

## MS STATISTICAL MODELING AND DECISION MAKING

### Fall 2023

*Professor:*

Malek Ben Sliman ([mab2343@columbia.edu](mailto:mab2343@columbia.edu))

Office Hours: By appointment

*Teaching Assistant(s):*

TBD

Office Hours: By appointment

*Course Times:*

Friday, August 25<sup>th</sup>: 10am - 1pm

Monday, August 28<sup>th</sup>: 10am - 1pm

Tuesday, August 29<sup>th</sup>: 10am - 1pm

Wednesday, August 30<sup>th</sup>: 10am - 1pm

Thursday, August 31<sup>st</sup>: 10am - 1pm

Friday, September 1<sup>st</sup>: 10am - 1pm

### **COURSE DESCRIPTION**

Companies often use statistical modeling techniques to help them understand and predict how consumers behave which in turn allows them to improve their business decisions. In this course, we will learn how to identify and utilize appropriate statistical techniques to address a given business problem and dataset. The course is organized around two modules. Python, R, and Excel may be used in the course but the course is primarily centered around R.

- The **first module** focuses on the building blocks of statistical modeling: linear algebra, probability theory and foundations of statistics.
- The **second module** focuses on modeling real data using core statistical models: regression and factor analysis.

### **PRE-TERM READINGS**

This course requires a basic understanding of Linear Algebra and R programming. I recommend the following resources:

- Richard A. Johnson and Dean W. Wichern, Applied Multivariate Statistical Analysis, Prentice Hall, (Latest Edition). Chapter 2
- Jared P. Lander, R for Everyone: Advanced Analytics and Graphics, Addison-Wesley

### **STUDENT EVALUATION**

#### **(1) Final Exam (40%)**

The final exam (closed book) will be designed to test your understanding of the topics covered in the lectures, readings, and exercises. The final will be two hours.

#### **(2) Assignments (40%)**

There are two individual assignments. The two individual assignments are to be completed individually without discussing the assignment or the solutions with other students. Failure to do so will result in a loss of all points allocated to the assignment for everyone who does not adhere to this guideline.

No late assignments will be accepted and failure to submit an assignment on time will result in a zero for the assignment.

### **(3) Pre-Term Assignments (10%)**

There are two pre-term assignments. These two individual assignments are due on the first day of class and will cover your pre-term readings.

### **(4) Class Participation / Concept Checks (10%)**

You are invited to highlight insightful linkages between class material and your experience as a professional and as a consumer, and to participate actively in class discussions. Class attendance will be required and will be monitored. Class preparedness will be assessed based on your responses to some short online pre-class surveys. You should fill out each survey before the start of the corresponding class. Note that the questions in these surveys typically do not have a unique correct answer. You will receive full credit for each survey if you fill it out and give some reasonable justification for your answers.

### **LAPTOP POLICY**

All students should have a laptop with R and Excel installed. Laptops will be utilized at designated times during class but **should otherwise remain closed**. Tablets are allowed for note taking. Cell phones and any other electronic devices are strictly prohibited.

### **HONOR CODE**

You are expected to conform to the norms of behavior outlined in the Columbia Business School Integrity Code given below:

*“As a lifelong member of the Columbia Business School Community, I adhere to the principles of TRUTH, INTEGRITY and RESPECT. I will not lie, cheat, steal or tolerate those who do.”*

Any allegation of academic dishonesty will be forwarded to the Dean’s office for investigation. Any case of proven academic dishonesty will result in failure in the course. Simple things such as arriving on time to class, turning cell phones off during class time and not being tempted by the many distractions that the Internet offers can make the experience more enjoyable and rewarding.

## OVERVIEW OF CLASS SCHEDULE

### Module 1: Building Blocks

Session	Topic	Key Questions	Due at 8 am day of class
Session 1 08/25	Course Introduction + Review of Linear Algebra and R Programming	<b>Key Questions:</b> <ul style="list-style-type: none"><li>• <i>What is Statistical Modeling?</i></li><li>• <i>HW</i></li></ul>	<b>Pre-class Assignment (individual)</b>
Session 2 08/28	Fundamentals of Probability	<b>Key Questions:</b> <ul style="list-style-type: none"><li>• <i>What is Probability?</i></li><li>• <i>What are random variables?</i></li></ul>	
Session 3 08/29	Fundamentals of Statistics	<b>Key Questions:</b> <ul style="list-style-type: none"><li>• <i>What are statistics and how can we estimate them?</i></li><li>• <i>What is hypothesis testing?</i></li><li>• <i>What is maximum likelihood?</i></li></ul>	First Individual Assignment

### Module 2: Statistical Modeling

Session	Topic	Key Questions	Due at 8 am day of class
Session 4 08/30	Regression	<b>Key Questions:</b> <ul style="list-style-type: none"><li>• <i>What is linear regression?</i></li><li>• <i>How do we build a regression model?</i></li><li>• <i>What is logistic regression?</i></li></ul>	
Session 5 08/31	Dimension Reduction	<b>Key Questions:</b> <ul style="list-style-type: none"><li>• <i>How do we analyze large, correlated datasets?</i></li></ul>	
Session 6 09/01	Predictive Analytics + Review	<b>Key Questions:</b> <ul style="list-style-type: none"><li>• <i>How to build a predictive model?</i></li></ul>	Second Individual Assignment

### Inclusion, Accommodations, and Support for Students

At Columbia Business School, we believe that diversity strengthens any community or business model and brings it greater success. Columbia Business School is committed to providing all students with the equal opportunity to thrive in the classroom by providing a learning, living, and working environment free from discrimination, harassment, and bias on the basis of gender, sexual orientation, race, ethnicity, socioeconomic status, or ability.

Columbia Business School will make reasonable accommodations for persons with documented disabilities. Students are encouraged to contact the Columbia University's Office of Disability Services for information about registration. Students seeking accommodation in the classroom may obtain information on the services offered by Columbia University's Office of Disability

Services online at [www.health.columbia.edu/docs/services/ods/index.html](http://www.health.columbia.edu/docs/services/ods/index.html) or by contacting (212) 854-2388.

Columbia Business School is committed to maintaining a safe environment for students, staff and faculty. Because of this commitment and because of federal and state regulations, we must advise you that if you tell any of your instructors about sexual harassment or gender-based misconduct involving a member of the campus community, your instructor is required to report this information to a Title IX Coordinator. They will treat this information as private, but will need to follow up with you and possibly look into the matter. Counseling and Psychological Services, the Office of the University Chaplain, and the Ombuds Office for Gender-Based Misconduct are confidential resources available for students, staff and faculty. "Gender-based misconduct" includes sexual assault, stalking, sexual harassment, dating violence, domestic violence, sexual exploitation, and gender-based harassment. For more information, see <http://sexualrespect.columbia.edu/gender-based-misconduct-policy-students>.

**For COVID-19 protocol, please visit: <https://covid19.columbia.edu/students>**