AEB 7184

Production Economics

Purpose: The purpose of this course is to introduce students to the standard theoretical and empirical models used in the investigation of firm level production decisions.

Instructor: Charles B. Moss
Office: 1175 McCarty Hall
Phone: 294-7630
Email: cbmoss@ufl.edu

Office Hours: My office hours are Monday, Tuesday and Wednesday from 10:30 to 12:00 and 1:30 to 2:30. I will meet with students by appointment outside these hours if I receive a request by Email at least 24 hours in advance.

Overview: This class meets three times a week (MWF – 3 [9:35 to 10:25]). Course grades will be assigned based on weekly homework, three examinations, a research proposal and class participation. Homework will be due in a week increment. Each assignment will be handed out at the beginning of each increment and will involve topics covered over that time span. The research proposal is not intended to be a completed research product. Instead, I would like the student to propose an interesting problem that can be solved using of the techniques from this course.

Textbooks: There are two primary textbooks used in this course:

Chambers, Robert G. 1980. *Applied Production Analysis: A Dual Approach*. New York: Cambridge University Press.

Other books referenced in this course include:

Beattie, Bruce R. and C. Robert Taylor. *The Economics of Production* (New York: John Wiley & Sons, 1985).

Coelli, Timothy J., Dodla Sai Prasada Rao, Christopher J. O'Donnell, and George Edward Battese. *An Introduction to Efficiency and Productivity Analysis* (Springer, 2nd Edition, 2005).

Cornes, Richard. *Duality and Modern Economics* (New York: Cambridge University Press, 1992).

Fare, Rolf and Daniel Primont. *Multi-Output Production and Duality: Theory and Applications* (Boston: Kluwer Academic Publishers, 1995).

Kumbhakar, Subal C. and C. A. Knox Lovell. *Stochastic Frontier Analysis* (New York: Cambridge University Press, 2003).

Shephard, Ronald W. *Theory of Cost and Production Functions* (Princeton, New Jersey: Princeton University Press, 1970).

Theil, Henri. *The System-Wide Approach to Microeconomics* (Chicago: Chicago University Press, 1980).

Background material can be found in:

Doll, John P. and Frank Orazem. *Production Economics: Theory with Applications* Second Edition (Malabar, Florida: Krieger Publishing Company, 1984).

Supplementary Material: Other materials such as lecture notes will be made available on the Internet at http://www.charlesbmoss.com:8080/production.economics .

Software and Computer Access: Often I will ask students to bring laptop computer to class. The primary numerical tool we will use is R which is publically available at (http://www.r-project.org). We will also be interested in code that provides analytical solutions. I suggest that students look into Mathematica™. However, a free ware program that does several applications is Maxima (http://maxima.sourceforge.net).

Grading: Grades will be assigned based on the following weights:

Course Grade Weights

Activity	Points	Percent of Grade
Test 3*100	300	60%
Research Proposal	100	20%
Homework	75	15%
Class Participation	25	5%
Total	500	100 %

Grading Scale*

Grade	Percentage of Total Points	Numeric GPA
A	96-100	4.00
A-	92-96	3.67
B+	88-92	3.33
B	84-88	3.00
B-	80-84	2.67
C+	76-80	2.33
C	72-76	2.00
C-	68-72	1.67
D+	64-68	1.33
D	60-64	1.00
D-	56-60	0.67
E	<56	0

*I reserve the right to lower the scale for any grade level.

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.

    - 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.

Course Outline

I. Production Functions

A. Lecture I: Basic Notions of Production Functions [Beattie and Taylor 2]
   1. The Single Input Production Function
   2. The Multiple Input Production Function

B. Lecture II: Definition and Properties of the Production Function [Chambers 1.1 – 1.5]
   3. The Production Function Defined [Chambers 1.1]
   4. Properties of the Production Function [Chambers 1.2]
   5. Law of Variable Proportions [Chambers 1.4]
   6. Measure of Simultaneous Input Variation: Elasticity of Scale [Chambers 1.5].

C. Lecture III: Substituting One Input for Another in Production [Chambers 1.6 – 1.8]
   1. Elasticity of Scale and Law of Variable Proportion
   2. Measures of Input Substitution
   3. Structure of Production Function

II. Some Simple Production Mechanics

A. Lecture IV: Some Simple Production Mechanics
   1. Profit Maximization
      a. Expansion Path
      b. Derived Demand
      c. Supply
   2. Cost Minimization
      a. Derived Demand (output conditional)
      b. Cost Function
      c. Marginal Cost

III. Estimation of the Primal Production Function

A. Lecture V: Estimation of the Primal Production Function
   1. Ordinary Least Squares

B. Lecture VI: Simultaneity and Other "Simple" Problems
   1. Simultaneity and sample selection
   2. Zeros and other data problems
   3. Nonparametric Surfaces

4. Existence of Stage III

C. Lecture VII: Stochastic Production Functions
D. Lecture VIII: Estimation of Production Functions: Fixed Effects in Panel Data
E. Lecture IX: Estimation of Production Functions: Random Effects in Panel Data
F. Lecture X: Stochastic Error Functions I: Another Composed Error
G. Lecture XI: Stochastic Error Functions II: Estimation of Stochastic Frontiers
H. Lecture XII: Empirical Applications of the Primal

Test on Primal

IV. Cost Functions

A. Lecture XIII: Definition and Properties of the Cost Function
    1. Definition of the Cost Function [Chambers 2.1]
    2. Properties of the Cost Function [Chambers 2.2]
B. Lecture XIV: Comparative Statics and Duality of the Cost Function
    1. Comparative Statics of the Cost Function [Chambers 2.3]
    2. Duality between Cost and Production Functions [Chambers 2.4]
C. Lecture XV: An Application of Duality
D. Lecture XVI: Shephard's Duality Proof: Part I
E. Lecture XVII: Shephard's Duality Proof: Part II

V. Estimation of Cost Functions

A. Lecture XVIII: Cost Functions and the Estimation of Flexible Functional Forms
    1. Flexible Function Forms [Chambers 5.1 and 5.2]
    2. Fourier Function Forms
    3. Estimation of Seemingly Unrelated Regression Models
B. Lecture XIX: Limitations, Aggregation, and Constraints
    1. Limitations to Flexible Functional Forms [Chambers 5.4]
    2. Aggregation Issues
    3. Imposing Restrictions
        a. Homogeneity
        b. Symmetry
        c. Concavity
C. Lecture XX: Subadditivity of Cost Functions

VI. Profit Functions

A. Lecture XXI: Profit Functions
    1. Definition of the Profit Function [Chambers 4.2]
    2. Comparative Statics of the Profit Function [Chambers 4.3]
    3. The Profit Function and Duality [Chambers 4.4]

Test on Duality

VII. Technical Change and Efficiency: Theory and Measurement

A. Lecture XXII: Measuring Changes in Productivity

1. Measurement of Technical Change from Indirect Objective Functions [Chambers 6.2]
2. Divisia Indices and Technical Change [Chambers 6.3]
3. Total Factor Productivity [Chambers 6.4]

B. Lecture XXIII: Measuring Technical Efficiency
1. Technical Efficiency
2. Data Envelope Analysis
3. Directed Distance Functions

C. Lecture XXIV: Factor Bias, Technical Change, and Valuing Research
1. Mathematical Model of Technical Change
2. Valuing State Level Funding for Research: Results for Florida

VIII. Differential Models of Supply

A. Lecture XXV: Differential Models of Production: The Single Product Firm

B. Lecture XXVI: Differential Models of Production: Change in the Marginal Cost and the Multi-Product Firm

IX. Review of Empirical Studies

A. Lecture XXVII: Applications in Production Economics