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REVIEWER'S REPORT

Manuscript No.: IJAR-51754 Date: 22-05-2025

Title: Least Squares Estimators of Drift Parameter for Discretely Observed Fractional Vasicek-type Model

Recommendation:
Accept as it is.................YES............
Accept after minor revision.................
Accept after major revision ....
Do not accept (*Reasons below*) ....

Rating	Excel.	Good	Fair	Poor
Originality			√	
Techn. Quality		√		
Clarity			√	
Significance		√		

Reviewer's Name: Mir Tanveer

Reviewer's Decision about Paper: **Recommended for Publication.**

Comments (*Use additional pages, if required*)

Reviewer's Comment / Report

Abstract Review:
The abstract clearly outlines the focus of the study on estimating the drift parameters θ\theta and μ\mu in a fractional Vasicek-type model driven by fractional Brownian motion (fBm) with Hurst index H∈(0,1)H \in (0,1). The problem is framed within the context of discrete-time observations, which is practically relevant given real-world data constraints. The paper analyzes discrete versions of least squares-type estimators for θ\theta and μ\mu and investigates their asymptotic properties. The results, including tightness of the scaled estimator for θ\theta and lack of tightness for μ\mu, along with strong consistency for θ\theta, are succinctly presented. The abstract successfully conveys the mathematical and statistical contributions of the paper, targeting readers interested in stochastic processes, parameter estimation, and fractional models.

Keywords:
The keywords are appropriate and reflect the core components of the research: Fractional Brownian motion, Vasicek-type model, Young integral, Parameter estimation, Discrete observations, Tightness.

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AMS Classification Numbers:
The provided AMS codes (60G15; 60G22; 62F12; 62M09; 62M86) correctly classify the paper in areas of Gaussian processes, statistical inference, and time series.

Introduction Review:
The introduction offers a solid theoretical foundation starting with the definition and properties of fractional Brownian motion (fBm), emphasizing its covariance structure and the special case where H=1/2H=1/2 corresponds to standard Brownian motion. It proceeds to define the fractional Vasicek-type model as the unique pathwise solution to the given stochastic differential equation with unknown parameters θ\theta and μ\mu. The rationale for using least squares estimators (LSEs) is grounded in minimizing a quadratic loss based on the model's differential form.

The formulas for the continuous-time LSEs of θ\theta and μ\mu are clearly stated, providing explicit analytical expressions (Equations 1.2 and 1.3). This lays the groundwork for the subsequent study of discrete-time estimators. The introduction also contextualizes the model's significance, noting its applications in finance, where μ\mu is interpreted as a long-run equilibrium and θ\theta as the mean reversion rate. This connection helps justify the practical relevance of the theoretical results.

Overall Impression:
The paper addresses an important problem in stochastic modeling and statistical inference for fractional Vasicek-type processes under discrete sampling schemes. The abstract and introduction are well-written, mathematically rigorous, and clearly present the research goals and key findings. The use of fractional Brownian motion introduces complexity that is well acknowledged and handled, making the paper relevant for researchers in stochastic processes, fractional calculus, and financial mathematics. The technical detail and theoretical results are presented with clarity, offering valuable contributions to parameter estimation literature in fractional stochastic models.