Moving Average Crossover Strategy Backtester for BTC-USD

1. Overview

This project deploys a Moving Average Crossover trading strategy on Bitcoin (BTC-USD), backtests against a buy-and-hold benchmark, and displays results with performance measures and charts.
The strategy seeks to minimize negative risk and capture positive price momentum by alternating between "in-market" and "out-of-market" positions using two basic moving averages (SMAs).

2. Objectives

Download and ready historical BTC-USD daily price data.

Implement a moving average crossover rule to produce buy/sell signals.

Backtest the strategy for several years and contrast it with buy-and-hold.

Compute performance metrics such as CAGR, volatility, Sharpe ratio, and maximum drawdown.

Visualize and persist results for later analysis.

3. Methodology

3.1 Data Collection

Data are downloaded from Yahoo Finance through the yfinance Python library.

The dataset ranges from 2020-01-01 to 2025-01-01 on a daily frequency.

3.2 Strategy Rules

Compute short-term SMA (50 days) and long-term SMA (200 days).

Buy signal: When short SMA crosses over long SMA.

Sell signal: When short SMA goes below long SMA.

One position at any given time (either 100% in or out of market).

3.3 Backtesting Approach

Position is arrived at by the SMA crossover rule (offset by one day to prevent lookahead bias).

Daily returns for strategy and buy-and-hold are calculated.

Returns are cumulated to produce the equity curve.

3.4 Performance Measures

For strategy and buy-and-hold:

- CAGR (Compound Annual Growth Rate)
- Annualized Volatility
- Sharpe Ratio (risk-adjusted return)
- Maximum Drawdown

4. Results

Equity Curve: Indicates that the SMA strategy missed large drawdowns during declining markets, but occasionally failed to catch sharp rallies.

Performance Measures:

- CAGR: Indicates whether the strategy performed better than buy-and-hold.
- Volatility: Strategy generally lower than buy-and-hold, indicating lower risk exposure.
- Sharpe Ratio: Reflects enhanced risk-adjusted returns in trending regimes.
- Max Drawdown: Typically much lower than buy-and-hold.

5. Visualizations

The software creates and saves:

Price & Moving Averages plot highlighting SMA crossover points.

Equity Curve comparing strategy vs buy-and-hold.

Drawdown Chart for the equity curve of the strategy.

All visualizations are saved to the results/ directory along with a CSV file containing performance statistics.

6. Conclusion

This project shows the application of a basic technical indicator strategy and compares its performance with a passive holding strategy.
The SMA crossover strategy minimizes drawdowns and volatility but relies significantly on market trends and can underperform in good bull markets with no pullbacks.

7. Improvements

- Make SMA periods optimal through walk-forward testing to prevent overfitting.
- Include transaction cost simulation to account for realistic returns.
- Investigate other trend-following indicators (e.g., EMA, MACD).
- Add risk management regulations (stop-loss, position sizing).