ECON 5060: Applied ML for Economic and Financial Analysis (2 units)

HKUST Department of Economics

2024/25 Spring Term

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Course Description

This course introduces the applications of machine learning for economic and financial analysis. It relates different business problems to the relevant supervised, unsupervised, and reinforcement learning tasks. Topics include valuation of property prices, macroeconomic forecasting, prediction of credit default risk, fraud detection of financial transaction, portfolio analysis, volatility prediction, and trading decision analysis. Students will learn and apply basic machine learning tools to solve practical economic and financial problems.

Prerequisites

Undergraduate training in introductory econometrics and statistics is 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 a potential economic and financial application. (PILO 6, 9)
2. Differentiate machine learning by regression, classification, clustering, and strategy optimization. (PILO 6, 9)
3. Apply machine learning methods to analyze practical problems related to economics and finance. (PILO 9, 10, 12)
4. Implement machine learning techniques in Python. (PILO 8, 9, 13)
5. Conduct empirical research using machine learning methods. (PILO 8, 9, 12, 13)

Assessment Scheme

Group Project*	55%	Due by March 27, 11:59pm
In-class Exam	45%	In-class exam on March 24, 9am

*Please form a group of 6 members. Email your group information (with student names and ID numbers) to me by Feb 6. Please refer to the file "Group Project Guidelines" (on CANVAS course website: Files/Group Project) for project requirements.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped CILOs	Explanation
Exam	CILOs 1, 2, 3	The exam assesses students' understanding of ML concepts discussed in the lectures.
Project	CILOs 3, 4, 5	The 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 Anaconda Python package online. You also need to install different machine learning libraries. Please refer to the file "Installation of ML Libraries" for details. You may bring your laptop when we teach the code examples in the lectures.

Course AI Policy

The use of Generative AI is permitted for self-learning only, but not for the assessment tasks including the group project and individual exam.

Final Grade Rubrics

Grade	Short Description	Elaboration
A range	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 exam and project.
B range (B+, 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 exam and project.
B-, C+, C	Marginal Performance	Demonstrate a basic understanding of the machine learning tools and techniques covered in the course. Demonstrates limited skills in utilizing them to solve related economic and financial problems. Performs fairly in the exam and project.
F	Fail	Students display a lack of understanding of course materials, inadequate use of tools, and unsuccessful completion of exam and project.

Course Outline

1: Machine Learning Landscape

2: Supervised Learning: Regularized Regression Models

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

3: Supervised Learning: Dimensionality Reduction and Feature Selection Methods

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

4: Supervised Learning: Classification Models

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

5: Supervised Learning: Ensemble Methods

- Banking and Economic Applications: Default Risk Prediction, Recession forecasting
- Methods: Random Forest, Extra Tree, Gradient Boosting, XGBoost

6: Unsupervised Learning: Outlier Detection Models

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

7: Unsupervised Learning: Clustering Analysis

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

8: Supervised Learning: Neural Networks

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

9: Reinforcement Learning

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

Academic Integrity

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.