

Decision Science in Public Affairs

PUBL6415

Spring 2020

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Class Room: M 102

Monday: 5:30-8:30PM

Version 1.1 (Subject to change)

There are two schools of thought on decision making: the study of descriptive models and the study of prescriptive models. The former studies how decisions are actually made. The latter is dealing with developing methods for making optimal decisions. We start with reviewing the literature on the descriptive models to understand how we tend to make our decisions. Especially, what are the causes that our managerial decisions or judgments invite undesirable consequences?

As a solution to improve decision making, we study some of the prescriptive models, i.e., decision tools. In recent years, more and more managers in both public and private sectors utilize mathematical models to solve their decision-making problems. Of course, there are pros and cons on relying on management science. However, it is widely recognized that the logical approach to problem-solving is valuable for all types of professions in various organizations to improve business and policy decisions. In this course, students will explore the various quantitative decision tools. Each of the modeling techniques is learned through simple examples. It might be, however, hard to perceive the usefulness of abstract quantitative approaches to actual applications. Therefore, I provide numerous readings of case studies to learn the scientific approach to improve managerial decisions and judgments.

Textbook:

Kahneman, Daniel. 2011. Thinking, fast and slow. New York: Farrar, Straus, and Giroux.

Powell, Stephen G., and Kenneth R. Baker. 2018. Business Analytics: The Art of Modeling with Spreadsheets, 5th edition. New York: Wiley.

Software: Excel add-in “Analytic Solver Platform”

Grade

| | |
|-------------------------|-----|
| Online Quiz&Assignments | 40% |
| Midterm Exam: | 30% |
| Final Exam: | 30% |

EXAMS

The First Exam: Tentatively scheduled for **March 1st**. This could be either in class or/and a take-home exam. The format will be announced in class.

The Final Exam: Provide a take-home exam document on **April 20th** (Last day of class) and term in by **April 27th**.

There will be two exams during the course of the semester: Midterm and Final. Exam questions will be based on information covered in the assigned reading materials as well as material presented during class lecture.

Students must provide sufficient justification for missing an exam (it must be a documented emergency) to be entitled to qualify for a make-up exam. It is your responsibility to contact me on or before the date of the missed exam in order to arrange for a make-up.

Due date

Policy on Submission Due Date

Take-Home Answer document: You upload your answer document (MS Word) to Blackboard Turnitin site. **The late submission document will not be graded.** If you encounter serious emergency such as illness during the exam period, submit the proper document such as a doctor's note. It is your responsibility to contact me.

Exam online: the starting time and closing time for online base exam will be set. All answers should be submitted within the preset exam period. The exam should be taken the specified the schedule. If you encounter serious emergency such as illness, submit the proper document such as a doctor's note. It is your responsibility to contact me.

Online Quiz: the starting time and closing time for online base exam will be set. All answers should be submitted within the preset exam period. The online quiz should be taken the specified the schedule. If you encounter serious emergency such as illness, submit the proper document such as a doctor's note. It is your responsibility to contact me.

Assignments: You upload all assignment answer document (MS Word) to Blackboard Turnitin site. **The late submission document will not be graded.** If you encounter serious emergency such as illness during the exam period, submit the proper document such as a doctor's note. It is your responsibility to contact me.

Attendance

If you **miss three class sessions** without my approval, I will take out 10 percent of your course grade. Also please avoid being late for class since it is very disturbing to the other students. A student being late for class frequently and my third warning will lose his or her 10 percent of course grade.

Spring Break (March 9 to 14)

No class on **March 9**

University Policies

Academic Honesty Policy (<http://www.uh.edu/provost/shared-interest/policy-guidelines/honesty-policy/>)

- The consequences of an academic honesty infraction: suspension, expulsion, and a violation notation on their permanent record.

Academic Accommodations for Students with Disability
(<http://www.uh.edu/provost/shared-interest/policy-guidelines/student-disability-accommodation/>)

Students with Disabilities: The College of Liberal Arts and Social Sciences, in accordance with 504/ADA guidelines, is committed to providing reasonable academic accommodations to students who request them. Students seeking accommodation must register with the Center for Students with Disabilities (CSD) 713-743-5400 and present approved documentation to me as soon as possible.

*If you need special accommodation to meet any of the requirements of this course, please contact me by the second class session.

Counseling and Psychological Services: Counseling and Psychological Services (CAPS)--www.uh.edu/caps--are available for students having difficulties managing stress, adjusting to college, or feeling sad and hopeless. You can reach CAPS by calling 713-743-5454 during and after business hours for routine appointments or if you or somebody you know is in crisis. The "Let's Talk" program provides a drop-in consultation service at convenient locations and hours around campus. http://www.uh.edu/caps/outreach/lets_talk.html

Classroom Conduct:

Student Conduct Policy: CLASS students are expected to abide by the University of Houston's Code of Student Conduct: <http://www.uh.edu/dos/behavior-conduct/student-code-of-conduct/>

Policy on Cell Phone and Laptop Use

DO NOT USE your electronic devices for playing with social media sites such as Facebook, Twitter, etc., texting, email, web surfing during the class session. **If you are expecting a work-related emergency message or call, please sit closer to the door and replay the text message or take the call outside of the classroom.** Needless to say, your cell phone or tablet should be either turned off or in manner mode during each class session.

Lecture series 1: Descriptive Decision Science

Required Readings

Topic 1: Two Systems

Kahneman Introduction & Part I

Gladwell, Malcolm. 2005. *Blink: The Power of Thinking without Thinking*. New York: Back Bay Books. *Introduction, Chapter 1 & 2*

Powell & Baker (Chapter 1)

Topic 2: Heuristics and Biases; Escalation

Kahneman Part II, III and IV

Recommended

Fisher, Roger, and William L. Ury. 1991. *Getting to Yes: Negotiating Agreement Without Giving In*. New York: Penguin Books.

Milkman, K. L., Rogers, T. & Bazerman, M. H. 2008. Harnessing our inner angels and demons: What we have learned about want/should conflict and how that knowledge can help us reduce short-sighted decision making. *Perspectives on Psychological Science*, 3(4): 324-338.

Woolley, A.W., Chabris, C.F., Pentland, A., Hashmi, N. & Malone, T.W. 2010. Evidence for Collective Intelligence Factor in the Performance of Human Groups. *Science*, 330, 686-688.

Lecture series 2: Introduction to Management Science

Topics:

Identifying and Structuring Problems

Crafting a model

Required Readings

Powell & Baker (Chapter 2)

Pidd, Michael. 2009. *Tools for thinking: modeling in management science*, 3rd edition. New York: Wiley. *Chapter3 Problem, Problem....*

Gupta, Dipak. 2011. *Analyzing Public Policy: Concepts, Tools, & Techniques*, Second edition. Washington D.C.: CQ Press. *Chapter 14 Choosing the Best Alternative: Cost-Benefit Analysis*

Recommended Future Readings

Management Science in Action

Labe, Russ, Raj Nigam, and Steve Spence. 1999. "Management Science at Merrill Lynch Private Client Group," *Interfaces* 29, no.2 (March/April): 1-14.

Forgione, G. 1983. "Corporate MS Activities: An Update," *Interface*, vol.33, no.1.

Hall, R. 1985. "What's So Scientific about MS/OR?" *Interfaces*, vol.15.

Sonntag, C. and Grossman, T. 1999. "End-User Modeling Improves R&D Management at AgrEvo Canada, 1999. Inc." *Interfaces*, vol.29, no.5.

Heinrich, Carolyn. 2007. "Evidence-Based Policy and Performance Management: Challenges and Prospects in Two Parallel Movements" *The American Review of Public Administration* 37 (3): 255-277.

Green, Linda V., and Peter J. Kolesar. 2004. "Improving Emergency Responsiveness with Management Science." *Management Science* 50 (8): 1001-1014.

Alford, John, and Owen Hughes. 2008. "Public Value Pragmatism as the Next Phase of Public Management" *The American Review of Public Administration* 38 (2): 130-148.

GUIDE FOR BASIC EXCEL SKILLS

Powell & Baker (Chapter 3, 4, and 5)

SPREADSHEET MODELING

Edwards, J., P. Finlay, and J. Wilson. 2000. "The role the OR specialist in 'do it yourself' spreadsheet development," *European Journal of Operational Research*, vol.127, no.1.

Caine, D. J., and A. J. Robinson. 1993. "Spreadsheet Modeling: Guidelines for Model Development." *Management Decision* 31, 38-44.

Conway D.G., and C.T. Ragsdale. 1997. "Modeling Optimization Problems in the Unstructured World of Spreadsheets." *Omega* 25, 313-322.

Panko, R. R. 1999. "Applying Code Inspection to Spreadsheet Testing." *Journal of Management Information System* 16, 159-176.

Lecture series 3: Data Mining (Data Analytics)

Readings

Cluster Analysis (Classification): Hierarchical Clustering and K-means clustering

Powell & Baker (Chapter 6 page 122 to 128)

Multiple Regression Analysis

Powell & Baker (Chapter 6, page 143 to 151)

Rabin, Mathew. 2002. "Inference by believers in the law of small numbers." *The Quarterly Journal of Economics*. Vol.117, No.3: 775-816.

Morton, Veronica, and David J. Torgerson. 2003. "Effect of Regression to the mean on decision making in Health Care." *BMJ*, Vol. 326. No. 73398: 1083-1084.

Greve, Henrich R. 1999. "The Effect of Core Change on Performance: Inertia and Regression Toward the Mean." *Administrative Science Quarterly*. Vol. 44: 590-614.

Logistic Regression

Logistic Regression Basics

Data mining using Logistic Regression

Powell & Baker (Chapter 6 page 151 to 158)

Hosmer, David W., Scott Taber, and Stanley Lemeshow. 1999. "The Importance of Assessing the Fit of Logistic Regression Models: A Case Study." *American Journal of Public Health*, Vol.81. No.12:1630-1635.

Classification and Prediction (Regression) Tree Analysis

Powell & Baker (Chapter 6 page 134 to 143)

Discriminant Analysis

Recommended readings:

Wang, R. Y., and D. M. Strong. 1996. "Beyond Accuracy: What Data Quality Means to Data Consumers." *Journal of Management Information Systems* 12 (4): 5-34.

B Baesens, T Van Gestel, S Viaene, M Stepanova, J Suykens & J Vanthienen. 2003. Benchmarking state-of-the-art classification algorithms for credit scoring, *Journal of the Operational Research Society*, 54:6, 627-635.

The updated study. 2015: *European Journal of Operational Research* 247 (1): 124-136

Lecture series 4: Forecasting

Readings

Powell & Baker (Chapter 6 page 117 to 122 and Chapter 7)

Journal Articles for various forecasting issues and applications

Harvey, A. C., and J. Durbin. 1986. "The effects of seat belt legislation on British road casualties: A case study in structural time series modeling." *Journal of the Royal Statistical Society, Series A*, Vol.149: 187-227.

Hydman, R. J., and A. B. Koehler. 2006. "Another look at measures of forecast accuracy." *International Journal of Forecasting*, Vol.22: 679-688.

Assimakopoulos, V., and K. Nikolopoulos. 2000. "The theta model: a decomposition approach to forecasting." *International Journal of Forecasting*, Vol. 16: 521-530.

Fildes, R. 1992. "The evaluation of extrapolative forecasting methods." *International Journal of Forecasting*, Vol. 8: 81-98.

Fildes, R., M. Hibon, S. Makridakis, and N. Meade. 1998. "Generalizing about univariate forecasting methods: Further empirical evidence." *International Journal of Forecasting*, Vol. 14: 339-358.

Gardmer. E. S., Jr. 1985. "Exponential smoothing: The state of the art." *Journal of Forecasting*. Vol. 4: 1-28.

Gardmer. E. S., Jr. 1985. "Exponential smoothing: The state of the art-Part II." *Journal of Forecasting*. Vol. 22: 637-677.

Tashman, J. 2000. "Out-of-sample tests of forecasting accuracy: an analysis and review." *Journal of Forecasting*. Vol. 16: 53-59.

Herbig, P., J. Milewicz, et al. 1993. "Forecasting: who, what, when and how." *Journal of Business Forecasting Methods & Systems* 12(2): 16-21.

Aaron, H. J. 2000. "Seeing through the Fog: Policymaking with Uncertain Forecasts." *Journal of Policy Analysis and Management* 19 (2):193-206.

Li, X., C. L. Ang, et al. 1999. "An intelligent business forecaster for strategic business planning." *Journal of Forecasting* 18(3): 181-204.

Wilson, J. H. and D. Allison-Koerber. 1992. "Combining Subjective and Objective Forecasts Improves Results." *The Journal of Business Forecasting*.

Lecture series 5: Sensitivity Analysis

Topics:

Difference Equation

Sensitivity Analysis

Estimating and Interpreting Shadow Price, Opportunity Cost, Reduced Cost

Modeling diseconomy of scale & Economy of scale

Readings

Powell & Baker (Chapter 4)

Stokey, Edith, and Richard Zeckhauser. 1978. A Primer for Policy Analysis. New York: W.W. Norton. Chapter 3 The Model Choice; Chapter 4 Difference Equation.

Boardman, Anthony E., David H. Greenberg, Aidan R. Vining, and David L. Weimer. 2011. Cost-Benefit Analysis: Concepts and practice, 4th edition. Boston: Prentice Hall (page 177 to 183).

Lecture series 6: Applications of Linear Programming Models

Linear Programming and Network Analysis

Topics:

Formulation of Linear Programs

Standardized Spreadsheet

Tailored Spreadsheet

Data Envelopment Analysis

Readings

Powell & Baker (Chapter 9)

Stokey, Edith, and Richard Zeckhauser. 1978. A Primer for Policy Analysis. New York: W.W. Norton. Chapter 11 Linear Programming.

Pidd, Michael. 2009. Tools for thinking: modeling in management science, 3rd edition. New York: Wiley. Chapter 9 Optimization modeling- linear programming

Baker, Kenneth R. 2006. Optimization Modeling with Spreadsheet. Belmont: Thomson. Chapter 1 Introduction to Spreadsheet Models for Optimization.

DEA Application

Baker, Kenneth R. 2006. Optimization Modeling with Spreadsheet. Belmont: Thomson. Chapter 5 Linear Programming Formulations: Data Envelopment Analysis.

Golany, B. and J. E. Storbeck. 1999. "A Data Envelopment Analysis of the Operational Efficiency of Bank Branches" *Interfaces* (May/June): 14-26.

Cooper, W. W. (2013). *Data envelopment analysis. Encyclopedia of operations research and management science*, Springer: 349-358.

Sherman, H. D. and F. Gold (1985). "Bank branch operating efficiency: Evaluation with Data Envelopment Analysis." *Journal of Banking & Finance* 9(2): 297-315.

Recommended Future Readings

Management Science in Action

Miller, Mark K., and Laura McCann. 2000. "Policy Analysis of the Use of Hepatitis B, Haemophilus Influenzae Type B-, Streptococcus Pneumoniae-Conjugate and Rotavirus Vaccines in national Immunization Schedules." *Health Economics* 9: 19-35.

Higle, J. L., and S. W. Wallace. 2003. "Sensitivity Analysis and Uncertainty in Linear Programming." *Interfaces* 33(4): 53.

Dantzig, G. B. 1990. "The diet problem." *Interfaces* 20 (4):43-7.

Lancaster, L. M. 1992. "The Evolution of the Diet Model in Managing Food Systems." *Interfaces* 22:59-68.

Might, R. 1987. "Decision support for aircraft and munitions procurement." *Interfaces* 17 (5):55–62.

Oggier, Christophe, Emmanuel Frangniere, and Jeremy Stuby. 2005. "Nestle Improves Its Financial Reporting with Management Science." *Interfaces* 35 (4): 271-280.

Rubin, D. S., and H. M. Wagner. 1990. "Shadow Prices: Tips and Traps for Managers and Instructors." *Interfaces* 20(4): 150-157.

Whitworth, Mark H. 2006. "Designing the Response to an Anthrax Attack" *Interfaces* 36 (6): 562-568.

Dantzig, G. B. 1990. "The diet problem." *Interfaces* 20 (4):43-7.

Lecture Series 7: Application of Integer Linear Programming

Integer Programming

Topics:

The Simplex Method

Integer Linear Programming (ILP)

Integrity conditions

LP Relaxation

Bound

Rounding

Branch-and-Bound (B&B)

Binary Variables

Capital Budgeting Model

Readings

Powell & Baker (Chapter 11)

Recommended Future Readings

Management Science in Action

Parnell, G. S., G. E. Bennett, et al. 2003. "Improving Resource Allocation Within the National Reconnaissance Office." Interfaces 32(3): 77-90.

Croxton, Keely L., Bernard Gendron, and Thomas L. Magnanti. 2003. "A Comparison of Mixed-Integer Programming Models for Nonconvex Piecewise Linear Cost Minimization Problems" Management Science 49 (9): 1268-1273.

Blake, J. T., and J. Donald. 2002. "Mount Sinai Hospital Uses Integer Programming to Allocate Operating Room Time." Interfaces 32(2): 63-73.

Tavakoli, A. and C. Lightner. 2004. "Implementing a mathematical model for locating EMS vehicles in Fayetteville, NC." Computers & Operations Research 31(9): 1549-1563.

Nauss, R. M., and R. E. Markland. 1981. "Theory and Application of an Optimizing Procedure for Lock Box Location Analysis." MANAGEMENT SCIENCE 27(8): 855-865.

Carraway, R. L., J. M. Cummins, et al. 1990. "Solving Spreadsheet-Based Integer Programming Models: An Example from International Telecommunications." Decision Sciences 21(4): 808.

Markland, R. E., and R. M. Nauss. 1983. "Improving Transit Check Clearing Operations at Maryland National Bank." Interfaces 13(1): 1-9.

Cutshall, Rex., Srinagesh Gavirneni, and Kenneth Schultz. 2007. "Indiana University's Kelley School of Business Uses Integer Programming to Form Equitable, Cohesive Student Teams." Interfaces 37 (3) 265-276.

Spencer, T., A. J. Brigandi, D. R. Dargon, and M. J. Sheehan. 1990. "AT&T's telemarketing site selection system offers customer support." *Interfaces* 20 (1):83–96.

Martin, C. H. 2004. "Ohio University's College of Business Uses Integer Programming to Schedule Classes." *Interfaces* 34 (6):460-5.

Taylor III, B. W., L. J. Moore, E. R. Clayton, K. R. Davis, and T. R. Rakes. 1985. "An Integer Nonlinear Goal Programming Model for the Deployment of State Highway Patrol Units." *Management Science* 31 (11):1335-47.

Tingley, Kim M., and Judith S. Liebman. 1984. "A Goal Programming Example in Public Health Resource Allocation." *Management Science* 30 (3): 279-289.

Benjamin, Colin O. 1985 "A Linear Goal-Programming Model for Public-Sector Project Selection." *Journal of the Operational Research and Society* 36 (1): 13-23.

Lecture series 8: Project Management (Project Scheduling Models)

Project Management with MS Project or OpProj

Recommended Future Readings

Management Science in Action

Schonberger, R. J. 1981. "Why Projects Are "Always" Late: A Rationale Based on Manual Simulation of a PERT/CPM Network." *Interfaces* 11(5): 66-70.

Pich, Michael T., Christoph H. Loch, and Arnoud De Meyer. 2002. "On Uncertainty Ambiguity, and complexity in Project Management" *Management Science*, August 2002; 48: 1008 - 1023.

Rolf H. Möhring, Andreas S. Schulz, Frederik Stork, and Marc Uetz. 2003. "Solving Project Scheduling Problems by Minimum Cut Computations" *Management Science*, March 2003; 49: 330 - 350.

Tormos, P., A. Lova. 2001. "Tools for Resource-Constrained Project Scheduling and Control: Forward and Backward Slack Analysis" *The Journal of the Operational Research Society*, Vol. 52, No. 7 (Jul. 2001), pp. 779-788

Chapman, C., and S. Ward. 2003. "Constructively Simple Estimating: A Project Management Example" *The Journal of the Operational Research Society*, Vol. 54, No. 10 (Oct. 2003), pp. 1050-1058

Zhu, G. J.F. Bard, and G Yu. 2005. "Disruption Management for Resource-Constrained Project Scheduling" *The Journal of the Operational Research Society*, Vol. 56, No. 4 (Apr. 2005), pp. 365-381

Sandøy, M., T. Aven, D. Ford. 2005. "On Integrating Risk Perspectives in Project Management" *Risk Management*, Vol. 7, No. 4 (2005), pp. 7-21

Rottman, Joseph W., L. Douglas Smith, David A. Long, and Chuck Crofts. 2007. "Implementing Judicial Management Systems Within an Integrated Justice Information Framework: A Case Study on Information Systems Development in the Public Sector" *The American Review of Public Administration*, Dec 2007; vol. 37: pp. 436 - 457.

Rocheleau, Bruce. 2000. "Prescriptions for Public-Sector Information Management: A Review, Analysis, and Critique" *The American Review of Public Administration*, Dec 2000; vol. 30: pp. 414 - 435.

Lecture series 9: Decision Models

Readings

Kahneman Part IV and V.

Powell and Baker (Chapter 13)

Stokey, Edith, and Richard Zeckhauser. 1978. A Primer for Policy Analysis. New York: W.W. Norton. *Chapter 12 Decision Analysis*.

Gupta, Dipak. 2011. Analyzing Public Policy: Concepts, Tools, & Techniques, Second edition. Washington D.C.: CQ Press. *Chapter 13 The Elements of Strategic Thinking: Decision Tree and Game Theory*

Recommended Future Readings

Management Science in Action

Heian, B. C., and J. R. Gale. 1988. "Mortgage Selection Using a Decision-Tree Approach: An Extension." *Interfaces* **18**(4): 72-83.

Wenstop, F. E., and A. J. Carlsen. 1988. "Ranking Hydroelectric Power Projects with Multicriteria Decision Analysis." *Interfaces* **18**(4): 36-48.

Zahedi, F. 1986. "The Analytic Hierarchy Process: A Survey of the Method and Its Applications." *Interfaces* **16**(4): 96-108.

Barron, F. H. and M. Connor. 1985. "Payoff Matrices Pay off at Hallmark." *Interfaces* **15**(4): 20-25.

- Bodin, L. and S. I. Gass. 2003. "On teaching the analytic hierarchy process." *Computers & Operations Research* **30**(10): 1487-1497.
- Corner, J. L., and C. W. Kirkwood. 1991. "Decision Analysis Applications in the Operations Research Literature, 1970-1989." *Operations Research* **39**(2): 206-219.
- Howard, R. A. 1988. "Decision Analysis: Practice and Promise." *Management Science* **34**(6): 679-695.
- Clemen, R. T., and R. C. Kwit. 2001. "The Value of Decision Analysis at Eastman Kodak Company, 1990-1999." *Interfaces* **31**(5): 74-92.
- Urbanovich, E., E. E. Young, et al. (2003). "Early Detection of High-Risk Claims at the Workers' Compensation Board of British Columbia." *Interfaces* **33**(4): 15-26.
- Stonebraker, J. S. 2002. "How Bayer Makes Decisions to Develop New Drugs." *Interfaces* **32**(6): 77-90.
- Ahlbrecht, M. and M. Weber. 1997. "An Empirical Study on Intertemporal Decision Making under Risk." *Management Science* **43**(6): 813-826.
- Anderson, Stephen H., and Natalia V. Smirnova. 2006. "A Study of Executive Budget-Balancing Decisions" *American Review of Public Administration* **36** (3): 323-336.

Critiques

- Brown, R. 1970. "Do Managers Find Decision Analysis Useful." *Harvard Business Review* **48**(3): 78-89.
- Smith, James E., and Detlof von Winterfeldt. 2004. "Decision Analysis in 'Management Science'" *Management Science* **50** (5): 561-574.
- Hammond, J. S., R. L. Kenney, and H. Raiffa. 1998. "The Hidden Traps in Decision Making." *Harvard Business Review* **76**(5): 47-60.
- Brown, R. V. 1992. "The state of the art of decision analysis: A personal perspective." *Interfaces* **22**(6): 5-14.

Lecture series 10: Simulation and Decision Analysis

Readings

Powell and Baker (Chapter 14)

Pidd, Michael. 2009. Tools for thinking: modeling in management science, 3rd edition. New York: Wiley. *Chapter 10 Computer simulation – visual interactive modeling and Monte Carlo simulation*

Recommended Future Readings

Management Science in Action

Saltzman, R. M., and V. Mehrotra. 2001. "A Call Center Uses Simulation to Drive Strategic Change." *Interfaces* **31**(3): 87-101.

Dekker, R., M. B. M. d. Koster, et al. 2004. "Improving Order-Picking Response Time at Ankor's Warehouse." *Interfaces* **34**(4): 303-313.

Russell, R. A., R. Hickle, et al. 1986. "Simulation of a CD Portfolio." *Interfaces* **16**(3): 49-54.

Cebry, M. E., A. H. deSilva, et al. 1992. "Management Science in Automating Postal Operations: Facility and Equipment Planning in the United States Postal Service." *Interfaces* **22**(1): 110-130.

Altschuler, S., D. Batavia, et al. 2002. "Pricing Analysis for Merrill Lynch Integrated Choice." *Interfaces* **32**(1): 5-19.

Goldberg, Michael A. 1973. "Simulation, Synthesis and Urban Public Decision-Making" *Management Science* **20** (4): 629-643.

Brennan, J. E., B. L. Golden, et al. 1992. "Go with the flow: Improving Red Cross bloodmobiles using simulation analysis." *Interfaces* **22**(5): 1-13.

Shtrichman, O., R. Ben-Haim, and M. Pollatschek. 2001. "Using Simulation to Increase Efficiency in an Army Recruitment Office." *Interfaces* **31**(4): 61-70.

Gavirneni, S., D. J. Morrice, et al. 2004. "Simulation Helps Maxager Shorten Its Sales Cycle." *Interfaces* **34**(2): 87-96.