

QA 732 (renumbered from 891) Tuesday and Thursday 4:30-5:45

## STATISTICAL INFERENCE

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**Office Hours:** 3:15-4:15 Tuesday and Thursday and by appointment.

Office hours provide you with an opportunity for personal discussion with me concerning course-related problems such as homework, clarification of classroom discussion, test grading etc. If the formal hours are unsuitable for you, please make an appointment with me at a mutually agreeable time. I strongly urge you to take advantage of these hours.

**Tests:** There will be one midterm exam. This will be a take-home exam. I plan to disseminate the midterm exam at the end of the sixth week of class (February 10). The comprehensive final will be given as scheduled by the university and will likely be an in-class exam. You may prepare five pages of notes on 8.5x11 inch paper to take with you to the final exam. You will be permitted to use these notes and a calculator on the exam. No other aids will be permitted. If you are forced to miss the midterm for a documented reason beyond your own control, the final exam score will be substituted for the missing midterm exam score. If, for a similar reason, you are forced to delay submitting the completed copy, in the case of a take-home, a special arrangement must be made with me. In all cases, I will be the judge of the severity and validity of the excuse. If this protocol is not followed, the midterm score will be counted as zero. You must contact either the QA department secretary or me before missing the midterm or the exam score will be counted as zero.

**Homework:** Text book practice problems and some other assignments, perhaps covering material not covered in the text, will be given in class. Some of these may be collected and graded. You are expected to complete a textbook practice problem, corresponding to a day's lecture, within one week of that lecture. Assignments to be collected will have a due date to which you must conform. Except under exceptional circumstances, as judged by me, no late assignments will be graded. You are urged to collaborate in a responsible manner when attempting the textbook practice problems, i.e. carrying your own weight in any cooperative arrangement. You are responsible for keeping current in the reading from the textbook.

**Class Communication:** Every student will obtain a *Blackboard* account by going to <http://blackboard.uc.edu/> on the INTERNET. This is mandatory. We will use Blackboard to communicate.

**Class Notes:** The class notes will be made available to you in electronic format. I will post the notes on my Blackboard site, in .pdf format. You may read these documents by obtaining the freeware Adobe Reader. You may print out a copy of the notes if you wish. The text is in a new and drastically different form than the previous editions. Therefore, I am in the process of a major revision of my notes. Because of this, my notes will become available on a periodic basis, when each section is completed.

**Group-Work Structure of the Course:** I firmly believe that student cooperation and knowledge exchange can enhance learning in a course such as this. Thus, after the first class, each student **may elect** to join a work group. A work group will consist of at least two students, but no more than six. This work group should optimally be maintained for the length of the quarter. The work group should cooperate in all work given during the quarter including practice problems, studying, and quizzes. All members of a group will share grades on any submitted work. One paper is to be submitted in behalf of all members of a work group, and the names of the members of that group should be clearly indicated on the front page. All members are to contribute equitably to the shared workload, carrying a fair weight for the burden. At the end of the quarter, members of each group will be asked to evaluate the contribution of the other work group peers on the basis of a number of criteria taking into consideration such factors as intellectual contribution, attendance at group meetings, mentoring and sharing knowledge, writing up the results, and performing relevant computations. The peer score will reflect, in some sense, an average over all of the work assigned as well as an average of the criterion above. Thus, a student in a work group who may have contributed much on one assignment, may not have contributed the majority of the work on another, yet still such work may be considered by other members to be meritorious "on the average".

**Grading:** The midterm exam will be worth 30% of the final grade. The final exam will be worth 40% of the final grade. Exam scores will be adjusted so that a "100-90-80-70-etc." scheme for the corresponding letter grade equivalent "A-B-C-D-F" is appropriate (I will use the "+ and -" option). The remaining 30% will be based upon any assignments that may be collected and other "intangible" sources that reflect "attitude" such as class participation and my personal impressions.

**Miscellaneous:** The grade of "Incomplete" will be given only for fully documented medical conditions or other catastrophes as judged by me. You may drop the course without penalty up to the Friday of the eighth week of class. No special exams or assignments will be given a quarter's end for grade improvement. Students are responsible for all material, assignments and announcements made in class whether or not they attended the class. All exams must be strictly personal efforts. No collaboration is permitted on take-home exams either. You are expected to bring a working hand-held calculator to in-class exams. In-class exams will probably be open-book, open-notes type exams. When required, all work must be shown. No work=no credit. Partial credit will be determined solely by me. Of course you may discuss the basis of your grade with me but this discussion must take place in private and not in open class. Keep all graded exams and assignments. The final exam will remain in my possession for two quarters. I regard a student's attitude and interest to be a very important component in evaluation and I reserve the right to raise a grade based upon my impression. You are strongly urged to suggest any improvements in the teaching or classroom procedure. In case a notice of class cancellation is posted, you must remain in class for a period of ten minutes to confirm the validity of that notice.

**Texts:** The text will be Introduction to Mathematical Statistics, 6th Ed., by Hogg, McKean, and Craig. In QA 732, we will cover a selection of topics from chapters 5 through 11. It is assumed that the student is familiar with the material in the first four and a half chapters of this text. Reference texts are Introduction to the Theory of Statistics, by Mood, Greybill and Boes, Statistical Theory, by Lindgren, and Introduction to Probability and Mathematical Statistics, by Bain and Engelhardt.

**AIMS AND OUTLINE:** This is the second of a two-quarter sequence in which the prerequisite course, QA 731, is entitled PRINCIPLES OF PROBABILITY. Together the two quarters are intended to provide a complete course in Mathematical Statistics. This two-quarter sequence, consisting of QA 731 and QA 732, has been designed to provide a solid conceptual foundation for students who require a moderately rigorous treatment of Probability and Statistical Inference as a prerequisite for course work which presumes a familiarity with this material (as in the areas of e.g. Econometrics, Quantitative Analysis, Math, or Biostatistics). While QA 731 is not a required prerequisite, the topics covered in that course are necessary for complete understanding of the material in QA 732. The topics covered in QA 732 can serve to justify and complement the material traditionally covered in statistical methods and data analysis courses and should aid practitioners of data analysis extend the techniques with which they are familiar. The prerequisite for both courses is a good four-quarter calculus sequence or its equivalent. Exposure to statistical methods is highly desirable but not required. In this course, many of the statistical principles and underlying philosophies behind those methods will be discussed. The topics covered in this course would be found useful to Masters and Ph.D. students in the College of Business Administration (particularly in the areas of Finance, Marketing, Accounting, Operations Research, and Business Statistics), College of Engineering, College of Medicine (particularly in Environmental Health) and in Economics, especially if their potential research demands a deeper conceptual foundation than is typically provided by a Statistical Methods course.

The syllabus includes the topics in the outline below but not *necessarily in this order*:

1. Point estimation
  - maximum likelihood and method of moments principles
  - methods based on quantiles
2. Confidence intervals
3. Tests of statistical hypotheses
4. Chi-square tests
5. Sufficient statistics
  - measures of quality and properties of estimators
  - Rao-Blackwell theorem
6. Complete families of distribution
  - exponential family of distributions
  - functions of a parameter and several parameters
  - minimal sufficient and ancillary statistics
  - location and scale parameters
  - sufficiency, completeness & independence (Basu's theorem)
7. Fisher Information and Rao-Cramer Inequality
  - efficient statistics
  - limiting distribution of MLE's
8. Theory of statistical tests
  - best tests and Neyman-Pearson theory
  - uniformly most powerful tests

9. Likelihood ratio tests
10. Sequential methods
11. Bayesian methods