Risky Business - How Operational Changes Impact Surety Risk

Erik Henrikkson and Chris Aeberli

Faculty Advisor: Prof. Rahul Mazumder
Liberty Mutual Team: Adam Johnson, Bobby Yuen, Thaya Psyhojos

Objective & Surety at Liberty Mutual

Project goal: Develop a comprehensive, quantifiable understanding of how changes to underlying contractor’s business operations affect surety bond risks.

• Surety bonds: provide a guarantee that specific contracted tasks will be fulfilled
• Large construction projects throughout the world depend on Surety bonds
• Liberty Mutual is the number one surety provider both in the US and the world
• Customers in 60 countries, projects up to $750M and $1.7B exposure limit

Why Operational Data?

• Liberty Mutual currently assesses contractor risk using their financial statements, work history, reputation and their relationship to underwriters
• This is the first attempt to enrich this data with operational changes
• Supporting underwriters in this process with more accurate and earlier indications of risk

Data Exploration

4 Years of survey results for contractor accounts
7 Questions related to categories of operational risk

Data Handling

Large degree of freedom problem: many possibilities to format our dataset e.g. temporal lags and handling of multi-tiered categorical variables

Challenges: Data inconsistencies, statistical outliers and low incidence variables

Unsupervised Learning

Clustering

1. Methodology:
   Clustering on Operational Features
   Analysis of Financial Distribution within Clusters
   Evaluation using Kolmogorov-Smirnov and Lepage Tests

2. Sample Outcome:

3. Insights:
   • Changes in variance within clusters are equally relevant to describe risk as mean
   • Statistically significant correlations identified and hypotheses confirmed

Supervised Learning

Regression & Trees

Models: OLS, LASSO, Ridge, CART, Ensemble Models

Transformations: Temporal Lags, Log Transformations, Outlier Filtering, YoY % Change, Change Absolute Values, Binarized Targets, Disaggregation by account type

Novel business insights generated despite limited predictive performance in R2

Optimization

If an operational change happens today, in how many years will that be reflected in financial features?

Optimization-based multi-objective-regression

The motivation was to identify the optimal temporal lags for different groups of operational changes

Low Level Insights into High Level Actions

Univariate Relationship Analysis & OCA Dashboard for Underwriters

To support Liberty Mutual underwriters in risk assessment, we developed an interactive Shiny dashboard including the most significant correlations between specific operational and financial variables found over the 4 years and all accounts

Glossary and context to educate user and abstract technical complexity

Portfolio level strongest correlations presented with 2 levels of granularity

Actionable insights on the account level based on operational changes

Business Impact & Results

First time that operational data has been integrated into surety risk assessment at Liberty Mutual
Identified statistically significant correlations between operational changes and financial risk
Fully responsive, easily interpretable dashboard for underwriter support in daily work
Repeatable process and pipeline set up to populate for coming years as survey signal increases