

Salisbury University Department of Mathematical Sciences

DSCI 318 : Advanced Methods in Data Science Syllabus (Tentative)

Description: An advanced course in data science concepts, focused on synthesizing diverse, possibly unstructured data to better understand and characterize the world. Topics covered include: the Data Science life-cycle, advanced data representation, data characterization and selection, time series analysis, numerical optimization, loss functions, model comparison, and visual analytics.

4 Hours Credit: Meets 4 Hours per week. **MTWTF 2:2-50**

Prerequisites: C or better in MATH 216, and DSCI 218.

Instructor: Kyle Teller (Professor/Dr. Teller)

Office: HS 118

Email: kgteller@salisbury.edu

Office Hours: XXX or by appointment

Intended Audience: Data science majors and minors, as well as anyone interested in gaining a comprehensive background of visual/quantitative storytelling using the mathematics and statistics fundamental to Data Science.

Objective: To introduce students to the Data Science life-cycle, preparing them to interpret and explain analytic results to broad audiences, using mathematics and statistics in Python and/or R.

Textbooks: Instructor provided lecture notes

References: *An Introduction to Statistical Learning, with Applications in Python*, by James, Witten, Hastie, Tibshirani, and Taylor; Springer, 2023.

Technology: *Common Data Science programming languages, such as Python, R, and their associated software packages. Version management such as GitHub.*

Topic	Weeks
Data Science Review	1
Review of the foundations of Data Science. This may include topics such as: the Data Science Life Cycle, Matrix and vector norms, database queries, and an overview of learning algorithms, etc.	
Exploratory Data Analysis and Data Transformation	2.5
Understand how to gain initial insight into data, representing and transforming data in meaningful and consistent ways. This includes pre-processing, statistical visualization, serial and vector transformation (including text data), processing data features, and dimensional reduction for model specification.	
Time Series Analysis	2
Understand key concepts of time series models such as moving average models (MA), and auto-regressive models (AR). Focusing on how to use these models as a basis for forecasting.	
Numerical Optimization and Loss Functions	2
Understand the mathematical formulation and practical meaning of loss functions; Solution optimization via gradient decent and iterative solvers.	
Ensemble and Aggregation Methods	2
Understand how to build more complex models using the aggregation and/or combination of simpler models, such as bagging, boosting, and voting.	
Model Assessment, Selection, and Tuning	2.5
Learn how to compare different models using metrics and how to tune model parameters to obtain better accuracy. Understand how to define accuracy of a model using vector and matrix norms. Understand the use of Mathematical and Statistical metrics, such as: ANOVA, accuracy, precision, recall, BIC, MDL, and cross-validation.	
Data Story-Telling	1
Effectively communicate results of a Data Science project/experiment using professional writing, mathematical plots, and interactive visualizations.	
Tests and Quizzes	1

Total

14

Evaluation

Homework	25%
Projects	35%
Tests and Quizzes	20%
Final project	20%

A: 90-100 B: 80-89.9 C: 70-79.9 D: 60-69.9 F: Below 60

Student Learning Outcomes (SLO's): At the successful completion of the course, students should be able to:

1. Perform exploratory data analysis to guide the development of associated predictive models
2. Expand computational and mathematical skills to include contemporary, industry-standard methods in Data Science
3. Effectively communicate the results of a data science projects using data and model visualizations, dashboards, professional writing, and professional presentations
4. Generate complex models in solution to real-world problems and understand the tradeoffs of adopting different model strategies

Attendance

I expect you to attend class every day. Please come to class prepared—I **expect you to ask and answer questions at least once during class**. When other classmates are presenting I expect you to pay attention and ask questions if you have them. Please behave respectfully!

Late Work

Work that is late without reasonable excuse will receive a 10% reduction in the grade for each class day it is late. Explanation documents with proper signature may be required for all reschedules.

Written Work

Clear descriptions of thought processes, evidence of critical thinking, and effective communication must be demonstrated in written work.

Homework

Students will have weekly reading assignments. Students will also have semi-weekly homework assignment. These homework assignments will give students practice with concepts and ideas talked about in class the previous week.

Projects

Projects will be assigned throughout the course. These projects will be started in the weekly lab class and finished outside of the classroom.

Tests and Quizzes

semi-weekly formative quizzes will be given. Summative tests will be given after one or more units have been covered.

Final Project

Students Students will utilize the knowledge they have developed throughout the class to investigate a dataset and use it to tell a story. Students will develop a proposal for their project around mid-semester and work on it during labs and outside of the class. These activities will culminate in a final written report and an in-class presentation during finals week.

Communication and MyClasses

MyClasses and email will be used extensively to make announcements and post course material. Please check your email at least once per day, and download and print the course material before the class. Additionally, if you want to share the material with anyone outside of this course, you must ask my permission — failure to do so violates copyright law.

Links to SU Course Policies and Procedures are provided via the sidebar in MyClasses.

Technology in Class

We will be using a computing lab for class once a week, but you may bring your own laptop. I ask that you use them in a way that does not distract your classmates. Please keep your cell phones in your bag or pocket. Python and Jupyter notebooks will mainly be used in this class. This software is available on all SU Lab computers. You can visit Academic Commons or Perdue Hall 141 for usage of Lab computers.

Students with Disabilities

Any student registered with the Office of Access & Accommodations (OAA) who would like to utilize approved accommodations in their courses should contact their faculty members as soon as possible to arrange a meeting to coordinate any and all accommodations.

Students with disabilities can request reasonable accommodations, auxiliary aids and services, and/or modifications to University policies, through the OAA by following the OAA's procedures for Requesting Accommodations, Modifications, Aids, and Services. For more information, refer to the OAA page at <https://www.salisbury.edu/administration/student-affairs/access-and-accommodations/> or contact the office at accommodations@salisbury.edu or the following address:

Office of Access & Accommodations
Guerrieri Student Union, Rm 229

Writing Across the Curriculum

Students will be expected to communicate mathematics and mathematical ideas effectively in speech and writing. At the University Writing Center, trained consultants are ready to help you at any stage of the writing process. In addition to the important writing instruction that occurs in the classroom and during professors' office hours, the Center offers another site for learning about writing. **All students are encouraged to make use of these important services.**

NOTE:

Once a student has received credit, including transfer credit, for a course, credit may not be received for any course with material that is equivalent to it or is a prerequisite for it.