

Paper 093-31

Show Me the Big Picture

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ABSTRACT:

This presentation will show how SAS can help to present complex data dynamically. Output Delivery System (ODS) is a helpful, easy to use tool in SAS that can produce colorful and interactive graphs, reports and maps. ODS integrates the various new Java and ActiveX methods that give the user control over the style of output. This paper uses ambient air pollution data to compare simple SAS output with ODS output and develop complex HTML output. ODS output is user-friendly, interactive and allows for creativity and innovation in the information display. This paper is intended for SAS users who have basic SAS knowledge and want to enhance their SAS output using the ODS.

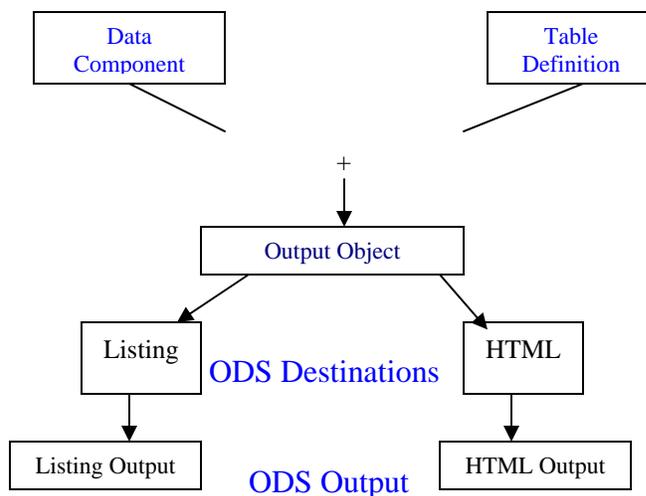
INTRODUCTION:

New York State's Environmental Public Health Tracking (EPHT) surveillance system contains hourly monitor values on six criteria pollutant at over 30 locations statewide. Following is an example of eight hours rolling average of ozone values in parts per million (ppm):

id1	DAY	Hour	OZONE
Mon i tor#1	30SEP98	H5	0.009
Mon i tor#1	30SEP98	H6	0.005
Mon i tor#1	30SEP98	H7	0.003
Mon i tor#1	30SEP98	H8	0.002
Mon i tor#1	30SEP98	H9	0.003
Mon i tor#1	30SEP98	H10	0.006
Mon i tor#1	30SEP98	H11	0.008
Mon i tor#1	30SEP98	H12	0.008
Mon i tor#1	30SEP98	H13	0.007
Mon i tor#1	30SEP98	H14	0.006

It is a difficult task to summarize a dataset with over 10 million records in small a number of tables. Most of the time tables are best suited for presenting specific information and graphs are better for presenting trends and making comparisons. The multiple levels of n -way tables can produce considerable output. Such bulky, often complex cross-tabulations often make the tables unreadable.

Based on the information required to present a qualitative summary of a big dataset, it will take approximately 5-7 tables to put together this information. By using the features of the new version of SAS®, generating reports and graphs has become easier. ODS provides an almost limitless number of choices for reporting and displaying analytical results with a greater variety of formatting selections and output destinations. Prior to version 7, most SAS output was designed for a line-printer and was limited to monospace fonts. ODS gives a greater flexibility in formatting, storing and reproducing SAS procedure output. It also provides formatting functionality that is not available when using individual procedures without ODS. While using the HTML and JavaScript is easy, it is important to understand the contribution of each programming step and statement to the formation of enhanced and comprehensive reports, charts and maps.



With SAS GRAPH® and ODS you can produce more user friendly graphs, tables and reports. There are options of static as well as interactive formats in both JAVA and ActiveX format. The difference between HTML and Java or ActiveX enabled graph is that HTML has an image associated with the html document, where as in Java or ActiveX there is only the document.

Creating HTML and PDF Reports:

A beginner level SAS user can easily use PROC REPORT to produce the output shown below to summarize the maximum and average ozone concentration for each ozone advisory region:

Monthly Average Ozone Measurements: Listing Output

Ozone Region	Monitor ID	Max Ozone	Average Monthly May	Monthly Ozone June	Measurement July	August	Season Mean
East	Monitor# 05	0.44	0.231	0.225	0.241	0.245	0.285
	Monitor# 06	0.45	0.236	0.230	0.247	0.251	0.291
North	Monitor# 03	0.44	0.228	0.223	0.239	0.243	0.282
	Monitor# 04	0.47	0.244	0.238	0.255	0.259	0.301
South	Monitor# 01	0.44	0.228	0.223	0.239	0.243	0.282
	Monitor# 02	0.39	0.203	0.198	0.212	0.216	0.251

If you want to know which monitoring stations exceeded the maximum ozone limits set by the Environmental Protection Agency (EPA), you need to search all the values in the Max Ozone column to find the highest values or create another table with the frequencies of the maximum values. Also, this report contains too many numbers to be able to find any information quickly.

Creating a more informative output from SAS is easy and the steps discussed in this paper will show how to use ODS to deliver your SAS output (reports, graphs, and charts) in a more user friendly format by turning it into an HTML or PDF file. There are several other ways to produce the output such as RTF and Microsoft® Word document.

For each type of formatted output you want to generate, you use an ODS statement to open the destination. At the end of the program you use another ODS statement to close the destination so that you can access the output. Following is a general form of ODS statement to open and close destinations:

ODS open-destination;
ODS close-destination CLOSE;

Most ODS destinations are closed by default and you open them at the beginning of your program and close them at the end. The exception is the Listing destination, which is open by default.

HTML Output:

The basic step in producing the HTML output is simple. You need to add the following two high-lighted statements to your basic reporting procedure:

```

ODS listing close;
ODS HTML file= "C:\SUGI\BasicRep.html";
Proc report data=mean1a NOWD HEADLINE HEADSKIP
              SPLIT='/' LS=134;
      COLUMN region station (MAX),ozone_max month, ozone_mean eason_mean;
      ***** more SAS statements
      BREAK AFTER Region /OL SKIP;
      RUN;
QUIT;
ODS HTML close;
ODS listing;

```

The result of adding the above two statements is shown below:

		Mean Ozone Value (ppm)								
		Max Ozone	Apr	May	Jun	Jul	Aug	Sep	Oct	
Ozone Region	Monitor ID									Season Mean
Region1	Monitor#1	0.091	0.034	0.045	0.042	0.042	0.049	0.044	0.035	0.050
	Monitor#2	0.108	0.047	0.050	0.040	0.043	0.042	0.039	0.030	0.053
	Monitor#3	0.092	0.039	0.041	0.032	0.032	0.028	0.028	0.025	0.042
	Monitor#4	0.092	0.038	0.034	0.027	0.026	0.024	0.023	0.023	0.038
Region2	Monitor#1	0.122	0.026	0.025	0.025	0.037	0.028	0.018	0.009	0.040

As shown in the above SAS output, the same report looks more organized and presentable, without doing any major changes in the SAS program statements.

PDF Output:

If you replace the word HTML in ODS statements in the above example with PDF you can get the output as a PDF file:

		Mean Ozone Value (ppm)								
		Max Ozone	Apr	May	Jun	Jul	Aug	Sep	Oct	
Ozone Region	Monitor ID									Season Mean
Region1	Monitor#1	0.091	0.034	0.045	0.042	0.042	0.049	0.044	0.035	0.050
	Monitor#2	0.108	0.047	0.050	0.040	0.043	0.042	0.039	0.030	0.053
	Monitor#3	0.092	0.039	0.041	0.032	0.032	0.028	0.028	0.025	0.042
	Monitor#4	0.092	0.038	0.034	0.027	0.026	0.024	0.023	0.023	0.038
Region2	Monitor#1	0.122	0.026	0.025	0.025	0.037	0.028	0.018	0.009	0.040

The PDF output is good for a printable report as well as for wider electronic distribution. The file can be read by free Acrobat® Reader that can be downloaded from the internet. One of the features of ODS is that you can produce output in multiple formats at once by opening each ODS destination at the beginning of the program. When you have more than one open ODS destination, you can use the keyword `_ALL_` in the ODS CLOSE statement to close all open destinations at once.

```
ODS html file="C:\SUG\Rep1.html";
ODS pdf file="C:\SUG\Rep2.pdf";
Proc report data=mean1a NOWD HEADLINE HEADSKIP SPLIT='+';
  COLUMN region station (MAX), ozone_max month, ozone_mean;
  *** more SAS statements
  RUN;
QUIT;
ODS _all_ close;
ODS listing;
```

While HTML and PDF formats offer some advantages, these tables still contain too many numbers. Including the ODS statements in the above program enhanced the appearance of the report, but the readability of the HTML or PDF report is still same as the listing report.

The rest of this paper will focus on generating a more complex web based output that will improve the appearance as well as readability of the SAS output.

Creating More Complex HTML Output:

There are many ways of enhancing the appearance and readability of the above report. One way to increase the readability is to create a web output that is content specific and can provide the viewer additional links (hotlinks) to further get the detailed information. The report created by using the hotlinks leads the viewer to critical information one step at a time and will provide the options to explore the detailed information, if needed. To enhance the default output you can add a Table of Contents (ToC) or a Table of Pages on the left side of the frame and the right side of the frame will be reserved for displaying the body file. The ToC contains a link to each body file generated by the HTML output. If a link in the ToC is clicked, the linked body file opens in the right side of the frame.

Similar to ToC, Table of Pages file contains a link to the body file for each page of HTML output. The frame file provides a view of the body file, the ToC or the Table of Pages. These three files (body, contents/pages and frame) can be generated by using the following SAS statements:

```
Filename ODSOUT 'C:\allworksk\SUGI';
ODS HTML
PATH=          ODSOUT
BODY=          "Demo_body.html"
CONTENTS=     "Demo_contents.html"
FRAME=        "Demo_Fram.html";
```

Following is the browser view of HTML Frame file. As you can see in the Tables of Contents, there is a link to see the PROC Report output in the right section of the frame:

The screenshot shows a SAS report frame. On the left, there is a 'Table of Contents' section with a link to '1. The Report Procedure -Detailed and/or summarized report' and a 'Table of Pages' section with a link to '1. The Report Procedure -Page 1'. On the right, the main report content is displayed, titled 'Monthly Average Ozone Measurements: Year 2001'. The data table has columns for 'Ozone Region', 'Monitor ID', 'Max Ozone', and monthly values from April to October, plus a 'Sea Me' column. Callouts identify the 'Contents File' (pointing to the table of contents), 'Page File' (pointing to the table of pages), 'Frame File' (pointing to the main report title), and 'Body File' (pointing to a data row).

Right section of the above report is the same as seen previously. The additional sections on the left side of the frame provide a place to link any additional SAS output. Every time a different link in 'table of contents' or 'table of pages' is clicked the linked output is displayed in the right section of the frame.

So far the HTML output shown above is the default style. To highlight the highest and lowest concentration, you can use various style elements available in SAS. Steps to highlight the selected information in the report are simple and require one extra compute block along with style information in the simple PROC REPORT program. A simple compute block along with style statement and output is shown below.

This screenshot shows the same SAS report frame as above, but with the data table cells highlighted in different colors to indicate maximum and minimum values. The 'Max Ozone' column has a red background for 0.091, 0.108, and 0.122, and a green background for 0.089. The 'Sea Me' column has a pink background for 0.042. Callouts identify the 'Procedure Name' and 'Link to Body File'.

```
COMPUTE max;
  IF ozone_max.max LT 0.09
    THEN CALL DEFINE (_col_, 'style',
      'style=[BACKGROUND=green
        FONT_FACE=Helvetica
        FONT_WEIGHT=bold]');
```

```

ELSE IF ozone_max.max GE 0.09 and oxone_max.max LE 0.1000
  THEN CALL DEFINE (_col_, 'style',
    'style=[BACKGROUND=#d8859f
    FONT_FACE=Helvetica
    FONT_WEIGHT=bold]');
ELSE IF ozone_max.max GT 0.1000 and oxone_max.max LE 0.1000
  THEN CALL DEFINE (_col_, 'style',
    'style=[BACKGROUND=red
    FONT_FACE=Helvetica
    FONT_WEIGHT=bold]');

```

Linking Several Outputs:

ODS provides the option to link separate outputs by using HTML anchors. Once a link is created the linked text is underlined to show the hotlink. By default, SAS generates a link for each output on ToC or Table of Pages as long as all the procedures are enclosed in one set of ODS open and close statements. The other method of linking several output is by creating anchors. Following example shows the steps to create a navigable HTML documents that will allow the viewer to navigate from a summary report to a detailed monthly report of ozone level for each monitor, by using monitors as anchor.

Step 1:

Generate two separate reports:

1. Report with only the maximum value for each station
2. A follow-up report, if needed, to show any additional information

The layout of the first report will include region, monitor and maximum ozone value and the second report will include region, monitor and average monthly ozone value followed by the season average for each monitor. Following is the output screen for both reports:

Address C:\allworksk\NESUG\demo_body1.html

Maximum Ozone Measurements: Year 2001

Ozone Region	Monitor ID	Max Ozone (ppm)
Region1	Monitor#1	0.091
	Monitor#2	0.108
	Monitor#3	0.092
	Monitor#4	0.092

Address C:\allworksk\NESUG\demo_body2.html

Average Monthly Ozone Measurements: Year 2001

Ozone Region	Monitor ID	Average Monthly Ozone (ppm)	
		Apr	May
Region1	Monitor#1	0.034	0.045
	Monitor#2	0.047	0.050
	Monitor#3	0.039	0.041
	Monitor#4	0.038	0.034

Step 2:

Next step is to provide links on summary report to navigate the second report. These linkages are created by using the following compute block in the first PROC REPORT:

```
COMPUTE BEFORE region;
```

```

        Region_number +1;
    ENDCOMP;
    COMPUTE region; Link_region="demo_body3.html#region" ||
    left(put(region_number, 3.0));
    CALL DEFINE (_col_,'url',Link_region);
    ENDCOMP;

```

The above Link_region refers to the filename of the second report (demo_body3.html) and adds the value of region number for creating linkage. The codes for second report are shown below:

```

ODS HTML PATH=ODSOUT
FILE="demo_body3.html"
ANCHOR= "region1";
PROC REPORT DATA=mean1a
  T. More SAS Statements
RUN;
  QUIT;
  ODS HTML CLOSE;

```

Note the use of ANCHOR in the above ODS statement. ODS HTML assigns anchor names by default, but you can assign specific anchor by ANCHOR= option. ANCHOR= specifies the base name of the HTML anchor that identifies each part of the output in the referenced body file. Following figures show the output screen for first and second report:

Address: C:\allworksk\NESUG\demo_fram2.html

Table of Contents

Report of Max values

1. The Report Procedure - Detailed and/or summarized report
2. The Report Procedure - Detailed and/or summarized report

Report of Mean values

Click to open the detailed report for Region 1 (shown below)

Ozone Region	Monitor ID	Max Ozone (ppm)
Region1	Monitor#1	0.091
	Monitor#4	0.000

Here is the output if you click on the link for Region 1 on first screen:

Address C:\allworksk\NESUG\demo_fram2.html

[Table of Contents](#)

1. The Report Procedure
-Detailed and/or summarized report
2. The Report Procedure
-Detailed and/or summarized report

Average Monthly Ozone Measurements

Ozone Region	Monitor ID	Apr	M
Region1	Monitor#1	0.034	0
	Monitor#2	0.047	0
	Monitor#3	0.020	0

Any subsequent reports, tables, graphs or charts can be linked to a specific section using the anchors. The report in the above example uses the basic style elements. You can change the appearance of the HTML output by specifying a style in the **STYLE= option** in the ODS HTML statement. There are several style definitions that are currently available in SAS including Beige, Brick, D3d, Minimal, Brown and Default.

Following is an example of a more advanced report with a user defined STYLE=option. Notice that there is no difference in the information included in the following report, but the changes enhanced the appearance of the report and made it more attractive.

Address F:\NESUG\Output\03_frame.html

[Table of Contents](#)

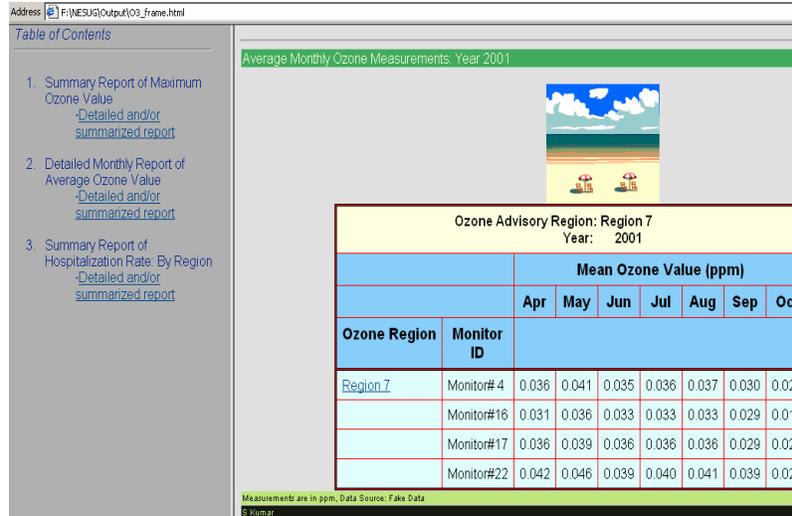
1. Summary Report of Maximum Ozone Value
-Detailed and/or summarized report
2. Detailed Monthly Report of Average Ozone Value
-Detailed and/or summarized report
3. Summary Report of Hospitalization Rate, By Region
-Detailed and/or summarized report

Maximum Ozone Measurements: Year 2001



Ozone Region	Monitor ID	Max Ozone (ppm)	Exceed?
Region 1	Monitor# 6	0.091	 Yes
	Monitor# 7	0.108	 Yes
	Monitor# 8	0.092	 Yes
	Monitor# 9	0.092	 Yes
Region 2	Monitor#27	0.122	 Yes

Titles in the tables of contents can be changed by using ODS PROCLABEL statement. In the above example the default label (“The Report Procedure”) for PROC REPORT has been replaced by more informative title.



JAVA and ActiveX Graphs:

Graphs can be produced by using the GPLOT and GCHART procedures available within SAS/GRAPH. As you saw in the previous example, the basic codes for producing a simple and web ready output are similar. You need to include some additional statements to the basic PROC GPLOT or PROC GCHART. Newer version of SAS includes many features that can generate the interactive maps and charts. You will need to define the CODEBASE to point to a specific file path that is used by the GOPTIONS devices. For Java device file path points to the directory that contains the java applets (jar files) and for the ActiveX device the file path is specified for an ActiveX control. User's browser attempts to install the control from the location specified in the CODEBASE= file path. Here are the codes followed by output:

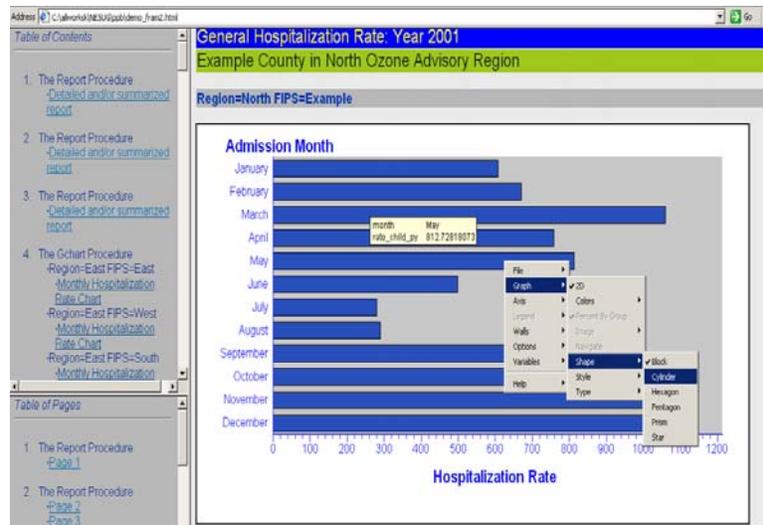
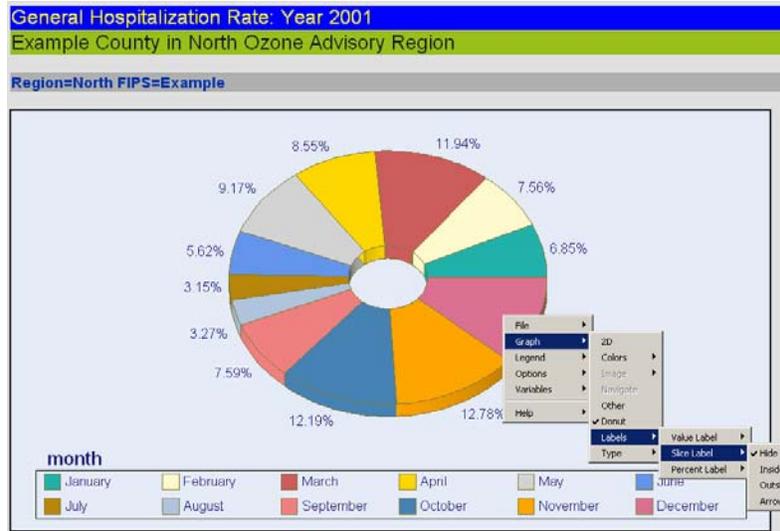


Chart type can also be changed from bar chart to pie or scatter chart. In the following example I selected the pie chart with some additional options available in the dropdown menu:

**CONCLUSION:**

This concludes an introduction to the ODS. I hope to have provided sufficient steps for a beginner level SAS programmer to get started in exploring the Output Delivery System. Using ODS to create internet ready output is a very helpful tool for including the reports and charts that let the user decide on various style elements. While the techniques used in the above examples are very basic, they provide the foundation for developing more complex reports and graphs.

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