White Paper

Leveraging Non-Linear Methods to Better Forecast Cash Needs

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The mathematical methodology most often used by automatic cash forecasting tools is based upon comparative statistics. Such statistics are compiled using various long-standing linear regression techniques that depend on repeating patterns within data.

Cash use and demand is the result of many undetermined factors, including seasonality as well as coinciding and unforeseen events. Therefore, it is no surprise that the assumptions of linear modeling are often ineffective in predicting cash needs. A better and more intuitive methodology for forecasting cash is now available due to the advances in Artificial Neural Network (ANN) technologies that more closely replicate the way in which people think. Unlike linear methods, ANN methodology is ideally suited to identifying very complex cash use patterns and recursively adapting the pattern definitions over time.

Traditional linear regression forecasting works on the assumption that past experience should be replicated in the future. To the extent that this assumption holds true, the methodology works quite well. However, if the assumption is contradicted, forecasted amounts can become seriously distorted. This often happens in cash operations when cash forecasting systems simply fail to accurately predict what will occur in terms of cash demand. In contrast, an Artificial Neural Network or ANN, as the name implies, seeks to emulate the learning ability of the human mind by dynamic modification.

If you consider how a person actually thinks, it is obvious that it is often a nonlinear process that references not only sequential thoughts and memories but also impulses and knowledge of exceptions. Using forward-looking reason and emotion from past experience, the brain learns by modifying the way it prioritizes and weighs experiences, feelings and choices to make assumptions. We learn by keeping track of the combinations of factors that result in a threshold or behavior that is likely to provide an intended result.

The way people spend and save their money is also non-linear, and the result of their interpretation of what they need to fund purchases is based on memories, past experiences and current events.

The goal of cash forecasting is to understand the complex relationships between the date stamp and characteristics of deposit and withdrawal transactions. In terms of time, events must be considered by time of day, day of the week, day of the month, day of the year, week of the month and month of the year. Then, event timing must be considered side-by-side with amounts and types of transactions. In a nutshell, giant matrices, which cover all the possible combinations of space, time and value are required so that accurate future need predictions can be made.

Over time, this approach to forecasting can weigh multiple factors and scenarios to more accurately predict patterns for cash use. For example, bi-weekly and bi-monthly pay days that also correspond with Fridays may produce increased need for cash. Seasonality creates an even more complex pattern when payday Fridays occur in tandem with national holidays. As more data accumulates, ANN technology uses the data recursively to adjust patterns and predictions.

Considering the Knowns and the Unknowns

Given the high level of automated pattern recognition involved to successfully forecast cash needs, it is important to separate useful patterns from misleading or random events that can confuse the engine. However, it is recognition and separation of anomalous events that choke most automated forecasting systems.

Philosophically speaking, there are three classifications of knowledge that facilitate the necessary predictions for cash forecasting.

1. Known-knowns – knowledge that we take for granted because we know that we know it.

2. Known-unknowns – things we know that we do not know.

3. Unknown-unknowns – things we do not know that we do not know.

In order to apply these classifications to the process of cash management, let's surmise that we expect a particular cash demand phenomena at a particular ATM vault or branch during a particular time because we have learned from experience and have made statistical inferences onto the future.

We also know that unforeseen things happen. Like, a circus could come to town, or an ATM could break or a road could be rerouted. The knowledge that there are unknowns to contend with erodes our confidence in forecasting solely based on our known-knowns. All we really know is that the known-knowns alone cannot provide the precision we require to forecast what is likely to happen. This is the business case for moving from linear regression modeling to non-linear and dynamic ANN forecasting technology.

Integrated Currency Manager™ from Fiserv Meets ANN

Cash and Logistics at Fiserv has been the leader in cash forecasting technology and consulting for more than 14 years and we are sensitive to our clients' need for more accurate cash forecasting. Our new Forecast Engine, which will debut as a component of Integrated Currency Manager 4, is the result of more than three years of rigorous research and development work. The engine uses ANN methodology.

Truly a bona-fide next-generation forecaster, the new engine possesses a non-linear and highly dynamic methodology ideally suited to recognizing complex cash use patterns which are often highly volatile, seasonal and subject to random disturbances. For many institutions, cash demand data possesses erroneous, missing, discontinuous and extreme values; phenomena that must be dealt with both philosophically and mathematically to achieve confidence that the best possible forecast has been made. Internal testing of the new Forecast Engine indicates that it improves forecasting accuracy, stability and speed and that the new forecaster is considerably less sensitive to anomalous data.

This solution's success is due to its ability to:

Automate the Known-Known Choices Within the Forecasting Process

This frees human capital to address the relatively few cash-points less conducive to automation. Hence, Integrated Currency Manager does not require events to be scheduled. It knows what they are and automatically defines, considers, measures and forecasts them. This reduces the need for user-defined events because the engine already incorporates knowledge of such events as national holidays for each region.

Facilitate Human Action to Address the Known-Unknowns of Prediction

Integrated Currency Managerhas a large array of post-forecast Effects so that a user can take normative control of the forecasting process and adjust the order in accordance with their best judgment. An example of using an Effect would be if there is an earlier than anticipated snowfall at a ski resort and experience tells the cash manager to select an Effect that adds an additional 25 percent cash buffer.

React Effectively to Unknown-Unknowns as They Present Themselves

The forecasting engine within Integrated Currency Manager will not only learn from its past predictive mistakes, it will also monitor actual and potential problems and alert the user accordingly. Consider a tour bus that drops off its passengers in front of an ATM outside of its normal route; although such a known-unknown, by definition, cannot be predicted, its negative impact can be mitigated via various early warning alerts within Integrated Currency Manager.

The Engine that Can is the Engine that Learns

The new Forecasting Engine is a radical departure from traditional cash forecasting practices. Its dynamic, non-linear methodologies have been tested and proven to more accurately forecast cash need and use. With ANN technology in place, Integrated Currency Manager cash forecasting is mathematically rigorous, philosophically correct and is the best of art and science combined. Integrated Currency Manager now has the capacity to continually learn and adapt its forecasting formulas to provide institutions with a considerable operational advantage.

About Fiserv

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