MSO205, Fall Semester, 2023

July 30, 2023

Lecture Hours : W-Th-F from 11 am to 11.50 am.

Venue : L-1.

Tutorial Hour : Monday from 11 am to 11.50 am.

Venue : L-1.

Instructor : Subhra Sankar Dhar.

Tutor : Swati Shukla.

Office of the Instructor : 511, Faculty building.

Telephone number of the Instructor : 6950.

Email id of the Instructor : subhra@iitk.ac.in

Email id of the Tutor : shukla@iitk.ac.in

References:
1. Lecture Notes.
2. Introduction to Mathematical Statistics by R. V. Hogg, A. Craig and J. W. McKean.
3. An Introduction to Probability and Statistics by V. K. Rohatgi and A. K. Md. E. Saleh.

Course Description: Core concepts of Probability (random variables/vectors and probability distributions) shall be covered in this course. At the end of the course, the students are expected to have enough familiarity with the subject to apply them in their own fields of study.

Course Contents:
(Topic 1) Basic definitions and ideas such as random experiment, sample space and event, Classical definition and relative frequency definition of probability, Axiomatic definition of probability, Elementary properties of probability function, Probability inequalities such as Boole's inequality and Bonferroni inequality.

(Topic 2) Conditional probability and its basic properties, Examples of conditional probability and multiplication law, Theorem of total probability and related examples, Bayes theorem and related examples, Independent events.

(Topic 3) Random variables and their distribution function, Induced probability space, Discrete and continuous random variables, Function of random variables (Discrete and Continuous), Expectation and moments of random variables, MGF of random variables and its application, Markov, Chebyshev and Jensen's inequality, Characteristics function and its application.

(Topic 4) Standard discrete distributions and their properties (e.g., Bernoulli, Binomial, Geometric, Negative Binomial, Hypergeometric, Poisson) Standard continuous distributions and their properties (e.g., Normal, Exponential, Gamma, Beta, Cauchy).

(Topic 5) Random vectors and their joint distribution functions, Marginal distribution, independent random variables, Conditional distribution of random vectors/variables, Expectation and moments of random vectors, Conditional Expectation, variance and covariance and their applications.

(Topic 6) Idea of limiting distribution, Convergence in distribution and probability, and related results, Convergence of moments and almost sure convergence, Various examples and counter examples.

(Topic 7) Weak law of large numbers, Central limit theorem, Applications, e.g., continuous mapping theorem and delta method.

Course policy:

1. The communication for the course will happen through emails.

2. Cases of cheating or immoral behaviour (e.g., any gender based comment or misbehaviour or racist remarks) will be strictly prohibited. The instructor will follow ZERO tolerance policy for such cases.

3. There is NO weightage of attendance on grades. However, the instructor strongly believes that the regular attendance will help the students to perform well in the course. Moreover, the instructor has right to deregister the irregular students unless the student has any critical health problem.

Important Dates:

1. **Classes Begin :** July 31, 2023.

2. **Mid Semester Recess :** October 21, 2023 to October 29, 2023.

3. **Date of Quiz 1:** Will be announced in due time.

4. **Date of Quiz 2:** Will be announced in due time.

5. **Mid Semester Exam:** See the DoAA website.

6. **End Semester Exam:** See the DoAA website.

7. **Classes End:** November 14, 2023.

The division of Marks: Quiz 1 : 20%, Mid Semester Exam : 30%, Quiz 2 : 20% and End Semester Exam : 30%.

Grading Scheme : A $\in [90\%, 100\%]$, B$^+$ $\in [80\%, 90\%)$, B$\in [70\%, 80\%)$, C$^+$ $\in [60\%, 70\%)$, C$\in [50\%, 60\%)$, D$^+$ $\in [40\%, 50\%)$, D$\in [30\%, 40\%)$ and F$\in (0\%, 30\%)$.

Note: The instructor reserves the right to modify the above if necessary