Maven Music- Final Course Project

1. Scope the Project

The plan is to use a supervised learning technique to predict which customers are most likely to cancel their subscription using **the past three months of customer data which includes subscription and listening history**.

2. Gather Data

In [97]:
```
# Read in the customer data
import pandas as pd

df_cus=pd.read_csv('maven_music_customers.csv')
df_cus.head()
```

Out[97]:

	Customer ID	Customer Name	Email	Member Since	Subscription Plan	Subscription Rate	Discount?	Cancellation Date
0	5001	Harmony Greene	Email: harmonious.vibes@email.com	3/13/23	Basic (Ads)	$2.99	NaN	NaN
1	5002	Aria Keys	Email: melodious.aria@email.edu	3/13/23	NaN	$2.99	NaN	NaN
2	5004	Lyric Bell	Email: rhythmical.lyric@email.com	3/13/23	NaN	$2.99	NaN	6/1/23
3	5267	Rock Bassett	Email: groovy.rock@email.com	3/20/23	Basic (Ads)	$2.99	NaN	NaN
4	5338	Rhythm Dixon	Email: beats.by.rhythm@email.edu	3/20/23	NaN	$2.99	NaN	NaN

In [98]:
```
# Collect basic info about the data
df_cus.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 30 entries, 0 to 29
Data columns (total 8 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   Customer ID        30 non-null     int64
 1   Customer Name      30 non-null     object
 2   Email              30 non-null     object
 3   Member Since       30 non-null     object
 4   Subscription Plan  25 non-null     object
 5   Subscription Rate  30 non-null     object
 6   Discount?          7 non-null      object
 7   Cancellation Date  13 non-null     object
dtypes: int64(1), object(7)
memory usage: 2.0+ KB
```

In [99]:
```
# Return number of rows and columns
df_cus.shape
```

Out[99]: (30, 8)

In [100]:
```
# Read in the listening history
df_lishis=pd.read_excel('maven_music_listening_history.xlsx')
df_lishis.head()
```

Out[100]:

	Customer ID	Session ID	Audio Order	Audio ID	Audio Type
0	5001	100520	1	101	Song
1	5001	100520	2	102	Song
2	5001	100520	3	103	Song
3	5001	100520	4	104	Song
4	5001	100520	5	105	Song

In [101]:
```
# Return number of rows and columns of listening history table
df_lishis.shape
```

Out[101]: (505, 5)

In [102]:
```
# Read in the audio data
df_audio=pd.read_excel('maven_music_listening_history.xlsx',sheet_name=1)
df_audio.head()
```

Out[102]:

	ID	Name	Genre	Popularity
0	Song-101	Dance All Night	Pop	1
1	Song-102	Unbreakable Beat	Pop	2
2	Song-103	Sunset Boulevard	Pop Music	5
3	Song-104	Glowing Hearts	Pop Music	10
4	Song-105	Pop Rocks	Pop Music	52

In [103]:
```
# Read in the session data
df_session=pd.read_excel('maven_music_listening_history.xlsx',sheet_name=2)
df_session.head()
```

Out[103]:

	Session ID	Session Log In Time
0	100520	2023-03-13 18:29:00
1	100522	2023-03-13 22:15:00
2	100525	2023-03-14 10:01:00
3	100527	2023-03-15 14:14:00
4	100538	2023-03-21 12:23:00

3. Clean Data

a. Convert Data Types

Check the data types of the data in the tables and convert to numeric and datetime values as necessary.

In [104]:
```
# Check the data types
df_cus.dtypes
```

Out[104]:
```
Customer ID           int64
Customer Name        object
Email                object
Member Since         object
Subscription Plan    object
Subscription Rate    object
Discount?            object
Cancellation Date    object
dtype: object
```

In [105]:
```
# Convert objects to numeric and datetime fields
df_cus['Member Since']=pd.to_datetime(df_cus['Member Since'])
df_cus['Cancellation Date']=pd.to_datetime(df_cus['Cancellation Date'])
df_cus.head()
```

Out[105]:

	Customer ID	Customer Name	Email	Member Since	Subscription Plan	Subscription Rate	Discount?	Cancellation Date
0	5001	Harmony Greene	Email: harmonious.vibes@email.com	2023-03-13	Basic (Ads)	$2.99	NaN	NaT
1	5002	Aria Keys	Email: melodious.aria@email.edu	2023-03-13	NaN	$2.99	NaN	NaT
2	5004	Lyric Bell	Email: rhythmical.lyric@email.com	2023-03-13	NaN	$2.99	NaN	2023-06-01
3	5267	Rock Bassett	Email: groovy.rock@email.com	2023-03-20	Basic (Ads)	$2.99	NaN	NaT
4	5338	Rhythm Dixon	Email: beats.by.rhythm@email.edu	2023-03-20	NaN	$2.99	NaN	NaT

In [106]:
```
# Replace $ sign and convert the datatype of the column from object to numeric
df_cus['Subscription Rate']=df_cus['Subscription Rate'].str.replace('$','',regex=False)
df_cus['Subscription Rate']=pd.to_numeric(df_cus['Subscription Rate'])
```

In [107]:
```
df_cus.dtypes
```

Out[107]:
```
Customer ID                   int64
Customer Name                object
Email                        object
Member Since         datetime64[ns]
Subscription Plan            object
Subscription Rate           float64
Discount?                    object
Cancellation Date    datetime64[ns]
dtype: object
```

b. Resolve Data Issues

Check for missing data, inconsistent text and typos, duplicate data and outliers.

i. Missing Data

In [108]:
```
# Look for NaN values in the data
df_cus.isna().sum()
```

Out[108]:
```
Customer ID           0
Customer Name         0
Email                 0
Member Since          0
Subscription Plan     5
Subscription Rate     0
Discount?            23
Cancellation Date    17
dtype: int64
```

In [109]:
```
# Look all the rows with missing values
df_cus[df_cus.isna().any(axis=1)]
```

Out[109]:

	Customer ID	Customer Name	Email	Member Since	Subscription Plan	Subscription Rate	Discount?	Cancellation Date
0	5001	Harmony Greene	Email: harmonious.vibes@email.com	2023-03-13	Basic (Ads)	2.99	NaN	NaT
1	5002	Aria Keys	Email: melodious.aria@email.edu	2023-03-13	NaN	2.99	NaN	NaT
2	5004	Lyric Bell	Email: rhythmical.lyric@email.com	2023-03-13	NaN	2.99	NaN	2023-06-01
3	5267	Rock Bassett	Email: groovy.rock@email.com	2023-03-20	Basic (Ads)	2.99	NaN	NaT
4	5338	Rhythm Dixon	Email: beats.by.rhythm@email.edu	2023-03-20	NaN	2.99	NaN	NaT
5	5404	Jazz Saxton	Email: jazzy.sax@email.com	2023-03-20	NaN	2.99	NaN	2023-06-03
6	5581	Reed Sharp	Email: sharp.tunes@email.com	2023-03-21	Premium (No Ads)	9.99	NaN	NaT
7	5759	Carol Kingbird	Email: songbird.carol@email.com	2023-03-22	Premium (No Ads)	9.99	NaN	2023-06-02
8	5761	Sonata Nash	Email: musical.sonata@email.com	2023-03-28	Premium (No Ads)	9.99	NaN	NaT
9	5763	Jazz Coleman	Email: coleman.jazzmaster@email.com	2023-03-28	Basic (Ads)	2.99	NaN	NaT
10	5826	Chord Hayes	Email: harmonic.chord@email.com	2023-03-28	Basic (Ads)	2.99	NaN	NaT
11	5827	Rhythm Franklin	Email: rhythmic.franklin@email.edu	2023-03-28	NaN	2.99	NaN	NaT
12	6029	Chord Campbell	Email: campbell.chordify@email.com	2023-03-29	Premium (No Ads)	9.99	NaN	2023-06-02
13	6092	Benny Beat	Email: rhythmic.benny@email.com	2023-04-01	Basic (Ads)	2.99	NaN	2023-06-01
14	6163	Melody Parks	Email: park.of.melodies@email.com	2023-04-05	Premium (No Ads)	9.99	NaN	NaT
15	6229	Symphony Rhodes	Email: rhodes.symphony@email.com	2023-04-06	Premium (No Ads)	99.99	NaN	2023-06-02
16	6406	Beatrice Sharp	Email: beats.by.beatrice@email.com	2023-04-08	Basic (Ads)	2.99	NaN	NaT
17	6584	Bobby Bass	Email: bass.master.bobby@email.edu	2023-04-09	Basic (Ads)	2.99	NaN	NaT
18	6586	Lyric Saunders	Email: lyrical.saunders@email.edu	2023-04-16	Basic (Ads)	2.99	NaN	NaT
19	6588	Harmony Bass	Email: bass.harmony@email.com	2023-04-16	Basic (Ads)	2.99	NaN	2023-06-01
20	6821	Reed Flat	Email: flat.tunes@email.com	2023-04-24	Basic (Ads)	2.99	NaN	NaT
21	6822	Kiki Keys	Email: kiki.keys.piano@email.com	2023-05-01	Premium (No Ads)	7.99	Yes	NaT
24	7158	Harmony Wallace	Email: wallace.harmony@email.com	2023-05-07	Basic (Ads)	2.99	NaN	NaT
27	7579	Jazz Drummond	Email: drumming.jazz@email.com	2023-05-15	Basic (Ads)	2.99	NaN	NaT

In [110]:
```
# check for rows with NaN values in the 'Subscription Plan' column
df_cus[df_cus['Subscription Plan'].isna()]
```

Out[110]:

	Customer ID	Customer Name	Email	Member Since	Subscription Plan	Subscription Rate	Discount?	Cancellation Date
1	5002	Aria Keys	Email: melodious.aria@email.edu	2023-03-13	NaN	2.99	NaN	NaT
2	5004	Lyric Bell	Email: rhythmical.lyric@email.com	2023-03-13	NaN	2.99	NaN	2023-06-01
4	5338	Rhythm Dixon	Email: beats.by.rhythm@email.edu	2023-03-20	NaN	2.99	NaN	NaT
5	5404	Jazz Saxton	Email: jazzy.sax@email.com	2023-03-20	NaN	2.99	NaN	2023-06-03
11	5827	Rhythm Franklin	Email: rhythmic.franklin@email.edu	2023-03-28	NaN	2.99	NaN	NaT

In [111]:
```
# Fill the missing values in the 'Subscription Plan' column with 'Basic (Ads)'
df_cus['Subscription Plan']=df_cus['Subscription Plan'].fillna('Basic (Ads)')
df_cus
```

Out[111]:

	Customer ID	Customer Name	Email	Member Since	Subscription Plan	Subscription Rate	Discount?	Cancellation Date
0	5001	Harmony Greene	Email: harmonious.vibes@email.com	2023-03-13	Basic (Ads)	2.99	NaN	NaT
1	5002	Aria Keys	Email: melodious.aria@email.edu	2023-03-13	Basic (Ads)	2.99	NaN	NaT
2	5004	Lyric Bell	Email: rhythmical.lyric@email.com	2023-03-13	Basic (Ads)	2.99	NaN	2023-06-01
3	5267	Rock Bassett	Email: groovy.rock@email.com	2023-03-20	Basic (Ads)	2.99	NaN	NaT
4	5338	Rhythm Dixon	Email: beats.by.rhythm@email.edu	2023-03-20	Basic (Ads)	2.99	NaN	NaT
5	5404	Jazz Saxton	Email: jazzy.sax@email.com	2023-03-20	Basic (Ads)	2.99	NaN	2023-06-03
6	5581	Reed Sharp	Email: sharp.tunes@email.com	2023-03-21	Premium (No Ads)	9.99	NaN	NaT
7	5759	Carol Kingbird	Email: songbird.carol@email.com	2023-03-22	Premium (No Ads)	9.99	NaN	2023-06-02
8	5761	Sonata Nash	Email: musical.sonata@email.com	2023-03-28	Premium (No Ads)	9.99	NaN	NaT
9	5763	Jazz Coleman	Email: coleman.jazzmaster@email.com	2023-03-28	Basic (Ads)	2.99	NaN	NaT
10	5826	Chord Hayes	Email: harmonic.chord@email.com	2023-03-28	Basic (Ads)	2.99	NaN	NaT
11	5827	Rhythm Franklin	Email: rhythmic.franklin@email.edu	2023-03-28	Basic (Ads)	2.99	NaN	NaT
12	6029	Chord Campbell	Email: campbell.chordify@email.com	2023-03-29	Premium (No Ads)	9.99	NaN	2023-06-02
13	6092	Benny Beat	Email: rhythmic.benny@email.com	2023-04-01	Basic (Ads)	2.99	NaN	2023-06-01
14	6163	Melody Parks	Email: park.of.melodies@email.com	2023-04-05	Premium (No Ads)	9.99	NaN	NaT
15	6229	Symphony Rhodes	Email: rhodes.symphony@email.com	2023-04-06	Premium (No Ads)	99.99	NaN	2023-06-02
16	6406	Beatrice Sharp	Email: beats.by.beatrice@email.com	2023-04-08	Basic (Ads)	2.99	NaN	NaT
17	6584	Bobby Bass	Email: bass.master.bobby@email.edu	2023-04-09	Basic (Ads)	2.99	NaN	NaT
18	6586	Lyric Saunders	Email: lyrical.saunders@email.edu	2023-04-16	Basic (Ads)	2.99	NaN	NaT
19	6588	Harmony Bass	Email: bass.harmony@email.com	2023-04-16	Basic (Ads)	2.99	NaN	2023-06-01
20	6821	Reed Flat	Email: flat.tunes@email.com	2023-04-24	Basic (Ads)	2.99	NaN	NaT
21	6822	Kiki Keys	Email: kiki.keys.piano@email.com	2023-05-01	Premium (No Ads)	7.99	Yes	NaT
22	6824	Greta Groove	Email: groovy.greta@email.com	2023-05-01	Premium (No Ads)	7.99	Yes	2023-06-02
23	7087	Harmony Heart	Email: heartfelt.harmony@email.com	2023-05-01	Premium (No Ads)	7.99	Yes	2023-06-02
24	7158	Harmony Wallace	Email: wallace.harmony@email.com	2023-05-07	Basic (Ads)	2.99	NaN	NaT
25	7224	Melody Fitzgerald	Email: fitzgerald.melody@email.com	2023-05-08	Premium (No Ads)	7.99	Yes	2023-06-01
26	7401	Reed Murphy	Email: murphy.reed.music@email.com	2023-05-08	Premium (No Ads)	7.99	Yes	2023-06-01
27	7579	Jazz Drummond	Email: drumming.jazz@email.com	2023-05-15	Basic (Ads)	2.99	NaN	NaT
28	7581	Lyric Keys	Email: keysoflyric@email.com	2023-05-16	Premium (No Ads)	7.99	Yes	2023-06-03
29	7583	Melody Singer	Email: melodic.singer@email.com	2023-05-16	Premium (No Ads)	7.99	Yes	2023-06-01

In [112]:
```
# Replace NaN in Discount column to '0' and Yes to '1'
import numpy as np
df_cus['Discount?']=np.where(df_cus['Discount?'] == 'Yes',1,0)
df_cus
```

Out[112]:

	Customer ID	Customer Name	Email	Member Since	Subscription Plan	Subscription Rate	Discount?	Cancellation Date
0	5001	Harmony Greene	Email: harmonious.vibes@email.com	2023-03-13	Basic (Ads)	2.99	0	NaT
1	5002	Aria Keys	Email: melodious.aria@email.edu	2023-03-13	Basic (Ads)	2.99	0	NaT
2	5004	Lyric Bell	Email: rhythmical.lyric@email.com	2023-03-13	Basic (Ads)	2.99	0	2023-06-01
3	5267	Rock Bassett	Email: groovy.rock@email.com	2023-03-20	Basic (Ads)	2.99	0	NaT
4	5338	Rhythm Dixon	Email: beats.by.rhythm@email.edu	2023-03-20	Basic (Ads)	2.99	0	NaT
5	5404	Jazz Saxton	Email: jazzy.sax@email.com	2023-03-20	Basic (Ads)	2.99	0	2023-06-03
6	5581	Reed Sharp	Email: sharp.tunes@email.com	2023-03-21	Premium (No Ads)	9.99	0	NaT
7	5759	Carol Kingbird	Email: songbird.carol@email.com	2023-03-22	Premium (No Ads)	9.99	0	2023-06-02
8	5761	Sonata Nash	Email: musical.sonata@email.com	2023-03-28	Premium (No Ads)	9.99	0	NaT
9	5763	Jazz Coleman	Email: coleman.jazzmaster@email.com	2023-03-28	Basic (Ads)	2.99	0	NaT
10	5826	Chord Hayes	Email: harmonic.chord@email.com	2023-03-28	Basic (Ads)	2.99	0	NaT
11	5827	Rhythm Franklin	Email: rhythmic.franklin@email.edu	2023-03-28	Basic (Ads)	2.99	0	NaT
12	6029	Chord Campbell	Email: campbell.chordify@email.com	2023-03-29	Premium (No Ads)	9.99	0	2023-06-02
13	6092	Benny Beat	Email: rhythmic.benny@email.com	2023-04-01	Basic (Ads)	2.99	0	2023-06-01
14	6163	Melody Parks	Email: park.of.melodies@email.com	2023-04-05	Premium (No Ads)	9.99	0	NaT
15	6229	Symphony Rhodes	Email: rhodes.symphony@email.com	2023-04-06	Premium (No Ads)	99.99	0	2023-06-02
16	6406	Beatrice Sharp	Email: beats.by.beatrice@email.com	2023-04-08	Basic (Ads)	2.99	0	NaT
17	6584	Bobby Bass	Email: bass.master.bobby@email.edu	2023-04-09	Basic (Ads)	2.99	0	NaT
18	6586	Lyric Saunders	Email: lyrical.saunders@email.edu	2023-04-16	Basic (Ads)	2.99	0	NaT
19	6588	Harmony Bass	Email: bass.harmony@email.com	2023-04-16	Basic (Ads)	2.99	0	2023-06-01
20	6821	Reed Flat	Email: flat.tunes@email.com	2023-04-24	Basic (Ads)	2.99	0	NaT
21	6822	Kiki Keys	Email: kiki.keys.piano@email.com	2023-05-01	Premium (No Ads)	7.99	1	NaT
22	6824	Greta Groove	Email: groovy.greta@email.com	2023-05-01	Premium (No Ads)	7.99	1	2023-06-02
23	7087	Harmony Heart	Email: heartfelt.harmony@email.com	2023-05-01	Premium (No Ads)	7.99	1	2023-06-02
24	7158	Harmony Wallace	Email: wallace.harmony@email.com	2023-05-07	Basic (Ads)	2.99	0	NaT
25	7224	Melody Fitzgerald	Email: fitzgerald.melody@email.com	2023-05-08	Premium (No Ads)	7.99	1	2023-06-01
26	7401	Reed Murphy	Email: murphy.reed.music@email.com	2023-05-08	Premium (No Ads)	7.99	1	2023-06-01
27	7579	Jazz Drummond	Email: drumming.jazz@email.com	2023-05-15	Basic (Ads)	2.99	0	NaT
28	7581	Lyric Keys	Email: keysoflyric@email.com	2023-05-16	Premium (No Ads)	7.99	1	2023-06-03
29	7583	Melody Singer	Email: melodic.singer@email.com	2023-05-16	Premium (No Ads)	7.99	1	2023-06-01

ii. Inconsistent Text & Typos

In [113]:
```
# Look for inconsistent text & typos
df_cus['Subscription Rate'].value_counts()
```

Out[113]:
```
2.99     17
7.99      7
9.99      5
99.99     1
Name: Subscription Rate, dtype: int64
```

In [114]:
```
# Max subscription rate is 99.99 which is likely found to be a typo
df_cus.describe()
```

Out[114]:

	Customer ID	Subscription Rate	Discount?
count	30.000000	30.000000	30.000000
mean	6276.333333	8.556667	0.233333
std	814.255587	17.517840	0.430183
min	5001.000000	2.990000	0.000000
25%	5759.500000	2.990000	0.000000
50%	6196.000000	2.990000	0.000000
75%	6823.500000	7.990000	0.000000
max	7583.000000	99.990000	1.000000

In [115]:
```
# Replace 99.99 with 9.99
df_cus.iloc[15,5] = 9.99
df_cus
```

Out[115]:

	Customer ID	Customer Name	Email	Member Since	Subscription Plan	Subscription Rate	Discount?	Cancellation Date
0	5001	Harmony Greene	Email: harmonious.vibes@email.com	2023-03-13	Basic (Ads)	2.99	0	NaT
1	5002	Aria Keys	Email: melodious.aria@email.edu	2023-03-13	Basic (Ads)	2.99	0	NaT
2	5004	Lyric Bell	Email: rhythmical.lyric@email.com	2023-03-13	Basic (Ads)	2.99	0	2023-06-01
3	5267	Rock Bassett	Email: groovy.rock@email.com	2023-03-20	Basic (Ads)	2.99	0	NaT
4	5338	Rhythm Dixon	Email: beats.by.rhythm@email.edu	2023-03-20	Basic (Ads)	2.99	0	NaT
5	5404	Jazz Saxton	Email: jazzy.sax@email.com	2023-03-20	Basic (Ads)	2.99	0	2023-06-03
6	5581	Reed Sharp	Email: sharp.tunes@email.com	2023-03-21	Premium (No Ads)	9.99	0	NaT
7	5759	Carol Kingbird	Email: songbird.carol@email.com	2023-03-22	Premium (No Ads)	9.99	0	2023-06-02
8	5761	Sonata Nash	Email: musical.sonata@email.com	2023-03-28	Premium (No Ads)	9.99	0	NaT
9	5763	Jazz Coleman	Email: coleman.jazzmaster@email.com	2023-03-28	Basic (Ads)	2.99	0	NaT
10	5826	Chord Hayes	Email: harmonic.chord@email.com	2023-03-28	Basic (Ads)	2.99	0	NaT
11	5827	Rhythm Franklin	Email: rhythmic.franklin@email.edu	2023-03-28	Basic (Ads)	2.99	0	NaT
12	6029	Chord Campbell	Email: campbell.chordify@email.com	2023-03-29	Premium (No Ads)	9.99	0	2023-06-02
13	6092	Benny Beat	Email: rhythmic.benny@email.com	2023-04-01	Basic (Ads)	2.99	0	2023-06-01
14	6163	Melody Parks	Email: park.of.melodies@email.com	2023-04-05	Premium (No Ads)	9.99	0	NaT
15	6229	Symphony Rhodes	Email: rhodes.symphony@email.com	2023-04-06	Premium (No Ads)	9.99	0	2023-06-02
16	6406	Beatrice Sharp	Email: beats.by.beatrice@email.com	2023-04-08	Basic (Ads)	2.99	0	NaT
17	6584	Bobby Bass	Email: bass.master.bobby@email.edu	2023-04-09	Basic (Ads)	2.99	0	NaT
18	6586	Lyric Saunders	Email: lyrical.saunders@email.edu	2023-04-16	Basic (Ads)	2.99	0	NaT
19	6588	Harmony Bass	Email: bass.harmony@email.com	2023-04-16	Basic (Ads)	2.99	0	2023-06-01
20	6821	Reed Flat	Email: flat.tunes@email.com	2023-04-24	Basic (Ads)	2.99	0	NaT
21	6822	Kiki Keys	Email: kiki.keys.piano@email.com	2023-05-01	Premium (No Ads)	7.99	1	NaT
22	6824	Greta Groove	Email: groovy.greta@email.com	2023-05-01	Premium (No Ads)	7.99	1	2023-06-02
23	7087	Harmony Heart	Email: heartfelt.harmony@email.com	2023-05-01	Premium (No Ads)	7.99	1	2023-06-02
24	7158	Harmony Wallace	Email: wallace.harmony@email.com	2023-05-07	Basic (Ads)	2.99	0	NaT
25	7224	Melody Fitzgerald	Email: fitzgerald.melody@email.com	2023-05-08	Premium (No Ads)	7.99	1	2023-06-01
26	7401	Reed Murphy	Email: murphy.reed.music@email.com	2023-05-08	Premium (No Ads)	7.99	1	2023-06-01
27	7579	Jazz Drummond	Email: drumming.jazz@email.com	2023-05-15	Basic (Ads)	2.99	0	NaT
28	7581	Lyric Keys	Email: keysoflyric@email.com	2023-05-16	Premium (No Ads)	7.99	1	2023-06-03
29	7583	Melody Singer	Email: melodic.singer@email.com	2023-05-16	Premium (No Ads)	7.99	1	2023-06-01

In [116]:
```
df_cus['Member Since'].max()
```

Out[116]: Timestamp('2023-05-16 00:00:00')

In [117]:
```
df_lishis.describe()
```

Out[117]:

	Customer ID	Session ID	Audio Order	Audio ID
count	505.000000	505.000000	505.000000	505.000000
mean	6112.247525	105225.554455	4.138614	112.063366
std	832.861221	3625.879577	2.669008	24.670285
min	5001.000000	100520.000000	1.000000	101.000000
25%	5267.000000	101925.000000	2.000000	103.000000
50%	6029.000000	105116.000000	4.000000	105.000000
75%	6822.000000	109654.000000	6.000000	109.000000
max	7583.000000	111333.000000	15.000000	205.000000

In [118]:
```
# Check listening history table
df_lishis.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 505 entries, 0 to 504
Data columns (total 5 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   Customer ID  505 non-null    int64
 1   Session ID   505 non-null    int64
 2   Audio Order  505 non-null    int64
 3   Audio ID     505 non-null    int64
 4   Audio Type   505 non-null    object
dtypes: int64(4), object(1)
memory usage: 19.9+ KB
```

In [119]:
```
# 'Audio type' is a categorical column so value_counts
df_lishis['Audio Type'].value_counts()
```

Out[119]:
```
Song       463
Podcast     42
Name: Audio Type, dtype: int64
```

In [120]:
```
# Check audio table
df_audio.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 17 entries, 0 to 16
Data columns (total 4 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
 0   ID          17 non-null     object
 1   Name        17 non-null     object
 2   Genre       17 non-null     object
 3   Popularity  17 non-null     int64
dtypes: int64(1), object(3)
memory usage: 676.0+ bytes
```

In [121]:
```
df_audio.head()
```

Out[121]:

	ID	Name	Genre	Popularity
0	Song-101	Dance All Night	Pop	1
1	Song-102	Unbreakable Beat	Pop	2
2	Song-103	Sunset Boulevard	Pop Music	5
3	Song-104	Glowing Hearts	Pop Music	10
4	Song-105	Pop Rocks	Pop Music	52

In [122]:
```
# Genre column is a categorical column.
df_audio.Genre.value_counts()
```

Out[122]:
```
Pop Music     3
Hip Hop       3
Comedy        3
Pop           2
Country       2
Jazz          2
True Crime    2
Name: Genre, dtype: int64
```

In [123]:
```
#'Pop Music' and 'Pop' are both same so replace 'Pop' by 'Pop Music'
import numpy as np
df_audio['Genre']=np.where(df_audio['Genre'] == 'Pop', 'Pop Music', df_audio['Genre'])
df_audio
```

Out[123]:

	ID	Name	Genre	Popularity
0	Song-101	Dance All Night	Pop Music	1
1	Song-102	Unbreakable Beat	Pop Music	2
2	Song-103	Sunset Boulevard	Pop Music	5
3	Song-104	Glowing Hearts	Pop Music	10
4	Song-105	Pop Rocks	Pop Music	52
5	Song-106	My Old Dog and My True Love	Country	23
6	Song-107	Dirt Road Romance	Country	30
7	Song-108	Chase the Dream	Hip Hop	4
8	Song-109	Rise Above	Hip Hop	9
9	Song-110	Boss Moves	Hip Hop	28
10	Song-111	Moonlit Serenade	Jazz	63
11	Song-112	Midnight Blues	Jazz	80
12	Podcast-201	Jokes on Jokes	Comedy	2
13	Podcast-202	Laugh Out Loudcast	Comedy	8
14	Podcast-203	The Comedian's Corner	Comedy	20
15	Podcast-204	Crime Chronicles	True Crime	4
16	Podcast-205	Investigating Darkness	True Crime	17

In [124]:
```
# Check session table
df_session.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 90 entries, 0 to 89
Data columns (total 2 columns):
 #   Column               Non-Null Count  Dtype
---  ------               --------------  -----
 0   Session ID           90 non-null     int64
 1   Session Log In Time  90 non-null     datetime64[ns]
dtypes: datetime64[ns](1), int64(1)
memory usage: 1.5 KB
```

In [125]:
```
# look for log in time
df_session['Session Log In Time'].max()
```

Out[125]: Timestamp('2023-05-31 06:03:00')

iii. Duplicate Rows

In [126]:
```
# Look for duplicate rows
df_cus[df_cus.duplicated()] # no duplicate rows in table df_cus
```

Out[126]:

Customer ID	Customer Name	Email	Member Since	Subscription Plan	Subscription Rate	Discount?	Cancellation Date

In [127]:
```
df_lishis.duplicated().sum() # no duplicate rows in table df_lishis
```

Out[127]: 0

In [128]:
```
df_audio.duplicated().sum() # no duplicate rows in table df_audio
```

Out[128]: 0

In [129]:
```
df_session.duplicated().sum() # no duplicate rows in table df_session
```

Out[129]: 0

iv. Outliers

In [130]:
```
# Look for outliers
df_cus.describe()
```

Out[130]:

	Customer ID	Subscription Rate	Discount?
count	30.000000	30.000000	30.000000
mean	6276.333333	5.556667	0.233333
std	814.255587	3.058998	0.430183
min	5001.000000	2.990000	0.000000
25%	5759.500000	2.990000	0.000000
50%	6196.000000	2.990000	0.000000
75%	6823.500000	7.990000	0.000000
max	7583.000000	9.990000	1.000000

In [131]:
```
df_lishis.describe()
```

Out[131]:

	Customer ID	Session ID	Audio Order	Audio ID
count	505.000000	505.000000	505.000000	505.000000
mean	6112.247525	105225.554455	4.138614	112.063366
std	832.861221	3625.879577	2.669008	24.670285
min	5001.000000	100520.000000	1.000000	101.000000
25%	5267.000000	101925.000000	2.000000	103.000000
50%	6029.000000	105116.000000	4.000000	105.000000
75%	6822.000000	109654.000000	6.000000	109.000000
max	7583.000000	111333.000000	15.000000	205.000000

In [132]:
```
df_audio.describe()
```

Out[132]:

	Popularity
count	17.000000
mean	21.058824
std	23.381271
min	1.000000
25%	4.000000
50%	10.000000
75%	28.000000
max	80.000000

In [133]:
```
df_session.describe()
```

Out[133]:

	Session ID
count	90.000000
mean	105619.788889
std	3616.208569
min	100520.000000
25%	102149.000000
50%	105390.500000
75%	109658.250000
max	111333.000000

c. Create New Columns

Create two new columns that will be useful for EDA and modeling:

- Cancelled: whether a customer cancelled or not
- Email: Remove the "Email:" from the email addresses

In [134]:
```
# Create a 'Cancelled' column
df_cus.head()
```

Out[134]:

	Customer ID	Customer Name	Email	Member Since	Subscription Plan	Subscription Rate	Discount?	Cancellation Date
0	5001	Harmony Greene	Email: harmonious.vibes@email.com	2023-03-13	Basic (Ads)	2.99	0	NaT
1	5002	Aria Keys	Email: melodious.aria@email.edu	2023-03-13	Basic (Ads)	2.99	0	NaT
2	5004	Lyric Bell	Email: rhythmical.lyric@email.com	2023-03-13	Basic (Ads)	2.99	0	2023-06-01
3	5267	Rock Bassett	Email: groovy.rock@email.com	2023-03-20	Basic (Ads)	2.99	0	NaT
4	5338	Rhythm Dixon	Email: beats.by.rhythm@email.edu	2023-03-20	Basic (Ads)	2.99	0	NaT

In [135]:
```
df_cus['Cancellation status']=np.where(pd.isna(df_cus['Cancellation Date']),0,1)
df_cus
```

Out[135]:

	Customer ID	Customer Name	Email	Member Since	Subscription Plan	Subscription Rate	Discount?	Cancellation Date	Cancellation status
0	5001	Harmony Greene	Email: harmonious.vibes@email.com	2023-03-13	Basic (Ads)	2.99	0	NaT	0
1	5002	Aria Keys	Email: melodious.aria@email.edu	2023-03-13	Basic (Ads)	2.99	0	NaT	0
2	5004	Lyric Bell	Email: rhythmical.lyric@email.com	2023-03-13	Basic (Ads)	2.99	0	2023-06-01	1
3	5267	Rock Bassett	Email: groovy.rock@email.com	2023-03-20	Basic (Ads)	2.99	0	NaT	0
4	5338	Rhythm Dixon	Email: beats.by.rhythm@email.edu	2023-03-20	Basic (Ads)	2.99	0	NaT	0
5	5404	Jazz Saxton	Email: jazzy.sax@email.com	2023-03-20	Basic (Ads)	2.99	0	2023-06-03	1
6	5581	Reed Sharp	Email: sharp.tunes@email.com	2023-03-21	Premium (No Ads)	9.99	0	NaT	0
7	5759	Carol Kingbird	Email: songbird.carol@email.com	2023-03-22	Premium (No Ads)	9.99	0	2023-06-02	1
8	5761	Sonata Nash	Email: musical.sonata@email.com	2023-03-28	Premium (No Ads)	9.99	0	NaT	0
9	5763	Jazz Coleman	Email: coleman.jazzmaster@email.com	2023-03-28	Basic (Ads)	2.99	0	NaT	0
10	5826	Chord Hayes	Email: harmonic.chord@email.com	2023-03-28	Basic (Ads)	2.99	0	NaT	0
11	5827	Rhythm Franklin	Email: rhythmic.franklin@email.edu	2023-03-28	Basic (Ads)	2.99	0	NaT	0
12	6029	Chord Campbell	Email: campbell.chordify@email.com	2023-03-29	Premium (No Ads)	9.99	0	2023-06-02	1
13	6092	Benny Beat	Email: rhythmic.benny@email.com	2023-04-01	Basic (Ads)	2.99	0	2023-06-01	1
14	6163	Melody Parks	Email: park.of.melodies@email.com	2023-04-05	Premium (No Ads)	9.99	0	NaT	0
15	6229	Symphony Rhodes	Email: rhodes.symphony@email.com	2023-04-06	Premium (No Ads)	9.99	0	2023-06-02	1
16	6406	Beatrice Sharp	Email: beats.by.beatrice@email.com	2023-04-08	Basic (Ads)	2.99	0	NaT	0
17	6584	Bobby Bass	Email: bass.master.bobby@email.edu	2023-04-09	Basic (Ads)	2.99	0	NaT	0
18	6586	Lyric Saunders	Email: lyrical.saunders@email.edu	2023-04-16	Basic (Ads)	2.99	0	NaT	0
19	6588	Harmony Bass	Email: bass.harmony@email.com	2023-04-16	Basic (Ads)	2.99	0	2023-06-01	1
20	6821	Reed Flat	Email: flat.tunes@email.edu	2023-04-24	Basic (Ads)	2.99	0	NaT	0
21	6822	Kiki Keys	Email: kiki.keys.piano@email.com	2023-05-01	Premium (No Ads)	7.99	1	NaT	0
22	6824	Greta Groove	Email: groovy.greta@email.com	2023-05-01	Premium (No Ads)	7.99	1	2023-06-02	1
23	7087	Harmony Heart	Email: heartfelt.harmony@email.com	2023-05-01	Premium (No Ads)	7.99	1	2023-06-02	1
24	7158	Harmony Wallace	Email: wallace.harmony@email.com	2023-05-07	Basic (Ads)	2.99	0	NaT	0
25	7224	Melody Fitzgerald	Email: fitzgerald.melody@email.com	2023-05-08	Premium (No Ads)	7.99	1	2023-06-01	1
26	7401	Reed Murphy	Email: murphy.reed.music@email.com	2023-05-08	Premium (No Ads)	7.99	1	2023-06-01	1
27	7579	Jazz Drummond	Email: drumming.jazz@email.com	2023-05-15	Basic (Ads)	2.99	0	NaT	0
28	7581	Lyric Keys	Email: keysoflyric@email.com	2023-05-16	Premium (No Ads)	7.99	1	2023-06-03	1
29	7583	Melody Singer	Email: melodic.singer@email.com	2023-05-16	Premium (No Ads)	7.99	1	2023-06-01	1

In [136]:

```
# Create an updated 'Email' column without the Email: portion
df_cus['Email']=df_cus['Email'].str.replace('Email:','')
df_cus
```

Out[136]:

	Customer ID	Customer Name	Email	Member Since	Subscription Plan	Subscription Rate	Discount?	Cancellation Date	Cancellation status
0	5001	Harmony Greene	harmonious.vibes@email.com	2023-03-13	Basic (Ads)	2.99	0	NaT	0
1	5002	Aria Keys	melodious.aria@email.edu	2023-03-13	Basic (Ads)	2.99	0	NaT	0
2	5004	Lyric Bell	rhythmical.lyric@email.com	2023-03-13	Basic (Ads)	2.99	0	2023-06-01	1
3	5267	Rock Bassett	groovy.rock@email.com	2023-03-20	Basic (Ads)	2.99	0	NaT	0
4	5338	Rhythm Dixon	beats.by.rhythm@email.edu	2023-03-20	Basic (Ads)	2.99	0	NaT	0
5	5404	Jazz Saxton	jazzy.sax@email.com	2023-03-20	Basic (Ads)	2.99	0	2023-06-03	1
6	5581	Reed Sharp	sharp.tunes@email.com	2023-03-21	Premium (No Ads)	9.99	0	NaT	0
7	5759	Carol Kingbird	songbird.carol@email.com	2023-03-22	Premium (No Ads)	9.99	0	2023-06-02	1
8	5761	Sonata Nash	musical.sonata@email.com	2023-03-28	Premium (No Ads)	9.99	0	NaT	0
9	5763	Jazz Coleman	coleman.jazzmaster@email.com	2023-03-28	Basic (Ads)	2.99	0	NaT	0
10	5826	Chord Hayes	harmonic.chord@email.com	2023-03-28	Basic (Ads)	2.99	0	NaT	0
11	5827	Rhythm Franklin	rhythmic.franklin@email.edu	2023-03-28	Basic (Ads)	2.99	0	NaT	0
12	6029	Chord Campbell	campbell.chordify@email.com	2023-03-29	Premium (No Ads)	9.99	0	2023-06-02	1
13	6092	Benny Beat	rhythmic.benny@email.com	2023-04-01	Basic (Ads)	2.99	0	2023-06-01	1
14	6163	Melody Parks	park.of.melodies@email.com	2023-04-05	Premium (No Ads)	9.99	0	NaT	0
15	6229	Symphony Rhodes	rhodes.symphony@email.com	2023-04-06	Premium (No Ads)	9.99	0	2023-06-02	1
16	6406	Beatrice Sharp	beats.by.beatrice@email.com	2023-04-08	Basic (Ads)	2.99	0	NaT	0
17	6584	Bobby Bass	bass.master.bobby@email.edu	2023-04-09	Basic (Ads)	2.99	0	NaT	0
18	6586	Lyric Saunders	lyrical.saunders@email.edu	2023-04-16	Basic (Ads)	2.99	0	NaT	0
19	6588	Harmony Bass	bass.harmony@email.com	2023-04-16	Basic (Ads)	2.99	0	2023-06-01	1
20	6821	Reed Flat	flat.tunes@email.edu	2023-04-24	Basic (Ads)	2.99	0	NaT	0
21	6822	Kiki Keys	kiki.keys.piano@email.com	2023-05-01	Premium (No Ads)	7.99	1	NaT	0
22	6824	Greta Groove	groovy.greta@email.com	2023-05-01	Premium (No Ads)	7.99	1	2023-06-02	1
23	7087	Harmony Heart	heartfelt.harmony@email.com	2023-05-01	Premium (No Ads)	7.99	1	2023-06-02	1
24	7158	Harmony Wallace	wallace.harmony@email.com	2023-05-07	Basic (Ads)	2.99	0	NaT	0
25	7224	Melody Fitzgerald	fitzgerald.melody@email.com	2023-05-08	Premium (No Ads)	7.99	1	2023-06-01	1
26	7401	Reed Murphy	murphy.reed.music@email.com	2023-05-08	Premium (No Ads)	7.99	1	2023-06-01	1
27	7579	Jazz Drummond	drumming.jazz@email.com	2023-05-15	Basic (Ads)	2.99	0	NaT	0
28	7581	Lyric Keys	keysoflyric@email.com	2023-05-16	Premium (No Ads)	7.99	1	2023-06-03	1
29	7583	Melody Singer	melodic.singer@email.com	2023-05-16	Premium (No Ads)	7.99	1	2023-06-01	1

4. Exploratory Data Analysis

Try to better understand the customers who cancelled:

- How long were they members before they cancelled?
- What percentage of customers who cancelled had a discount vs customers who didn't cancel?

In [137]:

```
# How long were customers members before they cancelled?
df_cus['Cancellation Date']-df_cus['Member Since']
```

Out[137]:

```
0         NaT
1         NaT
2     80 days
3         NaT
4         NaT
5     75 days
6         NaT
7     72 days
8         NaT
9         NaT
10        NaT
11        NaT
12    65 days
13    61 days
14        NaT
15    57 days
16        NaT
17        NaT
18        NaT
19    46 days
20        NaT
21        NaT
22    32 days
23    32 days
24        NaT
25    24 days
26    24 days
27        NaT
28    18 days
29    16 days
dtype: timedelta64[ns]
```

In [138]:

```
(df_cus['Cancellation Date']-df_cus['Member Since']).mean()
```

Out[138]:

```
Timedelta('46 days 07:23:04.615384615')
```

In [139]:

```
df_cus[df_cus['Discount?'] == 1]
```

Out[139]:

	Customer ID	Customer Name	Email	Member Since	Subscription Plan	Subscription Rate	Discount?	Cancellation Date	Cancellation status
21	6822	Kiki Keys	kiki.keys.piano@email.com	2023-05-01	Premium (No Ads)	7.99	1	NaT	0
22	6824	Greta Groove	groovy.greta@email.com	2023-05-01	Premium (No Ads)	7.99	1	2023-06-02	1
23	7087	Harmony Heart	heartfelt.harmony@email.com	2023-05-01	Premium (No Ads)	7.99	1	2023-06-02	1
25	7224	Melody Fitzgerald	fitzgerald.melody@email.com	2023-05-08	Premium (No Ads)	7.99	1	2023-06-01	1
26	7401	Reed Murphy	murphy.reed.music@email.com	2023-05-08	Premium (No Ads)	7.99	1	2023-06-01	1
28	7581	Lyric Keys	keysoflyric@email.com	2023-05-16	Premium (No Ads)	7.99	1	2023-06-03	1
29	7583	Melody Singer	melodic.singer@email.com	2023-05-16	Premium (No Ads)	7.99	1	2023-06-01	1

In [140]:

```
discounted=df_cus[df_cus['Discount?'] == 1]['Discount?'].sum()
```

In [141]:

```
cancelled=df_cus[(df_cus['Discount?'] == 1)]['Cancellation status'].sum()
```

In [142]:

```
# Cancellation rate for those who had a discount
CR_discounted=(cancelled/discounted)*100
CR_discounted
```

Out[142]:

```
85.71428571428571
```

In [143]:

```
# Not given discount
df_cus[df_cus['Discount?'] == 0]
```

Out[143]:

	Customer ID	Customer Name	Email	Member Since	Subscription Plan	Subscription Rate	Discount?	Cancellation Date	Cancellation status
0	5001	Harmony Greene	harmonious.vibes@email.com	2023-03-13	Basic (Ads)	2.99	0	NaT	0
1	5002	Aria Keys	melodious.aria@email.edu	2023-03-13	Basic (Ads)	2.99	0	NaT	0
2	5004	Lyric Bell	rhythmical.lyric@email.com	2023-03-13	Basic (Ads)	2.99	0	2023-06-01	1
3	5267	Rock Bassett	groovy.rock@email.com	2023-03-20	Basic (Ads)	2.99	0	NaT	0
4	5338	Rhythm Dixon	beats.by.rhythm@email.edu	2023-03-20	Basic (Ads)	2.99	0	NaT	0
5	5404	Jazz Saxton	jazzy.sax@email.com	2023-03-20	Basic (Ads)	2.99	0	2023-06-03	1
6	5581	Reed Sharp	sharp.tunes@email.com	2023-03-21	Premium (No Ads)	9.99	0	NaT	0
7	5759	Carol Kingbird	songbird.carol@email.com	2023-03-22	Premium (No Ads)	9.99	0	2023-06-02	1
8	5761	Sonata Nash	musical.sonata@email.com	2023-03-28	Premium (No Ads)	9.99	0	NaT	0
9	5763	Jazz Coleman	coleman.jazzmaster@email.com	2023-03-28	Basic (Ads)	2.99	0	NaT	0
10	5826	Chord Hayes	harmonic.chord@email.com	2023-03-28	Basic (Ads)	2.99	0	NaT	0
11	5827	Rhythm Franklin	rhythmic.franklin@email.edu	2023-03-28	Basic (Ads)	2.99	0	NaT	0
12	6029	Chord Campbell	campbell.chordify@email.com	2023-03-29	Premium (No Ads)	9.99	0	2023-06-02	1
13	6092	Benny Beat	rhythmic.benny@email.com	2023-04-01	Basic (Ads)	2.99	0	2023-06-01	1
14	6163	Melody Parks	park.of.melodies@email.com	2023-04-05	Premium (No Ads)	9.99	0	NaT	0
15	6229	Symphony Rhodes	rhodes.symphony@email.com	2023-04-06	Premium (No Ads)	9.99	0	2023-06-02	1
16	6406	Beatrice Sharp	beats.by.beatrice@email.com	2023-04-08	Basic (Ads)	2.99	0	NaT	0
17	6584	Bobby Bass	bass.master.bobby@email.edu	2023-04-09	Basic (Ads)	2.99	0	NaT	0
18	6586	Lyric Saunders	lyrical.saunders@email.edu	2023-04-16	Basic (Ads)	2.99	0	NaT	0
19	6588	Harmony Bass	bass.harmony@email.com	2023-04-16	Basic (Ads)	2.99	0	2023-06-01	1
20	6821	Reed Flat	flat.tunes@email.edu	2023-04-24	Basic (Ads)	2.99	0	NaT	0
24	7158	Harmony Wallace	wallace.harmony@email.com	2023-05-07	Basic (Ads)	2.99	0	NaT	0
27	7579	Jazz Drummond	drumming.jazz@email.com	2023-05-15	Basic (Ads)	2.99	0	NaT	0

In [144]:

```
No_discount= df_cus[(df_cus['Discount?'] == 0)]['Discount?'].count()
No_discount
```

Out[144]:

```
23
```

In [145]:

```
cancelled_no_discount=df_cus[(df_cus['Discount?'] == 0)]['Cancellation status'].sum()
cancelled_no_discount
```

Out[145]:

```
7
```

In [146]:

```
# Cancellation rate for those who did not have a discount
CR_notdiscounted=(cancelled_no_discount/No_discount)*100
CR_notdiscounted
```

Out[146]:

```
30.434782608695656
```

In [147]:

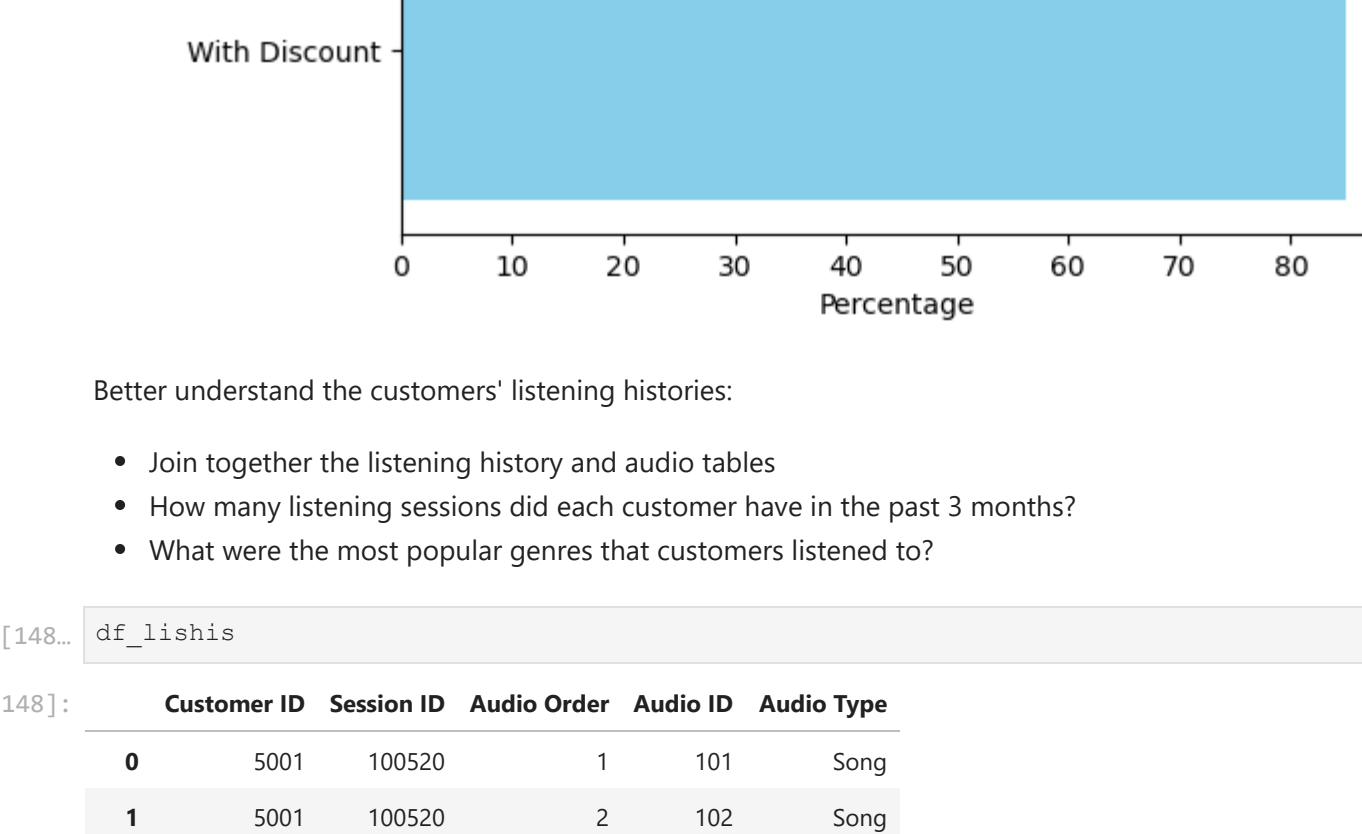
```
# Visualize the cancellation rate for those with a discount vs those without a discount
import matplotlib.pyplot as plt

# Sample data
Categories = ['With Discount', 'Without Discount']
Percentage = [85, 30]

# Create a horizontal bar plot
plt.barh(Categories, Percentage, color='skyblue')

# Add labels and title
plt.xlabel('Percentage')
plt.ylabel('Categories')
plt.title('Cancellation rate for those with a discount vs those without a discount')

# Show the plot
plt.show()
```



Better understand the customers' listening histories:

- Join together the listening history and audio tables
- How many listening sessions did each customer have in the past 3 months?
- What were the most popular genres that customers listened to?

In [148]:

```
df_lishis
```

Out[148]:

	Customer ID	Session ID	Audio Order	Audio ID	Audio Type
0	5001	100520	1	101	Song
1	5001	100520	2	102	Song
2	5001	100520	3	103	Song
3	5001	100520	4	104	Song
4	5001	100520	5	105	Song
...	...	...	...	...	...
500	7579	111282	4	111	Song
501	6588	111286	1	201	Podcast
502	5763	111333	1	110	Song
503	5763	111333	2	108	Song
504	5763	111333	3	110	Song

505 rows × 5 columns

In [149]:

```
df_audio.head()
```

Out[149]:

	ID	Name	Genre	Popularity
0	Song-101	Dance All Night	Pop Music	1
1	Song-102	Unbreakable Beat	Pop Music	2
2	Song-103	Sunset Boulevard	Pop Music	5
3	Song-104	Glowing Hearts	Pop Music	10
4	Song-105	Pop Rocks	Pop Music	52

In [ ]:

In [150]:

```
# Split the ID in the audio data so the column can be joined with other tables
# Split the number from audio id
df_audio['Modified_ID'] = np.where(df_audio['ID'].str.contains('Song'), df_audio['ID'].str[5:], df_audio['ID'].
df_audio['Modified_ID']=pd.to_numeric(df_audio['Modified_ID'])
df_audio['Modified_ID']
```

Out[150]:

```
0     101
1     102
2     103
3     104
4     105
5     106
6     107
7     108
8     109
9     110
10    111
11    112
12    201
13    202
14    203
15    204
16    205
Name: Modified_ID, dtype: int64
```

In [151]:

```
df_audio
```

Out[151]:

	ID	Name	Genre	Popularity	Modified_ID
0	Song-101	Dance All Night	Pop Music	1	101
1	Song-102	Unbreakable Beat	Pop Music	2	102
2	Song-103	Sunset Boulevard	Pop Music	5	103
3	Song-104	Glowing Hearts	Pop Music	10	104
4	Song-105	Pop Rocks	Pop Music	52	105
5	Song-106	My Old Dog and My True Love	Country	23	106
6	Song-107	Dirt Road Romance	Country	30	107
7	Song-108	Chase the Dream	Hip Hop	4	108
8	Song-109	Rise Above	Hip Hop	9	109
9	Song-110	Boss Moves	Hip Hop	28	110
10	Song-111	Moonlit Serenade	Jazz	63	111
11	Song-112	Midnight Blues	Jazz	80	112
12	Podcast-201	Jokes on Jokes	Comedy	2	201
13	Podcast-202	Laugh Out Loud	Comedy	8	202
14	Podcast-203	The Comedian's Corner	Comedy	20	203
15	Podcast-204	Crime Chronicles	True Crime	4	204
16	Podcast-205	Investigating Darkness	True Crime	17	205

In [152]:

```
# Hint: Check the data type of Audio ID in the audio table
df_lishis['Audio ID'].dtype
```

Out[152]:

```
dtype('int64')
```

In [153]:

```
df_audio.dtypes
```

Out[153]:

```
ID             object
Name           object
Genre          object
Popularity      int64
Modified_ID     int64
dtype: object
```

In [154]:

```
# Merge the listening history table and audio table
df_lisaudio=df_lishis.merge(df_audio, how ='left', left_on='Audio ID', right_on= 'Modified_ID')
df_lisaudio
```

Out[154]:

	Customer ID	Session ID	Audio Order	Audio ID	Audio Type	ID	Name	Genre	Popularity	Modified_ID
0	5001	100520	1	101	Song	Song-101	Dance All Night	Pop Music	1	101
1	5001	100520	2	102	Song	Song-102	Unbreakable Beat	Pop Music	2	102
2	5001	100520	3	103	Song	Song-103	Sunset Boulevard	Pop Music	5	103
3	5001	100520	4	104	Song	Song-104	Glowing Hearts	Pop Music	10	104
4	5001	100520	5	105	Song	Song-105	Pop Rocks	Pop Music	52	105
...	...	...	...	...	...	...	...	...	...	...
500	7579	111282	4	111	Song	Song-111	Moonlit Serenade	Jazz	63	111
501	6588	111286	1	201	Podcast	Podcast-201	Jokes on Jokes	Comedy	2	201
502	5763	111333	1	110	Song	Song-110	Boss Moves	Hip Hop	28	110
503	5763	111333	2	108	Song	Song-108	Chase the Dream	Hip Hop	4	108
504	5763	111333	3	110	Song	Song-110	Boss Moves	Hip Hop	28	110

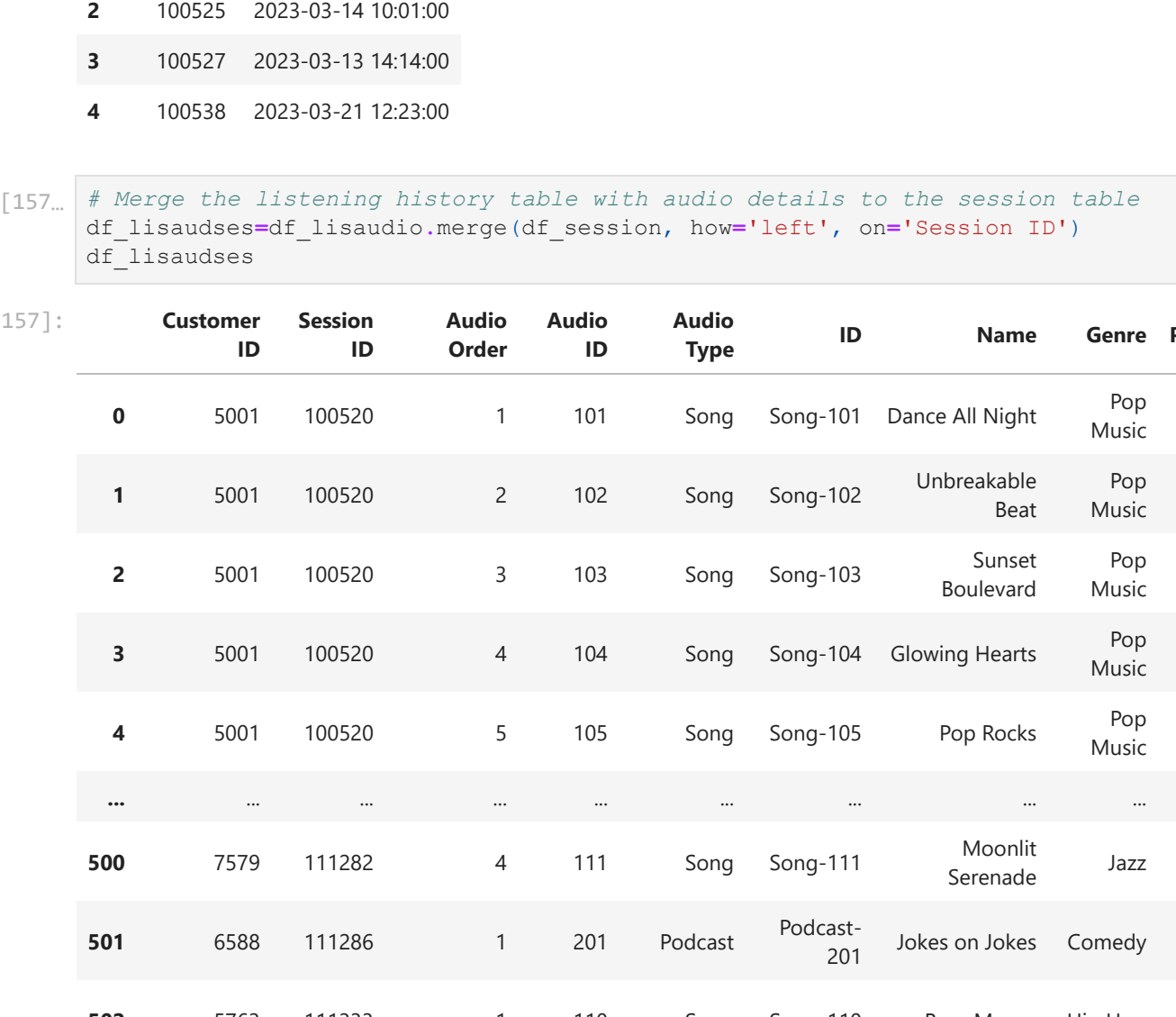
505 rows × 10 columns

In [155]:

```
df_lisaudio.groupby('Customer ID')['Session ID'].nunique().plot.hist()
```

Out[155]:

```
<Axes: ylabel='Frequency'>
```



In [156]:

```
df_session.head()
```

Out[156]:

	Session ID	Session Log In Time
0	100520	2023-03-13 18:29:00
1	100522	2023-03-13 22:15:00
2	100525	2023-03-14 10:01:00
3	100527	2023-03-13 14:14:00
4	100538	2023-03-21 12:23:00

In [157]:

```
# Merge the listening history table with audio details to the session table
df_lisaudses=df_lisaudio.merge(df_session, how='left', on='Session ID')
df_lisaudses
```

Out[157]:

	Customer ID	Session ID	Audio Order	Audio ID	Audio Type	ID	Name	Genre	Popularity	Modified_ID	Session Log In Time
0	5001	100520	1	101	Song	Song-101	Dance All Night	Pop Music	1	101	2023-03-13 18:29:00
1	5001	100520	2	102	Song	Song-102	Unbreakable Beat	Pop Music	2	102	2023-03-13 18:29:00
2	5001	100520	3	103	Song	Song-103	Sunset Boulevard	Pop Music	5	103	2023-03-13 18:29:00
3	5001	100520	4	104	Song	Song-104	Glowing Hearts	Pop Music	10	104	2023-03-13 18:29:00
4	5001	100520	5	105	Song	Song-105	Pop Rocks	Pop Music	52	105	2023-03-13 18:29:00
...	...	...	...	...	...	...	...	...	...	...	...
500	7579	111282	4	111	Song	Song-111	Moonlit Serenade	Jazz	63	111	2023-05-23 23:51:00
501	6588	111286	1	201	Podcast	Podcast-201	Jokes on Jokes	Comedy	2	201	2023-05-27 02:15:00
502	5763	111333	1	110	Song	Song-110	Boss Moves	Hip Hop	28	110	2023-05-27 20:46:00
503	5763	111333	2	108	Song	Song-108	Chase the Dream	Hip Hop	4	108	2023-05-27 20:46:00
504	5763	111333	3	110	Song	Song-110	Boss Moves	Hip Hop	28	110	2023-05-27 20:46:00

505 rows × 11 columns

In [158]:

```
# The number of listening sessions that each customer had in the past 3 months
```

In [159]:

```
df_lisaudses.dtypes
```

Out[159]:

```
Customer ID                     int64
Session ID                      int64
Audio Order                     int64
Audio ID                        int64
Audio Type                     object
ID                             object
Name                           object
Genre                          object
Popularity                      int64
Modified_ID                     int64
Session Log In Time    datetime64[ns]
dtype: object
```

In [160]:

```
df_lisaudses['Session Log In Time'].dt.month.value_counts()
```

Out[160]:

```
5    254
3    145
4    106
Name: Session Log In Time, dtype: int64
```

In [161]:

```
no_ses=(df_lisaudses.groupby('Customer ID')['Session ID']
                 .nunique()
                 .sort_values(ascending=False)
                 .to_frame()
                 .rename(columns={'Session ID': 'No of Sessions'})
                 .reset_index())
no_ses
```

Out[161]:

	Customer ID	No of Sessions
0	5001	8
1	5267	7
2	5763	6
3	6824	4
4	5338	4
5	5002	4
6	7224	4
7	7158	3
8	7087	3
9	6406	3
10	6163	3
11	6092	3
12	5826	3
13	6822	3
14	5761	3
15	7401	3
16	5581	3
17	6588	3
18	7579	2
19	7581	2
20	6229	2
21	6821	2
22	6586	2
23	6584	2
24	6029	2
25	5759	2
26	5827	1
27	5404	1
28	5004	1
29	7583	1

In [162]:

```
# The most popular genres that customers listened to
```

In [163]:

```
df_lisaudses['Genre'].value_counts()
```

Out[163]:

```
Pop Music     267
Hip Hop        88
Country        68
Jazz           48
Comedy         19
True Crime     15
Name: Genre, dtype: int64
```

In [164]:

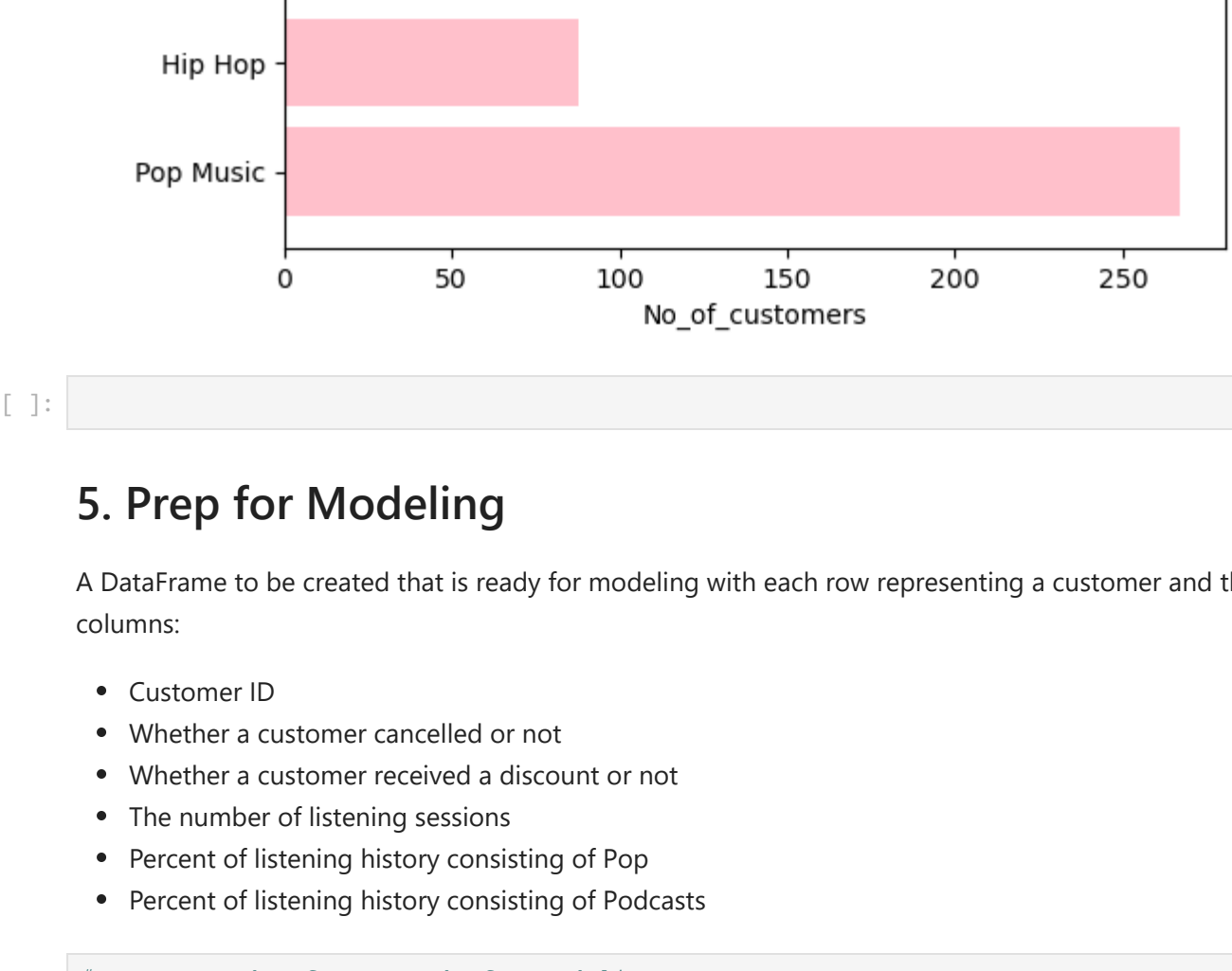
```
# Visualize the Genres customers listened to
import matplotlib.pyplot as plt

# Sample data
Genre = ['Pop Music', 'Hip Hop', 'Country','Jazz','Comedy','True Crime']
No_of_customers = [267, 88, 68, 48, 19, 15]

# Create a horizontal bar plot
plt.barh(Genre, No_of_customers, color='pink')

# Add labels and title
plt.xlabel('No_of_customers')
plt.ylabel('Genre s')
plt.title('Genres and Number of customers listened to')

# Show the plot
plt.show()
```



In [ ]:

5. Prep for Modeling

A DataFrame to be created that is ready for modeling with each row representing a customer and the following numeric, non-null columns:

- Customer ID
- Whether a customer cancelled or not
- Whether a customer received a discount or not
- The number of listening sessions
- Percent of listening history consisting of Pop
- Percent of listening history consisting of Podcasts

In [165]:

```
# Create a dataframe ready for modeling
df_lisaudses.head()
```

Out[165]:

	Customer ID	Session ID	Audio Order	Audio ID	Audio Type	ID	Name	Genre	Popularity	Modified_ID	Session Log In Time
0	5001	100520	1	101	Song	Song-101	Dance All Night	Pop Music	1	101	2023-03-13 18:29:00
1	5001	100520	2	102	Song	Song-102	Unbreakable Beat	Pop Music	2	102	2023-03-13 18:29:00
2	5001	100520	3	103	Song	Song-103	Sunset Boulevard	Pop Music	5	103	2023-03-13 18:29:00
3	5001	100520	4	104	Song	Song-104	Glowing Hearts	Pop Music	10	104	2023-03-13 18:29:00
4	5001	100520	5	105	Song	Song-105	Pop Rocks	Pop Music	52	105	2023-03-13 18:29:00

In [166]:

```
df_lisaudses.shape
```

Out[166]:

```
(505, 11)
```

In [167]:

```
df_cus
```

Out[167]:

	Customer ID	Customer Name	Email	Member Since	Subscription Plan	Subscription Rate	Discount?	Cancellation Date	Cancellation status
0	5001	Harmony Greene	harmonious.vibes@email.com	2023-03-13	Basic (Ads)	2.99	0	NaT	0
1	5002	Aria Keys	melodious.aria@email.edu	2023-03-13	Basic (Ads)	2.99	0	NaT	0
2	5004	Lyric Bell	rhythmical.lyric@email.com	2023-03-13	Basic (Ads)	2.99	0	2023-06-01	1
3	5267	Rock Bassett	groovy.rock@email.com	2023-03-20	Basic (Ads)	2.99	0	NaT	0
4	5338	Rhythm Dixon	beats.by.rhythm@email.edu	2023-03-20	Basic (Ads)	2.99	0	NaT	0
5	5404	Jazz Saxton	jazzy.sax@email.com	2023-03-20	Basic (Ads)	2.99	0	2023-06-03	1
6	5581	Reed Sharp	sharp.tunes@email.com	2023-03-21	Premium (No Ads)	9.99	0	NaT	0
7	5759	Carol Kingbird	songbird.carol@email.com	2023-03-22	Premium (No Ads)	9.99	0	2023-06-02	1
8	5761	Sonata Nash	musical.sonata@email.com	2023-03-28	Premium (No Ads)	9.99	0	NaT	0
9	5763	Jazz Coleman	coleman.jazzmaster@email.com	2023-03-28	Basic (Ads)	2.99	0	NaT	0
10	5826	Chord Hayes	harmonic.chord@email.com	2023-03-28	Basic (Ads)	2.99	0	NaT	0
11	5827	Rhythm Franklin	rhythmic.franklin@email.edu	2023-03-28	Basic (Ads)	2.99	0	NaT	0
12	6029	Chord Campbell	campbell.chordify@email.com	2023-03-29	Premium (No Ads)	9.99	0	2023-06-02	1
13	6092	Benny Beat	rhythmic.benny@email.com	2023-04-01	Basic (Ads)	2.99	0	2023-06-01	1
14	6163	Melody Parks	park.of.melodies@email.com	2023-04-05	Premium (No Ads)	9.99	0	NaT	0
15	6229	Symphony Rhodes	rhodes.symphony@email.com	2023-04-06	Premium (No Ads)	9.99	0	2023-06-02	1
16	6406	Beatrice Sharp	beats.by.beatrice@email.com	2023-04-08	Basic (Ads)	2.99	0	NaT	0
17	6584	Bobby Bass	bass.master.bobby@email.edu	2023-04-09	Basic (Ads)	2.99	0	NaT	0
18	6586	Lyric Saunders	lyrical.saunders@email.edu	2023-04-16	Basic (Ads)	2.99	0	NaT	0
19	6588	Harmony Bass	bass.harmony@email.com	2023-04-16	Basic (Ads)	2.99	0	2023-06-01	1
20	6821	Reed Flat	flat.tunes@email.edu	2023-04-24	Basic (Ads)	2.99	0	NaT	0
21	6822	Kiki Keys	kiki.keys.piano@email.com	2023-05-01	Premium (No Ads)	7.99	1	NaT	0
22	6824	Greta Groove	groovy.greta@email.com	2023-05-01	Premium (No Ads)	7.99	1	2023-06-02	1
23	7087	Harmony Heart	heartfelt.harmony@email.com	2023-05-01	Premium (No Ads)	7.99	1	2023-06-02	1
24	7158	Harmony Wallace	wallace.harmony@email.com	2023-05-07	Basic (Ads)	2.99	0	NaT	0
25	7224	Melody Fitzgerald	fitzgerald.melody@email.com	2023-05-08	Premium (No Ads)	7.99	1	2023-06-01	1
26	7401	Reed Murphy	murphy.reed.music@email.com	2023-05-08	Premium (No Ads)	7.99	1	2023-06-01	1
27	7579	Jazz Drummond	drumming.jazz@email.com	2023-05-15	Basic (Ads)	2.99	0	NaT	0
28	7581	Lyric Keys	keysoflyric@email.com	2023-05-16	Premium (No Ads)	7.99	1	2023-06-03	1
29	7583	Melodic Singer	melodic.singer@email.com	2023-05-16	Premium (No Ads)	7.99	1	2023-06-01	1

In [168]:

```
df=df_lisaudaes.merge(df_cus, how='left', on= 'Customer ID')
df.head()
```

Out[168]:

	Customer ID	Session ID	Audio Order	Audio ID	Audio Type	ID	Name	Genre	Popularity	Modified_ID	Session Log In Time	Customer Name	Em
0	5001	100520	1	101	Song	Song-101	Dance All Night	Pop Music	1	101	2023-03-13 18:29:00	Harmony Greene	harmonious.vibes@email.c
1	5001	100520	2	102	Song	Song-102	Unbreakable Beat	Pop Music	2	102	2023-03-13 18:29:00	Harmony Greene	harmonious.vibes@email.c
2	5001	100520	3	103	Song	Song-103	Sunset Boulevard	Pop Music	5	103	2023-03-13 18:29:00	Harmony Greene	harmonious.vibes@email.c
3	5001	100520	4	104	Song	Song-104	Glowing Hearts	Pop Music	10	104	2023-03-13 18:29:00	Harmony Greene	harmonious.vibes@email.c
4	5001	100520	5	105	Song	Song-105	Pop Rocks	Pop Music	52	105	2023-03-13 18:29:00	Harmony Greene	harmonious.vibes@email.c

In [187]:

```
df_model=df_cus[['Customer ID','Cancellation status','Discount?']]
df_model.head()
```

Out[187]:

	Customer ID	Cancellation status	Discount?
0	5001	0	0
1	5002	0	0
2	5004	1	0
3	5267	0	0
4	5338	0	0

In [188]:

```
# Calculate the number of listening sessions for each customer
dfmodel = df_model.merge(ns, how='left', on= 'Customer ID')
dfmodel.head()
```

Out[188]:

	Customer ID	Cancellation status	Discount?	No of Sessions
0	5001	0	0	8
1	5002	0	0	4
2	5004	1	0	1
3	5267	0	0	7
4	5338	0	0	4

In [189]:

```
# Percent pop
dummies=pd.get_dummies(df['Genre'])
dummies.head()
```

Out[189]:

	Comedy	Country	Hip Hop	Jazz	Pop Music	True Crime
0	0	0	0	0	1	0
1	0	0	0	0	1	0
2	0	0	0	0	1	0
3	0	0	0	0	1	0
4	0	0	0	0	1	0

In [172]:

```
df_music=pd.concat([df['Customer ID'],dummies],axis=1)
    .groupby('Customer ID')
    .sum()
    .reset_index()
df_music.head()
```

Out[172]:

	Customer ID	Comedy	Country	Hip Hop	Jazz	Pop Music	True Crime
0	5001	0	0	26	0	34	0
1	5002	0	22	0	0	0	0
2	5004	0	0	0	0	9	0
3	5267	0	0	22	0	23	0
4	5338	0	18	0	0	0	0

In [173]:

```
df_music['Total_audio']=df_music[['Comedy', 'Country','Hip Hop','Jazz','Pop Music','True Crime']].sum(axis=1)
df_music.head()
```

Out[173]:

	Customer ID	Comedy	Country	Hip Hop	Jazz	Pop Music	True Crime	Total_audio
0	5001	0	0	26	0	34	0	60
1	5002	0	22	0	0	0	0	22
2	5004	0	0	0	0	9	0	9
3	5267	0	0	22	0	23	0	45
4	5338	0	18	0	0	0	0	18

In [175]:

```
df_music['Percent_Pop']=round(df_music['Pop Music']/df_music['Total_audio']*100)
df_music.head()
```

Out[175]:

	Customer ID	Comedy	Country	Hip Hop	Jazz	Pop Music	True Crime	Total_audio	Percent_Pop
0	5001	0	0	26	0	34	0	60	57.0
1	5002	0	22	0	0	0	0	22	0.0
2	5004	0	0	0	0	9	0	9	100.0
3	5267	0	0	22	0	23	0	45	51.0
4	5338	0	18	0	0	0	0	18	0.0

In [176]:

```
model_final=pd.concat([dfmodel,df_music['Percent_Pop']],axis=1)
```

In [178]:

```
# Percent podcasts
filt_df=df_audio[df_audio['ID'].str.contains('Podcast')]
filt_df
```

Out[178]:

	ID	Name	Genre	Popularity	Modified_ID
12	Podcast-201	Jokes on Lives	Comedy	2	201
13	Podcast-202	Laugh Out Loudcast	Comedy	8	202
14	Podcast-203	The Comedian's Corner	Comedy	20	203
15	Podcast-204	Crime Chronicles	True Crime	4	204
16	Podcast-205	Investigating Darkness	True Crime	17	205

In [179]:

```
df_audio['Genre'].value_counts()
```

Out[179]:

```
Pop Music     5
Hip Hop       3
Comedy        3
Country       2
Jazz          2
True Crime    2
Name: Genre, dtype: int64
```

In [190]:

```
df_music['Percent_Podcast']=round(((df_music['True Crime']+df_music['Comedy'])/(df_music['Total_audio']))*100,2
df_music.head()
```

Out[190]:

	Customer ID	Comedy	Country	Hip Hop	Jazz	Pop Music	True Crime	Total_audio	Percent_Pop	Percent_Podcast
0	5001	0	0	26	0	34	0	60	57.0	0.0
1	5002	0	22	0	0	0	0	22	0.0	0.0
2	5004	0	0	0	0	9	0	9	100.0	0.0
3	5267	0	0	22	0	23	0	45	51.0	0.0
4	5338	0	18	0	0	0	0	18	0.0	0.0

In [183]:

```
final_model=pd.concat([dfmodel,df_music['Percent_Pop'],df_music['Percent_Podcast']],axis=1)
```

In [184]:

```
final_model
```

Out[184]:

	Customer ID	Cancellation status	Discount?	No of Sessions	Percent_Pop	Percent_Podcast
0	5001	0	0	8	57.0	0.00
1	5002	0	0	4	0.0	0.00
2	5004	1	0	1	100.0	0.00
3	5267	0	0	7	51.0	0.00
4	5338	0	0	4	0.0	0.00
5	5404	1	0	1	100.0	0.00
6	5581	0	0	3	0.0	100.00
7	5759	1	0	2	100.0	0.00
8	5761	0	0	3	0.0	100.00
9	5763	0	0	6	65.0	0.00
10	5826	0	0	3	0.0	0.00
11	5827	0	0	1	100.0	0.00
12	6029	1	0	2	100.0	0.00
13	6092	1	0	3	30.0	40.00
14	6163	0	0	3	0.0	100.00
15	6229	1	0	2	100.0	0.00
16	6406	0	0	3	33.0	44.44
17	6584	0	0	2	48.0	0.00
18	6586	0	0	2	45.0	0.00
19	6588	1	0	3	40.0	30.00
20	6821	0	0	2	48.0	0.00
21	6822	0	1	3	0.0	0.00
22	6824	1	1	4	100.0	0.00
23	7087	1	1	3	45.0	27.27
24	7158	0	0	3	0.0	0.00
25	7224	1	1	4	100.0	0.00
26	7401	1	1	3	45.0	27.27
27	7579	0	0	2	0.0	0.00
28	7581	1	1	2	93.0	7.14
29	7583	1	1	1	0.0	100.00

In [185]:

```
import seaborn as sns
sns.pairplot(final_model)
```

Out[185]: <seaborn.axisgrid.PairGrid at 0x21304ef4b90>

In [186]:

```
final_model.corr()
```

Out[186]:

	Customer ID	Cancellation status	Discount?	No of Sessions	Percent_Pop	Percent_Podcast
Customer ID	1.000000	0.269942	0.648514	-0.337083	-0.077422	0.083072
Cancellation status	0.269942	1.000000	0.471825	-0.333739	0.584480	-0.035419
Discount?	0.648514	0.471825	1.000000	-0.048877	0.111384	0.062925
No of Sessions	-0.337083	-0.333739	-0.048877	1.000000	-0.129659	-0.125458
Percent_Pop	-0.077422	0.584480	0.111384	-0.129659	1.000000	-0.487597
Percent_Podcast	0.083072	-0.035419	0.062925	-0.125458	-0.487597	1.000000

In [ ]:

```
# Observations
# Cancellation and Discount are positively correlated
# No. of listening sessions is negatively correlated to cancellation- higher listening session -lesser cancella
# Percent of Pop is positively related to cancellation
# Percent of Podcast not correlated to Cancellation
```