

MATH 475/575 – Statistical Machine Learning Fall 2020

Version: 0.5

This is a preliminary version of the syllabus.

The final version will be completed by August 26, based on student feedback.

Course Information

Instructor	Dr. Andrew Penland
Contact Information	Office: 443 Stillwell Phone: (828)227-2483 email: adpenland@email.wcu.edu
Class Times and Location	6 - 7:15 PM, Thursdays via Zoom: https://wcu.zoom.us/j/91628225789 .
Office Hours	TBD based on student feedback
Rental Textbook	Python Machine Learning: Machine Learning and Deep Learning with Python, sci-kitlearn and TensorFlow , by Raschka and Mirjalili. <i>Third Edition</i> , ISBN 978-1789955750 (If you have the second edition, we can probably make it work.)
Computer Requirements	Students should have regular access to a computer capable of running Python 3.7. Please see the handout <i>Getting Started with Computing Resources</i> for more information.

Course Learning Objectives

By the end of the course, students will be able to:

- Differentiate between classes of methods and the situations in which they should be applied
- Compare and contrast the flexibility and interpretability of multiple statistical procedures in the solution of a problem
- Evaluate and implement multiple statistical learning algorithms to answer a particular question of interest using data
- Justify the selection of a proposed method through an understanding of the theoretical framework supporting it
- Apply appropriate computing/programming skills to administer a statistical learning algorithm
- Communicate the results from a statistical analysis orally and in writing in an appropriate level of detail for an intended audience
- (For MATH 575 students) Create a report, application, or other work that is suitable for submission to an employer or inclusion in a portfolio

Course Description & Topics

This course blends the algorithmic perspective of machine learning in computer science and the predictive perspective of statistical thinking. Topics include regression, classification, algorithmic analysis of models, performance metrics and

prediction, cross-validation, data transformations, dimension reduction, supervised and unsupervised learning and ensemble methods.

Structure of the Course

- In a typical week, there will be 150 minutes of instructional time each week, split into
 - 75 minutes of asynchronous material (videos, readings, activities, etc.) posted to Blackboard by Monday morning
 - 75 minutes of synchronous video meeting, held via Zoom at <https://wcu.zoom.us/j/91628225789>, on Thursdays from 6-7:15 PM.
- Depending on the week, students may also be asked to complete:
 - formative “checkpoint” questions on new material (typically due Wednesday)
 - summative quizzes on previous material (typically due Saturday)
 - larger-scale projects, similar to purpose and scope to Exams

Grades

The final grade will be based out of 500 points. Each assignment graded will be given a point total. The final grade will be determined by the calculation

$$\frac{\text{total points earned}}{500}$$

Students will complete projects, activities, problem sets, quizzes, and a comprehensive final exam, with the anticipated weighting as follows:

Grade Breakdown	
Projects	40%
Problem sets	20%
Quizzes	20%
Activities	10%
Cumulative take-home final exam	10 %

The final course grade will be based on scales at least as generous as the following.

For MATH 475 Students:

A+	98 - 100	B+	88 - 89.9	C+	78 - 79.9	D+	68 - 69.9	
A	92 - 97.9	B	82 - 87.9	C	72 - 77.9	D	62 - 67.9	F 0 - 60
A-	90 - 91.9	B-	80 - 81.9	C-	70 - 71.9	D-	60 - 61.9	

For MATH 575 Students:

A	90 - 100	B	80 - 89.9	C	70 - 79.9	F	< 70
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Types of Assignments

- **Projects.** spaced roughly evenly throughout the semester. Projects will offer the opportunity to reflect upon and synthesize the course material up to that point. The final project for Math 575 students will be a professional-quality report, 8-10 pages in length. The final project for Math 475 students will be a poster presentation.
- **Activities (including checkpoints).** These are intended as small assignments that provide formative feedback on a student’s understanding of the material covered.
- **Problem Sets.** These are more in-depth than activities, often inviting mathematical exploration or computer experimentation. Students will not be required to write proofs, but they will be expected to give clear reasoning and supporting evidence. These will typically be assigned on a Thursday and due on a Friday (eight days later).
- **Quizzes.** These will be on Fridays, every other week, through Blackboard.
- **Final Exam.** The Final Exam will be a reflective experience with a mixture of theory and programming. I wish I could call it the “Fun-al Exam”, because I think you will enjoy it.

Attendance

Students should do everything possible to keep up with the material by accessing the videos, completing the activities on time, and attending the Zoom meetings. In the event that a student falls behind on material or must miss a scheduled class meeting, they should contact the instructor as quickly as possible.

Late Work

Each student has a total of five “day passes” that may be used to extend assignment deadlines without penalty. When a student chooses to use one of these passes, they must e-mail the instructor **before the scheduled due date** to indicate how many days they would like to extend their deadline. These “passes” may be used in any combination up to five days (e.g. extend one deadline by five days, extend one assignment deadline by two days and another by three days, extend five assignment deadlines by one day each, etc.)

Day passes may not be used past the final day of classes or on the Final Exam. Unused day passes may be redeemed at any time towards points (out of 500) on the final grade, at a rate of 3 points/day pass. In other words, if all assignments are turned in on time, the student will earn a +3% bonus towards their final grade, which may be enough to affect the letter grade

Expectations in and outside of the Classroom

These will be determined during a discussion during the first week of class. After this discussion occurs, a table summarizing the agreements made during the discussion will take place.

Communication: If you have any questions or concerns about the course, please **e-mail me**. You do not need to wait for a class meeting to raise an issue.

In a typical week, I check e-mail Monday - Friday at 3:30 PM, so you should expect responses during that time. Please try to be specific in your e-mail communication, especially when troubleshooting code. Don't be afraid to give too much information. Attached files, specific code snippets with error messages, screenshots, etc. are extremely helpful.

Instructor's Statement on Classroom Environment: According to 2018 study the American College Health Association¹, 63% of undergraduate students reported feeling “overwhelming anxiety” at some point within the last year. That this has become the norm rather than the exception among students is a serious issue that must be addressed.

The data doesn't tell us how much of this anxiety is related to academics. I believe, unfortunately, that many faculty bear a direct responsibility in this crisis. We too often create an environment which destroys the opportunity for learning, rather than promoting it. Growth mindset, the best attitude for learning, suffers tremendously in short-sighted, high-pressure environments.

To students: do you remember when learning was fun? When you couldn't wait to figure out something for yourself, to knock over a jar just to see what would happen, or to ask a wise adult why something was the way it was? How do you think it would affect your performance if you could capture even a small piece of that enthusiasm and curiosity you once felt?

I believe that faculty members have a professional obligation to model healthy work habits for students, including gratitude, enthusiasm, consistency, efficiency, and work-life balance. There are times when I fall short in each of these areas, yet I still know it is a worthwhile ideal. Let us strive in this class to focus on using our time and energy wisely, while taking care of ourselves and building a foundation for sustainable lifelong performance.

Tentative Topics and Schedule

Week 0: Let's Get Started (Laying the Foundation)

Week 1: What's In a Line? (Python Review, Linear Regression, Exploratory Data Analysis)

Week 2: Asking the Right Question (Feature Engineering, Data Preprocessing, Regularization)

Week 3: If I Had a Hammer (SVM, Classification, Assessing Model Performance, Logistic Regression)

Week 4: Making Decisions (k-Nearest-Neighbors, Decision Trees, Random Forests)

Week 5: Keep Trying, You'll Get Better (Boosting)

Week 6: Teamwork Makes the Dream Work (Ensemble Learning)

Week 7: Don't Label Me (Unsupervised Learning)

¹https://www.acha.org/documents/ncha/NCHA-II_Fall_2018_Undergraduate_Reference_Group_Data_Report.pdf

Weeks 8 - 10: The Power in a Neuron (Neural Networks)
Week 11: Let's Talk It Out (Natural Language Processing)
Week 12-13: Your Ideas (Additional topics related to student interest)

Statement on Accommodations for Students with Disabilities

Western Carolina University is committed to providing equal educational opportunities for students with documented disabilities and/or medical conditions. Students who require reasonable accommodations must identify themselves as having a disability and/or medical condition and provide current diagnostic documentation to the Office of Disability Services. All information is confidential. Please contact the Office of Disability Services at (828) 227-3886 or come by Suite 135 Killian Annex for an appointment.

Mentoring and Persistence to Success (MAPS):

Mentoring and Persistence to Success (MAPS) provides support to students who are first-generation (neither parent has a four-year degree), low-income, financially independent (emancipated youth, homeless or without consistent residence, or aged out of foster care), or those who have participated in the Academic Success Program (ASP) or Catamount Gap. For those who enroll, MAPS provides a variety of services, including academic advising, mentoring, and personal and social coaching. You may contact MAPS at (828) 227-7127 or email maps@wcu.edu for more information. MAPS is located in 205 Killian Annex.

Statement on Academic Integrity (including Plagiarism)

The allowed use of outside help and materials for each assignment will be clearly stated in the assignment. Students will sign a statement indicating that they understand the rules of the assignment. Any violation of the agreed-upon rules will place the offender in jeopardy of Academic Dishonesty proceedings, as outlined below.

Academic Integrity Policy

Western Carolina University, as a community of scholarship, is also a community of honor. Faculty, staff, administrators, and students work together to achieve the highest standards of honesty and integrity. Academic dishonesty is a serious offense at Western Carolina University because it threatens the quality of scholarship and defrauds those who depend on knowledge and integrity. Academic dishonesty includes:

1. **Cheating**-Intentionally using or attempting to use unauthorized materials, information, or study aids in any academic exercise.
2. **Fabrication**-Intentional falsification of information or citation in an academic exercise.
3. **Plagiarism**-Intentionally or knowingly representing the words or ideas of someone else as one's own in an academic exercise.
4. **Facilitation of Academic Dishonesty**-Intentionally or knowingly helping or attempting to help someone else to commit an act of academic dishonesty, such as knowingly allowing another to copy information during an examination or other academic exercise.

Instructors have the right to determine the appropriate sanction or sanctions for academic dishonesty within their courses up to and including a final grade of "F" in the course. Within 5 calendar days of the event the instructor will inform his/her department head, and the Associate Dean of the Graduate School when the student is a graduate student, in writing of the academic dishonesty charge and sanction.

The procedures for cases involving allegations of academic dishonesty can be found in the Student Handbook at <http://catalog.wcu.edu/content.php?catoid=29&navoid=560#honestypolicy>

Academic Calendar

WCU's Academic Calendar contains all important dates for the semester and year, as well as registration information.

Final Exam

The university final exam schedule can be found on this page: <http://www.wcu.edu/learn/academic-services/registrars-office/>

Changes

We live in a chaotic world where unforeseen events are the norm. The Instructor reserves the right to make changes as appropriate, with the goal of furthering student learning.