Daily Asset Volatility Dynamic Prediction Model, with an Example Using the EUR/USD Currency Pair

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ABSTRACT
The main objective of this work is to resolve the issue of predicting the daily volatility dynamic based on the history of quotes, while considering aspects of fundamental analysis. The process breaks down into the following stages: developing a theoretical model, implementation of model algorithms, estimating the impact of the news factor.

Categories and Subject Descriptors
D.4.8 [**Operating Systems**]: Performance – *modeling and prediction.*

General Terms
Algorithms, Performance, Economics, Experimentation, Theory.

Keywords
Volatility, financial markets, predictions, forecasts.

1. INTRODUCTION
It is important to make predictions in various applications both in engineering [1] and in economics [2, 3]. The volatility of the currency market is a crucial indicator for traders, because it is the basis for choosing appropriate financial instruments and predicting investment risks. Volatility prediction is one of the most popular approaches to the financial market.

The main concept of this model is to determine the function of the daily volatility dynamic, which is highly independent of economic events and is a certain pattern of volatility fluctuations. After that it is necessary to consider the impact of upcoming news and events.

2. PREPARING INPUT DATA
Input data is based on the history of quotes that can be found, for example, at http://histdata.com/ [4], which are the basis of volatility calculations for a certain period.

For convenience we will divide the data into financial days so that the beginning of the financial day coincides with the opening of the Wellington exchange and the end of the financial day coincides with the closing of the New York exchange. Calculating average volatility through the running window method.

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3. MODEL
We will consider the financial day as eight three-hour periods. This is the longest discretization period of the day, where the demarcations coincide with the time of opening and closing of the world's main foreign exchange markets.

Thus, any trade session always includes a strictly even number of segments of the financial day. Assuming that every foreign exchange market influences the volatility dynamic, this approach allows each segment to maintain homogeneity in relation to the number of active foreign exchange markets.

The financial market is a rather delicate instrument that may react not only to important economic and political events, but to essentially any event that influences a large number of people. Therefore the next important step is filtrating input data. It is necessary to exclude time periods that contain abnormal values and statistical random omissions.

The following stage is approximating the volatility function within each time segment. This allows for estimating the volatility trend within the segment.

After that we need to aggregate the results. However, analyzing data gathered from each segment is an insufficient approach. The behavior of the financial market on Monday for example may be dramatically different from that on Friday; a great deal of economic news comes out on certain days of the month, and many contracts expire on certain days of the week or of the month. Therefore results are aggregated not just by time segments, but by days of the week as well.

In this way, the eight time segments of the day, each illustrating the pattern of volatility fluctuations under the influence of the global market at a certain moment, are united into a single financial day pattern.

For a financial day without any significant events the prediction would be as follows (see Figure 1).

At the same time the basic volatility pattern for a saturated financial day doesn't reflect the dynamics of real behavior (see Figure 2).

4. NEWS FACTOR
With rare exceptions, precise dates of important news releases are known in advance, as well as numerous experts' predictions

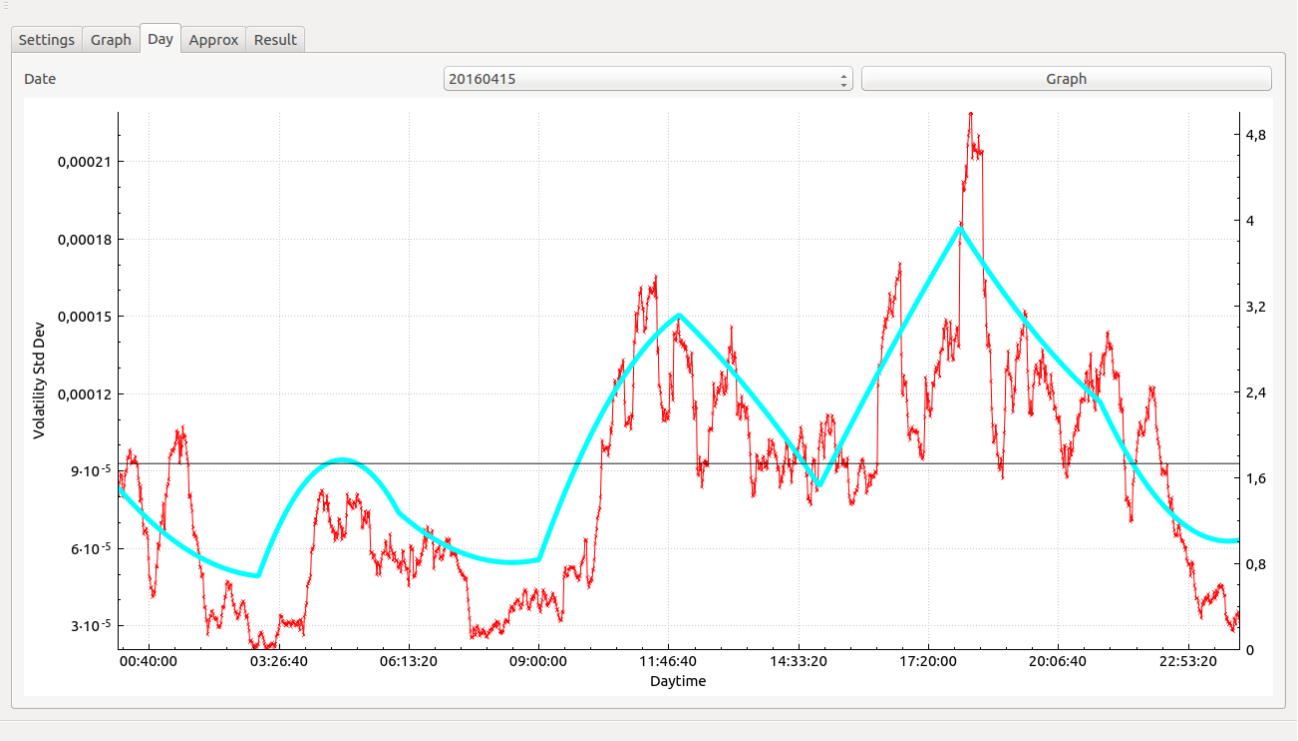

Figure 1. Financial day without news pattern – 4.15.2016. Vertical axis – Std Dev of volatility, horizontal axis – time of day, red curve line – real volatility, black straight line – median, blue line – predicted volatility.

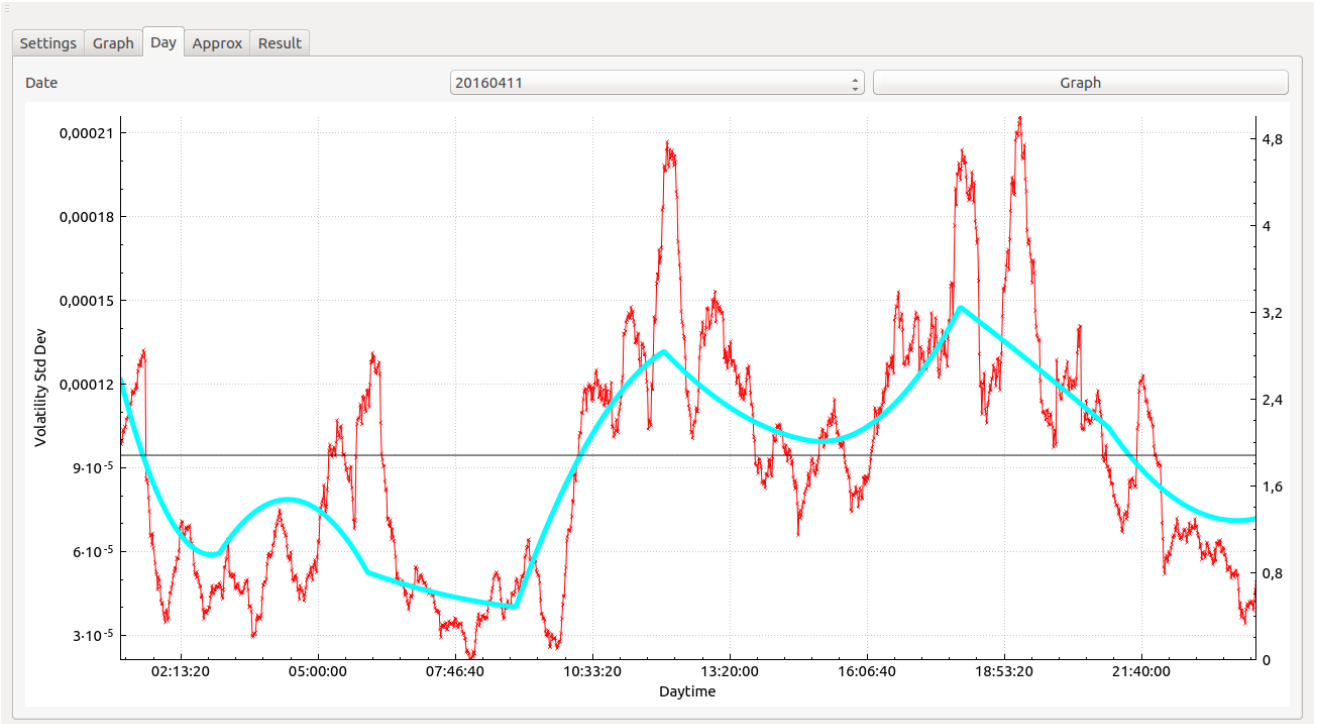

Figure 2. Financial day excluding news pattern – 4.11.2016. Vertical axis – Std Dev of volatility, horizontal axis – time of day, red curve line – real volatility, black straight line – median, blue line – predicted volatility.

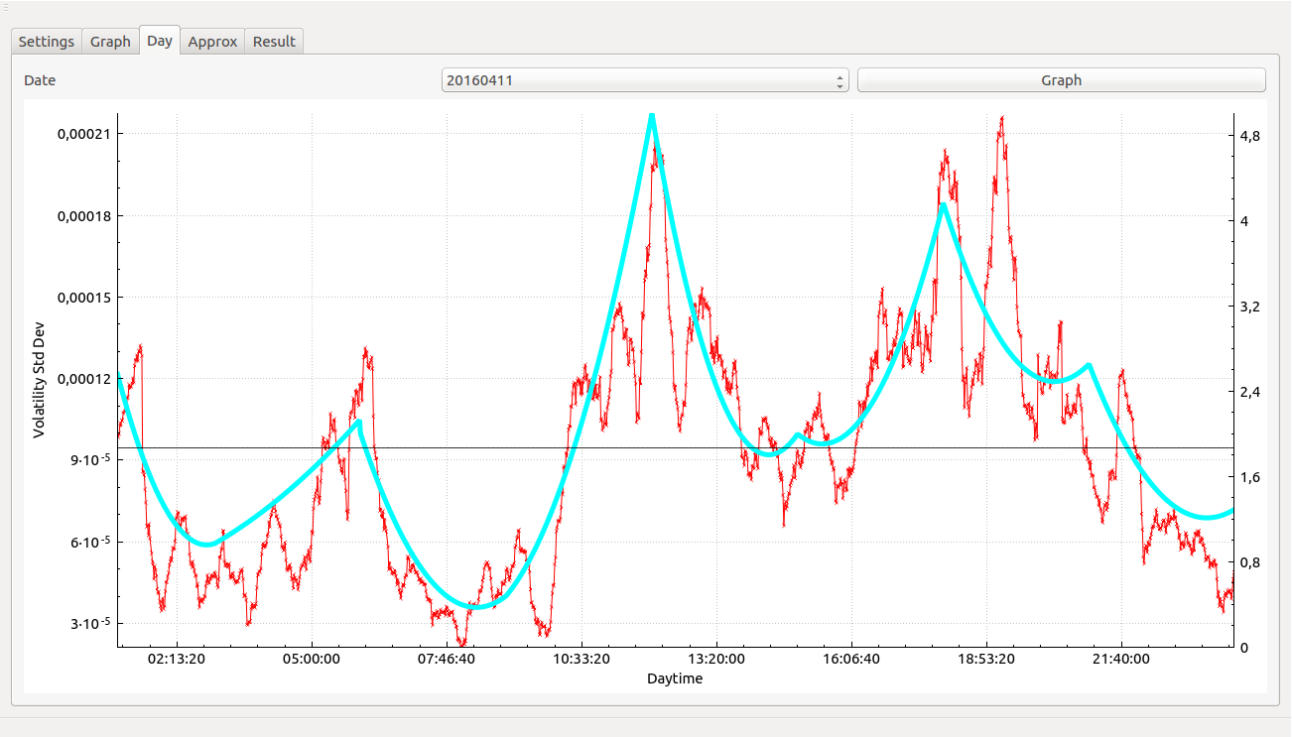

Figure 3. Financial day based on news pattern – 4.11.2016. Vertical axis – Std Dev of volatility, horizontal axis – time of day, red curve line – real volatility, black straight line – median, blue line – predicted volatility.

of their influence. This is also applicable to regular and irregular news. The only difference is the method of estimating their impact on the model. In order to estimate the influence of regular news we can always refer to historic data; for irregular news the only way to interpret it is with expert reviews.

Applying the news quotients will significantly improve the prediction (see Figure 3).

5. PROSPECTS

The prospects of developing and improving the model can be subdivided into two categories. The first category is fundamental statistical estimation of the influence of the news factor, which includes analysis of historic data, accumulating and structuring information as well as examining long-term trends that influence the changes in technical levels of volatility.

The second category is experiments with volatility approximation methods within time segments of the financial day, as well as experiments with the duration of the discreteness of the day, which may be necessary in order to apply the model for other currency pairs and assets.

6. REFERENCES

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