

**MAT 361(11): Probability and Statistics**

**Spring 2019**

**Instructor : Professor Md. Israt Rayhan, Ph.D. (IsR)**

**Course No. : MAT361**

**Section : 11**

**Class Time : ST 8:00 AM–9:30 AM (Sunday and Tuesday)**

**Class Room : SAC 401**

**Office : SAC 10th floor (1018)**

**Office Hours :ST 11:10 AM - 12:10 PM or by appointment**

**Email : israt@isrt.ac.bd**

**Text book**: Probability and Statistics for Engineers and the Scientists (4thedition, 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:

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| --- | --- |
| **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 univariate and multivariate random variables, marginal distribution, conditional distribution and independence of random variables. |
| CLO3 | Use of Binomial, Negative Binomial, Geometric, Hypergeometric, Poisson, Exponential and Normal probability models. |
| CLO4 | Develop skills on 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 | Create confidence intervals for means and interpret the results. Find and perform statistical test on means. |
| CLO8 | Understand hypothesis test and decision making troubleshoot. |

**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, A1, A5** | Lectures,  notes | Quiz, Exam |
| CLO2 | Analyze and conceptualize univariate and multivariate random variables, marginal distribution, conditional distribution and independence of random variables. | **C3, C4, P2** | Lectures,  notes | Quiz, Exam |
| CLO3 | Use of Binomial, Negative Binomial, Geometric, Hyper-geometric, Poisson, Exponential and Normal probability models. | **C1, C2, A4** | Lab class/  Discussion | Lab work/  Assignment |
| CLO4 | Develop skills on sample data with graphs and numerical summaries. | **C2, C4, P2** | Group discussion | Presentation/  Assignment |

|  |  |  |  |  |
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| 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, A4** | Lab class/  Discussion | Lab work/  Assignment |
| CLO7 | Create confidence intervals for means and interpret the results. Find and perform statistical test on means. | **C2, C6, A3** | Group discussion | Presentation/  Assignment |
| CLO8 | Understand hypothesis test and decision making troubleshoot. | **C6, P2, A2** | Demonstration | Quiz, Exam |

**Prerequisite course:** MAT250

**Grading:** Thefinal 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 | 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. Probabilities
  2. Events
  3. Combinations of events
  4. Conditional probability
  5. Probabilities of event intersectins
  6. Posterior probabilities
  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)**

5.1Probability 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 (3 lectures)**

6.1Experimentation

6.2 Data presentation

6.3 Sample statistics

6.4 Examples

**Chapter7**: **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

**Chapter8**: **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. 1.2.1, 1.2.3, 1.2,7, 1.2.11

1.31.3.2, 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

**Quiz 1 (Ch 1)**

**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

**Quiz 2 (Ch 2), Midterm Exam I (Ch 1, 2 , 6)**

**Chapter 3** 3.1 3.1.4, 3.1.6, 3.1.9, 3.1.11

* 1. 3.2.3, 3.2.4, 3.2.5, 3.2.9
  2. 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

**Quiz 3 (Ch 3)**

**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

**Quiz 4 (Ch 4), Midterm Exam II (Ch 3-5)**

**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

5.4 5.4.7, 5.4.8, 5.4.9, 5.4.14

**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

**Quiz 5 (Ch 5-7) 6.)**

**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

**Final Exam (Comprehensive)**

**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

**(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

**(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

**(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

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

**(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