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Easy as Pie Charts (Any Way You Slice 'Em)

Jonah P. Turner, International Trade Administration, Washington, D.C.

ABSTRACT

Businesses are increasingly exploring, examining, and exploiting data for quick decision-making and long-term planning. For this reason, it is essential that information can be analyzed efficiently across the enterprise and communicated effectively to different audiences. SAS/GRAPH® is a flexible and powerful tool that facilitates data analysis with a wide range of statistical methods and provides visualization capabilities to produce a variety of eye-catching charts, plots, and maps. With the use of such accurate, high-impact graphics, business analysts can uncover relationships more easily and present their findings in ways decision-makers may better understand. Perhaps the most ubiquitous visual for displaying summarized information is the pie. This kind of chart is practical for comparing a set of categorical data using the size of each slice to graphically represent a value as a percentage of the whole. Pie charts can be offered to highlight key statistics in place of or as a supplement to tabular data formats. This paper demonstrates how, as an extension of SAS'® sophisticated data analysis and report publishing components, SAS/GRAPH software enables the simple implementation and delivery of colorful, comprehensible, and customizable pie charts. Any way you slice them, pie charts serve well to increase understanding, provide meaning, save time, engage audiences, enhance retention and, ultimately, impact business decisions and planning.

INTRODUCTION

As the landscape of the Information Age continues to evolve, it is critical that businesses are able to anticipate, acknowledge, and accept change in order to be successful. This requires decision-makers at all different levels to understand and use data to their advantage. Nevertheless, it can be very challenging for organizational leaders to absorb and apply information given the ever-increasing amount that gets collected and disseminated these days. Business analysts are therefore tasked with examining certain data and producing summary tables on which decision-managers can draw. SAS software is a sophisticated and powerful tool to facilitate such data analysis and reporting activities. Data is typically presented in tabular format, which is a practical way to investigate and convey information, albeit not always the most effective. For those who need to gain a quick understanding of critical business issues or others looking to uncover meaningful relationships among different data, the use of graphical presentations works best. Maps, charts, and plots are just a few of the many constructive formats for data visualization. These output types make it easy for anyone to pick out patterns, trends, and items of interest within data. SAS/GRAPH is a flexible and robust software component that can help organizations keep pace with the visualization demands of today. The rich feature-set available allows developers to generate highly customizable, presentation-style graphics no matter which computing platforms are used or in what format the results are needed.

The visualization offerings of SAS/GRAPH software help bring to bear the insights derived from comprehensive data analyses by enabling users to present their results to business customers through a wide range of graphics. Users can create an assortment of plots (e.g. scatter, line, area, bubble) and charts, such as bar, pie, donut, star, and block. Data can even be displayed within a three-dimensional coordinate system to provide for more in-depth exploration. All of these graphical elements can be created and customized both statically and dynamically, and stored in catalogs for easy access. In the face of so many available output options, the content discussed herein focuses solely on the development of pie charts. Perhaps the most prevalent visual for displaying summarized information, the pie can be offered to highlight key statistics in place of or as a supplement to tabular data formats. This kind of chart is practical for comparing a set of categorical data using the size of each slice to graphically represent a value as a percentage of the whole. Pie charts are effective in providing snapshots of summary data that are quick and easy for decision-makers to interpret. SAS offers three variations of this chart type, including PIE, PIE3D, and DONUT, in addition to sub-grouped pies. Many options are available for programmers to control and enhance the results with different dimensions, labels, colors, and styles that are suitable for a variety of audiences. Pie charts can be delivered conveniently to customers via printed reports, presentation materials, email, the Web or embedded in other applications. On the whole, SAS users should employ the visualization capabilities of SAS/GRAPH to advance data analysis and reporting activities, and improve decision-making across their enterprise.

The examples to be discussed are intended for beginning programmers who are new to SAS/GRAPH, as well as those who just need of a refresher on how to create basic pie charts from scratch. The colorful graphics provided are reproducible using the corresponding code. The reader is encouraged to examine and execute these sample SAS programs to achieve the most effective understanding of the graphing utility as the narrative has been incorporated primarily for entertainment value. All PIE, PIE3D, and DONUT statement options can be found in the appendix.

BACKGROUND

Far and wide, word has spread of the fresh and scrumptious desserts served at The Pie Hole, a quaint restaurant that features some of the tastiest homemade pies in the country. For more than ten years, The Pie Hole has been highly praised throughout the community for serving familiar pie flavors like apple, key lime, pumpkin, and pecan, while using original, unique recipes known only to the restaurant's head pastry chef, Kevin Baken. Since the launch of The Pie Hole, nothing about the restaurant has ever changed, not the business model nor the establishment itself. The owners, Barry and Sweetie Pie, are adamant that keeping to their fixed ways has ensured the continued success of the restaurant. The Pie Hole has always offered the same 12 flavors, and pies are either sold whole or in small evenly cut slices. Most often, the same type and quantity of ingredients are purchased each week, allowing the owners to keep track of all their business expenditures, as well as the overall production of pies without having to be too occupied. Indeed, there have been times when too many or too few ingredients were purchased, which has led to a surplus or shortage of pies, respectively. Nevertheless, Barry and Sweetie have been satisfied and truly blessed with the success they have achieved despite not having been overly involved in the daily operation of the restaurant.

Not long ago, an effort was started to collect data from customers through comment cards and random feedback surveys in order to supplement other relevant business information that gets compiled during the year. Behind the scenes, the head of finances, John Dough, examines this corporate data using SAS to uncover trends of the marketplace and then presents his findings to the rest of the management team. For instance, John was able to determine that the customer-base has changed considerably over time. With the growing popularity of The Pie Hole, people are traveling great distances to eat the delectable desserts, whereas only locals used to enter the restaurant. Ever since the neighborhood has been renovated with new apartment complexes and fashionable shops, younger crowds have been regularly showing up at the restaurant. On the other hand, middle-aged consumers, who are more health-conscious than before, seem to dine in less frequently. It is typical, however, for Barry and Sweetie to disregard any inferences that are drawn from these kinds of analyses as the owners are too set in their ways to adjust any aspect of the business – as they see it, people will return no matter what because their pies are irresistible.

IMPLEMENTATION

● *Problem*

The Pie Hole is a local restaurant that has been widely recognized for its delicious homemade desserts. Over the past few months, however, business has declined on account of flaky management practices and a crumby marketing campaign. Ensuing financial problems have become significant enough that the owners have considered closing down the restaurant for good. The head of finances, who had in the past presented Barry and Sweetie with suggestions for overcoming these economic hardships, worked to convince the inflexible owners not to stick a fork in the restaurant. As a result of his persuasive efforts, a marketing team was formed to further investigate the issues at hand. After having performed an exploratory and thorough analysis of a variety of corporate data, it had become clear that these problems all stemmed from the fact that customers were just not as satisfied with their dining experience as they were with the food. For so long, management chose to disregard the branding of their restaurant and only focused on turning out tasty pies. The time had finally come for the owners of The Pie Hole to eat some humble pie, so to speak, and admit their business strategy was in need of change. Appropriately, the owners agreed to give this team of specialists full discretion to come with a list of recommendations and carry out the greatest plan.

● *Solution*

The results of this statistical research project uncovered the main reason behind The Pie Hole's more recent financial woes: there is nothing particularly alluring about the restaurant other than its delectable offerings. Knowing this piece of the pie, the marketing team figured it had to better brand the restaurant and improve customers' overall dining experience. A lengthy brainstorming session on ways to reinvent the business brought about many half-baked ideas; not surprisingly, it was Steffi Graph, the team's lead programmer, who chimed in and suggested how pie charts could be used to deliver messages to all company stakeholders, from upper management to restaurant patrons, effectively. Not only would the use of graphics provide for an easier way to present important information more clearly, but it would also help to engage and excite people. The team spent the next couple of days putting together a number of unique visuals using SAS/GRAPH. By taking advantage of different pie customizations offered through this SAS utility, the team was able to produce a colorful range of graphics that would help them communicate vital information about the restaurant to all stakeholders alike. Shortly following their latest presentation of the material at an all-hands meeting, the marketing team was promised the resources they would need to streamline the restaurant's brand. The content herein describes the marketing team's strategy to improve the business and, ultimately, ensure that the owners would never have to shut The Pie Hole, as they had once threatened.

▸ *Example 1*

John Dough contended that the restaurant's customer-base has changed considerably over time. This was further supported with the results of the latest research project, in which the team of analysts was able to identify the various reasons why patrons were coming in less frequently. Whereas some customers have become more conscious about what they eat, others are just looking hungrily to other competitors who offer super-sized portions. The team determined The Pie Hole would better satisfy the contrasting needs of customers by offering different styles of pies.

Under Steffi Graph's leadership, the team established three varieties of pies: Thin, Thick, and Trim. Taking advantage of the SAS/GRAPH GCHART procedure with the PIE, PIE3D, and DONUT statements, respectively, the team was able to create images that demonstrate the different pie types. The GOPTIONS statement was also used to specify general graphics options that would apply to all SAS/GRAPH procedures, like the driver (i.e. *device=gif*) and dimensions (i.e. *hpos=100 vpos=100*) of the output. As the results show, customers who want to stick with what they love best can buy the original Pie Hole Thin, while those looking for something heavier should get a Pie Hole Thick. Consumers concerned about their weight may purchase a Pie Hole Thin, which offers great taste, less filling.

```
goptions device=gif gsfname=chart hpos=100 vpos=100 htext=2 ftext=zapfb ;

data example1 ;
  input dessert $3. ;
  datalines ;
Pie
;
run ;

filename chart "C:\My Documents\Graphs\example1a.gif" ;
proc gchart data=example1 ;
  title "Example 1a: Pie Hole Thin" ;
  pie dessert / noheading slice=none value=none ;
  footnote "You always win with a Pie Hole Thin!" ;
run ;
quit ;

filename chart "C:\My Documents\Graphs\example1b.gif" ;
proc gchart data=example1 ;
  title "Example 1b: Pie Hole Thick" ;
  pie3d dessert / noheading slice=none value=none ;
  footnote "The greatest pick is a Pie Hole Thick! (50% more filling)" ;
run ;
quit ;

filename chart "C:\My Documents\Graphs\example1c.gif" ;
proc gchart data=example1 ;
  title "Example 1c: Pie Hole Trim" ;
  donut dessert / noheading slice=none value=none label=("50% less filling")
        donutpct=50 ;
  footnote "Stay slim with a Pie Hole Trim!" ;
run ;
quit ;
```
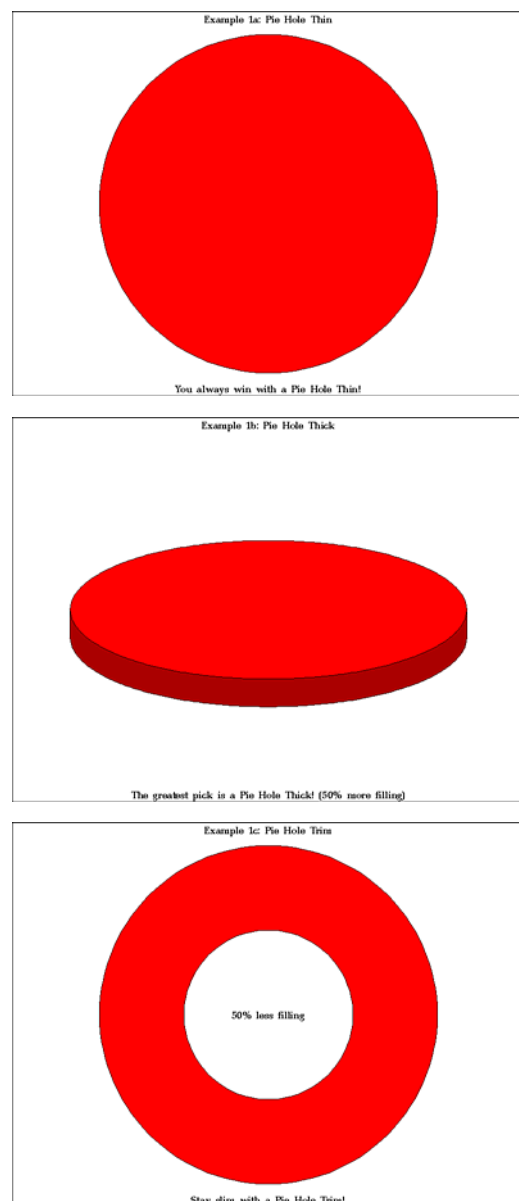
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Figures 1-3. PIE | PIE3D | DONUT statements

 ▸ *Example 2*

The team of specialists initially figured that presenting three styles of pie would add enough intrigue to draw more customers; however, additional analysis suggested that offering greater portion selection would help further attract people to the restaurant. Since its launch, The Pie Hole has only sold pies whole or in small evenly cut slices. A major downside of this is that patrons tend to buy only one slice at a time, resulting in lower sales. Having a wider range of slices and prices would surely bring in new and bring back old customers with varying degrees of appetites.

In order to properly demonstrate the breakdown in slice and price, Steffi Graph included the SUMVAR= option on the PIE, PIE3D, and DONUT statements that were used to create the above images. This particular option allows a programmer to specify the numeric variable for sum or mean calculations that the GCHART procedure uses to determine each midpoint (slice). The resulting statistics are represented by the size of the slice and displayed beside each one. In this case, the information is shown within the slices since the SLICE= and VALUE= options were both set to *inside*. A unique format was applied to display the prices for every slice instead of the actual values from the underlying data set that were used to calculate the midpoints. With this new price and slice structure in effect, customers will be likely to purchase larger slices to get more bang for their buck, ensuring an overall sales increase.

```
goptions device=gif gsfname=chart hpos=100 vpos=100 htext=2 ftext=zapfb ;

proc format ;
   value example2a 1="$1.99" 2="$2.99" 3="$3.99" 6="$6.99" ;
   value example2b 1="$3.99" 2="$5.99" 3="$7.99" 6="$13.99" ;
   value example2c 1="$0.99" 2="$1.49" 3="$1.99" 6="$3.49" ;
run ;

data example2 ;
   input size $8. portion ;
   datalines ;
Small     1
Medium    2
Large     3
X-Large   6
;
run ;

filename chart "C:\My Documents\Graphs\example2a.gif" ;
proc gchart data=example2 ;
   title "Example 2a: Pie Hole Thin Slices" ;
   pie size / sumvar=portion noheading slice=inside value=inside ;
   format portion example2a. ;
   footnote "Get a whole Pie Hole Thin for just $12.99!" ;
run ;
quit ;

filename chart "C:\My Documents\Graphs\example2b.gif" ;
proc gchart data=example2 ;
   title "Example 2b: Pie Hole Thick Slices" ;
   pie3d size / sumvar=portion noheading slice=inside value=inside ;
   format portion example2b. ;
   footnote "Get a whole Pie Hole Thick for just $25.99!" ;
run ;
quit ;

filename chart "C:\My Documents\Graphs\example2c.gif" ;
proc gchart data=example2 ;
   title "Example 2c: Pie Hole Trim Slices" ;
   donut size / sumvar=portion noheading slice=inside value=inside
         donutpct=50 ;
   format portion example2c. ;
   footnote "Get a whole Pie Hole Trim for just $6.49!" ;
run ;
quit ;
```
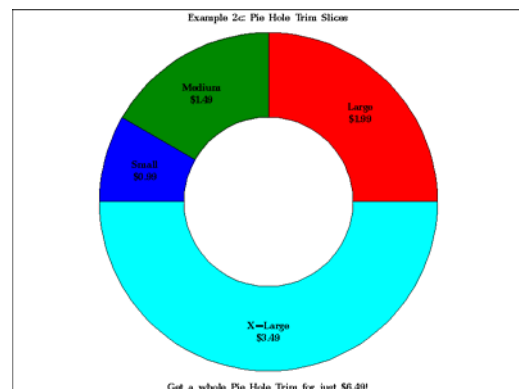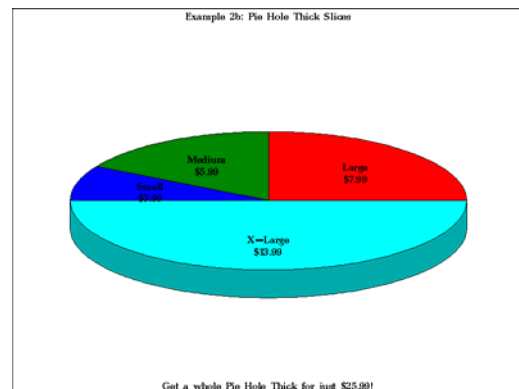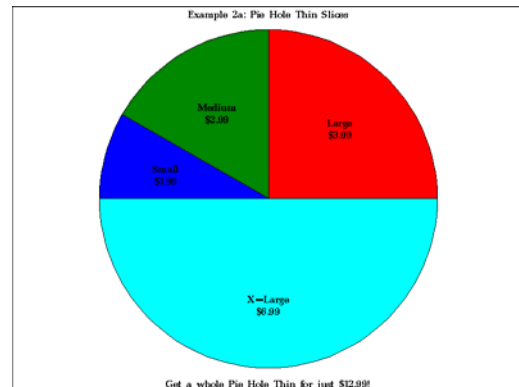
→

Figures 4-6. PIE | PIE3D | DONUT statements with SUMVAR= option

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Example 3

The results of the statistical research project performed by the marketing team indicated that customers were generally not as satisfied with their dining experience as they were with the food. The Pie Hole still has its traditional décor in place and has been in need of renovation for some time. Even the tableware is out-of-date, which presents customers with a bad impression of the restaurant and, consequently, the pies. Ryan SeaCrust, the well-liked host of The Pie Hole, has observed patrons exiting the restaurant lacking any enthusiasm, when in fact they should have been seen leaving in high spirits since they had just eaten the greatest pie in all of America. Many efforts have been made to convince management that changes are needed, but little has ever been done due to the elevated costs of implementation. Ryan knew that the owners would agree to make small improvements, as long as they were economical. Over time, the long-standing host had learned how to brighten up people's day for free simply by telling them interesting (and sometimes fictional) anecdotes about the restaurant, like how Kevin Baken stumbled upon his pie recipes. Just as how jokes and trivia printed on popsicle sticks, inside candy wrappers, or under bottle caps can instantly delight consumers, Ryan figured the same could be done with the desserts served at The Pie Hole. He suggested that the restaurant print interesting facts on all of its dishes so customers would also get some food for thought whenever they finished eating a pie. Given the recent developments, the team expanded upon this idea to produce pie charts with company information that would be printed on the bottom of every pie container.

Ryan SeaCrust understands that customers are curious to learn about the restaurant and its mouth-watering pies. One piece of information that people are always asking of him is what the best selling desserts are at The Pie Hole. For this reason, Ryan requested that the team create a chart showing the most frequently purchased pies. Moreover, Ryan thought the visuals would look best if they were printed in the same brownish color as the pie crusts. For this graphic, the size of each slice should be proportionate to the number of sales for the given flavor. To make certain the actual sales figures would not be disclosed to the public, the team chose to display only the percentage of each midpoint (i.e. *value=none percent=inside*). Also, the few flavors that are not as commonly sold were to be combined into a single slice. Conveniently, the OTHER= option can be included to collect midpoints with chart statistic values less than or equal to a user-defined value between 0 and 100 (4 is the default) into a generic "OTHER" slice. In this case, the team wanted to display slices for only those flavors making up more than 5% of total sales. Using the OTHERLABEL= option, the team could mark that particular "All Others" slice appropriately. To get the results to appear in the same color as the pie crusts, the CFILL= option, which specifies one color for all patterns in the chart, was set to *STYBR* (i.e. strong yellowish brown). This is just one of many predefined colors that can be used with SAS/GRAPH software. To rotate the same pattern for every slice in the chart, the FILL= option was set to *solid*. Customers (at least those who finish eating) can confirm that while nothing compares to the taste of warm apple pie, which makes up a quarter of all sales at the restaurant, cherry is also an American pie favorite served there. Knowing 12 flavors are available, it should be clear which pies are included in the "All Others" slice.

```
goptions device=gif gsfname=chart hpos=100 vpos=100 htext=2 ftext=zapfb ;

data example3 ;
  input flavor $15. sales ;
  datalines ;
Apple          6127
Banana Cream   911
Blueberry      875
Cherry         4592
French Silk    1106
Key Lime       1869
Lemon Meringue 1227
Peach          1322
Pecan          1870
Pumpkin        2991
Rhubarb        1794
Sweet Potato   997
;
run ;

filename chart "C:\My Documents\Graphs\example3.gif" ;
proc gchart data=example3 ;
  title "Example 3: Most Frequently Purchased Pies" ;
  pie flavor / sumvar=sales noheading slice=inside value=none percent=inside
     fill=solid cfill=STYBR other=5 otherlabel="All Others" ;
  footnote "The 'All Others' slice contains pies purchased < 5% of the time" ;
run ;
quit ;
```
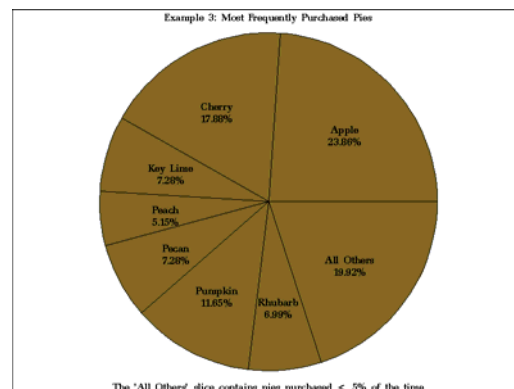

Figure 7. PIE statement with OTHER= option

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▸ Example 4

Barry and Sweetie Pie, relishing their past success, are usually more concerned with locking in the optimal tee time than they are with participating in the day-to-day operations of the restaurant. To keep their fingers in every pie, however, the owners of this popular establishment pass through the local markets themselves each week to purchase fresh ingredients. Spending most of the time chit-chatting with the vendors and singing their own praises, Barry and Sweetie typically take the easy route and purchase the same type and quantity of ingredients every visit. This allows the owners to not only keep better track of their business expenditures since they pay roughly the same amount for ingredients each week, but also to maintain oversight of the total production of pies. As a consequence of their cavalier efforts, there have been times when too many or too few ingredients were purchased, leading to a surplus or shortage of pies, respectively. John Dough, the head of finances, has looked at the company data and on occasion made known the fact that The Pie Hole has been losing money. To use up all ingredients, Kevin Baken spends a lot of time making pies that inevitably go unpurchased. In addition, some customers do not return after having traveled a great distance only to find that the flavor they desire is unavailable. John has tried to show Barry and Sweetie results that support his findings, but the owners do not go to the trouble of considering these lengthy tabular reports.

To get his message across, John had the team generate a pie chart that summarizes the critical data for Barry and Sweetie to grasp more quickly than the tabular formatted results. The sales of certain flavors fluctuate by season with changes in customers' tastes; therefore, it is necessary for the owners to adjust their purchasing habits, ensuring that the head chef has just enough ingredients to make the right amount of pies. Building on the previous example, the marketing team first broke down the sales figures to indicate pie purchases by Winter, Spring, Summer, and Fall. Using the GROUP= option, which performs much like the BY statement in a DATA step, the team could produce a separate pie chart for each season in one process. By default, the charts were created in ascending order of the group variable value and each was drawn to a separate display. Since the team wanted all four pies to appear in the same image, they assigned a value of "2" to both the ACROSS= and DOWN= options on the PIE statement. Similar to the desserts at The Pie Hole, which are all cut clearly, this chart is also clear-cut. The owners can at once come to terms with the data depicted in this visual and, thus, become inspired to adjust their purchasing patterns accordingly.

```
goptions device=gif gsfname=chart hpos=100 vpos=100 htext=2 ftext=zapfb ;

data example4 ;
   input season $7. flavor $15. sales ;
   datalines ;
Winter   Apple           1675
Winter   Banana Cream    164
Winter   Blueberry       137
Winter   Cherry          966
Winter   French Silk     278
Winter   Key Lime        134
Winter   Lemon Meringue  299
Winter   Peach           112
Winter   Pecan           787
Winter   Pumpkin         1125
Winter   Rhubarb         268
Winter   Sweet Potato    312
…
Fall     Apple           1466
Fall     Banana Cream    209
Fall     Blueberry       146
Fall     Cherry          1059
Fall     French Silk     258
Fall     Key Lime        186
Fall     Lemon Meringue  290
Fall     Peach           199
Fall     Pecan           759
Fall     Pumpkin         1254
Fall     Rhubarb         318
Fall     Sweet Potato    307
;
run ;

filename chart "C:\My Documents\Graphs\example4.gif" ;
proc gchart data=example4 ;
   title "Example 4: Most Frequently Purchased Pies by Season" ;
   pie flavor / sumvar=sales noheading slice=inside value=none percent=inside
       fill=solid cfill=STYBR other=5 otherlabel="All Others" group=season
       across=2 down=2 ;
   footnote "The 'All Others' slice contains pies purchased < 5% of the time" ;
run ;
quit ;
```
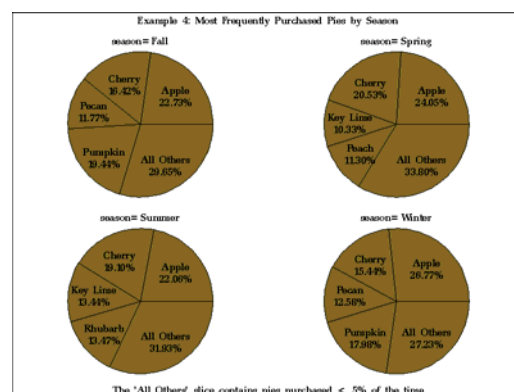

Figure 8. PIE statement with GROUP= option

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▸ *Example 5*

Even though the team had only designed a few basic pie charts up to this point, they seemed to be making substantial progress into improving how information gets delivered to both management and customers. Plans are underway to attach informative pie charts on the bottom of all serving containers in an effort to amuse customers who finish eating a whole pie. While this idea does set the restaurant in the right direction towards achieving a higher level of customer satisfaction, it will not necessarily have an effect on all patrons, particularly those who order pies by the slice. Another one of the marketing team's more practical recommendations for keeping customers interested and wanting to revisit the restaurant was to hold a contest to determine a new flavor of pie. The Pie Hole has been serving the same 12 pie flavors since its establishment, and the pastry chef, Kevin Baken, has been eager to share one more of his many favorite recipes with the rest of the community. By encouraging them to participate in this vote, customers would feel appreciated as they will have an actual impact on the menu offerings. The restaurant could definitely generate a lot of buzz if it were to publicize the "Baker's Dozen Contest" via meaningful pie charts.

With the support of Ryan SeaCrust and Kevin Baken, the marketing team was able to prove to the head financial executive, John Dough, and owners, Barry and Sweetie Pie, that pulling off the contest would be affordable and profitable. During their presentation, Steffi Graph, the team's key programmer, only needed to show the strategy by which the contest results would be made public to fully convince management. She demonstrated how easy it was with SAS/GRAPH to hide or emphasize the slice representing the winning pie flavor on all promotional materials. Once the vote is finally tallied, pie charts will be posted around the restaurant, throughout the town, and in the local newspaper denoting when the winning selection would be made available. The newly chosen flavor will not appear as a slice in that pie chart for added suspense. To show this effect, Steffi appropriately assigned the INVISIBLE= option on the PIE statement. A single hatch pattern was applied to the output with FILL= set to *X* (or by excluding this option, as shown here). The team chose to arrange the slices in ASCENDING order of the value of the chart statistic. To complete a Pac-Man-like appearance, the first midpoint was started at a specific angle (i.e. *angle=100*). While the total number and percentage of votes were displayed on the outside of every slice (i.e. *value=outside percent=outside*), the flavor label was included within each one (i.e. *slice=inside*). When the contest winner is finally revealed, the complete chart will be made widely public. For that image, EXPLODE= will be applied to add emphasis to the "Blackberry" slice such that it would be pulled slightly out from the rest of the pie. The "Baker's Dozen Contest" is sure to fuel the excitement of all those who have been interested in adding a 13th pie to the menu.

```
goptions device=gif gsfname=chart hpos=100 vpos=100 htext=2 ftext=zapfb ;

proc format ;
   picture example5_ low-high="999 Votes" ;
run ;

data example5 ;
   input flavor $15. votes ;
   datalines ;
Blackberry     648
Cranberry      377
Mixed Berry    393
…
Mud            341
Strawberry     479
Sugar          432
;
run ;

filename chart "C:\My Documents\Graphs\example5a.gif" ;
proc gchart data=example5 ;
   title "Example 5a: The New Customer-Voted Pie is...?" ;
   pie flavor / sumvar=votes noheading slice=inside value=outside
       percent=outside cfill=Y ascending angle=100 invisible="Blackberry" ;
   format votes example5_. ;
   footnote "The new pie will be revealed on Friday at noon!" ;
run ;
quit ;

filename chart "C:\My Documents\Graphs\example5b.gif" ;
proc gchart data=example5 ;
   title "Example 5b: The New Customer-Voted Pie is...Blackberry!" ;
   pie flavor / sumvar=votes noheading slice=inside value=outside
       percent=outside cfill=Y ascending angle=100 explode="Blackberry" ;
   format votes example5_. ;
   footnote "Buy 2 Blackberry pies, get 1 Blackberry pie free!" ;
run ;
quit ;
```
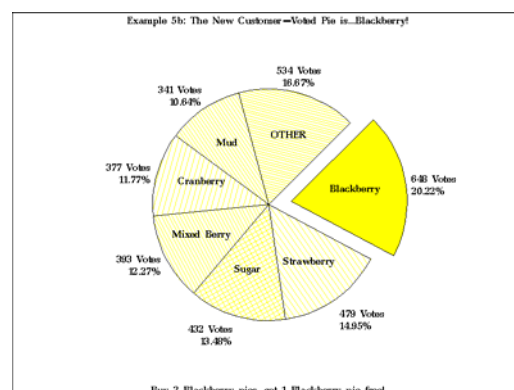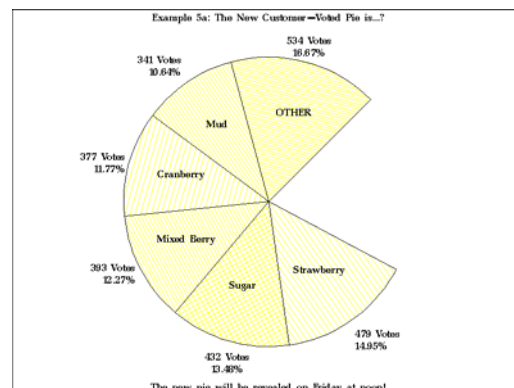
→

Figures 9-10. PIE statement with INVISIBLE= | EXPLODE= options

7

▸ *Example 6*

The number of health-conscious individuals has been growing over time due to an increased awareness of the importance of diet and exercise. These days, a great deal of restaurant-goers are more concerned with the nutritional value of their meal than they are about the cost. Efforts are now being made at The Pie Hole to deal with such changing needs of customers. As described earlier, the restaurant will soon be offering a wide variety of serving options to cater not only to individuals who want to limit their food intake, but also customers still craving sizeable portions. Staying committed to this idea, the team figured it would please a number of people if nutritional information regarding the pie ingredients was made available. Customers concerned with keeping a healthy diet and managing their weight may then select a pie flavor and slice size accordingly. The team could create a series of easy-to-read charts that show the nutritional content of every dessert and publish the graphics on the back of menus.

In order to persuade management that this idea was not just pie in the sky, the team needed to demonstrate how easy it was to generate the charts using SAS/GRAPH. Barry and Sweetie Pie asked the team to build a graphic providing a calorie breakdown of all 12 original pies served at the restaurant as an example of what could be achieved. Arranging all the slices in order of calorie content, from low to high, was determined to be the most effective way to present the data. To achieve the desired output, Steffi Graph, the team's main programmer, executed another GCHART procedure with a few additional options not previously used. The code was designed to draw all the slices CLOCKWISE starting at the 12 o'clock position and in ASCENDING order. Given the amount of content included inside the pie chart, the text boundaries for the slices overlapped. In view of that, Steffi assigned the SLICE= option to *arrow* to position the labels for each flavor outside the slice and connected by a line. The team wanted to match the colors of each slice to the corresponding flavor so that customers could at once recognize their pies of interest. With SAS/GRAPH, the color and type of area fill for patterns of a graphic can be controlled using the PATTERN statement. By including one for each slice, Steffi could define the specific colors applied to the midpoints. The RGB color-naming scheme was used to define the colors in terms of their red, green, and blue components. When a PATTERN statement is included, the outline color of each slice will be set to the same as that of the interior pattern by default. For that reason, the COUTLINE= option was assigned to *BL* to apply a dark outline around every slice. Building from this example, the team will be able to generate the other nutritional charts.

```
goptions device=gif gsfname=chart hpos=100 vpos=100 htext=2 ftext=zapfb ;

data example6 ;
   input flavor $15. calories ;
   datalines ;
Apple             255
Banana Cream      505
Blueberry         380
Cherry            450
French Silk       680
Key Lime          365
Lemon Meringue    355
Peach             425
Pecan             625
Pumpkin           280
Rhubarb           375
Sweet Potato      325
;
run ;

filename chart "C:\My Documents\Graphs\example6.gif" ;
proc gchart data=example6 ;
   title "Example 6: Calories per Slice" ;
   pie flavor / sumvar=calories noheading slice=arrow value=inside ascending
       clockwise coutline=BL ;
   pattern1 color=CX990000 ;
   pattern2 color=CXFFFF99 ;
   pattern3 color=CX3333CC ;
   pattern4 color=CXCC0000 ;
   pattern5 color=CX663300 ;
   pattern6 color=CX00CC66 ;
   pattern7 color=CXFFFF33 ;
   pattern8 color=CXFF9966 ;
   pattern9 color=CX996633 ;
   pattern10 color=CXFF9900 ;
   pattern11 color=CXCC0066 ;
   pattern12 color=CXFFCC66 ;
   footnote "These numbers are based on a small slice of a Pie Hole Thin" ;
run ;
quit ;
```
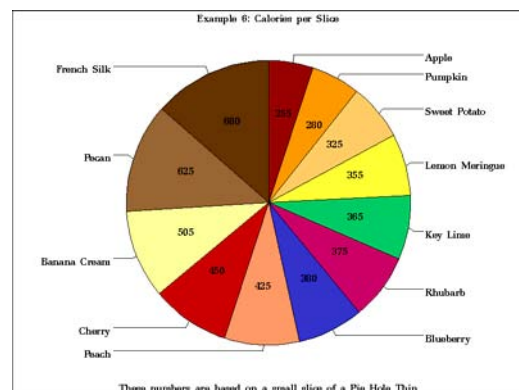
→

Figure 11. PIE statement with PATTERN statements

 ▸ *Example 7*

The previous demonstration had a very positive effect on management. Knowing how easy it would be for Steffi to create these informative charts using SAS/GRAPH, a plan was set to produce the updated menus. Before any orders for a new menu were authorized, however, the marketing team wanted to show the executives an alternative display of the same results. As more ideas for incorporating pie charts into the promotional campaign are cooked up, the team figured that information must be presented in a number of different ways in order to sustain the novelty effect.

Although the nutritional charts are not all that elaborate, the team wanted to prove to management that SAS/GRAPH offered the flexibility to present similar data with a variety of layouts and formats very easily. To make evident this point, Steffi Graph tailored the sample code slightly to produce an alternative "Calories per Slice" chart that included a legend. There are times when legends help minimize the confusion brought upon by charts with lots of pointers and labels. The LEGEND statement is used to define and control characteristics of a legend, including the position and appearance of the legend box; the text and appearance of the legend label; the appearance of the legend entries, including the size and shape of the legend values; and the text of the labels for the legend values. For this substitute chart, the text labeling each of the pie flavors and the connecting lines were removed. Steffi included a LEGEND statement defined as "label1" in the procedure with several unique settings applied. To get the legend to appear on the left-hand side of the pie and vertically centered in the graphic, she specified the POSITION= option. The ACROSS= option was set accordingly to ensure the legend entries are all shown in one column. Other options (i.e. *cblock=MEGR cborder=DAGR cframe=LIGR*) were included to control the colors of the three-dimensional block effect behind the legend, the colored frame around the legend, and the background color of the legend. All the entries appear in the same order they do in the pie given how they were listed with the ORDER= option. As a rule, LEGEND definitions are not automatically applied to chart results, so they must be explicitly assigned with a LEGEND= option in the procedure statement. Although this visual may not be any clearer than its counterpart above, the team was able to validate that the use of legends for other promotional pies can be an effective technique.

```
goptions device=gif gsfname=chart hpos=100 vpos=100 htext=2 ftext=zapfb ;

data example7 ;
  input flavor $15. calories ;
  datalines ;
Apple          255
Banana Cream   505
Blueberry      380
Cherry         450
French Silk    680
Key Lime       365
Lemon Meringue 355
Peach          425
Pecan          625
Pumpkin        280
Rhubarb        375
Sweet Potato   325
;
run ;

filename chart "C:\My Documents\Graphs\example7.gif" ;
proc gchart data=example7 ;
  title "Example 7: Calories per Slice" ;
  pie flavor / sumvar=calories noheading slice=none value=inside ascending
      clockwise coutline=BL legend=legend1 ;
  legend1 label=none position=(left middle) offset=(2, 4) across=1
          shape=bar(4, 4) cblock=MEGR cborder=DAGR cframe=LIGR
          order=("Apple" "Pumpkin" "Sweet Potato" "Lemon Meringue"
          "Key Lime" "Rhubarb" "Blueberry" "Peach" "Cherry" "Banana
          Cream" "Pecan" "French Silk") ;
  pattern1 color=CX990000 ;
  pattern2 color=CXFFFF99 ;
  pattern3 color=CX3333CC ;
  pattern4 color=CXCC0000 ;
  pattern5 color=CX663300 ;
  pattern6 color=CX00CC66 ;
  pattern7 color=CXFFFF33 ;
  pattern8 color=CXFF9966 ;
  pattern9 color=CX996633 ;
  pattern10 color=CXFF9900 ;
  pattern11 color=CXCC0066 ;
  pattern12 color=CXFFCC66 ;
  footnote "These numbers are based on a small slice of a Pie Hole Thin" ;
run ;
quit ;
```
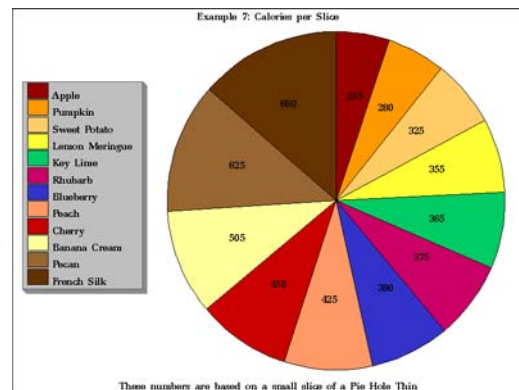
→

Figure 12. PIE statement with LEGEND statement

▸ *Example 8*

In the past, John Dough tried to get Barry and Sweetie Pie to make adjustments to their business by providing them with tabular reports to substantiate such changes, but he was never really successful. Using a few basic pie charts to deliver the same information, however, the team was able to win over the restaurant owners by showing the summary data in a way they could better understand. To keep pace with the new marketing campaign, the team must continue to produce pie charts to deliver important information to management. For instance, John Dough figured that some of the proposed changes, like the newly suggested pie types (i.e. Thin, Thick, and Trim), would affect the purchasing patterns of customers. Knowing the owners were more inclined to consider data presented in graphical format, John wanted to make a chart showing them the potential outcome of offering a wider pie selection.

To this point, the team had been using SAS/GRAPH to create some fairly simple graphics that would drive The Pie Hole's new marketing strategy. Still, the GCHART procedure can be tailored even further with additional options (available for PIE and DONUT only) to produce more detailed pie charts. Specifically, these options enable programmers to create pie charts with an inner pie overlay. This inner pie aligns with the slices of the outer pie and displays the major components that make up the outer pie's slices. Taking advantage of these particular options, John had Steffi Graph develop a chart to show the potential breakdown of pie orders by gender should the selection of pie sizes increase. The DETAIL= option was set to the "gender" variable, the values of which were used to construct the inner overlay. To display the variable labels, data values, and percentages for the detail pie slices, Steffi included the DETAIL_SLICE=, DETAIL_VALUE=, and DETAIL_PERCENTAGE= options, respectively. Setting these options to *best* forces SAS to utilize the best-fit algorithm to place the labels most effectively. The DETAIL_THRESHOLD= option indicates the percent threshold that determines if a detail slice is included in the inner pie. For this chart, Steffi set it to "0" to ensure that all the detailed information was displayed for the inner overlay. The size of the inner pie overlay was determined by specifying the percentage of the outer pie's radius (i.e. *detail_radius=85*). She chose unique colors for each slice, and also included the MATCHCOLOR option on the PIE statement to apply the same pattern colors to the text labels. Using previously learned tips, a legend was easily added to the chart to distinguish among the three styles of pies. A quick analysis of the results brings to light several meaningful conclusions. According to the sample data set used, the most popular size of pie sold at the restaurant is the original Thin. It is also clear to see that a little more than a quarter of all sales are to males purchasing a Pie Hole Thick. Closer inspection of this graphic reveals that females are three times more likely to purchase the Trim than their male counterparts. The owners expect an updated version of this pie chart whenever real data is available.

```
goptions device=gif gsfname=chart hpos=100 vpos=100 htext=2 ftext=zapfb ;

proc format ;
  picture example8_ low-high="999 Orders" ;
run ;

data example8 ;
  input gender $7. style $6. orders ;
  datalines ;
Male     Thin    366
Male     Thick   531
Male     Trim    103
Female   Thin    512
Female   Thick   181
Female   Trim    307
;
run ;

filename chart "C:\My Documents\Graphs\example8.gif" ;
proc gchart data=example8 ;
  title "Example 8: Pie Selection by Gender" ;
  pie style / sumvar=orders noheading slice=none value=outside
      percent=outside coutline=BL matchcolor legend=legend1
      detail=gender detail_slice=best detail_value=none
      detail_percent=best detail_threshold=0 detail_radius=85 ;
  legend1 label=none position=(bottom center) offset=(0, 4) across=3
          shape=bar(4, 2) cblock=MEGR cborder=DAGR cframe=LIGR ;
  pattern1 color=ROSE ;
  pattern2 color=OLIVE ;
  pattern3 color=LIGB ;
  format orders example8_. ;
  footnote "The first 1000 orders from each gender were counted" ;
run ;
quit ;
```
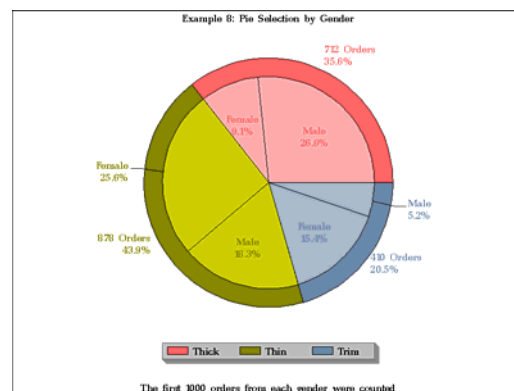
→

Figure 13. PIE statement with DETAIL= option

CONCLUSION

Once a notably thriving business, The Pie Hole fell into economic hardship due to flaky management practices and a crumby marketing campaign. A team was promptly formed to explore these problem areas and recommend a plan for recovery.   Thanks to the resourceful and diligent efforts of the staff, a new promotional strategy was implemented. Using the right amount of SAS/GRAPH ingredients, the team cooked up a series of interesting pie charts to deliver essential information to all the company's stakeholders. Graphics were presented to high-level executives to facilitate their decision-making activities by providing them a clear-cut snapshot of summarized corporate data. Customers benefited from the colorful charts in that they could learn more about the restaurant and its delicious dessert offerings. The team gained experience customizing the pie chart results using a wide variety of layout and format options available for the PIE, PIE3D, and DONUT statements. With total control over the appearance of text labels and color patterns, the pies could be tailored appropriately.   Legends were easily incorporated into the graphics to reduce clutter and minimize confusion. It was also possible for the team to include additional content with inner pie overlays using the detail options available with SAS/GRAPH. Having drawn on these pie charts in many ways, the restaurant had overcome its financial woes to become successful again. At the end of a recent corporate celebration, the pie-eyed owners thanked the team and vowed never to shut The Pie Hole. Over time, the team will continue to churn out different visuals and come up with innovative ways to reinvent the business. In point of fact, The Pie Hole is soon to unveil a new line of pot pies and pizza pies, venturing outside of the world of just desserts. This exciting promotion will make certain the popular restaurant remains a cut above the rest. Now familiar with the basics of SAS/GRAPH, the team plans to learn about and exploit some of the more advanced utilities to develop other stylish and informative charts to communicate vital data to business stakeholders.

The story of The Pie Hole is not all that unusual: as the landscape of the Information Age continues to evolve, it is critical that businesses are able to anticipate, acknowledge, and accept change in order to be successful. This requires decision-makers at all different levels to understand and use data to their advantage. It can be a challenge, however, for organizational leaders to absorb and apply information effectively as the need for data collection activities continues to rise in today's corporate world. Business analysts are therefore tasked with examining certain data and producing summary tables on which decision-managers can draw. These users can advance their data analysis and reporting efforts, and improve decision-making across the enterprise by exploiting software designed for interactive and dynamic statistical graphics. The visualization offerings of SAS/GRAPH help bring to bear the insights derived from comprehensive data analyses by enabling users to present their findings to business stakeholders through a wide variety of plots, charts, and maps. All these graphical elements can be created and customized, and then stored in catalogs for easy access. While there does exist a large assortment of output options, the content discussed in this paper serves solely as an introduction to the development of pie charts. Perhaps the most common and effective visual for displaying summarized information, the pie can be offered to highlight key statistics in place of or as a supplement to tabular data formats. Pie charts are useful for comparing a set of categorical data using the size of each slice to graphically represent the contribution of the corresponding value to the total chart statistic.   With the use of such accurate, high-impact graphics, business analysts can uncover relationships more easily and present the results in ways decision-makers may better understand. SAS offers three variations of this kind of chart, including PIE, PIE3D, and DONUT, in addition to sub-grouped pies. With the many options available through SAS/GRAPH, programmers can control and enhance their pie results with different dimensions, labels, colors, and styles. Pie charts can be delivered conveniently to key stakeholders via printed reports, presentation materials, email, the Web or embedded in other applications. By and large, SAS/GRAPH is a robust and flexible software solution that allows organizations to keep pace with the visualization demands of today.

RESOURCES

SAS Institute Inc. 2004. *SAS/GRAPH*® *9.1 Reference, Volumes 1 and 2*. Cary, NC: SAS Institute Inc.

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CONTACT INFORMATION

Jonah P. Turner
International Trade Administration
1401 Constitution Ave., NW
Washington, DC 20230-0001
(202) 482-5454 or jonah.turner@mail.doc.gov

APPENDIX

PIE | PIE3D | DONUT *chart-variable(s) </ option(s)>*;

option(s) can be one or more options from any or all of the following categories:

- appearance options

  ANNOTATE=*Annotate-data-set* – specifies a data set to annotate charts produced by the PIE, PIE3D, or DONUT statement.
  CFILL=*fill-color* – specifies one color for all patterns in the chart, regardless of whether the fill is solid or hatch.
  COUTLINE=*slice-outline-color* | SAME – outlines all slices, rings (subgroups), and legend values (if a legend appears) in the specified color.
  DETAIL_RADIUS=*percent* (PIE and DONUT only) – determines the size of the detail pie.
  EXPLODE=*value-list* – pulls the specified slices slightly out from the rest of the pie for added emphasis.
  FILL=SOLID | X – specifies the fill pattern for all slices in the chart.
  INVISIBLE=*value-list* – makes the specified slices invisible, as if they had been removed from the pie.
  NOHEADING – suppresses the heading that is normally printed at the top of each page or display of output for all devices except Java and ActiveX.
  OTHERCOLOR=*color* – specifies the color to use for the OTHER slice.
  WOUTLINE=*slice-outline-width* – specifies the width of the outline in pixels.

- statistic options

  FREQ=*numeric-variable* – specifies a variable whose values weight the contribution of each observation in the computation of the chart statistic.
  SUMVAR=*summary-variable* – specifies a numeric variable for sum or mean calculations.
  TYPE=*statistic* – specifies the chart statistic.

- midpoint options

  DISCRETE – treats a numeric chart variable as a discrete variable rather than as a continuous variable.
  LEVELS=*number-of-midpoints* | ALL – specifies the number of midpoints for a numeric chart variable.
  MIDPOINTS=*value-list* – specifies the midpoint values for the slices.
  MIDPOINTS=OLD – generates default midpoints using the Nelder algorithm.
  MISSING – accepts a missing value as a valid midpoint for the chart variable.
  OTHER=*percent-of-total* – collects all midpoints with chart statistic values less than or equal to *percent-of-total* into a generic midpoint named OTHER.

- detail pie options (PIE and DONUT only)

  DETAIL=*variable* – produces an inner pie overlay whose slices show the major components that comprise the outer pie's slice.
  DETAIL_RADIUS=*percent* – determines the size of the detail pie.
  DETAIL_THRESHOLD=*percent* – determines if a detail slice is included in the inner pie.

- grouping and subgrouping options

  ACROSS=*number-of-columns* – draws *number-of-columns* pies across the procedure output area.
  DOWN=*number-of-rows* – draws *number-of-rows* pies vertically in the procedure output area.
  GROUP=*group-variable* – organizes the data according to values of *group-variable* and produces a separate chart for each unique value of *group-variable*.
  NOGROUPHEADING – suppresses the headings that are normally printed above each pie when you use the GROUP= option.
  SUBGROUP=*subgroup-variable* – divides the chart into concentric rings according to the values of *subgroup-variable*.

- slice-ordering options

  ANGLE=*degrees* – starts the first slice at the specified angle.
  ASCENDING – arranges the slices in ascending order of the value of the chart statistic.
  CLOCKWISE – draws the slices clockwise starting at the 12 o'clock position.
  DESCENDING – arranges the slices in descending order of the value of the chart statistic.
  JSTYLE – arranges the midpoints in descending order of the statistic value and draws the slices clockwise starting at the 12 o'clock position.

- slice-labeling options

  CTEXT=*text-color* – specifies the color for all text on the chart that is not otherwise assigned a color.
  LEGEND | LEGEND=LEGEND<1...99> – generates a legend for the slice names (midpoint values) instead of printing them beside the slices.
  MATCHCOLOR – uses the slice pattern color for all slice labels.
  NOLEGEND – suppresses the legend that is automatically generated by the SUBGROUP= option.
  OTHERLABEL=*'text-string'* – specifies a text string up to 16 characters for the label for the OTHER slice.
  PERCENT=ARROW | INSIDE | NONE | OUTSIDE – prints the percentage represented by each slice using the specified labeling method.
  SLICE=ARROW | INSIDE | NONE | OUTSIDE – controls the position and style of the slice name (midpoint value) for each slice.
  VALUE=ARROW | INSIDE | NONE | OUTSIDE – controls the position and style of the slice value (chart statistic) for each slice.

- detail pie slice-labeling options (PIE and DONUT only)

  DETAIL_PERCENT=BEST | NONE – specifies the algorithm to use for displaying the percentage values for the detail pie slices.
  DETAIL_SLICE=BEST | NONE – specifies the algorithm to use for displaying the detail variable labels for the inner pie slices.
  DETAIL_VALUE=BEST | NONE – specifies the algorithm to use for displaying the data values for the detail pie slices.

- donut-labeling options (DONUT only):

  DONUTPCT=*percent* – specifies the size of the donut hole in percent of the radius of the whole chart.
  LABEL=(*text argument(s)*) – defines the text that is displayed in the donut hole.

- catalog entry description options

  DESCRIPTION='*entry-description*' – specifies the description of the catalog entry for the chart.
  NAME='*entry-name*' – specifies the name of the catalog entry for the graph.

- ODS options

  HTML=*variable* – identifies the variable in the input data set whose values create links in the HTML file that is created by the ODS statement.
  HTML_LEGEND=*variable* – identifies the variable in the input data set whose values create links in the HTML file created by the ODS statement.

Note: See *SAS/GRAPH® 9.1 Reference* to learn all about the GCHART procedure and the PIE, PIE3D, DONUT, GOPTIONS, PATTERN, and LEGEND statements.