Project Summary

MIBOR Interest Rate Modeling

Project Title

MIBOR Interest Rate Modeling (Vasicek vs. Hull-White)

# 1. Executive Summary

This capstone project aimed to model and forecast Indian MIBOR (Mumbai Interbank Offered Rate) interest rates using two fundamental stochastic short-rate models: the Vasicek and Hull-White models. Utilizing two years of historical MIBOR data directly sourced from Financial Benchmarks India Private Ltd. (FBIL), the project calibrated these models to project interest rates for 3.5, 4.5, and 5.5-year tenors. A key focus was to critically compare the models' performance and suitability given the specific data constraints.

# 2. Project Objectives

The primary objectives of this project were to:

* Acquire and preprocess historical Indian MIBOR rate data for the past two years.
* Calibrate the Vasicek and Hull-White models using this historical data.
* Project future interest rates for 3.5, 4.5, and 5.5-year periods using the calibrated models.
* Visualize the projected interest rates for comparative analysis.
* Evaluate and recommend which model is more suitable for this specific application, explaining the rationale.

# 3. Methodology Highlights

The project followed a structured approach:

* **Data Collection:** Daily Overnight MIBOR rates were obtained directly from FBIL, ensuring high data integrity.
* **Model Calibration:**
  + **Vasicek Model:** Parameters (speed of mean reversion, long-term mean, volatility) were estimated using Maximum Likelihood Estimation (MLE).
  + **Hull-White Model:** Its constant parameters (speed of mean reversion, volatility) were calibrated similarly to Vasicek. The time-dependent drift term, crucial for fitting the yield curve, was approximated as a constant due to the absence of a comprehensive initial yield curve dataset.
* **Rate Projection:** Zero-Coupon Bond (ZCB) pricing formulas, derived from each model, were employed to calculate continuously compounded interest rates for the specified future tenors, using the most recent MIBOR rate as the starting point.
* **Visualization:** Plots were generated to visually compare the interest rate projections from both models.

# 4. Key Findings and Observations

* **Calibration Success:** Both models successfully calibrated using the historical MIBOR data, providing interpretable parameters.
* **Parameter Insights:** The calibrated parameters (e.g., mean reversion speed, long-term mean, volatility) offered insights into the historical behavior and expected future dynamics of the MIBOR rate.
* **Projection Similarity (Due to Data):** A significant observation was that the projected interest rates from the simplified Hull-White model were remarkably similar to those from the Vasicek model. This is directly attributable to the limitation of calibrating Hull-White solely on historical short-rate data without a full initial yield curve, which is essential for its distinct advantage.
* **Model Limitations:** Both models, being single-factor, inherently simplify complex market dynamics. Vasicek also carries the theoretical possibility of generating negative interest rates.

# 5. Conclusion and Recommendation

For this specific capstone project, where model calibration was performed **solely on historical Indian MIBOR short-rate data without a comprehensive initial yield curve**, the **Vasicek Model emerged as the more suitable choice.**

**Rationale:**

* **Directness and Robustness:** Vasicek's calibration directly aligns with the available historical short-rate data, making it straightforward and robust for this context.
* **Transparency:** Its parameters offer clear, direct interpretations of the underlying interest rate dynamics.
* **Practicality:** Without the yield curve data, the Hull-White model's key theoretical advantage (its ability to perfectly fit the initial term structure) could not be leveraged. Consequently, its simplified implementation behaved very similarly to Vasicek, negating its added complexity without the corresponding data.

While the Hull-White model is theoretically more powerful and is the preferred choice for advanced applications like interest rate derivatives pricing (where fitting the current yield curve is paramount), its full potential was not realized under the constraints of this project's data.

# 6. Future Scope

Future enhancements could include:

* Acquiring and integrating a full Indian government bond yield curve for a complete Hull-White model calibration.
* Implementing Monte Carlo simulations to generate interest rate paths and confidence intervals.
* Exploring multi-factor interest rate models to capture more complex market dynamics.
* Developing a backtesting framework to assess predictive accuracy.