```
import pandas as pd
data = pd.read_csv('/content/all_songs_data.csv')
print(data.head())

```

```
                                Album  \
0               Battle of New Orleans
1                          That’s All
2      “Mr Personality” 15 Big Hits
3  The Greatest Hits Of Frankie Avalon
4           Paul Anka Sings His Big 15

                                           Album URL          Artist  \
0  https://genius.com/albums/Johnny-horton/Battle...   Johnny Horton
1   https://genius.com/albums/Bobby-darin/That-s-all     Bobby Darin
2  https://genius.com/albums/Lloyd-price/Mr-perso...     Lloyd Price
3  https://genius.com/albums/Frankie-avalon/The-g...  Frankie Avalon
4  https://genius.com/albums/Paul-anka/Paul-anka-...       Paul Anka

  Featured Artists                                             Lyrics  \
0               []  [Verse 1] In 1814 we took a little trip Along ...
1               []  Oh the shark, babe Has such teeth, dear And he...
2               []  Over and over I tried to prove my love to you ...
3               []  Hey, Venus! Oh, Venus!  Venus, if you will Ple...
4               []  I'm just a lonely boy Lonely and blue I'm all ...

                                          Media  Rank Release Date  \
0  [{'native_uri': 'spotify:track:0dwpdcQkeZqpuoA...     1   1959-04-01
1  [{'native_uri': 'spotify:track:3E5ndyOfO6vFDEI...     2          NaN
2  [{'provider': 'youtube', 'start': 0, 'type': '...     3          NaN
3                                                 []     4          NaN
4                                                 []     5          NaN

                 Song Title  \
0  The Battle Of New Orleans
1            Mack The Knife
2               Personality
3                     Venus
4               Lonely Boy

                                        Song URL  \
0  https://genius.com/Johnny-horton-the-battle-of...
1  https://genius.com/Bobby-darin-mack-the-knife-...
2  https://genius.com/Lloyd-price-personality-lyrics
3     https://genius.com/Frankie-avalon-venus-lyrics
4     https://genius.com/Paul-anka-lonely-boy-lyrics

                                         Writers    Year
0  [{'api_path': '/artists/561913', 'header_image...  1959.0
1  [{'api_path': '/artists/218851', 'header_image...  1959.0
2  [{'api_path': '/artists/355804', 'header_image...  1959.0
3  [{'api_path': '/artists/1113175', 'header_imag...  1959.0
4                                                 []  1959.0
```

```
# Descriptive statistics for numerical columns
print(data.describe())

# Descriptive statistics for categorical columns
print(data.describe(include='object'))

```

```
              Rank         Year
count  6500.000000  6500.000000
mean     50.500000  1991.000000
std      28.868291    18.763106
min       1.000000  1959.000000
```

```
25%      25.750000  1975.000000
50%      50.500000  1991.000000
75%      75.250000  2007.000000
max     100.000000  2023.000000
```

	Album	Album URL	\
count	6036	6036	
unique	4202	4285	
top	Greatest Hits	https://genius.com/albums/Morgan-wallen/One-th...	
freq	21	9	

	Artist	Featured Artists	Lyrics	Media	Release Date	\
count	6500	6384	6384	6384	4563	
unique	3181	612	6044	5054	3233	
top	Madonna	[]	[Instrumental]	[]	2022-05-06	
freq	35	5492	21	1043	10	

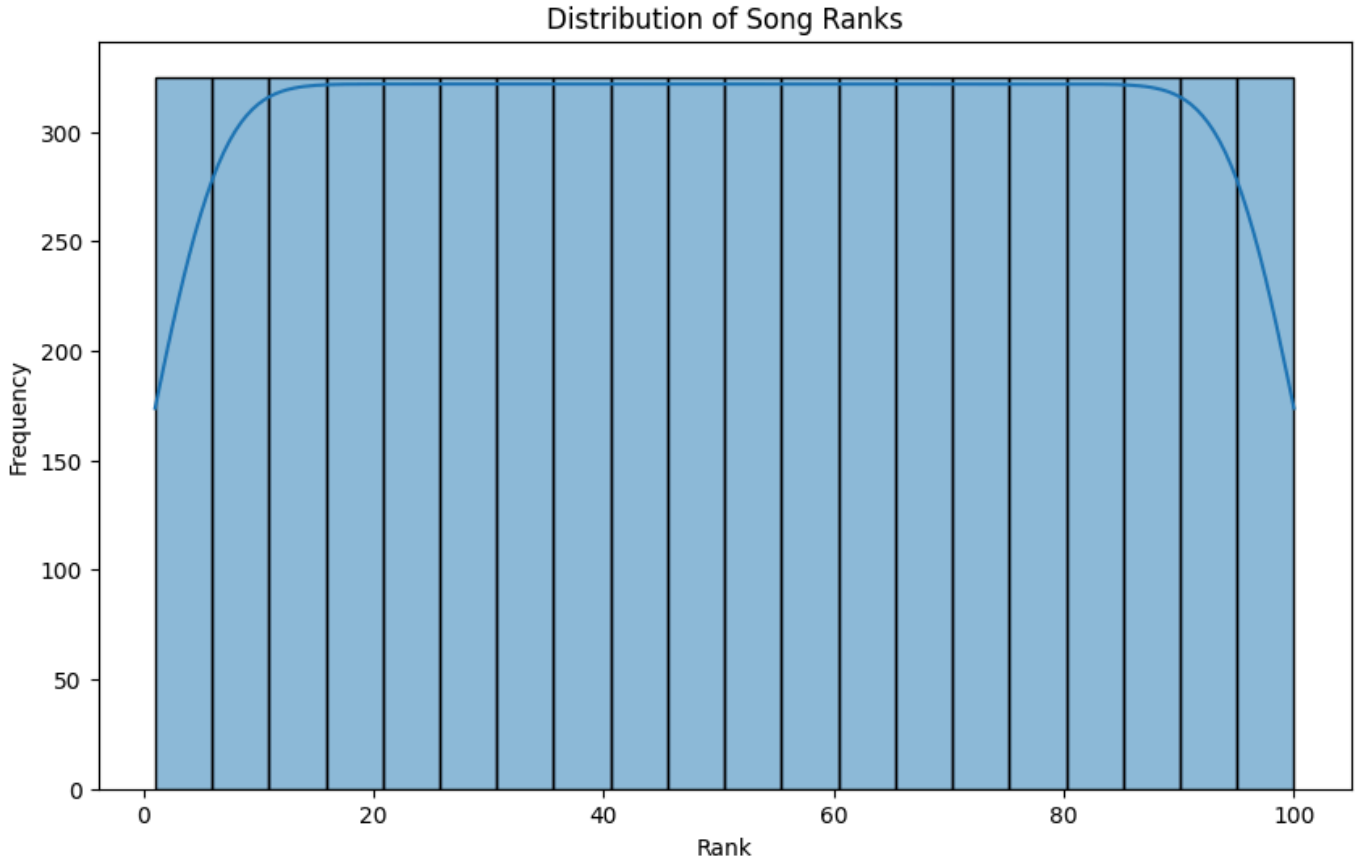
	Song Title	Song URL	Writers
count	6500	6384	6384
unique	5798	6065	4184
top	Stay	https://genius.com/Billboard-hot-rap-songs-cha...	[]
freq	7	5	971

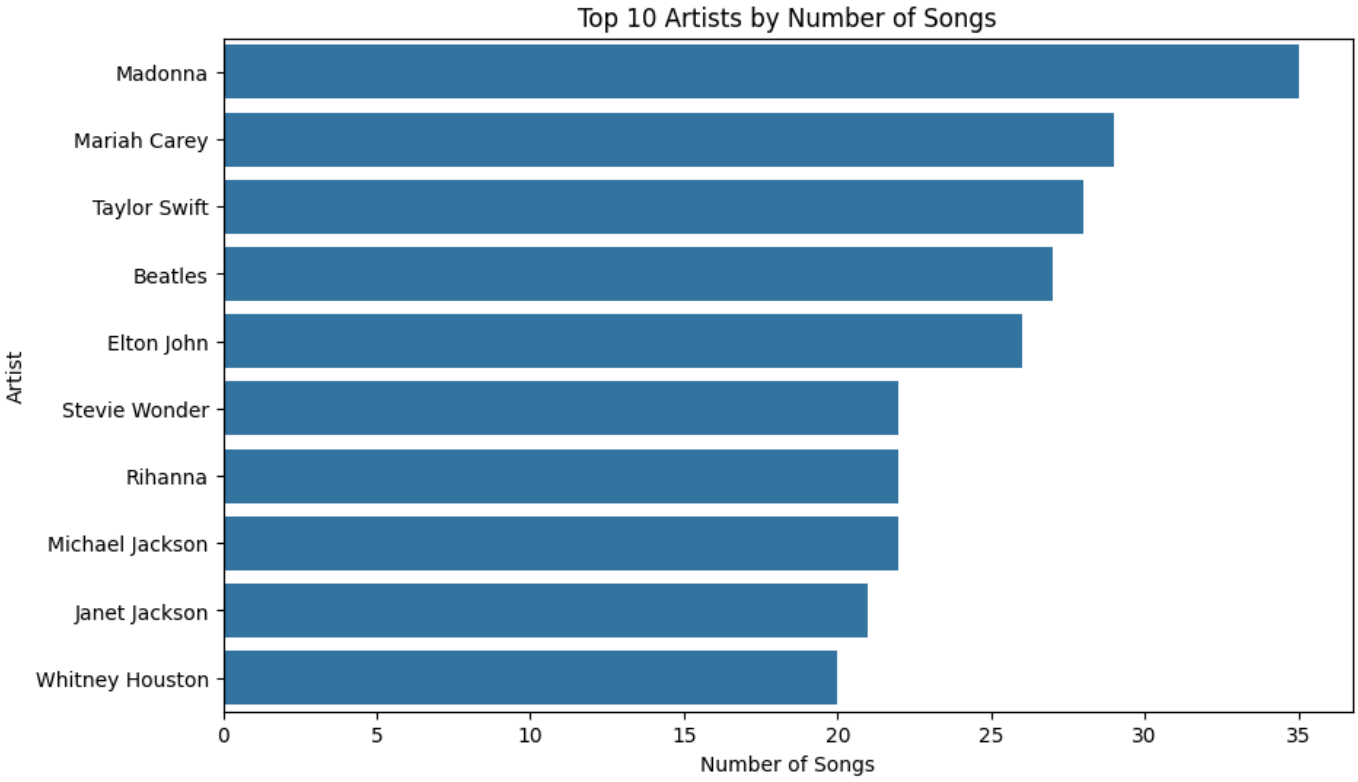
```
rank_stats = data['Rank'].describe()
rank_frequency = data['Rank'].value_counts().sort_index()
top_artists = data['Artist'].value_counts().head(10)

print("Descriptive Statistics for Song Ranks:")
print(rank_stats)
print("\nFrequency of Songs by Rank:")
print(rank_frequency)
print("\nTop 10 Artists by Number of Songs:")
print(top_artists)

```

```
Descriptive Statistics for Song Ranks:
count    6500.000000
mean       50.500000
std        28.868291
min         1.000000
25%        25.750000
50%        50.500000
75%        75.250000
max       100.000000
Name: Rank, dtype: float64

Frequency of Songs by Rank:
Rank
1      65
2      65
3      65
4      65
5      65
       ..
96     65
97     65
98     65
99     65
100    65
Name: count, Length: 100, dtype: int64

Top 10 Artists by Number of Songs:
Artist
Madonna           35
Mariah Carey      29
Taylor Swift      28
Beatles           27
Elton John        26
```

```
Stevie Wonder      22
Rihanna            22
Michael Jackson    22
Janet Jackson      21
Whitney Houston    20
Name: count, dtype: int64
```

```
import matplotlib.pyplot as plt
import seaborn as sns

plt.figure(figsize=(10, 6))
sns.histplot(data['Rank'], bins=20, kde=True)
plt.title('Distribution of Song Ranks')
plt.xlabel('Rank')
plt.ylabel('Frequency')
plt.show()

top_artists = data['Artist'].value_counts().head(10)
plt.figure(figsize=(10, 6))
sns.barplot(x=top_artists.values, y=top_artists.index)
plt.title('Top 10 Artists by Number of Songs')
plt.xlabel('Number of Songs')
plt.ylabel('Artist')
plt.show()

```


Distribution of Song Ranks
Frequency
Rank
0
50
100
150
200
250
300
0
20
40
60
80
100

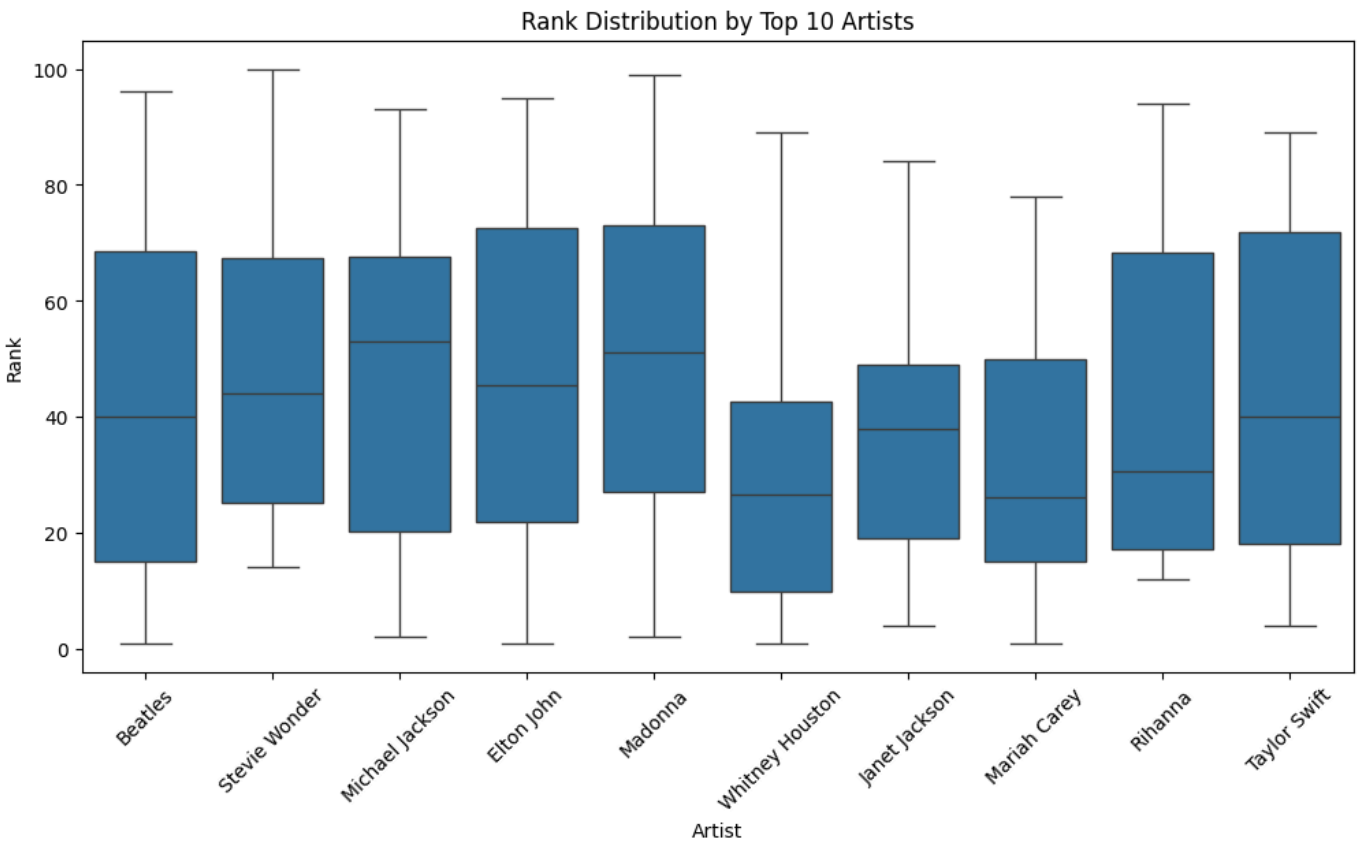

Top 10 Artists by Number of Songs
Artist
Number of Songs
Madonna
Mariah Carey
Taylor Swift
Beatles
Elton John
Stevie Wonder
Rihanna
Michael Jackson
Janet Jackson
Whitney Houston
0
5
10
15
20
25
30
35

```
# Converting 'Release Date' to datetime
data['Release Date'] = pd.to_datetime(data['Release Date'])

data['Year'] = data['Release Date'].dt.year
```

```
rank_year_corr = data[['Year', 'Rank']].groupby('Year').mean().reset_index()
rank_year_corr['Rank'] = rank_year_corr['Rank'].round(2)

correlation = data['Year'].corr(data['Rank'])

top_artists = data['Artist'].value_counts().head(10).index
rank_distribution_top_artists = data[data['Artist'].isin(top_artists)].groupby('Artist')['Rank'].desc

print("Average Rank by Year:")
print(rank_year_corr)
print("\nCorrelation between Year and Rank:")
print(correlation)
print("\nRank Distribution by Top 10 Artists:")
print(rank_distribution_top_artists)
```

```
Average Rank by Year:
      Year   Rank
0   1877.0  26.00
1   1922.0  70.00
2   1955.0  52.00
3   1957.0  77.00
4   1958.0  72.00
..     ...    ...
66  2020.0  52.36
67  2021.0  45.94
68  2022.0  48.67
69  2023.0  53.90
70  2024.0  82.00

[71 rows x 2 columns]

Correlation between Year and Rank:
0.040140674340618 61

Rank Distribution by Top 10 Artists:
                count       mean        std   min    25%   50%    75%    max
Artist
Beatles          27.0  42.777778  31.624398   1.0  15.00  40.0  68.50   96.0
Elton John       26.0  47.038462  29.200659   1.0  21.75  45.5  72.50   95.0
Janet Jackson    21.0  38.619048  21.973794   4.0  19.00  38.0  49.00   84.0
Madonna          35.0  49.285714  28.678308   2.0  27.00  51.0  73.00   99.0
Mariah Carey     29.0  33.724138  24.335301   1.0  15.00  26.0  50.00   78.0
Michael Jackson  22.0  47.409091  30.316833   2.0  20.25  53.0  67.50   93.0
Rihanna          22.0  42.090909  29.012163  12.0  17.25  30.5  68.25   94.0
Stevie Wonder    22.0  48.318182  26.141349  14.0  25.25  44.0  67.25  100.0
Taylor Swift     28.0  43.642857  27.214123   4.0  18.00  40.0  71.75   89.0
Whitney Houston  20.0  29.200000  23.625588   1.0   9.75  26.5  42.50   89.0
```

```
top_artists = data['Artist'].value_counts().head(10).index
plt.figure(figsize=(12, 6))
sns.boxplot(x='Artist', y='Rank', data=data[data['Artist'].isin(top_artists)])
plt.title('Rank Distribution by Top 10 Artists')
plt.xlabel('Artist')
plt.ylabel('Rank')
plt.xticks(rotation=45)
plt.show()
```



At this stage, I am moving on to exploring the categorical data and cleaning/preprocessing the text

```
# Checking for missing values
print(f"Missing Lyrics: {data['Lyrics'].isnull().sum()}")
empty_lyrics = data[data['Lyrics'].apply(lambda x: isinstance(x, str) and len(x) == 0)]
print(f"Empty Lyrics: {empty_lyrics.shape[0]}")
invalid_lyrics = data[data['Lyrics'].apply(lambda x: not isinstance(x, str))]
print(f"Invalid Lyrics (Non-string values): {invalid_lyrics.shape[0]}")

```

```
Missing Lyrics: 116
Empty Lyrics: 0
Invalid Lyrics (Non-string values): 116
```

```
# Removing missing values
data_cleaned = data.dropna(subset=['Lyrics'])

data_cleaned = data_cleaned[data_cleaned['Lyrics'].apply(lambda x: isinstance(x, str))]

print(f"Data after cleaning: {data_cleaned.shape[0]} rows")
print(data_cleaned['Lyrics'].isnull().sum())  # Check if there are any missing lyrics

```

```
Data after cleaning: 6384 rows
0
```

```
!pip install spacy
!python -m spacy download en_core_web_sm
```

Show hidden output

```
Start coding or generate with AI.
```

Next, I am loading the necesssary tools to preprocess the lyrical data

```
import spacy
import re
from nltk.corpus import stopwords
from nltk.stem import WordNetLemmatizer

# Implementing custom stopwords
custom_stopwords = set(stopwords.words('english')).union({'chorus', 'verse', 'bridge', 'hook', 'intro
nlp = spacy.load("en_core_web_sm")
lemmatizer = WordNetLemmatizer()

#in the first round, i noticed contractions were not removed properly so I used a dictionary to ensur
def expand_contractions(text):
    contractions_dict = {
        "don't": "do not", "can't": "cannot", "won't": "will not", "didn't": "did not",
        "isn't": "is not", "aren't": "are not", "wasn't": "was not", "weren't": "were not",
        "hasn't": "has not", "haven't": "have not", "hadn't": "had not", "doesn't": "does not",
        "didn't": "did not", "couldn't": "could not", "shouldn't": "should not", "mightn't": "might n
        "mustn't": "must not", "let's": "let us", "i'm": "i am", "you're": "you are", "he's": "he is",
        "she's": "she is", "it's": "it is", "we're": "we are", "they're": "they are", "that's": "that
        "what's": "what is", "who's": "who is", "where's": "where is", "how's": "how is"
    }
    for word, expansion in contractions_dict.items():
        text = re.sub(r'\b' + word + r'\b', expansion, text)
    return text

def preprocess_text(text):
    text = expand_contractions(text)

    # Converting to lowercase
    text = text.lower()

    # Removing non-alphanumeric characters (keeping spaces and words)
    text = re.sub(r'[^a-zA-Z\s]', '', text)

    # Tokenizing the text using spaCy
    doc = nlp(text)

    words = [token.text for token in doc if token.text not in custom_stopwords and not token.is_punct

    # Lemmatizing words
    words = [lemmatizer.lemmatize(word) for word in words]

    # Rejoining words
    cleaned_text = ' '.join(words)

    return cleaned_text
data_cleaned['cleaned_lyrics'] = data_cleaned['Lyrics'].apply(preprocess_text)

print(data_cleaned[['Song Title', 'Lyrics', 'cleaned_lyrics']].head())
```

```
                  Song Title  \
0  The Battle Of New Orleans
1             Mack The Knife
2                Personality
```

```
3                    Venus
4                Lonely Boy

                                                Lyrics  \
0  [Verse 1] In 1814 we took a little trip Along ...
1  Oh the shark, babe Has such teeth, dear And he...
2  Over and over I tried to prove my love to you ...
3  Hey, Venus! Oh, Venus!  Venus, if you will Ple...
4  I'm just a lonely boy Lonely and blue I'm all ...

                                     cleaned_lyrics
0      took little trip along colonel jackson mig...
1  oh shark babe teeth dear show pearly white jac...
2  tried prove love   friend say fool ill fool   ...
3  hey venus oh venus   venus please send little ...
4  lonely boy lonely blue alone nothin   got ever...
```

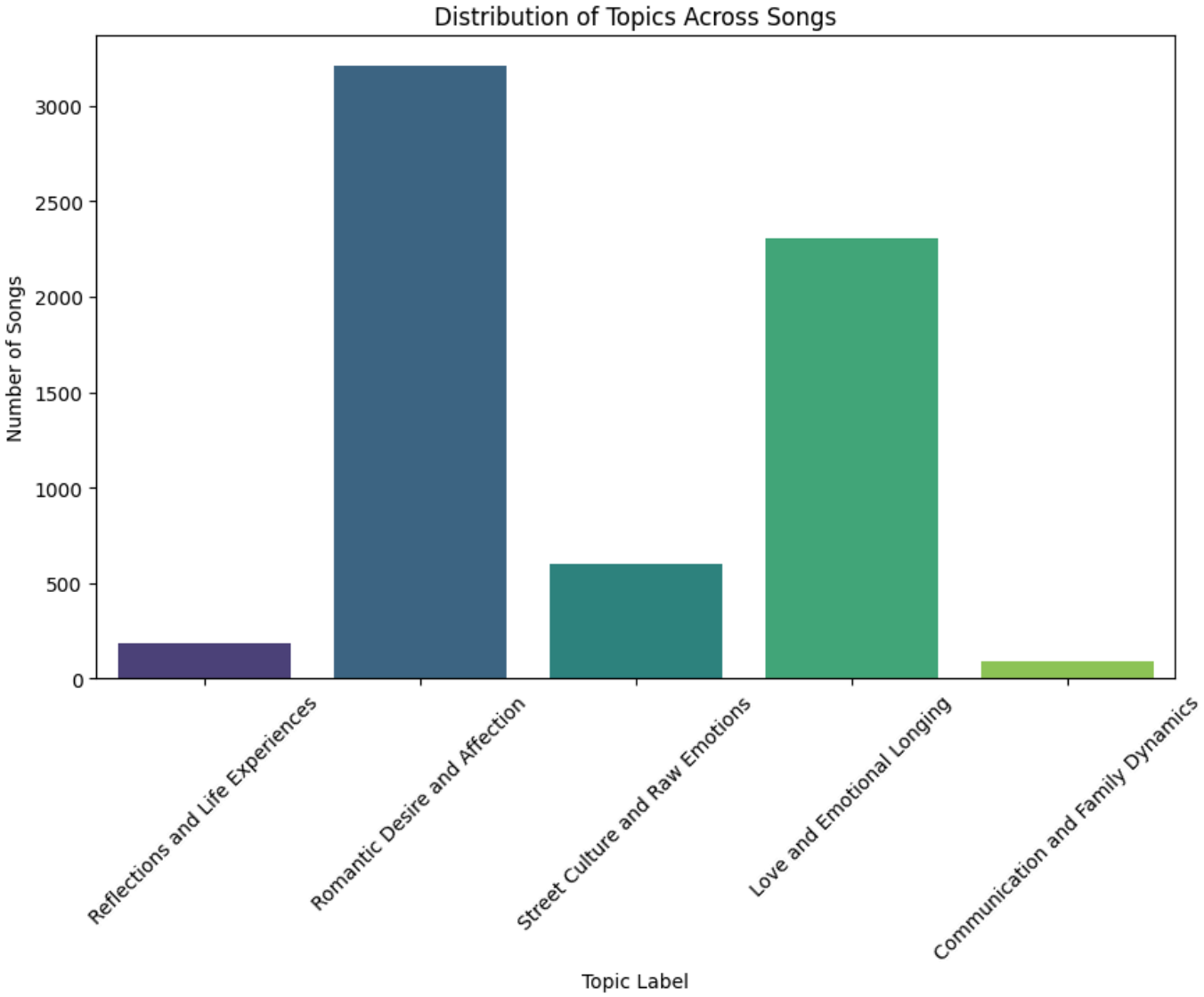
```
Start coding or generate with AI.
```

Now that the data is preprocessed, we move on to vectorizing the text data to fit the LDA model

```
import pandas as pd
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.decomposition import LatentDirichletAllocation
import matplotlib.pyplot as plt
import seaborn as sns

texts = data_cleaned['cleaned_lyrics'].dropna()

vectorizer = CountVectorizer(stop_words='english', max_features=5000)

X = vectorizer.fit_transform(texts)

lda = LatentDirichletAllocation(n_components=5, random_state=42)
lda.fit(X)

# Retreving the words for with each topic
words = vectorizer.get_feature_names_out()

#display/interpret top words/topic
def print_top_words(model, feature_names, n_top_words=10):
    topic_labels = {}
    for topic_idx, topic in enumerate(model.components_):
        top_words_idx = topic.argsort()[:-n_top_words - 1:-1]
        top_words = [feature_names[i] for i in top_words_idx]


        print(f"Topic {topic_idx + 1}:")
        print(" ".join(top_words))

        #Labels/catergory interpretations were created by human coder after first iteration retrieved t
        if topic_idx == 0:
            topic_labels[topic_idx] = "Reflections and Life Experiences"
        elif topic_idx == 1:
            topic_labels[topic_idx] = "Communication and Family Dynamics"
        elif topic_idx == 2:
            topic_labels[topic_idx] = "Love and Emotional Longing"
        elif topic_idx == 3:
            topic_labels[topic_idx] = "Street Culture and Raw Emotions"
        elif topic_idx == 4:
            topic_labels[topic_idx] = "Romantic Desire and Affection"

    return topic_labels
```

```
43
44 topic_labels = print_top_words(lda, words)
45
46 # Adding the dominant topic for each song
47 topic_probabilities = lda.transform(X)
48 dominant_topic = topic_probabilities.argmax(axis=1)
49 data_cleaned['dominant_topic'] = dominant_topic
50
51 # Mapping topic labels to the songs
52 data_cleaned['topic_label'] = data_cleaned['dominant_topic'].map(topic_labels)
53
54 print(data_cleaned[['Song Title', 'dominant_topic', 'topic_label']].head())
55
56 # Visualizing topic distribution across songs
57 plt.figure(figsize=(10, 6))
58 sns.countplot(x='topic_label', data=data_cleaned, palette='viridis')
59 plt.title('Distribution of Topics Across Songs')
60 plt.xlabel('Topic Label')
61 plt.ylabel('Number of Songs')
62 plt.xticks(rotation=45)
63 plt.show()
64
```

```
Topic 1:
said like man day time old know hand make say
Topic 2:
say tell mr know mam like boy come dad want
Topic 3:
love time night heart day away ill know life let
Topic 4:
like nigga got la bitch shit know love ai fuck
Topic 5:
baby yeah love oh know got like na want girl
                  Song Title  dominant_topic                      topic_label
0  The Battle Of New Orleans               0  Reflections and Life Experiences
1             Mack The Knife               4     Romantic Desire and Affection
2                Personality               3   Street Culture and Raw Emotions
3                      Venus               0  Reflections and Life Experiences
4                 Lonely Boy               2         Love and Emotional Longing
<ipython-input-40-152ba0ce7419>:58: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x`

  sns.countplot(x='topic_label', data=data_cleaned, palette='viridis')
```



Testing the coherence score to confirm quality of topics

```
from gensim.models import CoherenceModel
from gensim.corpora import Dictionary

texts = [text.split() for text in data_cleaned['cleaned_lyrics']]

dictionary = Dictionary(texts)
corpus = [dictionary.doc2bow(text) for text in texts]

from gensim.models import LdaModel
lda_gensim = LdaModel(corpus, num_topics=5, id2word=dictionary)

coherence_model_lda = CoherenceModel(model=lda_gensim, texts=texts, dictionary=dictionary, coherence=
coherence_score = coherence_model_lda.get_coherence()
print(f"Coherence Score: {coherence_score}")

```

```
WARNING:gensim.models.ldamodel:too few updates, training might not converge; consider increasing the
Coherence Score: 0.5125489353605521
```

0.51 coherence score represents moderate coherence

Comparing ML models for classifying the dominant topic of song lyrics

```
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import SVC
from sklearn.metrics import classification_report, accuracy_score
from sklearn.feature_extraction.text import CountVectorizer

vectorizer = CountVectorizer(stop_words='english', max_features=5000)
X = vectorizer.fit_transform(data_cleaned['cleaned_lyrics'].dropna())
y = data_cleaned['dominant_topic']

#Split data 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)

# Logistic Regression
logreg = LogisticRegression(max_iter=1000)
logreg.fit(X_train, y_train)
logreg_predictions = logreg.predict(X_test)

# Random Forest Classifier
rf = RandomForestClassifier(random_state=42)
rf.fit(X_train, y_train)
rf_predictions = rf.predict(X_test)

# Support Vector Machine (SVM)
svm = SVC(kernel='linear', random_state=42)
svm.fit(X_train, y_train)
svm_predictions = svm.predict(X_test)

# Evaluation
print("Logistic Regression Performance:")
print(classification_report(y_test, logreg_predictions))
print("Accuracy:", accuracy_score(y_test, logreg_predictions))

print("\nRandom Forest Performance:")
print(classification_report(y_test, rf_predictions))
print("Accuracy:", accuracy_score(y_test, rf_predictions))

```

```
print("\nSVM Performance:")
print(classification_report(y_test, svm_predictions))
print("Accuracy:", accuracy_score(y_test, svm_predictions))
```

```
Logistic Regression Performance:
              precision    recall  f1-score   support

           0       0.68      0.41      0.51        37
           1       0.45      0.26      0.33        19
           2       0.83      0.89      0.86       460
           3       0.90      0.70      0.79       125
           4       0.89      0.91      0.90       636

    accuracy                           0.86      1277
   macro avg       0.75      0.64      0.68      1277
weighted avg       0.86      0.86      0.86      1277

Accuracy: 0.860610806577917

Random Forest Performance:
              precision    recall  f1-score   support

           0       0.46      0.16      0.24        37
           1       0.67      0.11      0.18        19
           2       0.80      0.71      0.75       460
           3       0.94      0.36      0.52       125
           4       0.74      0.94      0.83       636

    accuracy                           0.76      1277
   macro avg       0.72      0.45      0.50      1277
weighted avg       0.77      0.76      0.74      1277

Accuracy: 0.7635082223962412

SVM Performance:
              precision    recall  f1-score   support

           0       0.31      0.38      0.34        37
           1       0.26      0.26      0.26        19
           2       0.81      0.84      0.82       460
           3       0.83      0.70      0.76       125
           4       0.89      0.88      0.89       636

    accuracy                           0.82      1277
   macro avg       0.62      0.61      0.61      1277
weighted avg       0.83      0.82      0.82      1277

Accuracy: 0.8238057948316366
```

```
#I have selected Logistic Regression to continue topic predictions in my analysis
```

```
vectorizer = CountVectorizer(stop_words='english', max_features=5000)
X = vectorizer.fit_transform(data_cleaned['cleaned_lyrics'].dropna())
y = data_cleaned['dominant_topic']

# Retraining Logistic Regression model
logreg = LogisticRegression(max_iter=1000)
logreg.fit(X, y)

# Get predictions
data_cleaned['predicted_topic'] = logreg.predict(X)

# Map the predicted topic to a label
topic_labels = {
    0: "Reflections and Life Experiences",
```

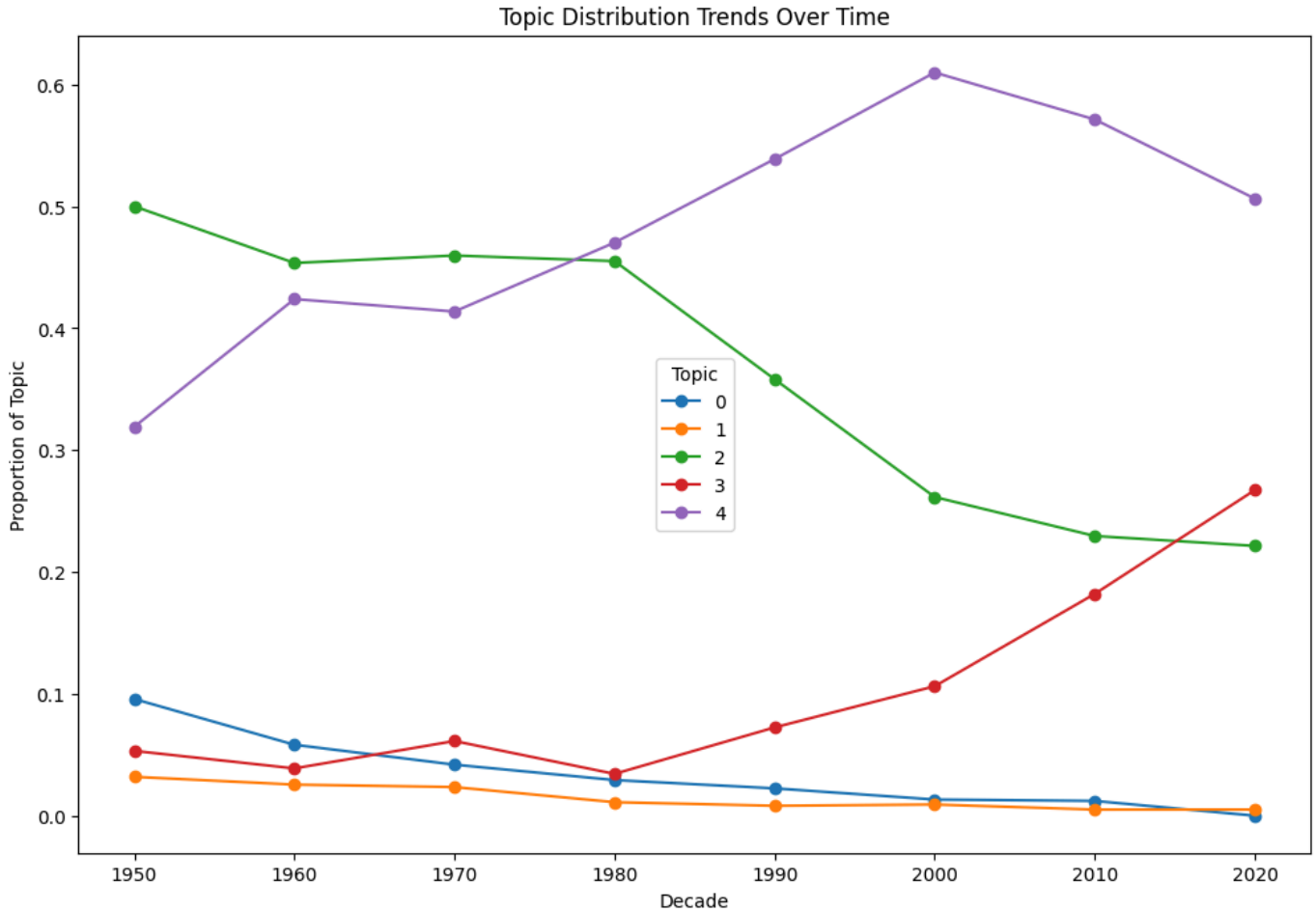
```
    1: "Communication and Family Dynamics",
    2: "Love and Emotional Longing",
    3: "Street Culture and Raw Emotions",
    4: "Romantic Desire and Affection"
}
data_cleaned['predicted_topic_label'] = data_cleaned['predicted_topic'].map(topic_labels)

```

Using the logistic regression model, continue visualizations

```
#grouping by decade
data_cleaned['Decade'] = (data_cleaned['Year'] // 10) * 10
decade_topic_distribution = data_cleaned.groupby(['Decade', 'predicted_topic']).size().unstack(fill_va
decade_topic_distribution_normalized = decade_topic_distribution.div(decade_topic_distribution.sum(ax
```

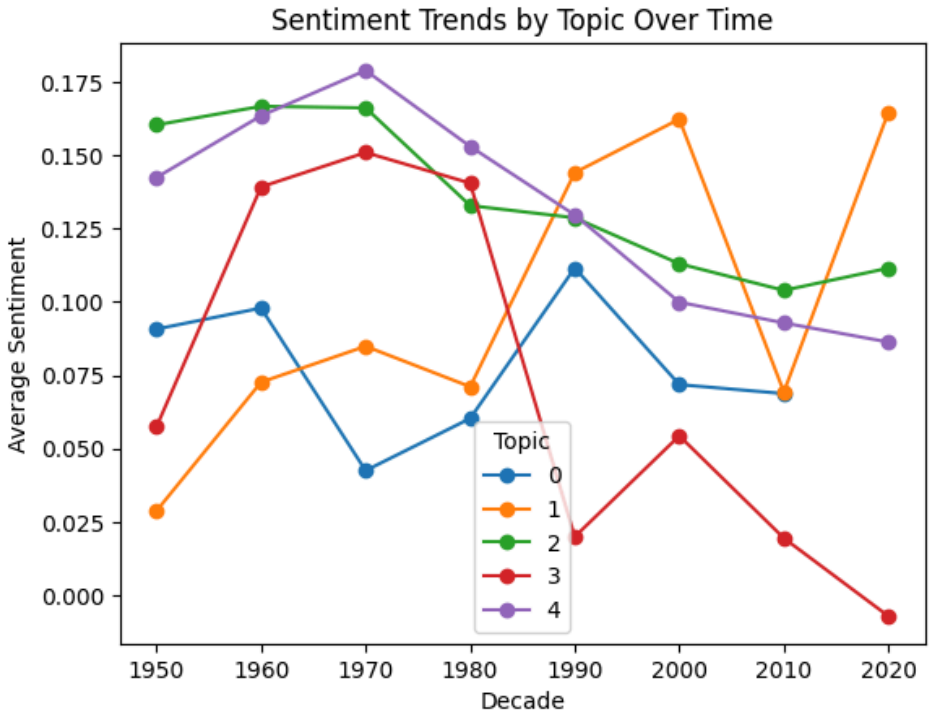
```
# Ploting topic distribution trends over time
plt.figure(figsize=(12, 8))
decade_topic_distribution_normalized.plot(kind='line', marker='o', figsize=(12, 8))
plt.title('Topic Distribution Trends Over Time')
plt.xlabel('Decade')
plt.ylabel('Proportion of Topic')
plt.legend(title='Topic')
plt.show()
```

```
<Figure size 1200x800 with 0 Axes>
```



```
from textblob import TextBlob

#sentiment polarity
def calculate_sentiment(text):
    return TextBlob(text).sentiment.polarity

data_cleaned['sentiment'] = data_cleaned['cleaned_lyrics'].apply(calculate_sentiment)

topic_sentiment_by_decade = data_cleaned.groupby(['Decade', 'dominant_topic'])['sentiment'].mean().uns

# Visualizing sentiment trends by decade
plt.figure(figsize=(12, 8))
topic_sentiment_by_decade.plot(kind='line', marker='o')
plt.title('Sentiment Trends by Topic Over Time')
plt.xlabel('Decade')
plt.ylabel('Average Sentiment')
plt.legend(title='Topic')
plt.show()

```

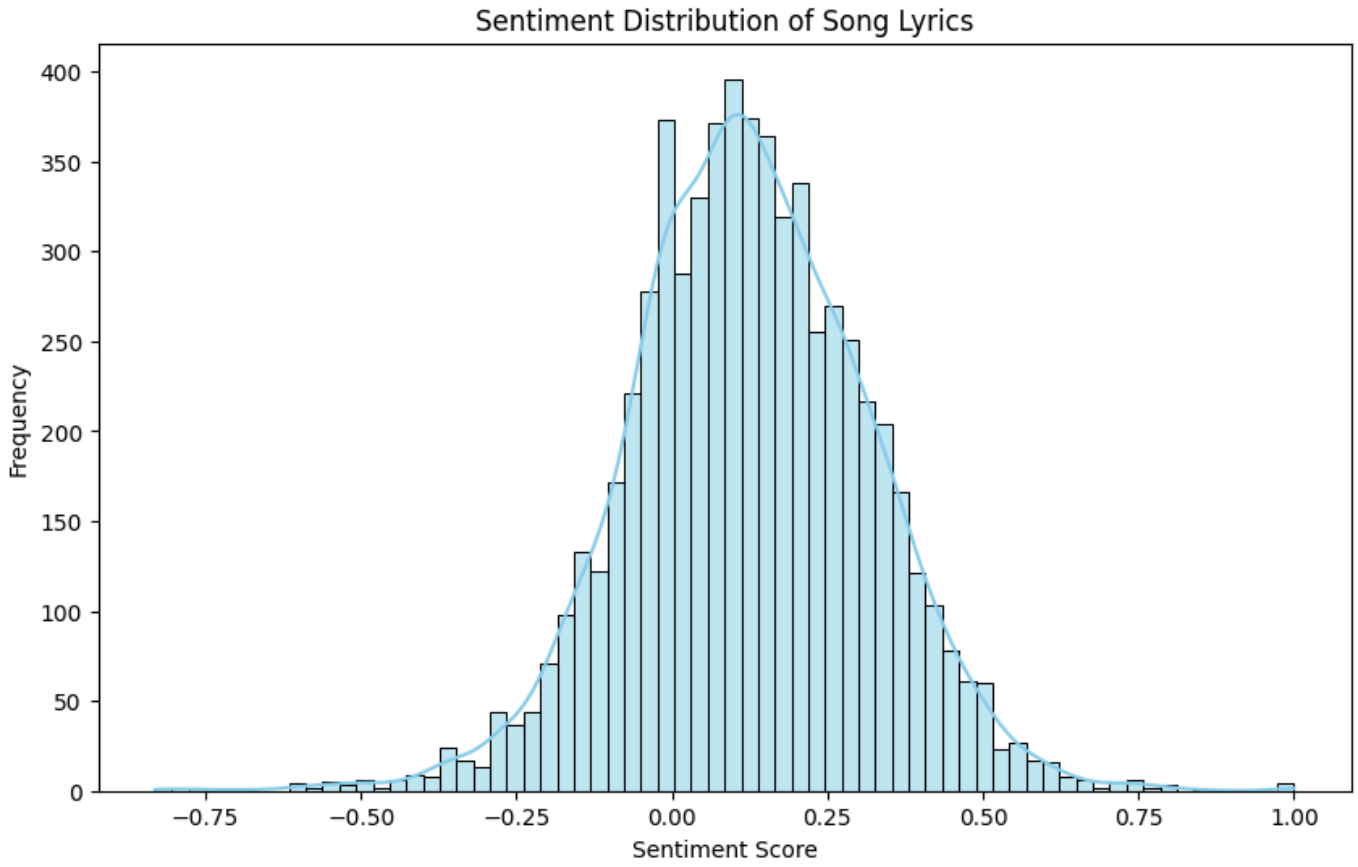
```
<Figure size 1200x800 with 0 Axes>
```




```
# Sentitment summary stats
sentiment_stats = data_cleaned['sentiment'].describe()
print("Sentiment Summary Statistics:")
print(sentiment_stats)

```

```
Sentiment Summary Statistics:
count    6384.000000
mean        0.123441
std         0.192460
min        -0.831108
25%         0.000000
50%         0.119649
75%         0.250969
max         1.000000
Name: sentiment, dtype: float64
```

```
import matplotlib.pyplot as plt
import seaborn as sns

# Plot the distribution of sentiment
plt.figure(figsize=(10, 6))
sns.histplot(data_cleaned['sentiment'], kde=True, color='skyblue')
plt.title('Sentiment Distribution of Song Lyrics')
plt.xlabel('Sentiment Score')
plt.ylabel('Frequency')
plt.show()

```




```
decade_sentiment = data_cleaned.groupby('Decade')['sentiment'].mean()

# Plot sentiment over decades
plt.figure(figsize=(12, 6))
decade_sentiment.plot(kind='line', marker='o', color='green')
plt.title('Average Sentiment of Song Lyrics by Decade')
plt.xlabel('Decade')
plt.ylabel('Average Sentiment')
plt.grid(True)
plt.show()

```