TA-Lib - Technical Indicator-Based Strategy Development

Objective: To develop a Python script that utilizes TA-Lib for calculating various technical indicators, integrating them into a trading strategy, and performing a thorough backtest. The task involves understanding how to use TA-Lib to derive trading signals, applying those signals in a portfolio context, and evaluating the performance of the strategy.

Task Description:

1. **Data Acquisition:**
    - Use yfinance or any preferred data provider to download historical price data for at least 5 assets (stocks, ETFs, or cryptocurrencies) over a 5-year period.
    - Ensure that the data includes at least daily open, high, low, close prices, and volume.
2. **TA-Lib Installation and Setup:**
    - Install and configure TA-Lib in your Python environment.
    - Provide a brief overview of TA-Lib and its capabilities.
3. **Technical Indicators Calculation:**
    - Calculate the following technical indicators using TA-Lib:
        - Moving Averages (SMA, EMA): Compute 50-day and 200-day SMAs and EMAs.
        - Relative Strength Index (RSI): Calculate the 14-day RSI.
        - Bollinger Bands: Compute the 20-day Bollinger Bands.
        - MACD (Moving Average Convergence Divergence): Calculate the MACD line and signal line.
        - ATR (Average True Range): Compute the 14-day ATR to assess market volatility.
    - Ensure that the indicators are calculated correctly and align with the price data.
4. **Strategy Development:**
    - Develop a simple crossover strategy using SMA (e.g., 50-day SMA crossing above 200-day SMA as a buy signal, and vice versa as a sell signal).
    - Integrate RSI for overbought/oversold conditions (e.g., buy only if RSI < 30 and sell if RSI > 70).
    - Use Bollinger Bands for mean reversion strategies (e.g., buy when the price crosses below the lower band and sell when it crosses above the upper band).
5. **Backtesting:**
    - Create a backtesting engine to simulate trading based on the developed strategy.
    - Calculate the strategy's performance metrics:

        - Total Return and Cumulative Return
        - Annualized Return and Volatility
        - Sharpe Ratio
        - Max Drawdown and Drawdown Duration
    - Compare the strategy's performance against a simple buy-and-hold strategy.
6. **Advanced Strategy Enhancement:**
    - Implement a combination strategy using multiple indicators (e.g., MACD crossover combined with RSI and Bollinger Bands).
    - Explore different parameter settings (e.g., different periods for SMA, EMA, RSI, and Bollinger Bands) and assess their impact on strategy performance.
    - Conduct a sensitivity analysis to determine which parameters are most critical to the strategy's success.
7. **Data Visualization:**
    - Plot the following:
        - The price data with overlaid technical indicators (SMA, EMA, Bollinger Bands).
        - Entry and exit points on the price chart based on your strategy.
        - Cumulative return of the strategy vs. buy-and-hold.
        - A risk-return profile of the strategy.
        - A histogram of daily returns to analyze the distribution of returns.
8. **Optimization Challenge (Optional but Recommended):**
    - Implement a parameter optimization routine to find the best combination of indicator periods for maximizing Sharpe Ratio or minimizing drawdown.
    - Compare the performance of the optimized strategy with the original settings.

Deliverables:

- A well-documented Python script or Jupyter Notebook that includes all steps of the task.
- Visualizations that effectively communicate the strategy's signals, performance, and risk.
- A report or markdown cells within the notebook explaining the strategy, key findings, and any optimizations performed.

This task sheet focuses on applying technical indicators to develop and backtest trading strategies using TA-Lib, providing a comprehensive understanding of how technical analysis can be leveraged in algorithmic trading.