REAL-TIME PREDICTIVE ANALYTICS

Better insight delivers better outcomes

Historical, streaming and predictive analytical tools provide an enterprise with three different types of insight. The first enables an organization to search through deep pools of historical data for patterns, trends and insights. The second, streaming analytics, enables an organization to monitor real-time information in search of data points that may announce the commencement of a pattern or trend that their analysts have identified in the historical data. The third, predictive analytics, enables an organization to project the likelihood of outcomes based on complex decision trees and probabilistic models.

These analytical tools complement one another, and each is distinctly valuable. More problematically, though, each one has historically been distinct. The historical tools cannot be used on real-time streaming data; the streaming data tools cannot perform historical analysis. Neither can be used to predict outcomes using data flowing by in real time.

Must these distinctions remain in place? With more flexible analytical tools and better ways to interact, an organization could respond faster and more effectively to a wide range of opportunities and challenges.
An analysis of analysis

Organizations have been analyzing data for a long time. We look for patterns, trends, models of behavior. It used to be that our focus was on the past so that we could better understand how certain events came to be. More and more, though, we found we could use that insight both to watch for evidence that this or that event might be about to occur again and to extrapolate from that insight to predict that this or that event might, like Halley’s Comet, recur at some specific point in the future.

Technology has both helped and hindered these efforts. On the one hand, organizations have more and more data that they can mine in search of patterns and trends. The longer an organization operates, the more historical data it accrues—about customers, products, sales and more. More data is available from third parties, too, and that data can be used to extend and enrich an organization’s existing data sets. Advances in storage, database and computational technologies have made it possible to analyze these vast pools of data more quickly than ever and to find patterns and trends both of greater complexity and greater subtlety. Some patterns may be defined by thousands of events occurring over the course of weeks; others may be defined by just a few events that occur within seconds.

And there lies one of the great challenges: The more we delve into the deep pools of data, the more aware we become of these patterns and trends—and the more we realize how difficult it can be to transform these insights into something we can use in real time. Traditional data mining tools can expose trends and patterns in historical data, but such tools are not designed to monitor the real-time data that streams through an organization on a day-to-day basis. They can tell you what to look for, but they cannot analyze the streaming data for you.

Streaming analytics

That’s where streaming analytics comes into play. Streaming analytical tools can watch, in real time, for evidence of the patterns and trends that your data mining tools have identified. The instant a streaming analytical tool encounters a data point or an event associated with one of the patterns or trends you are watching for, it can raise an alert or trigger an action.

Consider this: After performing a deep analysis of engine maintenance records, an automobile manufacturer might discover a pattern showing a higher incidence of costly engine repairs in cars where the engine oil has degraded past a certain viscosity level. Instead of recommending that owners change the oil every 5,000 miles, the manufacturer decides to recommend that owners change the oil when it reaches a specific viscosity level (as identified by the analysis of the historical record). To facilitate this new recommendation, the manufacturer decides to implement a streaming analytical system through which it can monitor sensor data pouring in from each car’s on-board computer. The moment the streaming analytical system detects that a car’s oil has reached that critical viscosity point—regardless of miles driven—it will send a message to the dealer responsible for servicing that car and prompt the service manager to contact the owner to schedule an oil change.

In this way, streaming analytics complements the Business Intelligence (BI) and data mining tools that an organization is using to discover deeper patterns in historical data. Streaming analytics enables you to detect events that match the characteristics of the patterns identified by those tools—in real time, as they occur. And, because the opportunities associated with each pattern may be fleeting (or, conversely, the risks associated with each pattern may be significant), insights delivered by streaming analytics enable you to respond in a timely manner. You can seize an opportunity while the window in which to do so remains open—increasing sales, operational uptime and more. Or, you can take action to mitigate a risk before it becomes greater—thus avoiding downtime, equipment failure, performance penalties, investment loss and so on.
Predictive analytics

While the combination of historical and streaming analytics can deliver significant benefits, there remain several important use cases in which key opportunities or risks will be insufficiently identified. Consider again the example of a car’s motor oil. While streaming analytical systems can issue an alert as soon as they detect that a car’s oil has reached a specific viscosity level, streaming analytical systems are not designed to predict when a given car’s oil viscosity will reach that point. That lack of advanced insight could be problematic: If a car owner drives 200+ miles every day, the viscosity of that car’s oil will change rapidly, and though the streaming analytical system can detect that the car should have its oil changed, it will not alert the local service manager to schedule the car for service sooner rather than later. If the service manager schedules the oil change 30 days in the future, the car’s oil may have degraded completely, and the engine may be irreparably damaged before it arrives for scheduled service.

In this scenario, a predictive analytical tool can better serve a manufacturer’s goals. Instead of monitoring streaming data in search of events and data points that conform to a set of rules defined by historical analysis, a predictive analytical tool relies on sophisticated probabilistic models to calculate the likelihood of certain events occurring. Using predictive analytics, the automobile manufacturer might look at sensor data and predict the likelihood of a car’s motor oil reaching the specified level of viscosity on a specific date. Predictive analytics might look at data points from dozens of sources and provide a prediction that could then be passed on to a local service manager. Because predictive analytics could take the rate of viscosity change into consideration, it could prompt the service manager to schedule an appointment on precisely the date that the oil should be changed.

Predictive analytics can help an organization seize opportunities that might not be apparent in a traditional analysis of the historical record—in part because predictive analytical tools are not limited to the structured data on which most traditional analytical tools focus. Predictive analytics can predict outcomes that take into consideration unstructured data as well, including images, video and audio data. And, because of the non-deterministic approach inherent in predictive analytics, predictions can be made based on patterns and events that the tool discovers on its own in the course of its analysis. Indeed, the patterns that predictive analytics can find and act upon may be far more subtle and complex than those described by traditional data mining approaches. They may involve many more conditions and variables.

Because real-time predictive analytics can quantify the likelihood of future outcomes well in advance of those outcomes, such a tool can provide greater forewarning to an organization when opportunities or dangers are detected. If the car manufacturer in our example is trying to increase customer loyalty, the use of real-time predictive analytics not only ensures better maintenance levels for each client’s car, but it can create competitive advantage by fostering a more personalized customer experience.

Software AG’s Solution

Combining Streaming Analytics and Predictive Analytics to deliver use cases such as:
- Predictive maintenance
- Connected customer
- Smart logistics
- Smart metering/manufacturing
- Fraud detection
Combining predictive and streaming analytics for real-time results

Predictive analytical solutions in themselves are not new. Organizations have been using tools such as R, KNIME® and SAS® to perform predictive analytics for some time. However, most predictive analytical tools operate offline, in batch mode. Like traditional data mining tools, these tools can create predictions from an analysis of static, historical data, but they cannot be used to create predictions from streaming real-time data.

Yet the ability to perform predictive analytics, in real time, on streaming data is a game-changer. If an organization could bridge that gap and perform predictive analytics in real time, working with data and events as they stream by, that organization could respond far more effectively and precisely to the opportunities and risks it encounters every day.

Let us consider several use cases in which real-time predictive analytics can make a powerful difference:

**Predictive maintenance**

By using predictive analytical tools in conjunction with sensors streaming real-time data from throughout the Internet of Things (IoT), an organization could more effectively predict when a wide range of maintenance tasks might be needed. The example of an ability to predict the appropriate time for a car to have its oil changed we have already seen—and there are many more examples. A real-time streaming analytical system might analyze a sudden change in the state of a device and predict the likelihood that that change will cause the device to fail at some specified time in the future. Or, it might predict the likelihood of a change in output from that device—or even the likelihood of a change in output further down the line because of the change in that one device. If you are monitoring machinery or systems as a service to customers, real-time predictive analytics can enable you to understand how likely it is that a problem will arise—and when. With that insight, you can schedule repairs or proactively replace the device well in advance of the device's predicted failure date. You can support your customers proactively, intervening before a problem reflects badly on your equipment, your services or your business.

**Connected customer**

There are scenarios in many different industries where real-time predictive analytics could be highly effective in engaging customers in a personalized manner.

In retail, a streaming analytical system might trigger an alert when a VIP customer’s cell phone connects to the store’s WiFi hotspot. Real-time predictive analytics could look at that customer’s purchase history, consider what section of the store the customer is visiting, consider the season, the weather, the time of day and a dozen other variables—and then predict the likelihood of that customer responding positively to a variety of customized offers.

In telecommunications, real-time predictive analytics could reduce churn by predicting which customers are likely to respond positively to a competitor’s offer. The predictive analytical system might also suggest which possible proactive interventions might be most likely to ensure that the customer does not switch providers.

In hospitality, financial services and other industries, there are opportunities to use predictive analytics to create customized interactions with customers. When connected to a facial recognition system, for example, a casino might use real-time predictive analytics to identify likely VIP customers who have arrived unannounced—at which point the system can alert management to roll out the red carpet. Conversely, the same facial recognition system could rely on real-time predictive analytics to rate the likelihood that a given individual is one suspected of counting cards in another casino—and alert security to watch this player carefully.
**Smart logistics**
In the area of logistics there are many opportunities to use predictive analytics. Logistics firms can draw on real-time data from a wide range of IoT sources, third-party data streams and more to make much more accurate predictions about when a truck will arrive at a loading dock or when a ship will arrive in port. That makes it possible to precisely coordinate loading and unloading activities, eliminate loading queues, facilitate customs processing and many more activities that, if streamlined, can eliminate significant amounts of waste. This can save money for the customer and ensure faster delivery of goods to the marketplace—both of which can improve a logistics provider’s position (and profitability) in this competitive marketplace.

**Smart metering/manufacturing**
Real-time predictive analytics in a smart metering or smart manufacturing scenario offers many benefits. Utilities, for example, could use real-time predictive analytics to determine whether sudden shifts in energy consumption patterns are likely to indicate energy theft. Manufacturers could use real-time predictive analytics to spot and fix quality problems even before they show up in the finished goods. Those predictions could arise from remote detection of anomalies in the quality of certain raw materials, for example. The predictive analytical tool might detect the difference noted by the sensor, even if there were no real-time analytical rule telling it to note that difference, and perform an analysis of the significance of that difference. It might determine that the strength of a finished product might be lower than others created with higher-quality materials and raise an alert to draw attention to this problem—long before the product is actually manufactured and long before a customer takes possession of it.

**Fraud detection**
Fraud detection is yet another area where real-time predictive analytics can play a powerful role. A real-time predictive analytical tool could analyze a debit card transaction as it is taking place, for example, and assess the likelihood of that transaction being fraudulent. It might take into consideration location data, previous purchase data, frequency of card use and more—and based on a fraud score arising from this analysis, it might recommend a certain real-time response. If the fraud score is high, the solution might prompt the transaction authorization systems to deny authorization; if the analysis yields a mid-range score, it might prompt the call center to initiate a priority call to the customer’s cell phone to verify that the customer really has initiated the transaction in question.
Software AG: Delivering real-time and predictive analytics in one

The marriage of streaming analytics and predictive analytics is not one destined to take place in the distant future. It's here today. Software AG's Apama Streaming Analytics provides both real-time and predictive analytical functionality. The predictive models that an organization might develop using tools such as KNIME, R or SPSS can be exported from those modeling tools using PMML (the XML-based Predictive Model Market Language). These PMML files can be imported into Apama through Software AG's Apama predictive analytics add-on. Within a matter of moments, Apama can perform real-time predictive analytics on the data streaming throughout the enterprise.

Because it supports both types of analysis, Apama is unique in its ability to monitor live data feeds. The real-time streaming aspect of Apama can respond (in real time) to conditions or events that have been identified through traditional data mining techniques. Simultaneously, the predictive aspect of Apama can analyze incoming events against a predictive model, such as a complex decision tree, in real time. This produces a value or score that represents the probability of a given outcome. By integrating both analytic types in a single tool, Apama Streaming Analytics enables you to close the loop between historical and real-time analysis. You can discover new patterns and models offline using historical data and then register them for immediate detection and action within Apama. You can even add new predictive models during runtime and analyze different types of data using different models.

Consider the role of this combination of analytical tools in the connected customer example: The moment a sensor in a shopping mall picks up a beacon from a mobile phone app, Apama could begin an analysis that will determine the likelihood of that customer to make specific kinds of purchases. The analysis might consider what is present in the customer record—the customer's gender, age, income, previous purchases and more. It might factor in location information to determine where in the mall the customer is standing. It analyzes all these data points in real time and produces a score predicting the likelihood of that customer responding positively to a promotion from one of the stores in the mall. If the analysis returns a score indicating that there is a 75 percent chance that the customer would respond positively to an offer from a sportswear store, Apama could initiate a process that would push a coupon for the sportswear store to the app on that customer's phone. If the analysis indicates a greater chance of the customer responding positively to an offer from another store—a conclusion that might have been influenced by the weather, the day of the week or some other factor—Apama could push a different coupon to the customer's mobile app.

As part of Software AG's Digital Business Platform, an organization can use Apama Streaming Analytics to integrate the power of real-time and predictive analytics into a broad set of solutions. It can extend the solutions you already have and help you take those solutions to the next level. The result? Greater real-time insights, a greater ability to respond to opportunities in real time and a greater ability to mitigate risks before they become much more significant and burdensome.
Summary

Historical, streaming and predictive analytical tools can be most useful when used together. By making it easy for an organization to move the insights and predictive models built on top of an analysis of historical data into the real-time world of Apama Streaming Analytics, Software AG is closing the loop between these previously distinct and disconnected analytical modes. And, by enhancing the real-time streaming analytical capabilities of Apama with powerful, real-time predictive analytical capabilities, Software AG makes it possible for an organization to stay on top of the opportunities and challenges that might slip by unnoticed if only one type of analysis were being applied to the real-time data streaming through the enterprise.
Recommended resources
For more information on Software AG, Apama Streaming Analytics and the Software AG Digital Business Platform, check out:

- Internet of Things Solutions for Smart, Connected Products fact sheet
- Driving Digital with the Internet of Things white paper
- Forrester Research Principal Analyst Mike Gualtieri on Streaming Analytics
- Observe, Decide & Act with Apama & webMethods video
- IoT Predictive Maintenance video
- Smart Signage video
- Smart Logistics for Manufacturers video

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