

Predictive Analytics

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My recent research interests (in insurance and finance)

Optimal Decision Problems

- Portfolio selection and estimation error in high-dimensional settings
- Risk management in the presence of basis risk
- Optimal reinsurance, optimal hedging, etc.

Predictive Analytics (PA)

- **Predictive analytics for variable annuities policyholders' withdrawal behaviors**
- **Insurance premium rating**
- Index tracking, etc.



Insurance predictive analytics

- Actuarial professional organizations' responses to PA
 - Society of Actuaries launched a new exam for (associate) fellowship designation
 - Predictive Analytics Symposium, Chicago, September, 2017
- Advances in predictive analytics 2017 conference
 - First academic conference on insurance PA
 - Waterloo, Dec, 2017
 - We plan to continue the conference either annually or biannually
 - Metlife's interests?



Predictive Analytics for Variable Annuities - 1/2

- **Objectives:** Use machine learning techniques to study VA policyholders' withdrawal/surrender behavior
- **Target:** Provide useful information for design of practically implementable competitive pricing frameworks and efficient hedging programs
- The typical pricing approach in previous study is **optimal control**
 - Investigate the best withdrawal/surrender strategies for policyholders, the worst case for insurers
 - Overpriced
 - Computationally cumbersome, nested simulation
 - No policyholders' covariate information is incorporated



Predictive Analytics for Variable Annuities – 2/2

- Beneficial consequences for insurers:
 - More competitive pricing
 - Enable price discrimination
 - More efficient hedging
- The role of machine learning
 - Supervised learning: from covariate information to withdrawal behavior
 - Unsupervised learning: categorize policyholders into a number of groups to facilitate various risk management purposes (e.g., hedging)



Insurance premium rating – 1/2

- It is an SOA sponsored research project
- **Objective:** build a tariffication system to enable price discrimination on insurance products
- Traditional methods in the literature:
 - Generalized linear model; Longitudinal data model; Credibility model
- Parametric regression model becomes increasingly unsatisfactory for the reasons
 - Restriction on the regression form
 - Need more robust model
 - More data are available
 - Variable selection problem becomes more prominent when a large number of covariate variables are available.



Insurance premium rating -2/2

- **Our solution:** Data-driven methods (machine learning techniques)
 - Customer personalized framework
 - Develop hierarchical structures to enable more accurate prediction on insurance claims.
 - The insurance premium for each customer is computed using whole dataset but placing different weights on data points according to their “distance” to the customer.
 - The building of the hierarchical structure is guided by covariate information.
 - No a prior variable selection procedure is needed
 - A large covariate information can be incorporated into our algorithm.

