

Course Syllabus

HEOR DS 520: Comparative Effectiveness, Causal Inference, and Real-World Evidence

Winter Quarter

Course 2 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 causal inference methods. Causality is often considered the holy grail of empirical analysis. Researchers have approached causality from econometric, statistical, behavioral, and even philosophical points of view. This course will review statistical and econometric methods developed for individual-level data on behavior (choices or exposures) and outcomes to make causal inferences. In particular, the course will introduce a wide array of causal inference methods and will lay out the fundamental assumptions that researchers need to make and defend in order to make causal claims when applying a specific method to a particular type of data.

Course Learning Outcomes

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

- Understand introductory concepts in causality, how to choose among covariates, and regressions for outcomes
- Analyze health care expenditure data
- Explain regressions for utilizations, count data and survival outcomes
- Define methods for evaluating policy and estimating causal treatment effects and projections using real-world data
- Understand and analyze longitudinal or panel data

Course Lessons

- Module 1 – Introduction to Causal Inference
 - Lesson 1: Correlation is not Causation – Introduction to Causal Inference
 - Lesson 2: What Should I Control For? – Choosing Variables Wisely
 - Lesson 3: To Do or Not to Do? - Choosing Variables in Empirical Settings

- Lesson 4: The Known Unknowns – Dealing with Unobserved Common Causes
- Lesson 5: The Battle of Effects – Introduction to Alternate Target Parameters
- Module 2 – Outcomes-Based Regression Analysis
 - Lesson 6: Coin Flip – Regressions for Binary Outcomes
 - Lesson 7: Categories – Regressions for Multinomial Outcomes
 - Lesson 8: Fistful of Dollars – Analyzing Data on Healthcare Expenditures
 - Lesson 9: A Few Dollars More – Analyzing Data on Healthcare Expenditures
 - Lesson 10: Who is Counting? – Analyzing Count Data on Utilizations
 - Lesson 11: Survival of the Fittest – Introduction to Comparative Survival Analysis
 - Lesson 12: Sweeping Money Under the Rug – Analyzing Cost Data with Censoring
- Module 3 – Matching Estimators
 - Lesson 13a: Meet Your Match - Part I – Estimating Propensity Scores
 - Lesson 13b: Meet Your Match - Part II – Estimating Treatment Effects using Propensity Scores
 - Lesson 14a: Match Made in Heaven—Alternate Uses of Matching Methods, Part 1
 - Lesson 14b: Match Made in Heaven—Alternate Uses of Matching Methods, Part II
- Module 4 – Dealing with Unobserved Confounding
 - Lesson 15: IV Drip – Introduction to Instrumental Variable Analysis
 - Lesson 16: Mind the Gap – Introduction to Regression Discontinuity Designs
- Module 5 – Policy Evaluation with Panel or Longitudinal Data
 - Lesson 17: Long Data – Introduction to Panel/Longitudinal Data Modeling
 - Lesson 18: Pardon the Interruption – Introduction to Interrupted Time-Series Approaches
 - Lesson 19: DID You Do Two Subtractions? – Difference-in-Differences
 - Lesson 20: Synthetic Thinking – Introduction to Synthetic Control Approaches
- Module 6 – Inference
 - Lesson 21: Laces