

- 1. Course number and name**
INDE 535 Data Analytics for Operations Research and Financial Engineering
- 2. Credits and contact hours**
3 Credits, 3 hours/week lectures
- 3. Instructor's or course coordinator's name**
Course Coordinator: Bacel Maddah
- 4. Text book: title, author, and year**
 - a. Required textbook**
Ledolter, J. (2013). *Data Mining and Business Analytics with R*. Wiley.
 - b. Other supplemental materials**
Lecture materials and readings will be posted on the course website.
- 5. Specific course information**
 - a. Catalog description**

In this course, the student will learn to identify, evaluate, and capture business analytic opportunities that create value for an organization. Theoretical data analytics methods, as well as case studies on successful analytics applications, will be covered. Basic descriptive analytics methods are reviewed along with a quick introduction to using R in analyzing large data sets. Predictive analytics techniques including clustering, classification, and regression, are covered in detail. Prescriptive analytics applications on utilization simulation and optimization over large data to improve business decisions are presented. Case studies emphasize financial applications such as portfolio management and automated trading.

- b. Prerequisites or co-requisites**

By course: STAT 230, INDE 301, INDE 302, INDE 303, INDE 504

By topic: Probability and statistics, engineering economy, optimization theory, stochastic processes, Monte Carlo simulation

- c. Required, elective, or selected elective course in the program**

This is a required course for fourth-year Industrial Engineering students.

- 6. Course Objectives**

The objectives of this course are to give students:

- An understanding of the importance of data analytics in the decision making process of modern organizations.
- An appreciation of the challenges in applying data analytics in practice.
- An exposure to modern applications of data analytics, especially in Finance.
- An overview of the main predictive analytics tools such regression, classification, and clustering.
- An understanding of prescriptive analytics and its applications.

7. Learning Outcomes

After completing the course, the students are expected to

- Analyze large data sets with R and perform basic descriptive analytics.
- Identify the suitable data analytics tools that assist organizations making data-driven decisions.
- Understand and implement basic linear and nonlinear regression, clustering, classification and other predictive analytics techniques.
- Apply familiar prescriptive analytics tools such as simulation and optimization in large-data contexts.
- Utilize predictive and prescriptive analytics in modern applications, especially financial planning and trading.

8. Brief list of topics covered

No.	Subjects covered	75 min lectures
1	Introduction to analytics for business, predicting outcomes, statistical learning	3
2	Linear regression models, quality of predictions, resampling methods: Cross-validation and the bootstrap, subset selection, ridge and lasso regressions, financial analytics	4
3	Classification models, logistic regression and linear discriminant analysis, k-nearest neighbors and tree based methods , support vector machines	5
4	Unsupervised learning methods, clustering, principal component analysis and partial least squares	3
5	Predictions and skill versus luck, Difference-in-differences method, Matched pairs and causal inference	3
6	Predictive financial analytics, identifying trends and signals in financial data	2
7	Prescriptive analytics, simulating complex scenarios, optimizing critical decisions, optimization with multiple objectives, simulation and optimization in R, applications in retailing and e-commerce	5
8	Prescriptive financial analytics, algorithmic trading, portfolio optimization	4

9. Class/laboratory schedule

- Two 75-minute lectures per week
- Four one-hour introductory R labs

10. Evaluation methods

Midterm Exam	25%
Final Exam	30%
Project	30%
Homework	10%
Class participation	5%

11. Computer usage

R, MS Excel

12. Professional component

Engineering topics: 60%
Mathematics and basic sciences: 20%
Business and Finance: 20%

13. Syllabus last updated

Bacel Maddah, Oct 24, 2017