Spotify Valence and Danceability

November 2, 2022

0.0.1 Statistical Inference: Spotify Data

[2]:

```python
#import necessary packages and libraries
from scipy import stats
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

#import the data using pandas
spotify_data = pd.read_csv("spotify_data.csv")
#show the first 10 rows of data
spotify_data.head(10)
```

[2]:

```
   acousticness                                         artists  danceability  \
0         0.995                              ['Carl Woitschach']         0.708
1         0.994    ['Robert Schumann', 'Vladimir Horowitz']         0.379
2         0.604                          ['Seweryn Goszczyński']         0.749
3         0.995                             ['Francisco Canaro']         0.781
4         0.990    ['Frédéric Chopin', 'Vladimir Horowitz']         0.210
5         0.995  ['Felix Mendelssohn', 'Vladimir Horowitz']         0.424
6         0.956         ['Franz Liszt', 'Vladimir Horowitz']         0.444
7         0.988                              ['Carl Woitschach']         0.555
8         0.995                  ['Francisco Canaro', 'Charlo']         0.683
9         0.846                          ['Seweryn Goszczyński']         0.674

   duration_ms  energy  explicit                      id  instrumentalness  \
0       158648  0.1950         0  6KbQ3uYMLKb5jDxLF7wYDD             0.563
1       282133  0.0135         0  6KuQTIu1KoTTkLXKrwlLPV             0.901
2       104300  0.2200         0  6L63VW0PibdM1HDSBoqnoM             0.000
3       180760  0.1300         0  6M94FkXd15sOAOQYRnWPN8             0.887
4       687733  0.2040         0  6N6tiFZ9vLTSOIxkj8qKrd             0.908
5       352600  0.1200         0  6NxAf7M8DNHOBTmEd3JSO5             0.911
6       136627  0.1970         0  6O0puPuyrxPjDTHDUgsWI7             0.435
7       153967  0.4210         0  6OJjveoYwJdIt76y0Pxpxw             0.836
8       162493  0.2070         0  6OaJ8Bh7lsBeYoBmwmo2nh             0.206
9       111600  0.2050         0  6PrZexNb16cabXR8Q418Xc             0.000

   key  liveness  loudness  mode  \
0   10    0.1510   -12.428     1
1    8    0.0763   -28.454     1
2    5    0.1190   -19.924     0
3    1    0.1110   -14.734     0
4   11    0.0980   -16.829     1
5    6    0.0915   -19.242     0
6   11    0.0744   -17.226     1
7    1    0.1050    -9.878     1
8    9    0.3370    -9.801     0
9    9    0.1700   -20.119     1

                                             name  popularity release_date  \
0                     Singende Bataillone 1. Teil           0         1928
1        Fantasiestücke, Op. 111: Più tosto lento           0         1928
2                  Chapter 1.18 - Zamek kaniowski           0         1928
3   Bebamos Juntos - Instrumental (Remasterizado)           0   1928-09-25
4     Polonaise-Fantaisie in A-Flat Major, Op. 61           1         1928
5                     Scherzo a capriccio: Presto           0         1928
6  Valse oubliée No. 1 in F-Sharp Major, S. 215/1           0         1928
7                             Per aspera ad astra           0         1928
8                Moneda Corriente - Remasterizado           0   1928-10-03
9                   Chapter 1.3 - Zamek kaniowski           0         1928

   speechiness    tempo  valence  year
0       0.0506  118.469   0.7790  1928
1       0.0462   83.972   0.0767  1928
2       0.9290  107.177   0.8800  1928
3       0.0926  108.003   0.7200  1928
4       0.0424   62.149   0.0693  1928
5       0.0593   63.521   0.2660  1928
6       0.0400   80.495   0.3050  1928
7       0.0474  123.310   0.8570  1928
8       0.1270  119.833   0.4930  1928
9       0.9540   81.249   0.7590  1928
```

[3]:

```python
#print descriptive statistics for "danceability" variable
spotify_data['danceability'].describe()
```

[3]:

```
count    169909.000000
mean          0.538150
std           0.175346
min           0.000000
25%           0.417000
50%           0.548000
75%           0.667000
max           0.988000
Name: danceability, dtype: float64
```

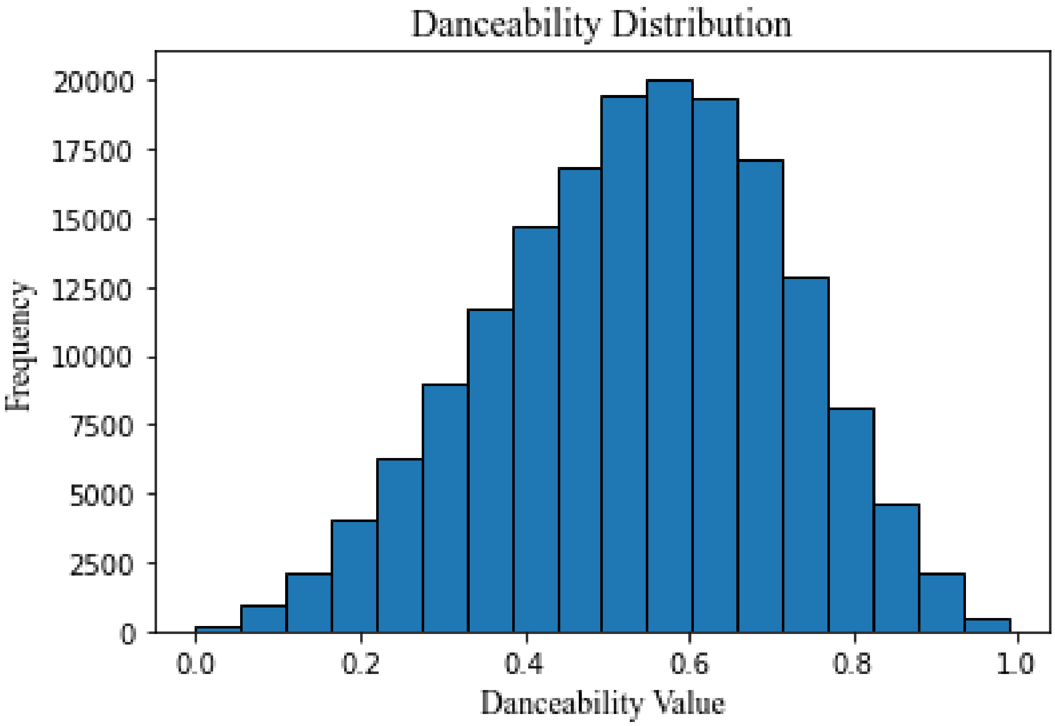
[4]:
```
#print descriptive statistics for "valeance" variable
spotify_data['valence'].describe()
```

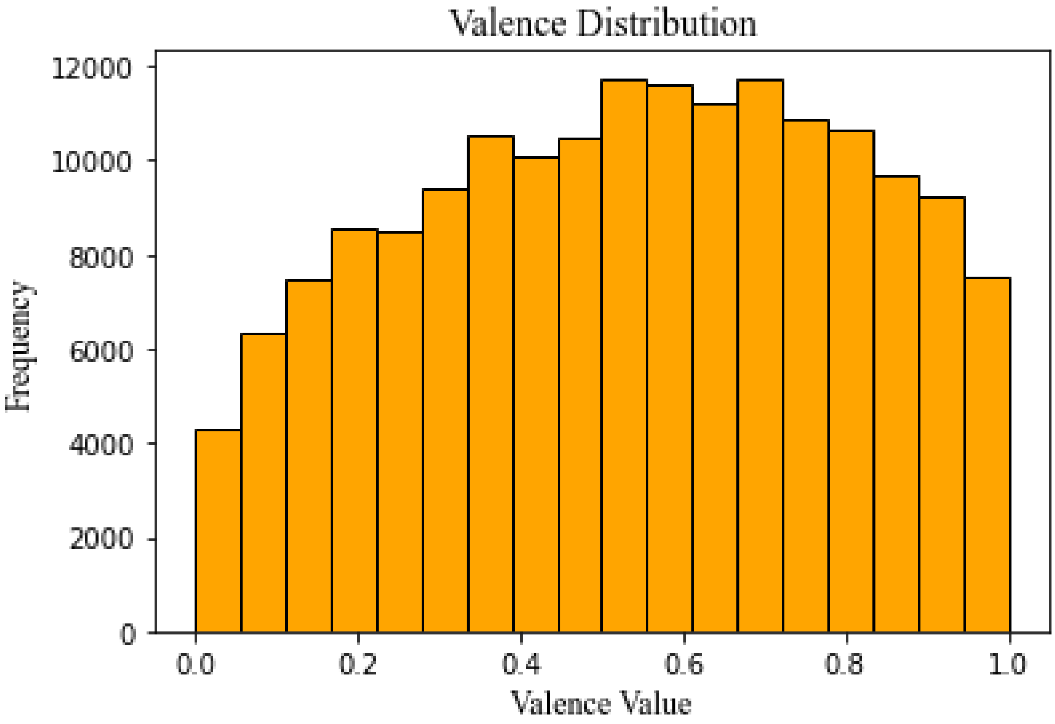
[4]:
```
count    169909.000000
mean          0.532095
std           0.262408
min           0.000000
25%           0.322000
50%           0.544000
75%           0.749000
max           1.000000
Name: valence, dtype: float64
```

[5]:
```
#calculate the meadian and the mode using library functions
print("Danceability")
print("- Median", spotify_data['danceability'].median())
print("- Mode", spotify_data['danceability'].mode())

print("Valence")
print("- Median", spotify_data['valence'].median())
print("- Mode", spotify_data['valence'].mode())
```

```
Danceability
- Median 0.5479999999999999
- Mode 0    0.565
dtype: float64
Valence
- Median 0.544
- Mode 0    0.961
dtype: float64
```

[6]:
```
#transfer the data into a list
danceability = spotify_data['danceability'].tolist()
valence = spotify_data['valence'].tolist()

#create histograms for each variable
spotify_data['danceability'].plot(kind = 'hist', bins = 18, ec = 'black')
plt.title('Danceability Distribution', fontname = 'times new roman', fontsize =␣
 ↪14)
plt.xlabel('Danceability Value', fontname = 'times new roman', fontsize = 12)
plt.ylabel('Frequency', fontname = 'times new roman', fontsize = 12)
plt.show()
spotify_data['valence'].plot(kind = 'hist', bins = 18, ec = 'black', color =␣
 ↪'orange')
plt.title('Valence Distribution', fontname = 'times new roman', fontsize = 14)
plt.xlabel('Valence Value', fontname = 'times new roman', fontsize = 12)
plt.ylabel('Frequency', fontname = 'times new roman', fontsize = 12)
plt.show()
```


Danceability Distribution
Frequency
20000
17500
15000
12500
10000
7500
5000
2500
0
0.0
0.2
0.4
0.6
0.8
1.0
Danceability Value


Valence Distribution
Frequency
12000
10000
8000
6000
4000
2000
0
0.0
0.2
0.4
0.6
0.8
1.0
Valence Value

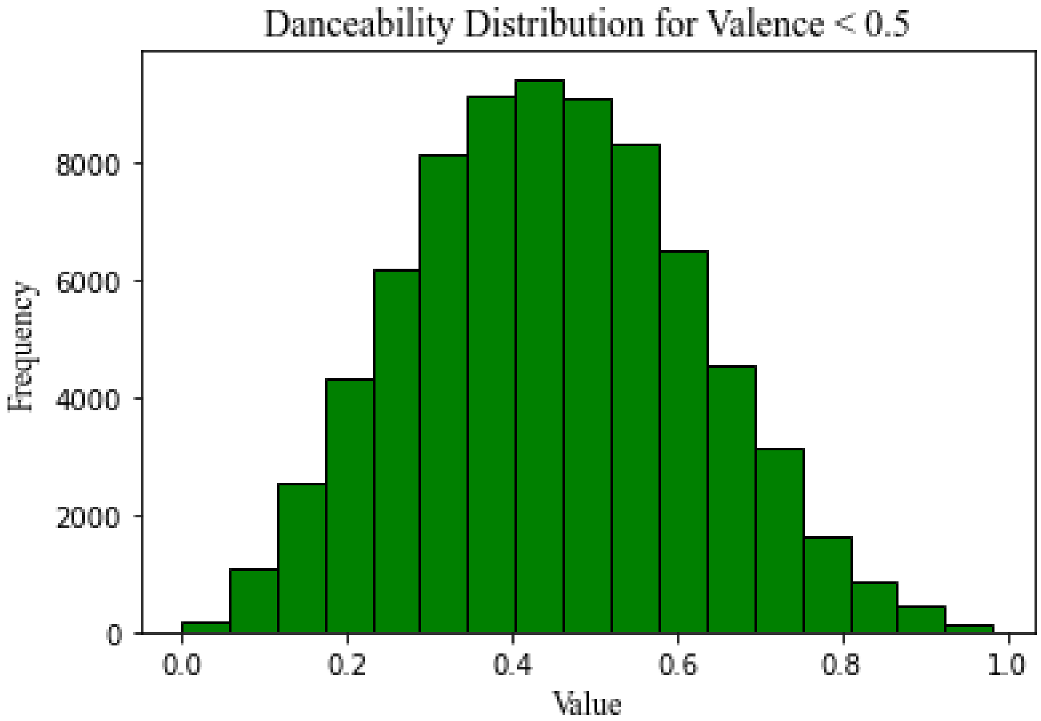
[7]:

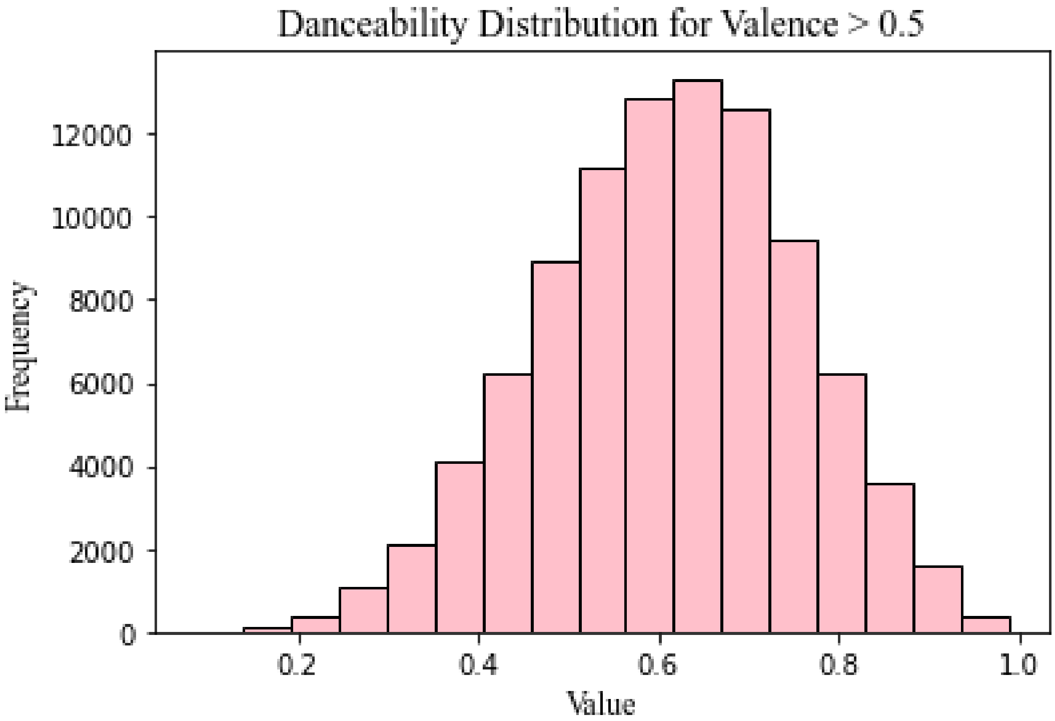
```
#divide valence data into two parts and finding statistics of danceability for␣
 ↪both

less_05 = spotify_data[spotify_data['valence'] < 0.5]
more_05 = spotify_data[spotify_data['valence'] > 0.5]

print("Valence less than 0.5:")
print("-Mean:", less_05['danceability'].mean())
print("-SD:", np.std(less_05['danceability'], ddof = 1))
print("-Sample size:", len(less_05))

print("Valence more than 0.5:")
print("-Mean:", more_05['danceability'].mean())
print("-SD:", np.std(more_05['danceability'], ddof = 1))
print("-Sample size:", len(more_05))
```

```
Valence less than 0.5:
-Mean: 0.447634003172918
-SD: 0.17063028352311016
-Sample size: 75640
Valence more than 0.5:
-Mean: 0.6109234717630982
-SD: 0.1421120289361929
-Sample size: 94079
```

[8]:

```
less_05['danceability'].plot(kind = 'hist', bins = 17, ec = 'black', color =␣
 ↪'green')
plt.title('Danceability Distribution for Valence < 0.5', fontname = 'times new␣
 ↪roman', fontsize = 14)
plt.xlabel('Value', fontname = 'times new roman', fontsize = 12)
plt.ylabel('Frequency', fontname = 'times new roman', fontsize = 12)
plt.show()
more_05['danceability'].plot(kind = 'hist', bins = 17, ec = 'black', color =␣
 ↪'pink')
plt.title('Danceability Distribution for Valence > 0.5', fontname = 'times new␣
 ↪roman', fontsize = 14)
plt.xlabel('Value', fontname = 'times new roman', fontsize = 12)
plt.ylabel('Frequency', fontname = 'times new roman', fontsize = 12)
plt.show()
```


Danceability Distribution for Valence < 0.5
Frequency
0
2000
4000
6000
8000
0.0
0.2
0.4
0.6
0.8
1.0
Value


Danceability Distribution for Valence > 0.5
Frequency
0
2000
4000
6000
8000
10000
12000
0.2
0.4
0.6
0.8
1.0
Value

[16]:

```python
#calculate the difference of means
n1 = len(less_05)
n2 = len(more_05)

x1 = less_05['danceability'].mean()
x2 = more_05['danceability'].mean()

s1 = np.std(less_05['danceability'], ddof = 1) #apply Bessel's correction
s2 = np.std(more_05['danceability'], ddof = 1)

SE = np.sqrt((s1**2)/n1 + (s2**2)/n2)
tscore = np.abs((x2-x1))/SE
df = min(n1, n2) - 1 #find degrees of freedom

pvalue = 2*stats.t.cdf(-tscore, df) #2 tails

Spooled = np.sqrt(((n1-1)*s1**2+(n2-1)*s2**2)/(n1+n2-2))
g = (x1-x2)/Spooled

print("Standard Error", SE)
print("T-score", tscore)
print("Degrees of freedom:", df)
print("P-value:", pvalue)
print("Hedge's g:", g)
```

```
Standard Error 0.0007743256212328783
T-score 210.87958878358097
Degrees of freedom: 75639
P-value: 0.0
Hedge's g: -1.0502990917576709
```

[26]:

```python
#calculate the confidence interval
mean = (x1+x2)/2

ME = tscore*np.sqrt(SE/(n1+n2))

upperbound = mean + ME
lowerbound = mean - ME

print('Confidence interval:', [lowerbound, upperbound])
```

```
Confidence interval: [0.51503476489526, 0.5435227100407563]
```