

## ODS: A Unique Method to Present Data

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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:

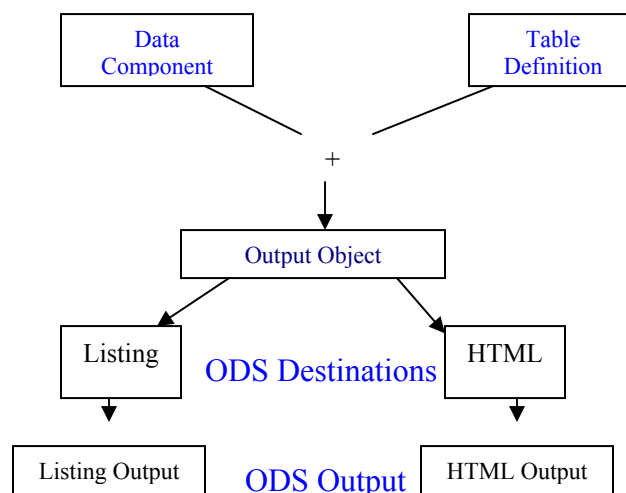
New York State's Environmental Public Health Tracking (EPHT) surveillance system contains hourly monitor values on six criteria pollutant at over 30 locations statewide. Following is an example of hourly ozone values:

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

Ozone Region	Monitor ID	Max Ozone	Mean Ozone Value (ppm)				
			Apr	May	Jun	Jul	Aug
Region1	Monitor#1	0.091	0.034	0.045	0.042	0.042	0.049
	Monitor#2	0.108	0.047	0.050	0.040	0.043	0.042
	Monitor#3	0.092	0.039	0.041	0.032	0.032	0.028
	Monitor#4	0.092	0.038	0.034	0.027	0.026	0.024

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:\NESUG\BasicRep.html";
Proc report data=meanla NOWD
HEADLINE HEADSKIP
                                SPLIT='/'
LS=134;
    COLUMN region station
(MAX), ozone_max month,
ozone_mean season_mean;
.... more statements
    BREAK AFTER Region /OL
SKIP;
    RUN;
QUIT;
ODS HTML close;
ods listing;
```

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

Ozone Region	Monitor ID	Max Ozone	Mean Ozone Value (ppm)							Season Mean
			Apr	May	Jun	Jul	Aug	Sep	Oct	
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

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:

Ozone Region	Monitor ID	Max Ozone	Mean Ozone Value (ppm)							Season Mean
			Apr	May	Jun	Jul	Aug	Sep	Oct	
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 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\nesug';
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 web browser window with a frame. On the left side of the frame, there is a 'Contents File' section with a 'Table of Contents' and a 'Table of Pages' section. On the right side, there is a 'Page File' section displaying a table titled 'Monthly Average Ozone Measurements: Year 2001'. The table has columns for 'Ozone Region', 'Monitor ID', and monthly mean ozone values (Max, Apr, May, Jun, Jul, Aug, Sep, Oct) and a 'Sea Me' column. The table data is as follows:

		_Mean Ozone Value (ppm)_								
		Max	Apr	May	Jun	Jul	Aug	Sep	Oct	Sea Me
Ozone Region	Monitor ID									
Region1	Monitor1	0.091	0.084	0.045	0.042	0.042	0.049	0.044	0.035	C
	Monitor2	0.108	0.047	0.050	0.040	0.043	0.042	0.039	0.030	C
	Monitor3	0.092	0.089	0.041	0.082	0.082	0.029	0.028	0.025	C
Region4	Monitor4	0.082	0.088	0.034	0.027	0.028	0.024	0.023	0.023	C
	Monitor5	0.122	0.029	0.025	0.025	0.037	0.029	0.018	0.009	C

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.

Procedure Name: Maximum Ozone Measurements: Year 2001

Ozone Region	Monitor ID	_Mean Ozone Value (ppm)_								
		Max Ozone	Apr	May	Jun	Jul	Aug	Sep	Oct	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
	Monitor#2	0.089	0.017	0.020	0.022	0.025	0.025	0.018	0.010	0.031

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:

```

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

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
Region2	Monitor#1	0.122
	Monitor#2	0.089

Address: C:\allworksk\NESUG\demo\_body2.html

**Average Monthly Ozone Measurements: Year 2001**

Ozone Region	Monitor ID	_Mea	
		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
Region2	Monitor#1	0.026	0.025
	Monitor#2	0.017	0.020

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:

```

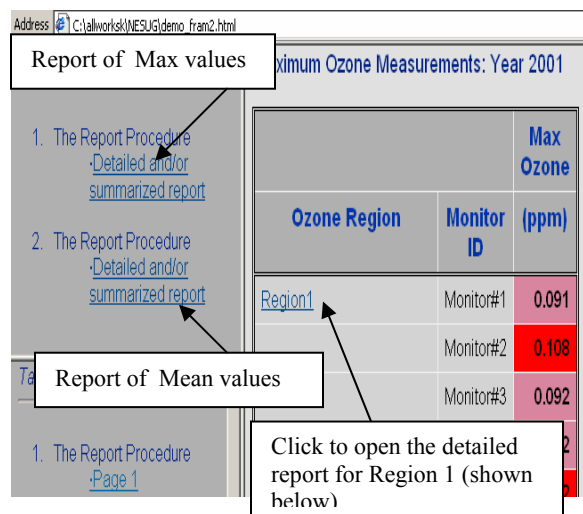
COMPUTE BEFORE region;
      Region_number +1;
ENDCOMP;
COMPUTE region;
Link_region="demo_body3.html#region" || left(put(region_number,
3.0));
CALL DEFINE
(_col_,'url',Link_region);
ENDCOMP;
    
```

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:

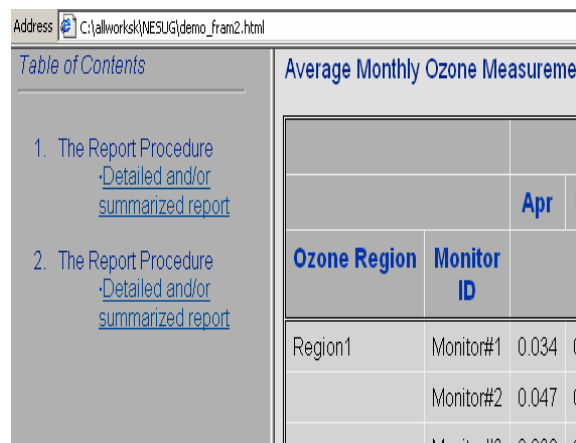
```

ODS HTML PATH=ODSOUT
FILE="demo_body3.html"
ANCHOR= "region1";
PROC REPORT DATA=mean1a
... 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:



Here is the output if you click on the link for Region1 on first screen:



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.

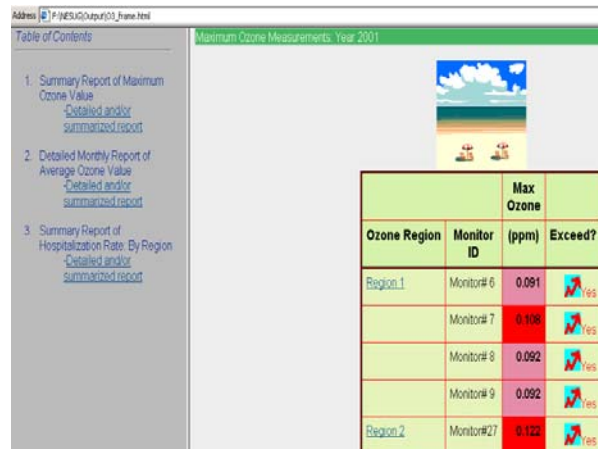


Table of Contents

- Summary Report of Maximum Ozone Value  
Detailed and/or summarized report
- Detailed Monthly Report of Average Ozone Value  
Detailed and/or summarized report
- Summary Report of Hospitalization Rate: By Region  
Detailed and/or summarized report

Average Monthly Ozone Measurements: Year 2001

Ozone Advisory Region: Region 7  
Year: 2001

		Mean Ozone Value (ppm)							
		Apr	May	Jun	Jul	Aug	Sep	Oct	
Ozone Region	Monitor ID								
Region 7	Monitor# 4	0.036	0.041	0.035	0.036	0.037	0.030	0.02	
	Monitor#16	0.031	0.036	0.033	0.033	0.033	0.028	0.01	
	Monitor#17	0.036	0.039	0.036	0.036	0.036	0.029	0.02	
	Monitor#22	0.042	0.046	0.039	0.040	0.041	0.039	0.02	

Measurements are in ppm. Data Source: Table Data

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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