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## DATA STRUCTURES AND ALGORITHMS

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Assignment supporting document

# FOREIGN EXCHANGE MARKET

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HO CHI MINH CITY, 04/2020

# 1 Introduction

The Foreign Exchange Market (FOREX - as it is mentioned in [1]) started with the appearance and development of money. Money has been used as a currency exchange for many different types of goods and services. The earliest evidence of money usage appeared about 4,500 years ago in Mesopotamia (nowadays in Iraq). Many archaeological evidence demonstrate that people used to pay a certain amount of silver in exchange for goods and began to use minted coins from various alloys as a means of payment.

The common parity system quickly spreads throughout the world. In different countries, different alloys are used to cast coins, however, gold, silver, brass and copper are the most common materials. Paper money appeared much later and first appeared in China [1]. Around the tenth century, the emperor of China released not only the heavy coins but also low value in payment. People felt uncomfortable by using these currencies and exchanging them for receipts that show the exact value of goods from merchants. A century later, the Chinese feudal court removed these receipts from circulation and ordered printing of banknotes to use them as legal tender. This is the starting point for paper money.

Today's forex market has existed since the 1970s, when the fixed exchange rate was replaced by floating exchange rates, which allowed thousands of individual and institutional investors to make a profit from their changes. The Forex market is often called by another name as the Forex market or Forex. The foreign exchange market is perhaps the world's most liquid financial market. Its average daily sales are about 4,000 billion US dollars [1]. High liquidity means that at any time, if an individual wants to sell a certain amount of foreign currency, there will be another individual who wants to buy that foreign currency with the same amount.

Nowadays, most of participants in the market are central banks, commercial banks and investment banks as well as professional investors and traders. In fact, these institutions conduct most of their transactions and are considered Market makers because they have the ability to influence the prices of currencies.

## 2 Terms and concepts

### 2.1 Currency and currency pairs

The national currency is the national monetary unit of a country or a group of countries; for instance, the Euro in Western Europe, the dollar in the US, and the Yen in Japan. The exchange rate between two currencies shows how much one currency is priced in another. The term currency pair [1] is commonly used on the Forex market.

In the market, a currency pair is valued by one value [2]. For a currency pair  $X / Y = A$ , it is said that if you want to buy 1 coin X, you will need A currency Y. For example,  $EUR / USD = 1.1025$ , we need 1.1025 USD to buy a EUR 1 or to buy 1 EUR we have to sell 1.1025 USD. Therefore, X is called Base Currency (BC) and Y is Quote Currency (QC).

### 2.2 PIP (Percentage In Point)

PIP [1] is another basic concept in forex trading. It stands for Percentage In Point (PIP) and the smallest fluctuating unit of exchange rate. For example, the exchange rate of the US dollar against the Swiss Franc is 1.2212 ( $USD/CHF = 1.2212$ ). After that, it rises to 1.2213, which means the amount increased slightly by one percentage point, or 0.0001.

The spread is the gap between the price of the market maker is willing to pay for buying a currency and the price, which someone is willing to accept the sale of that currency for a specified period of time. This is also the difference between the buying and selling prices of a currency. For example, if the purchase price of USD / CHF pair is 1.2212 and the corresponding selling price is 1.2215 at 10:30 am, the difference here is three percentage points.

### 2.3 Japanese candle pattern

The Japanese candlestick chart [1, 2] is the earliest and most popular method of performing price movements of financial markets. It was developed by a Japanese rice merchant named Homma Munehisa in the sixteenth century. He realized that it was possible to predict future prices through an analysis of its performance in the past. Homma found that candlestick patterns tended to repeat, so he began to analyze them and became a very successful trader. At this moment, Japanese candles are still the most popular market analysis method. Candlestick charts are very similar to bar charts because they indicate the direction of market trends.

Usually, the main body of a candle showing the upside will be white and the main body of a candle showing the down price will be black (Figure 1). The upper shadow of the Bullish candle is the gap between the closing price and the highest price and for the Bearish candle is

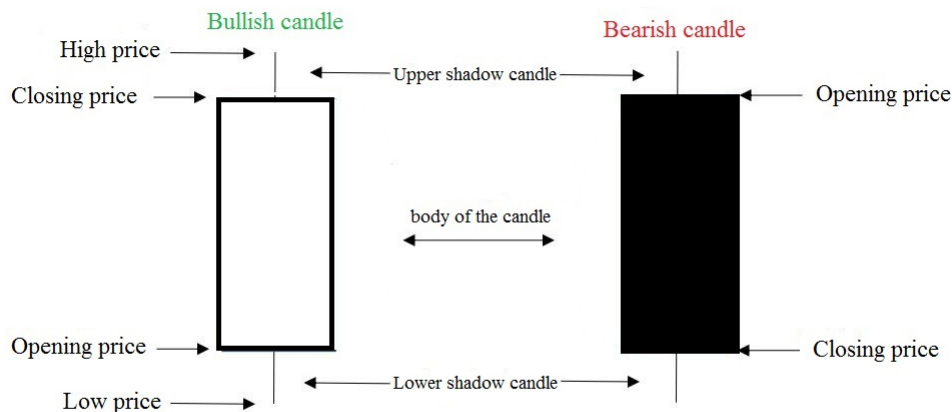


Figure 1: Definition of bullish and bearish candles

the different between the opening price and the highest price in the period that these candles are shown. In addition, the Bullish candle's lower shadow is the gap between the opening value and the lowest value and for the Bearish candle is the different between the closing value and the lowest price in the period that these candles represents. It should be noted that candles can also form gaps.

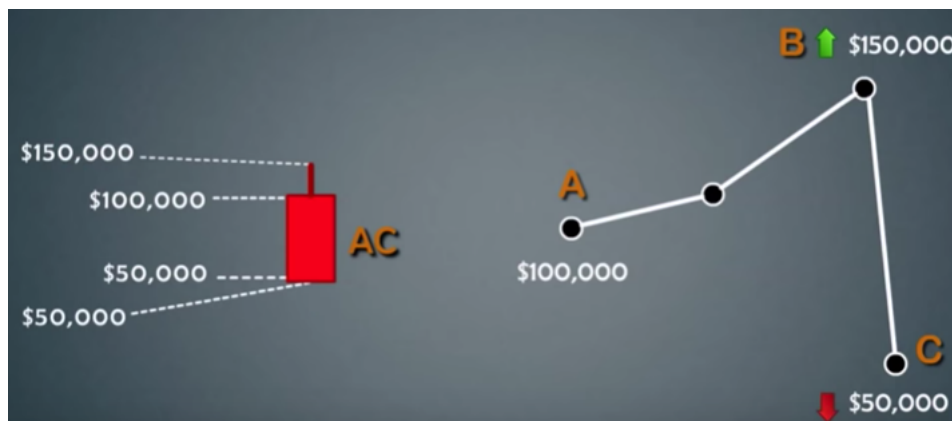


Figure 2: Correlation between price candle and line chart

Figure 2 illustrates the corresponding between the line chart (right) and the candlestick chart (left). In the line chart, A is the starting point for opening price at \$ 100,000, B is the time when the price reach a peak of \$ 150,000 and point C is the closing time at the value of \$ 50,000, which is also the lowest price. Therefore, in the corresponding candlestick chart, there is no lower shadow, only upper shadow and the body of candle. While the line chart reflects changes in price over time, a candlestick chart shows only the necessary information (opening,

closing, highest and lowest prices).

Note: According to [1], the authors usually use the term "High price" and "Low price" for the convenience of communication. However, these terms also mean as the highest price and the lowest price, respectively. Thus, we choose the latter to make the document more clearly.

## 3 Some basic candlestick patterns

### 3.1 Spinning top candlestick

Candlestick with a long upper shadow and long lower shadow, small body is called a spinning top candle [1].

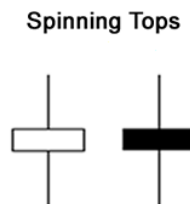


Figure 3: Example for a spinning top candle

For example, a candle with  $OP = 1.11025$ ,  $CP = 1.11028$ ,  $HP = 1.11126$ ,  $LP = 1.10985$  is a candle with a spinning top. Figure 3 illustrates two spinning top candles. The left candle is the Bullish spinning top candle and the other side is the Bearish spinning top candle.

### 3.2 Marubozu

Marubozu candle [2] is a non-shadow candle with have a long body, it means the candle can have only opening and closing price. At this time, the opening and closing value have coincided with the highest or lowest price of the session. For instance, a candle with  $OP = 1.11025$ ,  $CP = 1.11126$ ,  $HP = 1.11126$ ,  $LP = 1.11025$  is a Marubozu candle.

Figure 4 demonstrates that the left one is a white Marubozu candle (Bullish candle), and the other is a black Marubozu (Bearish candle).

### 3.3 Doji

A Doji [2] is a candlestick model that figures out the closing price and the opening price. These price are equal or nearly equal (difference of no more than 0.2 PIPs), which means the body of the candle will be very small. Thus, it will look like a thin horizontal line, if you look on the chart,

In addition, we have 4 types of special Doji candle:

- Long-legged Doji has both the long upper and lower shadow.
- Dragonfly Doji only exists the long lower shadow.
- Gravestone Doji only exists the long upper shadow.
- Four-price Doji illustrates that all four prices (opening, closing, highest and lowest) are equal and does not exist a candle shadow.

Figure 5 shows different types of the Doji candle.

### 3.4 Engulfing candlestick pattern

An Engulfing candlestick pattern [2] is a pair of candles and very dissimilar to the previous candlestick models, which contain only one candle. The Bullish Engulfing is a pair of 2 candles, which indicates a dramatically increased. This pattern appears when a Bearish candle turns up but is followed by a very large Bullish candle. The Bullish candle comes after and completely engulfs the previous Bearish (the Bearish candle's opening and closing price within the opening and closing value in range of the Bullish). In case of Bearish Engulfing, it happens in the opposite way. Figure 6 displays a pattern of Bullish Engulfing (left) and Bearish Engulfing (right).

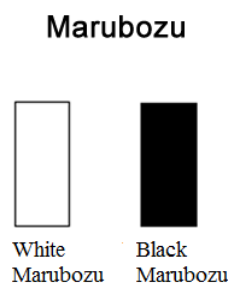


Figure 4: Example for Marubozu candle stick pattern

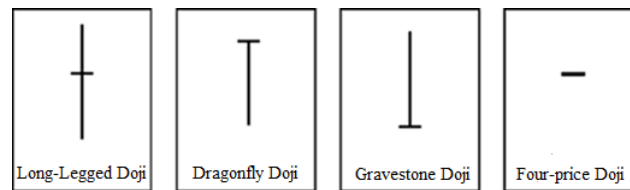


Figure 5: Example for Doji candlestick pattern

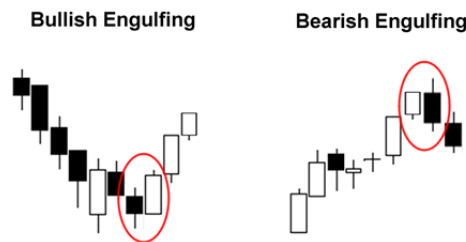


Figure 6: Example for Engulfing candlestick pattern

## 4 Trading on currency market

### 4.1 Bid price and ask price

All currency pairs will have two types of prices: the bid price and the ask price. In most pairs, the bid price is always lower than the ask price. In the Japanese candlestick pattern, all these prices are bid prices.

Bid price is the price that the broker is willing to buy your Quote Currency (for example, EUR/USD is the price that they buy EUR) in USD and this is the best bid price available in marketplace.

Ask price is the price that the broker will sell the Quote Currency to the market to exchange for the Base Currency (review subsection 2.1) and this is the best price that can be purchased from the market. Another word for ask price is offer price.

The distance between the bid and ask price is called the spread - the difference between the bid/ask price.

In this document, at one moment of trading, we write  $X/Y = B/A$  means that the currency pair  $X/Y$  is being traded at the bid price of  $B$  and the ask price is  $A$ .

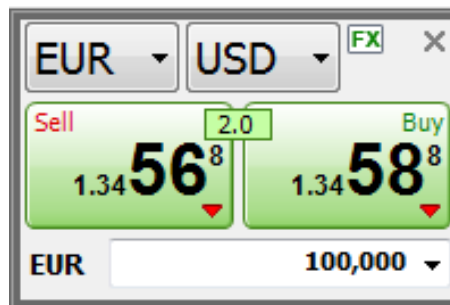


Figure 7: An example of bid/ask price of EUR/USD at a time.

For instance, in the EUR/USD quote above (Figure 7), the bid price is 1,34568 and the ask price is 1,34588. If we want to sell EUR, we click on the "Sell" button and we will sell EUR at 1,34568. If we want to buy EUR, we click "Buy" and will buy EUR at 1,34588.

## 4.2 Lot and financial leverage

The currency trading market will not exchange for every single currency but will trade for each standard lot, which is equivalent to 100,000 units of the currency. Such as EUR/USD, you cannot buy 1 EUR, but you must buy in lots, which means 100,000 EUR in USD. Beside the standard lot, we also have:

- Mini lot = 0.1 lot = 10,000 currency unit.
- Micro lot = 0.01 lot = 1,000 currency unit.
- Nano lot = 0.001 lot = 100 currency unit.

About trading multiple transactions at a time can lead to exceed the capabilities of many small investors. Therefore, brokers often allow investors to borrow a large amount of money but only need to deposit a small amount of it and make transactions with the borrowed money. The ratio of the deposit and the loan amount is called the leverage. For example, the broker will lend us 100,000 USD but only requires us to deposit 1,000 USD then we can say we are trading with a leverage of 1:100.

## 4.3 How to calculate the profit when trading

Assume, we are trading with the X/Y currency pair. At the time of  $t_1$  (open order), we exchange the currency pair for  $u_1$ . At the time of  $t_2$  (close order,  $t_2 > t_1$ ), we trade the currency pair for  $u_2$ . The lot number of transactions is  $l$ . The profit when closing an order is calculated by the



formula:

$$L = (u_2 - u_1) \times l \times 100,000$$

The unit of profit  $L$  is Y. If  $L > 0$ , we have a profit on the trade, otherwise we lose a trade.

**Example 1:** At the time of 1247, we open order **buy** the pair EUR/USD = 1.102090 / 1.102150 ( $u_1 = 1.102150$ ). As of 1257, we close order **sell** the pair EUR/USD = 1.101950/1.101980 ( $u_2 = 1.101950$ ). The number of lots we traded was 0.33. The profit is calculated as follow:

$$L = (1.101950 - 1.102150) \times 0.33 \times 100,000 = -6.6 \text{ USD}$$

**Example 2:** At 2247, we open order **sell** currency pair EUR/USD = 1.101090/1.101150 ( $u_1 = 1.101090$ ). At the time of 2257, we close order **buy** the pair EUR/USD = 1.102950/1.102980 ( $u_2 = 1.102980$ ). The number of lots we trade is 0.36. The profit is calculated by:

$$L = (1.102980 - 1.101090) \times 0.33 \times 100,000 = 68.04 \text{ USD}$$

**Example 3** At 1247, we open order **buy** the pair USD/CHF = 0.961520/0.961660 ( $u_1 = 0.961660$ ). At time 1257, we close order **sell** the pair USD/CHF = 0.961460/0.961620 ( $u_2 = 0.961460$ ). The number of lots we traded is 0.14. The profit is calculated by:

$$L = (0.961460 - 0.961660) \times 0.14 \times 100,000 = -2.8 \text{ CHF}$$

Thus, at the time of closing the trade, we are at a loss of 2.8 CHF, but we need to convert it into USD to know how do our deposit amount has been changed. Suppose at the time of 1257 (close order), we have 2.8 CHF and we use it to buy USD. Ask price of USD/CHF is 0.961620, it means to buy 1 USD we need 0.961620 CHF. Thus, if we have 2.8 CHF, we can buy

$$\frac{2.8}{0.961620} = 2.91 \text{ USD}$$

Assume that we deposit 1000 USD at the beginning, after three transactions, our deposit account will change to:

$$1000 - 6.6 + 68.04 - 2.91 = 1058.53 \text{ USD}$$



## References

- [1] A. Darazhanov, Forex 100%: Hoc cach kiem tien tu thi truong ngoai hoi, AdmiralMarkets (2018).
- [2] Series of lessons of Trader Viet community, <https://traderviet.com/forums/lop-hoc-mo-hinh-nen-nhat.39/>