

Chart Smart: Design Graphs to Inform and Influence

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Abstract and Introduction

The time and attention of a graph viewer, and the time of a graph creator, are precious resources. Are you troubled by graphic feature/option over-choice, special effects gimmicks, visual clutter enablers, and uninspired defaults?

This therapeutic paper for victims of VCTT (Visual Communication Technology Trauma) will help you create powerful presentation materials, and graphic reports digestible at a glance, to prevent the disappointing question, "What's your point?"

SAS/GRAPH[®] tips are given, but most ideas are software-independent. Emphasis is on design principles and innovative graphing techniques, that you can use to inform and to influence.

Design for 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 acts like an oasis in the desert."

Jan White

"Good Design should:

be purposeful; simplify; unify; organize; provide contrast; project an appropriate image; selectively emphasize; use restraint; save time; speed production; rely on editing, not compromise."

Roger C. Parker

"Design to inform and to influence, not to impress."

LeRB

Defaults vs. Elegant Customization (Figures 2, 3)

- Software & hardware are power tools, but yield potentially lots of sub-optimal results quickly
- Simple graphs focus on the message, the data
- Suppress/avoid inessential graphic elements

Middle of the Road: No Defaults, No Decoration

Software defaults reflect the grid-and-pen-based laboratory report tradition. Overriding the defaults requires more work, but abstaining from decoration requires less work.

Special Effects Are For Movies

Good design & interesting data can stand on their own. Productivity & communication are the real objectives. Omit the drop-shadow, shaded background, clip art, etc.

Just Say "No" to the Designer Drug 3D

- 3D pie charts—always distortion
- 3D bar charts—needless complexity
- 3D maps—hard to use, some parts hidden
- *Exception:* Use PROC G3D for a 3-variable plot

Consistency: Define a style, and stick to it

- For titles, footnotes, notes, font choices & sizes, symbols, line types, etc.
- Consistency breeds/speeds comprehension—the viewer needn't "recalibrate" page-to-page
- Productivity—preparer is spared over-choice: less decision-making, fewer iterations
- Implement standard formats with SAS[®] macros

Text Is Essential—Handle With Care

- If the letters or numbers aren't readable, change the design or abandon the chart.
- Usually use black—most readable
Can emphasize with *italics* (or bold)
- Use mixed upper and lower case—written communication standard, easier to read
- Keep it brief: *Focus attention with sparse text*
- Not doing science—usually suppress decimals
Footnote any imperfect sum of rounded values
- Make title the headline, main message of graph

Limit Font Styles to Two, Sizes to Three

- Fancy font: maybe title, footnotes, legend
- Fancy software fonts increase processing time, print file size, and print time. Use default characters if you like the printed result. Requires F=NONE (or FTEXT=NONE for parts for which F parameter unavailable), or not specifying F=(FTEXT=) at all; requires override of fancy font that is SAS/GRAPH default for TITLE1.
- Titles (usually all one size), maybe H>1
Footnotes smaller if to be downplayed
Body text usually H=1, smaller if dense

Remove Axis Clutter (Figures 3, 4, & 6-12)

- 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
Use *Sparse Annotation* whenever possible

Axis Range Affects the Message

- Start axis at zero, *not* the SAS/GRAPH default
De-accentuate fluctuations. *Prevent needless anxiety, questions.* Concern should be triggered by a measurement that fails or crosses management's pre-defined goal or threshold, not by insignificant bumps or dips.
De-accentuate change. *Prevent needless elation or alarm.* Growth or decline should be judged by the size of the numeric or percent change of a measurement, and by the practical effect of that change, not by the steepness of the slope of a trend, which is controlled by an arbitrary choice of axis range.
- 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: either January to December (same or multiple years), or Report Month N Years Ago to Current Report Month

Use Color If Needed

- No response levels or categories—black & white
- Few levels or categories—gray shades maybe
- Many levels or categories—color necessary
- Black-and-white hardcopy is:
faster, cheaper, more reliable;
easier to use—simpler equipment,
no agonizing over color strategy;
more copyable—more, cheaper, faster BW
copiers available—good graphs get copied

For more about color, see my paper "Color Smart: Design Applications for Effective Visual Communication", elsewhere in this *Proceedings*.

Usually Omit Area Fill

- Beneath line(s)—always
- In pie slices, unless for a presentation, or for my New, Improved Pie Chart (Figure 5)
- On simple bar charts—but maybe light gray, especially if bars close together

Avoid Ugly Area Fill

- To carry information, use solid colors or grays.
- *Reluctantly* use parallel lines or cross-hatching, *in desperation only*; never use them on maps.

Make Plots Easy to Interpret, Easy to Look At

- Use *Sparse Annotation* (see Figures 11 & 12)
Focus on start, end, & critical points
Other details are best provided in a table
Sparse Annotation makes the graph talk
- Use V=NONE for plots, if possible
Can use W= to distinguish multi-line, rather than V=, if only two lines
- For point detection, not just trend, use:
V=DOT (this is a BIG dot)
V=CIRCLE
V=- (traditional, circle around small dot)
- Avoid grid lines; if not, use fine line L=33

Use Simple or Side-By-Side Vertical Bar Charts

- Put values at ends of a bar chart
(See Figures 6 & 7)
- Use side-by-side, *not* stacked, bars
(Compare Figures 8 & 9)

Why and How to Supply Detail for Graphs

A chart can both depict relative size, and supply detail. Presentations or reports that deliver both image (impact) and numbers (precision) are memorable, quickly and easily comprehended, and both influencing and reliable for decision-making.

Effective ways to supply detail are shown in Figures 1, 3-7, 11, and 12. But sometimes a companion table is the best solution, as shown in Figure 10.

How to Choose Between Lines, Bars, Pies

Line charts (plots) show trends or relationships. A side-by-side bar chart works better than a multi-line chart if there would be too much crisscrossing. When annotating, a simple bar chart is better than a jagged single-line chart, to avoid obscuring the values.

Bar charts can display changes or compare magnitudes. SAS/GRAPH pie charts lose slice-related text if slices are too many or too small. A Custom Horizontal Bar Chart (Figures 3 & 4) solves that problem.

Sequence the Bars or Slices (Figures 3, 4, & 5)

The default order for SAS/GRAPH bar and pie charts is alphabetic order of bar and slice name (MIDPOINT value). To enable rapid identification and assessment of categories of significance, order chart entries by decreasing value of the response.

"De-alphabetize" the DESCENDING Pie Chart

PATTERNS are assigned by SAS/GRAPH to pie chart slices in alphabetic order of slice name. If, however, you want DESCENDING slices, and the colors to be arranged, e.g., from light to dark, then, to get pattern colors ordered by slice size, you must first determine the "size order for slice names".

Control Pie Labels

- Specify NOHEADING and OUTSIDE
- Do not match color of label to that of slice—e.g., yellow text on white paper is impossible to read
- SAS/GRAPH appends .0 to integer VALUES: Suppress with FORMAT statement

Be Careful with the Pie Chart PERCENT Feature

- % only displayed at tenths or hundredths; if input VALUE to tenths, % to tenths; if input VALUE to hundredths, thousandths, or "finer", % to hundredths.
- Get % at tenths for any VALUE finer than tenths, by reformatting input to GCHART:

$$\text{TOGCHART} = \text{ROUND}(\text{VALUE}, 0.1);$$
- If input VALUE is integer, or integer with zero(s) to right of decimal point, SAS/GRAPH insists on displaying % to hundredths—no circumventions.

Try My New, Improved Pie Chart (Figure 5)

Release 6.10 of SAS/GRAPH does provide a pie chart legend for slice names. But the legend in my New, Improved Pie Chart provides more information.

The usual SAS/GRAPH pie chart, even with legend, is still vulnerable to disappearing Value and Percent text when pie slices are too many or too small.

Use the Powerful "Pac-Man Pie Chart" (Figure 1)

The idea of a two-part pie chart may seem trivial, if not silly. But when the share of interest to your message is either tiny or huge, the image is very "impactful" and, therefore, memorable.

Images stick, long 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 photos staged or picked for emotional response.)

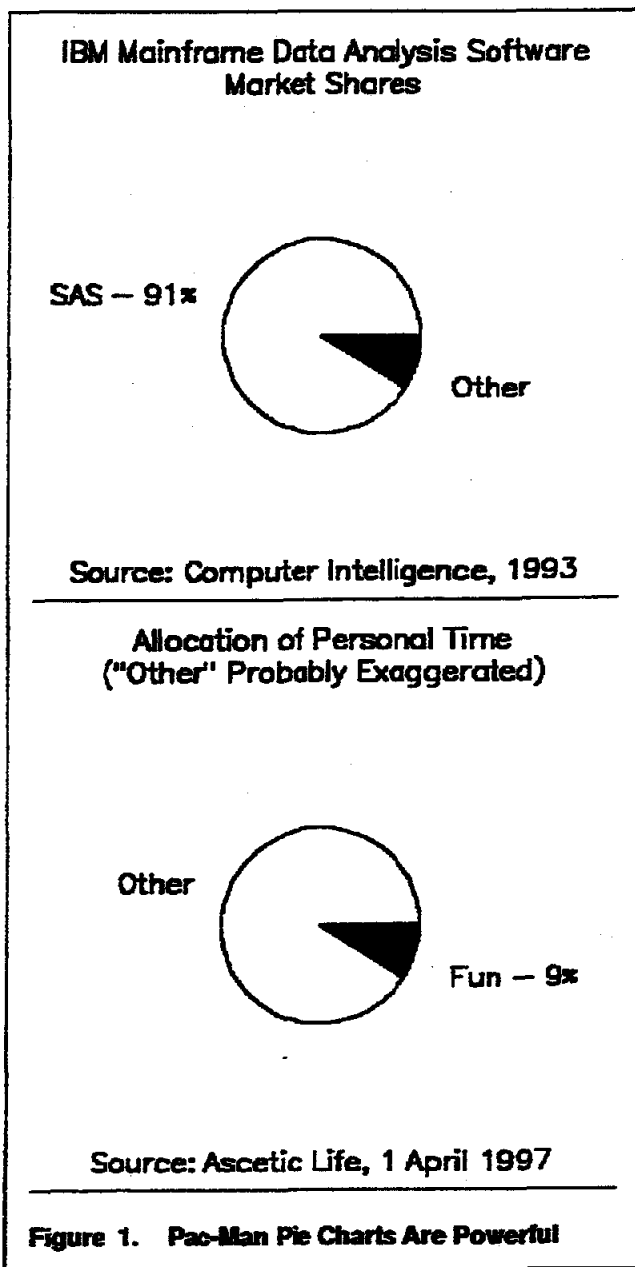
In the second case, you can easily satisfy curiosity—if any—about the large "Other" with a table displayed below the pie chart. But *it is essential to blunt the visual message by splitting the big wedge into a lot of little ones which may be as small as or smaller than the wedge whose smallness you wish to emphasize.*

Notices

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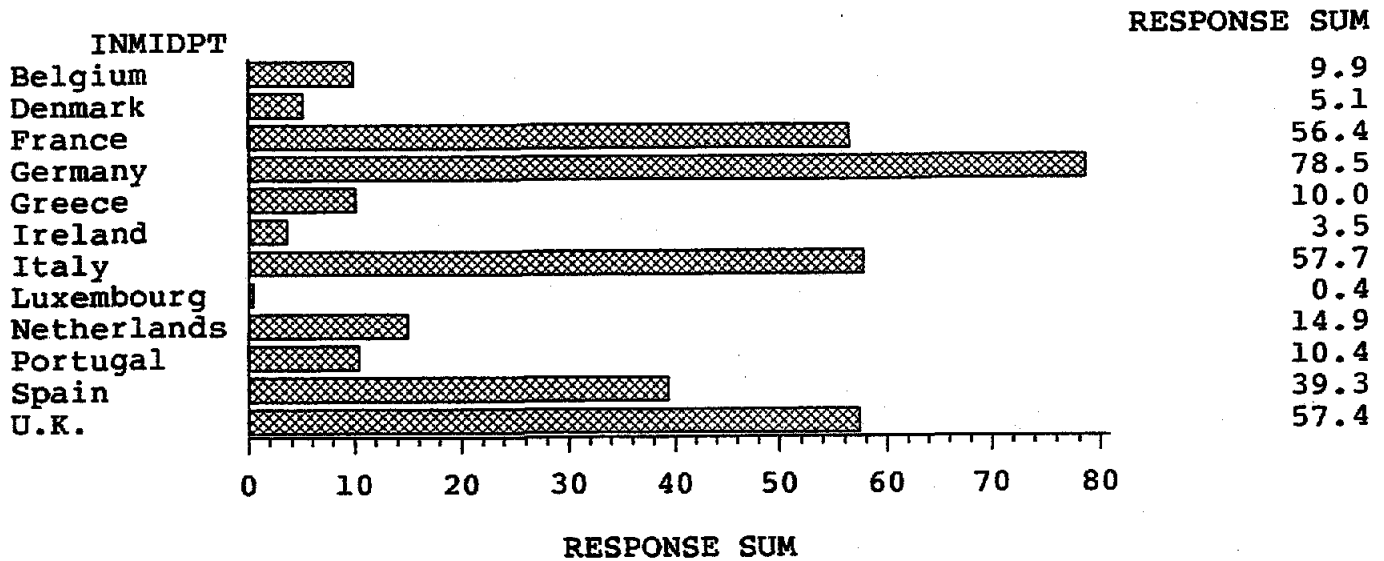
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1990 Population in the European Community, By Country

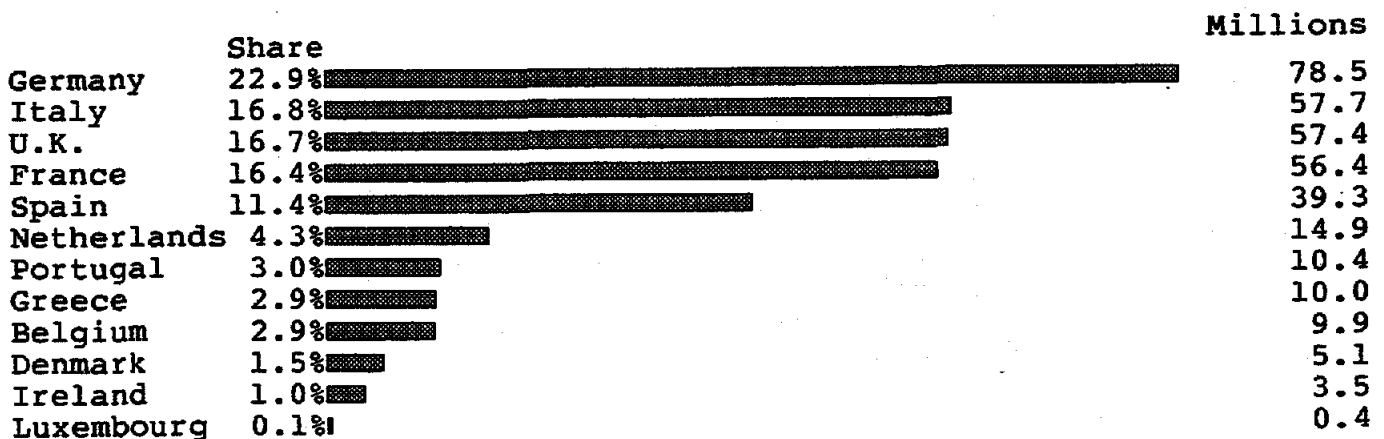
(in Millions)



Source: "The World Factbook 1990"

Figure 2. Default Horizontal Bar Chart

1990 Population in the European Community, By Country



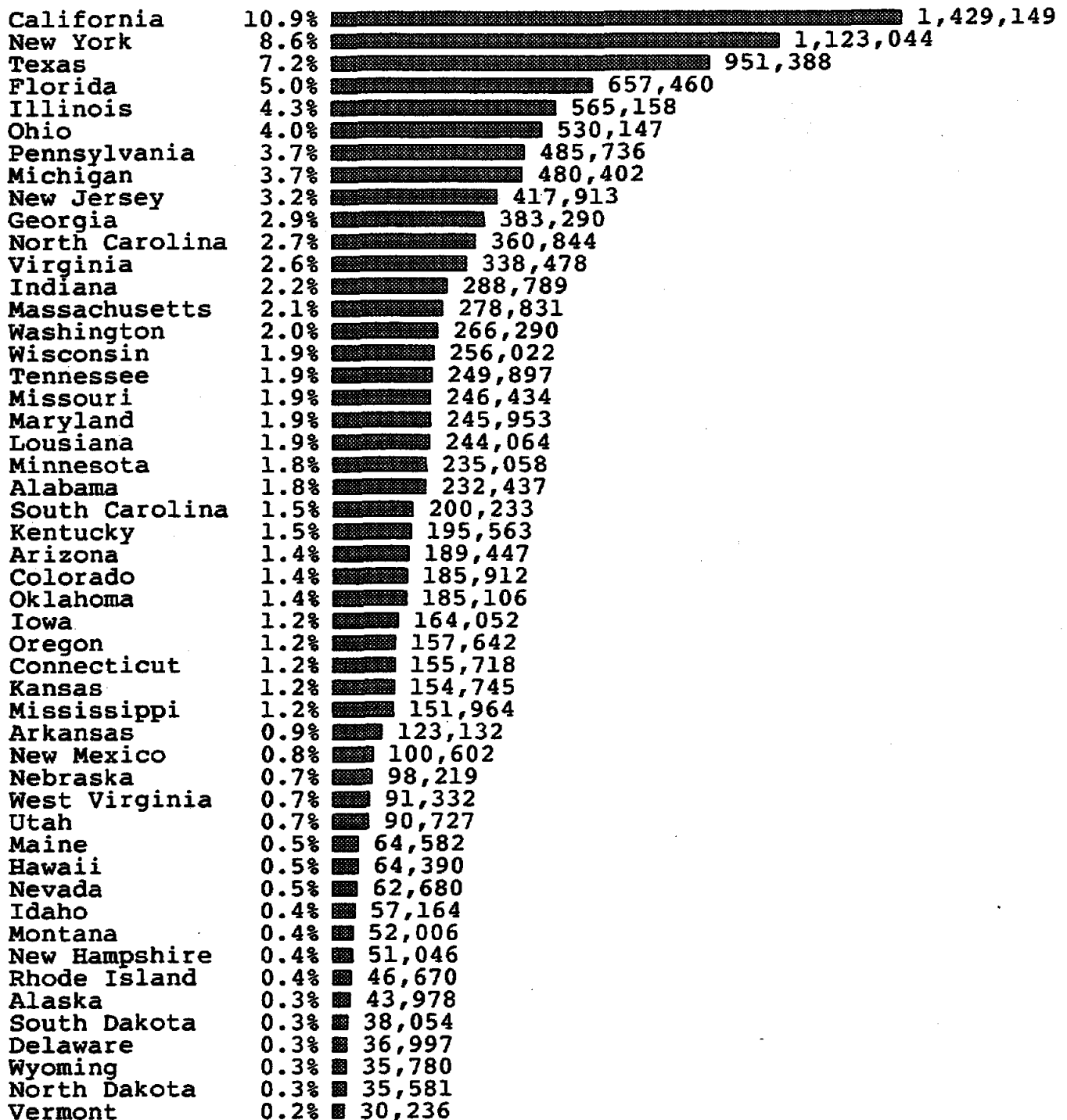
Total = 343.5

Source: "The World Factbook 1990"

Figure 3. Custom Horizontal Bar Chart

State and Local Government Employment By State In October 1991

State Name, Percent of USA Total, and Employee Count

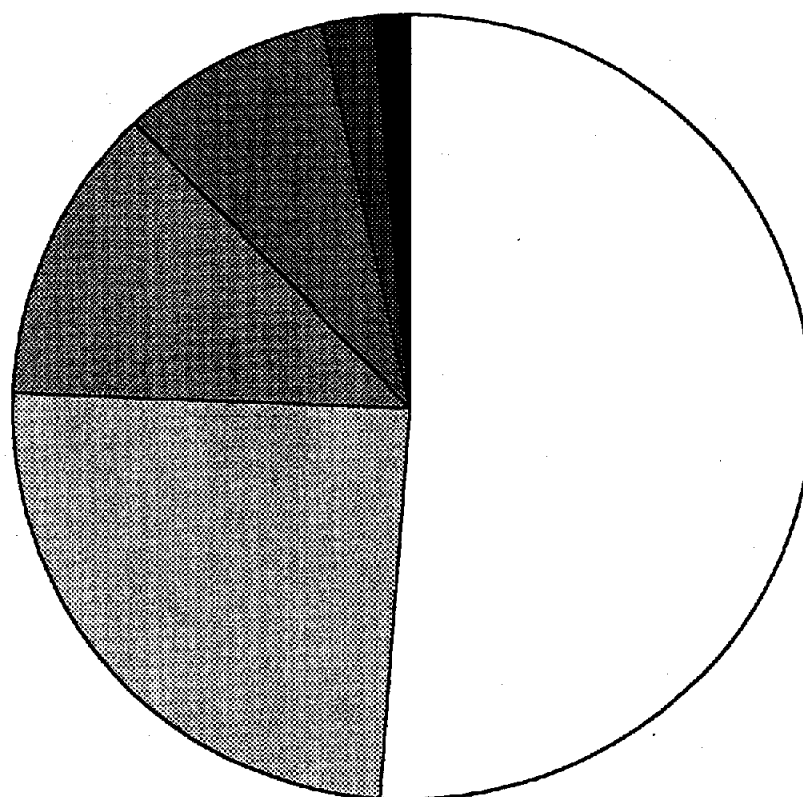


USA Total = 13,130,342

Figure 4. Annotated Ranked Horizontal Bar Chart:
For When No Pie Chart Will Work

1991 Per Capita Consumption of Beverages in Six Categories

Estimates from "Beverage World 1992-1993 Data Bank"



	Share		Gallons		Beverage Category
□	51.2%	—	48.4	—	Soft Drinks
▒	24.5%	—	23.2	—	Beer
▓	12.3%	—	11.6	—	Fruit Juices and Drinks
■	8.5%	—	8.0	—	Bottled Water
■	2.0%	—	1.9	—	Wine
■	1.5%	—	1.4	—	Spirits

Figure 5. New, Improved Pie Chart

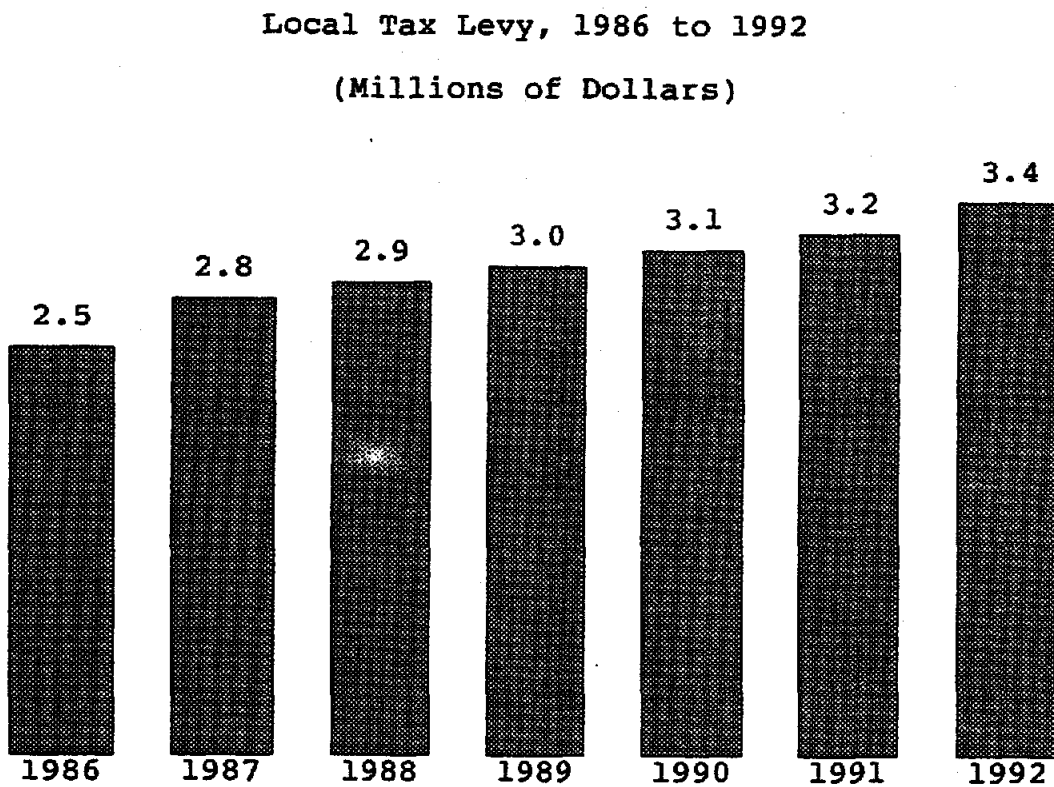


Figure 6. End-annotated Vertical Bar Chart, Using SUM Option

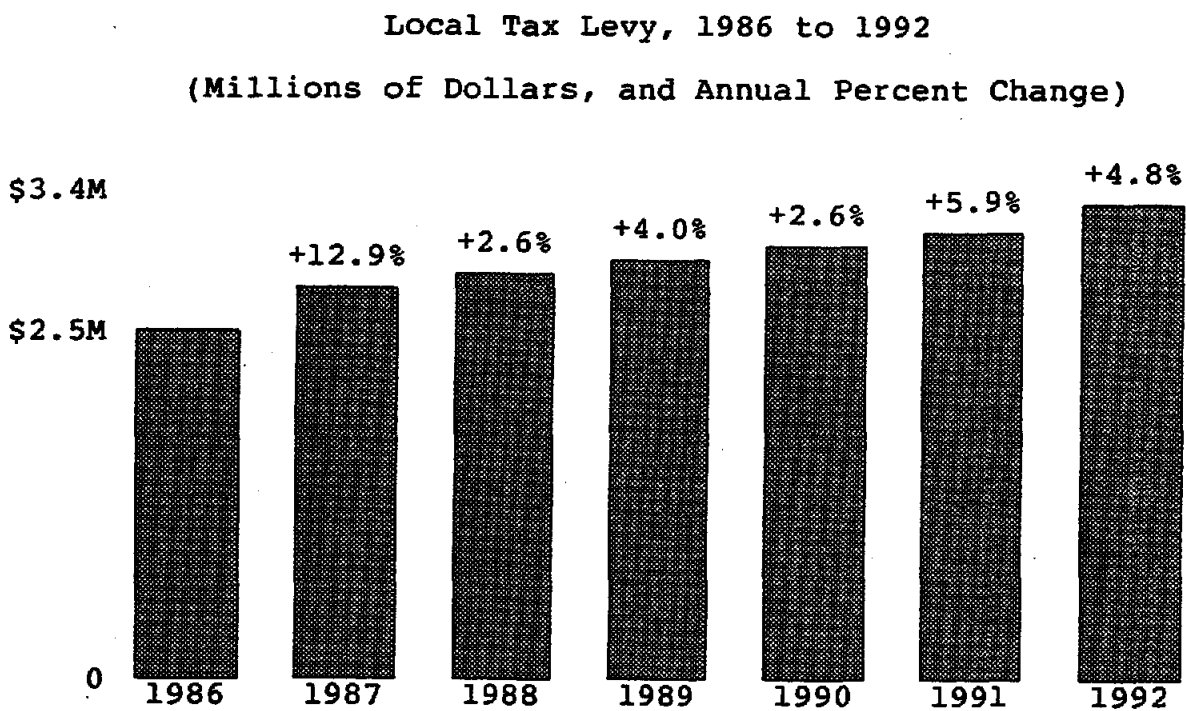


Figure 7. Custom End-annotated Vertical Bar Chart

1991 Club Sports Revenues, By Month

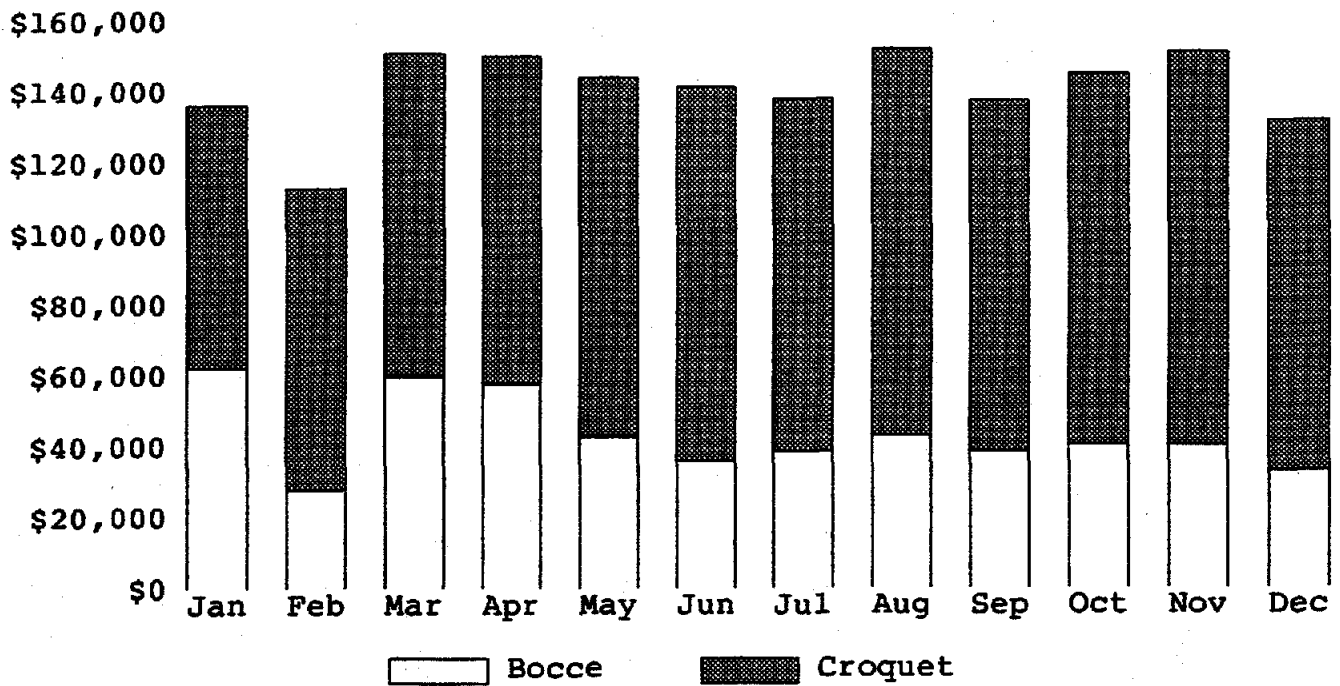


Figure 8. Stacked Bar Chart Undesirable: How Many Dollars from Croquet?

1991 Club Sports Revenues, By Month

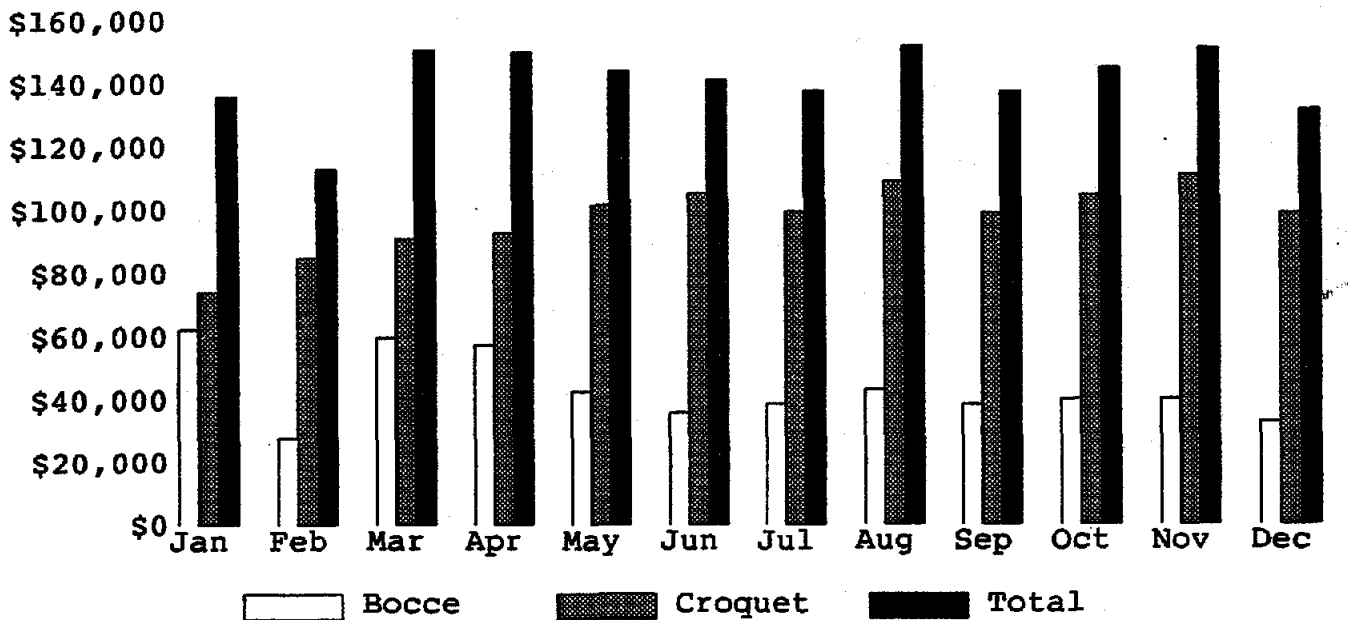
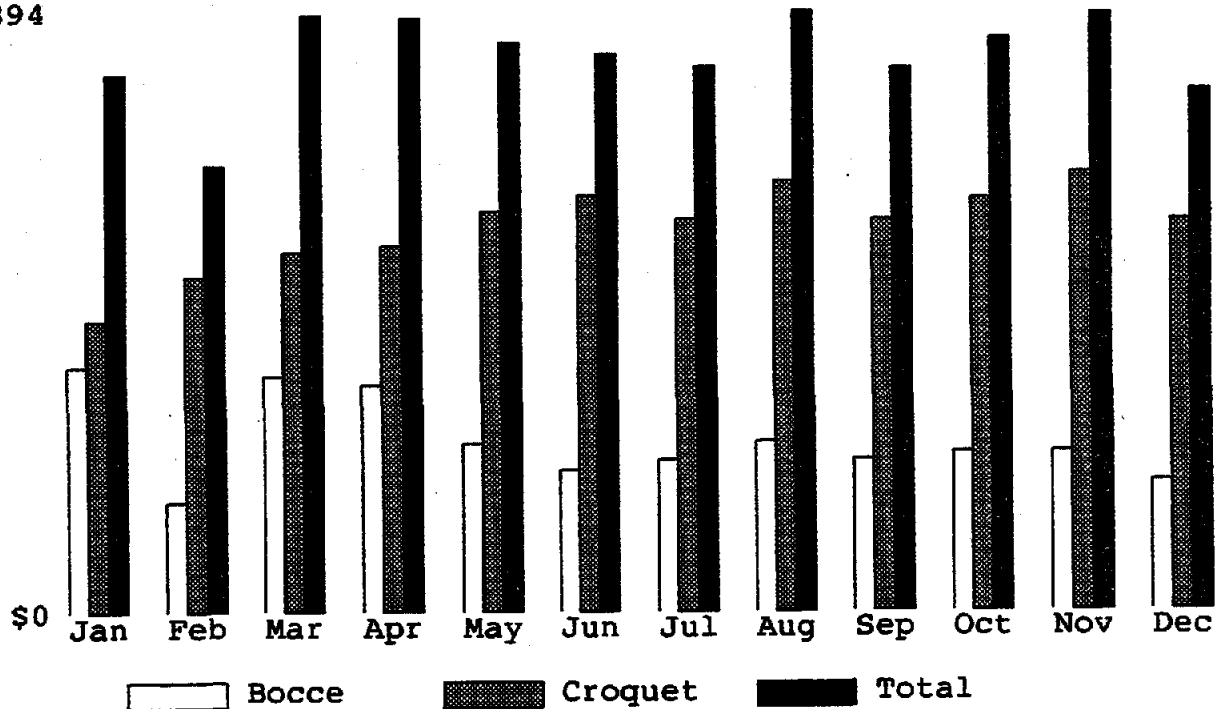


Figure 9. Side-By-Side Vertical Bar Chart Is Better

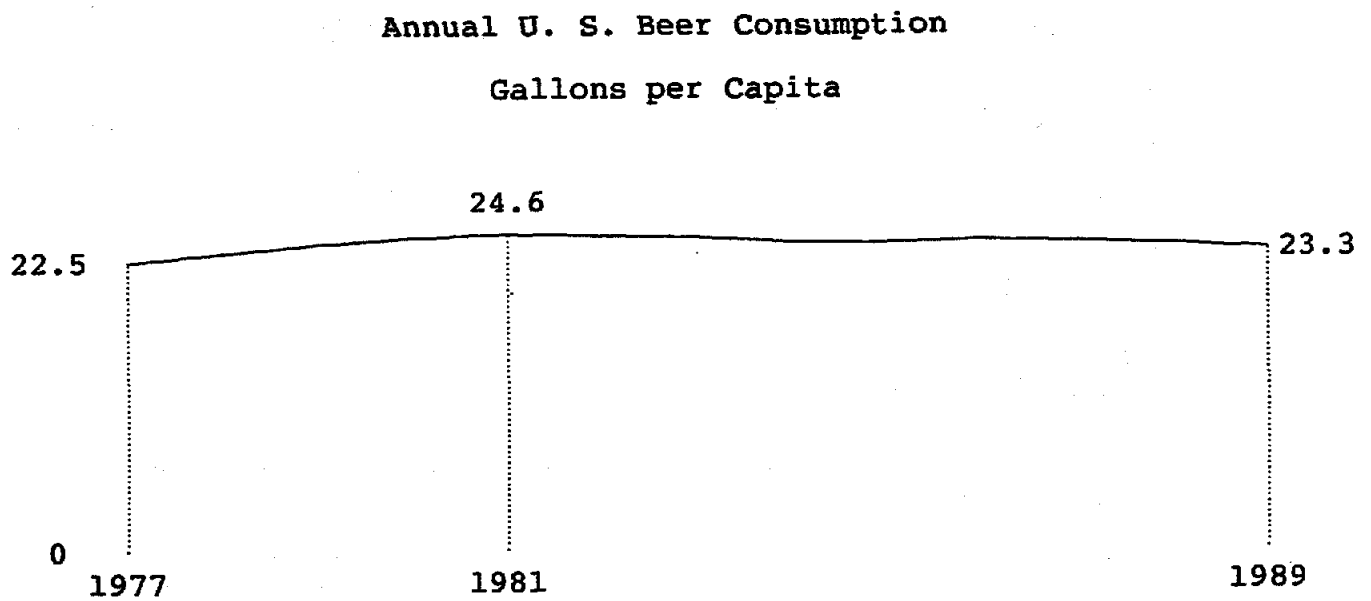
1991 Club Sports Revenues, By Month

Peak in
August
\$151,894



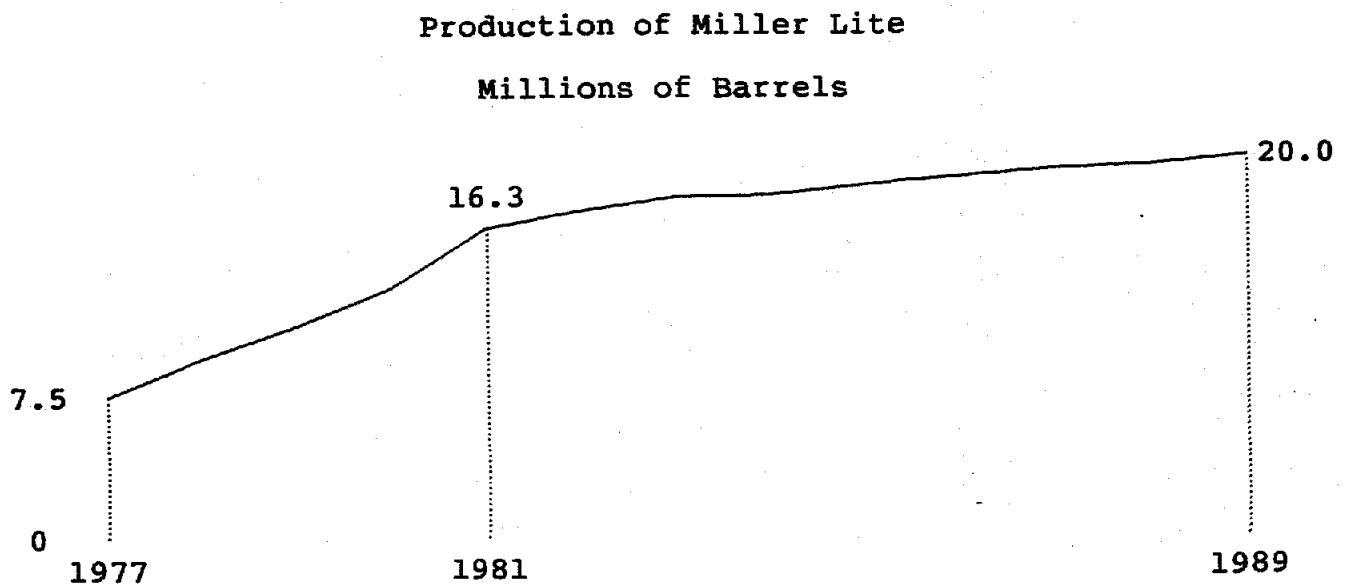
	Bocce	Croquet	Total
Jan	\$62,188	\$73,962	\$136,150
Feb	\$27,920	\$85,079	\$112,999
Mar	\$59,741	\$91,144	\$150,885
Apr	\$57,467	\$92,639	\$150,106
May	\$42,691	\$101,361	\$144,052
Jun	\$35,896	\$105,319	\$141,215
Jul	\$38,538	\$99,411	\$137,949
Aug	\$43,038	\$108,856	\$151,894
Sep	\$38,444	\$99,006	\$137,450
Oct	\$40,296	\$104,507	\$144,803
Nov	\$40,201	\$110,826	\$151,027
Dec	\$32,776	\$98,928	\$131,704

Figure 10. Composite Chart



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

Figure 11. Sparse Annotation, End-points and Maximum Only



Data Source: "Beverage Industry"

Figure 12. Sparse Annotation, End-points and Trend-Change Point Only