Duncan530Week10FinalProject

August 8, 2024

[40]:
```
import pandas as pd
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
from scipy import stats
from scipy.stats import skew, kurtosis
# Load the dataset
url = "https://github.com/taylorduncan/DSC530/raw/main/
 ↪Most%20Streamed%20Spotify%20Songs%202024.csv"

try:
    df = pd.read_csv(url, encoding='ISO-8859-1')
except UnicodeDecodeError as e:
    print(f"UnicodeDecodeError: {e}")

# Display the first few rows of the dataset
df.head()

# Display the dataset columns and basic statistics
df.info()
df.describe(include='all')
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4600 entries, 0 to 4599
Data columns (total 29 columns):
 #   Column                      Non-Null Count  Dtype  
---  ------                      --------------  -----  
 0   Track                       4600 non-null   object 
 1   Album Name                  4600 non-null   object 
 2   Artist                      4595 non-null   object 
 3   Release Date                4600 non-null   object 
 4   ISRC                        4600 non-null   object 
 5   All Time Rank               4600 non-null   object 
 6   Track Score                 4600 non-null   float64
 7   Spotify Streams             4487 non-null   object 
 8   Spotify Playlist Count      4530 non-null   object 
 9   Spotify Playlist Reach      4528 non-null   object 
 10  Spotify Popularity          3796 non-null   float64
 11  YouTube Views               4292 non-null   object
 12  YouTube Likes               4285 non-null   object
 13  TikTok Posts                3427 non-null   object
 14  TikTok Likes                3620 non-null   object
 15  TikTok Views                3619 non-null   object
 16  YouTube Playlist Reach      3591 non-null   object
 17  Apple Music Playlist Count  4039 non-null   float64
 18  AirPlay Spins               4102 non-null   object
 19  SiriusXM Spins              2477 non-null   object
 20  Deezer Playlist Count       3679 non-null   float64
 21  Deezer Playlist Reach       3672 non-null   object
 22  Amazon Playlist Count       3545 non-null   float64
 23  Pandora Streams             3494 non-null   object
 24  Pandora Track Stations      3332 non-null   object
 25  Soundcloud Streams          1267 non-null   object
 26  Shazam Counts               4023 non-null   object
 27  TIDAL Popularity            0 non-null      float64
 28  Explicit Track              4600 non-null   int64
dtypes: float64(6), int64(1), object(22)
memory usage: 1.0+ MB
```

[40]:

```
                       Track        Album Name Artist Release Date  \
count                   4600              4600   4595         4600
unique                  4370              4005   1999         1562
top     Danza Kuduro - Cover  Un Verano Sin Ti  Drake     1/1/2012
freq                      13                20     63           38
mean                     NaN               NaN    NaN          NaN
std                      NaN               NaN    NaN          NaN
min                      NaN               NaN    NaN          NaN
25%                      NaN               NaN    NaN          NaN
50%                      NaN               NaN    NaN          NaN
75%                      NaN               NaN    NaN          NaN
max                      NaN               NaN    NaN          NaN

                ISRC All Time Rank  Track Score Spotify Streams  \
count           4600          4600  4600.000000            4487
unique          4598          4577          NaN            4425
top     USWL11700269         3,441          NaN   1,655,575,417
freq               2             2          NaN               4
mean             NaN           NaN    41.844043             NaN
std              NaN           NaN    38.543766             NaN
min              NaN           NaN    19.400000             NaN
25%              NaN           NaN    23.300000             NaN
50%              NaN           NaN    29.900000             NaN
75%              NaN           NaN    44.425000             NaN
max              NaN           NaN   725.400000             NaN
```

```
       Spotify Playlist Count Spotify Playlist Reach  …  SiriusXM Spins  \
count                    4530                   4528  …            2477
unique                   4207                   4478  …             689
top                         1                      3  …               1
freq                       46                      8  …              54
mean                      NaN                    NaN  …             NaN
std                       NaN                    NaN  …             NaN
min                       NaN                    NaN  …             NaN
25%                       NaN                    NaN  …             NaN
50%                       NaN                    NaN  …             NaN
75%                       NaN                    NaN  …             NaN
max                       NaN                    NaN  …             NaN

       Deezer Playlist Count Deezer Playlist Reach Amazon Playlist Count  \
count            3679.000000                  3672           3545.000000
unique                   NaN                  3558                   NaN
top                      NaN                 1,097                   NaN
freq                     NaN                    17                   NaN
mean               32.310954                   NaN             25.348942
std                54.274538                   NaN             25.989826
min                 1.000000                   NaN              1.000000
25%                 5.000000                   NaN              8.000000
50%                15.000000                   NaN             17.000000
75%                37.000000                   NaN             34.000000
max               632.000000                   NaN            210.000000

       Pandora Streams Pandora Track Stations Soundcloud Streams  \
count             3494                   3332               1267
unique            3491                   2975               1265
top         56,972,562                      9                 27
freq                 2                      6                  2
mean               NaN                    NaN                NaN
std                NaN                    NaN                NaN
min                NaN                    NaN                NaN
25%                NaN                    NaN                NaN
50%                NaN                    NaN                NaN
75%                NaN                    NaN                NaN
max                NaN                    NaN                NaN

        Shazam Counts TIDAL Popularity Explicit Track
count            4023              0.0    4600.000000
unique           4002              NaN            NaN
top                 1              NaN            NaN
freq                5              NaN            NaN
mean              NaN              NaN       0.358913
std               NaN              NaN       0.479734
```

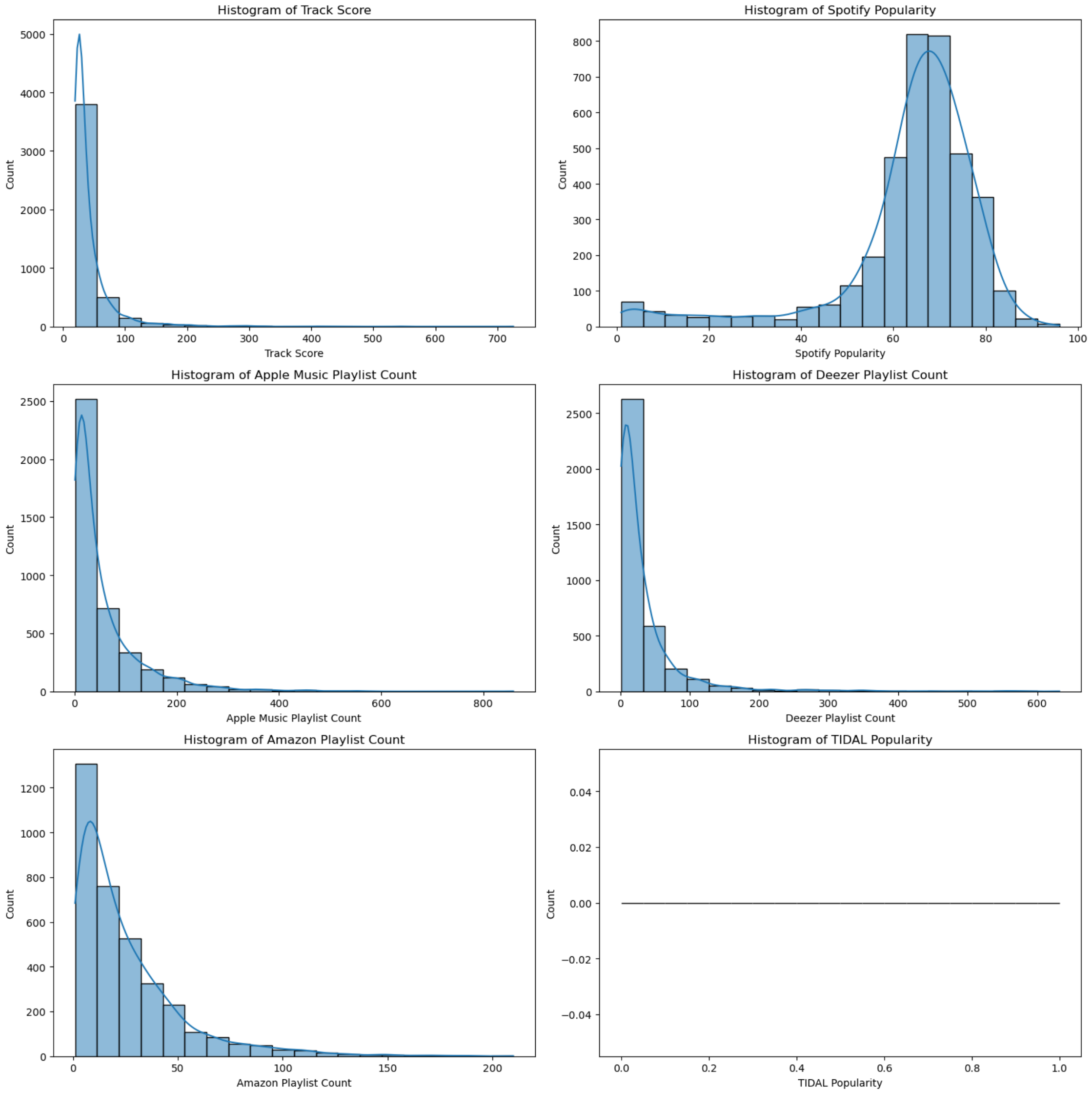
```
min                NaN              NaN        0.000000
25%                NaN              NaN        0.000000
50%                NaN              NaN        0.000000
75%                NaN              NaN        1.000000
max                NaN              NaN        1.000000

[11 rows x 29 columns]
```

[ ]:

```
'''
Describe these variables:
The dataset contains the following variables:
1.         Track Score: Likely a numerical value indicating the overall score or␣
 ↪ranking of the track based on certain criteria (e.g., popularity, user␣
 ↪ratings).
2.         Spotify Popularity: A numerical score representing how popular the␣
 ↪track is on Spotify, possibly on a scale from 0 to 100.
3.         Apple Music Playlist Count: The number of playlists that feature the␣
 ↪track on Apple Music.
4.         Deezer Playlist Count: The number of playlists that feature the track␣
 ↪on Deezer.
5.         Amazon Playlist Count: The number of playlists that feature the track␣
 ↪on Amazon Music.
6.         TIDAL Popularity: A numerical score representing the track's␣
 ↪popularity on TIDAL, similar to Spotify Popularity.

'''
```

[34]:

```
#Plot histograms for each of the numerical variables and calculate descriptive␣
 ↪statistics.

fig, axes = plt.subplots(3, 2, figsize=(15, 15))
axes = axes.flatten()

for idx, column in enumerate(['Track Score', 'Spotify Popularity', 'Apple Music␣
 ↪Playlist Count', 'Deezer Playlist Count', 'Amazon Playlist Count', 'TIDAL␣
 ↪Popularity']):
    sns.histplot(df[column], bins=20, kde=True, ax=axes[idx])
    axes[idx].set_title(f'Histogram of {column}')

plt.tight_layout()
plt.show()
```



[77]:

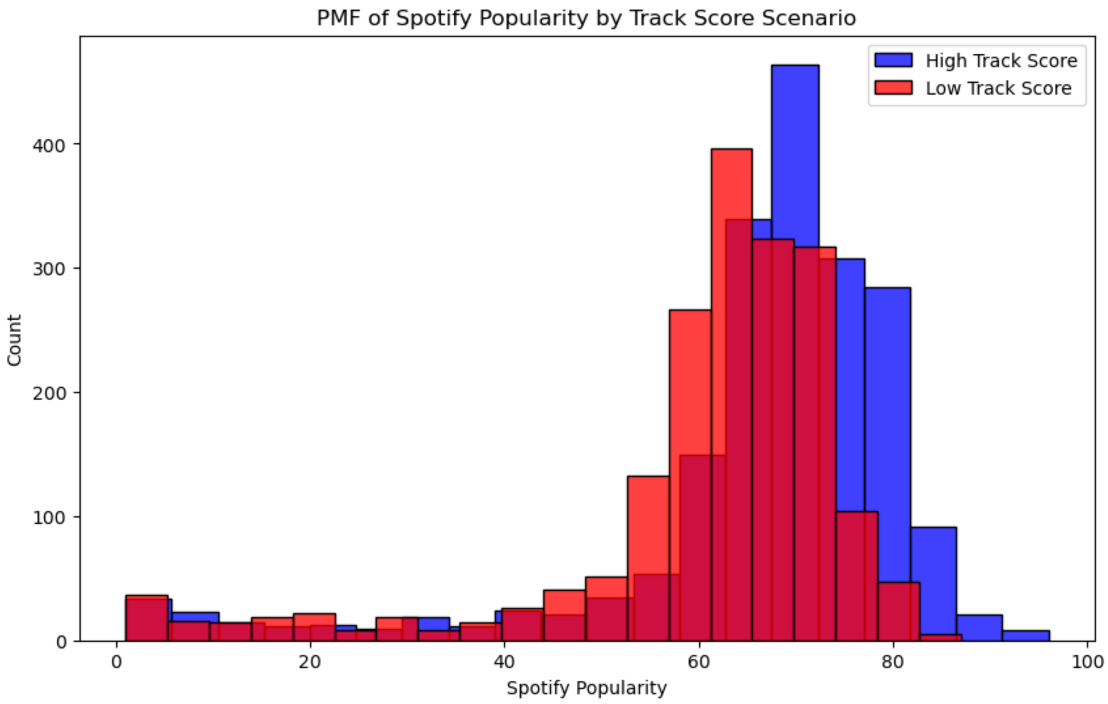
```
#Descriptive Statistics: Calculate the mean, mode, spread, and tails (skewness and kurtosis) for each variable.

# Identify columns with all NaN values
all_nan_columns = df.columns[df.isna().all()].tolist()

# Drop columns with all NaN values if needed
df = df.drop(columns=all_nan_columns)

# Select only numeric columns
numeric_df = df.select_dtypes(include=[float, int])
# Fill missing values for numeric columns
df_filled = numeric_df.fillna(numeric_df.mean())
```

```python
from scipy.stats import skew, kurtosis
# Initialize dictionary to store descriptive statistics
descriptive_stats = {}
# Iterate over each column to calculate descriptive statistics
for column in numeric_df.columns:
    try:
        # Calculate statistics
        mean = df_filled[column].mean()
        mode = df_filled[column].mode()
        mode_value = mode.iloc[0] if not mode.empty else None
        spread = df_filled[column].std()
        skewness = skew(df_filled[column].dropna())
        kurt = kurtosis(df_filled[column].dropna())

        # Store statistics in dictionary
        descriptive_stats[column] = {
            'Mean': mean,
            'Mode': mode_value,
            'Spread (Std Dev)': spread,
            'Skewness': skewness,
            'Kurtosis': kurt
        }
    except KeyError:
        descriptive_stats[column] = 'Column not found'
    except Exception as e:
        descriptive_stats[column] = str(e)

# Display descriptive statistics
descriptive_stats
```

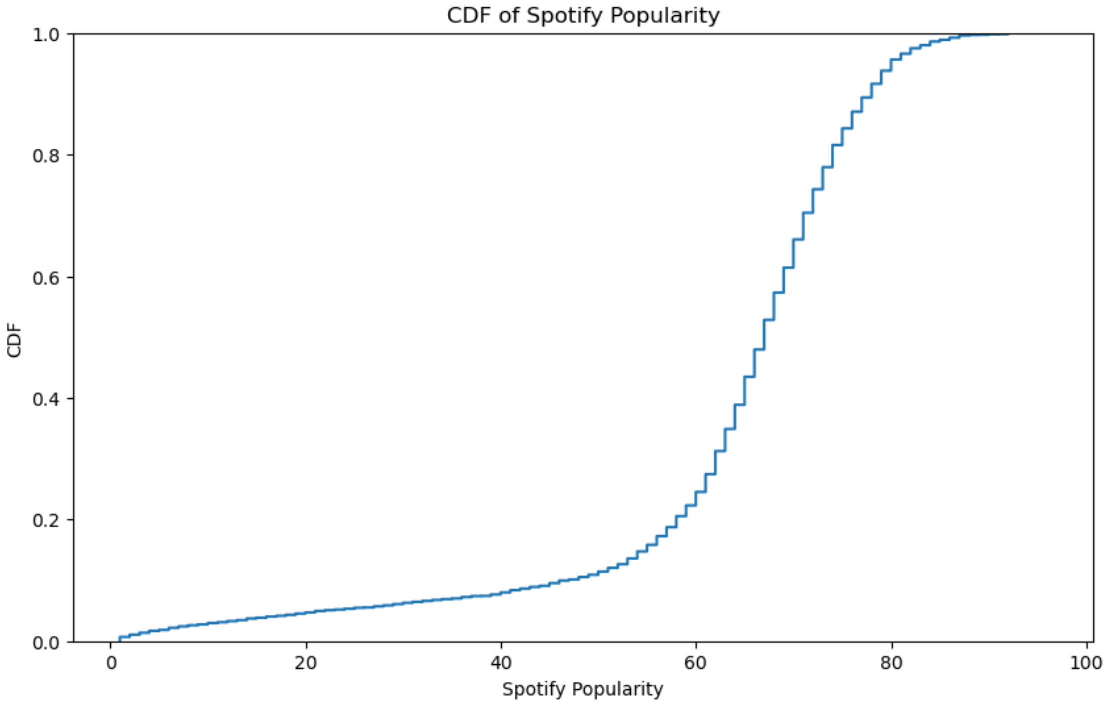
```
[77]: {'Track Score': {'Mean': 41.84404347826101,
        'Mode': 21.7,
        'Spread (Std Dev)': 38.54376574715532,
        'Skewness': 5.686368434584364,
        'Kurtosis': 53.87462816507168},
       'Spotify Popularity': {'Mean': 63.501580611169146,
        'Mode': 63.50158061116965,
        'Spread (Std Dev)': 14.7036610951589,
        'Skewness': -2.257955847370638,
        'Kurtosis': 6.286506435872026},
       'Apple Music Playlist Count': {'Mean': 54.60311958405621,
        'Mode': 54.603119584055456,
        'Spread (Std Dev)': 67.10252951585504,
        'Skewness': 3.0810885211454995,
        'Kurtosis': 14.830274224929838},
       'Deezer Playlist Count': {'Mean': 32.31095406360473,
        'Mode': 32.31095406360424,
        'Spread (Std Dev)': 48.53670525065182,
        'Skewness': 5.358580903488518,
        'Kurtosis': 41.3533812484804},
       'Amazon Playlist Count': {'Mean': 25.348942172073333,
        'Mode': 25.348942172073343,
        'Spread (Std Dev)': 22.814897297845793,
        'Skewness': 2.4890521710106395,
        'Kurtosis': 9.32674440860418},
       'Explicit Track': {'Mean': 0.35891304347826086,
        'Mode': 0,
        'Spread (Std Dev)': 0.47973378254293886,
        'Skewness': 0.5882524837561582,
        'Kurtosis': -1.653959015354711}}
```

[51]:

```python
#Probability Mass Function (PMF): Compare two scenarios using the PMF. For␣
 ↪instance, compare the distribution of Spotify Popularity when the Track␣
 ↪Score is above and below its median.



# Create two scenarios based on Track Score median
median_score = df['Track Score'].median()
high_score = df[df['Track Score'] > median_score]['Spotify Popularity']
low_score = df[df['Track Score'] <= median_score]['Spotify Popularity']

# Plot PMF
fig, ax = plt.subplots(figsize=(10, 6))
sns.histplot(high_score, bins=20, kde=False, label='High Track Score',␣
 ↪color='blue', ax=ax)
sns.histplot(low_score, bins=20, kde=False, label='Low Track Score',␣
 ↪color='red', ax=ax)
ax.set_title('PMF of Spotify Popularity by Track Score Scenario')
ax.legend()
plt.show()
```



[52]:
```
#Cumulative Distribution Function (CDF): Create a CDF for Spotify Popularity.

# Plot CDF
plt.figure(figsize=(10, 6))
sns.ecdfplot(df['Spotify Popularity'])
plt.title('CDF of Spotify Popularity')
plt.xlabel('Spotify Popularity')
plt.ylabel('CDF')
plt.show()
```

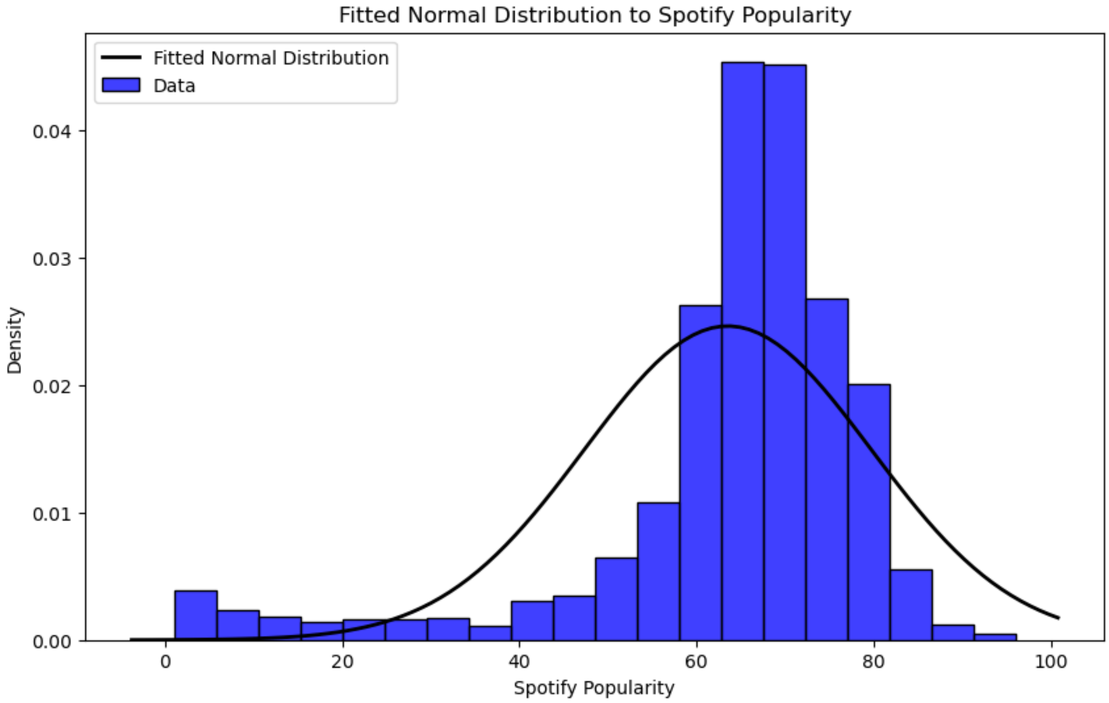


[55]:

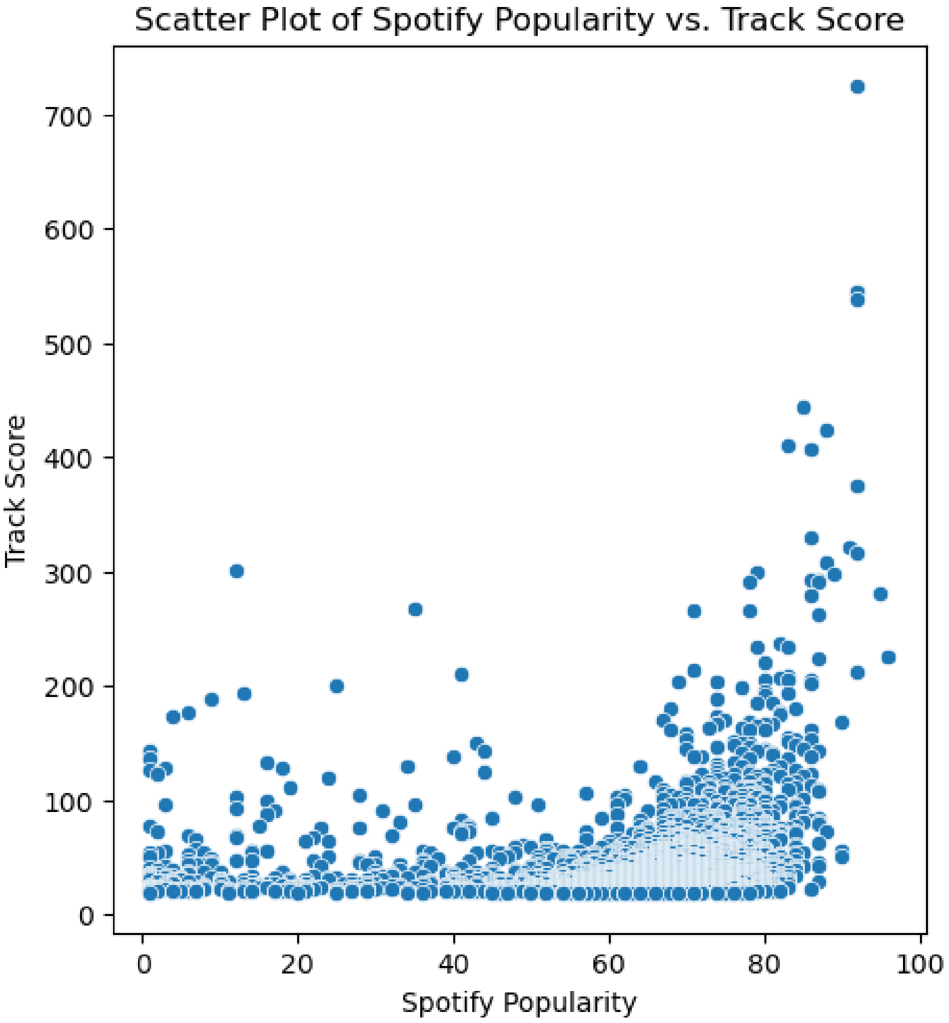
```
#Analytical Distribution: Fit a distribution (e.g., Normal) and compare it to␣
 ↪the actual data.

# Check for non-finite values in 'Spotify Popularity'
non_finite_values = df['Spotify Popularity'].isna().sum() + np.
 ↪isinf(df['Spotify Popularity']).sum()
print(f'Number of non-finite values: {non_finite_values}')

# Drop non-finite values
spotify_popularity_clean = df['Spotify Popularity'].dropna()
spotify_popularity_clean = spotify_popularity_clean[np.
 ↪isfinite(spotify_popularity_clean)]

from scipy.stats import norm
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt

# Fit a normal distribution to the cleaned data
mu, std = norm.fit(spotify_popularity_clean)

# Plot the distribution
plt.figure(figsize=(10, 6))
```

```
sns.histplot(spotify_popularity_clean, bins=20, kde=False, label='Data',␣
 ↪color='blue', stat='density')
xmin, xmax = plt.xlim()
x = np.linspace(xmin, xmax, 100)
p = norm.pdf(x, mu, std)
plt.plot(x, p, 'k', linewidth=2, label='Fitted Normal Distribution')
plt.title('Fitted Normal Distribution to Spotify Popularity')
plt.xlabel('Spotify Popularity')
plt.ylabel('Density')
plt.legend()
plt.show()
```

```
Number of non-finite values: 804
```



```
[74]: #Scatter Plots and Correlation Analysis: Compare two variables with scatter␣
       ↪plots and compute correlations.

      # Scatter plot between Spotify Popularity and Track Score
      plt.figure(figsize=(12, 6))
      plt.subplot(1, 2, 1)
      sns.scatterplot(data=df, x='Spotify Popularity', y='Track Score')
      plt.title('Scatter Plot of Spotify Popularity vs. Track Score')
      plt.xlabel('Spotify Popularity')
      plt.ylabel('Track Score')
      plt.show()
      # Compute correlation
      correlation = df[['Spotify Popularity', 'Track Score']].corr().iloc[0, 1]
      correlation
```

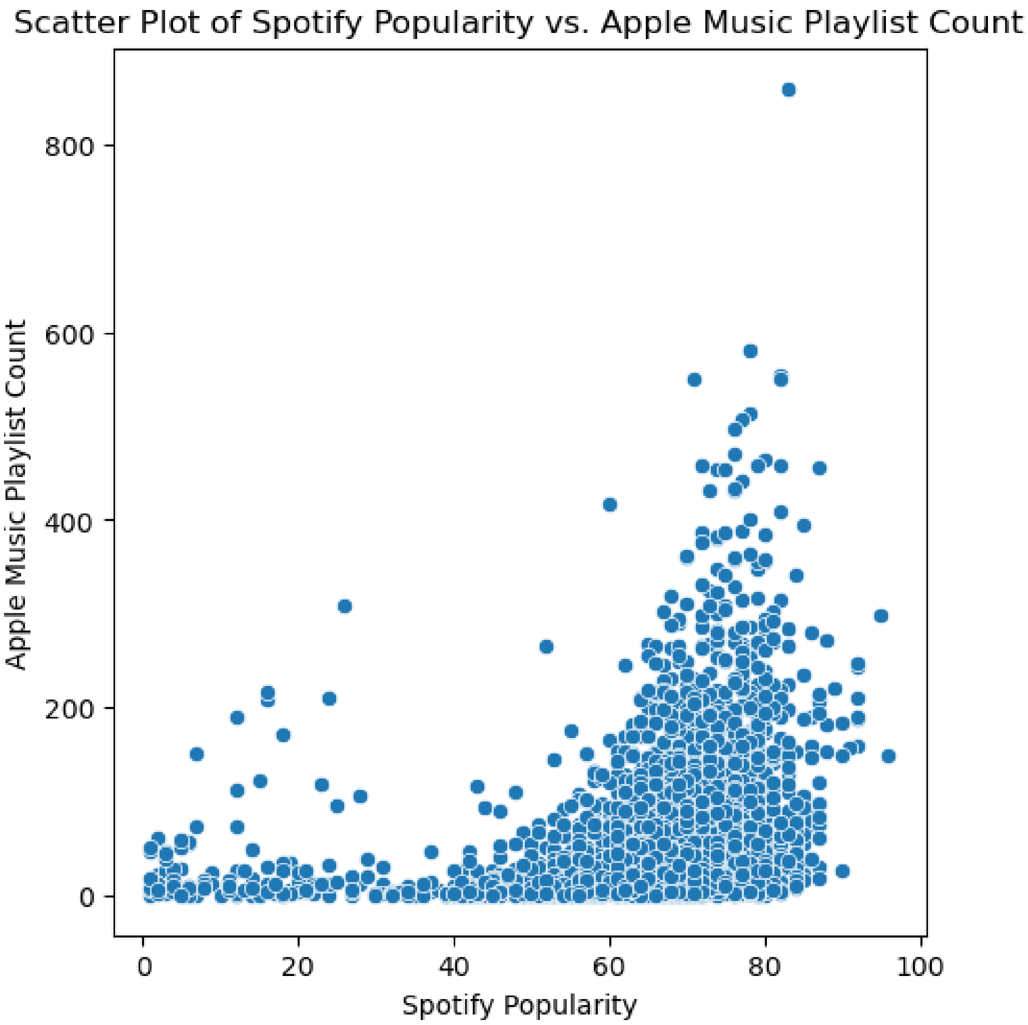


```
[74]: 0.19280775654813445
```

[75]:

```
# Scatter plot between Spotify Popularity and Track Score
plt.figure(figsize=(12, 6))
plt.subplot(1, 2, 2)
sns.scatterplot(data=df, x='Spotify Popularity', y='Apple Music Playlist Count')
plt.title('Scatter Plot of Spotify Popularity vs. Apple Music Playlist Count')
plt.xlabel('Spotify Popularity')
plt.ylabel('Apple Music Playlist Count')
plt.show()
```

```
# Compute correlation
correlation = df[['Spotify Popularity', 'Apple Music Playlist Count']].corr().
 ↪iloc[0, 1]
correlation
```



```
[75]: 0.2884300282744505
```

```
[57]: #Hypothesis Testing: Perform a hypothesis test, for example, testing if the␣
       ↪mean Spotify Popularity differs from a known value.

      from scipy.stats import ttest_1samp

      # Hypothesis test: mean Spotify Popularity differs from 50
      test_statistic, p_value = ttest_1samp(df['Spotify Popularity'].dropna(), 50)
      test_statistic, p_value
```

[57]: (51.392106212822206, 0.0)

[69]:
```
#Regression Analysis: Perform regression analysis to predict one variable based␣
 ↪on others. For instance, predicting Spotify Popularity from Track Score and␣
 ↪playlist counts.

import statsmodels.api as sm

# Option 1: Drop rows with any missing values
df_cleaned = df.dropna()

# Option 2: Fill missing values with the mean of each column
df_filled = df.fillna(df.mean())

df_cleaned.replace([float('inf'), -float('inf')], np.nan, inplace=True)
df_cleaned.dropna(inplace=True)  # Remove rows with any NaN values


# Prepare data for regression with cleaned dataset
X = df_cleaned[['Track Score', 'Apple Music Playlist Count', 'Deezer Playlist␣
 ↪Count', 'Amazon Playlist Count']]
X = sm.add_constant(X)  # Adds a constant term to the predictors
y = df_cleaned['Spotify Popularity']

# Fit regression model
model = sm.OLS(y, X).fit()
print(model.summary())
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:     Spotify Popularity   R-squared:                       0.172
Model:                            OLS   Adj. R-squared:                  0.166
Method:                 Least Squares   F-statistic:                     29.13
Date:                Thu, 08 Aug 2024   Prob (F-statistic):           5.05e-22
Time:                        22:49:30   Log-Likelihood:                -2111.5
No. Observations:                 565   AIC:                             4233.
Df Residuals:                     560   BIC:                             4255.
Df Model:                           4
Covariance Type:            nonrobust
================================================================================
==============
                                 coef    std err          t      P>|t|
[0.025      0.975]
--------------------------------------------------------------------------------
--------------
const                         64.1015      0.698     91.889      0.000
62.731      65.472
Track Score                    0.0436      0.009      5.078      0.000
```

```
0.027       0.060
Apple Music Playlist Count     0.0199      0.010      2.066      0.039
0.001       0.039
Deezer Playlist Count         -0.0072      0.013     -0.554      0.580
-0.033       0.018
Amazon Playlist Count          0.0411      0.021      1.954      0.051
-0.000       0.082
==============================================================================
Omnibus:                      394.388   Durbin-Watson:                   1.962
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             5421.998
Skew:                          -2.953   Prob(JB):                         0.00
Kurtosis:                      16.980   Cond. No.                         263.
==============================================================================
```