DESIGN OF AN EASY TO USE MACRO FOR TABLE GENERATION

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ABSTRACT

Beginning programmers sometimes find SAS macros a little daunting. This paper provides examples of what can be easily done using some of the more straightforward features of the SAS Macro Language. The intended end-users are non-programmers who need an easy way to summarize information quickly. The application here is a SAS program which generates a variety of tables measuring clinical trial enrollment over time. The basic approach can be used for many applications.

INTRODUCTION

This paper provides an example of how the SAS Macro Language can be utilized to write a flexible, modifiable, and user friendly program for table generation. The example could be easily modified for use in other applications where similar tables need to be produced repeatedly. The macro presented here produces a variety of study enrollment tables.

The original program has the capability of producing 8 different base tables, each with or without a percentage, for a total of 16 tables. A shortened version is listed in Appendix A. Examples of the macro in use are in Appendix B.

PROGRAM DESCRIPTION

The macro consists of three main sections:

1. The MASTER section which sets up all other parameters and contains all the other sections.

2. A SELECTION section (macro DOIT) which selects which module to execute based on parameter values passed to it from the MASTER macro.

3. A series of modular sections (macro ONE through macro FOUR and macro ERROR) which will execute only based on what is passed to them from the SELECTION section.

The program structure is as follows:

%MACRO MASTER
   title & footnote statements
   options statement

%macro doit (selects which macro [one-four, error]
   to execute based on values passed to it)
   %macro one
   .
   .
   %macro four
   %macro error
%MEND MASTER

Section Headings correspond to sections in the program in Appendix A.

MASTER

In the MASTER macro the user chooses the proc tabulate to be executed and controls the appearance of the table generated by defining the macro parameters.
The first three parameters make up the core of the macro. They include the parameters WHAT, which defines which table will be generated, PERCENT, which allows for specifying a percentage calculation; and FILENAME, which specifies the input SAS data set. The other parameters allow for more individualization of the tables depending on the needs of the users. The inclusion of the DATE parameter allows the user to quantify date of study enrollment. INSTN and TRT provide additional grouping variables. Finally, LOCF, TRTF, TITLES1-10, FOOT1-10, and OPTIONS allow for further customization of the table.

TITLES AND FOOTNOTES

The TITLE and FOOT sections of the program read the parameters defined for titles and footnotes, (TITLE1-10, FOOT1-10), when the MASTER macro is called. Because the macro produces only one table with each call, it is necessary to list these statements only once in the program.

PROGRAM OPTIONS

The OPTIONS parameter provides the user with access to all the usual SAS system options such as pagesize, linesize, nodate, symbolgen etc. Again it is necessary to define this only once in the program.

SELECTION MACRO

Macro DOIT is the selection macro. The resolution of values passed to this macro from the WHAT= and PERCENT= parameters (defined in MASTER) determine which table module is run. When a module is added or deleted a line must also be added or deleted here.

TABLE MODULES

The table modules execute only when the macro DOIT (selection macro) resolves to the macro name (ONE-FOUR,ERROR). For example, Macro ONE will be executed only if the parameter WHAT is equal to BY,MONTH,LOCATION,AND,INSTITUTION and PERCENT is equal to YES. Examples of the macro call and the four tables generated are in Appendix B.

FUTURE ENHANCEMENTS

While this macro is currently working well, there are several short-comings which will be addressed in the future.

1. Institution ordering is not consistent across tables. If users wish to present more than one table, they are often confronted with different institution ordering.

2. A menu driven front-end system might be implemented as part of a larger generic table generating system. This would further limit the amount of programming end-users will need to do in the production of routine reports.

ACKNOWLEDGEMENTS

SAS is a Registered trademark of SAS Institute, Inc. Cary, NC. USA

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**THE MACRO PROGRAM**;

** MASTER MACRO  
***********************************************************************;
"master master(" what=, /* table selection _REQUIRED_* /
percent=, /* calculate percentages? _REQUIRED_* /
filename=, /* Specify permanent or temporary SAS file name _REQUIRED_* /
options=, /* Specify which options (any valid SAS option can be used */
loc=location, /* Specify grouping variable (or use default) */
locf=, /* Specify user defined format for grouping variable */
inst=instn, /* Specify institution variable (or use default) */
date=randdate, /* Specify a enrollment date */
trt=, /* Specify a treatment variable */
trtf=, /* Specify user defined format for treatment variable */
title1=,title2=,title3=,title4=,title5=, /* up to 10 titles */
title6=,title7=,title8=,title9=,title10=, 
footnote1=,footnote2=,footnote3=,footnote4=,footnote5=,
footnote6=,footnote7=,footnote8=,footnote9=,footnote10=;

********************** TITLE AND FOOTNOTES  
********************************************************************************;

	title1; /*clear out previous titles*/
title1 &title1;
title2 &title2;
title3 &title3;
title4 &title4;
title5 &title5;
title6 &title6;
title7 &title7;
title8 &title8;
title9 &title9;
title10 &title10;
footnote1 &foot1;
footnote2 &foot2;
footnote3 &foot3;
footnote4 &foot4;
footnote5 &foot5;
footnote6 &foot6;
footnote7 &foot7;
footnote8 &foot8;
footnote9 &foot9;
footnote10 &foot10;

******************************************************************************** PROGRAM OPTIONS
***********************************************************************;
options &options; /* set options for each table */

******************************************************************************** SELECTION MACRO
***********************************************************************;
"doit doit("what,percent");

%if $upcase($WHAT)=BY.MONTH.LOCATION.AND.INSTITUTION and
   $upcase($PERCENT)=YES
      $one;
%else
%if $upcase($WHAT)=BY.INSTITUTION.TREATMENT.AND.MONTH and
   $upcase($PERCENT)=NO
      $two;
%else
%if $upcase($WHAT)=BY.LOCATION.INSTITUTION.TREATMENT.AND MONTH and
   $upcase($PERCENT)=YES
      $three;
%else
%if $upcase($WHAT)=BY.INSTITUTION.AND.TREATMENT and
   $upcase($PERCENT)=NO
      $five;

%enddo;  

%enddo;  

%enddo;

%enddo;  

%enddo;
%then %four;
    %error;
run;
%mend doit;

******************************************************************************
** TABLE MODULES
******************************************************************************

******************************************************************************
* Table one
* Produces a count by month location and
* institution with percents
******************************************************************************

%macro one;
  proc sort data = &filename out= temp;
    by &date &instn;
  run;

  proc tabulate data=temp format =8. order=data;
    class &instn &loct &date;
    label &date = 'ENROLLMENT MONTHS'
           &instn = 'SOURCE INSTITUTION'
           &loct = 'LOCATION';
    keylabel pctn = '%';
    table &loct*&instn all='MONTHLY TOTAL',&date*f=5.*(n)
         all='INSTITUTION TOTAL'*(n*f=10. pctn*f=8.1)/ rts=40
         miss text= '0 ';
    format &date monny5. &loct &locf.;
  run;

%mend one;

******************************************************************************
* Table two
* Produces a count by month and
* treatment and institution without percents
******************************************************************************

%macro two;
  proc sort data = &filename out=temp;
    by &trt &date;
  run;

  proc tabulate data=temp format =8. order=data;
    class &trt &instn &date;
    label &date = 'ENROLLMENT MONTHS'
           &instn = 'SOURCE INSTITUTION'
           &trt = 'TREATMENT ARMS';
    keylabel all='TOTAL';
    table &instn* &date all ,&trt all*f=5.*(n)
         / rts=40 miss text = '0 ';
    format &date monny5. &trt &trtf.;
  run;

%mend two;

******************************************************************************
* Table three
* Produces a count by month and
* treatment, location and institution
* with percents
******************************************************************************

%macro three;
  proc sort data = &filename out=temp;
    by &trt &date &loct;
  run;

  proc tabulate data=temp format =8. order=data;
    class &trt &loct &instn &date;
    label &date = 'ENROLLMENT MONTHS'
           &instn = 'SOURCE INSTITUTION'
           &loct = 'LOCATION'
           &trt = 'TREATMENT ARMS';

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Posters

keylabel all='TOTAL'

postn = 8;

table &loc&instn&date all.&trt

all*( n postn*f=8.1) / rts=55 misstext='0';

format &date monyy5. &trt &trtf. &loc &locf.;

run;

%mend three;

*****************************************************
* Table four
* Produces a count by institution and treatment
* without percents
*****************************************************;

%macro four;

proc sort data=&filename out=temp;

by &trt &instn;

run;

proc tabulate data=temp format =8. order=data;

class &trt &instn;

label &instn='INSTITUTION'

&trt='TREATMENT ARMS';

keylabel all='TOTAL';

table &instn all,&trt all*f=5.*( n*f=8. ) / rts=40 misstext='0';

format &trt &trtf.;

run;

%mend four;

*****************************************************
* ERROR MACRO
* Produces an Error message on output when
* incorrect what= or percent= parameters exist
*****************************************************;

%macro error;

data _null_;

file print;

put ***** ERROR IN SELECTION PARAMETERS (WHAT=? PERCENT=?)

/ "CHECK SPELLING AND SELECTIONS ! *****"

/ "what=&what"

/ "percent=&percent";

run;

%mend error;

%doit(&what,&percent);

%mend master;

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APPENDIX B

/* These formats are used in all examples */

proc format;
value strfmt
A = 'REGIMEN 1';
B = 'REGIMEN 2';
C = 'REGIMEN 3';
value locfmt
1 = 'BOSTON/CAMBRIDGE';
2 = 'SUBURBAN BOSTON';
run;

***************
* EXAMPLE ONE
***************

/* This macro call produces the table following it */

%master(where=by.month.location.and.institution.percent=yes,
   filename=file.nesug.options=ls=132 ps=50 nodate nonumber
   sprint mloglq.loc=location.locf=locfmt..inst=instn.date=date,
   title='EXAMPLE ONE',
title2='STUDY ENROLLMENT BY MONTH, LOCATION AND INSTITUTION',
footl='VALID AS OF APRIL 30, 1993');

<table>
<thead>
<tr>
<th>ENROLLMENT MONTHS</th>
<th>JUN92</th>
<th>JUL92</th>
<th>AUG92</th>
<th>SEP92</th>
<th>OCT92</th>
<th>NOV92</th>
<th>DEC92</th>
<th>JAN93</th>
<th>FEB93</th>
<th>MAR93</th>
<th>APR93</th>
<th>INSTITUTION TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>LOCATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOSTON/CAMBRIDGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beth Israel</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Hospital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brigham and Women's Hospital</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>New England Medical Center</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>General Hospital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUBURBAN BOSTON</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waltham Hospital</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Newton-Wellesley</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Hospital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MONTHLY TOTAL</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>17</td>
</tr>
</tbody>
</table>

VALID AS OF APRIL 30, 1993

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* EXAMPLE TWO

This macro call produces the table following it:*

```sql
$master$what=BY_INSTITUTION,TREATMENT.AN...-
foot1="VALID AS OF APRIL 30, 1993",
foot2="NO PERCENTAGES CALCULATED";

**EXAMPLE TWO**

**BY INSTITUTION TREATMENT AND MONTH**

<table>
<thead>
<tr>
<th>SOURCE INSTITUTION</th>
<th>ENROLLMENT MONTHS</th>
<th>REGIMEN 1</th>
<th>REGIMEN 2</th>
<th>REGIMEN 3</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brigham and Women's Hospital</td>
<td>JUL92</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>New England Medical Center</td>
<td>AUG92</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Newton-Wellesley Hospital</td>
<td>NOV92</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Massachusetts General Hospital</td>
<td>DEC92</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Walden Hospital</td>
<td>DEC92</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Beth Israel Hospital</td>
<td>JUN92</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**TOTAL** | 7 | 6 | 4 | 17

VALID AS OF APRIL 30, 1993
NO PERCENTAGES CALCULATED

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/* This macro call produces the table following it */

%master(what=BY LOCATION, INSTITUTION, TREATMENT AND MONTH, percent=yes, filename=file.nesug.options=ls=12 ps=55 nodate number
mprint alogic,loc=location,locf=locfmt,instn=instn,date=date, 
trt=trt, trtf=trtfmt,,
title=EXAMPLE THREE,
title2=BY LOCATION, INSTITUTION, TREATMENT AND MONTH,,
FOOT=VALID AS OF APRIL 30, 1993);

### EXAMPLE THREE

**BY LOCATION, INSTITUTION, TREATMENT AND MONTH**

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SOURCE INSTITUTION</th>
<th>ENROLLMENT MONTHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOSTON/CAMBRIDGE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brigham and Women's Hospital</td>
<td>JUL92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JUN93</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>New England Medical Center</td>
<td>AUG92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Massachusetts General Hospital</td>
<td>DBC92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MAR93</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OCT92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SEP92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Beth Israel Hospital</td>
<td>JUN92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>SUBURBAN BOSTON</td>
<td>Newton-Wellesley Hospital</td>
<td>NOV92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DBC92</td>
</tr>
<tr>
<td></td>
<td>Malden Hospital</td>
<td>NOV92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DBC92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MAR93</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OCT92</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FEB93</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>APR93</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

VALID AS OF APRIL 30, 1993

---

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### EXAMPLE FOUR
#### BY INSTITUTION AND TREATMENT

<table>
<thead>
<tr>
<th>INSTITUTION</th>
<th>REGIMEN 1</th>
<th>REGIMEN 2</th>
<th>REGIMEN 3</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brigham and Women's Hospital</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Malden Hospital</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>New England Medical Center</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Newton-Wellesley Hospital</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Beth Israel Hospital</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>7</td>
<td>6</td>
<td>4</td>
<td>17</td>
</tr>
</tbody>
</table>

**VALID AS OF APRIL 30, 1993**
**NO PERCENTAGES CALCULATED**