Customizing FREQ Procedure Output in SAS® 9.2

Introducing the new crosstabulation table template for multi-way tables and SAS ODS Graphics options
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Introduction

Prior to SAS 9.2, only one alternative was available for modifying the output of a multi-way table from the FREQ procedure (PROC FREQ). You had to use the FORMAT= option in the TABLES statement, which enabled the software to display the frequency count with a different format. For more customization, particularly in the non-listing destinations (such as HTML, PDF, and so on), the TABULATE procedure was the recommended alternative because it has style options available within the procedure syntax.

This paper introduces the new crosstabulation table template, which enables you to customize PROC FREQ output and highlights how to use the template to accomplish some common tasks, such as the following:

- formatting numbers in a table
- changing or suppressing headers and footers
- changing or suppressing the legend
- adding distinct styles to each region of the table

This paper also introduces the new SAS Output Delivery System (ODS) Statistical Graphics capability that is available with PROC FREQ.

The information in this paper is intended for people who understand multi-way frequency tables and who have a basic knowledge of the FREQ procedure and the SAS Output Delivery System.

The Crosstabulation Template

The crosstabulation template for PROC FREQ is a TEMPLATE procedure that enables you to customize multi-way frequency tables. The template, written in the standard table template language, is completely defined in "Appendix: Complete Crosstabulation Template Definition." The examples that follow illustrate how you can use the template to modify specific aspects of a multi-way frequency table.

Note: The default CrossTabFreqs table definition that is shipped with SAS is stored in the SASHELP.TMPLMST itemstore. You can return to that default definition by submitting the following statements:

```sas
proc template;
   delete base.freq.crosstabfreqs;
run;
```
Example 1: Changing the Color of Cell Values in Non-Listing Destinations

Adding colors to your output is useful when you want to highlight values. The following program changes the color of the frequency cell values in the table cell based on the color assigned in the FORMAT procedure. You can only add color to non-listing destinations such as HTML, PDF, and RTF.

```sas
proc format;
  value color low-2='green'
                  3-5='blue'
                  6-high='orange';
run;

proc template;
  define crosstabs Base.Freq.CrossTabFreqs;
    cell_style={foreground=color.};
    row_total_style={foreground=color.};
    col_total_style={foreground=color.};
    grand_total_style={foreground=color.};
  end;
ods listing close;
ods html file='body.html';
proc freq data=sashelp.class;
  tables age*sex / norow nocol nopercent;
run;
ods html close;
ods listing;
```

The preceding program generates the following output:

```
   F  M  Total
 11  1  1   2
 12  2  3   5
 13  2  1   3
 14  2  2   4
 15  2  2   4
 16  0  1   1
Total 9 10 19
```

Output 1. Cell Colors Changed Based on Format
Example 2: Replacing Row, Column, and Table Headings

By default, PROC FREQ creates a table with specific row, column, and table headings, as shown in this example:

```
<table>
<thead>
<tr>
<th>Frequency</th>
<th>Table of Sex by Age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sex</td>
</tr>
<tr>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Row Pct</td>
<td></td>
</tr>
<tr>
<td>Col Pct</td>
<td></td>
</tr>
<tr>
<td>Sex F</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>7.14</td>
</tr>
<tr>
<td></td>
<td>14.29</td>
</tr>
<tr>
<td></td>
<td>50.00</td>
</tr>
<tr>
<td>Sex M</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>7.14</td>
</tr>
<tr>
<td></td>
<td>14.29</td>
</tr>
<tr>
<td></td>
<td>50.00</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>14.29</td>
</tr>
</tbody>
</table>
```

Output 2. Default Table and Headings Generated by PROC FREQ

The following program suppresses the row-variable and the column-variable headings, replaces **Table of Sex by Age** with the header text (**Two-Way Table Output**), and suppresses the table legend in all ODS destinations:

```
proc template;
  define crosstabs Base.Freq.CrossTabFreqs;
  define header myheader;
    text 'Two-Way Table Output';
  end;
end;
run;
ods listing close;
ods html file='body.html';
proc freq data=sashelp.class;
  tables sex*age;
run;
ods html close;
ods listing;
```
The preceding program generates the following output:

```
data class;
  set sashelp.class;
  label sex='Gender'
  age='Age in Years';
run;

proc template;
define crosstabs Base.Freq.CrossTabFreqs;
  define header tableof;
    text "Table of " _row_label_ " by " _col_label_;
  end;

  define header rowsheader;
    text _row_label_ / _row_label_ ^= ' ';
    text _row_name_; 
  end;
end;
```

The output is shown in the following table:

<table>
<thead>
<tr>
<th></th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F</strong></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>47.77</td>
</tr>
<tr>
<td>5.26</td>
<td>10.53</td>
<td></td>
<td>10.53</td>
<td></td>
<td>10.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.11</td>
<td>22.22</td>
<td></td>
<td>22.22</td>
<td></td>
<td>22.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50.00</td>
<td>40.00</td>
<td></td>
<td>66.67</td>
<td></td>
<td>50.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>M</strong></td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>52.63</td>
</tr>
<tr>
<td>5.26</td>
<td>15.79</td>
<td>5.26</td>
<td>10.53</td>
<td>10.53</td>
<td></td>
<td>5.26</td>
<td></td>
</tr>
<tr>
<td>10.00</td>
<td>30.00</td>
<td>10.00</td>
<td>20.00</td>
<td>20.00</td>
<td></td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>50.00</td>
<td>60.00</td>
<td>33.33</td>
<td>50.00</td>
<td>50.00</td>
<td></td>
<td>100.00</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>10.53</td>
<td>26.32</td>
<td>15.79</td>
<td>21.05</td>
<td>21.05</td>
<td></td>
<td>5.26</td>
<td>100.00</td>
</tr>
</tbody>
</table>

**Example 3: Replacing Variable Names with Meaningful Labels**

Rather than using variable names (such as Sex or Age), you might want to customize your output with variable labels that are more meaningful, as shown in the following example:

```sas
data class;
  set sashelp.class;
  label sex='Gender'
  age='Age in Years';
run;

proc template;
define crosstabs Base.Freq.CrossTabFreqs;
  define header tableof;
    text "Table of " _row_label_ " by " _col_label_; 
  end;

  define header rowsheader;
    text _row_label_ / _row_label_ ^= ' ';
    text _row_name_; 
  end;
end;
```
This program generates the following output, replacing the variable names Sex and Age with the labels Gender and Age in Years and suppressing the legend in all ODS destinations. **Note:** In cases where a label is not provided, SAS uses the variable name.

### Table of Gender by Age in Years

<table>
<thead>
<tr>
<th>Gender</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>5.26</td>
<td>10.53</td>
<td>10.53</td>
<td>10.53</td>
<td>10.53</td>
<td>0.00</td>
<td>47.27</td>
</tr>
<tr>
<td></td>
<td>11.11</td>
<td>22.22</td>
<td>22.22</td>
<td>22.22</td>
<td>22.22</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50.00</td>
<td>40.00</td>
<td>66.67</td>
<td>50.00</td>
<td>50.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>5.26</td>
<td>15.79</td>
<td>5.26</td>
<td>10.53</td>
<td>10.53</td>
<td>5.26</td>
<td>52.63</td>
</tr>
<tr>
<td></td>
<td>10.00</td>
<td>30.00</td>
<td>10.00</td>
<td>20.00</td>
<td>20.00</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50.00</td>
<td>60.00</td>
<td>33.33</td>
<td>50.00</td>
<td>50.00</td>
<td>100.00</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>10.53</td>
<td>26.32</td>
<td>15.79</td>
<td>21.05</td>
<td>21.05</td>
<td>5.26</td>
<td>100.00</td>
</tr>
</tbody>
</table>
Example 4: Formatting Cell Contents for Requested Statistics and Changing Statistics Headings in the Legend

The following example changes the names of the default statistics to more meaningful names in the legend for all ODS destinations. The program also formats the percentage statistics (Percent, RowPercent, and ColPercent) with a percent (%) sign.

```sas
proc format;
   picture pctfmt (round) other='009.9%';
run;

proc template;
   define crosstabs Base.Freq.CrossTabFreqs;
      cellvalue frequency percent rowpercent colpercent;

      define frequency;
         format=8.;
         header='Count';
      end;

      define percent;
         format=pctfmt.;
         header='Overall %';
      end;

      define rowpercent;
         format=pctfmt.;
         header='Row %';
      end;

      define colpercent;
         format=pctfmt.;
         header='Col %';
      end;
   end;
run;

proc freq data=sashelp.class;
   tables sex*age;
run;
```
The preceding program generates the following table, shown as listing output:

<table>
<thead>
<tr>
<th>Count</th>
<th>Overall %</th>
<th>Row %</th>
<th>Col %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>F</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>5.3%</td>
<td>10.5%</td>
<td>10.5%</td>
</tr>
<tr>
<td></td>
<td>11.1%</td>
<td>22.2%</td>
<td>22.2%</td>
</tr>
<tr>
<td></td>
<td>50.0%</td>
<td>40.0%</td>
<td>66.7%</td>
</tr>
<tr>
<td>M</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>5.3%</td>
<td>15.8%</td>
<td>5.3%</td>
</tr>
<tr>
<td></td>
<td>10.0%</td>
<td>30.0%</td>
<td>10.0%</td>
</tr>
<tr>
<td></td>
<td>50.0%</td>
<td>60.0%</td>
<td>33.3%</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>10.5%</td>
<td>26.3%</td>
<td>15.8%</td>
</tr>
</tbody>
</table>

Output 5. Cell Contents Formatted for Requested Statistics with Changed Legend Headings

Example 5: Suppressing a Table’s Frequency Missing Row in All ODS Destinations

The Frequency Missing row in a table specifies the number of observations that have missing values. The following table shows the default table output with the Frequency Missing row:

```
<table>
<thead>
<tr>
<th>Frequency</th>
<th>Table of x by y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>y</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>
```

Output 6. Default Output Containing the Frequency Missing Row
Because the Frequency Missing row specifies observations with missing values, it is not often useful to display it because
the table output only shows non-missing values. The following program suppresses the Frequency Missing row from the
output table in all ODS destinations by assigning a blank value to TEXT in the DEFINE FOOTER statement:

```sas
data test;
  input x y;
cards;
1 1
1 2
2 1
2 2
..;
run;

proc template;
  define crosstabs Base.Freq.CrossTabFreqs;
  define footer foot;
    text ' ';
  end;
end;
run;

ods listing close;
ods html file='body.html';

proc freq data=test;
  tables x*y / norow nocol nopercent;
run;

ods html close;
ods listing;
```

This program generates the following table:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

*Output 7. Table with Suppressed Frequency Missing Row*
Example 6: Replacing the Row, Column, and Table Variables with Variable Labels and the ControllingFor String with Customized Text

In the following example, which is for a three-way table, the row-variable and the column-variable headings and the default text string (Table of y by z) are replaced with the variable labels. The table legend is also suppressed, and the ControllingFor string is replaced with the customized text ID=a. These changes affect all ODS destinations.

data test;
  label x='ID' y='Row Variable' z='Column Variable';
  input x $ y z;
  cards;
  a 1 1
  a 1 2
  a 2 1
  a 2 2
  b 1 1
  b 1 2
  b 2 1
  b 2 2
;
run;

proc template;
  define crosstabs Base.Freq.CrossTabFreqs;
    define header ControllingFor;
      dynamic StratNum StrataVariableNames StrataVariableLabels;
      text StrataVariableLabels / StratNum>0;
    end;
    define header tableof;
      text _row_label_ " by " _col_label_;  
    end;
  end;
end;
ods listing close;
ods html file='body.html';

proc freq data=test;
  tables x*y*z;
run;
ods html close;
ods listing;
The preceding program generates two tables. The tables are similar, so only one table is shown here.

<table>
<thead>
<tr>
<th>ID=a</th>
<th>Row Variable by Column Variable</th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.00</td>
<td>25.00</td>
<td>50.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50.00</td>
<td>50.00</td>
<td>50.00</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.00</td>
<td>25.00</td>
<td>50.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50.00</td>
<td>50.00</td>
<td>50.00</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50.00</td>
<td>50.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

*Output 8. Headers Replaced with Labels and Controlling For String Replaced with Custom Text*

---

**ODS Statistical Graphics**

In addition to creating tables, it is now possible to create statistical graphs with PROC FREQ and integrate the graphs with tables using the SAS 9.2 ODS Statistical Graphics (ODS Graphics) functionality. ODS Graphics is an extension of ODS, so you can display your graphs to various ODS destinations.

To enable ODS Graphics, submit the following statement:

```plaintext
ods graphics on;
```
After you specify ODS GRAPHICS ON, you can then request specific plots with the PLOTS= option in a TABLES statement. The following table lists the names of graphs that you can generate with PROC FREQ.

<table>
<thead>
<tr>
<th>ODS Graph Name</th>
<th>Plot Description</th>
<th>TABLES Statement Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>CumFreqPlot</td>
<td>Cumulative frequency plot</td>
<td>One-way table request</td>
</tr>
<tr>
<td>DeviationPlot</td>
<td>Deviation plot</td>
<td>CHISQ and one-way table request</td>
</tr>
<tr>
<td>FreqPlot</td>
<td>Frequency plot</td>
<td>Any table request</td>
</tr>
<tr>
<td>KappaPlot</td>
<td>Kappa plot</td>
<td>AGREE (h x r x r table)</td>
</tr>
<tr>
<td>ORPlot</td>
<td>Odds ratio plot</td>
<td>MEASURES or RELRISK (hx2x2 table)</td>
</tr>
<tr>
<td>WtKappaPlot</td>
<td>Weighted kappa plot</td>
<td>AGREE (h x r xr table, r &gt; 2)</td>
</tr>
</tbody>
</table>

*Table 1. Graphs Generated by PROC FREQ*

The following program generates a frequency plot within a table:

```sas
ods graphics on;
proc freq data=sashelp.class;
   tables age / plots=cumfreqplot;
run;
ods graphics off;

ods graphics on;
proc freq data=sashelp.class;
   tables sex*age / plots=freqplot;
run;
ods graphics off;
```
The preceding program generates the following frequency plot:

```
Distribution of Age

<table>
<thead>
<tr>
<th>Age</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>14</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>2</td>
</tr>
</tbody>
</table>

Output 9. Frequency Plot Generated with the SAS 9.2 ODS Graphics Functionality
```

Unless you are planning to generate only computational results, you can specify the ODS GRAPHICS ON statement and then just leave it on. However, if you need to turn it off, submit the following statement:

```
ods graphics off;
```

**Conclusion**

In summary, the new crosstabulation table template for PROC FREQ in SAS 9.2 greatly improves the level of customization that you can apply to multi-way tables. With the new template, you can format, customize, enhance, and exclude various elements of the output table. In addition, the SAS 9.2 ODS Graphics functionality enables you to create statistical graphs with PROC FREQ, integrate the graphs into tables, and display them in various ODS destinations.
Resources

Basic information on the FREQ procedure:


Information on the new crosstabulation table template:


Questions about the content of this paper:

Send e-mail to support@sas.com.
The complete crosstabulation template definition for the FREQ procedure is as follows:

```sas
proc template;
   define crosstabs Base.Freq.CrossTabFreqs;
      notes "Crosstabulation table";
      cellvalue Frequency Expected Deviation CellChiSquare TotalPercent
                     Percent RowPercent ColPercent CumColPercent;
      header TableOf ControllingFor;
      footer noobs Missing;
   define TableOf;
      dynamic StratNum NoTitle;
      text "Table " StratNum 10. " of " _ROW_NAME_ " by " _COL_NAME_ /
               (NoTitle=0) and (StratNum>0);
      text "Table of " _ROW_NAME_ " by " _COL_NAME_ / NoTitle=0;
   end;
   define ControllingFor;
      dynamic StratNum StrataVariableNames StrataVariableLabels;
      text "Controlling for" StrataVariableNames / StratNum>0;
   end;
   define header RowsHeader / nolist;
      text _ROW_NAME_ "(" _ROW_LABEL_ ")" / _ROW_LABEL_ not = '';
      text _ROW_NAME_;
      cindent = "";
      space=0;
   end;
   define header ColsHeader / nolist;
      text _COL_NAME_ "(" _COL_LABEL_ ")" / _COL_LABEL_ not = '';
      text _COL_NAME_;
      cindent = "";
      space=1;
   end;
   define Missing;
      dynamic FMissing;
      text "Frequency Missing = " FMissing -12.99 / FMissing not = 0;
      space=1;
   end;
   define noobs;
      dynamic SampleSize;
      text "Effective Sample Size = 0" / SampleSize=0;
      space=1;
   end;
end;
```
define Frequency;
  header="Frequency";
  format=BEST7.;
  label="Frequency Count";
  print;
  data_format_override;
end;

define Expected;
  header="Expected";
  format=BEST6.;
  label="Expected Frequency";
  print;
  data_format_override;
end;

define Deviation;
  header="Deviation";
  format=BEST6.;
  label="Deviation from Expected Frequency";
  print;
  data_format_override;
end;

define CellChiSquare;
  header="Cell Chi-Square";
  format=BEST6.;
  label="Cell Chi-Square";
  print;
end;

define TotalPercent;
  header="Tot Pct";
  format=6.2;
  label="Percent of Total Frequency";
  print;
end;

define Percent;
  header="Percent";
  format=6.2;
  label="Percent of Two-Way Table Frequency";
  print;
end;

define RowPercent;
  header="Row Pct";
  format=6.2;
  label="Percent of Row Frequency";
  print;
end;

define ColPercent;
  header="Col Pct";
  format=6.2;
  label="Percent of Column Frequency";
  print;
end;
define CumColPercent;
    header=%nrstr("Cumulative Col\%");
    format=6.2;
    label="Cumulative Percent of Column Frequency";
    print;
end;

cols_header=ColsHeader;
rows_header=RowsHeader;
end;
run;