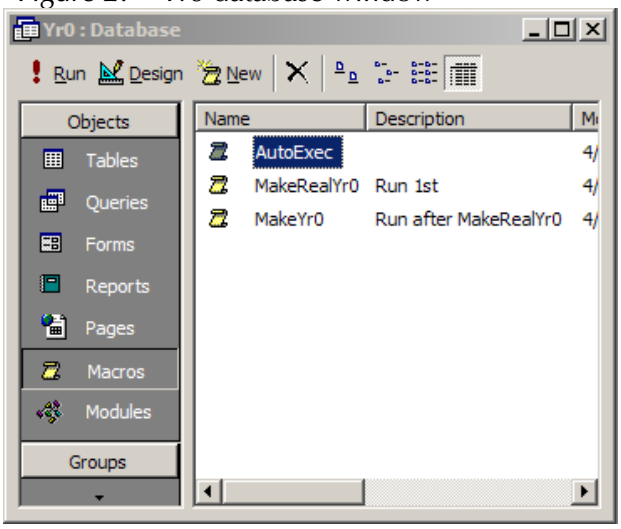
The purpose of the Yr0.mdb database is to clean the source data and prepare it for the PIAP model. It contains a link to the SourceData table in SourceData.mdb, and it also has one physical table named RealAttrRates with the following structure:

Table 2. RealAttrRates Fields

Field	Type	Description
rate	Text	The two- or three-character rating
pg	Byte	Paygrade
yos	Integer	Years of service
prob_sep	Double	Probability of separation in the next year

The attrition rates in this table are based on a 5-year weighted average[3] in the DMDC data through fiscal year 2007 with adherence to the Navy's High Year Tenure rules[4] [2].

Figure 2. Yr0 database window



In addition, this database contains three macros accessible from the Database Window: AutoExec, MakeRealYr0, and MakeYr0. AutoExec automatically executes when the database opens and refreshes the link to SourceData.mdb as long as the file is somewhere in the model's file path. MakeRealYr0 cleans the source data by deleting records with invalid paygrades, by converting the paygrades to a numeric field if necessary, and by creating a new table named RealYr0. This macro need only be run when SourceData.mdb has been updated with new data. The programming code for these macros and all supporting functions and subroutines can be found in appendix A.

[3] The weighting formula for attrition rates is:

$$\frac{5 * 2007\,Rate + 4 * 2006\,Rate + 3 * 2005\,Rate + 2 * 2004\,Rate + 2003\,Rate}{15}$$

[4] The 1 July 2005 change and Grandfather Clause to High Year Tenure for Navy E5s is handled programmatically.

Make Yr0

The MakeYr0 macro is used to create the rating specific data that will be accessed by the PIAP model. On activation, this macro

1. Asks the user to input a two- or three-character rating; if a three-character rating is entered, it is assumed that it is a compressed rating [3] that becomes a rating denoted by the first two characters at higher paygrades.
2. Determines the paygrade where the rating becomes compressed and calculates the ratio for distributing the compressed paygrades.
3. Queries the RealYr0 table for all records with the rate field equal to either the two- or three-character rating and stores them in a new table named Yr0.
4. "Promotes" all E1s and E2s to E3.
5. Deletes all records where any of the Time in Service or Time in Grade fields are missing or if Time in Grade is greater than Time in Service.
6. Warns the user if there is an overlap or a gap between the compressed and uncompressed paygrades. The user is asked to resolve the problem and code execution ceases.
7. Identifies each three-character rating that feeds into the compressed paygrades and calculates the proportion of the chosen rating among the uncompressed paygrades. It then randomly selects records among the compressed paygrades in this proportion.[5] Those not selected are dropped from Yr0, and the rating is changed to the chosen three-character rating for those selected. Since the selection for distribution is random, one execution of this macro *will not* result in the same dataset as that of another execution.

[5] For example, suppose the ratings ZZA, ZZB, and ZZC (composed of 10,000 sailors) combine into the rating ZZ at E9 (with 100 sailors) and that there are 5000 ZZAs, 3000 ZZBs, and 2000 ZZCs at paygrades E3-E8. If the user chose the rating ZZB, the model would randomly assign approximately 30 E9s to the ZZB rating.

8. Creates two new tables in the database.

    a. PGRollup has nine records containing the number of records in Yr0 for each paygrade.

    b. RateRollup has one record with the total number of records in Yr0.

9. Selects records from the RealAttrRates table that have the three-character rating for uncompressed paygrades and the two-character rating for compressed paygrades, and it puts them into a new table named AttrRates.

The final Yr0 table has the following structure:

Table 3. Yr0 fields

Field	Type	Description
ssn	Text	Psuedo SSN for tracking individuals year by year
pg	Integer	Paygrade
rate	Text	The two- or three-character rating
yos	Integer	Years of service
yig	Integer	Years in grade
months	Integer	Months of service
mos_pg	Integer	Months in grade
Drop	Long	Unused

Running the PIAP promotion model

The model produces three sets of outputs for each run, and each set uses a different promotion rule.

1. The Junior Rule first promotes those with the least Time in Service, assuming they meet the minimum requirements, and then it promotes progressively older individuals. See table 4 for minimum Time in Service / Time in Grade requirements [1].

2. The Benchmark Rule first promotes those individuals whose Time in Service is closest to the established Navy benchmarks. See table 5 for the benchmarks currently in

use. These can be changed by altering the ENs[6] function in the Main module. The programming code for the model can be found in appendix B.

3. The Senior Rule first promotes those with the most Time in Service and then promotes progressively younger individuals.

These rules establish a range for the promotion tempos that could be achieved with a given force profile.

Table 4. Service requirements for promotion (in months)

Paygrade	Minimum Time in Service	Minimum Time in Grade
4	24	6
5	36	12
6	84	36
7	132	36
8	132	36
9	228	36

Table 5. Navy time to promotion benchmarks [4]

Paygrade	Months
E4	26
E5	53
E6	108
E7	148
E8	222
E9	266

Outputs

The model produces outputs that allow for the analysis of

- Personnel profile by Time in Service, paygrade, promotion rule, and year.
- Time in Service and Time in Grade by paygrade, promotion rule, and year.
- Promotions by paygrade, promotion rule, and year.

[6] ENs is the name of a function in the model's programming and does not refer to the Navy's Engineman rating.

- Gaps between personnel and requirements by paygrade, promotion rule, and year.
- Separations by paygrade, promotion rule, and year.
- Time to promotion by paygrade, promotion rule, and year.
- Likelihood of Promotion to the next paygrade for the current personnel inventory by Time in Service, paygrade, and promotion rule.

The model also produces a table for each year named Yr1, Yr2, etc. The tables contain individual results so that an individual's career may be followed on a year-by-year basis. These tables have the following naming convention: Each is prefixed with the first letter of the rule and the rating currently being analyzed. For example, running the GSE rating for 5 years would produce

- JGSEYr1, JGSEYr2,…, JGSEYr5
- MGSEYr1, MGSEYr2,…, MGSEYr5[7]
- SGSEYr1, SGSEYr2,…, SGSEYr5

What the model does

The following nested pseudo code provides a simplified summary of the model's process, beginning with the current personnel inventory:

```
For each run
    For each promotion rule
        Make preparations
        For each year
            Separate E9s
```

[7] For formatting purposes in the final output, the Benchmark Rule is identified by the letter "M" rather than "B" in order to allow Excel to use its default alphabetical ordering.

For each paygrade E8-E3

Separate

Promote

Next paygrade

Access new E3s

Compile data for year

Next year

Compile data for all years

Cleanup

Next promotion rule

Next run

When the user clicks the Run button, any remaining tables from previous implementations are deleted and the target numbers for each paygrade are calculated simply by taking the number in each paygrade in [Yr0][8] and adjusting for changes in requirements as entered in the Increase Decrease Manpower Targets form. New tables are created to hold the output data. Each year up to the Number of Years input are handled in turn. First, the E9s in [Yr0] are loaded into a temporary table named "temp" and merged with data for separation probabilities and the manpower requirement [target] for E9. Each record in [temp] is either separated or aged depending on the value of a random number ($0 <= \alpha < 1$). If this number is less than the separation probability for that rating ([rate]), paygrade ([pg]), and years of service ([yos]) combination, then [target] is set to NULL; otherwise, [yig] is increased by 1 and [months] is

[8] It is common custom to denote database tables and fields by enclosing their names in brackets. When it is necessary to refer to a field in a specific table, the convention is to use the table name in brackets, an exclamation mark, and the field name in brackets, e.g., [table]![field].

increased by 12. Now, an SQL[9] statement deletes records where [target] = NULL, and the model calculates the number of E8s that need to be promoted to reach the target for E9s. The remaining records are loaded into a new table [Yr1].

Paygrades E8 to E3 are then handled in descending order. Each paygrade in turn is loaded into [temp] from [Yr0], along with the separation probabilities and the manpower requirements (in the process destroying the old [temp] table). These are sorted and indexed by [months] depending on the promotion rule. If it is the Junior Rule, then the records are in ascending order; they are in descending order if it is the Senior Rule. For the Benchmark Rule, the records are in ascending order of the absolute value of the difference between Time in Service ([months]) and the benchmark for that paygrade. The records are chosen for separation in the manner described above and deleted from [temp], and the number of promotions needed for the next lower paygrade is calculated. [months] and Time in Grade ([mos_pg]) are increased by 12 for the remaining records, and the program moves through the sorted records promoting each individual that is eligible until either there is no further need for more promotions or until the end of the data is reached.

Those promoted have Years in Grade ([yig]) and [mos_pg] set to 0; otherwise, [yig] increases by 1 and [mos_pg] increases by 12. The records are loaded into [Yr1], and the next paygrade is processed. At this point, data for Time in Service, Time in Grade, separations, and promotions are collected in tables that will be output later. Finally, the number of required accessions to E3 is calculated on the basis of current end strength, predicted first year attrition, and the manpower requirements entered by the user. The new E3s are added to [Yr1], and each is assigned a unique identifier in the [ssn] field. These are easily identified in the yearly table because the first character is the letter "A."

When this process is completed for each year, the statistics are compiled and loaded into new tables. First, [AllYrs] is created with the

[9] Structured Query Language—the industry standard language used by Access to manipulate database tables.

help of temporary queries. For each year and paygrade, the target number and actual resulting count is calculated by the first query. The second query calculates average number of months to promotion, by paygrade, for those promoted in that year. These two queries are combined and loaded into [AllYrs].

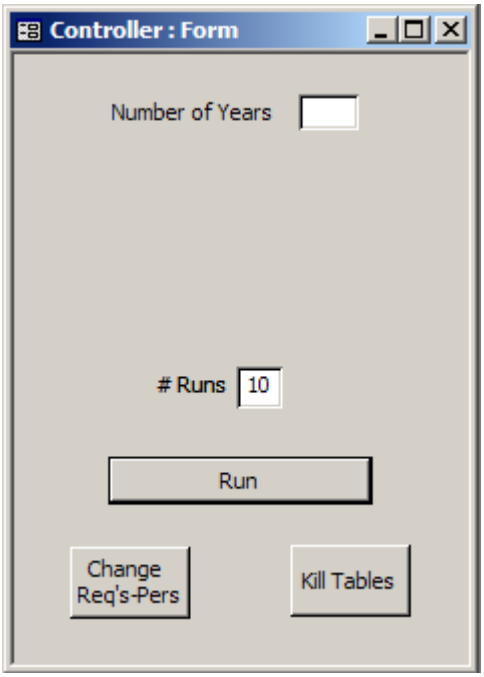
At the completion of the final year of the run, the [Likelihood] and [Expected] tables are created. The first step in this process is to dynamically build an SQL statement, based on the Number of Years, which creates a temporary table adding promotion results to the data for each paygrade/years of service cohort in the [Yr0] table. This table has individual-level, longitudinal records. Next, a dynamically built SQL statement based on the Number of Years, creates a new data structure and calculates counts and yearly averages by cohort in [Likelihood]. Another one calculates the overall likelihood of promotion. [Expected] is created in the same manner but uses only those records where there has been a promotion at some point. **Only the FIRST promotion for an individual is considered for the [Likelihood] table.** At the end of each run, the data tables are renamed and exported to Excel for further processing by PIAPM.xls.

PIAPM.mdb — the PIAP model

PIAPM.mdb contains four linked tables, five forms, one macro (the same AutoExec as in Yr0.mdb, described above), and six code modules. The linked tables (Yr0, AttrRates, OccRollup, and PGRollup) are linked to the Yr0.mdb database so as not to make the model unnecessarily large. Due to Access' inherent inefficiencies, the model's file size grows rapidly, so the user must compact it frequently. To do this, click on the menu bar: Tools→Database Utilities→Compact and Repair Database. The database will perform this automatically when it is closed.

Controller form

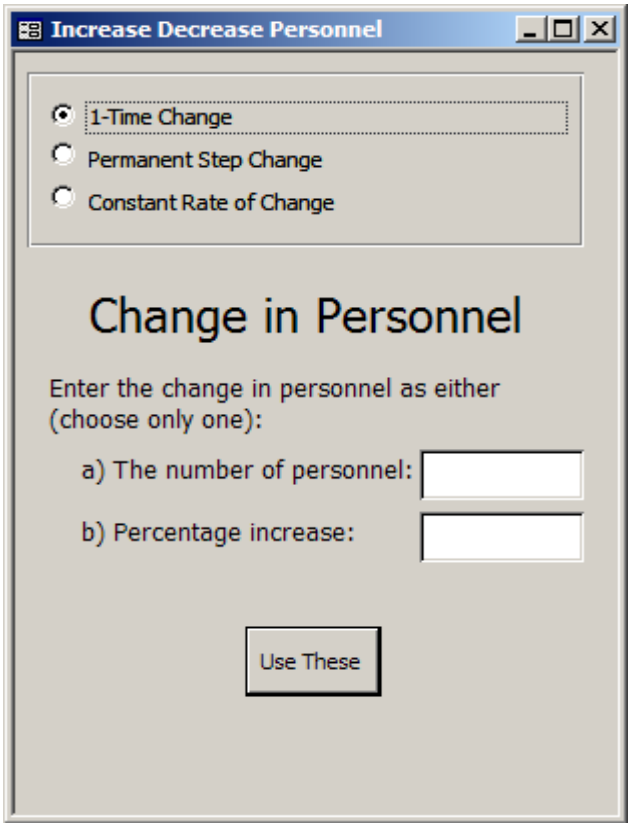
Figure 3. Controller form



When the model opens, the Controller form automatically opens. The form has two text boxes for user input, three visible buttons, and two hidden buttons in the bottom left- and right-hand corners. The user enters the Number of Years (required) into the future for which the model will project and generate data. The user also enters the number of runs that the model will make in order to smooth out the variations that occur. We explain why this is necessary later in this document. A subdirectory for each run will be created in the model's directory to hold its outputs. The Kill Tables button deletes all tables and queries created by the model, including those that were not destroyed during program execution because of an error or user intervention leading to program termination. All of these tables are deleted at the beginning of each run, but this button allows the user do so at will, usually before closing the file to reduce its storage size. The hidden button in the bottom right-hand corner deletes the output files in the subdirectories. These files are also deleted at the beginning of each run. This button requires a double-click because these deletions are permanent and the files cannot be recovered from the Recycle Bin. The hidden button at the bottom left-hand corner requires only a single-click and exports all of the form and code modules to a subdirectory named Modules that must already exist in the same directory where the model resides. For both of these hidden buttons, a message box alerts the user that the operation was successful. Clicking the Change Req's-Pers button opens the Increase Decrease Personnel form, and clicking the "Run" button begins the model's execution.

Increase Decrease Personnel Form

Figure 4. Increase Decrease Personnel Form



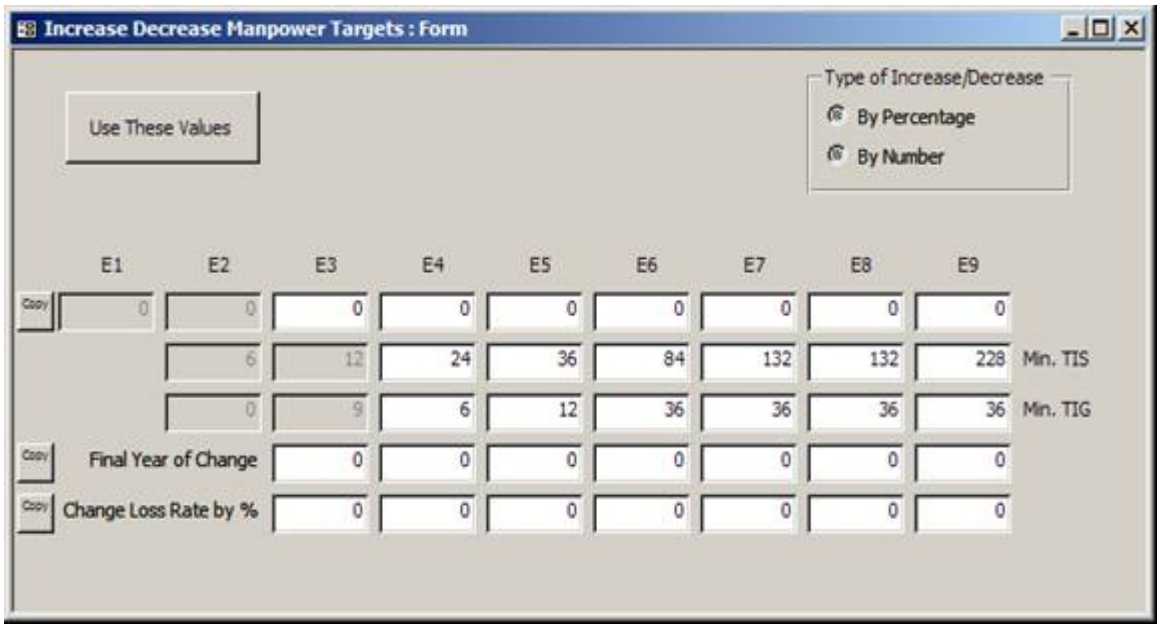
This form allows the user to add or subtract accessions. The user can select a one-time change, a permanent-step change (the same number or percent change every year), or a constant rate of change. By default, the model accesses to E3 the number that it predicts it will need to meet the personnel end strength requirements.

By entering a number in the first text box, the model will access that number over and above requirements. This is equivalent to changing the E3 requirement on the Increase Decrease Personnel form by the same amount. Entering a decimal (e.g., .1 to increase by 10 percent) in the second text box will do the same on a percentage basis. Enter a negative number to effect an equivalent decrease in accessions. If there are values in both text boxes, the first box will be used. Choosing 1-Time Change causes this increase to be applied to the first year only; choosing Permanent Step Change applies the increased accessions to each year; and choosing Constant Rate of Change will increase the accessions by this number or percentage in each year, compounding the change in the case of a percentage change.

Clicking the Use These button opens the Increase Decrease Personnel Manpower Targets form.

Increase Decrease Manpower Targets form

Figure 5. Increase Decrease Manpower Targets form



This form allows the user to alter the manpower requirements, promotion rules, and attrition rates. The first row of this matrix allows the user to enter an annual change in requirements for each paygrade, and the fourth row denotes the year in which the increase/decrease will end. For example, if there are currently 100 E5s and the user enters 10 in the first row of the E5 column and 5 in the fourth row, the requirements will be 110 in the first year, 120 in the second, and so on. In the fifth year and beyond, the requirements will be 150. Correctly choosing a Type of Increase/Decrease is necessary since this example would increase requirements 1000 percent each year if By Percentage were erroneously checked; this would likely cause the database to exceed its maximum size of 2Gb and make it permanently unusable. In this example, an alternative method of reaching 150 in the fifth year is to calculate the percentage change necessary in each year to reach that goal:

$$\left(\frac{150}{100}\right)^{\left(\frac{1}{5}\right)} - 1 = .08447$$

Enter that number into the first row and choose By Percentage for Type of Increase/Decrease. In the fifth row, the user can vary the overall assumed attrition rates for each paygrade. For example, if E5 has an overall loss rate of 10 percent, entering .2 in the fifth row under E5 will result in an overall attrition rate of 8 percent[10]. For ease of entry, rows one, four, and five have buttons to the far left that will copy the values in the E3 column to all columns. The second and third rows of the matrix allow variations in Time in Service and Time in Grade minimums (in months) for promotion to each paygrade.

Warning form

Since the consequences of reaching Access' maximum file size are so dire (permanent file corruption and nonfunctionality), we have included programming that monitors the size of the database and warns the user when it reaches 50 percent, 75 percent, and 90 percent of the size limit. In addition, the Warning form projects the size of the database at the end of its runs, and, should its projected size exceed the limit, it warns the user at each of these points with increasingly urgent (and apocalyptic) messages on the Warning form. Inexplicably, Access itself provides no such warnings; it simply continues to add data until it stops functioning.

[10] Recall that attrition rates are based on rating, paygrade, and years of service, so the effect may be, for example, to reduce the rate for a sailor in his tenth year from 20 percent to 16 percent and to reduce the rate for a sailor in his eleventh year from 5 percent to 4.5 percent. However, since these are linear transformations, the seniority profile of the E5s will not affect the overall change in attrition.

Figure 6. Database exceeds 1Gb

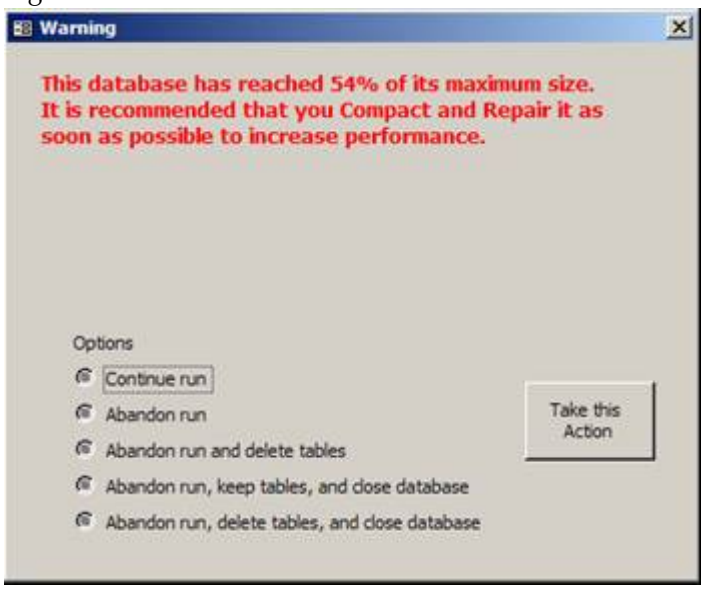
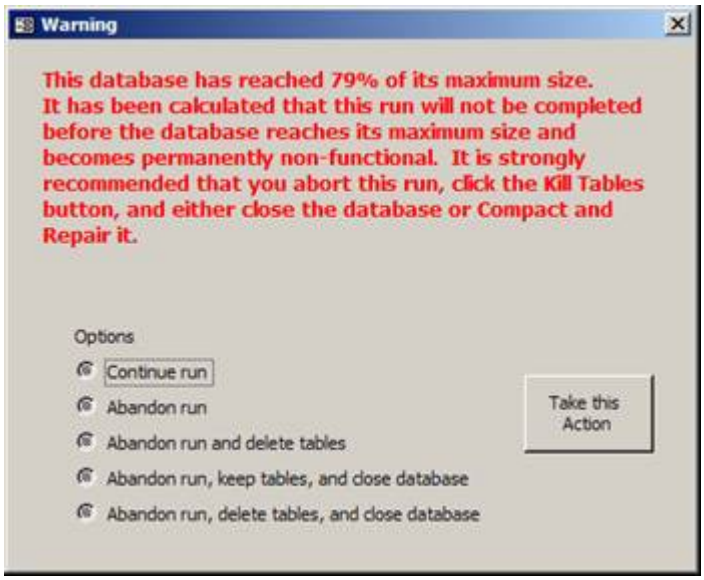


Figure 7. Database exceeds 1.5 Gb and is projected to fail



PIAP data processor

PIAPM.xls

The Excel workbook, PIAPM.xls is the driver for 1) importing the spreadsheets that were output by the PIAP model; 2) processing the data; 3) resetting the pivot tables, charts, and control objects; and 4) creating the sensitivity data. This file must be in the same directory as PIAPM.mdb and the Runs subdirectories containing the new data. When the file opens, it creates a new toolbar at the bottom left of the window with three buttons captioned Import New Data, Compile Multiple Files, and Sensitivity Data. When the file closes, this toolbar is destroyed.

The driver compiles the data exported by PIAPM.mdb to produce datasheets, pivot tables, and charts depicting

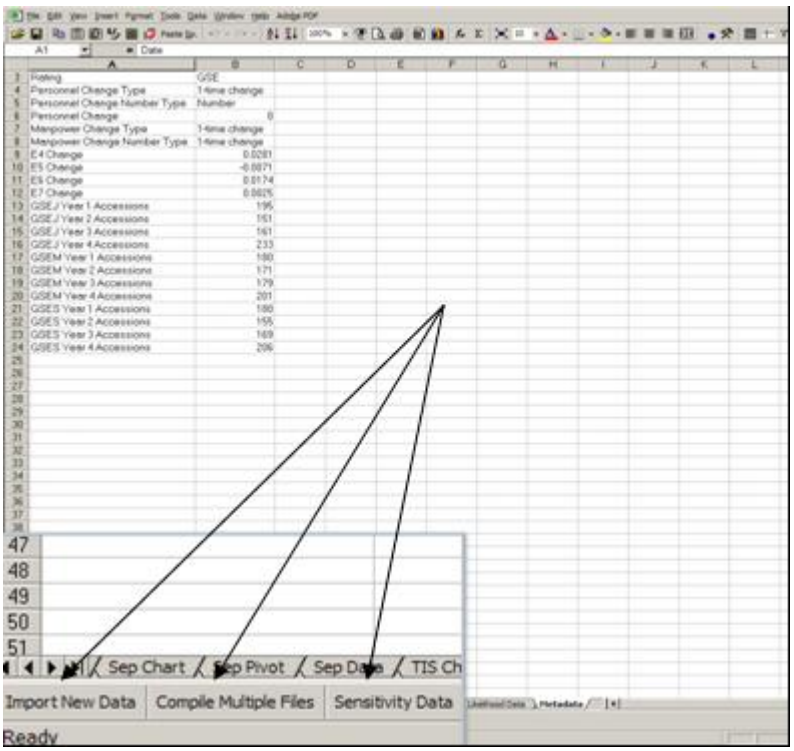
- Mean Time in Service and Time in Grade
- Percentage of individuals in each paygrade who promote
- Gaps between manpower and requirements
- Attrition rates
- Time to Promotion ranges achievable under the current promotion requirements and personnel profile
- Likelihood of promotion in each year for the individuals in the current inventory

Each of these metrics can be examined as year-by-year trends, by paygrade, and under any of our assumed promotion rules. The programming for PIAPM.xls is in appendix C.

Using the driver

PIAPM.xls contains templates for receiving the newly imported data, and these templates are updated to handle the configuration of the variably structured data (in terms of years and the number of runs that the user entered in the PIAP model).

Figure 8. Import Compile and Sensitivity buttons



When the user clicks the Import New Data button, he/she is prompted to enter the number of runs that the model had executed to produce the outputs, and the driver will import from each of the subdirectories up to this number. After importing and processing the data, the driver will save the file with the name Results_*date*_*time*.xls where *date* is the current date and *time* is the current time.[11] This results in one Excel file for each run. **Note: The driver opens and creates literally hundreds of workbooks and must keep track of each, so it is strongly recommended that the user allow the program to complete without interference, i.e., the user**

[11] Date is in the format "MMDDYY," and time is in the format "HHMMSS."

should not attempt to use or activate any other application until it is finished; otherwise, the driver will likely fail.

Clicking the Compile Multiple Files button imports the data from files created by the Import New Data procedure. It will attempt to import all Excel files whose name begins with "Results_," so it is necessary to remove all of the files created by a previous run. If these old files used a different number of years, the program will inform the user and abort, but if the same number of years were used but with different inputs, the consequence will be a mixture of results. The user could inadvertently attempt to analyze data produced from multiple, possibly contradictory, assumptions. The compiling procedure takes the results of these files, averages them, and calculates the standard deviations, minimums, and maximums. We do this to smooth out the variation among the PIAP model's runs. These smoothed data are used to produce a new file containing all of the datasheets, pivot tables, and charts contained in the individual files, plus the extra metadata statistics created during the compiling process. The driver saves the compiled data to a file named Compiled_*runs*_Files_ *years*_Yrs.xls where *runs* is the number of runs and *years* is the number of years used in the PIAP model.

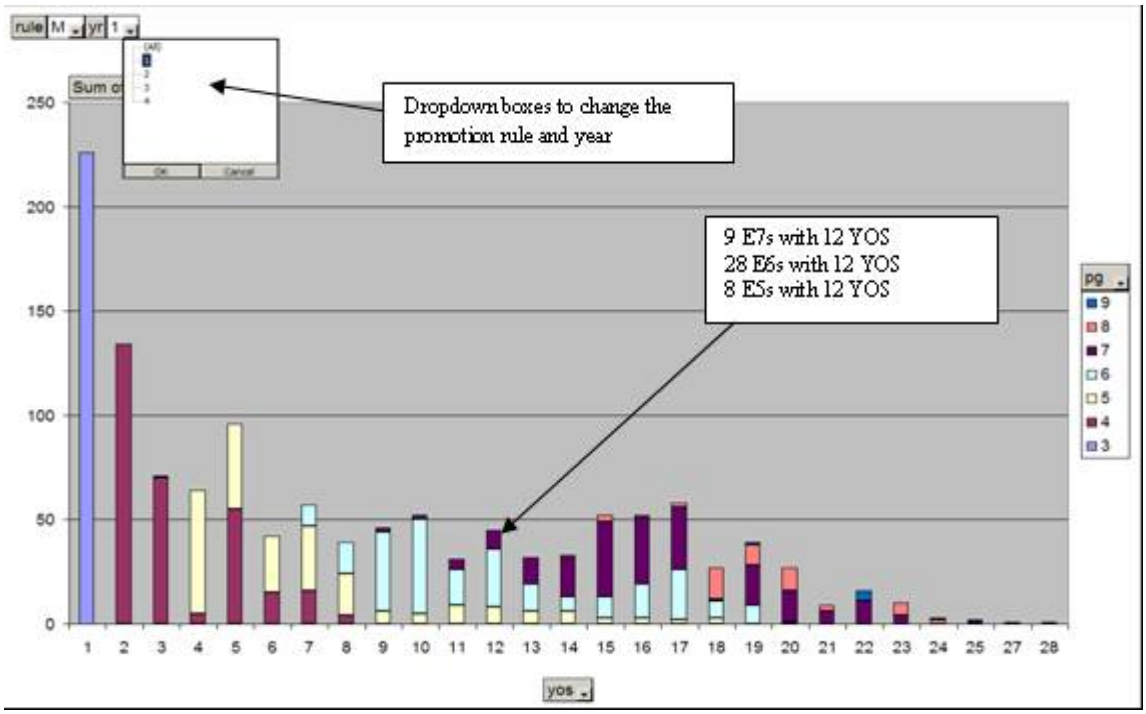
While promotions in this model are deterministic, the separation aspect is random at the individual level making the model a stochastic process. The probability of separation is assigned to each individual by rating, paygrade, and years of service based on a weighted 5-year average. Thus, it is necessary to get an idea of the robustness of the model.

With the file created by the Compile Multiple Files procedure open and activated, clicking the Sensitivity Data button will produce a new tool for examining the variation across all runs of the PIAP model.

Importing new data

Upon clicking the Import New Data button, the program loops through the runs and promotion rules, opening each spreadsheet produced by the PIAP model and saving a new file for each run. We now examine the result of a single run. The YOS_PG Chart shows the number of sailors with a GSE[12] rating in each year of service by stacked paygrade in the first year using the Benchmark Rule.

Figure 9. Years of service by paygrade



[12] Gas Turbine System Technician, Electrical

Figure 10. Time in Service / Time in Grade

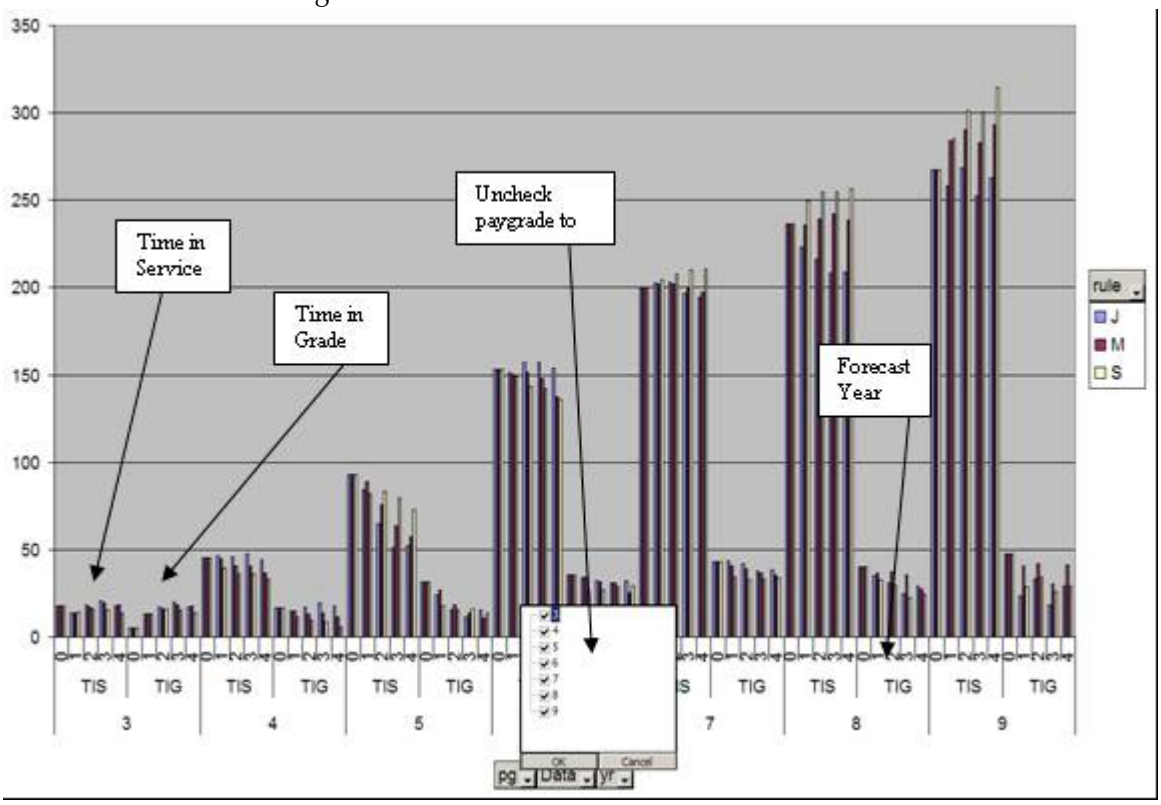


Figure 10, shows the average Time in Service and Time in Grade for GSEs year by year, in each paygrade, and for each promotion rule. Paygrade and year are along the x-axis, and the dropdown boxes provide a way to examine the data in more detail by deselecting values in any field. For example, the user can uncheck the 3, 4, 8, and 9 boxes to see just E5-E7.\

The Prom Chart in figure 11 shows the percentage of each paygrade that promotes in each year under each promotion rule. The numerators in these percentages are the number of individuals in each paygrade that promoted in that year, and the denominator includes the number in that paygrade at the beginning of the year plus the accessions to E3. Thus, the individuals not promoting include separations. A comparison with figure 13, the Separation chart, gives an indication of what percentage in each paygrade and year failed to promote, either through lack of need or by not being eligible due to Time in Service or Time in Grade requirements.

Figure 11. Prom chart

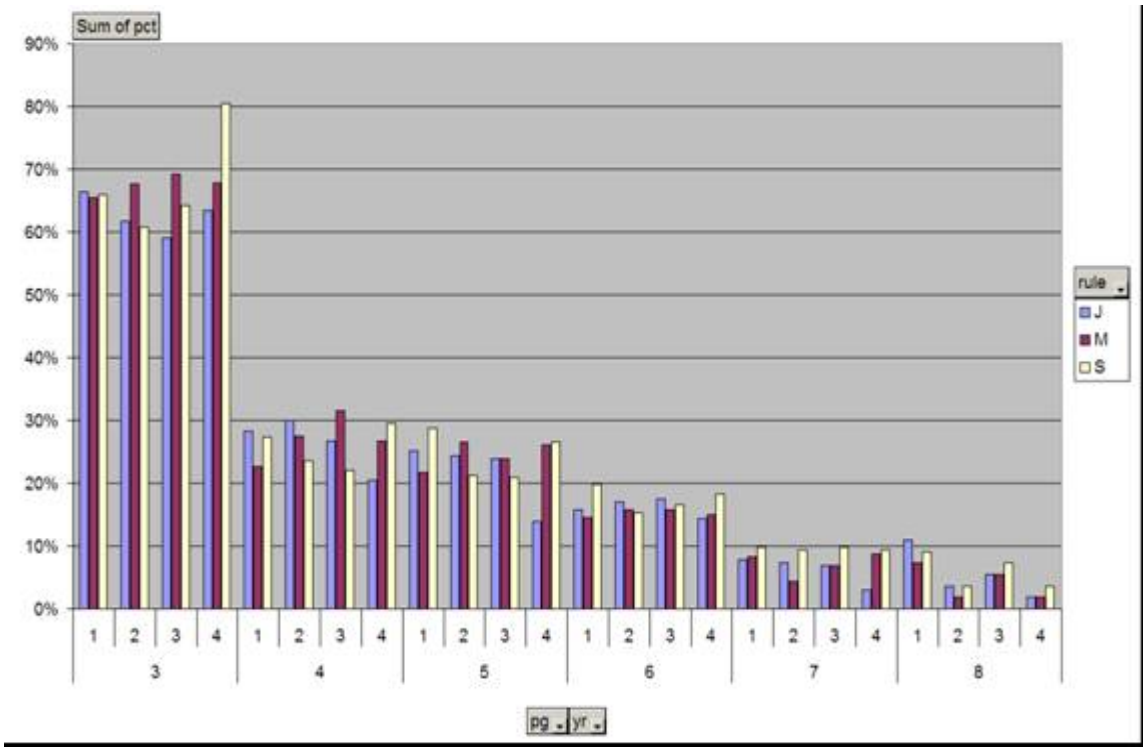


Figure 12, the Shortage chart, tells us that the PIAP model predicts we will have a shortage of 42 E6 GSEs in the fourth year under the Junior Rule. This is a 17.4 percent gap between personnel and requirements,[13] and it indicates a significant problem will occur in the future unless steps are taken. Since the model accesses to end strength and not simply to fill the E3 billets, we see overages (represented by negative shortages) in the first and fourth year due to the gaps for E4 and E6, respectively. The variation from zero in the second and third years for E3s is the result of imperfectly[14] predicting first-year attrition for the new accessions.

Figure 12. Shortage chart

[13] In this example, when all ten runs are compiled (as described later), the average gap for E6s in the fourth year is 33.7 (approximately 14 percent).

[14] These variations from requirements are in the 1 to 2 percent range.

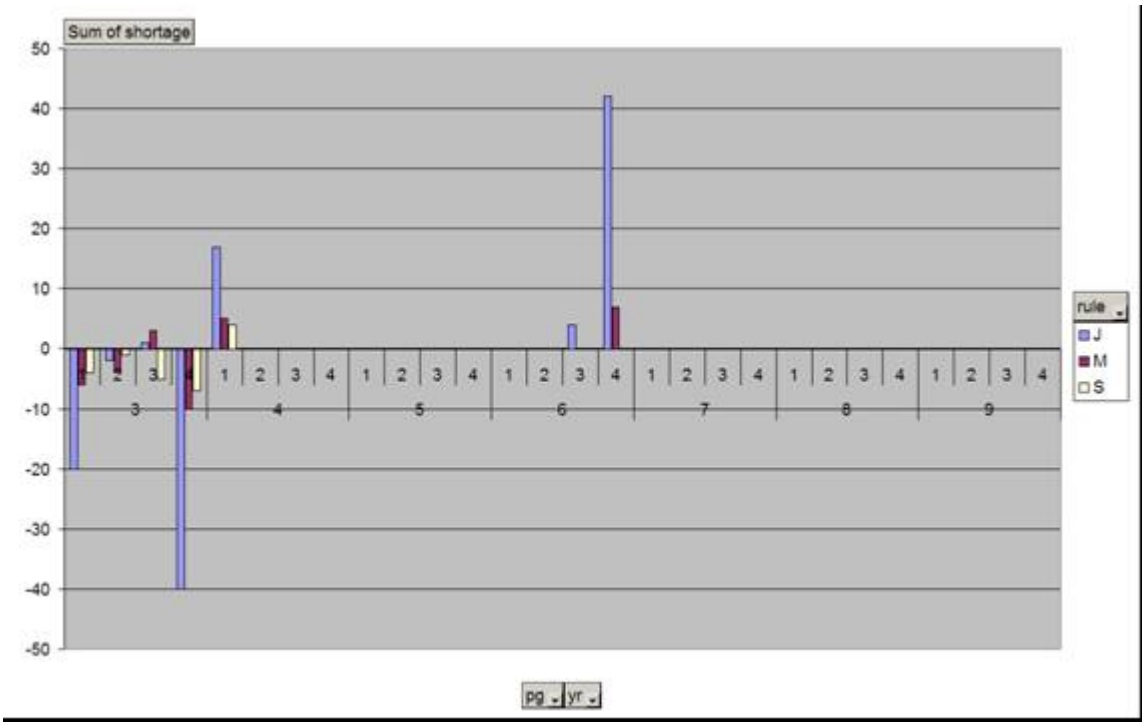
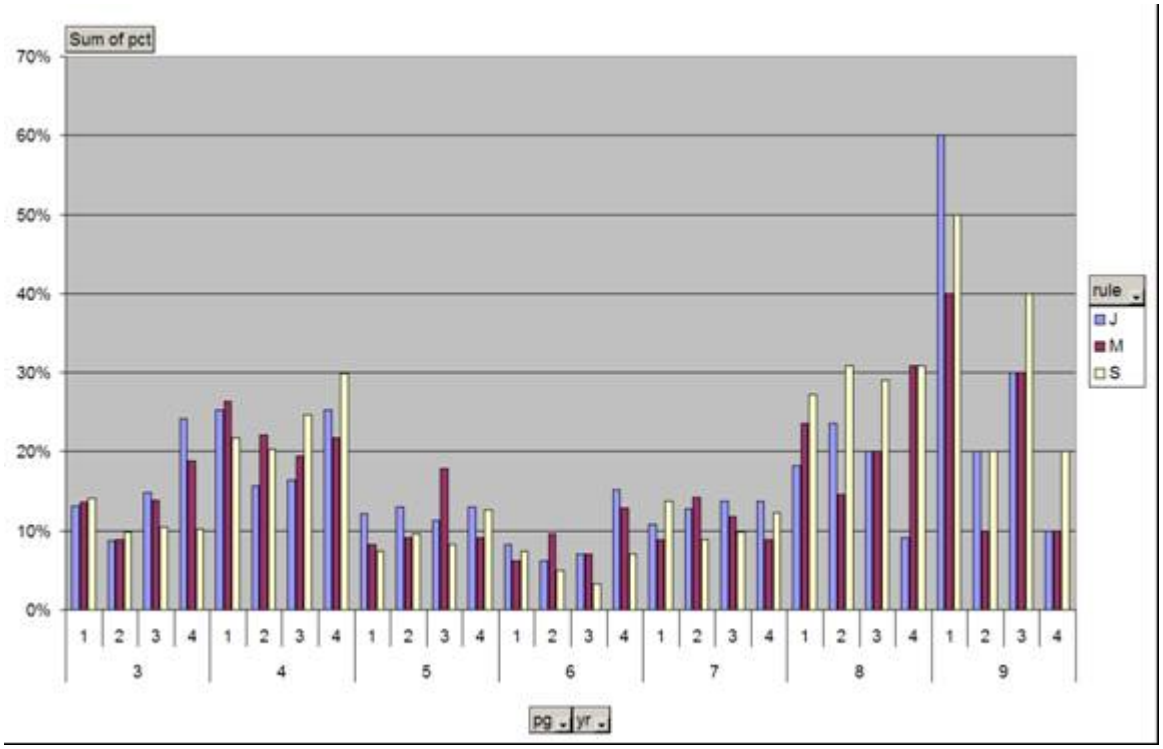


Figure 13. Sep Chart

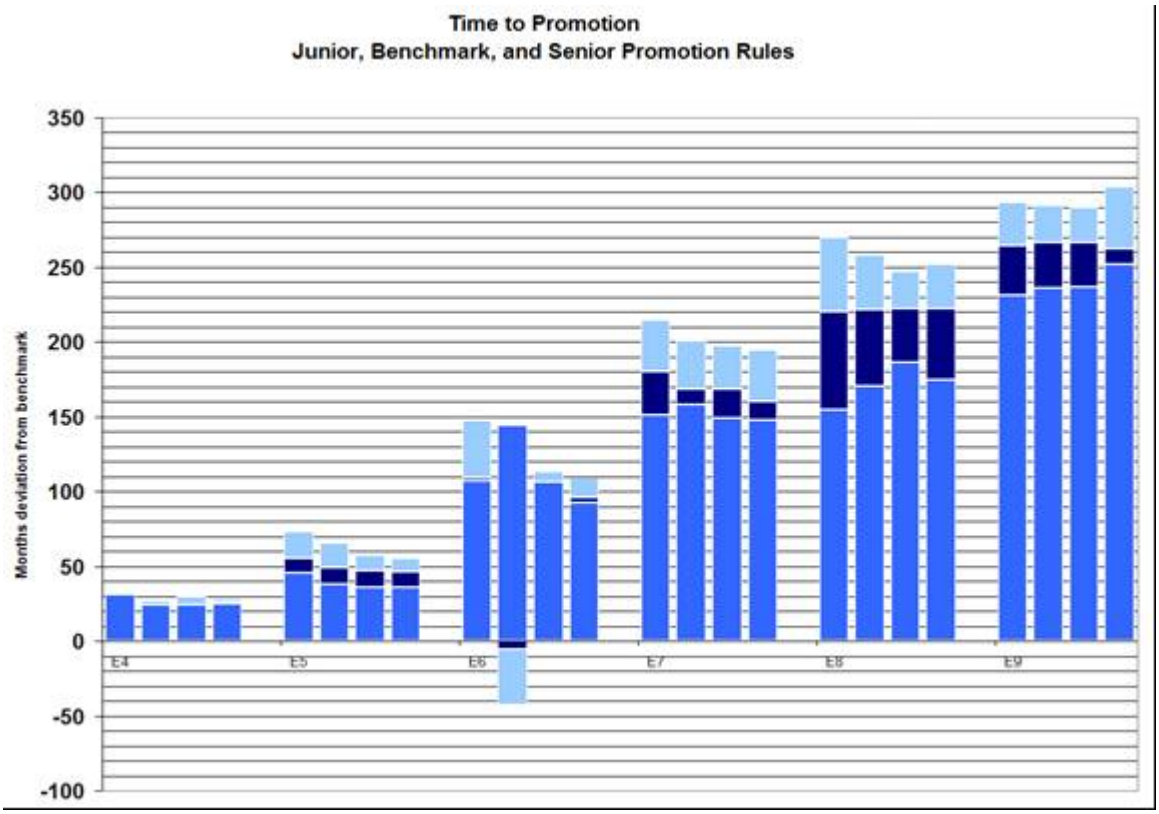


The Sep chart shows loss rates year by year, in each paygrade, and for each promotion rule. The unexpectedly large E9 attrition in the first year is reflective of both the small number of E9s in this rating and the large percentage of E9s in our data that are just reaching retirement eligibility in the first year of the model. All of our E9s and nearly three-fourths of our E8s are eligible to retire.

The TIS[15] Chart gives the user a view, by paygrade and year, of time to paygrade, in months, at the time of promotion for those who promoted in that year. The stacked bars show time for the Junior, Benchmark, and Senior Promotion Rules in blue, dark blue, and light blue, respectively.

Figure 14. TIS Chart

[15] Time in Service



Note the bars for E6s in the second year that extend below the 0 months line. This is not, of course, negative months; these times are relative to that of the Junior Rule. In this case, the Junior Rule yielded a mean of 142 months to E6, 130 months[16] for the Benchmark Rule, and 105[17] months for the Senior Rule.

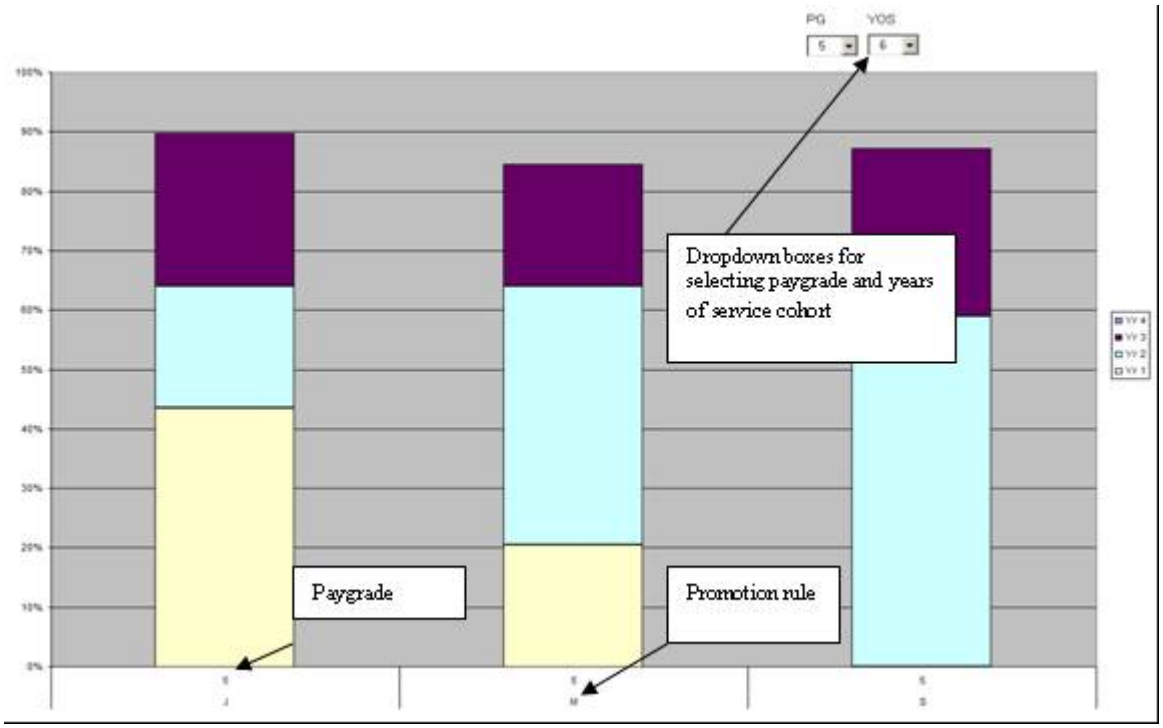
How can promoting older sailors result in a lower mean time to promotion than promoting younger sailors? This seeming anomaly sometimes results in the out years. In the first year under the Junior Rule, all of the younger sailors are promoted, leaving the older ones and those not yet eligible. Likewise, using the Senior Rule, all of the older sailors are promoted, leaving the younger ones and those not yet eligible. If there are relatively few E5s that become eligible for promotion in the next year, the reservoir of older sailors previ-

[16] -12 relative to the Junior Rule

[17] -37 relative to the Junior Rule

ously passed over using the Junior Rule must be promoted, increasing the average Time in Service. Again, likewise, all of the younger sailors previously passed over using the Senior Rule must be promoted, decreasing the average Time in Service.

Figure 15. Likelihood chart



The Likelihood chart differs from all of the other outputs in that it deals only with the current inventory. The model tracks the individuals in the Yr0 table through the years and finds their *first* promotion. In this example, we see that of our initial E5 cohort with 6 years of service, 44 percent promoted to E6 in the first year, 20 percent in the second, and 26 percent in the third using the Junior Rule. Under the Senior Rule, none promoted in the first year, 60 percent in the second, and 28 percent in the third.

Compiling multiple runs

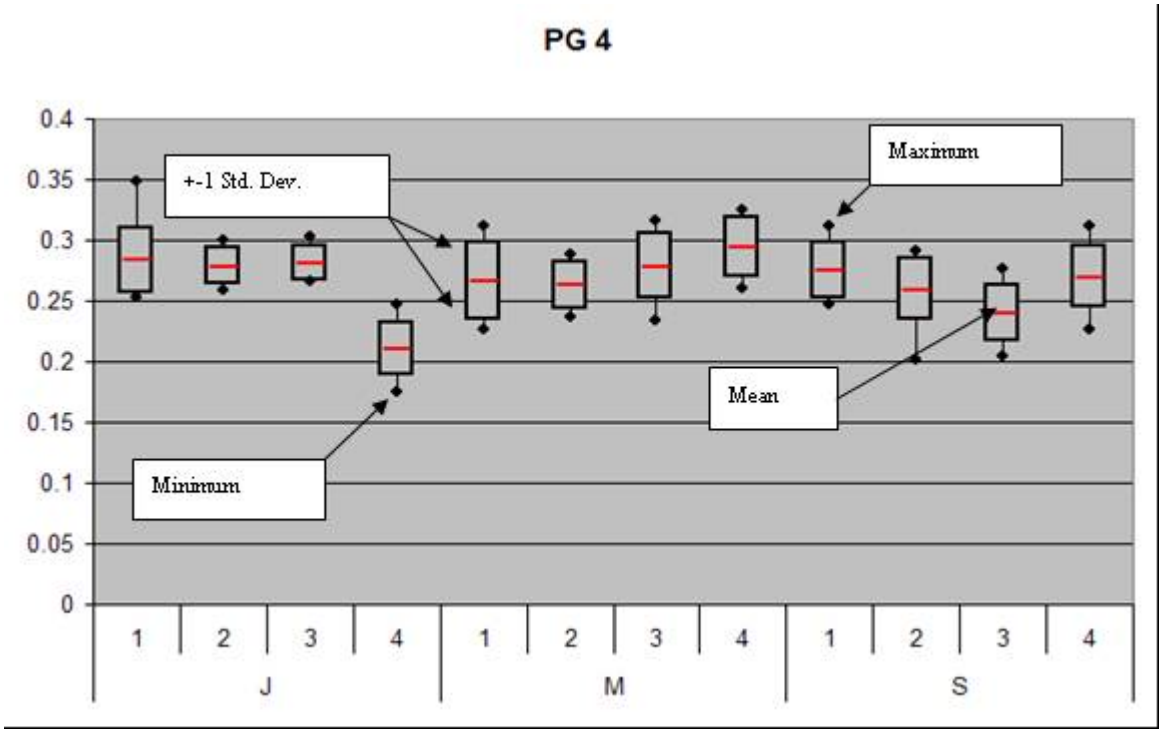
In order to smooth out the results and reduce the variation that will occur among the individual runs, they should be compiled into a single file and averaged. The resulting file is named Compiled_*rating_runs*_Files_*years*_Years.xls. It contains the same charts and data as the files for the individual runs, but it also has statistics for minimums, maximums, and standard deviations.

Sensitivity data

As previously noted, PIAPM.xls is fully functional under Excel 2003; however, a particular setting may need to be adjusted to allow the Sensitivity program to run. On the Menu Bar, under Tools→Macro→Security, the user should click on the Trusted Publishers tab and check the "Trust access to Visual Basic Project" checkbox. This security feature is disabled by default in Excel 2003.

To produce a new file in order to examine the robustness of the model, the user should open the file created by clicking the Compile button and click the Sensitivity Data button. Clicking this button **while the previously created compiled data file is active** will provide the user with a new tool to examine the robustness of the PIAP model, and it will help the user determine whether there is too much variation among the runs to be useful. If the user concludes this to be the case, he/she may try increasing the number of runs in the model. If this does not improve the results, it may be that the number of individuals in that rating is too small to model reliably. This new file will be named Sensitivity_Data_for_ *rating_runs*_Files_*years*_Years.xls. The sensitivity data are presented in the form of bar charts with indicators for mean, minimum, maximum, and plus or minus one standard deviation.

Figure 16. Box plot charts



In Figure 16, we see the variation in promotion rates for E4s in each year under each promotion rule. To see the promotion rates for other paygrades, the user should click the Open Chart button at the top right of the screen, shown in Figure 16, to open a context sensitive form and explore the data. As shown in Figure 17, the user should select the desired inputs and click the Create Chart button to add a new chart for comparison or for export. Checking the "Delete all old charts" box will leave just the new chart, making the file size much smaller; while leaving it unchecked makes it possible to create a large number of charts for examination or for copying and pasting into another application. The user must close the form to examine another sheet. Since the form is context sensitive in the sense that its controls depend on which worksheet is active when the Open Chart button is clicked, it is created as modal[18] so the

[18] A modal form or window requires the user to take some action before continuing. It may be operating-system wide (i.e. not allowing the user to use any application) or it may be specific to a particular application.

user cannot do anything else in Excel while the form is open; otherwise, errors may occur. If the user wishes to change this behavior and is familiar with Visual Basic for Applications (VBA) or some other integrated development environment (IDE), he/she can set the form's ShowModal property to False in the Visual Basic Editor.

Figure 17. Open Chart Form button

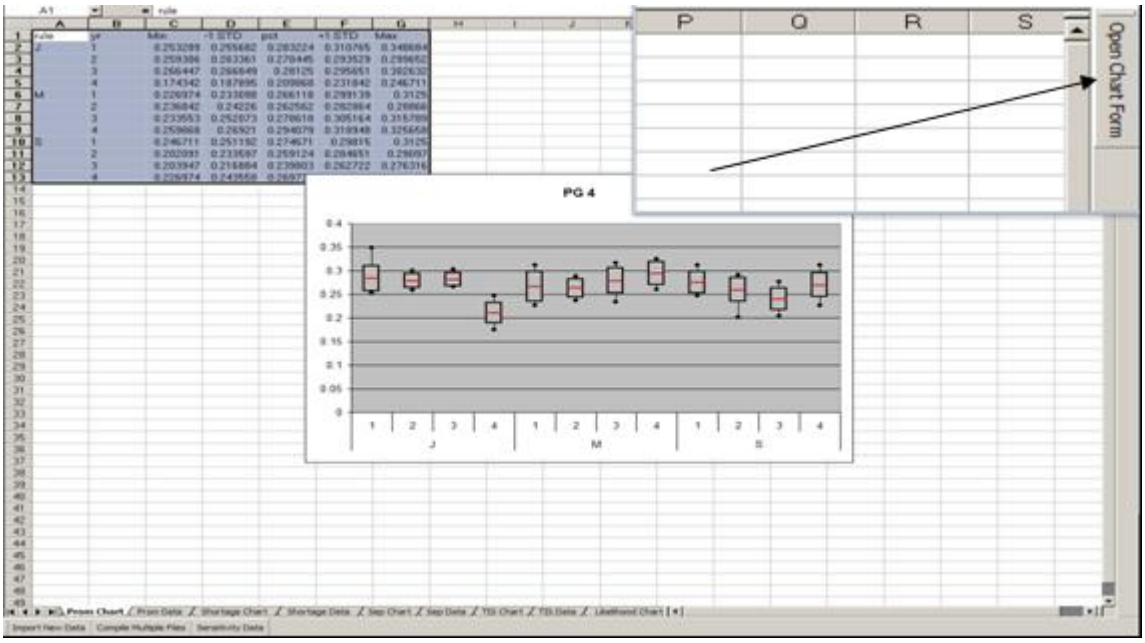
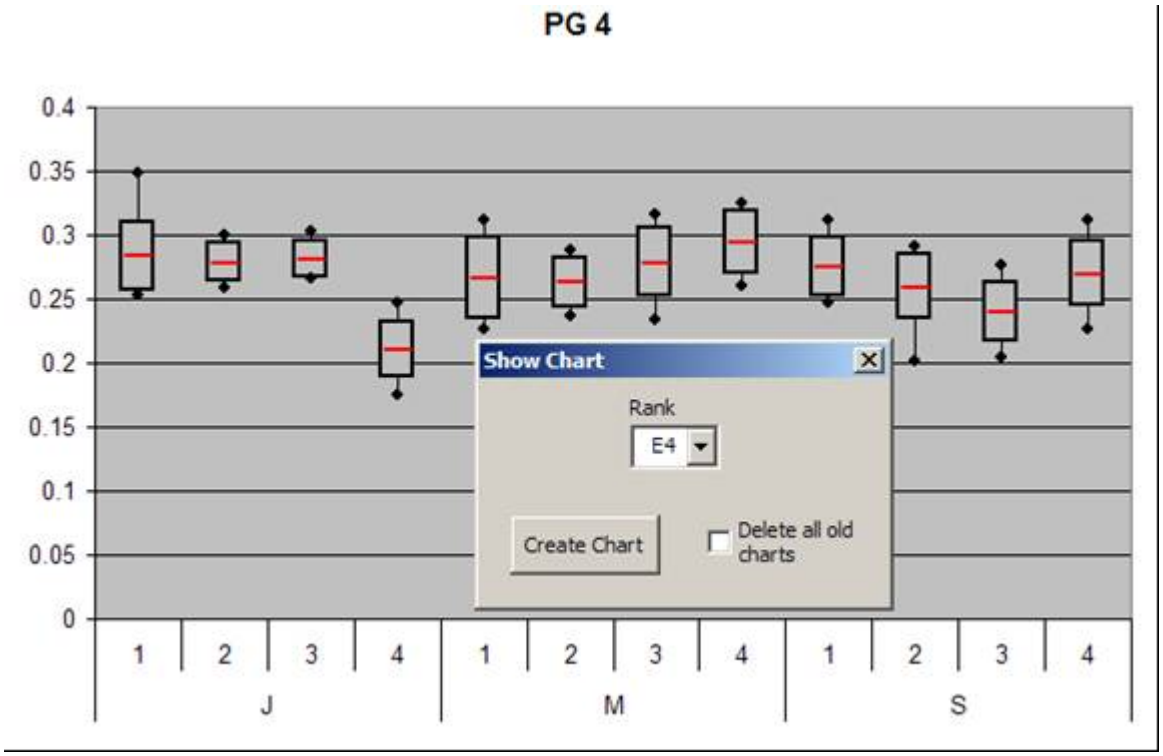


Figure 18. Robustness of promotion rates



The charts produced by PIAPM.xls provide a quick, graphical glimpse into the data output by the PIAP model, but a thorough analysis requires a rich dataset. As such, the data behind the charts are provided and transparent for both the compiled outputs and on the individual run level, as are the pivot tables behind the charts. For a more in-depth analysis, the user can access the yearly tables in PIAPM.mdb and examine the data at the individual level.

The model is user configurable

The PIAP model was designed to be versatile and scalable. The programming code modules for Yr0.mdb, PIAPM.mdb, and PIAPM.xls are unprotected and available to the user for additions and adjustments. If the user wishes to substitute updated source data, he/she should provide it in the format described earlier for SourceData.mdb and prepare it for the model using the macros in Yr0.mdb. Due to the change in the Navy's E5 High Year Tenure rules and their grandfathering of older sailors, there is a line in the Main module of PIAPM.mdb that must be changed. The line is near the top of the module, in the Global Variables section, above the Main subroutine. The line is

'Months since 7/1/2005 to 10/1/2007 (our current data)
Const E5ADJ = 27

and must be changed to reflect the number of elapsed months since July 2005, the beginning of the grandfather clause.

This page intentionally left blank.

Appendix A: Yr0.mdb programming code

Table of contents

MakeData

```
Attribute VB_Name = “MakeData”
‘Programming by Robert W. Shuford, CNA
Option Compare Database
Option Explicit
Private sngPGCount(8) As Single, strPG() As String
Function MakeYr0()
    Dim rating As String, LowHighPct As Single, LowPG As Byte, HighPG As Byte
    rating = UCase(InputBox(“Enter Rating”))
    DoCmd.SetWarnings False
    LowHighPct = GetHighPGRatios(rating)
    ‘Select records on rate
    DoCmd.RunSQL “SELECT RealYr0.ssn, RealYr0.pg, “ _
            & “RealYr0.rate, RealYr0.yos, RealYr0.yig, “ _
            & “RealYr0.months, RealYr0.mos_pg, 0 AS drop INTO Yr0 FROM RealYr0 “ _
            & “WHERE ((RealYr0.rate)=““ & rating & ““) OR ((RealYr0.rate)=““ _
            & Left(rating, 2) & ““);”
    ‘Change E1s & E2s to E3
    DoCmd.RunSQL “UPDATE Yr0 SET Yr0.pg = 3 WHERE (([Yr0].[pg])<3);”
    ‘Drop bad records
    DoCmd.RunSQL “DELETE [Yr0].[pg], [Yr0].[rate], “ _
            & “[Yr0].[yos], [Yr0].[yig], [Yr0].[months], [Yr0].[mos_pg]” _
            & “FROM Yr0 WHERE ((([Yr0].[pg]) Is Null)) Or ((([Yr0].[rate]) Is Null)) “ _
            & “Or ((([Yr0].[yos]) Is Null)) Or ((([Yr0].[months]) Is Null)) “ _
            & “Or ((([Yr0].[mos_pg]) Is Null));”
    ‘Drop if TIG>TIS
    DoCmd.RunSQL “DELETE Yr0.pg, Yr0.yos, Yr0.yig FROM Yr0 WHERE (Yr0.yig > [yos]);”
    ‘PGs & ratio for compressed ratings
    LowPG = Int(LowHighPct / 10)
    HighPG = Int(LowHighPct) Mod 10
    LowHighPct = LowHighPct - Int(LowHighPct)
    ‘Check for bad data
    If HighPG - LowPG <> 1 Then
        MsgBox “There is a problem with the PG distribution for rating “ & rating _
                & “.” & vbCrLf & “The high PG for the rating is “ & HighPG _
                & “, but the low PG for “ & Left(rating, 2) & “is “ & LowPG
        Exit Function
    End If
    DistributeHighPGs HighPG, LowHighPct
    ‘Change rate for high PGs
    DoCmd.RunSQL “UPDATE Yr0 SET Yr0.rate = ““ & rating _
```

```
            & """ WHERE (([Yr0].[rate]) = """ & Left(rating, 2) & """);"
    'CurrentDb.TableDefs("Yr0").Fields("rate").Name = "rate2"
    GetPGRateCount
    Attrition rating, LowPG, HighPG
    DoCmd.SetWarnings True
End Function
Private Function GetHighPGRatios(rt As String) As Single
    Dim rt2 As String, recs As Long, MinHigh As Byte, MaxLow As Byte
    Dim rs As DAO.Recordset
    rt2 = Left(rt, 2)

    'Get records into temporary table
    DoCmd.RunSQL "SELECT RealYr0.pg, RealYr0.rate INTO " & rt _
            & " FROM RealYr0 WHERE Left(RealYr0.rate,2) = """ & rt2 _
            & """ AND RealYr0.rate <> """ & rt2 & """;"
    Set rs = CurrentDb.OpenRecordset(rt)
    GetHighPGRatios = rs.RecordCount
    'Get number in rating
    DoCmd.RunSQL "SELECT * into tmp FROM " & rt & " WHERE " & rt _
            & ".rate=""" & rt & """;"
    Set rs = CurrentDb.OpenRecordset("tmp")
    'Ratio is to right of decimal
    GetHighPGRatios = rs.RecordCount / GetHighPGRatios

    'Find highest PG in rating
    Set rs = CurrentDb.OpenRecordset("SELECT Max(" & rt & ".pg) As pg FROM " _
            & rt & ";")
    rs.MoveFirst
    'High PG of uncompressed in tens place
    GetHighPGRatios = GetHighPGRatios + 10 * rs.Fields("pg")
    Set rs = Nothing

    'Find lowest PG in 2-character rating
    DoCmd.RunSQL "SELECT RealYr0.pg, Count(RealYr0.months) AS cnt INTO " _
            & rt & " FROM RealYr0 WHERE RealYr0.rate = """ & rt2 _
            & """ GROUP BY " & "RealYr0.pg;"
    Set rs = CurrentDb.OpenRecordset("SELECT Min(" & rt & ".pg) As pg FROM " & rt & ";")
    rs.MoveFirst
    'Low PG of compressed in ones place
    GetHighPGRatios = GetHighPGRatios + rs.Fields("pg")
    Set rs = Nothing
    DoCmd.DeleteObject acTable, rt
```

```
    DoCmd.DeleteObject acTable, “tmp”
End Function
Function DistributeHighPGs(HighPG As Byte, pct As Single)
    Dim rs As DAO.Recordset
    Randomize
    Set rs = CurrentDb.OpenRecordset(“Yr0”)
    With rs
        .MoveFirst
        Do Until .EOF
            ‘Select High PG records to delete
            If .Fields(“pg”) >= HighPG And Rnd > pct Then
                .Edit
                .Fields(“drop”) = 1
                .Update
            End If
            .MoveNext
        Loop
    End With
    DoCmd.RunSQL “DELETE Yr0.drop FROM Yr0 WHERE (Yr0.drop = 1);”
    Set rs = Nothing
End Function
Function MakeRealYr0()
    DoCmd.SetWarnings False
    DoCmd.RunSQL “SELECT SourceData.ssn, CInt(Right(Trim([grade]),1)) AS pg, “ _
            & “SourceData.rate, SourceData.yos, SourceData.yig, SourceData.mos AS months, “ _
            & “SourceData.mig AS mos_pg INTO RealYr0 FROM SourceData;”
    DoCmd.RunSQL “DELETE RealYr0.yos FROM RealYr0 WHERE (RealYr0.pg = 0);”
    DoCmd.SetWarnings True
End Function
Private Sub GetPGRateCount()
    ‘Create temp table with the number in each PG
    DoCmd.RunSQL “SELECT Yr0.pg, Count(Yr0.months) AS cnt INTO PGRollup “ _
            & “FROM Yr0 GROUP BY Yr0.pg ORDER BY Yr0.pg;”
    ‘Create temp table with the number in rating
    DoCmd.RunSQL “SELECT Yr0.rate, Count(Yr0.months) AS cnt INTO RateRollup “ _
            & “FROM Yr0 GROUP BY Yr0.rate ORDER BY Yr0.rate;”
End Sub
Private Sub Attrition(rt As String, rtPG As Byte, rt2PG As Byte)
    Dim rt2
    rt2 = Left(rt, 2)
    ‘Select compressed & uncompressed
    DoCmd.RunSQL “SELECT * INTO AttrRates FROM RealAttrRates WHERE “ _
```

```
            & "((RealAttrRates.rate=""" & rt & """) OR (RealAttrRates.rate=""" _
            & rt2 & """));"
    'Delete high PG for uncompressed
    DoCmd.RunSQL "DELETE AttrRates.rate FROM AttrRates WHERE ((AttrRates.rate = """ _
            & rt & """) AND (AttrRates.pg > " & rtPG & "));"
    'Delete low PG for compressed
    DoCmd.RunSQL "DELETE AttrRates.rate FROM AttrRates WHERE ((AttrRates.rate = """ _
            & rt2 & """) AND (AttrRates.pg < " & rt2PG & "));"
    'Make rate consistant
    DoCmd.RunSQL "UPDATE AttrRates SET AttrRates.rate = """ & rt _
            & """ WHERE ((AttrRates.rate) = """ & rt2 & """);"
End Sub

Function RefreshLinks()
    Dim dbs As Database, tdf As TableDef
    Dim CurPath As String, TblName As String
    CurPath = CurrentProject.Path
    ' Loop through all tables in the database.
    Set dbs = CurrentDb
    For Each tdf In dbs.TableDefs
        ' If the table has a connect string, it's a linked table.
        If Len(tdf.Connect) > 0 Then
            TblName = GetTableName(tdf.Connect)
            tdf.Connect = ";DATABASE=" & CurrentProject.Path & "\" _
                    & TblName
            Err = 0
            On Error Resume Next
            tdf.RefreshLink         ' Relink the table.

            ' Can't find the file, so search up the path
            If Err <> 0 Then
                Do
                    CurPath = HigherPath(CurPath)
                    Err = 0
                    tdf.Connect = ";DATABASE=" & CurPath & "\" _
                            & TblName
                    tdf.RefreshLink
                Loop While Err <> 0 And Len(CurPath) > 2
            End If

            If Err <> 0 And tdf.Name = "Yr0" Then
                MsgBox Err.Description
```

```
                RefreshLinks = False
            End If
        End If
    Next tdf
End Function
Private Function GetTableName(OldPath As String) As String
    'Get table name from full path & file name
    Dim bytSlash As Byte
    Do
        bytSlash = InStr(OldPath, "\")
        OldPath = Mid(OldPath, bytSlash + 1)
    Loop Until bytSlash = 0
    GetTableName = OldPath
End Function
Private Function HigherPath(OldPath) As String
    'Returns path of parent directory
    HigherPath = Left(OldPath, InStrRev(OldPath, "\") - 1)
End Function


Sub XportMods()
    Dim mdl As Variant, strFile As String, strExt As String
    For Each mdl In Application.VBE.ActiveVBProject.VBComponents()
        strFile = ".bas"
        If Left(mdl.Name, 5) = "Form_" Then strFile = ".cls"
        mdl.Export CurrentProject.Path & "\Modules\" & mdl.Name & strFile
    Next
    Set mdl = Nothing
End Sub
```

Appendix B: PIAPM.mdb programming code

Table of contents

Sub KillTables
Sub KillReportTables
Sub SQL
Function RefreshLinks
Private Function GetTableName
Private Function HigherPath
Public Sub FeedMeta
Sub KillXL
Sub MakeRunDirs
Function Maximum
Sub XportMods
Private Sub PrntTrgts

Controller form

Private Sub cmdIncDec
Private Sub cmdKill
Private Sub cmdRun
Private Sub cmdKillXL
Private Sub cmdXport

Personnel form

Private Sub cmdUse
Public Sub AssignPers

Manpower form

Private Sub cmdUse
Public Sub AssignMan
Private Sub lblocc0
Private Sub lblocc1
Private Sub lblocc2
Private Sub lblocc3
Private Sub lblocc4
Private Sub CopyAcross

Main

```
Attribute VB_Name = “Main”
‘Programming by Robert W. Shuford, CNA
Option Compare Database
Option Explicit
Option Base 0
‘Global variables
Public Const NUMRULES = 3
Const E5ADJ = 27 ‘Months since 7/1/2005 to 10/1/2007 (our current data)
Public strOcc As String, rs As DAO.Recordset
Public lngTarget(9) As Long, lngOccCount() As Long, strOccArray() As String
Public lngAllOccsPers As Long, occ As Byte, lngCurrCnt As Long
Dim strRule(NUMRULES) As String, bytWarnLevel As Byte, lngAccess As Long, AccumulatedShortage As Long
‘For Manpower form
Public frameRules As Byte, optManChange As Byte, min_tig(8) As Integer, min_tis(8) As Integer
Public sngIntDec(8, 6) As Single, optType As Byte, sngLossChange(9) As Single
Public bytStopYr(9) As Byte
‘For Personnel form
‘1 time, permanent, constant change option
Public optPersChange As Byte
‘Number or percent to change--array is by occ
Public sngPers As Single, sngIntDecPers(9) As Single
‘Number or percentage by occ option
Public optPers As Byte
Dim E1Sep As Single
Sub Driver(Run As Byte, yrs As Byte) ‘, MinYIG As Variant)
    Dim i As Byte, ruleocc As String
    Dim varReturn As Variant
    DoCmd.SetWarnings False
    KillTables
    MakeTables
    strOcc = “0”
    lngAllOccsPers = GetOccCount
    strRule(1) = “J”
    strRule(2) = “M”
    strRule(3) = “S”
    ‘Get form data in case Use buttons not clicked
    [Form_Increase Decrease Personnel].AssignPers False
    [Form_Increase Decrease Manpower Targets].AssignMan
    MakeMetaTable yrs ‘, MinYIG
    For occ = 0 To UBound(strOccArray())
```

```
        strOcc = strOccArray(occ)
        E1Sep = GetNewGuySepRate
        For frameRules = 1 To 3
            MakeGuysTable
            ‘Reset random number generator to be as consistent as possible
            ResetSeed
            GetTargets
            DoYears occ, yrs, frameRules
            Expected Run, yrs, strOcc & strRule(frameRules)

            ‘Rename tables, prepending rule & occ
            ruleocc = strRule(frameRules) & strOcc
            For i = 1 To yrs
                DoCmd.Rename ruleocc & “Yr” & i, acTable, “Yr” & i
                DoCmd.Rename ruleocc & “EYr” & i, acTable, “EYr” & i
            Next
            DoCmd.Rename ruleocc & “AllYrs”, acTable, “AllYrs”
            DoCmd.Rename ruleocc & “Expected“, acTable, “Expected“
            DoCmd.Rename ruleocc & “Likelihood”, acTable, “Likelihood”
        Next
    Next
    DoCmd.Rename “Sep”, acTable, “SepData”
    For Each varReturn In Array(“Sep”, “Shortage”, “Metadata”, “Prom”, _
                “TISTIG”, “YOS_PG”)
        DoCmd.TransferSpreadsheet acExport, 8, varReturn, CurrentProject.Path _
                & “\” & Run & “\” & varReturn & “.xls”, True, “”
    Next
    KillReportTables
‘    varReturn = SysCmd(acSysCmdClearStatus)
    DoCmd.SetWarnings True
End Sub
‘Loop through years and PGs
Sub DoYears(occ As Byte, MaxYear As Byte, rule As Byte)
    Dim i As Integer, bytYr As Byte
    Dim lngOldTarget As Long, lngNeed As Long
    ChangeTargets occ
    ‘Add Yr0 to TIS/TIG table
    SQL “INSERT INTO TISTIG ( rate, rule, yr, pg, cnt, TIS, “ _
            & “TIG ) SELECT Yr0.rate AS rate, “““ _
            & strRule(rule) & “““ AS rule, 0 AS yr, Yr0.pg, “ _
            & “Count(Yr0.ssn) AS cnt, Avg(Yr0.months) AS TIS, “ _
            & “Avg(Yr0.mos_pg) AS TIG FROM Yr0 GROUP BY Yr0.rate, Yr0.pg;”
```

```
‘Loop through years
For bytYr = 0 To MaxYear - 1
    AccumulatedShortage = 0
    ‘Increase or decrease manpower
    Select Case optManChange
        ‘1-time change
        Case 1
            If bytYr = 1 Then GetTargets
        ‘Permanent change
        Case 2
        ‘Change every year
        Case 3
            If bytYr > 0 Then ChangeTargets CByte(occ) Mod 10, bytYr
    End Select
    ‘How many E8s do we need to promote
    lngNeed = E9s(bytYr)

    ‘Loop through paygrades
    For i = 8 To 3 Step -1
        lngNeed = ENs(lngNeed, i, bytYr, rule)
    Next

    ‘Create yearly tables for individual data
    SQL “UPDATE Yr” & bytYr + 1 & “ SET Yr” & bytYr + 1 & “.prom_mnths = Null “ _
            & “WHERE ((Yr” & bytYr + 1 & “.prom_mnths)=0);”
    SQL “UPDATE Yr” & bytYr + 1 & “ SET Yr” & bytYr + 1 & “.target = “ _
            & lngTarget(3) & “ WHERE ((Yr” & bytYr + 1 & “.pg)=3);”
    ‘Update Shortage table
    SQL “INSERT INTO Shortage ( rate, rule, yr, pg, cnt, target, “ _
            & “shortage ) SELECT Yr” & bytYr + 1 & “.rate AS rate, “”” _
            & strRule(rule) & “””” AS rule, “ & bytYr + 1 & “ AS yr, Yr” _
            & bytYr + 1 & “.pg, Count(Yr” & bytYr + 1 & “.ssn) AS cnt, Yr” _
            & bytYr + 1 & “.target, Yr” & bytYr + 1 & “.target-Count(Yr” _
            & bytYr + 1 & “.ssn) AS shortage “ _
            & “FROM Yr” & bytYr + 1 _
            & “ GROUP BY Yr” & bytYr + 1 & “.rate, Yr” & bytYr + 1 & “.pg, Yr” _
            & bytYr + 1 & “.target;”
    ‘Update TIS/TIG table
    SQL “INSERT INTO TISTIG ( rate, rule, yr, pg, cnt, TIS, “ _
            & “TIG ) SELECT Yr” & bytYr + 1 & “.rate AS rate, “”” _
            & strRule(rule) & “””” AS rule, “ & bytYr + 1 & “ AS yr, Yr” _
            & bytYr + 1 & “.pg, Count(Yr” & bytYr + 1 & “.ssn) AS cnt, “ _
```

```
                & "Avg(Yr" & bytYr + 1 & ".months) AS TIS, " _
                & "Avg(Yr" & bytYr + 1 & ".mos_pg) AS TIG " _
                & "FROM Yr" & bytYr + 1 _
                & " GROUP BY Yr" & bytYr + 1 & ".rate, Yr" & bytYr + 1 & ".pg;"
        'Update YOS_PG table
        SQL "INSERT INTO YOS_PG ( rate, rule, yr, pg, yos, cnt ) SELECT """ _
                & strOcc & """ AS rate, """ _
                & strRule(rule) & """ AS rule, " & bytYr + 1 & " AS yr, Yr" _
                & bytYr + 1 & ".pg, Yr" & bytYr + 1 & ".yos, Count(Yr" _
                & bytYr + 1 & ".ssn) AS cnt " & "FROM Yr" & bytYr + 1 _
                & " GROUP BY Yr" & bytYr + 1 & ".pg, Yr" & bytYr + 1 & ".yos;"
    Next
    'Create AllYrs
    CompileData MaxYear
    'Prepare data for Likelihood and Expected tables
    GetDataForProbs MaxYear
    'Create Likelihood and Expected tables
    CalcProbs MaxYear, strRule(rule)
    DoCmd.DeleteObject acTable, "temp"
End Sub
'Handle E9s separately since they don't promote--only separate for speed
Private Function E9s(yr As Byte)
    'Create temp table with E9 data for occ
    SQL "SELECT Yr" & yr & ".ssn, Yr" & yr & ".pg, Yr" & yr & ".rate, " _
            & "Yr" & yr & ".months, Yr" & yr & ".yig, Yr" _
            & yr & ".yos, Yr" & yr & ".mos_pg, AttrRates.prob_sep, " _
            & "0 AS prom_mnths, " & lngTarget(9) & " AS target " _
            & "INTO temp FROM Yr" & yr & " INNER JOIN AttrRates " _
            & "ON (Yr" & yr & ".yos = AttrRates.yos) " _
            & "AND (Yr" & yr & ".rate = AttrRates.rate) " _
            & "AND (Yr" & yr & ".pg = AttrRates.pg) " _
            & "WHERE (Yr" & yr & ".rate=""" & strOcc & """) " _
            & "AND ((Yr" & yr & ".pg)=9) " _
            & "ORDER BY Yr" & yr & ".months;"
    'Change attrition rates
    SQL "UPDATE temp SET temp.prob_sep = prob_sep * (1 + " & sngLossChange(9) _
                & ") WHERE prob_sep <> 1;"
    'Separate guys
    E9Sep yr
    'Calculate needs
    E9s = lngTarget(9) - rs.RecordCount
    Set rs = Nothing
```

```
    ‘Load E9s into new YrX table
    SQL “SELECT temp.ssn, temp.rate, temp.pg, temp.months, temp.yig, temp.yos, “ _
            & “temp.mos_pg, temp.prom_mnths, temp.target “ _
            & “INTO Yr” & yr + 1 & “ from temp “ _
            & “ORDER BY temp.months;”
End Function
Private Sub E9Sep(yr As Byte)
    Dim losses As Long, sep As DAO.Recordset
    losses = 0
    Set rs = CurrentDb.OpenRecordset(“temp”)
    ‘Go through each record and either separate or age
    With rs
        .MoveFirst
        Do Until .EOF
            .Edit
            ‘Separate
            If Rnd() < !prob_sep Then
                !target = Null
                losses = losses + 1
            Else
                ‘Age
                !yos = !yos + 1
                !yig = !yig + 1
                !months = !months + 12
                !mos_pg = !mos_pg + 12
            End If
            .Update
            .MoveNext
        Loop
    End With
    AddSep yr + 1, 9, losses, rs.RecordCount
    ‘Delete seps
    SQL “DELETE temp.target FROM temp WHERE ((temp.target) Is Null);”
End Sub
Private Function ENs(Need As Long, pg As Integer, yr As Byte, rule As Byte)
    Dim lngProms As Long, strRule(3) As String, Benchmarks As Variant
    strRule(1) = “ASC”
    strRule(3) = “DESC”
    Benchmarks = Split(“0 0 0 2.2 4.4 9 14.8 18.5 22.2”)
    For lngProms = 0 To 8
        Benchmarks(lngProms) = Benchmarks(lngProms) * 12
    Next
```

```
lngProms = 0
Set rs = Nothing

If rule = 2 Then
    SQL "SELECT Yr" & yr & ".ssn, Yr" & yr & ".pg, Yr" & yr & ".rate, " _
            & "Yr" & yr & ".months, Yr" & yr & ".yig, Yr" _
            & yr & ".yos, Yr" & yr & ".mos_pg, AttrRates.prob_sep, " _
            & "0 AS prom_mnths, " & lngTarget(pg) & " AS target, ABS(Yr" _
            & yr & ".months + 12 - " & Benchmarks(pg) & ") AS bm " _
            & "INTO temp FROM Yr" & yr & " INNER JOIN AttrRates " _
            & "ON (Yr" & yr & ".yos = AttrRates.yos) " _
            & "AND (Yr" & yr & ".rate = AttrRates.rate) " _
            & "AND (Yr" & yr & ".pg = AttrRates.pg) " _
            & "WHERE (Yr" & yr & ".rate=""" & strOcc & """) " _
            & "AND ((Yr" & yr & ".pg)=" & pg & ") " _
            & "ORDER BY ABS(Yr" _
            & yr & ".months + 12 - " & Benchmarks(pg) & ") " & strRule(1) & ", Yr" _
            & yr & ".ssn;"
    'Change attrition rates
    SQL "UPDATE temp SET temp.prob_sep = prob_sep * (1 + " & sngLossChange(pg) _
            & ") WHERE prob_sep <> 1;"
    'Maintain correct sorting
    SQL "CREATE INDEX kKey on temp (bm ASC, ssn)"
Else
    SQL "SELECT Yr" & yr & ".ssn, Yr" & yr & ".pg, Yr" & yr & ".rate, " _
            & "Yr" & yr & ".months, Yr" & yr & ".yig, Yr" _
            & yr & ".yos, Yr" & yr & ".mos_pg, AttrRates.prob_sep, " _
            & "0 AS prom_mnths, " & lngTarget(pg) & " AS target " _
            & "INTO temp FROM Yr" & yr & " INNER JOIN AttrRates " _
            & "ON (Yr" & yr & ".yos = AttrRates.yos) " _
            & "AND (Yr" & yr & ".rate = AttrRates.rate) " _
            & "AND (Yr" & yr & ".pg = AttrRates.pg) " _
            & "WHERE (Yr" & yr & ".rate=""" & strOcc & """) " _
            & "AND ((Yr" & yr & ".pg)=" & pg & ") " _
            & "ORDER BY Yr" & yr & ".months " & strRule(rule) & ", Yr" _
            & yr & ".ssn;"
    'Change attrition rates
    SQL "UPDATE temp SET temp.prob_sep = prob_sep * (1 + " & sngLossChange(pg) _
            & ") WHERE prob_sep <> 1;"
    'Adjust attrition rates for change in E5 HYT
    If pg = 5 Then
        SQL "UPDATE temp SET temp.prob_sep = 1 WHERE temp.months < " _
```

```
            & 120 + E5ADJ + 12 * yr & " AND temp.yos >= 14;"
    End If
    'Maintain correct sorting
    SQL "CREATE INDEX kKey on temp (months " & strRule(rule) & ", ssn)"
End If

Set rs = CurrentDb.OpenRecordset("temp")
'New accessions
lngCurrCnt = rs.RecordCount
If pg = 3 Then
    'lngAccess =
    NewE1s yr, Need
    Set rs = CurrentDb.OpenRecordset("temp")
End If
'rs.Index = "kKey"
ENSep yr, pg
'Calculate needs
ENs = lngTarget(pg) - rs.RecordCount
Set rs = Nothing

'Promote
'Age months of service
SQL "UPDATE temp SET temp.months = [months] + 12, temp.yig = [yig] + 1, " _
        & "temp.yos = [yos] + 1, temp.mos_pg = [mos_pg] + 12;"
Set rs = CurrentDb.OpenRecordset("temp")
'Maintain correct sorting
rs.Index = "kKey"

AccumulatedShortage = AccumulatedShortage + Need
With rs
    .MoveFirst
    Do Until .EOF Or Need <= 0
        If !months >= min_tis(pg - 1) And !mos_pg >= min_tig(pg - 1) Then
            'Promote
            .Edit
            !pg = pg + 1
            !yig = 0
            !mos_pg = 0
            lngProms = lngProms + 1
            !prom_mnths = !months

            !target = lngTarget(pg + 1)
```

```
                .Update
                Need = Need - 1
            End If
            .MoveNext
        Loop
    End With
    Set rs = Nothing
    AccumulatedShortage = AccumulatedShortage - lngProms
    If pg = 3 Then ENs = lngCurrCnt Else ENs = ENs + lngProms
    ‘Append to YrX table
    SQL “INSERT INTO Yr” & yr + 1 & “ (ssn, pg, rate, months, “ _
            & “yig, yos, mos_pg, prom_mnths, target) “ _
            & “SELECT temp.ssn, temp.pg, temp.rate, temp.months, “ _
            & “temp.yig, temp.yos, temp.mos_pg, temp.prom_mnths, temp.target “ _
            & “FROM temp;”
    ‘Add to Promotion table
    AddProm yr + 1, pg, lngProms, lngCurrCnt
End Function
Private Sub ENSep(yr As Byte, pg As Integer)
    Dim losses As Long, cnt As Long, sep As DAO.Recordset
    losses = 0
    With rs
        .MoveFirst
        ‘Separate
        Do Until .EOF
            .Edit
            ‘Go through each record and decide whether to separate
            If Rnd() < !prob_sep Then
                !target = Null
                losses = losses + 1
            End If
            .Update
            .MoveNext
        Loop
    End With
    AddSep yr + 1, pg, losses, lngCurrCnt
    ‘Delete seps
    SQL “DELETE temp.target FROM temp WHERE ((temp.target) Is Null);”
End Sub
‘New accessions
Private Sub NewE1s(yr As Byte, promoted As Long)
    Static id As Long
```

```
    lngAccess = Round((NewAccess(yr) + promoted + Pred + AccumulatedShortage) / (1 - E1Sep))
    Dim i As Long
    With rs
        For i = 1 To lngAccess
            id = id + 1
            .AddNew
            ‘Create unique ID
            !ssn = “A” & Format(id, “00000000”)
            !pg = 3
            !Rate = strOcc
            !months = 0
            !yig = 0
            !yos = 0
            !mos_pg = 0
            !prob_sep = E1Sep
            !prom_mnths = Null
            !target = lngTarget(3)
            .Update
        Next
    End With
    Set rs = Nothing
    If yr = 0 Then SQL “INSERT INTO Guys (ssn, pg) SELECT temp.ssn, temp.pg “ _
            & “FROM temp WHERE (temp.ssn Like ““A*””);”
    FeedMeta strOcc & strRule(frameRules) & “ Year “ _
            & yr + 1 & “ Accessions”, lngAccess
End Sub
Private Sub AddSep(yr As Byte, pg As Integer, losses As Long, cnt As Long)
    ‘Add to Separation table
    Dim sep As DAO.Recordset
    Set sep = CurrentDb.OpenRecordset(“SepData”)
    With sep
        .AddNew
        .Fields(“rate”).Value = strOcc
        .Fields(“rule”) = strRule(frameRules)
        .Fields(“pg”) = pg
        .Fields(“yr”) = yr
        .Fields(“cnt”) = cnt
        .Fields(“seps”) = losses
        .Fields(“pct”) = losses / cnt
        .Update
    End With
    Set sep = Nothing
```

```
End Sub
Private Sub AddProm(yr As Byte, pg As Integer, promotions As Long, cnt As Long)
    ‘Add to Separation table
    Dim sep As DAO.Recordset
    Set sep = CurrentDb.OpenRecordset(“Prom”)
    With sep
        .AddNew
        .Fields(“rate”).Value = strOcc
        .Fields(“rule”) = strRule(frameRules)
        .Fields(“pg”) = pg
        .Fields(“yr”) = yr
        .Fields(“cnt”) = cnt
        .Fields(“proms”) = promotions
        .Fields(“pct”) = promotions / cnt
        .Update
    End With
    Set sep = Nothing
End Sub
Private Function NewAccess(yr As Byte) As Long
    Select Case optPersChange
    Case 1 ‘1-time change
        NewAccess = lngTarget(3) - lngCurrCnt
    Case 2 ‘Permanent change
        NewAccess = CalcByoptPers(1)
    Case 3 ‘Constant change
        NewAccess = CalcByoptPers(yr + 1)
    End Select
    If yr = 0 Then
        NewAccess = Maximum(CalcByoptPers(1) + lngCurrCnt - lngTarget(3), NewAccess)
    End If
End Function
Private Function CalcByoptPers(yrnum As Byte) As Long
    Select Case optPers
    Case 1 ‘By number in occ array
        CalcByoptPers = yrnum * sngIntDecPers(0) _
                + lngTarget(3) - lngCurrCnt
    Case 2 ‘By percentage in occ array
        CalcByoptPers = Round(lngOccCount(0) _
                * ((1 + sngIntDecPers(0)) ^ yrnum - 1), 0) _
                + lngTarget(3) - lngCurrCnt
    Case 3 ‘By number as global value
        CalcByoptPers = Round(yrnum * sngPers) _
```

```
                + lngTarget(3) - lngCurrCnt
    Case 4 'By percentage as global value
        CalcByoptPers = Round(lngOccCount(0) * ((1 + sngPers) ^ yrnum - 1), 0) _
                + lngTarget(3) - lngCurrCnt
    Case Else
        CalcByoptPers = lngTarget(3) - lngCurrCnt
    End Select
End Function
Private Function Pred() As Single
    Dim rs1 As DAO.Recordset
    Set rs1 = CurrentDb.OpenRecordset("SELECT Sum(temp.prob_sep) AS SumOfprob_sep FROM temp;")
    With rs1
        .MoveFirst
        Pred = rs1!SumOfprob_sep
    End With
    Set rs1 = Nothing
End Function
```

Preliminaries

```
Attribute VB_Name = “Preliminaries”
‘Programming by Robert W. Shuford, CNA
Option Compare Database
Option Explicit
Sub MakeGuysTable()
    SQL “SELECT Yr0.ssn, Yr0.pg, Yr0.yos INTO Guys FROM Yr0 “ _
            & “WHERE Yr0.rate=““ & strOcc & ““;”
End Sub
Sub MakeTables()
    MakeYOS_PGTable
    MakeSepTable
    MakeShortTable
    MakePromTable
    MakeTISTIGTable
End Sub
Private Sub MakeSepTable()
    Dim tdf As TableDef
    Set tdf = CurrentDb.CreateTableDef(“SepData”)
    With tdf
        MakeCommonFields tdf
        .Fields.Append .CreateField(“seps”, dbLong)
        .Fields.Append .CreateField(“pct”, dbDouble)
    End With
    CurrentDb.TableDefs.Append tdf
End Sub
Private Sub MakeShortTable()
    Dim tdf As TableDef
    Set tdf = CurrentDb.CreateTableDef(“Shortage”)
    With tdf
        MakeCommonFields tdf
        .Fields.Append .CreateField(“target”, dbLong)
        .Fields.Append .CreateField(“shortage”, dbLong)
    End With
    CurrentDb.TableDefs.Append tdf
End Sub
Private Sub MakePromTable()
    Dim tdf As TableDef
    Set tdf = CurrentDb.CreateTableDef(“Prom”)
    With tdf
```

```
        MakeCommonFields tdf
        .Fields.Append .CreateField(“proms”, dbDouble)
        .Fields.Append .CreateField(“pct”, dbDouble)
    End With
    CurrentDb.TableDefs.Append tdf
End Sub
Private Sub MakeTISTIGTable()
    Dim tdf As TableDef
    Set tdf = CurrentDb.CreateTableDef(“YOS_PG”)
    With tdf
        MakeCommonFields tdf
        .Fields.Append .CreateField(“yos”, dbByte)
    End With
    CurrentDb.TableDefs.Append tdf
End Sub
Private Sub MakeYOS_PGTable()
    Dim tdf As TableDef
    Set tdf = CurrentDb.CreateTableDef(“TISTIG”)
    With tdf
        MakeCommonFields tdf
        .Fields.Append .CreateField(“TIS”, dbDouble)
        .Fields.Append .CreateField(“TIG”, dbDouble)
    End With
    CurrentDb.TableDefs.Append tdf
End Sub
Private Sub MakeCommonFields(td As TableDef)
    With td
        .Fields.Append .CreateField(“rate”, dbText)
        .Fields.Append .CreateField(“rule”, dbText)
        .Fields.Append .CreateField(“pg”, dbByte)
        .Fields.Append .CreateField(“yr”, dbByte)
        .Fields.Append .CreateField(“cnt”, dbLong)
    End With
End Sub

Sub MakeMetaTable(yrs As Byte) ‘, AltYIG As Variant)
    ‘Make new table
    Dim tdf As TableDef
    Set tdf = CurrentDb.CreateTableDef(“Metadata”)
    With tdf
        .Fields.Append .CreateField(“f1”, dbText)
        .Fields.Append .CreateField(“f2”, dbText)
```

```
End With
CurrentDb.TableDefs.Append tdf
Set tdf = Nothing
‘Add info from Controller
FeedMeta “Date”, Now
FeedMeta “Years”, yrs
FeedMeta “Rating”, strOccArray(0)
Set rs = CurrentDb.OpenRecordset(“Yr0”)
rs.MoveFirst

‘Add info from Personnel
Dim str As String, i As Byte, j As Byte
Select Case optPersChange
Case 1
    str = “1-time change”
Case 2
    str = “Permanent change”
Case 3
    str = “Constant change”
End Select
FeedMeta “Personnel Change Type”, str
Select Case optPers
Case 1, 3
    str = “Number”
Case 2, 4
    str = “Percentage”
End Select
FeedMeta “Personnel Change Number Type”, str
Select Case optPers
Case 1, 2
    For i = 0 To 8
        FeedMeta “Change”, CStr(sngIntDecPers(i))
    Next
Case 3, 4
    FeedMeta “Personnel Change”, sngPers
End Select

‘Add info from Manpower
Select Case optManChange
Case 1
    str = “1-time change”
Case 2
```

```
        str = “Permanent change”
    Case 3
        str = “Constant change”
    End Select
    FeedMeta “Manpower Change Type”, str
    Select Case optType
    Case 1
        str = “Percentage”
    Case 2
        str = “Number”
    End Select
    FeedMeta “Manpower Change Number Type”, str
    For i = 0 To 8
        For j = 3 To 9
            If sngIntDec(i, j - 3) <> 0 Then FeedMeta _
                    “E” & j & “ Change”, sngIntDec(i, j - 3)
        Next
    Next
End Sub
‘Get number in each grade to be used as a target in each year
Sub GetTargets()
    Dim i As Byte
    ‘Create temp table with the number in each grade to be used as a target in each year
    SQL “SELECT Yr0.pg, Count(Yr0.pg) AS cnt “ _
            & “INTO temp FROM Yr0 “ _
            & “GROUP BY Yr0.pg, Yr0.rate “ _
            & “HAVING (Yr0.rate=““““ & strOcc & ““““) “ _
            & “ORDER BY Yr0.pg;”

    ‘Load into lngTarget array
    Set rs = CurrentDb.OpenRecordset(“temp”)
    rs.MoveFirst
    For i = 3 To 9
        lngTarget(i) = rs!cnt
        rs.MoveNext
    Next
    Set rs = Nothing
End Sub
‘Increase or decrease manpower by the values from the Increase Decrease Targets form
Sub ChangeTargets(oc As Byte, Optional yr As Byte = 0) ‘ Byte)
    Dim i As Byte
    Select Case optType
```

```
        Case 1 ‘By percentage
            For i = 3 To 9
                If yr < bytStopYr(i) Then lngTarget(i) = Round(lngTarget(i) _
                                * (1 + sngIntDec(oc, i - 3)), 0)
            Next
        Case 2 ‘By number
            For i = 3 To 9
                If yr < bytStopYr(i) Then lngTarget(i) = lngTarget(i) _
                                + sngIntDec(oc, i - 3)
            Next
        Case Else
    End Select
End Sub
‘Get number in each occ
Function GetOccCount() As Long
    Dim i As Byte
    ‘Load into lngOccCount array
    SQL “SELECT RateRollup.rate, RateRollup.cnt “ _
            & “INTO temp FROM RateRollup “ _
            & “ORDER BY RateRollup.rate;”


    Set rs = CurrentDb.OpenRecordset(“temp”)
    ReDim lngOccCount(rs.RecordCount - 1)
    ReDim strOccArray(rs.RecordCount - 1)
    rs.MoveFirst
    For i = 0 To UBound(strOccArray())
        strOccArray(i) = rs!Rate
        lngOccCount(i) = rs!cnt
        GetOccCount = GetOccCount + lngOccCount(i)
        rs.MoveNext
    Next
    Set rs = Nothing
End Function
‘Get separation rate for new accessions
Function GetNewGuySepRate() As Single
    Dim i As Byte
    ‘Create temp table with the number in each occ
    DoCmd.RunSQL “SELECT AttrRates.prob_sep INTO temp FROM AttrRates WHERE “ _
            & “((AttrRates.rate=““ & strOcc & ““) AND (AttrRates.pg=3) “ _
            & “AND (AttrRates.yos=0));”
    Set rs = CurrentDb.OpenRecordset(“temp”)
```

```
    rs.MoveFirst
    GetNewGuySepRate = rs!prob_sep
    Set rs = Nothing
End Function
```

Stats

```
Attribute VB_Name = “Stats”
‘Programming by Robert W. Shuford, CNA
Option Compare Database
Option Explicit
‘Create AllYrs table
Public Sub CompileData(MaxYear As Byte)
    Dim qdf As QueryDef, i As Byte

    ‘1st year
    With CurrentDb
        Set qdf = .CreateQueryDef(“b1”, “SELECT 1 AS yr, Yr1.pg, Yr1.rate” _
                & “, Avg(Yr1.target) AS target, Count(Yr1.pg) AS cnt “ _
                & “FROM Yr1 GROUP BY 1, Yr1.pg, Yr1.rate” _
                & “;”)
        Set qdf = .CreateQueryDef(“b2”, “SELECT Yr1.pg, Avg(Yr1.prom_mnths) “ _
                & “AS prom_mnths_ave FROM Yr1 GROUP BY Yr1.pg;”)
        SQL “SELECT b1.*, b2.prom_mnths_ave INTO AllYrs “ _
                & “FROM b1 INNER JOIN b2 ON b1.pg = b2.pg;”
    End With
    DoCmd.DeleteObject acQuery, “b1”
    DoCmd.DeleteObject acQuery, “b2”

    ‘Append other years
    For i = 2 To MaxYear
        With CurrentDb
            Set qdf = .CreateQueryDef(“b1”, “SELECT “ & i & “ AS yr, Yr” & i _
                    & “.rate,” & “ Yr” & i & “.pg, Avg(Yr” & i _
                    & “.target) AS target, “ _
                    & “Count(Yr” & i & “.pg) AS cnt FROM Yr” & i _
                    & “ GROUP BY “ & i & “, Yr” & i & “.pg, Yr” & i & “.rate” _
                    & “;”)
            Set qdf = .CreateQueryDef(“b2”, “SELECT Yr” & i & “.pg, Avg(Yr” & i _
                    & “.prom_mnths) AS prom_mnths_ave FROM Yr” & i _
                    & “ GROUP BY Yr” & i & “.pg;”)
            SQL “INSERT INTO AllYrs (prom_mnths_ave) SELECT b1.*, b2.prom_mnths_ave “ _
                    & “FROM b1 INNER JOIN b2 ON b1.pg = b2.pg;”
        End With
        DoCmd.DeleteObject acQuery, “b1”
        DoCmd.DeleteObject acQuery, “b2”
```

```
    Next
End Sub
Public Sub GetDataForProbs(yrs As Byte)
    'Compiles data for Yr0 PG, months cohots
    Dim i As Byte
    Dim strSelect As String, strFrom As String, strWhere As String
    SQL "UPDATE Guys SET Guys.yos = 0 WHERE (Guys.ssn Like ""A*"");"
    'Create SQL statement in segments
    strSelect = "SELECT Guys.ssn, Guys.pg, Guys.yos"
    strFrom = "FROM "
    For i = 1 To yrs
        strFrom = strFrom & "("
    Next
    strFrom = strFrom & "Guys "
    For i = 1 To yrs
        strSelect = strSelect & ", Yr" & i & ".pg AS pg" & i & ", Yr" & i _
                & ".prom_mnths AS prom_mnths" & i
        strFrom = strFrom & "LEFT JOIN Yr" & i & " ON Guys.ssn = Yr" & i _
                & ".ssn) "
    Next
    For i = 1 To yrs
        strSelect = strSelect & ", 0 AS prom_" & i
    Next
    strSelect = strSelect & ", 0 AS promoted INTO temp"
    'Whew, finally run it
    SQL strSelect & " " & strFrom & " " & strWhere
    DoCmd.DeleteObject acTable, "Guys"
End Sub
Public Sub CalcProbs(yrs As Byte, rule As String)
    Dim i As Byte, strSQL As String
    Set rs = CurrentDb.OpenRecordset("temp")

    SQL "UPDATE temp SET temp.prom_1 = 1, temp.promoted = 1 " _
            & "WHERE ((temp.prom_mnths1) Is Not Null);"
    For i = 2 To yrs
        SQL "UPDATE temp SET temp.prom_" & i & " = 1, temp.promoted = 1 " _
                & "WHERE (((temp.prom_mnths" & i & ") Is Not Null) " _
                & "AND ((temp.promoted) = 0));"
    Next
    'Likelihood
    strSQL = "SELECT '" & strOcc & "' as rate, '" & rule _
                & "' as rule, temp.pg, temp.yos, Count(temp.pg) AS cnt"
```

```
    For i = 1 To yrs
        strSQL = strSQL & “, Avg(temp.prom_” & i & “) AS av_” & i
    Next
    strSQL = strSQL & “, 0.1111111111111111 AS likelihood INTO Likelihood “ _
            & “FROM temp GROUP BY temp.pg, temp.yos;”
    SQL strSQL
    strSQL = “UPDATE Likelihood SET Likelihood.likelihood = Likelihood.av_1”
    For i = 2 To yrs
        strSQL = strSQL & “ + Likelihood.av_” & i
    Next
    strSQL = strSQL & “;”
    SQL strSQL
    ‘Expected
    strSQL = “SELECT temp.pg, temp.yos, Count(temp.pg) AS cnt”
    For i = 1 To yrs
        strSQL = strSQL & “, Avg(temp.prom_” & i & “) AS av_” & i
    Next
    strSQL = strSQL & “, 0.11111 AS Expected INTO Expected “ _
            & “FROM temp GROUP BY temp.pg, temp.yos, temp.promoted “ _
            & “HAVING ((temp.promoted)=1);”
    SQL strSQL
    strSQL = “UPDATE Expected SET Expected.Expected = Expected.yos + Expected.av_1”
    For i = 2 To yrs
        strSQL = strSQL & “ + (Expected.av_” & i & “ * “ & i & “)”
    Next
    strSQL = strSQL & “;”
    SQL strSQL
    Set rs = Nothing
End Sub
Public Sub Expected(Run As Byte, NumYrs As Byte, occrule As String)
    Dim qdf As QueryDef, i As Byte
    Dim fso
    Set fso = CreateObject(“Scripting.FileSystemObject”)
    On Error Resume Next
    fso.DeleteFile CurrentProject.Path & “\Expected“ & occrule & “.xls”
    fso.DeleteFile CurrentProject.Path & “\Likelihood” & occrule & “.xls”
    On Error GoTo 0
    For i = 1 To NumYrs
        Set qdf = CurrentDb.CreateQueryDef(“tmpQry”, _
                “SELECT Yr” & i & “.rate, ‘“ & Right(occrule, 1) _
                & “‘ as rule, Yr” & i & “.pg, “ & i & “ as yr, Count(Yr” _
                & i & “.prom_mnths) AS cnt, Avg(Yr” & i _
```

```
                & ".prom_mnths) AS AvgOfprom_mnths INTO EYr" _
                & i & " FROM Yr" & i & " GROUP BY Yr" & i & ".rate, Yr" & i _
                & ".pg HAVING (((Count(Yr" & i & ".prom_mnths)) Is Not Null));")
        DoCmd.OpenQuery "tmpqry", acNormal, acEdit
        DoCmd.TransferSpreadsheet acExport, 8, "EYr" & i, CurrentProject.Path _
                & "\" & Run & "\Expected" & occrule & ".xls", True, ""
        DoCmd.DeleteObject acQuery, "tmpQry"
    Next
    DoCmd.TransferSpreadsheet acExport, 8, "Likelihood", CurrentProject.Path _
            & "\" & Run & "\Likelihood" & occrule & ".xls", True, ""
    Set fso = Nothing
    Set qdf = Nothing
End Sub
```

Utilities

```
Attribute VB_Name = “Utilities”
‘Programming by Robert W. Shuford, CNA
Option Compare Database
Option Explicit
‘Minor Subs & Utilities
Sub ResetSeed()
    Randomize
End Sub
‘Delete individual year tables
Sub KillTables()
    Dim tdf As TableDef
    On Error Resume Next
    For Each tdf In CurrentDb.TableDefs
        If Left(tdf.Name, 2) = “Yr” And tdf.Name <> “Yr0” Then _
                        DoCmd.DeleteObject acTable, tdf.Name
        If Left(tdf.Name, 3) = “EYr” Then DoCmd.DeleteObject acTable, tdf.Name
        If Left(tdf.Name, 1) = “J” Then DoCmd.DeleteObject acTable, tdf.Name
        If Left(tdf.Name, 1) = “M” Then DoCmd.DeleteObject acTable, tdf.Name
        If Left(tdf.Name, 1) = “S” Then DoCmd.DeleteObject acTable, tdf.Name
    Next
    DoCmd.DeleteObject acTable, “Guys”
    On Error GoTo 0
    KillReportTables
End Sub
‘Delete individual year tables
Sub KillReportTables()
    Dim tdf As TableDef
    On Error Resume Next
    For Each tdf In CurrentDb.TableDefs
        If Left(tdf.Name, 4) <> “MSys” Then
            If Mid(tdf.Name, 5, 1) = “A” Then DoCmd.DeleteObject acTable, tdf.Name
            If Mid(tdf.Name, 5, 1) = “D” Then DoCmd.DeleteObject acTable, tdf.Name
            If Mid(tdf.Name, 5, 1) = “E” Then DoCmd.DeleteObject acTable, tdf.Name
            If Mid(tdf.Name, 5, 2) = “Li” Then DoCmd.DeleteObject acTable, tdf.Name
            If Mid(tdf.Name, 1, 2) = “YO” Then DoCmd.DeleteObject acTable, tdf.Name
        End If
    Next
    DoCmd.DeleteObject acTable, “Sep”
    DoCmd.DeleteObject acTable, “Shortage”
```

```
    DoCmd.DeleteObject acTable, “Prom”
    DoCmd.DeleteObject acTable, “TISTIG”
    On Error GoTo 0
End Sub
‘Shortcut to run SQL
Sub SQL(strSQL As String)
    Dim varReturn As Variant
‘    Debug.Print strSQL
    DoCmd.RunSQL strSQL
End Sub
Function RefreshLinks()
    Dim dbs As Database, tdf As TableDef
    Dim CurPath As String, TblName As String
    CurPath = CurrentProject.Path
    ‘ Loop through all tables in the database.
    Set dbs = CurrentDb
    For Each tdf In dbs.TableDefs
        ‘ If the table has a connect string, it’s a linked table.
        If Len(tdf.Connect) > 0 Then
            TblName = GetTableName(tdf.Connect)
            tdf.Connect = “;DATABASE=“ & CurrentProject.Path & “\” _
                    & TblName
            Err = 0
            On Error Resume Next
            tdf.RefreshLink         ‘ Relink the table.

            ‘ Can’t find the file, so search up the path
            If Err <> 0 Then
                Do
                    CurPath = HigherPath(CurPath)
                    Err = 0
                    tdf.Connect = “;DATABASE=“ & CurPath & “\” _
                            & TblName
                    tdf.RefreshLink
                Loop While Err <> 0 And Len(CurPath) > 2
            End If

            If Err <> 0 And tdf.Name = “Yr0” Then
                MsgBox Err.Description
                RefreshLinks = False
            End If
        End If
```

```
    Next tdf
End Function
Private Function GetTableName(OldPath As String) As String
    Dim bytSlash As Byte
    Do
        bytSlash = InStr(OldPath, “\”)
        OldPath = Mid(OldPath, bytSlash + 1)
    Loop Until bytSlash = 0
    GetTableName = OldPath
End Function
Private Function HigherPath(OldPath) As String
    HigherPath = Left(OldPath, InStrRev(OldPath, “\”) - 1)
End Function
Public Sub FeedMeta(f1 As String, ByVal f2 As String)
    DoCmd.RunSQL “INSERT INTO Metadata ( f1, f2 ) SELECT ““” & f1 _
            & ““” AS f1, ““” & f2 & ““” AS f2;”
End Sub
Sub KillXL(runs As Byte)
    On Error Resume Next
    Dim Run As Byte, i As Byte, fn As Variant
    fn = Split(“Expected* Likelihood* Shortage Sep Metadata Prom TISTIG”)
    For Run = 1 To runs
        For i = 0 To UBound(fn)
            Kill CurrentProject.Path & “\” & Run & “\” & fn(i) & “.xls”
        Next
    Next
End Sub
Sub MakeRunDirs(runs As Byte)
    On Error Resume Next
    Dim Run As Byte, i As Byte, fn As Variant
    KillXL runs
    For Run = 1 To runs
        MkDir CurrentProject.Path & “\” & Run
    Next
End Sub
Function Maximum(ParamArray Values() As Variant)
    Dim i As Integer
    Maximum = Values(0)
    ‘ Use UBound function to determine upper limit of array.
    For i = 1 To UBound(Values())
        If Values(i) > Maximum Then Maximum = Values(i)
    Next i
```

```
End Function

Sub XportMods()
    Dim mdl As Variant, strFile As String, strExt As String
    For Each mdl In Application.VBE.ActiveVBProject.VBComponents()
        strFile = ".bas"
        If Left(mdl.Name, 5) = "Form_" Then strFile = ".cls"
        mdl.Export CurrentProject.Path & "\Modules\" & mdl.Name & strFile
    Next
    Set mdl = Nothing
End Sub
Private Sub PrntTrgts(o As Byte, y As Integer)
    Dim i As Byte
    For i = 3 To 9
        Debug.Print o & " " & y & " " & i & " " & lngTarget(i)
    Next
End Sub
```

Controller form

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  ‘True
END
Attribute VB_Name = “Form_Controller”
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = True
Attribute VB_Exposed = False
‘Programming by Robert W. Shuford, CNA
Option Compare Database
Option Explicit
Private Sub cmdIncDec_Click()
    DoCmd.OpenForm “Increase Decrease Personnel”, acNormal, “”, “”, , acNormal
End Sub
Private Sub cmdKill_Click()
    KillTables
    On Error Resume Next
    DoCmd.DeleteObject acTable, “AllYrs”
    DoCmd.DeleteObject acTable, “Likelihood”
    DoCmd.DeleteObject acTable, “Expected“
    DoCmd.DeleteObject acTable, “temp”
    DoCmd.DeleteObject acTable, “tARates”
    DoCmd.DeleteObject acQuery, “b1”
    DoCmd.DeleteObject acQuery, “b2”
    DoCmd.DeleteObject acQuery, “tmpQry”
    On Error GoTo 0
    DoCmd.SetWarnings True
End Sub
Private Sub cmdRun_Click()
    Dim StartTime As Double, e As Double
    Dim hr As Byte, min As Byte, runs As Byte, i As Byte
    StartTime = Timer
    If IsNull(NumYrs) Or NumYrs < 1 Then
        MsgBox “Enter Number of Years”, , “Hold On, There”
        Exit Sub
    End If
    runs = CByte(txtRuns)
    MakeRunDirs runs
```

```
    For i = 1 To runs
        Driver i, NumYrs ‘, Array(E7Min, E8Min, E9Min, E7SMin, E8SMin, E9SMin)
    Next
    e = Timer - StartTime
    hr = Int(e / 3600)
    e = e - 3600 * hr
    min = Int(e / 60)
    e = e - 60 * min
    MsgBox “Done “ & vbCrLf & Format(hr, “00”) & “:” _
            & Format(min, “00”) & “:” & Format(e, “00”) & “ Elapsed.”
End Sub

Private Sub cmdKillXL_DblClick(Cancel As Integer)
    KillXL CByte(txtRuns)
    MsgBox “Files Deleted”, , “Delete”
End Sub

Private Sub cmdXport_Click()
    XportMods
    MsgBox “Modules Exported”, , “Export”
End Sub
```

Personnel form

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  ‘True
END
Attribute VB_Name = “Form_Increase Decrease Personnel”
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = True
Attribute VB_Exposed = False
‘Programming by Robert W. Shuford, CNA
Option Compare Database
Option Explicit
Private Sub cmdUse_Click()
    Dim varReturn  As Variant
    If IsNull(frmChange.Value) Then GoTo NoChange
    AssignPers True
    DoCmd.OpenForm “Increase Decrease Manpower Targets”, acNormal, “”, “”, , acNormal
    Exit Sub
NoChange:
    MsgBox “Choose a Type of Year-to-Year Change”, , “Not So Fast, My Friend”
End Sub
Public Sub AssignPers(warn As Boolean)
    Dim i As Byte
    optPersChange = frmChange.Value
    If Not IsNull(txtNumPers) Then
        sngPers = CLng(txtNumPers)
        optPers = 3
    ElseIf Not IsNull(txtPctPers) Then
        sngPers = CSng(txtPctPers)
        optPers = 4
    Else
        If warn Then GoTo NoType
    End If
    Exit Sub
NoType:
    MsgBox “Enter an Amount to Increase/Decrease”, , “Hang On”
End Sub
```

Manpower form

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  ‘True
END
Attribute VB_Name = “Form_Increase Decrease Manpower Targets”
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = True
Attribute VB_Exposed = False
‘Programming by Robert W. Shuford, CNA
Option Compare Database
Option Explicit
Private Sub cmdUse_Click()
    Dim varReturn  As Variant
    If IsNull(framPctNum.Value) Then GoTo NoType
    optType = framPctNum.Value
    DoCmd.SelectObject acForm, “Controller”, False
    Exit Sub
NoType:
    MsgBox “Choose a Type of Increase/Decrease”, , “Hang On”
    varReturn = SysCmd(acSysCmdClearStatus)
End Sub
Public Sub AssignMan()
    Dim i As Byte, j As Byte
    optManChange = frmChange
    For j = 3 To 8
        sngIntDec(i, j - 3) = Controls.Item(“txt” & i & j)
        min_tis(j - 1) = Controls.Item(“txt1” & j + 1)
        min_tig(j - 1) = Controls.Item(“txt2” & j + 1)
        sngLossChange(j) = Controls.Item(“txt3” & j)
        bytStopYr(j) = Controls.Item(“txt4” & j)
        If bytStopYr(j) = 0 Then bytStopYr(j) = 100
    Next
    sngLossChange(9) = Controls.Item(“txt39”)
    bytStopYr(9) = Controls.Item(“txt49”)
    If bytStopYr(9) = 0 Then bytStopYr(9) = 100
    min_tis(8) = 400
    min_tig(8) = 400
End Sub
```

```
Private Sub lblocc0_Click()
    CopyAcross 0
End Sub
Private Sub lblocc1_Click()
    CopyAcross 1
End Sub
Private Sub lblocc2_Click()
    CopyAcross 2
End Sub
Private Sub lblocc3_Click()
    CopyAcross 3
End Sub
Private Sub lblocc4_Click()
    CopyAcross 4
End Sub
Private Sub CopyAcross(rw As Byte)
    Dim i As Byte, txtval As String
    With Controls.Item("txt" & rw & "3")
        .SetFocus
        txtval = .Text
    End With
    For i = 4 To 9
        With Controls.Item("txt" & rw & i)
            .SetFocus
            .Text = txtval
        End With
    Next
    Controls.Item("txt" & rw & "3").SetFocus
End Sub
```

Appendix C: PIAPM.xls programming code

Table of contents

Public Function MakeChart
Public Sub LikChart
Sub EMakeBoxPlot
Private Sub EBoxPlotFormat
Private Sub EOutliers
Private Sub ESeriesOrder
Private Sub KillYr0

Utilities

Public Function ELastCell
Public Sub RefreshPivot
Public Sub KillCmdBar
Sub XportMods
Function EMax
Public Sub KillCharts
Function GetRating
Private Function GetTableName
Function CopyModule
Sub AddProcedureToModule
Private Sub NewModLine
Sub AddReference
Sub ListReferencePaths

Choice form

Private Sub UserForm
Private Sub cmdChart
Private Sub spnYOS
Private Sub txtYOS
Private Function WhichData

Workbook

Private Sub Workbook
Private Sub NewButton
Private Sub Workbook

Sheet4

Private Sub cboLikPG
Private Sub cboLikYOS

Sheet6

Private Sub cboPG

Main

```
Attribute VB_Name = “Main”
‘Programming by Robert W. Shuford, CNA
Option Explicit
Dim rating As String, yr As Byte, rule As Variant, run As Byte
Dim ws_t As Worksheet, ws_l As Worksheet, wb As Workbook
Sub LoopDirs()
    Dim i As Byte
    Application.ScreenUpdating = False
    For i = 1 To 10
        CompileData i
    Next
    Application.ScreenUpdating = True
End Sub
Sub CompileData(numrun As Byte)
    Dim yrs As Byte, strPath As String, rate As String
    strPath = ActiveWorkbook.Path
    Set ws_t = ActiveWorkbook.Sheets(“TIS Data”)
    Set ws_l = ActiveWorkbook.Sheets(“Likelihood Data”)
    run = numrun

    ‘Delete old data
    ws_t.Activate
    Range(Cells(1, 1), Cells.SpecialCells(xlLastCell)).ClearContents
    TISHeader
    ws_l.Activate
    ActiveSheet.AutoFilterMode = False
    Range(Cells(1, 1), Cells.SpecialCells(xlLastCell)).ClearContents
    rating = GetRating
    For Each rule In Array(“J”, “M”, “S”)
        On Error Resume Next
        Workbooks.OpenText Filename:=ActiveWorkbook.Path _
                & “\” & run & “\Expected” & rating & rule & “.xls”
        If Err <> 1004 Then
            On Error GoTo 0
            yrs = ActiveWorkbook.Worksheets.Count
            For yr = 1 To yrs
                FixGetExpected
            Next
            Workbooks(“Expected” & rating & rule & “.xls”).Close False
```

```
        Workbooks.OpenText Filename:=ActiveWorkbook.Path _
                & "\" & run & "\Likelihood" & rating & rule & ".xls"
        Set wb = ActiveWorkbook
        FixLikely
        GetLikely
        Workbooks("Likelihood" & rating & rule & ".xls").Close False
    End If
Next
On Error GoTo 0
GetNewData "Sep"
RefreshPivot "Sep"
GetNewData "Shortage"
RefreshPivot "Shortage"
GetNewData "Prom"
RefreshPivot "Prom"
GetNewData "TISTIG"
RefreshPivot "TISTIG"
GetNewData "YOS_PG"
RefreshPivot "YOS_PG"
ActiveSheet.PivotTables("PivotTable1").PivotFields("rule").CurrentPage = "M"
ActiveSheet.PivotTables("PivotTable1").PivotFields("yr").CurrentPage = "1"
rate = Metadata
Sheets("Metadata").Activate

CopyAllSheets
Set ws_l = ActiveWorkbook.Sheets("Likelihood Data")
FixLikChart yrs
FilterLikely
FixTISChart
FixAxis yrs
RefreshPivot "Sep"
RefreshPivot "Shortage"
Sheets("Metadata").Select
ActiveWorkbook.SaveAs strPath & "\Results_" & rate & "_" _
        & Format(Now, "mmddyy_hhmmss") & ".xls"
ActiveWorkbook.Close False
ws_t.Activate
FixLikChart yrs
FilterLikely
FixTISChart
FixAxis yrs
Sheets("Metadata").Select
```

```
    Set ws_t = Nothing
    Set ws_l = Nothing
    Set wb = Nothing
End Sub
Private Sub TISHeader()
    With Cells(1, 1)
        .Value2 = “rating”
        .Offset(0, 1).Value2 = “rule”
        .Offset(0, 2).Value2 = “pg”
        .Offset(0, 3).Value2 = “yr”
        .Offset(0, 4).Value2 = “cnt”
        .Offset(0, 5).Value2 = “AvgOfprom_mnths”
    End With
End Sub
Private Sub FixGetExpected()
    Workbooks(“Expected” & rating & rule & “.xls”).Activate
    ActiveWorkbook.Sheets(“EYr” & yr).Activate
    ‘Move data to driver
    Range(“A3:F8”).Copy
    ws_t.Activate
    ‘Move to first empty row
    Cells(ELastCell(ws_t).Row + 1, 1).Select
    ActiveSheet.Paste
    Application.CutCopyMode = False
End Sub
Private Sub FixLikely()
    wb.Activate
    ‘Move column headers to driver
    Rows(“1:1”).Select
    Selection.Cut
    ws_l.Activate
    Cells(1, 1).Select
    ActiveSheet.Paste
    wb.Activate
    Selection.Delete shift:=xlUp
End Sub
Private Sub GetLikely()
    ‘Move data to driver
    Selection.CurrentRegion.Select
    Selection.Copy
    ws_l.Activate
    Cells(ELastCell(ActiveSheet).Row + 1, 1).Select
```

```
    ActiveSheet.Paste
    Application.CutCopyMode = False
End Sub
Public Sub FilterLikely(Optional shift As Byte = 0)
    Sheets("Likelihood Data").Activate 'ws_l.Activate
    Selection.CurrentRegion.Select
    'Sort by rating, rule, pg
    Selection.Sort Key1:=Range("B2"), Order1:=xlAscending, Key2:=Range("C2") _
        , Order2:=xlAscending, Key3:=Range("D2"), Order3:=xlAscending, Header:= _
        xlGuess, OrderCustom:=1, MatchCase:=False, Orientation:=xlTopToBottom
    Selection.AutoFilter
'    Selection.AutoFilter Field:=3, Criteria1:=Cells(2, 3).Value2
    Selection.AutoFilter Field:=4, Criteria1:=Cells(2, 4).Value2
    Cells(1, 1).Select
End Sub
Private Sub GetNewData(dat As String)
    Dim s_address As String
    Set ws_l = ActiveWorkbook.Sheets(dat & " Data")
    ws_l.Activate
    Range(Cells(1, 1), Cells.SpecialCells(xlLastCell)).ClearContents
    Workbooks.OpenText Filename:=ActiveWorkbook.Path _
            & "\" & run & "\" & dat & ".xls"
    Cells(1, 1).CurrentRegion.Select
    Selection.Copy
    ws_l.Activate
    Cells(1, 1).Select
    ActiveSheet.Paste
    Application.CutCopyMode = False
    Workbooks(dat & ".xls").Close False
    Sheets(dat & " Chart").Select
NoPivot:
    Set ws_l = Nothing
End Sub
Private Function Metadata() As String
    Dim s_address As String
    Set ws_l = ActiveWorkbook.Sheets("Metadata")
    ws_l.Activate
    Range(Cells(1, 1), Cells.SpecialCells(xlLastCell)).ClearContents
    Workbooks.OpenText Filename:=ActiveWorkbook.Path _
            & "\" & run & "\Metadata.xls"
    Range(Cells(1, 1), Cells(1, 2)).ClearContents
    Cells(2, 1).CurrentRegion.Select
```

```
    Dim c As Range
    For Each c In Selection
        c.Value2 = c.Value2
    Next
    Selection.Copy
    ws_l.Activate
    Cells(1, 1).Select
    ActiveSheet.Paste
    Application.CutCopyMode = False
    Workbooks("Metadata.xls").Close False
    Range("B1").NumberFormat = "m/d/yy h:mm AM/PM"
    Columns("A:B").EntireColumn.AutoFit
    Metadata = Cells(3, 2).Value2
    Cells(1, 1).Select
End Function
Sub CopyAllSheets()
    Sheets(Array("YOS_PG Chart", "YOS_PG Pivot", "YOS_PG Data", _
            "TISTIG Chart", "TISTIG Pivot", "TISTIG Data", _
            "Prom Chart", "Prom Pivot", "Prom Data", _
            "Shortage Chart", "Shortage Pivot", "Shortage Data", _
            "Sep Chart", "Sep Pivot", "Sep Data", _
            "TIS Chart", "TIS", "TIS Pivot", "TIS Data", _
            "Likelihood Chart", "Likelihood Data", "Metadata")).Copy
End Sub
```

Compile

```
Attribute VB_Name = “Compile”
‘Programming by Robert W. Shuford, CNA
Option Explicit
Option Base 1
Const DATASHEETS = 7
Dim wb As Workbook, wbNew As Workbook, wbDriver As Workbook
Dim bytYrs As Byte
Public blnDisableEvents As Boolean
Sub CompileAllData()
    Dim intFiles As Integer, strPath As String, bytLikCol As Byte, i As Integer
    Dim rate As String
    Application.ScreenUpdating = False
    Set wbDriver = ActiveWorkbook
    bytLikCol = 0
    strPath = ActiveWorkbook.Path & “\”
    Worksheets(“Likelihood Data”).Select
    Set wbNew = Workbooks.Add
    With Application.FileSearch
        .NewSearch
        .LookIn = strPath
        .Filename = “Results_*.xls”
        ‘ Loop through files
        If .Execute() > 0 Then
            For i = 1 To .FoundFiles.Count
                Workbooks.Open Filename:=.FoundFiles(i)
                Set wb = ActiveWorkbook
                Sheets(“Metadata“).Activate
                If i = 1 Then rate = Cells(3, 2).Value2
                If bytLikCol = 0 Then
                    bytLikCol = Cells(2, 2) + 6
                    MakeNewWB bytLikCol
                ElseIf bytLikCol <> Cells(2, 2) + 6 Then
                    MsgBox wb.Name & “ does not contain the same “ _
                            & “number of years as the previous file(s).” _
                            & vbCrLf & vbCrLf & “All spreadsheets in “ _
                            & strPath & “ beginning with Results_ must “ _
                            & “have the same number of years.”, , _
                            “Houston, we have a problem!”
                    wb.Close False
```

```
                wbNew.Close False
                GoTo BadYrs
            End If
            CopyData “Shortage”
            CopyData “Sep”
            CopyData “TIS”
            CopyData “Likelihood”
            CopyData “Prom”
            CopyData “TISTIG”
            CopyData “YOS_PG”
            Application.CutCopyMode = False
            wb.Close False
        Next
    Else
        MsgBox “No files found in current directory”
        GoTo BadYrs
    End If
End With
blnDisableEvents = True
MakePivot “Shortage”
MakePivot “Sep”
MakePivot “TIS”
MakePivot “Likelihood”
MakePivot “Prom”
MakePivot “TISTIG”
MakePivot “YOS_PG”
wbDriver.Activate
Application.DisplayAlerts = False

CopyAllSheets
Sheets(“Metadata“).Delete
FixLikChart bytYrs
FilterLikely
FixTISChart
FixAxis bytYrs
RefreshPivot “Sep”
RefreshPivot “Shortage”
RefreshPivot “Prom”
RefreshPivot “TISTIG”
RefreshPivot “YOS_PG”
Application.DisplayAlerts = True
ActiveWorkbook.SaveAs strPath & “Compiled_” & rate & “_” _
```

```
            & Application.FileSearch.FoundFiles.Count & "_Files_ " _
            & bytYrs & "_Yrs" & ".xls"
BadYrs:
    blnDisableEvents = False
    wbNew.Close False
    Set wb = Nothing
    Set wbNew = Nothing
    Set wbDriver = Nothing
    Application.ScreenUpdating = True
End Sub
Private Sub MakeNewWB(bytLikCols As Byte)
    Dim i As Integer
    wbNew.Activate
    Application.DisplayAlerts = False
    For i = Worksheets.Count To 2 Step -1
        Worksheets(i).Delete
    Next
    For i = 2 To DATASHEETS
        Sheets.Add After:=Worksheets(Worksheets.Count)
    Next

    i = 1
    Sheets(i).Select
    ActiveSheet.Name = "YOS_PG Data"
    CommonData
    Cells(1, 6) = "yos"
    i = i + 1

    Sheets(i).Select
    ActiveSheet.Name = "TISTIG Data"
    CommonData
    Cells(1, 6) = "tis"
    Cells(1, 7) = "tig"
    i = i + 1

    Sheets(i).Select
    ActiveSheet.Name = "Prom Data"
    CommonData
    Cells(1, 6) = "proms"
    Cells(1, 7) = "pct"
    i = i + 1
```

```
    Sheets(i).Select
    ActiveSheet.Name = “Shortage Data”
    CommonData
    Cells(1, 6) = “target”
    Cells(1, 7) = “shortage”
    i = i + 1

    Sheets(i).Select
    ActiveSheet.Name = “Sep Data”
    CommonData
    Cells(1, 6) = “seps”
    Cells(1, 7) = “pct”
    i = i + 1

    Sheets(i).Select
    ActiveSheet.Name = “TIS Data”
    CommonData
    Cells(1, 6) = “AvgOfprom_mnths”
    i = i + 1

    Sheets(i).Select
    ActiveSheet.Name = “Likelihood Data”
    CommonData
    i = i + 1

    For i = 6 To bytLikCols - 1
        Cells(1, i) = “Yr “ & i - 5
    Next
    bytYrs = bytLikCols - 6
    Cells(1, bytLikCols) = “likelihood”
End Sub
Private Sub CommonData()
    Cells(1, 1) = “rating”
    Cells(1, 2) = “rule”
    Cells(1, 3) = “pg”
    Cells(1, 4) = “yr”
    Cells(1, 5) = “cnt”
End Sub
Private Sub CopyData(str As String)
    wbNew.Activate
    Worksheets(str & “ Data”).Select
    Cells(ELastCell(ActiveSheet).Row + 1, 1).Select
```

```
    wb.Activate
    Worksheets(str & " Data").Select
    Selection.AutoFilter
    Range(Cells(2, 1), ELastCell(ActiveSheet)).Copy
    wbNew.Activate
    ActiveSheet.Paste
End Sub
Sub MakePivot(str As String)
    Dim i As Byte, bytBadCol As Byte
    Worksheets(str & " Data").Select
    Cells(1, 1).Select
    Selection.CurrentRegion.Select
    ActiveWorkbook.PivotCaches.Add(SourceType:=xlDatabase, SourceData:= _
        Selection.Address).CreatePivotTable TableDestination:="", _
        TableName:="PivotTable1"
    ActiveSheet.PivotTableWizard TableDestination:=ActiveSheet.Cells(3, 1)
    ActiveSheet.Cells(3, 1).Select
    ActiveSheet.PivotTables("PivotTable1").SmallGrid = False
    ActiveSheet.Name = str & " Pivot"
    bytBadCol = 3
    Select Case str
        Case "YOS_PG"
            CommonFields
            With ActiveSheet.PivotTables("PivotTable1").PivotFields("yos")
                .Orientation = xlRowField
            End With
            FieldSets 5, "cnt", "pg"
            bytBadCol = 4

        Case "TISTIG"
            CommonFields
            FieldSets 4, "tis", "tig"

        Case "Prom"
            CommonFields
            FieldSets 4, "cnt", "proms", "pct"

        Case "Shortage"
            CommonFields
            FieldSets 4, "cnt", "target", "shortage"

        Case "Sep"
```

```
            CommonFields
            FieldSets 4, “cnt”, “seps”, “pct”

        Case “TIS”
            CommonFields
            FieldSets 4, “cnt”, “AvgOfprom_mnths”

        Case “Likelihood”
            CommonFields
            LikFieldSets bytYrs
    End Select

    With ActiveSheet.PivotTables(“PivotTable1”).PivotFields(“Data”)
        .Orientation = xlColumnField
        .Position = 1
    End With
    CleanPivot str, bytBadCol
End Sub
Sub CommonFields()
    Dim i As Byte
    i = 1
    With ActiveSheet.PivotTables(“PivotTable1”)
        With .PivotFields(“rule”)
            .Orientation = xlRowField
            .Position = i
            i = i + 1
        End With
        With .PivotFields(“pg”)
            .Orientation = xlRowField
            .Position = i
            i = i + 1
        End With
        With .PivotFields(“yr”)
            .Orientation = xlRowField
            .Position = i
            i = i + 1
        End With
    End With
End Sub
Private Sub NewField(fld As String, pos As Byte)
    With ActiveSheet.PivotTables(“PivotTable1”)
        With .PivotFields(fld)
```

```
            .Orientation = xlDataField
            .Position = pos
        End With
    End With
End Sub
Private Sub FieldSets(bytDatCol As Byte, ParamArray fields() As Variant)
    Dim i As Byte, bytStrt As Byte, bytFldNum As Byte, xl As Variant
    bytStrt = 1
    bytFldNum = 1
    For Each xl In Array(xlAverage, xlStDev, xlMin, xlMax)
        For i = LBound(fields) To UBound(fields)
            NewField CStr(fields(i)), bytFldNum
            bytFldNum = bytFldNum + 1
        Next
        For i = bytStrt To bytFldNum - 1
            With ActiveSheet.PivotTables("PivotTable1")
                .PivotFields(Cells(i + 3, bytDatCol).Value2).Function = xl
            End With
        Next
        bytStrt = bytFldNum
    Next
End Sub
Private Sub LikFieldSets(yrs As Byte)
    Dim i As Byte, bytStrt As Byte, bytFldNum As Byte, xl As Variant
    NewField "cnt", 1
    bytStrt = 1
    bytFldNum = 2
    For Each xl In Array(xlAverage, xlStDev, xlMin, xlMax)
        For i = 1 To yrs
            NewField "Yr " & i, bytFldNum
            bytFldNum = bytFldNum + 1
        Next
        For i = bytStrt To bytFldNum - 1
            With ActiveSheet.PivotTables("PivotTable1")
                .PivotFields(Cells(i + 3, 4).Value2).Function = xl
            End With
        Next
        bytStrt = bytFldNum
    Next
End Sub
Private Sub CleanPivot(str As String, col As Byte)
    Selection.CurrentRegion.Select
```

```
    Sheets.Add
    ActiveSheet.Name = str
    Sheets(str & " Pivot").Select
    Selection.Copy
    Sheets(str).Select
    Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, SkipBlanks:= _
        False, Transpose:=False
    Rows("1:1").Select
    Application.CutCopyMode = False
    Selection.Delete shift:=xlUp

    KillBadRow col
    FillCols col - 1
    Cells.Replace What:="Average of ", Replacement:="", LookAt:=xlPart, _
        SearchOrder:=xlByRows, MatchCase:=False
    ActiveCell.CurrentRegion.Columns.AutoFit
    Cells(1, 1).Select
    If str = "Likelihood" Then Cells(1, 3).Value2 = "yos"
    If str = "YOS_PG" Then
        Range("F:F,H:H,J:J,L:L").Select
        Selection.Delete shift:=xlToLeft
        Range("A1").Select
    End If
    MoveData str
End Sub
Private Sub KillBadRow(c As Byte)
    Dim R As Integer
    For R = ELastCell(ActiveSheet).Row To 1 Step -1
        If Cells(R, c).Value2 = "" Then
            Rows(R).EntireRow.Select
            Selection.Delete shift:=xlUp
        End If
    Next
End Sub
Private Sub FillCols(col As Byte)
    Dim R As Integer, c As Byte, intLastRow
    intLastRow = ELastCell(ActiveSheet).Row
    For c = 1 To col
        For R = 1 To intLastRow
            Cells(R, c).Activate
            If ActiveCell.Value2 = "" Then ActiveSheet.Paste
            ActiveCell.Copy
```

```
        Next
    Next
End Sub
Private Sub MoveData(str As String)
    wbDriver.Sheets(str & " Data").Activate
    ActiveSheet.AutoFilterMode = False
    Range(Cells(1, 1), Cells.SpecialCells(xlLastCell)).ClearContents
    Cells(1, 1).Select
    ActiveCell.Value2 = "rating"
    wbNew.Activate
    ActiveCell.CurrentRegion.Copy
    wbDriver.Activate
    If str = "Likelihood" Then Cells(1, 2).Select
    ActiveSheet.Paste
    ActiveCell.CurrentRegion.Columns.AutoFit

    Select Case str
        Case "YOS_PG", "TISTIG", "Prom", "Shortage", "Sep"
            RefreshPivot str

        Case "TIS"
            RefreshPivot str
            FixTISChart
            FixAxis bytYrs

        Case "Likelihood"
            Sheets(str & " Data").Select
            With Selection
                .AutoFilter
                .AutoFilter Field:=4, Criteria1:=Cells(2, 4).Value2
            End With
            FixLikChart bytYrs
            KillLikSeries
    End Select

    wbNew.Activate
End Sub
Private Sub KillLikSeries()
    ActiveSheet.ChartObjects("Chart 1").Activate
    ActiveChart.ChartArea.Select
    On Error GoTo Done
    Do While True
```

```
        ActiveChart.SeriesCollection(bytYrs + 1).Delete
    Loop
Done:
End Sub
```

Formatting

```
Attribute VB_Name = “Formatting”
‘Programming by Robert W. Shuford, CNA
Option Explicit
Option Private Module
Public Sub FixLikChart(yrs As Byte)
    Dim l_cols As Byte, l_rows As Long, l_address As String, i As Byte
    Sheets(“Likelihood Data”).Activate
    ‘Determine number of years
    ActiveSheet.AutoFilterMode = False
    l_cols = yrs + 5
    Range(Cells(1, 6), Cells(1, l_cols)).Select
    Selection.Replace What:=“av_”, Replacement:=“Yr “, _
            LookAt:=xlPart, SearchOrder:=xlByRows, MatchCase:=False
    Range(Selection, Selection.End(xlDown)).Select
    l_address = Selection.Address
    l_rows = Selection.Rows.Count

    ActiveWorkbook.Sheets(“Likelihood Chart”).Activate
    ‘Set source data for chart
    ActiveSheet.ChartObjects(“Chart 1”).Activate
    With ActiveChart
        For i = 1 To l_cols - 4
            .SetSourceData Source:=Sheets(“Likelihood Data”).Range(l_address)
        Next
    End With
    ActiveChart.SeriesCollection(1).XValues = “=‘Likelihood Data’!R2C2:R” _
            & l_rows & “C3”
    ActiveSheet.Cells(1, 3).Select

    ActiveSheet.Shapes(“cboLikYOS“).Select
    Selection.ListFillRange = “B1:B31”
    ActiveSheet.OLEObjects(“cboLikYOS“).Object.Value = Cells(1, 2)
    ActiveSheet.Cells(1, 3).Select
End Sub
Public Sub FixTISChart()
    ‘Refresh pivot table
    Sheets(“TIS Pivot”).Select
    RefreshPivot “TIS”
    ‘Set source data for controls
```

```
    Sheets(“TIS Chart”).Select
    ActiveSheet.Cells(1, 3).Select
End Sub
Public Sub FixAxis(numyrs As Byte)
    Dim i As Byte, o As Byte, ws_tp As Worksheet
    Set ws_tp = ActiveWorkbook.Sheets(“TIS Pivot”)
    ActiveWorkbook.Sheets(“TIS”).Activate
    Range(Cells(1, 1), Cells.SpecialCells(xlLastCell)).ClearContents
    Cells(1, 1).Select
    ActiveCell.Value2 = “PG”
    ActiveCell.Offset(0, 1).Select
    For i = 1 To numyrs
        ActiveCell.Value2 = “Junior” & i
        ActiveCell.Offset(0, 1).Select
        ActiveCell.Value2 = “Bench” & i
        ActiveCell.Offset(0, 1).Select
        ActiveCell.Value2 = “Senior” & i
        ActiveCell.Offset(0, 1).Select
    Next
    ActiveCell.Value2 = “Year”
    ActiveCell.Offset(1, 0).Select
    For o = 4 To 9
        For i = 1 To numyrs
            ActiveCell.Value2 = “y” & i
            ActiveCell.Offset(1, 0).Select
        Next
        ActiveCell.Offset(1, 0).Select
    Next
    Cells(2, 1).Value2 = “E4”
    For o = 5 To 9
        Cells((o - 4) * (numyrs + 1) + 2, 1).Value2 = “E” & o ‘
    Next
    For o = 4 To 9
        Cells((o - 4) * (numyrs + 1) + 2, 2).Select
        For i = 1 To numyrs
            ActiveCell.FormulaR1C1 = “=‘TIS Pivot’!R” & o + 2 & “C” & 4 * i - 2
            ActiveCell.Offset(0, 1).FormulaR1C1 = “=‘TIS Pivot’!R” & o + 2 _
                    & “C” & 4 * i - 1 & “-’TIS Pivot’!R” & o + 2 & “C” & 4 * i - 2
            ActiveCell.Offset(0, 2).FormulaR1C1 = “=IF(“ _
                    & ActiveCell.Offset(0, 1).Address(ReferenceStyle:=xlR1C1) _
                    & “>=0,’TIS Pivot’!R” & o + 2 & “C” & 4 * i & “-’TIS Pivot’!R” _
                    & o + 2 & “C” & 4 * i - 1 & “,’TIS Pivot’!R” & o + 2 & “C” & 4 * i _
```

```
                    & “-’TIS Pivot’!R” & o + 2 & “C” & 4 * i - 2 & “)”
            ActiveCell.Offset(1, 3).Select
        Next
    Next
    ActiveCell.Offset(-1, -1).Select
    SetSrc numyrs
End Sub
Private Sub SetSrc(yrs As Byte)
    Dim rng As Range, i As Byte
    ActiveWorkbook.Sheets(“TIS”).Activate
    Set rng = Range(ActiveCell, Cells(1, 1))
    ActiveWorkbook.Sheets(“TIS Chart”).Activate
    ActiveSheet.ChartObjects(“Chart 1”).Activate
    ActiveChart.ChartArea.Select
    ActiveChart.SetSourceData Source:=Sheets(“TIS”).Range(rng.Address)
    For i = 1 To ActiveChart.SeriesCollection.Count
        ActiveChart.SeriesCollection(i).XValues = _
                Worksheets(“TIS”).Range(“$A$2:$A$” & rng.Rows.Count)
        ActiveChart.SeriesCollection(i).Select
        Blue 37
    Next
    For i = 1 To yrs
        ActiveChart.SeriesCollection(i * 3 - 1).Select
        Blue 41
    Next
    For i = 1 To yrs
        ActiveChart.SeriesCollection(i * 3).Select
        Blue 25
    Next
    ActiveChart.Deselect
    Set rng = Nothing
End Sub
Private Sub Blue(clr As Byte)
    With Selection.Border
        .ColorIndex = 2
        .Weight = xlThin
        .LineStyle = xlContinuous
    End With
    Selection.Shadow = False
    Selection.InvertIfNegative = False
    With Selection.Interior
        .ColorIndex = clr
```

```
        .Pattern = xlSolid
    End With
End Sub
```

Robust

```
Attribute VB_Name = “Robust”
‘Programming by Robert W. Shuford, CNA
Option Explicit
Option Base 1
Const A = 1
Const B = 2
Const c = 3
Const D = 4
Const E = 5
Const F = 6
Const G = 7
Const H = 8
Const i = 9
Const j = 10
Const k = 11
Const L = 12
Const M = 13
Const N = 14
Const o = 15
Const p = 16
Const Q = 17
Const R = 18
Const S = 19
Const T = 20
Sub Robustness()
    Dim strFN As String, strPath As String
    Application.ScreenUpdating = False
    strPath = ActiveWorkbook.Path
    strFN = ActiveWorkbook.Name
    Sheets(Array(“TISTIG Data”, “Prom Data”, “Shortage Data”, “Sep Data”, “TIS Data”, “Likelihood Data”)).Copy
    Sheets(“Sep Data”).Copy Before:=Sheets(1)
    ActiveSheet.Name = “Count Data”
    Sheets(“TISTIG Data”).Copy Before:=Sheets(2)
    ActiveSheet.Name = “AveTIS Data”
    Sheets(“TISTIG Data”).Name = “AveTIG Data”
    ShortSepTIS “Count”, D, j, D, G, M, D ‘E, K, E, H, N, E
    ‘1st data column, min As Byte, base stat, std, max, id
    ShortSepTIS “AveTIS”, D, H, D, F, j, D
    KillYr0
```

```
    ShortSepTIS “AveTIG”, D, i, E, G, k, D
    KillYr0
    ‘ShortSepTIS “YOS_PG”, E, G, E, F, H, D
    ShortSepTIS “Prom”, D, L, F, i, o, D
    ShortSepTIS “Shortage”, D, L, F, i, o, D ‘E, M, G, j, p, E
    ShortSepTIS “Sep”, D, L, F, i, o, D ‘E, M, G, j, p, E
    ShortSepTIS “TIS”, D, i, E, G, k, D ‘E, j, F, H, L, E
    KillYr0
    MakeCharts
    CopyModule “Robust”, ThisWorkbook.VBProject, ActiveWorkbook.VBProject, True
    CopyModule “Utilities”, ThisWorkbook.VBProject, ActiveWorkbook.VBProject, True
    CopyModule “frmChoice”, ThisWorkbook.VBProject, ActiveWorkbook.VBProject, True
    AddProcedureToModule
    AddReference “{0002E157-0000-0000-C000-000000000046}”
    ActiveWorkbook.SaveAs strPath & “\Sensitivity_Data_for_” & Mid(strFN, 10)
    ‘ActiveWorkbook.Close False
    Application.ScreenUpdating = True
End Sub
Private Sub ShortSepTIS(dat As String, col As Byte, min As Byte, _
        base As Byte, std As Byte, max As Byte, id As Byte)
    Dim stat As Variant, bytcols As Byte
    Sheets(dat & “ Data”).Select
    Sheets.Add
    ActiveSheet.Name = dat & “ Chart”
    Sheets(dat & “ Data”).Select
    bytcols = ELastCell(ActiveSheet).Column
    For Each stat In Array(min, base, std, max)
        Columns(stat).Select
        Selection.Copy
        Columns(stat + bytcols).Select
        ActiveSheet.Paste
    Next
    ‘Min
    Columns(min + bytcols).Select
    Selection.Copy
    Columns(col).Select
    ActiveSheet.Paste
    ‘base stat
    Columns(base + bytcols).Select
    Selection.Copy
    Columns(col + 2).Select
    ActiveSheet.Paste
```

```
    ‘Max
    Columns(max + bytcols).Select
    Selection.Copy
    Columns(col + 4).Select
    ActiveSheet.Paste
    ‘-2
    Cells(2, col + 1).Select
    With ActiveCell
        .FormulaR1C1 = “=RC” & base + bytcols & “-1*RC” & std + bytcols
        .Copy
        Range(ActiveCell, Cells(ELastCell(ActiveSheet).Row, .Column)).Select
        ActiveSheet.Paste
        Selection.Copy
        Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, _
                SkipBlanks:=False, Transpose:=False
    End With
    ‘+2
    Cells(2, col + 3).Select
    With ActiveCell
        .Formula = “=RC” & base + bytcols & “+RC” & std + bytcols
        .Copy
        Range(ActiveCell, Cells(ELastCell(ActiveSheet).Row, .Column)).Select
        ActiveSheet.Paste
        Selection.Copy
        Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, _
                SkipBlanks:=False, Transpose:=False
    End With
    Cells(1, col).Value2 = “Min”
    Cells(1, col + 1).Value2 = “‘-1 STD”
    Cells(1, col + 3).Value2 = “‘+1 STD”
    Cells(1, col + 4).Value2 = “Max”

    Range(Cells(1, col + 5), ELastCell(ActiveSheet)).ClearContents
    ‘InsertID id
    Range(“A1”).Select
End Sub
Private Sub MakeCharts()
    MakeChart “Count”
    MakeChart “AveTIS”
    MakeChart “AveTIG”
    ‘MakeChart “YOS_PG”
    MakeChart “Prom”
```

```
    MakeChart “Shortage”
    MakeChart “Sep”
    MakeChart “TIS”
    Sheets(“Likelihood Data”).Select
    Sheets.Add
    ActiveSheet.Name = “Likelihood Chart”
    LikChart
End Sub
Public Function MakeChart(dat As String, Optional pg As Byte = 4)
    Dim yrs As Byte, rng As Range
    Sheets(dat & “ Chart”).Select
    Range(Cells(1, 1), ELastCell(ActiveSheet)).ClearContents
    Sheets(dat & “ Data”).Select
    Cells(2, 3).Select
    Range(Selection, Selection.End(xlDown)).Select
    yrs = EMax
    Selection.CurrentRegion.Select
‘    Selection.AutoFilter Field:=1, Criteria1:=rating
    Selection.AutoFilter Field:=2, Criteria1:=pg
    Cells(1, 3).Select
    Range(Selection, ELastCell(ActiveSheet)).Select
    Selection.Copy
    Sheets(dat & “ Chart”).Select
    Cells(1, 2).Select
    ActiveSheet.Paste
    Cells(1, 1).Value2 = “rule”
    Cells(2, 1).Value2 = “J”
    Cells(yrs + 2, 1).Value2 = “M”
    Cells(2 * yrs + 2, 1).Value2 = “S”
    Cells(2, 2).Select
    Range(Selection, Selection.End(xlDown)).Select
    For Each rng In Selection
        rng.Value2 = “’” & rng.Value2
    Next
    ActiveCell.CurrentRegion.Select
    EMakeBoxPlot pg
End Function
Public Sub LikChart(Optional pg As Byte = 3, _
        Optional yos As Byte = 0)
    Dim i As Byte, j As Byte, k As Byte, yrs As Byte, rng As Range, stat() As Single
    Sheets(“TIS Data”).Select
    Cells(2, 3).Select
```

```
    Range(Selection, Selection.End(xlDown)).Select
    yrs = EMax
    ReDim stat(3, 4, yrs)
    Sheets("Likelihood Chart").Select
    Range(Cells(1, 1), ELastCell(ActiveSheet)).ClearContents
    Sheets("Likelihood Data").Select
    Cells(1, 1).CurrentRegion.Select
'    Selection.AutoFilter Field:=1, Criteria1:=rating
    Selection.AutoFilter Field:=3, Criteria1:=pg
    Selection.AutoFilter Field:=4, Criteria1:=yos
    Cells(1, 6).Select
    Range(Selection, ELastCell(ActiveSheet)).Select
'    Sheets.Add
'    ActiveSheet.Name = "Likelihood Chart"
'    Sheets("Likelihood Data").Select
    Selection.Copy
    Sheets("Likelihood Chart").Select
    Cells(1, 1).Select
    ActiveSheet.Paste
    Cells(2, 1).Select
    For i = 1 To 4
        For j = 1 To yrs
            stat(1, i, j) = ActiveCell.Value2
            stat(2, i, j) = ActiveCell.Offset(1, 0).Value2
            stat(3, i, j) = ActiveCell.Offset(2, 0).Value2
            ActiveCell.Offset(0, 1).Select
        Next
    Next
    Rows("1:4").Select
    Selection.ClearContents 'Delete Shift:=xlUp
    Cells(1, 1).Value2 = "rule"
    Cells(1, 2).Value2 = "year"
    Cells(1, 3).Value2 = "'Min"
    Cells(1, 4).Value2 = "'-1 STD"
    Cells(1, 5).Value2 = "Pct"
    Cells(1, 6).Value2 = "'+1 STD"
    Cells(1, 7).Value2 = "'Max"
    Cells(2, 1).Value2 = "J"
    Cells(yrs + 2, 1).Value2 = "M"
    Cells(2 * yrs + 2, 1).Value2 = "S"
    Cells(2, 2).Select
    For k = 1 To 3
```

```
        For i = 1 To yrs
            With ActiveCell
                .Value2 = “‘“ & i
                .Offset(0, 1).Value2 = stat(k, 3, i)                    ‘Min
                .Offset(0, 2).Value2 = stat(k, 1, i) - stat(k, 2, i)    ‘-1 STD
                .Offset(0, 3).Value2 = stat(k, 1, i)                    ‘base
                .Offset(0, 4).Value2 = stat(k, 1, i) + stat(k, 2, i)    ‘+1 STD
                .Offset(0, 5).Value2 = stat(k, 4, i)                    ‘Max
                .Offset(1, 0).Select
            End With
        Next
        ‘Cells(yrs + 2, 2).Select
    Next
    Cells(1, 1).CurrentRegion.Select
    EMakeBoxPlot pg, yos
End Sub
Sub EMakeBoxPlot(pg As Byte, Optional yos As Byte = 99)
    Dim ws As String, rngR As String, title As String
    On Error Resume Next ‘GoTo BoxErr
    title = “PG “ & pg
    If yos <> 99 Then title = title & “ YOS “ & yos
    ws = ActiveSheet.Name
    rngR = Selection.Address
    Charts.Add
    With ActiveChart
        .HasTitle = True
        .ChartTitle.Characters.Text = title
        .ChartType = xlLineMarkers
        .SetSourceData Source:=Sheets(ws).Range(rngR)
        .Location Where:=xlLocationAsObject, Name:=ws
    End With
    With ActiveChart
        .SeriesCollection(1).Select

        With .ChartGroups(1)
            .HasDropLines = False
            .HasHiLoLines = True
            .HasUpDownBars = True
            .GapWidth = 150
        End With

        .ChartGroups(1).UpBars.Select
```

```
        With Selection.Border
            .Weight = xlMedium
            .LineStyle = xlContinuous
        End With
        With Selection.Interior
            .ColorIndex = 15
            .PatternColorIndex = 1
            .Pattern = xlSolid
        End With

        .Legend.Select
        Selection.Delete
        EBoxPlotFormat
    End With
    Exit Sub
    On Error GoTo 0
'BoxErr:
End Sub
Private Sub EBoxPlotFormat()
    Dim sc As Integer, lb As Integer, ub As Integer, i As Integer
    With ActiveChart
        sc = .SeriesCollection.Count
        lb = Int(sc / 2)
        ub = Int((sc / 2)) + 1 + (sc Mod 2)
        'Series outside of box
        For i = 1 To lb - 1
            EOutliers i
        Next
        For i = ub + 1 To sc
            EOutliers i
        Next
        'Median
        If ub - lb = 2 Then EOutliers lb + 1, 3, xlDash, 10
        'Box
        ESeriesOrder lb, 1
        ESeriesOrder ub, sc
    End With
    Range("A1").Activate
End Sub
Private Sub EOutliers(series As Integer, Optional color As Byte = 1, _
        Optional style As Integer = xlCircle, Optional size As Byte = 5)
    ActiveChart.SeriesCollection(series).Select
```

```
    Selection.Border.LineStyle = xlNone
    With Selection
        .MarkerBackgroundColorIndex = color
        .MarkerForegroundColorIndex = color
        .MarkerStyle = style
        .MarkerSize = size
    End With
End Sub
Private Sub ESeriesOrder(series As Integer, order As Integer)
    ActiveChart.ChartGroups(1).SeriesCollection(series).Select
    Selection.Border.LineStyle = xlNone
    With Selection
        Selection.MarkerStyle = xlNone
        .PlotOrder = order
    End With
End Sub
Private Sub KillYr0()
    Dim i As Long
    For i = 2 To ELastCell(ActiveSheet).Row
        If Cells(i, 3).Value2 = 0 Then
            Rows(i).EntireRow.Select
            Selection.Delete shift:=xlUp
        End If
    Next
End Sub
```

Utilities

```
Attribute VB_Name = “Utilities”
‘Programming by Robert W. Shuford, CNA
Option Explicit
Option Private Module
Public Function ELastCell(TheSheet As Worksheet) As Range
‘   Returns a single-cell range object that represents
‘   the intersection of the last non-empty row and the
‘   last non-empty column
    Dim ExcelLastCell As Range
    Dim Row As Long, col As Integer
    Dim LastRowWithData As Long, LastColWithData As Integer

‘   ExcelLastCell is what Excel thinks is the last cell
    Set ExcelLastCell = TheSheet.Cells.SpecialCells(xlLastCell)

‘   Determine the last row with data in it
    LastRowWithData = ExcelLastCell.Row
    Row = ExcelLastCell.Row
    Do While Application.CountA(TheSheet.Rows(Row)) = 0 And Row <> 1
        Row = Row - 1
    Loop
    LastRowWithData = Row

‘   Determine the last column with data in it
    LastColWithData = ExcelLastCell.Column
    col = ExcelLastCell.Column
    Do While Application.CountA(TheSheet.Columns(col)) = 0 And col <> 1
        col = col - 1
    Loop
    LastColWithData = col

‘   Create the range object
    Set ELastCell = TheSheet.Cells(Row, col)
End Function
Public Sub RefreshPivot(str As String)
    Dim s_address As String
    Sheets(str & “ Data”).Select
    Cells(1, 1).CurrentRegion.Select
    s_address = Selection.Address(ReferenceStyle:=xlR1C1)
```

```
    Sheets(str & " Pivot").Select
    Cells(4, 1).Activate
    ActiveSheet.PivotTableWizard SourceType:=xlDatabase, SourceData:= _
            "'" & str & " Data'!" & s_address
    If str = "YOS_PG" Then
        ActiveSheet.PivotTables("PivotTable1").PivotFields("rule").CurrentPage = "M"
        ActiveSheet.PivotTables("PivotTable1").PivotFields("yr").CurrentPage = "1"
    End If
    ActiveSheet.PivotTables(1).RefreshTable
End Sub
Public Sub KillCmdBar()
    On Error Resume Next
    Application.CommandBars("New Data").Delete
    On Error GoTo 0
End Sub
Sub XportMods()
    Dim mdl As Variant, strFile As String, strExt As String
    For Each mdl In Application.VBE.ActiveVBProject.VBComponents()
        strFile = ".bas"
        If Left(mdl.Name, 5) = "Form_" Then strFile = ".cls"
        strFile = Mid(ActiveWorkbook.Name, Len(ActiveWorkbook.Name) - 7, 4) & strFile
        If Left(mdl.Name, 5) <> "Chart" And (Left(mdl.Name, 5) <> "Sheet" _
                Or Left(mdl.Name, 6) = "Sheet4" _
                Or Left(mdl.Name, 6) = "Sheet6") Then _
                mdl.Export ActiveWorkbook.Path _
                & "\Modules\Excel\" & mdl.Name & strFile
        strFile = ".bas"
        If Left(mdl.Name, 5) = "Form_" Then strFile = ".cls"
        If Left(mdl.Name, 5) <> "Chart" And (Left(mdl.Name, 5) <> "Sheet" _
                Or Left(mdl.Name, 6) = "Sheet4" _
                Or Left(mdl.Name, 6) = "Sheet6") Then _
                mdl.Export ActiveWorkbook.Path _
                & "\Modules\Excel\" & mdl.Name & strFile
    Next
    Set mdl = Nothing
End Sub
Function EMax() As Double
    Dim rngRange As Range, rngMax As Range, c As Range
    Dim dblMaxVal As Double
    Set rngRange = Selection
    dblMaxVal = -1.79769313486231E+308
    Set rngMax = ActiveCell
```

```
    For Each c In rngRange
        If Not IsEmpty(c.Value) And Not IsError(c.Value) _
                And (IsNumeric(c.Value) Or IsDate(c.Value)) Then
                If c.Value > dblMaxVal Then
                    dblMaxVal = c.Value
                    Set rngMax = c
                End If
        End If
    Next
    EMax = dblMaxVal
    Set rngRange = Nothing
    Set rngMax = Nothing
    Set c = Nothing
End Function
Public Sub KillCharts()
    Dim i As Integer
    For i = ActiveSheet.ChartObjects.Count To 1 Step -1
        ActiveSheet.ChartObjects(i).Delete
    Next
End Sub
Function GetRating() As String
‘Extracts the rating from the data files in the current directory
    With Application.FileSearch
        .NewSearch
        .LookIn = ActiveWorkbook.Path & “\1\”
        .Filename = “Likelihood*.xls”
        If .Execute > 0 Then
            GetRating = Mid(GetTableName(.FoundFiles(1)), 11)
            GetRating = Left(GetRating, Len(GetRating) - 5)
        End If
    End With
End Function
Private Function GetTableName(OldPath As String) As String
    Dim bytSlash As Byte
    Do
        bytSlash = InStr(OldPath, “\”)
        OldPath = Mid(OldPath, bytSlash + 1)
    Loop Until bytSlash = 0
    GetTableName = OldPath
End Function
Function CopyModule(ModuleName As String, _
    FromVBProject As VBIDE.VBProject, _
```

```
ToVBProject As VBIDE.VBProject, _
OverwriteExisting As Boolean) As Boolean
‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘
‘ CopyModule
‘ This function copies a module from one VBProject to
‘ another. It returns True if successful or  False
‘ if an error occurs.
‘
‘ Parameters:
‘ --------------------------------
‘ FromVBProject         The VBProject that contains the module
‘                       to be copied.
‘
‘ ToVBProject           The VBProject into which the module is
‘                       to be copied.
‘
‘ ModuleName            The name of the module to copy.
‘
‘ OverwriteExisting     If True, the VBComponent named ModuleName
‘                       in ToVBProject will be removed before
‘                       importing the module. If False and
‘                       a VBComponent named ModuleName exists
‘                       in ToVBProject, the code will return
‘                       False.
‘
‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘

Dim VBComp As VBIDE.VBComponent
Dim FName As String

‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘
‘ Do some housekeeping validation.
‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘
If FromVBProject Is Nothing Then
    CopyModule = False
    Exit Function
End If

If Trim(ModuleName) = vbNullString Then
    CopyModule = False
    Exit Function
End If
```

```
If ToVBProject Is Nothing Then
    CopyModule = False
    Exit Function
End If

If FromVBProject.Protection = vbext_pp_locked Then
    CopyModule = False
    Exit Function
End If

If ToVBProject.Protection = vbext_pp_locked Then
    CopyModule = False
    Exit Function
End If

On Error Resume Next
Set VBComp = FromVBProject.VBComponents(ModuleName)
If Err.Number <> 0 Then
    CopyModule = False
    Exit Function
End If

‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘
‘ FName is the name of the temporary file to be
‘ used in the Export/Import code.
‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘
FName = Environ(“Temp”) & “\” & ModuleName & “.bas”
If OverwriteExisting = True Then
    ‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘
    ‘ If OverwriteExisting is True, Kill
    ‘ the existing temp file and remove
    ‘ the existing VBComponent from the
    ‘ ToVBProject.
    ‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘‘
    If Dir(FName, vbNormal + vbHidden + vbSystem) <> vbNullString Then
        Err.Clear
        Kill FName
        If Err.Number <> 0 Then
            CopyModule = False
            Exit Function
        End If
```

```
        End If
        With ToVBProject.VBComponents
            .Remove .item(ModuleName)
        End With
    Else
        ''''''''''''''''''''''''''''''''''''''''''''
        ' OverwriteExisting is False. If there is
        ' already a VBComponent named ModuleName,
        ' exit with a return code of False.
        ''''''''''''''''''''''''''''''''''''''''''''
        Err.Clear
        Set VBComp = ToVBProject.VBComponents(ModuleName)
        If Err.Number <> 0 Then
            If Err.Number = 9 Then
                ' module doesn't exist. ignore error.
            Else
                ' other error. get out with return value of False
                CopyModule = False
                Exit Function
            End If
        End If
    End If

    ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
    ' Do the Export and Import operation using FName
    ' and then Kill FName.
    ''''''''''''''''''''''''''''''''''''''''''''''''''''''''''
    FromVBProject.VBComponents(ModuleName).Export Filename:=FName
    ToVBProject.VBComponents.Import Filename:=FName
    Kill FName
    CopyModule = True
    On Error GoTo 0
End Function
Sub AddProcedureToModule()
    Dim VBProj As VBIDE.VBProject
    Dim VBComp As VBIDE.VBComponent
    Dim CodeMod As VBIDE.CodeModule
    Set VBProj = ActiveWorkbook.VBProject
    Set VBComp = VBProj.VBComponents("ThisWorkbook")
    Set CodeMod = VBComp.CodeModule

    NewModLine CodeMod, "Private Sub Workbook_Open()"
```

```
    NewModLine CodeMod, "    On Error GoTo BarExists"
    NewModLine CodeMod, "    Dim i As Byte"
    NewModLine CodeMod, "    Application.CommandBars.Add(""Robust"", msoBarRight, , True)" _
            & ".Visible = True"
    NewModLine CodeMod, "    Application.CommandBars(""Robust"")" _
            & ".Controls.Add Type:=msoControlButton, id:=2950, Before:=1"
    NewModLine CodeMod, "    With Application.CommandBars(""Robust"")" _
            & ".Controls(1)"
    NewModLine CodeMod, "        .style = msoButtonCaption"
    NewModLine CodeMod, "        .Caption = ""Open Chart Form"""
    NewModLine CodeMod, "        .OnAction = ""ThisWorkbook.OpenForm"""
    NewModLine CodeMod, "    End With"
    NewModLine CodeMod, "BarExists:"
    NewModLine CodeMod, "End Sub"

    NewModLine CodeMod, "Private Sub OpenForm()"
    NewModLine CodeMod, "    frmChoice.Show"
    NewModLine CodeMod, "End Sub"

    NewModLine CodeMod, "Private Sub Workbook_BeforeClose(Cancel As Boolean)"
    NewModLine CodeMod, "    On Error Resume Next"
    NewModLine CodeMod, "    Application.CommandBars(""Robust"").Delete"
    NewModLine CodeMod, "    On Error GoTo 0"
    NewModLine CodeMod, "End Sub"
End Sub
Private Sub NewModLine(modl As VBIDE.CodeModule, code As String)
    modl.InsertLines modl.CountOfLines + 1, code
    'NewModLine = num + 1
End Sub
Sub AddReference(strGUID As String)
    Dim theRef As Variant, i As Long
    'strGUID = "{00020905-0000-0000-C000-000000000046}"
    On Error Resume Next
    'Remove any missing references
    For i = ActiveWorkbook.VBProject.References.Count To 1 Step -1
        Set theRef = ActiveWorkbook.VBProject.References.item(i)
        If theRef.IsBroken = True Then
            ActiveWorkbook.VBProject.References.Remove theRef
        End If
    Next
    Err.Clear
    'Add the reference
```

```
    ActiveWorkbook.VBProject.References.AddFromGuid _
            GUID:=strGUID, Major:=1, Minor:=0
    Select Case Err.Number
        Case Is = 32813
        ‘Reference already in use. No action necessary
        Case Is = vbNullString
        ‘Reference added without issue
        Case Else
        ‘An unknown error was encountered, so alert the user
            MsgBox “A problem was encountered trying to” & vbNewLine _
                    & “add or remove a reference in this file” & vbNewLine _
                    & “Please check the “ & “references in your VBA project!”, _
                    vbCritical + vbOKOnly, “Error!”
    End Select
    On Error GoTo 0
End Sub
Sub ListReferencePaths()
     ‘To determine full path and Globally Unique Identifier (GUID)
     ‘to each referenced library.  Select the reference in the Tools\References
     ‘window, then run this code to get the information on the reference’s library

    Dim i As Long
    With ActiveSheet
        .Cells.Clear
        .Range(“A1”) = “Reference name”
        .Range(“B1”) = “Full path to reference”
        .Range(“C1”) = “Reference GUID”
    End With
    Cells(2, 1).Select
    For i = 1 To ThisWorkbook.VBProject.References.Count
        With ThisWorkbook.VBProject.References(i)
            ActiveCell = .Name
            ActiveCell.Offset(0, 1) = .FullPath
            ActiveCell.Offset(0, 2) = .GUID
        End With
        ActiveCell.Offset(1, 0).Select
    Next i
    On Error GoTo 0
End Sub
```

Choice form

```
VERSION 5.00
Begin {C62A69F0-16DC-11CE-9E98-00AA00574A4F} frmChoice
   Caption         =   “Show Chart”
   ClientHeight    =   1800
   ClientLeft      =   4050
   ClientTop       =   1830
   ClientWidth     =   3255
   OleObjectBlob   =   “frmChoice.frx”:0000
End
Attribute VB_Name = “frmChoice”
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = False
Attribute VB_PredeclaredId = True
Attribute VB_Exposed = False
‘Programming by Robert W. Shuford, CNA
Option Explicit
Private Sub UserForm_Initialize()
    Dim strName As String
    strName = WhichData
    ‘short tis no e3
    Select Case strName
        Case “AveTIS”, “AveTIG”, “Count”, “Shortage”, “Sep”
            cboRank.List = Array(“E3”, “E4”, “E5”, “E6”, “E7”, “E8”, “E9”)
        Case “TIS”
            cboRank.List = Array(“E4”, “E5”, “E6”, “E7”, “E8”, “E9”)
        Case “Prom”
            cboRank.List = Array(“E3”, “E4”, “E5”, “E6”, “E7”, “E8”)
        Case “Likelihood”
            cboRank.List = Array(“E3”, “E4”, “E5”, “E6”, “E7”, “E8”)
            lblYOS.Visible = True
            txtYOS.Visible = True
            spnYOS.Visible = True
    End Select
End Sub
Private Sub cmdChart_Click()
    Dim strName As String
    Application.ScreenUpdating = False
    If chkDeleteCharts = True Then KillCharts
    strName = WhichData
```

```
    If strName = “Likelihood” Then
        LikChart CByte(Right(cboRank.Value, 1)), spnYOS.Value
    Else
        MakeChart strName, CByte(Right(cboRank.Value, 1))
    End If
    Application.ScreenUpdating = True
End Sub
Private Sub spnYOS_Change()
    txtYOS.Value = spnYOS.Value
End Sub
Private Sub txtYOS_Exit(ByVal Cancel As MSForms.ReturnBoolean)
    spnYOS.Value = txtYOS.Value
End Sub
Private Function WhichData() As String
    Dim strName As String, lngSpace As Long
    strName = ActiveSheet.Name
    lngSpace = InStr(strName, “ “)
    WhichData = Mid(strName, 1, lngSpace - 1)
End Function
```

Workbook

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  ‘True
END
Attribute VB_Name = “ThisWorkbook”
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = False
Attribute VB_PredeclaredId = True
Attribute VB_Exposed = True
‘Programming by Robert W. Shuford, CNA
Option Explicit
Private Sub Workbook_Open()
    Const BUTTONS = 4
    Dim i As Byte
    On Error GoTo BarExists
    ‘Add toolbar and button
    Application.CommandBars.Add(“New Data”, msoBarBottom, , True).Visible = True
    For i = 1 To BUTTONS
        Application.CommandBars(“New Data”).Controls.Add _
                Type:=msoControlButton, id:=2950, Before:=1
    Next
    ‘Set buttons
    NewButton 1, “New Data”, “Import New Data”, “LoopDirs“
    NewButton 2, “New Data”, “Compile Multiple Files”, “CompileAllData“
    NewButton 3, “New Data”, “Sensitivity Data”, “Robustness“
    NewButton 4, “New Data”, “Export Modules”, “XportMods“
BarExists:
End Sub
Private Sub NewButton(item As Byte, bar As String, caption As String, macro As String)
    With Application.CommandBars(bar).Controls(item)
        .style = msoButtonCaption
        .caption = caption
        .OnAction = macro
        .BeginGroup = True
    End With
End Sub
Private Sub Workbook_BeforeClose(Cancel As Boolean)
    KillCmdBar
End Sub
```

Sheet4

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  ‘True
END
Attribute VB_Name = “Sheet4”
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = False
Attribute VB_PredeclaredId = True
Attribute VB_Exposed = True
‘Programming by Robert W. Shuford, CNA
Option Explicit
Private Sub cboLikPG_Change()
    Application.ScreenUpdating = False
    If Not blnDisableEvents Then
        Worksheets(“Likelihood Data”).Activate
        ActiveSheet.Cells(1, 1).Activate
        Selection.AutoFilter Field:=3, Criteria1:=CInt(cboLikPG.Value)
        Worksheets(“Likelihood Chart”).Activate
    End If
    Application.ScreenUpdating = True
End Sub
Private Sub cboLikYOS_Change()
    Application.ScreenUpdating = False
    If Not blnDisableEvents Then
        Worksheets(“Likelihood Data”).Activate
        ActiveSheet.Cells(1, 1).Select
        Selection.AutoFilter Field:=4, Criteria1:=CInt(cboLikYOS.Value)
        Worksheets(“Likelihood Chart”).Activate
    End If
    Application.ScreenUpdating = True
End Sub
```

Sheet6

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  ‘True
END
Attribute VB_Name = “Sheet6”
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = False
Attribute VB_PredeclaredId = True
Attribute VB_Exposed = True
‘Programming by Robert W. Shuford, CNA
Option Explicit
Private Sub cboPG_Change()
    If Not blnDisableEvents Then Sheets(“TIS Pivot”).PivotTables(“PivotTable1”).PivotFields(“pg”).CurrentPage _
            = CInt(cboPG.Value)
End Sub
```

References

[1] BUPERSINST 1430.16F, *Advancement Manual*, 2 November 2007

[2] MILPERSMAN 1160-120, *High Year Tenure*, 20 October 2005

[3] NAVPERS 18068F, *Manual Of Navy Enlisted Manpower And Personnel Classifications And Occupational Standards Volume II Navy Enlisted Classifications (NECs)*, January 2004

[4] This information is administratively sensitive and was provided by the project sponsor.

This page intentionally left blank

List of figures

This page intentionally left blank.

List of tables

This page intentionally left blank.

CIM D0020718.A1/Final

CNA
ANALYSIS & SOLUTIONS

4825 Mark Center Drive, Alexandria, VA 22311-1850 703-824-2000 www.cna.org