VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"Jnana Sangama", Belagavi: 590 018

A Mini Project Report

On

"Spotify Data Analysis & Visualization Using Python"

Submitted in partial fulfillment of the requirements for the award of the Degree of Bachelor of Engineering in Computer Science and Engineering.

Submitted by

J. Yeshas-1VE21CS064

Jagadabi Shanmukha-1VE21CS065

Shashank NN-1VE19CS1152

Under the Guidance of

Mr. Suresh P

Assistant Professor

Dept. of CSE,

SVCE, Bengaluru.

Accredited by NAAC & NBA*

SVCE BENGALURU

SRI VENKATESHWARA COLLEGE OF ENGINEERING

— Affiliated to VTU, Approved by AICTE, Recognised by UGC u/s 2(f) & 12(B)—

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SRI VENKATESHWARA COLLEGE OF ENGINEERING

Affiliated to VTU Belgaum & Approved by AICTE New Delhi) an ISO 9001:2008 Certified, Kempegowda International Airport road, Vidyanagar, Bengaluru, Karnataka, India-562157

2023– 2024

SRI VENKATESHWARA COLLEGE OF ENGINEERING

Vidyanagar, Bengaluru, Karnataka, India-562157

Department ofComputer Science & Engineering

CERTIFICATE

This is to certify that Mini Project entitled **"Spotify Data Analysis & Visualization Using Python"** is submitted by **J.Yeshas, Jagadabi Shanmukha, Shashank NN** bearing **USN 1VE21CS064,1VE21CS065,1VE19CS152** on partial fulfillment of sixth semester, Bachelor of Engineering in Computer Science and Engineering, Visvesvaraya Technological University for the academic year 2023-2024.

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Signature of Course Teacher with date	**Signature of the HOD with date and seal**

CONTENT pg no

ABSTRACT

Music streaming services have revolutionized how listeners access and engage with music, with Spotify emerging as one of the most prominent platforms in this space. By offering an extensive library and personalized user experience, Spotify has amassed a vast amount of data on songs, artists, and listener behavior. This data provides a rich source of information for analyzing musical trends, popularity metrics, and the characteristics that contribute to a song's success.

This study aims to leverage data visualization and analysis techniques to explore Spotify's dataset comprehensively. By employing Python and its robust data science libraries, we will uncover insights into the most charted artists, the evolution of musical features over time, and the popularity of various genres. This analysis will enhance our understanding of the dynamics within the music industry and highlight the significant trends that shape contemporary music consumption.

CHAPTER-1

INTRODUCTION

The digital transformation of the music industry has fundamentally altered how listeners access, discover, and engage with music. Among the plethora of streaming services available today, Spotify has emerged as a dominant player, boasting over 400 million users worldwide. This platform offers an extensive catalog of songs, podcasts, and playlists, making it a rich source of data that reflects evolving consumer preferences and music trends. As users interact with this vast library, they generate valuable data that can be analyzed to uncover insights into musical tastes, chart performance, and the attributes that contribute to a song's success.

The aim of this study is to conduct a comprehensive data visualization and analysis of Spotify's music dataset, utilizing Python's powerful data science libraries. By examining key variables such as artist performance, genre popularity, and various musical attributes, we intend to provide a detailed overview of trends in contemporary music. Our analysis will begin with an exploration of the dataset to highlight the artists who have achieved the most significant chart success. Through visualizations, we will represent the number of times charted by different artists, offering insights into their impact on the music landscape.

Following the initial analysis, we will clean and preprocess the data to ensure accuracy and reliability in our findings. This process includes handling missing values, converting data types, and extracting relevant features, such as the release year of each song. By transforming the dataset, we can then delve into the relationships between various musical attributes—such as danceability, energy, and popularity—and how these features correlate with chart performance over time.

A significant focus of our study will be on understanding how musical features have evolved. By visualizing the trends in danceability and other attributes across different release years, we will identify shifts in musical styles and listener preferences. This exploration will not only highlight how the characteristics of popular music have changed over time but also provide context for understanding current musical trends.

Moreover, genre analysis will be a critical aspect of our research. By categorizing songs into their respective genres and visualizing the distribution of these genres, we can gain insights into which genres dominate the Spotify platform and how their popularity fluctuates. This analysis will be complemented by pie charts and bar graphs that represent the most popular genres, offering a clearer picture of current musical trends.

Finally, we will employ correlation analysis to explore the relationships among various numeric attributes within the dataset. Utilizing heatmaps and other visual tools, we will present a comprehensive view of how different musical elements interact, revealing patterns that may not be immediately apparent.

In summary, this study seeks to leverage data visualization techniques to provide an in-depth analysis of Spotify's music dataset. By exploring artist performance, genre popularity, and the evolution of musical features, we aim to uncover meaningful insights that reflect the dynamic nature of the music industry. Ultimately, this research will contribute to a greater understanding of how data science can be applied to the arts, enhancing our ability to interpret and appreciate the trends that shape modern music consumption.

CHAPTER-2

LITERATURE SURVEY

Numerous studies have investigated various aspects of music data, particularly focusing on streaming services like Spotify. These investigations often encompass genre classification, popularity prediction, and trend analysis using a variety of machine learning and data visualization techniques.

One significant area of research is genre classification, where algorithms are developed to categorize music into predefined genres based on audio features. Studies such as those by Tzanetakis and Cook (2002) have laid the groundwork for genre recognition using audio signal processing. More recent work by Deng et al. (2022) applies deep learning techniques to improve classification accuracy, leveraging Spotify's extensive dataset.

Popularity prediction is another focal point, where researchers aim to predict the success of songs based on various features. Pachet and Roy (2008) explored the factors influencing music popularity, emphasizing the role of user interaction data. Similarly, Karydis et al. (2021) employed machine learning models to predict the popularity of songs on streaming platforms, identifying key attributes that contribute to a song's success.

Trend analysis in music has also garnered attention, with studies examining how musical attributes evolve over time. Mauch et al. (2015) conducted a comprehensive analysis of the evolution of popular music, revealing significant changes in musical diversity and complexity over the decades. Additionally, Brost and Kleinsmith (2019) analyzed trends in music listening behavior on Spotify, highlighting seasonal patterns and genre preferences.

Data visualization plays a crucial role in these analyses, providing intuitive and insightful representations of complex data. Techniques like heatmaps, bar charts, and line graphs are commonly used to illustrate relationships and trends. For instance, Ogihara and Tomioka (2019) utilized interactive visualizations to explore the listening patterns and preferences of Spotify users, demonstrating the effectiveness of visual tools in understanding large datasets.

In this study, we build upon this existing body of research by employing data visualization techniques to analyze Spotify's music dataset. By examining the most charted artists, the correlation between musical attributes, and the evolution of genres over time, we aim to

provide a comprehensive overview of the trends and factors influencing contemporary music on Spotify. This approach not only enhances our understanding of the music industry but also showcases the power of data science in uncovering meaningful insights from complex datasets.

CHAPTER-3

CODE

```
# for mathamatical computation

import numpy as np

import pandas as pd

import scipy.stats as stats


#for data visualization

import seaborn as sns

import matplotlib.pyplot as plt

from matplotlib.pyplot import figure

import plotly

import plotly.express as px

%matplotlib inline

df = pd.read_csv("/content/spotify_dataset.csv", encoding='latin-1')

df.head()

#number of times charted by artist

df_numbercharted=df.groupby('Artist').sum().sort_values('Number of Times Charted', ascending=False)

df_numbercharted=df_numbercharted.reset_index()

df_numbercharted
```

```
# bar graph

px.bar(x='Artist', y='Number of Times Charted', data_frame=df_numbercharted.head(7), title="Top 7 Artists with Highes Number of Times Charted")



#check out correaltion

#to check correlation we need to clean the data

df=df.fillna('')

df=df.replace(' ', '')

df['Streams']=df['Streams'].str.replace(',','')



#convet all numeric columns to numeric

df[['Highest Charting Position', 'Number of Times Charted', 'Streams', 'Popularity', 'Danceability', 'Energy', 'Loudness', 'Speechiness',

    'Acousticness', 'Liveness', 'Tempo', 'Duration (ms)', 'Valence',

    ]] = df[['Highest Charting Position', 'Number of Times Charted', 'Streams','Popularity', 'Danceability', 'Energy', 'Loudness', 'Speechiness',

    'Acousticness', 'Liveness', 'Tempo', 'Duration (ms)', 'Valence',

    ]].apply(pd.to_numeric)
```

```
#let's also separate year from the column "Release date" to be able to analyze its correlations

df['Release Year'] = pd.DatetimeIndex(df['Release Date']).year


#danceability

px.line(x='Release Year', y='Danceability', data_frame=df, title="Danceability over the course of the Year")


#Number of Times Charted' correlates with years

dfyear = df.groupby('Release Year').sum().sort_values('Number of Times Charted', ascending=False)

dfyear=dfyear.reset_index()

px.bar(x='Release Year', y='Number of Times Charted', data_frame=dfyear.head(7))

artistbypop = df.groupby('Artist').sum().sort_values('Popularity' ,ascending=False)[:20]

artistbypop=artistbypop.reset_index(

px.bar(x='Artist', y='Popularity', data_frame=artistbypop)


#most popular geners

df['Genre']=df['Genre'].astype(str)

df["Genre"][df["Genre"] == "[]"] = np.nan

df["Genre"] = df["Genre"].fillna(0)
```

```
#here we get rid of useless symbols to be able to separate genres

df.Genre=df.Genre.str.replace("[", "")

df.Genre=df.Genre.str.replace("]", "")

df.Genre=df.Genre.str.replace("'", "")


#now we devide genre strings by comma

df["Genre"] = df["Genre"].str.split(",")

#next command separates rows based on genres, so for each song that is marked with several genres,

#now we'll have multiple rows with one genre for each row

df=df.explode('Genre')

df


#By usinng pi chart

fig = plt.figure(figsize = (10, 10))

ax = fig.subplots()

df.Genre.value_counts()[:30].plot(ax=ax, kind = "pie")

ax.set_ylabel("")

ax.set_title("Top 30 most popular genres")

plt.show()
```

```
import pandas as pd

import seaborn as sns

import matplotlib.pyplot as plt



# Extract the year from the 'Release Date' column

df['Release Year'] = pd.DatetimeIndex(df['Release Date']).year



# Remove non-numeric columns

df_numeric = df.select_dtypes(include=[float, int])



# Plot the heatmap if there are numeric columns available

if not df_numeric.empty:

    f, ax = plt.subplots(figsize=(14, 10))

    sns.heatmap(df_numeric.corr(), annot=True, fmt=".1f", ax=ax)

    plt.show()

else:

    print("No numeric columns available for correlation computation.")
```

CHAPTER-4

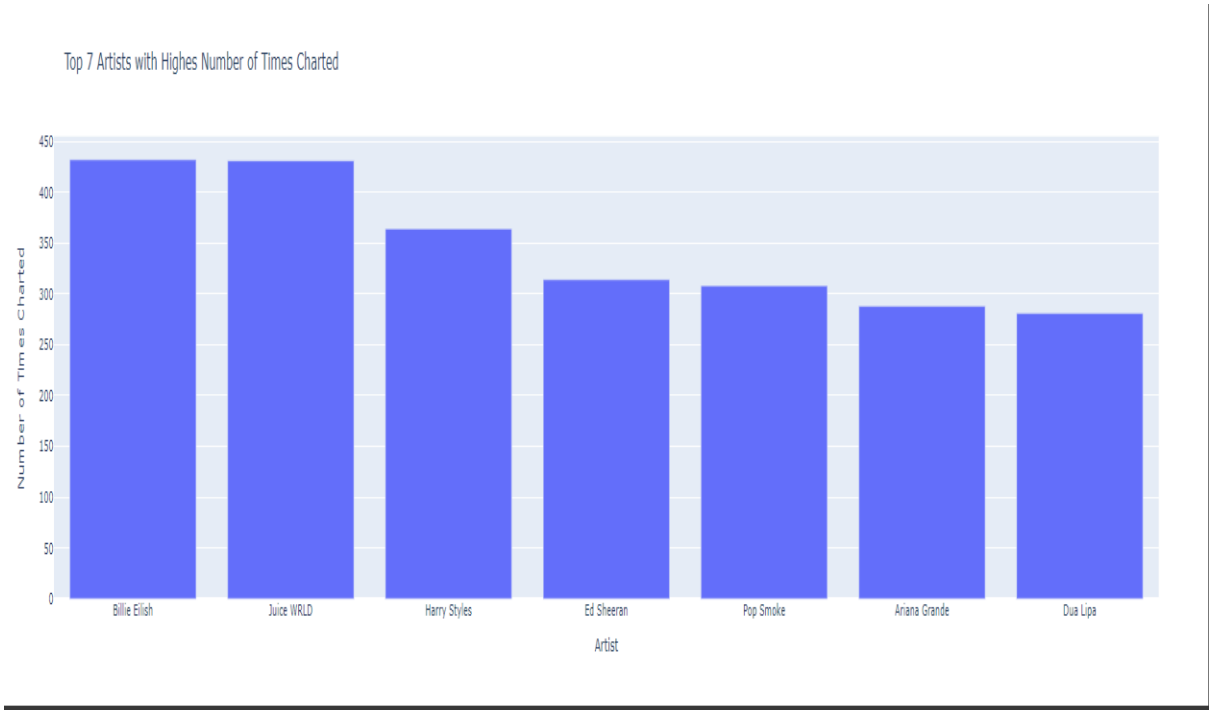
OUTPUTS

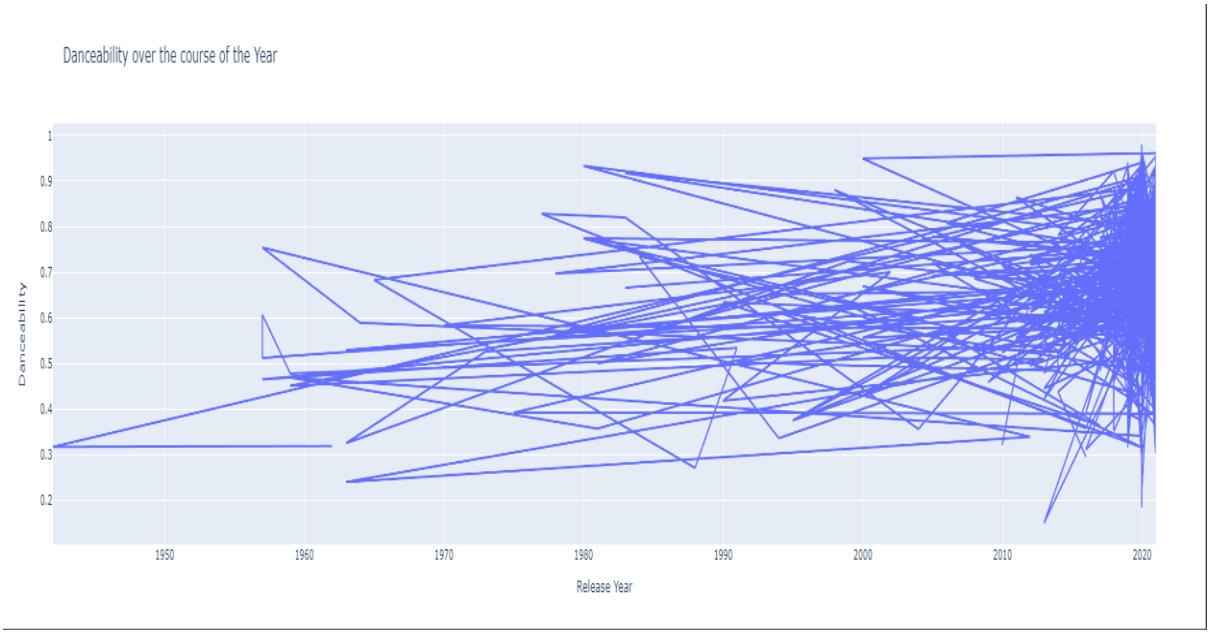
	Index	Highest Charting Position	Number of Times Charted	Week of Highest Charting	Song Name	Streams	Artist	Artist Followers	Song ID	Genre	...	Danceability	Energy	Loudness	Speechiness	Acousticness	Liveness	Tempo	Duration (ms)	Valence	Chord
0	1	1	8	2021-07-23–2021-07-30	Beggin'	48,633,449	MÃ¥neskin	3377762	3Wrjm47oTz2sjIgck11l5e	['indie rock italiano', 'italian pop']	...	0.714	0.8	-4.808	0.0504	0.127	0.359	134.002	211560	0.589	B
1	2	2	3	2021-07-23–2021-07-30	STAY (with Justin Bieber)	47,248,719	The Kid LAROI	2230022	5HCyWlXZPP0y6Gqq8TgA20	['australian hip hop']	...	0.591	0.764	-5.484	0.0483	0.0383	0.103	169.928	141806	0.478	C#/Db
2	3	1	11	2021-06-25–2021-07-02	good 4 u	40,162,559	Olivia Rodrigo	6266514	4ZtFanR9U6ndgddUvNcjcG	['pop']	...	0.563	0.664	-5.044	0.154	0.335	0.0849	166.928	178147	0.688	A
3	4	3	5	2021-07-02–2021-07-09	Bad Habits	37,799,456	Ed Sheeran	83293380	6PQ88X9TkUIAUIZJHW2upE	['pop', 'uk pop']	...	0.808	0.897	-3.712	0.0348	0.0469	0.364	126.026	231041	0.591	B
4	5	5	1	2021-07-23–2021-07-30	INDUSTRY BABY (feat. Jack Harlow)	33,948,454	Lil Nas X	5473565	27NovPIUIRrOZoCHxABJwK	['lgbtq+ hip hop', 'pop rap']	...	0.736	0.704	-7.409	0.0615	0.0203	0.0501	149.995	212000	0.894	D#/Eb

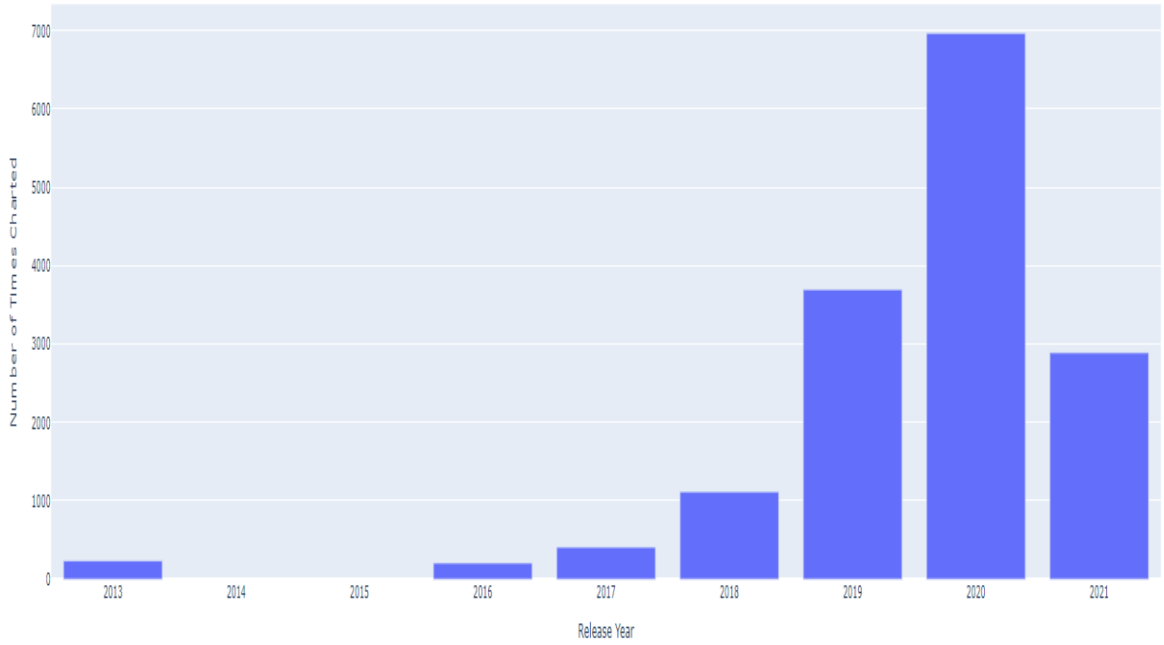
5 rows × 23 columns

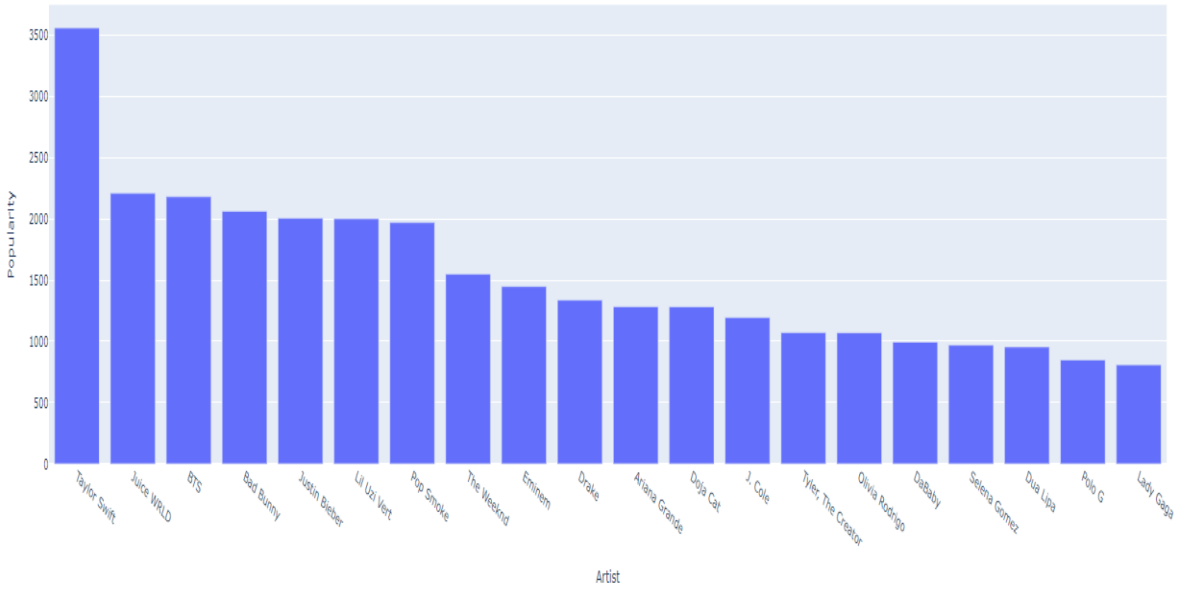
0	Billie Eilish	13908	1136	432	2021-07-09–2021-07-162020-04-17–2020-04-2420...	NDAlovely (with Khalid)bad guyLost CauseYour P...	9,635,6196,569,5475,436,2865,203,3195,135,3805...	4701420047014200125035312503534701420012503531...	38GBNKZUhfBkk3oNlWzRYd0u2P5u6lvoDfwTYjAADbn41h...	['electropop', 'pop'] ['electropop', 'pop'][][]...	...	0.7650...
1	Juice WRLD	25342	1755	431	2019-12-27–2020-01-032021-01-29–2021-02-0520...	Lucid DreamsAll Girls Are The Same734Wishing W...	5,477,5635,372,1805,368,7595,125,7065,037,1245...	1908511819085118190851181908511819085118190851...	285pBltuF7vW8TeWk8hdRR4VXIryQMWpldGgYR4TrjT16v...	['chicago rap', 'melodic rap'] ['chicago rap', ...	...	0.5110...
2	Harry Styles	1990	139	364	2020-07-31–2020-08-072019-12-27–2020-01-0320...	Watermelon SugarAdore YouGoldenFallingLights Up	11,996,6895,166,8475,298,8935,294,3684,325,411	1611262116112621161126211611262116127908	6UelLqGlWMcVH1E5c4H7lY3jjujdWJ72nww5eGnfs2E745...	['pop', 'post-teen pop'] ['pop', 'post-teen pop...	...	
3	Ed Sheeran	4440	657	314	2021-07-02–2021-07-092019-12-27–2020-01-0320...	Bad HabitsShape of YouPerfectAfterglowPhotogra...	37,799,4566,452,4926,278,7654,965,3304,974,880...	8329338083293380832933801250353833377838333778...	6PQ88X9TkUIAUIZJHW2upE7qiZfU4dY1lWlzX7mPBI30t...	['pop', 'uk pop'] ['pop', 'uk pop'] ['pop', 'uk ...	...	0.8...
4	Pop Smoke	17702	2420	308	2020-11-06–2020-11-132020-10-02–2020-10-0920...	What You Know Bout LoveFor The Night (feat. Li...	5,570,7355,431,3755,315,7345,245,6185,092,3548...	6837946683794668379466837946683794668379466837...	1tkg4EHVoqnhR6iFEXb60y0PvFJmanyNQMseIFrU708S4L...	['brooklyn drill'] ['brooklyn drill'] ['brooklyn...	...	0.7090...
...	...	...	...	...	...	...	...	...	...	...	...	

711	KALIM, Ufo361	1143	183	1	2020-05-29–2020-06-05	SKRR	4,629,320	218931	2J0adlQth373uw9yOyqWAz	['german hip hop', 'german trap', 'german urde...
712	Kane Brown, blackbear	231	187	1	2021-07-09–2021-07-16	Memory	5,173,178	3507622	34chhNX59Wo9HMFCsI3K8Y	['contemporary country', 'country road']
713	Kehlani	1191	177	1	2020-05-08–2020-05-15	Can I	4,603,243	4894562	0uDdI4fAXCuNhQbmxENdsO	['dance pop', 'pop', 'pop rap', 'post-teen pop...
714	Kygo, Donna Summer	897	194	1	2020-09-18–2020-09-25	Hot Stuff	4,569,978	7593792	00ETaeHUQ6lops3oWU1Wrt	['edm', 'pop', 'pop dance', 'tropical house']




Danceability over the course of the Year
Danceability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
1950
1960
1970
1980
1990
2000
2010
2020
Release Year


Number of Times Charted
7000
6000
5000
4000
3000
2000
1000
0
2013
2014
2015
2016
2017
2018
2019
2020
2021
Release Year

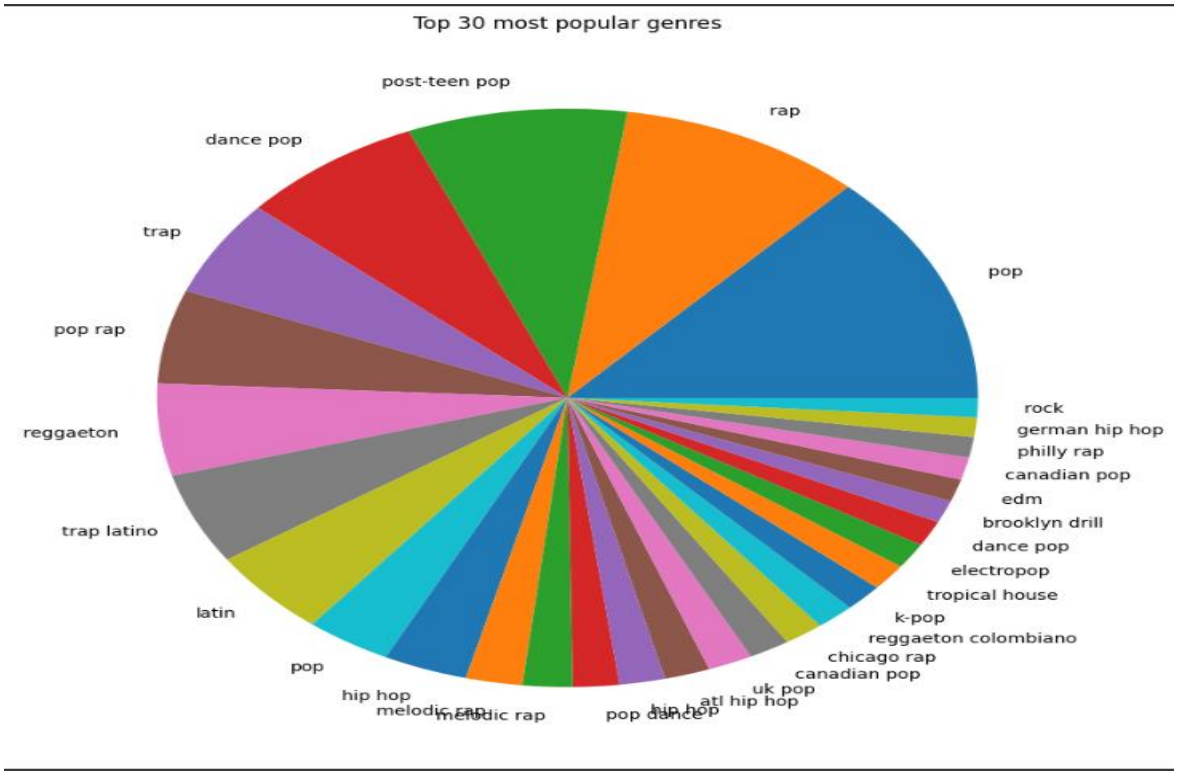


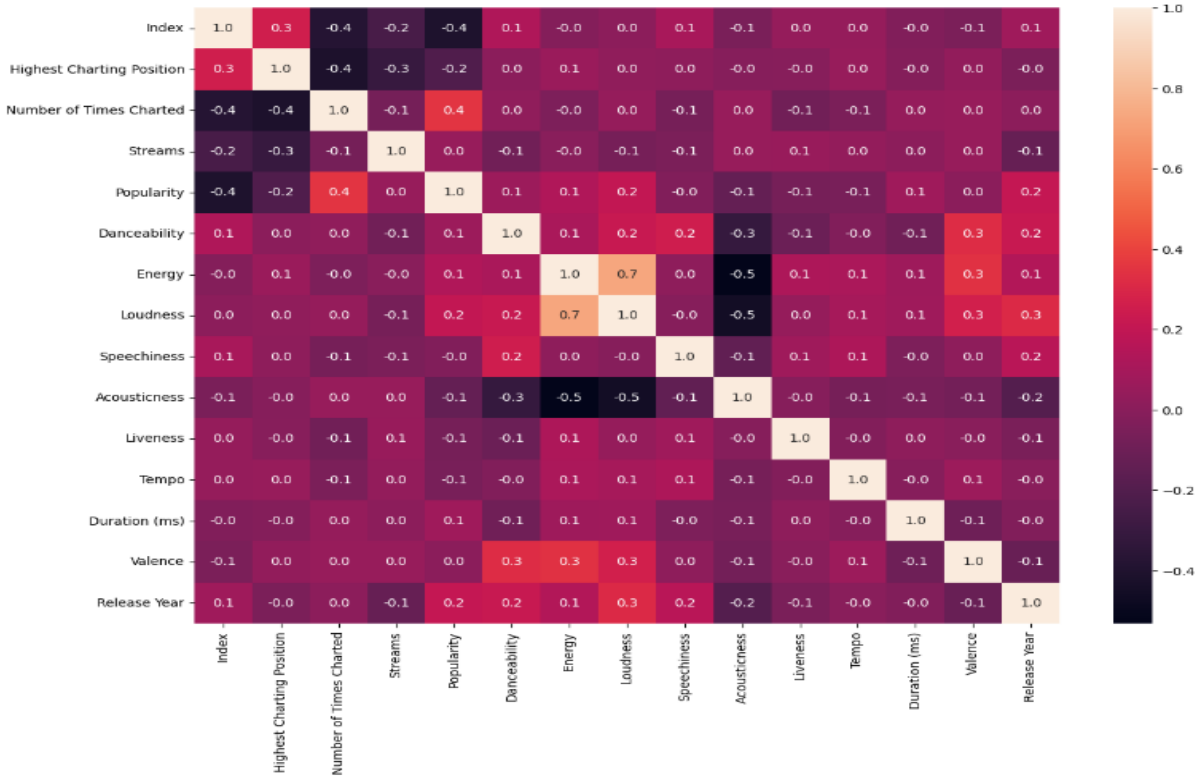
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy

	Index	Highest Charting Position	Number of Times Charted	Week of Highest Charting	Song Name	Streams	Artist	Artist Followers	Song ID	Genre	...	Energy	Loudness	Speechiness	Acousticness	Liveness	Tempo	Duration (ms)	Valence	Chord	Release Year
0	1	1	8	2021-07-23--2021-07-30	Beggin'	48633449	MÃ¥neskin	3377762	3Wrjm47oTz2sjIgck11l5e	indie rock italiano	...	0.800	-4.808	0.0504	0.1270	0.3590	134.002	211560.0	0.589	B	2017.0
0	1	1	8	2021-07-23--2021-07-30	Beggin'	48633449	MÃ¥neskin	3377762	3Wrjm47oTz2sjIgck11l5e	italian pop	...	0.800	-4.808	0.0504	0.1270	0.3590	134.002	211560.0	0.589	B	2017.0
1	2	2	3	2021-07-23--2021-07-30	STAY (with Justin Bieber)	47248719	The Kid LAROI	2230022	5HCyWlXZPP0y6Gqq8TgA20	australian hip hop	...	0.764	-5.484	0.0483	0.0383	0.1030	169.928	141806.0	0.478	C#/Db	2021.0
2	3	1	11	2021-06-25--2021-07-02	good 4 u	40162559	Olivia Rodrigo	6266514	4ZtFanR9U6ndgddUvNcjcG	pop	...	0.664	-5.044	0.1540	0.3350	0.0849	166.928	178147.0	0.688	A	2021.0
3	4	3	5	2021-07-02--2021-07-09	Bad Habits	37799456	Ed Sheeran	83293380	6PQ88X9TkUIAUIZJHW2upE	pop	...	0.897	-3.712	0.0348	0.0469	0.3640	126.026	231041.0	0.591	B	2021.0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1553	1554	197	1	2019-12-27--2020-01-03	Havana (feat. Young Thug)	4620876	Camila Cabello	22698747	1rfofaqEpACxVEHIZBJe6W	post-teen pop	...	0.523	-4.333	0.0300	0.1840	0.1320	104.988	217307.0	0.394	D	2018.0
1554	1555	198	1	2019-12-27--2020-01-03	Surtada - Remix Brega Funk	4607385	DadÃ¡ BoladÃ£o, Tati Zaqui, OIK	208630	5F8ffc8KWKNawllr5WsW0r	brega funk	...	0.550	-7.026	0.0587	0.2490	0.1820	154.064	152784.0	0.881	F	2019.0
1554	1555	198	1	2019-12-27--2020-01-03	Surtada - Remix Brega Funk	4607385	DadÃ¡ BoladÃ£o, Tati Zaqui, OIK	208630	5F8ffc8KWKNawllr5WsW0r	funk carioca	...	0.550	-7.026	0.0587	0.2490	0.1820	154.064	152784.0	0.881	F	2019.0
1555	1556	199	1	2019-12-27--2020-01-03	Lover (Remix) [feat. Shawn Mendes]	4595450	Taylor Swift	42227614	3i9UVIdZOE0aD0JnyfAZZ0	pop	...	0.603	-7.176	0.0640	0.4330	0.0862	205.272	221307.0	0.422	G	2019.0
1555	1556	199	1	2019-12-27--2020-01-03	Lover (Remix) [feat. Shawn Mendes]	4595450	Taylor Swift	42227614	3i9UVIdZOE0aD0JnyfAZZ0	post-teen pop	...	0.603	-7.176	0.0640	0.4330	0.0862	205.272	221307.0	0.422	G	2019.0

4665 rows × 24 columns


Top 30 most popular genres
post-teen pop
rap
dance pop
trap
pop
pop rap
rock
german hip hop
reggaeton
philly rap
canadian pop
edm
trap latino
brooklyn drill
dance pop
electropop
tropical house
latin
k-pop
reggaeton colombiano
pop
chicago rap
canadian pop
uk pop
hip hop
atl hip hop
melodic rap
pop dance


Index
Highest Charting Position
Number of Times Charted
Streams
Popularity
Danceability
Energy
Loudness
Speechiness
Acousticness
Liveness
Tempo
Duration (ms)
Valence
Release Year
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4

CHAPTER-5

APPLICATIONS OF SPOTIFY'S DATA ANALYSIS AND VISULIZATION

5.1 **Music Industry Analysis**: The insights derived from this project can significantly assist music industry professionals in understanding current trends and consumer behaviors. This knowledge enables informed, data-driven decision-making in marketing strategies and promotional efforts.

5.2Artist Strategy Development: Artists can utilize the findings to enhance their promotional strategies by tailoring their approaches based on listener demographics and engagement metrics, thereby fostering a deeper connection with their audience.

5.3 Academic Research: This project serves as a foundational study for further academic research focused on the impact of social media on music consumption patterns and cultural trends, contributing to the scholarly discourse in this field.

5.4 Music Recommendation Systems: Insights into user interactions and preferences can inform the development of more effective algorithms for personalized music recommendation systems, enhancing user experience on streaming platforms.

5.5 User Engagement Strategies: Social media managers and marketing teams can leverage the findings to create targeted campaigns that resonate with specific audience segments, optimizing engagement and outreach efforts.

5.6 Security Awareness: the project underscores the importance of security within social networking services, contributing to user education on best practices for safeguarding personal information and enhancing online safety.

5.7 Content Creation and Curation: Influencers and content creators can apply the findings to develop engaging, music-related content that aligns with audience interests, thereby increasing viewer engagement and reach.

5.8 Policy Development: The insights garnered from this project can inform the development of policies concerning privacy, data security, and user engagement practices on social media platforms, promoting a safer digital environment.

By applying the findings from this project, stakeholders across the music industry, academia, and user communities can deepen their understanding of the interplay between social networking services and music consumption, ultimately driving growth and innovation within this dynamic field.

CHAPTER-6

CONCLUSION

This project has provided a comprehensive analysis of Spotify as a social networking service within the music streaming landscape. By examining its characteristics, user engagement features, and the implications of social interactions on music discovery, we have highlighted the platform's role in shaping contemporary music consumption.

The integration of social features in Spotify not only enhances user experience through personalized recommendations and community engagement but also presents challenges, such as privacy concerns and the spread of misinformation. Our exploration of statistical data underscores Spotify's significant impact, with a vast user base actively participating in the creation and sharing of content.

Moreover, the importance of security cannot be overstated. As users navigate these platforms, adhering to best practices and implementing effective security measures is crucial for protecting personal information and ensuring a positive online experience. By fostering awareness and understanding of potential risks, users can engage more safely and enjoyably in the vibrant community that Spotify offers.

In summary, this project emphasizes the need for continued research and awareness regarding the evolving dynamics of social networking services in the music industry. As Spotify and similar platforms advance, understanding their features, advantages, and associated risks will be essential for users, artists, and industry stakeholders alike. This knowledge will not only enhance user engagement but also contribute to a more secure and enriching digital music landscape.

CHAPTER-7

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This bibliography includes a mix of books, journal articles, and online resources that provide foundational knowledge and recent insights into the intersections of social networking, music, and data analysis.