Create Communication-Effective Graphs in SAS® V9.3 Without SAS/GRAPH®

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Converting Complexity To Clarity™

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Put it before them

- briefly . . .
  so they will read it
- clearly . . .
  so they will understand it
- picturesquely . . .
  so they will remember it
- and, above, all accurately . . .
  so they will be guided by its light

— *Joseph Pulitzer*

For another reason

to always create a graph of your data

(i.e., to get "picturesque"),

on the Proceedings & Tools CD,

please see Phil Holland's article

"Anscombe's Quartet"

OK, I agree with Pulitzer about brevity, but my slides are verbose

- If you have poor hearing (like me), verbose text slides can help

- It is easier to understand written text than spoken text, in any language

- If verbose slides irritate or bore you, only listen to me, unless I show a graph

- My verbose slides are still communicative AFTER the presentation, or if you missed it.

I Recommend

- Good Survey Introduction to SG procedures:

  "Statistical Graphics Procedures by Example:

  Effective Graphics* Using SAS"

  by Sanjay Matange & Dan Heath (work for SAS)

- Compact Fold-Up Tip Sheets:

-- SGPLOT Procedure

-- ODS Graphics

*but I have a different idea of what constitutes

  "Effective Graphics"

Scope

➢ Management Reporting

➢ Presentation Graphics

➢ Not Analytical or Statistical Graphs

Chart Types

➢ Pie Chart

➢ Bar Charts

➢ Time Series Plots

Graphic Tool Evaluation Criteria

- ➢ Communication Effectiveness

- ➢ Reliability

- ➢ Ease of Use

Needs & Tools for
Mgt Rpting or Presentation Slides

➢ Comparison PLUS Shares – pie charts

➢ Comparison – bar charts*

➢ Tracking Over Time – plots

*bar charts can also do

   Comparison PLUS Shares

   and are only recourse

   if too many shares for viable pie chart

Pie Chart

➢ Please see the paper for these slides

➢ Other slide presentation will cover

➢ Best done with that macro

SAS Graphs Without SAS/GRAPH

New tools

➢ SG procedures

➢ ODS GRAPHICS statement

➢ Graph Style support

➢ Graph Template Language —

   a tool of last resort

Principia Graphika

Bessler's **Communication-Effective** Graphic & Web Design Principles

➢ For Today: A Very Short List

How Do New Tools

➢ deliver image PLUS precise numbers?

➢ support ordering of image elements?

➢ permit clutter removal?

➢ provide USABLE legend?

How Do New Tools

➢ permit clutter removal?

Why should you care about clutter?

The Power to Show™
The Power of Simplicity™

Complexity
Distorts, Impedes, Delays
Communication

Simplicity
- Powerful
- Elegant

Elegant
- everything needed
- only the needed

sparse image
focuses attention

sparse graph
more easily
and
more quickly
interpreted

Exclude Graphic Frills

➢ Most graphic frills come from the time when graph paper and pen and ink were used to plot laboratory results in a time before most of you were born

Clutter that I remove

➢ axis labels that can be in title or subtitle

➢ axis lines

➢ tick marks for tick values,

  especially if using grid lines

➢ frame around graph detail area

  (which is not Border around entire graph)

Clutter Removal - SG Procedures

➢ yaxis display=(nolabel) ; /* no axis label */

➢ yaxis display=(noline) ; /* no axis line */

➢ yaxis display=(noticks) ; /* no tick marks */

Above also apply to xaxis, rowaxis, and colaxis.

➢ hbar . . . / . . . nooutline ; /* no bar outline */

Above also applies vbar.

➢ Removing frame of graph detail area
   requires use of a customized style

Removal frame of graph detail area requires use of a customized style

```
proc template;
define style styles.YourStyleName;
   parent=styles.SomePreExistingStyle;
   class graphwalls / frameborder=off;
end;
run;
```

The pre-existing style can be

➢ from SAS (e.g., HTMLblue or listing)

➢ previously customized by user or site

ODS Styles

➢ applied to formatted ODS destinations
  based on defaults

➢ default styles for each destination

  ➢ HTML – Styles.Default (formerly)

  ➢ HTML – Styles.HTMLblue (V9.3)

  ➢ RTF – Styles.Rtf

  ➢ PDF – Styles.Printer

  ➢ LISTING – Styles.Listing (NEW)

For SAS OnlineDoc about Styles

TEMPLATE Procedure: Creating a Style Template

http://support.sas.com/documentation/cdl/en/odsug/62755/HTML/default/viewer.htm#p1t0ip5z3ouo89n1qbsztf3khjqr.htm

Understanding Styles

http://support.sas.com/documentation/cdl/en/grstatproc/64778/HTML/default/viewer.htm#n0ivwopmy7qj82n10dcq109zibj3.htm

Creating Graph on Disk with no HTML, PDF, or RTF wrapper

➢ ODS GRAPHICS / SG procedures

ODS LISTING GPATH="FolderName"
   STYLE=Styles.WhatYouLike;

ODS GRAPHICS ON / . . .
   IMAGENAME="FileName";

➢ You can omit STYLE= and take default

Creating Graph on Disk
Taking Defaults, Except Size

➢ Horizontal Bar Chart

➢ PROC SGPLOT

OK, but could be better

SGPLOT HBAR Frequency of Age in SASHELP.CLASS - Default Except Size
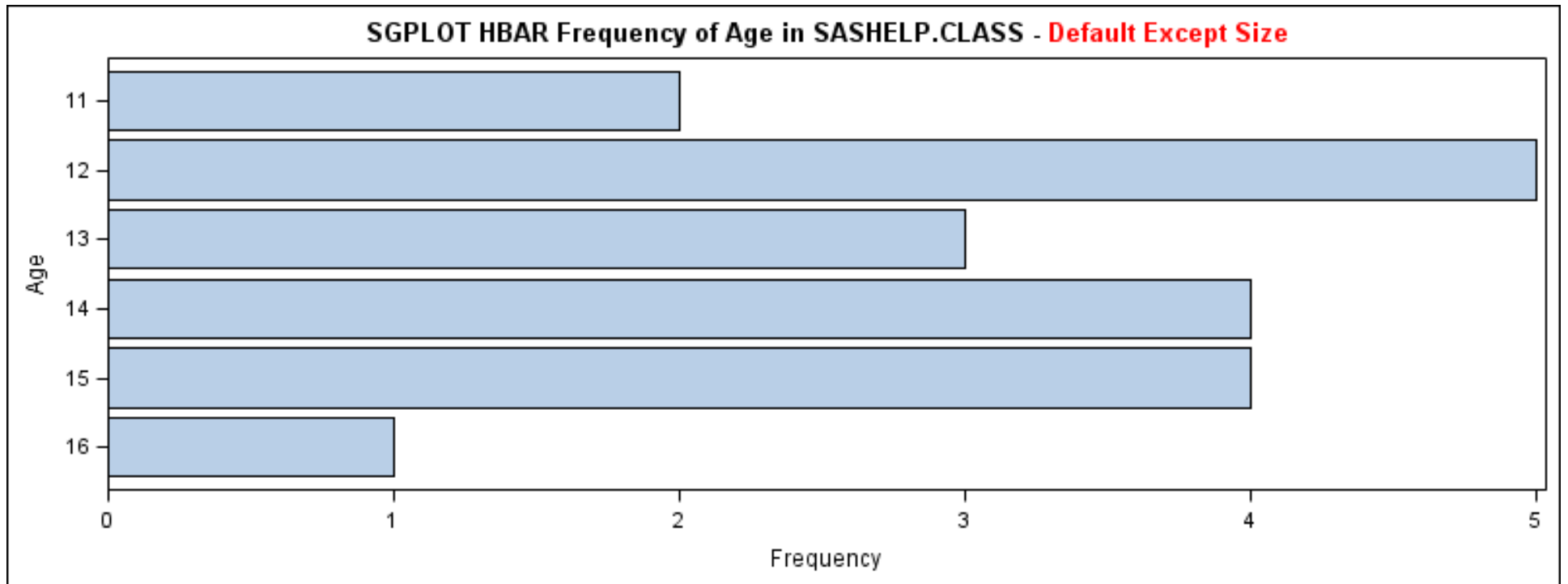
```
/* Default HBAR Chart */

ods listing gpath="Folder";
ods graphics on / reset=all height=300px width=800px
            imagename='SGPLOThbarFreqChart_SAS_Default';
title "SGPLOT HBAR Frequency of Age in SASHELP.CLASS - "
    color=red "Default Except Size";
proc sgplot data=sashelp.class;
hbar Age / stat=freq;
run;
```

All Clutter Removed

SGPLOT HBAR Frequency of Age in SASHELP.CLASS - Customized
Simplified and Ordered, But No Way To Get Extra Stats

Age		Frequency
12		5
14		4
15		4
13		3
11		2
16		1
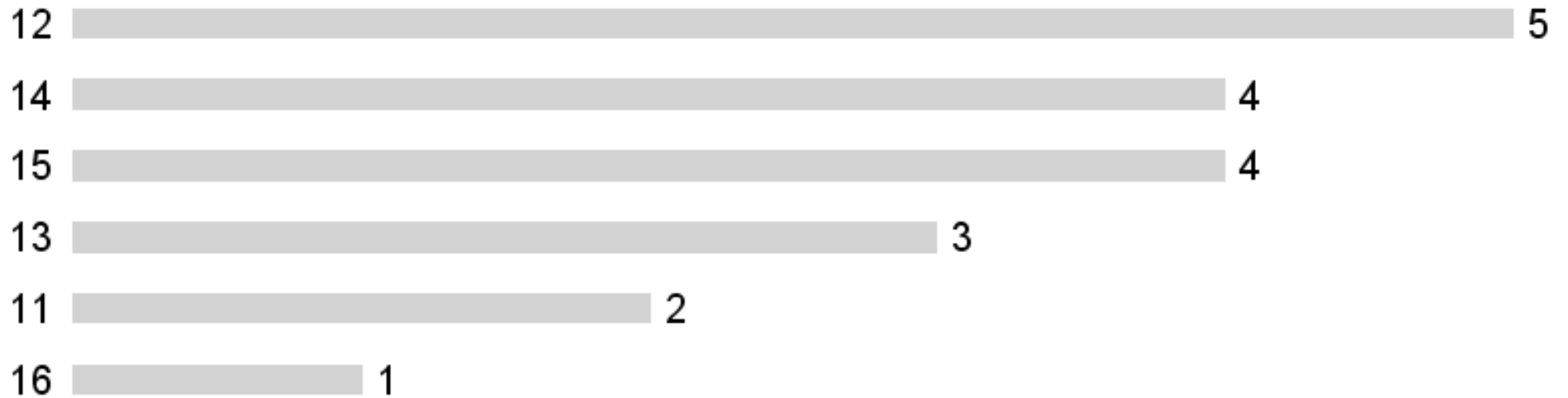
```
/* Clutter Removers are in red */

ods listing gpath="Folder"
    style=styles.MinimalWithNoFrame;
ods graphics on / . . . ;
title1 . . . ;  title2 . . . ;
proc sgplot data=sashelp.class;
yaxis display=(nolabel noline noticks)
    valueattrs=(size=16pt);
xaxis display=none;
hbar Age / stat=freq  categoryorder=respdesc
    datalabel  datalabelattrs=(size=16pt)  barwidth=0.4
    nooutline ;
run;
```

```
/* Order the image elements by significance
   Provide precise numbers
   Other customization  */

hbar Age / stat=freq
   categoryorder=respdesc    /* by descending bar length */
   datalabel     /* value at end of bar */
   datalabelattrs=(size=16pt)    /* size of that value label */
   barwidth=0.4    /* self-explanatory */
   nooutline ;
```
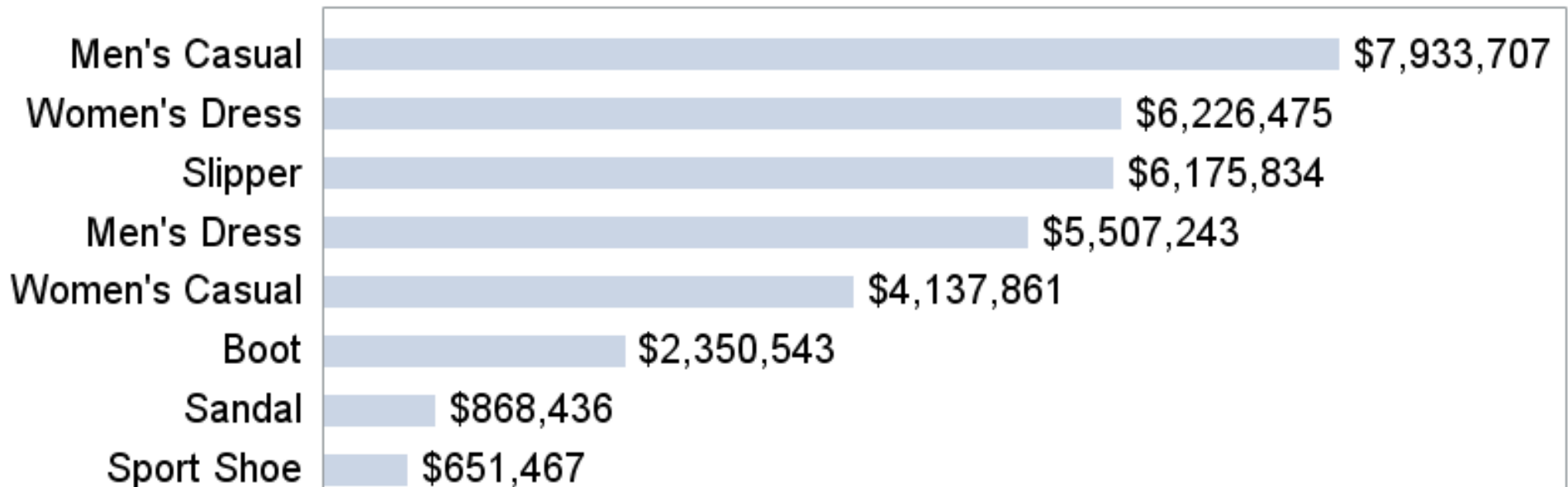
How Do New Tools

➢ support ordering of image elements?

➢ deliver image PLUS precise numbers WITHOUT unwanted and should-be unnecessary use of GRAPH TEMPLATE LANGUAGE or ANNOTATE?

Why order the image elements?

➤ Show them what's important

  with Ranking

Why Image PLUS Numbers?

Quick AND Reliable Inference

Communication-Effective Graphs

➢ Graphs for Decision Support

image ➜ easy, quick decision / inference

numbers ➜ reliable decision / inference

➢ Communication Effectiveness

clear simple visual

legible text & numbers

Power & Challenge

➢ Graph + Precise Numbers =

Quick Correct Conclusion

➢ How deliver both graph & precise numbers

at the same time?

Graph & Precise Numbers Same Time

➢ Horizontal Bar Chart – easiest & reliable

➢ Vertical Bar Chart – if few enough bars

```
/* Order the image elements by significance
   Provide precise numbers
   Other customization  */

hbar Age / stat=freq
   categoryorder=respdesc    /* by descending bar length */
   datalabel     /* value at end of bar */
   datalabelattrs=(size=16pt)    /* size of that value label */
   barwidth=0.4    /* self-explanatory */
   nooutline ;
```

New Bar Chart of Sums
(I did not bother using customized ODS style to remove the frame)

SGPLOT Sales By Product in SASHELP.SHOES - No Percent, Unneeded Frame

Product	Sales
Men's Casual	$7,933,707
Women's Dress	$6,226,475
Slipper	$6,175,834
Men's Dress	$5,507,243
Women's Casual	$4,137,861
Boot	$2,350,543
Sandal	$868,436
Sport Shoe	$651,467

Better New Solution
requires preprocessing the data

Code for Bar Chart of Sums With Percent Shares of Total*

➢ Code to do it the hard way: in this paper

➢ Code to do it easily and safely:

  see the macros paper, for

   ➢ macro invocation code

   ➢ macro source code

*This chart is an alternative

 when pie chart is infeasible or unwanted

Result From Macro

Horizontal Bar Chart of Ranked Totals and Percent Shares Using
HBARsummaryChartWithPctShares Macro

Men's Casual-23.4%	$7,933,707
Women's Dress-18.4%	$6,226,475
Slipper-18.2%	$6,175,834
Men's Dress-16.3%	$5,507,243
Women's Casual-12.2%	$4,137,861
Boot-06.9%	$2,350,543
Sandal-02.6%	$868,436
Sport Shoe-01.9%	$651,467
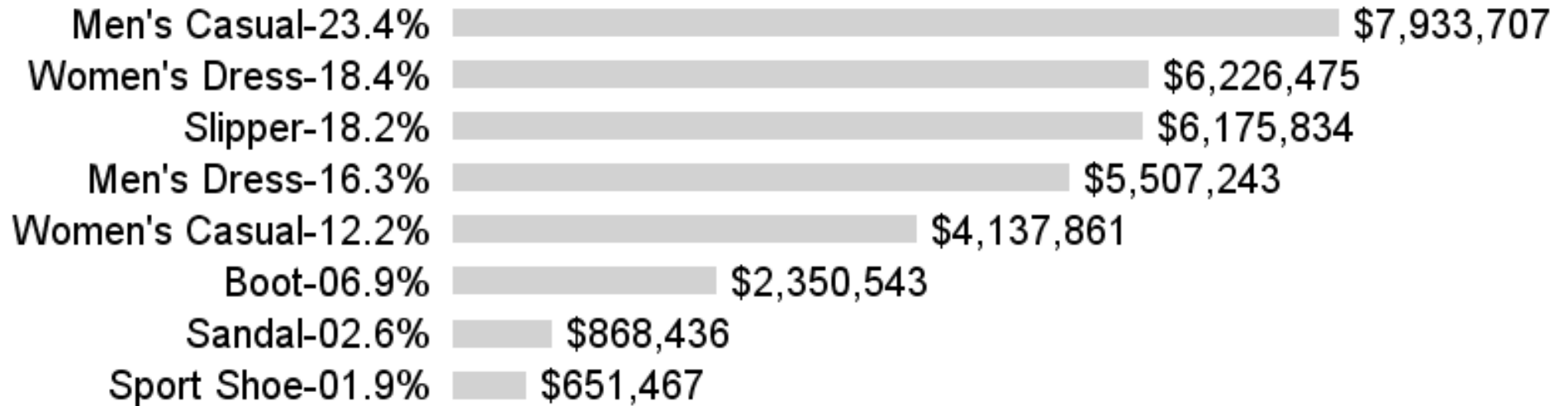
How Do New Tools

➢ provide USABLE legend?

How Do New Tools

provide USABLE legend?

➢ What graph needs a legend?

Needs a Legend & It Is Usable

800px BY 600px SERIES Plot: Dow by Day In 1990 With Monthly Plots Overlay
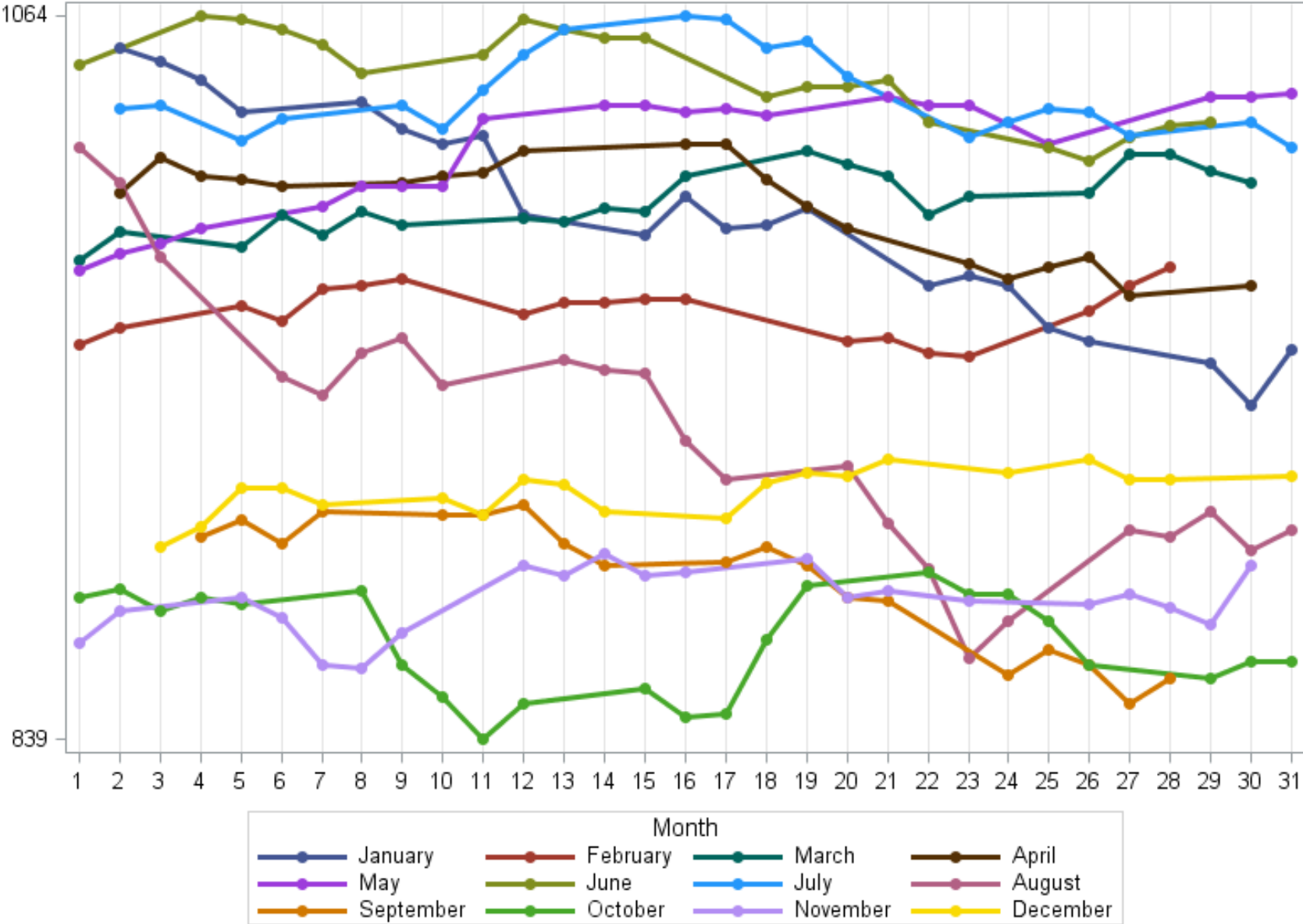
Legend Usability

➢ Plot markers themselves must be big

➢ Plot lines themselves must be thick

Color

➢ big enough markers

➢ thick enough lines

➢ if text, thick text

For more about Color, see the paper "Communication-Effective Use of Color for Web Pages, Graphs, Tables, Maps, Text, and Print"

The link is in the handout

What is an UnUsable Legend?

➢ Traditionally, Excel chart legends

➢ Now, also

   the SAS SG procedure legends

What is an UnUsable Legend?

➢ Will discuss later if time available

Time Plots

All examples in paper are web-enabled

Web-Enabled

➢ ALT text (a.k.a. "data tip")

➢ link to spreadsheet of the data

    ➢ detail lookup for correct inference

    ➢ postprocessing with Excel, if desired

Code Used For All Time Plots

```
ods graphics on /

   reset=all    /* Suppress any leftovers from prior code runs */

   border=off    /* Not usually desired on a web page

            but turn on if wanting to see how much extra space

            might be available in the browser window

            for a wider image */

   antialiasmax=2500    /* antialiasing is on by default,

              but antialiasmax is defaulted to 600.

              If that is insufficient,

              then antialiasing will be incomplete */

. . . ;
```

Code Used For All Time Plots

ods graphics on /

. . .

tipmax=2500 /* This is the maximum number of distinct

mouse-over areas allowed

before data tips are disabled. Default is 400. */

imagemap=on /* This turns on the data tips.

SAS/GRAPH allows customization of the data tips,

but ODS GRAPHICS does not. */

imagename=' DesiredFileNameForThePNGimageFile'

;

Code Used For All Time Plots

yaxis display=(nolabel) /* I identify axis vars in the plot title */

values=(&Ymin_1990 &Ymax_1990); /* I choose to show

only the yaxis minimum and maximum, available as

symbolic (or macro) vars from setup processing. */

xaxis display=(nolabel) /* I identify axis vars in the plot title */

grid /* provide reference lines for each xaxis value */

. . . /* here specify list with values= or use interval= */

Example of Sizing Parameters

ods graphics on / . . .

   width=800px /* width of image in pixels, default is 640 */

   height=600px /* height of image in pixels, default is 480 */

   ;

Typical (but not All) Parameters Used on SERIES Statement Here

series y=*YourYAXISvar* x=*YourXAXISvar* /

    markers   /* turns on plot-point markers

                           default is nomarkers */

    markerattrs=(size=7

           symbol=circlefilled

           color=red /* But DO NOT specify a color

                 if using GROUP= on the SERIES statement

                 to produce a multi-line overlay */

)

. . . ;

Typical (but not All) Parameters Used on SERIES Statement Here

series y=*YourYAXISvar* x=*YourXAXISvar* / . . .

lineattrs=(thickness=N   /* where, in this paper, N is 2 or 3.

3 is used when chart has multiple lines

(as in the twelve months of 1990 overlaid)

so that line colors are more easily distinguished */

pattern=solid   /* If you omit your pattern preference, the

software might make decision, which you might not like. */

color=blue   /* But DO NOT specify a color if using GROUP=

on the SERIES statement to produce a multi-line overlay */

);

Special XAXIS Parameters

For Date, Time, or DateTime Variables:

Interval= can have numerous different values.

Used here will be MONTH, SEMIMONTH, and WEEK.

FitPolicy= default is THIN. If you don't like thinning (value omission), options (besides increasing image width) are:

specify FitPolicy=Stagger

specify FitPolicy=StaggerRotate (first try Stagger,

if no help, use Rotate)

specify FitPolicy=RotateStagger (first try Rotate,

if no help, use Stagger)

specify FitPolicy=Rotate (least desirable)

YAXIS Value Thinning

➤ If yaxis thinning is undesired,

only option is increase height of image

➤ If yaxis variable has discrete character

values, thinning is absolutely unacceptable

➤ Astonishingly, xaxis or yaxis thinning by SAS

does NOT produce any messages in SAS log

New Tech Handling of Axis Values

- For ME
  - Unexpected
  - Unfriendly for ad hoc
  - Unacceptable for production
- Automatic "thinning" can happen even when specific expectations coded
- NO message in SAS log

New Tech Thinning of Axis Values

➢ Automatic "thinning" can happen

even when specific expectations coded

➢ NO message in SAS log

Context:

➢ Two ways to specify axis values

➢ value = (your list here)

➢ for date, time, datetime variables

interval =

day, week, semimonth, month, etc.

New Tech Thinning of Axis Values

➢ Automatic "thinning" can happen
   even when specific expectations coded
➢ NO message in SAS log
➢ for interval = day, week, month, etc.,
   graph viewer probably can guess
   and "interpolate" the missing values
➢ probably also for continuous numerics

New Tech Thinning of Axis Values

➢ Automatic "thinning" can happen even when specific expectations coded

➢ NO message in SAS log

➢ for bar charts, pie charts, or any chart with discrete character axis values, missing values CANNOT be guessed

Options To Try To UnDo Thinning

➢ Increase image height or width, depending on which axis affected
➢ Try other FitPolicy (7 choices)
➢ THIN is default
(THIN is ONLY option for vertical axis, besides increasing height of image)
➢ STAGGER, STAGGERTHIN
➢ ROTATE, ROTATETHIN
➢ STAGGERROTATE, ROTATESTAGGER

xaxis values=(1 to 31 by 1)...;

Default Size SERIES Plot: Dow by Day In 1990 With Monthly Plots Overlay

Increased width of image

800px BY 600px SERIES Plot: Dow by Day In 1990 With Monthly Plots Overlay
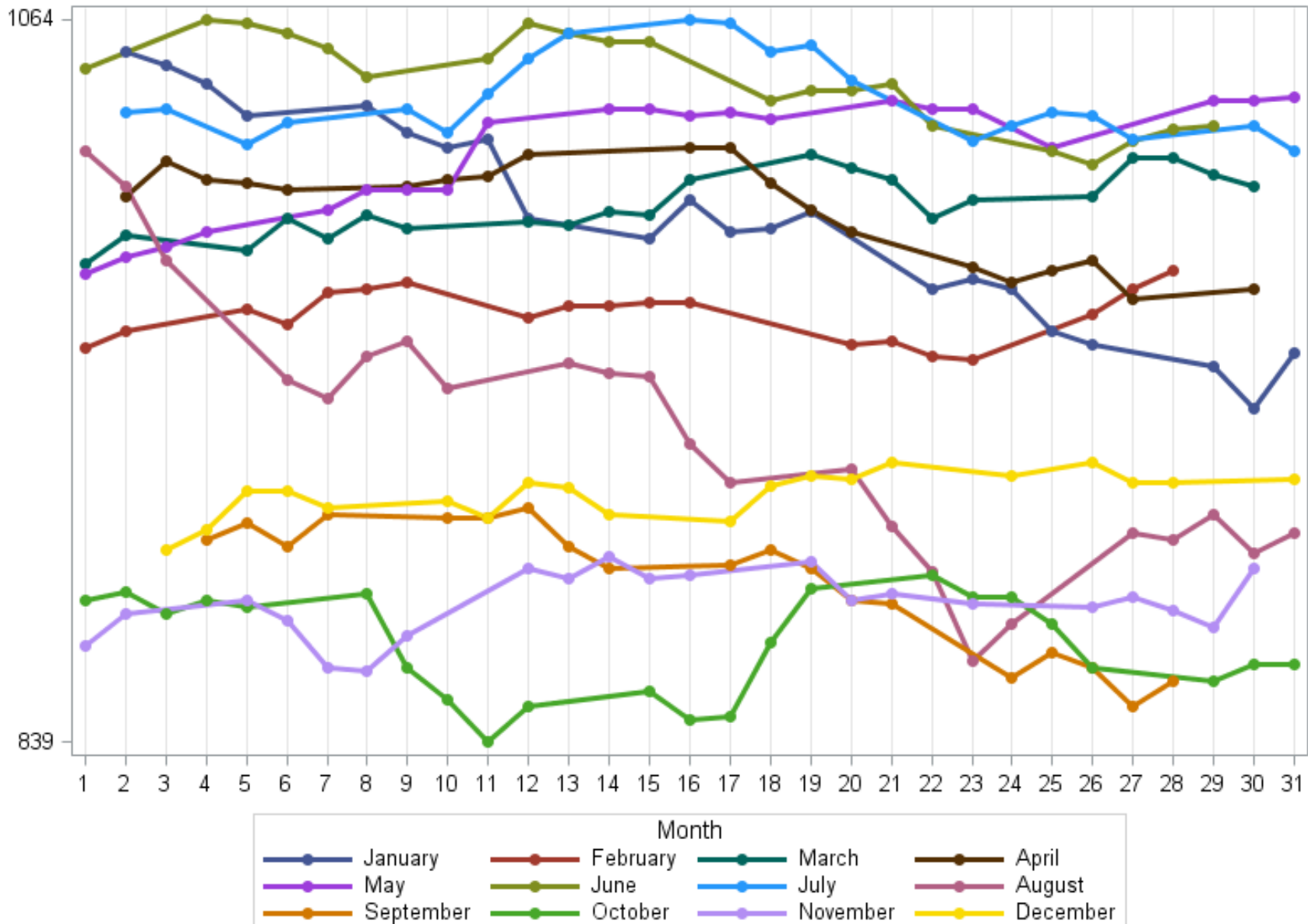
Could Fit WITHOUT Stagger

Default Size SERIES Plot: Dow by Day In 1990 With Monthly Plots Overlay
Using FitPolicy=stagger
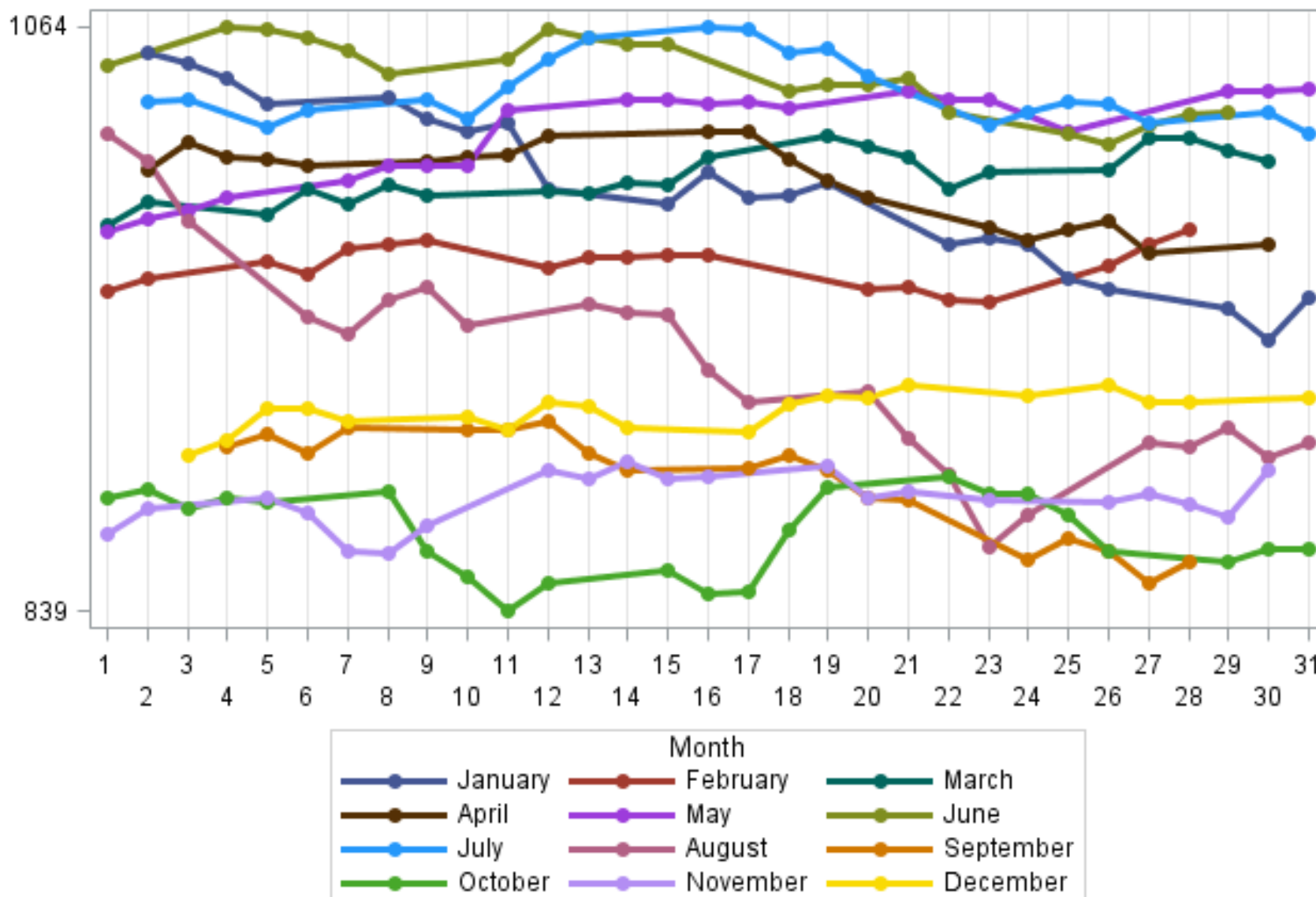
FitPolicy=Rotate for Weekly Plot

1500px BY 600px SERIES Plot with Grid Interval=Week: Dow by Day in 1990
Using FitPolicy=Rotate
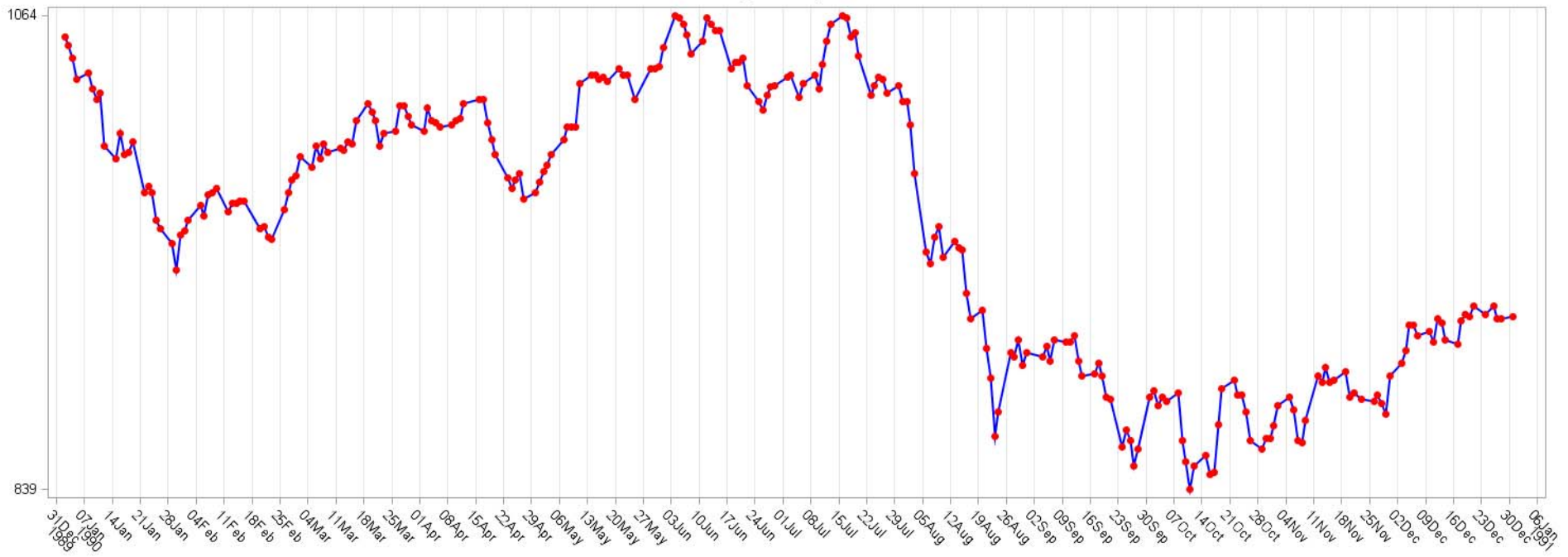
Rotate is a 45-Degree Tilt
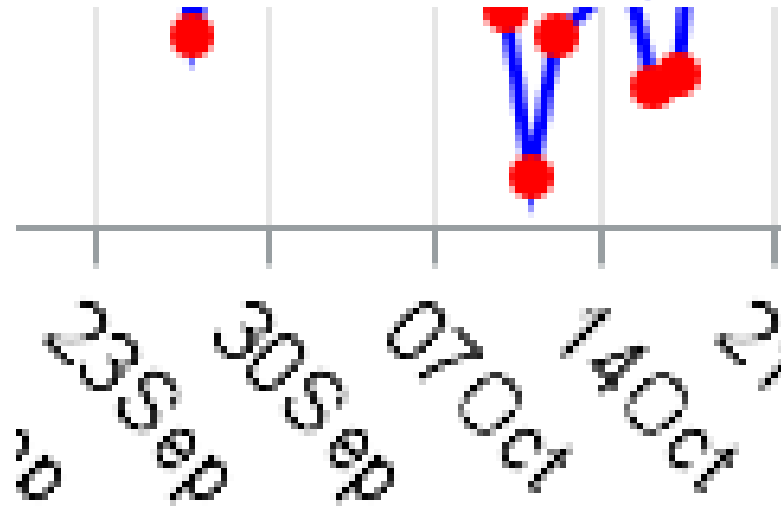
The Best Way
to present a
Time Series Graph

The viewer of a line plot CANNOT reliably determine precise numbers by comparing point to axis values.

The Most Communication-Effective
and Most Usable Information Delivery

Visual + Detail = Effective Communication:
Web-Enabled Graph + Spreadsheet

- Rest mouse on any plot point for ALT text
- Use hyperlink to get to ALL data values

Web-Enabled Graph
(1920 X 1080 screen not well used)

ODS HTML NOGTITLE
hyperlink NOT on image area
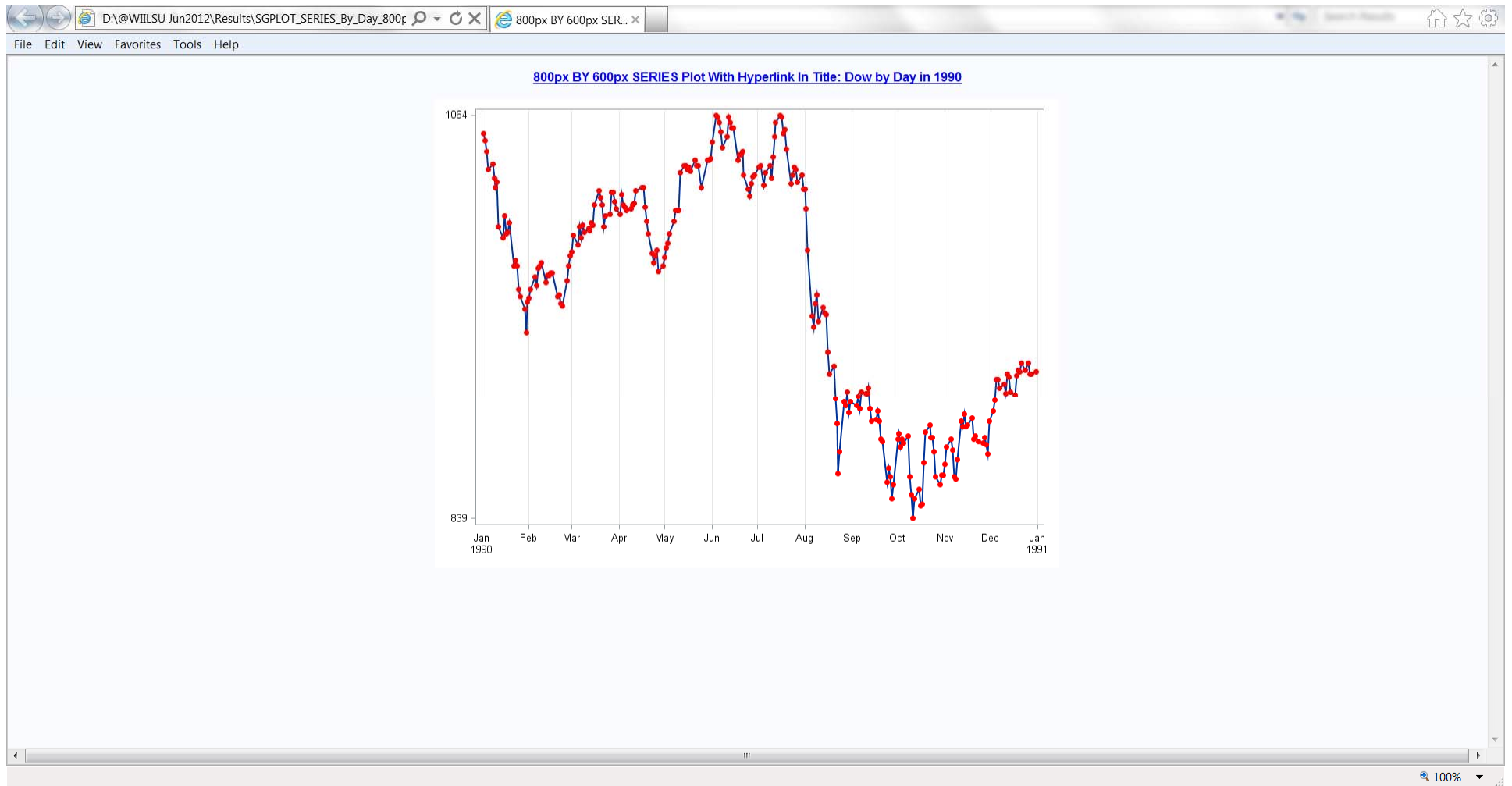
Resting the mouse
to see the ALT text ("data tip")

Zooming to better see the ALT text ("data tip")

Date of Observation = 02Aug1990
Dow = 1012

Zooming to better see the ALT text ("data tip")

Hyperlink In Title: Dow by Day in 1990

Date of Observation = 02Aug1990
Dow = 1012
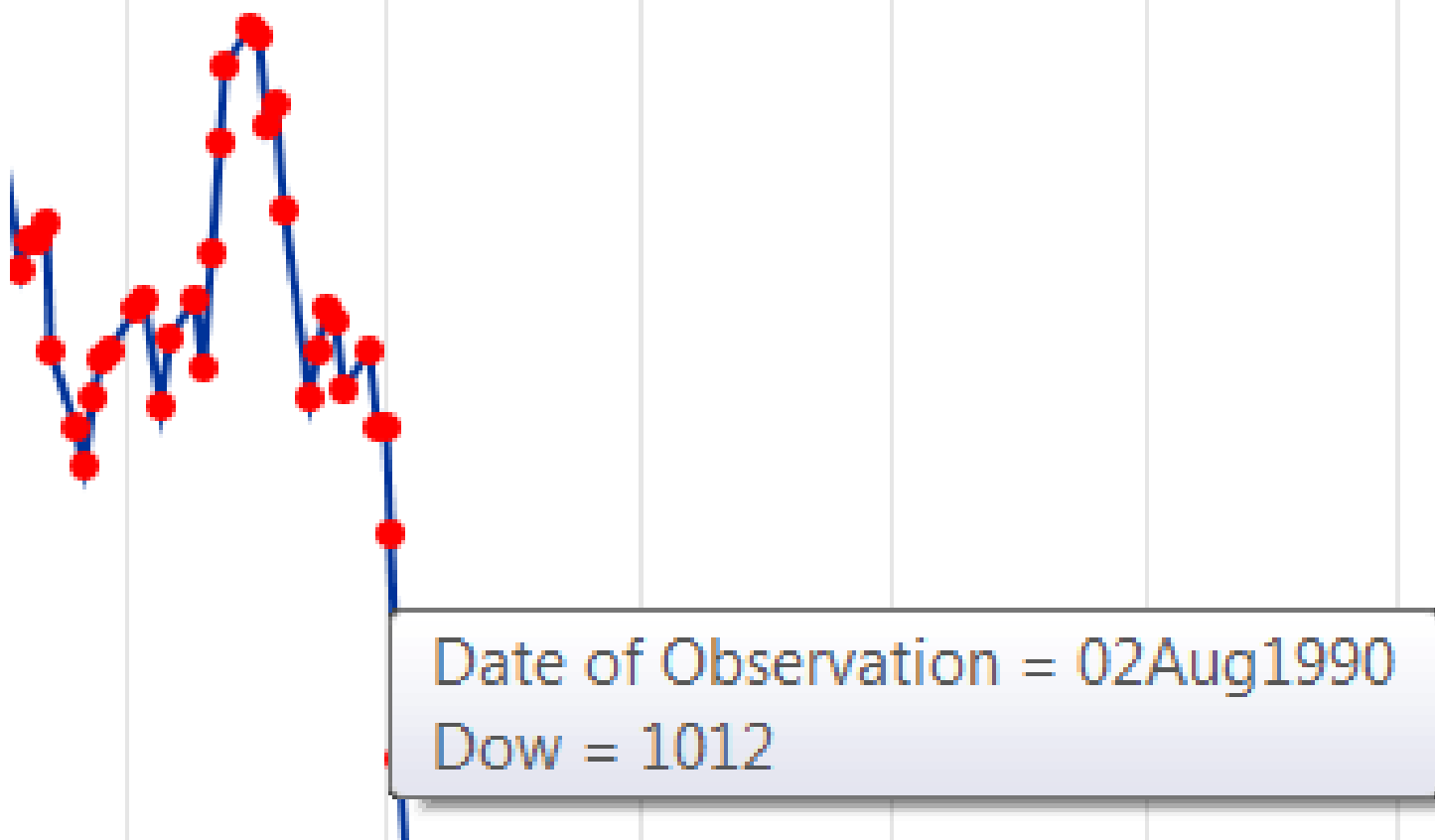
After linking to
and opening the spreadsheet

Zooming to see the link back

Creating Web-Enabled Graph

➢ ODS GRAPHICS / SG procs / SAS/GRAPH

➢ ODS HTML

PATH="Folder" (URL=NONE)

BODY="FileName.HTML"

(TITLE="Your Web Frame Title Goes Here")

STYLE=Styles.WhatYouLike

NOGTITLE NOGFOOTNOTE;

➢ URL=NONE for portable HTML & image files

➢ NOG . . . to use LINK= in title(s) or footnote(s)

```
ods noresults;
ods listing close;
ods graphics on / reset=all
    border=off
    width=800px height=600px
    imagename= 'GraphFileName'
    antialiasmax=2500
    tipmax=2500       /* increase limit on data tip count */
    imagemap=on;      /* turn on data tips */
```

```
ods html path="Folder" (url=none)
    nogtitle
    body='HTMLfilename.html'
    (title='web frame title');
title link='folder\SpreadSheetFileName'
    '800px BY 600px SERIES Plot With Hyperlink In Title: . . . ';
proc sgplot . . . ;
    . . .
run;
ods html close;
```

```
proc sgplot data=work.DowByDayIn1990;
series y=Dow x=Date /
    markers
    markerattrs=(size=7 symbol=circlefilled color=red)
    lineattrs=(thickness=2 pattern=solid);
yaxis display=(nolabel)
    values=(&Ymin_1990 &Ymax_1990);
xaxis display=(nolabel)
    grid; /* reference lines at each axis value */
format Dow 5.;
run;
```

```
ods html path="Folder" body='SpreadSheetFileName.xls';
title justify=left "<td COLSPAN=4>Dow by Day in 1990</td>"
      justify=left "<td COLSPAN=4>
                    <a href='HTMLfilename.html'>
                    Go To Graph of This Data
                    </a>
                    </td>";
proc print data=work.DowByDayIn1990;
var Date Dow;
format Dow 5. Date weekdatx.;
run;
ods html close;
ods listing;
```

When delivering a graph via html / web page

➤ 1. Prevent the need for scrolling

➤ 2. If not bar/pie chart,

ALWAYS supply ALT text

➤ 3. Provide a companion Excel spreadsheet,

linked from and back to the web page

   ➤ optional for bar/pie chart

   ➤ mandatory for plot

When delivering a graph via html / web page

1. Prevent the need for scrolling

➢ Optimize the size of the image file to fill what you expect as probable size & shape of screens used to view the web page*

➢ Allow for probable extra toolbars in use

*See "Optimizing Your Use of Web Page Space" in *VIEWS News* Issue 37

When delivering a graph via html / web page

2. If not bar/pie chart, ALWAYS supply ALT text

(also called data tip, tool tip, mouseover text,

flyover text, floatover text, hover text, and ???)

Use this:

```
ods graphics on / . . .
        tipmax=2500 /* increase limit on data tip count */
        imagemap=on; /* turn on data tips */
```

Complex Time Series Plots

Complex Time Series Plots

➢ Multi-Line (1 line / year, month, day)

➢ Panel / Array (1 cell / year, month, day)

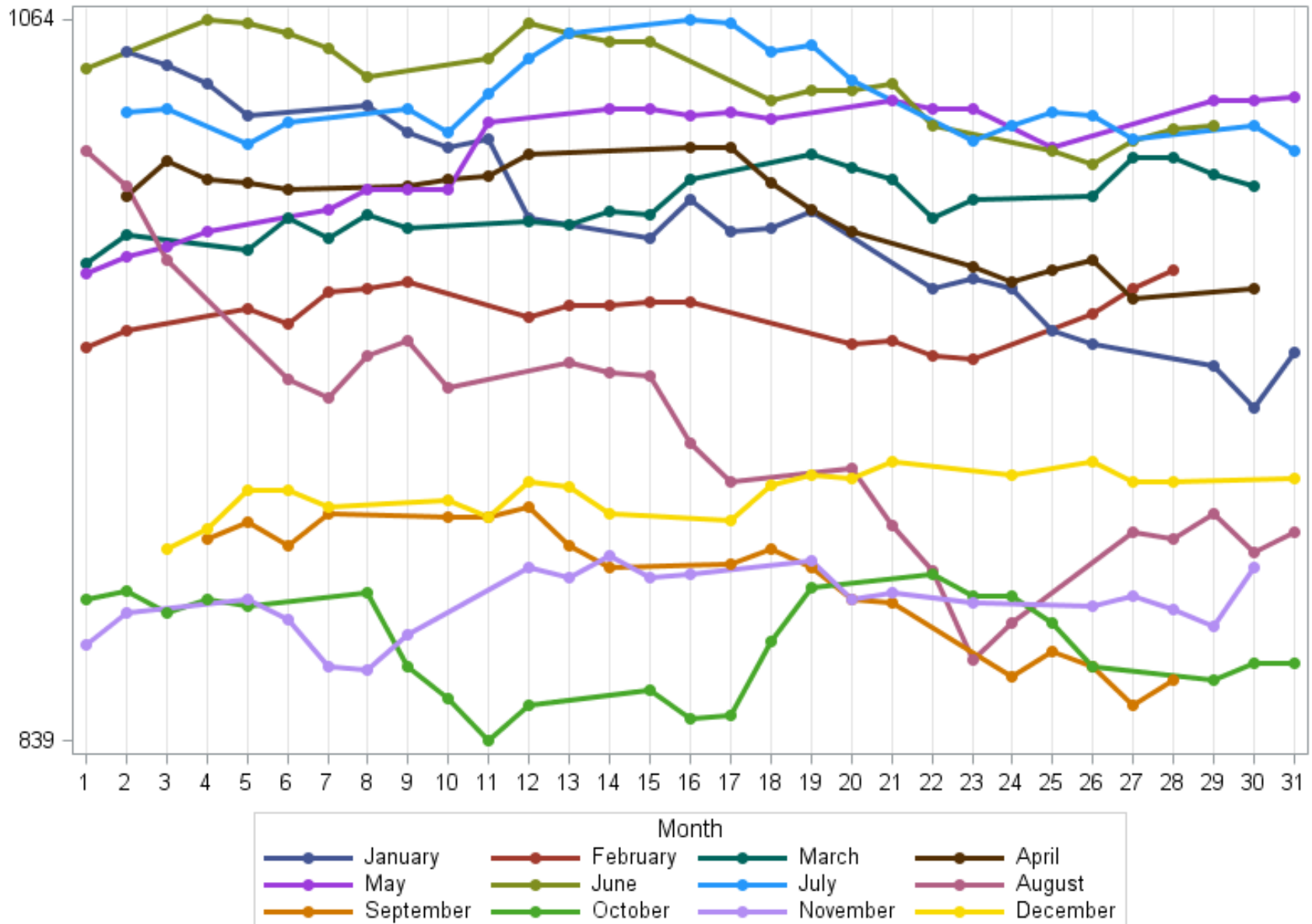For Very Long Time Plot, see my

articles in VIEWS News Issues 54, 55

http://www.sascommunity.org/mwiki/images/

7/75/VIEWS_News_Issue54.pdf

c/c1/VIEWS_News_Issue55.pdf

Overlay Monthly Plots By Day

800px BY 600px SERIES Plot: Dow by Day In 1990 With Monthly Plots Overlay

Code For Overlay Series Plot

```
ods noresults;
ods listing close;

ods graphics on / . . . ;
ods html . . . ;

SG procedure code here

ods html close;
ods listing;
```

```
ods noresults; ods listing close;

ods graphics on / reset=all
    border=off
    antialiasmax=2500
    tipmax=2500
    width=800px height=600px /* NOT 640 X 480 */
    imagemap=on
    imagename=' your image filename ';
ods html path= " your folder location " (url=none)
body='your file name.html'
    (title=' text in web frame title at top left of browser ');

SG procedure code here

ods html close; ods listing;
```

```sas
title ' title text here ';
proc sgplot data=work.DowByDayIn1990;
    series y=Dow x=Day / group=Month /* overlay */
        markers
        markerattrs=(size=7 symbol=circlefilled)
        lineattrs=(thickness=3 pattern=solid);
    yaxis display=(nolabel)
        values=(&Ymin_1990 &Ymax_1990);
    xaxis display=(nolabel)
        values=(1 to 31 by 1) grid;
    format Month MonthNm.;
    format Dow 5. Day 2.;
run;
```

Multiple Time Plots in Panel Instead of Multiple Lines Overlaid

I asked for day values 1, 8, 15, 22, 31, which WERE delivered by SGPANEL SERIES chart

SGPANEL SERIES Chart: Dow by Day in 1990 PanelBy Month
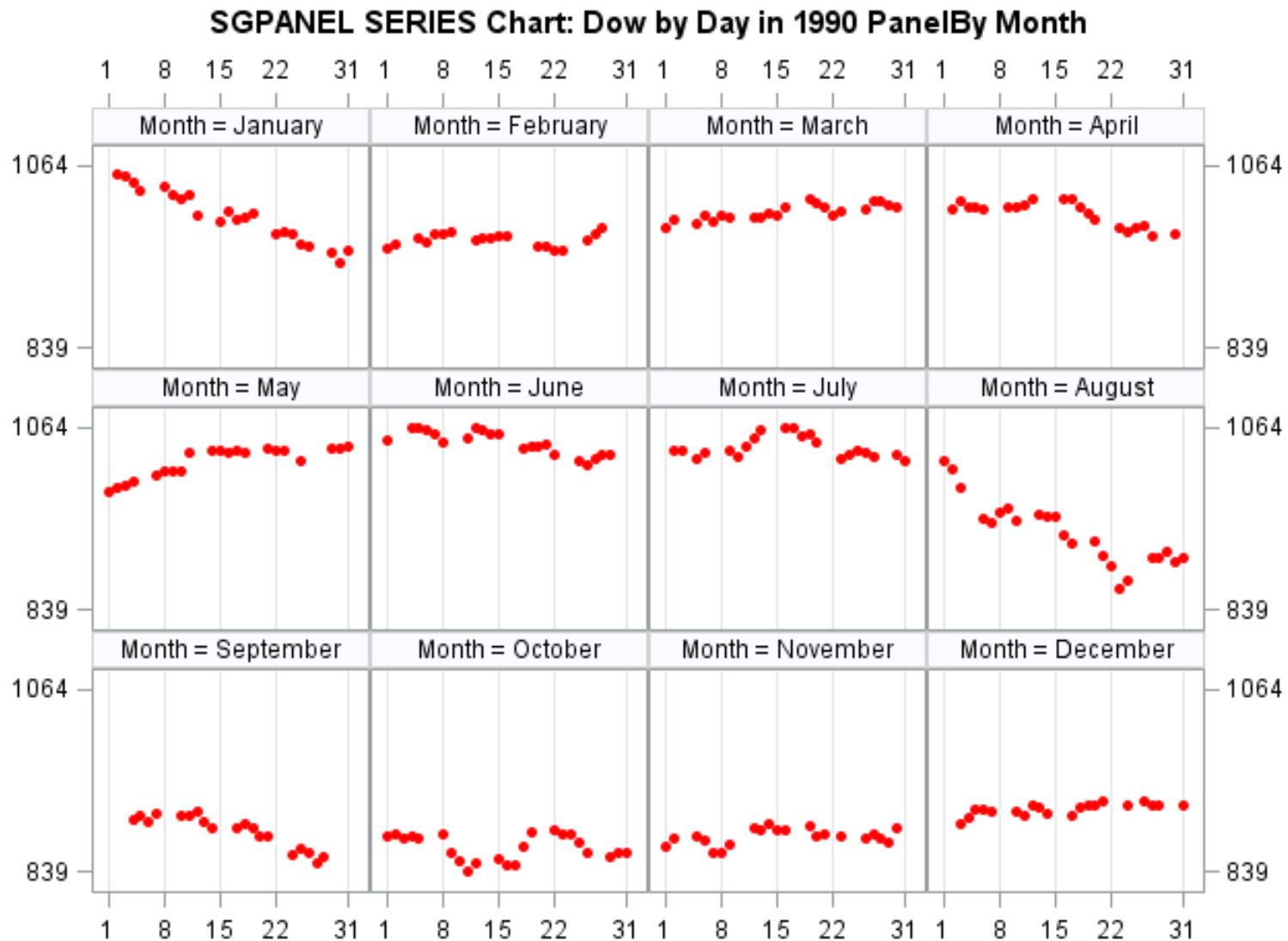
Code For Panel Of Plots

```
ods noresults;
ods listing close;

ods graphics on / . . . ;
ods html . . . ;

SG procedure code here

ods html close;
ods listing;
```

```
ods noresults; ods listing close;

ods graphics on / reset=all
   border=off
   antialiasmax=2500
   tipmax=2500
   /* accepting defaults 640px X 480px */
   imagemap=on
   imagename=' your image filename ';
ods html path= " your folder location " (url=none)
body='your file name.html'
   (title=' text in web frame title at top left of browser ');

SG procedure code here

ods html close; ods listing;
```

```sas
title ' title text here ';
proc sgpanel data=work.DowByDayIn1990;
    panelby Month / columns=4 rows=3;
    series y=Dow x=Day /
        markers
        markerattrs=(size=7
            symbol=circlefilled color=red)
        lineattrs=(color=white); /* hide the line which
                                    adds no value */
    rowaxis display=(nolabel) refticks=(values)
        values=(&Ymin_1990 &Ymax_1990);
    colaxis display=(nolabel) refticks=(values)
        values=(1 8 15 22 31) grid;
format Month MonthNm. format Dow 5. Day 2.;
run;
```

```
rowaxis display=(nolabel)
    refticks=(values)
    values=(&Ymin_1990 &Ymax_1990);
colaxis display=(nolabel)
    refticks=(values)
    values=(1 8 15 22 31)
    grid;

/* refticks=(values) not available for SGPLOT
which uses yaxis and xaxis statements. For them,
option is only refticks, not refticks=(values).
=values puts values on both left and right side,
or bottom and top of graph, not just tick marks. */
```

Overlaid Plots vs Array of Plots

➢ Overlaid Plots make discovery of

 seasonal or simultaneous effects easy

➢ Array of Plots always works

 in black and white*

➢ Array of Plots conforms to

 "Small Multiples" ideology

*Good graphs get photocopied, and

most workplace copiers are NOT color

Tables + Graphs in New Tech

➢ Easy to get a companion graph(s)

  in output from Base SAS procedures

  ➢ FREQ

  ➢ UNIVARIATE

  ➢ CORR

ods graphics on;
proc freq data=sashelp.class
order=freq; tables Age / list
plots=freqplot(orient=horizontal);
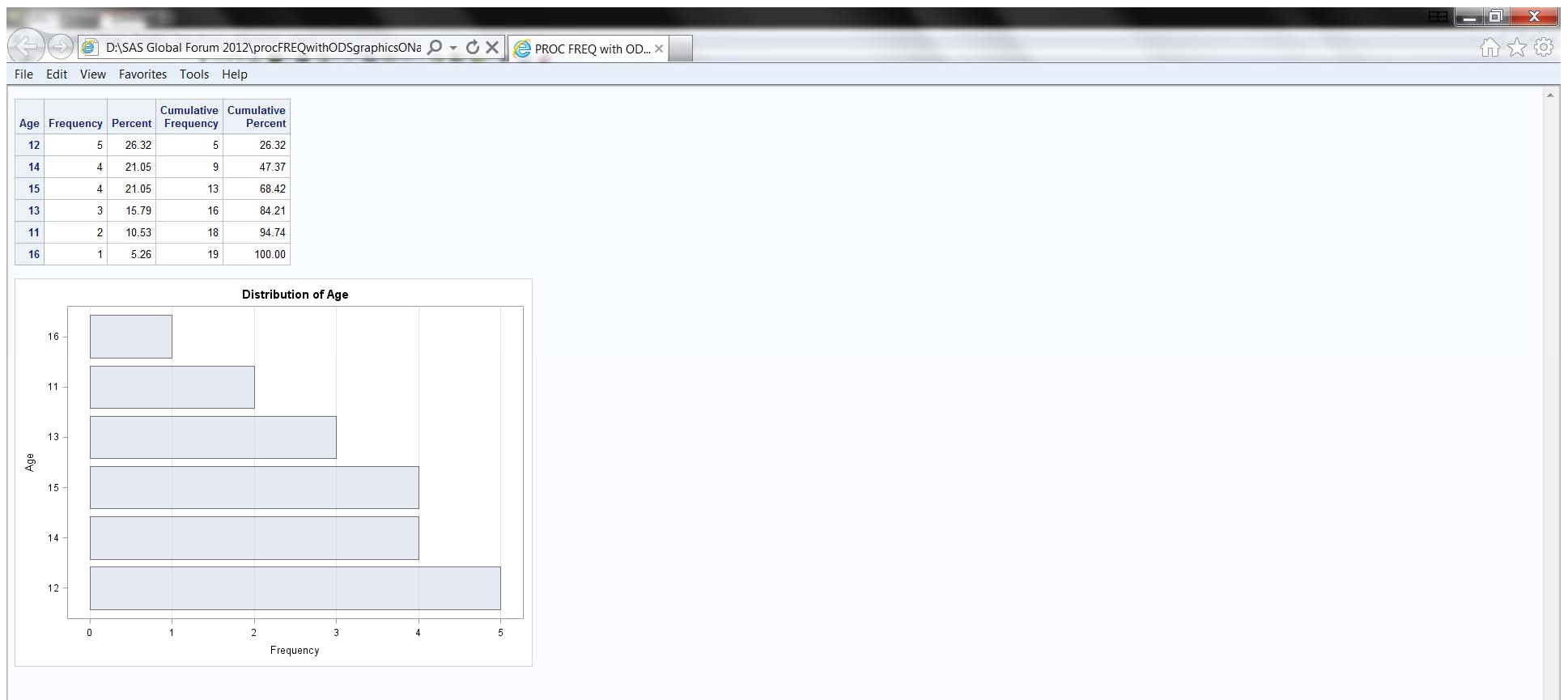
Quick & Easy for Personal Use
Not Presentation/Publication Grade
Note: Order of Bars NE Order of Table

If interested, you can find more of my work

➢ Bessler on SAS, SAS/GRAPH, ODS, Color, SAS with Excel, PDF, SAS Multi-Media, etc.

➢ go to www.lexjansen.com

➢ search by author name

➢ Lex Jansen's treasure trove of links

➢ over 17,000 SAS papers (some as early as 1996) by any author for SAS Global Forum, SUGI, MWSUG, NESUG, PharmaSUG, PhUSE, PNWSUG, SCSUG, SESUG, WUSS conferences

Thanks for coming today

For your comments, questions, suggestions, slide requests:

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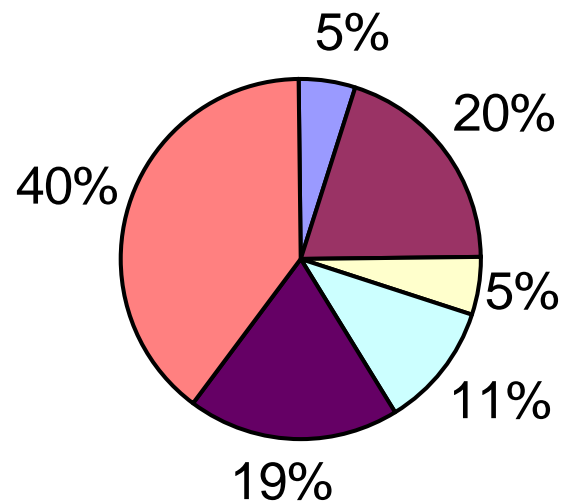
Converting Complexity To Clarity™

What MAKES a legend unusable?

➢ COULD be unreadable text

  but not the common problem

➢ Legend is MEANT to decode color of

  image elements—i.e., color used in

  ➢ area fill (pies, bars, maps)

  ➢ plot markers

  ➢ plot lines

Anti-Communicative Excel Pie Chart

Figure 7: Excel Pie Chart With Legend.
Legend Color Samples Are Too Small.
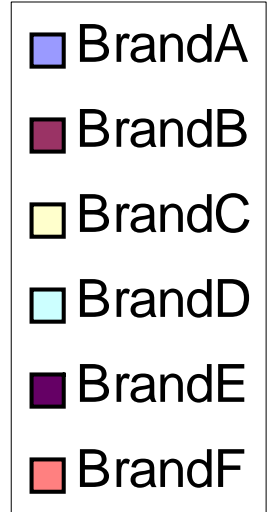
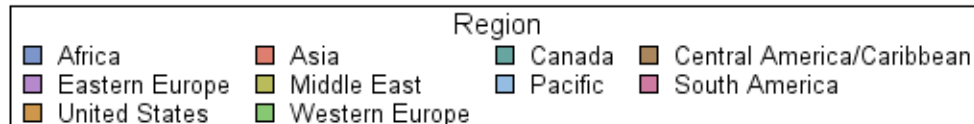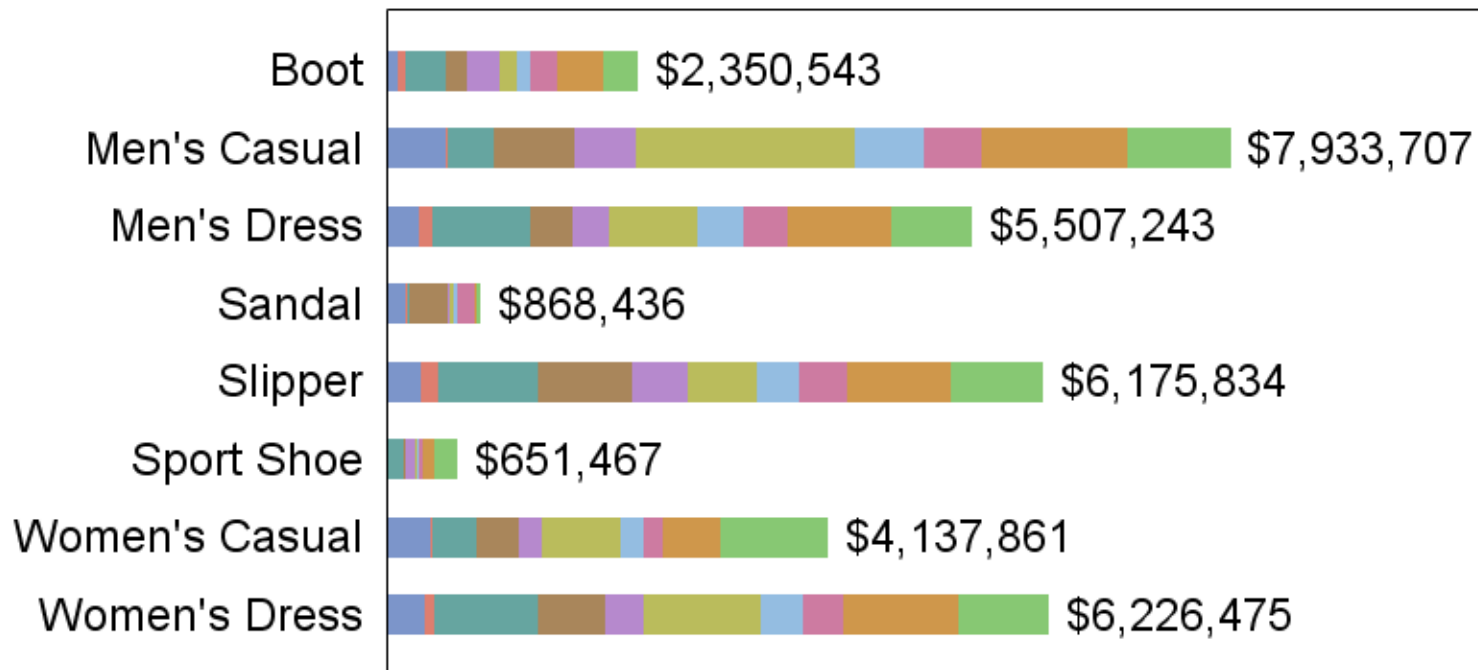# Communicative-Effective Pie Chart With Legend, Made With SAS/GRAPH
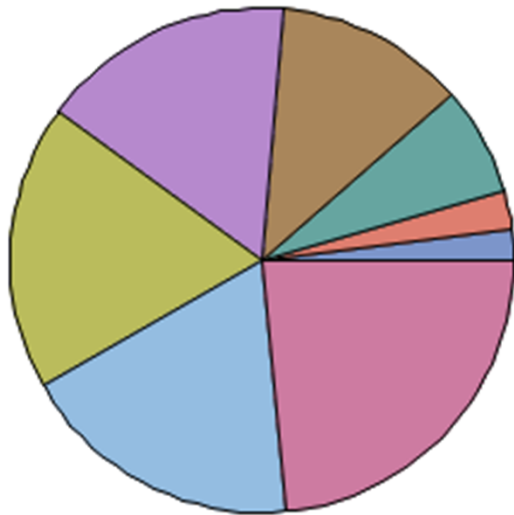
01.9% - Sport Shoe - $651,467
02.6% - Sandal - $868,436
06.9% - Boot - $2,350,543
12.2% - Women's Casual - $4,137,861
16.3% - Men's Dress - $5,507,243
18.2% - Slipper - $6,175,834
18.4% - Women's Dress - $6,226,475
23.4% - Men's Casual - $7,933,707

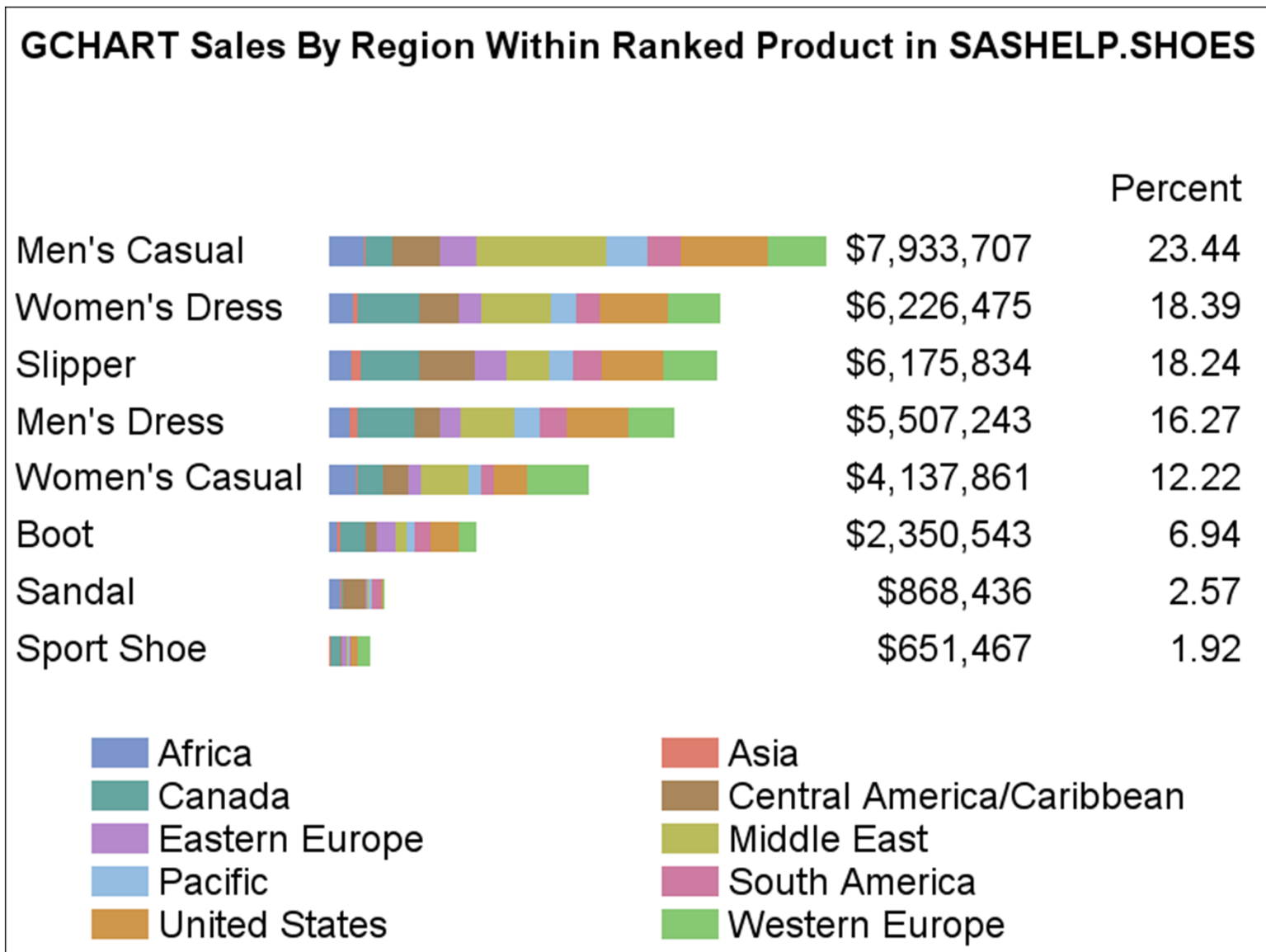# Anti-Communicative SGPLOT Legend Projected Image Not Representative

SGPLOT Sales by Region within Product in SASHELP.SHOES
No ranking is possible.
Legend color samples are too small:
MAXLEGENDAREA option is No Help, and
reducing text height and bar width is No Help.

Product	Sales
Boot	$2,350,543
Men's Casual	$7,933,707
Men's Dress	$5,507,243
Sandal	$868,436
Slipper	$6,175,834
Sport Shoe	$651,467
Women's Casual	$4,137,861
Women's Dress	$6,226,475

Region
- Africa
- Asia
- Canada
- Central America/Caribbean
- Eastern Europe
- Middle East
- Pacific
- South America
- United States
- Western Europe

SAS/GRAPH Legend Communicative-Effective Even Not Projected

Anti-Communicative SGPLOT Legend Projected Image Not Representative

SGPLOT Sales by Region within Product
This is better than the SGPLOT stacked bar chart
but there is no way to enlarge legend color samples
or to rank Region bars within Product