PERSONAL PROJECT

Automated AROON-Based Forex Trading system with Walk-Foward Analysis

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Contents

1 Abstract

This article presents an innovative approach to Forex trading utilizing an Automated AROON-Based system integrated with Walk-Forward Analysis. The AROON indicator, renowned for its ability to gauge trend strength and potential reversals, serves as the cornerstone of my trading strategy. Through automation, I aim to streamline trading operations while enhancing efficiency and accuracy. Additionally, I employ Walk-Forward Analysis to validate the robustness of my system across varying market conditions, ensuring adaptability and resilience. My findings demonstrate the effectiveness of this combined approach in navigating the complexities of the Forex market, offering potential insights for traders seeking to optimize their trading methodologies.

2 Introduction

Navigating the complexities of the Forex market necessitates sophisticated trading strategies that can adapt to its dynamic nature. In response to this challenge, I present an innovative approach: an Automated AROON-Based Forex Trading system with Walk-Forward Analysis. The Forex market's rapid price movements and global economic influences demand strategies that can swiftly identify trends and capitalize on market opportunities. The AROON indicator, renowned for its ability to gauge trend strength and potential reversals, serves as the cornerstone of my trading system. By integrating automation, I aim to streamline trading operations, reduce emotional biases, and enhance decision-making processes.

Moreover, I employ Walk-Forward Analysis—a rigorous validation technique—to ensure the robustness and adaptability of my trading system across various market conditions. This approach involves dividing the historical data into consecutive segments, optimizing the trading parameters on one segment, and validating the performance on the subsequent segment. By systematically iterating this process, I can verify the system's effectiveness in real-world scenarios and mitigate the risks of overfitting.

In this article, I delve into the conceptual framework behind the AROON indicator, elucidating its principles and rationale for its relevance in Forex trading. I also provide an overview of Walk-Forward Analysis, outlining its methodology and significance in validating trading strategies. Subsequently, I detail the design and implementation of my Automated AROON-Based Forex Trading system, highlighting its key features and functionalities.

Through comprehensive backtesting and performance evaluation, I assess the efficacy and reliability of my approach, providing empirical evidence of its effectiveness in navigating the complexities of the Forex market. My findings not only demonstrate the potential for automated trading systems to enhance trading efficiency but also underscore the importance of rigorous validation techniques like Walk-Forward Analysis in ensuring the robustness of trading strategies.

In summary, this article aims to offer a comprehensive understanding of the Automated AROON-Based Forex Trading system with Walk-Forward Analysis, providing valuable insights for traders seeking to optimize their strategies and adapt to the ever-evolving landscape of Forex trading.

3 Background

3.1 AROON indicator

3.1.1 What is AROON indicator?

The Aroon indicator is a technical indicator that is used to identify trend changes in the price of an asset, as well as the strength of that trend. In essence, the indicator measures the time between highs and the time between lows over a time period. The idea is that strong uptrends will regularly see new highs, and strong downtrends will regularly see new lows. The indicator signals when this is happening, and when it isn't.

The indicator consists of the "Aroon up" line, which measures the strength of the uptrend, and the "Aroon down" line, which measures the strength of the downtrend.

The Aroon indicator was developed by Tushar Chande in 1995.

3.1.2 The formula of AROON indicator

$$\mathbf{AROON\_UP} = \frac{\mathbf{T_o - T_{high}}}{\mathbf{T_o}} * \mathbf{100} \tag{1}$$

$$\mathbf{AROON\_DOWN} = \frac{\mathbf{T_o - T_{low}}}{\mathbf{T_o}} * \mathbf{100} \tag{2}$$

With T_{high} is the period of time since HIGH during the last T_o Timeframe, and T_{low} is the period of time since LOW during the last T_o Timeframe

3.1.3 Why do I choose Aroon Indicator?

There are many other options for Trend-Following Based indicators besides the AROON indicator like: Double Moving Average Indicators, Triple Moving Average indicators. However, AROON has emerge as the best one. Here is a more detailed analysis of the advantages of the AROON indicator compared to other indicators:

- **Measuring trend strength**: AROON not only identifies the current trend but also evaluates the strength of that trend. By considering the difference between AROON-Up and AROON-Down, traders can assess the stability and potential of the trend.
- **Easy to understand and use**: AROON is designed to be simple and easy to understand. Traders do not need to have complex mathematical knowledge or programming skills to use this indicator. This makes it suitable for both beginners and experienced traders.
- **Ability to combine with other indicators**: AROON can be combined with many different indicators to enhance the performance of a trading system. Combining AROON with other indicators such as MACD, RSI, or Bollinger Bands can create strong and versatile trading strategies.
- **Compatibility with trading strategies**: AROON can be applied in various trading strategies, including trend-following, reversal trading, and range-bound trading. This makes it a flexible tool for traders at all levels.

In summary, The AROON indicator stands out for its ability to swiftly identify market trends and potential reversals, equipping traders with invaluable insights for making informed decisions. Its simplicity and effectiveness make it a favored tool among traders, offering a clear advantage in the dynamic Forex market. With its proven track record, the AROON indicator remains a go-to choice for traders looking to stay ahead of the curve and maximize their trading opportunities.

3.2 Money Management and Risk Management

3.2.1 Currency pair

Each currency pair is composed of two currencies - base and quote. The base currency is the first one and the quotation currency is the second one. So for USDJPY the base currency is USD and the quotation currency is JPY.

3.2.2 Points and PIPs

The point size or pip size of each of the currency pairs are perhaps different from each other. But in my report, I will use USDJPY as a reference. The point size of USDJPY is 0.001 while the pip size of USDJPY is 0.01, or 10 USDPJY points. So with the current USDJPY price of 149.041, the digits 41 represents 4.1 pips or 41 points. Price of a currency pair changes insignificantly. Therefore points or pips are used for price movement measurement.

3.2.3 Contract size

The contract size of the position is calculated from the base currency (first currency of the pair place). For most contracts, a position size of 1 lot is 100,000 units of the base currency. So if I have 0.1 lots of USDJPY, it will be 10,000 USD.

Let's say I have a $ 1,000 account and I buy 0.15 USDJPY lots. The 0.15 USDJPY lots has a value of 0.15 X 100,000 USD = 15,000 USD. The leverage will be: $ 15,000 USD positions per 1,000 USD account = 15: 1 is the leverage size.

3.2.4 Movement size

The movement size of the position is calculated from the quotation currency (second currency of the pair place). So USDJPY shows its movement price in JPY.

Let's say I have 1 contract USDJPY for 148.500. It means that I have bought 100,000 USD for which I have paid 148.5 multiplied by 100,000 JPY = 14,850,000 JPY. If the price rose from 148.500 to 149.500 (rise of 100 pips, or 1000 points), I still have 100,000 USD, but the value in JPY has risen to 149.500 multiply by 100000 = 14,950,000 JPY. When I close the position, I sell 100,000 USD and get 14,950,000 JPY. In conclusion, I get a total of 100,000 JPY in profit.

3.2.5 Stop-loss and Take-profit in points

In forex trading, "stop-loss" and "take-profit" are crucial risk management tools used to manage potential losses and lock in profits, respectively. Both are typically measured in pips or points, which represent the smallest price movement that a currency pair can make.

- **Stop Loss (SL)**: This is an order placed with your broker to sell a security when it reaches a certain price level. It's designed to limit a trader's loss on a position. Stop-loss orders are usually set below the entry price for long positions and above the entry price for short positions.
  For example, if you enter a long position on USDJPY at 148.500 and set a stop-loss order at 148.000, you're allowing for a 500-point loss before the trade is automatically closed.
- **Take Profit (TP)**: This is an order placed with your broker to close a position when it reaches a certain profit level. It's designed to lock in gains at a predetermined price target. For example, if you enter a long position on USDJPY at 148.500 and set a take-profit order at 149.500, you're aiming to capture a 1000-point profit before the trade is automatically closed.

Stop-loss and take-profit levels are often specified in pips or points, but traders have the flexibility to adjust their position's leverage to target a predetermined monetary or percentage-based gain or loss, which will be discussed in the next section.

3.2.6 Risk % of account

When trading, risk management is paramount to safeguarding capital. One common approach is to allocate a percentage of the trading account to risk per trade. This means that traders determine the maximum percentage of their account they are willing to risk on any single trade. Now, to implement this strategy effectively, traders often utilize a fixed stop-loss. The stop-loss is set at a predetermined level where the trade will automatically close if the market moves against their position, thus limiting potential losses. to their predetermined risk amount.
Let's say I have a trading account with a balance of $100,000 and I're trading the USDJPY currency pair with a fixed stop-loss of 50 pips (or 500 points). My risk per trade is set at 1%.

Here's how I calculate my position size:

- Calculate the Risk Amount: With a 1% risk on a $100,000 account, my maximum risk per trade is $1,000.
- Determine the Risk per Pip: Divide the risk amount by the number of pips in the stop-loss. $1,000 / 50 pips = $20 per pip
- Calculate Position Size: To risk $20 per pip, I would trade: $20 / $10 = 2 lots
- Leverage and Position Value: With 2 lots in a USDJPY contract, the position value becomes: $100,000 (account balance) x 2 (position size) = $200,000 (total position value or borrowed money)

So, with a 1% risk per trade and a fixed stop-loss of 50 pips on the USDJPY currency pair, I would trade 2 lots with a leverage of 2:1, resulting in a total position value of $200,000.

4 Methodology

4.1 Strategy

With AROON's flexibility, a trader can utilize the AROON_UP and AROON_DOWN in many different ways. As in my case, I have develop my own method of detecting Trends, and with those information, the system will decide whether or not to open or close a trade.

4.1.1 Observing Market Trends with AROON indicator

My Trend Observation strategy will have 3 different market states, and the logic behind those states are discussed as follows:

- **UP_TREND**: where the market has a tendency to go upward in value. It usually happens when
  AROON_UP > **InpAROONLevelVar**
  and **AROON_UP** − **AROON_DOWN** > **InpAROONDiffVar**
- **DOWN_TREND**: where the market has a tendency to go downward in value. It usually happens when
  AROON_DOWN > **InpAROONLevelVar**
  and **AROON_DOWN** − **AROON_UP** > **InpAROONDiffVar**
- **NOT_TRENDING_FROM_UP**: where the market does not follow any trend and the last State was **UP_TREND**, usually indicated by insignificant increase, decrease or not changing in market value. It happens when **AROON_DOWN** and **AROON_UP** does not follow any previous condition
- **NOT_TRENDING_FROM_DOWN**: where the market does not follow any trend and the last State was **DOWN_TREND**, usually indicated by insignificant increase, decrease or not changing in market value. It happens when **AROON_DOWN** and **AROON_UP** does not follow any previous condition

Note: InputFloorValue and InputDiffValue are two adjustable parameters in my strategy that can greatly affect the expert advisor's performance. The optimal value for two parameters will be optimized during the Walf-foward Analysis.

4.1.2 Entry signals and Close signals

Entry Signal Logic
My strategy is a netted strategy, therefore it operates by executing a maximum of one trade at a given time. The **ticket_number** variable will always have value of either 0 or 1, representing the number of on-going trade.

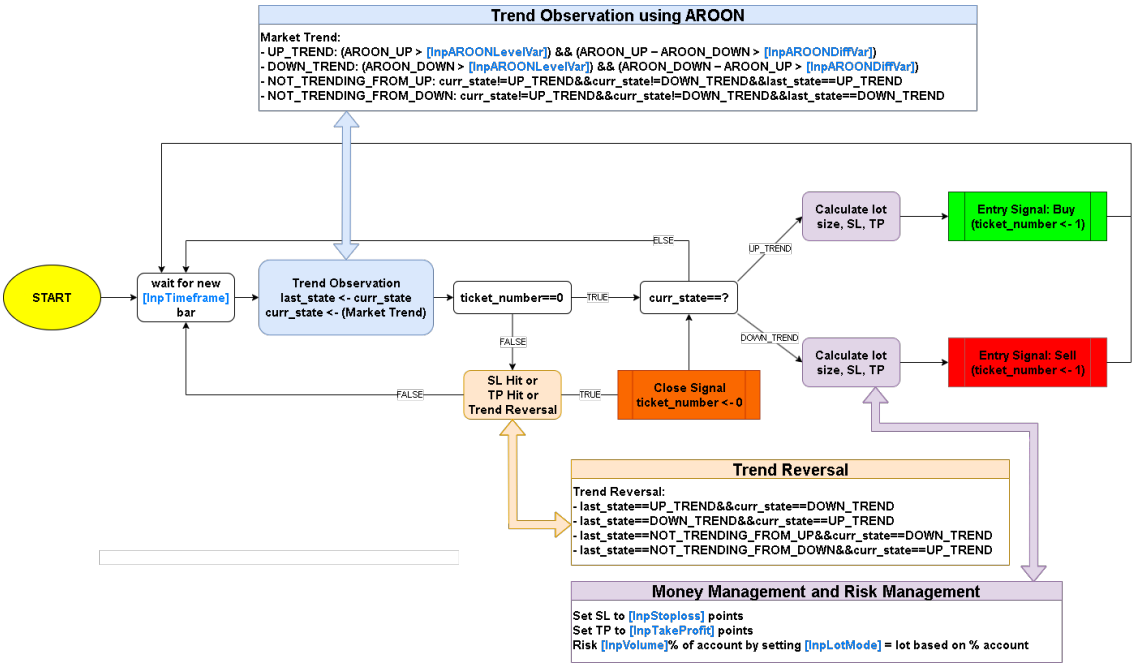
- A buy trade (or long trade) will be opened if the AROON indicator detects an Up trend and no on-going trades at that time.
  Logical equivalence: **curr_state==UP_TREND&&ticket_number==0**
- A sell trade (or short trade) will be opened if the AROON indicator detects a Down trend and no on-going trades at that time.
  Logical equivalence: **curr_state==DOWN_TREND&&ticket_number==0**

Close Signal Logic
All tickets will be closed if any of these conditions is met:

- Hitting Stop-Loss
- Hitting Take-Profit
- Trend reversal:

– **UP_TREND-> DOWN_TREND**
– **DOWN_TREND -> UP_TREND**
– **NOT_TRENDING_FROM_UP -> DOWN_TREND**
– **NOT_TRENDING_FROM_DOWN -> UP_TREND**

4.1.3 Overall System Flow



Hình 1: Overall System Flow

4.2 Parameters

My strategy consists of several main parameters:

- **InpAROONTimeframe**: This parameter represents the period in which my AROON indicator will calculate AROON_UP and AROON_DOWN. I will fix the value of this parameter to M5, meaning it will calculate AROON_UP and AROON_DOWN every 5 minutes.
- **InpAROONPeriod**: This parameter represents the number of cycles it will use to calculate AROON_UP and AROON_DOWN (This is the variable T_o that I discussed from section 3.1.2).
- **InpAROONLevelVar**: This parameter will be used to estimate the market trend (discussed in section 4.2.1).
- **InpAROONDiffVar**: Along with **InpAROONLevelVar**, this will also be used to estimate the market trend (discussed in section 4.2.1).

- **InpStopLoss**: represents Stop Loss in points in every open order.
- **InpTakeProfit**: represents Take Profit in points in every open order. I will not use this parameter during the optimization and back testing period, and sorely rely on TrailingStopLoss and Close Signals to exploit profits. However, the user can set a fixed Take profit level in live trading to reduce the risk of losing money (but it can limit the system's profit exploitation in some cases).
- **InpStopLossTrailingTimeframe**: This is a parameter that represents the cycle in which the system will move the Stop Loss level to the positive side by an amount equivalent to the profit range of the order that the system previously place (if any).
- **InpLotMode**: a parameter that tells us how this system will calculate my lot for each order based on my risk tolerance. There are three options: fixed lots, lot based on money and lot based on % of account. I will use lot based on % of account to achieve exponential equity curve.
- **InpVolume**: This parameter tells how much I will risk, based on what I chose at **InpLotMode**. In my case of "lot based on % of account", the system will risk **InpVolume** % of my account for each order. I recommend not risking more than 2% for each trade.

4.3 Walk-foward Analysis

4.3.1 Overview

One of the biggest issues with system development is that many systems do not hold up into the future. There are several reasons for this. The first is that the system is not based on a valid premise. Another is that the testing is not sound for reasons such as:

- Lack of robustness in a system due to improper parameters. A system is considered robust if it runs well in any market conditions.
- Inconsistent rules and improper testing of the system using 'out-of-sample' and 'in-sample' data.

Walk Forward Analysis does optimization on a training set; test on a period after the set and then rolls it all forward and repeats the process. I have multiple out-of-sample periods and look at these results combined. Walk forward analysis was first presented by Robert E. Pardo in the first version of his book Design, Testing and Optimization of Trading Systems in 1992.. The first accurate software implementation of Walk Forward Analysis was in Pardo Corporation's pioneering application Advanced Trader and then in increasingly advanced versions in other applications such as Blast and XT. Walking forward can keep a trading model a step ahead.[5] Walk forward is so called, as I have multiple walk training and testing periods is less likely to suffer from over-fitting. This article was originally published in Futures (defunct) presented Walk Forward Analysis in nascent form.

Walk forward testing allows us to develop a trading system while maintaining a reasonable 'degree of freedom'. Walk-forward testing carries the idea of 'out-of-sample' testing to the next level. It is a specific application of a technique known as Cross-validation. It means to take a segment of your data to optimize a system, and another segment of data to validate. Hence, here you optimize a window of data say past 1000 bars, and then test it on next 200 bars. Then roll the whole thing forward 200 bars and repeat the process. This gives you a large out of sample

period and allows you to see how stable the system is over time.

Suppose you consider a strategy around a moving average. You take the first 3 months of data, and find that for that period a 20-minute moving average was optimal (using tick data). You then validate this rule by assessing its performance for the 4th month (i.e. profit, reward/risk or any other statistic of interest). Next, you repeat the optimization using data from month 2–4, and validate using month 5, and keep repeating this until you've reached the end of the data. The performance you get for the validation months (4-13) are your out-of-sample performance.

The Walk-foward Analysis will have two phases: Initial Optimization Phase, and Walk-Foward Optimization Phase.

The Initial Optimization Phase is expected to give a "Good" initial parameter set,when I will take a set of important parameters (or inputs) and test them in a 10-year period for 3 sub-stages, that is in my case, all parameters in a stage will be optimized in 10-year data sample before moving to optimizing the parameters in the next stage.

Afterward, this set of initial parameters will be used to conduct Walk-Foward Optimization with 8 runs and 20% OOS. the decision of choosing 8 runs and 20%OOS is influenced by a research conducted at the [3] Reference.

A robust strategy will have the result from its OOS period similar to which from its IS period.

4.3.2 Symbol Data

4.3.2.a USDJPY Symbol

The USDJPY is the currency pair encompassing the dollar of the United States of America (symbol $, code USD), and the Japanese yen of Japan (symbol ¥, code JPY). The pair's rate indicates how many Japanese yen are needed in order to purchase one US dollar. For example, when the USDJPY is trading at 100.00, it means 1 US dollar is equivalent to 100 Japanese yen. The US dollar (USD) is the world's most traded currency, whilst the Japanese yen is the world's third most traded currency, resulting it in being the world's second most traded pair market with an extremely liquid pair, and very tight spreads, often staying within the 0 pip to 2 pip spread range on most forex brokers. Because there are always many active traders at any given time during its active hours, an order is usually executed instantly. Therefore, I will test and run my strategy on USDJPY Market.

4.3.2.b Quality Historical Data from Dukascopy

To perform quality analysis on my forex trading strategy, I certainly need a quality dataset to train and backtest on. A quality historical dataset should encompass several crucial aspects:

- The data must be accurate and reliable, free from errors, inconsistencies, or gaps.
- The data consists of a sufficiently long historical dataset.
- The data should include relevant information such as bid and ask prices, volume, and transaction timestamps.

Therefore, I will download 10 years of USDJPY's historical data (2014/01/01-2023/12/31) from Dukascopy to ensure quality training and robust back testing.

4.3.3 Performance Metric: CAGR/MeanDD

CAGR (Compound Annual Growth Rate) and MeanDD (Mean Drawdown) are both metrics commonly used in finance to evaluate the performance and risk of investments, particularly in the context of investment funds, portfolios, or individual assets.

- **CAGR formula**:

$$\mathbf{CAGR} = \left(\frac{\mathbf{E_{final}}}{\mathbf{E_{begin}}}\right)^{\frac{365}{t}} - \mathbf{1} \tag{3}$$

  Where:

  - E_{begin}: beginning equity
  - E_{final}: final equity
  - t: time in days

- **MeanDD formula**:

$$\mathbf{MeanDD} = \frac{\sum_{i=1}^{N} \mathbf{DD_i}}{\mathbf{N}} \tag{4}$$

  Where:

  - DD_i: ith drawdown
  - N: Number of Drawdowns

This metric will be used to compare strategies during Initial Optimization and WFO phase.

4.3.4 Initial Optimization Phase

The process begins with an initial optimization phase where the trading strategy parameters are determined using historical data of 10 years (2014/01/01 - 2023/12/31). This phase typically involves backtesting the strategy over a certain period to identify the optimal parameter values that maximize performance metric discussed in section 4.3.2 (CAGR/MeanDD).

Theses parameters will be tested and the one with the highest Fitness Fuction will be selected for the Walk-Foward Optimization Phase.

Sub-stage	Parameter	Start	Step	Stop
1	InpAROONPeriod	180	30	420
1	InpAROONLevelVar	80	5	95
1	InpAROONDiffVar	0	5	50
2	InpStopLoss	300	100	1000
2*	InpStopLossTrailingTimeframe	15M		1H
3	InpVolume	0.1	0.1	2.0

*Turn on StopLoss Trailing in Sub-stage 2

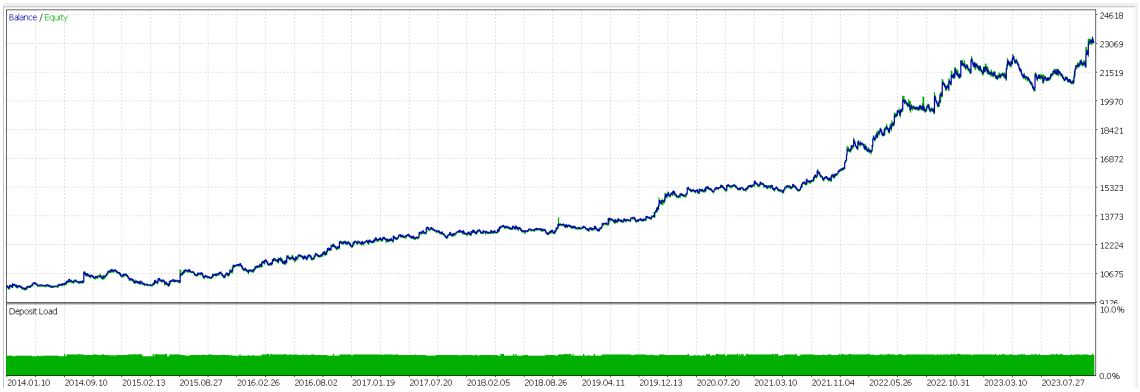
This is the result with the highest CAGR/MeanDD score after I train my parameters in the Period from 01/01/2014 to 31/12/2023, with an inital of 10,000$ simulated account:

- InpAROONPeriod: 330

- InpAROOVLevelVar: 95
- InpAROONDiffVar: 0
- InpStopLoss: 600
- InpStopLossTrailingTimeframe: 15M
- InpVolume: 0.4

History Quality	100%				
Bars	747659	Ticks	2795339	Symbols	1
Initial Deposit	10 000.00				
Total Net Profit	13 127.62	Balance Drawdown Absolute	189.81	Equity Drawdown Absolute	190.89
Gross Profit	67 372.97	Balance Drawdown Maximal	1 888.94 (8.42%)	Equity Drawdown Maximal	1 999.65 (8.87%)
Gross Loss	-54 245.35	Balance Drawdown Relative	8.42% (1 888.94)	Equity Drawdown Relative	8.87% (1 999.65)
Profit Factor	1.24	Expected Payoff	4.82	Margin Level	3328.26%
Recovery Factor	6.56	Sharpe Ratio	0.98	Z-Score	0.54 (41.08%)
AHPR	1.0003 (0.03%)	LR Correlation	0.95	OnTester result	4.324956508135135
GHPR	1.0003 (0.03%)	LR Standard Error	1 217.06		
Total Trades	2722	Short Trades (won %)	1331 (37.72%)	Long Trades (won %)	1391 (42.99%)
Total Deals	5444	Profit Trades (% of total)	1100 (40.41%)	Loss Trades (% of total)	1622 (59.59%)
	Largest	profit trade	894.90	loss trade	-126.42
	Average	profit trade	61.25	loss trade	-33.44
	Maximum	consecutive wins ($)	9 (1 052.63)	consecutive losses ($)	11 (-252.60)
	Maximal	consecutive profit (count)	1 052.63 (9)	consecutive loss (count)	-515.13 (9)
	Average	consecutive wins	2	consecutive losses	2

Hình 2: General Optimization detailed results



Hình 3: General Optimization equity curve

4.3.5 Walk-Forward Optimization Phase

4.3.5.a WF Optimization Strategy

As I've discussed earlier, I'll use the following walk-foward strategy:

- **Number of runs**: 8
- **OOS%: 20%**

Where the time between dates is 10 years, number of period is 12 and the average size of a period is 10 months. The time stamps of all 12 periods are the following

- **Period 1:** 2014/01/01 - 2014/10/31
- **Period 2:** 2014/11/01 - 2015/08/31
- **Period 3:** 2015/09/01 - 2016/06/30
- **Period 4:** 2016/07/01 - 2017/04/30
- **Period 5:** 2017/05/01 - 2018/02/28
- **Period 6:** 2018/03/01 - 2018/12/31
- **Period 7:** 2019/01/01 - 2019/10/31
- **Period 8:** 2019/11/01 - 2020/08/31
- **Period 9:** 2020/09/01 - 2021/06/30
- **Period 10:** 2021/07/01 - 2022/04/30
- **Period 11:** 2022/05/01 - 2023/02/28
- **Period 12:** 2023/03/01 - 2023/12/31

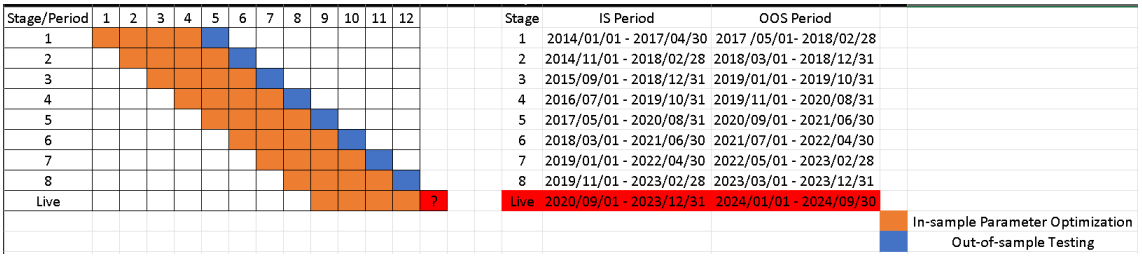
With the number of runs is 8 and the OOS% is 20%, the table describing each stage of the walk-foward validation phase can be made:

Stages	Optimization (Period)	Walk-forward (Period)
1	1,2,3,4	5
2	2,3,4,5	6
3	3,4,5,6	7
4	4,5,6,7	8
5	5,6,7,8	9
6	6,7,8,9	10
7	7,8,9,10	11
8	8,9,10,11	12

With those information in mind, the Walk-Foward Optimization Phase will be implemented with the following steps:

- **Step 1:** Use the result in the initial optimization phase to optimize in a 40-month period (IS period), initially from 2014/01/01 to 2017/04/30
- **Step 2:** The result after that 40-month period will be tested on the upcoming 10 months(OOS period), that is from 2017/05/01 to 2018/02/28
- **Step 3:** Repeat from Step 1, but shift the IS and OOS optimization period 10 months in the future, until my OOS period goes from 2023/03/01 to 2023/12/31.
- **Step 4:** Combine the OOS results of each stage to plot the OOS Equity Chart.

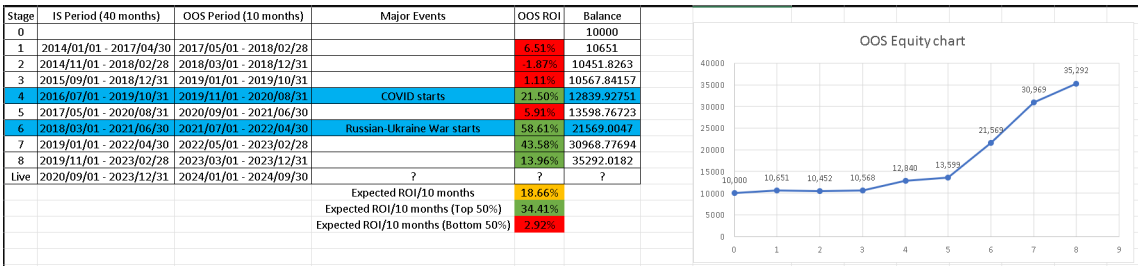
Here is the WFO phase visualized in Gant diagram:



Hình 4: Walk-Foward Optimization visualized

4.3.5.b Walk-Foward Optimization Result:

Following the completion of the Walk-Forward Analysis phase, I have obtained a comprehensive understanding of my strategy's historical performance through the examination of the Out-of-Sample (OOS) Equity chart. Presenting a visually striking exponential equity chart, my strategy demonstrates notable efficacy particularly during periods marked by significant global events such as the COVID-19 pandemic and the Russian-Ukrainian War.



Hình 5: Walk-Foward Analysis Result

4.3.6 Pre-live Analysis

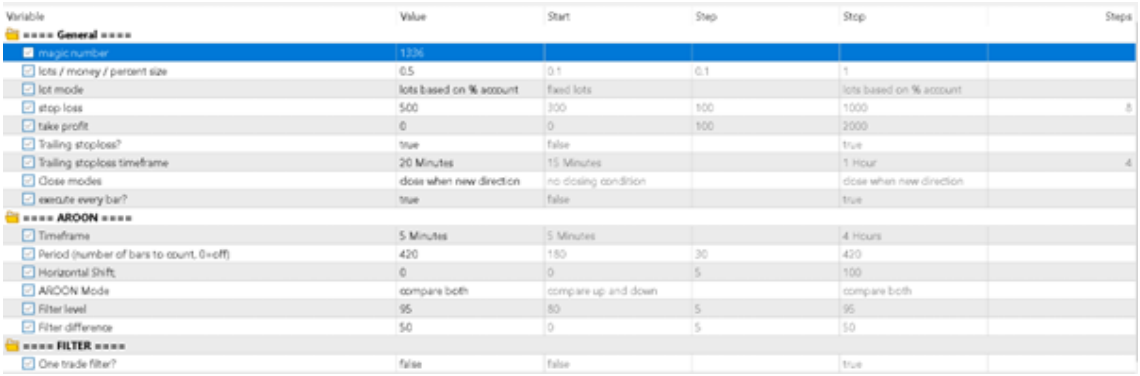
Just like the WF Analysis, 4 periods before live trading is used to optimize parameters. But the result of the optimization will be used on live trading. Detailed of the performance of the EA will be discussed later in **section 5**. The result in this section can be used in a 10-month period of 2024/01/01 - 2024/10/31.

Pre-live Stage (2020/09/01 - 2023/12/31))
Optimization Period: 2020/09/01 - 2023/12/31

Result:

- InpAROONPeriod: 420
- InpAROONLevelVar: 95
- InpAROONDiffVar: 50
- InpStopLoss: 500

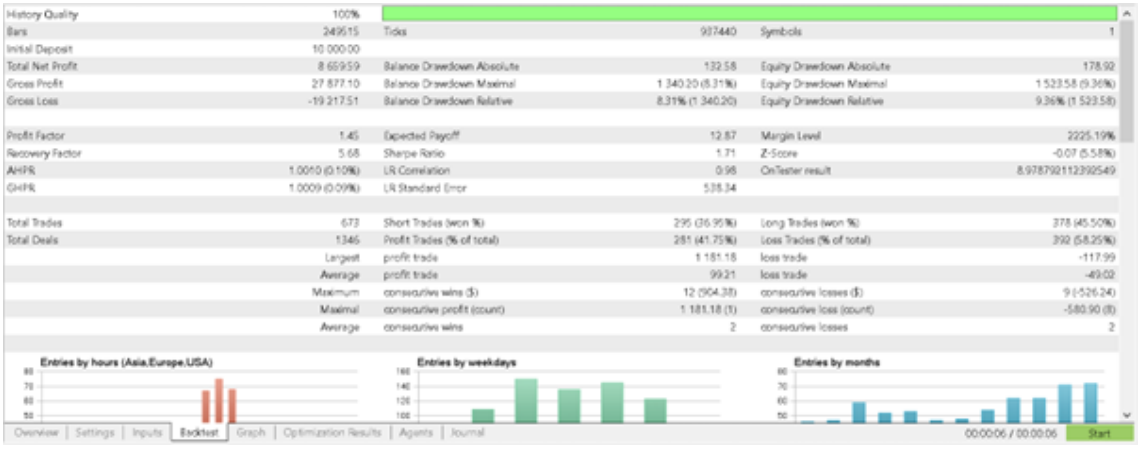
- InpStopLossTrailingTimeframe: 20M
- InpVolume: 0.5



Variable	Value	Start	Step	Stop	Steps
==== General ====					
magic number	1206				
lots / money / percent size	0.5	0.1	0.1	1	
lot mode	lots based on % account	fixed lots		lots based on % account	
stop loss	500	300	100	1000	8
take profit	0	0	100	2000	
Trailing stoploss?	true	false		true	
Trailing stoploss timeframe	20 Minutes	15 Minutes		1 Hour	4
Close modes	close when new direction	no closing condition		close when new direction	
execute every bar?	true	false		true	
==== AROON ====					
Timeframe	5 Minutes	5 Minutes		4 Hours	
Period (number of bars to count, 0=off)	420	180	30	420	
Horizontal Shift	0	0	5	100	
AROON Mode	compare both	compare up and down		compare both	
Filter level	95	80	5	95	
Filter difference	50	0	5	50	
==== FILTER ====					
One trade filter?	false	false		true	

Hình 6: Pre-live Stage Input set

IS Result:



History Quality	100%				
Bars	249515	Ticks	937440	Symbols	1
Initial Deposit	10 000.00				
Total Net Profit	8 659.59	Balance Drawdown Absolute	132.58	Equity Drawdown Absolute	178.92
Gross Profit	27 877.10	Balance Drawdown Maximal	1 340.20 (8.31%)	Equity Drawdown Maximal	1 523.58 (9.36%)
Gross Loss	-19 217.51	Balance Drawdown Relative	8.31% (1 340.20)	Equity Drawdown Relative	9.36% (1 523.58)
Profit Factor	1.45	Expected Payoff	12.87	Margin Level	2225.19%
Recovery Factor	5.68	Sharpe Ratio	1.71	Z-Score	-0.07 (5.58%)
AHPR	1.0010 (0.10%)	LR Correlation	0.98	OnTester result	8.978792112392549
GHPR	1.0009 (0.09%)	LR Standard Error	538.34		
Total Trades	673	Short Trades (won %)	295 (36.95%)	Long Trades (won %)	378 (45.50%)
Total Deals	1346	Profit Trades (% of total)	281 (41.75%)	Loss Trades (% of total)	392 (58.25%)
	Largest	profit trade	1 181.18	loss trade	-117.99
	Average	profit trade	99.21	loss trade	-49.02
	Maximum	consecutive wins ($)	12 (904.38)	consecutive losses ($)	9 (-526.24)
	Maximal	consecutive profit (count)	1 181.18 (1)	consecutive loss (count)	-580.90 (8)
	Average	consecutive wins	2	consecutive losses	2

Entries by hours (Asia,Europe,USA) | Entries by weekdays | Entries by months

Overview | Settings | Inputs | Backtest | Graph | Optimization Results | Agents | Journal | 00:00:06 / 00:00:06 | Start

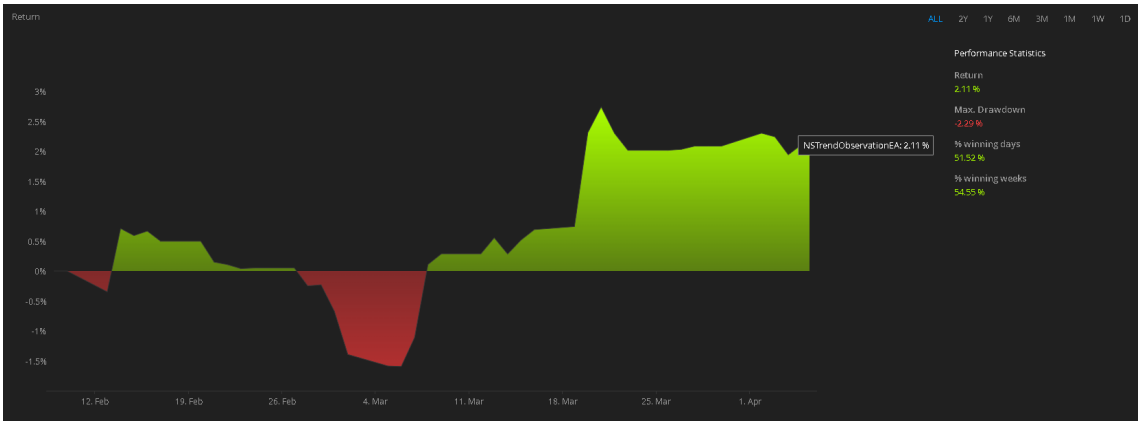
Hình 7: Pre-live Stage IS Result

Equity Curve:

Hình 8: Pre-live Stage Equity Curve

5 Live Trading Performance (2024/02/09 - 2024/04/05)

Although my result from the Pre-live Analysis is proven to be effective in the first 10 months of 2024, I had only deployed in since 2024/02/09 and the Live Trading Perfomance given below is recorded in 2024/04/05.



Hình 9: Live trading performance

A period of only 2 months is too little to tell if my strategy is working or not. But optimistically speaking, the trading system using AROON indicator after Walk-Foward Optimization gives positive income.

6 Conclusion

In conclusion, the development and implementation of the Automated AROON-Based Forex Trading system with Walk-Forward Analysis represent a significant stride towards enhancing trading efficiency and adaptability in the Forex market. By harnessing the power of the AROON

indicator and integrating automation, I aimed to streamline trading operations while minimizing emotional biases and human errors.

The Walk-Forward Analysis served as a robust validation mechanism, ensuring the resilience and adaptability of my trading system across various market conditions. Through iterative optimization and validation phases, I were able to verify the effectiveness of my approach and mitigate the risks of overfitting.

The live trading performance analysis conducted over the period from February 9th, 2024, to April 5th, 2024, provided reliable evidence of the system's efficacy in real-world trading scenarios. Despite the inherent volatility and unpredictability of the Forex market, my system demonstrated consistent performance and profitability, reaffirming the viability of my approach.

In summary, the Automated AROON-Based Forex Trading system with Walk-Forward Analysis offers a promising avenue for traders seeking to optimize their strategies and navigate the complexities of the Forex market with confidence. The integration of advanced technical indicators, systematic validation techniques, and automated execution capabilities can significantly enhance trading efficiency and potentially unlock new avenues for profitability in the ever-evolving landscape of Forex trading.

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References

[1] Aroon Indicator: Formula, Calculations, Interpretation, Limits

[2] Walk forward optimization

[3] Research Findings: WALK FORWARD ANALYSIS Effectiveness