

# Math 3670

## Probability and Statistics with Applications

### Spring 2024

#### ***Catalog Description***

Introduction to probability, probability distributions, point estimation, confidence intervals, hypothesis testing, linear regression and analysis of variance.

#### ***Prerequisites***

MATH 2401 or MATH 24X1 or MATH 2411 or MATH 2551 or MATH 2550 or MATH 2X51.

#### ***Textbook***

Title: Introduction to Probability and Statistics for Engineers and Scientists

Author: Sheldon Ross. Editor: academic Press. Edition: 6<sup>th</sup> edition

The book is available for free to Georgia students. The link for the 6<sup>th</sup> edition is:

<https://www.sciencedirect.com/book/9780128243466/introduction-to-probability-and-statistics-for-engineers-and-scientists>.

#### ***Instructor***

Dr. Alexandre Locquet, office 206.

Communication: Please send me messages using Canvas only. (“Inbox” tab on your dashboard)

#### ***Lecture Times***

TBD

#### ***Office hours***

TBD and by appointment

#### ***Attendance***

A 1% BONUS is associated to attendance. Attendance Polling using Turning Point Technology and/or attendance sheets will be used to count the number of absences.

Students need to install the TurningPoint app on a mobile device. As a Georgia Tech student, installation and use of the app is free. In the TurningPoint settings, the region needs to be set to “North/South America” and NOT to Europe.

Students who do not miss more than 2 lectures during the entire term get a 1% attendance BONUS. Students who miss more than 2 classes get 0% for the attendance BONUS.

## *In-Lecture Polling*

Students will be asked to answer questions during some lectures, using the Turning Point app. Students who will have correctly answered at least 80% of all questions asked get a 1% BONUS. Session ID is gt157160

## *Grading Policy*

<b>Homework</b>	<b>14%</b>
<b>Quiz 1</b>	<b>28%</b>
<b>Quiz 2</b>	<b>28%</b>
<b>Final Exam</b>	<b>30%</b>

## *Homework*

7 problems sets will be assigned. **Homework should be submitted electronically on Canvas as a single, legible, pdf file.** The submission time on Canvas will be used to determine whether a homework is submitted on time or not: no exceptions will be made. A completion grade will be assigned. If a given homework 1) has been submitted on time and 2) every problem is answered, the student gets 2% credit. **If one of the conditions above is not satisfied, 1% credit will be assigned. If none of the conditions are satisfied, 0% credit will be assigned. If a homework is submitted more than 2 days late, 0% credit will be assigned, even if every problem is answered.**

## *Quizzes and Final Exam*

The quizzes and the final exam will be in-person, closed-book and notes. The final exam will be comprehensive (cumulative). The use of a calculator will be allowed. Any request for regrading a quiz must be made to the instructor within one week of getting the quiz back. If you have an acceptable reason for missing quiz 1 or quiz 2, the weight associated to the quiz will be transferred to the final exam. If the sanitary situation requires it, the quizzes and final might be administered online at some point during the term. You can use [this](#) formula sheet for the quizzes and final.

## *Important Dates*

<b>Quiz 1</b>	<b>TBD</b>
<b>Quiz 2</b>	<b>TBD</b>
<b>Final Exam</b>	<b>TBD</b>

## *Student-Faculty Expectations Agreement*

At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See <http://www.catalog.gatech.edu/rules/22/> for an articulation of some basic expectation that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial

interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

### ***Honor Code***

Students are, of course, expected to abide by the [Georgia Tech Honor Code](#). Instances of academic misconduct will be viewed very seriously and reported to the Dean of Students.

### ***Feedback***

Anonymous feedback can be provided to the instructor using the link below:

[https://docs.google.com/forms/d/e/1FAIpQLSeCdgnMWhYMXHMNUJUIwcPd706nBW9NWaFkh4AehA2Dp\\_1tfw/viewform?usp=sf\\_link](https://docs.google.com/forms/d/e/1FAIpQLSeCdgnMWhYMXHMNUJUIwcPd706nBW9NWaFkh4AehA2Dp_1tfw/viewform?usp=sf_link)

You are also encouraged to fill in the course-instructor opinion survey (CIOS).

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## **I. Probability Basics. *Textbook: chapter 3***

### **I.1. Introduction**

- 1.1 Origin of uncertainty
- 1.2 Probability versus Statistics

### **I.2. Basic Definitions**

### **I.3. Sets and Set Operations**

### **I.4. Axiomatic Definition of Probability**

- 4.1 A Special Case: the Simple Sample Space

### **I.5. Conditional Probability**

- 5.1 Probability of Event Intersections
- 5.2 Independence of Events

### **I.6. Bayes' Theorem**

### **I.7. Counting Techniques**

- 7.1 Permutations
- 7.2 Combinations

## **II. Random Variables**

### **II.1 Introduction and Basic Definitions**

### **II.2 The Probability Mass Function of Discrete RVs function *Text: 4.1,4.2***

### **II.3 The Cumulative Distribution Function *Text:4.1, 4.2***

### **II.4 The Probability Density Function of Continuous Random Variables *Text: 4.1,4.2***

### **II.5 Expectation and Variance of a Random Variable *Text: 4.4,4.5,4.6***

#### 5.1 Expectation

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#### 5.3 Variance and Standard Deviation

#### 5.4 Moments of a Random Variable

### **II.6 Famous Discrete Random Variables**

#### 6.1 Bernoulli Distribution *Text: 5.1*

#### 6.2 Binomial Distribution *Text: 5.1*

#### 6.3 Geometric Distribution

#### 6.4 Poisson Distribution

### **II.7 Famous Continuous Random Variables**

#### 7.1 Uniform Distribution *Text: 5.4*

#### 7.2 Exponential Distribution *Text: 5.6*

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##### 7.2.2 Memoryless Property of the Exponential Distribution

##### 7.2.3 Link with the Poisson Process

#### 7.3 The Normal (or Gaussian) Distribution *Text: 5.5*

##### 7.3.1 Definition

##### 7.3.2 Properties of the Normal Random Variable

##### 7.3.3 The Standard Normal Distribution

#### 7.4 Relatives of The Normal Distribution

7.4.1 The chi square distribution

7.4.2 The  $t$ -distribution

7.4.3 The F-distribution

## **III Pairs of Random Variables and Combinations of Random Variables**

### **III.1 Pairs of Random Variables**

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1.2 Continuous Case *Text: 4.3*

1.3 Independence of 2 Random Variables *Text: 4.3*

1.4 Covariance and Correlation Coefficient *Text: 4.7*

### **III.2 Linear Combinations of Random Variable and the Central Limit Theorem**

2.1 Linear Function of a Single Random Variable

2.2 Linear Combination of Random Variables *Text: 6.2*

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## **IV Statistics**

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### **IV.2 Descriptive Statistics** *Textbook: 2*

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2.2 Charts

2.3 Sample Statistics *Textbook: 2.3*

2.3.1 Measures of Central Tendency

2.3.2 Measures of Spread

### **IV.3 Point Estimation** *Textbook: 7*

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3.2 Desired properties of an estimator

3.2.1 Unbiased Estimator

### 3.2.2 Minimum-Variance Estimates

## IV.4 Confidence Intervals

- 4.1 Introduction to Confidence Intervals. Textbook: 7.3
- 4.2 Confidence Interval for the Population Mean- Variance Known Textbook: 7.3
- 4.3 Confidence Interval for the difference of two means- variances known Textbook: 7.4
- 4.4 Confidence Interval for the mean of a normal population of unknown variance Textbook: 7.3.1
- 4.5 CI's for the difference of two means- variances unknown and equal Textbook: 7.4
- 4.6 Confidence Interval Variance of a Normal Population Textbook: 7.3.3

## IV.5 Hypothesis Testing

- 5.1 Introduction Textbook: 8.1, 8.2
- 5.2 Normal Mean Tests-Variance Known Textbook: 8.3.1
  - 5.2.1 Two-Sided Tests
  - 5.2.2 One-Sided Tests
- 5.3 Normal Mean Tests-Variance Unknown Textbook: 8.3.2
- 5.4 Normal Variance Tests Textbook: 8.5
- 5.5 Hypothesis tests on the difference between two means – variances known Textbook: 8.4.1
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- 5.7 Hypothesis tests on the difference between two normal means – variances unknown and different Textbook: 8.4.3
- 5.8 Hypothesis tests on the variances of two normal populations Textbook: 8.5.1