**Introduction To ARIMA for Time Series Forecasting**

Auto Regressive Integrated Moving Average (ARIMA) model is among one of the more popular and widely used statistical methods for time-series forecasting.

## **Introduction to Time Series Forecasting**

**A time series is a sequence where a metric is recorded over regular time intervals.**

Depending on the frequency, a time series **can be of yearly (ex: annual budget), quarterly (ex: expenses), monthly (ex: air traffic), weekly (ex: sales qty), daily (ex: weather), hourly (ex: stocks price), minutes (ex: inbound calls in a call canter) and even seconds wise (ex: web traffic).**

Now forecasting a time series can be broadly divided into two types.

If you use only the previous values of the time series to predict its future values, it is called **Univariate Time Series Forecasting**.

And if you use predictors other than the series (a.k.a exogenous variables) to forecast it is called **Multi Variate Time Series Forecasting**.

ARIMA, short for ‘**AutoRegressive Integrated Moving Average’,** is a forecasting algorithm based on the idea that **the information in the past values of the time series can alone be used to predict the future values.**

An ARIMA model is characterized by 3 terms: p, d, q

**p is the order of the AR term**

**q is the order of the MA term**

**d is the number of differencing required to make the time series stationary**

If a time series, **has seasonal patterns, then you need to add seasonal terms and it becomes SARIMA, short** **for ‘Seasonal ARIMA’**. More on that once we finish ARIMA.

**The first step to build an ARIMA model is to make the time series stationary.**

Because, term ‘Auto Regressive’ in ARIMA means it is a [**linear regression model**](https://www.machinelearningplus.com/machine-learning/complete-introduction-linear-regression-r/) that uses its **own lags as predictors. Linear regression models, as you know, work best when the predictors are not correlated and are independent of each other.**

**So how to make a series stationary?**

The most common approach is to difference it. **That is, subtract the previous value from the current value.** Sometimes, depending on the complexity of the series, more than one differencing may be needed.

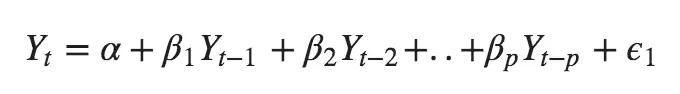
**The value of d, therefore, is the minimum number of differencing needed to make the series stationary**. And if the time series is already stationary, then d = 0.

Next, what are the ‘p’ and ‘q’ terms?

**‘p’ is the order of the ‘Auto Regressive’ (AR) term. It refers to the number of lags of Y to be used as predictors.** And ‘**q’ is the order** of **the ‘Moving Average’ (MA) term.** It **refers to the number of lagged forecast errors that should go into the ARIMA Model.**

## What are AR and MA models?

A pure **Auto Regressive (AR only) model** is one where Yt depends only on its own lags. That is, Yt is a function of the ‘lags of Yt’.



where**, Y{t-1} is the lag1 of the series,** beta1 is the coefficient of lag1 that the model estimates and `alpha` is the intercept term, also estimated by the model.

Likewise, a pure **Moving Average (MA only) model** is one where Yt depends only on the lagged forecast errors.

Data scientists use an Augmented Dickey-Fuller (ADF) test to determine whether the data is stationary.