Vande Bharat Express: A Comparative Study of 25 Active Trains in Indian Railways - July 2023

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.express as px
import plotly.graph_objects as go
```

In [2]:
```
import warnings
warnings.filterwarnings('ignore')
```

In [3]:
```
df = pd.read_csv("vande_bharat.csv")
```

In [4]:
```
df.head()
```

Out[4]:

	Sr. No.	Train Name	Train Number	Originating City	Originating Station	Terminal City	Terminal Station	Operator	No. of Cars	Frequency	Distance	Travel Time	Speed	Ave Spe
0	1	New Delhi - Varanasi Vande Bharat Express	22435/22436	Delhi	New Delhi	Varanasi	Varanasi Junction	NR	16	Except Thursdays	759 km (472 mi)	08h 00m	130 km/h (81 mph)	95 (59
1	2	New Delhi - Shri Mata Vaishno Devi Katra Vande...	22439/22440	Delhi	New Delhi	Katra	Shri Mata Vaishno Devi Katra	NR	16	Except Tuesdays	655 km (407 mi)	08h 00m	130 km/h (81 mph)	82 (51
2	3	Mumbai Central - Gandhinagar Capital Vande Bha...	20901/20902	Mumbai	Mumbai Central	Gandhinagar	Gandhinagar Capital	WR	16	Except Wednesdays	522 km (324 mi)	06h 25m	130 km/h (81 mph)	82 (51
3	4	New Delhi - Amb Andaura Vande Bharat Express	22447/22448	Delhi	New Delhi	Andaura	Amb Andaura	NR	16	Except Fridays	412 km (256 mi)	05h 10m	130 km/h (81 mph)	79 (49
4	5	MGR Chennai Central - Mysuru Vande Bharat Express	20607/20608	Chennai	Chennai Central	Mysuru	Mysore Junction	SR	16	Except Wednesdays	496 km (308 mi)	06h 30m	130 km/h (81 mph)	79 (49

In [5]:
```
df.tail()
```

Out[5]:

	Sr. No.	Train Name	Train Number	Originating City	Originating Station	Terminal City	Terminal Station	Operator	No. of Cars	Frequency	Distance	Travel Time	Speed	Averag Speed
21	21	KSR Bengaluru - Dharwad Vande Bharat Express	20661/20662	Bangalore	Bangalore City	Hubbali - Dharwad	Dharwad	SWR	8	Except Tuesdays	490 km (300 mi)	06h 25m	130 km/h (81 mph)	76 km (47 mp
22	22	Rani Kamalapati (Habibganj) - Jabalpur Vande B...	20173/20174	Bhopal	Habibganj (Rani Kamalapati)	Jabalpur	Jabalpur Junction	WCR	8	Except Tuesdays	337 km (209 mi)	04h 40m	110 km/h (68 mph)	73 km (45 mp
23	23	Indore - Bhopal Vande Bharat Express	20911/20912	Indore	Indore Junction	Bhopal	Bhopal Junction	WR	8	Except Sundays	250 km (160 mi)	03h 05m	110 km/h (68 mph)	82 km (51 mp
24	24	Jodhpur - Sabarmati (Ahmedabad) Vande Bharat E...	12461/12462	Jodhpur	Jodhpur Junction	Ahmedabad	Sabarmati Junction	NWR	8	Except Tuesdays	449 km (279 mi)	06h 10m	130 km/h (81 mph)	73 km (45 mp
25	25	Gorakhpur - Lucknow Charbagh Vande Bharat Express	22549/22550	Gorakhpur	Gorakhpur Junction	Charbagh	Lucknow Charbagh	NER	8	Except Saturdays	296 km (184 mi)	04h 15m	110 km/h (68 mph)	71 km (44 mp

In [6]:
```
df.shape
```

Out[6]:
```
(26, 16)
```

In [7]:
```
df.columns
```

Out[7]:
```
Index(['Sr. No.', 'Train Name', 'Train Number', 'Originating City',
       'Originating Station', 'Terminal City', 'Terminal Station', 'Operator',
       'No. of Cars', 'Frequency', 'Distance', 'Travel Time', 'Speed',
       'Average Speed', 'Inauguration', 'Average occupancy'],
      dtype='object')
```

In [8]:
```
df.duplicated().sum()
```

Out[8]:
```
0
```

In [9]:
```
df.isnull().sum()
```

Out[9]:
```
Sr. No.               0
Train Name            0
Train Number          0
Originating City      0
Originating Station   0
Terminal City         0
Terminal Station      0
Operator              0
No. of Cars           0
Frequency             0
Distance              0
Travel Time           0
Speed                 0
Average Speed         0
Inauguration          0
Average occupancy     0
dtype: int64
```

In [10]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 26 entries, 0 to 25
Data columns (total 16 columns):
 #   Column               Non-Null Count  Dtype 
---  ------               --------------  ----- 
 0   Sr. No.              26 non-null     int64 
 1   Train Name           26 non-null     object
 2   Train Number         26 non-null     object
 3   Originating City     26 non-null     object
 4   Originating Station  26 non-null     object
 5   Terminal City        26 non-null     object
 6   Terminal Station     26 non-null     object
 7   Operator             26 non-null     object
 8   No. of Cars          26 non-null     int64 
 9   Frequency            26 non-null     object
 10  Distance             26 non-null     object
 11  Travel Time          26 non-null     object
 12  Speed                26 non-null     object
 13  Average Speed        26 non-null     object
 14  Inauguration         26 non-null     object
 15  Average occupancy    26 non-null     object
dtypes: int64(2), object(14)
memory usage: 3.4+ KB
```

In [11]:
```
df.describe()
```

Out[11]:

	Sr. No.	No. of Cars
count	26.000000	26.000000
mean	13.230769	12.923077
std	7.306478	3.969112
min	1.000000	8.000000
25%	7.250000	8.000000
50%	13.500000	16.000000
75%	19.000000	16.000000
max	25.000000	16.000000

In [12]:
```
df = df.drop('Sr. No.', axis = 1)
```

In [13]:
```
df.nunique()
```

Out[13]:
```
Train Name             25
Train Number           25
Originating City       15
Originating Station    18
Terminal City          25
Terminal Station       25
Operator               15
No. of Cars             2
Frequency               9
Distance               24
Travel Time            20
Speed                   5
Average Speed          17
Inauguration           18
Average occupancy      22
dtype: int64
```

In [14]:
```
for i in df.columns:
    print(i)
    print(df[i].unique())
    print('\n')
```

```
Train Name
['New Delhi - Varanasi Vande Bharat Express'
 'New Delhi - Shri Mata Vaishno Devi Katra Vande Bharat Express'
 'Mumbai Central - Gandhinagar Capital Vande Bharat Express'
 'New Delhi - Amb Andaura Vande Bharat Express'
 'MGR Chennai Central - Mysuru Vande Bharat Express'
 'Bilaspur - Nagpur Vande Bharat Express'
 'Howrah - New Jalpaiguri Vande Bharat Express'
 'Visakhapatnam - Secunderabad Vande Bharat Express'
 'Mumbai CSMT - Solapur Vande Bharat Express'
 'Mumbai CSMT - Sainagar Shirdi Vande Bharat Express'
 'Rani Kamalapati (Habibganj) - Hazrat Nizamuddin Vande Bharat Express'
 'Secunderabad - Tirupati Vande Bharat Express'
 'MGR Chennai Central - Coimbatore Vande Bharat Express'
 'Delhi Cantonment - Ajmer Vande Bharat Express'
 'Kasaragod - Thiruvananthapuram Vande Bharat Express'
 'Howrah - Puri Vande Bharat Express'
 'Anand Vihar Terminal - Dehradun Vande Bharat Express'
 'New Jalpaiguri - Guwahati Vande Bharat Express'
 'Mumbai CSMT - Madgaon Vande Bharat Express'
 'Patna - Ranchi Vande Bharat Express'
 'KSR Bengaluru - Dharwad Vande Bharat Express'
 'Rani Kamalapati (Habibganj) - Jabalpur Vande Bharat Express'
 'Indore - Bhopal Vande Bharat Express'
 'Jodhpur - Sabarmati (Ahmedabad) Vande Bharat Express'
 'Gorakhpur - Lucknow Charbagh Vande Bharat Express']


Train Number
['22435/22436' '22439/22440' '20901/20902' '22447/22448' '20607/20608'
 '20825/20826' '22301/22302' '20833/20834' '22225/22226' '22223/22224'
 '20171/20172' '20701/20702' '20643/20644' '20977/20978' '20633/20634'
 '22895/22896' '22457/22458' '22227/22228' '22229/22230' '22349/22350'
 '20661/20662' '20173/20174' '20911/20912' '12461/12462' '22549/22550']


Originating City
['Delhi' 'Mumbai' 'Chennai' 'Bilaspur, Chhattisgarh' 'Kolkata'
 'Visakhapatnam' 'Bhopal' 'Hyderabad' 'Kasaragod' 'Siliguri' 'Patna'
 'Bangalore' 'Indore' 'Jodhpur' 'Gorakhpur']
```

```
Originating Station
['New Delhi' 'Mumbai Central' 'Chennai Central' 'Bilaspur Junction'
 'Howrah Junction' 'Visakhapatnam Junction' 'Chhatrapati Shivaji Terminus'
 'Habibganj (Rani Kamalapati)' 'Secunderabad Junction' 'Delhi Cantonment'
 'Kasaragod' 'Anand Vihar Terminal' 'New Jalpaiguri Junction'
 'Patna Junction' 'Bangalore City' 'Indore Junction' 'Jodhpur Junction'
 'Gorakhpur Junction']


Terminal City
['Varanasi' 'Katra' 'Gandhinagar' 'Andaura' 'Mysuru' 'Nagpur' 'Siliguri'
 'Hyderabad' 'Solapur' 'Shirdi' 'Delhi' 'Tirupati' 'Coimbatore' 'Ajmer'
 'Thiruvananthapuram' 'Puri' 'Dehradun' 'Guwahati' 'Madgaon' 'Ranchi'
 'Hubbali - Dharwad' 'Jabalpur' 'Bhopal' 'Ahmedabad' 'Charbagh']


Terminal Station
['Varanasi Junction' 'Shri Mata Vaishno Devi Katra' 'Gandhinagar Capital'
 'Amb Andaura' 'Mysore Junction' 'Nagpur Junction'
 'New Jalpaiguri Junction' 'Secunderabad Junction' 'Solapur'
 'Sainagar Shirdi' 'Hazrat Nizamuddin' 'Tirupati' 'Coimbatore Junction'
 'Ajmer Junction' 'Thiruvananthapuram Central' 'Puri' 'Dehradun Terminal'
 'Guwahati' 'Madgaon Junction' 'Ranchi Junction' 'Dharwad'
 'Jabalpur Junction' 'Bhopal Junction' 'Sabarmati Junction'
 'Lucknow Charbagh']


Operator
['NR' 'WR' 'SR' 'SECR' 'ER' 'ECoR' 'CR' 'WCR' 'SCR' 'NWR' 'SER' 'NFR'
 'ECR' 'SWR' 'NER']


No. of Cars
[16  8]


Frequency
['Except Thursdays' 'Except Tuesdays' 'Except Wednesdays' 'Except Fridays'
 'Except Saturdays' 'Except Sundays'
 'Except Wednesdays (22225) , Except Thursdays (22226)'
 'Except Fridays\n(Non-Monsoon)'
```

```
 'Monday, Wednesday, Friday (22229)\nTuesday, Thursday, Saturday (22230)\n(Monsoon)']


Distance
['759\xa0km (472\xa0mi)' '655\xa0km (407\xa0mi)' '522\xa0km (324\xa0mi)'
 '412\xa0km (256\xa0mi)' '496\xa0km (308\xa0mi)' '565\xa0km (351\xa0mi)'
 '698\xa0km (434\xa0mi)' '452\xa0km (281\xa0mi)' '339\xa0km (211\xa0mi)'
 '702\xa0km (436\xa0mi)' '661\xa0km (411\xa0mi)' '495\xa0km (308\xa0mi)'
 '428\xa0km (266\xa0mi)' '587\xa0km (365\xa0mi)' '500\xa0km (310\xa0mi)'
 '304\xa0km (189\xa0mi)' '407\xa0km (253\xa0mi)' '586\xa0km (364\xa0mi)'
 '379\xa0km (235\xa0mi)' '490\xa0km (300\xa0mi)' '337\xa0km (209\xa0mi)'
 '250\xa0km (160\xa0mi)' '449\xa0km (279\xa0mi)' '296\xa0km (184\xa0mi)']


Travel Time
['08h 00m' '06h 25m' '05h 10m' '06h 30m' '05h 30m' '07h 30m' '08h 30m'
 '05h 20m' '08h 15m' '05h 50m' '05h 15m' '08h 05m' '04h 45m'
 '07h 45m\n(Non-Monsoon)' '10h 05m\n(Monsoon)' '06h 00m' '04h 40m'
 '03h 05m' '06h 10m' '04h 15m']


Speed
['130 km/h (81 mph)' '130\xa0km/h (81\xa0mph)' '110\xa0km/h (68\xa0mph)'
 '160\xa0km/h (99\xa0mph)' '120\xa0km/h (75\xa0mph)']


Average Speed
['95\xa0km/h (59\xa0mph)' '82\xa0km/h (51\xa0mph)'
 '79\xa0km/h (49\xa0mph)' '75\xa0km/h (47\xa0mph)'
 '70\xa0km/h (43\xa0mph)' '64\xa0km/h (40\xa0mph)'
 '94\xa0km/h (58\xa0mph)' '80\xa0km/h (50\xa0mph)'
 '85\xa0km/h (53\xa0mph)' '73\xa0km/h (45\xa0mph)'
 '78\xa0km/h (48\xa0mph)' '74\xa0km/h (46\xa0mph)'
 '75\xa0km/h (47\xa0mph)\n(Non-Monsoon)'
 '57\xa0km/h (35\xa0mph)\n(Monsoon)' '63\xa0km/h (39\xa0mph)'
 '76\xa0km/h (47\xa0mph)' '71\xa0km/h (44\xa0mph)']


Inauguration
['2/15/2019' '10-03-2019' '9/30/2022' '10/13/2022' '11-11-2022'
 '12-11-2022' '12/30/2022' '1/15/2023' '02-10-2023' '04-01-2023'
 '04-08-2023' '04-12-2023' '4/25/2023' '5/18/2023' '5/25/2023' '5/29/2023'
```

```
 '6/27/2023' '07-07-2023']


Average occupancy
['126%' '114%' '132%' '70%' '75%' '96%' '100%' '120%' '93%' '90%' '110%'
 '150%' '177%' '99%' '91%' '94%' '118%' '72%' '44%' '37%' '53%' '77%']
```

In [15]:
```
for i in df.columns:
    print(i)
    print(df[i].value_counts())
    print('\n')
```

```
Train Name
Mumbai CSMT - Madgaon Vande Bharat Express                                  2
New Delhi - Varanasi Vande Bharat Express                                   1
Delhi Cantonment - Ajmer Vande Bharat Express                               1
Jodhpur - Sabarmati (Ahmedabad) Vande Bharat Express                        1
Indore - Bhopal Vande Bharat Express                                        1
Rani Kamalapati (Habibganj) - Jabalpur Vande Bharat Express                 1
KSR Bengaluru - Dharwad Vande Bharat Express                                1
Patna - Ranchi Vande Bharat Express                                         1
New Jalpaiguri - Guwahati Vande Bharat Express                              1
Anand Vihar Terminal - Dehradun Vande Bharat Express                        1
Howrah - Puri Vande Bharat Express                                          1
Kasaragod - Thiruvananthapuram Vande Bharat Express                         1
MGR Chennai Central - Coimbatore Vande Bharat Express                       1
New Delhi - Shri Mata Vaishno Devi Katra Vande Bharat Express               1
Secunderabad - Tirupati Vande Bharat Express                                1
Rani Kamalapati (Habibganj) - Hazrat Nizamuddin Vande Bharat Express        1
Mumbai CSMT - Sainagar Shirdi Vande Bharat Express                          1
Mumbai CSMT - Solapur Vande Bharat Express                                  1
Visakhapatnam - Secunderabad Vande Bharat Express                           1
Howrah - New Jalpaiguri Vande Bharat Express                                1
Bilaspur - Nagpur Vande Bharat Express                                      1
MGR Chennai Central - Mysuru Vande Bharat Express                           1
New Delhi - Amb Andaura Vande Bharat Express                                1
Mumbai Central - Gandhinagar Capital Vande Bharat Express                   1
Gorakhpur - Lucknow Charbagh Vande Bharat Express                           1
Name: Train Name, dtype: int64


Train Number
22229/22230    2
22435/22436    1
20977/20978    1
12461/12462    1
20911/20912    1
20173/20174    1
20661/20662    1
22349/22350    1
22227/22228    1
22457/22458    1
22895/22896    1
```

```
20633/20634    1
20643/20644    1
22439/22440    1
20701/20702    1
20171/20172    1
22223/22224    1
22225/22226    1
20833/20834    1
22301/22302    1
20825/20826    1
20607/20608    1
22447/22448    1
20901/20902    1
22549/22550    1
Name: Train Number, dtype: int64


Originating City
Delhi                     5
Mumbai                    5
Chennai                   2
Kolkata                   2
Bhopal                    2
Bilaspur, Chhattisgarh    1
Visakhapatnam             1
Hyderabad                 1
Kasaragod                 1
Siliguri                  1
Patna                     1
Bangalore                 1
Indore                    1
Jodhpur                   1
Gorakhpur                 1
Name: Originating City, dtype: int64


Originating Station
Chhatrapati Shivaji Terminus    4
New Delhi                       3
Chennai Central                 2
Howrah Junction                 2
Habibganj (Rani Kamalapati)     2
```

```
Anand Vihar Terminal           1
Jodhpur Junction               1
Indore Junction                1
Bangalore City                 1
Patna Junction                 1
New Jalpaiguri Junction        1
Delhi Cantonment               1
Kasaragod                      1
Mumbai Central                 1
Secunderabad Junction          1
Visakhapatnam Junction         1
Bilaspur Junction              1
Gorakhpur Junction             1
Name: Originating Station, dtype: int64


Terminal City
Madgaon               2
Varanasi              1
Ajmer                 1
Ahmedabad             1
Bhopal                1
Jabalpur              1
Hubbali - Dharwad     1
Ranchi                1
Guwahati              1
Dehradun              1
Puri                  1
Thiruvananthapuram    1
Coimbatore            1
Katra                 1
Tirupati              1
Delhi                 1
Shirdi                1
Solapur               1
Hyderabad             1
Siliguri              1
Nagpur                1
Mysuru                1
Andaura               1
Gandhinagar           1
Charbagh              1
```

```
Name: Terminal City, dtype: int64


Terminal Station
Madgaon Junction                2
Varanasi Junction               1
Ajmer Junction                  1
Sabarmati Junction              1
Bhopal Junction                 1
Jabalpur Junction               1
Dharwad                         1
Ranchi Junction                 1
Guwahati                        1
Dehradun Terminal               1
Puri                            1
Thiruvananthapuram Central      1
Coimbatore Junction             1
Shri Mata Vaishno Devi Katra    1
Tirupati                        1
Hazrat Nizamuddin               1
Sainagar Shirdi                 1
Solapur                         1
Secunderabad Junction           1
New Jalpaiguri Junction         1
Nagpur Junction                 1
Mysore Junction                 1
Amb Andaura                     1
Gandhinagar Capital             1
Lucknow Charbagh                1
Name: Terminal Station, dtype: int64


Operator
NR      4
CR      4
SR      3
WR      2
WCR     2
NWR     2
SECR    1
ER      1
ECoR    1
```

```
SCR     1
SER     1
NFR     1
ECR     1
SWR     1
NER     1
Name: Operator, dtype: int64


No. of Cars
16    16
8     10
Name: No. of Cars, dtype: int64


Frequency
Except Tuesdays                                                                  8
Except Wednesdays                                                                6
Except Thursdays                                                                 3
Except Saturdays                                                                 3
Except Sundays                                                                   2
Except Fridays                                                                   1
Except Wednesdays (22225) , Except Thursdays (22226)                             1
Except Fridays\n(Non-Monsoon)                                                    1
Monday, Wednesday, Friday (22229)\nTuesday, Thursday, Saturday (22230)\n(Monsoon)    1
Name: Frequency, dtype: int64


Distance
412 km (256 mi)    2
586 km (364 mi)    2
759 km (472 mi)    1
587 km (365 mi)    1
449 km (279 mi)    1
250 km (160 mi)    1
337 km (209 mi)    1
490 km (300 mi)    1
379 km (235 mi)    1
407 km (253 mi)    1
304 km (189 mi)    1
500 km (310 mi)    1
428 km (266 mi)    1
```

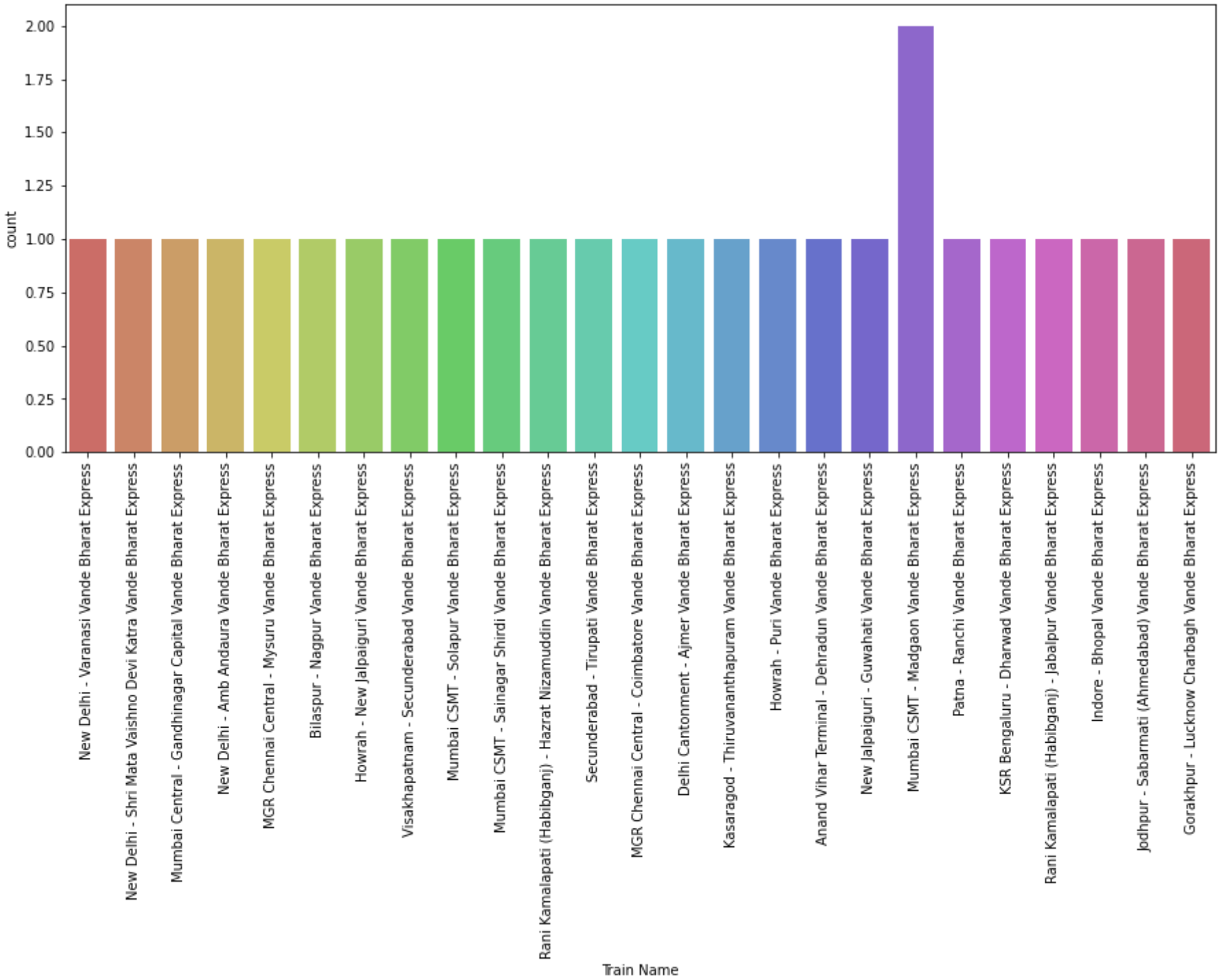
```
655 km (407 mi)    1
495 km (308 mi)    1
661 km (411 mi)    1
702 km (436 mi)    1
339 km (211 mi)    1
452 km (281 mi)    1
698 km (434 mi)    1
565 km (351 mi)    1
496 km (308 mi)    1
522 km (324 mi)    1
296 km (184 mi)    1
Name: Distance, dtype: int64


Travel Time
06h 25m                  3
08h 00m                  2
06h 30m                  2
05h 30m                  2
07h 30m                  2
04h 45m                  1
06h 10m                  1
03h 05m                  1
04h 40m                  1
06h 00m                  1
10h 05m\n(Monsoon)       1
07h 45m\n(Non-Monsoon)   1
05h 15m                  1
08h 05m                  1
05h 50m                  1
08h 15m                  1
05h 20m                  1
08h 30m                  1
05h 10m                  1
04h 15m                  1
Name: Travel Time, dtype: int64


Speed
130 km/h (81 mph)    14
110 km/h (68 mph)     8
120 km/h (75 mph)     2
```

```
130 km/h (81 mph)     1
160 km/h (99 mph)     1
Name: Speed, dtype: int64


Average Speed
82 km/h (51 mph)                    5
73 km/h (45 mph)                    3
79 km/h (49 mph)                    2
75 km/h (47 mph)                    2
64 km/h (40 mph)                    2
95 km/h (59 mph)                    1
74 km/h (46 mph)                    1
76 km/h (47 mph)                    1
63 km/h (39 mph)                    1
57 km/h (35 mph)\n(Monsoon)         1
75 km/h (47 mph)\n(Non-Monsoon)     1
85 km/h (53 mph)                    1
78 km/h (48 mph)                    1
80 km/h (50 mph)                    1
94 km/h (58 mph)                    1
70 km/h (43 mph)                    1
71 km/h (44 mph)                    1
Name: Average Speed, dtype: int64


Inauguration
6/27/2023     6
07-07-2023    2
04-08-2023    2
02-10-2023    2
5/29/2023     1
5/25/2023     1
5/18/2023     1
4/25/2023     1
04-12-2023    1
2/15/2019     1
10-03-2019    1
1/15/2023     1
12/30/2022    1
12-11-2022    1
11-11-2022    1
```

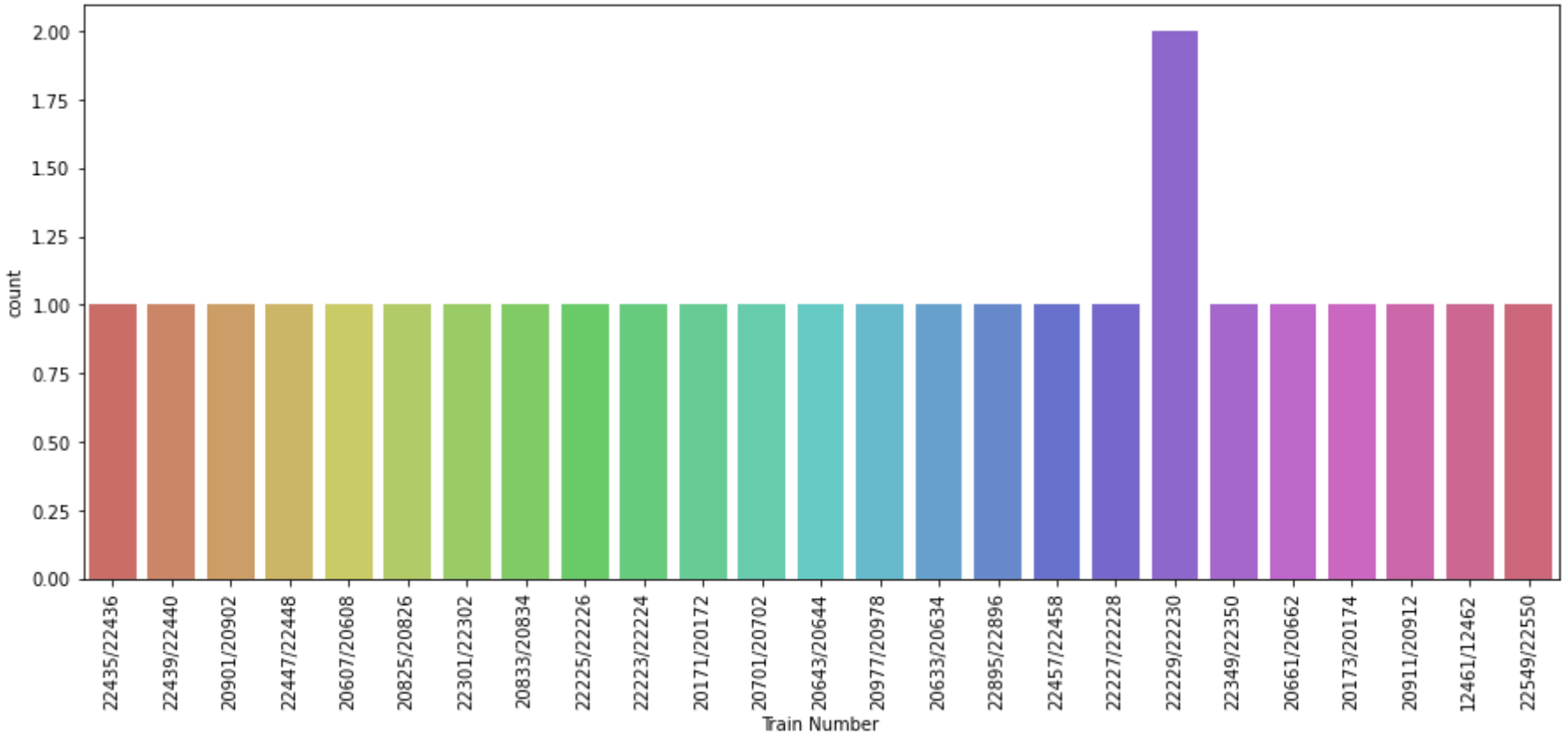
```
10/13/2022    1
9/30/2022     1
04-01-2023    1
Name: Inauguration, dtype: int64


Average occupancy
100%    3
70%     2
94%     2
126%    1
177%    1
53%     1
37%     1
44%     1
72%     1
118%    1
91%     1
99%     1
150%    1
114%    1
110%    1
90%     1
93%     1
120%    1
96%     1
75%     1
132%    1
77%     1
Name: Average occupancy, dtype: int64
```

In [16]:
```
for i in df.columns:
    print('Countplot for:', i)
    plt.figure(figsize=(15,6))
    sns.countplot(df[i], data = df, palette = 'hls')
    plt.xticks(rotation = 90)
    plt.show()
    print('\n')
```

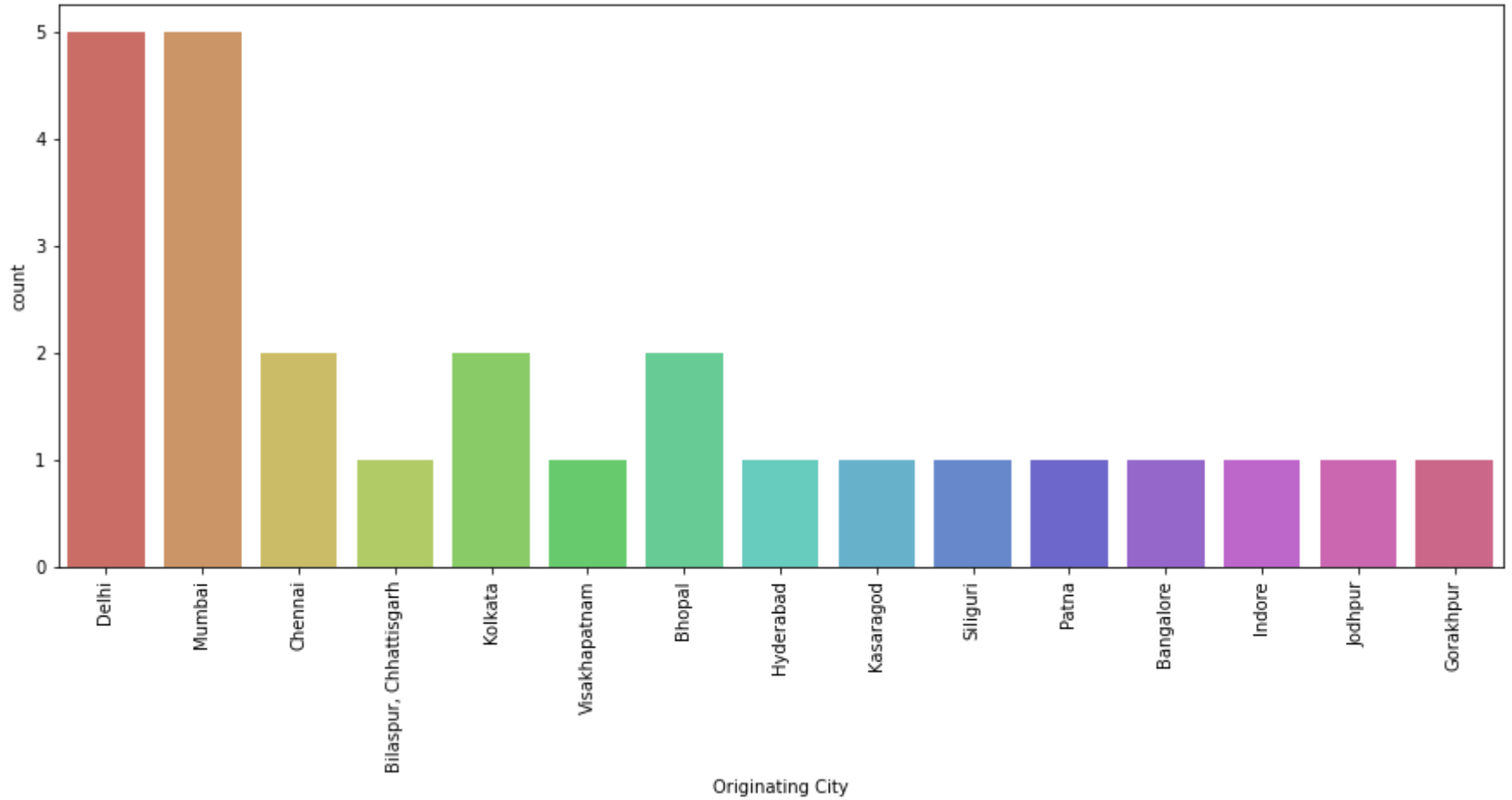
```
Countplot for: Train Name
```


count
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
New Delhi - Varanasi Vande Bharat Express
New Delhi - Shri Mata Vaishno Devi Katra Vande Bharat Express
Mumbai Central - Gandhinagar Capital Vande Bharat Express
New Delhi - Amb Andaura Vande Bharat Express
MGR Chennai Central - Mysuru Vande Bharat Express
Bilaspur - Nagpur Vande Bharat Express
Howrah - New Jalpaiguri Vande Bharat Express
Visakhapatnam - Secunderabad Vande Bharat Express
Mumbai CSMT - Solapur Vande Bharat Express
Mumbai CSMT - Sainagar Shirdi Vande Bharat Express
Rani Kamalapati (Habibganj) - Hazrat Nizamuddin Vande Bharat Express
Secunderabad - Tirupati Vande Bharat Express
MGR Chennai Central - Coimbatore Vande Bharat Express
Delhi Cantonment - Ajmer Vande Bharat Express
Kasaragod - Thiruvananthapuram Vande Bharat Express
Howrah - Puri Vande Bharat Express
Anand Vihar Terminal - Dehradun Vande Bharat Express
New Jalpaiguri - Guwahati Vande Bharat Express
Mumbai CSMT - Madgaon Vande Bharat Express
Patna - Ranchi Vande Bharat Express
KSR Bengaluru - Dharwad Vande Bharat Express
Rani Kamalapati (Habibganj) - Jabalpur Vande Bharat Express
Indore - Bhopal Vande Bharat Express
Jodhpur - Sabarmati (Ahmedabad) Vande Bharat Express
Gorakhpur - Lucknow Charbagh Vande Bharat Express
Train Name

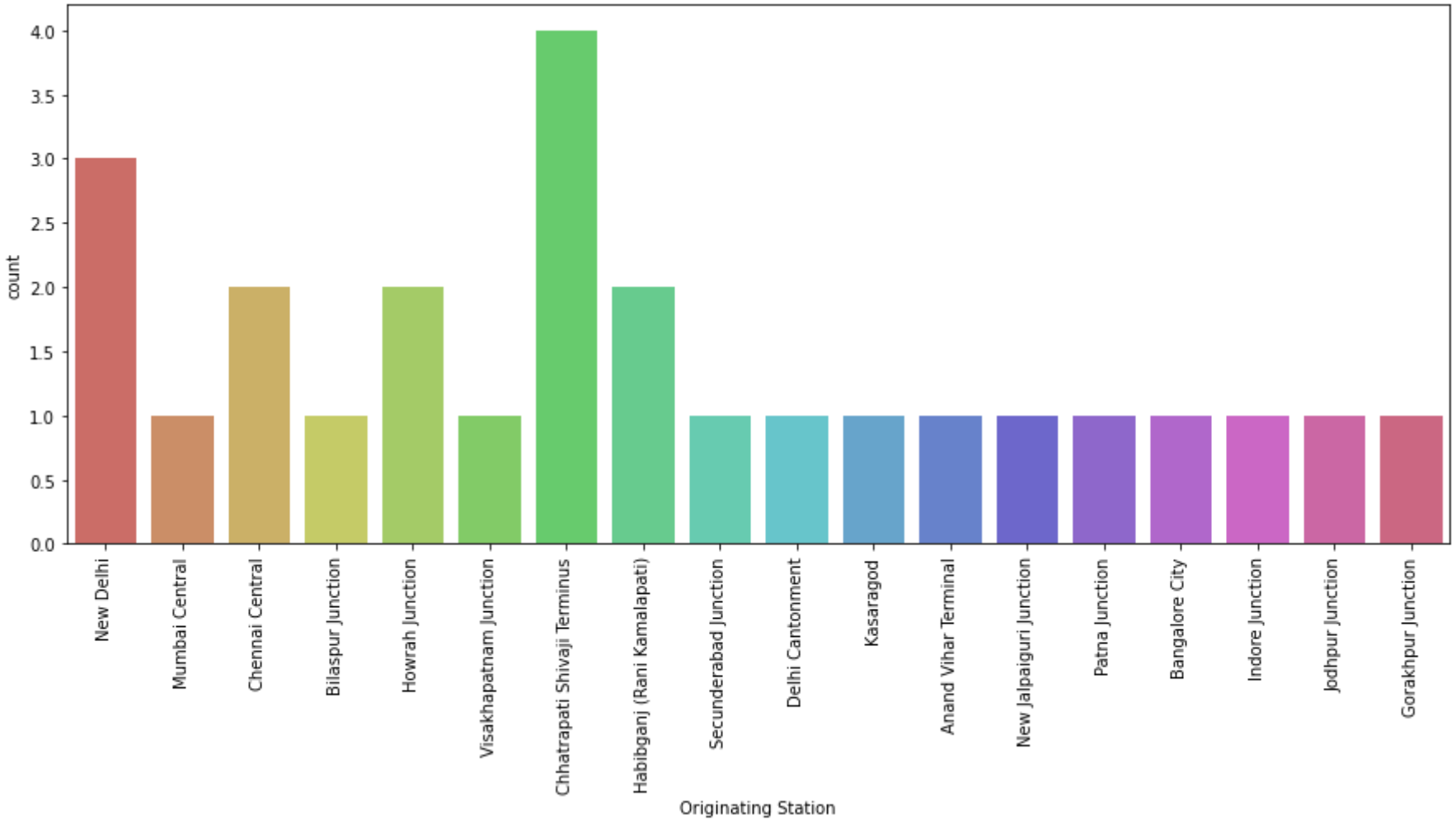
Countplot for: Train Number



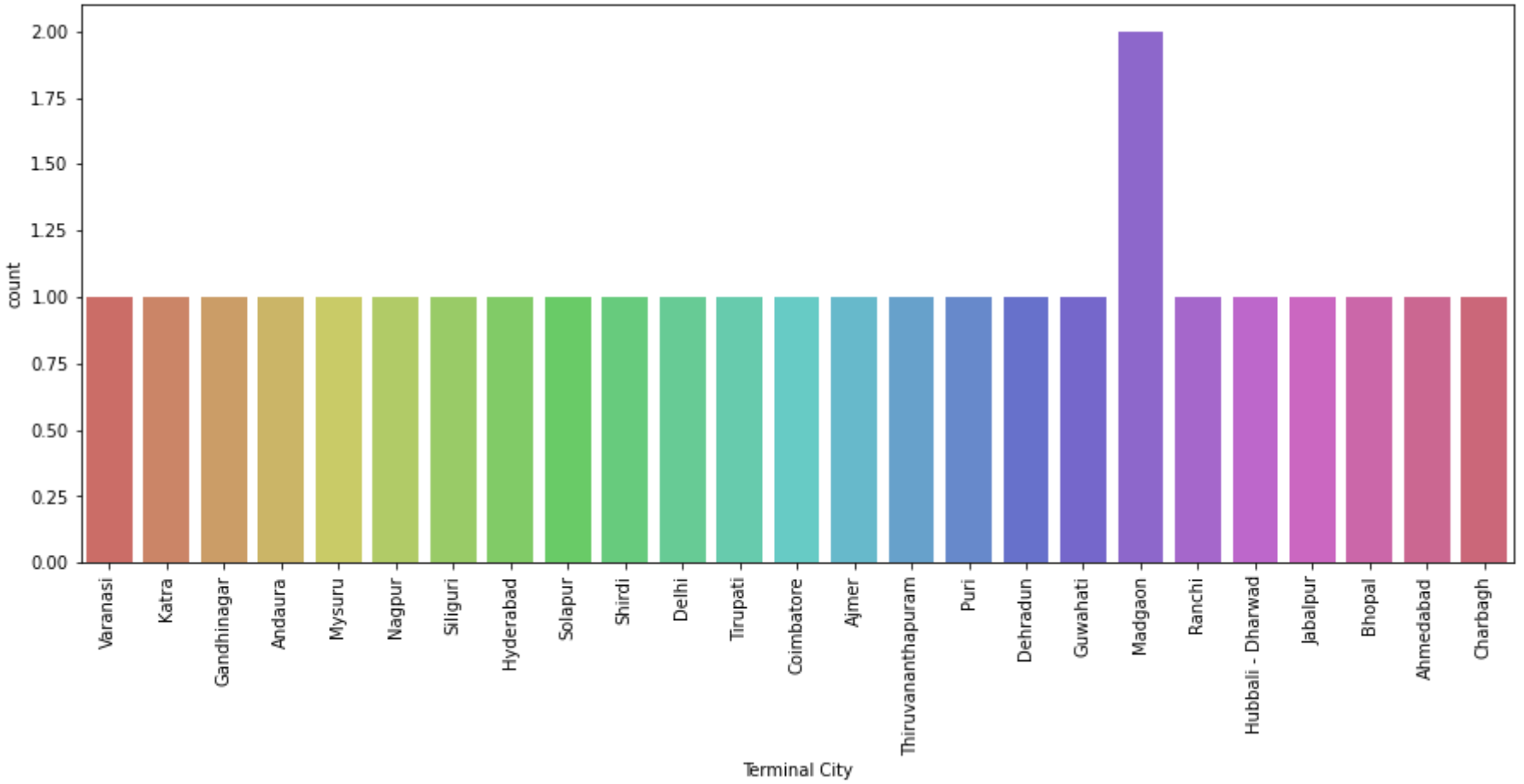
Countplot for: Originating City



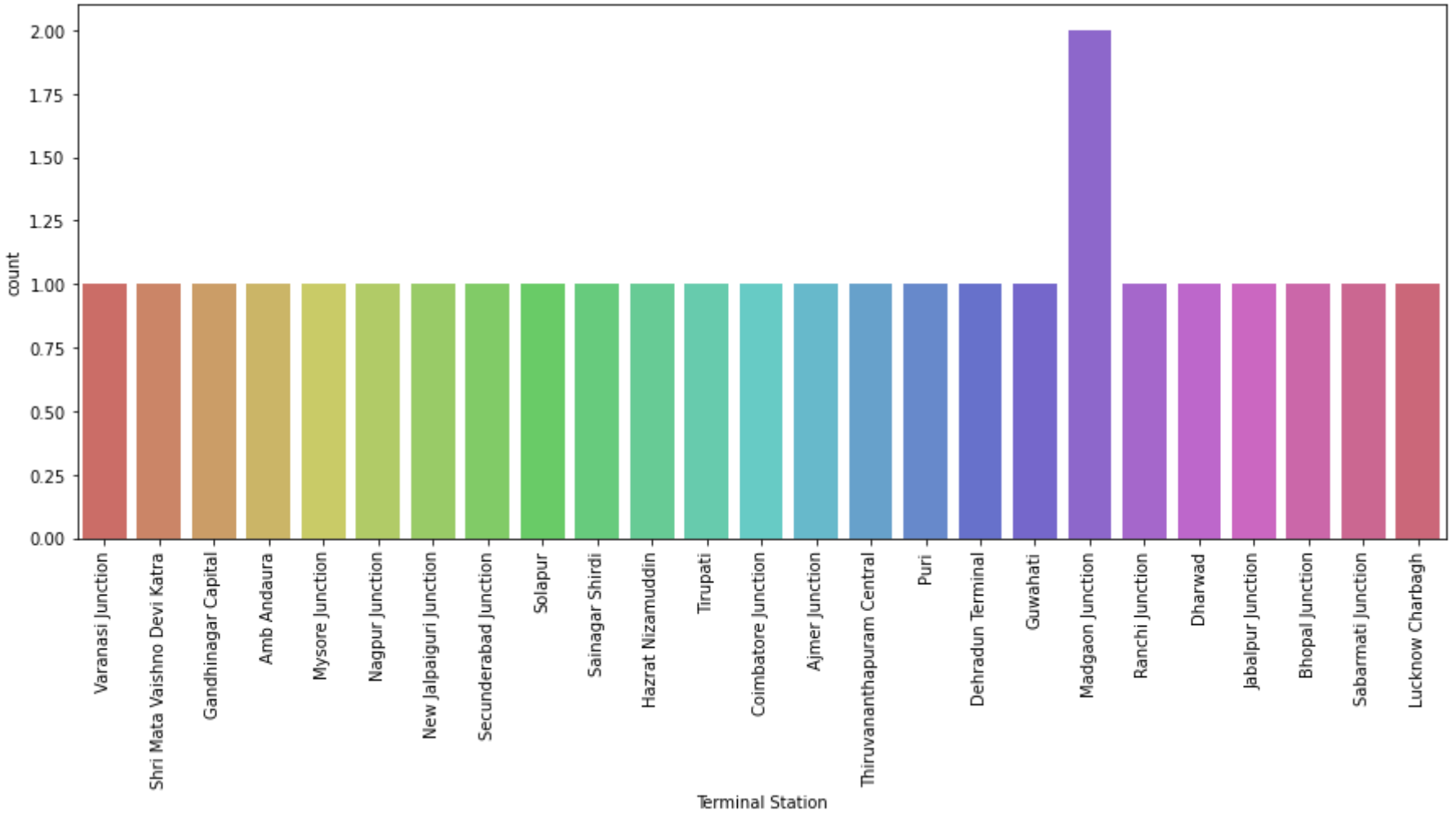
Countplot for: Originating Station



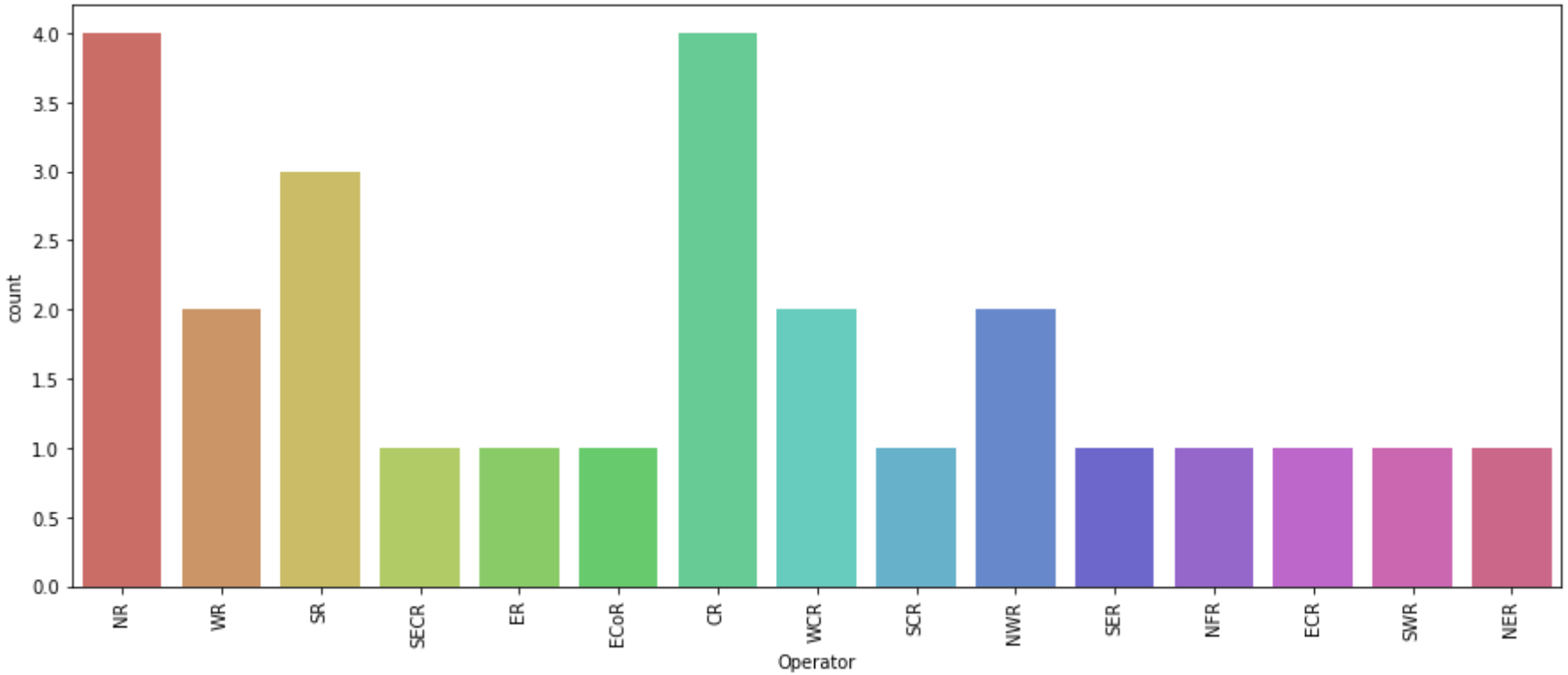
Countplot for: Terminal City



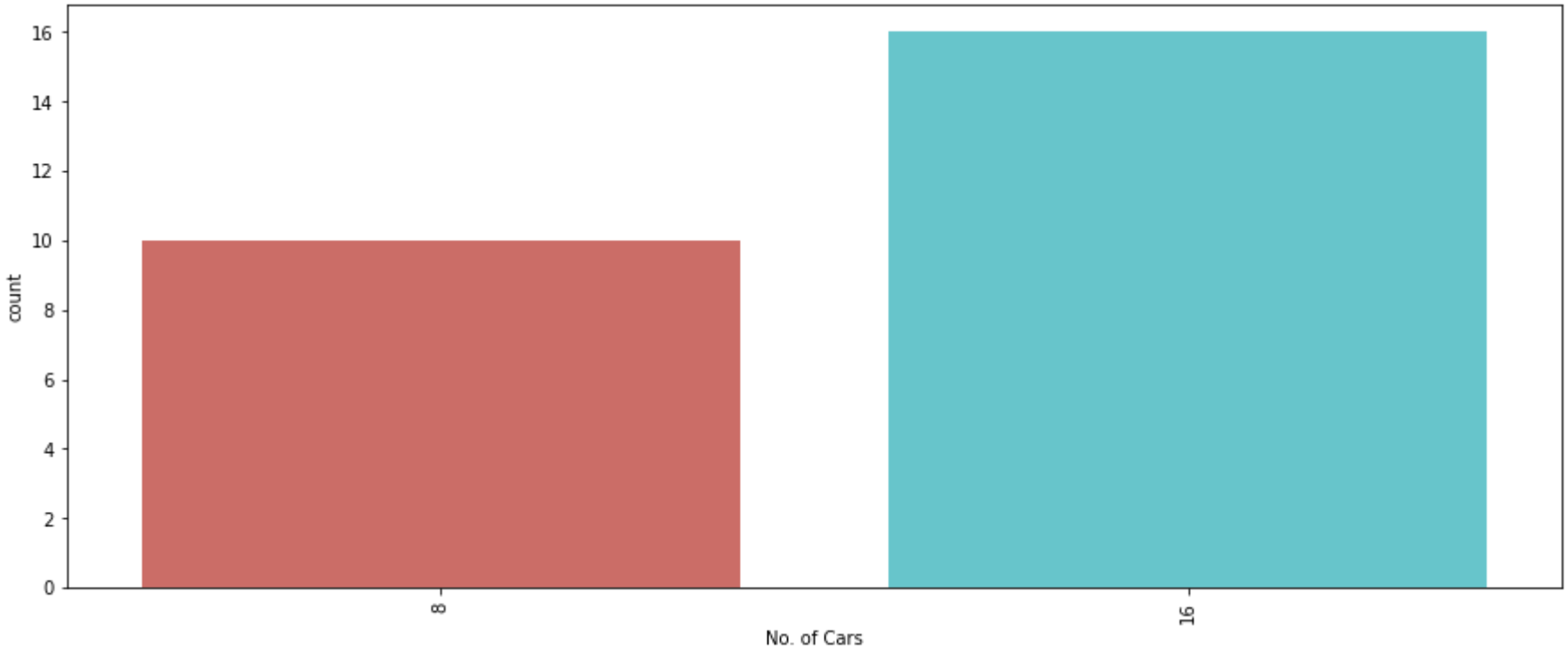
Countplot for: Terminal Station



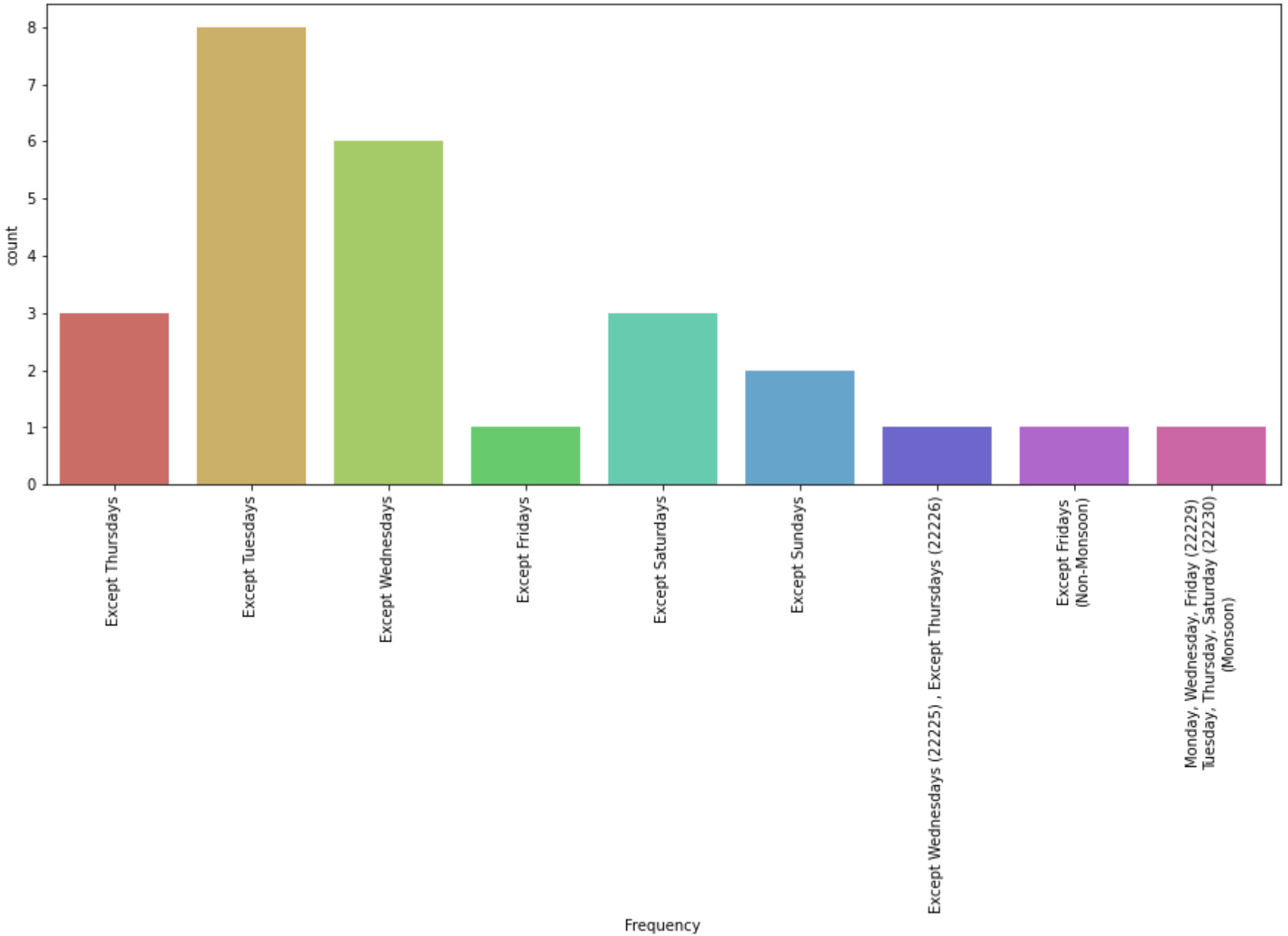
Countplot for: Operator



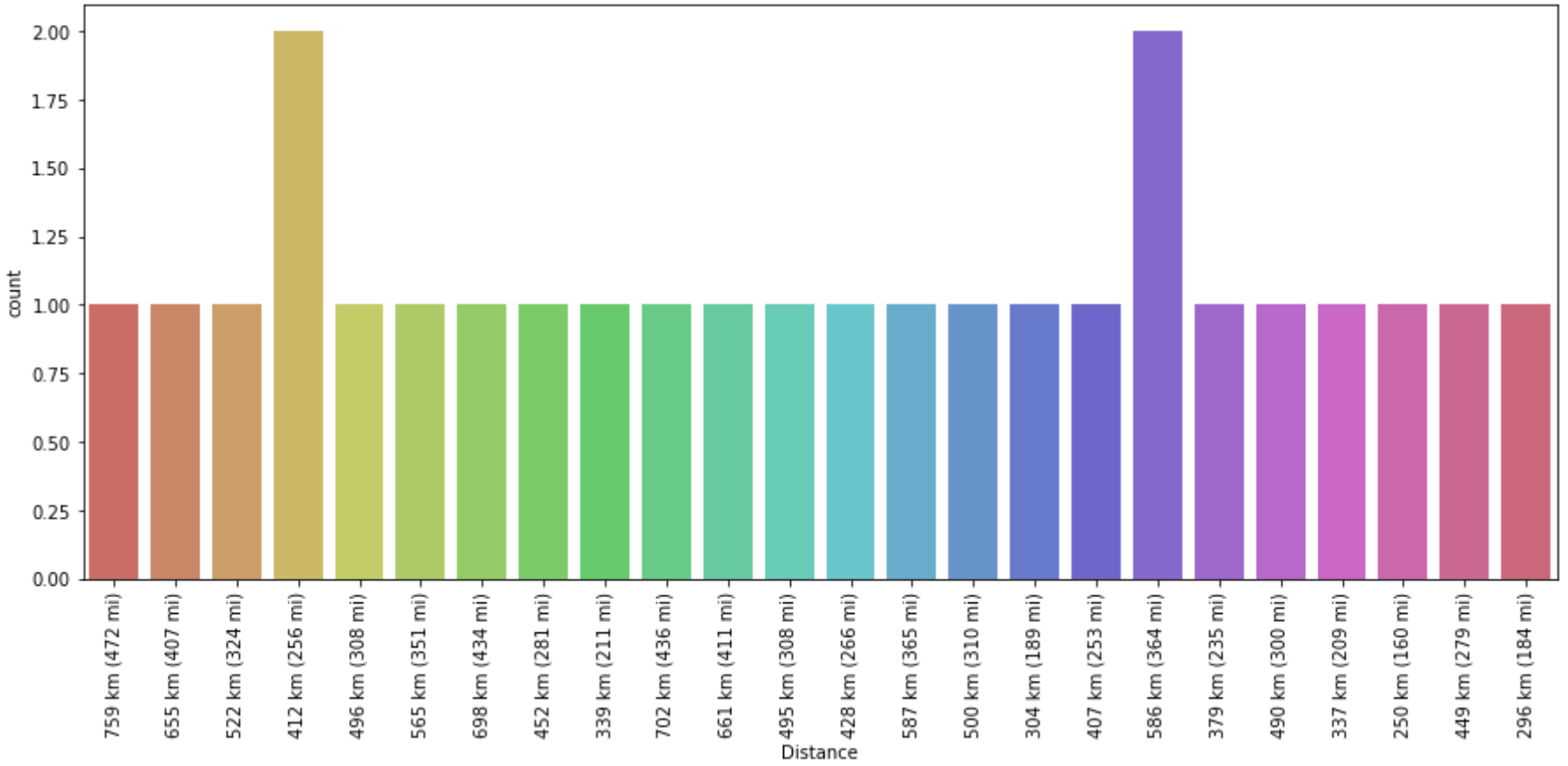
Countplot for: No. of Cars



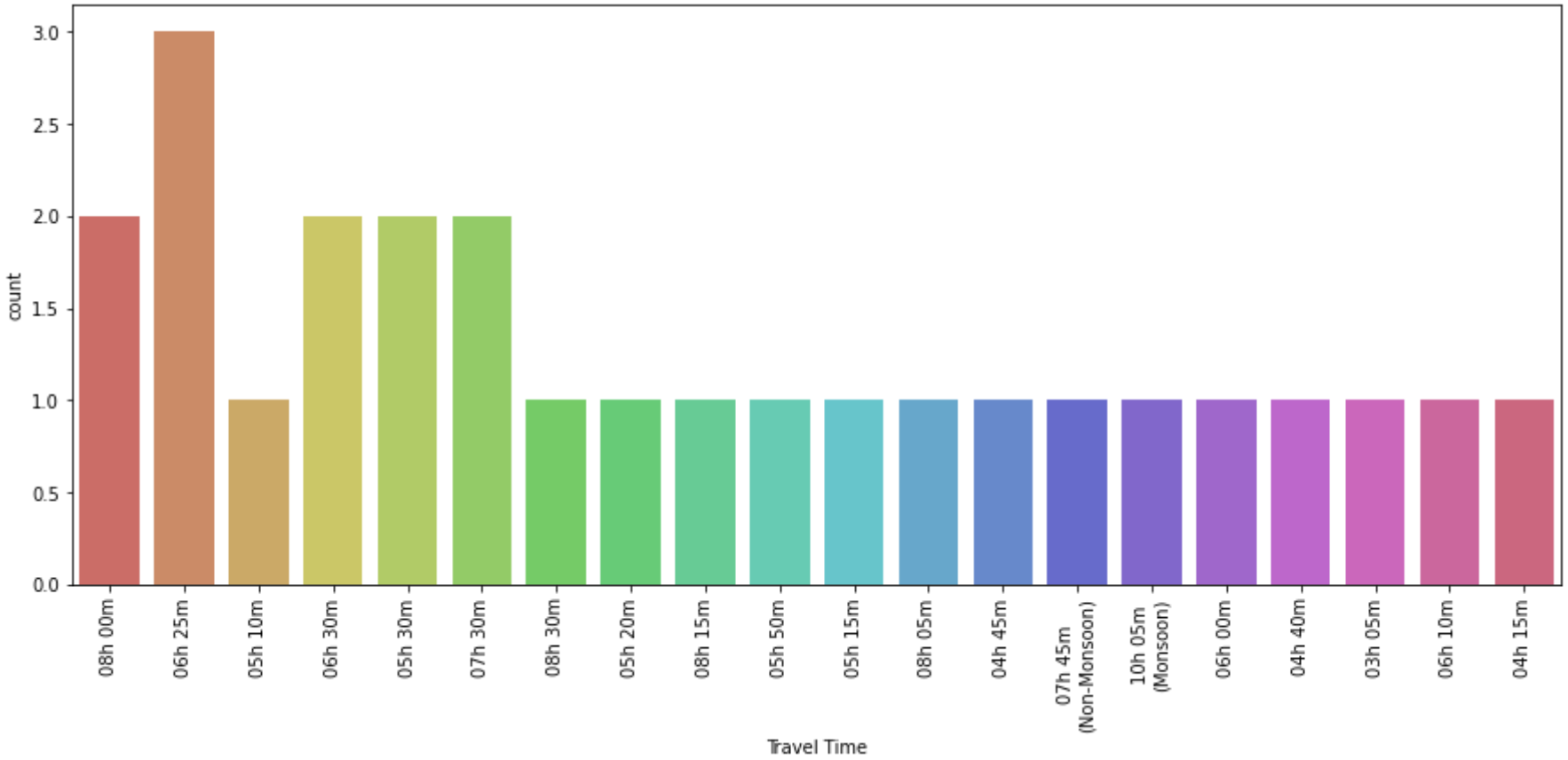
Countplot for: Frequency


count
0
1
2
3
4
5
6
7
8
Except Thursdays
Except Tuesdays
Except Wednesdays
Except Fridays
Except Saturdays
Except Sundays
Except Wednesdays (22225) , Except Thursdays (22226)
Except Fridays (Non-Monsoon)
Monday, Wednesday, Friday (22229) Tuesday, Thursday, Saturday (22230) (Monsoon)
Frequency

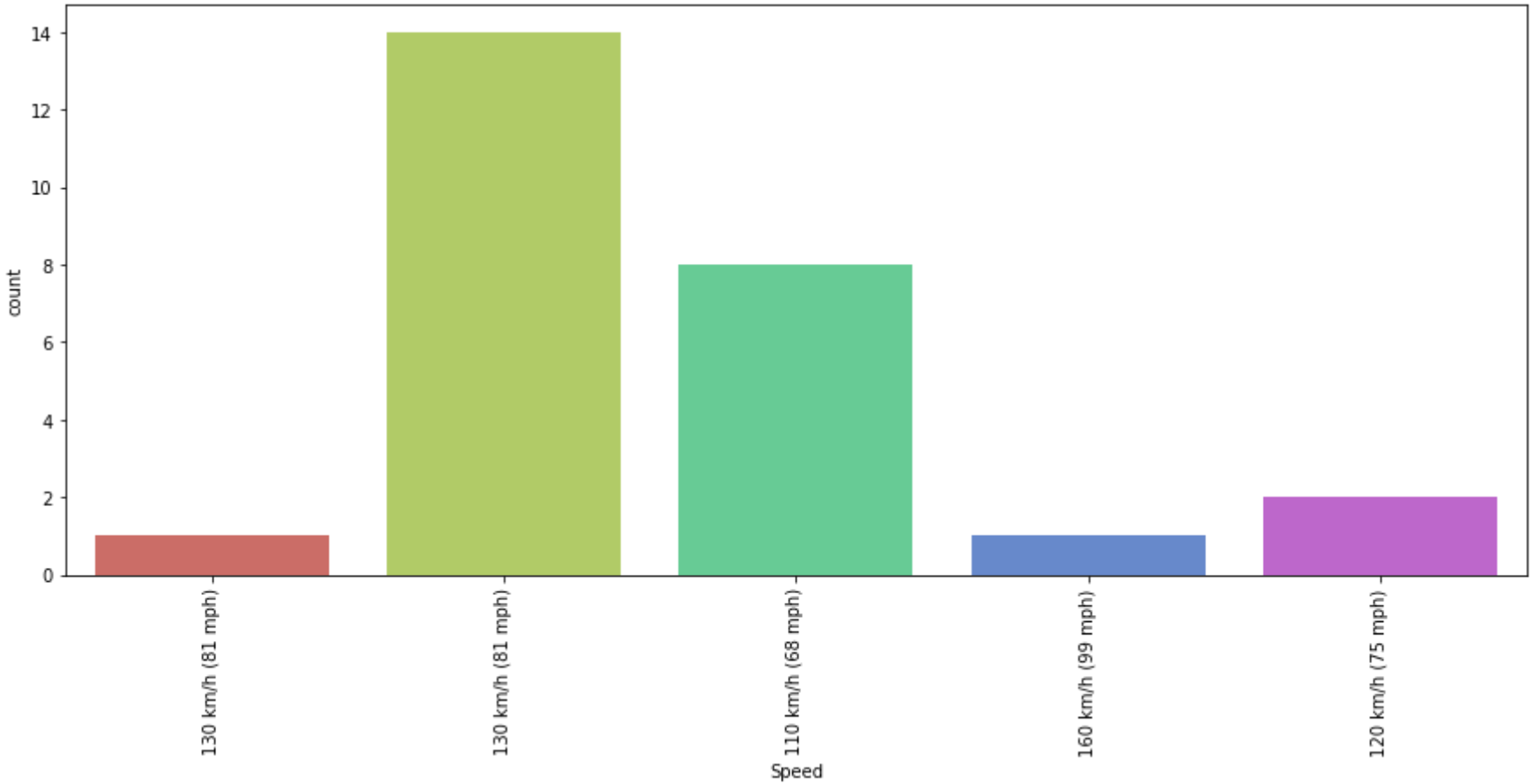
Countplot for: Distance



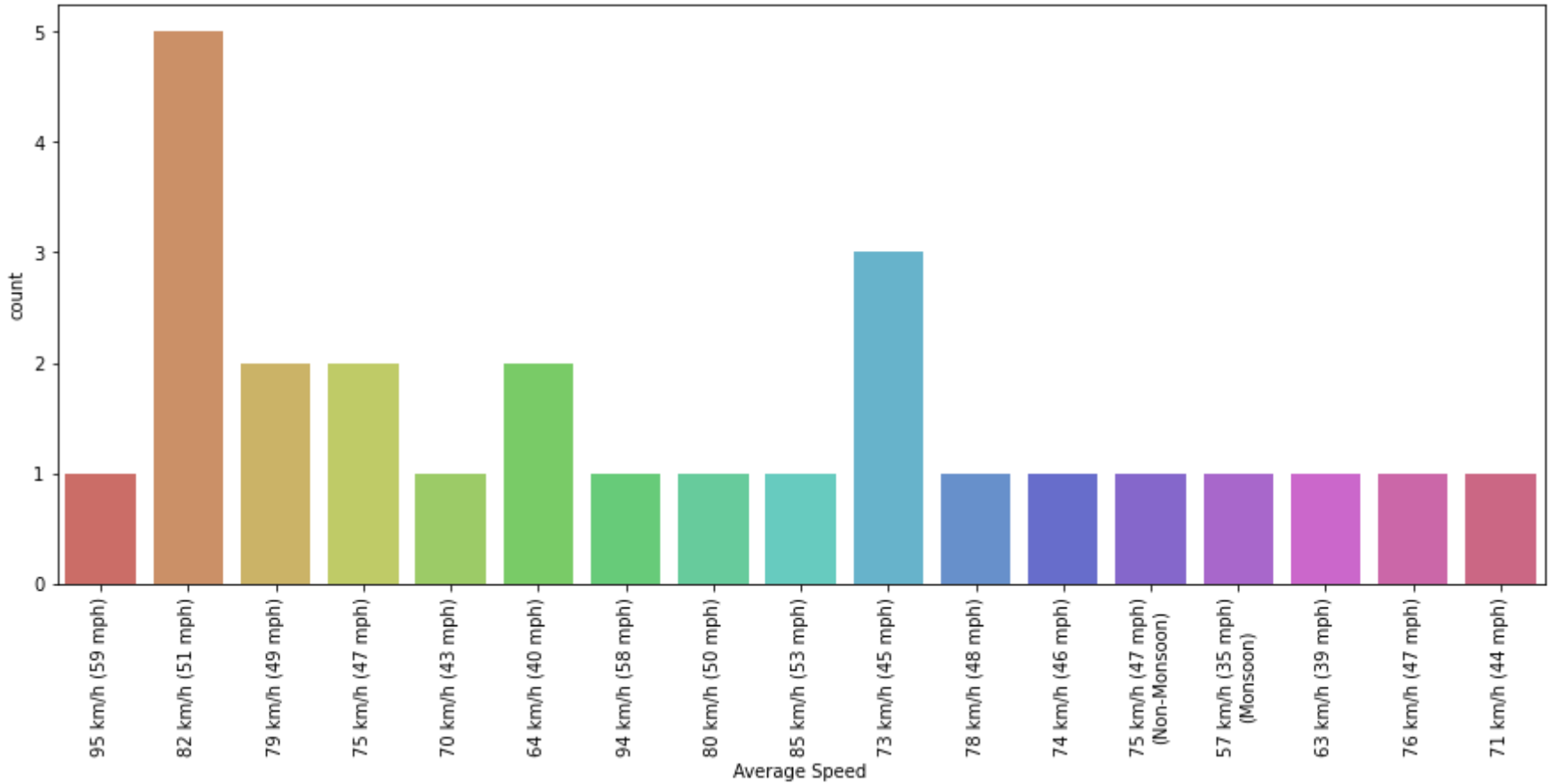
Countplot for: Travel Time



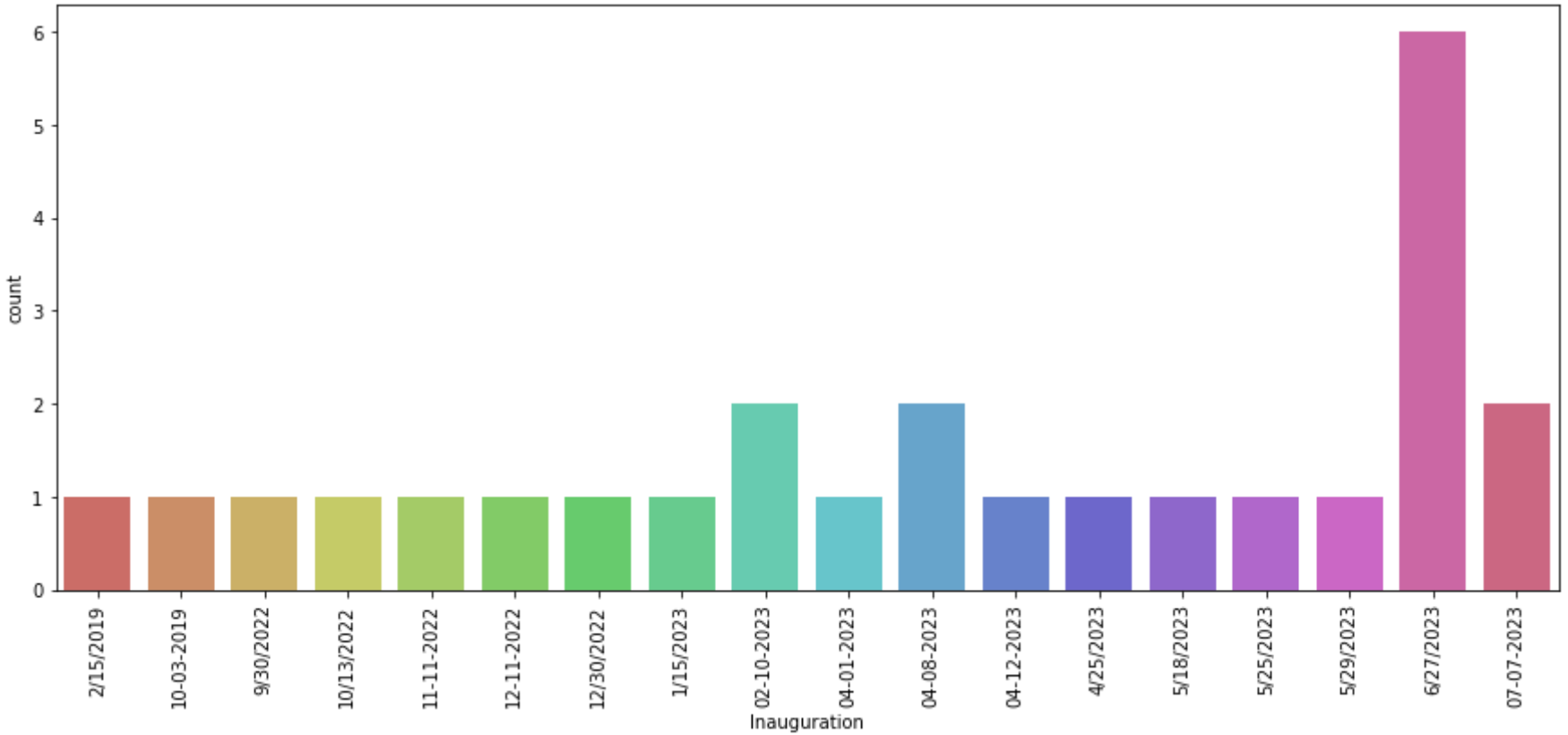
Countplot for: Speed



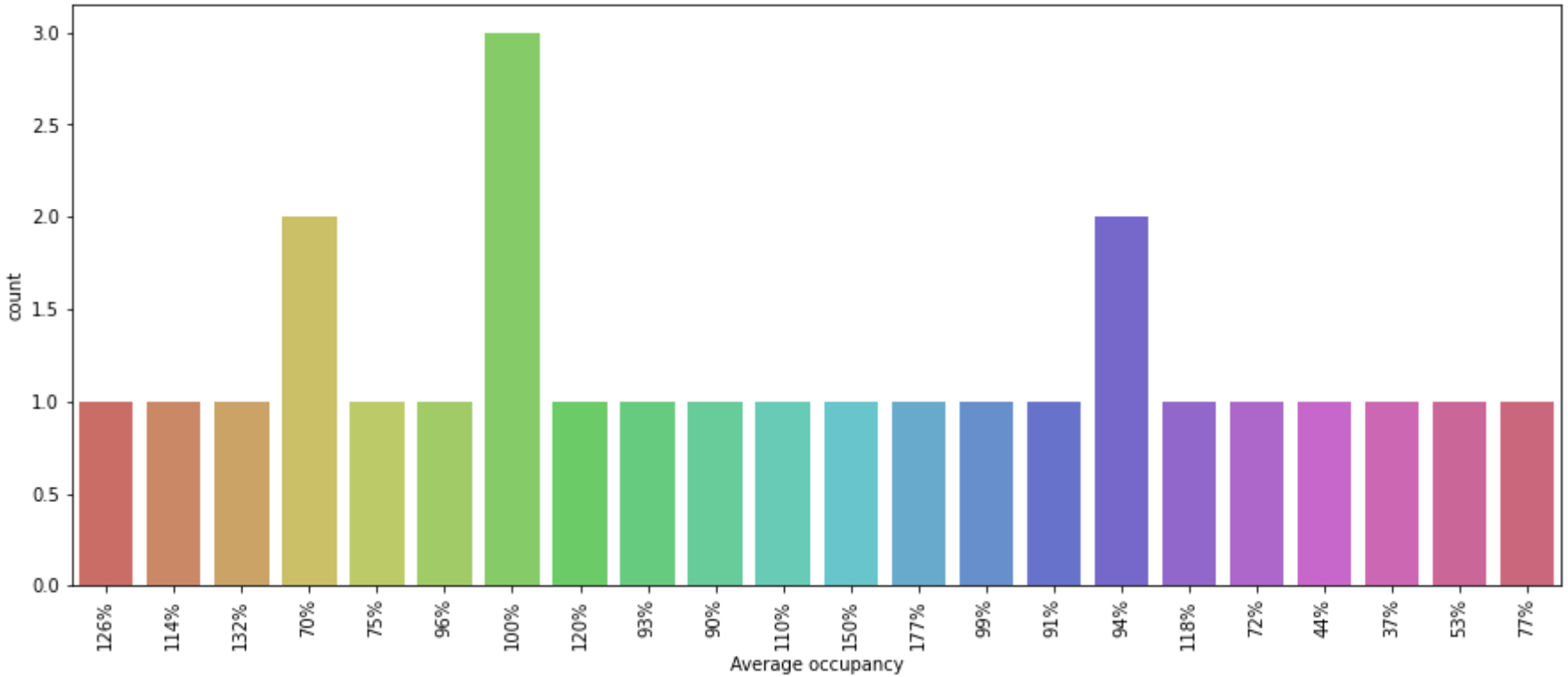
Countplot for: Average Speed



Countplot for: Inauguration

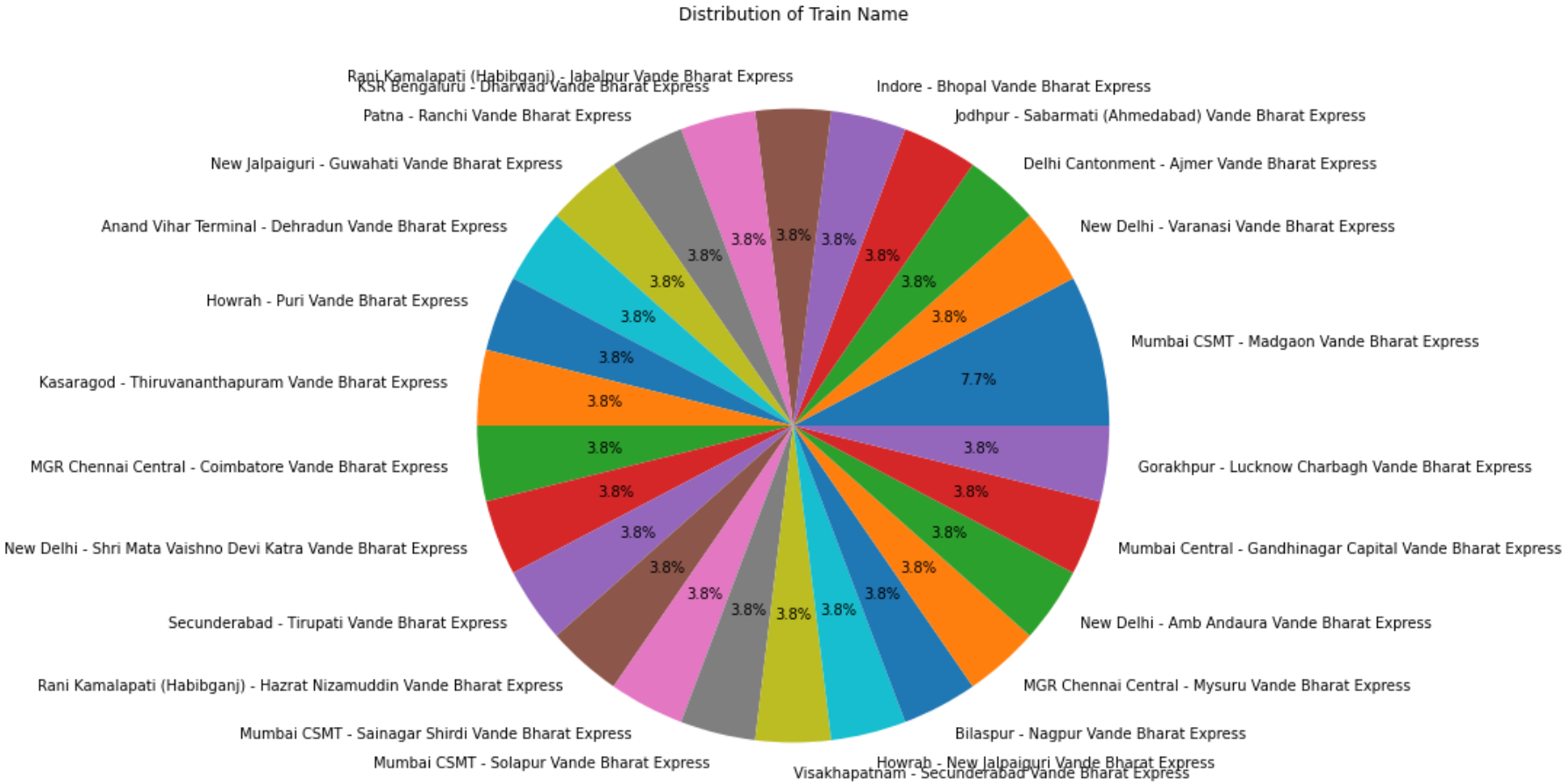


Countplot for: Average occupancy

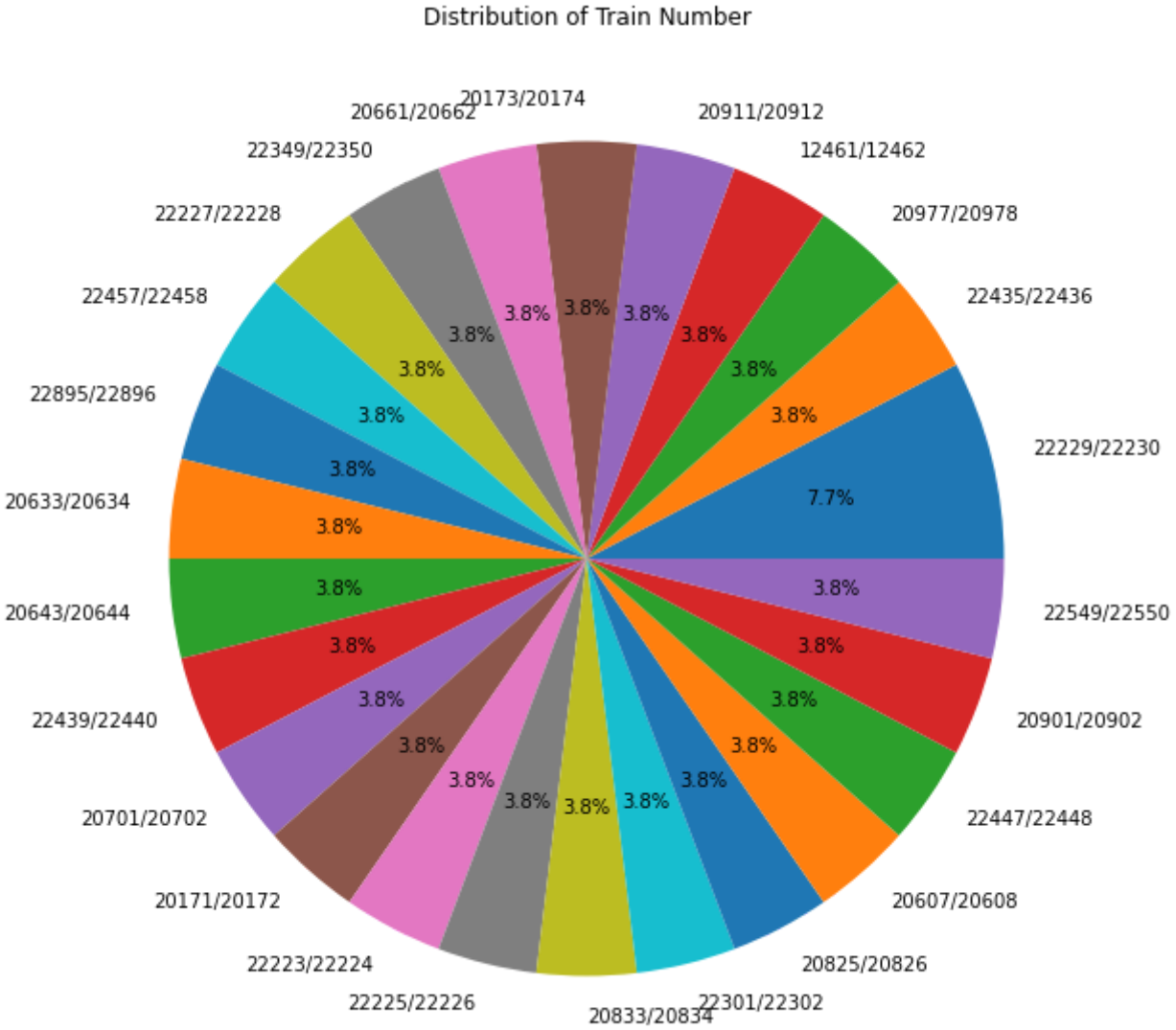

count
3.0
2.5
2.0
1.5
1.0
0.5
0.0
126%
114%
132%
70%
75%
96%
100%
120%
93%
90%
110%
150%
177%
99%
91%
94%
118%
72%
44%
37%
53%
77%
Average occupancy

In [17]:
```
for i in df.columns:
    print('Pie plot for:', i)
    plt.figure(figsize=(20, 10))
    df[i].value_counts().plot(kind='pie', autopct='%1.1f%%')
    plt.title('Distribution of ' + i)
    plt.ylabel('')
    plt.show()
    print('\n')
```

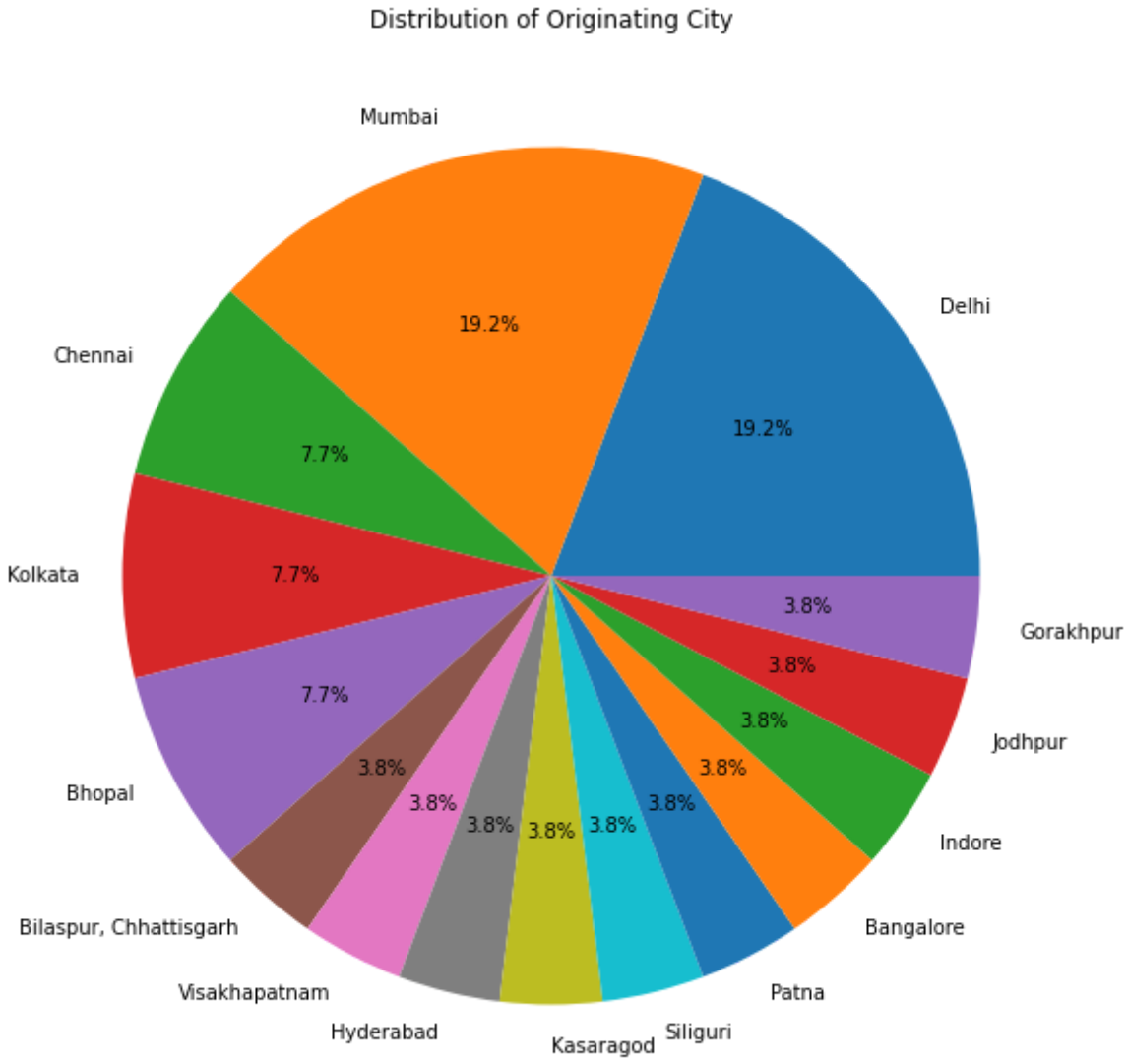
Pie plot for: Train Name



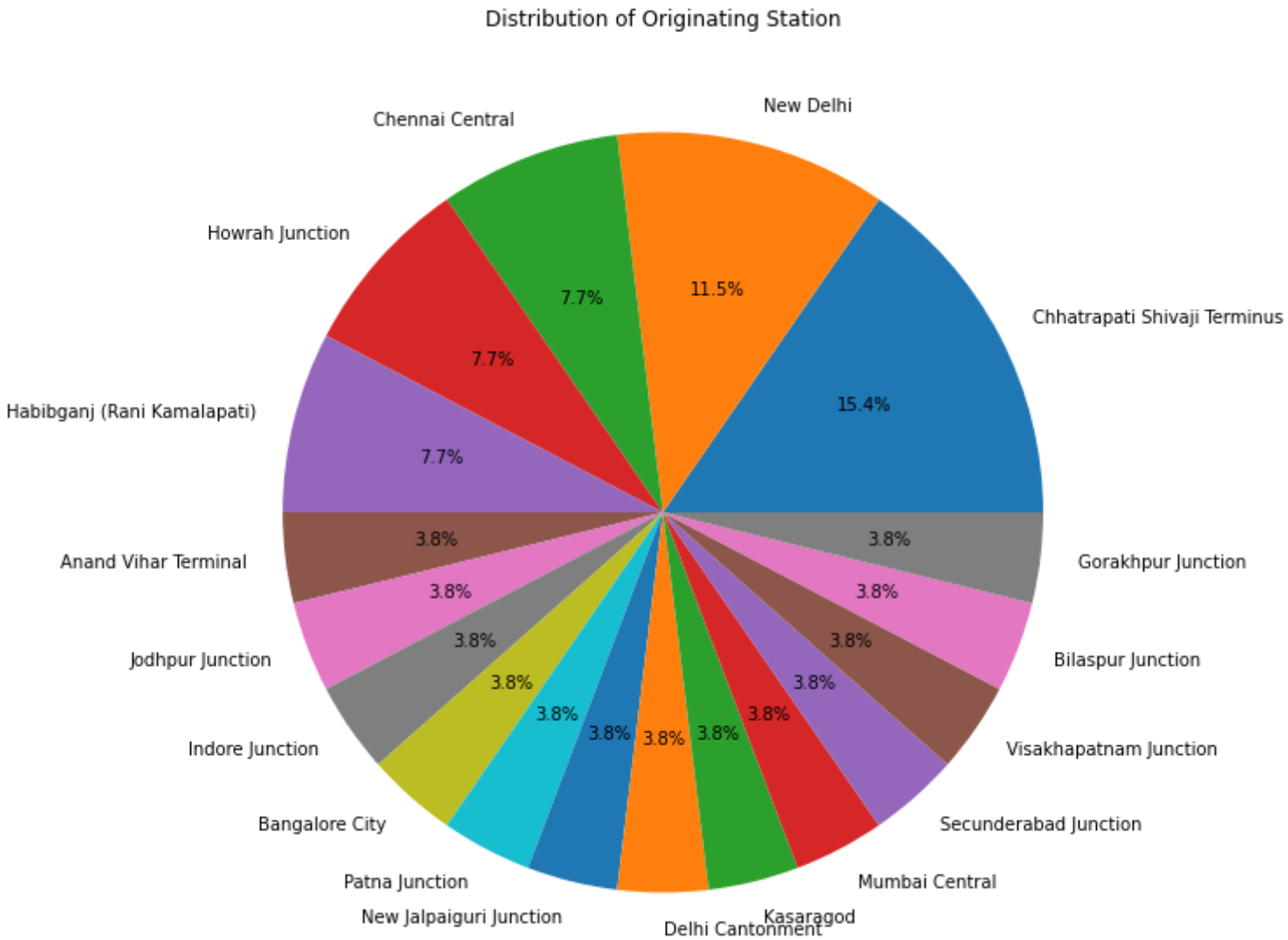
Pie plot for: Train Number



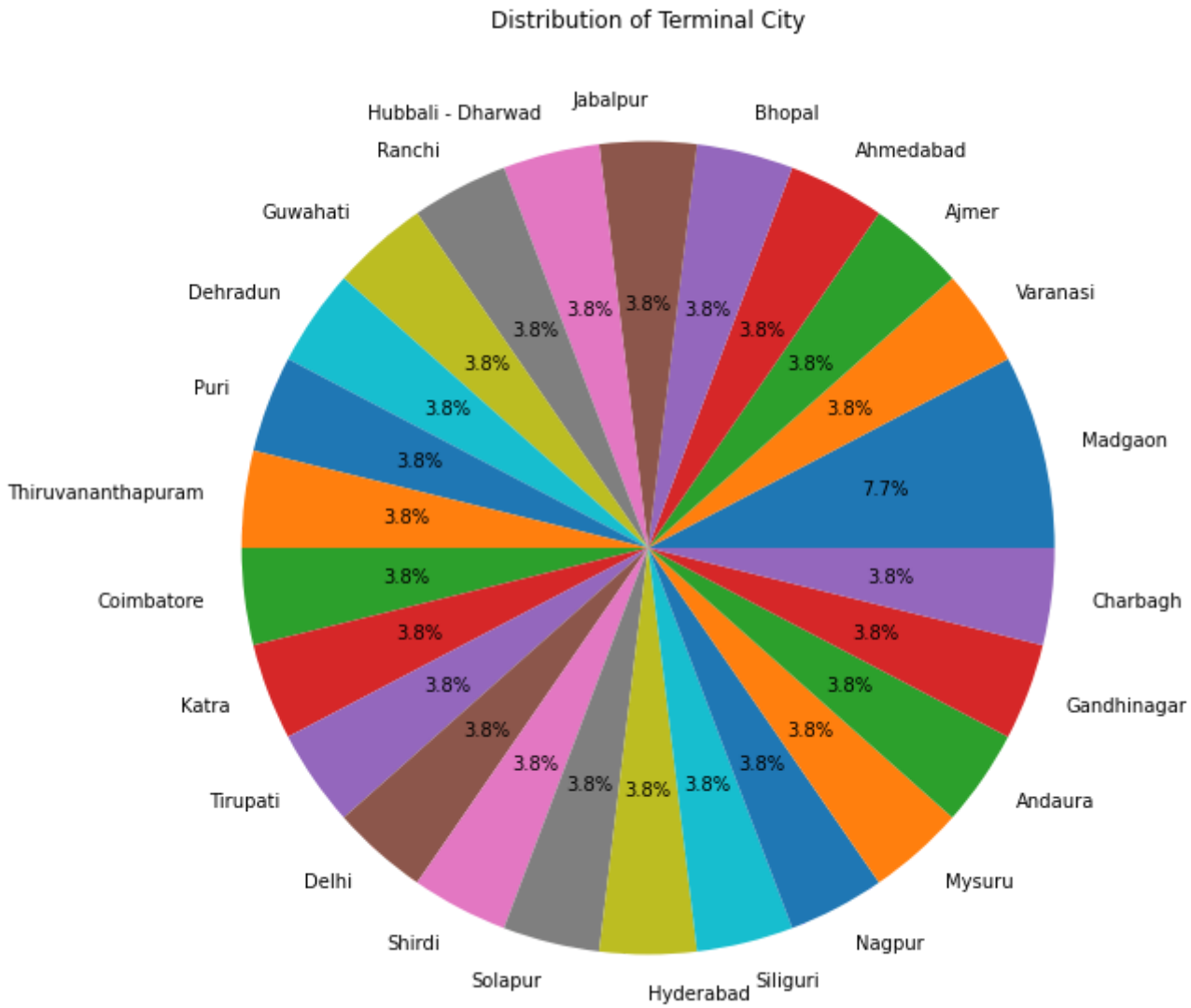
Pie plot for: Originating City



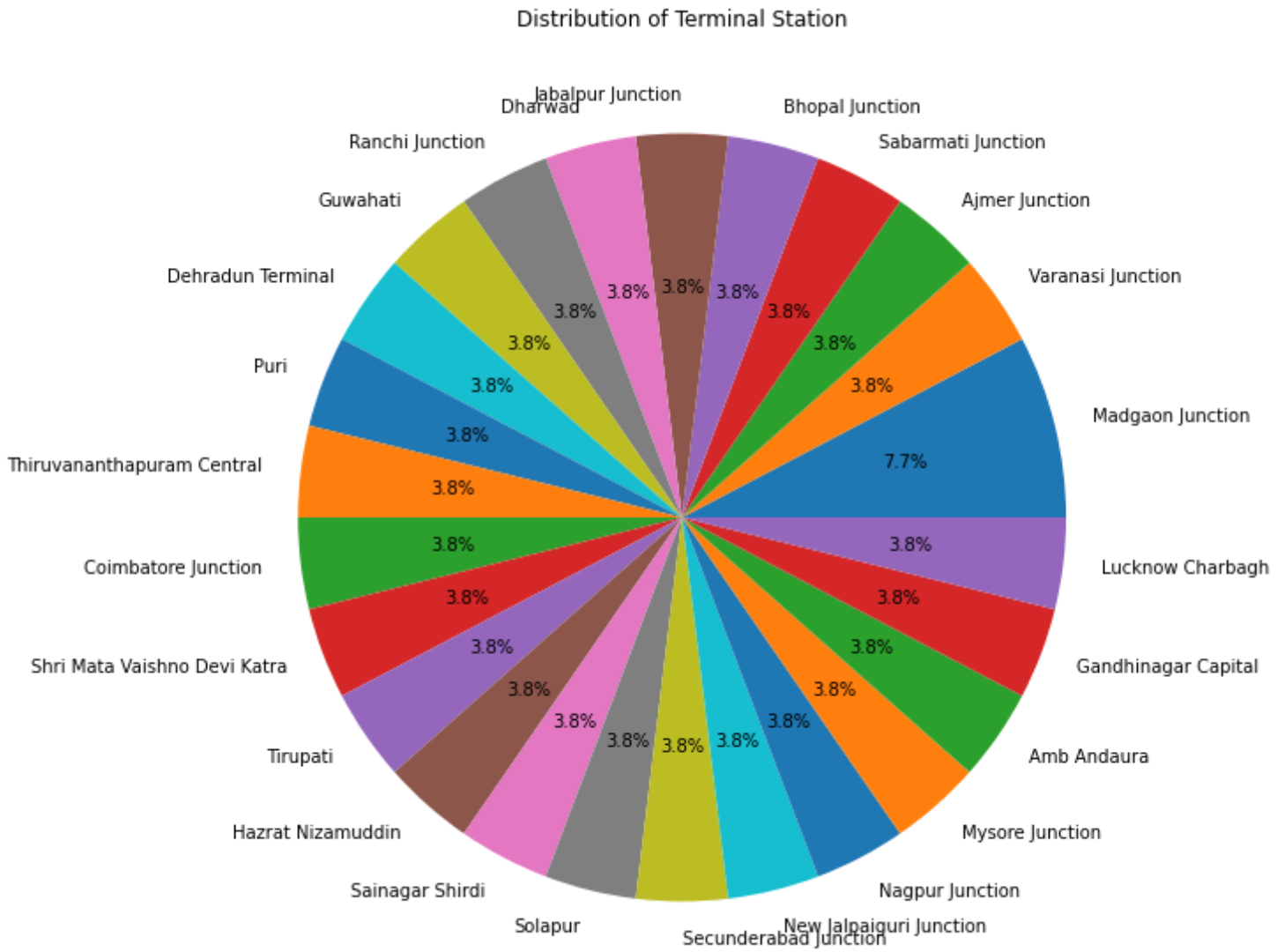
Pie plot for: Originating Station



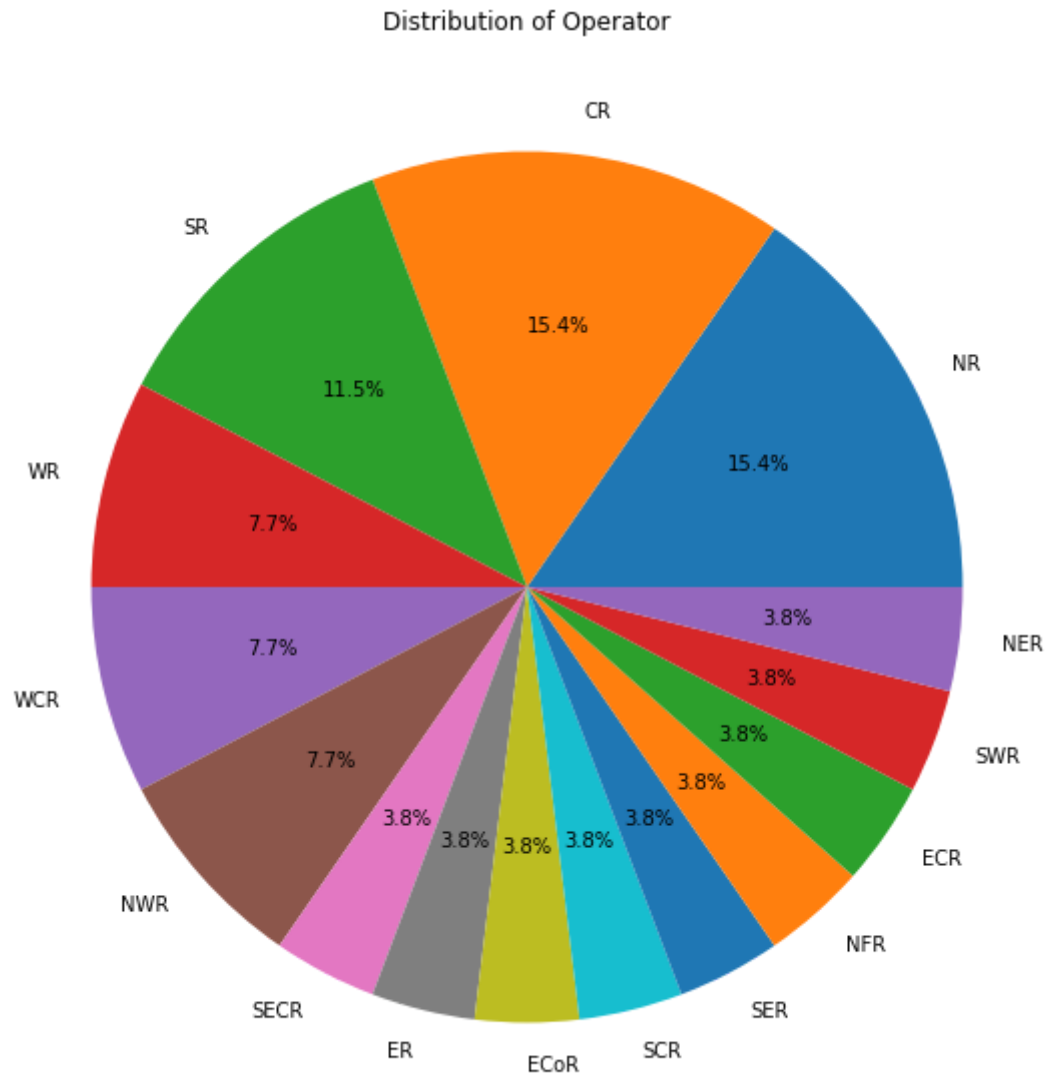
Pie plot for: Terminal City



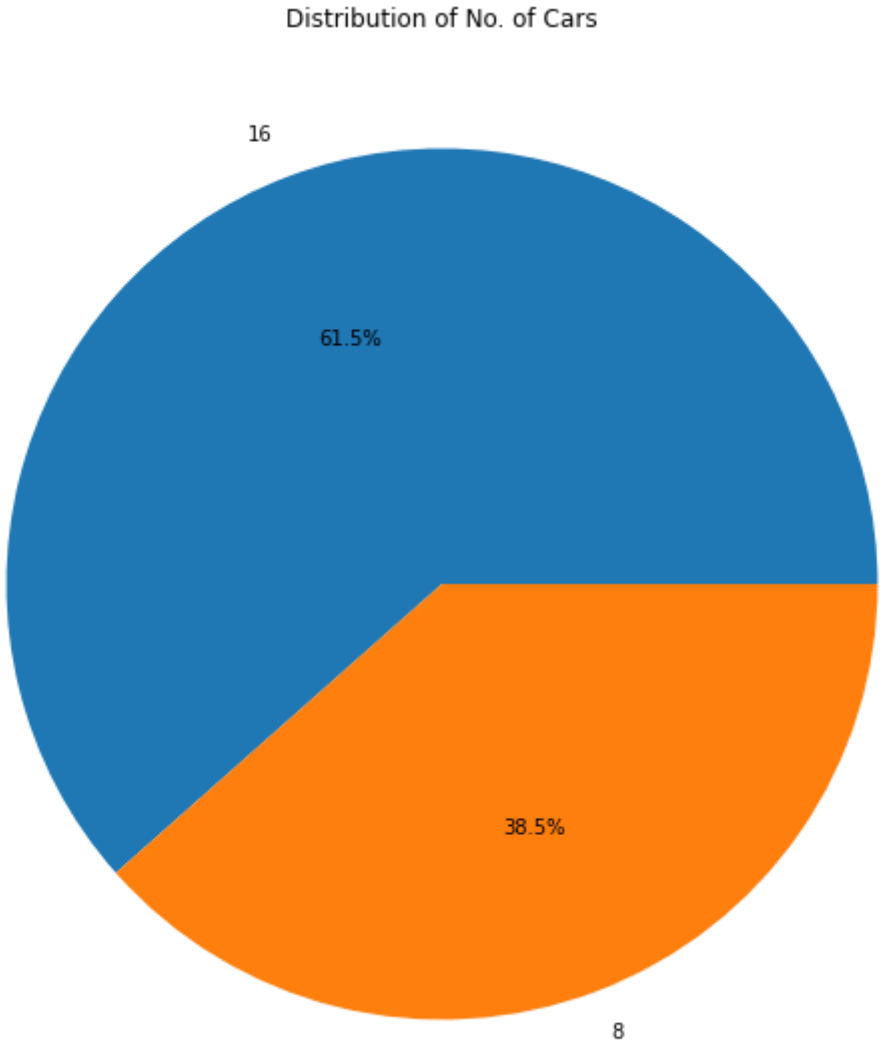
Pie plot for: Terminal Station



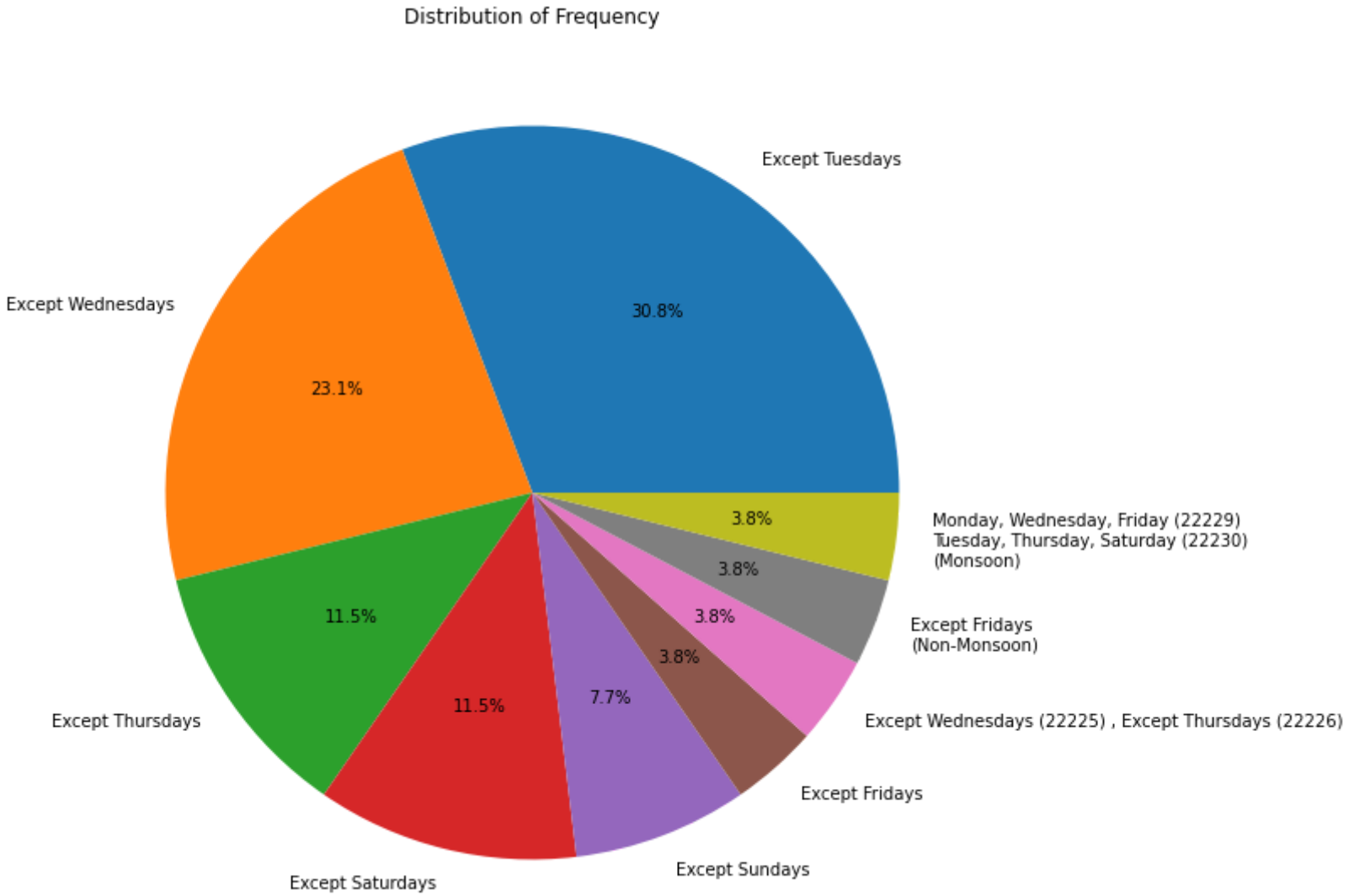
Pie plot for: Operator



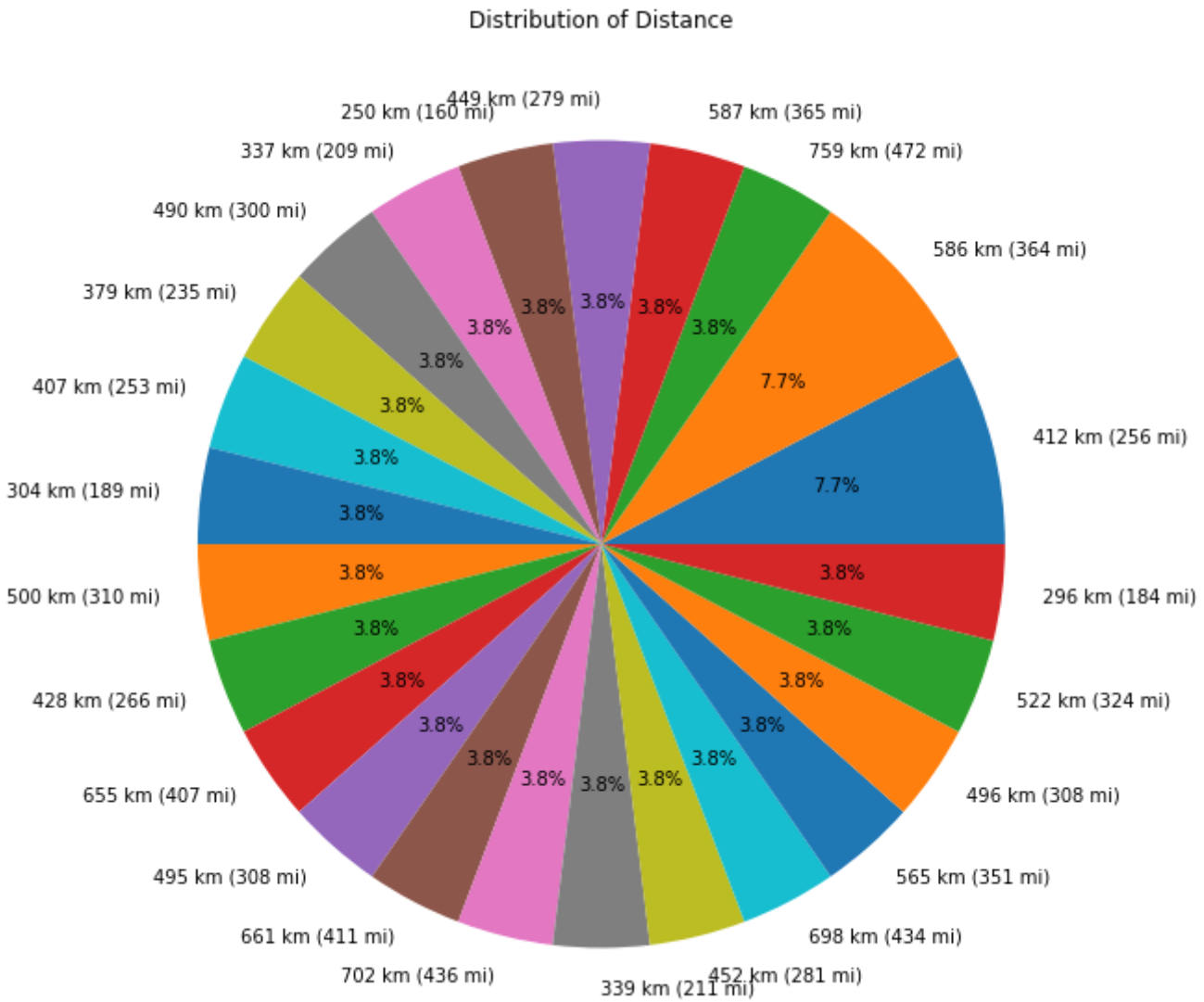
Pie plot for: No. of Cars



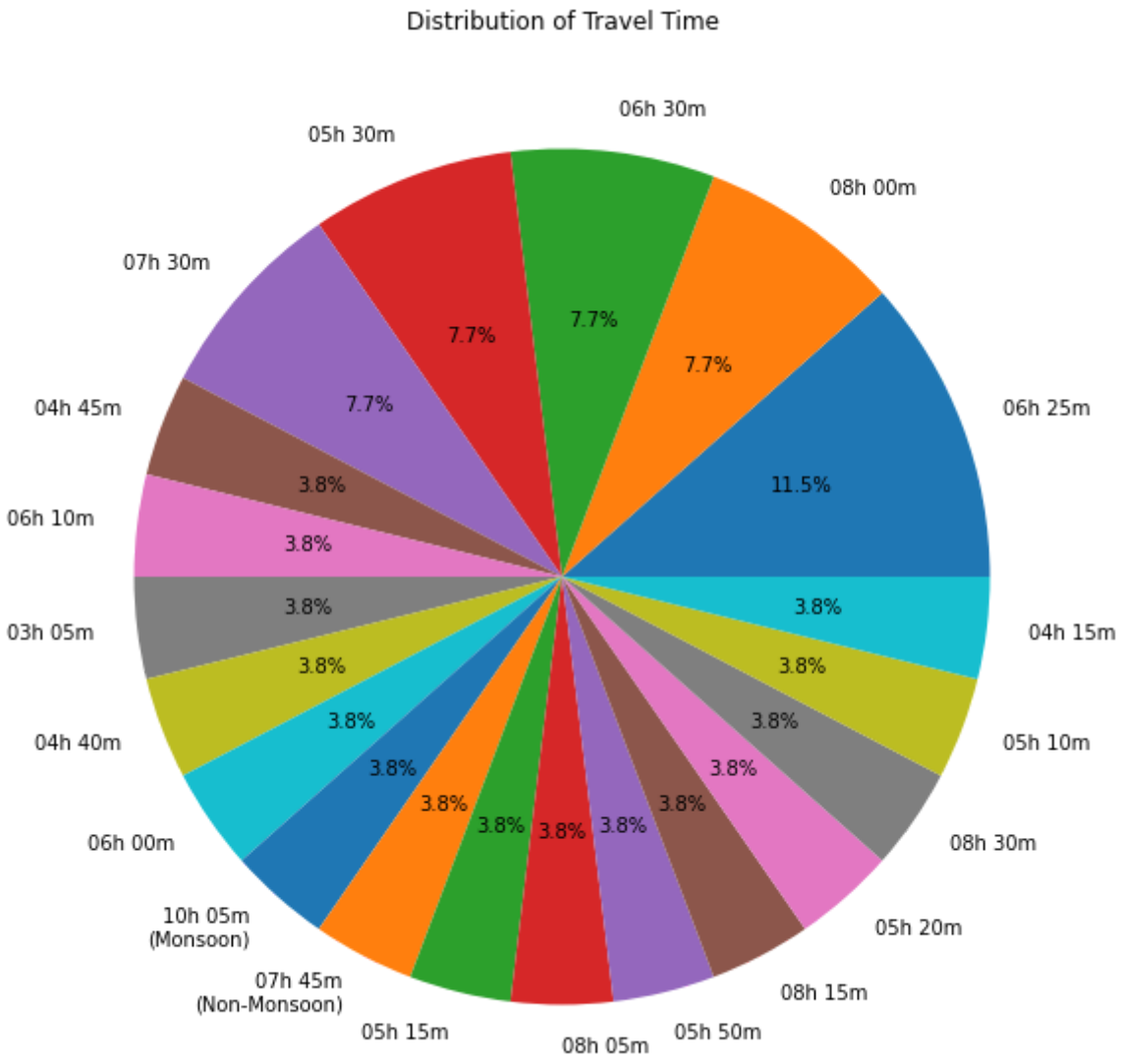
Pie plot for: Frequency



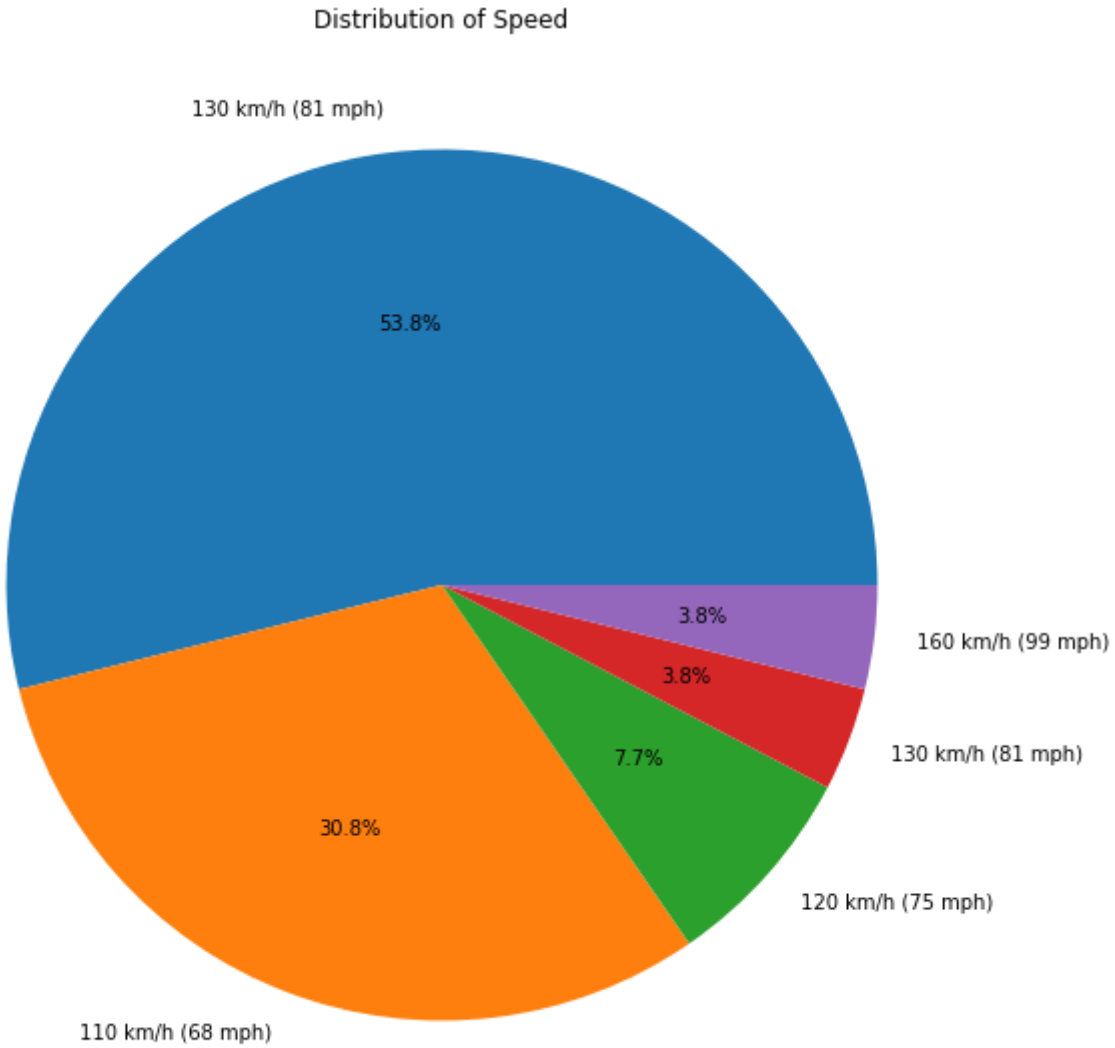
Pie plot for: Distance



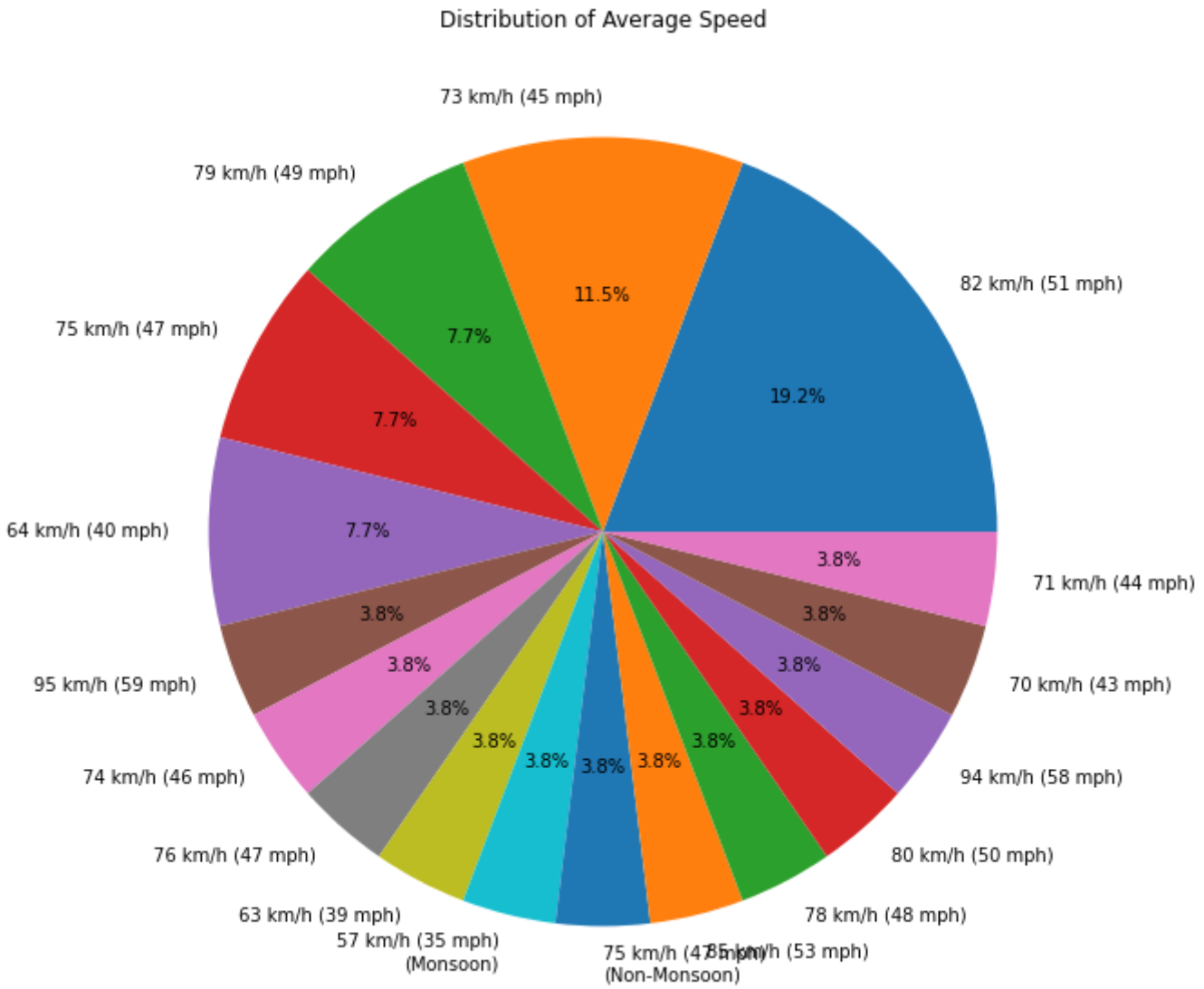
Pie plot for: Travel Time



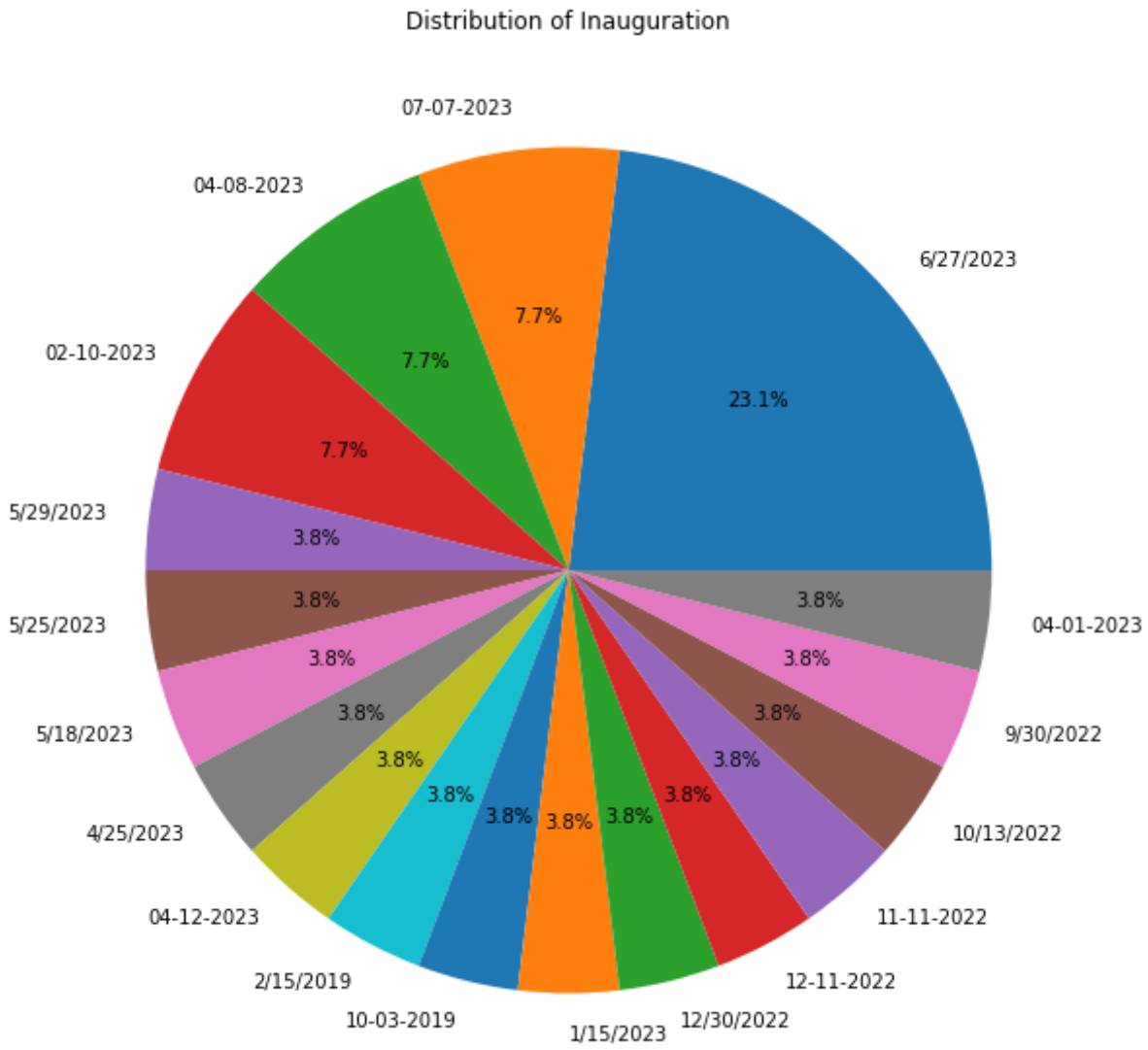
Pie plot for: Speed



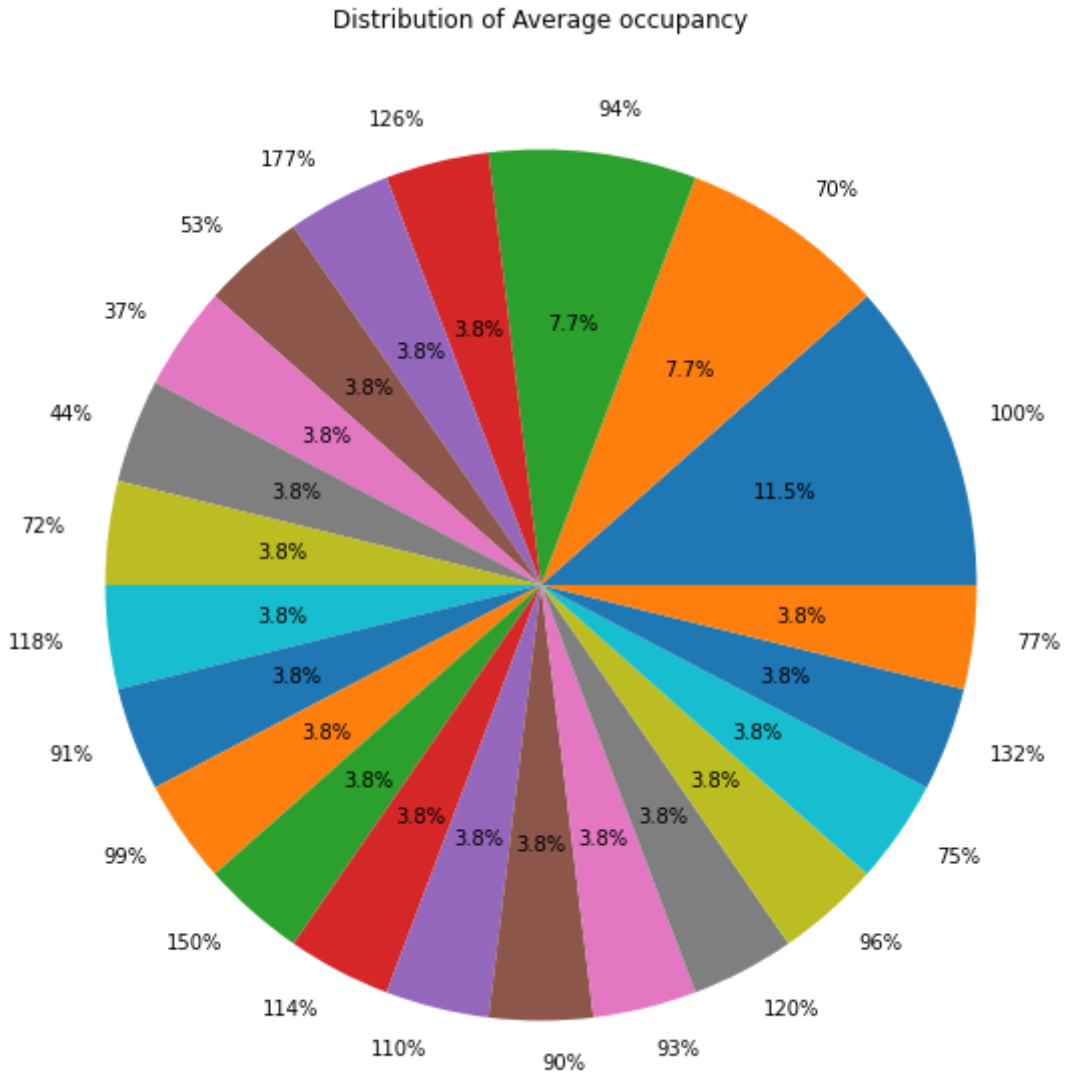
Pie plot for: Average Speed



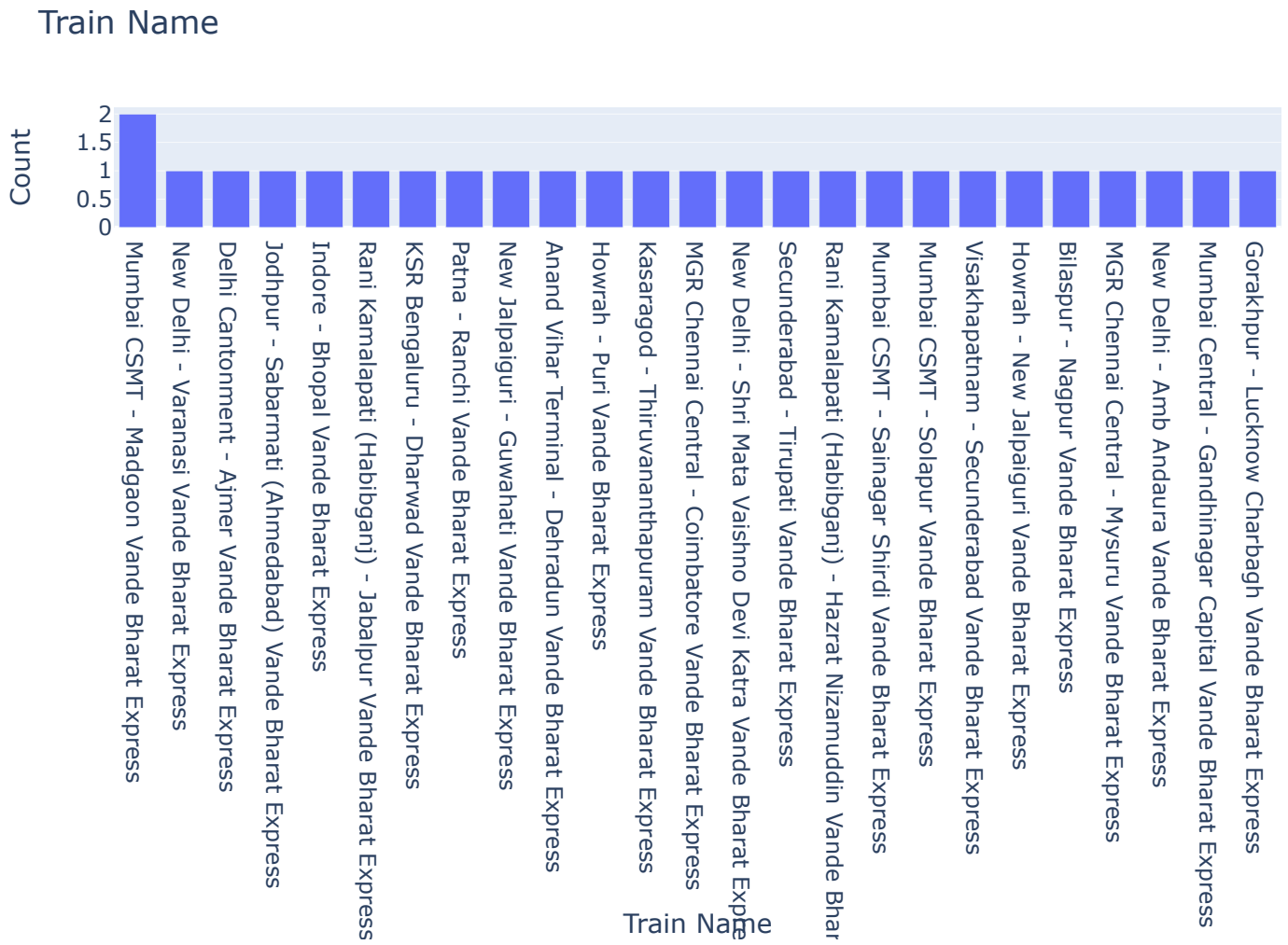
Pie plot for: Inauguration

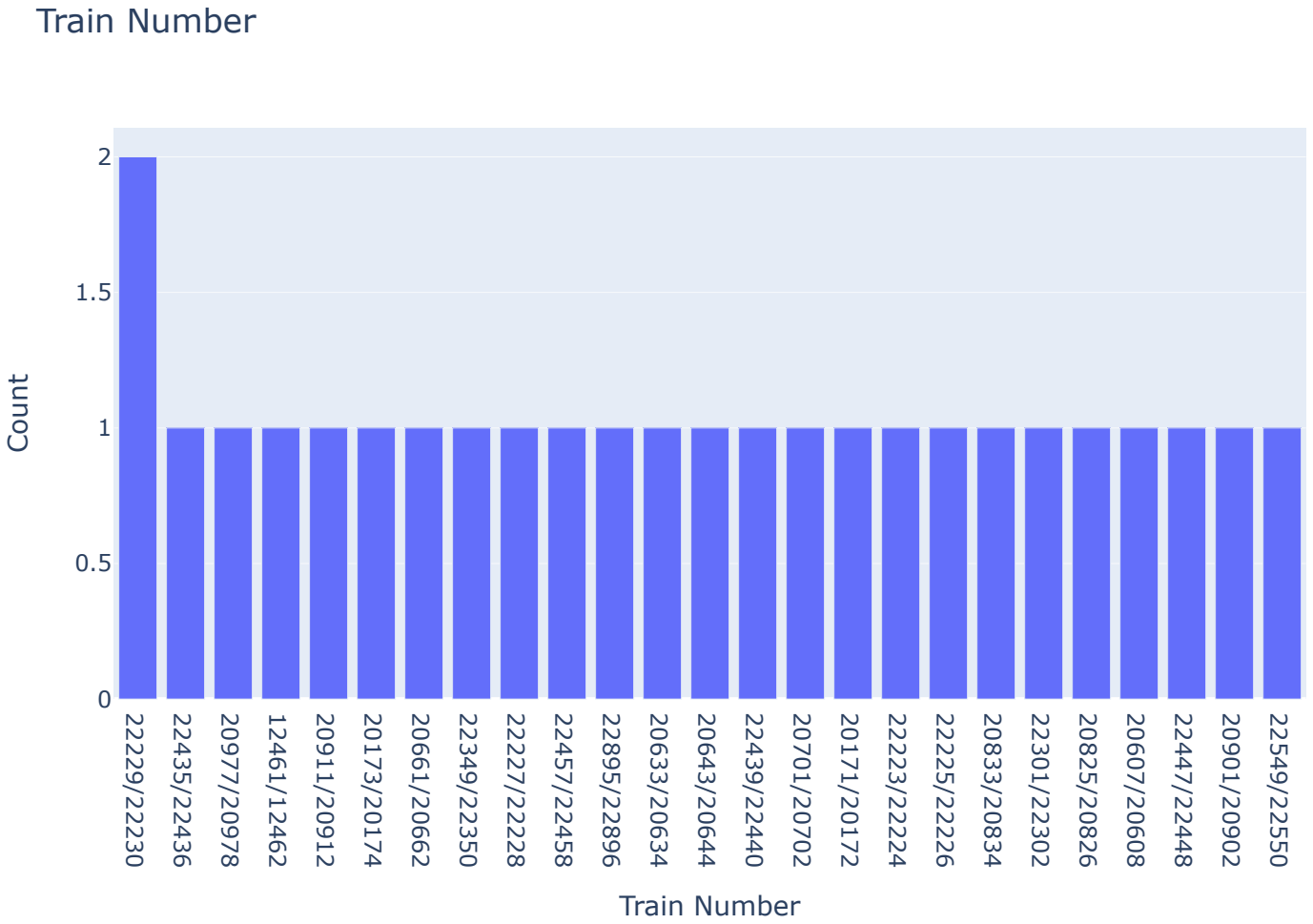


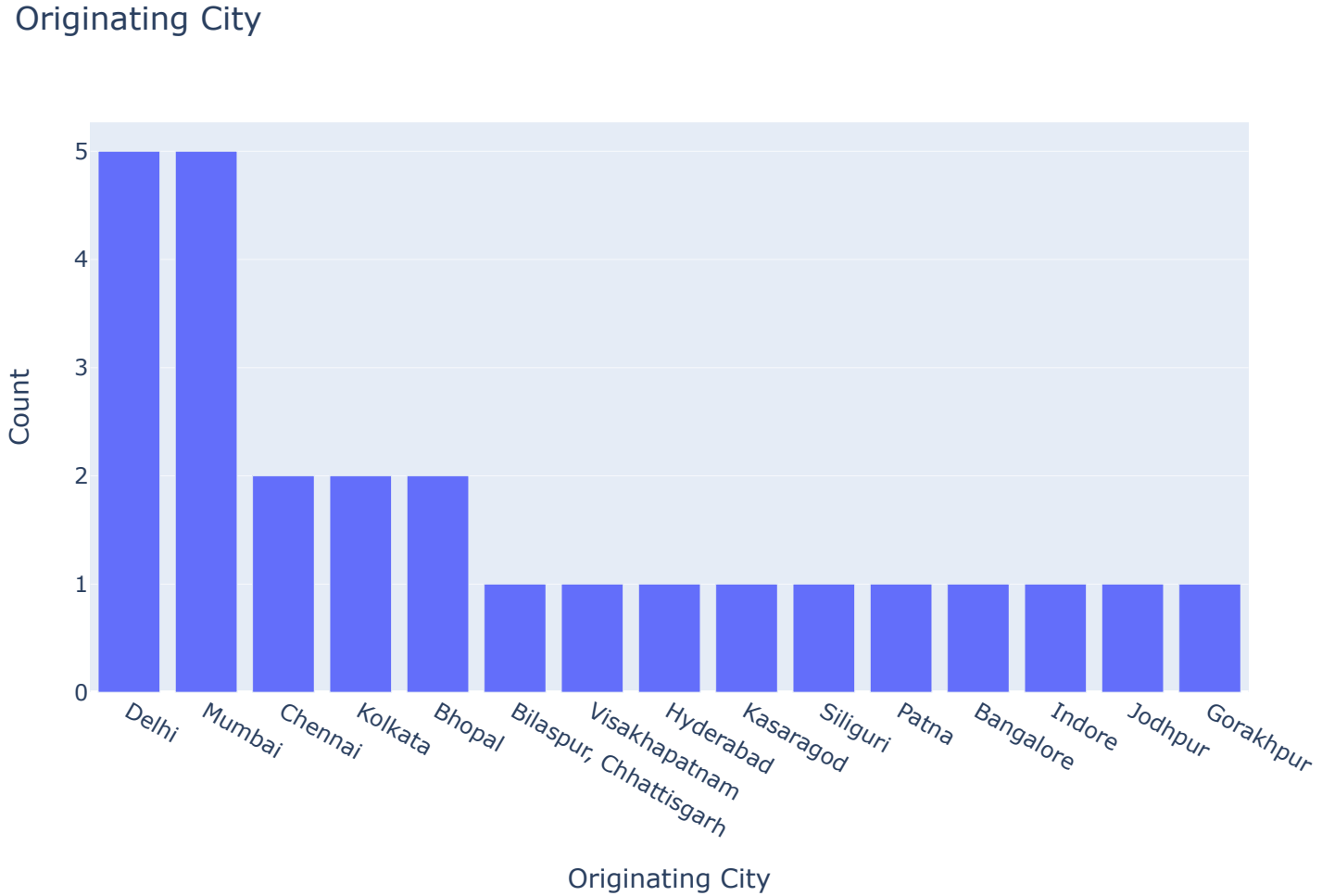
Pie plot for: Average occupancy

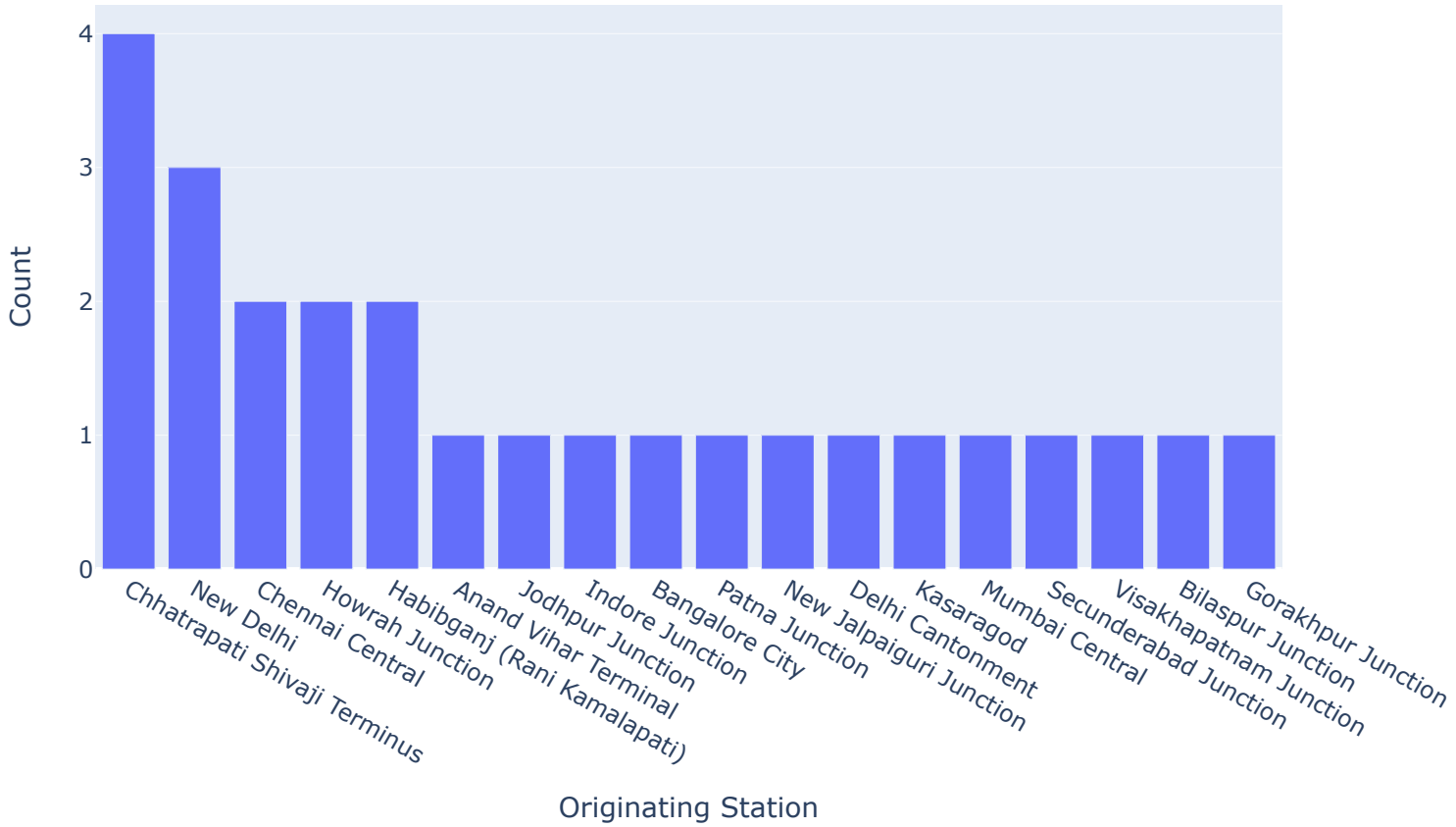

Distribution of Average occupancy
100%
11.5%
70%
7.7%
94%
7.7%
126%
3.8%
177%
3.8%
53%
3.8%
37%
3.8%
44%
3.8%
72%
3.8%
118%
3.8%
91%
3.8%
99%
3.8%
150%
3.8%
114%
3.8%
110%
3.8%
90%
3.8%
93%
3.8%
120%
3.8%
96%
3.8%
75%
3.8%
132%
3.8%
77%
3.8%

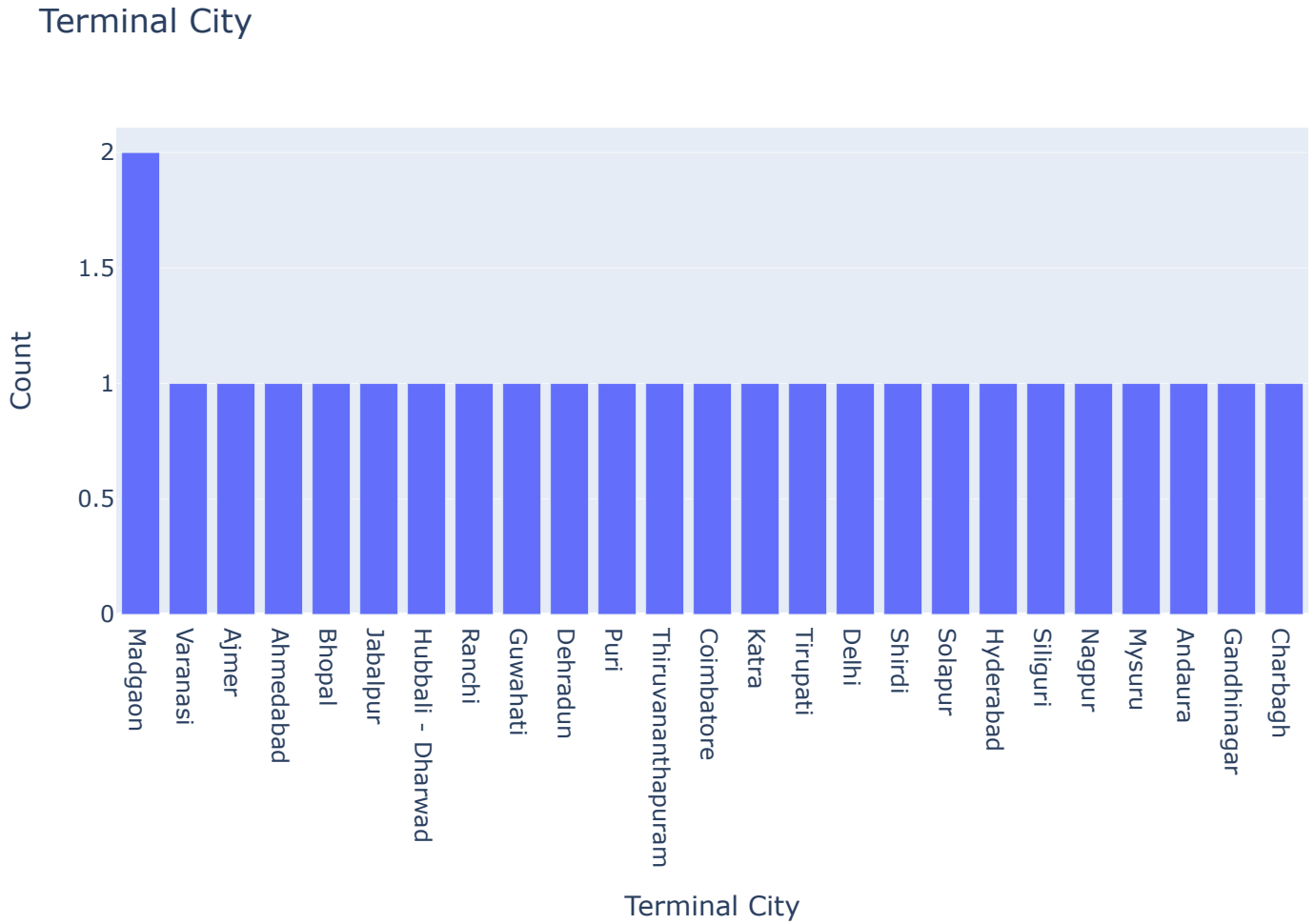
In [18]:
```
for i in df.columns:
    fig = go.Figure(data=[go.Bar(x=df[i].value_counts().index, y=df[i].value_counts())])
    fig.update_layout(
        title=i,
        xaxis_title=i,
        yaxis_title="Count")
    fig.show()
```

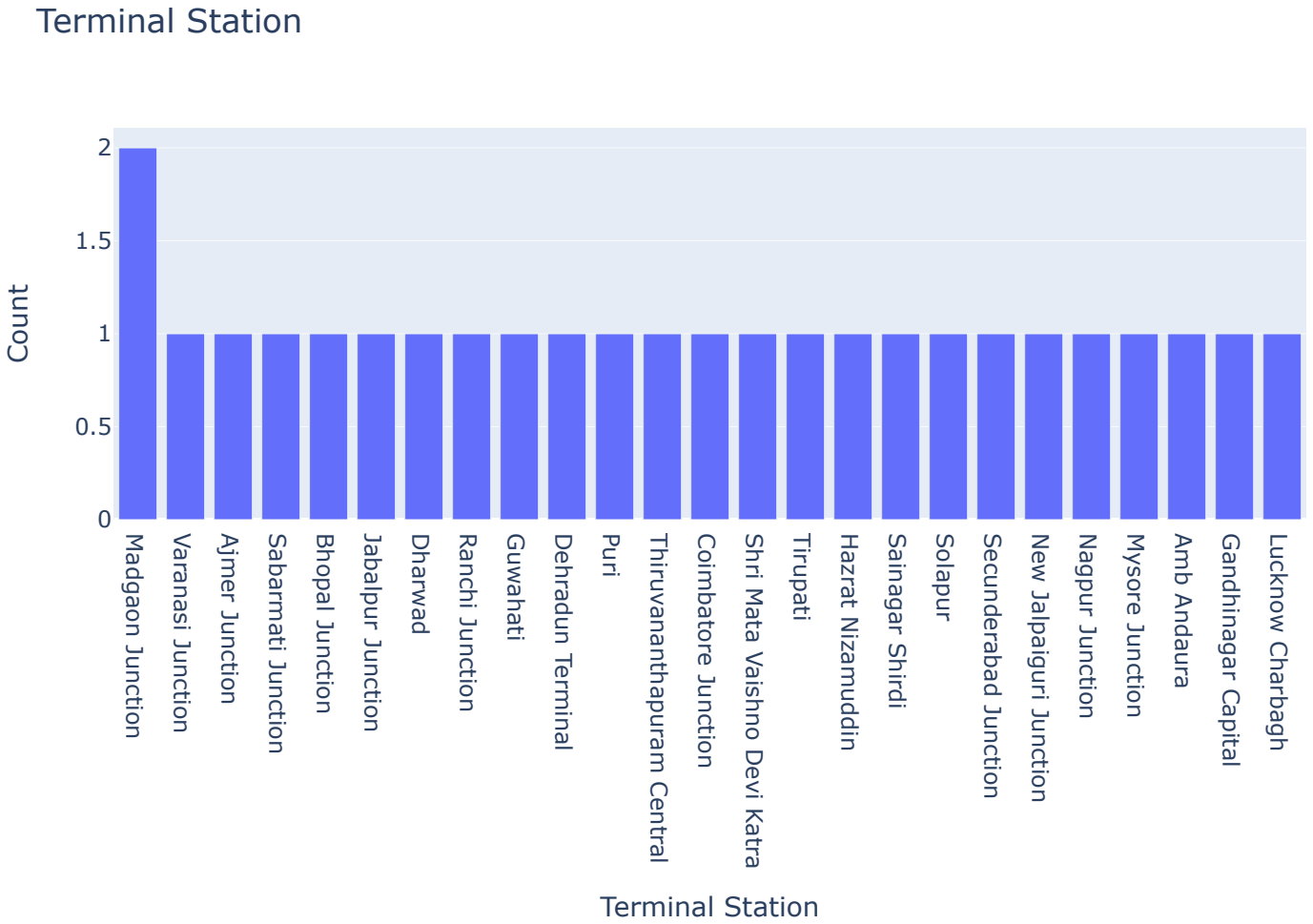


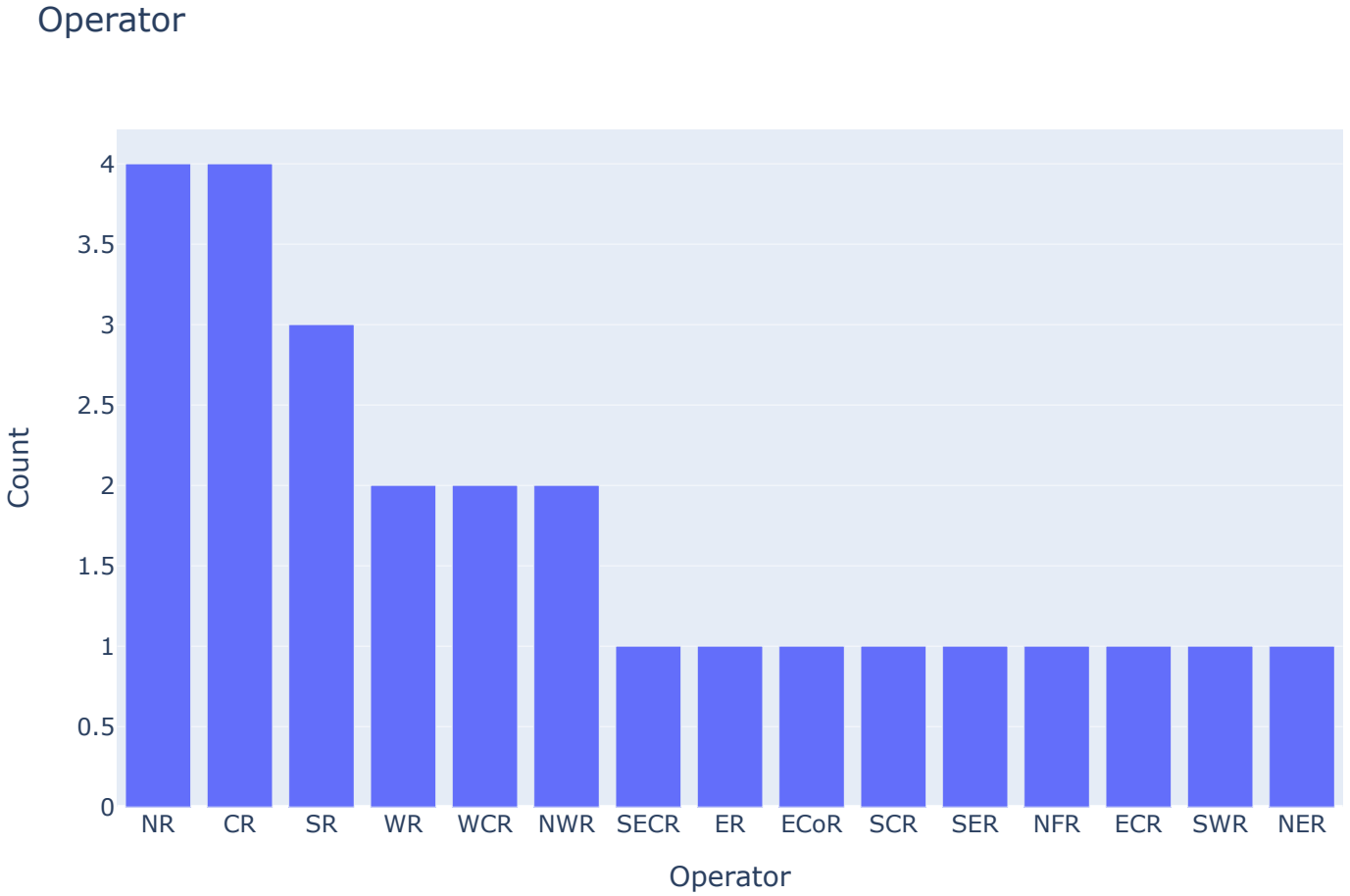

Train Number
Count
2
1.5
1
0.5
0
22229/22230
22435/22436
20977/20978
12461/12462
20911/20912
20173/20174
20661/20662
22349/22350
22227/22228
22457/22458
22895/22896
20633/20634
20643/20644
22439/22440
20701/20702
20171/20172
22223/22224
22225/22226
20833/20834
22301/22302
20825/20826
20607/20608
22447/22448
20901/20902
22549/22550
Train Number

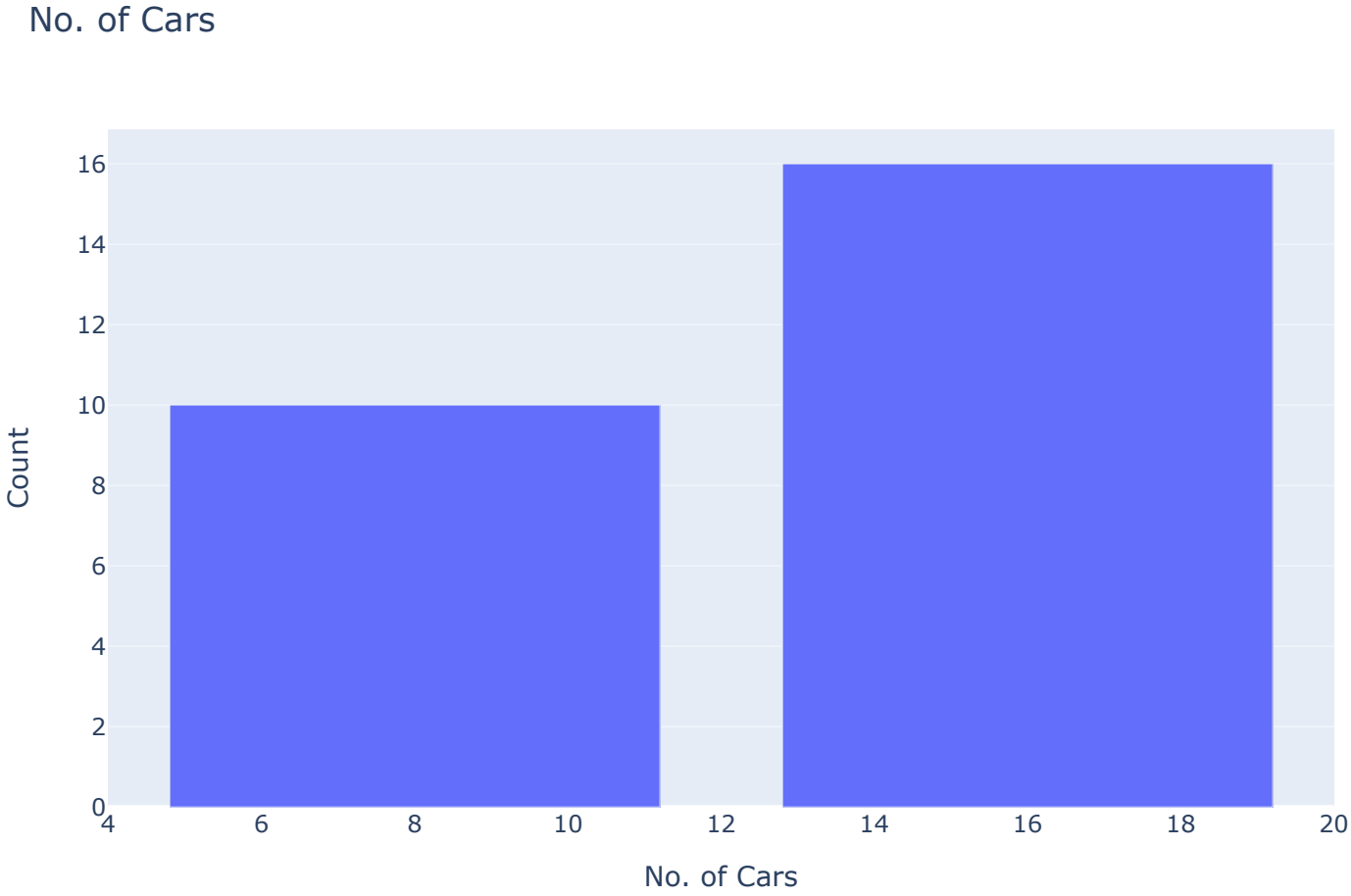

Originating City
Count
0
1
2
3
4
5
Delhi
Mumbai
Chennai
Kolkata
Bhopal
Bilaspur, Chhattisgarh
Visakhapatnam
Hyderabad
Kasaragod
Siliguri
Patna
Bangalore
Indore
Jodhpur
Gorakhpur
Originating City


Originating Station
Count
0
1
2
3
4
Chhatrapati Shivaji Terminus
New Delhi
Chennai Central
Howrah Junction
Habibganj (Rani Kamalapati)
Anand Vihar Terminal
Jodhpur Junction
Indore Junction
Bangalore City
Patna Junction
New Jalpaiguri Junction
Delhi Cantonment
Kasaragod
Mumbai Central
Secunderabad Junction
Visakhapatnam Junction
Bilaspur Junction
Gorakhpur Junction
Originating Station

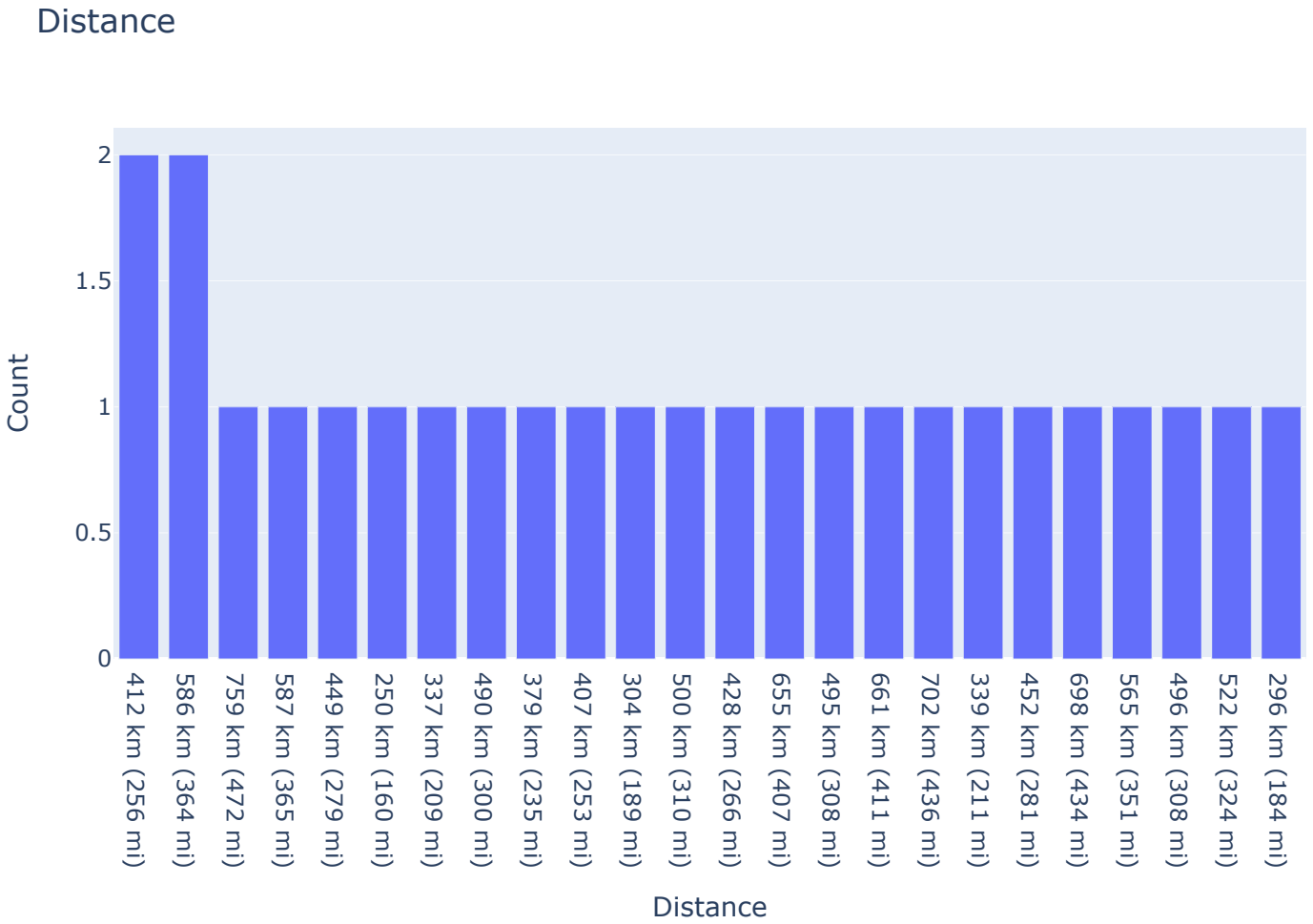

Terminal City
Count
2
1.5
1
0.5
0
Madgaon
Varanasi
Ajmer
Ahmedabad
Bhopal
Jabalpur
Hubbali - Dharwad
Ranchi
Guwahati
Dehradun
Puri
Thiruvananthapuram
Coimbatore
Katra
Tirupati
Delhi
Shirdi
Solapur
Hyderabad
Siliguri
Nagpur
Mysuru
Andaura
Gandhinagar
Charbagh
Terminal City

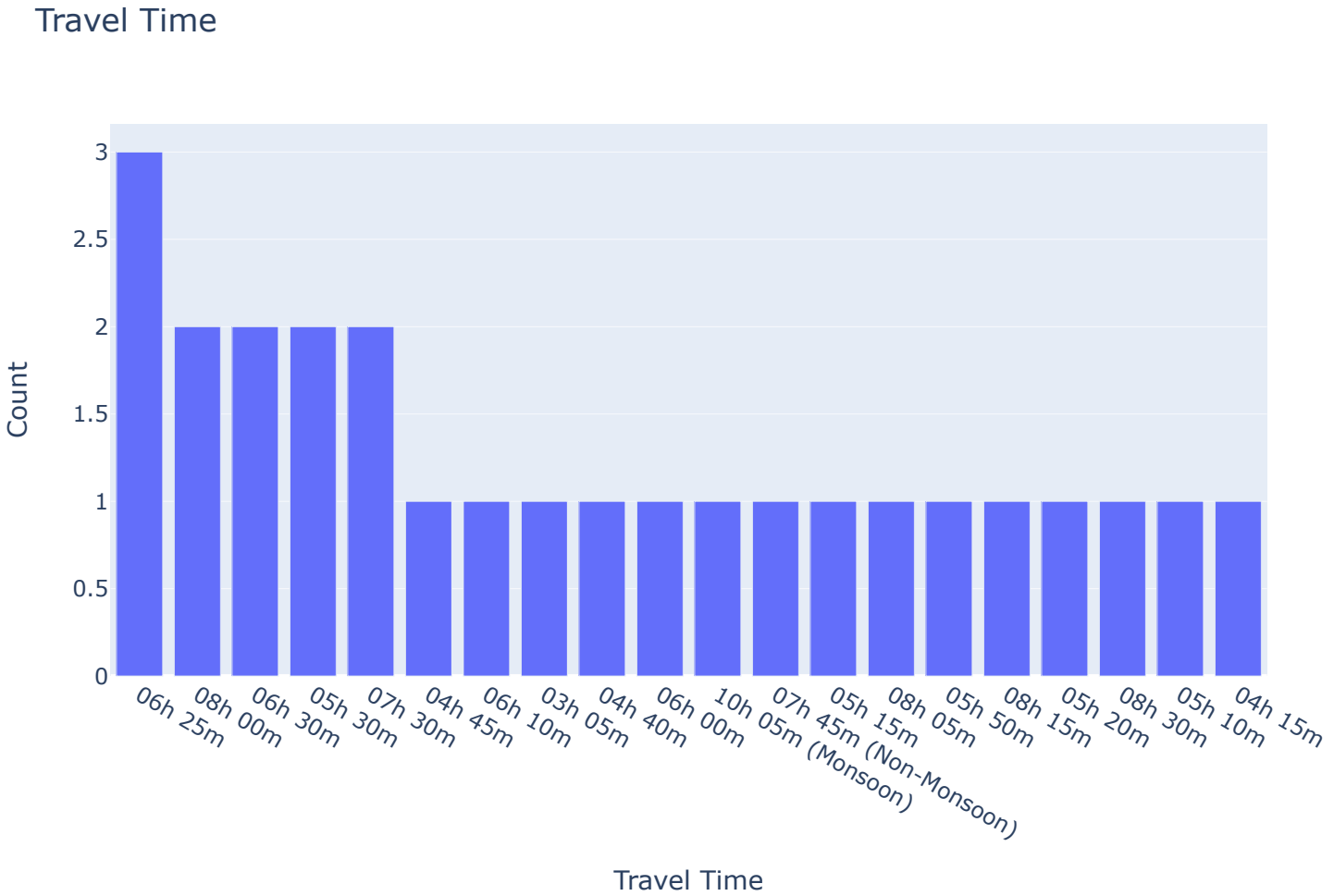

Terminal Station
Count
2
1.5
1
0.5
0
Madgaon Junction
Varanasi Junction
Ajmer Junction
Sabarmati Junction
Bhopal Junction
Jabalpur Junction
Dharwad
Ranchi Junction
Guwahati
Dehradun Terminal
Puri
Thiruvananthapuram Central
Coimbatore Junction
Shri Mata Vaishno Devi Katra
Tirupati
Hazrat Nizamuddin
Sainagar Shirdi
Solapur
Secunderabad Junction
New Jalpaiguri Junction
Nagpur Junction
Mysore Junction
Amb Andaura
Gandhinagar Capital
Lucknow Charbagh
Terminal Station

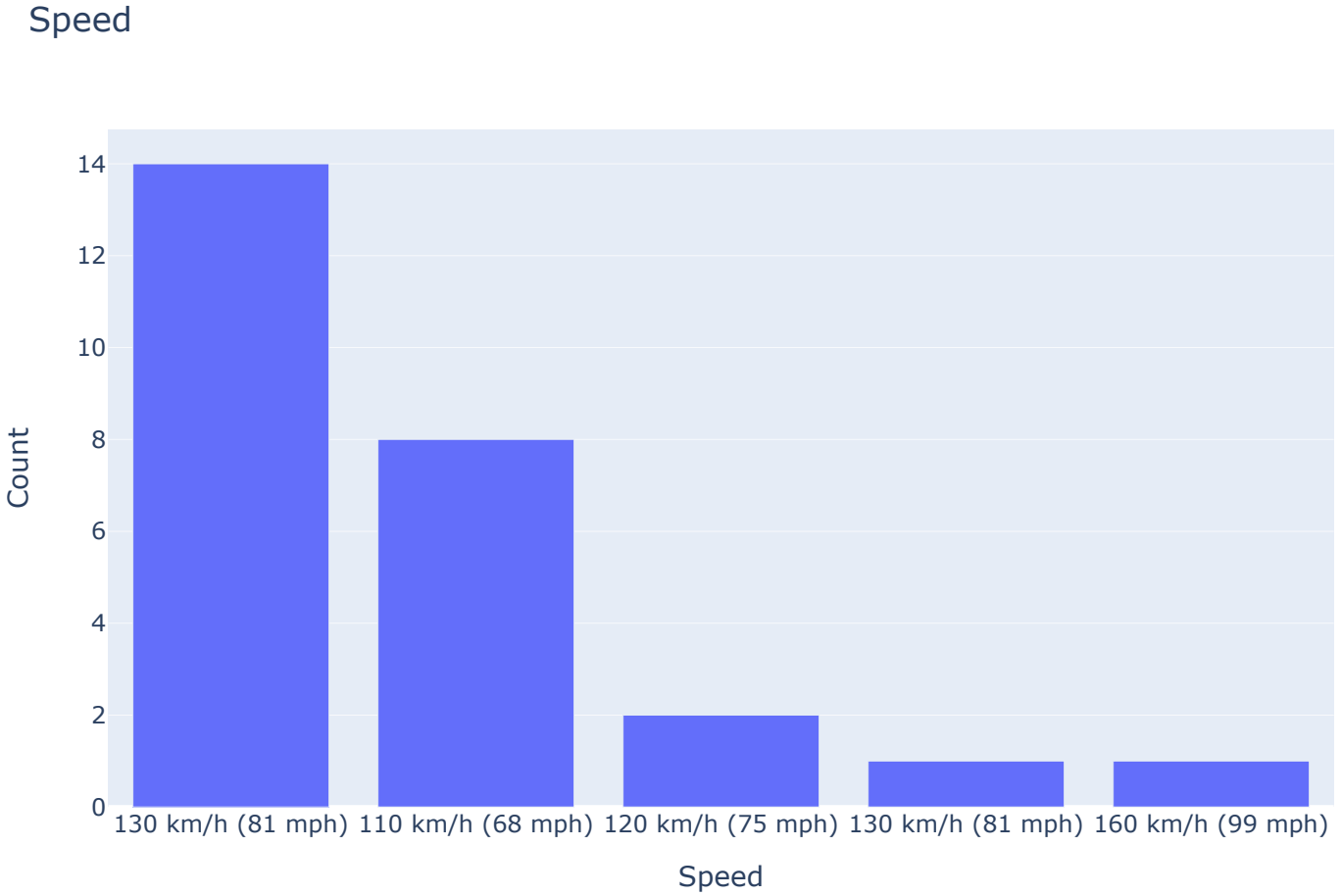

Operator
Count
4
3.5
3
2.5
2
1.5
1
0.5
0
NR
CR
SR
WR
WCR
NWR
SECR
ER
ECoR
SCR
SER
NFR
ECR
SWR
NER
Operator

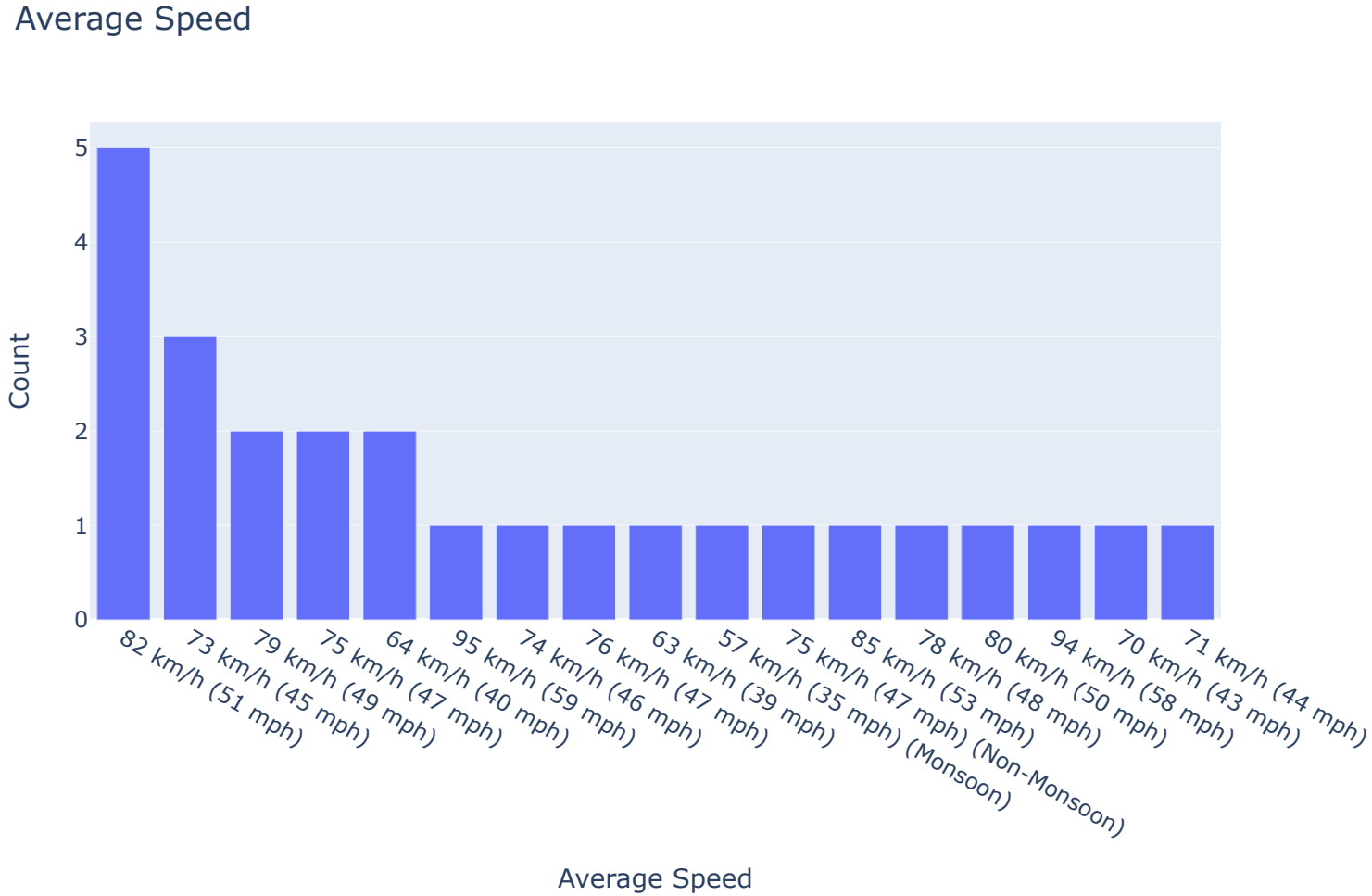

No. of Cars
Count
16
14
12
10
8
6
4
2
0
4
6
8
10
12
14
16
18
20
No. of Cars

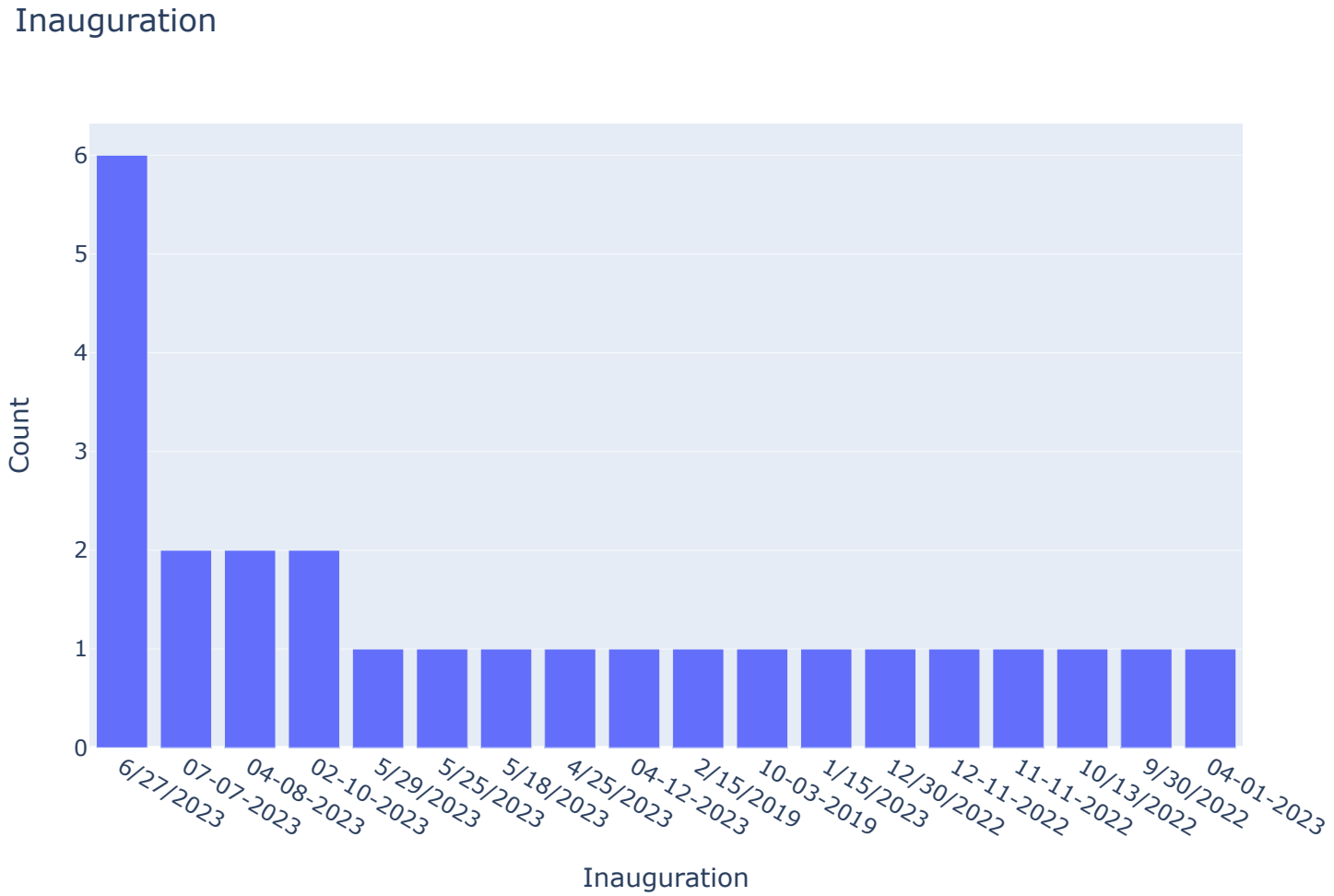
Frequency
Count
8
6
4
2
0
Except Tuesdays
Except Wednesdays
Except Thursdays
Except Saturdays
Except Sundays
Except Fridays
Except Wednesdays (22225) , Except Thursdays (22226)
Except Fridays (Non-Monsoon)
Monday, Wednesday, Friday (22229) Tuesday, Thursday, Satu
Frequency

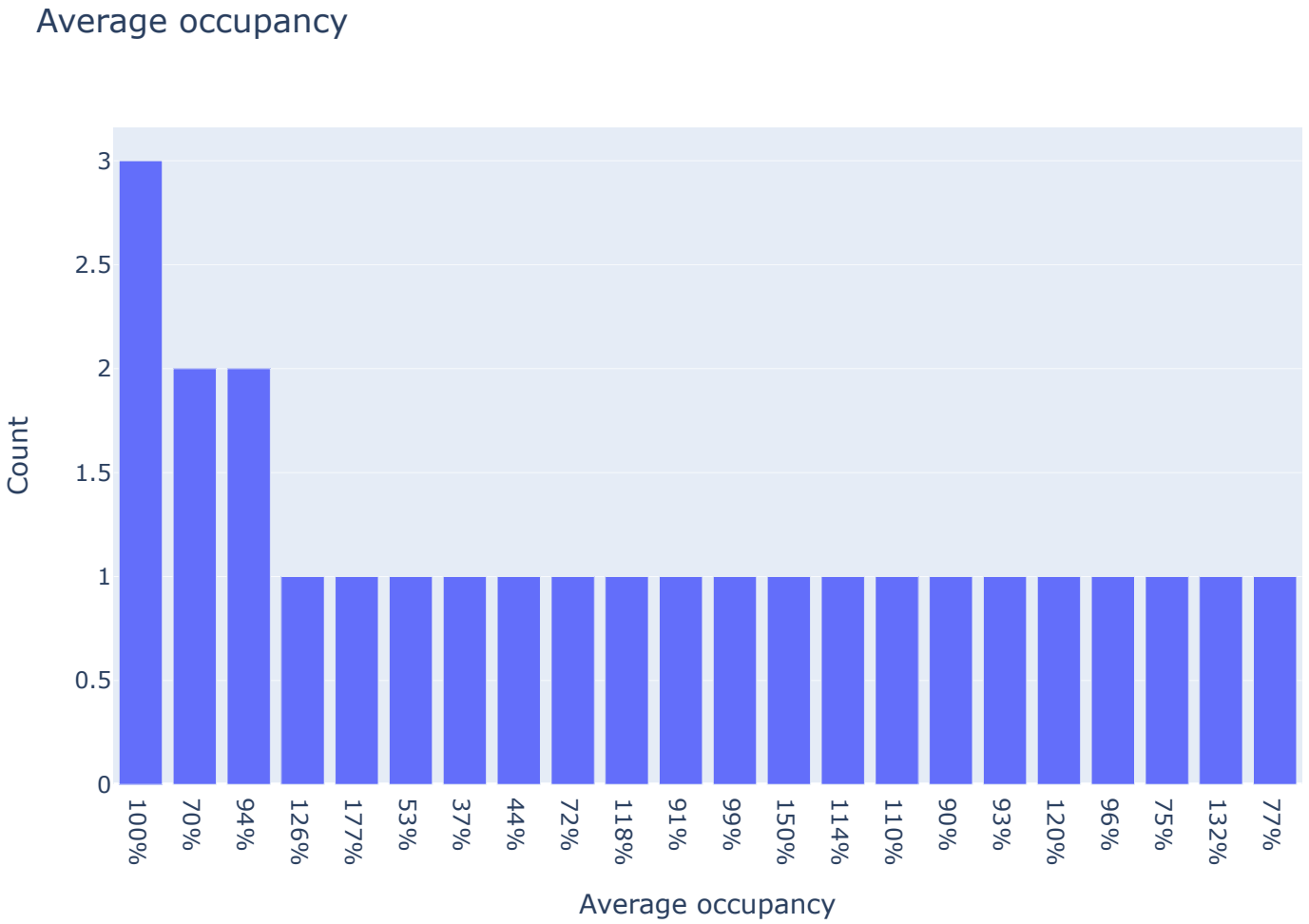

Distance
Count
2
1.5
1
0.5
0
412 km (256 mi)
586 km (364 mi)
759 km (472 mi)
587 km (365 mi)
449 km (279 mi)
250 km (160 mi)
337 km (209 mi)
490 km (300 mi)
379 km (235 mi)
407 km (253 mi)
304 km (189 mi)
500 km (310 mi)
428 km (266 mi)
655 km (407 mi)
495 km (308 mi)
661 km (411 mi)
702 km (436 mi)
339 km (211 mi)
452 km (281 mi)
698 km (434 mi)
565 km (351 mi)
496 km (308 mi)
522 km (324 mi)
296 km (184 mi)
Distance


Travel Time
Count
3
2.5
2
1.5
1
0.5
0
06h 25m
08h 00m
06h 30m
05h 30m
07h 30m
04h 45m
06h 10m
03h 05m
04h 40m
06h 00m
10h 05m (Monsoon)
07h 45m (Non-Monsoon)
05h 15m
08h 05m
05h 50m
08h 15m
05h 20m
08h 30m
05h 10m
04h 15m
Travel Time


Speed
Count
14
12
10
8
6
4
2
0
130 km/h (81 mph)
110 km/h (68 mph)
120 km/h (75 mph)
130 km/h (81 mph)
160 km/h (99 mph)
Speed

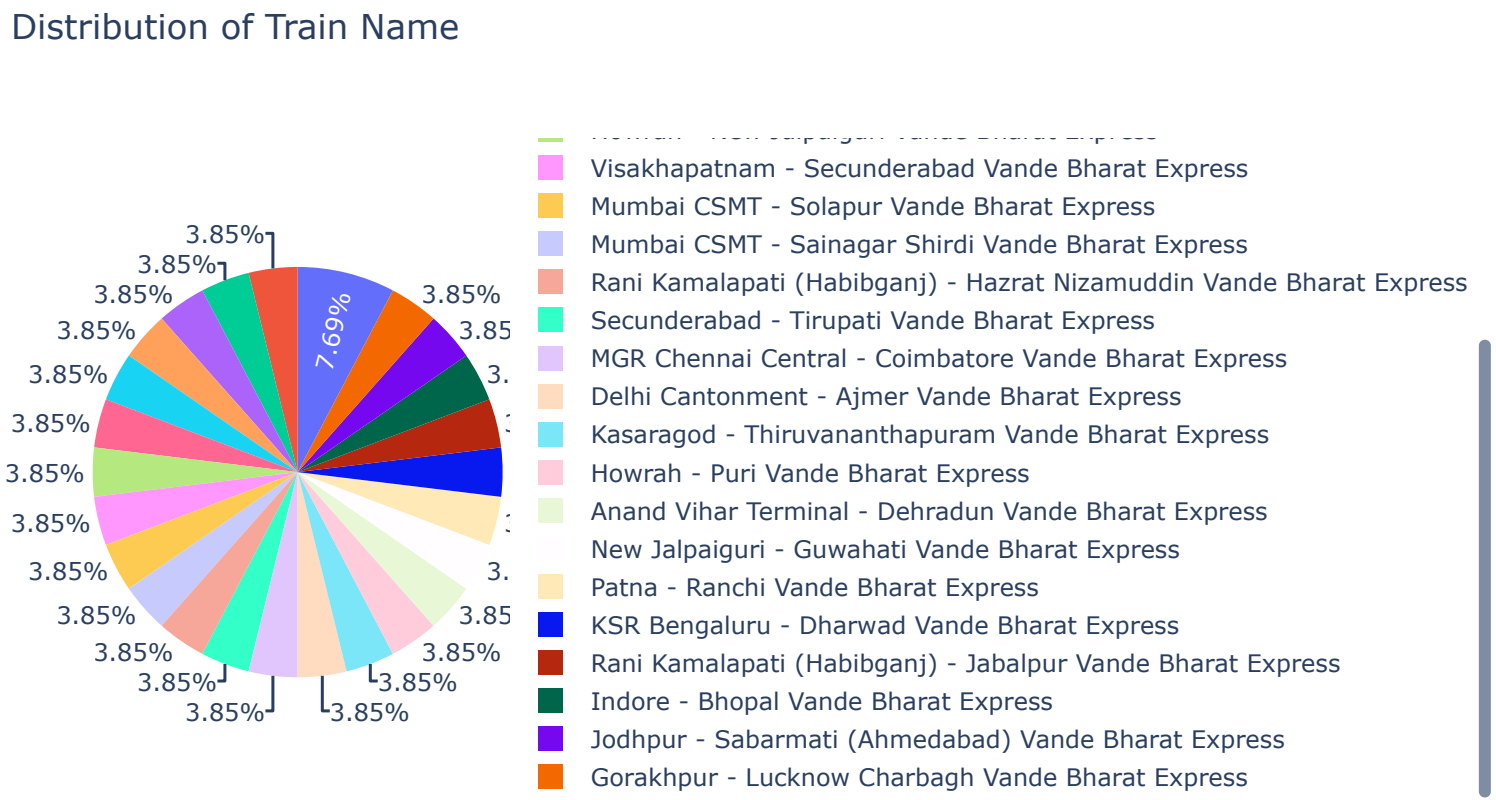

Average Speed
Count
0
1
2
3
4
5
82 km/h (51 mph)
73 km/h (45 mph)
79 km/h (49 mph)
75 km/h (47 mph)
64 km/h (40 mph)
95 km/h (59 mph)
74 km/h (46 mph)
76 km/h (47 mph)
63 km/h (39 mph)
57 km/h (35 mph)
75 km/h (47 mph) (Monsoon)
85 km/h (53 mph) (Non-Monsoon)
78 km/h (48 mph)
80 km/h (50 mph)
94 km/h (58 mph)
70 km/h (43 mph)
71 km/h (44 mph)
Average Speed


Inauguration
Count
0
1
2
3
4
5
6
6/27/2023
07-07-2023
04-08-2023
02-10-2023
5/29/2023
5/25/2023
5/18/2023
4/25/2023
04-12-2023
2/15/2019
10-03-2019
1/15/2023
12/30/2022
12-11-2022
11-11-2022
10/13/2022
9/30/2022
04-01-2023
Inauguration

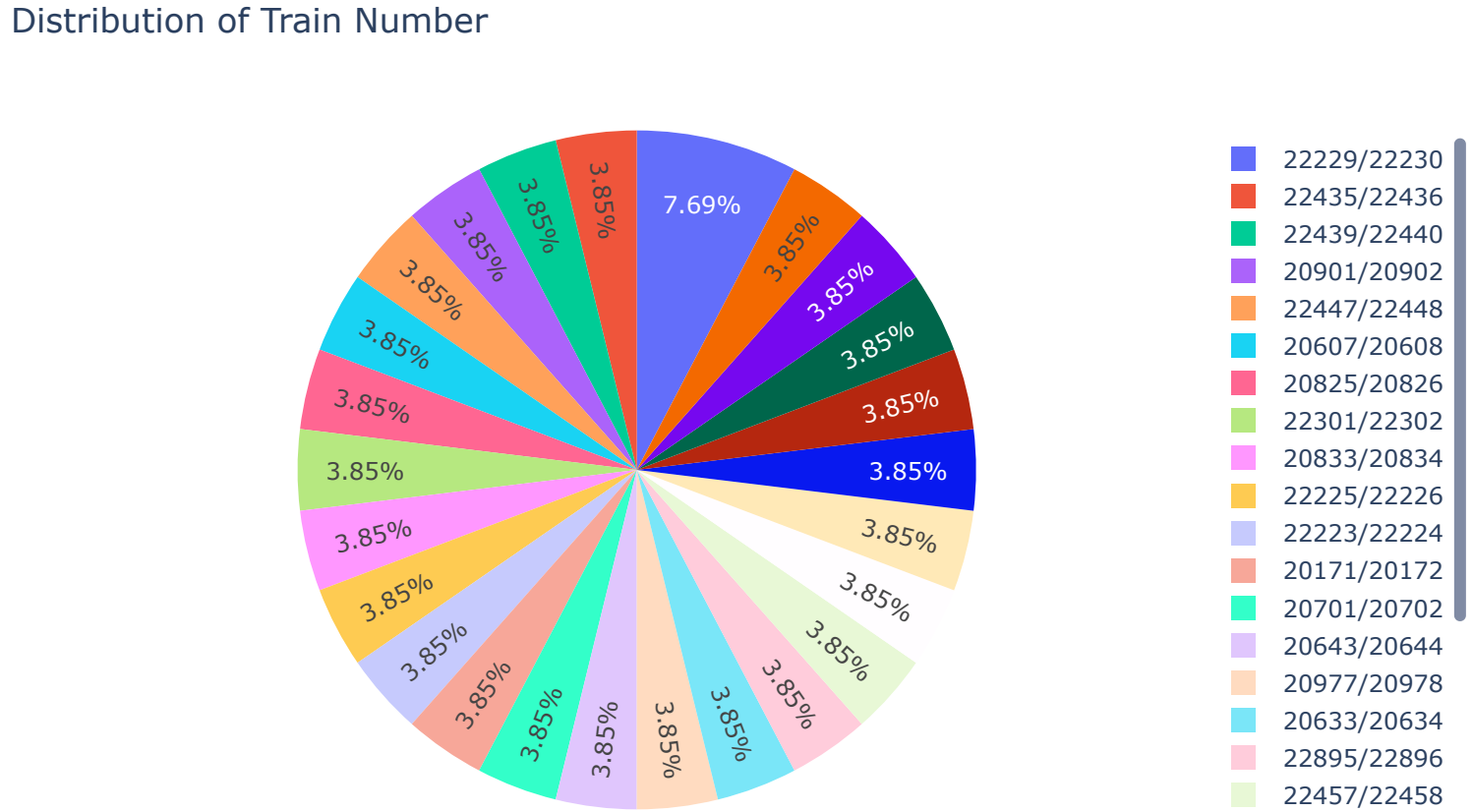

Average occupancy
Count
3
2.5
2
1.5
1
0.5
0
100%
70%
94%
126%
177%
53%
37%
44%
72%
118%
91%
99%
150%
114%
110%
90%
93%
120%
96%
75%
132%
77%
Average occupancy

In [46]:
```
for i in df.columns:
    print('Pie plot for:', i)
    fig = px.pie(df, names=i, title='Distribution of ' + i)
    fig.show()
    print('\n')
```

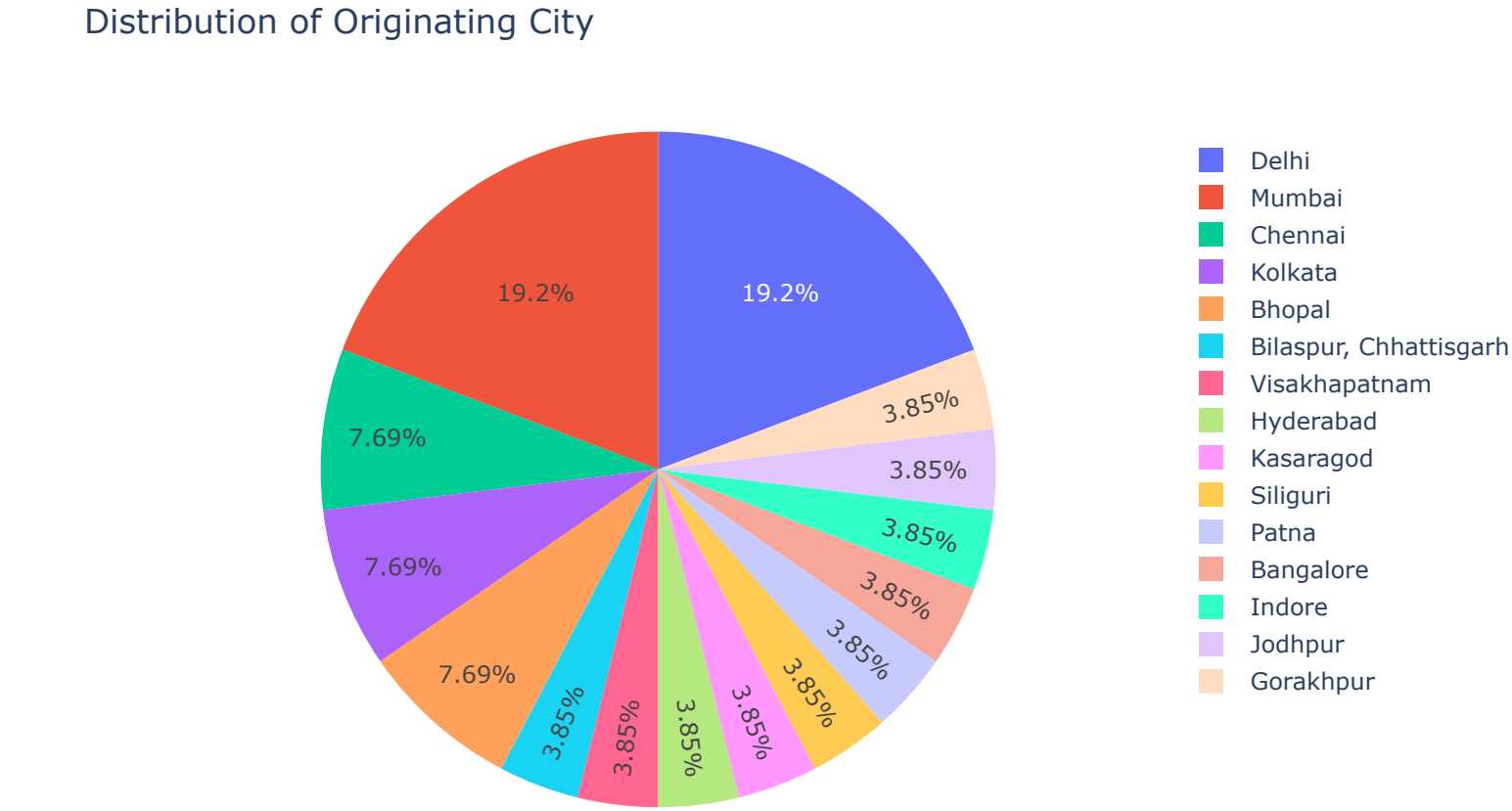
```
Pie plot for: Train Name
```



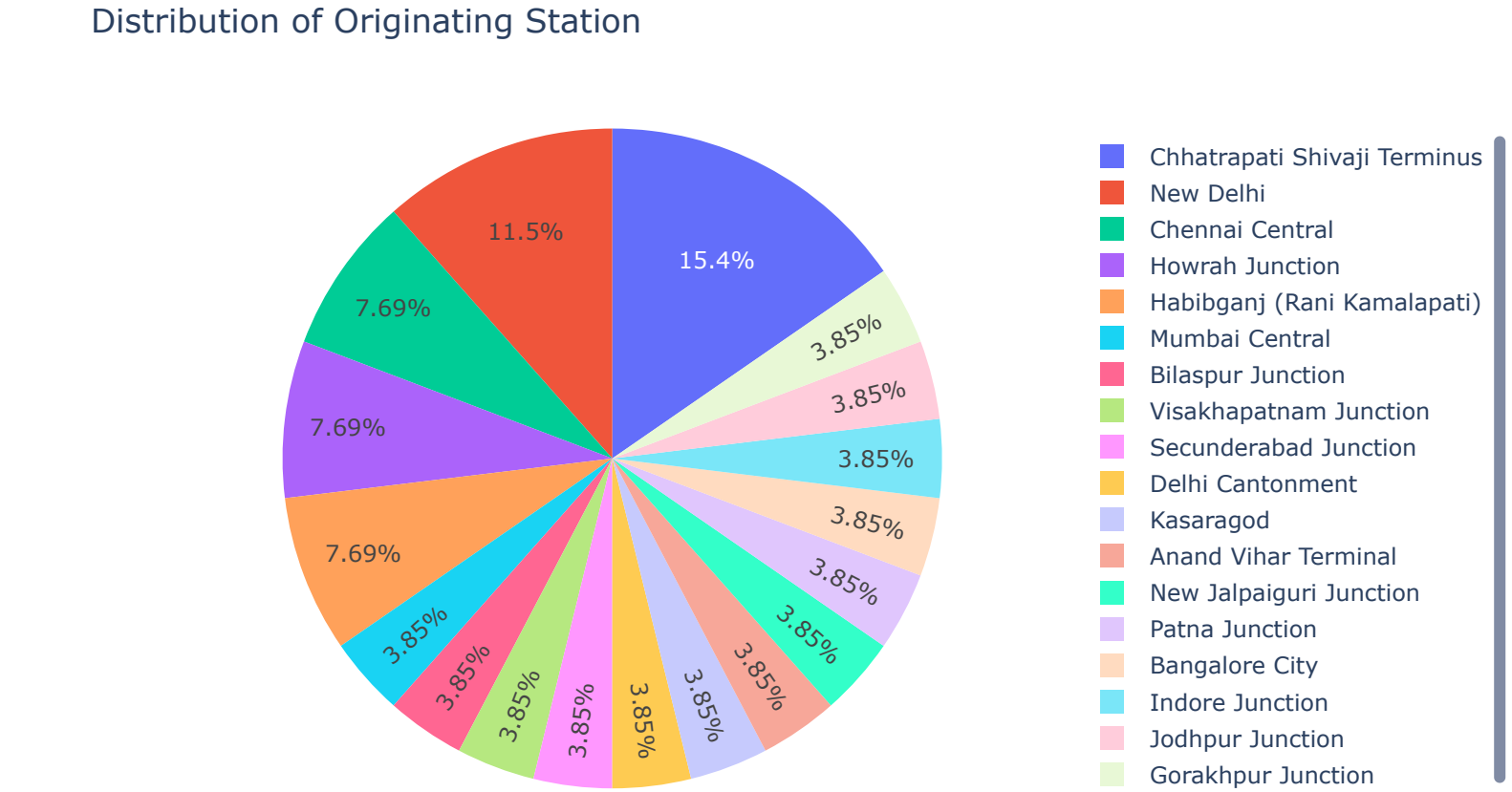
Pie plot for: Train Number



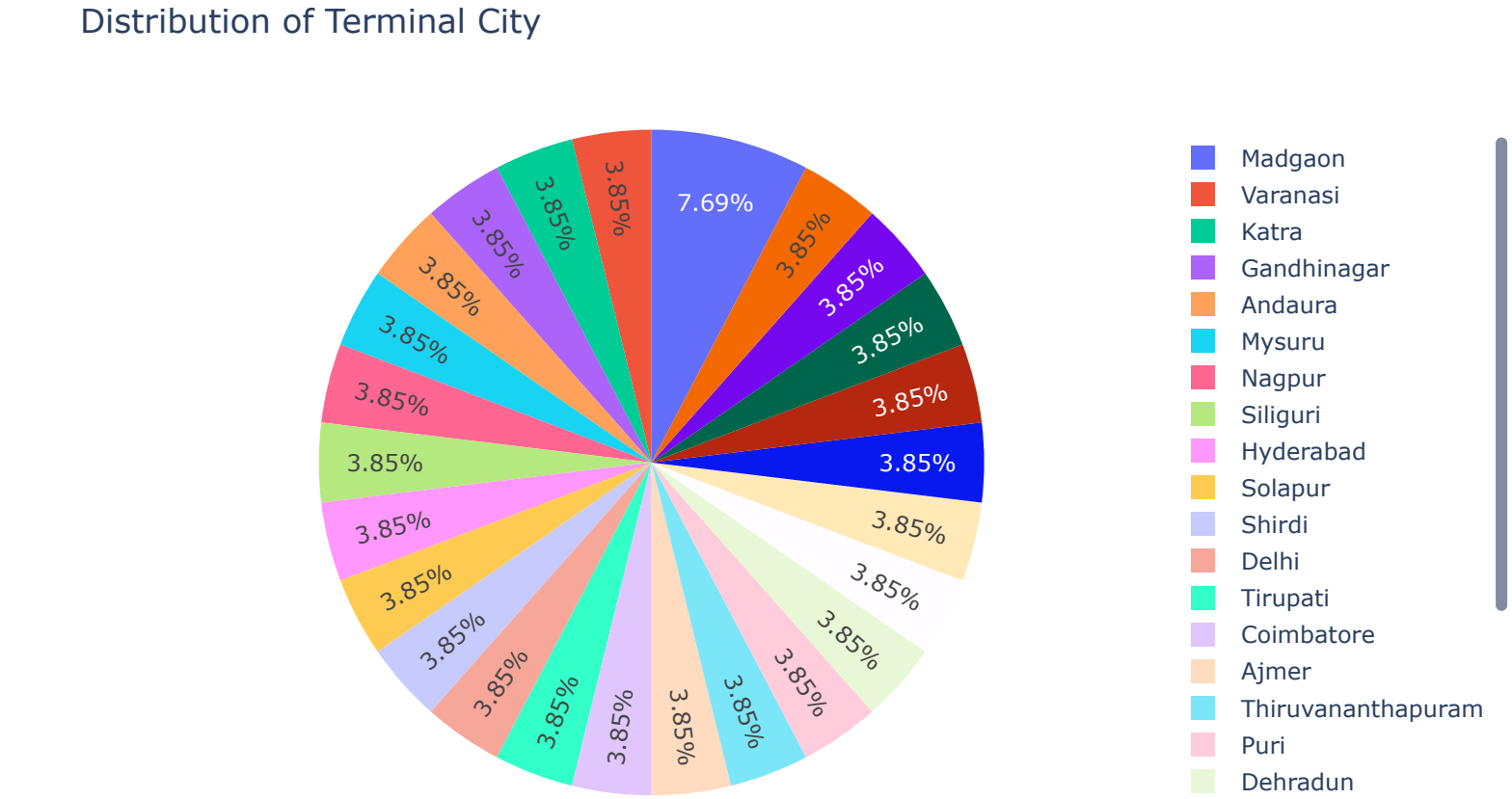
Pie plot for: Originating City



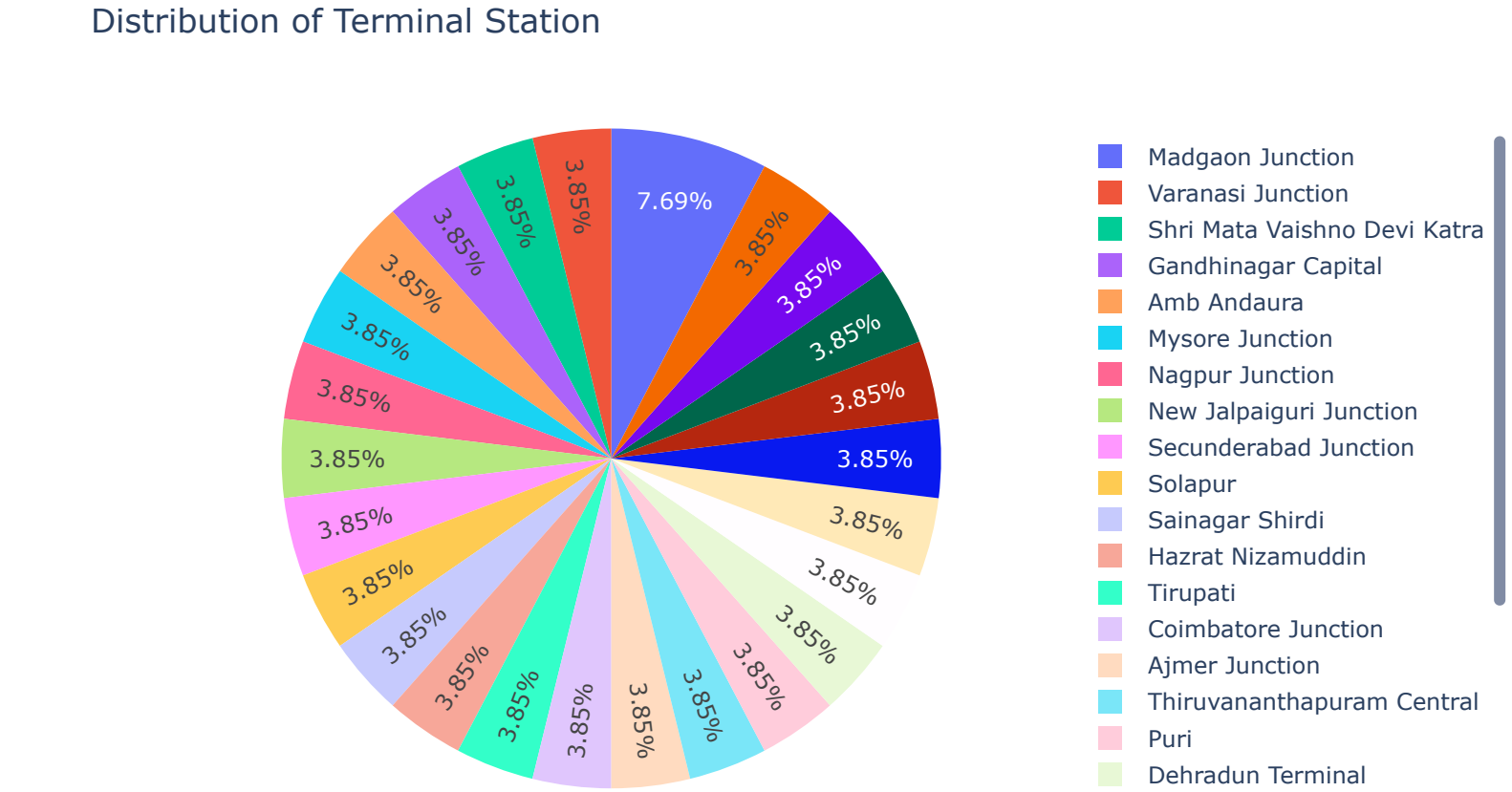
Pie plot for: Originating Station



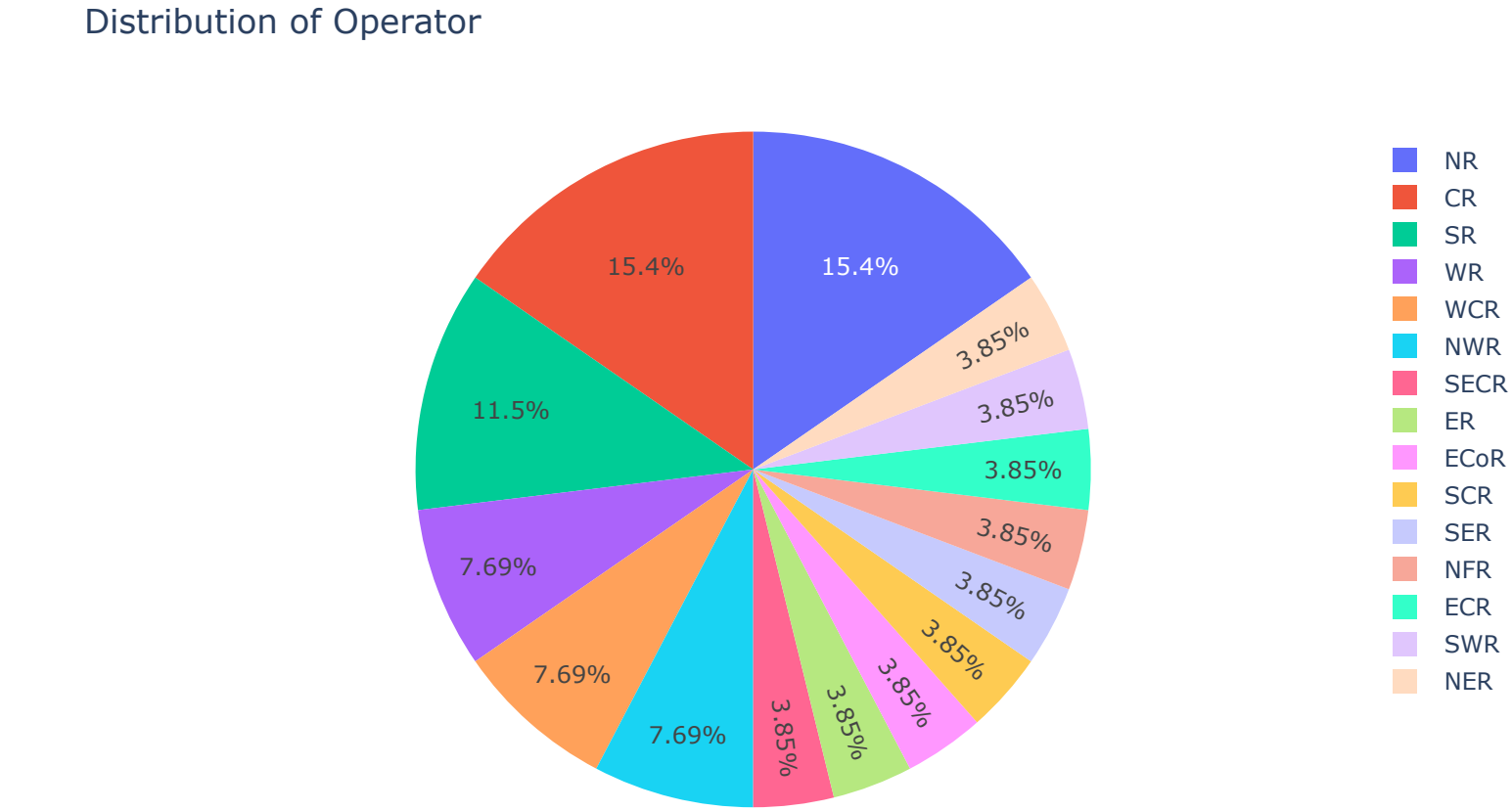
Pie plot for: Terminal City



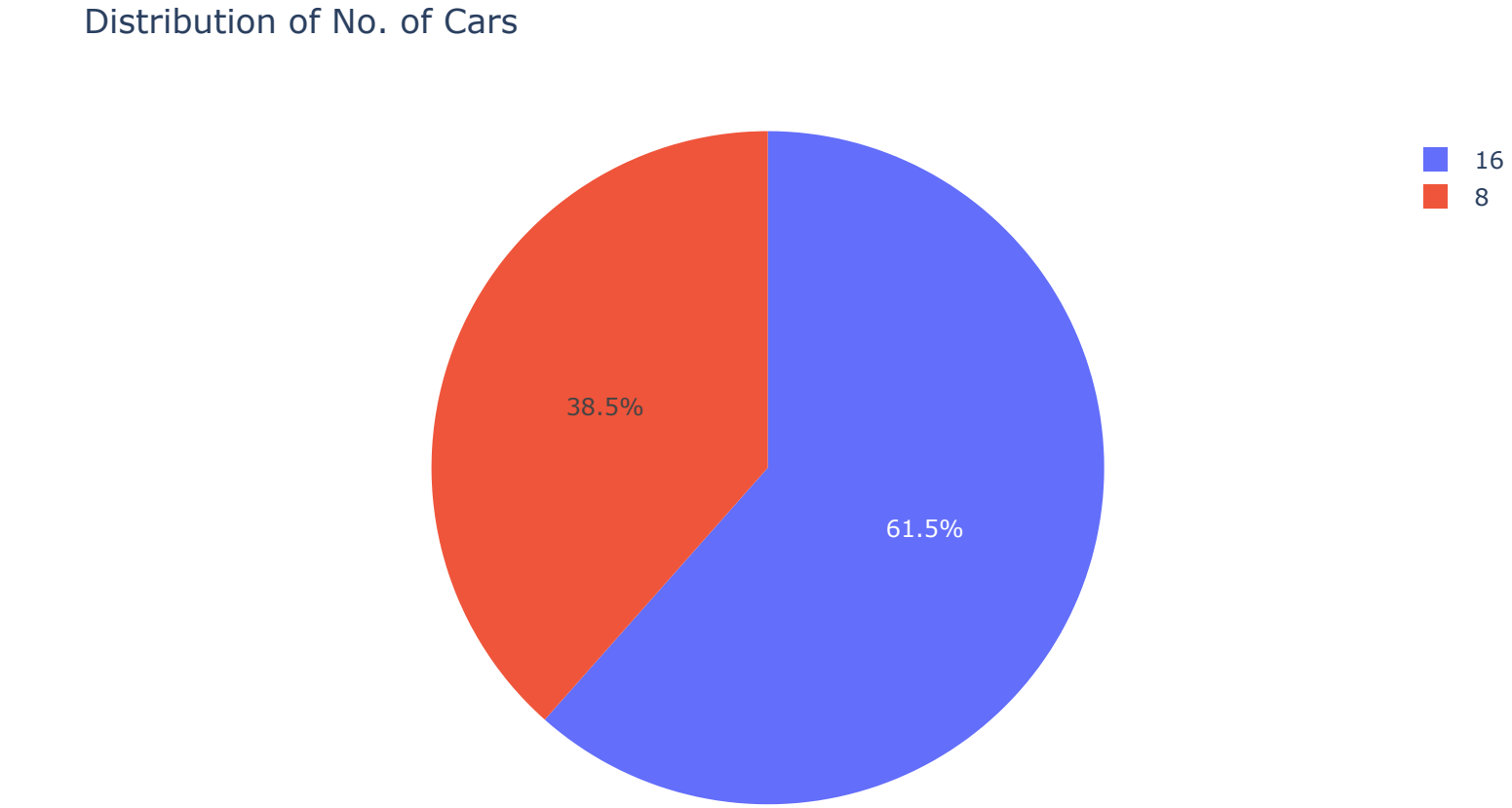
Pie plot for: Terminal Station



Pie plot for: Operator

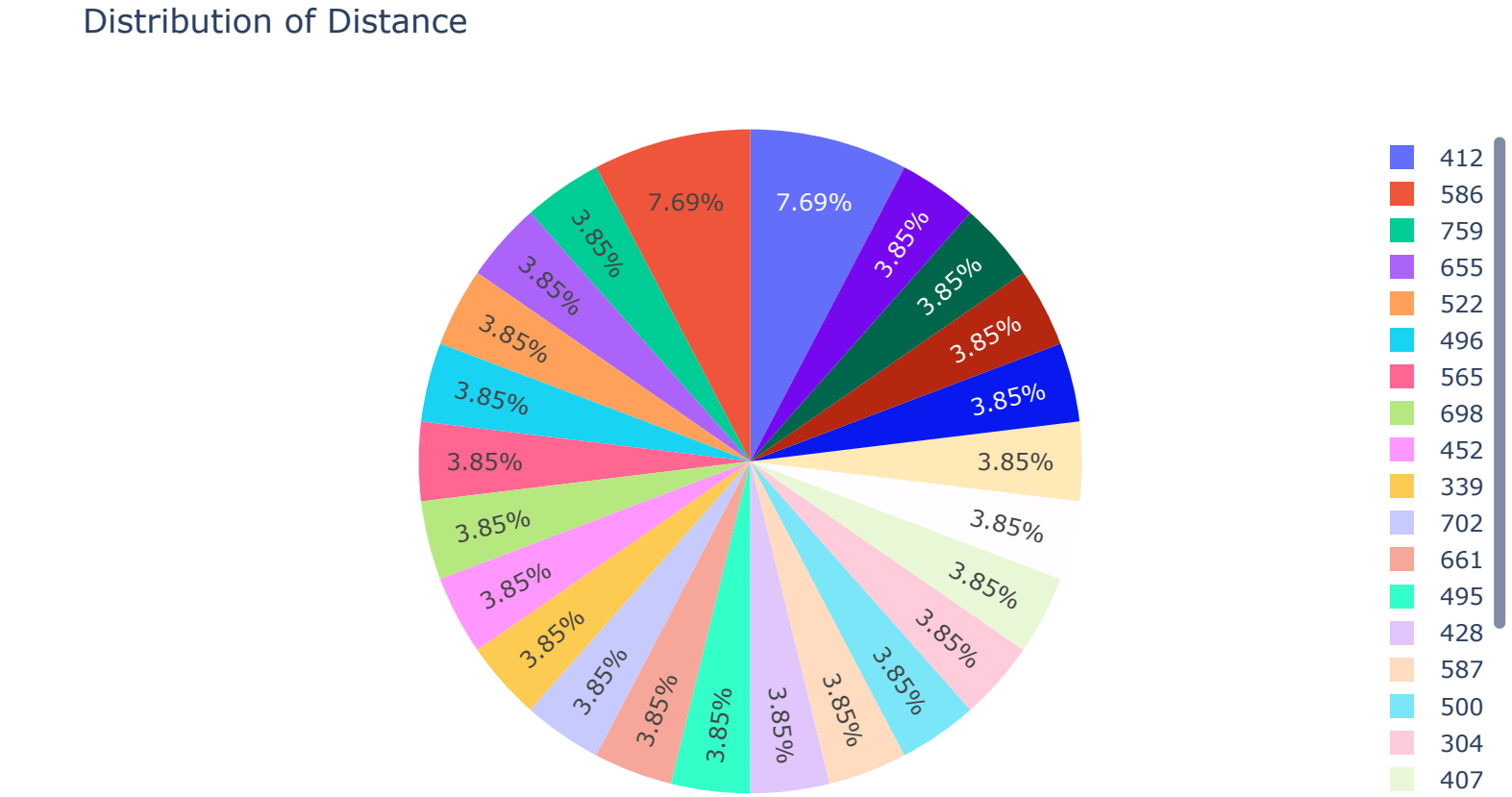


Pie plot for: No. of Cars

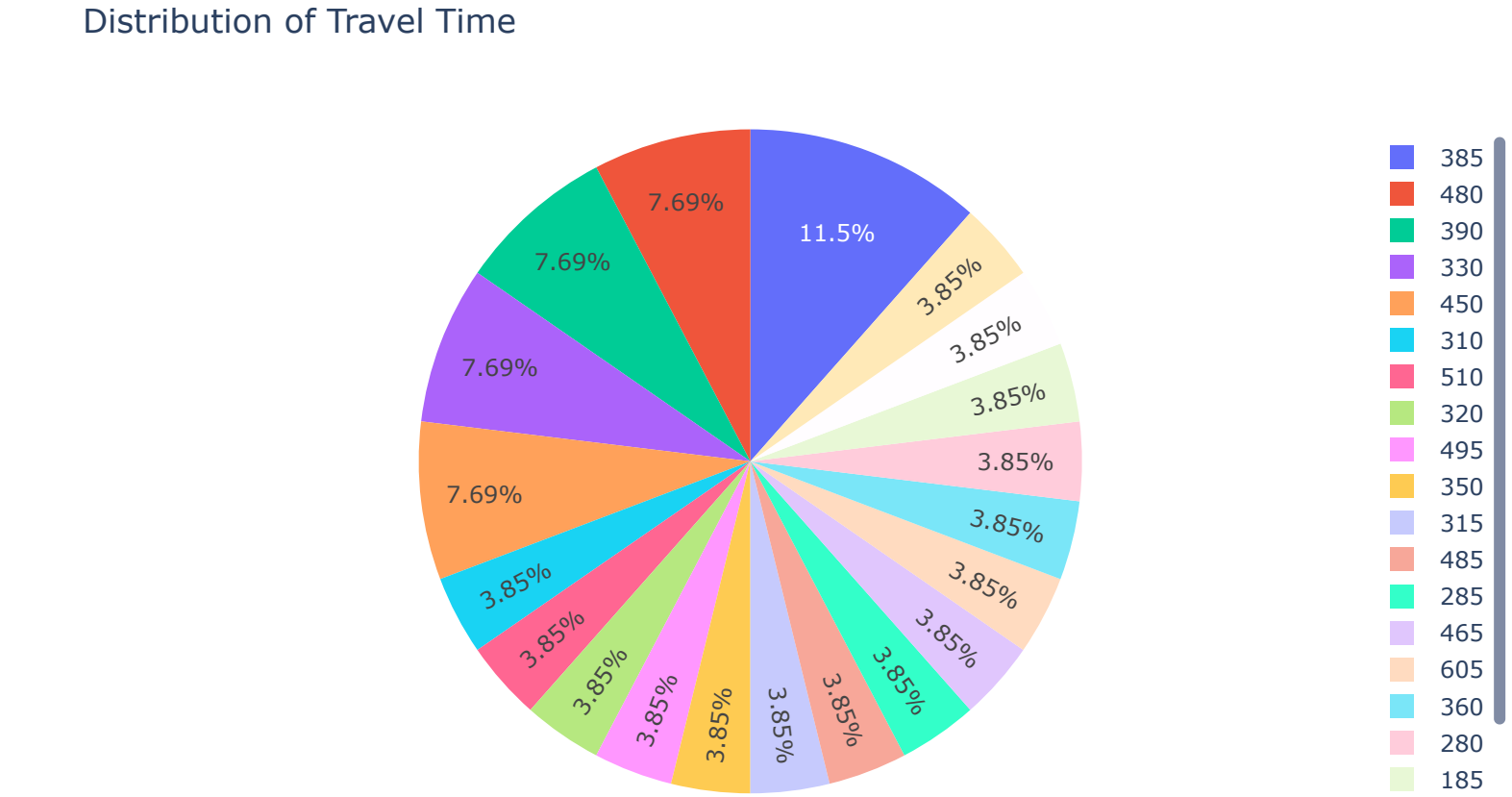


Pie plot for: Frequency

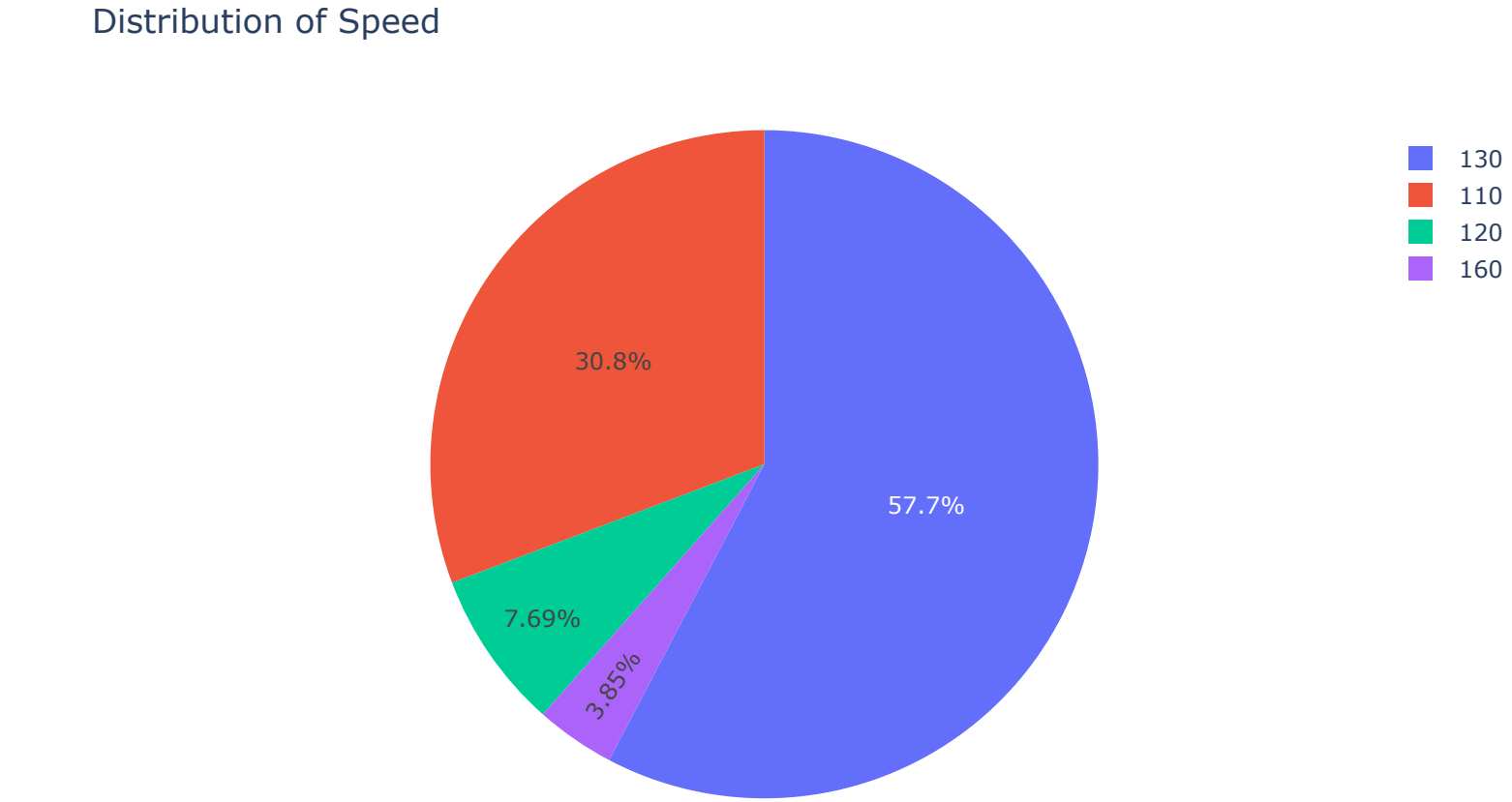
Pie plot for: Distance



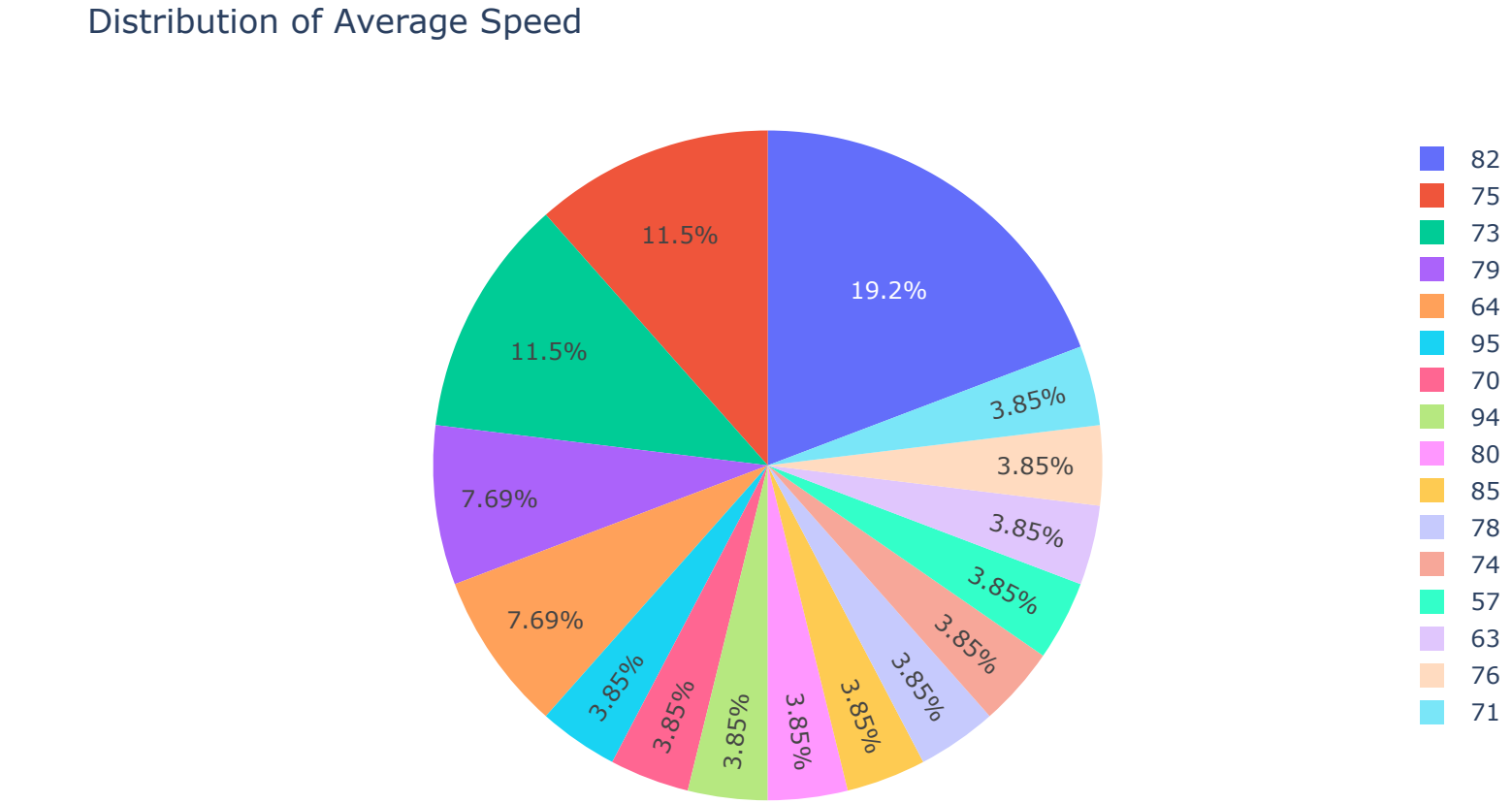
Pie plot for: Travel Time



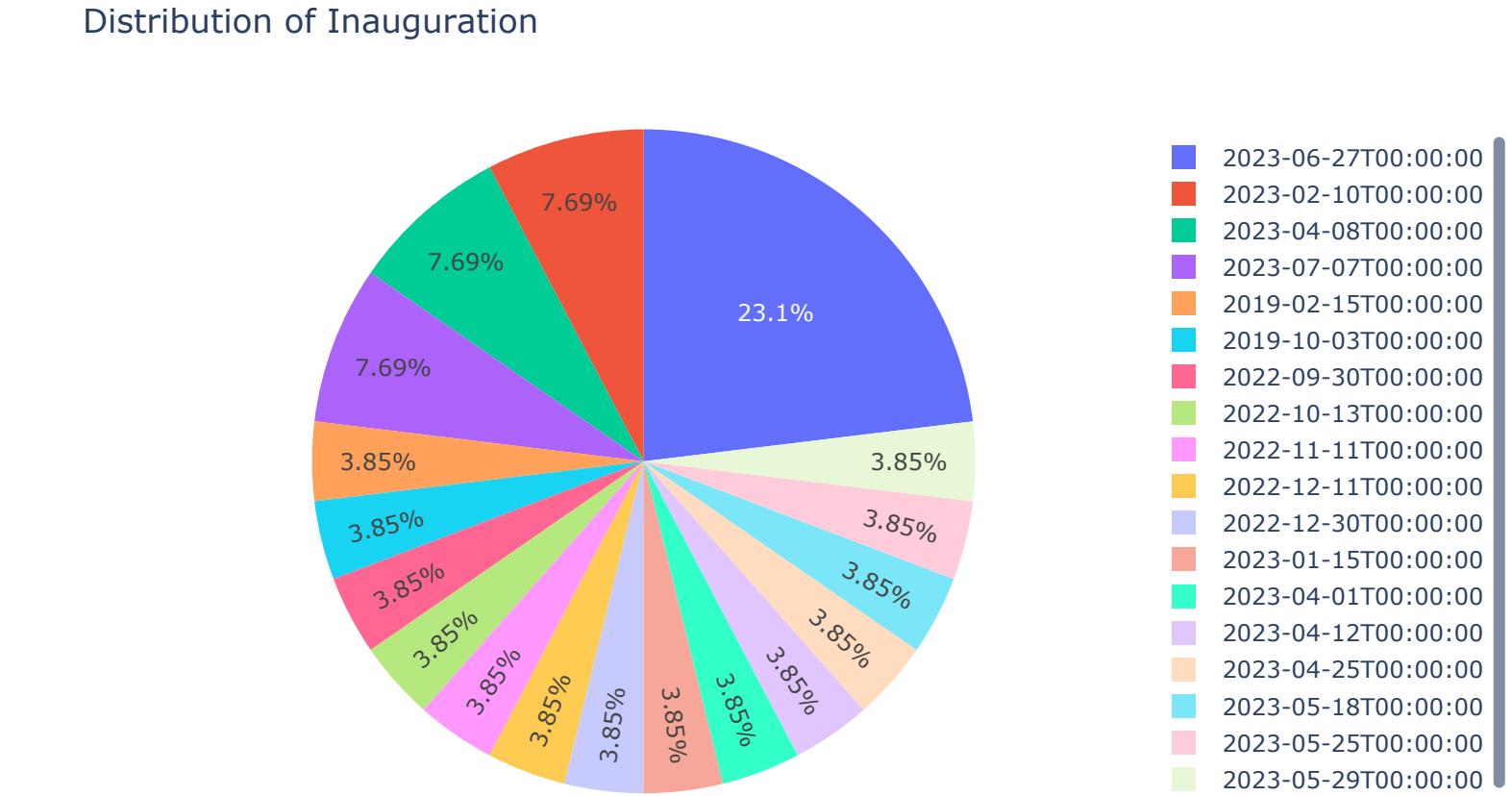
Pie plot for: Speed



Pie plot for: Average Speed

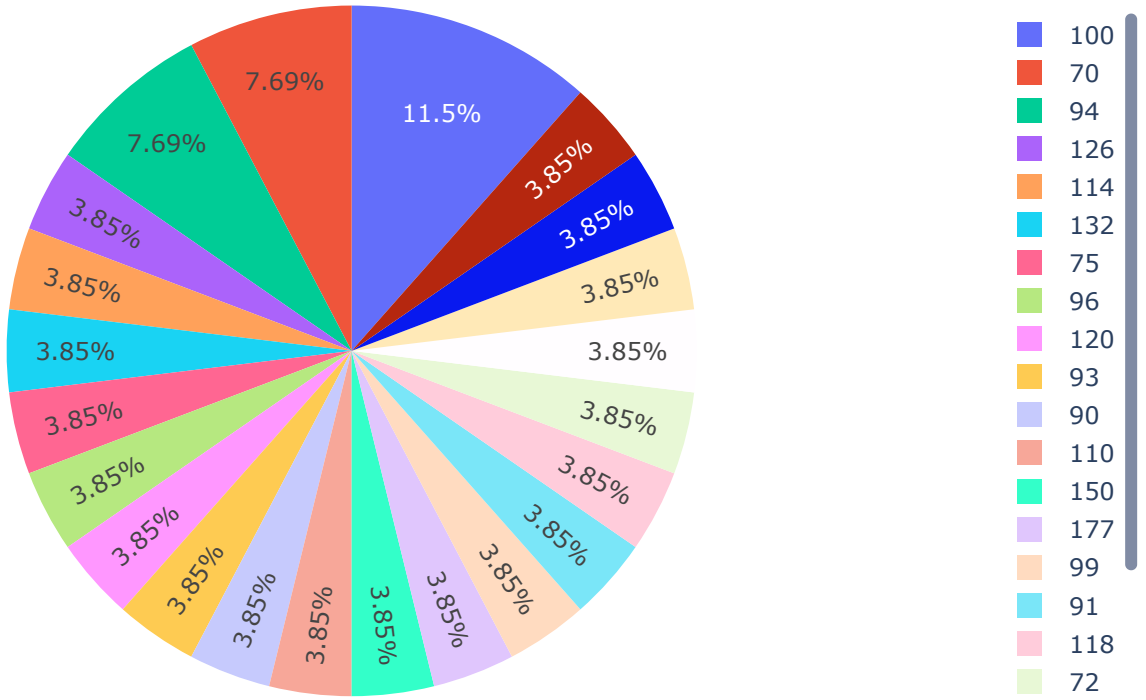


Pie plot for: Inauguration



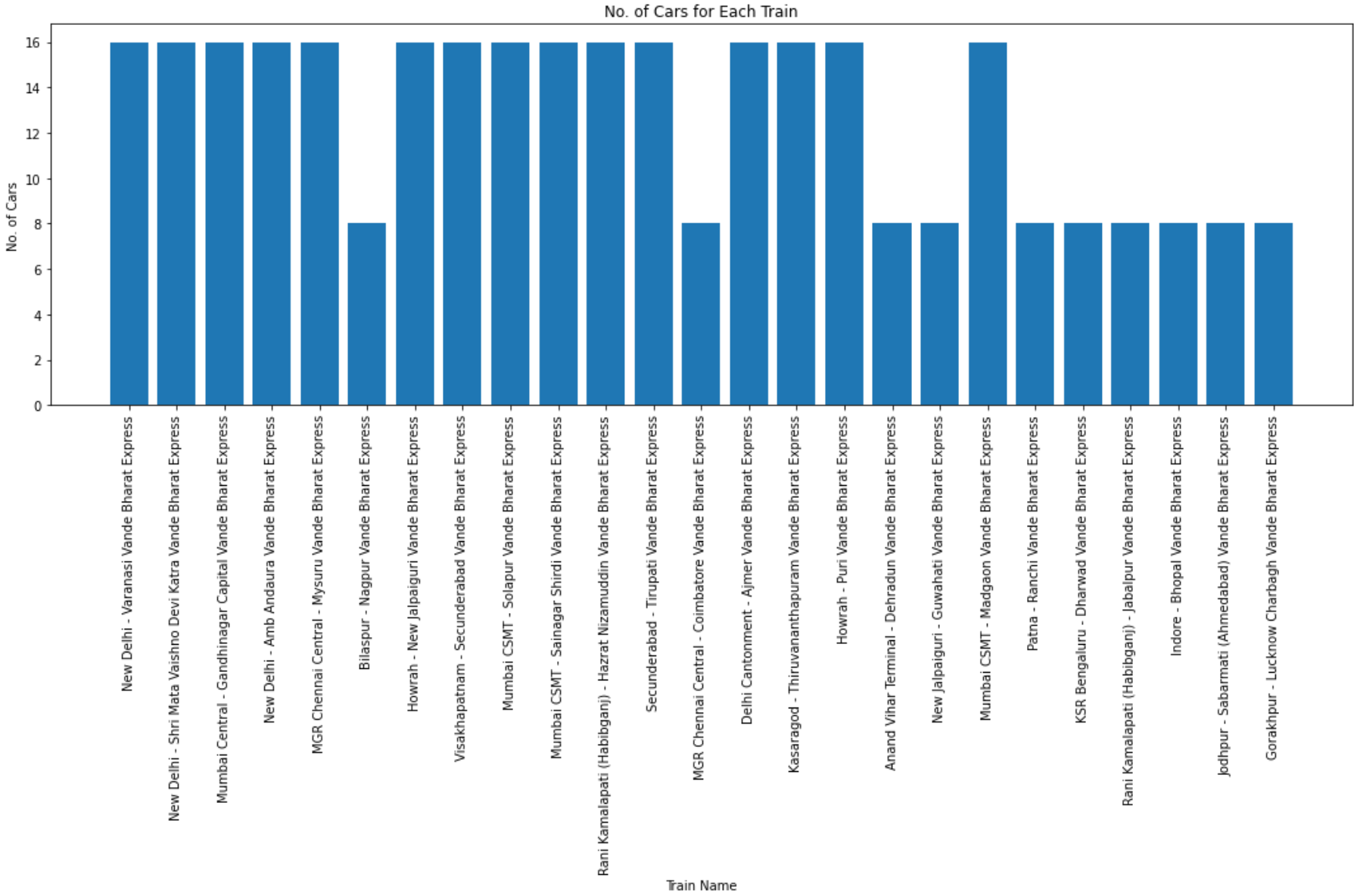
Pie plot for: Average occupancy

Distribution of Average occupancy

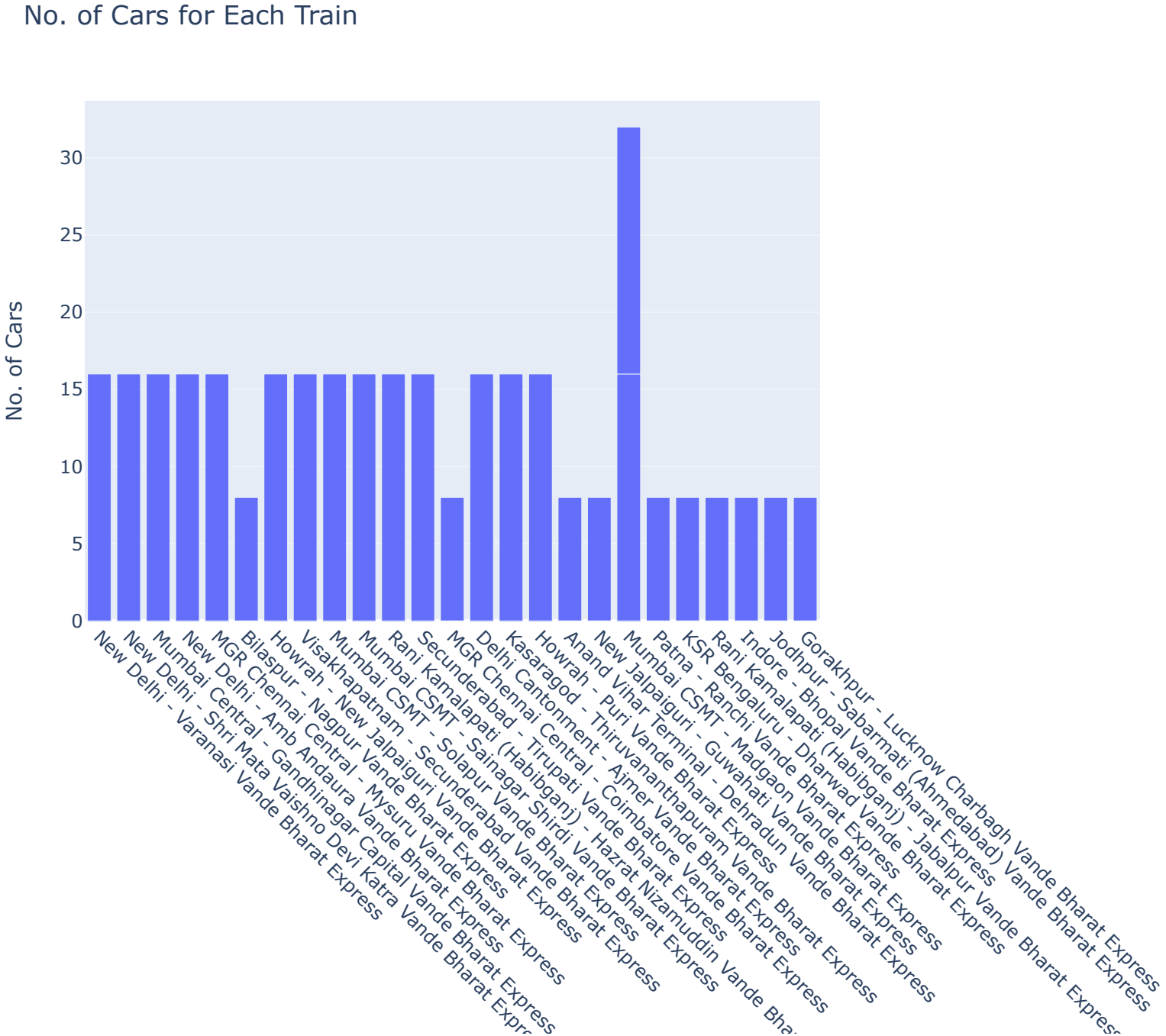


In [19]:

```
plt.figure(figsize=(15, 10))
plt.bar(df['Train Name'], df['No. of Cars'])
plt.xticks(rotation=90)
plt.xlabel('Train Name')
plt.ylabel('No. of Cars')
plt.title('No. of Cars for Each Train')
plt.tight_layout()
plt.show()
```


No. of Cars for Each Train
No. of Cars
0
2
4
6
8
10
12
14
16
New Delhi - Varanasi Vande Bharat Express
New Delhi - Shri Mata Vaishno Devi Katra Vande Bharat Express
Mumbai Central - Gandhinagar Capital Vande Bharat Express
New Delhi - Amb Andaura Vande Bharat Express
MGR Chennai Central - Mysuru Vande Bharat Express
Bilaspur - Nagpur Vande Bharat Express
Howrah - New Jalpaiguri Vande Bharat Express
Visakhapatnam - Secunderabad Vande Bharat Express
Mumbai CSMT - Solapur Vande Bharat Express
Mumbai CSMT - Sainagar Shirdi Vande Bharat Express
Rani Kamalapati (Habibganj) - Hazrat Nizamuddin Vande Bharat Express
Secunderabad - Tirupati Vande Bharat Express
MGR Chennai Central - Coimbatore Vande Bharat Express
Delhi Cantonment - Ajmer Vande Bharat Express
Kasaragod - Thiruvananthapuram Vande Bharat Express
Howrah - Puri Vande Bharat Express
Anand Vihar Terminal - Dehradun Vande Bharat Express
New Jalpaiguri - Guwahati Vande Bharat Express
Mumbai CSMT - Madgaon Vande Bharat Express
Patna - Ranchi Vande Bharat Express
KSR Bengaluru - Dharwad Vande Bharat Express
Rani Kamalapati (Habibganj) - Jabalpur Vande Bharat Express
Indore - Bhopal Vande Bharat Express
Jodhpur - Sabarmati (Ahmedabad) Vande Bharat Express
Gorakhpur - Lucknow Charbagh Vande Bharat Express
Train Name

In [20]:
```
fig = go.Figure(data=[go.Bar(x=df['Train Name'], y=df['No. of Cars'])])
fig.update_layout(
    title='No. of Cars for Each Train',
    xaxis_title='Train Name',
    yaxis_title='No. of Cars',
    xaxis_tickangle=45,
    width=800,
    height=800
)
fig.show()
```


No. of Cars for Each Train
No. of Cars
0
5
10
15
20
25
30
New Delhi - Varanasi Vande Bharat Express
New Delhi - Shri Mata Vaishno Devi Katra Vande Bharat Express
Mumbai Central - Gandhinagar Capital Vande Bharat Express
New Delhi - Amb Andaura Vande Bharat Express
MGR Chennai Central - Mysuru Vande Bharat Express
Bilaspur - Nagpur Vande Bharat Express
Howrah - New Jalpaiguri Vande Bharat Express
Visakhapatnam - Secunderabad Vande Bharat Express
Mumbai CSMT - Solapur Vande Bharat Express
Mumbai CSMT - Sainagar Shirdi Vande Bharat Express
Rani Kamalapati (Habibganj) - Hazrat Nizamuddin Vande Bharat Express
Secunderabad - Tirupati Vande Bharat Express
MGR Chennai Central - Coimbatore Vande Bharat Express
Delhi Cantonment - Ajmer Vande Bharat Express
Kasaragod - Thiruvananthapuram Vande Bharat Express
Howrah - Puri Vande Bharat Express
Anand Vihar Terminal - Dehradun Vande Bharat Express
New Jalpaiguri - Guwahati Vande Bharat Express
Mumbai CSMT - Madgaon Vande Bharat Express
Patna - Ranchi Vande Bharat Express
KSR Bengaluru - Dharwad Vande Bharat Express
Rani Kamalapati (Habibganj) - Jabalpur Vande Bharat Express
Indore - Bhopal Vande Bharat Express
Jodhpur - Sabarmati (Ahmedabad) Vande Bharat Express
Gorakhpur - Lucknow Charbagh Vande Bharat Express

In [21]:
```
df['No. of Cars'] = df['No. of Cars'].astype(int)
```

In [22]:
```
df['Distance'] = df['Distance'].str.extract(r'(\d+)').astype(float)
```

In [23]:
```
time_pattern = r'(?:(\d+)h)?\s*(?:(\d+)m)?'
time_extract = df['Travel Time'].str.extract(time_pattern)

hours = time_extract[0].fillna('0').astype(int)
minutes = time_extract[1].fillna('0').astype(int)

df['Travel Time'] = hours * 60 + minutes
```

In [24]:
```
df['Inauguration'] = pd.to_datetime(df['Inauguration'])
```

In [25]:
```
df['Average occupancy'] = df['Average occupancy'].str.rstrip('%').astype(float)
```

In [26]:
```
def convert_speed_to_kmph(speed):
    if 'km/h' in speed:
        return float(speed.split()[0])
    elif 'mph' in speed:
        mph_value = float(speed.split()[0])
        return mph_value * 1.60934
    else:
        return None
df['Speed'] = df['Speed'].apply(convert_speed_to_kmph)
df['Average Speed'] = df['Average Speed'].apply(convert_speed_to_kmph)
```

In [27]:
```
df
```

Out[27]:

	Train Name	Train Number	Originating City	Originating Station	Terminal City	Terminal Station	Operator	No. of Cars	Frequency	Dist
0	New Delhi - Varanasi Vande Bharat Express	22435/22436	Delhi	New Delhi	Varanasi	Varanasi Junction	NR	16	Except Thursdays	
1	New Delhi - Shri Mata Vaishno Devi Katra Vande...	22439/22440	Delhi	New Delhi	Katra	Shri Mata Vaishno Devi Katra	NR	16	Except Tuesdays	
2	Mumbai Central - Gandhinagar Capital Vande Bha...	20901/20902	Mumbai	Mumbai Central	Gandhinagar	Gandhinagar Capital	WR	16	Except Wednesdays	
3	New Delhi - Amb Andaura Vande Bharat Express	22447/22448	Delhi	New Delhi	Andaura	Amb Andaura	NR	16	Except Fridays	
4	MGR Chennai Central - Mysuru Vande Bharat Express	20607/20608	Chennai	Chennai Central	Mysuru	Mysore Junction	SR	16	Except Wednesdays	
5	Bilaspur - Nagpur Vande Bharat Express	20825/20826	Bilaspur, Chhattisgarh	Bilaspur Junction	Nagpur	Nagpur Junction	SECR	8	Except Saturdays	
6	Howrah - New Jalpaiguri Vande Bharat Express	22301/22302	Kolkata	Howrah Junction	Siliguri	New Jalpaiguri Junction	ER	16	Except Wednesdays	
7	Visakhapatnam - Secunderabad Vande Bharat Express	20833/20834	Visakhapatnam	Visakhapatnam Junction	Hyderabad	Secunderabad Junction	ECoR	16	Except Sundays	
8	Mumbai CSMT - Solapur Vande Bharat Express	22225/22226	Mumbai	Chhatrapati Shivaji Terminus	Solapur	Solapur	CR	16	Except Wednesdays (22225) , Except Thursdays (...	
9	Mumbai CSMT - Sainagar Shirdi Vande Bharat Exp...	22223/22224	Mumbai	Chhatrapati Shivaji Terminus	Shirdi	Sainagar Shirdi	CR	16	Except Tuesdays	
10	Rani Kamalapati (Habibganj) - Hazrat Nizamuddi...	20171/20172	Bhopal	Habibganj (Rani Kamalapati)	Delhi	Hazrat Nizamuddin	WCR	16	Except Saturdays	

	Train Name	Train Number	Originating City	Originating Station	Terminal City	Terminal Station	Operator	No. of Cars	Frequency	Dist
11	Secunderabad - Tirupati Vande Bharat Express	20701/20702	Hyderabad	Secunderabad Junction	Tirupati	Tirupati	SCR	16	Except Tuesdays	
12	MGR Chennai Central - Coimbatore Vande Bharat ...	20643/20644	Chennai	Chennai Central	Coimbatore	Coimbatore Junction	SR	8	Except Wednesdays	
13	Delhi Cantonment - Ajmer Vande Bharat Express	20977/20978	Delhi	Delhi Cantonment	Ajmer	Ajmer Junction	NWR	16	Except Wednesdays	
14	Kasaragod - Thiruvananthapuram Vande Bharat Ex...	20633/20634	Kasaragod	Kasaragod	Thiruvananthapuram	Thiruvananthapuram Central	SR	16	Except Thursdays	
15	Howrah - Puri Vande Bharat Express	22895/22896	Kolkata	Howrah Junction	Puri	Puri	SER	16	Except Thursdays	
16	Anand Vihar Terminal - Dehradun Vande Bharat E...	22457/22458	Delhi	Anand Vihar Terminal	Dehradun	Dehradun Terminal	NR	8	Except Wednesdays	
17	New Jalpaiguri - Guwahati Vande Bharat Express	22227/22228	Siliguri	New Jalpaiguri Junction	Guwahati	Guwahati	NFR	8	Except Tuesdays	
18	Mumbai CSMT - Madgaon Vande Bharat Express	22229/22230	Mumbai	Chhatrapati Shivaji Terminus	Madgaon	Madgaon Junction	CR	16	Except Fridays\n(Non-Monsoon)	
19	Mumbai CSMT - Madgaon Vande Bharat Express	22229/22230	Mumbai	Chhatrapati Shivaji Terminus	Madgaon	Madgaon Junction	CR	16	Monday, Wednesday, Friday (22229)\nTuesday, Th...	
20	Patna - Ranchi Vande Bharat Express	22349/22350	Patna	Patna Junction	Ranchi	Ranchi Junction	ECR	8	Except Tuesdays	
21	KSR Bengaluru - Dharwad Vande Bharat Express	20661/20662	Bangalore	Bangalore City	Hubbali - Dharwad	Dharwad	SWR	8	Except Tuesdays	

	Train Name	Train Number	Originating City	Originating Station	Terminal City	Terminal Station	Operator	No. of Cars	Frequency	Dist
22	Rani Kamalapati (Habibganj) - Jabalpur Vande B...	20173/20174	Bhopal	Habibganj (Rani Kamalapati)	Jabalpur	Jabalpur Junction	WCR	8	Except Tuesdays	
23	Indore - Bhopal Vande Bharat Express	20911/20912	Indore	Indore Junction	Bhopal	Bhopal Junction	WR	8	Except Sundays	
24	Jodhpur - Sabarmati (Ahmedabad) Vande Bharat E...	12461/12462	Jodhpur	Jodhpur Junction	Ahmedabad	Sabarmati Junction	NWR	8	Except Tuesdays	
25	Gorakhpur - Lucknow Charbagh Vande Bharat Express	22549/22550	Gorakhpur	Gorakhpur Junction	Charbagh	Lucknow Charbagh	NER	8	Except Saturdays	

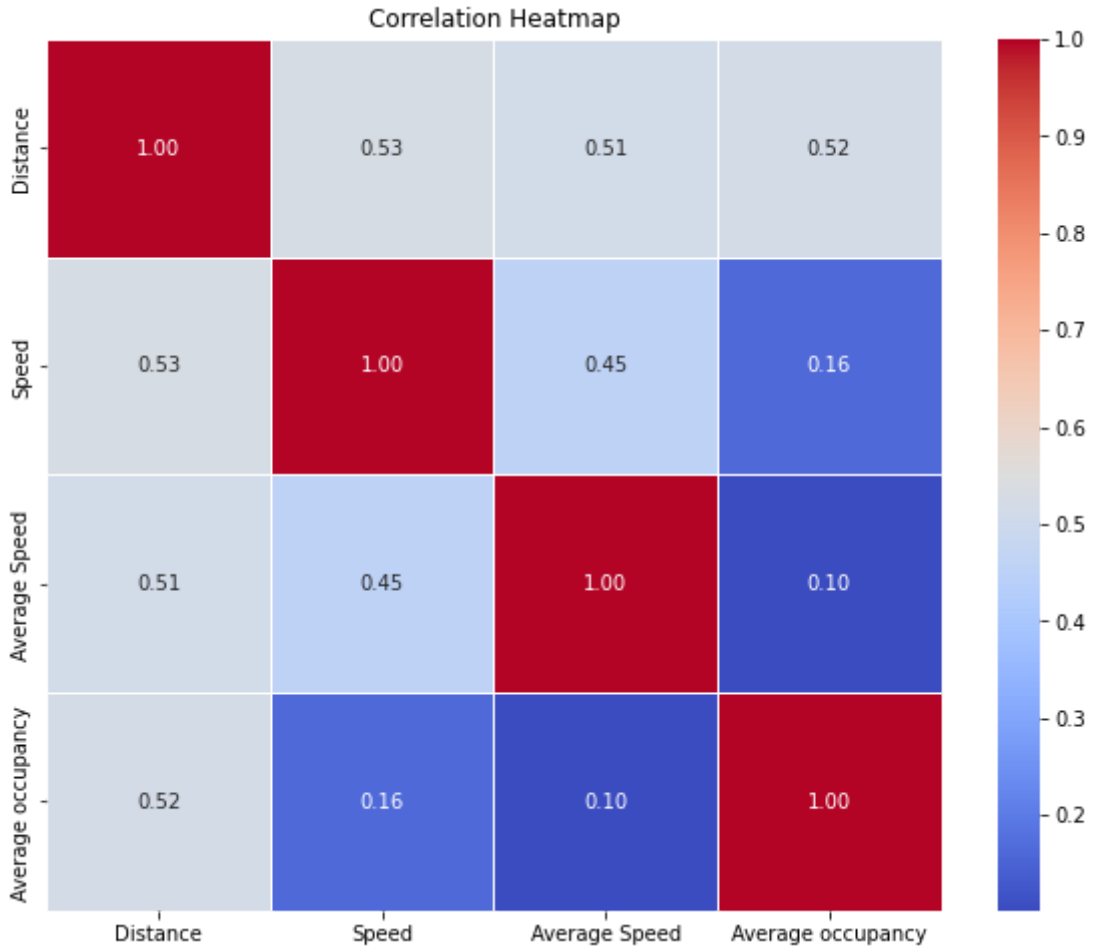
In [28]:
```
numerical_columns = df.select_dtypes(include=['int64', 'float64']).columns
descriptive_stats = df[numerical_columns].describe()
print(descriptive_stats)
```

```
          Distance       Speed  Average Speed  Average occupancy
count    26.000000   26.000000      26.000000          26.000000
mean    491.038462  124.230769      76.269231          96.230769
std     136.535265   11.721118       8.706585          31.080937
min     250.000000  110.000000      57.000000          37.000000
25%     408.250000  110.000000      73.000000          75.500000
50%     492.500000  130.000000      75.500000          95.000000
75%     586.000000  130.000000      82.000000         113.000000
max     759.000000  160.000000      95.000000         177.000000
```

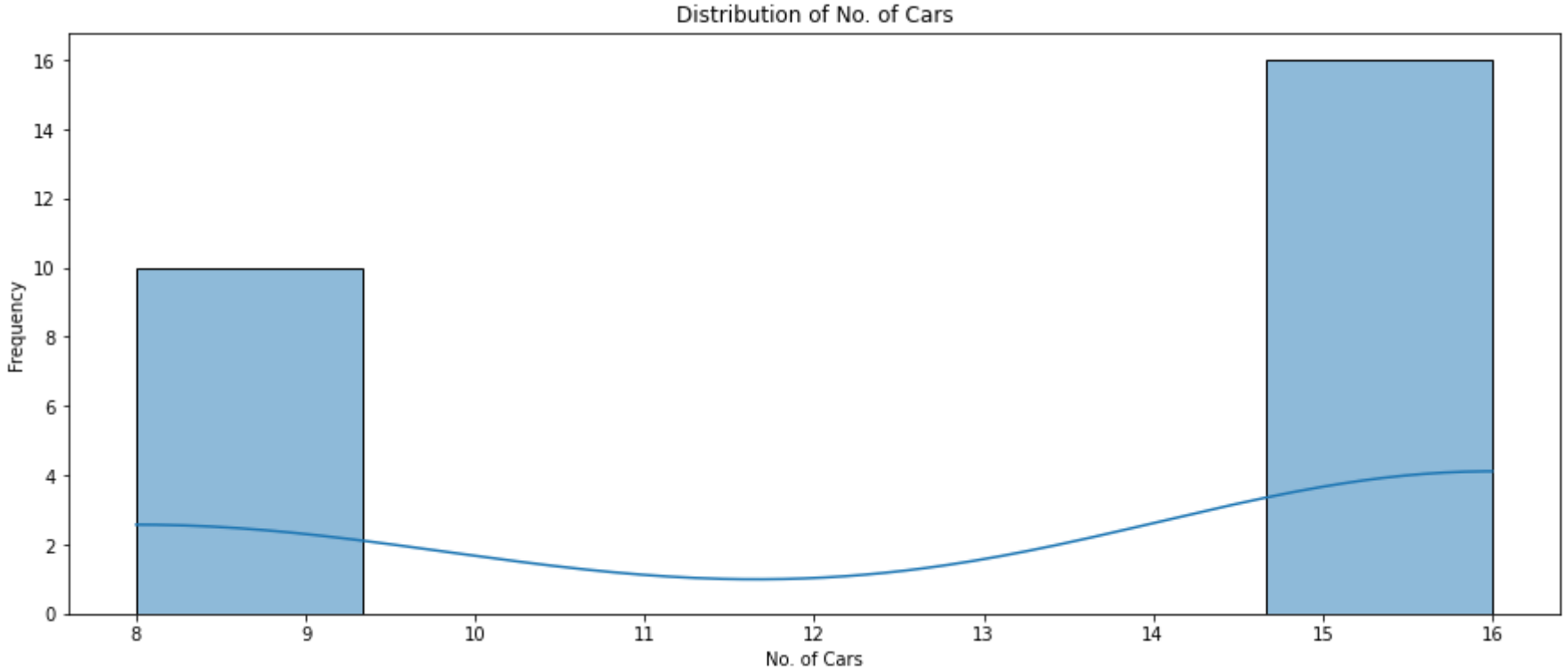
In [29]:
```
correlation_matrix = df[numerical_columns].corr()
print(correlation_matrix)
```

```
                  Distance     Speed  Average Speed  Average occupancy
Distance          1.000000  0.526780       0.514680           0.518251
Speed             0.526780  1.000000       0.454826           0.161911
Average Speed     0.514680  0.454826       1.000000           0.101458
Average occupancy 0.518251  0.161911       0.101458           1.000000
```

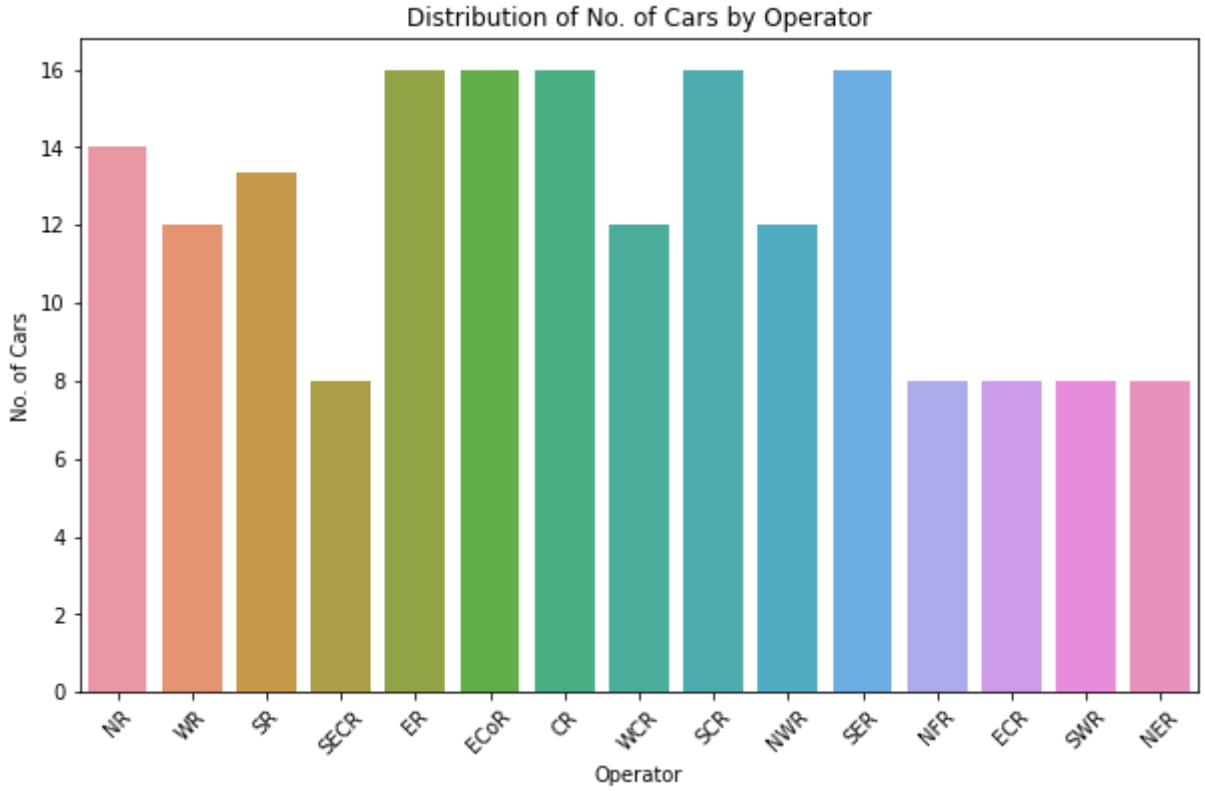
In [30]:
```
plt.figure(figsize=(10, 8))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt=".2f", linewidths=0.5)
plt.title("Correlation Heatmap")
plt.show()
```



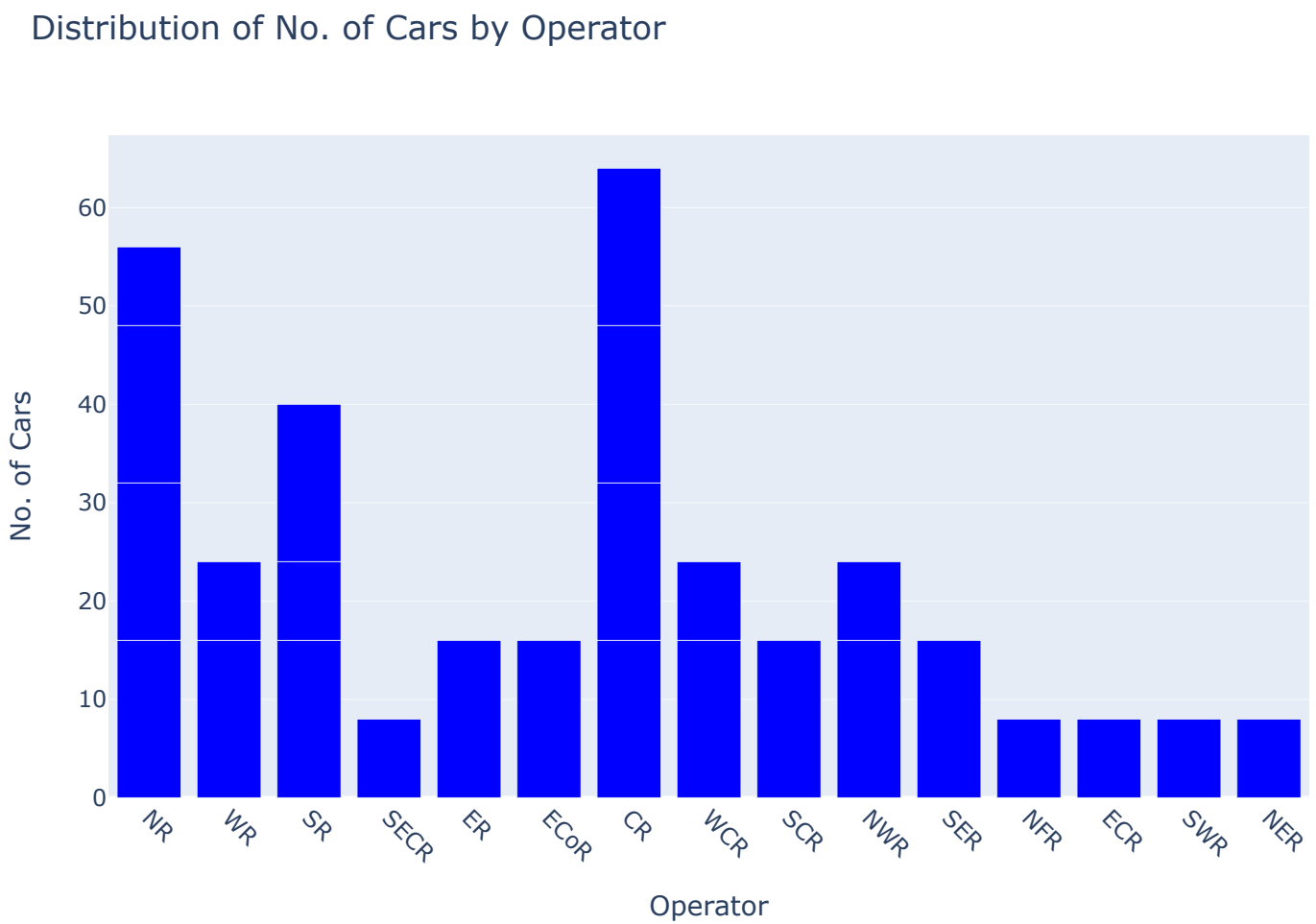
In [31]:
```
plt.figure(figsize=(15, 6))
sns.histplot(df['No. of Cars'], kde=True)
plt.title("Distribution of No. of Cars")
plt.xlabel("No. of Cars")
plt.ylabel("Frequency")
plt.show()
```



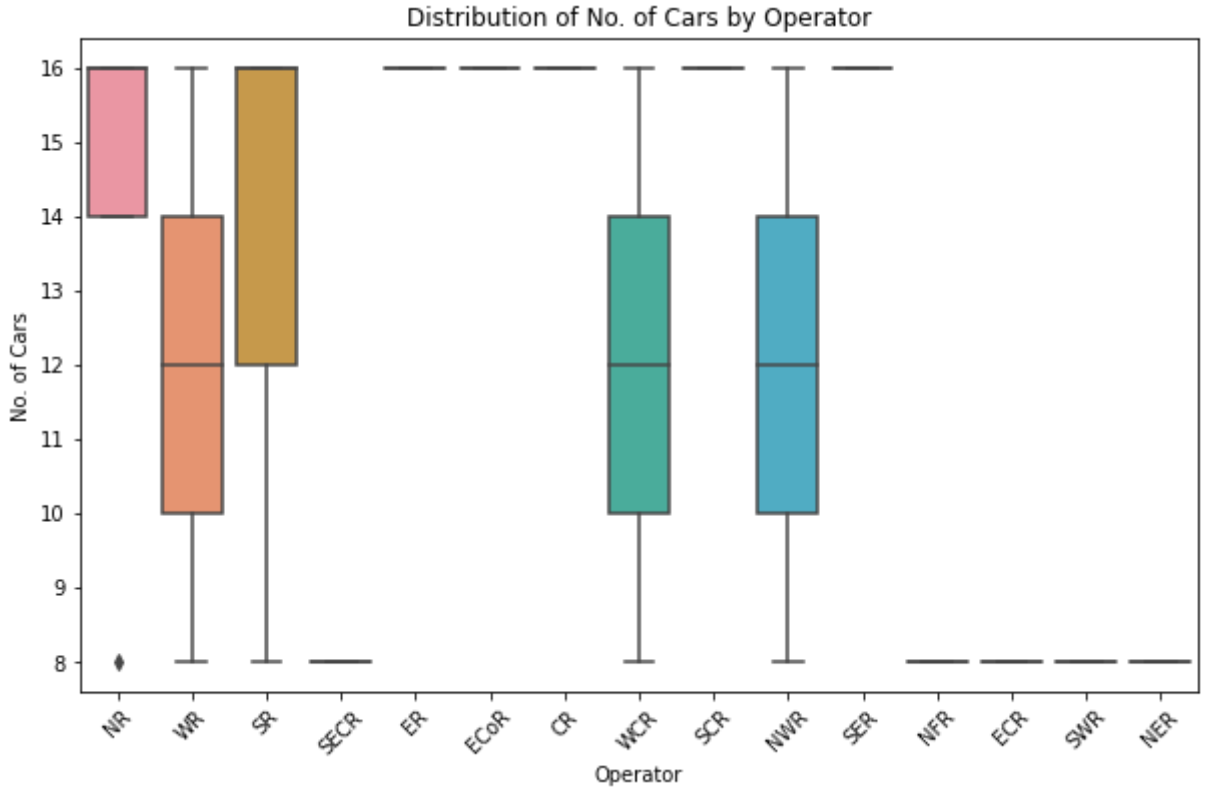
In [32]:
```
plt.figure(figsize=(10, 6))
sns.barplot(data=df, x='Operator', y='No. of Cars', ci = None)
plt.title("Distribution of No. of Cars by Operator")
plt.xlabel("Operator")
plt.ylabel("No. of Cars")
plt.xticks(rotation=45)
plt.show()
```



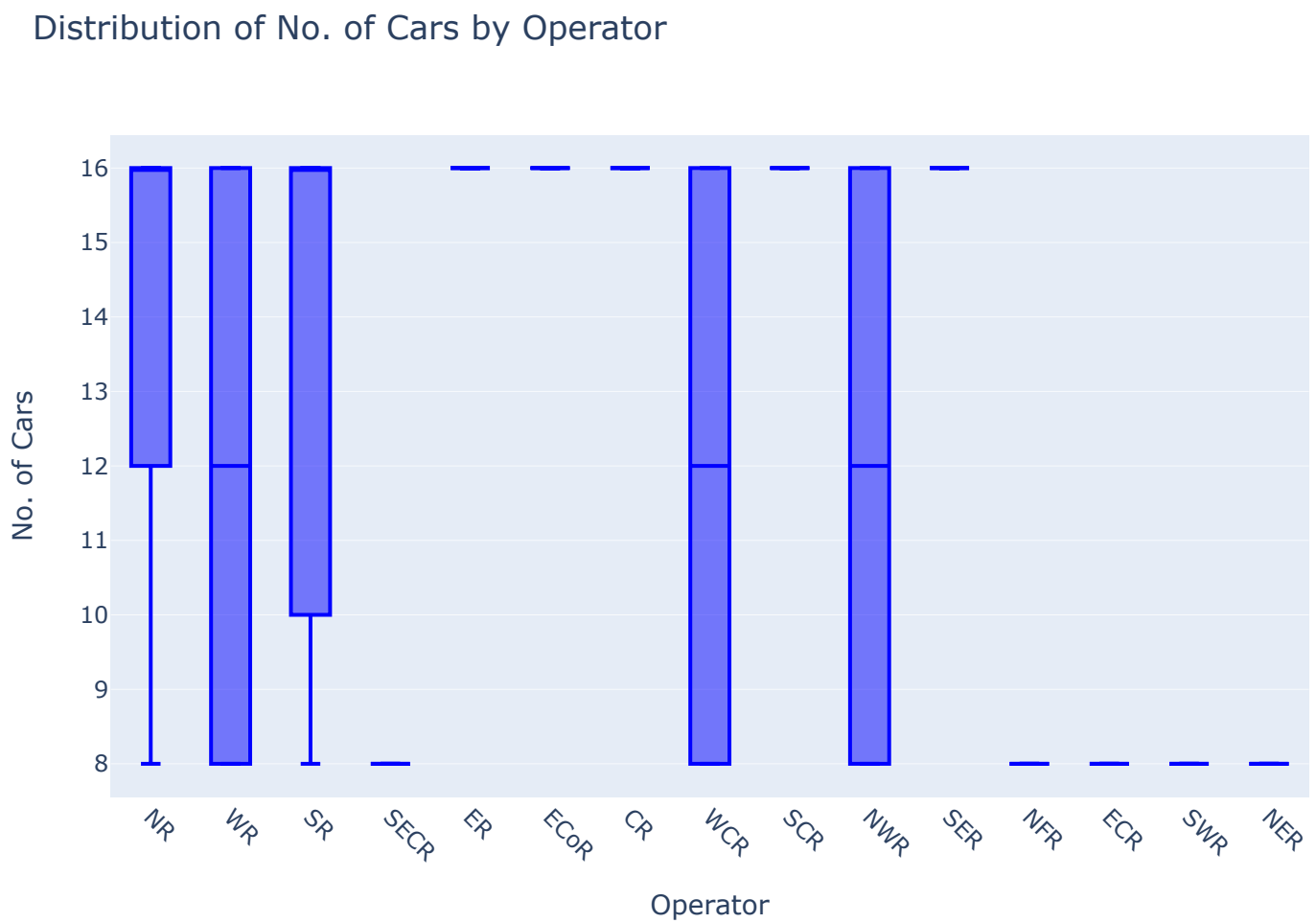
In [33]:
```
fig = px.bar(df, x='Operator', y='No. of Cars', title="Distribution of No. of Cars by Operator", labels={'No. of Cars'
fig.update_traces(marker_color='blue')
fig.update_xaxes(title_text="Operator", tickangle=45)
fig.update_yaxes(title_text="No. of Cars")
fig.show()
```



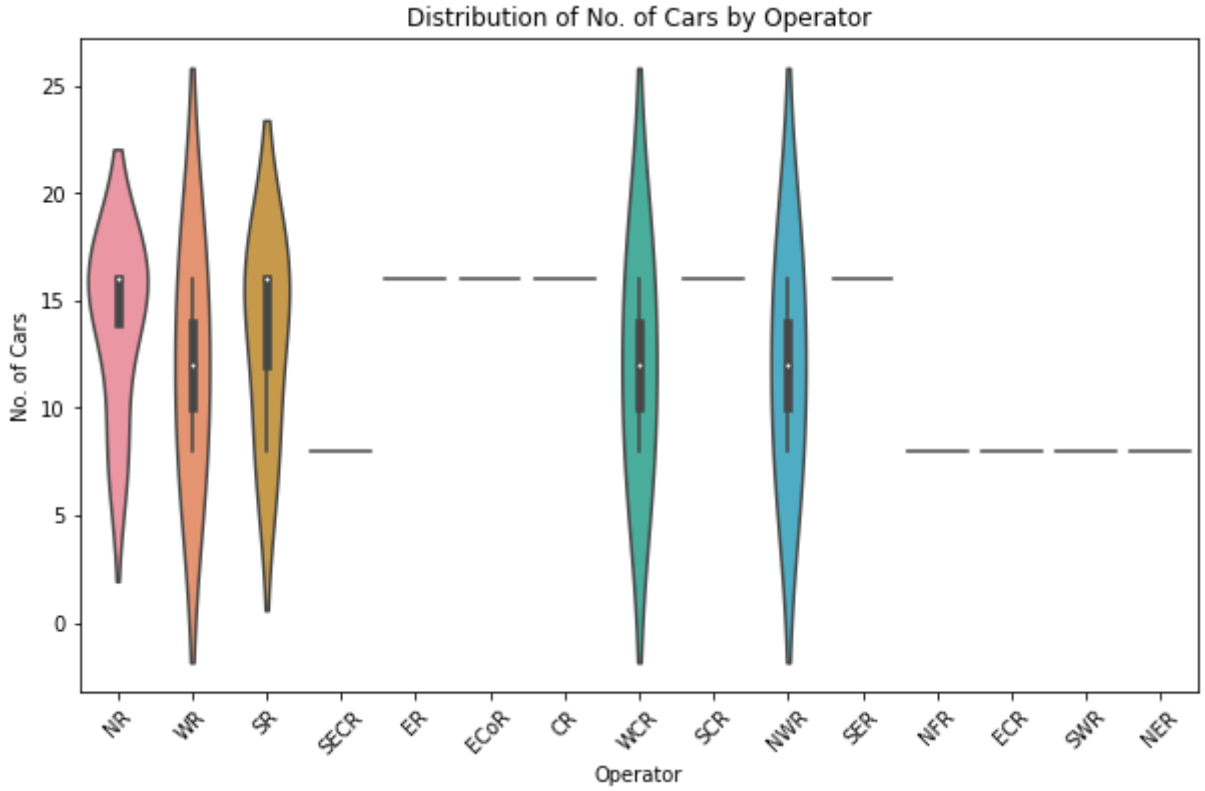
In [34]:
```
plt.figure(figsize=(10, 6))
sns.boxplot(data=df, x='Operator', y='No. of Cars')
plt.title("Distribution of No. of Cars by Operator")
plt.xlabel("Operator")
plt.ylabel("No. of Cars")
plt.xticks(rotation=45)
plt.show()
```



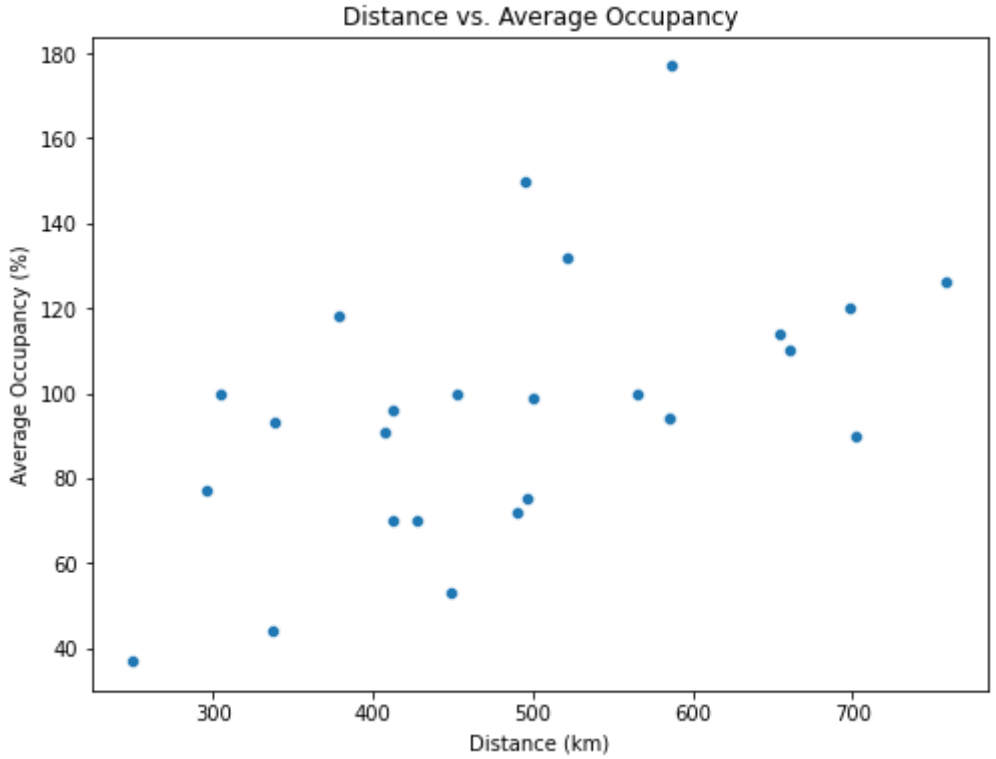
In [35]:
```
fig = px.box(df, x='Operator', y='No. of Cars', title="Distribution of No. of Cars by Operator", labels={'No. of Cars'
fig.update_traces(marker_color='blue')
fig.update_xaxes(title_text="Operator", tickangle=45)
fig.update_yaxes(title_text="No. of Cars")
fig.show()
```



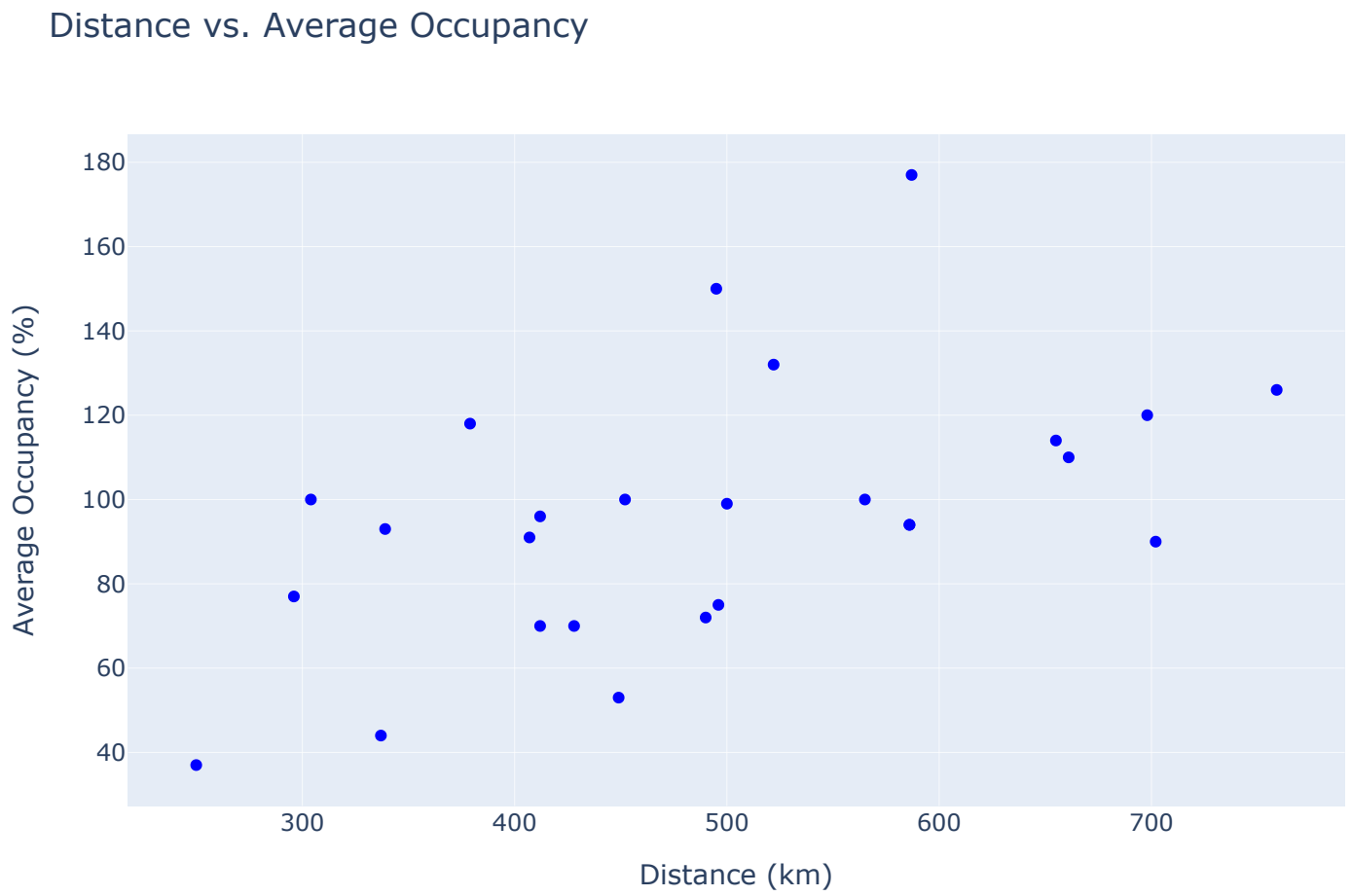
In [36]:
```
plt.figure(figsize=(10, 6))
sns.violinplot(data=df, x='Operator', y='No. of Cars')
plt.title("Distribution of No. of Cars by Operator")
plt.xlabel("Operator")
plt.ylabel("No. of Cars")
plt.xticks(rotation=45)
plt.show()
```



In [37]:
```
plt.figure(figsize=(8, 6))
sns.scatterplot(data=df, x='Distance', y='Average occupancy')
plt.title("Distance vs. Average Occupancy")
plt.xlabel("Distance (km)")
plt.ylabel("Average Occupancy (%)")
plt.show()
```



In [38]:
```
fig = px.scatter(df, x='Distance', y='Average occupancy', title="Distance vs. Average Occupancy",
                 labels={'Distance': 'Distance (km)', 'Average occupancy': 'Average Occupancy (%)'})
fig.update_traces(marker_color='blue')
fig.update_xaxes(title_text="Distance (km)")
fig.update_yaxes(title_text="Average Occupancy (%)")
fig.show()
```



In [39]:
```
grouped_df = df.groupby('Train Name')[numerical_columns].agg(['max', 'min'])
grouped_df = grouped_df.reset_index()
```

In [40]:
```
grouped_df
```

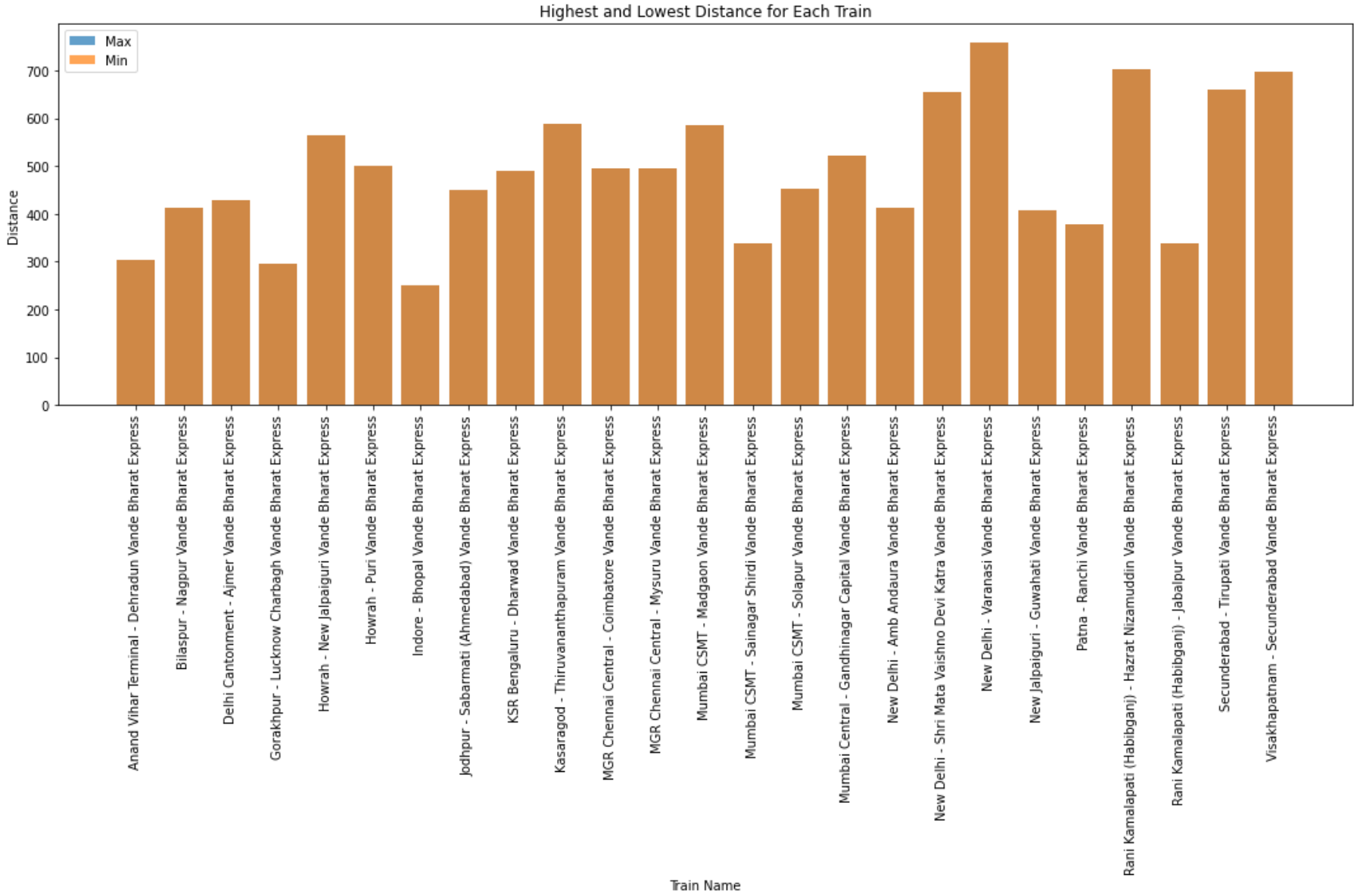
Out[40]:

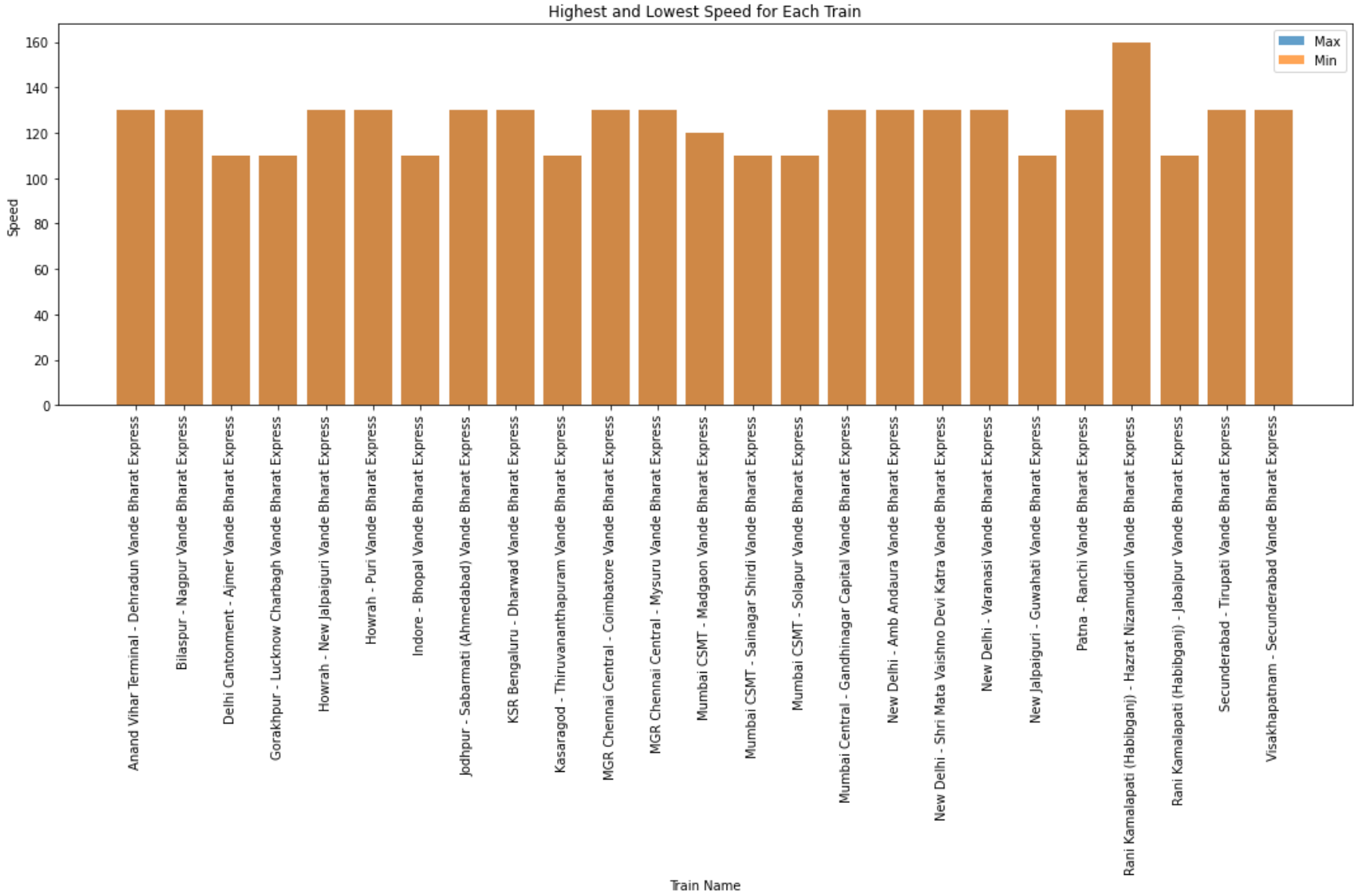
	Train Name	Distance		Speed		Average Speed		Average occupancy	
		max	min	max	min	max	min	max	min
0	Anand Vihar Terminal - Dehradun Vande Bharat E...	304.0	304.0	130.0	130.0	64.0	64.0	100.0	100.0
1	Bilaspur - Nagpur Vande Bharat Express	412.0	412.0	130.0	130.0	75.0	75.0	96.0	96.0
2	Delhi Cantonment - Ajmer Vande Bharat Express	428.0	428.0	110.0	110.0	82.0	82.0	70.0	70.0
3	Gorakhpur - Lucknow Charbagh Vande Bharat Express	296.0	296.0	110.0	110.0	71.0	71.0	77.0	77.0
4	Howrah - New Jalpaiguri Vande Bharat Express	565.0	565.0	130.0	130.0	75.0	75.0	100.0	100.0
5	Howrah - Puri Vande Bharat Express	500.0	500.0	130.0	130.0	78.0	78.0	99.0	99.0
6	Indore - Bhopal Vande Bharat Express	250.0	250.0	110.0	110.0	82.0	82.0	37.0	37.0
7	Jodhpur - Sabarmati (Ahmedabad) Vande Bharat E...	449.0	449.0	130.0	130.0	73.0	73.0	53.0	53.0
8	KSR Bengaluru - Dharwad Vande Bharat Express	490.0	490.0	130.0	130.0	76.0	76.0	72.0	72.0
9	Kasaragod - Thiruvananthapuram Vande Bharat Ex...	587.0	587.0	110.0	110.0	73.0	73.0	177.0	177.0
10	MGR Chennai Central - Coimbatore Vande Bharat ...	495.0	495.0	130.0	130.0	85.0	85.0	150.0	150.0
11	MGR Chennai Central - Mysuru Vande Bharat Express	496.0	496.0	130.0	130.0	79.0	79.0	75.0	75.0
12	Mumbai CSMT - Madgaon Vande Bharat Express	586.0	586.0	120.0	120.0	75.0	57.0	94.0	94.0
13	Mumbai CSMT - Sainagar Shirdi Vande Bharat Exp...	339.0	339.0	110.0	110.0	64.0	64.0	93.0	93.0
14	Mumbai CSMT - Solapur Vande Bharat Express	452.0	452.0	110.0	110.0	70.0	70.0	100.0	100.0
15	Mumbai Central - Gandhinagar Capital Vande Bha...	522.0	522.0	130.0	130.0	82.0	82.0	132.0	132.0
16	New Delhi - Amb Andaura Vande Bharat Express	412.0	412.0	130.0	130.0	79.0	79.0	70.0	70.0
17	New Delhi - Shri Mata Vaishno Devi Katra Vande...	655.0	655.0	130.0	130.0	82.0	82.0	114.0	114.0
18	New Delhi - Varanasi Vande Bharat Express	759.0	759.0	130.0	130.0	95.0	95.0	126.0	126.0
19	New Jalpaiguri - Guwahati Vande Bharat Express	407.0	407.0	110.0	110.0	74.0	74.0	91.0	91.0
20	Patna - Ranchi Vande Bharat Express	379.0	379.0	130.0	130.0	63.0	63.0	118.0	118.0
21	Rani Kamalapati (Habibganj) - Hazrat Nizamuddi...	702.0	702.0	160.0	160.0	94.0	94.0	90.0	90.0
22	Rani Kamalapati (Habibganj) - Jabalpur Vande B...	337.0	337.0	110.0	110.0	73.0	73.0	44.0	44.0
23	Secunderabad - Tirupati Vande Bharat Express	661.0	661.0	130.0	130.0	80.0	80.0	110.0	110.0

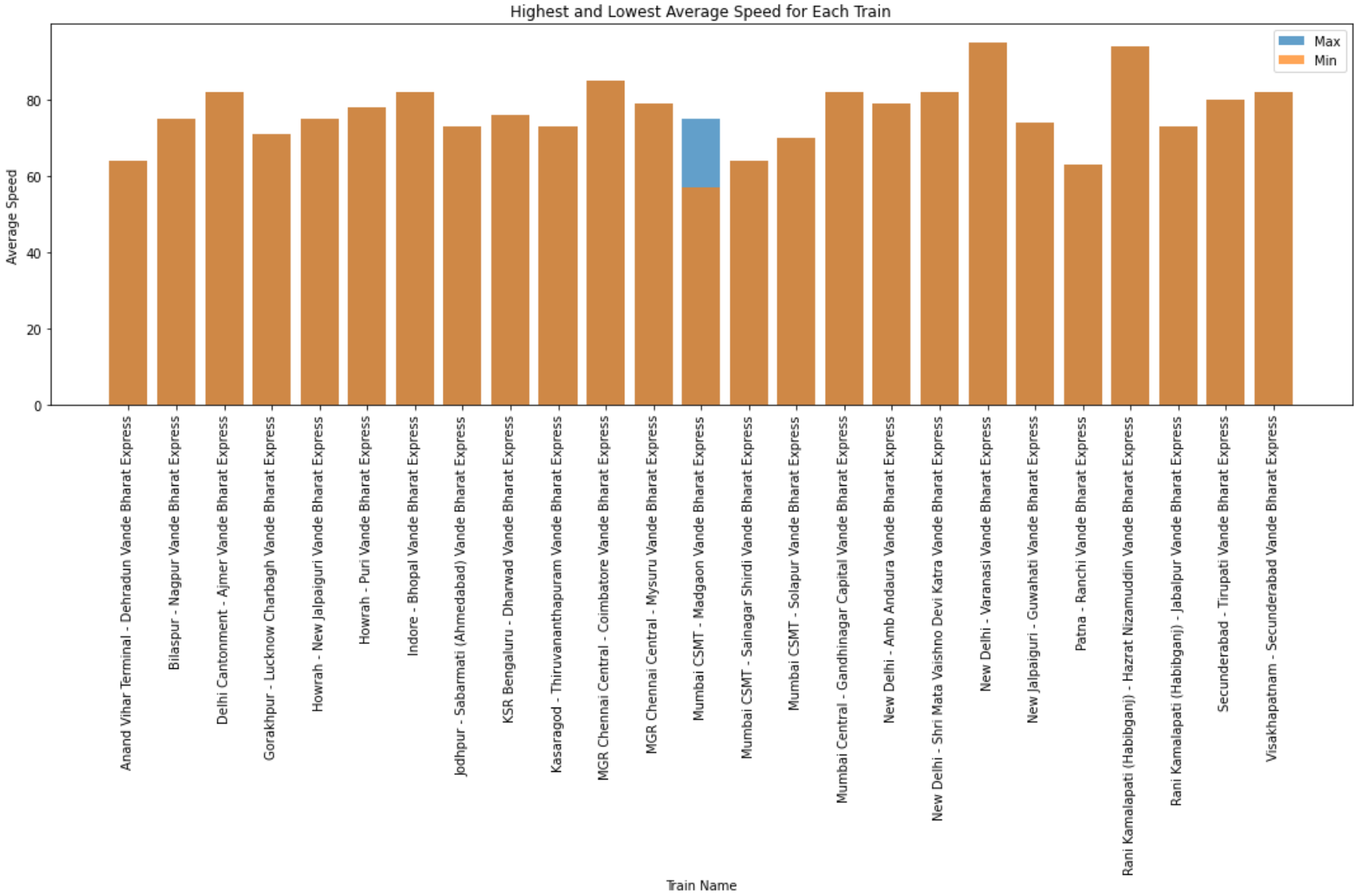
	Train Name	Distance		Speed		Average Speed		Average occupancy	
		max	min	max	min	max	min	max	min
24	Visakhapatnam - Secunderabad Vande Bharat Express	698.0	698.0	130.0	130.0	82.0	82.0	120.0	120.0

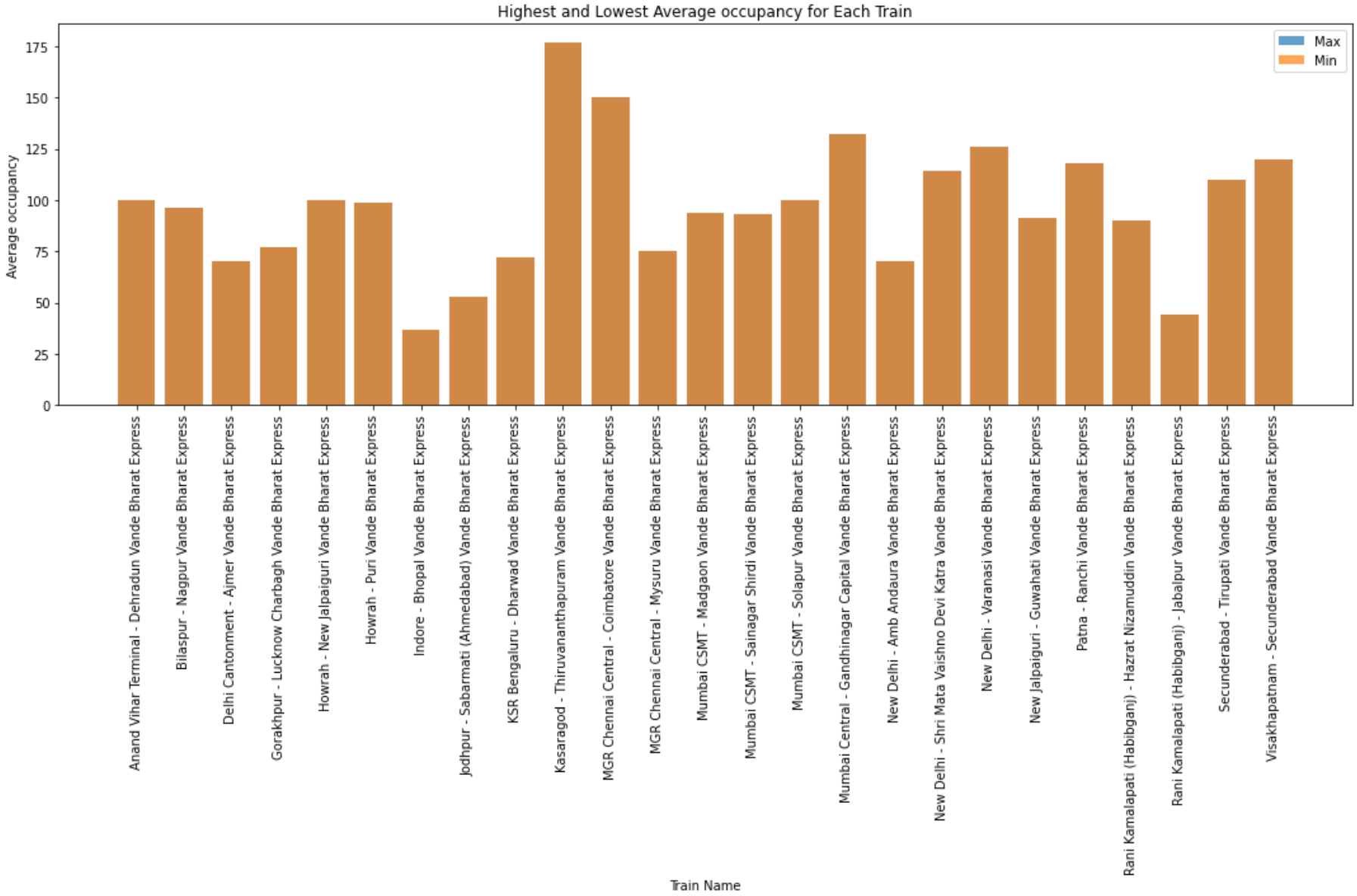
In [41]:

```
for feature in numerical_columns:
    plt.figure(figsize=(15, 10))
    plt.bar(grouped_df['Train Name'], grouped_df[(feature, 'max')], label='Max', alpha=0.7)
    plt.bar(grouped_df['Train Name'], grouped_df[(feature, 'min')], label='Min', alpha=0.7)
    plt.xlabel('Train Name')
    plt.ylabel(feature)
    plt.title(f'Highest and Lowest {feature} for Each Train')
    plt.xticks(rotation=90)
    plt.legend()
    plt.tight_layout()
    plt.show()
```

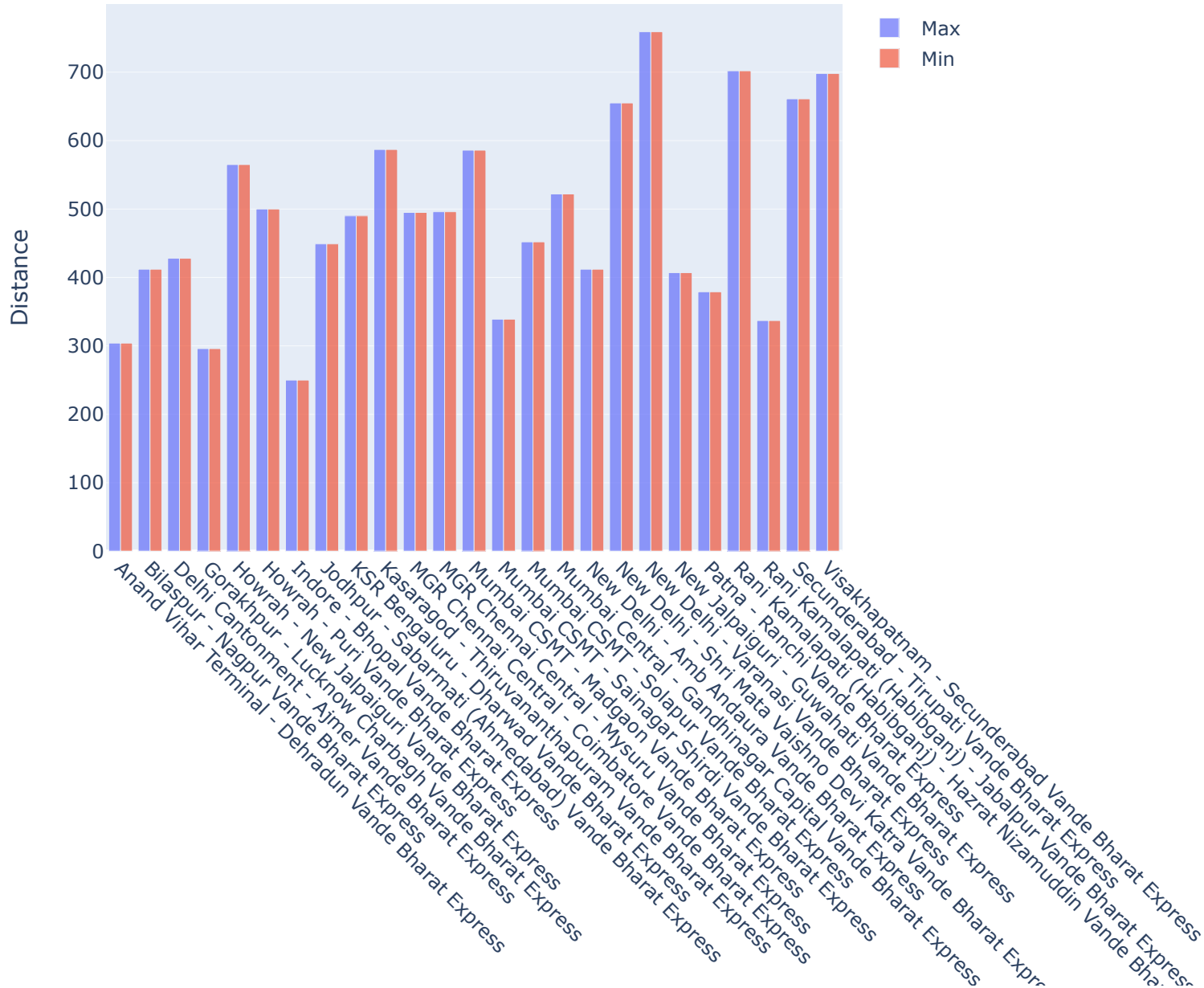

Highest and Lowest Distance for Each Train
Max
Min
Distance
0
100
200
300
400
500
600
700
Anand Vihar Terminal - Dehradun Vande Bharat Express
Bilaspur - Nagpur Vande Bharat Express
Delhi Cantonment - Ajmer Vande Bharat Express
Gorakhpur - Lucknow Charbagh Vande Bharat Express
Howrah - New Jalpaiguri Vande Bharat Express
Howrah - Puri Vande Bharat Express
Indore - Bhopal Vande Bharat Express
Jodhpur - Sabarmati (Ahmedabad) Vande Bharat Express
KSR Bengaluru - Dharwad Vande Bharat Express
Kasaragod - Thiruvananthapuram Vande Bharat Express
MGR Chennai Central - Coimbatore Vande Bharat Express
MGR Chennai Central - Mysuru Vande Bharat Express
Mumbai CSMT - Madgaon Vande Bharat Express
Mumbai CSMT - Sainagar Shirdi Vande Bharat Express
Mumbai CSMT - Solapur Vande Bharat Express
Mumbai Central - Gandhinagar Capital Vande Bharat Express
New Delhi - Amb Andaura Vande Bharat Express
New Delhi - Shri Mata Vaishno Devi Katra Vande Bharat Express
New Delhi - Varanasi Vande Bharat Express
New Jalpaiguri - Guwahati Vande Bharat Express
Patna - Ranchi Vande Bharat Express
Rani Kamalapati (Habibganj) - Hazrat Nizamuddin Vande Bharat Express
Rani Kamalapati (Habibganj) - Jabalpur Vande Bharat Express
Secunderabad - Tirupati Vande Bharat Express
Visakhapatnam - Secunderabad Vande Bharat Express
Train Name


Highest and Lowest Speed for Each Train
Max
Min
Speed
0
20
40
60
80
100
120
140
160
Anand Vihar Terminal - Dehradun Vande Bharat Express
Bilaspur - Nagpur Vande Bharat Express
Delhi Cantonment - Ajmer Vande Bharat Express
Gorakhpur - Lucknow Charbagh Vande Bharat Express
Howrah - New Jalpaiguri Vande Bharat Express
Howrah - Puri Vande Bharat Express
Indore - Bhopal Vande Bharat Express
Jodhpur - Sabarmati (Ahmedabad) Vande Bharat Express
KSR Bengaluru - Dharwad Vande Bharat Express
Kasaragod - Thiruvananthapuram Vande Bharat Express
MGR Chennai Central - Coimbatore Vande Bharat Express
MGR Chennai Central - Mysuru Vande Bharat Express
Mumbai CSMT - Madgaon Vande Bharat Express
Mumbai CSMT - Sainagar Shirdi Vande Bharat Express
Mumbai CSMT - Solapur Vande Bharat Express
Mumbai Central - Gandhinagar Capital Vande Bharat Express
New Delhi - Amb Andaura Vande Bharat Express
New Delhi - Shri Mata Vaishno Devi Katra Vande Bharat Express
New Delhi - Varanasi Vande Bharat Express
New Jalpaiguri - Guwahati Vande Bharat Express
Patna - Ranchi Vande Bharat Express
Rani Kamalapati (Habibganj) - Hazrat Nizamuddin Vande Bharat Express
Rani Kamalapati (Habibganj) - Jabalpur Vande Bharat Express
Secunderabad - Tirupati Vande Bharat Express
Visakhapatnam - Secunderabad Vande Bharat Express
Train Name

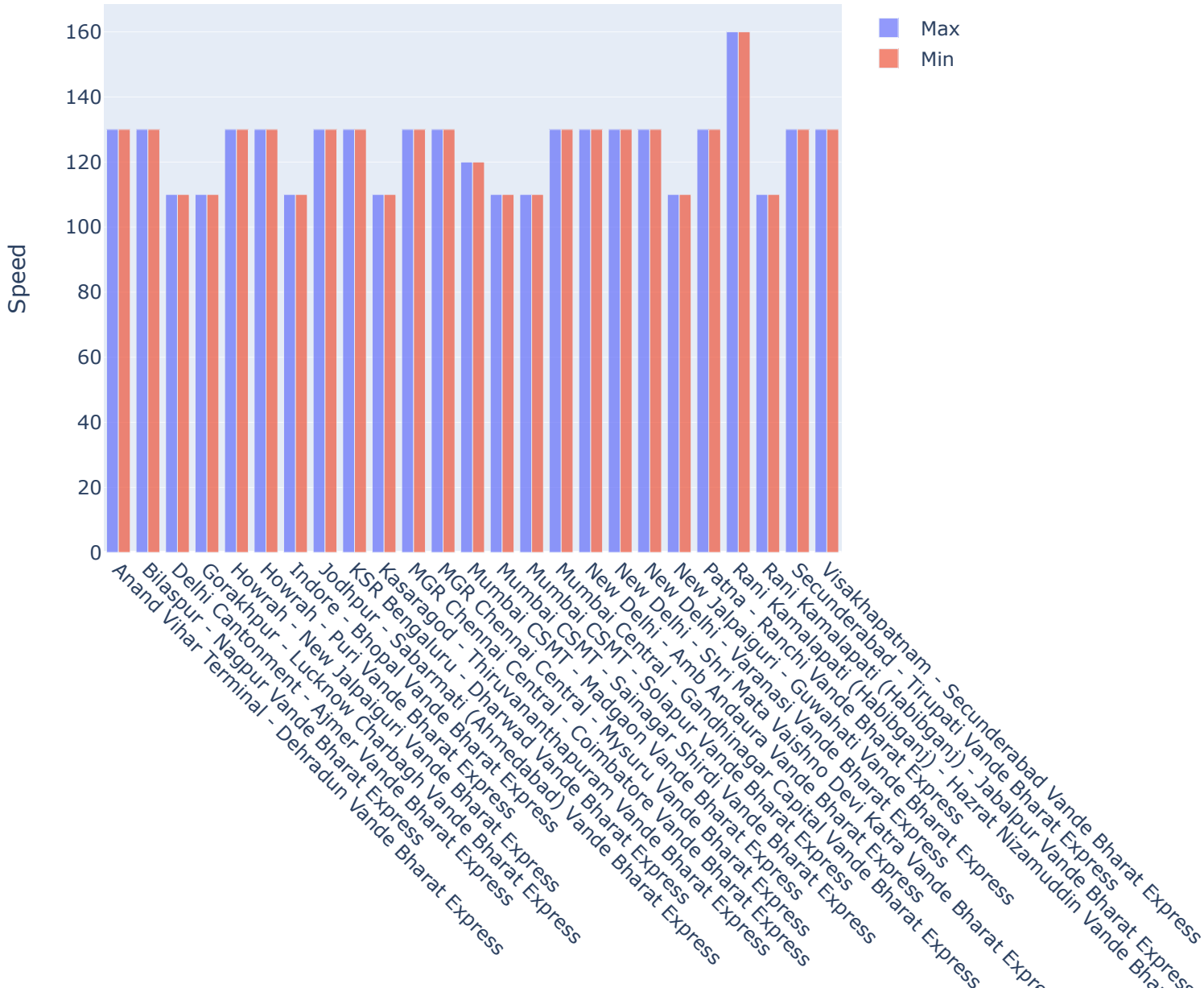

Highest and Lowest Average Speed for Each Train
Max
Min
Average Speed
0
20
40
60
80
Anand Vihar Terminal - Dehradun Vande Bharat Express
Bilaspur - Nagpur Vande Bharat Express
Delhi Cantonment - Ajmer Vande Bharat Express
Gorakhpur - Lucknow Charbagh Vande Bharat Express
Howrah - New Jalpaiguri Vande Bharat Express
Howrah - Puri Vande Bharat Express
Indore - Bhopal Vande Bharat Express
Jodhpur - Sabarmati (Ahmedabad) Vande Bharat Express
KSR Bengaluru - Dharwad Vande Bharat Express
Kasaragod - Thiruvananthapuram Vande Bharat Express
MGR Chennai Central - Coimbatore Vande Bharat Express
MGR Chennai Central - Mysuru Vande Bharat Express
Mumbai CSMT - Madgaon Vande Bharat Express
Mumbai CSMT - Sainagar Shirdi Vande Bharat Express
Mumbai CSMT - Solapur Vande Bharat Express
Mumbai Central - Gandhinagar Capital Vande Bharat Express
New Delhi - Amb Andaura Vande Bharat Express
New Delhi - Shri Mata Vaishno Devi Katra Vande Bharat Express
New Delhi - Varanasi Vande Bharat Express
New Jalpaiguri - Guwahati Vande Bharat Express
Patna - Ranchi Vande Bharat Express
Rani Kamalapati (Habibganj) - Hazrat Nizamuddin Vande Bharat Express
Rani Kamalapati (Habibganj) - Jabalpur Vande Bharat Express
Secunderabad - Tirupati Vande Bharat Express
Visakhapatnam - Secunderabad Vande Bharat Express
Train Name


Highest and Lowest Average occupancy for Each Train
Max
Min
Average occupancy
0
25
50
75
100
125
150
175
Anand Vihar Terminal - Dehradun Vande Bharat Express
Bilaspur - Nagpur Vande Bharat Express
Delhi Cantonment - Ajmer Vande Bharat Express
Gorakhpur - Lucknow Charbagh Vande Bharat Express
Howrah - New Jalpaiguri Vande Bharat Express
Howrah - Puri Vande Bharat Express
Indore - Bhopal Vande Bharat Express
Jodhpur - Sabarmati (Ahmedabad) Vande Bharat Express
KSR Bengaluru - Dharwad Vande Bharat Express
Kasaragod - Thiruvananthapuram Vande Bharat Express
MGR Chennai Central - Coimbatore Vande Bharat Express
MGR Chennai Central - Mysuru Vande Bharat Express
Mumbai CSMT - Madgaon Vande Bharat Express
Mumbai CSMT - Sainagar Shirdi Vande Bharat Express
Mumbai CSMT - Solapur Vande Bharat Express
Mumbai Central - Gandhinagar Capital Vande Bharat Express
New Delhi - Amb Andaura Vande Bharat Express
New Delhi - Shri Mata Vaishno Devi Katra Vande Bharat Express
New Delhi - Varanasi Vande Bharat Express
New Jalpaiguri - Guwahati Vande Bharat Express
Patna - Ranchi Vande Bharat Express
Rani Kamalapati (Habibganj) - Hazrat Nizamuddin Vande Bharat Express
Rani Kamalapati (Habibganj) - Jabalpur Vande Bharat Express
Secunderabad - Tirupati Vande Bharat Express
Visakhapatnam - Secunderabad Vande Bharat Express
Train Name

In [42]:
```
for feature in numerical_columns:
    fig = go.Figure()
    fig.add_trace(go.Bar(x=grouped_df['Train Name'], y=grouped_df[(feature, 'max')], name='Max', opacity=0.7))
    fig.add_trace(go.Bar(x=grouped_df['Train Name'], y=grouped_df[(feature, 'min')], name='Min', opacity=0.7))

    fig.update_layout(title=f'Highest and Lowest {feature} for Each Train',
                      xaxis_title='Train Name', yaxis_title=feature,
                      xaxis_tickangle=45, width=800, height=800)

    fig.show()
```


Highest and Lowest Distance for Each Train
Distance
0
100
200
300
400
500
600
700
Max
Min
Anand Vihar Terminal - Dehradun Vande Bharat Express
Bilaspur - Nagpur Vande Bharat Express
Delhi Cantonment - Ajmer Vande Bharat Express
Gorakhpur - Lucknow Charbagh Vande Bharat Express
Howrah - New Jalpaiguri Vande Bharat Express
Howrah - Puri Vande Bharat Express
Indore - Bhopal Vande Bharat Express
Jodhpur - Sabarmati (Ahmedabad) Vande Bharat Express
KSR Bengaluru - Dharwad Vande Bharat Express
Kasaragod - Thiruvananthapuram Vande Bharat Express
MGR Chennai Central - Coimbatore Vande Bharat Express
MGR Chennai Central - Madgaon Vande Bharat Express
Mumbai CSMT - Mysuru Vande Bharat Express
Mumbai CSMT - Sainagar Shirdi Vande Bharat Express
Mumbai CSMT - Solapur Vande Bharat Express
Mumbai Central - Gandhinagar Capital Vande Bharat Express
New Delhi - Amb Andaura Vande Bharat Express
New Delhi - Shri Mata Vaishno Devi Katra Vande Bharat Express
New Delhi - Varanasi Vande Bharat Express
New Jalpaiguri - Guwahati Vande Bharat Express
Patna - Ranchi Vande Bharat Express
Rani Kamalapati (Habibganj) - Hazrat Nizamuddin Vande Bharat Express
Rani Kamalapati (Habibganj) - Jabalpur Vande Bharat Express
Secunderabad - Tirupati Vande Bharat Express
Visakhapatnam - Secunderabad Vande Bharat Express


ess
rat Express
Train Name


Highest and Lowest Speed for Each Train
Speed
0
20
40
60
80
100
120
140
160
Max
Min
Anand Vihar Terminal - Dehradun Vande Bharat Express
Bilaspur - Nagpur Vande Bharat Express
Delhi Cantonment - Ajmer Vande Bharat Express
Gorakhpur - Lucknow Charbagh Vande Bharat Express
Howrah - New Jalpaiguri Vande Bharat Express
Howrah - Puri Vande Bharat Express
Indore - Bhopal Vande Bharat Express
Jodhpur - Sabarmati (Ahmedabad) Vande Bharat Express
KSR Bengaluru - Dharwad Vande Bharat Express
Kasaragod - Thiruvananthapuram Vande Bharat Express
MGR Chennai Central - Coimbatore Vande Bharat Express
MGR Chennai Central - Madgaon Vande Bharat Express
Mumbai CSMT - Mysuru Vande Bharat Express
Mumbai CSMT - Sainagar Shirdi Vande Bharat Express
Mumbai CSMT - Solapur Vande Bharat Express
Mumbai Central - Gandhinagar Capital Vande Bharat Express
New Delhi - Amb Andaura Vande Bharat Express
New Delhi - Shri Mata Vaishno Devi Katra Vande Bharat Express
New Delhi - Varanasi Vande Bharat Express
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Patna - Ranchi Vande Bharat Express
Rani Kamalapati (Habibganj) - Hazrat Nizamuddin Vande Bharat Express
Rani Kamalapati (Habibganj) - Jabalpur Vande Bharat Express
Secunderabad - Tirupati Vande Bharat Express
Visakhapatnam - Secunderabad Vande Bharat Express


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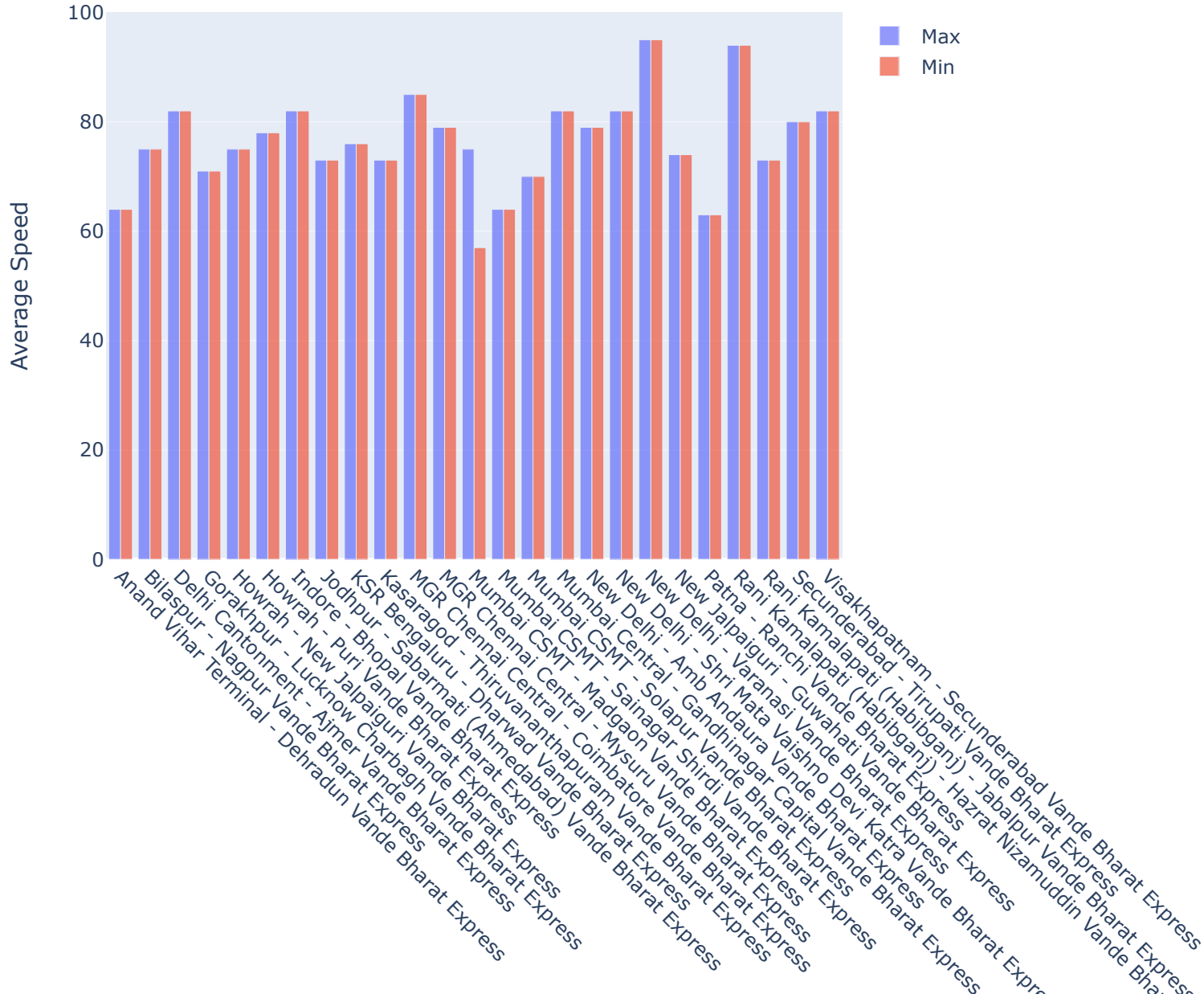
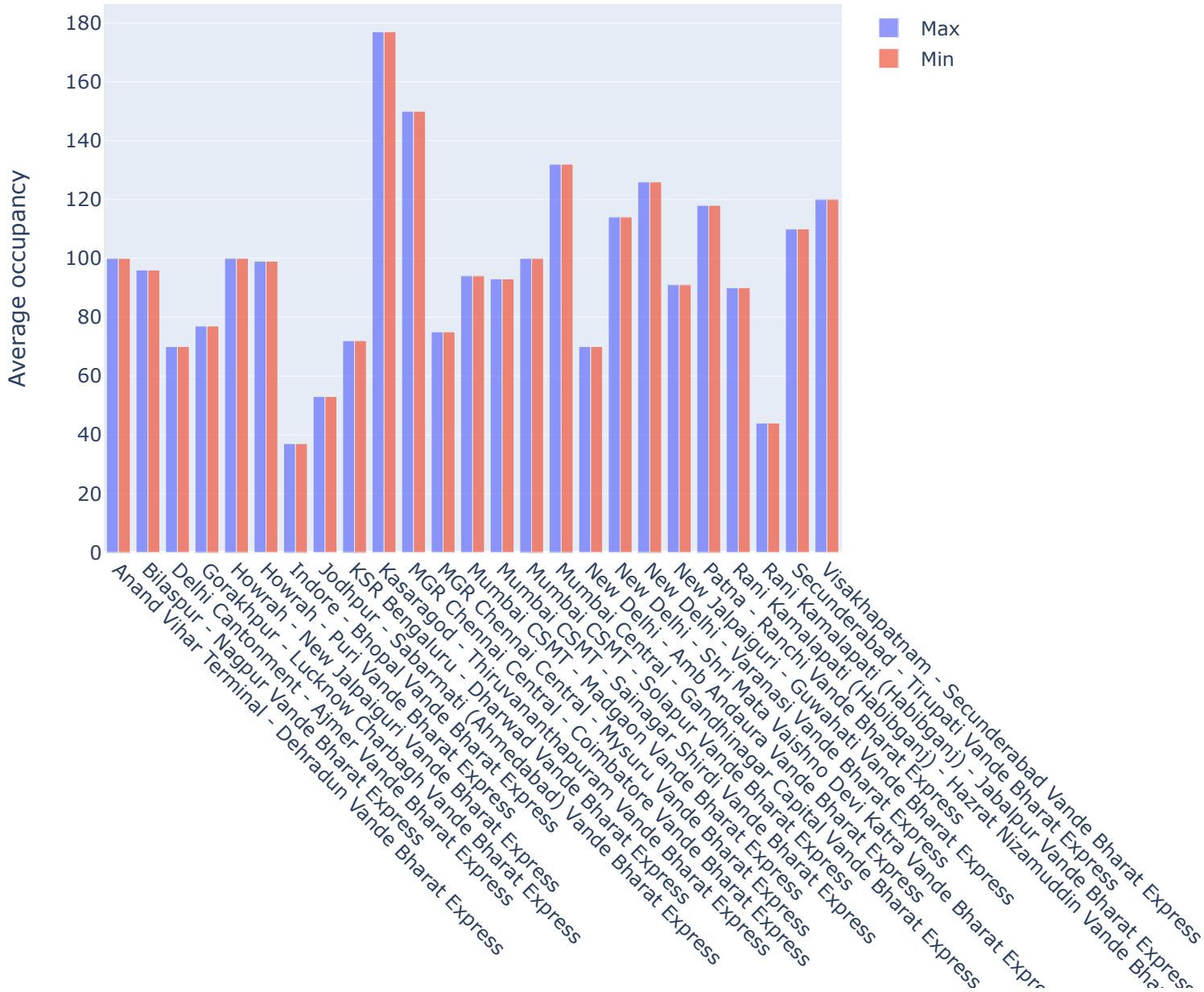
rat Express
Train Name


Highest and Lowest Average Speed for Each Train
Average Speed
100
80
60
40
20
0
Max
Min
Anand Vihar Terminal - Dehradun Vande Bharat Express
Bilaspur - Nagpur Vande Bharat Express
Delhi Cantonment - Ajmer Vande Bharat Express
Gorakhpur - Lucknow Charbagh Vande Bharat Express
Howrah - New Jalpaiguri Vande Bharat Express
Howrah - Puri Vande Bharat Express
Indore - Bhopal Vande Bharat Express
Jodhpur - Sabarmati (Ahmedabad) Vande Bharat Express
KSR Bengaluru - Dharwad Vande Bharat Express
Kasaragod - Thiruvananthapuram Vande Bharat Express
MGR Chennai Central - Coimbatore Vande Bharat Express
MGR Chennai Central - Mysuru Vande Bharat Express
Mumbai CSMT - Madgaon Vande Bharat Express
Mumbai CSMT - Sainagar Shirdi Vande Bharat Express
Mumbai CSMT - Solapur Vande Bharat Express
Mumbai Central - Gandhinagar Capital Vande Bharat Express
New Delhi - Amb Andaura Vande Bharat Express
New Delhi - Shri Mata Vaishno Devi Katra Vande Bharat Express
New Delhi - Varanasi Vande Bharat Express
New Jalpaiguri - Guwahati Vande Bharat Express
Patna - Ranchi Vande Bharat Express
Rani Kamalapati (Habibganj) - Hazrat Nizamuddin Vande Bharat Express
Rani Kamalapati (Habibganj) - Jabalpur Vande Bharat Express
Secunderabad - Tirupati Vande Bharat Express
Visakhapatnam - Secunderabad Vande Bharat Express


ess
rat Express
Train Name


Highest and Lowest Average occupancy for Each Train
Average occupancy
0
20
40
60
80
100
120
140
160
180
Max
Min
Anand Vihar Terminal - Dehradun Vande Bharat Express
Bilaspur - Nagpur Vande Bharat Express
Delhi Cantonment - Ajmer Vande Bharat Express
Gorakhpur - Lucknow Charbagh Vande Bharat Express
Howrah - New Jalpaiguri Vande Bharat Express
Howrah - Puri Vande Bharat Express
Indore - Bhopal Vande Bharat Express
Jodhpur - Sabarmati (Ahmedabad) Vande Bharat Express
KSR Bengaluru - Dharwad Vande Bharat Express
Kasaragod - Thiruvananthapuram Vande Bharat Express
MGR Chennai Central - Coimbatore Vande Bharat Express
MGR Chennai Central - Mysuru Vande Bharat Express
Mumbai CSMT - Madgaon Vande Bharat Express
Mumbai CSMT - Sainagar Shirdi Vande Bharat Express
Mumbai CSMT - Solapur Vande Bharat Express
Mumbai Central - Amb Andaura Vande Bharat Express
New Delhi - Gandhinagar Capital Vande Bharat Express
New Delhi - Shri Mata Vaishno Devi Katra Vande Bharat Express
New Delhi - Varanasi Vande Bharat Express
New Jalpaiguri - Guwahati Vande Bharat Express
Patna - Ranchi Vande Bharat Express
Rani Kamalapati (Habibganj) - Hazrat Nizamuddin Vande Bharat Express
Rani Kamalapati (Habibganj) - Jabalpur Vande Bharat Express
Secunderabad - Tirupati Vande Bharat Express
Visakhapatnam - Secunderabad Vande Bharat Express


ess
rat Express
Train Name

In [43]:

```
top_5_max_trains = {}
top_5_min_trains = {}

for feature in numerical_columns:
    sorted_df_max = df.sort_values(by=feature, ascending=False)
    top_5_max_trains[feature] = sorted_df_max.iloc[:5]['Train Name'].values.tolist()
    sorted_df_min = df.sort_values(by=feature)
    top_5_min_trains[feature] = sorted_df_min.iloc[:5]['Train Name'].values.tolist()

print("Top 5 Trains with the Highest Values:")
for feature, trains in top_5_max_trains.items():
    print(f"\n{feature}:")
    print(trains)

print("\nTop 5 Trains with the Lowest Values:")
for feature, trains in top_5_min_trains.items():
    print(f"\n{feature}:")
    print(trains)
```

Top 5 Trains with the Highest Values:

Distance:
['New Delhi - Varanasi Vande Bharat Express', 'Rani Kamalapati (Habibganj) - Hazrat Nizamuddin Vande Bharat Expres
s', 'Visakhapatnam - Secunderabad Vande Bharat Express', 'Secunderabad - Tirupati Vande Bharat Express', 'New Delhi
- Shri Mata Vaishno Devi Katra Vande Bharat Express']

Speed:
['Rani Kamalapati (Habibganj) - Hazrat Nizamuddin Vande Bharat Express', 'Patna - Ranchi Vande Bharat Express', 'KSR
Bengaluru - Dharwad Vande Bharat Express', 'Anand Vihar Terminal - Dehradun Vande Bharat Express', 'Howrah - Puri Va
nde Bharat Express']

Average Speed:
['New Delhi - Varanasi Vande Bharat Express', 'Rani Kamalapati (Habibganj) - Hazrat Nizamuddin Vande Bharat Expres
s', 'MGR Chennai Central - Coimbatore Vande Bharat Express', 'Visakhapatnam - Secunderabad Vande Bharat Express', 'I
ndore - Bhopal Vande Bharat Express']

Average occupancy:
['Kasaragod - Thiruvananthapuram Vande Bharat Express', 'MGR Chennai Central - Coimbatore Vande Bharat Express', 'Mu
mbai Central - Gandhinagar Capital Vande Bharat Express', 'New Delhi - Varanasi Vande Bharat Express', 'Visakhapatna
m - Secunderabad Vande Bharat Express']

Top 5 Trains with the Lowest Values:

Distance:
['Indore - Bhopal Vande Bharat Express', 'Gorakhpur - Lucknow Charbagh Vande Bharat Express', 'Anand Vihar Terminal
- Dehradun Vande Bharat Express', 'Rani Kamalapati (Habibganj) - Jabalpur Vande Bharat Express', 'Mumbai CSMT - Sain
agar Shirdi Vande Bharat Express']

Speed:
['Gorakhpur - Lucknow Charbagh Vande Bharat Express', 'Indore - Bhopal Vande Bharat Express', 'Rani Kamalapati (Habi
bganj) - Jabalpur Vande Bharat Express', 'New Jalpaiguri - Guwahati Vande Bharat Express', 'Mumbai CSMT - Solapur Va
nde Bharat Express']

Average Speed:
['Mumbai CSMT - Madgaon Vande Bharat Express', 'Patna - Ranchi Vande Bharat Express', 'Anand Vihar Terminal - Dehrad
un Vande Bharat Express', 'Mumbai CSMT - Sainagar Shirdi Vande Bharat Express', 'Mumbai CSMT - Solapur Vande Bharat
Express']

Average occupancy:
['Indore - Bhopal Vande Bharat Express', 'Rani Kamalapati (Habibganj) - Jabalpur Vande Bharat Express', 'Jodhpur - S

abarmati (Ahmedabad) Vande Bharat Express', 'New Delhi - Amb Andaura Vande Bharat Express', 'Delhi Cantonment - Ajme
r Vande Bharat Express']

In [44]:

```
top_5_max_trains = {}
top_5_min_trains = {}

for feature in numerical_columns:
    sorted_df_max = df.sort_values(by=feature, ascending=False)
    top_5_max_trains[feature] = sorted_df_max.iloc[:5][['Train Name', feature]]
    sorted_df_min = df.sort_values(by=feature)
    top_5_min_trains[feature] = sorted_df_min.iloc[:5][['Train Name', feature]]

print("Top 5 Trains with the Highest Values:")
for feature, trains in top_5_max_trains.items():
    print(f"\n{feature}:")
    print(trains)

print("\nTop 5 Trains with the Lowest Values:")
for feature, trains in top_5_min_trains.items():
    print(f"\n{feature}:")
    print(trains)
```

Top 5 Trains with the Highest Values:

Distance:

	Train Name	Distance
0	New Delhi - Varanasi Vande Bharat Express	759.0
10	Rani Kamalapati (Habibganj) - Hazrat Nizamuddi...	702.0
7	Visakhapatnam - Secunderabad Vande Bharat Express	698.0
11	Secunderabad - Tirupati Vande Bharat Express	661.0
1	New Delhi - Shri Mata Vaishno Devi Katra Vande...	655.0

Speed:

	Train Name	Speed
10	Rani Kamalapati (Habibganj) - Hazrat Nizamuddi...	160.0
20	Patna - Ranchi Vande Bharat Express	130.0
21	KSR Bengaluru - Dharwad Vande Bharat Express	130.0
16	Anand Vihar Terminal - Dehradun Vande Bharat E...	130.0
15	Howrah - Puri Vande Bharat Express	130.0

Average Speed:

	Train Name	Average Speed
0	New Delhi - Varanasi Vande Bharat Express	95.0
10	Rani Kamalapati (Habibganj) - Hazrat Nizamuddi...	94.0
12	MGR Chennai Central - Coimbatore Vande Bharat ...	85.0
7	Visakhapatnam - Secunderabad Vande Bharat Express	82.0
23	Indore - Bhopal Vande Bharat Express	82.0

Average occupancy:

	Train Name	Average occupancy
14	Kasaragod - Thiruvananthapuram Vande Bharat Ex...	177.0
12	MGR Chennai Central - Coimbatore Vande Bharat ...	150.0
2	Mumbai Central - Gandhinagar Capital Vande Bha...	132.0
0	New Delhi - Varanasi Vande Bharat Express	126.0
7	Visakhapatnam - Secunderabad Vande Bharat Express	120.0

Top 5 Trains with the Lowest Values:

Distance:

	Train Name	Distance
23	Indore - Bhopal Vande Bharat Express	250.0
25	Gorakhpur - Lucknow Charbagh Vande Bharat Express	296.0
16	Anand Vihar Terminal - Dehradun Vande Bharat E...	304.0

```
22  Rani Kamalapati (Habibganj) - Jabalpur Vande B...     337.0
9   Mumbai CSMT - Sainagar Shirdi Vande Bharat Exp...     339.0

Speed:
                                          Train Name  Speed
25  Gorakhpur - Lucknow Charbagh Vande Bharat Express  110.0
23               Indore - Bhopal Vande Bharat Express  110.0
22  Rani Kamalapati (Habibganj) - Jabalpur Vande B...  110.0
17     New Jalpaiguri - Guwahati Vande Bharat Express  110.0
8          Mumbai CSMT - Solapur Vande Bharat Express  110.0

Average Speed:
                                          Train Name  Average Speed
19         Mumbai CSMT - Madgaon Vande Bharat Express           57.0
20                Patna - Ranchi Vande Bharat Express           63.0
16  Anand Vihar Terminal - Dehradun Vande Bharat E...           64.0
9   Mumbai CSMT - Sainagar Shirdi Vande Bharat Exp...           64.0
8          Mumbai CSMT - Solapur Vande Bharat Express           70.0

Average occupancy:
                                          Train Name  Average occupancy
23               Indore - Bhopal Vande Bharat Express               37.0
22  Rani Kamalapati (Habibganj) - Jabalpur Vande B...               44.0
24  Jodhpur - Sabarmati (Ahmedabad) Vande Bharat E...               53.0
3         New Delhi - Amb Andaura Vande Bharat Express               70.0
13      Delhi Cantonment - Ajmer Vande Bharat Express               70.0
```

In [45]:
```
df_sorted_newest_to_oldest = df.sort_values(by='Inauguration', ascending=False)
print(df_sorted_newest_to_oldest[['Train Name', 'Inauguration']])
```

```
                                        Train Name Inauguration
25  Gorakhpur - Lucknow Charbagh Vande Bharat Express   2023-07-07
24  Jodhpur - Sabarmati (Ahmedabad) Vande Bharat E...   2023-07-07
23              Indore - Bhopal Vande Bharat Express   2023-06-27
22  Rani Kamalapati (Habibganj) - Jabalpur Vande B...   2023-06-27
21       KSR Bengaluru - Dharwad Vande Bharat Express   2023-06-27
20                Patna - Ranchi Vande Bharat Express   2023-06-27
19          Mumbai CSMT - Madgaon Vande Bharat Express   2023-06-27
18          Mumbai CSMT - Madgaon Vande Bharat Express   2023-06-27
17     New Jalpaiguri - Guwahati Vande Bharat Express   2023-05-29
16  Anand Vihar Terminal - Dehradun Vande Bharat E...   2023-05-25
15                 Howrah - Puri Vande Bharat Express   2023-05-18
14  Kasaragod - Thiruvananthapuram Vande Bharat Ex...   2023-04-25
13      Delhi Cantonment - Ajmer Vande Bharat Express   2023-04-12
12  MGR Chennai Central - Coimbatore Vande Bharat ...   2023-04-08
11       Secunderabad - Tirupati Vande Bharat Express   2023-04-08
10  Rani Kamalapati (Habibganj) - Hazrat Nizamuddi...   2023-04-01
9   Mumbai CSMT - Sainagar Shirdi Vande Bharat Exp...   2023-02-10
8           Mumbai CSMT - Solapur Vande Bharat Express   2023-02-10
7   Visakhapatnam - Secunderabad Vande Bharat Express   2023-01-15
6        Howrah - New Jalpaiguri Vande Bharat Express   2022-12-30
5              Bilaspur - Nagpur Vande Bharat Express   2022-12-11
4   MGR Chennai Central - Mysuru Vande Bharat Express   2022-11-11
3        New Delhi - Amb Andaura Vande Bharat Express   2022-10-13
2   Mumbai Central - Gandhinagar Capital Vande Bha...   2022-09-30
1   New Delhi - Shri Mata Vaishno Devi Katra Vande...   2019-10-03
0           New Delhi - Varanasi Vande Bharat Express   2019-02-15
```