COURSE AND CONTACT INFORMATION
Course: Statistics 8258 Distribution Theory
Semester: Spring, 2023
Time: Monday, 6:10-8:40pm
Location: 1776 G St. NW Room C-113

INSTRUCTOR
Name: Professor Joseph L. Gastwirth
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Office hours: Tuesday 4:00-5:00 pm. Problem session-To be determined.
            Friday afternoon (by appointment only)

COURSE DESCRIPTION
1. Review of basic probability distributions and inequalities based on moments. Improved probability bounds that are possible when one knows some properties of the distribution function, e.g. it is unimodal will be covered.

2. Measures of spread and measures of relative inequality and their relationship to the Lorenz curve. Estimation of the Gini index and Lorenz curve from grouped data. Comparing the Gini index to other indices placing greater weight on different parts of the distribution will be discussed.

3. Review of characteristic functions and their use. A more detailed study of several commonly used functions of random variables in statistics, especially quotients of random variables.

4. Order statistics and their properties and introduction to non-parametric methods including:
a. The Dirichlet distribution and it relationship to the spacings between order statistics in a sample from a Uniform distribution.
b. Pitman's lemma and its use in studying some functions of the spacing's of a sample from a uniform distribution. The Renyi representation of the order statistics from an exponential distribution and its use in deriving related distributions.
c. Properties of the Wilcoxon two sample rank test.
d. Goodness of fit tests

5. Basic results in large sample theory and their use. The asymptotic distribution theory of functions of random variables using the "delta" method. The theoretical results are compared to those obtained from modern computational approaches e.g. simulation. (the time spent on this topic will depend on the background knowledge of the class members).

Depending on the time it takes to cover the above topics, the course may also examine the effect of dependence on the sampling distributions of common estimators and test

statistics and/or carry out a small research project or develop a small R package on the material on grouped data.

APPROXIMATE SCHEDULE:
Weeks 1-3: Topics 1 and 2
Weeks 4 5: Topic 2
Weeks 6-9 Topics 4 a-d.
Weeks 10-11 Topic 5
Weeks 12-13: Student Presentations and a closed book exam.
Note: After the first two weeks, a portion of the second half of the class may be devoted to a research or reading project related to the material of the course. This may affect the time the listed topics are discussed by a week or two.

COURSE PREREQUISITE(S)
 Statistics 201-202 or the equivalent and Statistics 257 or sound knowledge of the main theorems of probability, e.g. law of large numbers and central limit theorem for non-identically distributed random variables. Students should be familiar with the basic mathematical results from the pre-requisite classes.

TEXTS (recommended)
Author (s)   Title   Edition
A. Stuart & K. Ord, Kendall's Theory of Statistics: Distribution Theory (5th ed.)
Recommended: H.A. David & H.N. Nagaraja Order Statistics (3rd Ed.) Wiley
R. Serfling, Approximation Theorems of Mathematical Statistics , Wiley
B.C. Arnold, Pareto Distributions (2nd Ed). CRC Press.
Note: The first book has been the main textbook for the class; however, it is out of print. Handouts of the relevant material will be distributed in class.

LEARNING OUTCOMES:
After completing this course, students will be able to:
1. Derive the basic properties of the major statistical distributions.
2. Work with statistical procedures based on order statistics.
3. Work with percentile based curves, e.g. the Lorenz curve and associated measures of relative inequality, Gini Index and Coefficient of Dispersion and know about related indices of inequality and disparity that are currently being used.
4. Derive the large sample approximate distributions of commonly used statistics.

GRADING
Homework (20%)
Class Participation and Project/Presentation (40%)
Exam (40%)

CLASS POLICIES
Students are expected to attend class and turn in homework regularly and on time. Late homework will not be accepted as the problems will be discussed in class or in a problem session. Sometimes the class will be given an additional week to complete a

problem, if the necessary material has not been covered sufficiently or we decide that more time is appropriate. The **last** scheduled day of class will be devoted to an exam on the material discussed during the semester. If possible, we will arrange a session to go over the exam, so you can learn any material you had difficulty with on the exam.

Credit hours: This course is for three credit hours. Two and one-half hours (150 minutes) each week are devoted to class room lectures, discussion and student presentations in class. Students should plan to spend 5 hours (300 minutes) per week to independent study, homework and assignments.

Religious Holidays: We will not meet on major holidays but will re-schedule at convenient time for everyone.

General Policies: We will follow the university policies with regard to teaching, retention of written work etc.

ACADEMIC INTEGRITY
I personally support the GW Code of Academic Integrity. It states: "Academic dishonesty is defined as cheating of any kind, including misrepresenting one's own work, taking credit for the work of others without crediting them and without appropriate authorization, and the fabrication of information." For the remainder of the code, see:
http://www.gwu.edu/~ntegrity/code.html

SUPPORT FOR STUDENTS OUTSIDE THE CLASSROOM
DISABILITY SUPPORT SERVICES (DSS)
Any student who may need an accommodation based on the potential impact of a disability should contact the Disability Support Services office at 202-994-8250 in the Marvin Center, Suite 242, to establish eligibility and to coordinate reasonable accommodations. For additional information please refer to: http://gwired.gwu.edu/dss/

UNIVERSITY COUNSELING CENTER (UCC) 202-994-5300
The University Counseling Center (UCC) offers 24/7 assistance and referral to address students' personal, social, career, and study skills problems. Services for students include:
  - crisis and emergency mental health consultations
  - confidential assessment, counseling services (individual and small group), and referrals
    http://gwired.gwu.edu/counsel/CounselingServices/AcademicSupportServices

SECURITY
In the case of an emergency, if at all possible, the class should shelter in place. If the building that the class is in is affected, follow the evacuation procedures for the building. After evacuation, seek shelter at a predetermined rendezvous location.