University of Notre Dame

Department of Applied and Computational Mathematics and Statistics

ACMS 30530-01   FALL 2023

Introduction to Probability
Syllabus

INSTRUCTOR
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CLASSES MEET
08/23/23 –12/06/23
Monday/Wednesday   11:00am – 12:15pm   DeBartolo Hall 320

OFFICE HOURS
Monday/Wednesday: 2:00pm – 3:00pm   **203F Crowley Hall**
TA Office Hours: Thursday 2:00pm-4:pm   **202 Crowley Hall**

CONTACT
- It is highly recommended and preferred that you contact the instructor and TA after class and/or during office hours.

COURSE WEBSITES
ACMS 30530 uses Canvas. You can gain access to **Canvas** by going to https://canvas.nd.edu/. Materials for this course will be distributed and managed via this website, and you will be able to monitor your grade entries throughout the semester.

PREREQUISITE
The later part of this course is mathematically involved. One year of Calculus, such as Taylor expansion, derivatives and (multivariate) integrals are required.

COURSE OVERVIEW

This course provides students a foundation in probability needed for statistical inference and modeling. We will cover

- Key concepts in probability such as probability spaces, conditional probability, and independence
- Random variables and their distributions commonly used in statistical inference and modeling: Binomial, Geometric, Hyper-geometric, Poisson, Normal, Exponential, Gamma, Beta distributions
- Numerical characteristics of a random variable including mean, standard deviation, expectation, moments, covariance and moment generating function
- Conditional distributions, conditional expectations, joint probability distributions and the transformation of random variables
- Law of Large Numbers, Central Limit Theorem and applications

COURSE MATERIALS

- ❖ **Textbook:** Math Stat with Applications, 7th Ed. Wackerley, et al. The course will cover Chapters 2 – 7, not necessarily in order.
- ❖ Supplementary Material (Optional): "A First Course in Probability" by Sheldon Ross; "Probability" by Jim Pitman.

HOMEWORK

- There will be weekly homework assignments. Homework will be assigned in class/on Canvas and will be due on **Friday, 11:59pm the next week**. You will need to submit your homework through Canvas.
- You are welcome, or even encouraged, to use LaTeX to typeset your homework, but handwritten homework is also OK.
- Late homework will be penalized 15% per day for a maximum of three days. Do not ask for extensions; just hand in the homework late –submit them through Canvas. After three days, no credit will be given. Fraction of a day counts as a full day.
- There will (probably) be 11 homework assignments. **Lowest homework grade will be dropped**.
- Homework is designed to teach, and you are encouraged to seek help from the instructor/TA if you have questions.
- Collaboration Policy: You are welcome to collaborate on your homework, but you must write up your own final version to hand in and write in your own words. You must **include the names of your collaborators** at the beginning of your homework (this will not result in any penalty). *Failure to comply will result in severe penalties.*
- **Missing** homework receives a score of zero and **will NOT be** counted as the lowest score.

EXAMS

- The midterm exams will be Wednesday, Sep. 20th; Wednesday, Oct. 25th; Monday, Nov. 15th. You will be allowed **one page** of notes for the midterm.
- The **final** examination will be Monday, Dec. 11 1:45 PM - 3:45 PM. You will be allowed **one page** of notes for the final.
- During examinations strict rules will be in effect regarding *honor code*.

EXAM POLICYIES

- Unexcused absences from an exam will result in a score of zero for that exam. An absence is considered excused only if written documentation is provided (e.g., a note from St. Liam's, an e-mail from the athletic office, etc.). In the case of an excused absence, the exam will be rescheduled.

GRADING

These will be based on scores in homework, midterms and final exam. There will be 3 midterms.
30% homework, 45% midterms (15% each), and 25% final examination.
Numerical scores will be converted to letter grades according to a scale that will be determined by the professor after the course is completed.

TENTATIVE SCHEDULE (subject to change)

Lecture	Week of		Materials	Chapters in Book
1	Aug. 23rd	W	Introduction	
2	Aug. 28th	M/W	Intro to Probability; Inclusion-Exclusion Formula	2.1-2.6, additional material
3	Sep. 4th	M/W	Conditional Probability, Independence, Bayes' Rule	2.7-2.10
4	Sep. 11th	M/W	Discrete RVs, Bernoulli, Binomial, Geometric, Negative Binomial Distributions, Expected Values and Variance of Discrete RVs, Poisson Distribution	3.1-3.8
5	Sep. 18th	M/W (Test1)	Poisson Distribution and Review; Midterm 1	3.8
6	Sep. 25th	M/W	Continuous RV, Expected Values and Variance of Continuous RV	4.1−4.4, 4.9
7	Oct. 2nd	M/W	Exponential Distribution, Normal Distribution	4.5
8	Oct. 9th	M/W	Gamma Distribution, Beta Distribution, Functions of a Random Variable	4.6-4.7
9	Oct. 16th	M/W	Mid-Term Break (No Class)	
10	Oct. 23rd	M/W (Test2)	Review; Midterm 2	
11	Oct. 30th	M/W	Joint Distributions, Marginal Distributions, Uniform distribution, Independence of RVs, Expectations of Sums	5.1-5.4, 5.6, 6.7
12	Nov. 6th	M/W	Variance of Sums of RVs, Covariance, Conditional Distributions, Conditional Expectations; Moment Generating Functions	5.3, 5.5, 5.7-5.11, 3.9
13	Nov. 13rd	M/W (Test3)	Review; Midterm 3	
14	Nov. 20th	M	Distributions of Sums of Independent RVs, Distributions of Quotient of RVs	6.3
15	Nov. 27th	M/W	Markov and Chebyshev Inequalities, Law of Large Numbers, Central Limit Theorem	7
16	Dec. 4th	M/W	Final Review	
17	Dec. 11th	M	Final Exam	