04-claret

October 14, 2018

1 Partical Work 04 - Linear Regression

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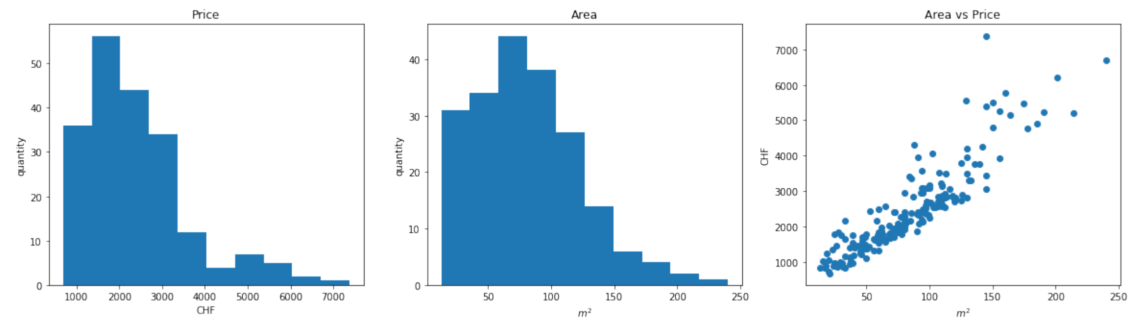
1.1 Exerice 1 - Get the data

```
In [1]: import pandas as pd
        import matplotlib.pyplot as plt
        %matplotlib inline

        dataset = pd.read_excel('lausanne-appart.xlsx',
                                usecols=[0, 2],
                                header=0,
                                names=['area', 'rent']
                               )

        data_rent = dataset['rent'].values
        data_area = dataset['area'].values

        fig, axes = plt.subplots(nrows=1, ncols=3, figsize=(20, 5))
        axe_1, axe_2, axe_3 = axes.flatten()

        axe_1.hist(data_rent)
        axe_1.set_title("Price")
        axe_1.set_xlabel('CHF')
        axe_1.set_ylabel('quantity')

        axe_2.hist(data_area)
        axe_2.set_title("Area")
        axe_2.set_xlabel('$m^2$')
        axe_2.set_ylabel('quantity')

        axe_3.scatter(data_area, data_rent)
        axe_3.set_title("Area vs Price")
        axe_3.set_xlabel('$m^2$')
        axe_3.set_ylabel('CHF')

        fig.show()
```

```
/anaconda3/envs/MachLe/lib/python3.6/site-packages/matplotlib/figure.py:457: UserWarning: matpl
  "matplotlib is currently using a non-GUI backend, "
```



1.2 Exercice 2

a)

```
In [2]: import numpy as np

        def get_theta(X, y):
            return (np.linalg.inv(X.T * X) * X.T).dot(y)

        X = np.matrix([np.ones(len(data_area)), data_area]).T

        theta = get_theta(X,data_rent).A[0]

        h_func = np.poly1d(np.roll(theta, 1))

        x_predict = np.linspace(np.min(data_area), np.max(data_area))
        y_predict = h_func(x_predict)

        plt.scatter(data_area, data_rent)
        plt.title("Area vs Price")
        plt.xlabel('$m^2$')
        plt.ylabel('CHF')
        plt.plot(x_predict, y_predict, color="red")
        plt.show()
```

b)

```
In [3]: def get_compute_cost(h,x,y):
            return sum(np.square((h(x[i]) - y[i])) for i in range(len(x))) / (2 * len(x))

        print("Cost is: ", get_compute_cost(h_func,data_area,data_rent))

Cost is:  138034.95779787409
```

1.3 Exerice 3 - Batch gradient descent for linear regression

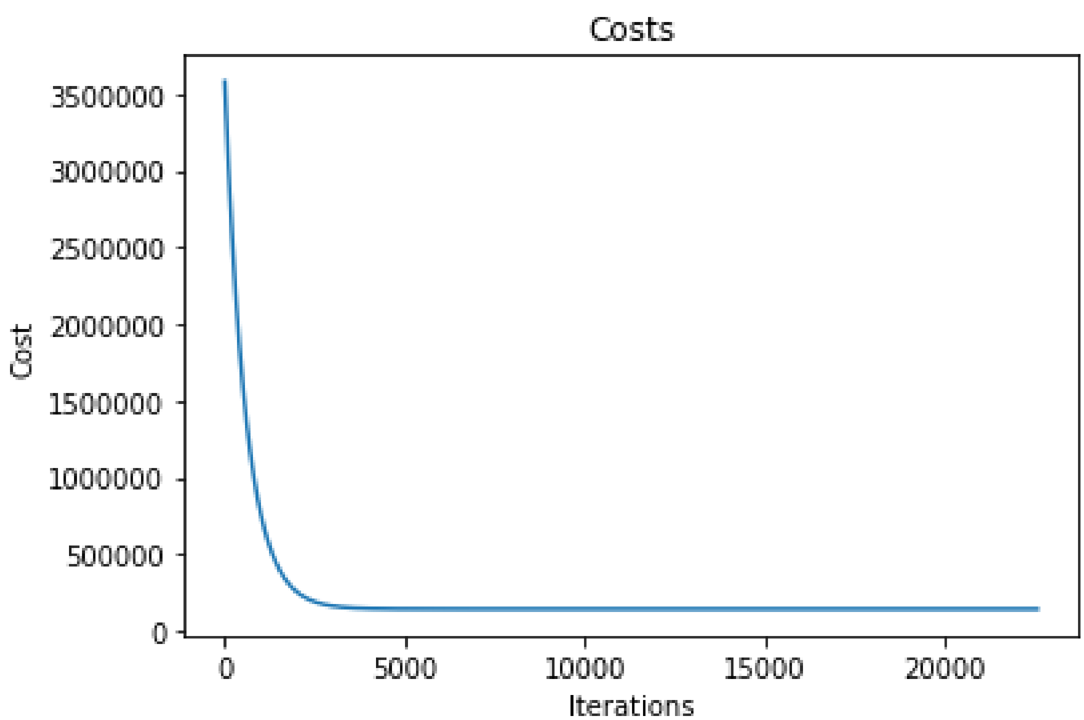
```
In [4]: import copy as cp
        import time



        alpha = .1e-6
        delta = .1e-9

        theta = np.zeros(2)
        theta_previous = np.full((2),1e+308)
        costs = []
        total_time = 0
```

```
start = time.time()
while ((abs(theta_previous[0] - theta[0]) > delta) and
       (abs(theta_previous[1] - theta[1]) > delta)):
    theta_previous = cp.copy(theta)
    theta -= alpha / len(X) * np.sum((np.matmul(X, theta) - data_rent) * X)

    cost = get_compute_cost(np.poly1d(np.roll(theta, 1)),data_area,data_rent)
    costs.append(cost)

end = time.time()
total_time = end-start
```

a) It stabilizes fast, no need for a lot of iterations

```
In [5]: print(theta)
        plt.title("Costs")
        plt.plot(costs)
        plt.xlabel("Iterations")
        plt.ylabel("Cost")
        plt.show()
```

```
[28.38924185 28.38924185]
```



b) It's using a delta between current and previous theta

c)

```
In [6]: h_func_batch = np.poly1d(np.roll(theta, 1))
        y_predict_batch = h_func_batch(x_predict)

        plt.scatter(data_area, data_rent)
        plt.title("Area vs Price")
        plt.xlabel('$m^2$')
        plt.ylabel('CHF')
        plt.plot(x_predict, y_predict_batch, color="red")
        plt.show()
```

d) Both costs are similar.

```
In [7]: print("Time elapsed:", total_time)
        print("Cost is:", get_compute_cost(h_func_batch,data_area,data_rent))
        print("Cost different with exercice 2:", get_compute_cost(h_func,data_area,data_rent)-g
```

```
Time elapsed: 68.67997074127197
Cost is: 142809.62280150174
Cost different with exercice 2: -4774.665003627655
```

1.4 Exerice 4 - Stochastic gradient descent for linear regression

```
In [8]: import random as rd

        alpha = .1e-6
        delta = .1e-9

        theta = np.zeros(2)
        theta_previous = np.full((2),1e+308)
        costs = []
        count = 0
        total_time = 0

        start = time.time()
        while ((abs(theta_previous[0] - theta[0]) > delta) and
               (abs(theta_previous[1] - theta[1]) > delta)):
            theta_previous = cp.copy(theta)
            idx = rd.randint(0, len(X)-1)
            t_0 = np.matmul(X[idx], theta)
            t_1 = t_0 - data_rent[idx]
            t_2 = t_1 * X[idx]
            t_3 = alpha * t_2
            theta = np.subtract(theta,t_3).A[0]
            count += 1
        end = time.time()
        total_time = end-start
```

a)

```
In [9]: h_func_stoch = np.poly1d(np.roll(theta, 1))
        y_predict_stoch = h_func_stoch(x_predict)

        plt.scatter(data_area, data_rent)
        plt.title("Area vs Price")
        plt.xlabel('$m^2$')
        plt.ylabel('CHF')
        plt.plot(x_predict, y_predict_stoch, color="red")
        plt.show()
```

b)

```
In [10]: print("Iterations to reach convergence:", count)

Iterations to reach convergence: 586066
```

c) It's using a delta between current and previous theta

d) Both costs are similar. However, we can note that the time performance is much better with the stochastic approach.

```
In [11]: print("Time elapsed:", total_time)
         print("Cost is:", get_compute_cost(h_func_stoch,data_area,data_rent))
         print("Cost different with exercice 2:", get_compute_cost(h_func,data_area,data_rent)

Time elapsed: 21.629117250442505
Cost is: 144042.88417393022
Cost different with exercice 2: -6007.92637605613
```