

SAS/AF - Overview

Sheri George

Texas State Comptroller of Public Accounts

Introduction

After each 10 year national census, the Texas Legislature is required by law to redraw senatorial and representative district lines according to the new population figures. If the legislative redistricting plan "fails" (for example, the Legislature fails to redraw legislative districts; the Governor vetoes the plan; or state or federal courts overturn the plan), the Legislative Redistricting Board (LRB) convenes. The LRB must convene in Austin within 90 days after the regular session adjourns, and then has 60 days within which to apportion the state into legislative districts. The LRB is composed of the Lieutenant Governor, the Speaker of the House, the Attorney General, the Land Commissioner, and the Comptroller of Public Accounts. In order to prepare for the Comptroller's role in legislative redistricting, a mainframe redistricting application was needed.

Overview

The mainframe system would store the complete redistricting database and would be able to perform most of the detailed reporting of demographic data for proposed districts and redistricting plans.

The database contains information on:

- 1990 Census population at the following Census geographic levels:
 - county boundaries in Texas
 - tract boundaries contained within Texas county boundaries

- block boundaries (which are similar to city blocks)
contained within tract boundaries
- voter tabulation district boundaries (similar to voting precincts). Vtds may or may not follow Census geography but are contained within Texas county boundaries
- House, Senate, and Congressional District assignments as they were in 1980
- any new district assignments as the lines are redrawn.

The functions the mainframe system needed to provide:

- access data (via SAS data sets and UNIX binary files)
- select different functions via menus
- on-line help as needed
- assign one legislative district or multiple districts according to county, tract, or block
- display population statistics for a given district as the district boundaries were changed
- run batch SAS reports
- facilitate the transfer of data to/from the UNIX system.

SAS/AF was chosen to be the software to develop the Mainframe Redistricting Application, referred to as MRED. It was chosen because SAS/AF allows you to create user-friendly interactive applications enabling both experienced and non-users to use it without writing any code. You have complete control over what the user sees and what the user does. In using SAS/AF, you have access to the entire SAS System to develop your application.

MRED was developed using SAS Display Manager on TSO. Everything pertaining to the SAS/AF MRED application was put into a single permanent SAS data library (or data set). The SAS/AF entries were stored in the SAS catalog, which is a type of SAS file that stores many different kinds of information (for example, function key settings) that is not data. The cross reference data values (for example, legislator's names) were stored in the SAS

data file. Both the SAS catalog and the SAS data were stored in the same SAS data library (example 2).

The following examples are taken directly from the MRED SAS/AF application.

Before you start your SAS/AF session, first allocate your SAS data library by submitting the LIBNAME statement (example 1). If you want to create or edit any SAS/AF entries, submit the BUILD procedure (example 3).

```
PROC BUILD CATALOG=libref.catalog[.entry.type] options  
           or CAT=  
           or C=
```

If you want to execute an existing SAS/AF application, execute the AF command (example 4).

```
AF CATALOG=libref.catalog.entry.type  
  or CAT=  
  or C=
```

In developing your SAS/AF application, one of the first things you need to do (after all of the preliminary analysis is finished) is design a screen to provide the user interaction. In order to design your screen, called the DISPLAY window, go into the PROGRAM entry type of the SAS/AF catalog (examples 5 and 6). You use the Display Manager text editor and design away.

The DISPLAY window can contain information only (as in a menu, example 6) or fields that accept user input and display information or program output (example 7). These fields are designated by an initial ampersand (&) that can be followed by a name and underscores (example 7).

Each field must have a name. If you don't assign a name (or if the field is one character long), SAS/AF assigns one for you. The default name is always FIELD*n*, where *n* is the field's number in relation to the fields that precede it. For fields without meaningful names, you can assign meaningful ones using the ATTR window (example 8).

While in the ATTR window, you can also assign the type of validation that is performed to verify user input to the field. Some of the TYPEs available are:

- CHAR valid character string
- INPUT verifies the value is an active SAS data set
- LIBNAME verifies the value is an active libref
- FILENAME verifies the value is an active fileref.

Selection lists and choice groups are also available through the ATTR window. Selection lists are used to display a list of values or choices to the user when a prompt character is entered into a display field (example 9). Choice groups display values to select from. The user positions the cursor on his choice to make the selection. If the user has a functioning mouse, he is able to use the point and click method with choice groups.

After you have designed your DISPLAY window, then you need to make it work. Use the SOURCE window to enter the Screen Control Language (SCL) program that controls the DISPLAY window (examples 10 through 14). SCL is a programming language (different than Base SAS) that uses variables, statements, and functions to manipulate data and control your DISPLAY windows during the SAS/AF session. SCL enables you to completely control the application by:

- validating user entries
- creating and manipulating variables
- accessing SAS data sets and external files
- defining error conditions and customizing error handling
- controlling branching and opening other windows
- constructing and submitting SAS statements for execution
- controlling interaction between the user and the application.

SCL programs are divided into sections that:

- specify when the program will execute
- begin with reserved labels:
 - INIT an initialization phase, executed before the display window is displayed (example 11)

- MAIN the main processing phase and executes each time the user modifies a field and presses ENTER or a function key (example 12)
- TERM a termination phase, executed when the display window is terminated with an END or CANCEL command (example 14)
- end with a RETURN statement.

After you get the DISPLAY window functioning properly, you might want to add on-line help. This help could be at the entire window level (examples 10 & 15), or at a field by field level (example 16). And what about function key settings? At the Comptroller's office, most of the moving around between windows is done with function keys. The MRED application is no exception. You can define function key settings for each individual window or the same definitions for the entire application (example 17).

After you have completed a DISPLAY window and its associated source code (SCL), on-line help etc., you probably want to test it out without leaving the SAS/AF session. The TESTAF command enables you to do just that (examples 18 & 19). Once you've finished testing it within the SAS/AF session, then end completely out of PROC BUILD (back to DISPLAY MANAGER) and try the AF command. It enables you invoke your application outside of PROC BUILD. This is what your user will see when the application is run.

References and Further Information

SAS Institute, Inc. (1989). *SAS/AF Software: Usage and Reference, Version 6, First Edition*. SAS Institute Inc., Cary, NC.

SAS Institute, Inc. (1990). *Making the Transition to Release 6.06 of the SAS System Course Notes*. SAS Institute Inc., Cary, NC.

SAS and SAS/AF are a registered trademark of SAS Institute Inc., Cary, NC.

example 1

```
+LOG-----+
| Command ==>
|
| NOTE: SAS system options specified are:
|       NOTES SOURCE2
|
| NOTE: The initialization phase used 0.15 CPU seconds and 3100K.
| ERROR: Libname CAT is not assigned.
|
| NOTE: Libref CAT was successfully assigned as follows:
|       Engine:      V606
|       Physical Name: USER.TRE.REDIST.MRED.SAS.CATALOG
+-----+
```

```
+PROGRAM EDITOR-----+
| Command ==>
|
| 00001 libname cat 'user.tre.redist.mred.sas.catalog';
| 00002
| 00003
| 00004
| 00005
| 00006
+-----+
```

example 2

```
+LOG-----+LIBNAME-----+
| Comman | Command ==>
|
|       Libref   Engine   Host Path Name
| FOR CU |
|       - CAT      V606     USER.TRE.REDIST.MRED.SAS.CATALOG
| NOTE: +DIR-----+
|       | Command ==>
| NOTE: | Libref: CAT
| NOTE: | Type:   ALL
|
|       SAS File  Type      Indexed
+-----+-----+-----+
| +PROGRAM | - CONMEN  DATA
| | Comman | - COUNTY  DATA
| |       | - HSEMEN  DATA
| | 00001 | - MRED    CATALOG
| | 00002 | - SENMEN  DATA
| | 00003 |
| | 00004 |
| | 00005 |
| | 00006 |
+-----+-----+-----+
```

example 3

```
+LOG-----+
| Command ==>
|
| WELCOME TO THE SAS SYSTEM, RELEASE 6.06.
|
| PLEASE REPORT ANY PROBLEMS TO KATHE RICHARDS AT (512) 463-4216.
|
| FOR CURRENT NEWS ABOUT SAS, FETCH BJ.SASNEWS.
|
| NOTE: SAS system options specified are:
|       NOTES SOURCE2
|
| NOTE: The initialization phase used 0.15 CPU seconds and 3100K.
+-----+
+PROGRAM EDITOR-----+
| Command ==>
| NOTE: 3 line(s) copied.
| 00001 libname cat 'user.tre.redist.mred.sas.catalog';
| 00002 proc build c=cat.mred;
| 00003 run;
| 00004
| 00005
| 00006
+-----+
```

example 4

```

+LOG-----+
| Command ==>
|
| NOTE: SAS system options specified are:
|       NOTES SOURCE2
|
| NOTE: The initialization phase used 0.15 CPU seconds and 3100K.
| ERROR: Libname CAT is not assigned.
|
| NOTE: Libref CAT was successfully assigned as follows:
|       Engine:      V606
|       Physical Name: USER.TRE.REDIST.MRED.SAS.CATALOG
|
+-----+
+PROGRAM EDITOR-----+
| Command ==> af c=cat.mred.mr0000.program
| NOTE: 6 line(s) copied.
| 00001 *****
| 00002 ***   running a SAS/AF Application   ***
| 00003 *** this goes on the command line to submit ***
| 00004 *** af catalog=libref.catalog.name.type ***
| 00005 *** ==> af c=cat.mred.mr0000.program <== ***
| 00006 *****

```

example 5

```

+BUILD: DIRECTORY CAT.MRED (E)-----+
| Command ==>
|
|      Name      Type      Description      Updated
|
| - MRVTDS      PROGRAM    Assign Districts By VTD - old      05/31/91
| - MR0000      PROGRAM    ***** SYSTEM STARTUP *****      04/04/91
| e MR0100      PROGRAM    Main Menu - First Screen of System      01/13/92
| - MR0110      PROGRAM    Setup the Plan File      01/06/92
| - MR030A      PROGRAM    old test for ext. table      06/03/91
| - MR1000      PROGRAM    Quickly Assign Districts Geo Area Menu      01/13/92
| - MR1010      PROGRAM    Assign Districts By County - entry      07/09/91
| - MR1020      PROGRAM    Assign Districts By Tract - entry      07/29/91
| - MR1030      PROGRAM    Assign Districts By VTD - entry      07/09/91
| - MR1040      PROGRAM    Assign Districts By Block - entry      07/09/91
| - MR2000      PROGRAM    Assign District (Maximum Data)-not used      07/09/91
| - MR2010      PROGRAM    Assign District (Maximum Data Entry)      07/26/91
| - MR3000      PROGRAM    Reports Menu      05/23/91
| - MR4000      PROGRAM    File Utilities      05/23/91
| - MR8000      PROGRAM    Save File routine      07/09/91
| - MR9000      PROGRAM    Exit routine      04/04/91
| - SAVEPLAN    PROGRAM    Quickly Assign Districts Geo Area Menu      07/23/91
|
+-----+
|                                     R

```

example 6

```

+BUILD: DISPLAY MR0100.PROGRAM (E)-----+
| Command ==>
|
| 00001      State Comptroller Mainframe Redistricting System
| 00002
| 00003      MAIN MENU
| 00004
| 00005
| 00006      F2   Initial Setup of Plan File
| 00007      F3   Quickly Assign Districts
| 00008      (Minimum Data Displayed)
| 00009      F4   Assign Single District
| 00010      (Maximum Data Displayed)
| 00011      F5   Generate Reports
| 00012      F6   Plan File Utility Features
| 00013
| 00014
| 00015      Press a Function Key for your choice
| 00016
| 00017
| 00018 --ENTER--F1--F2--F3--F4--F5--F6--F7--F8--F9--F10--F11--F
| 00019      Help                                     E
| 00020
+-----+
|                                     R

```

example 7

```
+BUILD: DISPLAY MR0110.PROGRAM (E)-----+
| Command ==>
|
| 00001          State Comptroller Mainframe Redistricting System
| 00002                      INITIAL SETUP OF PLAN FILE
| 00003 &DSNAME
| 00004          Plan Type:  H - House, S - Senate, C - Congressional  &
| 00005          Plan file: ('X' one)
| 00006          EXISTING plan                                &PNBR  &
| 00007          NEW plan - current district assignments      &
| 00008          NEW plan - no district assignments.          &
| 00009 All counties? Yes is default. For a listing, type E (EXISTING plan)
| 00010 N (NEW plan) in the first position of each line. 17 counties allow
| 00011 per line (separated by a blank), 108 counties total.
| 00012 &CNTIES1
| 00013 &CNTIES2
| 00014 &CNTIES3
| 00015 &CNTIES4
| 00016 &CNTIES5
| 00017 &CNTIES6
| 00018 --ENTER--F1--F2--F3--F4--F5--F6--F7--F8--F9--F10--F11--F
| 00019          Help                                &KEY1 Main E
| 00020          (cursor on field)                    &KEY
|-----+
|                                     R
```

example 8

```
+BUILD: DISPLAY MR0110.PROGRAM (E)-----+
| Command ==>
|
|+BUILD: ATTR MR0110.PROGRAM (E)-----+
| Command ==>
|
| Use the scroll commands or function keys to review the fields.
|
| Field name: FIELD2      Frame: 1   Row: 4      Col: 64      Length: 1
|
| Alias: PREFIX          Choice group:          Pad:
| Type: CHAR             Protect: YES NO        INITIAL
| Format:                Just: LEFT RIGHT CENTER NONE
| Informat:
| Error color: RED       attr: REVERSE          Help: PLANTYPE HELP
|
| List:
|
| Initial:
| Replace:
| Options: CAPS CURSOR REQUIRED AUTOSKIP NOPROMPT NON-DISPLAY
|
|-----+
| 00020          (cursor on field)                    &KEY
|-----+
|                                     R
```

example 9

```
+BUILD: DISPLAY MR0110.PROGRAM (E)-----+
| Command ==>
|
|+BUILD: ATTR MR0110.PROGRAM (E)-----+
| Command ==>
|
| Use the scroll commands or function keys to review the fields.
|
| Field name: CNTIES1     Frame: 1   Row: 12     Col: 3       Length: 69
|
| Alias: CNTIES1          Choice group:          Pad:
| Type: CHARLST           Protect: YES NO        INITIAL
| Format:                Just: LEFT RIGHT CENTER NONE
| Informat:
| Error color: RED       attr: REVERSE          Help: CNTYSEL HELP
|
| List: \N 17=COUNTY.HELP\
|
| Initial:
| Replace:
| Options: CAPS CURSOR REQUIRED AUTOSKIP NOPROMPT NON-DISPLAY
|
|-----+
| 00020          (cursor on field)                    &KEY
|-----+
|                                     R
```

example 10

```
+BUILD: DISPLAY MR1000.PROGRAM (E)-----+
| Command ==> source
|
| 00001          State Comptroller Mainframe Redistricting System
| 00002
| 00003          &TITLE
| 00004          (Minimum Data Displayed)
| 00005
| 00006
| 00007          F2  County
| 00008          F3  Tract
| 00009          F4  VTD
| 00010          F5  Block
| 00011
| 00012
| 00013
| 00014
| 00015          Press a Function Key for your choice
| 00016
| 00017
| 00018 --ENTER--F1---F2---F3---F4---F5---F6---F7---F8---F9---F10---F11---F
| 00019          Help                                     Main E
| 00020
+-----+ R
```

example 11

```
+BUILD: DISPLAY MR1000.PROGRAM (E)-----+
| Command ==>
|
+BUILD: SOURCE MR1000.PROGRAM (E)-----+
| Command ==>
|
| 00001 *****
| 00002 * quickly assign districts menu program
| 00003 ***** ;
| 00004 init:
| 00005 control always ;
| 00006 prefix=symget('m_plantp') ;
| 00007 *****
| 00008 * for title on screen *
| 00009 ***** ;
| 00010 planame=symget('m_pname') ;
| 00011 title='QUICKLY ASSIGN '||planame||' DISTRICTS' ;
| 00012
| 00013 pgm='quickly' ;
| 00014 call symput('m_assgn',pgm) ;
| 00015
| 00016 return;
+-----+ R
```

example 12

```
+BUILD: DISPLAY MR1000.PROGRAM (E)-----+
| Command ==>
|
+BUILD: SOURCE MR1000.PROGRAM (E)-----+
| Command ==>
|
| 00017
| 00018 main:
| 00019 cmd = word (1) ;
| 00020 *****
| 00021 * find the first plan file name that does not exist      *
| 00022 * so that it can be the default file                    *
| 00023 * ie., - if H0004 exists then the default would be H0005 *
| 00024 ***** ;
| 00025 do i = 1 to 999;
| 00026     if i < 10 then name = prefix||'000'||i ;
| 00027     else if i > 9  and i < 100 then name = prefix||'00'||i;
| 00028     else if i > 99 and i < 1000 then name = prefix||'0'||i;
| 00029     else if i > 999 then name = prefix||i;
| 00030     wholename = 'planln.'||name ;
| 00031     if (exist(wholename)) then continue;
| 00032     defname = name;
+-----+ R
```

example 13

```
+BUILD: DISPLAY MR1000.PROGRAM (E)-----+
| Command ==>
|
|+BUILD: SOURCE MR1000.PROGRAM (E)-----+
| Command ==>
|
| 00033 leave;
| 00034 end;
| 00035 *****
| 00036 * set macro variable for the mr8100 save program *
| 00037 *****;
| 00038 call symput('m_defnm', defname);
| 00039
| 00040 if cmd = 'PF1' then _msg_='Help is not yet available' ;
| 00041 if cmd = 'PF2' then call goto('mr1010','A') ;
| 00042 if cmd = 'PF3' then call goto('mr1020','A') ;
| 00043 if cmd = 'PF4' then call goto('mr1030','A') ;
| 00044 if cmd = 'PF5' then call goto('mr1040','A') ;
| 00045 if cmd = 'PF11' then call goto('mr0100','C') ;
| 00046 if cmd = 'PF12' then call goto('mr9000','C') ;
| 00047 return;
| 00048
+-----+
R
```

example 14

```
+BUILD: DISPLAY MR1000.PROGRAM (E)-----+
| Command ==>
|
|+BUILD: SOURCE MR1000.PROGRAM (E)-----+
| Command ==>
|
| 00049 term;
| 00050 return;
| 00051
| 00052
| 00053
| 00054
| 00055
| 00056
| 00057
| 00058
| 00059
| 00060
| 00061
| 00062
| 00063
| 00064
+-----+
R
```

example 15

```
+MR1000-----+
| Command ==>
|+Menu to Quickly Assign Districts Help-----+
| Command ==>
|
| Type END to exit.
|
| This option allows you to assign multiple districts at one time.
| There is an option to assign just one district. No population data
| is displayed.
|
| PF2 allows you to assign districts at the county level (the entire
| county will be assigned)
| PF3 allows you to assign districts at the tract level (county fips
| code is required)
| PF4 allows you to assign districts at the vtd level (county fips
| code is required)
| PF5 allows you to assign districts at the block level (county fips
| code and tract or vtd number are required)
|
+-----+
R
```

example 16

```

+MR0110-----
| Command ==>
|
|               State Comptroller Mainframe Redistricting System
|               INITIAL SETUP OF PLAN FILE
|
|       Plan Type:  H - House, S - Senate, C - Congressional
|       Plan file: ('X' one)
|               EXISTING plan
|+Selecting a Plan Type-----
| | Command ==>
| |
| | Type END to exit.
| |
| | If you want to create a HOUSE district plan, key in a 'H'.
| | If you want to create a SENATE district plan, key in a 'S'.
| | If you want to create a CONGRESSIONAL district plan, key in a 'C'.
| |
|+-----+
|-----F1---F2---F3---F4---F5---F6---F7---F8---F9---F10---F11---F12---
|               Help                                     Main Exit
| (cursor on field)

```

example 17

+BUILD: DIRECTORY CAT.MRED (E)-----			+KEYS <PROGRAM>-----	
Command ==>			Command ==>	
Name	Type	Descriptio	Key	Definition
CNTYSEL	HELP	county sel	F1	help
COUNTY	HELP	COUNTY.HEL	F2	PF2
MENU	HELP	main menu	F3	PF3
PLANFILE	HELP	PLAN FILE	F4	PF4
PLANTYPE	HELP	PLAN TYPE	F5	PF5
QUICK	HELP	quickly as	F6	PF6
SETUP	HELP	SETUP.HELP	F7	backward
BUILD	KEYS	Function K	F8	forward
HELP	KEYS	Function K	F9	PF9
PROGRAM	KEYS	Function K	F10	PF10
PROGRAM2	KEYS	Function K	F11	PF11
CNTY	LIST	CNTY.LIST	F12	PF12
CONMEN	LIST	CONMEN.LIS	F13	
ADDIT	PROGRAM	sample pro	F14	
CNTY	PROGRAM	COUNTY.PRO	F15	
MACRO	PROGRAM	MACRO.PROG	F16	
MRCNTY	PROGRAM	Assign Dis	F17	
MRMAX	PROGRAM	Assign Dis	F18	

R

example 18

```
+BUILD: DISPLAY MR0110.PROGRAM (E)-----
| Command ==> testaf
|
| 00001          State Comptroller Mainframe Redistricting System
| 00002                      INITIAL SETUP OF PLAN FILE
| 00003  &DSNAME
| 00004          Plan Type:  H - House, S - Senate, C - Congressional  &
| 00005          Plan file: ('X' one)
| 00006          EXISTING plan                                     &PNER  &
| 00007          NEW plan - current district assignments          &
| 00008          NEW plan - no district assignments.              &
| 00009 All counties? Yes is default. For a listing, type E (EXISTING plan)
| 00010 N (NEW plan) in the first position of each line. 17 counties allow
| 00011 per line (separated by a blank), 108 counties total.
| 00012  &CNTIES1
| 00013  &CNTIES2
| 00014  &CNTIES3
| 00015  &CNTIES4
| 00016  &CNTIES5
| 00017  &CNTIES6
| 00018 --ENTER---F1---F2---F3---F4---F5---F6---F7---F8---F9---F10---F11---F
| 00019          Help                                           &KEY1 Main E
| 00020          (cursor on field)                               &KEY  -
|-----R-----
```

example 19

```
+MR0110-----
| Command ==>
| WARNING: Cannot SUBMIT from TESTAF.
|          State Comptroller Mainframe Redistricting System
|          INITIAL SETUP OF PLAN FILE
|
|          Plan Type:  H - House, S - Senate, C - Congressional  -
|          Plan file: ('X' one)
|          EXISTING plan
|          NEW plan - current district assignments                -
|          NEW plan - no district assignments.                   -
| All counties? Yes is default. For a listing, type E (EXISTING plan) or
| N (NEW plan) in the first position of each line. 17 counties allowed
| per line (separated by a blank), 108 counties total.
|
|-----
|-----
|-----
|-----
| --ENTER---F1---F2---F3---F4---F5---F6---F7---F8---F9---F10---F11---F12--
|          Help                                           Main Exit
|          (cursor on field)
|-----R-----
```