STA 553 Data Visualization
Spring Semester

Professor: _
Email: _@wcupa.edu
Office Hours: Day 1
Day 2
Day 3

Phone: 610-436-_
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Prerequisites: STA 503

Required Materials: None

Course Description: This course focuses on the principles of data visualization and addresses questions about what, why and how to visualize. Topics include visualization design elements such as colors, shapes and movements, etc.; data exploratory visualization, statistical graphics, and model visualization; process visualization, dashboard design, and the ethics of data visualization. The course will also introduce some commonly used visualization tools.

Applicable Programmatic Student Learning Outcomes:

1. Demonstrate an understanding of probability and statistical inference, including the fundamental laws of classical probability, discrete and continuous random variables, expectation theory, maximum likelihood methods, hypothesis testing, power, and bivariate and multivariate distribution theory.
2. Demonstrated the ability to apply the elementary methods of statistical analysis, namely those based on classical linear models, categorical methods, and non-parametric ideas to perform data analysis for the purposes of statistical inference.
3. Demonstrate proficiency in the effective use of computers for research data management and for analysis of data with standard statistical software packages, particularly SAS.
4. Learn to develop and critically assess design of experimental studies and the collection of data.
5. **Apply one or more methods of statistical inference to a particular area of interest, particularly the program in the elective concentration.**
6. **Gain practical experience in statistical consulting and communicating with non- statisticians, culminating with interaction with research workers at a local company as part of the internship practicum.**

Course Student Learning Outcomes:

After taking this course, students should be able to: (**All relate to PSLOs 5 and 6**)

1. understand the principles of data visualization and graphic design
2. understand the importance of visual design and use of various visual components
3. understand the basics of colors, views, and important visualization-based issues.
4. effectively utilize various visualization structures.
5. create well-designed data visualizations with appropriate tools
6. evaluate the credibility, ethics, and aesthetics of data visualizations

Meeting & Assessing Student Learning Outcomes:

The course learning outcomes will be evaluated in the following components

(1). 7 biweekly assignments (5% each)

(2). 2 midterm projects (20% each)

(3). Final project and presentation (25%).

Attendance Policy: Attendance is class is expected. Attendance will be recorded each class session. One unexcused absence is allowed with no penalty; every unexcused absence after the first will result in a deduction from the participation component of the course grade.

Tentative Course Outline:

Part I. Visualization Theory (Weeks 1-2)

1. Introduction
   - 1.1. A brief history of data visualization
   - 1.2. Goals for visualization
   - 1.3. The power of data visualization
   - 1.4. Value of data visualization
   - 1.5. Steps for Visualizing Data
2. Data Foundations

2.1. Data Type

2.2. Data Preprocessing

2.3. Visual perception

3. Key Aspects of Visualization
   - 3.1. Visualization Basics
   - 3.2. Pre-attentive Processing
   - 3.3. Gestalt Laws
   - 3.4. Marks and Channels (Visual Variable)
4. Designing Visualizations
   - 4.1. Characteristics of Visual Variables
   - 4.2. Visual encoding
   - 4.3. Color Schemes
   - 4.4. Good, bad and weird visualization
5. Interactive Visualization
   - 5.1. What is interactive visualization
   - 5.2. Interactive maps with R leaflet()
   - 5.3. D3 related R package

6. Classroom Activity and Brief history
   - 6.1. Milestones in the history of thematic cartography, statistical graphics, and data visualization
   - 6.2. Using Data Visualization to Engage in Scientific Practices
   - 6.3. How to Pick the Best Data Visualization Format

Part II. Probabilistic /Statistical Graphics with R (Weeks 3-4)

1. Graphics and Data Visualization in R
   1.1. R basic plot function
   1.2. Graphical primitives data visualization with ggplot2 cheat sheets
2. Basic R plot facilities and graphic functions
   2.1. Some powerful graphical functions in base R
   2.2. Useful libraries for visualizations
3. Exploratory visualization with R
   3.1. Descriptive charts
   3.2. Inferential charts
4. Visualizing distributions and models
   4.1. Density plots
   4.2. Model diagnostic plot
   4.3. Marginal charts
5. Interactive visualization and animation with R
   5.1. Interactive visualization of spatial data with leaflet().
   5.2. R graphics devices for Animation

Part III. Dashboard Design (Weeks 5-6)

1. Types of Dashboards
   1.1. Operational Dashboard
   1.2. Strategic Dashboard
   1.3. Analytical Dashboard
2. Dashboard Design principles
   2.1. Why Dashboards?
   2.2. Key Features for Designing a Dashboard
   2.3. Principles of dashboard design
   2.4. Strategies of Dashboard Design

Part IV. Introduction to Tableau (Public) (Weeks 7-8)

1. Descriptive Visualization in Tableau
   1.1. Slicing data by dates
   1.2. Basic chart types – bars, lines, area charts, heat maps, tree-maps, etc.
   1.3. Creating hierarchy
   1.4. Creating grouping
2. Inferential Graphs and Features in Tableau
   2.1. Time series plots in Tableau
   2.2. Distributional charts (box plots, histogram, and Pareto chart).
   2.3. Relational plots – correlation and regression
   2.4. Table calculations

3. Dashboard and Interactive Visualization with Tableau

3.1. Creating dashboards
3.2. Creative interactive visualizations

Part V. Business Process and Workflow Visualization (Weeks 9-10)

1. Business Process vs Workflow
   1.1. Differences and commonalities
   1.2. Types of business processes
   1.3. Business process optimization
2. Business Process Modeling
   2.1. Steps in business process modeling
   2.2. Identify types of the process
3. Business Process Visualization
   3.1. What do we mean by process visualization?
   3.2. Where process visualization is used?
   3.3. Why process is used? Tangible and intangible benefits.
4. Case Studies – Control Charting Methods
   4.1. Supply chain and value chain
   4.2. Change of initiatives
   4.3. Projects that go off track

Part VI. Big Data Visualization (Weeks 11-12)

1. Big Data Visualizations: Challenges
2. Data Volume
   2.1. Aggregation
   2.2. Sampling
3. High Dimensional Data
   3.1. 2D and 3D Scatter plots
   3.2. Matrix of Scatter plots
   3.3. Heat Maps
   3.4. Height Maps
   3.5. Multiple line graph
   3.6. Other uncommon methods
4. Design Constraints
   4.1. Too much to process
   4.2. Hidden information
   4.3. Streaming adds more challenge

Part VIII. Visualization Ethics (Weeks 13-14)

1. Ethical standards in professional communications
2. Ethical issues in data visualization

Evaluation & Grading:

A letter grade will be assigned based on performance in the course, according to the following scale:

Grade	Quality Points	Percentage Equivalents	Interpretation
A	4.00		Superior graduate attainment
A-	3.67		
B+	3.33		Satisfactory graduate attainment
B	3.00		
B-	2.67		
C+	2.33		Attainment below graduate expectations
C	2.00		
C-	1.67		
F	0	< 70%	Failure

D grades are not used. Refer to the Graduate Catalog for description of NG (No Grade), W, & other grades.

Statements Common to All WCU Graduate Syllabi:

ACADEMIC & PERSONAL INTEGRITY

It is the responsibility of each student to adhere to the university's standards for academic integrity. Violations of academic integrity include any act that violates the rights of another student in academic work, that involves misrepresentation of your own work, or that disrupts the instruction of the course. Other violations include (but are not limited to): cheating on assignments or examinations; plagiarizing, which means copying any part of another's work and/or using ideas of another and presenting them as one's own without giving proper credit to the source; selling, purchasing, or exchanging of term papers; falsifying of information; and using your own work from one class to fulfill the assignment for another class without significant modification. Proof of academic misconduct can result in the automatic failure and removal from this course. For questions regarding Academic Integrity, the No-Grade Policy, Sexual Harassment, or the Student Code of Conduct, students are encouraged to refer to the Department Graduate Handbook, the Graduate Catalog, the *Ram's Eye View*, and the University website at www.wcupa.edu.

STUDENTS WITH DISABILITIES

If you have a disability that requires accommodations under the Americans with Disabilities Act (ADA), please present your letter of accommodations and meet with me as soon as possible so that I can support your success in an informed manner. Accommodations cannot be granted retroactively. If you would like to know more about West Chester University's Services for Students with Disabilities (OSSD), please visit them at 223 Lawrence Center. The OSSD hours of Operation are Monday – Friday, 8:30 a.m. – 4:30 p.m. Their phone number is 610-436-2564, their fax number is 610-436-2600, their email address is ossd@wcupa.edu, and their website is at www.wcupa.edu/ussss/ossd.

REPORTING INCIDENTS OF SEXUAL VIOLENCE

West Chester University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to meet this commitment and to comply with Title IX of the Education Amendments of 1972 and guidance from the Office for Civil Rights, the University requires faculty members to report incidents of sexual violence shared by students to the University's Title IX Coordinator, Ms. Lynn Klingensmith. The only exceptions to the faculty member's reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. Faculty members are obligated to report sexual violence or any other abuse of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred to the person designated in the University protection of minors policy. Information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is set forth at the webpage for the Office of Social Equity at http://www.wcupa.edu/_admin/social.equity/.

EXCUSED ABSENCES POLICY

Students are advised to carefully read and comply with the excused absences policy, including absences for university-sanctioned events, contained in the WCU Graduate Catalog. In particular, please note that the "responsibility for meeting academic requirements rests with the student," that this policy does not excuse students from completing required academic work, and that professors can require a "fair alternative" to attendance on those days that students must be absent from class in order to participate in a University-Sanctioned Event.

EMERGENCY PREPAREDNESS

All students are encouraged to sign up for the University's free WCU ALERT service, which delivers official WCU emergency text messages directly to your cell phone. For more information, visit www.wcupa.edu/wcualert. To report an emergency, call the Department of Public Safety at 610-436-3311.

ELECTRONIC MAIL POLICY

It is expected that faculty, staff, and students activate and maintain regular access to University provided e-mail accounts. Official university communications, including those from your instructor, will be sent through your university e-mail account. You are responsible for accessing that mail to be sure to obtain official University communications. Failure to access will not exempt individuals from the responsibilities associated with this course.