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Research Paper

Analysis of Spotify Top Songs During Covid-19 Pandemic

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Abstract

During the COVID-19 pandemic, many behaviors or habits have changed, especially in the industrial music field which has increased significantly, one example is Spotify as a music service provider. Not all songs on Spotify are popular or in the Top Songs. This study aims to examine whether there were differences in popular songs during the pandemic and before the pandemic and to determine the relationship between factors of popular songs on Spotify during the COVID-19 pandemic. The method used is to fetch Spotify songs via the API (Application Programming Interface) with the Spotify Python library. The features obtained are compared with the boxplot. The correlation between the Danceability and Energy features is obtained which ranges from 0.5-0.7, while the other features require further preprocessing because the values are not the same and are empty. This shows that every song that is considered good Danceability and Energy ranges from 0.5 to 0.7, regardless of singer, genre, or other song features.

Keywords *Spotify, API, Spotify library, feature extraction, python*

INTRODUCTION

The corona virus pandemic in several countries has been considered over, with the peak of the pandemic in 2020-2021, at that time many were carrying out lockdowns as a form of implementing social distancing to reduce the spread of COVID-19. We may still be affected by the Corona pandemic, which has passed its critical period marked by the more people being healed, the fewer deaths, and the fewer the affected (Huang et al., 2012). Many methods are obtained by survivors who are expected to help others, including treatment procedures, death handling procedures to psychological procedures during the Corona pandemic, due to lockdown, disability, or death (Altieri et al., 2021). Even some procedures can change habits or daily life (Balanzá-Martínez et al., 2021), such as wearing masks, keeping a distance, washing hands, dealing with stress, social distancing, and rest periods. Changes in activities and social attitudes to rest periods are influenced by the surrounding conditions, due to the geographical environment, the scope of the area, and even the state of the body (Burton, A.L., 2021) (Haruvi et al., 2021).

Listening to music is an activity that is often done, especially in times when there is no time for socialization, such as during lockdown (Carlson et al., 2021). Music is a means of connecting or communicating emotionally (Martín et al., 2021) (Liu et al., 2018). In addition to spending time, people listen to music to avoid stress, calm, or even increase concentration (Adiasto et al., 2022) (Thoma et al., 2013). On the other hand, some people can survive without listening to music. This relates to the preferences of music in the life of each individual (Schäfer, T., 2016). Music preference is what influences the individual's mood (Hennessy et al., 2021). There is even the creation of the MediaEval Database for Emotional Analysis in Music (DEAM) which detects the emotions generated from the music you listen to (Aljanaki et al., 2017). The procedures or actions taken by survivors of COVID-19 are the basic questions for this research so that they can be used to

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get through other pandemic times. The research focus is on analyzing the impact of the COVID-19 pandemic on music preferences and music listening habits.

LITERATURE REVIEW

Song preferences are influenced by the features of the song. Spotify makes features for songs that are played in it, these features are divided into several sections as follows: Danceability, Valence, Energy, and Tempo for mood. Loudness, Speechiness, Instrumentalness for property. Liveness, Acoustics for context, and more features like Segments, Tatums, Bars, Beats, Pitches, and Timbre. This study only focuses on features for mood, namely Danceability, Valence, Energy, and Tempo. The definition of danceability describes how suitable a song is for a dance song based on the combination of each musical element including tempo, rhythm stability, beat strength, and overall regularity. Its numerical value ranges from 0.0 for the least danceable song and as high as 1.0 for the most danceable song. While the notion of energy is a measure ranging from 0.0 to the highest is 1.0. This feature represents a perceived measure of song intensity and activity. Typically, energetic tracks feel fast, loud, and noisy. For example, heavy metal is high energy, whereas Mozart's preludes score low on the scale. Perceptual features that contribute to this attribute include dynamic range, perceived loudness, timbre, onset rate, and general entropy(Huang et al., 2012). The energy value is in the form of numeric the same as danceability between 0.0 to 1.0. For the Tempo feature, this means an estimate of the overall track tempo in beats per minute (BPM). In musical terminology, tempo is the speed or pace of a particular piece and is derived directly from the average beat duration. The valence feature is a feature that describes the positive effects of music conveyed by a song. Songs with high valence sound more positive (e.g. upbeat, happy, upbeat, euphoric), while songs with low valence sound more negative (e.g. depressed, sad, angry). Some people even use music with danceability and high energy as a therapy or analgesic for pain relief (Howlin et al., 2021) (Hohmann et al., 2017).

In Spotify, there is already a special module to access these features, which is named Spotify. To retrieve using the API (Application Programming Interface). Spotify API is an API (Application Programming Interface) provided by the music streaming service Spotify. This API allows developers and programmers to access data and functionality from the Spotify service, such as artist, album, song, and playlist information, and play songs in the application or website they create. By using the Spotify API, developers can create applications or websites that are integrated with the Spotify service. Examples of uses for the Spotify API include creating music applications, such as music players or music search applications, as well as creating social applications that allow users to interact with their friends on Spotify, share music, or create shared playlists.

The Spotify API also has several SDKs (Software Development Kits) that can help you make it easier to use the API with certain programming languages, such as Python, JavaScript, and iOS. In this study using the Python Programming Language with existing libraries in Python. The Spotify API provides access to various information and features available on the Spotify streaming music service. Some of the results that can be obtained from the Spotify API are:

1. Information about artists, albums, songs, and playlists on Spotify.
2. The ability to search and find music content based on certain criteria such as genre, year of release, or popularity.
3. Ability to create, update, and delete playlists using the user's Spotify account.
4. The ability to control music playback on Spotify-integrated apps or websites, such as playing, pausing, or changing songs. Ability to access user profile information including playlists and saved songs.
5. Analytical information about user behavior, such as the number of plays, the number of unique users, and the popularity of an artist or song.

This information and functionality enables programmers and developers to create applications or websites that are integrated with the Spotify service, such as a music player, a music search application, or a social application that allows users to interact with their friends on Spotify. The research was conducted using the Spotify API to get song features that are played on Spotify. Playing a song is what determines whether the song is popular or not. The more popular values indicate the more popular the song. A popular song at one time may not be popular the next and popular songs are usually the top songs of their time.

METHODOLOGY

Research Method

The stages carried out in this study were collecting data from Spotify, setting the data obtained, and then displaying it in the form of a boxplot for analysis. To access certain Spotify Platform features and APIs, we need to create a Spotify developer account and register our application. The Spotify Developer Dashboard is on their website at https://developer.spotify.com/. After creating the application, we will be given a Client_ID and Client_Secret. This is a unique identifier for our application and is needed to authenticate our requests to the Spotify API. Then, retrieval of data using the API is the first step to take, by entering the client_ID and client_secret obtained from Spotify, as shown in Figure 1. This process uses the Python programming language. By using the Jupiter Notebook application, we can use Google Colab. Next, the Spotify module takes the features needed and enters the desired year.

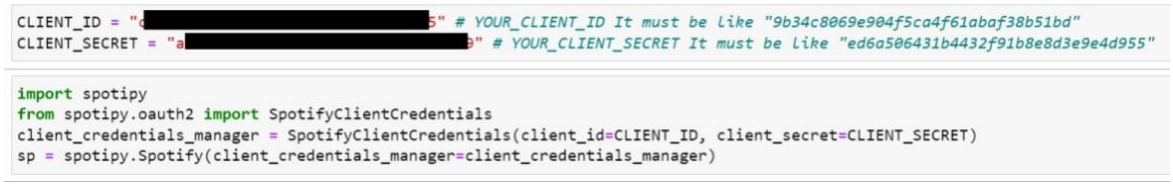

Figure 1. Spotify API

Popular song data from Spotify is governed by the popularity feature whose value is in the form of the number of plays for the song, ranging from 0 to 100, the closer to 100 the more popular it is because many Spotify users use it. The only drawback is that the value of this popular feature is real-time, so it depends on when the data is collected. It could be that songs from 2015 were still played frequently until 2018, even though in 2015 they didn't become top songs (Silver et al., 2016).

Song feature data is stored in text form. The saved file is in CSV format. For the next process pre- processing, the files obtained are checked for data, and the data type is made the same (numeric or text). Corrected data that is missing or not the same value. The data taken is data from 2015 to 2022, with data obtained around 994000000 (Table 1).

After going through pre-processing, it is followed by an analysis using the Python programming language. Can use Google Colab or Jupiter Notebook.

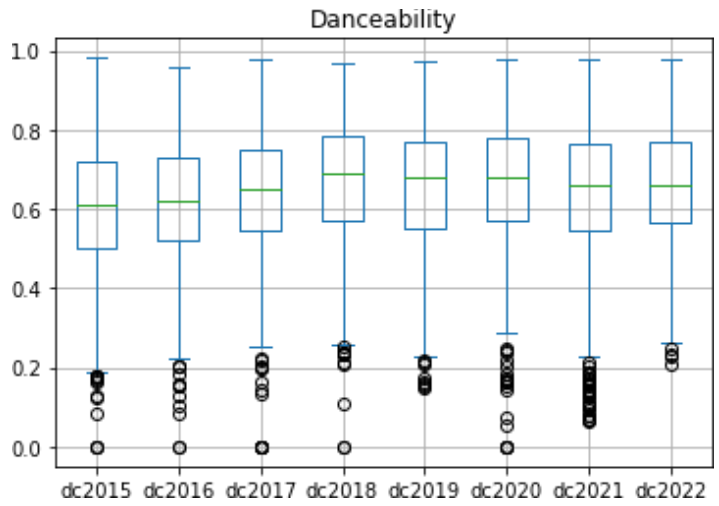

Figure 2. Danceability Boxplot

The depiction of Danceability using the boxplot is shown in Figure 2. In Figure 2 it can be seen that from 2015 to 2022 the danceability range of Spotify songs is in the range of 0.5 to 0.7. Existing data details can be seen in Table 1.

Table 1. Danceability Feature Description

	dc2015	dc2016	dc2017	dc2018	dc2019	dc2020	dc2021	dc2022
count	994.000.000	994.000.000	994.000.000	994.000.000	994.000.000	994.000.000	994.000.000	994.000.000
mean	0.602966	0.618510	0.636191	0.670621	0.660892	0.663350	0.640202	0.659364
std	0.160837	0.153623	0.158059	0.154096	0.153172	0.162071	0.171981	0.143580
min	0.000000	0.000000	0.000000	0.000000	0.149000	0.000000	0.065000	0.209000
25%	0.503500	0.519250	0.545000	0.572000	0.552000	0.570250	0.546250	0.565000
50%	0.609500	0.623000	0.651500	0.689000	0.679500	0.680500	0.658000	0.662000
75%	0.718750	0.730000	0.750000	0.784750	0.772000	0.779000	0.764750	0.771000
max	0.982000	0.960000	0.977000	0.966000	0.974000	0.980000	0.978000	0.978000

Tables 2 and 3 show some popular songs that started appearing in 2020 and 2021 (during the Covid-19 pandemic). Both tables present several songs which were popular songs at the time (2020-2021) with danceability values ranging from 0.5 to 0.7.

Table 2. Danceability feature on popular songs of 2020

Track Name	Artist Name	Danceability	Track Popularity
Blinding Lights	The Weeknd	0.514	90
Caile	Luar La L	0.704	89
Save Your Tears	The Weeknd	0.68	88
Shinunoga E-Wa	Fujii Kaze	0.6	86
Heat Waves	Glass Animals	0.761	86
August	Taylor Swift	0.532	85
Levitating (feat. DaBaby)	Dua Lipa	0.702	84
you broke me first	Tate McRae	0.667	83
Positions	Ariana Grande	0.737	83
La Santa	Bad Bunny	0.744	83
Heat Waves	Glass Animals	0.761	83
Levitating	Dua Lipa	0.695	83
Dynamite	BTS	0.746	83
Clouded	Brent Faiyaz	0.583	82
Chicago Freestyle (feat. Giveon)	Drake	0.735	82

Cardigan	Taylor Swift	0.613	82

Track Name	Artist Name	Danceability	Track Popularity
death bed (coffee for your head)	Powfu	0.726	82
DÁKITI	Bad Bunny	0.731	82
After Hours	The Weeknd	0.664	82
Stuck with U (with Justin Bieber)	Ariana Grande	0.597	82
Sky	Playboi Carti	0.785	81
Heat Waves	Glass Animals	0.761	81
telepatía	Kali Uchis	0.653	81
Sweet but Psycho	Ava Max	0.72	81
Save Your Tears (Remix) (with Ariana Grande)	The Weeknd	0.65	81

Table 3. Danceability feature on popular songs of 2021

Track Name	Artist Name	Danceability	Track Popularity
Sunroof	Nicky Youre	0.768	89
Until I Found You	Stephen Sanchez	0.539	88
STAY (with Justin Bieber)	The Kid LAROI	0.591	87
Where Are You Now	Lost Frequencies	0.671	87
Yonaguni	Bad Bunny	0.644	86
Ghost	Justin Bieber	0.601	86
Shivers	Ed Sheeran	0.788	86
good 4 u	Olivia Rodrigo	0.563	86
drivers license	Olivia Rodrigo	0.561	86
Cold Heart - PNAU Remix	Elton John	0.796	86
Enemy (with JID)	Imagine Dragons	0.728	85
THAT'S WHAT I WANT	Lil Nas X	0.737	85
STAY (with Justin Bieber)	The Kid LAROI	0.591	85
Lo Siento BB:	Tainy	0.639	85
Peaches (feat. Daniel Caesar & Giveon)	Justin Bieber	0.677	84
Memories	Maroon 5	0.775	84
Pepas	Farruko	0.762	84
Leave Before You Love Me	Marshmello	0.721	84
The Motto	Tiësto	0.754	84
INDUSTRY BABY (feat. Jack Harlow)	Lil Nas X	0.736	84
The Color Violet	Tory Lanez	0.645	84
abcdefu	GAYLE	0.695	84
METAMORPHOSIS	INTERWORLD	0.593	84
All Too Well (10 Minute Version)	Taylor Swift	0.631	83
Wants and Needs (feat. Lil Baby)	Drake	0.578	83

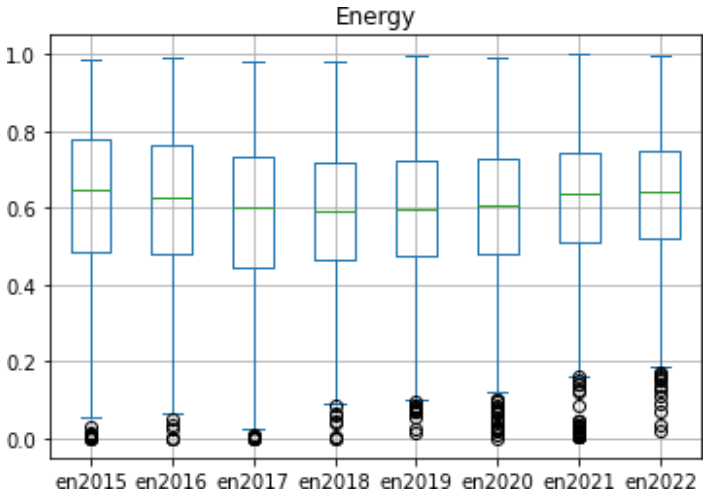

Figure 3. Energy Boxplot

The depiction of Energy using the boxplot is shown in Figure 3. In Figure 3 it can be seen

that from 2015 to 2022 the energy range of Spotify songs is in the range of 0.5 to 0.7. Existing data details can be seen in Table 4.

Table 4. Energy Feature Description

	en2015	en2016	en2017	en2018	en2019	en2020	en2021	en2022
count	994.000.000	994.000.000	994.000.000	994.000.000	994.000.000	994.000.000	994.000.000	994.000.000
mean	0.626021	0.614460	0.582012	0.583069	0.588272	0.591348	0.612512	0.633534
std	0.207276	0.198939	0.204586	0.181099	0.188433	0.189345	0.189851	0.176096
min	0.000020	0.000020	0.000020	0.000021	0.016700	0.000020	0.002340	0.020300
25%	0.486250	0.479000	0.446000	0.464000	0.475000	0.479000	0.508500	0.522000
50%	0.648000	0.628500	0.600500	0.591000	0.599000	0.609000	0.634500	0.644000
75%	0.781000	0.762750	0.735000	0.717000	0.724000	0.727000	0.741000	0.750000
max	0.985000	0.992000	0.983000	0.981000	0.995000	0.989000	1	0.996000

Tables 5 and 6 show some popular songs that started appearing in 2020 and 2021 (during the Covid-19 pandemic). Both tables present several songs which were popular songs at the time (2020-2021) with energy values ranging from 0.5 to 0.7.

Table 5. Energy feature on popular songs of 2020

Track Name	Artist Name	Energy	Track Popularity
Blinding Lights	The Weeknd	0.73	90
Caile	Luar La L	0.756	89
MIDDLE OF THE NIGHT	Elley Duhé	0.611	88
Shinunoga E-Wa	Fujii Kaze	0.76	86
Heat Waves	Glass Animals	0.525	86
August	Taylor Swift	0.623	85
I Really Want to Stay at Your House	Rosa Walton	0.738	84
Heat Waves	Glass Animals	0.525	83
Dynamite	BTS	0.765	83
Cardigan	Taylor Swift	0.581	82
Godzilla (feat. Juice WRLD)	Eminem	0.745	82
DÁKITI	Bad Bunny	0.573	82
After Hours	The Weeknd	0.572	82
A Tu Merced	Bad Bunny	0.791	82
Martin & Gina	Polo G	0.534	81
Good Days	SZA	0.655	81
Heat Waves	Glass Animals	0.525	81
telepatía	Kali Uchis	0.524	81
This Side of Paradise	Coyote Theory	0.664	81
Si Veo a Tu Mamá	Bad Bunny	0.603	81
CÓMO SE SIENTE - Remix	Jhayco	0.606	81
Sweet but Psycho	Ava Max	0.706	81
LA NOCHE DE ANOCHE	Bad Bunny	0.618	81
Don't Start Now	Dua Lipa	0.793	81
The Business	Tiësto	0.62	81

Table 6. Energy feature on popular songs of 2021

Track Name	Artist Name	Energy	Track Popularity
Sunroof	Nicky Youre	0.714	89
Until I Found You	Stephen Sanchez	0.508	88
Woman	Doja Cat	0.764	87
STAY (with Justin Bieber)	The Kid LAROI	0.764	87
Where Are You Now	Lost Frequencies	0.636	87
good 4 u	Olivia Rodrigo	0.664	86
deja vu	Olivia Rodrigo	0.612	86
Ghost	Justin Bieber	0.741	86
Yonaguni	Bad Bunny	0.648	86

Cold Heart - PNAU Remix	Elton John	0.798	86
Lo Siento BB:	Tainy	0.703	85
Enemy (with JID)	Imagine Dragons	0.783	85
STAY (with Justin Bieber)	The Kid LAROI	0.764	85
The Color Violet	Tory Lanez	0.534	84
Leave Before You Love Me	Marshmello	0.738	84

Track Name	Artist Name	Energy	Track Popularity
INDUSTRY BABY (feat. Jack Harlow)	Lil Nas X	0.704	84
Pepas	Farruko	0.766	84
Peaches (feat. Daniel Caesar & Giveon)	Justin Bieber	0.696	84
abcdefu	GAYLE	0.54	84
The Motto	Tiësto	0.763	84
METAMORPHOSIS	INTERWORLD	0.641	84
All Too Well (10 Minute Version)	Taylor Swift	0.518	83
Leave The Door Open	Bruno Mars	0.616	83
Close Eyes	DVRST	0.572	83
Desesperados	Rauw Alejandro	0.694	83

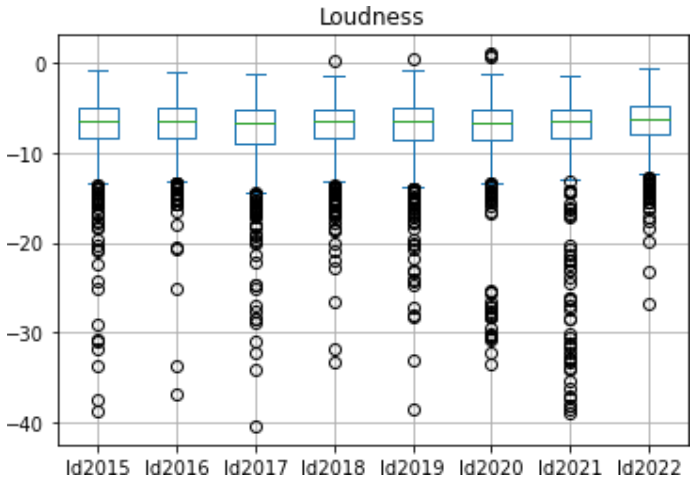

Figure 4. Loudness Boxplot

The depiction of Loudness using the boxplot is shown in Figure 4. In Figure 4 it can be seen that from 2015 to 2022 the loudness range of Spotify songs is in the range of -5 to -8. Existing data details can be seen in Table 7.

Table 7. Loudness Feature Description

	ld2015	ld2016	ld2017	ld2018	ld2019	ld2020	ld2021	ld2022
count	994.000000	994.000000	994.000000	994.000000	994.000000	994.000000	994.000000	994.000000
mean	-7.122653	-7.016948	-7.604810	-7.164176	-7.285668	-7.398858	-7.633066	-6.596418
std	3.753068	3.121767	3.972443	3.265697	3.674353	3.961878	5.113969	2.745339
min	-38.801000	-36.815000	-40.449000	-33.366000	-38.619000	-33.613000	-38.900000	-26.813000
25%	-8.391750	-8.314750	-8.873250	-8.409750	-8.567500	-8.444750	-8.285750	-7.891750
50%	-6.372000	-6.524000	-6.702500	-6.525000	-6.483000	-6.636500	-6.434500	-6.182500
75%	-4.994250	-5.019500	-5.183500	-5.167500	-5.021000	-5.165500	-5.176750	-4.744750
max	-0.716000	-0.930000	-1.262000	0.175000	0.457000	1.060000	-1.307000	-0.514000

Tables 8 and 9 show some popular songs that started appearing in 2020 and 2021 (during the Covid-19 pandemic). Both tables present several songs which were popular songs

at the time (2020-2021) with loudness values ranging from -5 to -8.

Table 8. Loudness feature on popular songs of 2020

Track Name	Artist Name	Loudness	Track Popularity
Blinding Lights	The Weeknd	-5.934	90
Save Your Tears	The Weeknd	-5.487	88

Track Name	Artist Name		Loudness	Track Popularity
Heather	Conan Gray		-7.301	86
Shinunoga E-Wa	Fujii Kaze		-6.124	86
Heat Waves	Glass Animals	-6.9		86
I Really Want to Stay at Your House	Rosa Walton		-7.399	84
Heat Waves	Glass Animals	-6.9		83
Chicago Freestyle (feat. Giveon)	Drake		-7.507	82
Godzilla (feat. Juice WRLD)	Eminem	-5.26		82
After Hours	The Weeknd		-6.099	82
Stuck with U (with Justin Bieber)	Ariana Grande		-6.658	82
Martin & Gina	Polo G		-7.813	81
Heat Waves	Glass Animals	-6.9		81
This Side of Paradise	Coyote Theory	-6.07		81
Si Veo a Tu Mamá	Bad Bunny		-5.313	81
The Business	Tiësto		-7.079	81
...And to Those I Love, Thanks for Sticking Around	$uicideboy$		-6.876	80
Jugaste y Sufrí	Eslabon Armado		-7.778	80
For The Night (feat. Lil Baby & DaBaby)	Pop Smoke		-6.606	80
Maniac	Conan Gray	-5.46		80
34+35	Ariana Grande		-6.476	80
Una Vez	Bad Bunny		-5.402	80
Glock In My Lap	21 Savage		-6.439	79
Wishing Well	Juice WRLD	-6.13		79
Come & Go (with Marshmello)	Juice WRLD		-5.181	79

Table 9. Loudness feature on popular songs of 2021

Track Name	Artist Name		Loudness	Track Popularity
Sunroof	Nicky Youre	-5.11		89
Until I Found You	Stephen Sanchez	-6.05		88
STAY (with Justin Bieber)	The Kid LAROI		-5.484	87
good 4 u	Olivia Rodrigo		-5.044	86
traitor	Olivia Rodrigo		-7.885	86
deja vu	Olivia Rodrigo		-7.222	86
Ghost	Justin Bieber		-5.569	86
Cold Heart - PNAU Remix	Elton John		-6.312	86
Lo Siento BB	Tainy	-6.33		85
STAY (with Justin Bieber)	The Kid LAROI		-5.484	85
INDUSTRY BABY (feat. Jack Harlow)	Lil Nas X		-7.409	84
Peaches (feat. Daniel Caesar & Giveon)	Justin Bieber		-6.181	84
abcdefu	GAYLE		-5.692	84
Memories	Maroon 5		-7.241	84
Wants and Needs (feat. Lil Baby)	Drake		-6.349	83
Leave The Door Open	Bruno Mars		-7.964	83
Easy On Me	Adele		-7.519	83
My Universe	Coldplay	-6.39		83
Mon Amour - Remix	zzoilo		-6.621	83
Wasted On You	Morgan Wallen	-5.24		82
Need to Know	Doja Cat		-6.509	82
You Right	Doja Cat		-6.414	82
jealousy, jealousy	Olivia Rodrigo		-6.334	82
Envolver	Anitta		-5.421	82
RAPSTAR	Polo G		-6.862	81

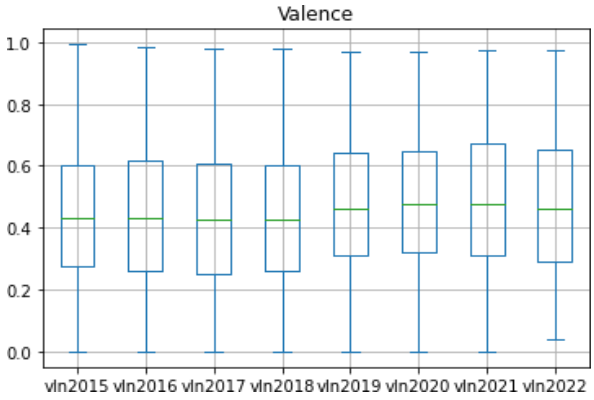

Figure 5. Valence Boxplot

The depiction of Valence using the boxplot is shown in Figure 5. In Figure 5 it can be seen that from 2015 to 2022 the valence range of Spotify songs is in the range of 0.3 to 0.6. Existing data details can be seen in Table 10.

Table 10. Valence Feature Description

	vln2015	vln2016	vln2017	vln2018	vln2019	vln2020	vln2021	vln2022
count	999.000000	999.000000	999.000000	1000.000000	1000.000000	999.000000	996.000000	997.000000
mean	0.452956	0.451410	0.437976	0.440519	0.476652	0.480542	0.485370	0.478161
std	0.231968	0.237159	0.227230	0.225382	0.226440	0.228907	0.237424	0.233158
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.037400
25%	0.277000	0.258500	0.251000	0.260750	0.312000	0.320000	0.312000	0.292000
50%	0.434000	0.431000	0.425000	0.424500	0.462500	0.477000	0.479000	0.464000
75%	0.601000	0.618000	0.605000	0.600500	0.644250	0.649000	0.672250	0.652000
max	0.993000	0.982000	0.980000	0.980000	0.969000	0.968000	0.972000	0.973000

Tables 11 and 12 show some popular songs that started appearing in 2020 and 2021 (during the Covid-19 pandemic). Both tables present several songs which were popular songs at the time (2020-2021) with valence values ranging from 0.3 to 0.6.

Table 11. Valence feature on popular songs of 2020

Track Name	Artist Name	Valence	Track Popularity
Blinding Lights	The Weeknd	0.334	90
Caile	Luar La L	0.461	89
Save Your Tears	The Weeknd	0.644	88
Shinunoga E-Wa	Fujii Kaze	0.519	86
Heat Waves	Glass Animals	0.531	86
Shut up My Moms Calling	Hotel Ugly	0.376	85
August	Taylor Swift	0.403	85
Heartbreak Anniversary	Giveon	0.543	83
positions	Ariana Grande	0.682	83
La Santa	Bad Bunny	0.586	83
Heat Waves	Glass Animals	0.531	83
Clouded	Brent Faiyaz	0.581	82
Cardigan	Taylor Swift	0.551	82
death bed (coffee for your head)	Powfu	0.348	82
Stuck with U (with Justin Bieber)	Ariana Grande	0.537	82
Sky	Playboi Carti	0.565	81
Good Days	SZA	0.412	81
Heat Waves	Glass Animals	0.531	81

Track Name	Artist Name	Valence	Track Popularity
telepatía	Kali Uchis	0.553	81
This Side of Paradise	Coyote Theory	0.321	81
CÓMO SE SIENTE - Remix	Jhayco	0.304	81
Sweet but Psycho	Ava Max	0.62	81
LA NOCHE DE ANOCHE	Bad Bunny	0.391	81
Save Your Tears (Remix) (with Ariana Grande)	The Weeknd	0.593	81
Don't Start Now	Dua Lipa	0.679	81

Table 12. Valence feature on popular songs of 2021

Track Name	Artist Name	Valence	Track Popularity
STAY (with Justin Bieber)	The Kid LAROI	0.478	87
good 4 u	Olivia Rodrigo	0.688	86
Ghost	Justin Bieber	0.441	86
Yonaguni	Bad Bunny	0.44	86
Bad Habits	Ed Sheeran	0.537	86
Freaks	Surf Curse	0.407	85
THAT'S WHAT I WANT	Lil Nas X	0.546	85
Enemy (with JID)	Imagine Dragons	0.555	85
STAY (with Justin Bieber)	The Kid LAROI	0.478	85
The Color Violet	Tory Lanez	0.463	84
happier	Olivia Rodrigo	0.338	84
Leave Before You Love Me	Marshmello	0.637	84
Pepas	Farruko	0.442	84
Peaches (feat. Daniel Caesar & Giveon)	Justin Bieber	0.464	84
abcdefu	GAYLE	0.415	84
The Motto	Tiësto	0.464	84
Memories	Maroon 5	0.595	84
Desesperados	Rauw Alejandro	0.511	83
Don't Be Shy	Tiësto	0.513	83
My Universe	Coldplay	0.443	83
Do It To It	ACRAZE	0.637	83
Mon Amour - Remix	zzoilo	0.362	83
Notion	The Rare Occasions	0.312	82
You Right	Doja Cat	0.436	82
jealousy, jealousy	Olivia Rodrigo	0.699	82

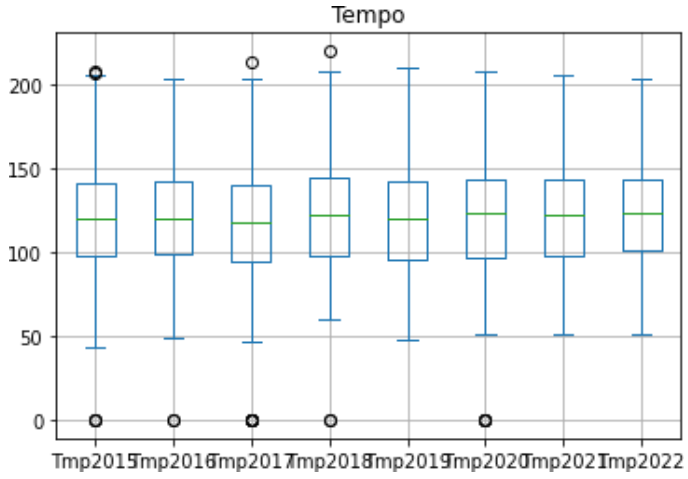

Figure 6. Tempo Boxplot

The depiction of Tempo using the boxplot is shown in Figure 6. In Figure 6 it can be seen that from 2015 to 2022 the tempo range of Spotify songs is in the range of 99 BPM to 142 BPM. Existing data details can be seen in Table 13.

Table 13. Tempo Feature Description

	Tmp2015	Tmp2016	Tmp2017	Tmp2018	Tmp2019	Tmp2020	Tmp2021	Tmp2022
count	999.000000	999.000000	999.000000	1000.000000	1000.000000	999.000000	996.000000	997.000000
mean	121.458930	121.792583	118.266272	123.122379	121.551094	122.494787	122.354506	124.838225
std	30.533759	29.776419	30.251772	30.432102	30.207446	31.205860	30.599947	28.247066
min	0.000000	0.000000	0.000000	0.000000	48.190000	0.000000	50.947000	51.660000
25%	98.018000	99.044500	94.994000	98.179500	95.987750	97.016500	97.983250	101.190000
50%	120.003000	120.207000	118.014000	122.020500	120.152000	123.066000	122.030500	122.984000
75%	141.224500	141.956500	139.977000	144.220000	142.313000	144.043000	143.969000	143.984000
max	207.982000	204.113000	213.788000	220.099000	210.164000	207.947000	205.863000	203.803000

Tables 14 and 15 show some popular songs that started appearing in 2020 and 2021 (during the Covid-19 pandemic). Both tables present several songs that were popular songs at the time (2020- 2021) with tempo values ranging from 99 BPM to 142 BPM.

Table 14. Tempo feature on popular songs of 2020

Track Name	Artist Name	Tempo	Track Popularity
Caile	Luar La L	121.737	89
Save Your Tears	The Weeknd	118.051	88
Heather	Conan Gray	102.078	86
Shut up My Moms Calling	Hotel Ugly	138.419	85
Levitating (feat. DaBaby)	Dua Lipa	102.977	84
I Really Want to Stay at Your House	Rosa Walton	124.966	84
Levitating	Dua Lipa	103.014	83
Dynamite	BTS	114.044	83
you broke me first	Tate McRae	124.148	83
After Hours	The Weeknd	108.959	82
DÁKITI	Bad Bunny	109.928	82
Chicago Freestyle (feat. Giveon)	Drake	122.947	82
Cardigan	Taylor Swift	130.033	82
Save Your Tears (Remix) (with Ariana Grande)	The Weeknd	118.091	81
The Business	Tiësto	120.031	81
Good Days	SZA	121.002	81
Don't Start Now	Dua Lipa	123.95	81
Si Veo a Tu Mamá	Bad Bunny	129.928	81
Sweet but Psycho	Ava Max	133.002	81
Sky	Playboi Carti	139.98	81
Lose You To Love Me	Selena Gomez	102.819	80
Maniac	Conan Gray	108.045	80
34+35	Ariana Grande	109.978	80
...And to Those I Love, Thanks for Sticking Around	$uiciseboy$	113.983	80
For The Night (feat. Lol Baby & DaBaby(	Pop Smoke	125.971	80

Table 15. Tempo feature on popular songs of 2021

Track Name	Artist Name	Tempo	Track Popularity
Sunroof	Nicky Youre	131.443	89
Until I Found You	Stephen Sanchez	101.358	88
Woman	Doja Cat	107.998	87
Where Are You Now	Lost Frequencies	120.966	87
traitor	Olivia Rodrigo	100.607	86
Cold Heart - PNAU Remix	Elton John	116.032	86
Bad Habits	Ed Sheeran	126.011	86
Shivers	Ed Sheeran	141.02	86
The Color Violet	Tory Lanez	105.02	84
The Motto	Tiësto	117.953	84
Leave Before You Love Me	Marshmello	119.976	84
abcdefu	GAYLE	121.932	84
Pepas	Farruko	130.001	84
My Universe	Coldplay	104.988	83
Mon Amour - Remix	zzoilo	116.041	83

Don't Be Shy	Tiësto	119.986	83

Track Name	Artist Name	Tempo	Track Popularity
Do It To It	ACRAZE	124.927	83
Wants and Needs (feat. Lil Baby)	Drake	136.006	83
Easy On Me	Adele	141.981	83
Save Your Tears (with Ariana Grande) (Remix)	The Weeknd	118.091	82
You Right	Doja Cat	128.986	82
Need to Know	Doja Cat	130.041	82
I WANNA BE YOUR SLAVE	Måneskin	132.507	82
Live Another Day	Kordhell	115.005	81
Move Your Body	Öwnboss	125.051	81

FINDINGS AND DISCUSSION

Danceability and Energy

The results obtained are the relationship between danceability and energy features which range from 0.5 to 0.7. These results show that Spotify users prefer songs that are upbeat or upbeat from 2020 to 2021. Because from 2015 to 2019 there was a tendency for the value of songs to decrease and then increase in 2020 and 2021. It can be said that the choice of songs during a pandemic is cheerful and happy can decrease stress levels during a pandemic.

Loudness

The boxplot results obtained show that the loudness feature is stable at -5 to -8. For 2021 there are some trends for songs with a loudness value higher than -14 (the loudness standard at Spotify). It can be said that the selection of songs during a pandemic is a song with a more loudness value. The -5 to -8 range is generally considered a fairly moderate or balanced loudness level, which can suit many music playback contexts. This can provide balance and stability in listening to songs.

Valence and Tempo

For the valence feature from 2015 to 2022, the mean value is at 0.4, then the tempo feature is about 120 BPM (Beats Per Minute). In this case, a valence of 0.4 indicates that the song tends to have slightly more negative or less positive overtones. Songs with low valence like these may have more melancholy or serious emotional elements. Meanwhile, the tempo of 120 indicates that the song has a speed of 120 beats per minute. Tempo 120 is often associated with moderate or medium speed. This can create a fairly dynamic atmosphere, but not too fast or too slow. If we search for songs in 2020 and 2021 with song features according to the criteria mentioned, we get Table 16 and Table 17.

Table 16. All feature on popular songs of 2020

Track Name	Artist Name	Danceability	Energy	Loudness	Valence	Tempo	Track Popularity
Maniac	Conan Gray	0.628	0.639	-5.46	0.493	108.045	80
hot girl bummer	blackbear	0.782	0.559	-7.106	0.685	129.992	79
No Idea	Don Toliver	0.652	0.631	-5.718	0.35	127.998	79
Invincible	Pop Smoke	0.548	0.732	-5.652	0.612	142.791	78
Paradise (feat. Dermot Kennedy)	MEDUZA	0.632	0.595	-7.644	0.435	124.114	78
Life Is Good (feat. Drake)	Future	0.676	0.609	-5.831	0.508	142.037	77
motive (with Doja Cat)	Ariana Grande	0.789	0.742	-5.664	0.661	116.965	77
Dancing With A Stranger (with Normani)	Sam Smith	0.741	0.52	-7.513	0.347	102.998	75
I'm so tired...	Lauv	0.576	0.736	-7.572	0.484	101.928	75

More Than A Woman -From"Saturday night Fever" Soundtrack	Bee Gees	0.601	0.703	-6.24	0.673	106.164	75
Ashes	Stellar	0.712	0.568	-7.864	0.46	130.019	74
Blueberry Faygo	Lil Mosey	0.774	0.554	-7.909	0.349	99.034	74
Del Mar	Ozuna	0.759	0.636	-5.585	0.536	109.976	74
Get Back	Pop Smoke	0.798	0.649	-6.546	0.566	142.006	74
Intro	Junior H	0.694	0.59	-6.023	0.338	105.022	74

Table 17. All feature on popular songs of 2021

Track Name	Artist Name	Danceability	Energy	Loudness	Valence	Tempo	Track Popularity
abcdefu	GAYLE	0.695	0.54	-5.692	0.415	121.932	84
Mon Amour - Remix	zzoilo	0.748	0.761	-6.621	0.362	116.041	83
My Universe	Coldplay	0.588	0.701	-6.39	0.443	104.988	83
Wildest Dreams (Taylor's Version)	Taylor Swift	0.583	0.67	-7.289	0.498	140.061	81
Better Days (NEIKED x Mae Muller x Polo G)	NEIKED	0.717	0.671	-5.077	0.699	110.054	80
Tiroteo - Remix	Marc Seguí	0.75	0.522	-7.018	0.601	110.427	80
Permission to Dance	BTS	0.702	0.741	-5.33	0.646	124.925	78

CONCLUSIONS

The conclusion drawn from the research conducted is that the value of danceability and energy ranges from 0.5 to 0.7, especially from 2020 to 2021 when the COVID-19 pandemic occurred. It can be said that during the COVID-19 pandemic, Spotify users tended to listen to upbeat songs, which made people happy for the spirit of life.

LIMITATION & FURTHER RESEARCH

The limitation of the research conducted is the ever-changing popularity value of a song. So the nature of popularity here is the number of songs played, not the top song. In addition, the value of the song features obtained is also not the same. Some songs have no data, or the value is different from the others. The need for pre-processing for data obtained through the API. This research also does not go into detailed emotional recognition such as using MER (Music Emotion Recognition), but is only limited to analyzing Spotify songs.

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