

MG221: Applied Probability & Statistics

Syllabus 2020

- 01/10:** Nature of Probabilistic and Statistical Problems. Types of Statistical Studies and Types of Variables. Recapitulation of Descriptive Statistics.
- 05/10:** Samples versus the Probability Universe. Interpretation and Definition of Probability. Discrete Sample Space. Combinatorial Probability.
- 08/10:** Probability Laws - Complementarity, Addition and Multiplication Law. Conditional Probability. Bayes Theorem.
- 12/10:** Random Variables. Discrete Random Variables - p.m.f., c.d.f., Moments & Quantiles.
- 15/10:** Discrete Random Variables - Chebyshev's Inequality. Continuous Random Variables - c.d.f..
- 19/10:** Continuous Random Variables - p.d.f., Moments, Quantiles. General Random Variables.
- 22/10:** Jointly Distributed Discrete Random Variables - Marginal & Conditional Distributions.
- 26/10:** Introduction to Covariance, Correlation, & Regression. Properties of Expectation, Variance, Covariance, Correlation, & Regression.
- 29/10:** Jointly Distributed Continuous Random Variables - Joint, Marginal & Conditional p.d.f.s. Probability Generating Functions.
- 02/11:** Probability Generating Functions of Binomial, Geometric and Negative Binomial Distributions. Moment Generating & Characteristic Functions.
- 05/11:** Binomial, Hypergeometric, Geometric & Negative Binomial Distributions.
- 09/11:** Poisson Distribution & Poisson Process.
- 12/11:** Uniform, Exponential & Gamma Distributions.
- 16/11:** Normal Distributions.
- 19/11:** Introduction to R. Probability distributions in R.
- 23/11:** Statistical Inference - Estimation, Hypothesis Testing & Forecasting. Frequentist Sampling Distribution. Convergence of Random Variables. Law of Large Numbers. Central Limit Theorem.
- 26/11:** Point Estimation Criteria - MSE, Unbiasedness, Standard Errors, Consistency, Sufficiency. Exponential Family of Distributions. Uniformly Minimum Variance Unbiased Estimation.
- 30/11:** Point Estimation Methods - Method of Moments & Method of Maximum Likelihood. Confidence Intervals.
- 03/12:** Discussion of the Midterm. Nature of Hypothesis Testing.
- 07/12:** Type I & Type II Errors in Hypothesis Testing. Size and Power of a Test. Neymann-Pearson Lemma. Testing for the Mean of a Normal Distribution with known Variance.
- 10/12:** Fixed Significance Level Testing versus Observed Significance Level (p -value) Testing. Likelihood Ratio Test. Inference for a Population Proportion. Inference for a Population Mean for large samples.
- 14/12:** One Sample Problem for Normal Variance - χ^2 Distribution, χ^2 -test, χ^2 -interval. One Sample Problem for Normal Mean with Unknown Variance - t distribution, t -test, t -interval.

17/12: Two Independent Sample Problem for Mean and Proportion for Large Samples. Sample size Determination for Estimation Problems of Mean and Proportion.

21/12: Two Independent Sample Problem for Normal Variances - F distribution, F -test and F -interval. Two Independent Sample Problem for Normal Means - Pooled & Welch t -tests.

24/12: Paired Sample Problem for Normal Means. Paired t -test. Introduction to Non-Parametrics. Empirical CDF and its properties.

28/12: Two Independent Sample Problem for Location - Wilcoxon Rank Sum Test.

31/12: One/Paired Sample Problem for Location - Binomial or Sign test, Extension to tests for Population Quantiles. Wilcoxon Signed Rank Test.

04/01: Multinomial Distribution. One Sample Problem for Qualitative Dependent Variable. χ^2 Test for Goodness of Fit for discrete models.

07/01: χ^2 Tests for Homogeneity and Independence.

11/01: Fisher's Exact test for the 2×2 Contingency Tables. Goodness of Fit Tests for Normal distribution.

14/01: Implementation of the learnt methods in R.

Reading Material:

1. Class Notes.
2. Lecture Notes Available at <http://www.mgmt.iisc.ernet.in/CM/MG221/ln.html>
3. Text Books:
 - A. *Applied Statistics and Probability for Engineers* by Douglas C. Montgomery & George C. Runger. Fifth Edition, 2014. Willey.
 - B. *Statistics* by David Freedman, Robert Pisani & Roger Purves. Fourth Edition, 2010. Viva Books.
 - C. *Elementary Probability Theory with Stochastic Processes* by Kai Lai Chung. Third Edition, 1974. Narosa Publishing House.

Grading:

IISc Norm: 70% Weightage on **Sessional** & 30% Weightage on **Final** and then Grading on the Curve (Relative Grading).

Sessional: Midterm/Quiz Score + Assignment.

Final: Endterm Examination Score + Assignment.

Attendance:

Will be taken and minimum 75% required (IISc stipulation).