

# Data Visualization with Tableau

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Sacramento, CA

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# Agenda

## Thursday Afternoon

- Data visualization best practices
- Common types of graph
- Overview of Tableau and the interface
- The foundations of Tableau visualizations  
(examples/exercises)
- Formatting and presenting Tableau visualizations

## Friday

- Intermediate Tableau visualizations
- Creating interactive dashboards
- Formatting data for Tableau
- (time permitting) Group exercise

# Data Visualization Best Practices

# Data Visualization Process



Start with a question, what information are you trying to communicate? What is the goal of the visualization?

# Data Visualization Process



What data do you have available?

What level of detail does it go down to?

How can you use other data to supplement your data?

# Who is your audience?

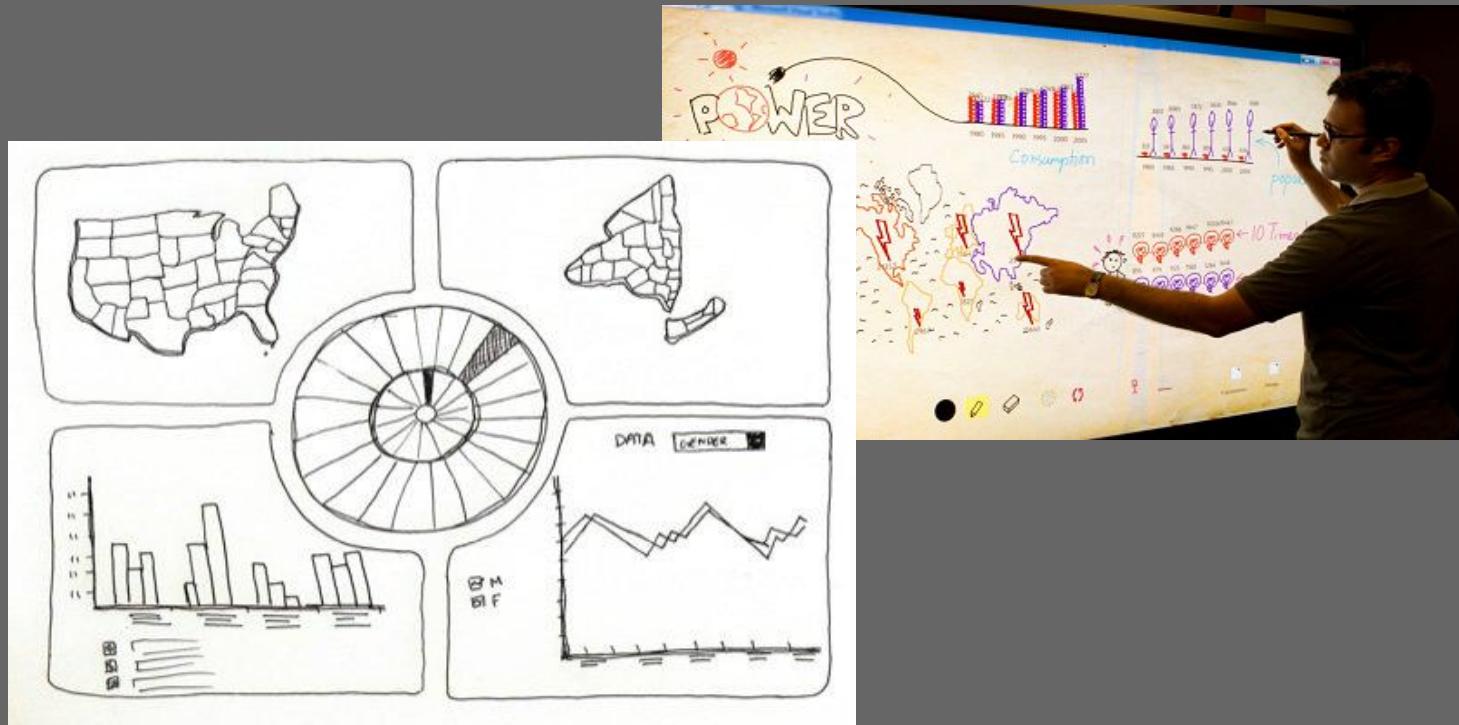
How detailed do they want to see the data?

Do they have a technical background?



# Make a sketch (pencil & paper)

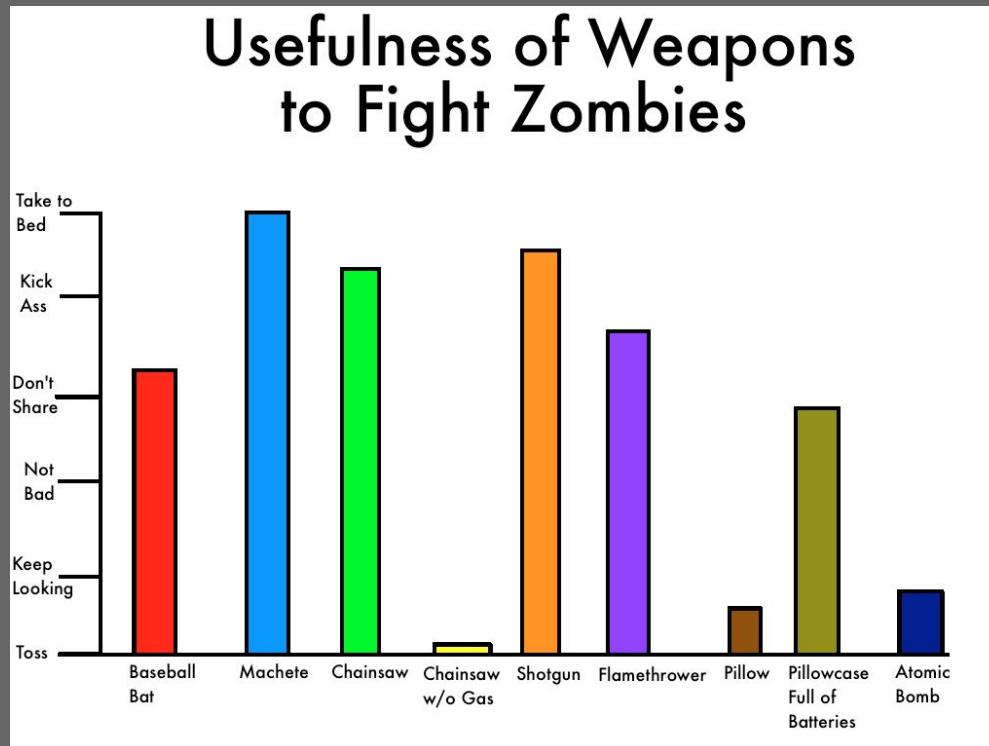
How will the visualization(s) be viewed? (desktop, mobile, print)



# Common Data Visualization Graphs

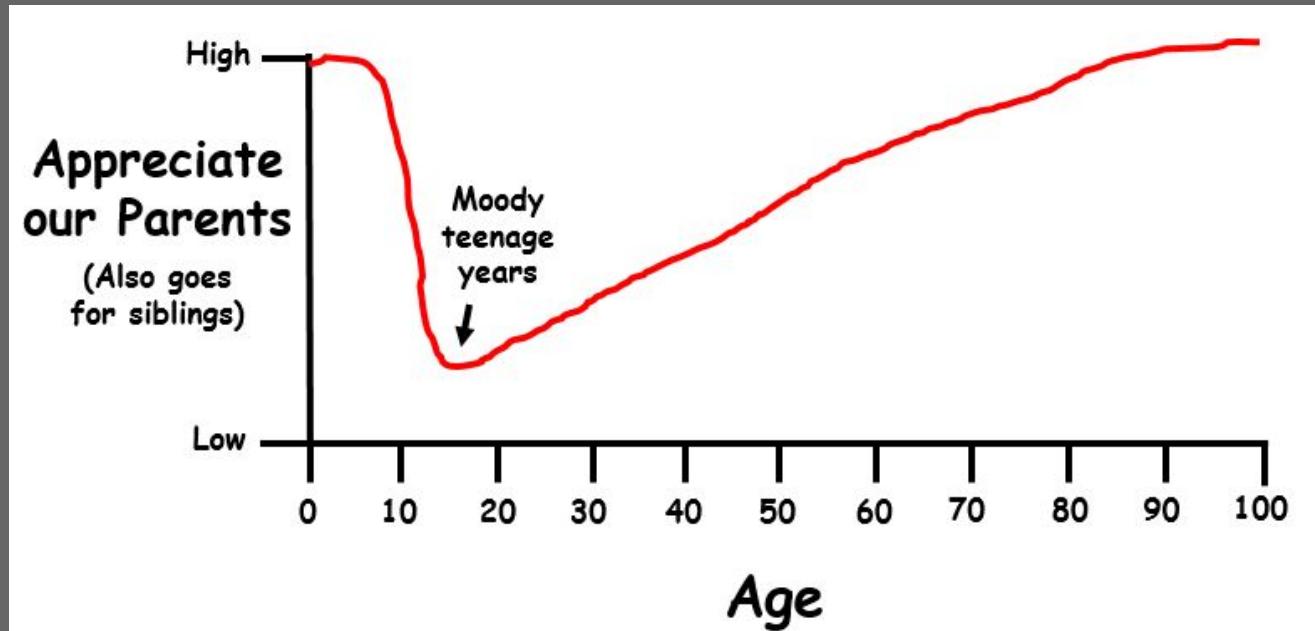
# Bar Graph

- Used for comparing categorical or time series points



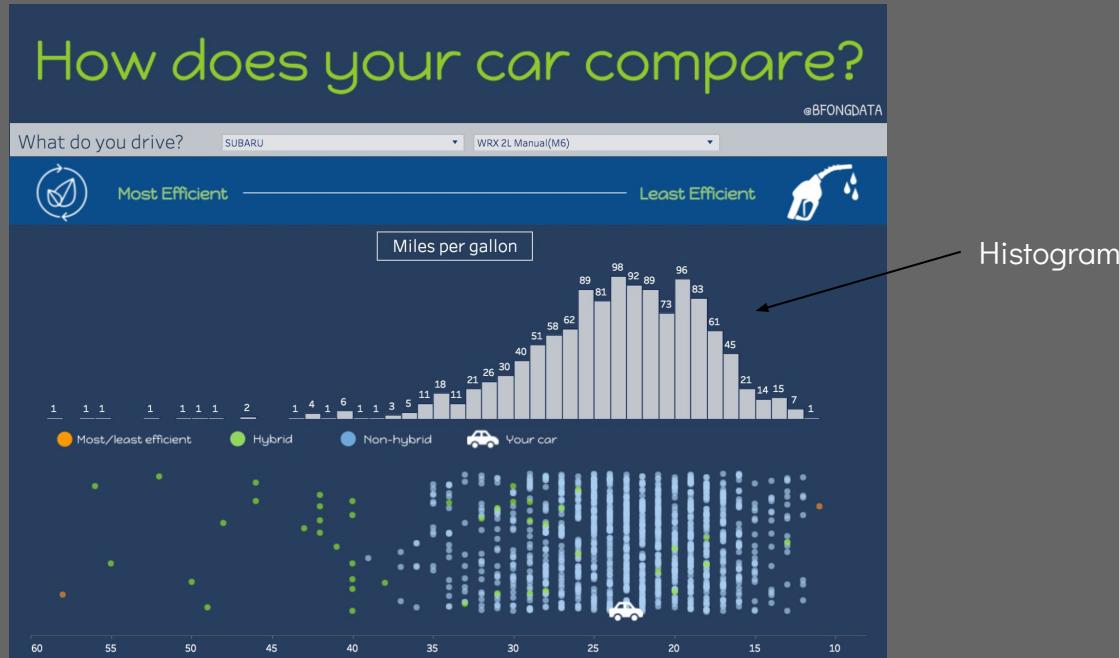
# Line Graph

- Used for viewing trends over time



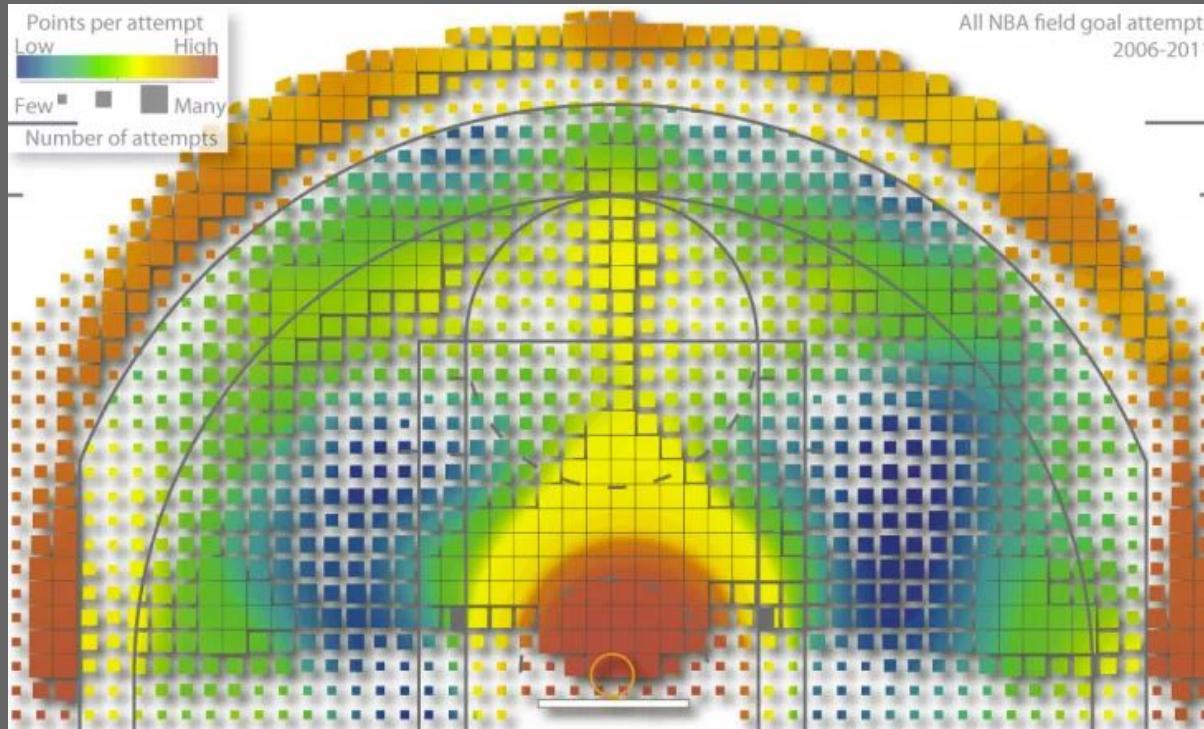
# Histogram

- Used for viewing frequency or distribution of a single measure



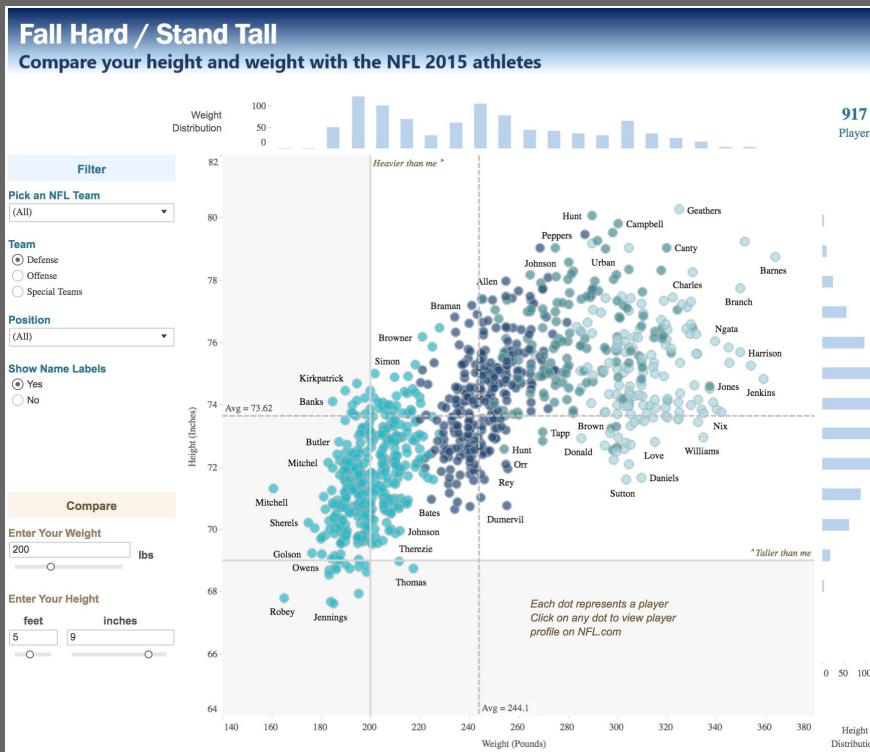
# Heat Map

- Shows frequency represented by color



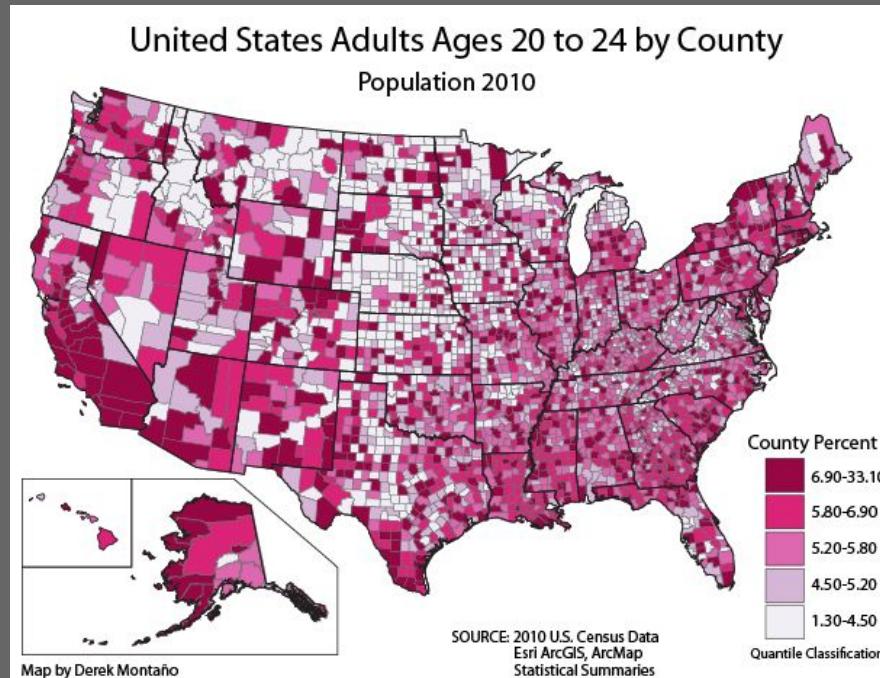
# Scatterplot

- Compares two measures to see how they relate to each other



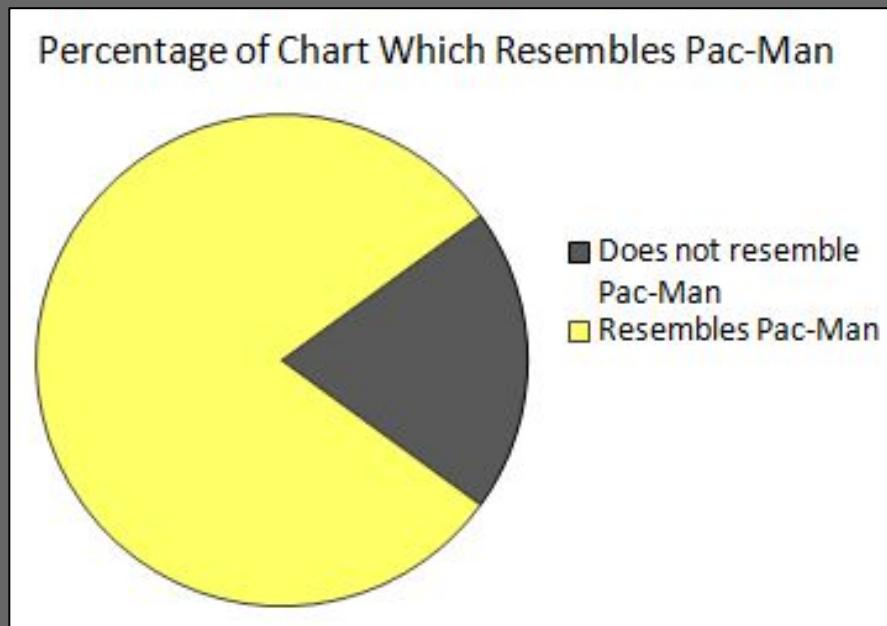
# Choropleth Map

- Shading, color, or pattern on a geographic map



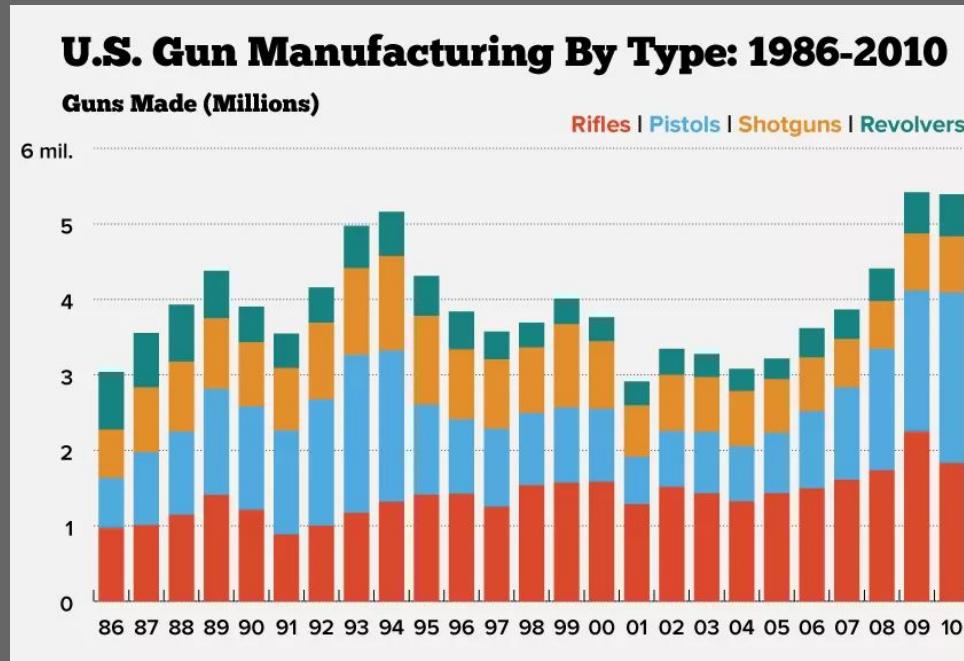
# Pie Chart

- Used to compare parts to a whole
- Not good with small percentages or more than 4 categories



# Stacked Bar Graph

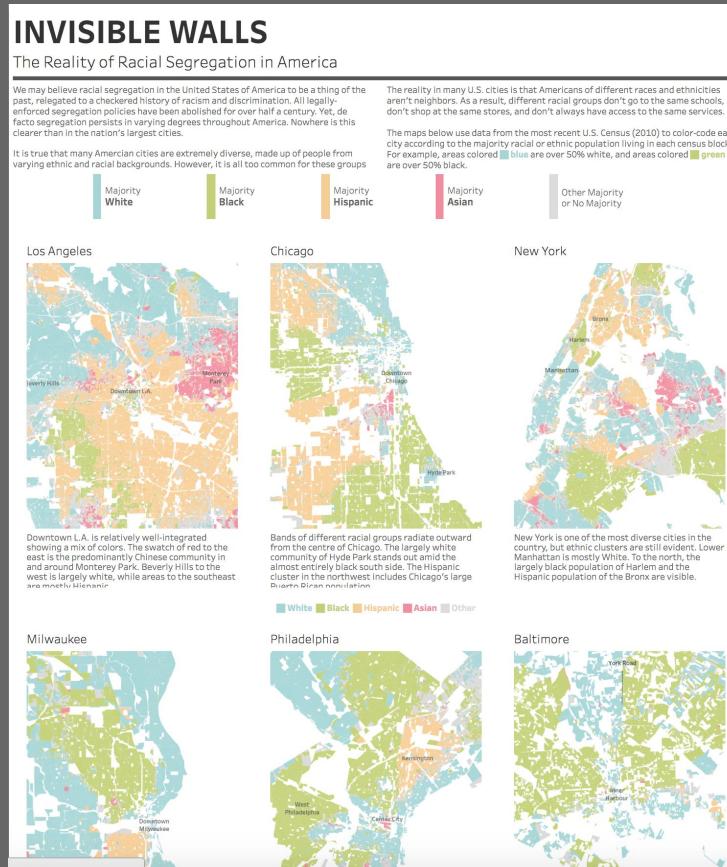
- Used to compare part to whole relationships
- Great alternative to a pie chart



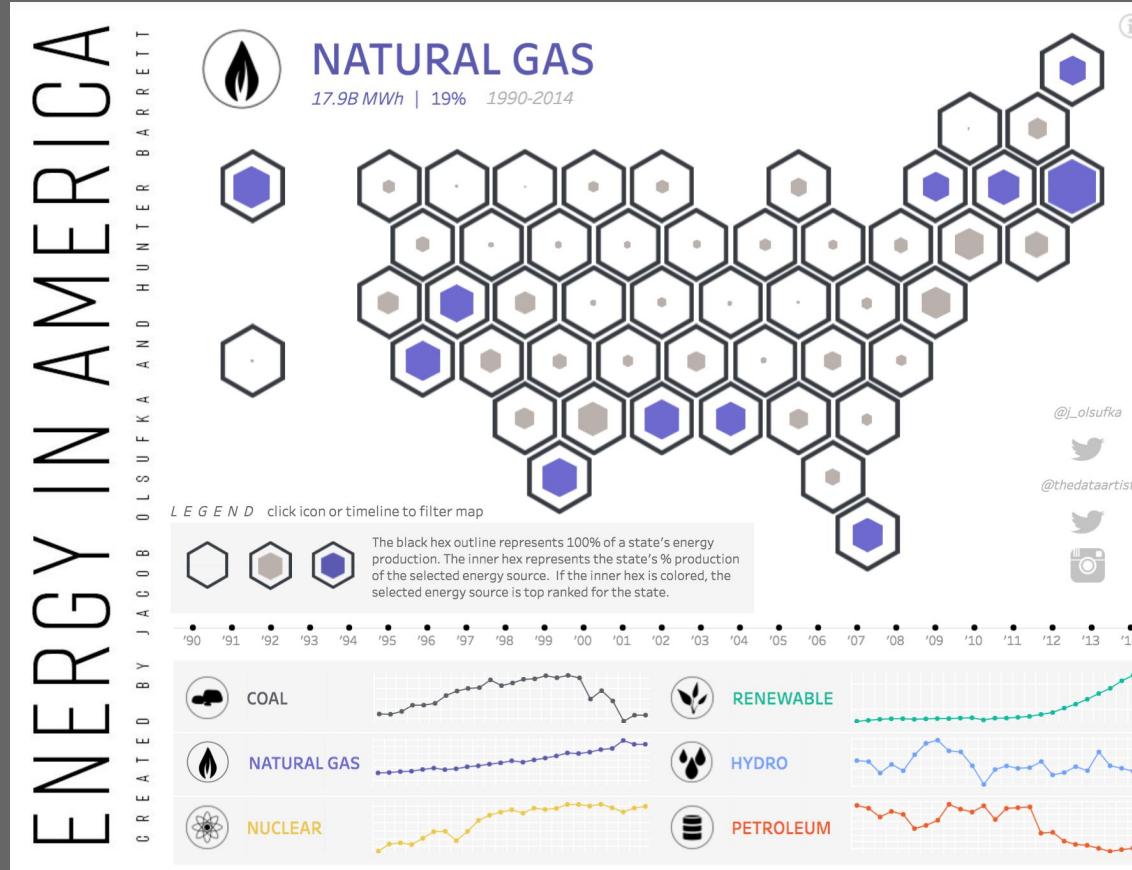
# Data Visualization Inspiration

- Tableau Public
- Journalism - The Upshot, Pro Publica, Washington Post, Five Thirty Eight
- Twitter - #dataviz
- Makeover Monday
- Dear Data

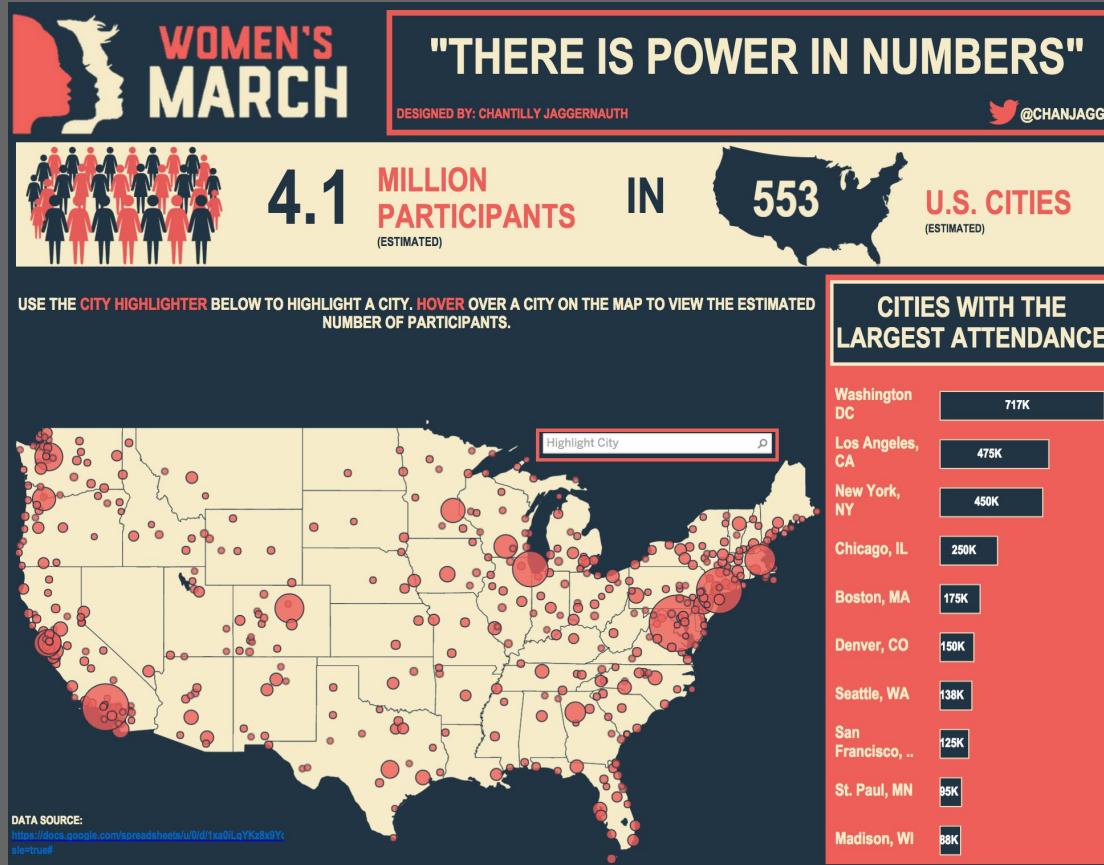
# Data Visualization Inspiration



# Data Visualization Inspiration



# Data Visualization Inspiration



Welcome to

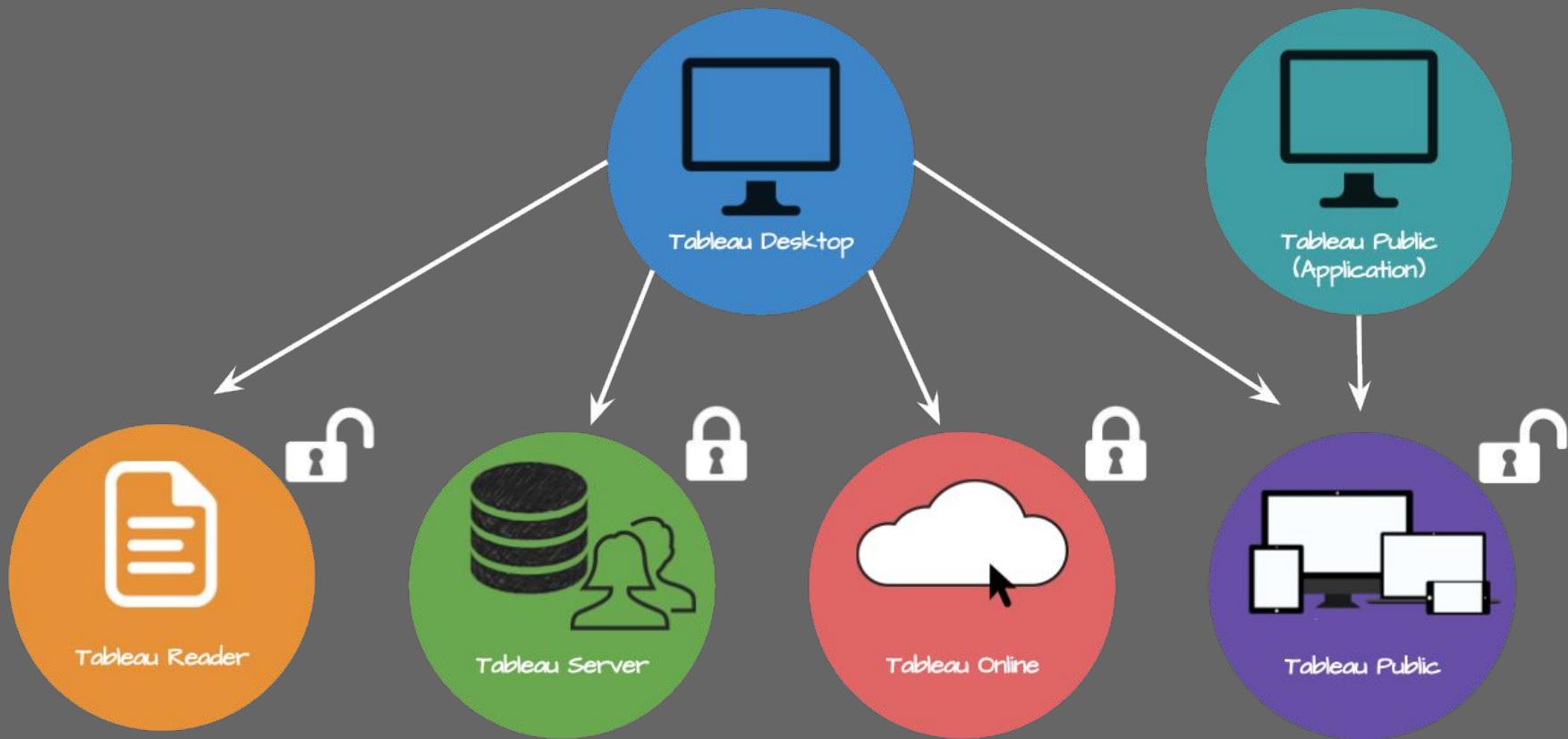


# What is Tableau?

Data visualization software that allows developers to build interactive dashboards that are easily updated with new data and can be shared with a wider audience

- Read-only application
- Connects to most data sources depending on level of license (public, personal, professional licenses)
- No coding experience necessary

# The Tableau Suite



# Tableau Data Connection Window

Name of data connection (only in Tableau)

Tableau - Book7

Connections Add

TableauTrainingDataset\_4.19 Excel

Sheets

Use Data Interpreter  
Data Interpreter might be able to clean your Excel workbook.

C2ERMembersByState  
CostOfLiving&MHIByState  
CountyPopulation  
EducationalAttainment  
MHIByStateByYear  
**NetMigrationByStateByYear**  
StatePopulationByGender  
Unemployment...YearByState  
WorkforceByAge  
WorkforceByGeneration  
New Union

NetMigrationByStateByYear

Connection Live Extract Filters 0 | Add

Drag and drop sheet

Column Data Type

Sort fields Data source order

Show aliases Show hidden fields 260 rows

Geography Region Net Migration - Total Net Migration - Int... Net Migration - Do... Year

Alabama  
Alaska  
Arizona  
Arkansas  
California  
Colorado  
Connecticut  
Delaware  
District of Colum...  
Florida

Column/dimension & measure names (only in Tableau)

Data preview window

Geography	Region	Net Migration - Total	Net Migration - Int...	Net Migration - Do...	Year
Alabama		696			2011
Alaska	West	702	1,101	-399	2011
Arizona	West	27,602	20,542	7,060	2011
Arkansas	South	6,658	3,178	3,480	2011
California	West	80,243	130,927	-50,684	2011
Colorado	West	33,737	8,797	24,940	2011
Connecticut	Northeast	-3,758	9,735	-13,493	2011
Delaware	South	3,821	1,877	1,944	2011
District of Colum...	South	8,769	1,862	6,907	2011
Florida	South	176,634	68,295	108,339	2011

Go to Worksheet

Go to Sheet 1 to get started

The screenshot shows the Tableau Data Connection window with an Excel connection named 'TableauTrainingDataset\_4.19'. The 'NetMigrationByStateByYear' sheet is selected. Annotations include: 'Name of data connection (only in Tableau)' pointing to the connection name in the top bar; 'Data connection file (excel)' pointing to the connection list; 'Tabs in Excel workbook' pointing to the list of sheets in the Excel workbook; 'Column Data Type' pointing to the column headers in the preview table; 'Column/dimension & measure names (only in Tableau)' pointing to the column headers in the preview table; 'Data preview window' pointing to the preview table itself; and 'Go to Sheet 1 to get started' at the bottom.

# Tableau Sheet Canvas

The screenshot shows the Tableau desktop application interface. The main area is the Sheet Canvas, which contains a single Marks Card. The Marks Card has a title 'Marks Card' and includes tabs for 'Detail' and 'Top 10'. The canvas itself is labeled 'Sheet 1' and features three 'Drop field here' placeholder areas.

Annotations on the left side of the interface:

- Data Connection**: Points to the 'Data' tab in the top navigation bar.
- Dimensions**:
  - Ways to categorize data
  - Dates
- Measures**:
  - Fields to calculate on (sum, avg...)
- Back to data connection window**: Points to the 'Data' tab in the bottom navigation bar.

Annotations at the bottom right of the interface:

- New story
- New dashboard
- New sheet

# Dimensions vs Measures

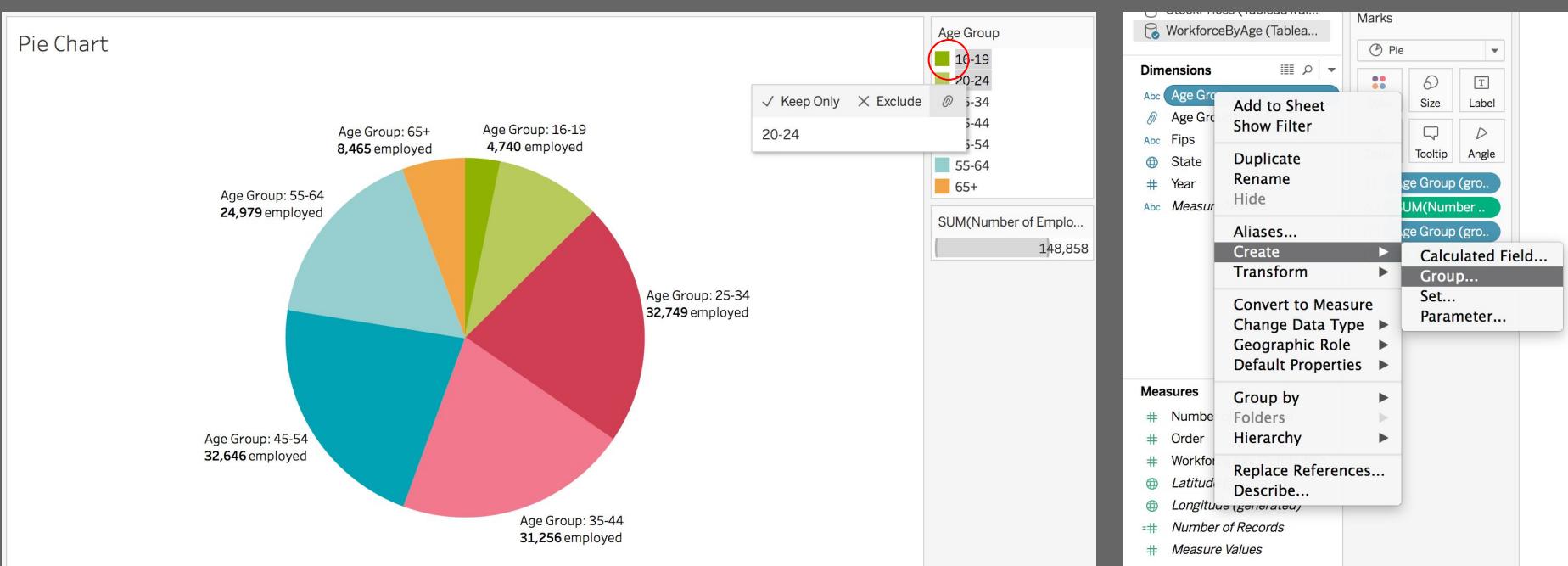
- Dimensions are ways to categorize data
  - Examples: Dates, categories, groups, geographic locations, names
  - Tableau will “write”/”spell” these values out
- Measures are values that can be aggregated (sum, avg...)
  - Examples: dollars, units, seconds
  - Tableau will graph these values

# The foundations of Tableau visualizations

- Text table
- Nested bar graph
- Line graph
- Shaded map
- Exercises
  - Text table
  - Bar graph
  - Line Graph
- Multi-line graph
- Stacked bar and groups
- Nested bar graph
- Exercises
  - Bar graph & measure color
  - Multi-line graph
- Dashboards

# Grouping Dimensions

OR



# *Saving & exporting your workbook*

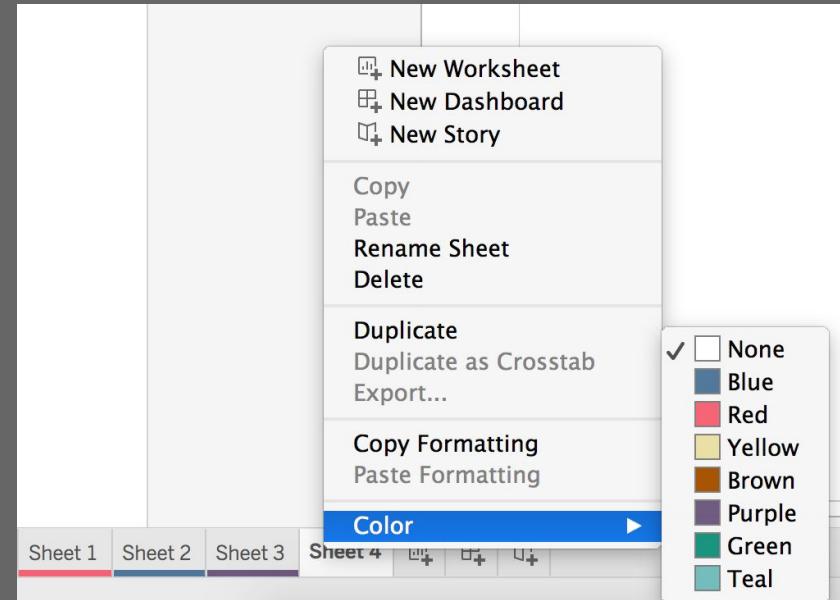
- Saving your workbook (packaged vs unpackaged)
  - Packaged (.twbx) - includes a snapshot of the data
  - Unpackaged (.twb) - need a version of the data
- Print to PDF
  - File > Print > PDF
- Export to Excel
  - Worksheet > Export > Data or Crosstab to Excel
- Copy & export images
  - Worksheet or Dashboard > Export > Image

# Working Efficiently in Tableau

- Duplicating worksheets
  - Right click on tab > duplicate
- Copying worksheets
  - Right click on tab > copy
- Copying formatting from worksheets
  - Right click on tab > copy formatting

# Organizing your Tableau workbook

- Reordering worksheets
  - Drag tabs to reorder
- Changing tab colors
  - Right click on tab > Color



# Formatting and presenting Tableau visualizations

- Totals, formatting & sorting
- Filters, labels, color & hierarchy
- Reference line & hide labels
- Tooltips, colors & borders
- Reference line & axis label
- Continuous dates & aggregation
- Discrete dates

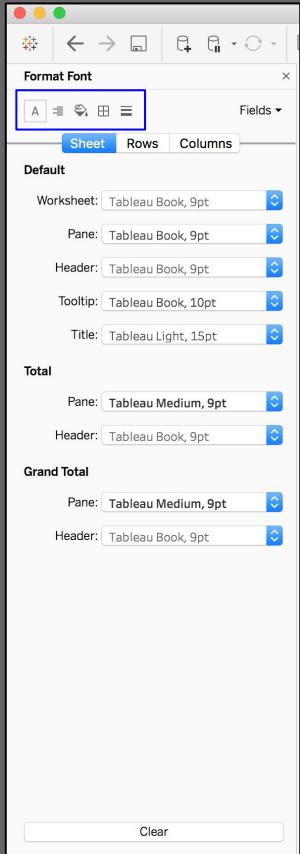
# Totals

Story    Analysis    Map    Format    Server    Window    Help

- Show Mark Labels
- Aggregate Measures
- Stack Marks
- View Data...
- Reveal Hidden Data
- Percentage Of
- Totals**
- Forecast
- Trend Lines
- Special Values
- Table Layout
- Legends
- Filters
- Highlighters
- Parameters
- Create Calculated Field...
- Edit Calculated Field
- Cycle Fields
- Swap Rows and Columns ⌘⌘W

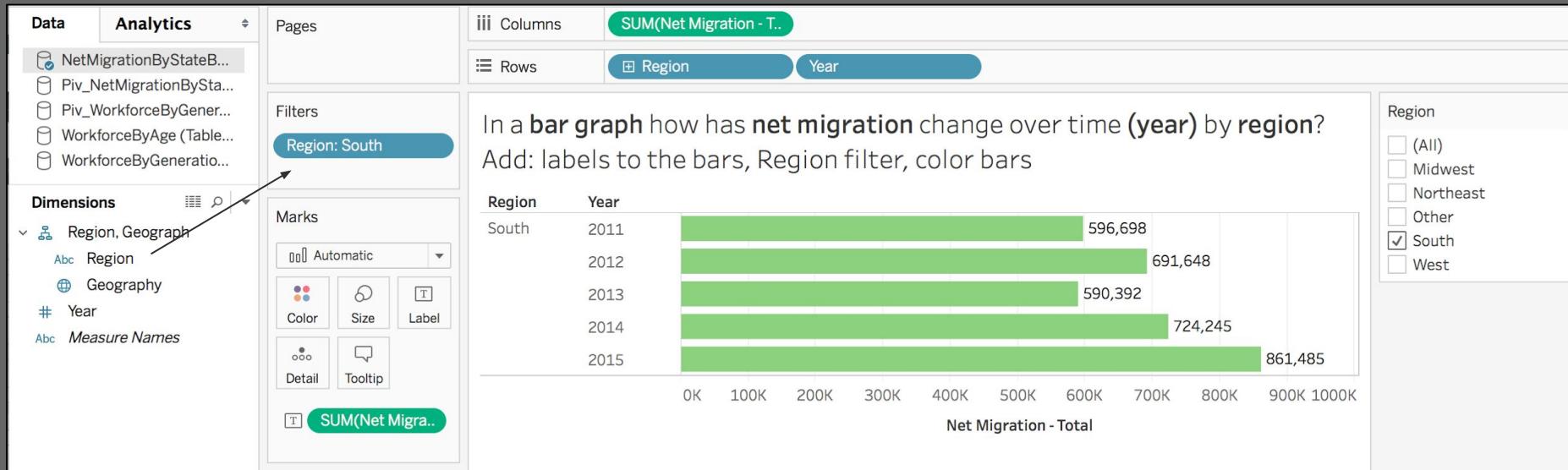
Region	2011	2012	2013	2014	2015	Grand Total
<b>Grand Total</b>	<b>675,433</b>	<b>847,440</b>	<b>797,381</b>	<b>940,852</b>	<b>1,085,439</b>	<b>4,346,545</b>
Midwest	-92,102	-73,328	-17,411	-54,450	-87,011	-324,302
Northeast	-29,190	578	18,540	-24,492	-25,203	-59,767
Other	-28,391	-38,364	-45,764	-55,092	-65,089	-232,700
South	596,698	691,648	590,392	724,245	861,485	3,464,468
West	228,418	266,906	251,624	350,641	401,257	1,498,846

# Formatting Visualizations



- Fonts
- Alignment
- Shading
- Borders
- Lines

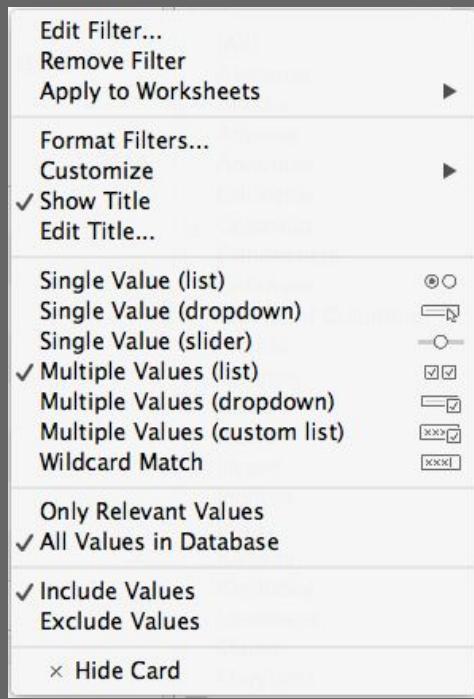
# Adding Filters



Add filters by dragging dimensions and/or measures to the filters shelf

To show the filter: right click, show filter

# Types of Filters



The screenshot shows the Power BI filter interface with two dropdown menus. The left dropdown is labeled "Year" and contains the following options:

- (All)
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015

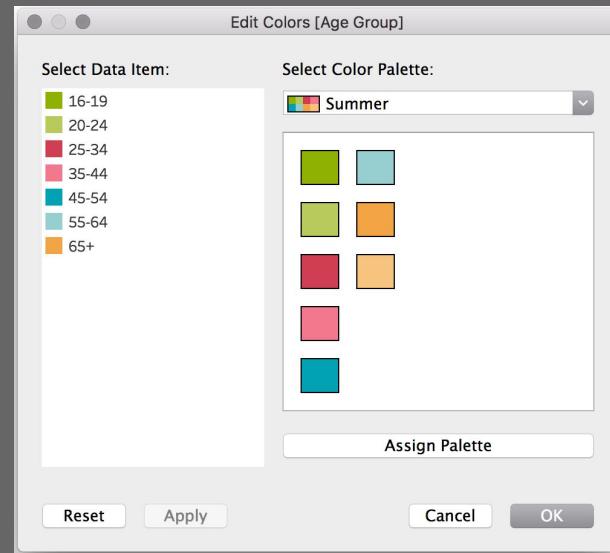
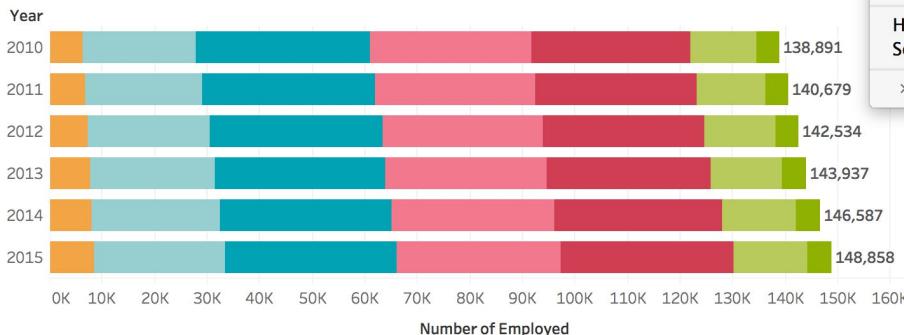
The right dropdown is labeled "State" and contains a list of US states. The state "Colorado" is selected, indicated by a checked checkbox:

- (All)
- Alabama
- Alaska
- Arizona
- Arkansas
- California
- Colorado
- Connecticut
- Delaware
- District of Columbia
- Florida
- Georgia
- Hawaii
- Idaho
- Illinois
- Indiana
- Iowa
- Kansas
- Kentucky
- Louisiana
- Maine
- Maryland
- Massachusetts
- Michigan
- Minnesota
- Mississippi

# Changing Legend Colors

In a stacked bar show the **number employed by year** broken out/colored by **age group**.

Add bar total numbers and change colors

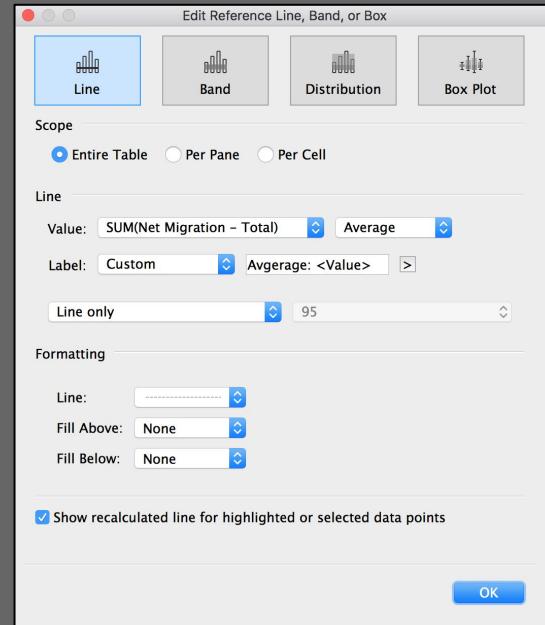
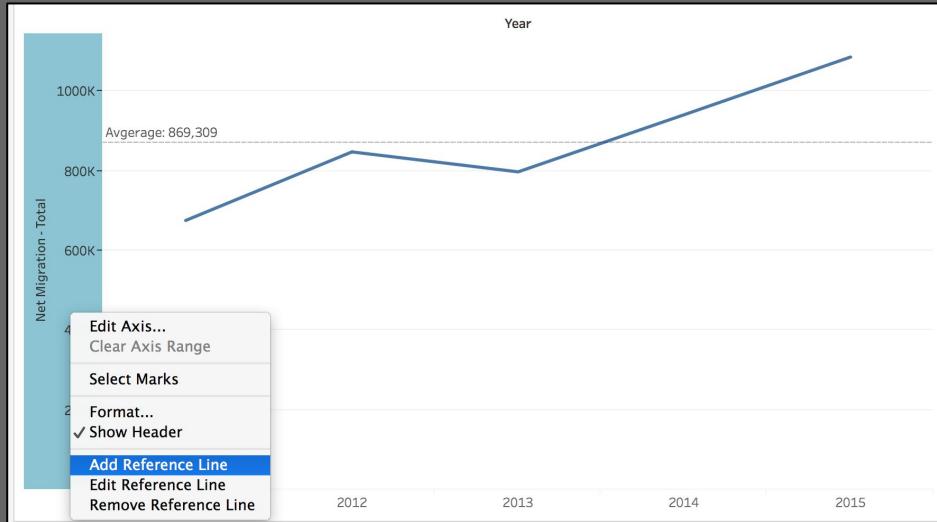


Right click on legend, edit colors

Click on the palette drop down to see more options

Click "assign palette" or assign the color manually

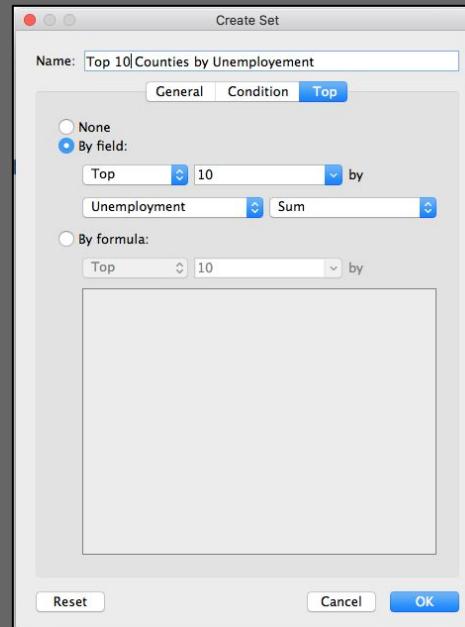
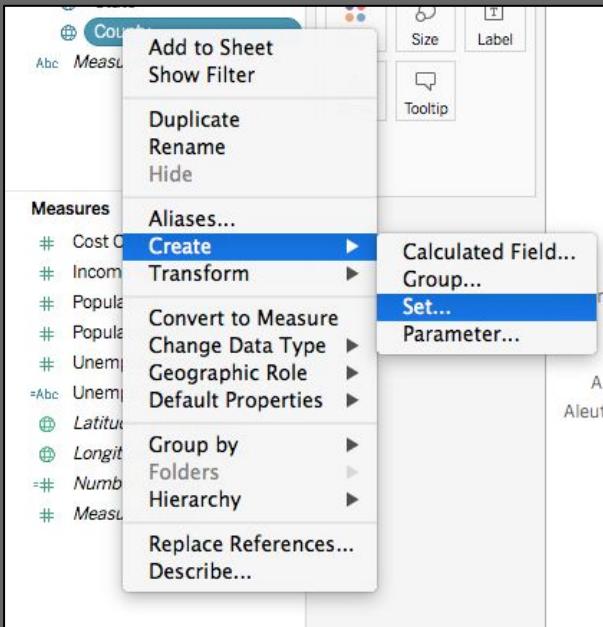
# Adding Reference Lines



Right click on the axis, add reference line

Click on the analytics pane and drag reference line to graph

# Creating Sets

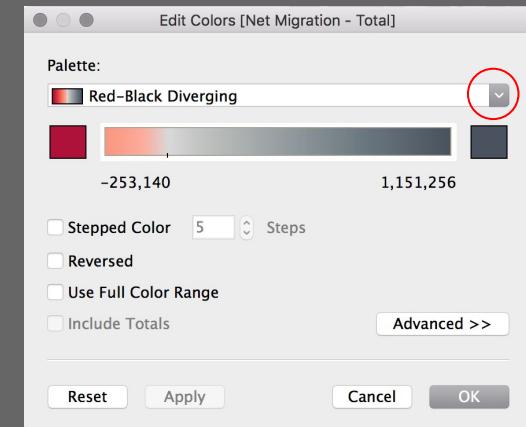
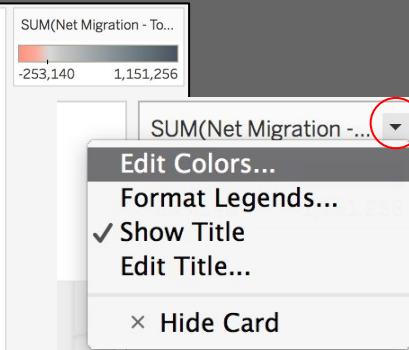
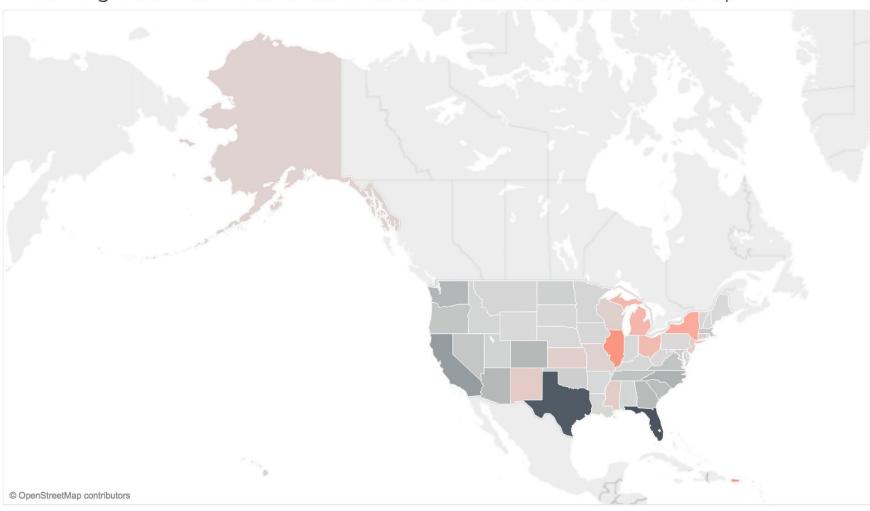


# Changing Legend Colors

In a map show how Net Migration - Total has changed in each state (geography).

Change the color gradient and change the border colors.

Show migration numbers for domestic and international in the tooltip.



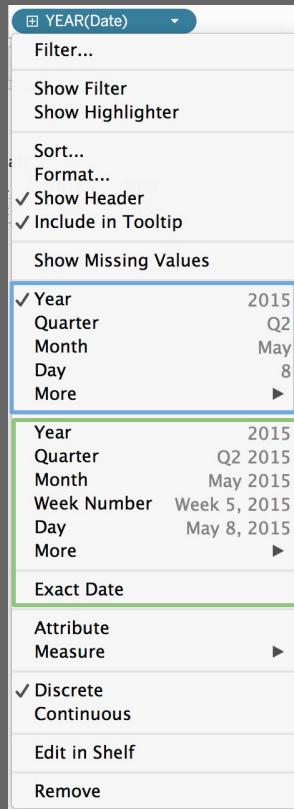
Right click on legend, edit colors

Click on the palette dropdown to see more options

# Working with Dates in Tableau

## Discrete Dates

Datepart or just that part of the date  
Ex: Month will add up all the “May’s”  
in the data, used for year over year  
comparisons



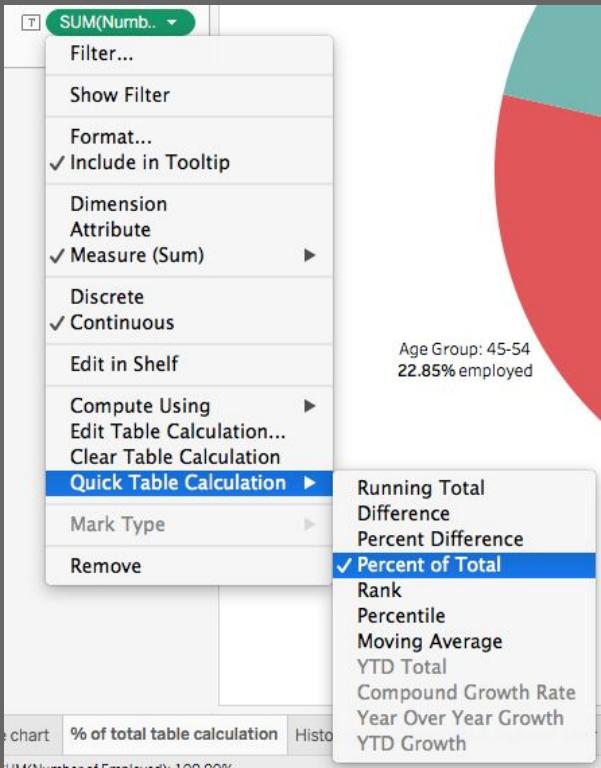
## Continuous Dates

That part of the date and the  
hierarchy  
Ex: May 2015 will be a different point  
than May 2016

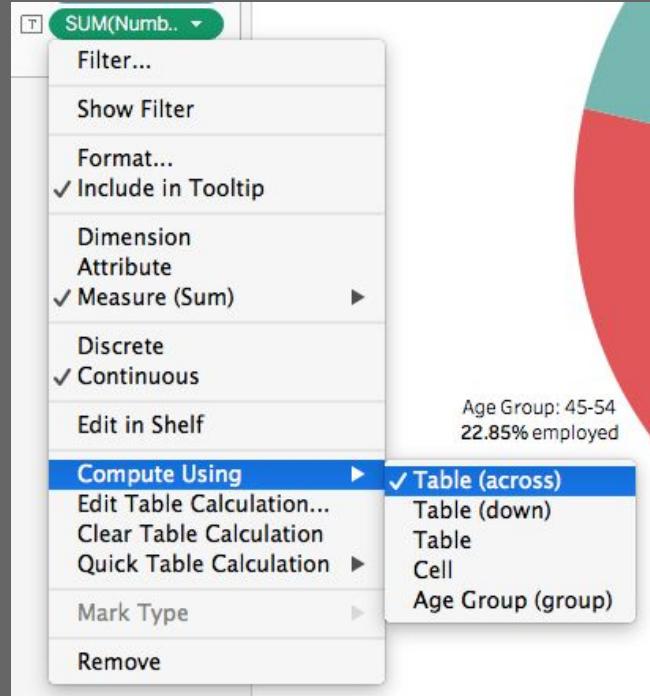
# Intermediate Tableau Visualizations

- Tree map
- Pie chart
- % of total table calculation
- Histogram
- Scatterplot & highlight filter
- Box plot
- Clusters
- Highlight table
- Calendar highlight table
- Difference table calculation
- Multiple marks
- Dual axis
- Multi-measure text table
- Basic calculations
- Parameter calculations
- String calculations
- Logical calculations
- Bullet graph

# Table Calculations



Depending on the complexity of your calculation and visualization you may need to edit the “compute using”.



# Measure Names & Measure Values

Measure Names

Geography	Less than 9th grade	9th to 12th grade, no diploma	High school	Some college	Associate's degree	Bachelor's degree	Graduate or professional degree
Alabama	173,767	350,751	1,000,768	707,938	244,561	466,596	276,740
Alaska	13,810	23,937	126,588	130,731	37,746	82,397	45,111
Arizona	269,941	334,213	1,049,770	1,109,757	359,921	732,697	428,478
Arkansas	113,098	193,046	682,487	436,792	120,898	263,245	138,447
California	2,511,452	2,088,733	5,147,234	5,470,491	1,939,538	4,873,710	2,834,709
Colorado	138,136	193,391	759,749	783,922	283,179	818,457	473,116
Connecticut	105,590	149,790	677,739	432,182	179,257	505,849	402,715
Delaware	25,456	49,050	195,579	122,315	45,325	108,655	73,885
District of Columbia	19,037	30,105	82,346	60,653	13,724	103,154	133,259
Florida	732,326	1,098,489	4,027,794	2,834,374	1,247,667	2,319,033	1,301,913
Georgia	358,983	602,579	1,833,379	1,352,598	448,729	1,147,464	666,683
Hawaii	40,887	47,543	267,193	211,092	94,135	192,074	97,939
Idaho	42,650	67,022	281,290	274,181	91,394	176,695	81,239
Illinois	470,831	590,678	2,311,350	1,814,838	642,042	1,686,429	1,044,388
Indiana	175,801	355,889	1,500,737	900,442	347,313	647,461	364,465

Measure Values

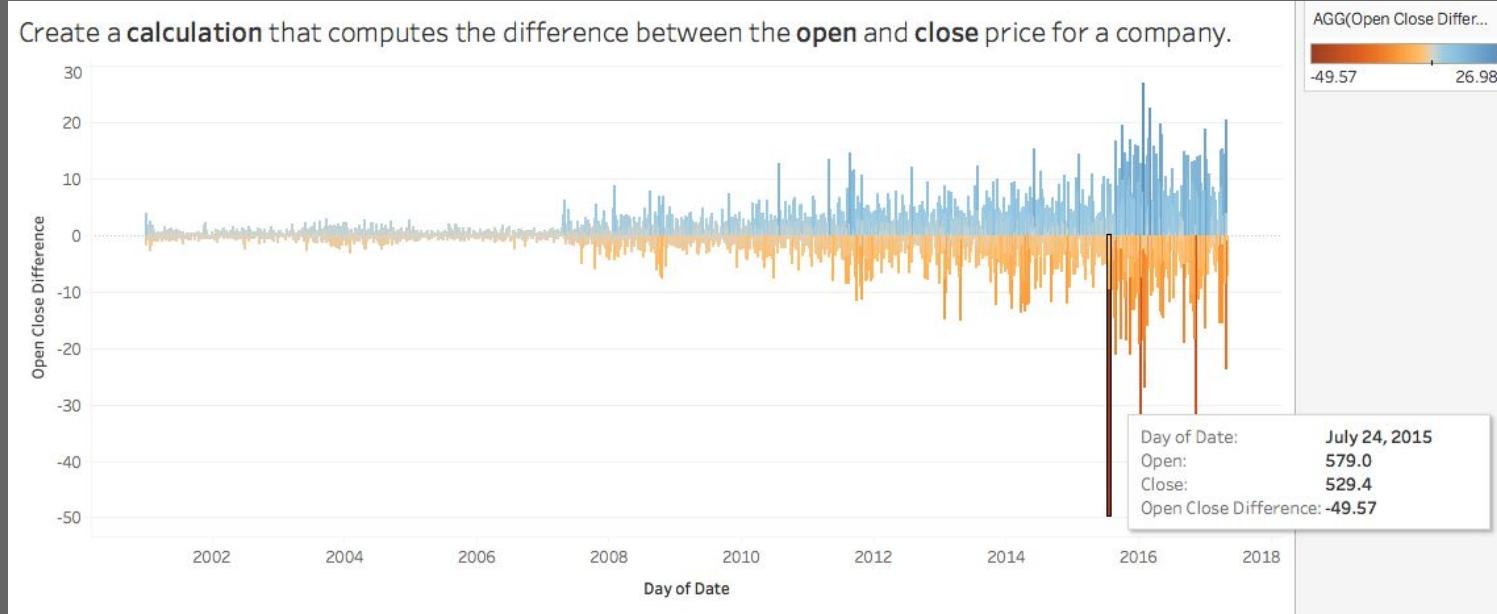
# Measure Names & Measure Values

Measure Names

Data	Analytics	Pages	Columns	Measure Names	Rows	Geography
C2ERMembersByState (...)						
CostOfLiving&MHIBySta...						
EducationalAttainment (...)						
EducationalAttainment (...)						
NetMigrationByStateByY...						
Piv_NetMigrationByStat...						
Piv_WorkforceByGenerat...						
StockPrices (TableauTrai...						
WorkforceByAge (Tableau...						
<b>Dimensions</b>						
# Fips						
Abc Geography						
Abc <b>Measure Names</b>						
<b>Measures</b>						
# 9th to 12th grade, no diploma						
# Associate's degree						
# Bachelor's degree						
# Graduate or professional ...						
# High school						
# Less than 9th grade						
# Some college						
# Total						
# Number of Records						
# Measure Values						
Measure Values						
SUM(Less than 9th g...)						
SUM(9th to 12th gra...)						
SUM(High school)						
SUM(Some college)						
SUM(Associate's deg...)						
SUM(Bachelor's degr...)						
SUM(Graduate or pro...)						

Measure Values

# Calculations



The calculation is valid.

Sheets Affected ▾ Apply OK

Open Close Difference StockPrices (TableauTrainingDataset\_0508)

All Enter search text

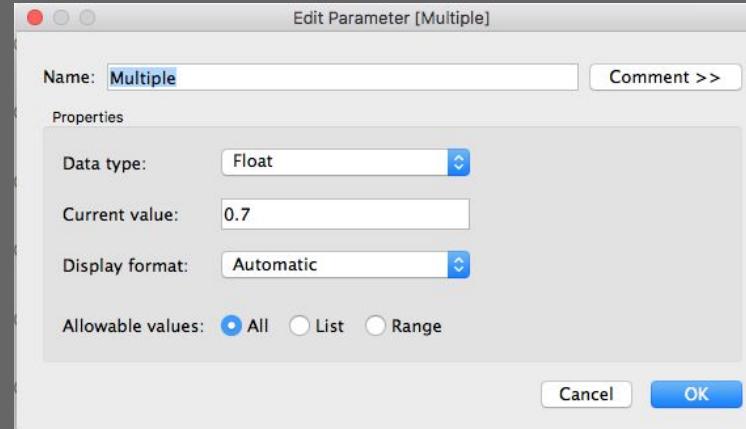
**ABS(number)**  
Returns the absolute value of the given number.  
Example: ABS(-7) = 7

ABS  
ACOS  
AND  
ASCII  
ASIN  
ATAN  
ATAN2  
ATTR  
AVG  
CASE  
CEILING

AVG([Close]) - AVG([Open])

# Parameters

The screenshot shows the Tableau Data Source pane. On the left, there are sections for Dimensions (Company, Date, Measure Names) and Measures (Adj Close, Adjusted Mu, Close, High, Low, Open, Open Close Difference, Volume, Number of Records, Measure Values). A context menu is open over the 'Measures' section, with the 'Create Parameter...' option highlighted in blue.

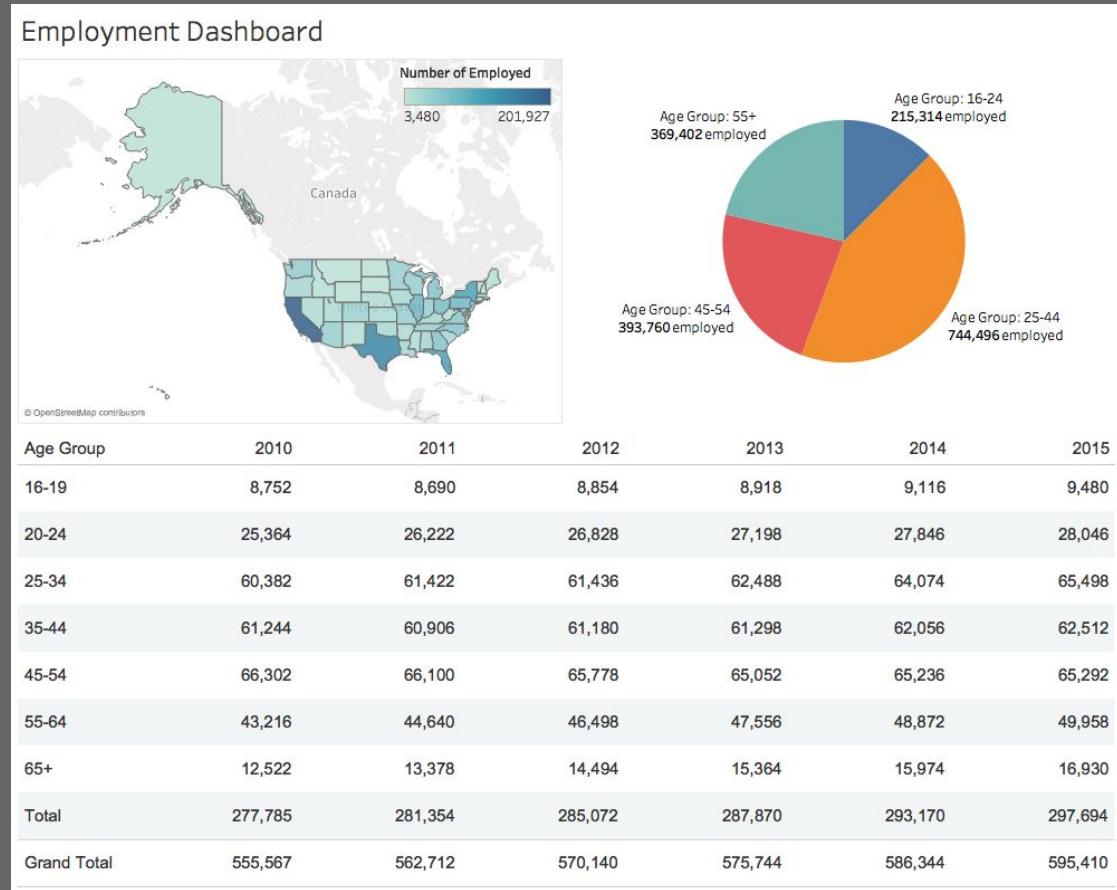
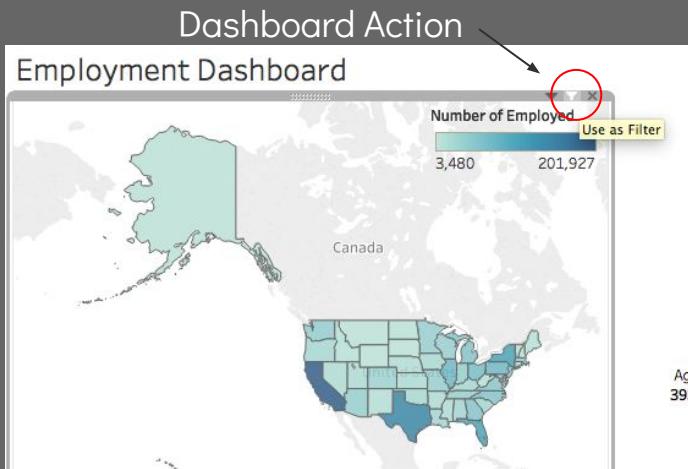


The screenshot shows a context menu with several options: Add to Sheet, Show Parameter Control (highlighted in blue), Cut, Copy, Edit..., Duplicate, Rename, Hide, Delete, Create, Default Properties, Folders, Replace References..., and Describe... Below these, under 'Parameters', there is an entry for '# Multiple'.

# Interactive Tableau Dashboards

- Floating dashboard objects
- Dashboard actions
- Dashboard filters

# Dashboard Actions



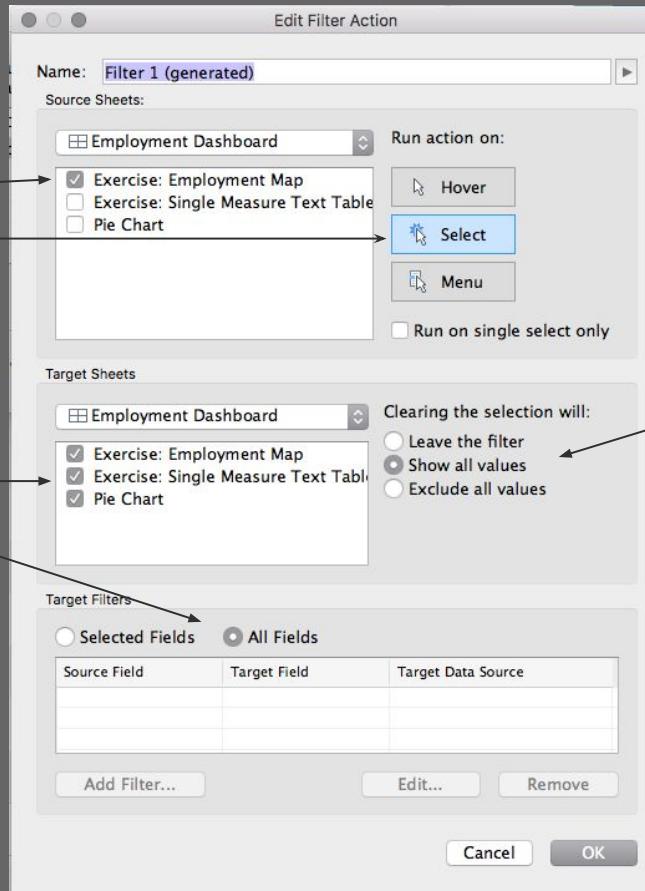
# Dashboard Actions

Top Menu bar, Dashboard -> Actions

When I click on:  
Exercise: Employment Map

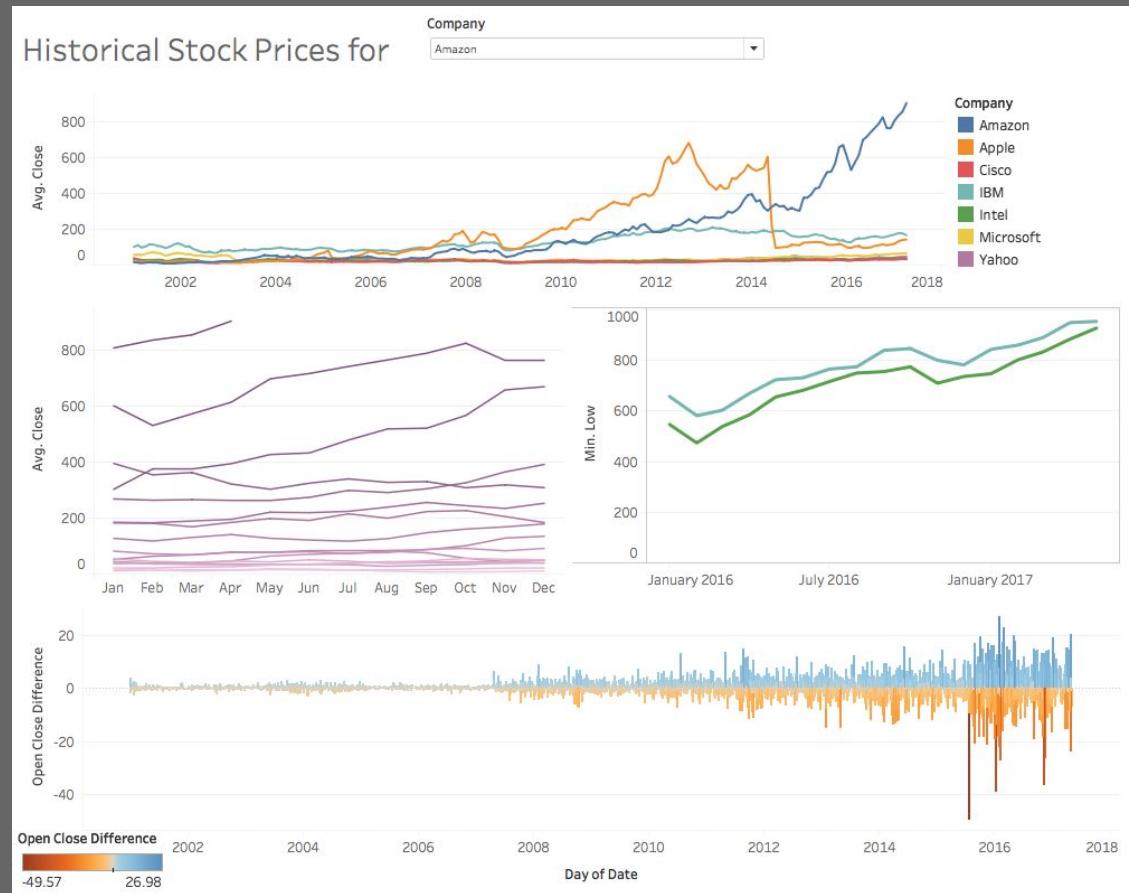
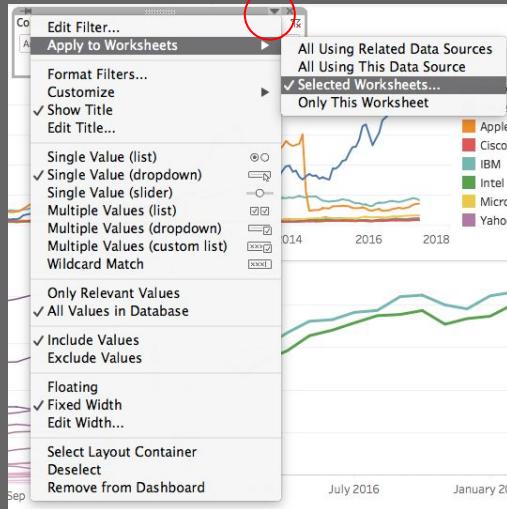
I want these sheets  
to filter on “all”

When I un-select I want all  
the values to show



# Dashboard Filters

Apply filter to multiple sheets



# Formatting data for Tableau

## Wide Data

State	2015 Measure	2016 Measure	2017 Measure
Alabama	0.789727804	0.787265102	0.929815228
Alaska	0.069223539	0.849489417	0.325685068
Arizona	0.458744699	0.225397942	0.112235825
Arkansas	0.472020611	0.269102644	0.922918379
California	0.807769941	0.433524907	0.416775096
Colorado	0.355480568	0.007733955	0.499048116

The screenshot shows the Tableau interface with the 'Dimensions' shelf open. It lists two dimensions: 'State' and 'Measure Names'. Under 'Measure Names', there are eight items: 2015 Measure, 2016 Measure, 2017 Measure, Latitude (generated), Longitude (generated), Number of Records, and Measure Values.

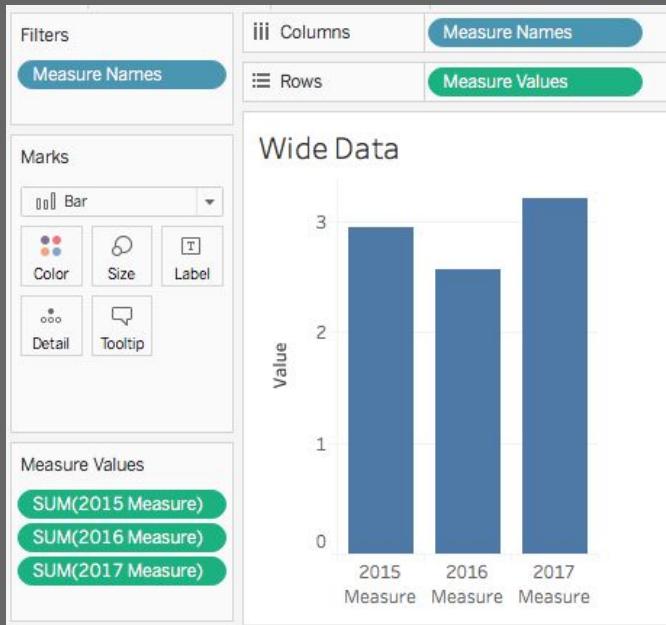
## Tall Data

State	Year	Measure
Alabama	2015	0.789727804
Alaska	2015	0.069223539
Arizona	2015	0.458744699
Arkansas	2015	0.472020611
California	2015	0.807769941
Colorado	2015	0.355480568
Alabama	2016	0.787265102
Alaska	2016	0.849489417
Arizona	2016	0.225397942
Arkansas	2016	0.269102644
California	2016	0.433524907
Colorado	2016	0.007733955
Alabama	2017	0.929815228
Alaska	2017	0.325685068
Arizona	2017	0.112235825
Arkansas	2017	0.922918379
California	2017	0.416775096
Colorado	2017	0.499048116

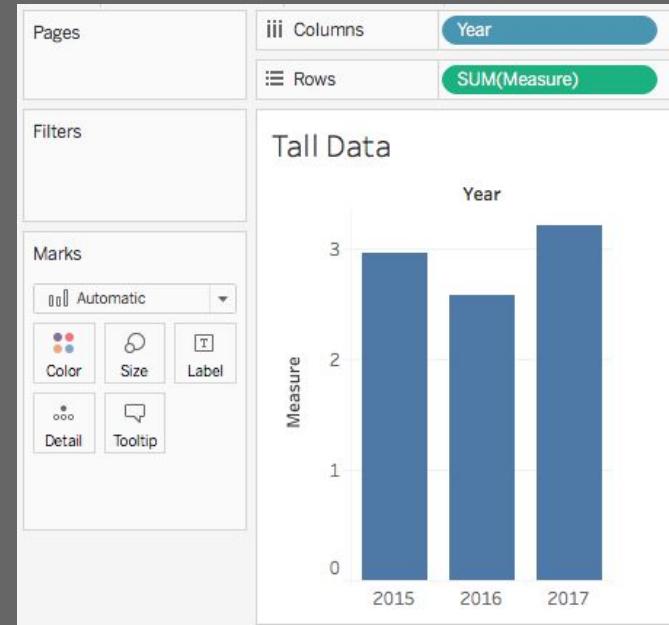
The screenshot shows the Tableau interface with both the 'Dimensions' and 'Measures' shelves open. The 'Dimensions' shelf includes 'State' and 'Year'. The 'Measures' shelf includes 'Measure', 'Latitude (generated)', 'Longitude (generated)', 'Number of Records', and 'Measure Values'. The data table on the right shows the same data as the previous table, but with additional columns for generated fields like Latitude and Longitude.

# Formatting data for Tableau

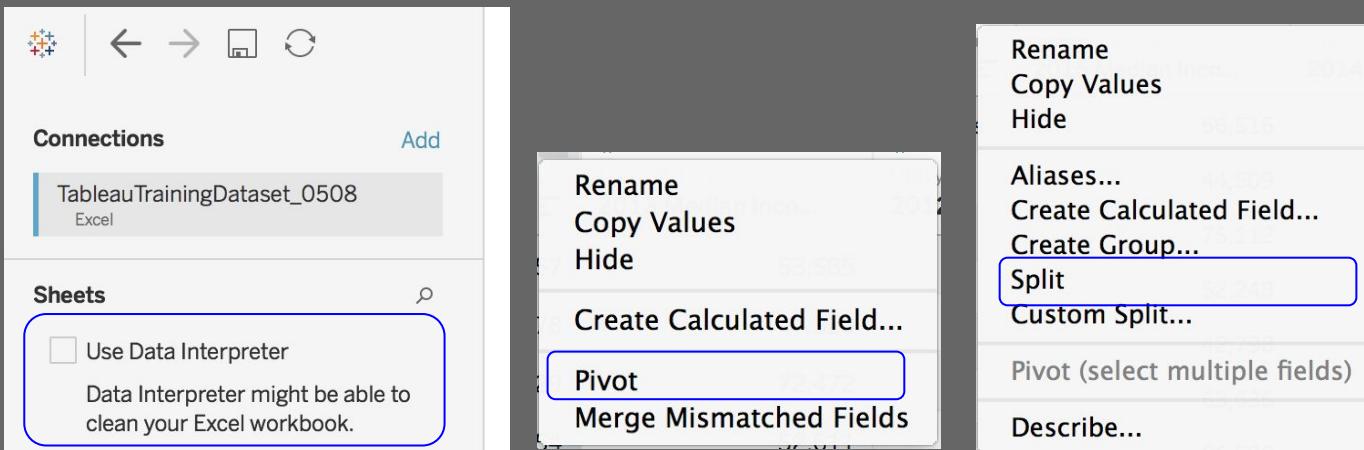
## Wide Data



## Tall Data



# Preparing Your Data in Tableau



- Data interpreter
- Tall vs wide data

# Group Exercise

Create a dashboard(s) in a small group with 3+ sheets using one of the following data sets. Publish your dashboard(s) to Tableau Public.

- Olympic Medal Winners
- Superbowl data
- TSA dangerous items FY15
- Craft brewery cans
- Instacart grocery orders
- World food prices (WFPVAM.xls)
- Data.gov
- Pick your own!