

ECON 5043: MANAGERIAL ECONOMICS II

MACHINE LEARNING AND CAUSAL INFERENCE

UNIVERSITY OF OKLAHOMA
DEPARTMENT OF ECONOMICS

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1 Remark

This syllabus is only tentative and subject to change. I will update it according to the progress of this course. **It is your responsibility to check Github constantly for updates.** There may be major changes regarding the course such as grading policy and exams if deemed necessary, but they will be explicitly announced in class at least one month ahead. **Email is the fastest way to contact me.**

2 Course Description

Managerial economics is primarily concerned with the applications of economic methodologies to key management decisions within organizations such as government and business. Virtually all decisions depend on prediction. A quantitative approach to prediction based on modern computer programs, as opposed to informal intuition or a qualitative approach, has proven to deliver more accurate predictions, thereby leading to more effective plans and decision making. The quantitative approach is indeed what we will focus on in this course.

Our course consists of two parts. The first part is focused on tools for predictive analytics such as regression and kernel estimation models, while the second part is focused on tools for program (or policy) evaluation. This distinction reflects different needs of decision making: some business decisions are often based on the predictions of certain outcome variables, while other decisions often involve understanding the impacts of certain policy or programs on certain outcomes. For the former, what actually determines the outcome variables to be predicted and why are not necessarily important; what matters is a precise prediction. For the second, we are actually interested in whether a program has any **causal** impacts on the outcomes

of interest. These differences reflect the subtle differences between correlation and causality (causeeffect), which is often mentioned in the undergraduate statistics/econometrics courses, but not emphasized or carefully examined. Although these two set of tools are presented separately, they are closely related. Specifically, the first set of methods (which themselves are built on the concepts and tools learned in Econ 5023) are the workhorse models upon which the second set of methods are built.

The world has changed rapidly in the past decades. One significant change is the availability of large or big datasets. These data are big not only because the sample size (N) is big but also because the number of dimensions (p) is large and often even larger than the sample size. The traditional tools, especially the conventional regression and logit/probit models, may not be adequate to handle such data (for example, the regression estimates are not unique when $p > N$). To this end, we will also discuss some extensions of these methods that could handle high-dimensional datasets, if time permits.

Our presentations of these methods are intended to be as general as possible. In-class examples of these techniques are also not necessary only in the business or government sectors; instead, a wide range of situations are examined. It is my hope that this way you can see and understand the generality of these techniques and apply them in the situations where others may not necessarily make the connections.

It is, again worth mentioning that, just as Econ 5023 (Statistics for Data Science), this is an applied course; you will learn not only theoretical concepts and tools, but also how to use R to analyze real-life data. R will again be heavily used. You should develop competency in R in order to apply the techniques learned *Learning by Doing!*

3 Required Readings

- Gareth, James, Witten Daniela, Hastie Trevor, and Tibshirani Robert. *An introduction to statistical learning: with applications in R*. Springer, 2013. **Available here**
- **(Optional)** Hastie, Trevor, Robert Tibshirani, Jerome H. Friedman, and Jerome H. Friedman. *The elements of statistical learning: data mining, inference, and prediction*. Vol. 2. New York: springer, 2009. **Available here**
- Angrist, Joshua D., and Jörn-Steffen Pischke. *Mastering'metrics: The path from cause to effect*. Princeton university press, 2014.
 - There are also a series Youtube Videos accompanying this course available **here**
- **Optional** Angrist, Joshua D., and Jörn-Steffen Pischke. *Mostly harmless econometrics: An empiricist's companion*. Princeton university press, 2009.

4 Statistical Software

1. R can be downloaded here.
2. RStudio, a powerful IDE for R, can be downloaded at here.

Bring a laptop to classroom (please email me if that would be a problem). **However, you should use it only when we need to use R for practice or a quiz.**

5 Assignment, Testing, and Grading

5.1 Policy regarding illness and special circumstances

It is expected that there will be students who become ill or face some other special circumstances that prevent them from attending a class, taking a test, or completing a problem set. To accommodate students in such situations, I allow you drop the lowest grades in homework assignments and quizzes as explained below. So, do not worry about re-taking the test or homework assignment you miss due to unexpected events.

Remark: This grading system already takes into account the possibility of missing a quiz or exam for any reasons! I do not want such a rare event to adversely impact your grades. That's why I allow you drop some quizzes and homework and move the weight of the midterm to the final. And because of this system, I do NOT give any make-up exams/quiz/homework, as stated above. If you insist on taking a make-up quiz or exam, you would lose the privilege of dropping the lowest one.

5.2 Tests

There will be one midterm (tentative date: 03/08/2023) and one final exam (May 10, 2023 W 4:30 - 6:30 pm Cate Center One 0326). The format of these exams will be announced later. No make-up exams will be given. If a student misses a midterm examination for any reason, the weight of that examination will be added to that of the final examination (e.g., missing Midterm would make the final worth 50% of the course grade in the case of two midterms). I'd like to have the flexibility to speed up or slow down depending on how I think the class understands the material. But should there be any changes to the schedule, it would be announced two weeks in advance.

5.3 Homework Assignment

There will be homework assignments following each topic. The total number of homework assignments will depend on the progress of the class. **Homework assignments will be due**

at the beginning of class and late homework assignments will not be graded for credit. It is important to know that the homework assignments are very important in that the basic ideas covered by them invariably show up on the mid-term and final exams. If you know you are going to be missing a class on the day a homework exercise is due, hand in your homework **in advance** to receive full credit for your work.

- You should try to type all the homework. This is also courteous to your TA who would be grading the homework.
- Group discussion is encouraged when working on the problem sets. Your answers should show individual understanding of the materials and be written in your own words. If you collaborate with other student(s), everyone in your group should be acknowledged at the beginning of the homework. Identical homework assignments would receive a zero for both students.

5.4 Quick Quizzes

There will also be many short quizzes (short answer and/or multiple-choice) given throughout the semester. Such quizzes are not announced beforehand and will usually be administered in the first five to ten minutes of the class. These quizzes are designed to help you understand better the materials covered and find out whether you have any problems with the materials and have done any assigned readings that I may have asked you to do. **No make-up quizzes will be given.** If you must miss a class due to legitimate circumstances beyond your control, be sure and contact me **beforehand** so that I will know of your circumstances. If excused, I will correspondingly excuse you from any QQ that is given that day. The lowest quiz grade will also be dropped.

5.5 Mistakes in Grading

Your TA and myself are only human. Sometimes it is possible that your TA makes some mistakes in grading or misplaces your homework, quiz, or exam papers. If that occurs, please report the incidence within **three** days after they are handed back and recorded on Canvas; after that, I would not be able to make any changes except in special circumstances such as illness that prevent you from doing so. Discuss first with your TA about your concerns or objections, and if it is not resolved, then present a written document to me for final decision on the matter.

5.6 Grading

The weights in the final grade are assigned as follows:

Assessment	Percentage
Homework Assignments	25
Midterm I	25
Final	35
Quick Quizzes	15

Table 1: Grading Distribution

The grading scale is:

Grade Range	Grade
90-100	A
80-90	B
70-80	C
60-70	D
0-60	F

Table 2: Grading System

A number with a parenthesis means any number less than it. For example 90) means any number less than 90 , but not equal to 90 . It could be 89.9999999. I reserve the right to change the grading scale. The required score for the final grade could be lower but not higher. For example, the current requirement for an A is 90 - 100, but later I may change the cut-off point to 85 – 100, but won't change it to 97 – 100.

6 University Policies

6.1 Accommodations for Student with Disabilities

The Accessibility and Disability Resource Center is committed to supporting students with disabilities to ensure that they are able to enjoy equal access to all components of their education. This includes your academics, housing, and community events. If you are experiencing a disability, a mental/medical health condition that has a significant impact on one or more life functions, you can receive accommodations to provide equal access. Possible disabilities include, but are not limited to, learning disabilities, ADHD, mental health, and chronic health. Additionally, we support students with temporary medical conditions (broken wrist, shoulder surgery, etc.) and pregnancy. To discuss potential accommodations, please contact the ADRC at 730 College Avenue, (ph.) 405.325.3852, or adrc@ou.edu.

6.2 Academic Honesty

Cheating is strictly prohibited at the University of Oklahoma, because it devalues the degree you are working hard to get. As a member of the OU community it is your responsibility to protect your educational investment by knowing and following the rules. For specific definitions on what constitutes cheating, review the Student's Guide to Academic Integrity at [here](#).

6.3 Religious Observance

It is the policy of the University to excuse the absences of students that result from religious observances and to reschedule examinations and additional required classwork that may fall on religious holidays, without penalty.

6.4 Title IX Resources and Reporting Requirement

Anyone who has been impacted by gender-based violence, including dating violence, domestic violence, stalking, harassment, and sexual assault, deserves access to resources so that they are supported personally and academically. The University of Oklahoma is committed to offering resources to those impacted, including: speaking with someone confidentially about your options, medical attention, counseling, reporting, academic support, and safety plans. If you would like to speak with someone confidentially, please contact OU Advocates (available 24/7 at 405-615-0013) or another confidential resource (see Can I make an anonymous report?). You may also choose to report gender-based violence and discrimination through other means, including by contacting the Institutional Equity Office (ieo@ou.edu, 405-325-3546) or police (911). Because the University of Oklahoma is committed to the safety of you and other students, I, as well as other faculty, Graduate Assistants, and Teaching Assistants, are mandatory reporters. This means that we are obligated to report gender-based violence that has been disclosed to us to the Institutional Equity Office. This includes disclosures that occur in: class discussion, writing assignments, discussion boards, emails and during Student/Office Hours. For more information, please visit the Institutional Equity Office.

6.5 Adjustments for Pregnancy/Childbirth Related Issues

Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact your professor or the Disability Resource Center at 405/325-3852 as soon as possible. Also, see [here](#) for answers to commonly asked questions.

6.6 Final Exam Preparation Period

Pre-finals week will be defined as the seven calendar days before the first day of finals. Faculty may cover new course material throughout this week. For specific provisions of the policy please refer to OU's Final Exam Preparation Period policy.

6.7 Emergency Protocol

During an emergency, there are official university procedures that will maximize your safety.

Severe Weather: If you receive an OU Alert to seek refuge or hear a tornado siren that signals severe weather 1. LOOK for severe weather refuge location maps located inside most OU buildings near the entrances 2. SEEK refuge inside a building. Do not leave one building to seek shelter in another building that you deem safer. If outside, get into the nearest building. 3. GO to the building's severe weather refuge location. If you do not know where that is, go to the lowest level possible and seek refuge in an innermost room. Avoid outside doors and windows. 4. GET IN, GET DOWN, COVER UP. 5. WAIT for official notice to resume normal activities.

6.8 Armed Subject/Campus Intruder

If you receive an OU Alert to shelter-in-place due to an active shooter or armed intruder situation or you hear what you perceive to be gunshots: 1. Avoid: If you believe you can get out of the area WITHOUT encountering the armed individual, move quickly towards the nearest building exit, move away from the building, and call 911. 2. Deny: If you cannot flee, move to an area that can be locked or barricaded, turn off lights, silence devices, spread out, and formulate a plan of attack if the shooter enters the room. 3. Defend: As a last resort fight to defend yourself. For more information, visit OU's Emergency Preparedness site. Shots Fired on Campus Procedure Video

6.9 Fire Alarm/General Emergency

If you receive an OU Alert that there is danger inside or near the building, or the fire alarm inside the building activates: 1. LEAVE the building. Do not use the elevators. 2. KNOW at least two building exits 3. ASSIST those that may need help 4. PROCEED to the emergency assembly area 5. ONCE safely outside, NOTIFY first responders of anyone that may still be inside building due to mobility issues. 6. WAIT for official notice before attempting to re-enter the building. OU Fire Safety on Campus

6.10 Mental Health Support Services

If you are experiencing any mental health issues that are impacting your academic performance, counseling is available at the University Counseling Center (UCC). The Center is located on the second floor of the Goddard Health Center, at 620 Elm Rm. 201, Norman, OK 73019. To schedule an appointment call (405) 325-2911. For more information, please visit University Counseling Center.