

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 curative paper for victims of VCTT (Visual Communication Technology Trauma) will help you create powerful presentation materials, and graphic reports that are digestible at a glance, to prevent that 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 is 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; and rely on editing, not compromise.

Roger C. Parker

Design to inform and influence, not to impress. A powerful image is "a visual sound bite".

LeRB

Defaults vs. Elegant Customization (Figures 2 & 3)

Software & hardware are power tools, but can produce lots of sub-optimal results quickly.

Customize to:

- Focus on the message
- Focus on the data
- Suppress inessential graphic elements

No Defaults, No Decoration

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

Special Effects Are For Movies

Good design and interesting data can stand on their own. Productivity and 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:** 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: viewer need not "recalibrate" page-to-page
- Spared over-choice (due to fewer decisions and iterations), preparer is more productive
- Implement standard formats with custom 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, the most readable color
- Can emphasize with *italics*, **bold**, underline, ALL CAPS, or a different font
- Use mixed upper and lower case: written communication standard, easier to read
- Keep it brief: **Focus attention with sparse text**
- If not science, suppress decimals (imperfect sum of rounded values can be footnoted)
- **Make the title your headline, the main message of your 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 (see explanation below) if you like the printed result
- Titles (usually all one size), maybe H > 1

- Footnotes smaller if to be downplayed
- Body text usually H=1, smaller if dense

Default Characters require F=NONE (or FTEXT=NONE for parts where the F parameter is unavailable), or not specifying F=(FTEXT=) at all. They require override of the fancy font that is the default for TITLE1.

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

- Turn off axis lines: they tell nothing
- Turn off tick marks
- Label (invisible) tick marks sparingly
- If not turning off axis labels, supply own
- Use Sparse Annotation whenever possible

Axis Range Affects Your Message

Usually start the vertical axis at zero, *not* at the default.

Zero de-accentuates 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 dips or bumps.

Zero de-accentuates change. *Prevent needless elation or alarm.* Growth or decline should be judged by the size of the absolute or percent change, and by the practical business effect of that change, not by the *visual* steepness of the slope of a trend, which is always controlled by an arbitrary choice of axis range.

For percents, use the range 0 to 100. Bar length then is a "visual percent", and 100 is a natural choice as it is the absolute maximum value.

For a trend chart issued monthly, use a fixed number of months: January to December (for the same year, or across years), or Report Month N Years Ago to Current Report Month.

Use Color Only If Needed

- No response levels/categories: black & white
- Few levels or categories: gray shades maybe
- Many levels or categories: color necessary

Boring black-and-white is:

- faster, cheaper, more reliable
- easier to use: simpler equipment, no agonizing over color strategy
- more copyable (more, cheaper, faster copiers available): **Good Graphs Get Copied**

For more about color, see my paper "Smart Color for Powerful Visual Communication in Your Applications", elsewhere in *Proceedings*.

Usually Omit Area Fill

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

Avoid Ugly Area Fill

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

Make Plots Easy to Interpret and Look At (See Figures 11 & 12)

- Use Sparse Annotation: focus on start, end, & critical points
- Details are best provided in a table
- **Sparse Annotation makes the graph talk**
- Use V=NONE for plots, if possible
- For point detection: V=DOT (a BIG dot), V=CIRCLE, or V=· (circle around dot)
- Avoid grid lines; if not, use fine line L=33

Use Simple or Side-By-Side Vertical Bars

- Values at ends of bar chart (Figures 6 & 7)
- Use side-by-side, *not* stacked, bars (compare Figures 8 & 9)

How and Why to Supply Detail to 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 decisions.

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.

Best Choice: Lines vs. Bars vs. Pie

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 crossing. When annotating, a simple bar chart is better than a jagged single-line chart, to avoid obscuring the values.

Bar charts show changes and 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 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 quick assessment of significance, order the bars or slices in decreasing (descending) size.

“De-alphabetize” 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 label color to slice (e.g., yellow text on white paper is illegible)
- SAS/GRAPH appends .0 to integer VALUEs: Suppress it with a FORMAT statement

Coping with 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:
 TOGCHART = ROUND(VALUE,0.1);

If the input VALUE is integer, or integer with zero(s) to right of decimal point, SAS/GRAPH insists on displaying % to hundredths, and there are *no circumventions*.

Try My New Improved Pie Chart (Figure 5)

Release 6.10 of SAS/GRAPH brought a legend for pie slice names, but the legend in my New, Improved Pie Chart provides more function.

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

The idea of a two-part pie chart may seem trivial, if not silly. But if the share important 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 a case where “Other” is the huge slice, you can easily satisfy curiosity (if any) about its content with a table displayed below the chart. *It is essential to not blunt the visual message* by splitting a 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.

Constraints on Good Design

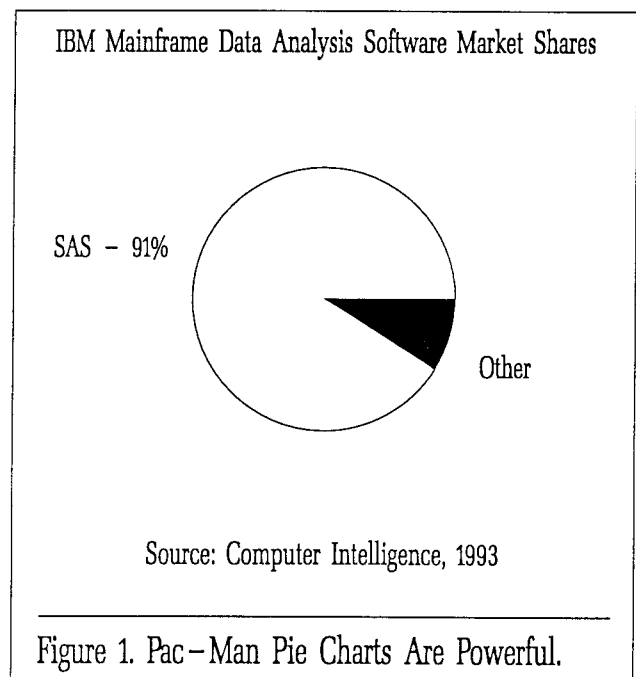
If there is someone whom you cannot persuade as to the rightness of what you have learned here and whose wishes cannot be ignored, always remember that: *The customer is always right, even when the customer is wrong.*

Notices

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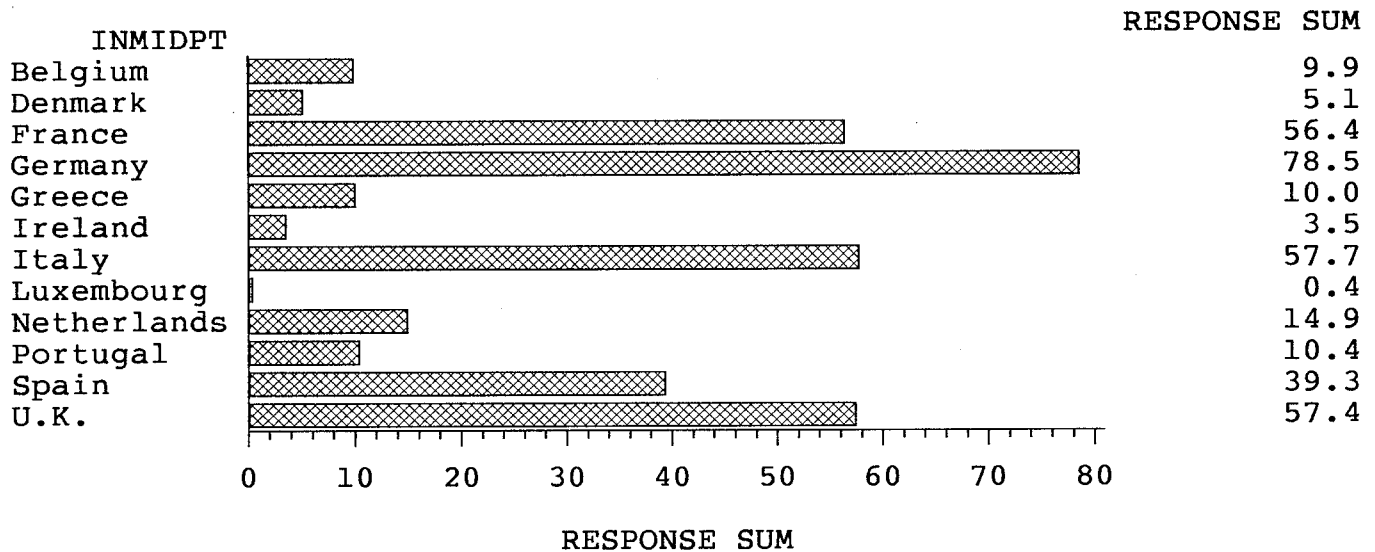
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1990 Population in the European Community, By Country

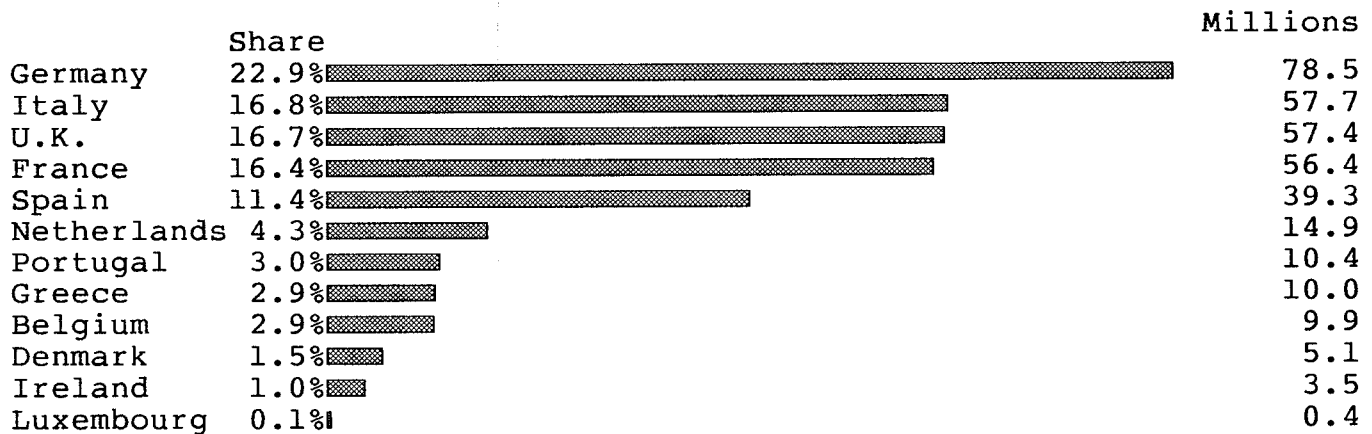
(in Millions)



Source: "The World Factbook 1990"

Figure 2. Default Horizontal Bar Chart

1990 Population in the European Community, By Country



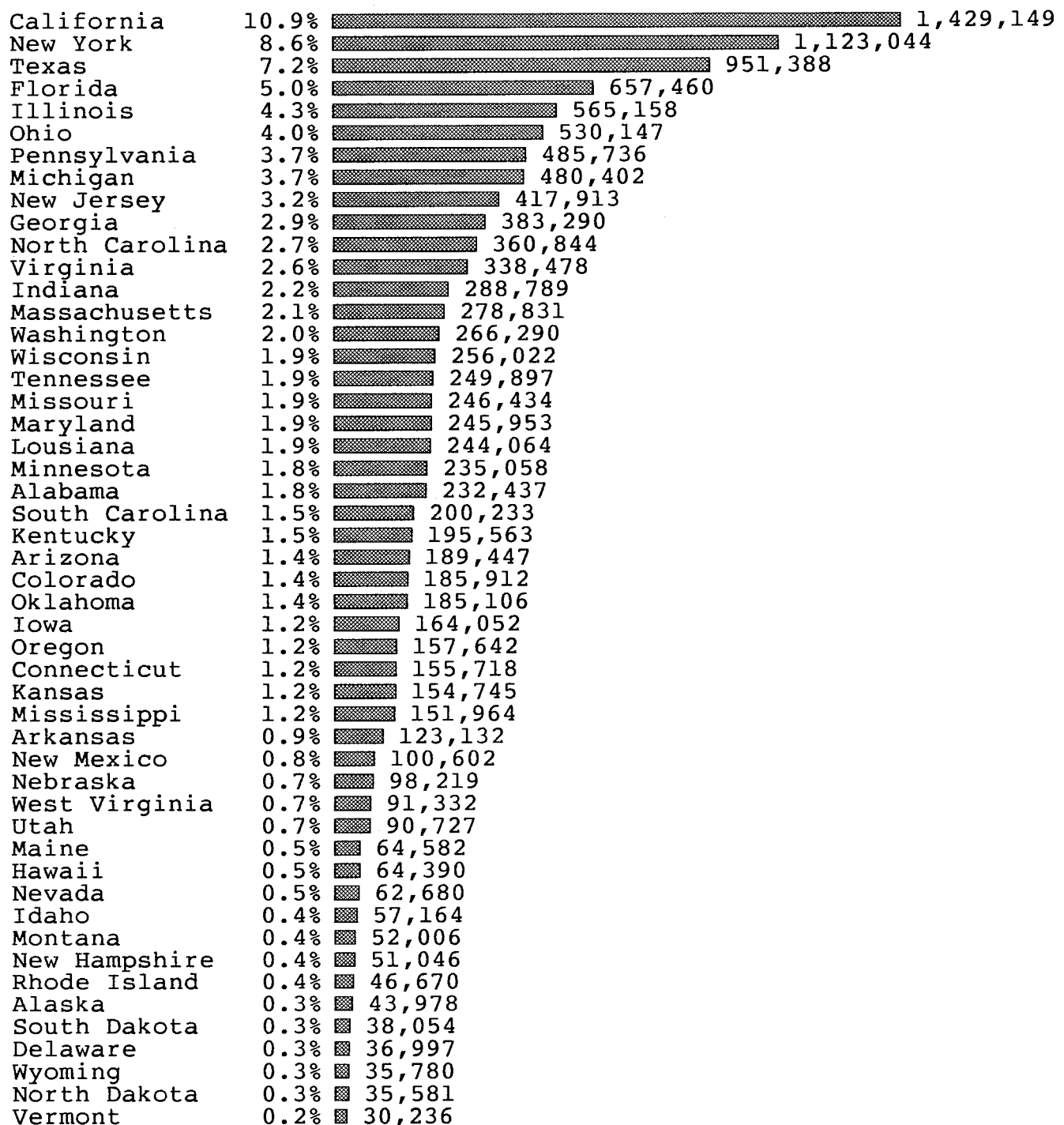
Total = 343.5

Source: "The World Factbook 1990"

Figure 3. Custom Horizontal Bar Chart

State and Local Government Employment By State In October 1991

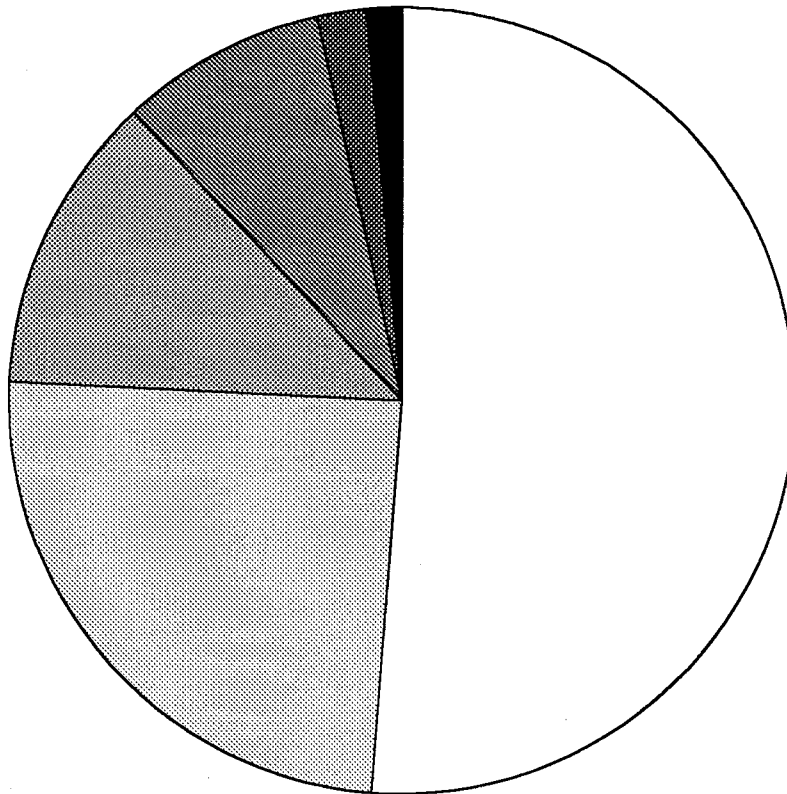
State Name, Percent of USA Total, and Employee Count



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

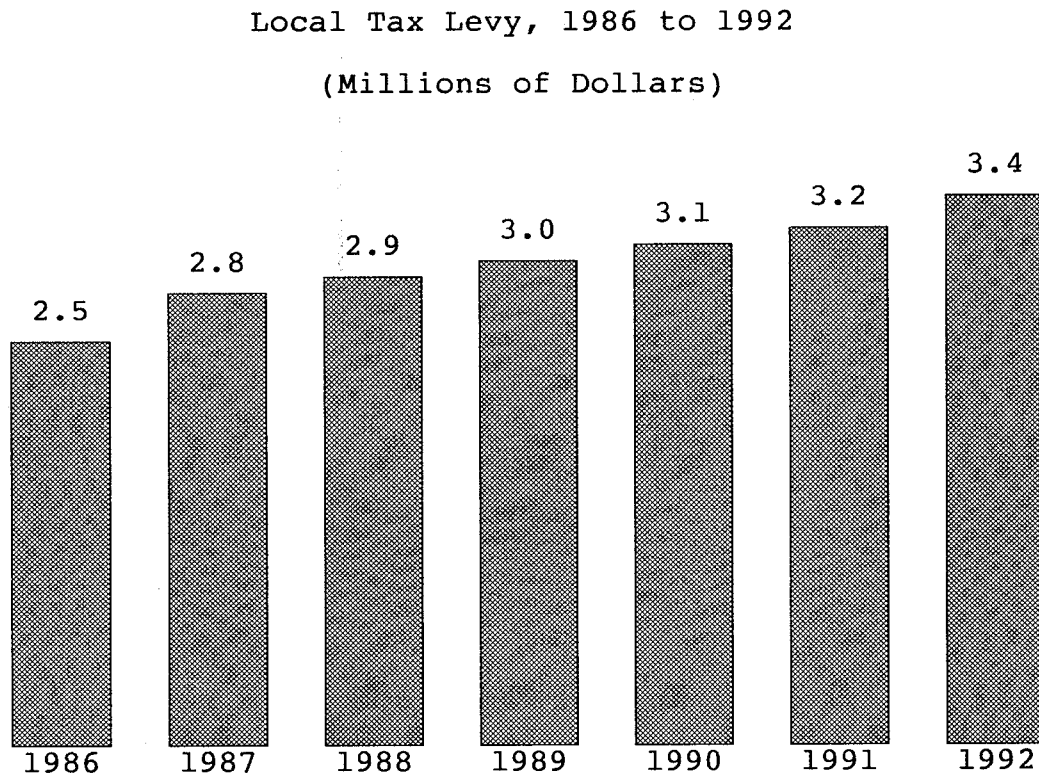


Figure 6. End-annotated Vertical Bar Chart, Using SUM Option

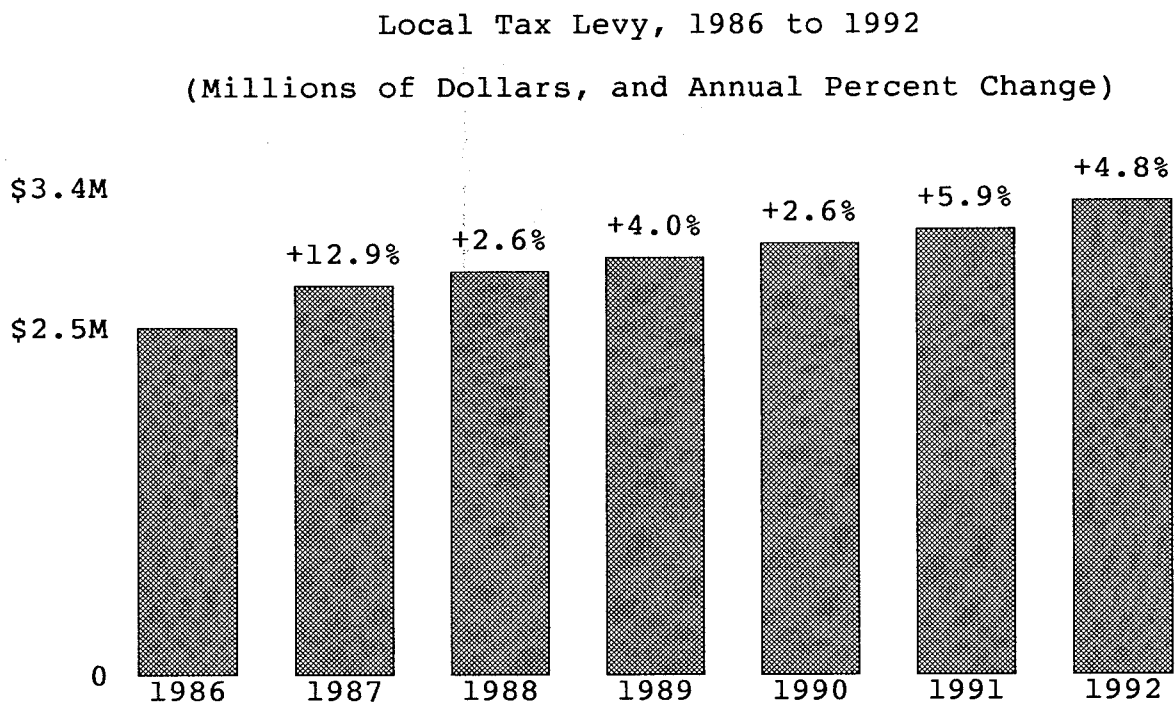


Figure 7. Custom End-annotated Vertical Bar Chart

1991 Club Sports Revenues, By Month

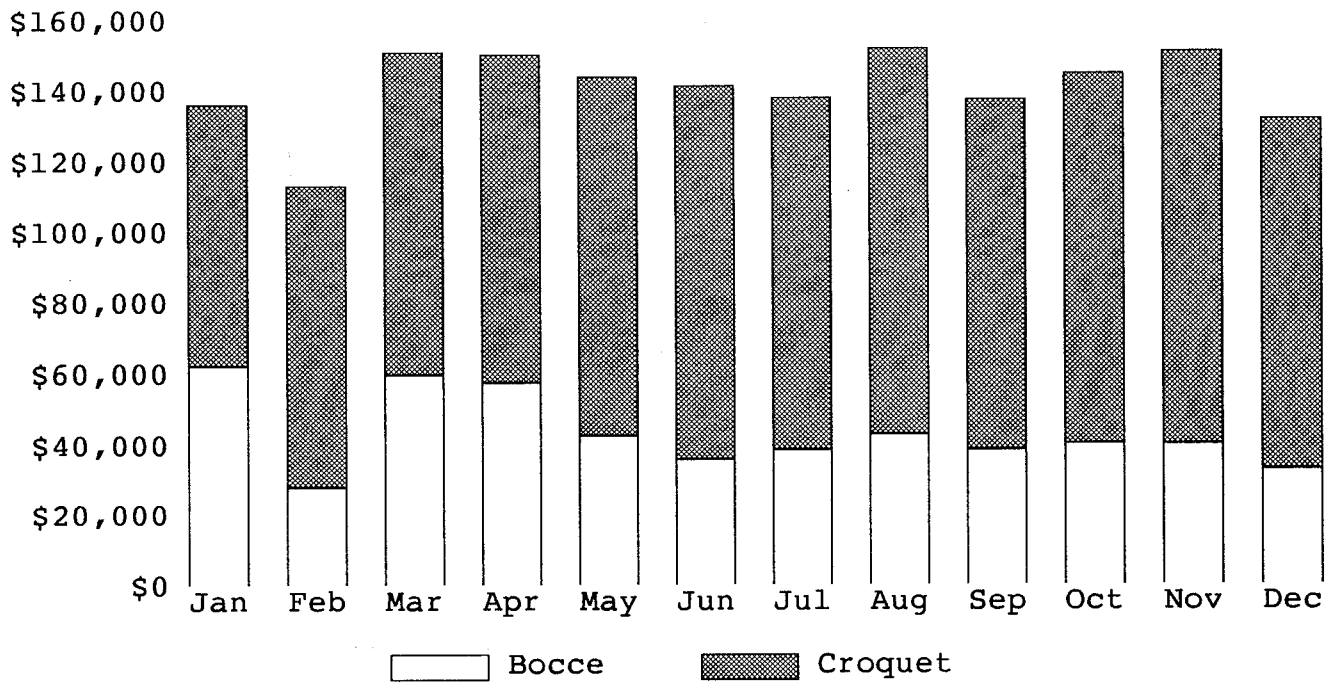


Figure 8. Stacked Bar Chart Undesirable: How Many Dollars from Croquet?

1991 Club Sports Revenues, By Month

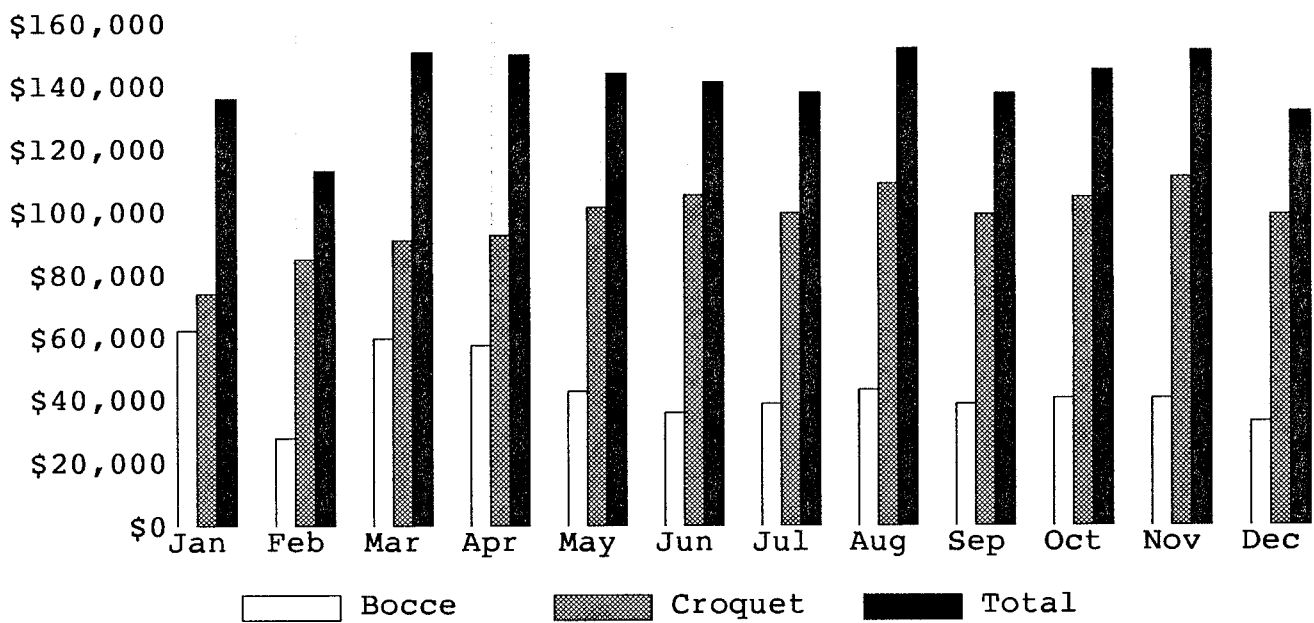
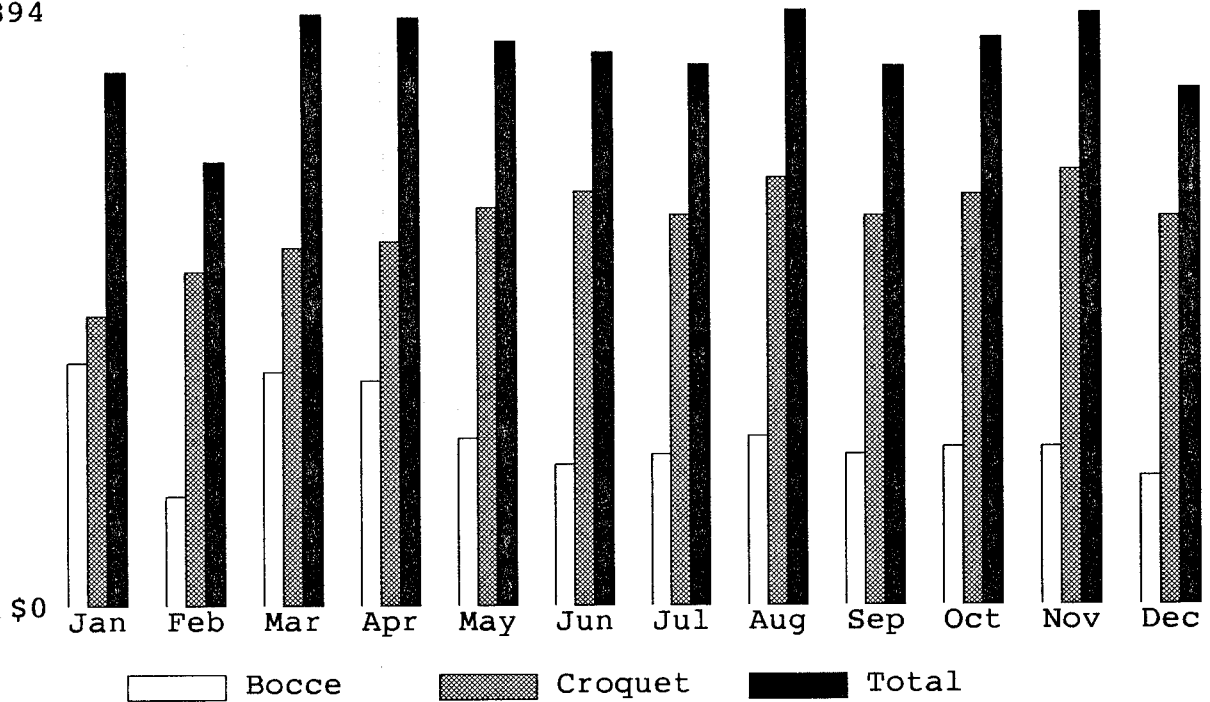


Figure 9. Side-By-Side Vertical Bar Chart Is Better

1991 Club Sports Revenues, By Month

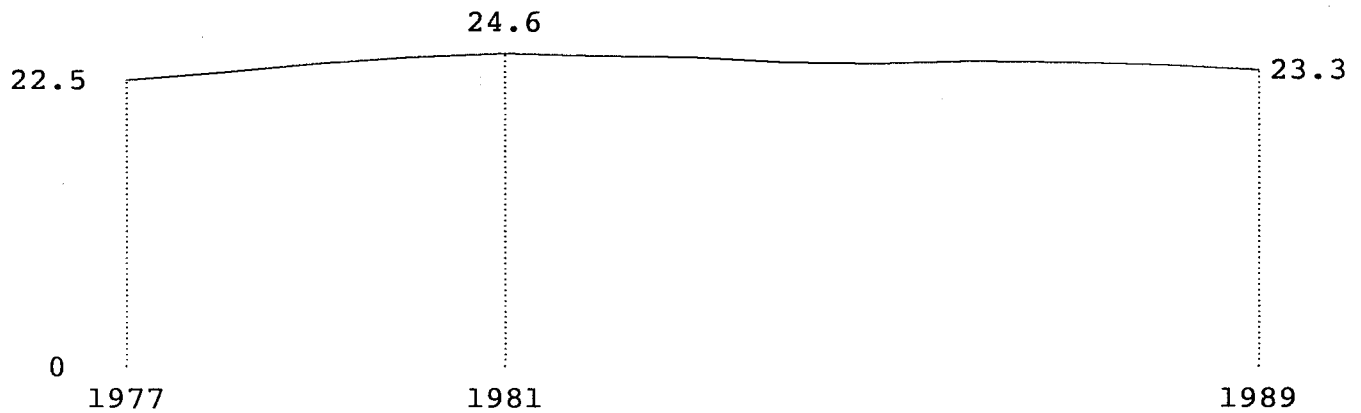
Peak in August
\$151,894



	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

Annual U. S. Beer Consumption
Gallons per Capita



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

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

Production of Miller Lite
Millions of Barrels



Data Source: "Beverage Industry"

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