**International Journal of Advanced Engineering and Management Research**

Vol. 6, No. 02; 2021

ISSN: 2456-3676

# OPTIMAL HOLDING INTERVAL FOR FOREIGN EXCHANGE TRADING

Chang Yu1*, Xiaodong Wang2, Rado Kotorov3, Jeremy Wood4

[1]Trendalyze, Inc.,
[1]Washington Park, Newark, United States,

[2]Trendalyze, Inc.,
[1]Washington Park, Newark, United States,

[3]Trendalyze, Inc.,
[1]Washington Park, Newark, United States,

[4]Trendalyze, Inc.,
[1]Washington Park, Newark, United States,

**Abstract**

Foreign exchange trading is popular among professional traders. There are many discussion boards online where the traders are wondering what the optimal time interval is. Despite the discussions, there is no scientific exploration. It is needed to see if empirical evidence will support the existence of such an optimal interval. It is also essential to establish a methodology for the calculation of such intervals for different asset classes. In this paper, we discuss two different models that can be used to find the optimal holding period of the foreign exchange for a given target profit. We also conduct numerical tests that illustrate the two models coincide with each other. The research is beneficial for automated trading systems.

**Keywords:** time series, optimal time interval, foreign exchange, trading, frequency model

## 1. Introduction

With the development of modern technology, there have been more and more professional and non-professional traders entering the market of foreign exchange. There have been heated discussions on forums and social media about the best holding interval for foreign exchange. However, it seems the conclusion is that it is dependent on different trading strategies. There has not been enough research in this area.

In Economics, the exchange rate is the rate of one country's currency in relation to another index or currency. It is used to determine an individual country's currency value relative to the other major currency in the market. In 1971, ten leading developed nations: Belgium, France, Canada, Germany, Japan, Italy, the Netherlands, Sweden, the United Kingdom, and the United States came to the famous Smithsonian Agreement. This deal has recreated the order and effectively set up the new standard for the dollar, as the rest of the C10 pegged their currencies to the U.S. dollar.

Vol. 6, No. 02; 2021

ISSN: 2456-3676

However, the value of a currency relative to another is not fixed. Many currencies, as well as digital currencies, has shown great ability to shift the market based on investor's expectation to the future performance. The value of currencies is determined in the foreign exchange market (Forex). Forex Market (also known as FX, or the currency market) is an over-the-counter (OTC) for participants to buy, sell, exchange, and predict major currencies. It is the largest and most comprehensive trading platform for everyone. It is open 24 hours a day and five days per week. The trade volume per day is more than 4 trillion USD. One significant property of Forex trading is that you always trade in pairs. The "value" of one currency is the value for that currency relative to the counter currency you are trading in the pair. Establishing this relationship (value in number) for the global market is the main use of the Forex. This provides great utility and liquidity in all other financial markets, which is key to the overall health of the financial industry and human society.

To be precise, we address the state of finding the optimal time interval for Forex trading by using time series data of exchange rate. However, this rate only provides valid information if it is a floating rate. A fixed or pegged rate is a rate that one government sets and maintains as the official exchange rate. A set price will be determined against a major world currency to achieve one country's stability of the political and financial state of independence. Examples of this will include the Chinese Yuan and the Indian Rupee.

The contribution of this paper consists of two major parts. First, we propose two new models that take in the time series as input and can output a detailed analysis about the profit under different holding intervals. Second, we develop quantitative strategy approaches that can calculate the best holding interval for different kinds of investors based on their individual investment goals and target profit.

The practical significance of our paper is in two major areas. First, most traders set some profit target and then try to identify patterns in the data that signal a trading opportunity. For them, we provide a methodology to validate the optimal period empirically. This helps them identify signals within objectively defined periods rather than rely on intuitions. Second, this is particularly valuable to building AI models that mine for patterns to be leveraged in algorithmic trading. One of the main challenges in AI is how to extract features in time series data where the beginning and ending intervals can vary greatly. We provide a solution to this problem.

## 2. Literature Review

(Ozorhan, et al., 2019) use motif discovery to predict short-term trends in financial time series found in the foreign exchange market. They aim to discover various patterns with similar routes from the time-series perspective. This article suggests using the Zigzag technical indicator to discover motifs that identify short-term financial data trends in a high prediction accuracy and trade profits.

(Gentle & Wilson, 2018) find out that certain patterns of stock prices over a specific time interval. Like the Forex market, the stock market often has a natural periodicity. It is a widespread belief that patterns have predictive value. They use symbolic aggregate approximation, or SAX, to approximate patterns in time series data. If the time series is assumed

Vol. 6, No. 02; 2021

ISSN: 2456-3676

to have a common beginning and end and equal sampling frequencies, the comparison is straightforward.

(Leivo & Pätäri, 2009) focus on determining how the relative risk of stocks and bonds evolves with the holding period, and it does so by assessing the evidence from 19 countries over 110 years. One interesting recommendation suggests that younger investors should have a higher proportion of their portfolio allocated to riskier assets than older investors; that is, as investors get older and their holding period shortens, they should gradually decrease the proportion of riskier assets and increase that of less risky assets in their portfolio. The concept of time diversification refers to the relationship between risk and the holding period.

(Bredin & Hyde, 2004) uses a portfolio based on FOREX exposure of a small open economy among its counterparties. The relative merits of different forecasting techniques are compared with an assumption that expected returns on the assets are zero. The results offer an indication of the level of accuracy of the various approaches and discuss the issues of models ensuring statistical accuracy or more conservative leanings. He finds that the Orthogonal GARCH model is the most accurate methodology, while the EWMA specification is the more conservative approach.

(Tsai, et al., 2020) work on an optimal trading model in their collaboration paper. They combine time-series modeling and convolutional neural networks (CNNs). Then they developed the model to classify the output into three actions: buy, sell, and not taking any action. The experimental results show that if the strategy is clear enough to make the images distinguishable, then the model can predict the prices of a financial asset.

(Erol, et al., 2010) propose a new approach that uses an optimization technique with a single-variable constraint to determine an optimal interval length in high order fuzzy time series models. They use an optimization procedure in order to determine the optimum length of interval for the best forecasting accuracy. They employ the model to forecast the enrollments of the University of Alabama.

(Pradeepkumar & Ravi, 2016) propose a new hybrid forecasting model for predicting the FOREX rates. His model determines whether chaos is present or not in the dataset and then follows another test on the optimal lag. Once the lag is determined, Pradeepkumar's model accepts it and obtains the result: scalar FOREX rate time series. From the comparisons of the proposed model with other models listed in the paper, we can see that his model yielded the most accurate predictions.

It can be seen from the literature that there are some studies focusing on interval research, but none of which is able to combine the concepts of optimal interval and pattern mining. In addition, they focus on predicting future trends rather than determining the best trading interval based on historical data. In our research, we will focus more on empirically verifying the best period, also combining the pattern extraction and the holding period.

## 3. Backward-Walking Frequency Model

Backward-Walking Forex Frequency Model is a model customized by the user for computing optimal time interval for holding/shorting Forex. It does not make any predictions regarding the

Vol. 6, No. 02; 2021

ISSN: 2456-3676

future value or trend of the Forex market. It is used to compute the best strategy for an individual investor who participates in the Forex market with an active trading habit. This model takes the historical Forex data as of today and backward, walking up to one month ago.

**Definition 3.1**
(Record Sufficient Trading Time Interval) – Given specific target profit level – p. Let $x$ be the difference between $r_i \; and \; r_{i-1}$, that is $x = r_i - r_{i-1}$

If $|x| \geq p$, we record the distance. In this case, the distance will be 1.

If $|x| < p$, we jump back 1 minute and find the new $x$.

**Definition 3.2**
(Classifying exchange rate times series data)

Given time series $T = < t_1, t_2, t_3, \ldots\ldots t_n > (t_i \in N^+)$, the targeted exchange rate is denoted as $R = < r_1, r_2, r_3, \ldots\ldots r_n >$ (floating rate). (n is greater than 600 for sufficient testing results).

**Definition 3.3**
(Time Series Segmentation) – Given a time series T = $< o_1, o_2, o_3, \ldots\ldots o_n >$ of length n, segmentation constructs a model T' such that dimensionality of T' is less than the dimensionality of T such that $d(T') \leq d(T)$ and T' approximates T with an error threshold e for a reconstruction function R where D(R(T'), T) <e.

Algorithm: Backward-Walking Frequency Model

**Require: D** ← current date**, n** ← numbers of time spot to walkover**, target** ← targeted profit level
1. Initiate i=n
2. **while** i< size:
3. **for** each possible window:
4. backward the trading window
5. **if** long/short trade profit in the trading window is greater than target:
6. record the time window.
**7. break**
8. i=i+1
9. record the total count of the possible window.

**4. Forward-Walking Profit Model**

Forward-Walking Profit Model is also a model designed to find the optimal holding time for the given target profit level. Like the Backward-Walking Frequency model, it searches for the best

Vol. 6, No. 02; 2021

ISSN: 2456-3676

holding interval rather than predicting the time series. This simple and heuristic model aims to maximize the total profit.

*4.1 Model Assumptions*

We assume the following hold:

(1) All data points are known in advance.

(2) Enter the FOREX contract only at the beginning of the interval.

(3) Hold the contract all through in the interval.

(4) Exit the FOREX contract only at the end of the interval.

*4.2 Algorithm*

Given a Time Series data, target profit $P_t$ and the holding window, we can compute the possible profit using the following algorithm after we split the time series into segments by the holding window:

Algorithm: Forward-Walking Profit Model

**Require: target** ← targeted profit level

1. Initialize total profit $P_0 = 0$
2. Go to the first segment.
3. Calculate the difference between the largest point and the starting point $p_t = t_{max} - t_0$.
4. **if** the segment is profitable $p_t > target$
5. Add to the total profit $P_0 = P_0 + p_t$
6. **else**
7. Do nothing
8. Go to the next interval and return to line 3

## 4. Numerical Results

*4.1 Backward-Walking frequency model*

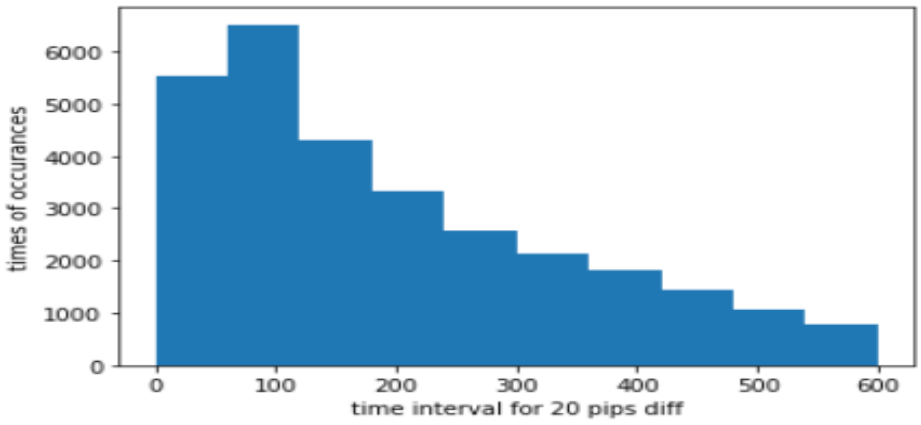


Figure 1 Optimal time interval using 2018.1, target profit level = 20 pips

Vol. 6, No. 02; 2021

ISSN: 2456-3676

Figure 1 shows that: Using Forex 2018 January data, the number of occurrences of 20 pips reaches the highest in the 2-hour interval. Then it declines gradually every hour. *Transactional cost is not considered.

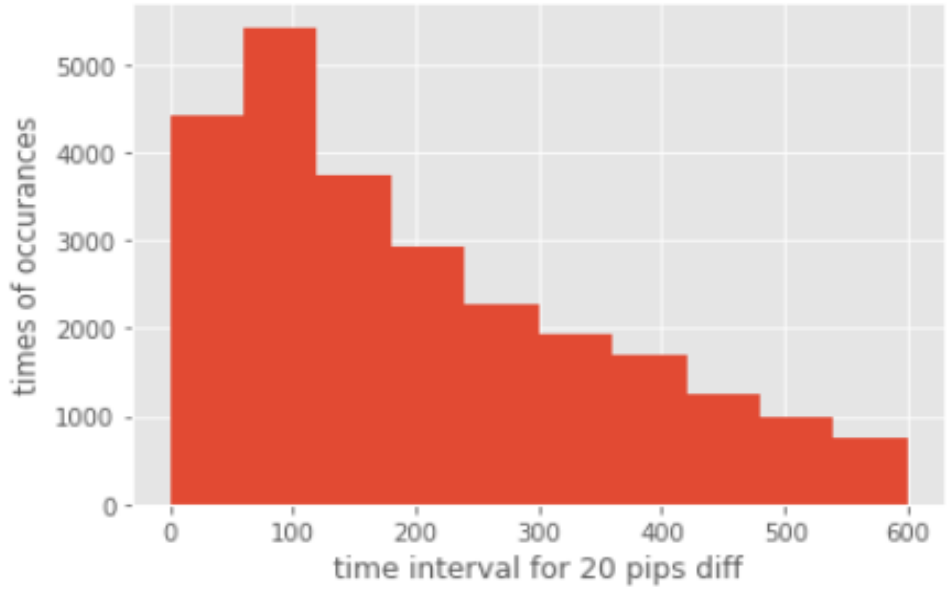


Figure 2 Optimal time interval using 2018.2, target profit level = 20 pips

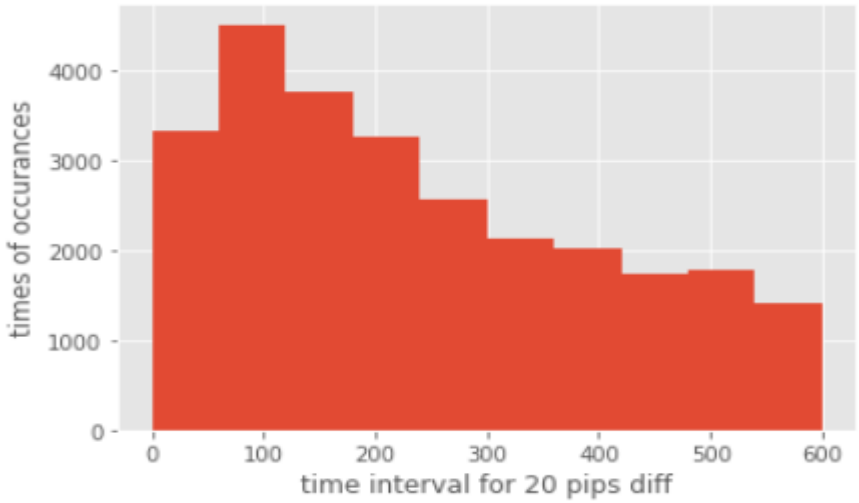


Figure 3 Optimal time interval using 2018.3, target profit level = 20 pips

Figures 2 and 3 show that: Using Forex 2018 February and March data, we repeat the algorithm, and we can come up with the same result. The number of occurrences of 20 pips reaches the

Vol. 6, No. 02; 2021

ISSN: 2456-3676

highest in the 2-hour interval. Then it declines gradually every hour. We indicate that there is no seasonal shift in this time series data.

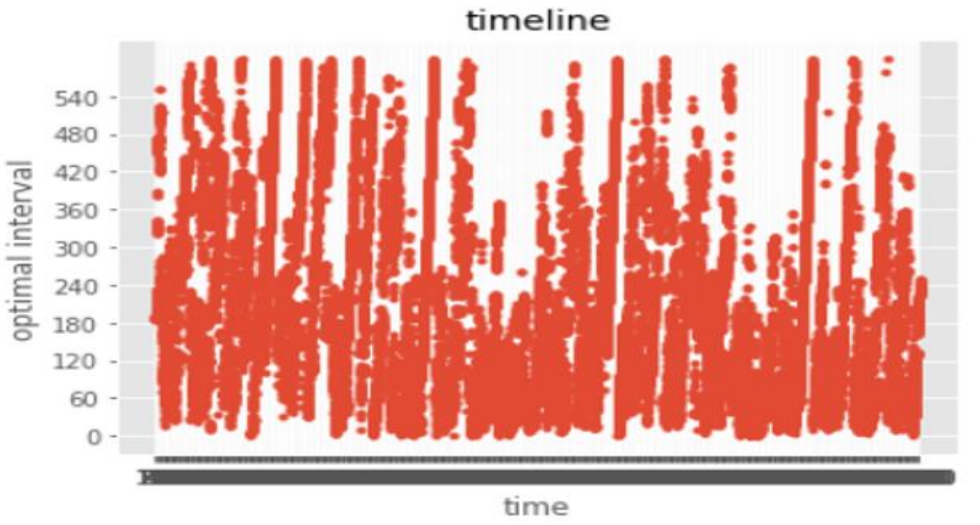


Figure 4 Optimal time interval using January 2018, target profit level = 20 pips

Figure 4 plots the distribution of profit opportunities throughout the month. It shows the results are evenly distributed. This is important for investors because it shows that opportunities are created randomly distributed instead of stacking on a specific time interval in one month.

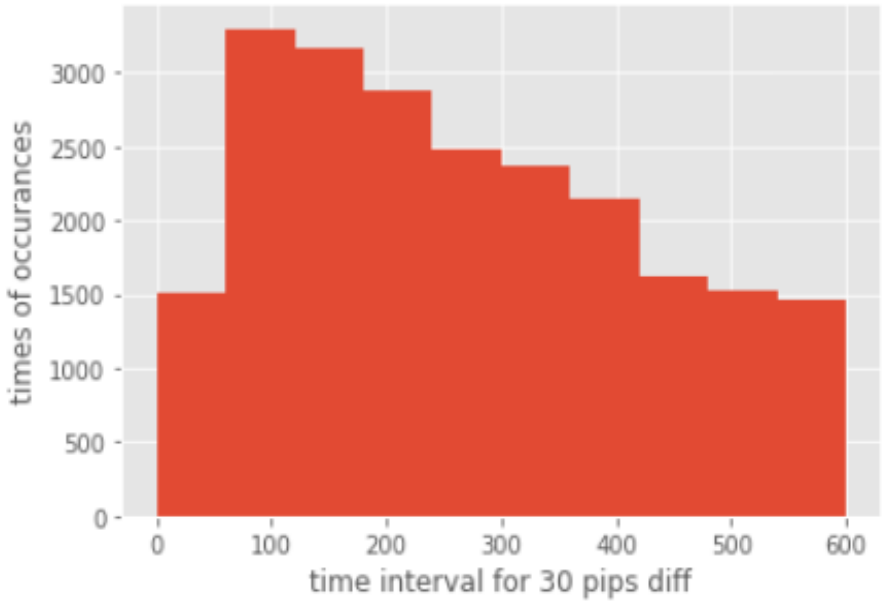


Figure 5 Optimal time interval using 2018.1, target profit level = 30 pips

Vol. 6, No. 02; 2021

ISSN: 2456-3676

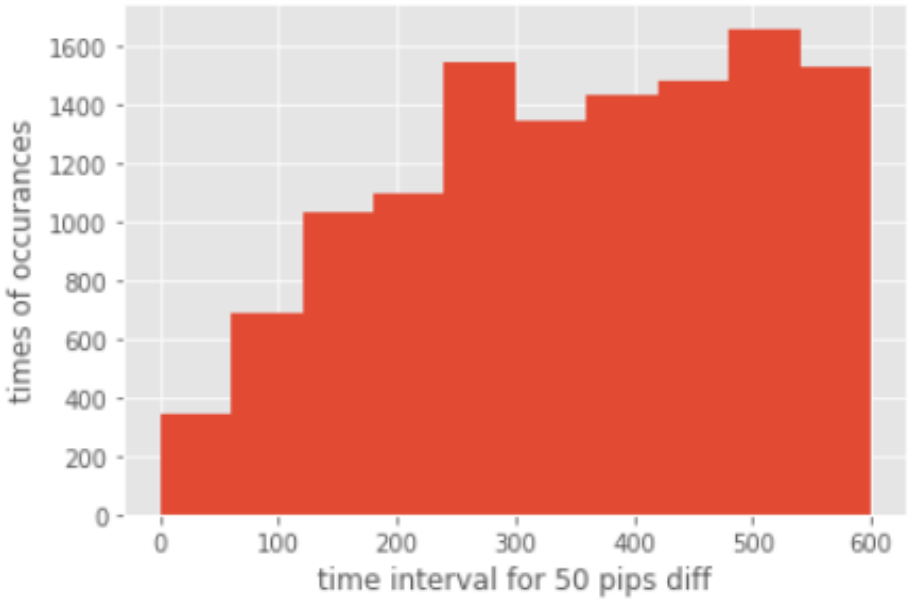


Figure 6 Optimal time interval using 2018.1, target profit level = 50 pips

Figure 5 and Figure 6 shows that as the user input (for target profit level) increases, the optimal time interval will increase accordingly.

*4.2 Forward-Walking Profit Model*

Similar to the Backward-walking model, we set the target profit to 20, 30, and 50 pips to test the result.

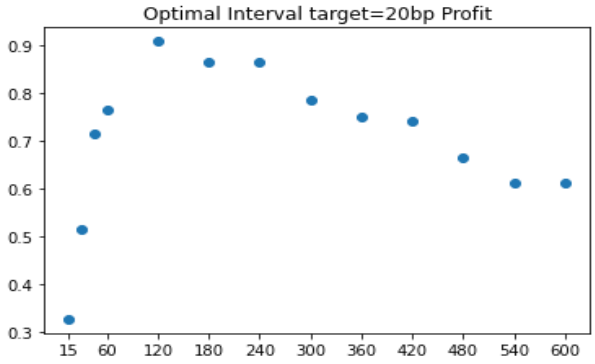


Figure 7 Total Profit Plot, with Target profit = 20 pips.

We can see that in Figure 7, the 120 minutes interval generates the best profit. The profit increases within an hour and declines after 2 hours interval.

Vol. 6, No. 02; 2021

ISSN: 2456-3676

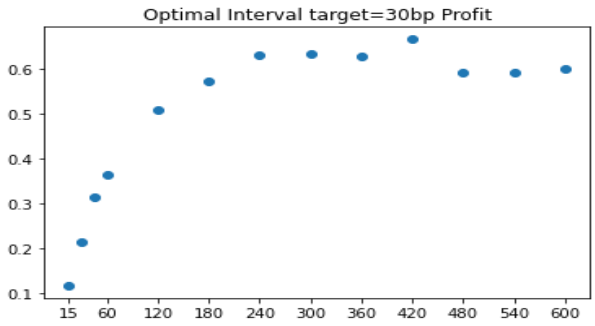


Figure 8 Total Profit Plot, with Target profit = 30 pips.

We can see that in Figure 8, the 420 minutes interval generates the best profit. The profit keeps increasing until it reaches the 7 hours interval.

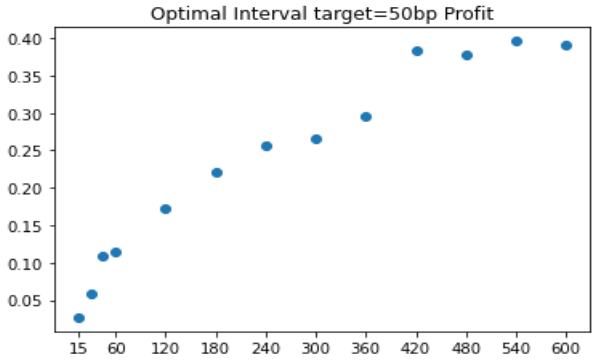


Figure 9 Total Profit Plot, with Target profit = 50 pips.

We can see for the 50 pips profit, the optimal holding period lies in 9 hours. The larger chosen interval is mainly the result of the higher profit target.

To better understand the result, we also plot the profitable segment count with the three target profit.

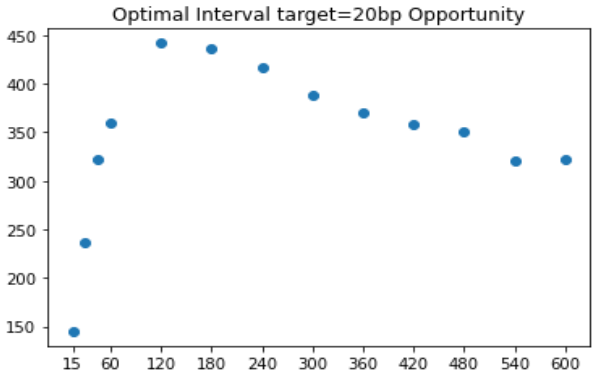


Figure 10 Total Opportunity Plot, with Target profit = 20 pips.

Vol. 6, No. 02; 2021

ISSN: 2456-3676

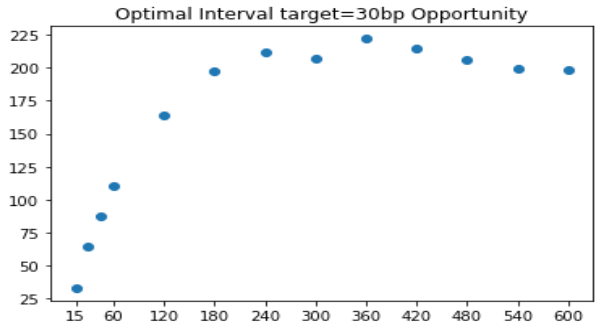


Figure 11 Total Opportunity Plot, with Target profit = 20 pips.

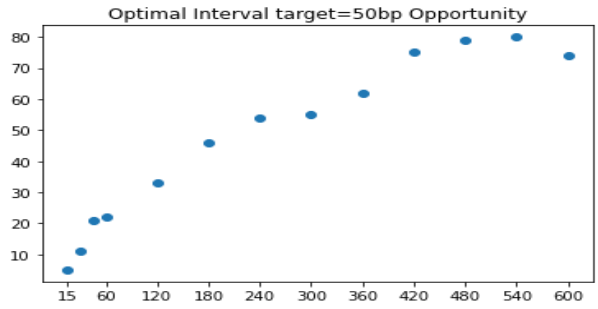


Figure 12 Total Opportunity Plot, with Target profit = 20 pips.

From Figures 10, 11, and 12, we see that the opportunity count first increases as the time interval gets bigger, then it reaches a maximum and decreases afterward. Also, the trading interval with the most opportunities is not necessarily the best profit interval.

## 5. Statistical Tests

In this section, we introduce two significant tests to tell us the probability is that the relationship we think we have found is not due only to random chance. At the 95% confidence level, we can say that a time interval is better than another.

Null hypothesis: $P_{1-2\ hour} = P_{2-3\ hour}$

| | Success | Fail | *Marginal Row Totals* |
|---|---|---|---|
| **1-2 hour** | 6650 (5375) [302.44] | 38040 (39315) [41.35] | 44690 |
| **2-3 hour** | 4100 (5375) [302.44] | 40590 (39315) [41.35] | 44690 |
| ***Marginal Column Totals*** | 10750 | 78630 | 89380 (Grand Total) |

The chi-square statistic is 687.5812. The *p*-value is < 0.00001. Significant at $p < .05$.

Figure 13 Significant test between 2 time intervals part I.

Vol. 6, No. 02; 2021

ISSN: 2456-3676

Interpret results: Since the p-value is less than the significance level, we cannot accept the null hypothesis.

Null hypothesis: $P_{1-2\ hour} = P_{0-1\ hour}$

| | Success | Fail | *Marginal Row Totals* |
|---|---|---|---|
| **0-1 hour** | 5502 (6076) [54.23] | 39188 (38614) [8.53] | 44690 |
| **1-2 hour** | 6650 (6076) [54.23] | 38040 (38614) [8.53] | 44690 |
| ***Marginal Column Totals*** | 12152 | 77228 | 89380 (Grand Total) |

The chi-square statistic is 125.5167. The *p*-value is < 0.00001. Significant at $p < .05$.

Figure 14 Significant test between 2 time intervals part II.

Interpret results: Since the p-value is less than the significance level, we cannot accept the null hypothesis.

## 5. Conclusions

With the development of modern computer science and automated quotations, more and more professional traders are entering the FOREX trading field. The optimal trading period has been discussed on many trading forums, but there is rarely any research debating this topic. We proposed two different models in this paper to try to solve this issue. The Backward-Walking Frequency Model and the Forward-Walking Profit Model start from different aspects but will give a similar result for the holding period. Along with the numerical results, we showed that the two models are effective for different levels of the target profit. Also, statistical tests are conducted to indicate whether the optimal interval is randomly selected. By calculating the Chi-Square test, it shows that we should reject the null hypothesis and the optimal holding period is better than others significantly.

This research would benefit the potential professional traders to design automated trading systems. Specifically, for any trader who wants to decide his trading interval, he would need to first design his target profit level based on his trading strategy, trading behavior, and personality. After that, he can use the two proposed models to evaluate the possible profit for each trading interval. After conducting the backtest, he would be able to make decisions based on the results. The same process also works for automated trading systems.

## Acknowledgments

The authors declare that there is no conflict of interest. All authors contributed equally to the study. We would like to thank Yoshiko from Trendalyze for the support and grammar check in this research.

Vol. 6, No. 02; 2021

ISSN: 2456-3676

**References**

Bredin, Hyde, 2004. FOREX Risk: Measurement and Evaluation Using Value-at-Risk. *Journal of Business Finance & Accounting.* Volume 31, Issue 9-10, pp. 1389-1417.

Erol, Cagdas, Ufuk, Vedide, Murat, 2010. Finding an optimal interval length in high order fuzzy time series. *Expert Systems with Applications*, Volume 37, Issue 7.

Estrada, Javier, 2013. Stocks, bonds, risk, and the holding period: An international perspective. *The Journal of Wealth Management*, 16.2: 25-44.

Gentle, Wilson, 2018. Finding Patterns in Time Series. In: Härdle W., Lu HS., Shen X. (Eds) *Handbook of Big Data Analytics*. Springer Handbooks of Computational Statistics. Springer, Cham.

Leivo, Pätäri, 2009. The impact of holding period length on value portfolio performance in the Finnish stock markets. *Journal of Money, investment and banking*, 2.8: 71-86.

Ozorhan, Toroslu, Sehitoglu, 2019. Short-term trend prediction in financial time series data. *Knowledge and Information Systems*, 61. 397-429.

Pradeepkumar, Ravi, 2016. FOREX Rate prediction using Chaos and Quantile Regression Random Forest. *2016 3rd International Conference on Recent Advances in Information Technology*, pp. 517-522.

Schaub, Simmons, 2019. Contributing Factors of Long-Term ADR Holding Period Returns: An Up-To-Date Analysis. *Financial Issues in Emerging Economies: Special Issue Including Selected Papers from II International Conference on Economics and Finance*, Volume 36.

Tsai, Chen, Wang, 2020. Predict Forex Trend via Convolutional Neural Networks. De Gruyter 2020. *Journal of Intelligent Systems*, Volume 29, Issue 1.