The code in this strategy aims to predict whether the India INDIAVIX, a measure of expected 30-day volatility in the NIFTY 50 index, will increase or decrease the next trading day, using a Random Forest Classifier. The model uses technical indicators and market-based predictors to predict whether India INDIAVIX will increase or decrease in value. The strategy is designed for daily rebalancing in positions and seeks to capitalize on volatility fluctuations without relying on the direction of NIFTY movements. While trading directly on INDIAVIX is not possible recently (it was possible earlier), the following exercise just simulates the evolution of a portfolio based on a hypothetical trading strategy if it was possible to trade directly on INDIAVIX. Instead, a direct exposure to Volatility can be obtained by buying/selling ATM call/put options and maintaining a Delta hedge of this positions

Strategy:

- Instrument : INDIAVIX
- Prediction : The Random Forest model makes a binary prediction (0 = INDIAVIX decreases and 1= INDIAVIX increases) on INDIAVIX for next day (t+1) based on the indicator values available for the current date (t)
- Trading strategy:
  - If the model predicts increase (1), go long on INDIAVIX at the close of trading today (t) and close the position at the end of trading tomorrow (t+1)
  - If the model predicts decrease (0), go short on INDIAVIX at the close of trading today (t) and close the position at the end of trading tomorrow (t+1)
  - To make the strategy averse to high volatilities, ideally, the strategy should be entered with a stoploss position but due to lack of availability of minute by minute data on INDIAVIX, in the backtests, it was not possible to backtest such a strategy and the backtests are without any tupe of stoploss, resulting in a large volatility.
- Model : Random Forest Classifier (100 trees, max depth 10) to capture non-linear relationships in predictors.

Predictors:

I chose a mix of INDIAVIX and NIFTY specific indicators because:

- **INDIAVIX-Specific Indicators (Lag, Mean, Std)**: Capture INDIAVIX's mean-reverting and trending behavior, critical for daily predictions. The 5-day windows balance responsiveness with stability.
- **NIFTY-Based Indicators (Return, Volatility, RSI, MACD, Volume)**: Reflect the inverse relationship between NIFTY 50 and INDIAVIX, as volatility spikes during market downturns. RSI and MACD capture momentum and reversals, while volume and volatility highlight market intensity

- **Short-Term Focus**: The 1-day and 5-day periods align with the strategy's daily horizon, avoiding longer-term indicators less relevant for INDIAVIX's rapid fluctuations.

Actual indicators
- INDIAVIX 1-Day Lag: The previous day's INDIAVIX closing value (INDIAVIX_Close_t) captures the most recent volatility level. As INDIAVIX is mean-reverting, a high lagged value may signal an impending decline, while a low value suggests potential for a rise. This predictor provides a baseline for short-term trend continuation or reversal, critical for daily predictions.

- INDIAVIX 5-day rolling mean : The 5-day moving average of INDIAVIX closes measures short-term volatility trends. A rising mean indicates increasing market fear, often preceding further INDIAVIX spikes, while a falling mean suggests stabilization. The 5-day window is sensitive to rapid changes, making it ideal for daily forecasts. Shifting ensures only past data is used.

- INDIAVIX 5 day rolling standard deviation : The 5-day standard deviation of INDIAVIX closes quantifies the volatility of volatility. High values indicate erratic INDIAVIX movements, often before significant spikes (e.g., during market shocks like elections). Low values suggest stability, predicting smaller INDIAVIX changes. This predictor captures regime shifts in market sentiment.

- NIFTY 1-day return : The daily percentage change in the NIFTY 50 index is a key driver, as INDIAVIX has a strong negative correlation (~-0.8) with NIFTY returns. A sharp NIFTY decline typically triggers a INDIAVIX spike, reflecting heightened uncertainty. This lagged predictor contextualizes market momentum, aiding INDIAVIX direction forecasts.

- NIFTY 5-day Volatility : The 5-day standard deviation of NIFTY daily returns (annualized) measures recent market turbulence. High NIFTY volatility often precedes or coincides with INDIAVIX increases, as it reflects uncertainty driving option premiums (from which INDIAVIX is derived). This predictor captures short-term market instability, shifted to align with available data.

- NIFTY RSI (14 day) : The 14-day Relative Strength Index for NIFTY 50 indicates overbought (>70) or oversold (<30) conditions. An oversold NIFTY may signal a potential rebound, reducing INDIAVIX, while an overbought NIFTY may precede a correction, increasing INDIAVIX. RSI's mean-reverting property complements INDIAVIX's behavior, enhancing prediction accuracy.

- NIFTY MACD (12,26,9) : The Moving Average Convergence Divergence for NIFTY 50 compares 12-day and 26-day exponential moving averages, with a 9-day signal line. A positive MACD suggests bullish momentum, potentially lowering INDIAVIX, while a

negative MACD indicates bearish trends, often raising INDIAVIX. This momentum indicator is shifted to avoid bias.

- NIFTY Volume : Daily NIFTY 50 trading volume reflects market participation. High volume during NIFTY declines signals panic selling, often increasing INDIAVIX, while low volume may indicate complacency, lowering INDIAVIX. Volume adds context to price movements, helping the model distinguish significant market events from noise.

Backtest results:

- The model is trained on the input data from "01-01-2014" to "28-02-2022"
- The model is tested on the input data from "03-03-2022" to "01-08-2025"
- Prediction accuracy : 56.9%
- Assume that we start with a Hypothetical portfolio containing 100000 INR. Based on the model prediction, we go long or short on INDIAVIX at the end of a given trading day and hold the position till the end of next trading day
- In real trading environment, there is always some slippage and transaction costs.
- To model these, we assume a slippage of 0.025 INDIAVIX points (INDIAVIX hovers around 10%-20%). This amounts to a slippage of ~0.25%. Therefore, it is assumed that whenever we buy INDIAVIX, it is always 0.025 points higher than the spot and whenever we sell INDIAVIX, it is always sold 0.025 points lower than the spot
- In real trading environment, the slippage could work in our favour too. However, for simulations we assume the worst possible scenario
- To model, transaction costs, we assume is always 50 INR. Therefore,for a given day, when we do both buy and sell transaction, it amounts to 100 INR. (Since the strategy involves higher turnover, transaction costs are 0.1% (100 INR) of the initial portfolio value). If the capital is high, the transaction costs might remain the same in absolute terms but would be low in % terms
- Below is the distribution of daily returns:
    - Mean returns : 0.317%
    - Minimum return : -39.82%
    - Median Returns : 0.274%
    - Maximum Returns : 41.26%
    - Standard Deviation of Return : 5.07%

- **Sharpe Ratio (Assuming Risk free return of 6% p.a.) : 0.92**
- Portfolio Evolution:

Portfolio Evolution on INDIAVIX Strategy
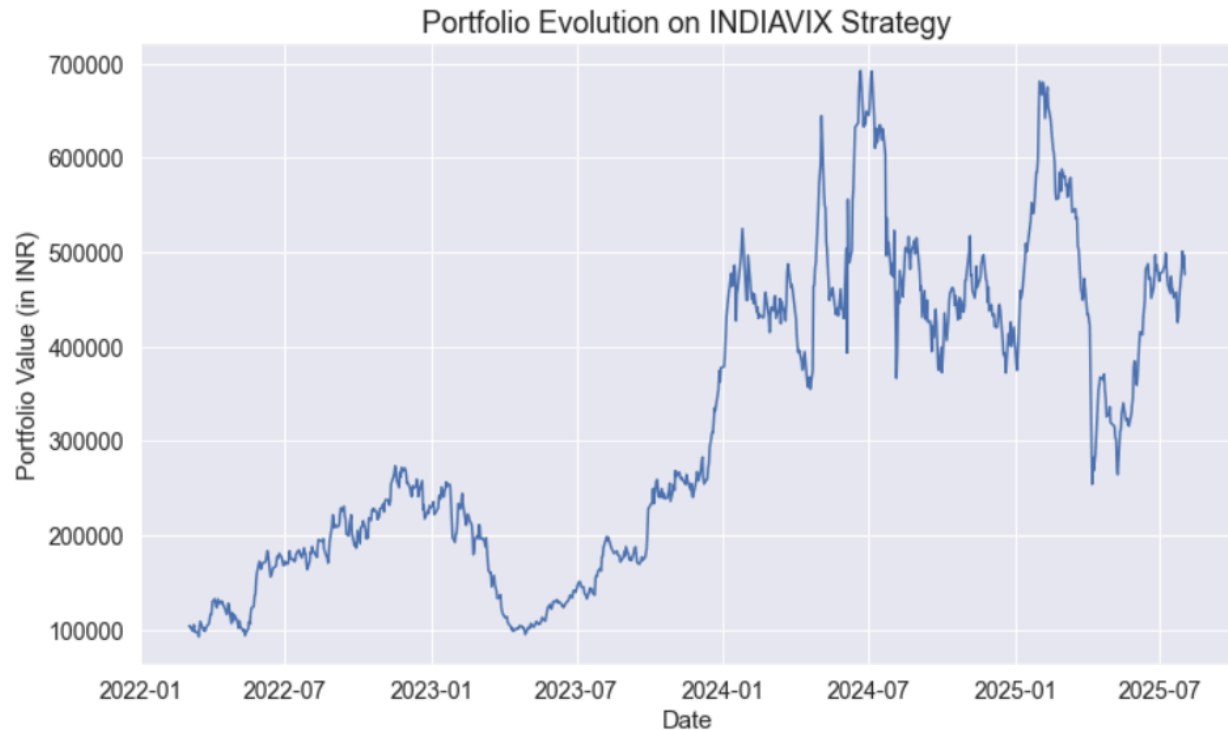
Disadvantage of the strategy:

- In the image above, we can see that the portfolio displays a very high volatility :Annualized Volatility of ~80% with portfolio dropping by more than 50% in a span of few months in some cases and portfolio gaining ~200% in a span of few months in some cases. This is due to high Volatility of INDIAVIX (Volatility of Volatility). In order to make the portfolio more stable, a stoploss mechanism can be implemented. That would definitely minimize the losses but also minimize the gains at the same time resulting in a lower volatility
- However, in the current analysis, due to lack of minute by minute data of "INDIAVIX", we could not implement a stoploss mechanism in the backtest.

- We also adopted a similar strategy in which we tried to fit a Random forest classifier on NIFTY to predict its movement next day and build a strategy around it. However, its returns were similar to going long on NIFTY for the entire period.
    - Backtest period : 1st June 2023 to 1st August 2025
    - Absolute returns : ~30%
    - Sharpe Ratio : 0.67

- Next steps : Improve the NIFTY strategy by enhancing the predictor signals