Project 1 - Exploratory Data Analysis

1. Assignment Tables

Student ID	Name	% of contribution	Task
20127214	Nguyễn Trương Minh Khôi	100	Collecting data Making question 3,6 + analyze + visualize
20127613	Phan Thanh Sang	100	Collecting data Making question 2,4 (Machine Learning) + analyze + visualize
20127612	Đỗ Khánh Sang	100	Load data Count number of rows and columns Check duplicate Check Columns' Datatypes, adjust if needed Making question 1,7 + analyze + visualize
20127484	Nguyễn Tư Duy	100	Find out distribution of numeric data columns (missing percentage, min, max, median,...) Find out distribution of non-numeric data columns (missing percentage, number of values, different value,..) Making question 5,8 + analyze + visualize
20127560	Phạm Trần Trung Lượng	100	Remove rows containing missing values if available Remove data outliers if needed Normalize data (genre,...) Making question 9,10,11 (Machine Learning) + analyze + visualize

In [1]:
```
## Libraries and Modules

from bs4 import BeautifulSoup
from selenium import webdriver

import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

import re
import json
import copy
import time
from datetime import datetime, timedelta

from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score
from sklearn.preprocessing import OrdinalEncoder
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import mean_absolute_error
```

2. Data Collection

Due to long running time, we have commented lines of data collection code.

Explanation

First of all, we create a list of keywords. And then for each keyword, we get 200 first results for playlist searching, and get links to those playlists. Finally, we write all these links to file playlist_link.txt.

In [2]:
```
# Get playlist links

def get_list_of_playlist_links(keywords):
    link = []
    driver = webdriver.Chrome()

    for k in keywords:
        url = f'https://soundcloud.com/search/sets?q={k}'
        driver.get(url)

        # scroll = 'window.scrollTo(0, document.body.scrollHeight);'
        for i in range(80):
            driver.execute_script("window.scrollBy(0, 300000);")
            time.sleep(0.5)

        page = BeautifulSoup(driver.page_source)
        find = page.find_all('a', class_ = 'sc-link-primary soundTitle__title sc-

        genre_link = [find[i]['href'] for i in range(len(find))]
        genre_link = ['https://soundcloud.com' + genre_link[i] for i in range(ler
        genre_link = genre_link[:200]
        print(len(genre_link))
        link.extend(genre_link)

        time.sleep(3)

    driver.quit()

    return link

keywords = ['indie', 'lofi', 'hiphop', 'edm', 'disco', 'rap', 'acoustic', 'folk',
# link = get_list_of_playlist_links(keywords)
# print(len(link))

# write_file = open('playlist_link.txt', 'w')

# for i in range(len(link)):
#     write_file.write(link[i] + '\n')

# write_file.close()
```

In [3]:
```
# Intialize variables

tracks_link = []
users_link = []

users_id = dict()       # dictionary contain corresponding id for users
tracks_id = dict()      # dictionary contain corresponding id for tracks
playlists_id = dict()   # dictionary contain corresponding id for playlists

number = 2000           # number of rows to get
```

- Traverse through each playlist link in file playlist_link.txt and get its information. While getting information of each feature, get link of user posting the playlist, as well as 10 first user links

and track links of the current playlist, and assign id for each link simultaneously. Then store these links in lists and write to files user_link.txt, track_link.txt, playlist_id.json, user_id.json and track_id.json

- information of playlist:

Fields	Description
ID	ID of playlist (each playlist has a unique ID)
Name	Name of playlist
Poster	User who posted playlist
NumTracks	Total tracks in playlist
TopTracks	List contain top 10 tracks in playlist
Likes	Number of likes
Reposts	Number of reposts
PostedTime	Posted time (ex: 5 March 2017)
Genre	Genre of playlist
Length	Duration time of playlist

In [4]:
```
# Get playlists and write to file playlist.csv

def get_playlists(users_id, tracks_id, playlists_id, tracks_link, users_link):
    file = open('playlist_link.txt', 'r')
    playlists_link = [line.strip() for line in file.readlines()]
    file.close()

    users_id_order = 1
    tracks_id_order = 1
    playlists_id_order = 1

    # Get all playlists genre
    genre = ''
    for kw in keywords:
        genre = genre + (kw + ',') * 200
    genre = genre.split(',')[:-1]

    keys = ['ID', 'Name', 'Poster', 'NumTracks', 'TopTracks', 'Likes', 'Reposts',
    values = [[], [], [], [], [], [], [], [], genre[:number], []]

    # Get playlists id
    current_playlists_id = []
    for playlist_link in playlists_link:
        if playlist_link not in playlists_id.keys():
            playlists_id[playlist_link] = 'P' + str(playlists_id_order)
            current_playlists_id.append(playlists_id[playlist_link])
            playlists_id_order += 1
        else:
            current_playlists_id.append(playlists_id[playlist_link])
    values[0] = current_playlists_id[:number]

    driver = webdriver.Chrome()

    for i in range(number):
        url = playlists_link[i]

        r = driver.get(url)

        time.sleep(2)
        driver.execute_script('window.scrollTo(0, document.body.scrollHeight);')
        time.sleep(2)

        source = BeautifulSoup(driver.page_source, features='html.parser')

        # Get Name
        find_name = source.find('h1', class_ =
                                'soundTitle__title sc-font g-type-shrinkwrap-inli
        if str(find_name) != 'None':
            name = find_name.get_text().strip()
            values[1].append(name)
        else:
            values[1].append('None')

        # Get Users link
        current_user_link = []
            #---Get Poster---#
```

```
            find_poster = source.find('a', class_ = 'sc-link-secondary')
            poster = ''
            if str(find_poster) != 'None':
                poster = 'https://soundcloud.com' + find_poster['href']
                current_user_link.append(poster)
                #---Get Poster---#

            find_users = source.find_all('a', class_ = 'trackItem__username sc-link-l
            if str(find_users) != 'None':
                current_user_link.extend(['https://soundcloud.com' + find_users[i]['h
                if len(current_user_link) > 11:
                    current_user_link = current_user_link[:11]

                # assign id for users
                for user_link in current_user_link:
                    if user_link not in users_id.keys():
                        users_id[user_link] = 'U' + str(users_id_order)
                        users_id_order += 1

                users_link.extend(current_user_link)


            # Set Poster
            if str(find_poster) != 'None':
                values[2].append(users_id[poster])
            else:
                values[2].append('None')

            # Get Number of tracks
            find_numtracks = source.find('div', class_ = 'genericTrackCount sc-font t
            if str(find_numtracks) != 'None':
                numtracks = find_numtracks['title'].split()[0]
                values[3].append(numtracks)
            else:
                values[3].append('None')

            # Get Tracks link
            find_tracks = source.find_all('a', class_ = 'trackItem__trackTitle sc-lir
            if str(find_tracks) != 'None':
                current_track_link = []
                for i in range(len(find_tracks)):
                    href = find_tracks[i]['href']
                    current_track_link.append('https://soundcloud.com' + href[:href.f

                if len(current_track_link) > 10:
                    current_track_link = current_track_link[:10]

                # Assign id for tracks
                current_track_id = []
                for track_link in current_track_link:
                    if track_link not in tracks_id.keys():
                        tracks_id[track_link] = 'T' + str(tracks_id_order)
                        current_track_id.append(tracks_id[track_link])
                        tracks_id_order += 1
                    else:
                        current_track_id.append(tracks_id[track_link])
```

```
            values[4].append(current_track_id)
            tracks_link.extend(current_track_link)
        else:
            values[4].append('None')

        # Get likes
        find_likes = source.find_all('li', class_ = 'sc-ministats-item')
        if str(find_likes) != 'None':
            try:
                likes = int(find_likes[0]['title'].split()[0].replace(',', ''))
                values[5].append(likes)
            except:
                values[5].append('None')
        else:
            values[5].append('None')

        # Get Reposts
        find_reposts = source.find_all('li', class_ = 'sc-ministats-item')
        if str(find_reposts) != 'None':
            try:
                reposts = int(find_reposts[1]['title'].split()[0].replace(',', ''
                values[6].append(reposts)
            except:
                values[6].append('None')
        else:
            values[6].append('None')

        # Get PostingTime
        find_postingtime = source.find('time', class_ = 'relativeTime')
        if str(find_postingtime) != 'None':
            postingtime = find_postingtime['title']
            values[7].append(postingtime)
        else:
            values[7].append('None')

        # Get Length
        find_length = source.find('div', class_ =
                                  'genericTrackCount__duration sc-type-small sc-t
        if str(find_length) != 'None':
            length = find_length.get_text()
            values[9].append(length)
        else:
            values[9].append('None')

    time.sleep(3)
    driver.quit()
    playlists = dict(zip(keys, values))
    return playlists

# playlists = get_playlists(users_id, tracks_id, playlists_id, tracks_link, users
# playlists = pd.DataFrame(playlists)
# pd.set_option('display.max_colwidth', None)
# playlists.to_csv('playlist.csv', index=False)
# playlists
```

In [5]:
```
# Write tracks_link, users_link, tracks_id, users_id, playlists_id to files

# tracks_link = list(set(tracks_link))
# users_link = list(set(users_link))

# write_file1 = open('track_link.txt', 'w')
# for i in range(len(tracks_link)):
#     write_file1.write(tracks_link[i] + '\n')
# write_file1.close()

# write_file2 = open('user_link.txt', 'w')
# for i in range(len(users_link)):
#     write_file2.write(users_link[i] + '\n')
# write_file2.close()

# write_file3 = open('track_id.json', 'w')
# json.dump(tracks_id, write_file3, indent = 1)
# write_file3.close()

# write_file4 = open('user_id.json', 'w')
# json.dump(users_id, write_file4, indent = 1)
# write_file4.close()

# write_file5 = open('playlist_id.json', 'w')
# json.dump(playlists_id, write_file5, indent = 1)
# write_file5.close()
```

In [6]:
```
# Read tracks_link, users_link, tracks_id, users_id from files

# read_file1 = open('track_link.txt', 'r')
# tracks_link = [line.strip() for line in read_file1.readlines()]

# read_file2 = open('user_link.txt', 'r')
# users_link = [line.strip() for line in read_file2.readlines()]

# read_file3 = open('track_id.json', 'r')
# tracks_id = json.load(read_file3)

# read_file4 = open('user_id.json', 'r')
# users_id = json.load(read_file4)
```

GET USERS

- get_users(users_link, users_id): find and get users information correspond to each track in playlists.
- Input:
  - `users_link` : list contains url of every users (url of users are got from playlists)
  - `users_id` : list contains id of every users which was assigned for user in a get_playlists cell
- Output: a list contains corresponding information of each user
- Information of user:

Fields	Description

Fields	Description
ID	ID of user (each user has a unique ID)
Name	Name of user
Num_followers	Number of followers of user
NumFollowing	Number of people this user follow
NumTracks	Number of tracks belongs to this user
Verified	Prove that artist was verified based on SoundCloud standard
NextPro	Mode for artist account

In [7]:
```
# Get users and write to file user.csv

def get_users(users_link, users_id):
    keys = ['ID', 'Name', 'NumFollowers', 'NumFollowing', 'NumTracks', 'Verified'
    values = [[], [], [], [], [], [], []]

    # Get user id
    for i in range(len(users_link)):
        values[0].append(users_id[users_link[i]])

    driver = webdriver.Chrome()

    for i in range(len(users_link)):
        print(i, end = ' ')
        user_link = users_link[i]
        driver.get(user_link)
        time.sleep(3)
        s = BeautifulSoup(driver.page_source, 'html.parser')

        # Get user name
        user_name = s.find('h2', {'class': 'profileHeaderInfo__userName g-type-sh
        if str(user_name) != 'None':
            user_name = user_name.text.strip().replace('\n', '').replace('Verifie
            values[1].append(user_name)
        else:
            values[1].append('None')

        # Get number of followers, following, tracks
        find3 = s.find_all('a', {'class': 'infoStats__statLink sc-link-light sc-l
        if str(find3) != 'None':
            try:
                num_followers = find3[0]['title'].split()[0].replace(',', '')
                num_following = find3[1]['title'].split()[1].replace(',', '')
                num_tracks    = find3[2]['title'].split()[0].replace(',', '')

                values[2].append(num_followers)
                values[3].append(num_following)
                values[4].append(num_tracks)
            except:
                values[2].append('None')
                values[3].append('None')
                values[4].append('None')
        else:
            values[2].append('None')
            values[3].append('None')
            values[4].append('None')

        # Get user verified
        user_verified = s.find('span', {'class': 'sc-status-icon sc-status-icon-v
        if str(user_verified) != 'None':
            values[5].append(user_verified.text)
        else:
            values[5].append('None')

        # Get user next_pro
        user_next_pro = s.find('a', {'class': 'creatorBadge'})
```

```
        if str(user_next_pro) != 'None':
            try:
                next_pro = user_next_pro['title']
                values[6].append(next_pro)
            except:
                values[6].append('None')
        else:
            values[6].append('None')

    driver.quit()
    users = dict(zip(keys, values))
    return users

# users = get_users(users_link, users_id)
# users = pd.DataFrame(users)
# users.to_csv('user.csv', index=False)
# users
```

GET TRACKS

- get_tracks(tracks_link, tracks_id, users_id): find and get tracks information correspond to each user in playlists.
- Input:
  - `tracks_link` : list contains url of every tracks (url of tracks are got from playlists)
  - `tracks_id` : list contains id of every tracks which was assigned for user in a get_playlists cell
  - `users_id` : list contains id of every users which was assigned for user in a get_playlists cell use for assign ID for track's poster
- Output: a list contains corresponding information of each track
- Information of track:

Fields	Description
`ID`	ID of track (each track has a unique ID)
`Name`	Name of track
`Poster`	User who posted track
`Plays`	Times people listen to this track
`Likes`	Number of likes
`Reposts`	Number of reposts
`PostedTime`	Posted time (ex: 5 March 2017)
`Tags`	Tags of this track
`Length`	Duration time of this track
`NumComments`	Number of comments

In [8]:
```
# Get tracks and write to file track.csv

def get_tracks(tracks_link, tracks_id, users_id):
    keys = ['ID', 'Name', 'Poster', 'Plays', 'Likes', 'Reposts', 'PostedTime', 'T
    values = [[], [], [], [], [], [], [], [], [], []]
    # Get tracks id
    for i in range(len(tracks_link)):
        values[0].append(tracks_id[tracks_link[i]])

    driver = webdriver.Chrome()

    for i in range(len(tracks_link)):
        track_link = tracks_link[i]
        driver.get(track_link)
        time.sleep(3)
        s = BeautifulSoup(driver.page_source, 'html.parser')

        # Get track name
        track_name = s.find('h1', {'class': 'soundTitle__title sc-font g-type-shr
        if str(track_name) != 'None':
            track_name = track_name.text.strip()
            values[1].append(track_name)
        else:
            values[1].append('None')

        # Get poster
        find_poster_link = s.find('a', {'class': 'sc-link-secondary'})
        try:
            poster_link = 'https://soundcloud.com' + find_poster_link['href']
            track_poster = users_id[poster_link]
            values[2].append(track_poster)
        except:
            values[2].append('None')

        # Get plays + likes + reposts
        find3 = s.find_all('li', {'class': 'sc-ministats-item'})
        if str(find3) != 'None':
            try:
                plays   = find3[0]['title'].split()[0].replace(',', '')
                likes   = find3[1]['title'].split()[0].replace(',', '')
                reposts = find3[2]['title'].split()[0].replace(',', '')

                values[3].append(plays)
                values[4].append(likes)
                values[5].append(reposts)
            except:
                values[3].append('None')
                values[4].append('None')
                values[5].append('None')
        else:
            values[3].append('None')
            values[4].append('None')
            values[5].append('None')

        # Get track posted time
        track_posted_time = s.find('time', {'class': 'relativeTime'})
```

```
        try:
            track_posted_time = track_posted_time['title']
            values[6].append(track_posted_time)
        except:
            values[6].append('None')

        # Get track tags
        track_tags = s.find('span', {'class': 'sc-truncate sc-tagContent'})
        if str(track_tags) != 'None':
            track_tags = track_tags.text
            values[7].append(track_tags)
        else:
            values[7].append('None')

        # Get track length
        find_track_length = s.find('div', {'class': 'playbackTimeline__duration s
        try:
            track_length = find_track_length.find('span', {'aria-hidden': 'true'}
            values[8].append(track_length)
        except:
            values[8].append('None')

        # Get number of comments
        track_num_comments = s.find('span', {'class': 'commentsList__actualTitle'
        if track_num_comments is not None:
            track_num_comments = track_num_comments.text.strip('s').strip(' comme
            values[9].append(track_num_comments)
        else:
            values[9].append('None')

    driver.quit()
    tracks = dict(zip(keys, values))
    return tracks

# tracks = get_tracks(tracks_link, tracks_id, users_id)
# tracks = pd.DataFrame(tracks)
# tracks.to_csv('track.csv', index=False)
# tracks
```

3. Exploratory Data Analysis

3.1. Preprocessing

3.1.1. Tracks

Load Data

In [9]:
```
tracks_df = pd.read_csv('track.csv')
tracks_df.head()
```

Out[9]:

	ID	Name	Poster	Plays	Likes	Reposts	PostedTime	Tags	Length	NumComments
0	T1	Locked Up	U4190	1033050	15590	421	1 January 2005	R & B	None	84
1	T2	Acsdjmix	U8577	120	1	3	22 April 2015	yujoooooo	1:07:21	None
2	T3	Ego Death	U10921	1882	48	9	17 June 2018	Hybrid	4:18	6
3	T4	Dabin x Fytch - Altitude	U4868	324493	7536	1018	28 September 2018	Electronic	3:27	85
4	T5	earned it	U3052	42037	805	71	28 July 2018	lofi	3:33	11

How many rows and columns does the data have?

Get the number of rows and columns of the DataFrame `tracks_df` and store it in `num_rows_track` and `num_cols_track` variables by counting length of DataFrame and counting columns of DataFrame

In [10]:
```
num_rows_track = len(tracks_df)
num_cols_track = len(tracks_df.columns)

print("Number of rows:", num_rows_track)
print("Number of columns:", num_cols_track)
```

```
Number of rows: 16190
Number of columns: 10
```

There are 16190 of rows, 10 of columns in `tracks_df`

Does the data have duplicate?

Calculate the number of samples are duplicated based on `'ID'` field and store it in the variable `num_duplicated_rows` . In a group of samples, the first sample is not counted as duplicated by using (`keep='first'`). Then count number of duplications if their value are `True`

In [11]:
```
track_duplicate = tracks_df['ID'].duplicated(keep='first')
num_duplicated_rows = np.count_nonzero(track_duplicate==True)

print('Duplicate:', num_duplicated_rows)
```

```
Duplicate: 0
```

There is no duplicate here

Check Columns' Datatypes, adjust if needed

In [12]:
```
tracks_df['NumComments'] = tracks_df['NumComments'].apply(lambda col: col.replace
tracks_df[['Plays', 'Likes', 'Reposts', 'NumComments']] = tracks_df[['Plays', 'Li
tracks_df[['Plays', 'Likes', 'Reposts', 'NumComments']] = tracks_df[['Plays', 'Li

tracks_df.dtypes
```

Out[12]:
```
ID             object
Name           object
Poster         object
Plays           int64
Likes           int64
Reposts         int64
PostedTime     object
Tags           object
Length         object
NumComments     int64
dtype: object
```

In [13]:
```
tracks_df['PostedTime'] = tracks_df['PostedTime'].apply(lambda col: col.replace('
tracks_df['PostedTime'] = pd.to_datetime(tracks_df['PostedTime'][tracks_df['Poste
tracks_df['Length'] = tracks_df['Length'].str.replace('^(\d+:\d+)$', r'0:\1', reg
tracks_df['Length'] = tracks_df['Length'].apply(lambda col: np.nan if col=='None'

tracks_df.dtypes
```

Out[13]:
```
ID                        object
Name                      object
Poster                    object
Plays                      int64
Likes                      int64
Reposts                    int64
PostedTime      datetime64[ns]
Tags                      object
Length         timedelta64[ns]
NumComments                int64
dtype: object
```

Find out distribution of numeric data columns

In [14]:
```
nume_cols = ['Plays', 'Likes', 'Reposts', 'PostedTime', 'Length', 'NumComments']

missing_percentages = np.isnan(tracks_df[nume_cols]).sum() / num_rows_track * 100
mins = np.percentile(tracks_df[nume_cols].loc[~pd.isnull(tracks_df['Length'])], 0
medians = np.percentile(tracks_df[nume_cols], 50, axis=0)
maxs = np.percentile(tracks_df[nume_cols], 100, axis=0)

nume_cols_df_track = pd.DataFrame(data=np.array([missing_percentages, mins, media
                                  index=['Missing percentage', 'Min', 'Median', 'Max'],
nume_cols_df_track
```

Out[14]:

	Plays	Likes	Reposts	PostedTime	Length	NumComments
Missing percentage	0.0	0.0	0.0	0.024707	8.987029	0.0
Min	0.0	0.0	0.0	1964-01-01 00:00:00	0 days 00:00:29	0.0
Median	343461.5	4653.0	340.0	2015-03-07 12:00:00	0 days 00:03:49	48.0
Max	326494454.0	3164637.0	98358122.0	2022-11-30 00:00:00	0 days 04:18:21	252878.0

Find out distribution of non-numeric data columns

In [15]:
```
cate_cols = ['ID', 'Name', 'Poster', 'Tags']
tracks_df['Tags'] = tracks_df['Tags'].replace('', np.nan)

missing_percentages = np.sum(tracks_df[cate_cols].isna()) / num_rows_track * 100
num_diff_vals = np.array(tracks_df[cate_cols].nunique())
diff_vals = np.array(tracks_df[cate_cols].apply(lambda col: col.dropna().unique()

cate_cols_df_track = pd.DataFrame(data=np.array([missing_percentages, num_diff_va
                                  index=['Missing percentage', 'Num diff val', 'Diff va
cate_cols_df_track
```

Out[15]:

	ID	Name	Poster	Tags
Missing percentage	0.0	0.0	0.0	0.006177
Num diff val	16190	15638	8901	4554
Diff val	[T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11,...	[Locked Up, Acsdjmix, Ego Death, Dabin x Fytch...	[U4190, U8577, U10921, U4868, U3052, U2800, U3...	[R & B, yujooooooo, Hybrid, Electronic, lofi, D...

Remove rows containing missing values if available

We can observe that only Tags have missing value when we calculate the missing percentage. So we'll investigate and get rid of it.

In [16]:
```
tags_missing = tracks_df[tracks_df['Tags'].isna()]
tags_missing
```

Out[16]:

	ID	Name	Poster	Plays	Likes	Reposts	PostedTime	Tags	Length	NumCommen
1966	T1967	Native America - Naturally Lazy	U10845	530740	8824	629	2014-09-17	NaN	0 days 00:02:50	

In [17]:
```
tracks_df.at[tags_missing.index,'Tags'] = 'None'
```

In [18]:
```
num_rows_track = len(tracks_df)
num_rows_track
```

Out[18]: 16190

Normalize data

In [19]:
```
tracks_df['Tags'].value_counts().iloc[:40]
```

Out[19]:
```
None                        2090
Pop                          877
Hip-hop & Rap                735
Rock                         643
Alternative                  562
Hip Hop                      460
Dance                        337
Electronic                   318
Disco                        260
Indie                        243
Dance & EDM                  227
House                        221
Rap                          219
lofi                         163
Rap/Hip Hop                  139
Folk                         137
Alternative Rock             137
R&B & Soul                   119
Acoustic                     114
Folk & Singer-Songwriter     103
Trap                         101
Deep House                    96
R&B                           94
Electro House                 78
Metal                         70
Progressive House             68
Dubstep                       60
Hip-Hop                       52
Reggae                        49
Country                       48
Indie Rock                    44
R & B                         43
pop                           43
World                         40
Remix                         35
Chill                         35
Soundtrack                    34
rap                           33
Hiphop                        33
Music                         32
Name: Tags, dtype: int64
```

We can see that a tags can contains some white space in the value so we will strip

In [20]:
```
tracks_df[cate_cols] = tracks_df[cate_cols].apply(lambda x : x.str.strip())
```

1. We can see that 'Indie' or 'indie' or 'indies' or 'Indies' is the same

In [21]:
```
tracks_df['Tags'] = tracks_df['Tags'].replace({'indie':'Indie','INDIE':'Indie','
                                               'alternative':'Alternative','ALTE
                                              'dance':'Dance','lofi':'Lofi','Hip
                                              'Hip-Hop':'Hip hop','Hip-Hop':'Hip
                                               'R & B':'R&B','R\'N\'B':'R&B','Fo
# tracks_df[tracks_df['Tags']=='indie rock']
```

Replace '/' & '//' by '&'

In [22]:
```
tracks_df['Tags'] = tracks_df['Tags'].replace({'\\\\':' & ','/':' & ','//':' & '
```

In [23]:
```
tracks_df['Tags'].value_counts().tail(30)
```

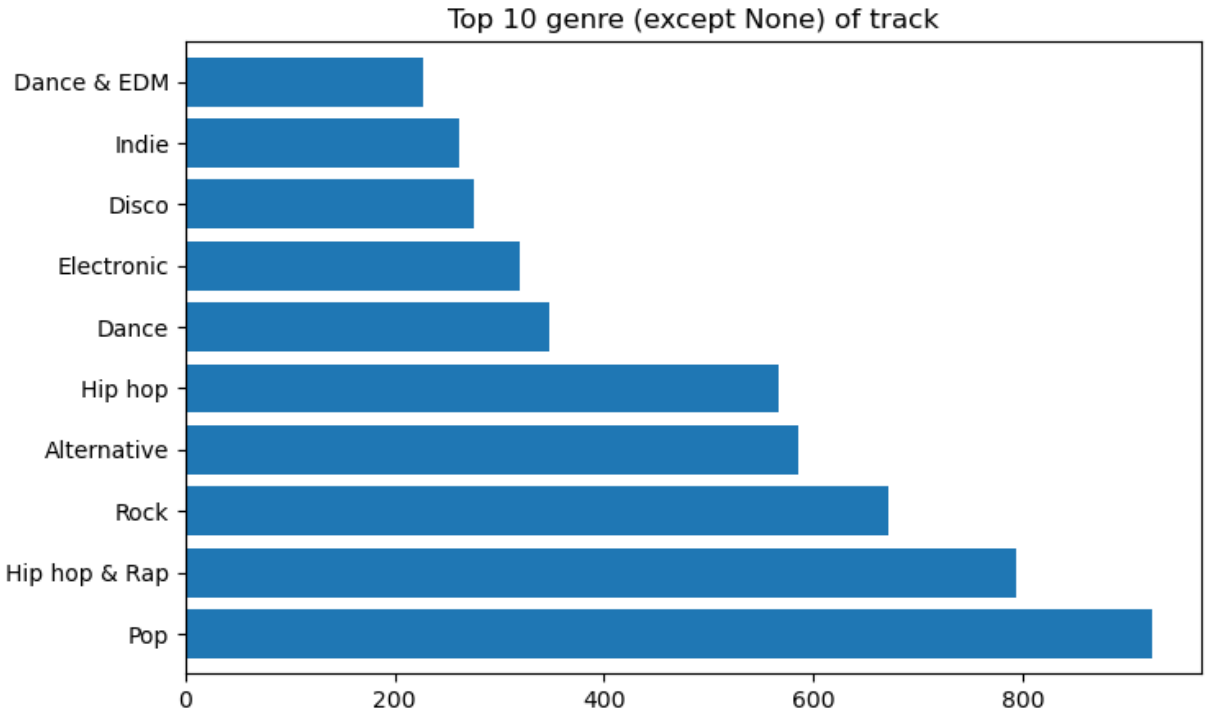
Out[23]:
```
HALSEY                                                    1
Balada y KPop                                             1
Indie  & Bandung  & bdg  & Folk  & Pop  & Acoustic  & solo    1
spiritual                                                 1
angry                                                     1
Touareq                                                   1
波                                                         1
tennis                                                    1
Electronic Hip hop                                        1
Set                                                       1
Flitz&Suppe                                               1
follow 1                                                ارجو
serial                                                    1
bob                                                       1
South Africa                                              1
Totally Enormous Extinct Dinosaurs                        1
Dr. Kucho!                                                1
arilasso                                                  1
House & Tech & Progressive                                1
ishaqzade                                                 1
Wednesday                                                 1
G-MAFIA                                                   1
easemymind                                                1
http: &  & soundcloud.com & syaugie & sets                1
D.R.A.M.                                                  1
S950 Boom Bap                                             1
https: &  & www.instagram.com & odelolabel &              1
abidaparveen                                              1
tronven  & t5ca                                           1
shadesheist                                               1
Name: Tags, dtype: int64
```

Many tags do not consider the definition of a genre or are seldom used, thus we eliminate them. We will just eliminate the row that doesn't contain any of the common tags that may be contained in a tag.

In [24]:
```
tracks_df['Tags'] = tracks_df['Tags'].replace({'Bersenjagurau':'None','Psychedeli
                                               'Beats':'Beat','Indie Folk':'Indie
                                              'Grunge':'Alternative'}, regex=True
value_count = tracks_df['Tags'].value_counts()
genre = tracks_df['Tags'].value_counts().iloc[:68].index
```

In [25]:
```
popular_genre = genre.to_series().str.split(' & ').explode().str.strip().drop_dup
pattern = '|'.join(popular_genre)
contain = tracks_df[tracks_df['Tags'].str.contains(pattern)]
notcontain = tracks_df[~tracks_df['Tags'].str.contains(pattern)]
notcontain =  notcontain.assign(Tags='None')
tracks_df = pd.concat([contain,notcontain])
# contain[~contain['Tags'].isin(popular_genre)]
```

In [26]:
```
tracks_df[tracks_df['Tags']!='None']['Tags'].value_counts()[:10].plot.barh(width=
plt.title('Top 10 genre (except None) of track')
fig=plt.gcf()
fig.set_size_inches(8,5)
plt.show()
```



3.1.2. Playlists

Load Data

In [27]:
```
playlists_df = pd.read_csv('playlist.csv')
playlists_df.head()
```

Out[27]:

	ID	Name	Poster	NumTracks	TopTracks	Likes	Reposts	PostedTime	Genre	L
0	P1	Gentle Dreams 🛏 - An Indie/Chill/Electronic P...	U1	18	['T1', 'T2', 'T3', 'T4', 'T5', 'T6', 'T7', 'T8...	121377	9211	13 May 2017	indie	1
1	P2	Relaxing Sunday Mornings ☕ - An Indie/Folk/Pop...	U1	16	['T11', 'T12', 'T13', 'T14', 'T15', 'T16', 'T1...	74566	4554	15 April 2017	indie	
2	P3	Indie	U22	522	['T21', 'T22', 'T23', 'T24', 'T25', 'T26', 'T2...	2236	149	22 June 2015	indie	2
3	P4	Indie	U32	379	['T31', 'T32', 'T33', 'T34', 'T35', 'T36', 'T3...	1159	180	1 August 2014	indie	2
4	P5	indie ♥	U43	291	['T41', 'T42', 'T43', 'T44', 'T45', 'T46', 'T4...	2300	685	21 January 2013	indie	2

How many rows and columns does the data have?

Get the number of rows and columns of the DataFrame `playlists_df` and store it in `num_rows_playlist` and `num_cols_playlist` variables by counting length of DataFrame and counting columns of DataFrame

In [28]:
```
num_rows_playlist = len(playlists_df)
num_cols_playlist = len(playlists_df.columns)

print("Number of rows:", num_rows_playlist)
print("Number of columns:", num_cols_playlist)
```

```
Number of rows: 2000
Number of columns: 10
```

There are 2000 of rows, 10 of columns in `playlists_df`

Does the data have duplicate?

Calculate the number of samples are duplicated based on `'ID'` field and store it in the variable `num_duplicated_rows` . In a group of samples, the first sample is not counted as duplicated by using (`keep='first'`). Then count number of duplications if their value are `True`

In [29]:
```
playlist_duplicate = playlists_df['ID'].duplicated(keep='first')
num_duplicated_rows = np.count_nonzero(playlist_duplicate == True)

print('Duplicate:', num_duplicated_rows)
playlists_df[playlist_duplicate == True]
```

```
Duplicate: 100
```

Out[29]:

	ID	Name	Poster	NumTracks	TopTracks	Likes	Reposts	PostedTime	Genre	Le
340	P340	Lofi	U2298	309	['T2959', 'T2960', 'T2961', 'T2962', 'T2963', ...	22	2	14 September 2018	lofi	2:2
380	P379	Vibes	U2228	207	['T3260', 'T3261', 'T2846', 'T2847', 'T2849', ...	45	1	17 November 2022	lofi	1:4
405	P207	| Chill | Lofi | Hip Hop |	U1493	122	['T1864', 'T1865', 'T1866', 'T1867', 'T1868', ...	98545	5614	28 October 2017	hiphop	1:5
406	P208	Study & Chill | Lofi Hiphop	U1502	24	['T1873', 'T1874', 'T1875', 'T1876', 'T1877', ...	98276	5976	3 September 2018	hiphop	4
420	P210	lofi hip hop playlist	U1515	90	['T1893', 'T1894', 'T1895', 'T1896', 'T1897', ...	61760	6913	22 February 2017	hiphop	2:2
...	...	...	...	...	...	...	...	...	...	
1974	P1867	rock	U11449	447	['T15919', 'T15920', 'T15921', 'T15922', 'T159...	7	7	27 February 2017	rock	2:3
1975	P1868	rock	U11455	481	['T15928', 'T15929', 'T15930', 'T15931', 'T159...	3	6	20 April 2019	rock	2:1
1976	P1869	rock	U11457	63	['T15938', 'T15764', 'T15085', 'T15939', 'T159...	2	9	13 April 2021	rock	1:4
1977	P1870	Rock	U11463	416	['T15163', 'T190', 'T15943', 'T7338', 'T15236'...	9	72	25 April 2016	rock	2:3

	ID	Name	Poster	NumTracks	TopTracks	Likes	Reposts	PostedTime	Genre	Len
1978	P1871	rock	U11465	379	['T15945', 'T15946', 'T15947', 'T15948', 'T159...	5	1	8 August 2016	rock	2:5

100 rows × 10 columns

Therefore having 100 duplicated data in `playlists_df` , we need to remove those duplicates. After removing, number of rows of `playlists_df` will be changed

In [30]:
```
duplicate_index = playlists_df[playlist_duplicate == True].index
playlists_df.drop(duplicate_index, inplace=True)
num_rows_playlist = len(playlists_df)
num_rows_playlist
```

Out[30]:
```
1900
```

Check Columns' Datatypes, adjust if needed

In [31]:
```
playlists_df['NumTracks'] = playlists_df['NumTracks'].apply(lambda col: col.repla
playlists_df[['NumTracks', 'Likes', 'Reposts']] = playlists_df[['NumTracks', 'Lik
playlists_df[['NumTracks', 'Likes', 'Reposts']] = playlists_df[['NumTracks', 'Lik

playlists_df.dtypes
```

Out[31]:
```
ID            object
Name          object
Poster        object
NumTracks      int64
TopTracks     object
Likes          int64
Reposts        int64
PostedTime    object
Genre         object
Length        object
dtype: object
```

In [32]:
```
playlists_df['PostedTime'] = pd.to_datetime(playlists_df['PostedTime'][playlists_
playlists_df['Length'] = playlists_df['Length'].str.replace('^(\d+:\d+)$', r'0:\1
playlists_df['Length'] = playlists_df['Length'].apply(lambda col: np.nan if col==

playlists_df.dtypes
```

Out[32]:
```
ID                      object
Name                    object
Poster                  object
NumTracks                int64
TopTracks               object
Likes                    int64
Reposts                  int64
PostedTime      datetime64[ns]
Genre                   object
Length         timedelta64[ns]
dtype: object
```

Find out distribution of numeric data columns

In [33]:
```
nume_cols = ['NumTracks', 'Likes', 'Reposts', 'PostedTime', 'Length']

missing_percentages = np.isnan(playlists_df[nume_cols]).sum() / num_rows_playlist
mins = np.percentile(playlists_df[nume_cols], 0, axis=0)
medians = np.percentile(playlists_df[nume_cols], 50, axis=0)
maxs = np.percentile(playlists_df[nume_cols], 100, axis=0)

nume_cols_df_playlist = pd.DataFrame(data=np.array([missing_percentages, mins, me
                                     index=['Missing percentage', 'Min', 'Median'
nume_cols_df_playlist
```

Out[33]:

	NumTracks	Likes	Reposts	PostedTime	Length
Missing percentage	0.0	0.0	0.0	0.315789	0.368421
Min	0.0	0.0	0.0	2012-11-06 00:00:00	0 days 00:02:44
Median	343.5	5.0	3.0	2017-11-28 12:00:00	0 days 02:52:56.500000
Max	4505.0	421046.0	177117.0	2022-11-26 00:00:00	12 days 22:25:17

Find out distribution of non-numeric data columns

In [34]:
```
cate_cols = ['ID', 'Name', 'Poster', 'TopTracks', 'Genre']

missing_percentages = np.sum(playlists_df[cate_cols].isna()) / num_rows_playlist
num_diff_vals = np.array(playlists_df[cate_cols].nunique())
diff_vals = np.array(playlists_df[cate_cols].apply(lambda col: col.dropna().uniqu

cate_cols_df_playlist = pd.DataFrame(data=np.array([missing_percentages, num_diff
                                     index=['Missing percentage', 'Num diff val',
cate_cols_df_playlist
```

Out[34]:

	ID	Name	Poster	TopTracks	Genre
Missing percentage	0.0	0.0	0.0	0.0	0.0
Num diff val	1900	186	1793	1880	10
Diff val	[P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11,...	[Gentle Dreams 🛏 - An Indie/Chill/Electronic ...	[U1, U22, U32, U43, U54, U63, U70, U81, U89, U...	[['T1', 'T2', 'T3', 'T4', 'T5', 'T6', 'T7', 'T...	[indie, lofi, hiphop, edm, disco, rap, acousti...

Drop missing value

In [35]:
```
PostedTime_missing = playlists_df[playlists_df['PostedTime'].isna()]
PostedTime_missing
```

Out[35]:

	ID	Name	Poster	NumTracks	TopTracks	Likes	Reposts	PostedTime	Genre	Length
214	P215	None	U1551	0	[]	0	0	NaT	lofi	NaT
396	P395	None	U1551	0	[]	0	0	NaT	lofi	NaT
803	P771	None	U1551	0	[]	0	0	NaT	disco	NaT
846	P814	None	U1551	0	[]	0	0	NaT	disco	NaT
912	P880	None	U1551	0	[]	0	0	NaT	disco	NaT
948	P916	None	U1551	0	[]	0	0	NaT	disco	NaT

In [36]:
```
playlists_df.drop(PostedTime_missing.index, inplace=True)
```

In [37]:
```
Length_missing = playlists_df[playlists_df['Length'].isna()]
Length_missing
```

Out[37]:

	ID	Name	Poster	NumTracks	TopTracks	Likes	Reposts	PostedTime	Genre	Length
1018	P982	rap	U6082	0	[]	2	2	2020-04-23	rap	NaT

In [38]:
```
playlists_df.drop(Length_missing.index, inplace=True)
```

Check if NumTracks equals 0 and remove it

In [39]:
```
playlists_df[playlists_df['NumTracks']==0]
```

Out[39]:

ID	Name	Poster	NumTracks	TopTracks	Likes	Reposts	PostedTime	Genre	Length

Check if length of list of track of a playlist is empty

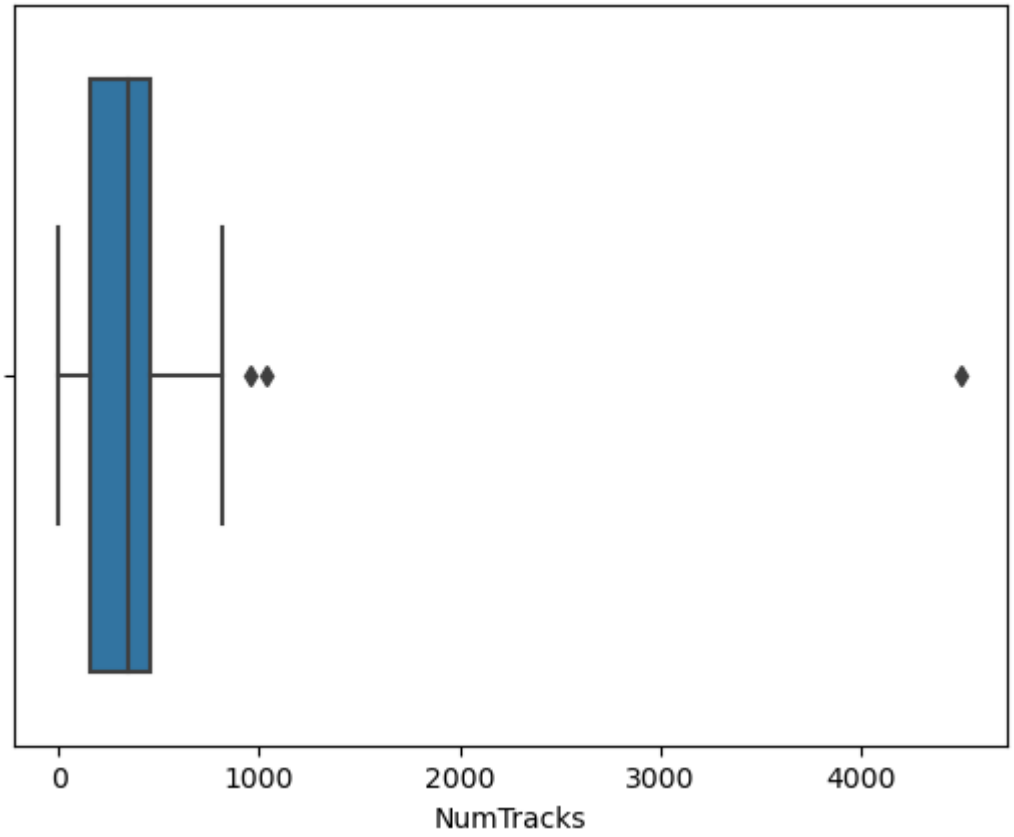
In [40]:
```
playlists_df['TopTracks'] = playlists_df['TopTracks'].apply(lambda x: re.findall(
sum(playlists_df['TopTracks'].apply(lambda x: len(x)==0))
```

Out[40]:
```
0
```

In [41]:
```
sns.boxplot(playlists_df['NumTracks'])
```

```
/home/minkoi/miniconda3/envs/min_ds-env/lib/python3.8/site-packages/seaborn/_de
corators.py:36: FutureWarning: Pass the following variable as a keyword arg: x.
From version 0.12, the only valid positional argument will be `data`, and passi
ng other arguments without an explicit keyword will result in an error or misin
terpretation.
  warnings.warn(
```

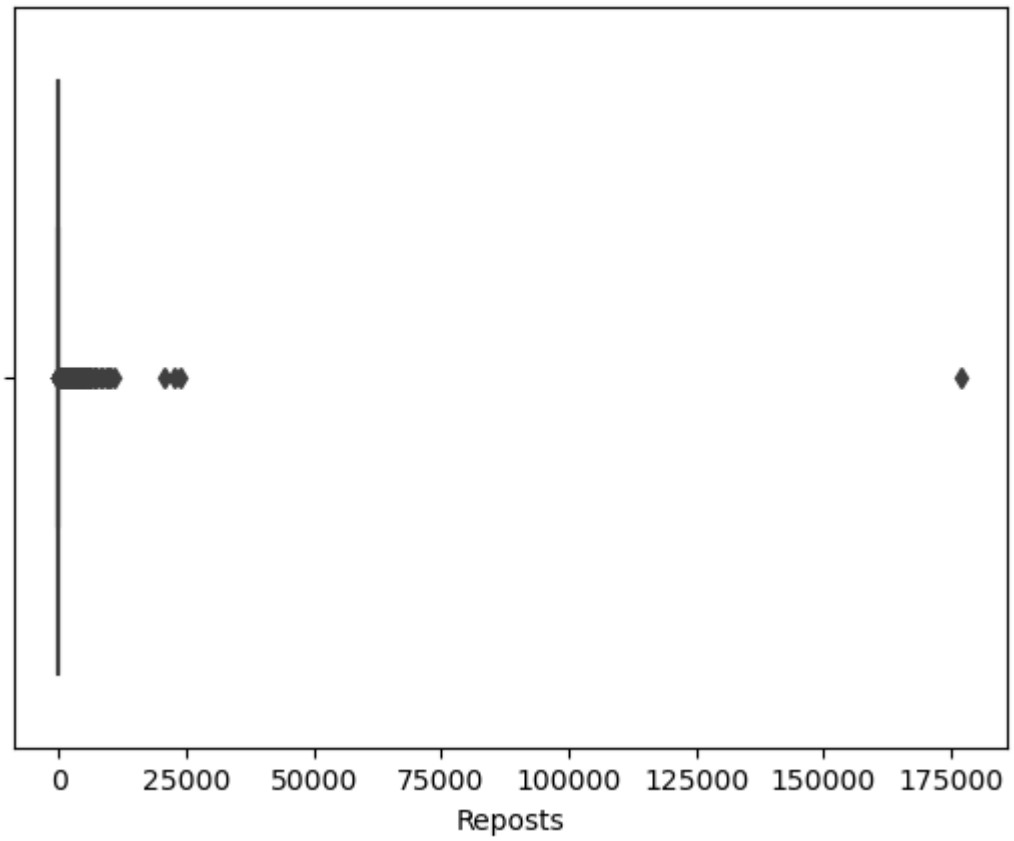
Out[41]:
```
<AxesSubplot:xlabel='NumTracks'>
```



In [42]:
```
sns.boxplot(playlists_df['Reposts'])
```

```
/home/minkoi/miniconda3/envs/min_ds-env/lib/python3.8/site-packages/seaborn/_de
corators.py:36: FutureWarning: Pass the following variable as a keyword arg: x.
From version 0.12, the only valid positional argument will be `data`, and passi
ng other arguments without an explicit keyword will result in an error or misin
terpretation.
  warnings.warn(
```

Out[42]: <AxesSubplot:xlabel='Reposts'>



3.1.3. Users

Load data

In [43]:
```
users_df = pd.read_csv('user.csv')
users_df.head()
```

Out[43]:

	ID	Name	NumFollowers	NumFollowing	NumTracks	Verified	NextPro
0	U1	Kupla	21093	720	95	Verified	Next Pro
1	U2	Matt	357	0	46	None	None
2	U3	ZCR WORLD	241	97	12	None	None
3	U4	Amin Mohammadi	2443	55	23	None	None
4	U5	Dr'Q	4318	102	21	None	None

How many rows and columns does the data have?

Get the number of rows and columns of the DataFrame `users_df` and store it in `num_rows_user` and `num_cols_user` variables by counting length of DataFrame and counting columns of DataFrame

In [44]:
```
num_rows_user = len(users_df)
num_cols_user = len(users_df.columns)

print("Number of rows:", num_rows_user)
print("Number of columns:", num_cols_user)
```

```
Number of rows: 11589
Number of columns: 7
```

There are 11589 of rows, 7 of columns in `users_df`

Does the data have duplicate?

Calculate the number of samples are duplicated based on `'ID'` field and store it in the variable `num_duplicated_rows` . In a group of samples, the first sample is not counted as duplicated by using (`keep='first'`). Then count number of duplications if their value are `True`

In [45]:
```
user_duplicate = users_df['ID'].duplicated(keep='first')
num_duplicated_rows = np.count_nonzero(user_duplicate==True)

print('Duplicate:', num_duplicated_rows)
```

```
Duplicate: 0
```

There are 0 duplicates in `users_df`

Check Columns' Datatypes, adjust if needed

In [46]:
```
users_df['NumFollowing'] = users_df['NumFollowing'].replace('1 person', '1')
users_df['NumFollowing'] = users_df['NumFollowing'].apply(lambda col: col.replace

users_df[['NumFollowers', 'NumFollowing', 'NumTracks']] = users_df[['NumFollowers
users_df[['NumFollowers', 'NumFollowing', 'NumTracks']] = users_df[['NumFollowers

users_df.dtypes
```

Out[46]:
```
ID             object
Name           object
NumFollowers    int64
NumFollowing    int64
NumTracks       int64
Verified       object
NextPro        object
dtype: object
```

In [47]:
```
users_df['Verified'] = users_df['Verified'].replace({'Verified':True, 'None':Fals

users_df.dtypes
```

Out[47]:
```
ID             object
Name           object
NumFollowers    int64
NumFollowing    int64
NumTracks       int64
Verified         bool
NextPro        object
dtype: object
```

Find out distribution of numeric data columns

In [48]:
```
nume_cols = ['NumFollowers', 'NumFollowing', 'NumTracks']

missing_percentages = np.isnan(users_df[nume_cols]).sum() / num_rows_user * 100
mins = np.percentile(users_df[nume_cols], 0, axis=0)
medians = np.percentile(users_df[nume_cols], 50, axis=0)
maxs = np.percentile(users_df[nume_cols], 100, axis=0)

nume_cols_df_user = pd.DataFrame(data=np.array([missing_percentages, mins, median
                                 index=['Missing percentage', 'Min', 'Median', 'M
nume_cols_df_user
```

Out[48]:

	NumFollowers	NumFollowing	NumTracks
Missing percentage	0.0	0.0	0.0
Min	0.0	0.0	0.0
Median	992.0	18.0	19.0
Max	10111989.0	2024.0	24393.0

Find out distribution of non-numeric data columns

In [49]:
```
cate_cols = ['ID', 'Name', 'Verified', 'NextPro']

missing_percentages = np.sum(users_df[cate_cols].isna()) / num_rows_user * 100
num_diff_vals = np.array(users_df[cate_cols].nunique())
diff_vals = np.array(users_df[cate_cols].apply(lambda col: col.dropna().unique())

cate_cols_df_user = pd.DataFrame(data=np.array([missing_percentages, num_diff_val
                                 index=['Missing percentage', 'Num diff val', 'Di
cate_cols_df_user
```

Out[49]:

	ID	Name	Verified	NextPro
Missing percentage	0.0	0.0	0.0	0.0
Num diff val	11589	11574	2	3
Diff val	[U1, U2, U3, U4, U5, U6, U7, U8, U9, U10, U11,...	[Kupla , Matt, ZCR WORLD, Amin Mohammadi, D...	[True, False]	[Next Pro, None, Pro]

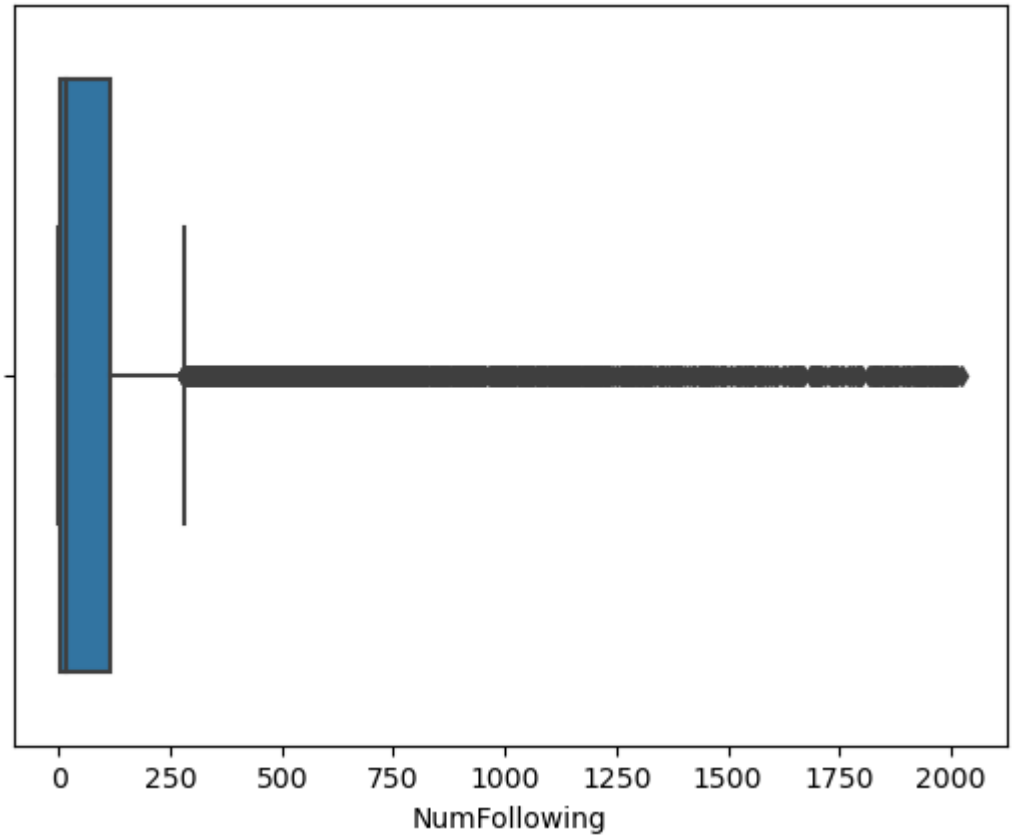
Remove rows containing missing values if available

Missing percentage of all field is 0 so we can skip this step

In [50]:
```
sns.boxplot(users_df['NumFollowing'])
```

```
/home/minkoi/miniconda3/envs/min_ds-env/lib/python3.8/site-packages/seaborn/_de
corators.py:36: FutureWarning: Pass the following variable as a keyword arg: x.
From version 0.12, the only valid positional argument will be `data`, and passi
ng other arguments without an explicit keyword will result in an error or misin
terpretation.
  warnings.warn(
```

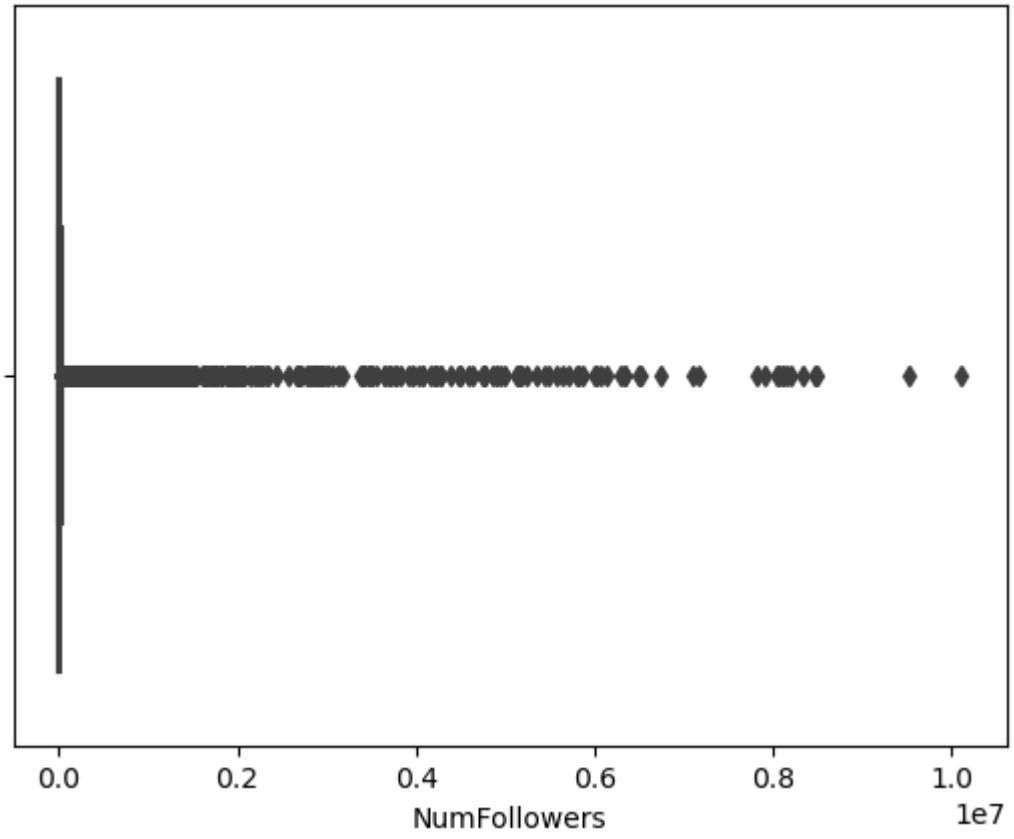
Out[50]: <AxesSubplot:xlabel='NumFollowing'>



In [51]:
```
sns.boxplot(users_df['NumFollowers'])
```

```
/home/minkoi/miniconda3/envs/min_ds-env/lib/python3.8/site-packages/seaborn/_de
corators.py:36: FutureWarning: Pass the following variable as a keyword arg: x.
From version 0.12, the only valid positional argument will be `data`, and passi
ng other arguments without an explicit keyword will result in an error or misin
terpretation.
  warnings.warn(
```

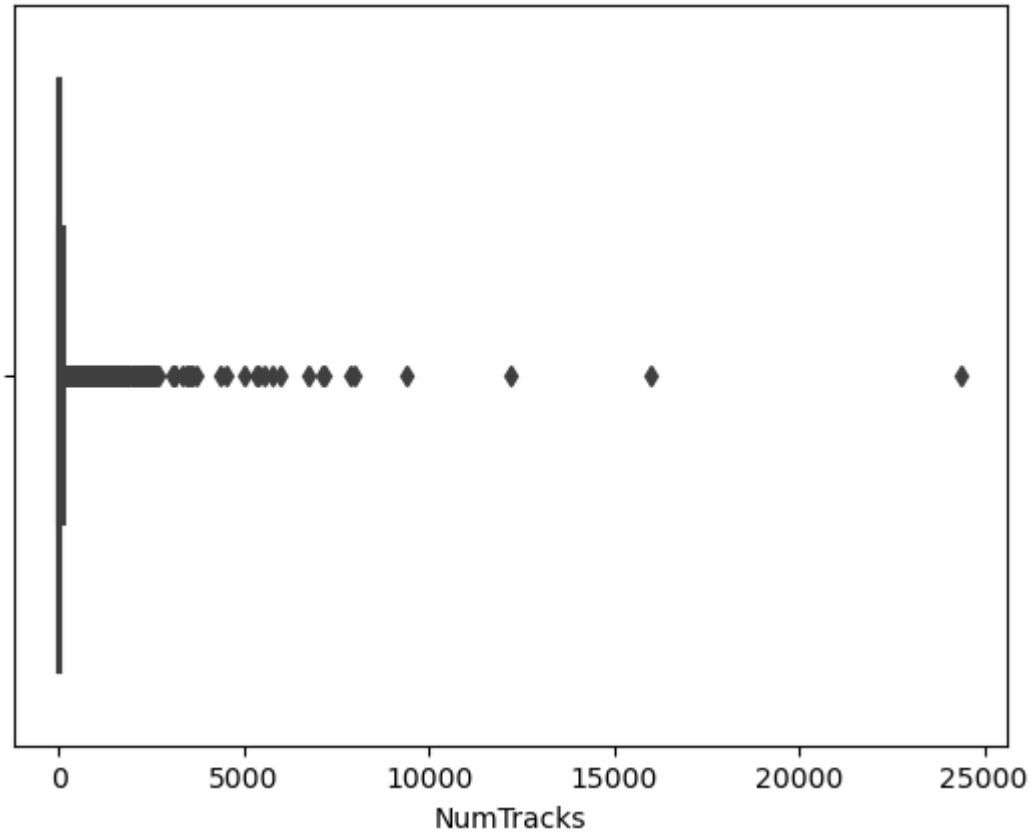
Out[51]: <AxesSubplot:xlabel='NumFollowers'>



In [52]:
```
sns.boxplot(users_df['NumTracks'])
```

```
/home/minkoi/miniconda3/envs/min_ds-env/lib/python3.8/site-packages/seaborn/_de
corators.py:36: FutureWarning: Pass the following variable as a keyword arg: x.
From version 0.12, the only valid positional argument will be `data`, and passi
ng other arguments without an explicit keyword will result in an error or misin
terpretation.
  warnings.warn(
```

Out[52]: <AxesSubplot:xlabel='NumTracks'>



Comment: We can see that there are outliers, but since it can tell us something about the other field in the rows, we won't delete it until the query is about "NumFollowers," "NumFollowing," or

something similar.

3.2. Making Question

Question 1

What is the ratio between the "verified users" and "None verified users" ?

1. Calculate the ratio of verified users and None verified users to show that the most/ the least kind of user in soundcloud in recent years
2. Draw a pie chart to show the ratio

Preprocessing

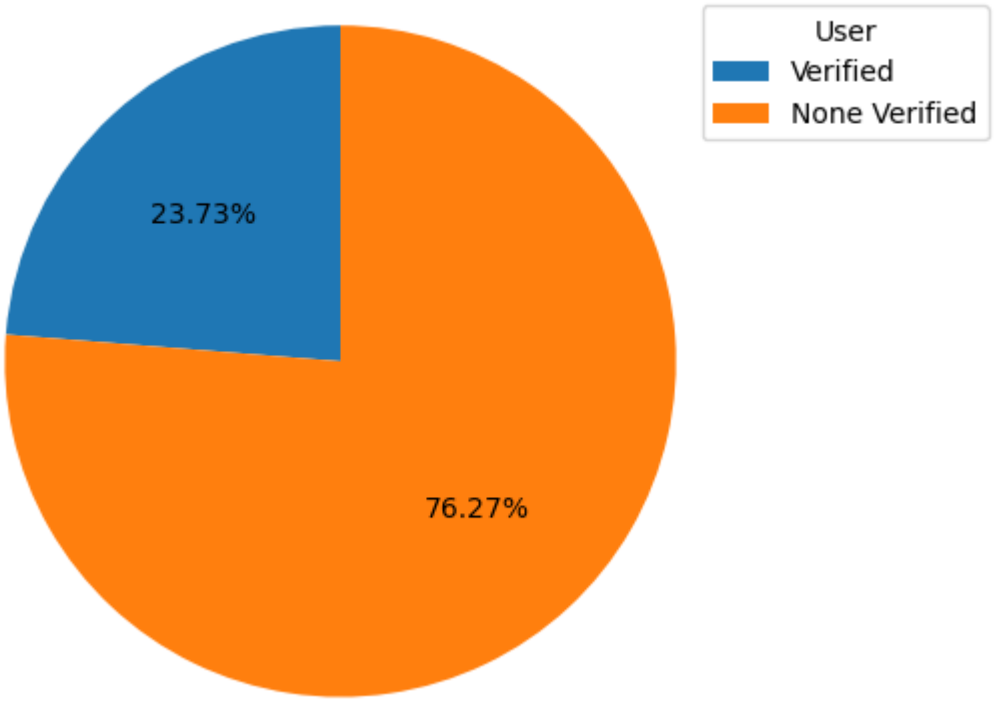
No need to preprocess

Data Analysis

In [53]:
```
verified_user_df = users_df.loc[users_df['Verified'] == True]

verified_user_ratio = len(verified_user_df) / len(users_df)
none_verified_user_ratio = 1 - verified_user_ratio
```

Data Visualization

In [54]:
```
# Pie chart, where the slices will be ordered and plotted counter-clockwise:
mylabels = ['Verified', 'None Verified']
sizes = [verified_user_ratio * 100, none_verified_user_ratio * 100]

fig1, ax1 = plt.subplots()
ax1.pie(sizes, autopct='%.2f%%', startangle=90)
ax1.axis('equal')
plt.legend(title = "User", bbox_to_anchor=(0.85, 1), loc='upper left', labels=myl

plt.show()
```



Answer

None verified users make up the majority (approximately 83.95%) of users. Verified users are less than (approximately 16.05%).

- It shows that the imbalance between two kinds of user.
- A large of people just like to hear music and post music on soundcloud for personal entertainment purposes or contribute their products to the community. In my opinion, maybe they do not want to be famous or well-known creators

---

Question 2

Does those users who are verified have more followers than those ones who are not?

Preprocessing

In [55]:
```
verified = users_df[users_df['Verified'] == True]
non_verified = users_df[users_df['Verified'] == False]
```

In [56]:
```
verified
```

Out[56]:

	ID	Name	NumFollowers	NumFollowing	NumTracks	Verified	NextPro
0	U1	Kupla	21093	720	95	True	Next Pro
12	U13	Dead Oceans	123394	20	233	True	Next Pro
20	U21	Fatboy Slim	307312	3	571	True	None
21	U22	Patrick Baker	9890	663	56	True	Pro
23	U24	Murda Beatz	147799	0	116	True	None
...	...	...	...	...	...	...	...
11533	U11534	SOURCE	46023	7	213	True	None
11547	U11548	quickly, quickly	56407	283	63	True	Pro
11577	U11578	Thomas Azier	10982	38	91	True	None
11578	U11579	Portugal. The Man	2276562	26	273	True	Next Pro
11584	U11585	Dada Life	3465379	4	404	True	Next Pro

2750 rows × 7 columns

In [57]:
```
non_verified
```

Out[57]:

	ID	Name	NumFollowers	NumFollowing	NumTracks	Verified	NextPro
1	U2	Matt	357	0	46	False	None
2	U3	ZCR WORLD	241	97	12	False	None
3	U4	Amin Mohammadi	2443	55	23	False	None
4	U5	Dr'Q	4318	102	21	False	None
5	U6	DatBoiCoop_	111	27	17	False	None
...	...	...	...	...	...	...	...
11583	U11584	KA$HPHON	1679	4	65	False	None
11585	U11586	SBG Movement 2011	900	0	20	False	None
11586	U11587	Play It Down	20141	158	234	False	Next Pro
11587	U11588	Noname	154940	30	24	False	None
11588	U11589	Casual Connection	35924	217	186	False	Next Pro

8839 rows × 7 columns

Data Analysis

In [58]:
```
q1_ver = verified['NumFollowers'].quantile(0.25)
q2_ver = verified['NumFollowers'].quantile(0.5)
q3_ver = verified['NumFollowers'].quantile(0.75)
print(q1_ver)
print(q2_ver)
print(q3_ver)
```

```
19357.75
52766.0
174812.5
```

In [59]:
```
print(len(verified[verified['NumFollowers'] < q1_ver]))
print(len(verified[(verified['NumFollowers'] >= q1_ver) & (verified['NumFollowers
print(len(verified[(verified['NumFollowers'] >= q2_ver) & (verified['NumFollowers
print(len(verified[verified['NumFollowers'] >= q3_ver]))
```

```
688
687
687
688
```

In [60]:
```
q1_nonver = non_verified['NumFollowers'].quantile(0.25)
q2_nonver = non_verified['NumFollowers'].quantile(0.5)
q3_nonver = non_verified['NumFollowers'].quantile(0.75)
print(q1_nonver)
print(q2_nonver)
print(q3_nonver)
```

```
49.0
356.0
2101.5
```

In [61]:
```
print(len(non_verified[non_verified['NumFollowers'] < q1_nonver]))
print(len(non_verified[(non_verified['NumFollowers'] >= q1_nonver) & (non_verifie
print(len(non_verified[(non_verified['NumFollowers'] >= q2_nonver) & (non_verifie
print(len(non_verified[non_verified['NumFollowers'] >= q3_nonver]))
```

```
2193
2223
2213
2210
```

In [62]:
```
print(verified['NumFollowers'].max())
print(non_verified['NumFollowers'].max())
```

```
10111989
2883793
```

In [63]:
```
cols = ['[0,20k)', '[20k, 40k)', '[40k, 60k)', '[60k, 80k)', '[80k, 100k)', '[100
        '[120k, 140k)', '[140k, 160k)', '[160k, 180k)', '[180k, 200k)', '[200k, 1
bins = [0, 20000, 40000, 60000, 80000, 100000, 120000, 140000, 160000, 180000, 20
count_ver = []
count_nonver = []

for i in range(len(bins) - 1):
    count_ver.append(verified[(verified['NumFollowers'] >= bins[i]) & (verified['
    count_nonver.append(non_verified[(non_verified['NumFollowers'] >= bins[i]) &
                                     (non_verified['NumFollowers'] < bins[i+1])].

print(count_ver)
print(count_nonver)
```

```
[715, 473, 276, 184, 143, 82, 78, 71, 54, 51, 623]
[8553, 158, 47, 28, 16, 8, 5, 4, 3, 3, 14]
```

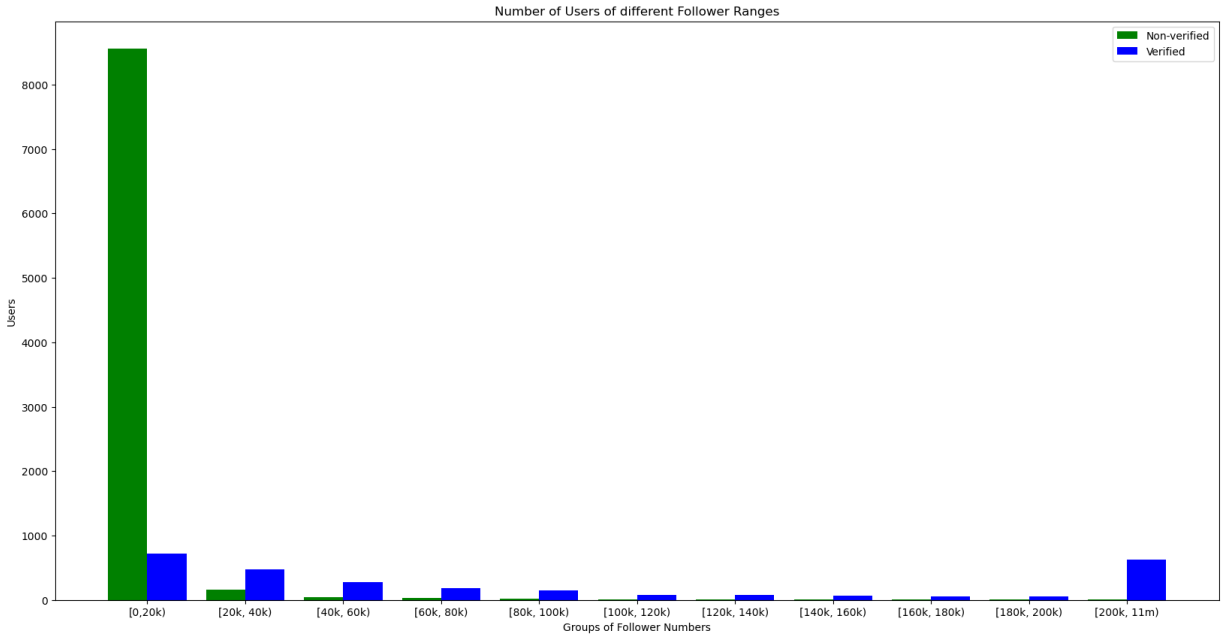
In [64]:
```
avg_verified_followers = verified['NumFollowers'].sum() / len(verified['NumFollov
avg_nonverified_followers = non_verified['NumFollowers'].sum() / len(non_verified
print(avg_verified_followers.round(0))
print(avg_nonverified_followers.round(0))
```

```
345873.0
4211.0
```

Data Visualization

Compare number of followers of two user groups

In [65]:
```
fig = plt.figure(figsize=(20, 10))

x_axis = np.arange(len(cols))

plt.bar(x_axis - 0.2, count_nonver, 0.4, label = 'Non-verified', color = 'green')
plt.bar(x_axis + 0.2, count_ver, 0.4, label = 'Verified', color = 'blue')

plt.xticks(x_axis, cols)
plt.xlabel('Groups of Follower Numbers')
plt.ylabel('Users')
plt.title('Number of Users of different Follower Ranges')
plt.legend()
plt.show()
```



Answer

As what can be seen from the chart, considering 2750 Verified Users and 8839 Non-verified Users, the number of Non-verified Users belonging to group from 0 to 20000 followers stands at around 8500, when the figures for the remaining groups are only below 200 users. Meanwhile, the number of Verified Users decreases from around 700 (Group from 0 to 20000 followers) to just above 50 users for group from 180000 to 200000 followers. However, there are upto more than 600 users belonging to group from 200000 to 11 million users. Moreover, the average number of followers of Verified Users is significantly greater than the figure for Non-verified Users, 345873 followers compared to 4211 followers. To summerize, it can be concluded that those users who are verified will have more followers than those ones who are not.

Question 3

Find out popular songs posted in the last 5 years

- Data: track.csv
- Idea: To display top 10 popular songs of each year in the last 5 years first we need to get the corresponding data set which means get columns Name, Plays, Likes, Reposts, PostedTime and Year. Year is not in the original data set but is added by interpolating from the PostedTime. Next we will classify tracks to corresponding year (2018 to 2022) base on its name and number of plays. After that, sorting tracks by its number of plays descending so we can get top 10 tracks with the most played time. Finally, display top 10 popular songs of each year in the last 5 years.

Preprocessing

In [66]:
```
popular_tracks = tracks_df[['Name', 'Plays', 'Likes', 'Reposts', 'PostedTime']].c
popular_tracks['Year'] = popular_tracks['PostedTime'].dt.year
index_order = range(0, len(popular_tracks))
popular_tracks = pd.DataFrame(popular_tracks, index = index_order)
```

Data Analysis

In [67]:
```
# list store top 10 tracks of each year based on number of plays
latest_5_years = [{}, {}, {}, {}, {}]
for i in range(len(popular_tracks)):
    if popular_tracks['Year'][i] == 2018:
        latest_5_years[0][popular_tracks['Name'][i]] = popular_tracks['Plays'][i]
    elif popular_tracks['Year'][i] == 2019:
        latest_5_years[1][popular_tracks['Name'][i]] = popular_tracks['Plays'][i]
    elif popular_tracks['Year'][i] == 2020:
        latest_5_years[2][popular_tracks['Name'][i]] = popular_tracks['Plays'][i]
    elif popular_tracks['Year'][i] == 2021:
        latest_5_years[3][popular_tracks['Name'][i]] = popular_tracks['Plays'][i]
    elif popular_tracks['Year'][i] == 2022:
        latest_5_years[4][popular_tracks['Name'][i]] = popular_tracks['Plays'][i]
# sorting dictionary to get most played tracks
# get top 10 tracks
for i in range(len(latest_5_years)):
    latest_5_years[i] = dict(sorted(latest_5_years[i].items(), key=lambda item: i
    latest_5_years[i] = list(latest_5_years[i].keys())[0: 10]
```

Data Visualization

In [68]:
```
# store to DataFrame
columns_name = ['2018', '2019', '2020', '2021', '2022']
index_names = ['Top 1', 'Top 2','Top 3','Top 4','Top 5','Top 6','Top 7','Top 8','
data = dict(zip(columns_name, latest_5_years))
most_played_tracks_5years = pd.DataFrame(data, index = index_names)
most_played_tracks_5years
```

Out[68]:

	2018	2019	2020	2021	2022
Top 1	약속 By JIMIN Of BTS	Robbery	Future - March Madness	Calling My Phone (feat. 6lack)	NLE Choppa - Capo
Top 2	Lucid Dreams	Lil Tecca - Ransom	NLE Choppa - Camelot	Monëy so big	Future feat. Drake & Tems - WAIT FOR U
Top 3	Lil Baby, Gunna - Drip Too Hard	Polo G feat. Lil TJay - Pop Out	Wishing Well	كليب انا بعشقني اوي يابا عصام صاصا الكروان - ...	Future - PUFFIN ON ZOOTIEZ
Top 4	Post Malone - rockstar (feat. 21 Savage)	Ballin' (with Roddy Ricch)	Lemonade Ft. Don Toliver, Gunna & NAV	By Your Side	Hide & Seek
Top 5	Envy Me	DaBaby - Suge	Future - Purple Reign	Astronaut In The Ocean	POLAND - LIL YACHTY(PROD. F1LTHY)
Top 6	F.N	MIDDLE CHILD	Future - Perkys Calling	مهرجان وسط دموع وجراح (ع الواتس الف رساله مبع...	Waddup (feat. Polo G)
Top 7	I Kill People! ft Tadoe & Chief Keef [Produced...	Pop Smoke - Dior	Pop Smoke - Element	Already Dead	YoungBoy Never Broke Again - Bring The Hook
Top 8	ZEZE (feat. Travis Scott & Offset)	23 Island	Drake - Laugh Now Cry Later (feat. Lil Durk)	Drake - Girls Want Girls (feat. Lil Baby)	Polo G - Distraction
Top 9	Lean Wit Me	Empty	Future - All Right	Burn	BILLIE EILISH.
Top10	YoungBoy Never Broke Again - Outside Today	Taki Taki (feat. Selena Gomez, Ozuna & Cardi B)	Come & Go Ft. Marshmello	مهرجان ابوا احتليت كوكب كونتر (ملك الموت جي ب...	FOR FUN Prod. By BEATSBYJEFF

Answer

We know which song is popular base on its number of plays then we can make a popular songs chart and recommend it to users.

Question 4

What is the best linear regression model that show correlation between number of plays of a track and its number of likes, reposts and comments?

Preprocessing

In [69]:
```
tracks_df
```

Out[69]:

	ID	Name	Poster	Plays	Likes	Reposts	PostedTime	Tags	Length	Nu
0	T1	Locked Up	U4190	1033050	15590	421	2005-01-01	R&B	NaT	
3	T4	Dabin x Fytch - Altitude	U4868	324493	7536	1018	2018-09-28	Electronic	0 days 00:03:27	
4	T5	earned it	U3052	42037	805	71	2018-07-28	Lofi	0 days 00:03:33	
5	T6	LOST IN MUSIC (DSD Balearic Mix)	U2800	39261	1440	381	2018-10-30	Disco	0 days 00:07:40	
7	T8	Whole Lotta Money - Remix (The Frenchies Remix)	U6648	549036	8054	202	2021-11-03	House	0 days 00:06:41	
...	...	...	...	...	...	...	...	...	...	...
16163	T16164	Monkey Bars - Colors	U3054	107295	1489	91	2014-11-12	None	0 days 00:04:25	
16164	T16165	Cold days w/ j'san.	U10551	1067592	8761	497	2017-09-01	None	0 days 00:02:04	
16169	T16170	the burn marks on my epiano wont go away	U253	4206783	48393	4353	2016-01-27	None	0 days 00:01:36	
16183	T16184	Rossa-Terlalu Cinta	U1387	1404120	20584	282	2013-12-31	None	0 days 00:04:00	
16184	T16185	Hot Nigga - Bobby Shmurda ft. Fabolous, Chris ...	U4635	30059121	391523	17282	2014-09-05	None	0 days 00:05:43	

16190 rows × 10 columns

In [70]:
```
lr_df = pd.concat((tracks_df[['Plays', 'Likes', 'Reposts']], tracks_df['NumCommer
lr_df.head()
```

Out[70]:

	Plays	Likes	Reposts	NumComments
0	1033050	15590	421	84
3	324493	7536	1018	85
4	42037	805	71	11
5	39261	1440	381	34
7	549036	8054	202	135

In [71]:
```
x = lr_df.drop(['Plays'], axis = 1).values
y = lr_df['Plays'].values
```

Data Analysis

In [72]:
```
# Split initial datasets into train and test datasets
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.3, random_s
```

In [73]:
```
lr = LinearRegression()
lr.fit(x_train, y_train)
```

Out[73]:
```
LinearRegression()
```

In [74]:
```
# Coefficient of each Feature
coef = lr.coef_
coef = list(coef)
coef = [coef[i].round(3) for i in range(len(coef))]
coef
```

Out[74]:
```
[68.301, 0.02, 553.235]
```

In [75]:
```
# Predict values
y_pred = lr.predict(x_test)
print(y_pred)
```

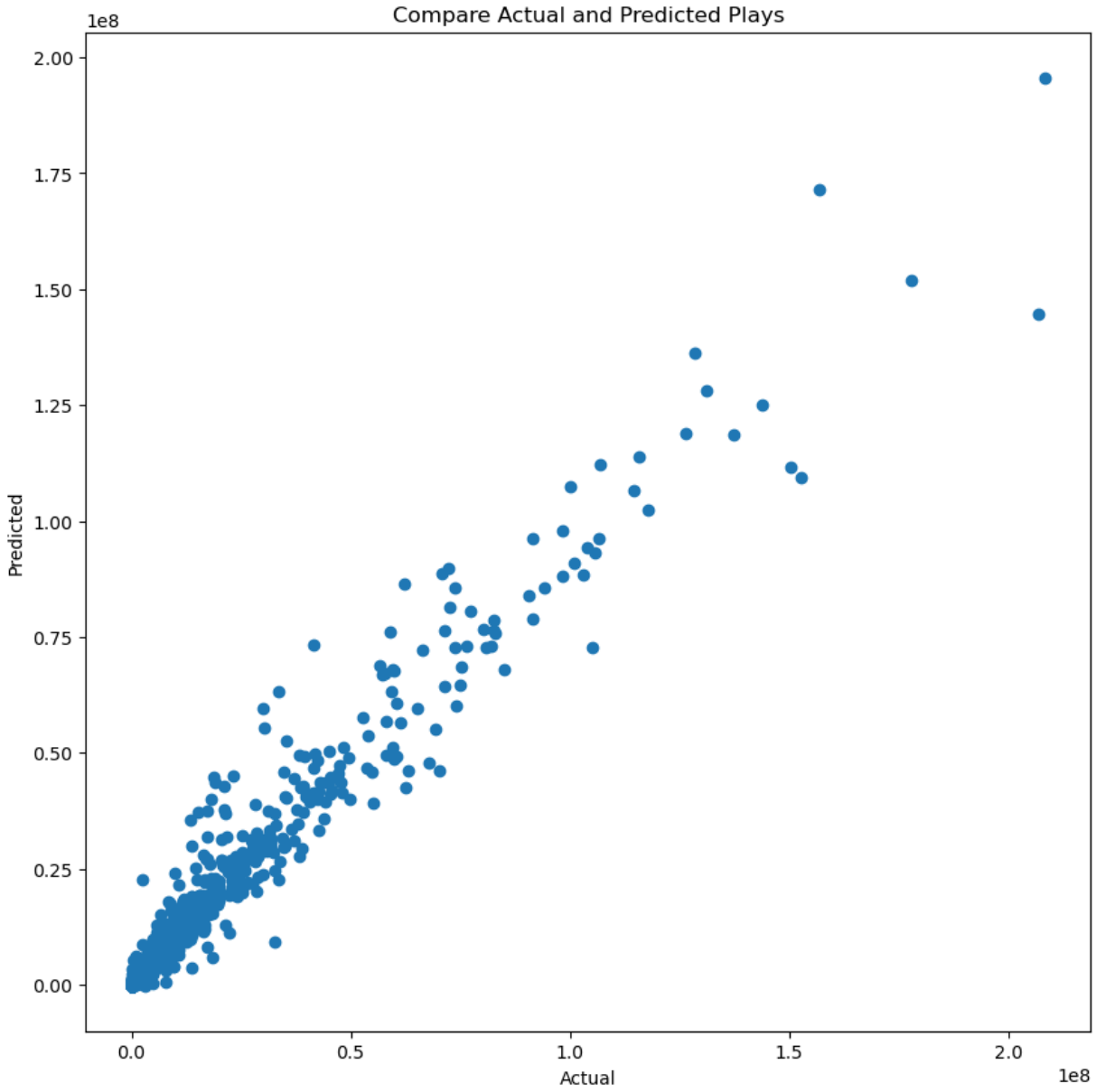
```
[-164425.06099534 1376667.96927179 3139232.140015   ... -219974.91518582
  361102.25129037 8073119.27613368]
```

In [76]:
```
# Evaluate the model
r2_score(y_test, y_pred)
```

Out[76]:
```
0.9561415339699525
```

Data Visualization

In [77]:
```
plt.figure(figsize = (10, 10))
plt.scatter(y_test, y_pred)
plt.xlabel('Actual')
plt.ylabel('Predicted')
plt.title('Compare Actual and Predicted Plays')
plt.show()
```



Answer

Linear Regression Model

$$\text{Plays} = 73.152(Likes) + 0.015(Reposts) + 262.24(NumComments)$$

Question 5

Number of tracks posted over the last 5 years

Preprocessing

No need to preprocess

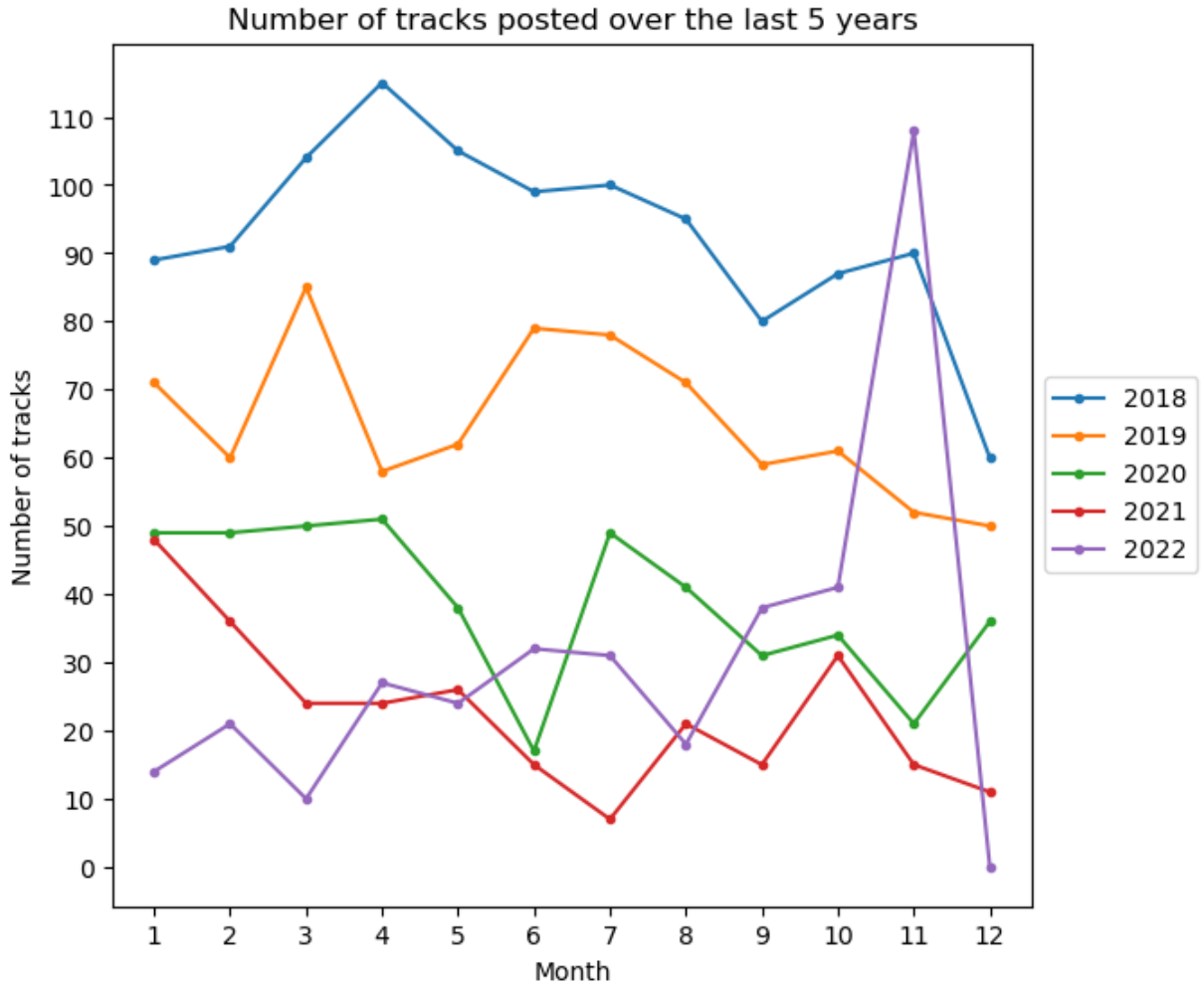
Data Analysis

In [78]:
```
temp = pd.DataFrame(data=np.array([tracks_df['ID'], tracks_df['PostedTime'].dt.ye
                    columns=['ID', 'Year', 'Month'])
temp = temp[temp['Year'] >= 2018].set_index('ID')
temp = pd.DataFrame(temp.groupby(['Year', 'Month']).size())
num_tracks_each_month = temp.groupby('Year')[0].apply(pd.Series.tolist).tolist()
num_tracks_each_month[len(num_tracks_each_month) - 1].append(0)
months = np.arange(1, 13)

num_tracks_each_month
```

Out[78]:
```
[[89, 91, 104, 115, 105, 99, 100, 95, 80, 87, 90, 60],
 [71, 60, 85, 58, 62, 79, 78, 71, 59, 61, 52, 50],
 [49, 49, 50, 51, 38, 17, 49, 41, 31, 34, 21, 36],
 [48, 36, 24, 24, 26, 15, 7, 21, 15, 31, 15, 11],
 [14, 21, 10, 27, 24, 32, 31, 18, 38, 41, 108, 0]]
```

Data Visualization

In [79]:
```
fig = plt.figure()
axes = fig.add_axes([0.1, 0.1, 1, 1])
axes.set_xticks(np.arange(1, 13, 1))
axes.set_yticks(np.arange(0, np.max(num_tracks_each_month), 10))
for i in range(0, 5):
    axes.plot(months, num_tracks_each_month[i], '.-', label=2018 + i)
box = axes.get_position()
axes.set_position([box.x0, box.y0, box.width * 0.8, box.height])
axes.legend(loc='center left', bbox_to_anchor=(1, 0.5))
axes.set_xlabel('Month')
axes.set_ylabel('Number of tracks')
axes.set_title('Number of tracks posted over the last 5 years');
```



Answer

Note: Because the collecting data time is in 11/2022, there is no data of 12/2022.

Answer: by observing the line chart above, we can draw some conclusions from that

1. The number of posted tracks decreases in recent years.
2. People usually post tracks on the first half of the year (in 2018 the month that has most tracks posted is April, in 2019 is March, in 2020 is April, in 2021 is January). Only in 2022, November has an outstanding number of data. It's maybe because the method that we use for collecting data.

Question 6

Does a playlist have a longer duration, the higher the number of likes?

- Purpose: Observe the playlist.csv, some playlists with a long duration time have large number of likes. We want to clarify the correlation between the length of a playlist and the number of likes of that playlist in the whole data set.
- Data: playlist.csv

Preprocessing

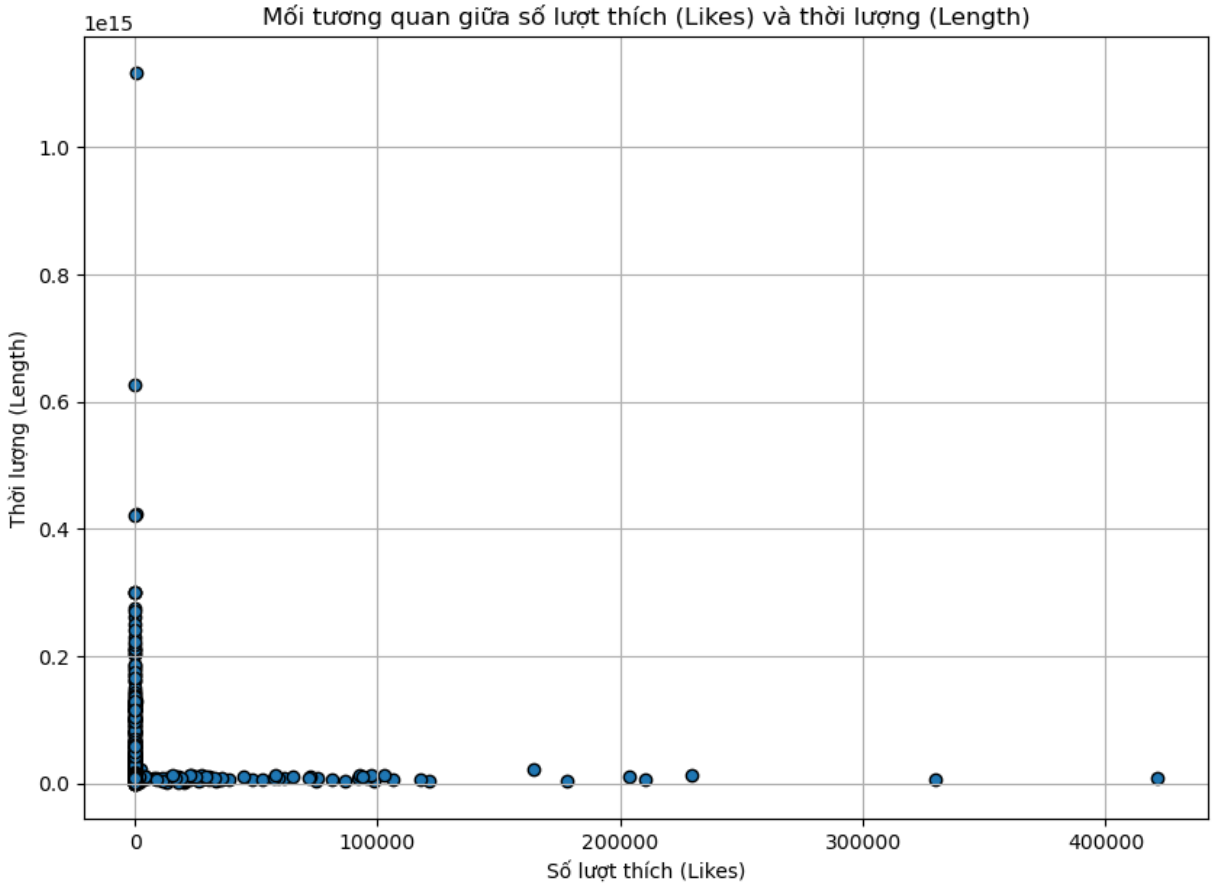
No need to preprocess

Data Analysis

Data Visualization

In [80]:
```
plt.figure(figsize=(10,7))
plt.grid()
plt.scatter(playlists_df['Likes'], playlists_df['Length'], edgecolors='black')
plt.xlabel('Số lượt thích (Likes)')
plt.ylabel('Thời lượng (Length)')
plt.title('Mối tương quan giữa số lượt thích (Likes) và thời lượng (Length)')
```

Out[80]:
```
Text(0.5, 1.0, 'Mối tương quan giữa số lượt thích (Likes) và thời lượng (Length)')
```



Answer

From the scatter plot above it is easy to see that there is no correlation, or very little correlation between length of a playlist and the number of likes of that playlist.

Question 7

So far, which genre has the highest average repost?

1. Calculate average repost of each genre to show that the most/ the least kind of genre
2. Draw a bar chart horizontally to show result

Preprocessing

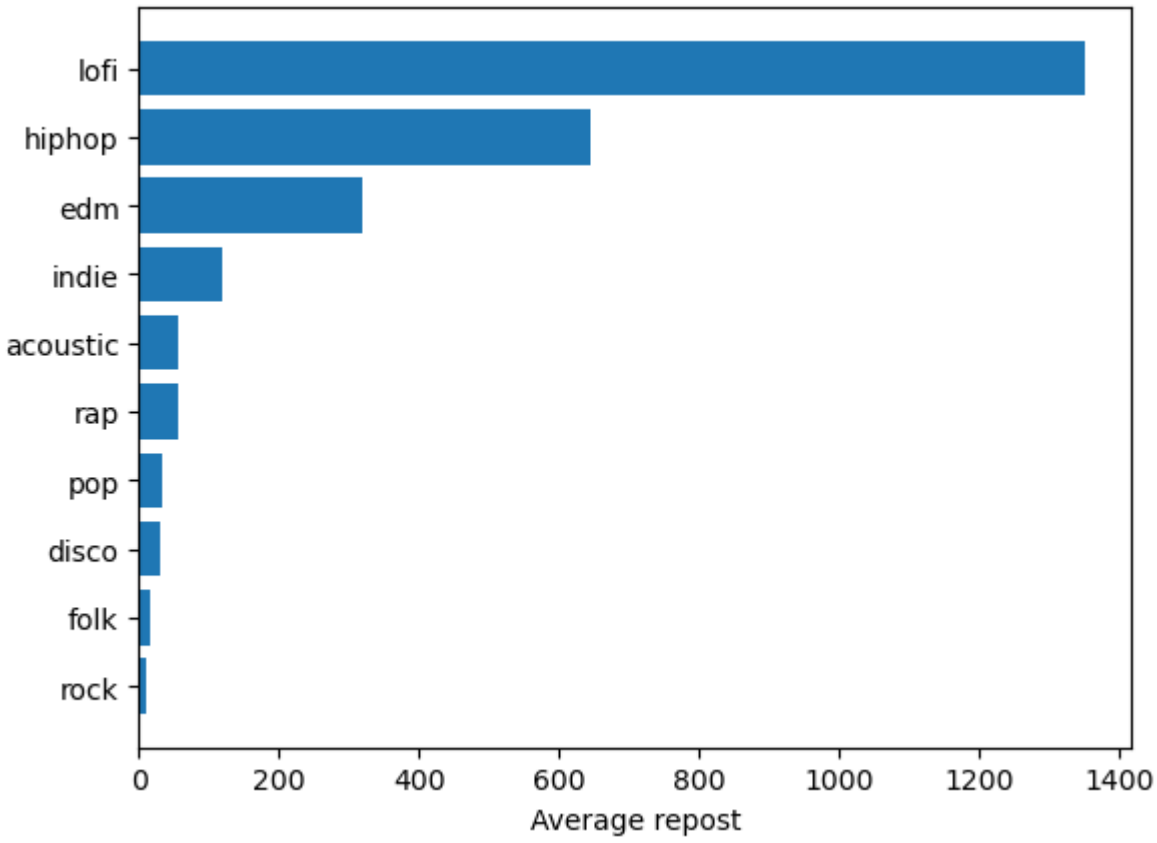
No need to preprocess

Data Analysis

In [81]:
```
most_repost_genre = playlists_df.groupby(['Genre'])['Reposts'].mean().sort_values
```

Data Visualization

In [82]:
```
plt.barh(y = most_repost_genre.index, width=most_repost_genre.values)
plt.xlabel("Average repost")
plt.show()
```



Answer

- The bar chart says that:
  - The most average repost is genre Lofi
  - The least average repost is genre Rock

- In this bar char, we can 'implicitly predict' that the trending of genre is Lofi, people nowadays keen on hearing and reposting these kinds of music.

Question 8

Comparing the number of plays, likes between Next Pro, Pro, and ordinary users.

Preprocessing

No need to preprocess

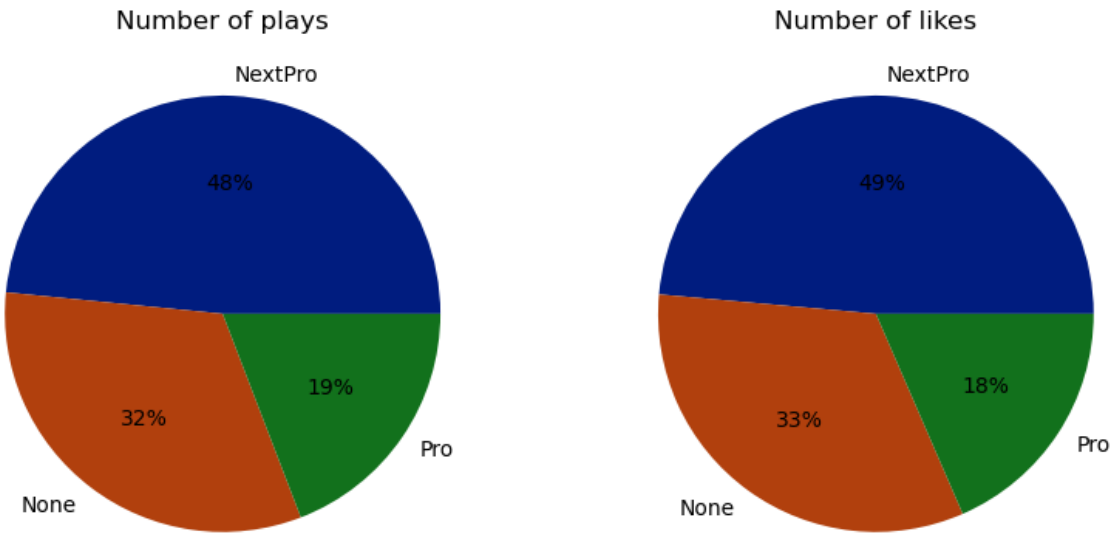
Data Analysis

In [83]:
```
user_track = pd.merge(tracks_df[['ID', 'Poster', 'Plays', 'Likes']], users_df[['I
data = np.array(user_track.groupby('NextPro').mean()).T
plays = data[0]
likes = data[1]
keys = ['NextPro', 'None', 'Pro']
palette_color = sns.color_palette('dark')

plays, likes
```

Out[83]:
```
(array([4873439.53564899, 3262178.62277253, 1927133.4611399 ]),
 array([67473.89892922, 45762.85091609, 25650.4119171 ]))
```

Data Visualization

In [84]:
```
fig, (axes1, axes2) = plt.subplots(1, 2, figsize=(10, 10))
axes1.pie(plays, labels=keys, colors=palette_color, autopct='%0.f%%')
axes1.set_title('Number of plays')
axes2.pie(likes, labels=keys, colors=palette_color, autopct='%0.f%%')
axes2.set_title('Number of likes');
```



Answer

As we can see from the 2 pie charts, tracks uploaded by NextPro users are the most popular and favorite. Followed by tracks from None users (ordinary users) and tracks posted by Pro users get the least attention. It seems that the NextPro service are favored among popular users, in the other hand the Pro service is not atractted enough and maybe there are not many popular users that pay for it.

Question 9

Users with a large following; the playlist has a sizable audience?

Preprocessing

In [85]:
```
users_df['NextPro'] = users_df['NextPro'].replace({'Next Pro':True, 'Pro':True, '
```

Data Analysis

In [86]:
```
def removeOutliers(df,colname):
    q3, q1 = np.percentile(df[colname], [75, 25])
    IQR = q3 - q1
#     print('Last length:',len(df))
    upper_bound = q3 + 1.5 * IQR
    lower_bound = q1 - 1.5 * IQR
    df = df[df[colname] < upper_bound]
    df = df[df[colname] > lower_bound]
#     print('After length:',len(df))
    return df
```

In [87]:
```
users_id = playlists_df.Poster.to_list()
playlist_user = playlists_df[['ID','Likes','Poster','Reposts','Length']]
playlist_user
```

Out[87]:

	ID	Likes	Poster	Reposts	Length
0	P1	121377	U1	9211	0 days 01:09:50
1	P2	74566	U1	4554	0 days 00:55:27
2	P3	2236	U22	149	0 days 02:13:41
3	P4	1159	U32	180	0 days 02:33:29
4	P5	2300	U43	685	0 days 02:25:35
...	...	...	...	...	...
1995	P1896	1	U11565	1	0 days 02:15:15
1996	P1897	9	U11574	1	0 days 01:27:12
1997	P1898	1	U11578	12	0 days 00:36:13
1998	P1899	1	U11581	39	0 days 02:35:53
1999	P1900	2	U11583	17	0 days 02:22:24

1893 rows × 5 columns

In [88]:
```
playlist_user = pd.merge(playlist_user, users_df, how='inner', left_on = 'Poster'
playlist_user
```

Out[88]:

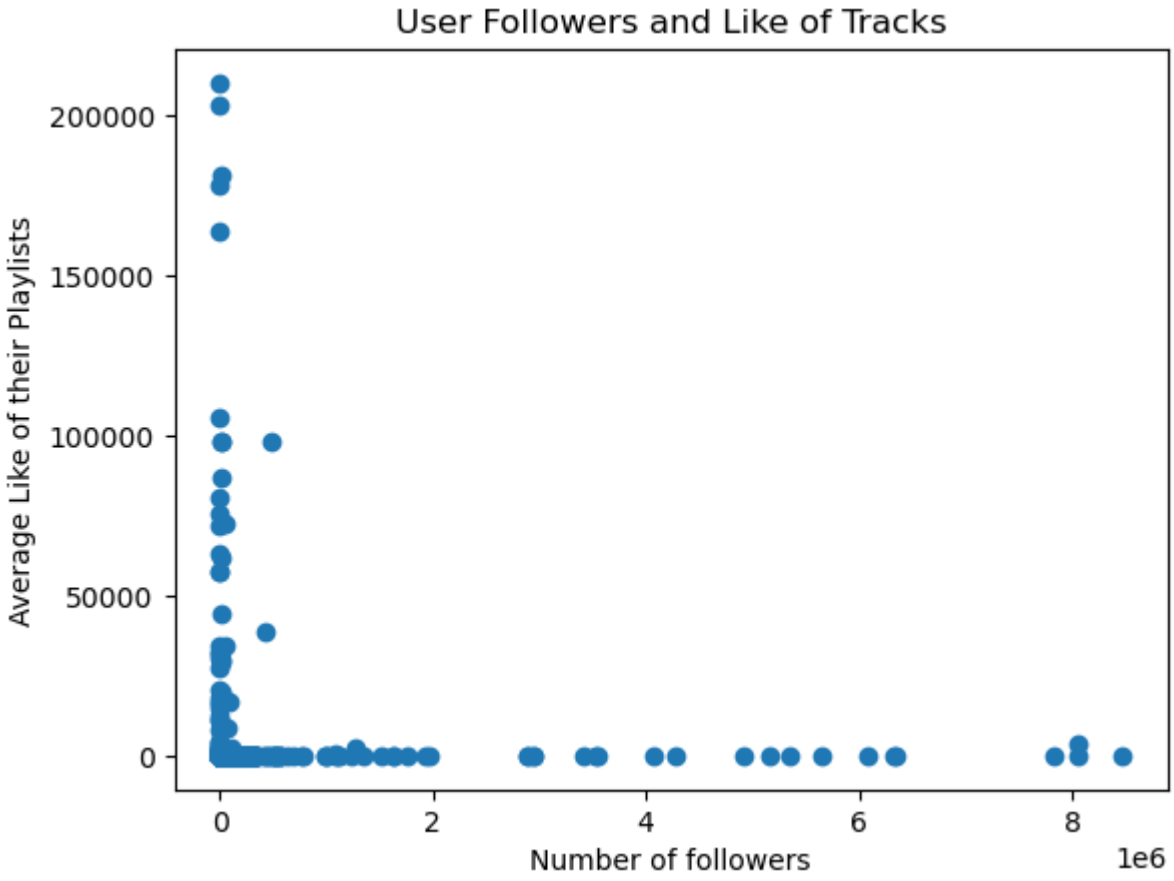
	ID_playlist	Likes	Poster	Reposts	Length	ID_user	Name	NumFollowers	NumFo
0	P1	121377	U1	9211	0 days 01:09:50	U1	Kupla	21093	
1	P2	74566	U1	4554	0 days 00:55:27	U1	Kupla	21093	
2	P3	2236	U22	149	0 days 02:13:41	U22	Patrick Baker	9890	
3	P4	1159	U32	180	0 days 02:33:29	U32	acy	14	
4	P92	20	U32	5	0 days 02:25:40	U32	acy	14	
...	...	...	...	...	...	...	...	...	
1888	P1896	1	U11565	1	0 days 02:15:15	U11565	Stash Konig	2091	
1889	P1897	9	U11574	1	0 days 01:27:12	U11574	StrangeFowx	37	
1890	P1898	1	U11578	12	0 days 00:36:13	U11578	Thomas Azier	10982	
1891	P1899	1	U11581	39	0 days 02:35:53	U11581	Jorge De La Rosa	97	
1892	P1900	2	U11583	17	0 days 02:22:24	U11583	Billy Bragg	1463	

1893 rows × 12 columns

In [89]:
```
average = playlist_user[['NumFollowers','Likes','ID_user','Reposts','Length','Num
```

Data Visualization

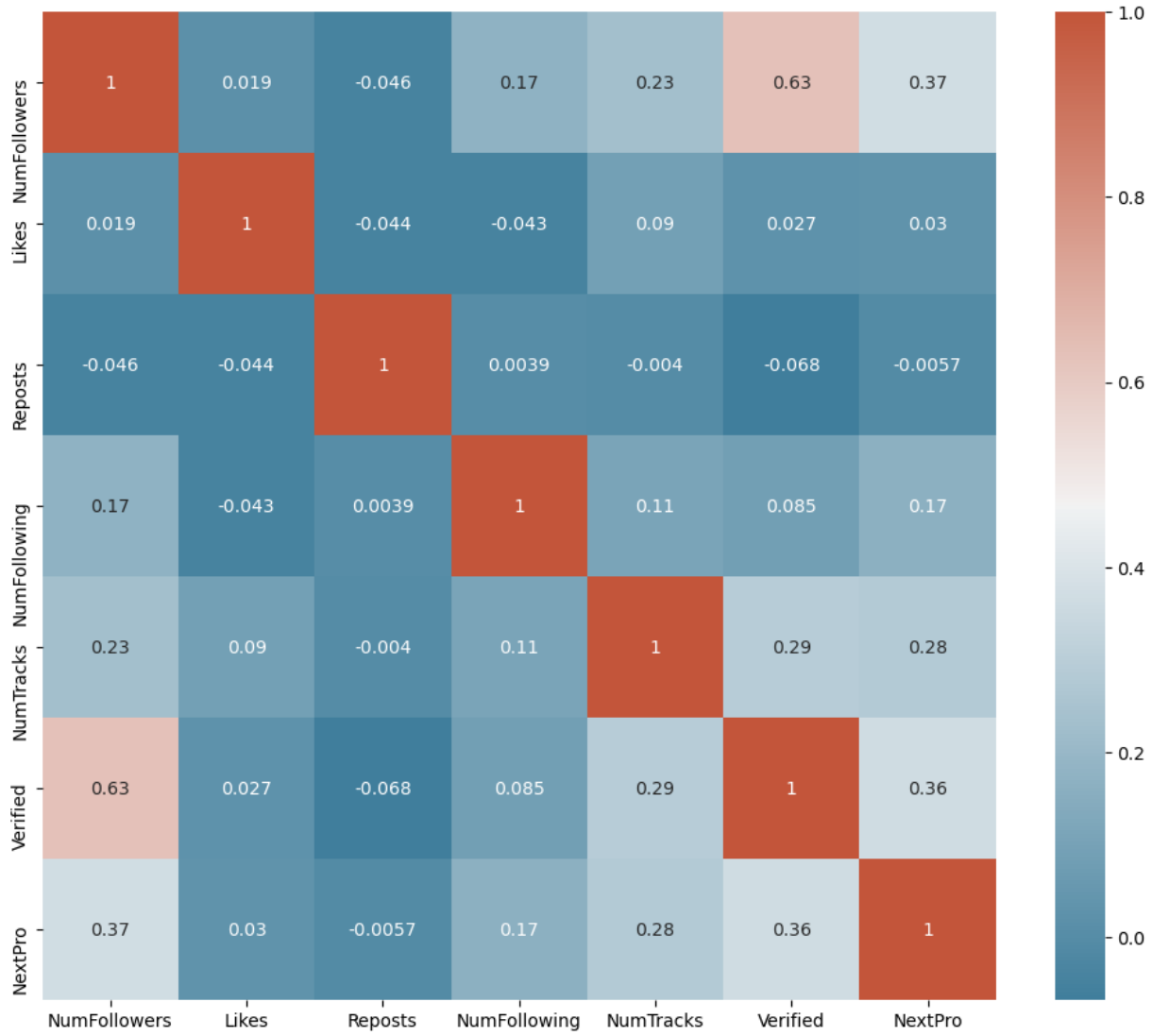
In [90]:
```
plt.scatter(average['NumFollowers'],average['Likes'] )
plt.title('User Followers and Like of Tracks')
plt.xlabel('Number of followers')
plt.ylabel('Average Like of their Playlists')
plt.show()
```



We can observe that even people with a small number of followers may have popular playlists. Having a large following does not ensure that their albums will receive more likes.

In [91]:
```
average = removeOutliers(average,'Likes')
average = removeOutliers(average,'NumFollowers')
average = removeOutliers(average,'Reposts')
corr = average[['NumFollowers','Likes','Reposts','NumFollowing','NumTracks','Veri

f, ax = plt.subplots(figsize=(12, 10))
cmap = sns.diverging_palette(230, 20, as_cmap=True)
sns.heatmap(corr, annot=True, cmap=cmap)
```

Out[91]: <AxesSubplot:>



Answer

After outliers are removed, we can observe that a person's following, verified user, or Next Pro

status has no influence much on how many times their playlist is liked or reposted.

Question 10

Compare the correlation of the likes of the playlist and the average likes of the first 10 tracks in the playlist

Preprocessing

No need to preprocess

Data Analysis

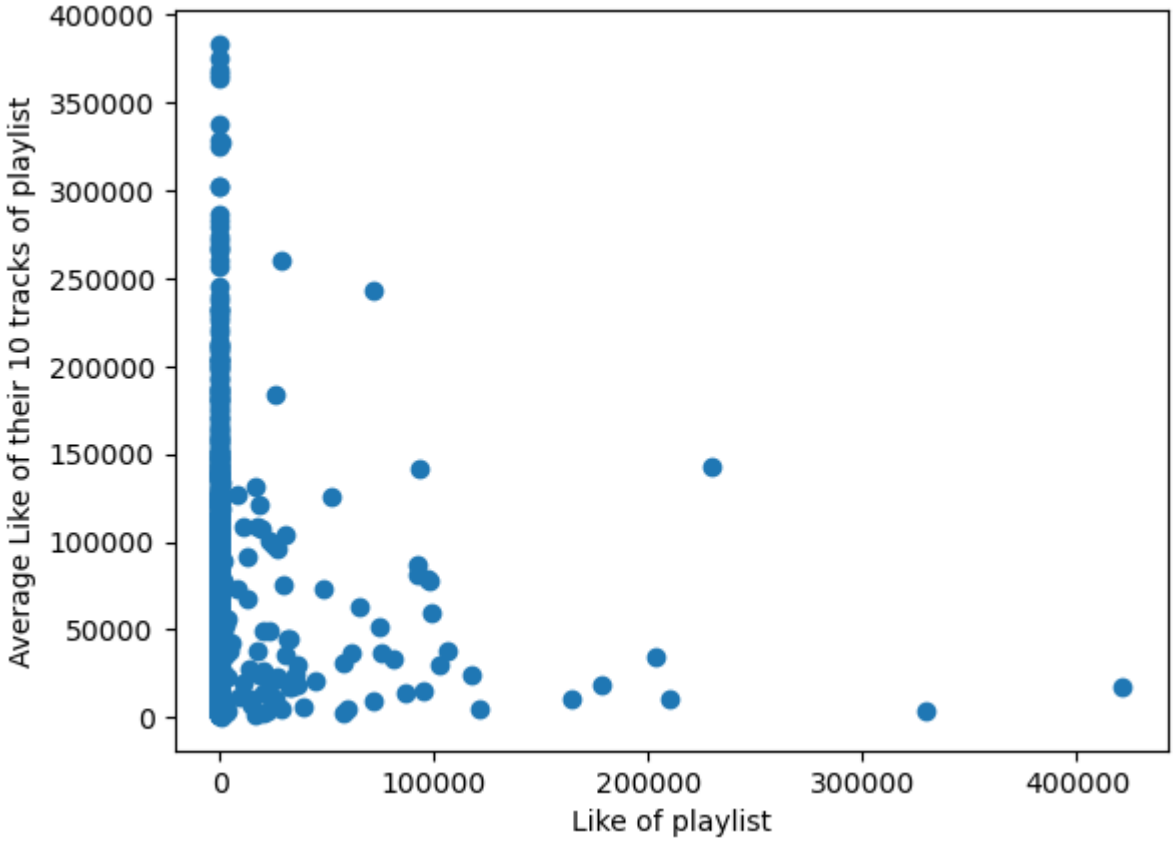
In [92]:
```
tracks_df.index = tracks_df['ID']
mean_like = playlists_df['TopTracks'].apply(lambda x: pd.Series(x).apply(lambda y
```

In [93]:
```
mean_like
```

Out[93]:
```
0        5409.8
1       51696.1
2       40462.1
3       75620.0
4        3188.8
         ...
1995    59644.8
1996    16422.6
1997    56035.0
1998    31576.5
1999     5500.9
Name: TopTracks, Length: 1893, dtype: float64
```

Data Visualization

In [94]:
```
plt.scatter(playlists_df['Likes'],mean_like )
plt.xlabel('Like of playlist')
plt.ylabel('Average Like of their 10 tracks of playlist')
plt.show()
```



Answer

Because a track may be on numerous playlists and users can access songs through different playlists as well as by themselves, the average like of their playlist's first 10 tracks might be significantly greater than the quantity of playlist likes.

Question 11

Based on user information and track forecast number of likes.

Preprocessing

In [95]:
```
track_user = pd.merge(users_df, tracks_df, how='inner', left_on = 'ID', right_on
track_user = track_user[['NumFollowers','NumFollowing','NumTracks','Verified','Ne
track_user.head()
```

Out[95]:

	NumFollowers	NumFollowing	NumTracks	Verified	NextPro	Name_track	Tags	Length	Likes
0	21093	720	95	True	True	I will wait for you to come home	Chill	0 days 00:02:10	2411
1	21093	720	95	True	True	Alone in the World	Chill	0 days 00:02:17	1833
2	21093	720	95	True	True	Aurora	Chill	0 days 00:02:27	1127
3	21093	720	95	True	True	Kupla X j'san - Out Of Town	Chill	0 days 00:02:32	1144
4	21093	720	95	True	True	Kupla x less.people - lost in translation	Chill	0 days 00:02:12	985

Add new feature length of the name and convert length of tracks to seconds

In [96]:
```
track_user['Length'] = track_user['Length'].apply(lambda x: x.total_seconds())
track_user['NameLength'] = track_user['Name_track'].apply(lambda x: len(x))
```

In [97]:
```
del track_user['Name_track']
track_user
```

Out[97]:

	NumFollowers	NumFollowing	NumTracks	Verified	NextPro	Tags	Length	Likes	Plays
0	21093	720	95	True	True	Chill	130.0	2411	213251
1	21093	720	95	True	True	Chill	137.0	1833	139150
2	21093	720	95	True	True	Chill	147.0	1127	65534
3	21093	720	95	True	True	Chill	152.0	1144	81721
4	21093	720	95	True	True	Chill	132.0	985	77259
...	...	...	...	...	...	...	...	...	...
16163	20141	158	234	False	True	Tech House	326.0	1019	24817
16164	35924	217	186	False	True	Disco	184.0	140	5658
16165	35924	217	186	False	True	None	250.0	1153	20831
16166	35924	217	186	False	True	None	235.0	440	14054
16167	35924	217	186	False	True	None	289.0	1029	18716

16168 rows × 11 columns

Remove the outliers and fill nan value of length of track

In [98]:
```
track_user = removeOutliers(track_user,'Likes')
print(track_user.isnull().sum())
track_user['Length']= track_user['Length'].fillna(track_user['Length'].median())
track_user.isnull().sum()
```

```
NumFollowers       0
NumFollowing       0
NumTracks          0
Verified           0
NextPro            0
Tags               0
Length          1259
Likes              0
Plays              0
Reposts            0
NameLength         0
dtype: int64
```

Out[98]:
```
NumFollowers    0
NumFollowing    0
NumTracks       0
Verified        0
NextPro         0
Tags            0
Length          0
Likes           0
Plays           0
Reposts         0
NameLength      0
dtype: int64
```

Data Analysis

Split the dataset into train set and test set

In [99]:
```
x = track_user[track_user['Tags'].isin(popular_genre)]
y = x.Likes
x = x.drop(['Likes'], axis=1)
X_train, X_valid, y_train, y_valid = train_test_split(x, y, train_size=0.8, test_
                                                      random_state=0)
```

Label Tags field

In [100]:
```
label_X_train = X_train.copy()
label_X_valid = X_valid.copy()

ordinal_encoder = OrdinalEncoder()
label_X_train[['Tags']] = ordinal_encoder.fit_transform(X_train[['Tags']])
label_X_valid[['Tags']] = ordinal_encoder.transform(X_valid[['Tags']])
```

Train the model

In [101]:
```
rf = RandomForestClassifier(criterion='gini',
                            n_estimators=40,
                            min_samples_split=10,
                            min_samples_leaf=1,
                            max_features='auto',
                            oob_score=True,
                            random_state=1,
                            n_jobs=-1)
rf.fit(label_X_train, y_train)
```

Out[101]:
```
RandomForestClassifier(min_samples_split=10, n_estimators=40, n_jobs=-1,
                       oob_score=True, random_state=1)
```

Test and calculate error by using mean_absolute_error

In [102]:
```
likepredict = rf.predict(label_X_valid)
```

In [103]:
```
print(mean_absolute_error(y_valid, likepredict))
likepredict[:10]
```

```
3750.6361646234677
```

Out[103]:
```
array([35356, 25825,   389,  2299, 43997,    45, 37589,    27,  1204,
         33])
```

In [104]:
```
y_valid[:10]
```

Out[104]:
```
16162    36297
3755     14471
12934      695
12540     4150
5261     31394
10710      101
10399    39273
15371       17
3506      1153
703         51
Name: Likes, dtype: int64
```

Data Visualization

Answer

It's not very precise, but you can make a rough guess as to how many likes a song might get.

4. References

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