Fall 2016

GEOG 261/361--Decision Methods for Environmental Management and Policy

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EN 261, GEOG 261, GEOG 361, EPP 261, IDCE 363
Decision Methods for Environmental Management
Fall Semester 2016
Course Syllabus as of 8/31/2016

INSTRUCTOR: **Sam Ratick**
Office: Jefferson 201C
Phone: 793-7368 (e-mail preferable)
Office Hours: Tuesday 3:00 to 4:00 PM or by appt.
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TA **Dan Santos**
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Office Hours: Monday 3-4pm; Thursday 10-11am
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CLASS TIME: Tuesday and Friday
1:25 – 2:40 PM
JF 222
Lab/discussion: Monday 1:25 – 2:40 PM
JC 103

Information resulting from environmental assessments needs to be systematically organized and analyzed to be useful in the decision making process. This course provides a survey of methods, tools, and processes that are currently used to aid environmental decision makers (who may include policy makers, environmental managers, and affected populations). The topics to be covered in the course are listed below:

Initial list of topics to be covered in course

Cost Benefit Analysis
Decision Analysis
Cooperative Game Theory
Multi-objective Programming
Multi-criteria Analysis
Geographic Information Systems and Science
Environmental Decision Support Systems
Creating Indices for Decision Making
Managing Uncertainty in Environmental Decision Making
Adaptive Environmental Management
+Multi-criteria Mapping
+Public Participation
+Environmental Negotiation/Mediation

These will be evaluated with respect to their theoretical foundations, systems formulation, and appropriate application. Evaluation of the strengths and weaknesses of these approaches will also be discussed. (+ indicates if time allows).

Conduct of the Course:
There will be readings provided on Moodle that include articles, book chapters, and reports for each of the topics covered. Students will be expected to have **read** the material for that course period **in advance** of the class meeting. Students may be assigned as discussion leaders for each of the readings on that week's topic. **Pop quizzes on the reading material may be given.**

Grading: There are two series of assignments that will be graded:

I. Reading Assignments:

Most reading assignments, unless otherwise specified, will be done individually. When specified in the instructions for the assignment, some assignments can be prepared in teams of up to 3 students (no more than 3) students. For the group assignments I strongly encourage you to change teams from one week to another. You will learn more this way and, should you encounter a free-rider phenomenon, you will not be stuck with it for more than one week at a time.

You must submit your reading assignments via the digital drop-box on Moodle (The first assignment may need to be submitted via e-mail, but this will be the only case). **To obtain full credit reading assignments must be submitted *before* class on the day they are due.**

The title for the reading assignment must be as follows: **RA #_last names of authors (if a group assignment, be sure to include your entire group).**

The reading assignments will be graded and posted on Moodle or returned via e-mail. *Late submissions are marked down*. **We will not accept reading assignments that are more than one week late.** The reading assignments are generally short, between half and one page per question (We will usually indicate the maximum length on the assignment. **If not indicated, use a one page limit**). *We strongly encourage you to keep the write-ups to the recommended length*. The length limit does not include any graphs or tables attached to support your main point.

These will be graded 0 through 10 with the following approximate relationship between the numerical value and a suggested letter grade.

9-10:A
8-9:B
7-8:C
6-7:D
<5:F
0: No Assignment Submitted

II. Problem Sets:

General Guidelines for Problem Sets:
Problem sets will be **due** about 1 week after the topic has been covered in lecture. Like the reading assignments, unless otherwise specified, problem sets are to be done individually. As with the reading assignments some problem set assignments will specify that you can work in teams of approximately 3 students (1 to no more than 3). Again I would strongly encourage you to change teams from one week to another. You will learn more this way and, should you encounter a free-rider phenomenon, you will not be stuck with it for more than one week at a time. Problem sets are generally graded 0-100.

The title for the Problem Sets must be as follows: **Problem Set #_last names of authors (be sure to include your entire group).**

You can submit your Problem Sets electronically via the digital drop box in Moodle or in hard copy directly to the TA, whichever works best for the assignment.

If submitting in hard copy:
Make sure to have the title of the assignment **Problem Set # and be sure to include the names of all the participants (be sure to include your entire group).**

The problem sets will be numerically graded (0-100) and posted on Moodle or returned via e-mail or in person. Late submissions are marked down 10 points for each week it is late.

Extra Credit:
At various times during the semester we will give out short problems to be worked out in-class (or some before class) that pertain to that day's lecture. These will be collected in class and you will be given extra credit for making a serious effort to work on these short problems. For most extra credit problems, credit will be given only if you do these in class. The extra credit given will be used to adjust your final grade.

Pop quizzes on the reading material may also be given in class; these will be factored in to the reading assignment grades.

Contribution to Final Grades:
Problem Sets: 65%
Reading Assignments: 35%

Optional: Students can choose to do an extra credit problem set in which you will apply and/or evaluate one or some of the methods, tools, or processes covered in the course. If sufficiently high enough this grade can be substituted for two of the reading summaries or one problem set (this may be subject to change). This Optional work is to be done individually.

When possible and where appropriate guest lecturers will be invited to class.

Readings and Assignments: Please note this is a tentative schedule that is likely to change. Some readings may be substituted by others as the semester progresses.

DATE:	TOPIC:	READINGS AND ASSIGNMENTS
Aug 29	**Lab**	**No Lab**
T Aug 30	**First Lecture**	Review of Syllabus and Class Structure
TOPIC 1: Introduction		
F Sept 2	**Introduction**	Math Tutorial Handout in class: Equations, Graphs and Contours
Reading Assignment 1		**Due Fri Sep 9, RA 1_Preferences**
M Sept 5	**Lab**	**No Lab Labor Day**
T Sep 6	**Introduction**	Math Tutorial Cont....
TOPIC 2: Modes and Preferences for Decision Making		
Reading Assignment 2		**Due Fri Sep 16, RA 2_Cost_Benefit_Analysis**
F Sep 9	**The Model of Choice**	Chapter 3 in: *A Primer for Policy Analysis*, Stokey and Zeckhauser. The Model of Choice.
M Sep 12	**Lab**	**Excel Tutorial**
Problem Set Assignment 1		**Due Tue Sep 20. Model of Choice and Decision Maker Preferences**
T Sep 13	**Decision-Makers Preferences**	Chapter 8 in: *A Primer for Policy Analysis*, Stokey and Zeckhauser. Defining Preferences.
TOPIC 3: Benefit Cost Analysis		
Reading Assignment 3		**Due Fri Sep 23 RA 3_Decision_Analysis**
F Sep 16	**Benefit/Cost Analysis**	Chapters 9 and 10 in: *A Primer for Policy Analysis*, Stokey and Zeckhauser. Ch. 9: Project Evaluation: Benefit-Cost Analysis. Ch. 10 The Valuation of Future Consequences: Discounting. Optional: Chapter 8 in: *Better Environmental Decisions,* Edited by: Sexton, Marcus, Easter, and Burkhardt: "Benefit-Cost Analysis and Its Use in Regulatory Decisions," Easter, Becker, and Archibald. Optional: Chapter 6 in: *Environmental Decision Making: A Multidisciplinary Perspective*, Chechile and Carlisle. "The Economic Model," Peter Rogers.
M Sep 19	**Lab**	Discounting in B/C analysis
T Sep 20	**B/C Analysis**	**(Continued)**
Problem Set Assignment 2		**Due Mon Sep 26: Problem Set #2: Benefit - Cost Analysis**
TOPIC 4: Decision Analysis		
Reading Assignment 4		**Due Tuesday Sept. 27: RA 4_AHP**
F Sep 23	**Decision Analysis (I)**	Chapter 4: Decision Analysis and Utility Theory: in *Business Analytics* (Miori, Klimberg and Ratick) Optional: Chapter 12 in: *A Primer for Policy Analysis*, Stokey and Zeckhauser. Decision Analysis. Optional: "Decision Analysis and Risk Management Decision Making: Issues and Methods," *Risk Analysis*, Vol. 7, NO. 2, 1987.
M Sep 26	**Lab**	**Decision Analysis (Sequential Decision Trees): Using TreePlan**
T Sep 27 **F Sep 30**	**Decision Analysis (II); Utility theory and Multi-**	Chapter 5: (First Part of) Decisions with Multiple Criteria: the Simple Multi-Attribute Rating Technique (SMART) and the Analytical Hierarchy Process (AHP) in *Business Analytics* (Miori, Klimberg and Ratick). Optional: Chapter 4 in: *Environmental Decision Making: A*

	Criteria Analysis (the Simple Multi-Attribute Rating Technique SMART)	*Multidisciplinary Perspective*, Chechile and Carlisle. "Probability, Utility, and Decision Trees in Environmental Decision Analysis," Richard Chechile
Problem Set Assignment 3		**Due Mon Oct 17: Problem Set #3: Decision Analysis**
TOPIC 5: Multi-Criteria Decision Making		
Reading Assignment 5		**Due Fri Oct 7: RA 5_GIS**
M Oct 3	**Lab**	SMART Work through Examples from Chapter 5 (Miori, Klimberg and Ratick)
T Oct 4	**The Analytical Hierarchy Process (AHP)**	Chapter 5: Decisions with Multiple Criteria: the Simple Multi-Attribute Rating Technique (SMART) and the Analytical Hierarchy Process (AHP) in *Business Analytics* (Miori, Klimberg and Ratick). Chapter 15 in: *Decision Analysis for Management Judgment: Second Edition*, Goodwin and Wright, The Analytical Hierarchy Process. Optional: Chapter 2: *Decision Analysis for Management Judgment: Second Edition*, Goodwin and Wright, Decisions Involving Multiple Objectives. Optional: "Evaluating Environmentally Conscious Business Practices," Joseph Sarkis, EJOR, 107 (1998), 159-174.
TOPIC 6: Spatial Decision Methods/Spatial Optimization		
F Oct 7	**Introduction to GIS and Decisions with Spatial Information**	Chapter 6 in: *Tools to Aid Environmental Decision Making*, Dale and English, eds. Integration of Geographic Information, Osleeb and Kahn. Chapter 1 in: *Geographic Information Systems: A Management Perspective,* Ottawa, An Introduction to Geographic Information Systems. Introductory material from Idrisi.
M Oct 10	**No Lab**	**FALL BREAK**
T Oct 11	**No Lecture**	**FALL BREAK**
Problem Set Assignment 4		**Due Mon Oct 24 Problem Set #4: AHP**
TOPIC 7: Normative Decision Methods – Optimization and Environmental Decision Support Systems		
F Oct 14 **T Oct 18**	**Prescriptive Models I: Linear and Integer Programming Optimization Models including Spatial Optimization**	Chapter 9: Linear programming Formulation and Solution, and, Chapter 10: Linear Programming Special Cases and Sensitivity, and, Chapter 11: Integer Programming in ***Business Analytics*** (Miori, Klimberg and Ratick) Optional: Chapter 17 and 19 in: *AIMMS: The Modeling System*, Bisschop and Entriken. Ch. 17: Introduction. Ch. 19: Tutorial: Formulating Optimization Models Optional:Chapter 11 in: *A Primer for Policy Analysis*, Stokey and Zeckhauser. Linear Programming.
M Oct 17	**Lab**	AHP Work Through Examples from Chapter 5 (Miori, Klimberg and Ratick)
F Oct 21	**Prescriptive Models I**	**(Continued)**
Problem Set Assignment 5		**Due Tues Nov 15 Problem Set #5: Mathematical Programming**
M OCT 24	**Lab**	Prescriptive Models, Cont.

T Oct 25 **F Oct 28**	**Prescriptive Models II: Multiobjective Models**	A Risk Sharing Model for Locating Noxious Facilities, Ratick and White, *Environment and Planning B*, 15, 165-179. Idrisi's Multiobjective Land Allocation Module (MOLA). Perhaps Guest Lecture by Dr. Kangping Si
M Oct 31	**Lab**	Using Solver in Excel
T Nov 1	**Prescriptive Models II**	**(Continued)**
F Nov 4	**Decision Support Systems**	Applying Industrial Ecology to Industrial Parks: An Economic and Environmental Analysis, Martin, Cushman, Weitz, Sharma, Lindrooth, *Economic Development Quarterly*, August 1998. Designing Eco-Industrial Parks: the North American Experience, *U.S. Sites and Development*, February 1998. *Applying Decision Support Tools for Eco-Industrial Park Planning: A Case Study in Burlington, Vermont*, Industrial Economics Inc.
Reading Assignment 6		**Due Tuesday November 15: RA6_Vulnerability Indicators**
M Nov 7	**Lab**	Using Solver in Excel (Continued)
T Nov 8	**Annual Guest Lecture**	**Dr. Chi-ho Sham (Vice President and Chief Scientist Eastern Research Group): *The Safe-Water Suite for Drinking Water Standards Development*** **Readings to be assigned**
M Nov 14	**Lab**	Using Solver in Excel (Continued)
Topic 8: Game Theory		
F Nov 11	**Game Theory**	Readings to be assigned.
Topic 9: Measuring and Mapping Vulnerability to Climate Change: Creating Composite Indicators		
T Nov 15 **F Nov 18**	**Vulnerability: Creating Composite Indicators**	Ratick, S. and Osleeb J., (2011) "Measuring the vulnerability of populations susceptible to lead contamination in the Dominican Republic: evaluating composite index construction methods". *Geojournal*, May 2011. Blue, J., Maxted J., et al., (2014) "Components of an Indicator-Based Climate Change Vulnerability Assessment", Cadmus Corporation (*Marsh Research Paper Series*). Runfola, D., Ratick, S., et al., (2014) "A Multi-Criteria GIS Approach to Composite Vulnerability Index Construction for Flood Vulnerability in the Contiguous United States", in press, *Mitigation and Adaptation Strategies for Global Change*
M Nov 21	**Lab**	Discussion
T Nov 22	**Vulnerability**	**(Continued)**
F Nov 25	**No Class**	**No Class Thanksgiving**
TOPIC 10: Managing Uncertainty in Environmental Decision-making		
M Nov 28	**Lab**	Standardizing and Aggregating Component Indicators into a Composite
T Nov 29 **F Dec 2**	**Monte Carlo Simulation**	Ratick S., and Schwarz G., (2009) "Monte Carlo Simulation", *International Encyclopedia of Human Geography*, Elsevier.
M Dec 5	**Lab**	Monte Carlo Simulation

Topic 11: Adaptive Environmental Management		
T Dec 6,9	**Adaptive Environmental Management**	"An Introductory Guide to Adaptive Management;" Ch.4. "How Can We Best Deal with the Unexpected?" Rob Goble, Roger Kasperson, Sam Ratick, in ***Risk Conundrums***, Forthcoming. Optional "Adaptive Environmental Assessment and Management," C. S. Holling; "Applying Adaptive Management Principles to the Cape Wind Development Controversy," Ashcraft. "Compass and Gyroscope." Kai Lee, Chps. 2 and 3
M Dec 12	**Lab**	Discussion if needed

Readings on additional topics available on Moodle

Introductory Material:

Chapters 1 through 4 in: *Better Environmental Decisions,* Edited by: Sexton, Marcus, Easter, and Burkhardt.

Introduction: "Integrating Government, Business, and Community Perspectives," Sexton, et al.

Chapter 1: "Making Decisions About Environmental Policy," Michael E. Kraft.

Chapter 2: "Understanding Individuals' Environmental Decisions: A Decision Sciences Approach," Paul R. Kleindorfer.

Chapter 3: Environmental Decision Making by Organizations: Choosing the Right Tools," Mary R. English.

Chapter 4: Business Decision Making About Environment: The Challenge of Sustainability," Stuart L. Hart.

Environmental Ethics:

"Environmental Ethics and Human Values," Douglas MacLean, in Handbook for Environmental Risk Decision Making: Values, Perception, and Ethics, Cothern, ed. 1996.

"Ethical Aspects of Environmental Decision Making," Bedau, in *Environmental Decision Making: A Multidisciplinary Perspective*, Chechile and Carlisle.

Multi-Criteria Mapping

Stirling, A. (2010) "Keep it Complex". *Nature*, 468: 1029-1031.

Stirling A, Mayer S. (2001) A novel approach to the appraisal of technological risk. *Environ Plan C*, 19: 529–555.

Fiorino, D, (1990) "Citizen Participation and Environmental Risk: A Survey of Institutional Mechanisms," *Science, Technology, and Human Values*, 1990.

Optional: Stirling A. (2006) *Analysis, Participation and Power: justification and closure in participatory multi-criteria appraisal*. Land Use Policy; 23: 95–107.

		Our decision methods tell us it is time to leave…. Have a good winter break

List of Assignments by Due Dates

ASSIGNMENT	DUE DATE	INDIVIDUAL WORK ALLOWED	GROUP WORK (UP TO 3) ALLOWED OR NOT
Reading Assignment #1	Fri Sept 9	Yes	No
Reading Assignment #2	Fri Sept 16	Yes	No
Problem Set #1	*Tue Sept 20*	*Yes*	*Yes*
Reading Assignment #3	Fri Sept 23	Yes	Yes
Problem Set #2	*Mon Sept 26*	*Yes*	*No*
Reading Assignment #4	Tue Sept 27	Yes	No
Reading Assignment #5	Mon Oct 7	Yes	Yes
Problem Set #3	*Mon Oct 17*	*Yes*	*Yes*
Problem Set #4	*Mon Oct 24*	*Yes*	*No*
Reading Assignment #6	Tues Nov 15	Yes	Yes
Problem Set #5	*Tues Nov 15*	*Yes*	*No*

Estimated Work Required Per Week:

ACTIVITY	TIME	TOTAL
Class Lectures	2 X 75 Min	150 Minutes (2.50 Hours)
Labs/Discussion	1 X 75 Min	75 Minutes (1.25 Hours)
Reading Assignments	1 X 255 Min	255 Minutes (4.25 Hours)
Problem Sets	1 X 300 Min	300 Minutes (5.00 Hours)
	Totals	780 Minutes (13 Hours)

Important Semester Dates: Sept. 5 Labor Day no classes; October 10-11 Fall Break – No Classes; November 4 last day for undergraduates to withdraw from class with a W; Nov. 23 – 25 Thanksgiving Recess no classes; Dec. 12 last day for graduate students to withdraw from class with a W; Dec. 12 last day of classes.

Students with Disabilities

If you require accommodations in this course due to a disability, you must be registered with the Student Accessibility Services office. For information, please contact Adam Kosakowski, Director of Student Accessibility Services, at 508-798-4368 or at AKosakowski@clarku.edu.