



Experiment-1.2

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Subject Name: Machine Learning Lab

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Aim of the Experiment :

Write a program in Python to implement Multiple Regression Algorithm.

Theory :

Multiple Regression involves predicting a dependent variable based on two or more independent variable.

Multiple Regression is an extension of Linear Regression.

The equation for Multiple Regression for two independent variables is:

$$y = \alpha_0 + \alpha_1 x_1 + \alpha_2 x_2$$

where, y = dependent variable

x_1, x_2 = independent variable (predictors)

α_1, α_2 = coefficients of regression

α_0 = constant (intercept)

The equation for Multiple Regression for **n** independent variables is:

$$y = \alpha_0 + \alpha_1 x_1 + \alpha_2 x_2 + \dots + \alpha_n x_n + \varepsilon$$

where, ε = error

Code for Experiment :

```
# Import Libraries
import numpy as np
import matplotlib.pyplot as plt
```

```
from mpl_toolkits.mplot3d import Axes3D

# Estimate Coefficients of Linear Regression Line
def estimate_coefficient(X, Y):
    # Create Matrix by adding bias
    X = np.concatenate((np.ones((len(X),1)),X),axis=1)

    # Calculating regression coefficients
    a = np.dot((np.linalg.inv(np.dot(X.T,X))), np.dot(X.T,Y))

    return (a)

# Plot the Regression Line and the Data Points
def plot_regression_line(x, y, a):
    # Plotting the actual points as scatter plot
    fig = plt.figure(figsize=(7,7))
    ax = fig.add_subplot(projection='3d')

    ax.scatter(x[:, 0], x[:, 1], y, label='Y', c='blue', s = 25, marker=".")
    ax.scatter(x[:, 0], x[:, 1], y_pred, label='Y_pred', c='red', s = 20, marker="^")

    ax.legend()
    ax.set_xlabel('X1')
    ax.set_ylabel('X2')
    ax.set_zlabel('Y')

    plt.title("Scatterplot of Actual and Predicted Data Points")
    plt.show()

# Observations / Data
X = np.array([[1, 4], [2, 5], [4, 8], [7, 12], [3, 6], [9, 15], [6, 13], [5, 9] ])
```

```
Y = np.array([1, 6, 8, 12, 7, 17, 18, 14])
```

```
print("X: ",X)
```

```
print("Y: ",Y)
```

```
# Estimating the Coefficients
```

```
a = estimate_coefficient(X, Y)
```

```
print("\nEstimated coefficients:\na0 = {}\na1 = {}\na2 = {}".format(a[0],a[1],a[2]))
```

```
# Predicted response vector
```

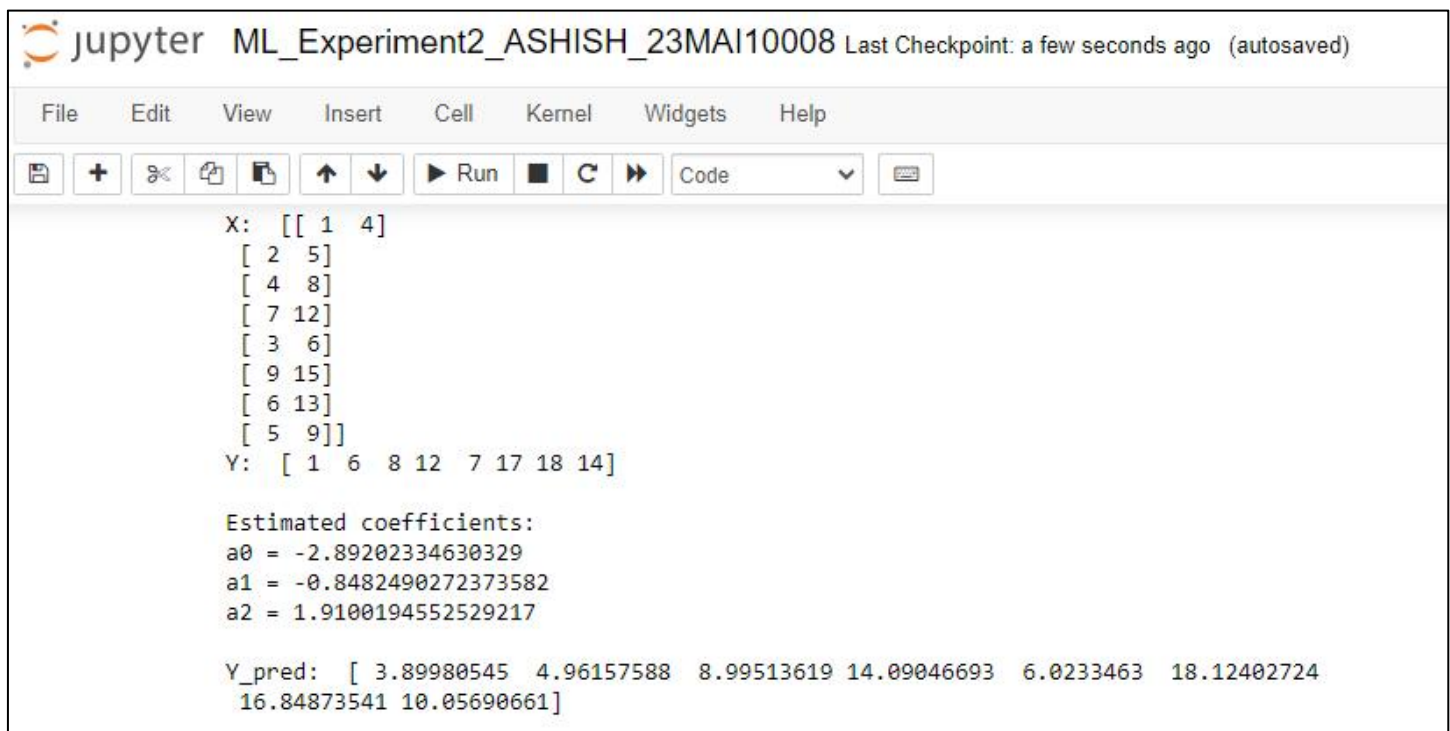
```
y_pred = a[0] + a[1]*X[:, 0] + a[2]*X[:, 1]
```

```
print("\nY_pred: ",y_pred)
```

```
# Plotting Regression Line
```

```
plot_regression_line(X,Y,a)
```

Result/Output :

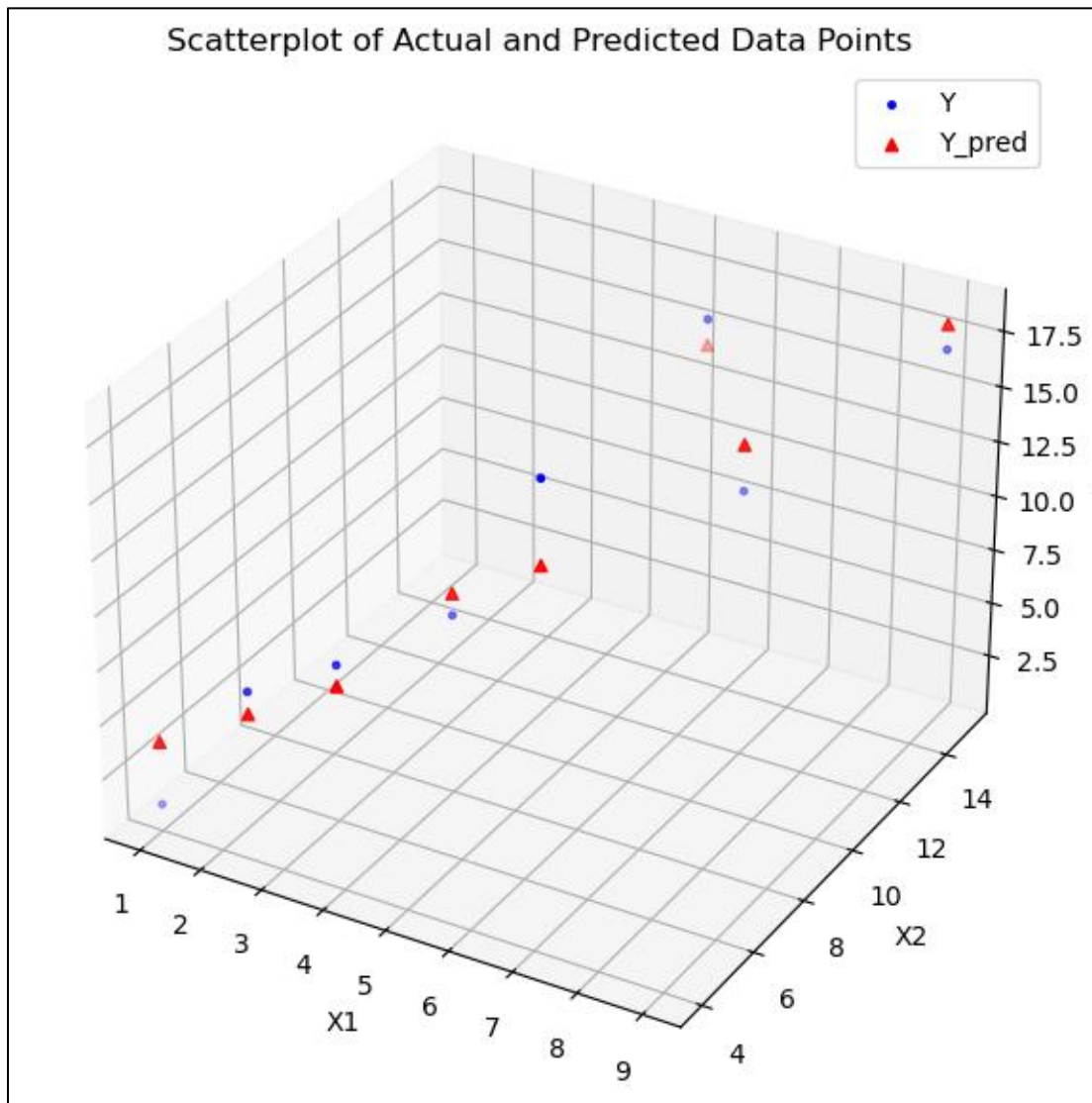


The screenshot shows a Jupyter Notebook interface with the title 'ML_Experiment2_ASHISH_23MAI10008'. The last checkpoint is noted as 'a few seconds ago (autosaved)'. The notebook has a menu bar with 'File', 'Edit', 'View', 'Insert', 'Cell', 'Kernel', 'Widgets', and 'Help'. Below the menu bar is a toolbar with icons for saving, adding cells, undo, redo, and running code. The code cell contains the following Python code:

```
X: [[ 1  4]
     [ 2  5]
     [ 4  8]
     [ 7 12]
     [ 3  6]
     [ 9 15]
     [ 6 13]
     [ 5  9]]
Y: [ 1  6  8 12  7 17 18 14]

Estimated coefficients:
a0 = -2.89202334630329
a1 = -0.8482490272373582
a2 = 1.9100194552529217

Y_pred: [ 3.89980545  4.96157588  8.99513619 14.09046693  6.0233463 18.12402724
16.84873541 10.05690661]
```



Learning outcomes (What I have learnt):

1. I learnt about various python libraries like numpy, matplotlib.
2. I learnt about the concept of Multiple Regression.
3. I learnt about the concatenate() and np.linalg.inv() function in Numpy.
4. I learnt about how to calculate the Regression coefficients.
5. I learnt about how to plot the 3D Scatter plot for Multiple Regression.