ECON 6110L: Applied Machine Learning for Economic and Financial Analysis

HKUST Department of Economics

2022/23 Fall

Instructor: **C-Y (Eric) NG** Email: ecyng@ust.hk Office: LSK 6016D Office hours: by appointment Teaching Assistant: Email: Office: TBA Office hours: by appointment	Date: 5 Sep – 31 Oct Lecture: Mon 3:00PM - 6:20PM Room: LSK 1003 Course website: https://canvas.ust.hk

Course Description

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

Prerequisites

Undergraduate training in introductory econometrics and statistics is expected

Course Intended Learning Outcomes (CILOs)

Upon successful completion of this course, students will be able to:
1. Identify the appropriate machine learning task for a potential economic and financial application.
2. Describe the core differences in machine learning by regression, classification, and clustering.
3. Apply machine learning methods to analyze practical cases related to economics and finance.
4. Implement machine learning techniques in Python.

Teaching Approach

This course is primarily delivered through lectures and a group project.

Teaching & Learning Activities	Roles in the Course	Course Learning Outcomes Addressed
Lectures	Explain machine learning concepts and methods to students.	1, 2, 3, 4
Group Project	Learn to apply machine learning methods to conduct research and present findings.	1, 2, 3, 4

Assessment Scheme

- Group Project (Due Nov 3):   70%
- In-class Quiz (Oct 31):   30%

Please form a group of 4 people and email your group information (names and student numbers) to me by 15 Sep. We may conduct peer evaluation to assess individual contribution to the group.

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 ML libraries. Please refer to the file "Installation_list" for details. You are highly recommended to bring your laptop when we teach the code examples in the lectures.

Group Project

Paper Content Requirements:

- Choose one of the given topics
- Formulate the procedures or methodologies in addressing the topic
- Collect, compile, preprocess, and analyze data
- Apply at least five different ML methods that you learn in this course to solve your ML task
- Report the findings

Paper Format Requirements:

- Word or PDF
- A cover page with title and group information (group number, student names and numbers).
- The structure includes an introduction (or executive summary), main body, conclusion, and a list of references.
- **Maximum 16 pages** (cover page/tables/charts included) with font size of 11 or 12, double spacing.

Submission of Term Paper:

- Please email your group project paper and the code file to me by 3 Nov.

Course Outline

Topic 1: Introduction

- Difference between statistical modeling and machine learning
- The machine learning landscape
- Installation of ML libraries

Topic 2: Supervised Learning: Regression Analysis

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

Topic 3: Supervised Learning: Regression with Dimensionality Reduction and Feature Selection

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

Topic 4: Supervised Learning: Classification Analysis

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

Topic 5: Supervised Learning: Ensemble Methods

- Banking Application: Credit Default Prediction
- Economic Application: Recession forecasting
- Methods: Ensemble Learning (Random Forest, Gradient Boosting, XGBoost)

Topic 6: Unsupervised Learning: Ensemble and Other Methods

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

Topic 7: Unsupervised Learning: Clustering Analysis

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

Topic 8: Supervised learning: Neural Network

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

Topic 9: Unsupervised Learning: Neural Network

- Financial Application: Stock Market Anomaly Detection
- Method: LSTM Autoencoder

*Note that I may fine tune some of the topics above while ensuring the course objectives being achieved.