WHITE PAPER

BayesFraud

Advanced Predictive Analytics Solution for Fraud Detection and Prevention

HUGINEXPERT

WHITE PAPER

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Fraud

– an expensive and unrelenting challenge

BayesFraud

- **Fast, consistent claims assessment**
- **Early alert to suspicious claims**
- **Increase in detected fraud**
- **Reduction in false positives**
- **Improved SIU hit-rate and efficiency**
- **Increased savings in claims and ROI**

Fraud is expensive. Insurance associations across the globe estimate that 10-20% of insurance claims involve fraud, and that a considerable amount of fraud goes undetected.

While claims savvy and investigative leg work are essential to anti-fraud efforts, as fraudsters become more and more sophisticated, insurers must think out of the box to meet the fraud challenge. Advanced predictive analytics is a huge leap forward in the fight against insurance fraud.

Implementing predictive analytics in claims is an effective way to identify potential fraud and abuse and improve efficiency in claims handling. Using BayesFraud, insurers can predict fraud early, with less labor, and before costly claims are paid.

This White Paper presents the BayesFraud predictive analytics solution for fraud detection and prevention. It describes how insurers can use it to identify fraud and improve decision-making efficiency in claims to create a stronger, more proactive defense against fraud.

Automated predictive analytics for fraud detection

Consistent assessment, early detection and speedy investigation are critical to successful fraud detection. BayesFraud is an early warning system that streamlines this process and provides insurance companies with automated fraud detection capabilities during claims handling.

BayesFraud is a flexible plug-in solution that integrates into claims software to calculate the probability of fraud in an insurance claim during claims handling. BayesFraud analytics can be implemented as a batch system for periodic fraud control, or as a traffic light system for real-time fraud identification.

Either way - automated BayesFraud provides consistent scrutiny of all incoming claims and immediately alerts claims handlers to those with a high probability of fraud.

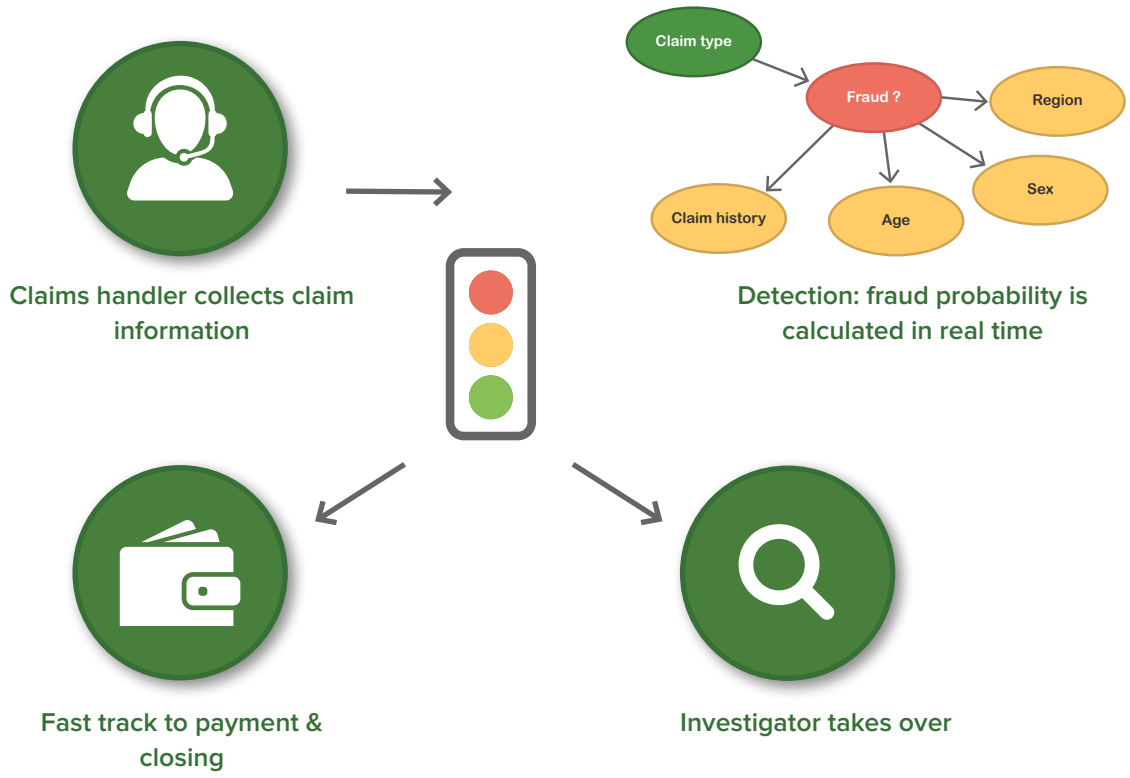

Figure 1: BayesFraud pinpoints claims for investigation

In Figure 1 BayesFraud is integrated as a traffic light on the screen of claims handlers. The traffic light indicates the likelihood of fraud and enables claims handlers to quickly prioritize claims as Fast-track, Regular Track or Requires Investigation.

Besides improving fraud detection rates, implementing an automated fraud detection solution reduces the claims workload and allows both novice and experienced claims handlers to assess claims with confidence – every time. And with a faster claims process, it is easier for insurers to meet policy-holder demands for fast claims settlement, which improves customer satisfaction and retention.

BayesFraud also improves efficiency at the investigative phase. When only claims with a high likelihood of fraud are sent to investigators, their hit-rate accuracy increases and they can focus on cases with the greatest potential for payback and savings.

Model-based decision support

The main component of the BayesFraud solution is the fraud detection model. The model is a graphical representation of a decision situation that organizes everything known about the situation into a network of probabilities. The model specifies the relations of dependence between a fraudulent claim and fraud indicators such as customer behaviors and characteristics. The model also specifies the characteristics that distinguish a fraudulent claim from a legitimate one.

Figure 2 shows a fraud detection model that specifies the dependence relations between fraud, claim type, claim history, customer age, sex and region.

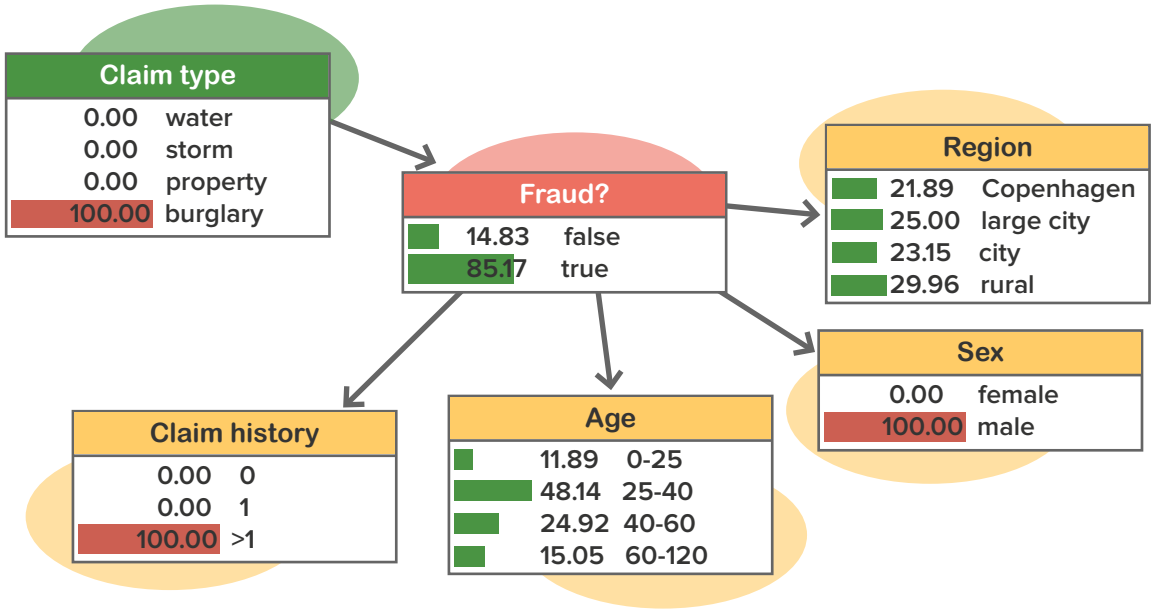

Figure 2: Fraud probability for a burglary claim from a man with a history of more than one claim is 85.17%.

According to this model, the probability of fraud for a burglary claim made by a male with a history of more than one claim is 85.17%. Even with incomplete information the model can calculate the probability of fraud. In this case the given information indicates a high likelihood of fraud.

Developing a fraud model

A fraud model integrates knowledge, information and data sources into a single model representation of fraud prediction. A model is constructed based on a set of test data and can be continuously updated to reflect changes in the domain, such as changing correlations between age and the likelihood of fraud.

BayesFraud can be used to construct models or "rules" from data only, or from a combination of data and expert knowledge – a feature unique to Bayesian network technology.

Insurance companies often start with a simple model and extend it as new knowledge is generated. This could involve adding or removing indicators from the fraud detection model based on experience or data analysis performed using HUGIN software.

The model development process starts by identifying fraud model variables and their dependence relations. Figure 3 illustrates the structure of a simple fraud detection model.

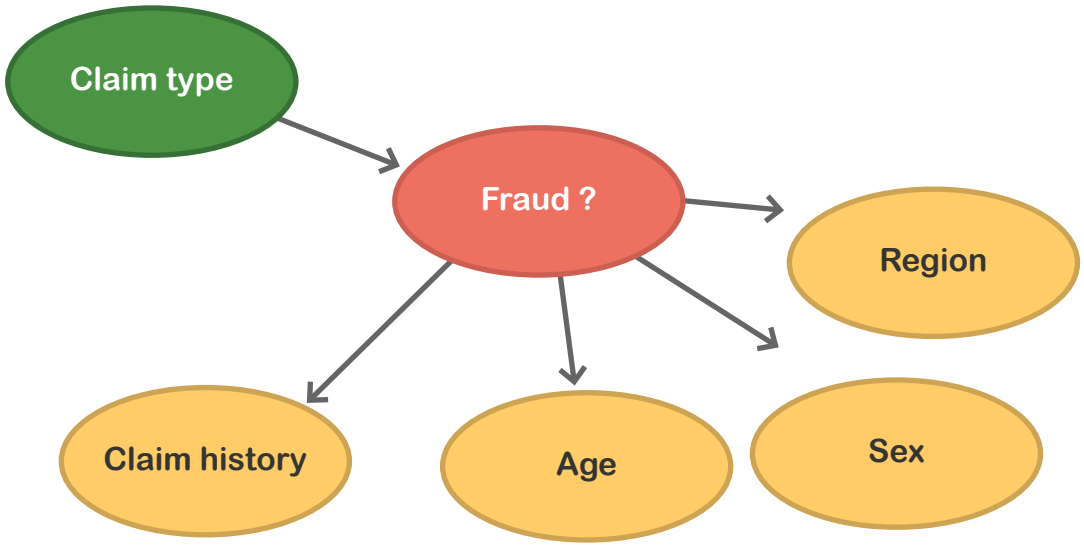

Figure 3: A simple fraud model and the dependence relations between fraud and claims history, age, etc.

The model in Figure 3 consists of six variables, the main variable being fraud? The purpose of the model is to compute the probability of fraud based on observations and variables that may or may not be known about the customer making an insurance claim. The graphical structure of the model specifies the dependence and independence relations between the variable pairs, with the model arrows often indicating cause-effect relationships.

In Figure 4 the dependence relations between a fraudulent claim and customer age are quantified. The probabilities communicated by the model can be assessed by domain experts, estimated from data or a combination of the two.

Fraud	False	True
Age 0-25	0.17	0.11
Age 25-40	0.03	0.56
Age 40-60	0.13	0.27
Age 60-120	0.67	0.06

Figure 4: Quantifying model relationships – in this case between age and fraud

BayesFraud - also a model for fraud investigation

The model used to support fraud detection can also be used to support fraud investigation. For example, the model can be used in real time by fraud investigators to identify the particular fraud indicator that points to fraud, to prioritize claims cases for investigation based on a fraud likelihood score, or to direct SIUs to the correct next action.

Key Features of BayesFraud

- ✔ **Combines historical data and expert knowledge**
- ✔ **Computes with missing observations and uncertain data**
- ✔ **Calculates fraud probability in real-time**
- ✔ **Integrates easily into claims IT**
- ✔ **Visual fraud communication tool**
- ✔ **Models are easy to adjust and extend**
- ✔ **Changes can be made by system users independent of IT staff**

Handles undertainty and combines multiple sources of data

BayesFraud is based on Bayesian networks and influence diagram technology, an advanced artificial intelligence technique widely used for supporting decision-making under uncertainty.

A key feature of Bayesian Networks is their ability to generate optimal predictions even when key information is missing. Programmed into computers, a Bayesian network model automatically uses whatever information is present in the model to generate optimal predictions and decisions.

Unlike traditional BI applications that are based on historical data alone, a Bayesian network flexibly combines objective data and information with subjective estimates, knowledge and observations of fraud experts in a single decision support solution.

The unique capabilities of Bayesian Networks and the growing need for automated solutions that can manage uncertainty and multiple sources of data and information make BayesFraud one of the best performing decision support tools for predicting fraud on the market.

A flexible analytics solution

Besides being able to combine historical data with the subjective – but valuable – knowledge of experts in one solution, BayesFraud makes it possible to take advantage of decision support capabilities on a step-by-step basis. This means that insurers need not build a total solution in one go, but can extend their initial fraud models over time with additional risk indicators as more/new claims information becomes available.

The fraud solution can be developed in-house after training in the HUGIN tool, and depending on data availability, an initial model can be developed in as little as 1-2 days.

The visual graphics of the fraud model make it easy for analysts and claims experts to communicate about the fraud model and its properties, and support a variety of methods to analyze the model and its results.

For example, in the burglary case shown in Figure 2, given the information that the customer is male with a claims history of more than one burglary, the operative observation is customer age. When customer age is between 25 and 40, fraud probability is high. When customer age is over 60, fraud probability decreases to 33%.

Besides this type of value of information analysis, sensitivity analysis can also pinpoint the model indicator that has the greatest impact on the probability of fraud. In the burglary case the probability of fraud is most sensitive to the observation on claims history.

Architecture and system integration

The BayesFraud software package consists of a Decision Engine, an easy to use graphical user interface (GUI) and an API for integrating HUGIN functionality into other applications.

The HUGIN GUI supports domain experts in the model development phase. Figure 5 shows an example of the HUGIN GUI.

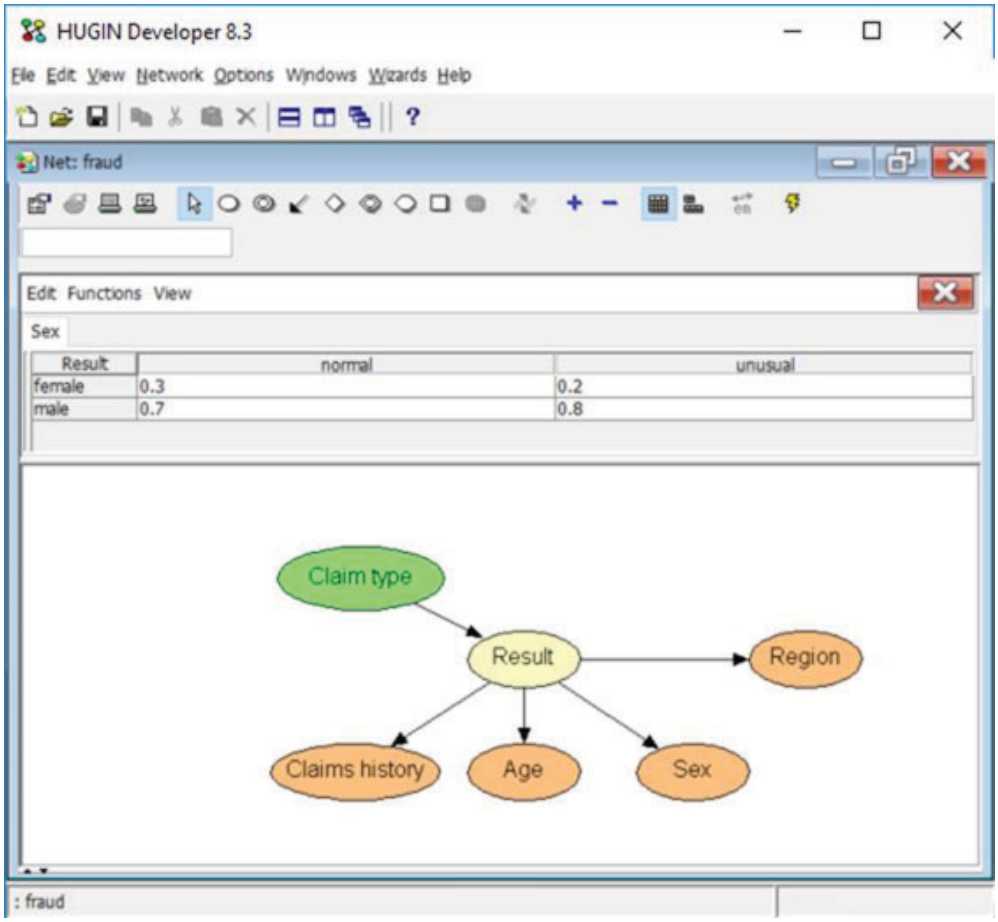

Figure 5: HUGIN Graphical User Interface showing a fraud model

A major advantage of BayesFraud is that it easily integrates into new and existing claims IT. HUGIN Application Programming Interfaces (APIs) make the system integration process simple and efficient. Figure 6 illustrates the typical setup. Model development takes place on standard PC platforms using the HUGIN GUI. Each model is stored in an ASCII text file, which is then transferred to the production system. On the production side, existing IT systems interact with the model through the HUGIN API, feeding information into the model and receiving results of the inferences.

System maintenance and model updates are separate processes. Once system integration is accomplished, it is easy to carry out model updates. Given the same set of input and output data, updating a model consists of replacing a single ASCII text file. This allows domain experts to adjust a model without requiring the support of IT.

System Highlights

- ✔ **User-friendly graphical modelling tool**
- ✔ **Highly efficient inference engine**
- ✔ **Straightforward integration into existing IT**
- ✔ **Easy to extend, modify and maintain**
- ✔ **Flexible, scalable analytics tools**
- ✔ **Models are easy to adjust and extend**
- ✔ **APIs for C, C++, Java, .NET and COM**

The muscle behind BayesFraud is the HUGIN Decision Engine. Based on breakthrough algorithms discovered by a Danish research team, the HUGIN decision engine is widely recognized as one of the most efficient and robust inference engines on the market.

The HUGIN Decision Engine comes with APIs for major programming languages enabling the easy integration of HUGIN into existing IT systems.

HUGIN software has been implemented on a wide range of platforms running on Microsoft Windows, UNIX and MAC operating systems.

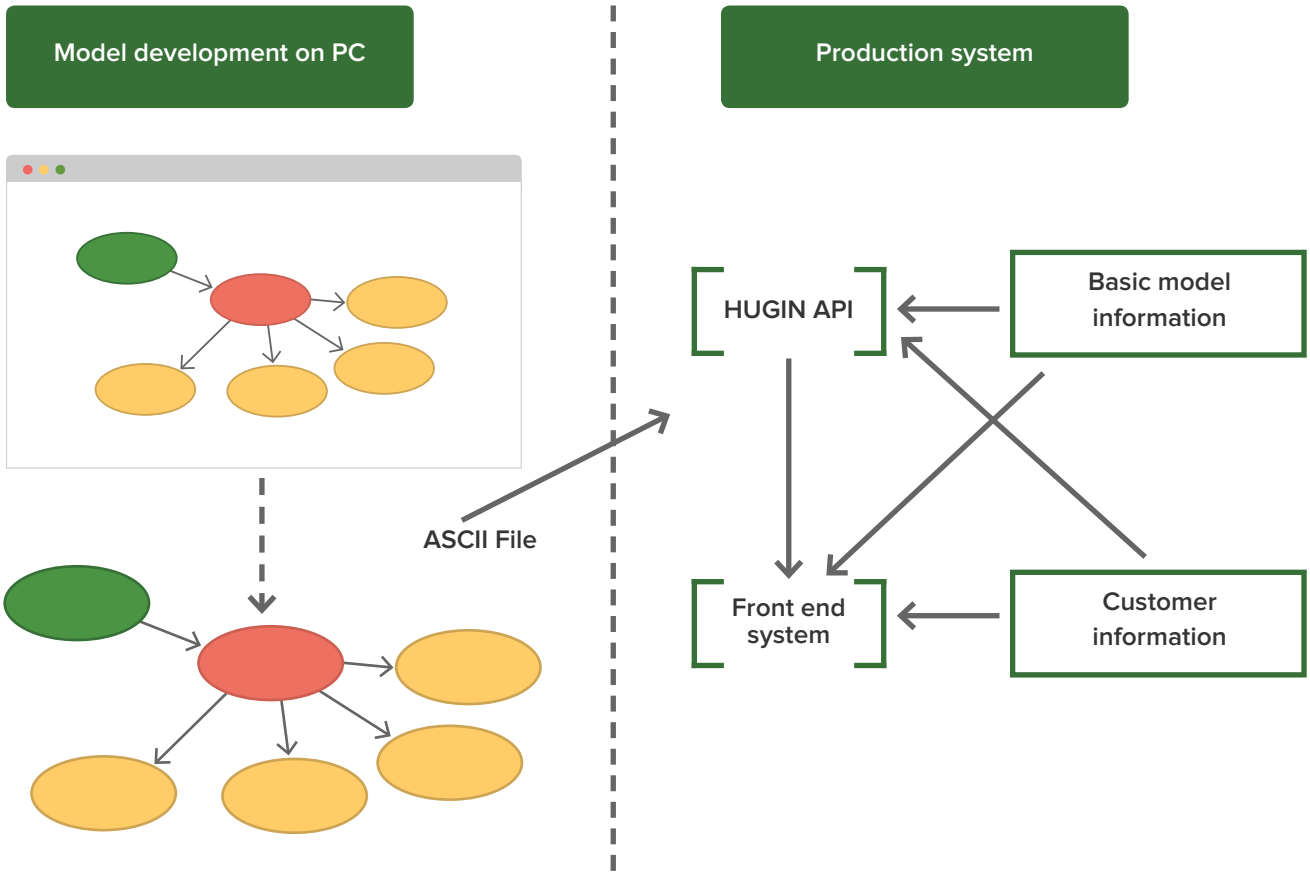

Figure 6: Simple and efficient system integration

Development and implementation process

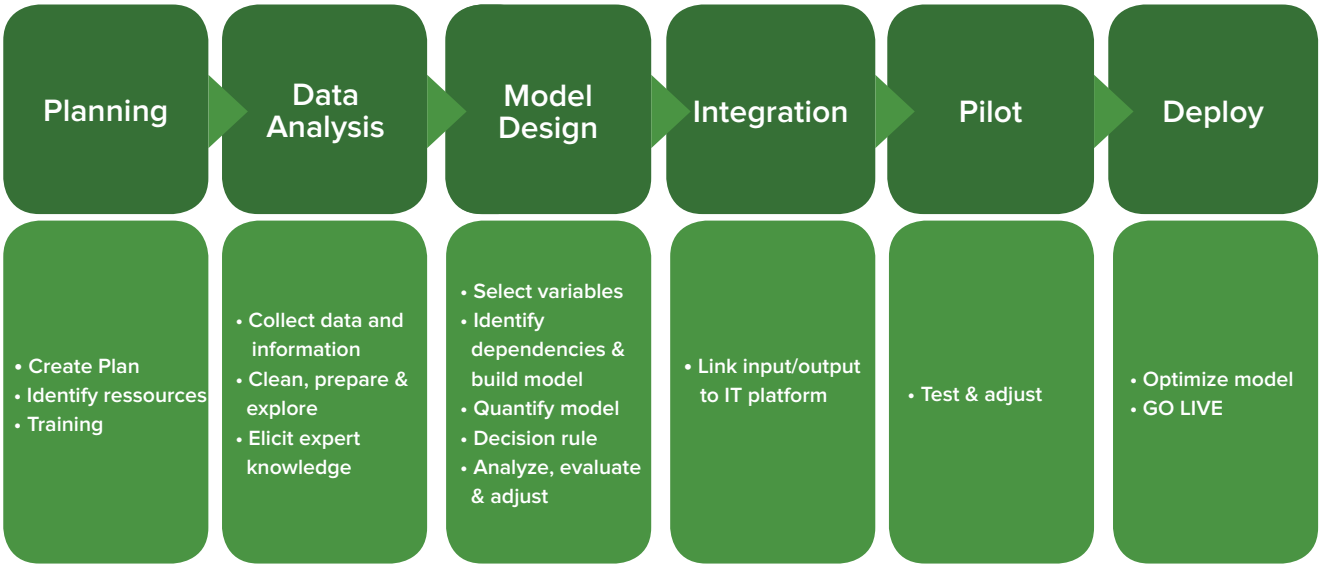

Figure 7: BayesFraud development process

Consultancy and Training

HUGIN EXPERT provides all the products and services a client needs to develop and integrate a Bayes-Fraud model into an existing IT platform.

To support clients in the model development and integration process, HUGIN EXPERT delivers training in the HUGIN tool. HUGIN training provides users with the knowledge and skills needed to develop customized fraud detection models and to integrate the BayesFraud solution into client IT. It also enables users to adjust and extend existing models as new fraud information becomes available over time.

Although fraud model development is usually carried out by the client organization on the basis of company data and expertise, and model integration by their IT staff, HUGIN consultants can assist clients in one or all steps of fraud model development and integration.

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HUGIN analytics – more than just fraud

Predictive analytics from HUGIN EXPERT can provide insurance companies with a great leap forward in a wide range of areas across their organization. Capturing more insight from data delivers a more complete view of your customers and enables insurers to reduce risk, achieve compliance and improve overall business performance and profitability.

Use HUGIN analytics to create innovative business solutions for straight-through processing, anti-money laundering, risk appetite, customer profitability analysis, individual customer pricing, disability prediction and more.

About HUGIN EXPERT A/S

HUGIN EXPERT A/S is a leading provider of predictive analytic software for building model-based risk analysis and decision support solutions that can handle uncertainty. For over 25 years HUGIN Expert has helped clients turn data and expertise into solutions for smarter, more efficient decision making.

Clients worldwide use HUGIN software to build predictive solutions for fraud detection, credit default prediction, anti-money laundering, operational risk management, medical diagnosis, risk analysis, data mining, troubleshooting, safety assessment, forensic identification and more

For more information visit: **www.hugin.com**

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