MTL108: Introduction to Statistics

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Course Content

Probability:

Sample space, events, and axioms of probability. Probability space, random variable, probability distribution of a random variable, sigma-field generated by a random variable, probability space on reals induced by a random variable.

Conditional probability and Bayes' theorem. Independence of events with examples. Independent random variables.

Discrete and continuous random variables, moments of a random variable, moment generating function, multiple random variables, joint distribution, marginal distributions, independent random variables, covariance, correlation.

Some discrete and continuous distributions (like Binomial, Poisson, Exponential, Normal, Lognormal, Beta, Gamma, Weibull) their properties and characterizations.

Weak law of large numbers, strong laws of large numbers and central limit theorem.

Statistics:

Descriptive statistics: Measures of central tendency and dispersion.

Population vs. sample: Concept and importance. Sampling distributions: Mean, variance, and proportion.

Estimation: Point estimation and properties of estimators (unbiasedness, consistency, efficiency). Maximum likelihood estimation. Interval estimation: Confidence intervals for mean and proportion.

Neyman Pearson lemma for hypothesis testing, critical region, hypothesis testing for mean and variance of one and two populations, goodness of fit, Kolmogorov Smirnov Test, One sample and paired sample tests: Sign Test, Signed-rank Test.

Correlation: Pearson and Spearman coefficients.

Simple linear regression and introduction to multiple regression (if time permits).

Suggested Readings:

1. An Introduction to Probability and Statistics, Vijay K Rohtagi and A. K. Md. Ehsanes Saleh, Wiley.
2. Introduction to Probability and Statistics for Engineers and Scientists, by S. M. Ross, Academic Press

3. Introduction to Probability, D. P. Bertsekas and J. N. Tsitsiklis, Athena Scientific.
4. A Course on Probability Theory, Kai Lai Chung, Academic Press
5. Introductory Statistics, Sheldon Ross, Academic Press
6. Mathematical Statistics with Applications, John E. Fruend, Pearson
7. Introduction to Probability and Statistics for Engineers and Scientists, R. E. Walpole, R. H. Myers, S. L. Myers, K. Ye, PHI
8. Introduction to the Theory of Statistics, A. M. Mood, F. A. Graybill, D. C. Boes, McGraw Hill
9. Probability and Statistical Inference, by Robert Hogg, Elliot Tanis, Dale Zimmerman, Pearson Press

Evaluation:

- Minor I Exam: 30 marks.
- Major Exam: 40 marks.
- Quizzes ($2 \times 12 = 24$): 12 marks each. Best two out of three quizzes will be accounted for in total.

Quiz schedule:

- Quiz-I: 31^{st} January, 2025
- Quiz-II: 18^{th} March, 2025
- Quiz-III: 16^{th} April, 2025

Attendance policies:

- Tutorial attendance (A): 6 marks
  $\{A \geq 11\} = 6$ marks; $\{9 \leq A \leq 10\} = 4$ marks; $\{7 \leq A \leq 8\} = 2$ marks; $\{6 \leq A \leq 5\} = 1$ mark; $\{A < 5\} = 0$ marks.
- Attendance in lecture class is to be maintained as per the Institute rules.

Other policies:

- There will be no make-up opportunity for the quizzes.
- Cell phones and laptops are discouraged during class.
- Zero-tolerance policy towards any unfair practices in quizzes and exams. Please be aware that IIT Delhi enforces this policy very strictly.