

Presenter Bio

Rule #1 – Know Your Audience

Rule #2 – Identify Your Message

Rule #3 – Support the Medium

Rule #4 – Captions Are Not Optional

Rule #5 – Do Not Trust the Defaults



Presenter Bio



Rule #6 – Use Color Effectively

Rule #7 – Avoid Misleading Viewer

Rule #8 – Avoid “Chartjunk”

Rule #9 – Ensure Readable Message

Rule #10 – Use the Right Tool

References

Kirk has been a SAS software user since 1979, and has worked as a consultant, application developer, programmer, data analyst, educator and author. Currently, Kirk is a lecturer and adjunct professor at San Diego State University; an advisor and adjunct professor at the University of California San Diego Extension; and teaches dozens of SAS, SQL, R and Python courses, seminars, workshops, and webinars. As the author of several books including PROC SQL: Beyond the Basics Using SAS, Third Edition (SAS Press, 2019) along with hundreds of papers and articles on a variety of SAS topics; Kirk has served as an Invited speaker, educator, keynote and section leader at SAS conferences and e-conferences worldwide; and is the recipient of 25 “Best” contributed paper, hands-on workshop (HOW), and poster awards.



Ten Rules for Better Charts, Figures and Visuals

a short presentation by

Kirk Paul Lafler

SAS® Consultant, Application Developer, Programmer, Data Analyst, Educator and Author

KirkLafler@cs.com

<https://www.linkedin.com/in/KirkPaulLafler/>

@sasNerd

Kirk Paul Lafler; @sasNerd; 2020.

Open-access, Creative Commons CC0 Public Domain Dedication.


This is an open-access presentation, free of all copyright, and may be freely reproduced, distributed, transmitted, modified, built upon, or otherwise used by anyone for any lawful purpose. The work was originally made available by Nicolas P. Rougier, Michael Droettboom, and Philip E. Borne, and is built upon and expanded by Kirk Paul Lafler. The contents of this presentation is made available under the Creative Commons CC0 public domain dedication !

SAS is the registered trademark of SAS Institute Inc., Cary, NC, USA.

All other company and product names mentioned are used for identification purposes only and may be trademarks of their respective owners.

“A picture is worth a thousand words.”

by Fred R. Barnard (1927)



Presenter Bio

Rule #1 – Know Your Audience

Rule #2 – Identify Your Message

Rule #3 – Support the Medium

Rule #4 – Captions Are Not Optional

Rule #5 – Do Not Trust the Defaults

Rule #6 – Use Color Effectively

Rule #7 – Avoid Misleading Viewer

Rule #8 – Avoid “Chartjunk”

Rule #9 – Ensure Readable Message

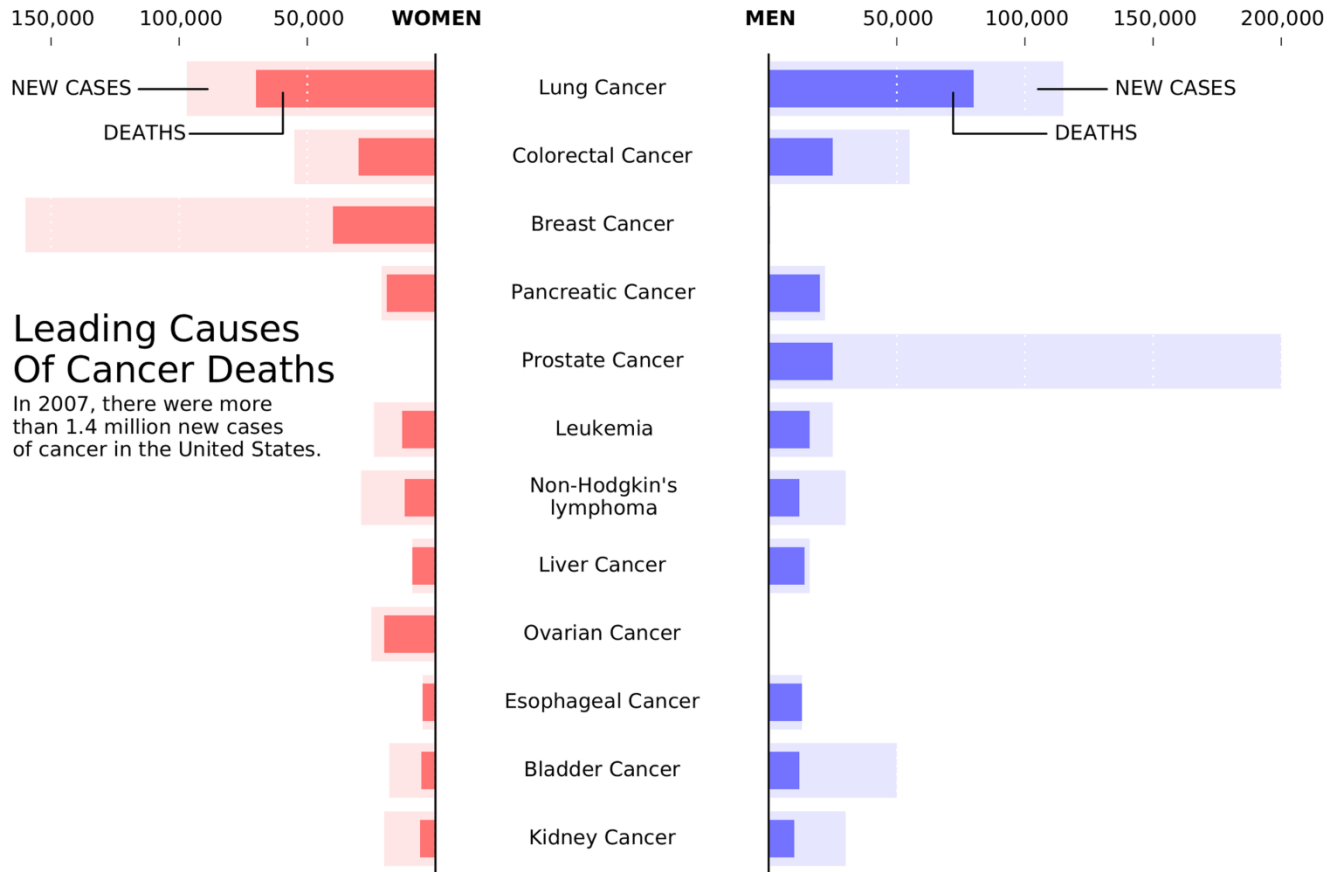
Rule #10 – Use the Right Tool

References


Rule #1: Know Your Audience

Know Your Audience

- **A study by Shugars (2018) found that 4.5% of the world's population possess some level of color vision deficiency, (therefore, avoid using color combinations like Green & Red, Green & Blue, Blue & Purple, Black & Green);**
- **Zarrella (2013) found that tweets with images are 94% more likely to be retweeted than tweets w/o images;**
- **Your audience achieves a better understanding when using effective visual techniques – a need that appeals to data analysts, statisticians and others.**



Remake of a figure that was originally published in the New York Times (NYT) in 2007 (Male deaths/cases, Female deaths/cases).



Presenter Bio

Rule #1 – Know Your Audience

Rule #2 – Identify Your Message

Rule #3 – Support the Medium

Rule #4 – Captions Are Not Optional

Rule #5 – Do Not Trust the Defaults

Rule #6 – Use Color Effectively

Rule #7 – Avoid Misleading Viewer

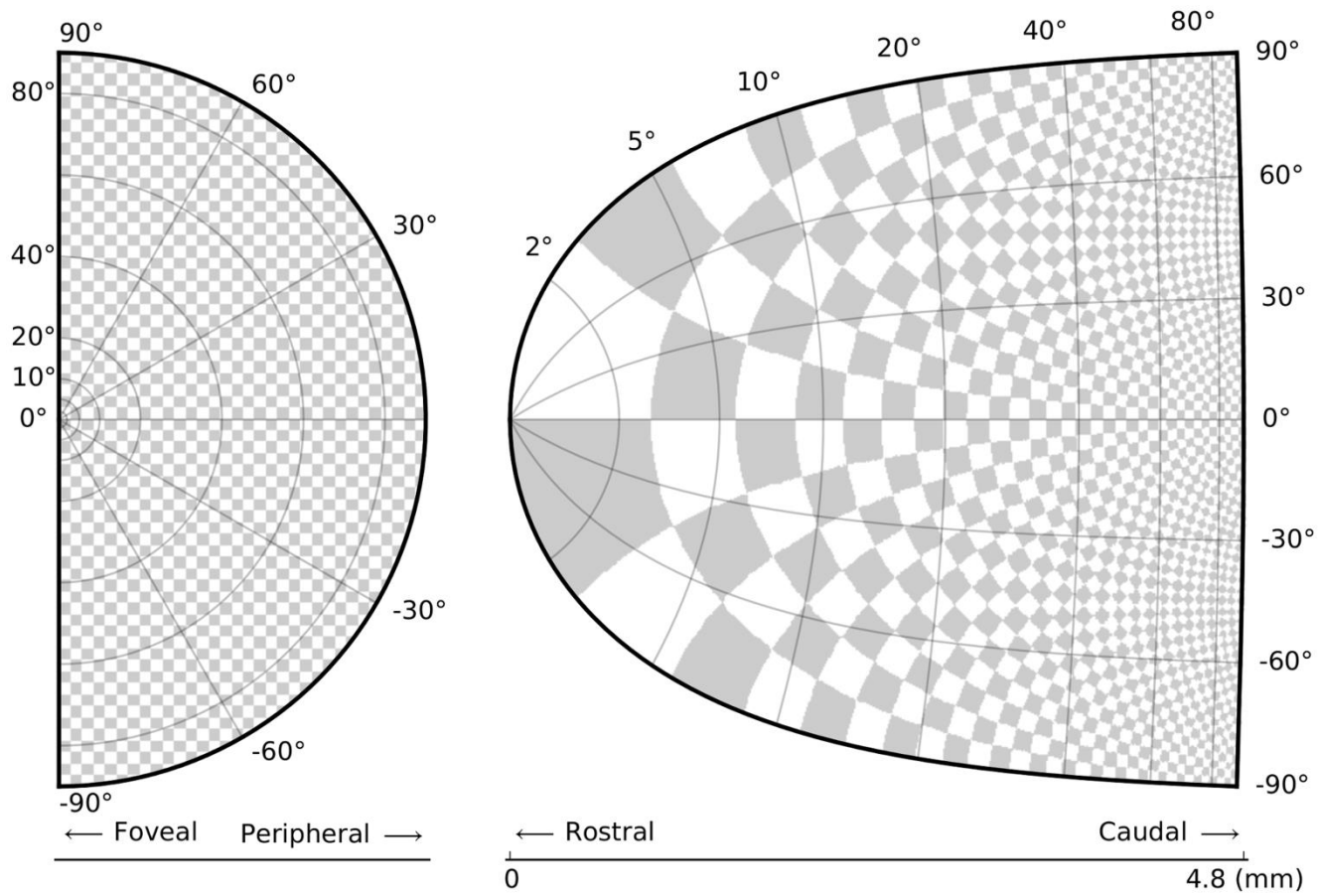
Rule #8 – Avoid “Chartjunk”

Rule #9 – Ensure Readable Message


Rule #10 – Use the Right Tool

References

Rule #2: Identify Your Message



A figure is meant to express an idea or introduce some facts or a result that would be too long (or nearly impossible) to explain only with words (The superior colliculus (SC) is a brainstem structure).



Presenter Bio

Rule #1 – Know Your Audience

Rule #2 – Identify Your Message

Rule #3 – Support the Medium

Rule #4 – Captions Are Not Optional

Rule #5 – Do Not Trust the Defaults

Rule #6 – Use Color Effectively

Rule #7 – Avoid Misleading Viewer

Rule #8 – Avoid “Chartjunk”

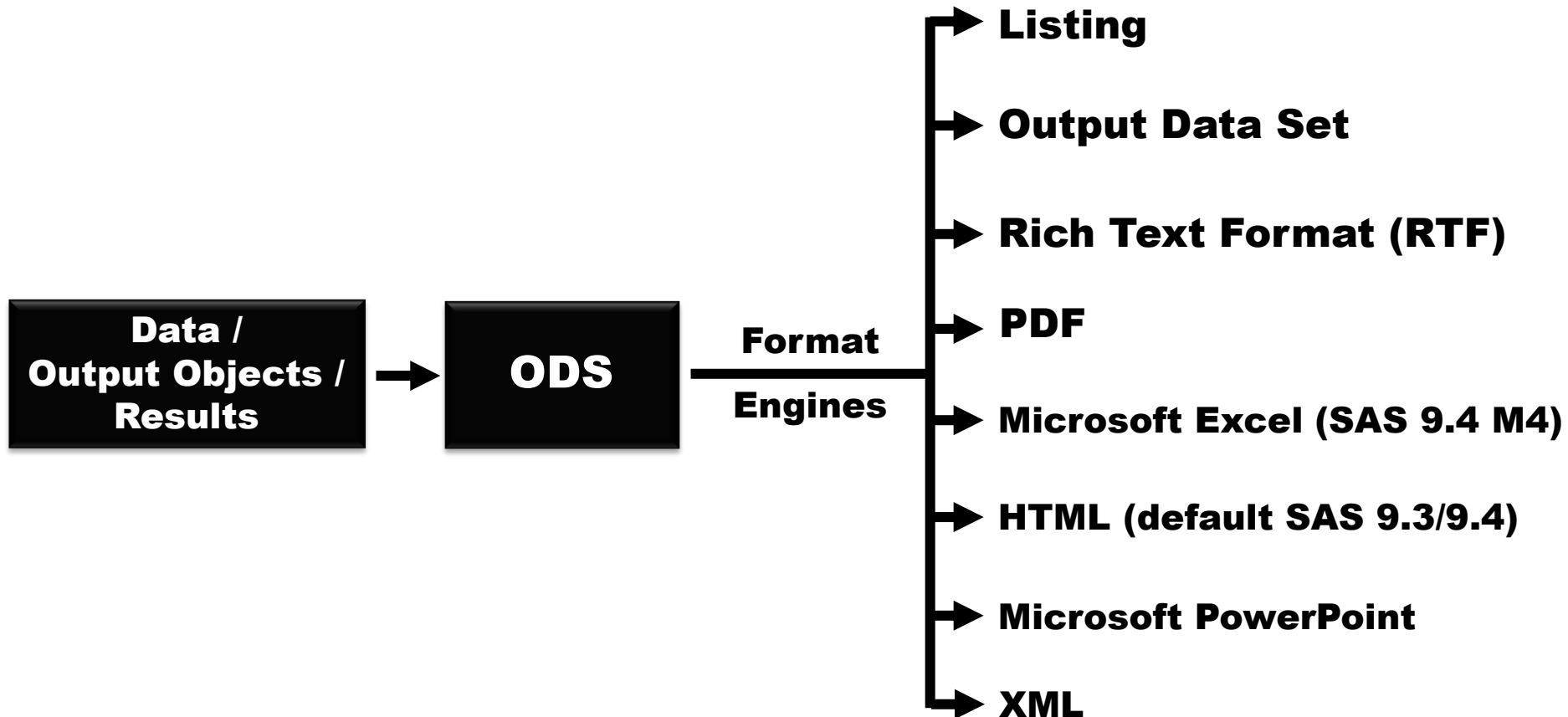
Rule #9 – Ensure Readable Message

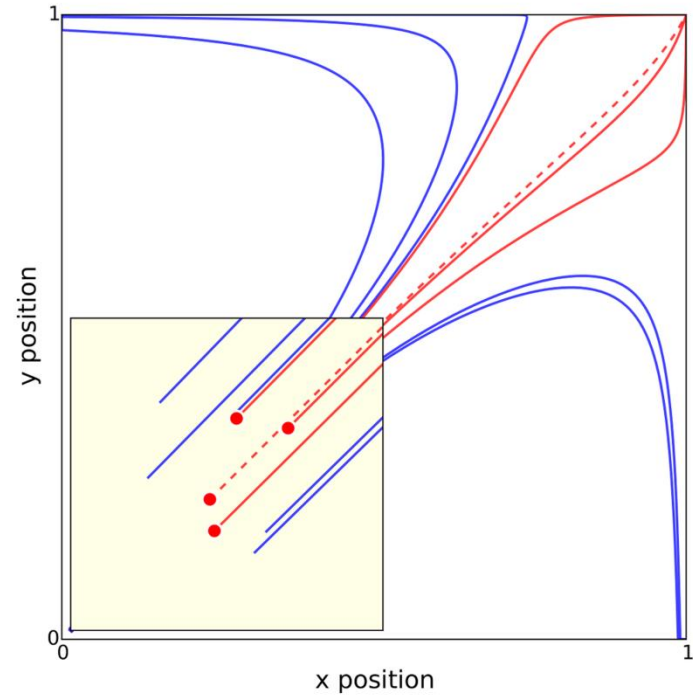
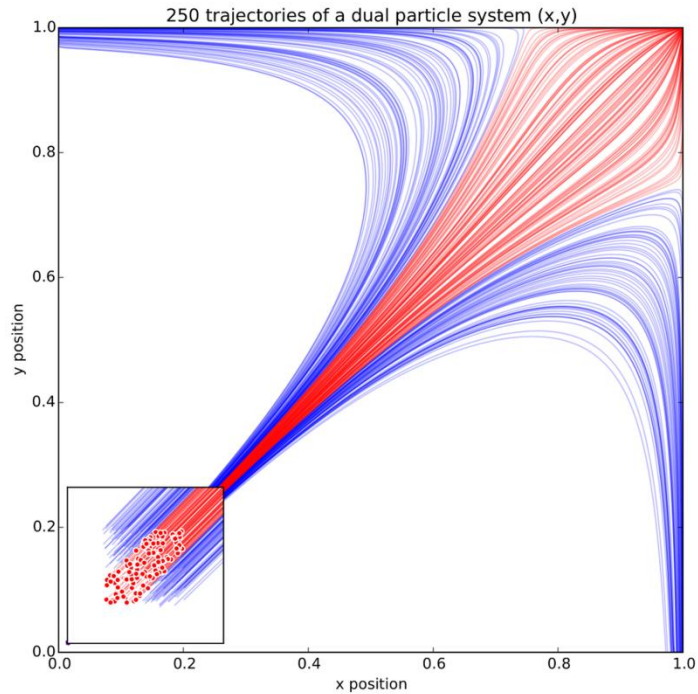
Rule #10 – Use the Right Tool

References


Rule #3: Adapt the Chart, Figure or Image to Support the Medium

SAS Output Delivery System (ODS) Destinations





The left figure has been prepared for a journal article where the reader is free to look at every detail. The right figure has been prepared for oral presentation.



Presenter Bio

Rule #1 – Know Your Audience

Rule #2 – Identify Your Message

Rule #3 – Support the Medium

Rule #4 – Captions Are Not Optional

Rule #5 – Do Not Trust the Defaults

Rule #6 – Use Color Effectively

Rule #7 – Avoid Misleading Viewer

Rule #8 – Avoid “Chartjunk”

Rule #9 – Ensure Readable Message


Rule #10 – Use the Right Tool

References

Rule #4: Captions Are Not Optional

Captions and Legends Are Not Optional

- **A chart, figure or visual cannot explain everything;**
- **Captions help to provide context about what cannot be graphically presented;**
- **Captions should be concise, but descriptive;**
- **Captions should also include the source of the image;**
- **A legend serves as a guide on how to read symbols that are used to display data.**



Presenter Bio

Rule #1 – Know Your Audience

Rule #2 – Identify Your Message

Rule #3 – Support the Medium

Rule #4 – Captions Are Not Optional

Rule #5 – Do Not Trust the Defaults

Rule #6 – Use Color Effectively

Rule #7 – Avoid Misleading Viewer

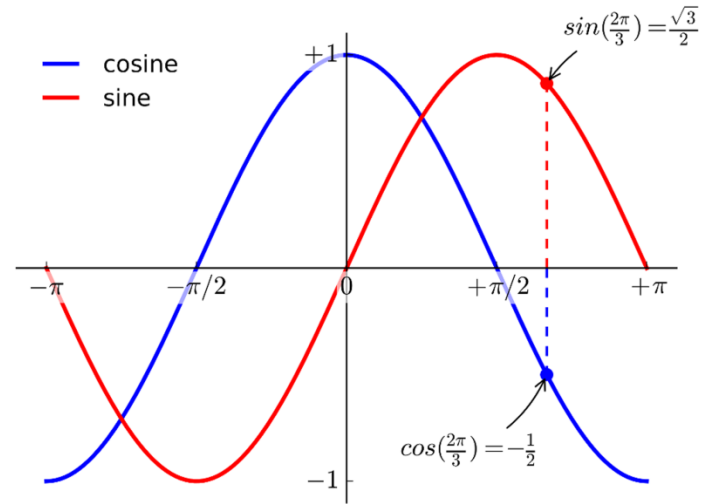
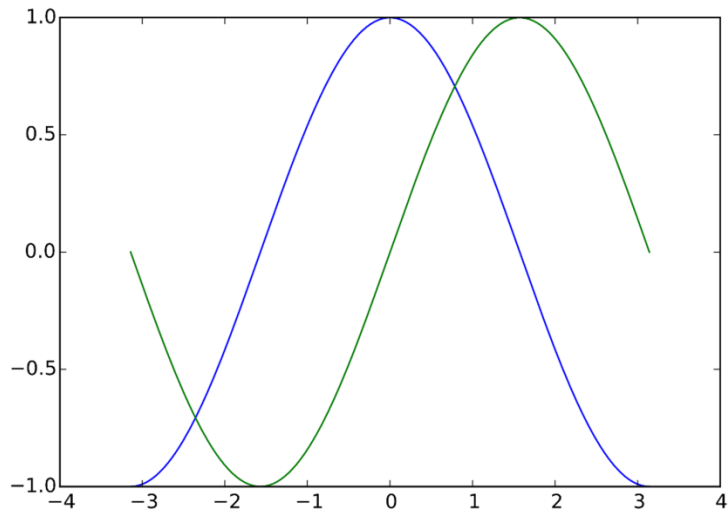
Rule #8 – Avoid “Chartjunk”

Rule #9 – Ensure Readable Message

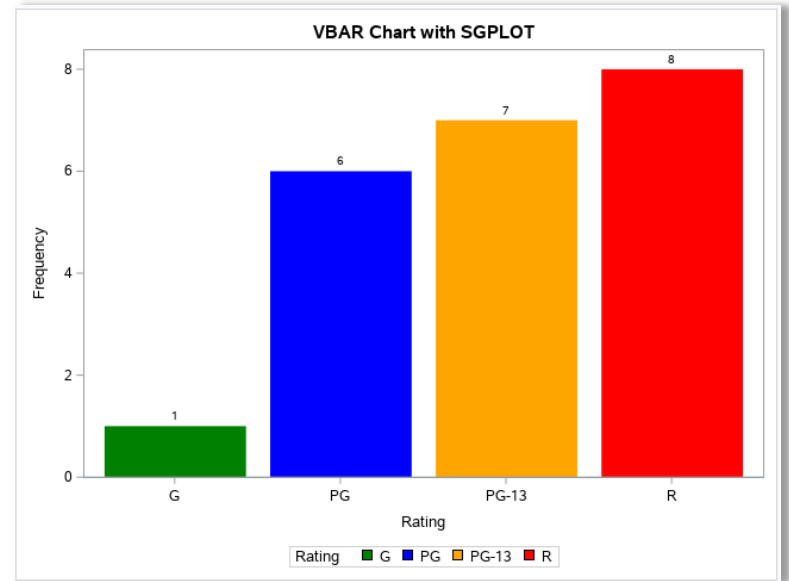
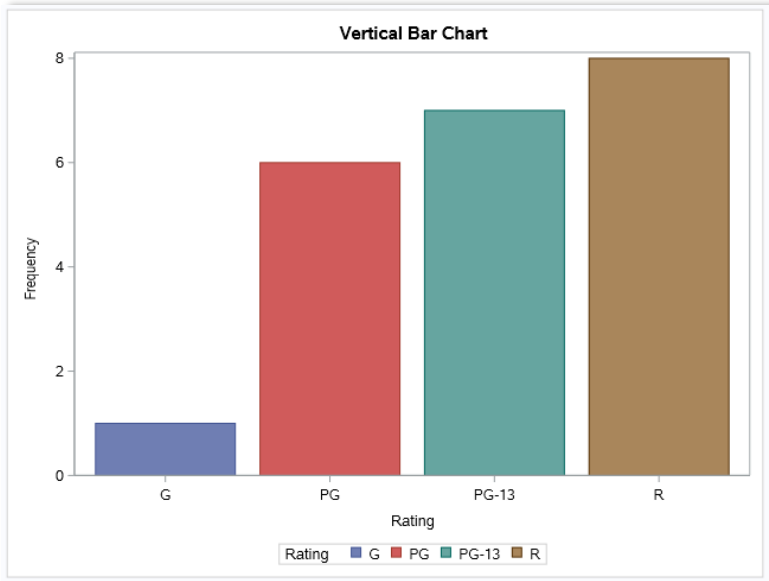
Rule #10 – Use the Right Tool

References


Rule #5: Do Not Trust the Defaults



While the figure on the left is clear enough, it can be visually improved by tweaking the various available settings, as shown on the right panel.



While the figure on the left uses default colors for the bars, it can be visually improved by tweaking the various available settings, as shown on the right panel.



Presenter Bio

Rule #1 – Know Your Audience

Rule #2 – Identify Your Message

Rule #3 – Support the Medium

Rule #4 – Captions Are Not Optional

Rule #5 – Do Not Trust the Defaults

Rule #6 – Use Color Effectively

Rule #7 – Avoid Misleading Viewer

Rule #8 – Avoid “Chartjunk”

Rule #9 – Ensure Readable Message

Rule #10 – Use the Right Tool

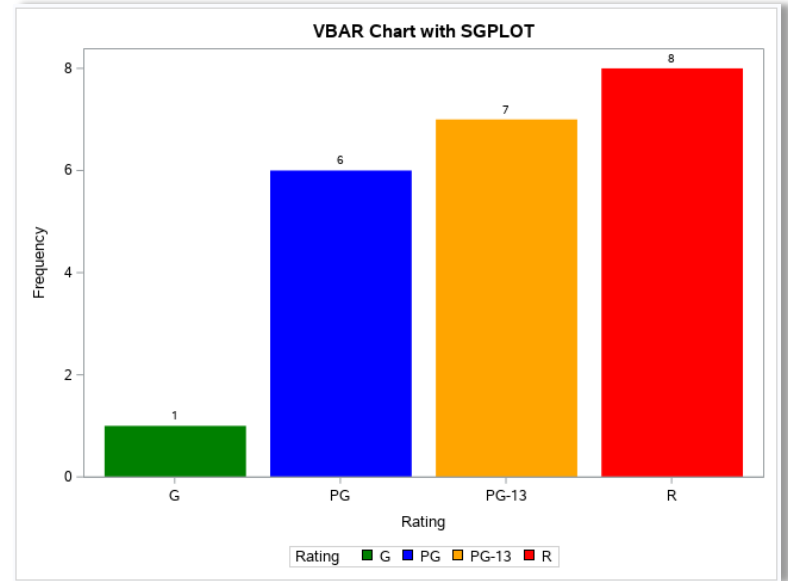
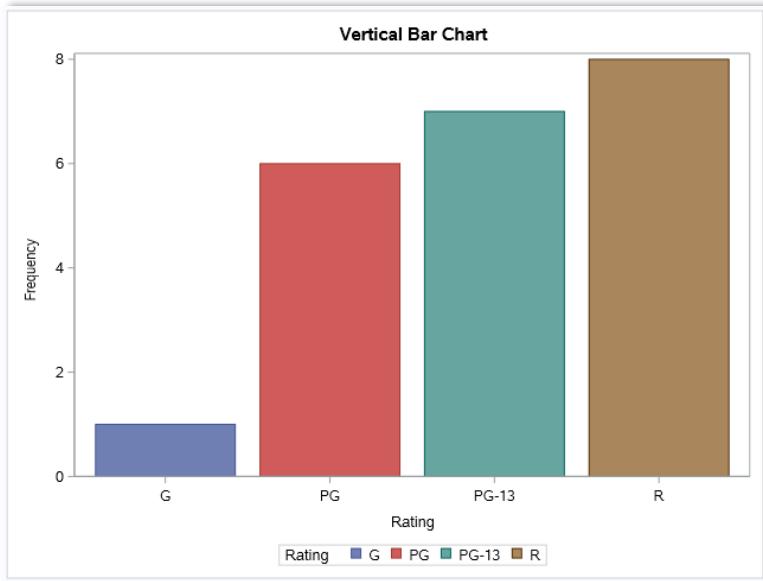
References

Rule #6: Use Color Effectively

Using Color Effectively

- **Helps to organize, engage, promote and encourage greater comprehension with an audience;**
- **Makes charts, figures and visuals more meaningful;**
- **Emphasizes and draws attention to important data elements and issues, including headings, subheadings, footers, minimum and maximum values, missing values, ranges, outliers, special conditions, and other elements.**

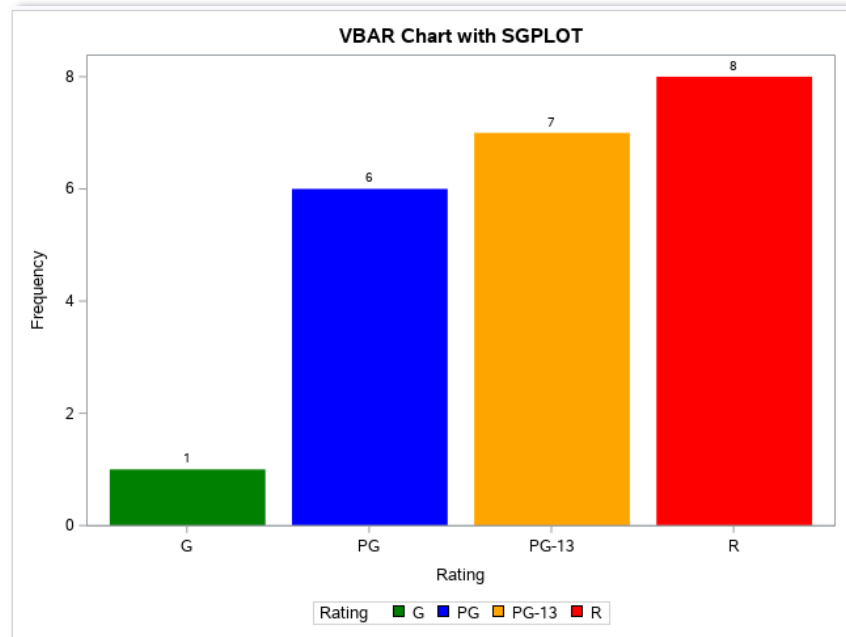
Using Color Effectively



While the figure on the left uses color, it can be visually improved by tweaking the various available settings, as shown on the right panel.

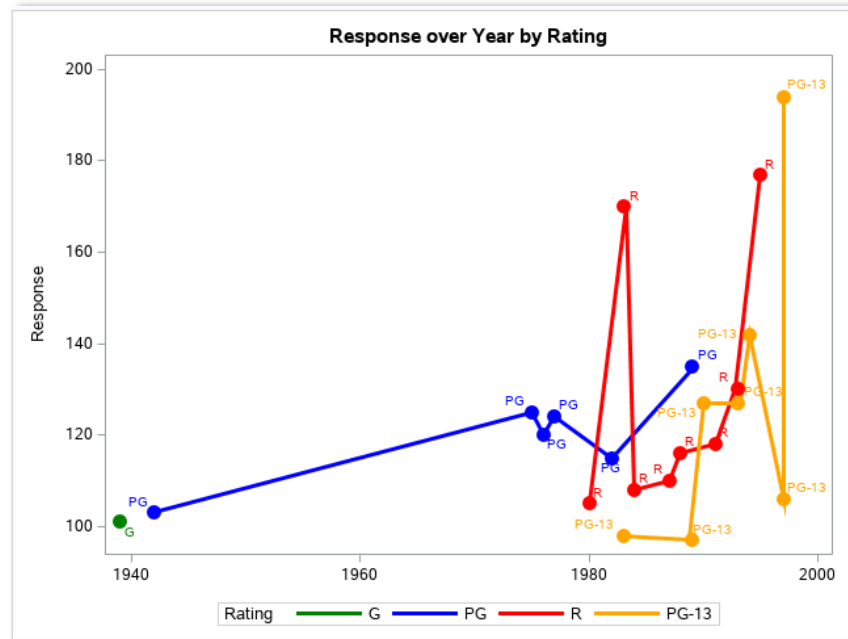
Adding Color to Bar Charts with Attribute Maps


```
DATA ATTRMAP ;  
  INPUT @1 ID $6.  
        @8 Value $5.  
        @14 FillColor $6. ;  
DATALINES ;  
Rating G      Green  
Rating PG     Blue  
Rating PG-13  Orange  
Rating R      Red  
;  
RUN ;  
  
TITLE 'VBAR Chart with SGPLOT' ;  
PROC SGPLOT DATA=MOVIES DATTRMAP=ATTRMAP ;  
  VBAR Rating / GROUP=Rating  
    DATALABEL  
    FILL  
    GROUPDISPLAY=Cluster  
    ATTRID=Rating ;  
  
RUN ;
```



Adding Color to Series Plots with Attribute Maps

```
DATA ATTRMAP ;
  INPUT @1 ID $6.
        @8 Value $5.
        @14 LineColor $6.
        @21 MarkerColor $6. ;
DATALINES ;
Rating G      Green  Green
Rating PG     Blue   Blue
Rating PG-13  Orange Orange
Rating R      Red    Red
;
RUN ;
PROC SORT DATA=Movies OUT=work.Movies_Sorted ;
  BY Year ;
RUN ;
TITLE 'Response over Year by Rating' ;
PROC SGPLOT DATA=work.Movies_Sorted
  DATTRMAP=ATTRMAP ;
  SERIES X=Year
         Y=Length / GROUP=Rating
         LINEATTRS=(THICKNESS=3) GROUPDISPLAY=Cluster
         ATTRID=Rating DATALABEL=Rating ;
  SCATTER X=Year
          Y=Length / GROUP=Rating MARKERATTRS=
            (SYMBOL=CIRCLEFILLED SIZE=11)
            ATTRID=Rating ;
  XAXIS DISPLAY=(NOLABEL) ;
  YAXIS LABEL='Response' ;
RUN ;
```





Presenter Bio

Rule #1 – Know Your Audience

Rule #2 – Identify Your Message

Rule #3 – Support the Medium

Rule #4 – Captions Are Not Optional

Rule #5 – Do Not Trust the Defaults

Rule #6 – Use Color Effectively

Rule #7 – Avoid Misleading Viewer

Rule #8 – Avoid “Chartjunk”

Rule #9 – Ensure Readable Message

Rule #10 – Use the Right Tool

References

Rule #7: Avoid Misleading the Reader

The Brain and Human Perception

- **Human Perception is the process of how the brain recognizes, organizes, and interprets sensory stimulations in the world around us;**
- **During the development and use of visuals, we should have firm answers to the following questions:**
 - ✓ **How do we want visuals to be perceived by others?**
 - ✓ **Are visuals understood by everyone viewing them?**
 - ✓ **Are visuals perceived in the same way by different viewers?**

Context and Perception

- Few (2008) found that context helps shape perception;
- Perception is affected by what surrounds the visual;
- An optical illusion is produced by background and color gradients in these rectangles.

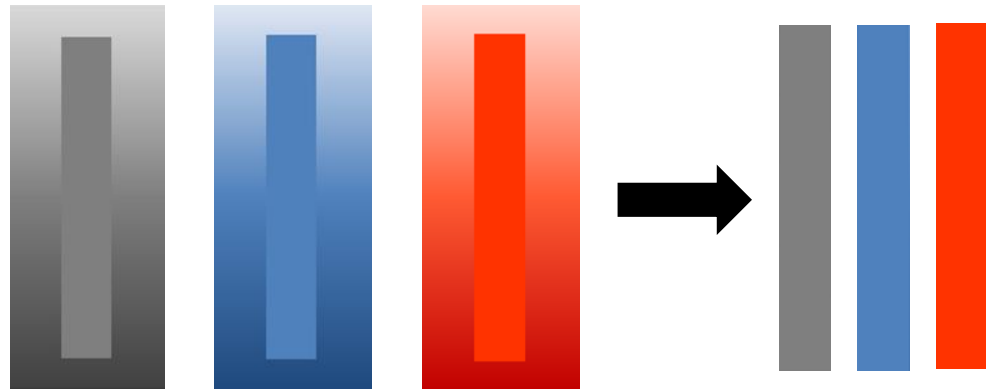


Figure. Optical illusion produced by background color gradients


Tips to Avoid Misleading Readers

Tip #1:

Ensure the background color being used is a solid color and avoids the use of gradients.

Tip #2:

Use background and foreground colors that sufficiently contrast with the visual being used.



Presenter Bio

Rule #1 – Know Your Audience

Rule #2 – Identify Your Message

Rule #3 – Support the Medium

Rule #4 – Captions Are Not Optional

Rule #5 – Do Not Trust the Defaults

Rule #6 – Use Color Effectively

Rule #7 – Avoid Misleading Viewer

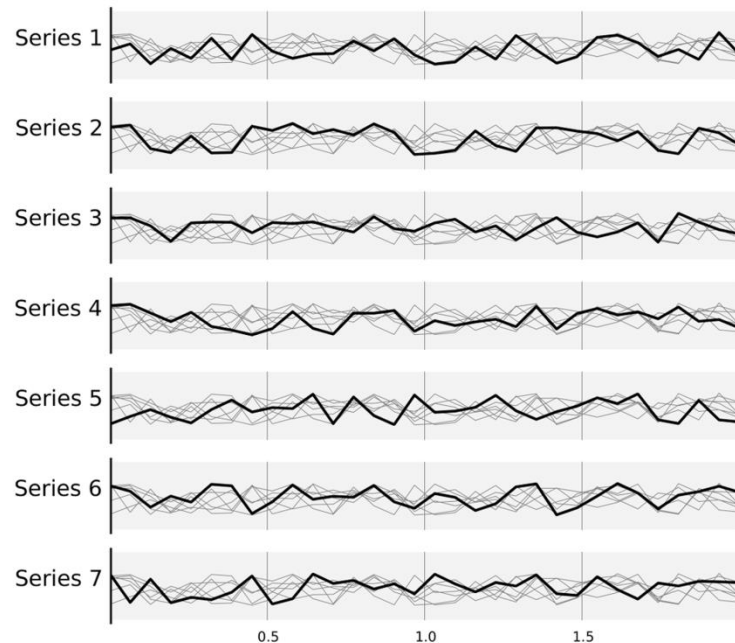
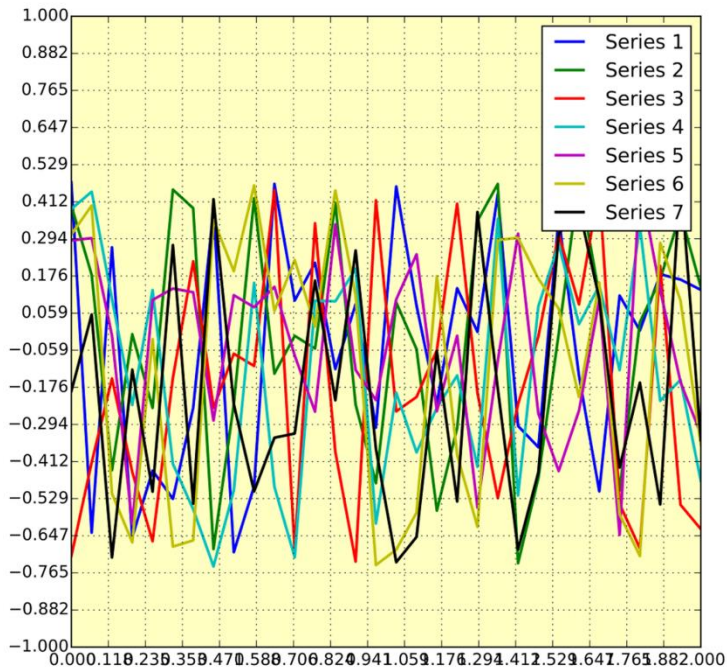
Rule #8 – Avoid “Chartjunk”

Rule #9 – Ensure Readable Message


Rule #10 – Use the Right Tool

References

Rule #8: Avoid “Chartjunk”



The left figure demonstrates a “poor” design where all the curves cover each other and the different colors do not help to distinguish the lines. The right figure adopts a different layout to display the lines.



Presenter Bio

Rule #1 – Know Your Audience

Rule #2 – Identify Your Message

Rule #3 – Support the Medium

Rule #4 – Captions Are Not Optional

Rule #5 – Do Not Trust the Defaults

Rule #6 – Use Color Effectively

Rule #7 – Avoid Misleading Viewer

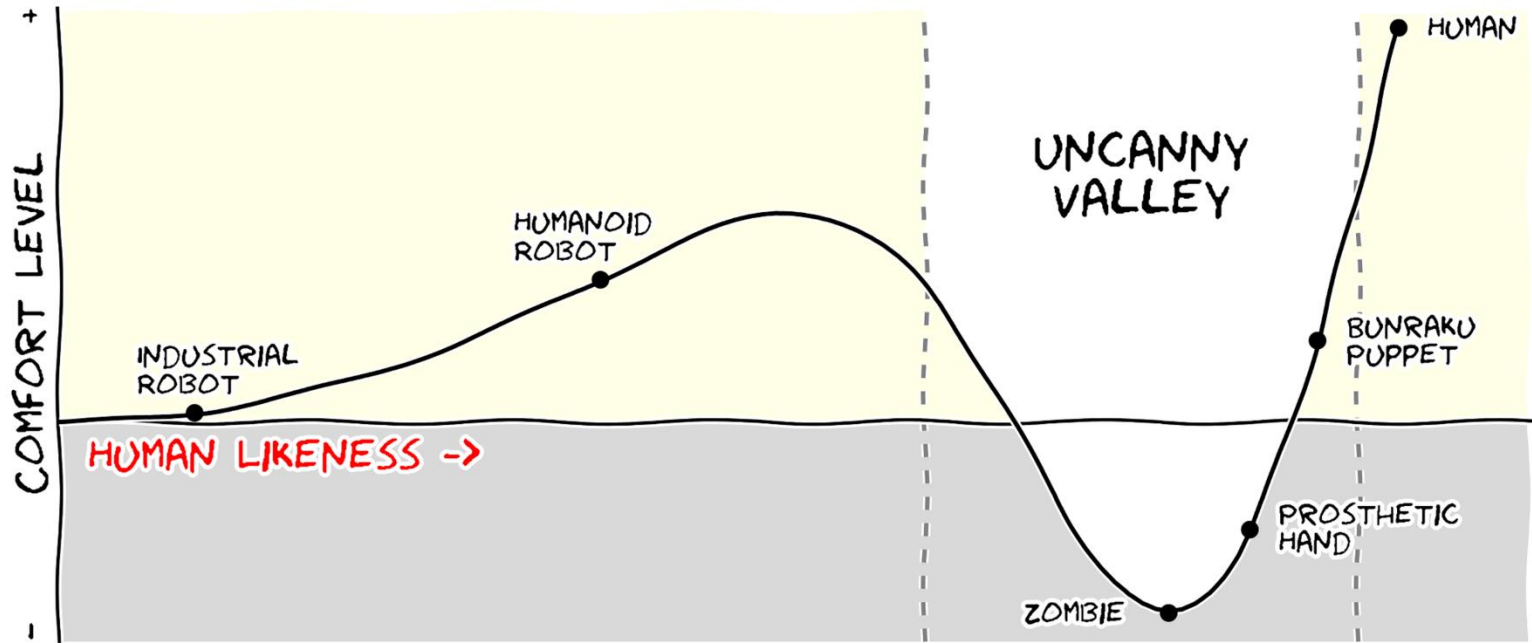
Rule #8 – Avoid “Chartjunk”

Rule #9 – Ensure Readable Message


Rule #10 – Use the Right Tool

References

Rule #9: Ensure a Readable Message is Used



This figure depicts a message that is clear even if the aesthetic of the figure is questionable.



Presenter Bio

Rule #1 – Know Your Audience

Rule #2 – Identify Your Message

Rule #3 – Support the Medium

Rule #4 – Captions Are Not Optional

Rule #5 – Do Not Trust the Defaults

Rule #6 – Use Color Effectively

Rule #7 – Avoid Misleading Viewer

Rule #8 – Avoid “Chartjunk”

Rule #9 – Ensure Readable Message

Rule #10 – Use the Right Tool

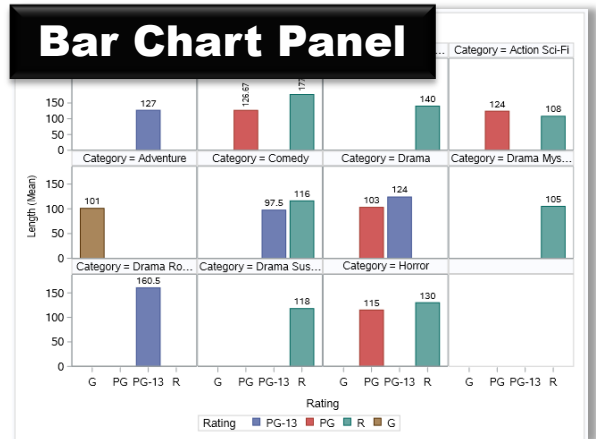
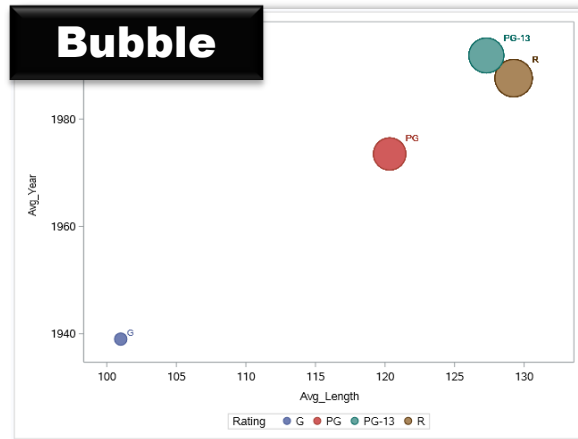
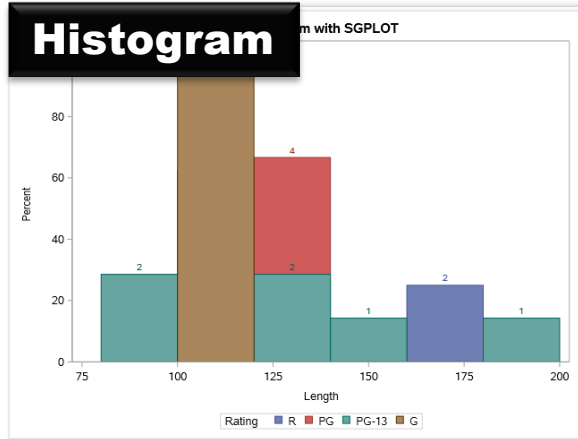
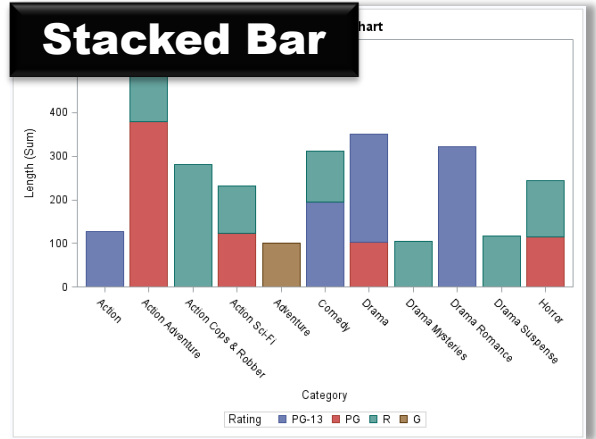
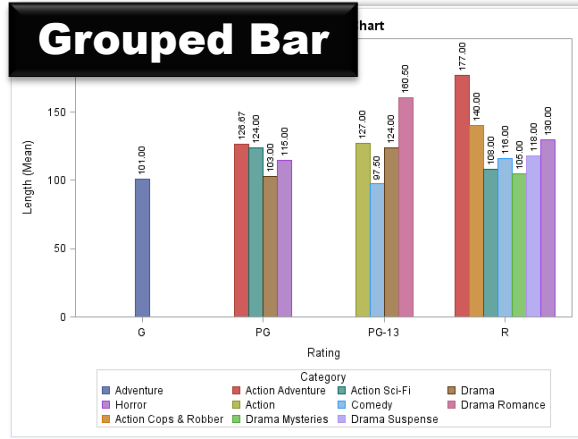
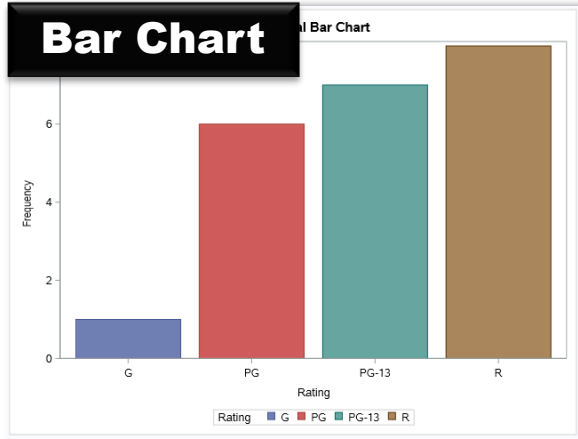
References

Rule #10: Use the Right Tool

Use the Right Tool

- **Base SAS software:**
 - ✓ ODS Statistical Graphics Procedures
 - ✓ PROC REPORT
 - ✓ ODS Excel Destination
- **With ODS Statistical Graphics tools, SAS users are able to produce high-quality charts, figures and visuals during data exploration, data analysis, and statistical analysis.**

Example Charts with SGPLOT and SGPANEL



Example PROC REPORT and Excel Results

Origin	Make	Type	Model	Vehicle MSRP
Asia	Kia	Wagon	Rio Cinco	\$11,905
Asia	Toyota	Truck	Tacoma	\$12,800
Asia	Scion	Wagon	xB	\$14,165
Asia	Mazda	Truck	B2300 SX Regular Cab	\$14,840
Asia	Toyota	Truck	Tundra Regular Cab V8	\$16,495
Asia	Suzuki	Wagon	Aerio SX	\$16,497
Asia	Toyota	Wagon	Matrix XR	\$16,695
Asia	Mitsubishi	Wagon	Lancer Sportback LS	\$17,495
Asia	Nissan	Truck	Frontier King Cab XE V6	\$19,479
Asia	Subaru	Wagon	Forester X	\$21,445
Asia	Mazda	Truck	B4000 SE Cab Plus	\$22,350
Asia	Subaru	Wagon	Outback	\$23,895
Asia	Subaru	Truck	Baja	\$24,520
Asia	Toyota	Truck	Tundra Access Cab V6 SR5	\$25,935
Asia	Nissan	Truck	Titan King Cab XE	\$26,650
Asia	Nissan	Wagon	Murano SL	\$28,739
Asia	Lexus	Wagon	IS 300 SportCross	\$32,455
Asia	Infiniti	Wagon	FX35	\$34,895
Asia	Infiniti	Wagon	FX45	\$36,395

Europe	Volkswagen	Wagon	Jetta GL	\$19,005
Europe	Volkswagen	Wagon	Passat GLS 1.8T	\$24,955
Europe	Volvo	Wagon	V40	\$26,135
Europe	BMW	Wagon	325xi Sport	\$32,845
Europe	Mercedes-Benz	Wagon	C240	\$33,780
Europe	Volvo	Wagon	XC70	\$35,145
Europe	Volkswagen	Wagon	Passat W8	\$40,235
Europe	Audi	Wagon	A6 3.0 Avant Quattro	\$40,840
Europe	Saab	Wagon	9-5 Aero	\$40,845
Europe	Audi	Wagon	S4 Avant Quattro	\$49,090
Europe	Mercedes-Benz	Wagon	E320	\$50,670
Europe	Mercedes-Benz	Wagon	E500	\$60,670


USA	Ford	Truck	Ranger 2.3 XL Regular Cab	\$14,385
USA	GMC	Truck	Canyon Z85 SL Regular Cab	\$16,530
USA	Pontiac	Wagon	Vibe	\$17,045
USA	Ford	Wagon	Focus ZTW	\$17,475
USA	Dodge	Truck	Dakota Regular Cab	\$17,630
USA	Chevrolet	Truck	Colorado Z85	\$18,760
USA	Dodge	Truck	Ram 1500 Regular Cab ST	\$20,215
USA	Dodge	Truck	Dakota Club Cab	\$20,300
USA	Chevrolet	Truck	Silverado 1500 Regular Cab	\$20,310
USA	Ford	Truck	F-150 Regular Cab XL	\$22,010
USA	Chevrolet	Wagon	Malibu Maxx LS	\$22,225
USA	Ford	Wagon	Taurus SE	\$22,290
USA	Mercury	Wagon	Sable GS	\$22,595
USA	Saturn	Wagon	L300 2	\$23,560
USA	GMC	Truck	Sonoma Crew Cab	\$25,395
USA	GMC	Truck	Sierra Extended Cab 1500	\$25,717
USA	GMC	Truck	Sierra HD 2500	\$29,322
USA	Chrysler	Wagon	Pacifica	\$31,230
USA	Ford	Truck	F-150 Supercab Lariat	\$33,540
USA	Chevrolet	Truck	Avalanche 1500	\$36,100
USA	Chevrolet	Truck	Silverado SS	\$40,340
USA	Chevrolet	Truck	SSR	\$41,995
USA	Cadillac	Truck	Escalade EXT	\$52,975

Base SAS Tools Used:
PROC SORT
PROC FORMAT
PROC REPORT
ODS EXCEL Destination

Custom Traffic Lighting with PROC FORMAT

	A	B	C	D	E	F
1	Movie Title	Movie Length	Movie Category	Year of Movie	Studio	Movie Rating
2	Brave Heart	177	Action Adventure	1995	Paramount Pictures	R
3	Casablanca	103	Drama	1942	MGM / UA	PG
4	Christmas Vacation	97	Comedy	1989	Warner Brothers	PG-13
5	Coming to America	116	Comedy	1988	Paramount Pictures	R
6	Dracula	130	Horror	1993	Columbia TriStar	R
7	Dressed to Kill	105	Drama Mysteries	1980	Filmways Pictures	R
8	Forrest Gump	142	Drama	1994	Paramount Pictures	PG-13
9	Ghost	127	Drama Romance	1990	Paramount Pictures	PG-13
10	Jaws	125	Action Adventure	1975	Universal Studios	PG
11	Jurassic Park	127	Action	1993	Universal Pictures	PG-13
12	Lethal Weapon	110	Action Cops & Robber	1987	Warner Brothers	R
13	Michael	106	Drama	1997	Warner Brothers	PG-13
14	National Lampoon's Vacation	98	Comedy	1983	Warner Brothers	PG-13
15	Poltergeist	115	Horror	1982	MGM / UA	PG
16	Rocky	120	Action Adventure	1976	MGM / UA	PG
17	Scarface	170	Action Cops & Robber	1983	Universal Studios	R
18	Silence of the Lambs	118	Drama Suspense	1991	Orion	R
19	Star Wars	124	Action Sci-Fi	1977	Lucas Film Ltd	PG
20	The Hunt for Red October	135			Paramount Pictures	PG
21	The Terminator	108			Live Entertainment	R
22	The Wizard of Oz	101			MGM / UA	G
23	Titanic	194			Paramount Pictures	PG-13

Base SAS Tools Used:
PROC SORT
PROC FORMAT
PROC REPORT
ODS EXCEL Destination



Presenter Bio

Rule #1 – Know Your Audience

Rule #2 – Identify Your Message

Rule #3 – Support the Medium

Rule #4 – Captions Are Not Optional

Rule #5 – Do Not Trust the Defaults

Rule #6 – Use Color Effectively

Rule #7 – Avoid Misleading Viewer


Rule #8 – Avoid “Chartjunk”

Rule #9 – Ensure Readable Message

Rule #10 – Use the Right Tool

References

Conclusion



Presenter Bio

Rule #1 – Know Your Audience

Rule #2 – Identify Your Message

Rule #3 – Support the Medium

Rule #4 – Captions Are Not Optional

Rule #5 – Do Not Trust the Defaults

References

Rule #6 – Use Color Effectively

Rule #7 – Avoid Misleading Viewer

Rule #8 – Avoid “Chartjunk”

Rule #9 – Ensure Readable Message

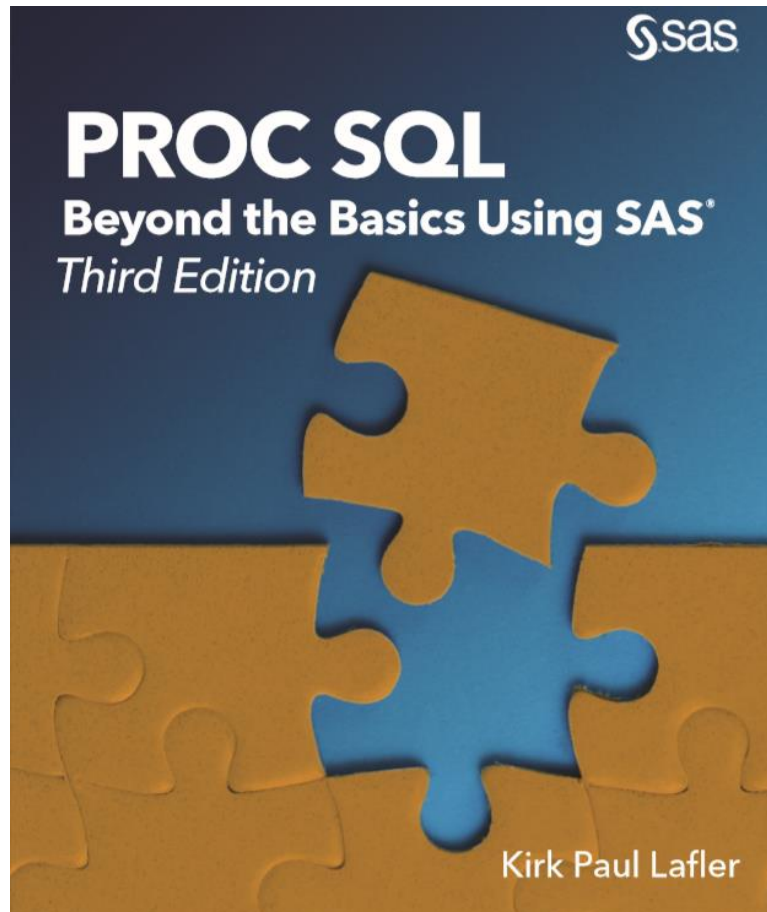
Rule #10 – Use the Right Tool

References


Ten Simple Rules for Better Figures (2014), by Rougier, Droettboom, Bourne; PLoS Computational Biology.

Statistical Graphics Procedures by Example: Effective Graphs Using SAS (2011), by Sanjay Matange and Dan Heath.

Clinical Graphs Using SAS (2016), by Sanjay Matange.



Available on Amazon.com and Online Book Stores everywhere!



Presenter Bio

Rule #1 – Know Your Audience

Rule #2 – Identify Your Message

Rule #3 – Support the Medium

Rule #4 – Captions Are Not Optional

Rule #5 – Do Not Trust the Defaults

Training from Kirk Paul Lafler

Rule #6 – Use Color Effectively

Rule #7 – Avoid Misleading Viewer

Rule #8 – Avoid “Chartjunk”


Rule #9 – Ensure Readable Message

Rule #10 – Use the Right Tool

References

Elevate Your SAS® Skills with Cutting-Edge Training

Kirk Paul Lafler offers dozens of popular cutting-edge SAS® instructor-led, courses, e-courses, hands-on workshops and webinars around the world. Whether you're a beginner, intermediate or advanced user, you'll find quality training solutions to enhance and elevate your SAS skills and knowledge. Attendees learn practical and results-oriented techniques and solutions using real-world examples. Training courses are affordably priced, comprehensive and immediately available. For more information, please send an email to KirkLafler@cs.com.



Presenter Bio

Rule #1 – Know Your Audience

Rule #2 – Identify Your Message

Rule #3 – Support the Medium

Rule #4 – Captions Are Not Optional

Rule #5 – Do Not Trust the Defaults



Rule #6 – Use Color Effectively

Rule #7 – Avoid Misleading Viewer

Rule #8 – Avoid “Chartjunk”

Rule #9 – Ensure Readable Message

Rule #10 – Use the Right Tool

References



Thank You for Attending!

Questions?

Kirk Paul Lafler

**SAS Consultant, Application Developer, Programmer,
Data Analyst, Educator and Author**

@sasNerd

<https://www.linkedin.com/in/KirkPaulLafler>

