

# A hierarchical model for micro–level stochastic loss reserving

KATRIEN ANTONIO  
Amsterdam School of Economics  
Universiteit van Amsterdam  
Amsterdam, The Netherlands  
e-mail: k.antonio@uva.nl

EDWARD W. (JED) FREES  
School of Business  
University of Wisconsin–Madison  
Madison, Wisconsin, USA  
e-mail: jfrees@bus.wisc.edu

EMILIANO A. VALDEZ \*  
Department of Mathematics  
University of Connecticut  
Storrs, Connecticut, USA  
e-mail: valdez@math.uconn.edu

## Abstract

In this paper we develop a micro–level stochastic model for the run–off of automobile insurance claims. Our analysis uses policy exposure, claims and payments experience data from vehicle insurance portfolios obtained from a major general insurance company in Singapore. The data are from the General Insurance Association ('GIA') of Singapore, an organization comprising most of the general insurers in Singapore. Modelling the run–off of individual Reported But Not Settled (RBNS) claims is the very aim of our work. We put focus on the following components of the development process: the time to an event, the conditional event type, the conditional payment type (if any), and the conditional severity (if any). We distinguish three types of events: settlement without any payments made during development, settlement with a payment and a payment without settlement. Given that a payment is to be made, the conditional payment type model describes the probability that it will be one of three claim types, or any possible combination of them. The conditional severity component describes the claim amount structure according to the combination of types paid. We provide appropriate statistical models for each component and calibrate them to the available data. These building blocks are consequently used to predict the future development of open RBNS claims. Our approach is in line with the intensity–based approach in Haastrup and Arjas (1996) but is adapted to the specific hierarchical structure of our data. Our intention is to illustrate the close connection between the actuarial problem of individual claims development in non–life insurance and the statistical framework of *recurrent events*. Cook and Lawless (2007) provides a recent overview of statistical techniques for the analysis of this type of data.

**Keywords:** Individual loss triangle; hierarchical model; recurrent events.