

Course Syllabus

HEOR DS 530: Principles of Machine Learning & Applications in Healthcare

Spring Quarter

Course 3 of 3 in the *Certificate in Data Science Methods for Real-World Evidence in Health*

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Course Description

(2025-2026 curriculum; subject to slight changes for 2026-2027)

An introduction to machine learning concepts and their application to the field of health economics and outcomes research. The course goal is to give students the skills to be able to understand the applied machine learning literature and communicate results to a general scientific audience. The course introduces a wide array of machine learning methods for prediction of outcomes and lays out the fundamental differences between different classes of methods, discusses the application of machine learning to causal inference, and ends with considerations for the real-world deployment of machine learning in healthcare, such as discrimination in health care decision-making with machine learning algorithms, model drift, generalizability, and regulation.

Course Learning Outcomes

By the end of this course, students will be able to:

- Understand introductory concepts in machine learning
- Read and interpret articles that apply machine learning in HEOR
- Explain differences between supervised vs. unsupervised learning
- Understand introductory concepts in algorithmic fairness
- Describe considerations for the real-world application of machine learning in healthcare, such as model drift, generalizability, and regulation

Course Lessons

- Module 1 – Introduction to Machine Learning
 - Lesson 1: Introduction to Machine Learning in HEOR
 - Lesson 2: Application of Machine Learning to Prediction vs. Inference
 - Lesson 3: Machine Learning Application Landscape in HEOR
- Module 2 – Supervised Learning for Regression Problems
 - Lesson 4: Evaluating Model Predictive Accuracy for Regression Problems

- Lesson 5a: Introduction to Supervised Learning Methods for Regression Problems – Part I, Regression-Based Methods
 - Lesson 5b: Introduction to Supervised Learning Methods for Regression Problems – Part II, Tree-Based Methods
 - Lesson 5c: Introduction to Supervised Learning Methods for Regression – Part III, Super Learner and Deep Learning
- Module 3 – Supervised Learning for Classification Problems
 - Lesson 6: Evaluating Model Predictive Accuracy for Classification Problems
 - Lesson 7a: Introduction to Supervised Learning Methods for Classification Problems – Part I
 - Lesson 7b: Introduction to Supervised Learning Methods for Classification Problems – Part II
- Module 4 – Unsupervised Learning Methods
 - Lesson 8a: Introduction to Unsupervised Learning Methods - Part I, Principal Components Analysis
 - Lesson 8b: Introduction to Unsupervised Learning Methods - Part II, Clustering
- Module 5 – Machine Learning for Estimation of Treatment Effects
 - Lesson 9a: Machine Learning for Causal Inference: Average Treatment Effects – Part I
 - Lesson 9b: Machine Learning for Causal Inference: Average Treatment Effects – Part II
 - Lesson 9c: Machine Learning for Causal Inference: Average Treatment Effects – Part III
 - Lesson 10: Estimating Heterogeneous Treatment Effects
- Module 6 – Algorithmic Bias
 - Lesson 11: Introduction to Algorithmic Bias
 - Lesson 12a: Clinical Algorithmic Discrimination – Part I
 - Lesson 12b: Clinical Algorithmic Discrimination – Part II
- Module 7 – Considerations for the Real-World Application of Machine Learning in Healthcare and Other Contemporary Topics
 - Lesson 13: Informing Treatment Stratification Using Machine Learning
 - Lesson 14: Deployable Machine Learning for Healthcare
 - Lesson 15: Regulation of AI in Healthcare
 - Lesson 16: Generative AI in Healthcare: The Next Frontier