

**University of Massachusetts Boston**

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Fall 2016

# Course Syllabus: PPOL-G 742 Community-Based Operations Research

Michael P Johnson, Jr.



Available at: [https://works.bepress.com/michael\\_johnson/49/](https://works.bepress.com/michael_johnson/49/)

# PPOL-G 742 – Syllabus

## Community-Based Operations Research

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### Instructor Information

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**Note:** The following link will assist you in forwarding your UMB email account to your personal account: [http://www.umb.edu/it/getting\\_services/email/office365/o365\\_forward](http://www.umb.edu/it/getting_services/email/office365/o365_forward). Throughout the semester, I will communicate with you via your UMB email account. You may have e-mail redirected from your official UMass Boston address to another e-mail address at your own risk. The University will not be responsible for the handling of e-mail by outside vendors or by departmental servers.

### Course Information

**Course Title:** PPOL-G 742 Community-Based Operations Research

**Credits:** 3

**Online?** no

**Course**

**Description:** This elective course in the Public Policy PhD program provides an introduction to analytic methods to improve planning and operations activities of not-for-profit organizations, especially mission-driven community-based organizations. A deeper understanding of relevant methods will help organizations better measure the impact of their services, and design new ways to provide these services to optimize efficiency, effectiveness and equity. The course will emphasize iterative, inductive, mixed-methods and critical approaches. Examples of public-sector applications we will address include: public safety and emergency services, human services, community and public health, economic development, humanitarian logistics and housing and community development.

Students will learn how to identify public-sector problems that are amenable to solution-focused analytic methods from a variety of disciplinary traditions. Students will learn how to structure and solve decision problems using qualitative and quantitative methods. Some methods may use commonly-available technologies such as spreadsheets; others, such as insights into preferences of stakeholders, or heuristics ('rules of thumb') to guide strategies or routine operations, require little to no technology.

**Context:** This course assumes a foundation in multi-disciplinary traditions within public policy such as that provided by first-year core courses in the Public Policy PhD program. It provides students with ways to develop policies, programs and prescriptions based on best theory and practice in the social sciences that are intended to support community change and social justice. It also provides students with the ability to

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develop their own research programs that reflect diverse methodologies and disciplinary traditions.

**Prerequisites:** Graduate status.

**Prerequisite**

**Skills:** Students should have mathematical skills at the level of pre-calculus. Completion of a first graduate course in quantitative methods is helpful. Knowledge of Microsoft Excel or an equivalent software package is helpful.

**Course**

**Objectives:** By fully participating in this course, you should be able to:

1. Identify opportunities to apply decision models to public-sector problems
2. Identify alternative decision modeling approaches to a given problem
3. Formulate and solve a decision problem using quantitative or qualitative methods
4. Describe ways that model solutions can be used to support organization and system change and generate beneficial client and community outcomes

**Core**

**Competencies:** The objectives for this course focus on the following core competencies:

1. Problem identification, i.e. recognizing that determining the nature of a problem to be solved is an opportunity for application of problem structuring and values clarification methods.
2. Problem formulation, i.e. using best evidence, stakeholder analysis and a collaborative approach to produce a qualitative statement of a problem to be solved.
3. Problem solution, i.e. recognizing that solutions to a defined problem may be derived from quantitative analytic methods such as optimization or simulation, or mixed-methods approaches such as problem structuring and collaborative learning.
4. Implementation, i.e. translation of problem solutions into practice, reflecting a fundamental concern with community change for the public good.

**Required**

**Assignments:** There are four problem sets that are due at various points during the semester. These assignments are intended to reinforce material presented during lecture. They consist of exercises drawn from the course text as well as customized exercises using data collected specifically for this class. These assignments may be completed in consultation with classmates, though the final product should reflect the students' own insights. Each problem set is worth 10% of the final grade.

The course project is intended to integrate analytics and operations research/management science into students' research and practice interests. It is worth 45% of the final grade. In this project, students will propose, and implement, a research project that includes:

- A real-world client organization
- Discussion of problem structuring and solution approaches
- Collection of administrative data as well as new data via field research
- One or more explicit decision models

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- Model solution through qualitative and/or quantitative methods
- Solution deliverables, such as: spreadsheets, databases, values structures, guidelines, heuristics
- Recommendations for policy and practice
- Written final report

Class participation, worth 15% of the final grade, consists of productive, informed verbal contributions during lectures and tutorials and on class discussion boards, professional-quality verbal and written presentations of case studies and mature, collaborative engagement with classmates and community clients. Attendance at every lecture is essential to full and active class participation.

### Course Rubric:

| Assignment/Deliverable  | Number | Grade % |
|---|--------|---------|
| <b>Problem Sets</b>   |        |         |
| 1. Assignment #1: Introduction to spreadsheet modeling and linear optimization                | 1      | 10%     |
| 2. Assignment #2: Soft OR, problem structuring methods  | 1      | 10%     |
| 3. Assignment #3: Integer programming, stochastic models                                      | 1      | 10%     |
| 4. Assignment #4: Decision-making under uncertainty, multiobjective optimization, critical OR | 1      | 10%     |
| <b>Final Project/Presentation</b>   |        |         |
| 1. Course project topic and description   | 1      | 5%      |
| 2. Course project outline: problem, models, data, analytic strategy                           | 1      | 5%      |
| 3. Course project final presentation  | 1      | 15%     |
| 4. Course project final paper   | 1      | 20%     |
| <b>Class Participation</b>  |        |         |
| 1. Group Work   | 1      | 5%      |
| 2. Participation (as defined above)   | 1      | 5%      |
| 3. Attendance (as defined above)  | 1      | 5%      |

### Course Policies:

- ❖ Participation - Participation includes completing all required reading and writing assignments prior to class, thoughtfully participating in discussions, and taking responsibility for helping create a positive learning environment by arriving promptly, listening respectfully, and participating constructively
- ❖ Attendance - Attendance at every class session is expected. Students may be excused from class attendance by notifying the instructor in advance of an anticipated absence
- ❖ Group Work – Students are encouraged to consult with one another regarding alternative approaches to solving problems in assignments. However, each

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student is expected to hand in his or her own complete assignment, reflecting the student's own unique work. Students are encouraged to work on a final project in teams. Student team work is expected to be professional-grade, with workloads equitably distributed.

- ❖ Late Work – Student work is expected to be handed in on time. Late work will be docked a letter grade for each week that it is handed in late, or fraction thereof.

### Grading

**Grading:** Grade type for the course is a whole or partial letter grade. (Please see table below)

Note: the lowest passing grade for a graduate student is a "C". Grades lower than a "C" that are submitted by faculty will automatically be recorded as an "F".

Please see the Graduate Catalog for more detailed information on the University's grading policy.

(this is an example)

| Grading Policy |   |  |                |
|----------------|---|--|----------------|
| Letter Grade   | Percentage  |  | Quality Points |
| A              | 93-100%   |  | 4.00           |
| A-             | 90-92%  |  | 3.75           |
| B+             | 87-89%  |  | 3.25           |
| B              | 83-86%  |  | 3.00           |
| B-             | 80-82%  |  | 2.75           |
| C+             | 77-79%  |  | 2.25           |
| C              | 73-76%  |  | 2.00           |
| F              | 0-72%   |  | 0.0            |
| INC            | A grade of Incomplete (INC) is not automatically awarded when a student fails to complete a course. Incompletes are given at the discretion of the instructor. They are awarded when satisfactory work has been accomplished in the majority of the course work, but the student is unable to complete course requirements as a result of circumstances beyond his/her control. The student must negotiate with and receive the approval of the course instructor in order to receive a grade of incomplete |  | N/A            |
| IF             | Received for failure to comply with contracted completion terms.  |  | N/A            |
| W              | Received if withdrawal occurs before the withdrawal deadline.   |  | N/A            |
| AU             | Audit (only permitted on space-available basis)   |  | N/A            |
| NA             | Not Attending (student appeared on roster, but never attended class. Student is still responsible for tuition and fee charges unless withdrawal form is submitted before deadline. NA has no effect on cumulative GPA.)   |  | N/A            |

### Required Text(s):

Winston, Wayne and Albright, S. Christopher. 2011. *Practical Management Science, 4th Edition*. Mason, OH: South-Western/CENGAGE Learning. ASIN: B009O2ZRJ4.

### Technical

**Requirements:** Microsoft Excel; Frontline Premium Solver Pro, Frontline Risk Solver Platform.

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### Recommended

**Texts:** Stokey, Elizabeth and Zeckhauser, Robert. 1978. *A Primer for Policy Analysis*. New York: W.W. Norton & Company. ISBN 0393090981.

Midgley, Gerald. 2001. *Systemic Intervention: Philosophy, Methodology, and Practice*. New York: Kluwer Academic/Plenum Publishers. ISBN 0306464888.

### Other

**Reading:** Other reading as assigned.

## Course Schedule

### Class 1: September 2, 2015

|                                     |   |
|-------------------------------------|---|
| <b>Core Topic(s):</b>               | Introduction to decision modeling for community impact  |
| <b>Learning Objectives:</b>         | Understand role of operations research, management science and analytics in public-interest & not-for-profit program design, implementation and evaluation  |
| <b>Reading Assignment</b>           | Pollock and Maltz (1994) (Chapter 1 – “Operations Research in the Public Sector: An Introduction and Brief History”)<br><br>Winston and Albright Chapter 1 – “Introduction to Modeling”<br><br>Stokey and Zeckhauser Chapter 2 – “Models: A General Discussion”<br><br>Midgley (2001) |
| <b>Class Activities</b>             | Readings discussion   |
| <b>Assignment(s):<br/>Due Date:</b> | Assignment #1 (10 points)<br>Due September 23 <sup>rd</sup> , 2015  |

### Class 2: September 9, 2015

|                             |  |
|-----------------------------|--|
| <b>Core Topic(s):</b>       | Community OR; introduction to spreadsheet modeling   |
| <b>Learning Objectives:</b> | Use spreadsheets and spreadsheet add-ins as fundamental analytic basis for quantitative analytics and OR/MS modeling   |
| <b>Reading Assignment</b>   | Kaplan (2008)<br><br>Johnson Chapter 1 – “Community-Oriented Operations Research: Introduction, Theory and Applications”<br><br>Winston and Albright Chapter 2 – “Introduction to Spreadsheet Modeling”<br><br>Wagner and Keisler (2006)<br><br>Midgley (2001)<br><br>Case study TBD |
| <b>Class Activities</b>     | Readings discussion<br>Student case presentation   |



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### Class 3: September 16, 2015

|   |  |
|---|--|
| <b>Core Topic(s):</b>                     | Analytics and the art of modeling  |
| <b>Learning Objectives:</b>               | Relate analytics and OR/MS modeling to policy-analytic fundamentals, and understand application- and methods-area scope of 'analytics' |
| <b>Reading Assignment</b>                 | Stokey and Zeckhauser Chapter 3 – “The Model of Choice”<br>Liberatore and Luo (2010)<br>Levine (2012)<br>Case study TBD                |
| <b>Class Activities</b>                   | Readings discussion<br>Student case presentation   |
| <b>Assignment(s):</b><br><b>Due Date:</b> | Course project topic and description (5 points)<br>Due September 30 <sup>th</sup> , 2015   |

### Class 4: September 23, 2015

|   |   |
|---|---|
| <b>Core Topic(s):</b>                     | Spreadsheet optimization and linear programming   |
| <b>Learning Objectives:</b>               | Use Excel and add-ins to solve linear modeling and optimization problems  |
| <b>Reading Assignment</b>                 | Winston and Albright Chapter 3 – “Introduction to Optimization Modeling”<br>Winston and Albright Chapter 4 – “Linear Programming Models”<br>Stokey and Zeckhauser Chapter 11 – “Linear Programming”<br>Case study TBD |
| <b>Class Activities</b>                   | Readings discussion<br>Student case presentation  |
| <b>Assignment(s):</b><br><b>Due Date:</b> | Assignment #2 (10 points)<br>Due October 7 <sup>th</sup> , 2015   |

### Class 5: September 30, 2015

|                             |  |
|-----------------------------|--|
| <b>Core Topic(s):</b>       | Soft OR, problem structuring methods, value-focused thinking   |
| <b>Learning Objectives:</b> | Use a variety of qualitative, inductive and critical approaches for analytics modeling that complement traditional quantitative tools.   |
| <b>Reading Assignment</b>   | Franco and Montibeller (2010)<br>Mingers (2011)<br>Rosenhead and Mingers (2001) (excerpts)<br>Keeney 1992 (excerpts)<br>Edwards, Miles and von Winterfeldt (2001), Chapter 7: “Developing Objectives and Attributes”<br>Case study TBD |

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|                                 |  |
|---------------------------------|--|
| <b>Class Activities</b>         | Readings discussion<br>Student case presentation   |
| <b>Assignment(s): Due Date:</b> | Course project outline: problem, models, data, analytic strategy (5 points)<br>Due October 21 <sup>st</sup> , 2015 |

### Class 6: October 7, 2015

|                                 |  |
|---------------------------------|--|
| <b>Core Topic(s):</b>           | Integer programming and network models   |
| <b>Learning Objectives:</b>     | Model and solve decision problems with discrete decision variables, and those associated with underlying networks.                                   |
| <b>Reading Assignment</b>       | Winston and Albright Chapter 5 – “Network Models”<br>Winston and Albright Chapter 6 – “Optimization Models with Integer Variables”<br>Case study TBD |
| <b>Class Activities</b>         | Readings discussion<br>Student case presentation   |
| <b>Assignment(s): Due Date:</b> | Assignment #3 (10 points)<br>Due October 28 <sup>th</sup> , 2015   |

### Class 7: October 14, 2015

|                             |   |
|-----------------------------|---|
| <b>Core Topic(s):</b>       | Stochastic models, Part 1   |
| <b>Learning Objectives:</b> | Learn how to think in terms of stochastics and probability distributions, and master fundamentals of Markov analysis  |
| <b>Reading Assignment</b>   | Winston, Albright and Zappe Chapter 5 – “Normal, Binomial, Poisson and Exponential Distributions”<br>Stokey and Zeckhauser Chapter 7 – “Markov Models”<br>Ross (2010) Chapter 4 – “Markov Chains”<br>Case study TBD |
| <b>Class Activities</b>     | Readings discussion<br>Student case presentation  |

### Class 8: October 21, 2015

|                             |  |
|-----------------------------|--|
| <b>Core Topic(s):</b>       | Stochastic models, Part 2  |
| <b>Learning Objectives:</b> | Use non-optimization stochastic approaches such as simulation for difficult or intractable decision problems, and queueing theory for certain well-defined customer-serving systems and organizations  |
| <b>Reading Assignment</b>   | Winston and Albright Chapter 10 – “Introduction to Simulation Modeling”<br>Stokey and Zeckhauser Chapter 6 – “Simulation”<br>Winston and Albright Chapter 14 – “Queueing Models”<br>Stokey and Zeckhauser Chapter 5 – “Queues”<br>Case study TBD |



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|-------------------------|--|
| <b>Class Activities</b> | Readings discussion<br>Student case presentation |
|-------------------------|--|

### Class 9: October 28, 2015

|                                 |   |
|---------------------------------|---|
| <b>Core Topic(s):</b>           | Decision making under uncertainty and decision analysis   |
| <b>Learning Objectives:</b>     | Solve decision problems in which the number of alternatives is finite, decision-makers choose from alternatives under uncertainty, and have varying attitudes about risk.   |
| <b>Reading Assignment</b>       | Winston and Albright Chapter 9 – “Decision Making Under Uncertainty”<br>Stokey and Zeckhauser Chapter 12 – “Decision Analysis”<br>Edwards, Miles and von Winterfeldt (2001) (excerpts)<br>Case study TBD                      |
| <b>Class Activities</b>         | Readings discussion<br>Student case presentation  |
| <b>Assignment(s): Due Date:</b> | Assignment #4 (10 points)<br>Due December 2 <sup>nd</sup> , 2015<br>Final project presentation (15 points)<br>Due December 16 <sup>th</sup> , 2015<br>Final project paper (20 points)<br>Due December 18 <sup>th</sup> , 2015 |

### Class 10: November 11, 2015

|                             |   |
|-----------------------------|---|
| <b>Core Topic(s):</b>       | Multiobjective optimization   |
| <b>Learning Objectives:</b> | Generate Pareto frontier of alternative solutions to optimization models with multiple objectives.  |
| <b>Reading Assignment</b>   | Winston and Albright Chapter 16 (online) – “Multiobjective Decision Making”<br>Stokey and Zeckhauser Chapter 8 – “Defining Preferences”<br>Case study TBD |
| <b>Class Activities</b>     | Readings discussion<br>Student case presentation  |

### Class 11: November 18, 2015

|                             |   |
|-----------------------------|---|
| <b>Core Topic(s):</b>       | Critical approaches to OR/MS, ethics in OR and disadvantaged populations  |
| <b>Learning Objectives:</b> | Understand how traditional models of OR/MS can be problematic when used to address community-based concerns, and build theory of OR/MS/analytics that can work with social science-based methodologies for active & engaged research. |
| <b>Reading Assignment</b>   | Wenstop and Koppang (2009)<br>Mingers (2000)<br>Mingers (2011)  |

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|-------------------------|--|
|                         | Le Menestrel and Van Wassenhove (2009)<br>Case study TBD |
| <b>Class Activities</b> | Readings discussion<br>Student case presentation         |

### Class 12: December 2, 2015

|                             |   |
|-----------------------------|---|
| <b>Core Topic(s):</b>       | Special topic: decision models for foreclosed housing redevelopment; course project open discussion |
| <b>Learning Objectives:</b> | Discuss a wide range of decision modeling approaches to community-level foreclosure response.       |
| <b>Reading Assignment</b>   | Johnson et al. (2015)   |
| <b>Class Activities</b>     | Readings discussion<br>Student case presentation  |

### Class 13: December 9, 2015

|                             |   |
|-----------------------------|---|
| <b>Core Topic(s):</b>       | What comes next: OR in the field, developing countries, appropriate technology  |
| <b>Learning Objectives:</b> | Discuss opportunities to apply OR/MS in the real world as opposed to the classroom, recognizing constraints in resources, capacity and knowledge. |
| <b>Reading Assignment</b>   | Sodhi and Tang 2010<br>Caulkins et al. 2008<br>White, Smith and Currie 2010<br>Celik et al. 2012  |
| <b>Class Activities</b>     | Readings discussion<br>Student case presentation  |

### Methods of Instruction

**Methods:** This course uses a combination of conventional instructor-led lecture, student-led discussion of cases and student-led presentation of course projects.

### Accommodations

The University of Massachusetts Boston is committed to providing reasonable academic accommodations for all students with disabilities. This syllabus is available in alternate format upon request. If you have a disability and feel you will need accommodations in this course, please contact the Ross Center for Disability Services, Campus Center, Upper Level, Room 211 at 617.287.7430. <http://www.umb.edu/academics/vpass/disability/> After registration with the Ross Center, a student should present and discuss the accommodations with the professor. Although a student can request accommodations at any time, we recommend that students inform the

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professor of the need for accommodations by the end of the Drop/Add period to ensure that accommodations are available for the entirety of the course.

### Academic Integrity and the Code of Student Conduct

#### **Code of Conduct and Academic Integrity**

It is the expressed policy of the University that every aspect of academic life--not only formal coursework situations, but all relationships and interactions connected to the educational process--shall be conducted in an absolutely and uncompromisingly honest manner. The University presupposes that any submission of work for academic credit is the student's own and is in compliance with University policies, including its policies on appropriate citation and plagiarism. These policies are spelled out in the Code of Student Conduct. Students are required to adhere to the Code of Student Conduct, including requirements for academic honesty, as delineated in the University of Massachusetts Boston Graduate Catalogue and relevant program student handbook(s). [UMB Code of Student Conduct](#)

Students are encouraged to consult with one another regarding alternative approaches to solving problems in assignments. However, each student is expected to hand in his or her own complete assignment, reflecting the student's own unique work. Students are encouraged to work on a final project in teams. Student team work is expected to be professional-grade, with workloads equitably distributed.

You are encouraged to visit and review the UMass website on *Correct Citation and Avoiding Plagiarism*: <http://umb.libguides.com/citations>

### Other Pertinent and Important Information

**Incomplete Policy:** The grade incomplete (INC) is reported only where a portion of the assigned or required class work, or the final examination, has not been completed because of serious illness, extreme personal circumstances, or scholarly reasons at the request of the instructor. If your record is such that you would fail the course regardless of your missing work, you will fail.

Permission of the instructor must be obtained and the form for Grade Incomplete must be completed.

If you are receiving the grade of incomplete (INC), you are allowed up to one year in which to complete the course. The new grade must be submitted to the Registrar by the grading deadline for that semester, i.e., by the end of the next fall for the fall semester incompletes. The grade for any course not completed by this deadline will be converted to the grade of 'IF'.

**Coursework Difficulties:** Please discuss all coursework matters with me sooner than later.

**Withdrawing From This Course:** Please refer to the written policies and procedures on formal withdrawal and add/change dates listed in the Graduate Studies Catalog.

You are advised to retain a copy of this syllabus in your personal files for use when applying for future degrees, certification, licensure, or transfer of credit.

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### Bibliography

Winston, W. and S. Albright. 2012. *Practical Management Science, 4<sup>th</sup> Edition*. Mason, OH: South-Western/CENGAGE Learning

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Edwards, W., Miles, R.F. Jr., D. von Winterfeldt. 2007. *Advances in Decision Analysis: From Foundations to Applications*. Cambridge: Cambridge University Press (selected chapters on electronic reserve at Healey Library)

Johnson, M.P. (Ed.) 2011. *Community-Based Operations Research: Decision Modeling for Local Impact and Diverse Populations*. New York: Springer (selected chapters on electronic reserve at Healey Library).

Johnson, M.P., Keisler, J., Solak, S., Turcotte, D., Bayram, A. and R.B. Drew. 2015. *Decision Science for Housing and Community Development: Localized and Evidence - Based Responses to Distressed Housing and Blighted Communities*. In press, John Wiley & Sons, Inc. (selected chapters on electronic reserve at Healey Library).

Keeney, R. 1992. *Value-Focused Thinking: A Path to Creative Decisionmaking*. Cambridge: Harvard University Press (print copy and selected chapters on electronic reserve at Healey Library).

Midgley, G. 2001. *Systemic Intervention: Philosophy, Methodology, and Practice*. New York: Kluwer Academic/Plenum Publishers (selected chapters on electronic reserve at Healey Library).

Pollock, S.M., Rothkopf, M.H. and A. Barnett (Eds.) 1994. *Operations Research and the Public Sector*. Amsterdam: North-Holland (selected chapters on electronic reserve at Healey Library).

Rosenhead, J. and J. Mingers (Eds.) 2001. *Rational Analysis for a Problematic World Revisited: Problem Structuring Methods for Complexity, Uncertainty and Conflict, 2<sup>nd</sup> Edition*. Chichester: John Wiley & Sons, Ltd (selected chapters on electronic reserve at Healey Library).

Ross, S.M. *Introduction to Probability Models, 10<sup>th</sup> Edition*. Amsterdam: Academic Press (available online at Healey Library via Ebrary).

Stokey, E. and R. Zeckhauser. 1978. *A Primer for Policy Analysis*. New York: W.W. Norton & Company (print copy and selected chapters on reserve at Healey Library)

Journal articles, research reports and popular press articles (selected resources on electronic reserve at Healey Library).