

KAVOUT K SCORE METHODOLOGY WHITEPAPER



Table Of Contents

03	Machine Investing by Kavout
05	K Score Methodology
08	Kai-vantage
09	How to Use a K Score
10	Back Test and Portfolio Showcase
13	Conclusion
14	Contact Us

Machine Investing by Kavout

How Kavout leverages machine learning for better investing

Technical analysis, value investing, factor models, mean reversion, trend following, statistical arbitrage etc., there are many schools and techniques devised to solve the financial markets. Staying ahead of the competition in the modern investing and asset management market has become increasingly challenging, considering the markets as many termed dynamic, non-stationary, or chaotic.

In recent years with the availability of big data and the advancement of new algorithms, it has become much easier to explore complicated, nuanced, dynamic, and oftentimes nonlinear relationships among data sets. The complexity of this problem is beyond traditional statistical models and needs to integrate with the latest machine learning and deep learning algorithms, which have achieved great success in other highly intelligent tasks, such as driving autonomous vehicles, playing Go against human masters, or painting like an artist, etc.

The astounding accomplishments and generalizations of the new AI in these domains brings us a new perspective on investing and portfolio management.

The founding team of Kavout used to work at Google, Microsoft, Baidu, and financial firms have designed and built many mission-critical machine learning systems where billions of data points are processed in real-time to predict the best outcome for core search ranking, ads monetization, recommendations, and trading platforms.

Kavout creates an edge by assimilating vast quantities of complex data through the latest AI and Machine Learning methods to generate alpha signals capturing dynamic and nonlinear patterns in the financial markets.

We call this Machine Investing: data with adaptive learning algorithms shed light upon investing with a new solution to help investors.

It is true that financial markets change every second and every day, so are the data recorded and observed. Machine learning, unlike traditional statistical or quantitative models, is designed on day one to deal with this complexity to learn from evolving data sets.

Machine Investing by Kavout

Everyone knows the limitations of linear models especially when hundreds and thousands of signals need to be considered and weighed before a decision is drawn. Machine learning, especially the latest deep learning, is up to this kind of task to learn data characteristics among diverse data sets, and to uncover extremely complicated nonlinear patterns. Advanced machine learning is the secret source why Google, Facebook, and Amazon could scale their business exponentially and disrupt traditional giants in such a short time.

Still some may ask, like AlphaGo or an autonomous vehicle, will machine investing beat or replace investors?

We tend to take a more hybrid view on this question: machine algorithms are more like co-pilots, portfolio managers, and investors are still at the driving seat. To elaborate our point of view, the following principles we learned from our experience in building K Score will help:

- Investing is at the center of this process, not the machine, which means human plays a critical role;
- Machine algorithms only get as smart and as far as data tell and human insights guide;
- Don't underestimate the edge of advanced algorithms when applied in the right context.

K Score Methodology

As many quantitative factor models have become less profitable in recent years, market practitioners are searching for dynamic and factor-timing models for stock selection. Few have found success in traditional quantitative approaches when the relationships are usually non-linear and variable. It is extremely difficult for a linear regression model to capture dynamic relationships between predictors and stock returns.

Unlike popular econometric techniques used by many, K score is Kavout's machine learning-driven predictive model to stock selection. It combines a variety of data, signals, and factors that help in forecasting future returns and uses machine learning to learn which factors matter and how they are related to future returns.

It encompasses many methods such as deep neural networks, boosting trees, random forests, Bayesian optimization, and more. Harnessing years of proprietary data and applying a suite of strong learning algorithms, K Score identifies the hidden non-linear contextual relationships by combining many weak sources of information into a composite signal stronger than any of its sources. This ensemble approach K score adopts is extremely important for its success in this low signal-to-noise ratio environment of noisy financial data.

To find patterns in the data that not only work in the past but also generalize out of the sample, we expose our model to more data, some might be termed as too weak and/or noisy to present any significant prediction power under the human scrutiny of econometric analysis. Our representation-learning engine could process massive amounts of data and identify valuable and complex patterns beyond traditional quantitative approaches. Some examples of the signals and factors used include:

- Financial statement information including sales, net income, EBITDA
- Scores including the Z-Score, F-Score, and M-Score
- Ratios including capital to long-term debt, ROA and ROE
- Technical indicators including MFI, MACD, and RSI
- Price action patterns, including chart patterns and candlestick patterns
- The time series of the features above as well as price-related data
- Market and investors sentiment information
- Information from alternate data such as SEC reports, blogs, site traffic, sales on e-commerce sites, etc.

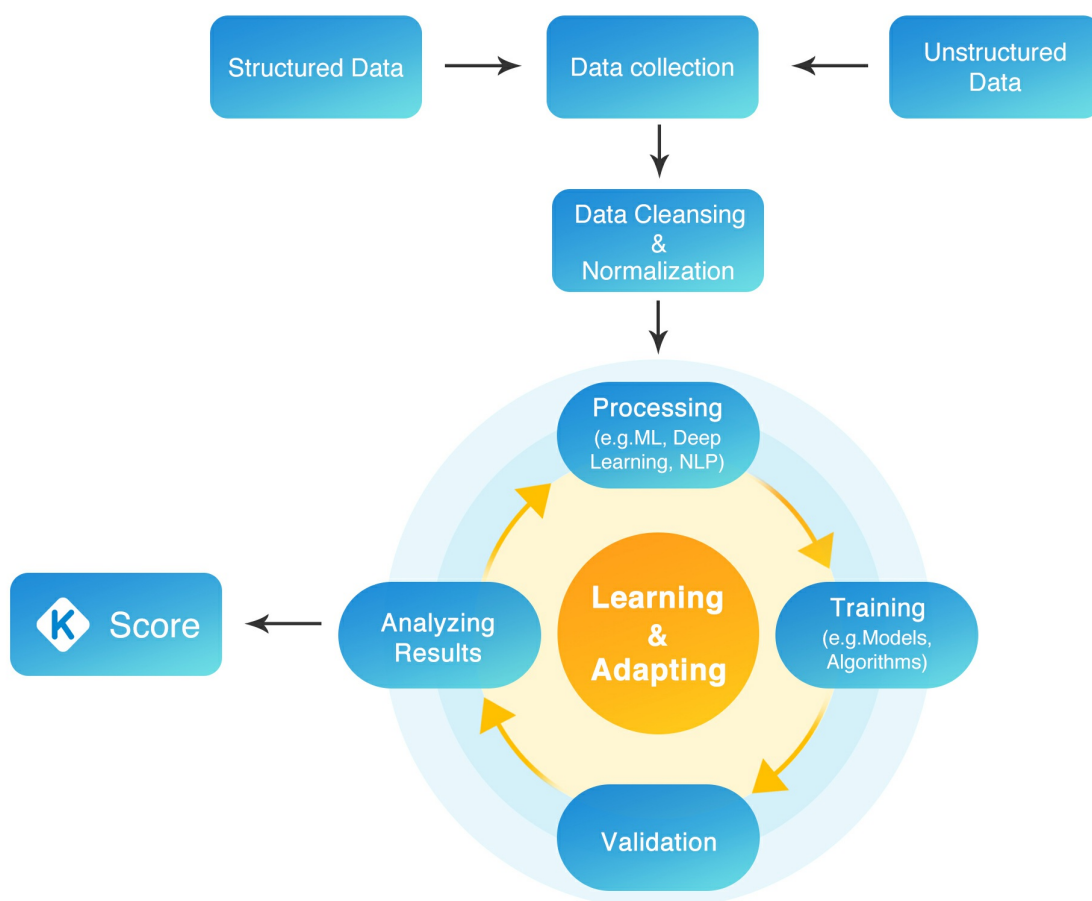
On a higher level, Kavout's AI engine takes in signals and factors from both structured and unstructured data like financial ratios, insider transactions, analyst opinions, transactions, financial reports, news, and social media, etc., and leverages machine learning algorithms to extract quantitative signals for K Score.

K Score Methodology

The advantage of K Score is that our machine investing algorithms can dynamically learn the changing relationships between factors and future returns. Thousands of factors are analyzed for current influence and predictive capabilities for a given time horizon, and our algorithm ranks and reduces this long list of signals from thousands to hundreds. It is difficult and almost impossible for typical linear factor models and humans to determine what and when various factors are predictive of future returns.

This effective reduction of factors helps us build the K Score with more generalization out-of-sample by focusing on factors with high signal-to-noise ratio and avoid overfitting which is one of the most challenging tasks in machine learning.

Each stock is rated between 1 and 9, a higher K Score (9) assigned to a stock indicates a higher probability of outperformance over the next few months, whereas a lower K Score (1) indicates a lower probability of outperformance.



K Score Methodology

For the US, China, UK, and Germany markets, we provide a show case of intermediate sub-scores in addition to the K Score for each ticker, based on four well-known factor groups: Value, Quality, Momentum, and Growth.

Much like the K Score, these intermediate sub-scores are rated with value from 1 to 9, where the higher the number indicates the stronger the factor for a particular stock.

Intermediate sub-scores are designed to be used in tandem with the K Score. By using the intermediate sub-scores with the K Score, you can:

- Determine which stocks align with your own factor investing style, while still taking advantage of the predictive analytic power of the K Score
- Buy stocks that receive a high K Score, while aligning your decision with a particular factor or combination of factors
- Mitigate risk by selling stocks with a low K Score, while overlaying them with lowly rated intermediate sub-scores



Each ticker is assigned with a K score ranging from 1 to 9.

Symbol	Date	K Score	Value Score	Momentum Score	Quality Score	Growth Score
AAPL	2018-01-02	4	6	4	8	5

Kai-Vantage

While statistical analysis are used, Kai intelligence platform was built from the ground up using machine learning technologies. It has several advantages over analysis using traditional financial analytics only.

First, our machine learning platform is built to process big, complex and inhomogeneous data.

Statistical models are limited to a few input factors, and are used to find parameters to fit the models over a period of time. Moreover, statistical models require the modeler to understand or hypothesize the relations among variables in advance, such as linear relation between independent and dependent variable.

Machine learning approach is fundamentally different in that it's not limited on the number of factors or features. Our Kai platform can assimilate data types that are wide (high number of attributes) and deep (high number of observations), that are greater than traditional structured core financial data and quantitative analyses.

This high dimensional approach takes in a large amount of data sets, looks at signals from different places including non-linear patterns, learns, and tries to find relationships and patterns hidden in the data, and makes predictions not conceivable with statistical models.

As a result, the models we built are most advantageous when it comes to processing voluminous and complex signals at scale in today's capital market, and creating new capabilities that no human investor could match, both in terms of data integration and processing speed.

Second, Kavout's advanced models are built for the purpose of predictive analytics for outperformance in the future.

These sophisticated predictive models and techniques for analyzing stocks are built into our modern automated adaptive stock ranking system. As the Kai engine continues to process new and additional data, it progressively improves its predictive ability by constantly learning from its performance, incorporating new data and dynamically adapting to the market.

Some of the techniques incorporated include

- Deep learning to capture nonlinear insights and correlations among massive data sources
- Reinforcement Learning (RL) to develop goal-oriented algorithms that dynamically drive the optimal behavior towards the objectives. A key advantage of RL is that over time it automatically incorporates new data, and self-evaluates past actions, and optimizes decisions.

Grounded in fundamental research, the advantage of Kavout's approach is the breadth of the data coverage - historic and current, predictive analytics, and the speed of which it processes daily market data for next day trading.

How to Use a K Score

A higher K Score assigned to a stock indicates a higher probability of outperformance over the next month, whereas a lower K Score indicates a lower probability of outperformance. K Scores can be used as a buy/sell signal incorporated into your investment process. Buy stocks with high K Scores (7-9), and short stocks with low K Scores (1-3).

Most K Scores do not fluctuate dramatically on a daily basis. For portfolios that are rebalanced less frequently, it is more useful to track K Score's month over month change.

However, financial information such as earnings announcement are not always released on the first day of the month. Additionally, pricing and technical trading signals are fluid, which can cause a meaningful change that impact the rating of the stock. Clients who want a greater control may want to opt in for daily delivery, which allow them to adapt to market change quicker.

K Score reflects the quality of stocks over time. If the K score for a stock is trending downward, then the stock is likely to have a relatively weaker performance ahead, compared to the period with a higher K score. The opposite is true when the K score shows an upward trend. If the stock's K score changes rapidly, that may be a reflection of significant changes in the fundamentals, price movements, and technical signals.

Back Test and Portfolio Showcase

Here is a portfolio showcase constructed using K Scores for the United States market. To demonstrate back testing results we created two portfolios, called Top Picks and Bottom Picks.

Selection Procedure

K Score US Top Picks portfolio comprises of stocks that are assigned with a K Score 9 from the largest 500 by market cap US stocks. Bottom Picks portfolio comprises of stocks that are assigned with a K Score 1 from the same pool.

Benchmark

SPY

Weighting Scheme

The strategy is to apply equal-weights to all chosen stocks within each of the two portfolios.

Rebalancing Frequency

Stocks were purchased at the closing price on the first trading day of each month and sold at the closing price on the last trading day of the same month.

Transaction cost

Transaction cost was tested with various assumptions. The difference was insignificant since only highly liquid stocks were selected for the portfolios. To simplify this for illustration purpose, transaction cost in the two portfolios are set to zero, which is a reasonable assumption.

Kai Top Picks Portfolio

As we can see in Figure 1, the Top Picks portfolio, which consists of 9 K Scores, has generated a cumulative return of 223.77%.

The returns statistics are reported in Table 2. The compound annual growth rate (CAGR), which is the average annual growth rate of an investment, for the Top Picks portfolio is 14.82%, which is significantly higher than the 11.20% CAGR of the benchmark. Adjusted for volatility, the Top Picks portfolio also has a higher Sharpe ratio of 0.89 than the benchmark's 0.90.

Looking closer at the returns in Figure 3, the Top Picks portfolio generates stable positive returns 79.41% of the time. The best quarterly return is 35.09% while the worst quarterly performance is -28.83%.

Back Test and Portfolio Showcase

Figure 1. Cumulative Return of Top Picks and Bottom Picks Portfolios (2012-01-03 to 2020-06-01)

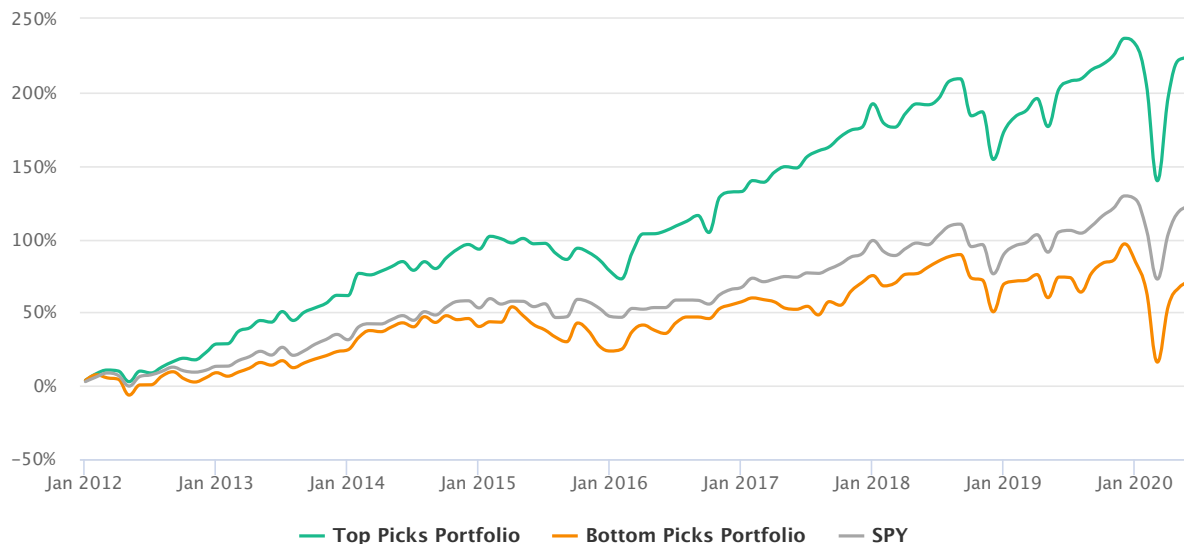
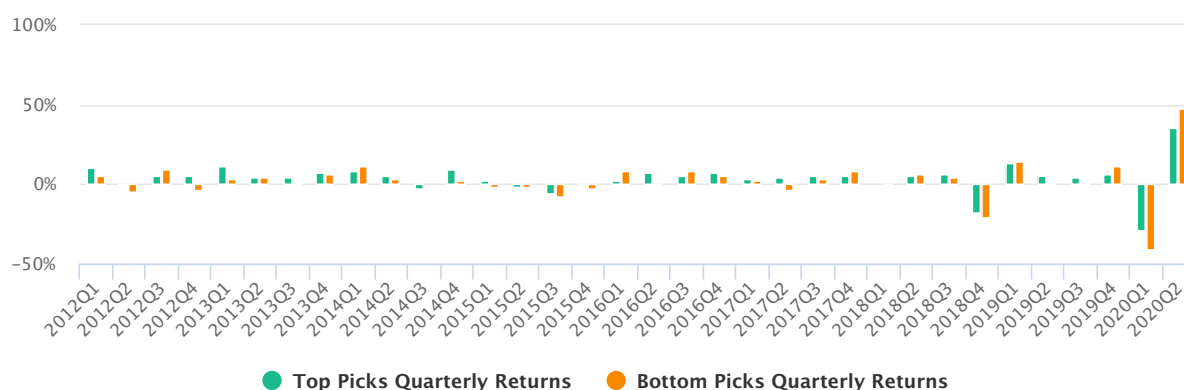


Table 2. Return Statistics

Statistics	CAGR	Alpha	Volatility	Beta	Sharpe
Top Picks	14.82%	3.64%	17.24%	1.13	0.89
SPY	11.20%	0.00%	12.79%	1.00	0.90
Bottom Picks	6.51%	-5.84%	21.68%	1.39	0.40

Figure 3. Quarterly Returns



Back Test and Portfolio Showcase

Kai Bottom Picks Portfolio

The Bottom Picks portfolio, which consists of stocks with stocks in K Score of 1, has generated only a 70.89% cumulative return from 2012-01-03 to 2020-06-01. This far lags the benchmark's performance of 122.11% over the same time period.

As summarized in Table 2, the Bottom Picks portfolio overall has a lower return and higher volatility. The compound annual growth rate (CAGR) for the Bottom Picks portfolio is just 6.51%, which is significantly lower than the 11.20% CAGR of the benchmark. Adjusted for volatility, the Bottom Picks portfolio also has a very low Sharpe ratio of 0.40 than the benchmark's 0.90. In other words, low K Scores have been very predictive for the corresponding stocks' future underperformance.

As we can see in Figure 3, even though the highest quarterly return generated by the Bottom Picks portfolio was 47.24% back in 2020Q2, the returns are mixed and volatile, with the worst quarterly performance coming in at -40.96% in 2020Q1.

Moreover, the Bottom Picks portfolio is substantially more volatile than the Top Picks portfolio, suggesting there are more risks associated with the Bottom Picks portfolio.

With these insights, investors can use K Score to potentially mitigate risk in their equity portfolios by avoiding stocks with low K Scores.

Conclusion

Kavout utilizes and develops state of the art AI and machine learning (ML) engines that turn vast amounts of complex data into useful investment intelligence. Our AI/ML approach provides a predictive framework that is not only methodical and powerful, but also adaptive and scalable. We will continuously fine-tune and add additional capabilities to our Kai intelligence platform. In our view, this is a very bright direction that will lead our clients to long-term successes in investing.

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Contact Us

To inquire about K Score purchase, partnerships, historical sample data or for more information on K Score, please contact us at

contact@kavout.co

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