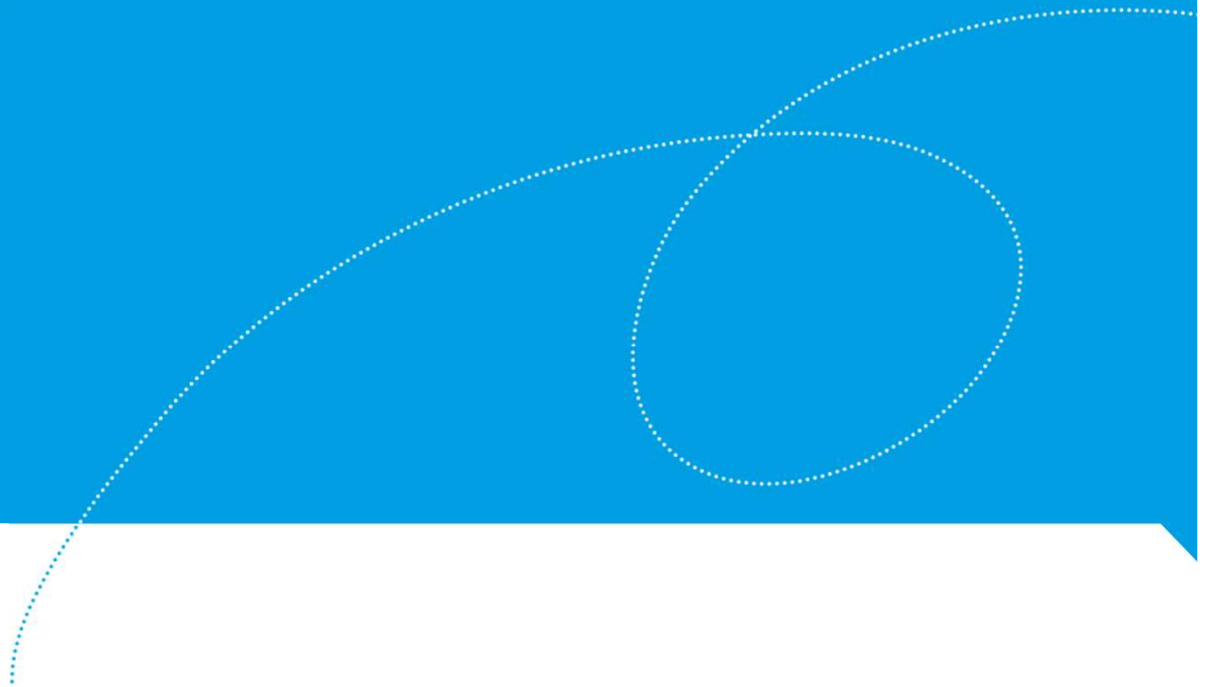




Forward looking. Forward thinking.

# Science meets Industry – Predictive Analytics with Blue Yonder

Dr. David Fischer  
Blue Yonder GmbH



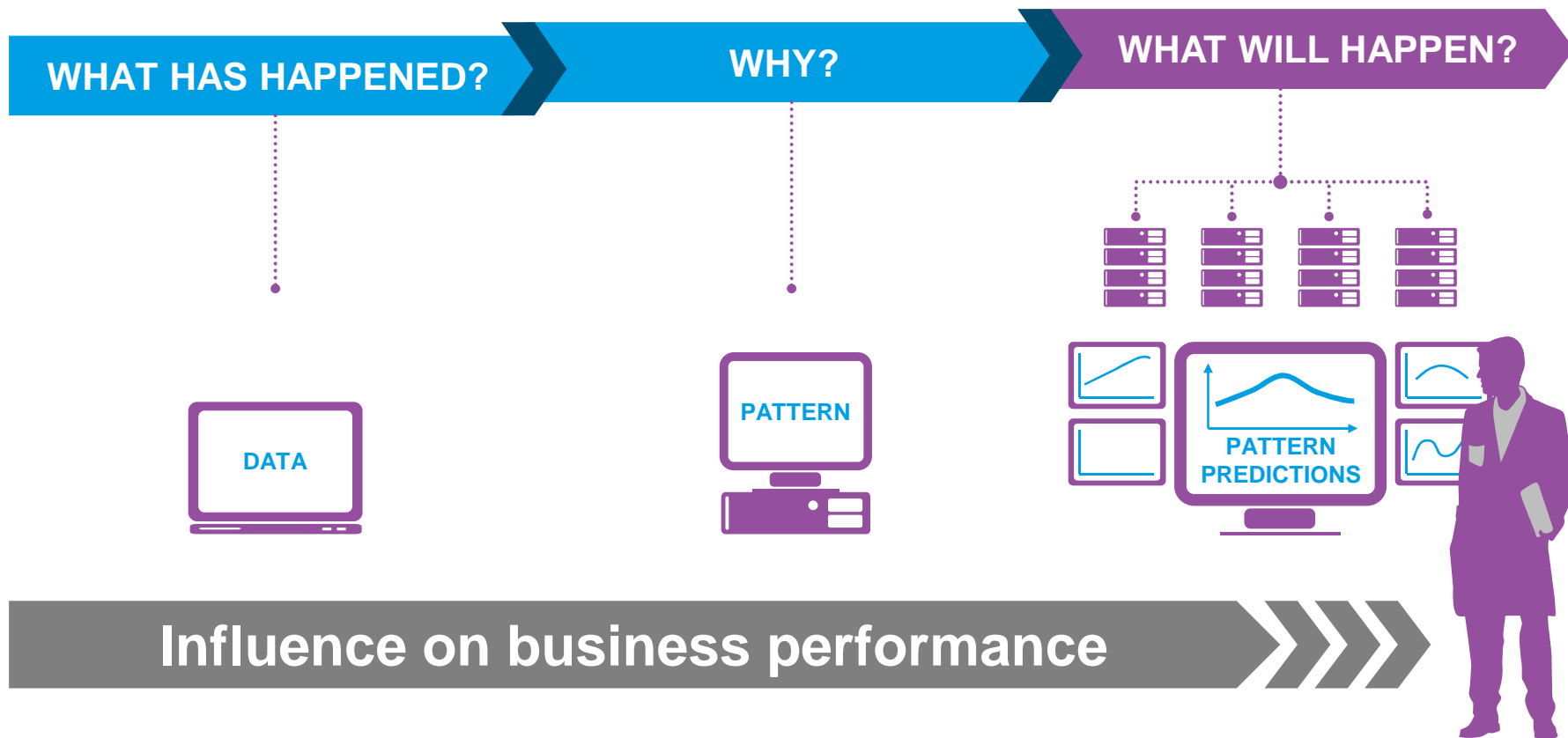
- Blue Yonder – Who we are and what we do
- What is NeuroBayes®? Where does it come from?
- A spoonful of neural networks
- Applications in industry



# Predictive Analytics

Data Mining and conventional  
Business Intelligence

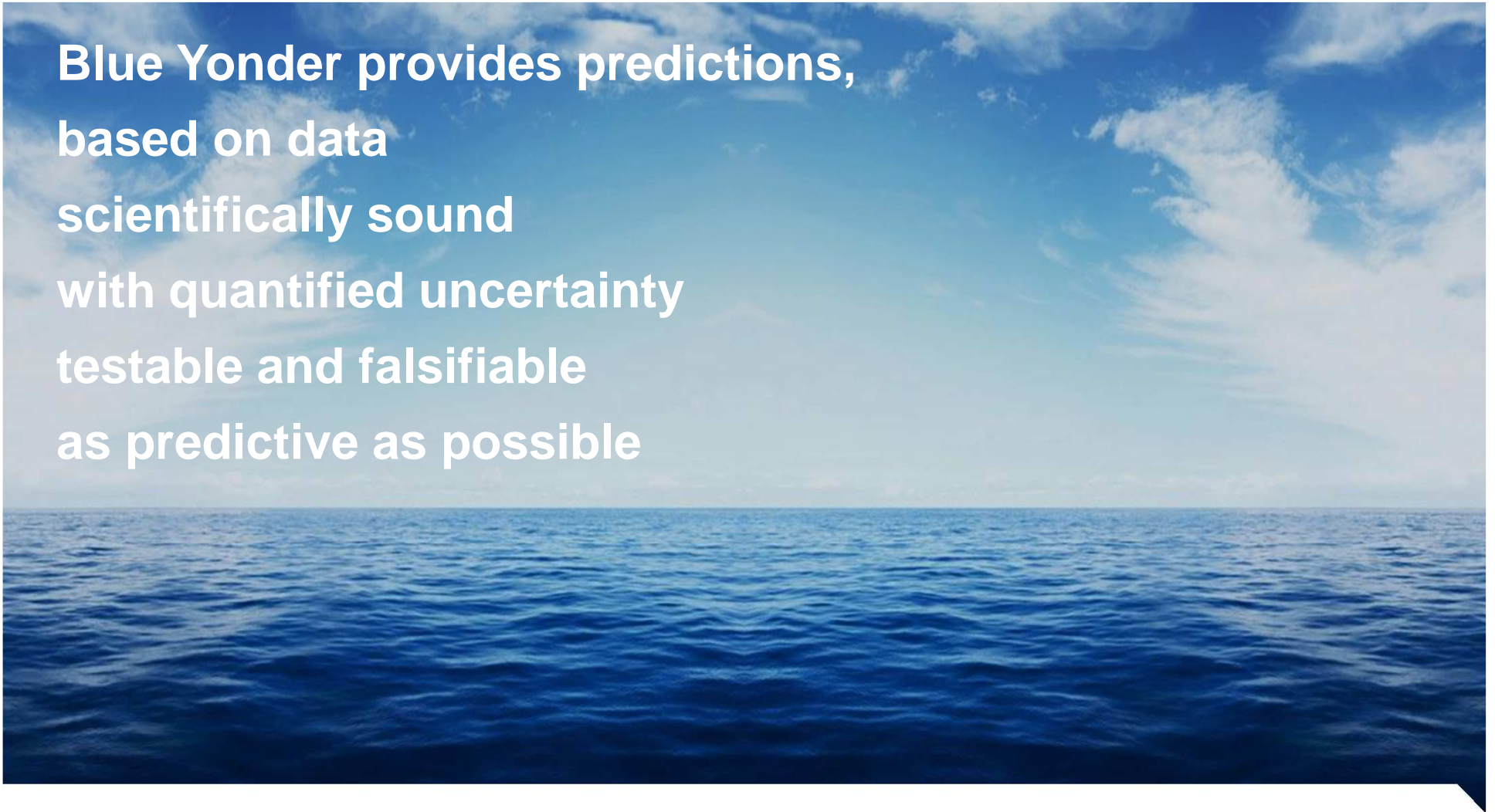
Predictive  
Analytics





Forward looking. Forward thinking.

**Blue Yonder provides predictions,  
based on data  
scientifically sound  
with quantified uncertainty  
testable and falsifiable  
as predictive as possible**



# Where we come from ...

**1999**

Invention of NeuroBayes® at DELPHI

<phi-t>®  
Physics Information Technologies

**blueyonder**  
Forward looking. Forward thinking.

**2000 – 2002**

NeuroBayes® - specialization  
for economy at the University  
of Karlsruhe, supported by BMBF

**2002**

Phi-T GmbH founded (Karlsruhe),  
first industrial projects

**2006**

NeuroBayes® in investment funds  
(Lupus alpha)



**blueyonder**

# Where we come from ...

**2008**

Second office in Hamburg

**2011**

Relaunch as Blue Yonder

**2013**

Third office in London

**Now**

Staff currently about 100

Mainly HEP physicists

> 80% PhDs

Internationalization underway.



blueyonder

# Blue Yonder – Fastest growing BI company in Germany

## Aufsteiger: Top 10-Anbieter von Business-Intelligence-Software nach Umsatzzuwachs

Unternehmen	Umsatzwachstum 2011-2012	Softwareumsatz 2012 (in Mio. €)
Blue Yonder	175%	3,3
Talend	100%	8,5
Splunk	100%	7,0
Rapid-I	78%	1,6
Jedox	43%	3,0
Tibco Spotfire	40%	18
LucaNet	39%	6,4
Bissantz	38%	6,2
SAP	37%	240
Datawatch	35%	2,3
<b>BI-Gesamtmarkt</b>	<b>13,0%</b>	<b>1190</b>

Quelle: „Der Markt für Business Intelligence in Deutschland 2012“, BARC.



The Business Application Research Center (BARC) found that Blue Yonder is the fastest growing BI software company in Germany.

With 175% turnaround increase in 2012 Blue Yonder is leading the field compared to 250 competitors in the area of Business Intelligence and data management.

# References

## Retail, Financial Services, Telecoms & Media

axel springer

BGV  
BADISCHE VERSICHERUNGEN

bon  
prix  
it's me!

B breuninger

BÜRDEL  
WIRTSCHAFTSINFORMATIONEN

central  
Gesundheit bewegt uns.

Crate&Barrel

dm  
HIER BIN ICH MENSCH  
HIER KAUF ICH EIN

dunnhumby

EOS

Schwab

SportScheck

QUELLE.  
www.quelle.ru

real

heine  
IMMER ETWAS BESONDERES

M Müller

vodafone

WITT  
WEIDEN

*"The decision to select Blue Yonder's technology followed a hunt for a new predictive analytics platform, which saw the leading software firms in the market compete for the contract."*

*Blue Yonder's results were better than any of the other software houses could deliver. We gave them historical data, from which we already knew the results, let them make forecasts and compared the forecasts to the results. There was a huge gap to the next best software supplier"*

*Michael Sinn, VP Buying Division Support, OTTO*



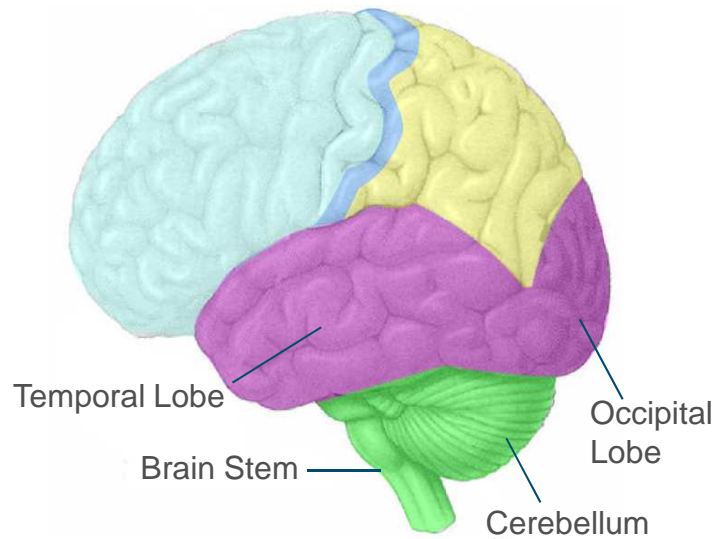
next

OTTO

blueyonder

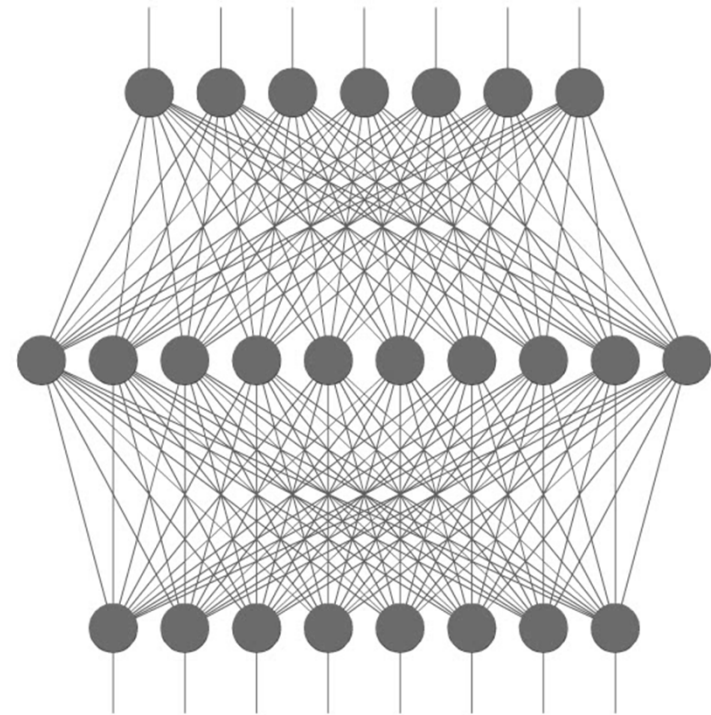
# Neural Networks

- ▶ A way to construct a low dimensional statistic from multidimensional input.
- ▶ A self learning procedure, copied from nature.
- ▶ Learn correlations between inputs, learn most significant inputs.



# Neural Networks

- ▶ In NeuroBayes®, the classification core is based on a simple feed forward neural network.
- ▶ The information (the expertise) is coded in the connections between the neurons.
- ▶ Each neuron performs fuzzy decisions.
- ▶ A neural network can learn from examples.



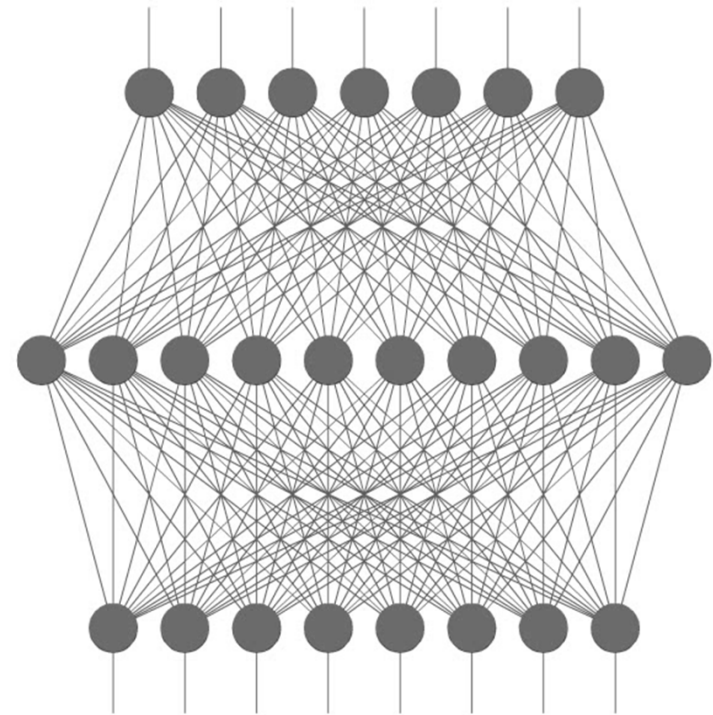
# Neural Networks

## Human brain

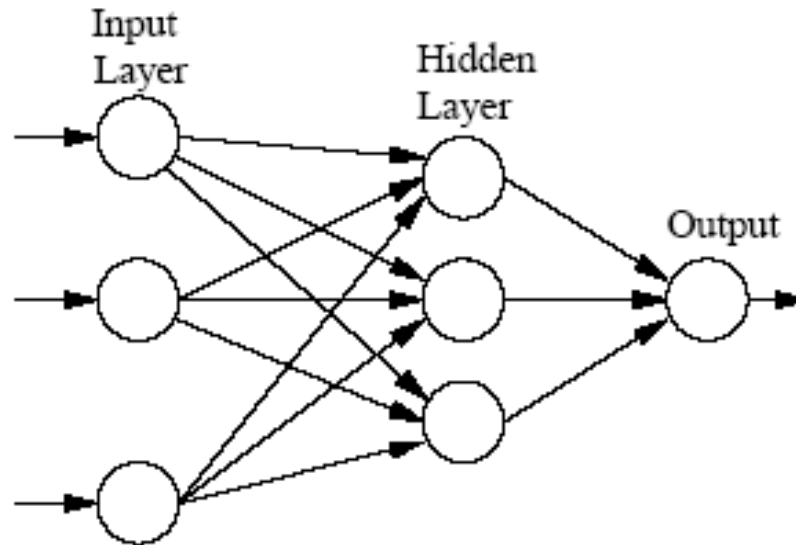
- ▶ About 100 billion (  $10^{11}$  ) neurons
- ▶ About 100 trillion (  $10^{14}$  ) connections

## NeuroBayes

- ▶ 10 to few 100 neurons



# Neural Networks Basic Functions



The output of node  $j$  in layer  $n$  is calculated from weighted sum of outputs in layer  $n - 1$ :

$$o_j = S\left(\sum_l w_{lj}^{2 \rightarrow 3} \cdot S\left(\sum_k w_{kl}^{1 \rightarrow 2} \cdot x_k\right)\right)$$

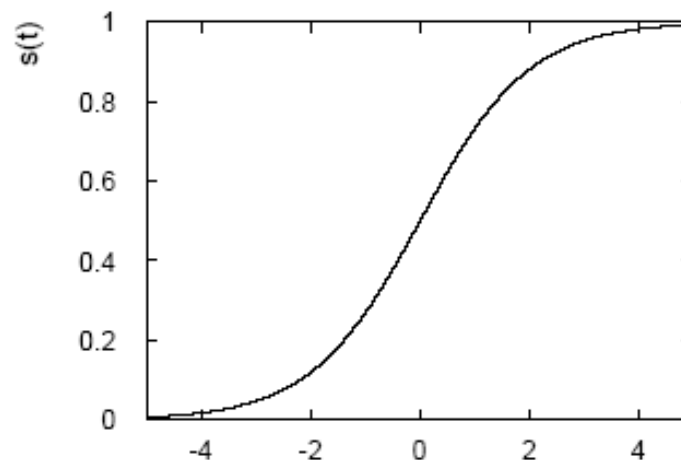
Each connection has associated a weight  $w_{i,j}^{(n)}$

# Neural Network Transfer Functions

A non-linear monotonuous transfer function  $S(x)$  is applied at the output of each node, e.g. the sigmoid function:

$$S(x) = \frac{1}{1 + \exp(-x)}$$

It maps the intervall  $(-\infty, \infty)$  to the compact  $(0, 1)$ .



# Neural Network Training

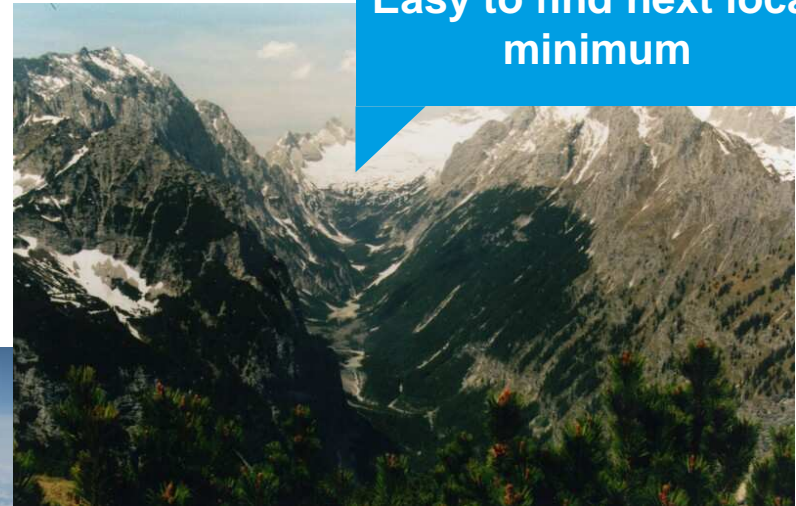
## Difficulty

Find global minimum of

- ▶ highly non-linear function
- ▶ In high dimensional space (potentially more than 100 dimensions)



Globally a lot harder!



Easy to find next local minimum

➔ Good preconditioning Needed!

# Neural Network Training

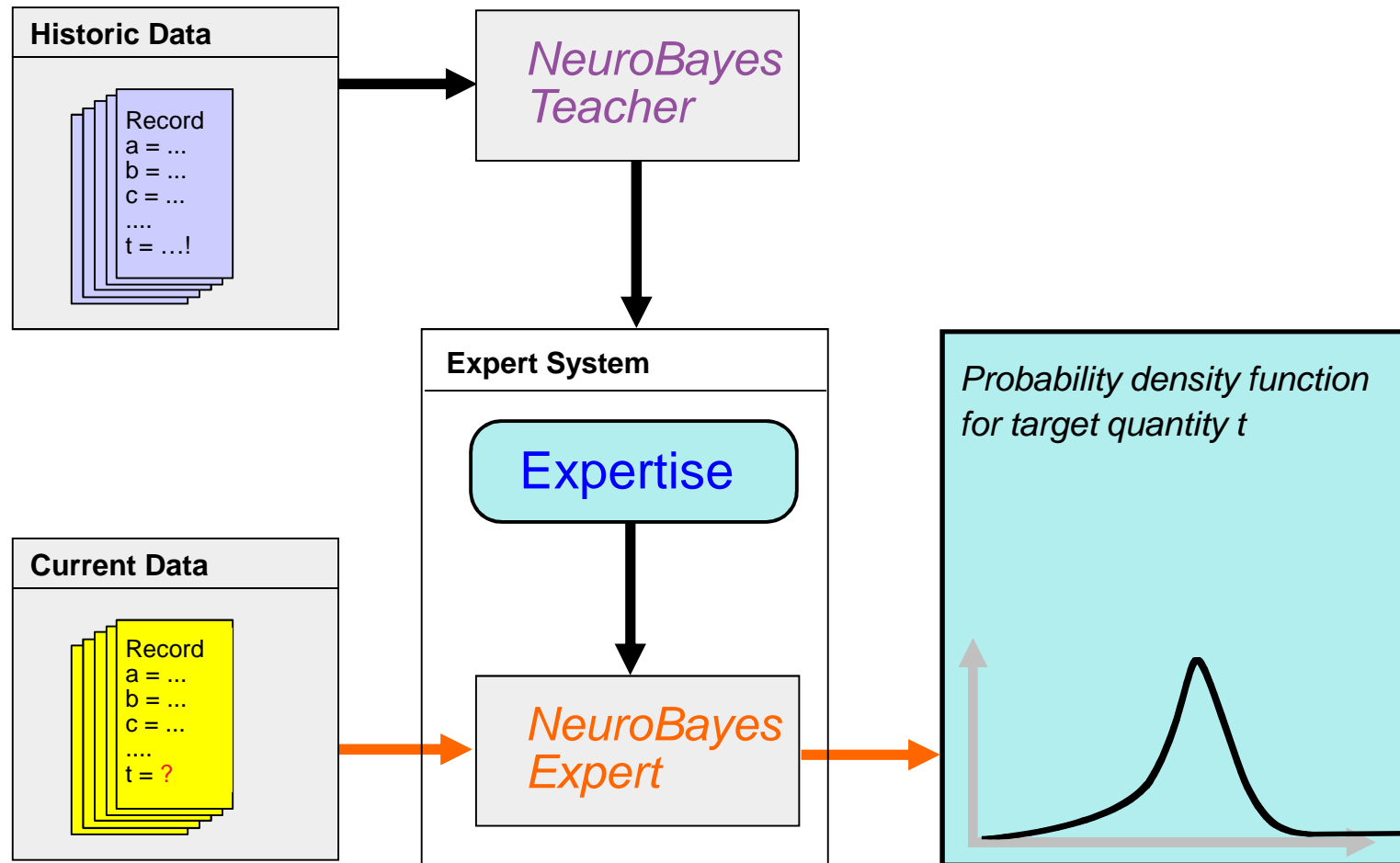
- ▶ Number of features can be large.
- ▶ Features may be arbitrarily correlated.
- ▶ Features can values from an ordered / unordered.
- ▶ sets and continuous / discrete variables.
- ▶ Variables can be missing.

➡ **This results in a complex and high-dimensional Problem.**

## Example:

What's the right dose for a patient, if she is 56 years old, slightly overweight, works out on 2 days a week, enjoys late dinners, has been treated for 2 other diseases already, etc, etc ...

# NeuroBayes System Working principle



# Preprocessing

**Automatic preprocessing needed before training.**

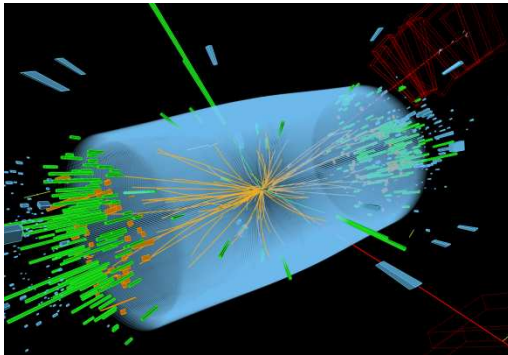
## **Involved steps:**

- ▶ Smoothing out statistical fluctuations and outliers in input variables.
- ▶ Transforming variables to unified characteristics (mean, width).
- ▶ Decorrelate variables
- ▶ Find variables with significant impact, throw out others

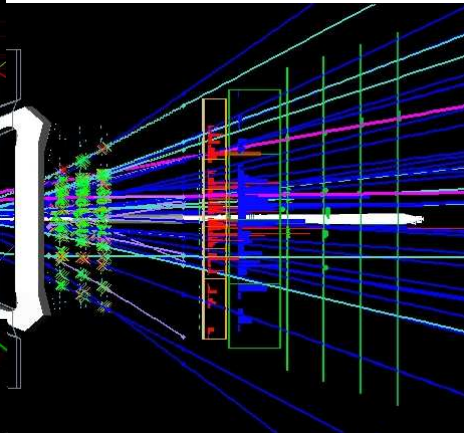
## **The benefits of a powerful preprocessing algorithm:**

- ▶ Increased robustness
- ▶ Increased network training results (minima easier to find)
- ▶ Increased training speed

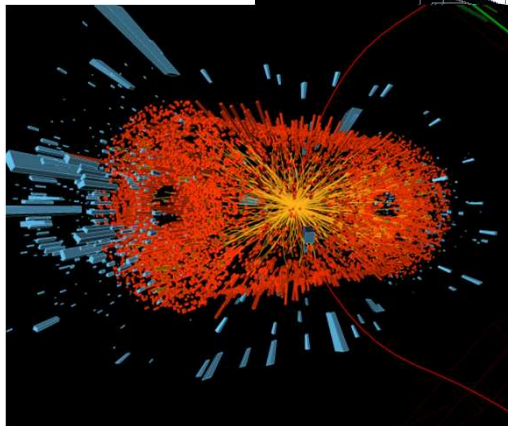
# NeuroBayes® example: The LHCb trigger



- ▶ At the LHC (CERN) – per experiment: 40 000 000 events per second, which translates into 1 PetaByte (1.000.000.000.000.000 Byte) per second raw data



- ▶ But only 1 PB of interesting data per year can be stored.
- ▶ Need online reduction by 1:10,000,000



- ▶ At the LHCb experiment 30.000 instances of NeuroBayes® running real-time 24/7 filter out the interesting events without introducing lifetime bias

Photo: CERN

# NeuroBayes® in the „Real Life“



# Sales Forecast Fashion

Example: OTTO Group



## Solution:

- ▶ Provision of item sales predictions on a daily basis
- ▶ Predictions for calculation of the return quota
- ▶ Creation of detailed merchandise planning suggestions

## Result:

Improvement of predictions by 40%

Inventory improvement in the  
**double-digit million € range per year.**

40%



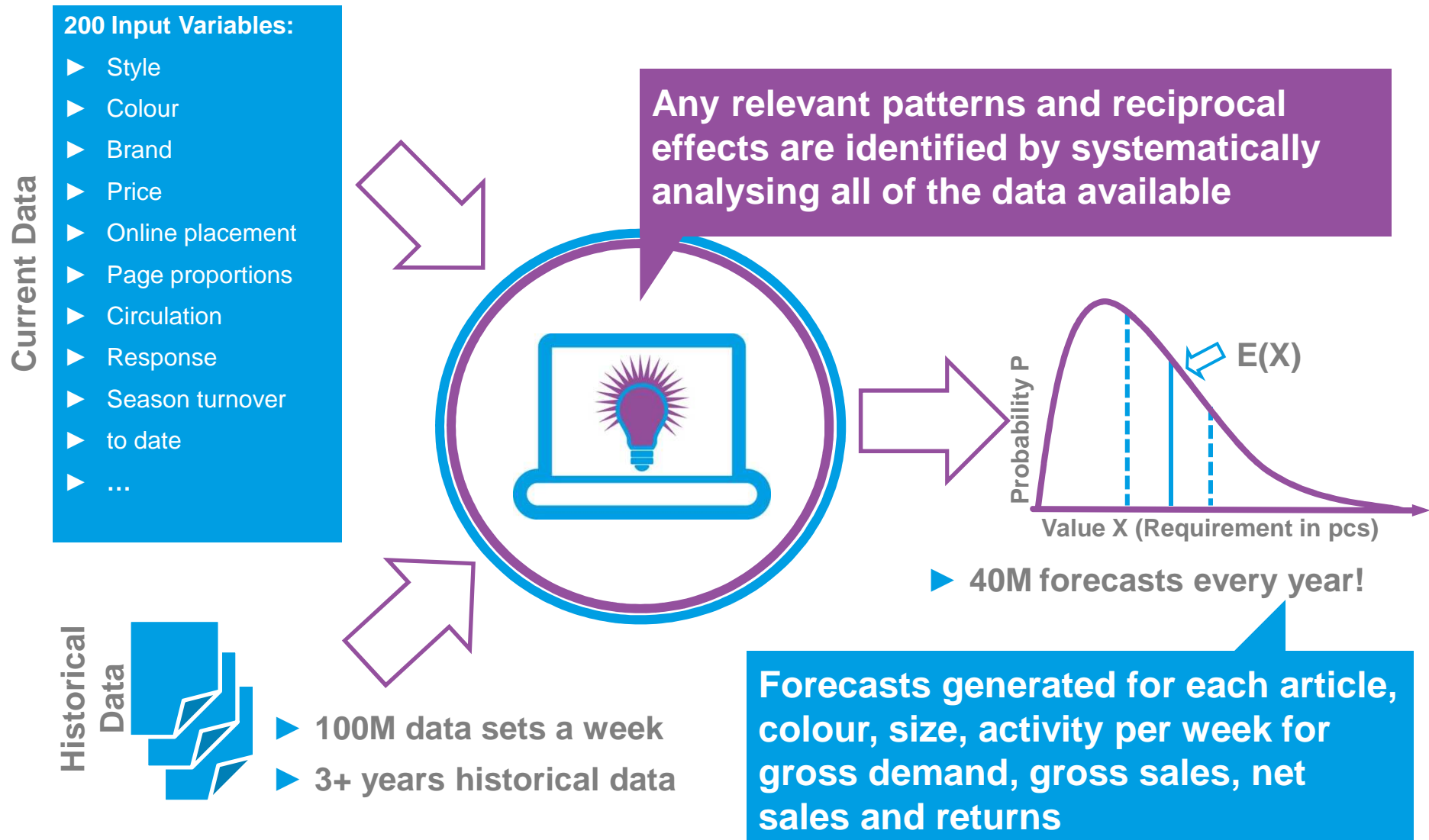
"A **self-learning system** such as NeuroBayes suits our dynamic business model Our **prediction quality is increasing constantly** and the **sales quantities predicted are becoming ever more precise.**

The solution helps us adjust **early on** to future developments."

Michael Sinn, Director Purchasing Support

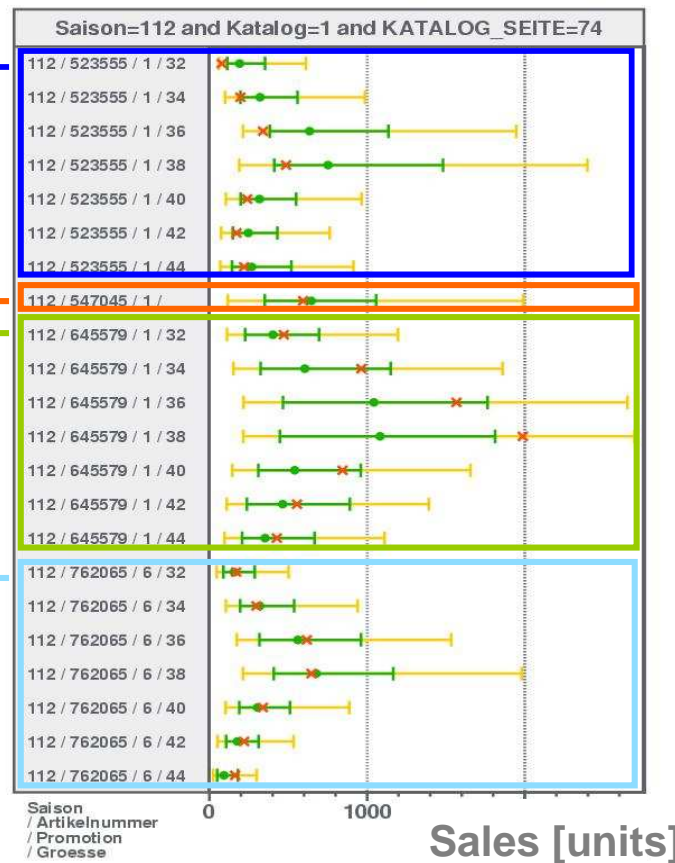
# Sales Forecast Fashion

Example: OTTO Group



# Sales Forecast Fashion

Example: OTTO Group

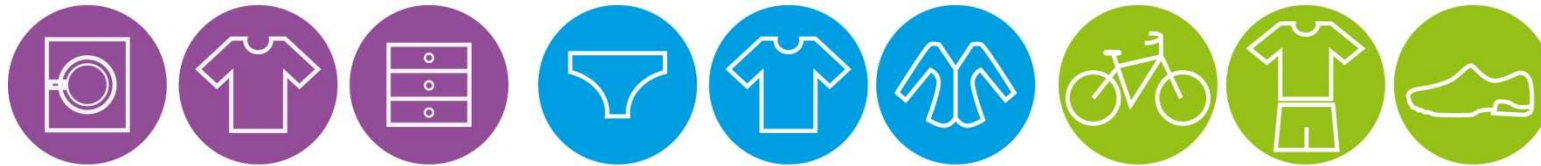


Per item:

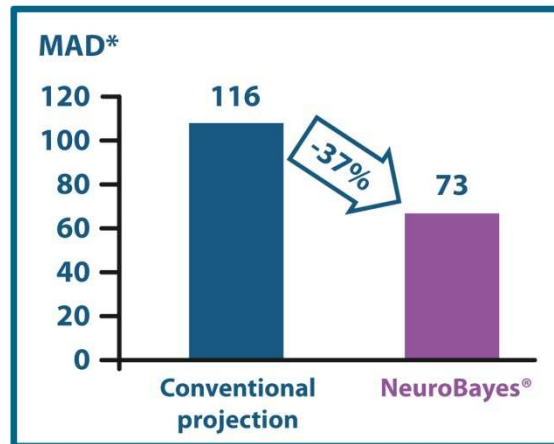
- Sales forecast
- Two estimates on spread: 68% and 95% confidence intervals

# Sales Forecast Fashion

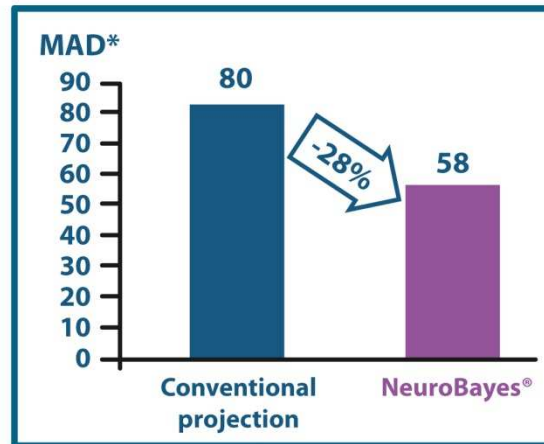
Example: OTTO Group



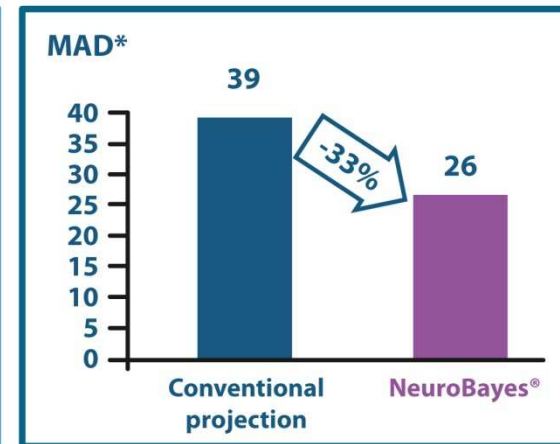
Full-Line Mail Order Firm



Specialist  
Multichannel Retailer



Specialist  
Sports Retailer



MAD = Mean Absolute Deviation

Even during early stages of the forecast timeline, numerous different firms belonging to the OTTO Group are able to achieve high two-digit forecasting improvements compared to using traditional methods of forecasting.

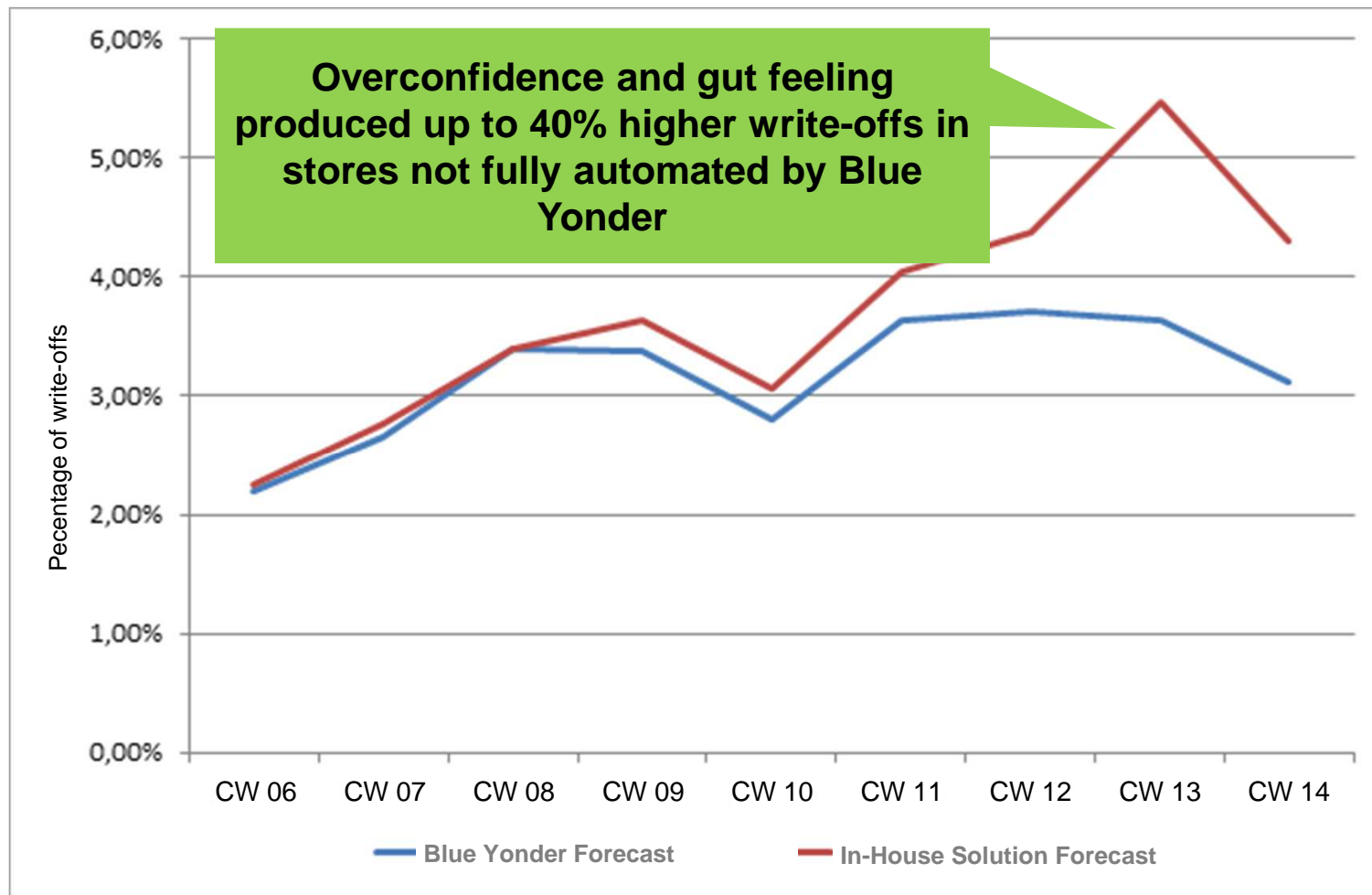
## Perishable goods in Supermarkets

Meat, fruit & veg, bread, dairy, ....

**7% of all perishable foods have to be disposed of in German supermarkets. That's 89M tons of food wasted yearly...**

# Grocery Chain

Auto Replenishment Predictions from Blue Yonder vs. in-house solution



# Risk Management

Example: BGV

## Car Insurances:

Individual risk predictions

- ▶ Accident probability
- ▶ Claims distribution
- ▶ Large claim prediction
- ▶ Contract cancellation prediction

➔ Successfully implemented at

Badisch gut versichert.

BGV



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# Risk Management

## Premium differentiation:

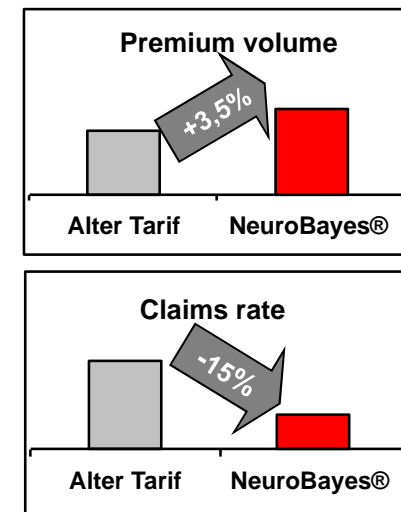
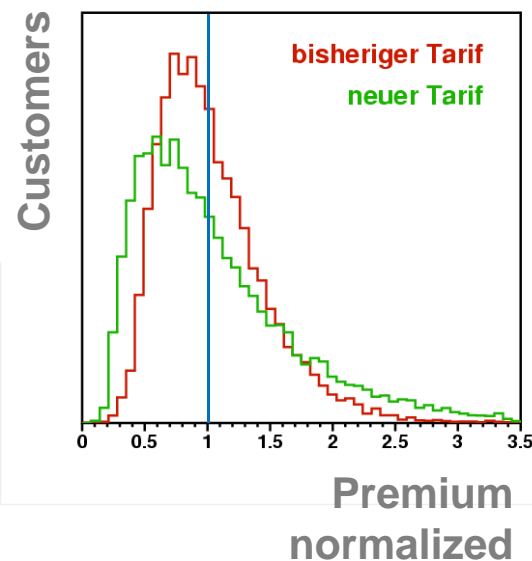
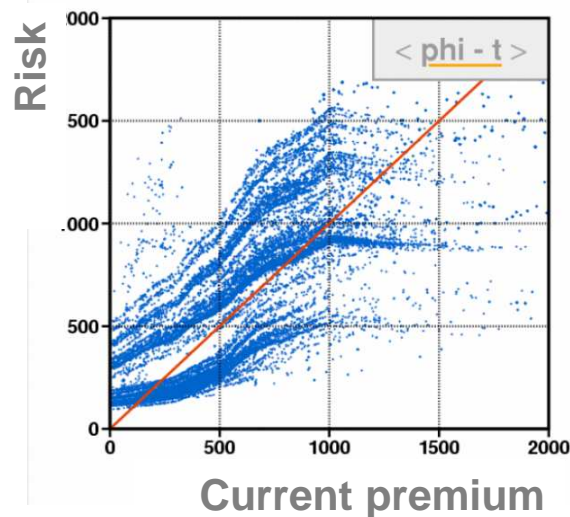
NeuroBayes® adjusts premium to customer-individual risk

## Customer structure optimisation:

Bind “good” customers and take out the „bad“ customers

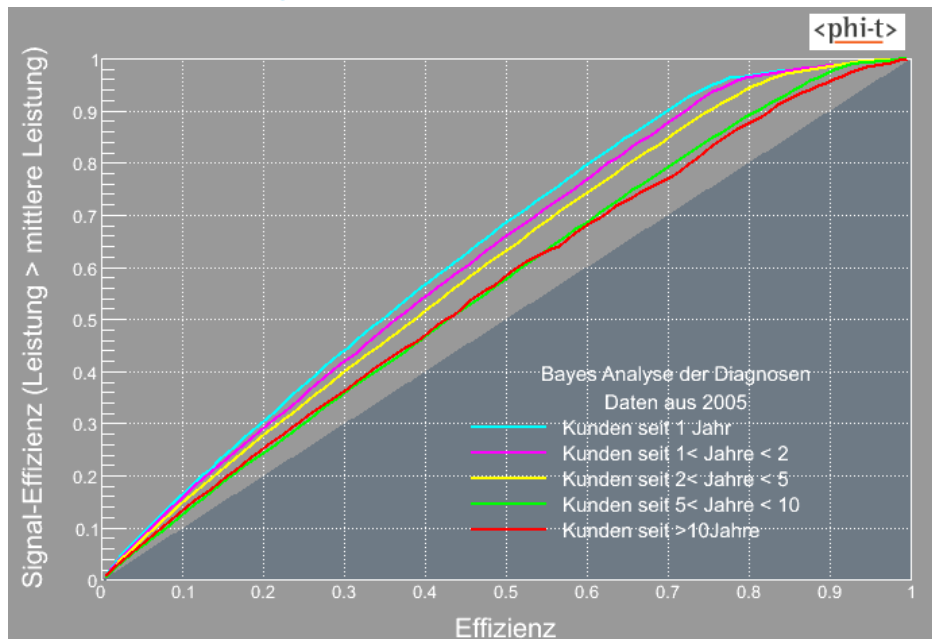
## Rentability improvement:

Increase total premium volume and decrease claims rate with an optimized tariff system

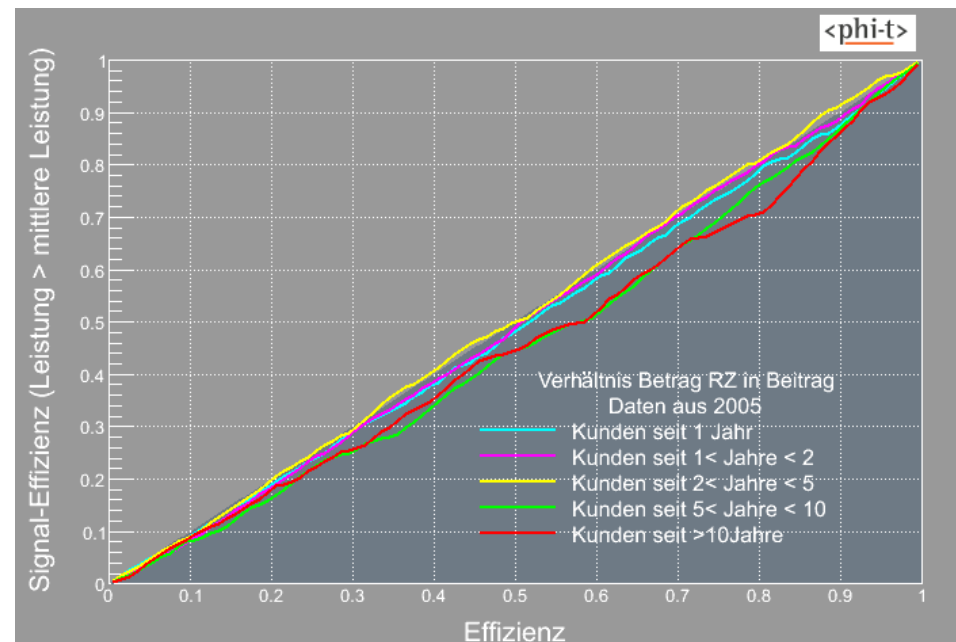


# Healthcare insurance – Long term prediction from anamnesis

## NeuroBayes®:



## Expert Estimation:



- ▶ Expert estimations are at best random –  
for patients with a long history even systematically wrong.
- ▶ NeuroBayes® forecasts costs correctly and significantly beats expert estimations  
more than 10 years into the future.

# Revenue Forecast

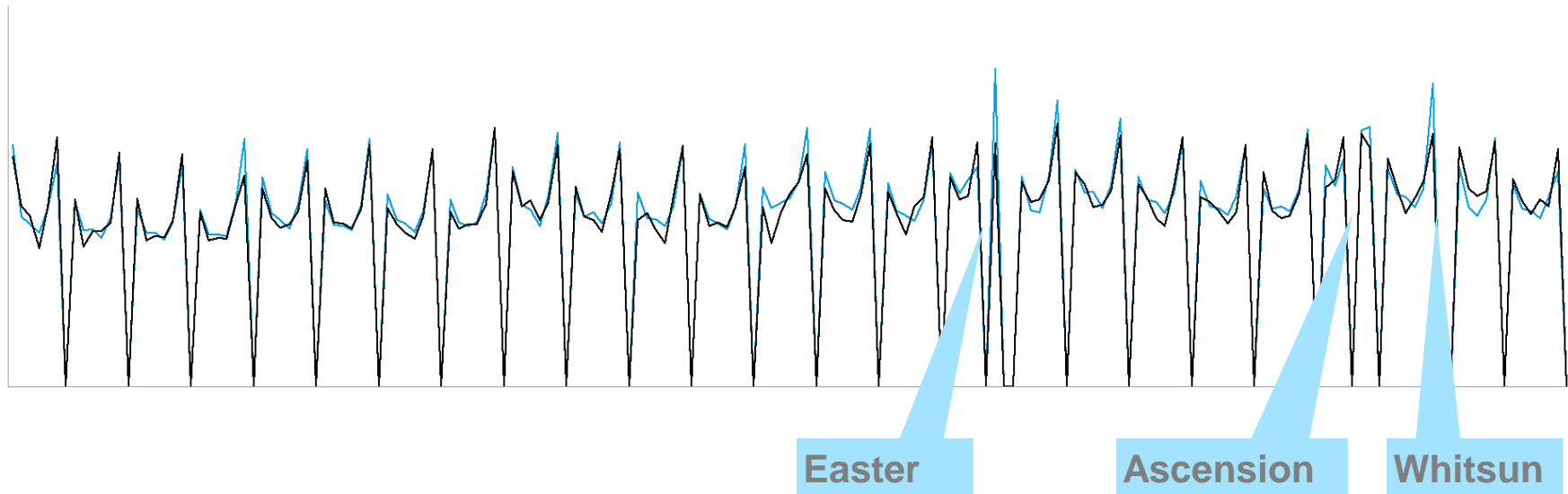
Example: dm– Large German drug-store chain



## Key Challenge:

- ▶ Revenue prediction for each individual store.
- ▶ Used for staff planning.
- ▶ Up to ½ year in advance.
- ▶ Keep track of opening times, public holidays, weather, etc.

$$\frac{\sum \text{Forecast}}{\sum \text{Sales}} = 1.02$$



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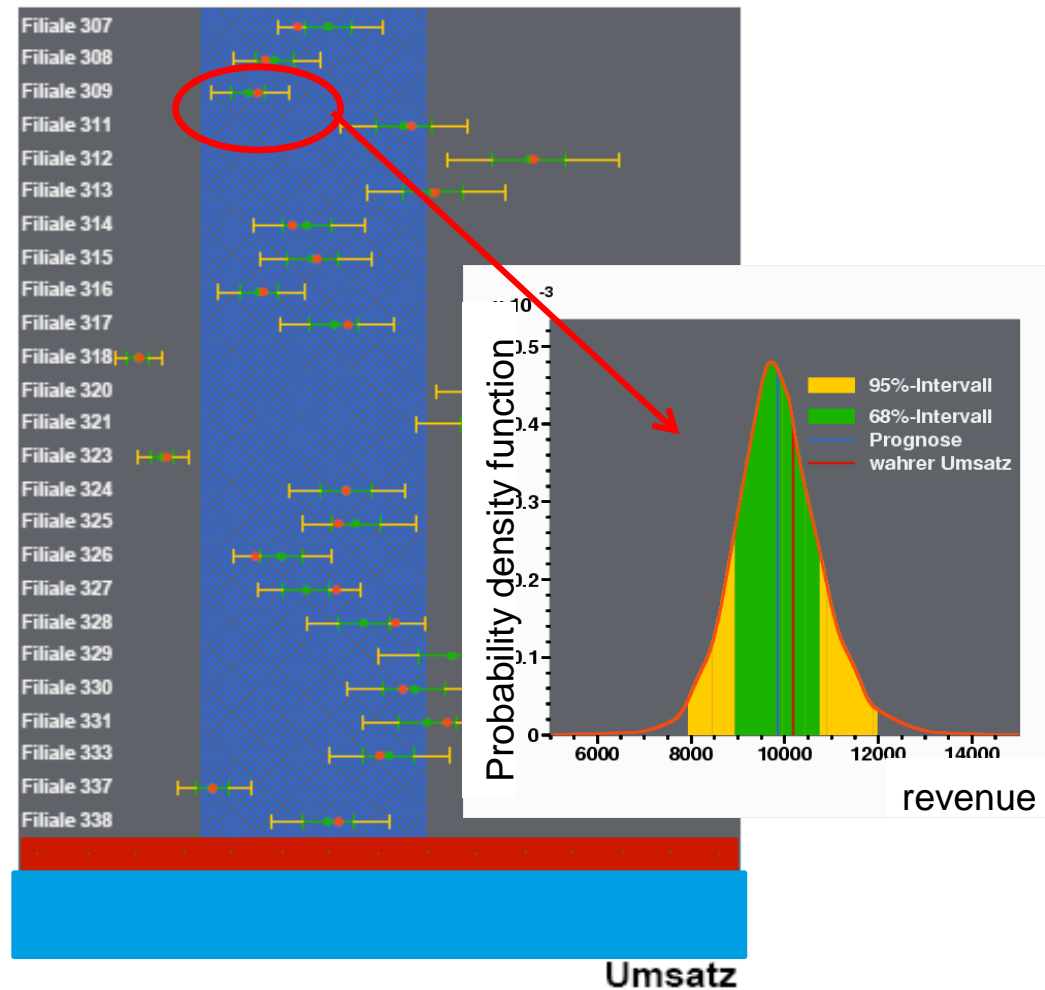
# Revenue Forecast

Example: dm– Large German drug-store chain



## Forecasts for individual stores

- Prediction of the full probability density function.
- Precise forecast of the expected revenue including expected spread (68% and 95% confidence intervals).



# Customer Propensity: Churn Management

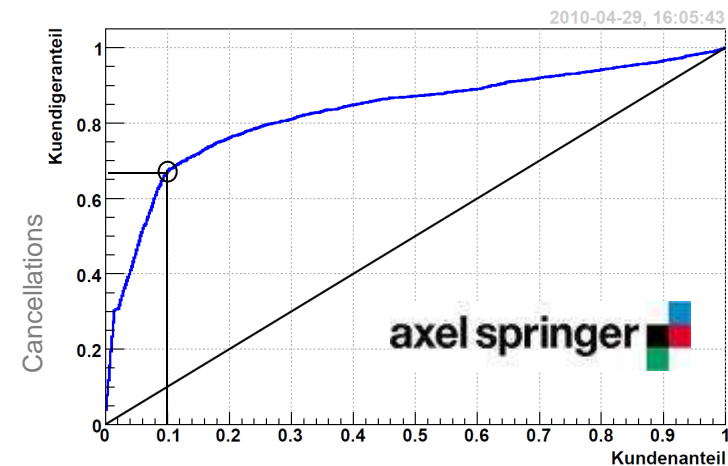
- ▶ Identify customers who have a high risk to cancel their monthly contract
- ▶ Forecast of targeted promotions and individual measures to prevent churn.



**vodafone**

„Blue Yonder beats all our churn prediction models. The more complicated and challenging the task the better. NeuroBayes® outperforms the competition.“

- ▶ Identify 67% of all customers likely to cancel their contract by predicting the “most interesting” 10% of all customers to target.

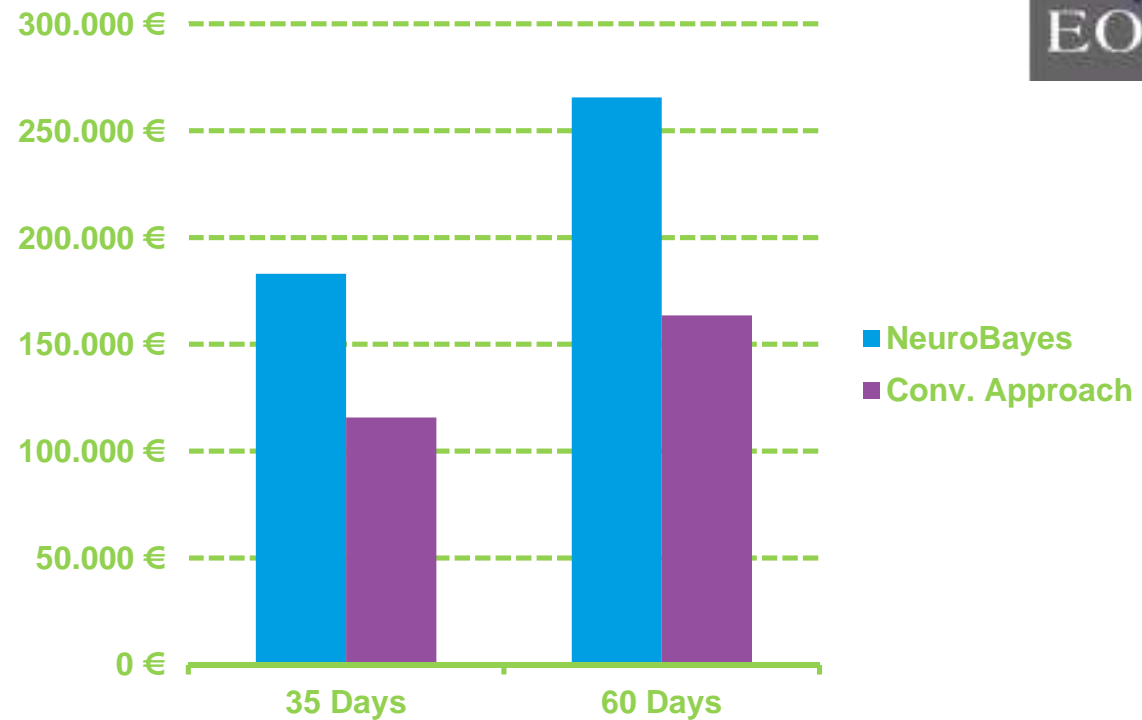


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# Customer Propensity: Risk Management

Identify the propensity of a customer to:

- ▶ Default on Debts
- ▶ Pay Debts
- ▶ Take Credit



- ▶ Allocate correct risk profile / credit limit to a customer
- ▶ Identify which marketing spend & activities provide the optimum return

# Customer Propensity: Optimised Customer Targeting

## Solution:

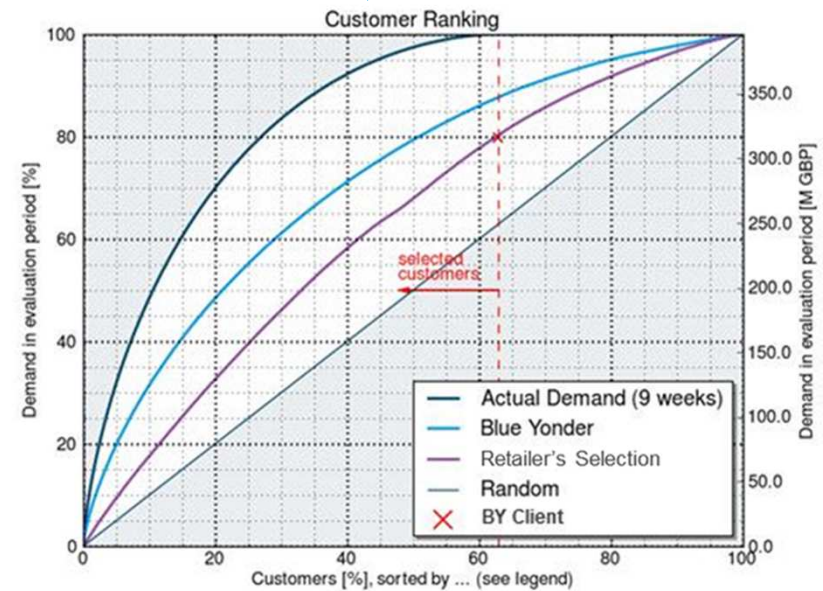
- ▶ Customer Selection for Advertisement and Targeted Campaigns
- ▶ Selection of the most profitable customers
- ▶ Special selections for any season



## Results:

- ▶ 6% Increase in Sales (gross demand)
- ▶ Increase in Sales > €1m in the first three weeks of the Christmas Season

> 6%



blueyonder

# Customer Propensity: Next Plc. Optimised Customer Targeting

## Solution:

- Blue Yonder used data sets provided by Next to analyse variables and attributes, such as customer location, in order to predict the most relevant customers in the Autumn / Winter 2012 season.

## Result:

Blue Yonder provided a different selection of customers who went on to purchase more from the catalogue contributing to a strong uplift in sales in their Autumn / Winter 2012 season.

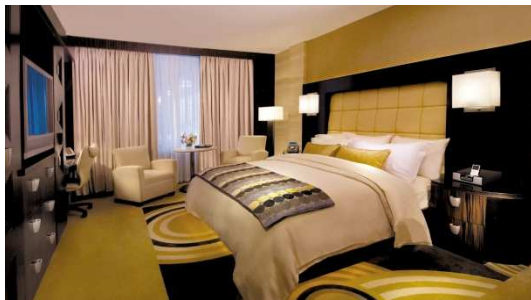
Next continually takes advantage of this capability in order to maximize sales across each and every season.

“The team at Blue Yonder were extremely efficient during the whole process. After spending an initial two days with our internal team to extract the data from our system, it took just two weeks to analyse and send back the results.”

Marketing Planning Manager at Next Directory

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# Dynamic Pricing



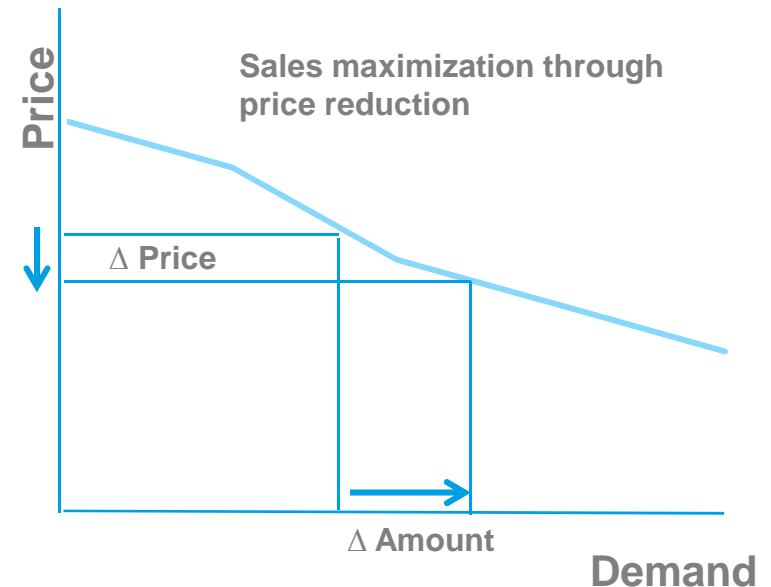
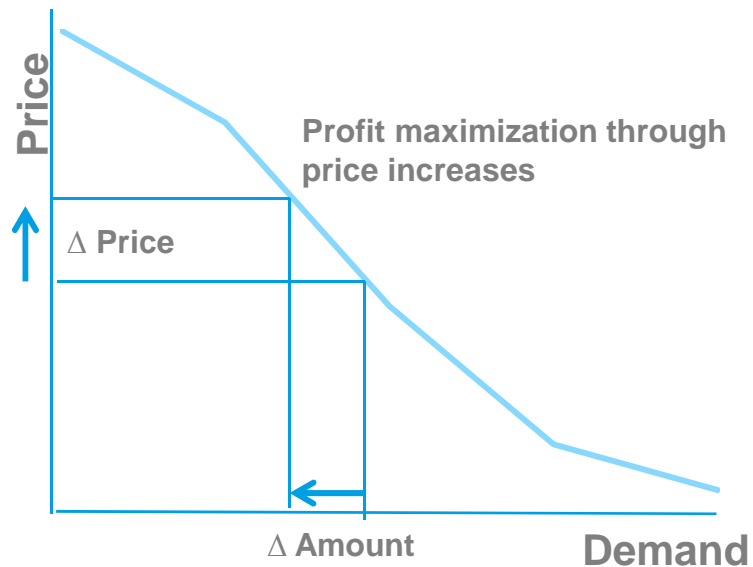
# Dynamic Pricing: E Commerce Retailer – Menswear / Single Country

## Objective:

- ▶ Increase in the average calculation by 5%
- ▶ Increase in sales in the test sample by 5%

## Implementation:

- ▶ Daily price adjustment within the A / B test
- ▶ Consideration of constraints such as price thresholds, minimum and maximum prices

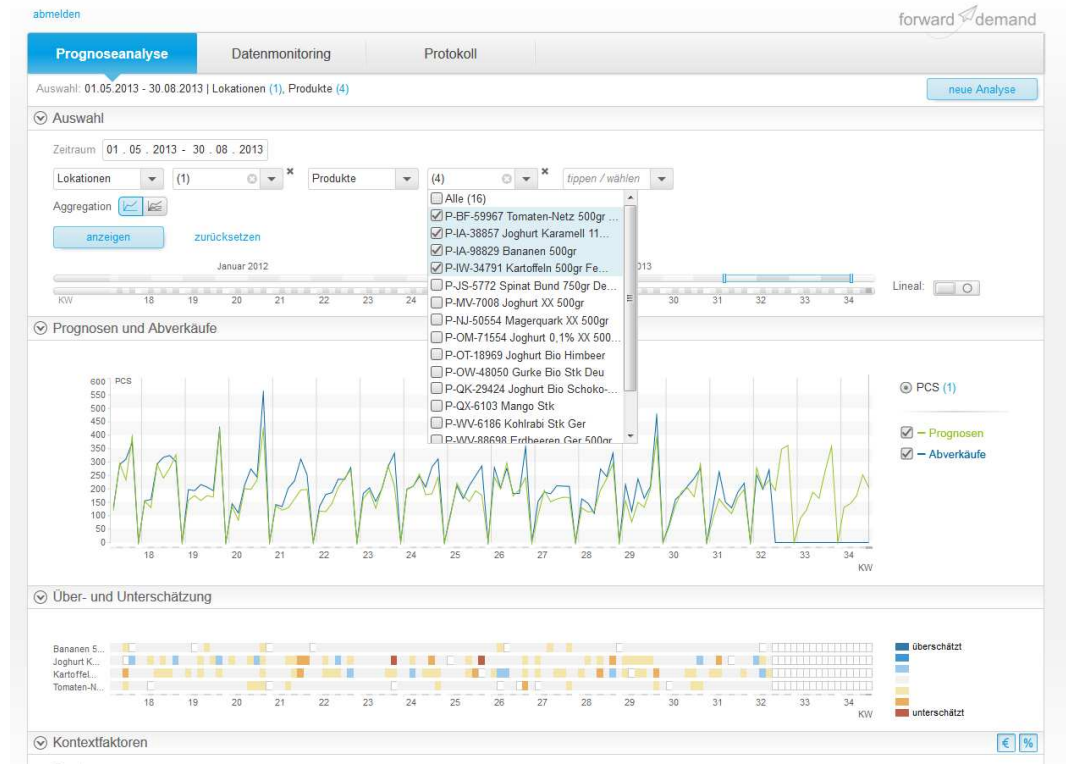


## Results

- ▶ 7% Increase of Sales
- ▶ 6% Increase of gross margin
- ▶ 3% Increase of Net New Customers
- ▶ 50% Increase of EBIT

# forward demand

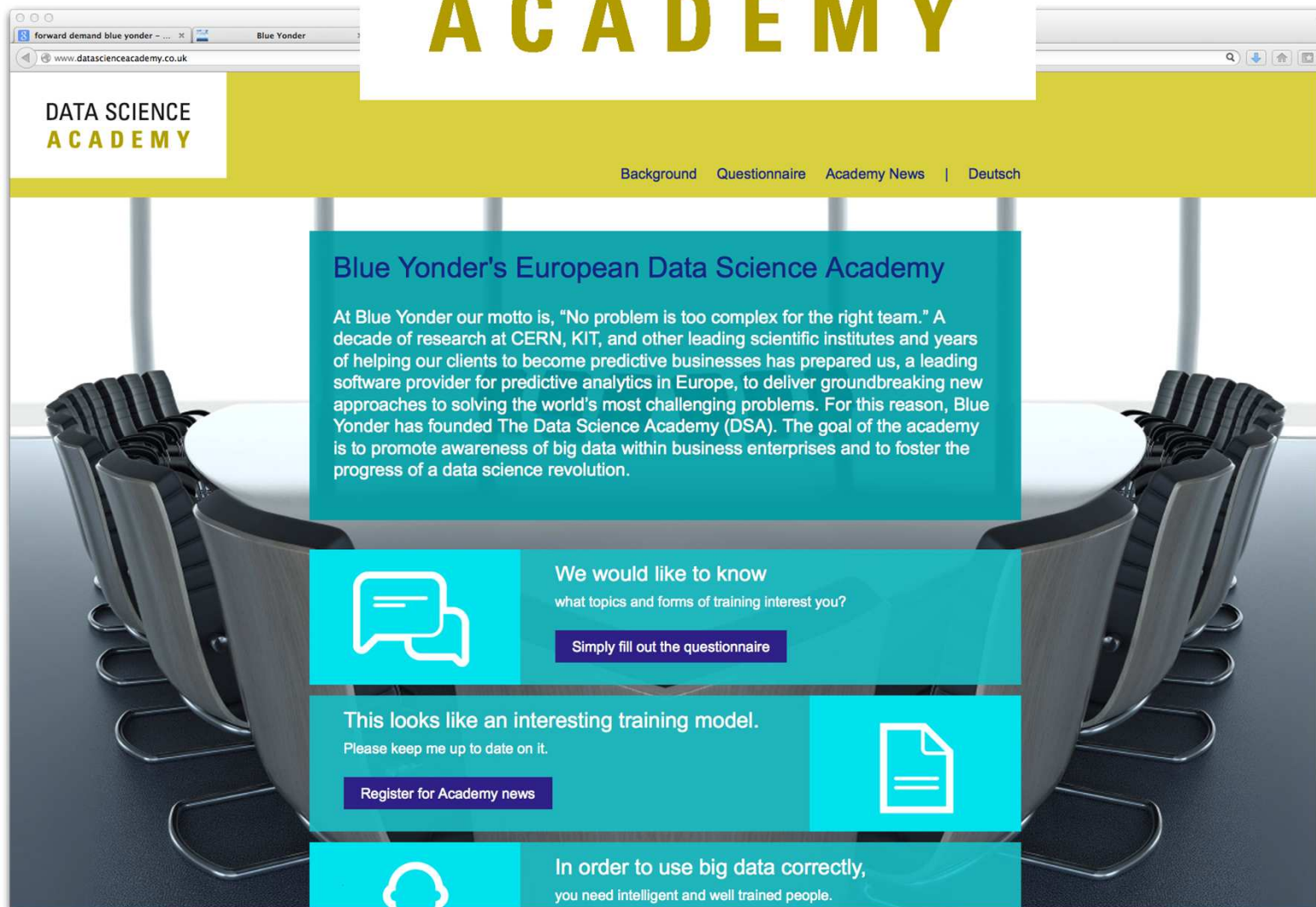
- ▶ Just released: First big data predictive analytics **standard software solution**
- ▶ Precise sales forecasts for retail and CPG
- ▶ Access to big data predictive analytics for B2B end users
- ▶ Easy handling through intuitive web-UI
- ▶ Software-as-a-Service allows usage of Forward Demand without high in-advance investments into software, infrastructure or highly skilled personell



[www.blue-yonder.com/forwarddemand](http://www.blue-yonder.com/forwarddemand)

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# DATA SCIENCE ACADEMY





















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## Prognosen 29. Spieltag

### Paarung

	Hamburger SV - Bayer 04 Leverkusen	
	FC Augsburg - FC Bayern München	
	SV Werder Bremen - FC Schalke 04	
	1.FC Nürnberg - Bor. M'gladbach	
	VfB Stuttgart - SC Freiburg	
	Eintr. Frankfurt - 1.FSV Mainz 05	
	Bor. Dortmund - VfL Wolfsburg	
	Eintr. Braunschweig - Hannover 96	
	Hertha BSC Berlin - 1899 Hoffenheim	

## Saison 2013/2014

Heim	Remis	Gast
23%	27%	49%
11%	27%	61%
25%	33%	42%
30%	30%	40%
40%	27%	32%
37%	35%	28%
66%	21%	14%
37%	31%	32%
36%	32%	32%

Join us!

► <http://www.blue-yonder.com/unternehmen/karriere.html>



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# blueyonder

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