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

HKUST Department of Economics

2021/22 Fall

Instructor: **C-Y (Eric) NG** Email: ecyng@ust.hk Office: LSK 6016D Office hours: by appointment Teaching Assistant: TBA Email: Office: Office hours: by appointment	Date: 22-OCT-2021 - 10-DEC-2021 Lecture: Fri 09:00AM - 12:20PM Room: Rm 1005, LSK Bldg Course website: https://canvas.ust.hk

Course Description

This course discusses the applications of machine learning for economic and financial case study analysis. It relates different business problems to the relevant supervised and unsupervised learning tasks. The application case studies include forecasting of macroeconomic variables, financial market prediction and anomaly detection, valuation of property prices, banking applications related to default risk prediction and fraud detection, and others. Students will learn basic machine learning tools and some simple deep learning models to solve practical economic and financial problems.

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: 70%
- In-class Quiz: 30%

Please form a group of no more than 4 people and email your group information (names and student numbers) to me by 27 Oct. We may conduct peer evaluation to assess individual contribution to the group.

Learning Resources

There is no required textbook for this course. Instead, we use lecture slides and code examples for teaching. All teaching materials and other references are downloadable from the course CANVAS website.

You need to use Jupyter Notebook to write Python codes. One popular way to get Jupyter Notebook is to download the free Anaconda Python package. After installing the Anaconda environment, you can download and install many useful machine learning libraries.

You are highly recommended to bring your laptop with Jupyter Notebook installed when we teach the code examples in the lectures.

Group Project

Paper Content Requirements:

- Identify the appropriate machine learning task for the given topic
- 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 should include an introduction (or executive summary), main body, conclusion, and a list of data sources and 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 15 Dec.

Course Outline

Topic 1: Introduction

- Difference between statistical modeling and machine learning
- The machine learning landscape
- Installation of ML open-source software/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, Pipeline in ML

Topic 4: Supervised Learning: Classification Analysis

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

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

Topic 7: Unsupervised Learning: Clustering Analysis

- Financial Application: Portfolio Construction
- Method: K-Means

Topic 8: Supervised learning: Neural Network

- Financial Application: Prediction of Stock Market Direction
- Methods: Multilayer Perceptron 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.