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
Semester	Spring 2024
Course Coordinator	Dr. Shams Forruque Ahmed (shams.forruque@northsouth.edu)

Instructor & Department Information	
Instructor's Name	
Office Room	
Office Hours	
Office Phone	
Email Address	
Links	North South University (NSU) Website: http://www.northsouth.edu Department Website: http://www.northsouth.edu/academic/seps/mp.html

Course & Section Information	
Prerequisites	MAT250
Class Time	
Course Credit Hours	3.0
Text Book	Probability and Statistics for Engineers and the Scientists (4th edition, 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:

(CO-1) Apply basic probability concepts such as conditional probabilities, independence, Bayes Rule, and combinations and permutations to calculate probabilities of events of practical interest.

(CO-2) Analyze and conceptualize random variables, single and multivariate distributions, conditional distribution and independence of random variables.

(CO-3) Identify and apply Binomial, Negative Binomial, Geometric, Hyper-geometric, Poisson, Exponential and Normal probability models to find mean, variance and associated probabilities.

(CO-4) Develop skills on representation of sample data with graphs and numerical summaries. Derive sampling distribution of statistics and estimate point estimators for various parameters using the method of moments and the method of maximum likelihood.

(CO-5) Evaluate the performance of various estimators using properties such as unbiasedness, efficiency and minimum variance. Perform a hypothesis test to make the decision.

Mapping of Course Outcomes:

COs	**Description**	**Bloom's taxonomy domain/level (C:** Cognitive, **P**: Psychomotor, **A**: Affective)	**Delivery methods and activities**	**Assessment tools**
CO1	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

CO2	Analyze and conceptualize random variables, single and multivariate distributions, conditional distribution and independence of random variables.	**C3, C4, P2**	Lectures, notes	Quiz, Exam
CO3	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
CO4	Develop skills on representation of sample data with graphs and numerical summaries. 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, P2, P3**	Group discussion	Presentation/ Assignment
CO5	Evaluate the performance of various estimators using properties such as unbiasedness, efficiency and minimum variance. Perform a hypothesis test to make the decision.	**C3, C4, P2, P3**		Lab work/ Assignment

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

Course Contents

Chapter 1: Probability Theory

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

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

3.1 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

4.1 The Uniform distribution
4.2 The exponential distribution

Chapter 5: The Normal Distribution

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

6.1Experimentation
6.2 Data presentation
6.3 Sample statistics
6.4 Examples

Chapter 7: Statistical Estimation and Sampling Distributions

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

8.1 Confidence intervals
8.2 Hypothesis testing

Tentative Lecture Plan

(CLO4) Lecture 1: Introduction, definition and scope of statistics
(CLO4) Lectures 2 and 3: Population and sample, descriptive and inferential statistics, variables and observations
(CLO4) Lecture 4: Frequency tables and graphs and histograms
(CLO4) Lecture 5: Measures of central tendency
(CLO4) Lectures 6 and 7: Measures of position, measures of dispersion
(CLO1) Lectures 8: Probability, sample space and events, Properties of Probability, Venn diagrams, algebra of events
(CLO1) Lecture 9: Axioms of probability, calculating probability
(CLO1) Lecture 10: Counting, Experiments having equally likely outcomes
(CLO1) Lecture 11: Conditional probability, independent events
(CLO1) Lecture 12: Bayes theorem, applications of Bayes theorem
(CLO2) Lectures 13: Random variables, probability mass and density functions, distribution function
(CLO2) Lecture 14: Joint distribution, independent random variables
(CLO2) Lectures 15: Expectation and its properties, expectation of the sum of variables
Lecture 16: **Midterm Exam**
(CLO2) Lectures 17: Variance, covariance, variance of sum of variables

(CLO2) Lecture 18: Chebychev's inequality
(CLO3) Lectures 19: Bernoulli and binomial random variables
(CLO3) Lectures 20 and 21: Poisson and hypergeometric random variables
(CLO3) Lecture 22: Uniform and exponential random variables
(CLO3) Lectures 23: Normal random variables
(CLO5) Lectures 24 and 25: Distribution of sum and mean, Central Limit Theorem
(CLO6) Lecture 26 and 27: Parameter estimation: point estimates, interval estimates
(CLO7) Lecture 28: Single mean z & t test
(CLO8) Lecture 29: Test of hypothesis I
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. <u>Please note that the retake exam questions are generally a bit tricky and critical compared to the regular ones.</u>

Students may get to see/recheck their midterm and Final exam scripts.

Cell phones are prohibited in exam sessions.

Attendance Policy: As per NSU policy.