

Case Study: Automated reporting and anomaly detection



Challenge

The late discovery of operational outages or sub-optimal performance of a business function have significant repercussions that may lead to substantial financial losses. Operational disasters are often easily identified when they occur, and most companies have high level monitoring dashboards to identify such disasters. However, it would be far better to recognise the warning signs that such a disaster is impending and apply corrective action early, such that the problem can be averted before excessive financial damage is experienced.

Few companies regularly monitor behaviour at the granular level of sub-processes or model outputs. In a lending environment, an example of this would be the risk of the models drifting away from the risk appetite defined by business. Should the accumulation of these small yet repeated deviations from the desired behaviour go unnoticed for extended periods then significant and unexplained financial losses could consequently be encountered in the future.

Continuous monitoring of granular performance and regular reporting are suitable solutions but impose a substantial workload on skilled staff who are required to analyse large quantities of data, produce reports and screen for unusual results. If processes aren't monitored at the appropriate level, the risk of insufficient process oversight and the late detection of problems increases. Automating the process of creating reports *and* automating the ability to identify anomalous process behaviour ensures that the business oversight is provided, while being resource efficient – allowing skilled staff to focus on more appropriate tasks.

The Solution

Opti-Num Solutions consultants developed a MATLAB®-based reporting and anomaly detection system for a South African registered credit provider. This self-contained and automated system was developed to filter through massive company-wide databases, to automate the repetitive and time-consuming activity of compiling operational performance and process reports and to identify anomalous process behaviour using machine learning algorithms.

Automated Report Generation:

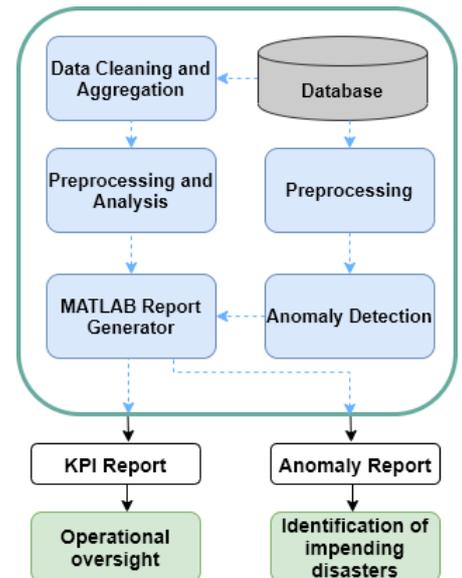
The report generation system automatically extracts, cleans, aggregates, and analyses high-level and granular operational company data. The system is built using object-oriented programming, making it highly robust, modular and customizable. Meaningful graphical analyses of the company's performance are exposed via a KPI report, providing a data-driven, scientifically substantiated foundation from which critical decisions can be made. The reports are generated at a specified time every day, week or month following which they are emailed to key personnel in the organization.

Anomaly Detection:

An anomaly is an occurrence where an observation of a monitored process or KPI metric deviates from the expected or desired behaviour. An independent anomaly detection framework was built in conjunction with the main automated reporting system using the same modular principles to create a scalable modeling infrastructure. This structure allows an anomaly detection algorithm to be selected or customized for each process or KPI metric that is being reported on. If, for some reason, the algorithm needs to be changed, it is easy to switch algorithms with a few small changes in the modular code.

One such anomaly detection algorithm is a Nonlinear Autoregressive Network with External Input (NARX) model. These neural networks make accurate predictions of future values based on past time series data. In the case of the current framework, predictions from a collection of NARX models are used to create a probability distribution estimating a range where "normal" behaviour is expected to lie. If points fall outside of this range, they are labeled as anomalous and summarized in an anomaly report. The models are automatically retrained weekly on new normal operational data, ensuring that the models remain accurate over long periods of time.

Figure 1: Automated Reporting System process flow



Outcome

A fully automated reporting and anomaly detection system was developed and implemented in MATLAB®. The reporting system provides oversight of global and granular performance and processes. The fully automated system requires little to no resources to support following setup; therefore staff are available to investigate and address the causes of unexpected process results or perform more meaningful work. The anomaly detection system provides alerts to unexpected or unwanted process behaviour where early identification and rapid response is critical to preventing financial or reputational losses.