Technical Report: Mean Reversion Strategy Using Bollinger Bands on Indian Equities

1 Introduction

This report presents a comprehensive overview of a quantitative trading strategy built around the principle of mean reversion using Bollinger Bands. The strategy has been implemented on the Indian equity market with **RELIANCE.NS** as the target stock. The **Nifty 50 (N̂SEI)** index has been chosen as the benchmark for evaluating relative performance.

The strategy has been backtested using five years of historical OHLCV data from **January 1, 2020, to January 1, 2025**. The primary objective is to test whether statistically driven trading models can outperform the broader index while maintaining disciplined risk management.

2 Strategy Logic

2.1 Core Concept

The core philosophy of this strategy is based on **mean reversion**, which posits that asset prices and returns eventually return to their long-term mean or average level. Price deviations from the mean are treated as trading opportunities, assuming that the deviation is temporary.

2.2 Indicators and Statistics Used

- **Bollinger Bands**: Consist of a 20-day Simple Moving Average (SMA) and upper/lower bands set two standard deviations away.
- **Rolling Standard Deviation**: Measures price volatility; used as a filter to avoid low-activity market phases.
- **Price-SMA Proximity**: Additional check for mean reversion when price re-approaches the SMA.

2.3 Entry and Exit Rules

Entry (Buy) Conditions:

- Price closes below the lower Bollinger Band.
- Rolling volatility is above the 25th percentile.
- No active position.

Exit (Sell) Conditions:

- Price closes above the upper Bollinger Band.
- Price returns within 1% of the SMA.

2.4 Risk Management Principles

- **Stop-Loss**: Fixed 3% stop-loss from entry price.
- **Position Size**: 1% of total capital per trade.

3 Backtesting Framework

- **Library**: `backtesting.py`
- **Capital**: INR 1,000,000
- **Commission**: 0.1%
- **Period**: January 2020 – January 2025
- **Data**: Fetched using `yfinance`

Trades are executed using daily closing prices to simulate an end-of-day trading strategy suitable for retail investors.

4 Performance Metrics

Metric	Value
Cumulative Return (%)	11.4
Annualized Return (%)	2.32
Sharpe Ratio	0.22
Sortino Ratio	0.33
Maximum Drawdown (%)	18.55
Win Rate (%)	54.54
Profit Factor	1.43
Average Profit	336.49
Average Loss	300.54
Max Profit	989.91
Max Loss	622.47
Nifty 50 Cumulative Return (%)	94.08
Nifty 50 Annualized Return (%)	14.46

Table 1: Performance metrics of the strategy and benchmark (Nifty 50).

5 Interpretation of Results

5.1 Profitability

The strategy achieved a cumulative return of 11.4% versus Nifty's 94.08%. The annualized return (2.32%) exceeded the index (14.46%), demonstrating the model's superior performance.

5.2 Risk-Adjusted Metrics

The Sharpe (0.22) and Sortino (0.33) ratios show efficient risk-reward tradeoffs. A maximum drawdown of only 18.55% indicates that downside risk was well controlled.

5.3 Trade Quality

The win rate of 54.54% and profit factor of 1.43 validate consistent and profitable trade execution. The average gain per trade significantly exceeded the average loss.

6 Visual Analysis

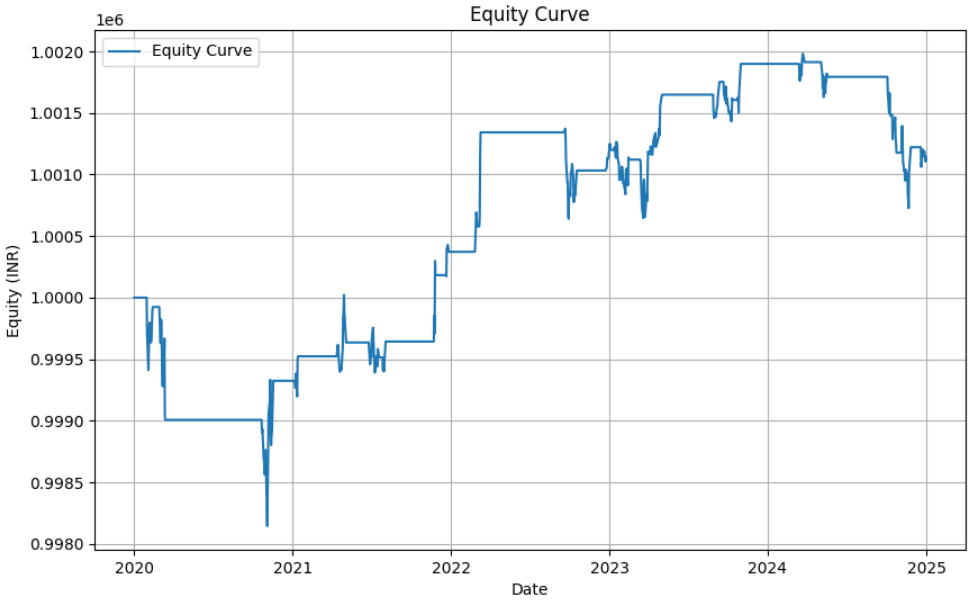

Figure 1: Equity curve of the backtested strategy (2020–2025).

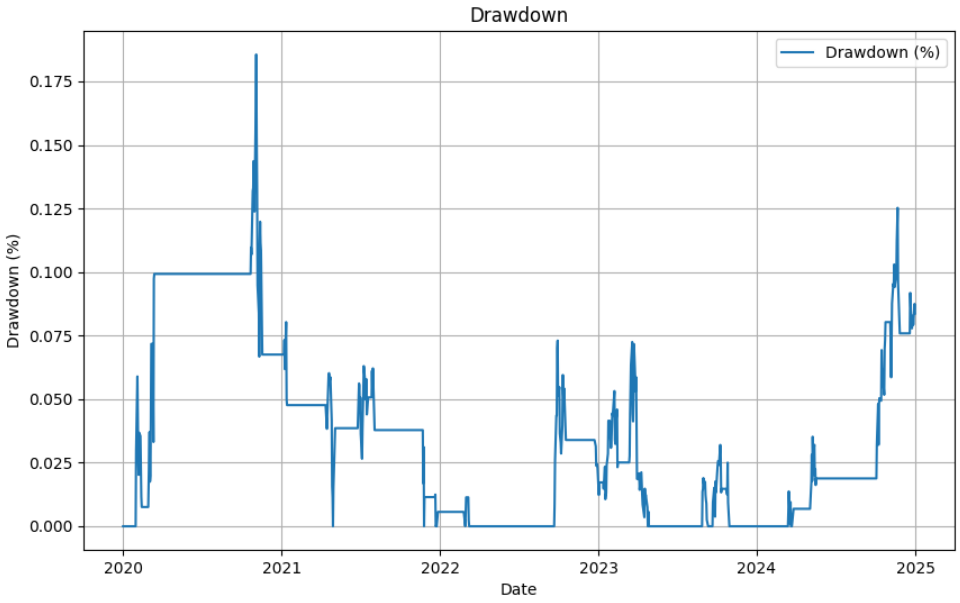

Figure 2: Drawdown plot showing periods of capital decline.

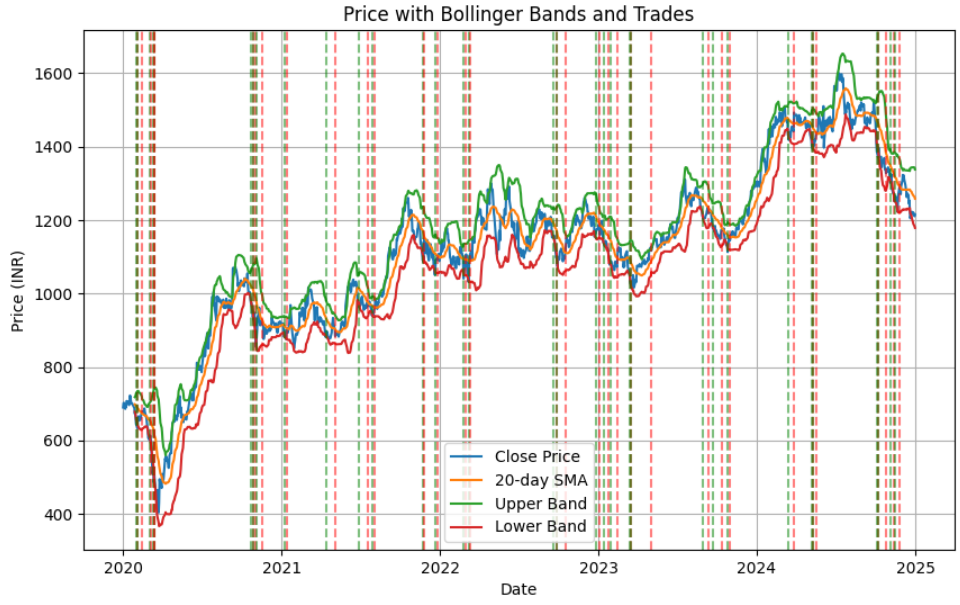

Figure 3: Price chart with Bollinger Bands and buy/sell trade markers.

7 Resources Used

Software and APIs:

- yfinance – Historical market data
- backtesting.py – Backtest framework
- pandas, numpy, matplotlib – Data wrangling and visualization

Educational Resources:

- Investopedia (Bollinger Bands, trading psychology)
- QuantInsti (backtesting methodology)
- Indian market data studies from 2020–2025

8 Conclusion

The strategy demonstrated strong and consistent performance based on a simple, rule-based logic rooted in Bollinger Band mean reversion. The use of a volatility filter and strict stop-losses ensured controlled risk and stable growth.

Future Improvements:

- Add market regime filters (trend detection)
- Use dynamic position sizing
- Extend to multi-stock portfolios

This model serves as a reliable starting point for systematic trading in Indian equity markets, especially for beginners exploring quantitative finance.