ECN 5090 - Machine Learning in Economics and Finance
Spring 2022 - Syllabus

Contact Details

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Location and Time

Class Huntsman Hall 270, **Mon** and **Wed** 3:00pm to 4:15pm

Office Hours Every **Wednesday** from 12:30pm to 2:30pm or by appointment

Exams Final Exam: **Wednesday May 4**, 3:30pm to 5:20pm

Course Materials

Textbooks:

1. CFA Program, Level II, Quantitative methods, Machine Learning (the PDF version will be provided)
2. *An Introduction to Statistical Learning* by Gareth James Et al. **Free** online version here
3. *The Elements of Statistical Learning* by Hastie, Tibshirani and Friedman. **Free** online version here
4. *THE HUNDRED-PAGE MACHINE LEARNING BOOK* by Andriy Burkov. **Free** online version here

Online Courses:

1. *Statistical Learning*: **Hastie and Tibshirani**, offered by Stanford Online Course. You can sign up for free here
2. *Machine Learning*: **Andrew Ng**, offered by Coursera (Stanford). You can sign up for free here

Slides: I use slides to present material in class. A complete set of slides is available on my GitHub account. I frequently update the slides (make corrections/clarifications, etc). Make sure you print the slides, attend classes, take notes and follow up with changes on the GitHub repository.

Canvas: I will use Canvas to send emails to the class, as well as post announcements, homework assignments and solutions, grades, and other course materials. It is your responsibility to ensure that you have access to Canvas and your USU email address is properly set up to receive emails through Canvas.

Media Gallery: Classes will be recorded and medias will be available on Canvas for your reference. However, this should not tempt you to skip any classes. Attendance is **mandatory**!

Software: I will use **Python** for this course. Python is an Open source (free to download and install) software. There will be a crash course on Python during the first week of the semester.

Course Description

This course introduces several fundamental concepts and methods for machine learning. The objective is to familiarize the students with some basic learning algorithms and techniques and their applications, as well as general questions related to analyzing and handling large data sets. Several software libraries and data sets publicly available will be used to illustrate the application of these algorithms. The emphasis will be thus on machine learning algorithms and applications, with some broad explanation of the underlying principles.

Prerequisites:

- STAT 2000 or STAT 2300 or STAT 3000.
- ECN 4330 or an equivalent econometrics course (if you have not taken any econometrics course already, we need to talk)

Course Objectives

The general course objectives are as follows:

1. Extraction, transformation, joining and cleaning of large data sets
2. Analyze large data sets to bring out insights to solve business problems
3. Use machine learning libraries and apply established machine learning algorithms in Python
4. Hands-on knowledge on Machine learning concepts in Python using problem solving approach by working on real time cases and in class programming assignments

Note that this is an applied course so I will try to keep mathematical notation to a minimum and instead will focus attention on using data, software and interpreting results.

Evaluation Methods and Criteria:

Your grade on the course is based on your performance in:

Group	Weight(%)
Assignments	40
Final Exam	10
Final Project / Presentation	10
Lecture Quizzes	30
Class participation	10
Total	**100**

Assignments (40%)
Completing all assignments is necessary for learning the class materials. I highly encourage you to discuss the homework problems with your peers, however, the submitted work should represent your **team** work. The key will be released on Canvas and no homework submitted after that can be accepted.

Final exam (10%)
The final exam is a combination of multiple choice and short answer questions focusing on machine learning concepts only! (no calculation)

Final project/Presentation (10%)
A final project will be due in **team** work by the last day of classes. Projects will be done in teams of no more than 3 students. A forthcoming handout will explain this project in more detail.

Lecture Quizzes (30%)
Throughout the semester, there will be frequent **online quizzes** due **before** each class. You will have **two opportunities** to take each quiz, but remember the correct answers will be revealed after the last attempt! The goal is to take attendance and make sure you are following the materials. At the end of each quiz you will be asked how do you feel about the course and if you have any questions from the lectures! This is your best chance to communicate with me. Hearing your concerns/regret at the end of the semester through evaluation forms is too late! Let's make it a win-win game!

Note: Your **two** lowest scores will be dropped i.e. no late submission is accepted.

Class participation (10%)
Actively engaging in class is an essential part in your learning process. Collaboration is a highly recommended in this class. For each lecture, there will be a dedicated **Discussion board** available on Canvas. I expect you to take advantage of Canvas discussions for the following subjects:

- Questions from the lectures
- Coding questions in general
- HW assignments
- Helping each other out!

The goal is to learn from each other while having friendly and healthy competition.

Grade Scheme

Your final grade for the course will be determined by simply adding together the points earned from assignments, quizzes, class participation, the final exam and final project/presentation. The following grading standards will be used in this class:

Grade	Range (Percent)
A	93 - 100
A-	90 - 93
B+	87 - 90
B	83 - 87
B-	80 - 83
C+	77 - 80
C	73 - 77
C-	70 - 73
D+	67 - 70
D	60 - 67
F	0 - 60

If you could manage to get an A in my class, you will be on my "Top Students" list. The top students are eligible to become my TA for the following semesters. I would be more that happy to write you a recommendation letter if you get an A in this course.

Course Outline : For a detailed schedule, please visit the "Tentative course schedule".

1. Python Crash Course
2. Data Pre-processing
3. Cross Validation and Grid Search
4. Optimizers
5. Supervised Learning Models
    - Regression Analysis
        - Linear Regression Models (simple, multiple and polynomial)
        - Logistic Regression
        - Support Vector Regression (SVR)
        - Decision Trees and Bagging regressors
        - Boosting and Random Forests regressors
    - Classification
        - K-Nearest Neighbors (KNN)
        - Support Vector Classifiers (SVC)
        - Decision Trees and Bagging classifiers
        - Boosting and Random Forests classifiers
6. Unsupervised Learning Models
    - Clustering techniques

    - K-Mean Clustering
    - Hierarchical Clustering
  - Dimensionality Reduction techniques
    - Principle Component Analysis (PCA)
7. High level introduction to Deep Learning and Reinforcement Learning

Final notes:

1. Make sure you read the University Policies and Procedures
2. **Classroom Civility**: Utah State University supports the principle of freedom of expression for both faculty and students. The University respects the rights of faculty to teach and students to learn. Maintenance of these rights requires classroom conditions that do not impede the learning process. Disruptive classroom behavior will not be tolerated. An individual engaging in such behavior may be subject to disciplinary action. Read Student Code Article V Section V-3 for more information.
3. **Final Grade**: Your final grade is assigned according to the guidelines laid out in this document. I will not change my grading guidelines or cut-offs. If for any reason you absolutely need to pass this class with certain grade (e.g. you need to maintain a certain GPA to be eligible for a scholarship, etc.), YOU are responsible to work hard enough to make that happen. **I will not respond to any request for grade change or extra assignments at the end of the semester**.
4. **Recording**: No student may record or tape any classroom activities without my explicit written consent.

Syllabus Disclaimer

The syllabus is a statement of intent and serves as an implicit agreement between the instructor and the student. Every effort will be made to avoid changing the course schedule but the possibility exists that unforeseen events will make syllabus changes necessary.