CMDA 2006 CRN 82989 Integrated Quantitative Science II Fall 2022

MATH TR NCB 210 and STAT MW NCB 270

Professor: Dr. Paul Cazeaux | **Office**: McBryde Hall 570 | **Email:** cazeaux@vt.edu
Class Time: TR 2:00 - 3:15PM | **Office hours:** Th/F 10:15-11:15AM | **Course Modality:** In-person.

Professor: Dr. Hamdy Mahmoud | **Office**: Hutcheson Hall 415B | **Email:** ehamdy@vt.edu
Class Time: MW 2:30 - 3:45PM | **Office hours:** TH/F 11:30 AM-12:30 PM Sunday 5:00-6:00 PM | **Course Modality:** In-person.

Announcements are made repeatedly and posted on Canvas. Students are responsible for checking Canvas regularly, and it is advised that students turn on Canvas email notifications.

Course description: Integrated topics from quantitative sciences prepare students for advanced computational modeling and data analytics courses. Topics include: Intermediate linear algebra, regression, differential equations, and model validation. Assignments in the course will require the use of the programming languages R and Python.

Prerequisites: CMDA 2005

Mathematics Part Objectives:
We will cover fundamental topics in linear algebra and differential equations. We shall concentrate on essential techniques for understanding and manipulating matrices and build understanding of system modeling through differential equations. These topics are the foundation of modern research and industrial practice in computational and data science. Specific topics include:

1. Orthogonality, and orthogonal decomposition
2. Matrix factorisation
3. Eigenvalues, diagonalization, singular value decomposition
4. Ordinary differential equations, first and second order
5. Systems of differential equations, nonlinear systems
6. Numerical methods of solving systems of ODEs (with Python)

Statistics Part Objectives:
Students should leave CMDA-2006 with an understanding of the common types of traditional statistical methodology and procedures that are prevalent in modern research. This includes an expansion of many of the topics from CMDA-2005, and includes, but is not limited to:

1. Probability Distribution Models
2. Multivariate Distributions
3. Regression Methods
4. Model Validation Selection Methods
5. One-Way & Two-Way ANOVA with Contrast Analysis
6. Random and Mixed-Effects Models

7. Categorical Data Analysis
8. Generalized Linear Models
9. Nonparametric Methods
10. Simulation

Course Materials

- **STAT Textbook - Recommended**
  - Statistics for Engineers and Scientists, by William Navidi, 4th edition. McGraw-Hill ISBN 978-0-07-340133-1
  - Applied Statistics and Probability for Engineers, 5th ed. By Montgomery Runger. John Wiley Sons, Inc. ISBN 978-0470053041
- **Math Textbook - Recommended**
  - "Linear Algebra: A Modern Introduction" , 4th ed, by D. Poole, ISBN-13: 978-1285463247 (Strongly Recommended).
  - "Elementary Differential Equations", 2nd ed., by W. Kohler, L. Johnson, ISBN-13: 978-0321290441 (Strongly Recommended).
  - "Linear Models with R", 2nd ed., by Faraway, ISBN-13: 978-1439887332 - Very optional, only if you want a much deeper discussion on various topics.
- **Calculator:** A scientific calculator may be needed for the statistics portion of the course. TI-83, TI-83 Plus, TI-84, or TI-84 Plus calculators are preferred. These calculators may be used on Statistics exams but the memory must be cleared before each exam. Be sure to check the batteries BEFORE the exam. Phones/tablets MAY NOT be used for exams.

- **Required free Software: R, RStudio and the Anaconda3 distribution of Python**
  - Download and install R: https://cran.r-project.org/
  - Download and install RStudio: https://www.rstudio.com/products/rstudio/download/
  - Download and install Python https://conda.io/docs/user-guide/install/download.html

Course Expectations:

- Attendance is key to success. If you miss a lecture, you are responsible for getting all notes/materials and announcements from a fellow classmate and/or Canvas.
- Be an active, non disruptive participant in the class. Take notes, ask/answer questions, and be respectful of others. Please do not talk, text, etc. during class. Silence or turn off your phone.
- Recording (voice, video, pictures) of the lecture is NOT allowed without permission granted for special circumstances.
- Be prepared for class. Read the assigned textbook sections before class. The lectures are designed to be best understood if you have read the textbook.

Assessments and Grading Criteria:

	Midterms	Homework, Quizzes, project and Class activities	Final
Mathematics	2 midterms (15% each)	10%	10%
Statistics	2 midterms (15% each)	10%	10%

Appeals for points, partial credit, incorrect score, missing scores on Canvas, etc., should be brought to our attention in a timely manner. For homework that has been submitted to Canvas, use the comments box to contest grades first, then follow up with the TA. If the appeal is not resolved with the TA, then proceed to contact the professor.

The grading scale will be as follows:

Overall grade	Grade letter	Overall grade	Grade letter
[92.5, ∞)	A	[72.5, 76.5)	C
[89.5, 92.5)	A-	[69.5, 72.5)	C-
[86.5, 89.5)	B+	[66.5, 69.5)	D+
[82.5, 86.5)	B	[62.5, 66.5)	D
[79.5, 82.5)	B-	[59.5, 62.5)	D-
[76.5, 79.5)	C+	[0, 59.5)	F

The instructors reserve the right to use their discretion in assigning grades in borderline cases. Note that this grading scale already incorporates rounding so you should not assume, for example, that a final percentage grade of 89.47 will be rounded to an A-.

Attendance
You are expected to attend and participate in class. Additionally, you are also responsible for knowing any and all announcements made during class time. All in-class announcements are repeated on canvas.

Use of cell phones or computers during class for entertainment purposes (games, texting, social media, web browsing, etc) is not acceptable.

Class notes are essential: If you miss a class, it is your responsibility to obtain the material missed in class. This means asking other students to copy notes or downloading slides from Canvas.

Midterm Exams

- **Mathematics**
  - Mid-term Exam 1: Thursday, September 22
  - Mid-term Exam 2: Thursday, November 17
- **Statistics**
  - Mid-term Exam 1: Monday, October 5

- Mid-term Exam 2: Monday, November 9

Final Exam: 4:25PM-6:25PM on December 13, 2022. The final exam will be comprehensive for all topics in the course. The final exam will be given in our classroom. It is a required class meeting that will not be rescheduled for discretionary reasons, including conflicts with work schedules and with classes and exams at other colleges, or attempting to leave for vacation early because of cheaper flights, etc.

Exam Policies
The exams are closed book (no calculators, computers, phones or other handheld devices, formula sheets, textbook, notes, etc.) unless exceptions are specifically announced.

Some exams (especially Statistics) may allow the use of calculators for the exam. See the calculator requirement section at the top. Tablets, phones, and other connected devices are strictly forbidden. Make sure to check your calculator batteries before coming to the exam. You will not be allowed to share calculators.

Missed Exam Policy
Exams can be made up only with PRIOR consent of the instructor. An exceptional arrangement might be made only in the case of a legitimate documented excuse. All university policies regarding religious observances and health related absences will be followed.

Homework, Quizzes, Projects, and Class Activities

- **Time**
  Weekly homework assignments will be posted online. Do not wait until the last second to submit your homework. **Canvas will flag late assignments. Late assignments will be accepted within 24 hours of the due date for 80% of your actual grade, otherwise you will receive zero.** The deadline for each week are as follows:
  - **Mathematics** Homework will be assigned and collected on a regular basis. Due dates will be posted on the assignment and on Canvas. We will also remind you about due dates during class.
  - **Statistics** Assignments are due each Sunday 11:59PM starting from the second week, unless otherwise announced in class.
- **Format**
  Homework assignments must be uploaded to canvas in order to be graded. Do not email the instructors/TAs your assignment materials to be graded. If the assignment is completed by hand, you must scan/take a picture of your work. It must be saved as a .pdf to be uploaded. Specific instructions will be given in the assignments. **Showing no work will result in no credit.**
  - **Statistics** Additionally for problems that use R, you will need to upload your small write-up (.pdf format) and computer code (.R files) to canvas.
  - **Mathematics** Additionally for problems that require computation using Python, you will need to upload your small write-up (.pdf format) and computer code (.py or .ipynb files) to Canvas.
- **Quizzes**
  Occasional quizzes and in-class exercises will be given and may not be announced ahead of time.You may talk with each other about homework assignments, but what you turn in must be your own work. No make-up quizzes or in-class exercises will be given without a valid and documented excuse.
- **Work Presentation**
  You should do your best to present your work in a well-organized and professional manner. Work should be done in pencil (mistakes happen, easier to erase than to smear/scratch out ink!). Do your best to write legibly and scan/photograph your assignments so that your writing is clearly visible. The easier it is to read, the easier it is to grade! You may LaTeX your assignments if you wish.

- **When completing assignments, keep in mind that we grade solutions, not answers! Solutions are a series of sentences, equations, algebraic manipulations, plots, etc that justify why an answer is correct. Answers without work are not enough! Showing no work will result in no credit.**
- You are permitted, and encouraged, to discuss the assignments with other students, but the final work (including computer code) must be entirely your own. Copying the work of other students is a violation of the Honor Code (see section below).
- **Projects** are like homework assignments but require more effort and may feature open ended questions with less direction. Due dates will typically be longer than a regular homework assignment. The use of R and/or Python will be essential to completing projects.

Course Feedback
Toward the end of the semester the online Student Perceptions of Teaching (SPOT) questionnaire will be used to gather feedback on particular aspects of the course and instruction. Constructive student feedback is important for enhancing the learning experience in this course. We read and consider all student comments regarding the course and instruction.

Honor Code
The Undergraduate Honor Code pledge that each member of the university community agrees to abide by states:

"As a Hokie, I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do."

Students enrolled in this course are responsible for abiding by the Honor Code. A student who has doubts about how the Honor Code applies to any assignment is responsible for obtaining specific guidance from the course instructor before submitting the assignment for evaluation. Ignorance of the rules does not exclude any member of the University community from the requirements and expectations of the Honor Code. For additional information about the Honor Code, please visit: www.honorsystem.vt.edu

Honor Code Pledge for Assignments
The Virginia Tech honor pledge for assignments is as follows: "I have neither given nor received unauthorized assistance on this assignment." The pledge is to be written out on all graded assignments at the university and signed by the student. The honor pledge represents both an expression of the student's support of the honor code and an unambiguous acknowledgment that the student has, on the assignment in question, abided by the obligation that the Honor Code entails. In the absence of a written honor pledge, the Honor Code still applies to an assignment.

Accommodations
If you require accommodations for the class, please arrange to meet with us as soon as possible to discuss them. If for any reason you need special considerations please let me know as soon as possible. We can work together to make sure your needs are met. All requests must be approved by university. Feel free to visit www.ssd.vt.edu for additional information

IMPORTANT NOTICE

- Please check your schedule which comes out after the last add date. Students who are not registered cannot receive a grade.
- The policies in this syllabus and related course schedule are subject to reasonable adjustments as the class progresses. In such instances, the instructor will provide students with sufficient notice in the form of announcements in class and on Canvas.