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# Multi-year non-life insurance risk of dependent lines of business in the multivariate additive loss reserving model

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## Abstract

We derive analytical estimators of non-life insurance risk in multi-year view for the multivariate additive loss reserving model. Thereby we jointly assess reserve and premium risk of multiple years for portfolios of possibly dependent lines of business in one integrated approach. By extending existing formulae for the univariate additive model to the multivariate case, risk estimators for the aggregated portfolio now include the inherent dependencies among all lines of business. The resulting risk evaluation over one-year and general multi-year horizons is fundamental to regulatory reporting (e.g. the ORSA process in Solvency II) and risk-based business planning of non-life insurers with multiple lines of business. A case study illustrates the fruitful application of our formulae and reproduces previous findings for the special case of ultimo view.

*JEL codes:* D81, G22

*Keywords:* Non-Life Insurance Risk, Stochastic Claims Reserving, Dependent Lines of Business, Multivariate Additive Loss Reserving Model, Multi-year View

## 1 Introduction

Quantifying non-life insurance risk, i.e. the uncertainty in pricing and reserving resulting from the stochastic nature in occurrence and settlement of claims, is a principal feature of actuarial risk- and value-based management in non-life insurance. Increasing regulatory constraints call for risk assessment methodologies under flexible time horizons, ranging from classical ultimo views in claims reserving (Mack, 1993; England and Verrall, 2002) and pricing (Kaufmann et al., 2001) to the one-year risk view that has become fundamental for solvency capital calculations (Ohlsson and Lauzenings, 2009; Wüthrich et al., 2008). Recently, Diers and Linde (2013) and Diers et al. (2016) built a bridge between both horizons through an analytic framework for multi-year premium and reserve risk assessment of single portfolios under standard triangle-based reserving model assumptions. It supports actuaries in, e.g., the Own Risk and Solvency Assessment (ORSA) for regulatory reporting under Solvency II and consistent multi-year enterprise risk management (Diers, 2011), and further allows solvency capital predictions in prospective one-year view at future accounting dates for approximate calculations of risk margins and cost of capital loadings.

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