

New Directions in Graphics

This paper is an overview of enhancements, add-on products, and new products that add graphic capabilities to the SAS® System.

SAS/GRAPH® enhancements

New device drivers

Many new device drivers will be available in Version 6.09 of the SAS System.

- SIXEL
- HP LaserJet IV
- HP XL300
- TIFF drivers - Classes B and P
- Microsoft Word Windows CGM driver
- Aldus PageMaker for Windows CGM driver
- Aldus Persuasion 2.0 Fonts CGM driver
- Prime PT200 terminals (Unix only)
- Data General terminals (Unix only)

Device drivers with metric dimensions

Most are configured for A4 paper. A good way of locating these in your device catalog is to check for A4 or M at the end of the device name.

- CalComp ColorMaster thermal printer
- HP 7550
- HP 7475
- HP LaserJet
- HP DeskJet 500C
- PostScript
- Apple Laserwriter
- imPRESS Printers
- QMS ColorScript—RGB color defs
- QMS Lasergrafix 800 printer
- Tektronix LN01 A4 Paper (Tektronix 4014 emulation)
- Tektronix Phase II and Phaser III PXi Printer
- Xerox 4045

PROC JCHART

Introduction

PROC JCHART is a 6.09 experimental version of PROC GCHART. JCHART produces all of the chart types that GCHART produces with the addition of a *donut* chart. A donut chart is merely a pie chart with a hole in the middle. JCHART also allows subgrouping of pie and donut charts. Subgrouping arranges the charts in concentric circles for easy comparisons of slice variables.

Syntax

The JCHART procedure uses the BLOCK, HBAR, PIE, STAR and VBAR statements as documented in **SAS/GRAPH Software, Version 6, Volume 1** for the GCHART procedure. The syntax for PROC JCHART itself is identical to that of PROC GCHART:

```
PROC JCHART <DATA=SAS-data-set> <ANNOTATE=Annotate-data-set> <GOUT=output-catalog>;
```

The DONUT statement uses all of the same options as the pie statement with the additions of 'DONUTPCT=' and 'LABEL='; DONUTPCT is the size of the donut hole. The LABEL option is used to place text inside of the donut hole. The general form of the DONUT statement is:

DONUT variables / options;

A DONUT statement for the variable, location, in the input SAS data set newsales with a donut hole of 40 percent, and a red, swiss donut hole label of 'Location' would look like this:

```
PROC JCHART DATA=newsales;
  DONUT location /
    donutpct=40
    label=(font=swiss color=red 'Location');
RUN;
```

A DONUT statement may contain more than one chart variable and a separate donut chart will be drawn for each chart variable.

The subgroup option places the subgroups in concentric pie or donut charts. The concentric chart sizes are evenly divided between the donut hole (if any) and the outside chart radius.

The order of the slices for subgroups is determined by the outer most pie/donut chart. Any of the inner charts that have a variable that is not in the outer chart is placed last... before the 'OTHER' slice. That order is then continued for any charts remaining in the subgrouping.

When subgroup is used, a legend for the slices is produced. GOPTIONS NOLEGEND is ignored if used with subgrouping for JCHART.

A PIE statement for the variable, location, in the input SAS data set newsales with subgrouping on the variable 'dept' would look like this:

```
PROC JCHART DATA=newsales;
  PIE location /
    subgroup=dept;
RUN;
```

Most of the options that are used for pie or star charts in PROC GCHART can be applied to the donut chart in PROC JCHART. The differences are:

ANGLE= <i>degrees</i>	In PROC GCHART, the angle starts in the 3 o'clock position and moves counter-clockwise. In PROC JCHART, it starts in the 12 o'clock position and moves clockwise.
ASCENDING	the direction of the pie and donut slices differ as mentioned in the ANGLE= option. When subgrouping is used, ASCENDING is ignored.
DESCENDING	the direction of the pie and donut slices differ as mentioned in the ANGLE= option. When subgrouping is used, ASCENDING is ignored.
DONUTPCT= <i>n</i>	specifies the size of the donut hole. Valid values are between 0 and 99. The value is a percentage of the whole pie. Twenty five percent is the default value for the donut hole.
EXPLODE= <i>value-list</i>	pulls the specified slices slightly out from the rest of the chart for added emphasis. Explode is ignored if subgrouping is specified.
LABEL= (<i><text description>'text'></i>) / NONE	defines the appearance or the text of the donut hole label. Values for the LABEL= option are text description parameters and text strings. Each text string must be enclosed in single quotes and separated by blanks. If you specify LABEL=NONE, the label is suppressed. The <i>text description</i> portion of the value takes one or more text description parameters listed below. For more information on this option, see the AXIS section of SAS/GRAPH Software, Version 6, Volume 1.

ANGLE=*degrees*

specifies the angle at which the baseline of the entire

	text string is rotated with respect to the horizontal.
COLOR= <i>color</i>	specifies the color for the label text.
FONT= <i>font</i>	specifies the font for the label text.
HEIGHT= <i>height</i>	specifies the height of the label text characters. By default, the size of the text is proportionally calculated for the size of the donut hole.
	pJUSTIFY=LEFT CENTER RIGHT specifies the alignment of the label text.
ROTATE= <i>degrees</i>	specifies the angle at which <i>each character</i> of text is rotate with respect to the baseline of the text string.
LEGEND=	controls formatting options for the legend on pie and donut charts. Legends are available in 6.09 when subgrouping is used. In 6.10, they are available when specified.
SUBGROUP= <i>variable</i>	divides the pie or donut into rings according to the values of <i>variable</i> . The subgroup option places the subgroups in concentric rings in the chart and, by default, produces a legend for the slices within each ring. The concentric rings are divided up evenly between the donut hole (if any) and the outside radius. The subgroup labels are only labeled on the first chart of each page. The LEGEND= option can be used to assign a LEGEND definition to the subgroup legend and the NOLEGEND option can be used to suppress the subgroup legend. For more information on the LEGEND= option, see the LEGEND section of SAS/GRAPH Software, Version 6, Volume 1.

PROC JPRINT

PROC JPRINT is an experimental version of PROC GPRINT for 6.09. It converts characters normally associated with borders and separators into graphics. These characters are +, -, =, >, <, and |. You can use this procedure to dress up line printer graphics. This procedure is good for improving output to procedures such as PROC TABULATE, PROC CALENDAR, and PROC NETFLOW.

Graphics class

The Graphics class is available in SAS/AF[®] software as a FRAME object in 6.08. It produces simple plots and charts and retrieves information about the data used to produce the chart by a mouse click. The value of the object is an SCL list that contains the data values of the dependent, independent, and ID variable where the last click occurred. If text is clicked on, the text string is stored in the list.

SAS/IMAGE™

SAS/IMAGE is an Image Processing product that will be added to the SAS System. This product will allow users to access, store, manage, manipulate and display many types of images. It will extend the primary functions of the SAS System (Access, Management, Analysis, and Presentation of data) to include image data.

An image is binary data that “describes” a picture. Image data can be generated by sheet and film scanners, facsimile machines, digital or image cameras (also called still video cameras), medical devices (MRI, CATscan, etc), satellites, and a variety of software packages including modeling and animation software (like SAS/NVISION), and paint and draw software. The image data is stored and compressed in a wide variety of standard file formats such as TIFF, GIF, Targa, PCX, and GEN. The image data can be displayed on a high resolution device or printed to paper or film.

The SAS/IMAGE product will be used by those interested in both Document and Graphical Image Processing. The needs of both types of users are very similar.

Document Image Processing involves creating a “picture” or image of a document with a scanner or facsimile machine, storing the image data in a file format, managing the “picture” by associating it with structured data (eg. SAS dataset) and displaying or printing the picture. In addition, the image may be manipulated to remove “noise”, reduce the size, or make the document more readable. Most of the SAS Institute customer base is a potential user of Docu-

ment Image Processing.

Graphical Image Processing is similar to Document Image Processing, but places more emphasis on manipulating the image. Potential users include photographers, artists and others involved in producing publications, users analyzing scientific images (medical, space, and etc), users wanting to do post-production work on SAS/NVISION images, users building photographic databases (eg. human resources or real estate applications) and users wishing to combine photographs with business graphics (eg. putting a SAS/GRAPH chart on a photograph). The graphical applications are almost unlimited. Many of the SAS Institute customer base would have a need for Graphical Image Processing.

SAS/IMAGE will include:

- Screen Control Language (SCL) functions. SCL functions will be added to read/write, manage, manipulate and display images. Users will be able to create custom applications by combining the existing power of SCL with SAS/IMAGE.
- Image object with Frame. These will methods similar to the SCL functions.
- DMS Image window for displaying images.
- Interactive Image Processing Tool. This tool will allow users to perform many different types of image manipulation including image editing, painting, drawing and many scientific or "classical" image processing functions. The tool will provide functionality to a wide range of users. A comprehensive list of capabilities is attached.
- SAS Dastep Functions. Functions will be added to the dastep so that users can directly read and write lines of image data. This will allow users to develop specialized image processing algorithms in the dastep.
- Ready-to-use (pre-built) Document Image Processing application. We will provide a prototype application that can be used as a generalized application or the user can customize it.
- Ready-to-use application to view and modify images.
- Possibly other ready-to-use applications.

The product will be production as a 6.09 add-on product. A beta version will be available when 6.09 goes production. The product initially be available under Unix, Windows NT and VMS Alpha. OS/2 and Windows32S may be shipped as a later release. The 6.09 code will include the SCL functions, the image frame object, and a DMS Image window. Games are used as sample applications that use SAS/IMAGE.

In the future, we will be examining "Pattern Recognition". This may include features such as searching images for a matching pattern, Optical Character Recognition (OCR) and Image to SAS/GRAPH conversion.

The product should be able to run on all hardware that supports The SAS System. The limitation will be on the display device. SAS/IMAGE will require a high resolution display and a GUI such as X11, Windows or Presentation Manager. SAS/IMAGE will work on 1 bit monochrome, 8 bit colormapped and 24 bit truecolor displays. Some functionality will be unavailable on lower level displays. Users without these devices will be able to do non-interactive processing of images.

It is likely that there will be direct relationships between SAS/IMAGE and:

SAS/GIS™	Ability to display images.
SAS/PUBLISH™	Ability to print and display pictures with written info.
SAS/NVISION™	Ability to do post-production work on NVISION images.
SAS/PH-Clinical®	Display patient reports and other documents.
SAS/EIS®	Various uses with EIS, such as image pushbuttons and tool bars
SAS/GRAPH	Saving graphs in an image format.

Introduction to SAS/GIS Software

Abstract

SAS/GIS™ Software is a new part of the SAS® System to be available as a Version 6.09 add-on. As more and more data becomes available to enterprises, new tools are needed to make sense of this massive amount of information. SAS/GIS Software is a tool for handling spatially related data. The data importing, querying, analysis, and dis-

play will be covered as well as the strong connection to the rest of the SAS System.

Introduction

SAS/GIS Software adds the ability to analyze, display and interact with geographic data to the SAS System. This type of powerful tool is needed to make sense of the massive amount of data becoming available to enterprises. Much data has a spatial aspect that tells where it is located. GIS is a tool to manage this spatial aspect to visualize potentially important relationships in the data. Since SAS/GIS Software is still under development, some features may change but this paper describes the basic functionality that SAS/GIS Software will provide. The most powerful aspect is its strong ties to the rest of the SAS system.

While SAS/GIS Software is new, GIS has been used for many years. Up till now GIS has been primarily used in areas where the data and geography are very closely tied. Enterprises charged with managing areas (whether they be forests, cities, utility networks, or the whole country) have used GIS as a tool. These organizations have been able to gain enough efficiency to justify the often high costs of creating the digital spatial data bases they need. However, some of this spatial data is now available for a minimal cost and this makes GIS a cost-effective solution for more types of enterprises than in the past.

There is not enough room here to completely describe all of the spatial data that is available, but here is brief description of some of the data available. The U.S. Census Bureau has developed TIGER data as part of the 1990 census. TIGER is digital map data for 1990 census geographic areas, basic map features (streets, rivers, railroads, etc). Also for 345 core metropolitan areas, the names, address ranges and ZIP codes are included. The Census Bureau has made this public domain data available for a nominal fee of \$250 per CD-ROM, where, for example, all of North Carolina is on one CD-ROM.

The Digital Chart of the World (DCW) was produced for the U.S. Defense Mapping Agency. The DCW is a comprehensive 1:1,000,000-scale vector basemap of the world. It consists of cartographic, attribute, and textual data stored on CD-ROMs. The primary source for the database is the U.S. Defense Mapping Agency Operational Navigation Chart series. This is the largest-scale unclassified map series in existence that provides consistent, continuous global coverage of essential basemap features.

The U.S. Geological Survey has various digital data in their DLG format. This planimetric data represents the cartographic line information usually portrayed on a map. DLG's are available for 1:20,000, 1:24,000, 1:48,000, 1:62,500, 1:63,360, 1:100,000, and 1:2,000,000 scale maps. A CD-ROM of the 1:2,000,000 scale data is available.

Geographic Data Technology, Inc. (GDT) provides Dynamap/2000™ data, a nationwide, up-to-date, topologically correct street center-line database. GDT also has other geographic data including ZIP code boundaries, census boundaries, and highways.

Basic Concepts

GIS is a tool for making sense of spatially related data. Thus understanding the data leads to understanding GIS. There are two basic types of data used in the GIS, the spatial data base and data related to the spatial data base. The first type, spatial data, contains the coordinates and identifying information for the various map features. In SAS/GIS Software, a feature is any point, line or polygon that can be visually represented on a map. For example, using TIGER data, SAS/GIS Software can create a spatial data base that contains information for city boundaries, census tract and block boundaries, streets, etc.

The second type of data is other data sets containing information about features on the map. This type of data is associated with the map by ID variables. For example, a data set with population for each census tract is connected to the spatial data base by the ID variable, TRACT. This type of data is already widely used in SAS for analysis, summary, reporting, and graphing. SAS/GIS Software moves beyond just drawing maps by allowing interaction with the data to explore relationships in the data.

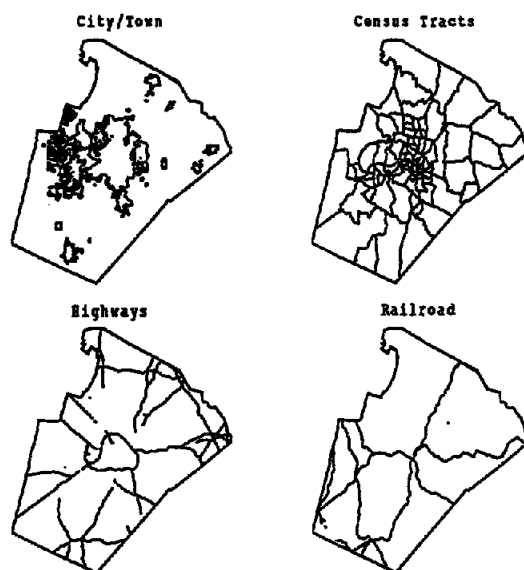
The basic operation of SAS/GIS Software is to select features of interest on the map and then do things with the data associated with those features. The things that you do are called actions and there are six types of actions, each described below. As well as the type, each action definition tells when the action is to be performed. An immediate action is performed as soon as the selected features on the map change. A deferred action will not be performed until requested by the user from the map window menus. Here is a brief description of each action type.

1. A **browse action** shows the observations in a data set that correspond to the selected features in the map in a FSBROWSE window task. A screen catalog entry can be specified to customize the appearance and performance of the FSBROWSE window.

2. A **view action** shows the observations in a data set that correspond to the selected features in the map in a FSVIEW window task. A formula catalog entry can be specified to customize the FSVIEW window.
3. A **spatial information action** shows the values from the spatial data base for the current feature.
4. A **data action** creates a data set that is a subset of a data set, choosing only the observations that correspond to the selected map features.
5. A **report action**, like a data action, creates a data set that is a subset of a data set, choosing only the observations that correspond to the selected map features, and then also submits SAS statements to run. This is the most powerful action because it allows direct access to the powerful analysis and report writing components of the SAS System.
6. An **image action** shows an image that corresponds to the current selected feature in the map. The name of the image file is stored in a variable in the associated data set.

The map definition tells everything about the map you are going to see and use, including the coverage, layers, actions and other map options. The coverage tells which spatial data base and which part of it to use. For example, a coverage might indicate to use a spatial data base of the Southeast U.S., but only read and show the data for Florida on the map.

A layer is a logical subset of features from the spatial data base. It might be all the roads, the county polygons, or points representing bank locations. The various layer definitions of a map define all of the features you can see on the map. If a feature is not part of one of the map's layers, it will not be on the map. The following pictures show some of the layers that can be defined from TIGER data for Wake County, North Carolina.



Implementing an Application Using SAS/GIS Software

SAS/GIS Software can be used for many different applications. The following is a brief description of a fairly simple application, using data available from the U.S. Census Bureau.

Define Application and Determine Data Needs

While describing an interactive application on paper makes it difficult to capture the true feel of the application, the following description should give a taste of what SAS/GIS Software can do. It is very straight forward to setup an application to examine Summary Tape File (STF) data with a spatial data base created from TIGER data. STF data comes in several varieties. TIGER data contains the matching spatial information.

Import Data

Upon receiving the desired data, the interactive importing screens are used to read in the TIGER spatial data and the associated demographic data. The importing window takes the specified input files and creates data sets and catalog entries for the spatial data base, a coverage, basic layers, and a map. Very little information needs to be provided, only the location of the files to be imported and a place to store the spatial data base and the SAS/GIS catalog. The importing process will create enough layers, coverages, and maps to allow viewing the data without

any further definitions.

Setting Up the Map

The basic map created during the importing allows a quick view of the spatial data base. With TIGER data this would include the following layers: COUNTY, HIGHWAY, CITY, and TRACT. A new map with just these layers can be simply created in the map window from the imported map generated by:

1. Removing the unwanted layers,
2. Reordering the remaining layers,
3. Saving the map into a new catalog entry.

That would leave a map looking like the following.



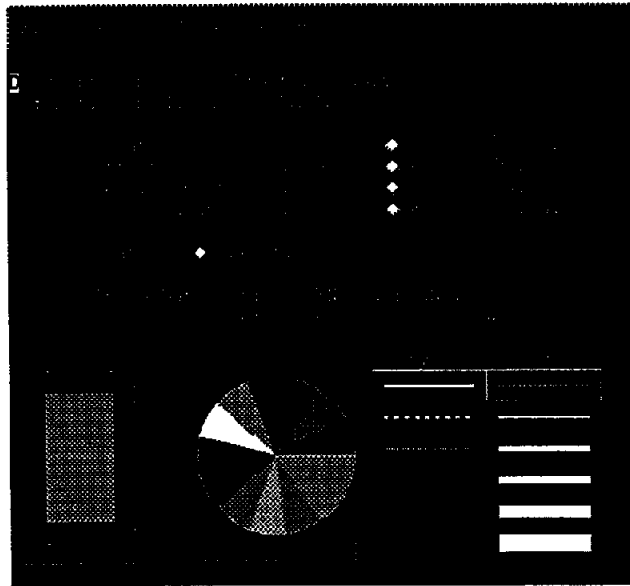
The map window has a tool palette along the left side, and layer boxes across the top. The tools can be used for various selection methods as well as panning and zooming the map display. The layer buttons can be used to turn on and off the layers. A pop-up menu for each layer gives further control including making a layer selectable, adding labels, and allowing further editing of the layer definition in a separate window.

Changing a Layer

In the layer edit window there are controls to cause a layer to be automatically turned on or off as the scale of the map display changes. This allows a layer with much detail, such as all streets, to be off when viewing a whole county, but turned on when zoomed in to a neighborhood. Layers can be static or thematic. In a static layer, all of the features are drawn in the same color and style. In a thematic layer, the value of a data set variable determines the color and style.

Choosing *Thematic* in the layer window radio causes the data set window to come up. A data set can be associated with the map by entering the data set name and then selecting the corresponding variables from the data set and the spatial data base. Once an association is made, it is stored as part of the map definition so this process does not have to be repeated.

After choosing a variable to associate the color, the area at the bottom of the layer window can be used to set the color for the ranges of that variable. The range values are shown next to the variable and the color in the area in the bottom left corner of the window. The arrows in this area are used to move thru the ranges. The range in this figure is from 1600 to 2400.



Querying the Map

There are several ways that features can be selected from the map. Using the mouse, features can be selected by clicking, dragging a rectangle or circle, or drawing a polygon. Features can also be selected by their attribute values using an SQL where clause builder. The various selection mechanisms can be combined. For example, you could drag out a 10 mile circle around a retail business and select all of the census tracts in the circle. Then use a WHERE clause to select only the tracts with 400 or more people over age 65.

Other Examples

While it would be impossible to list all of the possible applications for SAS/GIS Software, I will describe a few.

Real Estate

Another application that most people can relate to is real estate. Using a street database from TIGER or Dynamap/2000 you can add point data to represent available houses for sale. Then you could drag out a 10 mile circle around a business and select all of the available houses in the circle. Then use a WHERE clause to select only the houses with 4 or more bedrooms and a garage. Actions could be defined to allow browsing data about the house (like number of bedrooms and baths, size of garage, square feet, price, etc.) and showing a picture of the house in a separate window.

Market Research

A market research application to examine and build a demographic profile of customers can allow better target marketing and data to coordinate consumer preference studies. A simple start would be to view customer locations on a map. Then exam the demographics of the census blocks or tracts where they live. Next select other blocks or tracts with the same demographics. These are also potential customers. Are they on the mailing list? Draw symbols at the points from the addresses in the mailing list. If so, why are they not buying? Draw the competition on the map. Is the competition closer? Is there a barrier, like a river? The asking and answering of these kinds of questions lead to a better understanding of a market and more efficient marketing expenditures.

SAS/GIS Software will add a powerful tool to the SAS System that allows enterprises to explore and display the spatial relationships in their data. The software is highly interactive, easy to use and does not require a sophisticated knowledge of GIS to setup and use. These are only the highlights of features for a Version 6.09 release of SAS/GIS Software. Other features will be available for both Version 6.09 and beyond. Some of these features are:

1. A GIS map as a FRAME object
2. Better labels and gridding on the Map display.
3. More import and export formats
4. Using images as a layer

SAS/NVISION

SAS/NVISION is a modeling, rendering, and animation package available as a 6.09 add-on. This version is available on two new platforms, the RS 6000 and the HP 700 series, as well as on the Silicon Graphics systems. The implementation of tutorials is a major enhancement. The tutorials guide you examples by letting you click on the appropriate buttons in order to create an example. If you do not select the button on three tries, the button is selected for you. Other enhancements include an improved method of rendering that results in better performance and a revamped menu system that has been structured based on usability studies done within the Institute.

Texture mapping has been included in the menu side of SAS/NVISION. Previously this could be done only through the command language interface. The interactive method allows you to manipulate the texture map on the object in order to ensure a seamless fit when wrapped around the object. Simple scaling transforms are also available through the interactive method. This feature is located under the Attributes button.

Future Development

- Use SAS catalogs to store SAS/NVISION files
- SAS/VIDEO (digital VCR)
- Thumbnail display of model in files
- improved 256 color (8 bitplane support)
- Free form model deformation
- 2D and 3D morphing
- Spline rendering, animation, and creation journaling

The DATASCOPE procedure

The DATASCOPE procedure adds the functions of multi-dimensional data visualization and analysis to the SAS system and is available as a 6.09 add-on. Its interactive interface allows you to explore and make analyses upon scientific data. It differs from SAS/NVISION in its data-driven emphasis rather than the rendering and presentation emphasis that SAS/NVISION has. Its functionality includes:

- Orthogonal & non-orthogonal contour cutting planes
- Iso-surface generation
- Point cloud "subsetting"
- Probe analysis
- "G3D"-like surface generation from two-dimensional contour cutting planes
- "GPLOT"-like line plots from intersection of contour cutting planes
- Data filtering
- WHERE clause processing
- Animation over time with BY-variable processing
- Text annotation
- Color ramp legend
- Axis labeling (major & minor tick marks)

Companies in the environmental, pharmaceutical, medical, and geological fields can take advantage of this new procedure, but anyone who examines multi-dimensional data will find it useful.

This is a general description of new features available in the SAS system. Detailed information is available through Changes and Enhancements documentation for existing products and through manuals for the new products.