businessproblem

November 20, 2024

[1]:

```
# Data Manipulation and Analysis
import pandas as pd
import numpy as np

# Data Visualization
import matplotlib.pyplot as plt
import seaborn as sns

# Machine Learning (Linear Regression and Evaluation)
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score
```

[2]:

```
df = pd.read_csv('/Users/vishal/Desktop/CSV files/Labourtraining.csv')
```

[3]:

```
df.head()
```

[3]:

```
   Age           Eduacation      Race          Hisp MaritalStatus  Nodeg  \
0   45  LessThanHighSchool  NotBlack  NotHispanic       Married      1
1   21        Intermediate  NotBlack  NotHispanic    NotMarried      0
2   38          HighSchool  NotBlack  NotHispanic       Married      0
3   48  LessThanHighSchool  NotBlack  NotHispanic       Married      1
4   18  LessThanHighSchool  NotBlack  NotHispanic       Married      1

   Earnings_1974  Earnings_1975  Earnings_1978
0      21516.670      25243.550      25564.670
1       3175.971       5852.565      13496.080
2      23039.020      25130.760      25564.670
3      24994.370      25243.550      25564.670
4       1669.295      10727.610       9860.869
```

[4]:

```
print(df.columns)
```

```
Index(['Age', 'Eduacation', 'Race', 'Hisp', 'MaritalStatus', 'Nodeg',
       'Earnings_1974', 'Earnings_1975', 'Earnings_1978'],
      dtype='object')
```

[5]:

```
df.describe()
```

```
[5]:                Age        Nodeg  Earnings_1974  Earnings_1975  Earnings_1978
      count  15992.000000  15992.000000   15992.000000   15992.000000   15992.000000
      mean      33.225238      0.295835   14016.800304   13650.803376   14846.659673
      std       11.045216      0.456432    9569.795893    9270.403225    9647.391524
      min       16.000000      0.000000       0.000000       0.000000       0.000000
      25%       24.000000      0.000000    4403.452250    4398.823000    5669.298000
      50%       31.000000      0.000000   15123.580000   14557.110000   16421.975000
      75%       42.000000      1.000000   23584.180000   22923.737500   25564.670000
      max       55.000000      1.000000   25862.320000   25243.550000   25564.670000
```

```
[6]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 15992 entries, 0 to 15991
Data columns (total 9 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Age            15992 non-null  int64
 1   Eduacation     15992 non-null  object
 2   Race           15992 non-null  object
 3   Hisp           15992 non-null  object
 4   MaritalStatus  15992 non-null  object
 5   Nodeg          15992 non-null  int64
 6   Earnings_1974  15992 non-null  float64
 7   Earnings_1975  15992 non-null  float64
 8   Earnings_1978  15992 non-null  float64
dtypes: float64(3), int64(2), object(4)
memory usage: 1.1+ MB
```

0.0.1 Handle Missing Values

```
[8]: df = df.dropna()
```

0.0.2 Encode Categorical Variables Convert categorical variables (e.g., Race, Hispanic, Married) into numeric form.

```
[10]: # Convert categories into numerical values (e.g., 0 and 1)
      df['Race'] = df['Race'].apply(lambda x: 1 if x == 'Black' else 0)
      df['Hisp'] = df['Hisp'].apply(lambda x: 1 if x == 'Yes' else 0)
      df['MaritalStatus'] = df['MaritalStatus'].apply(lambda x: 1 if x == 'Yes' else␣
        ↪0)
```

```
[11]: print(df[['Race', 'Hisp', 'MaritalStatus']].head())
```

```
   Race  Hisp  MaritalStatus
0     0     0              0
1     0     0              0
```

```
2      0      0                 0
3      0      0                 0
4      0      0                 0
```

[12]:

```
# Features for prediction
X = df[['Age', 'Race', 'Eduacation', 'Hisp', 'MaritalStatus', 'Earnings_1974',␣
 ↪'Earnings_1975']]

# Target variable
y = df['Earnings_1978']
```

[13]:

```
print(df.columns)
```

```
Index(['Age', 'Eduacation', 'Race', 'Hisp', 'MaritalStatus', 'Nodeg',
       'Earnings_1974', 'Earnings_1975', 'Earnings_1978'],
      dtype='object')
```

1 Train-Test Split

[15]:

```
from sklearn.model_selection import train_test_split

# Split into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
```

2 Build and Train the Linear Regression Model

[17]:

```
X = df[['Age', 'Race', 'Hisp', 'MaritalStatus', 'Nodeg', 'Earnings_1974',␣
 ↪'Earnings_1975']]
y = df['Earnings_1978']

# Train-test split
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)

# Train the model
from sklearn.linear_model import LinearRegression
model = LinearRegression()
model.fit(X_train, y_train)
```

[17]:

```
LinearRegression()
```

[18]:

```
# Make predictions on the test set
y_pred = model.predict(X_test)
```

3 Evaluate the Model

[20]:

```python
from sklearn.metrics import mean_squared_error, r2_score

# Calculate Mean Squared Error
mse = mean_squared_error(y_test, y_pred)
print("Mean Squared Error (MSE):", mse)

# Calculate R-squared Score
r2 = r2_score(y_test, y_pred)
print("R-squared Score:", r2)
```

```
Mean Squared Error (MSE): 48607834.103273086
R-squared Score: 0.47690656591862246
```

4 Analyze the Coefficients

[22]:

```python
# Display model coefficients
coefficients = pd.DataFrame({
    'Feature': X.columns,
    'Coefficient': model.coef_
})
print(coefficients)
```

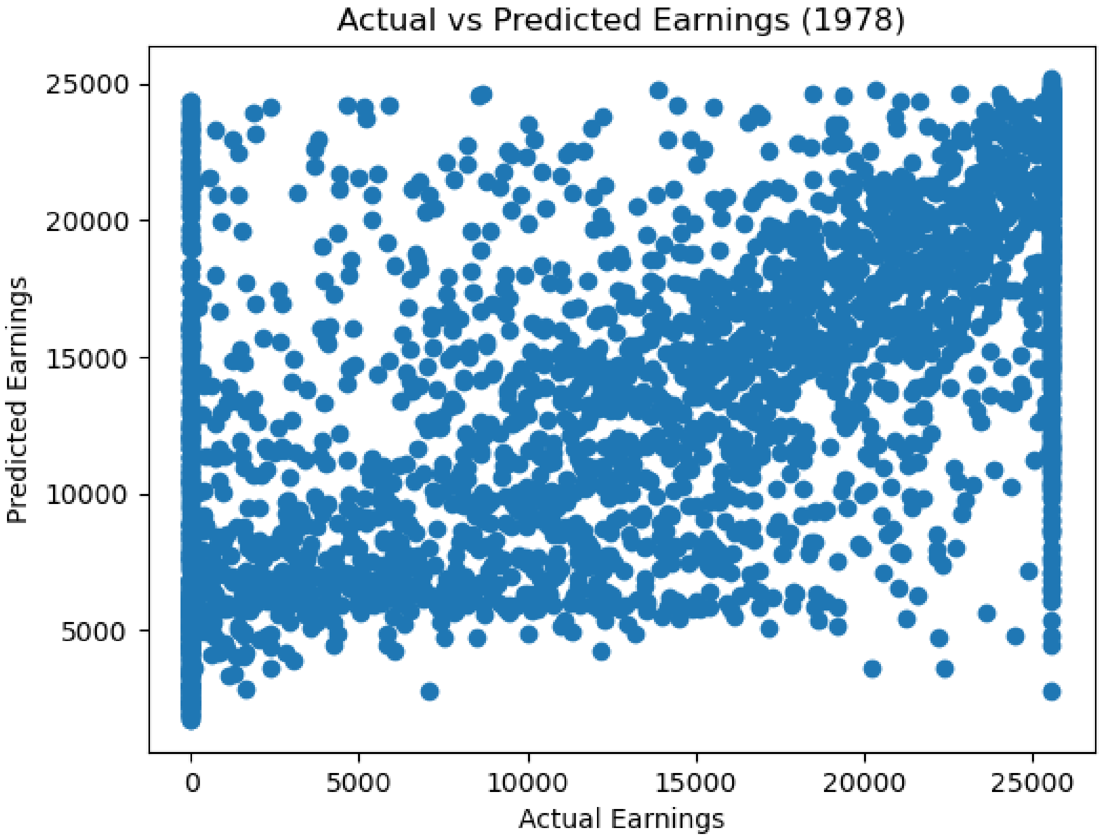
```
         Feature   Coefficient
0            Age -1.066479e+02
1           Race -9.265411e-11
2           Hisp -2.246764e-11
3  MaritalStatus  1.705303e-13
4          Nodeg -4.028111e+02
5  Earnings_1974  2.804689e-01
6  Earnings_1975  4.820691e-01
```

5 Visualize Predictions

6 Scatter Plot

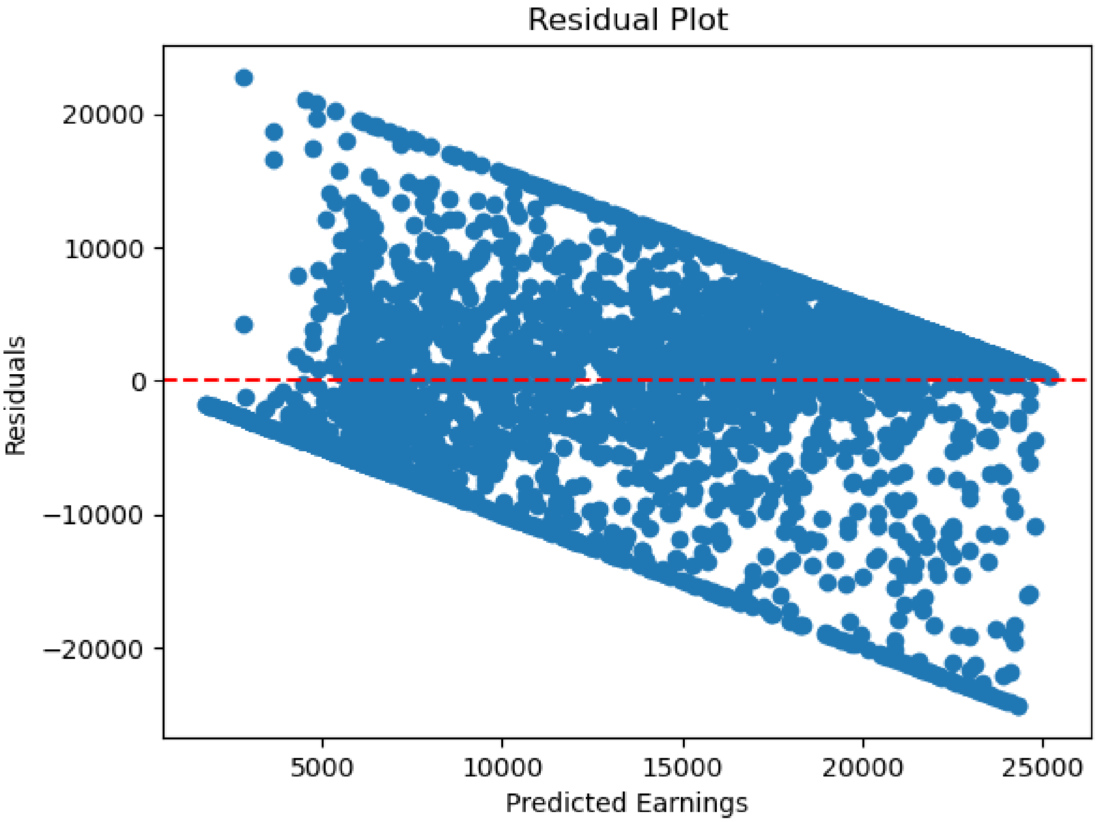
[25]:

```python
import matplotlib.pyplot as plt

plt.scatter(y_test, y_pred)
plt.xlabel("Actual Earnings")
plt.ylabel("Predicted Earnings")
plt.title("Actual vs Predicted Earnings (1978)")
plt.show()
```



7 Residual Plot

[27]:
```
residuals = y_test - y_pred

plt.scatter(y_pred, residuals)
plt.axhline(0, color='red', linestyle='--')
plt.xlabel("Predicted Earnings")
plt.ylabel("Residuals")
plt.title("Residual Plot")
plt.show()
```



8 Make Predictions on New Data

[29]:
```
# Example new data
new_data = pd.DataFrame({
    'Age': [35],
    'Race': [1],
    'Hisp': [0],
    'MaritalStatus': [1],
    'Nodeg': [0],
    'Earnings_1974': [15000],
    'Earnings_1975': [16000]
})

# Predict earnings for 1978
predicted_earnings = model.predict(new_data)
print("Predicted Earnings for 1978:", predicted_earnings)
```

```
Predicted Earnings for 1978: [16204.28454823]
```