

C&RP 721: SEMINAR ON MATHEMATICAL MODELS OF ENERGY MANAGEMENT
AND PLANNING

Credit: 3 hours
Call No.: 04182-9
Place: 274 Brown Hall
Time: Tuesday 9:30-11:30 a.m.
Instructor: J.M. Guldmann
281 Brown Hall
Tel.: 292-2257
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INTRODUCTION

This course is designed for students interested in the use of quantitative methods and in the formulation and application of mathematical models in the areas of energy forecasting, management, planning and policy, dealing with supply, demand, and their equilibrium. The focus will be set on the formulation of these models and their potential usefulness in the decision-making process. Models in the following areas will be presented and critically assessed: (1) coal, (2) electric utilities, (3) gas utilities, (5) energy distribution, and (6) energy/environment interactions. Students will learn how to program simple models with GAMS.

COURSE METHOD

Different models in the above-mentioned areas, drawn from the literature and the instructor's own research, will be presented through lectures, and their strengths, weaknesses, and potential for improvements will be critically assessed. These lectures should be complemented by independent readings. Both lectures and reading materials make-up the reference list presented further on. When deemed necessary, the principles and technical aspects of the modeling method will be reviewed.

Each student will be required to write a paper. This paper may consist in (1) a critical review of existing models applied to some specific energy area, with suggestions for improvements and extensions of such models, or (2) the original formulation of a modeling approach for an energy problem for which no such approach is available. In addition, computer homeworks will be provided, that illustrate the concepts and issues presented in class, and that use the software GAMS. Students will be introduced to the use of this software.

All students are held responsible for knowing and abiding by the Department's policies on plagiarism and the University policies on academic misconduct. These policies have been distributed to all C&RP students. If you have not received a copy, please see the Department secretary.

EVALUATION

The final grade for the course will be determined as follows:

Paper	40%
Computer homeworks	40%
Class participation	20%

OFFICE HOURS

An appointment can be made to meet with the course instructor by contacting the instructor, Jean-Michel Guldmann: 292-2257.

COURSE OUTLINE

1. Math refresher (1 week).
2. Coal production, transportation, and usage planning (1 week): Minimum-cost coal mining under air quality standards and land reclamation constraints.
3. Electric utility planning (2 weeks): Optimal expansion of an electricity generation and transmission system and marginal costs estimation for peak-load pricing.
4. Introduction to GAMS (1 week).
5. Gas utility planning, pricing and management (1 weeks): Gas marginal cost pricing; cost reallocation policies; expansion of natural gas delivery infrastructure in New England.
6. Energy distribution cost modeling (1 week): Application of econometric techniques to the estimation of cost functions for gas and electricity distribution networks; analyses of economies of scale and price discrimination.
7. Energy/environment interactions modeling (3 weeks): Modeling the interactions between energy, air pollution, water pollution, and land use.

REFERENCES

NOTE: All the following articles are in journals available in the OSU library system. Their exact locations are indicated further on.

1. Coal Production, Transportation, and Usage Planning

W.J. Krivant, C.E. Moody, Jr., and P.L. Valentine, 1982, "Sources of Productivity Decline in U.S. Coal Mining, 1972-1977," The Energy Journal 3, 3: 53-70.

Alan Schlottmann, 1976, "A Regional Analysis of Air Quality Standards, Coal Conversion, and the Steam-Electric Coal Market," Journal of Regional Science, Vol. 16, No. 3, pp. 375-87.

Alan Schlottmann and Robert L. Spore, 1976, "Economic Impacts of Surface Mine Reclamation," Land Economics, Vol. 52, No. 3, pp. 266-77.

J.F. Shapiro, and D.E. White, 1982, "A Hybrid Decomposition Method for Integrating Coal Supply and Demand Models," Operations Research 30, 5:887-906.

C.W. Yang, 1990, "An Evaluation of the Maxwell-Boltzmann Entropy Model of the Appalachian Steam Coal market," Review of Regional Studies 20, 1: 21-29.

Martin B. Zimmerman, 1981, The U.S. Coal Industry: The Economics of Policy Choice, The MIT Press, Cambridge, Ma.

_____, 1977, "Modeling Depletion in a Mineral Industry: The Case of Coal," The Bell Journal of Economics, Vol. 8, No. 1, pp. 41-65.

2. Electric Utility Planning, Pricing and Management

Charles R. Scherer, 1976, "Estimating Peak and Off-peak Marginal Costs for an Electric Power System: An Ex Ante Approach," The Bell Journal of Economics, Vol. 7, No. 2, pp. 575-601.

Noel D. Uri, 1975, "A Spatial Equilibrium Model for Electrical Energy," Journal of Regional Science, Vol. 15, No. 3, pp. 323-333.

3. Gas Utility Planning, Pricing, and Management

Jean-Michel Guldman, 1986, "A Marginal Cost Pricing Model for Gas Distribution Utilities," Operations Research, Vol. 34, No. 6, pp. 851-63.

_____, 1987, "Cost Reallocation as a State Regulatory Policy Option in Natural Gas

Distribution Pricing," Energy Systems and Policy, Vol. 10, No. 4, pp. 373-404.

Jean-Michel Guldmann and Donald A. Hanson, 1991, "Natural Gas Market Expansion and Delivery Infrastructure Costs: The Case of New England," Resources and Energy 13: 57-94.

5. Energy Distribution Cost Modeling

Jean-Michel Guldmann, 1989, "Capacity Cost Allocation in the Provision of Urban Public Services: The Case of Gas Distribution," Growth and Change, Vol. 20, No. 2, pp. 1-18.

_____, 1988, "Land Use, Market Mix, and the Allocation of the Investment Costs of Electricity Distribution Networks," Socio-Economic Planning Sciences, Vol. 22, No. 5, pp. 201-212.

_____, 1985, "Economies of Scale and Natural Monopoly in Urban Utilities: The Case of Gas Distribution," Geographical Analysis, Vol. 17, No. 4, pp. 302-317.

_____, 1983, "Modeling the Structure of Gas Distribution Costs in Urban Areas," Regional Science and Urban Economics, Vol. 13, No. 3, pp. 299-316.

7. Energy/Environment

John A., Dracup and Thomas J. Fogarty, 1974, "Optimal Planning for a Thermal Discharge Treatment System," Water Resources Research, Vol. 10, No. 1, pp. 67-71.

Jean-Michel Guldmann, 1988, "A Chance-Constrained Dynamic Model of Air Quality Management," Journal of Environmental Engineering, Vol. 114, No. 5, pp. 1116-35.

_____, 1986, "Interactions Between Weather Stochasticity and the Location of Pollution Sources and Receptors in Air Quality Planning: A Chance-Constrained Approach," Geographical Analysis, Vol. 18, No. 3, pp. 198-214.

William D. Nordhaus, 1977, "Economic Growth and Climate: The Carbon Dioxide Problem," American Economic Review, Vol. 67, No. 1, pp. 341-46.

Alan Schlottman, 1977, "New Life for Old Garbage - Resource and Energy Recovery from Solid Wastes," Journal of Environmental Economics and Management, Vol. 4, pp. 57-67.

Daniel Shefer and Jean-Michel Guldmann, 1973, "Mathematical Models of Industrial Plant Location and Pollution Abatement Strategies," Environment and Planning, Vol. 5,

pp. 577-88.

JOURNALS' LOCATIONS

Science and Engineering Library

Energy

Energy Systems and Policy

Journal of Environmental Economics and Management

Journal of Environmental Engineering (ASCE)

Journal of Water Resources Planning and Management (ASCE)

Water Resources Research

Socio-Economic Planning Sciences

Journal of Regional Science

Management Science

Operations Research

Commerce Library

The Bell Journal of Economics
The American Economic Review
Land Economics
Regional Science and Urban Economics
Environment and Planning A
Resources and Energy
The Energy Journal

Main Library

Geographical Analysis

Agriculture Library

Growth and Change