COURSE DESCRIPTION FORM

INSTITUTION FAST School of Computing, National University of Computer and Emerging Sciences, Islamabad

PROGRAM(S) TO BE EVALUATED **BS-AI, BS-DS, FALL 2024**

Course Description

(Fill out the following table for each course in your computer science curriculum. A filled out form should not be more than 2-3 pages.)

<table>
<tr><td>Course Code</td><td>MT-2005</td></tr>
<tr><td>Course Title</td><td>Probability and Statistics</td></tr>
<tr><td>Credit Hours</td><td>3</td></tr>
<tr><td>Prerequisites by Course(s) and Topics</td><td>Calculus and Analytic Geometry</td></tr>
<tr><td>Assessment Instruments with Weights (homework, quizzes, midterms, final, programming assignments, lab work, etc.)</td><td>100% theory and application in R programming language
Assessment items
<table>
<tr><th>Assessment Item</th><th>Number</th><th>Weight (%)</th></tr>
<tr><td>Assignments</td><td>04</td><td>10</td></tr>
<tr><td>Quiz</td><td>06 (best 5)</td><td>10</td></tr>
<tr><td>Sessional – I</td><td>01</td><td>15</td></tr>
<tr><td>Sessional – II</td><td>01</td><td>15</td></tr>
<tr><td>Final Exam</td><td>01</td><td>50</td></tr>
<tr><td>Grading Policy</td><td colspan="2">Absolute Grading</td></tr>
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<tr><td>Course Instructors</td><td>Mr. Hazber Samson, Miss Rijah Khan</td></tr>
<tr><td>Lab Instructors</td><td></td></tr>
<tr><td>Course Coordinator</td><td>Mr. Hazber Samson</td></tr>
<tr><td>URL (if any)</td><td></td></tr>
<tr><td>Current Catalog Description</td><td>This course covers probability, statistics and statistical inference topics required for computer scientists/software engineers to analyze and interpret data and interpretation of data and moves on to develop advance concepts. The course is targeted primarily at under graduate students in the Computer Science Department. The exploration of these central ideas will draw examples from a range of application areas. Course work will use the R programming language.</td></tr>
<tr><td>Textbook (or Laboratory Manual for Laboratory Courses)</td><td>• Elementary Statistics: A Step by Step Approach, 10th edition, Bluman
• Probability & Statistics For Engineers & Scientists, 9th edition By R. E. Walpole
• Applied Statistics & Probability For Engineers, 6th edition by D.C. Montgomery</td></tr>
<tr><td>Reference Material</td><td>• Probability with R: An Introduction with Computer Science Applications Jane, M. Horgan
• Susan Milton and Jesse C. Arnold, Introduction to Probability and Statistics
• William Mendenhall and Terry Sincich, Statistics for Engineer and Sciences
• Soong T. F., Fundamentals of Probability and Statistics for Engineers</td></tr>
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Course Learning Outcomes

A. Course Learning Outcomes (CLOs)

After completion of the course, the students shall be able to:

1. Understand concepts of Statistical methods for data analysis, frequency distribution, measure of central tendency and variability, measure of dispersion, moments and skewness and their need in engineering.
2. Apply probability theory including sample space, joint probability, conditional probability, Bayes' rule, total probability and independence on different software engineering problems.
3. Define theory of random variable, illustrate the use of CDFs, PDFs and PMFs of continuous as well as discrete nature
4. Transform given information to PMFs, PDFs and CDFs and express probability of events from statistical data.
5. Apply knowledge of probability to solve problems from the field of software of applicable nature, falling in both discrete and continuous domain.
6. Basic concepts of statistical inference. Implementation of one/two sample/samples t and z test. Regression, correlation and testing of regression coefficients.
7. Be able to use software i.e. R programming language for statistical computing and graphics and the application of R functions for probability distributions.

B. Program Learning Outcomes

For each attribute below, indicate whether this attribute is covered in this course or not. Leave the cell blank if the enablement is little or non-existent.

1. Academic Education:	To prepare graduates as computing professionals	✔
2. Knowledge for Solving Computing Problems:	Apply knowledge of computing fundamentals, knowledge of a computing specialization, and mathematics, science, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.	✔
3. Problem Analysis:	Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.	✔
4. Design/ Development of Solutions:	Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for	✔

	public health and safety, cultural, societal, and environmental considerations.	
5. Modern Tool Usage:	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.	✔
6. Individual and Team Work:	Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings.	✔
7. Communication:	Communicate effectively with the computing community and with society at large about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.	
8. Computing Professionalism and Society:	Understand and assess societal, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice.	
9. Ethics:	Understand and commit to professional ethics, responsibilities, and norms of professional computing practice.	
10. Life-long Learning:	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.	

C. Mapping of CLOs on PLOs
(CLO: Course Learning Outcome, PLOs: Program Learning Outcomes)

		PLOs									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CLOs	1	✔	✔			✔	✔				
	2	✔	✔	✔	✔		✔				
	3	✔	✔	✔		✔	✔				
	4	✔	✔		✔	✔	✔				
	5	✔	✔		✔	✔	✔				
	6	✔	✔	✔		✔	✔				

Topics Covered in the Course, with Number of Lectures on Each Topic (assume 16-week instruction and one-hour and 30 minutes lectures)

Topics to be covered:

List of Topics	No. of Weeks	Contact Hours	CLO(s)
Introduction to statistics, organization, and graphical representation of data Measures of Location, Mean, Median, Mode Grouped and Ungrouped Data Measure of Dispersion, Range, Variance And Standard Deviation Measures of Position, Quartiles, Deciles, Percentiles, Box and Whisker Plot	**3**	**9**	**1,5,6**
Probability Theory, Set Theory, Sample Space, events, Types of Events, Definition of Probability, Use of Permutations and Combinations in Probability. Addition and Multiplication Laws of Probability. Independent events, Conditional Probability, Dependent Events and Bayer's Theorem.	**4**	**12**	**2,5**
Random Variable, Discrete Probability Distribution. Probabilities and CDF of DRV, Probability Density Functions, Probabilities and CDF of CRV, Expectation and Variance of Discrete and continuous Random Variables	**2**	**6**	**3, 4,5,6**
Probability distributions i.e. Binomial, Poisson, Geometric, Negative binomial Distributions and Normal Distribution,	**2**	**6**	**4,5,6**
Regression and Correlation, Correlation Analysis, Scatter Plots, Coefficient of Correlation, Simple Linear Regression, Multiple Linear Regression, Data Analysis and Regression Analysis using **R**	**2**	**6**	**5,6**
Concept of Hypothesis Testing and Confidence Intervals (CI), One-Sample and Two Samples Hypothesis Testing and CI about mean using Z-Test and t – test. Hypothesis Testing using P-value Approach. Hypothesis Testing of the estimators of the Regression model using Software **R**	**3**	**9**	**5,6**
Total	**16**	**48**	

Programming Assignments Done in the Course

Yes, Algorithms were implemented using a preferred programming language (e.g. **R**)

Class Time Spent on (in credit hours, Hrs./ Min.)

Theory	Problem Analysis	Solution Design	Social and Ethical Issues
1.5/90	1.2/70	1.2/70	0.1/10

Written Communications

Every student is required to submit at least 5 written reports/assignments.