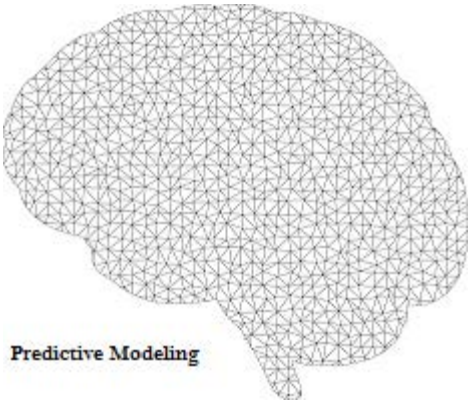
ReservePrism LLC



Technical Proposal for

Fire Service Fiscal Review

TOWN OF ATHERTON, CALIFORNIA

March 24, 2017

March 24, 2017

George Rodericks
Town of Atherton
91 Ashfield Road
Atherton, CA 94027

Dear Mr. Rodericks:

This is a response to the RFP for fire service fiscal review issued by the Town of Atherton. We (ReservePrism LLC) would like to submit this proposal for assessing different options of providing fire services needed by the Town of Atherton. We are an actuarial consulting firm focusing on big data analysis, predictive modeling, financial analysis and actuarial services. We also have a proprietary predictive modeling software called Envision built upon the R platform. We believe that our experience can help you make more informed decision on fire services.

We have read this RFP, understands it, and agrees to be bound by its requirements. We do not have any past, ongoing, or potential conflicts of interest as a result of performing the anticipated work. Our proposal is designed based on our understanding of the RFP. We are willing to adjust it to meet the requirements of the Town of Atherton.

I will be the person authorized by ReservePrism LLC for signing the contract and the representative for all matters relating to the RFP. Thank you!

Yours Sincerely,

Hai You
VP Technology, ReservePrism LLC
Mailing Address: 9809 Soaring Sky Run Verona, WI 53593
Email: hyou@reserveprism.com
Telephone: (608) 239 1670

Table of Contents

Executive Summary

This is a response from ReservePrism LLC to the RFP for fire service fiscal review issued by the town of Atherton, CA. ReservePrism LLC is an actuarial consulting firm focusing on financial analysis, big data analysis, predictive modeling, reinsurance, actuarial loss reserving, pricing, and statistical modeling. We also have a proprietary predictive modeling software called Envision built upon the R platform. Our team members have years' experience on financial analysis, actuarial applications, statistical modeling and innovative solutions.

In this proposal, we rely on a variety of analytical models to assess and predict the costs, benefits and financial outcomes of current and alternative fire service options for the Town of Atherton. By using local, regional and national data, we will be able to have an objective benchmark for the cost of fire service and predict the cost and revenue trend. The study will be composed, but not limited, by the following:

1. Economic models will be used to predict the tax revenue that provides the funding of fire service.
2. Actuarial/predictive models will be used to predict the cost of fire services.
3. Financial projection models will be used to predict the financial impact of all fire service options.
4. Risk analysis models will be used to assess the chance and magnitude of adverse financial impacts each fire service option may have on the town.
5. Insurance pricing models will be used to help design and determine the cost of additional insurance arrangements that may be used to minimize the volatility of financial impact.

At the end of project, we will be able to answer the following questions:

1. How much funding received by the fire district is generated by the Town of Atherton?
2. How much is the cost of fire service received by the Town of Atherton? The cost will be categorized into basic services, hazmat, CERT, USAR, etc.
3. What are expected in the next few years based on trend analysis of both funding and costs?
4. What other options are available for fire service, in regarding to costs, benefits, financial implication and risks?

A formal report, presentation materials, data and models will be delivered at the end of the project. Data visualization will be used to help deliver results to non-technical audience. The proposed timeline is 90 days for this project.

We believe that our years' of experience and knowledge can help the Town of Atherton to make more informed decision on its fire service choices.

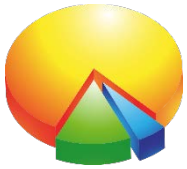
Technical Proposal

Final Deliverables

Our final deliverables will include a formal report to document the data, model, numerical results, main findings, and recommendations for fire service options. An executive summary will also be available to provide a high-level overview. All the data, materials, and models used in the study will be shared as resources. The report and/or accompanying materials will consist:

1. Fire District Revenue Decomposition Pie Chart Report (Current and Future), from Atherton residents via property taxes and fees in support of fire services.

2. Fire Service Cost Decomposition Pie Chart Report (Current and Future) for the Town of Atherton, received from Fire District. The cost will be categorized into basic services, hazmat, CERT, USAR, etc.



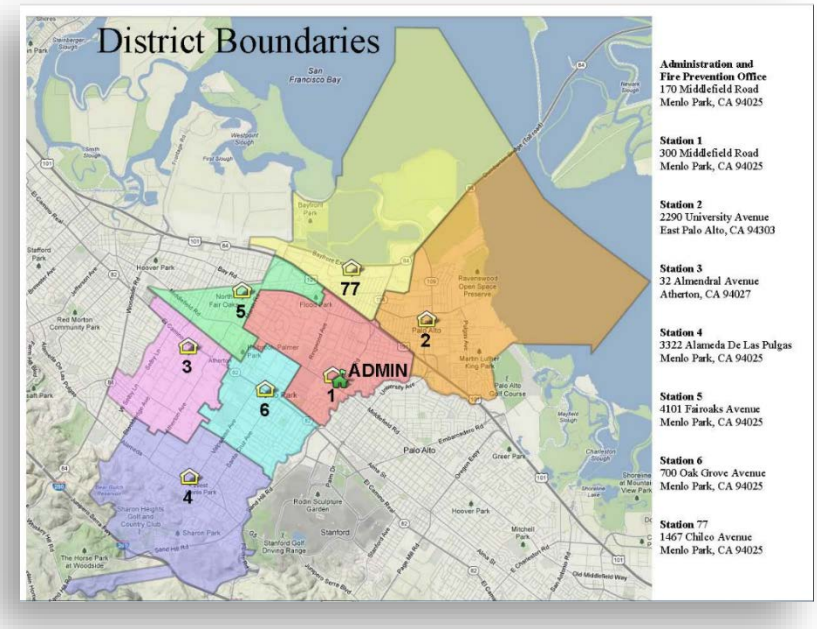
3. Fire Service Cost Decomposition Pie Chart Report (Current and Long-Term) for the Town of Atherton, **if** the town were responsible for providing satisfied fire service independently. The cost will also be categorized into basic services, hazmat, CERT, USAR, etc.

4. Fire Station Density/Count Study for Town of Atherton based on comparative analysis with state and nationwide data. Fire station count and distribution information from similar towns/cities/counties will be used for optimal design.

5. Fire Station Construction and Maintenance Cost Analysis with comparative analysis based on state and nationwide data.

6. What additional measures are needed to manage the risk if the town were responsible for providing fire service?

Data and models will be documented so that the results can be replicated. We will maximize the usage of data visualization to help communicate technical findings with non-technical audiences. The map below contains current Fire Stations from entire Fire District.



Menlo Park Fire District Map

Data Collection

We will rely on a variety of sources for data collection.

1. Local data
    - Property tax data
    - Property value data
    - Fire alarm data
    - Fire service charge data
    - Historical fire accidence data
    - Economic data
    - Demographic data
    - Geographic information

2. Regional data: We will look for the similar data from other fire departments/districts within the State of California. Areas with similar conditions (economic, demographic and geographic) will be used to provide benchmark information. https://en.wikipedia.org/wiki/List_of_California_fire_departments

3. National data: This data, combined with local and regional data, will be relied on for general trend and hypothetical analysis of fire service cost and property value. These trends will be included in predicting the future financial outcomes of different fire service modes.

4. Additional statewide and nationwide data such as fire station construction cost, fire station annual maintenance cost, fire station density data, and fire service insurance loss data will be considered as well. They are useful for additional consideration of financial risk and in suggestion of certain fire service alternatives.

Model

We will implement a variety of analytical models in this project to answer the 3 questions raised in RFP. Predictive Modeling analysis will be conducted for future trend and hypothetical analysis.

Basic Analysis:

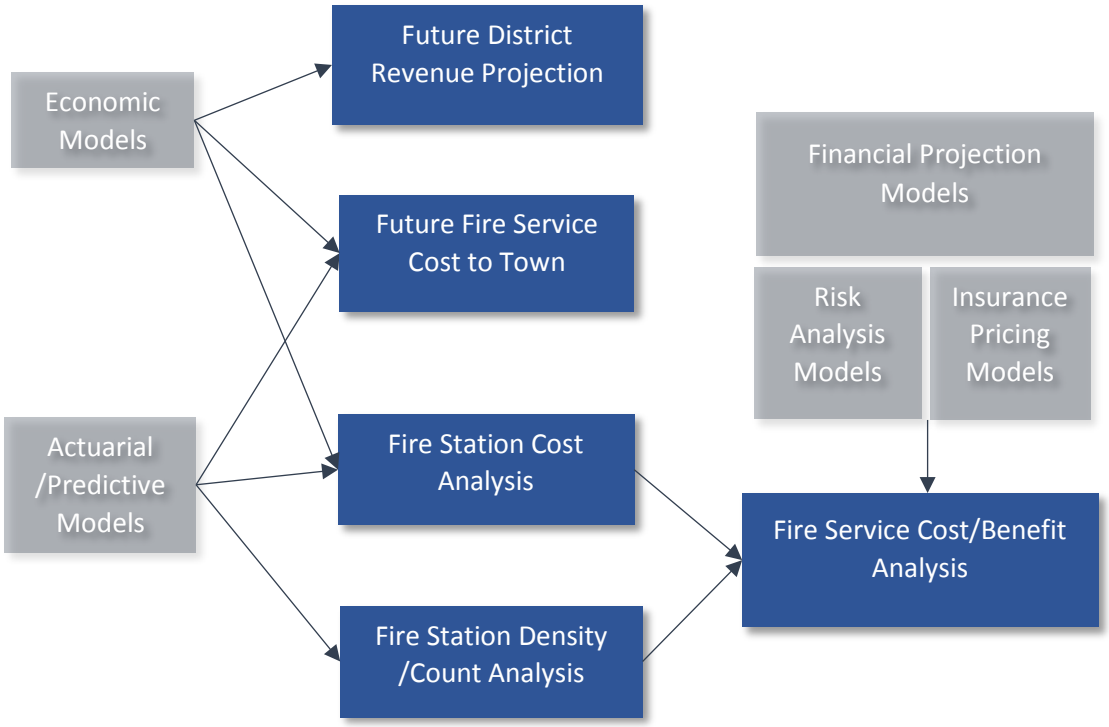
- What revenue does the Fire District receive from Atherton residents via property taxes and fees in support of fire services?

- What is the cost of providing basic fire protection services within the jurisdictional boundaries of the Town of Atherton from the Fire District? Beyond basic services, what other special services does the District provide to Atherton residents (i.e., hazmat, CERT, urban search/rescue, etc.)? In total, what do these add to the cost of basic fire services?

To answer the above 2 questions in RFP regarding current Fire District Revenue and fire service cost to Town, we will use the provided district tax and revenue data to perform accounting and economic analysis. We may pay some visits to collect more detailed data.

Predictive Analysis:

Various analytical models, including Predictive Modeling analysis, will be conducted for any future and hypothetical analysis, such as future fire district revenue, future fire service cost to town, fire station construction and maintenance cost, fire station counts, and potential risks, etc.



1. Economic and real estate market projection models. They are useful for estimating the future revenues received by the fire district generated by the Town of Atherton. Trend analysis based on historical economic data and macroeconomic models will be used for the prediction. Plausible scenarios will also be constructed to help understand possible outcomes in the future.

   Possible *economic model*

   $House\ Price = f(Unemployment\ Rate, Mortgage\ Rate, Demograohic\ Info, Local\ Economy, \dots)$

   The function *f* could take the form of linear regression, generalized linear model, random forest model, and so on.

   Possible *trend analysis model* such as autoregressive integrated moving average (ARIMA) model:

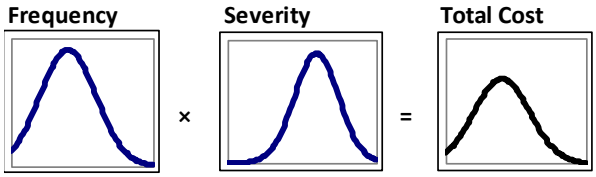
   $$H_t - \alpha_1 H_{t-1} - \cdots - \alpha_p H_{t-p} = \varepsilon_t + \theta_1 \varepsilon_{t-1} + \cdots + \theta_q \varepsilon_{t-q}$$

   Where H stands for house price and ε stands for errors.

2. Actuarial models. Based on experience data, we will use actuarial/predictive models to predict the future frequency and severity of different fire services. This helps us understand the pure cost of these services and choose the combination of services that are important and appropriate for the town.

   Possible *actuarial models*

   $$frequency\ of\ USAR \sim Poisson(\lambda)$$
   $$Severity\ of\ USAR \sim Gamma(\alpha, \beta)$$
   $$Cost = frequency \times Severity$$



3. Financial projection model. With the revenue and cost estimations, financial projection will be conducted to predict both the short term and long term financial impact of different fire service options. Options will be evaluated based on measures such as net present value (NPV) considering all the future costs and returns, plus the internal rate of return (IRR) which is the discount rate that makes NPV = 0.

$$NPV = \sum_{t=1}^{n} \frac{NCF_t}{(1+k)^t} - C_0$$

Where:

NCF_t: Net cash flow at time t; it is calculated as the difference between benefits and costs of a fire service option.

k: Hurdle rate; it is the expected return required from an investment project

n: Time horizon

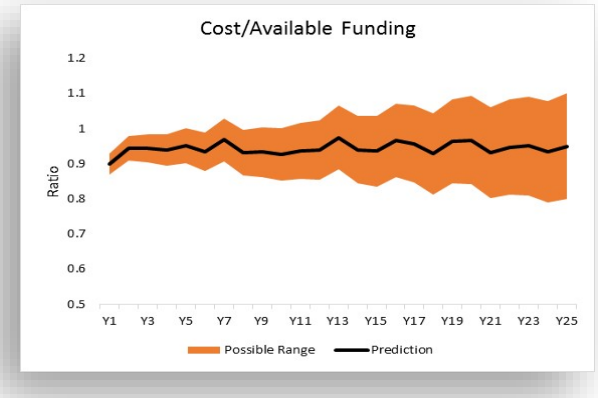
C_0: Initial investment at time 0

By this way, different options can be compared based upon a consistent base.

4. Risk analysis models. To be able to understand the bad yet possible financial impact of different options, simulation models will be used to estimate all possible outcomes. A distribution of financial outcomes will be provided to include the element of risk in the decision-making.

Possible *risk analysis*

The cost/available funding of a fire service option is predicted with a range estimation. A ratio above 100% means a risk of underfunding which could have adverse impact on the town's financial stability. Both the chance and magnitude of such unwanted event can be predicted using the simulation model.



5. Insurance pricing models. As we consider insurance arrangements that may be used to manage unwanted financial impact on the town, we will use insurance pricing models to estimate the cost of such arrangements. Insurance design and pricing models will be used in the process.

   Possible *insurance pricing models*
   Cost of insurance against total fire service cost exceeding a threshold
   $= \sum_{i=1}^{N} p_i \cdot Max(Cost_i - Threshold, 0)$
   Where i is the scenario number and p_i is the probability of the scenario.

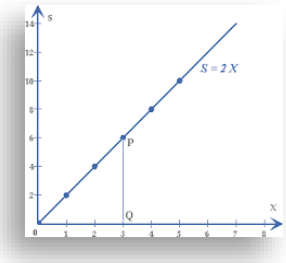
6. ***Possible*** Predictive models we use in this project are illustrated below, including linear regression (LM), generalized linear model (GLM), classification and regression trees (CART), Random Forest (RF), artificial neural network (ANN), and k-nearest neighbors (KNN).

   For example, we will set up the following predictive model formula and apply the models mentioned above to answer the key RFP question: How many fire stations does the Town of Atherton need?

   Fire Station Counts = f (population density, economic data, weather hazards count, car accidents, fire accidents, earthquake, Municipal area size, …)

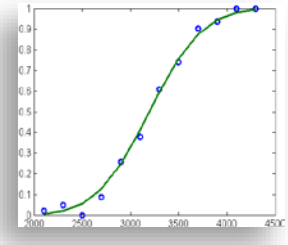
   (*Statewide or nationwide data at city/town/county level may be used to derive the relationship)

Linear Regression Model



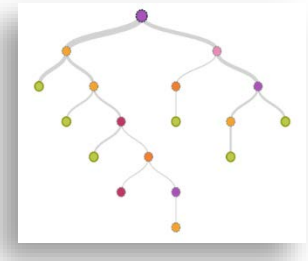
Linear regression is the most basic regression model used in the statistical world. It assumes a linear relationship between the response variable Y and one or multiple explanatory variables (X), with an error term that follows the normal distribution.

Generalized Linear Model



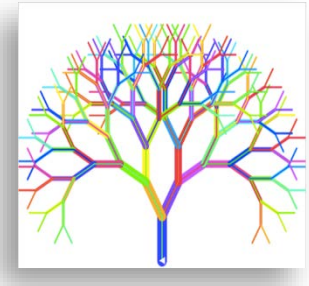
The Generalized Linear Model (GLM) extends the linear regression model by allowing the error function to belong to distributions other than normal distribution. The response variable Y can be transformed using a link function before being fed into the linear equation. A famous form of GLM is Logistic regression by assuming the error function following the Binomial distribution and a logit link function.

Classification and Regression Trees



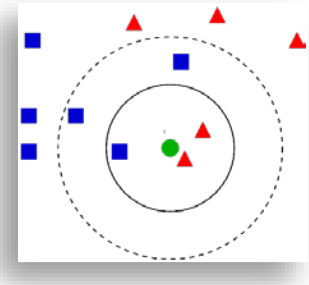
Classification and Regression Trees (CART) model is an extension of decision tree model. It constructs a tree to split the data using explanatory variables (X). The splitting is determined to maximize the accuracy improvement. CART can be used for both classification and regression (taking the mean of all cases in the terminal nodes).

Random Forest



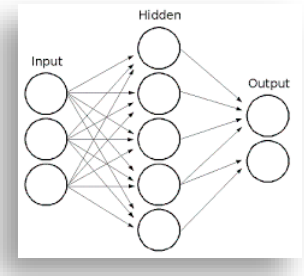
The Random Forest model is an ensemble method based on CART. The data is sampled into small subsets with a CART model fitted to each subset. Each CART model generates its own prediction. The final estimate is based on the average result of all CART models.

K-Nearest Neighbors



K-Nearest Neighbours (KNN) is a nonparametric model that use the distance between data points to determine their closeness. It can be used for classification based on the clusters and regression based on the representative value of the clusters (mean, median, etc.)

Artificial Neural Network



Artificial Neural networks (ANN) are one of the most fascinating machine-learning models. An ANN model mimics the network of neurons in brain and can approximate any relationships (linear or nonlinear). Multiple hidden layers also enable us to apply a deep learning algorithm for sophisticated relationship modeling.

Project Plan

Here is our proposed time line, assuming the start of the contract is 05/01/2017.

Task	***Deliverable***	***Days after Contract Effective Date***	***Date***
Project Start			*05/01/2017*
Project planning	*Detailed project plan*	*6 days*	*05/07/2017*
Data Collection	*Raw data and documentation of data sources*	*35 days*	*06/05/2017*
Data Cleaning	*Clean data set for predictive modeling and documentation of data processing methods*	*50 days*	*06/19/2017*
Model Training/Validation	*Model documentation and R codes*	*60 days*	*06/30/2017*
Financial analysis of current fire service arrangement	*Cost and benefit analysis of current service mode*	*70 days*	*07/10/2017*
Financial analysis of various fire service options	*Cost, benefit and risk analysis of alternative options*	*80 days*	*07/20/2017*
Revision and Finalization	*Revisions according to the comments received from the Town of Atherton; Final package of data, model and report.*	*90 days*	*08/01/2017*

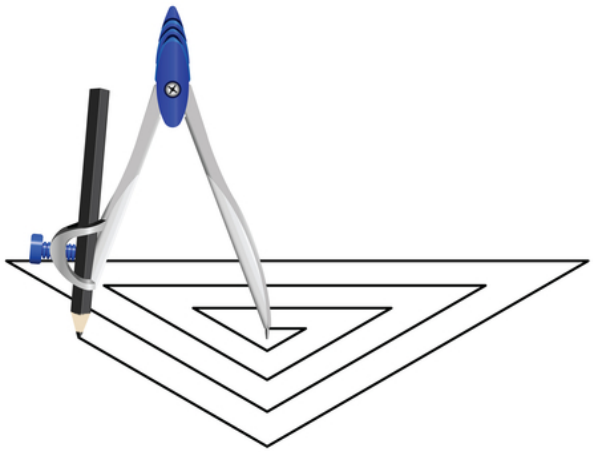
About ReservePrism, LLC

We are an actuarial consulting firm focusing on actuarial applications, innovative analytical solutions and training services. Our clients are insurance companies, actuaries, other consulting companies, and education institutions.

ReservePrism provides actuarial consulting services on insurance Loss Reserve studies, predictive modeling, statistical applications, financial analysis, pricing applications, reinsurance applications, and ERM applications such as capital management. We provide training and education services on concept of Simulation and Predictive Modeling. We are very strong at the R statistical language in various actuarial studies. We provide data mining and sophisticated statistical modeling services to streamline big database solution, project management, and product implementation.

We have two software systems: ReservePrism and Envision. They are comprehensive software platforms that simplify critical elements for risk analysis and predictive analytical solutions.

Our members are very experienced experts from the actuarial, financial analysis, statistical modeling, and computer engineering industry. We combine hundred years of experience in reinsurance, reserving, pricing, predictive modeling, litigation, and statistical modeling.



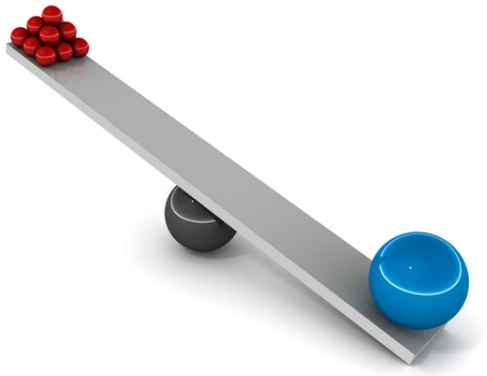
Relevant Experience

Our staffs' experience will help deliver scientific and practical findings and recommendations for this project. We have strengths in three areas:

1. Financial analysis, planning and reporting. Our staffs have worked in the insurance industry for decades and two principal consultants held senior management positions in insurance companies. Their daily job was to assess different project options and select the best ones for the company. Our key modeler is also a Chartered Financial Analyst (CFA) with extensive working experience on financial analysis and project management. He was a co-author of the book "Handbook of Research on Leveraging Risk and Uncertainties for Effective Project Management."

2. Statistical modeling. Predictive models are essential for predicting the cost of different fire service options in this project. We have two qualified P&C actuaries and one qualified life actuary. Our major works are to estimate the cost of different risk events and provide a fair estimation of the price. We also have our proprietary predictive modeling platform "ENVISION" which can be leveraged on for this project.

3. Innovation. We are experts on providing innovative solutions to our clients. Our staffs have published numerous practical research reports. For example, we will be able to consider different financial options including insurance to help manage the cost of fire service were the town choose to provide its own fire service. This will help the town maintain financial stability in case of unexpected cost of fire service.



Staffing and Leaders

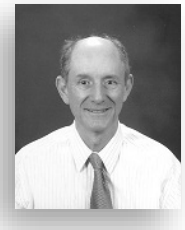
Robert Bear, Principal Consultant, FCAS, CPCU, MAAA

Robert Bear is a Property and Casualty Consulting Actuary, Reinsurance Consultant and Insurance Arbitrator with 42 years of insurance industry experience that include 20 years managing reinsurance actuarial services. After beginning his career at Insurance Services Office, he served as an actuarial manager at Prudential Reinsurance, Signet Star Reinsurance and SCOR Reinsurance Company. He then served as Senior Vice President and Chief Actuary of PXRE Group, where he was responsible for loss reserving functions and pricing model development, along with related corporate modeling.

Mr. Bear is a Fellow of the Casualty Actuarial Society, a member of the American Academy of Actuaries, a Chartered Property Casualty Underwriter. He has earned MS degrees in theoretical mathematics from New York University and in applied mathematics (focusing on mathematical statistics) and in economic systems from the Polytechnic Institute of New York. He graduated summa cum laude with a BA in mathematics from the University of Bridgeport.

Robert Bear has served as Vice Chairperson of the AIRROC Actuarial Committee, Chairperson of the CAS Dynamic Risk Modeling Committee, Chairperson of the Reinsurance Association of America (RAA) Actuarial Committee and as President of Casualty Actuaries in Reinsurance (CARe). He has also authored several CAS discussion papers and articles on reinsurance pricing, loss reserving, and risk modeling issues.

Joe Marker, Principal Consultant, FCAS, MAAA, Mathematics Dept., Univ. of Michigan



Joe has over 40 years actuarial, managing, and consulting experience in property-casualty insurance, with 28 years serving insurance companies. The last fifteen of these years, he was Chief Actuary at two regional companies. He also served on the board of the Michigan Catastrophic Claims Association, chairing that organization one year.

Since 2007, Joe has been teaching upper-level Actuarial Science and Financial Mathematics at the University of Michigan. Joe graduated with Highest Honors in Mathematics from the University of Michigan and has a Master of Science in Mathematics from the University of Minnesota. He is an FCAS and MAAA and a past president of the Midwestern Actuarial Forum and has spoken frequently at regional and CAS meetings. He published the paper, Studying Policy Retention using Markov Chains, PCAS LXXXV, 1998.

Joe also co-authored the paper Rating Claims-Made Insurance Policies, Call Paper Program 1980. This paper was part of the CAS exam syllabus for many years.

Hai You, VP, Technology

Hai is responsible for actuarial modeling, product development and innovative solutions. He is the author/co-author of the following actuarial engineering systems:

1. ReservePrism, the advanced synthetic loss claim simulation and statistical platform for P&C loss reserving and pricing, created in R, VB.NET, and VC#.
2. Envision, the innovative Predictive Modeling and Big Data analysis platform.
3. ReserveMaster, the cutting edge deterministic and stochastic loss reserving platform for P&C insurers, created in Visual Basic
4. CAS Public Loss Simulator, the CAS sponsored loss claim simulation engine, created in R and VB.NET.
5. Depict - a drag and drop Enterprise Risk Model workflow management web platform, created in Java and Web.

Hai has been served as an IT expertise level consultant in various industries especially insurance companies since 1998, he has accumulated sound knowledge in both insurance, actuarial, statistical, and IT fields. Hai masters various computer languages, web, securities, databases, 3D, email, UI, and data communication. He is keen to use solid computer technology and mathematical skills to create actuarial and statistical solutions.

SKILLS

R	Microsoft Visual Basic 6.0	C/C++
Microsoft VB.NET	Java 2	Visual C#
JavaScript	Web design/CSS/JS	OOA/OOD/OOP
Client/Server	Windows programming	Servlet, Jsp, Asp, IIS, CGI
XML, XSL, SOAP	Database design/schema	Unix/Internet Security
Network programming	System programming	LINUX system administration
3D programming	Actuarial Science	SSL (RSA Algorithm)
SQL Server Management	E-mail application	Windows Memory turning
Architecture	SQL	Mathematics and Statistics

Kailan Shang, Principal Consultant, VP, Predictive Modeling, FSA, CFA, PRM, SCJP

Kailan has over ten years of actuarial, financial reporting, data mining and risk management experiences. He is a qualified actuary and a chartered financial analyst. He built all the predictive models for our predictive modeling platform Envision. He also worked on many research projects related to data mining, including the deep learning for cancer mortality and variable selection methods for predictive modeling. He won several research prizes from the Society of Actuaries (SOA) and was awarded the outstanding volunteer award by the SOA.

Kailan will serve as lead modeler for this project, so his resume is attached.

Professional Summary

- ✓ Over ten years' experience on data mining, financial reporting, risk management, and insurance pricing.
- ✓ Skilled at presenting technical and abstract concepts in a clear and concise way.
- ✓ Creative problem-solving and analytical skills.
- ✓ Extensive research experience and award winning publications.

Working Experience

VP, Predictive Modeling, ReservePrism *2014.3-Present*

- ✓ Actuarial and risk management Consulting
- ✓ Predictive modeling and social media data mining
- ✓ Training for insurance companies on risk management and quantitative analysis
- ✓ Research projects with the CAS and the SOA
- ✓ Business development

Associate Actuary, Retail Markets Pricing**, *Manulife Financial**,* Waterloo** *2010.12-2014.3*

- ✓ Universal Life product development
- ✓ Seg fund product development
- ✓ New business planning

Financial Risk Manager, Group ERM – Risk Analytics**, *American International Assurance***

Hong Kong/Shanghai *2007.6-2010.12*

- ✓ Built dynamic and stochastic ALM models and ALM report
- ✓ Capital Management and Stress testing
- ✓ Set up risk appetite and liquidity risk management framework
- ✓ Economic capital modeling and implementation such as SAA and performance measurement
- ✓ VA product development with GMxB using stochastic on stochastic method
- ✓ Communicated with business units and conducted training sessions
- ✓ Economic scenario generation

Actuarial Associate, Business Development**, *AEGON-CNOOC Life Insurance Company***

Shanghai *2005.1-2007.6*

- ✓ Built economic capital model for pricing and risk management
- ✓ Developed life, health, annuity, UL and VUL products
- ✓ Planned compensation scheme for financial advisors in bancassurance and telemarketing channel

Education

- ✓ **M.A.** in Economics, ***York University***, Toronto *2003.8-2004.6*
- ✓ **B.A.** in World Economics, ***Fudan University***, Shanghai *1999.9-2003.7*

Selected Publications and Awards

- ✓ Author of the paper "The Optimal Timing of Risk Management" (2016) and was awarded the JRMS

Best Paper Award for Practical Risk Management.

- ✓ Co-author of the prize winning paper "An Affordable Long-Term Care Solution through Risk Sharing" (2014) sponsored by the SOA.
- ✓ Author of the prize winning paper "Inconsistent Inference in Qualitative Risk Assessment" (2014) sponsored by the North American CRO Council.
- ✓ Co-author of the paper "Applying Fuzzy Logic to Risk Assessment and Decision-Making" (2013) sponsored by the JRMS of the CAS, CIA, and the SOA.
- ✓ Co-author of the paper "Pension Plan Embedded Option Valuation" (2013) sponsored by the Pension Section of the SOA.
- ✓ Author of the paper "Understanding Contingent Capital" (2013) sponsored by the CAS.
- ✓ Co-author of the paper "Risk Appetite: Linkage with Strategic Planning" (2012) sponsored by the JRMS of the CAS, CIA, and the SOA.
- ✓ Author of the paper "Loss Simulation Model Testing and Enhancement" (2011) and was awarded the Emerging Issues Prize from the CAS.

Computer Skills

- ✓ Software: **MS Office, Prophet, MoSes, R, Matlab, AXIS, ReservePrism**
- ✓ Programming: **VBA, C++, JAVA (Sun Certified Java Programmer), Python, Scala, PHP**

References

Project Name: Resale Prediction
Contact: Zhiwei Li
Email: zhiwei.li@sino-life.com
Tel: +86 755 2383 4292
Funde Sino Life Insurance Co. Ltd.
Website: http://www.sino-life.com/ensinolife/index.shtml
Address: F22, Tower B, East Pacific International Center, 7888 Shennan Road, Futian CBD, Shenzhen, P.R.China

Project Description: This big data project is to predict the probability of resale to existing customers for a life insurance company. Using policy information, we helped our client find the customers who are most likely going to buy another product from the company.

Project Name: Deep Learning for Cancer Mortality
Contact: Mrs. Ana Sojo Gil
Email: asojo@fundacionmapfre.org
Tel: +34 91 581 1240
FUNDACIÓN MAPFRE
Website: https://www.fundacionmapfre.org/fundacion/en/
Address: Pº Recoletos, 23, 28004 Madrid, Spain

Project Description: This is a project awarded to Kailan Shang to study cancer mortality of individual patients based on demographic information, diagnostic information, histological information, and medical treatment. Using linear regression, GLM, CART, Random Forest, and deep learning models, millions of patient records are analyzed to predict the 40-year mortality rates. The result is useful for improving insurance cancer patients.

Project Name: Keenan Associate IBNP Loss Reserving
Contact: Mrs. Christine Hough, Mrs. Denise Keener
Email: Chough@Keenan.com, dkeener@keenan.com
Phone**:** 310.212.3344
Website: http://www.keenan.com
Address: P.O. Box 4328, Torrance, CA 90510

Project Description: This is not a Predictive Modeling project, instead, this is a client we have for Health Insurance Claim Loss Reserving. Keenan is an industry leader providing actuarial services to self-insured employers nationwide. We have served Keenan for years by setting up their internal Loss Reserving system for IBNP (incurred but not paid) projected loss reserving and pricing calculation. The algorithm we have been using is Bornhuetter-Ferguson method for health insurance.

Disclosure

ReservePrism LLC and its staffs have no past, ongoing, or potential conflicts of interest as a result of performing the anticipated work.