Lesson Plan

Operations Research for Healthcare

Offered by:

Ahmad Reza Pourghaderi, Ph.D.,
Healthcare Systems Engineering
Industrial & Systems Engineering
National University of Singapore (NUS)
Website: www.pourghaderi.com
Email: pourghaderi@u.nus.edu , ar.pourghaderi@gmail.com

Course Description:

Today's health care industry is multidisciplinary with many players and levels each with its own set of complex behaviors. Better planning and management of these complexities can help improve the efficacy of health care. Examples of such management include (but are not limited to) managing big health care facilities, improving efficiency of emergency services, better decision making in complicated treatments, preventing and managing epidemics, etc. Analytical and quantitative methods developed in Operations Research (OR) for other complex systems like manufacturing systems, supply chains, infrastructure and service systems are becoming useful for today's health care systems as well. This course will serve two purposes:
(1) introduce the students to planning and management problems arising in health care, and
(2) train them in developing and applying techniques of OR for solving these problems.

The course is designed to provide practical and research training to the master and doctoral students in healthcare services/operations management as well as graduate industrial engineering students in healthcare systems engineering. Also, healthcare professionals who have managing/planning functions and wish to learn quantitative techniques for problem framing, analysis of decisions with a structured approach will find this course very useful.

Operations Research:

Our world seems to ever become more complex and uncertain. Future leaders must be able to act under these conditions. Optimal decision making in many complex systems facing big data and high uncertainty is surely impossible without using computer based advanced analytical methods. Operations research (O.R.) is the discipline of applying advanced analytical methods to help make

better desicions. Operations Research (OR) techniques are useful to determine the best course of action of a decision problem under limited resources. It's science and art. The science is in the mathematics and algorithms for addressing decision problems. It's an art as success in all the phases that precede and succeed the solution of a mathematical model, depends largely on the creativity and personal abilities of the decision maker.

Gathering of the data for model construction, validation of the model, and implementation of the obtained solution depends on the ability of the OR team to establish good lines of communication with the sources of information as well as with the individuals in charge of implementation of the recommended solutions.

Course Overview:

Many healthcare issues benefit from a holistic and quantitative framework to identify the leverage points and to engage different stakeholders. For example:

- Feasible service planning needs understanding of patients' proximity, short and medium term utilization, capacity sizing and patient demand as a function of aging.
- Good appointment scheduling requires understanding of balance of clinicians' overtime, patient wait time, no show rate, variation of consult duration and lateness of arrival.
- Acceptable operating theatre capacity allocation requires a balance of OT utilization, elective surgery wait time, supply constraints, demand growth and downstream bed usage.
- Ring fencing of beds while containing overflow may have an impact on patients' admission wait time.

The course will introduce OR concepts with healthcare applications. It will focus on building intuition around theory, walk through illustrative examples and show insights from results that will support and in-form decision making. Case studies will show applications of OR techniques as well as the process of problem solving during the engagement with the decision maker.

The course will focus on applications of OR techniques in the following topics.

- Scheduling appointments of patients with primary health care providers and specialists
- Resource planning for equipment, rooms and staff
- Capacity planning and inventory management in health care supply chains
- Planning and managing emergency services
- Designing and operating organ exchanges
- Modeling spread of epidemics and planning response
- Mathematical modeling of biological systems
- Financial planning and pricing in health care

References:

- **Handbook of Healthcare Operations Management: Methods and Applications**, Brian T. Denton, ed., 2013, Springer New York.
- **Handbook of healthcare system scheduling**, Hall, R. W., 2012, New York: Springer Science+ Business Media, LLC.
- **Operations Research and Health Care: A Handbook of Methods and Applications**, Margaret L. Brandeau, Francois Sainfort, William P. Pierskalla, eds., 2004, Kluwer Academic Publishers, Massachusetts.
- **Operational Research for Health Policy: Making Better Decisions**, Brailsford, Sally, and Paul Harper, Proceedings of the 31st Annual Conference of the European Working Group on Operational Research Applied to Health Services. Vol. 31. Peter Lang, 2007.
- **Operations research: applications in health care planning**, Kwak, N. K., Homer H. Schmitz, and Marc J. Schniederjans, University Press of Amer, 1984.
- **Operational research applied to health services**, Boldy, Duncan, 1981.
- **Operations research in health care: a critical analysis**, Shuman, Larry J., Robert Dixon Speas, and John P. Young, 1975.

Course Requirement and Evaluation:

- Project 40%

  Groups of two to three students will select a project about a current decision in which there are underlying health care operations management issues. The project is a practical guide for applying techniques to a real world problem. Students go through a complete analytical decision making cycle from finding a proper problem, modeling, data gathering, validating and solving the model (using LINGO software), and results verification. Each group will submit a final project report in the form of a case study. Students will be assigned a group grade for the project report and individual grade for their participation in project discussion.
- In-class participation and short exams 20%
- Assignments (2) 10%
- Final Exam 30%