



An application of Sigmoid and Double-Sigmoid functions for dynamic policyholder behaviour

Fabio Baione¹ · Davide Biancalana² · Paolo De Angelis³

Received: 6 October 2019 / Accepted: 24 March 2020

© Associazione per la Matematica Applicata alle Scienze Economiche e Sociali (AMASES) 2020

Abstract

The growing relevance of risk-based valuations of insurance contracts has stimulated the extension of the traditional deterministic lapse rate models towards a dynamic modelling. A popular dynamic model uses deterministic lapse rates as base rates and dynamic adjustment factors, generally assuming a relationship between lapses and one or more economic factors to describe policyholder behaviour. This relationship is generally represented by an S-Shaped function. This implies a monotonic increase in lapse rate by increasing the economic variable, usually set equal to a “market spread” between a benchmark rate and the policy crediting rate. In this paper, we assume a different policyholder behaviour, based on the assumption that the policyholder does not modify his/her behaviour for small values of the market spread. Hence, for a better description of such behaviour, the double-sigmoid function appears to be more adequate. The double-sigmoid function is obtained as a combination of two logits in their sum or product. Theoretical features and practical applications of the model are discussed.

Keywords Logistic function · Double-Sigmoid function · Policyholder behaviour · Double-step function · Lapse rate

JEL Classification C02 · C65 · G02 · G22

✉ Fabio Baione
fabio.baione@uniroma1.it

Davide Biancalana
biancalana@unisannio.it

Paolo De Angelis
paolo.deangelis@uniroma1.it

¹ Department of Statistics, Sapienza University of Rome, Viale Regina Elena 295, Rome, Italy

² Department of Law, Economics, Management and Quantitative Methods (DEMM), Università degli Studi del Sannio, Via delle Puglie, 82, 82100 Benevento, (BN), Italy

³ Department of Methods and Models for Economy, Finance and Territory, Sapienza University of Rome, Viale del Castro Laurenziano 9, 00161 Rome, Italy