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# 1 Introduction

The FOREX market is the world's largest and most liquid market. Forecasting this market is one of the biggest challenges of modern time series analysis. A lot of noise and high volatility are characteristics of this market; see [Huang, Lai, Nakamori & Wang, 2004](#). Forecasting is done via statistical methods. Since the 1990s artificial neural networks are also utilized.

A survey at the Bank of England shows that 90% of the participants use technical analysis at least to some degree in their FOREX forecasts, see [Taylor & Allen, \(1992\)](#). That indicates that technical analysis has a predictive value for forecasts. These results are confirmed by recent surveys of various scientists, see [Lui & Mole, 1998](#); [Menkhoff & Gehrig, \(2006\)](#).

This raises the question of whether commonly used technical indicators are able to achieve higher profits than a moving average crossover trading strategy. Therefore a model building process including artificial neural networks (ANNs) is developed and tested. This implies the question, in which way these improvements can be achieved. The used indicators are set to simple moving average, exponential moving average, Relative Strength Index, Momentum indicator and Bollinger Bands. The investigation period is chosen from 2006 to 2013 on the basis of daily data.

In the course of this section the research subjects are explained. In the following section 0 an introduction into the research development is given. The introduction is split into two parts. The first part discusses the possible alternatives for currency forecasts. These are statistical methods and ANNs. In addition an overview of several methods of feature selection is given. Section 3 explains fundamentals such as ANNs, technical indicators and the neurosimulator FAUN. Section 4 describes the model building process. Therefore the process is split up into several steps. The first step contains the training preparation, which creates the input data for the ANNs. Afterwards the training process is shown. The last step explains the developed trading system. In section 5 the model building process is employed. In section 6 the results of the research are compared and conclusions are drawn. Section 7 summarizes the results.

The first objective is to develop a model building process to create FOREX market predictions which utilizes a feature selection method and ANNs. The feature selection method should be used to determine which indicators have an impact on future pricing. The third objective is to create a trading system using the results obtained from training ANNs to prove the effectiveness. By comparison to a benchmark the trading systems performance is checked.

As a result two of the five expectations are discarded. The first expectation which says that the ratio of often selected indicators improves the performance of the trading system does not apply. There is no indication that a higher amount of hidden neurons provides a better forecast, therefore the third expectation must be discarded. The second expectation is highly relevant. Using the first differences of the data as inputs has a huge impact on the trading results. There might be an influence on the forecast quality by using added price lags. It gives the impression that the price lags are advantageous for the in-sample error reduction. Evidence is found that it might be beneficial for the generalization quality to not use additional price lags as inputs.

## 7 Conclusion

The first objective was to develop a model building process to create FOREX market predictions which utilizes a feature selection method and ANNs. This objective was accomplished in section 0. As a part of the model building the feature selection was used to select indicators from a predefined pool. To measure the impact on future pricing ANNs have to be trained with the selected indicators. Afterwards the analysis of the trained ANNs according to the RMSE and the indicators enables the creation of certain expectations which have to be met to verify the benefit of these indicators. To test the expectations the previously created trading system is applied to the outputs of the artificial neural networks. In the same step a comparison of the trading system and the benchmark is done.

To verify certain aspects of the model building process five expectations were created. Two assumptions could not be confirmed while one is accepted. The influence of the other two expectations cannot be refused.

Further research could be made by using one of the presented feature selection methods in section 2.2.<sup>9</sup> The entire process is very time consuming because of the required retraining after each elimination step. This process could increase the prediction quality of the ANNs as well as the trading results. An alternative to changing the feature selection is to compare trained ANNs with both the selected and randomly chosen indicators. By analyzing the results a rating of the feature selection method can be made whether it improves the forecasting quality or not.

Another area of investigation is the trading system. By adding additional data like high, low, open and close prices, several trading rules can be added such as money management rules, stop losses and take profit targets could be applied.

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<sup>9</sup> For a possible training pattern see appendix C