Stochastic Modeling
BUAD 5032
Fall 2021, 3 Credits

Raymond A. Mason School of Business
WILLIAM & MARY

Course Description:

Stochastic Modeling is a foundation course in the study of business analytics. It provides an understanding of the principles associated with modeling of stochastic processes. The topics include probability theory (important probability distributions, sampling from distributions, interaction of multiple stochastic processes); statistical analysis (descriptive/inferential/predictive statistics, multivariate statistics, time series models); and modeling (modeling concepts, simulation, decision analytics). Students will also be introduced to a variety of statistical modeling tools.

Course Days/Time/Location:

Section 1: MWF 9:30am - 10:50am. Miller 1027
Section 2: MWF 2:00pm - 3:20pm. Miller 1027
Office hours: https://calendly.com/jagelves/office-hours

Course Instructor:

J. Alejandro Gelves, Ph.D., M.S.B.A.
W&M Email: jagelves@wm.edu [preferred contact method]
Zoom Personal Link: https://cwm.zoom.us/my/**jagelves10**

Reference Books (Not Required):

- Suggested Text: Winston and Albright. Practical Management Science, *6th ed*. Cengage, 2018. ISBN: 978-1337406659
- Supplemental Text: Bertsimas & Freund. Data, Models, & Decisions: The Fundamentals of Management Science, 2nd ed. Dynamic Ideas, Mass., 2004. ISBN-13: 978-0975914601

Software:

We will primarily use R and Excel in this course. Instructions for software installation are provided at the myMSBA site. Later in the course, we will be using R packages which can be installed from CRAN.

- **R:** To interface with an R environment, I highly recommend R Studio, and you can install packages using the menu Tools > Install Packages. Once installed, you can load packages using, for example, library(simmer). The packages can be installed on demand when we get to the relevant part of the course. RStudio can be installed from Anaconda or directly from the RStudio website.
- **Excel:** the capability of having the additional Add-In packages (Data Analysis, Solver, etc.) installed may be required to complete the assignments. For those using Macs this may be an issue which requires additional installation time and effort.

The Big Picture:

This course introduces you to *predictive analytics*—a branch of analytics concerned with bounding uncertainty about future events. From an ambiguous problem statement, we collect and organize data, perform an analysis, and contribute clarity to the decision-making process. We start with *descriptive analytics* of a data set to summarize and identify patterns. It is expected that you have had exposure to elementary statistics and probability. For predictive analytics, after a thorough validation of assumptions, we can develop probabilistic models to bound the uncertainty about the future. These insights can be used directly to aid in the decision-making process. Further, data can be subsequently processed and consumed by other models, for instance, as input parameters in your optimization course. The theory in this course provides a foundation for your concurrent study of Machine Learning, as well as a good backdrop for your study of Visualization in the Spring. Your database course also provides support for this course in two ways: using data models to structure raw data to be consumed by statistical models and developing descriptive statistics by aggregating data to aid in reporting. Your optimization course will converge with this course especially as we consider simulation modeling.

Course Topics:

This course introduces Intermediate Probability and Statistics through four broad areas, with the general theme being *stochastic processes*. Note: Your Machine Learning course will cover regression models.

- **Probability** - A reintroduction of probability through the lens of Random Variables, their parameters, and their composition into analytic models of stationary processes. Important distributions and applications.
- **Time Series and Forecasting** - Non-stationary processes and models used to predict future events. Includes smoothing, decomposition, Holt-Winters, ARIMA/Box-Jenkins.
- **Statistics** - Using R to compute statistics and develop insights, considering the greater business context. Plus, considerations regarding design of experiments and statistical power.
- **Simulation** - When probabilistic models become too complex for an analytic (closed) solution, analysts may turn to simulation to explore the behavior of random processes.

Learning Objectives:

- Transform data and apply descriptive statistics to summarize both stationary and non-stationary processes.
- Validate assumptions before employing a statistical model.
- Produce forecasts using multiple approaches to time series.
- Develop Monte Carlo simulations to explore interacting random processes.

Evaluation:

This is a letter-grade class. Grades will be computed as follows:

Scale:

A	A-	B+	B	B-	C+	C	C-	F Below
95	90	87	83	80	77	73	70	70

There will be 4 assignments assigned throughout the semester, a midterm and a final exam. All portions of the exam will be due at the scheduled exam slot. The final and midterm will be completed individually. *Unless otherwise specified, assignments are due to Blackboard at 11:59pm on the day they are due.* Emailed assignments will NOT be accepted.

Assignment	**Category**	**Weight**
Decisions Under Uncertainty	A	15%
Data Wrangling with Tidyverse	A	15%
Midterm	A	15%
HBR Case Study: Appshop	B	20%
Time Series Prediction	B	20%
Final	A	15%

Assignment Category Definitions:

Category A: An individual assignment. You may not receive help from anyone on this assignment. It must be 100% your own work. All questions concerning this assignment should be addressed to your professor. It is an honor code offense to give or receive any assistance on this assignment.

Category B: Your group may not receive help from anyone outside your group. All questions concerning this assignment should be addressed to your professor. It is an honor code offense to give help to other groups and individuals or receive assistance from other groups and individuals.

Category C: An individual assignment. You may work with others or receive help from a tutor on this assignment. You must, however, turn in your own original paper. You may not divide the work with others or copy another student's paper. It would be an honor code offense to do so.

Grading:

All deliverables will be graded on a 10-point scale using the criteria below unless stated differently either on the syllabus or assignment description. The baseline/average grade is an 8.

Points: Criteria:

10 Excellent. All questions answered correctly, completely, and succinctly. The writing or presentation is clear and concise. The deliverable makes it clear that the student took the assignment seriously and completed it in a thoughtful way.

8 Good. Some deficiency exists between this and excellent performance either in that questions were not answered completely, the presentation was not succinct, or some observations or points were not made.

6 Poor. In addition to not sufficiently satisfying the assignment deliverables, the presentation may have been rough or not succinct.

3 Evidence of some effort, but many serious errors and omissions. 0 Not submitted or little evidence of serious effort.

Late work will be accepted with a punitive penalty. However, once the work is reviewed during class, then no late work can be accepted for that particular assignment. In general, work submitted 3 days after the deadline will not be accepted.

ADA Accommodation:

William & Mary accommodates students with disabilities in accordance with federal laws and university policy. Any student who feels they may need an accommodation based on the impact of a learning, psychiatric, physical, or chronic health diagnosis should contact Student Accessibility Services staff at 757-221-2512 or at sas@wm.edu to determine if accommodations are warranted and to obtain an official letter of accommodation. For more information, please see www.wm.edu/sas.

W&M Honor Code:

The College of William & Mary has had an honor code since at least 1779. Academic integrity is at the heart of the College, and we all are responsible for upholding the ideals of honor and integrity. The student-led honor system is responsible for resolving any suspected violations of the Honor Code, and I will report all suspected instances of academic dishonesty to the honor system. The Student Handbook (www.wm.edu/studenthandbook) includes your responsibilities as a student and the full Code. Your full participation and observance of the Honor Code is expected. To read the Honor Code, see www.wm.edu/honor. All academic work in this course is to be your own.

Notice of Copyright:

All course materials, including the syllabus, lectures, presentations, recordings, quizzes, assessments, tests, exams, outlines, assignments, electronic files, and similar materials, for this course are protected by copyright and are the sole property of the course instructor. You may use these materials for your personal, non-commercial educational use. You may not, nor may you knowingly allow others, to reproduce or distribute any course materials publicly without the express written consent of the instructor. This includes providing materials to commercial course material suppliers such as CourseHero and other similar services. To do so is both a copyright violation and a violation of W&M's Honor Code.

Recording Class Sessions:

Students are strictly prohibited from recording class sessions and other interactions with the instructor using any type of technology. Recordings and synchronous class sessions provided by the instructor are protected by both copyright and the Family Education Rights and Privacy Act (FERPA) and may not be shared or redistributed to anyone at any time now or in the future. To do so is both a violation of law and of W&M's Honor Code.

Zoom Protocol:

Before connecting with a Zoom session, log into Zoom either on the W&M Zoom website (cwm.zoom.us) or using the Zoom desktop app. This permits the verification of approved Zoom participation via your WM email address and the use of Zoom breakout rooms. When joining a Zoom session, please change your Zoom screen name to your preferred name (i.e. the name you wish me to use to address you in class) if different from the default name shown in Zoom. Because you may need to join a Zoom session while in the classroom, please bring a device capable of connecting to Zoom, an Ethernet cable, and a quality headset (preferable noise cancelling) with a built-in microphone.

Zoom Etiquette:

Please be on time when entering a Zoom session, remain muted unless you have a question, and keep your video on during the entire class session. In order to replicate the in person experience for all students, you are required to show your video during the class session. You may use a virtual background if you wish, but all participants should be able to see you as if you were in the physical classroom. If you are on Zoom in the classroom without a headset, you should mute both the microphone and your speakers.

Face Masks and Physical Distancing:

Please do your part in keeping our university community safe. Per university policy, wearing of face mask is required in all public or communal spaces including classrooms. There are absolutely no exceptions to this policy by any faculty, staff, student or visitor on our campus. This face mask must fully cover your mouth and nose. The university provided you with a wellness kit consisting of washable masks, hand sanitizer, wipes, and an educational pamphlet.

Students will be responsible for cleaning classroom desk space before and after use. Our classroom has been reconfigured to allow at least six feet between each student and at least six feet from the instructor. Please do your part to maintain that distance. Although students and faculty normally interact in close proximity during class, especially just before and just after class at or near the podium, that will not be possible this semester. We must maintain at least a six feet physical distance at all times. To better accommodate our need to be in close proximity to review assignments or assist in solving technology issues, office hours will be held via Zoom to allow screen sharing.

Diversity and Inclusion

William and Mary welcomes students from around the country and around the world, and their unique perspectives enrich our learning community. It is our collective responsibility to create and foster an environment that is inclusive and respectful for all. To do this we must demonstrate:

- Respect and responsibility for self and others
- A spirit of generosity
- A life dedicated to inquisitive learning and development
- An acknowledgement that an individual's own words, actions, and relationships show a commitment to these values

I would like to create a learning environment that supports a diversity of thoughts, perspectives and experiences, and honors your identity. To help accomplish this, please notify me:

- If you have a name and/or set of pronouns that differ from those that appear in your official W&M records.
- If you feel like your performance in the class is being impacted by your experiences outside of class.
- If something was said or done in the classroom, by either myself or another student, that causes discomfort or offense.

Technology Policy:

Use of technology can have a tremendous, positive impact on your learning. It can also have a strong, negative impact on your and your colleague's learning. Laptops should be brought to every class. During the in-class assessments, exercises, and practice, students will be using laptops. Only applications directly relevant to the coursework will be allowed. Other devices, such as mobile phones, are not to be used at anytime in class. To remove temptation and misunderstandings, your mobile phones should be on silent and placed in your bag, not out in the open.

Food and Drink Policy:

Food and drink are not allowed in the classroom. This policy is especially important to follow during the pandemic as face coverings must be always used.

Recommended Equipment:

Because you will be remote for at least some portion of this course due to social distancing requirements, I strongly advise you to obtain a secondary monitor to work effectively in the course. This is because one monitor will need to be used to receive my shared screen which will contain multiple windows and there is simply not enough space on your laptops to then split my shared screen with your own version of software we are using to work along with me. The plan, therefore, is to have one monitor to view my shared screen and the other monitor for your own software. External monitors (try to get a 24 to 27 inch one) are inexpensive to purchase, but you may also use a high-definition television for this second monitor. This second monitor will come in handy for any other hybrid or remote courses you take. You should also have a quality headset (preferable noise cancelling) with a built-in microphone to use while on Zoom both in and outside of class.

Syllabus Changes:

This is a dynamic syllabus, meaning it may undergo change. This class will follow the rules and guidelines outlined by the university regarding best practices surrounding Covid-19. There is a chance that recommended protocols for delivering class material will change based on new information. In the event this happens, I will update our syllabus on Blackboard and inform you in class or via email. It is the student's responsibility for reviewing the syllabus for changes each week on Blackboard.