



Making Sense of Machine Learning

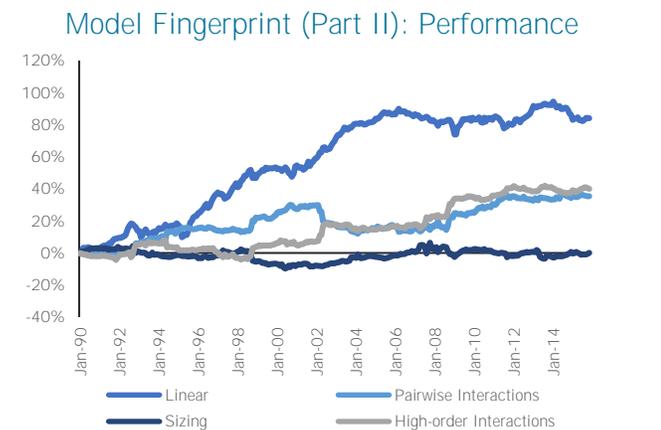
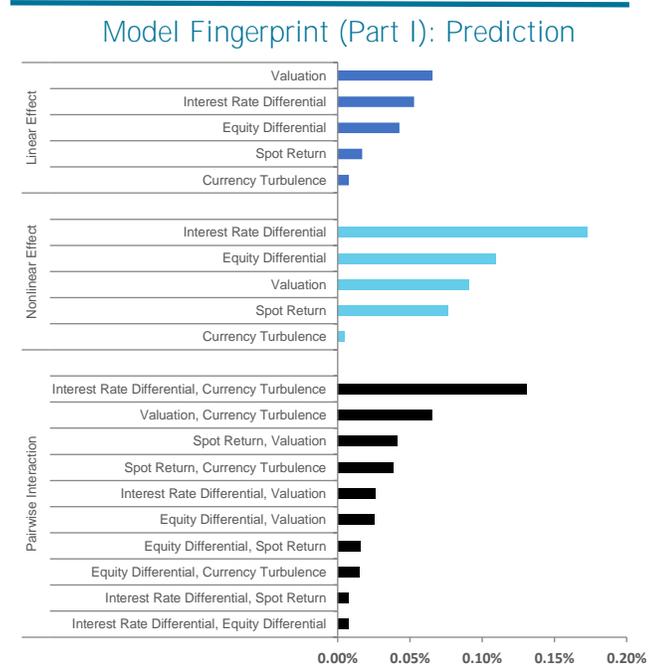
It is easier to trust machine learning predictions when we understand them better

Machine learning (ML) methods empower sophisticated algorithms to analyze financial data sets and make predictions against a defined goal. However, ML models are sometimes regarded as “black box” when used for investment applications. In particular, investors demand reliable and intuitive interpretation of how ML models “think” about data before they are confident enough to use them in practice.

To address this challenge, we propose a framework that decomposes ML predictions into three basic components: linear, nonlinear, and interaction effects – and evaluates the predictive efficacy of these components. Together, this forms a “Model Fingerprint,” which can be used to summarize key characteristics of model predictions.

We apply our framework to a real-world case study where Random Forest (RF), Gradient Boosting Machine (GBM), and Neural Network (NN) models are trained to predict monthly currency returns in the G10 universe. Carry, trend, valuation, equity differential and market turbulence are used as input factors. The bar chart at right shows the prediction decomposition of the GBM model. Valuation is the top driver in the linear space. Carry has the largest nonlinear effect, and the GBM model highlights the interaction between carry and turbulence when it comes to monthly forward return prediction. The component efficacy chart reveals that the GBM can learn reliably simple rules in the linear space. The model also homes in on the efficacy of interaction effects. Both pairwise and higher-order interactions captured by the model boost the risk-adjusted portfolio performance.

As a way to demystify how an algorithm “thinks”, our “Model Fingerprint” framework is intuitive and may be generalized to other predictive models and investment portfolios. As such, it allows researchers to tease out a machine learning model’s “personality”, or more aptly, its “machinality”.



Source: State Street Global Markets, DataStream. Results from a Gradient Boosting Machine that is trained on monthly data from Jan 1990 to Dec 2015 and validated from Jan 2016 to April 2019.

For more on this topic, see our paper on *The Journal of Financial Data Science Winter 2020*:

“Beyond the Black Box – An Intuitive Approach to Investment Prediction with Machine Learning” by Yimou Li, David Turkington and Alireza Yazdani.

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