# Phase 1

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:
```
df = pd.read_csv("C:\\Users\\Shaun Alex\\Downloads\\archive\\NetflixOrigina
df
```

Out[2]:

| | Title | Genre | Premiere | Runtime | IMDB Score | Language |
|---|---|---|---|---|---|---|
| **0** | Enter the Anime | Documentary | August 5, 2019 | 58 | 2.5 | English/Japanese |
| **1** | Dark Forces | Thriller | August 21, 2020 | 81 | 2.6 | Spanish |
| **2** | The App | Science fiction/Drama | December 26, 2019 | 79 | 2.6 | Italian |
| **3** | The Open House | Horror thriller | January 19, 2018 | 94 | 3.2 | English |
| **4** | Kaali Khuhi | Mystery | October 30, 2020 | 90 | 3.4 | Hindi |
| **...** | ... | ... | ... | ... | ... | ... |
| **579** | Taylor Swift: Reputation Stadium Tour | Concert Film | December 31, 2018 | 125 | 8.4 | English |
| **580** | Winter on Fire: Ukraine's Fight for Freedom | Documentary | October 9, 2015 | 91 | 8.4 | English/Ukranian/Russian |
| **581** | Springsteen on Broadway | One-man show | December 16, 2018 | 153 | 8.5 | English |
| **582** | Emicida: AmarElo - It's All For Yesterday | Documentary | December 8, 2020 | 89 | 8.6 | Portuguese |
| **583** | David Attenborough: A Life on Our Planet | Documentary | October 4, 2020 | 83 | 9.0 | English |

584 rows × 6 columns

In [3]:
```
df.info
```

Out[3]:
```
<bound method DataFrame.info of
Title                      Genre  \
0                                        Enter the Anime            Documentary
1                                            Dark Forces               Thriller
2                                                The App  Science fiction/Drama
3                                         The Open House        Horror thriller
4                                            Kaali Khuhi                Mystery
..                                                   ...                    ...
579           Taylor Swift: Reputation Stadium Tour           Concert Film
580  Winter on Fire: Ukraine's Fight for Freedom            Documentary
581                          Springsteen on Broadway          One-man show
582      Emicida: AmarElo - It's All For Yesterday            Documentary
583       David Attenborough: A Life on Our Planet            Documentary

              Premiere  Runtime  IMDB Score                  Language
0       August 5, 2019       58         2.5          English/Japanese
1      August 21, 2020       81         2.6                   Spanish
2    December 26, 2019       79         2.6                   Italian
3     January 19, 2018       94         3.2                   English
4     October 30, 2020       90         3.4                     Hindi
..                 ...      ...         ...                       ...
579  December 31, 2018      125         8.4                   English
580    October 9, 2015       91         8.4  English/Ukranian/Russian
581  December 16, 2018      153         8.5                   English
582   December 8, 2020       89         8.6                Portuguese
583    October 4, 2020       83         9.0                   English

[584 rows x 6 columns]>
```

In [4]:
```
df.describe
```

Out[4]:
```
<bound method NDFrame.describe of
Title                  Genre  \
0                                 Enter the Anime            Documentary
1                                     Dark Forces               Thriller
2                                         The App  Science fiction/Drama
3                                  The Open House        Horror thriller
4                                     Kaali Khuhi                Mystery
..                                            ...                    ...
579           Taylor Swift: Reputation Stadium Tour           Concert Film
580  Winter on Fire: Ukraine's Fight for Freedom            Documentary
581                      Springsteen on Broadway           One-man show
582     Emicida: AmarElo - It's All For Yesterday            Documentary
583      David Attenborough: A Life on Our Planet            Documentary

              Premiere  Runtime  IMDB Score                  Language
0       August 5, 2019       58         2.5          English/Japanese
1      August 21, 2020       81         2.6                   Spanish
2    December 26, 2019       79         2.6                   Italian
3     January 19, 2018       94         3.2                   English
4     October 30, 2020       90         3.4                     Hindi
..                 ...      ...         ...                       ...
579  December 31, 2018      125         8.4                   English
580    October 9, 2015       91         8.4  English/Ukranian/Russian
581  December 16, 2018      153         8.5                   English
582   December 8, 2020       89         8.6                Portuguese
583    October 4, 2020       83         9.0                   English

[584 rows x 6 columns]>
```

In [5]:
```
df.rename(columns = {'IMDB Score':'IMDBScore'}, inplace = True)
df
```

Out[5]:

| | Title | Genre | Premiere | Runtime | IMDBScore | Language |
|---|---|---|---|---|---|---|
| **0** | Enter the Anime | Documentary | August 5, 2019 | 58 | 2.5 | English/Japanese |
| **1** | Dark Forces | Thriller | August 21, 2020 | 81 | 2.6 | Spanish |
| **2** | The App | Science fiction/Drama | December 26, 2019 | 79 | 2.6 | Italian |
| **3** | The Open House | Horror thriller | January 19, 2018 | 94 | 3.2 | English |
| **4** | Kaali Khuhi | Mystery | October 30, 2020 | 90 | 3.4 | Hindi |
| **...** | ... | ... | ... | ... | ... | ... |
| **579** | Taylor Swift: Reputation Stadium Tour | Concert Film | December 31, 2018 | 125 | 8.4 | English |
| **580** | Winter on Fire: Ukraine's Fight for Freedom | Documentary | October 9, 2015 | 91 | 8.4 | English/Ukranian/Russian |
| **581** | Springsteen on Broadway | One-man show | December 16, 2018 | 153 | 8.5 | English |
| **582** | Emicida: AmarElo - It's All For Yesterday | Documentary | December 8, 2020 | 89 | 8.6 | Portuguese |
| **583** | David Attenborough: A Life on Our Planet | Documentary | October 4, 2020 | 83 | 9.0 | English |

584 rows × 6 columns

In [6]:
```
df.isnull().sum()
```

Out[6]:
```
Title        0
Genre        0
Premiere     0
Runtime      0
IMDBScore    0
Language     0
dtype: int64
```

In [7]:
```
df.columns
```

Out[7]:
```
Index(['Title', 'Genre', 'Premiere', 'Runtime', 'IMDBScore', 'Language'],
dtype='object')
```

In [8]:
```
language=df['Language'].value_counts().sort_values(ascending=False)
language=language[:10]
language
```

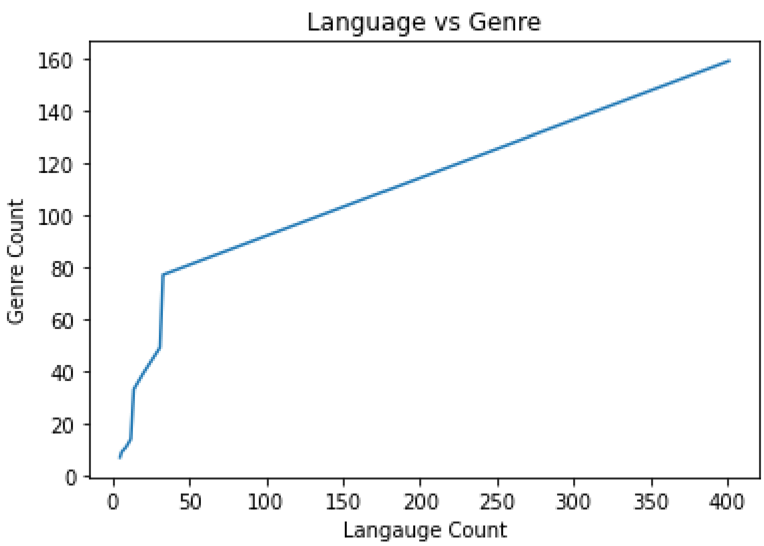
Out[8]:
```
English       401
Hindi          33
Spanish        31
French         20
Italian        14
Portuguese     12
Indonesian      9
Korean          6
Japanese        6
German          5
Name: Language, dtype: int64
```

In [9]:
```
Genre=df["Genre"].value_counts().sort_values(ascending=False)
Genre=Genre[:10]
Genre
```

Out[9]:
```
Documentary        159
Drama               77
Comedy              49
Romantic comedy     39
Thriller            33
Comedy-drama        14
Crime drama         11
Biopic               9
Horror               9
Action               7
Name: Genre, dtype: int64
```

In [10]:
```
plt.plot(language,Genre)
plt.xlabel("Langauge Count")
plt.ylabel("Genre Count")
plt.title("Language vs Genre")
```

Out[10]:
```
Text(0.5, 1.0, 'Language vs Genre')
```



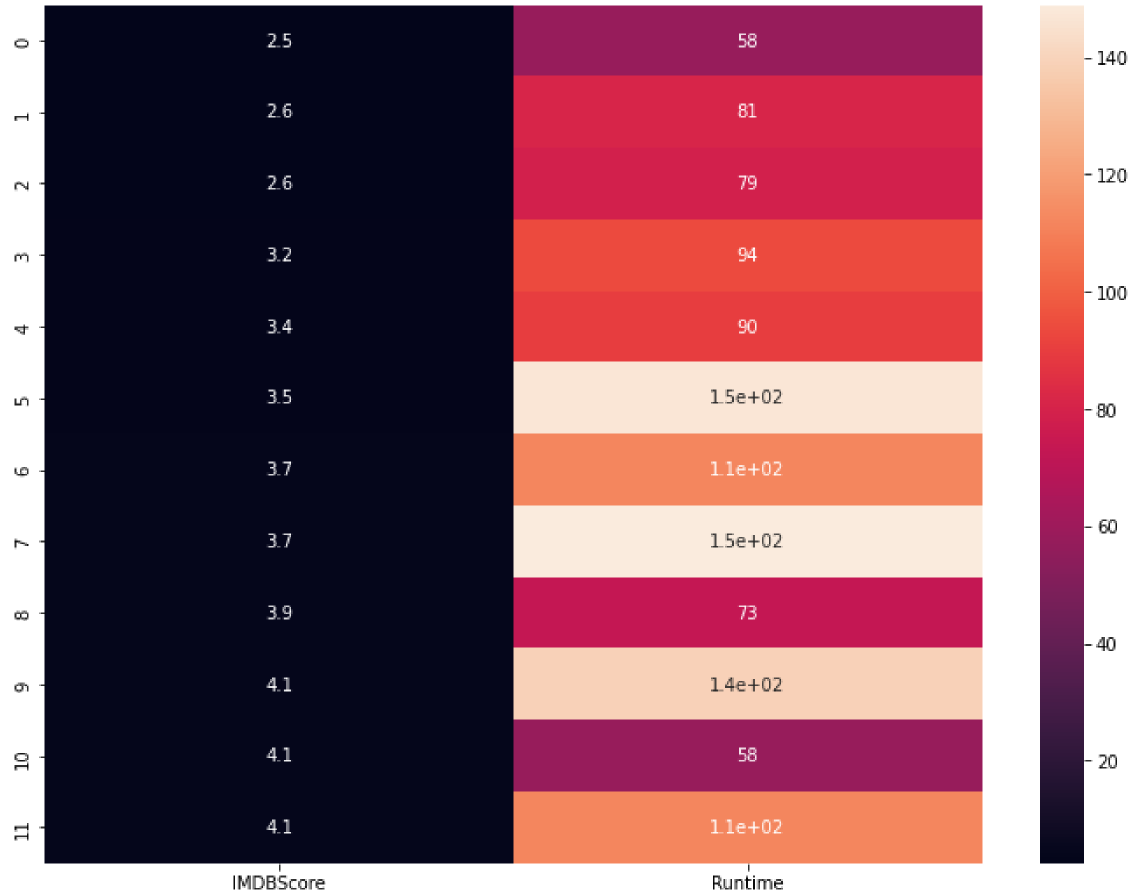
In [11]:
```python
cols=["IMDBScore","Runtime"]
x=df[cols].head(12)

x.corr()
```

Out[11]:

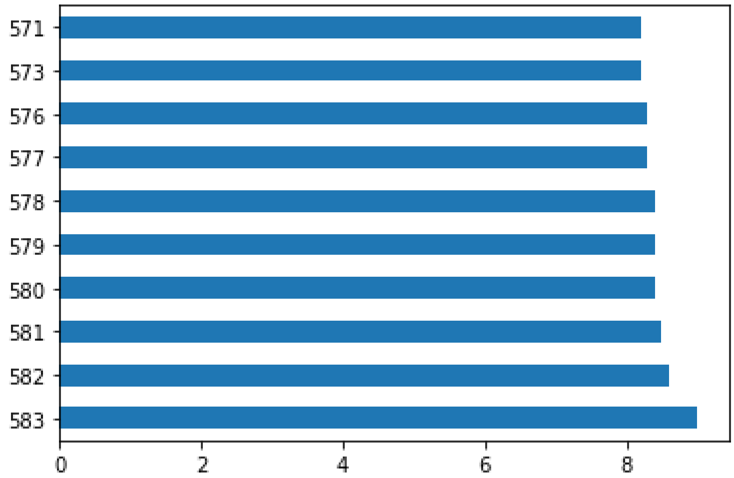
| | IMDBScore | Runtime |
|---|---|---|
| **IMDBScore** | 1.00000 | 0.40416 |
| **Runtime** | 0.40416 | 1.00000 |

In [12]:
```python
plt.figure(figsize=(12,9))
sns.heatmap(x,annot=True)
```

Out[12]:
```
<AxesSubplot:>
```

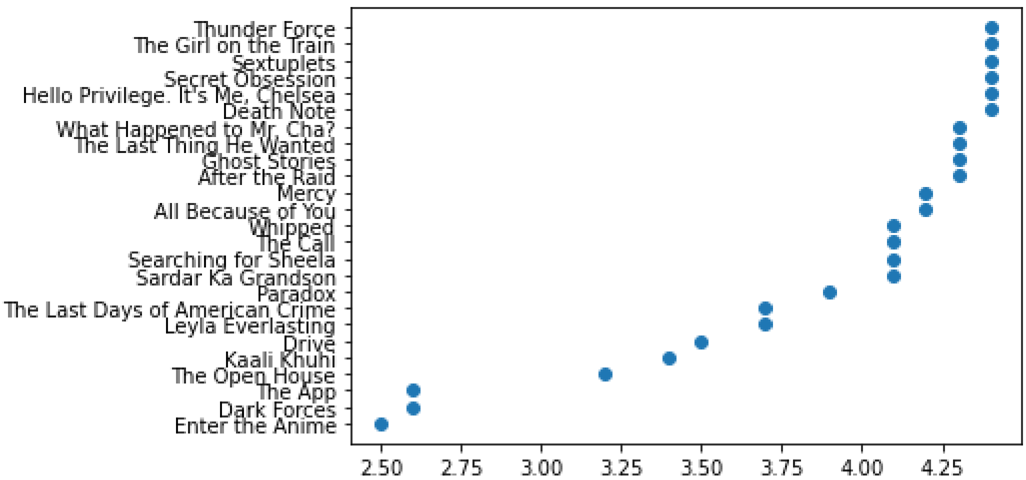


In [13]:
```
score=df["IMDBScore"].sort_values(ascending=False)[:10]
score.plot.barh()
plt.show()
```




In [14]:
```
plt.scatter(df["IMDBScore"][:25],df["Title"][:25])
plt.figure(figsize=(30,30))
```

Out[14]: <Figure size 2160x2160 with 0 Axes>




<Figure size 2160x2160 with 0 Axes>

In [15]:
```
from sklearn.preprocessing import LabelEncoder
object_cols = ["Title","Genre"]
label_encoder = LabelEncoder()
df2=df.copy()
for col in object_cols:
    label_encoder.fit(df2[col])
    df2[col] = label_encoder.transform(df2[col])
df2
```

Out[15]:

| | Title | Genre | Premiere | Runtime | IMDBScore | Language |
|---|---|---|---|---|---|---|
| **0** | 147 | 45 | August 5, 2019 | 58 | 2.5 | English/Japanese |
| **1** | 120 | 106 | August 21, 2020 | 81 | 2.6 | Spanish |
| **2** | 433 | 93 | December 26, 2019 | 79 | 2.6 | Italian |
| **3** | 500 | 63 | January 19, 2018 | 94 | 3.2 | English |
| **4** | 243 | 73 | October 30, 2020 | 90 | 3.4 | Hindi |
| **...** | ... | ... | ... | ... | ... | ... |
| **579** | 425 | 40 | December 31, 2018 | 125 | 8.4 | English |
| **580** | 575 | 45 | October 9, 2015 | 91 | 8.4 | English/Ukranian/Russian |
| **581** | 410 | 74 | December 16, 2018 | 153 | 8.5 | English |
| **582** | 145 | 45 | December 8, 2020 | 89 | 8.6 | Portuguese |
| **583** | 121 | 45 | October 4, 2020 | 83 | 9.0 | English |

584 rows × 6 columns

In [16]:
```
df2.drop(["Premiere"],axis=1,inplace=True)
```

In [17]:
```
df2.drop(["Language"],axis=1,inplace=True)
```

In [18]:
```
df2.drop(["IMDBScore"],axis=1,inplace=True)

df2
```

Out[18]:

| | Title | Genre | Runtime |
|---|---|---|---|
| **0** | 147 | 45 | 58 |
| **1** | 120 | 106 | 81 |
| **2** | 433 | 93 | 79 |
| **3** | 500 | 63 | 94 |
| **4** | 243 | 73 | 90 |
| **...** | ... | ... | ... |
| **579** | 425 | 40 | 125 |
| **580** | 575 | 45 | 91 |
| **581** | 410 | 74 | 153 |
| **582** | 145 | 45 | 89 |
| **583** | 121 | 45 | 83 |

584 rows × 3 columns

In [19]:
```
y=df["IMDBScore"]
y
```

Out[19]:
```
0      2.5
1      2.6
2      2.6
3      3.2
4      3.4
      ...
579    8.4
580    8.4
581    8.5
582    8.6
583    9.0
Name: IMDBScore, Length: 584, dtype: float64
```

In [20]:
```
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
```

In [21]:
```
xtrain,xtest,ytrain,ytest=train_test_split(df2,y,test_size=0.2,random_state
```

In [22]:
```
print(xtrain.shape,ytrain.shape)
```

```
(467, 3) (467,)
```

In [23]:
```python
print(xtest.shape,ytest.shape)
```

```
(117, 3) (117,)
```

In [24]:
```python
lr=LinearRegression()
```

In [25]:
```python
lr.fit(xtrain,ytrain)
```

Out[25]:
```
LinearRegression()
```

In [26]:
```python
lr.fit(xtest,ytest)
```

Out[26]:
```
LinearRegression()
```

In [27]:
```python
lr.score(xtrain,ytrain)
```

Out[27]:
```
0.031119103871776743
```

In [28]:
```python
y_pred=lr.predict(xtest)
x=[[147,45,58]]
predict=lr.predict(x)
predict
```

```
C:\Users\Shaun Alex\anaconda3\lib\site-packages\sklearn\base.py:450: UserW
arning: X does not have valid feature names, but LinearRegression was fitt
ed with feature names
  warnings.warn(
```

Out[28]:
```
array([6.3065107])
```

In [29]:
```python
print(lr.score(xtest, ytest))
```

```
0.019033211731675936
```

In [30]:
```python
# Assuming df2 is your first DataFrame and df is your second DataFrame

# Filter rows in df2 where 'Title' is equal to 147
filtered_rows_df2 = df2[df2['Title'] == 147]

# Get the indices of the filtered rows
indices = filtered_rows_df2.index

# Use the indices to access the corresponding rows in df
resulting_rows_df = df.loc[indices]

# Now, resulting_rows_df contains the rows from df where 'Title' is equal t
resulting_rows_df
```

Out[30]:

| | Title | Genre | Premiere | Runtime | IMDBScore | Language |
|---|---|---|---|---|---|---|
| **0** | Enter the Anime | Documentary | August 5, 2019 | 58 | 2.5 | English/Japanese |

In [31]:
```
from sklearn.ensemble import RandomForestRegressor

# create regressor object
regressor = RandomForestRegressor(n_estimators=100,
                                  random_state=0)

# fit the regressor with x and y data
regressor.fit(df2, y)
```

Out[31]:
```
RandomForestRegressor(random_state=0)
```

In [32]:
```
Y_pred = regressor.predict(xtest)
```

In [33]:
```
print(regressor.score(xtest, ytest))
```

```
0.8844757926660178
```

In [34]:
```
print(regressor.score(xtrain, ytrain))
```

```
0.8848317625613643
```

In [35]:
```
x=[[147,45,58]]
predict=regressor.predict(x)
predict
```

```
C:\Users\Shaun Alex\anaconda3\lib\site-packages\sklearn\base.py:450: UserW
arning: X does not have valid feature names, but RandomForestRegressor was
fitted with feature names
  warnings.warn(
```

Out[35]:
```
array([3.752])
```

In [36]:
```
from sklearn.metrics import accuracy_score
```

In [37]:
```
import numpy as np

# Assuming ytest is a Pandas Series
ytest_array = np.array(ytest)
reshaped_ytest = ytest_array.reshape(-1, 1)
print(reshaped_ytest)

ytpred_array = np.array(y_pred)
reshaped_ypred = ytpred_array.reshape(-1, 1)
print(reshaped_ypred)
```

```
[[6.7]
 [6.9]
 [5.3]
 [7.1]
 [7.4]
 [6.4]
 [5.5]
 [6.2]
 [5.6]
 [6.6]
 [7.6]
 [5.2]
 [7.9]
 [5.8]
 [6.9]
 [6.1]
 [6. ]
 [5.4]
 [8.2]
```

In [38]:
```
from sklearn.metrics import mean_squared_error, mean_squared_log_error,r2_s
```

In [39]:
```
mse = mean_squared_error(ytest, y_pred)

# Calculate Root Mean Squared Error (RMSE)
rmse = np.sqrt(mse)
r2_score=r2_score(ytest,y_pred)  # For the Linear Regression
print(rmse,mse,r2_score)
```

```
1.0090520571992603 1.0181860541380592 0.019033211731675936
```

In [40]:
```
Y_pred1 = Y_pred.astype(int)
Y_pred1
```

Out[40]:
```
array([6, 6, 5, 6, 7, 6, 5, 5, 5, 6, 7, 5, 7, 5, 6, 6, 5, 5, 8, 6, 7, 5,
       3, 7, 7, 5, 5, 7, 6, 4, 5, 6, 5, 6, 5, 5, 6, 7, 7, 7, 6, 6, 6, 5,
       7, 6, 4, 6, 6, 6, 5, 6, 5, 5, 5, 6, 7, 6, 6, 6, 5, 6, 6, 5, 5, 6,
       5, 7, 6, 5, 6, 6, 5, 5, 6, 6, 5, 5, 6, 7, 6, 4, 5, 6, 7, 5, 6, 7,
       6, 6, 6, 7, 5, 6, 6, 6, 6, 4, 6, 7, 6, 7, 6, 5, 6, 7, 6, 6, 5, 5,
       5, 5, 6, 7, 5, 7, 6])
```

In [41]:

```
mse = mean_squared_error(ytest, Y_pred1)

# Calculate Root Mean Squared Error (RMSE)
rmse = np.sqrt(mse)
print(rmse,mse)
```

```
0.6717116801102846 0.45119658119658124
```

In [42]:

```
from sklearn.metrics import r2_score

# Assuming ytest contains actual labels and Y_pred1 contains predicted labe
r2_result = r2_score(ytest, Y_pred1)  # Calculate the R^2 score
r2_result
```

Out[42]:

```
0.565296677031442
```

In [43]:

```
from sklearn.model_selection import train_test_split, GridSearchCV

param_grid = {
    'n_estimators': [100, 200, 300],        # Number of trees
    'max_depth': [None, 10, 20, 30],       # Maximum depth of each tree
    'min_samples_split': [2, 5, 10],      # Minimum samples required to spl
    'min_samples_leaf': [1, 2, 4]         # Minimum samples required at eac
}
grid_search = GridSearchCV(estimator=regressor, param_grid=param_grid, cv=5
grid_search.fit(xtrain, ytrain)
```

Out[43]:

```
GridSearchCV(cv=5, estimator=RandomForestRegressor(random_state=0),
             param_grid={'max_depth': [None, 10, 20, 30],
                         'min_samples_leaf': [1, 2, 4],
                         'min_samples_split': [2, 5, 10],
                         'n_estimators': [100, 200, 300]},
             scoring='neg_mean_squared_error')
```

In [44]:
```python
best_params = grid_search.best_params_
print("Best Hyperparameters:", best_params)

# Train the model with the best hyperparameters
best_rf_regressor = grid_search.best_estimator_
best_rf_regressor.fit(xtrain, ytrain)

# Make predictions on the test set
ypred = best_rf_regressor.predict(xtest)

# Evaluate the model
mse = mean_squared_error(ytest, ypred)
rmse = np.sqrt(mse)
r2 = r2_score(ytest, ypred)

print("Mean Squared Error:", mse)
print("Root Mean Squared Error:", rmse)
print("R-squared:", r2)
```

```
Best Hyperparameters: {'max_depth': 10, 'min_samples_leaf': 4, 'min_sample
s_split': 10, 'n_estimators': 100}
Mean Squared Error: 0.7810925200023665
Root Mean Squared Error: 0.8837943878540792
R-squared: 0.24745991405688794
```

# Phase 2

# Neural Network

In [45]:
```python
import pandas as pd
import numpy as np
import tensorflow as tf
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from tensorflow import keras
from tensorflow.keras import layers
```

In [46]:
```python
x = df[['Genre', 'Runtime', 'Language']]
y = df['IMDBScore']

# Encode categorical variables (Genre and Language) using one-hot encoding
x = pd.get_dummies(x, columns=['Genre', 'Language'], drop_first=True)

# Split the dataset into training and testing sets
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.2, ra

# Standardize features (optional but can help neural networks converge fast
scaler = StandardScaler()
x_train = scaler.fit_transform(x_train)
x_test = scaler.transform(x_test)

# Build the neural network model
model = keras.Sequential([
    layers.Dense(64, activation='relu', input_shape=(x_train.shape[1],)),
    layers.Dense(32, activation='relu'),
    layers.Dense(1)  # Output layer for regression
])

# Compile the model
model.compile(optimizer='adam', loss='mean_squared_error', metrics=['mean_a

# Train the model
model.fit(x_train, y_train, epochs=100, batch_size=32, validation_split=0.2

# Evaluate the model on the test set
loss, mae = model.evaluate(x_test, y_test)
print(f"Mean Absolute Error on Test Set: {mae}")

# Make predictions
y_pred = model.predict(x_test)
```

```
Epoch 1/100
12/12 [==============================] - 1s 18ms/step - loss: 33.8856 -
mean_absolute_error: 5.6779 - val_loss: 27.4807 - val_mean_absolute_err
or: 5.0510
Epoch 2/100
12/12 [==============================] - 0s 5ms/step - loss: 21.2297 -
mean_absolute_error: 4.2941 - val_loss: 18.0831 - val_mean_absolute_err
or: 3.9985
Epoch 3/100
12/12 [==============================] - 0s 4ms/step - loss: 13.4957 -
mean_absolute_error: 3.2651 - val_loss: 11.0699 - val_mean_absolute_err
or: 3.0246
Epoch 4/100
12/12 [==============================] - 0s 5ms/step - loss: 9.1994 - m
ean_absolute_error: 2.7003 - val_loss: 6.8790 - val_mean_absolute_erro
r: 2.3458
Epoch 5/100
12/12 [==============================] - 0s 5ms/step - loss: 6.3300 - m
ean_absolute_error: 2.2119 - val_loss: 5.0011 - val_mean_absolute_erro
```

In [47]:
```
y_pred
```

Out[47]:
```
array([[6.03637   ],
       [5.601603  ],
       [5.5962715 ],
       [6.932173  ],
       [6.819642  ],
       [7.0490417 ],
       [5.909452  ],
       [5.3236194 ],
       [6.5592623 ],
       [5.440313  ],
       [7.1735015 ],
       [7.0880504 ],
       [7.0843143 ],
       [5.3240213 ],
       [6.6149597 ],
       [5.327671  ],
       [4.8287206 ],
       [5.0816717 ],
       [7.204135  ],
```

## Gradient Boosting

In [48]:
```python
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.metrics import mean_absolute_error, mean_squared_error, r2_scc
from sklearn.preprocessing import LabelEncoder, StandardScaler

# Load the dataset
# data = pd.read_csv("NetflixOriginals.csv")

# Preprocess the data
# Assuming you want to use 'Genre', 'Runtime', and 'Language' as features
X = df[['Genre', 'Runtime', 'Language']]
y = df['IMDBScore']

# Encode categorical variables (Genre and Language) using Label Encoding
label_encoders = {}
for col in ['Genre', 'Language']:
    label_encoders[col] = LabelEncoder()
    X[col] = label_encoders[col].fit_transform(X[col])

# Split the dataset into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, ra

# Standardize features (optional but can help gradient boosting)
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)

# Build and train the gradient boosting model
regressor = GradientBoostingRegressor(n_estimators=100, learning_rate=0.1,
regressor.fit(X_train, y_train)

# Make predictions
y_pred = regressor.predict(X_test)

# Evaluate the model
mae = mean_absolute_error(y_test, y_pred)
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)

print(f"Mean Absolute Error: {mae}")
print(f"Mean Squared Error: {mse}")
print(f"R-squared (R2): {r2}")
```

```
Mean Absolute Error: 0.6737418660432508
Mean Squared Error: 0.7646858702215756
R-squared (R2): 0.2632668272200527

C:\Users\Shaun Alex\AppData\Local\Temp\ipykernel_28416\1193338420.py:20: S
ettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-doc
s/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (https://
pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-
view-versus-a-copy)
  X[col] = label_encoders[col].fit_transform(X[col])
```

# Phase 3

# Data Preprocessing

In [49]:
```
from sklearn.preprocessing import StandardScaler
```

In [50]:
```
data = df2.join(y)
data
```

Out[50]:

| | Title | Genre | Runtime | IMDBScore |
|---|---|---|---|---|
| **0** | 147 | 45 | 58 | 2.5 |
| **1** | 120 | 106 | 81 | 2.6 |
| **2** | 433 | 93 | 79 | 2.6 |
| **3** | 500 | 63 | 94 | 3.2 |
| **4** | 243 | 73 | 90 | 3.4 |
| **...** | ... | ... | ... | ... |
| **579** | 425 | 40 | 125 | 8.4 |
| **580** | 575 | 45 | 91 | 8.4 |
| **581** | 410 | 74 | 153 | 8.5 |
| **582** | 145 | 45 | 89 | 8.6 |
| **583** | 121 | 45 | 83 | 9.0 |

584 rows × 4 columns

In [51]:
```
scaler = StandardScaler()
model = scaler.fit(data)
scaled_data = model.transform(data)
scaled_data
```

Out[51]:
```
array([[-0.85712914, -0.30324457, -1.28261511, -3.85494543],
       [-1.01728476,  2.00257926, -0.45342484, -3.75273959],
       [ 0.83933407,  1.51117418, -0.52552834, -3.75273959],
       ...,
       [ 0.70290521,  0.79296676,  2.1423012 ,  2.27740523],
       [-0.86899252, -0.30324457, -0.16501084,  2.37961107],
       [-1.01135307, -0.30324457, -0.38132134,  2.78843445]])
```

In [52]:
```
data.isnull().sum()
```

Out[52]:
```
Title        0
Genre        0
Runtime      0
IMDBScore    0
dtype: int64
```

In [53]:
```
data.dropna()
```

Out[53]:

| | Title | Genre | Runtime | IMDBScore |
|---|---|---|---|---|
| **0** | 147 | 45 | 58 | 2.5 |
| **1** | 120 | 106 | 81 | 2.6 |
| **2** | 433 | 93 | 79 | 2.6 |
| **3** | 500 | 63 | 94 | 3.2 |
| **4** | 243 | 73 | 90 | 3.4 |
| **...** | ... | ... | ... | ... |
| **579** | 425 | 40 | 125 | 8.4 |
| **580** | 575 | 45 | 91 | 8.4 |
| **581** | 410 | 74 | 153 | 8.5 |
| **582** | 145 | 45 | 89 | 8.6 |
| **583** | 121 | 45 | 83 | 9.0 |

584 rows × 4 columns

In [54]:
```
data.sort_values(by='IMDBScore', ascending = False)
```

Out[54]:

| | Title | Genre | Runtime | IMDBScore |
|---|---|---|---|---|
| **583** | 121 | 45 | 83 | 9.0 |
| **582** | 145 | 45 | 89 | 8.6 |
| **581** | 410 | 74 | 153 | 8.5 |
| **580** | 575 | 45 | 91 | 8.4 |
| **579** | 425 | 40 | 125 | 8.4 |
| **...** | ... | ... | ... | ... |
| **4** | 243 | 73 | 90 | 3.4 |
| **3** | 500 | 63 | 94 | 3.2 |
| **2** | 433 | 93 | 79 | 2.6 |
| **1** | 120 | 106 | 81 | 2.6 |
| **0** | 147 | 45 | 58 | 2.5 |

584 rows × 4 columns

In [55]:
```
data.sort_values(by='IMDBScore', ascending = False).head()
```

Out[55]:

| | Title | Genre | Runtime | IMDBScore |
|---|---|---|---|---|
| **583** | 121 | 45 | 83 | 9.0 |
| **582** | 145 | 45 | 89 | 8.6 |
| **581** | 410 | 74 | 153 | 8.5 |
| **580** | 575 | 45 | 91 | 8.4 |
| **579** | 425 | 40 | 125 | 8.4 |

In [56]:
```
data.isna()
```

Out[56]:

| | Title | Genre | Runtime | IMDBScore |
|---|---|---|---|---|
| **0** | False | False | False | False |
| **1** | False | False | False | False |
| **2** | False | False | False | False |
| **3** | False | False | False | False |
| **4** | False | False | False | False |
| **...** | ... | ... | ... | ... |
| **579** | False | False | False | False |
| **580** | False | False | False | False |
| **581** | False | False | False | False |
| **582** | False | False | False | False |
| **583** | False | False | False | False |

584 rows × 4 columns

In [57]:
```
from sklearn.preprocessing import MinMaxScaler
```

In [58]:
```
scaler1 = MinMaxScaler()
model1 = scaler1.fit(data)
scaled_data1 = model.transform(data)
scaled_data1
```

Out[58]:
```
array([[-0.85712914, -0.30324457, -1.28261511, -3.85494543],
       [-1.01728476,  2.00257926, -0.45342484, -3.75273959],
       [ 0.83933407,  1.51117418, -0.52552834, -3.75273959],
       ...,
       [ 0.70290521,  0.79296676,  2.1423012 ,  2.27740523],
       [-0.86899252, -0.30324457, -0.16501084,  2.37961107],
       [-1.01135307, -0.30324457, -0.38132134,  2.78843445]])
```

# Univariate Analysis

In [59]:
```
column1 = df['Runtime']
column1
```

Out[59]:
```
0       58
1       81
2       79
3       94
4       90
      ...
579    125
580     91
581    153
582     89
583     83
Name: Runtime, Length: 584, dtype: int64
```

In [60]:
```
column1.head()
```

Out[60]:
```
0    58
1    81
2    79
3    94
4    90
Name: Runtime, dtype: int64
```

In [61]:
```
column1.dropna()
```

Out[61]:
```
0       58
1       81
2       79
3       94
4       90
      ...
579    125
580     91
581    153
582     89
583     83
Name: Runtime, Length: 584, dtype: int64
```

In [62]:
```
column1.fillna('Nan')
```

Out[62]:
```
0       58
1       81
2       79
3       94
4       90
      ...
579    125
580     91
581    153
582     89
583     83
Name: Runtime, Length: 584, dtype: int64
```

In [63]:
```
column1.info()
```

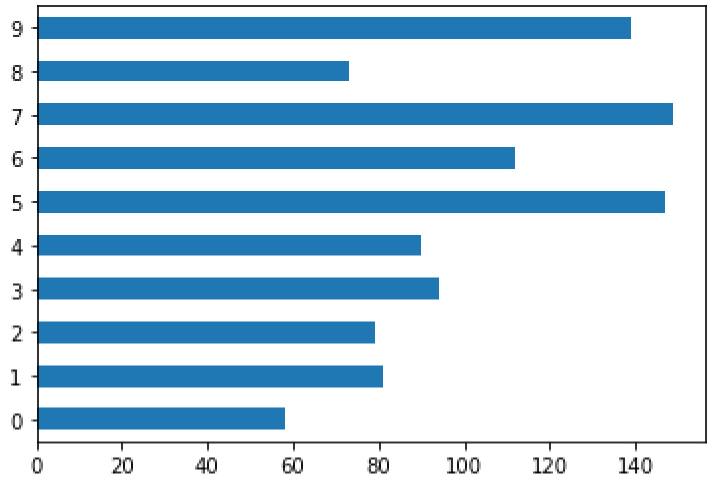
```
<class 'pandas.core.series.Series'>
RangeIndex: 584 entries, 0 to 583
Series name: Runtime
Non-Null Count  Dtype
--------------  -----
584 non-null    int64
dtypes: int64(1)
memory usage: 4.7 KB
```

In [64]:
```
column1.describe()
```

Out[64]:
```
count    584.000000
mean      93.577055
std       27.761683
min        4.000000
25%       86.000000
50%       97.000000
75%      108.000000
max      209.000000
Name: Runtime, dtype: float64
```

In [65]:
```
column11=column1.head(10)
column11.plot.barh()
```

Out[65]:
```
<AxesSubplot:>
```




# Bivariate Analysis

In [66]:
```
df.groupby('Genre').agg({'IMDBScore':'mean'})
```

Out[66]:

| | IMDBScore |
|---|---|
| **Genre** | |
| **Action** | 5.414286 |
| **Action comedy** | 5.420000 |
| **Action thriller** | 6.400000 |
| **Action-adventure** | 7.300000 |
| **Action-thriller** | 6.133333 |
| **...** | ... |
| **War** | 6.750000 |
| **War drama** | 7.100000 |
| **War-Comedy** | 6.000000 |
| **Western** | 6.066667 |
| **Zombie/Heist** | 5.900000 |

115 rows × 1 columns

In [67]:
```
df.groupby('Runtime').agg({'IMDBScore':'mean'})
```

Out[67]:

| | IMDBScore |
|---|---|
| **Runtime** | |
| **4** | 4.70 |
| **7** | 6.90 |
| **9** | 6.50 |
| **10** | 5.20 |
| **11** | 7.20 |
| **...** | ... |
| **149** | 6.20 |
| **151** | 6.25 |
| **153** | 8.50 |
| **155** | 6.50 |
| **209** | 7.80 |

124 rows × 1 columns

In [68]:
```
df.groupby('Premiere').agg({'IMDBScore':'mean'})
```

Out[68]:

| | IMDBScore |
|---|---|
| **Premiere** | |
| **April 1, 2021** | 6.10 |
| **April 10, 2020** | 6.00 |
| **April 12, 2019** | 5.55 |
| **April 13, 2018** | 6.15 |
| **April 14, 2017** | 5.20 |
| **...** | ... |
| **September 4, 2020** | 6.60 |
| **September 7, 2018** | 6.20 |
| **September 7, 2020** | 8.10 |
| **September 8, 2017** | 5.20 |
| **September 9, 2020** | 7.60 |

390 rows × 1 columns

In [69]:
```
df.groupby('Title').agg({'IMDBScore':'mean'})
```

Out[69]:

| | IMDBScore |
|---|---|
| **Title** | |
| **#REALITYHIGH** | 5.2 |
| **13th** | 8.2 |
| **13th: A Conversation with Oprah Winfrey & Ava DuVernay** | 7.1 |
| **15 August** | 5.8 |
| **1922** | 6.3 |
| **...** | ... |
| **Yes Day** | 5.7 |
| **You've Got This** | 5.8 |
| **Zion** | 7.2 |
| **iBoy** | 6.0 |
| **Òlòt?ré** | 5.5 |

584 rows × 1 columns

In [70]:

```
df.groupby('Language').agg({'IMDBScore':'mean'})
```

Out[70]:

| | IMDBScore |
|---|---|
| **Language** | |
| **Bengali** | 7.100000 |
| **Dutch** | 5.800000 |
| **English** | 6.380050 |
| **English/Akan** | 7.700000 |
| **English/Arabic** | 7.300000 |
| **English/Hindi** | 7.300000 |
| **English/Japanese** | 4.400000 |
| **English/Korean** | 7.300000 |
| **English/Mandarin** | 7.050000 |
| **English/Russian** | 7.300000 |
| **English/Spanish** | 6.220000 |
| **English/Swedish** | 6.500000 |
| **English/Taiwanese/Mandarin** | 6.500000 |
| **English/Ukranian/Russian** | 8.400000 |
| **Filipino** | 5.100000 |
| **French** | 5.770000 |
| **Georgian** | 6.800000 |
| **German** | 5.640000 |
| **Hindi** | 5.981818 |
| **Indonesian** | 5.844444 |
| **Italian** | 5.542857 |
| **Japanese** | 6.400000 |
| **Khmer/English/French** | 7.200000 |
| **Korean** | 5.916667 |
| **Malay** | 4.200000 |
| **Marathi** | 6.066667 |
| **Norwegian** | 5.100000 |
| **Polish** | 5.166667 |
| **Portuguese** | 6.216667 |
| **Spanish** | 6.303226 |
| **Spanish/Basque** | 5.600000 |
| **Spanish/Catalan** | 6.400000 |
| **Spanish/English** | 7.300000 |
| **Swedish** | 5.500000 |
| **Tamil** | 7.200000 |
| **Thai** | 5.450000 |
| **Thia/English** | 6.700000 |

| | IMDBScore |
|---|---|
| **Language** | |
| **Turkish** | 5.660000 |

# Phase 4

# Feature Engineering

## Imputation

In [71]:
```
from sklearn.impute import SimpleImputer
```

In [72]:
```
imputer = SimpleImputer(strategy='mean')
df_imputed = pd.DataFrame(imputer.fit_transform(df2), columns=df2.columns)
df_imputed
```

Out[72]:

| | Title | Genre | Runtime |
|---|---|---|---|
| **0** | 147.0 | 45.0 | 58.0 |
| **1** | 120.0 | 106.0 | 81.0 |
| **2** | 433.0 | 93.0 | 79.0 |
| **3** | 500.0 | 63.0 | 94.0 |
| **4** | 243.0 | 73.0 | 90.0 |
| **...** | ... | ... | ... |
| **579** | 425.0 | 40.0 | 125.0 |
| **580** | 575.0 | 45.0 | 91.0 |
| **581** | 410.0 | 74.0 | 153.0 |
| **582** | 145.0 | 45.0 | 89.0 |
| **583** | 121.0 | 45.0 | 83.0 |

584 rows × 3 columns

# Outliers

In [73]:

```
import numpy as np

# Sample dataset
data=df["IMDBScore"]

# Calculate the first quartile (Q1) and third quartile (Q3)
Q1 = np.percentile(data, 25)
Q3 = np.percentile(data, 75)

# Calculate the interquartile range (IQR)
IQR = Q3 - Q1

# Define a lower bound and upper bound to identify outliers
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR

# Detect and handle outliers
outliers = [x for x in data if x < lower_bound or x > upper_bound]

# Print the outliers and the modified dataset
print("Outliers:", outliers)
data_no_outliers = [x for x in data if lower_bound <= x <= upper_bound]
print("Data without outliers:", data_no_outliers)
```

```
Outliers: [2.5, 2.6, 2.6, 3.2, 3.4, 3.5, 3.7, 3.7, 9.0]
Data without outliers: [3.9, 4.1, 4.1, 4.1, 4.1, 4.2, 4.2, 4.3, 4.3, 4.3,
4.3, 4.4, 4.4, 4.4, 4.4, 4.4, 4.4, 4.5, 4.5, 4.5, 4.5, 4.6, 4.6, 4.6, 4.6,
4.6, 4.6, 4.6, 4.6, 4.7, 4.7, 4.7, 4.7, 4.7, 4.7, 4.8, 4.8, 4.8, 4.8, 4.8,
4.8, 4.8, 4.9, 4.9, 4.9, 4.9, 5.0, 5.0, 5.0, 5.0, 5.0, 5.1, 5.1, 5.1, 5.1,
5.1, 5.1, 5.2, 5.2, 5.2, 5.2, 5.2, 5.2, 5.2, 5.2, 5.2, 5.2, 5.2, 5.2, 5.2,
5.2, 5.2, 5.2, 5.2, 5.2, 5.2, 5.3, 5.3, 5.3, 5.3, 5.3, 5.3, 5.3, 5.3, 5.3,
5.3, 5.4, 5.4, 5.4, 5.4, 5.4, 5.4, 5.4, 5.4, 5.4, 5.4, 5.4, 5.4, 5.4, 5.5,
5.5, 5.5, 5.5, 5.5, 5.5, 5.5, 5.5, 5.5, 5.5, 5.5, 5.5, 5.5, 5.5, 5.5, 5.5,
5.5, 5.5, 5.5, 5.6, 5.6, 5.6, 5.6, 5.6, 5.6, 5.6, 5.6, 5.6, 5.6, 5.6, 5.6,
5.6, 5.6, 5.6, 5.7, 5.7, 5.7, 5.7, 5.7, 5.7, 5.7, 5.7, 5.7, 5.7, 5.7, 5.7,
5.7, 5.7, 5.7, 5.7, 5.7, 5.7, 5.7, 5.7, 5.8, 5.8, 5.8, 5.8, 5.8, 5.8, 5.8,
5.8, 5.8, 5.8, 5.8, 5.8, 5.8, 5.8, 5.8, 5.8, 5.8, 5.8, 5.8, 5.8, 5.8, 5.8,
5.8, 5.8, 5.8, 5.8, 5.8, 5.8, 5.8, 5.8, 5.9, 5.9, 5.9, 5.9, 5.9, 5.9, 5.9,
5.9, 5.9, 5.9, 5.9, 5.9, 5.9, 5.9, 5.9, 5.9, 6.0, 6.0, 6.0, 6.0, 6.0, 6.0,
6.0, 6.0, 6.0, 6.0, 6.0, 6.0, 6.0, 6.1, 6.1, 6.1, 6.1, 6.1, 6.1, 6.1, 6.1,
6.1, 6.1, 6.1, 6.1, 6.1, 6.1, 6.1, 6.1, 6.1, 6.1, 6.1, 6.1, 6.1, 6.1, 6.1,
6.1, 6.2, 6.2, 6.2, 6.2, 6.2, 6.2, 6.2, 6.2, 6.2, 6.2, 6.2, 6.2, 6.2, 6.2,
6.2, 6.2, 6.2, 6.2, 6.3, 6.3, 6.3, 6.3, 6.3, 6.3, 6.3, 6.3, 6.3, 6.3, 6.3,
6.3, 6.3, 6.3, 6.3, 6.3, 6.3, 6.3, 6.3, 6.3, 6.3, 6.3, 6.3, 6.3, 6.3, 6.3,
6.3, 6.3, 6.3, 6.3, 6.4, 6.4, 6.4, 6.4, 6.4, 6.4, 6.4, 6.4, 6.4, 6.4, 6.4,
6.4, 6.4, 6.4, 6.4, 6.4, 6.4, 6.4, 6.4, 6.4, 6.4, 6.4, 6.4, 6.4, 6.4, 6.4,
6.4, 6.4, 6.5, 6.5, 6.5, 6.5, 6.5, 6.5, 6.5, 6.5, 6.5, 6.5, 6.5, 6.5, 6.5,
6.5, 6.5, 6.5, 6.5, 6.5, 6.5, 6.5, 6.5, 6.5, 6.5, 6.5, 6.5, 6.5, 6.6, 6.6,
6.6, 6.6, 6.6, 6.6, 6.6, 6.6, 6.6, 6.6, 6.6, 6.6, 6.6, 6.6, 6.6, 6.6, 6.6,
6.6, 6.7, 6.7, 6.7, 6.7, 6.7, 6.7, 6.7, 6.7, 6.7, 6.7, 6.7, 6.7, 6.7, 6.7,
6.7, 6.7, 6.7, 6.7, 6.7, 6.7, 6.7, 6.7, 6.7, 6.7, 6.7, 6.8, 6.8, 6.8, 6.8,
6.8, 6.8, 6.8, 6.8, 6.8, 6.8, 6.8, 6.8, 6.8, 6.8, 6.8, 6.8, 6.8, 6.8, 6.8,
6.8, 6.8, 6.8, 6.8, 6.8, 6.9, 6.9, 6.9, 6.9, 6.9, 6.9, 6.9, 6.9, 6.9, 6.9,
6.9, 6.9, 6.9, 6.9, 6.9, 6.9, 6.9, 6.9, 6.9, 7.0, 7.0, 7.0, 7.0, 7.0, 7.0,
7.0, 7.0, 7.0, 7.0, 7.0, 7.0, 7.0, 7.0, 7.0, 7.0, 7.0, 7.0, 7.0, 7.1, 7.1,
7.1, 7.1, 7.1, 7.1, 7.1, 7.1, 7.1, 7.1, 7.1, 7.1, 7.1, 7.1, 7.1, 7.1, 7.1,
7.1, 7.1, 7.1, 7.1, 7.1, 7.1, 7.1, 7.1, 7.1, 7.1, 7.1, 7.2, 7.2, 7.2, 7.2,
7.2, 7.2, 7.2, 7.2, 7.2, 7.2, 7.2, 7.2, 7.2, 7.2, 7.2, 7.2, 7.2, 7.2, 7.2,
7.2, 7.3, 7.3, 7.3, 7.3, 7.3, 7.3, 7.3, 7.3, 7.3, 7.3, 7.3, 7.3, 7.3, 7.3,
7.3, 7.3, 7.3, 7.3, 7.3, 7.3, 7.3, 7.4, 7.4, 7.4, 7.4, 7.4, 7.4, 7.4, 7.4,
7.4, 7.4, 7.4, 7.4, 7.5, 7.5, 7.5, 7.5, 7.5, 7.5, 7.5, 7.5, 7.5, 7.5, 7.6,
7.6, 7.6, 7.6, 7.6, 7.6, 7.6, 7.6, 7.6, 7.6, 7.7, 7.7, 7.7, 7.7, 7.7, 7.7,
7.7, 7.7, 7.8, 7.8, 7.8, 7.9, 7.9, 7.9, 7.9, 8.0, 8.1, 8.1, 8.1, 8.2, 8.2,
8.2, 8.2, 8.2, 8.3, 8.3, 8.4, 8.4, 8.4, 8.5, 8.6]
```

# Log Transformation

In [74]:
```
import numpy as np

# Sample dataset
# Apply log transformation
log_transformed_data = np.log(data)

# Print original and log-transformed data
print("Original Data:", data)
print("Log-Transformed Data:", log_transformed_data)
```

```
Original Data: 0      2.5
1      2.6
2      2.6
3      3.2
4      3.4
      ...
579    8.4
580    8.4
581    8.5
582    8.6
583    9.0
Name: IMDBScore, Length: 584, dtype: float64
Log-Transformed Data: 0      0.916291
1      0.955511
2      0.955511
3      1.163151
4      1.223775
         ...
579    2.128232
580    2.128232
581    2.140066
582    2.151762
583    2.197225
Name: IMDBScore, Length: 584, dtype: float64
```

# One Hot Encoding

In [75]:
```
df2=df.copy()
```

In [76]:
```
from sklearn.preprocessing import LabelEncoder
object_cols = ["Title","Genre"] # doing one hor encoding for Columns Title
label_encoder = LabelEncoder()
for col in object_cols:
    label_encoder.fit(df2[col])
    df2[col] = label_encoder.transform(df2[col])
df2
```

Out[76]:

| | Title | Genre | Premiere | Runtime | IMDBScore | Language |
|---|---|---|---|---|---|---|
| **0** | 147 | 45 | August 5, 2019 | 58 | 2.5 | English/Japanese |
| **1** | 120 | 106 | August 21, 2020 | 81 | 2.6 | Spanish |
| **2** | 433 | 93 | December 26, 2019 | 79 | 2.6 | Italian |
| **3** | 500 | 63 | January 19, 2018 | 94 | 3.2 | English |
| **4** | 243 | 73 | October 30, 2020 | 90 | 3.4 | Hindi |
| **...** | ... | ... | ... | ... | ... | ... |
| **579** | 425 | 40 | December 31, 2018 | 125 | 8.4 | English |
| **580** | 575 | 45 | October 9, 2015 | 91 | 8.4 | English/Ukranian/Russian |
| **581** | 410 | 74 | December 16, 2018 | 153 | 8.5 | English |
| **582** | 145 | 45 | December 8, 2020 | 89 | 8.6 | Portuguese |
| **583** | 121 | 45 | October 4, 2020 | 83 | 9.0 | English |

584 rows × 6 columns

## Scaling

In [77]:
```
import pandas as pd
from sklearn.preprocessing import MinMaxScaler, StandardScaler


data1 = data.to_numpy()
data1=data1.reshape(-1,1)

# Scaling (Min-Max scaling)
scaler = MinMaxScaler()
scaled_data = scaler.fit_transform(data1)



# Print results
print("Original DataFrame:")
print(data1)
print("\nScaled DataFrame (Min-Max scaling):")
print(pd.DataFrame(scaled_data1, columns=data1.columns))
```

```
Original DataFrame:
[[2.5]
 [2.6]
 [2.6]
 [3.2]
 [3.4]
 [3.5]
 [3.7]
 [3.7]
 [3.9]
 [4.1]
 [4.1]
 [4.1]
 [4.1]
 [4.2]
 [4.2]
 [4.3]
 [4.3]
 [4.3]
```

## Normalization

In [78]:
```
data=df["IMDBScore"].to_numpy()
# Sample data
data = data.reshape(-1, 1)

# Initialize the StandardScaler
scaler = StandardScaler()

# Fit and transform the data to normalize it
normalized_data = scaler.fit_transform(data)

# Print the normalized data
print(normalized_data)
```

```
[[-3.85494543]
 [-3.75273959]
 [-3.75273959]
 [-3.13950452]
 [-2.93509283]
 [-2.83288699]
 [-2.6284753 ]
 [-2.6284753 ]
 [-2.42406361]
 [-2.21965192]
 [-2.21965192]
 [-2.21965192]
 [-2.21965192]
 [-2.11744608]
 [-2.11744608]
 [-2.01524024]
 [-2.01524024]
 [-2.01524024]
 [-2.01524024]
```

## Standardization

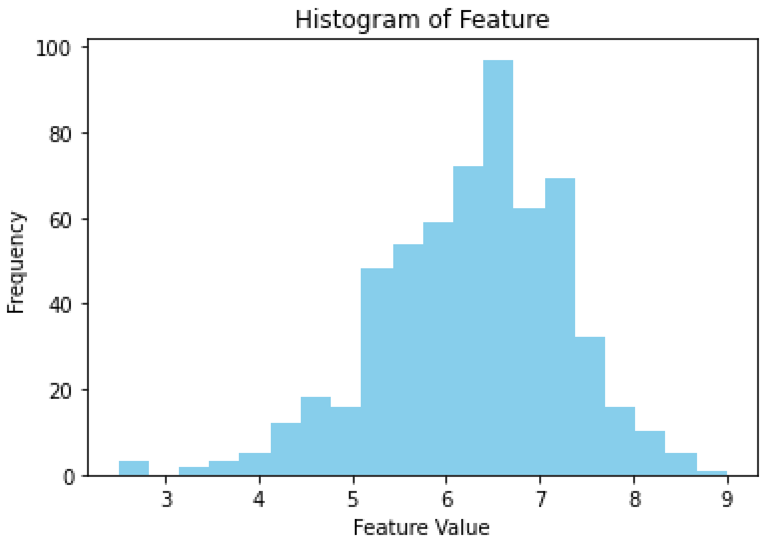
In [79]:
```
# Sample data

# Initialize the StandardScaler
scaler = StandardScaler()

# Fit and transform the data to standardize it
standardized_data = scaler.fit_transform(data)

# Print the standardized data
print(standardized_data)
```

```
[[-3.85494543]
 [-3.75273959]
 [-3.75273959]
 [-3.13950452]
 [-2.93509283]
 [-2.83288699]
 [-2.6284753 ]
 [-2.6284753 ]
 [-2.42406361]
 [-2.21965192]
 [-2.21965192]
 [-2.21965192]
 [-2.21965192]
 [-2.11744608]
 [-2.11744608]
 [-2.01524024]
 [-2.01524024]
 [-2.01524024]
 [-2.01524024]
```

# Plot for Feature Engineering

In [84]:

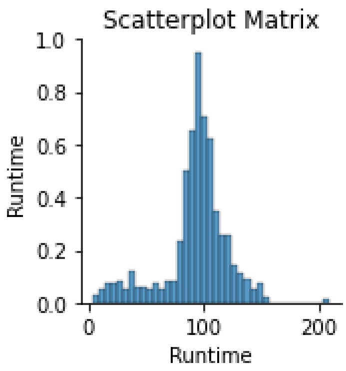
```
import pandas as pd
import matplotlib.pyplot as plt

# Assuming you have a DataFrame 'df' with your data

# 1. Histogram
plt.hist(df2['IMDBScore'], bins=20, color='skyblue')
plt.xlabel('Feature Value')
plt.ylabel('Frequency')
plt.title('Histogram of Feature')
plt.show()

# 2. Scatter Plot
plt.scatter(df2['Genre'], df2['IMDBScore'], alpha=0.5, c='green')
plt.xlabel('Feature 1')
plt.ylabel('Feature 2')
plt.title('Scatter Plot')
plt.show()

# 3. Box Plot
plt.boxplot(df2['Genre'])
plt.xlabel('Feature')
plt.title('Box Plot')
plt.show()


# 5. Bar Plot for Categorical Data
plt.bar(df2['Genre'], df['IMDBScore'], color='orange')
plt.xlabel('Category')
plt.ylabel('Count')
plt.title('Bar Plot for Categorical Data')
plt.show()

# 6. Time Series Plot (assuming a time-series dataset)
plt.plot(df['Runtime'], df['IMDBScore'], color='purple')
plt.xlabel('Timestamp')
plt.ylabel('Value')
plt.title('Time Series Plot')
plt.show()

# 7. Pair Plot (for a selection of features)
import seaborn as sns
features = ['Genre', 'Runtime', 'IMDBScore']
sns.pairplot(df[features])
plt.title('Pair Plot')
plt.show()
```

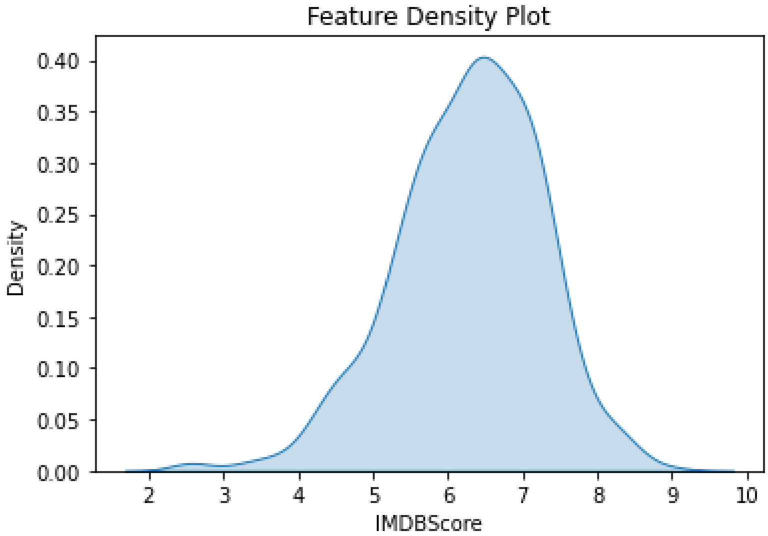

Histogram of Feature
Frequency
0
20
40
60
80
100
3
4
5
6
7
8
9
Feature Value

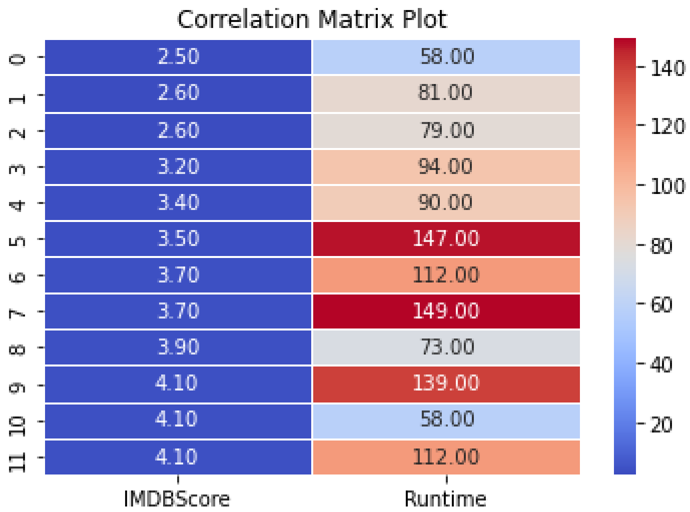

Scatter Plot
9

In [86]:

```python
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns  # Import Seaborn for scatter plots

# Assuming you have a DataFrame 'df' with your data

# 1. Scatterplot Matrix
features = ['Genre', 'Runtime']  # Replace with your feature names
sns.pairplot(df[features])
plt.title('Scatterplot Matrix')
plt.show()

# 2. Feature Density Plot
feature = 'IMDBScore'  # Replace with your feature name
sns.kdeplot(df2[feature], shade=True)
plt.title('Feature Density Plot')
plt.show()

# 3. Correlation Matrix Plot
x=df[cols].head(12)
sns.heatmap(x, annot=True, fmt=".2f", cmap='coolwarm', linewidths=0.5)
plt.title('Correlation Matrix Plot')
plt.show()
```

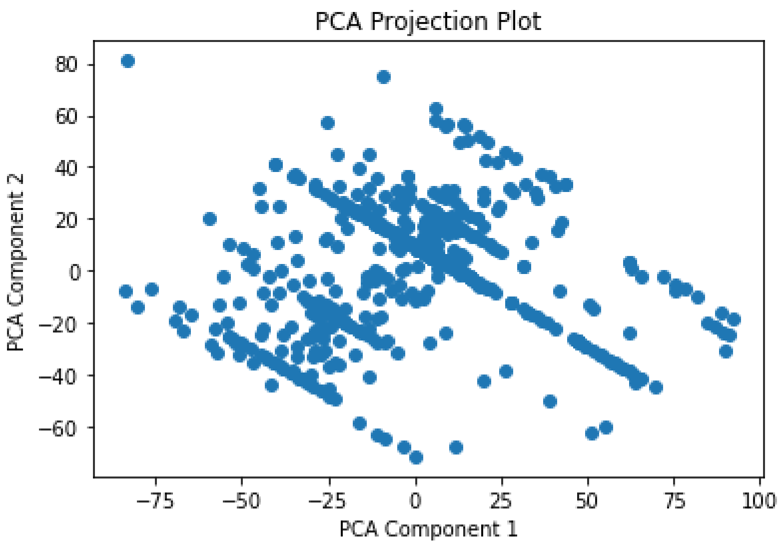





In [87]:

```
from sklearn.decomposition import PCA

# Assuming you have a DataFrame 'df' with your data

# Specify the features you want to include in the PCA
features = ['Genre', 'Runtime']  # Replace with your feature names

# Standardize the data (if necessary)
# You can use a StandardScaler from scikit-learn
# from sklearn.preprocessing import StandardScaler
# scaler = StandardScaler()
# df[features] = scaler.fit_transform(df[features])

# Create a PCA model and fit it to your data
pca = PCA(n_components=2)  # You can choose the number of components
pca_result = pca.fit_transform(df2[features])
plt.scatter(pca_result[:, 0], pca_result[:, 1])
plt.xlabel('PCA Component 1')
plt.ylabel('PCA Component 2')
plt.title('PCA Projection Plot')
plt.show()
```




# Model Training

# Linear Regression

In [88]:

```
# Import necessary libraries
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score

X_train, X_temp, y_train, y_temp = train_test_split(X, y, test_size=0.3, ra
X_val, X_test, y_val, y_test = train_test_split(X_temp, y_temp, test_size=0

# Create and train the model (linear regression in this case)
model = LinearRegression()
model.fit(X_train, y_train)

# Make predictions on the validation set
y_val_pred = model.predict(X_val)

# Evaluate the model
mse = mean_squared_error(y_val, y_val_pred)
r2 = r2_score(y_val, y_val_pred)

print(f"Mean Squared Error: {mse}")
print(f"R-squared: {r2}")
```

```
Mean Squared Error: 0.8778747725462929
R-squared: 0.027707099323870277
```

## Decision Tree

In [89]:

```
# Import necessary libraries
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeRegressor
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error, r2_score


X_train, X_temp, y_train, y_temp = train_test_split(X, y, test_size=0.3, ra
X_val, X_test, y_val, y_test = train_test_split(X_temp, y_temp, test_size=0

# Feature scaling
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_val = scaler.transform(X_val)

# Create and train the decision tree model with adjusted hyperparameters
model = DecisionTreeRegressor(max_depth=5, min_samples_split=5, min_samples
model.fit(X_train, y_train)

# Make predictions on the validation set
y_val_pred = model.predict(X_val)

# Evaluate the model
mse = mean_squared_error(y_val, y_val_pred)
r2 = r2_score(y_val, y_val_pred)

print(f"Mean Squared Error: {mse}")
print(f"R-squared: {r2}")
```

```
Mean Squared Error: 0.8258483907246518
R-squared: 0.08532907830650449
```

## Random Forest

In [90]:

```
# Import necessary libraries
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error, r2_score


X_train, X_temp, y_train, y_temp = train_test_split(X, y, test_size=0.3, ra
X_val, X_test, y_val, y_test = train_test_split(X_temp, y_temp, test_size=0

# Create and train the Random Forest model
model = RandomForestRegressor(n_estimators=100, random_state=42)  # You can
model.fit(X_train, y_train)

# Make predictions on the validation set
y_val_pred = model.predict(X_val)

# Evaluate the model
mse = mean_squared_error(y_val, y_val_pred)
r2 = r2_score(y_val, y_val_pred)

print(f"Mean Squared Error: {mse}")
print(f"R-squared: {r2}")
```

```
Mean Squared Error: 0.8215188404881246
R-squared: 0.09012428496893776
```

## Gradient boosting model

In [91]:
```
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.metrics import mean_squared_error, r2_score,mean_absolute_erro

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, ra

# Standardize features (optional but can help gradient boosting)
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)

# Build and train the gradient boosting model
regressor = GradientBoostingRegressor(n_estimators=100, learning_rate=0.1,
regressor.fit(X_train, y_train)

# Make predictions
y_pred = regressor.predict(X_test)

# Evaluate the model
mae = mean_absolute_error(y_test, y_pred)
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)

print(f"Mean Absolute Error: {mae}")
print(f"Mean Squared Error: {mse}")
print(f"R-squared (R2): {r2}")
```

```
Mean Absolute Error: 0.6737418660432508
Mean Squared Error: 0.7646858702215756
R-squared (R2): 0.2632668272200527
```

## Evaluation

In [92]:
```
mse = mean_squared_error(ytest, y_pred)

# Calculate Root Mean Squared Error (RMSE)
rmse = np.sqrt(mse)
r2_score=r2_score(ytest,y_pred)  # For the Linear Regression
print(rmse,mse,r2_score)
```

```
0.8744631897464727 0.7646858702215756 0.2632668272200527
```

In [93]:
```
mse = mean_squared_error(ytest, Y_pred1)

# Calculate Root Mean Squared Error (RMSE)
rmse = np.sqrt(mse)
print(rmse,mse)
```

```
0.6717116801102846 0.45119658119658124
```

In [94]:
```
from sklearn.metrics import r2_score

# Assuming ytest contains actual labels and Y_pred1 contains predicted labe
r2_result = r2_score(ytest, Y_pred1)  # Calculate the R^2 score
r2_result
```

Out[94]:
```
0.565296677031442
```

In [95]:
```
best_params = grid_search.best_params_
print("Best Hyperparameters:", best_params)

# Train the model with the best hyperparameters
best_rf_regressor = grid_search.best_estimator_
best_rf_regressor.fit(xtrain, ytrain)

# Make predictions on the test set
ypred = best_rf_regressor.predict(xtest)

# Evaluate the model
mse = mean_squared_error(ytest, ypred)
rmse = np.sqrt(mse)
r2 = r2_score(ytest, ypred)

print("Mean Squared Error:", mse)
print("Root Mean Squared Error:", rmse)
print("R-squared:", r2)
```

```
Best Hyperparameters: {'max_depth': 10, 'min_samples_leaf': 4, 'min_sample
s_split': 10, 'n_estimators': 100}
Mean Squared Error: 0.7810925200023665
Root Mean Squared Error: 0.8837943878540792
R-squared: 0.24745991405688794
```

In [96]:
```
rmse = np.sqrt(mse)

# Create a bar chart to visualize the errors
errors = [mae, mse, rmse, r2]
error_labels = ['MAE', 'MSE', 'RMSE', 'R²']

plt.bar(error_labels, errors, color=['blue', 'green', 'orange', 'red'])
plt.xlabel('Error Metric')
plt.ylabel('Error Value')
plt.title('Error Metrics for the Model')
plt.show()
```