Instructors:
Jeffrey A. Shaffer
Vice President, IT and Analytics, Unifund
JeffreyShaffer@gmail.com
513.615.0001

Required Course Materials
Text: Provided by Instructors

Suggested Reading (not required)
*Information Dashboard Design: Displaying Data for At-a-Glance Monitoring*
Stephen Few, O’Reilly Media (2013)
*Show Me the Numbers: Designing Tables and Graphs to Enlighten*
*Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics*
Nathan Yau, Wiley (2011)

Suggested Feeds/Blog Subscriptions
*Viz of the Day* by Tableau Software
*The Functional Art* by Alberto Cairo
*Perceptual Edge* by Stephen Few
*Data + Science* by Jeffrey Shaffer
*Flowing Data* by Nathan Yau
*Storytelling with Data* by Cole Nussbaumer
*VizWiz* by Andy Kriebel
*Dear-Data.com* by Giorgia Lupi and Stefanie P
*Dear-Data-Two.com* by Jeffrey Shaffer and Andy Kriebel

Summary
This course provides an introduction as well as hands-on experience in data visualization. It introduces students to design principles for creating meaningful displays of quantitative and qualitative data to facilitate managerial decision-making.

Course Objectives
- Provide an overview and brief history of the practice of data visualization
- Introduce students to the key design principles and techniques for visualizing data
- Develop an understanding of the fundamentals of communication and alignment around concepts that are required for effective data presentation
• Provide an overview and develop an introductory level of competency on the use of several available software tools that can be used for data visualization
• Allow for project-based opportunities to identify, understand, analyze, prepare, and present effective visualizations on a variety of topics

Course Prerequisites
• General computer skills and a familiarity with charting tools like Microsoft Excel are necessary, along with access to the Internet for research and data gathering.
• Direct access to a computer on which the student can install software is highly recommended (see Required Software below)
• An understanding of basic charting and statistical terms and practices will be helpful, but not required.

Student Outcomes
After taking this course, students should be able to collect and process data, create an interactive visualization, and use it to demonstrate or provide insight into a problem, situation, or phenomenon.

Moreover, students should have the basic knowledge needed to critique various visualizations (good and bad), and to identify design principles that make good visualizations effective. Students should also have a basic understanding of some of the challenges present in making data understandable across a wide range of potential audiences.

Finally, students will have the opportunity to demonstrate their own skills in identifying a visualization that can be improved, completing their own design and/or analysis on the underlying data, and working to publish or promote acceptance of their presentation.

Course Format
Students will read class material, study best and worst practices, compare and contrast real-world examples, engage in problem solving, and participate in discussions related to the course material. Students will also practice applying the techniques and best practices discussed to real-world problems.

Required Software
A significant amount of time that students spend completing their assignments will involve the use of visualization software. Instruction will be focused and directed based on the capabilities/features of:

- Tableau Desktop Professional (TFT License), Student License or Tableau Public
- Microsoft Excel (Win 2007/Mac 2008 or Win 2010/Mac 2011 or Win 2013) - Optional
- R, R Studio and Shiny - Optional

Students will be able to learn the basic features of one or more of these through training videos that are posted in Blackboard, self-directed studies or by using available resources online. The instructor is also willing to help with specific questions or techniques as needed.

Students may use any technology platform for their projects, as long as work is presentable for in class review, and accessible for review by the course instructor. If there is any question about whether work can be accessed for review or presentation (e.g., if it is not created in one of the software tools listed above), you must check with the instructor prior to submitting your work.

Microsoft Windows and Excel can be purchased from the University Bookstore for a nominal charge if needed. A fully licensed version of Tableau Desktop is made available to each student for the duration
of the class, or if preferred, the student may use the freely available Tableau Public software for non-
proprietary and non-confidential data.

A full copy of Tableau Desktop is also available to full-time students for free for a year, available from
Tableau. Microsoft Excel and Tableau Desktop Professional are available for both Apple Macintosh and
Windows operating systems.

Expectations of Students
Students are expected to prepare and participate by:

1. Reading scheduled assignments each week
2. Participating in class discussions posted on Blackboard, projects, and quizzes
3. Completing the assigned homework projects by the due date
4. Participate in Group Projects

Students are expected to complete each test, exam, homework, and all other assignments
independently. The student’s submissions must represent his or her individual work, and citations must
be provided where content from other sources is referenced. Also, you may not re-use a data set from
one project to another; you must start with a completely new data set each time.

Students will be assigned to groups for the purpose of completing specific assignments. It is important
that you participate as necessary in the groups to complete assignments. Low participation in your
group may affect your final grade for any group assignments.

Academic Integrity
If there is a question about the academic integrity of a submission, or if it is believed that a submission
does not fully represent the unique work of the student or assigned group members, the instructors will
take all appropriate action in accordance with the university policy on Academic Misconduct and
Plagiarism (http://www.uc.edu/conduct/Academic_Integrity.html). This includes issuance of an “F”
grade for the course. Group projects should be collaborative only within your group and not shared
between groups.

As with all Lindner College of Business efforts, this course will uphold the highest ethical standards,
critical to building character (the C in PACE). Ensuring your integrity is vital and your responsibility. LCB
instructors are required to report ANY incident of academic misconduct (e.g., cheating, plagiarism) to
the college review process, which could result in severe consequences, including potential dismissal
from the college. For further information on Academic Misconduct or related university policies and
procedures, please see the UC Code of Conduct (http://www.uc.edu/conduct/Code_of_Conduct.html).

Performance Evaluation
Course grades will be determined as follows:

<table>
<thead>
<tr>
<th></th>
<th>%</th>
<th>Points</th>
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<tbody>
<tr>
<td>1) Homework – Halloween Viz (Individual)</td>
<td>5%</td>
<td>50 pts</td>
</tr>
<tr>
<td>2) Homework – Halloween Viz Redesign (Individual)</td>
<td>5%</td>
<td>50 pts</td>
</tr>
<tr>
<td>3) Test (Individual)</td>
<td>20%</td>
<td>200 pts</td>
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<tr>
<td>4) Dear-Data Postcard (Individual)</td>
<td>10%</td>
<td>100 pts</td>
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<tr>
<td>5) Project 1 (Group)</td>
<td>20%</td>
<td>200 pts</td>
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<tr>
<td>6) Final Project - Final Interactive Data Visualization and Presentation (Group)</td>
<td>40%</td>
<td>400 pts</td>
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<tr>
<td>Total:</td>
<td>100%</td>
<td>1,000 pts</td>
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Extra credit (one opportunity allowed for extra credit per student, see below)  Up to 3%  Up to 30 pts
Grading Scale

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
<th>Grade</th>
<th>Percentage</th>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A</td>
<td>93% - 100%</td>
<td>A-</td>
<td>90% - 92.9%</td>
<td>B+</td>
<td>87% - 89.9%</td>
</tr>
<tr>
<td>B</td>
<td>83% - 86.9%</td>
<td>B-</td>
<td>80% - 82.9%</td>
<td>C</td>
<td>Below 80%</td>
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<tr>
<td>F</td>
<td>Below 70%</td>
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Please see the Grading Rubric for grading criteria on assignments. Points for the Test will be awarded as marked on the exam.

All students have the same opportunity to earn points in the course. Any questions regarding grading must be addressed within one week of return of the graded assignment, quiz or exam to the student.

Group Member Feedback and Grading

For group projects, the instructor may allow for members to provide feedback on contributions and work effort of other group members. This feedback may be taken into account in issuing individualized grades for group projects. In other words, the input of your group members may positively or negatively affect your grade on these projects.

Extra Credit Assignment

Each student has an opportunity to earn extra credit by completing one additional assignment. The subject / topic and data set used must be approved by the instructor, and work on the extra credit assignment must be by individual only (no group extra credit assignments).

Students may select one of the two options below for their extra credit assignment. Please note that you must complete all requirements of the assignment to be eligible for full credit:

1) Participate in Andy Kriebel’s Makeover Monday
   a. Andy Kriebel’s makeover Monday dataset is published every Sunday. Use any Sunday dataset and create a makeover of the chart using the provided data.
   b. Publish your own blog post about your redesign or post to Tableau Public and/or Twitter

2) Create an Infographic
   a. Identify a dataset (for example, information about schools performance in Ohio, economic reports, government or corporate report, etc.) that would make a good infographic
   b. Redesign or create an infographic using the dataset you found
   c. Write a blog article explaining your graphic and what you believe to be the benefits of your approach
   d. Publish the article yourself on your own blog, or have your article published on an industry-related blog or site.

3) Pick a topic from Dear-Data.com or Dear-Data-Two.com and create your own post card. You are welcome to mail it to someone you know, but please take a high resolution picture of both sides of the card to submit for your extra credit assignment.
Exam

The test will cover the concepts and material in each of the first 3 classes. Students will be expected to apply the class readings and lectures in answering the test questions.

The test will be taken in class, online through Blackboard. Without prior approval, prior to the exam time, make-up opportunities are limited to documented emergencies. Instructor discretion is used in determining whether a situation constitutes an emergency.

Projects
Through a variety of projects, we will analyze best practices and compare and contrast with not-so-best practices. Students will learn to critique good and bad data visualizations and will be required to create and recreate various data visualizations using various sets of data. The final project will be interactive in nature and not simply a static chart. Points will be deducted for final projects that are not interactive.

Homework
Homework assignments will be given in this class and are due by the date and time indicated in the syllabus or as indicated by the instructor.

Submission of Homework and Project Deliverables
Students must submit all required assignments and supporting work via Blackboard. The submission time listed in Blackboard will be used to determine whether an assignment is on time or late. If multiple submissions are received, the final submission will be considered for grading (along with determining if the assignment was submitted on time). Submissions that are “in progress” or “draft” status in Blackboard at the designated due date and time will not be considered submitted. For group projects, the designated spokesperson is responsible for submitting all materials on behalf of the group.

Late Assignments
Late assignments will receive a deduction of 5% per day, beginning with a 5% deduction for assignments turned in past the date and time due. Assignments more than 3 days late will not be accepted.

Adjustments to Assignments, Schedule, and Syllabus
The scope, timing, and due date/time of any assignments, projects, homework, exams, or any other required work may be adjusted by the instructor as needed to maximize learning opportunities for students and/or better serve the goals of the course. The syllabus may likewise be modified at the discretion of the instructor.

Any adjustments will be communicated to students in class and on Blackboard with as much advance notice as possible.
### GRADING RUBRICS for BANA6037 Visualization, Project, and Lab Assignments

<table>
<thead>
<tr>
<th>Criteria</th>
<th>10 – Outstanding</th>
<th>9 – Proficient</th>
<th>8 – Basic</th>
<th>7 (or lower) - Below Expectations</th>
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<tbody>
<tr>
<td><strong>OBJECTIVE</strong></td>
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<tr>
<td>Completed assignment per requirements</td>
<td>All portions of the assignment, including presentations, data preparation, and visualizations were attempted and submitted. This is a pass / fail component. All or no points are awarded.</td>
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<tr>
<td>Data is appropriate and sufficient for the analysis</td>
<td>The data set chosen or used is appropriate, correct, and sufficient to support the thesis of the analysis.</td>
<td>Data is appropriate but minor data issues may be present or enhancements may be needed for a proper analysis.</td>
<td>Data is related but not sufficient to support the analysis, or significant data issues prevent a clear reading of the results.</td>
<td>Data has little or no relation to the topic being explored, errors will lead to incorrect conclusion, and/or data issues make the analysis unusable.</td>
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<tr>
<td>Headers, directions, citations, and visual cues are given as guides</td>
<td>Clear direction is provided. Visual cues, tooltips, and citations are consistently and correctly employed to inform and guide.</td>
<td>Header, footers, and instructions are present, but visual cues may be missing or could be improved.</td>
<td>The user must self-discover functionality. Headers and footers may be missing. Difficult to know what to do.</td>
<td>The user has little or no indication of how to engage. Directions are missing on clear. Missing headers and footers for context and meaning.</td>
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<tr>
<td>Basic visualization rules and best practices are consistently applied and demonstrated</td>
<td>Chart types are suitable and best options for the analysis. All axes and text are treated appropriately. The application of color is correct and clearly conveys meaning.</td>
<td>Chart types chosen are acceptable, but axes may be cluttered or have rotated text. Color choices communicate meaning but can be improved.</td>
<td>Charts incorrectly used for the purpose intended. Axes are difficult to read and detract from understanding. Color used in a distracting or unsuitable manner.</td>
<td>Difficult to understand what is intended with the chart and data. Color actively distracts and confuses. Chart junk dominates the visualization and the meaning is unreadable.</td>
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<tr>
<td>The visualization allows the user to conduct the intended analysis</td>
<td>The visualization facilitates quick cognition and leading to a fact-based conclusion or assertion.</td>
<td>Study is required to interpret the data and how it applies to the thesis of the analysis.</td>
<td>The visualization does not directly address the topic or relies on presentation support.</td>
<td>The visualization is completely inappropriate and cannot be used to conduct the intended analysis.</td>
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<tr>
<td><strong>SUBJECTIVE</strong></td>
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<tr>
<td>Viz is clean, clear, concise, captivating (Shaffer 4 C’s)</td>
<td>The 4Cs are well represented; the visualization is clear, clean, concise, and captivating.</td>
<td>Aspects of the 4Cs are apparent; opportunity exists for further enhancement.</td>
<td>Multiple aspects of the 4Cs are missing, or have not been well addressed in the visualization.</td>
<td>Significant or complete disregard for the guidance present in the 4Cs, resulting in a poor visualization.</td>
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<tr>
<td>Attractiveness and attention to design and details of craft</td>
<td>Fonts choices are conscious and consistent, proper grammar and spelling is used, and choice of position, size, and emphasis integrate elements into a visually appealing and engaging whole.</td>
<td>Visualization shows thought and planning, and most aspects work in harmony. May exhibit minor issues with spelling, alignment, or sizing mismatched with importance.</td>
<td>Visualization appears sloppy and may be difficult to understand as a coherent whole. Multiple issues with spelling, font consistency, positioning, or other distracting characteristics.</td>
<td>Little or no apparent thought or given and visualization comes across as disorganized. May be visible through numerous spelling or grammar issues, poor alignment and positioning choices inappropriate font use, etc.</td>
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<td>The visualization is usable and actionable (Duell Rules)</td>
<td>The visualization is targeted to the audience, the story is evident, and the conclusion or action required is clearly apparent. No additional interpretation is needed.</td>
<td>There is a clear message or story conveyed, but the action or conclusion that should be drawn is not definitive. May require interpretation.</td>
<td>The visualization suggests some possibilities, but does not lead to clarity of understanding and therefore action is not possible.</td>
<td>No apparent message or relevancy to the user; no actions can nor should be taken based on the analysis.</td>
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<td>Quality, integrity, and impact of the findings and analysis</td>
<td>The analysis shows a level of quality, integrity, and competency that makes the viz impactful, generating a high level of trust.</td>
<td>The overall conclusions of the analysis seem to be sound, with support by anecdotes or additional evidence.</td>
<td>The analysis shows a trend or suggests a result, but is not trustworthy because of errors in process, omission, or scope.</td>
<td>The analysis appears to be poorly conducted, greatly compromising the integrity of some or all of the visualization.</td>
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<tr>
<td>Overall effectiveness of communication and presentation</td>
<td>The visualization (or presentation) is delivered in a convincing way that demonstrates confidence, competency, and thoroughness.</td>
<td>Delivery provides a strong argument and is well supported; minor details should be vetted and affirmed.</td>
<td>The presentation and communication leaves concerns or lingering lack of clarity. Work required to review and confirm.</td>
<td>The communication and presentation results in confusion and low level of confidence in the analysis, requiring a significant or complete re-do.</td>
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<tr>
<td>Week</td>
<td>Topic</td>
<td>Assignments</td>
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| #1   | Part 1: **Course Introduction**  
Summary of projects, assignments, and homework for the course  
Review of policy on academic integrity  
Part 2: **A Primer on Visual Perception** (Videos and Slides)  
Part 3: **Introduction to the Art and Science of Data Visualization**  
What is Data Visualization and why does it matter?  
Brief History of Data Visualization  
Current visualization practitioners of note  
Part 4: **Introduction to Tableau**  
Importing Data / Connecting to External Sources  
Interface Overview  
Creating Sheets and Dashboard | Install Tableau Desktop Professional (license key provided) prior to first class.  
**FOR NEXT CLASS**  
1. Read Shaffer 4C’s and Clean Examples  
2. Homework #1: Prepare a data visualization using Halloween Trick or Treater data set (provided)  
   Due at beginning of Class #2 |
| #2   | Part 1: **Examine HW #1 Assignments**  
Part 2: **Design Fundamentals**  
Design Principles, Colors, and “Chart Junk”  
Design perspectives from the experts  
**The Shaffer 4 C’s of Data Visualization**  
Not-so-best practices (examples)  
Critique and redesign  
Part 3: **Creating a good data set for analysis**  
Data modeling fundamentals for analytics  
Selecting data for your KPIs  
Part 4: **Advanced Excel Techniques**  
Data Bars, Sparklines, Box Plots, Mapping, and Bullet Charts | **HOMEWORK 1**  
(Trick or Treater data visualization)  
Due at beginning of class  
**FOR NEXT CLASS**  
1. Redesign HW#1  
2. Read Juice Analytics Whitepaper (3 parts) |
<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Assignments</th>
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<tbody>
<tr>
<td>#3</td>
<td><strong>Part 1: In Depth Design Fundamentals</strong>&lt;br&gt;<strong>Part 2: Storytelling with Data</strong>&lt;br&gt;What are the main approaches to storytelling with data?&lt;br&gt;- Dashboards vs. Storyboards vs. Infographics&lt;br&gt;- Designing with the user in mind&lt;br&gt;The Duell Rules for Actionable Visualizations</td>
<td>Redesign of HW#1&lt;br&gt;Due at beginning of class&lt;br&gt;FOR NEXT CLASS&lt;br&gt;Study for exam&lt;br&gt;Review all lecture and homework content from classes 1-3.&lt;br&gt;Take Exam on Blackboard</td>
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<td><strong>Part 3: Advanced Tableau Topics</strong>&lt;br&gt;Interactive Visualization Features – build interactive visualization&lt;br&gt;Actions and filters&lt;br&gt;Calculated measures&lt;br&gt;Data blending, joins, and custom queries&lt;br&gt;Custom Shape Files</td>
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<td>#4</td>
<td><strong>Part 1: EXAM ON BLACKBOARD (covers materials presented in classes 1-3)</strong>&lt;br&gt;Multiple choice and short answer on Blackboard&lt;br&gt;Create graphs appropriate for data&lt;br&gt;Chart critique</td>
<td>Exam using Blackboard&lt;br&gt;Take Exam any time prior to class #4&lt;br&gt;FOR NEXT CLASS&lt;br&gt;Create a Dear-Data Postcard.&lt;br&gt;Pick any week from the Dear-Data.com or Dear-Data-Two.com project and create a postcard.</td>
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<td><strong>Part 2: Infographics and other Visualizations</strong>&lt;br&gt;Infographics Examples&lt;br&gt;OECD Better Life Index and Museum Example&lt;br&gt;Dear-Data.com&lt;br&gt;Dear-Data-Two.com</td>
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<tr>
<td>#5</td>
<td><strong>Part 1: Geocoding and Mapping</strong>&lt;br&gt;Geocoding&lt;br&gt;Digital Cartographer Eric Fischer and John Nelson&lt;br&gt;Using geocoded data in Tableau&lt;br&gt;Map Projections</td>
<td>Dear-Data Postcard&lt;br&gt;Due at beginning of class&lt;br&gt;Post Images to Blackboard or Bring postcard to Class to turn in&lt;br&gt;FOR NEXT CLASS&lt;br&gt;PROJECT 1 COMPLETED&lt;br&gt;Due at beginning of class</td>
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<td><strong>Part 2: Advanced Tableau</strong>&lt;br&gt;Advanced Chart types&lt;br&gt;Custom Color Palettes</td>
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<tr>
<td>Week</td>
<td>Topic</td>
<td>Assignments</td>
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</table>
| #6   | WMS Servers  
|      | R Integration  
|      | **Part 3: Questions on Project 1 and Final Project**  
|      |      | PROJECT 1 (Team)  
|      |      | Due at beginning of class  
|      |      | (teams will not present in class)  
|      |      | FOR NEXT CLASS  
|      |      | Final Project Due  
|      |      | Visualizations and Presentation  
|      |      | (teams will present in class)  
|      | **Part 1: Business Alignment and Leadership**  
|      | What are the social aspects of visualization, BI, and analytics?  
|      | Creating a vision and alignment among stakeholders  
|      | **Part 2: Trends in Data Visualization and Other Tools**  
|      | Stanford Visualization Group  
|      | Data Wrangler  
|      | D3.js  
|      | R and Shiny  
|      | **Part 3: Other Data Visualizations**  
|      | Compare and Contrast real-world examples  
|      | Flowing Data - Nathan Yau  
|      | Information is Beautiful  
|      | Tableau Vizzes in the wild  
|      |      | #001: Due FRIDAY 10/7 at 10:00 P.M.  
|      |      | (the evening prior to class)  
|      |      | #003: Due FRIDAY 10/3 at 10:00 P.M.  
|      |      | (the evening prior to class)  
| #7   | **Final Data Visualization Project presentations**  
|      | In class presentations  
|      | At least one person from each team presents  
|      | Discuss and demonstrate your Interactive Data Visualization  
|      |      | FINAL PROJECT  
|      |      | Visualizations and Presentation  
|      |      | #001: Due FRIDAY 10/7 at 10:00 P.M.  
|      |      | (the evening prior to class)  
|      |      | #003: Due FRIDAY 10/3 at 10:00 P.M.  
|      |      | (the evening prior to class)  
|      |      | Teams Present in Class #7  
|      |      | **Final Data Visualization Project presentations**  
|      | In class presentations  
|      | At least one person from each team presents  
|      | Discuss and demonstrate your Interactive Data Visualization  
|      |      | FINAL PROJECT  
|      |      | Visualizations and Presentation  
|      |      | #001: Due FRIDAY 10/7 at 10:00 P.M.  
|      |      | (the evening prior to class)  
|      |      | #003: Due FRIDAY 10/3 at 10:00 P.M.  
|      |      | (the evening prior to class)  
|      |      | Teams Present in Class #7  
|      |      | **Final Data Visualization Project presentations**  
|      | In class presentations  
|      | At least one person from each team presents  
|      | Discuss and demonstrate your Interactive Data Visualization  
|      |      | FINAL PROJECT  
|      |      | Visualizations and Presentation  
|      |      | #001: Due FRIDAY 10/7 at 10:00 P.M.  
|      |      | (the evening prior to class)  
|      |      | #003: Due FRIDAY 10/3 at 10:00 P.M.  
|      |      | (the evening prior to class)  
|      |      | Teams Present in Class #7  
|      |      | **Final Data Visualization Project presentations**  
|      | In class presentations  
|      | At least one person from each team presents  
|      | Discuss and demonstrate your Interactive Data Visualization  
|      |      | FINAL PROJECT  
|      |      | Visualizations and Presentation  
|      |      | #001: Due FRIDAY 10/7 at 10:00 P.M.  
|      |      | (the evening prior to class)  
|      |      | #003: Due FRIDAY 10/3 at 10:00 P.M.  
|      |      | (the evening prior to class)  
|      |      | Teams Present in Class #7  

Revised on 1/9/2016
J. Shaffer