THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC

Visualization of Complex data

DATS 6401

Wednesday 15:30 - 18:00

Spring 2026

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GitHub
Email
Office hours Webex link
Class location : GOV 101
Dr. Jafari's office Hours: Wednesday 1.30pm-3pm in-person Location: TBA

Course Description:
The main objective of this course is to explore various techniques for the visualization of multivariate and complex datasets. The course objectives will be achieved through hands-on activities using real-world datasets.
In this course, students will learn how to create interactive dashboards for data visualization that can be published on the web (using Google Cloud Platform).
Topics covered include:

- Fundamentals of statistics
- Hypothesis testing
- Statistical normality tests
- Data collation
- Data preprocessing
- Conversion from non-Gaussian to Gaussian distribution
- Pearson correlation coefficient
- Significance testing for correlation coefficients
- Partial correlation coefficient
- Visualization of time-series and categorical data
- Principal Component Analysis (PCA)
- Outlier detection and treatment

Tools:
Python and Tableau Desktop will be the primary tools used throughout the course.

Learning Outcomes: Upon completion of this course, students will be able to analyze and visualize complex data using various Python packages. Tentative Python libraries include:

- pandas
- matplotlib
- seaborn
- numpy
- statsmodels
- scipy

- plotly
- geoplot
- dash

Tableau Desktop will be used in parallel with Python for multivariate data visualization.

Visualization Techniques:

- Line plot
- Subplot
- Bar plot
- Histogram
- Pair plot
- Box plot
- Pie chart
- Scatter plot
- Regression plot
- Heatmap
- Distribution plot
- Q-Q plot
- Hexbin plot

Plotly and Dash will be used to develop interactive, web-based data visualizations.

Prerequisites:

- Python programming

Recommended Course Textbooks:

(1) *Data Analysis and Visualization Using Python*, 1 st Edition **Author(s):** Dr. Ossama Embarak **ISBN-13:** 978-1484241080

(2) *Python for Data Analysis* , 2 nd Edition **Author(s):** Wes McKinney **ISBN-13:** 978-491-95766-0

(3) *Python Data Visualization Cookbook* , 2 nd Edition **Author(s):** Igor Milovanovic **ISBN-13:** 978-1-78216-336-7

(4) *Practical Tableau* , 1 st Edition **Author(s):** Ryan Sleeper **ISBN-13:** 978-149219773

Grading Policy:

- The top three scores from homework/quizzes, Exam I, Exam II and comprehensive final exam will be selected and combined with the final project score to calculate the total course grade. The final term project is a required component of the course and cannot be substituted. All exams and quizzes will be conducted in class. No make-up exams will be provided. Students are expected to attend class on campus and complete assignments. Habitual failure to do so will result in a reduced grade. An incomplete grade will only be granted if a student misses part of the semester due to a medical reason or military deployment. Cheating on examinations, plagiarism, and other forms of academic dishonesty

are serious offenses and may subject the student to penalties ranging from failing grades to dismissal.

The course grade breakdown is calculated as follows:

Homework	$25pts$
Exam I (Wednesday, October 8^{th} @6:10-8:40pm)	$25pts$
Exam II (Wednesday, December 3^{rd} @6:10-8:40pm)	$25pts$
Comprehensive Final Exam (Wednesday, December 10^{th}@ 6:10-8:40pm)	$25pts$
Term Project (Required)	$25pts$

Tentative Course Outline (Subject to Change)

day	Topic	comments
1	Introduction to Data visualization	
2	Fundamental of statistics	
3	Exploratory Data Analysis (EDA)	
4	Static Visualization I	
5	Static Visualization II	
6	Principal Component Analysis (PCA)	
7	Interactive Visualization I	
8	Interactive Visualization II	
9	Front End Dashboard Development	
10	Google Cloud Platform Deployment	
11	Non-Gaussian→ Gaussian	
	No Class November 26^{th}	Thanksgiving
12	Tableau	
13	Final Term Project Presentation	

Attendance:

- The course modality is in-person. On-campus attendance is required.
- All exams & quizzes are timed and closed notes.
- Exams or quizzes may be given during the class time or outside of the class time.
- If missing the exam/quiz day, you will receive zero.
- There will be no make-up exam/quiz.

Grading Scale:

- The tentative grading scale below, based on % determine your final letter grade:

100 - 94 : A	93 - 90 : A^-	89 - 87 : B^+
86 - 83 : B	82 - 80: B^-	79 - 77 : C^+
76 - 73 : C	72 - 70: C^-	69 - 67 : D^+
66 - 63 : D	62 - 60: D^-	$\leq$ 59 : F

- **Labs and Assignments:**
  - The homework will be associated with each module; the homework might be collected or a quiz will be taken.
  - Late assignments will **NOT** be accepted and will receive zero.

Technology:

- The required **IDE** for this class is **Pycharm** (Professional version). You can download the professional version of the Pycharm IDE at [Web Link]
- The instructor for this course does not provide technical support. For technical support assistance please contact GW Information Technology at [Web Link]
- Computer with internet connection.
- Windows or macOS operating system.
- Microphone and camera.

University policies

Use of Electronic Course Materials and Class Recordings

- Students are encouraged to use electronic course materials, including recorded class sessions, for private personal use in connection with their academic program of study. Electronic course materials and recorded class sessions should not be shared or used for non-course related purposes unless express permission has been granted by the instructor. Students who impermissibly share any electronic course materials are subject to discipline under the Student Code of Conduct. Please contact the instructor if you have questions regarding what constitutes permissible or impermissible use of electronic course materials and/or recorded class sessions. Please contact Disability Support Services at disabilitysupport.gwu.edu if you have questions or need assistance in accessing electronic course materials.

University policy on observance of religious holidays

- Students must notify faculty during the first week of the semester in which they are enrolled in the course, or as early as possible, but no later than three weeks prior to the absence, of their intention to be absent from class on their day(s) of religious observance. If the holiday falls within the first three weeks of class, the student must inform faculty in the first week of the semester. For details and policy, see "Religious Holidays" at provost.gwu.edu/policies-procedures-and-guidelines.

Academic Integrity Code

- Academic Integrity is an integral part of the educational process, and GW takes these matters very seriously. Violations of academic integrity occur when students fail to cite research sources properly, engage in unauthorized collaboration, falsify data, and in other ways outlined in the Code of Academic Integrity. Students accused of academic integrity violations should contact the Office of Academic Integrity to learn more about their rights and options in the process. Outcomes can range from failure of assignment to expulsion from the University, including a transcript notation. The Office of Academic Integrity maintains a permanent record of the violation. More information is available from the Office of Academic Integrity at studentconduct.gwu.edu/academic-integrity. The University's "Guide of Academic Integrity in Online Learning Environments" is available at studentconduct.gwu.edu/guide-academic-integrity-online-learning-environments. Contact information: rights@gwu.edu or 202-994-6757.

Academic support

Writing Center

- GW's Writing Center cultivates confident writers in the University community by facilitating collaborative, critical, and inclusive conversations at all stages of the writing process.

Working alongside peer mentors, writers develop strategies to write independently in academic and public settings. Appointments can be booked online at gwu.mywconline.

Academic Commons

- Academic Commons provides tutoring and other academic support resources to students in many courses. Students can schedule virtual one-on-one appointments or attend virtual drop-in sessions. Students may schedule an appointment, review the tutoring schedule, access other academic support resources, or obtain assistance at academiccommons.gwu.edu.

Support for students outside the classroom

Disability Support Services (DSS) 202-994-8250

- Any student who may need an accommodation based on the potential impact of a disability should contact Disability Support Services at disabilitysupport.gwu.edu to establish eligibility and to coordinate reasonable accommodations.

Counseling and Psychological Services 202-994-5300

- GW's Colonial Health Center offers counseling and psychological services, supporting mental health and personal development by collaborating directly with students to overcome challenges and difficulties that may interfere with academic, emotional, and personal success. healthcenter.gwu.edu/counseling-and-psychological-services.

Safety and Security

- In an emergency: call GWPD 202-994-6111 or 911.
- For situation-specific actions: review the Emergency Response Handbook at: safety.gwu.edu/emergency-response-handbook.
- In an active violence situation: Get Out, Hide Out, or Take Out. See go.gwu.edu/shooterpret.
- Stay informed: safety.gwu.edu/stay-informed.

Average Amount time learning per week: Students are expected to spend a minimum of 100 minutes of out-of-class work for every 50 minutes of direct instruction, for a minimum total of 2.5 hours a week. A 3-credit course should include 2.5 hours of direct instruction and a minimum of 5 hours of independent learning or 7.5 hours per week.