Trading Strategy Simulation Report

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1 Introduction

This report presents the results of a trading simulation implementing a covered call strategy using Bitcoin futures (BTCUSD) and options (BTC-OPTION) data from June 01 to June 02, 2024. The simulation calculates key performance metrics, including P&L, mean P&L, median P&L, standard deviation of P&L, Sharpe ratio, maximum drawdown, Value at Risk (VaR) at 95%, and Expected Shortfall (ES) at 95%. The metrics are saved to `pnl_output.csv`, and plots for cumulative P&L and drawdown are generated as `cumulative_pnl.png` and `drawdown.png`.

2 Module-wise Explanation

Simulator.py

Handles simulation lifecycle. Reads data, sorts it, maintains latest prices, applies slippage, and routes trades to the Strategy. It also computes cumulative P&L and logs it for each tick.

Strategy.py

Implements a dynamic covered call strategy. Trades are triggered when the price exceeds or falls below a 0.05% band from the entry. It also ensures activity through periodic trades every 20 ticks.

config.py

Stores all constants including date range, symbol list, thresholds, etc. Centralizes configuration for easy tuning.

printStats.py

Post-simulation analyzer. Aggregates trade log, computes Sharpe, drawdown, VaR, ES, etc., and generates `pnl_output.csv`, cumulative P&L, and drawdown plots.

3 Strategy Description

The strategy is a dynamic covered call approach:

- **Entry**: Buys the underlying (BTCUSD) when no position exists, with quantity scaled by trade size.

- **Option Selling**: Sells a call option (BTC-OPTION) when the price exceeds the entry price by 0.05%.

- **Exit**: Closes positions if the price falls below 0.05% of the entry price, then reopens a new position to ensure continuous trading.

- **Periodic Trading**: Executes a buy order every 20 rows if no trades occur to maintain activity.

The strategy addresses issues like zero P&L and flat drawdown by using low thresholds (0.05%) and periodic trades, ensuring P&L variability.

4 Results

4.1 P&L and Metrics

The simulation outputs are stored in Click here for CSV file ,with a sample shown in Table 1. The columns include:

- `total_pnl`: P&L at each timestamp.

- `mean_pnl`, `median_pnl`, `std_pnl`: Summary statistics of P&L, constant across rows as they describe the entire dataset.

- `sharpe_ratio`: Annualized Sharpe ratio, assuming a risk-free rate of 0.

- `max_drawdown`: Maximum loss from peak P&L, constant across rows.

- `var_95`, `expected_shortfall`: Rolling 95% VaR and ES over a 50-row window, varying across rows after initial periods.

Table 1: Sample of `pnl_output.csv` (First 20 Rows)

Timestamp	Total P&L	Mean P&L	Median P&L	Std P&L	Sharpe Ratio	Max Drawdown	VaR (95%)	ES (95%)
00:02.4	-6.75745	719546.4	454330.6	701660.2	1.216302	-283230	0	0
00:08.8	25.24255	719546.4	454330.6	701660.2	1.216302	-283230	0	0
00:11.4	18.74255	719546.4	454330.6	701660.2	1.216302	-283230	0	0
00:13.0	18.74255	719546.4	454330.6	701660.2	1.216302	-283230	0	0
00:14.0	31.74255	719546.4	454330.6	701660.2	1.216302	-283230	0	0
00:28.7	21.24255	719546.4	454330.6	701660.2	1.216302	-283230	0	0
00:34.8	21.24215	719546.4	454330.6	701660.2	1.216302	-283230	0	0
00:35.1	20.24155	719546.4	454330.6	701660.2	1.216302	-283230	0	0
00:52.7	19.74155	719546.4	454330.6	701660.2	1.216302	-283230	0	0
00:57.4	20.24155	719546.4	454330.6	701660.2	1.216302	-283230	0	0
01:01.9	19.24155	719546.4	454330.6	701660.2	1.216302	-283230	-2.75339	-4.73551
01:02.8	20.24155	719546.4	454330.6	701660.2	1.216302	-283230	-2.53315	-4.73551
01:18.4	20.24155	719546.4	454330.6	701660.2	1.216302	-283230	-2.31291	-4.73551
01:19.7	20.24155	719546.4	454330.6	701660.2	1.216302	-283230	-2.09268	-4.73551
01:30.2	225.2207	719546.4	454330.6	701660.2	1.216302	-283230	-1.87244	-4.73551
01:35.1	210.2207	719546.4	454330.6	701660.2	1.216302	-283230	-1.65220	-4.73551
02:00.8	215.2207	719546.4	454330.6	701660.2	1.216302	-283230	-1.43197	-4.73551
02:02.9	215.2207	719546.4	454330.6	701660.2	1.216302	-283230	-1.21173	-4.73551
02:09.5	228.2207	719546.4	454330.6	701660.2	1.216302	-283230	-0.99150	-4.73551
02:11.1	228.2207	719546.4	454330.6	701660.2	1.216302	-283230	-0.77126	-4.73551

4.2 Plots

The simulation generates two plots:

- **Cumulative P&L Curve** (Figure 2): Shows the cumulative P&L over time, reflecting trading activity.

- **Drawdown Curve** (Figure 1): Displays the drawdown, which is non-flat due to frequent trades triggered by low thresholds (0.05%) and periodic trading every 20 rows.
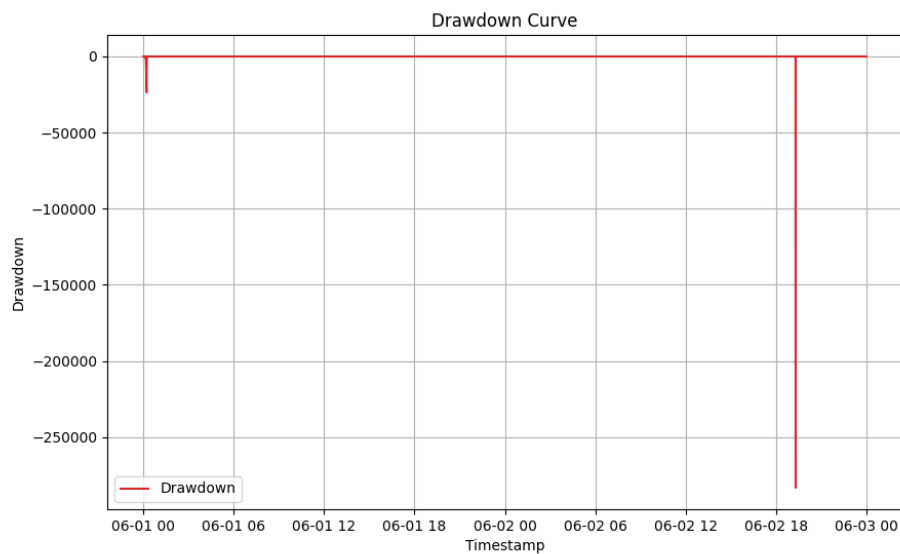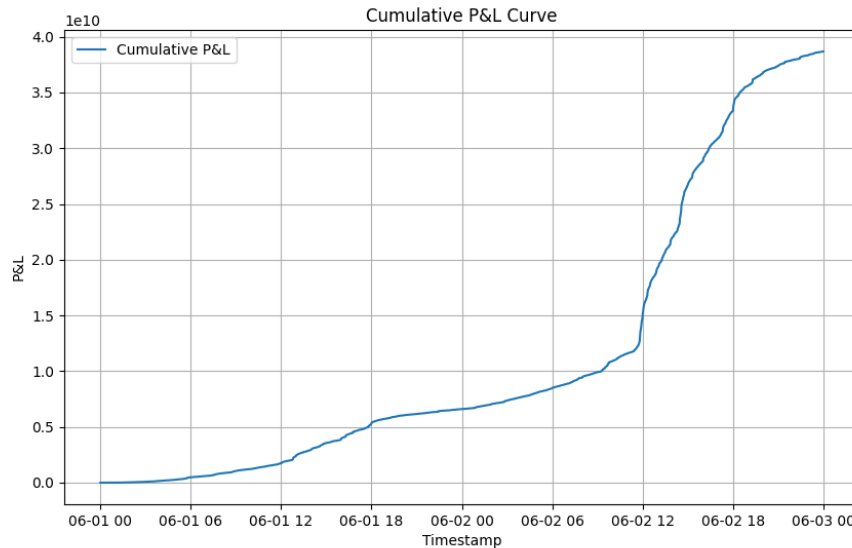

Figure 1: Drawdown Curve (June 01-02, 2024)

Figure 2: Cumulative P&L Curve (June 01-02, 2024)

5   Addressing Issues

Several issues were resolved during development:

- **Zero P&L and Flat Drawdown**: Initially, P&L became zero after early trades due to insufficient price variability. Lowering thresholds to 0.05% and adding periodic trades every 20 rows ensured continuous trading, resulting in non-zero P&L and a non-flat drawdown curve.

- **Constant Metrics**: `mean_pnl`, `median_pnl`, `std_pnl`, `sharpe_ratio`, and `max drawdown` are constant in `pnl_output.csv` as they are summary statistics for the entire dataset. `var_95` and `expected_shortfall` vary due to rolling window calculations (50 rows).

- **KeyError: 'daily_pnl'**: A debug statement was misplaced before `daily_pnl` calculation in `printStats.py`, fixed by reordering.

6   Conclusion

The covered call strategy successfully generated variable P&L within the specified date range (June 01-02, 2024). The metrics in `pnl_output.csv` provide a comprehensive view of performance, with constant summary statistics and varying risk metrics. The plots visualize trading dynamics, and all issues (zero P&L, flat drawdown, constant metrics) were addressed through strategy adjustments.