Producing Maps with SAS® Enterprise Guide®
Harmon Jolley, Chattanooga, TN

ABSTRACT
A variety of maps can be created using SAS/GRAPH® programs. However, writing SAS® programs to create these maps may not be in your repertoire, or you may just prefer to use your workstation's mouse whenever possible. This paper illustrates a point-and-click, process flow approach to producing maps using SAS Enterprise Guide®.

INTRODUCTION
SAS Enterprise Guide allows the user to build a process flow to produce results.

Within SAS Enterprise Guide are various pull-down menus and wizards that allow the user to build a process flow. One can still write SAS programs and save them as Code objects.

Maps are generated via the Graph | Map pull-down menu option of SAS Enterprise Guide.

Data preparation for mapping involves assigning a map geometry variable from one of the standard SAS/GRAPH map datasets. This paper illustrates how to prepare your data for mapping by joining your SAS dataset to some of the standard SAS datasets.

PREREQUISITES
If you're new to the software, you may want to pursue training such as the "Getting Started with SAS Enterprise Guide" tutorial available on www.support.sas.com.

There are some prerequisites for map-making using SAS Enterprise Guide. Make sure that these are available to you:

- SAS Enterprise Guide, with either Base SAS or a SAS Server and Metadata Repository available
- SAS/GRAPH
- MAPS library of SAS/GRAPH installed

You may need to contact your SAS system administrator for those components. Even if you have SAS/GRAPH available, you may not have the MAPS library which is part of the SAS/GRAPH product. The maps files are fairly large, and some sites do not deploy them in their standard SAS package.

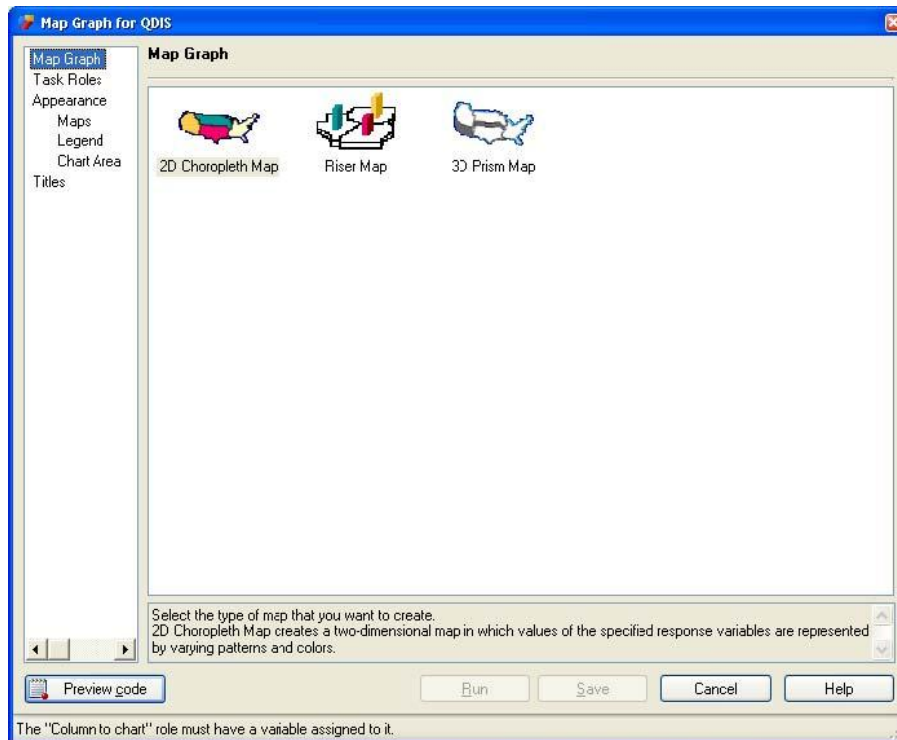Some important variables that are required for producing detailed maps of the United States are:

- ZIP code – 5-digit, numeric variable in your SAS dataset
- STATE and COUNTY FIPS codes – available in standard SAS datasets described later in this paper
- _MAP_GEOMETRY variable – available in standard SAS/GRAPH map datasets described later in this paper.

GRAPH | MAP
Let's review the Graph | Map pull-down. This is so that you will have an idea of the map formats available, and the parameters which are required. Your first actual step in creating a map will be in the STEP 1 – PREPARE DATA USING DATA | FILTER AND QUERY section below.
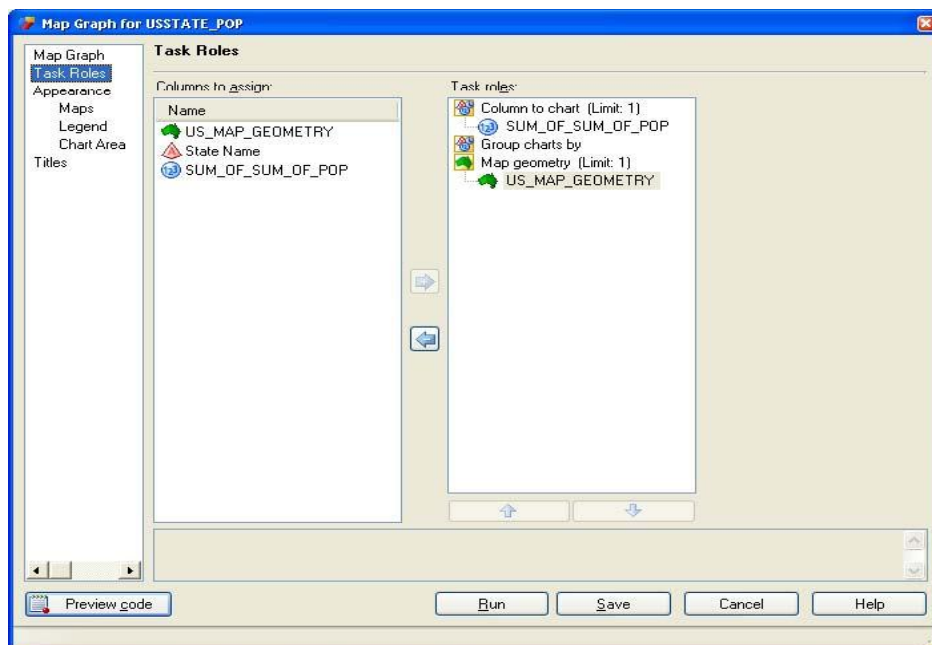
My illustrations are all from SAS Enterprise Guide 4.1.

MAP GRAPH

The Map Graph section allows the user to choose the format of the map from available types. Each of the three choices will show the distributions of data by geographic region.

The first choice is a two-dimensional, choropleth map. "Choropleth" comes from two Greek words meaning "region" and "multiply." A choropleth map uses different colors or hues to illustrate the distribution of a variable by region. The other choices illustrate distributions by means of risers or prisms.

TASK ROLES

The Task Roles section allows the user to assign certain variables to different roles.

The analysis variable from the input dataset will be assigned to "Column to chart." This is the variable whose values will determine the shading in the choropleth map.

If required, separate maps for each value of a variable may be produced. This is accomplished by assigning a variable to the "Group charts by" role.

A variable must be assigned to the "Map geometry" role. I will provide details on this later in this paper.

STEP 1 – PREPARE DATA USING DATA | FILTER AND QUERY

In this step, we will access your SAS dataset which contains the analysis variable to assign to the "Column to chart" in the map's task role. The analysis variable could be sales, population, or other numeric variable.

We will access a standard SAS dataset called SASHELP.ZIPCODE in order to assign the state and county code for each ZIP code in our SAS dataset.

We will also access two standard datasets from the SAS/GRAPH MAPS library, MAPS.US2 and MAPS.CNTYNAME in retrieving the variable _MAP_GEOMETRY. The map geometry variable is used by SAS/GRAPH in plotting the data by state or county onto the maps. You will be assigned _MAP_GEOMETRY to the "Map geometry role."

Now, launch SAS Enterprise Guide, and indicate that you want to create a new project.

YOUR SAS DATASET WHICH CONTAINS YOUR ANALYSIS VARIABLE

Using Data | Filter and Query or File | Open Data, add your dataset to the SAS Enterprise Guide process flow.

Your SAS dataset must include the numeric analysis variable which you will assign to the Map role of "Column to chart." The SAS dataset will also need to contain a numeric, 5-digit ZIP code variable to use in producing the map.

SASHELP.ZIPCODE – A STANDARD SAS DATASET CONTAINING STATE AND COUNTY FIPS CODES

Using the Join function in the Data | Filter and Query window, indicate that you want to open the SAS dataset called SASHELP.ZIPCODE. This SAS dataset contains a numeric 5-digit ZIP code in variable ZIP which you will join to the ZIP code in your SAS dataset.

On the Select tab of the Data | Filter and Query window, select the variables STATE (State FIPS) and COUNTY (County FIPS). The FIPS (Federal Information Processing Standards) codes are assigned by the United States federal government for each state and county.

For later use as a Parameter, include the variable STATENAME from SASHELP.ZIPCODE. Optionally, you may select other variables from the SASHELP.ZIPCODE SAS dataset.

Use the summary functions within the Data | Filter and Query window to ensure that your data will be summarized by the STATE and COUNTY variables.

Run the join of your SAS dataset and SASHELP.ZIPCODE to create a new SAS dataset that includes the STATE and COUNTY FIPS codes. I will refer to the new SAS dataset as SASUSER.MAP_EXAMPLE_ANALYSIS_VARIABLE.

MAPS.US2 – A SAS/GRAPH DATASET CONTAINING THE MAP GEOMETRY VARIABLE FOR EACH STATE

Using the Join function of Data | Filter and Query, open SAS dataset MAPS.US2. This contains the map geometry variable for each state in the United States.

Add SAS dataset SASUSER.MAP_EXAMPLE_ANALYSIS_VARIABLE to be joined.

Review the Tables and Joins window to verify that SAS Enterprise Guide automatically linked SASUSER.MAP_EXAMPLE_ANALYSIS_VARIABLE to MAPS.US2 using the common STATE variable.

Select the variable _MAP_GEOMETRY from MAPS.US2, as well as your analysis variable and the variable STATE.

Summarize your analysis variable and indicate "Automatically select groups."

Run the join of SASUSER.MAP_EXAMPLE_ANALYSIS_VARIABLE and MAPS.US2 to create a new SAS dataset that includes the mapping geometry variable for each state. I will refer to the new SAS dataset as SASUSER.MAP_EXAMPLE_STATE_DATA.

MAPS.CNTYNAME – A SAS/GRAPH DATASET CONTAINING THE MAP GEOMETRY VARIABLE FOR EACH COUNTY
Using the join function of Data | Filter and Query, open SAS dataset MAPS.CNTYNAME. This contains the map geometry variable for each county in the United States.

Add SAS dataset SASUSER.MAP_EXAMPLE_ANALYSIS_VARIBLE to be joined.

Review the Tables and Joins window to verify that SAS Enterprise Guide automatically linked SASUSER.MAP_EXAMPLE_ANALYSIS_VARIABLE to MAPS.CNTYNAME using the common variables STATE and COUNTY.
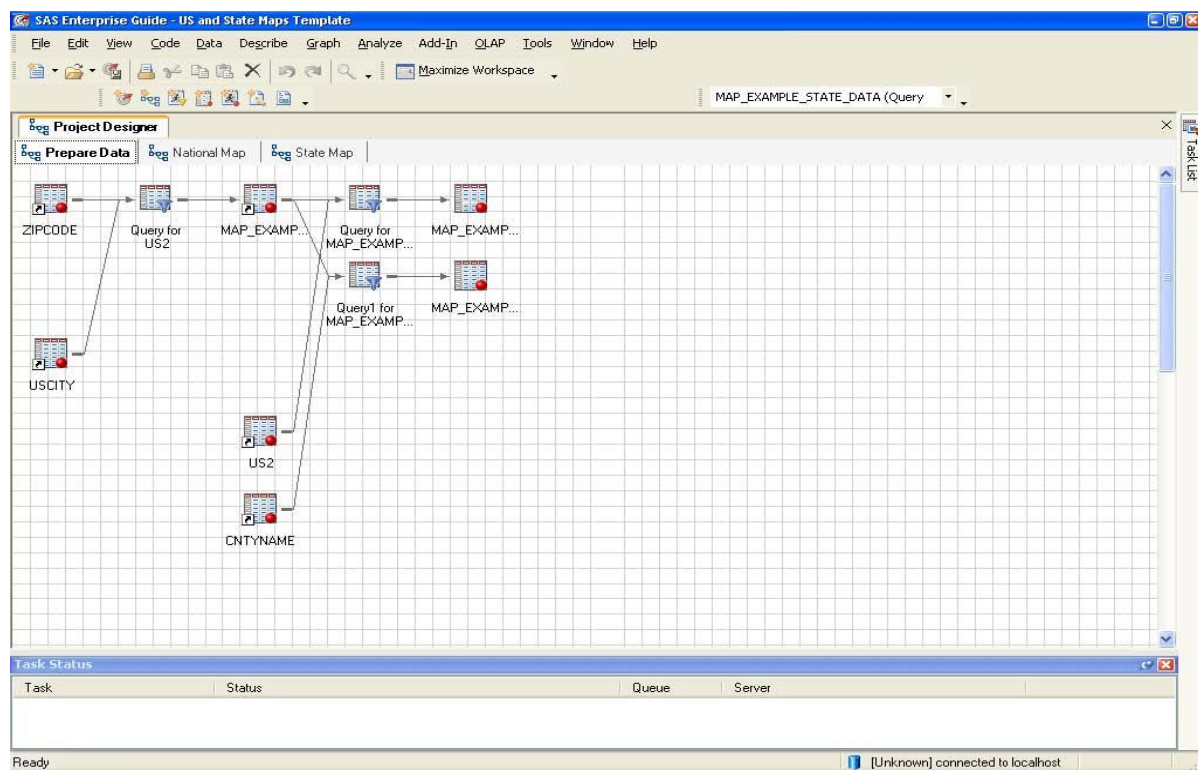
Select the variable _MAP_GEOMETRY from MAPS.CNTYNAME, as well as your analysis variable, STATE, COUNTY, and STATENAME.

Summarize your variable and indicate "Automatically select groups."

Run the join of SASUSER.MAP_EXAMPLE_ANALYSIS_VARIABLE and MAPS.CNTYNAME to create a new SAS dataset that includes the mapping geometry variable for each state/county. I will refer to the new SAS dataset as SASUSER.MAP_EXAMPLE_COUNTY_DATA.

You may now wish to rename the process flow tab from the default "Process Flow" to something more descriptive such as "Prepare Data."

When this step is finished, the Prepare Data process flow should look something like this. Note that I used the standard SAS dataset SASHELP.USCITY and its population (POP) variable as my analysis variable.

4

It is a good idea to save your work frequently while in SAS Enterprise Guide. Now that the data preparation step is complete, you should save your SAS Enterprise Guide project.

STEP 2 – PRODUCE A UNITED STATES NATIONAL MAP USING GRAPH | MAP

The data preparation step is the more time-consuming part of map-making. Once your data are prepared correctly, then producing maps is done through the Map | Graph pull-down menu option which I covered at a high level earlier in this paper.

Begin by selecting File | New | Process Flow, and rename the process flow tab something like "National Map."
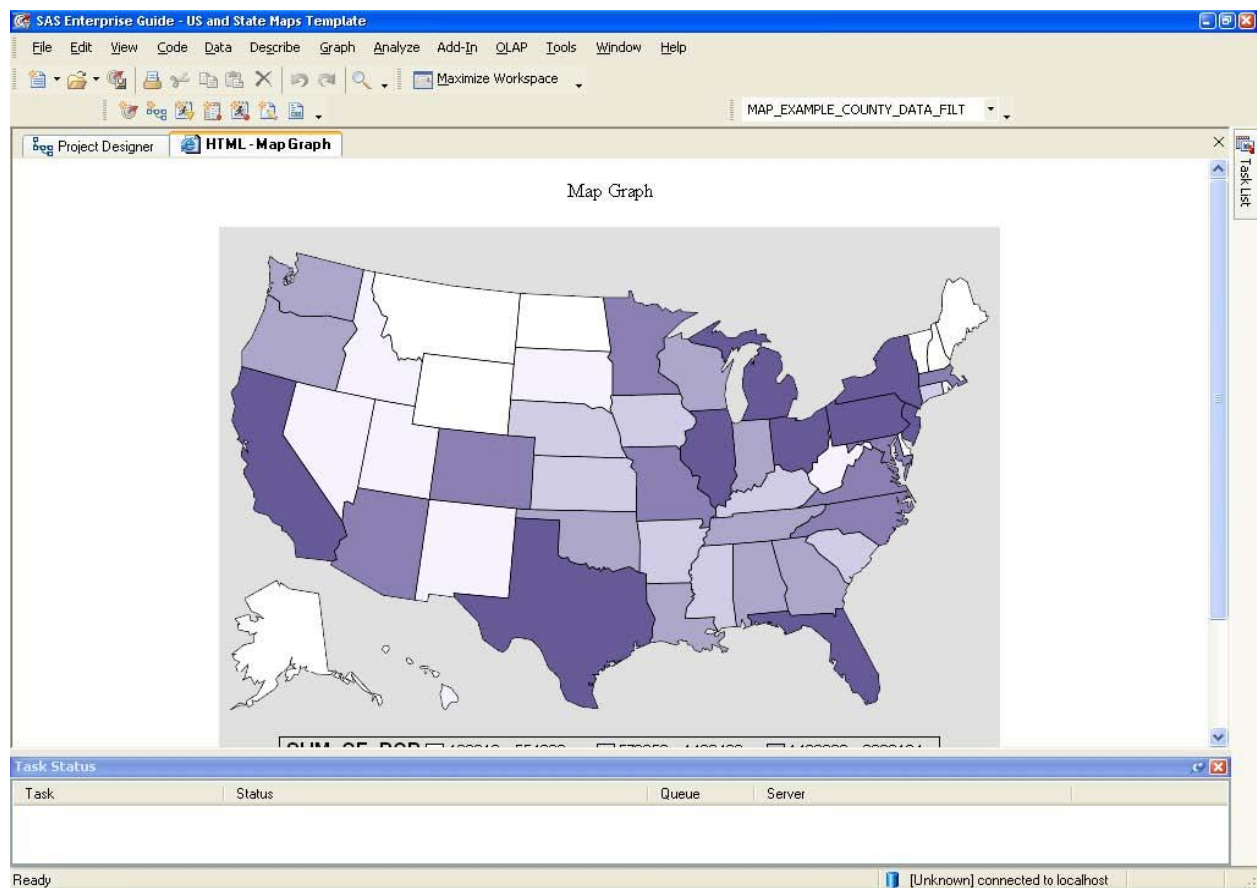
Open the SAS dataset SASUSER.MAP_EXAMPLE_STATE_DATA, and then click on it so that it is highlighted.

From the pull-down menu, select Map | Graph. The parameters should be set as follows:

- Map Graph – choose the type of map required. I selected 2D Choropleth Map in my example.
- Task Roles – Your analysis variable should be assigned to the "Column to chart."   "Group charts by" is optional; use it if you have a variable for which a separate map page should be created for each value. "Map geometry" should be assigned to the _MAP_GEOMETRY variable in SASUSER.MAP_EXAMPLE_STATE_DATA.
- Appearance – I generally select "Accept missing values" and "Include every unit" so that my maps will indicate borders of states and counties, even if there is no data for them. Other options under Appearance allow the user to customize the response levels, colors of borders, the legend, and the chart area.
- Titles – The user may edit the title to be descriptive.

By selecting Run, the user can generate a map with data plotted by state.

Using Tools | Options | Results, or by right-clicking on Map Graph and indicating preference, the user can set the format of the output, such as HTML or PDF. The following is the map produced by this step in my example.

STEP 3 – PRODUCE A STATE MAP USING GRAPH | MAP

Select File | New | Process Flow, and rename the process flow tab something like "State Map."

The following example will demonstrate how to create a Parameter list in SAS Enterprise Guide, and then apply the Parameter list both in filtering data and in customizing the title of the map.

Open the SAS dataset SASUSER.MAP_EXAMPLE_COUNTY _DATA, and then click on it so that it is highlighted.

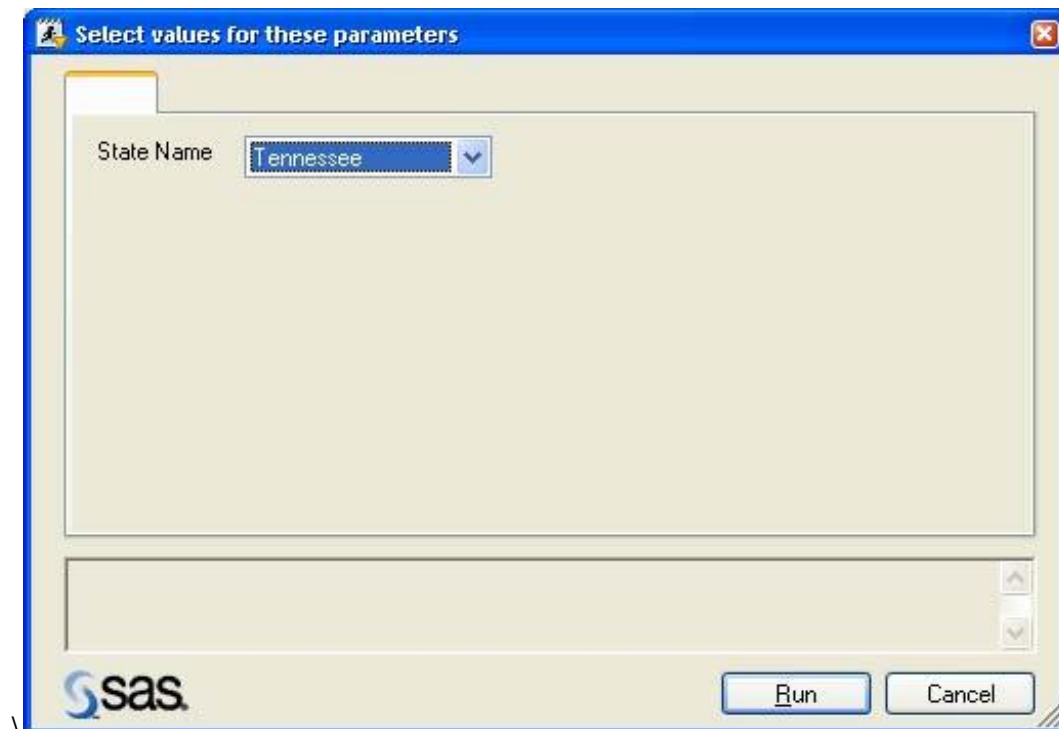From the pull-down menu, select Data | Filter and Query. Select all variables from SASUSER.MAP_EXAMPLE_COUNTY_DATA.

Click on Parameters, and then follow these steps:

- On the General tab, enter "State Name" in the "Display name" box." Tab through the remaining fields, so that "SAS code name" contains "State_Name" and "Data type" is "String."
- On the Data Type and Values tab, the "Data type" should be "String," and "Data value type" should be "A list of values."
- Remaining on the Data Type and Values tab, select "Load Values" and then "SAS Server." Locate the SAS dataset SASHELP.ZIPCODE, and select STATENAME. Save by selecting "Add and Close."
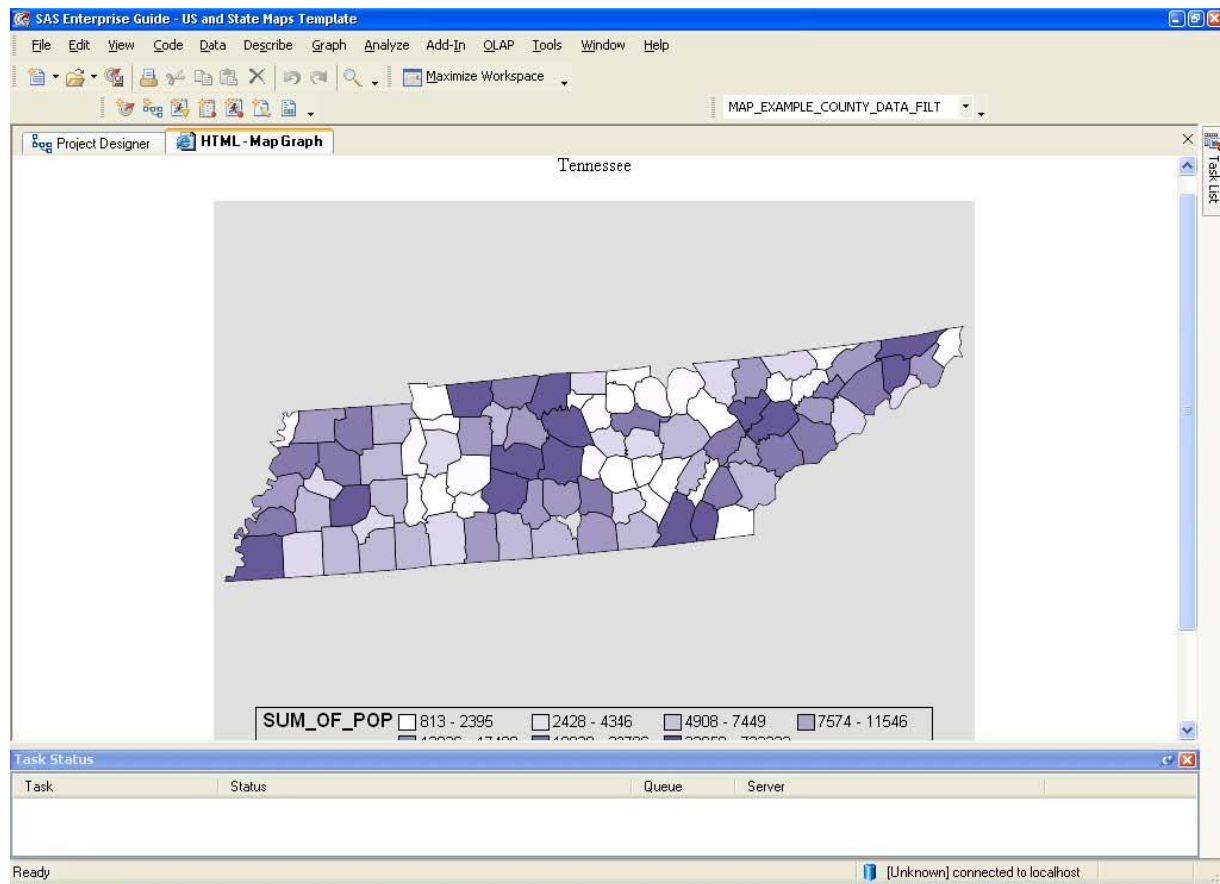
Returning to the Data | Filter and Query window, select the Filter Data tab. Drag and drop the variable STATENAME to the filters box. The Operator defaults to "Equal to." Expand the Value box and click on the Parameters tab. Select &State_name as the parameter.

Repeat the Map | Graph parameters from Step 2 using the SAS dataset that you have just created through filtering. However, you should modify the Titles box to deselect the "Use default text" and then add &State_Name as the title.

When the process flow is run, the user is shown a list box of available state names.

\

The resulting map is as follows.

DOING MORE WITH SAS CODE
Not all features of the SAS language are supported by the point-and-click wizards of SAS Enterprise Guide.   However, there is an easy way to convert a node on your process flow into a SAS program.

For example, right-click on the Map Graph node, and select "Add as Code Template."   This results in a Code node being placed onto the process flow. You can then edit the Code as needed.

CONCLUSION
SAS Enterprise Guide provides the user the ability to prepare data for mapping, and to illustrate geographic differences in the data by means of various types of maps. Both experienced SAS programmers, as well as less-technical users, can find value in using SAS Enterprise Guide.

CONTACT INFORMATION:
Your comments and questions are valued and encouraged. Contact the author at:

> Harmon Jolley
> 1841 Crabtree Road
> Hixson, TN   37343
> jolleyh@bellsouth.net:

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration.

Other brand and product names are trademarks of their respective companies.