MTH515a: Inference-II
2017-2018-I Semester

Prerequisite: MTH418a: Inference-I

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Lectures: Days: Mon, Fri (08:00-08:50 Hrs) at L-15 (Lecture Hall Complex); Tue (11:00-11:50 Hrs.) at L-14 (Lecture Hall Complex);

Tutorials: Venue: L-17 (Lecture Hall Complex); Day: Thu (11:00-11:50 Hrs)

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

Course Webpage: http://home.iitk.ac.in/~neeraj/mth515a/mth515a.htm

Reference Books:
(i) Mathematical Statistics, by Jun Shao, Springer;
(ii) Theory of Point Estimation, by E.L. Lehmann and George Casella, Springer;
(iii) Theory of Statistical Hypotheses, by E L Lehmann, Wiley;
(iv) Linear Statistical Inference, by C.R. Rao, Wiley.

Course Content:
Group families, the principle of equivariance, location family, scale family, location scale family. Minimum risk equivariance estimators, risk functions, admissibility, prior distribution, posterior distribution, geometric interpretation for finite parameter space, Bayes estimators, limit of Bayes estimators, minimax estimators and their relations. Review of convergence in probability and convergence in distributions. Consistency results of the mle's, and the mme's. Asymptotic relative efficiency. Consistent and Asymptotic Normal (CAN) estimators, Invariance of CAN estimators under different transformations. CAN estimators obtained by moments and MLE methods in one parameter exponential family and multiparameter exponential family. Sequential Probability Ratio Tests and its applications in different practical problems. Invariant test and unbiased tests, Likelihood ratio test and its asymptotic distributions, Wald test, Rao's score test, Pearson c2 est for goodness of fit. Large sample tests and confidence intervals based on CAN estimators. Consistency of large sample tests and asymptotic powers of large sample tests.

Course Objectives
The sequence of courses MTH418a: Inference-I and MTH515a: Inference-II are designed to expose students to basic principles and statistical theory of statistical inference with

main emphasis on statistical estimation and statistical testing problems. In the course MTH418a, the students were introduced to data reduction notions of sufficiency, minimal sufficiency and completeness. Various methods of estimation (MLE, MME, UMVUE etc.) and their properties were discussed. In addition basic principles of hypothesis testing problems and various associated notions (Type I and II errors, power and size of the test, MP, UMP and UMPU tests) were discussed. Techniques to derive UMP and UMPU tests were developed. Problems of interval estimation and confidence intervals were introduced and techniques to find confidence intervals of specified confidence, shortest expected length CI and most accurate one sided CI were discussed. Interrelation of CI with UMP tests were also discussed.

In the course MTH515a, some other methods of estimation and hypothesis testing will be introduced. Principles of invariance in estimation and testing problems will be discussed. Bayes and minimax estimation procedures will be introduced and asymptotic (as the sample size tends to ∞) properties of MLE and MME will be discussed. Some asymptotically efficient estimation and testing procedures will be discussed. Methods for deriving invariant, unbiased and likelihood ratio tests will be taught and their asymptotic properties will be studied.

Prerequisites

Students are expected to have knowledge of advanced calculus and various probabilistic convergence concepts (such as convergence in probability, convergence in distribution, Weak and Strong Law of Large Numbers, Central Limit Theorem, etc.). Students are also expected to revise the content of MTH418a of their own. Whenever possible, above topics will be reviewed in the context while developing various topics in the course MTH515a.

Course Policies

I. Weightages

There will be a mid-semester examination of two hour duration (on one of the days during 18-09-17 to 23-09-17, to be announced by DOAA), carrying 25% wieghtage; an end-semester examination of three hour duration (on one of the days during 18-11-17 to 27-11-17, to be announced by DOAA) carrying 50% weightage; and two long quizzes of forty five minutes duration each (on 24-08-17 (Thursday) and 26-10-17 (Thursday)), each carrying a weightage of 12.5%.

II. Academic Performance Evaluation Scheme

The absolute grading policy will be followed for awarding the final grades. The minimum

performance requirements for various grades are as follows:

A* Grade: 85% Marks
A Grade: 75% Marks
B Grade: 60% Marks
C Grade: 45% Marks
D Grade : 35% Marks
E Grade: 25% Marks

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. As students are expected to attend all sessions of the course, attendance will be taken on random days (especially on the days of low attendance in the lectures/tutorials of the course). Habitual absentees will be penalized by up to 10% of total marks secured by them.

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 be made available on the web page of the course only after a particular module of the course has been fully covered in the lectures. This is done to encourage students to read standard text books on the

course material.

A list of suggested home assignment problems will be provided during lectures and, whenever possible, on the web page of the course. Most of the questions appearing in examinations/quizzes will be either from material covered in lectures or will be similar to problems covered in lectures/tutorials and home assignments.

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.