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ISPOR Student Network Event

“Artificial Intelligence in HEOR”

Monday, May 16, 2022 | 4:30-5:30 PM EDT

Overview of Agenda

Topic	Presenter
Welcome & Introduction to Student Network Event Planning Committee (2 minutes)	Jada Lamptey, <i>ISPOR Staff Liaison</i>
Session Format & Introduction to Session Panelists (3 minutes)	Shrey Gohil, <i>Event Planning Committee Chair</i>
Discussion Topics With Panelists (20-25 minutes) <ol style="list-style-type: none"> 1. History of AI in HEOR 2. Current Applications of AI in HEOR 3. Future of AI in HEOR 	Panelists: All
Open Discussion (25 minutes)	Discussion Lead: Shrey Gohil Panelists: All
Closing Remarks (5 minutes)	Jada Lamptey, <i>ISPOR Staff Liaison</i>

Student Network Event Planning Committee



Shrey Gohil
University of Houston



Enrique M. Saldarriaga
University of Washington



Daniela Yucumá
Pontificia Universidad
Javeriana



Prashant Srivastava
Amity University
Madhya Pradesh

Speakers:



Shrey Gohil
Moderator



Chris Cameron,
MSc, PhD, P. Stat.
Panelist



William H. Crown,
PhD
Panelist



William Vincent
Padula, PhD
Panelist

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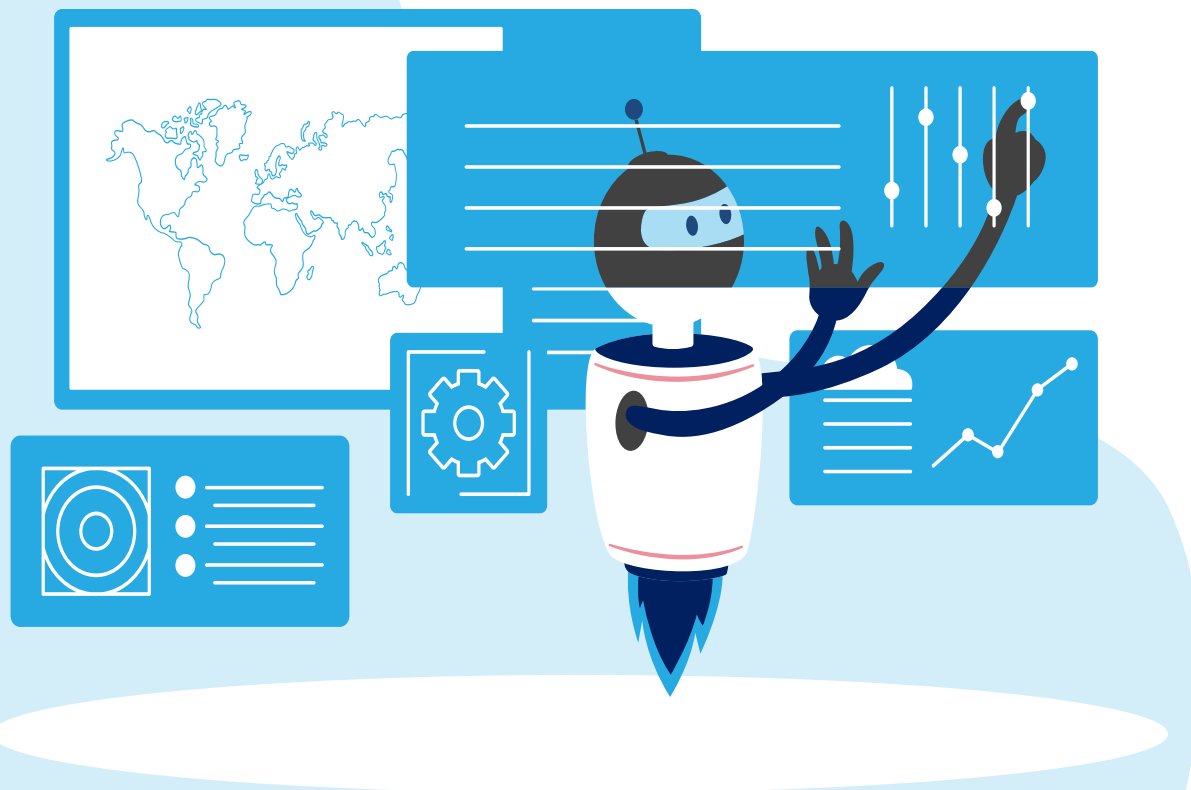
History of Artificial Intelligence (AI) in HEOR

Chris Cameron, MSc, PhD, P. Stat.

EVERSANA

Sydney, NS, CAN

What is Machine Learning and how has it been applied for HEOR?



- Machine learning refers to a family of statistical methods that generally focus on classification, ranking, and prediction.¹
- Health economics focuses on measuring and valuing the outcomes of healthcare interventions; outcomes research comprises a set of scientific disciplines that evaluate the effect of healthcare interventions on patients.
- Machine Learning for HEOR is the confluence of machine learning and HEOR to provide data and insights for healthcare decision makers.

¹ ISPOR Machine Learning Methods in Health Economics and Outcomes Research – An Introduction and the PALISADE Checklist: A Report of the ISPOR Machine Learning Methods Emerging Good Practices Task Force

² ISPOR <https://www.ispor.org/heor-resources/about-heor>

Historical Applications of Machine Learning for HEOR

STUDY SELECTION

Use of machine learning to improve the precision and efficiency of studies for a literature review (e.g., DAISY in DistillerSR)

COHORT SELECTION

Use of machine learning to improve the precision and efficiency of selecting individuals for a study population from complex real-world data sources (e.g., MACS in Flatiron).

FEATURE SELECTION

Use of machine learning to identify variables that have associations with the main outcome measure from a large volume of potential predictors.



PREDICTIVE ANALYTICS

Use of data, statistical algorithms and machine learning techniques to identify the likelihood of future outcomes based on historical data.

CAUSAL INFERENCE

Use of causal inference methods combined with machine learning to generate estimates of treatment effect (and heterogeneous treatment effects) to support parameters in HEOR.

ECONOMIC EVALUATION

Use of machine learning methods to reduce uncertainty in economic models with respect to structural, parameter and sampling uncertainty for HEOR model needs.

Historical Applications of Machine Learning for HEOR

- Interest and investment in the development of tools or methods that rely on machine learning for HEOR are increasing.
- Propelling this interest and applications are the growing amount of data and advances in the machine learning methods.
- Although there have been some historical applications of machine learning for HEOR, uptake has been limited, particularly for machine learning supporting HEOR within HTA
- To harness the enormous potential of machine learning in HEOR, we need to improve the quality of available data, train researchers and decision makers on these methods and applications, and develop better guidelines to support use



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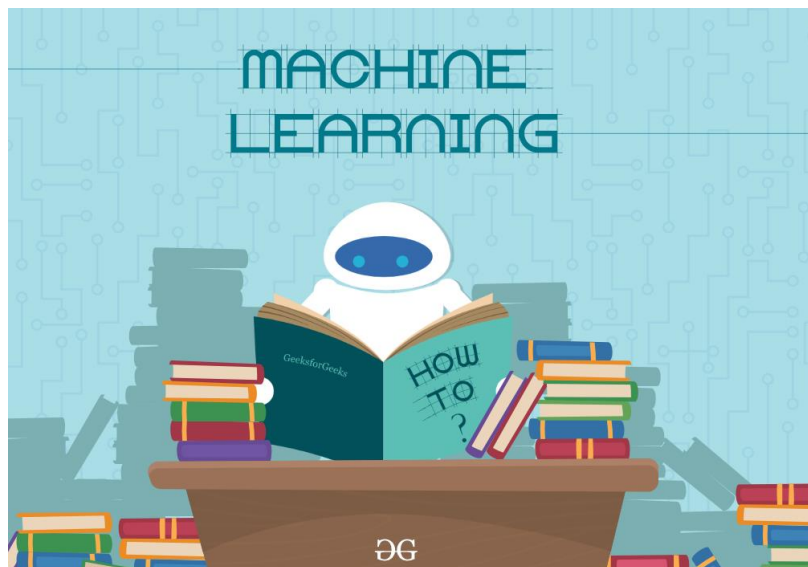
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Current Applications of Artificial Intelligence (AI) in HEOR

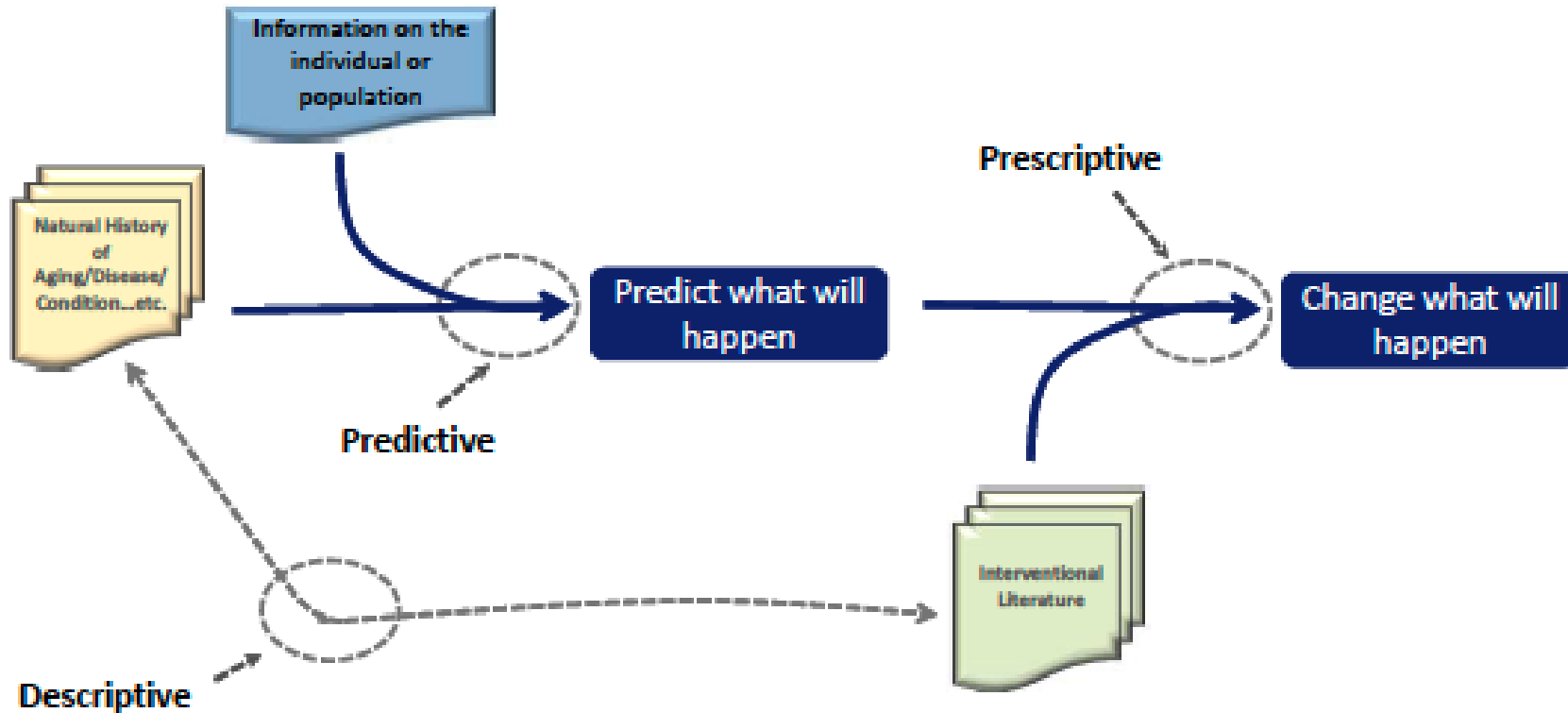
William Vincent Padula, PhD
University of Southern California
Los Angeles, CA, USA

What is Machine Learning?



- A large family of mathematical and statistical methods for classification and prediction
- Used to automate analytical process with high volumes of information
- Two general domains
 - **Unsupervised** methods are focused mainly on dimension reduction and learning the underlying structure of the data
 - **Supervised** methods require the specification of an outcome variable and are focused on prediction or classification
- Enormous potential to couple ML methods with big data to undertake classification and clustering tasks to a higher degree of accuracy

Potential for Big Data and ML in HEOR



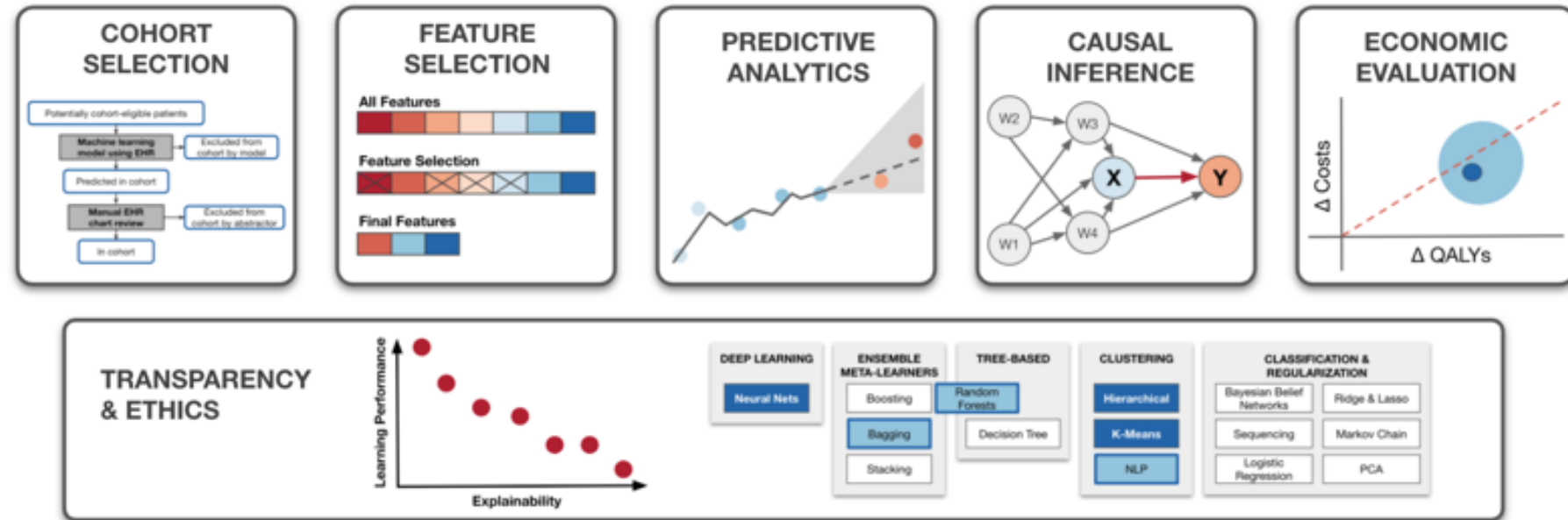
ML Task Force Objectives

To establish guidance for emerging good practices in the application of machine learning (ML) methodology to traditional ISPOR methods, including economic evaluation, decision sciences and outcomes research in order to improve the value of healthcare delivery.

- Introduce ML methods and their value in conducting research on health economics, as well as patient- and system-level outcomes research
- Describe problems for which machine learning methods are appropriate

Task Force SWGs: Overview

- Cohort Selection
- Feature Selection
- Predictive Analytics
- Causal Inference
- Economic Evaluation
- Transparency and Explainability



Conclusions

- Methods for machine learning are advancing more quickly than HEOR can keep pace with
- Seek Consultation with computer scientists and applied mathematicians/statisticians to determine whether ML fits your research question
- Consider a range of ML and traditional HEOR methods to serve your analytical needs
- *Is the juice worth the squeeze?* ML requires a great deal of effort to initiate for clinical research purposes

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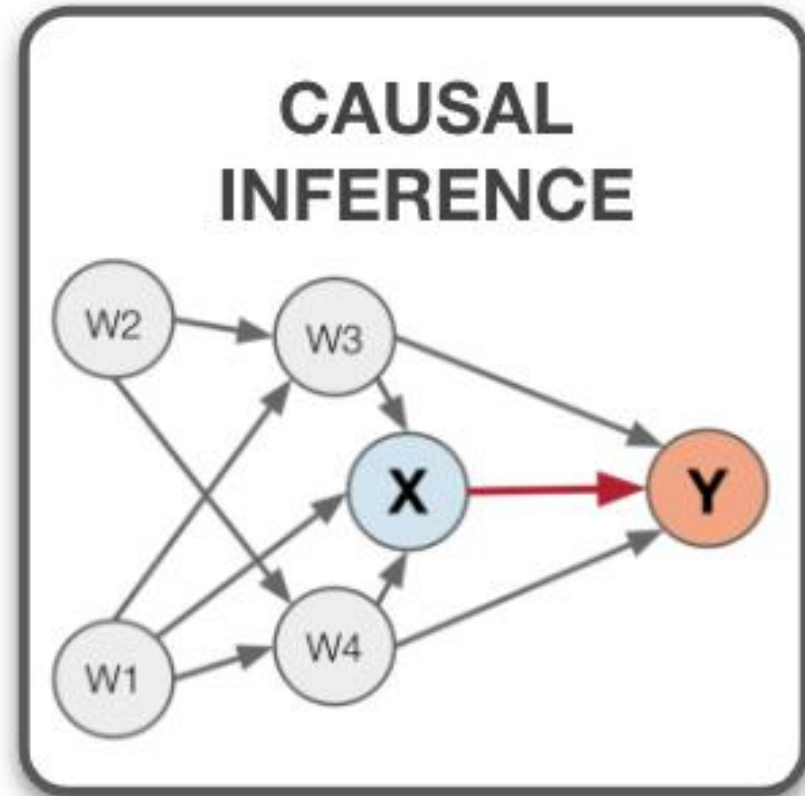
Future Role of Artificial Intelligence (AI) in HEOR

William H. Crown, PhD
Brandeis University
Waltham, MA, USA

Beyond Prediction and Classification: Causal Inference

Bill Crown, PhD

Brandeis University



Future Role of Artificial Intelligence (AI) in HEOR

- AI of the future will increasingly use causal effects estimated by machine learning
- Will enable “What if” analyses. For example, what will happen to hospitalizations for opioid use disorder if I expand access to medication assisted therapy by 20 percent?
- Explicitly identifies the policy levers

Casual Inference: Definition

- Causal inference is the unbiased estimation of the effect of a particular intervention (e.g., clinical or policy) on an outcome of interest. It requires consideration of the assumptions, study designs, and estimation strategies necessary to draw causal conclusions from data.

The Challenge: The Yhat versus Bhat Problem

Journal of Economic Perspectives—Volume 31, Number 2—Spring 2017—Pages 87–106

Machine Learning: An Applied Econometric Approach

Sendhil Mullainathan and Jann Spiess

Machines are increasingly doing “intelligent” things: Facebook recognizes faces in photos, Siri understands voices, and Google translates websites. The fundamental insight behind these breakthroughs is as much statistical as computational. Machine intelligence became possible once researchers stopped approaching intelligence tasks procedurally and began tackling them empirically. Face recognition algorithms, for example, do not consist of hard-wired rules to scan for certain pixel combinations, based on human understanding of what constitutes a face. Instead, these algorithms use a large dataset of photos labeled as having a face or not to estimate a function $f(x)$ that predicts the presence y of a face from pixels x . This similarity to econometrics raises questions: Are these algorithms merely applying standard techniques to novel and large datasets?

Many Methods for Causal Inference with ML

- Causal Forests
- Double De-Biased Methods
- Targeted Maximum Likelihood

Causal Inference Requires Causal Frameworks and Causal Inference with Non-randomized Data is Hard!

- Rubin. Estimating Causal Effects of Treatments in Randomized and Nonrandomized Studies. *Journal of Educational Psychology* 1974. 66(5):688-701.
- Pearl. *Causality*. Cambridge University Press, 2000.

Journal of Economic Literature 2020, 58(4), 1129–1179
<https://doi.org/10.1257/jel.20191597>

Potential Outcome and Directed Acyclic Graph Approaches to Causality: Relevance for Empirical Practice in Economics†

GUIDO W. IMBENS*

*In this essay I discuss potential outcome and graphical approaches to causality, and their relevance for empirical work in economics. I review some of the work on directed acyclic graphs, including the recent *The Book of Why* (Pearl and Mackenzie 2018). I also discuss the potential outcome framework developed by Rubin and coauthors (e.g., Rubin 2006), building on work by Neyman (1990 [1923]). I then discuss the relative merits of these approaches for empirical work in economics, focusing on the questions each framework answers well, and why much of the the work in economics is closer in spirit to the potential outcome perspective. (JEL C31, C36, I26)*

1. Introduction

Causal inference (CI) in observational studies has been an integral part of econometrics since its start as a separate field

in the 1920s and 1930s. The simultaneous equations methods developed by Tinbergen (1930), Wright (1928), Haavelmo (1943), and their successors in the context of supply and demand settings were from the beginning, and continue to be, explicitly focused on causal questions. Subsequently, the work by the Cowles Commission, and both the structural and reduced form approaches since then, have thrived by focusing on identifying and estimating causal and policy-relevant parameters. Over the last thirty years close

* Stanford University, SIEPR, and NBER. I am grateful for help with the graphs by Michael Pollmann and for comments by Alberto Abadie, Jason Abaluck, Alexei Alexandrov, Josh Angrist, Susan Athey, Gary Chamberlain, Stephen Chaudoin, Rebecca Diamond, Dean Eckles, Ernst Fehr, Avi Feller, Paul Goldsmith-Pinkham, Chuck Manski, Paul Milgrom, Evan Munro, Franco Perrachi, Michael Pflanzmann, Thomas Richardson, Imoizet Sabhan, Samuel

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Open Discussion

Questions?

Submit questions to
StudentNetwork@ispor.org

