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Title: Markov switching models: an application to roadway safety

**Abstract:**

In this research, two-state Markov switching models are proposed to study accident frequencies and severities. These models assume that there are two unobserved states of roadway safety, and that roadway entities (e.g., roadway segments) can switch between these states over time. The states are distinct, in the sense that in the different states accident frequencies or severities are generated by separate processes (e.g., Poisson, negative binomial, multinomial logit). Bayesian inference methods and Markov Chain Monte Carlo (MCMC) simulations are used for estimation of Markov switching models. To demonstrate the applicability of the approach, we conduct the following three studies. In the first study, two-state Markov switching count data models are considered as an alternative to zero-inflated models for annual accident frequencies, in order to account for preponderance of zeros typically observed in accident frequency data. In the second study, two-state Markov switching Poisson model and two-state Markov switching negative binomial model are estimated using weekly accident frequencies on selected Indiana interstate highway segments over a five-year time period. In the third study, two-state Markov switching multinomial logit models are estimated for severity outcomes of accidents occurring on Indiana roads over a four-year time period. One of the most important results found in each of the three studies, is that in each case the estimated Markov switching models are strongly favored by roadway safety data and result in a superior statistical fit, as compared to the corresponding standard (non-switching) models.