ECON 490 - Syllabus

Applied Machine Learning in Economics

Fall 2021

Logistics

- **Credits**: 3 Undergraduate
- **Class Time**: TR 2:00pm–3:20pm
- **Class Location**: Zoom
- **Course Content and Announcements**: Compass2g
- **Lecture Recordings**: Box
- **Discussion Board**: Piazza

Instructor: Julian Wade Oolman (jjpwade2@illinois.edu)

Teaching Assistants Email Office Hours

- **OMITTED**

Please give advanced notice that you will be attending office hours. Otherwise, you might find yourself in an empty Zoom room.

Prerequisites

- **Courses**: ECON 203 & MATH 220/221
- **Programming**: None

Required Textbooks

- **Required** – Python for Data Analysis 2nd Ed. by Wes McKinney
- **Required** – Hands on Machine Learning 2nd Ed. by Aurélien Géron

Program Downloads

- Anacodna – Data science hub (Python and more!)
- Git – Version control

The Course

This is an introductory applied machine learning course with applications in economics. You will gain exposure to a variety of data science topics. We will cover data wrangling and cleaning, exploratory data analysis, inference, and prediction in Python. Prediction constitutes the bulk of the course, where we will predict continous variables, binary variables, and multiclass variables.

Lectures will be recorded. The first quarter of the course has a more traditional lecture style with slides and live coding. The remainder of the lecture will be focused on active learning, where the first portion will provide intuition of techniques with slides and the last is a workshop. Students will work in groups of 3–4 on a task. A random group will present each workshop.

Coding is like riding a bike. You can read as many books on it as your want, but the only way to learn how to ride is to do it. Oh, and the other use of the simile "like riding a bike".

Learning Objectives

By the end of the course, you should be able to describe what is in the black box of machine learning. You should have a solid understanding of when to apply specific techniques, how to validate these models, and how to compare across different methods. Furthermore, you should have an intuitive understanding of the bias-variance tradeoff for each technique.

You should also feel comfortable programming in Python. This includes implementing the statistical techniques learned in class and dealing with data, from loading and saving, cleaning and wrangling, exploratory data analysis, and presenting results.

This course is also intended to help you interact with the material and teach you good analyst habits. Coding is not as glamorous as Hollywood would have you believe. It is a lot of, why the @#!&$ isn't my code working? We will learn how to attempt to solve the problem ourselves, if not to ask a friend, if not ask a forum, if not ask a superior. With regards to this class, the steps are outlined in the Coding Assistance Checklist

Teaching Philosophy

I never want to give work that is just busy work or irrelevant. If you find some assignments are a pain, know that I have assigned it for a reason. My goal is to help you learn and become a professional. This primarily a coding class, but there will be some important theory all data scientists should know.

I believe asking questions and communicating early paired with putting in the effort is the key to success not limited to this course. Remember, I will not try to overwhelm you in this course.

Any sort of discrimination is strictly prohibited and unacceptable. I will follow up with the university about any cases. Everyone is, and should feel, included.

Expectations

Of you

I expect you to start on course work early, to follow the Coding Assistance Checklist, to be prepared with questions and do the readings for course time (such as questions on the muddiest point), to attend lecture, to communicate about inability about deadlines ASAP, and to ask for help when you need it.

Of me

I will only give assignments and problems if I believe they will help you understand the material and/or will be applicable in future life. I am most likely available by email from 9:00am-5:00pm central time. I will always do my best to respond within 24 hours. I will ask for periodic anonymous feedback on the course and adjust accordingly. I am teaching to help you learn.

Grading

GPA	Letter	Percentage
4.0 & ★	A+	[97%, ∞)
4.0	A	[93%, 97%)
3.7	A-	[90%, 93%)
3.3	B+	[87%, 90%)
3.0	B	[83%, 87%)
2.7	B-	[80%, 83%)
2.3	C+	[77%, 80%)
2.0	C	[73%, 77%)
1.7	C-	[70%, 73%)
1.3	D+	[67%, 70%)
1.0	D	[60%, 67%)
0.0	F	[0, 60%)

The final grade is broken down into **six homework assignments** to apply the concepts learned in class; **quizzes** from a pool of prior given questions source from readings, lectures, or workshops and are due at the end of the day; **attendance**[1]; and a **final project** to creatively apply techniques learned in class to an individually chosen (approved by instructor) research question.

Homework		Final Project		Other	
HW1 - Yeehaw! Data Wrangling	10%	FP1 - Proposal	2%	Quizzes	5%
HW2 - EDA, Regression, & You	10%	FP2 - EDA	3%	Attendance	5%
HW3 - Classy Validity	10%	FP3 - Preliminary Results	5%		
HW4 - Rise of the Machines	10%	FP4 - Presentation	10%		
HW5 - Forest through the Trees	10%	FP5 - Final Draft	10%		
HW6 - LearNNing Deeply	10%				
Total:	60%		30%		10%

See the Tentative Schedule for tentative due dates.

Grading FAQs

Can I work together with my classmate?

Yes. If you work with another student on **homework assignments**, you must write up your own solutions and write "Collaborated with (insert_peer's_name_here)" on the top of your assignment. I encourage you to try the problems on your own first, however.

You may also work with a partner on the **final project** if you get prior approval from the instructor. Working as a group comes with additional requirements. Both partners receive the same grade.

[1] Please let me know in advance if you cannot attend due to timezone differences. Accommodations will be made.

Will there be a curve?

Nope.

But what about extra credit?

1. Each instructor endorsed answer on Piazza will add 0.2% to your final grade *at the end of the semester*
2. If I start a lecture without recording and you verbally remind me, I will give you a 1% bonus to your final grade.
3. The second half of neural network is open ended. There will be a bonus for the top performing model.
4. Final project presentations will be recorded (unless you tell me you don't want to be recorded). The person voted wtih the best presentation will receive a 10% bonus on her/his presentation.

Are there late assignment penalties?

Yep. Here is a list of lateness to total possible credit:

- (0, 1 hour] - 90% credit
- (1 hour, 2 days] - 75% credit
- (2 days, 1 week] - 50% credit
- (1 week, ∞] - 0% credit

Can I provide homework solutions for partial credit?

Yes. You must provide the reason why you got the problem wrong in addition to a completely corrected assignment. You can get 50% of the points back. Late penalties still apply.

Reasons such as "I didn't know the answer", "I got it wrong", or "my dog at my homework"[2] are invalid. An example of a valid reason is "I mistakenly thought that $C \to \infty$ means no margin violations". It is up to the discretion of the grader to assign either 50% or 0% credit for each problem.

Can I ask for a regrade?

Yes. All regrade requests must be submitted in writing to the instructor no more than one week after the assignment has been graded. The request must be written and include a detailed summary of why you believes the grade they received was incorrect. I will regrade the entire assignment, so the grade may go up or down. Consequently, you should only request a regrade if they are very confident that the original grade they received was incorrect.

[2] Your dog ate your computer!?

Policies

Make-up Exams

There will be no make-up exams, because there are no exams.

Attendance Policy

Attendance is five percent of your final grade as are quizzes that will be given during class time. It is entirely up to you if you do not want to show up to class. I can tell how long you are in the meeting. *You must attend for the entire duration of the lecture to receive credit.* **Please let me know in advance if you cannot attend.**

Student Code pertaining to student attendance.

Office of the Dean of Students helps to assist students navigate the Student Code and course policies. If students will be absent for an extended period of time, they should discuss with this office.

Piazza Policy

Students are encouraged to use Piazza for their questions and to help their peers. In doing so, students may **not post solutions in any form in public posts** whether in a question or response to another student. If you are concerned about this violation, please make a private post.

Coding Assistance Checklist

1. Read your error code
2. `the_function.you_are_using?`
3. Web search your error code
4. Check for your question or ask on Piazza (remember the Piazza Policy)
5. Email TA, email instructor, and/or go to office hours

Academic Assistance

Students are encouraged to utilize the many resources we have throughout campus to assist with academics. We recommend that you seek them out starting early in the semester, not just in times of academic need, in order to develop good study habits and submit work which represents your full academic potential. Many resources may be located on the Economics Website, including information about the Economics Tutoring Center, other tutoring centers.

Academic Integrity

According to the Student Code, "It is the responsibility of each student to refrain from infractions of academic integrity, from conduct that may lead to suspicion of such infractions, and from conduct that aids others in such infractions." Please know that it is my responsibility as an instructor to uphold the academic integrity policy of the University, which can be found here.

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policies. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity. Read the full Student Code.

Students with Disabilities

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES you may visit 1207 S. Oak St., Champaign, call 333-4603 (V/TTY), or e-mail a message to disability@illinois.edu

DRES Website

Emergency Response Recommendations

Emergency response recommendations.

I encourage you to review this website and the campus building floor plans website within the first 10 days of class.

Family Educational Rights and Privacy Act (FERPA)

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See the registrar's website for more information on FERPA. Student information and records will not be released to anyone other than the student, unless the student has provided written approval or as required by law. More information may be found here.

Sexual Misconduct Reporting Obligation

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX and Disability Office. In turn, an individual with the Title IX and Disability Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options. A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here. Other information about resources and reporting is available here.

Student Support

The Counseling Center is committed to providing a range of services intended to help students develop improved coping skills in order to address emotional, interpersonal, and academic concerns.

Please visit their website to find valuable resources and services:

Counseling Center

- Information: 217-333-3704
- Location: Room 206, Student Services Building 610 East John Street, Champaign, IL
- Appointment: Scheduled for same day, recommend calling at 7:50 a.m.

McKinley Mental Health Information:

- 217-333-2705
- **Location:** 3rd Floor McKinley Health Center 1109 South Lincoln, Urbana, IL
- **Hours:** 8 a.m. – 5 p.m., Monday through Friday Appointment: Scheduled in advance.

The **Emergency Dean** may be reached at (217) 333-0050 and supports students who are experiencing an emergency situation after 5 pm, in which an immediate University response is needed and which cannot wait until the next business day. The Emergency Dean is not a substitute for trained emergency personnel such as 911, Police or Fire. If you are experiencing a life threatening emergency, call 911. Please review the Emergency Dean procedures.

Academic Dates and Deadlines

Students should make note of important academic dates for making changes to their courses (add, drop, credit/no-credit, grade replacement, etc.). Please check with your academic department regarding specific procedures and policies.

Tentative Schedule

The schedule is tentative and subject to change. You will be notified via compass announcements if changes are made. There will be no class on:

- 13 April 2021 - Official no-instruction day
- 15 April 2021 - Official let's-take-a-break-from-this-class day

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Module 1: Introduction and Data

- ML fundamentals, GitHub, Intro to Python, thinking about data, dealing with data, constructing in-class data set

Module 2: Ordinary Least Squares and Regularization

- OLS theory, OLS in Python, regularization

Module 3: Classification and Resampling Methods

- regression-based classification, naïve bayes, k-nearest neighbors, classification diagnostics, bootstrapping and cross-validation

Module 4: Support Vector Machines

- maximal margin classifier, support vector classifier, support vector machines

Module 5: Ensemble Learning

- tree-based models, bagging and random forests, boosting, stacking

Module 6: Neural Networks

- gradient descent, neural network anatomy, Keras, recurrent neural networks, convolution neural networks

Module 7: Additional Topics

- unsupervised learning, limitations of ML

All assignments are **due at 11:59pm** central time *except for FP4*, which will be due before the class in which you present.

Assignment		Due	
HW1	Yeehaw! Data Wrangling	Monday	22 Feb 2021
FP1	Proposal	Wednesday	24 Feb 2021
HW2	EDA, Regression, & You	Wednesday	3 Mar 2021
HW3	Classy Validity	Monday	15 Mar 2021
HW4	Rise of the Machines	Monday	22 Mar 2021
FP2	EDA	Friday	26 Mar 2021
HW5	Forest through the Trees	Monday	5 Apr 2021
HW6	LearNNing Deeply	Monday	12 Apr 2021
FP3	Preliminary Results	Monday	19 Apr 2021
FP4.1	Presentations Day 1	Thursday	29 Apr 2021
FP4.2	Presentations Day 2	Tuesday	4 May 2021
FP4.3	Presentations Day 3	**Wednesday 1:30pm**	12 May 2021
FP5	Final Draft	Friday	14 May 2021