Data Visualization with Tableau

October 26-27, 2017
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

Usefulness of Weapons to Fight Zombies

<table>
<thead>
<tr>
<th>Weapon</th>
<th>Take to Bed</th>
<th>Kick Ass</th>
<th>Don't Share</th>
<th>Not Bad</th>
<th>Keep Looking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseball Bat</td>
<td>11</td>
<td>20</td>
<td>16</td>
<td>21</td>
<td>17</td>
</tr>
<tr>
<td>Machete</td>
<td>17</td>
<td>18</td>
<td>22</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Chainsaw</td>
<td>17</td>
<td>19</td>
<td>20</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>Chainsaw w/o Gas</td>
<td>13</td>
<td>14</td>
<td>18</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>Shotgun</td>
<td>11</td>
<td>12</td>
<td>14</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Flamethrower</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Pillow</td>
<td>8</td>
<td>10</td>
<td>11</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Pillowcase Full of Batteries</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Atomic Bomb</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>
Line Graph

- Used for viewing trends over time

![Line Graph]

Appreciate our Parents
(Also goes for siblings)

Moody teenage years

Age

High

Low
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

INVISIBLE WALLS
The Reality of Racial Segregation in America

The reality in many U.S. cities is that American of different races and ethnicities aren’t neighbors. As a result, different racial groups don’t shop at the same stores, and don’t always have access to the same services.

The maps below use data from the Census U.S. Census (2010) to color-code cities according to the majority racial or ethnic population living in each census tract. The categories are over 60% white, 60% to 50% white, and less than 50% white.
Data Visualization Inspiration
Welcome to Tableau Software
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 Desktop
- Tableau Public (Application)
- Tableau Reader
- Tableau Server
- Tableau Online
- Tableau Public
Tableau Data Connection Window

Data connection file (Excel)

Tabs in Excel workbook

Name of data connection (only in Tableau)

Drag and drop sheet

Column Data Type

Column/dimension & measure names (only in Tableau)

Data preview window

Go to Sheet 1 to get started
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
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

<table>
<thead>
<tr>
<th>Region</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand Total</td>
<td>675,433</td>
<td>847,440</td>
<td>797,381</td>
<td>940,852</td>
<td>1,085,439</td>
<td>4,346,545</td>
</tr>
<tr>
<td>Midwest</td>
<td>-92,102</td>
<td>-73,328</td>
<td>-17,411</td>
<td>-54,450</td>
<td>-87,011</td>
<td>-324,302</td>
</tr>
<tr>
<td>Northeast</td>
<td>-29,190</td>
<td>578</td>
<td>18,540</td>
<td>-24,492</td>
<td>-25,203</td>
<td>-59,767</td>
</tr>
<tr>
<td>South</td>
<td>596,698</td>
<td>691,648</td>
<td>590,392</td>
<td>724,245</td>
<td>861,485</td>
<td>3,464,468</td>
</tr>
<tr>
<td>West</td>
<td>228,418</td>
<td>266,906</td>
<td>251,624</td>
<td>350,641</td>
<td>401,257</td>
<td>1,498,846</td>
</tr>
</tbody>
</table>
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.

In a bar graph, how has net migration change over time (year) by region?
Add: labels to the bars, Region filter, color bars.

<table>
<thead>
<tr>
<th>Region</th>
<th>Year</th>
<th>Net Migration</th>
</tr>
</thead>
<tbody>
<tr>
<td>South</td>
<td>2011</td>
<td>596,698</td>
</tr>
<tr>
<td></td>
<td>2012</td>
<td>691,648</td>
</tr>
<tr>
<td></td>
<td>2013</td>
<td>590,392</td>
</tr>
<tr>
<td></td>
<td>2014</td>
<td>724,245</td>
</tr>
<tr>
<td></td>
<td>2015</td>
<td>861,485</td>
</tr>
</tbody>
</table>
Types of Filters
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
- Date part 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”.
<table>
<thead>
<tr>
<th>Geography</th>
<th>Less than 9th grade</th>
<th>9th to 12th grade, no diploma</th>
<th>High school</th>
<th>Some college</th>
<th>Associate’s degree</th>
<th>Bachelor’s degree</th>
<th>Graduate or professional degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>173,767</td>
<td>350,751</td>
<td>1,000,768</td>
<td>707,938</td>
<td>244,561</td>
<td>466,596</td>
<td>276,740</td>
</tr>
<tr>
<td>Alaska</td>
<td>13,810</td>
<td>23,937</td>
<td>126,588</td>
<td>130,731</td>
<td>37,746</td>
<td>82,397</td>
<td>45,111</td>
</tr>
<tr>
<td>Arizona</td>
<td>269,941</td>
<td>334,213</td>
<td>1,049,770</td>
<td>1,109,757</td>
<td>359,921</td>
<td>732,697</td>
<td>428,478</td>
</tr>
<tr>
<td>Arkansas</td>
<td>113,098</td>
<td>193,046</td>
<td>682,487</td>
<td>436,792</td>
<td>120,898</td>
<td>263,245</td>
<td>138,447</td>
</tr>
<tr>
<td>California</td>
<td>2,511,452</td>
<td>2,088,733</td>
<td>5,147,234</td>
<td>5,470,491</td>
<td>1,939,538</td>
<td>4,873,710</td>
<td>2,834,709</td>
</tr>
<tr>
<td>Colorado</td>
<td>138,136</td>
<td>193,391</td>
<td>759,749</td>
<td>783,922</td>
<td>283,179</td>
<td>818,457</td>
<td>473,116</td>
</tr>
<tr>
<td>Connecticut</td>
<td>105,590</td>
<td>149,790</td>
<td>677,739</td>
<td>432,182</td>
<td>179,257</td>
<td>505,849</td>
<td>402,715</td>
</tr>
<tr>
<td>Delaware</td>
<td>25,456</td>
<td>49,050</td>
<td>195,579</td>
<td>122,315</td>
<td>45,325</td>
<td>108,655</td>
<td>73,885</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>19,037</td>
<td>30,105</td>
<td>82,346</td>
<td>60,653</td>
<td>13,724</td>
<td>103,154</td>
<td>133,259</td>
</tr>
<tr>
<td>Florida</td>
<td>732,326</td>
<td>1,098,489</td>
<td>4,027,794</td>
<td>2,834,374</td>
<td>1,247,667</td>
<td>2,319,033</td>
<td>1,301,913</td>
</tr>
<tr>
<td>Georgia</td>
<td>358,983</td>
<td>602,579</td>
<td>1,833,379</td>
<td>1,352,598</td>
<td>448,729</td>
<td>1,147,464</td>
<td>666,683</td>
</tr>
<tr>
<td>Hawaii</td>
<td>40,887</td>
<td>47,543</td>
<td>267,193</td>
<td>211,092</td>
<td>94,135</td>
<td>192,074</td>
<td>97,939</td>
</tr>
<tr>
<td>Idaho</td>
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<td>67,022</td>
<td>281,290</td>
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<td>81,239</td>
</tr>
<tr>
<td>Illinois</td>
<td>470,831</td>
<td>590,678</td>
<td>2,311,350</td>
<td>1,814,838</td>
<td>642,042</td>
<td>1,686,429</td>
<td>1,044,388</td>
</tr>
<tr>
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<td>175,801</td>
<td>355,889</td>
<td>1,500,737</td>
<td>900,442</td>
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<td>647,461</td>
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<td>-----------------</td>
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<td>1,500,737</td>
<td>900,442</td>
<td>347,313</td>
<td>647,461</td>
<td>364,465</td>
</tr>
<tr>
<td>Iowa</td>
<td>71,363</td>
<td>106,025</td>
<td>662,666</td>
<td>440,431</td>
<td>220,206</td>
<td>367,010</td>
<td>171,271</td>
</tr>
<tr>
<td>Kansas</td>
<td>74,476</td>
<td>111,714</td>
<td>506,435</td>
<td>452,440</td>
<td>145,228</td>
<td>370,517</td>
<td>201,085</td>
</tr>
<tr>
<td>Kentucky</td>
<td>205,780</td>
<td>279,272</td>
<td>990,682</td>
<td>608,520</td>
<td>214,599</td>
<td>379,229</td>
<td>261,634</td>
</tr>
<tr>
<td>Louisiana</td>
<td>183,661</td>
<td>334,202</td>
<td>1,020,671</td>
<td>644,337</td>
<td>159,574</td>
<td>442,592</td>
<td>222,801</td>
</tr>
<tr>
<td>Maine</td>
<td>30,335</td>
<td>52,138</td>
<td>317,566</td>
<td>190,540</td>
<td>86,160</td>
<td>173,476</td>
<td>95,744</td>
</tr>
<tr>
<td>Maryland</td>
<td>170,947</td>
<td>256,204</td>
<td>1,021,111</td>
<td>778,746</td>
<td>250,311</td>
<td>806,558</td>
<td>675,443</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>223,506</td>
<td>255,433</td>
<td>1,167,765</td>
<td>743,499</td>
<td>351,224</td>
<td>1,030,864</td>
<td>793,674</td>
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<tr>
<td>Michigan</td>
<td>218,455</td>
<td>489,868</td>
<td>1,099,150</td>
<td>1,582,140</td>
<td>582,545</td>
<td>1,065,793</td>
<td>681,843</td>
</tr>
</tbody>
</table>
Create a calculation that computes the difference between the open and close price for a company.

$$\text{Open Close Difference} = \text{AVG}([\text{Close}]) \ - \ \text{AVG}([\text{Open}])$$

Example: \(\text{ABS}(-7) = 7\)
Parameters

- Create Calculated Field
- Create Parameter
- Group by Folder
- Group by Data Source Table
- Sort by Name
- Sort by Data Source Order
- Hide All Unused Fields
- Show Hidden Fields

Edit Parameter [Multiple]

- Name: Multiple
- Data type: Float
- Current value: 0.7
- Display format: Automatic
- Allowable values: All, List, Range
Interactive Tableau Dashboards

- Floating dashboard objects
- Dashboard actions
- Dashboard filters
Dashboard Actions

Employment Dashboard

<table>
<thead>
<tr>
<th>Age Group</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-19</td>
<td>8,752</td>
<td>8,690</td>
<td>8,864</td>
<td>8,918</td>
<td>9,116</td>
<td>9,480</td>
</tr>
<tr>
<td>20-24</td>
<td>25,364</td>
<td>26,222</td>
<td>26,828</td>
<td>27,196</td>
<td>27,846</td>
<td>28,046</td>
</tr>
<tr>
<td>25-34</td>
<td>60,382</td>
<td>61,422</td>
<td>61,436</td>
<td>62,486</td>
<td>64,074</td>
<td>65,498</td>
</tr>
<tr>
<td>35-44</td>
<td>61,244</td>
<td>60,906</td>
<td>61,180</td>
<td>61,298</td>
<td>62,056</td>
<td>62,512</td>
</tr>
<tr>
<td>45-54</td>
<td>66,302</td>
<td>66,100</td>
<td>65,778</td>
<td>65,052</td>
<td>65,236</td>
<td>65,292</td>
</tr>
<tr>
<td>55-64</td>
<td>43,216</td>
<td>44,840</td>
<td>46,498</td>
<td>47,556</td>
<td>48,872</td>
<td>49,958</td>
</tr>
<tr>
<td>65+</td>
<td>12,522</td>
<td>13,378</td>
<td>14,494</td>
<td>15,364</td>
<td>15,974</td>
<td>16,930</td>
</tr>
<tr>
<td>Total</td>
<td>277,785</td>
<td>281,354</td>
<td>285,072</td>
<td>287,870</td>
<td>293,170</td>
<td>297,694</td>
</tr>
<tr>
<td>Grand Total</td>
<td>555,567</td>
<td>562,712</td>
<td>570,140</td>
<td>575,744</td>
<td>586,344</td>
<td>595,410</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>State</th>
<th>2015 Measure</th>
<th>2016 Measure</th>
<th>2017 Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>0.789727804</td>
<td>0.787265102</td>
<td>0.929815228</td>
</tr>
<tr>
<td>Alaska</td>
<td>0.069223539</td>
<td>0.849489417</td>
<td>0.325685068</td>
</tr>
<tr>
<td>Arizona</td>
<td>0.458744699</td>
<td>0.225397942</td>
<td>0.112235825</td>
</tr>
<tr>
<td>Arkansas</td>
<td>0.472020611</td>
<td>0.269102644</td>
<td>0.922918379</td>
</tr>
<tr>
<td>California</td>
<td>0.807769941</td>
<td>0.433524907</td>
<td>0.416775096</td>
</tr>
<tr>
<td>Colorado</td>
<td>0.355480568</td>
<td>0.007733955</td>
<td>0.499048116</td>
</tr>
</tbody>
</table>

Tall Data

<table>
<thead>
<tr>
<th>State</th>
<th>Year</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>2015</td>
<td>0.789727804</td>
</tr>
<tr>
<td>Alaska</td>
<td>2015</td>
<td>0.069223539</td>
</tr>
<tr>
<td>Arizona</td>
<td>2015</td>
<td>0.458744699</td>
</tr>
<tr>
<td>Arkansas</td>
<td>2015</td>
<td>0.472020611</td>
</tr>
<tr>
<td>California</td>
<td>2015</td>
<td>0.807769941</td>
</tr>
<tr>
<td>Colorado</td>
<td>2015</td>
<td>0.355480568</td>
</tr>
</tbody>
</table>

Dimensions
- State
- Measure Names

Measures
- 2015 Measure
- 2016 Measure
- 2017 Measure
- Latitude (generated)
- Longitude (generated)
- Number of Records
- Measure Values
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!