Interview with Michael Feindt on "Prescriptive Big Data Analytics"

Michael Feindt studied physics at the University of Hamburg and worked as a researcher at the DESY and CERN research centers for many years. Since 1997 he is a professor of experimental nuclear physics at the Karlsruhe Institute of Technology (KIT), Germany. In 2000, he invented the NeuroBayes algorithm, a tool for exact predictions in scientific research as well as for different branches and research questions in business. After his students won the prestigious Data Mining Cup three times with NeuroBayes since 2005, he founded the company Blue Yonder in 2008. Blue Yonder offers predictions and data patterns for questions such as sales, supply chain optimization, and cancellation probabilities. Michael Feindt is currently Chief Scientific Officer at Blue Yonder.

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Prof. Dr. Michael Feindt
Blue Yonder GmbH
Ohiostraße 8
76149 Karlsruhe
Germany
michael.feindt@blue-yonder.com

Interview by

Prof. Dr. Matthias Jarke (✉)
Lehrstuhl für Informationssysteme
RWTH Aachen University
Ahornstr. 55
52074 Aachen
Germany
jarke@dbis.rwth-aachen.de

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BISE: Prof. Feindt, Blue Yonder is seen as an innovation market leader in Predictive Analytics. What do you mean by the term Predictive Analytics? How does it differ from other Big Data methods?

Feindt: Predictive Analytics is different from traditional descriptive data analysis in that early Business Intelligence solutions only enabled a look into the past: what has happened and why? In contrast, Predictive Analytics allows a glimpse into the future and permits reliable predictions based on Big Data.

In a decisive additional step, *Prescriptive Analytics* enables automated decision making by offering advanced predictive capabilities. Thus, you can make business processes more efficient, but you can also implement new, disruptive business models. For this purpose Blue Yonder combines scientifically based technologies such as Predictive Modeling, Reinforcement Learning, and modern Neural Networks.

BISE: Can you sketch a typical application example from your customers?

Feindt: We apply our methods, e.g., in the supply-chain process of a fresh food retailer and thus ensure availability of their products in each store every day. Blue Yonder does not just analyze historical sales figures for the predictions but also includes context factors such as weather predictions or holidays. The system generates purchase order proposals for each product in each store and enters these directly into the ERP system. A second example: For an online shop, we daily propose new prices for thousands of products, based on sales, stock level, as well as product properties. Neither scenario would be conceivable without automated decision-making, i.e. Prescriptive Analytics.

BISE: Predictive Analytics seems to imply the ability to predict the future. Especially in public financial markets (e.g. stock exchanges), many researchers claim that such a prediction is in principle impossible in efficient markets, or if at all possible only in the very short time range. How do you see the applicability conditions for Predictive Analytics?

Feindt: I agree that financial markets are very hard to predict, in fact increasingly so over the past 20 years. Our studies of prediction quality show, moreover, that the US are about five years ahead of Europe in this regard.

But what exactly do we mean by predictability? A good prediction describes the probability distribution for all possible future values adequately. This cannot just contain the average expected value, but equally importantly the variance and even non-Gaussian outliers (crash proba-

bilities). Risk management in banks usually only looks at this risk aspect and does not even try to predict the positive or negative sign of the expected value. However, both are important, and both are included in all Blue Yonder predictions.

Of course, the main requirement is that the prediction must be accurate. Even though it is unavoidable that in individual cases an event may occur which has only been predicted with low probability, the true distribution must on average comply with the predicted one. Our method achieves a probability distribution that is tailored to each individual situation and as narrow as possible, but: not narrower than the distribution later found in reality.

BISE: In which domains would you rather recommend caution?

Feindt: It is in the nature of things that some systems can be individualized more easily than others. Our method can only learn statistically significant correlations. Thus, it is good to have many observation data points; the prediction quality grows with the square root of the number of independent observations.

Unfortunately, if there is no predictable dynamics in a system, many observations do not help. You cannot predict the lottery numbers if they are truly random (deterministic chaos); however, sports betting includes both a deterministic and a stochastic share. Likewise, the weather is a chaotic system which you can predict more reliably on a short-term than on a long-term basis, and much more accurately in some context situations than in others. Blue Yonder's software is optimized to reliably separate these two components – predictable and random ones. Roughly speaking, the first component is reflected in the relative position of the individual expected value to the overall expected value, the second one in the variance of the distribution.

Prescriptive Analytics is of particularly high value if the predictions apply to many special cases in many places in relatively short time intervals. The automation and optimization of a large number of small operative decisions easily adds up to million-Euro values.

BISE: Your fundamental NeuroBayes algorithms have their scientific background in methods that were initially developed for physics data analysis at CERN. What is the mathematical approach behind these methods? For which CERN applications were they actually used?

Feindt: The mathematical background of NeuroBayes is a combination of Bayesian statistics, multivariate statistics, neural networks, and regularization methods. From existing simulation or experimental data predictions are computed in the form of probability densities. NeuroBayes is being used in the very large accelerator experiments in places such as CERN, Fermilab, and KEK. Applications include many aspects of analyzing the origin of the world, e.g. particle identification, optimizing the resolution of measurement devices, or the question if a bundle of particles was produced from a Quark or Anti-Quark. In addition, NeuroBayes is utilized for the important task of data reduction from peta bytes per second towards peta bytes per year, as the approach can decide extremely fast for 30.000 parallel instances which observed events are potentially interesting and which ones are already known in principle and can thus be discarded.

BISE: How did the knowledge transfer from physics to business and the subsequent successful company start-up happen?

Feindt: We found the first cases for application in business in the retail sector. Here, the huge variety of products produces enormous streams of data. Moreover, the profit margins in this sector are so small that precise sales planning is crucial for the survival of companies: underprocurement does not just result in a loss of sales, but may also turn away customers towards the competition. Overprocurement reduces profit by required down-pricing or even discarding of products. The mail order trader Otto recognized the advantages of automated processes very early and is now using our solutions also in other areas such as dynamic pricing, trend recognition, and management of returned goods.

BISE: Under which conditions do you see the key customer value of your solutions? In what business domains or types of business processes do you mostly find these conditions?

Feindt: With our solutions, customers can realize the new values created by the digitalization of business processes in the last decades. The added value is easily identifiable by growing sales, cost reduction, or enabling of novel business processes and models. Early adopters of digitized business processes were, and are up until now, companies that put their bets on the Internet since the early days. This has created huge new players and has put a lot of pressure on existing enterprises.

Established enterprises must consider how to secure their existing markets, or re-enter their market with disruptive business models to counter this pressure. We are convinced that this trend will grow to affect all fields of business in which digitized business processes enriched with Predictive Analytics and automated decisions are feasible. This is always the case where thousands or millions of business transactions happen every day and individual customer preferences need to be considered in enterprise decision making, e.g. Media, Trade, Utilities, Travel & Transport, Insurance, and Banking.

The next major target is Industry 4.0 which will be digitizing the industry sector itself in order to obtain these properties of mass-customized digital business. All big players even in this field have recognized the value of data and their exchange and are preparing their role in the next industrial revolution.

BISE: Can you offer a few hints for entrepreneurs from Big Data Science from these experiences?

Feindt: I would like to emphasize to upcoming entrepreneurs that they need to truly believe in their innovations. Courage, durability, and unwavering belief in the idea certainly belong to the most important properties of an entrepreneur. For quite a while we were smiled at and had to offer many a proof before big customers accepted our solutions. Now this is quite different: customers as well as investors stand in line.

A good idea alone is not enough. It is decisive that an innovative approach delivers a direct value contribution for the customer. And you need to be able to make this clear to the customer. In addition to technical excellence, references and professional marketing and sales are extremely important.

BISE: Professor Feindt, thank you very much for this interview!