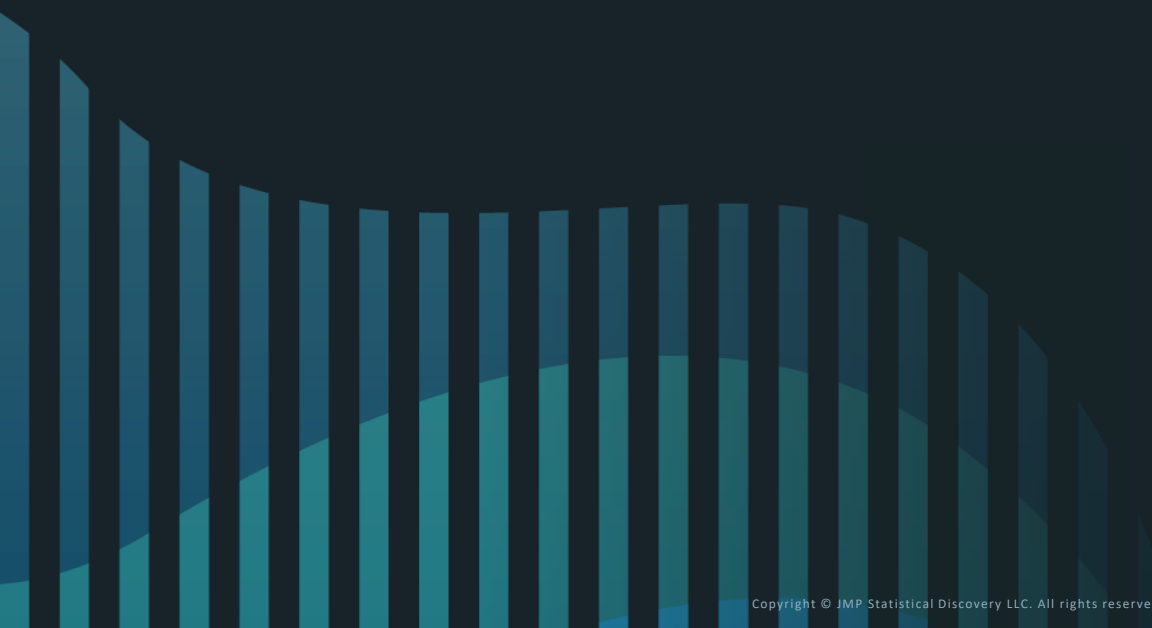


Principles of Graphing Data

Di Michelson (foreground)
Principal Analytical Training Consultant

Scott Wise (background)
Principal Systems Engineer

Poll #1



Streamline your Analytic Workflow

JMP is your singular platform for data access, analysis and sharing

Data

Files
Docs
Webpages
Databases
Web APIs
Cloud Sources
Open Source Languages
3rd Party Files



Analytic Capabilities



Insights

JMP Live >
HTML
Business Docs
Images

Why is Graphing so Important?

January 28, 1986: space shuttle Challenger disaster

Why is Graphing so Important?

January 28, 1986: space shuttle Challenger disaster

BLOW BY HISTORY

SRM-15 WORST BLOW-BY

- 2 CASE JOINTS (80°), (110°) ARC
- MUCH WORSE VISUALLY THAN SRM-22

SRM 22 BLOW-BY

- 2 CASE JOINTS (30-40°)

SRM-13A, 15, 16A, 18, 23A 24A

- NOZZLE BLOW-BY

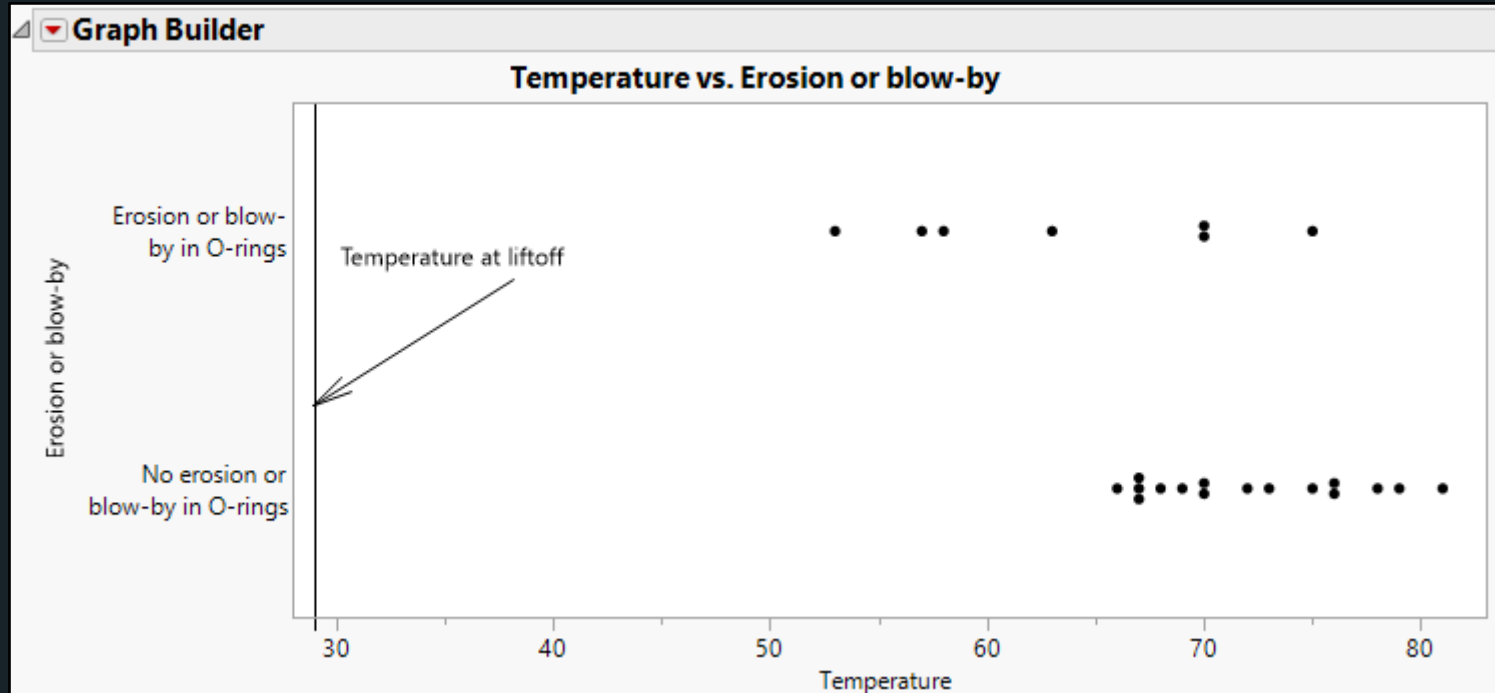
HISTORY OF O-RING TEMPERATURES (DEGREES - F)

<u>MOTOR</u>	<u>MBT</u>	<u>AMB</u>	<u>O-RING</u>	<u>WIND</u>
DM-4	68	36	47	10 MPH
DM-2	76	45	52	10 MPH
QM-3	72.5	40	48	10 MPH
QM-4	76	48	51	10 MPH
SRM-15	52	64	53	10 MPH
SRM-22	77	78	75	10 MPH
SRM-25	55	26	29 27	10 MPH 25 MPH

E. Tufte (1997). *Visual Explanations*, Graphics Press LLC: Cheshire, CT, pp. 38-53.

Why is Graphing so Important?

January 28, 1986: space shuttle Challenger disaster



S.R. Dalal, E.B. Fowlkes, B. Hoadley (1989). "Risk Analysis of the Space Shuttle: Pre-Challenger Prediction of Failure," Journal of the American Statistical Association, Vol. 84, #408, pp. 945-957.

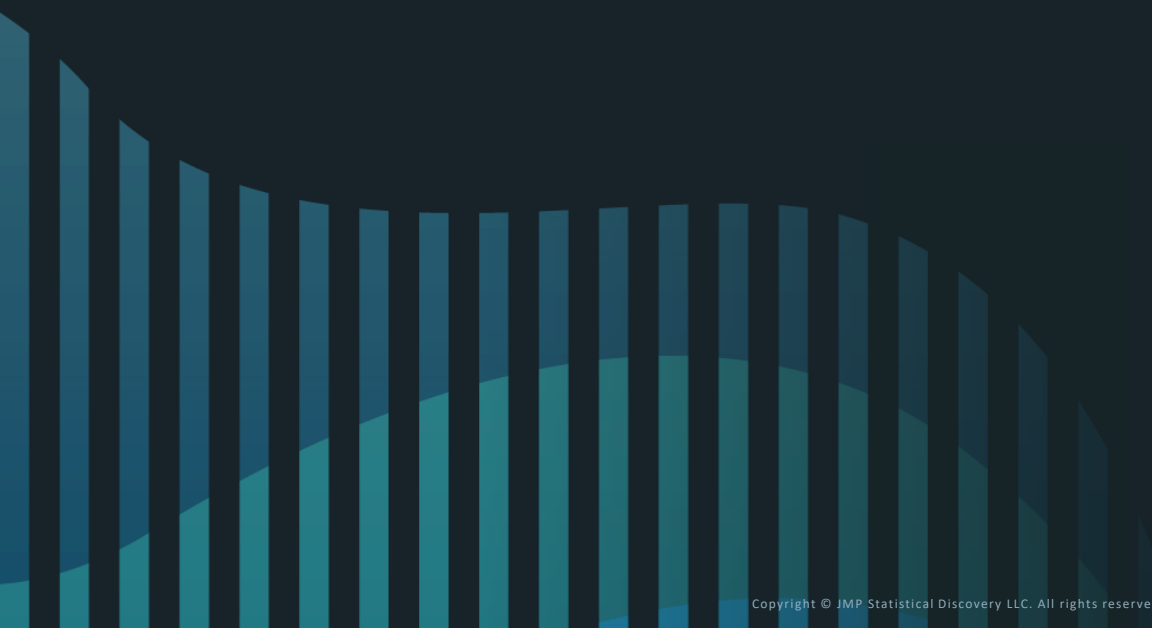
Why is Graphing so Important?

January 28, 1986: space shuttle Challenger disaster

"...there are right ways and wrong ways to show data; there are displays that reveal the truth and displays that do not."

– E. Tufte

Poll #2



Data Visualization

Learning how to build good graphs of your data can be useful for

- data exploration
- discovering patterns
- exploring data structure
- detecting unusual observations
- identifying trends over time
- evaluating models
- presenting results

Principles of Graphing Data

- Make the data stand out, avoid superfluity.
- Use visually prominent graphical elements to show the data.
- Overlapping plotting symbols must be readable.
- Do not clutter the interior of the graph frame.
- Deemphasize grid lines.
- Visual clarity must be preserved under reduction and reproduction.
- Proofread graphs.
- Draw the data to scale.
- Do not show changes in one dimension by area or volume.
- Use a common baseline wherever possible.
- Graphing data should be an iterative, experimental process.
- Don't require the reader to make calculations.
- If showing improvement, plot improvement rather than before and after.

Principles of Graphing Data

- A large amount of quantitative information can be packed into a small region.
- Use a log scale to understand percent changes or multiplicative factors.
- Showing data on a log scale can cure skewness.
- Avoid deceptive double-y axes.
- Choose an aspect ratio that shows variation in the data.
- All axes require scales.
- The horizontal axis should increase from left to right and the vertical axis from bottom to top.

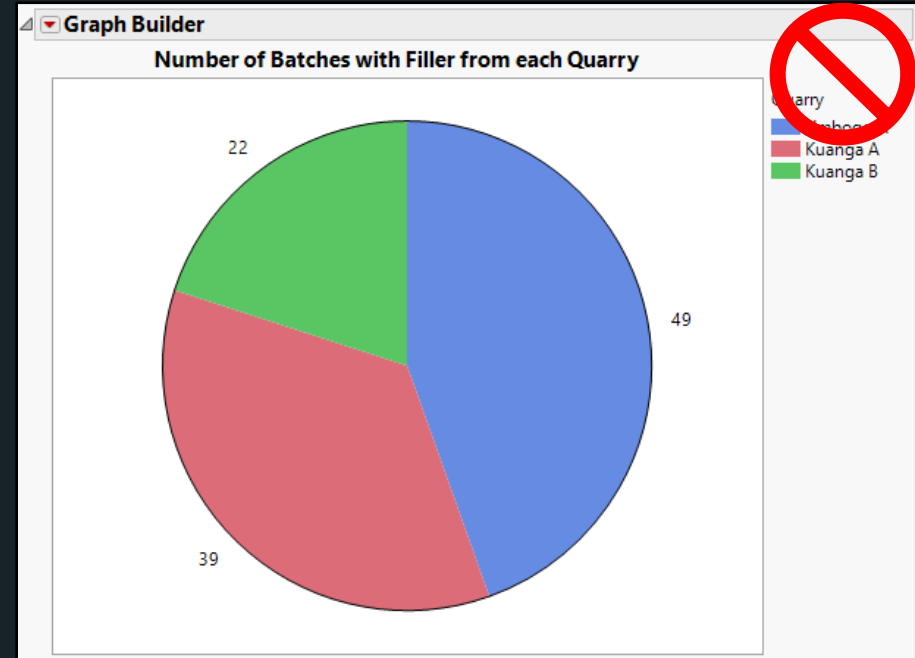
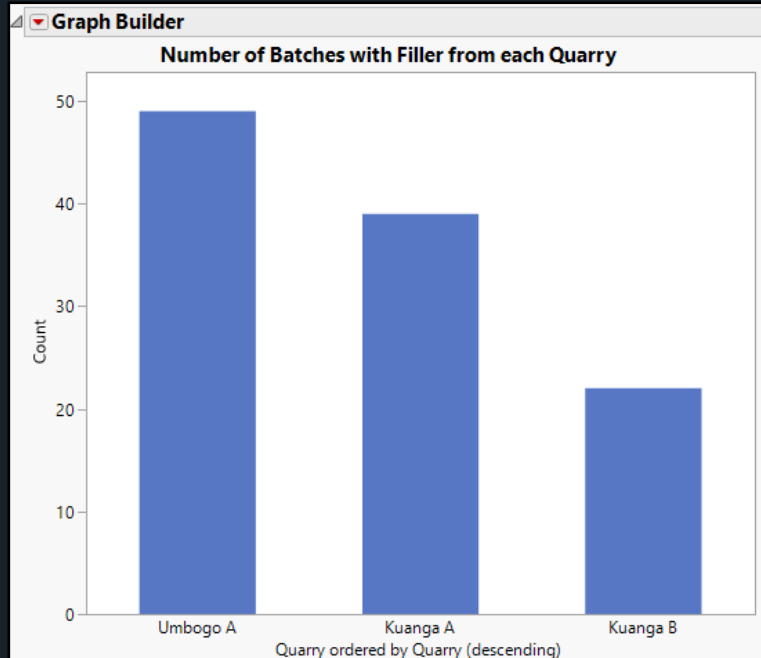
Elementary Graphing Tasks

In difficulty order, starting with easiest

1. position along a common scale
2. position along identical, non-aligned scales
3. length
4. angle or slope
5. area
6. volume
7. color hue, color saturation, density

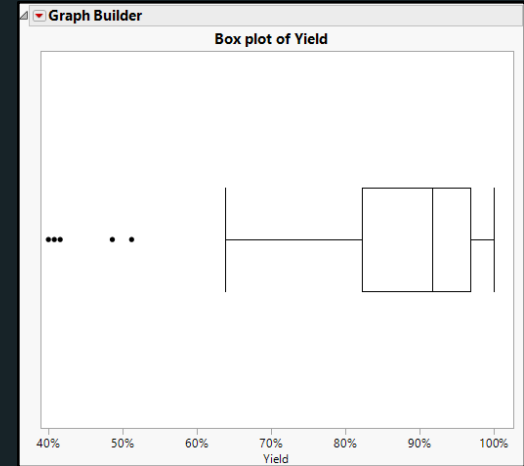
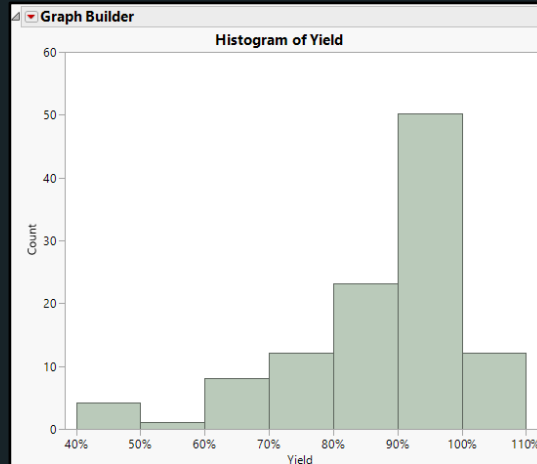
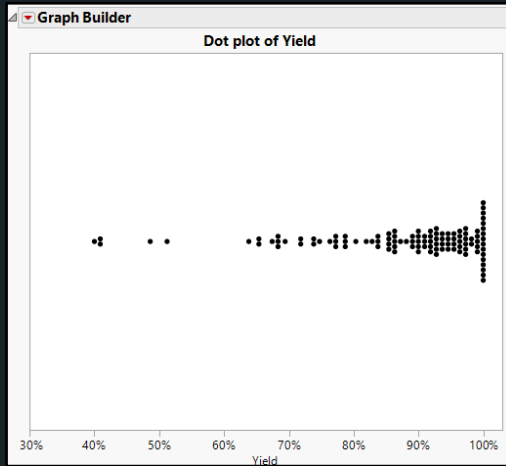
Graphing One Variable

Categorical



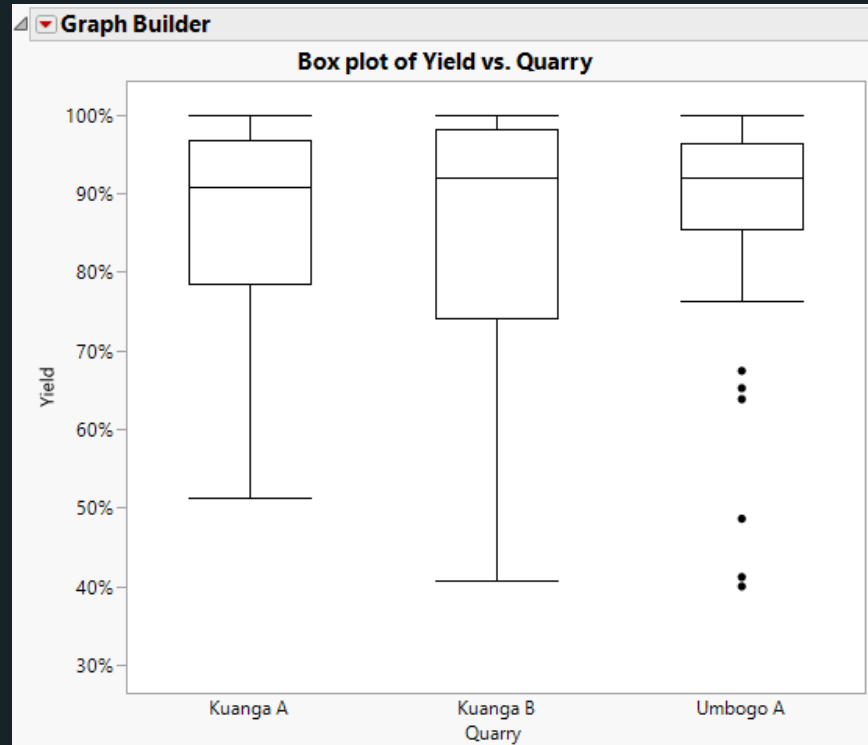
Graphing One Variable

Continuous



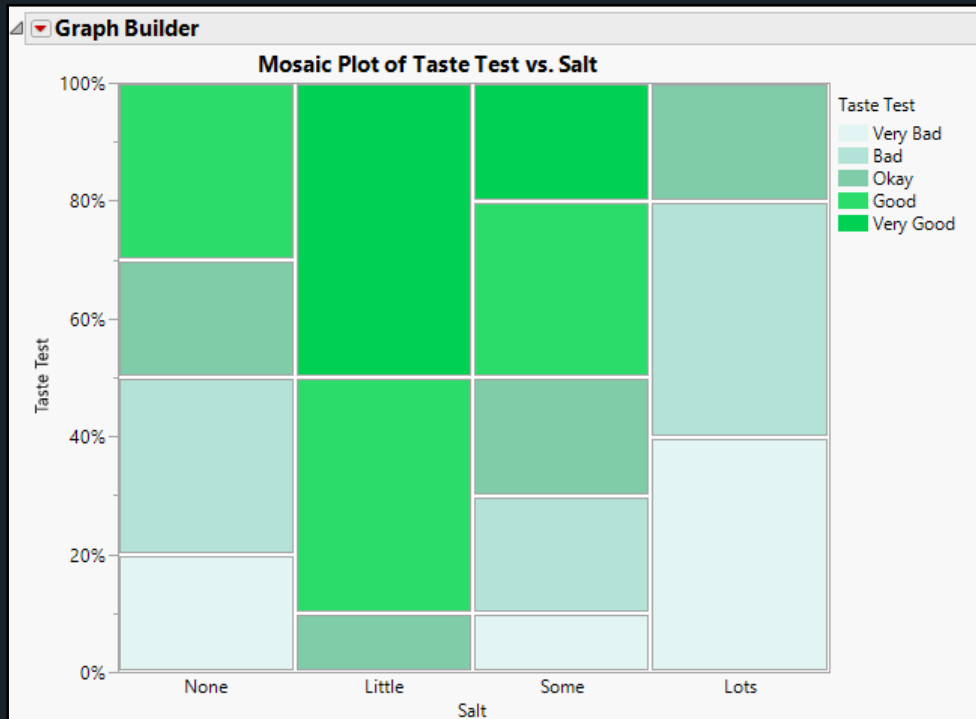
Graphing Two Variables

Continuous vs. Categorical



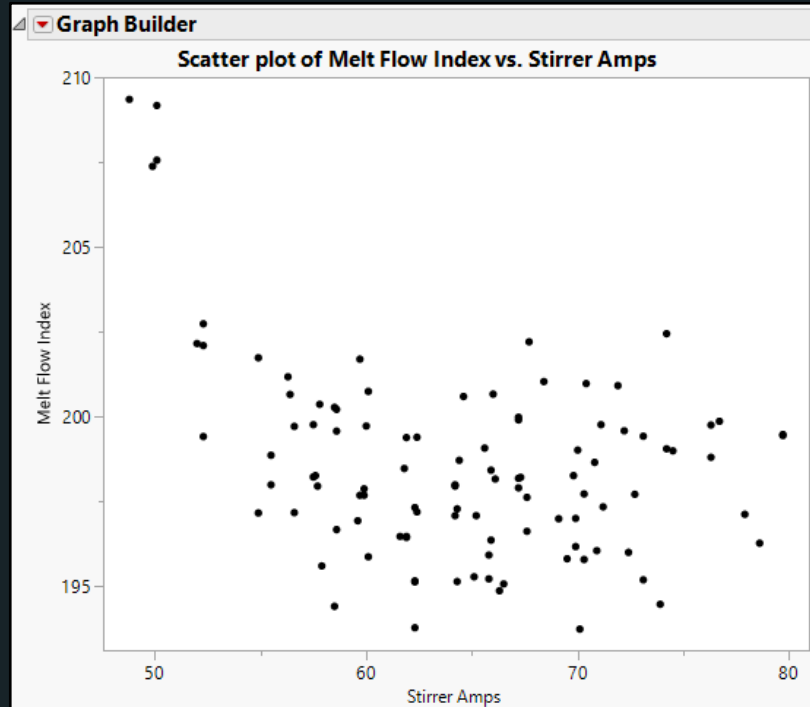
Graphing Two Variables

Categorical vs. Categorical



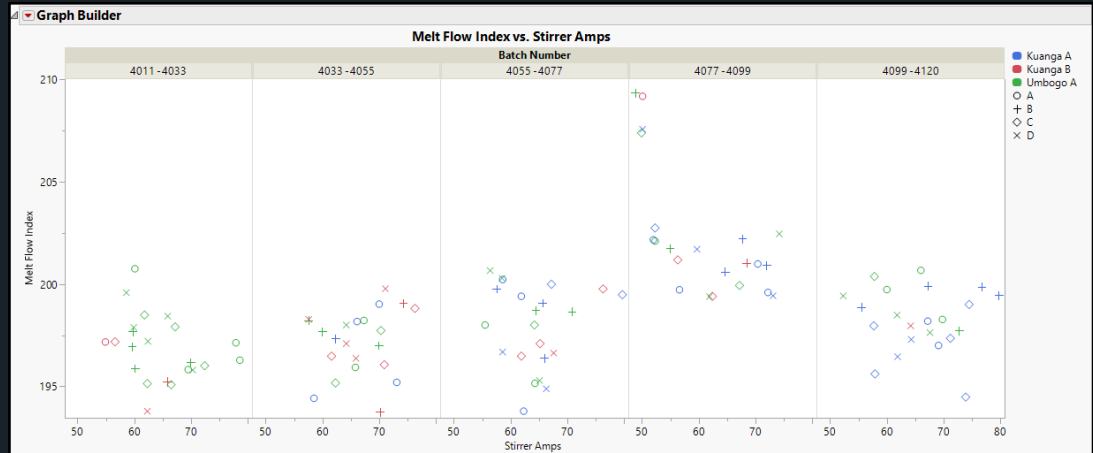
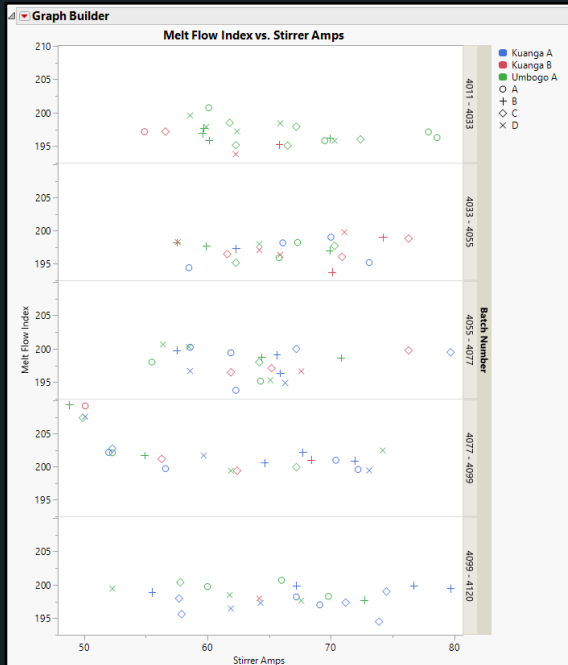
Graphing Two Variables

Continuous vs. Continuous



Graphing Multiple Variables

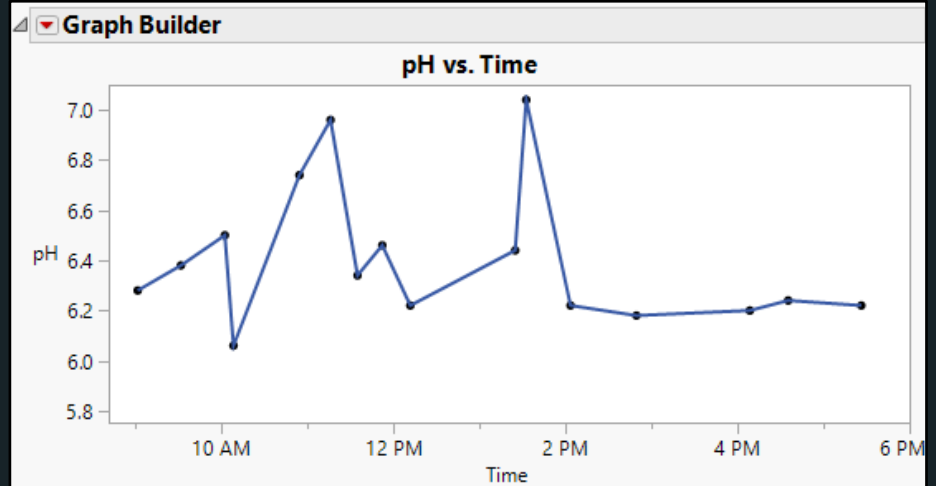
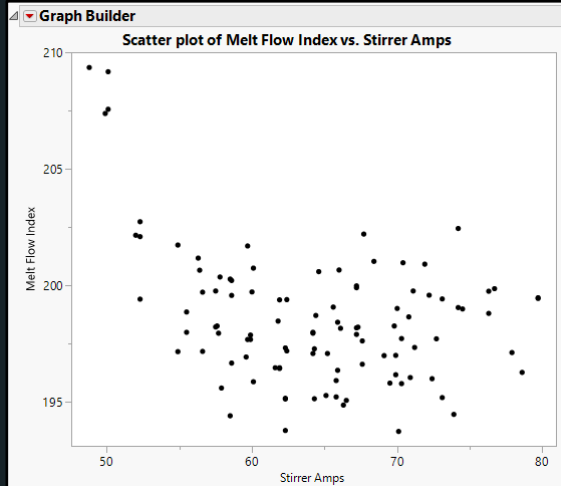
Trellis, Color, Overlay



Experiment with layout

Important Graphing Elements

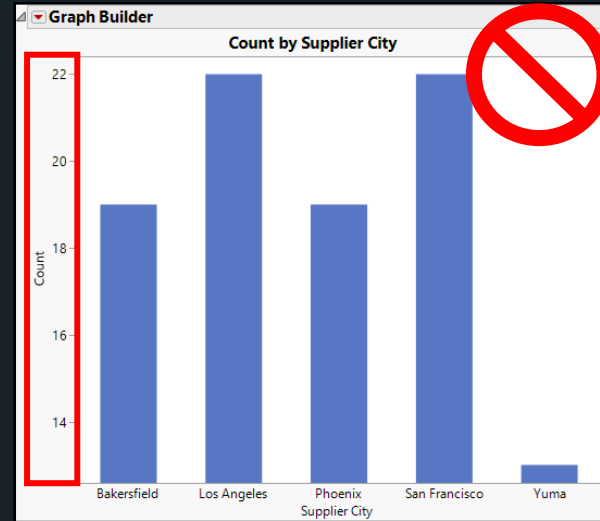
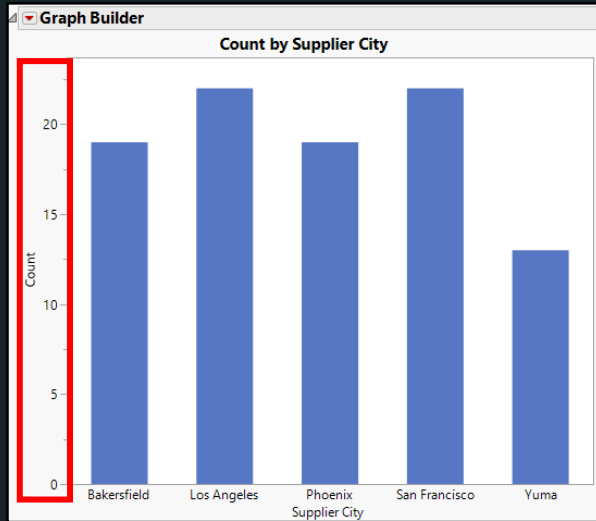
Aspect ratio



Choose an aspect ratio that shows variation in the data.

Important Graphing Elements

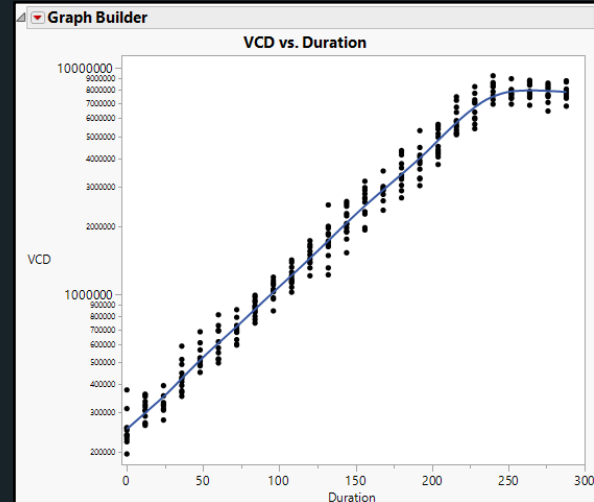
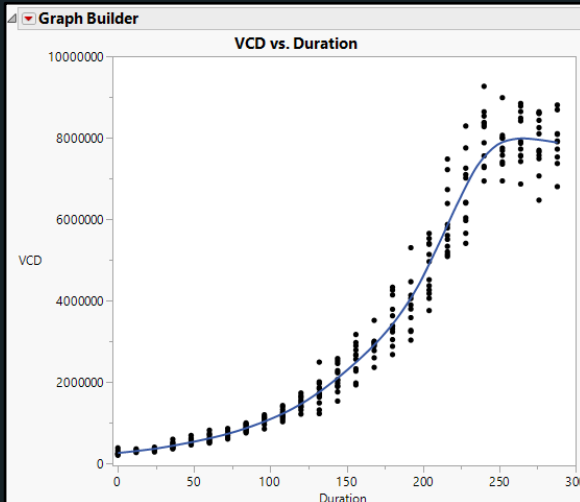
Zero baseline



Use a common baseline wherever possible.

Important Graphing Elements

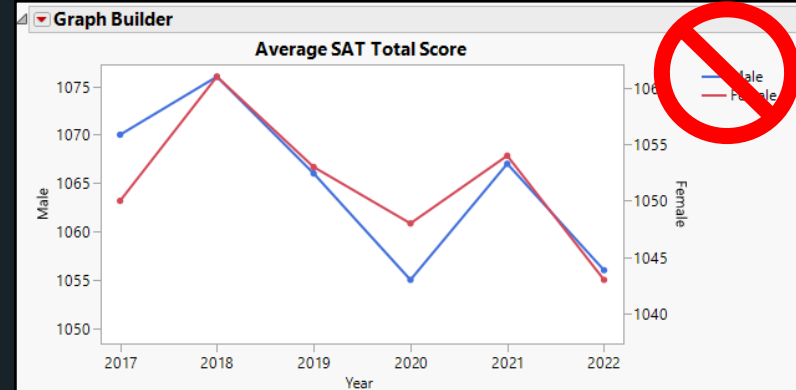
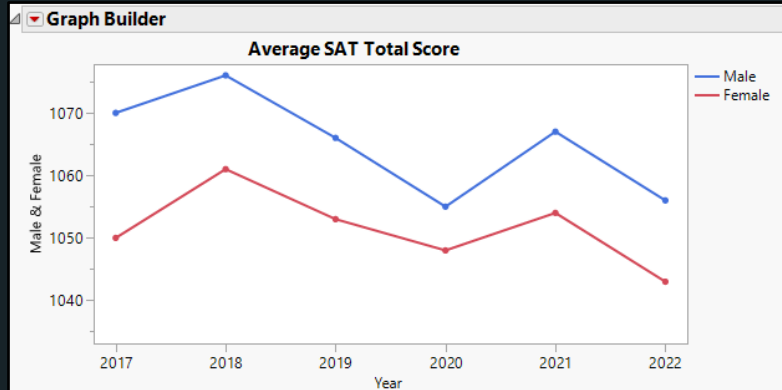
Log/linear scale



- Use a log scale to understand percent changes or multiplicative factors.
- Showing data on a log scale can cure skewness.

What to Avoid

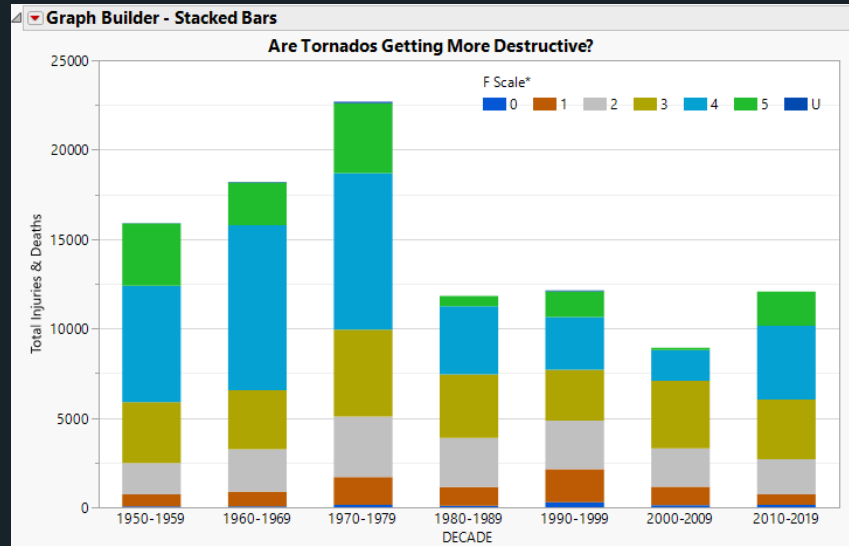
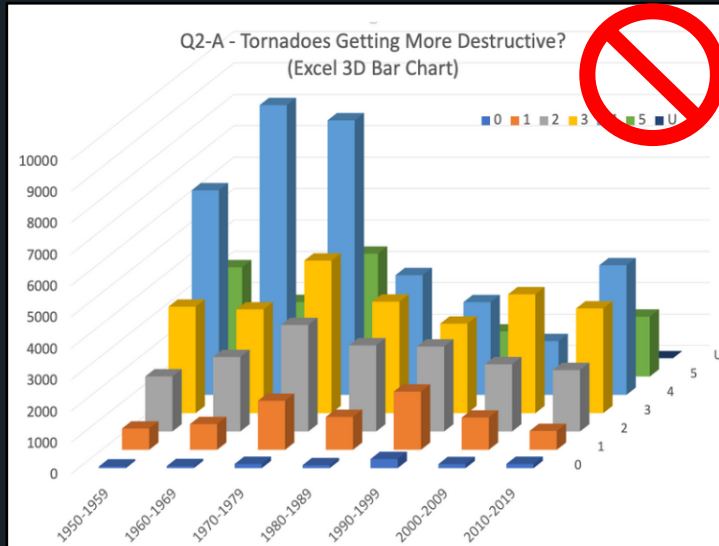
Two Y Axes with Different Scales for the Same Variable



- Using a common scale shows the gap.
- Using different scales loses the story.
- Be careful with two y axes.

What to Avoid

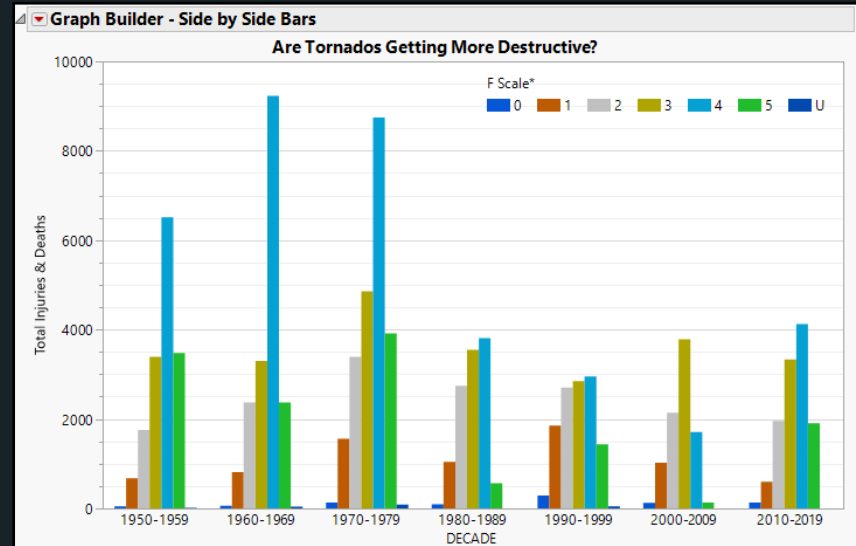
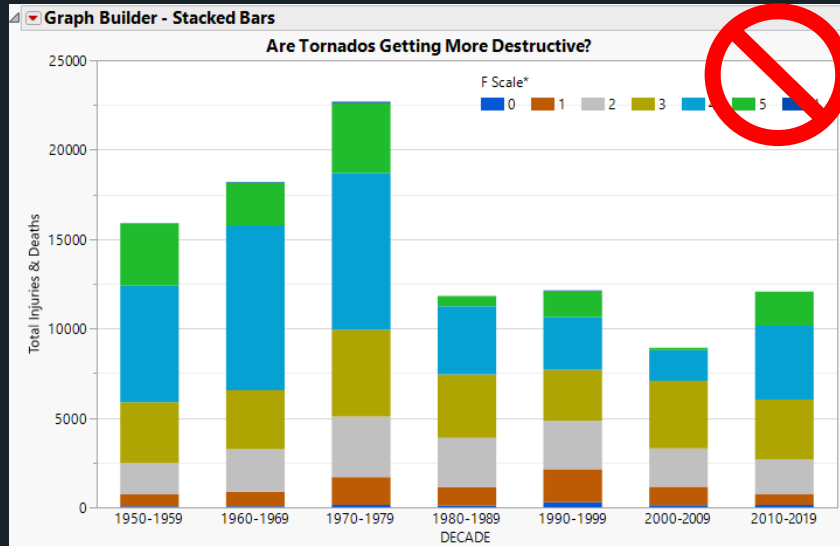
Three Dimensional Graphs



- Three dimensional graphs are inherently misleading.
 - bars in the “back” are obscured
 - reader must work to decode data values

What to Avoid

Stacked Bar Graphs



If the intent is to compare across groups, stacked bars do not have a common baseline, use another type of bar graph instead.

References

- N. Robbins (2005). *Creating More Effective Graphs*, Wiley-Interscience.
- W. Cleveland (1985). *The Elements of Graphing Data*, Wadsworth.
- E. Tufte (2001). *The Visual Display of Quantitative Information*, 2nd Ed., Graphics Press.
- [Scott Wise JMP Blog: Pictures from the Gallery - Advanced Graph Building Series](#)
- [30 day free trial of JMP software](#)