

Data Visualization

Drawn from Chapter 1 of [Beautiful Visualization](#)

Why should we visualize?

What is the goal of visualizing information?

- We are translating information from an effective method for **storing** it to an effective way of **consuming** it!
- My brain (and probably yours, too!) does not like to consume spreadsheets
- We perceive the world visually!

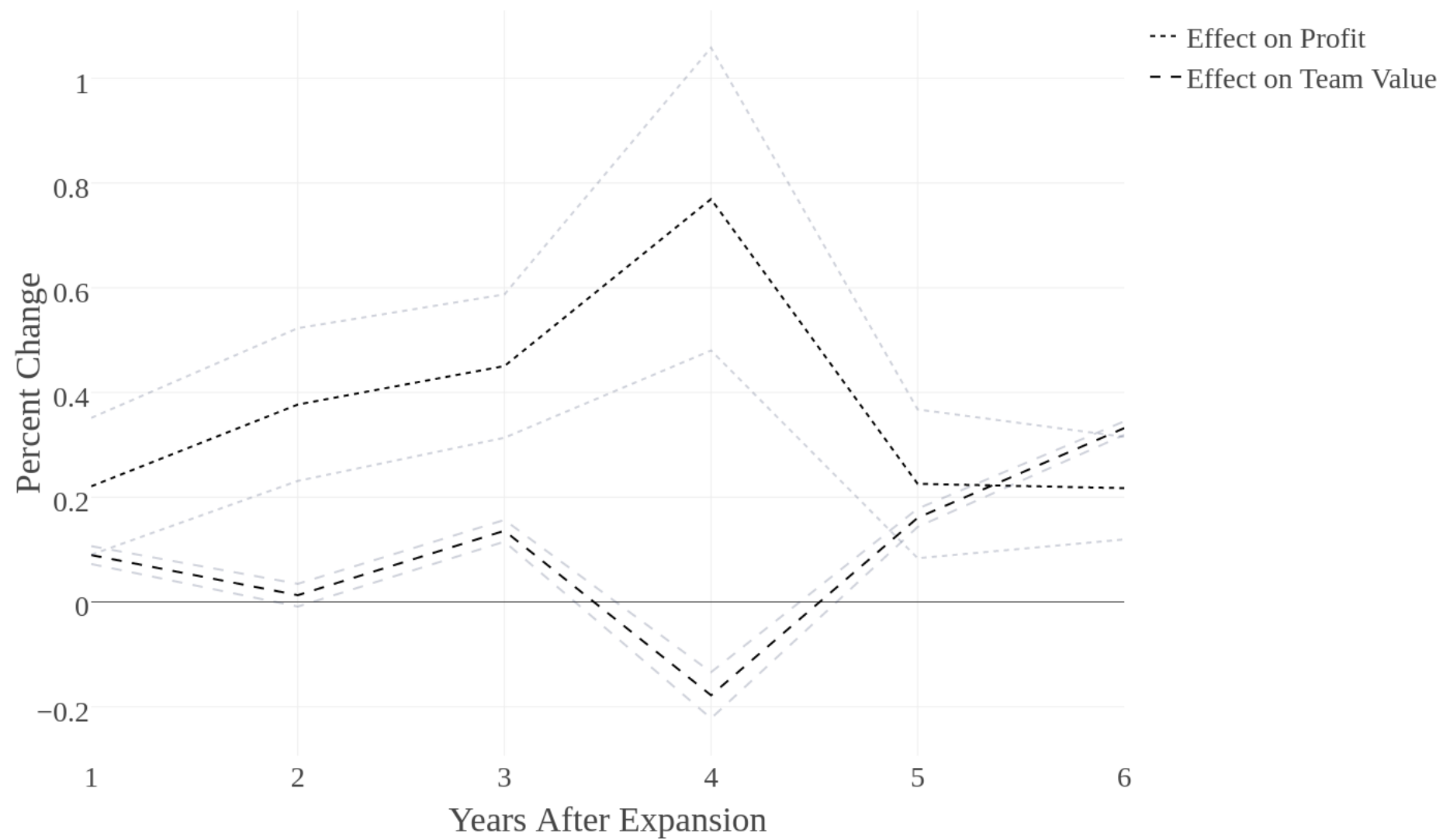
Table 3: Fixed Effects Model results for NFL Panel Data

| Variable | Effect on Profit | Effect on Team Value |
|--------------------------|----------------------|----------------------|
| Intercept | -0.273 (0.596) | 6.267 (0.068) |
| Expansion Past Year | 0.221*** (0.066) | 0.089*** (0.009) |
| Expansion (2 Years Ago) | 0.377*** (0.074) | 0.013 (0.011) |
| Expansion (3 Years Ago) | 0.45*** (0.07) | 0.136*** (0.011) |
| Expansion (4 Years Ago) | 0.769*** (0.147) | -0.178*** (0.022) |
| Expansion (5 Years Ago) | 0.226*** (0.072) | 0.161*** (0.009) |
| Expansion (6 Years Ago) | 0.217*** (0.05) | 0.332*** (0.007) |
| TVDeal | 0.22** (0.108) | -0.04** (0.016) |
| Labor Contract Past Year | -0.272*** (0.095) | 0.5*** (0.012) |
| Playoffs Past Year | 0.011 (0.061) | 0.008 (0.008) |
| Super Bowl Past Year | 0.049 (0.1) | 0.036** (0.015) |
| Revenues | 0.017 (0.003) | 0.0*** (0.0) |
| % Change in Team Value | 0.006 (0.004) | 0.004*** (0.001) |
| N | 509 | 537 |
| Adj. R ² | .508 | .967 |

Note: * Significant at 10% Level, ** Significant at 5% Level, *** Significant at 1% Level
Both regressions also include team effects, year effects, and profit and team value (where they are not the dependent variable).

Results are robust to excluding the alternate dependent variable from the X vector.

A rockin' table



Data is the art of storytelling, so let's really make it ART

When we present data, we are trying to tell a story.

- Kids prefer stories with illustrations, because they are only just learning about how the world looks and works
- Visualization aids unfamiliar audiences

Find a clear story to tell, and let your visuals help you tell it.

What are the challenges of visualization?

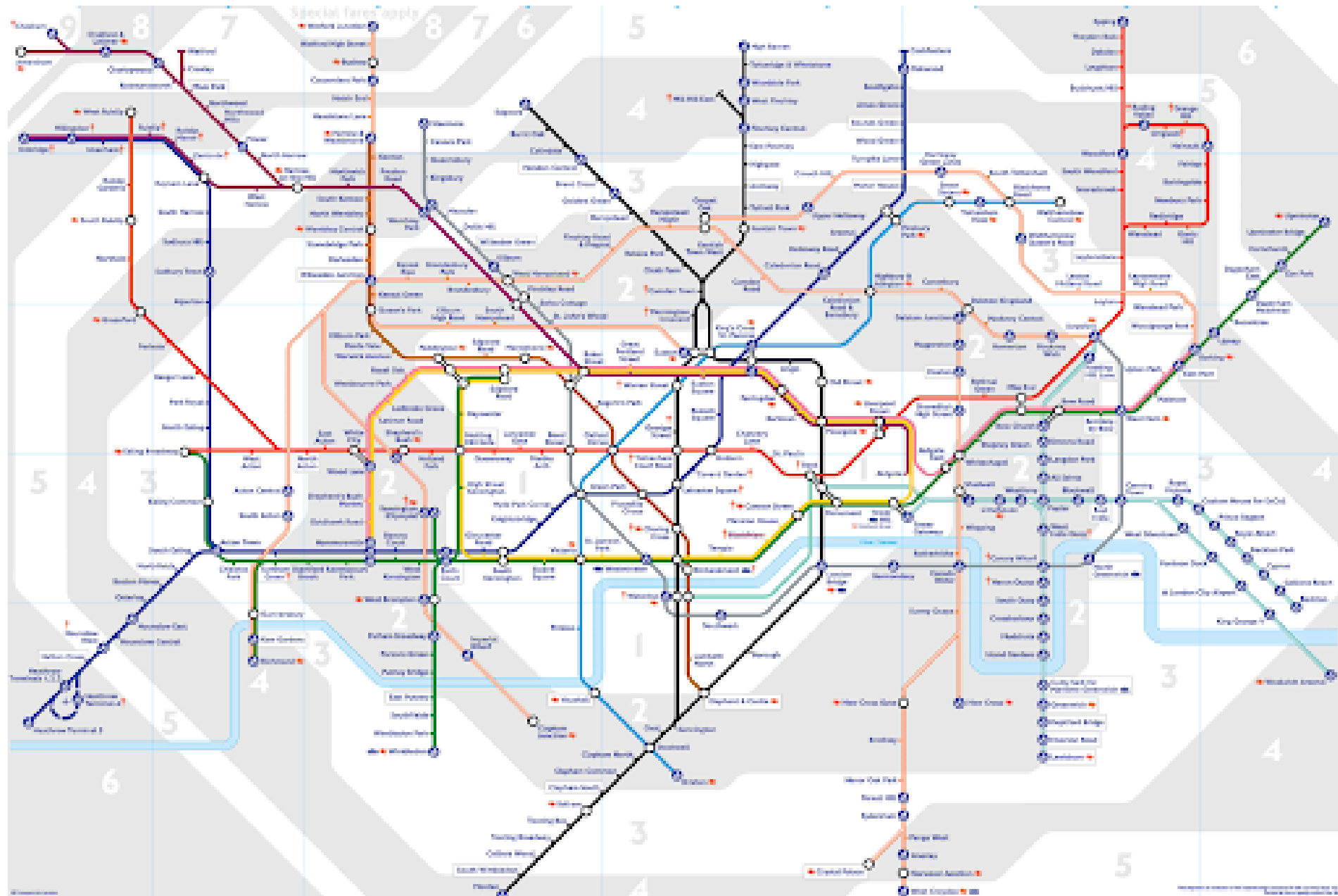
1. Dimensionality

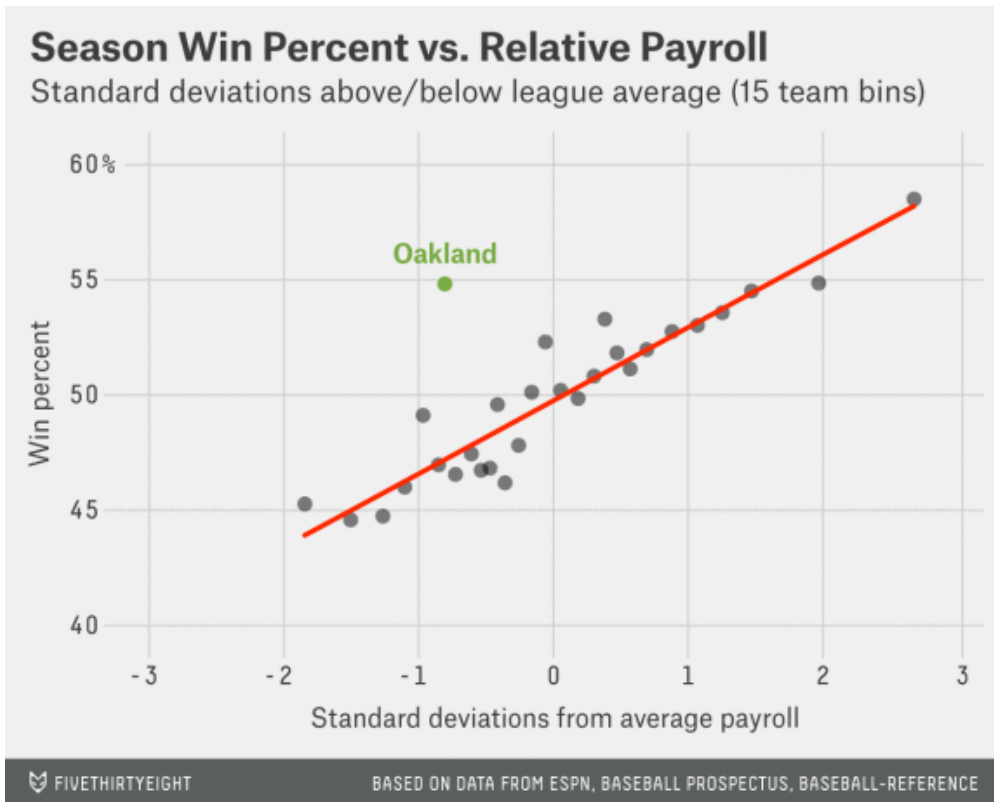
- We often have a lot of different features in our data
- We can't easily process more than 2 or 3 at once

2. Context

- It can be hard to understand a figure's context

Classic Visuals





Classic Visuals

Our visuals should be

1. Aesthetically Pleasing
2. Novel
3. Informative
4. Efficient

Aesthetically Pleasing

- Don't let beauty overwhelm data
- Aesthetics should accentuate the information
- Familiar looks and feels can help!

Novel

A visual can be novel in many ways:

- Novel Data
- Novel Insights
- Novel Presentation

Most often, designs that delight us do so not because they were designed to be novel, but because they were designed to be effective -- Beautiful Visualization

Informative

A visual that [is not informative] has failed. -- Beautiful Visualization

Ask: What is the intended usage of our visual?

My goal is to display _____ so that _____ can _____.

- What is our context of use?
- Is it for presentation or exploration?

Catering a visual to our audience ensures that they can quickly obtain the most valuable information.

Informative

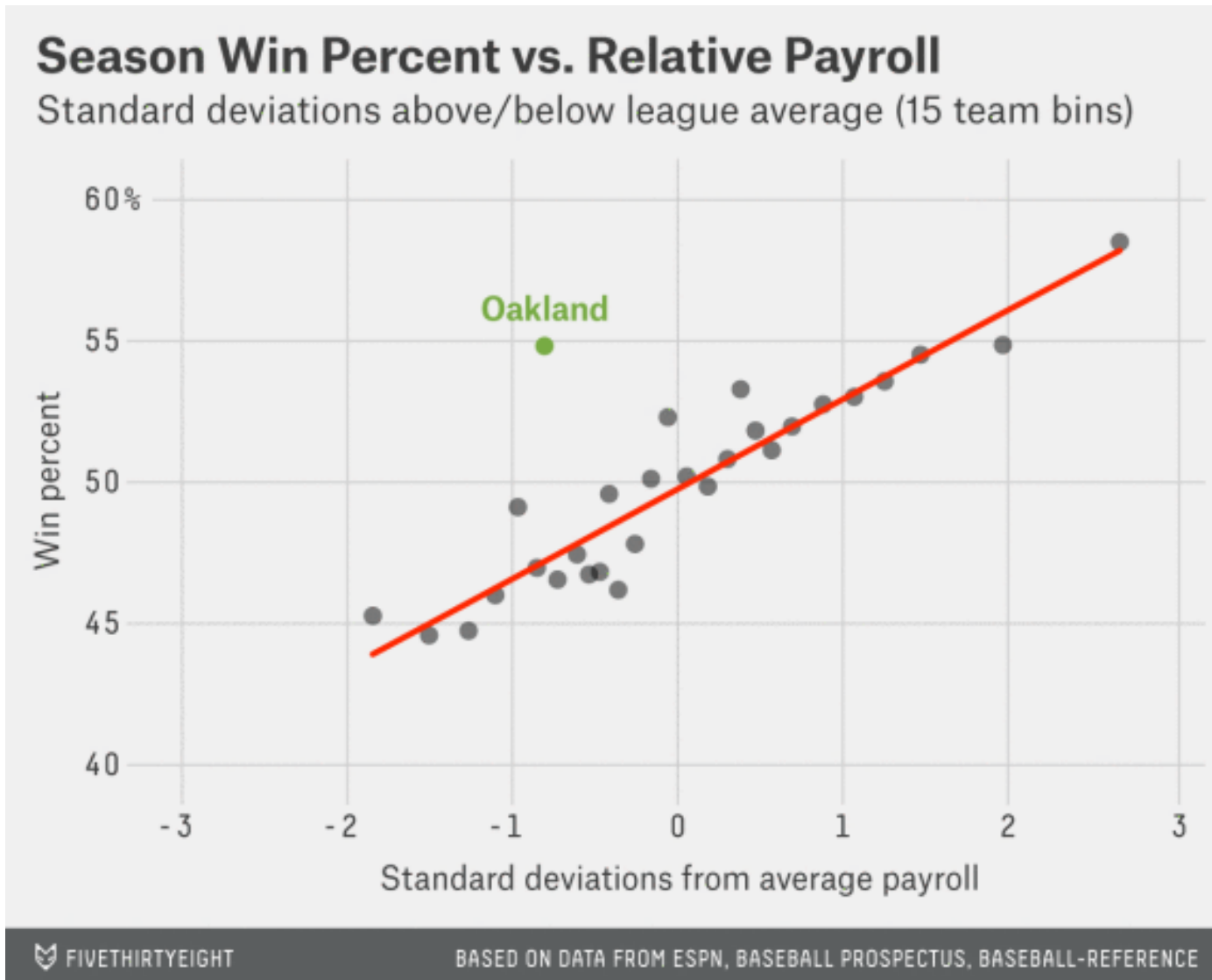


Efficient

Irrelevant data is the same thing as noise. If it's not helping, it's probably getting in the way. -- Beautiful Visualization

- The minimum viable product concept is critical in visualization of data
 - Each new element slows your audience's perception of the important points
 - BUT! Don't omit critical components










Efficient



An amazing visual

Periodic Table of the Elements

| | | | | | | | | | | | | | | | | | |
|----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|------------------|-------------------|------------------|-------------------|-------------------|
| 1 IA | 2 IIA | | | | | | | | | | | 13 IIIA | 14 IVA | 15 VA | 16 VIA | 17 VIIA | 18 VIIIA |
| 1 H | | | | | | | | | | | | 5 B | 6 C | 7 N | 8 O | 9 F | 2 He |
| 2 Li | 4 Be | | | | | | | | | | | 13 Al | 14 Si | 15 P | 16 S | 17 Cl | 10 Ne |
| 3 Na | 12 Mg | 3 IIIV | 4 IVB | 5 VB | 6 VIB | 7 VIIB | 8 — | 9 VII | 10 — | 11 IB | 12 IIB | 13 Al | 14 Si | 15 P | 16 S | 17 Cl | 18 Ar |
| 4 K | 20 Ca | 21 Sc | 22 Ti | 23 V | 24 Cr | 25 Mn | 26 Fe | 27 Co | 28 Ni | 29 Cu | 30 Zn | 31 Ga | 32 Ge | 33 As | 34 Se | 35 Br | 36 Kr |
| 5 Rb | 38 Sr | 39 Y | 40 Zr | 41 Nb | 42 Mo | 43 Tc | 44 Ru | 45 Rh | 46 Pd | 47 Ag | 48 Cd | 49 In | 50 Sn | 51 Sb | 52 Te | 53 I | 54 Xe |
| 6 Cs | 56 Ba | 57-71 | 72 Hf | 73 Ta | 74 W | 75 Re | 76 Os | 77 Ir | 78 Pt | 79 Au | 80 Hg | 81 Tl | 82 Pb | 83 Bi | 84 Po | 85 At | 86 Rn |
| 7 Fr | 88 Ra | 89-103 | 104 Rf | 105 Db | 106 Sg | 107 Bh | 108 Hs | 109 Mt | 110 Ds | 111 Rg | 112 Cn | 113 Uut | 114 Fl | 115 Uup | 116 Lv | 117 Uus | 118 Uuo |
| | | 57 La | 58 Ce | 59 Pr | 60 Nd | 61 Pm | 62 Sm | 63 Eu | 64 Gd | 65 Tb | 66 Dy | 67 Ho | 68 Er | 69 Tm | 70 Yb | 71 Lu | |
| | | 89 Ac | 90 Th | 91 Pa | 92 U | 93 Np | 94 Pu | 95 Am | 96 Cm | 97 Bk | 98 Cf | 99 Es | 100 Fm | 101 Md | 102 No | 103 Lr | |



- | | | | | |
|--|---|---|---|--|
|  Alkali Metals |  Alkali Earth Metals |  Transition Metals |  Other Metals |  Metalloids |
|  Other Non Metals |  Halogens |  Noble Gases |  Lanthanides & Actinides | |

A PERIODIC TABLE OF VISUALIZATION METHODS

| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|--|---|---|--|--|---|--|--|---|---|--|--|--|---|---|---|--|--|--|---|---|---|
| <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>C continuum</div> | | | | | | | | | | | | | | | | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>G graphic facilitation</div> | | | | | | | | | | | |
| <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Tb table</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Ca circular continuum</div> | | | | | | | | | | | | | | | | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Ct cartoon</div> | | | | | | | | | | |
| <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Pi pie chart</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>L line chart</div> | | | | | | | | | | | | | | | | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Me meeting trace</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Mm meeting map</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Tm triangle</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>St story template</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Tr tree</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Cs conceptualization diagram</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Fp flight plan</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Co communication diagram</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Br bridge</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Fu funnel</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Ri rich picture</div> |
| <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>B bar chart</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Ac area chart</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>R radar chart cubemap</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Pa parallel coordinates</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Hy hyperbolic tree</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Cy cycle diagram</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>T treemap</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Ve venn diagram</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Mi mindmap</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Sq square 90° opposition</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Cc concentric circles</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Ar argument side</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Sw swim lane diagram</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Gc gantt chart</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Pm perspective diagram</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>D diamond diagram</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Pr parameter table</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Kn knowledge map</div> | | | | | | | | | | |
| <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Hi histogram</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Sc scatterplot</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Sa sawtooth diagram</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>In information base</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>E entity relationship diagram</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Pt part tree</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Fl flow chart</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Cl clustering</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Lc layer chart</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Py pyramid technique</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Ce cause-effect chain</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Tl timeline map</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Dt decision tree</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Cp open critical path method</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Cf concept fan</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Co concept map</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Ic iceberg</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Lm learning map</div> | | | | | | | | | | |
| <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Tk tally bar plot</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Sp spectrum</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Da data map</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Tp treemap</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Cn concentric</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Sy system dynamics simulation</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Df data flow diagram</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Se semantic network</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>So soft system modeling</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Sn energy map</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Fo force field diagram</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Ib iceberg representation map</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Pr process event chain</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Pe part chart</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Ev evolutionary knowledge map</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>V ice diagram</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>Hh house of hell chart</div> | <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div>I inherent</div> | | | | | | | | | | |

 **Cy** Process Visualization

 **Hy** Structure Visualization

 **Overview**
 **Detail**

 **Detail AND Overview**





























 **Divergent thinking**

 **Convergent thinking**

Notes: Depending on your location and connection speed it can take some time to load a pop-up picture.

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version 1.5

| | | | | | | | | | | | | | |
|--|---|---|--|---|---|---|--|---|---|--|---|--|---|
|  Su supply demand curve |  Pe performance charting |  St strategy map |  Oc organization chart |  Ho house of quality |  Fd feedback diagram |  Ft future time |  Mq maturity question |  Ld life-cycle diagram |  Po process flow times |  S cycle |  Sm stockholder map |  Is iceberg diagram |  Tc technology roadmap |
|  Ed edge-weight box |  Pf portfolio diagram |  Sg strategic game chart |  Mz marketing's organograph |  Z zoo's morphological box |  Ad advertising diagram |  De decision discovery diagram |  Bm big matrix |  Stc strategy canvas |  Vc value chain |  Hy hyper-cycle |  Sr stockholder rating map |  Ta taps |  Sd spring diagram |

So terrible...

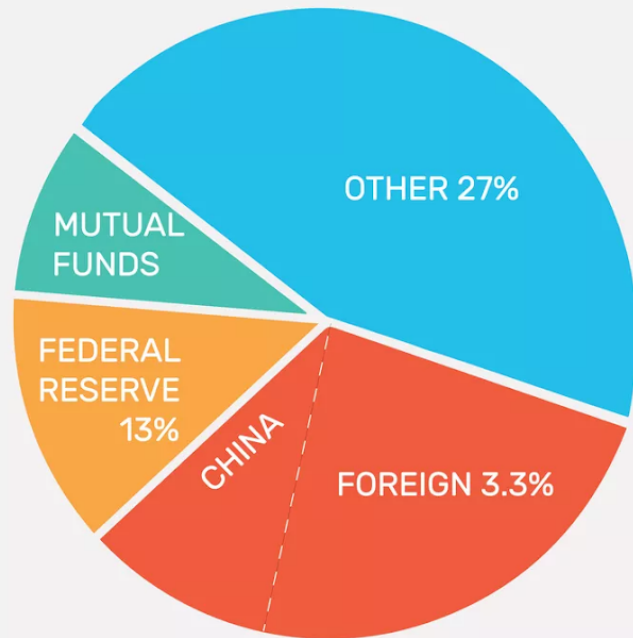
Maybe we do **this** instead...

Or **this**?

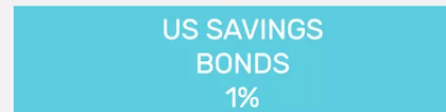
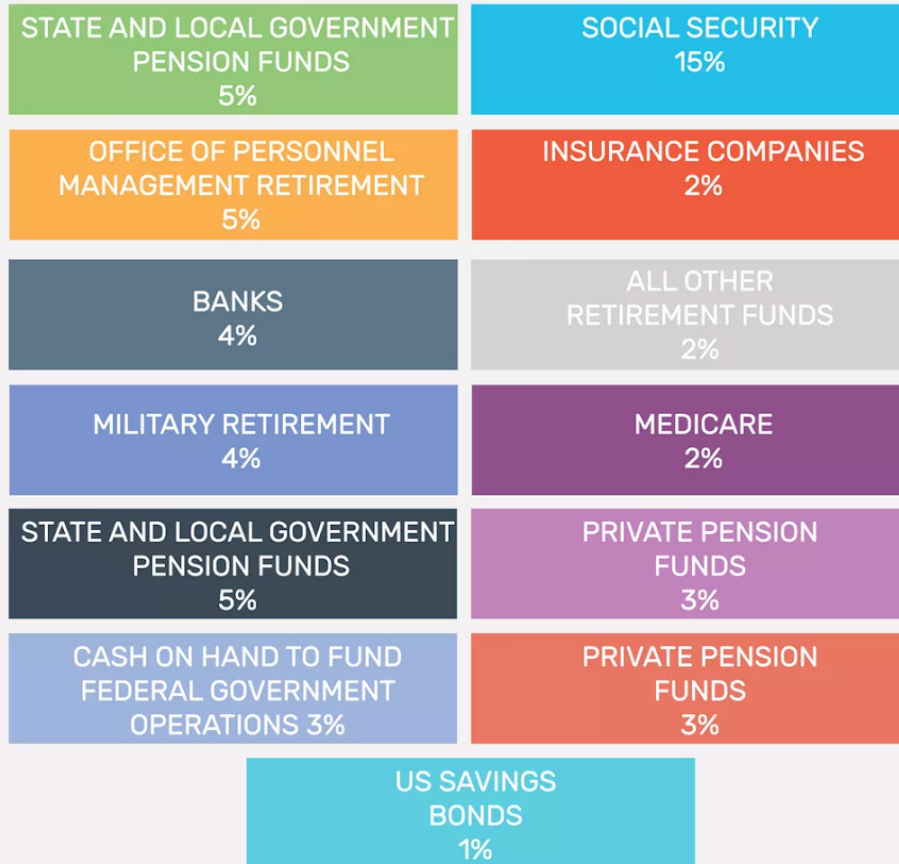
Or anything else!

Another atrocity

US National Debt Holdings in Trillions



OTHER 27%



A template process

1. Write down your goal and intent for the visual
2. Gather the data that will help you achieve that goal
3. Decide how to tell your intended story with the data
4. Apply a visual representation of your data

Example

I worked on a project exploring the pay and education levels in different occupations in Nebraska relative to other states. I prepared the project by following the steps from the last slide:

1. Write down your goal and intent for the visual

My goal is to *display wage and education patterns in occupations over time* so that *policymakers* can *understand the relationship between education and productivity in various job categories*.

Example

2. Gather the data that will help you achieve that goal

Here is one of the SQL Statements that I used:

```
SELECT
    product/nobs AS wage,
    100.0*product/(
        SELECT SUM(product)
        FROM reducedOcc
        WHERE statefip=31
        GROUP BY year) AS percent
FROM reducedOcc
WHERE
    occ2010=1010
    AND statefip=31
GROUP BY year
ORDER BY year ASC
```

Example

3. Decide how to tell your intended story with the data
4. Apply a visual representation of your data

Let's take a look at a webpage I made to explore and test my visuals:

<http://dash4hank.herokuapp.com/>

For Lab:

Using the data you extraced last week, work with your group to visualize the answers to your research question in Tableau. It will be useful to follow the steps described earlier for creating effective visualizations of data:

1. Write down your goal and intent for the visuals
2. Gather the data that will help you achieve that goal
3. Decide how to tell your intended story with the data
4. Create the visual representations of your data

Remember to focus on making visuals **Aesthetically Pleasing, Novel, Informative, and Efficient**