**School of Economics**

**Quaid-i-Azam University, Islamabad**

**Machine Learning in Economics**

This course is designed to understand role of machine learning in practical decision making and for Prediction and Public Policy. Large-scale data sets (”big data”) have become ubiquitous across many applied areas. The goal of this course is to provide an introduction to methods that allow to deal with this situation.

**Objectives**

We focus on statistical learning techniques and high-dimensional statistics, and show how they can be applied in economics and business administration. Students will learn how to program statistical methods in R/PYTHON, as well as how and when to use the common libraries in these languages.

**Learning Outcomes**

After having this course, students in social sciences will be able to make better understanding of machine learning role in policy making. How machine learning can help to have better predictions and simultaneously students will be able to get an idea of the limitations of machine learning in social sciences as it does not address causal questions. How econometrics and AI are linked to each other will also be part of the learning process. Students will learn to analyze text data as its most widely used in economics, law, linguistics, history among many other disciplines.

**Prerequisites**: For students majoring in Economics, we require Econometrics course and students coming from different departments are welcome, but should have similar level background or at least have passed one quantitative course.

**Syllabus**

**Course Outline This is the first time this course will be taught, so please**

**be advised that the material may change during the semester.**

**1. Introduction: statistical models, loss functions, optimization**

**2. Review of multivariate linear regression**

**3. Beyond linear regression: nonlinear regression, polynomial regression**

**4. Learning theory: model selection, bias-variance trade-off, overfitting**

**and underfitting, penalization.**

**5. Regularization: Ridge regression**

**6. Sparsity: LASSO**

**7. Ensemble methods: Random forests, Boosting**

**8. Classification: Logistic regression, Neural net/Deep Learning**

**9. Dimensionality reduction: Nearest-neighbors clustering, Principal**

**component analysis (PCA).**

**10. Text as data**

**11. Deep Learning and AI in Economics and Social Sciences**

**Required Resources**

(ISLR) An introduction to Statistical Learning, 2nd edition. James, Witten, Hastie, and

Tibshirani. Springer. 2021.

Business Data Science (BDS): combining machine learning and economics to optimize, automate,and accelerate business decisions. Taddy. McGraw Hill. 2019.

**Useful references:**

Data Science for Business (DSB): What you need to know about data mining and data-analytic

thinking. Provost and Fawcett. O’Reilly. 2013.

The Elements of Statistical Learning (ESL): data mining, inference, and prediction, 2nd edition. Hastie, Tibshirani, and Freidman. 2017.

American Economics Association workshops on Machine Learning, Big Data and Causal Inference 2018 and 2023

Matt Taddy , *Business Data Science: Combining Machine Learning and Economics to Optimize, Automate, and Accelerate Business Decisions*

Varian, Hal R. 2014. "Big Data: New Tricks for Econometrics." *Journal of Economic Perspectives*, 28 (2): 3-28**.**DOI: 10.1257/jep.28.2.3