**What is Regression Problem?**

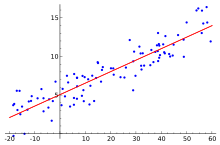
In regression problem the goal of the algorithm is to predict real-valued output.

**What is Linear Regression?**

Linear regression is a very simple approach for supervised learning. It is used to predict a dependent variable (Output) from an independent variable (Feature).

Mathematically described as:

Y= Mx + C -> Equation of straight line



A Linear regression algorithm is widely used in the cases where there is need to predict numerical values using the historical data.

There are a bunch of regression algorithms to predict numerical values. Such as:

* Polynomial Regression
* Stepwise Lasso Regression
* Elastic Net Regression

Simple Linear regression is the best approach to find the relation between different attributes. Suppose finding the relationship between increase in temperature leads to increase in cold drinks or not.

It is used to predict a dependent variable (Output) from an independent variable (Feature).

Dependent variable(Y) -> referred as Predicting/Criterion variable  
Independent variable(X) -> referred as Predictor/Base variable

When there is only one predictor variable(X), the prediction method is called simple Linear regression.

The aim of linear regression is to find the best-fitting straight line through all the points. The best-fitting line is called a **regression line**.

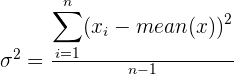
\hat{y} = {w}_{0} + {w}_{1} * {x}

Where y is value we are going to predict for x.  
 w0 is a constant  
 w1 is regression coefficient  
 x is predictor variable  
We Assume that Y is a linear function of x

#### Formula for calculating mean value

\textrm{mean(x)} = \frac{(x_1)+ (x_2)+(x_3) ... + (x_n)} {n}

#### Formula for calculating the variance value



#### Formula for calculating covariance between two series of readings

cov_{x,y}=\frac{\sum_{i=1}^{N}(x_{i}-mean(x))(y_{i}-mean(y))}{N-1}

#### Formula for calculating the {w}_{0} and {w}_{1} values

The regression coefficient (w1)

{w}_1 = \frac{covariance(x,y)} {variance(x)}

The regression constant (w0) is equal to the y-intercept of the regression line.{w}_0 = mean(y) - (w_1 * mean(x))

The below function is called as a cost function, the cost function (J(θ)) is nothing but just a **Squared error function**.  
**Cost function:**

[img12](https://i2.wp.com/dataaspirant.com/wp-content/uploads/2014/09/img12.png)

The goal of hypothesis is to choose w0 and w1 so that hθ(x) is close to Y for our training data.   
While choosing w0 and w1 we have to consider the cost function (J(θ)) where we are getting low value for cost function (J(θ)).

**Examples of Linear Regression**

* Using the features like numbers of rooms, Square feet, years old, garden area to predict the house price.
  + The number of rooms, Square feet, years old, garden area are independent variables, and the house price is the dependent variable.
* By considering the numbers of hours student spent on English, Mathematics, Physics subject to predict the marks percentage the student will get.
  + The number of hours the student spent on English, mathematics, physics are the independent variables, and the student scores percentage is the dependent variable.

**Problem Statement**

Sales (in thousands of units) for a product as a function of advertising budgets (in thousands of dollars) for TV, radio, and newspaper media. Suppose that in our role as statistical consultants we are asked to suggest.

**(1).**We want to find a function that given input budgets for TV, radio and newspaper predicts the output sales.

**(2).**Which media contribute to sales?

(**3).** Visualize the relationship between the features and the response using scatter plots.

Solution: See Linear\_Regression\_1.ipynb and Linear\_Regression\_2.ipynb