

# EEP 162: ECONOMICS OF WATER RESOURCES

UC BERKELEY – SPRING, 2019

## COURSE SYLLABUS

### 1 General Information

#### 1.1 Instructors

Professor: David Sunding  
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#### 1.2 Schedule

##### Lecture

- M/W 11:10 AM–12:00 PM,  
101 Morgan

##### Sections (begin on M, Jan. 28)

- 101: M 2:10–3:00 PM, 20 Wheeler
- 102: F 8:10–9:00 AM, 150D Moffitt
- 103: F 11:10–12:00 PM, 150D Moffitt
- 104: W 2:10–3:00 PM, 242 Hearst Gym

##### Midterm Exam

- W 11:10 AM–12:00 PM, Mar. 13  
in class, 101 Morgan

##### Final Exam

- Tu 7:00–10:00 PM, May 14, 2019  
location: TBD

#### 1.3 Office Hours

##### GSI (begin on W, Jan. 30)

- W 12:10–2:00 PM, 55A McCone
- F 9:10–11:00 AM, 55A McCone

##### Professor

- M/W 10:10–11:00 AM,  
714D University 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, water markets, water quality, water conservation, and investment analysis. 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, two problem sets, and participation points measured by quiz questions answered with an iClicker device. It is highly advised you attend class, and the participation points serve as encouragement to do so. Solely reading the lecture slides will not be sufficient to do well in this challenging course. 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: 40%
- Midterm Exam: 20%
- Problem Sets: 20% (2 at 10% each)
- iClicker Quizzes/Participation: 20%

## 5 Course Policies

### 5.1 Attendance

You will be graded on attendance through the participation questions that will be answered through an iClicker device. You are strongly encouraged to regularly attend both lecture and section. Lecture and section are designed to complement each other; they are not substitutes. In previous years, the students who struggled the most on the exams were those who least often attended lecture and section.

## 5.2 iClickers

This course will require the use of a device that is compatible with the iClicker 2 system. Acceptable devices are the original iClicker (no longer available new), the iClicker +, or the iClicker 2 (all available at the UCB Bookstore). Additionally, you may download and use iClicker REEF mobile application on a smart phone device if you are not interested in purchasing an iClicker device, but the REEF does have a download fee.

Once you have your device, you will need to register it on bCourses. I have activated the iClicker registration tab on bCourses, where you should be able to enter your remote ID. After you have registered the device, make sure to bring the remote to class each meeting and have spare batteries in case the remote dies. If you have any questions on setting up or operating your iClicker device, please see [this helpful student guide set up by UC Berkeley](#).

## 5.3 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.

## 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, however the necessary material will largely be focused on what is discussed in lecture. 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.<sup>1</sup> If you're having trouble finding a reading, ask a friend how they found it. If they have not been able to find it either, then ask your GSI.

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<sup>1</sup>After 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.

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, plagiarism, and other forms of academic dishonesty are unacceptable.

If you have any questions about what constitutes academic dishonesty, ask either myself or the GSIs. 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. 23 – Lecture 1: Course Introduction and Overview

### Water Rights

- M, Jan. 28 – Lecture 2: 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 30 – Lecture 3: 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. 4 – Lecture 4: Agricultural Water Use: 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. 6 – Lecture 5: Land Quality and Farmers’ Choice of Irrigation Technology
  - Green, G. *et al.*, “Explaining Irrigation Technology Choices: A Microparameter Approach,” *American Journal of Agricultural Economics* 78(1996): 1064-1072.
- M, Feb. 11 – Lecture 6: Empirical Evidence on Irrigation Technology Adoption

– Zilberman, D. *et al.*, “Changes in Water Allocation Mechanisms for California Agriculture,” *Contemporary Economic Policy* 12(1994): 122-133.

- W, Feb. 13 – Lecture 7: Transition from Queuing to Markets
- M, Feb. 18 – **No Class**: University Holiday (Presidents’ Day)

### **Groundwater Resources**

- W, Feb. 20 – Lecture 8: Optimal Groundwater Management I
  - Gisser, M., “Groundwater: Focusing on the Real Issue,” *Journal of Political Economy* 91(1983): 1004-1027.
- M, Feb. 25 – Lecture 9: Optimal Groundwater Management II
- W, Feb. 27 – Lecture 10: Property Rights and Efficient Use of Groundwater
- M, Mar. 4 – Lecture 11: Property Rights and Efficient Use of Groundwater
- W, Mar. 6 – Lecture 12: The Value of Groundwater Storage Rights

### **Problem Set 1 and Midterm Examination**

- M, Mar. 11 – **Problem Set #1 DUE**
- W, Mar. 13 – **Midterm (in class)**

### **Urban Water Use**

- M, Mar. 18 – Lecture 13: Urban Water Use
- W, Mar. 20 – Lecture 14: Urban Water Pricing
- M, Mar. 25 – **No Class**: Spring Recess
- W, Mar. 27 – **No Class**: Spring Recess
- M, Apr. 1 – Lecture 15: Water Supply Reliability
  - 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.
  - Buck, S., Auffhammer, M., Hamilton, S., & Sunding, D. (2016). Measuring welfare losses from urban water supply disruptions. *Journal of the Association of Environmental and Resource Economists*, 3(3), 743-778.

- W, Apr. 3 – Lecture 16: Water Supply Reliability: Case Study
- M, Apr. 8 – Lecture 17: Water Supply Reliability and the Value of Supply Investments

### **Water Markets**

- W, April 10 – Lecture 18: Typology of Water Markets in California
  - Chong, H. & D. Sunding, “Water Markets and Trading,” *Annual Review of Environment and Resources* 31(2006): 239-264.
  - Public Policy Institute of California, California’s Water Market By the Numbers, 2012 Update. [http://www.ppic.org/content/pubs/report/R\\_1112EHR.pdf](http://www.ppic.org/content/pubs/report/R_1112EHR.pdf)

### **Other Topics in Water**

- M, Apr. 15 – Lecture 19: The Delta and California’s Water
- W, Apr. 17 – Lecture 20: Cost Benefit Analysis of Water Projects
- M, Apr. 22 – Lecture 21: Irreversibility and Option Value
- W, Apr. 24 – Lecture 22: Review

### **Problem Set 2, Review, and Final Exam**

- M, Apr. 29 – **Problem Set #2 DUE**
- W, May 1 – **Review for Final Exam**
- M, May 6 – **No Class: RRR Week**
- M, May 8 – **No Class: RRR Week**
- Tu, May 14 – **FINAL EXAM (7:00–10:00 PM), TBD**