AN OVERVIEW OF GRAPHICAL REPRESENTATION OF DAIRY SCIENCE DATA USING SAS AND EG

A.P. Ruhil and Tara Chand
National Dairy Research Institute, Karnal-132001

Science is a discipline that involves the planning of experimentations, collecting and organizing data, evaluating the results and presenting its findings to public or concerned person. Therefore as a researcher one need to develop the skills for researching information, designing experiments then analyzing and presenting the data produced. The produced data can be presented in various forms like text, table or graph. Each method has some merits and demerits. It is commonly said that “a graph is worth a thousand words” so we can understand the importance of graphs in scientific community. Among all methods the graphical method is the most effective way to describe, explore and summarize a set of numbers. In modern society graphs are extensively used to represent trend, profit and loss, quantities, sales figures, growth and decline, comparison, ratios, etc. Statistical methods in combination with graphical representation form a powerful tool to analyze and communicate information. According to an estimate two trillion images of statistical graphs are produced every year. The new techniques of graphical representation are evolving rapidly.

Though it is difficult to trace the history of creation of graphs but it is assumed that first time the graphs appeared around 1770 and they became popular only around 1820-30. They appeared in three different places independently at different time at statistical atlases of William Playfair, the indicator diagrams of James Watt, and the writings of Johann Heinrich Lambert. William Playfair’s first presented the graphs in his Commercial and Political Atlas of 1785. James Watt’s indicator was the first self recording instrument which drew a pressure-volume graph of steam in the cylinder of an engine while it was in action. Johann Heinrich Lambert used the graphs extensively in eighteenth century. He used graphs in the 1760-70s not only to present data but also to average random errors by drawing the best curve through experimental data points. By 1790s graphs of several different forms were available but they were ignored until 1820-30s, when statistical and experimental graphs became much more common.

With the advent of computers the generation of graphs has becomes an easier task and even a novice can produce beautiful graphs with in a few minutes with the help of computer. However it has also restrained the creative process involved in graphical representation of data by making the creation of such graphs easy only in certain standardized forms available in the software packages. In the literature we found that the words Diagram, Charts and Graph are commonly being used interchangeably. Therefore, let us first understand the meaning of each of the term before moving ahead. The dictionary meanings of these words are as follows:

**Diagram:** 1. A figure usually consisting of lines drawing, made to accompany and illustrate a geometrical theorem, mathematical demonstration, etc.
   2. A drawing, sketch or plan that outlines and explains the parts, operation, etc. of something for example a diagram of an engine.
   3. A pictorial representation of a quantity or of a relationship.

**Chart:** 1. A map designed to aid navigation by sea or air.
   2. An outline map showing special conditions or facts e.g. a weather chart.
3. A sheet exhibiting information in tabulated or methodical form.
4. A graphic representation of data as by lines, curves, bars, etc. of a dependable variable e.g. temperature, price, etc.

**Graph:**
1. A drawing representing the relationship between certain set of numbers or quantities by means of a series of dots, lines, bars, etc. plotted with reference to a set of axes.
2. A drawing depicting a relationship between two or more variables by means of a curve or surface containing only those points whose coordinates satisfy the relation.
3. A network of lines connecting points.

This lecture will introduce different tools for generating graphs through computers and presenting the scientific data graphically.

**Comparison between Tabular and Diagrammatic Presentation**
The most popular ways of presenting the data are tabular form or graphical form. Both of these methods have their own importance. Sometime data can be better presented by table than by graphs. For example to determine the price of milk using two axes formula based on fat and SNF percentage. This information can be effectively presented in the form of a table rather than graph. On the other hand generally graphs are efficiently when there is a trend or comparison to be shown. The following table highlights the comparison between the tabular presentation of data and diagrammatic or graphic presentation of data.

<table>
<thead>
<tr>
<th>Diagrammatic Presentation</th>
<th>Tabular Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Diagrams and Graphs are meant for a layman.</td>
<td>Tables are meant for statisticians for the purpose of further analysis.</td>
</tr>
<tr>
<td>2 Diagrams give only an approximate idea.</td>
<td>Tables contain precise figures. Exact values can be read from tables.</td>
</tr>
<tr>
<td>3 Diagrams can be more easily compared, and can be interpreted by a layman.</td>
<td>Comparison and interpretations of tables can only be done by statisticians and it is a difficult task.</td>
</tr>
<tr>
<td>4 Diagrams and graphs cannot present much information.</td>
<td>Tables can present more information.</td>
</tr>
<tr>
<td>5 Diagrams are more attractive and have a visual appeal.</td>
<td>Tables are dull for a layman (may be attractive to a statistician).</td>
</tr>
</tbody>
</table>

**Different forms of Graphical Representations and Visualization**
The various forms of graphical representation and visualization of data or information are as follows:
- Graphs
- Charts
- Diagrams
- Time series
- Data maps and geographical information systems (GIS)
- Narrative graphs
- Animation
- Virtual reality

**Difference between Graph and Diagram**
Actually it is difficult to find out a clear-cut line of demarcation between a diagram and a graph however based on our experience and exposure to different situation we can summarize the following points of difference between a diagram and a graph:
• A graph needs a graph paper but a diagram can be drawn on a plain paper. In the technical way we can say that a graph is a mathematical relation between two variables. This however is not the case of a diagram.
• As diagrams are attractive to look at, they are used for publicity and propaganda. Graphs on the other hand are more useful to statisticians and research workers for the purpose of further analysis.
• For representing frequency distribution, diagrams are rarely used when compared with graphs. For example, for the time series graphs are more appropriate than diagrams.
• Graphs are drawn using axes while diagram can be drawn in any way.

**Purpose of a Graph/ Diagram**
The purpose of any graph is to visually communicate complex ideas with clarity, precision and efficiency. The presented information in a graph must be understood easily and quickly. The graphs should serve the following purposes:
• To present the data visually.
• To show trends, not detail.
• To show and compare changes.
• To show and compare relationship between quantities.
• To explore data and identify areas worthy of further study.
• To communicate the meaning of large volumes of data in summarized form.
• To make viewer think about the substance of the data not the graphic itself.

**General Principles of Constructing Effective Graph/ Diagram**
How to convey the information through graphs is important in the presentation. The objective of graph is to depict data visually, therefore it is important to avoid visual elements that do not add to the data, and to choose a graph design that visually shows the comparisons you intend to make. Some general rules to keep in mind while preparing graphs are given below:
The graph should be simple and not too messy.
• Show data without changing the data’s message.
• Visual sense should prevail.
• Each diagram must be given a clear, concise and suitable title without damaging clarity.
• Make all text horizontal, practical and readable.
• A proper proportion between height and width must be maintained in order to avoid an unpleasant look.
• Select a proper scale; it should be in even numbers or in multiples of five or ten. e.g. 25, 50, 75 … or 10, 20, 30, 40 … but no fixed rule.
• Use footnotes in order to clear certain points
• An index (or legends), explaining different lines, shades and colors should be given.
• Graphs should be absolutely neat and clean.
• Use a consistent format when showing groups of graphs.
• The methodology, design and technology used to create graph should be transparent.
• Independent, explanatory and category variables are usually plotted on the X-axis.
• Dependent or response variables are usually plotted on Y-axis.
• The position, size, shape, length, symbols, angle and color are all visual codes that carry messages so be sure these must be right one.
• The graph should be closely supported with statistical and textual description of data.
"The important point that must be borne in mind at all times that the pictorial representation chosen for any situation must depict the true relationship and point out the proper conclusion. Above all the chart must be honest."... C. W. LOWE.

<table>
<thead>
<tr>
<th>Advantages of Graphs</th>
<th>Disadvantages of Graphs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick way for the reader to visualize what we want to convey – trends up or down</td>
<td>Time consuming to make – decision must be made in advance for layout, color, etc.</td>
</tr>
<tr>
<td>Forceful – Emphasize main point</td>
<td>Technical in nature – knowledge is required to interpret and understand.</td>
</tr>
<tr>
<td>Convincing – proves a point, see and hear</td>
<td>Costly – depending on the medium used</td>
</tr>
<tr>
<td>Compact way of conveying information</td>
<td></td>
</tr>
<tr>
<td>More interesting than talk</td>
<td></td>
</tr>
</tbody>
</table>

**Software Packages for Constructing Graphs**

Following is the list of few commonly used software packages for constructing graphs, charts, etc.

<table>
<thead>
<tr>
<th>Software Package</th>
<th>Software Package</th>
<th>Software Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS Excel</td>
<td>Sigma Plot</td>
<td>SYSTAT</td>
</tr>
<tr>
<td>Lotus 1-2-3</td>
<td>MATLAB</td>
<td>FOCUS</td>
</tr>
<tr>
<td>Harvard Graphics</td>
<td>Graphical Analysis</td>
<td>SAS &amp; Enterprise Guide</td>
</tr>
<tr>
<td>Prism</td>
<td>SmartDraw</td>
<td>JMP</td>
</tr>
</tbody>
</table>

**Types of Graphs/ Charts**

It is important to know what type of graphs should be used when presenting statistics. There are several types of graphs available for different purposes. Each graph has some characteristics that make it useful and suitable in certain situation. Some of the most commonly used graphs/ charts are given as follows:

<table>
<thead>
<tr>
<th>Type of Graph/ Chart</th>
<th>Line Graph</th>
<th>Pictogram</th>
<th>Cause and Effect Diagram (Ishikawa diagram)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Scatter Plot</td>
<td>Dandogram</td>
<td>Surface plots</td>
</tr>
<tr>
<td></td>
<td>Bar Graph</td>
<td>Dot Chart</td>
<td>Bubble plots</td>
</tr>
<tr>
<td></td>
<td>Histogram</td>
<td>Age pyramid</td>
<td>Radar Chart (or Star Chart)</td>
</tr>
<tr>
<td></td>
<td>Pie Chart</td>
<td>Stem-and-leaf Chart</td>
<td>Tile Chart</td>
</tr>
<tr>
<td></td>
<td>Flow Chart</td>
<td>Box and Whisker</td>
<td>Contour plots and Maps</td>
</tr>
<tr>
<td></td>
<td>Organizational Charts</td>
<td>Cosmograph</td>
<td>Key performance indicator charts (Slider, Dial, Traffic light, Speedometer)</td>
</tr>
</tbody>
</table>

**Selection of the Right Graph**

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Line Graph</th>
<th>Scatter Plots</th>
<th>Bar Graph</th>
<th>Histogram</th>
<th>Pie / Tile Chart</th>
<th>Flow Chart</th>
<th>Organizational Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole and its parts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Proportion of components</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>May be</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hierarchy of components</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple Comparisons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple Comparisons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trends</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
An Overview of Graphical Representation of Dairy Science Data using SAS and EG

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relationship between two variables</td>
<td>May be</td>
<td>Yes</td>
<td>May be</td>
<td></td>
</tr>
</tbody>
</table>

**Graphics using SAS**

SAS provides a wide range of graphical features to produce high quality presentation graphics. As such, SAS/GRAPH:

- Organizes the presentation of data and visually represents the relationship between data values as two- and three-dimensional graphs, including charts, plots, and maps.
- Enhances the appearance of output by allowing selecting text fonts, colors, patterns, and line styles, and controlling the size and position of many graphics elements.
- Creates presentation graphics. SAS/GRAPH can create text slides, display several graphs at one time, combine graphs and text in one display, and create automated presentations.
- Generates a variety of graphics output that can display on screen or in a Web browser, store in catalogs, review, or send to a hardcopy graphics output device such as a laser printer, plotter, or slide camera.
- Provides utility procedures and statements to manage the output.
- Output through ODS – listing, html, pdf, rtf. Default output is Listing stored in SAS catalog.

This lesson describes the graphs that are produced by SAS/GRAPH and explains some of the parts and features of SAS/GRAPH programs.

**Major Components of SAS/GRAPH**

There are several components to SAS/GRAPH software. A few important components are as follows:

**Device-based SAS/GRAPH procedures**: enable to create a variety of graphs, including bar charts, pie charts, scatter plots, surface plots, contour plots, a variety of maps, and much more. The device-based SAS/GRAPH procedures include the GAREABAR, GCHART, G.PLOT, GMAP, GBARLINE, GKPI, GCONTOUR, and G3D procedures, as well as others. These procedures use device drivers to generate output.

**The Annotate Facility**: enables to generate a special data set of graphics commands from which one can produce graphics output. This data set is referred to as an Annotate data set. One can use it to generate custom graphics or to enhance graphics output from many device-based SAS/GRAPH procedures, including GCHART, GPLOT, GMAP, GBARLINE, GCONTOUR, and G3D, as well as others.

**SAS/GRAPH statistical graphics procedures**: provide a simple syntax for creating graphics commonly used in exploratory data analysis and for creating customized statistical displays. These procedures include the SGPANEL, SGPLOT, and SGSCATTER procedures. In addition, the SGRENDER procedure provides a SAS procedure interface to create graphs using the Graph Template Language. These procedures are template-based procedures; they do not use devices like the device-based SAS/GRAPH procedures.
General Procedure for producing Graphs (Submitting SAS/GRAPH Code)

| GOPTIONS graphics specific options
| PROC graphics procedure name DATA = libref.data set;
|     statements specific to the graphics procedure
|     / <statement options>;
| RUN;
| QUIT;

Important Graph/ Charts in SAS

SAS/GRAPH produces many kinds of charts, plots, and maps in both two- and three-dimensional versions. A few important graphs are for understanding the features of SAS are described as follows:

Line Chart

Simple line plots show the relationship of one variable to another, often as movements or trends in the data over a period of time. Typically, each variable value on the horizontal axis has only one corresponding value on the vertical axis. The line connecting data points can be smoothed using a variety of interpolation methods, including the Lagrange and the cubic spline interpolation methods. SAS/GRAPH uses the GPLOT procedure to produce line charts.

A typical procedure is given below for drawing a line chart. In the program there are three sections separated by lines. First section describes the global setting of the chart. Second section describes the actual procedure/ code for drawing a line chart for one variable. Third section reset graphic options and closes all the files opened in first section. Several line charts for one variable, two variables on single axis and four variables on two axis are shown below along with code.

goptions reset = all;
ods html file = 'aprhmt.html' style = egdefault;
ods pdf file = 'apprpdf.pdf';
symbol v=star i=join;

-----------------------------------------------------------
proc gplot data = aprsas.fodder;
title 'Line Chart of Green Fodder';
where farm = 'A';
plot dry *year / overlay legends;
run;
quit;
-----------------------------------------------------------
ods html close;
ods pdf close;
goptions reset = all;
An Overview of Graphical Representation of Dairy Science Data using SAS and EG

```sas
options nogstyle;
goptions reset = all;
ods html file = 'aprhtm.html' style = egdefault;
ods pdf file = 'aprpdf.pdf';
symbol v=star i=join;
-----------------------------------------------------------
proc gplot data = aprsas.fodder;
title 'Line Chart of Green and Dry Fodder';
where farm = 'A';
plot (dry green )*year / overlay legends;
run;
quit;
-----------------------------------------------------------
ods html close;
ods pdf close;
goptions reset = all;
-----------------------------------------------------------
goptions reset=all border;
ods html file = 'aprhtm.html' style = egdefault;
ods pdf file = 'aprpdf.pdf';
symbol1 i=spline w=2 v=triangle c=steelblue;
symbol2 i=spline w=2 v=circle c=indigo;
symbol3 i=spline w=2 v=square c=orchid;
symbol4 interpol=join width=2 value=star c=red;
-----------------------------------------------------------
proc gplot data = aprsas.fodder;
title 'Line Chart for Feed and Fodder Consumption (Two Axis)';
footnote1 j=l "Source: APRSAS.Fodder_Year_Char"
   j=r "A.P. Ruhil";
/*axis2 label=none;*/
axis2 label=('Quantity (kg)');
where farm = 'A';
plot (dry green concentrate)*year / overlay legends vaxis=axis2 ;
plot2 mineral * year/ overlay legends;
run;
quit;
-----------------------------------------------------------
ods html close;
ods pdf close;
goptions reset = all;
```

Vertical Bar Charts
SAS/GRAPH uses the GCHART procedure to produce charts that graphically represent the value of a statistic for one or more variables in a SAS data set. Vertical bar charts use vertical bars to represent statistics based on the values of one or more variables. Vertical bar charts, which generate only one statistic, are useful for displaying exact magnitudes and emphasizing differences.
An Overview of Graphical Representation of Dairy Science Data using SAS and EG

Using aprsas.fodder draw a vertical bar chart to display year wise consumption of green fodder of all farms and also for individual farm=A. The procedure (code) and output are given below.

```
proc gchart data=aprsas.fodder;
  vbar year / sumvar = Green
  type = sum;
  title 'Bar Chart of Green Fodder';
  /*where farm = 'A'*/;
run;
quit;
```

```
proc gchart data=aprsas.fodder;
  vbar year / sumvar = Green
  type = sum;
  title 'Bar Chart of Green Fodder';
  where farm = 'A';
run;
quit;
```

In the above procedures and graphs the data set used is aprsas.fodder in which year is a numeric type field. It can be observed that the SAS/GRAPH has automatically grouped the field `year` arbitrarily. Actually Year should be a character field and therefore corresponding changes have to be made in data set in SAS to convert this field into numeric type or data set can be imported a fresh from Excel sheet by converting the Year into text field in excel sheet o. After correction the results are as follows:

```
proc gchart data=aprsas.fodder;
  vbar year / sumvar = Green
  type = sum;
  title 'Bar Chart of Green Fodder';
run;
quit;
```

**Block Charts**

Block charts use three-dimensional blocks to graphically represent values of statistics. Block charts are useful for emphasizing relative magnitudes and differences among data values.
An Overview of Graphical Representation of Dairy Science Data using SAS and EG

**proc gchart**
data=aprsas.fodder_year_char;
block farm / sumvar = Green
type = sum;
title 'Block Chart for Consumption of Green Fodder';
run;
quit;

---

**Block Chart for Consumption of Green Fodder**

---

**Scatter Plots**

Two-dimensional scatter plots show the relationship of one variable to another, often revealing concentrations or trends in the data. Typically, each variable value on the horizontal axis can have any number of corresponding values on the vertical axis. The following figure shows the influence of good grazing of ewes prior to lambing on the birth weights of male lambs through a scatter plot drawn using data from aprsas.bodyweight data set.

```
goptions reset=all border;
title "Study of Birth Weight of Lamb vs Grazing Days of Ewes";
footnote1 j=l "Example of Scatter Plot";
footnote2 j=r "A.P. Ruhil";
proc gplot data=aprsas.bodyweight;
plot BodyWeightLamb*GrazingDays;
run;
footnote1; /* this clears footnote1 */
symbol1 interpol=rcclm95
  value=circle
  cv=darkred
  ci=black
  co=blue
  width=2;
/* Section of regression analysis*/
plot BodyWeightLamb*GrazingDays / haxis=0 to 70 by 10
  vaxis=2 to 5 by 1
  hminor=1
  regeqn;
run;
quit;
goptions reset=all;
```
Tile Chart
The GTILE procedure produces charts that tile charts, which consist of a rectangle or square, divided into tiles. The sizes of the individual tiles represent the value of the size variable. You can also specify a color variable, so that the colors of the individual tiles represent the magnitude of the color variable. Tile charts are useful for determining the relative magnitude of categories of data or the contribution of a category toward the whole.

To draw tile chart data set human_animal_population is used. The variable Area of states is used as size variable and variable human population is used to color the states.

Radar Chart
The GRADAR procedure produces radar charts that show the relative frequency of data measures. On a radar chart, the chart statistics are displayed along spokes that radiate from the center of the chart. The charts are often stacked on top of one another with reference circles, thus giving them the look of a radar screen. Radar charts are frequently called star charts and are often used in quality control or market research problems.

Using the calf birth data different type of radar charts can be drawn as given below. The variable Total number of births is treated as frequency data, bread and seasons are used as controlled variables and time group is used as chart variable.
goptions reset=all;

proc gradar data=aprsas.calf_birth;
  chart time_group / freq=total;
  /* chart season / freq=total;*/
run;
quit;

goptions reset=all border;

proc gradar data=aprsas.calf_birth;
  chart time_group / freq=total
  overlayvar=season;
run;
quit;

goptions reset=all border;

proc gradar data=aprsas.calf_birth;
  chart time_group / freq=total
  overlayvar=bread
cstars=(red, blue, green)
wstars=2 2 2
lstars=1 1 1
starcircles=(0.5 1.0);
run;
quit;

goptions reset=all border;

proc gradar data=aprsas.calf_birth;
  chart time_group / acrossvar=breed
    freq=total
    ncols=3
    starlegend=clock
    starlegendlab="Birth Group Hours"
run;
quit;
An Overview of Graphical Representation of Dairy Science Data using SAS and EG

goptions reset=all border;

----------------------------------------------

proc gradar data=aprsas.calf_birth;
chart time_group /
acrossvar=season
downvar=breed
freq=total
startype=spoke
nrows=3 ncols=4
starlegend=clock;
run;
quit;

Key Performance Indicator (KPI) Charts

KPIs are metrics that help a business monitor its performance and measure its progress toward specific goals. There are five KPI chart types:

- **Slider (vertical or horizontal):** Slider KPI charts display a bar divided into segments according to the boundary values that you specify. The actual value of the KPI is indicated with a triangle pointer on the top (for a horizontal slider) or the left (for a vertical slider). This actual value indicator is the same color as the segment that contains the actual KPI value. The target value, if it is specified, is displayed as a smaller triangle on the bottom (or right side) of the slider.

- **Bullet graph (vertical or horizontal):** Bullet graphs display a bar divided into segments according to the boundary values that you specify. The actual value of the KPI is indicated with a black line, or bullet, down the center of the graph. The target value, if it is specified, is displayed as a vertical line (in a horizontal bullet graph) or a horizontal line (in a vertical bullet graph) across the graph.

- **Radial dial:** Dial KPI charts display a dial divided into segments according to the boundary values. The actual value of the KPI is indicated with a large, white triangle pointer. The target value, if it is specified, is displayed as a small, black triangle.

- **Speedometer:** Speedometer KPI charts display a speedometer with the tick marks evenly spaced around the dial and colored segments that correspond to the segment boundaries that you specify. Speedometers can be displayed as a full speedometer, as a half speedometer, or as a quarter speedometer. The actual value of the KPI is indicated by a long pointer.

- **Traffic light (vertical or horizontal):** Traffic light KPI charts display a traffic light that contains one light for each segment. The segment that contains the actual value is displayed in color. The remaining segments are gray. In other words, only one "light" is "turned on" at a time. Traffic lights do not display target values.
For example, create a slider and dial KPI for indicating the actual sale of milk product (in Rs.) on the scale 0-500000. Another example is showing the computation of sale amount from SAS data set `aprsas.milkproductsale` for drawing speedometer KPI.

```sas
%let target = 350000;
%let bounds = 0 100000 250000 400000 500000;
proc sql noprint;
select sum(Sale) into : TotalSale
from aprsas.Milkproductsale
where year(date) = &year;
run;
quit;
```

```sas
goptions reset=all border device=javaimg;
ods listing close;
ods html;
---------------------------------------------------------
proc gkpi mode=raised;
hslider actual=200000 bounds=(0 100000 250000 400000 500000)/
target = 350000;
run;
quit;
-------------------------------------------------------
ods html close;
goptions reset=all border device=javaimg;
ods listing close;
ods html style=listing;
proc gkpi mode=raised;
dial actual=200000 bounds=(0 100000 250000 400000 500000)/
target = 350000;
run;
quit;
ods html close;
```
SAS Enterprise Guide

SAS Enterprise Guide is a window-based application that provides a guided mechanism to exploit the power of SAS in an easy way using intuitive and visual interface. SAS enterprise guide provides a point and click interface for managing data and generating reports. EG organizes all work in form projects and one can work only on one project at a time. Each project is stored in a single file which includes all reports, shortcuts to all data files, graphs, etc. Basic elements of SAS EG are:

- **Project Tree**: Window displays project in a hierarchical tree diagram
- **Workspace**: Container for process flow, results from tasks run, data grids, SAS code, logs, etc.
- **Process Flow**: Window displays a graphical representation of the project
- **Resources Pane**: Server list, Task list, SAS Folders and Prompt Manager
- **Task status**: View → Task Status (messages about progress of the task)

SAS EG provides powerful features for generating variety of graphs as described below:

**Bar charts**: create vertical, horizontal, or three-dimensional block charts that compare numeric values or statistics between different values of a chart variable. Block charts show the relative magnitude of data by displaying bars of varying height. Each set of blocks in a bar represents a category of data. Block charts are most useful when the relative magnitude of the bars is more significant than the exact magnitude of any particular bar.

**Pie charts**: create simple, group, or stacked charts that represent the relative contribution of the parts to the whole by displaying data as wedge-shaped "slices" of a circle. Each slice represents a category of data. The size of a slice represents the contribution of the data to the total chart statistic. For example, a pie chart can show the sales of each store as a fraction of a chain's total sales.

**Area plots**: create area, spline, step, or overlay plots that show the mathematical relationship between two variables where the area under the curve is important or where you fill the area under the curve with a pattern or color combination to make a visual impact.

**Line plots**: create line, spline, needle, step, regression, smooth, STD, Lagrange interpolation, or overlay plots that show the mathematical relationships between numeric variables by revealing trends or patterns of data points.

**Scatter plots**: create two-dimensional scatter plots, three-dimensional scatter plots, or three-dimensional needle plots that show the relationships between two or three variables by revealing patterns or concentrations of data points.
Surface plots: create three-dimensional wireframe plots, three-dimensional smooth plots, or three-dimensional gradient plots that show the mathematical relationships between three numeric variables. The three-dimensional charts plot one vertical variable ($z$) for a position on a plane that is specified by two horizontal variables ($x$ and $y$). The coordinates of each point correspond to the values of three numeric variable values in an observation of the input data set. The observation can contain values in the form $z = f(x, y)$ or independent values such as the altitude at a given longitude and latitude.

Map graphs: create two-dimensional choropleth, riser, or three-dimensional prism graphs that display values of a numeric variable for different geographic areas, such as counties, states, and countries.

Bubble plots: create a plot that shows the relative magnitude of one variable in relation to two other variables. The values of two variables determine the position of the bubble on the plot, and the value of the third variable determines the size of the bubble.

Box plots: create box plots, hi-lo plots, or hi-lo-close plots that display multiple summary statistics for some numeric variable across different values of a chart variable. For instance, a box plot can show the range, the interquartile range, and the mean of a variable. A hi-lo-close plot can show the high, low, and closing price of a stock on different dates.

Donut charts: create simple or group charts that show the relative contribution of the parts to the whole. The data appears as wedge-shaped "slices" of a circle. Each slice represents a category of data. The size of a slice represents the contribution of the data to the total chart statistic. For example, a donut chart can show the sales of each store as a fraction of a chain's total sales. Donut charts are similar to pie charts, except that a hole appears in the middle of a donut chart.

Contour plots: create line, filled, pattern, or smooth contour plots that show the mathematical relationships between three numeric variables. The plots represent three-dimensional relationships in two dimensions. Lines or areas in a contour plot represent levels of magnitude ($z$) that correspond to a position ($x, y$) on a plane.

Radar charts: create radar (or star) charts that show the relative frequency of data measures in quality control or market research problems. The chart statistics are displayed along spokes that radiate from the center of the chart.

Graphics Output Format
In the SAS Add-In for Microsoft Office, you can choose from the following graphics output formats: ActiveX, ActiveX image, GIF, JPEG, PNG, and Java image. In SAS Enterprise Guide, you can also choose the Java and SAS EMF formats.

The ActiveX and Java output formats are interactive. You can right-click on any graphics that are generated in these output formats and change certain options. The options that you can change are different for the ActiveX and the Java output formats. Any options that you change are reflected in the output only, not in the task window selections that you made to create the graph.

The ActiveX image, GIF, JPEG, PNG, Java image, and SAS EMF output formats are non interactive. You cannot change the appearance of the graph after you generate it.

Procedure for Generating Graphs
1. Create a new project or open an existing project.
2. Open a data file (new or existing). Data can be imported from excel files. There are few self explanatory steps to follow.
3. Kindly take care of data type of each variables while importing data from excel file. If required you can modify the data type at this moment.
4. After importing data, click on Graph option in the data window
5. Select the required chart type and then assign variables to appropriate analysis role.
6. Set the appearance options such as appearance, layout, axis scale, legends etc.
7. Specify the title and footnotes.
8. View the results.

In the following examples, data sets are imported from Sample data sets.xlsx excel file. Every step in drawing the graphs is performed by point and click interface.

**Line Chart:** Import data set Fodder Consumption from Sample data sets.xlsx and draw line chart of type *Multiple vertical column line plots using overlay.*
Bar Chart: Import data set Calve Birth from Sample data sets.xlsx and draw bar chart of type Grouped colored Vertical Group.

Tile Chart: The Tile Chart task enables you to create a tile chart so you can view a large quantity of hierarchical data in a limited space. Each unique category combination is represented by a rectangular tile whose size and color are determined by response variables. These tiles are placed in a hierarchical arrangement. Procedure for creating tile chart is given below:
An Overview of Graphical Representation of Dairy Science Data using SAS and EG

Finally the project workspace looks as given below. This project can be saved for future use.