Date: 01-08-25

Expt. No.: .....

Page No.: .....01.....

EXPERIMENT NO: 1

LEAST SQUARE FITTING - STRAIGHT LINE FITTING

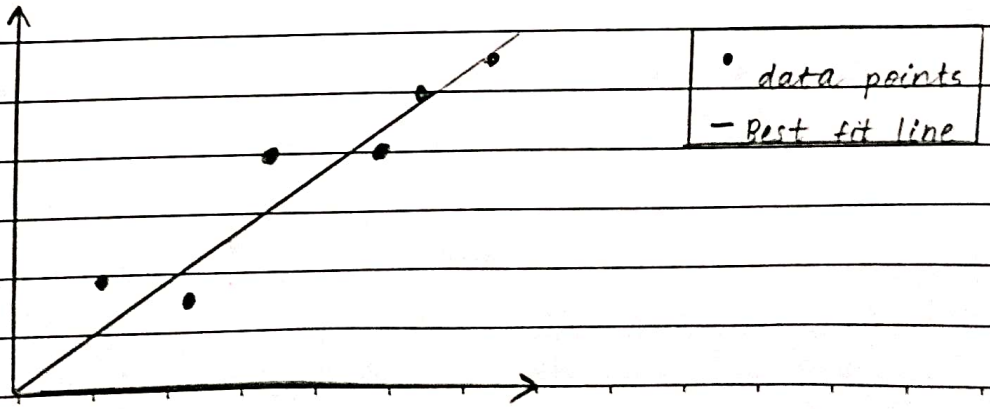
AIM:

To write a code that fits a straight line to the data given and to calculate the slope and intercept by plotting regression line along with data points (given by labels, titles, legends and different colours) by using the help of an example to apply linear regression.

THEORY:

The least square fitting method is a statistical technique used in linear regression to find the 'Best fit' line that minimises the sum of squared differences b/w the observed data points and the points lying on the line (residual squares)

Consider few points $(x_1, y_1), (x_2, y_2), \ldots, (x_i, y_i)$, plotted on a graph. The 'Best fit' line is the line that has minimum differences of residual squares.



Teacher's Signature _____

For a straight line fit, the equation is :

$$y = mx + b$$

where,
- y = dependent variable
- x = independent variable
- m = slope of the line
- b = y - intercept.

From the given n data points (x_i, y_i), the slope and intercept are calculated :

$$m = \frac{n\Sigma_i x_i y_i - \Sigma_i x_i \Sigma_i y_i}{n\Sigma_i x_i^2 - (\Sigma_i x_i)^2} \quad , \quad b = \frac{\Sigma_i y_i - m\Sigma_i x_i}{n}$$

Here, $\Sigma_i x_i y_i$ represents correlation b/w x and y
$\Sigma_i x_i^2$ represents the spread of x
$\Sigma_i x_i$ represents the sum of n x values
$\Sigma_i y_i$ represents the sum of n y values.

ALGORITHM :

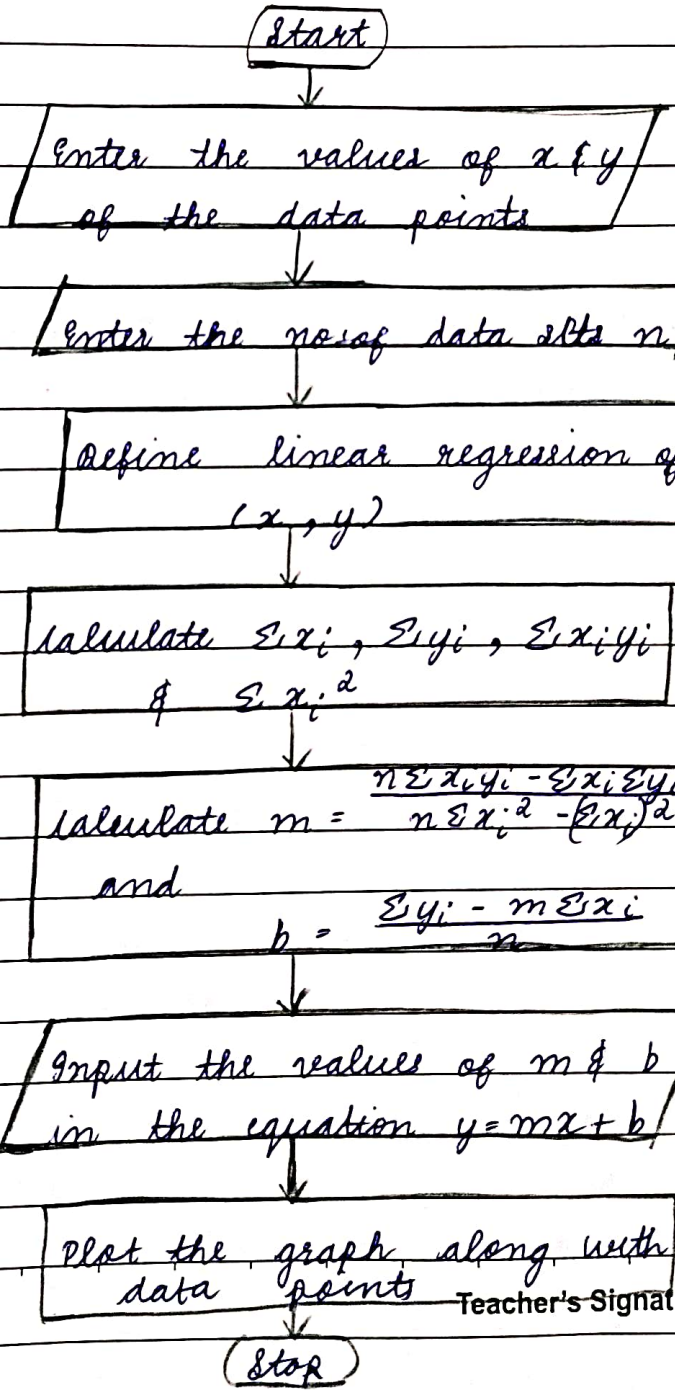
1. Start
2. Enter the values of x and y of the data points
3. Enter the number of data sets n
4. Define linear regression (x, y)
5. Calculate $\Sigma_i x_i$, $\Sigma_i y_i$, $\Sigma_i x_i y_i$ & $\Sigma_i x_i^2$
6. Calculate, slope of the line, $m = \frac{n\Sigma_i x_i y_i - \Sigma_i x_i \Sigma_i y_i}{n\Sigma_i x_i^2 - (\Sigma_i x_i)^2}$

Teacher's Signature _____

and $b = \frac{\Sigma y_i - m \Sigma x_i}{n}$ (intercept)

7. Input the values of m & b in the equation for 'Best fit line' $y = mx + b$
8. Plot the graph of the line and show the data points
9. Stop.

FLOWCHART :-



Teacher's Signature _____

Date: .....

Expt. No.: .....

Page No.: .....04.....

EXAMPLE:

Here a real life example of relation b/w the blood pressure (systolic, SBP) and the oxygen uptake in response to exersice done (L of O_2 per min, VO_2) is taken. The person's blood pressure is measured after each 5 mins.

x [VO_2 (L/min)]	3.5	4	4.5	5	5.5
y [SBP (mm of Hg)]	140	180	220	225	250

CODE:

```
import numpy as np
import matplotlib.pyplot as plt
x = np.array[(3.5, 4, 4.5, 5, 5.5)]
y = np.array[(140, 180, 210, 225, 250)]
n = len(x)
def lin_reg(x,y):
    sum_x = np.sum(x)
    sum_y = np.sum(y)
    sum_xy = np.sum(x*y)
    sum_x2 = np.sum(x**2)
    m = ((n*sum_xy)-(sum_x*sum_y))/(n*sum_x2)
                                   -(sum_x)**2)
    b = ((sum_y) - m*_sum_x)/(n))
    return m, b
m, b = lin_reg(x, y)
print(f"slope: m = {m}, and intercept: b = {b}")
plt.scatter(x, y, colour = 'blue', label = data points)
plt.x label('VO2')
plt.y label('SBP')
```

Teacher's Signature _____

Date: .....

Expt. No.: ..... Page No.: .....05.....

```
print (f" Equation of the line : y ={m}* x + {b} ")
plt. plot (x, m * x + b , colour 'red', label = Best fit line)
plt. title ("RELATION OF SBP AND VO2")
plt. legend ()
plt. grid (True)
plt. show()
```

RESULT :

The program calculated 'Best fit' line using the least square method for the given data :

- Slope (m) = 53
- Intercept (b) = -37.5
- Equation of the 'Best fit line' = 53.0 * x + -(37.5)

Teacher's Signature _____