Effective and Efficient Use of SAS/GRAPH Software
LeRoy Bessler, Miller Brewing Company

Abstract and Introduction
This paper on SAS/GRAPHic communication explains how to create powerful graphic presentation materials, and graphic reports that can be digested at a glance. This paper does not consider analytic/scientific graphs.

Familiarity with the basics of SAS/GRAPH is assumed. Though some code is presented, emphasis is on principles and illustrations. However, due to the page-count limit for publication, only a few of the illustrations can be printed here.

This paper also explains how to save resources: computer time, computer memory, print/plot time, etc. By saving resources as suggested, the user gets the benefit of more graphs per unit time.

On Communication
"Put it before them--briefly... so they will read it, clearly... so they will appreciate it, picturesquely... so they will remember it, and, above all, accurately... so they will be guided by its light."
Joseph Pulitzer

"Simplicity has power."
LeRB

Need for Care
- Software & hardware = power tools
- Potentially lots of sub-optimal results quickly

Accept Software Defaults?
Only if you're undemanding (Figure 2)

Use Options?
- Customize for elegant graphs (Figure 3)
  powerful presentation materials--easily interpreted
  reports digestable at a glance
- Eschew inessential graphic elements
- Design & implement standard formats

Consistency
Define a style, and stick to it
- Titles, footnotes, notes
- Font choices & sizes
- Tick marks, tick-mark values
- Symbols
- Line types & weights
- Reference lines
- Etc.

Benefits of Standard Formats
- Viewer needn't recalibrate graph-to-graph
- Consistency breeds/speeds comprehension
- Productivity--preparer spared over-choice:
  less decision-making, fewer iterations

Benefits of Macro-based Standard Formats
- Good design with no effort, no thought
- But overrideable/ignorable, if special need

Maximize Data, Not Paper-marking
- Software defaults biased to traditional props
- Turning off props = more work, but--
  - Restraint in elaboration/decoration = less work

Widely Unappreciated Benefits of Restraint
- Less computer resource requirements
- Faster processing
- Faster display
- Shorter print/plot time
  ultimate target usually hardcopy--print/plot time critical

505
Even Less Appreciated Benefit of Restraint

- More graphs between out-of-paper-marker (i.e., toner, plotter pens, ink, or ribbon)
- If OOPM at unattended device, output either queues or is scrap

Special Effects

- Good design & interesting data can stand on their own
- Productivity & communication are the real objectives
- Save time & computer resources:
  - Drop the drop-shadow
  - Block out blocks
- Do use PROC GREPLAY & TEMPLATES to create composites (e.g., Figure 9)

What are Hardware Characters?
If no font (or if F = NONE) specified--

- SAS/GRAPH gives driver text string, start position
- Uses hardware font, if available: built-in/cartridge/downloaded
- If none available, inelegant characters instead

Cautions about Hardware Characters (Figure 4)

- If default H = 1 overridden, inelegant characters instead
- Hardware characters usually fixed-width:
  - If string too long to fit on one line, inelegant characters instead
  - Important know characters-per-line limit

What are Software Characters?
If using SAS/GRAPH named font (F = TRIPLEX, F = XSWISS, etc.)

- Driver gets detailed instructions
- Draws with arcs & line segments
- Slow, resource-intensive

Benefits of Hardware Characters (Figure 4)

- Less computer processing time
- Less computer memory
- Less computer disk for print file
- Quicker print file transmission
- Quicker output
- Conformation better than software fonts

Version 6 Hardware Characters

- Multiple hardware fonts in same graph
- Proportional fonts also possible. Wise?
  - Complex--you must define dimensions
  - Risky--positioning errors if you err

Version 6 Default Font

If no font (or if F = NONE) specified,

- Default hardware font overrideable
- Use GOPTION FTEXT = to specify:
  - SAS/GRAPH software font, or non-default hardware font

Font Choices

- At most, use one or two type styles
- Prefer hardware characters, if available
- Fancy software font: maybe title (& footnotes)
- Maybe italic form (if available) of basic font, for emphasis
- TITLE1 default is F = COMPLEX

Font Sizes

- At most, use three
- Titles, maybe H > 1
  - TITLE1 default is H > 1
- Body text, usually H = 1
  - (unless need dense tick-mark text)
- Footnotes smaller, only if downplayed

What are Software Characters?

- Driver gets detailed instructions
- Draws with arcs & line segments
- Slow, resource-intensive
Text on Graphs
• Always black--most readable
• Emphasize with italics (or bold), not color
• Text uses resources--if fancy, lots
• Keep it brief
  omit filler words;
  also (not "additionally"),
  use (not "utilize") short words
• Omit needless punctuation--e.g.,
  "May 1991" is correct as is
• Omit obvious axis labels--e.g.,
  if titles explain enough
  if tick marks are dated
• Focus viewer attention with sparse text

Labels, Text, Decimals
• SAS variable an name unacceptable label
• Unless compelling counter-need,
  use upper & lower case
  Mixed-case: business communication standard,
  and easier to read
  All-upper-case: hold-over from primitive
  computer printing
• Not doing science--usually suppress decimals

Axes
• Turn off axis lines (they tell nothing)
• Turn off tick marks
• If not turning off axis labels, supply your own
• Label (invisible) tick marks sparingly
• To produce preferred date-tick labels (as shown
  in Figure 3), see the author's tutorial Intelligent
  Production Graphic Reporting Applications,
  elsewhere in these Proceedings

Axis Ranges
• De-accentuate fluctuations--
  Start axis at zero, not the SAS/GRA PH default
  Prevent needless anxiety, questions
• For percents, use range 0-100 (& label the ends)
  Bar length = visual percent
  Absolute maximum is natural choice
• For trend chart issued monthly,
  use fixed number of months

Sparse "Annotation" of Trend Lines
(Figures 5 and 6, and Appendix)
• Annotate via the AXIS statement
  Astutely using ORDER = & VALUE =,
  identify only starting value, ending value, and
  in-between peak(s), valley(s), critical point(s)
• Make the graph talk

Color vs. Black-and-White
• No response levels or categories--black and white
• Few levels or categories--grey shades
• Many levels or categories--color

Color Feasibility
• So far, no color device combines
  high speed
  high quality
  fuss-free & reliable operation
  low price
  plain paper
• Reject any device with fewer than 8 colors

In Praise of Drabness
Compared with color, black-and-white hardcopy is
  faster;
  cheaper;
  more reliable;
  easier to use--
  simpler equipment,
  no agonizing over color strategy;
  more copyable--
  there are more, cheaper, faster BW copiers

Area Fill: When?
• Area fill uses resources. So--
• If color/pattern carries no information, leave area
  EMPTY:
    Beneath line(s)--ALWAYS;
    Pie slices, unless color presentation;
    Simple bar charts,
    but light grey if bars close together;
    Maps, unless for response levels

Area Fill: How?
• To carry information,
  use solid colors or grey shades
• In desperation only,
  use parallel lines or cross-hatching
• On maps (Figures 7 and 8),
  never use parallel lines or cross-hatching
Symbols on Plot Lines

- Use V = NONE, if possible
  Can use W = to distinguish multi-line, rather than V = , if only two lines
- If need point detection, not just trend, recommended choices are:
  V = DOT (Version 6, BIG dot)  
  V = CIRCLE (Version 6)
  V = - (traditional, circle around dot)

Tip: Some devices can’t print 
V = PAW, (Version 6) V = POINT

Line Types on SYMBOL Statements

- Many (all?) Version 5 drivers 
draw curves poorly with L = 2
- Version 6 dotted lines L = 33 & L = 34:
  Untested with my devices
Use for grid lines or fine reference line, 
but grid lines are for analytical graphs, 
not for presentations or management reports

Numeric Detail Look-up

Except for column of numbers at right margin of 
horizontal bar chart, or numbers supplied at ends of 
bars on a simple vertical bar chart, best solution is 
usually a companion table. For a simple trend line, 
see Sparse Annotation Section above. For a 
multi-line plot, the best solution is a companion 
table. For a CHOROPLETH Map, use Subichin’s 
annotation technique. See Figure 9 for an example 
of the Pac-Man Pie Chart augmented with a detail 
look-up table.

Pie, Bar, and Trend-line Charts

For pies and bars, see the author’s tutorial Pie Charts 
and Bar Charts: Getting Their Best out of 
SAS/GRAPH Software, elsewhere in these 
Proceedings. Especially see the Enhanced Horizontal 
Bar Chart presented there.

For trend lines, see also Intelligent Production 
Graphic Reporting Applications (loc. cit.).

I Call It the Pac-Man Pie Chart (Figures 1 and 9)

Even if not “worth a thousand words”,
- A picture is more memorable
  Images stick, after are numbers forgotten--there 
have been reports that the use of images, in 
addition to text, improves, e.g., effectiveness of 
fundraising and memory of request.

SAS and SAS/GRAPH are registered trademarks of 
SAS Institute Inc., Cary, NC, USA. Pac-Man is a 
registered trademark of Namco Ltd., Tokyo, Japan. 
The remarks and examples in this paper are based on 
Version 5.18 and Version 6.06 of SAS/GRAPH. The 
SAS code listed in the Appendix was tested, and is 
reliable, but it can only be presented “as is”. Any 
code adopted by you should be tested by you, 
and you must assume responsibility for the consequences 
of its use. Also, it must be tested, and might require 
modification, for compatibility with Version 6.

Author

Dr. LeRoy Bessler
Miller Brewing Company
P.O. Box 482
Milwaukee, WI 53201-0482, USA
Telephone 414-931-2773

Appendix: Sparse “Annotation” for Figure 5

508

Mainframe Data Analysis Software
Market Shares

SAS - 82%

Other - 18%

Source: Computer Intelligence, August 1981

Figure 1. Pac-Man Pie Chart: not worth a 
thousand words, but memorable
Demand, in Percent of Capacity
By Month, January 1989 to August 1991

90% is threshold for considering capacity increase

Figure 2. Trend Line Using SAS/GRAPH Defaults
Demand, in Percent of Capacity
By Month, January 1989 to August 1991

90% is threshold for considering capacity increase

Figure 3. Custom Trend Line, Using Macro-based Standard Format
See "Intelligent Production Graphic Reporting Applications"
This shows default height & font for TITLE1

This is an H=1.5 and F=TRIPLEX example of a text line

This is an H=1.5 and F=XSWISS example of a text line

This is a hardware characters example of text lines--to produce such, either omit H= and F=, or specify H=1 and F=NONE

This is an example of text lines with height specification less than H=1, and with font specification of F=NONE or omission of F=

Notice that in the last two examples SAS/GRAPH draws its own default software characters, because it can't use hardware characters

In this example of text lines with height specification more than H=1, and with font specification of F=NONE or omission of F=, SAS/GRAPH simply ignores the height specification for the text lines, and uses the hardware characters for some lines, but draws its own default software characters for other lines

From all these examples it should be clear that if you want to use hardware characters: (a) you must be sure that you are specifying H=1 and F=NONE, or that you are getting them as the default--which is not the case for TITLE1; and (b) you must know how many hardware characters fit on a line.

The only hardware characters that SAS/GRAPH can reliably position are fixed-width fonts (a.k.a. "fixed-pitch" or "uniform"). Fixed-width hardware fonts typically come in sizes 10 per inch, 12 per inch, 15 per inch, 20 per inch, and some exotic fractional pitches. With a 10-pitch font, SAS/GRAPH can fit 10 characters across each inch of useable width of the page. It seems to be an industry standard that there are no fixed-width fonts wider than 10-pitch. However, some devices have optional tall fixed-width fonts.

Impact of Choice of Font, for SAS/GRAPH with Xerox 4045 Laser CP Printer

<table>
<thead>
<tr>
<th>Text String on One Line</th>
<th>CPU Time (multiple of base)</th>
<th>Print Time (multiple of base)</th>
<th>File Size (multiple of base)</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 hardware characters</td>
<td>1.0</td>
<td>1.00</td>
<td>1.0</td>
</tr>
<tr>
<td>76 default characters</td>
<td>3.0</td>
<td>1.28</td>
<td>14.4</td>
</tr>
<tr>
<td>75 TRIPLEX characters</td>
<td>7.3</td>
<td>1.88</td>
<td>63.0</td>
</tr>
<tr>
<td>75 XSWISS characters</td>
<td>15.7</td>
<td>4.09</td>
<td>448.5</td>
</tr>
</tbody>
</table>

Figure 4. Hardware Characters, Default Software Characters, & Facts
(The text above had to be photoreduced to 91% in order to fit within the side margins used for this publication.)
A Quarter Century of Thirst

Annual U. S. Beer Consumption, in Gallons per Capita

Peak in 1981 at 24.6

Gallonage: John C. Maxwell, Jr., Wheat First Securities
Reported in: "Beverage Industry", February 1990

Figure 5: Sparse Annotation, End-points and Maximum Only

Production of Miller Lite - 1977 to 1990

Millions of Barrels

20.3
16.3
7.5
0

1977 1981 1990

Source: "Beverage Industry"

Figure 6: Sparse Annotation, End-points and Special-Interest Point Only
Figure 7. Unacceptable Map with SAS/GRAPH Fill Patterns on IBM 3820

Pattern

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1X000</td>
<td></td>
</tr>
<tr>
<td>M3X000</td>
<td></td>
</tr>
<tr>
<td>M2X045</td>
<td></td>
</tr>
<tr>
<td>M4X000</td>
<td></td>
</tr>
</tbody>
</table>

Figure 8. Map with Site-customized GDDM Grey Shades for IBM 3820

Pseudo-color

<table>
<thead>
<tr>
<th>Color</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED</td>
<td></td>
</tr>
<tr>
<td>V=MEMPTY</td>
<td></td>
</tr>
<tr>
<td>YELLOW</td>
<td></td>
</tr>
<tr>
<td>BLACK</td>
<td></td>
</tr>
</tbody>
</table>
Where Will Your Property Tax Go in 1992?

Taxing Unit of Government          Tax Levy          Versus 1991

Elementary School District #1      $3,768,973        +14%
Village                           $3,396,151        +4.8%
County & State                    $2,712,226*       ?
Secondary School District         $2,548,073        +6%
Metropolitan Sewerage District    $1,498,906        +8.8%
Elementary School District #2      $1,017,174        -5%
Area Technical College            $990,180          +9%

*Not available yet—estimate same as 1991

Figure 9. Pac-Man Pie Chart Augmented with Detail Look-up (Designed for Village government, which must collect property tax for all other taxing units.)