Reporting and Interacting with Excel® spreadsheets with ODS® and DDE

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ABSTRACT

By now everyone knows SAS® can direct output to HTML files, which can be viewed by a browser. But Excel can also open HTML files, with some of the appearance features available. In addition, by using relative cell references to pass in formulas, programmers can also create spreadsheets that serve as applications. The application can display data in a user-friendly format which also allows the user to modify values. By reading and writing to the Excel file through DDE, the full functionality of SAS is available interactively. This is ideal for applications in which the user considers the data and tries out the results of various manual adjustments to specific variables.

THE HTML DESTINATION

Writing a file to the HTML destination with ODS creates an output file which is usually opened in a browser. But when the file is opened by Excel, many of the common appearance features are retained. A simple procedure writes to the HTML destination as follows:

```sas
data total;
  input id entity $  7-32 charter $ v1 $ v2 $;
  cards;
  15223 National Bank of Stafford 57 98237 32987
  23932 Stafford Federal Loan 23 23497 43283
  20939 First Stafford United 98 43290 32098
; run;

title;
ods html file='I:\dev\nesug\2005\report1.xls';
proc report nowindows data=total;
  columns id entity charter v1 v2;
  define id/display 'ID';
  define entity/display 'ENTITY';
  define charter/display 'CHARTER';
  define v1/display 'V1';
  define v2/display 'V2';
run;
ods html close;
```

with this appearance in the Excel spreadsheet:

<table>
<thead>
<tr>
<th>ID</th>
<th>ENTITY</th>
<th>CHARTER</th>
<th>V1</th>
<th>V2</th>
</tr>
</thead>
<tbody>
<tr>
<td>15223</td>
<td>National Bank of Stafford</td>
<td>57</td>
<td>98237</td>
<td>32987</td>
</tr>
<tr>
<td>23932</td>
<td>Stafford Federal Loan</td>
<td>23</td>
<td>23497</td>
<td>43283</td>
</tr>
<tr>
<td>20939</td>
<td>First Stafford United</td>
<td>98</td>
<td>43290</td>
<td>32098</td>
</tr>
</tbody>
</table>
Add a simple title and footnote:

title 'REPORT 2';
footnote 'Charter is current year only.'

still produces a readilyusable table:

<table>
<thead>
<tr>
<th>ID</th>
<th>ENTITY</th>
<th>CHARTER</th>
<th>V1</th>
<th>V2</th>
</tr>
</thead>
<tbody>
<tr>
<td>15223</td>
<td>National Bank of Stafford</td>
<td>57</td>
<td>98237</td>
<td>32987</td>
</tr>
<tr>
<td>23932</td>
<td>Stafford Federal Loan</td>
<td>23</td>
<td>23497</td>
<td>43283</td>
</tr>
<tr>
<td>20939</td>
<td>First Stafford United</td>
<td>98</td>
<td>43290</td>
<td>32098</td>
</tr>
</tbody>
</table>

Charter is current year only.

However, a longer title and footnote:

title "REPORT &r.. Based on preliminary figures for regional strata area.");
footnote 'Charter is current year only. If the analysis year is not the current year, defer to subsequent ratings';

displays wrapped and limited to the initial columns:

<table>
<thead>
<tr>
<th>ID</th>
<th>ENTITY</th>
<th>CHARTER</th>
<th>V1</th>
<th>V2</th>
</tr>
</thead>
<tbody>
<tr>
<td>15223</td>
<td>National Bank of Stafford</td>
<td>57</td>
<td>98237</td>
<td>32987</td>
</tr>
<tr>
<td>23932</td>
<td>Stafford Federal Loan</td>
<td>23</td>
<td>23497</td>
<td>43283</td>
</tr>
<tr>
<td>20939</td>
<td>First Stafford United</td>
<td>98</td>
<td>43290</td>
<td>32098</td>
</tr>
</tbody>
</table>

Charter is current year only. If the analysis year is not the current year, defer to subsequent ratings
To center the title and span it over most of the table’s columns, add HTML codes, which will be interpreted by Excel, to the title. The footnote can remain left aligned:

```html
<title>&lt;td align=center colspan=4&gt;REPORT &r.. Based on preliminary figures for regional strata area.&lt;/td&gt;";
footnote '&lt;td align=left colspan=4&gt;Charter is current year only. If the analysis year is not the current year, defer to subsequent ratings&lt;/td&gt;';
```

The appearance is now acceptable:

### REPORT 4. Based on preliminary figures for regional strata area.

<table>
<thead>
<tr>
<th>ID</th>
<th>ENTITY</th>
<th>CHARTER</th>
<th>V1</th>
<th>V2</th>
</tr>
</thead>
<tbody>
<tr>
<td>15223</td>
<td>National Bank of Stafford</td>
<td>57</td>
<td>98237</td>
<td>32987</td>
</tr>
<tr>
<td>23932</td>
<td>Stafford Federal Loan</td>
<td>23</td>
<td>23497</td>
<td>43283</td>
</tr>
<tr>
<td>20939</td>
<td>First Stafford United</td>
<td>98</td>
<td>43290</td>
<td>32098</td>
</tr>
</tbody>
</table>

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### FORMULAS

In Excel formulas may be entered for cell values. These calculate the value of a cell based on other cells in that (or another) spreadsheet. In a SAS data step the text of such a formula may be specified as the value of a variable, which will be written by the PROC REPORT as any other data. The observation with the formula as the value of one of the results variables can be output following what will appear as a blank line:

```sas
data rows;
  length v1-v2 $30;
  set total nobs=obs end=last;
  output;
  if last then do;
    /* Set values to missing and output the blank line. */
    id=.;
    entity=' ';
    charter=' ';
    v1=' ';
    v2=' ';
    output;
    /* Output a line with tab value for the total summed values. */
    charter='Total';
    v1='=sum(d4:d7)';
    v2='=sum(e4:e7)';
    output;
    /* Create macro variable with number of observations for later use. */
    call symput('obs',obs);
  end;
run;
```
To eliminate the need for manually determining the rows to sum when the data set changes, the values for the rows that vary can be calculated. A quick visual inspection shows that the data begins on line 4, which will be the starting row to sum. This is added to the number of observations in the data set to yield the last row to sum:

\[
\begin{align*}
n1 &= 4 + \text{obs}; \\
v1 &= \text{sum(d4:d}||\text{trim(left(put(n1,1.))))||')} \\
v2 &= \text{sum(e4:e}||\text{trim(left(put(n1,1.))))||')}
\end{align*}
\]

In the actual spreadsheet the summed value is calculated in the place of the formula:

**REPORT 5. Based on preliminary figures for regional strata area.**

<table>
<thead>
<tr>
<th>ID</th>
<th>ENTITY</th>
<th>CHARTER</th>
<th>V1</th>
<th>V2</th>
</tr>
</thead>
<tbody>
<tr>
<td>15223</td>
<td>National Bank of Stafford</td>
<td>57</td>
<td>98237</td>
<td>32987</td>
</tr>
<tr>
<td>23932</td>
<td>Stafford Federal Loan</td>
<td>23</td>
<td>23497</td>
<td>43283</td>
</tr>
<tr>
<td>20939</td>
<td>First Stafford United</td>
<td>98</td>
<td>43290</td>
<td>32098</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>=sum(d4:d7)</td>
<td>=sum(e4:e7)</td>
</tr>
</tbody>
</table>

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**USER INTERACTION**

It is now possible to explore the effect of changes in the data on the results by entering values in the cells that are summed. Or, additional cells may be designated for user input. An additional variable is created in this example specifically to allow for simple adjustments. The previously defined formulas now refer to this cell as well:

\[
\begin{align*}
n2 &= 2 + \text{obs} + 3; \\
v1 &= \text{sum(d4:d}||\text{trim(left(put(n1,1.))))||')} \times \text{adjust} \\
v2 &= \text{sum(e4:e}||\text{trim(left(put(n1,1.))))||')} \times \text{adjust}
\end{align*}
\]

with the resulting formulas in the spreadsheet:
REPORT 6. Based on preliminary figures for regional strata area.

<table>
<thead>
<tr>
<th>ID</th>
<th>ENTITY</th>
<th>CHARTER</th>
<th>V1</th>
<th>V2</th>
<th>Adjust</th>
</tr>
</thead>
<tbody>
<tr>
<td>15223</td>
<td>National Bank of Stafford</td>
<td>57</td>
<td>98237</td>
<td>32987</td>
<td></td>
</tr>
<tr>
<td>23932</td>
<td>Stafford Federal Loan</td>
<td>23</td>
<td>23497</td>
<td>43283</td>
<td></td>
</tr>
<tr>
<td>20939</td>
<td>First Stafford United</td>
<td>98</td>
<td>43290</td>
<td>32098</td>
<td></td>
</tr>
</tbody>
</table>

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INCORPORATING SAS OUTPUT INTO A SPREADSHEET INTERACTIVELY

To extend the utility of the Excel-SAS interface further, it is also possible to write to the spreadsheet interactively using DDE. For example, an application could use SAS to generate an initial spreadsheet, then allow for user input or modification of the spreadsheet, and then use SAS to calculate interactively statistics which will appear in the report.

In this example, an additional data set and PROC REPORT will generate a table appearing in the same spreadsheet following the initial table:

```sas
data skeleton;
  length dummy1 dummy2 $10 v1_prev v2_prev $20;
  tab='PREVIOUS';
  v1_prev='230932';
  v2_prev='320984';
  output;
  tab='TOTAL';
  c1=put(3+&obs+2,1.);
  c2=put(3+&obs+2+10,2.);
  v1_prev='=d'||trim(left(c1))||'+d'||trim(left(c2));
  v2_prev='=e'||trim(left(c1))||'+e'||trim(left(c2));
  output;
run;
```
title "<td align=center colspan=4>MULTI-YEAR TOTALS</td>";
footnote;
proc report nowindows data=skeleton;
   columns dummy1 dummy2 tab v1_prev v2_prev;
   define dummy1/display ' ';
   define dummy2/display ' ';
   define tab/display ' ';
   define v1_prev/display 'V1';
   define v2_prev/display 'V2';
run;

Users otherwise unfamiliar with the data can scan the table rapidly and experiment with the ADJUST value’s effects on the totals:

REPORT 7. Based on preliminary figures for regional strata area.

<table>
<thead>
<tr>
<th>ID</th>
<th>ENTITY</th>
<th>CHARTER</th>
<th>V1</th>
<th>V2</th>
<th>Adjust</th>
</tr>
</thead>
<tbody>
<tr>
<td>15223</td>
<td>National Bank of Stafford</td>
<td>57</td>
<td>98237</td>
<td>32987</td>
<td></td>
</tr>
<tr>
<td>23932</td>
<td>Stafford Federal Loan</td>
<td>23</td>
<td>23497</td>
<td>43283</td>
<td></td>
</tr>
<tr>
<td>20939</td>
<td>First Stafford United</td>
<td>98</td>
<td>43290</td>
<td>32098</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>=sum(d4:d7)*f8</td>
<td>=sum(e4:e7)*f8</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Charter is current year only. If the analysis year is not the current year, defer to subsequent ratings.

MULTI-YEAR TOTALS

<table>
<thead>
<tr>
<th></th>
<th>V1</th>
<th>V2</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREVIOUS</td>
<td>230932</td>
<td>320984</td>
</tr>
<tr>
<td>TOTAL</td>
<td>=d8+d18</td>
<td>=e8+e18</td>
</tr>
</tbody>
</table>

In this example, after the user modifies the cell for ADJUST as desired in Excel, the next step is to define a SAS file reference using DDE that points to only the cells with formulas as previously described. The INPUT statement reads from those selected cells:
/* Calculate row numbers as before: fixed numbers of lines + number of observations. */
%let c3=%eval(3+&obs+12);
%let c4=%eval(3+&obs+13);

/* Specify the full path of the file and spreadsheet */
/* The row and column specifications of the beginning and ending cell locations follow the "!" */

filename in dde "excel|I:\dev
esug\2005\[report&r..xls]
report&r!r&c3.c4:r&c4.c5";

data t;
  infile in;
  input r1 r2;
run;

Subsequent steps use the data set created from those cells, with the output data set restricted to only the needed statistic:

ods output 'chi-square tests'=chisq;

proc freq data=t;
  tables r1*r2/chisq;
run;

ods output close;

/* Add a header to appear above the statistic */

data out;
  set chisq;
  where statistic='Chi-Square';
  text='Chi-Square';
  output;
  text=put(prob,10.5);
  output;
run;

Then, define a file reference for the location of the cells in Excel in which the header and statistic header will appear, and write to that location:

filename out dde "excel|I:\dev
esug\2005\[report&r..xls]
report&r!r&c3.c6:r&c4.c6";

data _null_;  
  file out;
  set out;
  put text;
run;

The user now sees the statistic calculated on the adjusted data, and can stop with that or test other adjustments:
## MULTI-YEAR TOTALS

<table>
<thead>
<tr>
<th></th>
<th>V1</th>
<th>V2</th>
<th>Chi-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREVIOUS</td>
<td>230932</td>
<td>320984</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>=d8+d18</td>
<td>=e8+e18</td>
<td>0.157</td>
</tr>
</tbody>
</table>

The modified spreadsheet may be the final output. Alternatively, other SAS code may use the value selected for the ADJUST variable to produce final output.

### SPREADSHEET APPEARANCE FEATURES

Style elements specified in the PROC REPORT can enhance the appearance of the spreadsheet. A few elements in this example demonstrate that styles can affect various parts of the table. Here the background color for the table header is set:

```sas
proc report nowindows data=rows style(header)=[background=yellow];
```

This statement sets an attribute for a column:

```sas
define adjust/display 'Adjust' style(column)=[background=yellow];
```

Or, COMPUTE blocks can set style elements conditionally to highlight notable values:

```sas
compute v1;
  if input(v1,6.)<30000 and input(v1,6.) ne . then do;
    call define('v1','style','style=[font_weight=bold]');
  end;
endcomp;
compute v2;
  if input(v2,6.)>40000 then do;
    call define('v2','style','style=[background=red]');
  end;
endcomp;
```

The attributes apply to the cell rather than the data, so the statistic written through the DDE file reference will appear as specified as well:

```sas
compute dummy3;
  if tab='TOTAL' then do;
    call define('dummy3','style',
      "style=[font_style=italic background=yellow]");
  end;
endcomp;
```

The resulting spreadsheet appearance is as follows:
REPORT 9. Based on preliminary figures for regional strata area.

<table>
<thead>
<tr>
<th>ID</th>
<th>ENTITY</th>
<th>CHARTER</th>
<th>V1</th>
<th>V2</th>
<th>Adjust</th>
</tr>
</thead>
<tbody>
<tr>
<td>15223</td>
<td>National Bank of Stafford</td>
<td>57</td>
<td>98237</td>
<td>32987</td>
<td></td>
</tr>
<tr>
<td>23932</td>
<td>Stafford Federal Loan</td>
<td>23</td>
<td>23497</td>
<td>43283</td>
<td></td>
</tr>
<tr>
<td>20939</td>
<td>First Stafford United</td>
<td>98</td>
<td>43290</td>
<td>32098</td>
<td></td>
</tr>
</tbody>
</table>

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MULTI-YEAR TOTALS

<table>
<thead>
<tr>
<th></th>
<th>V1</th>
<th>V2</th>
<th>Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREVIOUS</td>
<td>230932</td>
<td>320984</td>
<td>Chi-Square</td>
</tr>
<tr>
<td>TOTAL</td>
<td>=d8+d18</td>
<td>=e8+e18</td>
<td>0.157</td>
</tr>
</tbody>
</table>

CONCLUSION

SAS output to HTML intended for use in Excel by itself provides an easy way to display data in a convenient and familiar format, but access to the full range of SAS is limited. Using DDE makes the capabilities of the full range of the SAS products available interactively while preserving the easy to assimilate format.

CONTACT INFORMATION

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