Change Points and a Regime-Switching, Scenario Generator with Continuous Parameter Distributions for Mean and Volatility

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Matthew C. Modisett, Ph.D., A.S.A., M.M.A[1]

Abstract: A change-point in a time-series model indicates when an underlying parameter changes.   Specifically, in a regime-switching model, a change-point indicates when the mean and/or volatility parameter(s) change(s). Given a historical set of returns, to solve for the best-fit set of change-points would appear to be a very large problem, but techniques exist for efficient calculation. Due perhaps to the creation of these techniques, change-point models are becoming important in numerous research fields and practical applications, including economics, finance, medicine and multimedia processing.

This research uses change-points to calibrate a regime-switching, scenario generator for the total return of the S&P 500. The generator has a continuous parameter distribution for mean and volatility which are set within a Markov process. Historical regimes are determined using change-points and over each regime one can calculate mean and volatility. These historic, regime-specific parameters are in turn analyzed to deduce the underlying distribution of mean and volatility, along with the Markov transition probabilities.

The issues surrounding how many change-points to use is addressed by appealing to necessary conditions for the Markov process. This alternative methodology, applicable in this situation, for determining the number of change points provides an alternative to the standard "log-likelihood minus penalty" methodology. After the number of change-points is determined, the final regime-switching scenario generator is judged using AIG and SBC.

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[1] Department of Statistics & Actuarial Science, University of Central Florida, Orlando, FL 32816. Phone: 407-823-2289, Fax: 407-823-3930. mmodiset@mail.ucf.edu.