Syllabus for STAT 375 - 01, Probability Theory

College of the Holy Cross, Fall 2024

Instructor: Dr. Neranga Fernando

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Office Hours: 2:30pm - 4pm on Wednesdays and 9:15am - 10:45am on Fridays. I am not available on Thursdays.

Meeting Times and Location: 12pm - 12:50pm on MWF, Swords 302

Course Objectives: At the end of this semester, you will be able to:
- Calculate the probability of an event using the basic axioms of probability as well as through the use of probability distributions
- Find expected values of random variables
- Use moment generating functions to describe a random variable
- Analyze functions of random variables, including pairs of random variables
- Understand the variation inherent to a sample from a population

Textbook: *Mathematical Statistics with Applications*, 7th Edition by Wackerly, Mendenhall, and Scheaffer

Course Materials: All announcements, materials and grades will be posted on Canvas.

Quizzes: There will be nine in-class quizzes during the semester. The two lowest quiz grades will be dropped.

Here are the dates you will be taking a quiz:

Quiz 1 (September 6), Quiz 2 (September 13), Quiz 3 (September 20), Quiz 4 (September 27), Quiz 5 (October 4), Quiz 6 (October 25), Quiz 7 (November 1), Quiz 8 (November 8), Quiz 9 (November 15)

It is strongly advised that you do all of assigned homework since the quizzes will closely resemble the homework problems.

Homework: Each homework assignment will be posted on Canvas a week prior to its due date. You must submit your solutions as a hard copy. Ten points will be deducted from late homework. No homework assignment will be accepted after 5 days from the due date. No homework grade will be dropped.

No help from any Internet sources is allowed. Plagiarism will not be tolerated and will be treated as a violation of the Departmental Policy on Academic Integrity.

By doing mathematics you learn mathematics. You learn math best when you approach the subject as something you enjoy. Learn to explain mathematics to your classmates. Mathematics can be fun and rewarding when there are people around you who enjoy figuring out problems as much as you do. Take advantage of this opportunity and organize study groups. I will not consider working on homework problems with your classmates as a violation of the academic honesty policy in the department. However, you must prepare and submit your own solutions.

Please follow these guidelines when you submit homework assignments:
- Put your name, the date, and the homework assignment number at the top of the first page.
- Staple multi-page assignments.
- Write neatly and show all your work.
- On the last page of your assignment, please write the name(s) of your classmate(s) with whom you work on homework problems (with an asterisk).
- Make sure you attach the honor code.

All homework assignments are due by 4pm on the following days:

Homework 1 (September 6), Homework 2 (September 13), Homework 3 (September 20), Homework 4 (September 27)
Homework 5 (October 4), Homework 6 (October 25), Homework 7 (November 1), Homework 8 (November 8),
Homework 9 (November 15), Homework 10 (November 26)

Exams: There will be two exams during the semester. The exams are 90-minute exams; they will be held from 6pm to 7.30pm on October 9 and November 20 in Swords 302. No exam grade will be dropped.

Presentation: You will present the solution to a problem assigned to you in class during the semester.

Final Exam: There will be a mandatory cumulative final exam in this course. Location and time of the final exam are to be determined. **Check for final exam schedule conflicts as soon as possible.**

Snow Days: If classes are cancelled due to snow, or for other official reasons, any scheduled quiz or test will occur during next class meeting.

Final Class Grade: Final exam is mandatory. If you score at least an 80% on the final exam, both your class grades before the final and after the final will be considered. Whichever one higher will be your final class grade. If you do not take the final exam, then it will be a zero on the final exam. If you miss the final exam for a valid reason, you must still take a make-up final exam and score at least an 80% on the final to be eligible for the final class grade option explained above. If you miss the final exam for a valid reason and you do not take a make-up final exam, then it will be a zero on the final exam.

If your final exam grade is less than 80%, then you do not qualify for the final class grade option explained in the previous paragraph, and the final class grade will be computed according to the criterion described in **Grading**.

Grading: The course grade will be determined as follows:
Homework: 30%
Quizzes: 14% (2% each)
Presentation: 6%
Exams: 30% (15% each)
Final Exam: 20%

Final grades will be given according to the following percentage cutoffs. These cutoffs, although fairly strict, can be lowered (according to class performance), but not raised, no matter how well the class performs.

$A \geq 93$, $90 \leq A- \leq 92$, $87 \leq B+ \leq 89$, $83 \leq B \leq 86$, $80 \leq B- \leq 82$, $77 \leq C+ \leq 79$, $73 \leq C \leq 76$, $70 \leq C- \leq 72$,

$67 \leq D+ \leq 69$, $63 \leq D \leq 66$, $60 \leq D- \leq 62$, $F \leq 59$

An incomplete grade is given if you have a good attendance record, have completed all the assignments with an overall grade of at least 70%, and have missed the final exam for a valid reason. An incomplete grade is given at the discretion of the instructor.

Calculators: You are allowed to use a scientific (not graphing) calculator on quizzes, mid-term exams and the final exam.

Issues with the Course/Instructor: If you have issues with this course and/or instructor which you are not comfortable discussing with your instructor, you should contact the Chair of the Department of Mathematics and Computer Science, Professor Eric Ruggieri, at eruggier@holycross.edu.

Academic Honesty: A necessary prerequisite to the attainment of the goals of the College is maintaining complete honesty in all academic work. Students are expected to present their own work in exams and in any material submitted for credit. Students may not assist others in presenting work that is not their own. Offenders are subject to disciplinary action. A violation of the Department Policy on Academic Integrity will result in a 0 for that quiz or exam, and a letter describing the occurrence of academic dishonesty will be sent to the Chair of the Department of Mathematics and Computer Science and your Class Dean.

For more on Academic Integrity see:

https://www.holycross.edu/academics/programs/mathematics-and-computer-science/node/211581/academic-integrity

Diversity and Inclusion: It is my intent that students from all diverse backgrounds and perspectives be well-served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength, and benefit. Any suggestions you have pertaining to diversity and inclusion are encouraged and appreciated.

Important:

(1) Any student with special needs is encouraged to meet with me during the first week of classes to discuss accommodations. The student must bring a current Memorandum of Accommodations from the Office of Accessibility Services. The following is the link to the Office of Accessibility Services:

    `https://www.holycross.edu/health-wellness-and-access/office-accessibility-services`

(2) Please note that, consistent with applicable federal and state law, this course may be video/audio recorded as an accommodation only with permission from the Office of Accessibility Services. Students are not permitted to record the contents of this class under any other circumstances.

(3) If you are an athlete and have conflicts with an important class activity (homework, quiz, exam, or final), please let me know in advance.

(4) For College's Excused Absence Policy see:

    `https://catalog.holycross.edu/requirements-policies/academic-policies/#coursepoliciestext`

(5) All electronic devices (mobile phones, laptops etc.) must be turned off during class time, quizzes, exams and final exam.

Syllabus: Syllabus is subject to change. It is your responsibility to be aware of any changes I may make to the syllabus as they are announced in class. Students are responsible for all information given when they are absent.

Some Additional Notes:

(1) I will hold an additional 2-hour final exam review session the day before (or two days before) the final exam. We will discuss and find a time that works for all of us. I will let you know the location before you go home for Thanksgiving Break.

(2) I will hand out worksheets in class. Since we do not have time to work on all the problems on problem sheets in class, I will post their solutions on Canvas. However, I encourage you all to work on the problems and bring questions to my office hours.

Important Dates:

October 14 – 18	Fall Break: no classes
November 27 – 29	Thanksgiving Break: no classes

December 6, Friday, Last day of classes
December 11, Wednesday – December 16, Monday, Final Exams
Final Exam is based on all sections covered in class.

The mind is not a vessel to be filled but a fire to be kindled.
— Plutarch

Schedule of Topics

Sections 2.1 - 2.2 Samples Spaces and Events

Section 2.3   Review of Set Theory

Sections 2.4 - 2.5 Probability Axioms and Properties

Section 2.6 Counting Techniques

Sections 2.7 - 2.9 Envelopes Problem, Conditional Probability; Independence; Laws of Probability

Section 2.10 Law of Total Probability and Bayes' Rule

Section 2.11 Discrete Random Variables (RV)

Sections 3.1 - 3.2 Probability Mass Functions, CDFs

Section 3.3 The Expected Value of a Random Variable or a Function of a Random Variable

Section 3.4 The Binomial Distribution

Sections 3.5 - 3.7 Negative Binomial, Geometric, and Hypergeometric Distributions

Section 3.8 Poisson Distribution

Sections 4.1 - 4.2, 4.4 Introduction to Continuous RVs; Prob. Density Functions; Cumulative Distribution Functions (CDF)

Section 4.3 Expected Value and Variance of a Continuous RV, Moment Generating Functions

Section 3.9 Moment Generating Functions: Discrete RVs

Section 4.9 Moment Generating Functions: Continuos RVs

Section 4.5 Normal Distributions

Section 4.6 The Gamma, χ^2, and Exponential Distributions

Section 4.7 Beta Distribution

Sections 3.11, 4.10 Chebyshev's Inequality

Sections 5.1 - 5.2 Joint Distributions: Discrete, Joint Distributions: Continuos

Section 5.9 The Multinomial Distribution

Sections 5.3 Marginal Distributions

Section 5.4 Independence of RVs

Sections 5.5 - 5.6 The Expected Value of a Function of RVs

Section 5.7 Covariance of Two RVs, Correlation of Two RVs

Section 5.3 Conditional Probability Distributions

Section 5.11 Conditional Expectation and Variance

Section 5.8 Linear Combinations of Random Variables

Sections 6.1 - 6.3 Transformation of a RV: The CDF Method

Section 6.4 Transformation: The Change of Variables Theorem

Section 6.7 Order Statistics

Section 7.3 The Central Limit Theorem

Final Exam Review