ISE 529 Predictive Analytics
4 Units

Day/Time: Fall 2024, Tue & Thu 2:00-3:50 PM
Location: ZHS 163

Instructor: Dr. Tao Ma
Office: GER 216
Office Hours: Thursday 11:00 AM-12:00 PM or by appointment via email

Contact Info: ma.tao@usc.edu

Teaching Assistants: Ke Xu
Office Hours: Friday 10:00 AM-12:00 PM via ZOOM
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Course Description

This course aims to learn fundamental statistical (machine) learning methods for quantitative prediction and categorial classification through intensive programing exercises with Python. The course covers the following topics:

- Linear Regression: model estimation, assessment and selection, shrinkage and regularization, cross-validation and bootstrap
- Generalized Linear Models for Classification: Logistic regression, Poisson regression, Linear Discriminant Analysis, Naïve Bayesian Method
- Dimension Reduction Methods: Principal Component Analysis for high-dimensional data
- Nonparametric Methods for Nonlinear Variables: Spline and Kernel regression
- Tree-Based Methods and Ensemble Models: Decision Trees, Bagging, Boosting, Random Forest
- Support Vector Machine for classification
- Deep learning Neural Networks: MLP, CNN and RNN for prediction and classification

Learning Objectives and Outcomes

- Understand key concepts for measuring the performance of analytical models and techniques and evaluate and determine appropriate machine learning models.
- Analyze the given data set and apply appropriate modeling techniques for quantitative prediction and/or categorial classification
- Develop supervised Neural Network models for prediction and classification.
- Develop skills in using the Python programming environment and the primary packages and tools to implement basic machine learning tasks.

Prerequisite(s):

Working knowledge on Python programing, statistics and probability, linear algebra

Recommended Preparation:

ISE 150 Python programing, ISE 220/225 Probability/Engineering Statistics
https://www.datacamp.com/courses/intro-to-python-for-data-science

Course Notes

All course materials (lecture slides, homework, labs/exercises, etc.) will be distributed via Brightspace. All assignments will be submitted through Brightspace.

Technological Proficiency and Hardware/Software Required

The course requires Python programming language and several of its key data science packages. Jupyter Lab or Notebook is used as the main interface for documenting the scripts and results. These are all open source and can be downloaded by the student for no cost. The computing platform can be personal laptop, the Viterbi VDI (virtual desktop) or HPC in USC CARC

Textbooks

Required:
- James, Gareth et. al., An Introduction to Statistical Learning with Applications in Python (ISLP), Springer 2023, ISBN 978-3-031-38746-3. This textbook can be downloaded free of charge from the author's website at: https://www.statlearning.com/

Optional:
- Trevor Hastie et. al., The Elements of Statistical Learning Data Mining, Inference, and Prediction, 2nd Edition, 12th printing, Springer 2017
- Max Kuhn and Kjell Johnson, Applied Predictive Modeling, Springer 2013, ISBN 978-1-4614-6848-6
- Sebastian Raschka and Vahid Mirjalili, Python Machine Learning, 2nd Edition, Packt Publishing 2017 ISBN 978-1-78712-593-3
- José Unpingco, Python Programming for Data Analysis, Springer 2021, ISBN 978-3-030-68951-3

Description and Assessment of Assignments

The course grade distribution is as follows:
- Homework assignments (approximately 9) – 50% of final grade
- Midterm exam (in class) – 20% of final grade
- Final exam – 30% of final grade

Grading Scale

Course final grades will be determined using the following scale

A	95-100
A-	90-94.9
B+	87-89.9
B	83-86.9
B-	80-82.9
C+	77-79.9
C	73-76.9
C-	70-72.9
D+	67-69.9
D	63-66.9
D-	60-62.9
F	59.9 and below

Up to two points may be added to the overall grade based on class participation.

Assignment Submission Policy

Assignments will all be prepared and submitted using Jupyter Lab or Notebook or PDF as directed. Any other file format (e.g., jpeg) will not be accepted for grading. They should be submitted via Brightspace by the due date. No make-up exams are considered.

Timeline and Rules for Submission

Homework assignments will be posted on Brightspace.
All assignments must be submitted by the due date. No late assignments will be accepted. Any student who fails to submit an assignment on time will receive a zero grade for that assignment.

Course Schedule

This following table is a weekly breakdown tentative schedule and subject to change according to the actual class situation throughout the semester. Please follow the announcement in class or Brightspace for the latest update.

Week	Tue/Thu	Topics/Contents	Homework	Reading Textbook (ISLP)
1	8/27	Introduction		
	8/29			
2	9/3	Linear Regression		Chapter 2, 3, 5, 6
	9/5		HW 1	
3	9/10			
	9/12		HW 2	
4	9/17	Generalized Linear Models (for classification)		Chapter 4, 5
	9/19			
5	9/24		HW 3	
	9/26			
6	10/1		HW 4	
	10/3	Review Session		
7	10/8	Midterm Exam		
	10/10	No class (Fall Recess)		
8	10/15	Tree-Based Methods		Chapter 8
	10/17		HW 5	
9	10/22	Dimension Reduction Method		Chapter 6
	10/24		HW 6	
10	10/29	Nonparametric Methods		Chapter 7
	10/31	Support Vector Machine		Chapter 9
11	11/5		HW 7	
	11/7	Deep Learning Neural Networks		Chapter 10
12	11/12			
	11/14		HW 8	
13	11/19			
	11/21			
14	11/26		HW 9	
	11/28	No Class (Thanksgiving Holiday)		
15	12/3	Review Session		
	12/5	Final Exam		

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Office of Equity and Diversity http://equity.usc.edu or to the Department of Public Safety http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The Center for Women and Men http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage http://sarc.usc.edu describes reporting options and other resources.

Support Systems:

Student Health Counseling Services - (213) 740-7711 – 24/7 on call
engemannshc.usc.edu/counseling
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call
suicidepreventionlifeline.org
Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 – 24/7 on call
engemannshc.usc.edu/rsvp
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) | Title IX - (213) 740-5086
equity.usc.edu, titleix.usc.edu
Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

Bias Assessment Response and Support - (213) 740-2421
studentaffairs.usc.edu/bias-assessment-response-support
Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

The Office of Disability Services and Programs - (213) 740-0776
dsp.usc.edu
Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Support and Advocacy - (213) 821-4710
studentaffairs.usc.edu/ssa
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.
Diversity at USC - (213) 740-2101
diversity.usc.edu
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
dps.usc.edu, emergency.usc.edu
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call
dps.usc.edu
Non-emergency assistance or information.