Energy and Transportation Modeling for Policy Analysis

TTP 289A-001 (CRN 54914)

Course Details:

Quarter:	Winter 2019
When:	Mon/Wed: 2:10-4:00pm
Instructor:	Alan Jenn (ajenn@ucdavis.edu)
Eligibility:	Graduate level
Classroom:	146 Robbins
Number of Units:	4
Grading:	Letter graded

Course Description:

The course will familiarize students with building energy and transportation models for policy analysis. Energy systems modeling covers a wide gamut of energy sectors and some of the most important elements (transportation, electricity, fuels, resources, infrastructure) will be reviewed in the course. The primary aim of the course will be on understanding the elements and techniques for modeling energy and transportation systems as they relate to relevant policy actions.

The class will be divided into material understanding the energy and transportation systems and methods for modeling and analysis. The former concepts include how different fuels are converted to energy, infrastructure to support various energy/transportation systems, consumption/end use, and different technologies. The latter concepts include decision making, uncertainty analysis, energy economics, optimization, regression, and life-cycle analysis. We will also discuss past and current transportation and energy policies and introduce techniques for policy analysis to provide context and inform decision regarding for future policies. The students will learn to integrate multi-disciplinary knowledge, build analytical tools, conduct alternative scenario analysis, and carry out sensitivity and uncertainty analysis.

The students will be introduced to several genres of energy models and will be required to complete a number of model building exercises using Excel, other tools introduced in class, or developed by students based on his/her own skills (some level of computer programming would be helpful, but not absolutely required, for this class). Students will become familiar with forecasting energy use and demands, gain experience of building techno-economic models, and develop skills for policy analysis. Assignments will draw on real-life policy problems in addressing challenges in transportation and energy systems.

Prerequisites:

None, programming and statistics/linear algebra background would be helpful but not required.

Course requirements:

1. Course participation: Students are required to actively participate in class discussion, this means attending class and interacting. Due to the hands-on nature of the course, participation will be the largest determinant of the final grade at 30% of the total.

2. Homework: Students will gain practical experience by analyzing real world data and applying learned techniques from lectures. The homework will replicate real world research: less as structured assignments and rather as open-ended practical problems that students may encounter as researchers. The homework will be worth 40% of the total.
3. Final project: Students will be required to select a dataset of their choice and analyze it using techniques learned throughout the class with a particular emphasis on maintaining an overarching research idea (as opposed to a series of disparate analyses). Projects will be conducted individually and are worth 30% of the final grade.

Grading:

Class participation	30%
Homework	40%
Final project	30%

Assignments:

There will be four different homework assignments, spaced throughout the quarter. The assignments will be relatively open-ended and aimed at replicating issues that students will encounter as they conduct research in graduate school. The assignments will not only help to apply techniques learned in class but to get students to think critically about how to approach data analysis. Late homework will be accepted with points deducted (25% deduction within 1 week, 50% deduction the next week).

Project:

The final project will be similar to the assignments but larger in scope. Students will be expected to conduct a cohesive and deep analysis of a dataset of their choosing using techniques learned throughout the course. Grading will be based on the accuracy and breadth of the analysis, as well as how the analysis would stand to critique in the academic realm.

Plagiarism:

"Plagiarism" means using the words or ideas of another without giving appropriate credit. Even if the student paraphrases the ideas in his/her own words, the source must be cited. If exact words are used, the student must put the words in quotation marks and cite the source. Students are responsible for knowing what plagiarism is and avoiding it. Be particularly careful about copying and pasting information from the Internet - materials used from Internet sources must be quoted and cited just like information from other sources. Students must also be aware that copying or adapting pictures, charts, computer programs or code, music, or data without citing sources and indicating that the material has been copied or adapted is plagiarism. It may also be copyright infringement.[1]

[1] http://sja.ucdavis.edu/faq.html#20

Week	Date	Lecture	HW	Title	Topics
1	1/7/19	1		Introduction and energy fundamentals	Course introduction, overview of modeling; efficiency, energy density thermo review, energy metrics, efficacy
	1/9/19	2		Primary energy: fossil fuels	Coal, natural gas, oil; resource acquisition, power generation, consumption figures, comparisons
2	1/14/19	3	HW 1 assigned	Primary energy: renewables	Solar, wind, hydro; resource availability, power generation, consumption figures, comparisons
	1/16/19	4		Infrastructure	Overview, connecting energy production and consumption, efficiency and losses
3	1/21/19	5	HW 1 due	Energy consumption	Sankey diagram, Kaya equation, stock turnover, international versus US
	1/23/19	6		Optimization in a day	Formulation, solving algorithms, optimization in practice
4	1/28/19	7	HW 2 assigned	Introduction to the electricity grid	Components of the power sector, how the grid works, dispatch modeling, unit commitment, capacity expansion
	1/30/19	8		Energy economics and analysis/decision making	Discounting, inflation, levelized costs, payback, costs, financing, McKinsey curves
5	2/4/19	9	HW 2 due	Decision making continued	Utility, risk analysis
	2/6/19	10		Scenario analysis	Sensitivity, uncertainty analysis, Monte Carlo simulation
6	2/11/19	11	HW 3 assigned	Regression in a day	Introduction to regression, linear models
	2/13/19	12		Forecasting	Regression, structural approach, growth curves, technological innovation
7	2/18/19	13	HW 3 due	Energy economics in practice	Carbon tax, cap and trade, examples/modeling, theory v. practice
	2/20/19	14		History of environmental policy in CA	Regulatory agencies, AB32, overview of bills and impacts; corresponding modeling efforts
8	2/25/19	15	HW 4 assigned	Policy in practice: fuels	RFS, LCFS; corresponding modeling efforts; corresponding modeling efforts
	2/27/19	16		Policy in practice: efficiency	Policies in buildings, transportation, industry, power; corresponding modeling efforts
9	3/4/19	17	HW 4 due	Policy in practice: technology	Lighting, renewables, DARPA and ARPA-E, ZEV; corresponding modeling efforts
	3/6/19	18		Policy in practice: emissions	Pollution regulation (SOx/NOx controls), GHG regulation (Clean power plan, GHG emission standards)
10	3/11/19	19		Final project presentation	
	3/13/19	20		Final project presentation	