TRADING STRATEGY ROBUSTNESS ANALYSIS REPORT

PREPARED BY

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CONTENTS

Background

This analysis focused on testing the robustness of five trading strategies. In this study, we aim to objectively evaluate the performance of these strategies across various market conditions. As the financial landscape shifts, understanding the reliability and effectiveness of different trading approaches is crucial for traders seeking to navigate markets successfully. The strategies below have been considered for robustness tests.

1. Bollinger Bands
2. Relative Strength Index (RSI)
3. Moving Average Convergence Divergence (MACD)
4. Simple Moving Average Crossover Strategy
5. Stochastic Oscillator

Performance

Trading Strategies

In this version of the report, the strategies have been tested on the 'EUR/USD' fiat currency pair, with data loaded from the Yahoo Finance (yfinance) API. The following criteria is applied:

- Currency pair – 'EUR/USD'
- Period – 2 years
- Interval – 1 hour
- Start date - As a requirement in the yfinance API, we cannot fetch hourly data beyond 730 days. Therefore, we use start date that is 729 days from the current date
- End date – The current day's date

Strategy Datasets

This parent dataset loaded above is then sliced into two separate datasets:

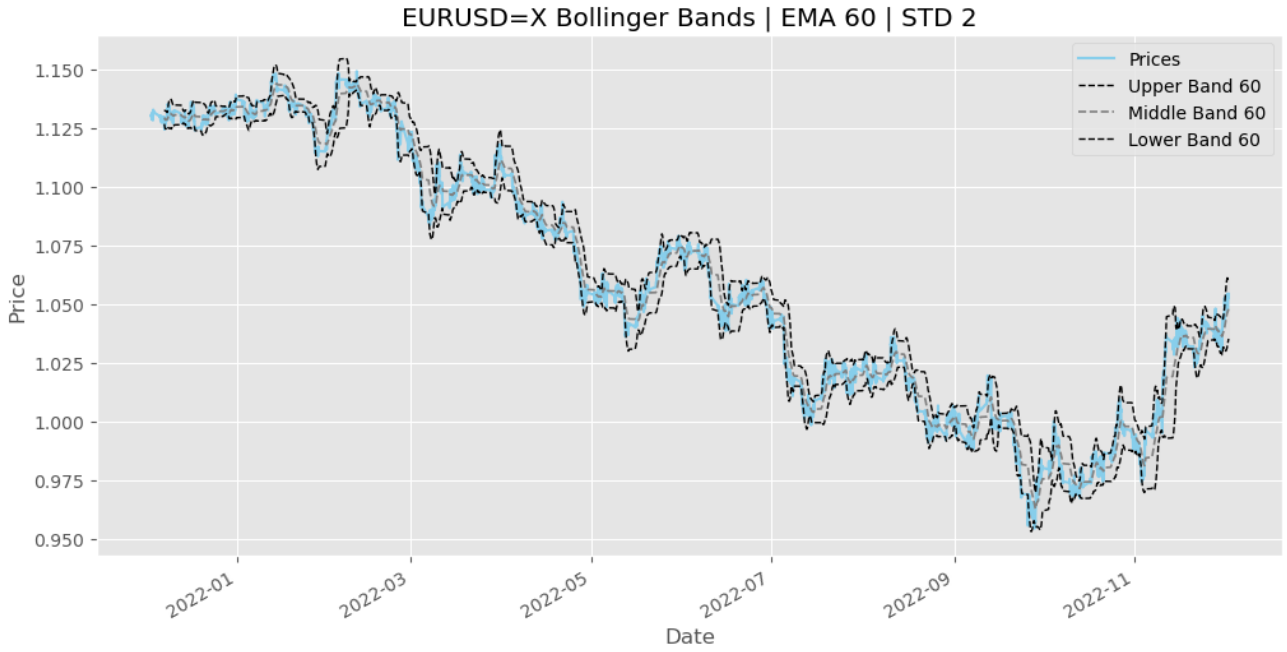
- 'insample_dataset' – This contains data from the start date to the date 365 days / 1 year ahead in the future
- 'outsample_dataset' – This contains data from 1 day after the end date of the *''insample_dataset'* to the current day's date

Strategy Setup

Bollinger Bands

The Bollinger Bands are created using the pandas ta library with the parameters below:

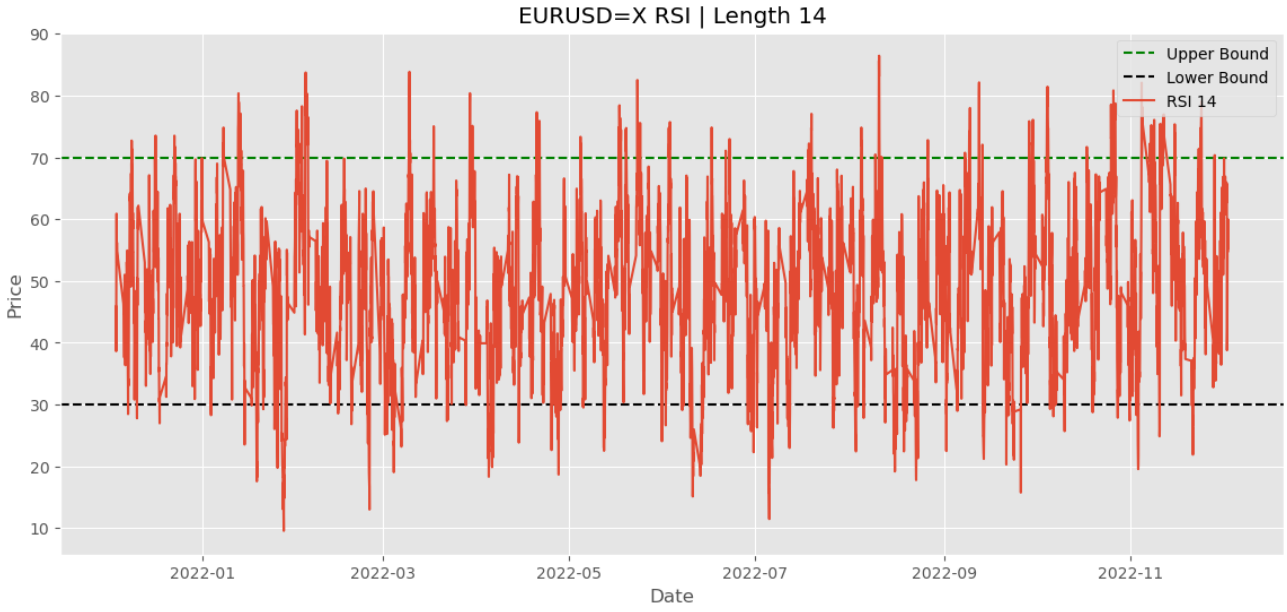
- Exponential Moving Average window of 60
- Standard Deviation of 2



Relative Strength Index (RSI)

The RSI series is created using the pandas ta library with the parameters below,:

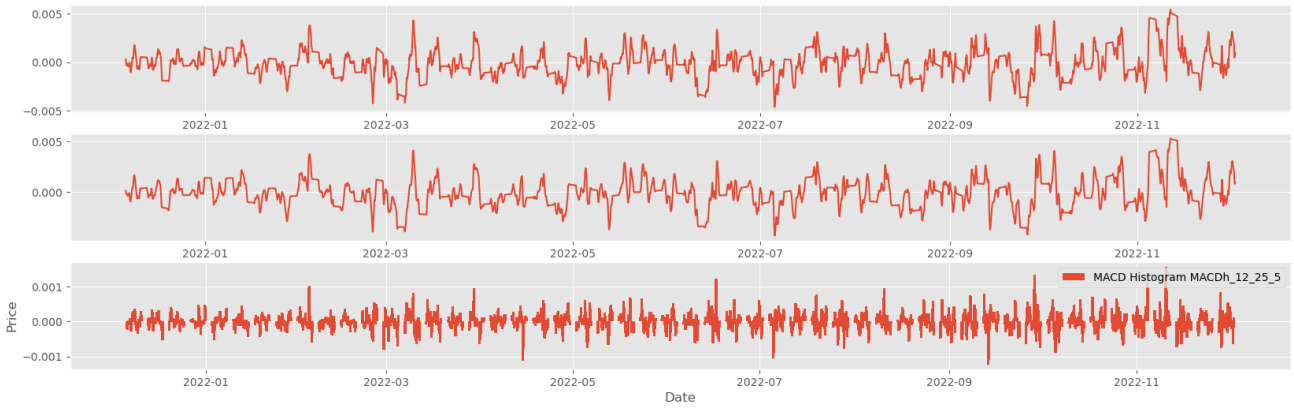
- RSI window of 14
- RSI scalar of 100
- Lower threshold of 30
- Upper threshold of 70



Moving Average Convergence Divergence (MACD)

The MACD is generated using the pandas ta library with the parameters below,:

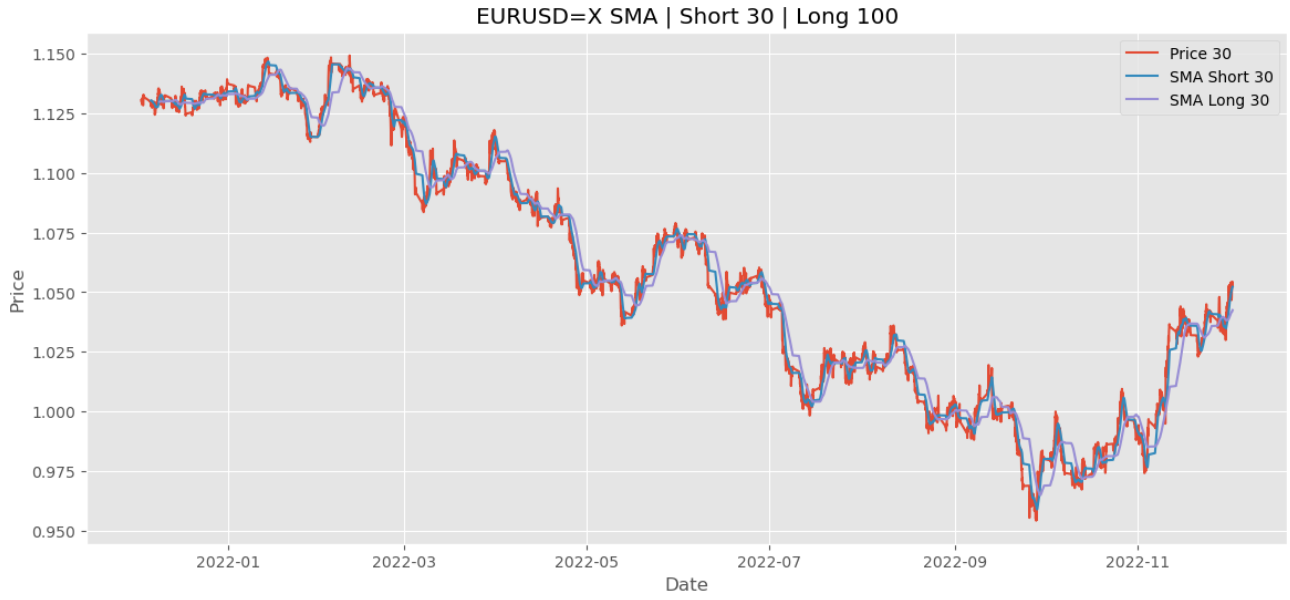
- Fast line of 12
- Slow line of 25
- Signal line of 5



Simple Moving Average Strategy Crossover

The SMA is generated using the pandas ta library with the parameters below:

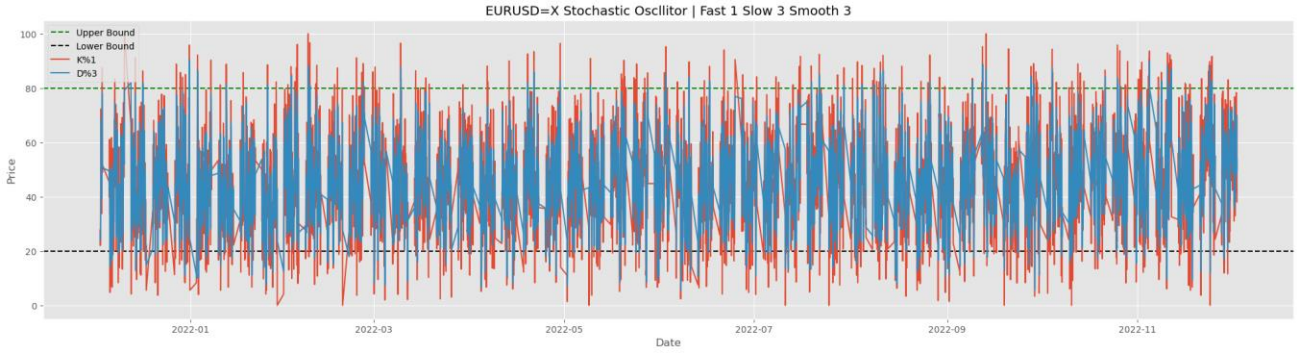
- SMA short window length of 30
- SMA long window length of 30



Stochastic Oscillator

The Stochastic Oscillator series is generated using the pandas ta library with the parameters below,:

- Fast line of 1
- Slow line of 3
- Smooth value of 3
- Offset of 0
- Lower threshold of 20
- Upper threshold of 80



Backtesting and Cross Validation

Backtesting.py Strategy Setup

To backtest our strategy, we use the python library **backtesting.py**.

First, we define a four indicator functions below, that will create the technical indicators to be used by the Strategy class:

i. **bands_indicator**

Buy - If Closing Price crosses over the Upper Bollinger Band

Sell - If Closing Price crosses below the Lower Bollinger Band

ii. **rsi_indicator**

Buy - If RSI crosses over the Upper Threshold

Sell - If RSI crosses below the Lower Threshold

iii. **macd_indicator**

Buy - If MACD line crosses over the Signal Line

Sell - If MACD line crosses below the Signal Line

iv. **sma_indicator**

Buy - If Closing Price crosses over the SMA line

Sell = If Closing Price crosses below the SMA line

v. **stoch_indicator**

Buy - If %K line crosses above the %D line, set our position to close because the price is predicted to drop

Sell - If %K line crosses below the %D line, enter a buy position because the price is predicted to increase

Backtesting and validating a single currency pair EUR/USD

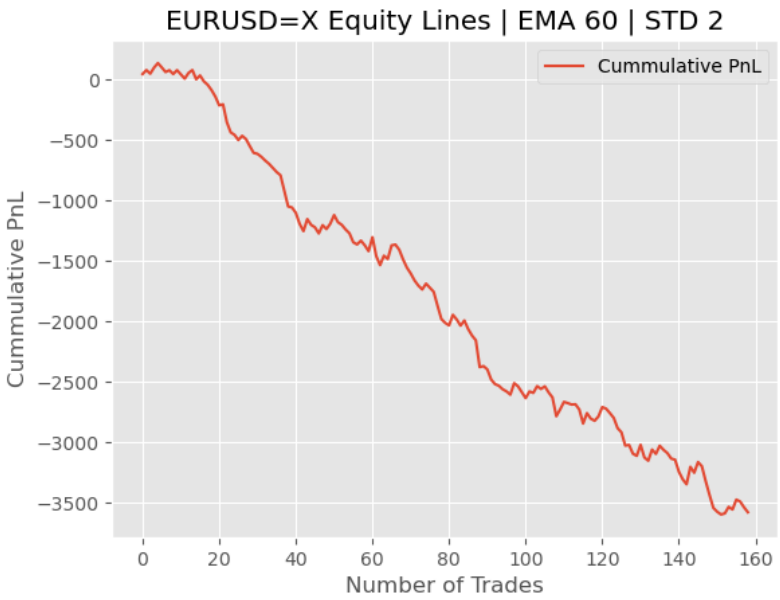
All backtests were run with cash of $10,000 and commission at 0.24% per trade

Bollinger Bands

Results

Result	Value
Start Date	2021-12-03 00:00:00+00:00
End Date	2022-12-02 22:00:00+00:00
Peak Equity	10135.4448976203
Final Equity	6422.168181221631
Sharpe Ratio	0.0
PnL	$-3577.832
Return %	-35.778%
Win Rate [%]	27.044%
Number of trades	159

Close-to-Close Equity Lines



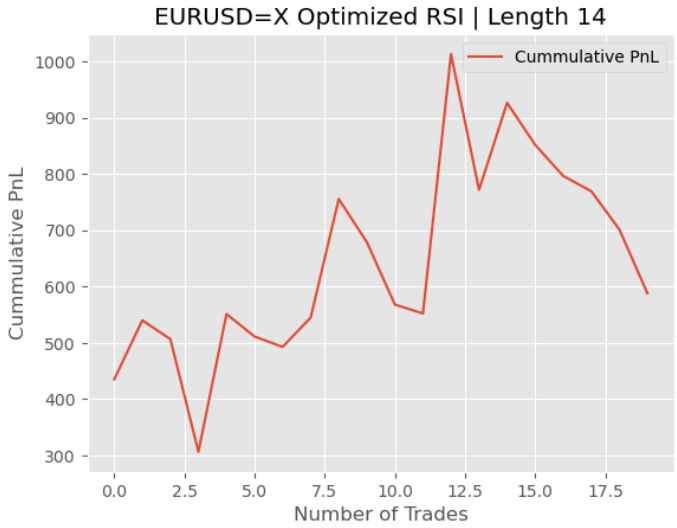
Relative Strength Index (RSI)

Results

RSI Backesting results with investment of 10000 and commission of 0.24%

Result	Value
Start Date	2021-12-03 00:00:00+00:00
End Date	2022-12-02 22:00:00+00:00
Peak Equity	10318.99836582594
Final Equity	5684.029825890044
Sharpe Ratio	0.0
PnL	$-4315.97
Return %	-43.16%
Win Rate [%]	23.316%
Number of trades	193

Close-to-Close Equity Lines



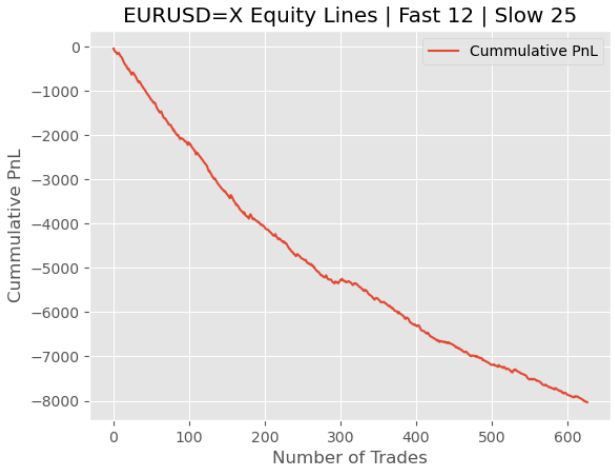
Moving Average Convergence Divergence (MACD)

Results

MACD Backesting results with investment of 10000 and commission of 0.24%

Result	Value
Start Date	2021-12-03 00:00:00+00:00
End Date	2022-12-02 22:00:00+00:00
Peak Equity	10000.0
Final Equity	1966.3638600280174
Sharpe Ratio	0.0
PnL	$-8033.636
Return %	-80.336%
Win Rate [%]	18.82%
Number of trades	627

Close-to-Close Equity Lines



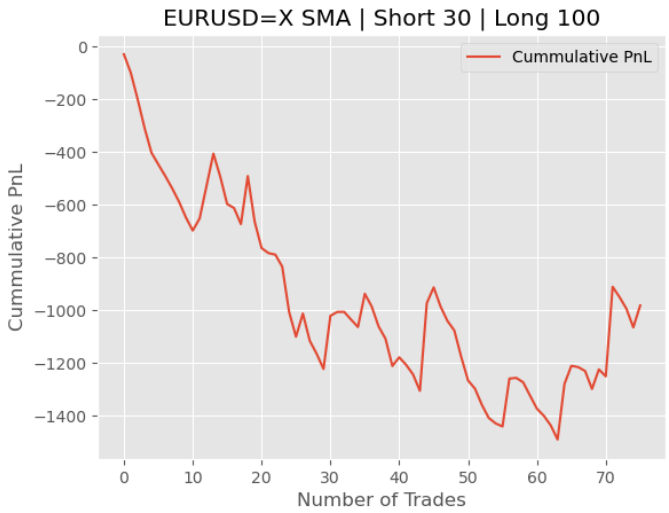
Simple Moving Average Strategy

Results

SMA Backesting results with investment of 10000 and commission of 0.24%

Result	Value
Start Date	2021-12-03 00:00:00+00:00
End Date	2022-12-02 22:00:00+00:00
Peak Equity	10000.0
Final Equity	9018.02921655096
Sharpe Ratio	0.0
PnL	$-981.971
Return %	-9.82%
Win Rate [%]	25.0%
Number of trades	76

Close-to-Close Equity Lines



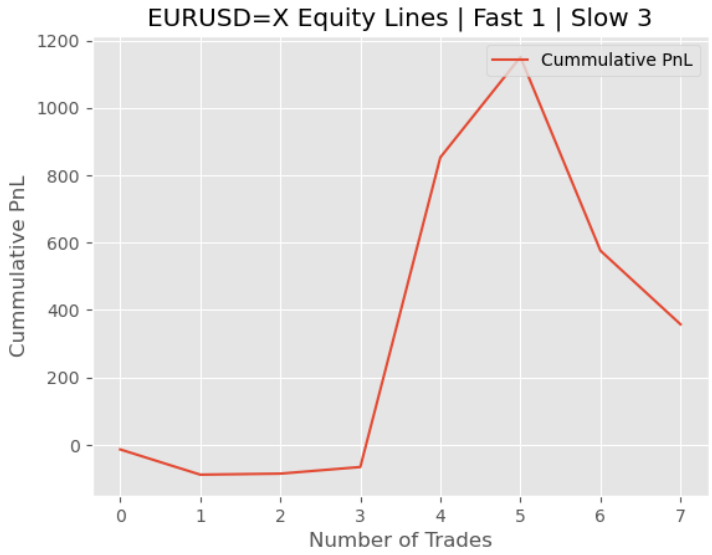
Stochastic Oscillator

Results

Stochastic Oscillator Backesting results with investment of 10000 and commission of 0.24%

Result	Value
Start Date	2021-12-03 00:00:00+00:00
End Date	2022-12-02 22:00:00+00:00
Peak Equity	11489.206572299101
Final Equity	10357.437455777077
Sharpe Ratio	0.35303
PnL	$357.437
Return %	3.574%
Win Rate [%]	50.0%
Number of trades	8

Close-to-Close Equity Lines



Insample Backtest Performance Summary

Indicator	Final PnL	Number of Trades	Profitable
MACD	357	8	Yes
SMA Crossover	-981	76	No
Bollinger Bands	-3,577	159	No
RSI	-4,315	193	No
Stochastic Oscillator	-6,588	473	No

Optimizing Backtest Hyperparameters for EUR/USD

To optimize this strategy, we take the instances of the Strategy classes created above and run the backtesting.py function optimize () on it.

Bollinger Bands

Hyperparameter Ranges

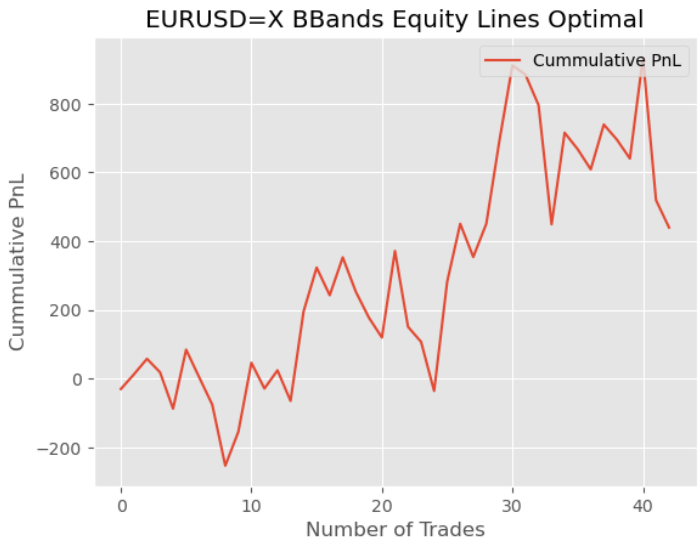
- Exponential Moving Average: Range 20 to 71 with a step value of 1
- Standard Deviation: Range 1 to 3 with a step value of 0.5

Optimized Backtest Results

```
Bollinger Bands Optimized Backesting Results

----------------  -------------------------
Start Date        2021-12-03 00:00:00+00:00
End Date          2022-12-02 22:00:00+00:00
Peak Equity       10944.31382699768
Final Equity      10439.820269442676
Sharpe Ratio      0.41151
```

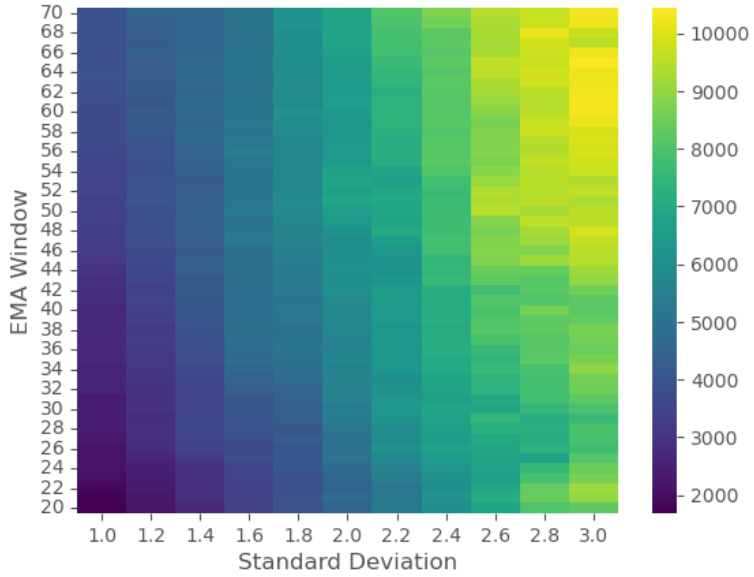
```
PnL                $439.82
Return %           4.398%
Win Rate [%]       41.86%
Number of trades   43
```

Close-to-Close Equity Lines



Cross Validation Results

Optimization Heatmap for EUR/USD

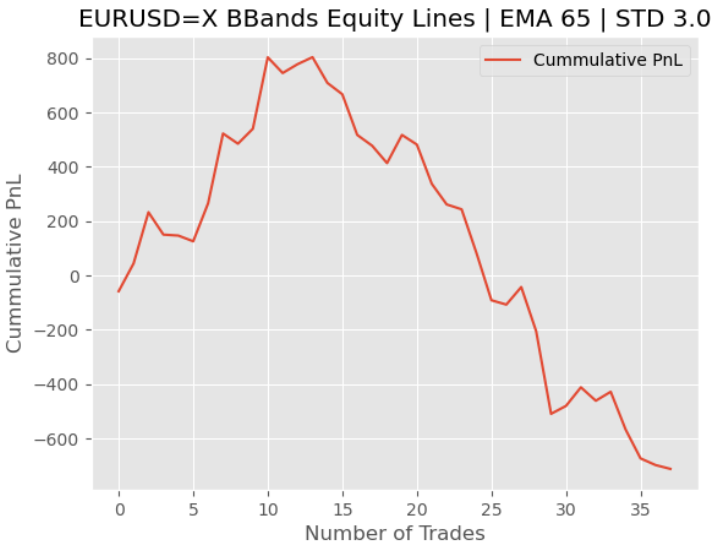


Cross-validation Results Table

```
Backesting optimized reults with investment of 10000 and commission of 1%

Result            Value
----------------  -------------------------
Start Date        2022-12-05 00:00:00+00:00
End Date          2023-12-01 22:00:00+00:00
Peak Equity       10982.876085256585
```

```
Final Equity       9287.915450146686
Sharpe Ratio       0.0
PnL                $-712.085
Return %           -7.121%
Win Rate [%]       34.211%
Number of trades   38
```

Cross-validation Close-to-Close Equity Lines



RSI

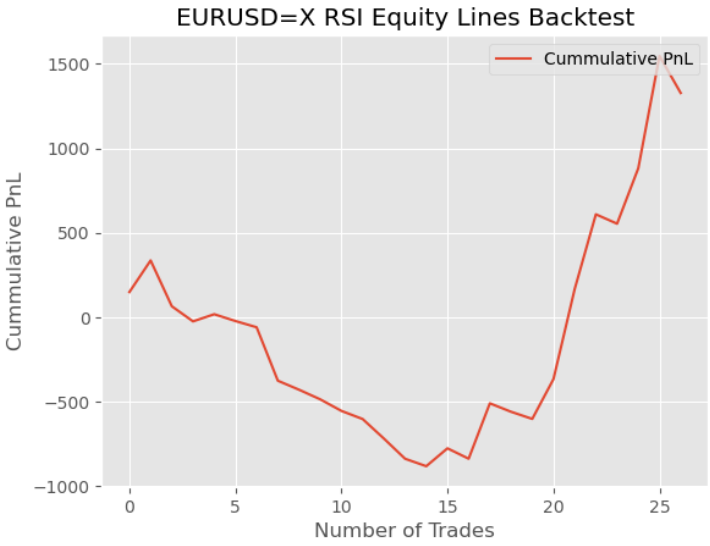
Hyperparameter Ranges

- RSI window: In the range of 20 to 71 with a step value of 1
- RSI scalar: In the range of 5 to 50 with a step value of 5

Optimized Backtest Results

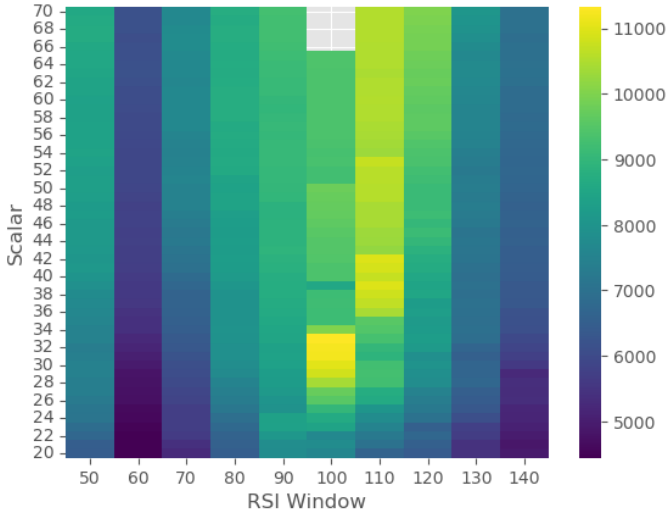
```
RSI Optimized Backesting Results

----------------  -------------------------
Start Date        2021-12-03 00:00:00+00:00
End Date          2022-12-02 22:00:00+00:00
Peak Equity       11662.776385172574
Final Equity      11326.978769644467
Sharpe Ratio      1.15946
PnL               $1326.979
Return %          13.27%
Win Rate [%]      37.037%
Number of trades  27
```

Close-to-Close Equity Lines



Cross Validation Results

Optimization Heatmap for EUR/USD

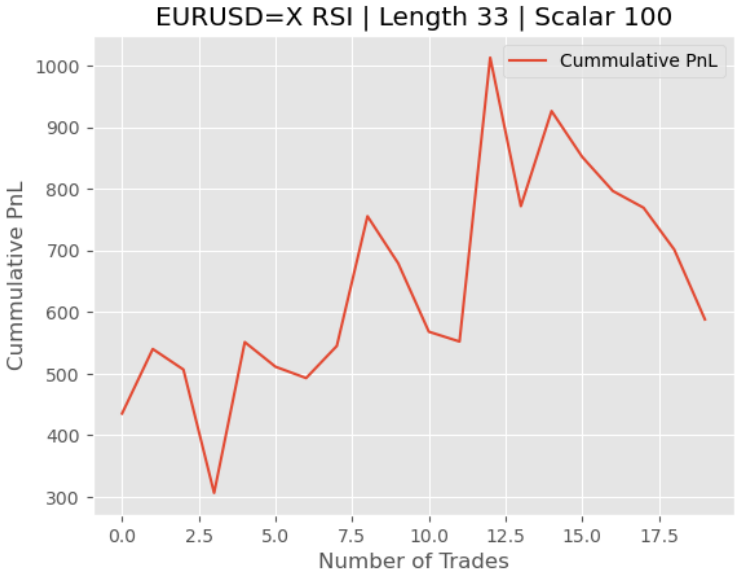


Cross-validation Results Table

Backesting optimized reults with investment of 10000 and commission of 1%

Result	Value
Start Date	2022-12-05 00:00:00+00:00
End Date	2023-12-01 22:00:00+00:00
Peak Equity	11051.097857368095
Final Equity	10588.181074396143
Sharpe Ratio	0.75864
PnL	$588.181
Return %	5.882%
Win Rate [%]	35.0%
Number of trades	20

Cross-validation Close-to-Close Equity Lines



MACD

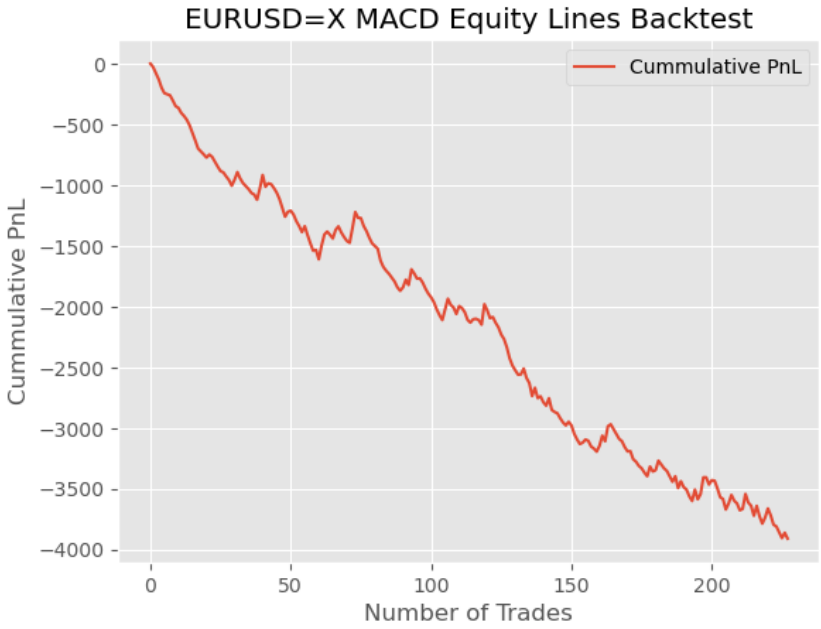
Hyperparameter Ranges

- MACD fast window: in the range of 10 to 30 with a step value of 2
- MACD slow window: in the range of 10 to 50 with a step value of 2
- MACD signal window: in the range of 5 to 20 with a step value of 1

Optimized Backtest Results

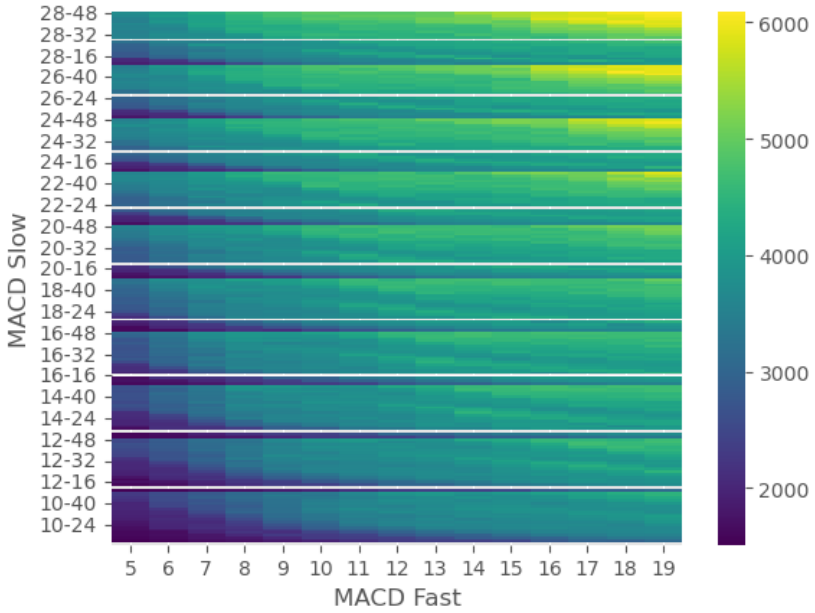
```
MACD Optimized Backesting Results

----------------  -------------------------
Start Date        2021-12-03 00:00:00+00:00
End Date          2022-12-02 22:00:00+00:00
Peak Equity       10038.347850990294
Final Equity      6090.757344064357
Sharpe Ratio      0.0
PnL               $-3909.243
Return %          -39.092%
Win Rate [%]      26.316%
Number of trades  228
```

Close-to-Close Equity Lines



Cross Validation Results

Optimization Heatmap for EUR/USD



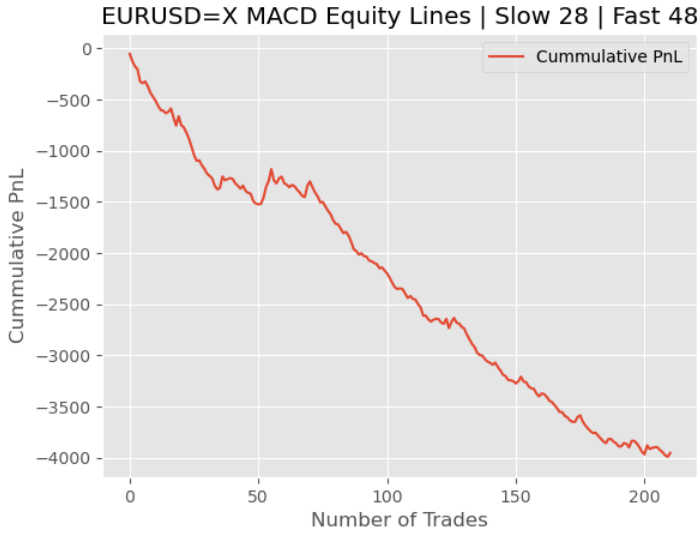
Cross-validation Results Table

Backesting optimized reults with investment of 10000 and commission of 1%

Result	Value
Start Date	2022-12-05 00:00:00+00:00
End Date	2023-12-01 22:00:00+00:00
Peak Equity	10003.346322757721
Final Equity	6044.868107915185
Sharpe Ratio	0.0
PnL	$-3955.132

```
Return %           -39.551%
Win Rate [%]       23.223%
Number of trades   211
```

Cross-validation Close-to-Close Equity Lines



SMA Crossover

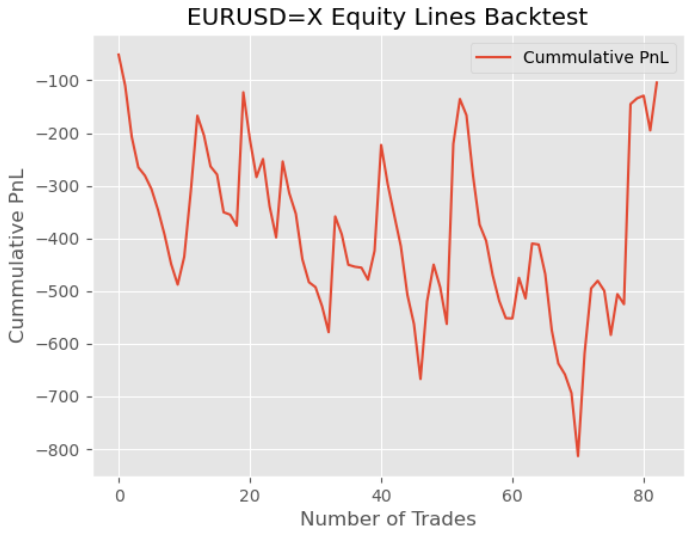
Hyperparameter Ranges

- SMA short window: in the range of 10 to 50 with a step value of 5
- SMA short window: in the range of 50 to 200 with a step value of 5

Optimized Backtest Results

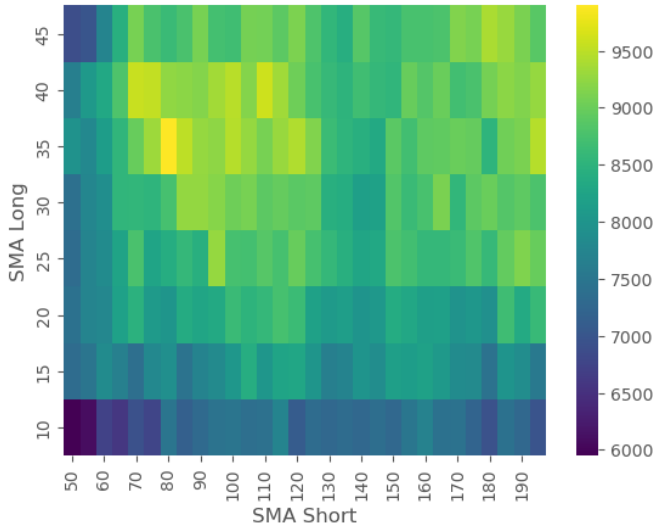
```
SMA Optimized Backesting Results

----------------  -------------------------
Start Date        2021-12-03 00:00:00+00:00
End Date          2022-12-02 22:00:00+00:00
Peak Equity       10007.37507589274
Final Equity      9895.859741315875
Sharpe Ratio      0.0
PnL               $-104.14
Return %          -1.041%
Win Rate [%]      27.711%
Number of trades  83
```

Close-to-Close Equity Lines



Cross Validation Results

Optimization Heatmap for EUR/USD

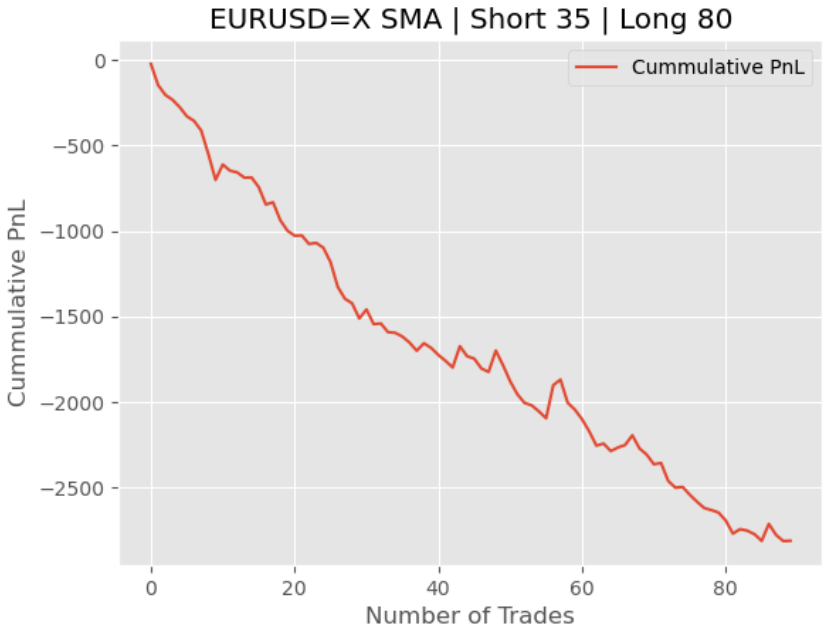


Cross-validation Results Table

Backesting optimized reults with investment of 10000 and commission of 1%

Result	Value
Start Date	2022-12-05 00:00:00+00:00
End Date	2023-12-01 22:00:00+00:00
Peak Equity	10014.065880002212
Final Equity	7187.209823538237
Sharpe Ratio	0.0
PnL	$-2812.79
Return %	-28.128%
Win Rate [%]	23.333%
Number of trades	90

Cross-validation Close-to-Close Equity Lines



Stochastic Oscillator

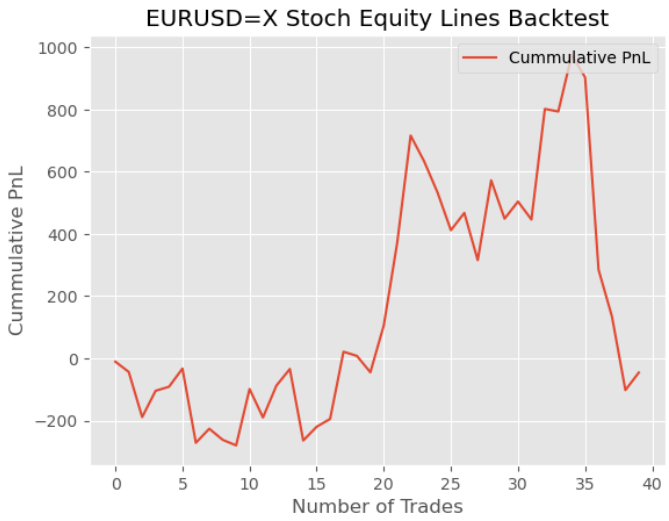
Hyperparameter Ranges

- Slow window: 1
- Fast window: In the range of 1 to 3 with a step value of 1
- Smooth window: In the range of 1 to 3 with a step value of 1

Optimized Backtest Results

```
Stochastic Oscillator Optimized Backesting Results

----------------  -------------------------
Start Date        2021-12-03 00:00:00+00:00
End Date          2022-12-02 22:00:00+00:00
Peak Equity       11214.717336701891
Final Equity      9954.403920264222
Sharpe Ratio      0.0
PnL               $-45.596
Return %          -0.456%
Win Rate [%]      47.5%
Number of trades  40
```

Close-to-Close Equity Lines

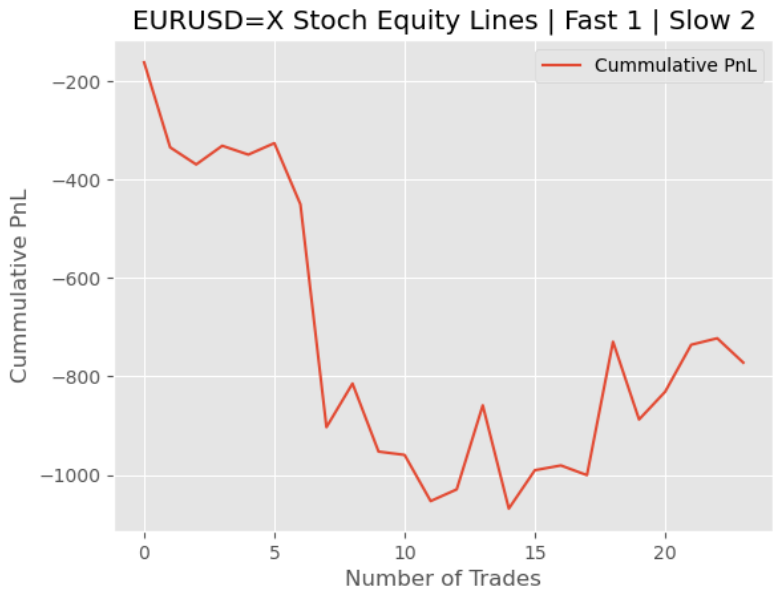


Cross Validation Results

Cross-validation Results Table

```
Backesting optimized results with investment of 10000 and commission of 1%

Result            Value
----------------  -------------------------
Start Date        2022-12-05 00:00:00+00:00
End Date          2023-12-01 22:00:00+00:00
Peak Equity       10005.279791479494
Final Equity      9227.887282471575
Sharpe Ratio      0.0
PnL               $-772.113
Return %          -7.721%
Win Rate [%]      45.833%
Number of trades  24
```

Cross-validation Close-to-Close Equity Lines



Outsample Cross-Validation Performance Summary (EUR/USD)

Indicator	Initial PnL	Optimized PnL	Cross-validation	Initial Parameters	Optimized Parameters	Performance
Bollinger Bands	-3,577	439.82	-712.085	EMA Window 16 STD 2	EMA Window 65 STD 3	Improved
RSI	-4,315	1326.979	588.181	Length 14 Scalar 100	Length 33s Scalar 100	Improved
MACD	-6588	-3909.243	-3955.132	Fast 12 Slow 25 Smooth 5	Fast 28 Slow 48 Smooth 19	Improved
SMA Crossover	-981	-104.14	-2812.79	Short 30 Long 100	Short 35 Long 80	Lowered
Stochastic Oscillator	357	-45.596	-772.113	Fast 1 Slow 3 Smooth 3 Offset 0	Fast 1 Slow 2 Smooth 2 Offset 0	Lowered

Backtesting and validating multiple currency pairs

In this section, we apply the logic above to the list of nineteen currency pairs below:

Here is the list presented as a numbered word list:

1. USDJPY=X
2. GBPUSD=X
3. AUDUSD=X
4. USDCAD=X
5. USDCHF=X
6. EURGBP=X
7. EURJPY=X
8. GBPJPY=X
9. EURCHF=X
10. USDNOK=X
11. USDCNY=X
12. EURCAD=X
13. USDHKD=X
14. USDSGD=X
15. USDKRW=X
16. USDSGD=X
17. EURAUD=X
18. EURNZD=X
19. GBPCHF=X

Multiple currency backtesting data

For each currency pair in the currency list, we download data with the following criteria from the yfinance API:

- Period – 2 years
- Interval – 1 hour
- Start date - As a requirement in the yfinance API, we cannot fetch hourly data beyond 730 days. Therefore, we use start date that is 729 days from the current date
- End date – The current day's date

Each parent dataset is then sliced into two separate datasets:

- 'insample_dataset' – This contains data from the start date to the date 365 days / 1 year ahead in the future
- 'outsample_dataset' – This contains data from 1 day after the last date in the insample_dataset to the current day's date

For each currency pair, the insample_dataset is saved to a file in the insample directory, and 'outsample_dataset' saved to the outsample directory.

Backtesting

To backtest, we iterate through the currency data files in the insample directory. For each iteration:

i. Run each strategy on the dataset with cash of $10,000 and commission at 0.24% per trade. The initial parameter values for each strategy are maintained.
ii. Run the backtesting.py optimize () function during each iteration, and select the hyperparameters for that currency pair
iii. Select and save all the backtesting statistics
iv. Save the currency pair, backtest statistics and optimal parameters into the list bulk_backtest_results.
v. Write the list bulk_backtest_results to the file 'backtest_metrics.csv' for each strategy

Cross-validation

To cross-validate, we iterate through the currency data files in the outsample directory. For each iteration:

i. Load the currency's file from the insample directory, and select the optimal hyperparameters
vi. Run each trading strategy on the dataset with cash of $10,000 and commission at 0.24% per trade.
vii. Select and save all the cross-validation statistics
ii. Save the currency pair and cross-validation statistics into the list bulk_validate_results
iii. Write the list bulk_validate_results to the file 'validation_metrics.csv' for each strategy

Bulk backtesting and cross-validation results and findings

Performance Summary

Below is a ranked summary of the strategy performance for the 20 currency pairs.

Strategy	# Improved Trades (In 20)	# Worsened Trades (In 20)	# Profitable Trades (In 20)	# Non-Profitable Trades (In 20)	Improved Ratios (In 20)
RSI	13	7	9	11	7
Bollinger Bands	19	1	4	16	5
Stochastic Oscillator	3	17	2	19	2
MACD	19	1	0	20	0
SMA Crossover	8	12	0	20	0

Detailed Performance

To determine the robustness of a strategy, I have considered the Final Equity generated for each currency pair, against an investment of $10,000 and commission of 0.24%.

For each strategy, three considerations below have been made using the backtest and cross-validation metrics to determine robustness:

1. Total number of profitable currency pair trades out of 20 currency pairs

2. Number of currency pair trades that show improved performance on backtesting versus on cross-validation. In this case, improved performance includes both going from making a loss to making a profit and making a lower loss on cross-validation. Therefore, a strategy that makes a bigger loss on cross-validation is considered to have a worse performance

3. The change in Sharpe, Sortino and Calmar ratios. For context, the below must be considered:

    a. **Sharpe Ratio** – This is a ratio of the return of an investment with its risk [7]. This ratio considers the overall volatility of an investment.[8] A higher Sharpe ratio is preferred.
    b. **Sortino Ratio** – This is a ratio of the downside risk or negative volatility of a trade. A Sortino risk of two and above is considered ideal [9]
    c. **Calmar Ratio** - This is a ratio of the return of an investment with its risk. This ratio focuses on the worst-case scenario through the maximum drawdown. [8] A higher Calmar ratio, is preferred.

Bollinger Bands

Currency Pair	Initial PnL	Optimized PnL	Final Sharpe Ratio	Final Sortino Ratio	Final Calmar Ratio	Performance	Profitable
EURUSD=X	439.82	-712.085	0	0	0	Lowered	No
AUDUSD=X	-2826.48	53.44352	0.04646	0.065417	0.042148	Improved	Yes
EURAUD=X	-1151.02	-1059.48	0	0	0	Improved	No
EURCAD=X	-3887.28	-2414.5	0	0	0	Improved	No
EURCHF=X	-3246.39	-1218.22	0	0	0	Improved	No
EURGBP=X	-3041.5	283.367	0.474868	0.68657	0.70168	Improved	Yes
EURJPY=X	-4516.84	1766.528	1.454421	2.509794	3.152124	Improved	Yes
EURNZD=X	-2251.48	-783.981	0	0	0	Improved	No
GBPCHF=X	-3213.3	-1302.01	0	0	0	Improved	No
GBPJPY=X	-4162.31	-569.041	0	0	0	Improved	No
GBPUSD=X	-4242.09	-376.694	0	0	0	Improved	No
USDCAD=X	-2751.5	-411.442	0	0	0	Improved	No
USDCHF=X	-4061.75	-625.709	0	0	0	Improved	No
USDCNY=X	-3231.48	-1430.52	0	0	0	Improved	No
USDHKD=X	-3774.41	-1603.16	0	0	0	Improved	No
USDJPY=X	-3987.38	-1006.62	0	0	0	Improved	No
USDKRW=X	-3230.92	-1728.97	0	0	0	Improved	No
USDNOK=X	-2691.77	663.1463	0.449165	0.70007	0.586914	Improved	Yes
USDSGD=X	-3476.87	-955.037	0	0	0	Improved	No

The Bollinger Bands indicator shows the second-best performance of the 5 strategies.

i. 19 of the 20 currency pairs show an improved performance on cross-validation. Although they are still making losses, the losses are lower than those incurred during backtesting. The one strategy that shows a worsened performance loses $712 dollars, which when compared to the other currency pairs' final PnLs ranks among the lower losses made.
ii. 4 of the 20 are profitable on cross-validation with positive ratios.

RSI

Currency Pair	Initial PnL	Optimized PnL	Final Sharpe Ratio	Final Sortino Ratio	Final Calmar Ratio	Performance	Profitable
EURUSD=X	1326.979	588.181	0	0	0	Lowered	Yes
AUDUSD=X	-3295.25	402.314	0.378576	0.552038	0.538607	Improved	Yes
EURAUD=X	-2935.84	50.33214	0.051888	0.071244	0.052277	Improved	Yes
EURCAD=X	-3146.24	-490.393	0	0	0	Improved	No
EURCHF=X	-3305.5	0	nan	nan	nan	Improved	No
EURGBP=X	-2501.92	-270.617	0	0	0	Improved	Yes
EURJPY=X	-3475.07	90.83062	0.088502	0.121494	0.08953	Improved	Yes
EURNZD=X	-1808.12	-974.204	0	0	0	Improved	No
GBPCHF=X	-3488.21	174.5158	0.311075	0.446034	0.326818	Improved	Yes
GBPJPY=X	-3232.57	-323.926	0	0	0	Improved	No
GBPUSD=X	-3784.16	-276.495	0	0	0	Improved	No
USDCAD=X	-3021.99	0	nan	nan	nan	Improved	No
USDCHF=X	-4302.64	-479.844	0	0	0	Improved	No
USDCNY=X	-4122.97	-552.335	0	0	0	Improved	No
USDHKD=X	-1808.83	-204.608	0	0	0	Improved	No
USDJPY=X	-4663.44	862.6549	0.76966	1.190809	1.188121	Improved	Yes
USDKRW=X	-3644.12	-115.551	0	0	0	Improved	No
USDNOK=X	1326.979	588.181	0.559252	0.831043	0.65424	Lowered	Yes
USDSGD=X	-3295.25	402.314	0.009587	0.0128	0.008714	Improved	Yes

The RSI indicator shows the best performance of the 5 strategies.

i. 18 of the 20 currency pairs show an improved performance on cross-validation. Though this figure is lower than the 19 of 20 in the Bollinger Bands Strategy, RSI has 9 profitable currency-pair investments compared to the 4 for Bollinger Bands.
ii. 2 currency pairs do not execute trades and require further checks

MACD

Currency Pair	Initial PnL	Optimized PnL	Final Sharpe Ratio	Final Sortino Ratio	Final Calmar Ratio	Performance	Profitable
EURUSD=X	-3909.243	-3955.132	0	0	0	Lowered	No
AUDUSD=X	-8108.45	-4649.85	0	0	0	Improved	No
EURAUD=X	-7330.94	-6031.07	0	0	0	Improved	No
EURCAD=X	-7760.71	-5471.45	0	0	0	Improved	No
EURCHF=X	-8266.69	-5545.54	0	0	0	Improved	No
EURGBP=X	-7666.37	-5510.16	0	0	0	Improved	No
EURJPY=X	-7459.28	-4878.03	0	0	0	Improved	No
EURNZD=X	-8057.12	-5613.41	0	0	0	Improved	No
GBPCHF=X	-8119.09	-6502.73	0	0	0	Improved	No
GBPJPY=X	-7091.97	-4277.9	0	0	0	Improved	No
GBPUSD=X	-7337.56	-6177.05	0	0	0	Improved	No
USDCAD=X	-7615.29	-4770.58	0	0	0	Improved	No
USDCHF=X	-8392.15	-5458.53	0	0	0	Improved	No
USDCNY=X	-6716.47	-4474.94	0	0	0	Improved	No
USDHKD=X	-8810.28	-5728.63	0	0	0	Improved	No
USDJPY=X	-7361.28	-4710.64	0	0	0	Improved	No
USDKRW=X	-6704.55	-4085.68	0	0	0	Improved	No
USDNOK=X	-7869.32	-5239.09	0	0	0	Improved	No
USDSGD=X	-8063.35	-5610.3	0	0	0	Improved	No

The MACD indicator ranks fourth in performance out of the 5 strategies.

i. On cross-validation, all the currency pairs continue to make losses, though the losses are lower than those incurred on backtesting
ii. The MACD makes significantly large losses, losing between 45% to 88% of the total investment, which shows poor performance.
iii. No currency pairs show profitable investments

SMA Crossover

Currency Pair	Initial PnL	Optimized PnL	Final Sharpe Ratio	Final Sortino Ratio	Final Calmar Ratio	Performance	Profitable
EURUSD=X	-104.14	-2812.79	0	0	0	Lowered	No
AUDUSD=X	-2854.89	-1471.43	0	0	0	Improved	No
EURAUD=X	-2786.68	-1241.19	0	0	0	Improved	No
EURCAD=X	-664.903	-1758.14	0	0	0	Lowered	No
EURCHF=X	-1235.83	-2111.13	0	0	0	Lowered	No
EURGBP=X	-1285.09	-1727.74	0	0	0	Lowered	No
EURJPY=X	-349.544	-2741.73	0	0	0	Lowered	No

EURNZD=X	-2054.73	-1753.68	0	0	0	Improved	No
GBPCHF=X	-1269.04	-1197.07	0	0	0	Improved	No
GBPJPY=X	756.7595	-2895.06	0	0	0	Lowered	No
GBPUSD=X	-1107.76	-1276.43	0	0	0	Lowered	No
USDCAD=X	-3304.9	-1550.92	0	0	0	Improved	No
USDCHF=X	-46.5606	-2922.98	0	0	0	Lowered	No
USDCNY=X	-1393.8	-535.86	0	0	0	Improved	No
USDHKD=X	-1820.5	-727.463	0	0	0	Improved	No
USDJPY=X	-427.023	-1720.16	0	0	0	Lowered	No
USDKRW=X	-844.876	-1494.59	0	0	0	Lowered	No
USDNOK=X	-2166.62	-1449.03	0	0	0	Improved	No
USDSGD=X	-654.526	-1873.24	0	0	0	Lowered	No

The SMA Crossover indicator shows the worst performance out of the 5 strategies.

i. Though 8 of the currency pairs show an improved performance, none of the investments are profitable on cross-validation

Stochastic Oscillator

Currency Pair	Initial PnL	Optimized PnL	Final Sharpe Ratio	Final Sortino Ratio	Final Calmar Ratio	Performance	Profitable
EURUSD=X	-45.596	-772.113	0	0	0	Lowered	No
AUDUSD=X	-188.99	-1674.85	0	0	0	Lowered	No
EURAUD=X	-486.616	-580.291	0	0	0	Lowered	No
EURCAD=X	333.7083	-442.9	0	0	0	Lowered	No
EURCHF=X	-693.174	-1297.57	0	0	0	Lowered	No
EURGBP=X	0	378.8307	0.652283	1.017039	0.944213	Improved	Yes
EURJPY=X	624.2178	-718.81	0	0	0	Lowered	No
EURNZD=X	-463.564	-685.189	0	0	0	Lowered	No
GBPCHF=X	-619.715	-652.059	0	0	0	Lowered	No
GBPJPY=X	637.2335	-1162.22	0	0	0	Lowered	No
GBPUSD=X	-547.035	-534.656	0	0	0	Improved	No
USDCAD=X	456.1877	-653.797	0	0	0	Lowered	No
USDCHF=X	-164.771	-1011.57	0	0	0	Lowered	No
USDCNY=X	20.74069	-974.734	0	0	0	Lowered	No
USDHKD=X	-365.552	-1117.52	0	0	0	Lowered	No
USDJPY=X	1383.371	-33.4917	0	0	0	Lowered	No
USDKRW=X	-101.052	-940.94	0	0	0	Lowered	No
USDNOK=X	0	203.2383	0.154295	0.236189	0.181256	Improved	Yes
USDSGD=X	392.7346	-607.423	0	0	0	Lowered	No

The Stochastic Oscillator indicator ranks third out of the 5 strategies.

i. Though only 3 of the currency pair investments how an improved performance compared to the 8 for the SMA Crossover Strategy, two of the pairs are profitable on cross-validation, compared to the SMA Crossover Strategy which had none.
ii. This indicator fails to generate the %K and %d series for the insample data when the fast value is not 1. The slow and smooth ranges used for hyper-parameterization are also low, between 1 and 3. This will be reviewed for improvement.

Conclusion

In conclusion, according to my findings Relative Strength Index (RSI) is the most robust trading strategy for hourly data.

Costs and Backtesting Assumptions

i. The costs assumed for this backtest were an investment of $10,000 and commission of 0.24%
ii. All trading activities were performed at the adjusted closing price at that day (retrieved from Yahoo finance)
iii. Volume of each trading activities was unlimited

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