East China Normal University
GEC International Summer School

MAT 32: Probability and Statistics 2

Term: June 17th to July 19th, 2024
Class Hours: Monday through Friday, 110 minutes each day (2,750 minutes in total)
Instructor: TBD
Home Institution: TBD
Office Hours: TBD
Email: TBD

Course Description

This is the second course in the Probability and Statistics. The course mainly covers Sampling probability distributions (t-student, Chi-squared and F-Fisher distribution). Point estimation. Maximum Likelihood estimation. Estimation by confidence intervals. Hypothesis testing. ANOVA one- and two-way. Simple linear regression models; multiple regression analysis including variable selection techniques; regression inference. Basic experimental design. Analysis of variance. Some non-parametric test.

Prerequisite: MAT 31 Probability and Statistics 1

Learning Objective

1. To obtain a broad idea about the sampling distribution, estimation and basic introduction of statistical hypothesis theory, linear regression and a brief idea on Bayesian and EM algorithm.

2. To learn and understand basic results and statistical techniques in intermediate statistical knowledge.

3. This course also gives the student basic R/Markdown/Rmarkdown language skills by assignments and tutorial and R code techniques.

Required Text

Mathematical Statistics with Applications, 7th Edition, by Dennis D. Wackerly, William Mendenhall III, Richard L. Scheaffer.

ISBN: 978-0-495-11081-1

Optional materials are

Statistical Inference, 2nd edition, by George Casella and Roger L Berger

ISBN: 0-534-24312-6

Course Hours

The course has 25 class sessions in total. Each class session is 110 minutes in length, for a total of 2750 minutes of in-class time. The course meets from Monday to Friday. ECNU awards 3 credits for this course. Different universities may count course credits differently. Consult officials at your own home institution.

Attendance

Summer school is very intense and to be successful, students need to attend *every class*. Occasionally, due to illness or other unavoidable circumstance, a student may need to miss a class. ECNU policy requires a medical certificate to be excused. Any absence may impact on the student's grade. Moreover, ECNU policy is that a student who has more than 3 absences will fail the course. Arriving late or leaving early will count as a partial absence.

Grading Policy

ECNU awards grades of A, A-, B+, B, B-, C+, C, D, and F. Most colleges and universities do not award transfer credit for grades of D or F.

In this course, grading will be based on the following:

Assignments*2	20%*2=40%
Midterm Exam	20%
Final Exam	40%

General Expectations

Students are expected to:
- Attend all classes and be responsible for all material covered in class and otherwise assigned. Any unexcused absence may impact a student's grade.
- Arrive to class on-time: Late arrivals are disruptive to your fellow students and to the conduct of the class.
- Complete the day's required reading and assignments before class
- Review the previous day's notes before class; make notes about questions you have about the previous class or the day's reading
- Refrain from texting, phoning or engaging in computer activities unrelated to class during class (不要用手机) It is highly disrespectful to the professor and to the class.
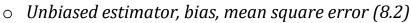- Participate in class discussions and complete required written work on time.

Course Schedule

The planned schedule sketched out below may be modified to suit the interests or abilities of the enrolled students or to take advantage of special opportunities or events that may arise during the term.

Week 1

- *Day 1*
    - *Course outline*
    - *Brief Review: Transformation among R.V., MGF, Order Statistics (6.1-6.7)*
- *Day 2*
    - *Statistic, sampling distribution related to normal distribution (7.1-7.2)*
    - *Central limit theorem (7.3)*
    - *Normal approximation to binomial distribution (7.5)*
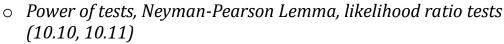- *Day 3*
    - *Point estimator (8.1)*

- o *Unbiased estimator, bias, mean square error (8.2)*
- *Day 4*
  - o *Common unbiased estimators (8.3)*
  - o *Error of estimation (8.4)*
- *Day 5*
  - o *Tutorial/R-Lab*

Week 2

- *Day 1*
  - o *Sampling distribution of parameter estimators (9.1)*
  - o *Method of moments (9.6)*
  - o *Method of maximum likelihood (9.7)*
  - o *Relative efficiency (9.2)*
- *Day 2*
  - o *Sufficient estimator (9.4)*
  - o *Rao-Blackwell theorem and minimum-variance unbiased estimator (9.5)*
  - o *Some statistical inequality and Cramer-Rao lower bounds (Statistical Inference 3.6 and 7.3)*
- *Day 3*
  - o *Midterm*
- *Day 4*
  - o *Pivot and pivotal quantities, confidence intervals (interval estimators), confidence coefficient (8.5)*
  - o *Large-sample confidence intervals (8.6)*
  - o *Small-sample confidence intervals (8.8)*
  - o *Confidence intervals for population variance (8.9)*
- *Day 5*
  - o *Tutorial/R-Lab*

Week 3

- *Day 1*
  - o *Null hypothesis, alternative hypothesis, test statistic, rejection region, type I error, Type II error, level of test, Relationship between hypothesis testing and confidence intervals, p-values (10.2, 10.4, 10.5, 10.6)*
- *Day 2*
  - o *Common Hypothesis Testing (10.3, 10.7, 10.8)*
- *Day 3*

- o Power of tests, Neyman-Pearson Lemma, likelihood ratio tests (10.10, 10.11)
- Day 4
  - o Simple/Multiple linear models, least square methods(11.1- 11.4)
- Day 5
  - o Tutorial/R-Lab

Week 4

- Day 1
  - o Property of estimation and inference, correlation (11.5 – 11.8)
- Day 2
  - o Analysis of Variance (13.1 – 13.6)
- Day 3
  - o Experimental design (12.1 – 12.4, 13.7, 13.8)
- Day 4
  - o Analysis of categorical data: some Chi-square test, goodness of fit test. (14.1 – 14.4)
- Day 5
  - o Tutorial/R-Lab

Week 5

- Day 1
  - o Non-parameteric test: Sign test, Wilcoxon rank test and Mann-Whitney U test (15,3, 15.4, 15.6)
- Day 2
  - o Introduction to Bayesian and EM Algorithm (16.1, 16.2 and Statistical Inference 7.2.3, 7.2.4)
- Day 3
  - o Final exam review session
- Day 4
  - o Final review session
- Day 5
  - o Final exam

Academic Honesty

Students are expected to maintain high standards of academic honesty. Specifically, unless otherwise directed by the professor, students may not

consult other students, books, notes, electronic devices or any other source, on examinations. Failure to abide by this may result in a zero on the examination, or even failure in the course.