



North South University

Department of Mathematics and Physics

MAT 361(10): Probability and Statistics Fall 2018

Instructor	: Professor Md. Israt Rayhan, Ph.D. (IsR)
Course No.	: MAT361
Section	: 10
Class Time	: ST 8:00 AM–9:30 AM (Sunday and Tuesday)
Class Room	: SAC 313
Office	: SAC 10 th floor (1018-D)
Office Hours	: ST 11:10 AM - 12:10 PM or by appointment
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Text book: Probability and Statistics for Engineers and the Scientists (4th edition, 2012), Anthony J. Hayter (Brooks/Cole, Cengage Learning).

Course Short Description: This course is an introduction to the probability theory and statistical inference for undergraduates in engineering and the sciences. This course attempts to provide basic concepts of set theory, central tendency, dispersion and different approaches of conceptualizing probability. It discusses useful laws of probability, Bayes rule, random variables and their distribution. It also covers discussions on certain operators like mathematical expectation, variance of random variables and probability distributions such as Binomial, Geometric, Negative Binomial, Poisson, Uniform, Normal, Exponential and their applications. It focuses on sampling distribution, single mean test and preliminary ideas on test of hypothesis.

Course Objectives:

1. To apply basic concepts of sets, sample space and randomness of data.
2. To acquaint students with probability and its laws.
3. To develop skills on probability and sampling distributions.
4. To analyze generating functions and its application in real life data.
5. To make familiar with hypothesis test and decision making troubleshoot.

Course Learning Outcomes: Upon completion of this course students should be able to:

CLOs	Description
CLO1	Apply basic probability concepts such as conditional probabilities, independence, Bayes Rule, and combinations and permutations to calculate probabilities of events of practical interest.
CLO2	Analyze and conceptualize random variables, single and multivariate distributions, conditional distribution and independence of random variables.
CLO3	Identify and apply Binomial, Negative Binomial, Geometric, Hyper-geometric, Poisson, Exponential and Normal probability models to find mean, variance and associated probabilities.
CLO4	Develop skills on representation of sample data with graphs and numerical summaries.
CLO5	Derive sampling distribution of statistics and estimate point estimators for various parameters using the method of moments and the method of maximum likelihood.
CLO6	Evaluate the performance of various estimators using properties such as unbiasedness, efficiency and minimum variance.
CLO7	Build confidence intervals for means and interpret the results. Find and perform statistical test on means.
CLO8	Perform hypothesis test to make decision.

CO/PO Mapping:

CLOs	Description	Bloom's taxonomy domain/level (C: Cognitive, P: Psychomotor, A: Affective)	Delivery methods and activities	Assessment tools
CLO1	Apply basic probability concepts such as conditional probabilities, independence, Bayes Rule, and combinations and permutations to calculate probabilities of events of practical interest.	C3, P2	Lectures, notes	Quiz, Exam
CLO2	Analyze and conceptualize random variables, single and multivariate distributions, conditional distribution and independence of random variables.	C3, C4, P2	Lectures, notes	Quiz, Exam
CLO3	Identify and apply Binomial, Negative Binomial, Geometric, Hyper-geometric, Poisson, Exponential and Normal probability models to find mean, variance and associated probabilities.	C3, C4	Lab class/ Discussion	Lab work/ Assignment
CLO4	Develop skills on representation of sample data with graphs and numerical summaries.	C4, P2	Group discussion	Presentation/ Assignment
CLO5	Derive sampling distribution of statistics and estimate point estimators for various parameters using the method of moments and the method of maximum likelihood.	C3, C4, C5, P3	Lectures, notes	Quiz, Exam
CLO6	Evaluate the performance of various estimators using properties such as unbiasedness, efficiency and minimum variance.	C5, P3	Lab class/ Discussion	Lab work/ Assignment
CLO7	Build confidence intervals for means and interpret the results. Find and perform statistical test on means.	C3	Group discussion	Presentation/ Assignment
CLO8	Perform hypothesis test to make decision.	C4, P2	Demonstration	Quiz, Exam

Prerequisite course: MAT250

Grading: The final grade in this course will be determined by the marks earned by a student on a final exam, two (2) midterm exams and five (5) quizzes. The relative weightings of these components towards the final grade are as follows.

Midterm Exam 1	15%	Exam date to be announced in class
Midterm Exam 2	15%	Exam date to be announced in class
Five (5) Quizzes Quiz 1 on Ch. 6 & 1 Quiz 2 on Ch. 2 Quiz 3 on Ch. 3 Quiz 4 on Ch. 4-5 Quiz 5 on Ch. 7-8	15%	Quiz dates are to be announced in class
Attendance	5%	
Lab work/ Assessment	5%	
Assignment	5%	
Final Exam	40%	Exam date and place to be announced in class
Total	100%	

(As per NSU policy) The final letter grades will be assigned according to final averages as follows

A	93 – 100
A-	90 – 92
B+	87–89
B	83– 86
B-	80 – 82
C+	77–79
C	73– 76
C-	70 –72
D+	67 – 69
D	60 –66
F	0 –59

Examination Dates:

- Midterm Exam I (Ch 1-2, 6) : To be announced in class
- Midterm Exam II (Ch 3-5): To be announced in class
- Final (comprehensive) Exam : To be announced in class

Attendance Policy

Attendance at all classes is mandatory and is a NSU policy. Students are expected to remain in class the *entire* period. This means that students must arrive on time and stay until class is finished. Each student is responsible for all material covered during his/her absence.

Cell Phone Policy

Students are not allowed to use any phone/texting/email device during class period, test, or final.

Assignment and Examination Policy

Assignments are to be submitted on time, late submission will not be allowed. No makeup quizzes and Final exam. Makeup Mid exam will only be considered with a penalty of 20% reduced marks in case of serious illness or accident with proper justification and documentation.

Tentative Syllabus for MAT-361

Chapter 1: Probability Theory (2 lectures)

- 1.1 Probabilities
- 1.2 Events
- 1.3 Combinations of events
- 1.4 Conditional probability
- 1.5 Probabilities of event intersectins
- 1.6 Posterior probabilities
- 1.7 Counting techniques

Chapter 2: Random Variables (3 lectures)

- 2.1 Discrete random variables
- 2.2 Continuous random variables
- 2.3 The expectation of a random variable
- 2.4 The variance of a random variable
- 2.5 Jointly distributed random variables
- 2.6 Combinations and functions of random variables

Chapter 3: Discrete Probability Distributions (3 lectures)

- 3.1 The Binomial distribution
- 3.2 The Geometric and Negative Binomial distribution
- 3.3 The Hypergeometric distribution
- 3.4 The Poisson distribution

Chapter 4: Continuous Probability Distribution (2 lecture)

- 4.1 The Uniform distribution
- 4.2 The exponential distribution

Chapter 5: The Normal Distribution (2 lectures)

- 5.1 Probability calculations using the normal distribution
- 5.2 Linear combinations of normal random variables
- 5.3 Approximating distributions with the normal distribution
- 5.4 Distributions related to the normal distribution

Chapter 6: Descriptive Statistics (3 lectures)

- 6.1 Experimentation
- 6.2 Data presentation
- 6.3 Sample statistics
- 6.4 Examples

Chapter 7: Statistical Estimation and Sampling Distributions (3.5 lectures)

- 7.1 Point estimates
- 7.2 Properties of point estimates
- 7.3 Sampling distributions
- 7.4 Constructing parameter estimates

Chapter 8: Inferences on a Population Mean (3.5 lectures)

- 8.1 Confidence intervals
- 8.2 Hypothesis testing

HOMEWORK EXERCISES

Chapter 1	1.1	1.1.1, 1.1.3, 1.1.7, 1.1.9
	1.2	1.2.1, 1.2.3, 1.2.7, 1.2.11
	1.3	1.3.2, 1.3.6, 1.3.7, 1.3.11, 1.3.12
	1.4	1.4.1, 1.4.9, 1.4.12, 1.4.16
	1.5	1.5.1, 1.5.2, 1.5.7, 1.5.9, 1.5.16
	1.6	1.6.1, 1.6.3, 1.6.7
	1.7	1.7.4, 1.7.5, 1.7.7, 1.7.13

Chapter 2	2.1	2.1.1, 2.1.7, 2.1.11
	2.2	2.2.1, 2.1.3, 2.2.5, 2.2.9, 2.2.11
	2.3	2.3.5, 2.3.11, 2.3.19
	2.4	2.4.1, 2.4.5, 2.4.11, 2.4.15
	2.5	2.5.1, 2.5.3, 2.5.5, 2.5.8
	2.6	2.6.1, 2.6.2, 2.6.5, 2.6.9, 2.6.11, 2.6.13
Chapter 3	3.1	3.1.4, 3.1.6, 3.1.9, 3.1.11
	3.2	3.2.3, 3.2.4, 3.2.5, 3.2.9
	3.3	3.3.2, 3.3.3, 3.3.7, 3.3.8
	3.4	3.4.3, 3.4.6, 3.4.8, 3.4.7, 3.4.9
Chapter 4	4.1	4.1.1, 4.1.2, 4.1.5
	4.2	4.2.1, 4.2.3, 4.2.5, 4.2.7, 4.2.9, 4.2.11
Chapter 5	5.1	5.1.1, 5.1.3, 5.1.7, 5.1.9, 5.1.11, 5.1.13
	5.2	5.2.1, 5.2.3, 5.2.9, 5.2.11, 5.2.19
	5.3	5.3.5, 5.3.7, 5.3.9, 5.3.13, 5.3.15
Chapter 6	6.2	6.2.1, 6.2.3
	6.3	6.3.1, 6.3.2, 6.3.15
Chapter 7	7.2	7.2.1, 7.2.2, 7.2.3, 7.2.7
	7.3	7.3.3, 7.3.7, 7.3.9, 7.3.8, 7.3.22, 7.3.27, 7.3.34
	7.4	7.4.1, 7.4.3
Chapter 8	8.1	8.1.1, 8.1.3, 8.1.5, 8.1.7, 8.1.11
	8.2	8.2.1, 8.2.3, 8.2.5, 8.2.7, 8.2.9, 8.2.11, 8.2.13

Tentative lecture plan

(CLO4) Day 1: Introduction

(CLO4) Day 2: Definition and scope of statistics, population and sample, descriptive and inferential statistics

(CLO4) Day 3: Variables and observations, frequency tables and graphs and histograms **(Quiz1)**

(CLO4) Day 4: Measures of central tendency

(CLO4) Day 5: Dispersion

(CLO1) Day 6: Probability, sample space and events, Venn diagrams, algebra of events

(CLO1) Day 7: Axioms of probability, calculating probability **(Quiz2)**

(CLO1) Day 8: Conditional probability, independent events

Day 9: **Midterm I**

(CLO1) Day 10: Bayes theorem

(CLO2) Day 11: Random variable, probability mass and density functions, distribution function

(CLO2) Day 12: Joint distribution, independent random variables **(Quiz3)**

(CLO2) Day 13: Expectation and its properties, expectation of sum of variables

(CLO2) Day 14: Variance, covariance, variance of sum of variables

(CLO2) Day 15: Chebychev's inequality

(CLO3) Day 16: Bernoulli and binomial random variables **(Quiz4)**

Day 17: **Midterm II**

(CLO3) Day 18: Poisson and hypergeometric random variables

(CLO3) Day 19: Uniform and exponential random variables

(CLO3) Day 20: Normal random variables

(CLO5) Day 21: Distribution of sum and mean, Central Limit Theorem

(CLO6) Day 22: Parameter estimation: point estimates, interval estimates **(Quiz5)**

(CLO7) Day 23: Single mean z & t test

(CLO8) Day 24: Test of hypothesis I

Final examination's date will be announced by the Registrar's office