8C_Solution

April 12, 2022

0.1 Task-C: Regression outlier effect.

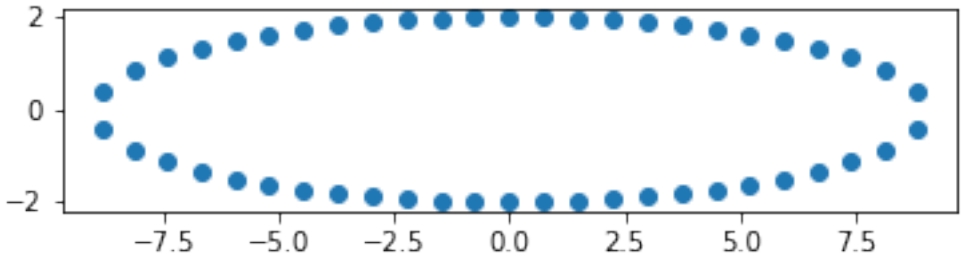
Objective:Visualization best fit linear regression line for different scenarios

[1]:
```
# you should not import any other packages
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings("ignore")
import numpy as np
from sklearn.linear_model import SGDRegressor
```

[2]:
```
import numpy as np
import scipy as sp
import scipy.optimize

def angles_in_ellipse(num,a,b):
    assert(num > 0)
    assert(a < b)
    angles = 2 * np.pi * np.arange(num) / num
    if a != b:
        e = (1.0 - a ** 2.0 / b ** 2.0) ** 0.5
        tot_size = sp.special.ellipeinc(2.0 * np.pi, e)
        arc_size = tot_size / num
        arcs = np.arange(num) * arc_size
        res = sp.optimize.root(
            lambda x: (sp.special.ellipeinc(x, e) - arcs), angles)
        angles = res.x
    return angles
```

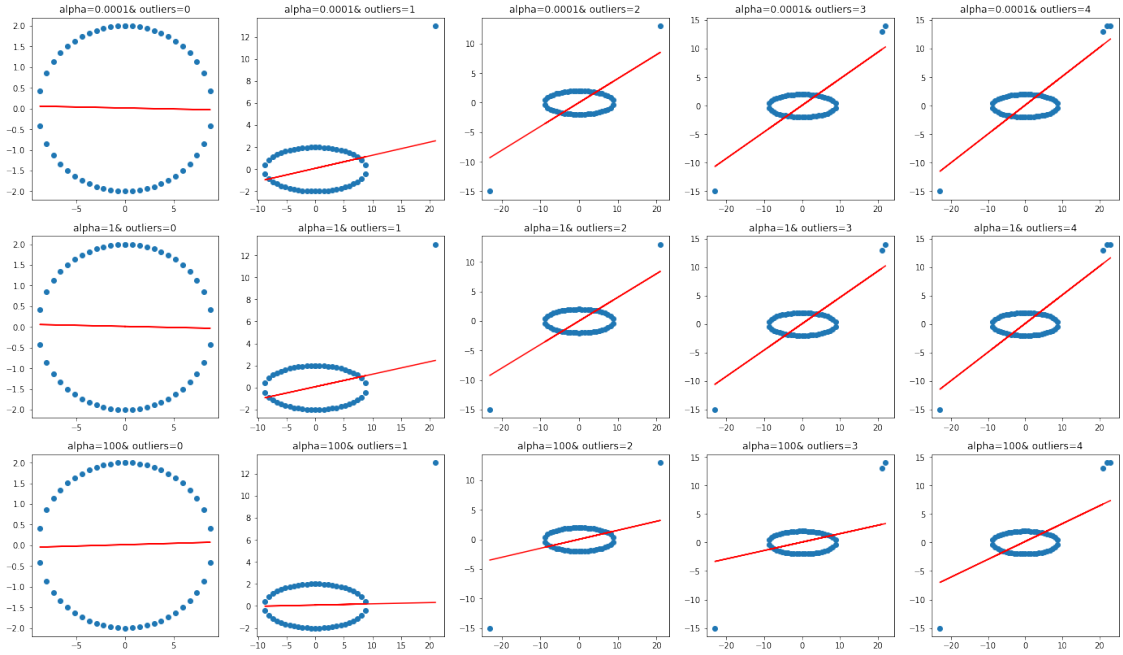
[3]:
```
a = 2
b = 9
n = 50

phi = angles_in_ellipse(n, a, b)
e = (1.0 - a ** 2.0 / b ** 2.0) ** 0.5
arcs = sp.special.ellipeinc(phi, e)

fig = plt.figure()
```

```
ax = fig.gca()
ax.axes.set_aspect('equal')
ax.scatter(b * np.sin(phi), a * np.cos(phi))
plt.show()
```



[4]:
```
X= b * np.sin(phi)
Y= a * np.cos(phi)
```

[5]:
```
s=0
outlier = [(0,2),(21, 13), (-23, -15), (22,14), (23, 14)]
alpha=[0.0001,1,100]
plt.figure(figsize=(24,14))
for reg in alpha:
    X_NEW=X
    Y_NEW=Y
    for j,i in enumerate(outlier):
        s=s+1
        X_NEW=np.append(X_NEW,i[0]).reshape(-1,1)
        Y_NEW=np.append(Y_NEW,i[1]).reshape(-1,1)
        model=SGDRegressor(alpha=reg, eta0=0.001,␣
 ↪learning_rate='constant',random_state=0)
        model.fit(X_NEW,Y_NEW)
        predict=model.predict(X_NEW)
        plt.subplot(3, 5, s)
        plt.title("alpha="+str(reg)+"& outliers="+str(j))
        plt.scatter(X_NEW,Y_NEW)
        plt.plot(X_NEW,predict,color="red")
```



0.1.1 Observations:

- We can see that when there are no outliers, we get the perfect hyperplane.
- As regularization term increases it tries to neglect the effect of outliers.
- we know that Reguralization term is added to prevent the overfitting of the model
- Alpha is a Constant that multiplies the regularization term. The higher the value, the stronger the regularization
- When regularization strength increases, it will try to reduce overfit as the number of outlier increases but we should be careful that too much reguralization will leads to underfitting
- From the plots we can observe:
  - when alpha has values 0.0001 and 1, for more than 1 outlier model will overfit.
  - But when alpha is 100 it works well upto 3 outliers, for 4 outliers model starts to overfit.