

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!

A rockin' table

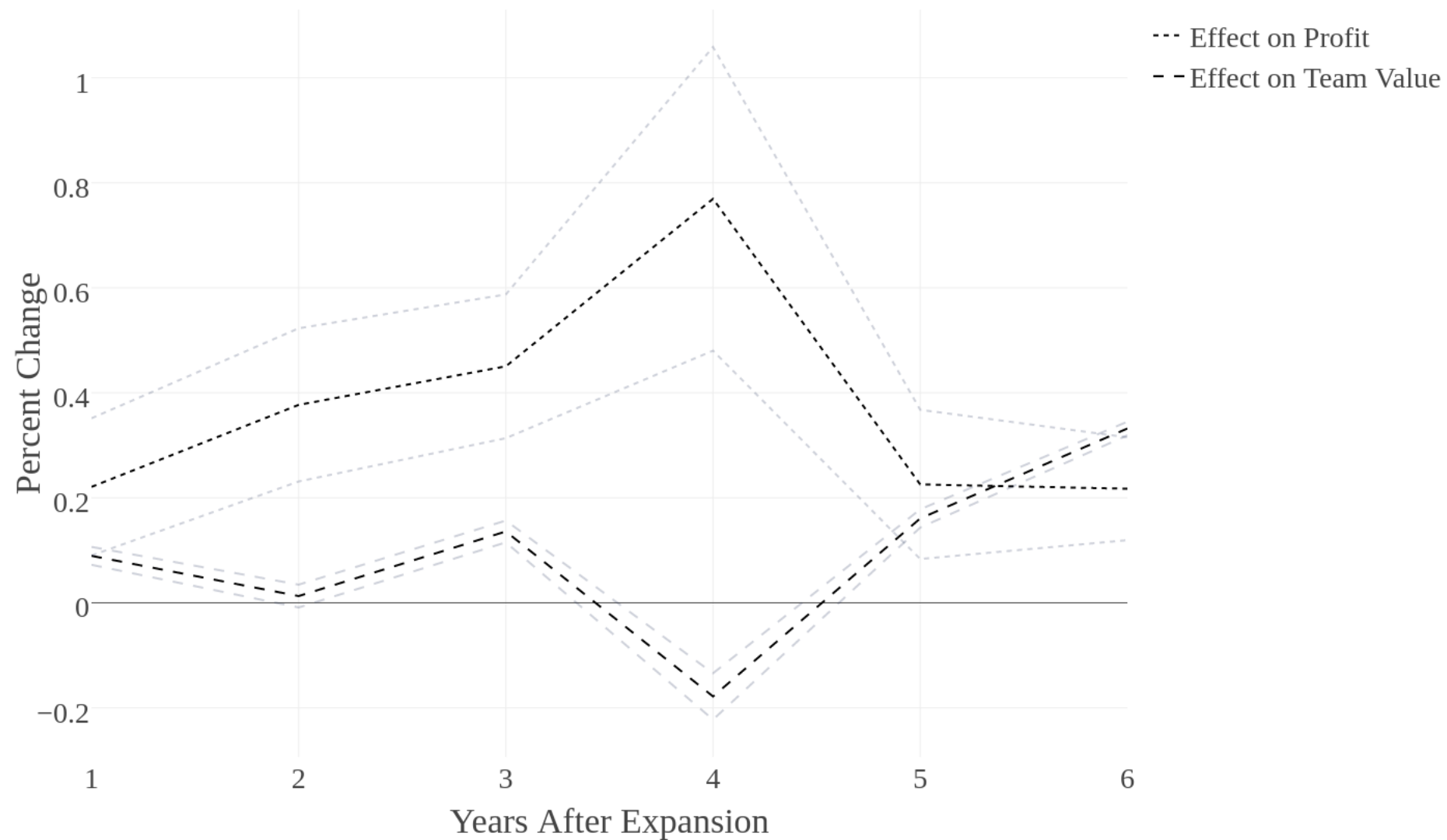
Table 3: Fixed Effects Model results for NFL Panel Data

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)
TVDDeal	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?

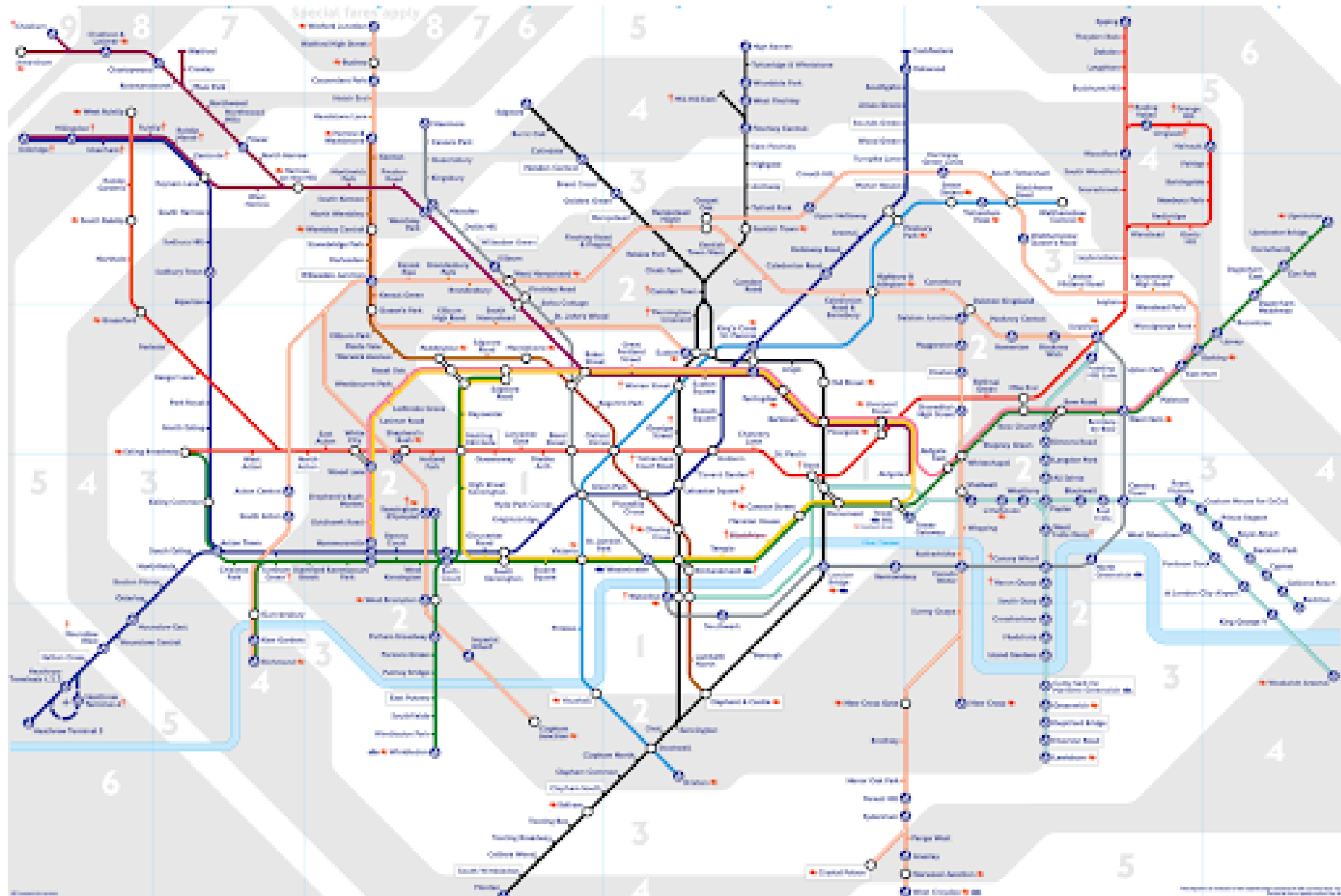
1. Dimensionality

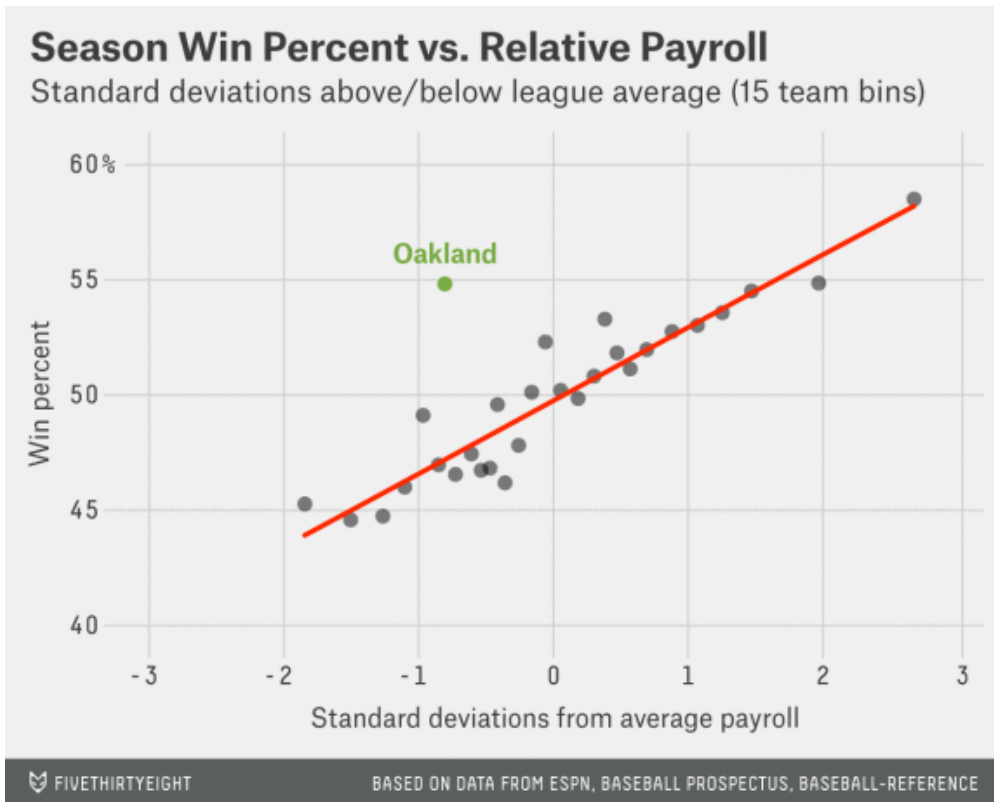
- We often have a lot of different features in our data
- We can't easily process more than 2 or 3 at once

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

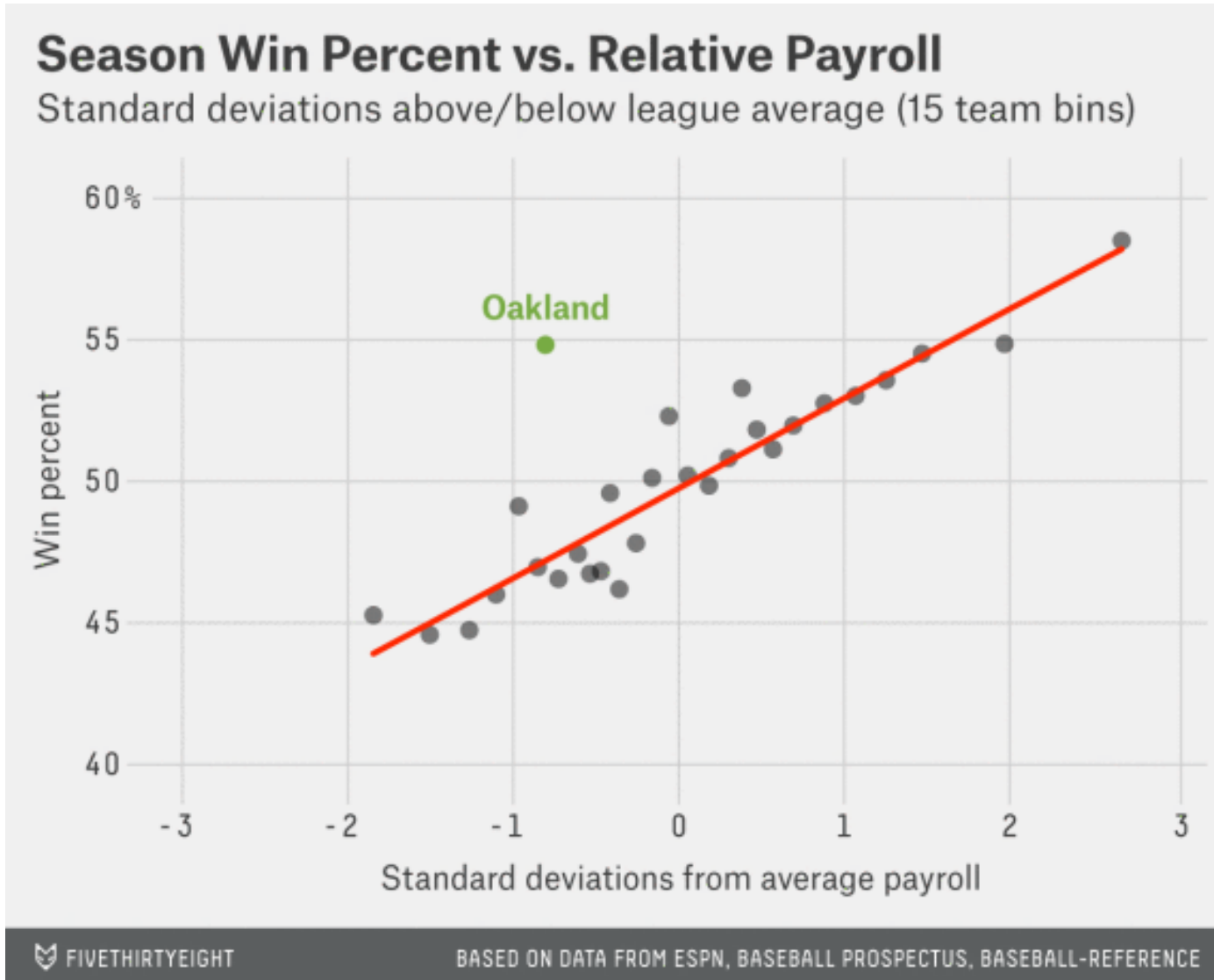


Efficient

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																	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 H	2 He																					
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne					
11 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					
19 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					
37 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					
55 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					
87 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					
6	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	6						
7	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr	7						



- | | | | | |
|--|---|---|---|--|
|  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>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 cubek</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 network</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 tree	 Mq maturity question	 Ld life-cycle diagram	 Po process flow chart	 S cycle	 Sm stakeholder 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 stakeholder rating map	 Ta taps	 Sd story diagram

So terrible...

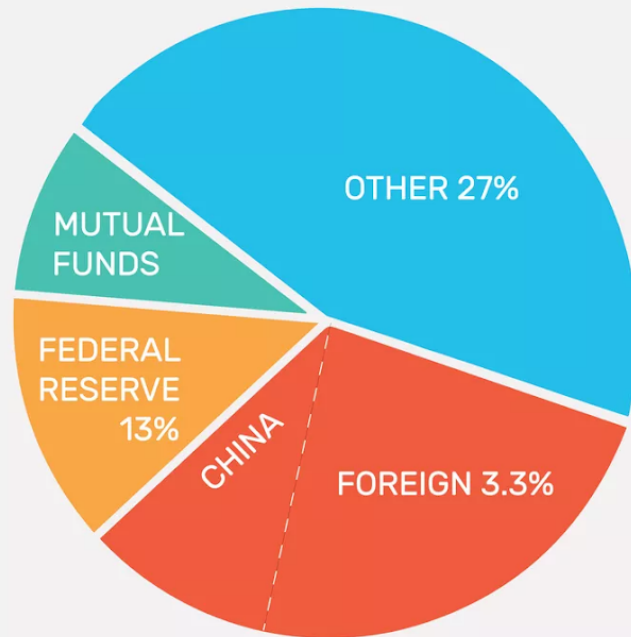
Maybe we do **this** instead...

Or **this**?

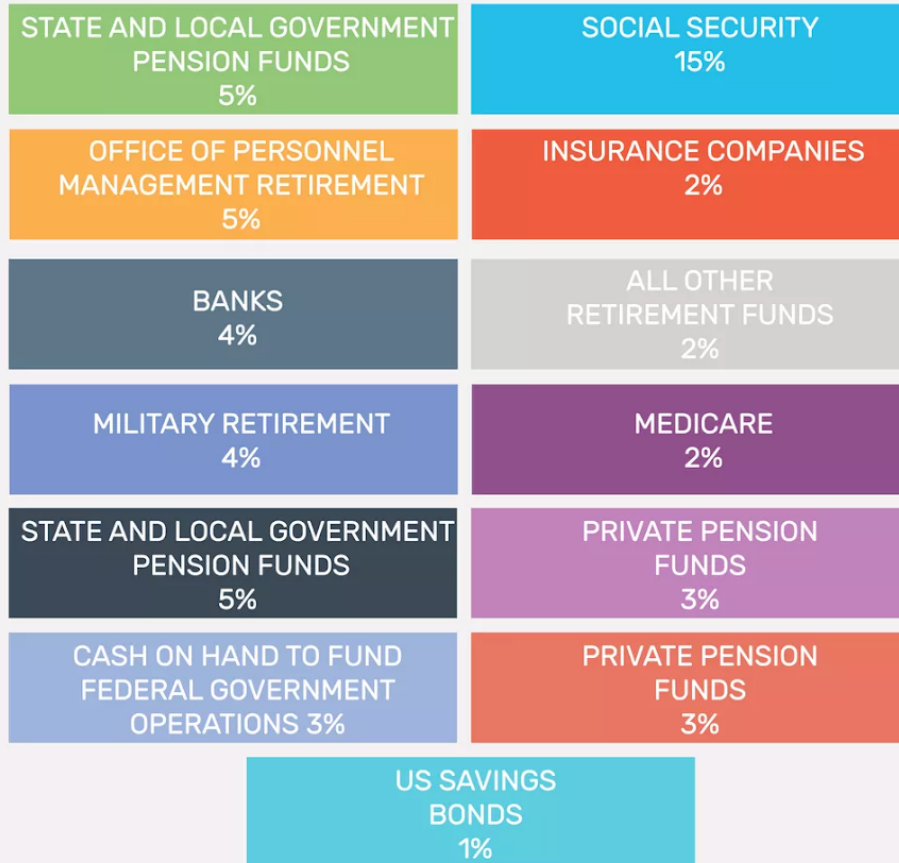
Or anything else!

Another atrocity

US National Debt Holdings in Trillions



OTHER 27%



the balance

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 reduced0cc
        WHERE statefip=31
        GROUP BY year) AS percent
FROM reduced0cc
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**