

# Multiple Linear Regression

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# Multiple LR

We have another example of multivariable data like below.

Three independent variables

$x_1$	$x_2$	$x_3$	$y$
3.9	2.1	7.5	19.05
2.1	3.2	4.5	13.25
4.7	4.1	7.8	22.05
8.5	5.4	1.2	12.05
1.9	3.4	6.2	16.75
6.3	4.3	7.7	22.85
8.9	4.4	3.3	15.45

```

1  import numpy as np
2
3  data = np.array([[3.9, 2.1, 7.5, 19.05],
4                  [2.1, 3.2, 4.5, 13.25],
5                  [4.7, 4.1, 7.8, 22.05],
6                  [8.5, 5.4, 1.2, 12.05],
7                  [1.9, 3.4, 6.2, 16.75],
8                  [6.3, 4.3, 7.7, 22.85],
9                  [8.9, 4.4, 3.3, 15.45]])
10 x = data[:, :-1]
11 y = data[:, -1]
12
13 # initialization
14 w1, w2, w3 = 0, 0, 0
15 b = 0
16
17 # learning rate
18 alpha = 0.05
19
20 # GD
21 for i in range(10000):
22     w1 = w1 - alpha * (1 / len(data)) * sum((x[:, 0]*w1+x[:, 1]*w2+x[:, 2]*w3 + b - y) * x[:, 0])
23     w2 = w2 - alpha * (1 / len(data)) * sum((x[:, 0]*w1+x[:, 1]*w2+x[:, 2]*w3 + b - y) * x[:, 1])
24     w3 = w3 - alpha * (1 / len(data)) * sum((x[:, 0]*w1+x[:, 1]*w2+x[:, 2]*w3 + b - y) * x[:, 2])
25     b = b - alpha * (1/len(data)) * sum(x[:, 0]*w1+x[:, 1]*w2+x[:, 2]*w3 + b - y)
26 print("w1 = %f, w2 = %f, w3 = %f, b = %f" % (w1, w2, w3, b))

```

# Multiple LR

Answer is

$$w_1 = 0.5, w_2 = 1.0, w_3 = 2.0, b = 0.0$$

Much  
Better

```
1 # multivariable_lr_gd_matrix.py
2 import numpy as np
3
4 data = np.array([[3.9, 2.1, 7.5, 19.05],
5                 [2.1, 3.2, 4.5, 13.25],
6                 [4.7, 4.1, 7.8, 22.05],
7                 [8.5, 5.4, 1.2, 12.05],
8                 [1.9, 3.4, 6.2, 16.75],
9                 [6.3, 4.3, 7.7, 22.85],
10                [8.9, 4.4, 3.3, 15.45]])
11
12 x = data[:, :-1]
13 y = data[:, -1]
14
15 # initialization
16 w = np.array([0, 0, 0])
17 b = 0
18 # learning rate
19 alpha = 0.01
20 # GD
21 for i in range(50000):
22     w = w - alpha * (1 / len(data)) * np.dot(np.transpose(np.dot(x, w)+b - y), x)
23     b = b - alpha * (1 / len(data)) * sum(np.dot(x, w)+b - y)
24
25 print(w, b)
```

# Lab 46

Train a linear model (estimate optimal  $w_1, w_2, w_3, b$ ) given the data below. The answer is  $w_1 = 1.0, w_2 = 2.0, w_3 = 3.0, b = 1.0$ . Submit both source codes and screenshots in the blackboard.

$x_1$	$x_2$	$x_3$	$y$
3.5	4.7	2.3	20.8
4.4	5.7	4.1	29.1
2.5	7.3	1.2	21.7
8.5	3.3	4.8	30.5
4.9	6.4	5.7	35.8
7.2	7.1	7.4	44.6
5.6	8.2	6.5	42.5