KPMG

Predictions under uncertainty

Predictive Analytics for financial forecasting

Artificial Intelligence and Mathematical Modelling

COVID19 has brought the effectiveness of Predictive Analytics into sharp focus. Can we really predict the future? Can Predictive Analytics methodologies anticipate pandemics? How can Predictive Analytics cope with the current macro and microeconomic uncertainty?

1. Could COVID19 have been predicted?

The exact timing and severity of COVID19 could have not been predicted. However, records of epidemics date back as far as 1200 BC, the Babylon influenza [1].

Decision makers can leverage historical epidemiological data and integrate rare events and catastrophe modelling in their day to day decision making. The development of predictive analytics models begins with the identification of risks. While the focus is currently on epidemics, disruption factors should also include tail events such as adverse weather and geopolitical risks.

2. What COVID19 means for Predictive Analytics?

Predictive Analytics (PA) is a broad discipline. Traditionally, PA has been associated with Time Series Analysis: the use of mathematical methodologies (econometrics, machine learning) aimed at the extraction of patterns from historical data [2] COVID19 has stressed the limitations of Time Series Analysis: its inability to cope with the inductivist turkey [4]. Working with time series data of limited duration leads to an underestimation of the risk of disruptive events.
Predictive analytics has, fortunately, other arrows in its quiver: probabilistic models [4].

3. What is a probabilistic model?

Probabilistic models are models where inputs, model parameters and the uncertainty regarding the correct model are expressed as probability distributions. The output of a probabilistic model is also a probability distribution.
A systematic approach where uncertainty is explicitly quantified leads to more robust models capable of identifying regime shifts such as abrupt changes in the micro or macroeconomic environment.

Structured probabilistic models

Value driver trees facilitate the identification of risks and help understand trade-offs as well as the impact of internal and external drivers on the north star financial metric. The use of Probabilistic Models that match the value drivers tree of the company leads to models that are inherently interpretable by the decision maker.

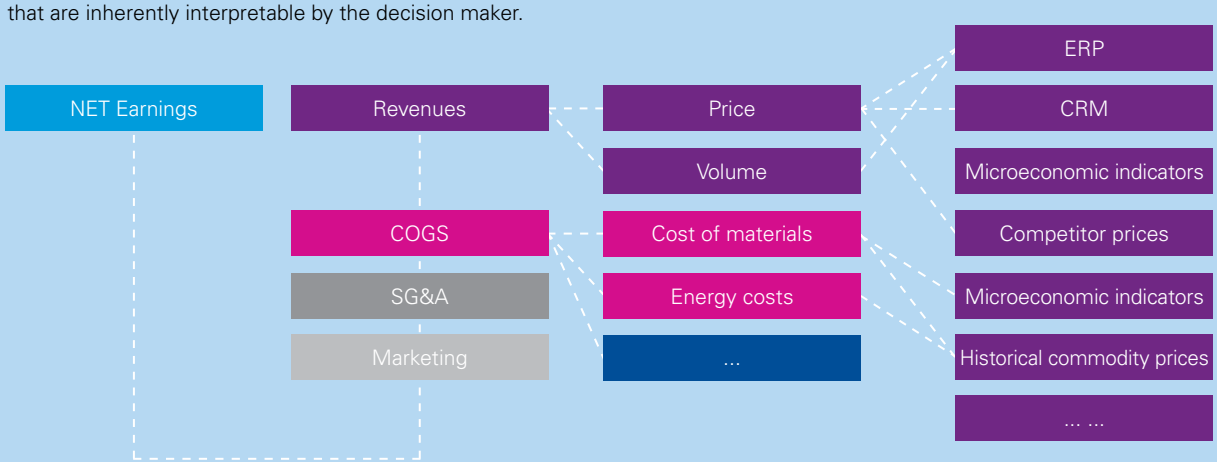

Fig. 1 – A generic example of a value drives tree where a north star financial metric (net earnings) is decomposed into profit and loss items and subsequently financial KPIs

4. Probabilistic models in financial forecasting

We recommend the definition of Probabilistic models whose structure closely resembles the value driver tree of a company (fig. 1).

Integrate experts' opinion

Probabilistic Models allow the definition of key inputs as probability distributions. Input probability distributions can be estimated from historical data, taking also into account the assumptions of key stakeholder. Bayesian methods provide the right framework and the necessary computation toolboxes to achieve this goal.

Simulations and scenario analyses

Probabilistic models allow the execution of rigorous simulations in order to estimate the distribution of the forecasted quantity. A mathematically rigorous approach to numerical simulations enables scenario analysis and the assessment of the financial impact of tail events (rare events), ultimately empowering decision makers with tools from actuarial sciences and catastrophe modelling.

5. One model to rule them all

Companies have invested significantly in the development of forecasting models. It is often the case that different forecasting models are operated in different areas of the organization. Probabilistic models allow the integration and the reconciliation of different models developed with different forecasting goals.

6. Strategic and tactical decisions

Is rare event modelling and stress-testing only a strategic consideration to be contemplated in long-term planning? We believe that every risk should be reflected in short-term planning. Furthermore, the economic impact of tail events on short-term forecasts should be coherent with the estimates for longer timeframes and short-term forecasts should aggregate into long-term forecasts.

Cash forecasting

Structured approaches are extremely effective in cash and liquidity forecasting. A structured probabilistic model would exploit customer data, historical and current account receivables data as well as historical cash flow data. In order to integrate cash flow data and account receivable data, the probabilistc models will estimate customer defaults and the distribution of repayment times against different payment terms.

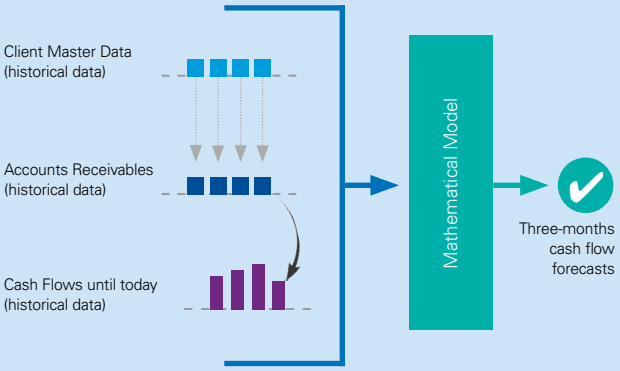

Fig. 2 – A structured model for cash forecasting

7. Alternatives to the use of black-boxes

KPMG has a long-standing experience in developing predictive analytics models. We support our clients with:

- Alignment of project goals with overall company strategy
- Identification of risk factors
- Identification of external and internal data sources
- Data integration and cleansing
- Mathematical modelling
- Model validation
- Reporting and data visualizations
- Integration of the predictive analytics solution in the existing business processes

References

[1] Mouritz, A. (1921). The Flu. Retrieved April 5, 2020.
[2] Hamilton, James Douglas. Time series analysis. Princeton university press, 2020.
[3] Peter Godfrey-Smith. (2010). Theory and Reality: an Introduction to the Philosophy of Science. University of Chicago Press.
[4] van de Meent, Jan-Willem, et al. "An introduction to probabilistic programming." arXiv preprint arXiv:1809.10756 (2018).

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