Mathematical Statistics for Applied Econometrics
AEB 7504, section MSAE, class #28438 (3 credit hours)

Class Meeting Times: MWF 2 (8:30 – 9:20)
Location: 1142 McCarty B (MCCB)
Academic Term: Fall 2023

Instructor
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Office Hours: Monday & Wednesday 10:45 a.m. – 12:00 p.m., or by appointment

Course Description
Develops statistical foundations used in agricultural economics, including microeconomic theory, econometrics, production economics, and financial economics.

Course Prerequisites
STA 6166 or equivalent.

Course Objectives
Upon successful completion of this course, you should be able to:
1. Differentiate between probability distribution types and discuss the relevance as related to econometric analysis.
2. Discuss the implications of large samples on econometric analysis.
3. Conduct data analyses using the methodologies covered in this course.
4. Select the most appropriate methods to analyze data as presented.
5. Establish hypothesis testing in econometric analysis.
6. Interpret the results of these analyses.

Materials and Supply Fees
None

Required Textbooks
- Amemiya, Takeshi. 1994. *Introduction to Statistics and Econometrics*. Cambridge Massachusetts, Harvard University Press.
- Popper, K. 1959. *The Logic of Scientific Discovery.* New York, Routledge Classics.
- Salsburg, D. 2002. New York: Holt Paperbacks. *A Lady Tasting Tea: How Statistics Revolutionized Science in the Twentieth Century.*

A most the materials presented in the class are provided on the webpage "Mathematical Statistics for Applied Economics" (http://www.charlesbmoss.com:8080/econometrics.mathstat). These materials are contained in the textbook:

- Moss, Charles B. 2014. *Mathematical Statistics for Applied Econometrics.* Boca Raton, FL: CRC Press.

Topic Outline
Week 1
  I.   Introduction
         a. Defining Mathematical Statistics (Amemiya 1, Popper 1, Moss 1)
         b. Introduction to Statistics, Probability & Econometrics
 Assignment 1 – Basic Observations in Probability: What is the Weather and Flipping Coins

Week 2
  II.   Basic Concepts of Probability
         a. Basic Axioms of Probability (Amemiya 2, Popper 2, Moss 2)
         b. Probability and Measure (Moss 3.1)

Week 3 & 4
  III.   Random Variables and Probability Distributions
         a. Random Variables and Probability Distributions: I (Amemiya 3.1 – 3.4, Popper 3
             - Theories, Moss 3.2-3.4)
         b. Random Variables and Probability Distributions: II (Amemiya 3.6- 3.7, Popper 4
             – Falsification, Moss 3.5-3.7)
         c. An applied Sabbatical (Moss 3.8)
                 i.   Basics of Crop Insurance – Nelson, C.H. 1990. The Influence of
                       Distributional Assumptions on the Calculation of Crop Insurance Premia.
                       North Central Journal of Agricultural Economics 12(1): 71-78
                 ii.   Estimating distribution functions of Crop Yields 0 Moss, C.B. and J.S.
                       Shonkwiler. 1993. Estimating Yield Distributions with a Stochastic Trend
                       and Nonnormal Errors. *American Journal of Agricultural Economics*
                       75(4): 1056-62
                 iii. Comparing Distribution Functions Out-Of-Sample – Norwood, B., M.C.
                       Roberts, and J.L. Lusk. 2004. Ranking Crop Yield Models Using Out-Of-
                       Sample Likelihood Functions. *American Journal of Agricultural
                       Economics* 86(4): 1032-43.
 *Assignment 2 – Correlations Between High and Low Temperatures and Verifying the
    Probability Density Function.*

Week 5
  IV.   Moments and Moment Generating Functions
         a. Mean and Higher Moments (Amemiya 4.1-4.2, Popper 5 – The Problem of the
             Empirical Bias, Moss 4.1-4.2)
         b. Moments of More than One Random Variable (Amemiya 4.3-4.4, Popper 6 –
             Degrees of Testability, Moss 4.3-4.4)
         c. Moment Generating Functions (Popper 7 – Simplicity, Moss 4.5)
 Assignment 3 – Derivation of the Mean, Variance and Higher Moments

Week 6
  V.   Binomial and Normal Random Variables

a. Binomial Random Variables (Amemiya 5.1, Popper 8 – Probability [it is a long chapter], Moss 5.1)
b. Normal Random Variables (Amemiya 5.2, Moss 5.2-5.3)
c. Bivariate and Multivariate Normal Random Variables (Amemiya 5.3-5.4, Moss 5.4)

Assignment 4 – Moment Generating Functions and Approximating Sample Moments

Test I

Week 7 & 8
VI.   Large Sample and Asymptotic Theory
a. Large Sample Theory (Amemiya 6.1, Popper Chapter 10 – Corroboration, or How a Theory Stands Up to Tests [skipping Chapter 9 – Some Observations on Quantum Theory], Moss 6.1-6.2)
   i. White, H. 199. Asymptotic Theory for Econometricians Revised Edition. San Diego, CA: Academic Publishers
b. Limits and the Law of Large Numbers (Amemiya 6.2-6.3, Moss 6.3-6.5)
   i. Almost Sure Convergence (White Chapter (II)
   ii. Asymptotic Normality (White Chapter III)
c. Empirical Examples of the Central Limit Theorem (Amemiya 6.4, Salsburg 1)

Assignment 5 – Convergence of Empirical and Theoretical Moments as the Sample Size Increases

Week 9
VII.   Point Estimation
a. Definition of an Estimator (Amemiya 7.1, Salsburg 2, Moss 7.1-7.2)
b. Properties of Estimators and Sufficient Statistics (Amemiya 7.2, Salsburg 3, Moss 7.3-7.4)
c. Concentrated Likelihood Functions, Normal Equations, and Properties of Maximum Likelihood (Amemiya 7.3-7.4, Salsburg 3, Moss 7.5-7.7)

Assignment 6 – Maximum Likelihood Estimation and the Cramer-Rao Lower Bound

Week 10
VIII.   Interval Estimation
a. Interval Estimation (Amemiya 8.1, Salsburg 4, Moss 8.1)
b. Bayesian Estimation and Confidence Intervals (Amemyia 8.2-8.3, Salsburg 5, Moss 8.2-8.3)

Assignment 7 – Confidence Intervals from Maximum Likelihood and Bayesian Confidence Intervals

Week 11
IX.   Testing Hypotheses
a. Type I and Type II Errors and the Neyman-Pearson Lemma (Amemiya 9.1-9.3, Salsburg 6, Moss 9.1-9.2)
b. Composite Tests and the Likelihood Ratio Tests (Amemiya 9.4-9.5, Salsburg 7, Moss 9.3-9.6)
c. Examples of Multivariate Testing (Amemiya 9.6-9.7, Salsburg 8)

Assignment 8 – Derivation of the Log-Likelihood Test and other Tests.

Test II

Week 12
X. Elements of Matrix Analysis
   a. Review of Matrix Algebra and Vector Spaces (Amemiya 11.1-11.3, Salsburg 9, Moss 10.1-10.2)
   b. Vector Spaces and Eigenvalues (Amemiya 11.4-11.5, Salsburg 10, Moss 10.14-10.5)

Assignment 9 – Spanning Spaces and Orthogonality

Week 13
XI. Bivariate and Multivariate Regression
   a. Simple Linear Regression (Amemiya 10.1-10.2, Salsburg 11, Moss 11.1)
   b. Distribution of Estimates and Multivariate Regression (Amemiya 10.3 Salsburg 11, Moss 11.2-11.5)

Assignment 10 – Ordinary and Restricted Least Squares.

Week 14
XII. Exceptions to Ordinary Least Squares
   a. Heteroscedasticity (Salsburg 12, Moss 11.4.1)
   b. Endogeneity (Salsburg 13, Moss 11.4.2)
   c. Generalized Method of Moments (Salsburg 14,11.4.3)

Week 15
XIII. Variety of Specialized Topics of Student's Interest – Students choose 2
   a. System of Differential Input Demands
   b. Time Series Models
   c. Non-Stationary Time Series
   d. Spatial Models in Econometrics
   e. Other topics may be requested by the class.

   Final Exam: December 14, 12:30 – 2:30

Grading Policy

Percent	Grade	Grade Points
96.0 - 100.0	A	4.00
92.0 – 95.9	A-	3.67
88.0 – 91.9	B+	3.33
84.0 – 87.9	B	3.00
80.0 – 83.9	B-	2.67
76.0 – 79.9	C+	2.33
72.0 – 75.9	C	2.00
68.0 - 71.9	C-	1.67
64.0 - 67.9	D+	1.33
60.0 - 63.9	D	1.00

56.0 - 59.9   D-   0.67
0 - 55.9   E   0.00

Evaluation of Grades

Assignment	Percentage of Final Grade
Homework (approximately 10 assignments)	20%
2 Exams (25% each)	50%
Final Exam	30%
Total	100%

Grades and Grade Points
For information on current UF policies for assigning grade points, see UF Grading Policy.

Attendance Policy
Attendance is not required, but students should attend in order to keep up with the pace of the course. Students should not arrive late or leave early.

Cellphone/Laptop Policy
Cell phones and laptops must be turned off.

Makeup Policy
Missed exams and homework due to illness require documentation of absence by a physician. Must be submitted within one week of absence.

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at UF Attendance and Makeup Policy.

COVID Response
We will have face-to-face instructional sessions to accomplish the student learning objectives of the course. In response to COVID-19, the following policies and requirements are in place to maintain your learning environment and to enhance the safety of our in-classroom interactions.

- You are required to wear approved face coverings at all times during class and within buildings. Following and enforcing these policies and requirements are all of our responsibility. Failure to do so will lead to a report to the Office of Student Conduct and Conflict Resolution.
- This course is assigned a physical classroom with enough capacity to maintain physical distancing (6 feet between individuals) requirements. Please utilize designated seats and maintain appropriate spacing between students. Please do not move desks or stations.
- Sanitizing supplies are available in the classroom.
- Follow your instructor's guidance on how to enter and exit the classroom. Practice physical distancing to the extent possible when entering and exiting the classroom.
- If you are experiencing COVID-19 symptoms (Click here for guidance from the CDC on symptoms of coronavirus), please use the UF Health screening system and follow the

instructions on whether you are able to attend class. Click here for UF Health guidance on what to do if you have been exposed to or are experiencing Covid-19 symptoms.

- o Course materials will be provided to you with an excused absence, and you will be given a reasonable amount of time to make up work. Find more information in the university attendance policies.

Online Course Evaluation Process
Student assessment of instruction is an important part of efforts to improve teaching and learning. At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

Academic Honesty
As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following Pledge: *"We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity."* You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: *"On my honor, I have neither given nor received unauthorized aid in doing this assignment."*

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g., assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations. Of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action.

Student Privacy
Federal laws exist, which protect your privacy with regard to grades earned in courses and individual assignments. More information at Notification to Students of FERPA Rights.

Software Use
All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, the University will take disciplinary action as appropriate.

Services for Students with Disabilities

The Disability Resource Center (DRC) coordinates the needed accommodations for students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student, who must then provide this documentation to the Instructor when requesting the accommodation. For more information, visit the DRC website, or in person at 0001 Reid Hall, or call 392-8565.

Campus Helping Resources

Counseling & Well-Being

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- University Counseling & Wellness Center, 3190 Radio Road, 392-1575
    - Counseling services,
    - Groups and workshops
    - Outreach and consultation
    - Self-help library
    - Wellness coaching
- U Matter We Care, 392-1575, umatter@ufl.edu
- Career Connections Center, 1st Floor, JWRU, 392-1601
- Student Success Initiative
- Sexual Assault Recovery Services (SARS): Student Health Care Center, 392-1161
- University Police Department, 392-1111, or 9-1-1 for emergencies, police@ufl.edu
- Student Complaints:
    - On-campus course
    - Online course

Academic Resources
- E-learning technical support, 392-4357 (select option 2) or email Learning-Support@ufl.edu
- Library Support, Various ways to receive assistance with respect to using the libraries or finding resources.
- Teaching Center, Broward Hall, 392-2010, 392-6420. General study skills and tutoring.
- Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.