NORTH SOUTH UNIVERSITY

Centre of Excellence in Higher Education

DEPARTMENT OF MATHEMATICS AND PHYSICS

School of Engineering and Physical Sciences

Course Title	Probability and Statistics
Course Code	MAT 361, Section-14
Semester	Summer 2024
Course Coordinator	Dr. Md. Alamin (md.alamin06@northsouth.edu)

Instructor & Department Information	
Instructor's Name	Professor Dr. Md Hasinur Rahaman Khan (hmn)
Office Room	**SAC1139**
Office Hours	9:25-10:45 AM & 1:30 - 3:00 PM in RA
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Course & Section Information	
Prerequisites	MAT250
Class Time	12:15-1:30 PM (NAC 315)
Course Credit Hours	3.0
Text Book	Probability and Statistics for Engineers and the Scientists (4thedition, 2012), Anthony J. Hayter (Brooks/Cole, Cengage Learning).
Reference Book	Introductory Statistics by Sheldon M. Ross

Course Assessment System:

Category	*Weight*
Attendance	10%
Assignments (Minimum 2)	10%
Quizzes (Minimum 3)	20%
Mid-Term	25%
Final Exam	35%
Total	100%

Grading Policy:

Numerical Scores	Letter Grade	Grade Points
93 & above	A	4.0
90 - 92	A-	3.7
87 – 89	B+	3.3
83 – 86	B	3.0
80 – 82	B-	2.7
77 – 79	C+	2.3
73- 76	C	2.0
70 – 72	C-	1.7
67 - 69	D+	1.3
60 - 66	D	1.0

Course Short Description: This course is an introduction to 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 to 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, the variance of random variables and probability distributions such as Binomial, Geometric, Negative Binomial, Poisson, Uniform, Normal, and Exponential and their applications. It focuses on sampling distribution, single mean test and preliminary ideas on the 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 in probability and sampling distributions.
4. To analyze generating functions and their application in real-life data.
5. To become familiar with hypothesis tests and decision-making troubleshooting.

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 a hypothesis test to make the 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,	**C3, P2**	Lectures, notes	Quiz, Exam

	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.	**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 in 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 tests on means.	**C3**	Group discussion	Presentation/ Assignment
CLO8	Perform a hypothesis test to make decision.	**C4, P2**	Demonstration	Quiz, Exam

Examination Dates: To be announced in class. The final exam will be declared by the Controller of Examinations.

Tentative Syllabus for MAT-361

Chapter 1: Probability Theory (3 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 (4 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 (4 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 (1.5 lecture)

4.1 The Uniform distribution
4.2 The exponential distribution

Chapter 5: The Normal Distribution (3.5 lectures)

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

Chapter 6: Descriptive Statistics (4 lectures)

6.1Experimentation
6.2 Data presentation
6.3 Sample statistics
6.4 Examples

Chapter7: **Statistical Estimation and Sampling Distributions (5 lectures)**

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

Chapter8: **Inferences on a Population Mean (4 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.l.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

(CLO1) Lectures 1: Probability, sample space and events, Properties of Probability, Venn diagrams, algebra of events
(CLO1) Lecture 2: Axioms of probability, calculating probability
(CLO1) Lecture 2: Counting, Experiments having equally likely outcomes
(CLO1) Lecture 3: Conditional probability, independent events
(CLO1) Lecture 3: Bayes theorem, applications of Bayes theorem
(CLO2) Lecture 4: Random variables, probability mass and density functions, distribution function
(CLO2) Lecture 5: Joint distribution, independent random variables
(CLO2) Lecture 6: Expectation and its properties, expectation of the sum of variables
(CLO2) Lecture 7: Variance, covariance, variance of sum of variables **(Quiz 1)**
(CLO2) Lecture 7: Chebychev's inequality
(CLO3) Lectures 8 an 9: Bernoulli and binomial random variables
(CLO3) Lectures 10 and 11: Poisson and hypergeometric random variables (**Assignment-1**)
(CLO3) Lectures 12 : Uniform and exponential random variables
Lecture 13: **Midterm Exam**
(CLO3) Lectures 14, 15 and 16: Normal random variables
(CLO4) Lecture 17: Introduction, definition and scope of statistics
(CLO4) Lecture 18: Population and sample, descriptive and inferential statistics, variables and observations **(Quiz 2)**

(CLO4) Lecture 19: Frequency tables and graphs and histograms
(CLO4) Lecture 19: Measures of central tendency
(CLO4) Lecture 20: Measures of position, measures of dispersion
(CLO5) Lectures 21 and 22: Distribution of sum and mean, Central Limit Theorem **(Quiz 3)**
(CLO6) Lectures 23 --25: Parameter estimation: point estimates, interval estimates
(CLO7) Lectures 26 and 27: Single mean z & t test (**Assignment-2**)
(CLO8) Lecture 28: Test of hypothesis I **(Quiz 4)**
(CLO8) Lecture 29: Linear regression model

Lecture 30: Revision on the previous lectures for the final exam

Classroom Rules of Conduct

Please Refer to the NSU Student Handbook, Sections: "Disciplinary Actions" and "Procedures and Guidelines".

Exams & Make-up Exam Policy

NO makeup for quizzes and NO Formative assessment will be retaken under any circumstances. If a student misses the Midterm and/or Final exams due to circumstances beyond their control (official valid documents are required) and is informed beforehand (if possible), reasonable arrangements may be considered. Please note that the retake exam questions are generally a bit tricky and critical compared to the regular exam questions. **Students may get the opportunity to see/recheck their midterm and Final exam scripts.**
Cell phones are prohibited in exam sessions.

Attendance Policy: As per NSU policy.