

A Multifaceted Study of Risk Management for Insurance - First Year Progress Report

Publications in Scientific Journals

This is the first year progress report for our three-year CAE research grant titled “A Multifaceted Study of Risk Management for Insurance.” This report is written nine months into the grant, as stipulated in the agreement. As stated therein, we were expected to submit four papers, and present the results in three conference presentations by the end of the grant year on 04/14/2014.

We begin by listing five papers dealing with the areas of study proposed in the grant, on which work was done during the grant year, and which have already been submitted to respected journals in actuarial science or related broader fields. Two of these have been published, one is accepted for publication, and the other two are under revision with journals.

1. Ahn, J. Y.; Shyamalkumar, N. D. Asymptotic theory for the empirical Haezendonck–Goovaerts risk measure. *Insurance: Mathematics and Economics* (2014), to appear.
2. Cheung, K. C.; Dhaene, J.; Lo, A.; Tang, Q. Reducing risk by merging counter-monotonic risks. *Insurance: Mathematics and Economics* **54** (2014), 58–65.
3. Gerber, H. U.; Shiu, E. S. W.; Yang, H. Valuing equity-linked death benefits in jump diffusion models. *Insurance: Mathematics and Economics* **53** (2013), 615–623.
4. Li, J.; Tang, Q. Interplay of insurance and financial risks in a discrete-time model with strongly regular variation. Under revision with *Bernoulli*.
5. Tang, Q.; Yuan, Z. Randomly weighted sums of sub-exponential random variables with application to capital allocation. Under revision with *Extremes*.

The first paper listed deals with the area of *Statistical Estimation of Risk Measures*, the second, the fourth and the fifth papers make contributions in the area of *Quantitative Risk Management with Extreme Risks*, and the third paper contributes to the area of *Valuation of Equity-Linked Death Benefits in Variable Annuities*.

The following two papers also contain work in the latter two areas. Work on these was completed after the initial approval of our grant in June 2011, but due to the substantial delay in completing the grant agreement, they were also published before the start date of 04/15/2013.

1. Gerber, H. U.; Shiu, E. S. W.; Yang, H. Valuing equity-linked death benefits and other contingent options: a discounted density approach. *Insurance: Mathematics and Economics* **51** (2012), 73–92.
2. Tang, Q.; Yang, F. On the Haezendonck–Goovaerts risk measure for extreme risks. *Insurance: Mathematics and Economics* **50** (2012), 217–227.

In all of the papers listed above we have acknowledged the financial support of the SOA through the CAE grant.

Besides these papers, since June 2011 (when we were informed of the approval of our grant) we have played a role in the following papers, in either areas adjacent to those proposed or which use some techniques common to those used in the proposed areas. It was our pleasure to also acknowledge the financial support of the SOA through the CAE grant in these papers.

1. Chakraborty, I.; Shyamalkumar, N. D. Revenue and efficiency ranking in large multi-unit and bundle auctions. *Journal of Mathematical Economics* (2014), to appear (available online).
2. Dhaene, J.; Kukush, A.; Linders, D.; Tang, Q. Remarks on quantiles and distortion risk measures. *European Actuarial Journal* **2** (2012), 319–328.
3. Gerber, H. U.; Shiu, E. S. W.; Yang, H. The omega model: from bankruptcy to occupation times in the red. *European Actuarial Journal* **2** (2012), 259–272.
4. Hao, X.; Tang, Q. Asymptotic ruin probabilities for a bivariate Lévy-driven risk model with heavy-tailed claims and risky investments. *Journal of Applied Probability* **49** (2012), 939–953.
5. Li, B.; Tang, Q.; Zhou, X. A time-homogeneous diffusion model with tax. *Journal of Applied Probability* **50** (2013), 195–207.

The following paper is in its final stage and will be ready for submission to *Insurance: Mathematics and Economics* by 04/14/2014; it pertains to the area of *Statistical Estimation of Risk Measures*.

Ahn, J. Y.; Shyamalkumar, N. D. Theoretical results on the Haezendonck–Goovaerts risk measures: the design and analysis of a computational algorithm.

Also, currently Prof. Tang and graduate student and Hickman scholar Huan Zhang are working with Junnan He on a problem in the area of *Quantitative Risk Management with Extreme Risks*; the working paper is titled *Risk reducers in convex order*.

Dissemination of Research in Conferences

During the grant period we have presented our results in the following conferences; financial support of the grant facilitated our participation in these events.

1. Prof. Elias Shiu gave the following two talks:
 - a. *Option pricing without tears: valuing equity-linked death benefits* at The 17th International Congress on Insurance: Mathematics and Economics, University of Copenhagen, Copenhagen, Denmark, July 1–3, 2013
 - b. *Option pricing without tears: valuing equity-linked death benefits* at The 48th Actuarial Research Conference (ARC), Temple University, Philadelphia, Pennsylvania, USA, August 1–3, 2013
2. Prof. N. D. Shyamalkumar gave the following talk:
 - a. *Asymptotic confidence intervals for the Haezendonck–Goovaerts risk measure* at The 48th Actuarial Research Conference (ARC), Temple University, Philadelphia, Pennsylvania, USA, August 1–3, 2013
3. Prof. Qihe Tang gave the following two talks:
 - a. *Asymptotic expressions for the Haezendonck–Goovaerts risk measure with general Young function* at The 17th International Congress on Insurance: Mathematics and Economics, University of Copenhagen, Copenhagen, Denmark, July 1–3, 2013
 - b. *Interplay of insurance and financial risks in a discrete-time model with strong regular variation* at The 48th Actuarial Research Conference (ARC), Temple University, Philadelphia, Pennsylvania, USA, August 1–3, 2013
4. Graduate student and Hickman scholar Huan Zhang participated in the following conference:
 - a. *Risk reducers in convex order* at The 48th Actuarial Research Conference (ARC), Temple University, Philadelphia, Pennsylvania, USA, August 1–3, 2013