CLASS SESSIONS
Exec weekends (July – December 2015), Location TBA

INSTRUCTOR
Nan Liu, Ph.D.
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Office hour: after class or by appointment

TEACHING ASSISTANT
Van Trinh Nguyen
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Office hour: after class

COURSE DESCRIPTION
This course introduces a variety of data analytic and modeling methods commonly used in healthcare management. The course covers data analytic approaches such as statistical regression and time series analysis, and operations research (OR) techniques such as linear programming and queueing models. These methods not only enable practitioners to learn and build evidence from data, but also to develop data-driven solutions to improve the performance of a service system. In addition to the analytic methods, this course discusses a few operations management (OM) tools that are crucial in the management of modern healthcare organizations, such as capacity management and process/bottleneck analysis. In the current healthcare practice environment, knowledge of these data analytic and modeling methods is essential to anyone who manages an enterprise, conducts research, or formulates policies. The course takes a case-based, participatory approach to learning. Data management and analysis are conducted using Excel.

PREREQUISITES
P6103: Managerial Data Analysis & Decision-Making I (or other equivalent courses)

COURSE COMPETENCIES AND LEARNING OBJECTIVES
The faculty of the Department of Health Policy and Management has adopted a carefully researched Competency Model to guide the design of all courses in the Management curriculum. Each course is explicitly charged with reinforcing and developing further a number of the key Competencies identified in the Model. This course focuses specifically on the following competencies:

- Analytical thinking – breaking down problems, understanding and assess basic relationships, and recognizing and analyzing complex relationships;
- Innovative thinking – recognizing, explaining, and predicting patterns;
- Resource management and allocation – understanding techniques for performance improvement;
- Apply biostatistical and epidemiological methods to health policy and management problems on the population level – applying biostatistical methods to health management problems on the population level.

These competencies are reflected and implemented throughout all activities in the course. Students who successfully complete this course will

- be able to derive data-driven analytic solutions for healthcare management problems;
- be able to comprehend results delivered by quantitative researchers;
- be equipped with necessary methodological foundation to learn advanced analytic methods.
COURSE REQUIREMENTS

Homework assignment and grading policy
1. There are 5 individual homework assignments in total. The one with the lowest grade will be dropped from the calculation of overall homework grades. Each homework assignment accounts for 10% of the final grade.
2. Homework assignments will be posted on the Courseworks website after each module, and is due at the beginning of next module. Please use analyticmethods2015e@gmail.com for online submission. Late submissions will NOT be accepted and will receive a ZERO grade.

Case assignment and grading policy
1. There are totally 3 case assignments as team projects. Each case will be briefly discussed in class before assignment.
2. The first case will be presented by teams 1 and 2; the second case will be presented by all teams. Presentation of case 3 consists of two parts. Part 1 will be presented by teams 3 and 4; all teams participate in the presentation of part 2.
3. All teams (regardless presentation or not) should submit slides for grading purpose.
4. Presenting teams will be judged based on the quality of their work and presentation. Non-presenting teams’ work will be judged based on the materials submitted.
5. Cases 1 and 2 each account for 15% of the final grade. Case 3 serves as the final project (20% of the final grade). Besides presentation, each team needs to submit a 3-4 page summary of recommendations made to the executive committee considered in the case.
6. Please use analyticmethods2015e@gmail.com for online submission of the slides and final report. Late submissions are NOT accepted.

Class participation and attendance
Class participation is highly valued and strongly encouraged. To make the learning process much more beneficial and enjoyable, you are expected to contribute to class activities and discussions.

CRITICAL DATES
July 16 First class
Aug 13 Homework 1 due; Case 1 presentation
Sep 19 Homework 2 due;
Oct 16 Homework 3 due;
Nov 12 Homework 4 due; Case 2 presentation
Dec 11 Homework 5 due; Case 3 workshop
Dec 18 Final report of Case 3 due

COURSE STRUCTURE
The course content can be obtained in lectures, labs, homework, case assignments and readings.

ASSESSMENT AND GRADING POLICY
Student grades will be based on:
Homework assignments (individual effort) 50%
Cases 1 and 2 analysis (team effort) 30%
Final case analysis and report (team effort) 20%

FEEDBACK
Your feedback is important for the success of this course. Please feel free to talk to the instructor, or send him an email to share your views with him.
COURSE WEBSITE
http://courseworks.columbia.edu

REFERENCES
There are no required textbooks for this class. Reading materials can be downloaded from the course website or will be distributed in class.

Technical references (not required to buy)

Excel References (not required to buy)
  Login using your uni/password. Select Catalog of Courses, Course Curricula and then Desktop Curricula. Select your version of Office and there you will find Excel Beginning/Excel Advanced/Excel Power User.

MAILMAN SCHOOL POLICIES AND EXPECTATIONS
Students and faculty have a shared commitment to the School’s mission, values and oath. http://mailman.columbia.edu/about-us/school-mission/

Academic Integrity
Students are required to adhere to the Mailman School Honor Code, available online at http://mailman.columbia.edu/honorcode.

Disability Access
In order to receive disability-related academic accommodations, students must first be registered with the Office of Disability Services (ODS). Students who have, or think they may have a disability are invited to contact ODS for a confidential discussion at 212.854.2388 (V) 212.854.2378 (TTY), or by email at disability@columbia.edu. If you have already registered with ODS, please speak to your instructor to ensure that s/he has been notified of your recommended accommodations by Lillian Morales (lm31@columbia.edu), the School’s liaison to the Office of Disability Services.
### Module 1

**Pre-module Assignment:**
- Be prepared to introduce yourself.
- Be prepared to discuss your view on the role and use of “data” in healthcare administration.
- Watch David McCandless: The Beauty of Data Visualization" (duration 18:17) on [www.ted.com](http://www.ted.com).
- Read the case of Women and Children First on the Titanic (Ivey case 9B13E017)

### Session 1 – Overview and Introduction to Data Analytics

<table>
<thead>
<tr>
<th>July 16</th>
<th>Learning Objectives:</th>
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<tbody>
<tr>
<td>1:30-5</td>
<td>• Provide an overview of the course</td>
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<tr>
<td></td>
<td>• Review basic probability and statistics (concepts, probability distributions, descriptive statistics, confidence intervals, hypothesis testing)</td>
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<td>• Discuss data visualization and exploring techniques</td>
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**References:**
- Jank, Chapter 2.

**Lab:**
- Excel basics: descriptive statistics, hypothesis testing, data plotting.

### Session 2 – Analysis of Categorical Data

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<tr>
<th>July 17</th>
<th>Learning Objectives:</th>
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<tbody>
<tr>
<td>1:30-5</td>
<td>• Review contingency tables and Chi-square test</td>
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<tr>
<td></td>
<td>• Introduce measures of association for categorical data: Gamma and Lambda</td>
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<td></td>
<td>• Analyze multidimensional contingency tables using statistical control tables</td>
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<tr>
<td></td>
<td>• Introduce the case of Women and Children First on the Titanic</td>
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</tbody>
</table>

**References:**
- Meier, Chapters 15, 16, 17.

**Lab:**
- Pivot tables in Excel.

- Homework 1 assigned (due Aug 13)
- Case 1 assigned: Women and Children First on the Titanic (slides due Aug 13)

### Module 2

### Case Presentation & Discussion

<table>
<thead>
<tr>
<th>Aug 13</th>
<th>Teams 1 and 2 present Case 1; all other teams need to prepare slides as well.</th>
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<td>9-9:50</td>
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### Session 3 – Forecasting

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<tr>
<th>Aug 13</th>
<th>Learning Objectives:</th>
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<tr>
<td>10-12:30</td>
<td>• Introduce the concept of time-series analysis</td>
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<td></td>
<td>• Discuss different forecasting techniques and use them appropriately</td>
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<tr>
<td></td>
<td>• Introduce the case of Northern Napa Valley Winery, Inc.</td>
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### References:

### Lab:
- Practice different forecasting techniques in Excel.

- Homework 2 assigned (due Sep 19)

### Module 3

### Pre-module Reading:
- Vanderbilt University Medical Center: Elective Surgery Schedule. (Ivey case 9B15E011).

### Session 4 – Simple Linear Regression (Review)
**Sep 18**
**1:30-5:00**

**Learning Objectives:**
- Review assumptions and application context for linear regression
- Understand basic steps to conduct simple linear regression analysis

**References:**
- Jank, Chapters 3, 4.

**Lab:**
- Linear regression in Excel.

### Session 5 – Multiple Linear Regression (Introduction)
**Sep 19**
**9-12:30**

**Learning Objectives:**
- Describe variable transformation in linear regression
- Understand basic steps to conduct multiple linear regression analysis

**References:**
- Jank, Chapters 3, 4.

**Lab:**
- Linear regression in Excel.

### Session 6 – Multiple Linear Regression (Additional topics)
**Sep 20**
**1-4**

**Learning Objectives:**
- Discuss dummy variables and interaction terms in regression models
- Learn how to build a regression model using various variable selection methods
- Introduce the concepts of (multi)collinearity
- Discuss how to avoid pitfalls involved in regression analysis
- Introduce the case of VUMC

**References:**
- Jank, Chapters 4, 5.

**Lab:**
- Linear regression in Excel.

- Homework 3 assigned (due Oct 16)
- Case 2 assigned: Vanderbilt University Medical Center: Elective Surgery Schedule (slides due Nov 12)
Module 4

Pre-module Assignment:
- Read very carefully Merton Truck Company (HBS Case 9-189-163). We will deal with this case in class.

Session 7 – Introduction to Operations Research
Oct 16 5:15-7:30
Learning Objectives:
- Outline operations research methods and their applications to healthcare management

References:

Session 8 – Optimization (Introduction)
Oct 17 9-12:30
Learning Objectives:
- Introduce linear programming (LP)
- Understand the formulation of an LP model
- Solve LP problems using Excel Solver
- Work on the case of Merton Truck Company

References:
- Ozcan, Chapter 10 (ignore the software part).

Lab:
- Formulate LP models and solve them using Excel Solver.

Session 9 – Optimization (Modeling applications)
Oct 18 1-4
Learning Objectives:
- Apply LP to solve various resource allocation problems

Lab:
- Applications of Excel Solver.

- Homework 4 assigned (due Nov 12)

Module 5

Pre-module Assignment:
- Read the case of Paediatric Orthopaedic Clinic at the Children’s Hospital of Western Ontario (Abridged) (Ivey case 9B09D011)

Case Presentation & Discussion
Nov 12 All teams present Case 2.
1:30-2:20
Session 10 – Queueing Theory and its Applications
Nov 12 Learning Objectives:
2:30-5

- Define the components of a queueing system
- Discuss the applications of queueing models in health services management
- Introduce the M/M/s queueing model
- Discuss psychology of waiting and its implication in management

References:
- Ozcan, Chapter 14 (ignore the software part) and Chapter 15.

Lab:
- Analyze queueing models using QtsPlus.

Session 11 – Process Analysis

Nov 15 1-4

Learning Objectives:
- Analyze (existing) business process to reveal bottlenecks
- Improve (business) process to achieve higher productivity
- Introduce the case of Paediatric Orthopaedic Clinic (Abridged)

Lab:
- Develop simple process flow diagram and calculate basic measures of process performance.

- Homework 5 assigned (due Dec 11)
- Case 3 assigned: Paediatric Orthopaedic Clinic at the Children’s Hospital of Western Ontario (Abridged).

Module 6

Case 5 Presentation & Discussion

Dec 9-11:20

All teams participate.

Teams 3 & 4 present the analysis of process. All teams present the recommendations.

Session 12 – Final Review

Dec 11 11:30-12:30

- Final report of Case 3 due Dec 18.