

A Transparent Alternative to Neural Networks

Capturing the complexity without the opacity

Nearly a hundred years ago, Rube Goldberg introduced his famous satirical cartoons of mechanical devices that perform simple tasks in ridiculously convoluted and impractical ways. For example, to put a stamp on an envelope you sneeze, scaring a dog, tipping a hat rack, breaking glass, spilling water, filling a bucket, ... and so on. Nowadays our sequences are more sophisticated: for example, we use computers to train parameters and form predictions using deep neural networks. In both cases we get an outcome from a long chain of steps, and the purpose of each step is mostly a mystery.

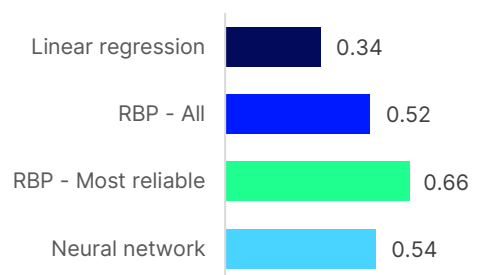
To be fair, neural networks have achieved amazing feats, even if they are unwieldy to operate and hard to decipher. But in new research we show that a direct and interpretable approach to forming a prediction, called Relevance-Based Prediction (RBP), delivered values that were highly similar, and often better, at predicting volatility across constantly shifting market regimes (Exhibit 1).

A neural network forms a prediction by performing many sequences of linear combinations and nonlinear transformations of the original inputs. In doing so, it has the potential to extract nearly all the useful information from a dataset. However, a neural network is difficult to implement and notoriously opaque.

Alternatively, RBP is a model free and theoretically-grounded approach that forms a prediction as a relevance-weighted average of past outcomes. It adapts the selection of observations and predictive variables to each prediction task, which enables RBP to capture complex relationships, like a neural network. However unlike a neural network, RBP is remarkably transparent, revealing how each observation and variable contributes to a prediction, and disclosing the reliability of a prediction in advance. This transparency, combined with its ease of implementation, suggests that RBP may serve as a compelling alternative to neural networks.

For more on this topic, see our 2024 working paper: **"A Transparent Alternative to Neural Networks with an Application to Predicting Volatility"** by Megan Czasonis, Mark Kritzman, and David Turkington.

Exhibit 1: Correlations of actual S&P 500 volatility and out-of-sample predictions




This chart summarizes the results of predicting the subsequent one quarter volatility of daily S&P 500 returns using a collection of 14 variables. The neural network has 10 hidden layers with 100 nodes per layer. Results cover the period December 1999 through September 2023. For additional details, please refer to the paper cited below.
Source: State Street Global Markets

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