Paper 121-27

All Things to All People: A User-Defined Report in SAS/AF®

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ABSTRACT

You have built a SAS/AF application to maintain metadata on the survey data you process. The metadata are in a set of SAS data sets which can be joined with each other on various keys, much like a relational database. The users can add, delete, and browse the data. They also want to produce reports. There are some pre-defined reports, but they also want a user-defined report which can have any data from any of the data sets. They want the capability to choose data sets, specify a WHERE clause for each one, choose variables and a sort order, and store the report definition. You have to program the report to join the data sets properly and inform the user if he selected an unworkable combination of data sets. How? Use SCL lists and work from the data set relationship diagram.

INTRODUCTION

The Census Bureau's American Community Survey Data Processing and Tabulation teams have tried to make the survey edit and table generation processes as data-driven as possible. To that end, they designed a data dictionary consisting of 14 SAS data sets ("entities") which contain information about all the survey variables, including their formats, values, and history, all the tables, including the definition of each cell, and all the edits. Each data set can be joined with at least one other data set on such keys as variable name and table ID number, and the data sets as a group form a kind of relational database. (See the diagram on page 6.) The entities are CELRANGE, DICT, EDITS, EDITVARS, FMTDEFS, HEDITALS, PEDITALS, ROOTDEFS, TABLES, TBLCELLS, TBLVARS, UNIVARS, UNIVERSE, and VARHIST.

To make maintenance of these data easier, a Version 8 SAS/AF application was built with browse, edit, and report capabilities. In addition to pre-defined reports, a user-defined report was requested, where the user could select any variables from any legal combination of entities, specify WHERE clauses and sort order, and store and retrieve the specifications once the report was run.

Programming such a report is not straightforward because the entities must be joined in different ways according to their keys and you must account for all the different combinations of entities which may be selected.

SCREEN DESIGN

The SAS/AF FRAME entry for the report is a tab layout object with three tabs: one for selecting entities and entering WHERE clauses, one for selecting variables for the header and body of the report, and one for running, printing, and saving the report and its definition which displays the user's selections. The design is based on the example given in Stanley, Chapter 5.

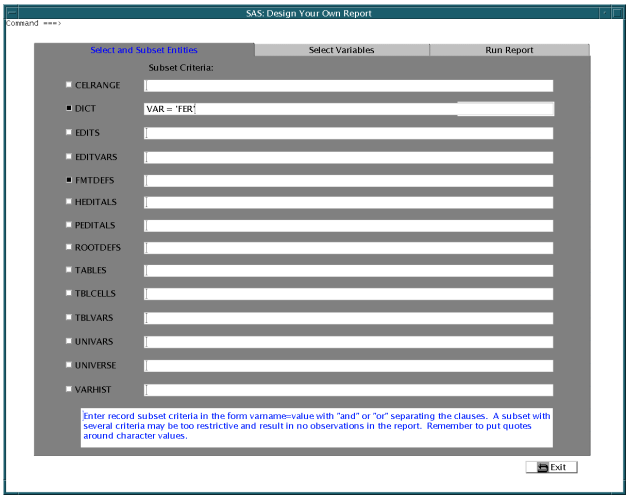
INIT SECTION

The INIT section declares variables and arrays and creates the SCL lists varlist and validlist. Validlist is filled with all legal entity combinations listed in the file rel.dat. An SCL variable containing the libref is created for use with the data sets DICT, EDITVARS, TBLCELLS, TBLVARS, and UNIVERSE, because they may be joined with other entities more than once, and the two-level name will be used only for the first join. Finally, the first tab on the tab layout object is made active.

```
INIT:
length keepvars vars $ 500 t1-t10 $100;
declare char text sortv1-sortv4 headvars
 lastds entities evflag tcflag tbflag
 tvflag unflag,
 list entitylist varlist validlist msglist
 headlist keeplist subsetlist sortlist;
array sorts[4] sortv1-sortv4;
array titles[10] $ t1-t10;
varlist = makelist();
validlist = makelist();
/*load valid combinations into SCL list*/
sysrc =
fillist('file(trim)','rel.dat',validlist);
/*make data set names two-level*/
dcflag = 'dd.'; evflag = 'dd.';
tcflag = 'dd.'; tbflag = 'dd.';
tvflag = 'dd.'; unflag = 'dd.';
/*make the Select and Subset tab active*/
call notify('tab','_setActiveTab',1);
return;
```

TAB 1 – SELECT AND SUBSET ENTITIES

The select and subset tab is displayed first. The user can click on the entity name or check box and specify a WHERE clause to limit the selection. The SCL code for this tab clears previous selections and resets SCL variables.

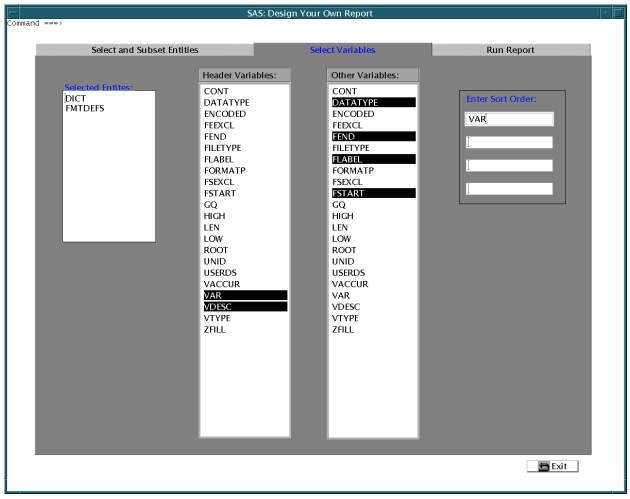



```
TAB:
call
notify('tab','_getActiveTab',selected_tab);
if selected_tab=1 then do; *Select Entities;
   /*make data set names two-level*/
   dcflag = 'dd.'; evflag = 'dd.';
   tcflag = 'dd.'; tbflag = 'dd.';
   tvflag = 'dd.'; unflag = 'dd.';
   /*clear the where clauses*/
   Where_Celrange.Text = '';
   … (continues for each entity)
   Where_Varhist.Text = '';
   celrange_where = ''
   … (continues for each entity)
   varhist_where = '';
   /*clear selections*/
   Celrange.Selected = 'No';
   … (continues for each entity)
   Varhist.Selected = 'No';
```

```
end; *Active Tab = 1 (Select Entities);
```

TAB 2 – SELECT VARIABLES

Once entities are selected and WHERE clauses entered, the user clicks on the "Select Variables" tab. The code associated with this tab checks the list of selected entities against the list of valid combinations in the SCL list called validlist. The combination of UNIVERSE and ROOTDEFS would not be legal, for example, unless DICT was also selected, because there is no common variable to join them with (see diagram). If the combination is illegal, a message box is displayed to inform the user, and the "Select and Subset Entities" tab is redisplayed. If the combination is legal, the variables from the selected entities are put into the SCL list varlist, which is sorted and has duplicate variable names removed. The variable list is displayed in two list boxes, along with a list of selected entities. The user clicks on the variables he wants as "header" variables (BY variables) and other variables to appear in the body of the report. He must also specify at least one and up to four variables by which the data will be sorted. The SCL code creates a title for each entity selected, containing the entity name and the WHERE clause, if any, and variable lists.




```
if selected_tab=2 then do; *Select Variables;
   /*clear the titles*/
   t2 = ''; t3 = ''; t4 = '';
   t5 = ''; t6 = ''; t7 = '';
   t8 = ''; t9 = ''; t10 = '';
   /*clear the sort selections*/
   sort1.Text = ''; sort2.Text = '';
   sort3.Text = ''; sort4.Text = '';
   sortv1 = ''; sortv2 = '';
   sortv3 = ''; sortv4 = '';
   /*clear the variable lists*/
   headvars = ''; keepvars = '';
   vars = '';
   /*reset the title count*/
   titlecount = 2;
   subsetlist = makelist();
   entities = '';
   entitylist = makelist();
   rc = clearlist(varlist);
   /*For each entity selected:        */
   /*add its variables to a SCL list  */
   /*put its name into a SCL list     */
   /*put its WHERE subset into a list */
   /*create a title with its name     */
   if Celrange.selected = 'Yes' then do;
     dsid = open('dd.celrange');
     link getvars;
     entitylist =
      insertc(entitylist,'CELRANGE',-1);
     celrange_where = Where_Celrange.Text;
     if celrange_where ^= '' then do;
        subsetlist=insertc
         (subsetlist,celrange_where,-1);
        titles[titlecount] =
         'title'||left(put(titlecount,2.))||'
          "CELRANGE, '||celrange_where||'"';
     end;
     else titles[titlecount] =
      'title'||left(put(titlecount,2.))||
      ' "CELRANGE"';
     titlecount + 1;
    end;
    … (repeat for the other entities)
    /*string entity names together for search
      against list of valid combinations*/
    do i = 1 to listlen(entitylist);
       cur_entity = getitemc(entitylist,i);
       select (length(cur_entity));
        when (4) pad = '     ';
        when (5) pad = '    ';
        when (6) pad = '   ';
        when (7) pad = '  ';
        otherwise pad = ' ';
       end;
       entities = entities||cur_entity||pad;
    end;
   if listlen(entitylist) > 1 &
    not(searchc(validlist,entities)) then do;
      /*invalid combination selected*/
      rc = clearlist(varlist);
      msglist = makelist();
      msglist = insertc(msglist,'You have
       selected an invalid combination of
       entities.');
      msglist = insertc(msglist,'Please make
       another selection.',-1);
      text = messagebox(msglist);
      call notify('tab','_setActiveTab',1);
    end;
    rc = sortlist(varlist,'nodup');
    Entities_Tab2.text = entitylist;
    Headerbox.items = varlist;
    Varbox.items = varlist;
 end; *Active Tab = 2 (Select Variables);
```

The GETVARS section, which is linked for each entity chosen, opens the entity data set and adds the names of its variables to the SCL list varlist:

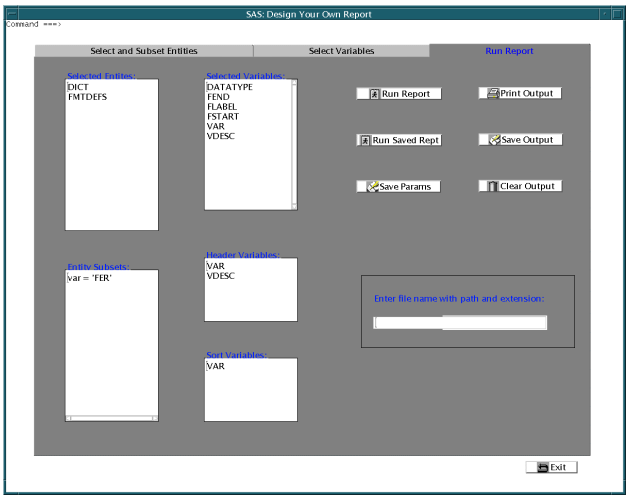
```
GETVARS:
/*get variable names from data set and add to
list*/
do j = 1 to attrn(dsid,'nvars');
   rc = insertc(varlist,varname(dsid,j),-1);
end;
rc = close(dsid);
return;
```

TAB 3 – RUN REPORT

After selecting entities, variables, and sort order, the user then clicks on the third tab to run the report. The SCL code checks to see that all required choices have been made; if not, the user is directed to the appropriate selection tab with a message. The header and other variables are combined into another SCL list called keeplist. The third tab is displayed, with list boxes containing the user's selections and buttons for running and saving the report and its output.

```
else if selected_tab=3 then do; *Run Report;
```

```
if listlen(entitylist) < 1 then do;
*No entities selected;
   _msg_ = 'Select Entities';
   call notify('tab','_setActiveTab',1);
   return;
end;
headlist = makelist();
if listlen(Headerbox.Selecteditems) > 0
 then do; *make list of header variables;
   do i = 1 to
   listlen(Headerbox.Selecteditems);
      headlist = insertc(headlist,getitemc
      (Headerbox.Selecteditems,i),-1);
   end;
end;
do i = 1 to listlen(headlist);
   headvars = headvars||' '
    ||getitemc(headlist,i);
end;
keeplist = makelist();
if listlen(Varbox.Selecteditems) > 0 then
 do; *make list of other variables;
   do i = 1 to
    listlen(Varbox.Selecteditems);
      keeplist = insertc(keeplist,getitemc
      (Varbox.Selecteditems,i),-1);
   end;
end;
else do; *No variables selected;
   _msg_ = 'Select Variables';
   call notify('tab','_setActiveTab',2);
   return;
end;
do i = 1 to listlen(keeplist);
   vars = vars||' '||getitemc(keeplist,i);
end;
keeplist=copylist(headlist,'n',keeplist);
/*sort list to eliminate duplicates*/
rc = sortlist(keeplist,'nodup');
do i = 1 to listlen(keeplist);
   keepvars = keepvars||' '
    ||getitemc(keeplist,i);
end;
sortv1 = sort1.Text; sortv2 = sort2.Text;
sortv3 = sort3.Text; sortv4 = sort4.Text;
sortlist = makelist();
do i = 1 to 4; *check sort variables
               against variables selected;
   if sorts[i] ^= '' & not (searchc
   (keeplist,sorts[i])) then do;
      msglist = makelist();
      msglist = insertc(msglist,'Sort
       variable '||sorts[i]||' is not
       among the variables selected.');
      msglist = insertc(msglist,'Please
       select it or change the sort
       variable.',-1);
      text = messagebox(msglist);
      call notify(
      'tab','_setActiveTab',2);
      return;
   end;
   if sorts[i] ^= '' then sortlist =
    insertc(sortlist,sorts[i],-1);
end;
if sortv1='' & sortv2='' & sortv3='' and
 sortv4='' then do;
 *No sort variables specified;
   _msg_ = 'Please specify at least one
    sort variable';
   cursor sort1;
   call notify('tab','_setActiveTab',2);
      return;
   end;
   Entities_Tab3.text = entitylist;
   Header.text = headlist;
   Selvars.text = keeplist;
   Sort.text = sortlist;
   Subsets.text = subsetlist;
end; *Active Tab = 3 (Run Report);
return;
```



RUNNING THE REPORT

When the run report button is clicked, the report code is built and submitted. If only one entity was chosen, a simple PROC SORT and PROC PRINT are run, followed by a check on whether the subset has resulted in no observations being printed. A message is displayed if there are no observations.

```
RUNRPT:
/*build where clauses*/
if celrange_where ^= '' then celrange_where =
'(where=('||celrange_where||'))';
… (repeat for the other entities)
if varhist_where ^= '' then varhist_where =
'(where=('||varhist_where||'))';
/*make data set names two-level*/
dcflag = 'dd.'; evflag = 'dd.';
tcflag = 'dd.'; tbflag = 'dd.';
tvflag = 'dd.'; unflag = 'dd.';
if listlen(entitylist) = 1 then do; *only one
entity selected;
   wherestr = celrange_where||dict_where||
   edits_where||editvars_where||fmtdefs_where
   ||rootdefs_where||tables_where||
   tblcells_where||tblvars_where||
univars_where||universe_where||varhist_where;
 ent1 = getitemc(entitylist,1);
 submit continue;
  proc sort data=dd.&ent1 &wherestr
   out=outdata;
   by &sortv1 &sortv2 &sortv3 &sortv4;
   run;
  proc print;
   by &headvars notsorted;
   var &vars;
   title 'ACS Data Dictionary';
   &t2;
   run;
 endsubmit;
 dsid = open('outdata','i');
 if attrn(dsid,'nobs') = 0 then do;
```

```
      msglist = makelist();
      msglist = insertc(msglist,'There were no
       observations in the subset.');
      text = messagebox(msglist);
   end;
   else do;
      link footer;
      call execcmdi('output');
   end;
   rc = close(dsid);
  end; *one entity;
```

When more than one entity is selected, they must be joined together. The report specification requested inner joins. The join order depends on which entities were selected. The entities at the extremities of the diagram are dealt with first. EDITS is joined with EDITVARS, creating an EDITVARS data set in the WORK directory. Any further joins involving EDITVARS will use this temporary data set, so the SCL variable evflag is changed to missing. Similarly, CELRANGE and TBLCELLS are joined into a new temporary TBLCELLS data set. The SCL variable lastds contains the name of the last data set created and is used in the final submit block.

```
  else do; *join entities;
   if index(entities,'EDITS    EDITVARS') then
    do;
      submit;
       proc sql;
       create table editvars as
        select * from dd.editvars
  &editvars_where, dd.edits &edits_where
        where editvars.edit = edits.edit;
      endsubmit;
      evflag = '';
      lastds = 'editvars';
   end;
   if index(entities,'CELRANGE') &
    index(entities,'TBLCELLS') then do;
      submit;
       proc sql;
        create table tblcells as
        select * from dd.celrange
  &celrange_where, dd.tblcells &tblcells_where
        where celrange.tblid = tblcells.tblid
  and celrange.lineno = tblcells.lineno;
      endsubmit;
      tcflag = '';
      lastds = 'tblcells';
   end;
```

The TABLES data set is dealt with next. It is joined first with TBLCELLS, then with TBLVARS, and finally with UNIVERSE. UNIVARS and UNIVERSE are joined together next.

```
   if index(entities,'TABLES   TBLCELLS') then
    do;
      submit;
       proc sql;
        create table tables as
        select * from &tcflag tblcells
  &tblcells_where, dd.tables &tables_where
        where tblcells.tblid = tables.tblid;
      endsubmit;
      tbflag = '';
      lastds = 'tables';
   end;
   if index(entities,'TABLES') &
    index(entities,'TBLVARS') then do;
      submit;
       proc sql;
        create table tables as
        select * from &tbflag tables
  &tables_where, dd.tblvars &tblvars_where
        where tables.tblid = tblvars.tblid;
      endsubmit;
      tbflag = '';
      lastds = 'tables';
   end;
   if index(entities,'TABLES') &
    index(entities,'UNIVERSE') then do;
      submit;
       proc sql;
       create table universe as
        select * from &tbflag tables
  &tables_where, dd.universe &universe_where
        where tables.unid = universe.unid;
      endsubmit;
      unflag = '';
      lastds = 'universe';
   end;
   if index(entities,'UNIVARS  UNIVERSE') then
    do;
      submit;
       proc sql;
        create table universe as
        select * from &unflag universe
  &universe_where, dd.univars &univars_where
        where universe.unid = univars.unid;
      endsubmit;
      unflag = '';
      lastds = 'universe';
   end;
```

Finally, there is DICT. DICT is the central entity, the one which can be joined with the most other entities. It is joined first with UNIVERSE (by UNID), then ROOTDEFS (by ROOT), and then with the entities it can be joined with by VAR, in no particular order: VARHIST, FMTDEFS, EDITVARS, TBLVARS (if TBLVARS hasn't already been joined with TABLES above), HEDITALS, and PEDITALS.

```
   if index(entities,'DICT') &
    index(entities,'UNIVERSE')then do;
      submit;
       proc sql;
        create table dict as
        select * from &unflag universe
        &universe_where, dd.dict &dict_where
        where universe.unid = dd.unid;
      endsubmit;
      dcflag = '';
      lastds = 'dict';
   end;
   if index(entities,'DICT') &
    index(entities,'ROOTDEFS')then do;
      submit;
       proc sql;
        create table dict as
        select * from dd.rootdefs
  &rootdefs_where, &dcflag dict &dict_where
        where rootdefs.root = dd.root;
      endsubmit;
      dcflag = '';
      lastds = 'dict';
   end;
   if index(entities,'DICT') &
    index(entities,'VARHIST')then do;
      submit;
       proc sql;
        create table dict as
        select * from dd.varhist
  &varhist_where, &dcflag dict &dict_where
        where varhist.var = dd.var;
```

```
    endsubmit;
    dcflag = '';
    lastds = 'dict';
 end;
 if index(entities,'DICT') &
  index(entities,'FMTDEFS')then do;
    submit;
     proc sql;
      create table dict as
      select * from dd.fmtdefs
&fmtdefs_where, &dcflag dict &dict_where
      where fmtdefs.var = dd.var;
    endsubmit;
    dcflag = '';
    lastds = 'dict';
 end;
 if index(entities,'DICT') &
  index(entities,'EDITVARS')then do;
    submit;
     proc sql;
      create table dict as
      select * from &evflag editvars
&editvars_where, &dcflag dict &dict_where
      where editvars.var = dd.var;
    endsubmit;
    dcflag = '';
    lastds = 'dict';
 end;
 if index(entities,'DICT') &
  index(entities,'TBLVARS') &
  not(index(entities,'TABLES')) then do;
    submit;
     proc sql;
      create table dict as
      select * from &tvflag tblvars
&tblvars_where, &dcflag dict &dict_where
      where tblvars.var = dd.var;
    endsubmit;
    dcflag = '';
    lastds = 'dict';
 end;
 if index(entities,'DICT') &
  index(entities,'HEDITALS')then do;
    submit;
     proc sql;
      create table dict as
      select * from dd.heditals
&heditals_where, &dcflag dict &dict_where
      where heditals.var = dd.var;
    endsubmit;
    dcflag = '';
    lastds = 'dict';
 end;
 if index(entities,'DICT') &
  index(entities,'PEDITALS')then do;
    submit;
     proc sql;
      create table dict as
      select * from dd.peditals
&peditals_where, &dcflag dict &dict_where
      where peditals.var = dd.var;
    endsubmit;
    lastds = 'dict';
 end;
```

Now that all chosen entities have been combined into one data set, submit code to sort and print the last data set created. If the combined data set has no observations, display a message box, otherwise call the FOOTER section to print “END OF REPORT” and display the output window.

```
 submit;
  proc sort data=&lastds(keep=&keepvars);
   by &sortv1 &sortv2 &sortv3 &sortv4;
   run;

  proc print data=&lastds noobs;
   by &headvars notsorted;
   var &vars;
   title 'ACS Data Dictionary';
   &t2; &t3; &t4; &t5; &t6; &t7; &t8; &t9;
   &t10;
   run;
 endsubmit;
 sysrc = filename('outfile','rptparams.sas');
 rc = preview('file','outfile');
 submit continue;
 endsubmit;
 dsid = open(lastds,'i');
 if attrn(dsid,'nobs') = 0 then do;
    msglist = makelist();
    msglist = insertc(msglist,'There were no
     observations in the joined data set.');
    text = messagebox(msglist);
 end;
 else do;
    link footer;
    call execcmdi('output');
 end;
 rc = close(dsid);
end; *multiple entities;
return;

FOOTER:
submit continue;
  data _null_;
  file print;
  put 'END OF REPORT';
  return;
  run;
endsubmit;
return;
```

SAVING AND PRINTING

The other buttons on the third tab allow the user to print the output, save the output and/or the report parameters in a file, run a report whose parameters have been saved previously, or clear the output window. The code shown below is executed when the user enters a filename for saving output or parameters or retrieving parameters. The file name is entered in a text entry field displayed when those buttons are clicked.

```
FILENAME:
 if Filename.Text ^= ' ' then do;
    select(fflag);
    when ('o') do; *save parameters;
       filecmd = 'cp rptparams.sas '
                 ||Filename.Text;
       rc = system(filecmd);
    end;
    when ('r') do; *run a saved report;
       sysrc = filename
       ('outfile',"'"||Filename.Text||"'");
       rc = preview('include','outfile');
       submit continue;
       endsubmit;
       link footer;
       call execcmdi('output');
    end;
    when ('s') do; *save output;
       filecmd = 'output;file "'
                 ||Filename.Text||'"';
       rc = system(filecmd);
```

```
    end;
    otherwise; end;
    Enter_filename.visible = 'No';
    Textlabel1.visible = 'No';
    Filename.visible = 'No';
    Filename.Text = ' ';
end;
return;
```

CONCLUSION

With careful planning, it is possible to program for any possible combination of data sets in a report. Start with the data sets which are joined with only one other data set and work toward the one which can be joined with the most others.

Due to space limitations, not all of the SCL code for the report is shown in this paper. The complete code is available at http://users.starpower/net/abennet.

REFERENCES

SAS Institute Inc., Don Stanley (1998), *Solutions for Your GUI Applications Development Using SAS/AF FRAME Technology*, Cary, NC: SAS Institute Inc.

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ENTITY RELATIONSHIP DIAGRAM