

ECON 4305: Applied Machine Learning for Economic and Financial Analysis

HKUST Department of Economics

2026-27 Fall

Instructor: 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: 10:30 – 11:50 Room: Rm 1034, LSK Bldg Tutorial: Tue: 18:00 – 18:50 Room: Rm 1009, 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 valuation of residential property price, forecasting of GDP and economic recession, prediction of credit default risk, 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 (introductory econometrics), and introductory calculus is also expected.

Course Intended Learning Outcomes (CILOs) and Mapped PILOs

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

1. Identify the appropriate machine learning approach for an economic or financial problem. (PILOs 1, 2, 3).
2. Differentiate ML by regression, classification, clustering, and reinforcement learning. (PILOs 1, 2, 3).
3. Apply ML 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/Exam Dates
Assignments (Individual)	15%	Sep 30, Oct 21, Nov 9
Group Project*	35%	Nov 23
In-class Test**	10%	Oct 27 (in tutorial session)
Final Exam	40%	Final exam period (Dec 7-19), TBA by AR

*Please form your group of 4 members on CANVAS course page by Sep 14: navigate to the course page and click People on the left-hand course menu. Then click the Groups tab, find the group you want to join, and click Join. For project requirements, please refer to “**Group Project Guidelines**”. The file is available on CANVAS course page under Files menu: Group Project. If you are taking ECON4670, you can use the group project’s paper to fulfill its requirements.

**There is no make-up test. If you miss the in-class test, the weight of the test will be transferred to the final exam.

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.
Exams	CILOs 1, 2, 3	The exams assess 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 CANVAS course page (<https://canvas.ust.hk>) under the Files section (with sub-sections of Lecture Slides, Code Examples, and Group Project).

This course uses Anaconda, a software that comes pre-loaded with hundreds of popular Python data science packages (e.g., Jupyter Notebook, Numpy, Pandas, Python, Scikit-learn, Matplotlib), to implement code examples. You also need it to do assignments and project. Please refer to the file “**Installation of ML Libraries**” on how to install Anaconda and other ML libraries in your PC/MacBook. The file is available on the CANVAS course page under the Files menu: Code Examples.

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, exams, 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, exams, 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, exams, and group project.
D	Marginal Pass	Students show limited understanding of course materials, inconsistent use of tools, and incomplete performance in assignments, exams, and group project.
F	Fail	Students display a lack of understanding of course materials, inadequate use of tools, and unsuccessful completion of assignments, exams, 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, 6)

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

5: Supervised Learning: Ensemble Methods (Week 6, 7)

- Economic Application: Recession Forecasting
- Methods: Random Forest, Extra Tree, Gradient Boosting, XGBoost

6: Supervised Learning: Neural Networks (Week 7, 8)

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

7: Unsupervised Learning: Clustering Analysis (Week 9)

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

8: Unsupervised Learning: Outlier Detection Models (Week 10)

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

9: Reinforcement Learning (Week 11, 12)

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

Course AI Policy

The use of Generative AI is encouraged for self-learning only but not permitted for doing the assessment tasks (assignments, group project, and exam).

Exam Policy

There is no make-up final exam for any reasons other than acute medical illness or unexpected family emergencies. Under such circumstances, students should seek approval of exam absence from the instructor before the final exam and provide medical certificates or other legitimate documents to justify the absence of final exam. Absence from final exam without prior approval of absence and valid documentary proof would result in zero score. The make-up exam, if arranged, will be scheduled as soon as possible within 5 business days after the original final exam date.

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.