Maximum Likelihood Estimation for Discretely Observed Multivariate Vasicek Processes

Michael Pokojovy[*,†,‡], Ebenezer Nkum[*] and Thomas M. Fullerton, Jr.[§]

[*]Data Science Program
[†]Computational Science Program
[‡]Department of Mathematical Sciences
[§]Department of Economics and Finance

The University of Texas at El Paso, El Paso, TX

Abstract

Because of low correlation with other asset classes, bonds play major roles in portfolio diversification efforts. A pure discount or a zero-coupon bond is a contract that does not involve intermediate interest payments but is traded at a deep discount, rendering yields at maturity when redeemed at full face value. As investment funds can create robust diversified portfolios with bonds, it is imperative that multiple bonds be analyzed simultaneously. The classical Vasicek model studies individual zero-coupon bonds and assumes the instantaneous interest rate follows a mean reverting process. In this talk, we consider an extension of the original Vasicek model to multiple zero-coupon bonds. The resulting coupled model is given by a stochastic differential equation driven by a p-dimensional white noise process. Given a set of observations over an equispaced time grid, our goal is to calibrate the system and forecast future short rate dynamics. Those forecasts can play important roles in risk management, portfolio optimization, and other applications.

Keywords: zero-coupon bonds; multivariate Vasicek model; multivariate Ornstein-Uhlenbeck process; model calibration; maximum likelihood estimation.