

Chart Smart: Designing Graphs and Tables for Effective Communication

LeRoy Bessler, Miller Brewing Company

Abstract and Introduction

The time and attention of a communication recipient, whether a clerk, an analyst, or an executive, are valuable resources.

This paper on business communication with SAS* and SAS/GRAPH* explains how to create powerful presentation materials, and graphic or tabular reports that can be digested at a glance.

Familiarity with SAS/GRAPH is assumed. No code is presented. Emphasis is on design principles and illustrations. However, due to the page-count limit for publication, not all the illustrations can be included.

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 digestible 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
- Symbols, line types, etc.

Standard Formats

- Consistency breeds/speeds comprehension
- Viewer needn't "recalibrate" page-to-page
- Productivity--preparer spared over-choice:
less decision-making, fewer iterations
- Best implemented with macros

Maximize Data, Not Paper-marking

- Software defaults biased to traditional props
- Turning off props
= more work, but--
- Restraint in elaboration/decoration
= less work

Special Effects

- Good design & interesting data
can stand on their own
Productivity & communication
are the real objectives
- 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 8)

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

Text

- Always use black--it's the most readable
Emphasize with *italics* (or **bold**), not color
- SAS variable name an unacceptable label
- Unless compelling counter-need,
use mixed upper and lower case

Mixed case is the business communication standard, and easier to read; all upper case is a hold-over from primitive computer printing.

- Keep it brief

Focus viewer attention with sparse text

Decimal Precision

- Not doing science--usually suppress decimals (Footnote any imperfect sum of rounded values)

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

Font Sizes

- At most, use three
- Titles (usually make all same size), maybe $H > 1$
- Body text, usually $H=1$ (unless need dense tick-mark text)
- Footnotes smaller, only if downplayed

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

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

Color vs. Black-and-White

- No response levels or categories--black & 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

Usually Omit Area Fill

- Beneath line(s)--ALWAYS
- In pie slices, unless color presentation
- On simple bar charts--
but maybe light grey,
especially if bars close together
- On maps, unless for response levels

Area Fill Types

- To carry information, use solid colors or grey shades
- *In desperation only*, use parallel lines or cross-hatching
- On maps, *no* 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
- For point detection, not just trend, recommend:
 $V=DOT$ (this is a BIG dot)
 $V=CIRCLE$
 $V=-$ (traditional, circle around small dot)

Pies vs. Bars vs. Lines

SAS/GRAPH pie charts tend to lose the SLICE, VALUE, and PERCENT text if there are too many slices, especially for the small ones. However, the Pac-Man Pie Chart (Figure 1) is an excellent use of the pie chart, and never has that problem. If the small slice needs detail provided, that can be put (with the big slice as well) in a table.

The Enhanced Horizontal Bar Chart (Figure 4) is a foolproof, better alternative to the over-used pie chart. It provides image and detail optimally combined: category name; percent of whole; graphic depiction of relative size; and value (ranked). It always works, even if the pie chart fails--when text for small pie slices does not print.

Besides comparing percents of the whole in this way, bar charts can, of course, simply compare magnitudes, or can display trends or changes.

Line charts are for trends. If one wishes to annotate data points, a simple bar chart is better than a single-line chart--there is no chance of a value being obscured by a line. If a multi-line chart has too much crisscrossing, a side-by-side bar chart works better.

Order of Pie Slices

- Default--by slice name
- More useful--by decreasing size:
Release 6.07, DESCENDING option;
Before that, achieve via MIDPOINTS=

Pie Labels

- Specify NOHEADING
- All OUTSIDE
- *Do not* match color of label to that of slice--e.g., yellow text on white paper is impossible to read
- SAS/GRAPH-computed PERCENT always NN.NN%: Can be circumvented--see paper "Pie Charts and Bar Charts" cited below
- SAS/GRAPH appends .0 to integer VALUES: Suppress with FORMAT statement

Vertical Bar Charts

- Put values at ends of *simple* vertical bars
- If complex, use side-by-side, not stacked, bars
- For complex vertical bar chart, use PROC GREPLAY with a template to put the bar chart above, and a table below for detail look-up

Graphs Versus Tables

A good business use of a chart is to display visually the relative size of measurements, and to supply detail at the same time. Presentations or reports that integrate image (i.e., impact) and numbers (i.e., precision) are memorable, quickly and easily comprehended, and both influencing and reliable for decision-making.

Except for the numbers at the right margin of horizontal bar chart, or the numbers supplied at the ends of bars on a simple vertical bar chart, the best solution is usually a companion table for the graph.

For a simple trend line, you can *make the graph talk* with "Sparse Annotation" (see Figures 6 and 7). For

a map, use the techniques reported in my paper "Programarium and Atlas of Statistical Cartography: How to Find/Show Your Data With PROC GMAP", elsewhere in these *Proceedings*.

The best answer to the question of "graph versus table" is often "graph *and* table". See Figure 8.

"Let Part Stand for the Whole"

I once read the above recommendation for effective communication. The point is that often, if not almost always, the *essence* or the *most significant* is enough. And, if more turns out to truly be desired, it can be supplied on demand, rather than as routine.

Implementations of this precept include:

Exception Report
Summary Report
Ranking Report (Figure 5)
Pac-Man Pie Chart (Figure 1)

Sequencing the Information Presentation

- First, the Exception Report
To monitor actual measurements versus goals or thresholds, any exceptions must be on Page 1 of a hardcopy report, or selectable as Option 1 on the main menu for an online report. All exceptions should be on one page, even if the measurements are for totally unrelated items.
- Second, the Summary Report
If the report includes trend charts and/or historical tables, there should be a one-page summary to show all the current report-month (or report-week or report-day) critical values.
- Then, everything else.

Sequencing Information in a Graph or Table

- To provide an all-encompassing look-up tool for a large set of categories, order the graph or table entries alphabetically by category name.
- To provide a tool for rapid identification and assessment of categories of significance, order the graph or table entries by decreasing value of the measurement of interest.

Ranking Report (Figure 5)

- Focus attention on high-impact categories
- Often the high-ranking categories that can be fit on one page account for 80-99% of the total of the measurement of interest, even if the full list of categories would run to several pages.
- Also, limit the list:
 - Show only the Top NN--e.g., Top 10
 - Show only values above a minimum cut-off

The Enhanced Horizontal Bar Chart (Figure 4), though it includes all the values, is a *graphic* ranking report.

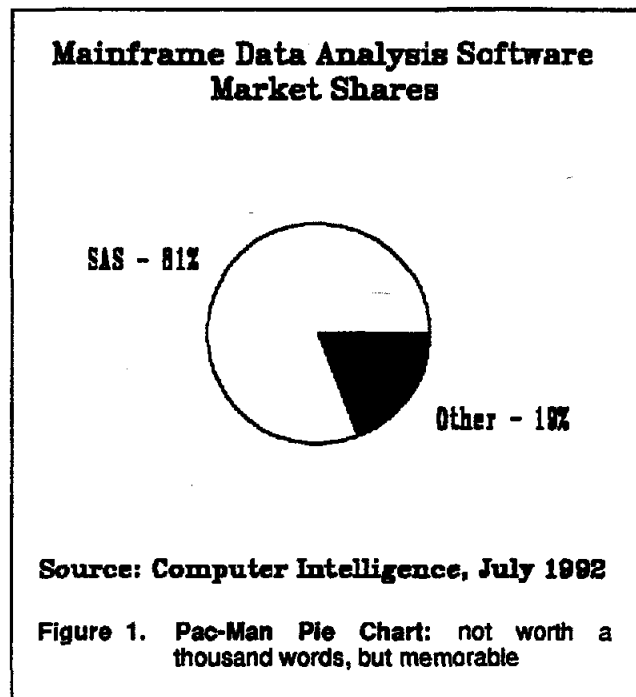
Graphic Formatting for Tabular Output

One can use a graphic "format" to display a tabular listing. Then, PROC GREPLAY can be used (as in case of Figure 8) to print a table on the same page as a graph. Also, such tables can be packaged with graphs (even on separate pages) in the same report with a uniform style for graphs and tables. Style includes, e.g., the choice and size of font(s), and the size of titles and footnotes. This is accomplished by running PROC PRINT, PROC TABULATE, or whatever, in conjunction with PROC PRINTTO, and then using PROC GPRINT.

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

Even if not "worth a thousand words",

- A picture is more memorable
- *Images stick, after numbers are forgotten--* images, added to text, have been found to improve, e.g., effectiveness of fundraising and memory of the request. (Such images were thematic symbols, *not* obvious emotion-evoking photographs.)



Related Papers By the Same Author

For SAS code for the Enhanced Horizontal Bar Chart (Figure 4) and the Top NN List (Figure 5), see "Software Intelligence: Applications That Customize Themselves", in *Proceedings of the Eighteenth Annual SAS Users Group International Conference*, SAS Institute Inc. (Cary, N.C.), 1993.

For how to produce the Custom Trend Line (Figure 3), see "Intelligent Production Graphic Reporting Applications".

For how to improve on the SAS/GRAPH-provided pie chart PERCENT, and for more on pies and bars, see "Pie Charts and Bar Charts: Getting Their Best out of SAS/GRAPH Software".

For the SAS code for Sparse Annotation, or for how to save resources (computer time, computer memory, print/plot time, etc.), see "Effective and Efficient Use of SAS/GRAPH Software".

The last three papers cited are on pages 183-189, pages 264-273, and pages 505-514, respectively, of *Proceedings of the Seventeenth Annual SAS Users Group International Conference*, SAS Institute Inc. (Cary, N.C.), 1992.

Notices

SAS and SAS/GRAPH are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. * denotes USA registration.

Pac-Man is a registered trademark of Namco Ltd., Tokyo, Japan.

Author

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

Demand, in Percent of Capacity

By Month, January 1989 to August 1991

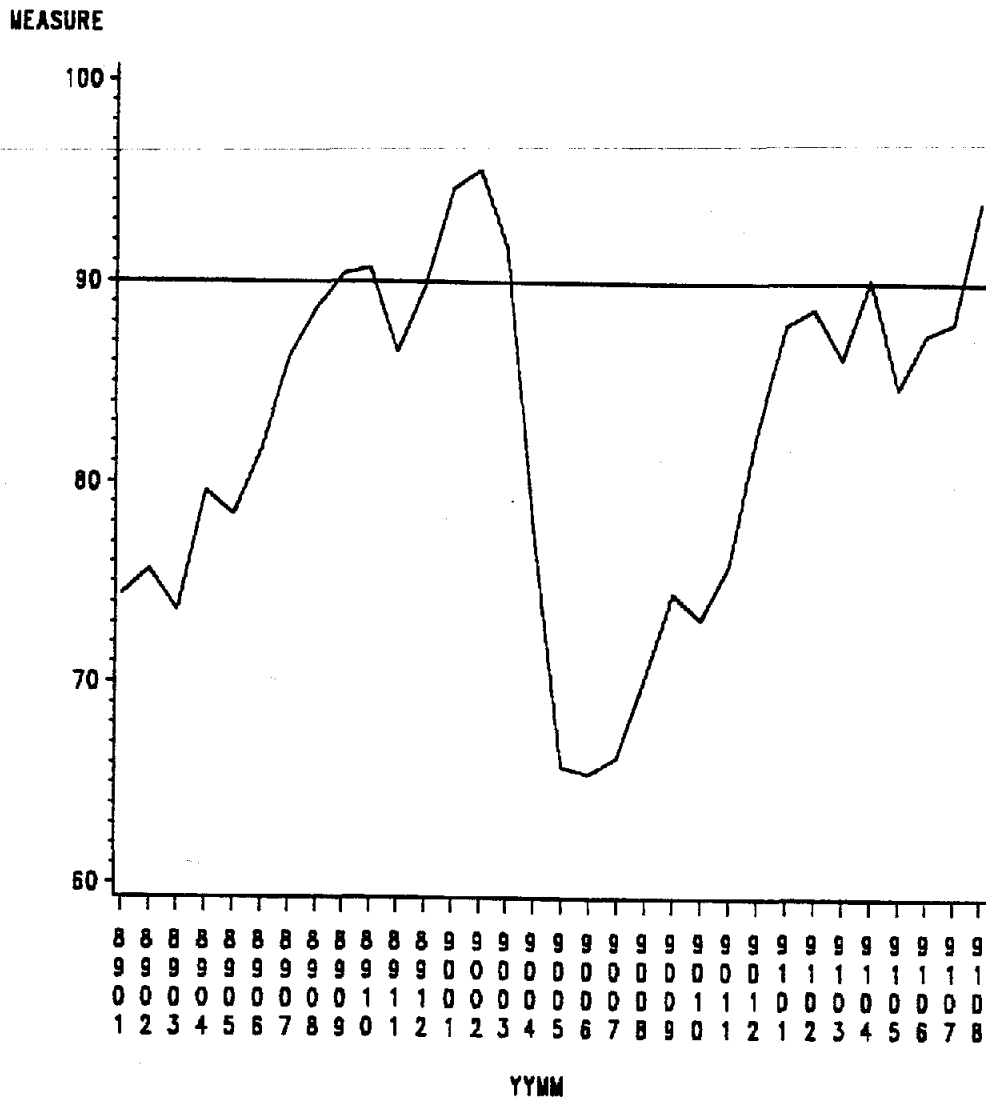
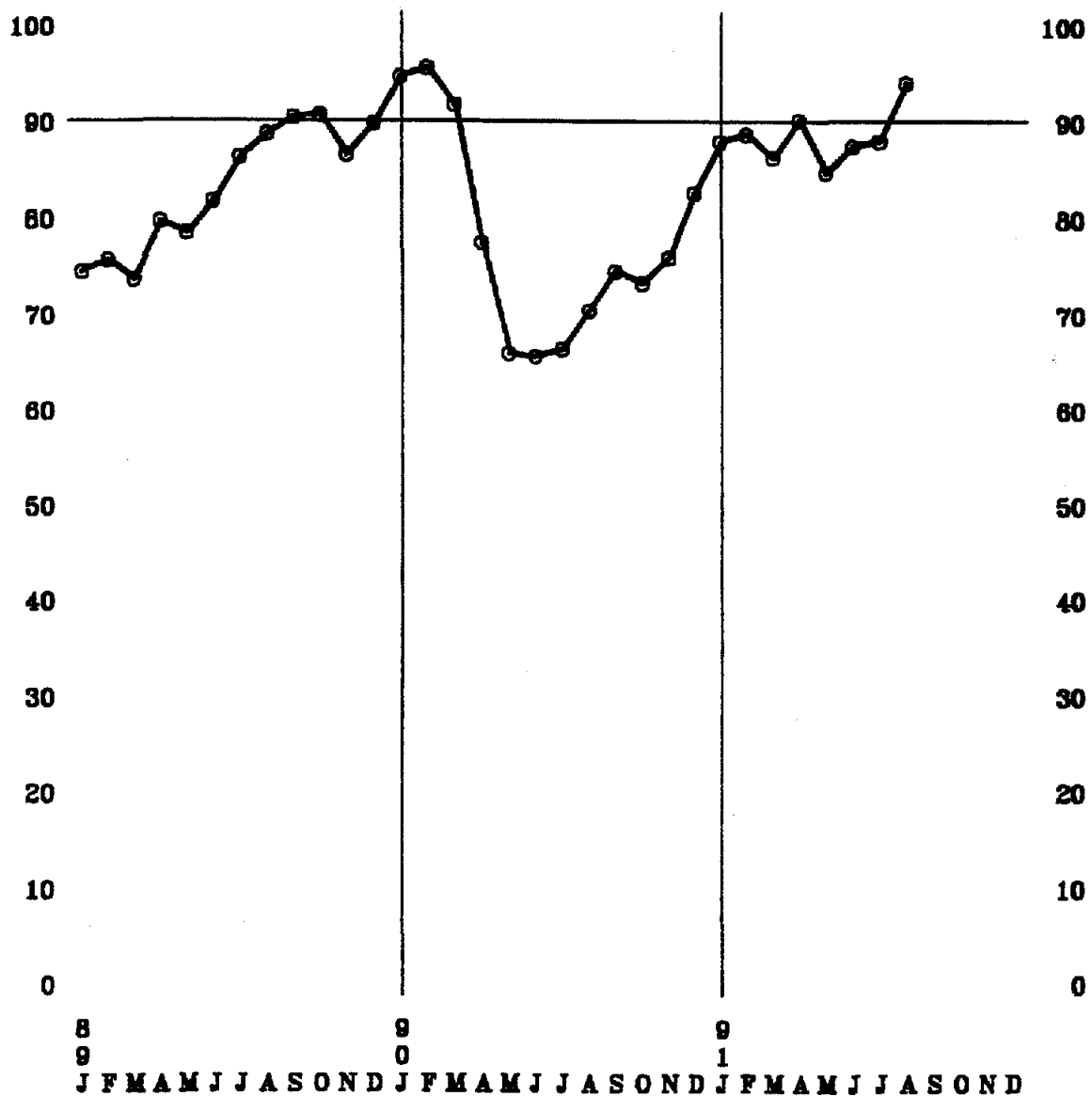


Figure 2. Trend Line Using SAS/GRAPH Defaults

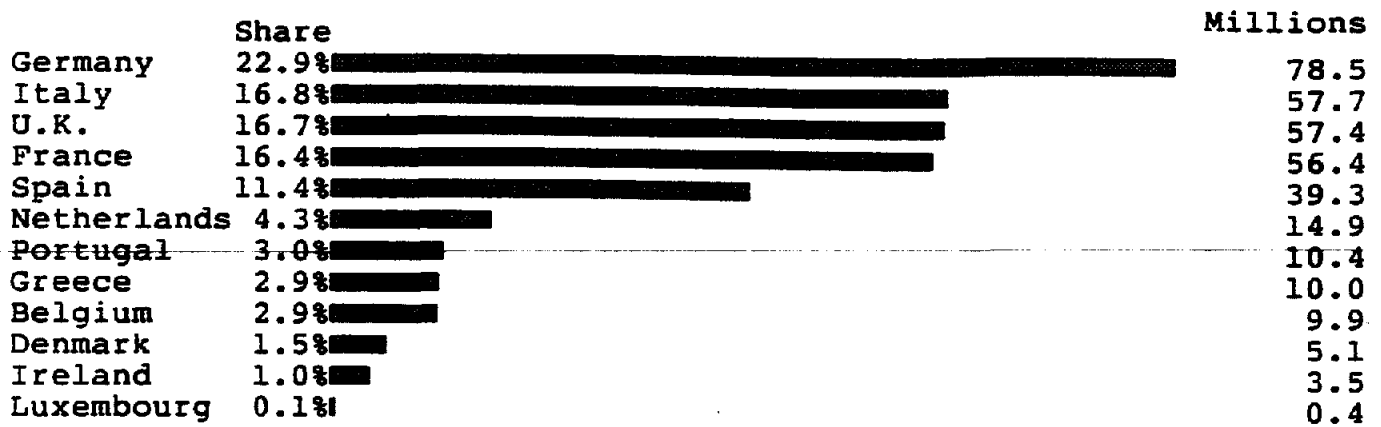
Demand, in Percent of Capacity By Month, January 1989 to August 1991



90% is threshold for considering capacity increase

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

1990 Population in the European Community, By Country



Total = 343.5

Data Source: "The World Factbook 1990"

Figure 4. Bessler's Enhanced Horizontal Bar Chart

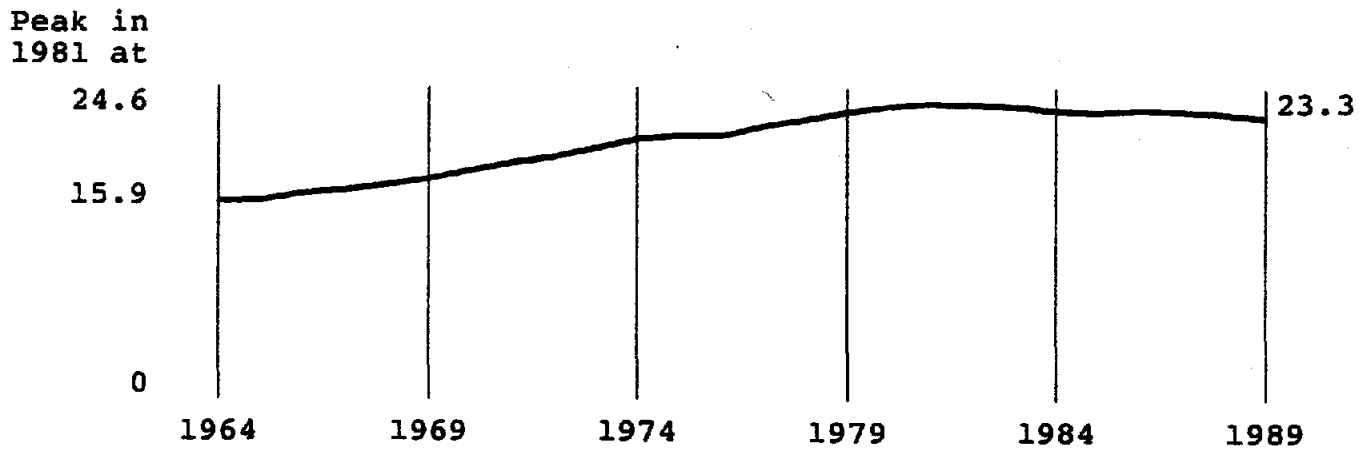
Top 10 Test SAS PROCs Used, 92-08-17 to 92-12-30

This list accounts for 92.5% of the total

Rank	PROC	Count
1	DATASTEP	19,877
2	SORT	6,392
3	REG	4,716
4	DATASETS	2,963
5	CONTENTS	2,877
6	PRINT	2,690
7	MEANS	1,680
8	SUMMARY	1,467
9	FREQ	1,101
10	GPLOT	1,048
		=====
		44,811

Figure 5. Ranking Report--Top 10 List

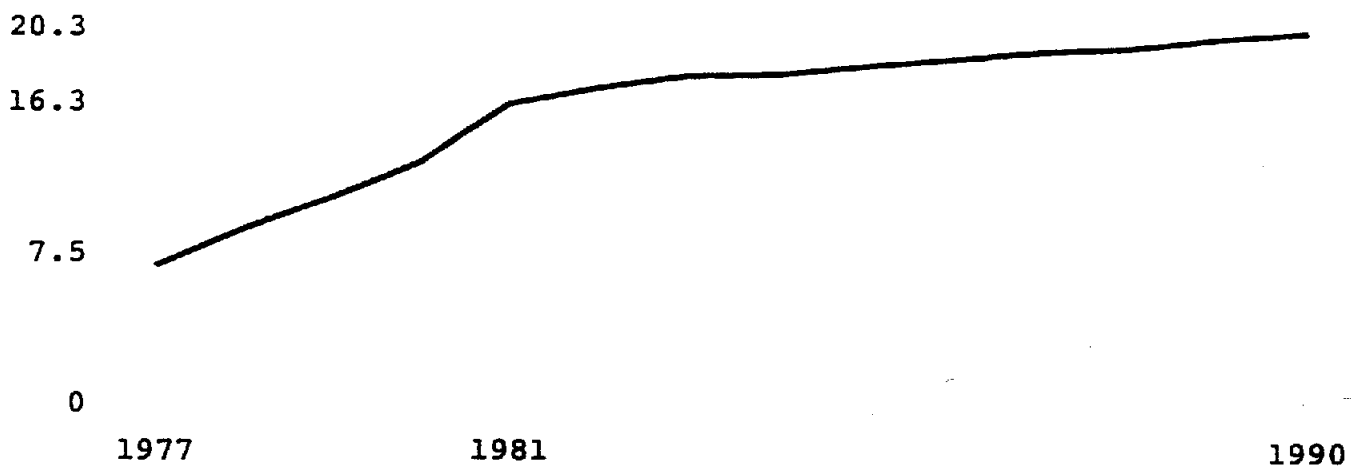
A Quarter Century of Thirst
Annual U. S. Beer Consumption, in Gallons per Capita



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

Figure 6. Sparse Annotation, End-points and Maximum Only

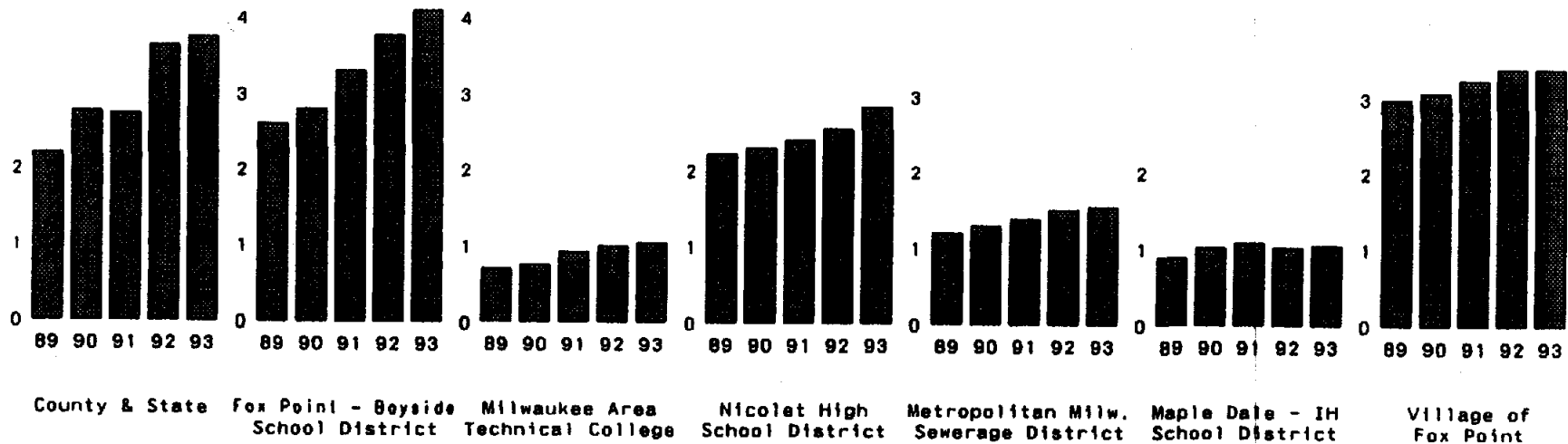
Production of Miller Lite - 1977 to 1990
Millions of Barrels



Data Source: "Beverage Industry"

Figure 7. Sparse Annotation, End-points and Special-Interest Point Only

Trends in Property Tax Levies (Millions of Dollars) in Fox Point



Growth and Amount of Property Tax Levies in Fox Point

Taxing Unit of Government	This Year's Increase	Increase Since 1989	This Year's Tax Levy
Nicolet High School District	+11.5%	+29%	\$2,841,432
Fox Point - Bayside School District	+8.6%	+58%	\$4,091,652
Milwaukee Area Technical College	+3.6%	+51%	\$1,025,940
Milwaukee County & State of Wisconsin	+3.1%	+71%	\$3,738,185
Milwaukee Metropolitan Sewerage District	+2.4%	+29%	\$1,534,529
Maple Dale - Indian Hills School District	+1.9%	+19%	\$1,035,738
Village of Fox Point	+0.0%	+14%	\$3,396,151

For the five-year period, ability to pay (i.e., personal income) in the Milwaukee metropolitan area grew only 22%.

Figure 8. Composite Chart