Linear Regression

- Y = a + bx + b1 x1 + b2 x2……
- Y => dependent/target (1) [1D]
- X => independent/features (n) [2D]

```
from sklearn.linear_model import LinearRegression
import numpy as np
from sklearn.metrics import
r2_score,mean_absolute_error,mean_squared_error

#independent values
time = np.array([5,7,12,16,20]).reshape(-1,1)

#dependent values
mass = np.array([40,120,180,210,240])

mymodel = LinearRegression()
#model.fit(independent,dependent)
mymodel.fit(time,mass)
```

```
LinearRegression()
```

```
x = int(input("Enter the time in minutes : "))
result = mymodel.predict([[x]]) #passing independent variable(time in
2D)
print("if the time is ",x,"minutes the mass is",result[0],"grams")
```

```
Enter the time in minutes :  40
```

```
if the time is  40 minutes the mass is 499.81818181818187 grams
```

Linear Regression on large data

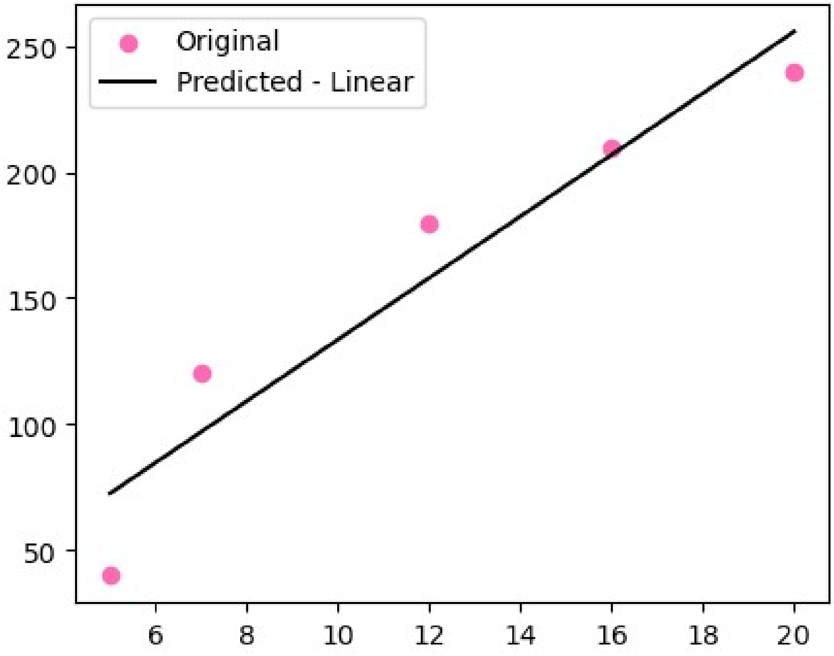
Case : Predicting the salary from age,experience,gender,education

1. Import Libraries
2. Load data
3. Split data
4. Create and train model
5. Test the model
6. Evaluation

```
mass_model = mymodel.predict(time)
print(mass_model)
```

```
[ 72.54545455  96.96103896 158.         206.83116883 255.66233766]
```

```
#plotting original values - scatter
import matplotlib.pyplot as plt
plt.figure(figsize = (5,4))
plt.scatter(time,mass,label = "Original", color = "hotpink")
#plotting model values - line
plt.plot(time,mass_model,label = "Predicted - Linear", color = "k")
plt.legend()
plt.show()
```



R-Square

- Larger, the better

```
r2score = r2_score(time,mass_model)
print(r2score)

-816.6925282509699
```

MSE

- Lower the better

```
mse = mean_squared_error(time,mass_model)
print(mse)

25184.929870129872
```

MAE

- Lower the better

```
mae = mean_absolute_error(time,mass_model)
print(mae)

146.0

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression
from sklearn.metrics import
r2_score,mean_absolute_error,mean_squared_error
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder

df=pd.read_csv(r"C:\Mypythonfiles\Salary_EDA.csv")
df.head()

    Age  Gender Education Level          Job Title  Years of
Experience  \
0  32.0    Male      Bachelor's  Software Engineer
5.0
1  28.0  Female        Master's       Data Analyst
3.0
2  45.0    Male             PhD     Senior Manager
15.0
3  36.0  Female      Bachelor's    Sales Associate
7.0
4  36.0  Female      Bachelor's    Sales Associate
7.0

     Salary
0   90000.0
1   65000.0
2  150000.0
3   60000.0
4   60000.0
```

Clean Data

```
df.isnull().sum()

Age                    2
Gender                 4
Education Level        3
Job Title              5
Years of Experience    2
Salary                 3
Gender_encoded         0
```

```
Education_Level_encoded    0
dtype: int64
```

```
df.dropna(inplace = True)
df.head()
```

```
    Age  Gender Education Level          Job Title  Years of
Experience  \
0  32.0    Male      Bachelor's  Software Engineer
5.0
1  28.0  Female        Master's       Data Analyst
3.0
2  45.0    Male             PhD     Senior Manager
15.0
3  36.0  Female      Bachelor's    Sales Associate
7.0
4  36.0  Female      Bachelor's    Sales Associate
7.0

     Salary  Gender_encoded  Education_Level_encoded
0   90000.0               1                        0
1   65000.0               0                        1
2  150000.0               1                        2
3   60000.0               0                        0
4   60000.0               0                        0
```

```
df.isnull().sum()
```

```
Age                        0
Gender                     0
Education Level            0
Job Title                  0
Years of Experience        0
Salary                     0
Gender_encoded             0
Education_Level_encoded    0
dtype: int64
```

```
df.head()
```

```
    Age  Gender Education Level          Job Title  Years of
Experience  \
0  32.0    Male      Bachelor's  Software Engineer
5.0
1  28.0  Female        Master's       Data Analyst
3.0
2  45.0    Male             PhD     Senior Manager
15.0
3  36.0  Female      Bachelor's    Sales Associate
7.0
4  36.0  Female      Bachelor's    Sales Associate
```

```
7.0

     Salary  Gender_encoded  Education_Level_encoded
0   90000.0               1                        0
1   65000.0               0                        1
2  150000.0               1                        2
3   60000.0               0                        0
4   60000.0               0                        0
```

Data Preprocessing

```
# encoding gender
g_e = LabelEncoder()
df['Gender_encoded'] = g_e.fit_transform(df['Gender'])
edu_le = LabelEncoder()
df['Education_Level_encoded'] = edu_le.fit_transform(df['Education 
Level'])
df.head()
```

```
    Age  Gender Education Level          Job Title  Years of 
Experience  \
0  32.0    Male      Bachelor's  Software Engineer                 
5.0   
1  28.0  Female        Master's       Data Analyst                 
3.0   
2  45.0    Male             PhD     Senior Manager                
15.0   
3  36.0  Female      Bachelor's    Sales Associate                 
7.0   
4  36.0  Female      Bachelor's    Sales Associate                 
7.0   

     Salary  Gender_encoded  Education_Level_encoded
0   90000.0               1                        0
1   65000.0               0                        1
2  150000.0               1                        2
3   60000.0               0                        0
4   60000.0               0                        0
```

Split Data

```
x = df[['Age','Gender_encoded','Education_Level_encoded','Years of 
Experience']]
y = df['Salary']
```

Split-train and test

```
x_train, x_test, y_train, y_test = train_test_split(x,y,test_size =
0.2, random_state=42)
#total 700 records
#x_train- 560(age,ge,e)
#x_test- 140(age,ge,e)
#y_train- 560(sal)
#y_test- 140(sal)
```

Create and train model

```
salary_model = LinearRegression()
salary_model.fit(x_train,y_train)
```

```
LinearRegression()
```

```
a = float(input("Enter your age: "))
g_user = input("Enter your gender: ")
ed_user = input("Enter your educational level: ")
Exp = float(input("Enter your experience in years: "))
```

```
Enter your age:  34
Enter your gender:  Male
Enter your educational level:  PhD
Enter your experience in years:  12
```

```
gen_enc = g_e.transform([g_user])[0]
edu_enc = edu_le.transform([ed_user])[0]
print(gen_enc,edu_enc)
```

```
1 2
```

```
result = salary_model.predict([[a,gen_enc,edu_enc,Exp]]) #passing
independent variable(time in 2D)
print("the predicted salary is : ",result[0])
```

```
the predicted salary is :  119917.1432632611
```

```
C:\ProgramData\anaconda3\Lib\site-packages\sklearn\base.py:439:
UserWarning: X does not have valid feature names, but LinearRegression
was fitted with feature names
  warnings.warn(
```

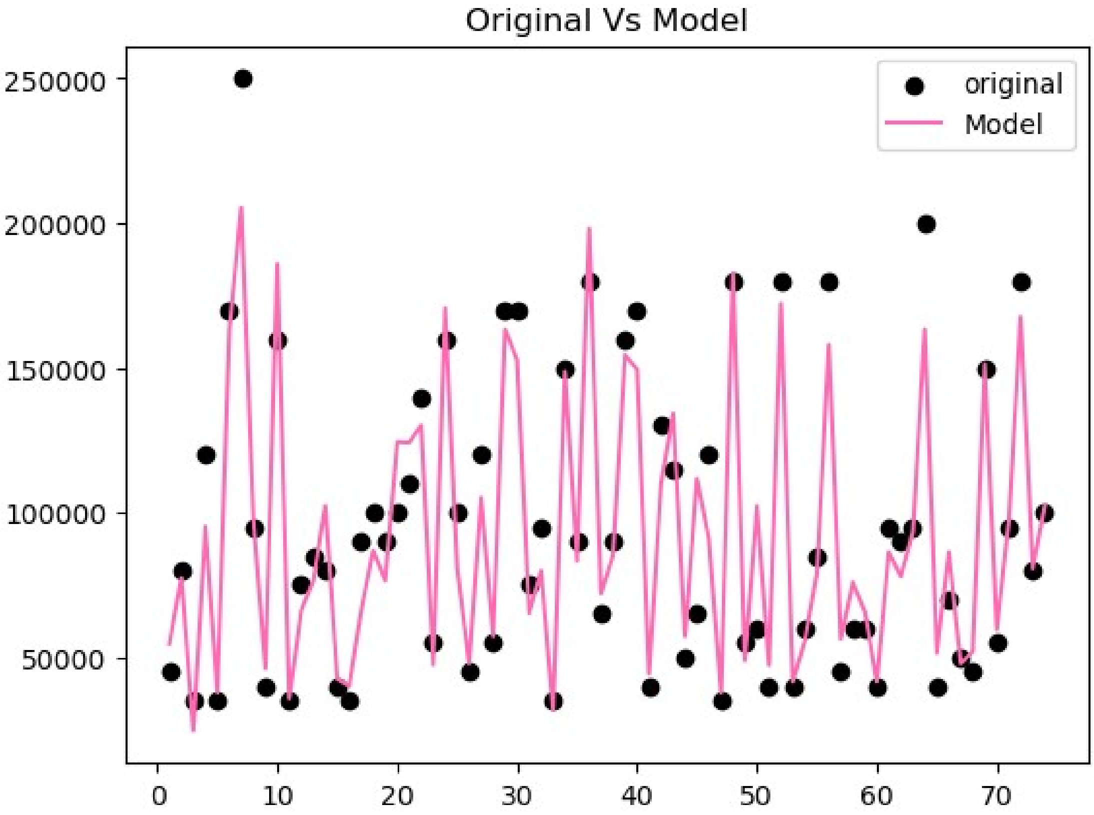
# Evaluation

1. predict test values
2. visualize
3. metrics

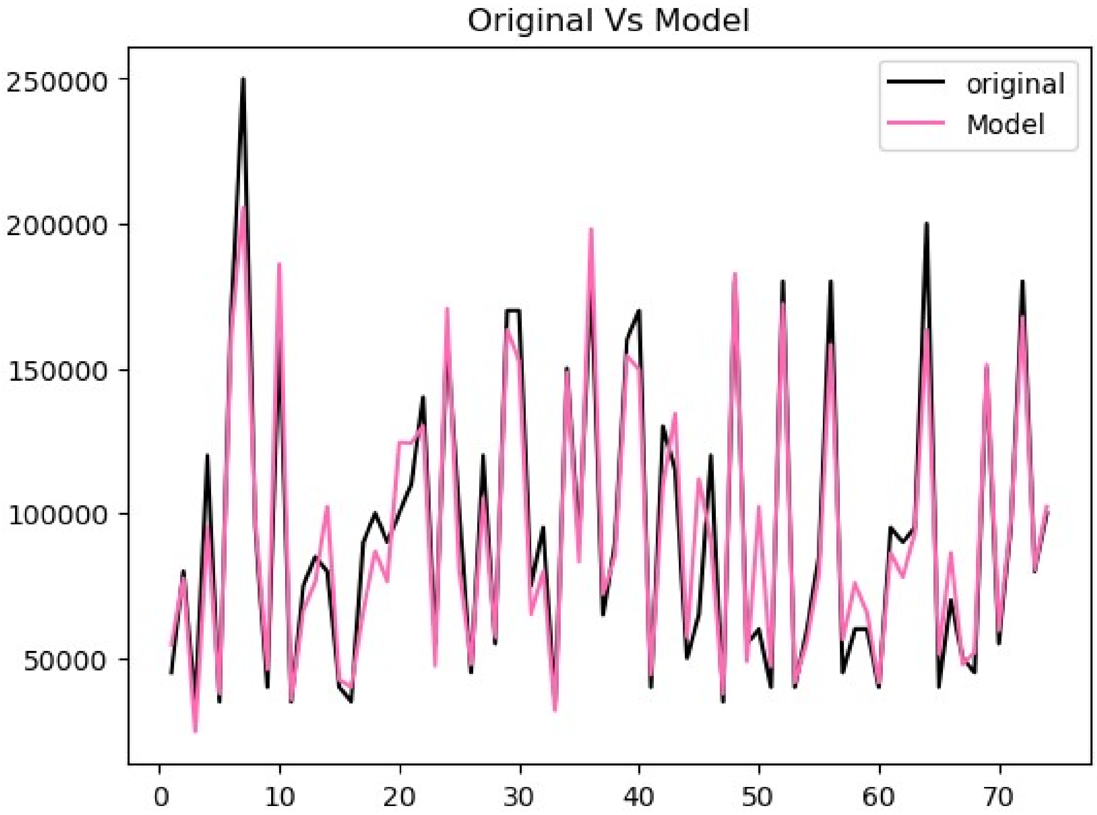
```
model_predictions = salary_model.predict(x_test)
```

1.visualize

```
len(y_test)

74

len(x_test)

74

#plotting original values
plt.scatter(np.arange(1,75), y_test, color = 'k', label= 'original')
plt.plot(np.arange(1,75),model_predictions, color = 'hotpink', label =
'Model')
plt.title("Original Vs Model")
plt.legend()
plt.show()
```



```
plt.plot(np.arange(1,75), y_test, color = 'k', label= 'original')
plt.plot(np.arange(1,75),model_predictions, color = 'hotpink', label =
'Model')
plt.title("Original Vs Model")
plt.legend()
plt.show()
```


Original Vs Model
original
Model
250000
200000
150000
100000
50000
0
10
20
30
40
50
60
70