Looking at data through visualizations can be enlightening and powerful (and, sometimes, deceptive - see recommended reading). Data visualization is a science and an art, and can be very hard to get right; we'll just skim the surface.

Basic tools today, Python later, more advanced tool near end of the course. As last time, some students may be a bored today, but might learn a few new things near the end.

Note: Visualizations (charts) in Google Sheets have a way to go to catch up with Excel.

*Students should work along on their computers.*

**Bar charts**

*Useful when one axis is categories and the other is numeric*

- Select first 10 cities, bar chart for temp, then lat+lng+temp
- Average temp for each region: pivot table with Rows region, Values temp AVERAGE; then bar chart; then sort + new bar chart
- Number of states in each region divided into coastal and non-coastal: pivot table with Rows region, Columns coastal, Values state COUNTUNIQUE, sort region Descending by Grand Total; then stacked bar chart, show Customization (data labels, title)

**Pie charts**

*Useful when comparing sizes of categories*

- Number of cities in coastal versus non-coastal states: select coastal column, show three types of pie chart
- Number of cities in each region: pivot table with Rows Region, Values city COUNTA; pie chart
- Nonsensical: Temps in each region (change pivot table Values temp SUM or AVERAGE)

**Scatterplots**

*Useful when both axes are numeric (or at least ordered)*

- Latitude versus temperature, Longitude versus temperature
- Latitude versus Longitude - select lng then lat for lng on x-axis, can't reverse lng

**Map**

*Values by geographical region*

- Columns state and temp; Maps chart; set Region, Aggregate, colors

**More advanced/exotic visualizations using Raw tool**

*http://raw.densitydesign.org/*

- Scatterplot: X lat, Y temp; then X lng, Y lat, add COLOR region then COLOR coastal, add size TEMP
- Alluvial diagram: STEPS region then coastal; add SIZE temp (implicit SUM)
- Circle packing: HIERARCHY region then state; add COLOR lat Linear, then lng