Why should Economists use AI?

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This paper examines the need for artificial intelligence in economics. Based on the arguments from influential economists such as Fredrik Hayek, James Buchanan as well as Google economist Matt Taddy, economists need to use AI in statistical models to form more accurate inference and cut labor costs. By doing so, economists can spend more time painting a narrative to why their research is important to advancing economic theory.

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Introduction

Artificial intelligence, machine learning, and big data are at the forefront of statistical innovation. In recent years there has a been a sharp increase in the demand for artificial intelligence in business applications and prediction analysis. Economists should apply artificial intelligence methods in their models so that they can more efficiently and effectively make statistical inference. Applying these tools will allow economists to focus their time on motivating better research and advancing economic theory.

Articial Intelligence

AlphaZero Artificial Intelligence (AI), a game playing algorithm created by Google can beat a chess champion within four hours of learning. This is possible because AI excels at tasks with patterns and parameters. In chess, the algorithm can choose to move one of the 16 pieces in a variety of possibilities in an attempt to respond to the opponents move. Four hours of learning means that the AI algorithm learns which moves are effective and which are not. This is possible through many test iterations or learning cycles.

A single iteration could proceed as follows: The opponent moves his pawn forward two spaces. Next, the AI algorithm decides to also move his pawn forward two spaces. However, the algorithm moves the pawn so that its facing the opponent at a diagonal. The opponent will then eliminate the AI's the pawn. The AI would lose a piece and that mistake would put the AI closer to a loss. Through these learning cycles a sophisticated AI can formulate a strategy to beat

a chess champion. Unlike its human counterpart, an AI has perfect memory and quickly learns throughout the learning cycles what works and what does not.

However, it is important to understand the limits of AI before concluding that robots will take over the world. While AI is excels at math, Its computer brain struggles with other types of tasks simple to a three-year-old. Human emotions, creativity, and natural language are impossible for an AI algorithm and these complex human traits are unlikely to be solved soon. AI is controlled by humans and develops further because of human intelligence. That being said, AI has enormous capabilities and applications, especially in fields that require data analysis and forecasting, such as economics and other data science-related professions.

Aside from winning games, AI is also great with data. The amount of new data generated every day is nothing shy of enormous. There is estimated to be over 2 million terabytes of data generated every day and over 90% percent of the data in the digital universe was created in the last 2 years alone. With so much data being generated, economists and other data professionals are having a serious issue keeping up. Social media, digital communication, photos, videos, and many other forms of structured and unstructured data generated each second is creating an even greater demand for AI.Varian (2014)

Need for AI

Traditionally, economists used three main groups of methods to analyze data. Casual regressions, time series, and quantitative methods. Within these different groups, there are several models to forecast or explain economic problems. Introducing big data into these models without AI can create a cumbersome and complex model, that requires extensive amounts of time and labor to work through. Other limitations of these methods with big data are that they are often very expensive and difficult to run and the design skill is highly sophisticated.Clements and Hendry (2002)

These traditional methods are slowing the time that economists can perform the work required of them. There are simply not enough PhDs to satisfy the demand of companies.**?** Before the dawn of computers, an economists may be tasked to price a single good for one company. Now economists are tasked with pricing thousands of goods in a short amount of time for many com-

panies. Economists spend too much time adjusting variables to achieve effective p-values and not enough time focusing on the economic theory involved.**?** James Buchanan in his essay "What should Economists do""" urges economists to focus their time on market systems rather than tuning the mathematical variables. He concludes,"Modern economists are simply doing what other economists are doing while living off a form of dole that will simply not stand critical scrutiny." As technology evolves, economists need to refocus on their time on painting a narrative why their research really matters.Buchanan (1979)

Austrian economists Friedrich Hayek writes "If we can agree that the economic problem of society is mainly one of rapid adaptation to changes in the particular circumstance of time and place, it would seem to follow the ultimate decisions must be left to people who are familiar with those circumstances". With such rapid change happening with data, economists need to adapt the tools and methods of AI in their models to combat data at its a rapidly growing pace. Economist should keep in mind that the application of AI doesn't disregard economic methods, but aids them to cut costs, and automate and speed up their computational methods.Hayek (1945)

Economist at Google, Matt Taddy summarized the meaning of AI as a "system of Intelligence that is able to ingest human-level knowledgeâ". AI is the technology to automate and accelerate tasks that were beforehand only capable of being completed by humans. To incorporate AI into economic models an economist would first need a massive bank of data. Then they would also need a way to generate new data so that the machine learning part of AI can respond to the new inputs and learn. Below, is the summarized structure of AI created by Taddy.Taddy (2018)

Taddy's AI formula

AI = Domain Structure + Data Generation + General Purpose Machine Learning

* Domain Structure: Business Expertise, Structural Econometrics, Relaxations and Heuristics

* Generation: Reinforcement Learning Big Data Assets, Sensor/Video Tracking

* General Purpose Machine Learning: Deep Neural Nets, Video/Audio/Text, OOS + SGD + GPU's

Methods

Simply, Domain Structure is the mechanism used to break a complex problem into simpler tasks that can be solved compositely by Machine Learning(ML)."The reason the first advances AI were achieved in video games is that the games were explicit and codified". Taddy (2018) The first step to use AI outside of video games is an understanding of the rules and the theory of the problem at hand. Domain structure emphasizes Buchanan's argument that "Economists should be Market Economists" Economist need to understand theory and markets well enough to be able to apply parameters and patterns to the heuristics of the model to effectively use ML. A lack of understanding of econometrics and economic theory would prevent an economist from being able to understand the rules of the game at hand, making it impossible to solve with AI. General Purpose ML will become faster and cheaper over time. The expertise needed to create the domain structure and make ML possible will not commoditized. Taddy (2018)

Another variable in the AI equation, Data Generation, could also be viewed as data collection. Recall how Google's AlphaZero AI improves its chess-playing performance with every iteration as new situations evolve. The first iteration, however, is extremely ineffective based on underlining instructions. It's not until AlphaZero experiences new data or new situations that the algorithm evolves. Economic AI is only effective if a steady stream of new and useful information flows into the ML algorithms. Therefore, an active data connection is necessary. Large data assets are crucial for a business to implement. This is why the growth of data over the last view years has been so large. The more data that can be gathered the more accurate the AI predictions will become.

Machine Learning(ML) is the final portion of the model that gets the most attention. ML is closely related to modern statistics.Taddy (2018) The difference between the two is in the desired outcome. Where statistics and econometrics is heavily focused on model inference, the ML community is largely focused on maximizing predictive performance. This is where ML is most effective. With large and complex data sets, statistical inference can be extremely laborssome and complicated. ML techniques such as Regularized Regression(LASSO), Random Forests, and Neural Networks have found application in modern business problems to forecast and predict business needs. Economists can use ML techniques to aid them in their models such as analysing time series, and panel data. If implemented correctly, ML can be more accurate of the population than

a randomized sample.

Another key aspect to ML is that averaging over many small models gives a better out-of-sample prediction. In 2006 Netflix offered a million dollar prize to the researchers who could provide the best improvement to there movie recommendation system. The winners of this competitions used ML system blending over 800 different methods. Further, by blending the first and second place submissions Netflix's prediction recommendations became even more effective.Varian (2014)

It's important to also consider model uncertainty in ML algorithms. Similar to the aggregate averages of the Netflix models that provided better results, research has shown that averaging economic models also provided increase accuracy. Model uncertainty and variation between models comes from variable choice and difference of representation of specifications of the model. In the past economists critiqued models by raising the issue of sample uncertainty, and violations of Gauss-Markov assumptions. While this issue should be addressed, in the era of big data, however, model uncertainty can be much more serious to the integrity of an economists findings.Varian (2014)

Summary and Conclusion

In the physical sciences ML has historically dealt with pure prediction, but as economists know well, there is big difference between correlation and causation. Causation is the issue where economist need to spend their time in painting a narrative of their findings. AI can predict, but only economists can develop inference. This is why Domain structure is foundational to AI. Economists must be able to interpret the predictions and correlations for statistical inference. For this reason, economists can feel confident that their expertise are highly valued and shouldn't shy away from using AI.

Big data will only grow larger, and Hayek suggests, economists must adapt. The technologies and methods developed for small data sets will only become more and more inadequate. Researchers of AI and big data have developed the tools methods to handle big data, Economists too, should learn how to incorporate these tools and methods into their models. By doing so, economists will allow the further expansion of economic theory.

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