

Effective and Efficient Use of SAS/GRAPH Software

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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. Very little code is presented. Emphasis is on design principles and illustrations. However, 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

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*)
- Do use PROC GREPLAY & TEMPLATES to create composites (e.g., Figure 9)

2 Is Enough

- 3D pie charts--always distortion
- 3D bar charts--needless complexity
- 3D maps--
SURFACE, PRISM, BLOCK cute, but poor interpretability (even hidden parts)
- Exception: 3 variables

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 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

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 my paper "Intelligent
Production Graphic Reporting Applications" in
*Proceedings of the Seventeenth Annual SAS
Users Group International Conference*, 183-189,
Cary, NC, USA: SAS Institute Inc., 1992.

Axis Ranges

- De-accentuate fluctuations--
 - Start axis at zero, *not* the SAS/GRAPH 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

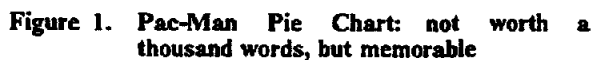
- Use V = NONE, if possible
Can use W = to distinguish multi-line, rather than V = , if only two lines
- If need point detection, not just trend, recommended choices are:
V = DOT (Version 6, BIG dot)
V = CIRCLE (Version 6)
V = - (traditional, circle around dot)
- *Tip:* Some devices can't print
V = PAW,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

- 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

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.

For pies and bars, see my paper "Pie Charts and Bar Charts: Getting Their Best out of SAS/GRAPH Software" in *Proceedings of the Seventeenth Annual SAS Users Group International Conference*, 264-273, Cary, NC, USA: SAS Institute Inc., 1992. Especially see the discussion there of my Enhanced Horizontal Bar Chart.

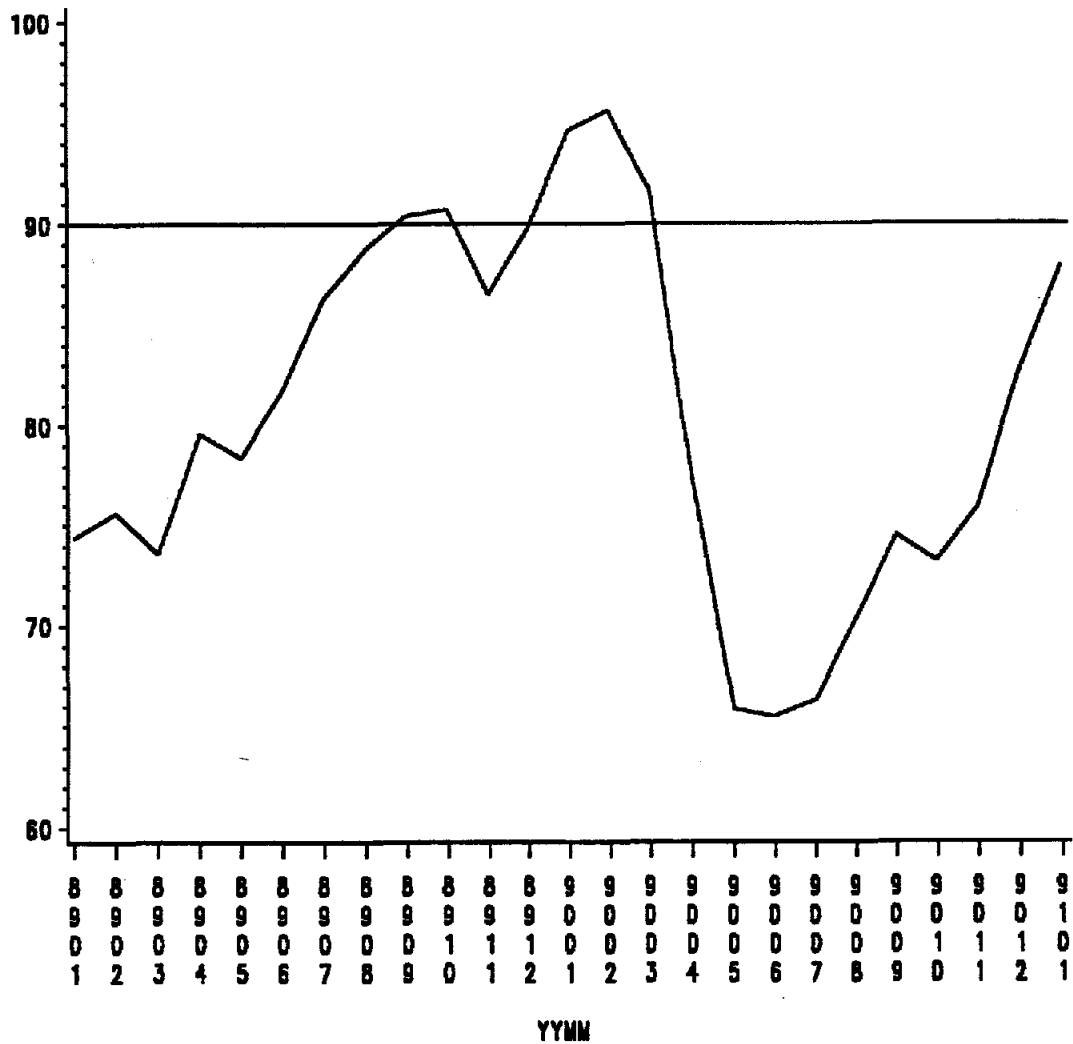
- A picture is more memorable
- *Images stick, after are numbers forgotten*--there have been reports that the use of images, in addition to text, improves, e.g., effectiveness of fundraising and memory of request.

[illegible]

Demand, in Percent of Capacity

By Month, January 1989 to August 1991

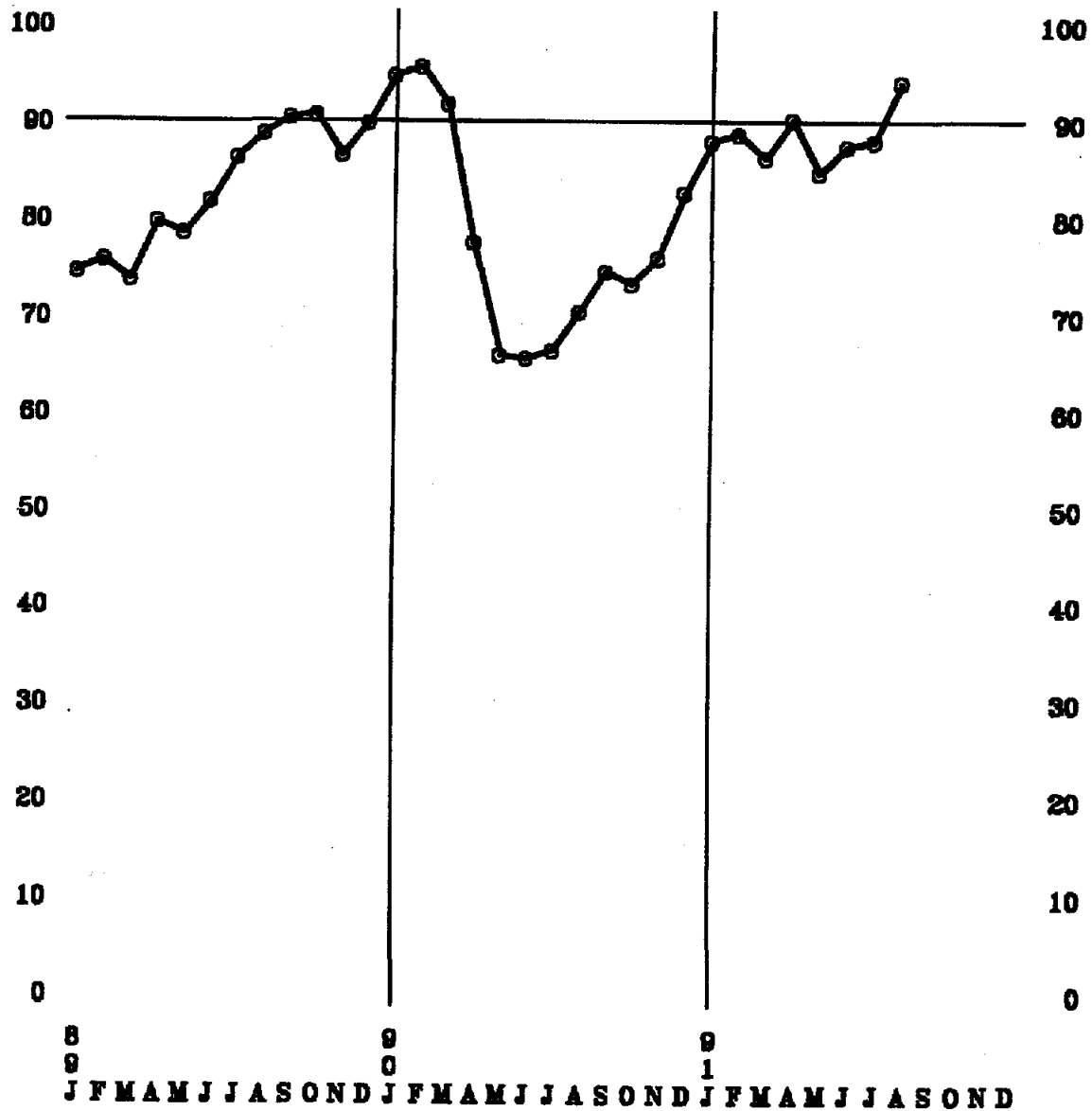
MEASURE



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=

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.

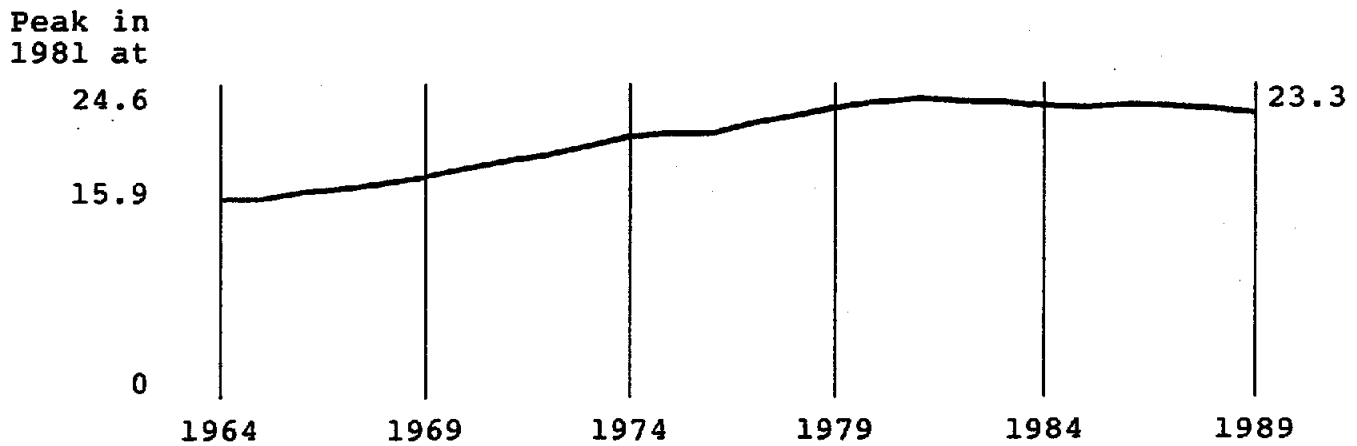
Impact of Choice of Font, for SAS/GRAPH with Xerox 4045 Laser CP Printer

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 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

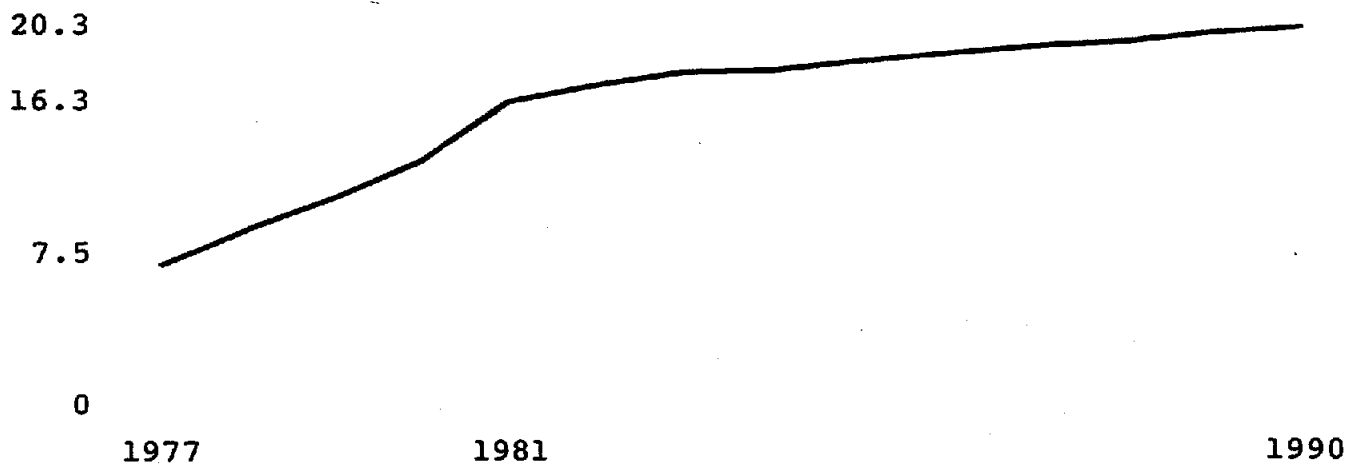


Gallonage: John C. Maxwell, Jr., Wheat First Securities
Reported in: "Beverage Industry", February 1990

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

Production of Miller Lite - 1977 to 1990

Millions of Barrels



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

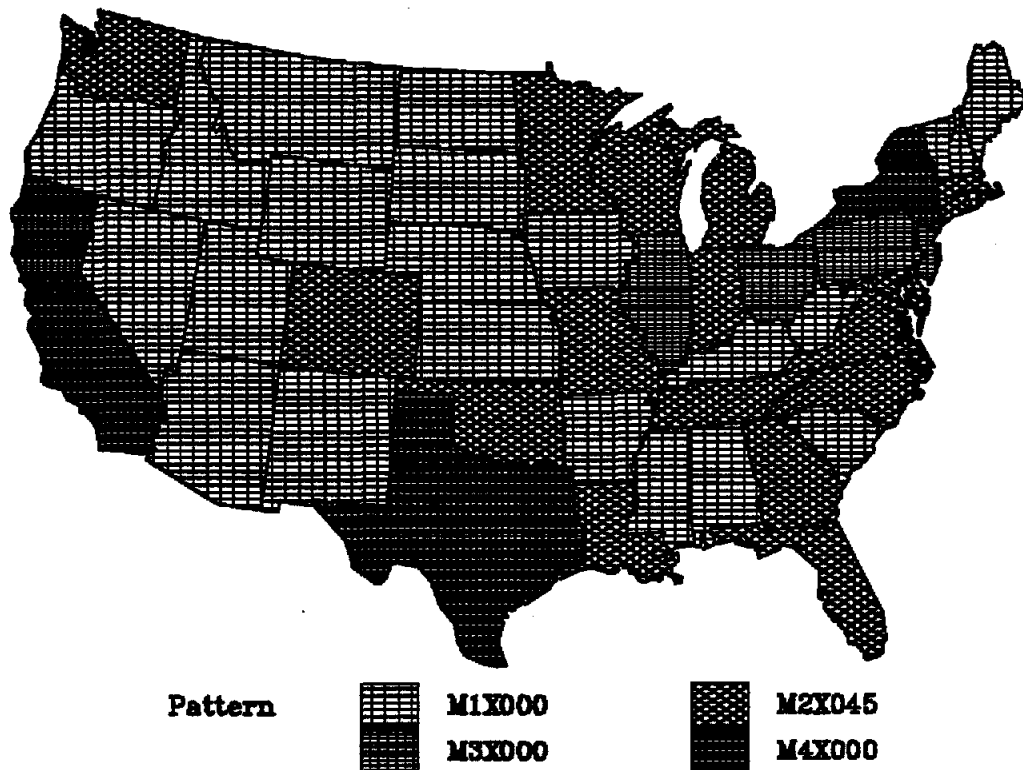
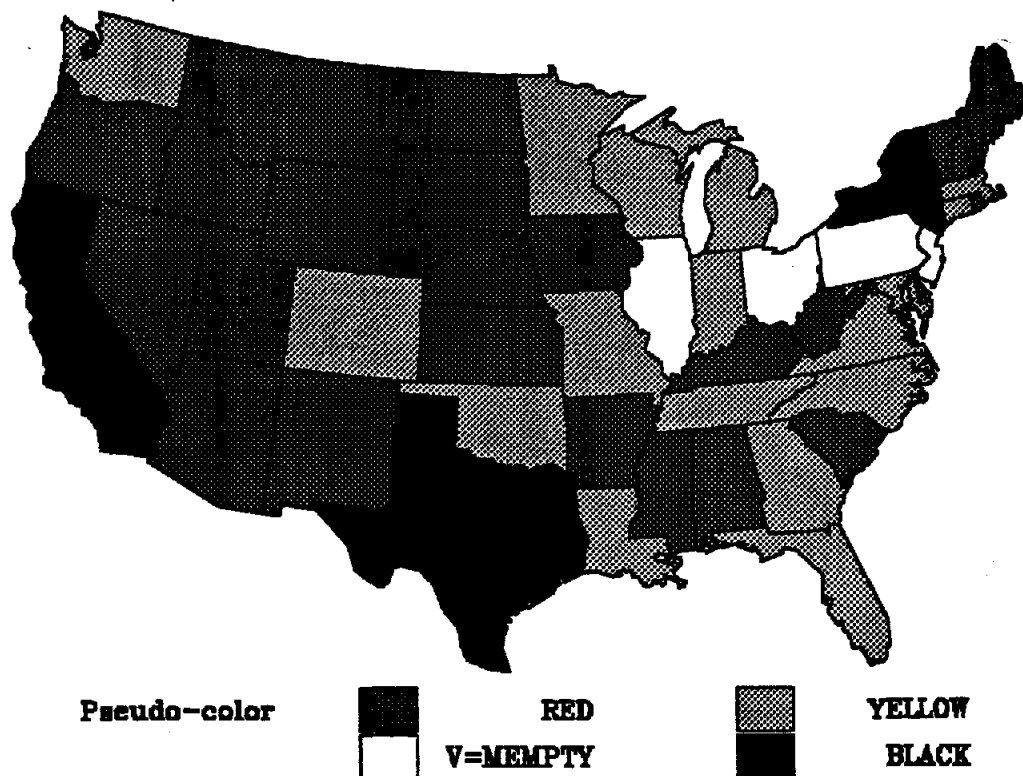
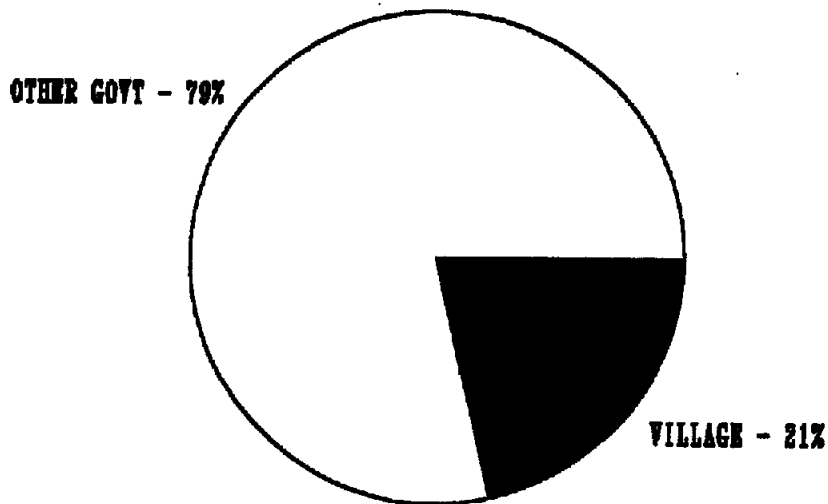


Figure 8. Map with Site-customized GDDM Grey Shades for IBM 3820



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.)