

# An Introduction to Markov Modelling for Economic Evaluation

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## Summary

Markov models are often employed to represent stochastic processes, that is, random processes that evolve over time. In a healthcare context, Markov models are particularly suited to modelling chronic disease. In this article, we describe the use of Markov models for economic evaluation of healthcare interventions. The intuitive way in which Markov models can handle both costs and outcomes make them a powerful tool for economic evaluation modelling. The time component of Markov models can offer advantages of standard decision tree models, particularly with respect to discounting. This paper gives a comprehensive description of Markov modelling for economic evaluation, including a discussion of the assumptions on which the type of model is based, most notably the memory-less quality of Markov models often termed the 'Markovian assumption'. A hypothetical example of a drug intervention to slow the progression of a chronic disease is employed to demonstrate the modelling technique and the possible methods of analysing Markov models are explored. Analysts should be aware of the limitations of Markov models, particularly the Markovian assumption, although the adept modeller will often find ways around this problem.

The use of decision-analytical modelling to estimate the cost effectiveness of healthcare interventions is becoming widespread.<sup>[1,2]</sup> Models have a range of uses including the synthesis of data from various sources and extrapolation from primary data sources. Hence, a sound knowledge of modelling can be an important and powerful tool for economic evaluation.

A particular type of model that is now used frequently in economic evaluation is the Markov model. Markov models have a long history of use in health service decision-making, including clinical and epidemiological applications.<sup>[3,4]</sup> Health economists are also beginning to use Markov models widely in economic-evaluation studies.<sup>[5-8]</sup> The fundamental difference between economic and

other applications of Markov modelling in medical decision-making is that economists are interested in both the resource and health outcome consequences of healthcare interventions. The way in which Markov models simply and intuitively handle both costs and outcomes simultaneously is one of their strengths.

The aim of this article is to provide an introduction to the use of Markov models for performing economic evaluation. An excellent and comprehensive introduction to Markov modelling has been provided by Sonnenberg and Beck,<sup>[9]</sup> which we strongly recommend to interested readers. We hope that our article will add additional insight to the use of Markov modelling in economic evaluation. The paper is divided into 3 main sections. The

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