

Effective and Efficient Use of SAS/GRAPH

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Preface

"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

Space Constraints

- Permit printing few visual examples here

Need for Care

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

Software Defaults Acceptable?

- Analysis of data: Sometimes (Usually)
- Presentation of information: Rarely
in-person presentation,
on-line or hard-copy management report

Scope of Tutorial

- Excludes analytic/scientific graphs
- Includes:
trend lines, bar charts, pie charts, maps

Software Defaults

- Quick success, but only if undemanding
(e.g., Figure 2)
- Astute customization yields elegant graphs
(e.g., Figure 3):
powerful presentation materials--
easily interpreted
reports digestable at a glance

Use of Options

- Design & implement standard formats
- Eschew inessential graphic elements

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

Consistency for Easy Comprehension

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.

Proliferation of Style

Throughout all work of

- One person
- One application
- One organization

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

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
 - Adumbrate the "Shaded Background" (shown in Output 21.2 of *SAS/GRAPH User's Guide, Version 5 Edition*)
- PROC GREPLAY & TEMPLATES for composites or juxtaposition

2 Is Enough

- 3D pie charts--always distortion
- 3D bar charts--unless values at ends, interpretation often difficult
- 3D maps--
SURFACE, PRISM, BLOCK cute, but poor interpretability (even hidden parts)
- *Exception:* PROC G3D for 3 numeric VARs

Font Choices

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

Font Sizes

- At most, use three
- Titles, maybe H > 1
(TITLE1 default H = 2, often too big)

- Body text, usually H = 1
(unless need dense tick-mark text)
- Footnotes smaller, only if downplayed

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 unavailable or inaccessible, driver draws inelegant default characters

Cautions about Hardware Characters (Figure 7)

- If default H = 1 overridden, SAS/GRAPH inelegant characters instead
- Hardware characters usually fixed-width:
 - If string too long to fit on one line, SAS/GRAPH inelegant characters instead
 - Important to 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 7)

- 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 define each character's dimensions
 - risky--
positioning errors ensue 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

Text on Graphs

- Always black--most readable
Emphasize with *italics* (or **bold**), not color

Text uses resources--if fancy, lots. Therefore,

- Keep it brief
omit inessential words
use short words--e.g.,
"use", not "utilize" or "utilization"
- Omit needless punctuation--e.g.,
"September 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

- Unless lucky,
VAR name unacceptable label
- Unless compelling counter-need,
use upper & lower case
Mixed-case:
business communication standard,
easier to read
All-upper-case:
hold-over from primitive computer printing
- Unless doing science,
suppress decimals on tick-mark values

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
- SAS/GRAPH date-tick labels unacceptable
E.g., compare Figures 2 and 3

Axis Ranges

- De-accentuate fluctuations:
Start axis at zero,
not the SAS/GRAPH default
- For percents, end axis at 100:
bar length = visual percent
absolute maximum is natural choice
- For trend chart issued monthly, use fixed
number of months, even if some empty

Annotation Avoidance (Figure 4)

- Annotating values sometimes impractical:
trend charts (jagged or multi-line),
or complex vertical bar charts
- Instead, two-up juxtaposition via GREPLAY
trend or bar chart above,
with GPRINTed table* below
*PROC PRINT, TABULATE, GSLIDE

Color vs. Black-and-White

- No response levels or categories--black and white
- Few levels or categories--grey shades
- Many levels or categories--color
(grey shades sometimes hard to distinguish)
- COUTLINE = BLACK if colored maps or pies:
avoid color mixing at boundaries

Color Feasibility

- 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

Black-and-white hardcopy--

- is faster than color
- is cheaper than color
- is more reliable than color
- is easier to use than color
simpler equipment
no agonizing over color strategy
- is more copyable than color--
there are more, cheaper, faster BW copiers

Area Fill?

- Area fill uses resources. So--
- If color/pattern carries no information, leave area EMPTY:
beneath line(s)--ALWAYS
pie slices & simple bar charts--
unless color presentation
simple bar, maybe light grey shade;
pie slice color could be useful
if SAS/GRAPH supported pie LEGEND
(especially when large number of slices)
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 5 & 6),
never use parallel lines or cross-hatching

Symbols

- On line graph,
use V = NONE, if possible
can use W = to distinguish multi-line,
rather than V = , if two lines
- If need point detection, not just trend,
V = is essential

Recommended:

V = DOT (Version 6, BIG dot)
V = CIRCLE (Version 6)
V = - (see result in Figure 3)

- *Tip:* Some devices can't print
V = PAW
V = POINT (Version 6)

Line Types on SYMBOL Statements

- Many (all?) Version 5 drivers
draw curves poorly with L = 2
- Version 6 finally delivers!
dotted lines L = 33 & 34 (*I've not tested*)
use for fine reference line
or for traditional grid lines
- *Caution:* Grid lines for some analytical graphs,
not for presentations, management reports

Numeric Detail Look-up

- Line Graph--use companion table (Figure 4)
- Bar Chart--
horizontal, it's automatic
(but may want Bread Chart instead);
vertical, option in Version 6
- Pie Chart--handle pie percents as
in Appendix A, or use Bread Chart
- CHOROPLETH Map--
Subichin's annotation technique

Bessler's Bread Chart

How is the loaf divided up?

- Image & detail optimally combined
- Always works--even when pie chart fails
(e.g., when labels of small pie slices vanish)

See the following paper--Bessler, LeRoy. "Intelligent Production Graphic Reporting Applications." In Proceedings of the Sixteenth Annual SAS Users Group International Conference, 337-346. Cary, N.C.: SAS Institute Inc., 1991. Some macros therein have been improved and enhanced (details available at SUGI 17).

Order of Pie Slices

- SAS/GRAPH default: by slice name
- More natural--decreasing slice size:
Use technique of Appendix A

Pie Labels

- Specify NOHEADING
- All OUTSIDE or all INSIDE
Do not use MATCHCOLOR
- SAS/GRAPH-computed PERCENT always
NN.NN%: Circumvent as in Appendix A
- SAS/GRAPH appends .0 to integer VALUES:
Suppress with FORMAT statement

Future topics

- Guidelines for color use
- Elegant summary/ranking reports
- Special effects for communication,
not decoration

I Call It the Pac-Man Pie Chart (Figure 1)

Does a picture have to be
"worth a thousand words"?

- A picture is more memorable!
- Images stick, after numbers forgotten

Notices and Clarification

SAS/GRAPH is a registered trademark of SAS Institute, Inc., Cary, N.C., 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.

Figures 1-6 were produced with the GDDMFAM4 driver on an IBM 3820 Page Printer. The default characters in Figure 2 were drawn by the GDDMFAM4 driver, which cannot access the printer's fonts. Figure 7 was produced with the X4045X driver, and printed on a Xerox 4045 Laser CP printer.

Citations

The correct citation of this paper is as follows: Bessler, LeRoy. "Effective and Efficient Use of SAS/GRAPH." In *Proceedings of MWSUG '91*, edited by LeRoy Bessler, 1-10. Fox Point, Wis.: Midwest SAS Users Group, 1991.

A similar, but non-identical, paper of the same title was previously published by the author in *WISAS Proceedings, Volume 2, December Issue*, edited by LeRoy Bessler, 37-50. Fox Point, Wis.: Wisconsin Illinois SAS Users Group, 1990.

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Appendix A: Improved Pie Chart

To produce a pie chart with integer percents and with slices ordered by decreasing size, use this:

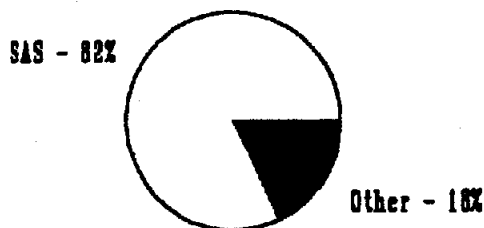
```

XMACRO VARLIST(PREFIX=,VARCOUNT=);
XDO I = 1 XTO &VARCOUNT;
  &PREFIX&I
XEND;
XMACRO MAKLIST(ITEM=);
XDO I = 1 XTO &SLAST&ITEM;
  "&ITEM&I"
XEND;
XMACRO;
GOPTIONS statements;
OPTIONS DQUOTE;
DATA;
INFILE INDDNAME;
INPUT SLICENAM $10. /* maximum 10 characters */
  RESPONSE ;
PROC SORT OUT=SORTED; BY SLICENAM;
PROC FREQ DATA=SORTED;
TABLE SLICENAM / OUT=FROMFREQ NOPRINT;
WEIGHT RESPONSE;
PROC SORT DATA=FROMFREQ OUT=PERCENTS; BY DESCENDING PERCENT;
DATA;
XGLOBAL LASTMDPT;
XGLOBAL XVARLIST(PREFIX=MDPT,VARCOUNT=2); /* equate VARCOUNT
to the number of slices, or to any greater number */
RETAIN I 0;
SET PERCENTS;
FORMAT PCT 2.;
PCT=ROUND(PERCENT,1);
FORMAT SLICWPCT $10.;
SLICWPCT = TRIM(SLICENAM) || ' ' || LEFT(PCT) || '%';
I = I + 1;
CALL SYMPUT ('LASTMDPT',I);
CALL SYMPUT ('MDPT' || LEFT(I),SLICWPCT);
PROC SORT OUT=PCTS; BY SLICENAM;
DATA TOCHART;
MERGE SORTED PCTS; BY SLICENAM;
PATTERNn statements; /* one for each slice */
PROC GCHART DATA=TOCHART;
PIE SLICWPCT /
  SUMVAR = RESPONSE
  MIDPOINTS = XMAKLIST(ITEM=MDPT)
  NOHEADING
  COUTLINE = BLACK
  SLICE = OUTSIDE
  VALUE = NONE /* if included, put OUTSIDE & use a FORMAT */
  PERCENT = NONE;
TITLEN statements;
FOOTNOTEn statements;

/* For a one-time chart, one can do all the SAS/GRAPH code "by
hand". But for a production application, scheduled and run
hands-off by the computer center, the program above always
delivers. The program could be further "macro-ized", taking
INDDNAME and PATTERN information as parameters, and GOPTIONS,
TITLES, and FOOTNOTES as the only extra statements. */

```

Mainframe Data Analysis Software Market Shares



Source: Computer Intelligence, August 1990

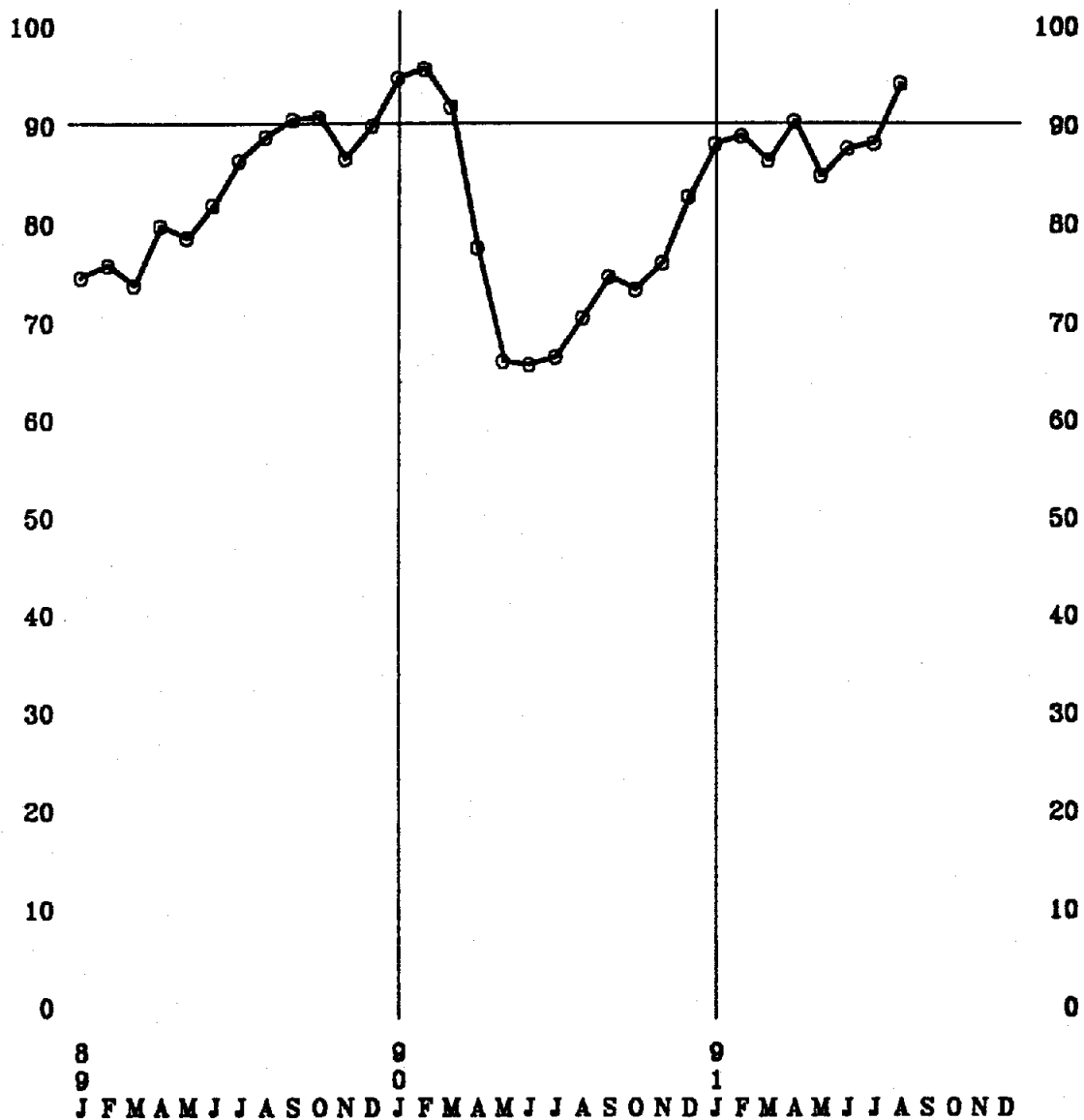
Figure 1. Pac-Man Pie Chart: not worth a thousand words, but memorable

By Month, January 1989 to August 1991



6 Advanced Tutorials

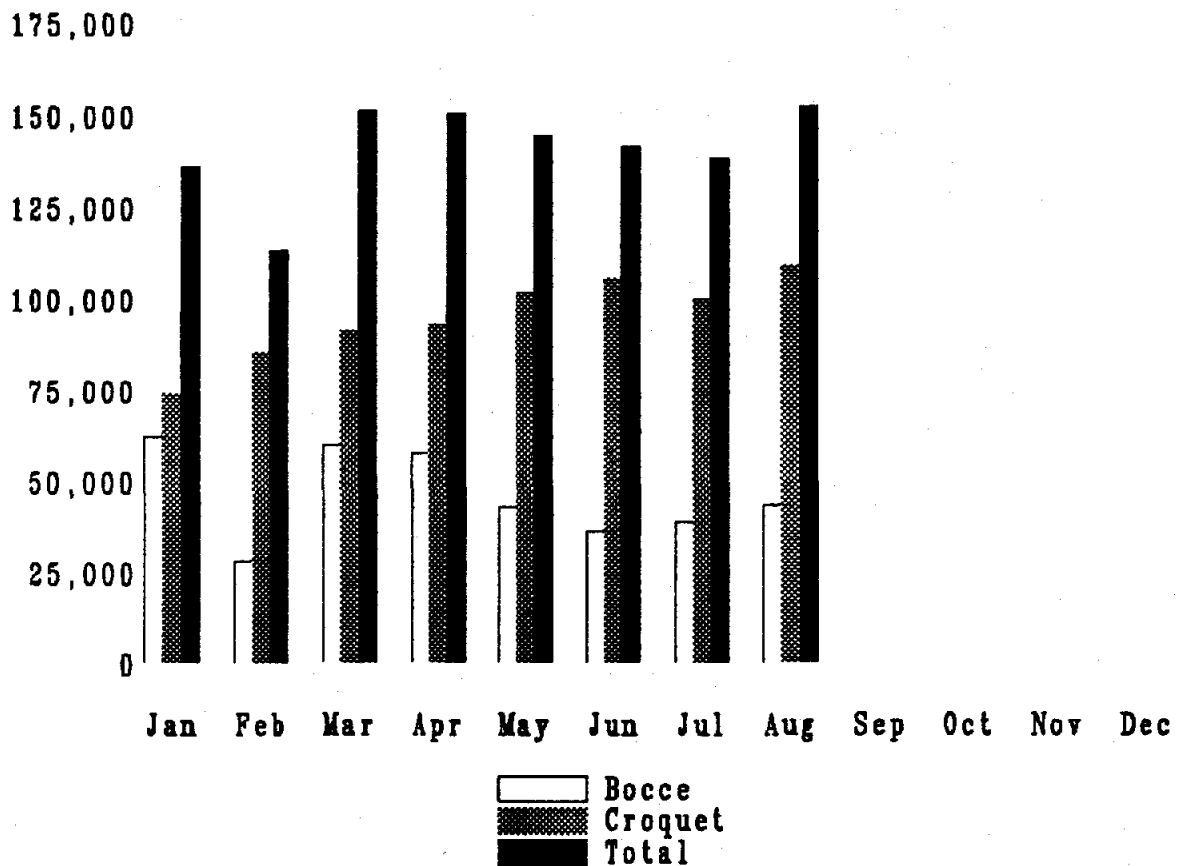
Demand, in Percent of Capacity By Month, January 1989 to August 1991



90% is threshold for adverse impact on service

**Figure 3. Custom Trend Line, Using Macro-based Standard Format
See "Intelligent Production Graphic Reporting Applications"**

Club Sports Revenues, in Dollars By Month, January 1991 to August 1991



	Bocce	Croquet	Total	Current YTD	Previous YTD
Jan	62,188	73,962	136,150	136,150	144,139
Feb	27,920	85,079	112,999	249,149	283,137
Mar	59,741	91,144	150,885	400,034	472,731
Apr	57,467	92,639	150,106	550,140	598,951
May	42,691	101,361	144,052	694,192	739,112
Jun	35,896	105,319	141,215	835,407	890,019
Jul	38,538	99,411	137,949	973,356	1,018,469
Aug	43,038	108,856	151,894	1,125,250	1,136,897
Sep					
Oct					
Nov					
Dec					

Figure 4. Composite GREPLAY of VBAR over GPRINT of PROC PRINT

Figure 5. Unacceptable Map with SAS/GRAPH Fill Patterns on IBM 3820

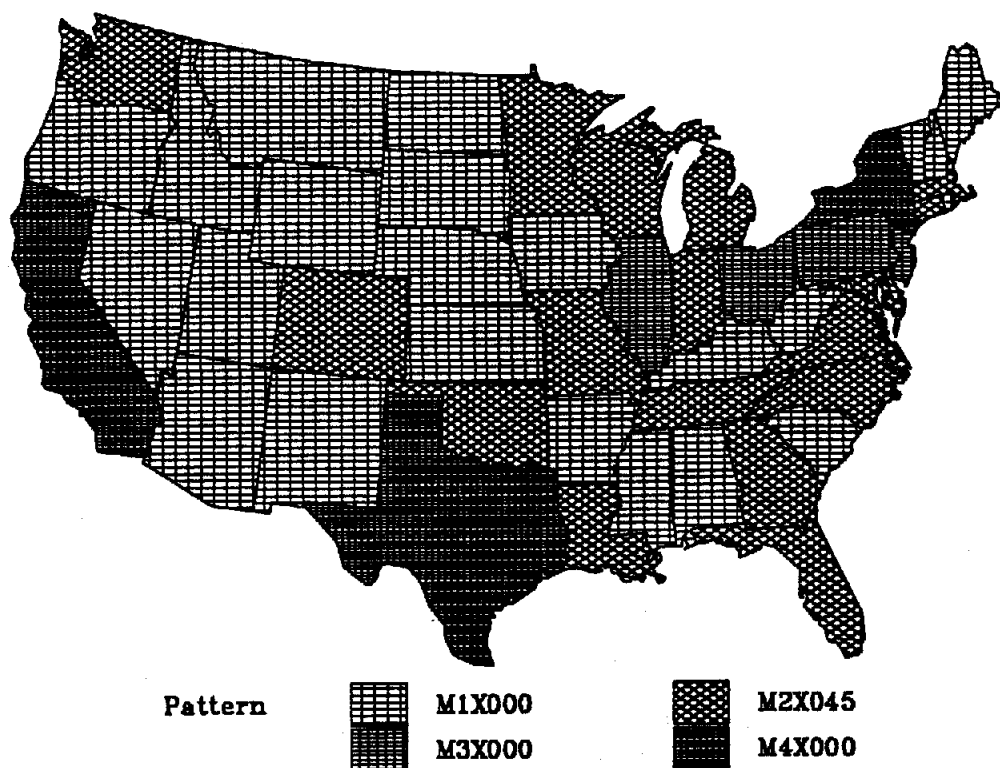
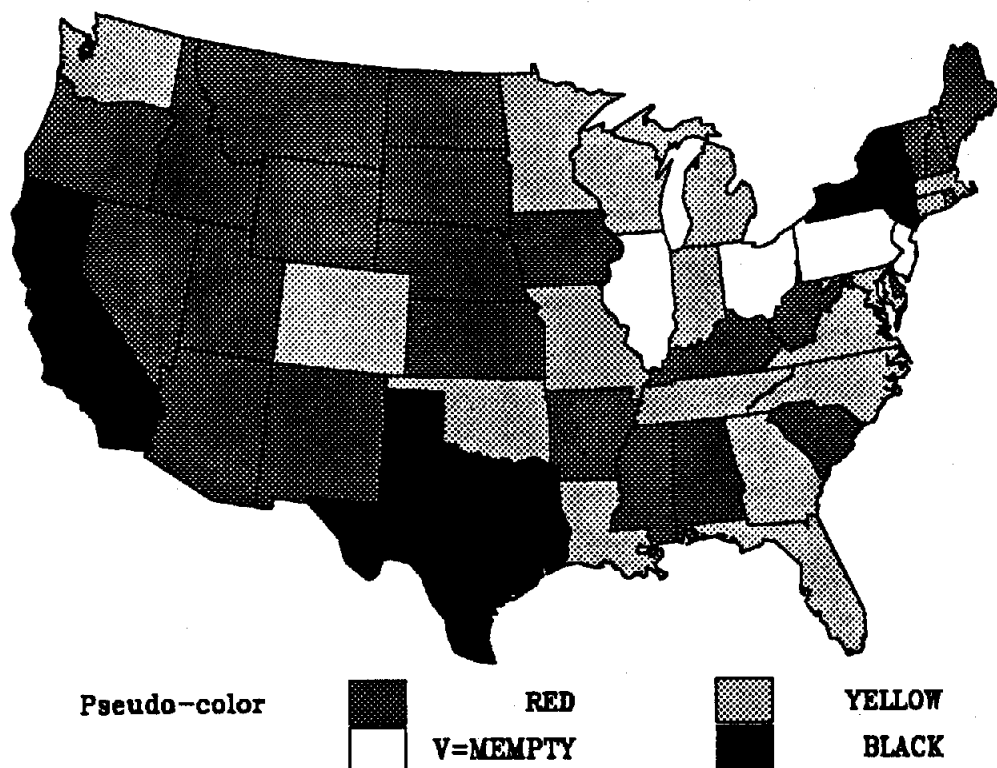


Figure 6. Map with Site-customized GDDM Grey Shades for IBM 3820



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=

This is an example of a text line with H=1 F=NONE (explicit or default), but with too many characters

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

Text String on One Line	CPU Time (multiple of base)	Print Time (multiple of base)	File Size (multiple of base)
75 hardware characters	1.0	1.00	1.0
76 default characters	3.0	1.28	14.4
75 TRIPLEX characters	7.3	1.88	63.0
75 XSWISS characters	15.7	4.09	448.5

Figure 7. 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.)