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AN OPTIMIZATION MODEL FOR EXTRACTING FORWARD INTEREST RATES FROM A DYNAMICAL SYSTEMS UNDER FINANCIAL UNCERTAINTY

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Abstract. In this paper the underlying law of motion of a financial instrument is a linear differential equation under uncertainty with perturbations for the financial instrument generating the time series. Instead of stochastic characteristics of uncertainty being known, only sets of possible values of perturbations are known, where a finite set of observed data points is taken as inputs into the system. Analogous to the classical Vasicek stochastic differential equation the dependent variable represents an integrand (the "forward rate") in a continuous time discounting mechanism involving its integral in exponentiation. From this structure we develop a two–sided geometric programming approximation formulation for the problem of extracting the spot interest rate curve from Government Bills and coupon–paying Notes & Bonds data. We present comparative numerical results for the 26 April 1996 market prices of French Treasury Bonds, where results from 5 well-known extraction methods are presented in the 2003 book of L. Martellini, P. Priaulet, and S. Priaulet.

Keywords. fixed–income markets, spot interest rates, interest rate yield curve, forward rate Cauchy formula, geometric programming

1 Introduction

The main contribution of this paper is the further analysis and application of a geometric programming optimization model for solving an important problem in the field of finance that is referred to as the *coupon bond stripping problem*. The problem is also referred to as extracting an interest rate yield curve from coupon–paying financial instruments. We show that there is no difficulty in solving problems accurately in fixed income market where there are a lot of zero coupon bonds stemming from the stripping of a relatively small number of bonds. Real markets occur in applications, see [11, pp. 311-312] and [12] where there are many more coupon payment dates that security prices. In both these papers the response has been to employ piecewise constant forward rate curves with a small number of segments, 8 segments in