Course outline
Probability and Statistics

Course		
Lectures Days, Time,	Monday and Wednesday	***11:30AM –2:30PM***
	Tuesday and Thursday	***10:00AM –11:30AM***
class room location		***Room E&M 5 and CE1***
Semester	Spring 2022	***First Day of Classes: Feb 14, 2022***
Course Instructor	***Dr. Mubashir Qayyum***	
Office	E-159 (Electrical Engineering Block)	
Office Telephone	+92 42 111 128 128 (283)	
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Consulting hours	Tuesday, Thursday	***2:00 PM -4:00 PM***
	Any other days	By appointments
Required Text & Recommended Additional Readings, Books and Other Material	Probability and Random Processes by Leon Garcia Probability and Stochastic Processes by Roy D. Yates, David J. Goodman Probability and Statistics for Computer Scientists by Michael Baron (3rd Edition). Introduction to Statistical Theory Part – I & II by Prof. Sher Muhammad Chaudhry Introduction to Statistics by Walpole.	
Course Credit hours	3+0	
Other Course Pack Material	Shall be made available through photocopier or through SLATE/Google classroom	
Pre requisites of the Course	Nil	
Methodology	Primarily Lecture method based on Lectures including the explanations of different topics and solutions of numerical problems related to topics.	

Course Objectives, Expected outcome & Policy

Probability and Statistics is one of the very important courses for the students of computer science and engineering to help them in understanding the real world problems. This course has four sections. First section includes basic statistics including introduction to Statistics, measure of central tendency, measure of dispersion, curve fitting by method of least square and simple regression etc.

In second section, probability theory will be deliberated which is a powerful tool that helps computer scientists and telecommunication/electrical engineers to explain model, analyze and design the technology they develop. Moreover, probability theory is used to give a mathematical description of the behavior of real world systems that involve randomness such a system might be as simple as a coin flipping experiment, in which we are interested in whether 'head' or 'tail' is the outcome, or it might be more complex, as in the study of random error in a coded digital system e.g. CD recording or digital mobile phone.

Third section includes the concept of random variables, its different types, functions of random variables and their expectations, variances, correlations and covariance etc.

Fourth section includes testing of hypothesis using z and t tests etc.

This course is design to equip students with the knowledge of statistical techniques and skills, which are greatly needed in their future work.

Course Evaluation and Rewards

Quizzes **10 %**

There shall be at least 3 quizzes from the assigned and lecture topics, No Makeup quizzes shall be allowed whatsoever.

Assignments **10 %**

There shall be at least 3 individual assignments which may include theoretical as well as numerical problems. Also, evaluation of the assignment may be through assignment quiz.

Mid Term **(15% + 15%) = 30 %**

First Mid Term will be conducted in 6th Week and second Mid Term will be in 12th Week of the semester.

Final Comprehensive Examination **50 %**

The final examination could be mixture of short questions and long questions. Students should also expect questions from the assignments & quizzes.

Grading Policy

Relative

Week	Contents	Assigns/Quiz
1,2	**Introduction to Statistics** Basic Statistical Concepts (definition of Statistics, types, Characteristics, Applications, Importance) (sample and Population Data, Observation and Variable, Discrete and Continuous Variables, Grouped and Ungrouped Data, Class type Data etc) **Presentation of Data** Classification of Data Tabulation Frequency Distribution Graphical Representation of Data Diagrams, Graphs **Measure of Central Tendency** Arithmetic Mean for Ungroup Data, Grouped Data and Specifically Class type Data Properties of A.M	
3,4	Geometric Mean for Ungroup Data, Grouped Data and Specifically Class Type Data Harmonic Mean for Ungroup Data, Grouped Data and Specifically Class Type Data Median, Quartiles, Deciles and Percentiles for Ungroup Data, Grouped Data and Specifically Class Type Data Mode for Ungroup Data, Grouped Data and Specifically Class Type Data Advantages and Disadvantages of these averages **Measure of Dispersion** General Introduction containing meaning and need of measure of dispersion or scatter Coefficient of Variation, Dispersion Range, Inter quartile range, Semi inter quartile range, Mean Deviation, Standard Deviation and Variance for Ungroup Data, Grouped Data and Specifically Class Type Data Properties of Variance Skewness and Kurtosis Coefficients of Skewness, Coefficients of Kurtosis	Assignment No. 1 Quiz No. 1
5,6	**Curve Fitting by Least Squares** Introduction Fitting a straight line, second degree parabola and higher degree curves Fitting exponential curves, other type of curves **Regression Analysis** Scattered diagram. Introduction to linear regression. The simple linear regression **Probability** **Introduction**: Sets, Subsets, Set operations, Vann Diagram, Cartesian Product of sets, Random Experiment, Sample space and their types, Events and their types.	
7,8	**Definitions of Probability** Classical Definition, Relative Frequency Definition	

	Laws of Probability Addition Law of Probability, Conditional Law of Probability, Multiplication Law of Probability, Dependent and Independent Events, Total Probability Law and Baye's Law of Probability with its application in Computer Science and Engineering.	
9, 10	**The concept of random variable** Types of random variables a) Discrete random variable b) Continuous random variable The probability function The probability density function The probability distribution Conditional *pdf* and conditional *cdf* **Important Discrete random variables** a) Binomial random variable b) Poisson random variable c) Geometric random variable d) multinomial random variable e) Discrete uniform random variable etc	Quiz No. 2 Assignment No. 2
11,12	**Important Continuous random variables** (a) Exponential random variable (b) Uniform random variable (c) Normal random variable (d) Laplacian random variable (e) Cauchy random variable (f) Poisson random variable etc. The Expected value of a random variable The Expected value of a function of a random variable Mean and Variance of a) Binomial random variable b) Poisson random variable c) Geometric random variable	
13,14	d) Exponential random variable e) Uniform random variable f) Normal random variable etc Application of the expected value of a random variable Moment generating function and Characteristic functions, its application in random variables. The concept of multiple random variable The joint probability function The joint probability density function (Joint PDF) The joint cumulative probability distribution (Joint CDF) The joint probability distribution Marginal probability density function of X and Y (Marginal PDFs)	Quiz No. 3 Assignment No. 3
15	Expected value of a function of two random variables The Covariance of two random variables The Correlation of two random variables Application of correlation and covariance of random variables	
16	**Hypothesis Testing** Introduction (Null and Alternative Hypothesis, Simple and Composite Hypothesis, Test Statistic, Acceptance and Rejection Region, Type I and Type II Errors), Testing of hypothesis using Z-test, Testing of hypothesis using t-test etc.	