MSO201a: Probability and Statistics
2019-2020-II Semester

Prerequisite: MTH101: Mathematics-I

Instructor: Dr. Neeraj Misra
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Tutors:

Dr. Subhajit Dutta (duttas@iitk.ac.in) - Section O1, L10
Dr. Ketan Rajawat (ketan@iitk.ac.in) - Section O2, L11
Dr. Vipul Arora (vipular@iitk.ac.in) - Section O3, L13

Lectures: Venue: L07 (Lecture Hall Complex); Days: M, Th, F (08:00-08:50 Hrs);

Tutorials: Venue: L10, L11, L13 (Lecture Hall Complex); Day: Wed (08:00-08:50 Hrs)

Makeup Lectures/Tutorials: Venue: L07; Day: S; Time: 08:00-08:50 Hrs

Office Hours: Faculty Building, Room No. 515 (Through prior appointment)

Course Webpage: http://home.iitk.ac.in/ neeraj/mso201a/mso201a.htm

Reference Books:

- Modern Mathematical Statistics, by Edward J Dudewicz and Satya N Mishra, John Wiley & Sons;

- Introduction to Mathematical Statistics, by R V Hogg, A Craig and J W McKean;

- An Introduction to Probability and Statistics, by V.K. Rohatgi and A.K. Md. E. Saleh;

- Introduction to Probability and Statistics, by S. Milton and J.C. Arnold.

- Introduction to Probability Theory and Statistical Inference by H.J. Larson.

- Introduction to Probability and Statistics for Engineers and Scientists by S.M. Ross

Course Content:

Probability: Axiomatic definition, properties, conditional probability, Bayes' rule and independence of events. Random variables, distribution function, probability mass and density functions, expectation, moments, moment generating function, Chebyshev's inequality. Special distributions; Bernoulli, binomial, geometric, negative binomial, hypergeometric, Poisson, exponential, gamma, Weibull, beta, Cauchy, double exponential, normal. Reliability and hazard rate, reliability of series and parallel systems. Joint distributions, marginal and conditional distributions, moments, independence of random variables, covariance and correlation. Functions of random variables. Weak Law of large numbers and Central limit theorems.

Statistics: Descriptive statistics, graphical representation of the data, measures of location and variability. Population, sample, parameters. Point estimation; method of moments, maximum likelihood estimator, unbiasedness, consistency. Confidence intervals for mean, difference of means, proportions. Testing of hypothesis; Null and alternate hypothesis, Neyman Pearson fundamental lemma, Tests for one sample and two sample problems for normal populations, tests for proportions.

Course Objectives

A common goal in various scientific and engineering applications is to make conclusions (inferences) about a phenomenon (process) by observing it on a few occasions (collection of data). Many phenomena (processes) encountered in real life have some element of randomness associated with them. To make inferences about the random process the randomness associated with it is first modeled through the use of Probability Theory and then, based on the probability modeling and the collected data, inferences about the random phenomenon are made. Statistics is a branch of science that deals with collection, organization and analysis of data (outcomes) of a random phenomenon, and to make inferences and conclusions about the random phenomenon based on the data. The foundation of Statistics is based on Probability Theory. In this course basic concepts of Probability Theory and Statistics will be introduced to develop statistical thinking among students.

Prerequisites

Students are expected to have knowledge of differential and integral calculus of MTH101: Mathematics-I level.

Course Policies

I. Weightages

There will be a mid-semester examination of two hour duration (on one of the days during 17-02-20 to 22-02-20, to be announced by DOAA), carrying 25% wieghtage; an end-semester examination of three hour duration (on one of the days during 20-04-20 to 29-04-20, to be announced by DOAA) carrying 50% weightage; and two long quizzes of forty five minutes duration each (on 01-02-20 (Saturday) and 28-03-20 (Saturday)), each carrying a weightage of 12.5%.

II. Academic Performance Evaluation Scheme

Although the policy of relative grading will be followed for awarding the final grades, there is a minimum performance requirement for each grade as follows:

A^* Grade:　max(85% Marks, $\mu + 2.03\sigma$)
A Grade:　max(70% Marks, $\mu + 1.29\sigma$)
B Grade:　max(55% Marks, $\mu + 0.12\sigma$)
C Grade:　max(40% Marks, $\mu - 0.84\sigma$)
D Grade :　max(25% Marks, $\mu - 1.28\sigma$)
E Grade:　max(20% Marks, $\mu - 1.64\sigma$)

here μ and σ are the mean and the standard deviation, respectively, of final marks of all the students.

III. Attendance Policy

Except for reasons beyond student's control, every student is expected to attend all sessions (lectures, tutorials, examinations, quizzes) of the course. 80% attendance is mandatory for securing a passing grade.

IV. Code of Conduct and Ethics

Students are expected to maintain highest standards of ethics, honesty and integrity. There will be zero tolerance for cheating during examinations and quizzes. Students caught using unfair means during examinations or quizzes will in addition to getting F grade may also face strict disciplinary action. Students are also expected to maintain proper decorum during lectures, tutorials and examinations. Any act of indiscipline will be sternly dealt with and severely penalized.

V. Makeup Examination Policy

There will be no makeup examinations for missed Mid Semester Examination or Quizzes. If a student does not appear in mid semester examination or a quiz due to bonafide reasons, he/she may be considered for prorating the missed portion of grade with the average grades in remaining portions of evaluation. For missing Mid Semester Examination or a Quiz due to bonafide non-emergent situation, request for proration shall be made well before the date of mid semester examination or quiz. For missing Mid Semester Examination or a Quiz due to an emergent situation, request for proration shall be made as soon as

possible after the date of mid semester examination or quiz. In case of medical emergency the student must present a letter from the doctor stating that the student was not in condition to take the examination/quiz (simply producing a note stating that the student reported to the doctor will not be acceptable). Makeup examination for end-semester examination will be as per the policy of the institute.

VI. Lecture Notes, Assignment Problems and Examination/Quizzes

Students are expected to go through the suggested text books for further understanding of course material covered during lectures. Lecture notes will also be made available on the web page of the course whenever possible.

A list of suggested home assignment problems will be provided during lectures and, whenever possible, on the web page of the course.

For mastering the course material and doing well in examinations, student must first try to solve home assignment problems of their own. All difficulties may be discussed during tutorial sessions or through prior appointment with the instructor. This course is of 11 credits with 4 hours of classroom sessions (3 lectures and 1 tutorial). Thus every student is expected to do 7 hours ($3 \times 2 + 1 \times 1 = 7$ hours) of self study for the course.