



AYASDI

Regime Forecasting using  
Machine Intelligence

## Why Understanding Market Regimes Matters

Price trends for publicly traded securities and their relationship to other variables such as macroeconomic indicators often demonstrate stability over selected periods of time. However, these trends and relationships, often referred to as regimes, can shift quickly. Investors with the ability to characterize each regime and quickly recognize the onset of new ones can capitalize on the accompanying opportunities.

A precise understanding of market regimes aids the creation of better asset allocation strategies and more accurate liquidity forecasts. However, this requires the ability to analyze highly complex market and economic data to uncover the key characteristics of each regime. Conventional statistical tools and machine learning techniques usually limit analyses to small sets of explanatory variables. They require analysts to hypothesize relevant partitions and forms prior to analysis. As a result, uncovering regimes, their explanatory variables, and the implications for the future can be difficult and time-consuming. There is a need for a new approach.

Ayasdi's machine intelligence software represents a new approach to rapidly analyzing and uncovering deep insights from highly complex financial data. It draws on the power of machine learning and topological data analysis (TDA) to help portfolio managers uncover subtle, valid combinations of features that characterize different market regimes. It then rapidly pinpoints similarities to past regimes to help them more accurately assess the performance of various asset classes. The software can also surface the complex relationships between market regimes and liquidity proxies to aid the creation of more precise liquidity forecasting models.

## Current Approaches to Understanding Market Regimes

Asset class performance varies significantly under different market conditions. Portfolio managers who rely on their personal experiences to forecast the performance of specific trades under certain conditions are restricted by the extent of their experience and their ability to accurately recall similar market periods. As a result, they cannot fully capitalize on the vast amount of financial information (and its permutations) that is available.

Portfolio managers also leverage explicit models developed using conventional statistical and machine learning techniques. However, these approaches require analysts to spend significant amounts of time forming and testing hypotheses about the current state of the market cycle to determine the most attractive risks. They assume that the functional form of the relationship between dependent and independent variables within the analyzed set has the same structure. These approaches risk producing over-fit models that may miss key characteristics of different market states.

## How Machine Intelligence Delivers a Deeper Understanding of Market Regimes

Ayasdi's machine intelligence software offers a new approach to gaining deep insights into current financial market conditions to help assess market risks. Ayasdi's software was designed from the ground up to rapidly analyze highly complex data sets. It is adept at uncovering relationships that drive a more accurate understanding of market regimes and contextually valid forecasts.

The software draws on innovations in topological data analysis (TDA) and machine learning to analyze thousands of variables spanning market, macroeconomic, and sentiment data simultaneously. It automatically groups these variables using abstract notions of similarity to create visual, topological summaries that reveal the key characteristics of the current regime as well as the similarities to past regimes. Discretionary investors can then use these structures to identify the most attractive risks, or export them as part of a systematized workflow to form the basis of more accurate, local models.

As opposed to making global assumptions regarding all the underlying data, TDA effectively constructs an ensemble of models, each representing different market regimes and responsible for a different segment of the data. The resulting set of asset allocation or liquidity forecasting models can be much more accurate as they are each optimized for different segments of the data, thus reducing the possibility of systematic errors in the model output. The insights derived from Ayasdi's machine intelligence software can supplement hedge fund managers' professional experiences and help them create effective regime-based asset allocation strategies and more precise liquidity forecasting models.

### DRIVING MORE EFFECTIVE REGIME-BASED ASSET ALLOCATION STRATEGIES

To maximize returns on investments while minimizing risk, different market regimes require significantly different asset allocation strategies. Current statistical techniques and approaches to understanding market regimes require that an analyst select a feasible set of variables to be considered, prior to conducting an analysis, that deeply influences the conclusions drawn from it.

Consider a simplistic example where an analyst is evaluating the performance of the U.S. equity markets. A typical approach might involve the analyst selecting two variables, GDP growth and unemployment, and performing a linear regression to understand the impact of these variables on market performance. The analysis is likely to produce a best-fit line for the two variables as they relate to market performance, thereby suggesting that positive economic data bodes well for equity markets. However, there may be specific market regimes where investors pay more attention to inflation expectations set by central banks, where bad economic news typically precedes more easing by the central banks. In these regimes, "bad news" is actually "good news" from the investors' perspective, as more bad news means more accommodative policies from central banks.

Identifying valid regimes is similarly difficult, however as the value of a variable at any given point in time tends to be highly correlated with the values preceding it (referred to as autocorrelation) and often times, variables are related to one another in ways that are not always immediately apparent (referred to as multicollinearity). Successful regime investing is reliant on being able to accurately model such complex

relationships between assets and their performance drivers. Understanding the key characteristics of market regimes through human-directed queries is time-consuming and risks over-fitting. An analyst has to formulate and test out multiple hypotheses, which deeply influences the results generated, and in turn, the asset allocation strategies. Ayasdi's machine intelligence software addresses these problems. It draws on the power of topological data analysis to correlate and analyze complex, high dimensional data sets - including financial market performance data (e.g., interest rate, currency, credit, commodity, and equity-related), economic data (e.g., GDP, inflation, unemployment, wages, and productivity), and data that represents the current price of financial risk (e.g., credit spreads, term structures, volatility structures, and equity risk premiums).

Unlike conventional approaches where the portfolio manager is forced to select a relatively small number of variables prior to analysis, Ayasdi's software is adept at analyzing a broad set of variables. It can surface the existence of multiple regimes through topological summaries, a visual representation of all the relationships that exist in the data. The software provides portfolio managers with a simple way of isolating and understanding the statistically valid variables that characterize each of these regimes. These variables can then be used to create local, higher fidelity market regime detection models. The software can also surface the historical performance of various asset classes, in similar market regimes.

Ayasdi's software can then compare the outcomes in different states to create a ranking of attractive and unattractive risks for a particular state, or at the least identify where a risk premium is more or less fairly priced and therefore unattractive, long or short. This enables portfolio managers to create better allocation strategies. By uncovering indicators of similarities in current market patterns to those in the past, Ayasdi's software provides a better picture of what markets may do in the future, or at the very least, enables a better understanding of when markets exhibit patterns that are not similar to previously identified regimes.

## CREATING PRECISE LIQUIDITY FORECASTING MODELS FOR ALGORITHMIC TRADING

Being able to accurately estimate liquidity conditions is essential for creating a trading schedule, especially when trading illiquid securities. For instance, a fund manager seeking a new position in a small cap, thinly traded stock needs to be able to estimate liquidity conditions in order to spread trades more strategically throughout a period, avoiding market price impact while minimizing transaction costs.

Proxies for measuring liquidity conditions include trading volumes for stocks, bid-offer spreads for OTC instruments, and other liquidity metrics for less frequently traded instruments such as corporate bonds. Traditional analytical techniques for forecasting the average daily volume of a stock, for instance, include building autoregressive moving average (ARMA) models with inputs such as a moving average of the daily volume, a day-of-week effect, and lagged daily volume terms. However, these models do not take into account the multi-dimensional nature of market regimes and often result a high error rate.

Ayasdi's machine intelligence software can help portfolio managers and traders more accurately forecast liquidity to drive the efficient algorithmic execution of trades. The software can create more robust liquidity estimates by uncovering the presence of different market regimes and identifying their key characteristics. It can analyze and identify the impact of the relationships between traditional stock market risk factors, sector risk factors, interest rates, sentiment information, and the lag-lead interplays between each of these

drivers on liquidity demand and supply. Instead of analyzing the liquidity of a single stock or bond in isolation, portfolio managers can use the software to understand responses to changes to the overall stock market, the sector, the global economy, and sentiment. Determining how changes in these factors affect the traded volumes of a stock result in more accurate liquidity forecasts.

## Summary

Creating regime-based asset allocation strategies and liquidity forecasting models using conventional statistical tools and machine learning techniques can be difficult as well as time-consuming. Ayasdi's machine intelligence software combines innovations in machine learning and TDA to help firms analyze thousands of variables simultaneously. It leverages the shape of the data to surface meaningful relationships that characterize each regime, often hard to uncover using conventional analytical tools. Using Ayasdi's software, hedge funds and asset management firms can create an effective framework for executing a regime-based asset allocation strategy. It provides them with a better understanding of the current market regime and the implications for the future. The software also enables portfolio managers to identify the key characteristics of each market regime to drive the creation of local, high fidelity models. An understanding of market regimes coupled with knowledge of the outcomes of specific risk premia in similar conditions can inform better asset allocation strategies and more accurately forecast liquidity in the current market regime resulting in significant transaction cost savings.

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## ABOUT AYASDI

Ayasdi is on a mission to make the world's complex data useful by automating and accelerating insight discovery. The company's Machine Intelligence software leverages Topological Data Analysis (TDA), to simplify the extraction of knowledge from even the most complex data sets confronting organizations today. Developed by Stanford computational mathematicians, Ayasdi's approach combines machine learning algorithms, abundant compute power and topological summaries to revolutionize the process for converting data into business impact. Ayasdi is funded by leading venture capitalists including Kleiner Perkins, Khosla Ventures, Institutional Venture Partners, Citi Ventures, and FLOODGATE. The company counts many of the Fortune 500 as clients.

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