The Future of Bank Risk Management is AI

White Paper

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In the latter half of the 20th century, advances in mathematics and technology enabled banks to develop sophisticated risk measurement models. These models provided banks with a more quantitative and data-driven approach to understanding and managing their product portfolio risks, leading to a significant increase in the adoption and usage of conventional models for managing credit, liquidity, market, and interest rate risk. As a result, bank risk managers became knowledgeable of traditional probability and statistics – the backbone of quantitative modeling. Over time, this practice evolved into a mature discipline.

Three decades later, the advent of AI, and specifically machine learning, is spurring banks to go beyond these traditional mathematical models to achieve greater sophistication in quantitative risk management. The key driver behind this evolution is the increased accuracy of bank portfolio risk management predictions. Machine learning performs exceptionally well in this area: predictions.

Banks are already using machine learning models, but not extensively in portfolio analysis. Usage is focused on transaction processing, such as product cross-selling, loan credit scoring, and fraud detection. Several fintech companies have already addressed transactional-level AI, but not too many have their attention on portfolio analysis. Still, machine learning usage in bank portfolio management has already started and is likely to grow, as the measurement of capital adequacy, liquidity cushions, maturity transformation, potential loan defaults and prepayments, and virtually any other aspect of bank risk management can be modeled and predicted with greater accuracy using machine learning. The business case for banks is clear: they will be able to lower capital requirements, optimize leverage ratios, make intelligent investments, and increase dividend payouts, all in a more controlled risk environment. Since calculations are more accurate, the risk of setting aside too much capital when the economy is expanding or too little when the economy is contracting, is reduced.

But how does machine learning work? Machine learning processes, by definition, learn from the past. In the case of bank risk management, the relevant history consists in past product portfolio behavior and macroeconomic variables. Combining this history with future macroeconomic scenarios (provided by central banks or industry research companies), the machine learning process will predict bank portfolio behavior. The larger the history learned, the more accurate the prediction. As banks continue accumulating historic data, the process will learn from different economic scenarios and the results will be increasingly more precise. Currently, banks have access to around ten to twenty years of product portfolio data. As time goes by the amount of data will increase, and every bit of additional information will make these models even more accurate.

When considering the choice between traditional statistical models such as Generalized Linear Models (GLM) and advanced machine learning models for bank risk management, it's essential to delve into the nuances of each approach. Traditional statistics offers simplicity and ease of interpretation, making it a valuable tool, especially for understanding basic relationships within the data. On the other hand, advanced machine learning models, including Gradient Boosting Models (GBMs), Random Forests, Neural

Networks, and Deep Learning, provide a spectrum of capabilities that can significantly outperform traditional methods in terms of predictive accuracy. As bank portfolio management requires the analysis of inherent complex data patterns, banks are increasingly adopting machine learning as its usage demonstrates more accurate results.

For example, one of the key advantages of machine learning models over traditional statistics is their ability to learn from non-linear relationships in the data. Statistical models are limited to linear relationships, which can be insufficient for modeling complex risk management problems. To that end, Gradient Boosting can be used to model the relationship between loan defaults and a variety of factors, such as the borrower's credit score, income, and debt-to-income ratio. A Gradient Boosting model can learn complex interactions between these factors that a more traditional statistical linear model could not capture.

Another advantage of machine learning models is their ability to handle large datasets. Legacy models can become computationally expensive to train and run on large amounts of data. Machine learning models, on the other hand, are designed to handle large datasets efficiently.

Still, there are also some disadvantages to using machine learning models in bank risk management. One disadvantage is that these models can be more difficult to interpret than traditional statistics. Advances in Explainable AI (XAI) are targeting this problem; XAI is a solid trend that will become even more reliable with time.

The following table compares the different models, including traditional linear statistics and machine learning:

Model	Pros	Cons
Traditional Linear Models	- Simplicity - Easy interpretation	- Limited ability to capture complex relationships - Assumes linearity
Boosting Models	- High predictive accuracy - Ability to handle non-linearity	- May overfit noisy data - Complex ensemble models
Random Forest	- Robust to overfitting - Handles large datasets efficiently	- Difficult to interpret individual trees - Less effective on imbalanced data
Neural Network	- Excellent at capturing complex, non-linear relationships	- Black-box nature makes results less interpretable - Prone to overfitting
Deep Learning	- State-of-the-art predictive performance	- Extremely complex architecture - High computational requirements

To summarize, the usage of machine learning – a branch of Artificial Intelligence – in bank risk management is a trend that has already started and is evolving as it allows to model more efficiently complex bank portfolios. Banks that embrace risk management with machine learning will gain a competitive advantage as they will achieve greater accuracy in their forecasts compared to the industry average. They will push the envelope and bring their asset and liability management to a higher level. Large banks have already started this adoption, and smaller banks are ready to leverage their experience. Machine learning brings to banks an opportunity to raise their game: banks that welcome this change will increase their efficiency in portfolio risk management and secure a competitive edge.