MIDDLE EAST TECHNICAL UNIVERSITY FALL 2025
DEPARTMENT OF BUSINESS ADMINISTRATION

BA 4845/5845 – MACHINE LEARNING FOR FINANCE
Monday and Wednesday 14:40-15:55 @ Ömer Yağız Computer Lab

Instructor:	Dr. Berna N. YILMAZ
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Office Hours:	Wednesday 13:00-14:00
Course Web Page:	https://odtuclass.metu.edu.tr/

Course Description:

This course begins with the fundamentals of Python programming, providing students with the skills needed for data analysis, visualization, and manipulation using essential libraries such as Pandas, NumPy, and Matplotlib. It is designed as a comprehensive introduction to the application of machine learning in finance for students with no prior programming or data science experience. Students will then progress to core machine learning concepts, including regression, classification, and model validation, all taught within a financial context. The second half of the course focuses on the unique challenges and advanced techniques specific to financial data, such as market prediction, risk assessment, and sentiment analysis. The course culminates in a final project where students will build and evaluate a complete financial machine learning model, moving from raw data to actionable insights.

Course Prerequisites:

- Students who have completed any one of the following courses with at least the stated semester grade are allowed to register for this course: BA 2802 (DD) or BA 2803 (DD) or BA 5802 (CC) or IAM 521 (CC) or BAS 381 (DD) or ECON 311 (DD) or ECON 312 (DD).
- Familiarity with BA 1502 - Business Statistics is useful.
- No prior programming or machine learning experience is required.

Course Student Learning Objectives: (CSLOs)

Upon successful completion of this course, students should be able to:

Course Specific Skills:

1. Write and execute Python scripts for data analysis within a Jupyter Notebook environment.
2. Utilize core data science libraries (NumPy, Pandas) to perform numerical operations and data manipulation.
3. Source financial data programmatically from online APIs and local files.
4. Clean, preprocess, and wrangle raw financial data to prepare it for machine learning applications.
5. Create informative and insightful data visualizations for financial analysis using Matplotlib and Seaborn.
6. Implement and train linear regression models using scikit-learn to predict continuous financial outcomes.
7. Implement and train classification models (e.g., Logistic Regression, Random Forest) using scikit-learn for tasks like predicting market direction or credit risk.
8. Evaluate model performance using standard metrics such as Mean Squared Error, R-squared, Accuracy, and the Confusion Matrix.
9. Apply robust model validation techniques, including the train/test split and k-fold cross-validation, to prevent overfitting.
10. Implement and interpret results from tree-based ensemble models (Random Forests, Gradient Boosting Machines).

Discipline Specific Skills:

11. Analyze and interpret the unique structural properties and challenges of financial time series data.
12. Interpret model outputs within the context of financial decision-making, risk, and return.
13. Utilize feature importance techniques to identify the key drivers behind a financial model's predictions.

14. Recognize the common pitfalls in quantitative finance, particularly the dangers of backtest overfitting and data leakage in cross-validation.
15. Conduct basic sentiment analysis on financial texts (e.g., news headlines) to create features for predictive models.

Personal and Key Skills:

16. Develop a systematic, problem-solving mindset by tackling complex, real-world financial datasets.
17. Enhance critical thinking by evaluating the assumptions, limitations, and ethical implications of machine learning models in finance.
18. Effectively communicate complex analytical findings using data visualizations and structured reports.
19. Adapt to and apply new computational tools and quantitative methodologies that are actively transforming the finance industry.

Learning and Teaching Methods:

This course follows a hands-on, application-driven approach. The pedagogical method is built around interactive lectures that combine financial theory with live Python coding demonstrations in Jupyter Notebooks. Each week, students will reinforce their learning through practical assignments that require them to work with real-world financial datasets. The course structure is designed to build skills incrementally, starting with Python fundamentals and culminating in a comprehensive final project. Assessment includes weekly assignments, a practical midterm exam to ensure mastery of core concepts, and a final project with a presentation to demonstrate the student's ability to synthesize and apply all learned skills to a financial problem.

Required Reading:

1. Chen, S., Cheung, K. C., & Yam, P. (2024). *Financial Data Analytics with Machine Learning, Optimization and Statistics*. John Wiley & Sons.
2. Tatsat, H., Puri, S., & Lookabaugh, B. (2020). *Machine learning and data science blueprints for finance*. O'Reilly media.
3. Klaas, J. (2019). *Machine Learning for finance*. Birmingham, UK: Packt Publishing.
4. Lopez de Prado, M. (2018). *Advances in Financial Machine Learning*. John Wiley & Sons.

Suggested Reading:

All Python sources over the www, i.e. W3Schools Python Tutorial, Kaggle Python Tutorial.

Required Software:

- Python 3.8 or higher, or
- The Anaconda Distribution (which includes Python and Jupyter Notebook), or
- Google Colab with a Gmail account (no installation required).

Required Python libraries: pandas, numpy, scikit-learn, matplotlib, seaborn, yfinance, statsmodels.

Assessment and Grading:

Form of Assessment	% Contribution	Size of the assessment	CSLOs covered by the assessment	Feedback Method
Midterm Examination	30	120-minute in-class exam	1, 2, 3, 4, 5, 6, 11	Written (via ODTUClass)
In-Class Assignments	30	Weekly short assignments (~15 minutes each)	1-19	Written (via ODTUClass)
Final Project & Presentation	40	Final report (~3000 words) & 30-minute presentation.	1-19	Written (via ODTUClass) and oral feedback

Makeup Examinations: There will be no make-ups for exams, projects or presentations without a department-approved excuse. If you have a time conflict, please contact me ahead of time. There will be no make-ups for in-class exercises under any circumstances, but missed exercises may be compensated by attending those held in other sessions.

Important Note About Re-sit (Bütünleme) Exams: Please note that re-sit exams are no longer given at METU, unless it is the graduation semester.

Course Policies:

STUDENT DISABILITIES: Any student, who, because of a disabling condition, may require special arrangements in order to meet course requirements, should contact the instructor as soon as possible. Students should present the appropriate documentation from the university's Disability Support Office (Engelsiz ODTÜ Birimi, ODTÜ Kütüphanesi, Solmaz İzdemir Salonu, Tel: 210.7196; engelsiz@metu.edu.tr) verifying their disability, and outlining the special arrangements required. Please note that no accommodations will be provided to the disabled students prior to the completion of this approved University process.

ACADEMIC DISHONESTY: The Department of Business Administration has no tolerance for acts of academic dishonesty. Such acts damage the reputation of METU, the department and the BA/MBA/MS degree and demean the honest efforts of the majority of the students. The minimum penalty for an act of academic dishonesty will be a zero for that assignment or exam.

CHEATING: All university, faculty/institute, and department principles on academic honesty will be strictly enforced. The usual consequence for academic dishonesty is failure of the course and referral of the case to the Dean of the Faculty/Institute for additional disciplinary action. Examinations are individual and are to be completed without outside assistance of any sort. Persons observed cheating during examinations will receive a failing grade in the course. Homework assignments are individual, unless otherwise specified by the instructor, and are to be completed without outside assistance of any sort, as well. Persons observed cheating in their homework assignments will receive a score of zero for the portion of the semester grade that is allocated to such assignments.

PLAGIARISM: The instructor assumes that students will do their own work. By placing their names on assignments (individual or team), students are affirming that the contents are their original work. Any previous work available from files or past students, as well as materials available on the internet may be used only as a suggestive model. Violation of this provision will be considered as unethical behavior, subject to disciplinary action. If you have any doubt about the use of a specific material, see the instructor ahead of time. Any material used from outside sources should be referenced appropriately. Persons observed to plagiarize while preparing assignments will be referred to the Graduate School of Social Sciences for additional disciplinary action and also, they will receive a score of zero for the portion of the semester grade that is allocated to such assignments.

Please read the following documents carefully:

Turkish: https://oidb.metu.edu.tr/sites/oidb.metu.edu.tr/files/ODTUAkademikDurustluk-Kilavuzu-7.3.2016.son .pdf
English: http://oidb.metu.edu.tr/sites/oidb.metu.edu.tr/files/Academic%20Integrity%20Guide%20for%20Students.pdf

Turkish: http://oidb.metu.edu.tr/sites/oidb.metu.edu.tr/files/ODTU%20Sinav%20Kurallari-Kilavuz-7.4.2016.son .pdf
English: http://oidb.metu.edu.tr/sites/oidb.metu.edu.tr/files/Guide%20for%20Rules%20to%20Be%20Followed%20In%20an%20Examination%20Environment.docx

METU HONOR CODE

Every member of METU community adopts the following honor code as one of the core principles of academic life and strives to develop an academic environment where continuous adherence to this code is promoted.

"The members of the METU community are reliable, responsible and honorable people who embrace only the success and recognition they deserve, and act with integrity in their use, evaluation and presentation of facts, data and documents."

Students arrive on time. Timely arrival ensures that classes are able to start and finish at the scheduled times. Timely arrival shows respect for both fellow students and faculty and it helps to create a better learning environment by reducing avoidable distractions.
Students are fully prepared for each class. Much of the learning in this course takes place during classroom discussions. When students are not prepared, they cannot contribute to the learning process. This affects not only the individual but also the classmates who count on them.
Students respect the views and opinions of their colleagues. Disagreement and debate are encouraged; however, intolerance for the views of others is unacceptable.

STUDENT EXCUSES: Unless you inform me in advance, I will not excuse you from any of the grade requirements. At the same time, this does not mean that I will allow you to miss a test or an assignment with any excuse that you present to me. Please note that the excuse is acceptable for only the most extreme circumstances and only after stringent verification and approval by the Department.

KNOW YOUR RIGHTS AND RESPONSIBILITIES! http://oidb.metu.edu.tr/en/academic-rules-and-regulations

NOTE THE IMPORTANT DATES ON THE ACADEMIC CALENDAR! https://oidb.metu.edu.tr/en/academic-calendar

Notes:

- Usage of cell phones is strictly prohibited during class. Please be courteous to your classmates and me and make sure that your phones are on silent mode before the class begins.
- Please arrive on time and do not enter the classroom if I already have closed the classroom doors. If you have to leave early, please inform me in advance, but note that there will be no make-up or compensation for in-class assignments missed due to leaving early.
- You are encouraged to drop by my office during office hours for questions, concerns, or suggestions. Outside the office hours, please make an appointment with me in advance, before or after the class, via phone or e-mail. For quick questions that you may have, note that e-mailing is a very effective means of communicating with me.

The instructor assumes that students who attend the next class have understood and accepted to agree with all the requirements and rules of this course.

Don’t be Trashy. Recycle.

Do not throw items away in the trash that should go into the recycling bin.

Show a little class.

REFUSE, REDUCE, REUSE, REPURPOSE, RECYCLE!

The following table gives the tentative schedule for the semester. The lectures will stress the most important and/or most difficult material. Appendices are required only if they are assigned. The students are required to read the chapters and appendices before they are covered in class.

Tentative Course Schedule				
Month	Day	Topic	Reading/ Assignment	CSLO
		PART 1: PYTHON AND FINANCIAL DATA FOUNDATIONS		
September	29	Introduction to Python, Anaconda, and Jupyter	Various	1, 16
October	1			
	6	Numerical Analysis with NumPy & Data Structures with Pandas	Various	2
	8			
	13	Sourcing & Wrangling Financial Data	Various	3, 4
	15			
	20	Exploratory Data Analysis & Visualization	Various	5, 18
	22			
	27	Working with Time Series Data, Part I	Various	11
	29	*No Class: Republic Day*		
November	3	Working with Time Series Data, Part II	Various	11
		PART 2: MACHINE LEARNING FUNDAMENTALS		
	5	Supervised Learning I: Regression Models	Various	6, 8, 12
	10			
	12	MIDTERM EXAMINATION		1, 2, 3, 4, 5, 6, 11
	17	Supervised Learning II: Classification Models	Various	7, 8, 12
	19			
	24	Model Validation & Hyperparameter Tuning	Various	9, 17
	26			
December	1	Tree-Based and Ensemble Models	Various	10
	3			
		PART 3: ADVANCED TOPICS		
	8	The Dangers of Backtesting	Various	14, 17
	10			
	15	Unsupervised Learning & Natural Language Processing (NLP)	Various	15, 16
	17			
	22	Risk Management and Case Study	Various	12, 14, 16, 17
	24			
	29	Final Project and Presentations		13, 18, 19
	31			