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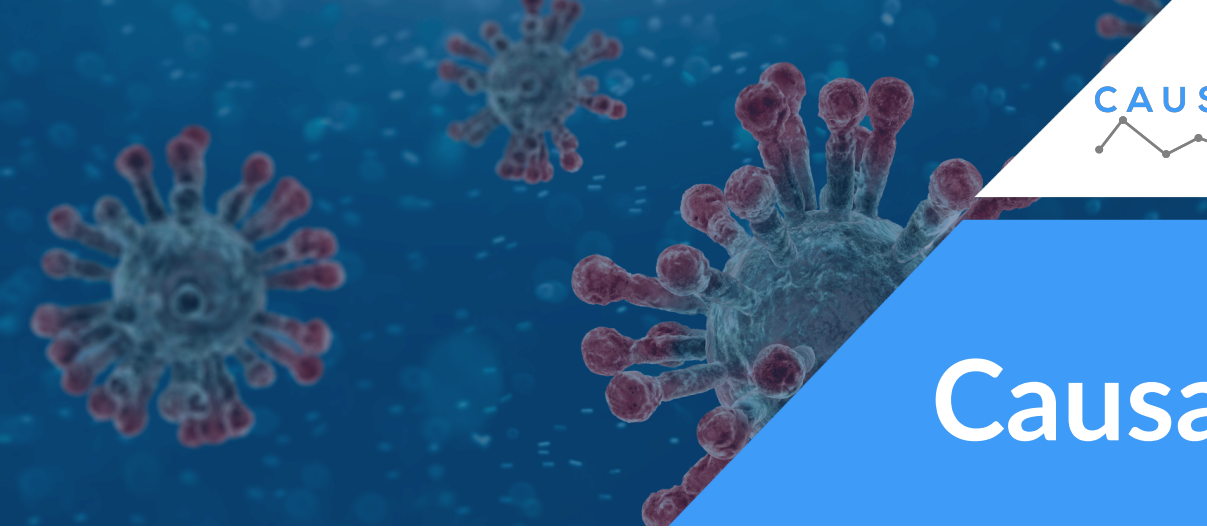

# Causal AI

## Machine Learning Fails When We Need It Most

We are in the midst of a crisis. A health crisis, with over 2 million confirmed infections and over 120,000 deaths and counting. An economic crisis, with millions becoming unemployed and GDP falling by unprecedented magnitudes (the Office for Budget Responsibility estimates 2 million jobs lost and a 35% drop in GDP in the UK). And a social crisis, leading to increased loneliness and mental health issues, together with spikes in domestic violence, divorces and suicides. These are truly unprecedented times.

During these extraordinary circumstances, the rapidly evolving conditions and government regulations make it even harder for organisations of all kinds to quickly adapt and avoid collapse. And now, when machine learning is needed the most, it fails to deliver.

**Current machine learning techniques are unable to understand cause and effect**

The reason is that traditional machine learning (ML) works by learning patterns observed in past data. ML models can work very well when the new data that is fed in looks similar to the data they have been trained on. When modelling the real world, however, this is hardly ever the case, and this problem is especially pronounced during a crisis.

A paradigm shift in the science of ML is required so models will be able to promptly and efficiently adapt to changing conditions. Understanding causality is the key in achieving this goal. A machine that truly understands the relationship between cause and effect only requires a few data points to make an accurate assessment about a new regime; much in the same way a domain expert would. An additional benefit is that truly causal models are able to reduce cognitive biases and are even able to identify such biases present in the underlying data.

This is the philosophy that powers Causal AI, enabling it to forecast based on a much more profound understanding of the world, rather than on just statistical analysis. In this way, Causal AI is able to detect any sudden change of regime and alert its user. Subsequently, it autonomously rediscovers the causal structure of the new reality and uses this information to make predictions that reflect the emerging situation.

## Case Study

To demonstrate how Causal AI works in practice, we present the following case study based on a financial dataset. This example illustrates how correctly identifying causal drivers not only results in improved performance but, more importantly, in faster model adaptation, especially in times of crisis.

### Data

This case study uses a series of stock market indicators, including returns and dividend yields as well as interest rates, including the US treasury yield curve rates to predict Moody's AAA Corporate Bond Yields one day ahead.

As monetary policy in times of crisis drives interest rates even lower, high grade corporate bonds are one of the few low-risk vehicles to obtain a yield from cash. Predicting bond yields can help investors navigate the markets, financial managers manage their firms' exposure to interest rates, and economists to model the global economy.

### Results with Current State of the Art

The latest automated machine learning (AutoML) techniques were used as a baseline. These include online learning, robust cross-validation, regularisation, model parsimony and meta-learning.

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Forecasts proved to be reasonably accurate during stable times, with a mean absolute percentage error of 1.06% up to 24/02/2020. However, as the crisis hit the financial markets and volatility started to increase, these conventional AutoML models produced increasingly larger errors, proving them highly inadequate for modelling in the new regime.

## Results with Causal AI

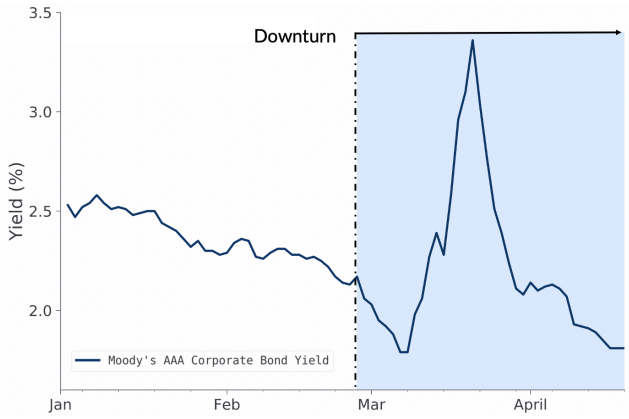
Forecasts with Causal AI also proved to be accurate in times of stability, achieving a similar level of accuracy to the current state of the art models in machine learning (in fact, with 7% higher directional accuracy).

Nonetheless, where Causal AI really excelled was during volatile times. Causal AI was able to detect the change of regime and rapidly adapt to the new conditions in only a few data points, yielding great results when needed the most.

Causal AI achieved much lower error rates across various metrics, as well as a 18% higher directional accuracy than current machine learning during the crisis period. More importantly, it adapted significantly quicker, taking only 1/3rd of the time to perform as accurately as during stable times, and find the causal relationships governing the new regime.

While current machine learning used a total of 10 features to predict bond yields, Causal AI settled on 3 main drivers causing the changes in bond yields. In addition to making the models more robust, the greater simplicity of the models built with Causal AI offers advantages in model explainability and interpretability, as well as consuming lower computations resources.

**Models built with Causal AI adapted 3 times quicker to the new reality that models built with current state of the art ML technology**




The case study presents just the tip of the iceberg of what the science of causality and Causal AI have to offer. Causal AI isn't just relevant for financial markets, but for every type of time-series, including healthcare data.

**Models built with Causal AI produced 18% higher directional accuracy than models built with current state of the art ML technology**

## Summary of Findings

- Current state of the art machine learning can perform reasonably well during stable markets, however, it fails to perform during crises, when it is most needed.
- Causal AI identifies causal relationships that provide better forecasting accuracy and allow models to rapidly adapt to a constantly changing world.
- The ability of Causal AI to provide accurate predictions, even during periods of crisis, enable you to optimise your business and maximise your bottom line.

## About Us

causaLens is pioneering a completely new approach to time-series prediction. Its Enterprise Platform is used to transform and optimise businesses that need accurate and robust predictions – including significant businesses in Finance, IoT, Energy and Telecoms.

Almost all current machine learning approaches, including AutoML solutions, severely overfit on time-series problems and therefore fail to unlock the true potential of AI for the enterprise. causaLens was founded with the mission to devise Causal AI, which does not overfit, and so provides far more reliable and accurate predictions. The platform also includes capabilities such as autonomous data cleaning and searching, autonomous model discovery and end-to-end streaming productisation.

causaLens is on a mission to build truly intelligent machines that go beyond current machine learning approaches - a curve-fitting exercise. Devising Causal AI has allowed us to teach machines cause and effect for the first time - a major step towards true AI.

causaLens is run by scientists and engineers, the majority holding a PhD in a quantitative field. Contact us on info@causaLens.com or follow us on LinkedIn and Twitter.

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