

# On the Evolution of a Markov Open Long Term Care Population

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March 2010

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## Abstract

Long Term Care Insurance provides a combination of medical, nursing, social and community services designed to help people who have disabilities or chronic care needs. It may be provided in the person's home or in nursing homes.

Our starting point is a continuous time Markov chain model for a Long Term Care population with 5 states, three of them corresponding to different degrees of dependence, one being the healthy state and the last one representing the withdrawals of population elements for which intensities are known, see [1].

Considering the embedded Markov chain, see [6], the Stochastic Vortices theory, see [2], [3] and [4], is used to estimate, through an open population perspective, the evolution of the population structure, which will be crucial for an accurate risk measurement and portfolio management.

**Keywords:** Markov Chains, Stochastic Vortices, Long Term Care.

## References

- [1] Carrujo, R. (2008) : Seguro de Dependência - Proposta de um modelo de avaliação financeiro-actuarial, Msc Thesis, Universidade Nova de Lisboa, Faculdade de Ciências e Tecnologia (In Portuguese).
- [2] Guerreiro, G.R. & Mexia, J.T. (2004) : *An alternative approach to bonus malus*, *Discussiones Mathematicae, Probability and Statistics*, **24(2)**, 197-213.
- [3] Guerreiro, G.R. & Mexia, J.T. (2008) : *Stochastic vortices in periodically reclassified populations*, *Discussiones Mathematicae, Probability and Statistics*, **28(2)**, 209-227.
- [4] Guerreiro, G.R. & Mexia, J.T. (2009) : *Stochastic vortices in periodically reclassified populations - an application to pension funds*, *Proceedings of the 5th Conference in Actuarial Science and Finance, Samos 2008*, 83-97.
- [5] Habermann, S. & Pitacco, E. (1999) : *Actuarial Models for Disability Insurance*. Chapman and Hall/CRC, Londres.
- [6] Resnick, S.I. (1994) *Adventures in Stochastic Processes*, Birkhäuser, Boston.

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