Data mining with python: Automated FOREX trading

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***Abstract*—This project will utilize the oandapy API to get realtime data from the currency market to analyse, as well as enter and exit trades on based on the analytics. In the analytics we are going to use a short and a long moving averages, furthermore we are going to use MCAD as an extra precaution before we enter trades and use recovery zones to prevent losses on the account**

I. Introduction

We all know the feeling about having money, but we also know the feeling of all the work we have to do in order to get the money. But what if you could have someone doing it for you? In this project we will try to make an automated trading bot. This bot will use oanda's API, and in that way get a currency data and make trades on it. For retrieving the data and making trades we will use machine learning with python, and in that way hopefully end out with some sort of profit.

II. Analysis

A. Getting data

We obtain all the financial data of the financial instrument EUR vs USD, on a 5 minute timeframe from oanda, using their own REST API for python. From oanda's API we get the financial charts of a 7 year time period, going from 2007-10-01 to 2014-10-20. After obtaining the data, it is stored in json fileformat in a file called "fxdata.txt", this data will then be used both to form our hypothosis of forex trading on the EUR vs USD currency pair, as well as performing a trading simulation on this set of data. However in order for us to use the naive Bayes classifier, we need to have two dataset's and not just a single one. In our domain the one dataset needs to be the trades which gained profit, and the other set needs consist of the trades which lost. We then have the possibility to analyze the data with different sets of features.

The pseudo code of the random trading algorithm, where we will keep the orders for no more than 20 minutes:

while $streamFinancialData$ **do**
  $i = random(0, 10)$
  if $i = 0$ **then**
    $openOrder(short)$
  else if $i = 1$ **then**
    $openOrder(long)$
  end if
  for $order\ in\ orders$ **do**
    if $order.hasProfit()$ **then**
      $profitList.append(order)$
      $order.close()$
    else if $order.hasLoss()$ **then**
      $lossList.append(order)$
      $order.close()$
    else if $order.duration >= 4$ **then**
      $order.close()$
    else
      $order.duration+ = 1$
    end if
  end for
end while
$saveListToFile(profitList, "profit.txt")$
$saveListToFile(lossList, "loss.txt")$

This algorithm should theoretically give us equally profitable trades in both the long and the short direction.

B. Specific features

To analyse the data we use a supervised classification learning algorithm, or to be more specific we use a naive Bayes classifier. The idea is to use a naive Bayes classifier, on our financial data that we gathered using our random algorithm. This isn't a new concept, in fact there are a couple of scientific articles on this already, as can be seen in the article by KAWABATA and TAKATA [1].
We will train the classifier on some specific features, accordingly to what we found on the internet. One of the indicators many beginners are told to use, are two moving averages, and when the functions cross it's an indicator to enter a trade, and also in what direction to enter the trade, the reasons why this is a good idea is explained in this video https://www.youtube.com/watch?v=2_csKQ6iqx4 from a website called "Financialtradingschool.com", he also explains about Price Action and how to use it in a strategy in the following video https://www.youtube.com/watch?v=6FPfY1z1MyA. So far we know, that we should look at two SMA functions, a slow and a fast, and look at when they cross. We also know that we should look at the prices directly in order to use it for Price Action, however since Price Action really is just a strategy to trade if the price reaches a certain point, we let our classifier doing the job, of defining when to trade or not directly based on the current prices of the currencies. Another indicator we found using the powerful internet was the relative strength

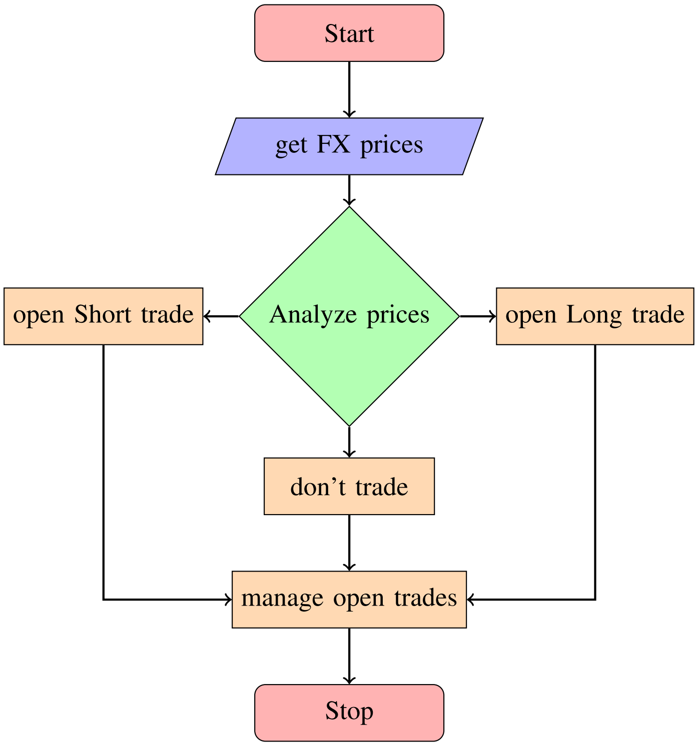

Fig. 1. Flowchart of decision making

index or the RSI indicator as it, is called in finance. Directly cited from http://www.investopedia.com/terms/r/rsi.asp

("A technical momentum indicator that compares the magnitude of recent gains to recent losses in an attempt to determine overbought and oversold conditions of an asset.").

This basically translate to, that if the RSI indicator gets to 70 or above, it is a good indicator that you should make a short trade, and likewise if the RSI approaches 30 or below it is very likely a good idea to open a long trade. However we let our classifier determine whether it's a good idea to trade, depending on what the RSI level is directly. Due to our research on investment strategies our classifier should use the following features.

- CrossGraph(SMA(10,40))
- RSI(period=100)
- openBid(period=1)
- closeBid(period=1)
- volume(period=1)
- spread(period=1)

III. Design

Before we start trading, we need to train our classifier based on the feature set we mentioned in the analysis. After the training is completed, we can then start trading based on our historical data. After a completed run of the historical data, the result of the trade is then shown on a graph, showing the profit/loss of a 5 minute interval. Figure 1. is showing a flowchart of how the trading cycles. From this we know that we need a driver to run the program, that retrieves signals from either the Random trader or the classifier, depending on what is chosen. The driver then creates orders of trades, but to keep track of them all, we need an order manager. The driver also needs to be able to withdraw/deposit money to an account manager. Figure 2. is showing the class diagram on how we will implement it all.

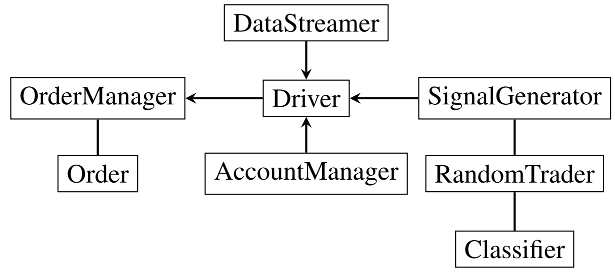

Fig. 2. Overview of Classes

IV. Implementation

A. Order

In the terminology of the FX market, an order contains all the relevant informations regarding the positions the trader opens. The information, that every order needs to have is the following.

the **required** is shown in bold

- **units**
- **side**
- take profit
- stop loss
- duration or expatriation date
- signals

In addition to these properties the Order class does also contain the following methods.

- check for close
- close

However we choose to save even more, we also store the signals the order was based on, this data will later be used by the classifier. In trading it's usually not enough to know, when it is smart to enter a trade. You also need to know when you should exit a trade, or to say it in terms of the FX market, you need to know when you should close your orders. In our implementation we do this by letting the order be set by some goals on the take profit, and stop loss and if the price ever reaches above or below those prices the order will return how much it's worth in the account currency. All the logic about when the order should be closed is happening in the check for close method. The close method is used to close the order right now. In other words, the check for close will only close the order if the order reaches it take profit or stop losses points or if it has reached it expiration date. One thing that is very important to stress is that every time we close an order we take the spread into consideration and sell or buy at the lowest price. The way that we take the spread into consideration is that we buy at the highest available price, and sell at the lowest available price.

B. Order Manager

Explain about this class is managing every open order, and is also responsible for creating new trades. Some methods that should be explained in depth signal generator, update, and crossGraph.

C. Classifier

Explain a bit more in detail how the Classifier works, by going a little into detail in how a naive bayes classifier works. And what the meaning of the confidence interval is. features

V. Test & Results

A. Test

Our control test are made by running the program on the data.txt(roughly 23 days), with a leverage at 20, an account on 10000$, and set the confidence level of the classifier at 96%. When the program have gone though data, we retrieve the profit/loss. Hereafter we deviate one variable from the control, firstly we change the leverage to 400, then we change the confidence level of the classifier to 85%.
We also want to check different datasets, the largest dataset goes from 2007 to 2014(, roughly 2557 days), then we use a data set that is newer than the control, going from 2014/11/10 - 2014/12/03(roughly 24 days) and the last data we go through is roughly a single day, the 2014/12/03, with a 5 second interval.

We also test the random trader to see how effective it is, on both the control data and the large data FOOTNOTE The result may differ because the trade is random.

We have generated graphs for each test, that shows the profit/loss on each interval, and the exchange rate for EUR/USD on each interval. FOOTNOTE See appendix for all graphs

Now that we have several test data, with the profit and by knowing how many days each data spanned over, we calculate the daily profit/loss for each test.

B. Results

	Profit	Days	Profit/Days
Control data	357,18	23	15,53
leverage=400	8974,66	23	390,20
confidence=0.85	189,32	23	8,23
Large data	-7251,99	2557	-2,84
Newer data	31,54	24	1,31
ODD(One day data)	36,18	1	36,18
ODD leverage=400	713,91	1	713,91
Random Control	-398,45	23	-17,32
Random Large	-9998,00	2557	-3,91

VI. Discussion

By changing some of the variables for the control data, we retrieve a result for the control data, one with the leverage on 400 and one with the confidence level on 85%.
In these cases, the test with leverage on 400 gets the best result, even though we multiply the leverage with 20, the profit gained is more than 20 times the control(, it is 25 times more). This is due to that each time we make a trade we use 2%, of the current account balance, which is capital projection. Changing the leverage creates a bigger risk, but might also improve the gain.
When we reduce the confidence level to 85%, the classifier opens more trades, that have a higher risk, than with the leverage. This is duo to that you might get profit on more trades but the profit on each trade is closely the same, but duo to the higher risk you might also loose profit on more orders than earlier.
So if lowering the confidence level was a higher risk, then raising the confidence level will lower the risk. This is somewhat true, because raising the confidence level to high, only prevents the classifier of making any orders and therefore never trades.

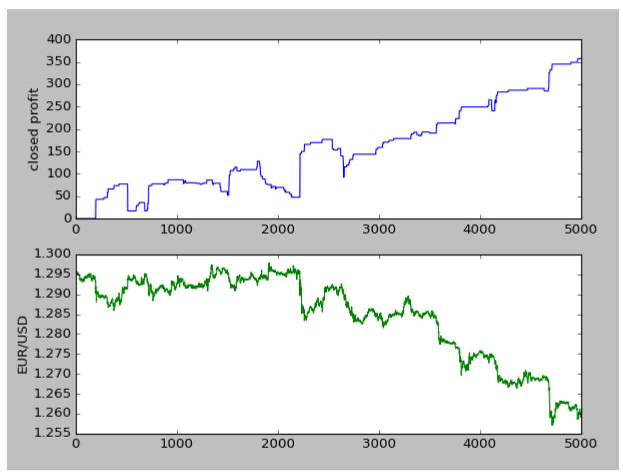

Fig. 3. This is a graph of the closed profit, on the control data.

The next three result are where we keep the variables the same, but change the data we test on. So far we have had profit on each test, but with the large dataset, we get a closed profit of about -7250. Even though it might seem a lot, it is less than 3 dollars a day, spanning over 7 years. This shows that even with a confidence level on 96%, you still might lose your money. By looking at the graph for the large data[1], we see that in the beginning, the classifier creates positive profit, but as we go on it looses. This might be because that we do not update the classifier each state.

We therefore also made a test data, that was newer than both the large data and the control data. By looking at this graph[2], we see that the classifier makes less trades, but

[1] See appendix for graph
[2] See appendix for graph

also makes some larger mistakes. Even though we end in a profit with this data set, it is around 12 times less than in the control data. This confirms our theory that the classifier needs to be updated regularly to be able to work properly.

So far all our data have been collected over several day's, with a 5 min interval. We therefore decided to have a data set from a single day, with a 5 sec interval instead. This gave us the most profitable closed profit, at two times more than the control, a day.

To see how well our classifier works, we use our Random trader with both the control data, and the larger data, these test represents how a normal person might trade. We ran these test several times, and not a single time did we end with a positive closed profit. This is quite expected, and also shows that without having knowledge of professional trader, or in our case having a bot trading for you.

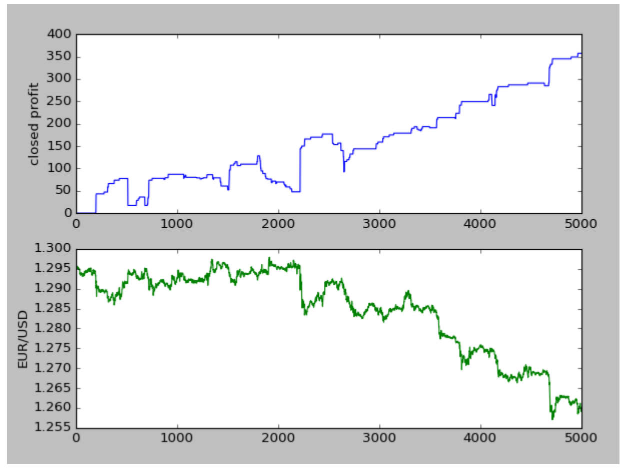

Fig. 4. This is a graph of the closed profit, on the control data.

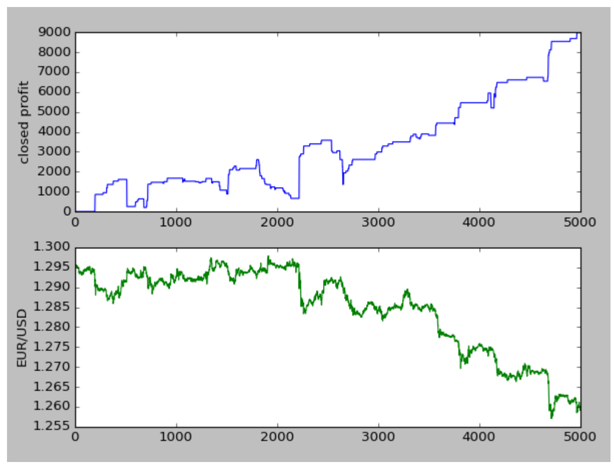

Fig. 5. This is a graph of the closed profit, on the control data, with a leverage at 400.

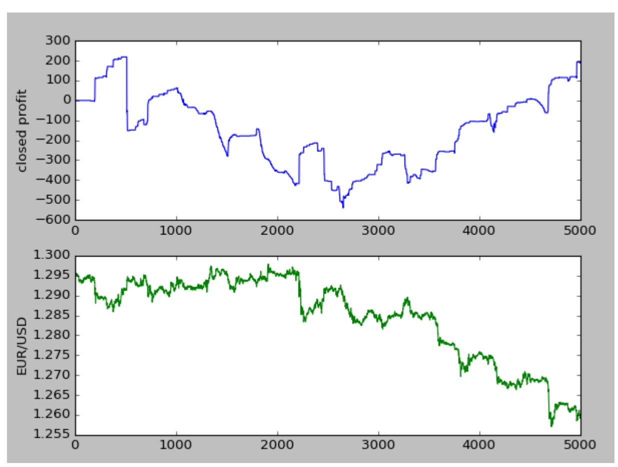

Fig. 6. This is a graph of the closed profit, on the control data, with a confidence level at 85%.

VII. Conclusion

Through this process we have gathered several data sets, some larger than others, and used these to train a classifier to automatically make currency trades. All but one test of the classifier have resulted in a positive closed profit. We also show that using our classifier to trade, is better than letting a normal person trade. To improve our classifier, we would need to implement an updater, that trains the classifier with the newest data each interval. Most of our features are also some that newer traders use, therefore using other more intricate features might result in lower risk.

VIII. Terms & abbrivations

Domain	Term or Abbreviation	Meaning
Trading	FX	Forex
Trading	Bid	An offer made by an investor, a trader or a dealer to buy a security
Trading	Ask	The price a seller is willing to accept for a security
Trading	SMA	Simple Moving Average
Trading	MACD	Moving Average Convergence/Divergence
Trading	SAR	Parabolic SAR(Parabolic Stop and Reverse)
Machine Learning	NBC	Naive Bayes Classifiers

References

[1] Kimihisa KAWABATA and Hitoshi TAKATA. Fx trading using logistic regression analysis and naive bayes model. Technical report, Kyushu Sangyo Universit JAPEAN and Kagoshima University JAPAN. URL http://www.jsst.jp/e/JSST2012/extended_abstract/pdf/11.pdf. Accessed November 2014.

IX. Appendix

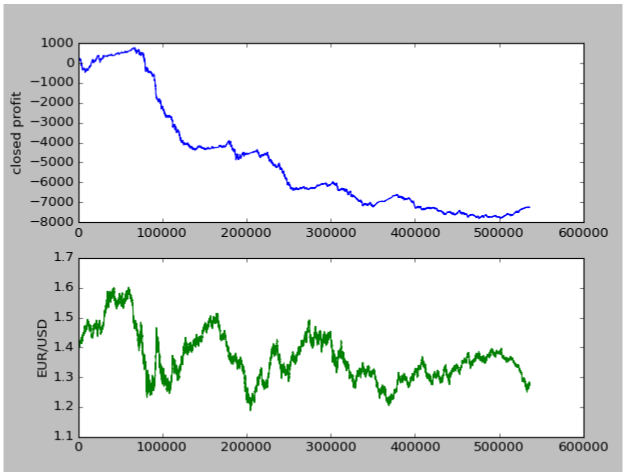

Fig. 7. This is a graph of the closed profit, on the larger data.

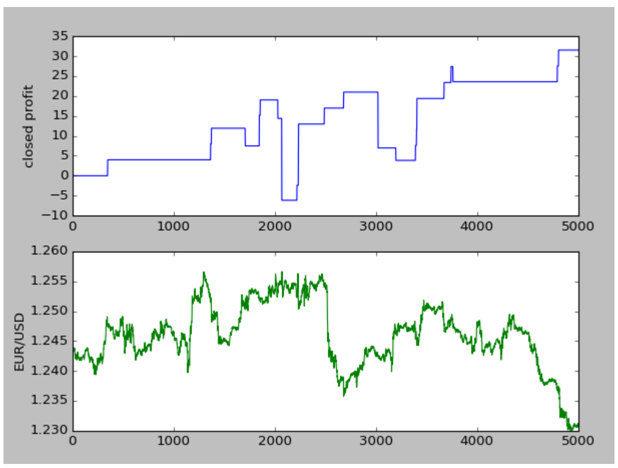

Fig. 8. This is a graph of the closed profit, on the newer data.

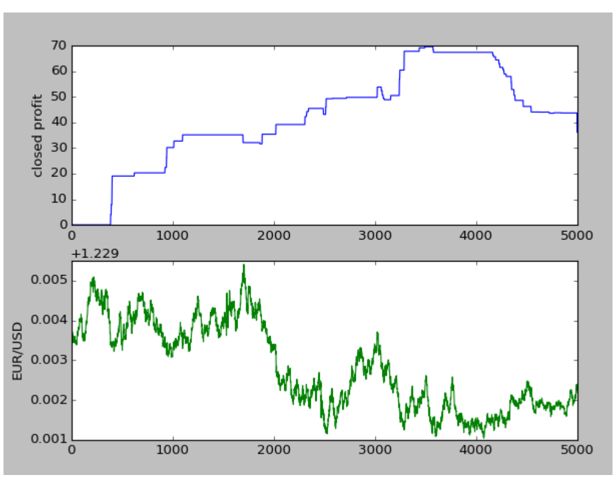

Fig. 9. This is a graph of the closed profit, on the one day data.

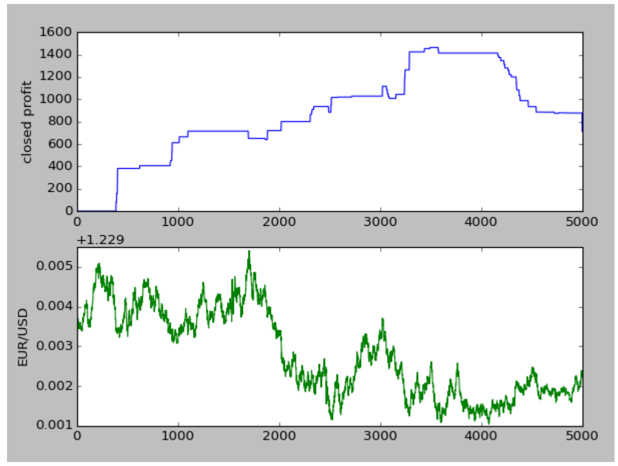

Fig. 10. This is a graph of the closed profit, on the one day data, with a leverage on 400.

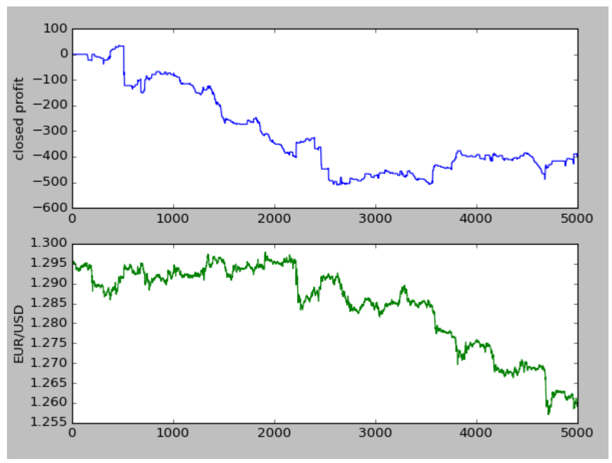

Fig. 11. This is a graph of the closed profit, on the control data, with the random trader.

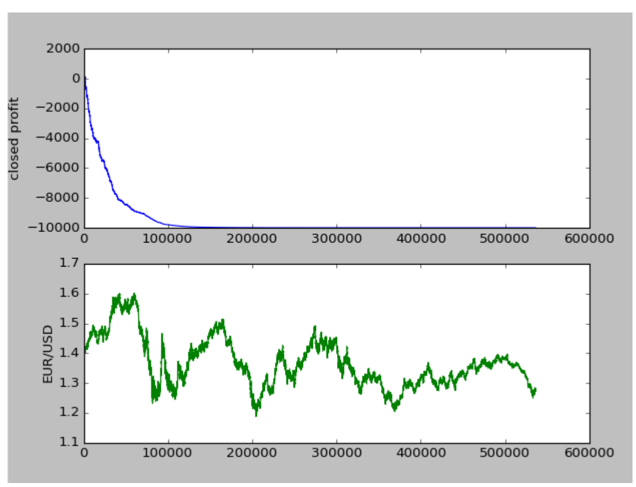

Fig. 12. This is a graph of the closed profit, on the larger data, with the random trader.