A fast, effective and collaborative process for risk modeling is critical

There is an absolute need for financial institutions to deploy a fast and effective process to put models in place that can accurately measure and control risk, proactively detect and prevent fraud, and effectively evaluate capital reserve adequacy. Failure to adopt an effective process for risk modeling is not just costly, it can also be catastrophic to a firm’s financial condition and can lead to serious penalties.

Increasingly, time is the enemy. Whereas it used to be acceptable to update risk models on an annual basis, regulatory regimes are now pushing banks towards monthly updates, and business owners need models to be continuously updated to reflect current conditions. But with current processes, most banks measure the time to develop, validate and roll out models in months or quarters. Banks need a new approach that will compress the time to build a model from thousands of hours down to tens of minutes.

Costs are also a serious concern. For many banks, the current process of creating a single model is manual and iterative and costs hundreds of thousands to millions of dollars. There simply aren’t enough data scientists in the world to keep up, and even the largest banks can’t afford to spend a million dollars or more each time a risk model needs to be created or updated. An industrialized, linear and predictable process that drives costs down to just hundreds of dollars per model is required.

Collaboration between business people and analysts is critical. Many banks suffer from siloed processes, where business people and analysts have no formalized way to work together collaboratively through the modeling process. The resulting “throw it over the wall” approach leads to time consuming and wasteful iteration by analysts, and a lack of understanding of or buy-in for the resulting models by line of business and/or regulators. What is needed is a fast and interactive process where business people and analysts work together side by side, quickly developing and validating risk models together.

But banks are struggling

While global banks have enormous resources and access to the best and brightest quants and data scientists in the world, current analytics technology is not well suited to solving these new classes of problems at the scale or timeliness that is required, or with the level of collaboration that is needed.

The problem is that the analytics technologies in use such as machine learning and statistical analysis tools and

“Citi’s unmatched multinational business footprint creates a complex data analytics landscape. Ayasdi’s big data technology simplifies and accelerates the analysis of thousands of discrete variables and delivers insights that enable Citi to tailor services to specific client needs, operate more efficiently, and mitigate risk.”

Deborah Hopkins,
Chief Innovation Officer

AYASDI
languages are inherently manual in nature. They rely on inefficient, repetitive and manual processes and they impose drudgery on some of the bank’s smartest, mostly highly compensated employees. And because they are highly technical and only accessible to quants, they impose an artificial barrier between the analyst and the business person, preventing collaboration.

The need is for the next generation of automated analytic technology that will empower your analysts, freeing them to spend their time actually analyzing and adding value to the business, and that provides a user experience and workflow that enables your business people and analysts to work together. Banks are finding this new solution in machine intelligence.

Machine intelligence is an entirely new class of analytic software in which high performance computers directly interrogate your big and complex data using a wide range of algorithms - and then automatically surface trends, anomalies and insights. Machine intelligence lets your data tell its story in a statistically provable fashion, so your analysts and executives can make rapid, informed decisions.

For example, in risk modeling, machine intelligence will ingest your internal and external data and automatically surface the most important variables that drive your business. Next your business people and your analysts can work together to refine the machine’s selection, and then the system will automatically generate all possible models and validate and rank how each performs in terms of best fit with your business. The final step is publish the completed model. With machine intelligence, the whole process follows a predictable, linear workflow and is self documenting.

In multiple global deployments at systemically important banks, machine intelligence has been proven to be literally 1,000’s of times more efficient and effective than manual approaches to developing risk models using machine learning and statistical tools. The time to build and evaluate a new risk model is literally compressed from thousands of hours to tens of minutes. The costs to develop risk models decrease commensurately, and because the approach is collaborative and self documenting, both business people and regulators have full confidence in the results.

**Challenges with current approaches to risk model development, validation and improvement**

A model is a means for applying statistical, mathematical, economic, or financial techniques to data to arrive at an idealized representation of the highly complex, actual relationships that exist between various events and variables. The key to defining effective risk models involves identifying and incorporating the right combinations of variables that accurately assess risk while maintaining model stability and reliability.
Creating effective risk models requires sound model development and validation techniques. However, current approaches using spreadsheets, statistical tools, and standard machine learning techniques can result in models that fail to account for important subtleties in the data. Because they are manual processes, they also take a long time, and as such struggle to keep pace with evolving market conditions, customer behavior, products, and regulations.

**MODEL DEVELOPMENT CHALLENGES**

Most approaches to model development are dependent on scarce quants and data scientists, and are typically drudgery filled and extremely time-consuming. They are heavily reliant on manual tools coupled with subjective domain expertise, published research, and industry experience. Simple communication challenges with business people lead to unnecessary iterations, wasted time and mutual frustration. Approximation and adjustments to data inputs and assumptions introduced across the process can result in unstable or misleading models. In addition, if the underlying assumptions and methods are subjective, the models are likely to be called into question by both regulators and business managers.

Because it is so difficult to develop models, particularly in situations of many variables / high dimensionality, banks tend to rely on a small number of vetted regional or low level models that are in turn relied upon by broader and more global models. It’s just been too painful and expensive to develop separate independent models at all levels of the business.

The root of the problem is that manual approaches struggle to produce reliable and defensible models, and are too expensive to proliferate across the business. General models are not adept at identifying and reflecting the complex relationships that exist between a bank’s specific business activities and its risk exposures. And the opportunity to introduce accidental bias is great.

**MODEL VALIDATION CHALLENGES**

The “Supervisory Guidance on Model Risk Management” issued by banking regulators defines model validation as a set of processes and activities intended to verify that models perform as expected, in line with their design objectives and business uses. It involves rigorous testing using a myriad of actual market conditions. It assesses the impact on dependent models, and ensures that these models can hold up under extreme economic and business conditions. The challenge with model validation lies in being able to assess the potential impact of

“Credit Suisse intends to lead our industry in understanding complex datasets. We evaluate employing the world’s most advanced analytic technologies, to gain the greatest possible advantage for our clients. At today’s accelerated pace of business, rapidly uncovering subtle signals across our massive data sources, would help us to deliver superior results for our clients.”

Marco Abele
Head of Digital Private Banking

Credit Suisse
factors that are not immediately apparent. Uncovering combinations of features that represent stressed conditions, previously not considered, and then incorporating them into models to make them stress test-proof, for instance, often proves to be a difficult exercise.

**MODEL MONITORING AND IMPROVEMENT CHALLENGES**

Monitoring and updating risk models to reflect environmental and structural changes can be challenging at best. It’s common at banks for many models to be updated annually or even less frequently. But the world changes far faster than this.

The inability to update models to keep pace with change results in rapid model deterioration. Business decisions using outdated models will result in financial losses for a bank. Current model diagnostics and improvement techniques are simply too resource intensive and expensive and hence limit the frequency at which models can be updated or improved. Because the automation underlying machine intelligence makes it so fast and inexpensive to update risk models, frequent or even continuous updates become possible.

**A better way to build and deploy risk models**

Leaders in the financial services sector are using Ayasdi machine intelligence to tackle some of their toughest big data problems – from revenue-related challenges like client micro-segmentation and product recommendations, to market regime forecasting and risk modeling. Within risk analysis and mitigation, common applications include stress testing, credit and equity risk modeling, probability of downgrade, loss given default, anti-money laundering, fraud detection and many more. Our clients quickly find hundreds of applications across the business.

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**Figure 1: How financial services firms are deploying Ayasdi machine intelligence**
BETTER RISK MANAGEMENT

Accurately assessing your risk exposure requires a deep understanding of the complex and dynamic interplay of a large number of market and macroeconomic variables as well as the ability to continuously update your models as conditions change.

Ayasdi’s machine intelligence platform is uniquely suited to accelerate the delivery of more accurate and defensible risk models. The key to defining effective risk models involves identifying and incorporating the right combinations of thousands of candidate variables that can potentially serve as indicators of risk.

Ayasdi rapidly identifies combinations of factors that impact your revenue streams. By incorporating the appropriate variables, you can create more accurate operational risk models. You can also create many more models. Our highly automated, highly scalable platform is literally hundreds of times more productive than using traditional statistical or machine learning tools and languages for creating and validating risk models.

Following the 2008-09 financial collapse, major institutions are required as part of the CCAR, DFAST, Basel III and IFRS-9 processes to demonstrate to regulators that they have adequate capital in reserve to withstand stressed economic and financial conditions. These tests put your internal teams under immense pressure to create models that can accurately forecast revenues and reserves required to absorb losses, for all lines of your business.

Figure 2: Ayasdi automatically surfaces variables that are highly correlated with revenue forecasts
Using conventional approaches such as statistical modeling tools, machine learning technologies and spreadsheets to identify the key variables that impact your business is a time-consuming, and manually intensive process. Worse, this often turns into a “black box” approach, leaving your business unit leads with little room or time to weigh in on the logic behind the choice of variables selected for inclusion in the models – before you run out of time in the annual stress testing cycle. The risks are that your business people don’t buy in, and your teams cannot confidently defend the models to your regulators.

Ayasdi’s machine intelligence platform is adept at correlating and analyzing thousands of market and macroeconomic variables to help you understand their impact on your revenue performance.

Ayasdi provides your business leaders with the ability to work together with your analysts to screen variables prior to their inclusion in your models. Our platform also automatically conducts exhaustive statistical tests (including stationarity and multicollinearity tests) to validate the models’ ability to predict revenues for your business.

Figure 3: Ayasdi provides an intuitive user experience that both your business people and your analysts can use to work together to quickly develop risk models
In applying a consistent, collaborative and linear workflow to model development, your business people and analysts will automatically winnow down trillions of possible models to a small set of statistically valid models that best represent your business. The system will build and evaluate all possible models, and present them to your teams for review based on statistically proven best fit. Once your team makes their final selections, the resulting models may be deployed into your production environments. The whole process takes just minutes.

This automated and consistent approach to identifying, validating, and selecting the variables and models ensures that business logic is built into the process, and that you end up with accurate and defensible models that will stand up to regulatory scrutiny. As an added benefit, the entire process is transparent and self-documenting – eliminating the time consuming manual model documentation that is required with existing approaches.

The end result is a linear, predictable and repeatable process for creating risk models that is thousands of times faster and less costly than what banks are using today. The key is the automation provided by the machine intelligence platform, which makes this interactive and collaborative approach possible.

KNOW YOUR CUSTOMER, ANTI-MONEY LAUNDERING, FRAUD AND SECURITY

With the rise in global terrorism, international crime and fraud, every year sees a commensurate rise in regulatory pressures concerning your Anti-Money Laundering (“AML”) and Know Your Customer (“KYC”) initiatives, with the threat of high profile fines and investigations always looming.

Compliance with KYC, AML, and sanctions requirements continues to be a key focus area from the board level on down, and firms must ensure they are following appropriate compliance procedures to meet the increasing regulatory demands. Banks operating at global scale must also ensure that each territory has sufficient management oversight such that all of these requirements are being adhered to at both a local and global level.

To comply with AML/KYC standards, most banks have deployed a combination of software such as Mantas, Actimize and Norkom with an internal army of as many as 10,000 people to perform investigations on suspicious parties and transaction, ultimately to file Currency Transaction Reports and Suspicious Activity Reports (“CTRs and SARs”).

Banks are deploying Ayasdi Machine intelligence to dramatically reduce the number of false positives associated with their existing processes. Ayasdi can quickly and automatically build an ensemble of fine grained models that you can deploy to eliminate a significant percentage of the false positives generate by your existing systems.

And because generating and updating models is an automated, rapid and inexpensive process, you can refresh your KYC / AML / Fraud models as frequently as you wish – even
daily or more frequently. This ensures that your systems always reflect your latest intelligence as well as the most current tactics global criminals and terrorists are using.

The end result is that by reducing false positives, machine intelligence can dramatically reduce the headcount you need for manual investigations, which is your primary cost-driver for compliance with KYC initiatives.

**Based on Ayasdi’s machine intelligence platform**

Ayasdi is an enterprise scale machine intelligence platform that provides a new approach to gaining competitive advantage from your big and complex data, without requiring large teams of data scientists to write queries or code algorithms. It supports large numbers of business analysts, data scientists, end-users, developers and operational systems across your organization, simultaneously creating, validating, using and deploying sophisticated analyses and mathematical models.

Ayasdi layers on top of information already resident in your business applications, data warehouses, data lakes or other big data infrastructure and automatically applies many algorithms to your data, dramatically speeding the discovery and model development process.

Ayasdi uniquely features a breakthrough mathematical framework called topological data analysis (TDA) that layers on top of more than 30 machine learning, statistical and geometric algorithms to extract critical intelligence from your data that was previously hidden or overlooked by conventional analytical approaches.

Ayasdi Workbench is a graphical modeling environment that creates a compressed visual summary of all of your data so your analysts can rapidly uncover the relationships, clusters, progressions, anomalies, and cycles in your data, and explain the underlying reasons for these patterns.

Ayasdi automatically creates and validates mathematical models based on your data, and allows these models to be deployed into your production systems. Your developers can
leverage scalable APIs, web services and robust scripting capabilities to deploy intelligent applications at enterprise scale.

The Ayasdi machine intelligence platform can be deployed in public or private cloud infrastructures, and leverages inexpensive, scalable Intel-based computing platforms and Hadoop infrastructure.

And finally, Ayasdi is a software company. We focus on creating an amazing machine intelligence platform and we train your people to become self-sufficient and productive – so you can scale to get maximum ROI and transform your business.

**For the risk analyst – build even better models**

**HOW AYASDI MACHINE INTELLIGENCE IMPROVES MODEL DEVELOPMENT TECHNIQUES**

Most banks use conventional machine learning techniques such as dimensionality reduction methods to analyze complex data and uncover variables to incorporate into their models. These powerful techniques reduce the number of attributes required to describe the data while still revealing some of the inherent patterns and relationships in that data. However, the compression of a large number of attributes down to a few can result in the analyst missing out on subtle insights. For example, consider credit card transactions that have thousands of attributes. Visualizing the patterns and relationships in these transactions that signal fraud can be extremely difficult given that one cannot see more than three dimensions at a time.

Ayasdi’s machine intelligence platform eliminates these issues by applying Topological Data Analysis as a unifying layer after processing your data with machine learning, statistical and geometric algorithms. You can use TDA within Ayasdi Workbench, our graphical modeling environment, to visually identify and explain distinct segments and sub-segments within your data that would have been missed using standard dimensionality reduction methods.

As opposed to making global assumptions regarding all of your underlying data, you can use Ayasdi to automatically construct an ensemble of models. Each model is responsible for a different segment of your data. This eliminates the need to create a single uber-risk model, which never works consistently well across all of your data. An ensemble of risk models can be much more accurate as each are optimized for different segments of your data, thus reducing the possibility of systematic errors in the model output.
HOW MACHINE INTELLIGENCE IMPROVES MODEL VALIDATION AND ENHANCEMENT

Models for fraud detection, compliance, and regulatory risk management within organizations can range from simple rule-based systems to those that are the results of sophisticated machine learning algorithms. One of the primary steps in validation or auditing exercises is the discovery of systematic errors or biases in a model.

Models created by standard machine learning techniques tend to “over-fit” as they attempt to describe all of the underlying data. Ayasdi’s machine intelligence software uses TDA to uncover such errors in models. For instance, consider the process of validating models used to detect fraudulent credit card transactions. Ayasdi’s platform can identify errors in a model by comparing visual networks that represent the outcomes predicted by the existing model as well as the actual ground truth (e.g., were the transactions fraudulent or not).

By comparing the model estimation with the ground truth, you can quickly focus on the subgroups of transactions in the network where the model made mistakes. Ayasdi automatically generates a list of statistically significant variables associated with each subgroup. This helps you identify combinations of attributes that indicate fraud that had previously gone undetected and then incorporate them into your models. Ayasdi’s data-driven approach to model diagnostics and improvement also helps you create models that automatically adjust as new data arrives, thereby curbing performance deterioration.

AVOID ACCIDENTAL BIAS

A major challenge with risk modeling on top of big data is that your business people and data scientists cannot directly interpret your data – it’s simply too large and complex. Instead you may be forced to manually choose which variables to investigate and which adjustments and algorithms to apply. This can introduce accidental bias – it’s just too easy to adjust results to match preconceived notions. Ayasdi machine intelligence eliminates bias because it automatically interrogates your entire data set, and it automatically chooses which algorithms to use based on statistical best fit. It has no preconceptions; it simply lets your data tell its story.
THE BACKGROUND

The 2008-09 financial collapse led to a Federal Reserve directive that banks with consolidated assets over $50 billion have additional risk assessment frameworks and budgetary oversight in place. To assess a bank’s financial foundation, the Federal Reserve oversees a number of scenarios (company-run stress tests). Referred to as the Comprehensive Capital Analysis and Review (CCAR) process, these tests are meant to measure the sources and use of capital under baseline as well as stressed economic and financial conditions to ensure capital adequacy in all market environments.

This Fortune 50 bank had failed to pass its annual stress test twice. It was unable to demonstrate to the regulators that it could adequately forecast revenues across the many countries it serves and the lines of business it maintains. Passing the test would put the bank on the road to doubling its share price.

The bank was in need of a way to create accurate, defensible models that would prove to the Federal Reserve that they could adequately forecast revenues and the capital reserve required to absorb losses under stressed economic conditions. The bank’s previous approach using spreadsheets and conventional machine learning techniques for identifying the key variables that impact revenue streams to incorporate into its models was found by regulators to be inadequate. This “black box” approach left the business unit leads with little room and time to weigh in on the logic behind the choice of the variables selected – before they ran out of time on the annual stress tests. It also meant that they were not in a position to confidently defend the models that they included in the filings they presented to the Federal Reserve.

HOW AYASDI MACHINE INTELLIGENCE HELPED

The bank decided to explore the use of the Ayasdi’s machine intelligence platform to supplement its capital planning process. The process began with the leaders of all of the bank’s business units reviewing the macroeconomic variables stipulated by the Federal Reserve. Ayasdi augmented these variables using several techniques (e.g., time series transforms such as lags, differences, and percent changes) which resulted in more than two thousand variables. The bank then used the Ayasdi platform to correlate and analyze the impact of these variables on each business unit’s monthly revenue performance over a six-year period. Ayasdi rapidly uncovered the statistically significant variables that were highly correlated with each business unit’s performance.
The bank’s analysts conducted a comprehensive business review to screen the identified variables prior to inclusion in the models for each business unit. Then they used Ayasdi to perform exhaustive statistical tests (including stationarity and multicollinearity tests) to validate the new models’ ability to predict revenues for their business units. Business leads then selected the models that best represented their units. This new approach to identifying, validating and selecting the variables and models ensured that business logic was built into the process and that the bank had accurate, defensible revenue forecast models that stood up to the Federal Reserve’s scrutiny.
THE BENEFITS OF THE NEW APPROACH

SPEED
Ayasdi’s machine intelligence platform helped shorten the variable selection process from three months to two weeks. Ayasdi helped rapidly analyze and uncover variables that were highly correlated with each business unit’s performance from amongst thousands of transformed variables and six years of monthly revenue data.

DEFENSIBILITY
Ayasdi produced statistically ranked variables that the business leads could evaluate and approve for inclusion in the model construction process. It automatically whittled down millions of combinations of models to a select group of statistically valid and empirically sound candidate models that business leaders could then select from and confidently include in their CCAR filing.

ACCURACY
Using Ayasdi now helps the bank implement a regimented and statistically sound process for rapidly provisioning models that accurately forecast revenues under all of the stress test scenarios stipulated by the Federal Reserve.
A leading payments firm creates more accurate fraud detection models

THE BACKGROUND

According to the Nilson Report, payment card issuers, merchants, and their acquiring banks lose over $11 billion to fraud each year. These enormous losses are indicative of the challenges that risk departments face when it comes to creating and updating fraud detection models. The ability to quickly identify clear correlations between transaction characteristics and patterns of fraud to keep pace with evolving fraud tactics is critical.

A credit and debit card-processing giant estimated that six cents out of every hundred dollars in transactions that it processed was fraudulent. In an increasingly competitive payments market, it could not afford to lose the trust of its customers.

The payments firm employs sophisticated analysts and data scientists, but found existing statistical analysis and machine learning tools were inadequate to objectively evaluate the massive amount of data as rapidly as the organization needed. The firm was looking for breakthrough ways to improve the accuracy of its models for detecting and predicting fraud.

HOW AYASDI HELPED

The payments firm decided to explore the use of Ayasdi’s machine intelligence platform to evaluate and improve its existing fraud detection models. It used Ayasdi to ingest over a million credit card transactions and to analyze more than 600 variables that characterized these transactions.

With Ayasdi, the firm’s analysts were able to produce actionable results within six weeks. Ayasdi quickly visualized regions with fraudulent transactions and produced a listing of the statistically ranked features that described these regions. The analysis also helped the firm visually compare the ground truth to the existing model’s predictions and to zero-in on systematic model performance issues (decreasing both false positives and false negatives). It also helped the firm identify the statistically-significant features that characterize these regions of false positives and false negatives to improve their existing models and to create new ones.
THE BENEFITS OF THE NEW APPROACH

**SPEED**

The firm was able to glean actionable results in six weeks. Their analysts were also able to uncover systematic issues with their current models, which would have been difficult or impossible to uncover using any other approach.

**DEFENSIBILITY**

Ayasdi’s platform provided the firm with a simple way of correlating and analyzing hundreds of variables to uncover combinations of variables that are more accurate predictors of fraud. Ayasdi lets them visually explore model performance as compared with the ground truth.

**ACCURACY**

The Ayasdi platform helped the firm identify localized segments of transactions with high concentration of fraud. It produced statistically ranked features for specific segments that could then be used to build new, local models. It also helped the firm uncover the characteristics of false positives and false negatives and incorporate these features into their existing models. This increases fraud detection accuracy, reduces revenue losses, and improves customer satisfaction.
Summary

Flawed risk models can result in huge financial losses and regulatory exposure for financial services firms. It is imperative that institutions create and maintain sound models that can accurately measure and control risk, proactively detect and prevent fraud, and effectively evaluate capital reserve adequacy.

Leading banks are finding Ayasdi machine intelligence to be as much as 1000x faster and more cost effective than their current systems and processes for risk modeling. Ayasdi also allows your business people and analysts to collaborate in the model development process, driving great confidence in your results and increasing likelihood of regulatory success.

Plus, you can use machine intelligence for a lot more than just building risk models. You can use it to drive stronger and more profitable customer relationships, deploy your capital more effectively, detect fraud, comply with KYC and AML regulations, provide better transparency to regulators, improve your asset allocation strategies, and much more.

Ayasdi’s machine intelligence platform combines innovations in scalable computing, automation, machine learning and topological data analysis to help your firm find previously unknown insights in massive volumes of data with thousands of variables. It leverages the shape of your data to surface subtle relationships, often hard to uncover using conventional analytical tools.

Using Ayasdi’s platform, financial institutions worldwide are building and deploying intelligent applications at scale to become truly data driven businesses.

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**Figure 8: Why financial institutions are finding Ayasdi to be so transformative**
Ayasdi is on a mission to help our customers gain transformative advantage through their big and complex data. Our revolutionary machine intelligence platform leverages automation, machine learning and topological data analysis to simplify the extraction of knowledge from even the largest and most complex data sets confronting organizations today and to facilitate the deployment of intelligent applications across the enterprise. Developed by Stanford computational mathematicians, Ayasdi’s unique approach to machine intelligence leverages breakthrough mathematics, highly automated software and scalable compute to revolutionize the process of converting big data into business impact. We are excited to count many of the Fortune 500, plus leading governments and research institutions as our clients and partners.