An Introduction to Analysis and Data Visualization using Tableau Software
Presentation Overview

01 What is Tableau Software?
02 Benefits for Teachers & Researchers
03 What is Data Visualization?
04 General Overview of Tableau
05 Use for Reporting - Examples
06 Use for Storytelling - Examples
07 Use for Analysis - Examples
08 Advanced Features - Example
09 Resources (Public, WMTUG, Books)
What is Tableau Software?

- Software company Founded in 2003 from Stanford research
- Intent is to bring ‘data to the people’ through easy to use data visualization software
- Would be classified as a hybrid business intelligence (BI) / analytics software company
- Used by many of the largest companies in the world and most large companies in West Michigan
What is Tableau Software?

- Similar tools to Tableau include Microsoft Power BI, Qlik, Tibco Spotfire, and Looker – these are all data visualization tools.
What is Tableau Software?

The main focus of Tableau software is for you to better understand your datasets, especially large datasets.

BI software in the past required highly technical IT skills and took a long time to build dashboards. Tableau has changed that paradigm.

Tableau invests a lot of research time into developing intuitive software. They approach software design from the human perspective.

We believe in power for the people

Building a company that fundamentally changes how people see and understand data requires a different philosophy. So Tableau founders imbued their company with disruptive points of view.

Courtesy: www.Tableau.com
Benefits for Researchers & Teachers

- Free course licenses for students
- Pre-built curriculum for teaching Tableau and data analysis
- Use of powerful ‘big’ data platform for large datasets
- Provides skills needed in industry (various professions)

https://www.tableau.com/academic/teaching
Benefits for Researchers

• Ability to handle ‘big’ data (hundreds of millions of rows) that Excel cannot

• Ability to share (link) your research articles to datasets and results through Tableau Public

• Access to online help forums & local users groups

• Ability to connect to “R” and Python for more advanced analytics and analysis
What is Data Visualization?
What is Data Visualization

What is the Purpose of Data Visualizations?

- Drive Action
- Inform
- Persuade
- Entertain

Communicate

What guides the design process?
How do we judge success?
What is Data Visualization?

Matthew Fontaine Maury

- Unfit for duty due to a leg injury
- Sent to Depot of Charts and Instruments
- Vault of logs from every ship in US Navy
- Hundreds of thousands of observations available in written logs
- Manual ‘data mining’ with his team
- Standardized collection moving forward (form)

Ref. (The Clipper Ships – Time Life Books)
Ref. (Wind & Current Charts -1847)
What is Data Visualization?

Wind & Current Charts - 1847

- Visualization of his team’s findings
- Use of symbols and colors to highlight best routes
- Findings were counter-intuitive (heading west to go faster east)

Results

- Roundtrip from Virginia to Rio 75 days instead of 112 days
- Found the Gulf Stream’s full shape
- Cut time from Cape Horn to California by a third
- Reduced ship lost due to storms
What is Data Visualization

A Basic Framework – Rhetoric for Data Visualization

Methodology
1. Identify Purpose (Intended Use)
2. Consider Audience
3. Research
   i. Identify Available Datasets
   ii. Identify Data Elements
   iii. Benchmark Designs
4. Design
   i. Sketch
   ii. Iterate
   iii. Collect Feedback
5. Execute Design
   i. Collect Feedback
6. Document – Deploy
7. Sustain

- Who will be using the tool?
- What level in the organization?
- Strategic, tactical, operational?
- Multiple user types?
- Global?

- Informative, persuasive
- What action will result?
- Guided, static, decision support

- Summary data (<10,000 records)
- 1 million records?
- 10 million records?
- “Big Data”? 

- Microsoft Excel, PowerPoint
- Adobe Illustrator
- Tableau, Qlikview, MSBI
- SAS Visual Analytics

Audience

Purpose

Tool (Software)

Visualization

Design

Datasets
What is Data Visualization

Example – Decision Support

Those looking to catch big fish in Michigan

Michigan DNR Database; Public Use Pictures

Provide decision support to increase chances of catching big fish

Tableau

Fishing Navigator | Data References

Fishin’ in the Mitten: Catching Big Fish in Michigan

Michigan has a diverse selection of gamefish for fishing adventures year round. Select a species from the drop down menu to find out helpful hints for catching the big ones!

SEw SELECT A FISH SPECIES

BLUEGILL

WHERE TO FIND BIG BLUEGILL

For big bluegill, look no further than Houghton Lake. Use a leech and be prepared to become a Master Angler!

Based on Master Angler records from 1993-2014, the map to the left shows the hot spots for big bluegill. The size of the circle represents the total Master Angler award level fish caught in that location. Zoom in or mouse over a circle for additional information about that location. Click on a circle to filter the results below for just that body of water.

YEAR | WATERBODY | COUNTY | INCHES | POUNDS

1983 | Vaughn Lake | Alcona | 13.75 | 2.75

TOP FISHING METHODS AND BAITS FOR BIG BLUEGILLS

Stiltfishing: 46.13%
Spincasting: 16.47%
Driftfishing: 12.78%
Baitcasting: 10.33%
Ice Fishing: 6.61%
Trolling: 3.89%
Flycasting: 3.63%

CRAWLER: 28.27%
WORM: 18.08%
WAX WORM: 9.02%
LEECH: 8.29%
RED WORM: 2.16%
CRAWLER HARNESS: 1.94%
LEAF WORM: 1.86%
CRICKET: 1.64%
What is Data Visualization

Elements of Design - Unity

Unity is the application of methods that ensure that elements in the design appear to ‘go together’ - (color, font, & shape consistency)

https://public.tableau.com/s/gallery/beatles-albums   Author: Mike Moore
What is Data Visualization

Elements of Design - Hierarchy

Hierarchy is the application of design methods to indicate importance and ‘flow’ within the visual (size, placement)

https://public.tableau.com/s/gallery/blame-weather-us-flight-delayed-precipitation  Author: Matt Chambers
Elements of Design - Color

Use of color provides contrast for data points in opposition and brings attention to relevant elements within the visual.

https://public.tableau.com/s/gallery/road-accidents-germany
Author: Oliver Linder
What is Data Visualization

Elements of Design – Balance & Alignment

Balance and alignment are used to create harmonious visuals that do not distract from the message being communicated.

https://public.tableau.com/s/gallery/chicago-crime-scene

Author: George Gorczynski
What is Data Visualization

Elements of Design – Grouping / Spacing

Grouping and spacing can be used to associate similar elements and provide a narrative or visual flow within the visualization.

https://public.tableau.com/s/gallery/50-years-crime-us  Author: Shine Pulikathara
What is Data Visualization

The Iterative Design Process
What is Data Visualization

Detailed Example - Design

Hierarchy

Grouping

Balance
Now . . .
Back to Tableau

General Overview
Tableau – General Overview

- All worksheets & dashboards start with data
- Tableau connects to almost every type of data file imaginable
- You can join across different type of data sources!
Tableau – General Overview – simple example

- A simple table with 15 rows of data in an Excel spreadsheet
- Build an interactive dashboard in under three minutes

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th></th>
<th>B</th>
<th></th>
<th>C</th>
<th>D</th>
<th>E</th>
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<td></td>
<td></td>
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<td></td>
<td>Michigan</td>
<td></td>
<td>49012</td>
<td>$ 78,847</td>
<td>$ 13,462</td>
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<td></td>
<td>Ohio</td>
<td></td>
<td>45891</td>
<td>$ 9,558</td>
<td>$ 940</td>
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<tr>
<td>7</td>
<td>Chairs</td>
<td></td>
<td>Ohio</td>
<td></td>
<td>45888</td>
<td>$ 51,831</td>
<td>$ 6,443</td>
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<td>Ohio</td>
<td></td>
<td>45871</td>
<td>$ 34,972</td>
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<td></td>
<td>45871</td>
<td>$ 84,076</td>
<td>$ 6,996</td>
</tr>
</tbody>
</table>
Tableau – General Overview
Calculated Fields

```sql
if CONTAINS([Product Type], "CHAIR")
then "SEATING"
else "NOT SEATING" END
```

CONTAINS(string, substring)
Returns true if the string contains the substring.

Example:
CONTAINS("Calculation", "alca") is true
Tableau – General Overview
Basic Analytics
Tableau – General Overview: Bringing it all together

- Many different worksheets, text boxes, parameters, and filters come together to create a dashboard.
- Multiple dashboards can be ‘chained’ together so that users are guided through multiple analytical paths.
Use for Reporting
- Examples
Tableau – Reporting Example

- The results of detailed statistical analysis can be made available freely on Tableau Public where individuals can interact with data visualizations to view results – to supplement published research or publicly available reports.

- Expands the audience for consuming research and provides a visual and interactive experience.

Impact of Proposed Policy Changes to SNAP Categorical Eligibility by State

On July 24, 2019, the United States Department of Agriculture (USDA) issued a proposed rule to eliminate SNAP categorical eligibility. USDA estimates that, under the proposed rule, 9 percent of current SNAP households would not otherwise meet SNAP’s income and resource eligibility requirements and would therefore lose all of their SNAP benefits. This visualization explores the impact of the proposed rule by state and household demographic.

Tableau – Reporting Example

- Story Points – (a Tableau feature) provides a user experience similar to PowerPoint but with interactive data visualizations
- This allows for guided analytics where you create a general narrative and allow users to interact with visualizations to ‘deep dive’ into key points.

https://public.tableau.com/profile/texaschs#!/vizhome/HFP_1/Story1
Use for Storytelling - Examples
Tableau – Storytelling Example (Story Points)

Visualizing Weather Data in Tableau Software

To map each ZIP code to the nearest WBAN, a simple pairwise comparison was used. For each ZIP code, a distance was calculated from the center of the ZIP code to the location of each WBAN utilizing the Latitude and Longitude data from the dataset. Each ZIP code was assigned to one WBAN’s sensor based on the minimum calculated distance in the pairwise matrix. The map above shows the ZIP codes assigned to each sensor.
Tableau – Storytelling Example (K-MAX)
Advanced Features
- Examples
Advanced Features – Connecting Tableau to “R”

• Step #1
  • Install “R” or “R” Studio on your computer
  • Load the Rserve library package
  • Start Rserve
Advanced Features – Connecting Tableau to “R”

• Step #2
  • Connect Tableau to your Rserve instance
Advanced Features – Connecting Tableau to “R”

- **Step #3**
  - Write “R” script within a calculated field in Tableau

**Note:** This is also generally the same way to connect Tableau to Python in Anaconda – with a few small configuration differences.

```r
INT(SCRIPT_Str("library(xml2);
dater <- as.Date(Sys.Date()-arg2);
year <- paste('year_', format(dater, '%Y'), '/', sep = "");
month <- paste('month_', format(dater, '%m'), '/', sep = "");
day `<- paste('day_', format(dater, '%d'), '/', sep = ");
xmlFile `<- paste('http://gd2.mlb.com/components/game/mlb/', year,
month, day, 'miniscoreboard.xml', sep = ");
x `<- read_xml(toString(xmlFile));
games=xml_children(x);
ns `<- xml_ns(x);
awayruns `<- xml_attr(games,'away_team_runs',ns);
awayrunsdf `<- as.data.frame(awayruns);
awayrunsdf$ID `<- seq.int(nrow(awayrunsdf));
toString(awayrunsdf[,arg1, 1]);
","MAX([Idvalue]),max([zz_date]))")
```
Advanced Features – Example

- Example that queries Major League Baseball’s open API for statistics
- “R” script downloads data as an XML file, parses the data and returns the results to Tableau for visualization.
Available Resources
Books

- The Functional Art
  Alberto Cairo

- Information Dashboard Design
  Stephen Few

- Universal Principles of Design
  William Lidwell

- Envisioning Information
  Edward Tufte

- Visual Explanations
  Edward Tufte

- The Visual Display of Quantitative Information
  Edward Tufte

- Design Basics Index
  Jim Krause

- Beautiful Evidence
  Edward Tufte

- Information Design Workbook
  Kim Baer
Tableau Public & Other Resources

https://public.tableau.com/s/gallery

- Daily inspiration through ‘viz of the day’
- A place to upload your work to the cloud
- Open environment to share visualizations and data (don’t post confidential data here 😊)

http://www.visualnews.com/
http://www.flowingdata.com
http://www.thisiscolossal.com/
http://vizwiz.blogspot.com/
http://www.datavizdoneright.com/
National Geographic Magazine
Bloomberg Businessweek

Rule of Law Around the World

The Rule of Law Index is an internationally respected ranking of how countries around the world apply laws. Explore this visualization by Balkan Pandey to see how Hong Kong and China rank in terms of fundamental rights, criminal justice and more.

Featured On: September 13, 2019
West Michigan Tableau Users Group (WMTUG)

- Meet three to four times a year in Kalamazoo or Grand Rapids
- 100-150 participants
- Sharing tips, tricks, and case studies
- Develops a strong network with other analytics focused individuals

https://community.tableau.com/groups/west-michigan
Tableau Conference

• 15,000 of your best data visualization friends in the same place

• One week of in-depth sessions on data visualization and Tableau software