

MTL108: Introduction to Statistics

2nd Semester, 2025-2026

Instructor: Rahul Singh
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Office Hours: 4:00-5:00 pm on Monday and Wednesday

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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).

Textbooks:

1. Introduction to probability, by J. K. Blitzstein and J. Hwang, Chapman and Hall/CRC.

2. Introduction to Probability and Statistics for Engineers and Scientists, by S. M. Ross, Academic Press.

References:

1. An Introduction to Probability and Statistics, Vijay K Rohtagi and A. K. Md. Ehsanes Saleh, Wiley.
2. Introduction to the Theory of Statistics, A. M. Mood, F. A. Graybill, D. C. Boes, McGraw Hill.
3. Statistics 110 course Lecture Videos by Joe Blitzstein (Harvard), <https://www.youtube.com/watch?v=dzFf3r1yph8&list=PLLVp1P80IVc8EtkrD3Q8td0GmId7DjW0>

Evaluation:

- Minor I Exam: 60 marks (30 %).
- Major Exam: 80 marks (40 %).
- 2 Quizzes: 30 marks (15 %) each; $2 \times 30 = 60$ (30 %).

Quiz schedule:

- Quiz-I: 3rd Feb, 2026
- Quiz-II: 7th Apr, 2026

Attendance policies:

- While there is no weightage for attendance, students are highly encouraged to attend all lectures and tutorial classes.
- Attendance policy is as per the Institute rules.

Examination questions:

Examination questions will largely reflect the types of problems we have worked on in lectures and tutorials. In addition, a few questions may present new scenarios, giving you the opportunity to apply the concepts you have learned in fresh and interesting ways.

Audit Policy:

To receive an audit pass, a student must secure at least 30% of the total marks.

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.