

ECON 4305: Applied Machine Learning for Economic and Financial Analysis

HKUST Department of Economics

2025-26 Fall

Instructor: C-Y (Eric) NG Email: ecyng@ust.hk Office: LSK 6016D Office hours: by appointment Teaching Assistant: Jeremy TO Email: ecjeremy@ust.hk Office LSK 6066 Office hours: by appointment	Lecture: Tue & Thu: 12:00 – 13:20 Room: Rm 1033, LSK Bldg Tutorial: Tue: 15:00 – 15:50 Room: Rm 1033, LSK Bldg Course website: https://canvas.ust.hk
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Course Description

This course applies machine learning to solve economic and financial problems, including residential property valuation, GDP and recession forecasting, default risk prediction, credit card fraud detection, portfolio analysis, market volatility prediction, and stock trading decisions. It maps those problems into the relevant supervised, unsupervised, and reinforcement learning tasks, and introduces basic machine learning methods. Students will get hands-on practical machine learning experience by analyzing empirical data.

Prerequisites

ECON 3334 or equivalent

Course Intended Learning Outcomes (CILOs) and Mapped PILOs

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

1. Identify the machine learning approach for a potential economic and financial application. (PILOs 1, 2, 3).
2. Differentiate machine learning tasks by regression, classification, clustering, and reinforcement learning. (PILOs 1, 2, 3).
3. Apply machine learning methods to analyze practical economic and financial problems. (PILOs 1, 2, 3)
4. Implement machine learning techniques in Python. (PILO 3).
5. Conduct empirical research using machine learning methods (PILOs 1, 2, 3).

Assessment Scheme

Assessment Tasks	Contribution to Final Grade (%)	Due Dates
Assignments (Individual)	15%	Oct3, Oct 24, Nov 14
In-class Exam (Individual)	35%	Nov 27
Group Project*	50%	Nov 30

*Please refer to the file “**Group Project Guidelines**” for details. You need to form a group of 3-4 members. Please email your group information (names and student numbers) to me by Sep 13. We may conduct peer evaluation to assess individual contribution to the group project. For students in BBA ECON and BSc ECOF students admitted in 2021-22 or before, and students in the BSc MAEC program, you can use the group project’s paper to fulfill the requirement of ECON 4670.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped CILOs	Explanation
Assignments	CILOs 3, 4	The assignments evaluate students' ability to apply ML tools to solve economic and financial problems.
Exam	CILOs 1, 2, 3	The exam assesses students' understanding of ML concepts discussed in the lectures.
Group Project	CILOs 3, 4, 5	The group project assesses students' ability to conduct empirical research using machine learning methods.

Learning Resources

There is no required textbook. We use lecture slides and code examples for teaching. All teaching files are downloadable from the course CANVAS website (<https://canvas.ust.hk>).

This course uses Jupyter Notebook to write Python codes. Please download the Anaconda Python package. You also need to install different ML libraries. Please refer to the file “**Installation of ML Libraries**” for details.

Final Grade Rubrics

Grade	Short Description	Elaboration
A	Excellent Performance	Demonstrate a deep understanding of the machine learning tools covered in the course. Exhibits exceptional skills in utilizing the taught techniques to solve related economic and financial problems. Excels in the assignments, exam, and group project.
B	Good Performance	Shows a solid grasp of the machine learning tools and techniques covered in the course. Demonstrates good skills in utilizing them to solve related economic and financial problems. Performs well in the assignments, exam, and group project.
C	Satisfactory Performance	Demonstrate an adequate understanding of the machine learning tools and techniques covered in the course. Demonstrates fair skills in utilizing them to solve related economic and financial problems. Performs fairly in the assignments, exam, and group project.
D	Marginal Pass	Students show limited understanding of course materials, inconsistent use of tools, and incomplete performance in assignments, exam, and group project.
F	Fail	Students display a lack of understanding of course materials, inadequate use of tools, and unsuccessful completion of assignments, exam, and group project.

Course Outline (tentative)

1: Machine Learning Landscape (Week 1)

2: Supervised Learning: Regression Models with regularization (Week 2, 3)

- Financial Application: Residential Property Valuation
- Methods: Regression with Regularization (Ridge, LASSO, Elastic Net)

3: Supervised Learning: Dimensionality Reduction and Feature Selection Methods (Week 3, 4)

- Economic Application: Forecasting of GDP Growth
- Methods: Principal Component Analysis, SelectKBest, Recursive Feature Elimination

4: Supervised Learning: Classification Models (Week 4, 5)

- Banking Application: Default Risk Prediction
- Methods: Logistic Regression, SGD Classifiers, Decision Trees, Support Vector Machines

5: Supervised Learning: Ensemble Methods (Week 5, 6)

- Banking Application: Default Risk Prediction
- Economic Application: Recession Forecasting
- Methods: Random Forest, Extra Tree, Gradient Boosting, XGBoost

6: Cost-Sensitive Learning Models (Week 6, 7)

- Banking Application: Payment Card Fraud Detection
- Methods: Example-Dependent Cost-Sensitive Logistic Regression, Decision Trees, Random Forest

7: Unsupervised Learning: Outlier Detection Models (Week 7, 8)

- Banking Application: Credit Card Fraud Detection
- Methods: Isolation Forest, Local Outlier Factor, One-Class Support Vector Machine

8: Unsupervised Learning: Clustering Analysis (Week 8, 9)

- Financial Application: Portfolio Construction
- Methods: K-Means, Gaussian Mixture

9: Supervised Learning: Neural Networks (Week 9, 10)

- Financial Application: Volatility Prediction
- Methods: Multilayer Perceptron Neural Network, Recurrent and Long Short-Term Memory Network

10: Reinforcement Learning (Week 11, 12)

- Financial Application: Stock Trading Decisions
- Methods: Q-Learning, Deep Q-Learning, Policy Gradient methods

Course AI Policy

The use of Generative AI is permitted for learning only, but not for all of the assessment tasks.

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to [Academic Integrity | HKUST - Academic Registry](#) for the University's definition of plagiarism and ways to avoid cheating and plagiarism.