pa3fzfmwi

November 26, 2024

[2]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error, r2_score
from statsmodels.stats.outliers_influence import variance_inflation_factor
import statsmodels.api as sm
```

[3]:
```
data = pd.read_csv('Labour_training.csv')
```

[4]:
```
data.head()
```

[4]:
```
   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
```

[5]:
```
data.tail()
```

[5]:
```
       Age          Eduacation      Race         Hisp MaritalStatus  Nodeg  \
15987   22          HighSchool     black  NotHispanic    NotMarried      0
15988   20          HighSchool     black  NotHispanic       Married      0
15989   37          HighSchool  NotBlack  NotHispanic    NotMarried      0
15990   47  LessThanHighSchool  NotBlack  NotHispanic       Married      1
15991   40  LessThanHighSchool  NotBlack  NotHispanic    NotMarried      1
```

```
       Earnings_1974  Earnings_1975  Earnings_1978
15987       3975.352       6801.435       2757.438
15988       1445.939      11832.240       6895.072
15989       1733.951       1559.371       4221.865
15990      16914.350      11384.660      13671.930
15991      13628.660      13144.550       7979.724
```

[6]:
```
data.describe()
```

[6]:
```
                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
```

[7]:
```
data.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
```

[8]:
```
data.isnull().sum()
data = data.dropna()
```

[9]:
```
df_encoded = pd.get_dummies(data, columns=['Eduacation', 'Race', 'Hisp',␣
  ↪'MaritalStatus'], drop_first=True)
```

[10]:
```
X = df_encoded.drop(columns=['Earnings_1978'])
y = df_encoded['Earnings_1978']
```

[11]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
```

[12]:
```
# Train the Linear Regression model
model = LinearRegression()
model.fit(X_train, y_train)
y_pred = model.predict(X_test)

# Residuals
residuals = y_test - y_pred
```

[13]:
```
y_pred = model.predict(X_test)
```

[14]:
```
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)
```

[15]:
```
print(f"Mean Squared Error: {mse:.2f}")
print(f"R-Squared Score: {r2:.2f}")
```

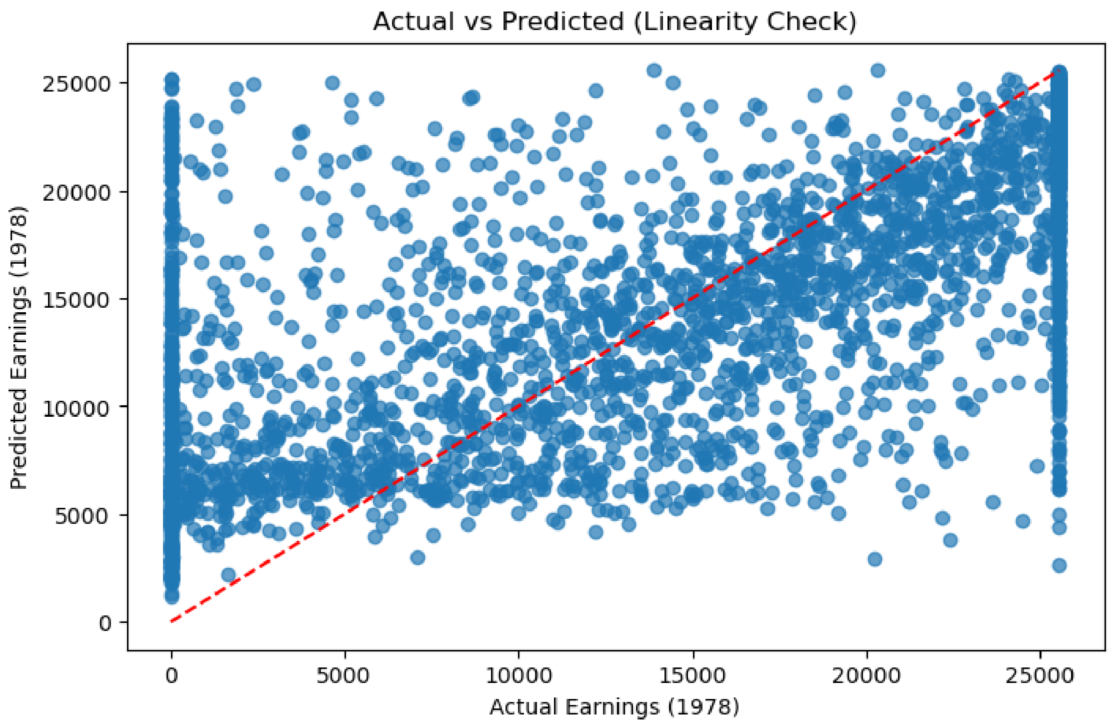
```
Mean Squared Error: 48625764.00
R-Squared Score: 0.48
```

[16]:
```
coefficients = pd.DataFrame({'Feature': X.columns, 'Coefficient': model.coef_})
print("Feature Coefficients:")
display(coefficients)
```

```
Feature Coefficients:

                         Feature  Coefficient
0                            Age  -107.350492
1                          Nodeg   -29.339019
2                  Earnings_1974     0.283039
3                  Earnings_1975     0.475135
4         Eduacation_Intermediate   274.149983
5    Eduacation_LessThanHighSchool   -29.339019
6         Eduacation_PostGraduate  1059.095110
7             Eduacation_graduate  1033.137733
8                     Race_black  -857.181352
9                   Hisp_hispanic  -442.428781
10        MaritalStatus_NotMarried   -86.350484
```

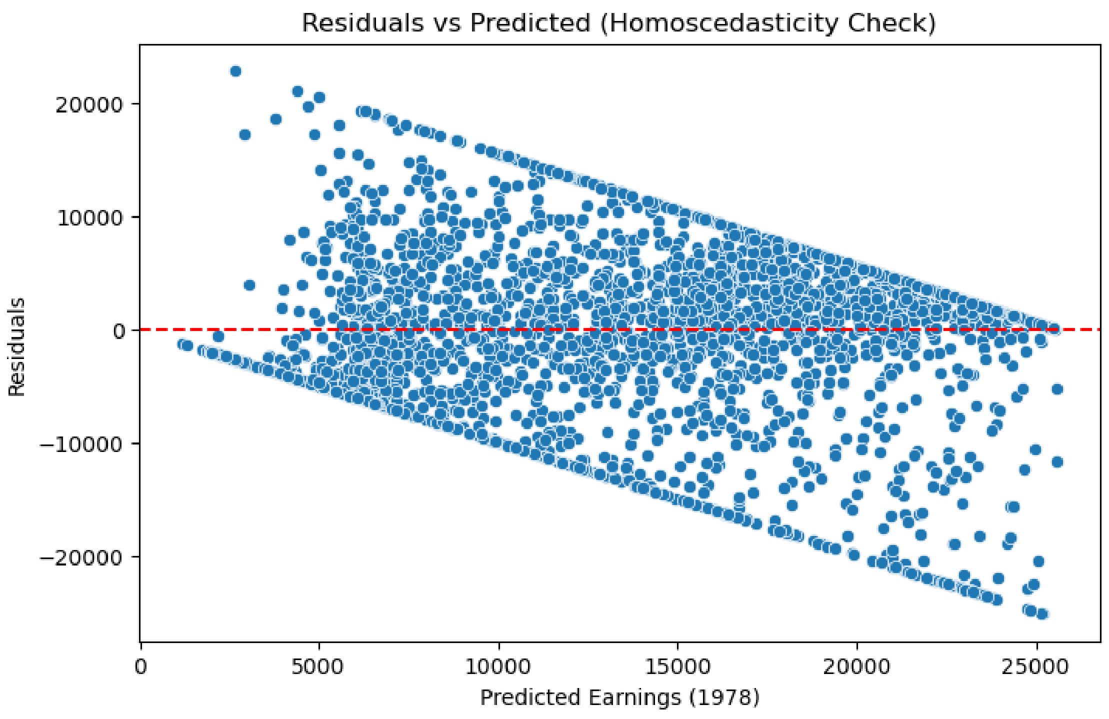
[24]:
```
plt.figure(figsize=(8, 5))
plt.scatter(y_test, y_pred, alpha=0.7)
plt.plot([y_test.min(), y_test.max()], [y_test.min(), y_test.max()],␣
 ↪color='red', linestyle='--')
plt.title("Actual vs Predicted (Linearity Check)")
plt.xlabel("Actual Earnings (1978)")
plt.ylabel("Predicted Earnings (1978)")
plt.show()
```



[25]:
```
dw_test = sm.stats.durbin_watson(residuals)
print(f"Durbin-Watson Test Statistic: {dw_test}")
# Values close to 2 indicate no autocorrelation.
```

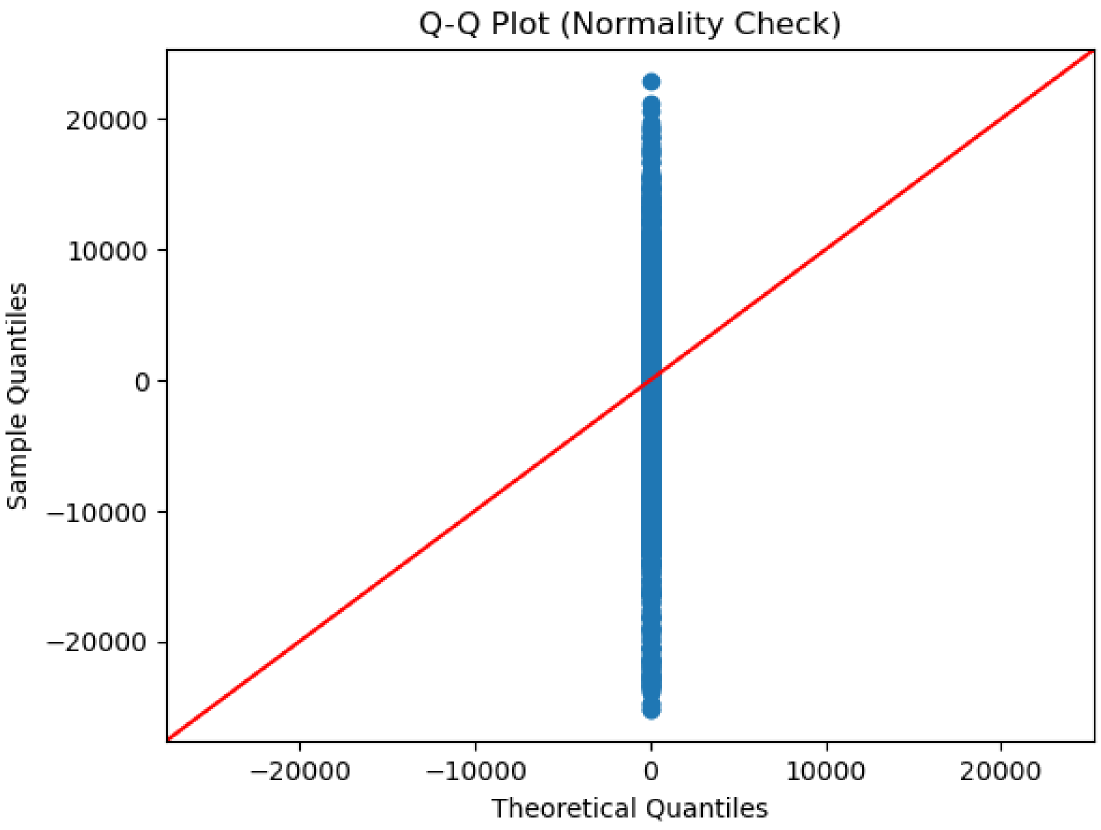
```
Durbin-Watson Test Statistic: 1.9323083671337922
```

[26]:
```
plt.figure(figsize=(8, 5))
sns.scatterplot(x=y_pred, y=residuals)
plt.axhline(y=0, color='red', linestyle='--')
plt.title("Residuals vs Predicted (Homoscedasticity Check)")
plt.xlabel("Predicted Earnings (1978)")
plt.ylabel("Residuals")
plt.show()
```

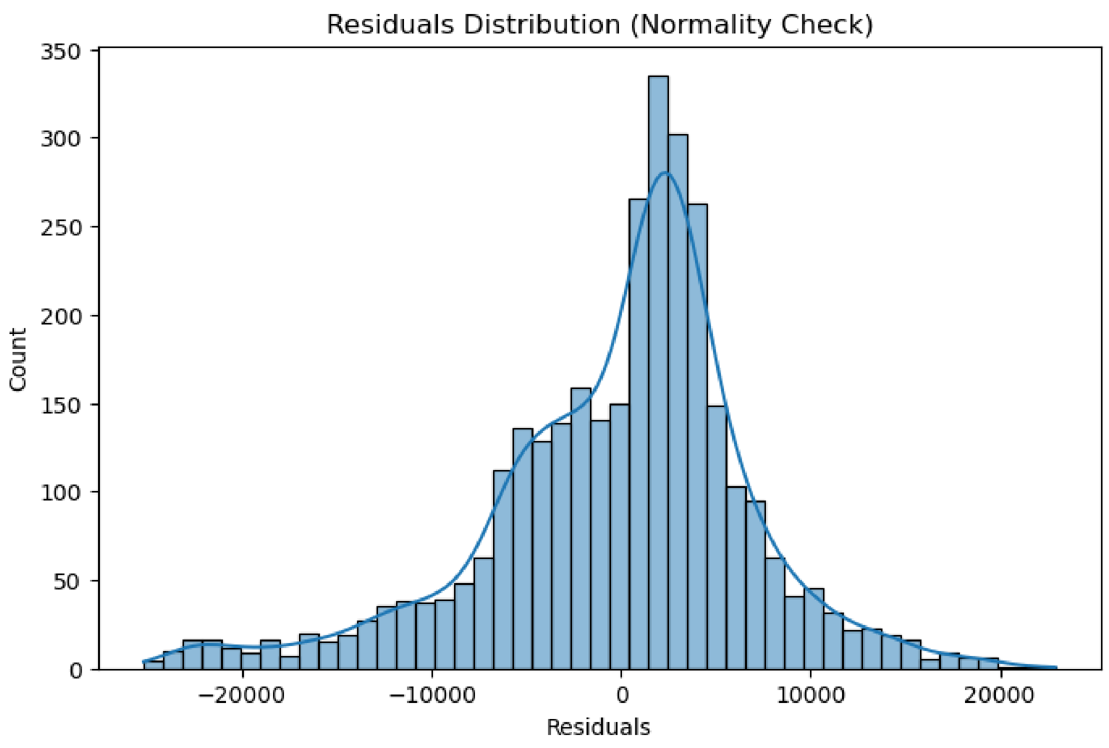


[27]:
```
# Q-Q plot
sm.qqplot(residuals, line='45')
plt.title("Q-Q Plot (Normality Check)")
plt.show()

# Histogram of residuals
plt.figure(figsize=(8, 5))
sns.histplot(residuals, kde=True)
plt.title("Residuals Distribution (Normality Check)")
plt.xlabel("Residuals")
plt.show()
```



```
D:\python\Lib\site-packages\seaborn\_oldcore.py:1119: FutureWarning:
use_inf_as_na option is deprecated and will be removed in a future version.
Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
```


Residuals Distribution (Normality Check)
Count
Residuals
0
50
100
150
200
250
300
350
−20000
−10000
0
10000
20000