

American University of Beirut
Maroun Semaan Faculty of Engineering and Architecture
Department of Industrial Engineering and Management

INDE 535 Data Analytics for OR & Financial Eng'g

Spring 2023-2024

Lectures: F 15.30 – 18.00, Bechtel 204

Office Hours: F 18.00 – 19.00, TBD

Instructor

Eng. Mario Karam

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Course Description

In this course, we will learn to identify, evaluate, and capture business analytics opportunities that create value for an organization. We will cover theoretical data analytics methods as well as applications.

We will first review basic descriptive analytics methods to uncover trends and patterns. Descriptive analytics are often displayed using visual data representations and often act as a foundation for future analysis.

Second, we will cover predictive analytics techniques including regression, classification, and clustering. Predictive analytics is a more advanced method of data analysis that uses probabilities to make assessments of what could happen in the future. For example, organizations are using predictive analytics to prevent fraud by looking for patterns in criminal behavior, optimizing their marketing campaigns through targeted marketing and reducing risk by using past behaviors to predict which customers are most likely to default on payments.

Third, we will cover prescriptive analytics applications on utilization of simulation and optimization over large data to improve business decisions. Prescriptive analytics shows companies which option is the best. For example, cost-effective delivery is essential for success and profitability in the package delivery and transportation industry. Minimizing energy usage through better route planning can save time and money. Shippers produce massive amounts of data. Rather than employing armies of analysts and dispatchers to decide how to best operate, these businesses can automate and build prescriptive models to provide recommendations.

Course Objectives

1. Interpret the importance of data analytics in the decision-making process of modern organizations.
2. Implement methods to overcome challenges in applying data analytics in practice.
3. Apply modern applications of data analytics.
4. Utilize the main predictive analytics tools such as regression, classification, and clustering and prescriptive analytics techniques.

Learning Outcomes

1. Visualize and analyze large data sets using appropriate charts and methods.
2. Use the suitable methods to clean data and handle missing values.
3. Understand and analyze the trade-off between bias and variance in dealing with outcome errors.
4. Identify and utilize the proper performance evaluation measures to assess the performance of built machine learning models.
5. Implement data preprocessing techniques to provide proper data format and an improved performance of models.
6. Extract appropriate features from data through the implementation of different techniques.
7. Understand and implement predictive analytics techniques such as regression, classification, and clustering and prescriptive analytics techniques.
8. Utilize predictive and prescriptive analytics in modern applications such as finance, healthcare, and logistics.
9. Use Python to apply the various learnings of the course and build appropriate models to case studies and a final project.

Textbook

None

Suggested Readings

Trevor Hastie, Robert Tibshirani, Jerome Friedman. (2017). [The Elements of Statistical Learning](#). Second edition. Springer.

Yaser S. Abu-Mostafa, Malik Magdon-Ismael, Hsuan-Tien Lin: [Learning from Data](#), AMLBook, 2012.

P. Harrington, [Machine Learning in Action](#), Manning, 2012.

A. Rajaraman, J. Leskovec and J. Ullman, [Mining of Massive Datasets](#), v1.1.

H. Daumé III, [A Course in Machine Learning](#), v0.8.

Additional References

Lecture material and readings will be posted on Moodle.

Topics Covered

The below is a list of topics that will be covered:

Introduction

- Introduction to Data Analytics
- Probability Review

Descriptive Analytics

- Data Visualization
- Data Cleaning and Preparation

Predictive Analytics

- Overview of Machine Learning
- Generalization Bias-Variance Trade-off
- Performance Evaluation

- Data Preprocessing
- Feature Engineering
- Supervised Learning:
 - Linear Regression
 - Logistic Regression
 - Decision Trees
 - Naive Bayes
 - K-Nearest Neighbors
 - Support Vector Machines
 - Deep Learning
- Unsupervised Learning:
 - K-means
 - Dimensionality Reduction – *if time permits*

Prescriptive Analytics

- Optimization
- Simulation

Grading

Attendance and Participation	10%
Assignments and Homework	15%
Group Project	15%
Midterm Exam	25%
Final Exam	35%

Programming Language

The programming language that will be used for class lectures and assignments will be Python. **Students are expected to be familiar with it.**

Project

Students will be required to submit a proposal for applying data analytics methods, learned in the course, on a real-life problem they choose. Then, they will apply these methods using Python and report and present their work and findings. More information on the details of the project will be provided throughout the semester.

Email

Information concerning the course may be sent by the instructor to students by email or through Moodle. Students are responsible for keeping AUB email accounts functioning properly.

Course Website

Moodle

University Policies

By signing up for this course, you confirm that you have read and accepted the terms and provisions of AUB's [Privacy Statement](#).

Academic Integrity

Please refer to AUB Student Code of Conduct:

<https://aub.policytech.eu/dotNet/documents/?docid=147&public=true>, in particular section 1.1, which concerns academic misconduct including cheating, plagiarism, in-class disruption, and dishonesty.

Please be aware that misconduct is vigorously prosecuted and that AUB has a zero-tolerance policy. Course policy is that **credible evidence of cheating will result in course failure**.

Recommended Accessibility Statement to Acknowledge the Unique Learning Needs of Students with Disabilities

AUB strives to make learning experiences as accessible as possible. If you anticipate or experience academic barriers due to a disability (including mental health, chronic or temporary medical conditions), please inform me immediately so that we can privately discuss options. In order to help establish reasonable accommodations and facilitate a smooth accommodations process, you are encouraged to contact the Accessible Education Office: accessibility@aub.edu.lb; +961-1-350000, x3246; West Hall,304.

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The policies are applicable to all the AUB Community including: officers, faculty, staff, academic appointees, students (including medical interns and residents), visiting students, alumni, trainees, visitors, contractors, subcontractors, suppliers, located on campus and at AUB Medical Center, Advancing Research Enabling Communities Center (AREC), or any other facility or program affiliated with the University. The “AUB community” also includes the dependents and domestic employees of faculty and staff dwelling on campus and at AREC.

If you think you have experienced discrimination, discriminatory harassment, or sexual harassment, we encourage you to inform the Equity/Title IX Coordinator, Mitra Tauk at 01-350000 ext. 2514, titleix@aub.edu.lb, report to a Title IX deputy at your faculty or at any other faculty (www.aub.edu.lb/titleix), or report online (www.aub.ethicspoint.com). Reports may be submitted anonymously or not. Please know that the University will maintain the confidentiality of the complaint and privacy of the persons involved to the greatest extent possible, consistent with its goal of conducting a thorough and complete investigation and to the extent permitted by law.

You need to also know that the University has designated academic and administrative department/unit heads, managerial level staff, academic advisors, protection officers, and residence hall staff/monitors, as responsible employees or “mandatory reporters”, and may designate others at its discretion. These individuals are obligated to report actual or suspected discrimination or

discriminatory harassing conduct to the Equity/Title IX Coordinator, unless they are a “confidential” resource. The following have been designated as confidential resources: on campus counselors in the Counseling Center of the Office of Student Affairs and AUB Medical Center counselors, and healthcare providers at the University Health Services (UHS) and at the AUB Medical Center. Confidential resources are not required to report actual or suspected discrimination or harassment to appropriate university officials, except in cases of suspected abuse of a minor, in the event of an external investigation or prosecution, or in the event of imminent danger to the reporting party or others.