

Charting Your Path to Using the “New” SAS® ODS and SG Graphics Successfully While Interactively Generating the Code

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ABSTRACT

SAS® Output Delivery System (ODS) Graphics started appearing in SAS® 9.2. Collectively these new tools were referred to as “ODS Graphics,” “SG Graphics” and “Statistical Graphics”. When first starting to use these tools, the traditional SAS/GRAPH® software user might come upon some very significant challenges in learning the new way to do things. This is further complicated by the lack of simple demonstrations of capabilities. Most graphs in training materials and publications are rather complicated graphs that, while useful, are not good teaching examples for starting purposes. This paper contains many examples of very simple ways to get very simple things accomplished. Many different graphs are developed using only a few lines of code each, using data from the SASHELP data sets. The use of the SGPLOT, SGPANEL, and SGSCATTER procedures are shown. In addition, the paper addresses those situations in which the user must alternatively use a combination of the TEMPLATE and SGRENDER procedures to accomplish the task at hand. Most importantly, the use of the “ODS Graphics Designer” as a teaching tool and a generator of sample graphs and code are covered. This tool makes use of the TEMPLATE and SGRENDER Procedures, generating Graphics Template Language (GTL) code. Users get extremely productive fast. A much more recent development of a learning tool has been the release of the SAS Studio interactive environment where SAS is executed through an internet browser. Code is generated in a somewhat similar manner working strictly with Proc SGPlot. There are also provisions in SAS Studio to optionally install ODS Graphics Designer in the individual machine installation. The emphasis in this paper is the simplicity of the learning process. Users will be able to take the generated code and run it immediately on their personal machines and use the code as a learning mechanism.

INTRODUCTION

This paper is oriented to users of the original SAS/Graph software (now included in the base product, formerly marketed as a separate product) who are now wanting to move into SAS ODS Graphics (also referred to as SG graphics). The original intention of this paper was to present a number of sample graphs with the “SG” procedures. This has been expanded to include the “Proc Template/Proc SGrrender approach”, and ODS Graphics Designer. There is an introduction to the routing of output with the “ODS sandwich” and an example of outputting to multiple frame HTML files. The original paper from which this presentation was abstracted is much wider in scope and published at <http://www.mwsug.org/proceedings/2015/DV/MWSUG-2015-DV-05.pdf>. It was entitled: “Getting Productive Fast in SAS® ODS Graphics – a Simple Look–See Approach. This paper extracts and expands the discussion addressing the ODS Graphics Designer as a self-teaching tool. The electronic poster accompanying this paper is on YouTube (Google search for “SAS Video Playlists by Roger Muller” without the quotes for a dynamic video displaying of the ODS Graphics Designer. Videos are also posted at Vimeo (www.vimeo.com)). Search for “Trinomium” in their search facility.

SAS has long supported an interactive relatively simple code environment called the Display Manager. In Microsoft Windows environments, SAS developed a more powerful code development and systems development tool called SAS Enterprise Guide. Both of these will be used to show the use of the ODS Graphics Designer. More recently, SAS has released a third environment called SAS Studio which makes use of an internet browser to interact with SAS. This environment has a “Task” tool which allows for the development in a similar, although more limited, manner for Proc SGPlot. In addition, there are options to install the ODS Graphics Designer tool for use in SAS Studio, single machine edition.

Please be aware that this paper summarizes the options available in the latest releases of SAS during 2015 – 2016 that the author has worked with. There are many additional features added as both major

and maintenance releases take place. Always look carefully at the “what’s new” documentation on assorted SAS websites.

WHAT IS THE “BOTTOM LINE” ON THIS PAPER?

This paper addresses learning only a portion of the components of ODS Graphics. The approach allows you to get productive fast and while doing this learn to understand the coding required to successfully use the “Proc Template/Proc SGRRender” portion of the software. Briefly the steps are:

1. Locate ODS Graphics Designer in your interactive environment and launch it.
2. Pick a graph type from the menu presented that more-or-less represents what you want.
3. Fill in the fields presented with variable names etc. using sashelp datasets such as sashelp.class, sashelp.cars.
4. Look at the graph presented, repeat steps 2, 3 and 4 until you get the graphic you wish. You may not get 100% of the way there and will have to do some “hand-coding” to finish as indicated in the next step.
5. Then view the code that SAS generated to develop this graph. Study it, copy it, modify it in an editor, etc. You are now well on your way to learning the “Proc Template/Proc SGRRender” part of ODS Graphics.
6. Now start exploring options to learn procedures such as SGPlot, SGScatter and SGPanel. You will for the most part have to use standard code-learning techniques to master these Procs – classes, reading, modifying someone other programmer’s code.
7. Above all else, try to get reasonably productive fast. Do not get frustrated by the fast number of options and approaches available. Be Successful!

I. WHERE TO START?

What a question when starting to code ODS Graphics! The beginning user can get frustrated with all of the options available and may very easily go down a path that may not get them where they want as fast as they want. First, there are many different SAS graphics offerings. The diagram in **Error! Reference source not found.** summarizes SAS graphic offerings (with some liberties taken for brevity).

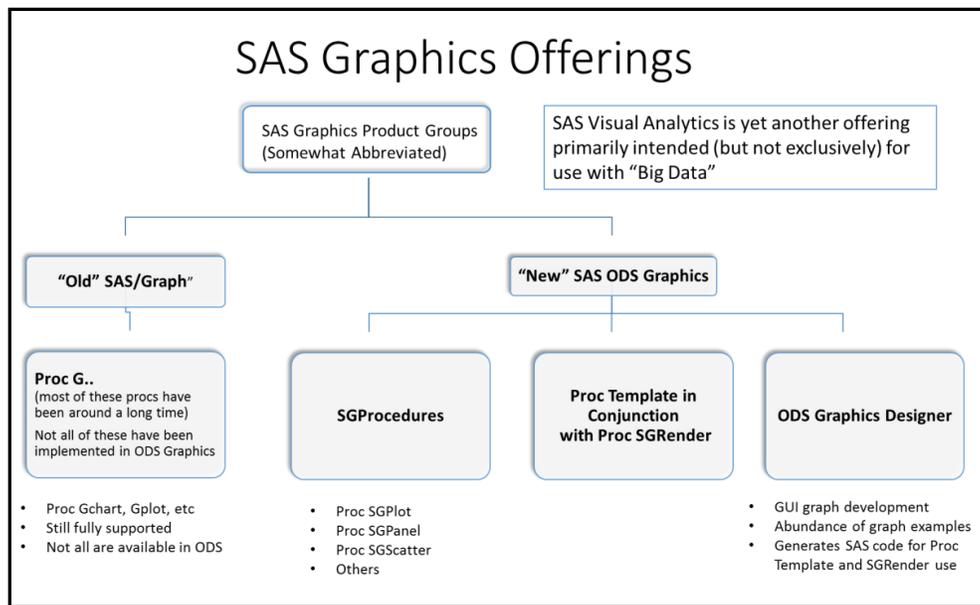


Figure 1 Abbreviated Diagram of SAS Offerings for Graphic Development.

Several points need to be made before we start:

- The ODS Graphics Designer is clearly the easiest way to teach yourself the code needed to generate many, but not all, ODS graphics FAST. We are not extensively covering the ODS Graphics Designer in this written paper since it is so dynamic in nature. Rather, it will be shown in the electronic poster and accompanying video segments on YouTube as it is highly interactive. It is awful easy for serious SAS programmers to casually overlook this tool. You've heard it before: "real programmers write code, they don't drag-and-drop". The ODS Graphics Designer is best described as point-and-choose software (GUI – Graphical User Interface) that is highly interactive and can make graphics in SAS Enterprise Guide environment and in PC SAS. It does generate SAS code in addition to producing the graphics.
- ODS Graphics Designer is often used by occasional users who do not want to get into extensive programming. The Graphics Designer can be used to generate graphic template code that can be copied and pasted in the SAS environments (PC, EG, batch), and will greatly speed up the development process when learning the new procedures.
- ODS Graphics Designer is available in SAS Enterprise Guide, SAS Display Manager in interactive PC SAS. Similar functionality is now available for optional installation in SAS Studio. SAS Studio also generates code for Proc Sgplot in a section entitled "Tasks and Utilities", "Tasks", "Graph". This will be discussed briefly. Hopefully similar capabilities will be added to the DM and EG (Display Manager and Enterprise Guide) in PC SAS for Windows in future editions.
- **ODS Graphics Designer can most definitely be used as the "Training Program for Learning How to Code SAS ODS Graphics"**. Bear in mind that this does not cover the "SG procedures, but rather covers the use of Proc Template in combination with Proc SGRender. It will often get you 90% of the way there in 10% of the time. That is not a bad tradeoff. Bottom line: ***START HERE!*** Look at the YouTube videos. In Google, search for "SAS Video Playlists by Roger Muller" without the quotes. Also look for "Trinomium" in Vimeo at www.vimeo.com. Furthermore, there is a 320-page book on the ODS Graphics Designer (see Additional Reading reference at end of the paper). **GET THE BOOK AND/OR THE DOWNLOADABLE PDF!**
- We are not addressing the assorted SAS ODS graphics that are produced as supplementary output by numerous SAS statistical procedures. These are usually documented with the procedures. They are too numerous to list here.
- The "SG" procedures (SGPLOT, SGPANEL, and SGSCATTER) collectively referred to as "the SG procedures" are addressed in this paper.
- Another major point of emphasis is the combined use of Proc Template to create "skeleton template" files for graphic development with Proc SGRender. The stored templates are merged against SAS datasets to develop graphics with Proc SGRender. We are not discussing this feature. For more information, do a Google search for "SGD" files or ".SGD". In some environments, this could be a very powerful feature for letting user who know nothing about programming run routine graphs at their won discretion.
- The use of SAS/Graph, the original SAS graphics development tool, is not the subject of this presentation. SAS/Graph is still fully supported and may occasionally be preferred or the only means of accomplishing certain graphics development projects.
- SAS Visual Analytics is yet another SAS offering that will not be covered here. It is primarily marketed for use with "Big Data" and is not really used much by users of the traditional SAS/Graph product. This could change as there are pricing options that would allow for its use in environments that are less than "big data".
-

II. SOURCES OF INFORMATION ON ODS GRAPHICS

There are many sources of information on the “new” SAS graphics. So many in fact, that it can be overwhelming. The use of internet search engines such as Google will return so many links that it can be counterproductive to achieving a quick fast start. If you are fortunate enough to have source code from previous programs developed by other competent programmers that you can modify, this will obviously get you off to a good start. There are classes available. The problem with classes is that they may not necessarily be well synchronized with the software availability at your institution and the timing of the projects you are working on. While the SAS user’s and procedures manuals are available on line, the somewhat condensed version available in html form is not always helpful. The full PDF versions of the manual are on line, but can be unwieldy to use because of their sheer size.

SAS MANUALS

I have found that the following manuals purchased as book editions are very useful. They are not necessarily long on examples, but they do contain in-depth information on the numerous programming options (complete information in the Additional Reading section at the end of this paper):

- SAS 9.4 ODS Graphics Procedures Guide 4th edition, 2013. Total pages is 959. There are 361 pages on Proc SGPlot, 291 pages on Proc SGPanel. These procs are heavily used. This has been superseded by the 5th edition.
- SAS 9.4 ODS Graphics Procedures Guide 5th edition, September, 2015. See special section near the end of this paper regarding use of this document including downloading and using a PDF version. Expanded to 1624 pages.
- SAS 9.4 Graph Template Language User’s Guide, Third Edition, 2014. Total pages is 633. This book covers many uses of Proc Template for creating templates that are then rendered to SAS ODS graphics with Proc SGRender. This method of operation is preferred by many users as their requirements and skills grow and advance.
- SAS 9.4 Output Delivery System User’s Guide, Third Edition, 2013. 1,130 pages. While much broader in scope than just ODS graphics, this manual addresses many issues in handling and understanding ODS (Output Delivery System) usage that programmers will eventually need.
- SAS 9.4 Graphics Designer User’s Guide, Third Edition, 2013. 340 pages. Users will find this a very thorough coverage of the capabilities of the ODS Graphics Designer. At a minimum, download the pdf. Why are we not giving examples of these capabilities in the paper? This book already does it.

SAS BLOGS

The following blog by the graphics team from SAS most frequently speaking at meetings contains many examples of using ODS Graphics. It is updated frequently:

<http://blogs.sas.com/content/graphicallyspeaking/>

III. SOME QUESTIONS TO ANSWER BEFORE YOU START

- What version of SAS do you have? If you are creating a graphics system for widespread use, what version will eventual users of the system have access to? SAS ODS graphics started with version 9.2. If you are earlier than that, you must use the original SAS/Graph software. There has been a continual stream of enhancements ODS graphics as SAS releases have moved to the current releases of 9.4. This paper was written with a system that had SAS 9.4 M3 installed. If you do not have the latest releases, you may be missing significant ODS graphics capabilities.

From the author's viewpoint, you really should at a minimum be in version 9.3 or higher to really gain the benefit of this software.

- What is my operating environment? Likewise, what is the environment of the eventual users?
 - PC, with or without Enterprise Guide?
 - Unix (or some other remote batch facility)?
 - Mainframe?
- What is the desired output and where does it get placed?
 - To a graphics file?
 - Just to a screen?
 - Inside a document such as an html page, a Microsoft Word RTF file, or an Adobe Acrobat PDF?
- Do you like to use Graphical User Interfaces or do you want to hardcode programs with an editor?
- Is this a "one-time deal" for creating graphics for a one-person project? Or is this a system to be used by others over an extended period?

This paper does not address all of these issues. It is intended to get a single SAS programmer rapidly developing graphics using the ODS Graphics Designer.

IV. THE ODS GRAPHICS DESIGNER AS A CODE TRAINER AND "PROTOTYPER"

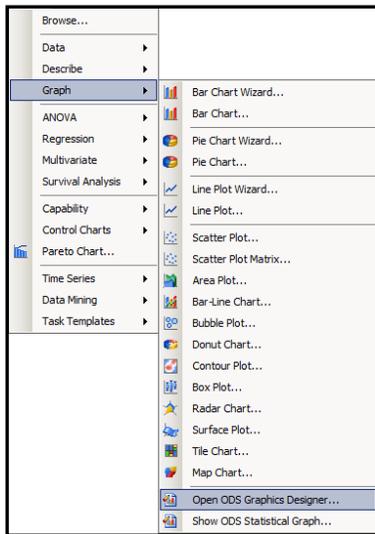
Do yourself a big favor and forget any preconceived notions about the use of GUI tools with their drag-and-drop features. Use ODS Graphics Designer as your initial code prototype tool and your personal trainer. There is no better set of examples of potential SAS ODS Graphs that can be generated here. While it does take the approach of developing underlying code using Proc Template with Proc SGRRender, it will also benefit users of SGPlot, SGPanel and SGScatter as there are lots of similarities in the code developed. The code used in Proc Template to produce graphics is called "GTL – the Graphics Template Language.

V. GETTING ODS GRAPHICS DESIGNER STARTED.

This depends a little bit on your environment. It should be installed as the ODS graphics software has been included with the Base SAS installation since version 9.3.

"DESIGNER" LOCATION IN ENTERPRISE GUIDE.

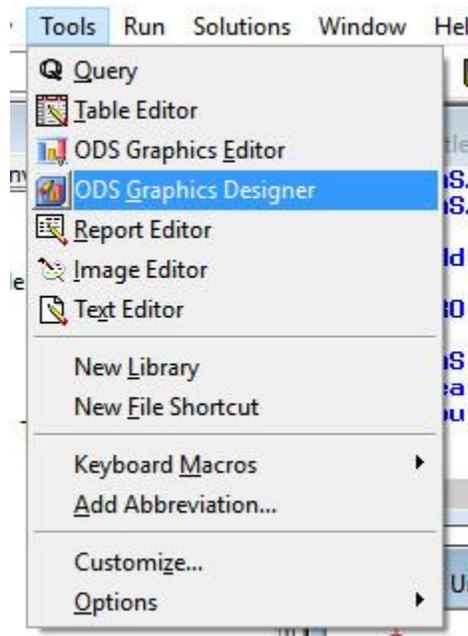
In SAS Enterprise Guide 7.1, ODS Graphics Designer is somewhat hidden. From the Enterprise Guide menu bar select “Tasks” and proceed to select “Graph”. Then select “Open ODS Graphics Designer” as shown in the figure to the left and it will open into the “Graph Gallery” window. Find a sample that more-or-less matches what you want to do.



An Important Note: When pulling down the menu “Tasks” – “Graphics” in SAS Enterprise Guide, many other graphics options are available besides “Open ODS Graphics Designer”. These are for generating graphs and SAS code with the older SAS/Graph product. This is not SAS ODS graphics. These procedures are fully supported by SAS Institute.” Do not hesitate to use them (the older procedures). These assorted icons are designed to be dragged into the Process Flow diagrams of SAS Enterprise Guide. **For assistance in doing this see the papers or video by Muller, 2013.**

“DESIGNER” LOCATION IN THE DISPLAY MANAGER OF PC SAS.

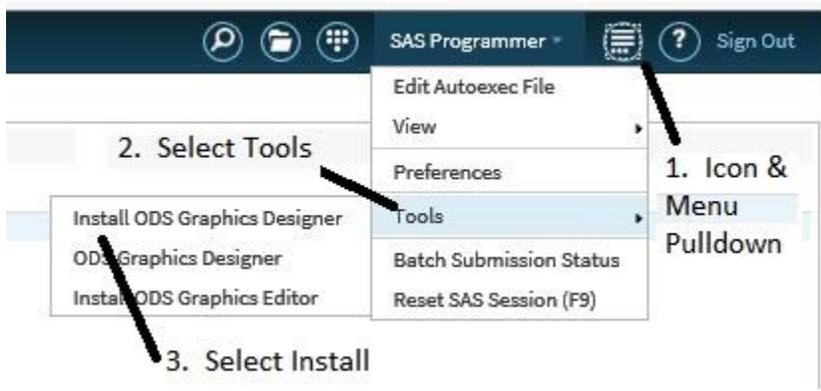
In “plain old interactive Windows PC SAS”, the display manager is located under the Tools Tab.



DESIGNER LOCATION IN SAS STUDIO

The ODS Graphics Designer is installed separately in SAS Studio – Individual Machine User Only. In most likelihood it was not installed in your setup. The following figures show with icons/menus to install

and start Designer once installed. The nondescript icon in version 3.5 is located near the top right of the browser as shown in the following figure. Select the icon, then Tools, then Install ODS Graphics Designer for installation and ODS Graphics Designer for use. Remember this is available at the current time only on the individual machine version of SAS Studio.



VI. WORKFLOW FOR ODS GRAPHICS DESIGNER

The following figure shows the workflow for ODS Graphics Designer, regardless of the interactive SAS environment (DM, EG, or Studio). Much more could be written here about all of the options available. The book "SAS 9.4 ODS Graphics Designer User' Guide", 3rd edition does an excellent job of covering these so they will not be discussed here. The purpose of this paper is to steer you to that resource.

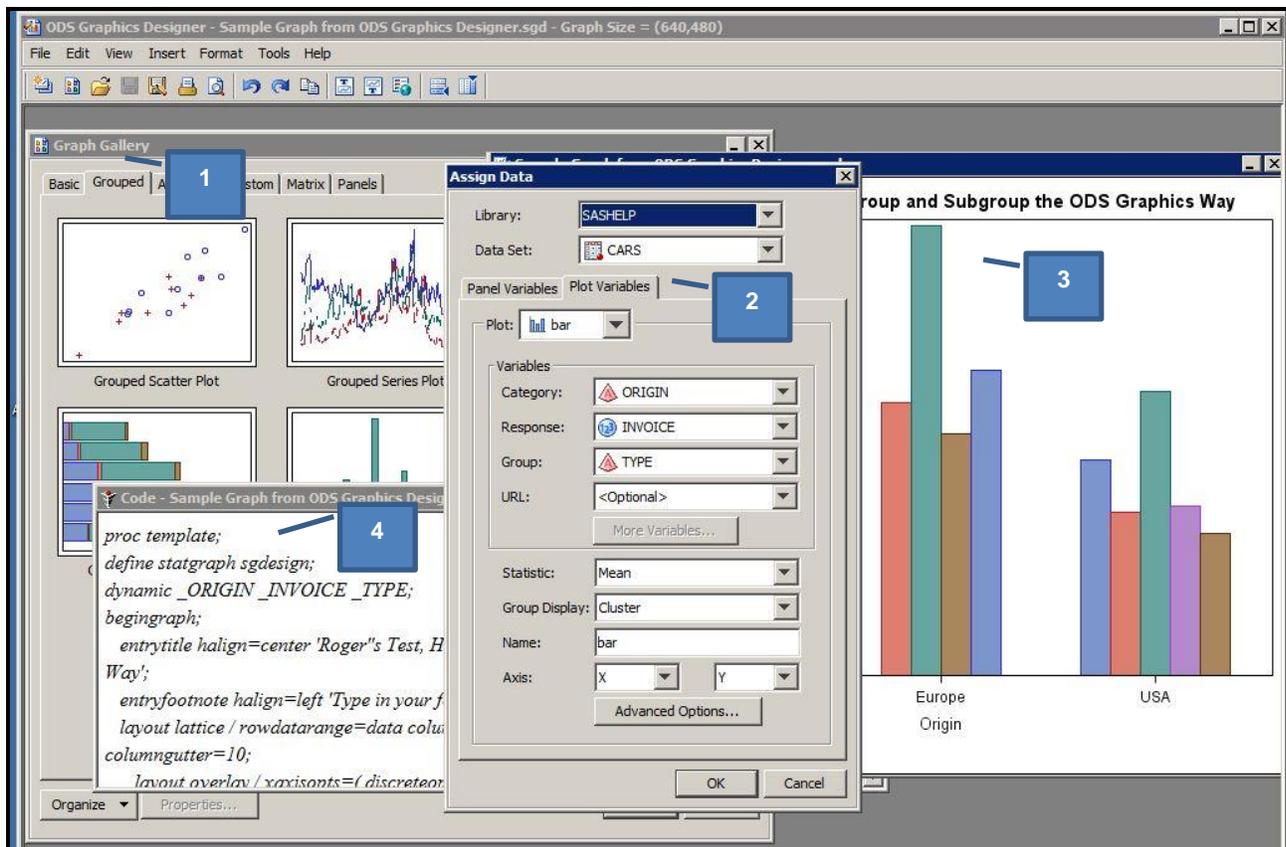


Figure 2. The Workflow for Designer, A Consolidation of Four Screens.

In the figure above, 4 windows are overlapped for simplicity of discussion. In the Graph Gallery of samples (1), a “Cluster Grouped Vertical Bar” was selected. The “filled-in” data panel is partially shown (2) and the graph as currently specified is shown at the right (3). Most importantly, from the Menu at the top of the screen “View” – “Code” was selected and the SAS code to do this graph via Proc Template and Proc SGRender is shown in the code window (4).

Author’s personal opinion: I am repeating a position stated earlier. This tool is the best training tool out there to learn what SAS code it takes to accomplish programming in SAS “SG” graphics as far as the Graphics Template Language is concerned. Remember that the is “ the Proc Template with Proc SGRender” approach. The only somewhat self-generating code facility for the “SG procs” like Proc SGPlot is just now appearing in some version of SAS studio. This is “do-it-yourself” training and “do-it-yourself” example building via the “look-see” approach for GTL. **Start Here!**

VII. THE “SG” PROCEDURES VS. THE COMBINATION OF PROC TEMPLATE AND PROC SGRENDER VS ODS GRAPHICS DESIGNER

As you work through assorted ODS Graphics publications, you will find three procedures which address most frequently for creating graphics:

1. Proc SGPlot will have the most examples as it is the proc most often used and the one for which you will find the most examples published..

2. Proc SGPanel can do most of the graphics that are done in SGPlot, but also provides an interesting “panelby” option to place multiple graphics into a lattice grid.
3. Proc SG Scatter is used to develop scatter plots of data points. Again, there are usually multiple graphs within one figure.
4. Numerous references have been made earlier to the combined use of Proc Template and Proc SGrender. This is the basis of the ODS Graphics Designer. It has been suggested to start with the ODS Graphics Designer and use that code to learn ODS graphics techniques and programming. A lot of the coding that was developed there is similar to Proc SGPLOT, SGPanel and SGScatter.
5. And lastly, remember you can program GTL for Proc Template “from Scratch”.

Are there overlaps in the functionality of these proc’s and approaches? Yes.

Start with ODS Graphics Designer to train yourself.

IF you wish to do standalone coding, move one to with SGPlot and then to Proc SGPanel, and Proc SGScatter.

If the 3 “SG” procs don’t get the job done, then where do you go? Back to Proc Template. Nearly all of the functionality of the “SG” procs and MORE is available. The Graphics Template Language (GTL) is robust.

VIII. BEFORE GETTING STARTED, REVIEW A DISCUSSION ON THE ODS STATEMENTS THAT “WRAP THE GRAPHICS CODE” – “THE ODS SANDWICH”

There is a wrapper around the graphics code that is developed. This wrapper usually contains a statement on some specific graphics options and then some code concerning the routing of output. There may more.

Typical order (very primitive and simplified):

```
ODS graphics on;
ODS HTML ...etc.    ;
Lots of graphics code (Proc SG..whatever);
ODS HTML close;
```

The following are a few comments on just a few of these statements and the wrapper. See Muller 2015 for more complete details.

<code>ODS Graphics On /Reset;</code>	Turns on ODS graphics (or Off if desired). Reset will set other options to default
<code>ODS Graphics On /imagemap</code>	Enables display of data tips in HTML graphics. These are not displayed in other output destinations such as PDF, RTF, etc. Data tips are mouse overs that display underlying data values and more (see intense HTML example).
<code>ODS Graphics Height=3in width=3in;</code>	Set graphics size.
<code>ODS Graphics imagefmt=jpeg ; /* png bmp etc (15 are available)*/</code>	Set format for image to be produced. If that format is not compatible with the current active output destination, this will be ignored and the default for destination will be used

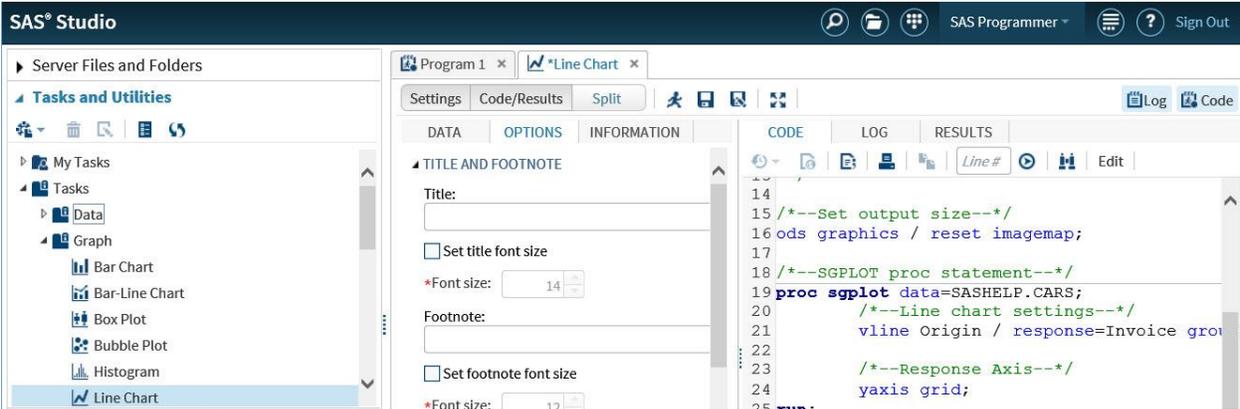
<pre>ODS Graphics /* any or all of 25 plus settings -*/</pre>	<p>Control a wide variety of graphics options too numerous to list here. See ODS Graphics Statement (abbreviated), ODS Graphics Statement (more complete documentation)</p>
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IX. AN EXCITING DEVELOPMENT -- THE “NEW KID ON THE BLOCK” – A CODE GENERATOR IN SAS STUDIO WILL GENERATE PROC SGPLOT CODE.

SAS recently released SAS Studio, a product that allows programmers to work interactively in an internet browser window. There are many different configurations available ranging from the free “University Edition” for educational use up to full blown enterprise editions. Remember the university edition is for noncommercial use. As mentioned earlier, there is a provision to add ODS Graphics Designer to this environment, but on only one of the versions – that being the individual machine installation of SAS Studio

However, in addition to this, there is a facility in the GUI interface under “Tasks and Utilities” that generates code for Proc SGPlot. This facility is not nearly as extensive as the code development tools in “ODS Graphics Designer”, but does serve as a nice launchpad for developing Proc SGPlot Code, something ODS Graphics Designer does not do. In the following figure, working from left to right:

1. In the left most pane, “Tasks and Utilities” is selected, then “Tasks”, then “Graph”, then a small icon with “Line Chart”.
2. In the middle pane, appropriate “fill in the blank” fields appear for the data, role assignments, titles, etc.
3. In the right pane in the Code tab, the code is displayed. The code can be run, the graph viewed, modified, saved etc.



The code development tool is the only one currently available for Proc SGPlot. It does give a faster start to graphics development than starting with learning to write code from scratch. Hopefully with time a more robust tool like that available for that “Proc Template, Proc SGRender” approach provided by ODS Graphics Designer will become available. And – hopefully this will find its way to the DM and EG environments.

X. BOOKS ON THE ODS GRAPHICS DESIGNER

A User’s Guide is published both in HTML and PDF formats for version 9.4. These are in their 3rd edition in 2016. At 320 pages in the PDF version, this is a very substantial publication

Recent development. A new book has been released that is filled with examples of the what can be done with ODS Graphics Designer and some of the more complicated graphics. The approach to this book is to show the designer input screens and the resultant graphics with no emphasis on the behind the scenes SAS code that is generated, This code is off course available to you should you choose to run the Designer panels and then select to view the code. This book will save countless hours in preparing more advanced “out-of-the-ordinary” graphics and before you have learned all of the nuances associated the the programming statement

Matange, Sanjay and Jeanette Bottitta, 2017. [SAS® ODS Graphics Designer by Example: A Visual Guide to Creating Graphs Interactively](#), Cary NC. SAS Press

The URL locations for these documents are listed in the “Further Reading” section at the end of these papers. It is suggested that you also run Google searches for these documents as updates may be available.

XI. A NOTE ON THE ODS GRAPHICS DEVELOPMENT USER’S GUIDE AND A SPECIAL NOTE ON THE 5TH EDITION OF THE SAS ODS GRAPHICS PROCEDURES GUIDE

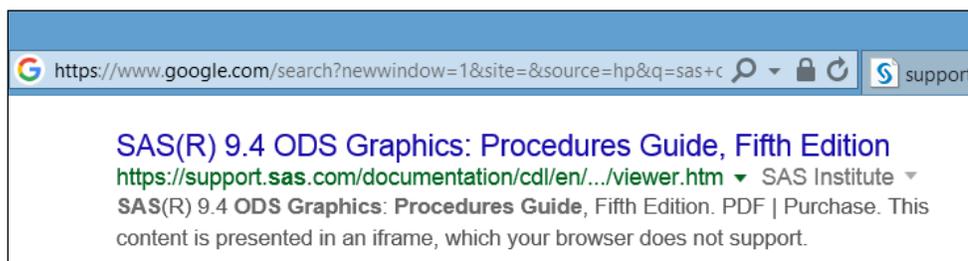
The hard links for these documents at the time of publication of this paper are located in the “Further Reading section at the end of this document. At the end of 2015, the 5th edition of this book was released. Content was increased by a whopping 60%. When search engines such as Google are crawled on this book, only the on-line html versions are returned in the search engine (perhaps this will change over time). I find the contents of this HTML approach to often be somewhat abridged. I would suggest using the Google search engine to search for the updates of these books. Search for both HTML and PDF versions.

The better methodology to use these publications is to (1) buy the printed version of the book, and (2) download the free PDF version of the book to your local machine and used Adobe Acrobat Reader. The PDF version of the book is encrypted and search crawlers are not allowed access to the metadata. Without this, there are no results returned to Google and other engines!

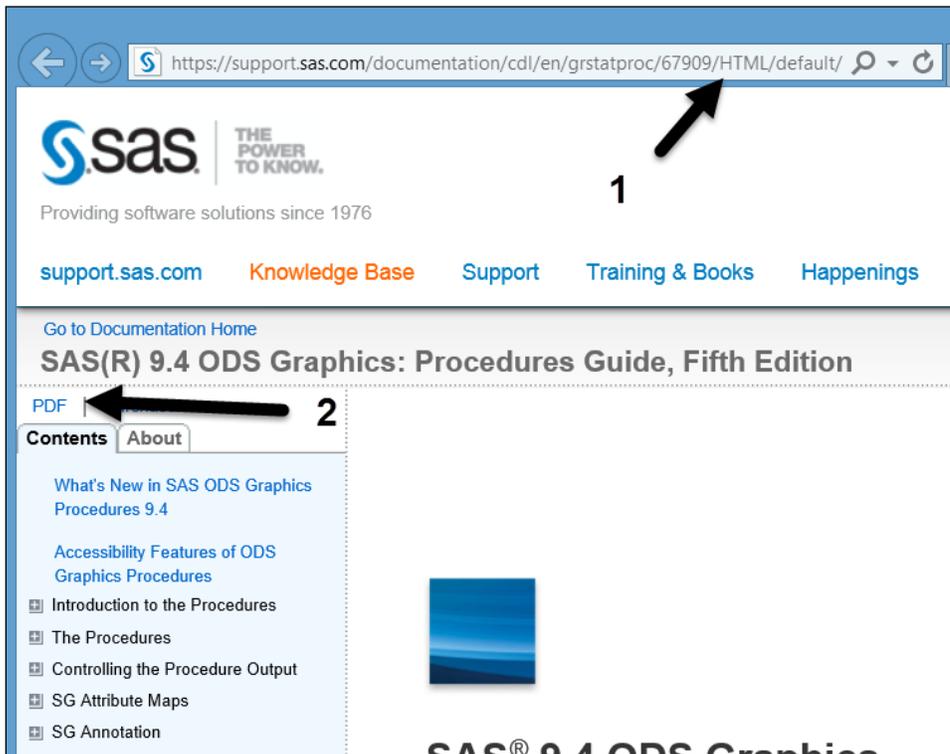
Steps to find, download, save, search and comment with Acrobat Reader are shown in the following figures. Note: Extensive as this book is, it contains only minimal reference to the use of ODS Graphics Designer and the use of Proc Template with Proc SGRend as techniques for graphics development with SAS. These are in other separate books.

To work with this manual in PDF form:

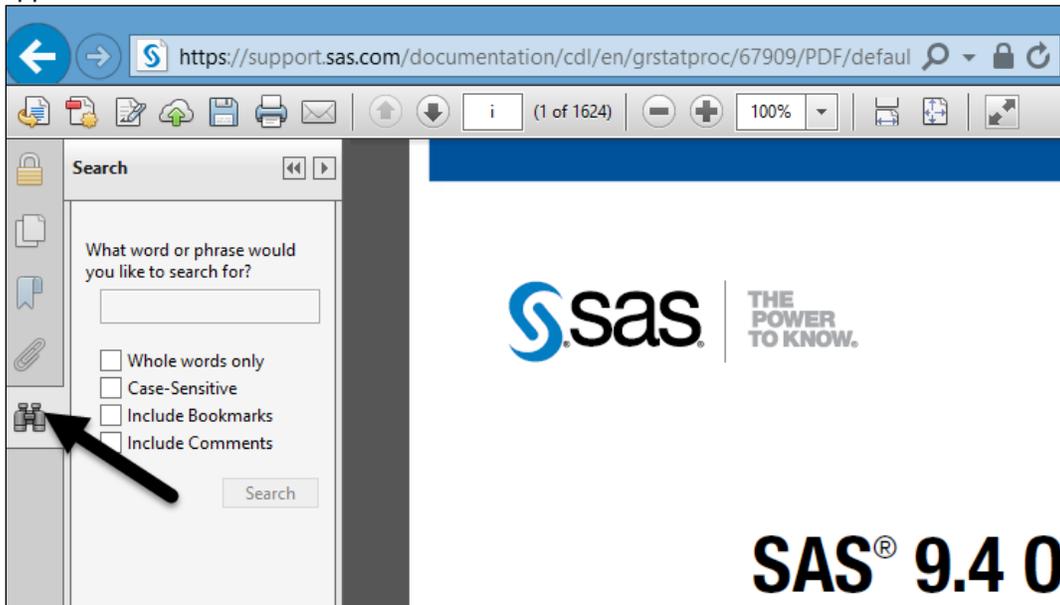
1. Search for the guide in Google, only the HTML version is crawled.



2. Open the returned HTML reference (Arrow 1) and look at the top left corner for the “PDF” link (Arrow 2).

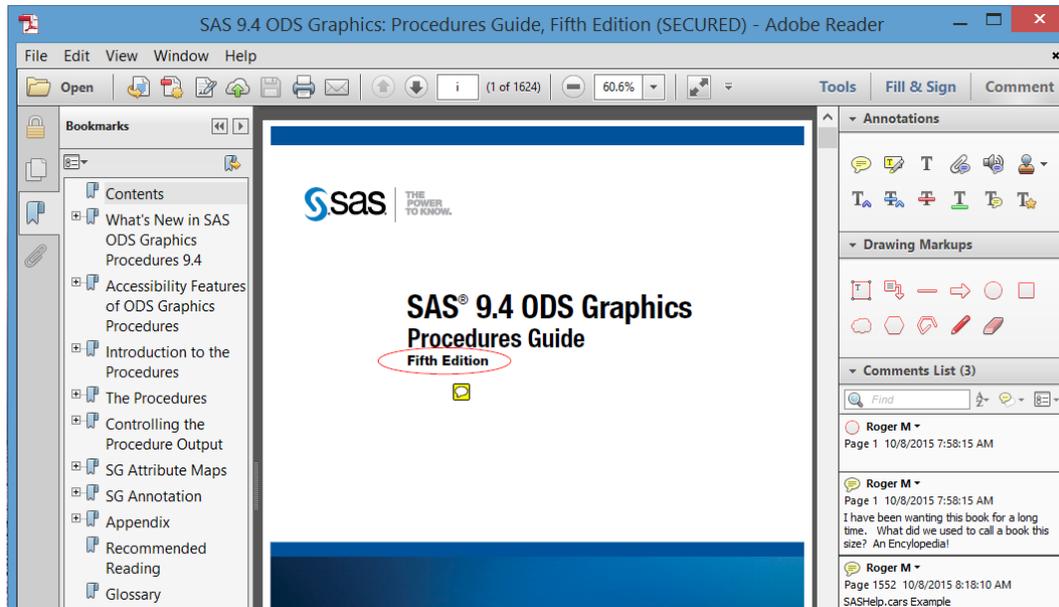


3. Open the PDF link. Depending on your browser and how it has been configured by you or your enterprise technicians, some sort of reader will open displaying the document. You may even have some sort of search capability within the document as indicated in this configuration which appears to be a modification of the Adobe Acrobat Reader.



These readers and their configurations which may have their place in certain documents and configurations, can be extremely limited and downright irritating. Download the “real” Adobe Acrobat Reader.

4. Save the PDF document to your local hard drive. Remember that you do not have write access to the document when viewing the web version. Yes, SAS allows you to save the PDF to your hard drive and write notes and more in it.
5. Open with the “Real” Adobe Acrobat Reader. Note the bookmarks, the comments that you can insert, the hilighting tools, etc. Installation may vary from site to site and with different version of the Adobe Reader. For some reason, “find” does not have an icon, but rather is opened from the Menu with “Edit – Find” or with Ctrl-F. An advanced search is available with “Shift + Ctrl + F”. Your comments, highlights and more are written to the file residing on your hard drive. You can modify the reader to have a find icon.



For more information on using Adobe Acrobat Reader, the use of Adobe search techniques within the document and the insertion of comments, see Muller and Horstman, 2010.

<http://www.mwsug.org/proceedings/2010/resources/MWSUG-2010-120.pdf>

XII. CONCLUSION AND MORE

Getting off to a good start using SAS ODS Graphics is challenging. The use of the ODS Graphics Designer with its GUI interface will write creative SAS code that will help meet initial needs and will steer you in the right direction.

ACKNOWLEDGEMENTS

The author would like to thank the following individuals for their efforts: (1) All of the behind the scenes programmers at SAS Institute who do a great job bringing these tools forward. (2) Mr. Chris Hemedinger, Mr. Dan Heath, Mr. Warren Kuhfeld, and Mr. Sanjay Matange for the publishing and speaking efforts at meetings, in blogs and in assorted publications to help get users motivated and going in the right direction with new technologies. (3) The outstanding technical support given to users at SAS Institute This paper would not have happened without the guidance from Mr. Martin Mincey and Ms. Lelia McConnell in navigating through issues. (4) All of the volunteers associated with various SAS user groups who make these meetings and publications possible. Having only been distantly involved with the process, there are many hours of time given freely to do this and they are to be admired. They all have real jobs and personal lives to tend to besides this effort.

ADDITIONAL READING

The following are links to books that contain ODS Graphics documentation and examples:

- http://www.sas.com/store/books/categories/examples/statistical-graphics-procedures-by-example-effective-graphs-using-sas-/prodBK_63855_en.html
- http://www.sas.com/store/books/categories/getting-started/statistical-graphics-in-sas-an-introduction-to-the-graph-template-language-and-the-statistical-graphics-procedures/prodBK_63120_en.html
- http://www.sas.com/store/books/categories/getting-started/getting-started-with-the-graph-template-language-in-sas-examples-tips-and-techniques-for-creating-custom-graphs/prodBK_66550_en.html
- SAS 9.4 ODS Graphics Designer: User's Guide, 3rd edition, HTML
<http://support.sas.com/documentation/cdl/en/grstatdesignug/68403/HTML/default/viewer.htm#n10ak7fhfm8q6n121080pt0rp0n.htm>
- SAS 9.4 ODS Graphics Designer User's Guide, 3rd edition, PDF
<http://support.sas.com/documentation/cdl/en/grstatdesignug/68403/PDF/default/grstatdesignug.pdf>
- SAS 9.4 ODS Graphics Procedures Guide, 5th edition, HTML.
<https://support.sas.com/documentation/cdl/en/grstatproc/67909/HTML/default/viewer.htm#titlepage.htm>
- SAS 9.4 ODS Graphics Procedures Guide, 5th edition, PDF.
<https://support.sas.com/documentation/cdl/en/grstatproc/67909/PDF/default/grstatproc.pdf>

Another good resource for examples include:

- <http://support.sas.com/sassamples/graphgallery/index.html>
- <http://support.sas.com/rnd/datavisualization/index.htm>
- <http://blogs.sas.com/content/graphicallspeaking/>

Attributes and style:

- <http://support.sas.com/documentation/cdl/en/grstatproc/67909/HTML/default/viewer.htm#n02bywwj20lezn15x30wucq9pn8.htm>

Videos:

- [Vimeo.com](https://www.vimeo.com) Search for "Trinomial" for current videos.
- [Youtube.com](https://www.youtube.com) "Search for "SAS Video Playlists by Roger Muller" without the quotes

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