

**Agricultural Economics 637**  
**Production Economics and Dynamic Optimization (Part II)**  
**Summer 2009**

**Instructor**

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**Office Hours and communication**

- Open door policy
- e-mail messages usually receive prompt response.
- If necessary, you may call me at home, but please not after 9:00.

**I. Course Objectives**

- To develop an intuitive understanding of dynamic economic problems including (discrete and continuous, deterministic and stochastic).
- To understand applications of dynamic economic analysis in the areas of agricultural and natural resource economics.
- To be able to read and understand papers in which dynamic optimization plays a central role.
- To become competent in the process of setting up and solving dynamic optimization problems, both analytically and numerically, and to understand the strengths and weaknesses of alternative methods.

**II. Class home page**

The class homepage is located at <http://agecon2.tamu.edu/people/faculty/woodward-richard/637/>. Notes, problem sets and other information relevant to the course will be available there. I will provide notes for each lecture on the web site at least 48 hours prior to each class. If notes are not posted by this time, contact me because it is likely that there has been a computer glitch. If for some reason I fail to post the notes at that time, I will supply printed copies in class.

**III. Prerequisites**

It will be assumed that you have a very strong understanding of calculus (constrained optimization and integration), linear algebra and fundamental principals of probability and statistics. You must also be comfortable with the basic microeconomic results of consumer and producer theory. Previous exposure to differential equations would be helpful, but is not assumed. Economics 629 and Econometrics 669 together satisfy the prerequisites.

**IV. Dates**

These are probable dates. Any modifications will be announced in class.

Class will be held M W F from 10:00 – 11:35. We will occasionally go over, but the total number of class sessions will be reduced to 12.

Homework 1 due on Monday July 13 by 5:00 p.m.

Homework 2 due on Monday July 20 by 5:00 p.m.

Homework 3 will have several due dates, July 24, 27, and 31,

Final exam: In class portion on Tuesday Aug 4. Take-home portion will be due Aug. 6, 5:00 p.m.

## V. Grading

The course grade will be determined based on an equal weighting of your performance on the two parts of AGE637. The other half of 637 is taught by Dr. Ximing Wu.

The purpose of grades is to provide a signal to you, the department, the university, future employers, and others. Here is what I believe those signals should indicate for a graduate-level course:

A - Thorough understanding of the material, and demonstrated ability to apply the concepts to problems beyond the scope of the course.

B - Good understanding of the material but unclear whether the student would be able to extend the concepts beyond the course.

C - Failed to achieve of the objectives noted above.

D - A lot worse than C.

F - Forgot to withdraw from the class.

That said, how you will demonstrate these skills? Your final grade will be based on your average grade on the problem sets (45%), and an exam (55%).

*Homeworks:* Each homework assignment will contain a mathematical or computational component and a component of interpretation. These two components will be given approximately equal weight. Hence, interpretation of the results is just as important as getting the right numbers and/or equations. The mathematical or computational component of your homeworks should be “commented” so that I can easily follow what you are doing. Your comments, written in your own words, must convince me that you understand what you are doing. For example, an answer that consists of only a series of equations with no explanation of the intuition behind the math is not acceptable. The first time uncommented work is found in an assignment it will be returned for revision. After that, no credit will be given for work that is not explained. Similarly, computer programs need to be written in such a way that even someone entirely unfamiliar with the language can understand the logic of the program. In your interpretation, clarity of writing will be taken into account.

**This is a Ph.D. level class.** As such, I expect your assignments to be neat, well formatted, and should be written in a manner that communicates to the reader. **Do not turn in unformatted computer printout or pages of sloppy equations with your homework.** Your results should be in well-prepared tables or (often better) figures, and should be specifically referred to in your discussion of your results. All computer programs used in solving your program should be submitted electronically. Finally, answer the assigned questions.

*Exam:* A two-part final exam will be given. An in-class exam, and a take-home portion in which the student must write a computer program to solve dynamic programming problems.

*Extensions:* Extensions are not in the best interest of either the student or the instructor and will be granted only in special conditions.

*Writing skills:* The clarity of your writing will be considered in the evaluation of your work. Spelling and grammatical errors will be penalized. Always use a spell and grammar checker before submitting typed work.

*Working with others:* Anything you hand in for this class must reflect your own understanding. On homework assignments, you are encouraged to work with others, but you must understand what is finally handed in. The algebra or computer commands that you hand in might be identical to that handed in by another student, but the discussion, explanation of the steps, and comments in your computer code should be written independently.

**But:**

(1) **it is strictly forbidden to obtain assistance from anyone else on the take-home final.**

(2) It is also strictly forbidden to use computer code or homework from students who have taken this course in previous years.

(3) Finally, you are prohibited from giving extensive help to students taking 637 in future years. You may of course answer conceptual questions or help them understand the notes, but you may not share copies of your homework assignments with them or guide them through questions based on your experience. Be careful that copies of your homework assignments do not circulate among graduate students – you will be held responsible. I have had this problem before. In that case I contacted the offending student's advisory committee and the Department Head. If I discover that you have given inappropriate assistance to students in future years, I will take the most serious steps in my power to ensure that you pay the consequences for violating the integrity of Texas A&M as an academic institution. If in the future you are asked for help and you aren't sure whether it crosses the line, just ask me and I will clarify.

## VI. How to have fun and succeed in AGECE 637

To get the most out of this class and not be overwhelmed by stress, I have one simple piece of advice: Plan ahead.

*Read ahead.* Complete lecture notes are available before each class. You should print and read the lecture notes that we will be presented in class. Since the lecture notes are available in advance, we will make best use of our time if people indicate questions that they have before class begins and I will make sure that all those questions are addressed. In addition, if there is an assigned reading, do it in advance.

*Work ahead.* Start on the problem sets as soon as possible. This will give you an opportunity to ask questions. I am very willing to help out if you ask questions well in advance after you've made a good faith effort to find the solution, but am much more reluctant to help out when the deadline is hours away.

*Work in groups:* I encourage you to help each other. Asking another student for help will usually benefit both of you. However, there are limits to this. First, be considerate of other students' time. If you are asking questions because you procrastinated, then the student who worked hard for many hours is under no obligation to help you. Moreover, help that is only one-way is pathway to failure. If you find that you're always on the receiving end of the advice line, then you need to start worrying. If you find yourself in this situation, then on the next assignment get started well in advance and ask me for help, then you can provide assistance to your classmates. Finally, as mentioned above, work you turn in must reflect your own understanding. *Turning in work that you have copied from another student that you do not understand is **plagiarism** and is a very serious offense.*

## VII. Computer programming

The use of computers is central to much of applied economic analysis and will play a major role in this course. The only way to learn a foreign language is by practicing. The same rule holds for programming languages. I believe that you should look at each course you take as an opportunity to learn a new language. The more languages you "speak", the more flexibility that you have as you try to solve a problem. On the other hand, learning a language can be time consuming and get in the way of learning the economic concepts that are the focus of the course. So you must balance the associated benefits and costs based on your own interests, time constraints and talents.

We will have computer labs during which students I will be available to assist in the use of programming languages that will be used to complete the homework assignments.

All of the computer homework assignments can, at least in theory, be completed using any one of a number of programs including GAMS, Fortran, Gauss, Matlab, or Visual Basic. Some of the problems could even be solved in Excel or other spreadsheets. You may use almost any program language to complete the assignments for this course. However, the default language for the dynamic programming part of this course will be Visual Basic. VB is used because it is readily accessible (if you have Excel, you have VB), its syntax is quite easy to learn, it integrates easily with the graphing and analytical capabilities of Excel, and it provides a nice stepping stone to other languages. We will

have several sessions in which we spend some time working in the computer lab. There are a number of books that will help you learn to program, including the book by Albright noted below.

I encourage you to use languages other than VB, but if you want to do so, please discuss this with me to make sure that it will work.

### VIII. Outline of the course (This outline is substantive, not sequential)

- A. Nature of Dynamics
- B. Optimal control theory
  1. Derivation of optimal control necessary conditions, Hamiltonians
  2. Finite horizon problems
  3. Infinite horizon problems
  4. Economic Interpretation
  5. Bang-bang and most-rapid-approach-path solutions to optimal control
  6. Stochastic optimal control (Ito calculus) (we usually don't get to this)
- C. Dynamic Programming
  1. Deterministic DP
  2. Stochastic DP
  3. Infinite horizon problem and convergence
- D. Dynamic programming in planning, management and positive analysis
  1. Using DP in econometric analysis
  2. Integrating DP with large simulation models

### IX. Texts

The following are optional texts and should be available at the book store. I would *not* recommend buying all of these books as the cost would be excessive and there is some repetition. You are welcome to look at my copies of these books before making a decision and copies of some books are available for loan. For the nuts and bolts of numerical dynamic programming, excellent available references are the chapter by Rust (*Handbook of Computational Economics*), the text by Miranda and Fackler, and a few chapters of the book by Judd. If you have not done a lot of programming, then the Albright or Miranda and Fackler texts might be helpful, depending on whether you intend to do the programming assignments in VB or Matlab.

#### Optimal Control

Leonard, Daniel, and Ngo Van Long. 1992. *Optimal Control Theory and Static Optimization in Economics*. New York: Cambridge University Press. [Very well written introduction to optimal control]

Kamien, Morton I. and Nancy Lou Schwartz. 1991. *Dynamic Optimization : The Calculus of Variations and Optimal Control in Economics and Management*. New York, N.Y. : Elsevier. [A very good reference for optimal control]

#### Dynamic Programming & Numerical Methods

Adda, Jerome and Russell W. Cooper. 2003. *Dynamic Economics: Quantitative Methods and Applications*. Cambridge Mass.: MIT Press.

Bertsekas, Dimitri P. 1987. *Dynamic Programming : Deterministic and Stochastic Models*. Prentice Hall.

Miranda, Mario J., and Paul L. Fackler. 2002. *Applied Computational Economics and Finance*. Cambridge, Mass.: MIT Press. [excellent applied text. The authors use Matlab to solve a wide range of problems]

Judd, Kenneth L. 1996. *Numerical Methods in Economics*. Cambridge, Mass.: The MIT Press. [An excellent overview of methods with strong theoretical foundations - a useful reference book]

### **VB Programming**

Albright, S. Christian. 2001. *VBA for Modelers: Developing Decision Support Systems with Microsoft Excel*. Pacifica Grove, CA.: Duxbury. [A nice reference for those who will do their programming using visual basic]

## **X. Acknowledgments**

In developing the material for this course I draw on numerous sources, and I want to give the authors credit. As a general disclaimer, I claim the discovery of none of the material covered in the course. If you are unsure of the source for the material that I am presenting, simply ask and I will normally gladly provide the necessary citation, at least after the problem set has been handed in. Unpublished sources that I will be drawing on include:

Karp, Larry. Lecture notes on Methods of Dynamic Analysis and Control. University of California, Berkeley

Provencher, Bill. Lecture notes on Dynamic Resource Economics. University of Wisconsin – Madison.

## **XI. Students with disabilities**

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities, be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. Texas A&M University has a strong institutional commitment to the principle of diversity in all areas. In that spirit, admission to Texas A&M University and any of its sponsored programs is open to all qualified individuals without regard to subgroup, class or stereotype.

If you believe you have a disability requiring an accommodation, please contact the Department of Disability Services in Room B118 of the Cain Hall Building. The phone number is 845-1637. ADA accommodations will be made in accordance with the law.