UIT University

Department of Computer Science
(Fall – 2024)

Course Information

Course Title: Probability and Statistics		**Code: ASC 201**
Program: BS(CS, SE)	**Semester:** IV	**Credit Hours: 3+0** **Lecture: 48**
Knowledge Area	Computing/ Inter-Disciplinary	

1. **Course description and objectives:**
   This course comprehensively introduces probability and statistical methods, emphasizing their application in computer science. The objective is to equip students with the skills to model, analyze, and interpret real-world data, enhancing their decision-making abilities using statistical tools such as regression analysis, hypothesis testing, and probability distributions. The course integrates these concepts into artificial intelligence, machine learning, and software engineering.
2. **Course Learning Outcomes (CLOs):**
   Upon successful completion of the course, students will be able to:
   Course Learning Outcomes (CLOs):

CLO	Description	Domain & Level	Program Learning Outcome (PLO)	Emphasis
1	Represent and summarize data using descriptive statistics and understand central tendency and variability measures.	Cognitive (C2)	PLO I (Critical Thinking)	Medium (2)
2	Apply basic probability theory to solve problems involving discrete and continuous probability distributions.	Cognitive (C3)	PLO IV (Problem Analysis)	Medium (2)
3	Conduct statistical inference, including hypothesis testing and estimation, using appropriate techniques.	Cognitive (C3)	PLO V (Solution Design)	Medium (2)
4	Use statistical software to analyze datasets and present findings in technical reports.	Cognitive (C5)	PLO III (Technical Skills)	High (1)
5	Develop and evaluate statistical models for applications in computer science, including AI and machine learning.	Cognitive (C6)	PLO VI (Application)	High (1)

Note:

✓ *C → Cognitive, P → Psychomotor, A → Affective domains and 'n' is the taxonomy level.*

✓ *It is strongly suggested that one CLO should be mapped to one PLO and one domain only.*

LO Categories	After completing this course, a student will be able to:	UITU Graduate Qualities
Knowledge LOs	Data representation, Probability Distributions	Critical thinking
Comprehension LOs	Understand and explain statistical methods and probability distributions.	Ethical decision-making skills, Critical thinking
Application LOs	To fit the probability distribution over the given data and calculate probability.	Technical skills, Critical thinking
Analysis LOs	Analyze data, interpret results, and write statistical reports.	Technical skills, Critical thinking
Synthesis LOs	Combine various statistical methods to solve complex problems and create data-driven strategies.	Communication and interpersonal skills, Writing skills, Decision-making skills
Evaluation LOs	Evaluate and critique statistical models and interpret their real-world relevance.	Managerial skills, Critical thinking

Code of Conduct:

Students must follow the rules stated below to avoid a failing grade in the course:

- Understand and follow the University policy regarding attendance.
- Arrive in and leave the classroom strictly on time. Late arrival will be marked as an absence. If you leave the classroom in the middle of a session, even briefly, you will be marked absent.
- Keep your cell phone off during the class.
- Do the assigned readings for a class before coming to the class.
- Maintain a disciplined, cordial, and respectful attitude towards the teacher and fellow students.
- Submit your homework on the due date before the class begins.
- Do not plagiarize from books, journals, or the internet.
- Do not cheat (make someone else do your work or present work for some other course as work for this course).

Teaching Plan

1. Weekly Lecture Breakdown:

Week	Topics Covered	CLOs	Assessments
Week 1	Introduction to Data: Mean, Median, Mode, Variance, Standard Deviation	CLO 1	Homework 1
Week 2	Probability Theory: Sample Spaces, Events, Tree Diagrams	CLO 2	Homework 2
Week 3	Permutations and Combinations, Basic Probability Rules	CLO 2	Case Study 1
Week 4	Discrete and Continuous Probability Distributions	CLO 2	Homework 3
Week 5	Binomial, Poisson, and Normal Distributions	CLO 2	Case Study 2
Week 6	Central Limit Theorem, Sampling Distributions	CLO 3	Homework 4
Week 7	Hypothesis Testing: Z-test, t-test	CLO 3	Homework 5

Week	Topics Covered	CLOs	Assessments
Week 8	Midterm Examinations	CLO1,2, &3	Midterm Exam
Week 9	Confidence Intervals with Z and t Distributions	CLO 3	Case Study 3
Week 10	Regression Analysis: Correlation, Linear Regression	CLO 1, 4	Homework 6
Week 11	Multiple Regression, Model Evaluation	CLO 4	Homework 7
Week 12	Applications of Multiple Regression in AI and Machine Learning	CLO 5	Case Study 4
Week 13	Statistical Software Tools: MS Excel, SPSS, and Python for Data Analysis	CLO 4, 5	Homework 8
Week 14	Time Series Analysis and Forecasting	CLO 5	Homework 9
Week 15	Case Studies on Machine Learning Applications Using Statistical Models	CLO 5	Case Study 5
Week 16	Final Exam and Project Presentations	All CLOs	Final Exam

2. Syllabus and Books:

Statistics: Introduction, Types of data & variables, presentation to data, object, classifications, Tabulation, Frequency distribution, Graphical representation, Simple & Multiple Bar diagrams, Sartorial& Pie-Diagram, Histogram, Frequency, Polygon, Frequency Curves & their types.

Measures of Central Tendency and Dispersion: Statistics Averages, Median Mode, Quartiles, Range, Moments, Skewness & Kurtosis, Quartile Deviation, Mean Deviation, Standard Deviation, Variance & its coefficient, Practical Significance in related problems.

Curve Fitting: Fitting of a first and Second-degree curve, fitting of exponential and logarithmic curves, and related problems. The principle of least squares is the second-order Statistics & Time series, which is not in a bit of detail. Simple Regression and Correlation Scatter diagrams, Correlation & Coefficient, Regression lines, Rank Correlation & Coefficient, Probable Error (P.E), and related problems.

Sampling and Sampling Distributions: Population, Parameter & Statistic, Objects of sampling, Sampling distribution of Mean, Standard errors, Sampling & Non- Sampling Errors, Random Sampling, Sampling with & without replacement, Sequential Sampling, Central limit theorem with practical significance in related problems.

Statistical Inference and Testing of Hypothesis: Estimation, Types of Estimates, Confidence interval, Tests of hypothesis, Chai square one tails & two tails tests. Application in related problems.

Probability: Basic concepts, Permutation & Combination, Definitions of probability, Laws of Probability. Conditional probability, Bayes' Rule. Related problems in practical significance.

Random Variables: Discrete and continuous random variables, Random Sequences and transformations, probability distribution, Probability density function, Distribution function, Mathematical expectations, Moment Generating Function (MGF), Markov random walks chain/ related problems.

Probability Distributions: Discrete probability distributions, Binomial Poisson, Hypergeometric & Negative binomial distributions, Continuous probability distribution, Uniform, Exponential, & Normal distributions & their practical significance.

3. **Books:**
   a. **Textbook**

- Walpole, Myers, Myers, and Ye, *Probability & Statistics for Engineers and Scientists*, 9th Edition.

   b. **Reference Books**

- Devore, Jay L. *Probability and Statistics for Engineering and the Sciences*. 9th Edition.
- Montgomery, Douglas C., and George C. Runger. *Applied Statistics and Probability for Engineers*. 7th Edition.
- Hastie, Trevor, Tibshirani, Robert, and Friedman, Jerome. *The Elements of Statistical Learning*. 2nd Edition. (For advanced applications in machine learning)

4. **Percentage of theoretical background, problem analysis and solution design**

Elements covered in the course	Percentage of full course coverage
Theoretical background	20
Problem analysis	40
Solution design	40

5. **Teaching and learning methods:**
   - L**ectures** with active participation through problem-solving exercises.
   - **Statistical Software:** Hands-on experience with MS Excel, SPSS, and Python to apply statistical methods in real-world scenarios.
   - **Group Projects:** Collaborating to solve complex statistical problems.
   - **Industry Case Studies:** Reviewing real-world applications in data science and AI.

6. **Student assessment methods:**
   (You may add/delete as suitable for the course)
   a. Quiz
   b. Assignment
   c. Exams (Theory)
   d. Activities
   e. Presentations
   f. Homework

7. **Assessment schedule:**

Quiz	3 Quizzes before Midterm and two after Midterm.
Activities	Throughout semester
Case Studies	Throughout semester
Homework	Throughout semester
Presentations	Throughout semester
Midterm	Week 8
Final Term	Week 17-18 (End of term)

8. **Weighting of assessments:**
   Theory:

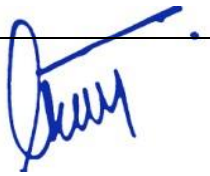
a. Quizzes/Activities 10 Marks
b. HomeWorks 10 Marks
c. Case Studies 10 Marks
d. Midterm examination 20 Marks
e. Final term examination 50 Marks
Total 100 Marks

9. Facilities required for teaching and learning

a. Computer Usage
b. Online board + online ppt writing
c. Internet connection,
d. MS-Teams account

Course group leader name: Muhammad Iftikhar Mubbashir

Signatures:

S. No.	Course group member (if any)	Theory/Lab	Signature
1	M. Iftikhar Mubbashir	Theory	
2	Engr. Asif Hussain	Theory	

Signature		Signature
		Dr. Muhammad Waseem
Coordinator		HoD