Lancaster University Management School

timberlake
statistics | econometrics | forecasting

Econ620 : Advanced Machine Learning and Deep Learning

COURSE AIMS & OBJECTIVES, KEY SKILLS AND LEARNING OUTCOMES

Course Aims & Objectives: This course takes a look at modern machine learning techniques. It takes participants through recent advances in supervised and unsupervised methods and algorithms with a focus on complex business applications. Practical implementations include the use of modern recommendation systems packages, XGBoost, CatBoost, LightGBM, transparent inference, SHAP value analysis, mixture of expert architectures and more. It also provides an introduction to deep learning techniques. More specifically, it reviews the use of deep neural networks, deep reinforcement learning, recurrent nets, and convolutional neural networks among others.

Key Skills: By the end of this course, students should have some knowledge and understanding of:

- Problem-Solving with ML: Ability to address real-world challenges using machine learning.
- Comprehensive ML Knowledge: Broad understanding of diverse machine learning topics.
- Deep Learning: Mastery of advanced techniques in deep learning.
- Generative Models: Understanding and application of generative models.
- Natural Language Processing (NLP): Skills in leveraging NLP for complex problem-solving.
- Advanced AI Techniques: Exploration and application of cutting-edge AI techniques.
- Reinforcement Learning: Proficiency in applying reinforcement learning methodologies.
- Complex Problem Tackling: Application of skills to address intricate real-world problems.

Desired Outcomes: By the end of this course, students should be able to:

- Demonstrate a sound knowledge of supervised and unsupervised learning techniques;
- Present, interpret and analyse information in numerical form and use econometric and other packages effectively;
- Understand the relevance of different econometric approaches to specific applications in economics;
- Be able to select relevant information from large amounts of data;
- Master the advanced tools of machine learning and deep learning.
- Communicate and present complex arguments with clarity and succinctness
- Plan and manage time effectively.

COURSE STRUCTURE

Econ 620 is a 20 credits course and therefore students are expected to input approximately 200 hours of study into the course. The total number of contact hours on Econ 620 is 25 hours. This leaves 175 hours for private study. Course Delivery comes in the form of Lectures with 25 hours delivered over the first 5 weeks of the term (20 hours of lectures and 5 hours of tutorials). There will be optional clinics on the last day of the course.

During your private study you should strike a balance between reading the course material (which is the primary source of information) and the recommended textbooks, thinking critically about how these fit into the body of knowledge on the subject and about how our level of knowledge can be improved, performing exercises, completing coursework and revising for examinations. You can expect to perform well on this course only if you work consistently through the year.

Prior to enrolment on the module, the student must have successfully completed
ECON601
Econ619
Econ621

COURSE CONVENOR

Prof. Badih Ghatthas

LECTURERS CONTACT INFORMATION (Including Office Hours)

Prof. Badih Ghatthas

email: badihghattas@gmail.com

COURSEWORK ASSESSMENT

The CWA mark will be calculated as 100% coursework. The coursework will be assigned at the end of the course

The coursework will be delivered to students at the end of week 6 of each term and is due for submission at the end of week 10 of the term, allowing students 4 weeks for completion.

Coursework must be submitted electronically through the Moodle site for this course:

FEEDBACK ON COURSEWORK:

The coursework will be marked and returned to students within 4 weeks of the submission deadline. Feedback will consist of marker's notes appended to the pdf of your coursework.

MARKING CRITERIA AND PENALTIES

Marking criteria can be found in the Economics Undergraduate Handbook and the general course information paper. An electronic copy of this can be found via the Current Student page of the university website then follow the Academic Regulations link https://gap.lancs.ac.uk/ASQ/QAE/MARP/Documents/UG-Assess-Regs.pdf

FINAL MARK INFORMATION

This course is assessed 100% by means of coursework. The final mark is the average of the marks obtained in the two pieces of coursework.

COURSE TEXT AND RECOMMENDED READING

Lecture notes and Lecture slides.

Python Data Science Handbook: Essential Tools for Working with Data - Oreilly.

Hands-On Data Science and Python Machine Learning - Frank Kane, Packt Publishing Ltd

Statistical Foundations, Reasoning and Inference: For Science and Data Science - Göran Kauermann , Helmut Küchenhoff, Christian Heumann, Springer Nature

Introduction to Deep Learning: From Logical Calculus to Artificial Intelligence - Sandro Skansi, Springer

Deep Learning with Python. Francois Chollet. Simon and Schuster.

COURSE OUTLINE/LECTURE SCHEDULE

Introduction to Advanced Machine Learning Techniques

- The role of advanced techniques in solving complex problems
- Overview of popular advanced techniques, including deep learning, reinforcement learning, and generative models

Ensembles

- The basics of model ensembles
- Random forests
- Gradient Boosting, XGBoost, CatBoost

Deep Learning

- What is deep learning and how does it work?
- Successes and limitations of Deep learning approaches
- Implementing deep learning models using popular libraries and frameworks
- Convolutional networks, pooling and dropout
- Natural language processing and Recurrent Neural networks.
- Applications of deep learning in computer vision and natural language processing

Reinforcement Learning

- The basics of reinforcement learning and its applications
- Implementing reinforcement learning algorithms using popular libraries and frameworks
- Examples of reinforcement learning in real-world applications