

EEP 162: ECONOMICS OF WATER RESOURCES

UC BERKELEY – SPRING, 2016

COURSE SYLLABUS

1 General Information

1.1 Instructors

Professor: David Sunding
e-mail: sunding@berkeley.edu
office: 207 Giannini Hall
phone: (510) 642-8229

GSI: Andrew Stevens
e-mail: stevens@berkeley.edu
office: 241 Giannini Hall*
***not the location of GSI office hours**

1.2 Schedule

Lecture

- M/W 11:10 a.m. – 12:00 p.m.,
103 Moffitt Library (basement)

Sections (begin on W, Jan. 27)

- W 2:10 – 3:00 p.m., 201 Giannini Hall
- F 10:10 – 11:00 a.m., 258 Dwinelle Hall

Midterm Exam

- Monday, Feb. 29, in class
103 Moffitt Library (basement)

Final Exam

- Tuesday, May 10, 7:00 – 10:00 p.m.,
103 Moffitt Library (basement)

1.3 Office Hours

Professor

- M/W 10:00 – 11:00 a.m.,
207 Giannini Hall

GSI (begin on M, Feb. 1)

- Mondays 9:00 – 11:00 a.m.,
234 Giannini Hall
- No GSI OH on M, Feb. 15. (Holiday)
Instead, W, Feb. 17, 9:00 – 11:00 a.m.,
234 Giannini Hall

2 Course Description

This course is designed to introduce students with a background in intermediate economics to the subject of water economics. The course will provide students with a set of analytic tools that will be useful in further work or study on water issues or natural resource issues more broadly. In particular, students will learn about water rights, agricultural water use, groundwater management, urban water use, and water markets. In each of the above subject areas, students will read relevant primary research papers and learn canonical economic models of water use. Students will demonstrate their understanding of these models by completing two problem sets, a midterm exam, and a final exam. Successful students will be able to understand a given problem, identify a relevant economic model that fits the problem, correctly set up the analytic framework, successfully derive solutions, and clearly interpret the qualitative results of their quantitative analysis.

This course will make extensive use of calculus and optimization methods. Students are expected to be comfortable with multivariable calculus at the level of Berkeley's MATH 53 course. Students are also expected to have passed a course in intermediate economics at the level of Berkeley's EEP 100 or ECON 100A/101A courses. Finally, students are *strongly* encouraged to have already taken a course in econometrics such as EEP 118 or ECON 140.

3 Learning Objectives

The following is a list of learning objectives for this course. These objectives describe what students should gain over the course of the semester. These objectives also guide the development of class learning activities and student assessments.

By the end of the semester, students should be able to...

- set up and explain the basic economic models presented in class (and explain in words how and why the models are useful for analyzing real-world problems)
- slightly extend basic economic models to new contexts by slightly adjusting the models' set-up or assumptions
- select the appropriate economic model to solve a given problem
- use optimization methods to derive analytic solutions to an economic model
- qualitatively interpret quantitative/analytic results
- succinctly summarize the economic literature covered in class
- articulate the benefits and limits of the economic models covered in class for solving real-world water policy problems

These learning objectives will guide the development of problem sets and exams. If you want to know “what the exam is going to look like,” these objectives will give you the best idea of what to expect.

4 Grading

Your final grade will be determined by a midterm exam, a final exam, and two problem sets. Letter grades will be assigned at the end of the semester on a curve. In previous years, the median letter grade has been a B+ and the modal letter grade has been an A-. However, as with investments, “past performance is not necessarily a guide to future performance.”

Problem sets are due *at the beginning of class on the day they are due*. Late problem sets will NOT be accepted and students will receive a zero for any problem set not received on time. If you know you will be absent the day a problem set is due, it is *your* responsibility to submit the assignment ahead of time to the GSI. If there is an emergency that prevents you from handing in a problem set or taking an exam, you should contact me immediately. You are expected to provide written documentation of any such emergency in order to receive an exception to the above policy.

Neither hard copies nor electronic copies of problem set solutions will be made available. Solutions will be covered in class on the day the problem set is due.

Students should provide their own “blue books” for both the midterm and final exam.

Grading Breakdown:

- Final Exam: 50%
- Midterm Exam: 30%
- Problem Sets: 20% (2 at 10% each)

5 Course Policies

5.1 Attendance

You are not graded on attendance for either class lecture or section. Nonetheless, you are strongly encouraged to regularly attend both. Lecture and section are designed to complement each other; they are not substitutes. In previous years, the students who struggled most on the exams were those who least often attended lecture and section.

5.2 Tardiness

Do not arrive to class late. Our lecture is only 50 minutes long, and every time a student arrives late, that student disrupts lecture for everyone else. If you have a recurring reason you

might be a few minutes late (e.g. you're coming directly from another class across campus), please let me know.

No one is perfect, and everyone arrives to class a little late once in a while. I understand. But if your tardiness becomes a recurring issue, we will need to have a conversation.

Pro-tip: professors know the people who repeatedly show up to our classes late. And we remember these things when you ask us for letters of recommendation and such.

5.3 Grading

See the section above for the course grading breakdown. If you have further questions about grading, ask either myself or the GSI. I am responsible for all final grading decisions.

5.4 Readings

Most days on our syllabus schedule have a reading assigned. You should read the assigned readings *before* their assigned day. (You may want to read/skim them again afterwards as well to re-solidify the content.) The assigned readings are of varying difficulties. Some readings will have very complicated derivations that you are not expected to master. In these cases, look for the big picture and try to draw the connection between what you see in the reading and what is covered in lecture.

In problem sets and on exams, you are responsible for material from the readings on the syllabus whether that specific material is discussed in lecture or not. However, you are only expected to know the reading material at the *level* covered in lecture/section (i.e. you don't need to master differential equations just to answer questions about a reading that employs differential equations). When I ask questions based on the readings, my goal is not to "get" you or trick you. I ask questions that (1) confirm whether you have actually done the reading or not, and (2) give me a sense of whether you understand the relevant take-aways from the reading.

In this syllabus, readings are identified using their citations. You should find the readings yourself each week using a resource such as Google Scholar.¹ If you're having trouble finding a reading, ask a friend how they found it. If they haven't been able to find it either, then ask your GSI.

While you are not required to buy any books for this course, those books on the reading list are included for a reason: they're quite good. If you don't buy the books, they can be found in the Course Reserves at Moffitt Library.

5.5 Academic Integrity

Academic dishonesty is a serious issue. As a student, you are responsible for abiding by the UC Berkeley Code of Conduct (<http://sa.berkeley.edu/code-of-conduct>). Cheating,

¹After several years of teaching this class, I found that many students have not developed the skill of finding academic sources from a citation. This is not a difficult skill, but it is extremely useful – especially if you are interested in further academic study.

plagiarism, and other forms of academic dishonesty are unacceptable.

If you have any questions about what constitutes academic dishonesty, ask either myself or the GSI. For instance: working with others on your problem sets is acceptable, but turning in two identical problem sets will be considered cheating. (Write up your own solutions.)

There are serious consequences for engaging in academic dishonesty. If you are found cheating, the incident will be referred to the Center for Student Conduct for review and possible disciplinary action.

5.6 Religious Accommodations

In accordance with University policy, exams and assignments may be rescheduled for students whose religious creed prevents them from participating in these activities at the normal time. If this policy is relevant to you, please speak with me immediately to request a religious accommodation. Such accommodations are usually unavailable when requested at the last minute.

5.7 Accommodations for Students with Disabilities

If you have been issued a letter of accommodation from the Disabled Students Program (DSP), please inform me as soon as possible to work out the necessary arrangements. If you believe you need an accommodation and have not yet seen a Disability Specialist at the DSP, please do so as soon as possible. DSP accommodation requests should be made at the *beginning* of the semester, and may not be able to be granted if requested at the last minute.

6 Texts

Readings are assigned from the following two books. Purchase is not required; the books are available as Course Reserves at Moffitt Library:

- Reisner, Marc. *Cadillac Desert: The American West and Its Disappearing Water, Revised Edition*, Penguin Books, 1993.
- Wilkinson, Charles F. *Crossing the Next Meridian: Land, Water, and the Future of the West*, Island Press, 1992.

The following book is not assigned for this course, but may be of interest to many students. It is also available as a Course Reserve at Moffitt Library:

- Hundley, Norris. *The Great Thirst: Californians and Water – A History, Revised Edition*, University of California Press, 2001.

7 Course Schedule

The schedule below is an outline and subject to change.

Introduction

- W, Jan. 20 – Course Introduction and Overview

Water Rights

- M, Jan. 25 – Introduction to Water Rights
 - Wilkinson, Charles F. *Crossing the Next Meridian: Land, Water, and the Future of the West*, Island Press, 1992. Chapters 1, 5, & 6.
 - (Optional) Reisner, Marc. *Cadillac Desert: The American West and Its Disappearing Water, Revised Edition*, Penguin Books, 1993.
- W, Jan 27 – Prior Appropriation and Investment Incentives
 - Burness, S. & J. Quirk, “Appropriative Water Rights and the Efficient Allocation of Resources,” *American Economic Review* 69(1979): 25-37.

Agricultural Water Use

- M, Feb. 1 – Environmental Quality, Technology Choice, and Land Allocation
 - Caswell, M. & D. Zilberman, “The Effects of Well Depth and Land Quality on the Choice of Irrigation Technology,” *American Journal of Agricultural Economics* 68(1986): 798-811.
- W, Feb. 3 – Irrigation Efficiency
 - Green, G. *et al.*, “Explaining Irrigation Technology Choices: A Microparameter Approach,” *American Journal of Agricultural Economics* 78(1996): 1064-1072.
- M, Feb. 8 – Transition from Queuing to Markets
 - Zilberman, D. *et al.*, “Changes in Water Allocation Mechanisms for California Agriculture,” *Contemporary Economic Policy* 12(1994): 122-133.
- W, Feb. 10 – The Basin Approach to Efficiency
 - Gleick, P. *et al.*, “Water Use Efficiency and Productivity: Rethinking the Basin Approach,” *Water International* 36(2011): 784-798.
- M, Feb. 15 – University Holiday: NO CLASS

- W, Feb. 17 – Programming Models to Value Agricultural Water Rights
 - Mérel, P. & R. Howitt, “Theory and Application of Positive Mathematical Programming in Agriculture and the Environment,” *Annual Review of Resource Economics* 6(2014): 451-470.
- M, Feb. 22 – Hedonic Methods and Land Markets
 - Buck, S. *et al.*, “Land Markets and the Value of Water: Hedonic Analysis Using Repeat Sales of Farmland,” *American Journal of Agricultural Economics* 96(2014): 953-969.
- W, Feb. 24 – Problem Set #1 DUE
- M, Feb. 29 – Midterm (in class)

Groundwater Resources

- W, March 2 – Optimal Groundwater Management I
- M, March 7 – Optimal Groundwater Management II
- W, March 9 – Property Rights and Efficient Use of Groundwater
 - Gisser, M., “Groundwater: Focusing on the Real Issue,” *Journal of Political Economy* 91(1983): 1004-1027.
- M, March 14 – The Value of Groundwater Storage Rights

Urban Water Use

- W, March 16 – Residential Water Demand
 - Renwick, M. & R. Green, “Do Residential Demand Side Policies Measure Up? An Analysis of Eight California Water Agencies,” *Journal of Environmental Economics and Management* 40(2000): 37-55.
- M, March 21 – Spring Recess: NO CLASS
- W, March 23 – Spring Recess: NO CLASS
- M, March 28 – Urban Water Pricing
- W, March 30 – Value of Water Supply Reliability
 - Auffhammer, M. *et al.*, “The Value of Supply Reliability in Urban Water Systems,” *Journal of the Association of Environmental and Resource Economists*, forthcoming. (Available from instructor.)

- M, April 4 – Water Conservation Programs
 - Gleick, P. *et al.*, Waste Not Want Not: The Potential for Urban Water Conservation in California, Pacific Institute, 2003. http://www.pacinst.org/wp-content/uploads/2013/02/waste_not_want_not_full_report3.pdf
- W, April 6 – Natural Hazards
 - Brozovic, N. *et al.*, “Estimating Business and Residential Water Supply Interruption Losses from Catastrophic Events,” *Water Resources Research* 43(2007): 1-14.

Water Markets

- M, April 11 – Typology of Water Markets
 - Chong, H. & D. Sunding, “Water Markets and Trading,” *Annual Review of Environment and Resources* 31(2006): 239-264.
- W, April 13 – Water Markets in California
 - Public Policy Institute of California, California’s Water Market By the Numbers, 2012 Update, 2012. http://www.ppic.org/content/pubs/report/R_1112EHR.pdf

Case Studies

- M, April 18 – Case Study TBA
- W, April 20 – Case Study TBA
- M, April 25 – Case Study TBA
- W, April 27 – Problem Set #2 DUE
- M, May 2 – RRR Week: NO CLASS
- W, May 4 – RRR Week: NO CLASS
- Tu, May 10 – FINAL EXAM (7:00 – 10:00 p.m.)