

# ECON 5023: STATISTICS FOR DECISION MAKING

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 Canvas online constantly for updates.** It is your responsibility to set up your Canvas correctly to receive notifications and announcements, and you would be the person who bear the consequences of missing any important announcements such as homework deadlines and exam times and locations.

Email is the fastest way to contact me. Please include **ECON 5023** in the subject line.

## 2 COURSE DESCRIPTION

This course focuses on the *applications* of statistics or econometrics in the decision-making process. A statistical approach to decision making, unlike informal intuition or a qualitative approach, is based on two things: modern computer programs and analysis of large-scale data. The traditional “paper-and-pencil” type of introductory statistics courses usually covers some theoretical concepts and techniques, but fails to include much programming and data analysis, which is nowadays at the heart of “data science”. Because of this, emphasis of this course will be placed on combining programming techniques and statistical concepts simultaneously through the analysis of real-life data sets taken from various sources. Our goal is to demonstrate how economists use data analysis to aid decision making and to answer important questions about complex social and economic issues. Throughout the process, we will learn how to programming with R and to manipulate and explore data in R, although this is not an R course.

At the end of the semester, you should gain a basic understanding of how one could apply statistical techniques to analyze micro, macroeconomic, financial events and issues, or even other social issues. You will learn not only theoretical concepts and tools, but also how to use statistical softwares to analyze real-life data. The ‘application’ aspect entails becoming familiar

with statistical software (R will be heavily used). You will develop competency in R in order to apply the techniques learned. *Learning by Doing!*

### 3 OUR GOALS: THREE LAYERS

Our ultimate goal is to provide statistical foundations for further learning of data science and machine learning.

1. We will review **basic concepts**, which have been covered in your previous statistics courses. This is to make sure that everyone is on the same page. But more importantly, we want to take this opportunity to introduce how you can implement these concepts using a programming language and apply them to some real-life data.
2. We will focus on the “Why” behind the basic concepts to gain **better and deeper** understanding of them. We will provide a unified framework to organize and connect all these concepts and tools, as opposed to “pieces”. Throughout the process, we will offer a more rigorous **re-introduction** of some basic concepts, as well as intuition and historical background behind their development. Hopefully such process will help you think about what may be a more appropriate method to apply in a real-life setting, and what you can do differently (with some creativity).
3. We will introduce some **new concepts** or methods. Some can only be introduced when computers are available to us (such as Monte Carlo simulation and Bootstrap), some are more complicated extensions of the basic concepts (e.g., exponential smoothing methods), and some are concepts more specific to decision making (e.g., criteria for model selections).

### 4 Conceptual Understanding vs. *Real* Understanding: Importance of Practice

A common scenario (From Barbara Oakley’s WSJ Opinion): I just don’t see how I could have done so poorly. I understood it when you taught it in class.

That one think he/she understood an idea in a classroom “doesn’t necessarily mean that this person *truly* understood the idea. It certainly doesn’t mean that the student with retain that idea. And it absolutely doesn’t mean that the student has mastered the idea.”

“Understanding is key. But not superficial, light-bulb moments of understanding or conceptual understanding. In [a field like this], true and deep understanding comes with the mastery gained through practice.”

### 5 REQUIRED READING

*Statistical Techniques in Business & Economics* by Lind, Marchal, and Wathen (hereafter LMW).

*Forecasting: Principles and Practice* by Rob J. Hyndman and George Athanasopoulos (hereafter FPP). The latest version of the book is available for free at <https://otexts.org/fpp2/>. All the examples are written in R.

The first book provides detailed material on introductory statistics and the applications of these elementary concepts and methods in business and economics, while the second book provides a more specific purpose for statistics and econometrics, namely forecasting. I will also try to supply my slides or provide pointers (additional readings) for the topics that are not covered or in less detail by these two books.

**Note:** We do not follow the books closely. Rather, I will use my own structure to organize select topics. As a graduate student, it is your responsibility to find out what would be the corresponding material in the book and independently look for additional readings if needed. Two approaches: look for the index at the back of the book, or Google material on the topic.

## 6 Statistical Software

1. R can be downloaded at <http://cran.r-project.org/bin/windows/base/>.
2. RStudio, a powerful IDE for R, can be downloaded at <http://www.rstudio.com/>.
3. R Markdown, <https://help.github.com/articles/about-remote-repositories/>

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.

## 7 Useful Data Sources

1. Analyze Data for Free <http://www.asdfree.com/>

## 8 RECOMMENDED READINGS

There is no single textbook that covers every topic well. Here I also list some books that may be useful for certain topics under “Introductory Level”, and some books for more advanced and technical treatments under “Advanced Level”.

### 8.1 Machine Learning

1. Sugiyama, Masashi. *Introduction to statistical machine learning*. Morgan Kaufmann, 2015.
2. Robert, C. (2014). *Machine learning, a probabilistic perspective*.

## 8.2 Introductory Level

1. OpenIntro Statistics 3rd Edition. Available for free at <https://www.openintro.org/stat/textbook.php>
2. *Business Forecasting: Text Alone* by J.Holton Wilson, Barry P. Keating, and Solutions Inc. Publisher: McGraw-Hill Publishing Co.; 5th edition (August 5, 2011) ISBN-10: 0072979674; ISBN-13: 978-0072979671. This textbook contains more detailed discussions of the contents and many useful examples. The software is however dated.
3. Elements of Forecasting by Francis X. Diebold, Cengage Learning; 4 edition (December 8, 2006), ISBN-10: 0324359047
4. *An Introduction to Statistical Learning* by Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, available for free at <http://www-bcf.usc.edu/~gareth/ISL/>

## 8.3 Advanced Level

1. *The Elements of Statistical Learning: Data Mining, Inference, and Prediction.* by Trevor Hastie, Robert Tibshirani, Jerome Friedman. available for free at <https://web.stanford.edu/~hastie/ElemStatLearn/>.
2. Introduction to Econometrics, Fourth Edition, Maddala and Lahiri, Wiley: 2009, ISBN: 9780470015124
3. Introductory Econometrics, Fourth Edition: Wooldridge, South-Western: 2009, ISBN: 9780324660545
4. Symposium on Econometric Tools, Journal of Economic Perspectives, Vol. 15, No. 4, Fall 2001
5. Time Series Data Analysis Using EViews, First Edition, Gusti Ngurah Agung, Wiley: 2008, ISBN: 9780470823675
6. Applied Time Series Econometrics, First Edition, by Lukepohl and Krazig, Cambridge: 2004, ISBN: 0521547873
7. *Applied Econometric Time Series, 2e or 3e* by Walter Enders

# 9 ASSIGNMENT, TESTING, AND GRADING

## 9.1 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 a midterm and some quizzes. And because of this system, I do NOT give any make-up exams, as stated above. If you insist on taking a make-up quiz or exam, you would lose the privilege of dropping the lowest one.

## 9.2 Tests

There will be one or two midterm exams and one final exam. 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 I 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. So, midterms will be announced at least one week in advance.

If the class goes more slowly than expected and only one midterm is given, the weight of the second midterm will be evenly distributed across other categories (see below for detail).

## 9.3 Homework Assignment and R Markdown

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 using R Markdown. 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.

## 9.4 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.

## 9.5 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.

## 9.6 Grading

The weights in the final grade are assigned as follows:

Homework Assignments:	20
Midterm I:	20
Midterm II:	20
Final	30
Quick Quizzes	10

In the case of only one midterm, the weighting scheme is as follows:

Homework Assignments:	25
Midterm I:	25
Final	35
Quick Quizzes	15

The grading scale is:

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

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.

## **10 University Policies**

### **10.1 ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES**

If you are a student with a documented disability who will require accommodations in this course, please register with the Disability Resource Center (Goddard Health Center, Room 166, 325-3852). Students who are already registered with the Office of Disability Services and wish to receive accommodations in this course are strongly encouraged to share their Accommodation Letter with me in a timely manner so I can provide an appropriate contact to discuss accommodations necessary to ensure full participation and facilitate your educational opportunities. Students with disabilities must be registered with the Disability Resource Center before receiving academic adjustments.

### **10.2 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 <http://integrity.ou.edu/students.html>.

### **10.3 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.

### **10.4 TITLE IX RESOURCES AND REPORTING REQUIREMENT**

For any concerns regarding gender-based discrimination, sexual harassment, sexual assault, dating/domestic violence, or stalking, the University offers a variety of resources. To learn more or to report an incident, please contact the Sexual Misconduct Office at 405/325-2215 (8 to 5, M-F) or [smo@ou.edu](mailto:smo@ou.edu). Incidents can also be reported confidentially to OU Advocates at 405/615-0013 (phones are answered 24 hours a day, 7 days a week). Also, please be advised that a professor/GA/TA is required to report instances of sexual harassment, sexual assault, or discrimination to the Sexual Misconduct Office. Inquiries regarding non-discrimination policies may be directed to: Bobby J. Mason, University Equal Opportunity Officer and Title IX Coordinator at 405/325-3546 or [bjm@ou.edu](mailto:bjm@ou.edu). For more information, visit <http://www.ou.edu/eoo.html>.

### **10.5 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 <http://www.ou.edu/eoo/faqs/pregnancy-faqs.html> for answers to commonly asked questions.

## 11 Tentative Course Outline

**Note that the schedule is subject to change depending on the pace of the course.**

**The material will not be necessarily covered in the same order as below.**

Date	Content	Reading
8/20/2018	Syllabus, Broad Introduction to class	Chapter 1 (LMW)
8/22/2018	Introduction to R and R Markdown	
8/27/2018	Introduction to R and R Markdown	
8/29/2018	What are we trying to do? A Naïve Example to decompose and forecast a variable	FPP: Chapters 2.1-2.5; Chapters 6.1,6.3, 6.6 LMW: Chapters 18 p. 639-642
9/3/2018	Labor Day	
9/5/2018	Brief History and Basic Probability Theory	LMW: Chapter 5 p.132-145
9/10/2018	Random Variable, Probability and Distribution Functions Discrete Variables and Classification	LMW: Chapter 6 p.173-177;
9/12/2018	Special Discrete Variables: Text Mining	
9/17/2018	Random Variable, Probability and Distribution Functions Continuous Variables	LMW: Chapter 6 p.177-178;
9/19/2018	Applications in Finance: Distribution and Risks	
9/24/2018	Parts of Distributions: Mean or Expected Value and Sample Estimates	LMW: Chapter 6 p.178-179
9/26/2018	Applications and Misapplications of Mean	
10/1/2018	Parts of Distributions: Which one to focus on? Loss and Risk Functions	Slides
10/3/2018	Mean and Everything else (distribution and moments)	Slides and
10/8/2018	Deeper thinking: Applications of moments and distribution	



Date	Content	Reading
10/10/2018	Midterm 1	
10/15/2018	Extension of Mean for time series: Exponential Smoothing (Optional)	FPP: Chapter 7
10/17/2018	Extension of Mean for time series: Exponential Smoothing (Optional)	
10/22/2018	Computational Statistics I: Monte Carlo Simulation	
10/24/2018	Parametric Distribution and Monte Carlo Simulation: Discrete, Binomial Distribution	LMW: Chapter 6 p.182-191;
10/29/2018	Parametric Distributions: Discrete	LMW: Chapter 6
10/31/2018	Parametric Distributions: Uniform and Normal Distributions	LMW: Chapter 7
11/5/2018	Computational Statistics II: Bootstrap (Optional)	
11/7/2018	Parametric Distributions: Continuous	LMW: Chapter 12 p.380-381; Chapter 15,
11/12/2018	Introduction to Maximum Likelihood Estimation (Optional)	
11/14/2018	Hypothesis Testing (1): What is a Large/Unlikely Value in Statistics?	
11/19/2018	Hypothesis Testing (2): Introduction and Test of Mean	LMW: Chapter 10
11/21/2018	Thanksgiving	
11/26/2018	Hypothesis Testing (3): More Examples	LMW: Chapters 15 p.534-543; Chapter 12
11/28/2018	Joint Distribution, Marginal Distribution, and Independence	
12/3/2018	Joint Distribution, Marginal Distribution, and Independence	
12/5/2018	Measure of Relations: Covariance and Correlation	LMW: Chapter 13 p.426-440
12/14/2018	Final	