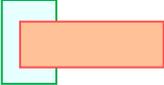


Linear Regression and Finance



- Regression analysis is a statistical method used in finance, business and investing. Linear regression is one of the most common techniques of regression analysis.
 - Finance is a broad term that describes activities associated with banking, leverage or debt, credit, money and investment. In general, finance represents money management and the process of acquiring needed funds. Finance also encompasses the oversight, creation, and study of money, banking, credit, investments, assets, and liabilities that make up financial systems.
- Regression as a tool helps pool data together to help people and companies make informed decisions. There are different variables at play in regression, including a dependent variable—the main variable that you are trying to understand—and an independent variable—factors that may have an impact on the dependent variable.
- In order to make regression analysis work, you must collect all the relevant data. It can be presented on a graph, with an x -axis and a y -axis.
- Simple linear regression is commonly used in forecasting and financial analysis—for a company to tell how a change in the GDP (Gross Domestic Product) could affect sales.
 - GDP represents the total monetary value of all final goods and services produced (and sold on the market) within a country during a period of time (typically 1 year).



The Least Square Method



■ The Least Square Method

The Least Squares Method was first developed by the German mathematician, Carl Friedrich Gauss between 1777 and 1855. The **Least Squares Method** was developed in Year 1795. Now, the Least Squares Method can be used automatically using most statistical software programs.

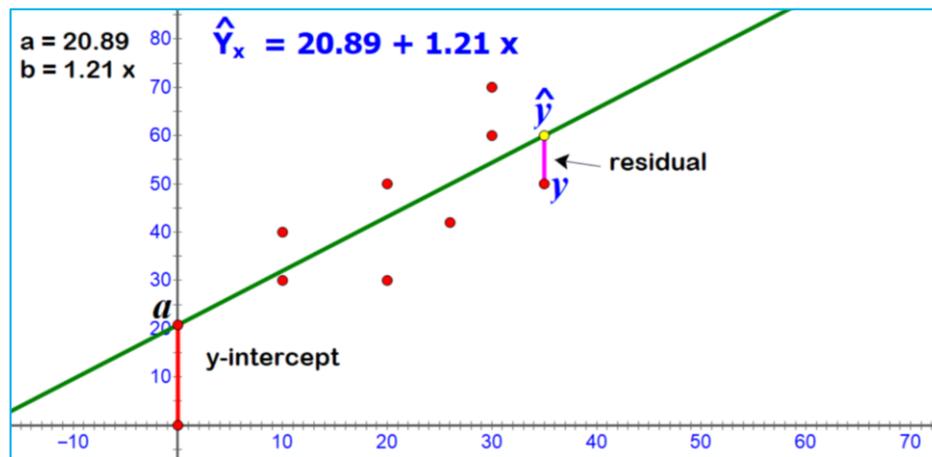
■ The Least Square method is a form of mathematical regression analysis used to determine the **line of best fit** for a set of data, providing a visual demonstration of the relationship between the data points. Each point of data represents the relationship between a **known** independent variable (x) and an **unknown** dependent variable (y).

■ Residuals

Since we cannot draw a line through all the points, the best line might not hit any of the points. We want to find the line that comes closer to all the points than any other line. Some of the points will be above the line and some below. The estimate made from a model the predicted value, and write as \hat{y} (called y -hat) to distinguish it from the true value y .

The difference between the observed value and it associated predicted value is called the **residual**.

$$\text{Residual} = \text{observed value} - \text{predicted value.}$$



If the data shows a relationship between two variables, the line that best fits this linear relationship is known as a *least squares regression* line, which **minimizes** the vertical distance from the data points to the regression line. The term *least squares* is used because it is the *smallest sum* of squares of errors, which is also called the *variance*.

This method of regression analysis begins with a set of data points to be plotted on an x- axis and y-axis graph. An analyst using the least squares method will generate a *line of best fit* that explains the potential relationship between independent variables (x) and dependent variables (y).

- The **least squares method** is a statistical procedure to find the **best fit** for a set of data points by minimizing the sum of the *residuals* of observed value and its associated predicted value.
- Least squares regression is used to **predict** the behavior of **dependent variables**.

■ Example of the Least Squares Method in Finance

1. The relationship between a *company's stock returns*, and the *returns of the index*

An example of the least squares method is an analyst who wishes to test the relationship between a *company's stock returns*, and the *returns of the index* for which the stock is a component. In this example, the analyst seeks to test the dependence of the stock returns on the index returns. To achieve this, all of the returns are plotted on a chart. The **index returns** are then designated as the independent variable (x), and the **stock returns** are the dependent variable (y). The line of best fit provides the analyst with coefficients explaining the level of dependence.

2. The case of an investment in a gold mining company

To illustrate, consider the case of an investment considering whether to invest in a *gold mining company*. The investor might wish to know how sensitive the *company's stock price* is to changes in the *market price of gold*. To study this, the investor could use the Least Squares Method to trace the relationship between those two variables over time onto a scatter plot. This analysis could help the investor predict the degree to which the stock's price would likely rise or fall for any given increase or decrease in the price of gold.



Correlation and Forex



■ Currency Pairs

A **currency pair** is the quotation of two different currencies, with the value of one currency being quoted against the other. The first listed currency of a currency pair is called the **base currency**, and the second currency is called the **quote currency**.

- A currency pair is a price quote of the exchange rate for two different currencies traded in Forex markets.

A typical currency pair listing may appear as, **EUR/USD 1.3045**. In this example, the euro (EUR) is the **base currency**, and the U.S. dollar (USD) is the **quote currency**. The difference between the two currencies is a ratio price. In the example, one euro will trade for 1.3045 U.S. dollars.

Currency pairs are generally **written** by concatenating the ISO **currency** codes (ISO 4217) of the base **currency** and the counter **currency**, and then separating the two codes with **a slash**. Alternatively the slash may be *omitted*, or replaced by either *a dot* or *a dash*.

■ Currency Correlations or Forex Correlations

Currency correlations or forex correlations are a statistical measure of the extent that **currency pairs** are related in value and will move together. If two currency pairs go up at the same time, this represents a *positive correlation*, while if one *appreciates* and the other *depreciates*, this is a *negative correlation*.

- **Currency appreciation** refers to the increase in value of one currency relative to another in the forex markets.
- **Currency depreciation** is an opposite of currency appreciation, it is a fall in the value of a currency in a floating exchange rate system. Currency depreciation can occur due to any number of reasons – economic fundamentals, interest rate differentials, political instability, risk aversion among investors and so on.

Currency correlation tells us **whether two currency pairs move in the same, opposite, or totally random direction**, over some period of time.

Understanding and monitoring currency correlations is important for traders because it can affect their level of risk when trading in the forex market. In this article, we will look at how forex correlation is determined and calculated, how it affects trades and trading systems, and what tools can be used to track currency correlations.

■ Correlation Coefficient Formula

Correlation Coefficient (r) or Pearson product moment correlation coefficient

Sample Correlation Coefficient or Sample Pearson Correlation Coefficient (r_{xy}) formula:

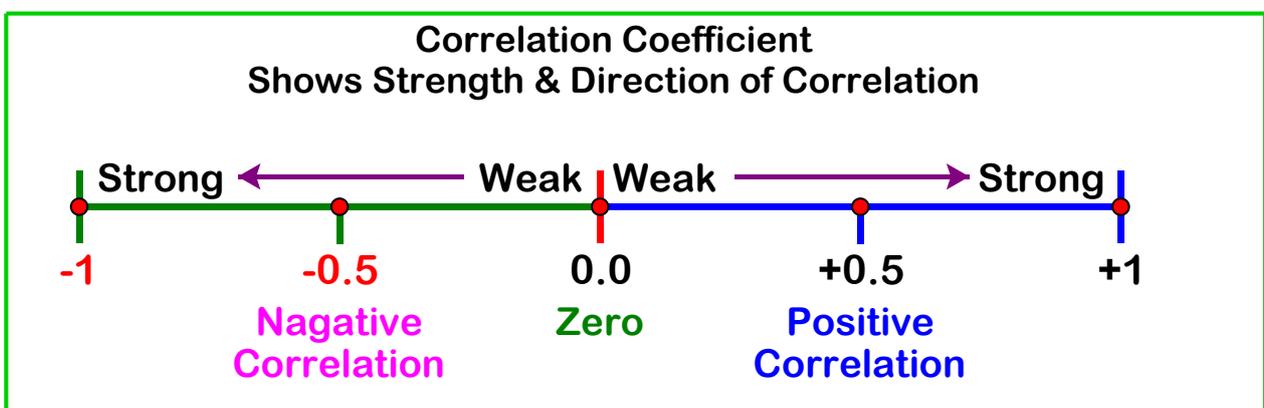
$$r_{xy} = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2 \sum (y - \bar{y})^2}}$$

$$r_{xy} \text{ or } r = \frac{n \sum xy - (\sum x)(\sum y)}{\sqrt{n(\sum x^2) - (\sum x)^2} \sqrt{n(\sum y^2) - (\sum y)^2}}$$

The currency correlation is presented in decimal format by a correlation **coefficient**, simply a **number** between **-1.00 and +1.00**. A coefficient near or at **+1** indicates that the two pairs have a strong positive correlation and will likely move in the **same direction**.

A coefficient near or at **-1** indicates that the two pairs still have a strong correlation, but a negative one, resulting in the pairs moving in **opposite directions**.

A coefficient near or at zero indicates a very weak or random relationship.



■ Currency correlations coefficient or Forex correlations coefficient

A correlation coefficient represents how strong or weak a correlation is between two forex pairs. Correlation coefficients or currency correlation are expressed in values and can range from **-100 to 100**, or **-1 to 1**, with the decimal representing the coefficient.

Anything in the negative range of **-100** means that the pairs move nearly identically but in opposite directions, whereas, if it is above **100**, it means that the pairs move nearly identically in the same direction. “Nearly identically” is an important distinction to make because correlation

only looks at direction but not magnitude. For example, one pair may move up 100 pips (**percentages in point**) while another moves down 70 pips. Both pairs may have a very high inverse correlation, even though the size of the movement is different. If a reading is below -70 and above 70, it is considered to have strong correlation, as the movements of one are largely reflected in movements of the other. Readings anywhere between -70 and 70, on the other hand, mean that the pairs are less correlated. With forex correlation coefficients near the zero mark, both pairs are showing little or no detectable relationship with one another.

■ Major currencies pairs

The five currencies that make up the major pairs—the U.S. dollar, Euro, Japanese yen, British pound, and Swiss franc—are all among the top seven of the most traded currencies as of 2021.

The four traditional majors currencies pairs are:

1. **EUR/USD**
2. **USD/JPY**
3. **GBP/USD**
4. **USD/CHF**

- The EUR/USD is the world's most heavily traded currency pair, representing more than 20% of all forex transactions.
- The USD/JPY is a distant second place, followed by the GBP/USD, and the USD/CHF with a small share of the global forex market.

■ Trading EUR/USD

EUR/USD is the most traded forex pair in the world. It holds the euro as the base currency and the US dollar as the quote currency, so the price represents how many dollars you would need to spend in order to buy one euro. For example, if the price quoted for EUR/USD was 1.2500, you would have to spend \$1.25 in order to buy €1.

The popularity of EUR/USD as a currency pair means that it is highly liquid and that brokers often offer tight spreads. Equally, it tends to be less volatile than other currency pairs because the US dollar and the euro are backed by the world's two largest economies.

■ Forex Correlation Pairs

The following table shows the correlation between some of the [most traded currency pairs](#) across the world. You can compare each currency on the y-axis to those on the x-axis to see how they are correlated to one another. While the pairs won't always move in exactly the same direction, they do move mostly together.

Forex Correlation Pairs

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	EUR/USD	USD/JPY	USD/CHF	GBP/USD	USD/CAD	AUD/USD	NZD/USD	EUR/JPY	EUR/GBP
1 week	-0.23	-1.00	0.94	-0.98	0.98	0.93	0.93	0.86	
1 month	0.63	-0.98	0.13	-0.90	0.90	0.96	0.91	0.86	
3 month	-0.62	-0.92	0.83	0.14	0.63	0.42	0.61	0.75	
6 month	-0.62	-0.85	0.31	-0.35	0.61	0.65	0.28	0.71	
1 year	-0.69	-0.98	0.88	-0.93	0.95	0.96	0.66	0.02	

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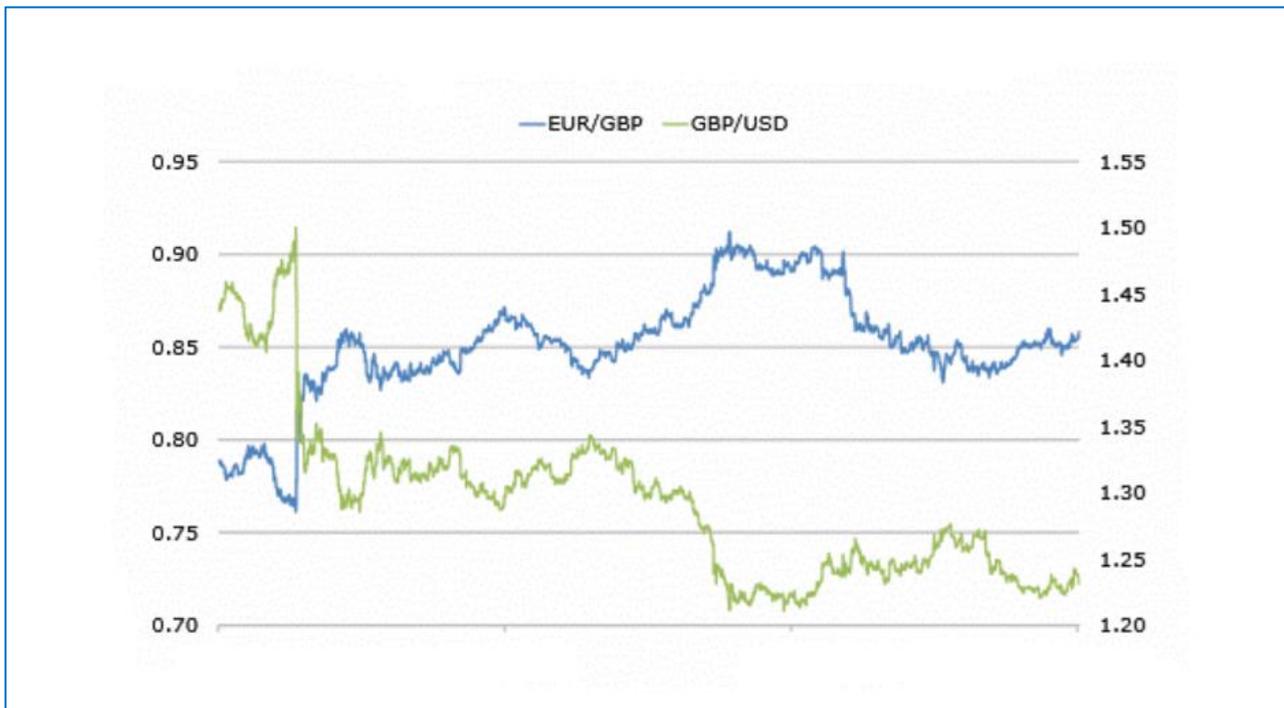
EUR/GBP Correlations

	EUR/GBP	EUR/USD	USD/JPY	USD/CHF	GBP/USD	USD/CAD	AUD/USD	NZD/USD	EUR/JPY
1 week	0.86	-0.20	-0.83	0.64	-0.88	0.83	0.83	0.81	
1 month	0.86	0.77	-0.79	-0.39	-0.70	0.67	0.79	0.90	
3 month	0.75	-0.35	-0.67	0.26	-0.02	0.28	0.17	0.58	
6 month	0.71	-0.68	-0.74	-0.45	-0.45	0.58	0.72	-0.09	
1 year	0.02	-0.20	-0.01	-0.45	0.13	-0.03	0.00	-0.20	

Full-period (from Nov 17 2012) correlations: Price versus price

	AUDUSD	EURCHF	EURGBP	EURJPY	EURUSD	GBPJPY	GBPUSD	USDCHF	USDJPY	XAUUSD
AUDUSD		0.4098	-0.0727	0.5184	0.5257	0.5356	0.5907	-0.2357	0.0536	-0.2046
EURCHF	0.4098		0.1464	0.7159	0.5435	0.6190	0.4859	0.2480	0.3078	-0.4889
EURGBP	-0.0727	0.1464		0.2017	0.3672	-0.3012	-0.1974	-0.3054	-0.2115	0.2244
EURJPY	0.5184	0.7159	0.2017		0.7655	0.8730	0.6867	-0.2515	0.4397	-0.0520
EURUSD	0.5257	0.5435	0.3672	0.7655		0.5617	0.8392	-0.6779	-0.2405	0.3438
GBPJPY	0.5356	0.6190	-0.3012	0.8730	0.5617		0.7661	-0.0963	0.5344	-0.1552
GBPUSD	0.5907	0.4859	-0.1974	0.6867	0.8392	0.7661		-0.5372	-0.1333	0.2351
USDCHF	-0.2357	0.2480	-0.3054	-0.2515	-0.6779	-0.0963	-0.5372		0.5555	-0.8286
USDJPY	0.0536	0.3078	-0.2115	0.4397	-0.2405	0.5344	-0.1333	0.5555		-0.5493
XAUUSD	-0.2046	-0.4889	0.2244	-0.0520	0.3438	-0.1552	0.2351	-0.8286	-0.5493	





Correlation Coefficient (r) or Pearson Product Moment Correlation Coefficient using Excel.

■ Correlation Coefficient (r) Method:

Step 1 Enter all data in Excel software program as shown below

Step 2: Find the correlation coefficient (r) by using the **CORREL** function:

- Move cursor to column B12 or any empty space
- Type = Correl(B2:B9, C2:C9)
- Press Enter
- You shall get the correlation coefficient (r) = 0.977008421 on the screen.

Family	Income (x)	Expenses (y)
A	1	1
B	3	2
C	4	4
D	6	4
E	8	5
F	9	7
G	11	8
H	14	9

=Correl(B2:B9,C2:C9)		
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