City and Regional Planning (CRP) 621

QUANTITATIVE TECHNIQUES
for
POLICY ANALYSIS AND PROGRAM MANAGEMENT

Spring 2006

4 credit hours

Lectures:	Mondays and Wednesdays: 10:10 am to 12:00 noon in G01 Stimson Hall.
Labs:	Fridays: 10:10 am to 12:00 noon 222 Sibley (GEDDES)
	Fridays: 2:30 am to 4:30 in 222 Sibley (GEDDES)—alternative session

Course Website: http://blackboard.cornell.edu then CRP621: Quantitative Techniques for Policy Analysis and Program Management

Professor: David Lewis
203 W. Sibley and 292 Caldwell Hall
Phone: (607) 255-0177
E-mail: DBL2@cornell.edu
Office Hours: Tuesdays 10:00 - 12:00 at CIPA, and Wednesdays at CRP 3:00 – 5:00

T.A: Nanji Jung
E-mail: NJ33@cornell.edu

Grader: Carrie George
E-mail: CMG65@cornell.edu

Quantitative Techniques for Policy Analysis and Program Management encourages students to approach policy problems with analytical techniques and practical tools appropriate to professional work. It is an advanced quantitative course in City and Regional Planning, but also serves students from the Cornell Institute for Public Affairs (CIPA), Industrial and Labor Relations, Policy Analysis and Management, International Development, International Agriculture, and Engineering. The course has been adopted by CIPA as a core requirement for the MPA degree.

Description

The course is designed for students who expect to be analysts placed in the position of having to make decisions in both policy and program management. It draws concepts from system analysis, management science, operations research, and economics to provide students with an efficient coverage of selected policy analysis and program management techniques that are useful across a wide range of applications. The emphasis is on understanding the structure of problems so that basic analytical techniques can be appropriately applied.

The course addresses simulation modeling, cost-benefit analysis, and optimization. The strengths and weaknesses of each technique, and the appropriate conditions for application, are reviewed. Appropriate software such as Vensim® and Excel® (with its "add-ins") are used. Students are encouraged to explore innovative extensions of these tools to non-classical, public policy situations of special interest, for example, environmental resource management, social service delivery systems, or economic development planning. Simulation modeling will focus on understating system components, how they interact with each other, and the result of such interactions. The section on cost-benefit analysis will discuss topics related to probabilistic outcomes, cost-effectiveness, the use of cost-benefit ratios and the internal rate of return, choice among multiple alternatives, and the appropriateness of each approach. The section on optimization will deal primarily with linear programming, with additional applications related to integer programming, network analysis, critical path method (CPM) and program evaluation and review technique (PERT).

Required Texts

Forrester, J., et al, (various years), *Road Maps: A Guide to Learning System Dynamics*, http://sysdyn.clexchange.org/, MIT, Boston.
Navigate to the Road Maps page and download the sections cited in the syllabus.

Boardman, Anthony E., Greenberg, David H., Vining, Aidan R. and Weimer, David L., (2001) 2nd ed., *Cost-Benefit Analysis: Concepts and Practice*, Prentice Hall.

Ragsdale, Cliff T., (2004) 4th ed., *Spreadsheet Modeling and Decision Analysis: A Practical Introduction to Management Science*, Thomson South-Western College Publishing.

Recommended Texts

Sterman, John D., (2000), *Business Dynamics: Systems Thinking and Modeling for a Complex World*, Irwin McGraw-Hill.

Grant, Eugene L., Ireson, Grant and Leavenworth, Richard, (1990) 8th ed., *Principles of Engineering Economy*, John Wiley and Sons

Recommended and Supplementary Readings

The syllabus indicates recommended reading where appropriate with the full citation. For those readings without citations, these are: (Note: Most of the papers listed below are available on-line in the course web-site)

General Readings:

For those who need a quick introduction to Excel, consult Cornell Information Technology's webpage at http://www.cit.cornell.edu/training/cbt/ and follow the instructions.

Stokey, E. and Zeckhauser, R., (1978) A Primer for Policy Analysis, Norton, New York. A book of cross-cutting methods used in policy analysis.

Simulation Modeling:

Forrester, J., (1969) Principles of Systems, MIT, Boston.

Demonstration software for systems modeling:
http://www.hps-inc.com/.
Follow the links to Stella and to the demonstration program.

Ackere, Ann van and Larsen, Erik R., (2004) Self-organising behaviour in the presence of negative externalities: A conceptual model of commuter choice, European Journal of Operations Research, 157, pp. 501 – 513.

Boin, Arjen; Kofman-Bos, Celesta and Overdijk, Werner, (2004) Crisis simulations: Exploring tomorrow's vulnerabilities and threats, Simulation and Gaming, Vol. 35, No. 3, pp. 378 – 393.

FEMA-Based Modeling Program Helps Assess Threats Accurately, (2004), Public Management, June 2004.

Smith, Denis, (2004) For whom the bell tolls: Imagining accidents and the development of crisis simulation in organizations, Simulation and Gaming, Vol. 35, No. 3, pp. 347 – 362.

Bendoly, Elliot, (2004) Integrated inventory pooling for firms servicing both on-line and store demand, Computers & Operations Research, 31, pp. 1465 – 1480.

Jenvald, Johan and Morin, Magnus, (2004) Simulation-supported live training for emergency response in hazardous environments, Simulation and Gaming, Vol. 35, No. 3, p.p. 363 – 377.

Eirk, James K., (2004) The making of a gaming-simulation course: A personal tale, Simulation and Gaming, Vol. 35, No. 1, pp. 85 – 93.

Gaw, Kevin, (2002) Communication Hurdles Simulation, Simulation and Gaming, Vol. 33, No. 1, pp. 109 – 113.

Johanson, Maria and Kuller Rikard, (2002) Traffic Jam: Psychological Assessment of a Gaming Simulation, Simulation and Gaming, Vol. 33, No. 1, pp. 67 – 88.

Cecchini, Arnaldo, (2001) Is Urban Gaming Simulation Useful?, Simulation and Gaming, Vol. 32, No. 4, pp. 507 – 521.

Meadows, Dennis L., (2001) Tools for understanding the limits to growth: Comparing a simulation and a game, Simulation and Gaming, Vol. 32, No. 4, pp. 522 – 536.

Sweeney, Linda Booth and Meadows, Dennis, (2000) Paper Fold: An Exercise in Exponential Growth, Pegasus Communications, The System Thinker, Vol. 11, No. 3, pp. 5 – 6.

Benefit – Cost Analysis:

Munger, M. (2000) Analyzing Policy: Choices, Conflicts, and Practices, Norton, New York.
Useful Chapters on Benefit-Cost Analysis.

Gramlich, Edward M., (1990) A Guide to Benefit-Cost Analysis, Prentice Hall, New York.
A book on cost-benefit analysis from the perspective of economics. This book is available in the Cornell Library and you can obtain it from several libraries in campus.

Lind, R. C., and Schuler, R. E., (1998) Equity and Discounting in Climate-change Decisions, in Economics and policy issues in climate change, William Nordhaus, ed., Resources for the Future, Washington, DC.
A thought provoking paper that deals with issues related to choosing discount rates over a long-time period in the context of environmental changes.

For a discussion on the benefit-cost analysis of incarceration:
http://www.fcc.state.fl.us/fcc/reports/crime/crben.html

Giacomello, Giampiero, (2004) Bangs for the Buck: A Cost-Benefit Analysis of Cyberterrorism, Studies in Conflict and Terrorism, 27, pp. 387 – 408.

Schweitzer, Lisa and Valenzuela Jr., Abel, (2004) Environmental Injustice and Transportation: The Claims and the Evidence, Journal of Planning Literature, Vol. 18, No. 4, pp. 383 – 398.

Atkinson, Scott E. and Morton, Brian J., (2004) Determining the cost-effective size of an emission trading region for achieving an ambient standard, Resource and Energy Economics, 26, pp. 295 – 315.

Machiwal, Deepesh; Jha, Madan K.; Singh, P.K.; Mahnot, S.C. and Gupta, A., (2004) Planning and Design of Cost-effective Water Harvesting Structures for Efficient Utilization of Scarce Water Resources in Semi-arid Regions of Rajasthan, India, Water Resource Management, 18, pp. 219 – 235.

Goodman, John C. and Porter, Philip K., (2004) Political Equilibrium and the Provision of Public Goods, Public Choice, 120, pp. 247 – 266.

Abramowicz, Michael, (2004) Information Markets, Administrative Decisionmaking, and Predictive Cost-Benefit Analysis, The University of Chicago Law Review, Vol. 71, No. 3, pp. 933 – 1020.

Homer, Jack; Hirsch, Gary; Minniti, Mary and Pierson, Marc, (2004) Models for Collaboration: How System Dynamics Helped a Community Organize Cost-Effective Care for Chronic Illness, System Dynamics Review, Vol. 20, No. 3, pp. 199 – 222.

Garcia, Serge and Reynaud, Arnaud, (2004) Estimating the benefits of efficient water pricing in France, Resource and Energy Economics, 26, pp. 1 – 25.

Lambert, James H.; Baker, Jeffrey A. and Peterson, Kenneth D., (2003) Decision aid for allocation of transportation funds to guardrails, Accident Analysis and Prevention, 35, pp. 47 – 57.

Public Technology Inc., (2003) National GIS Survey Results: 2003 Survey on the Use of GIS Technology in Local Governments.

Ziller, Alison and Phibbs, Peter, (2003) Integrating Social Impacts into Cost-Benefit Analysis: A Participative Method: Case Study: The NSW Area Assistance Scheme, Impact Assessment and Project Appraisal, Vol. 21, No. 2, pp. 141 – 146.

De Jong, Martin and Geerlings, Harry, (2003) Exposing Weaknesses in Interactive Planning: the Remarkable Return of Comprehensive Policy Analysis in The Netherlands, Impact Assessment and Project Appraisal, Vol. 21, No. 4, pp. 281 -291.

Kurre, James A., (2003) Is the Cost of Living is Less in Rural Areas?, International Regional Science Review, Vol. 26, No. 1, pp. 86 – 116.

Lu, Jie and Zhang, Guangquan, (2003) Cost Benefit Factor Analysis in e-services, International Journal of Service Industry Management, Vol. 14, No. 5, pp. 570 – 595.

Winkler, Harald; Spalding-fecher, Randall; Tyani, Lwazikazi and Matibe, Khorommbi, (2002) Cost–benefit Analysis of Energy Efficiency in Urban Low-cost Housing, Development Southern Africa, Vol. 19, No. 5, pp. 593 – 614.

Optimization:

Reveliotis, S., (undated) An Introduction to Linear Programming and the Simplex Algorithm:
http://www.isye.gatech.edu/~spyros/LP/LP.html.
A virtual text on the web that is a good complement to Ragsdale for linear programming.

Osei-Bryson, Kweku-Muata, (2004) Evaluation of Decision Trees: A Multi-Criteria Approach, Computers & Operations Research, 31, 1933 – 1945.

Agrell, Per J.; Stam, Antonie and Fischer, Gunther W., (2004) Interactive Multiobjective Agro-Ecological Land Use Planning: The Bungoma Region in Kenya, European Journal of Operational Research, 158, pp. 194 – 217.

Geunes, Joseph and Zeng, Amy Z., (2003) Optimizing Supply Shortage Decisions in Base Stock Distribution Operations, Journal of Global Optimization, 26, pp. 25 – 42.

Polavieja, Javier C., (2003) Optimizing Supply Shortage Decisions in Base Stock Distribution Operations, European Sociological Review, Vol. 19, No. 5, pp. 501 – 517.

Chambal, Stephen; Shoviak, Mark and Thal, Alfred E., (2003) Decision Analysis Methodology to Evaluate Integrated Solid Waste Management Alternatives, Environmental Modeling and Assessment, 8, pp. 24 – 34.

Pastor, Rosario; Benqlilou, Chouaib; Paz, Dora; Cardenas, Geronimo; Espuna, Antonio; and Puigjaner, Luis, (2003) Design Optimisation of Constructed Wetlands for Wastewater Treatment, Resources, Conservation and Recycling, 37, pp. 193 – 204.

Kunreuther, Howard; Meyer, Robert; Zeckhauser, Richard; Slovic, Paul; Schwartz, Barry; Schade, Christian; Luce, Mary Frances; Lippman, Steven; Krantz, David; Kahn, Barbara and Hogarth, Robin, (2002) High Stakes Decision Making: Normative, Descriptive and Prescriptive Considerations, Marketing Letters, Vol. 13, No. 3, pp. 259 – 268.

Gomes, Eliane Goncalves and Estellittalins, Marcos Pereira, (2002) Integrating Geographical Information Systems and Multi-Criteria Methods: A Case Study, Annals of Operations Research, 116, pp. 243 – 269.

Shenoy, Prakash P., (1998) Game Trees for Decision Analysis, Theory and Decision, 44, 149 – 171.

Web Page

Access to the course web page requires that you set up an account with the Blackboard web site. This site can be found at http://blackboard.cornell.edu. For those of you who already have accounts for other courses, you can use the same "username" and password to access the site for this class: CRP621: Quantitative Techniques for Policy Analysis and Program Management. *It will be your responsibility to check the course website frequently for announcements or to download homework assignments*.

Requirements

The course requirements are designed with two objectives in mind. First, they give students an opportunity to demonstrate competence and understanding of what is taught in class. Second, they position students in professional situations – working with colleagues to address non-classical problems. A straightforward application of techniques will not be sufficient. Students are required to "think outside of the box," to be innovative, and importantly, to work with peers in time-constrained situations. With the above in mind, the course requirements are as follows.

Assignment	Points
Group Technical Memorandum (Simulation)	15
Group Proposal (Benefit/Cost Analysis)	5
Group Project (Benefit/Cost Analysis)	20
Individual Proposal (Optimization)	5
Critique (of another student's individual proposal)	5
Individual Project (Optimization)	35
Homework	5
Class participation	10

There will be no exams.

Class and Syllabus Schedule

Date	Topic	Required Reading	Recommended Reading
INTRODUCTION			
Mon -- Jan 23	Course Introduction	Ragsdale Ch 1	Stokey and Zeckhauser, Ch 1-3
SIMULATION MODELING			
Wed – Jan 25	Definitions and Basic Concepts	Road Maps 1,	Sterman Ch 1-4, Forrester Ch 1-2, and Stokey and Zeckhauser Ch 6
Fri – Jan 27	*Lab: Basic Simulation*		
Mon – Jan 30	Illustrative Models	Road Maps 2	Sterman Ch 5-8 Forrester Ch 3-4 Macgill, S. M. (1986) Research Policy and Review: Evaluating a Heritage of Modeling Styles, *Environment and Planning A*, **18**, 1423-46.
Tues – Jan 31	*Homework 1 due*		
Wed – Feb 1	Population Models	Road Maps 3	Sterman Ch 5-8 Forrester Ch 5-7, 9 Rogers, A. (1966) Matrix Methods of Population Analysis, *Journal of the American Institute of Planners*, **XXXII**, 1.
Fri – Feb 3	*Lab: Spreadsheet Applications*		
Mon Feb 6	Housing Market Models	Road Maps 4	Sterman Ch 9-10 Edmonson, Sara E. Evaluation Design for Southern Tier Information and Referral, unpublished thesis, Cornell University.
Tues – Feb 7	*Homework 2 due*		
Wed – Feb 8	Social Service Delivery Systems Models	Road Maps 4	Sterman Ch 9-10 Simulation software: http://www.hps-inc.com/
Fri – Feb 10	*Lab: Vensim Applications*		
Mon – Feb 13	National Development Models	Road Maps 5	Sterman Ch 9-10 Meadows, D. L. (1974) Limits to Growth? *Development Digest*, October, 1-32.
Tues – Feb 14	*Homework 3 due*		
Wed – Feb 15	Systems Growth Models	Road Maps 5	Sterman Ch 9-10 Haq, M. (1974) Reports on Limits to Growth *Development Digest*, October 33-42.

Date	Topic	Required Reading	Recommended Reading
Fri – Feb 17	*Lab: Technical Memorandum Consultancy*		

BENEFIT – COST ANALYSIS

Date	Topic	Required Reading	Recommended Reading
Mon – Feb 20	Basic Principles	Boardman et al Ch 1-2	Grant et al Ch 1-3 Williams, A. (1972) Cost-Benefit Analysis: Bastard Science? And/or Insidious Poison in the Body Politick? *Journal of Public Economics*, **1**, 199-225.
Tues –Feb 21	*Group Technical Memorandum due*		
Wed – Feb 22	Interest Formulas	Boardman et al Ch 6, Appendix 6A, and Appendix 6B	Grant et al Ch 1-3 Munger Ch 11
Fri – Feb 24	*Lab: Review of Concepts*		
Mon – Feb 27	Equivalent Uniform Annual Cash Flow	Boardman et al Ch 6, Appendix 6A, and Appendix 6B	Grant et al Ch 4
Tues – Feb 28	*Homework 4 due*		
Wed – Mar 1	Present Worth	Boardman et al Ch 6, Appendix 6A, and Appendix 6B	Grant et al Ch 5 Weiss, J., (1980) Practical Appraisal of Industrial Projects (Pakistan) UNIDO. Munger Ch 10
Fri – Mar 3	*Lab: Investment Analysis*		
Mon – Mar 6	Internal Rate of Return, Benefit/ Cost Analysis	Boardman et al Ch 6, Appendix 6A, and Appendix 6B	Grant et al Ch 6-7 Lewis, D., (1969) An Analysis of the Rate of Return on Investment in Business Education in East Pakistan, unpublished report to the Ford Foundation (p.c.). Gramlich Ch. 3 Munger Ch 10
Tues – Mar 7	*Homework 5 due*		
Wed – Mar 8	Analysis of Multiple Alternatives	Boardman et al Ch 6, Appendix 6A, and Appendix 6B	Grant et al Ch 11 Gramlich Ch. 8
Fri – Mar 10	*Lab: Proposal Consultancy*		

Date	Topic	Required Reading	Recommended Reading
Mon – Mar 13	Analysis of Multi. Alt. (cont.)	Boardman et al Ch 6, Appendix 6A, and Appendix 6B	Grant et al Ch 12 Mao, J. C., (1966) Efficiency in Public Urban Renewal Expenditures Through Benefit-Cost Analysis, *AIP Journal*, no. 3, 95-107.
Tues – Mar 14	*Group Proposal A due*		
Wed – Mar 15	Probability	Boardman et al Ch 7	Grant et al Ch 13 Munger, Ch 9
Fri – Mar 17	*Lab: Analysis of Multiple Alternatives*		

**** Spring Break, March 20 to 24 ****

Date	Topic	Required Reading	Recommended Reading
Mon – Mar 27	Application Examples (Health and Education)		Grant et al Ch 13 Bin Ran, *et al*., (1998) Cost-Benefit Analysis on Deployment of Automated Highway Systems, *Transportation Res. Record*, 1588.
Tues – Mar 28	*Homework 6 due*		
Wed – Mar 29	Sensitivity Analysis and Inflation	Boardman et al Ch 7	Grant et al Ch 14 Gramlich Ch. 9-10
Fri – Mar 31	*Lab: Project Consultancy*		

OPTIMIZATION TECHNIQUES

Date	Topic	Required Reading	Recommended Reading
Mon – Apr 3	Linear Models	Ragsdale Ch 2 Sec 2.1-2.9	Reveliotis Ch 1: http://www.isye.gatech.edu/~spyros/LP/LP.html
Tues – Apr 4	*Group Project (Benefit/Cost) Analysis due*		
Wed – Apr 5	Algebraic and Geometric Representation	Ragsdale Ch 2 Sec 2.10-2.12	Reveliotis Ch 2 – 3: http://www.isye.gatech.edu/~spyros/LP/LP.html
Fri – Apr 7	*Lab: Geometric Representation*		

Date	Topic	Required Reading	Recommended Reading
	and Simplex Algorithm		
Mon – Apr 10	Simplex Solution Method	Ragsdale Ch 4 Sec 4.8	Reveliotis Ch 3 – 5: http://www.isye.gatech.edu/~spyros/LP/LP.html
Tues – Apr 11	*Homework 7 due*		
Wed – Apr 12	Simplex (cont.)	Ragsdale Ch 4 Sec 4.8	Reveliotis Ch 3 – 5: http://www.isye.gatech.edu/~spyros/LP/LP.html
Fri – Apr 14	*Lab: Computer Software for Linear Programming*		
Mon – Apr 17	Computer Utilization	Ragsdale Ch 3	
Tues – Apr 18	*Homework 8 due*		
Wed – Apr 19	Sensitivity Analysis	Ragsdale Ch 4 Sec 4.0-4.7	Ochitwa, J., (1984) Applicability and Efficiency in a Land Use Plan Design, *Urban Studies*, **21**, 149-154.
Fri – Apr 21	*Lab: Proposal Consultancy*		
Mon – Apr 24	Sensitivity Analysis (cont.)	Ragsdale Ch 4 Sec 4.0-4.7	Ridgley, M., (1984) Water and Urban Land Use Planning in the Developing World, *Environment and Planning* B, **11**, 229-242.
Tues – Apr 25	*Individual Proposal B due*		
Wed – Apr 26	Application Example (Industrial Development)		Lewis, D., (1969) A Decision Model for Allocating Foreign Exchange Among Industrial Sectors in East Pakistan, unpublished report to East Pakistan Small Industries Corporation (p.c.).
Fri – Apr 28	*Lab: Spreadsheet Analysis*		
Mon May 1	Project Management (CPM/PERT)	Ragsdale Ch 14	
Tues – May 2	*Critique due*		
Wed – May 3	Advanced Topics	Ragsdale Ch 5	Stokey and Zeckhauser Ch 4
Fri – May 5	*Lab: Project*		

Date	Topic	Required Reading	Recommended Reading
	Consultancy		
Mon – May 8	*Project 3 due*		