

A Multifaceted Study of Risk Management for Insurance

Third Year Progress Report

This is the third (last) year progress report for our three-year CAE research grant titled “A Multifaceted Study of Risk Management for Insurance” on the following four areas:

- (a) Valuation of Equity-Linked Death Benefits;
- (b) Quantitative Risk Management with Extreme Risks;
- (c) Statistical Estimation of Risk Measures;
- (d) Optimal Reinsurance with Multiple Risks and Optimization Constraints.

Publications

We were expected to produce at least five research papers during the timeframe (04/15/2015–04/14/2016) for submission to reputable actuarial science or related journals.

Listed below are 9 papers dealing with the four areas of study, which have appeared in, or have been submitted to, or will soon be submitted to journals in actuarial science or related fields during this timeframe:

1. Cheung, K. C.; Lo, A. Characterizations of optimal reinsurance treaties - a cost-benefit approach. *Scandinavian Actuarial Journal* (2015), in press.
2. Gerber, H. U.; Shiu, E. S. W.; Yang, H. Geometric stopping of a random walk and its applications to valuing equity-linked death benefits. *Insurance: Mathematics and Economics* **64** (2015), 313–325.
3. He, J.; Tang, Q.; Zhang, H. Risk reducers in convex order. *Insurance: Mathematics and Economics* **70** (2016), 80–88.
4. Li, J.; Tang, Q. Interplay of insurance and financial risks in a discrete-time model with strongly regular variation. *Bernoulli* **21** (2015), no. 3, 1800–1823.
5. Lo, A. A Neyman-Pearson perspective on optimal reinsurance with constraints. *ASTIN Bulletin* (2016), submitted.
6. Lo, A. A unifying approach to risk-measure-based optimal reinsurance problems with practical constraints. *Scandinavian Actuarial Journal* (2016), in press.
7. Shi, X.; Tang, Q.; Yuan, Z. A limit distribution of loss given default in the presence of extreme risks. *Journal of Banking & Finance* (2016), submitted.
8. Shyamalkumar, N. D. Algorithmic explorations in clustering of variable annuity and variable universal life policies. *Working Paper* (2016), for submission.
9. Wang, X. Discussion on “Capital forbearance, ex ante life insurance guaranty schemes, and interest rate uncertainty.” *North American Actuarial Journal* **20** (2016), 88–93.

In all of these papers we have acknowledged the financial support of the CAE grant. Paper (2) contributes to area (a), papers (3), (4) and (7) to area (b), papers (8) and (9) to area (c), and papers (1), (5) and (6) to area (d).

In addition, one of our graduate students has written MATLAB functions contributing to area (a):

10. Zhou, Z. Approximating a life table by linear combinations of exponential distributions and valuing life-contingent options. *Technical Report* (2016), available for download from our CAE grant website.

Dissemination of Research in Conferences

During 04/15/2015–04/14/2016, we have presented our results at several conferences for which the financial support of the grant facilitated our participation.

Prof. Ambrose Lo gave the following two talks:

- “On Hoeffding’s Covariance Lemma: Its Functional Generalizations and Applications” at The 19th International Congress on Insurance: Mathematics and Economics (IME), University of Liverpool, Liverpool, UK, June 24–26, 2015
- “Characterizations of Optimal Reinsurance Treaties: A Cost-benefit Approach” at The 50th Actuarial Research Conference (ARC), University of Toronto, Toronto, Canada, August 5–8, 2015

Prof. Elias Shiu gave the following two talks:

- “Actuarial Approach to Pricing Barrier Options” at The 50th Actuarial Research Conference (ARC), University of Toronto, Toronto, Canada, August 5–8, 2015
- “Valuing Options and Guarantees by R” at R(ob) in Insurance, University of Amsterdam, Amsterdam, The Netherlands, June 29–30, 2015

Prof. Qihe Tang gave the following two talks:

- “Losses Given Default in the Presence of Extreme Risks” at The 19th International Congress on Insurance: Mathematics and Economics (IME), University of Liverpool, Liverpool, UK, June 24–26, 2015
- “Reducing Risk in Convex Order” at The 50th Actuarial Research Conference (ARC), University of Toronto, Toronto, Canada, August 5–8, 2015

Graduate student Huan Zhang gave the following talk:

- “EVT Approach to Portfolio Selection for Insurance” at The 50th Actuarial Research Conference (ARC), University of Toronto, Toronto, Canada, August 5–8, 2015