

Ruin and Dividend problems in the dual risk model

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Abstract

We consider the renewal dual risk model, dual to the well known classical risk model for insurance applications, where premiums are regarded as costs and claims are viewed as profits. The surplus can be interpreted as a venture capital like the capital of an economic activity involved in research and development. Like most authors, we consider an upper dividend barrier so that we model the gains of the capital and its return to the capital holders. Most authors have worked the model in the case of exponentially distributed waiting times. Afonso *et al.* (2013) made connections between the compound Poisson dual and the classical insurance models. Following the same line of research, Rodríguez–Martínez *et al.* (2015) generalized to the case of Erlang(n) waiting times and also worked some connections to the primal classical model. The income condition between the two models is reversed.

In this work we generalize further to a compound renewal (dual) risk model where the waiting times between gains follow a (general) distribution in the Phase–Type family. Using the roots of the fundamental and the generalized Lundberg’s equation, we perform calculations to obtain ruin probabilities, the probability to attain a given barrier level, the probability of a dividend, distribution of the number and amount of dividends, among others. We work some numerical examples to illustrate the techniques used and show results.

Keywords: Dual risk model; Phase–Type distribution, generalized Lundberg’s equation; discounted dividends.

References

- Afonso, L. B., Cardoso R. M. R. & Egídio dos Reis, A. D. (2013), *Dividend problems in the dual risk model*, Insurance: Mathematics and Economics, 53(3), 906–918.
- Avanzi, B., Gerber, H. U. & Shiu, E. S. W. (2007), Optimal dividends in the dual model, *Insurance: Mathematics and Economics* 41(1), 111–123.
- Bergel, A. I., Egídio dos Reis, A. D. & Rodríguez–Martínez E. V. (2016), A study of dividends and optimal barriers for a dual risk model, (*preprint*).
- Bergel, A. I. & Egídio dos Reis, A. D. (2016), Ruin problems in the generalized Erlang(n) risk model, *European Actuarial Journal*, doi: 10.1007/s13385-016-0130-2.
- Cheung, E. C. K. & Drekić, S. (2008), Dividend problems in the dual risk model: exact and approximate approaches, *ASTIN Bulletin*, 38(2), 399–422.
- Ng, A. C. Y. (2009), On a dual model with a dividend threshold, *Insurance: Mathematics and Economics* 44(2), 315–324.

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