Risk and Fraud in the Insurance Industry

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Abstract

This paper examines risk in the insurance industry, discusses some initial thoughts on how intelligent applications can be used to model, understand and control risk and describes a recent use of natural language processing in insurance underwriting.

We will discuss risk from two perspectives:

- Risk as an essential element of insurance and the related underwriting task
- Fraud Risk
  - Fraud perpetrated against insurance companies
  - Poor Sales practice.

Intelligent Applications including machine learning, natural language processing and Expert Systems can be used to model, understand and control risk.

Introduction

The insurance industry is evaluating new methods under the rubric of data mining which derive from analytics on very large databases, statistics and artificial intelligence to determine what advantages they have over classic statistical approaches. Are these methods more accurate, do they allow for non-linearities and coupling, are they quicker and easier to use, are they usable by business people instead of actuaries and statisticians, will they help visualize solutions better, can they provide new insights? Some of the questions include: How can Neural Nets be used to recognize patterns that relate to risk; Can genetic algorithms be used to search large solution spaces to find good if not optimum solutions, can clustering suggest new insights?

Insurance Risk and Underwriting

Risk is an essential element of Insurance. The purpose of the insurance industry is to provide a mechanism to deal with risk. Contrast this with banking where risk exists (bankruptcy, robberies, credit default) but commerce, exchange of money and the growth of money are the essential elements. Not surprisingly risk and the mathematics associated with risk namely probability and statistics were accepted and advanced at insurance companies. Insurance companies employ actuaries who are proficient in mathematics to build risk models and to help design products that protect clients against risk while keeping the companies offering these insurance products solvent.

Developing an underwriting model is a clustering problem. Given a set of attributes determine a subset of attributes and their associated ranges of values that are predictors of well separated outcomes (that is why it is a clustering problem.) For life insurance the distribution of life expectancy, mortality, is the variable which has to be modeled. One program to be carried out is to divide our historical mortality records into three classes long, medium, short mortality and to cluster on the demographic and life style information. Obvious clusters relating to health, dangerous occupations, avocations will emerge but additional more subtle clusters may also arise which will provide additional underwriting criteria to model risk rating.

The risk rating assigned is fair if the premium paid and the investment income earned is sufficient to cover their payout (including any required payments to stockholders or contributions to surplus) while meeting the client's needs. This balance will not hold for any one individual but must hold for the entire ensemble of insured.

The actual underwriting process is a classification problem that assigns a risk rating to the insured. Use of expert systems to automate this process has floundered in the past for a number of reasons: systems produced were brittle and that were not robust enough to handle the subtleties of underwriting; the presence of free form text. Recent advances in Natural Language Processing focused on information extraction and population of a frame instance. MITA, MetLife Intelligent Text Analyzer (Glasgow 1997) has been built and is in the process of being deployed to extract important concepts from free form text entries on insurance applications.

Fraud as a Risk

Fraud is both perpetrated on insurance companies and unfortunately fraud, in the sense of poor sales practice, is sometimes perpetrated by rogue personal at an insurance company.

In areas of insurance where customer claims are frequent such as Property and Casualty, Health and long term disability customer fraud exists. It is estimated that 10% of all property and casualty claims submitted are fraudulent. Medical claims fraud discovery and prevention is similar to problems faced by Credit Card and Telcos. An individual, health practitioner or claims adjuster is involved in a series of transactions. Individually each transaction makes sense but collectively the set of transactions is suspicious. Unlike credit card fraud real-time analysis is not required. Association rules, sequential analysis visualization tools similar to those used to detect money laundering are helpful in detecting these problems.

In some insurance areas, particularly Personal Insurance, poor sales practice have to be detected. Similar problems also occur in the brokerage industry. Some sales people are motivated by greed and their own self interest at the expense of their clients and the firm. Recently Prudential Insurance has agreed to resolve complaints of allegedly deceptive sales practice for over 400 Million dollars.

Sales practice violations can take several forms:

- Misrepresentation of product information Including false Illustrations or claiming features that a product does not have. An Illustration is a particular class of insurance product/client literature that shows how the coverage, dividends, cash value and premium change over time for a particular product and client.

- Selling an unsuitable product to a client. Unsuitable products do not have the benefits required by the client or have a cost structure not commensurate with the benefits. In the brokerage industry a similar problems arises when the product being sold does not have an appropriate risk/reward profile. Sometimes the situation is complex i.e., life insurance to 70 year widower with no dependents (what about if he was contemplating getting married?)

- Churning is the practice of converting an existing policy into a new policy, generating additional commission for the agent without commensurate benefits to the customer.

- Licensing violations are sales by representative not approved to sell certain products i.e. mutual funds

Insurance companies, as do brokerage companies, have a compliance department responsible for the detection of poor sales practices.

Fraud detection and supervised and unsupervised learning

If examples of fraud and non-fraud cases exist then supervised learning can be used to determine the relationship between attributes and the occurrence of fraud.

Supervised learning can be used to find patterns of known fraud. However salespeople are particularly adapt at varying their pattern so supervised learning is not sufficient. Unsupervised learning can be used to cluster sales records, and the presence of small cluster would be indicative of novel sales practices which would require more detailed analysis.

Natural Language Processing

Processing Customer Complaint Letters. MetLife has nine million active life insurance customers. A 1% complaint level generates 90K letters per year. At 30 minutes/letter this would require 45 thousand hours, about 20 people to read and digest customer complaints. Some of these letters are hand written, but many letters are word processed documents from clients, state insurance departments or law firms. Can Information Extraction be used to: build a frame for each complaint; describe any attached documents; build an index; generate a strategy for handling; find additional records relating to this case, client, product, sales person; generate a draft of a response; based on similarities of complaints evaluate potential for class action suit; be an intelligent agent to bring potential serious situations to the attention of senior management?

Fraud Detection on hierarchical data

One final point. Most pattern recognition algorithms that I am familiar with work on flat data structure. They do not make use of hierarchical information or of variable number of occurrences. Suppose that we had sales and demographic information at the company, regional, branch and individual salesperson level. What algorithms would find patterns and rules in this hierarchical data?

References

Glasgow, B., et al 1997. MITA: An Information Extraction Approach to Analysis of Free-form Text in Life Insurance Applications. In Proceedings of the Ninth Innovative Applications of Artificial Intelligence