Priority Allocation in Railway Reservations: A Focus on Overnight Travelers with Waiting Tickets

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

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

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

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

Out[4]:

	baseFare	reservationCharge	superfastCharge	fuelAmount	totalConcession	tatkalFare	serviceTax	otherCharge	cateringCharge	dynamicl
0	1059	60	0	0	0	0	56	0	0	
1	626	50	0	0	0	0	34	0	0	
2	441	40	0	0	0	0	24	0	0	
3	125	20	0	0	0	0	0	0	0	
4	1059	60	0	0	0	0	56	0	0	

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

Out[5]:

	baseFare	reservationCharge	superfastCharge	fuelAmount	totalConcession	tatkalFare	serviceTax	otherCharge	cateringCharge	dyr
326638	786	40	45	0	0	0	44	0	0	
326639	786	40	45	0	0	0	44	0	0	
326640	786	40	45	0	0	0	44	0	0	
326641	786	40	45	0	0	0	44	0	0	
326642	786	40	45	0	0	0	44	0	0	

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

Out[6]:
```
(326643, 19)
```

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

Out[7]:
```
Index(['baseFare', 'reservationCharge', 'superfastCharge', 'fuelAmount',
       'totalConcession', 'tatkalFare', 'serviceTax', 'otherCharge',
       'cateringCharge', 'dynamicFare', 'totalFare', 'availability',
       'trainNumber', 'timeStamp', 'fromStnCode', 'toStnCode', 'classCode',
       'distance', 'duration'],
      dtype='object')
```

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

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

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

Out[9]:
```
baseFare             0
reservationCharge    0
superfastCharge      0
fuelAmount           0
totalConcession      0
tatkalFare           0
serviceTax           0
otherCharge          0
cateringCharge       0
dynamicFare          0
totalFare            0
availability         0
trainNumber          0
timeStamp            0
fromStnCode          0
toStnCode            0
classCode            0
distance             0
duration             0
dtype: int64
```

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

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 326643 entries, 0 to 326642
Data columns (total 19 columns):
 #   Column             Non-Null Count   Dtype
---  ------             --------------   -----
 0   baseFare           326643 non-null  int64
 1   reservationCharge  326643 non-null  int64
 2   superfastCharge    326643 non-null  int64
 3   fuelAmount         326643 non-null  int64
 4   totalConcession    326643 non-null  int64
 5   tatkalFare         326643 non-null  int64
 6   serviceTax         326643 non-null  int64
 7   otherCharge        326643 non-null  int64
 8   cateringCharge     326643 non-null  int64
 9   dynamicFare        326643 non-null  int64
 10  totalFare          326643 non-null  int64
 11  availability       326643 non-null  object
 12  trainNumber        326643 non-null  int64
 13  timeStamp          326643 non-null  object
 14  fromStnCode        326643 non-null  object
 15  toStnCode          326643 non-null  object
 16  classCode          326643 non-null  object
 17  distance           326643 non-null  int64
 18  duration           326643 non-null  int64
dtypes: int64(14), object(5)
memory usage: 47.3+ MB
```

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

Out[11]:

	baseFare	reservationCharge	superfastCharge	fuelAmount	totalConcession	tatkalFare	serviceTax	otherCharge	cateringCh
count	326643.000000	326643.000000	326643.000000	326643.0	326643.0	326643.0	326643.000000	326643.000000	326643.00
mean	890.075122	38.157805	20.058091	0.0	0.0	0.0	42.761510	0.053208	4.99
std	793.765711	14.324952	24.646072	0.0	0.0	0.0	45.080793	1.018403	42.58
min	30.000000	15.000000	0.000000	0.0	0.0	0.0	0.000000	0.000000	0.00
25%	362.000000	20.000000	0.000000	0.0	0.0	0.0	0.000000	0.000000	0.00
50%	626.000000	40.000000	0.000000	0.0	0.0	0.0	34.000000	0.000000	0.00
75%	1222.000000	50.000000	45.000000	0.0	0.0	0.0	65.000000	0.000000	0.00
max	6541.000000	60.000000	75.000000	0.0	0.0	0.0	334.000000	25.000000	1365.00

In [12]:
```
df.nunique()
```

Out[12]:
```
baseFare             1840
reservationCharge       5
superfastCharge         5
fuelAmount              1
totalConcession         1
tatkalFare              1
serviceTax            276
otherCharge             3
cateringCharge         69
dynamicFare           475
totalFare             976
availability        27639
trainNumber           533
timeStamp             573
fromStnCode          1480
toStnCode            1594
classCode               6
distance             2759
duration             2912
dtype: int64
```

In [13]:
```
object_columns = df.select_dtypes(include=['object', 'bool']).columns
print("Object type columns:")
print(object_columns)

numerical_columns = df.select_dtypes(include=['int64', 'float64']).columns
print("\nNumerical type columns:")
print(numerical_columns)
```

```
Object type columns:
Index(['availability', 'timeStamp', 'fromStnCode', 'toStnCode', 'classCode'], dtype='object')

Numerical type columns:
Index(['baseFare', 'reservationCharge', 'superfastCharge', 'fuelAmount',
       'totalConcession', 'tatkalFare', 'serviceTax', 'otherCharge',
       'cateringCharge', 'dynamicFare', 'totalFare', 'trainNumber', 'distance',
       'duration'],
      dtype='object')
```

In [14]:
```
def classify_features(df):
    categorical_features = []
```

```
    non_categorical_features = []
    discrete_features = []
    continuous_features = []

    for column in df.columns:
        if df[column].dtype in ['object', 'bool']:
            if df[column].nunique() < 15:
                categorical_features.append(column)
            else:
                non_categorical_features.append(column)
        elif df[column].dtype in ['int64', 'float64']:
            if df[column].nunique() < 10:
                discrete_features.append(column)
            else:
                continuous_features.append(column)

    return categorical_features, non_categorical_features, discrete_features, continuous_features
```

In [15]:
```
categorical, non_categorical, discrete, continuous = classify_features(df)
```

In [16]:
```
print("Categorical Features:", categorical)
print("Non-Categorical Features:", non_categorical)
print("Discrete Features:", discrete)
print("Continuous Features:", continuous)
```

```
Categorical Features: ['classCode']
Non-Categorical Features: ['availability', 'timeStamp', 'fromStnCode', 'toStnCode']
Discrete Features: ['reservationCharge', 'superfastCharge', 'fuelAmount', 'totalConcession', 'tatkalFare', 'oth
erCharge']
Continuous Features: ['baseFare', 'serviceTax', 'cateringCharge', 'dynamicFare', 'totalFare', 'trainNumber', 'd
istance', 'duration']
```

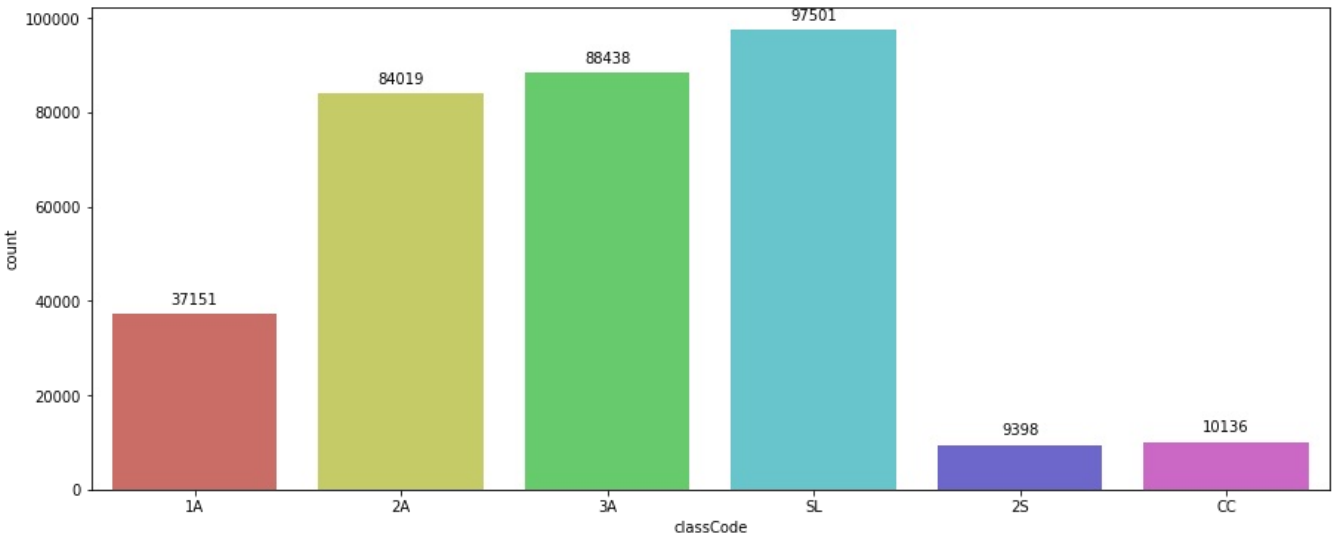
In [17]:
```
for i in categorical:
    print(i, ':')
    print(df[i].unique())
    print()
```

```
classCode :
['1A' '2A' '3A' 'SL' '2S' 'CC']
```

In [18]:
```
for i in categorical:
    print(i, ':')
    print(df[i].value_counts())
    print()
```

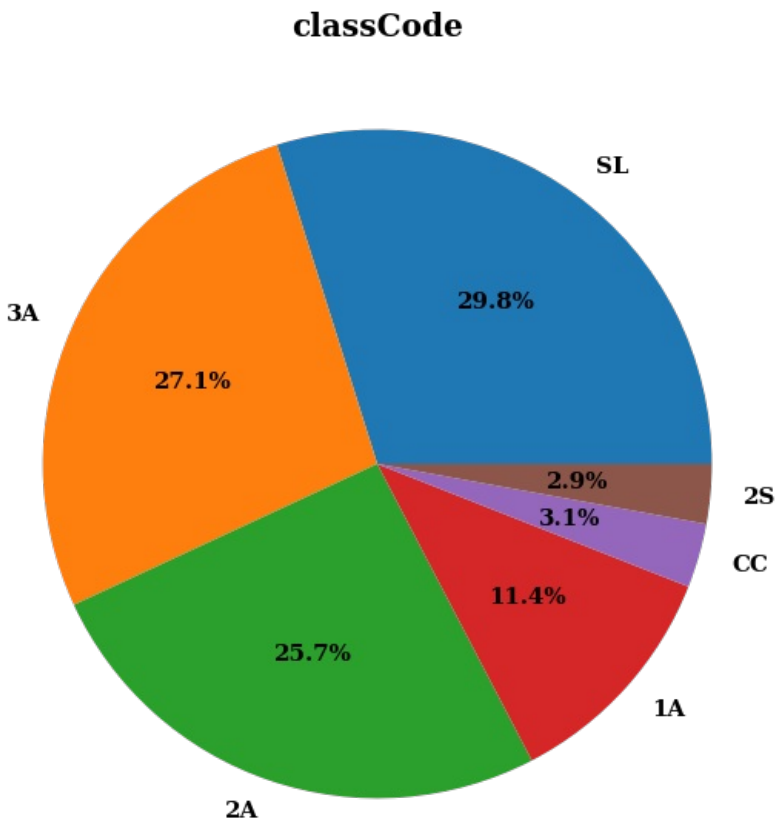
```
classCode :
SL    97501
3A    88438
2A    84019
1A    37151
CC    10136
2S     9398
Name: classCode, dtype: int64
```

In [19]:
```
for i in categorical:
    plt.figure(figsize=(15, 6))
    ax = sns.countplot(x=i, data=df, palette='hls')
    for p in ax.patches:
        ax.annotate(f'{p.get_height()}', (p.get_x() + p.get_width() / 2., p.get_height()),
                    ha='center', va='center', xytext=(0, 10), textcoords='offset points')
    plt.show()
```



In [20]:
```
for i in categorical:
```

```
    plt.figure(figsize=(20,10))
    plt.pie(df[i].value_counts(), labels=df[i].value_counts().index, autopct='%1.1f%%', textprops={'fontsize':
                                            'color': 'black',
                                            'weight': 'bold',
                                            'family': 'serif' })
    hfont = {'fontname':'serif', 'weight': 'bold'}
    plt.title(i, size=20, **hfont)
    plt.show()
```



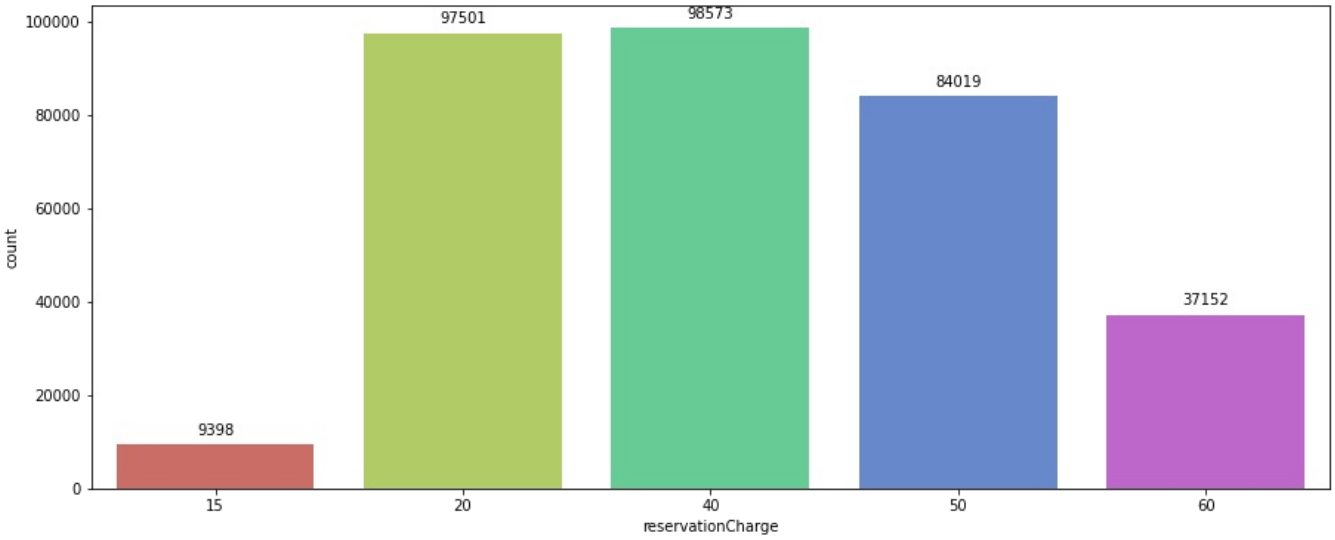
In [21]:
```
for i in discrete:
    print(i, ':')
    print(df[i].unique())
    print()
```

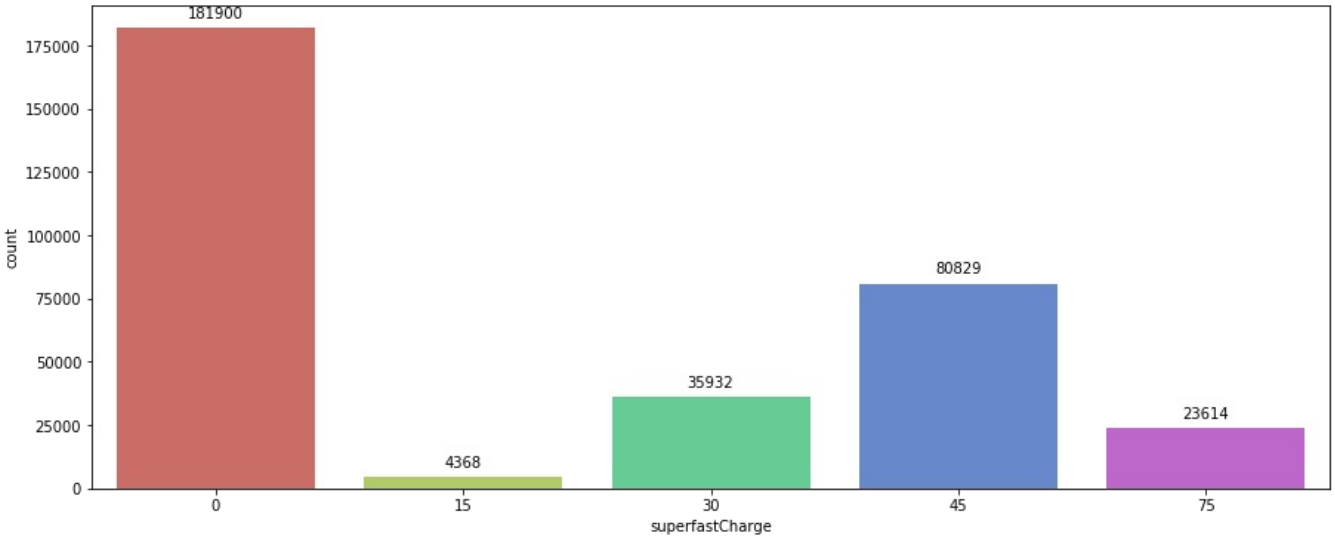
```
reservationCharge :
[60 50 40 20 15]

superfastCharge :
[ 0 45 30 15 75]

fuelAmount :
[0]

totalConcession :
[0]

tatkalFare :
[0]

otherCharge :
[ 0 25 15]
```

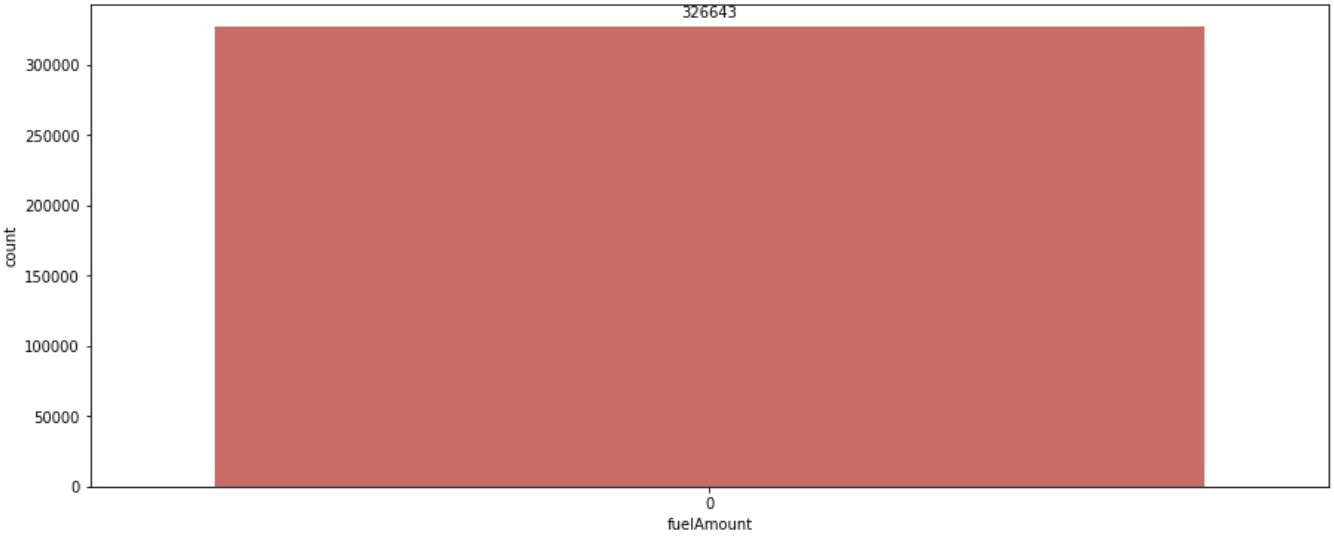
In [22]:
```
for i in discrete:
    print(i, ':')
    print(df[i].value_counts())
    print()
```

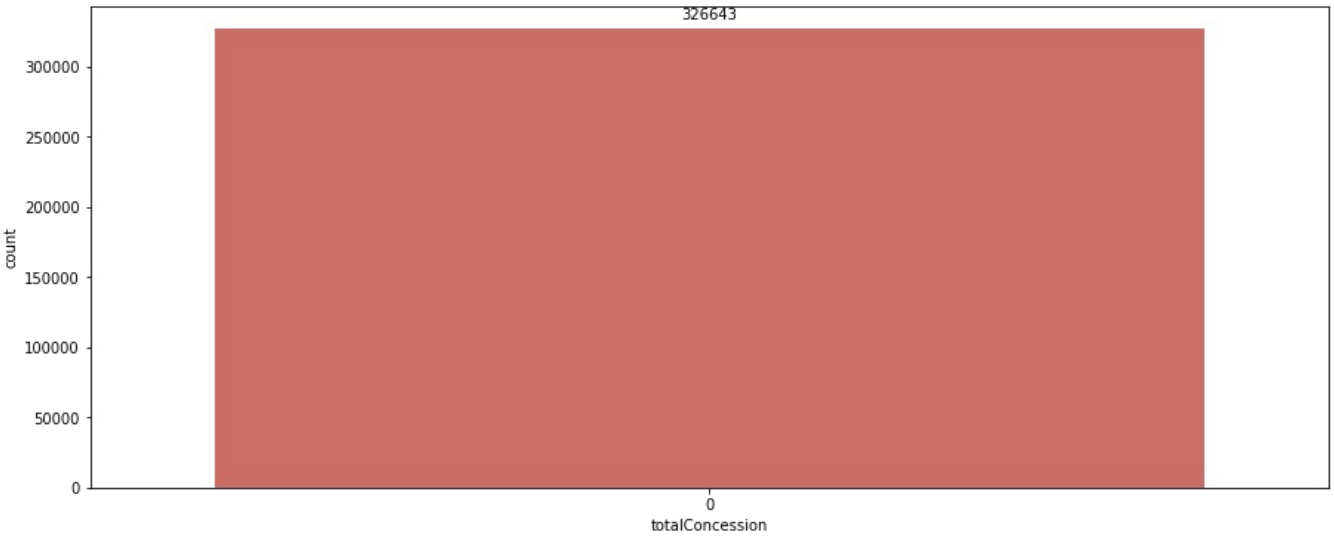
```
reservationCharge :
40    98573
20    97501
50    84019
60    37152
15     9398
Name: reservationCharge, dtype: int64

superfastCharge :
0     181900
45     80829
30     35932
75     23614
15      4368
Name: superfastCharge, dtype: int64

fuelAmount :
0    326643
Name: fuelAmount, dtype: int64

totalConcession :
0    326643
Name: totalConcession, dtype: int64

tatkalFare :
0    326643
Name: tatkalFare, dtype: int64

otherCharge :
0     325695
15       632
25       316
Name: otherCharge, dtype: int64
```

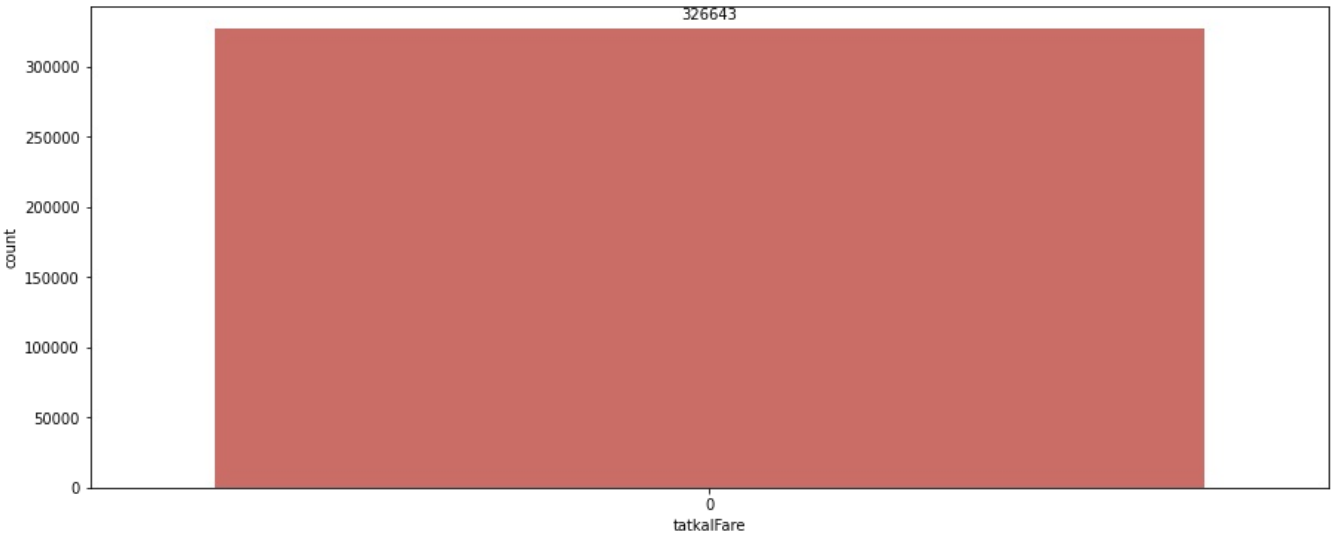
In [23]:
```
for i in discrete:
    plt.figure(figsize=(15, 6))
    ax = sns.countplot(x=i, data=df, palette='hls')
    for p in ax.patches:
        ax.annotate(f'{p.get_height()}', (p.get_x() + p.get_width() / 2., p.get_height()),
                    ha='center', va='center', xytext=(0, 10), textcoords='offset points')
    plt.show()
```

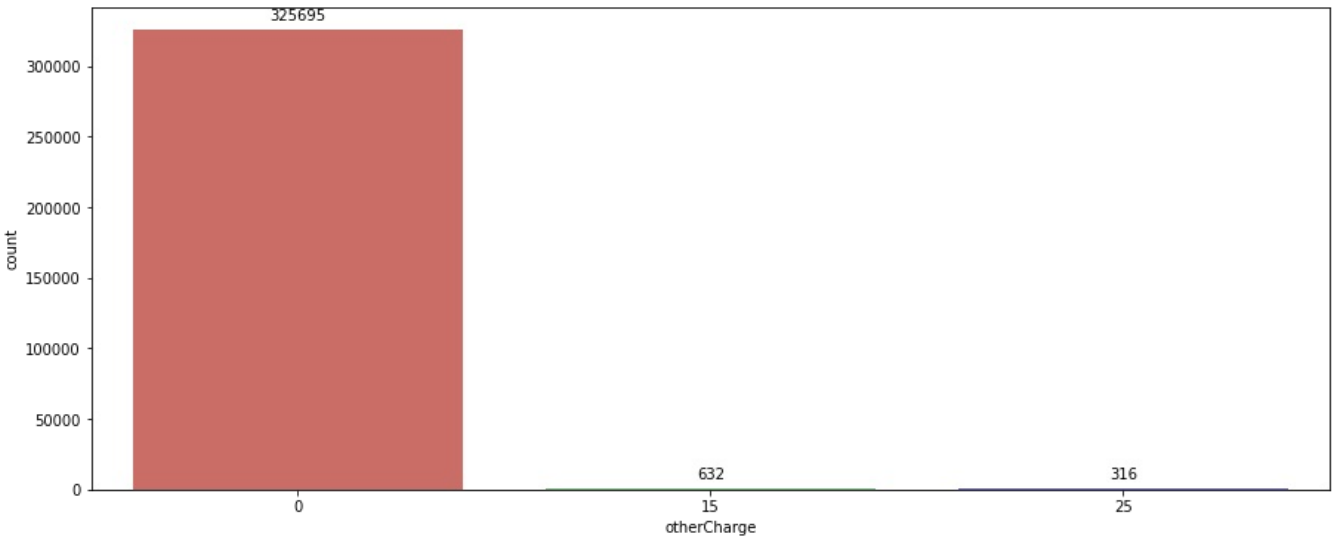





326643
300000
250000
200000
150000
100000
50000
0
count
0
fuelAmount

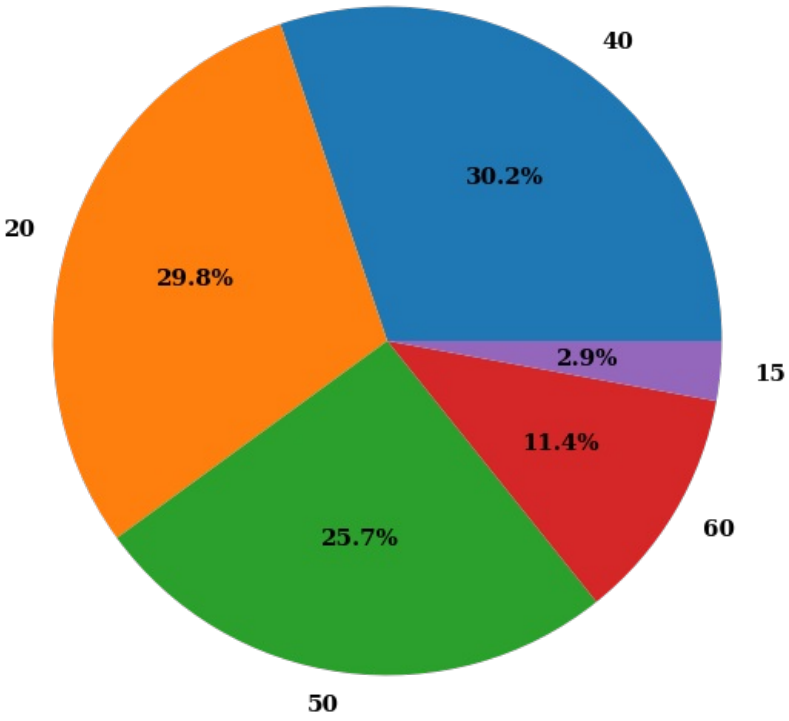

326643
300000
250000
200000
150000
100000
50000
0
count
0
totalConcession


326643
300000
250000
200000
150000
100000
50000
0
count
0
tatkalFare

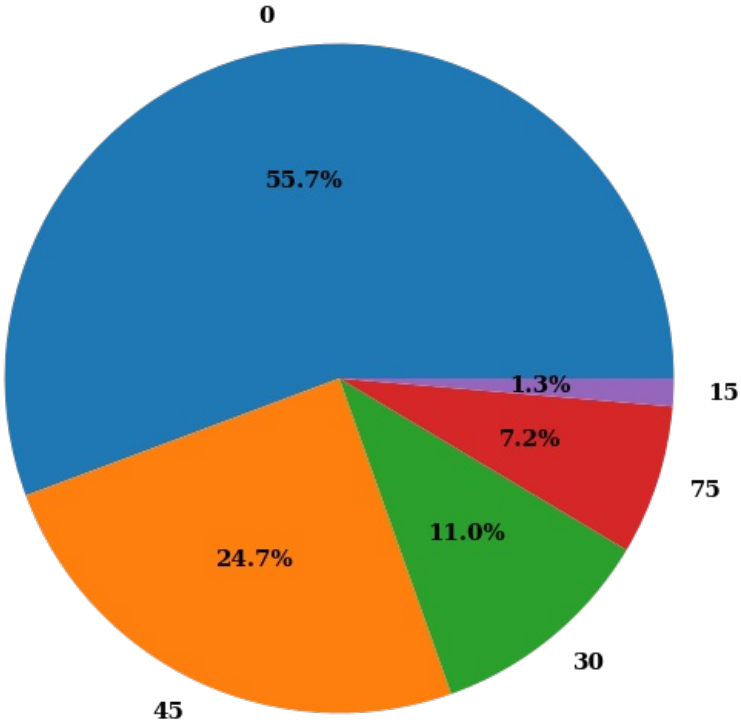


In [24]:
```
for i in discrete:
    plt.figure(figsize=(20,10))
    plt.pie(df[i].value_counts(), labels=df[i].value_counts().index, autopct='%1.1f%%', textprops={'fontsize':
                                          'color': 'black',
                                          'weight': 'bold',
                                          'family': 'serif' })
    hfont = {'fontname':'serif', 'weight': 'bold'}
    plt.title(i, size=20, **hfont)
    plt.show()
```

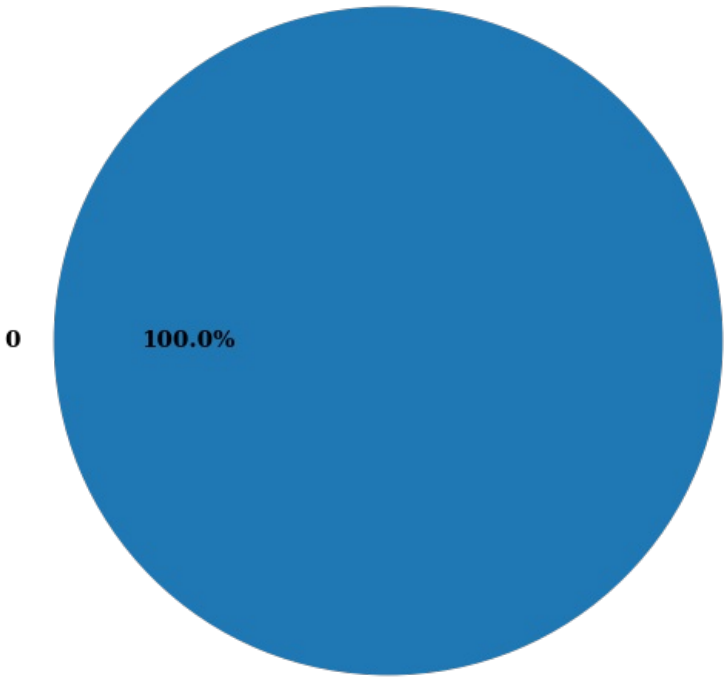
reservationCharge



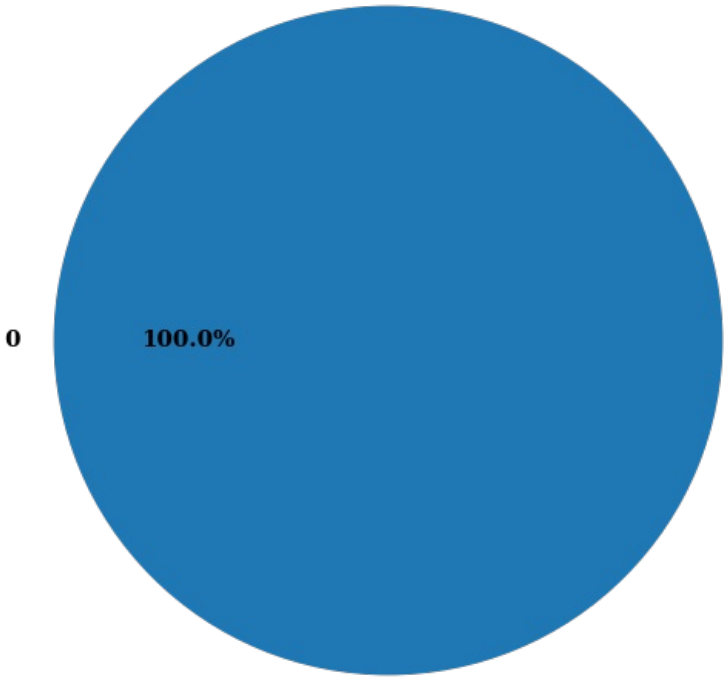
superfastCharge

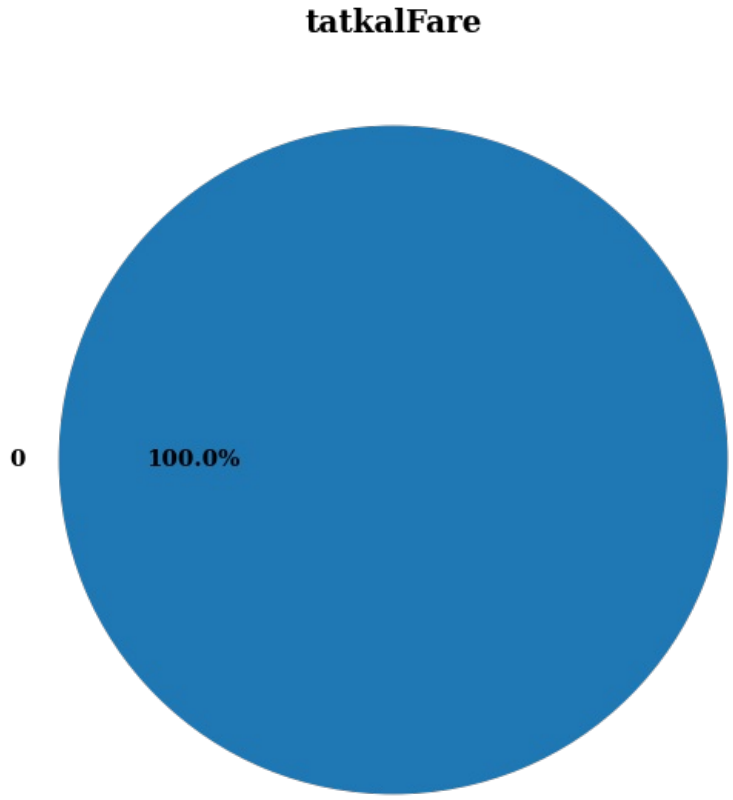


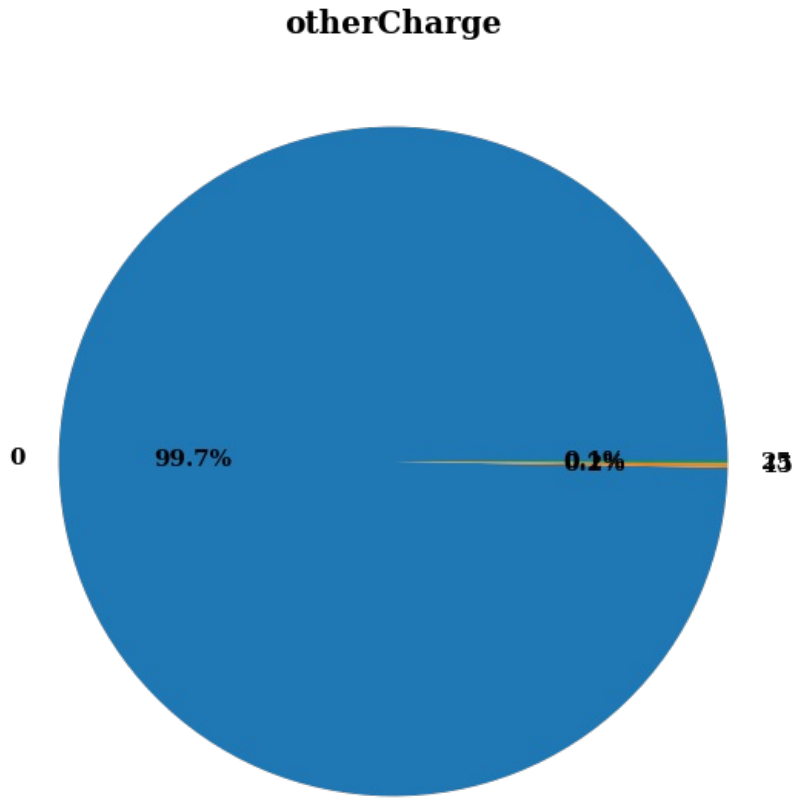
fuelAmount



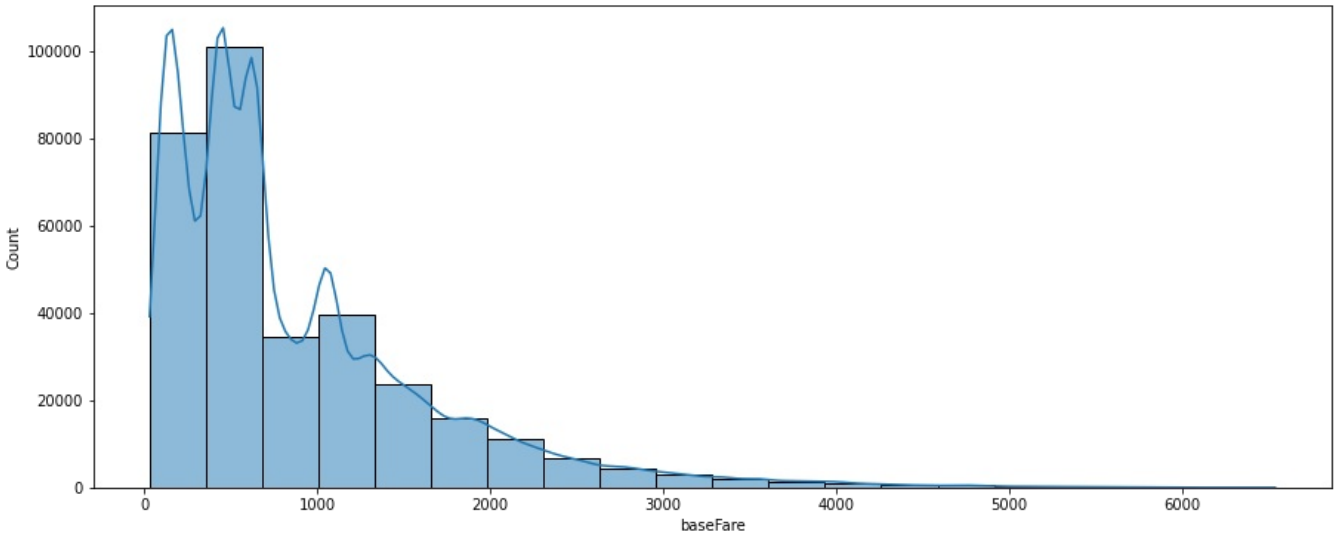
totalConcession

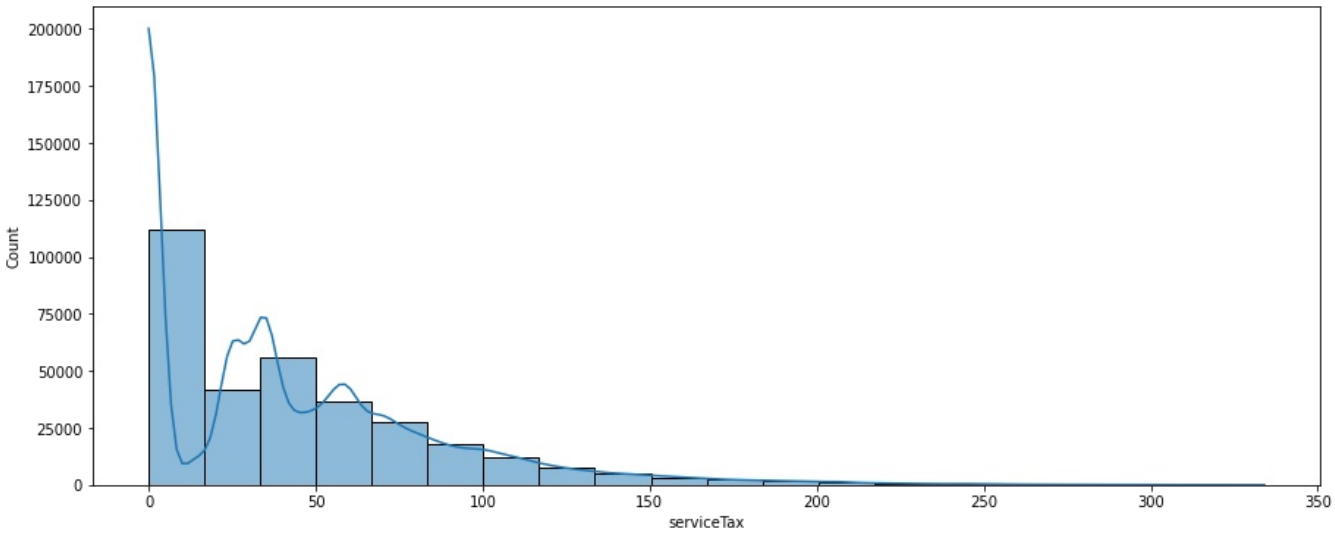


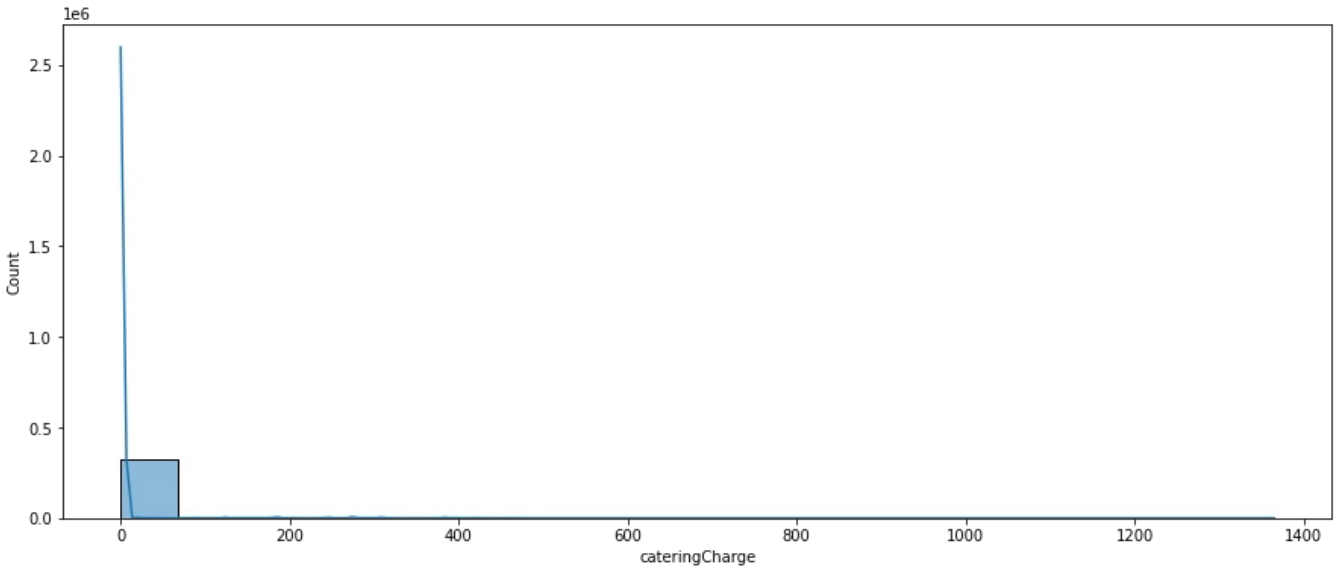


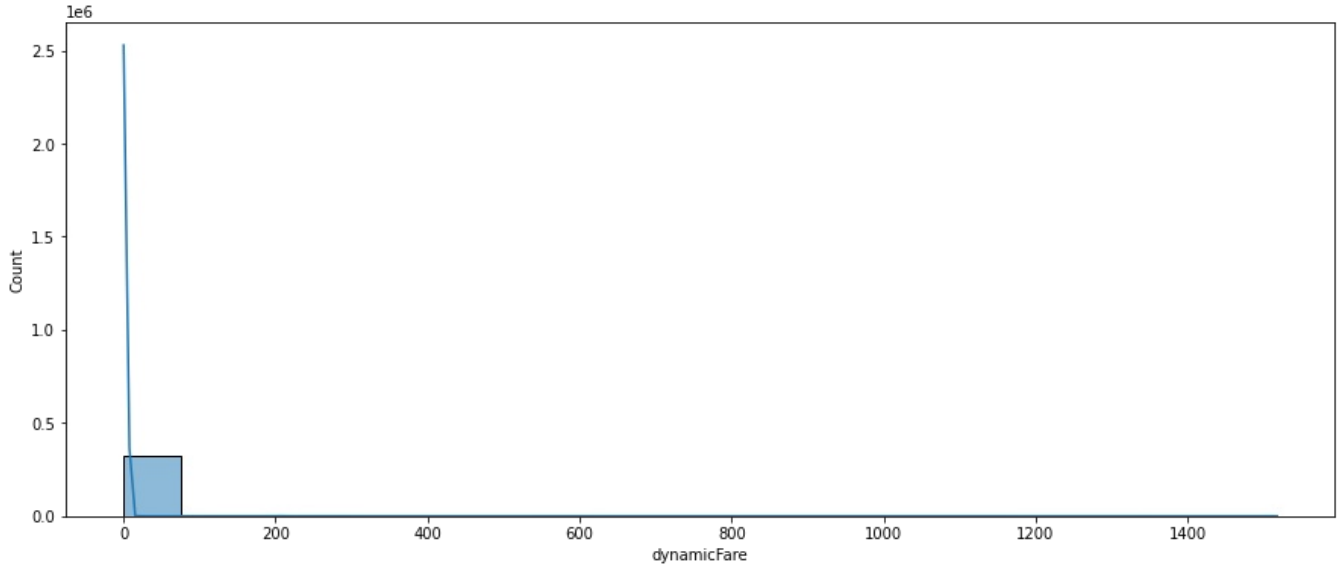


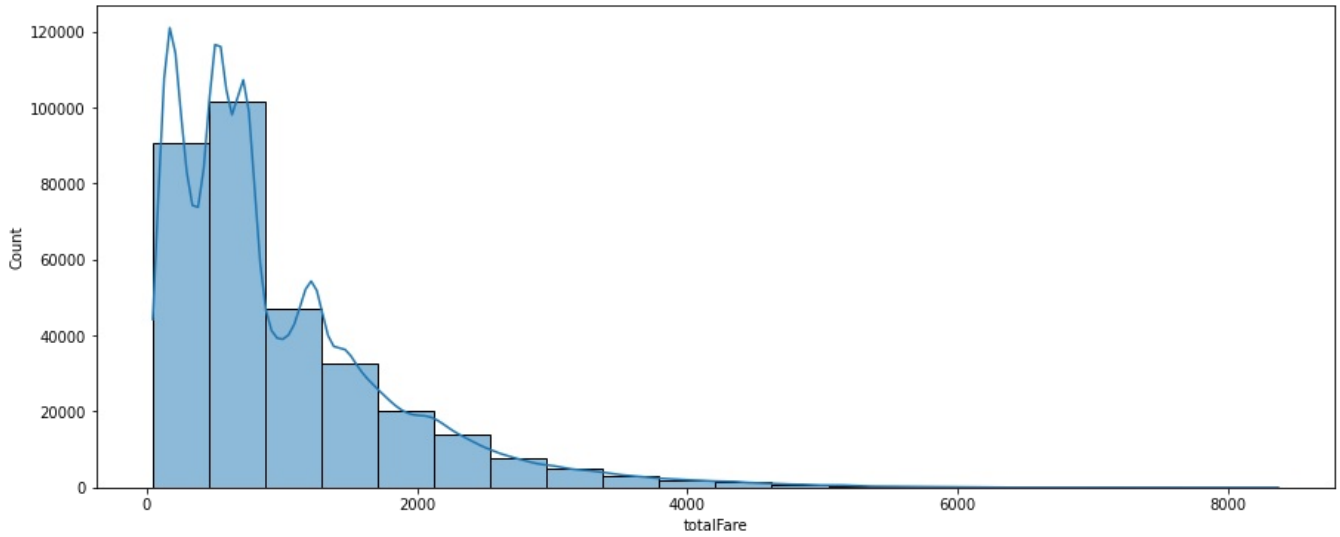
In [25]:
```
for i in continuous:
    plt.figure(figsize=(15,6))
    sns.histplot(df[i], bins = 20, kde = True, palette='hls')
    plt.show()
```

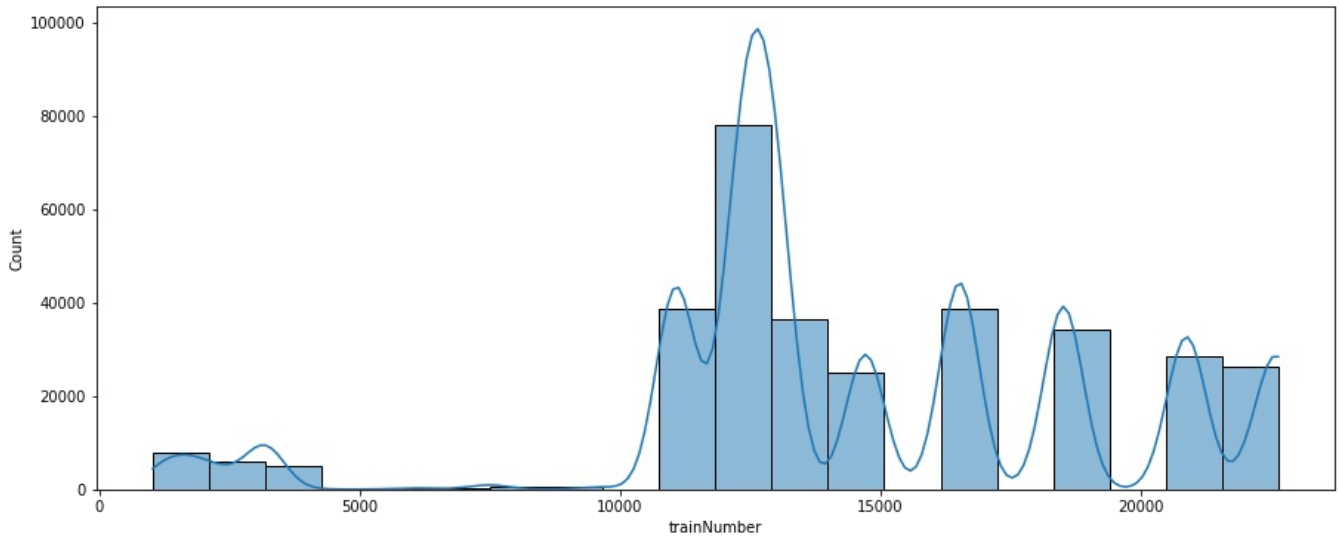

Count
baseFare

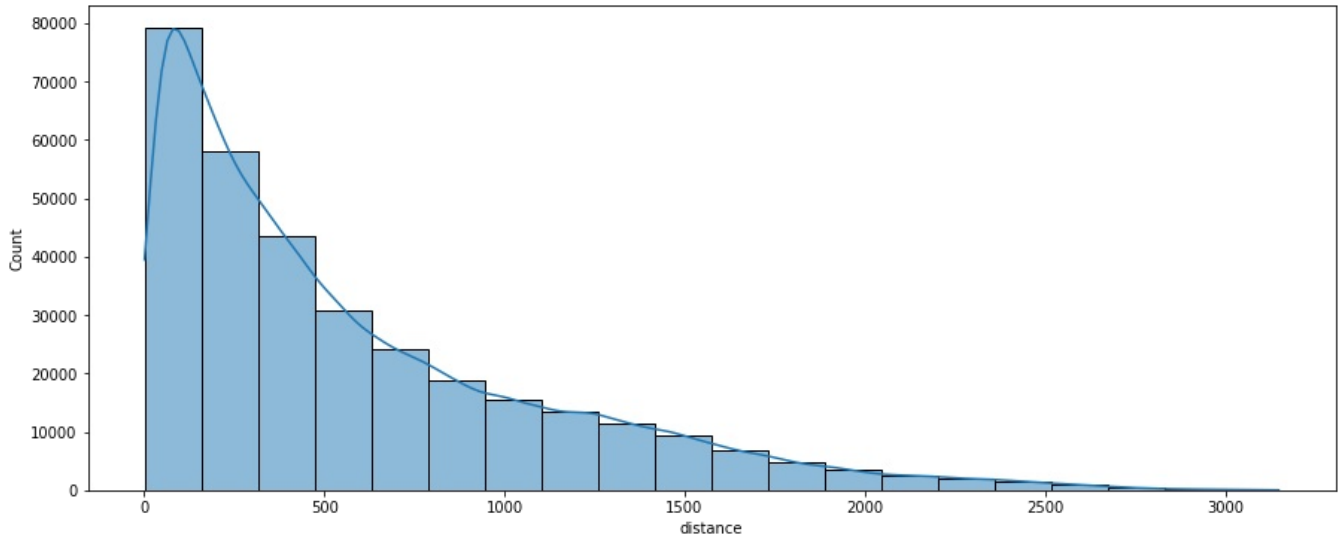

Count
serviceTax

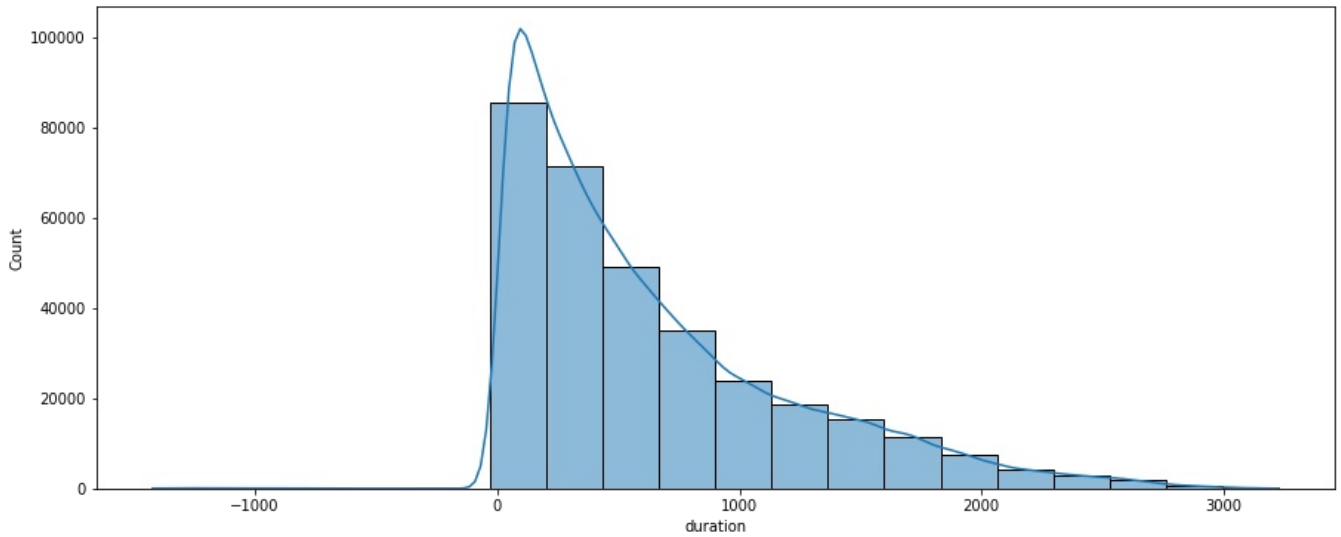

1e6
Count
cateringCharge


1e6
2.5
2.0
1.5
1.0
0.5
0.0
Count
0
200
400
600
800
1000
1200
1400
dynamicFare

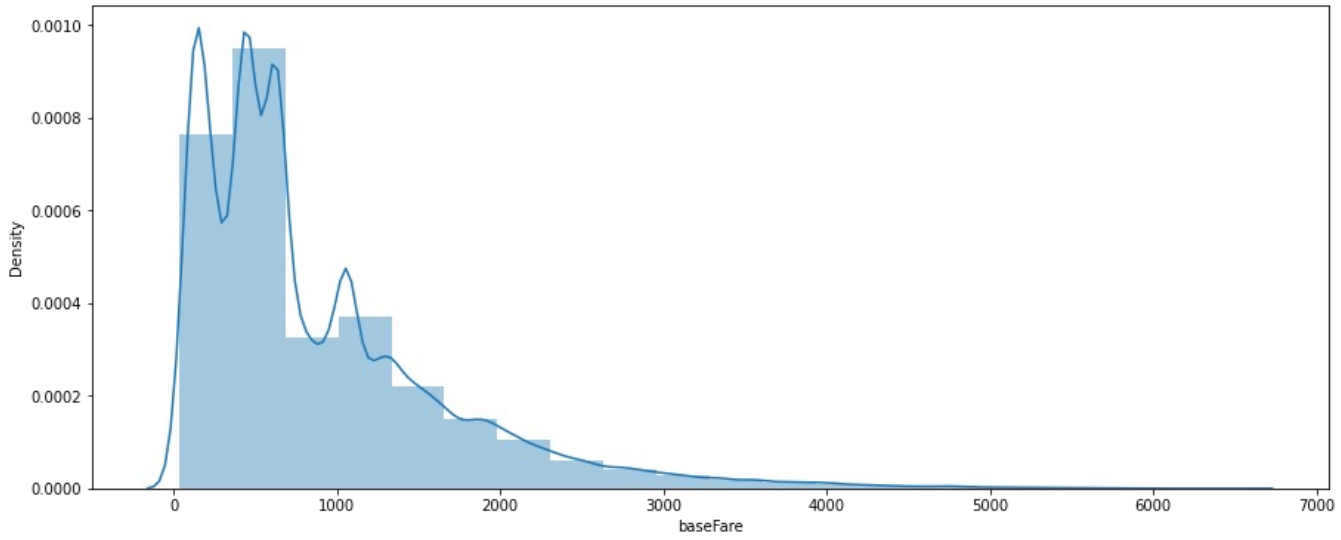

120000
100000
80000
60000
40000
20000
0
Count
0
2000
4000
6000
8000
totalFare

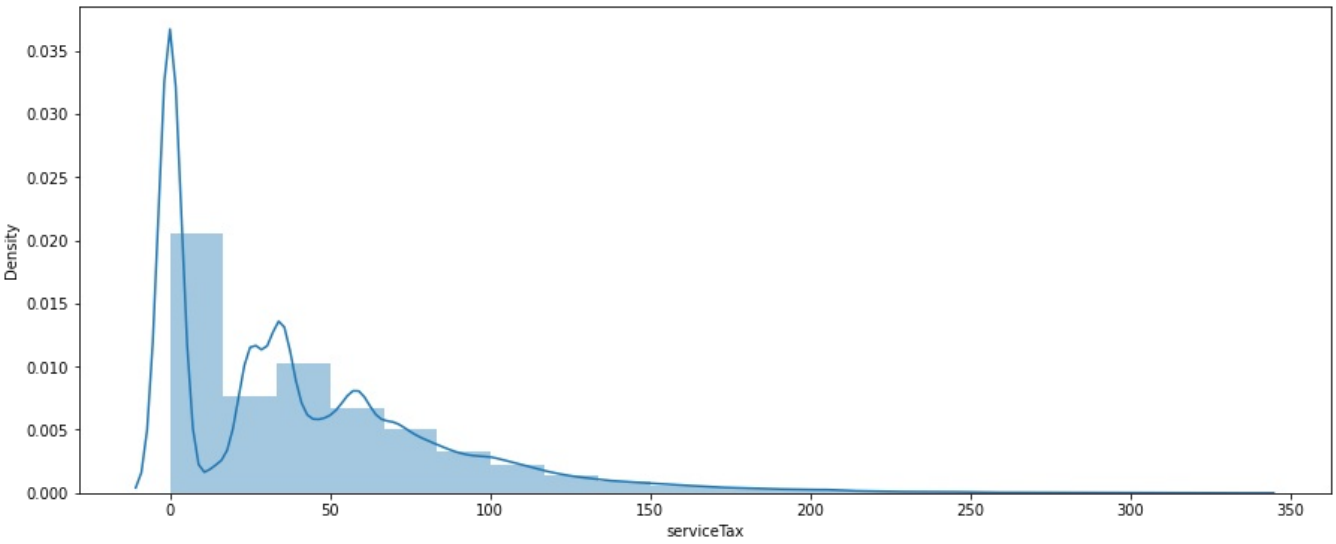

100000
80000
60000
40000
20000
0
Count
0
5000
10000
15000
20000
trainNumber

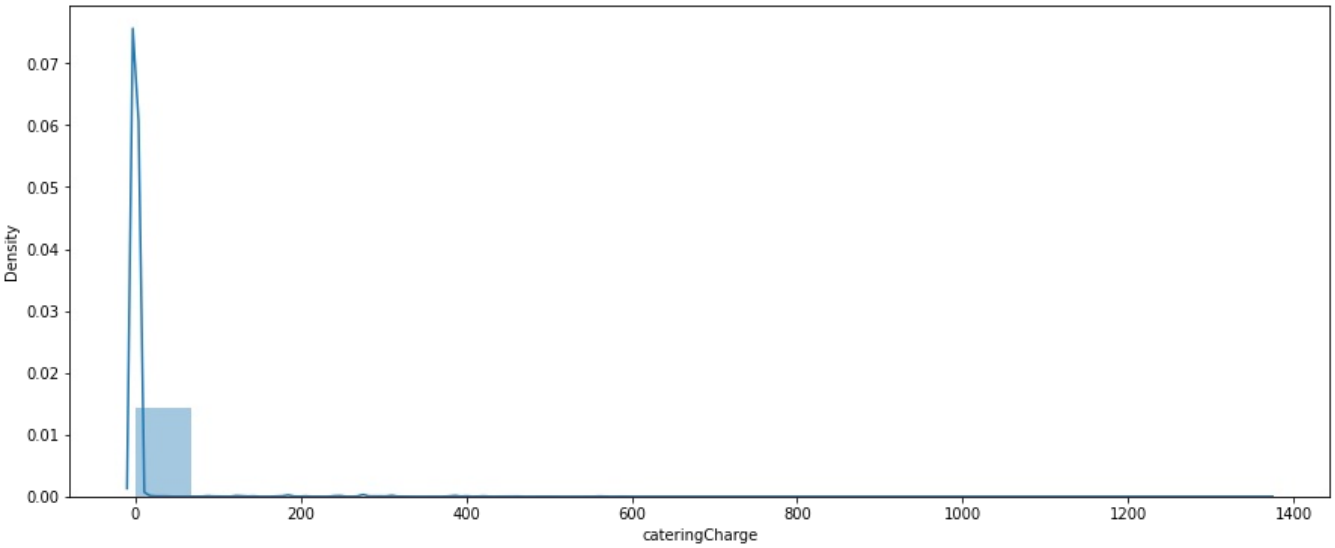


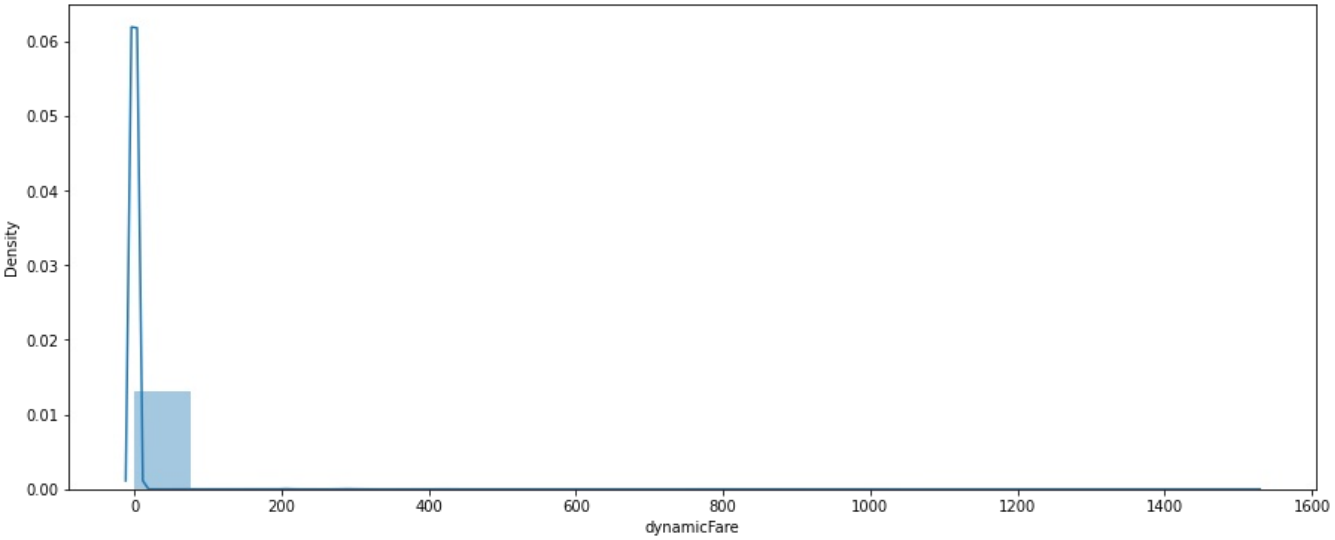


In [26]:
```
for i in continuous:
    plt.figure(figsize=(15,6))
    sns.distplot(df[i], bins = 20, kde = True)
    plt.show()
```




Density
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0
50
100
150
200
250
300
350
serviceTax


Density
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0
200
400
600
800
1000
1200
1400
cateringCharge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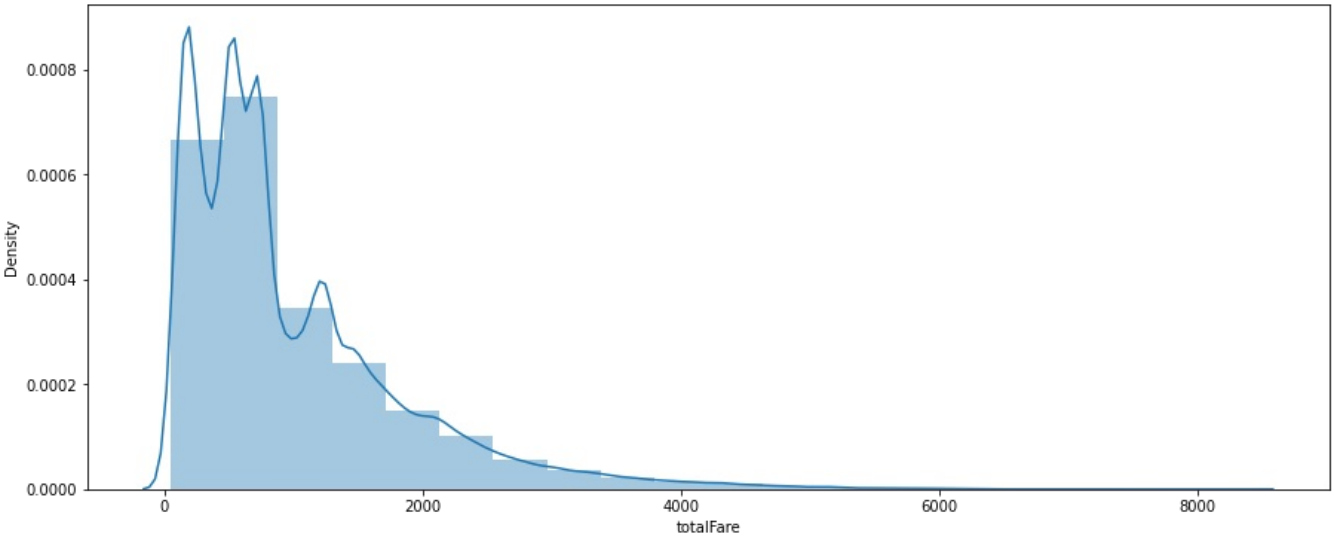
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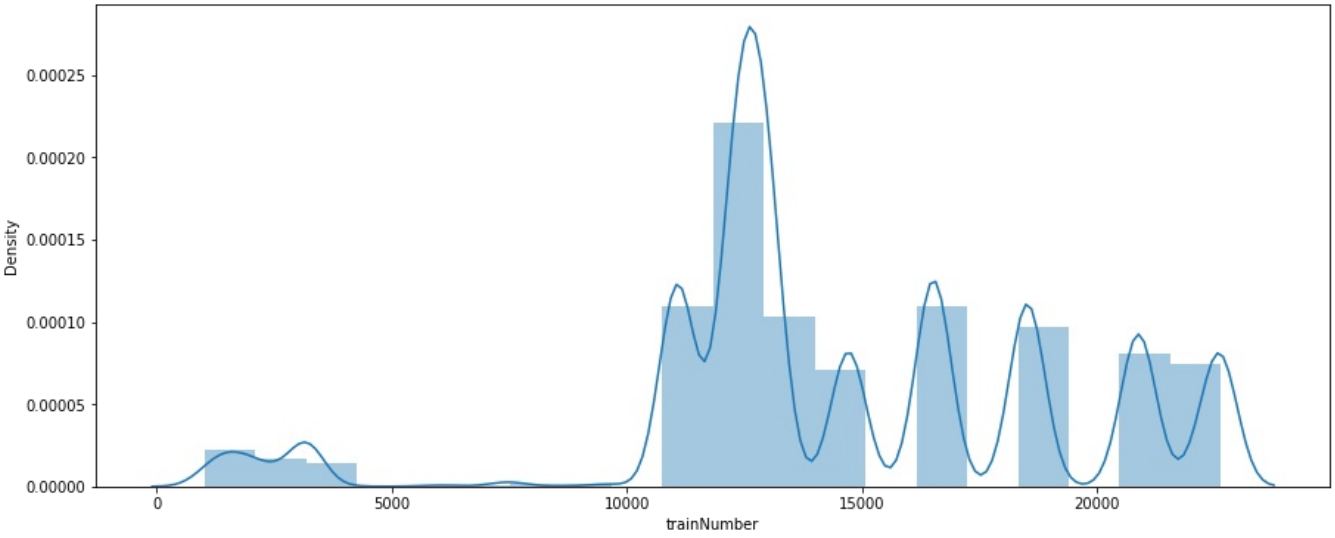
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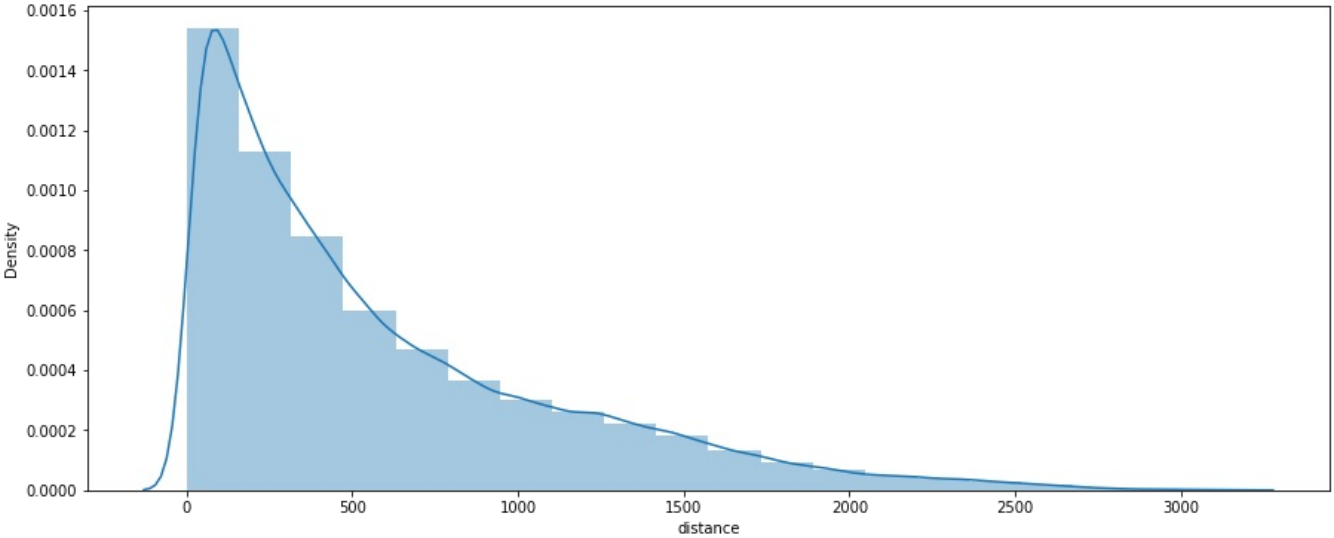
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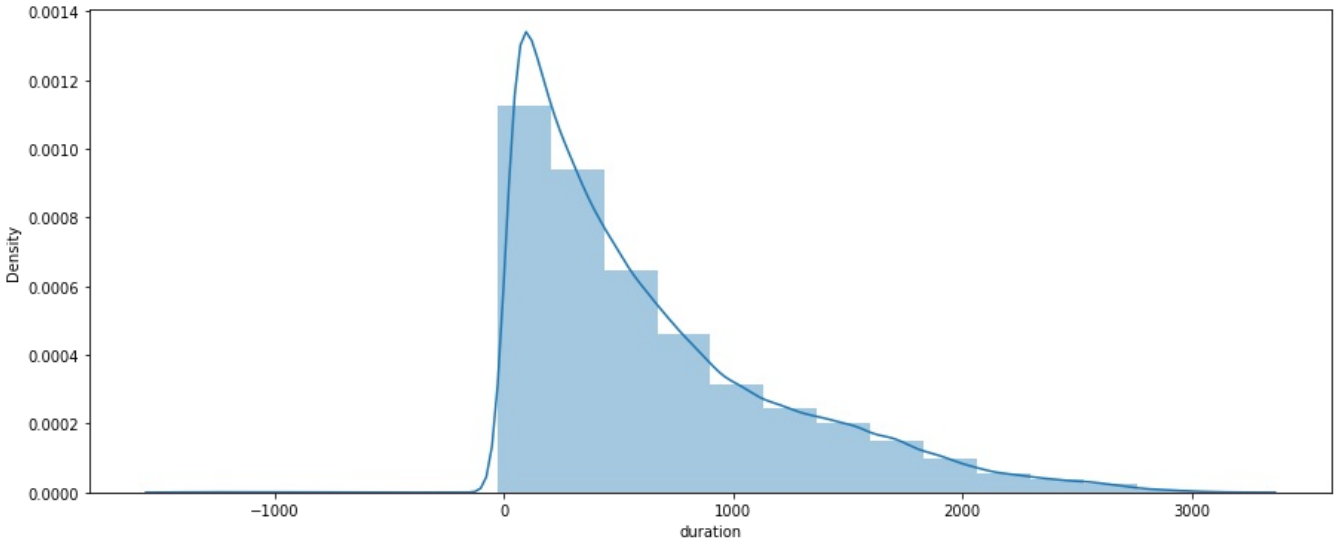
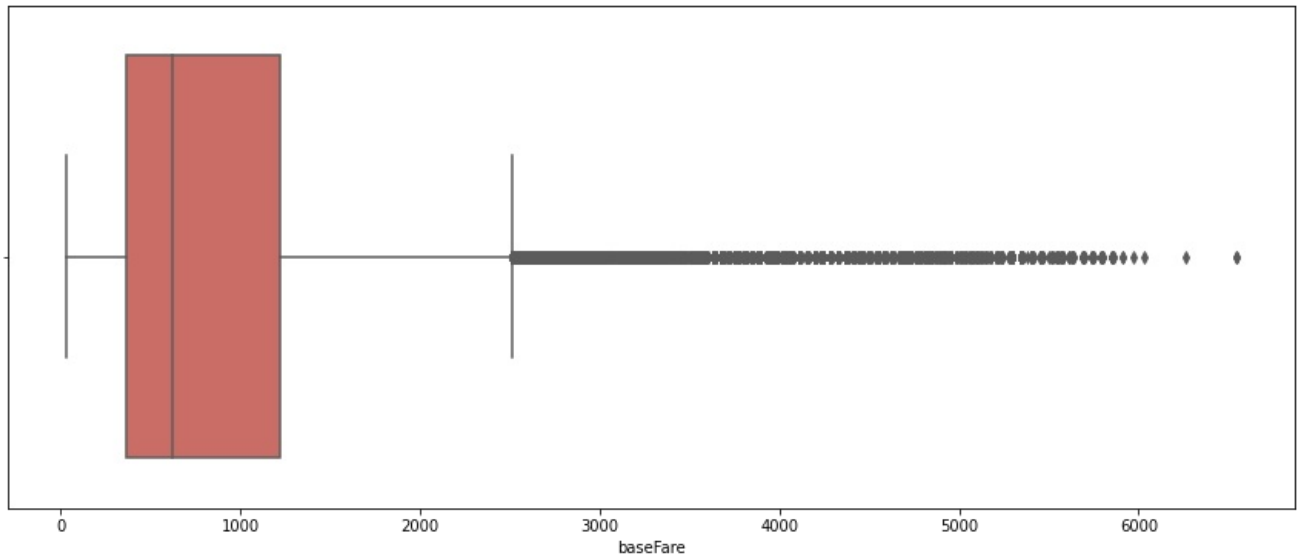
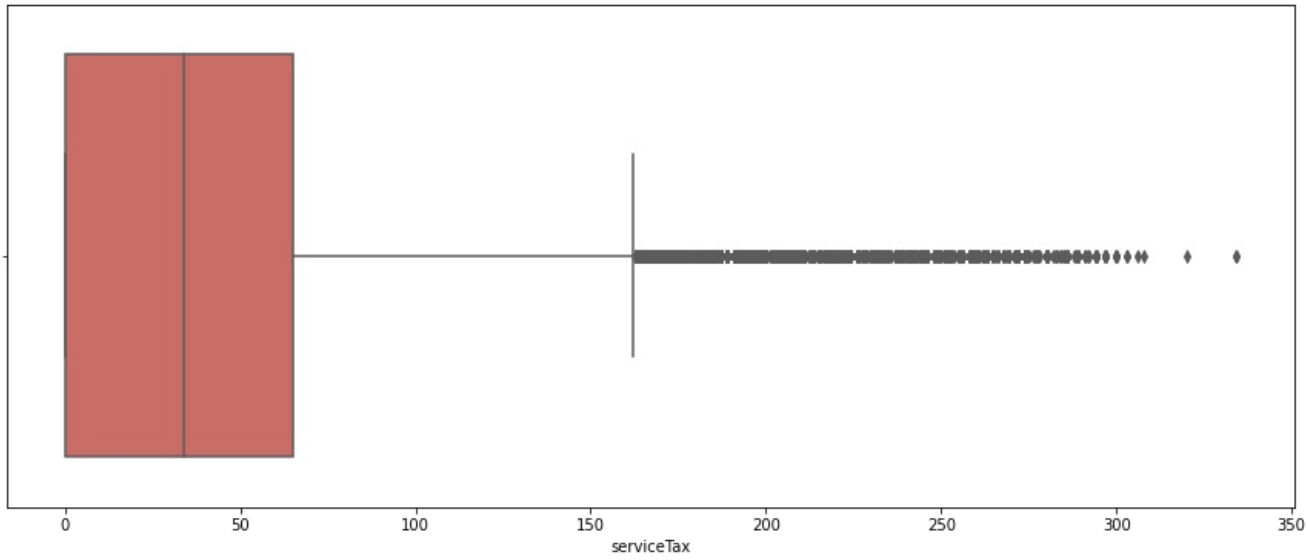


In [27]:
```
for i in continuous:
    plt.figure(figsize=(15,6))
    sns.boxplot(i, data = df, palette='hls')
    plt.show()
```

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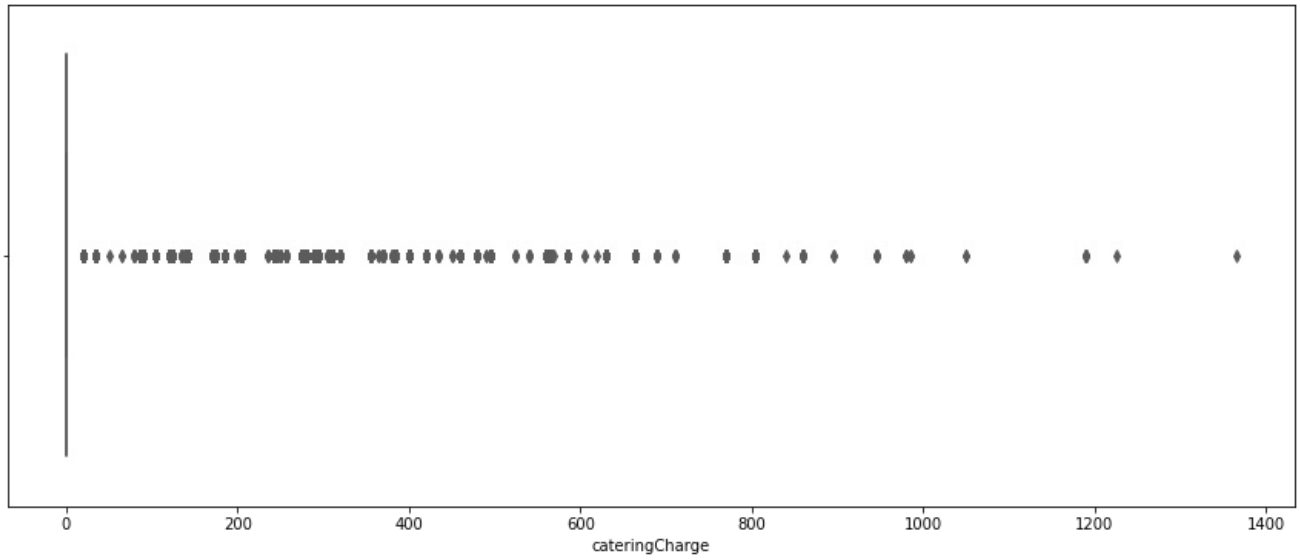
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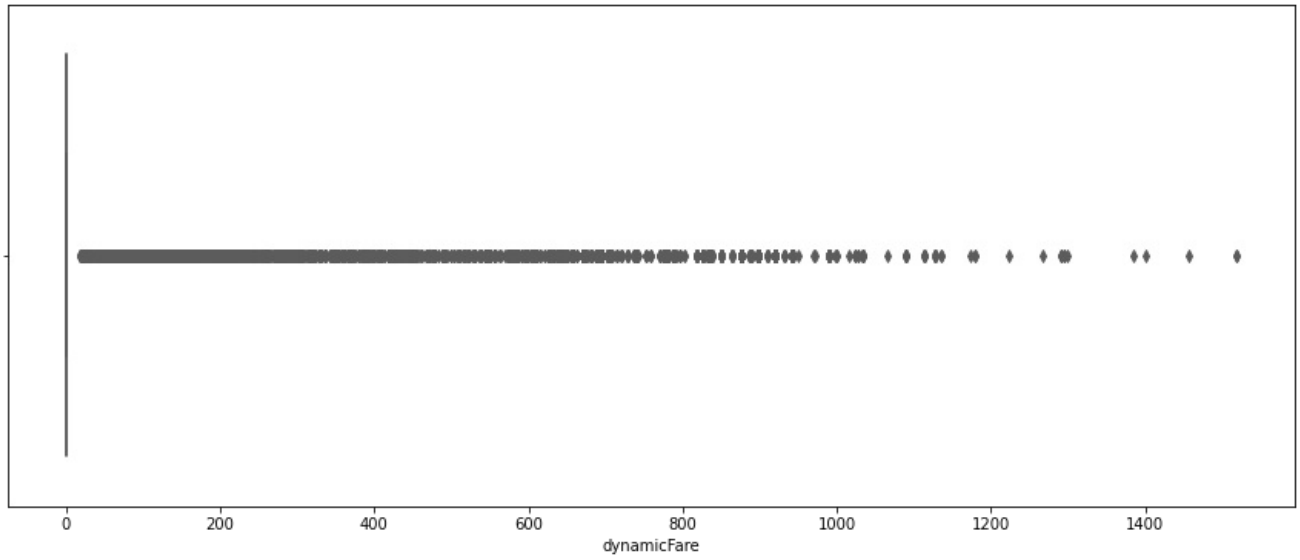
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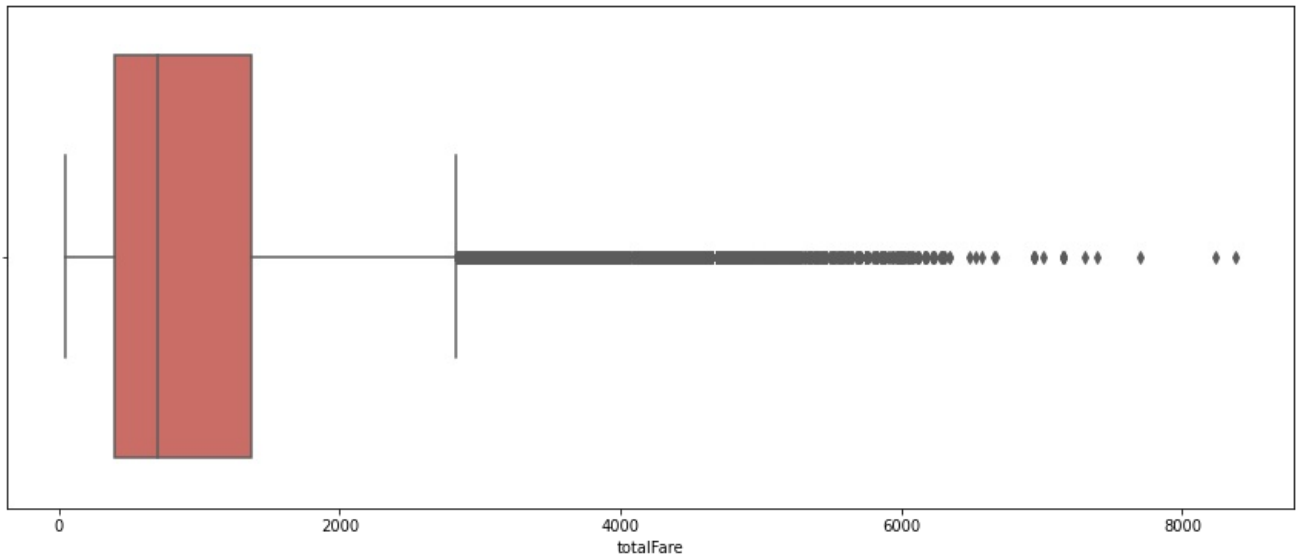
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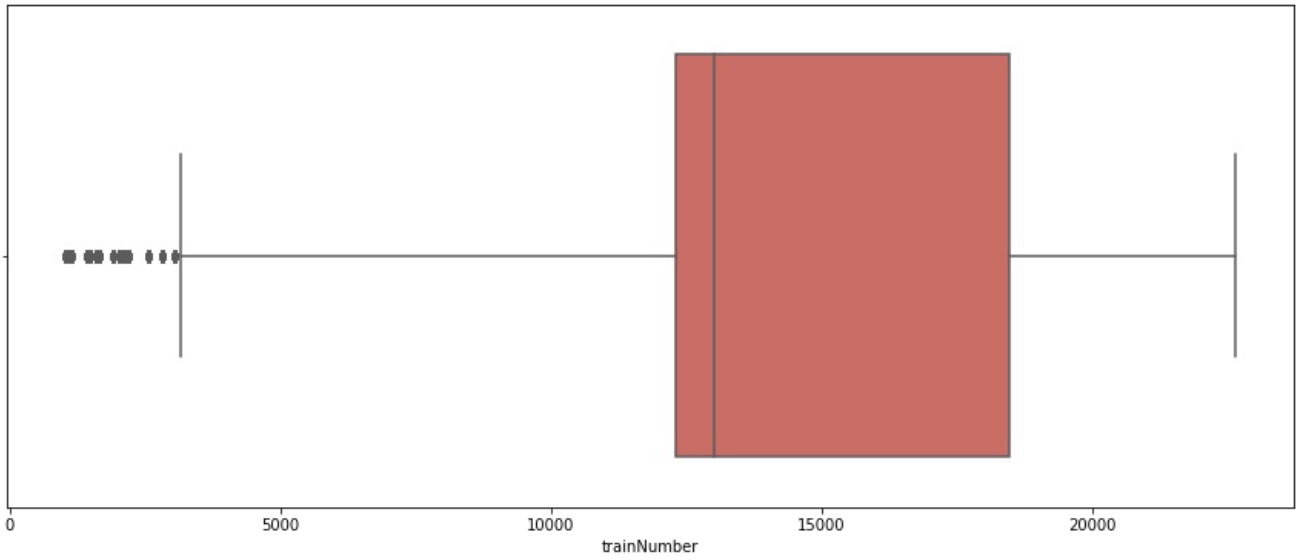
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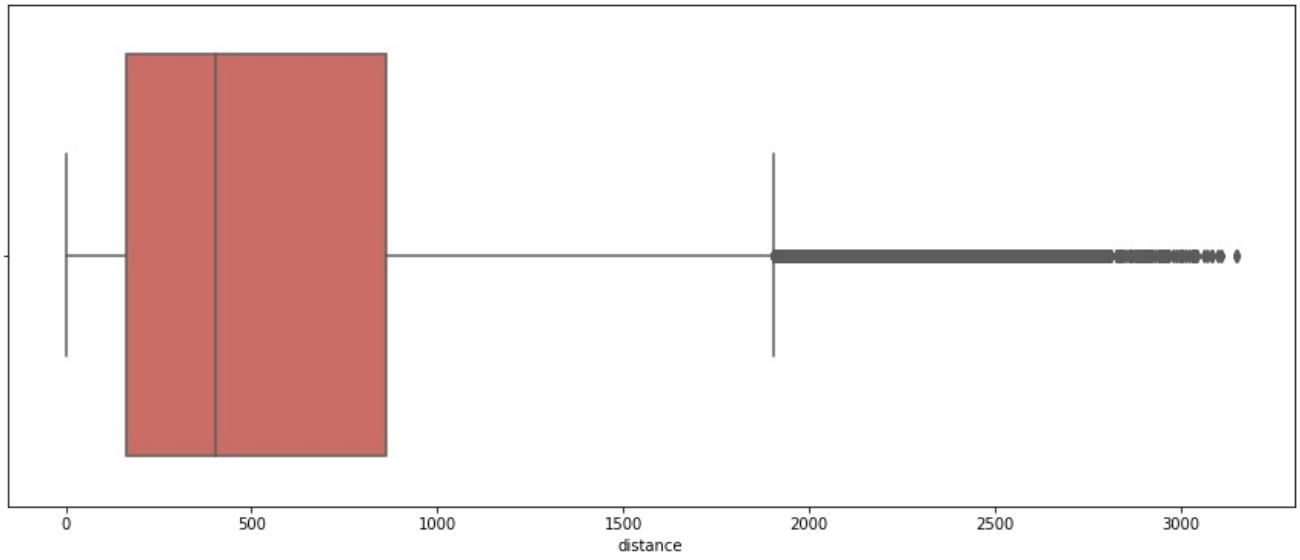
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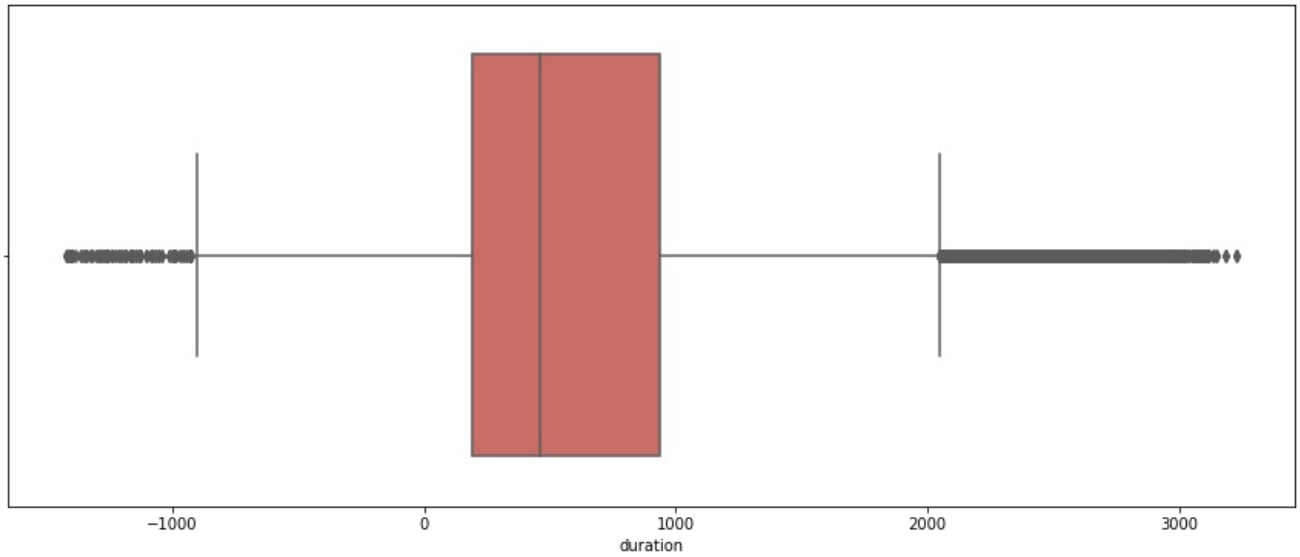
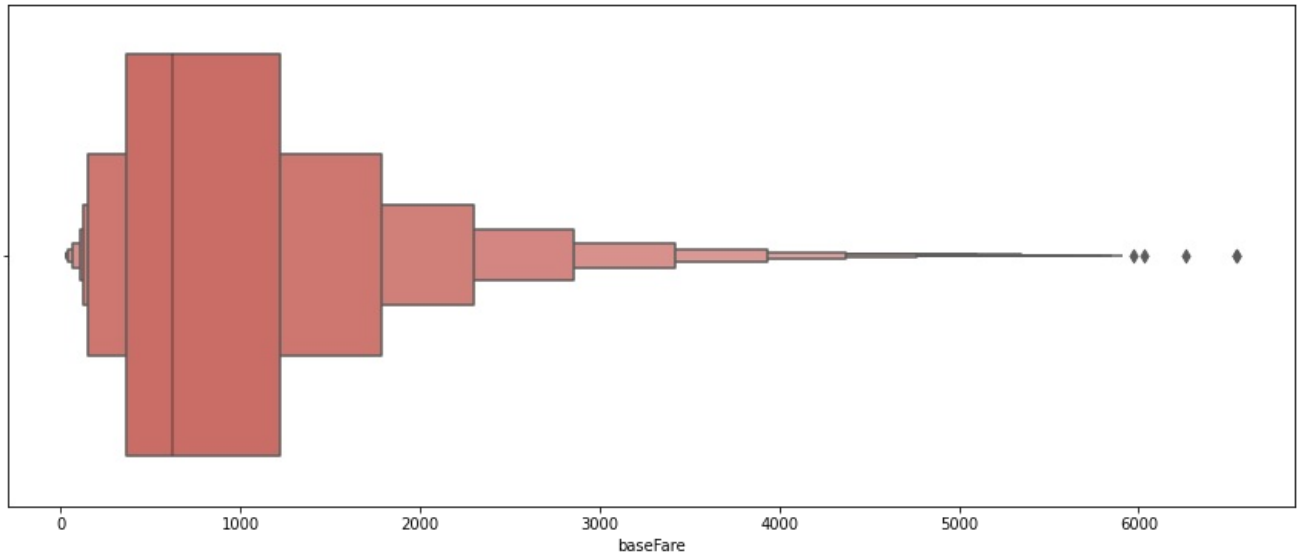
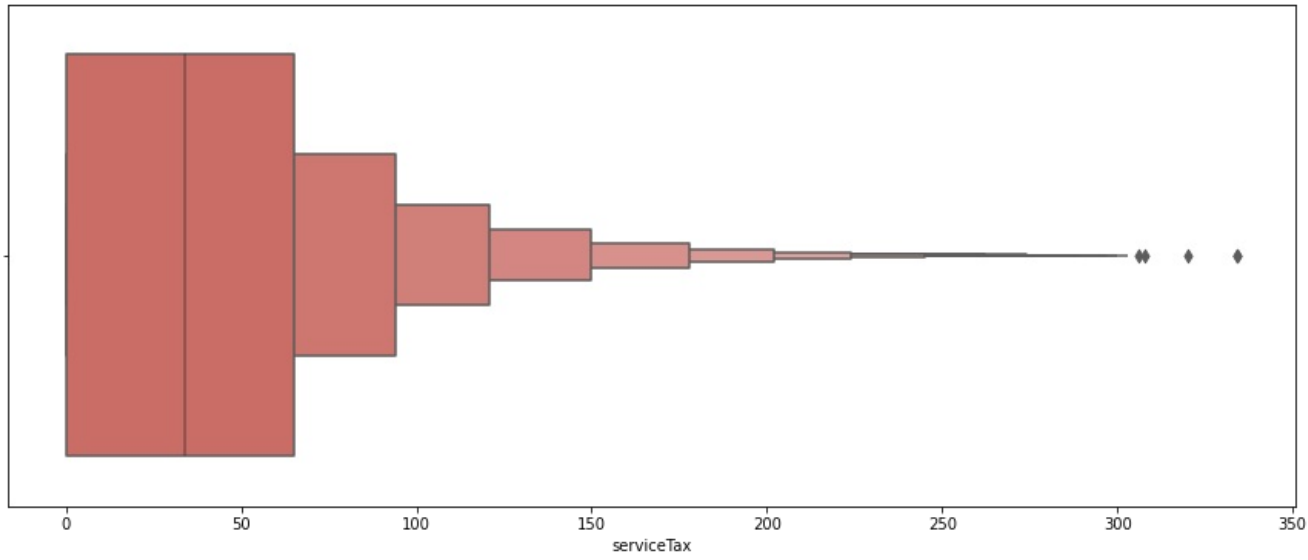


In [28]:
```
for i in continuous:
    plt.figure(figsize=(15,6))
    sns.boxenplot(i, data = df, palette='hls')
    plt.show()
```

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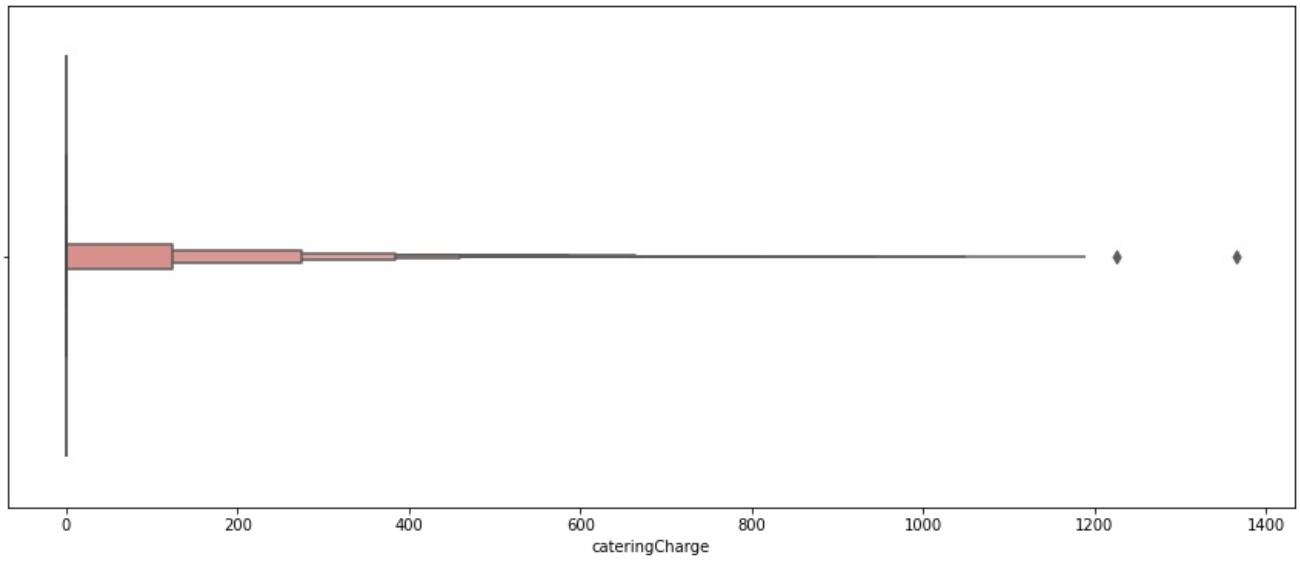
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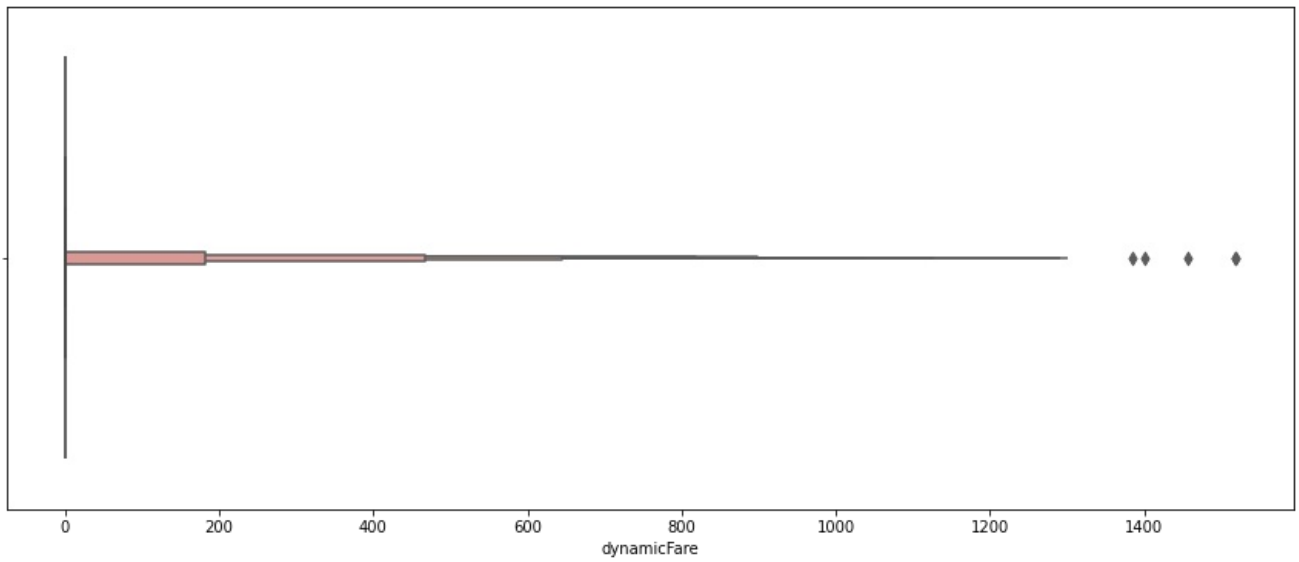
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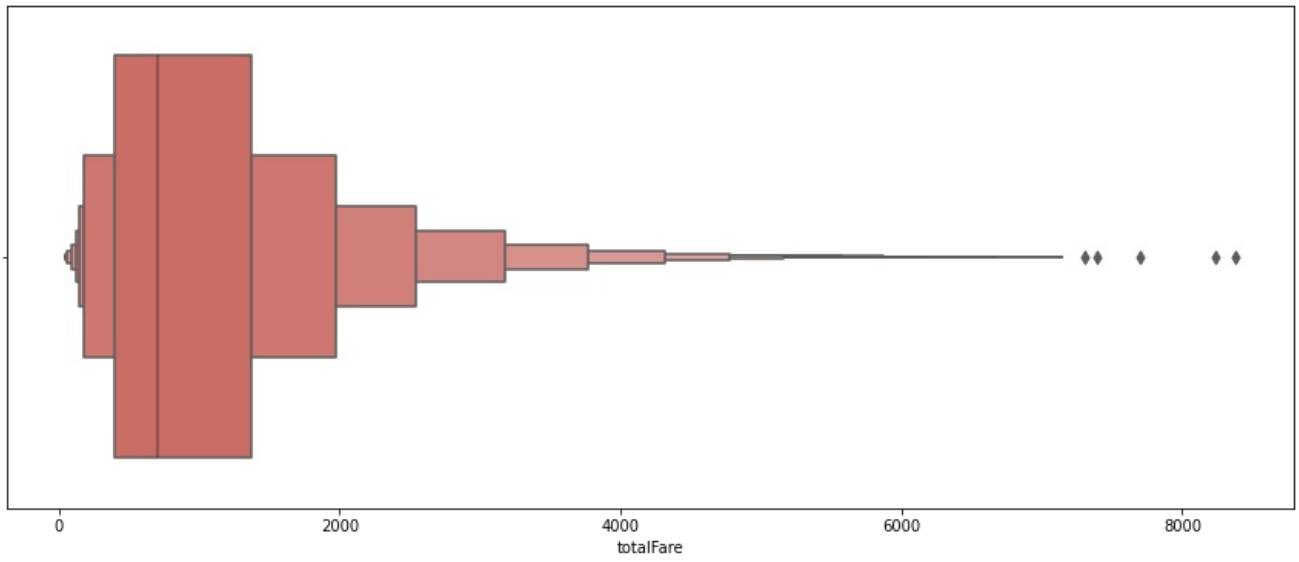
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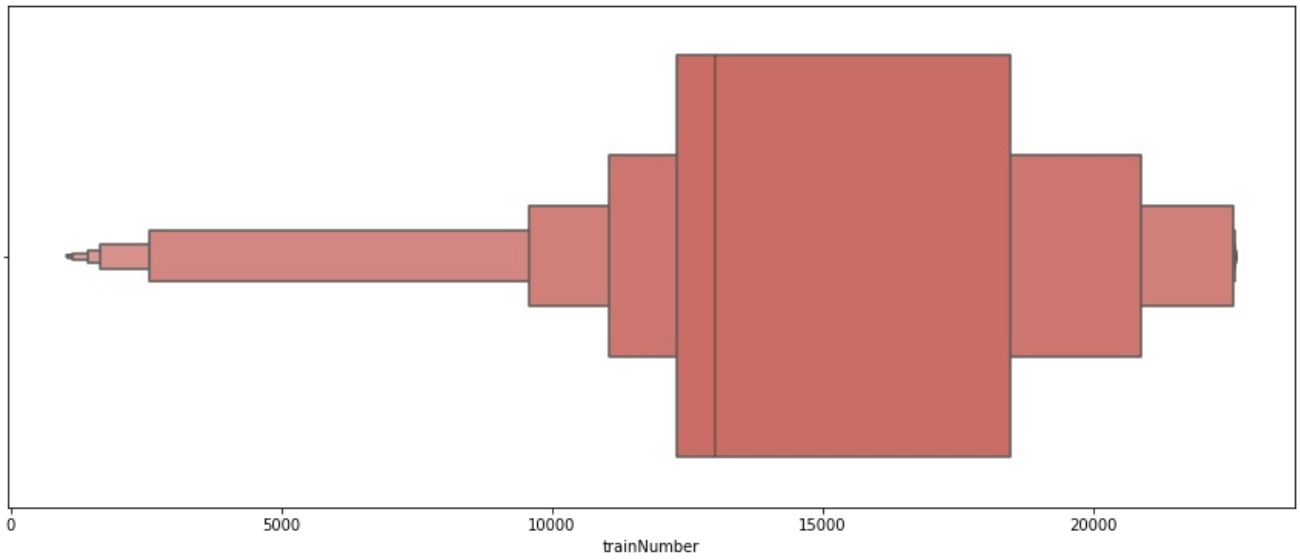
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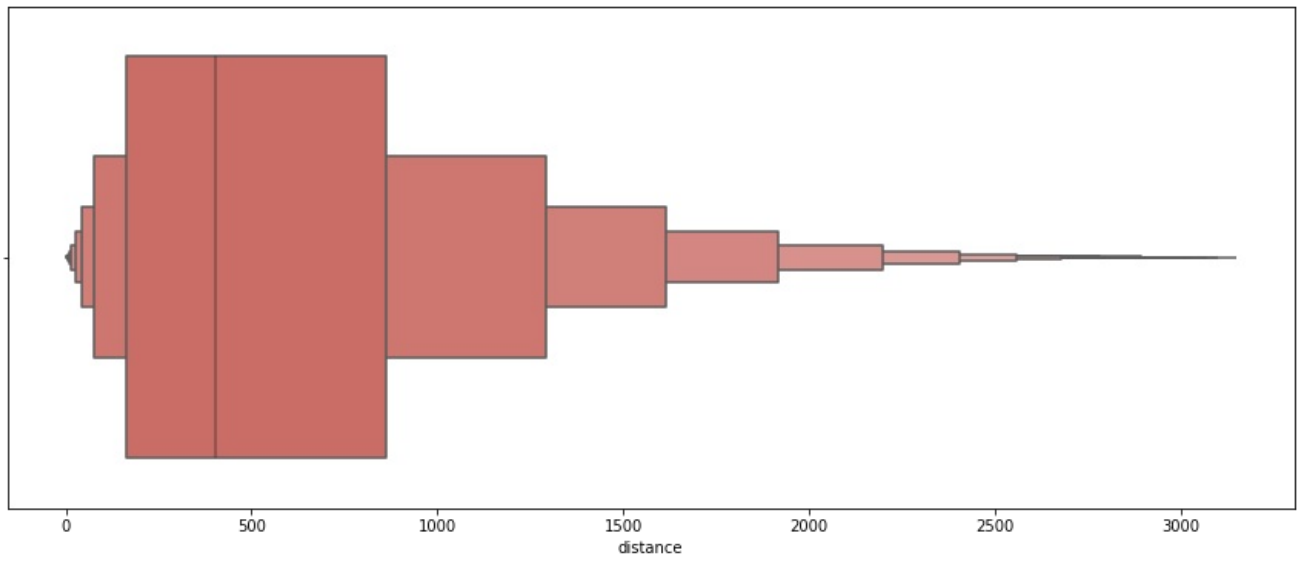
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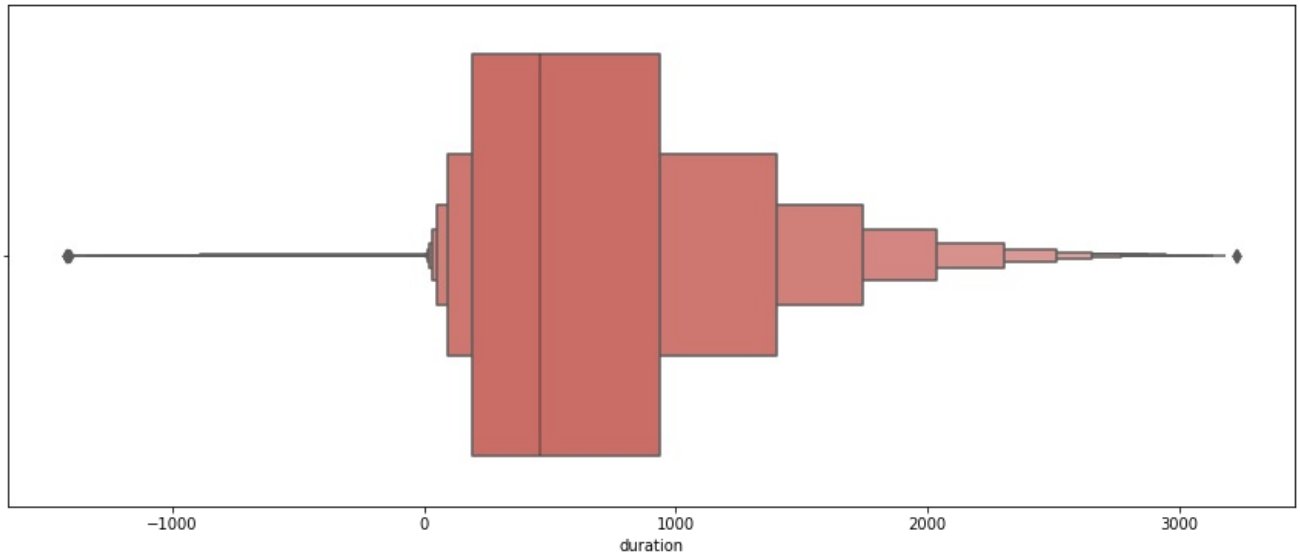
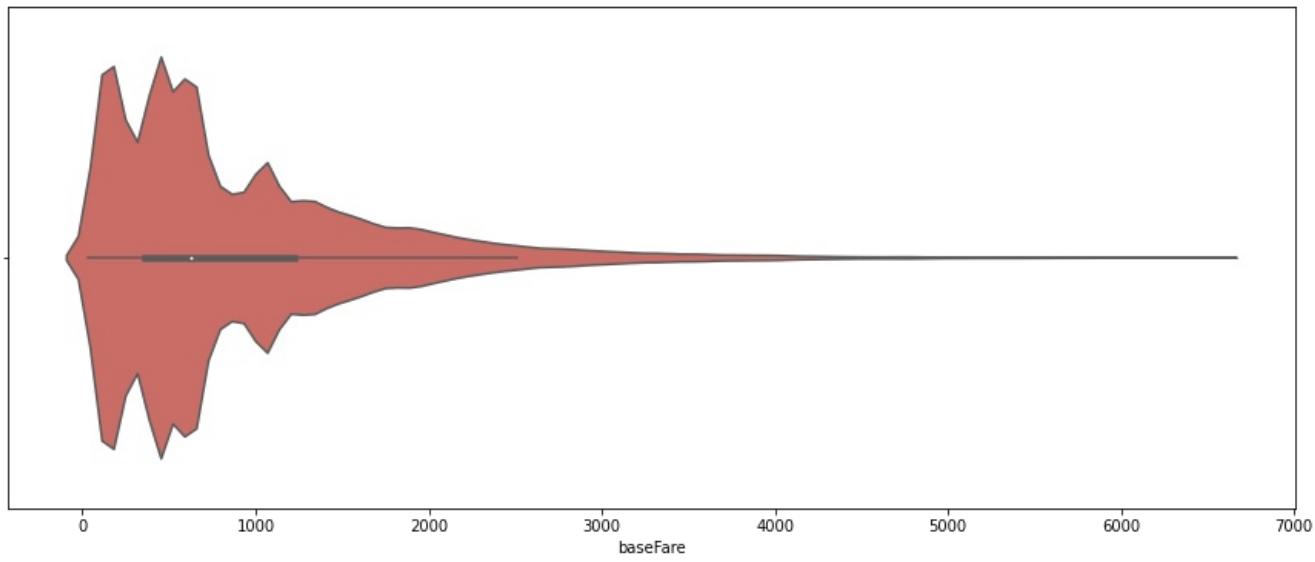
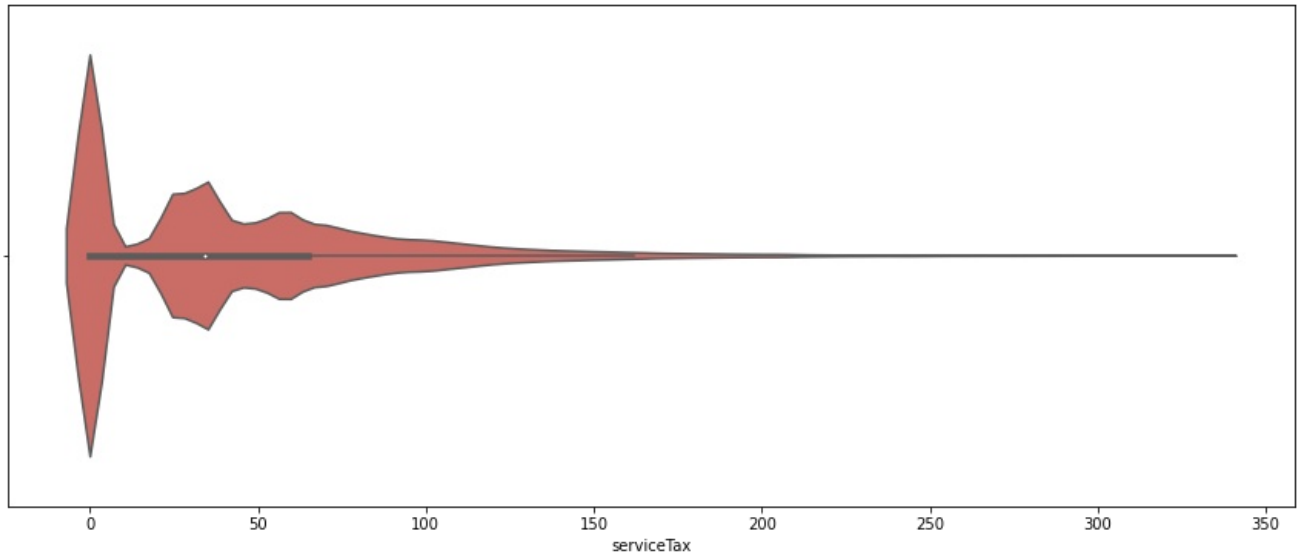


In [29]:
```
for i in continuous:
    plt.figure(figsize=(15,6))
    sns.violinplot(i, data = df, palette='hls')
    plt.show()
```

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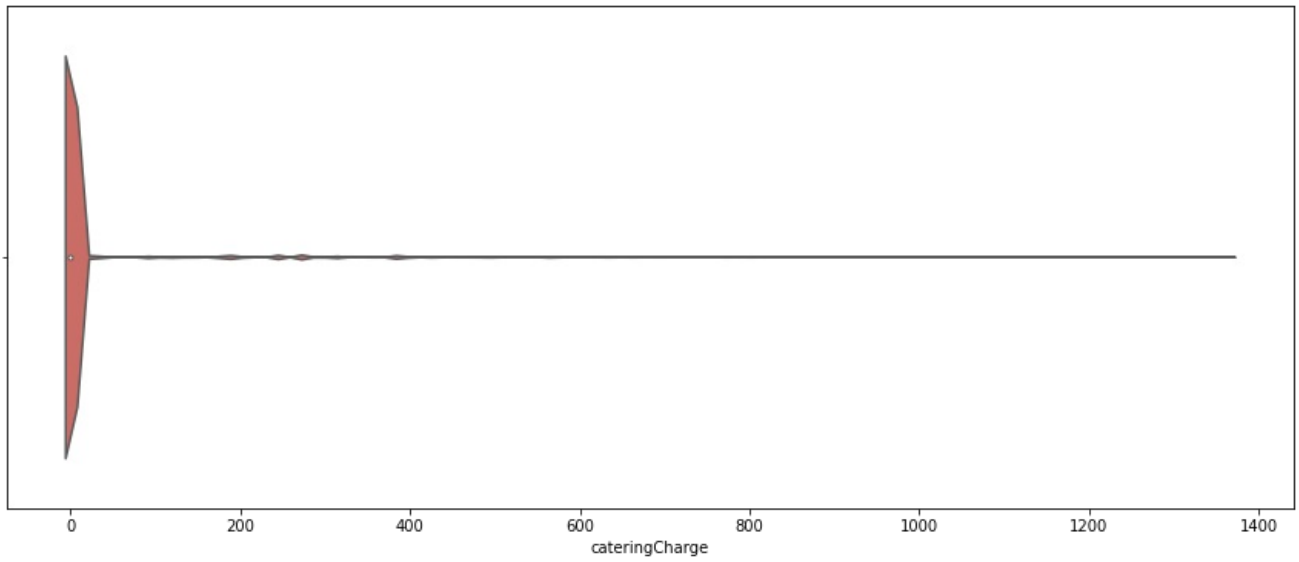
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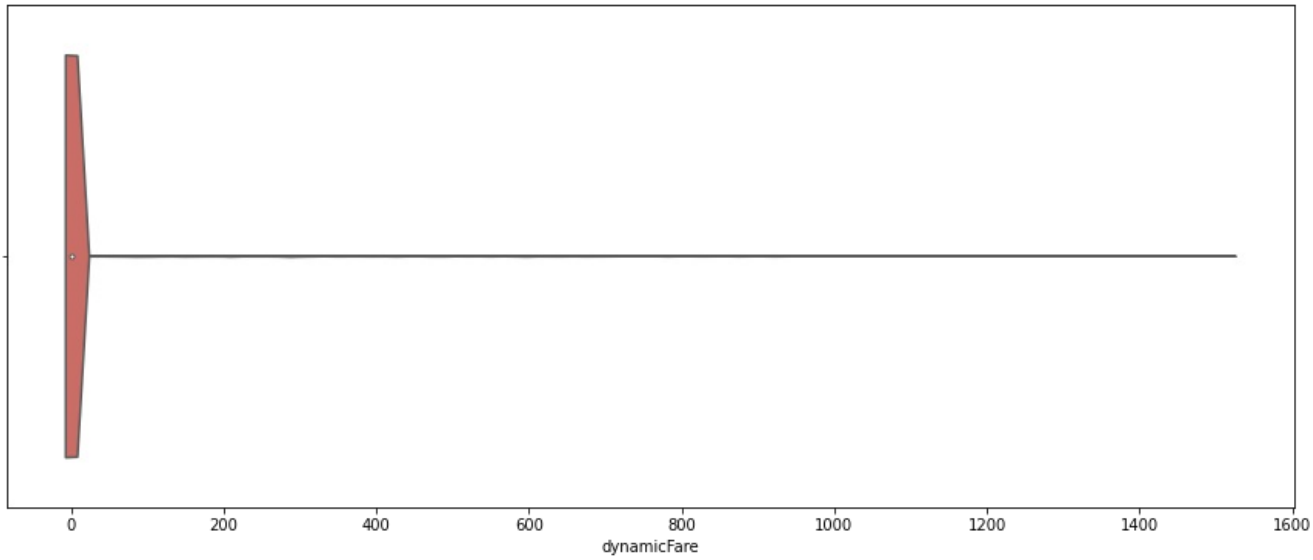
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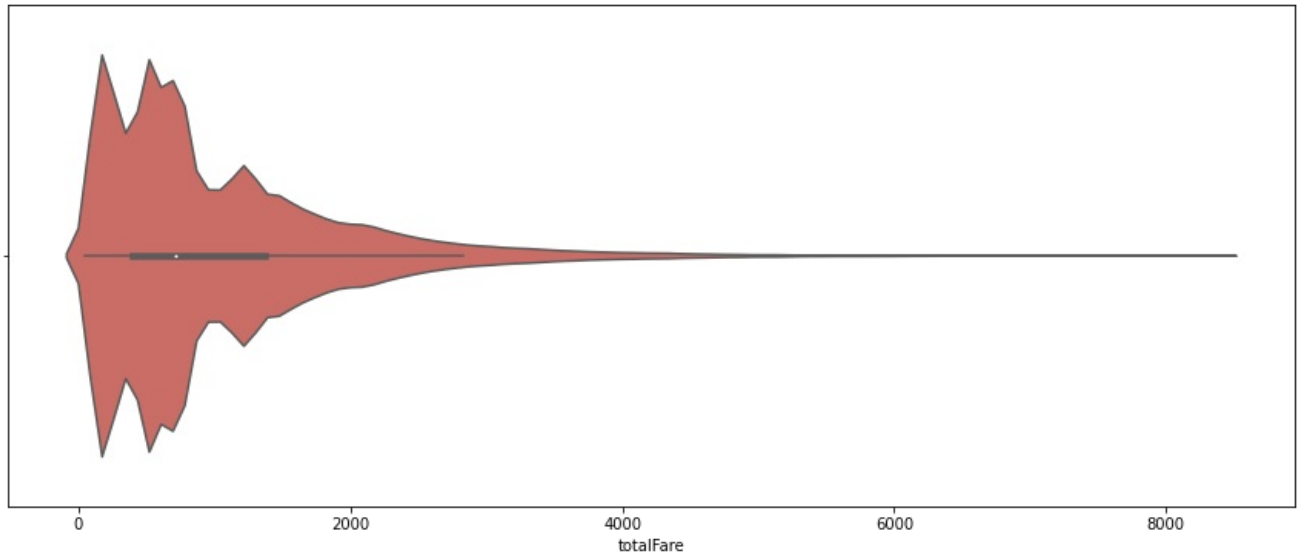
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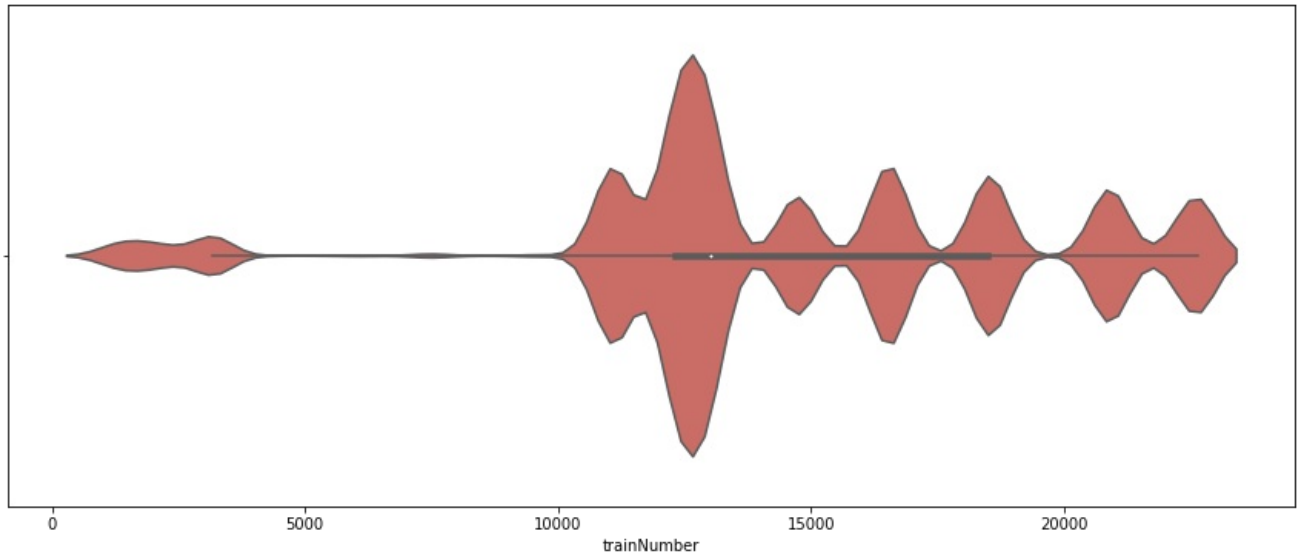
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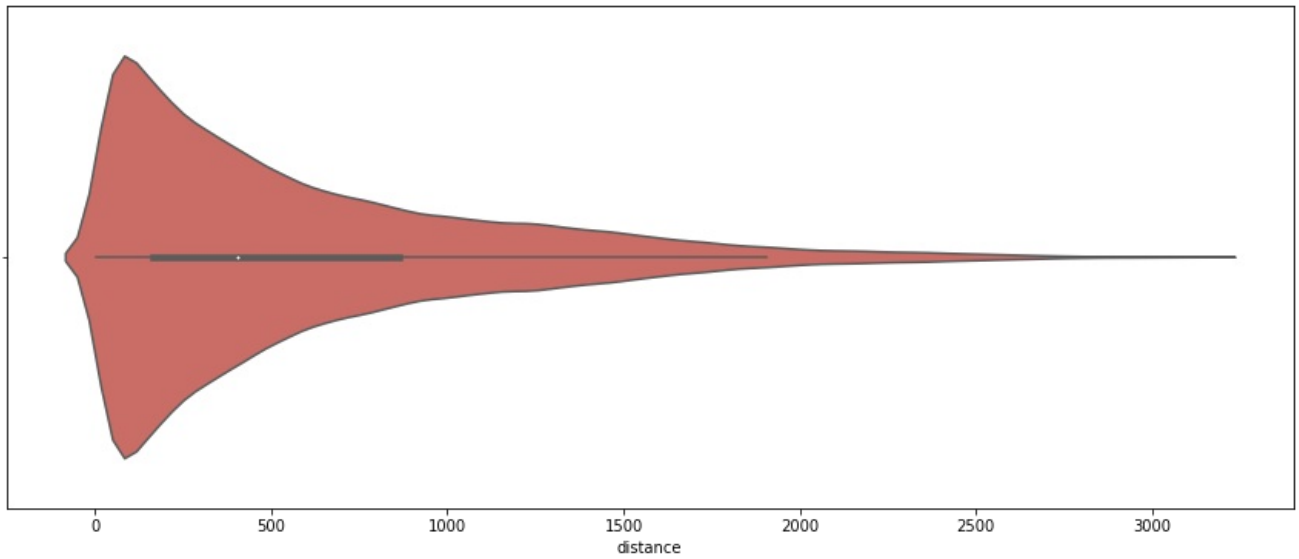
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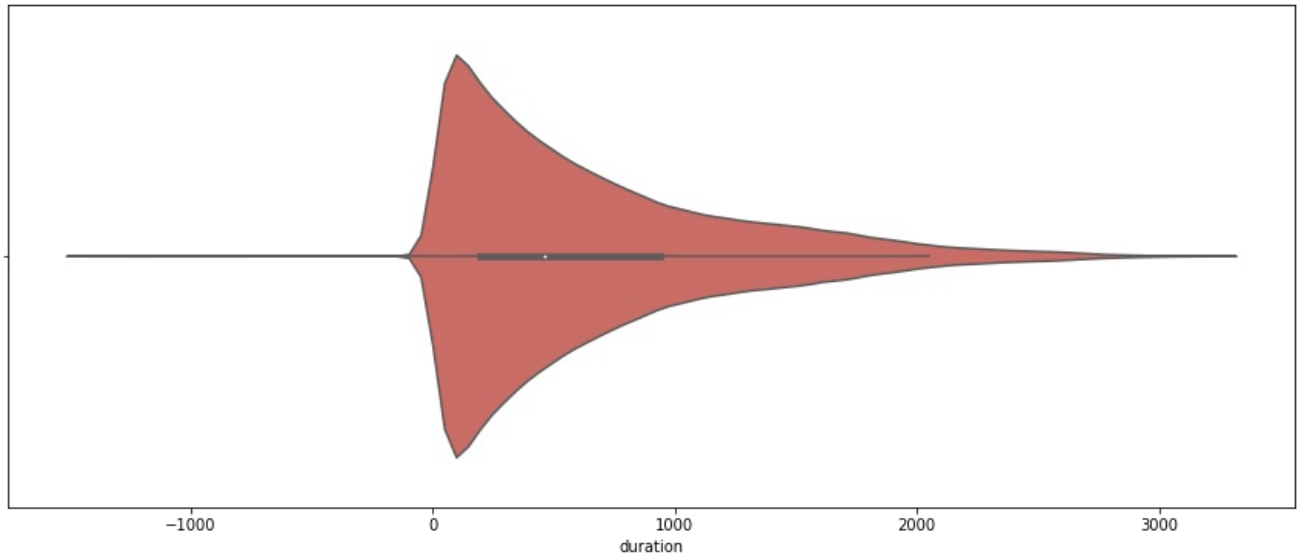
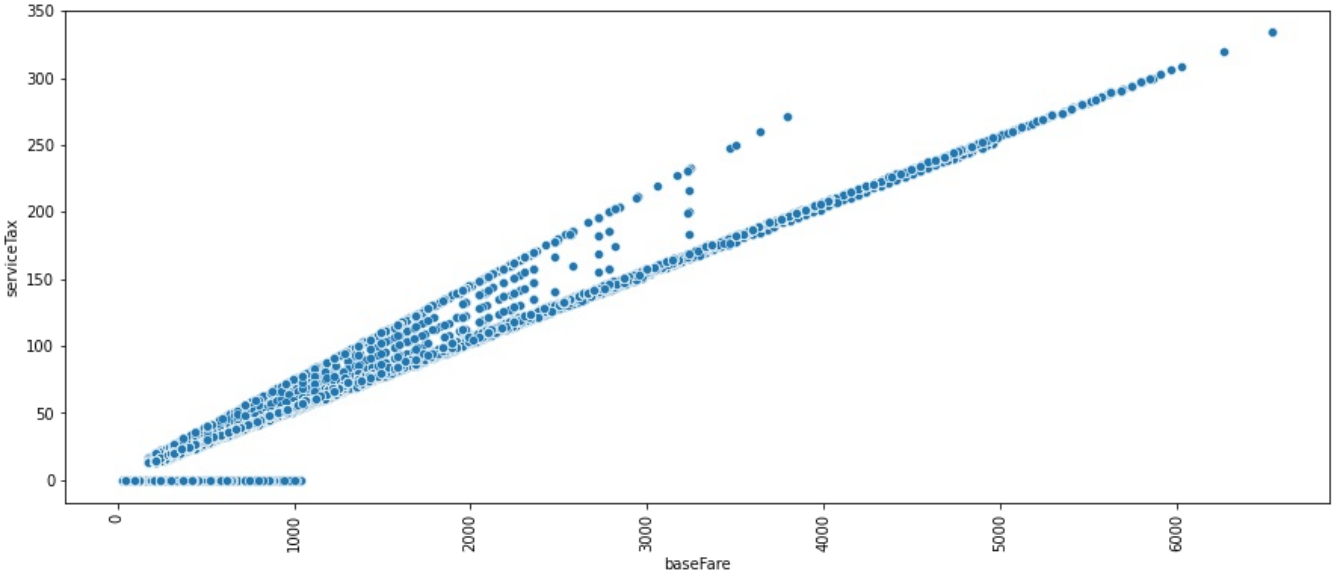
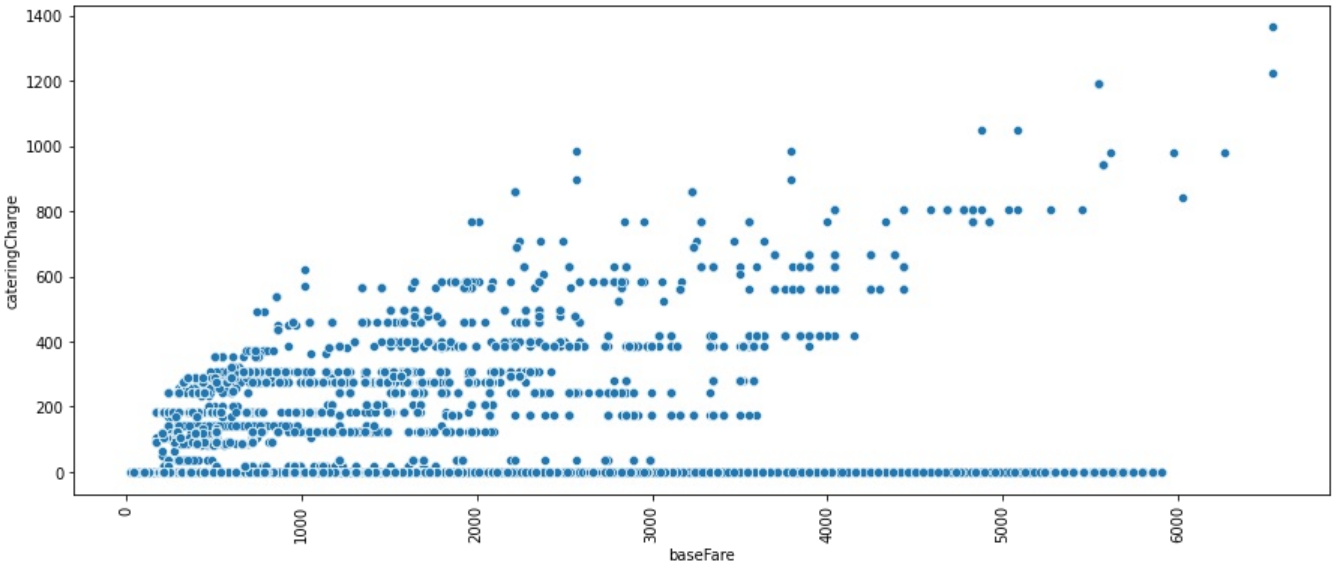


In [30]:
```
for i in continuous:
    for j in continuous:
        if i != j:
            plt.figure(figsize=(15,6))
            sns.scatterplot(x = i, y = j, data = df, ci = None, palette='hls')
            plt.xticks(rotation = 90)
            plt.show()
```

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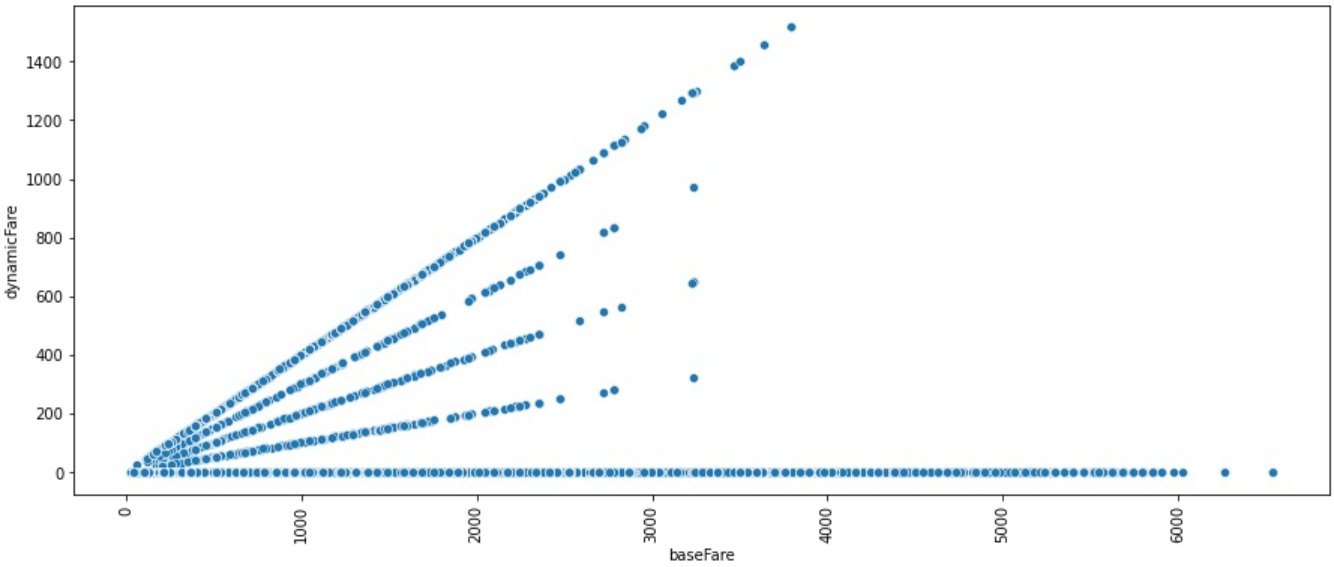
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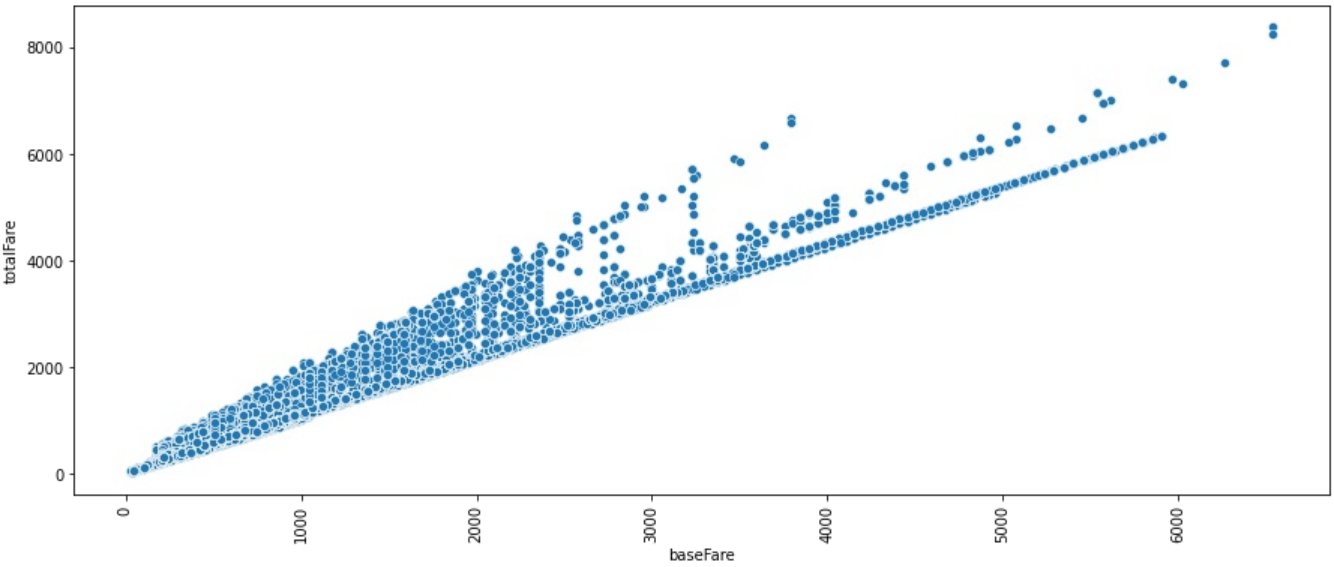
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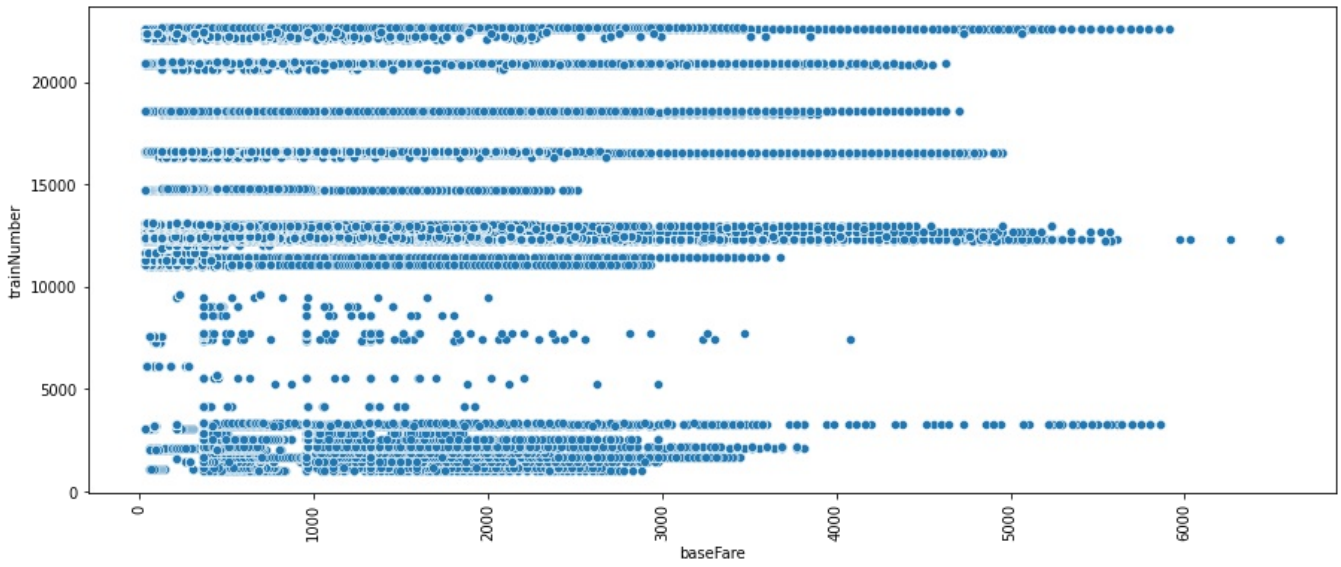
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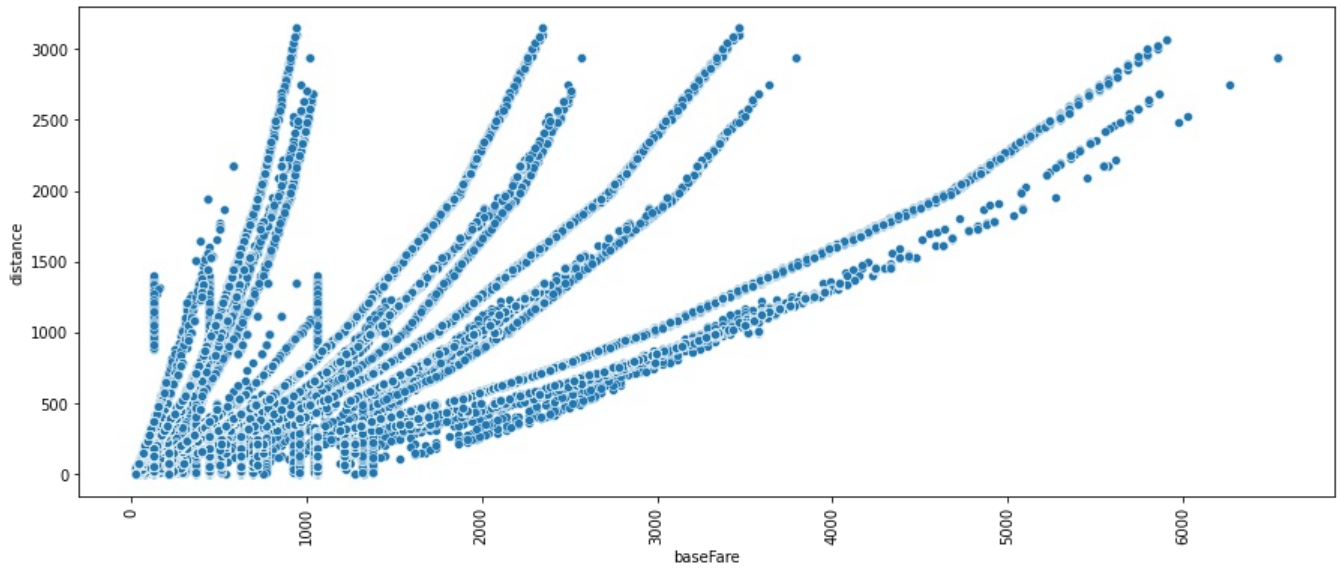
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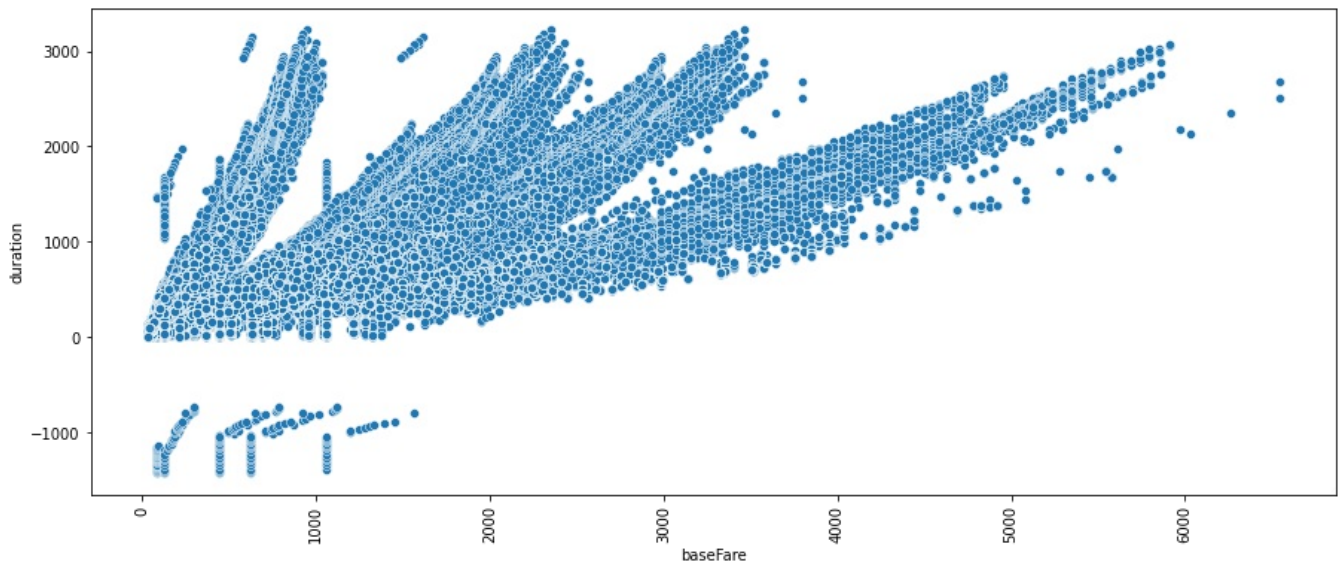
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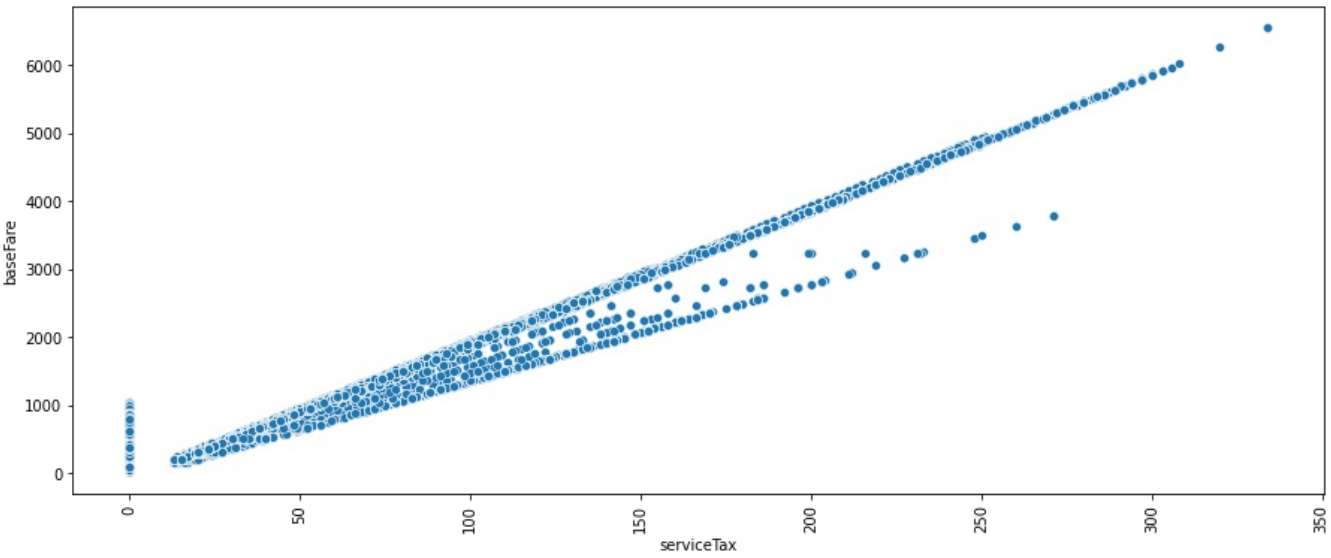
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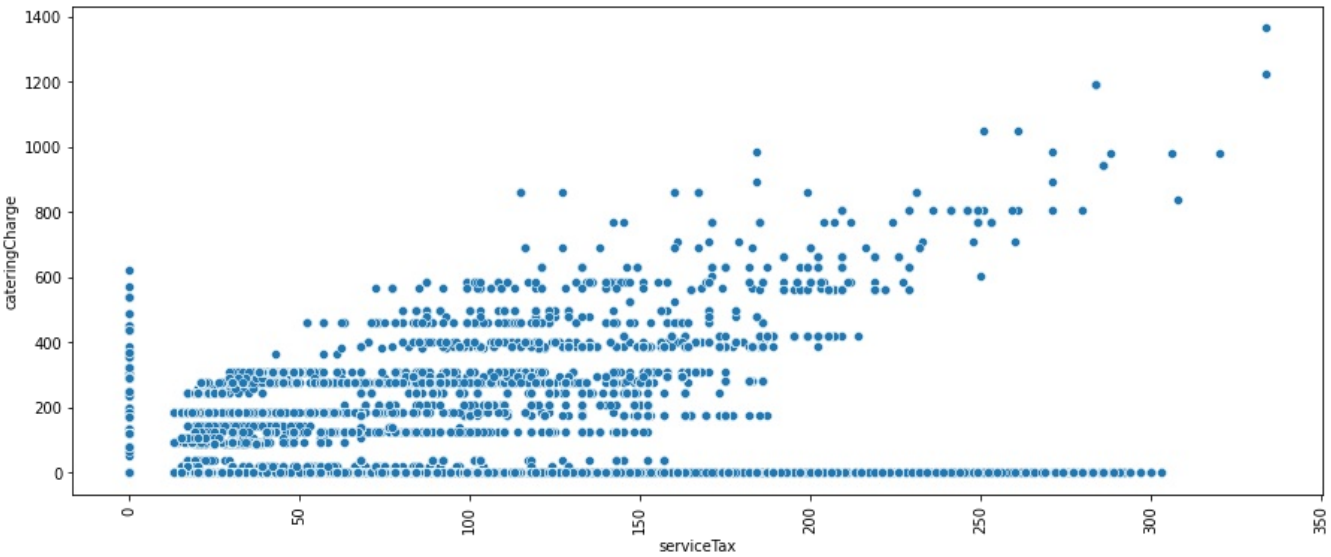
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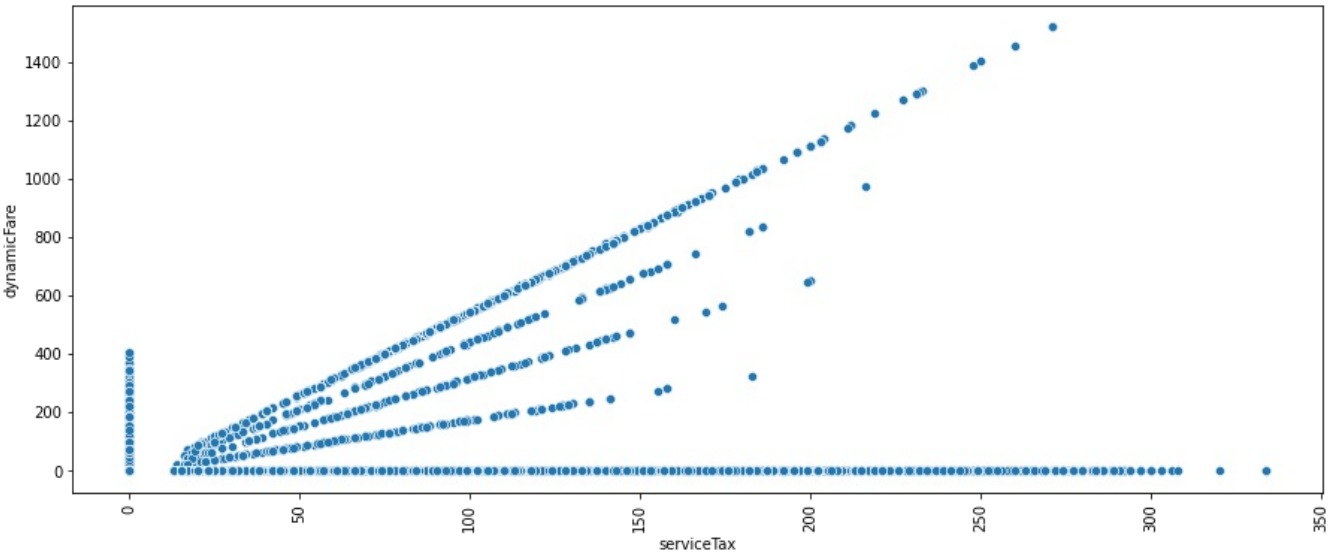
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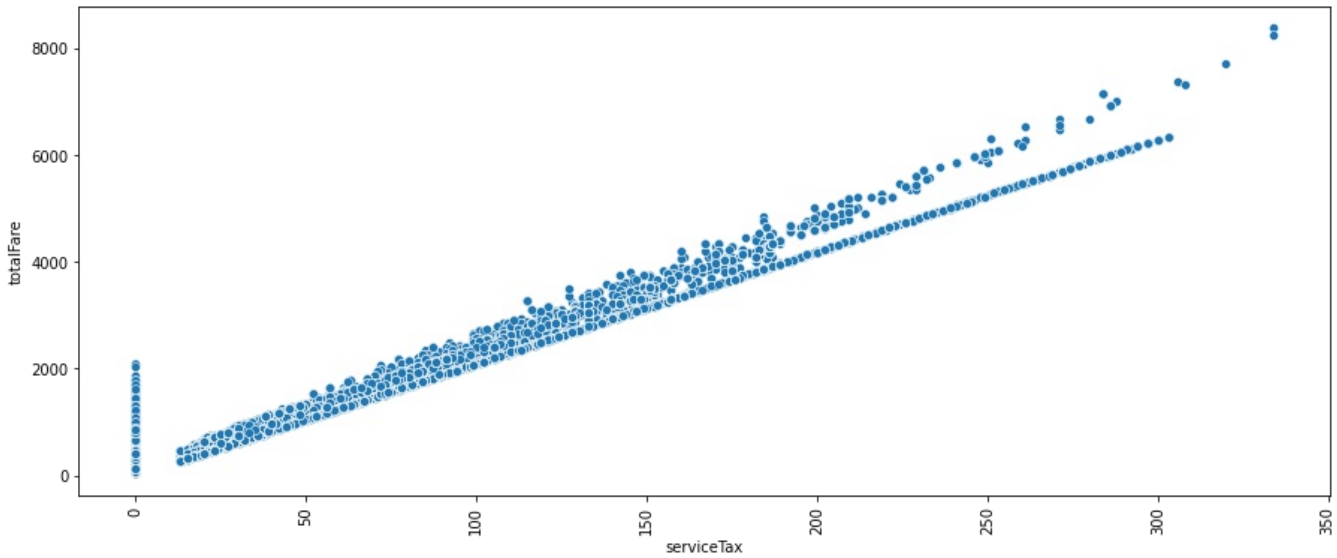
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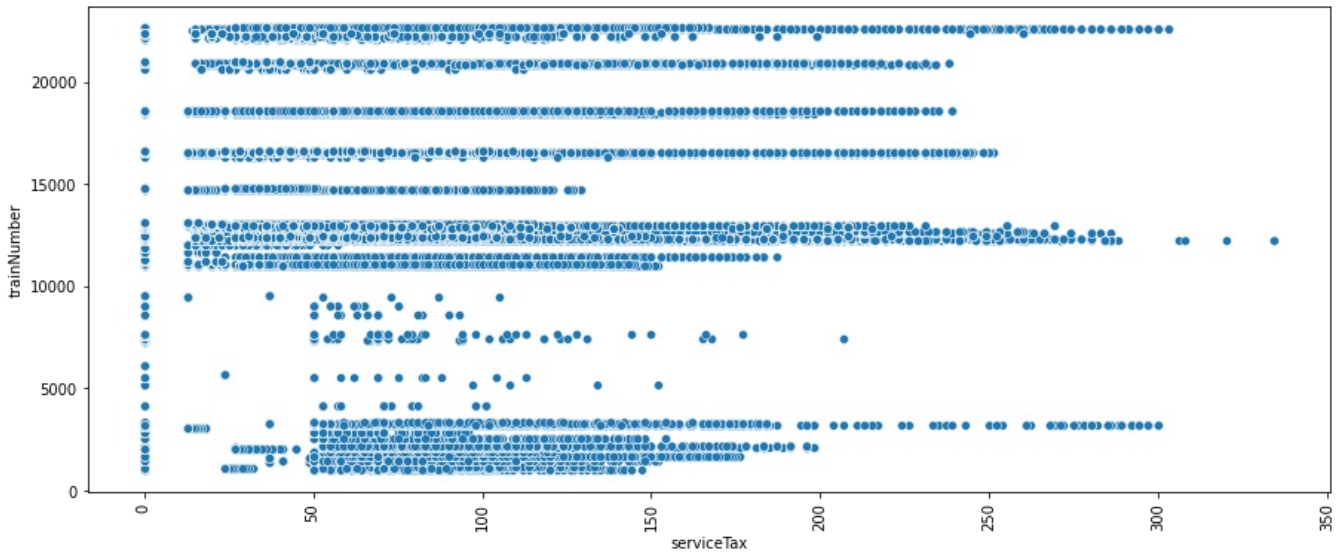
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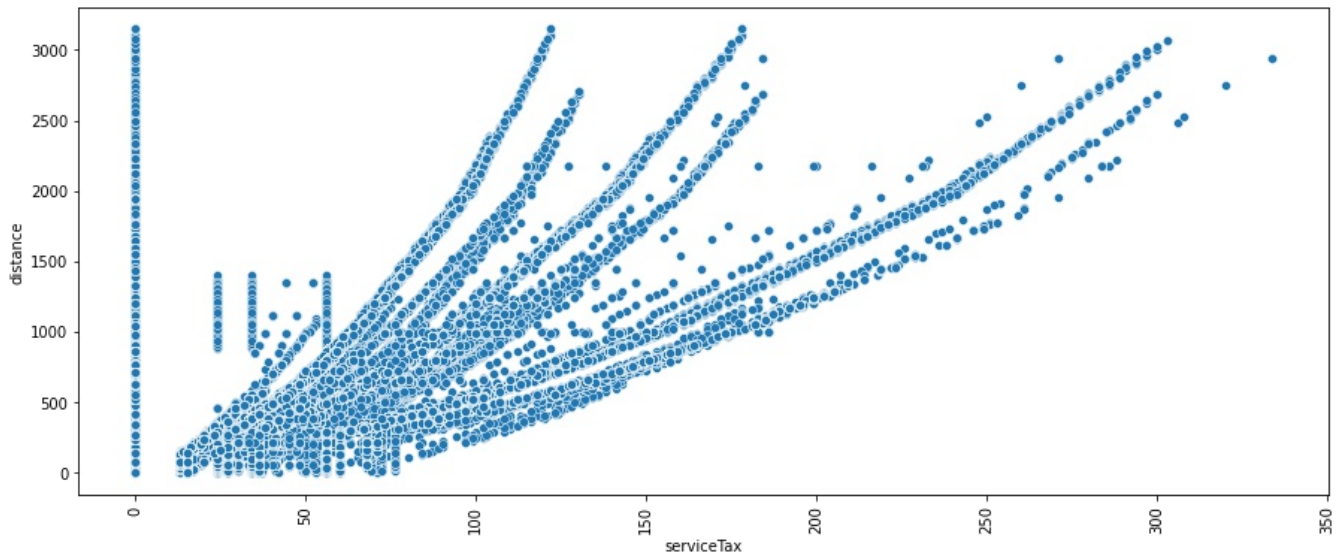
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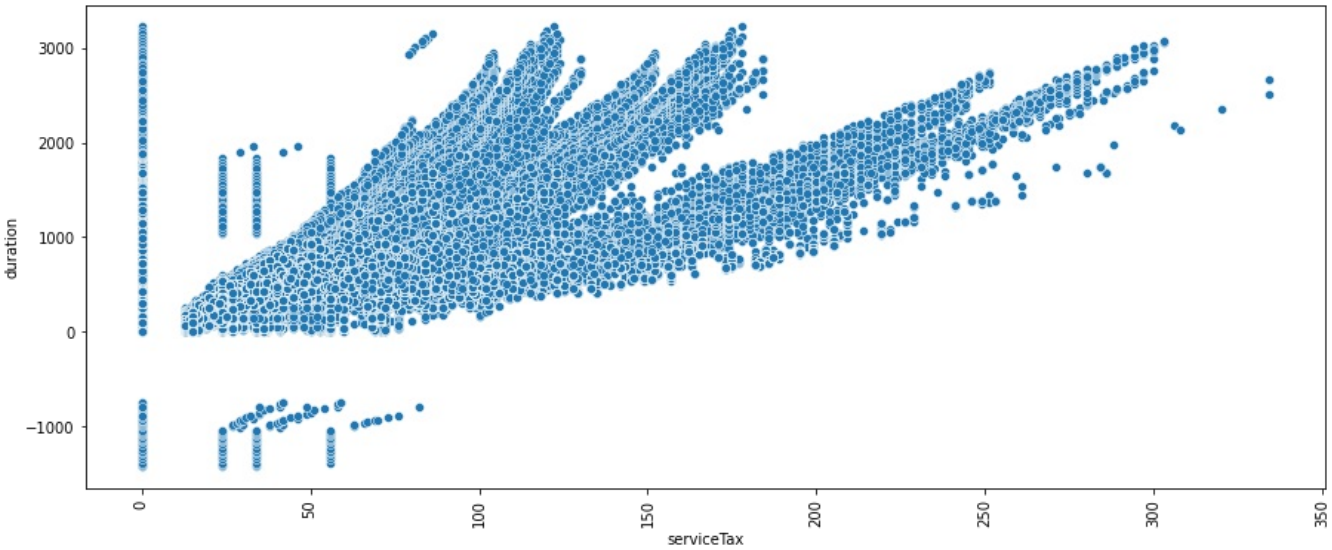
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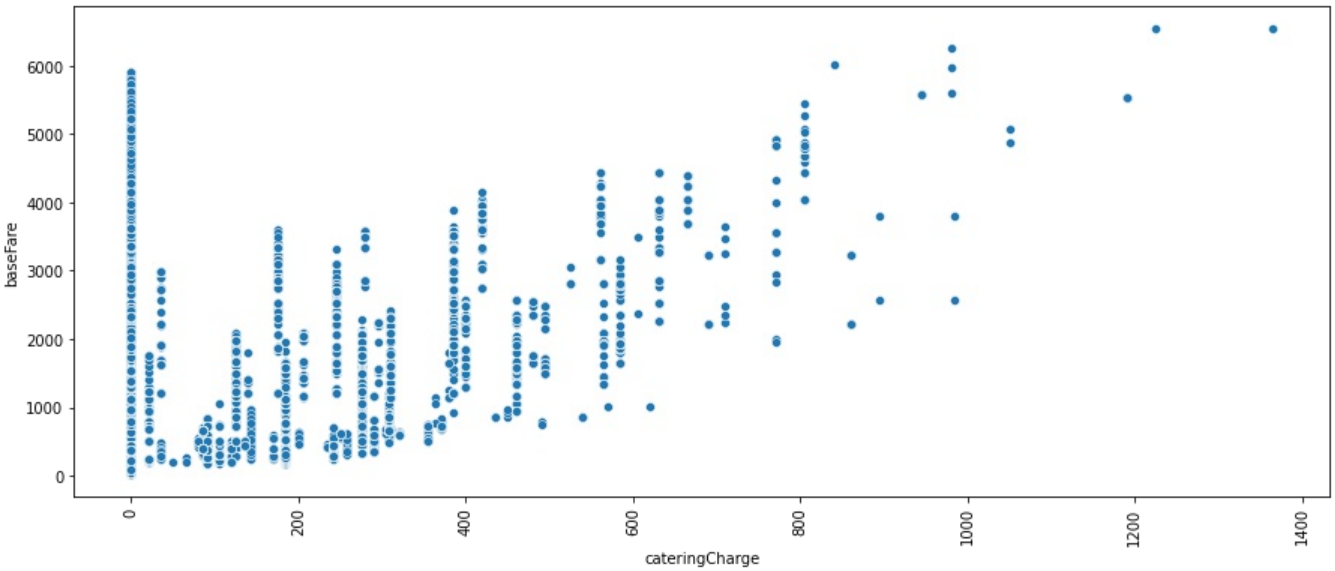
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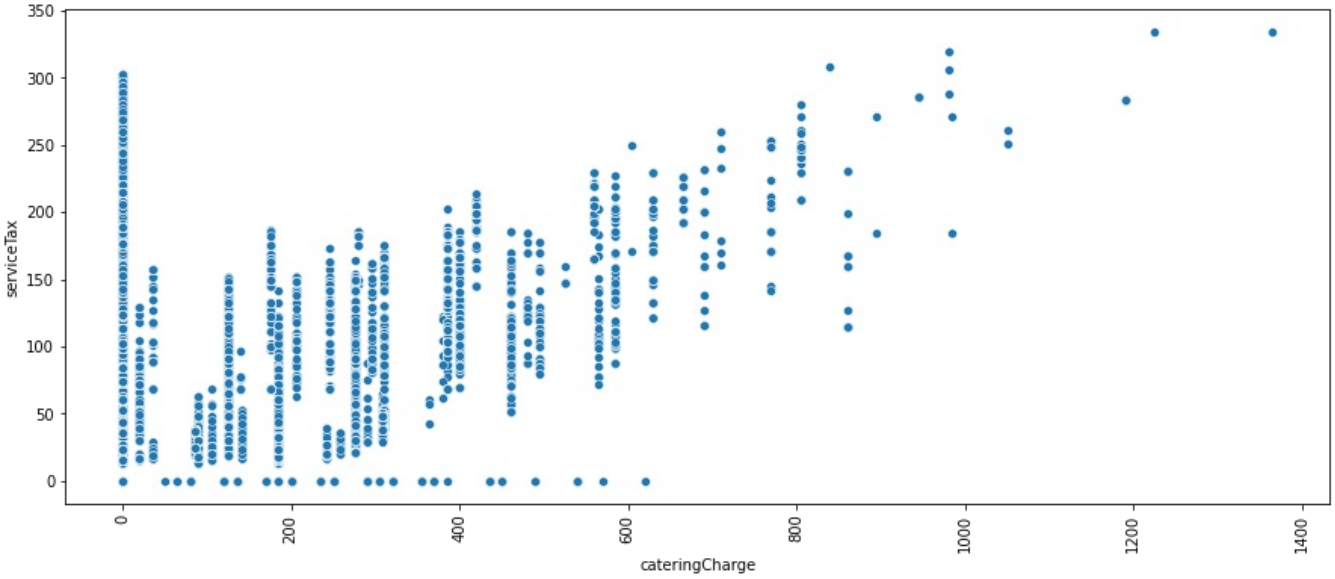
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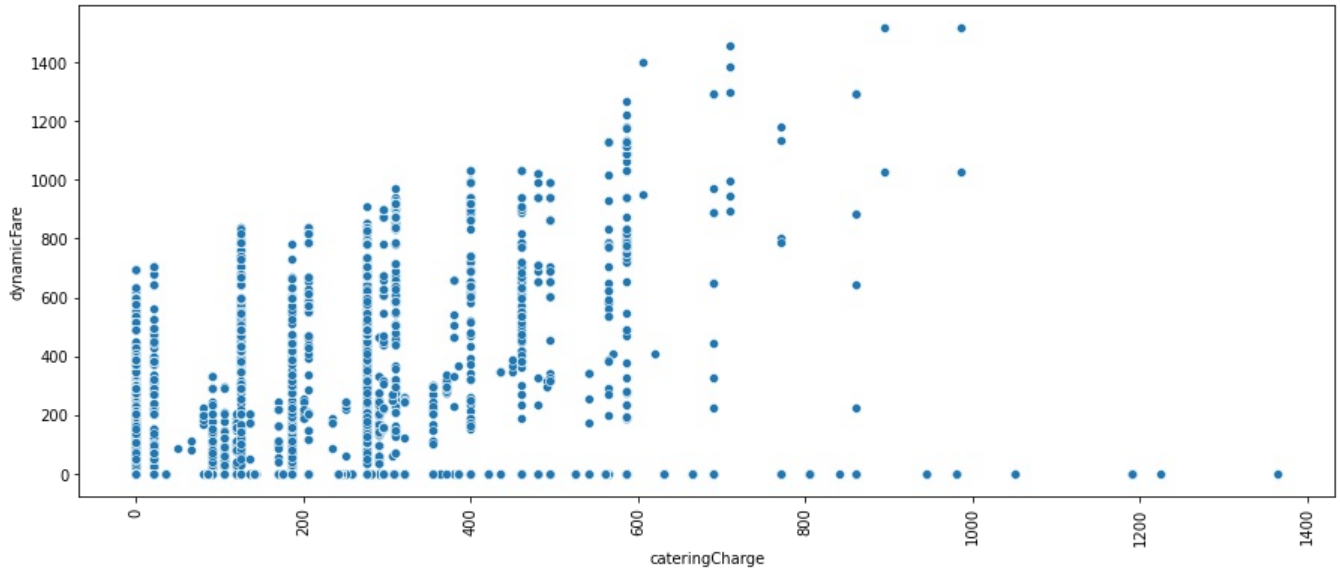
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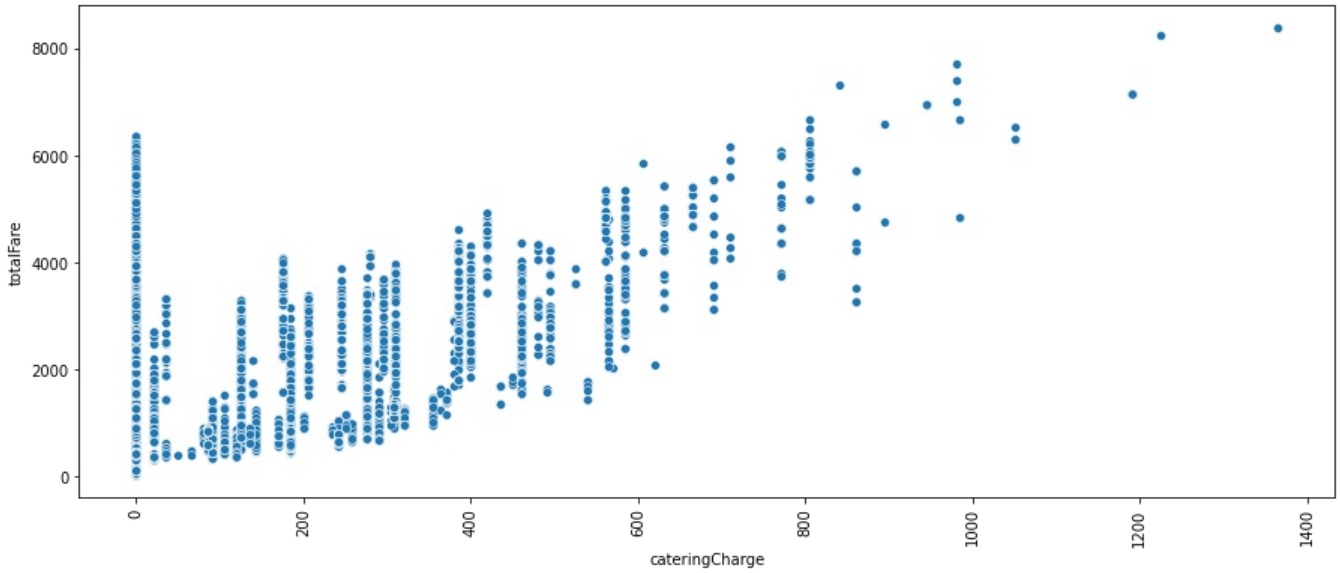
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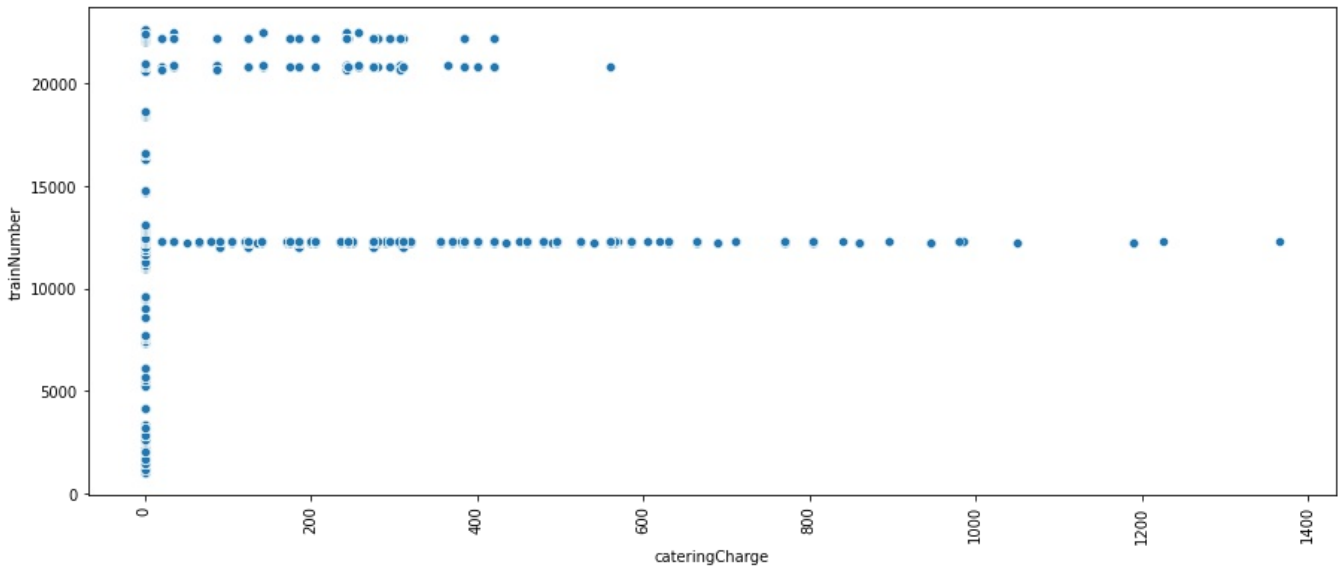
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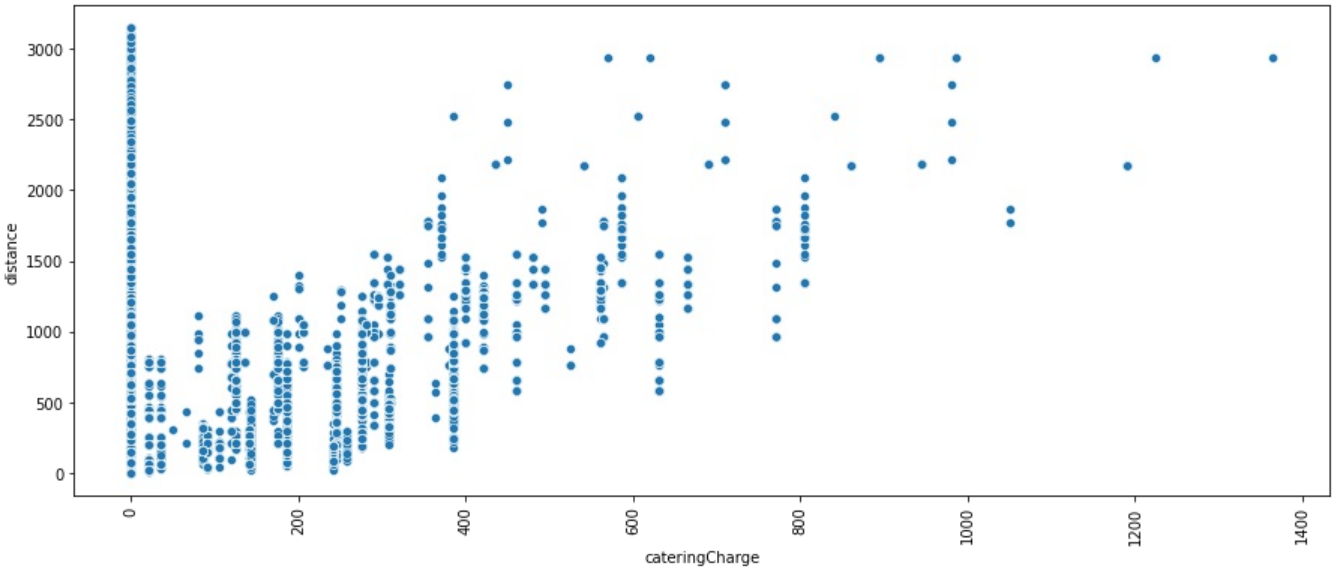
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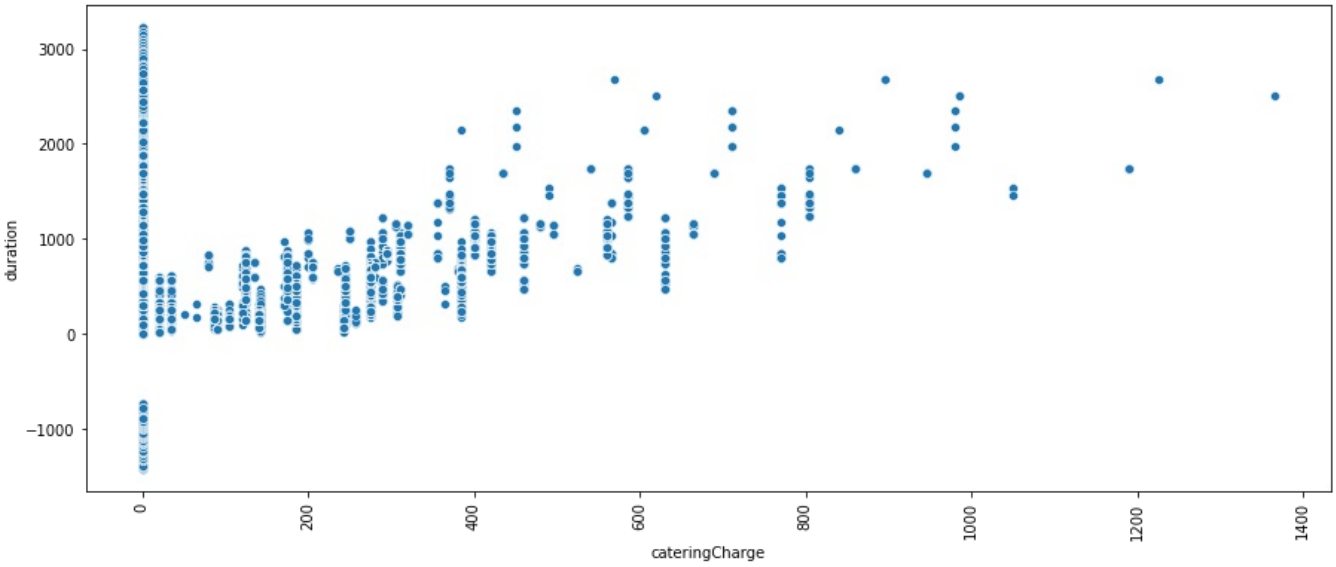
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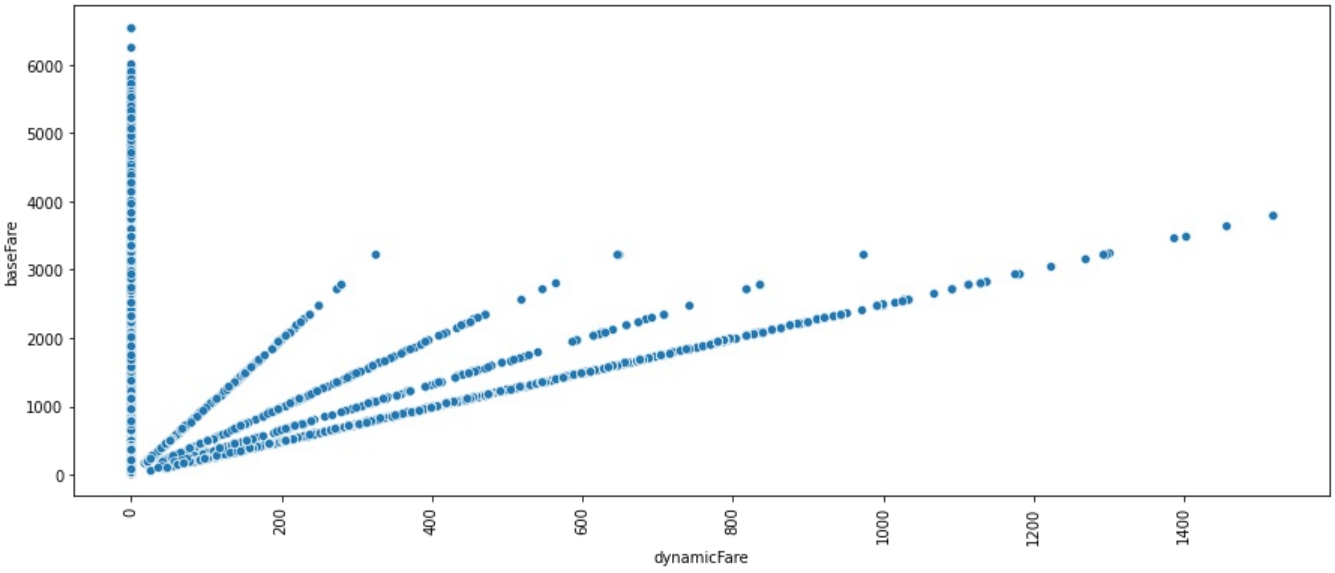
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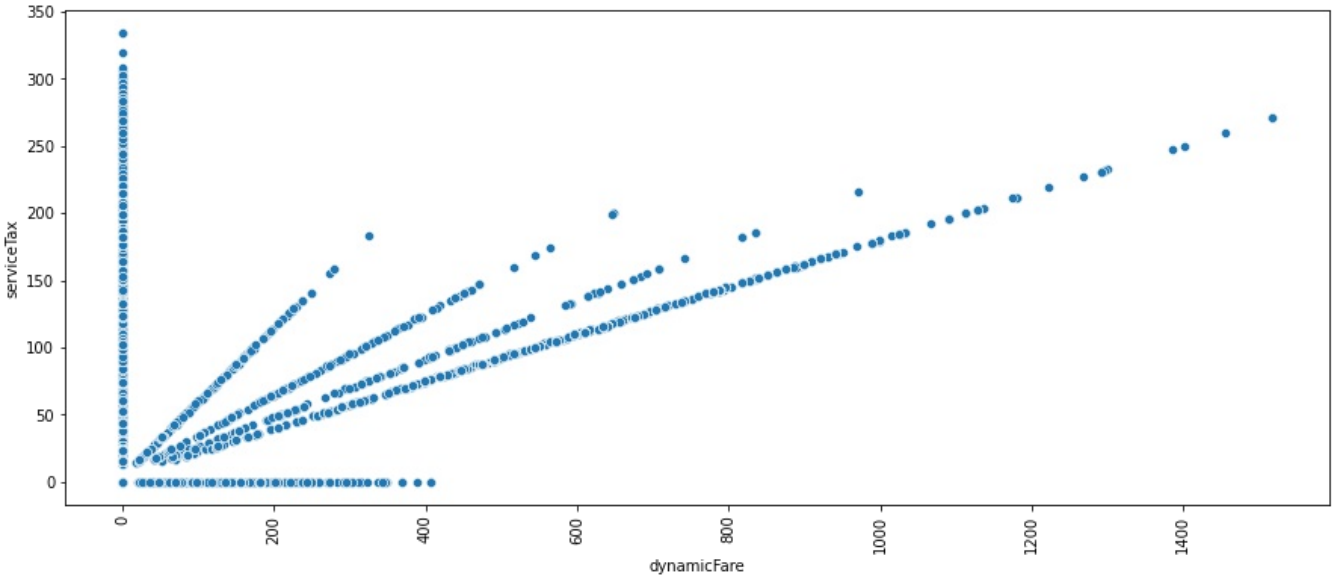
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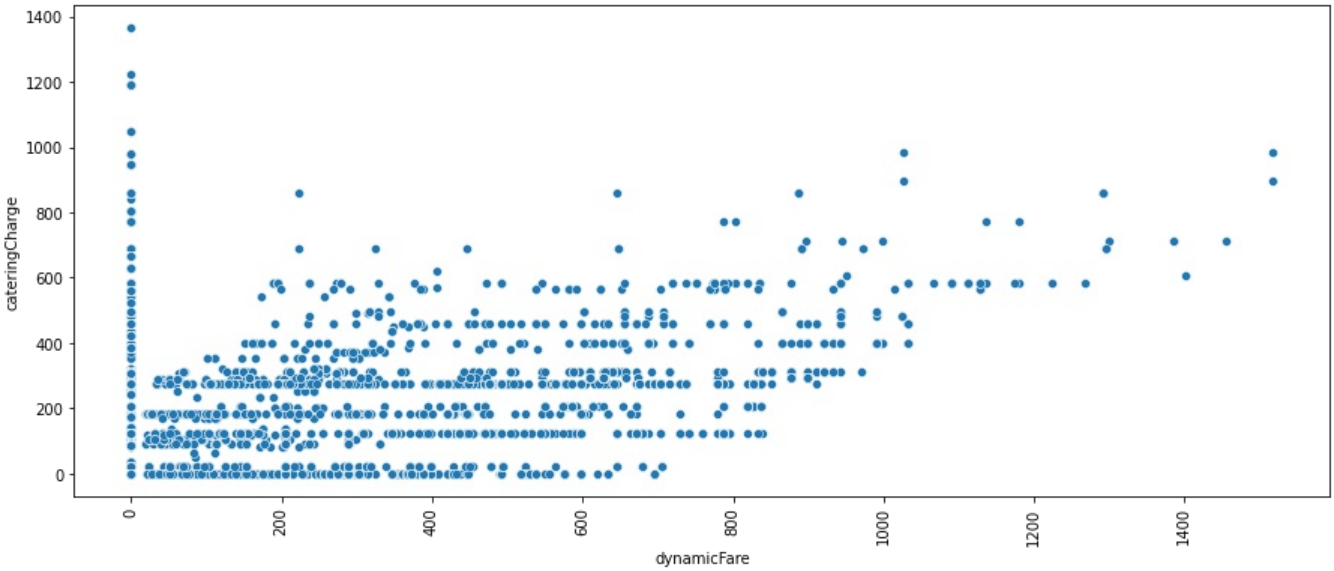
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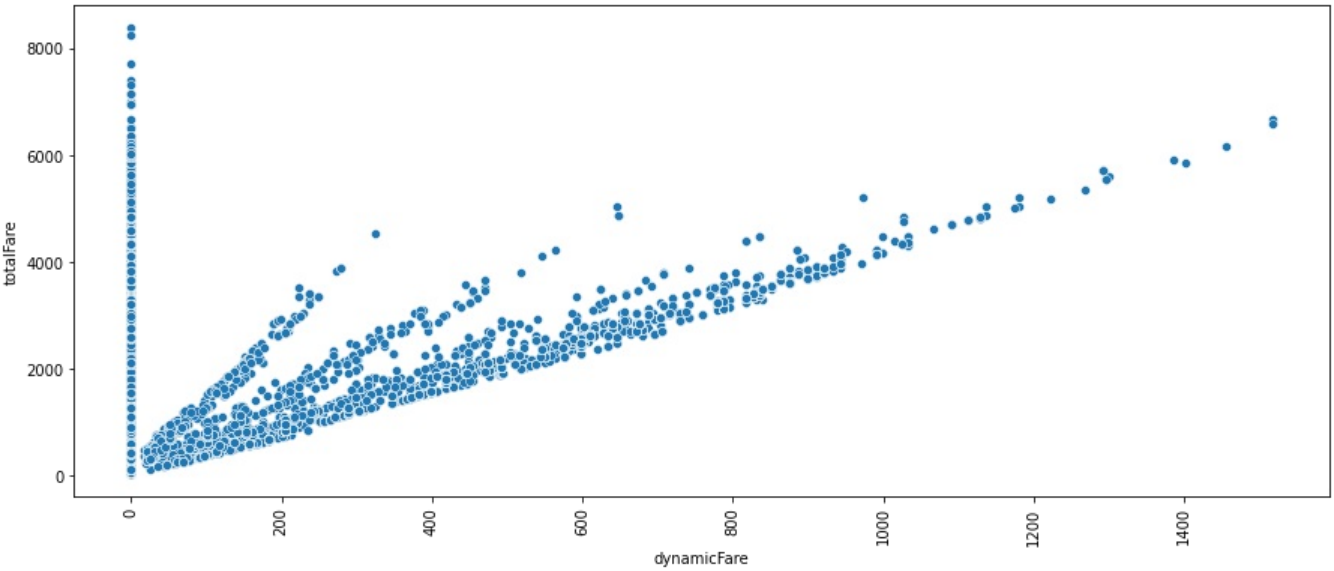
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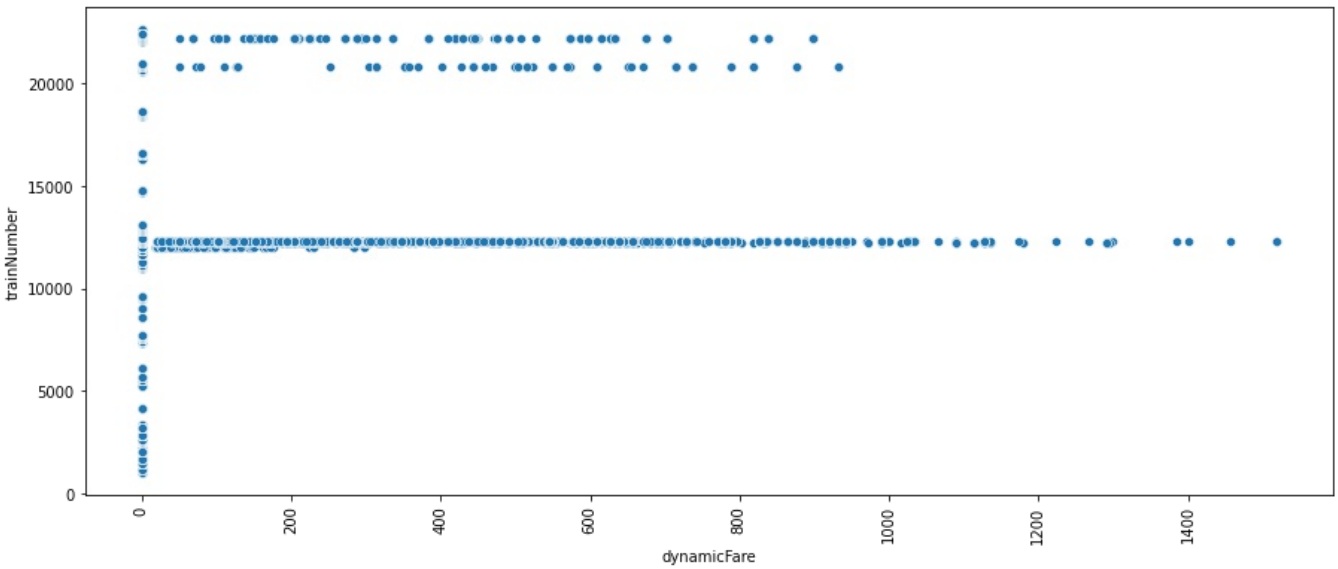
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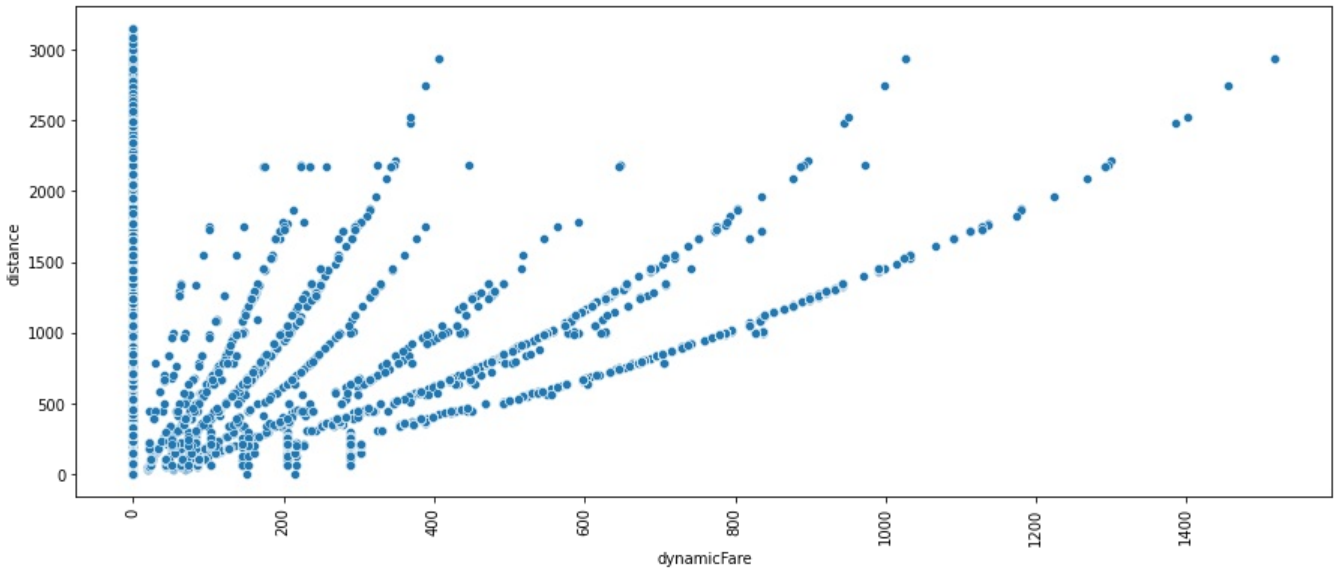
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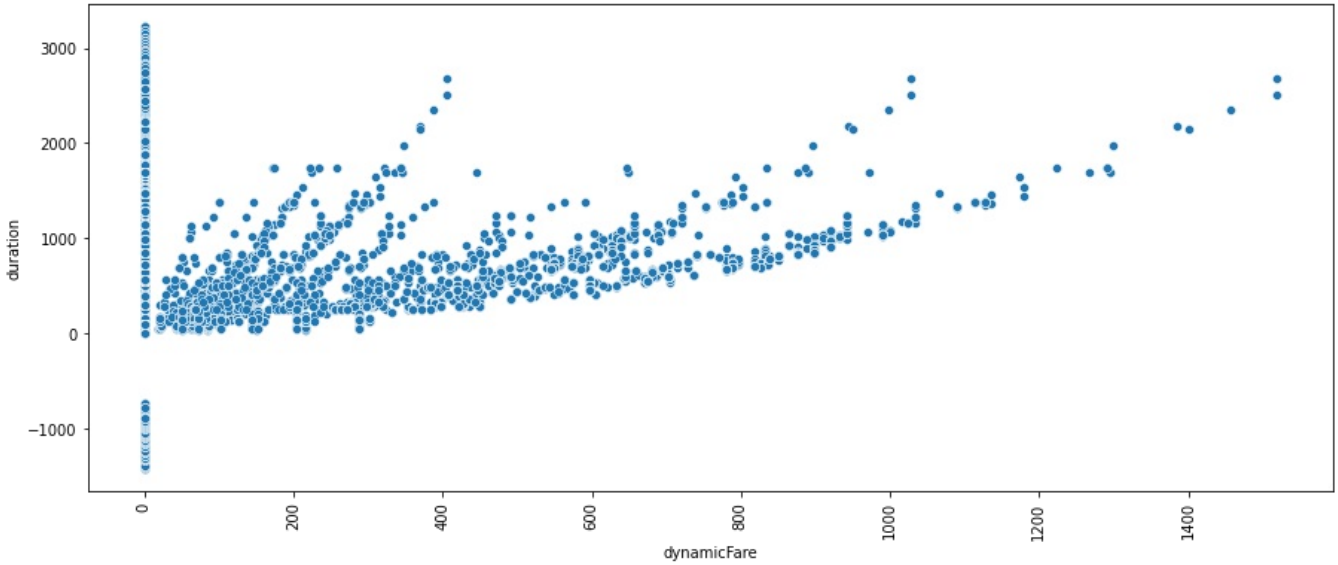
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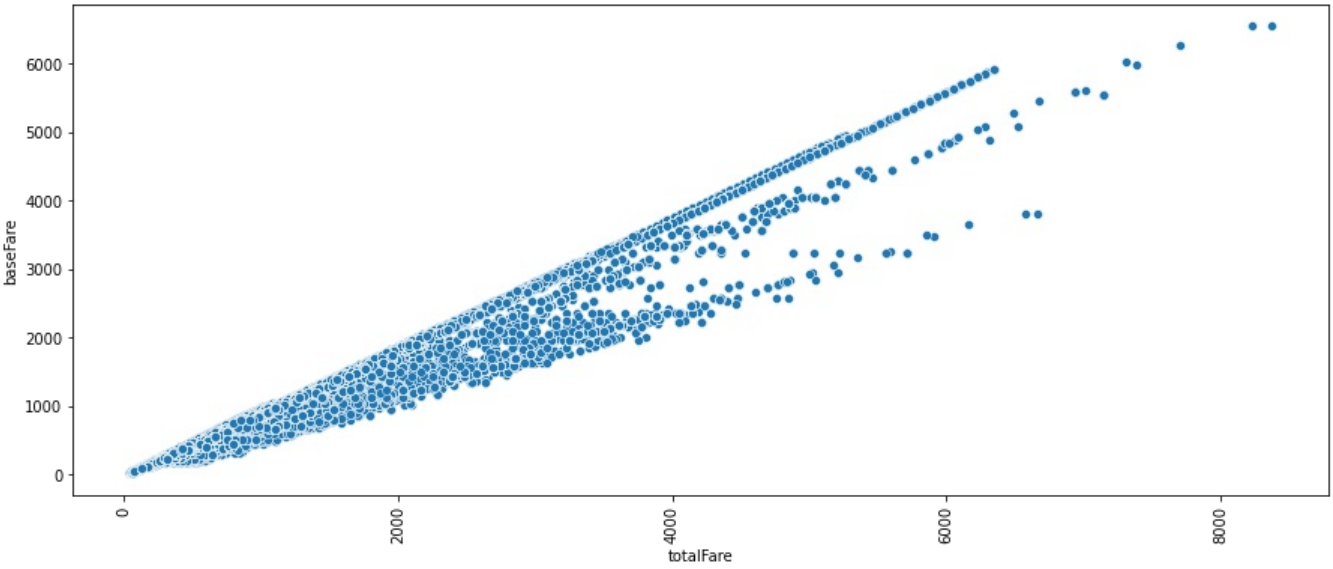
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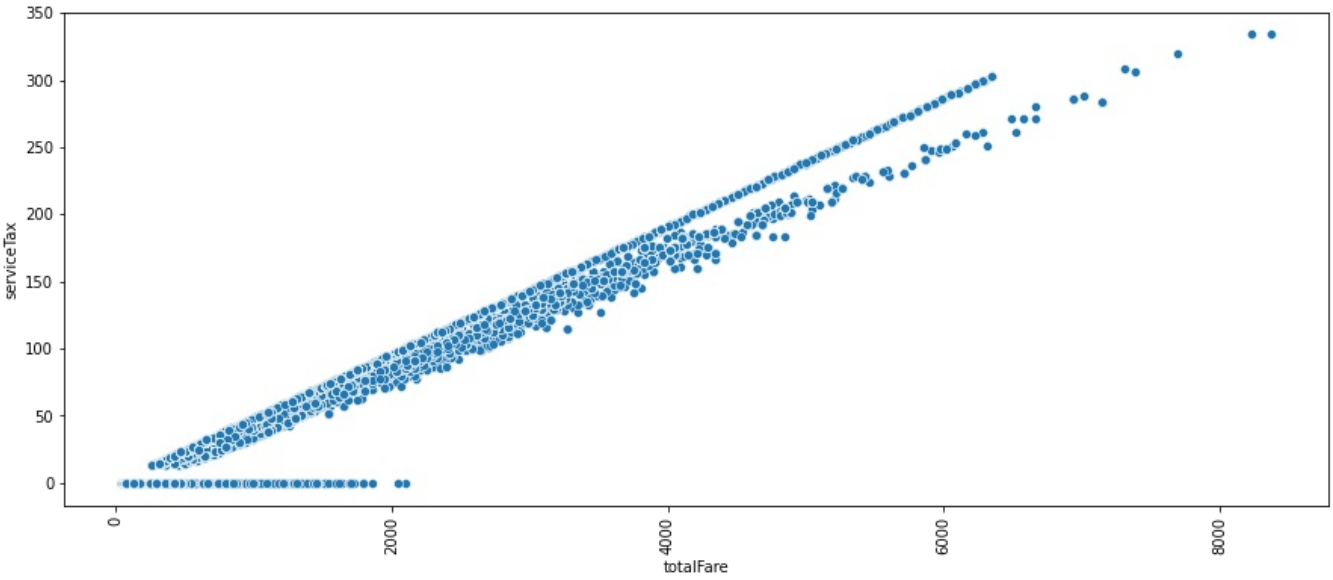
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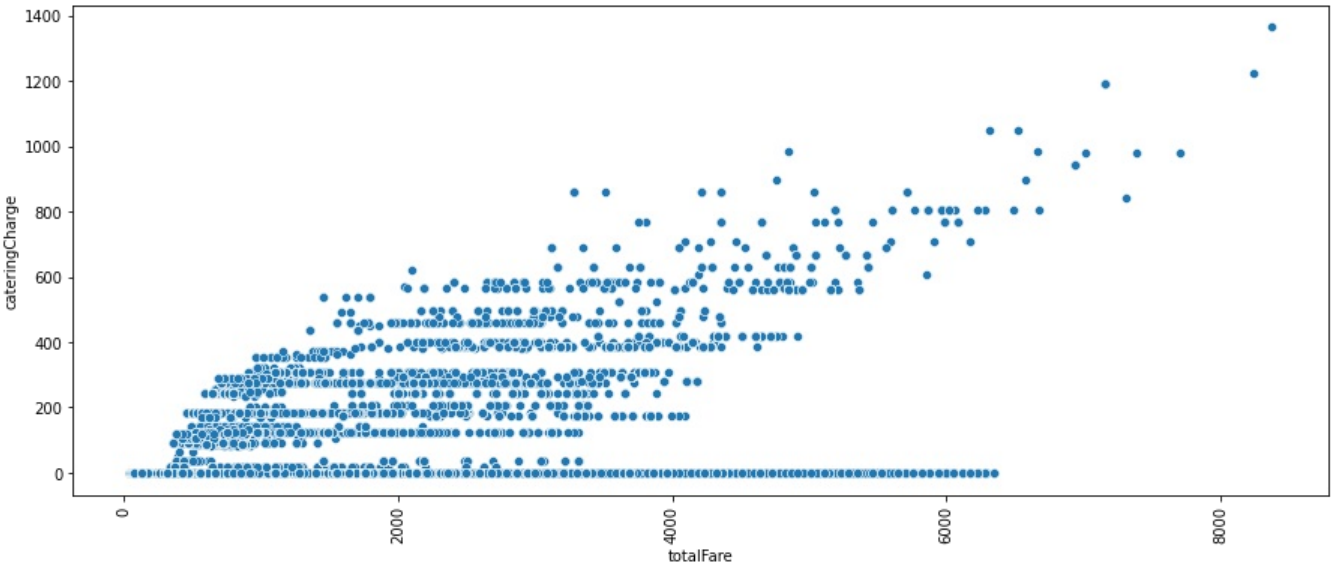
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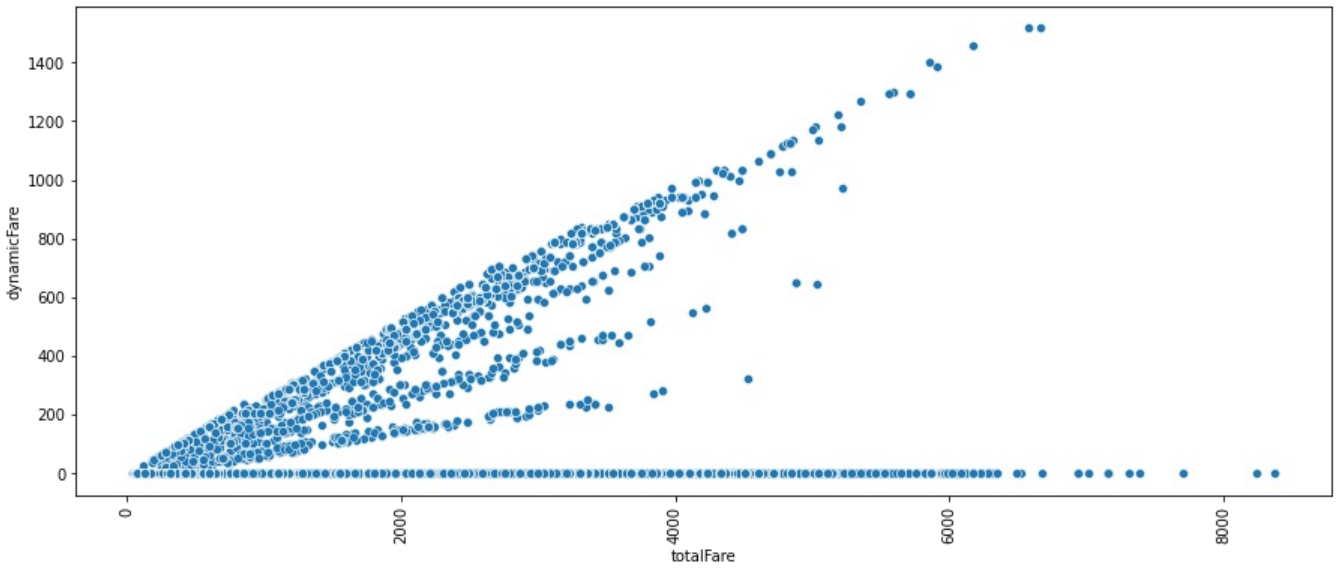
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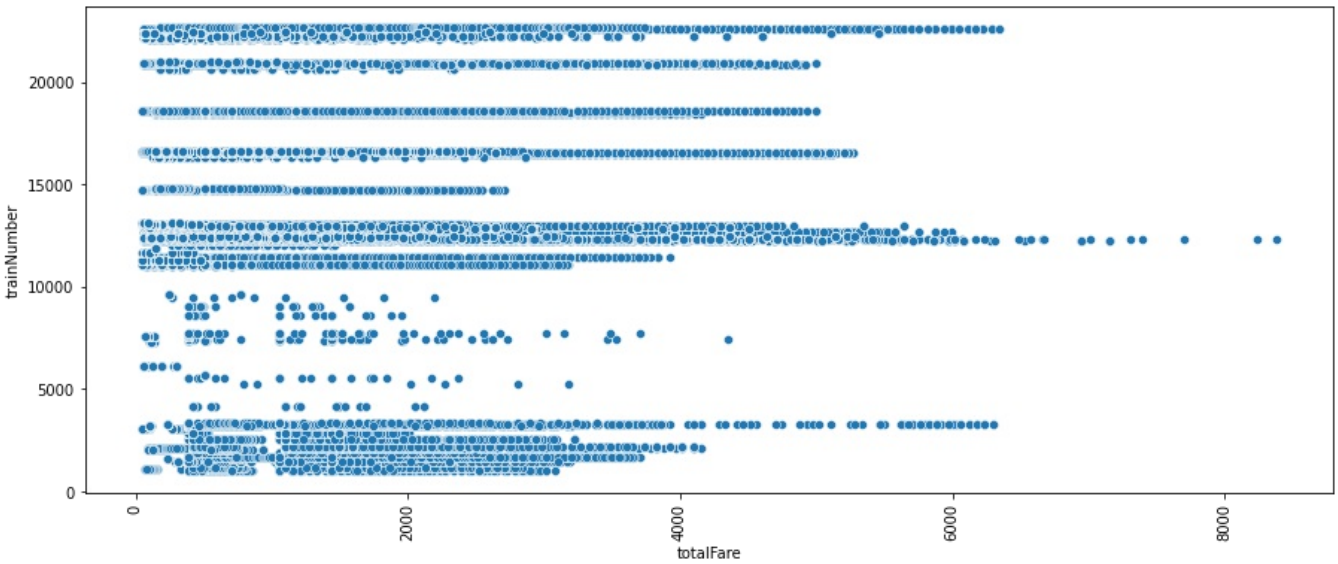
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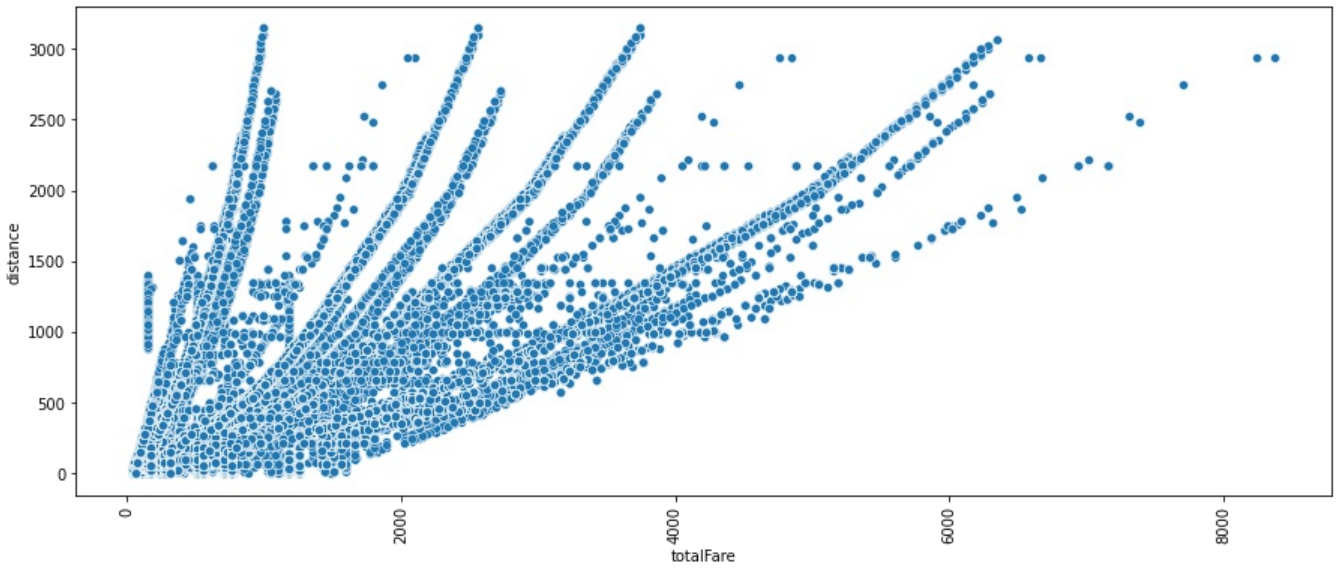
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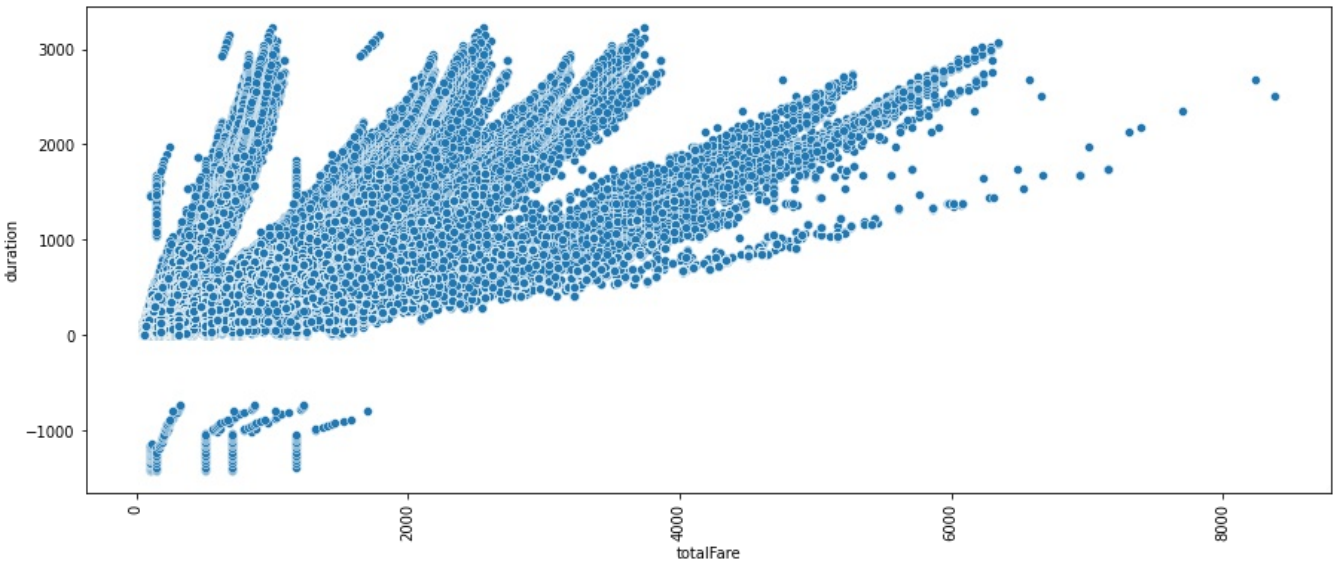
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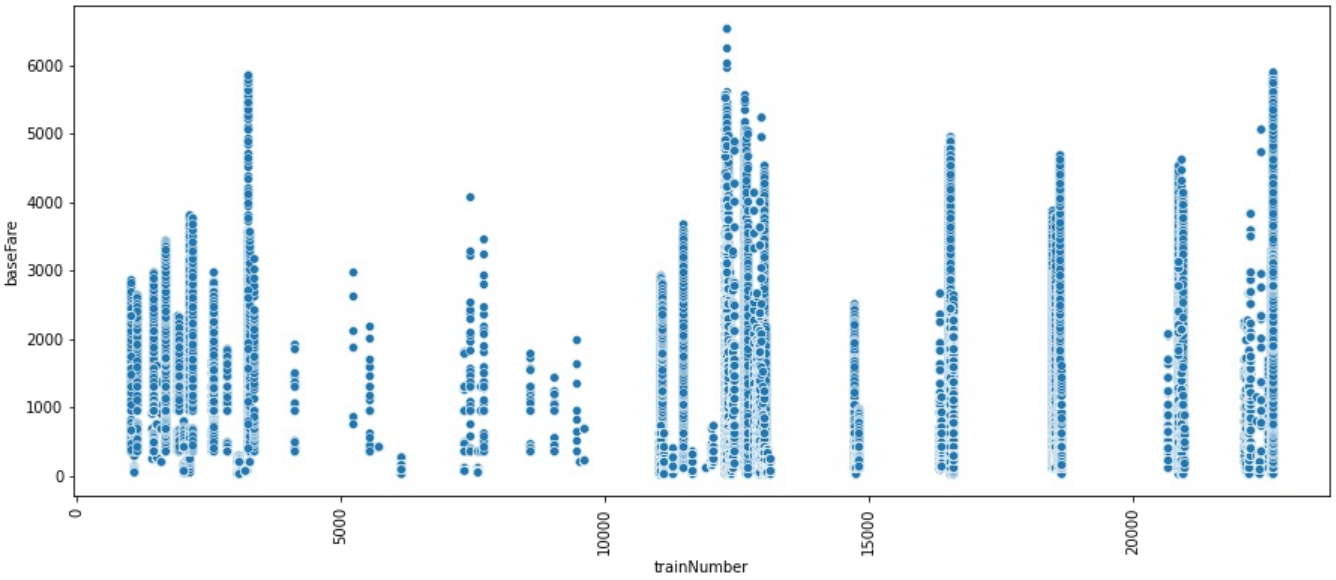
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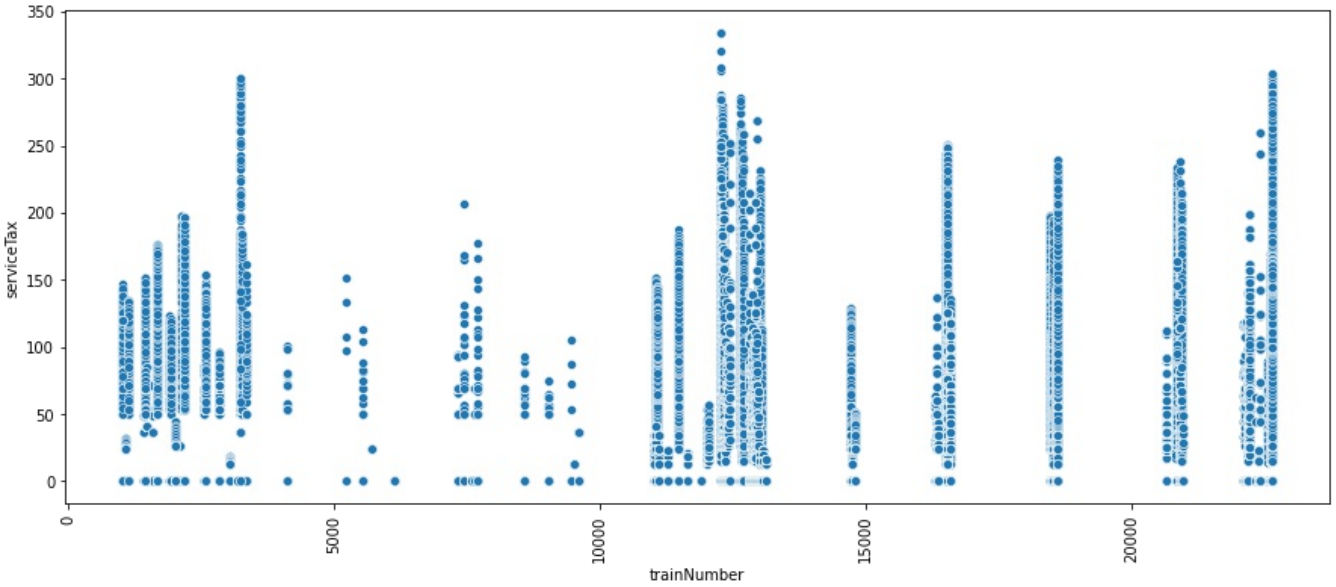
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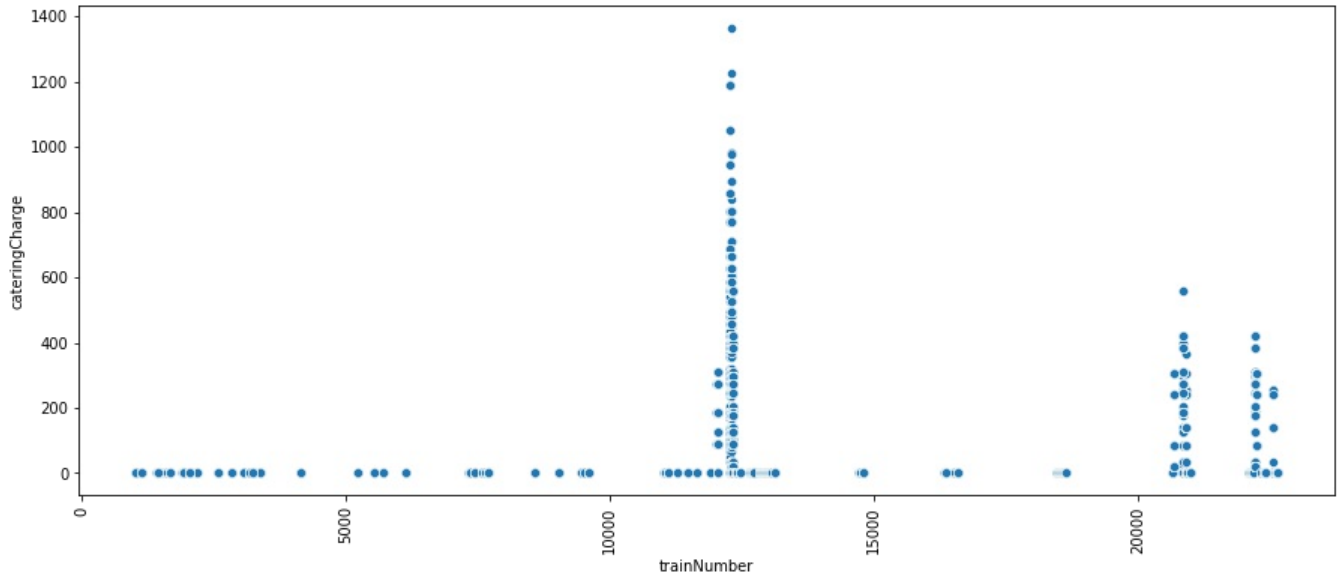
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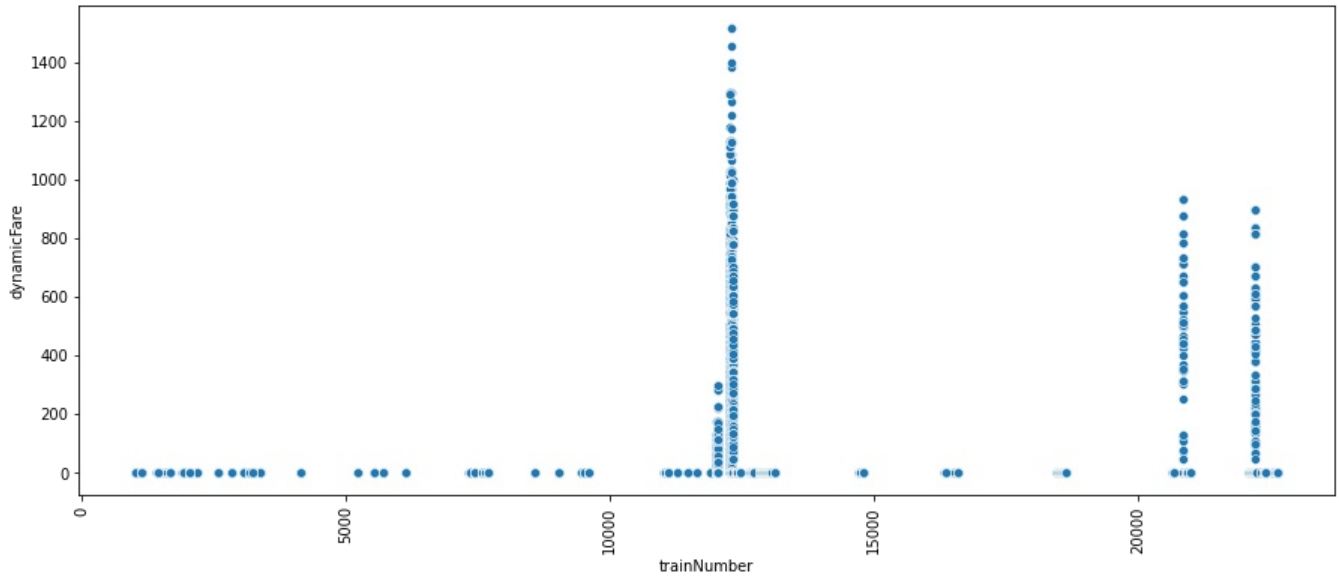
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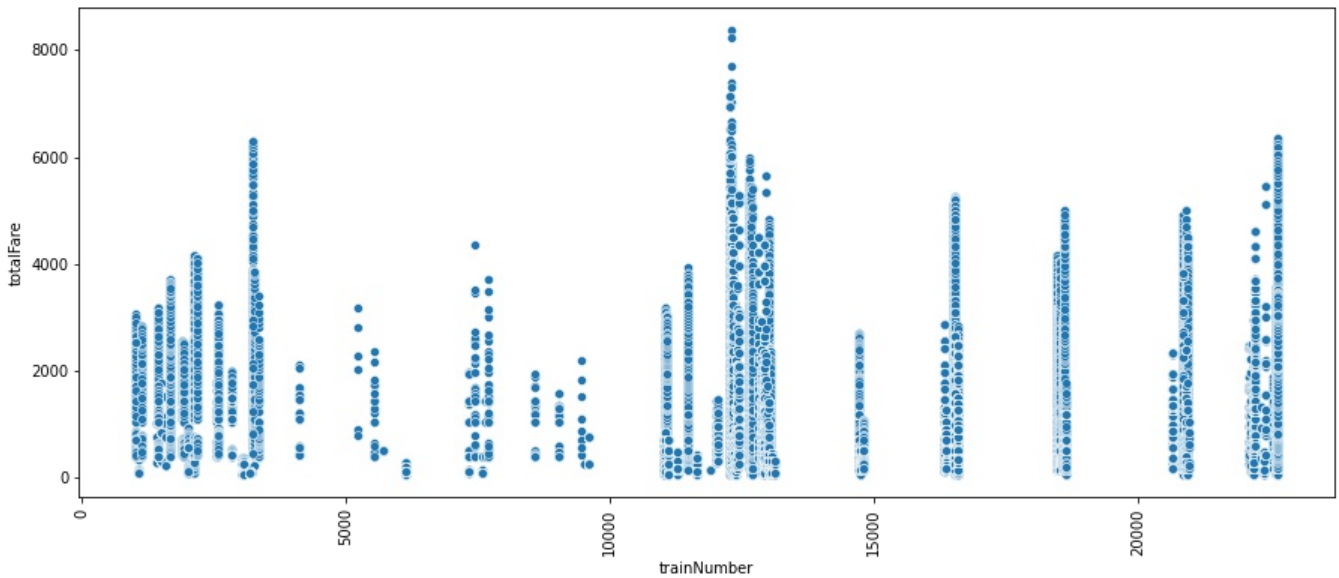
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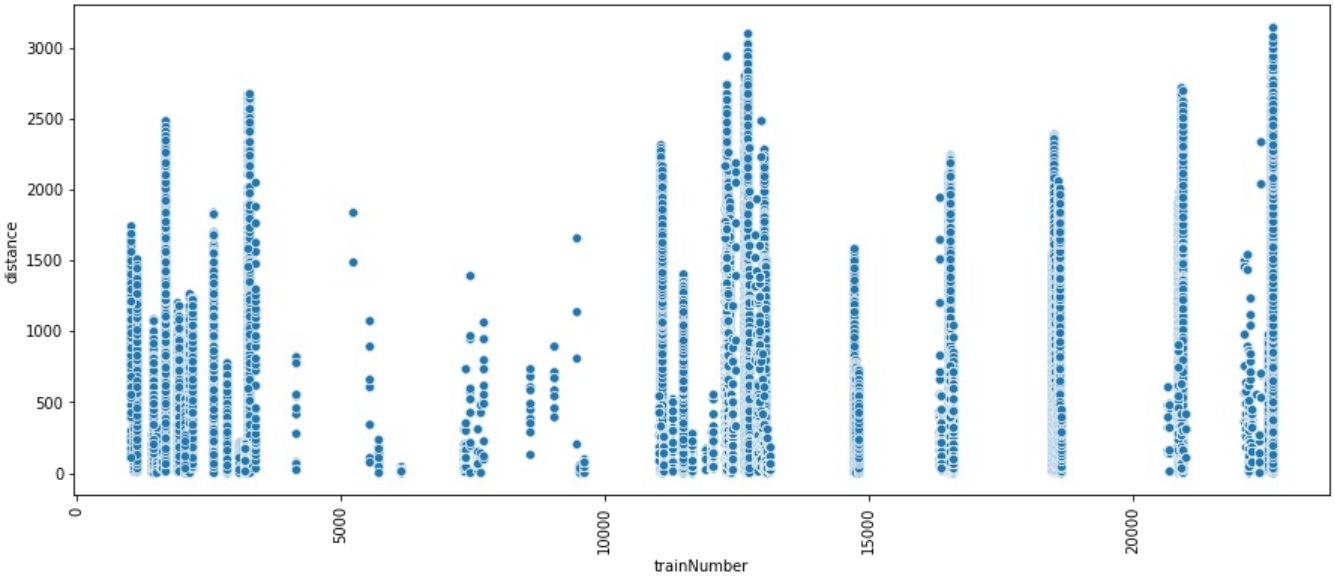
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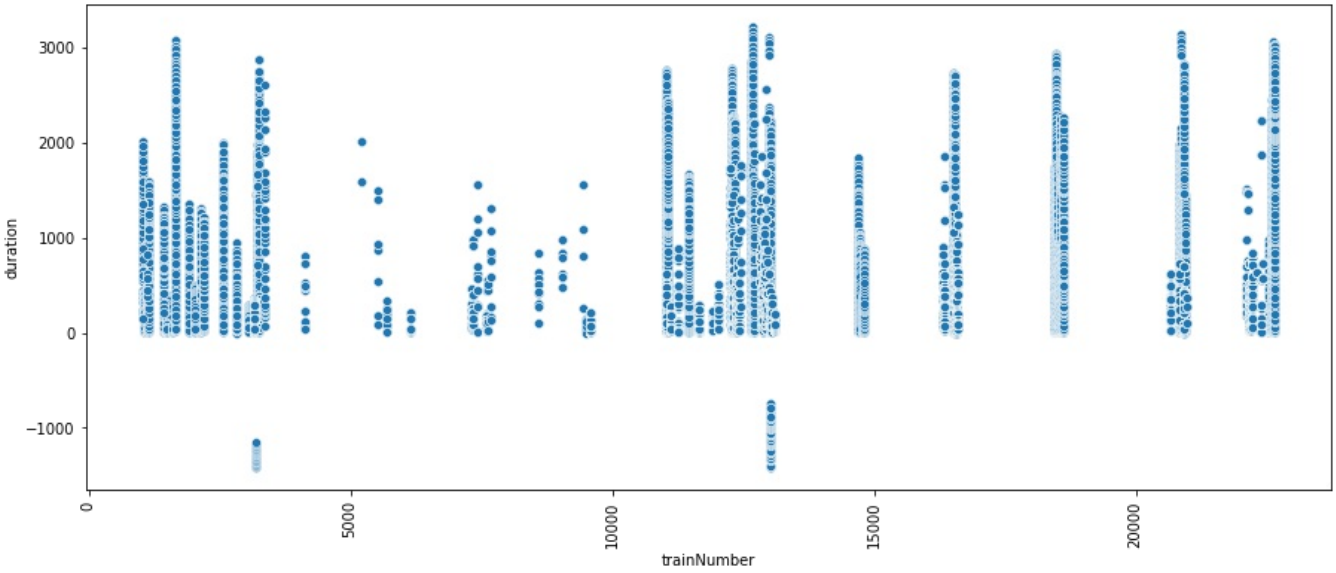
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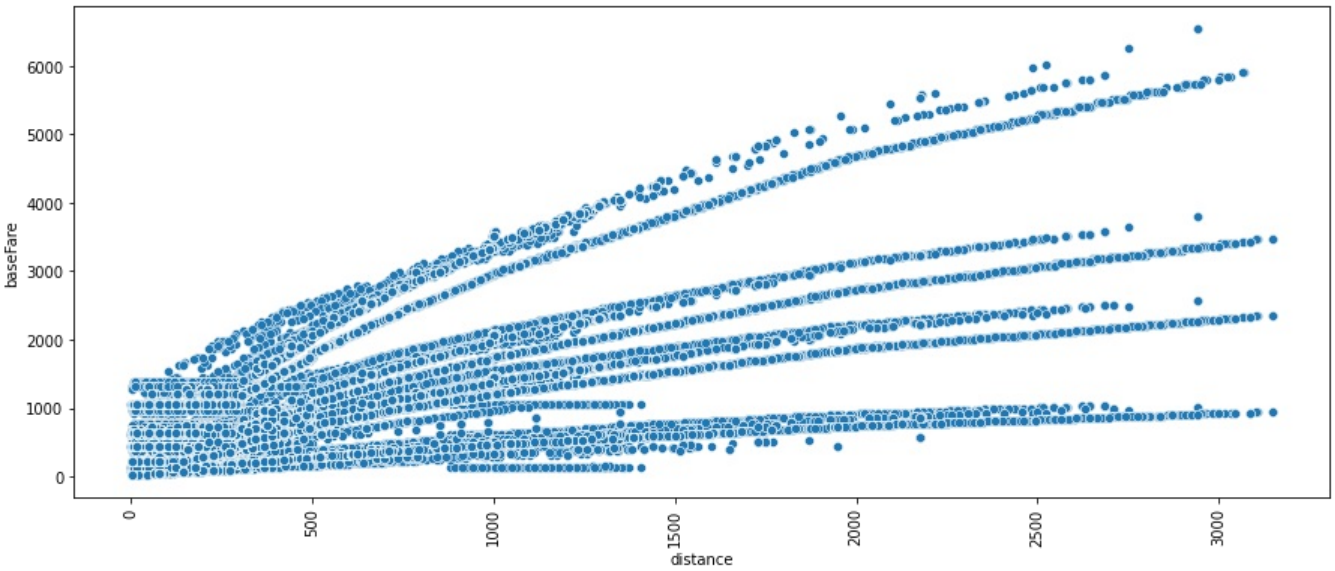
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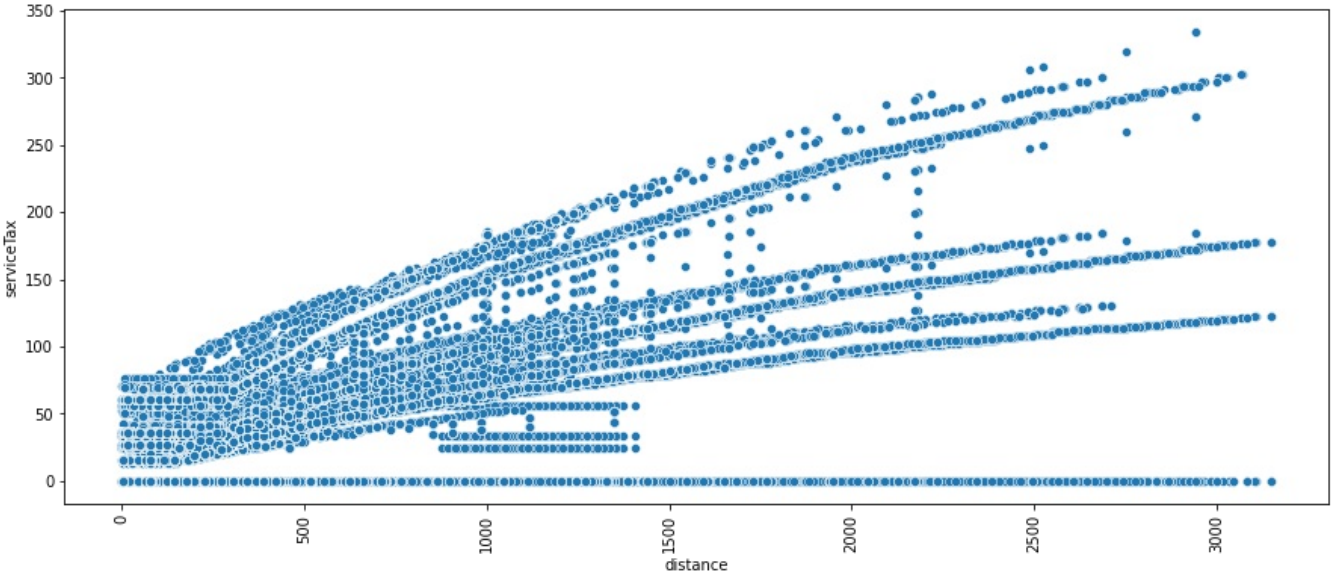
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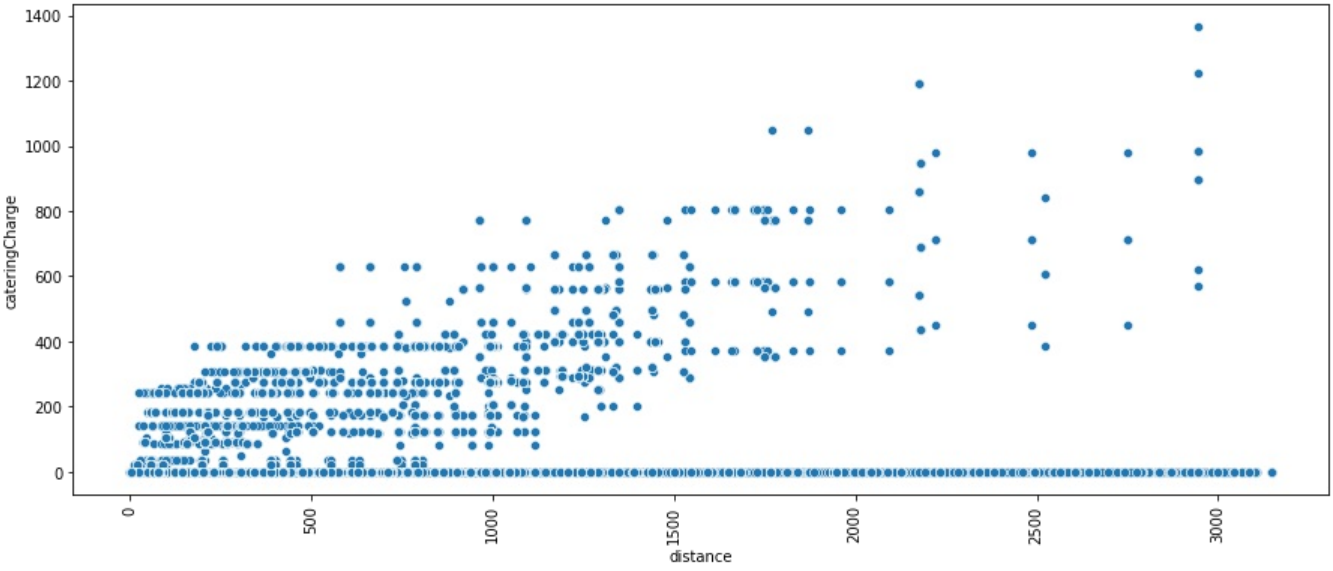
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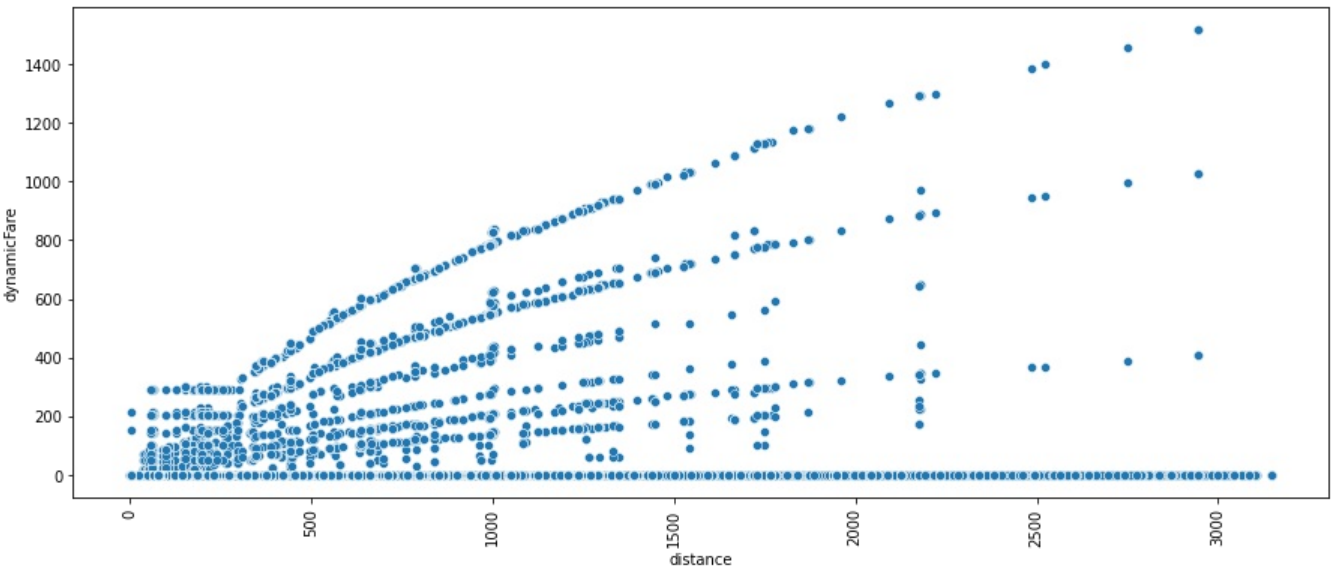
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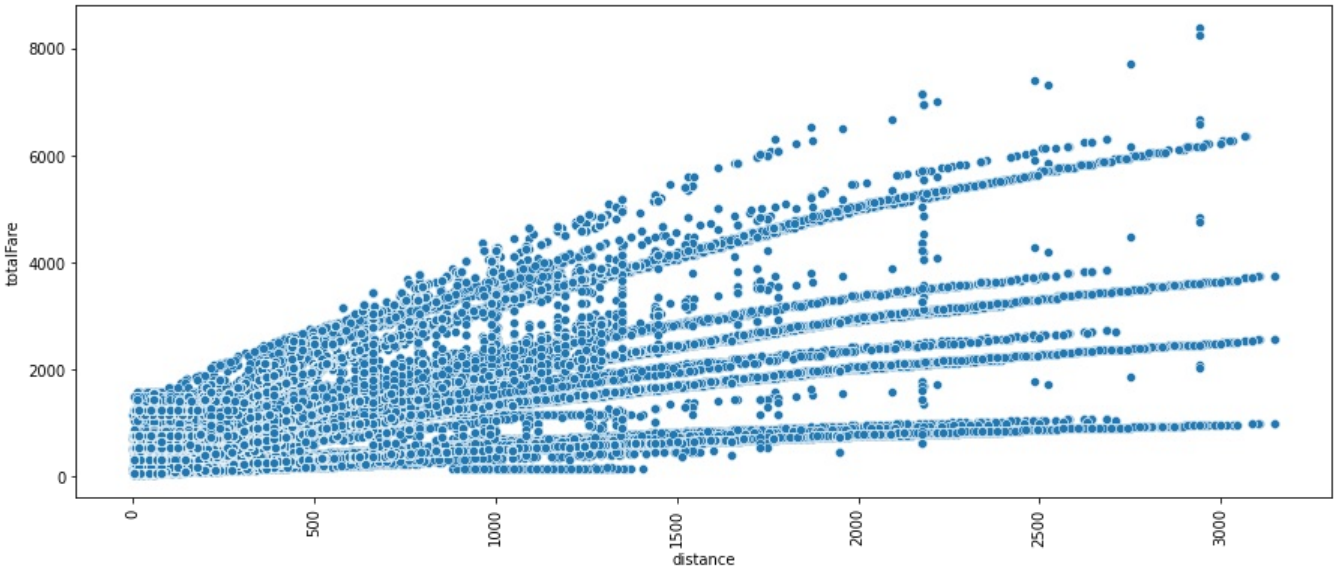
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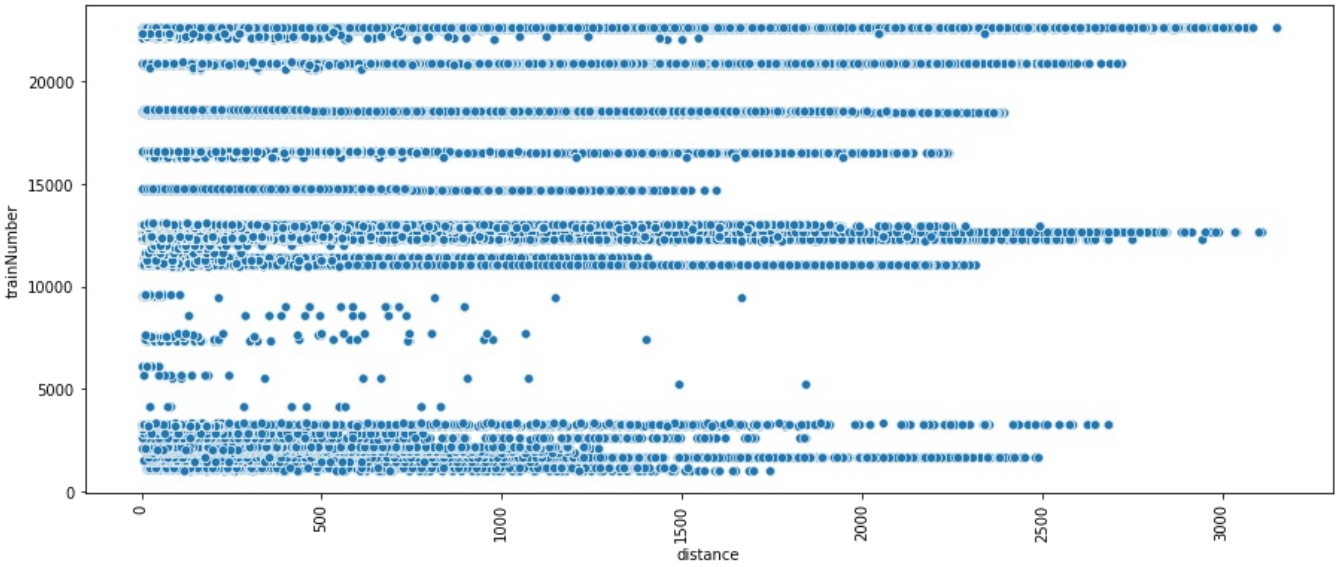
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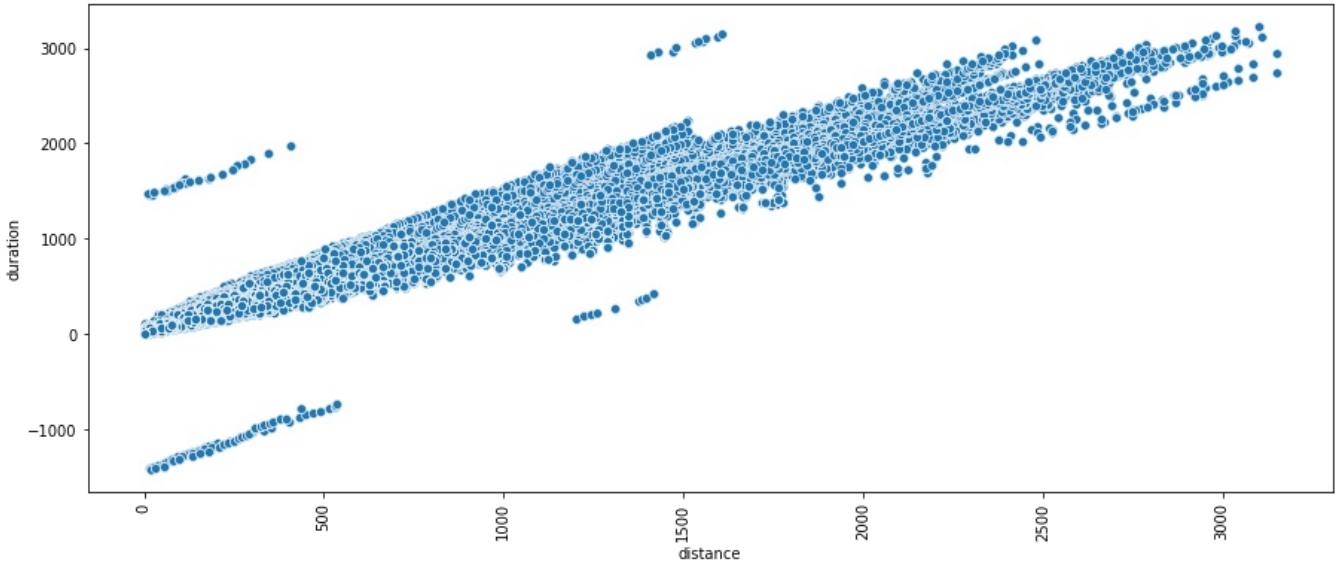
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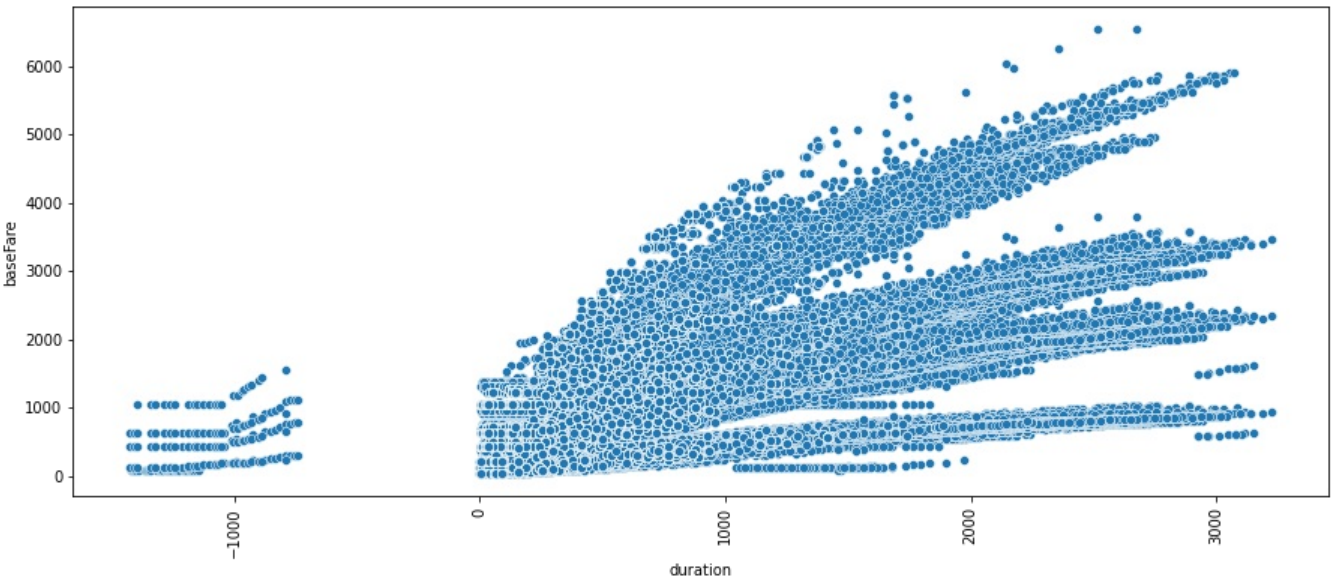
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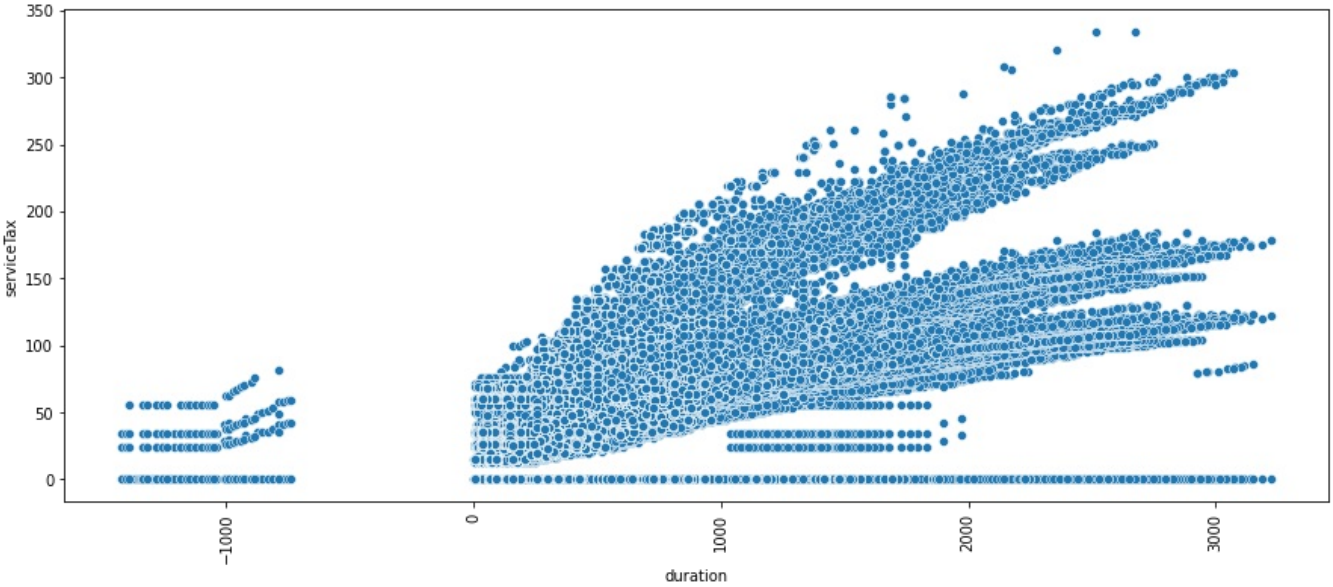
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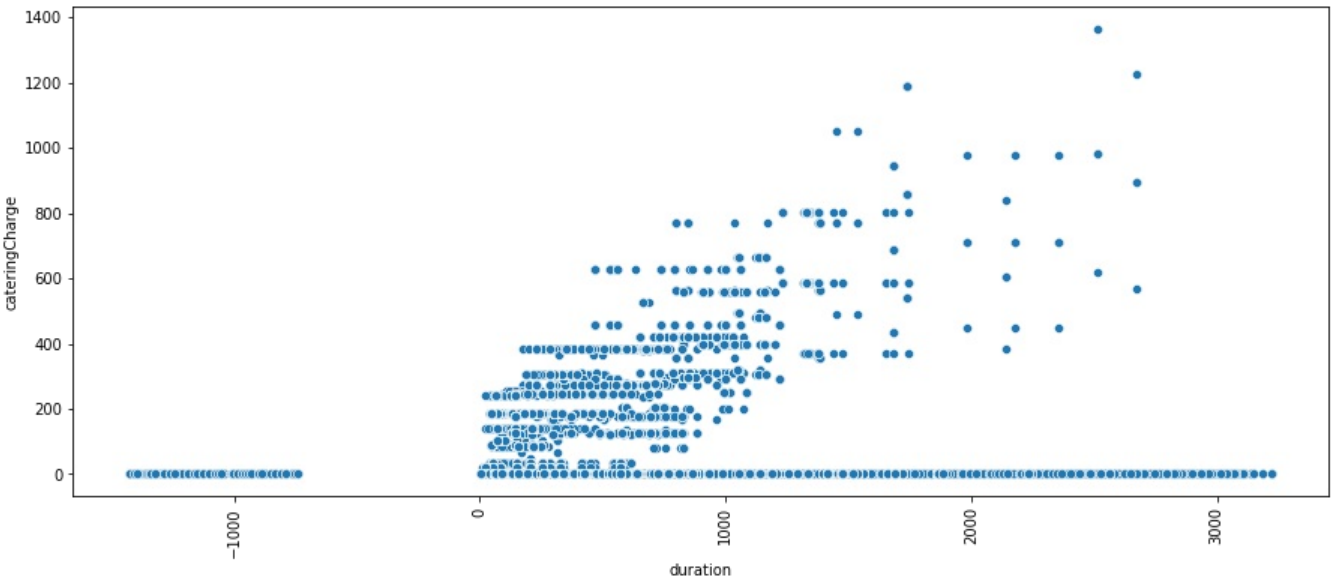
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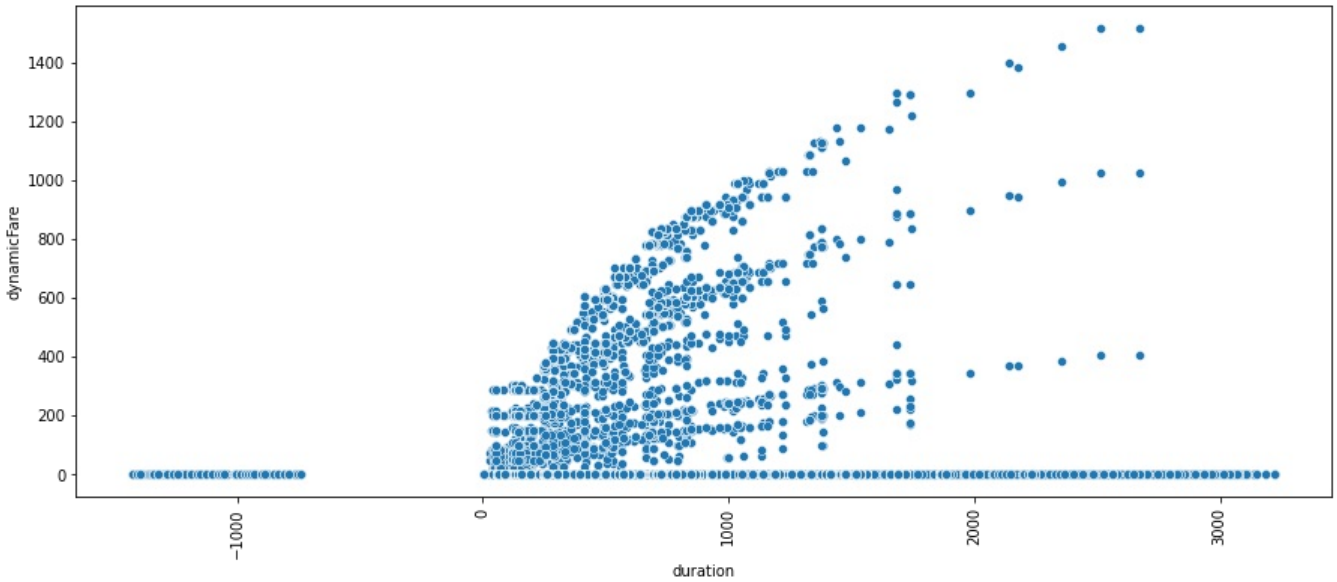
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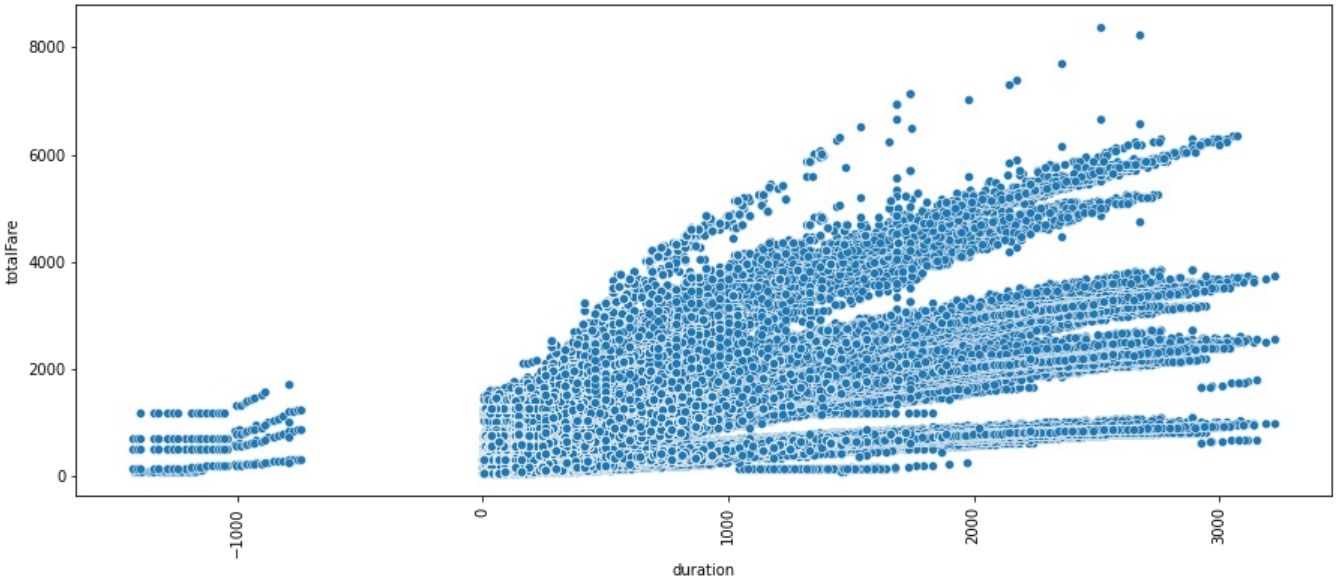
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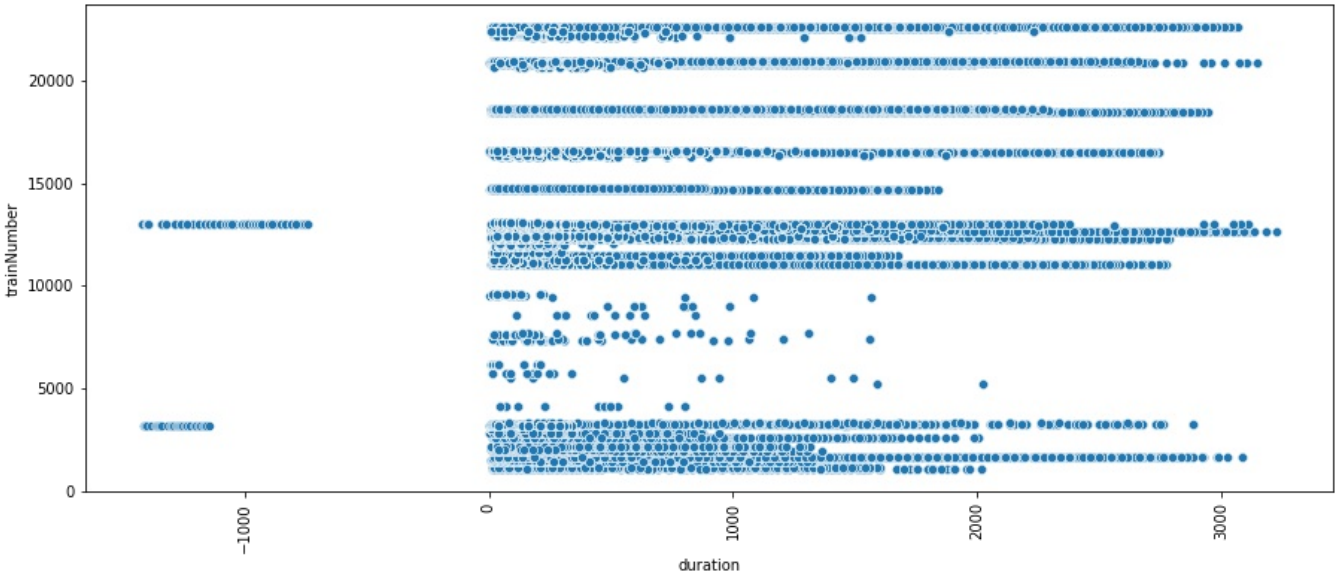
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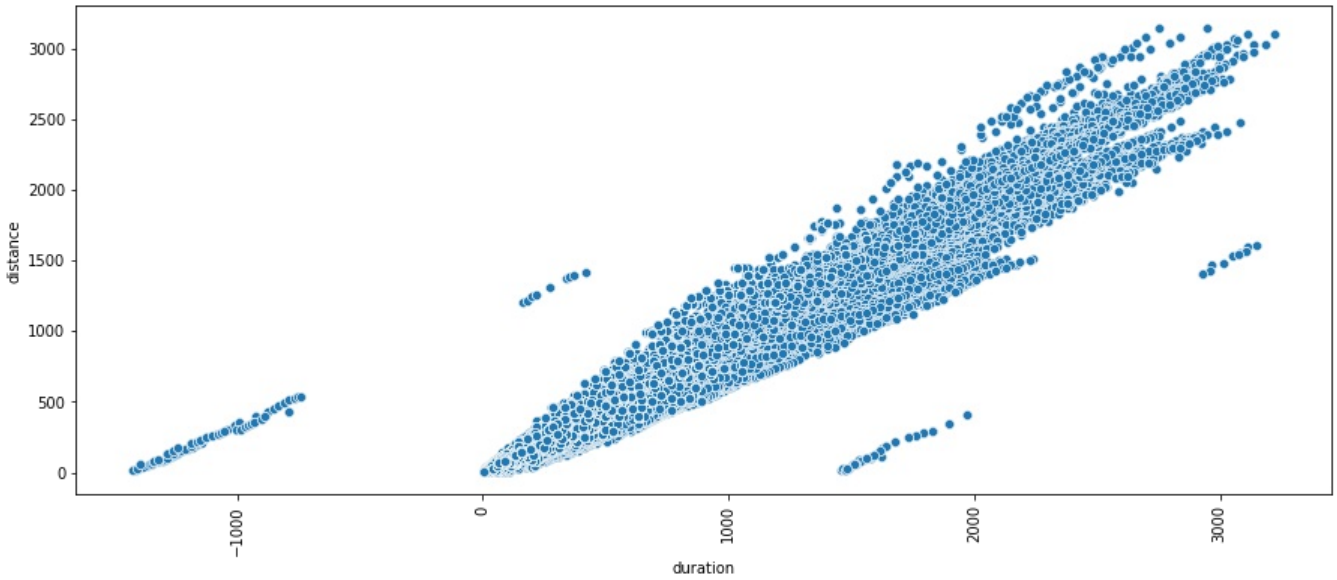

In [31]:
```
for i in categorical:
    for j in continuous:
        plt.figure(figsize=(15,6))
        sns.barplot(x = df[i], y = df[j], data = df, ci = None, palette = 'hls')
        plt.xticks(rotation = 90)
        plt.show()
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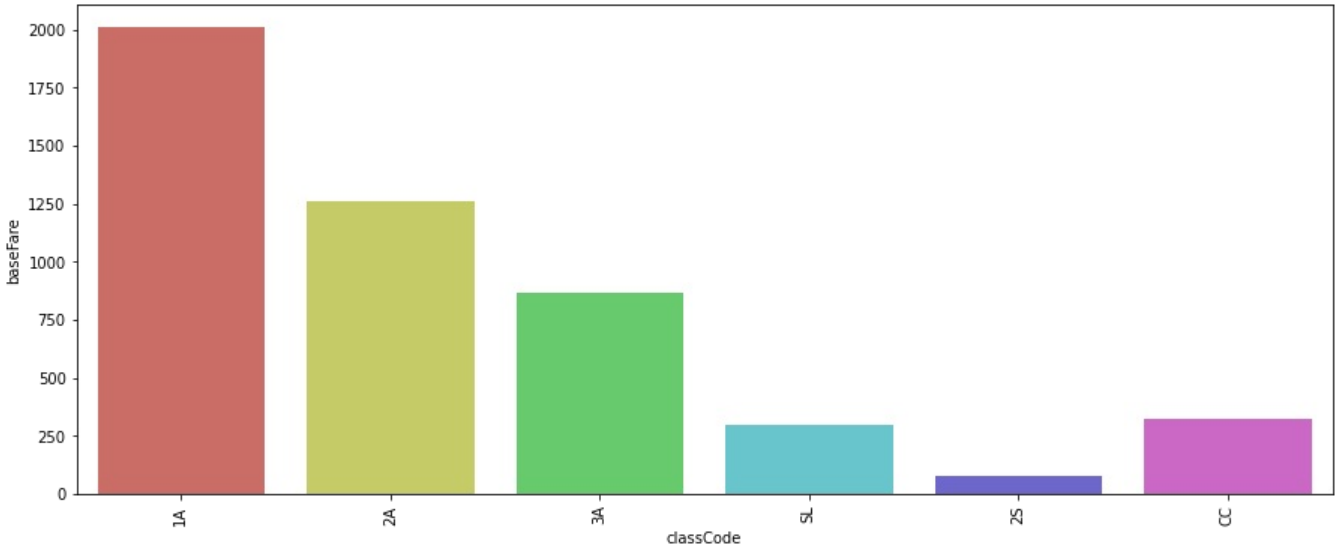

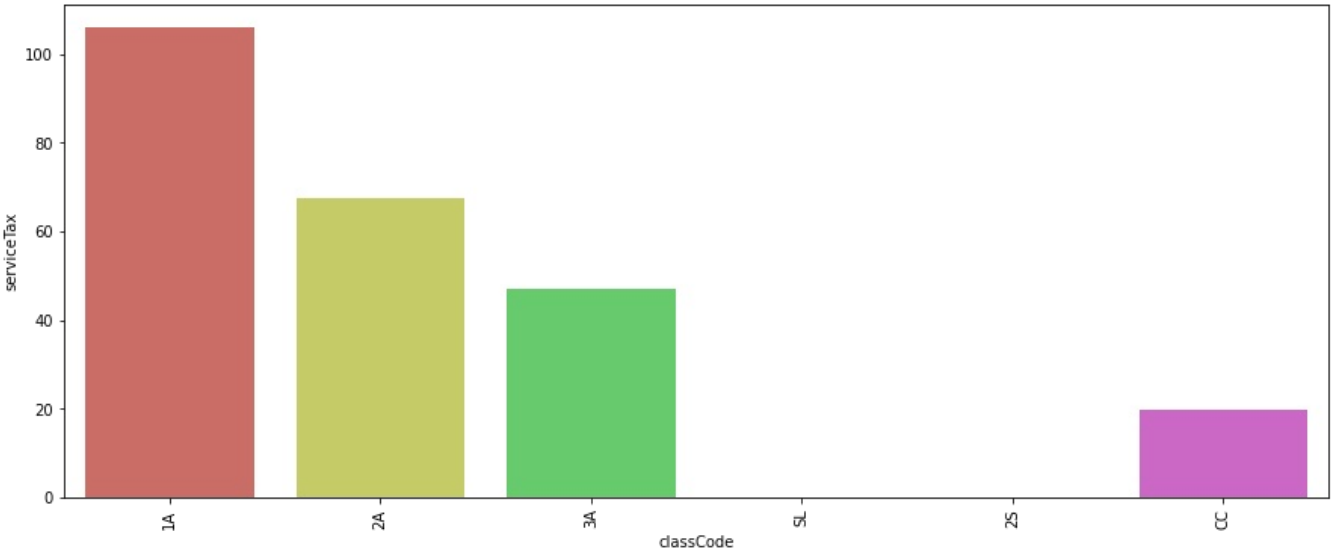
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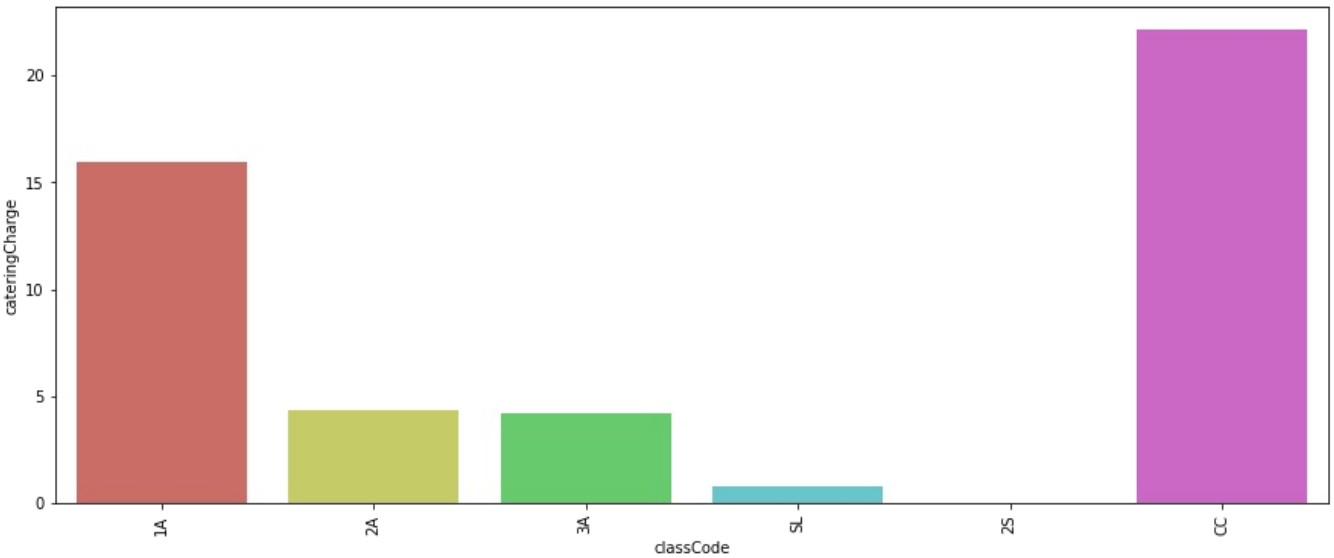
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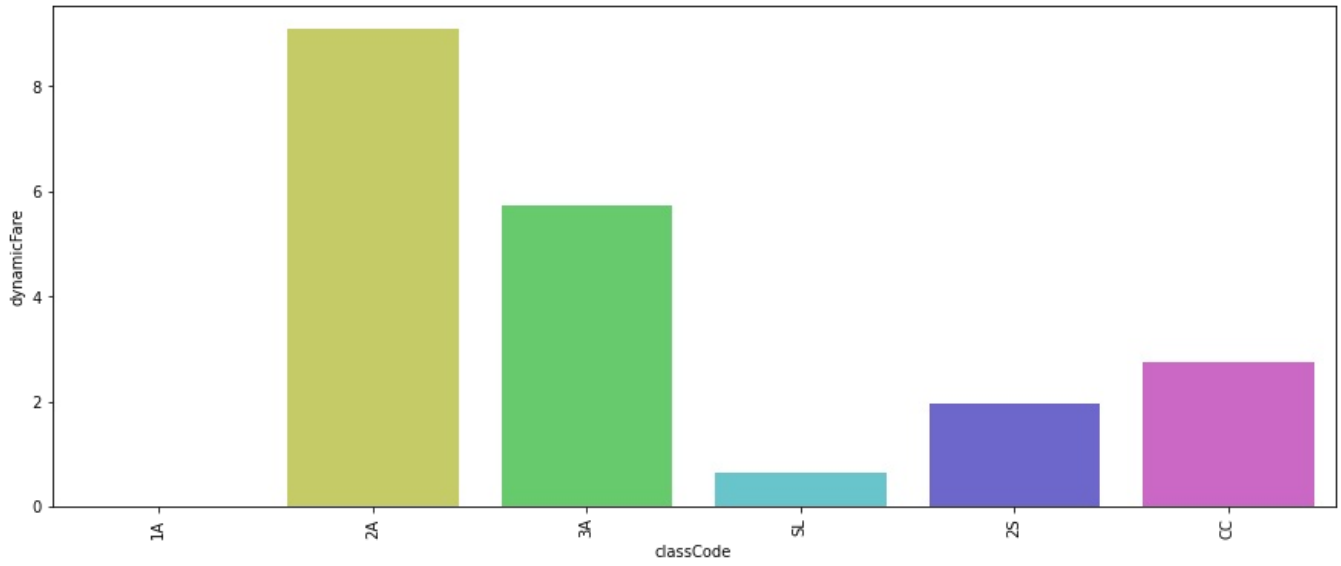
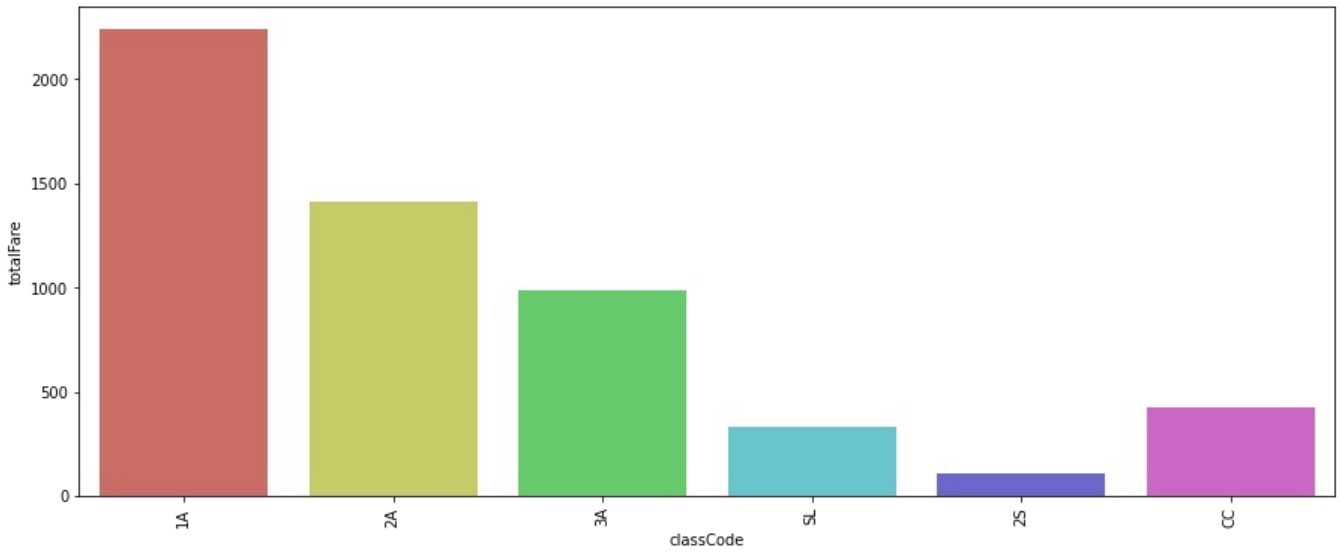
classCode


dynamicFare
0
2
4
6
8
1A
2A
3A
SL
2S
CC
classCode


totalFare
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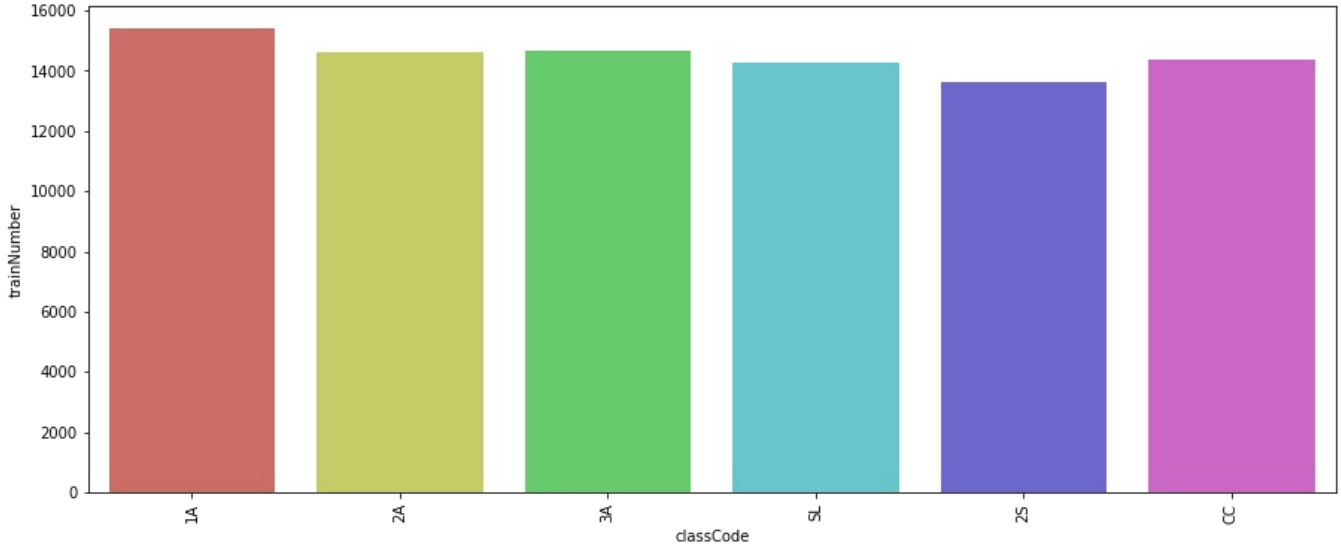
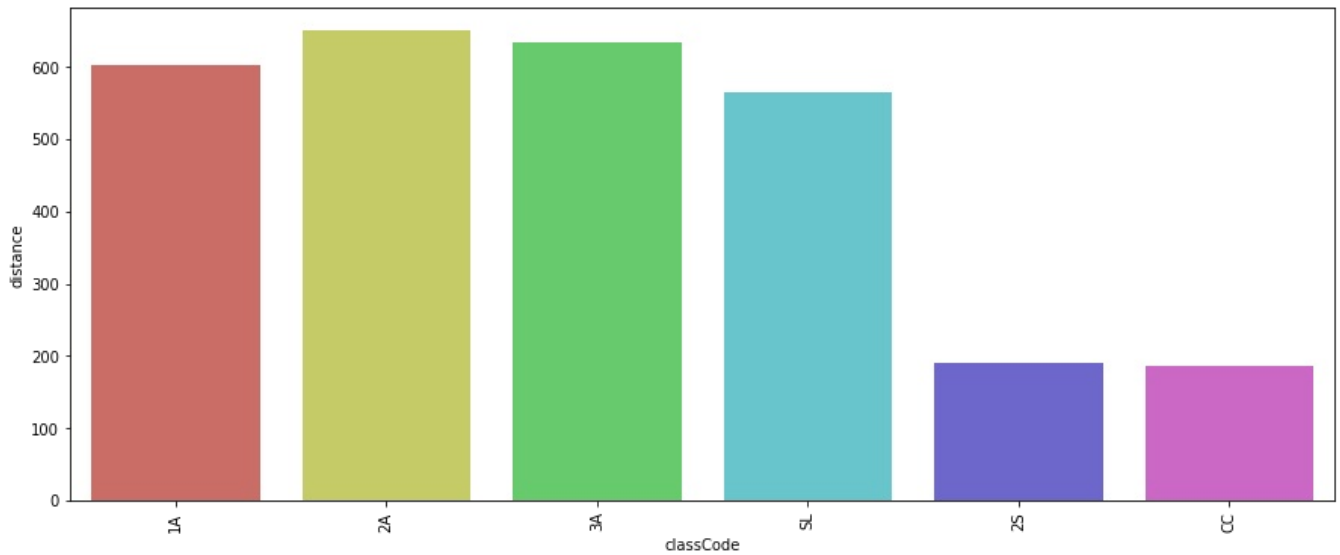
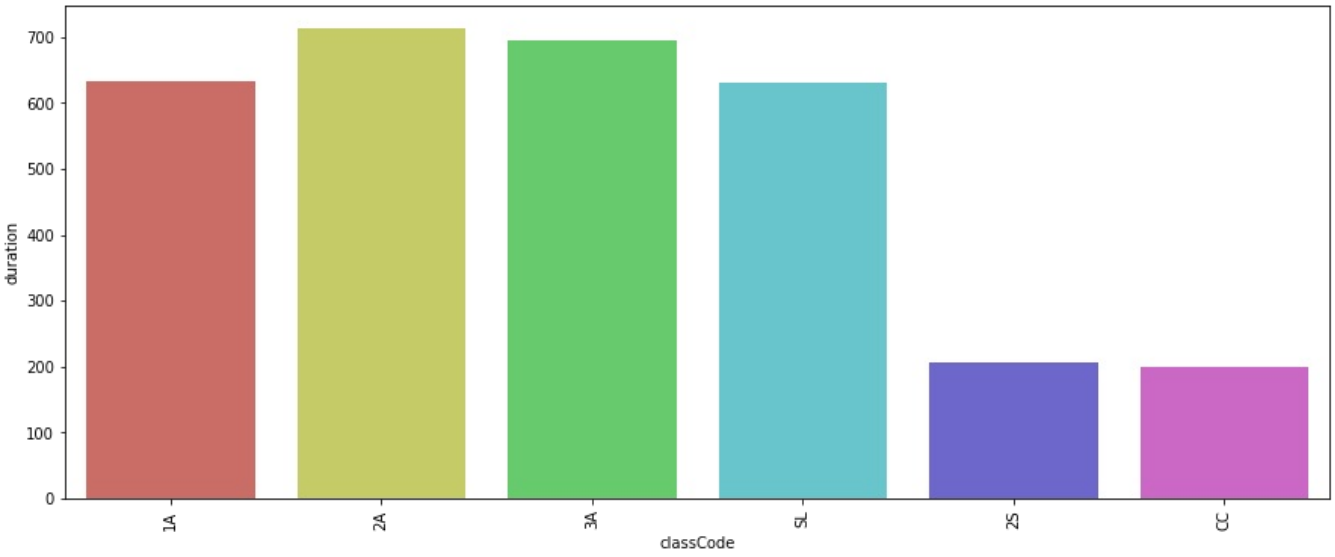
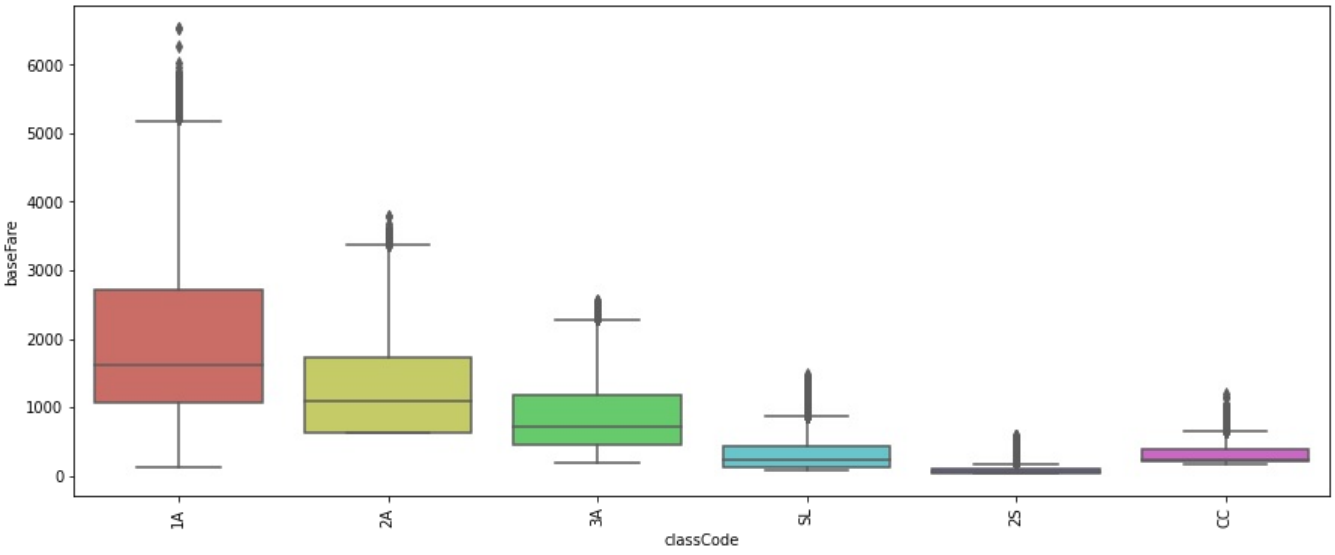
1000
1500
2000
1A
2A
3A
SL
2S
CC
classCode

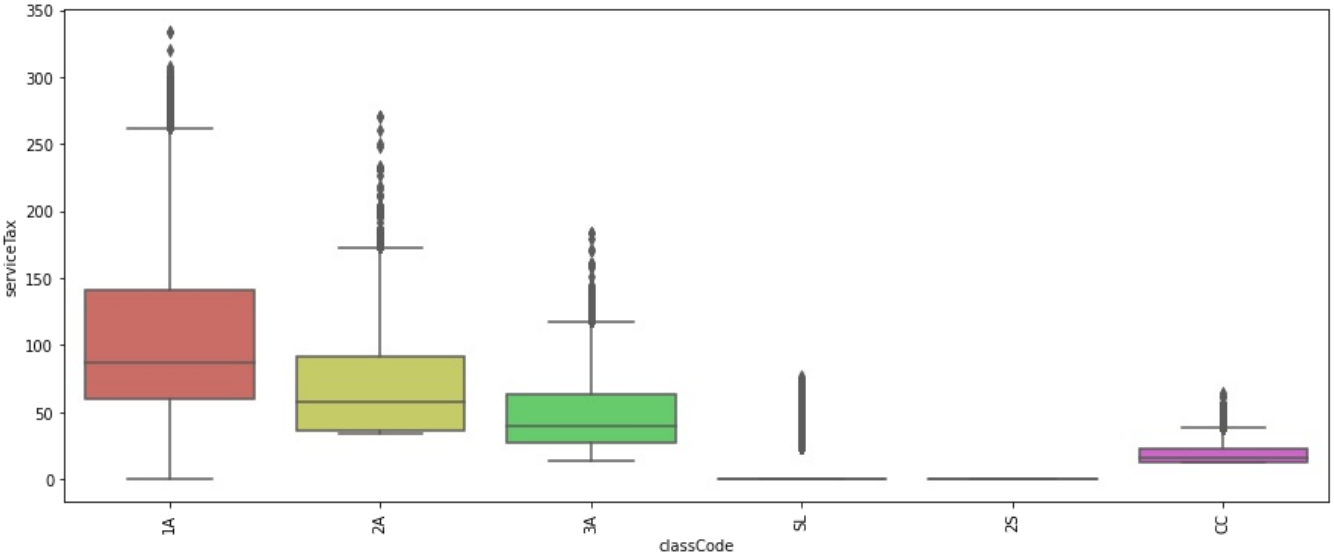

16000
14000
12000
10000
8000
6000
4000
2000
0
trainNumber
1A
2A
3A
SL
2S
CC
classCode


600
500
400
300
200
100
0
distance
1A
2A
3A
SL
2S
CC
classCode



In [32]:
```
for i in categorical:
    for j in continuous:
        plt.figure(figsize=(15,6))
        sns.boxplot(x = df[i], y = df[j], data = df, palette = 'hls')
        plt.xticks(rotation = 90)
        plt.show()
```




serviceTax
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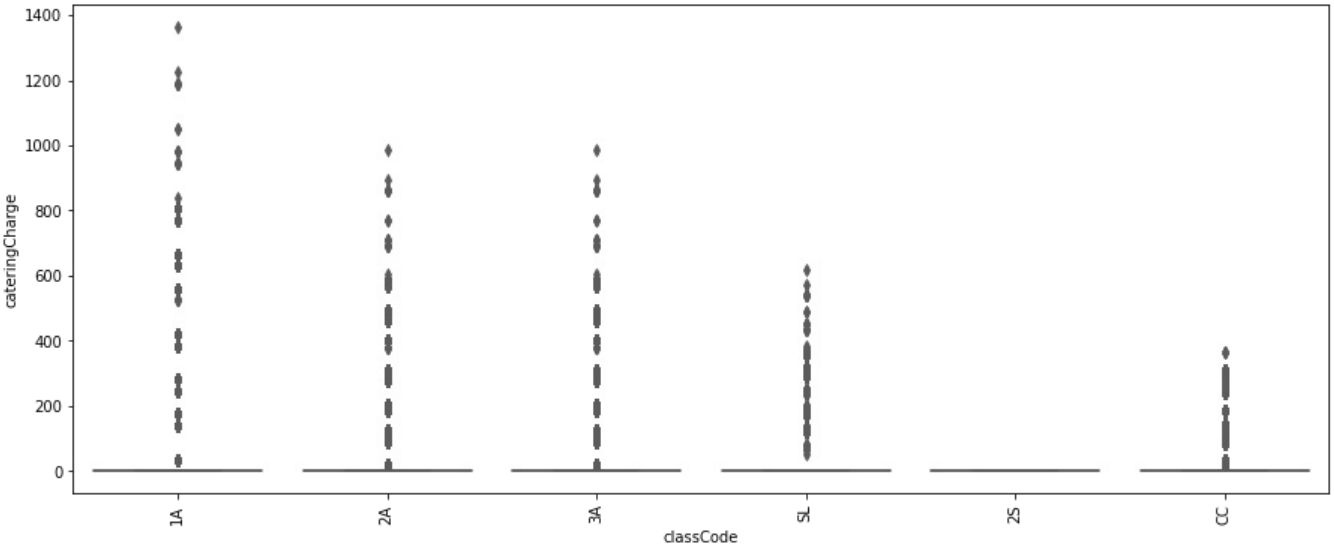
300
250
200
150
100
50
0
1A
2A
3A
SL
2S
CC
classCode


cateringCharge
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1200
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800
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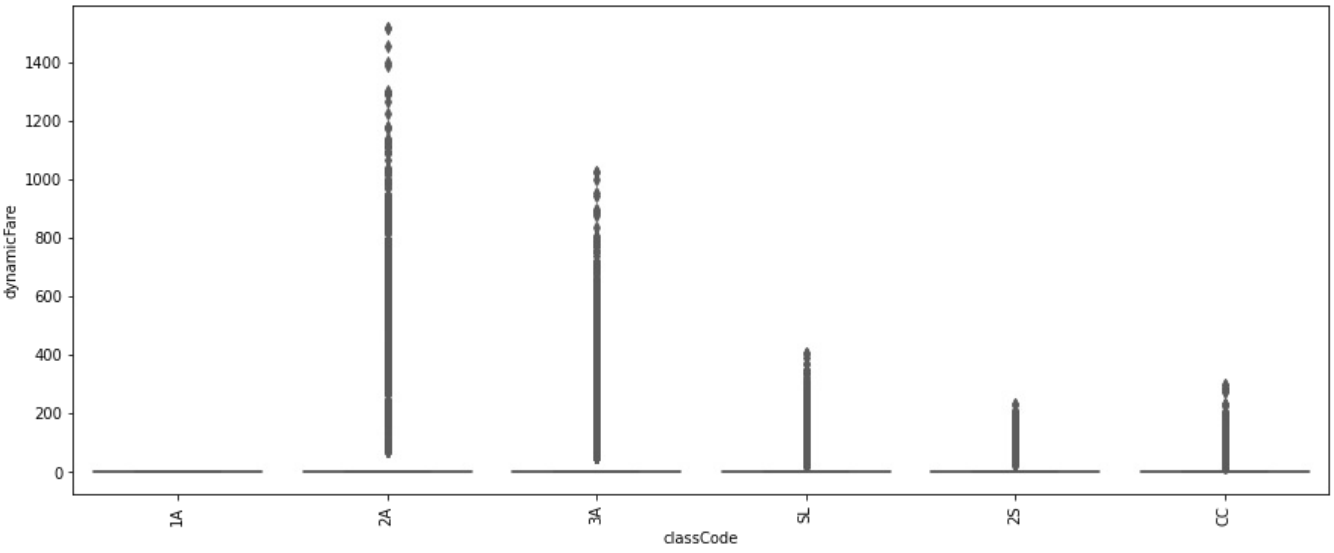
400
200
0
1A
2A
3A
SL
2S
CC
classCode


dynamicFare
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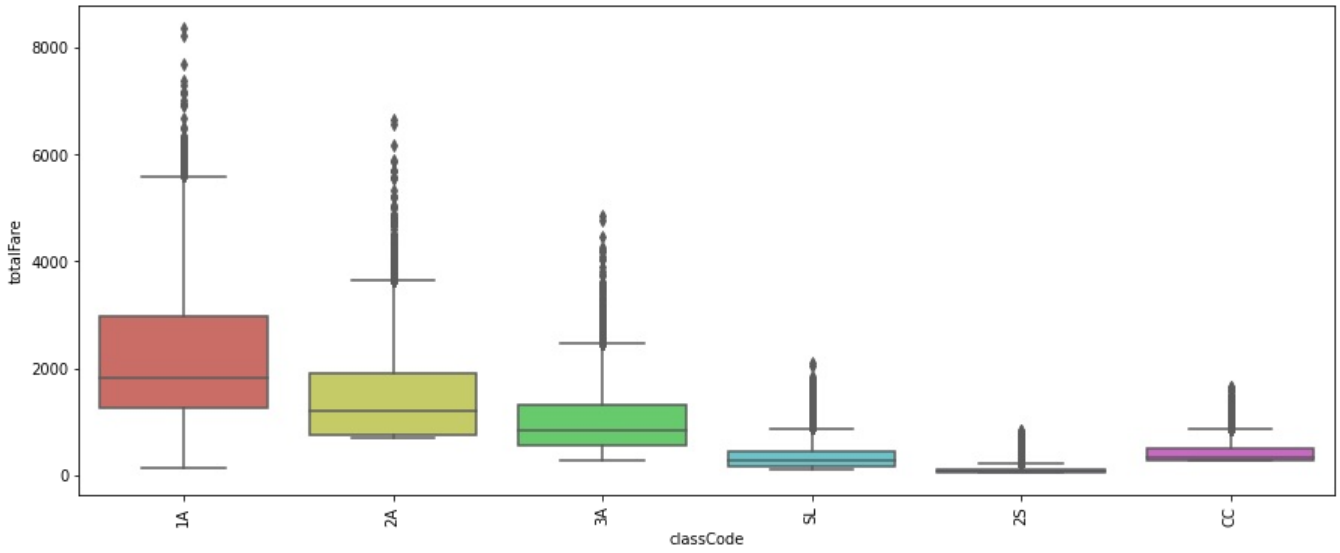
1200
1000
800
600
400
200
0
1A
2A
3A
SL
2S
CC
classCode


totalFare
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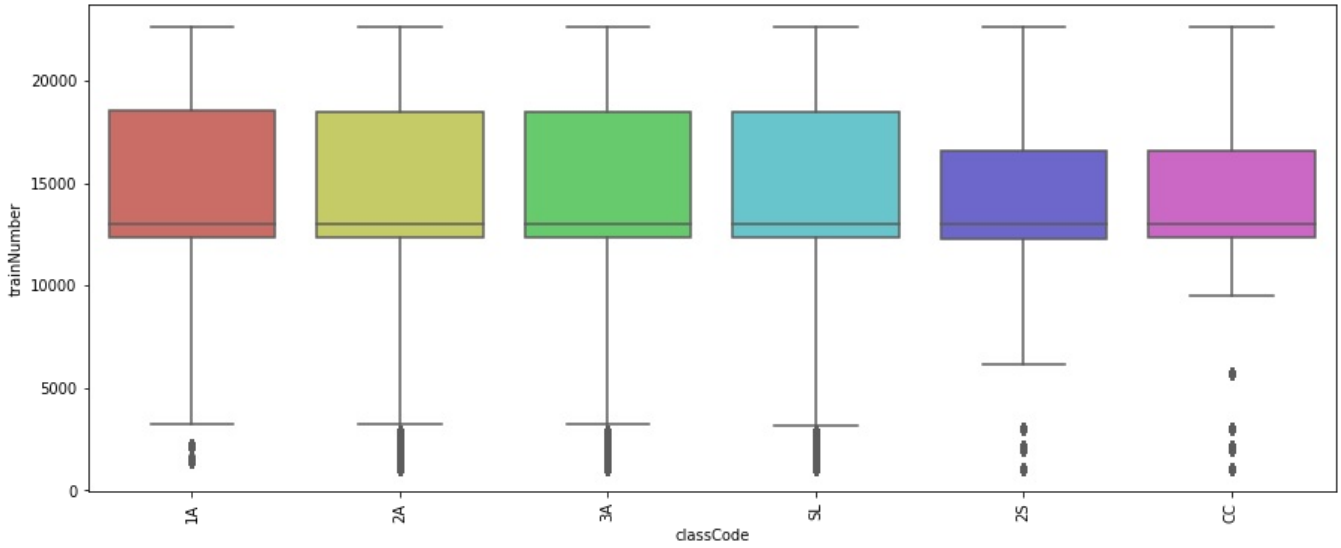
2000
0
1A
2A
3A
SL
2S
CC
classCode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10000
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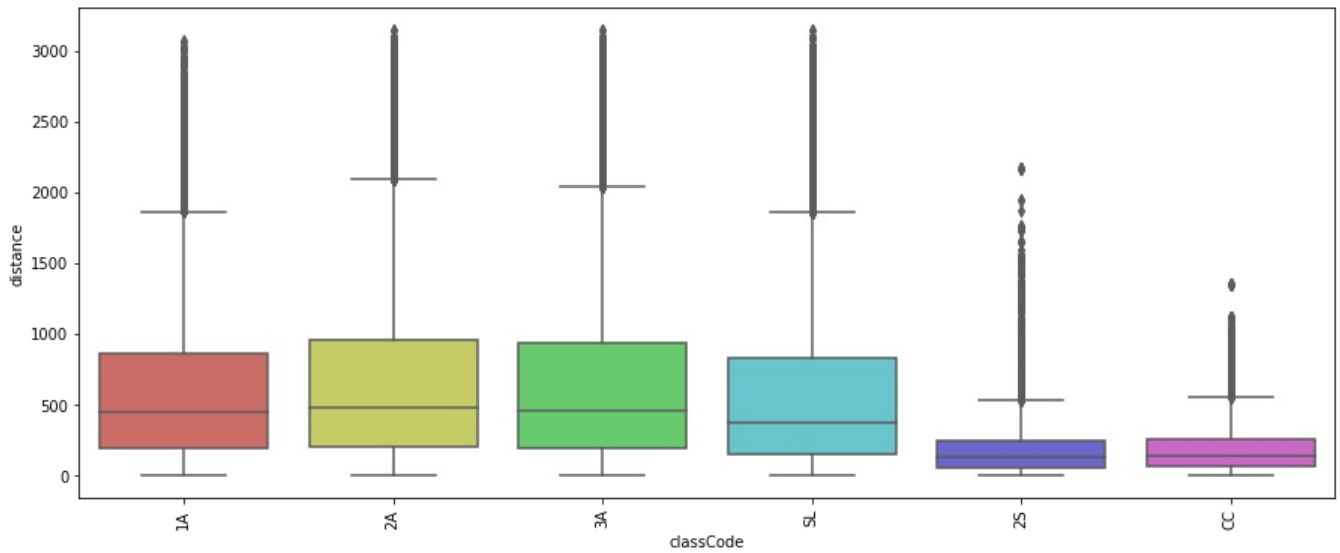
2A
3A
SL
2S
CC
classCode


distance
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1500
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500
0
1A
2A
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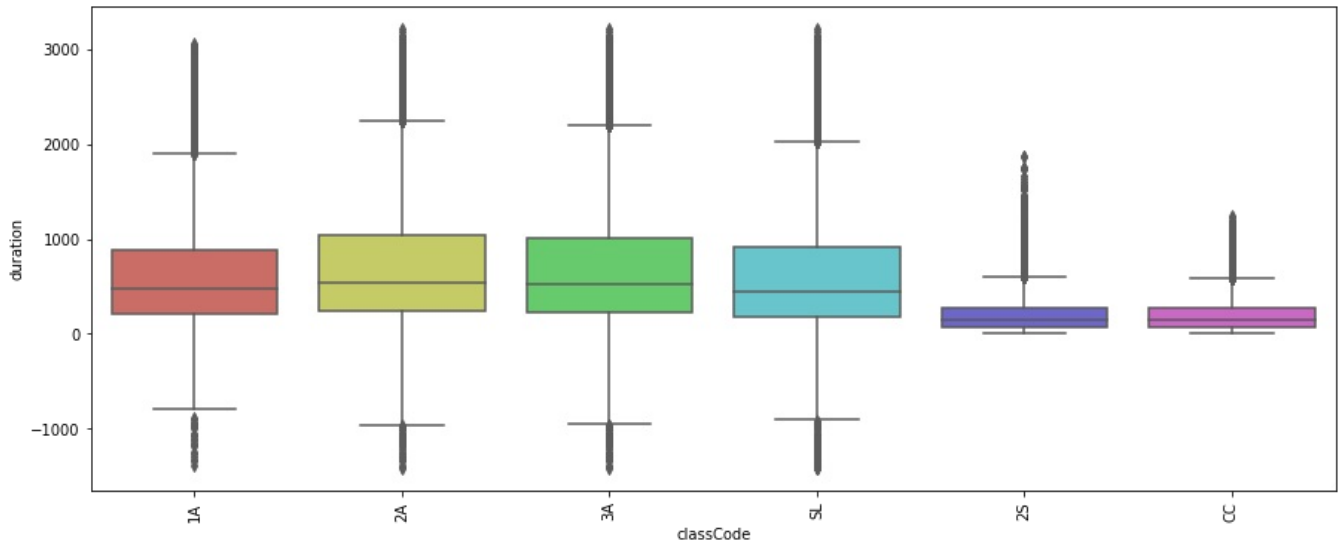
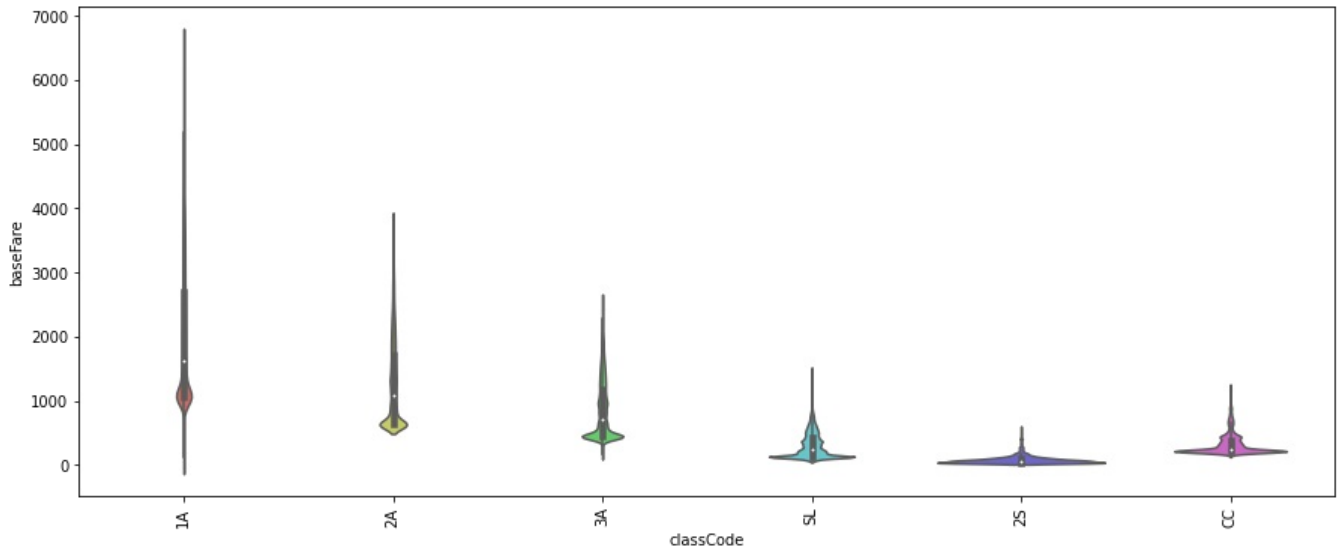
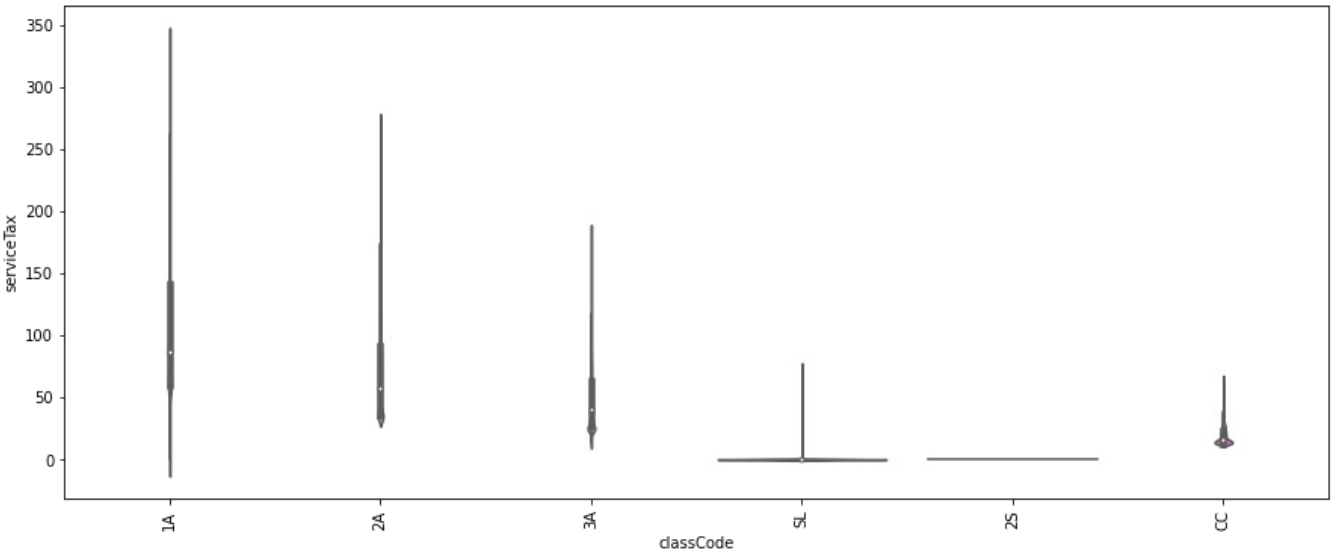
SL
2S
CC
classCode



In [33]:
```
for i in categorical:
    for j in continuous:
        plt.figure(figsize=(15,6))
        sns.violinplot(x = df[i], y = df[j], data = df, palette = 'hls')
        plt.xticks(rotation = 90)
        plt.show()
```




serviceTax
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150
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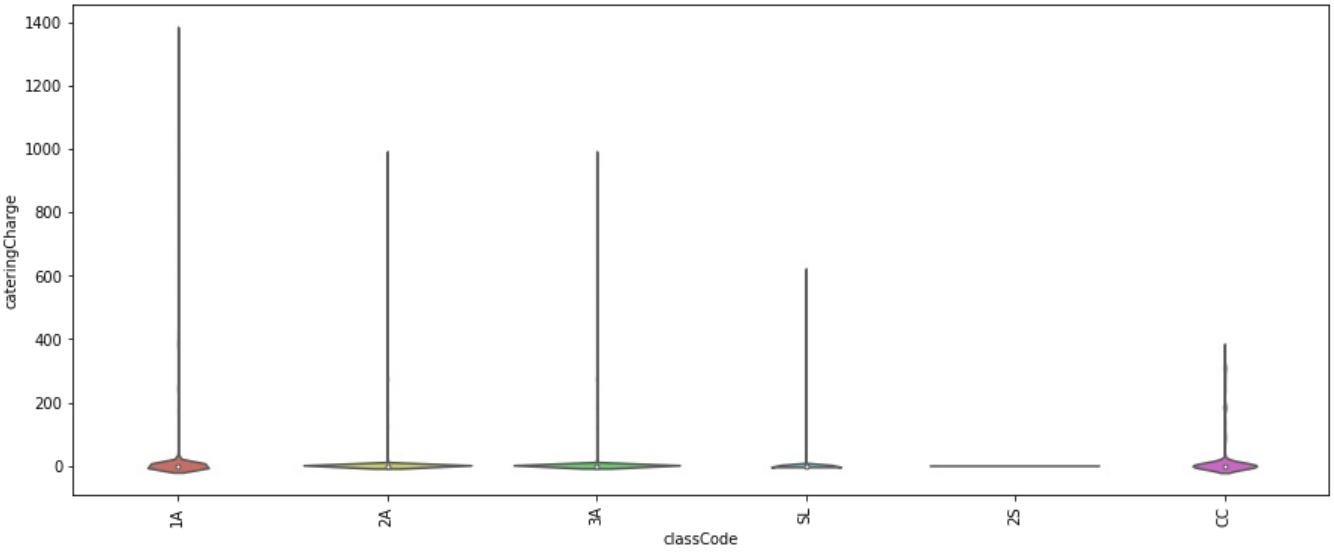
50
0
1A
2A
3A
SL
2S
CC
classCode


cateringCharge
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1000
800
600
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200
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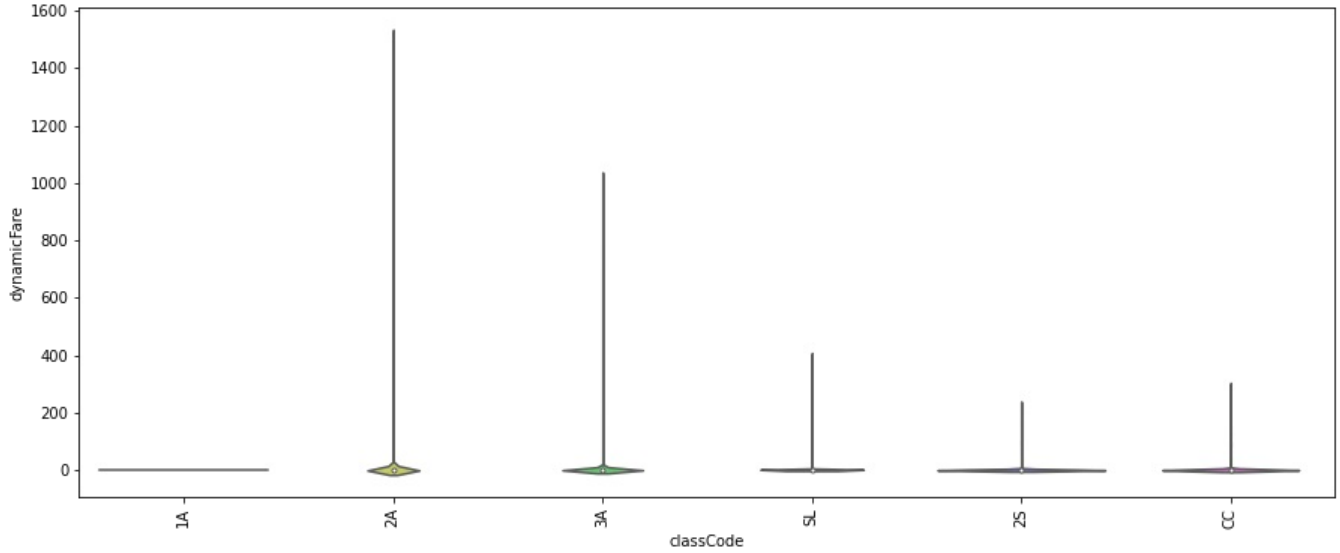
2A
3A
SL
2S
CC
classCode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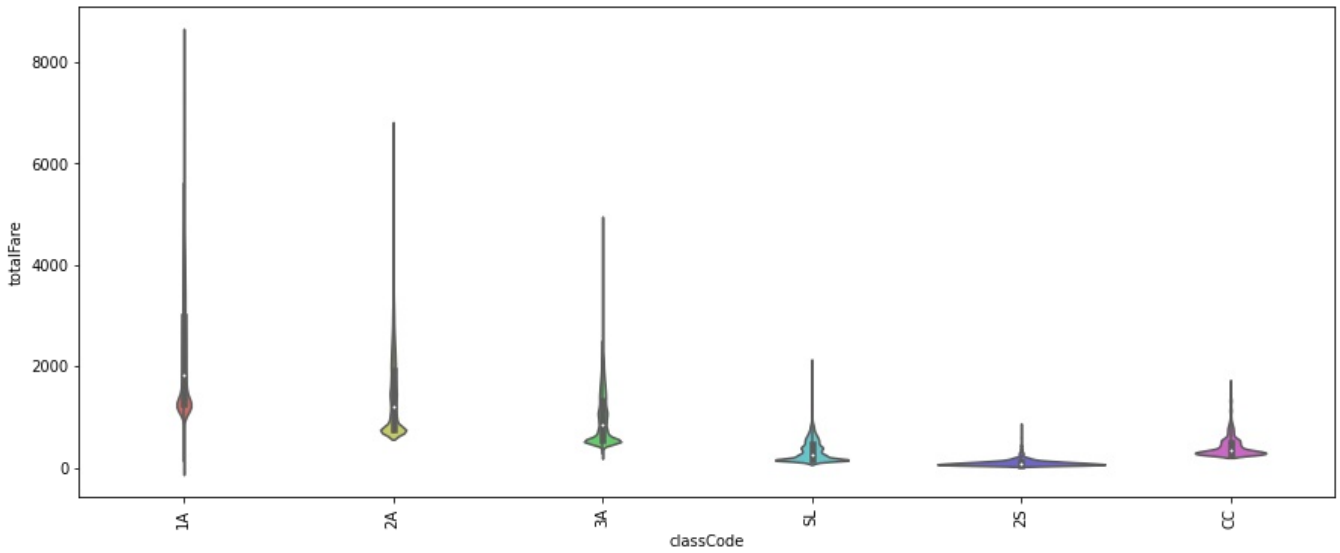
0
dynamicFare
1A
2A
3A
5L
2S
CC
classCode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totalFare
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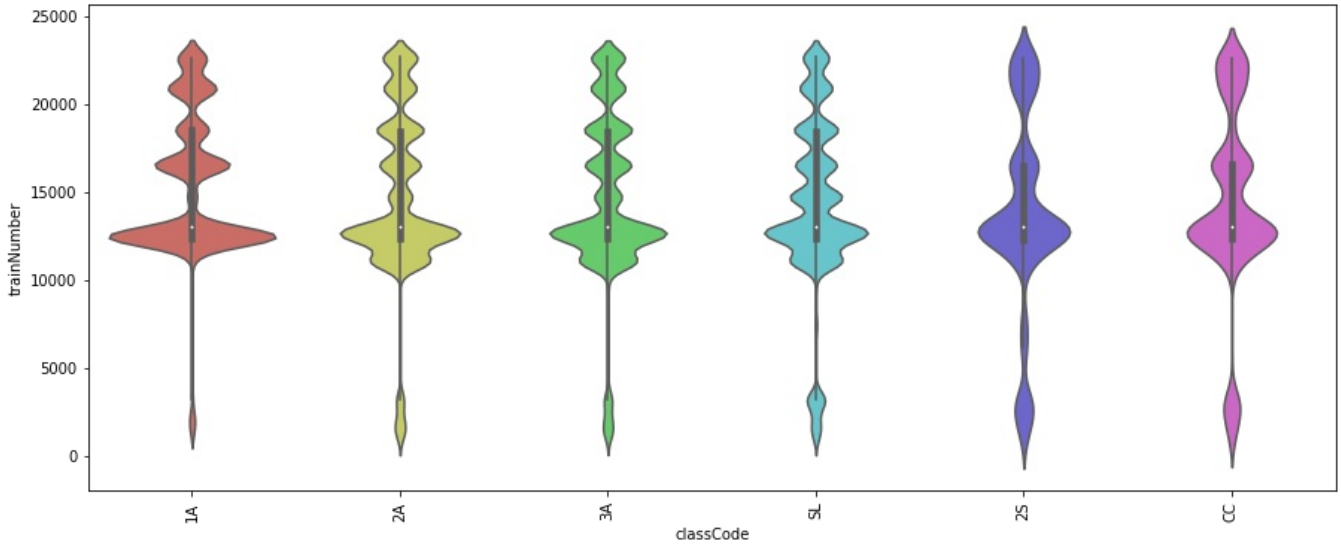
2S
CC
classCode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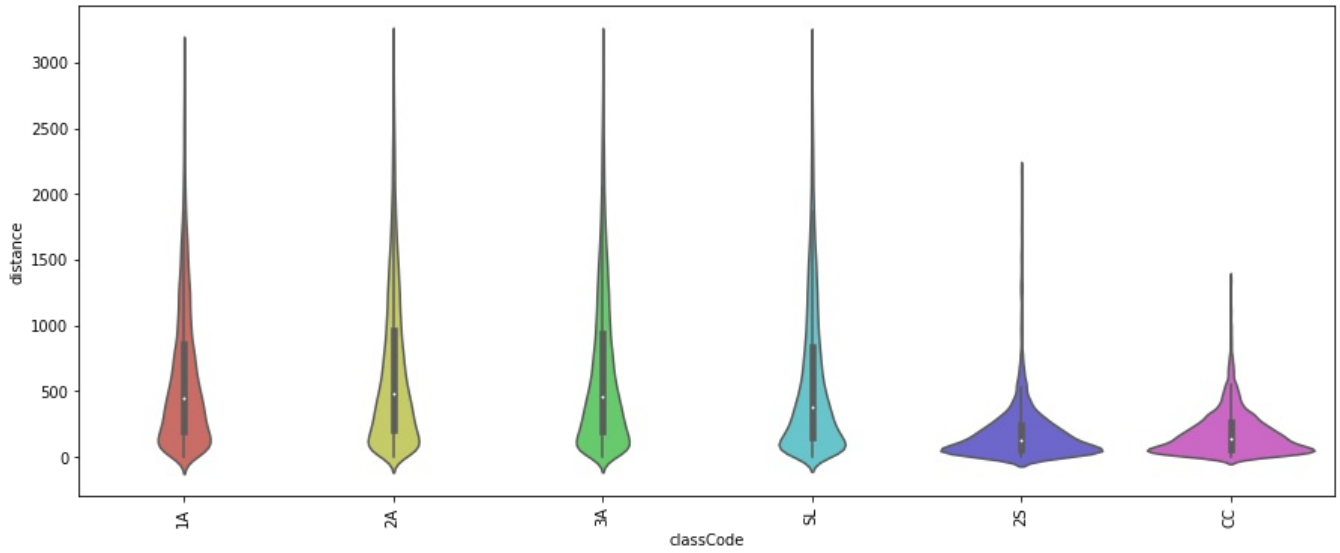
CC
classCode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500
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distance
1A
2A
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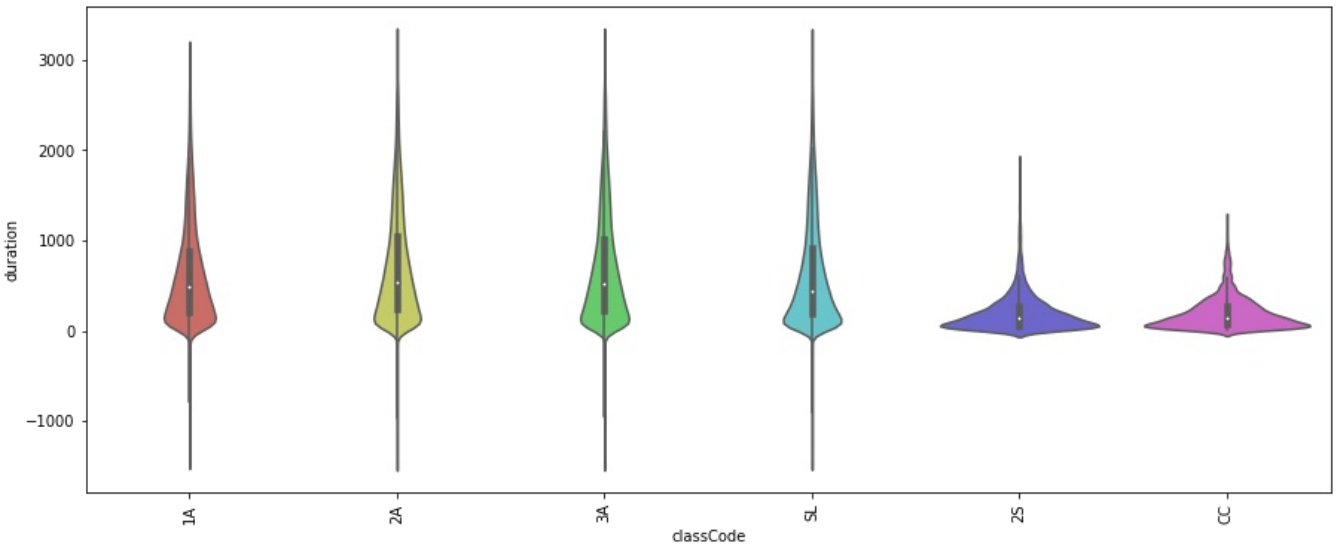
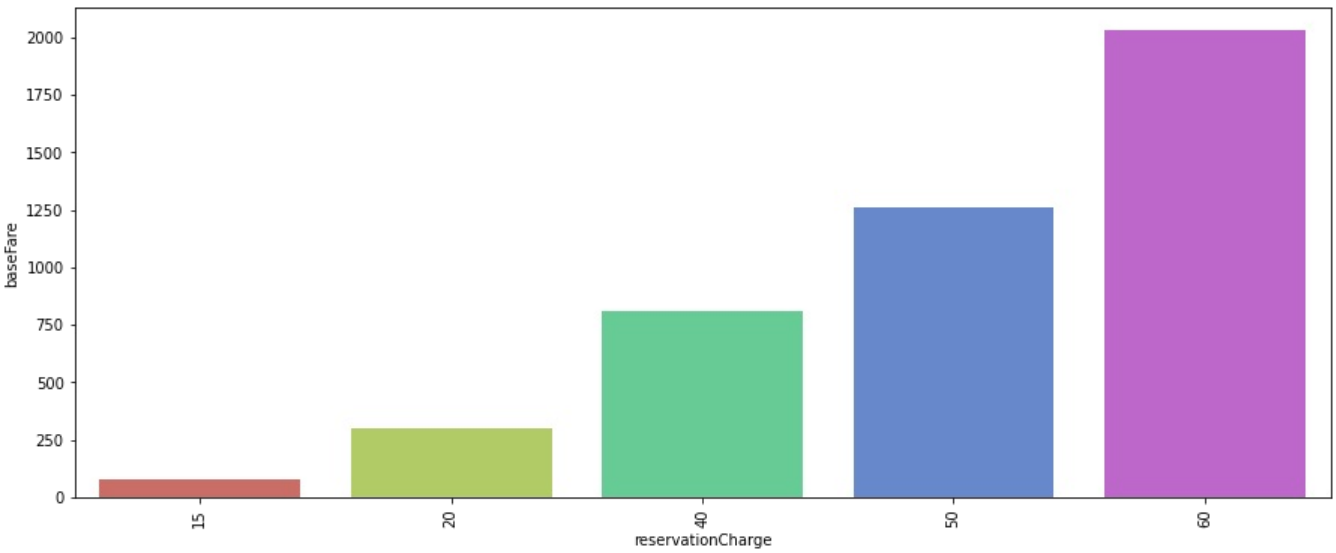
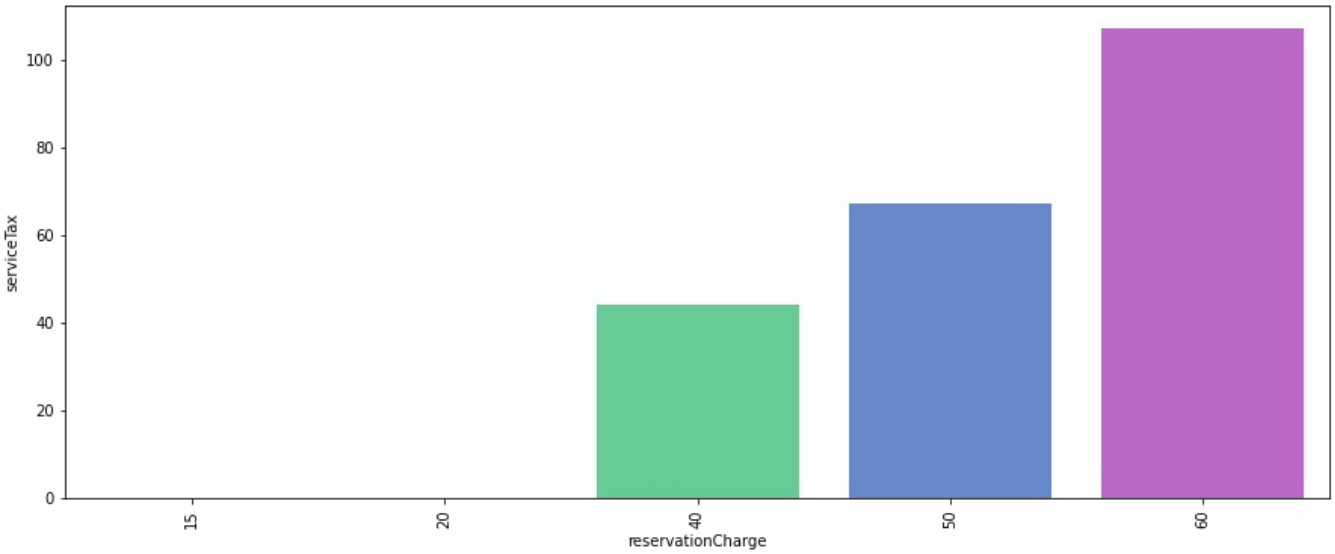
2S
CC
classCode



In [34]:
```
for i in discrete:
    for j in continuous:
        plt.figure(figsize=(15,6))
        sns.barplot(x = df[i], y = df[j], data = df, ci = None, palette = 'hls')
        plt.xticks(rotation = 90)
        plt.show()
```




serviceTax
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100
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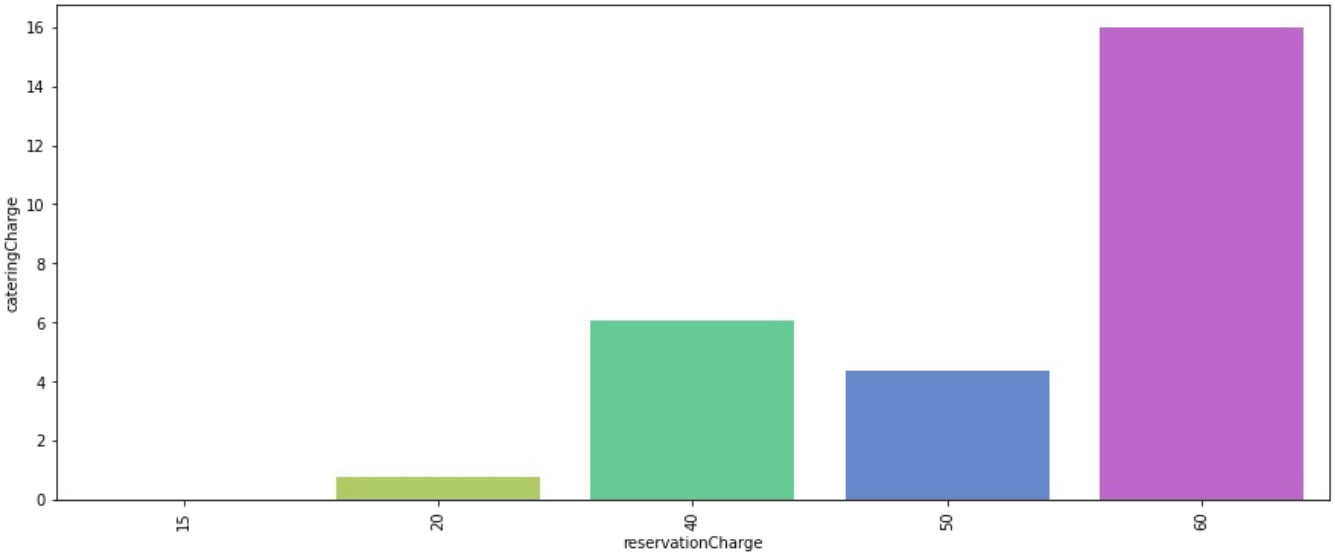
50
60
reservationCharge


cateringCharge
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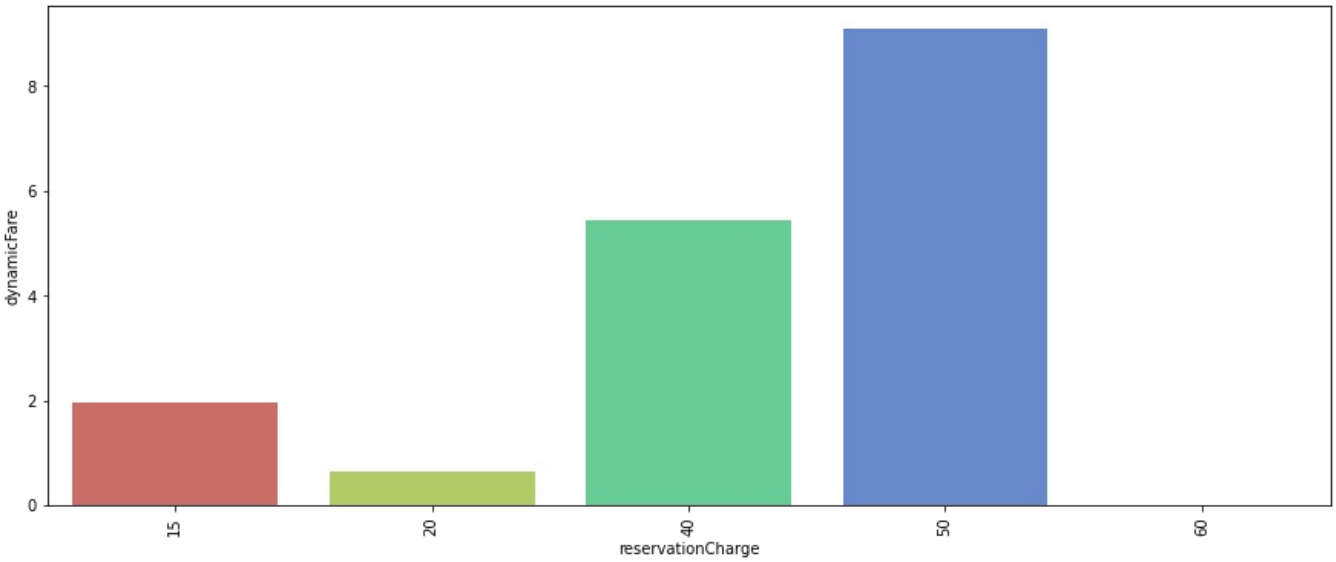
reservationCharge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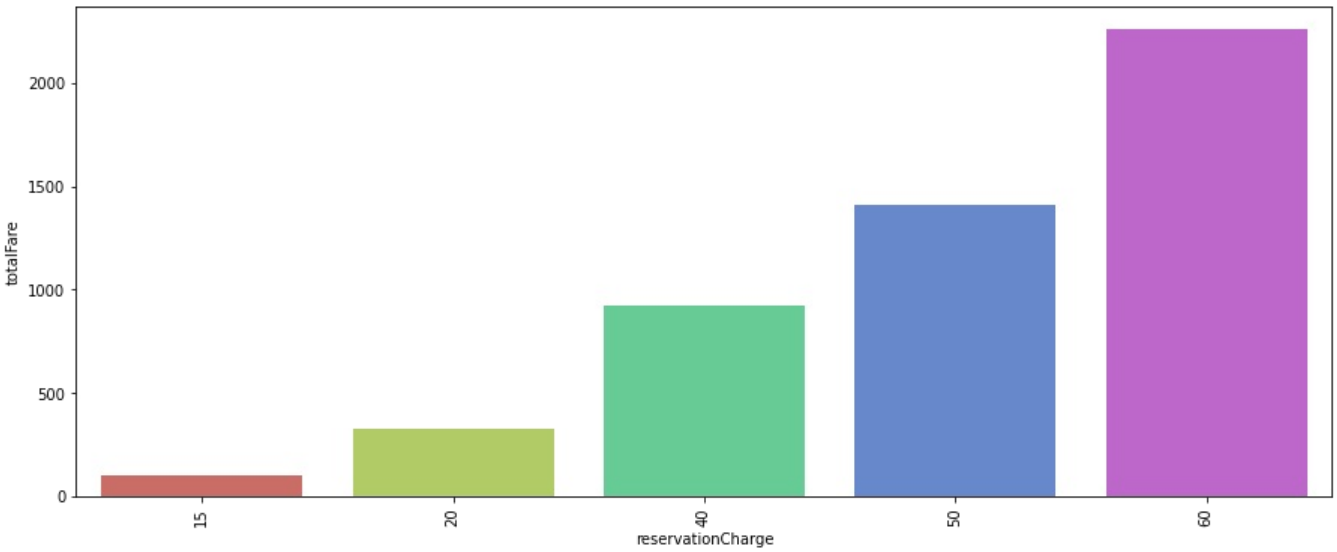
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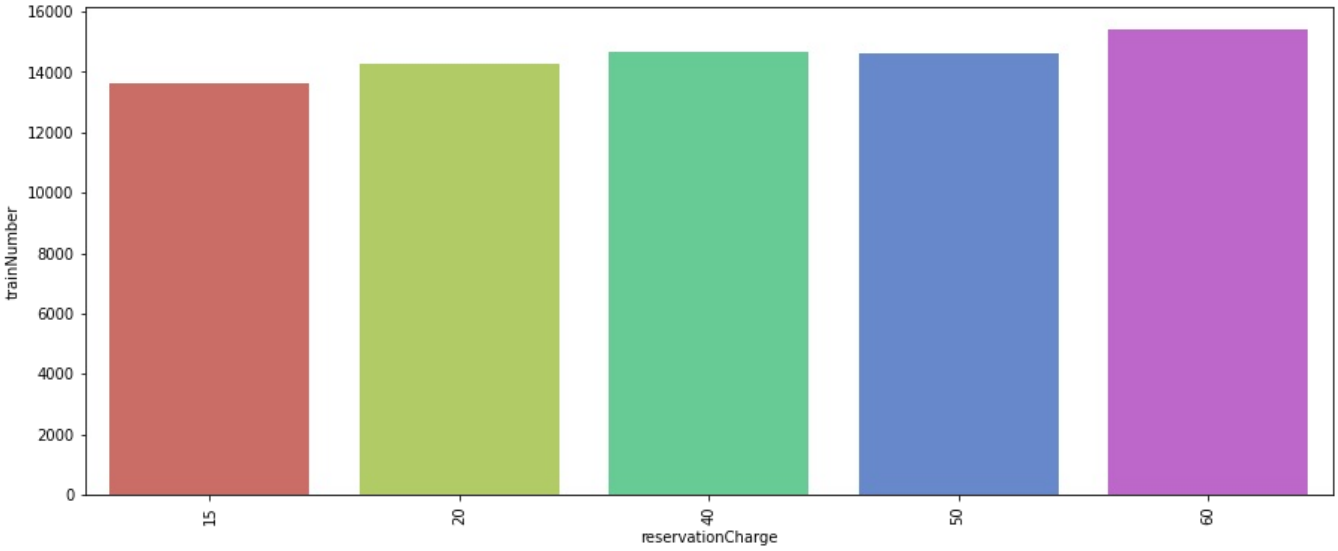
reservationCharge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20
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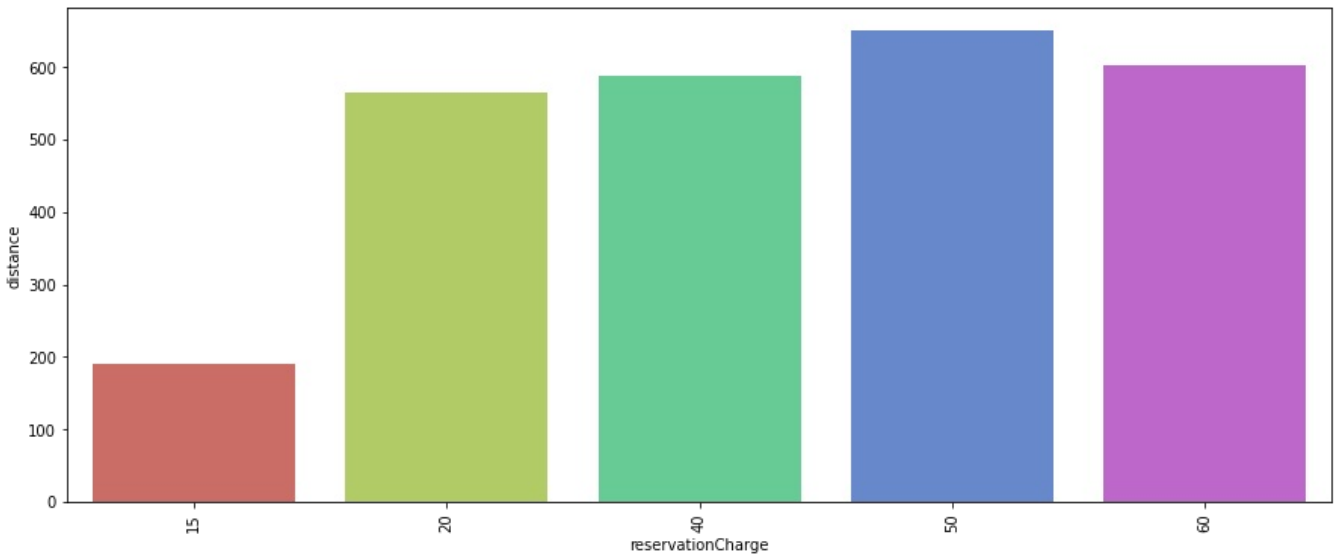
50
60
reservationCharge


distance
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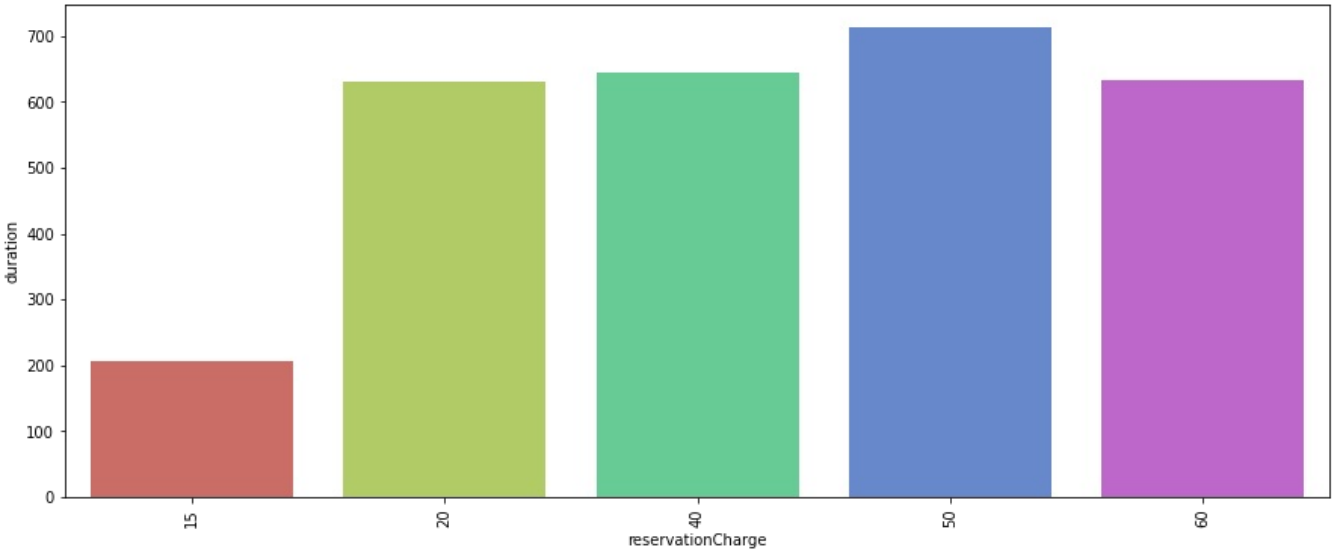
500
400
300
200
100
0
15
20
40
50
60
reservationCharge


duration
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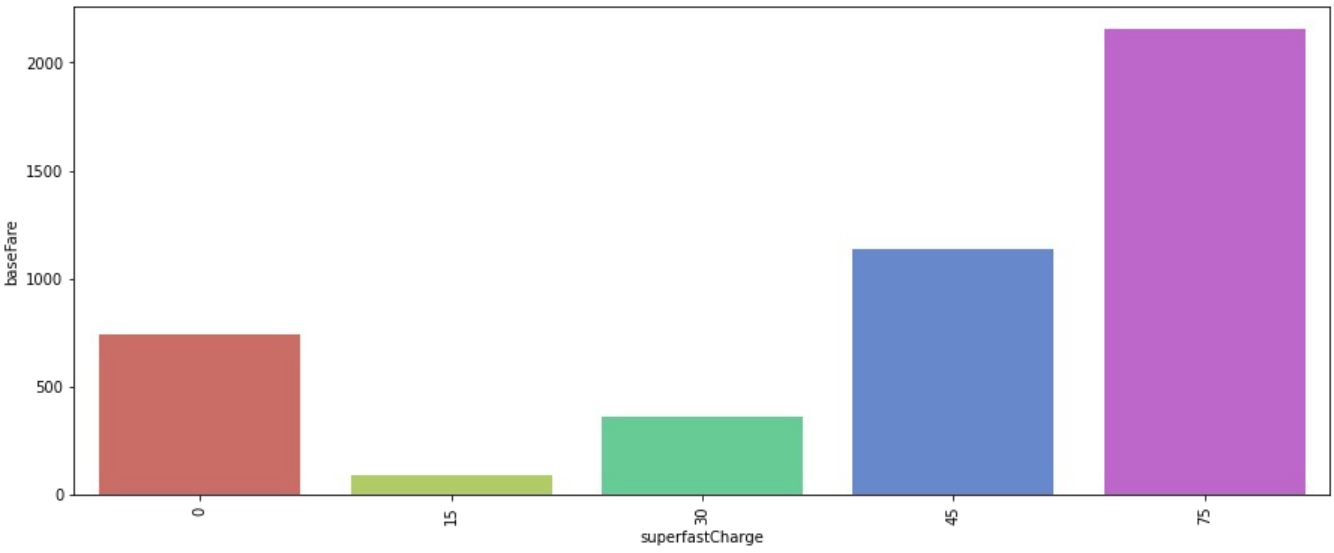
300
400
500
600
700
15
20
40
50
60
reservationCharge


baseFare
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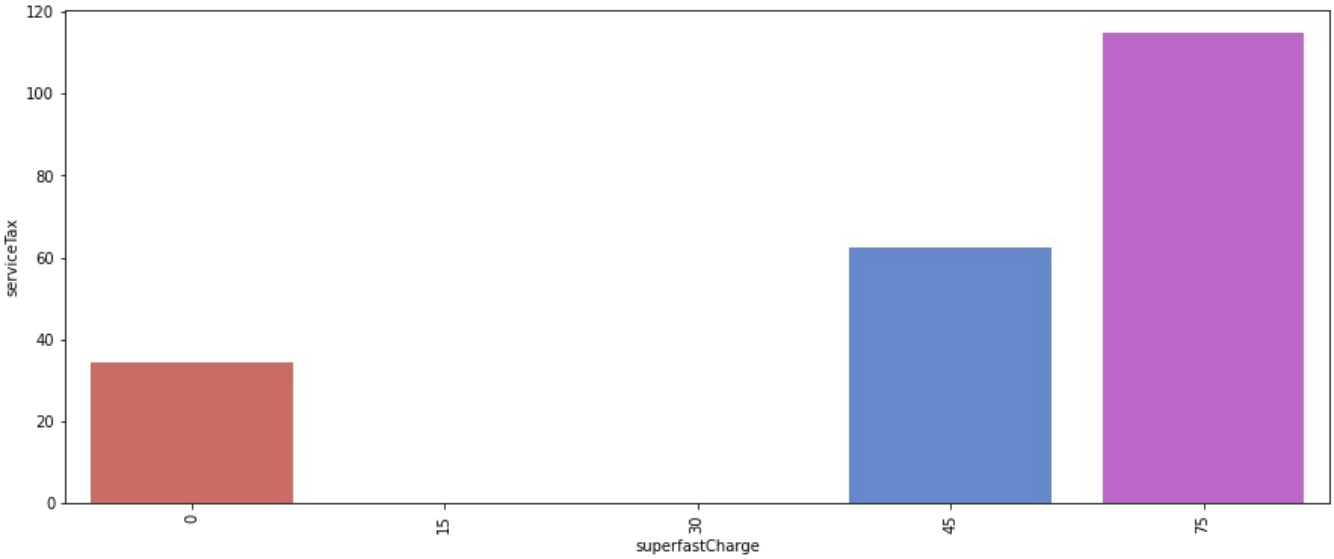
75
superfastCharge


serviceTax
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80
100
120
0
15
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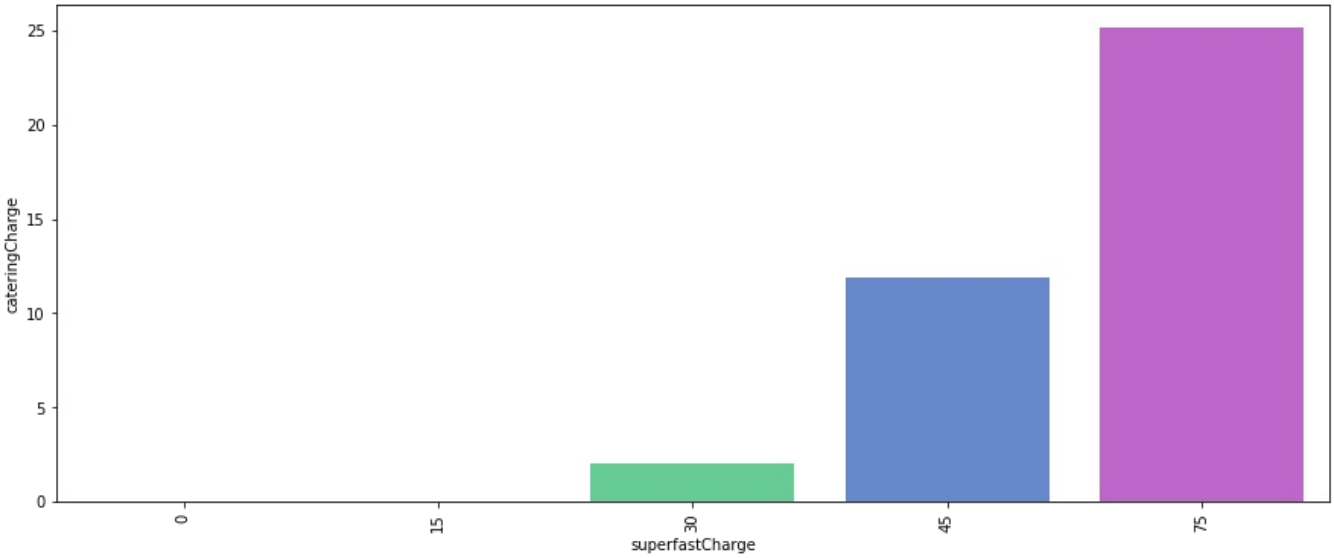
45
75
superfastCharge


cateringCharge
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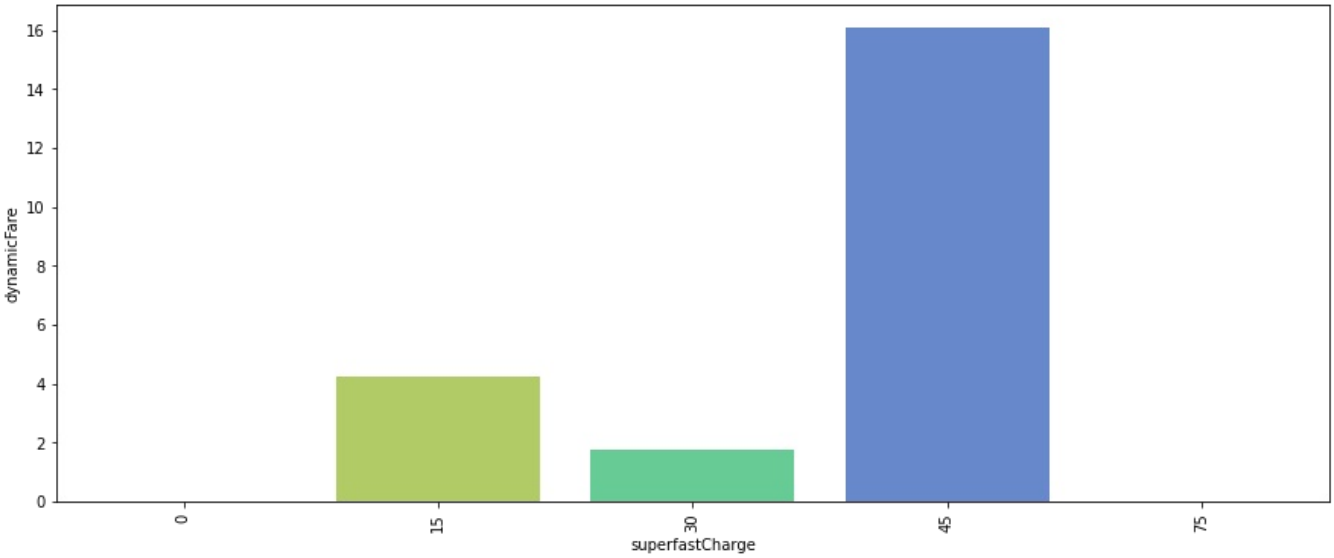
45
75
superfastCharge


dynamicFare
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6
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45
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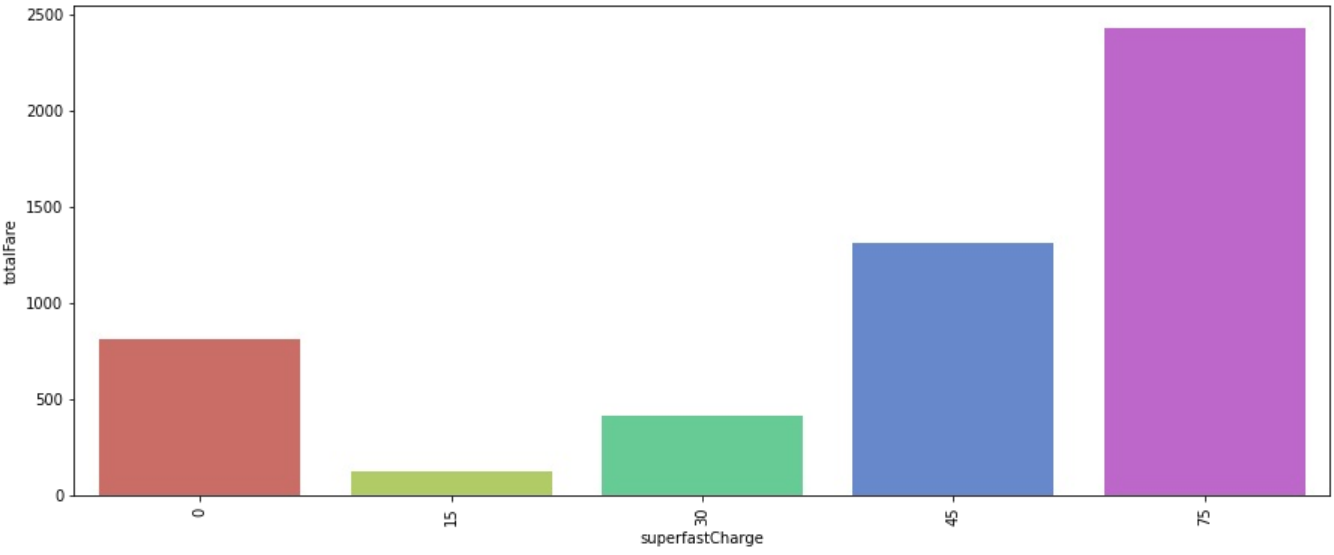
superfastCharge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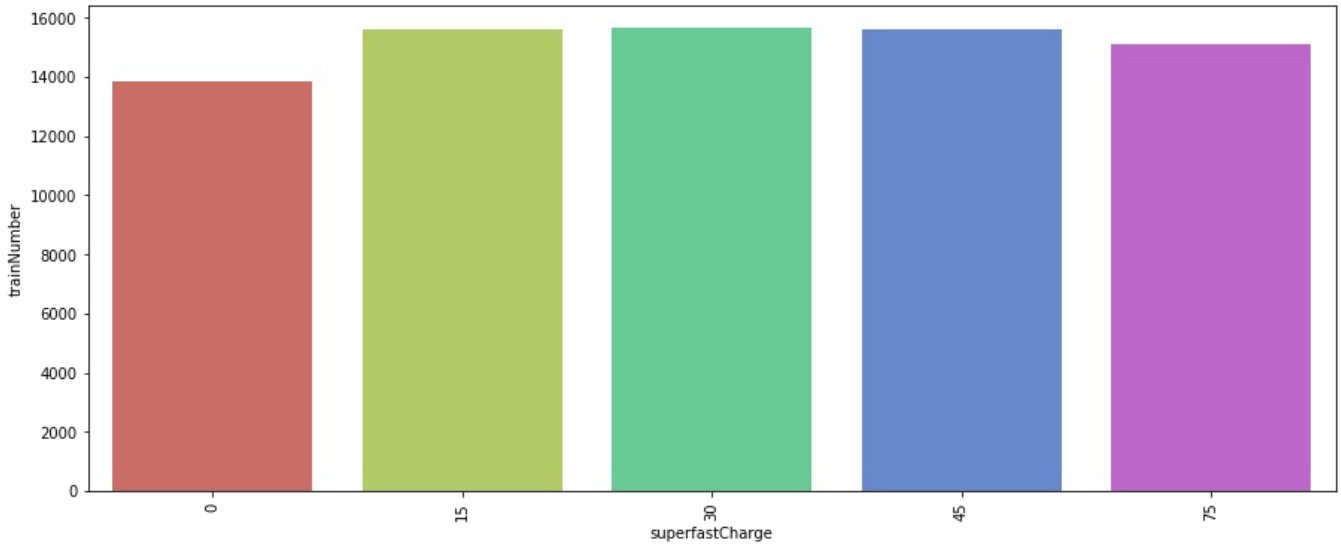
superfastCharge


trainNumber
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14000
12000
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6000
4000
2000
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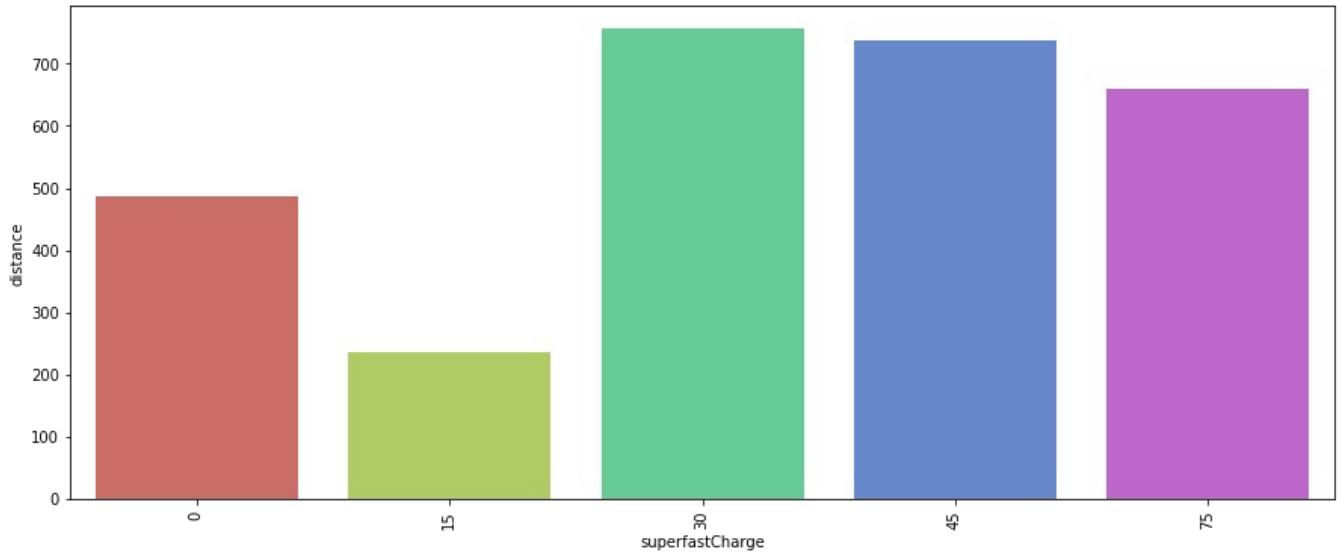
0
15
30
45
75
superfastCharge


distance
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500
400
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100
0
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15
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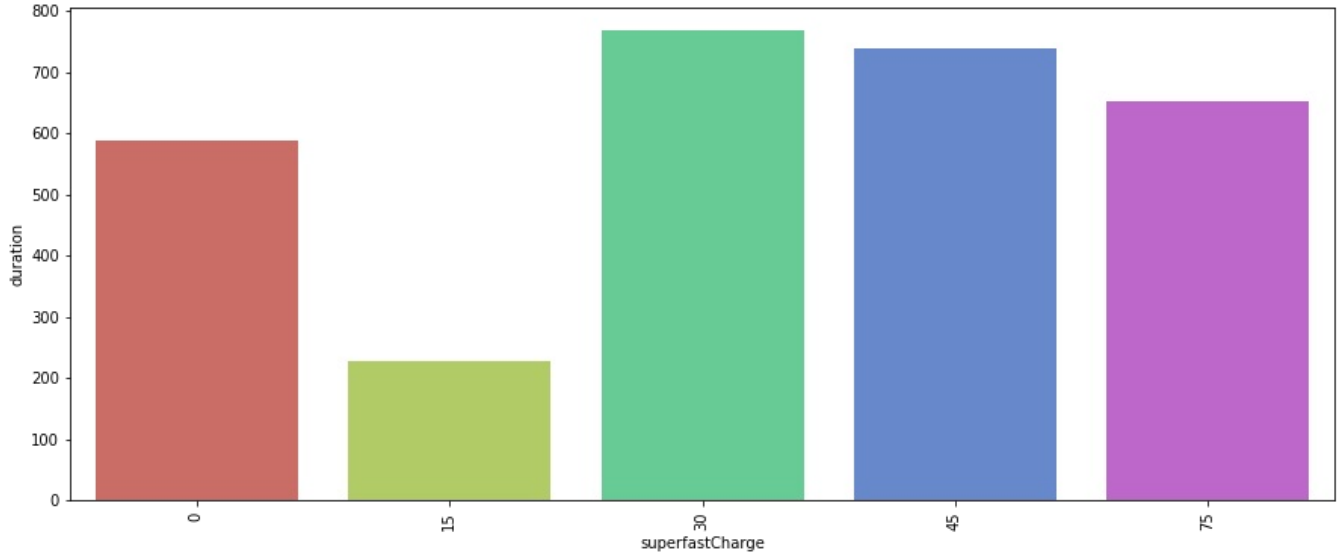
45
75
superfastCharge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100
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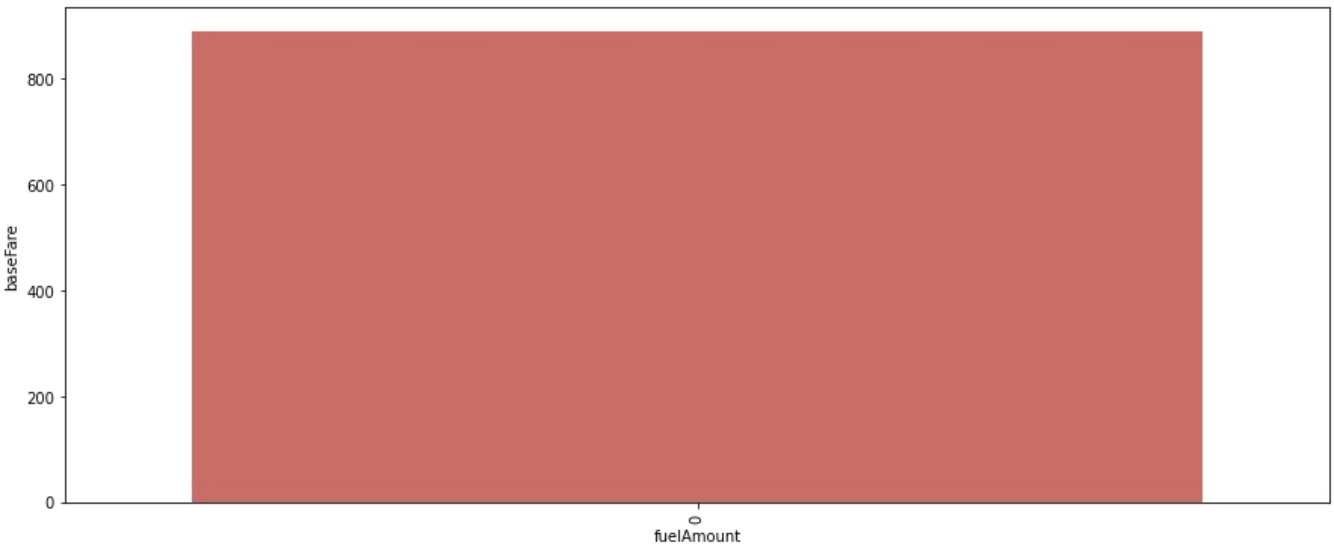
75
superfastCharge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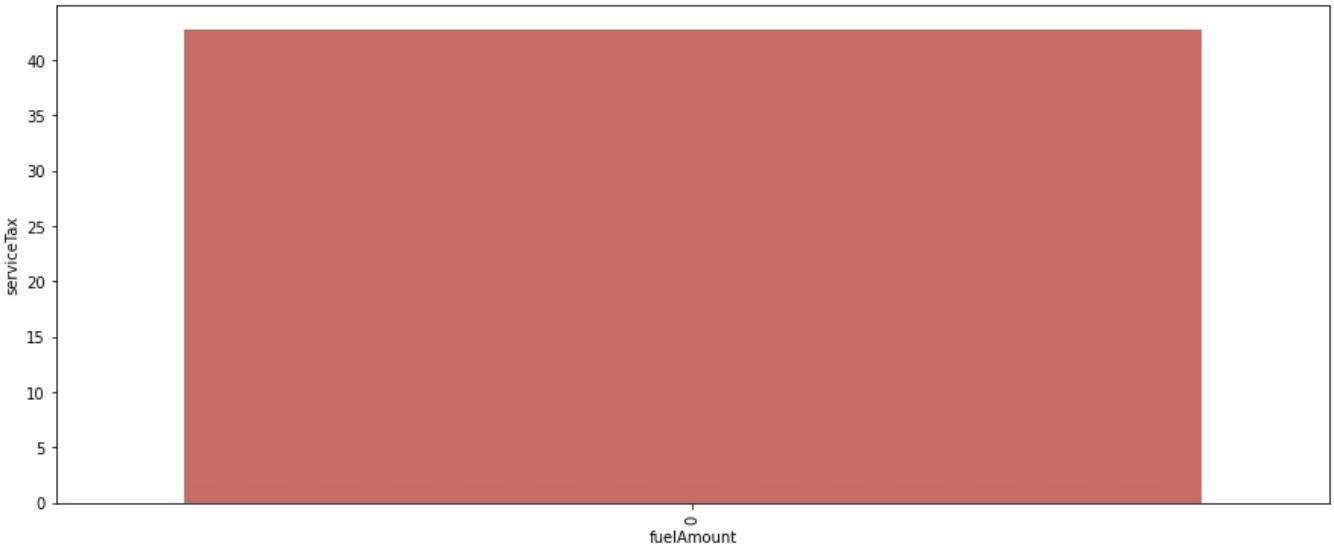
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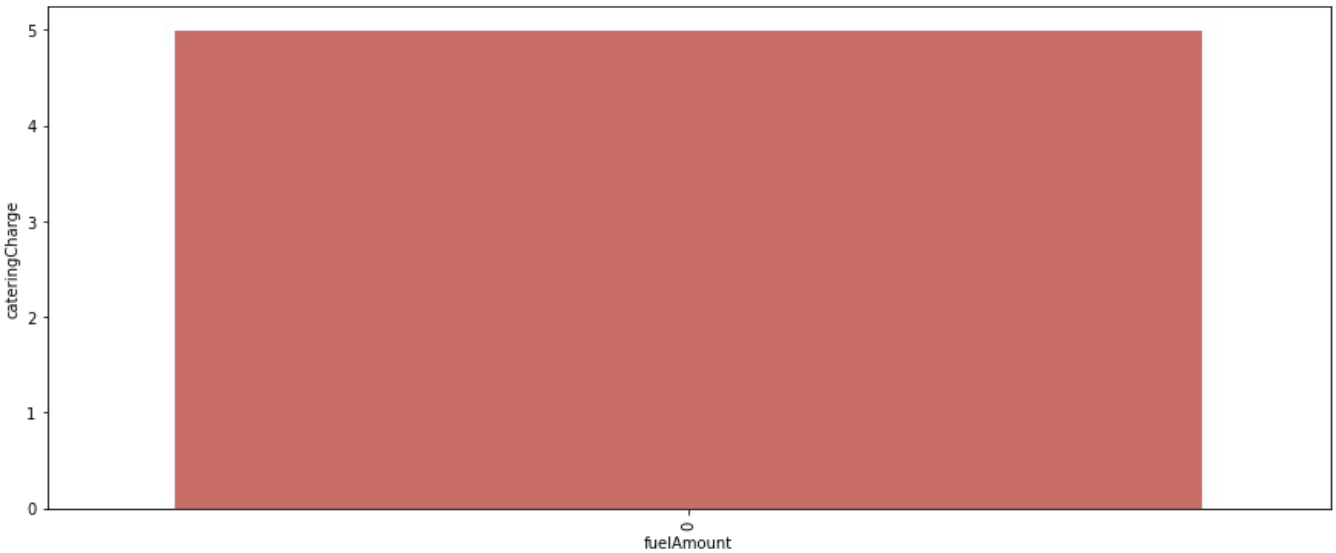
fuelAmount


cateringCharge
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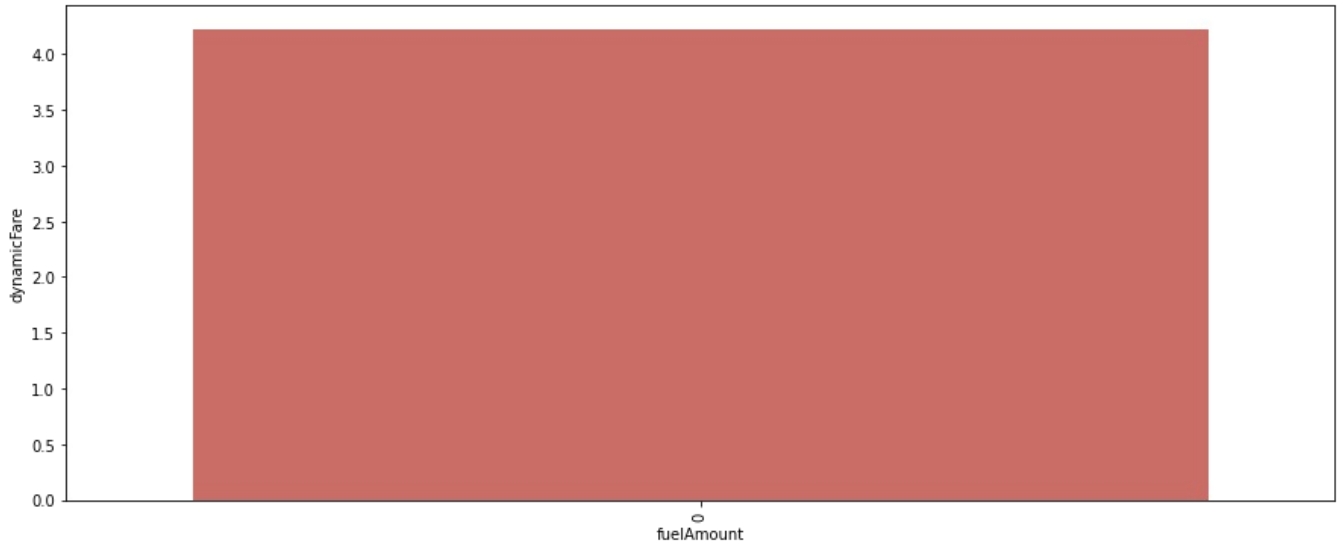
fuelAmount


dynamicFare
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1.0
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0.0
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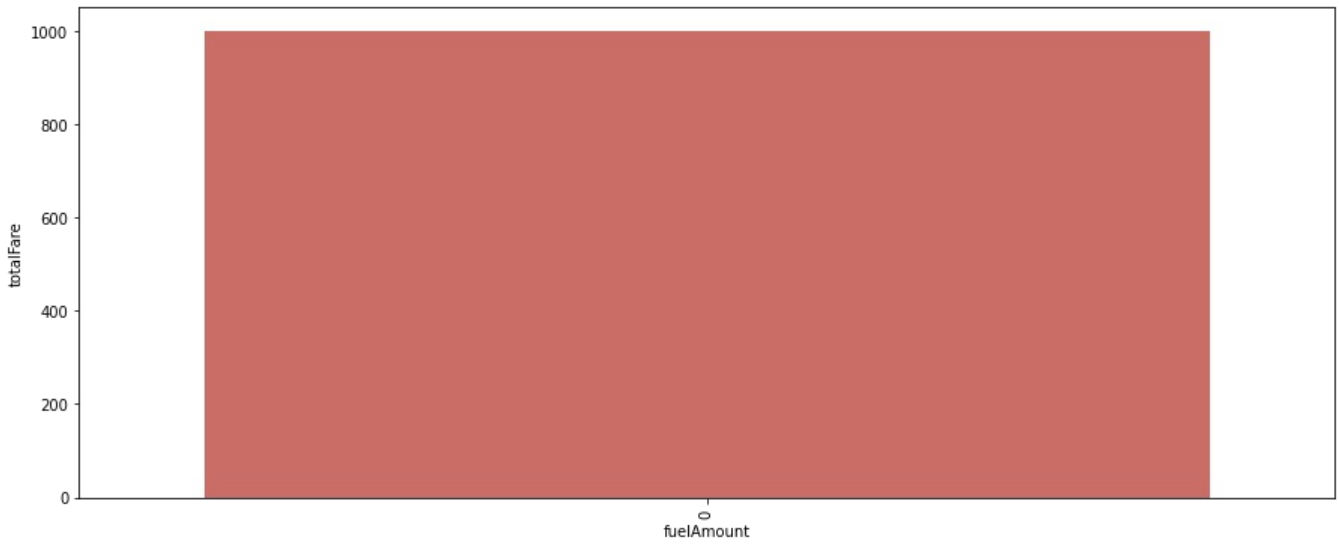
fuelAmount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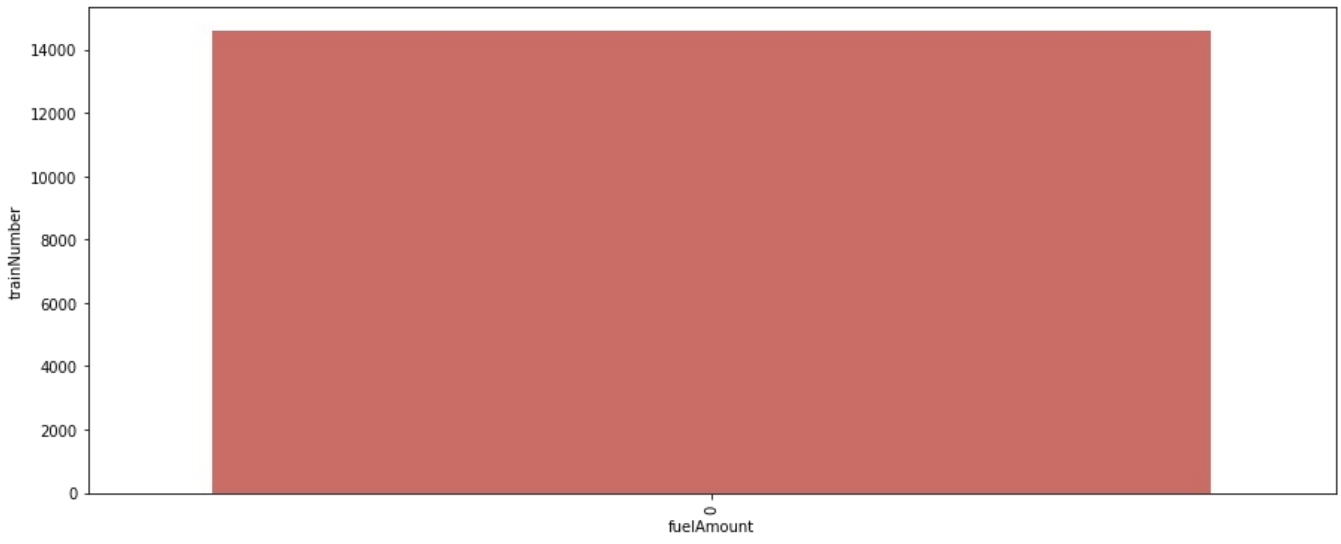
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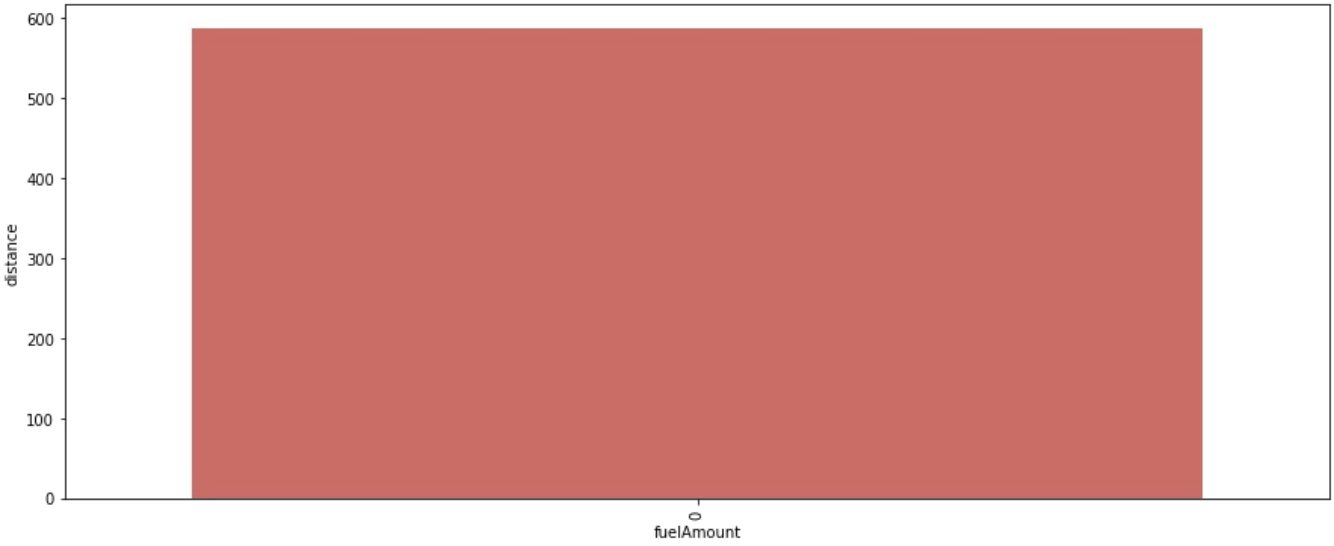
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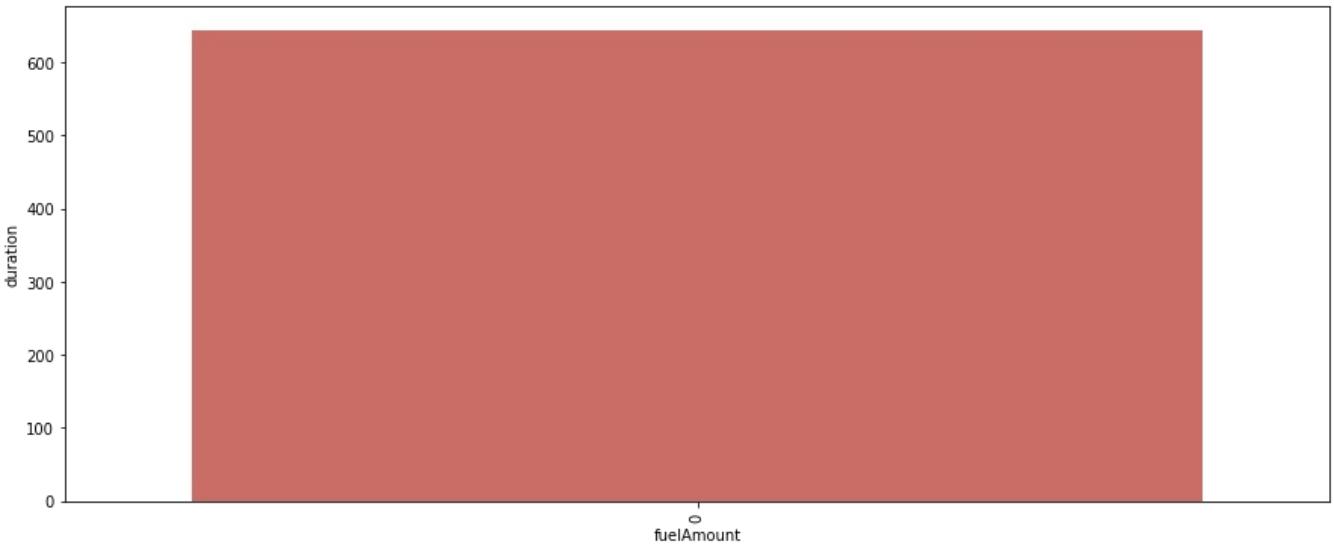
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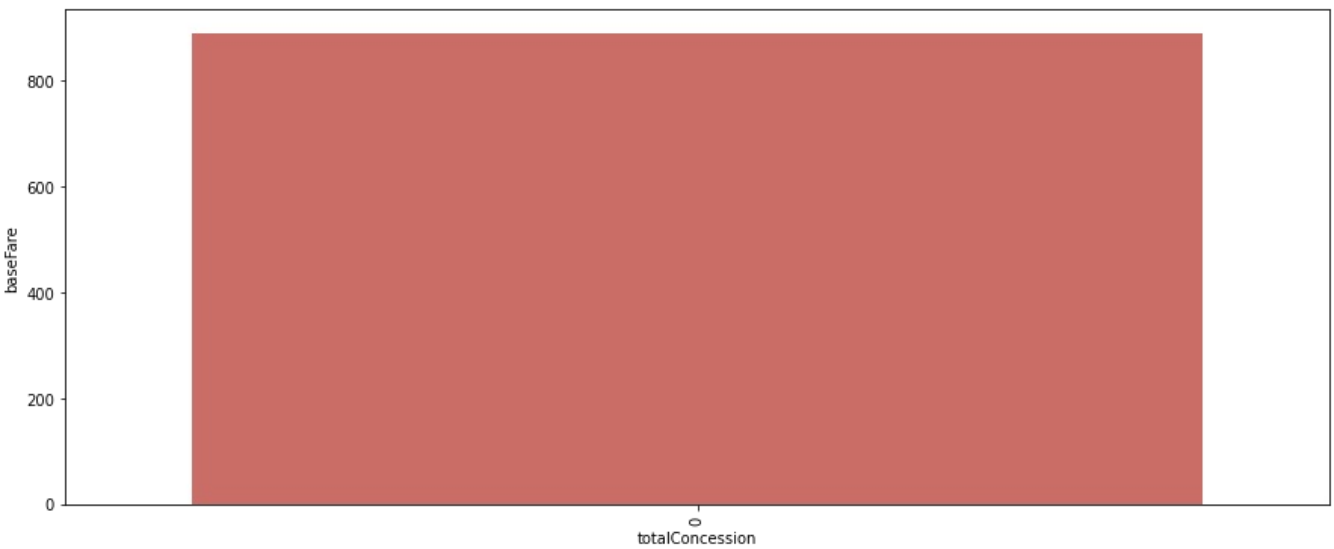
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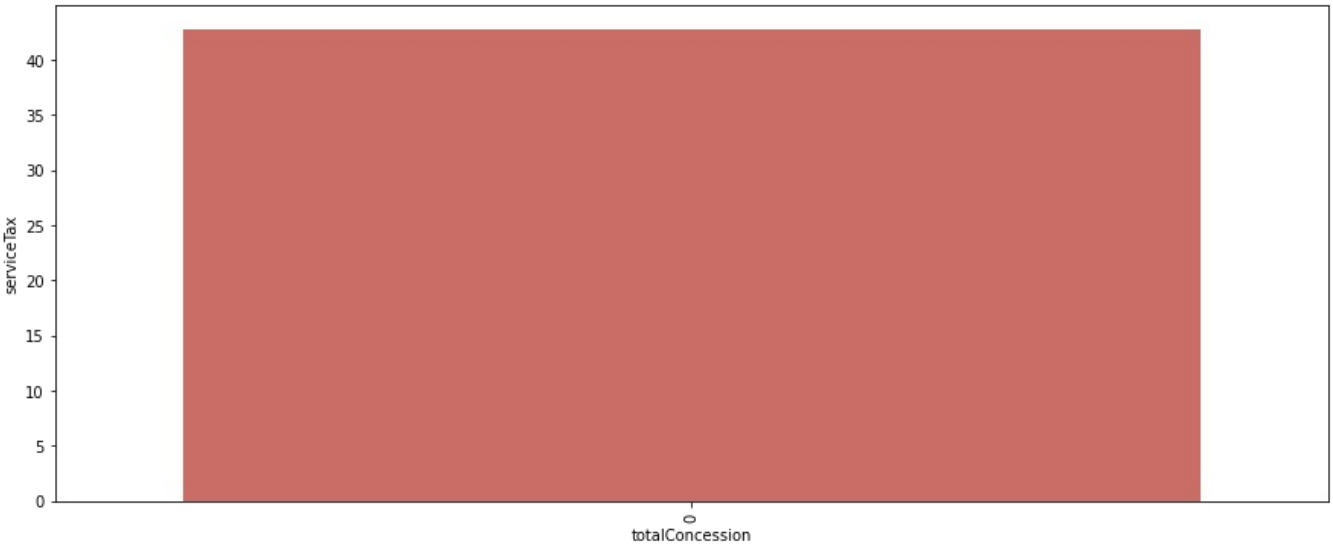
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20
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35
40
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totalConcession


cateringCharge
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1
2
3
4
5
0
totalConcession


dynamicFare
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3.0
3.5
4.0
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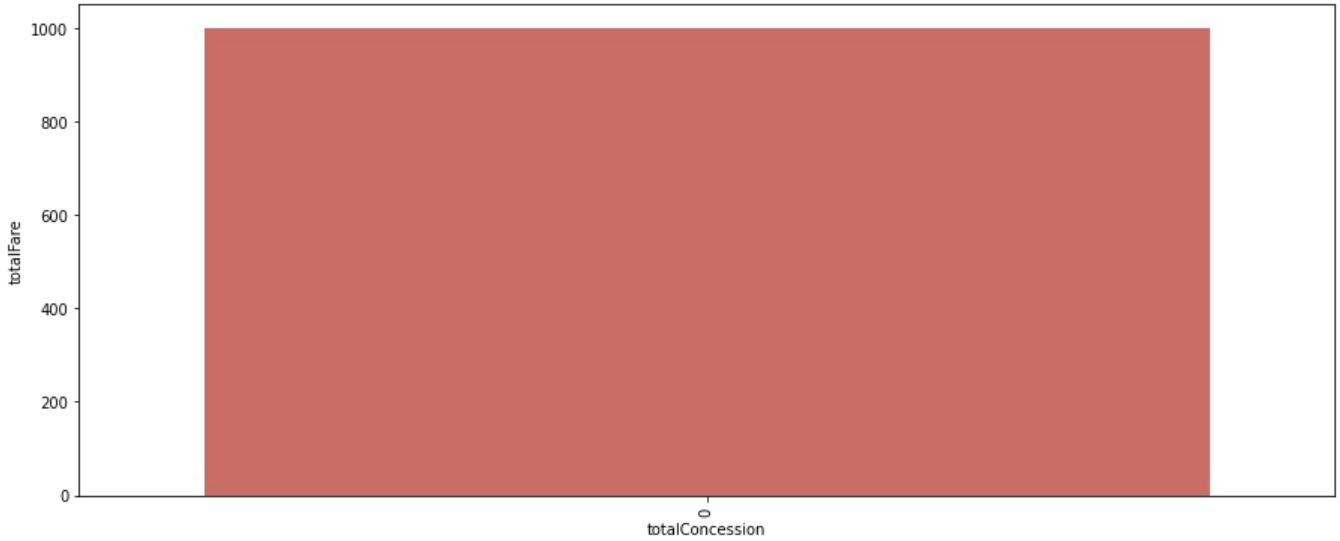
totalConcession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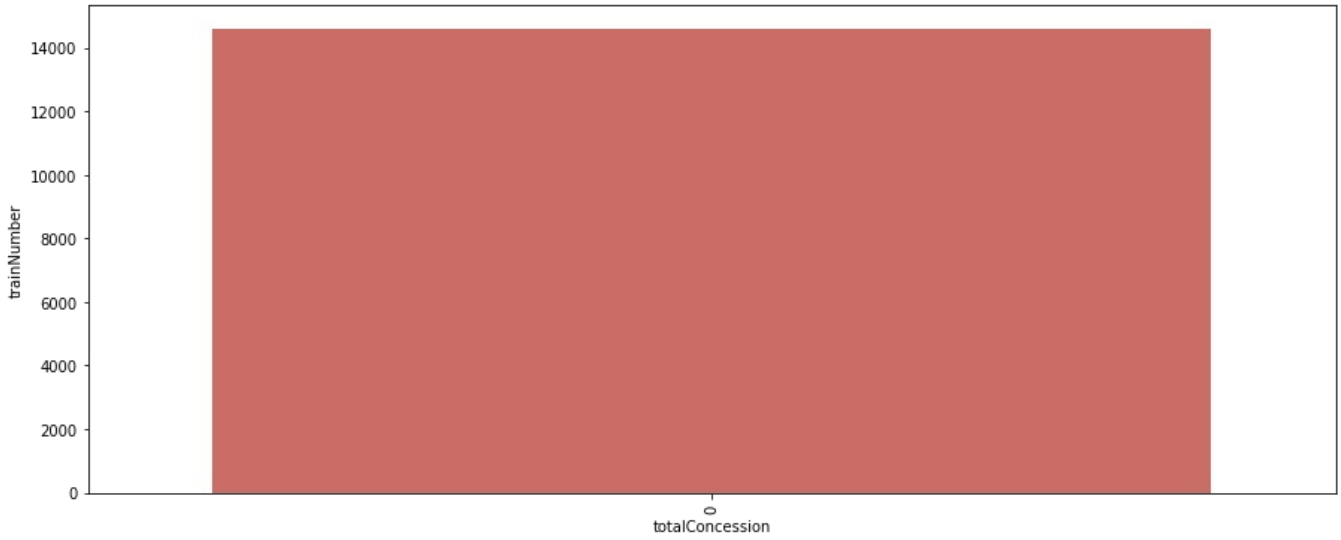
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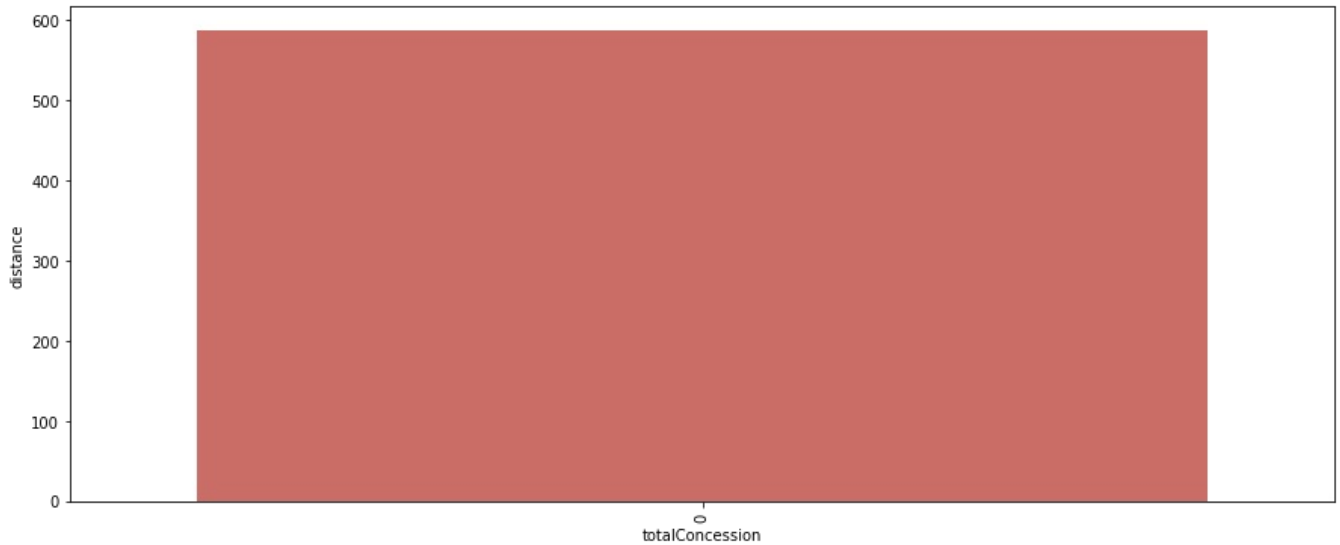
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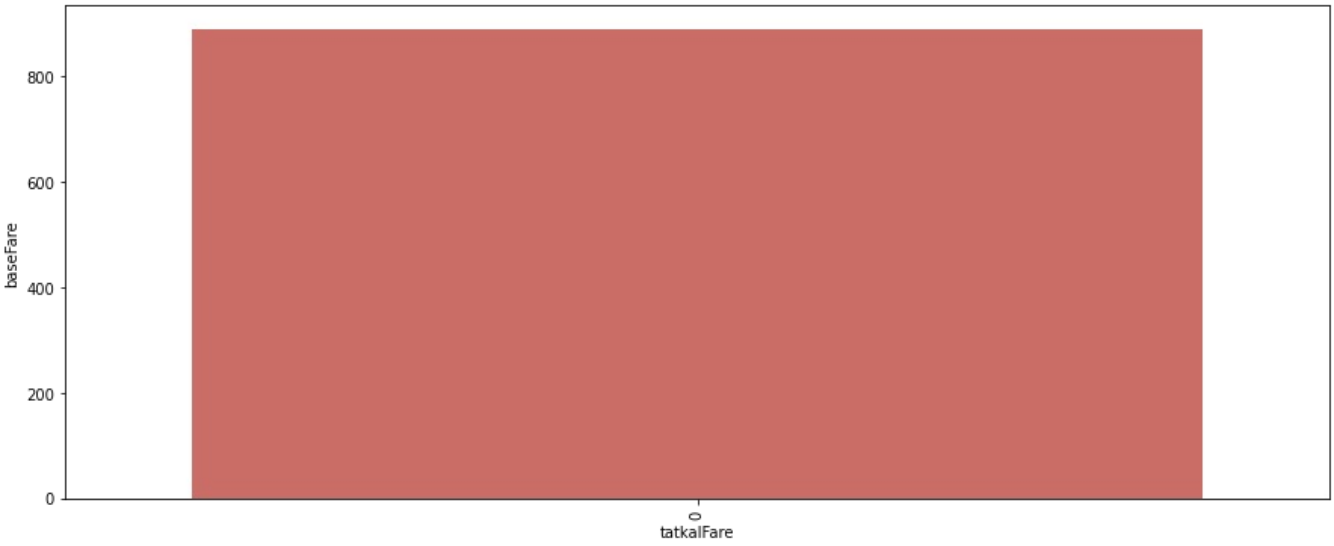
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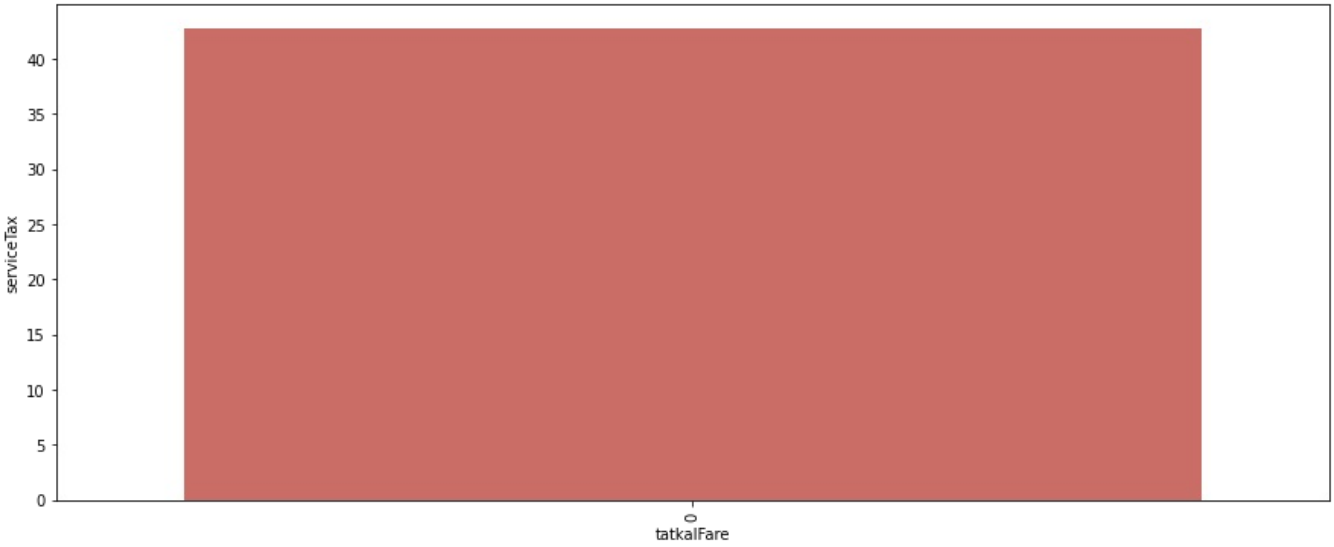
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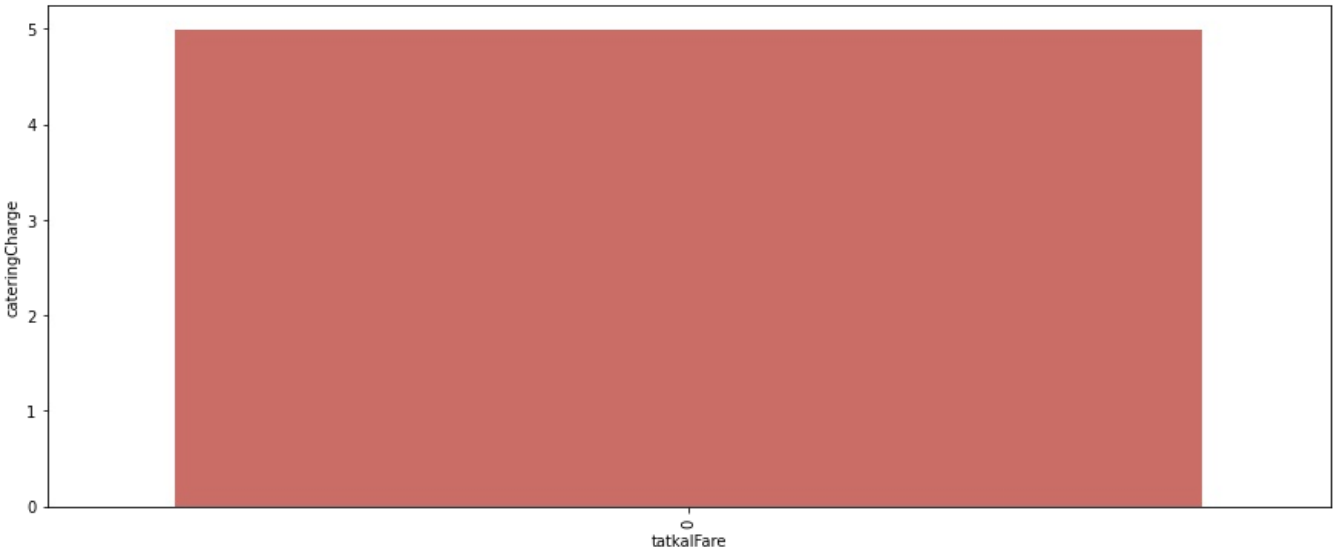
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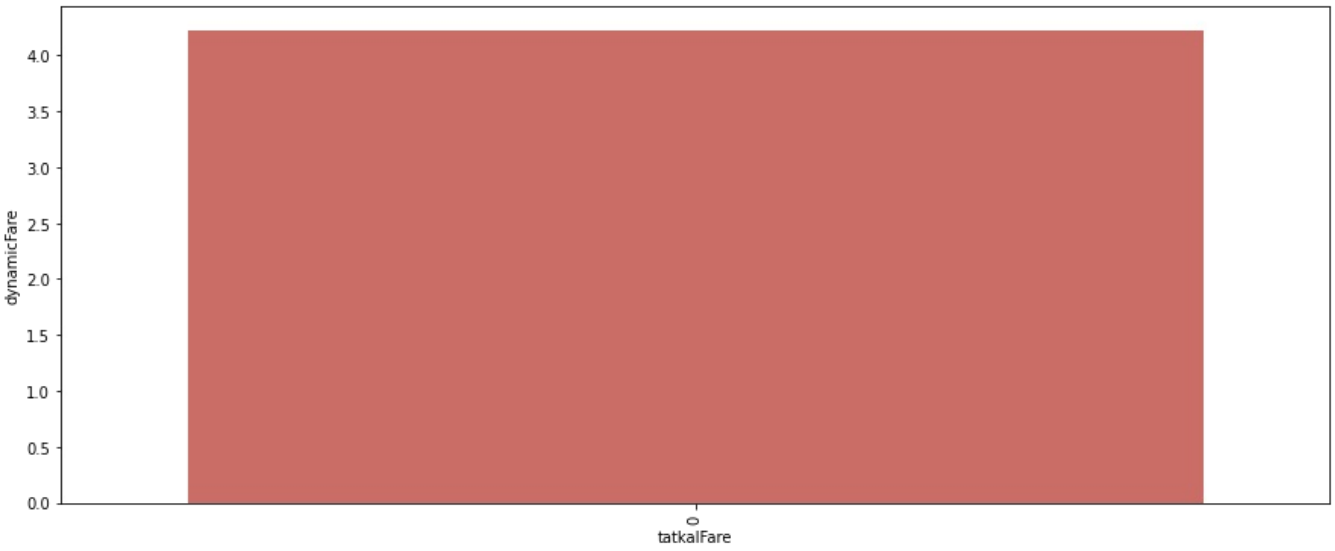
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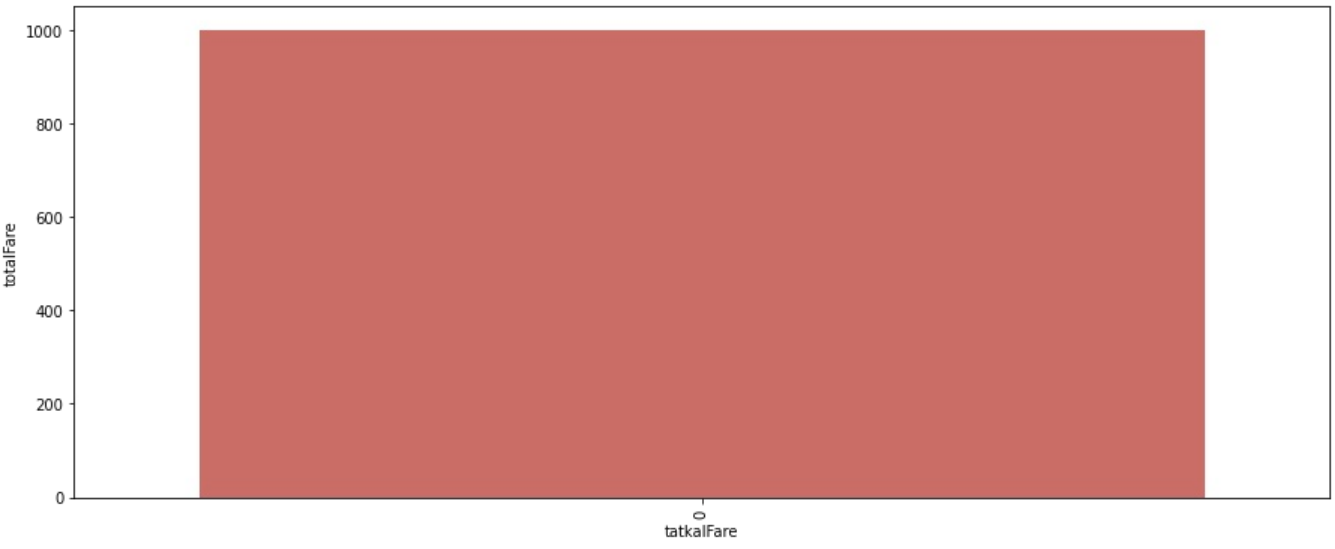
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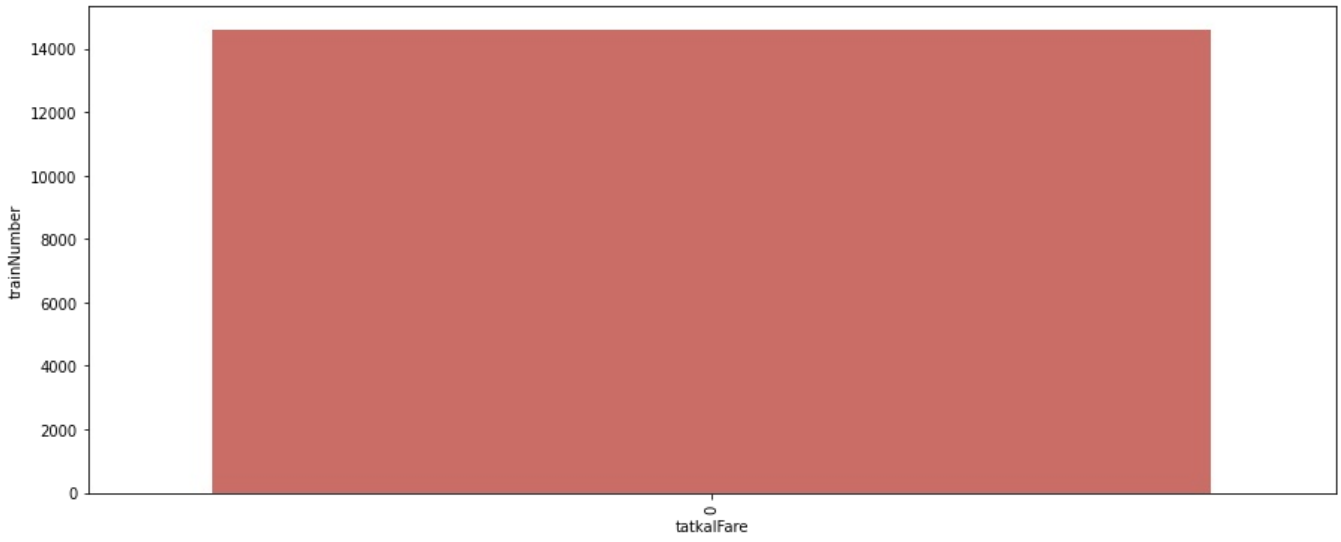
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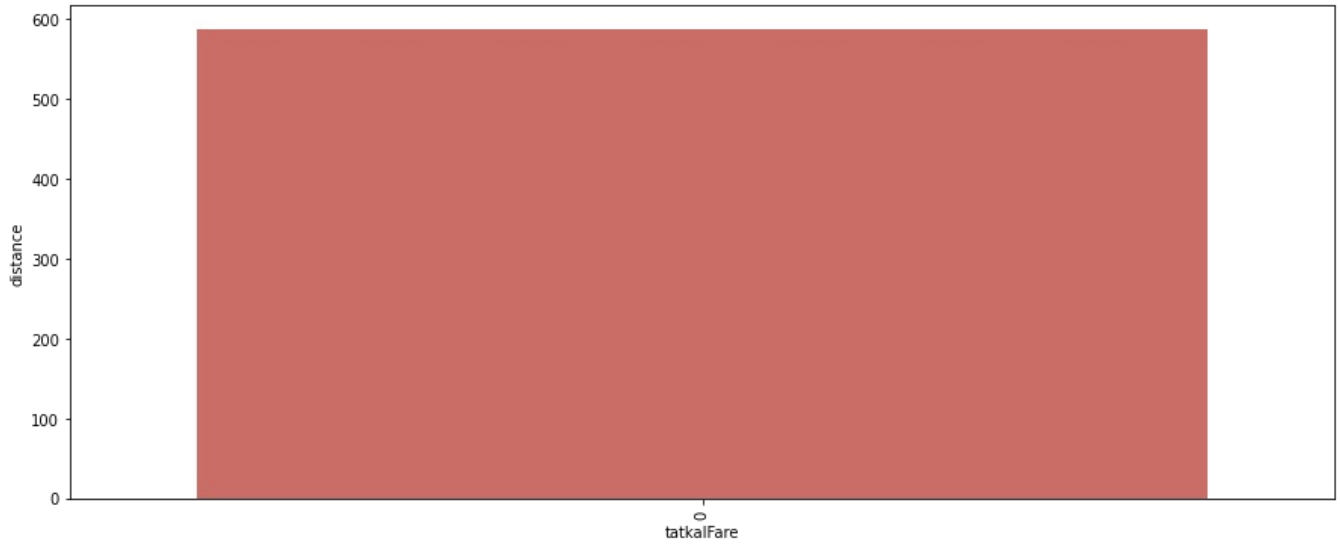
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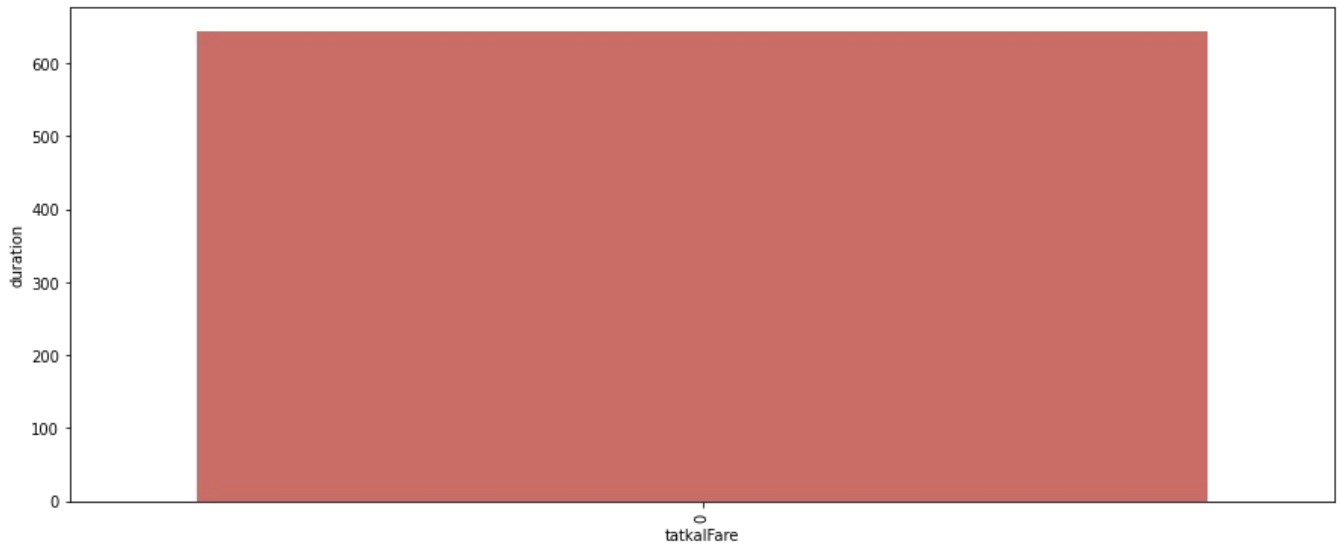
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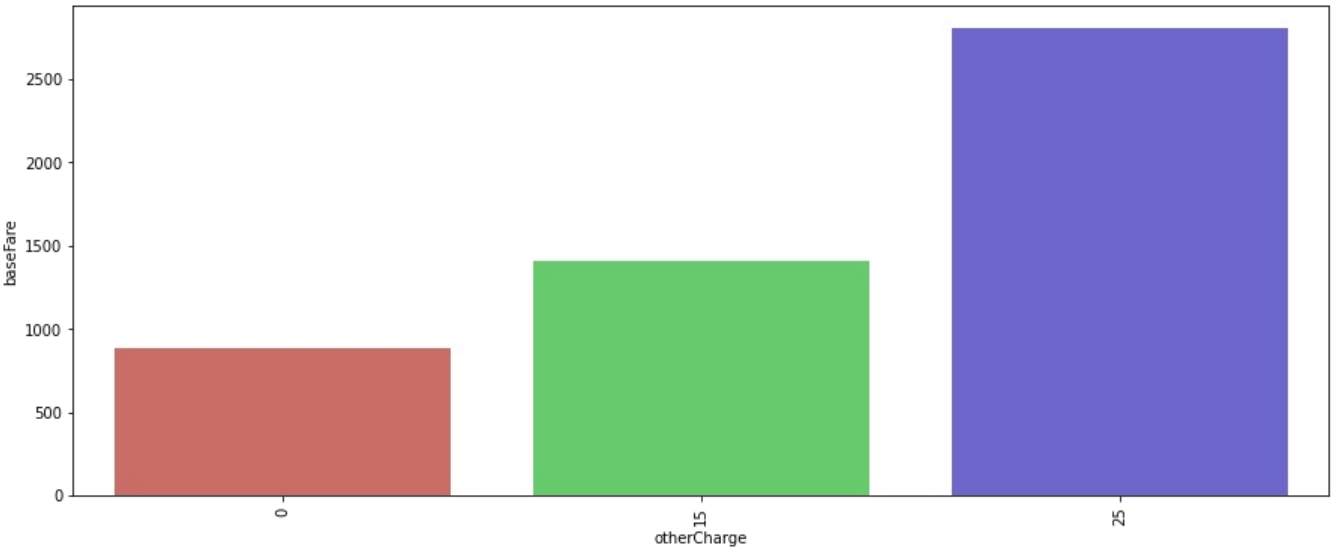
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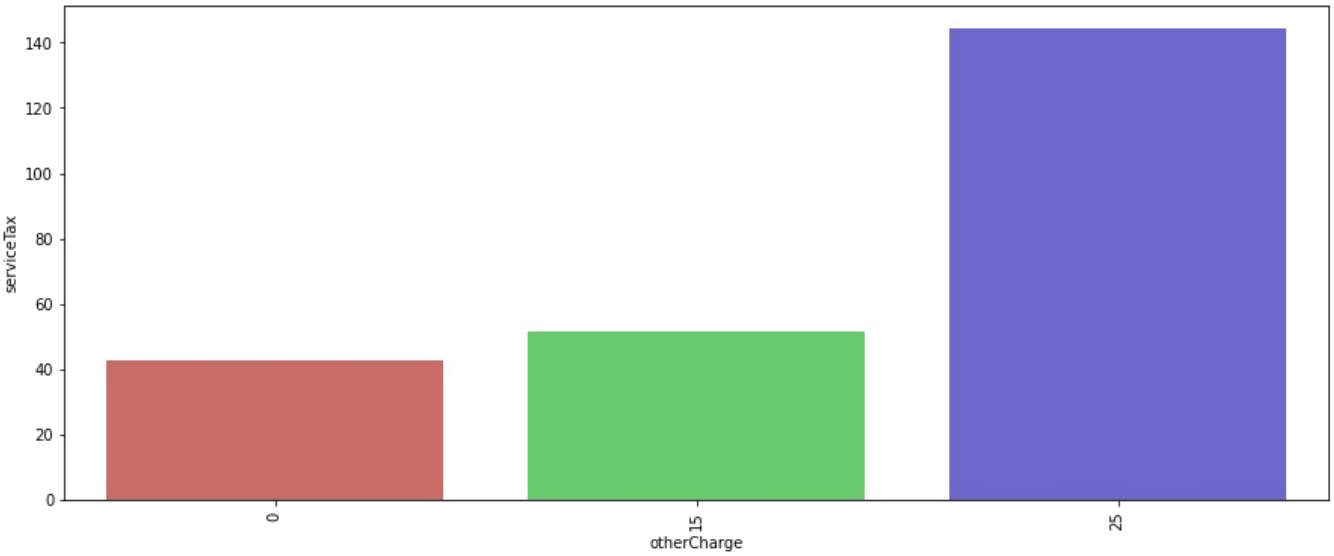
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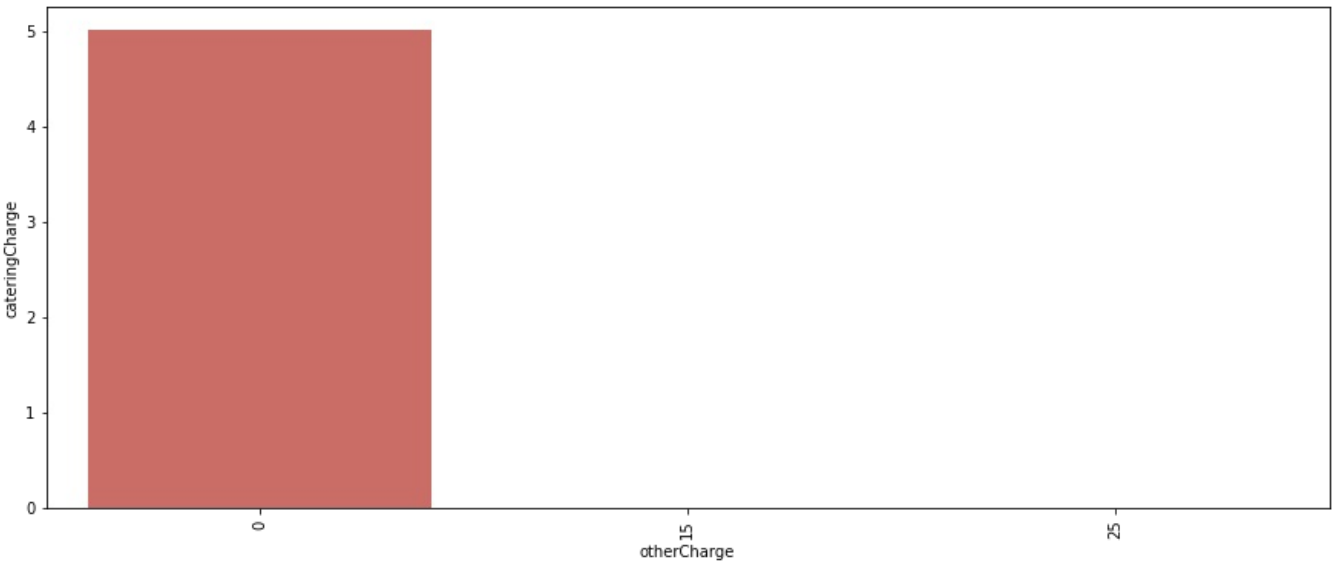
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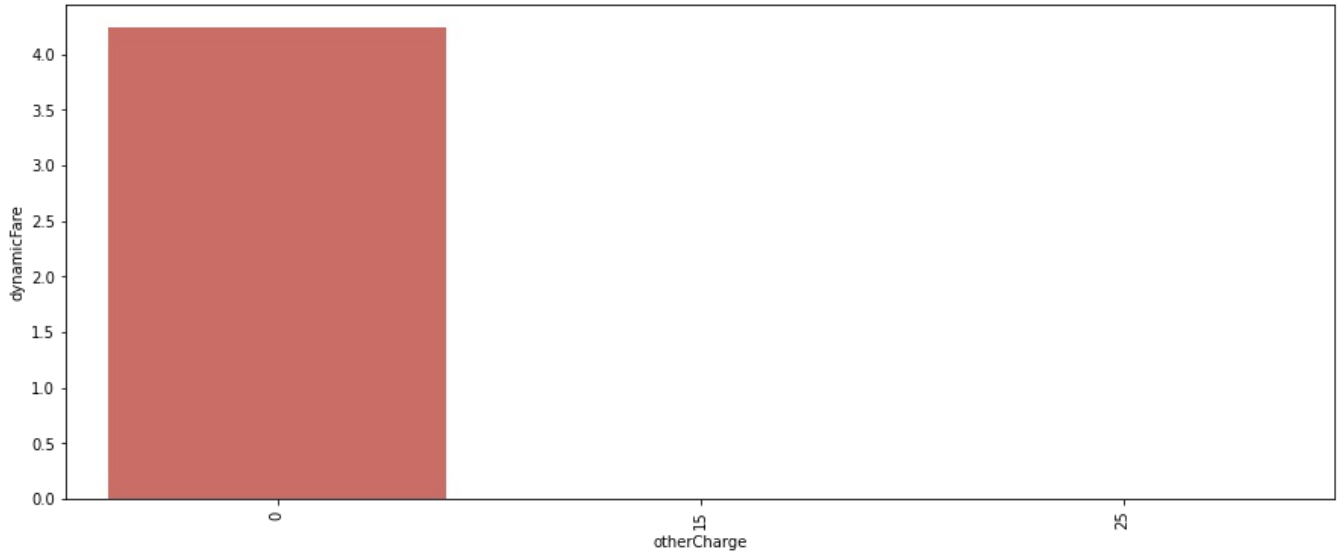
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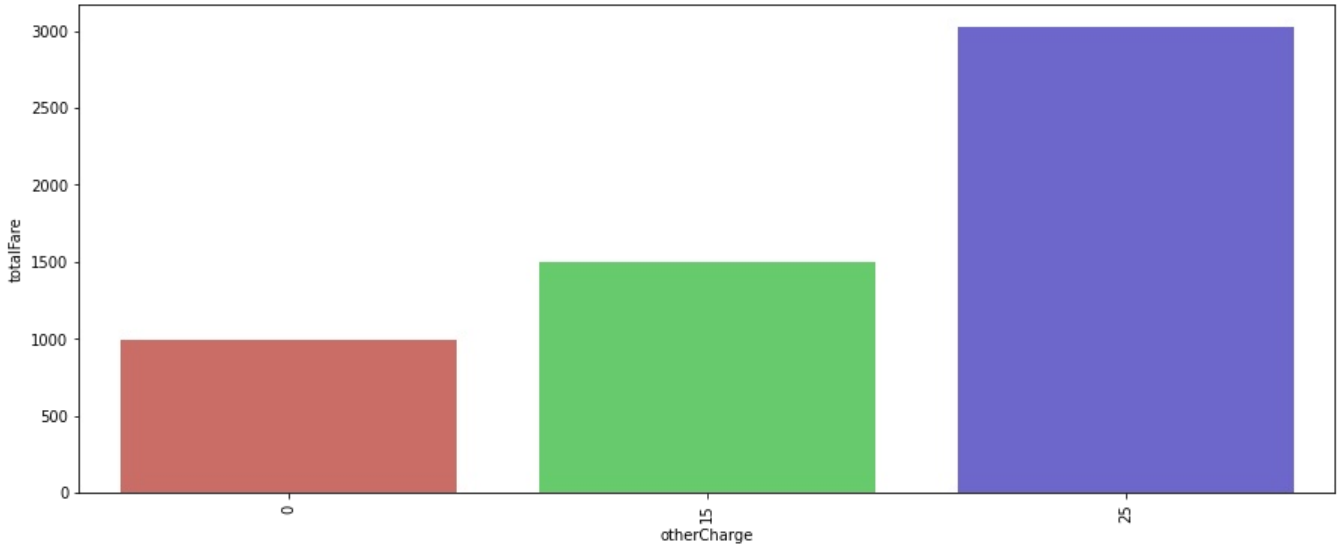
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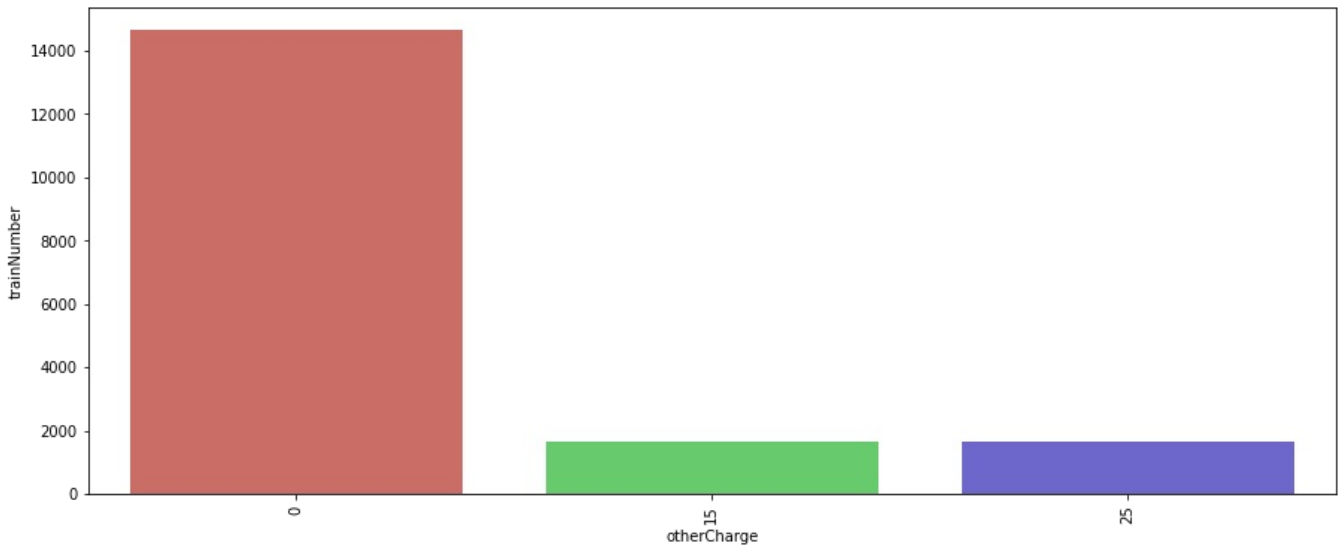
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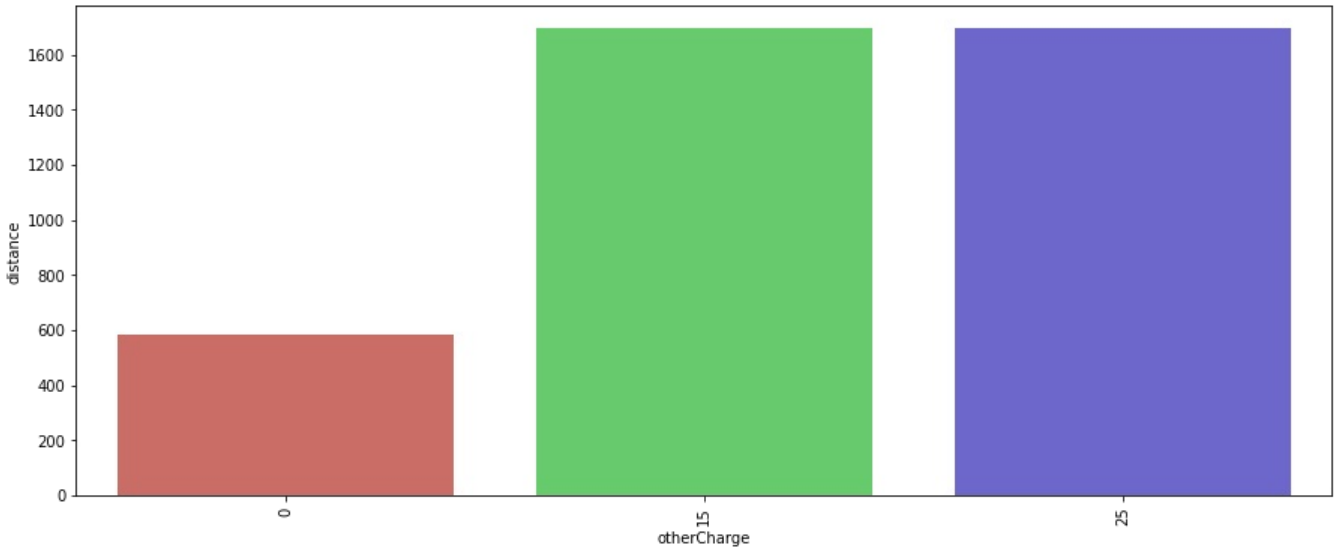
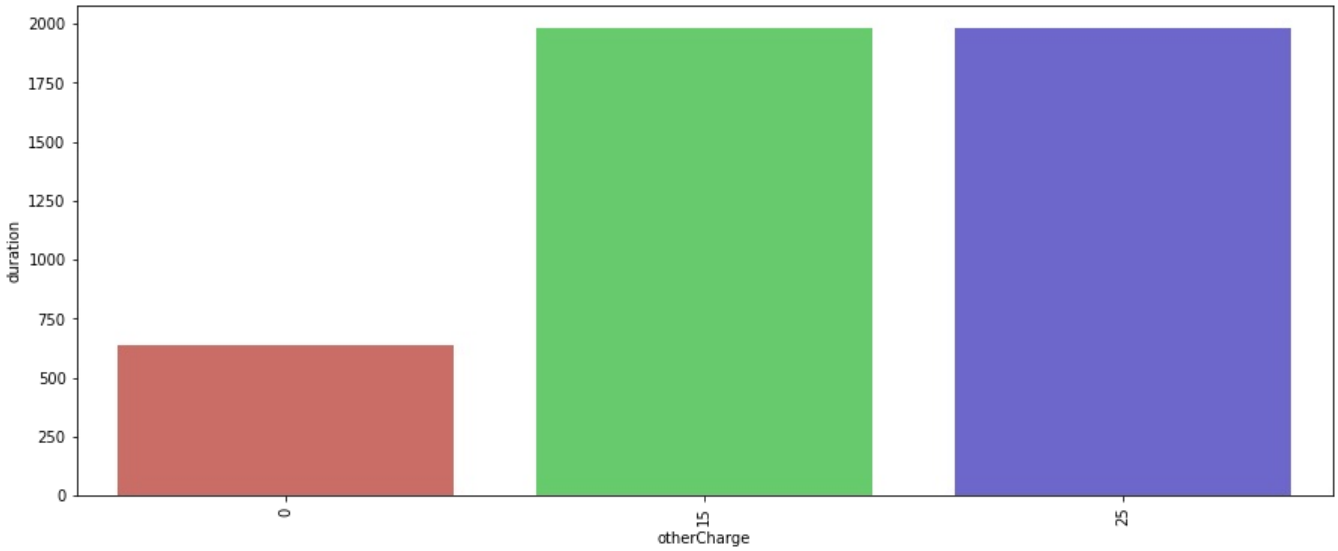
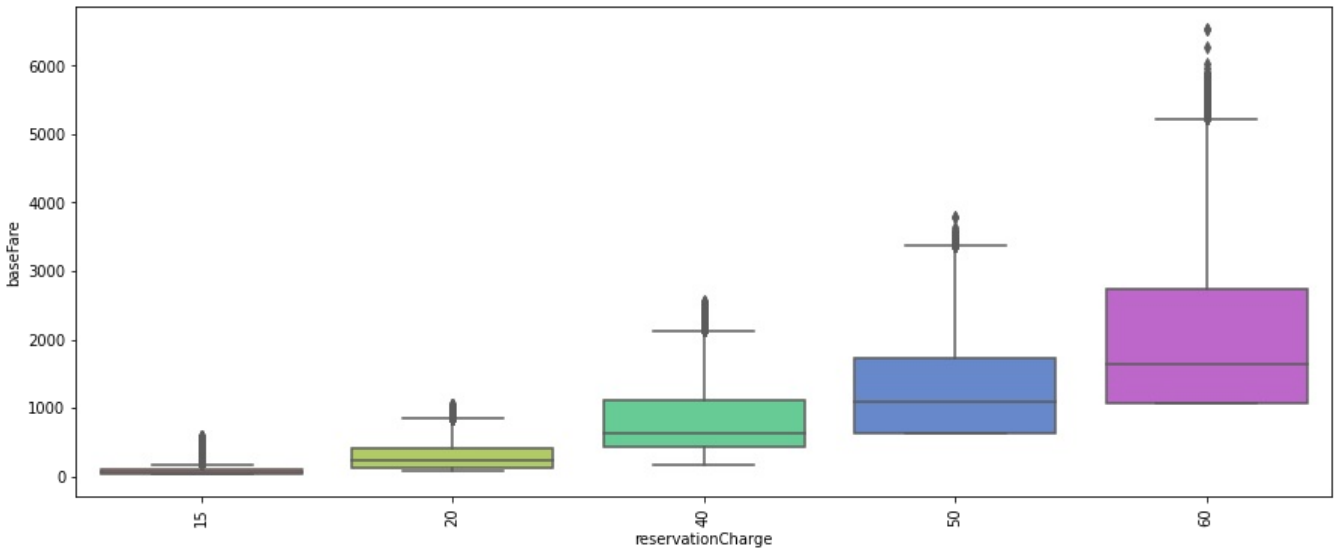
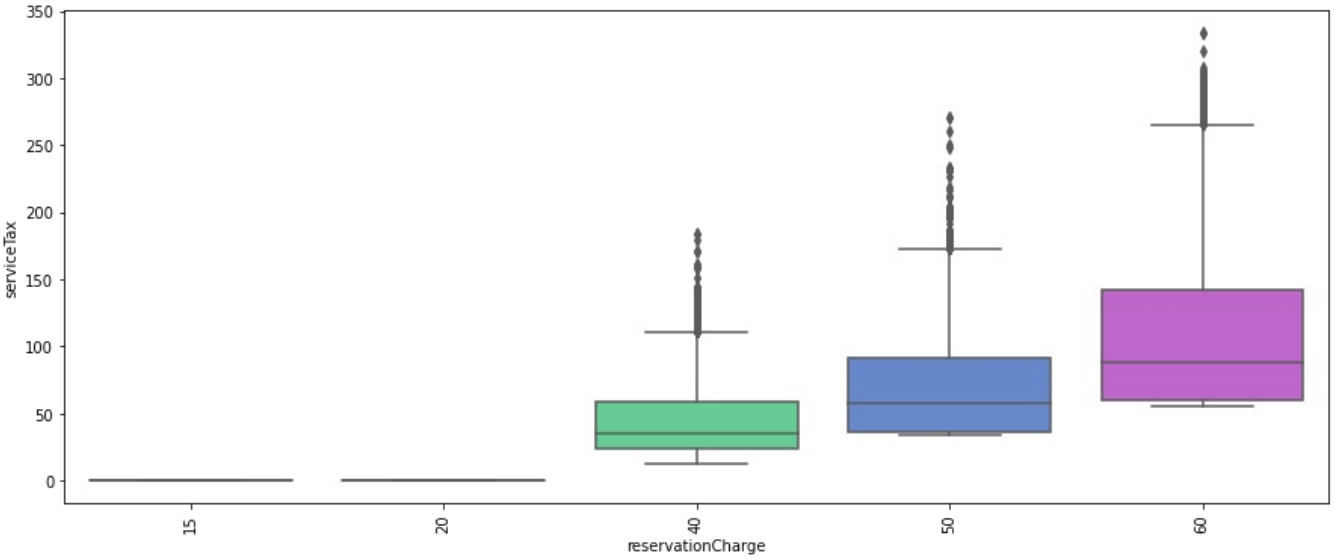




In [35]:
```
for i in discrete:
    for j in continuous:
        plt.figure(figsize=(15,6))
        sns.boxplot(x = df[i], y = df[j], data = df, palette = 'hls')
        plt.xticks(rotation = 90)
        plt.show()
```

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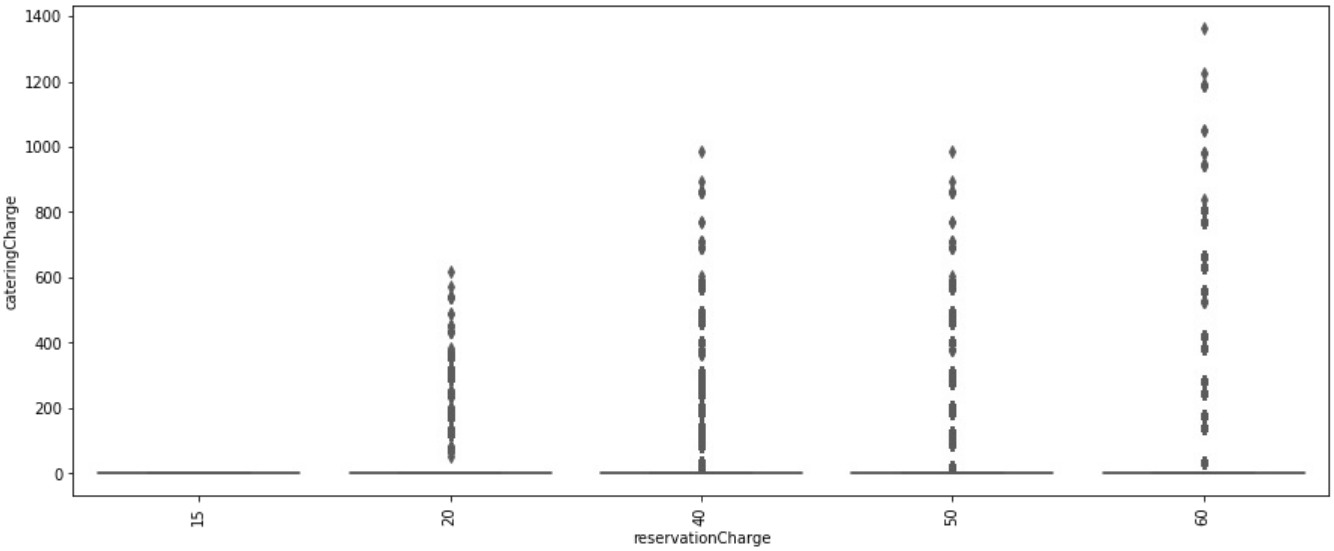
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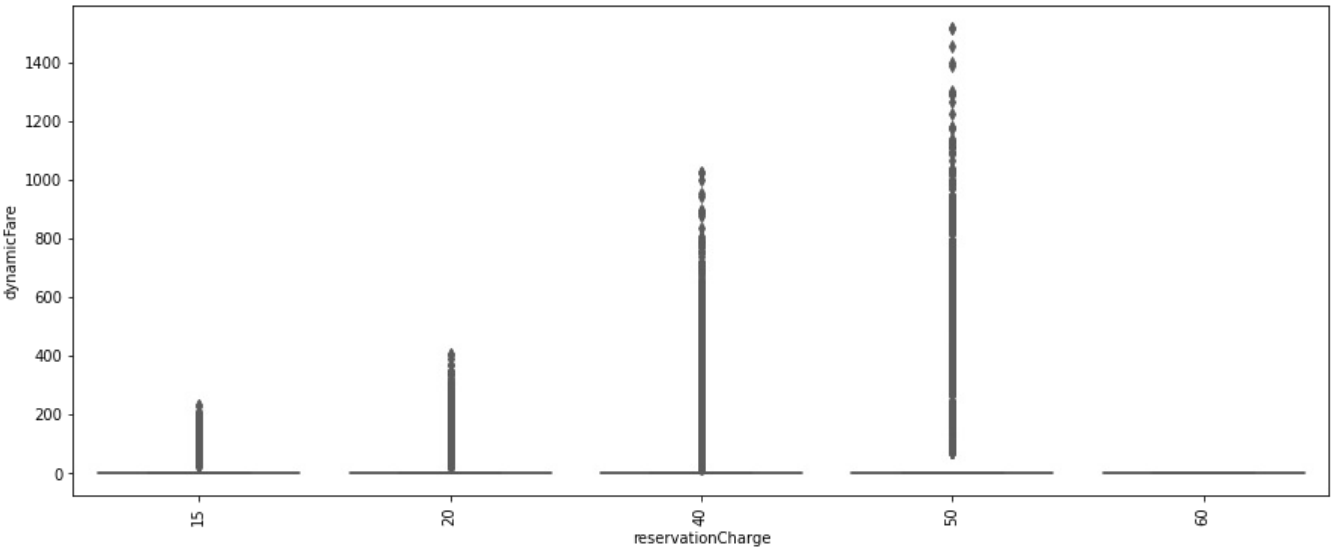
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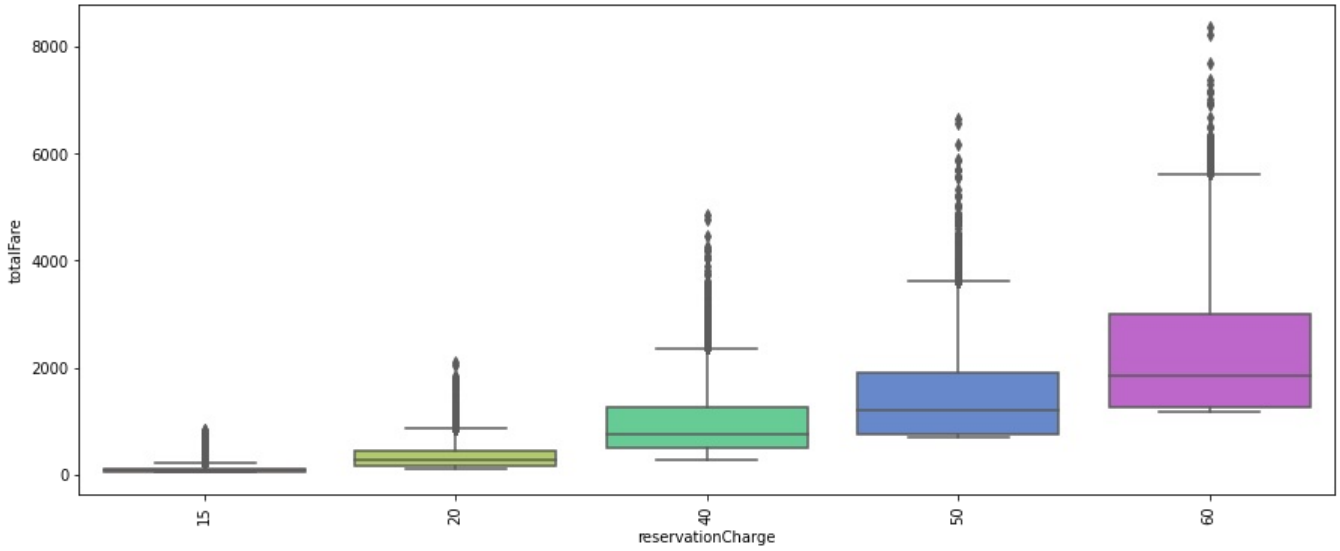
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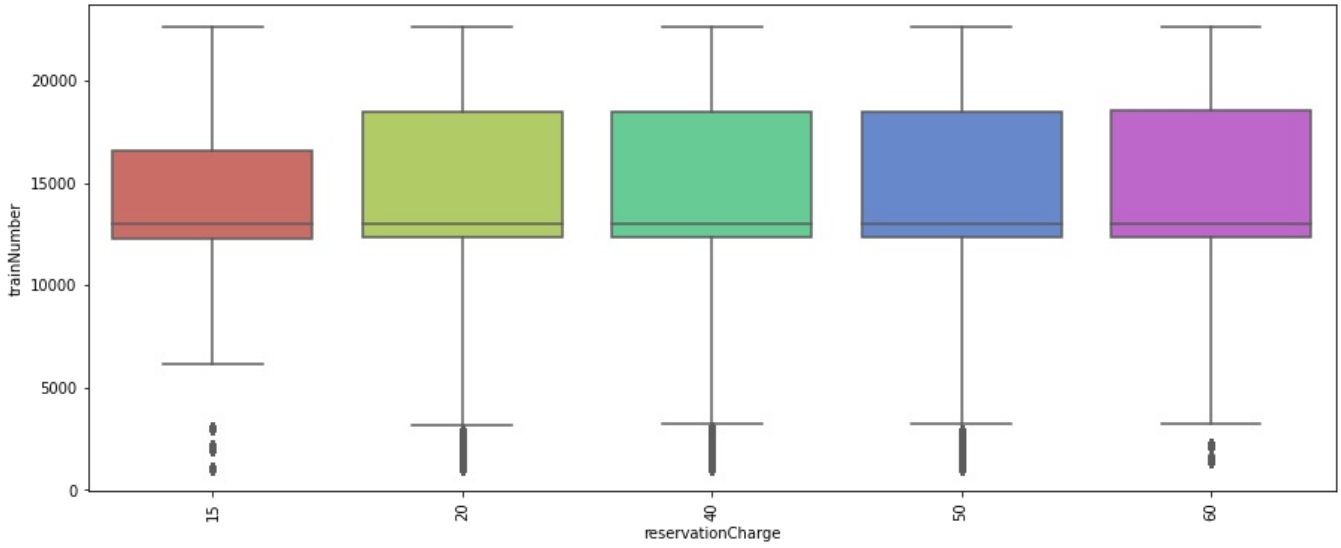
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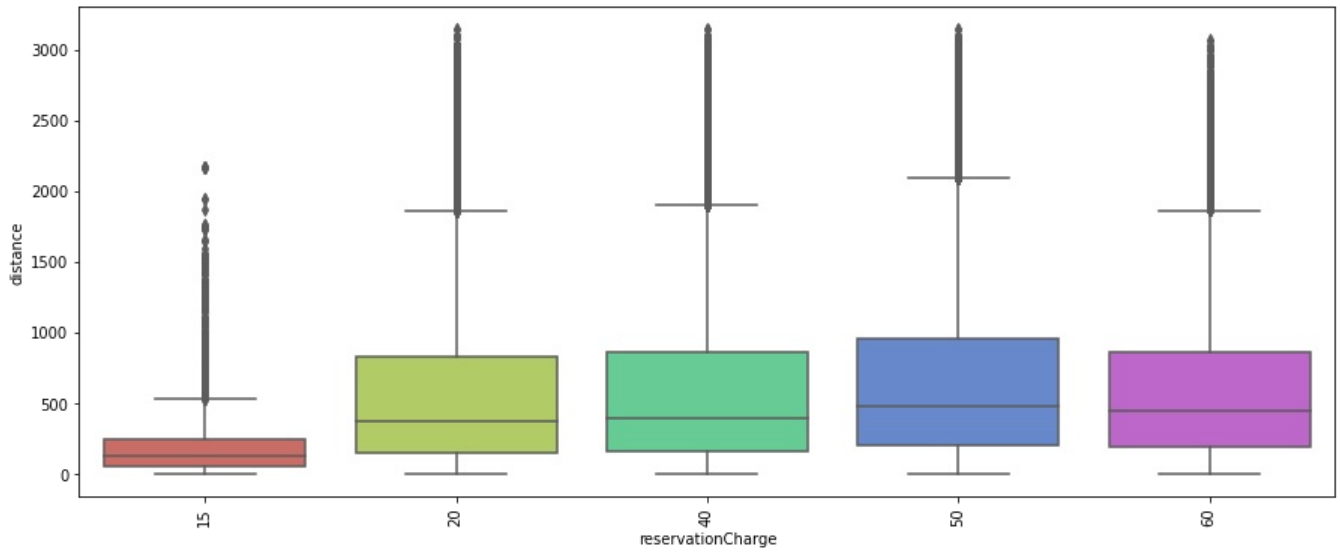
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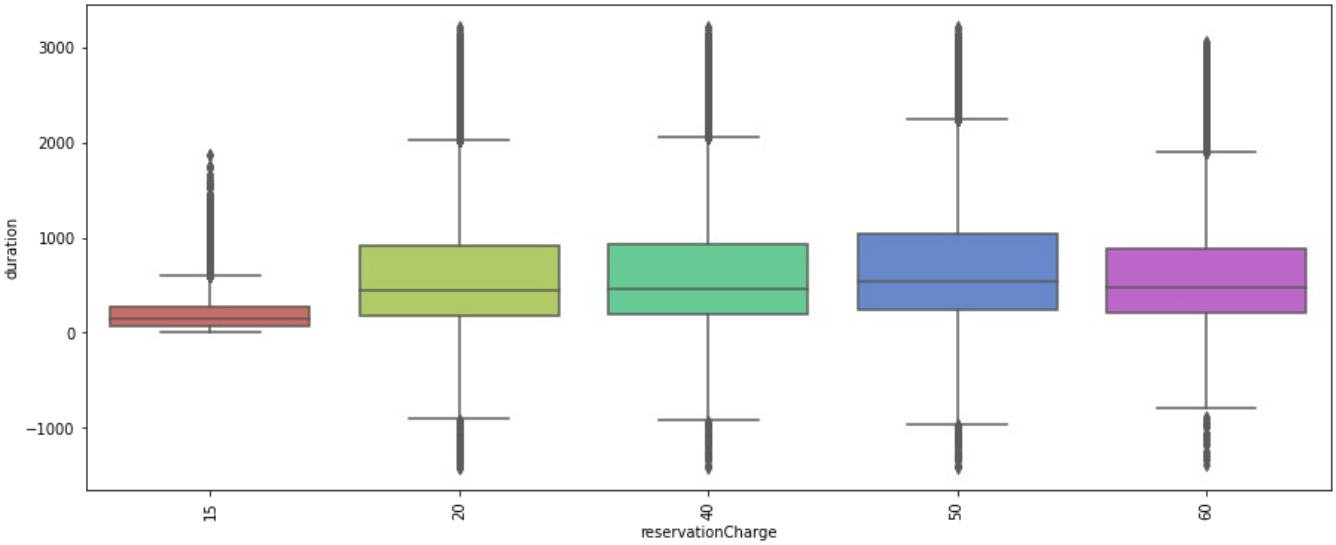
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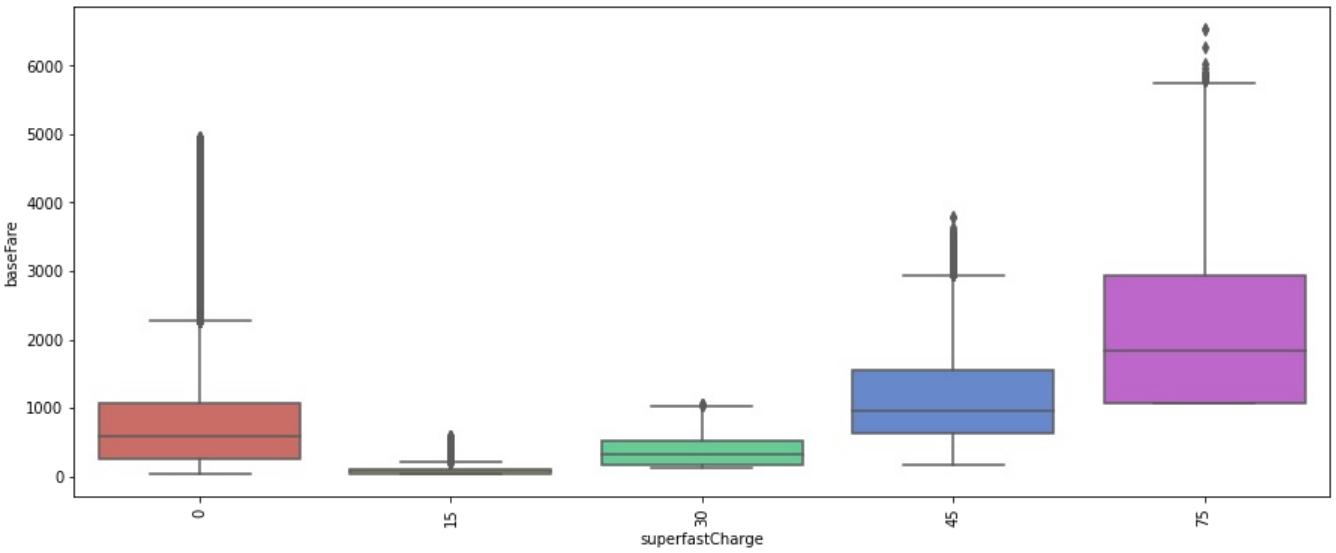
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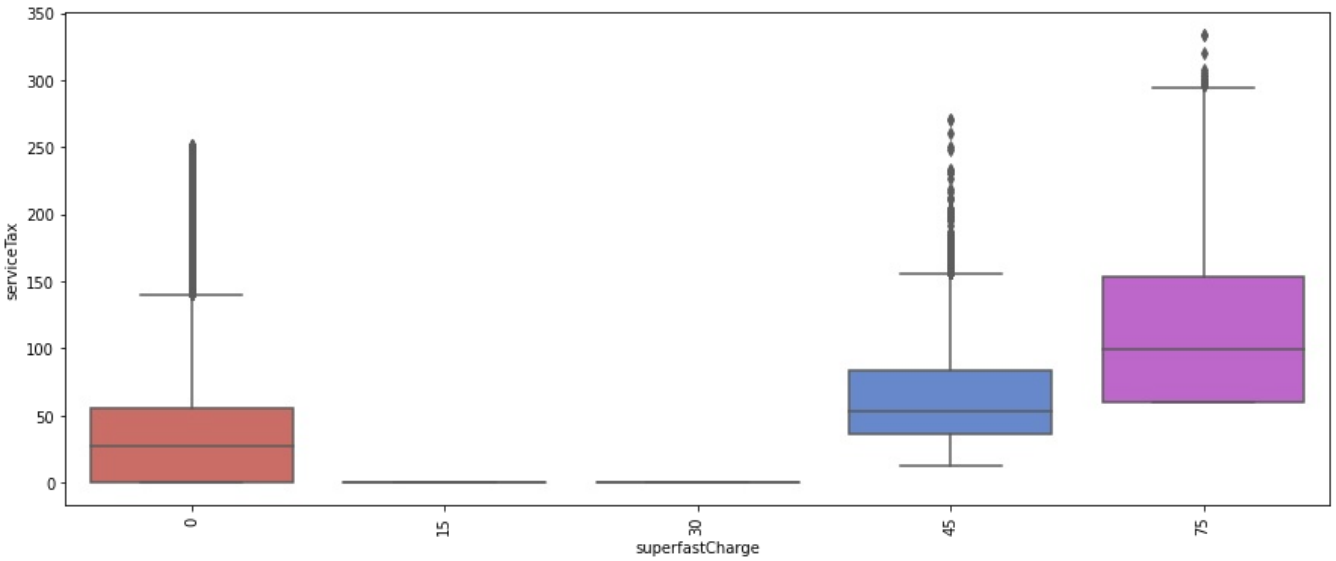
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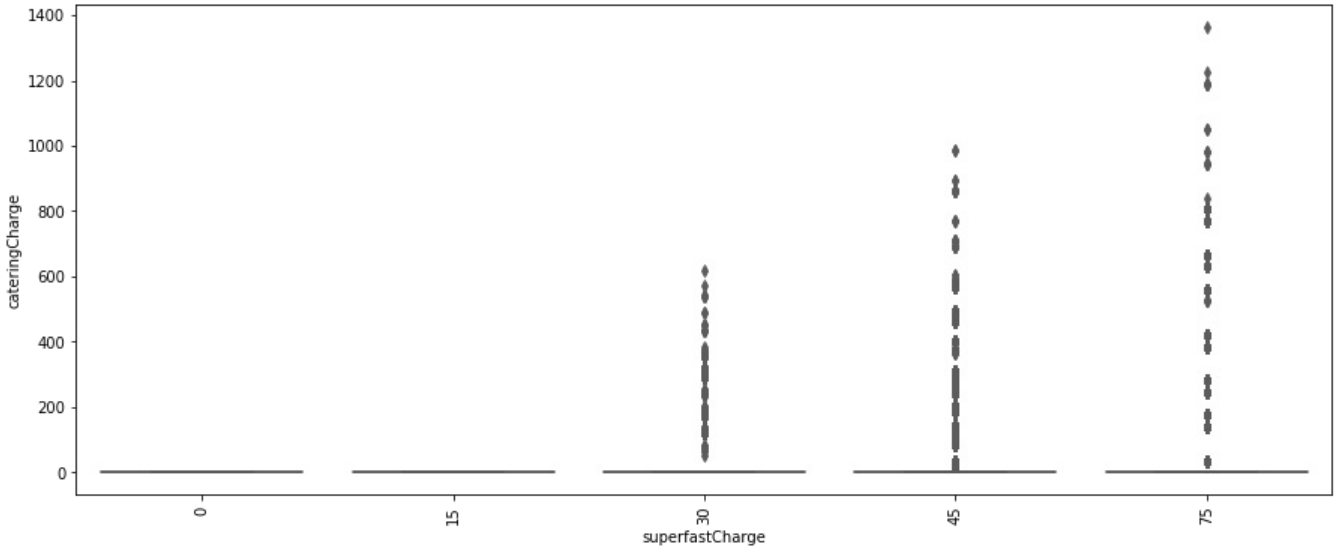
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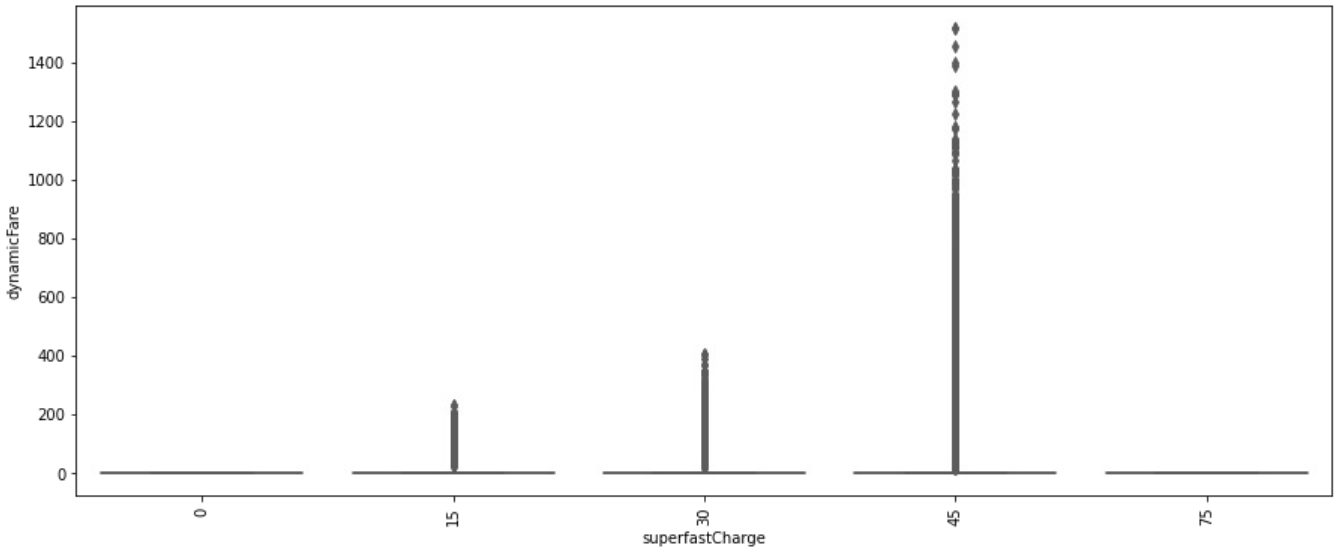
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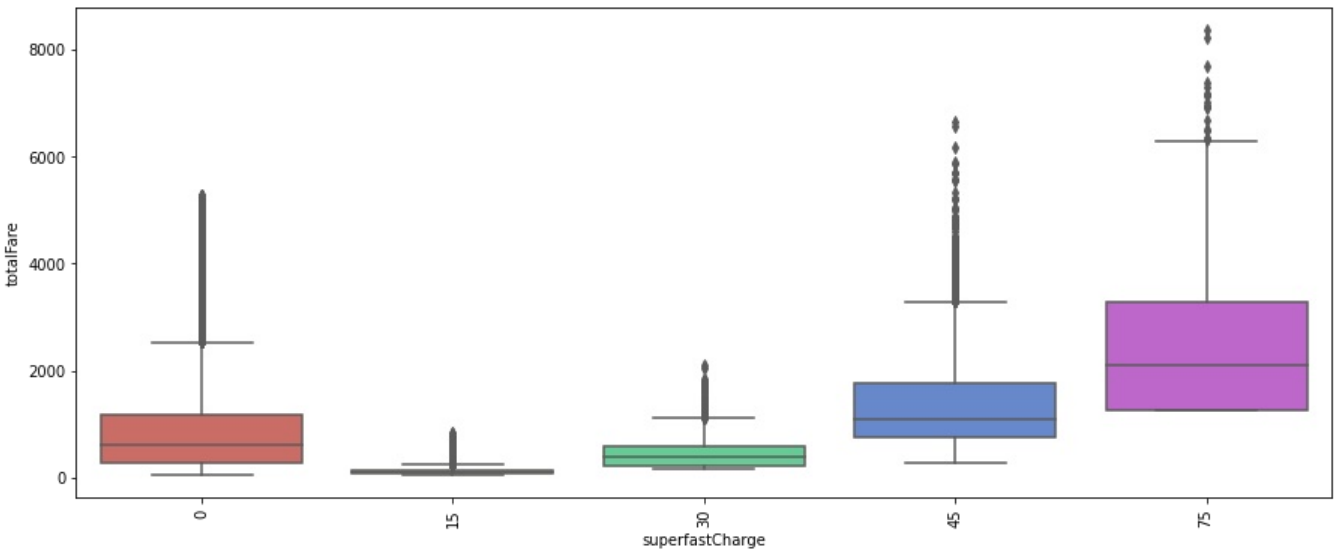
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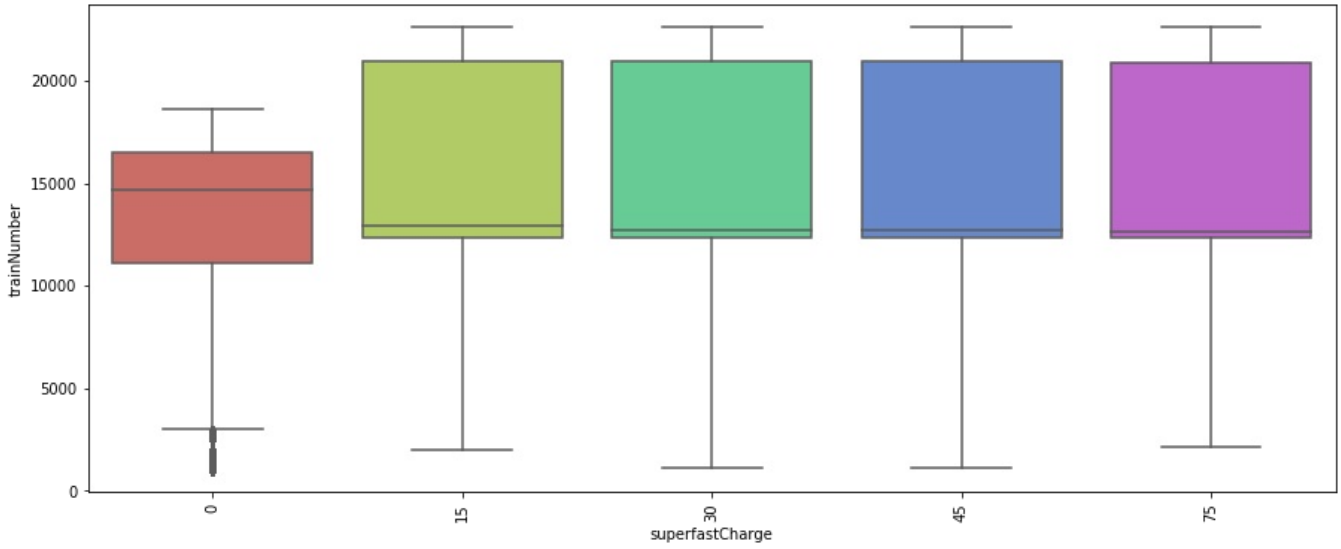
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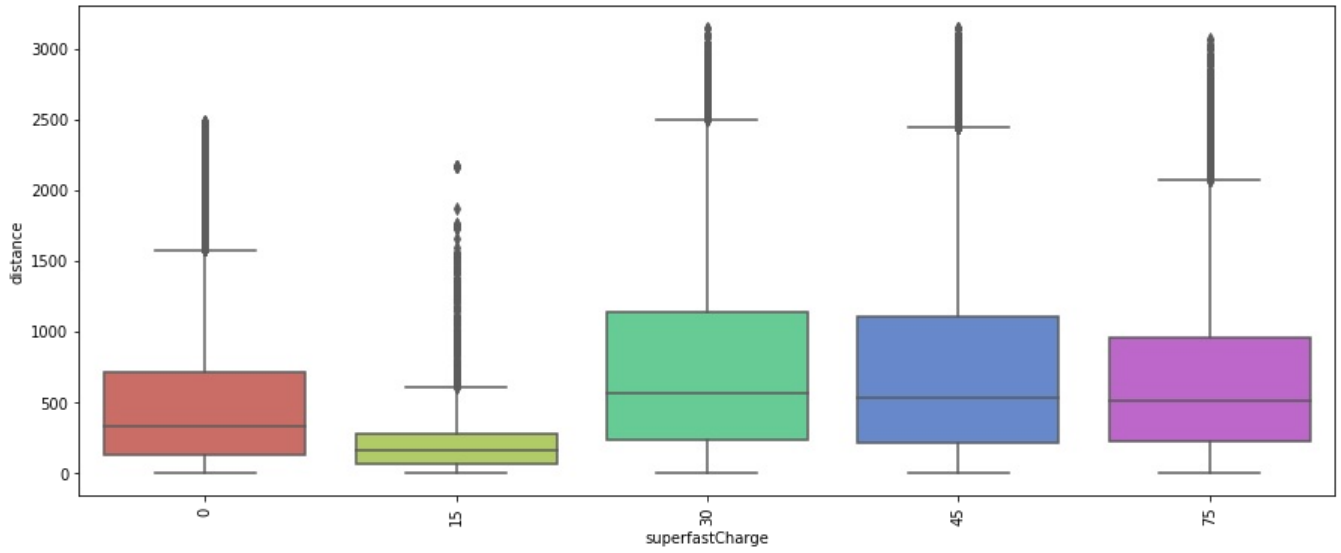
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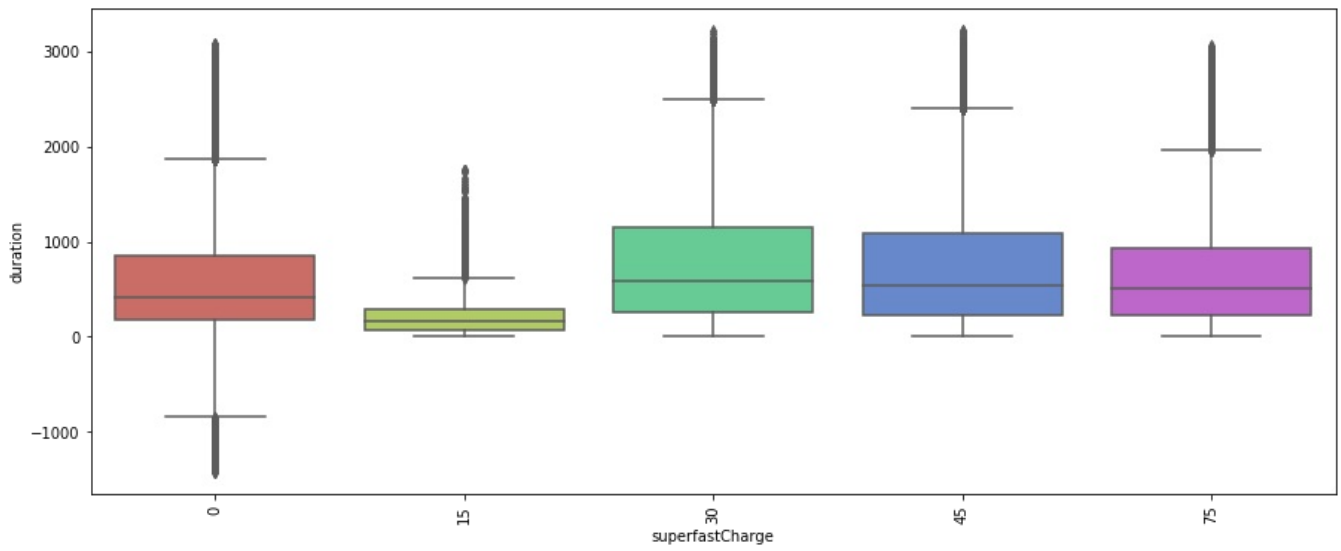
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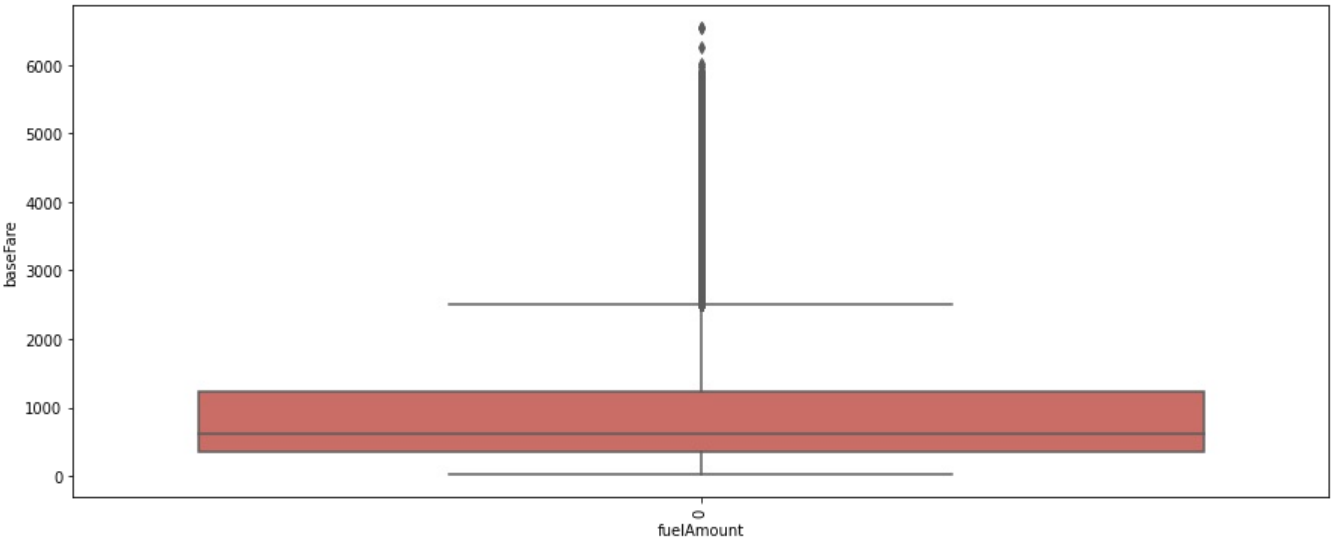
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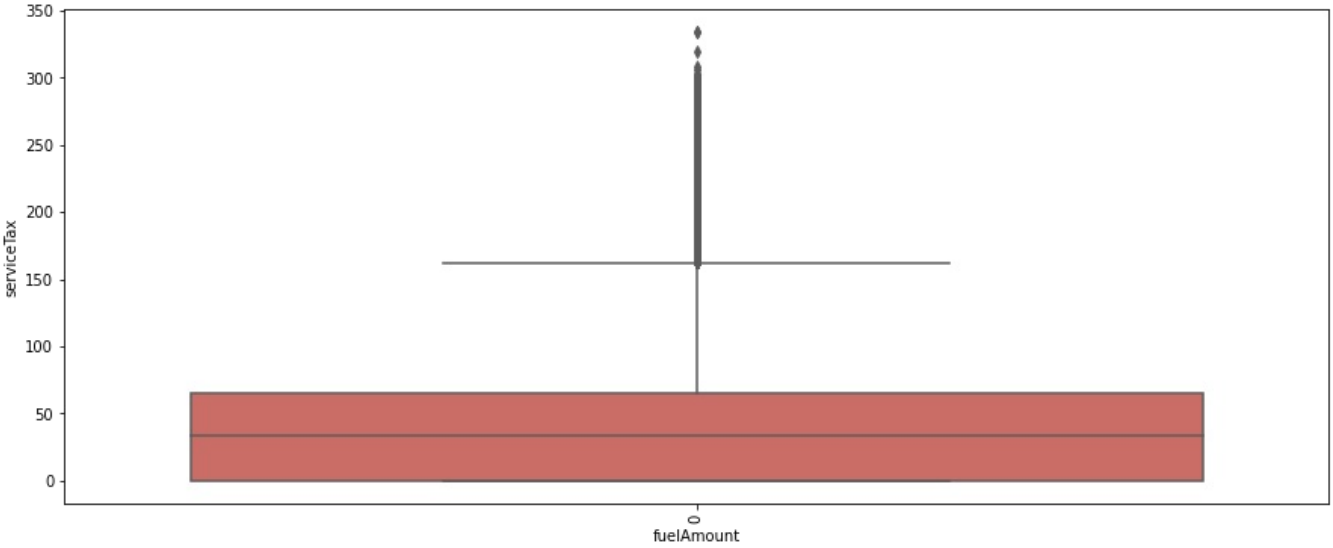
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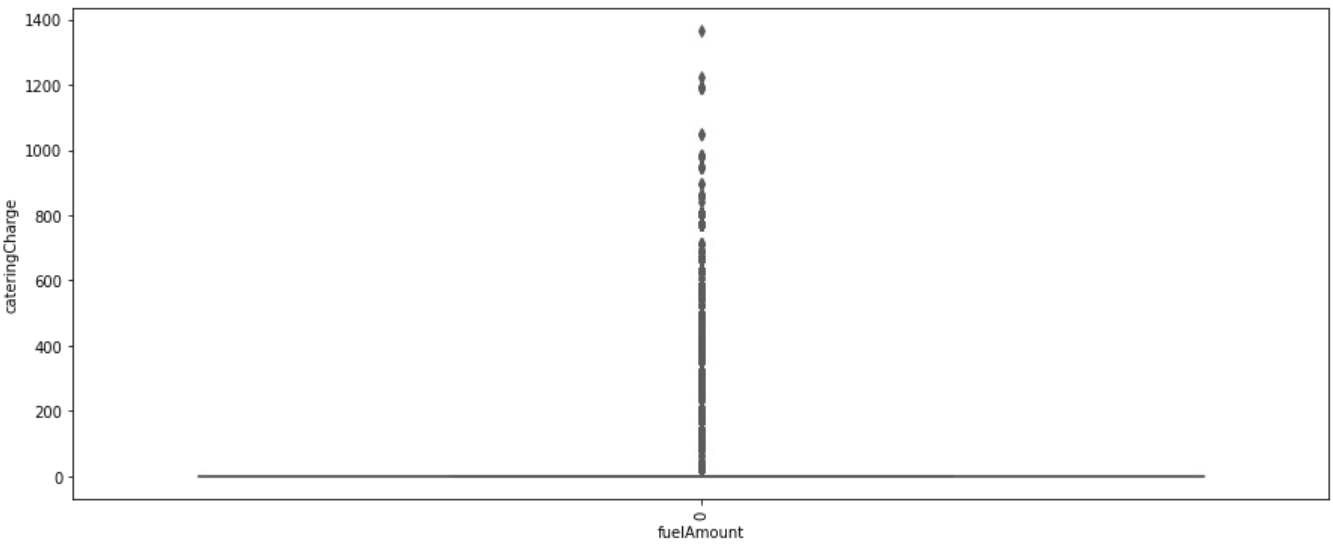
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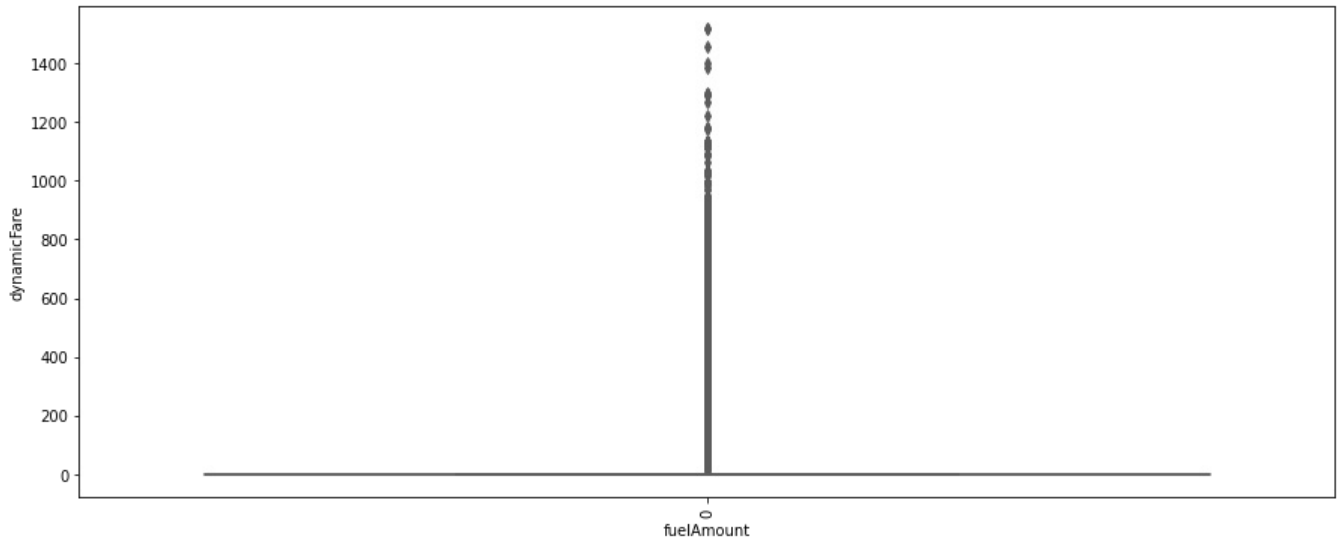
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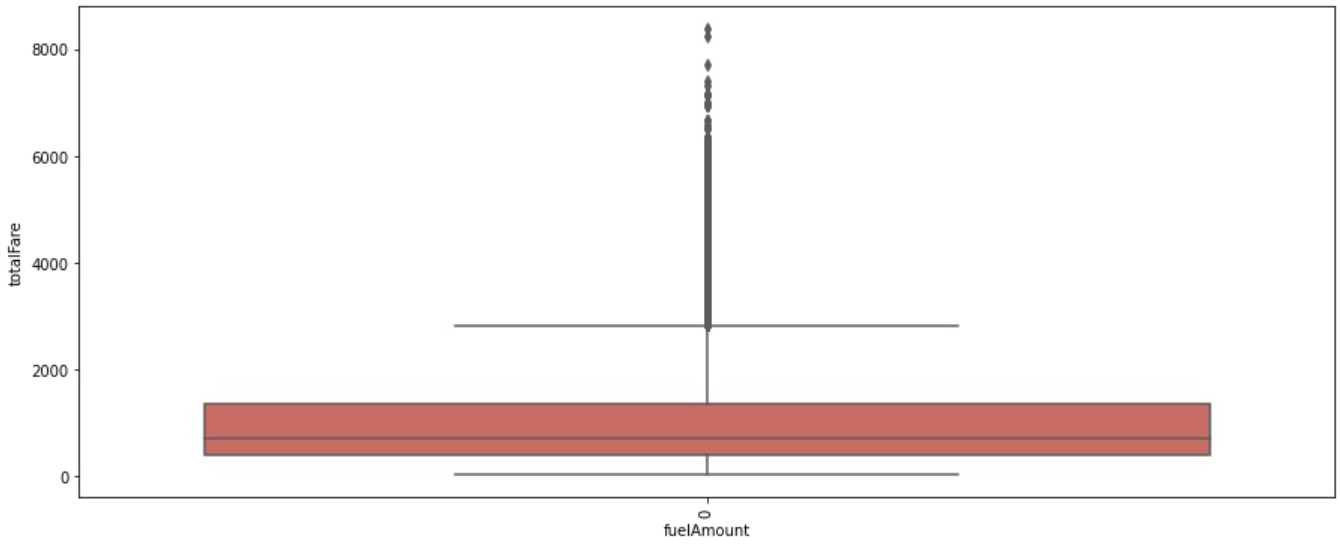
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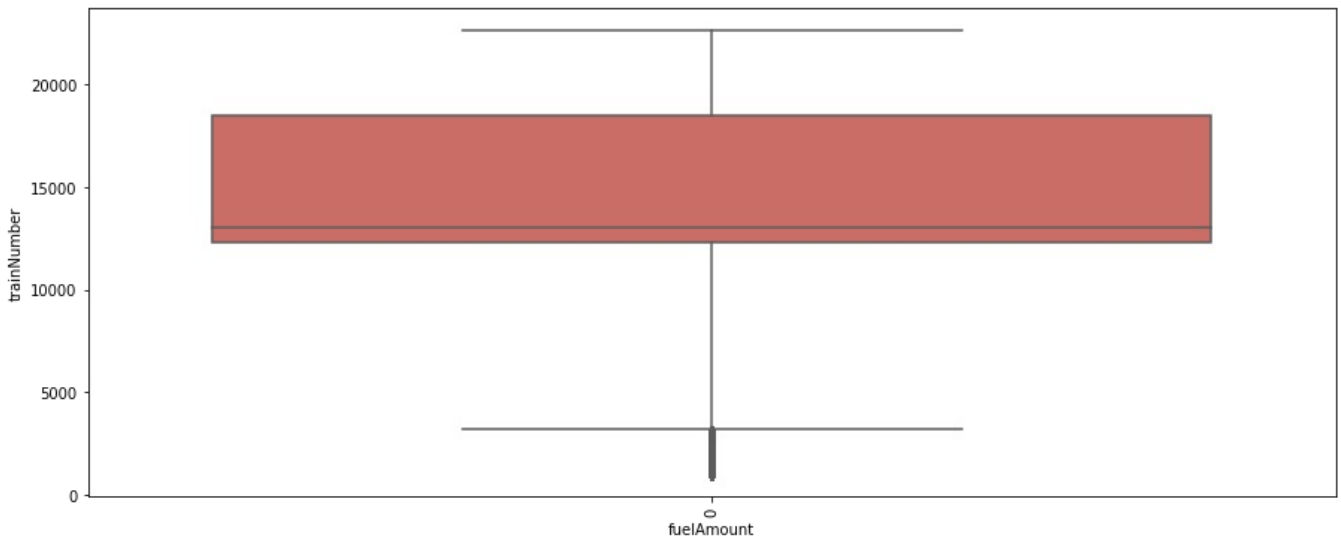
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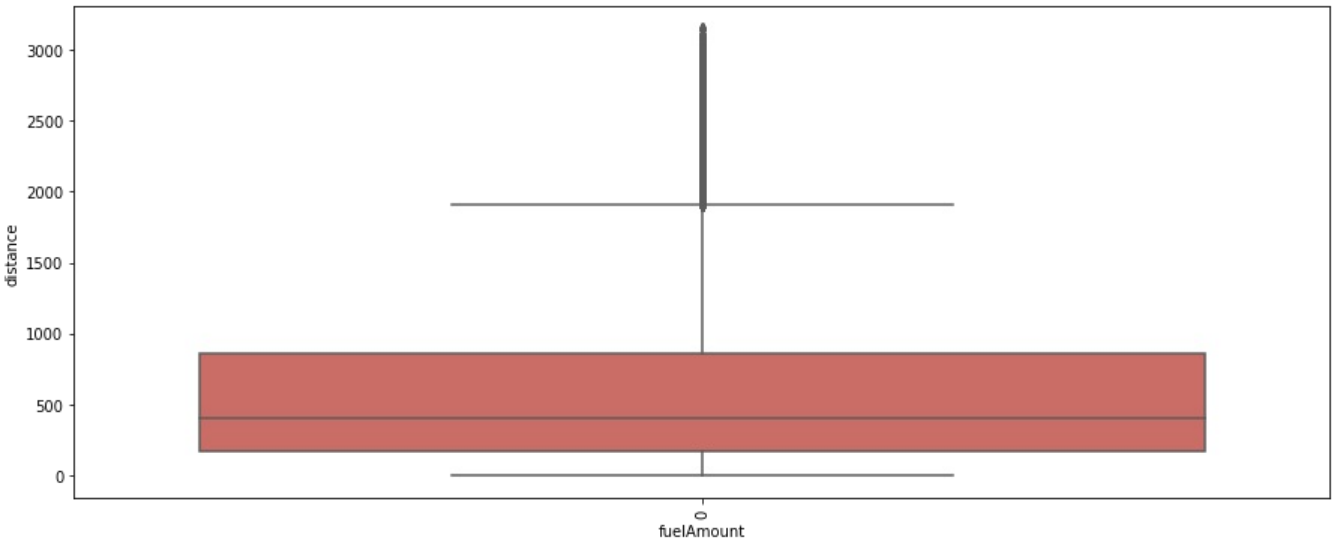
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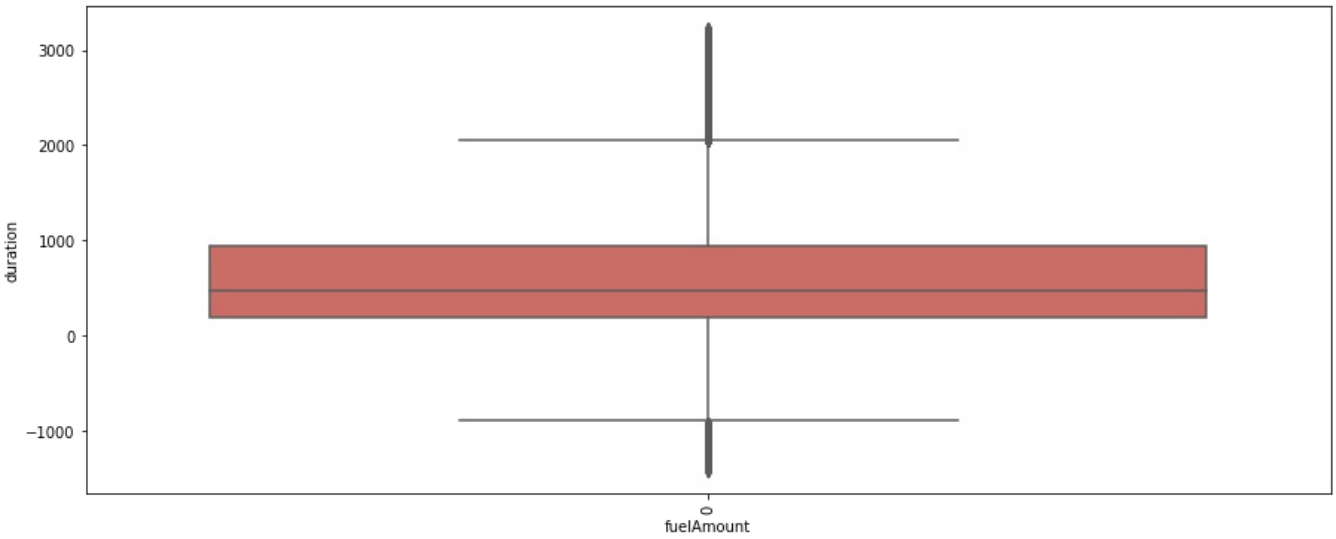
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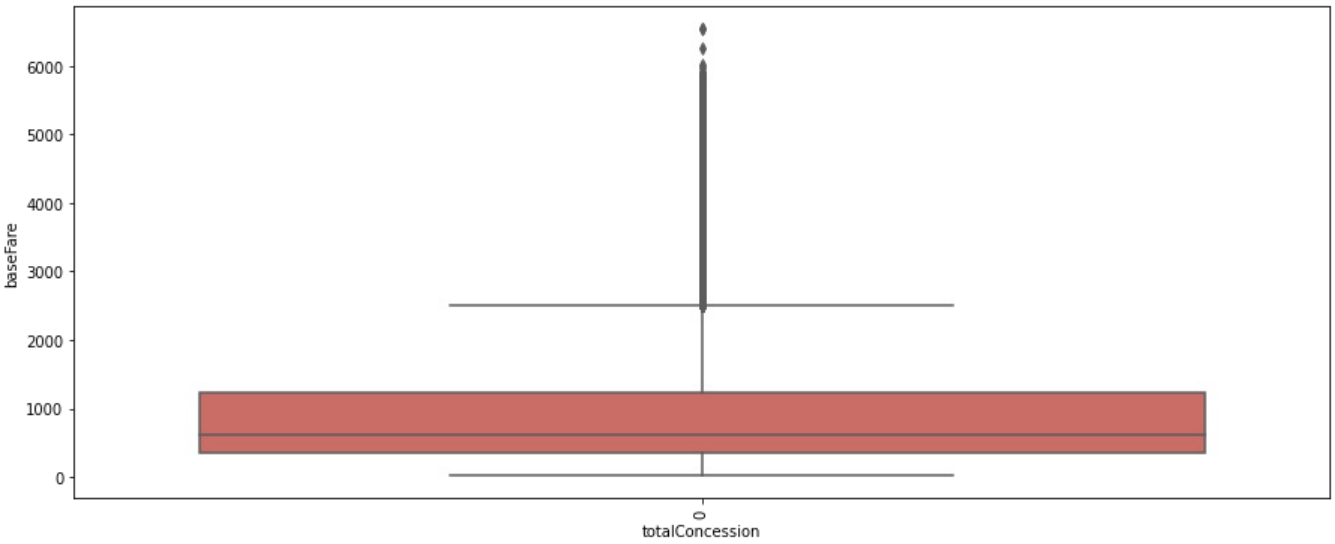
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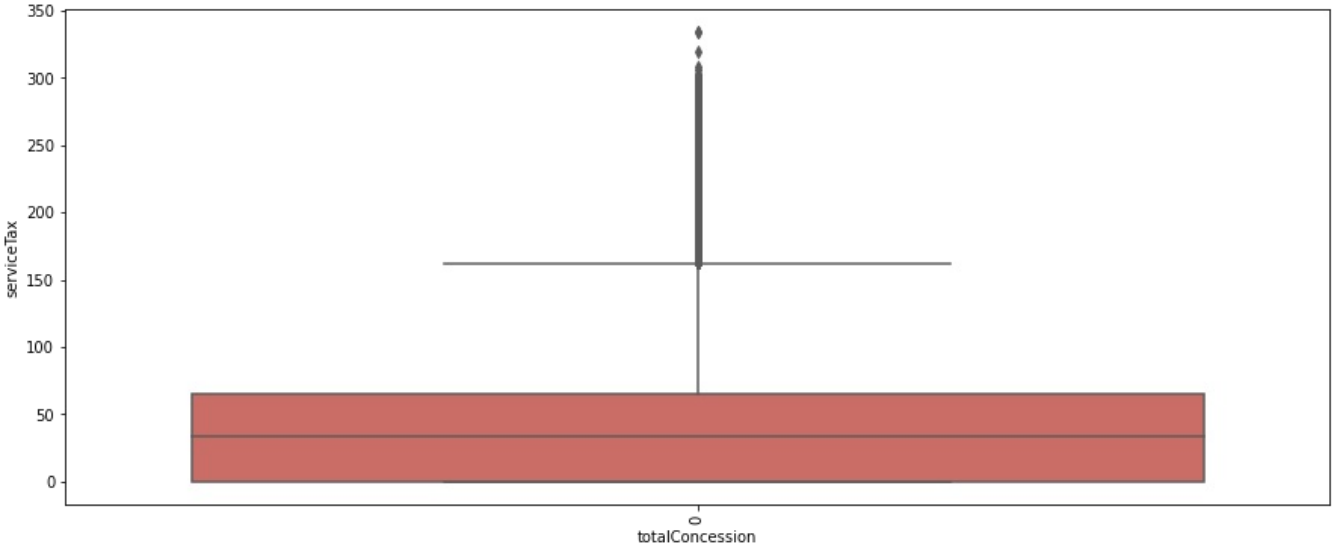
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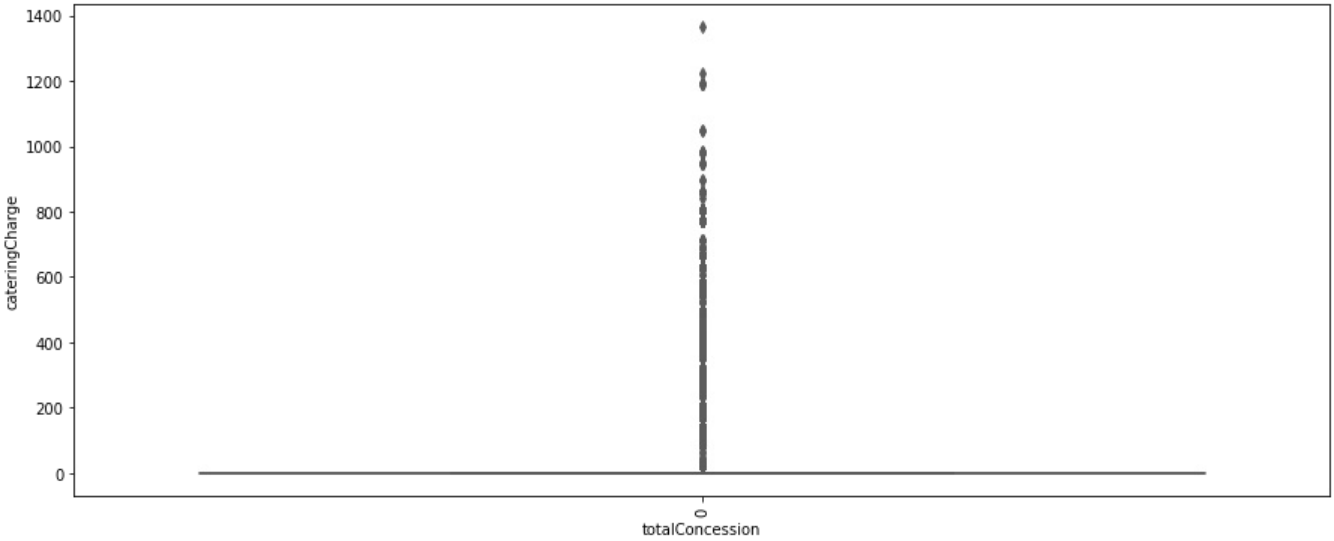
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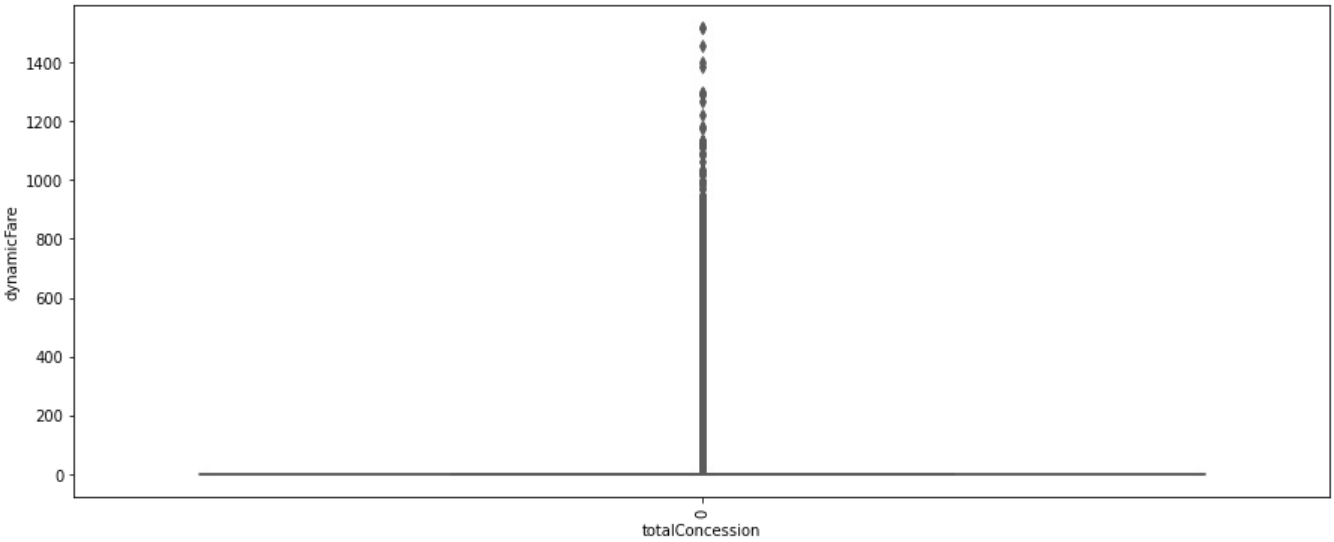
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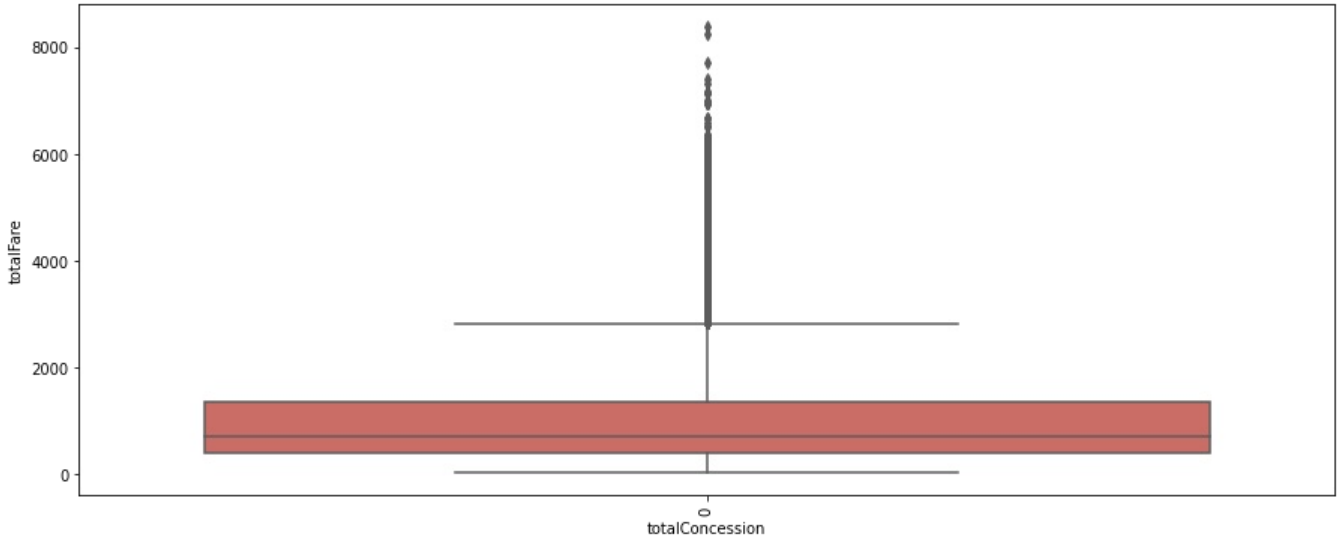
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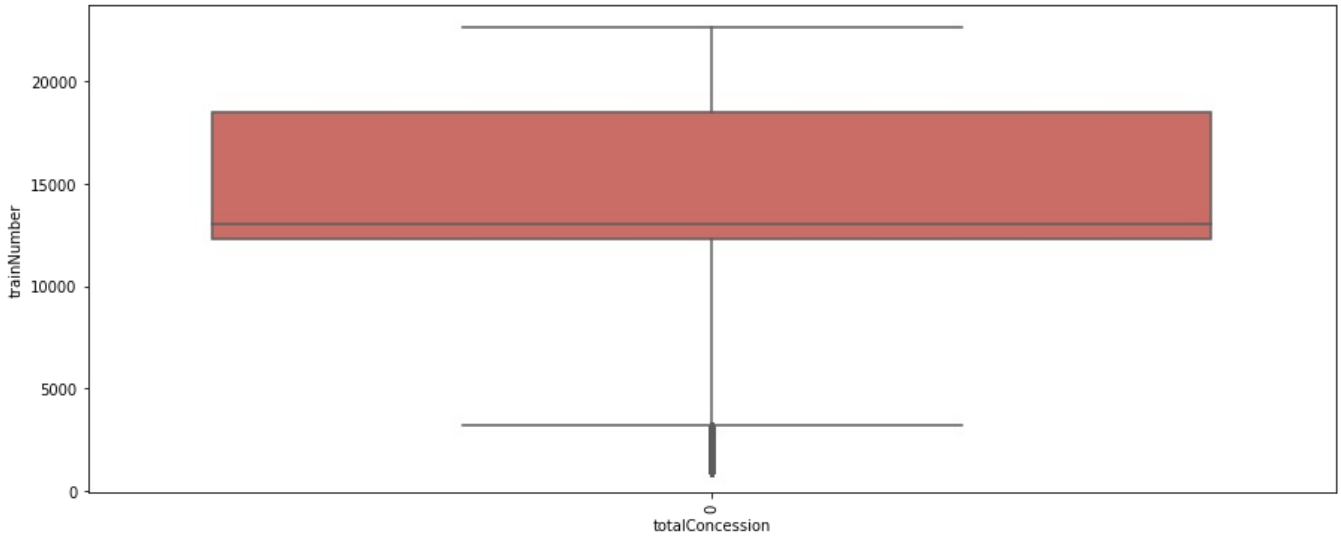
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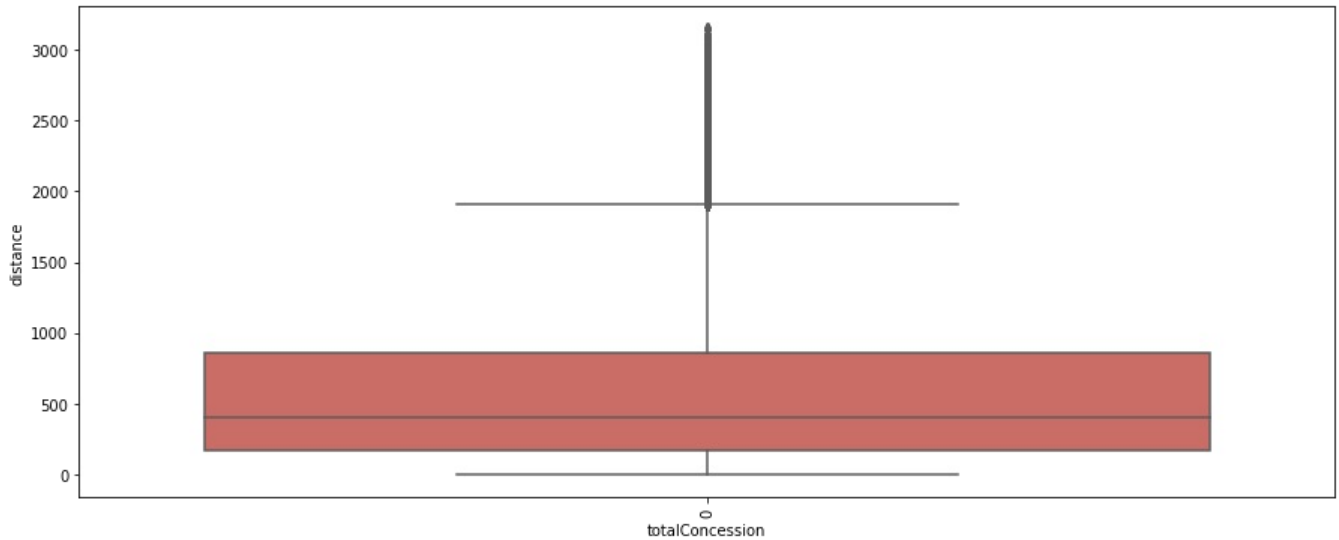
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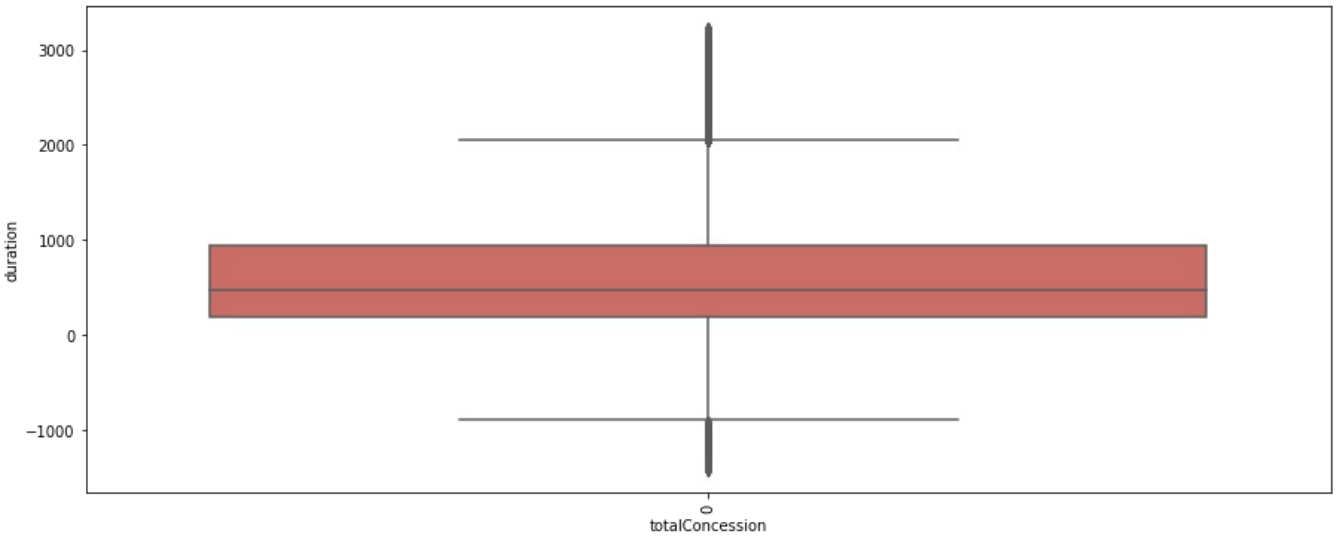
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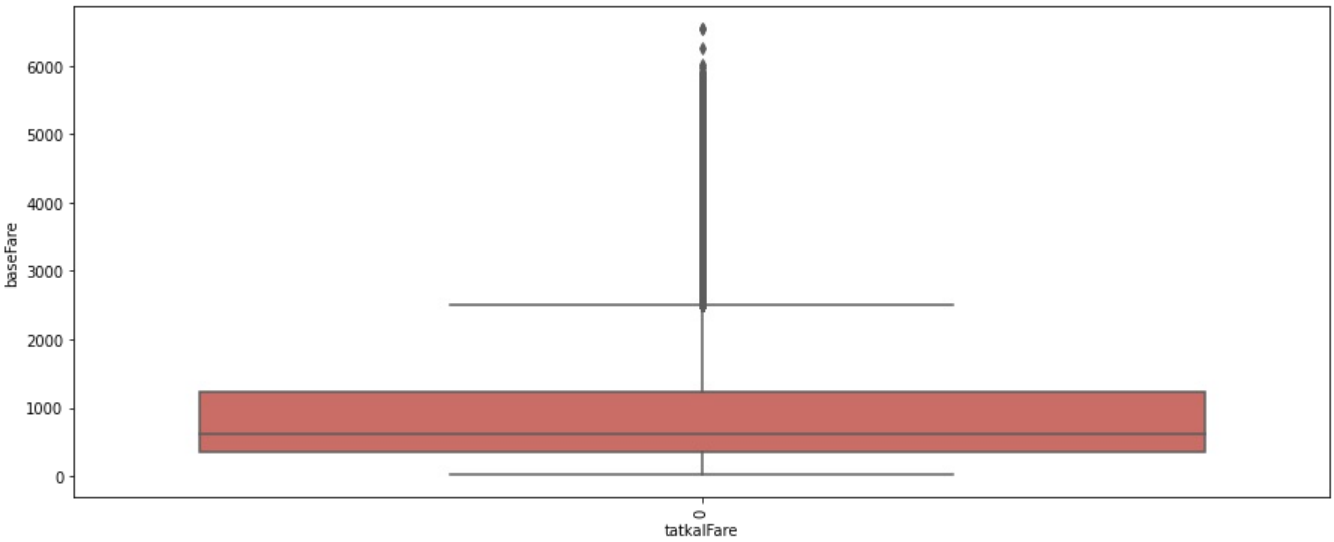
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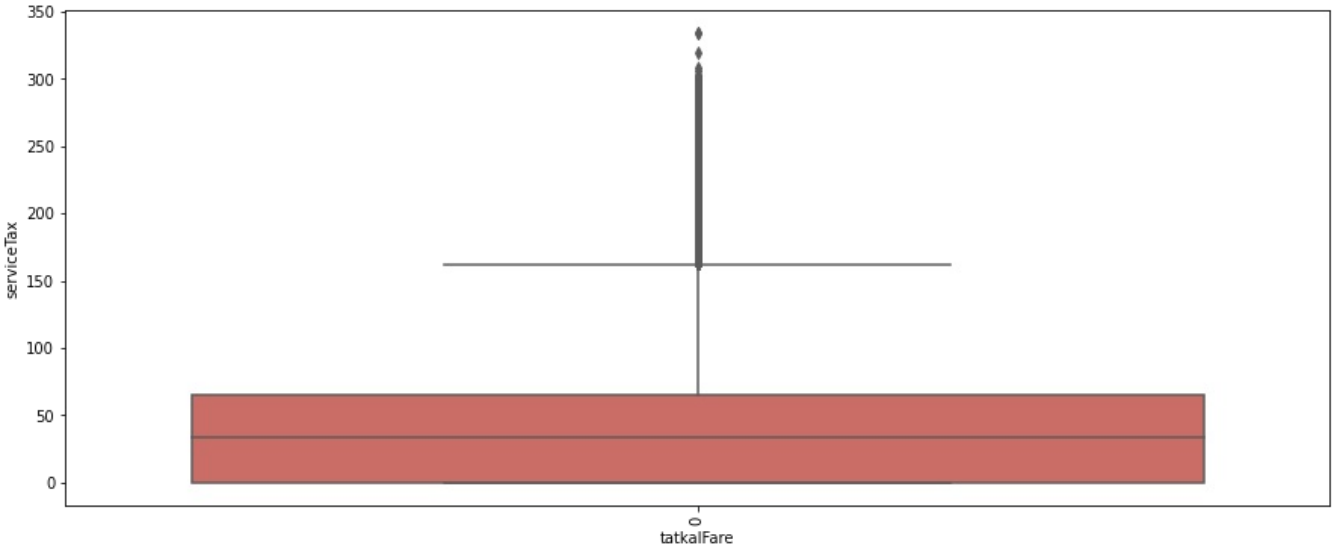
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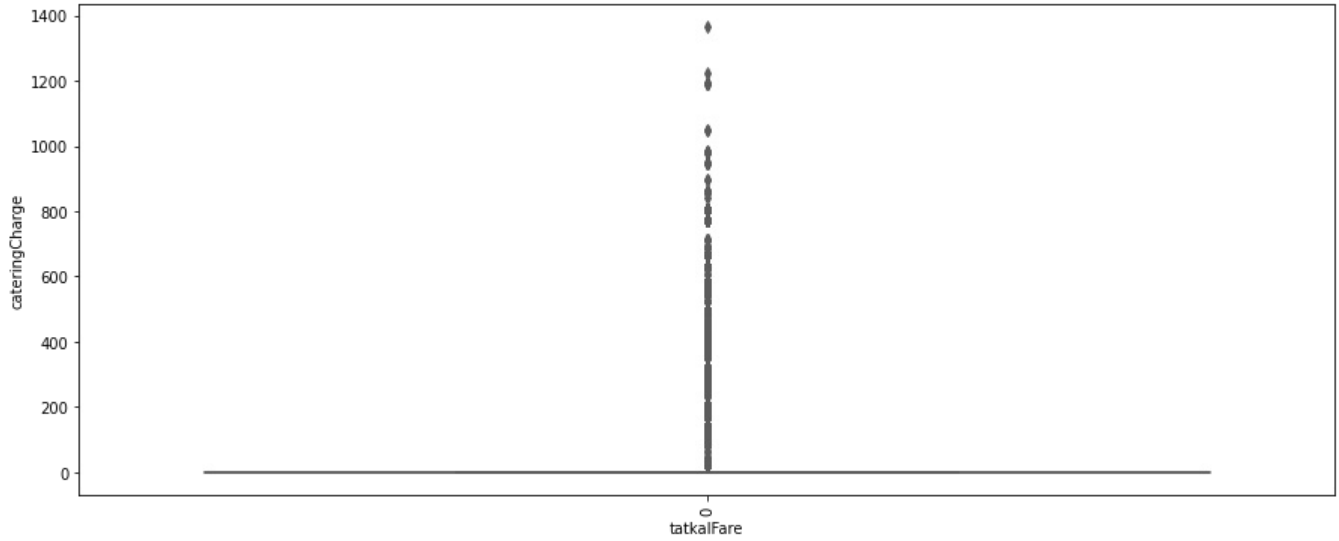
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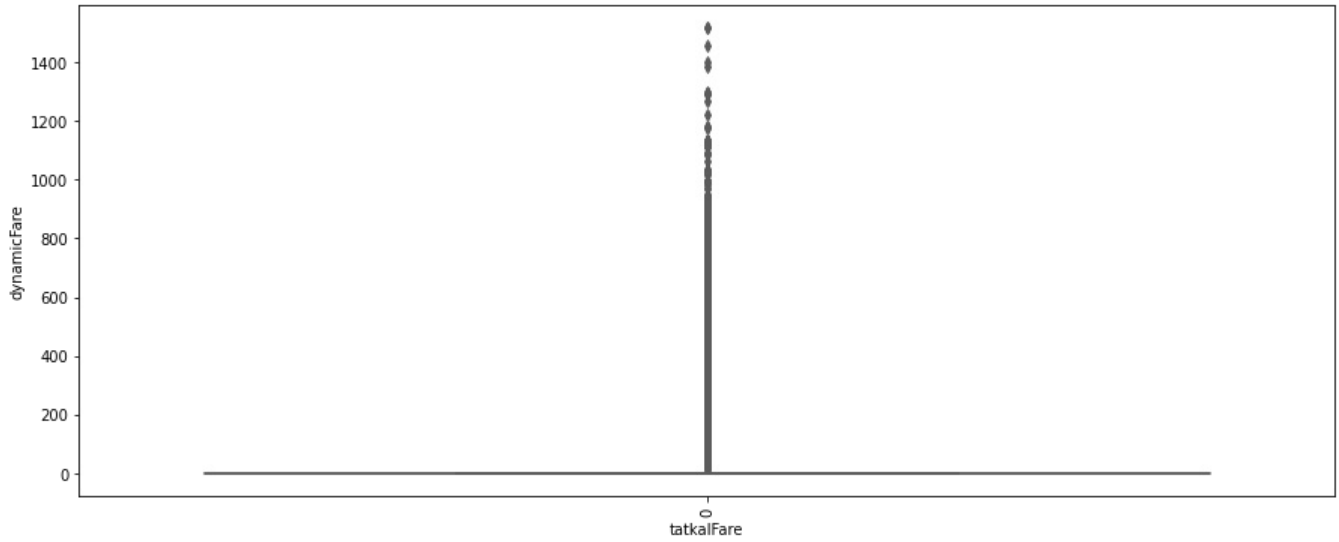
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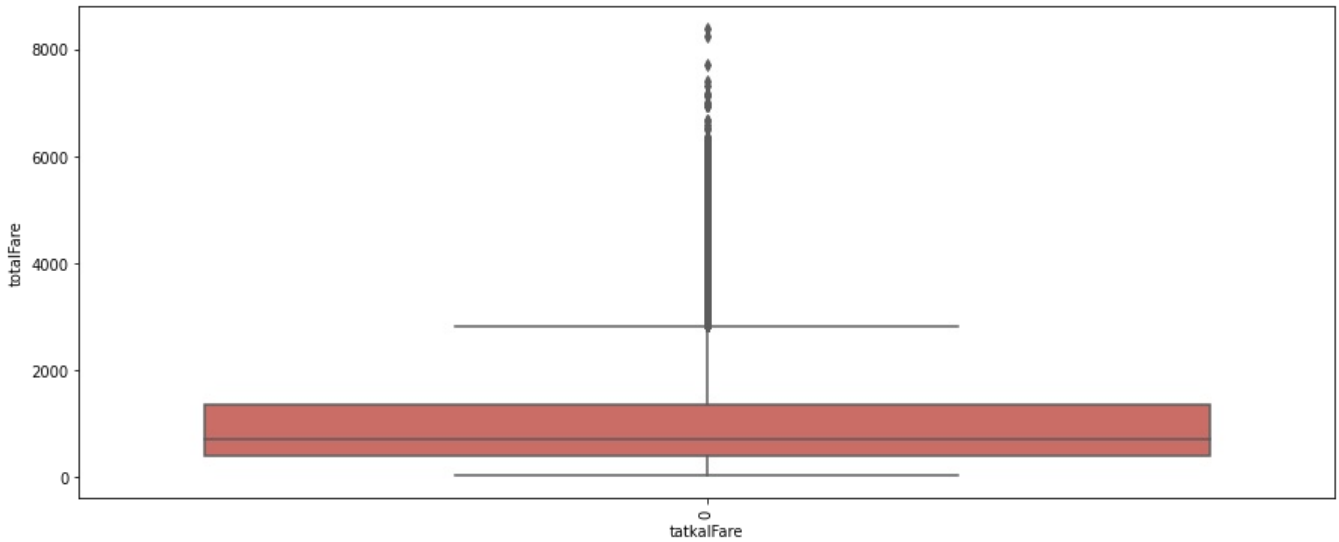
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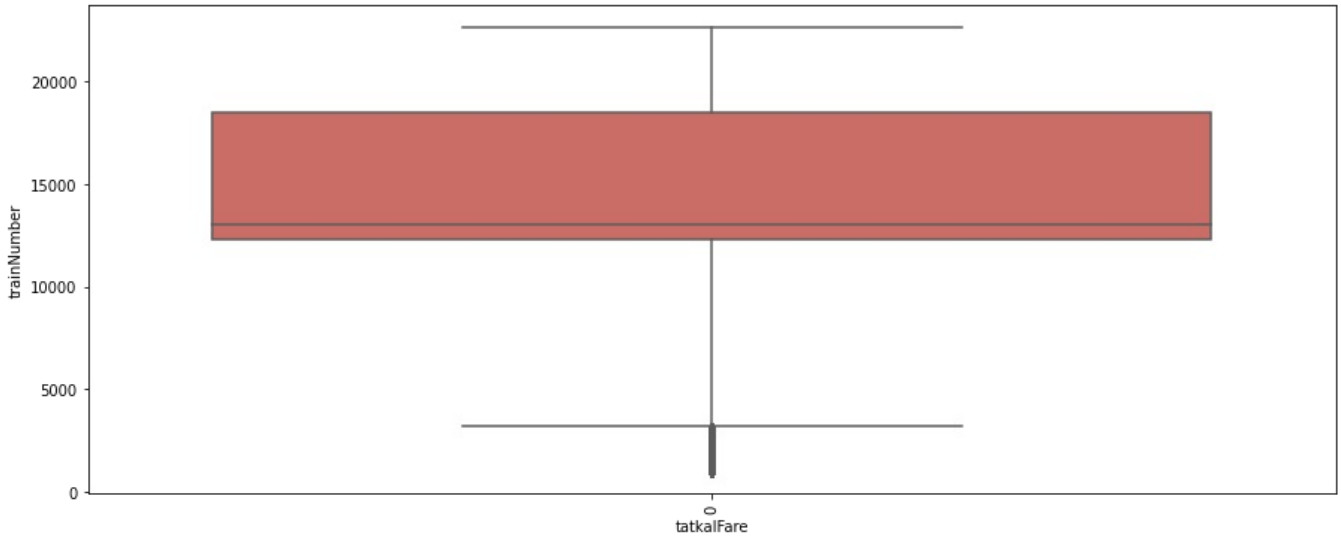
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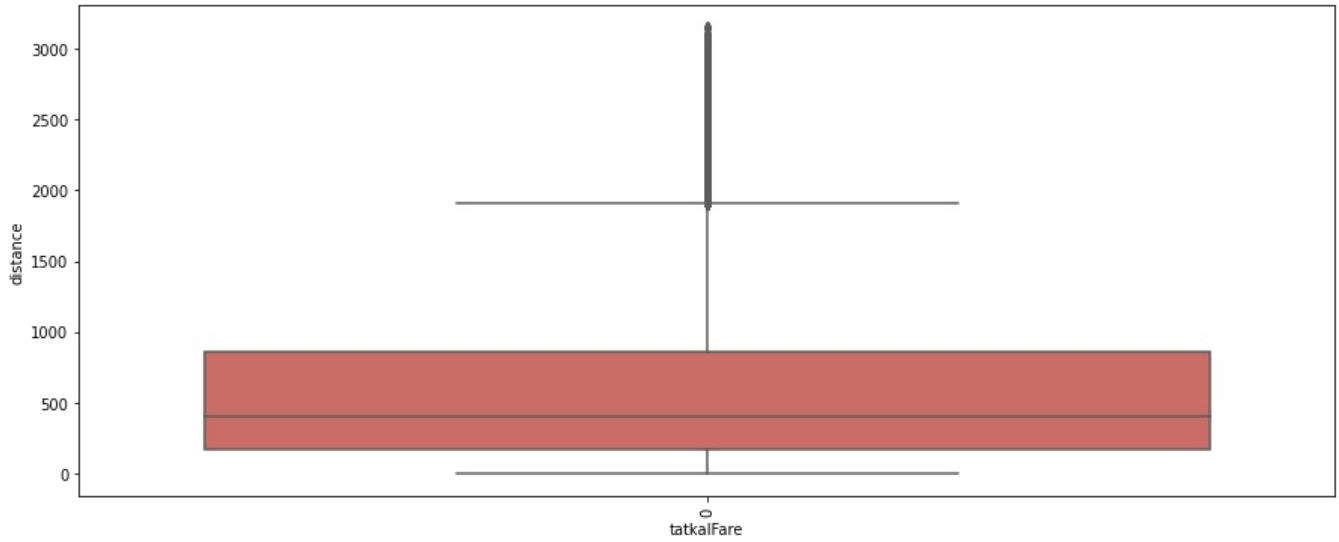
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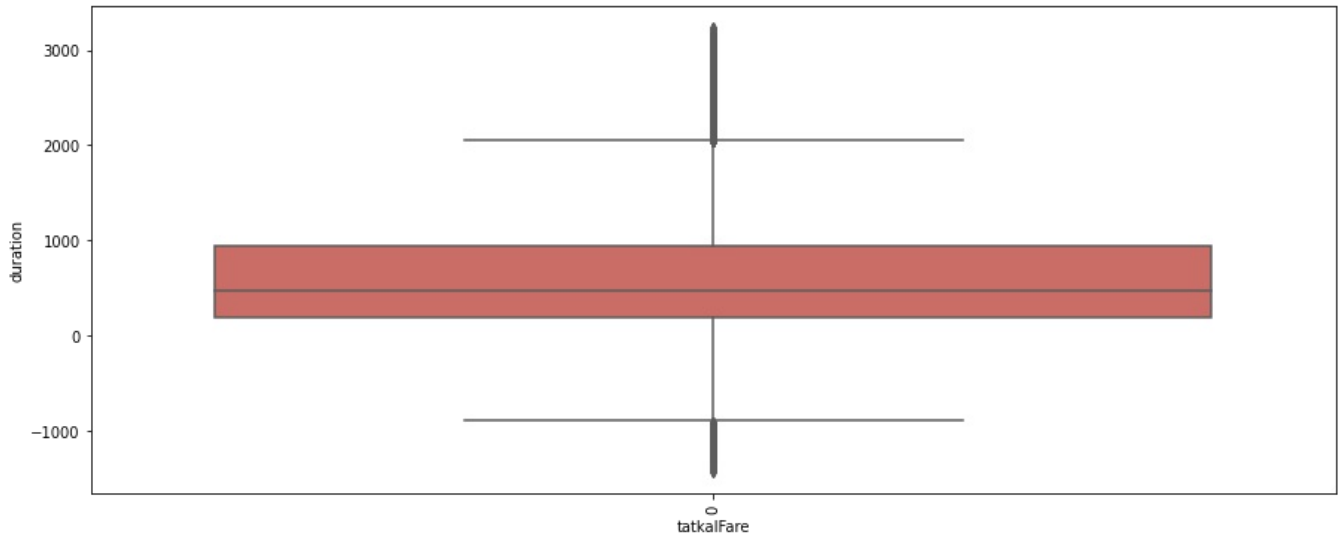
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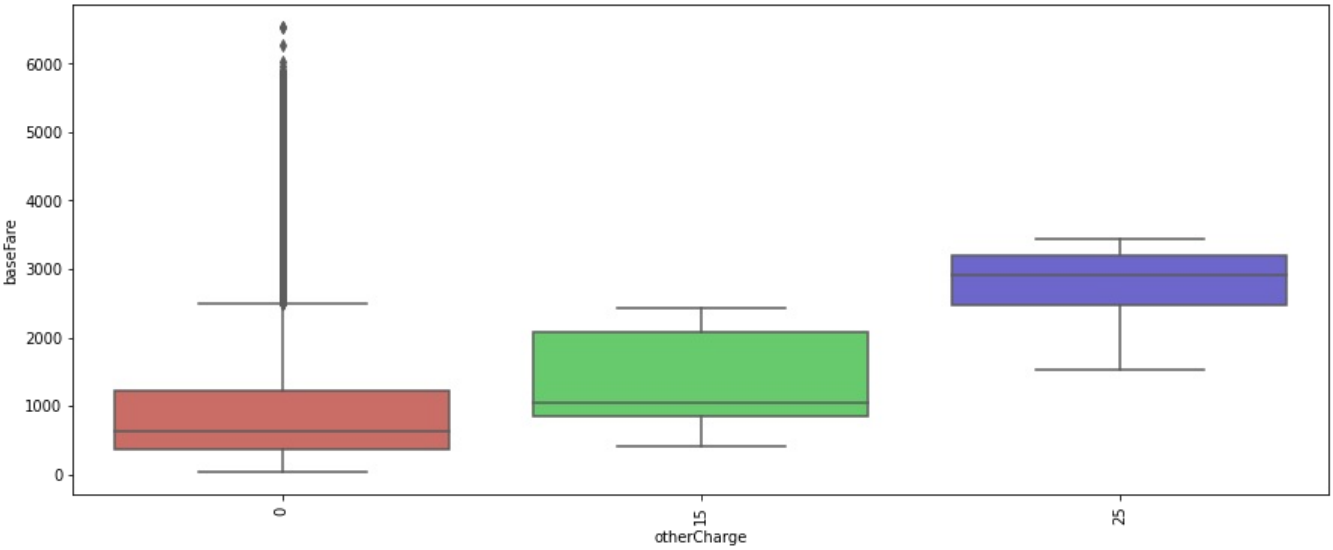
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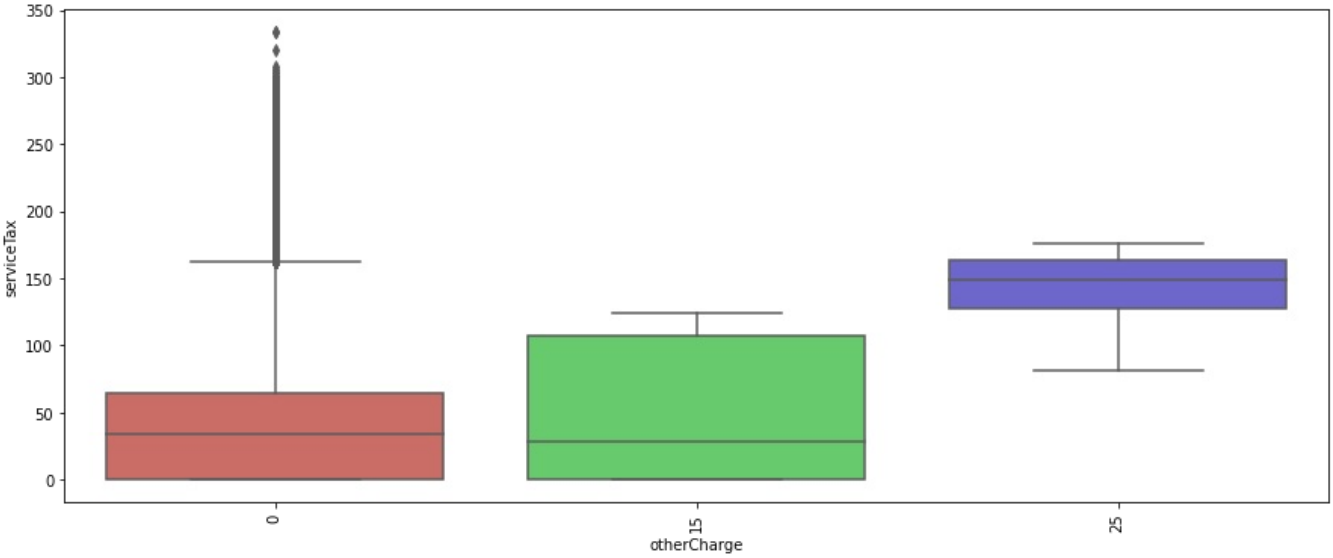
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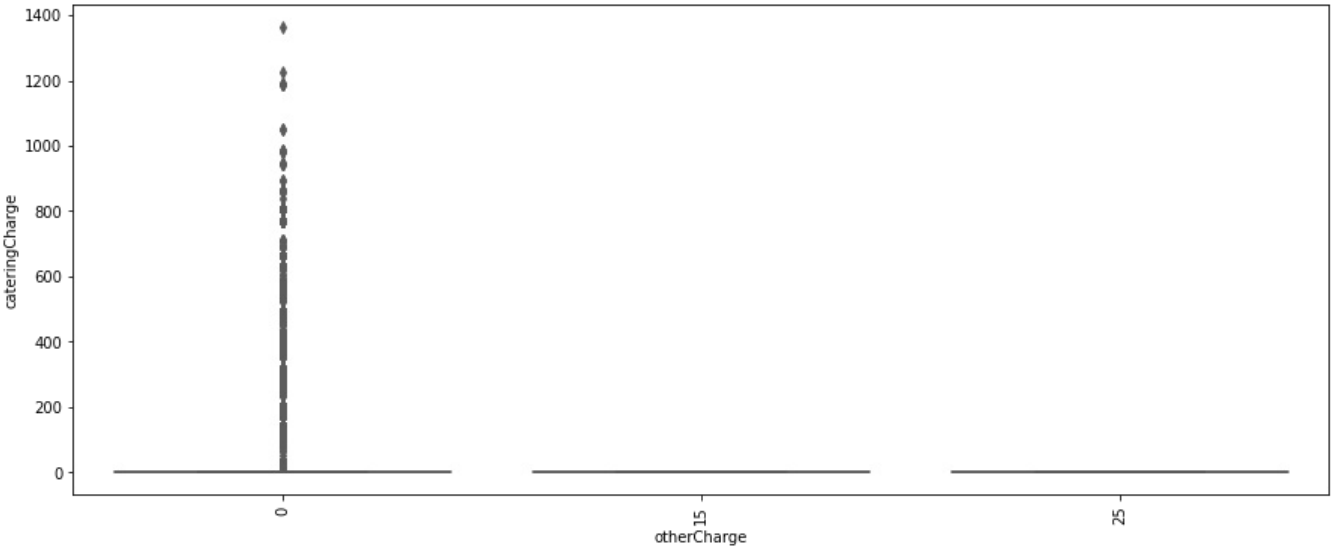
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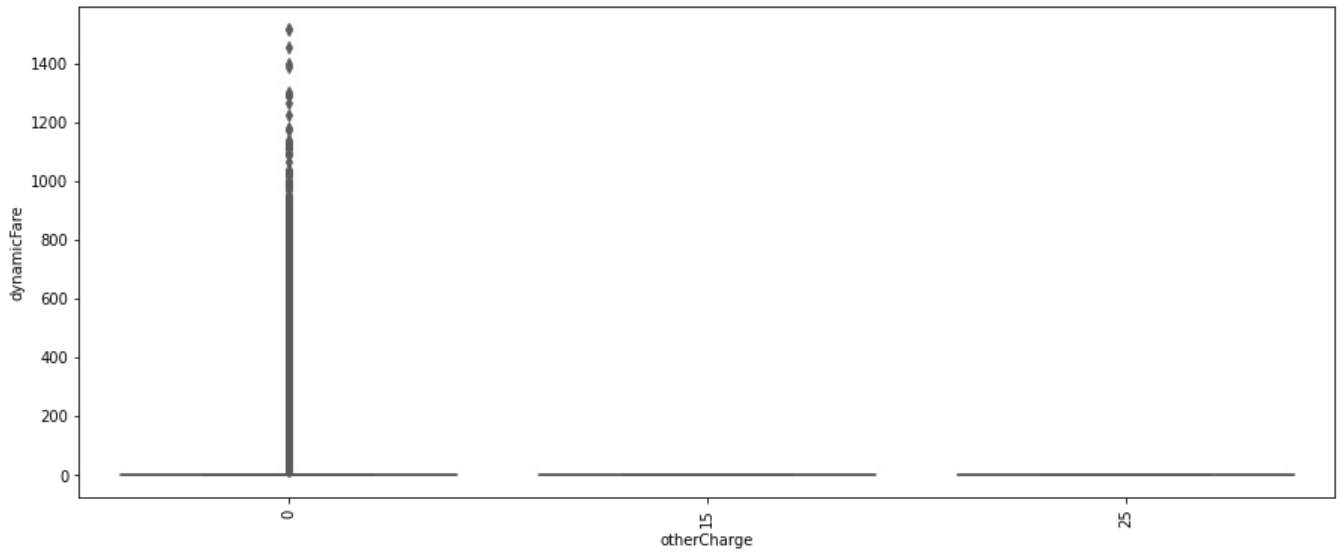
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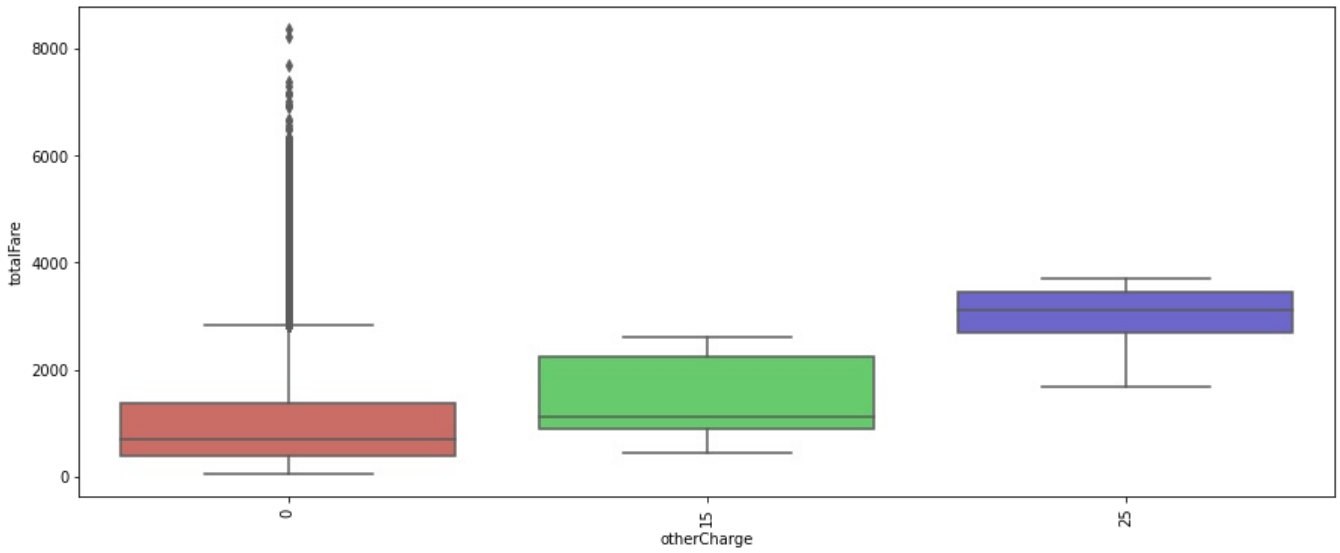
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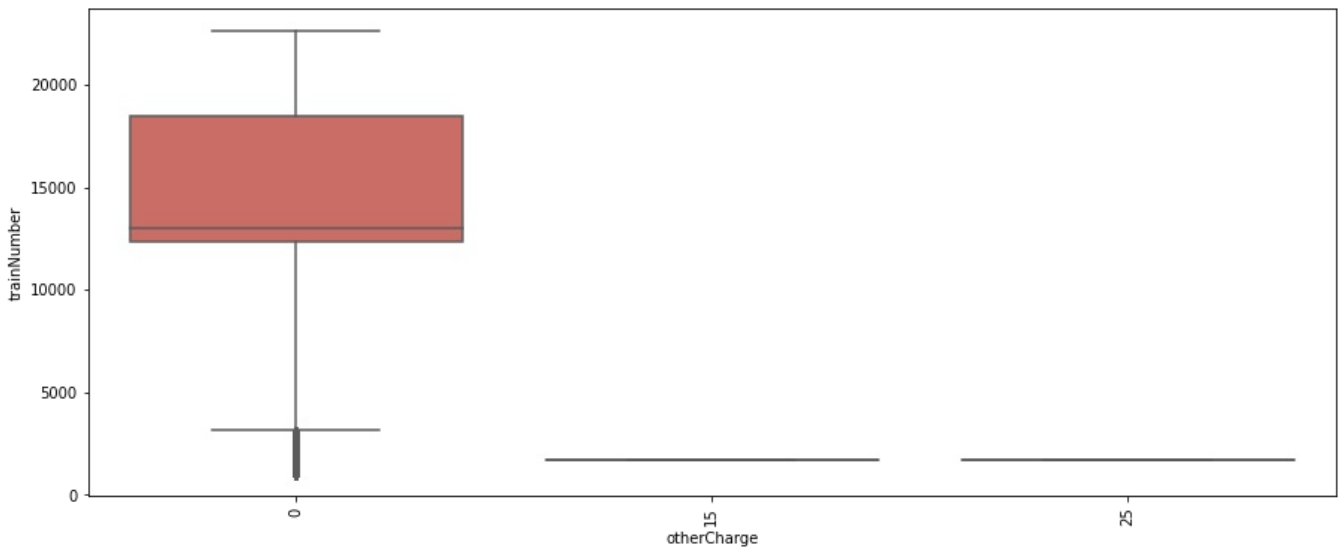
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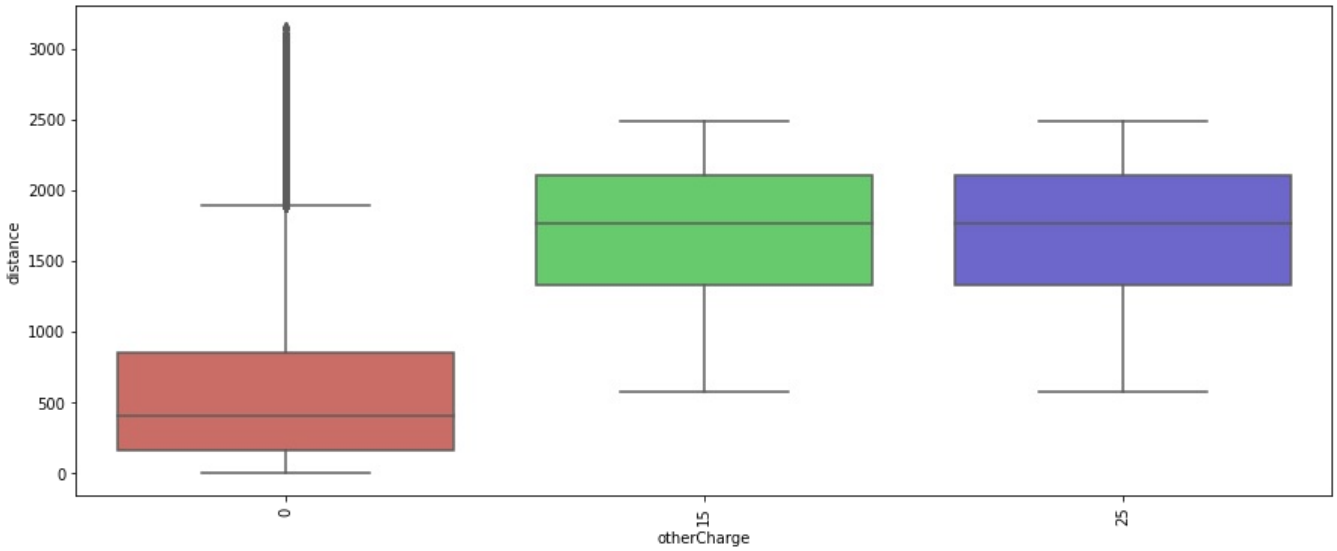

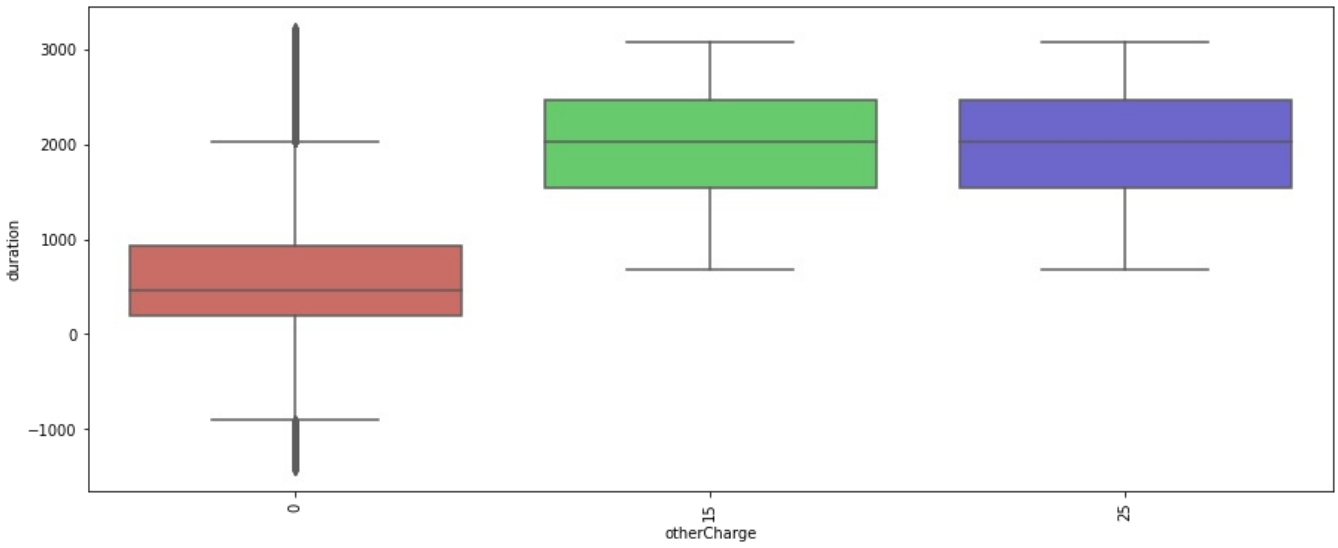

In [36]:
```
for i in discrete:
    for j in continuous:
        plt.figure(figsize=(15,6))
        sns.violinplot(x = df[i], y = df[j], data = df, palette = 'hls')
        plt.xticks(rotation = 90)
        plt.show()
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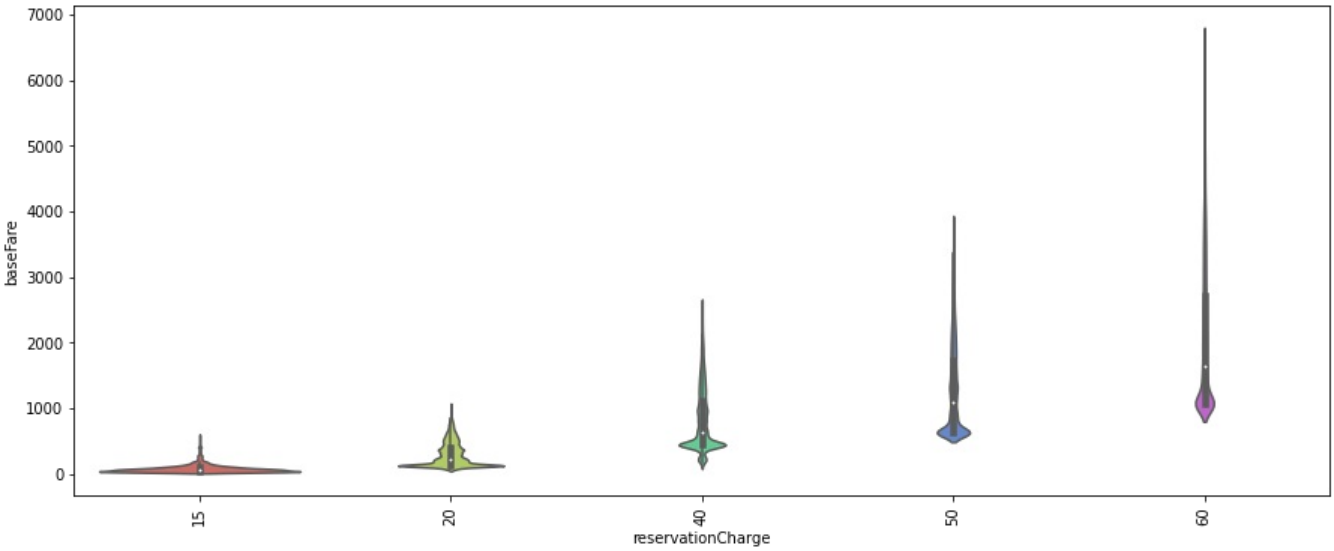
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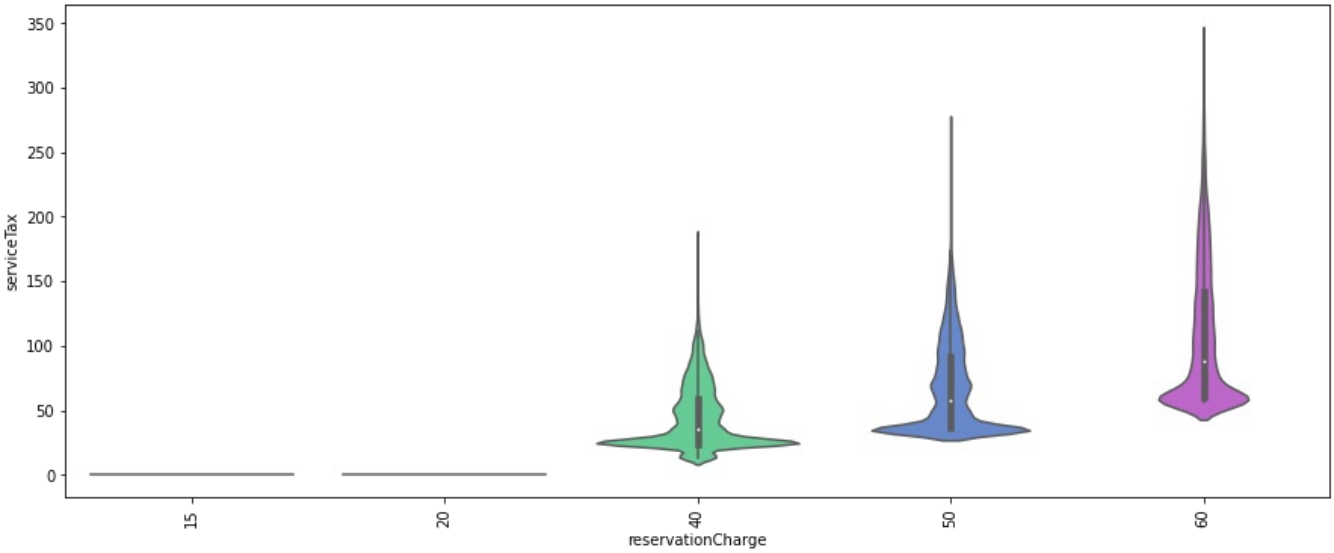
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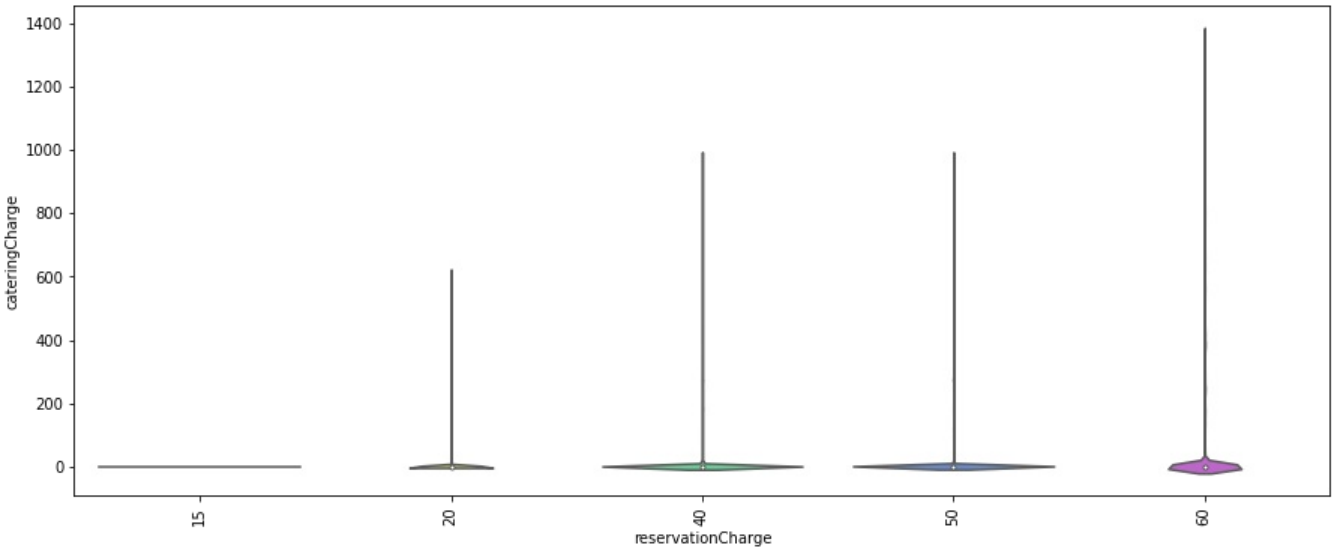
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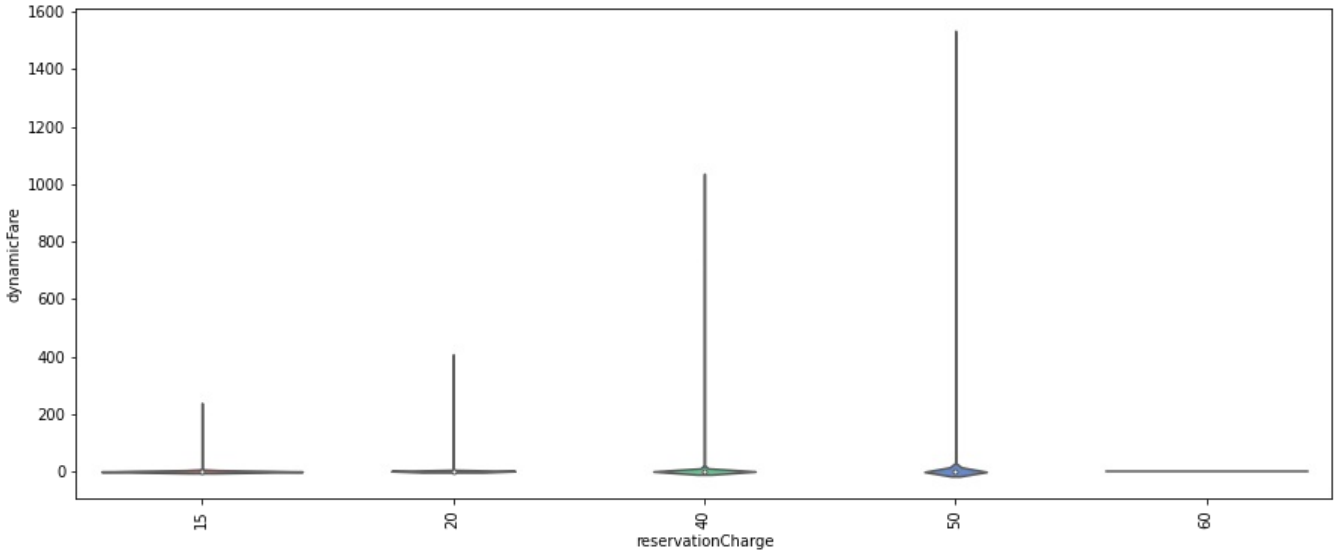
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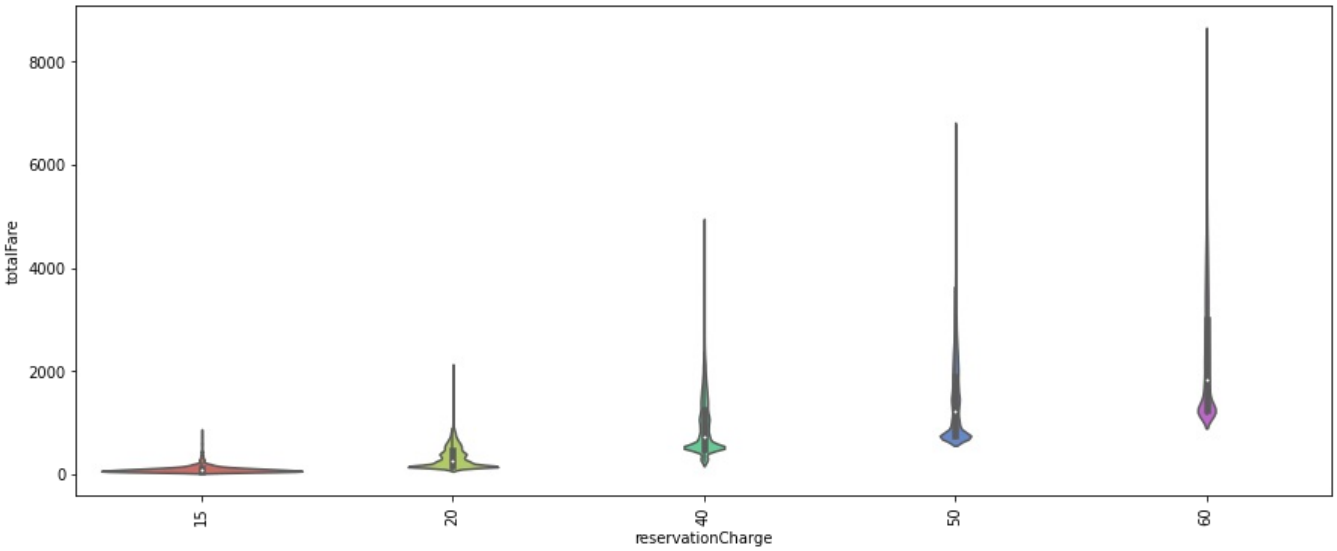
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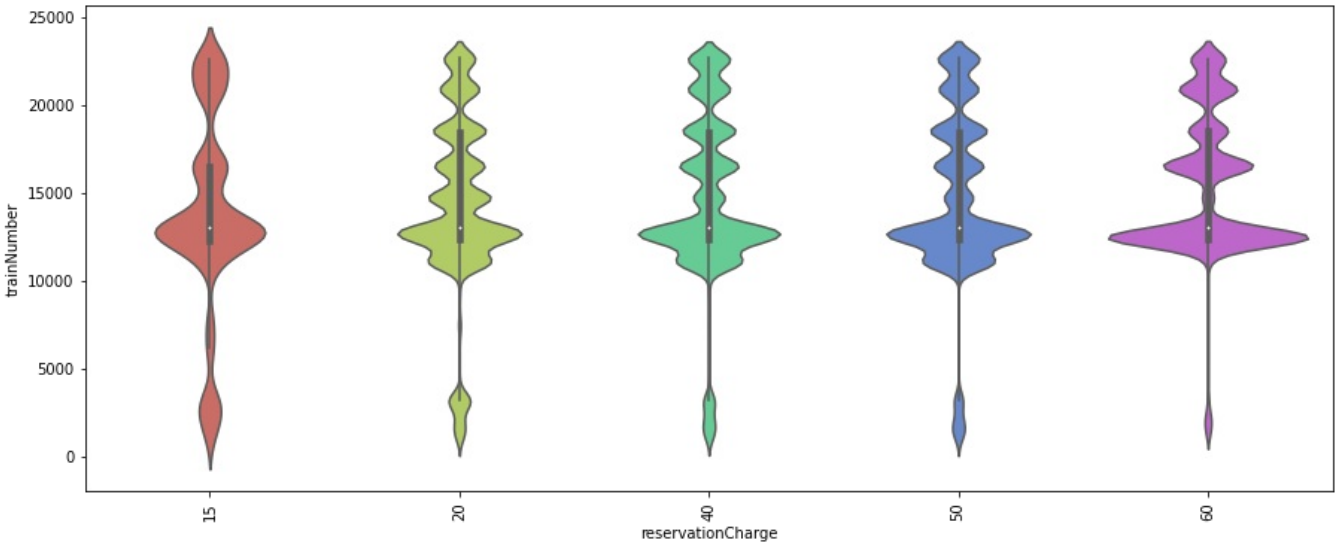
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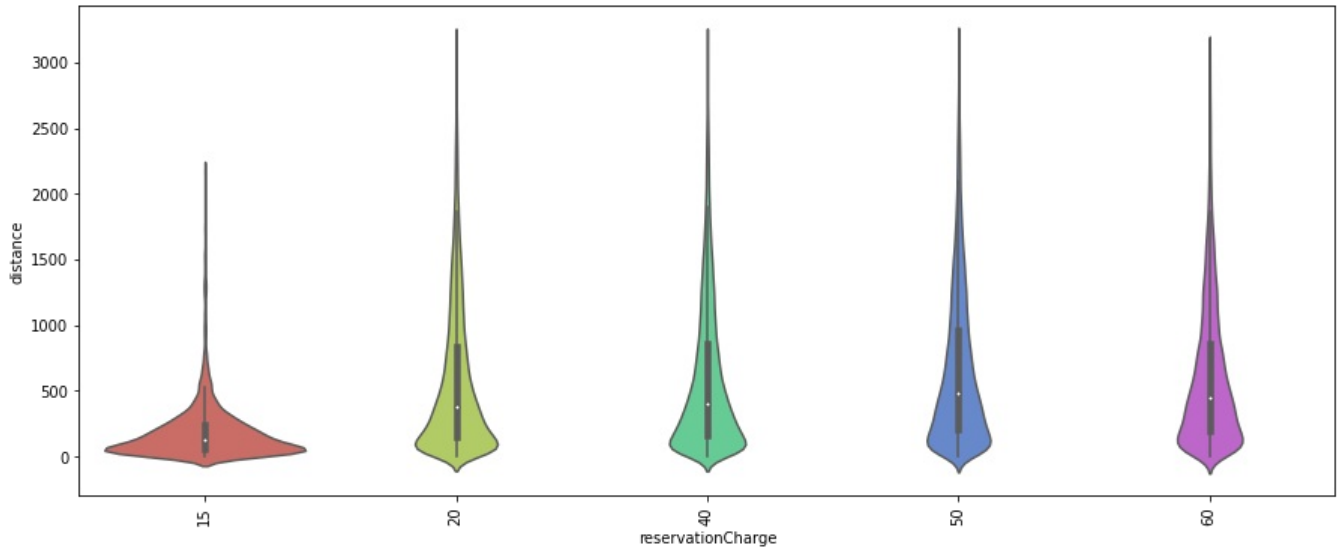
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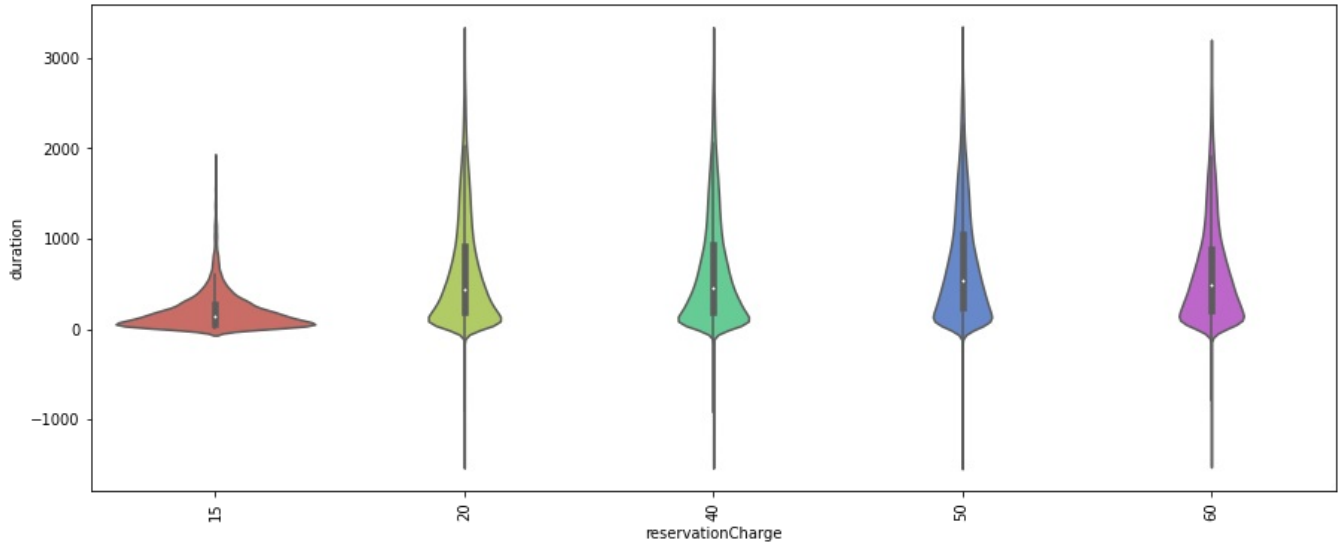
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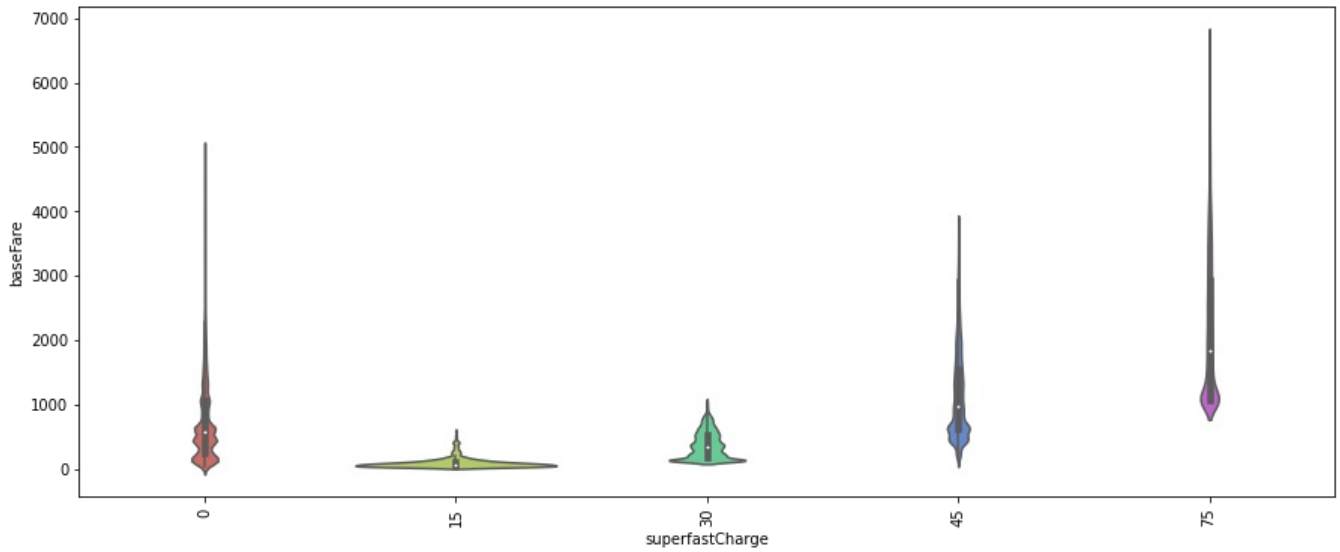
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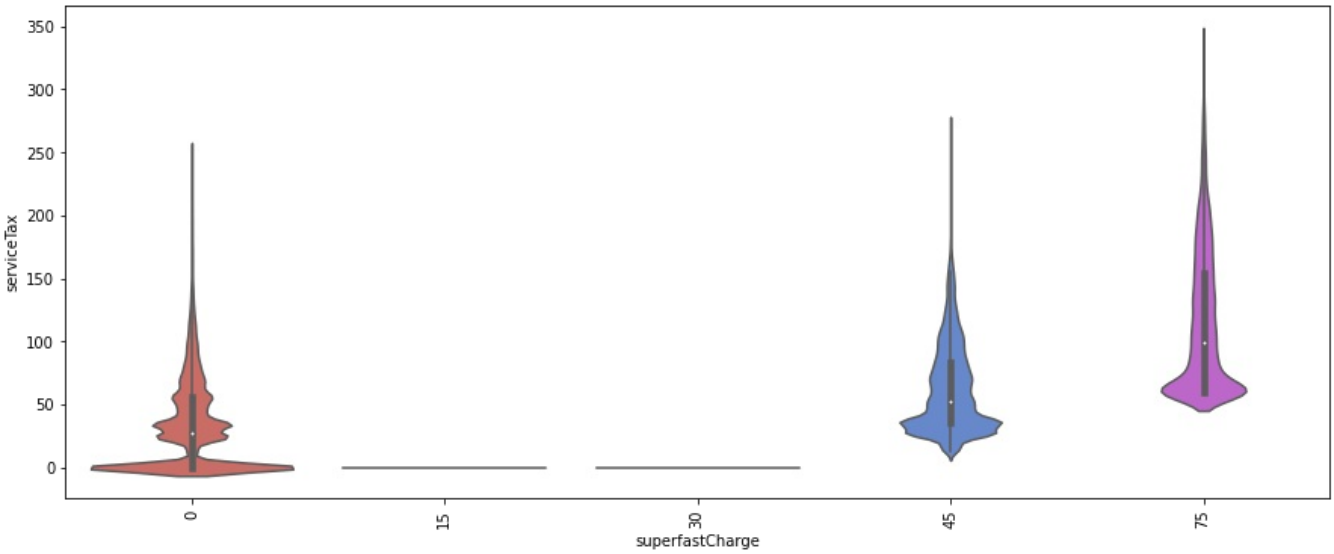
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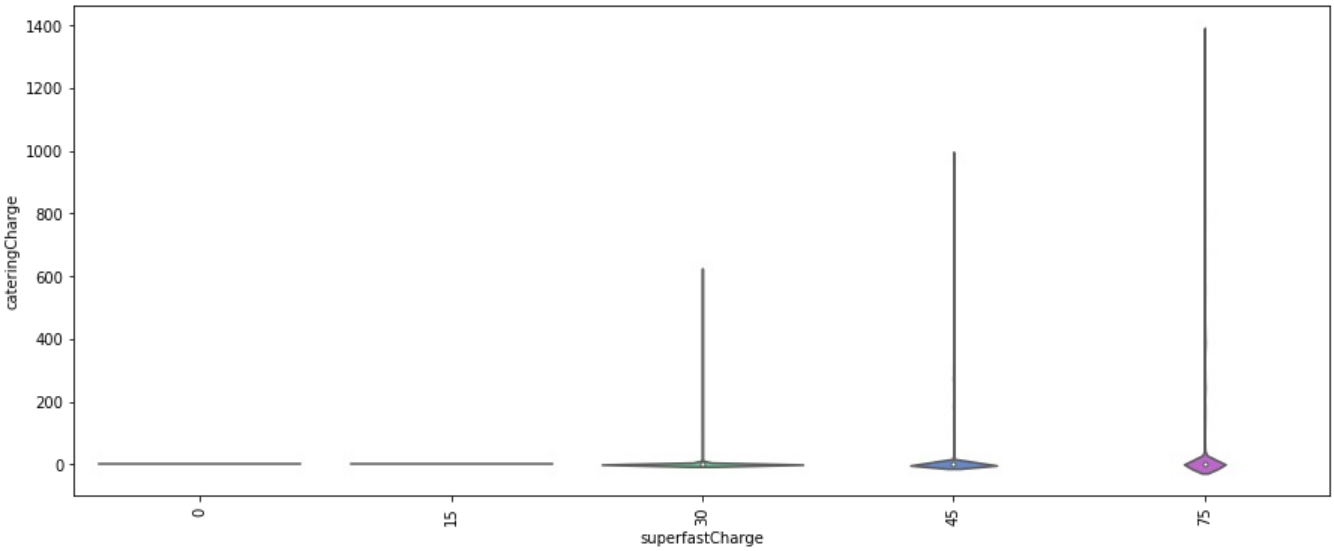
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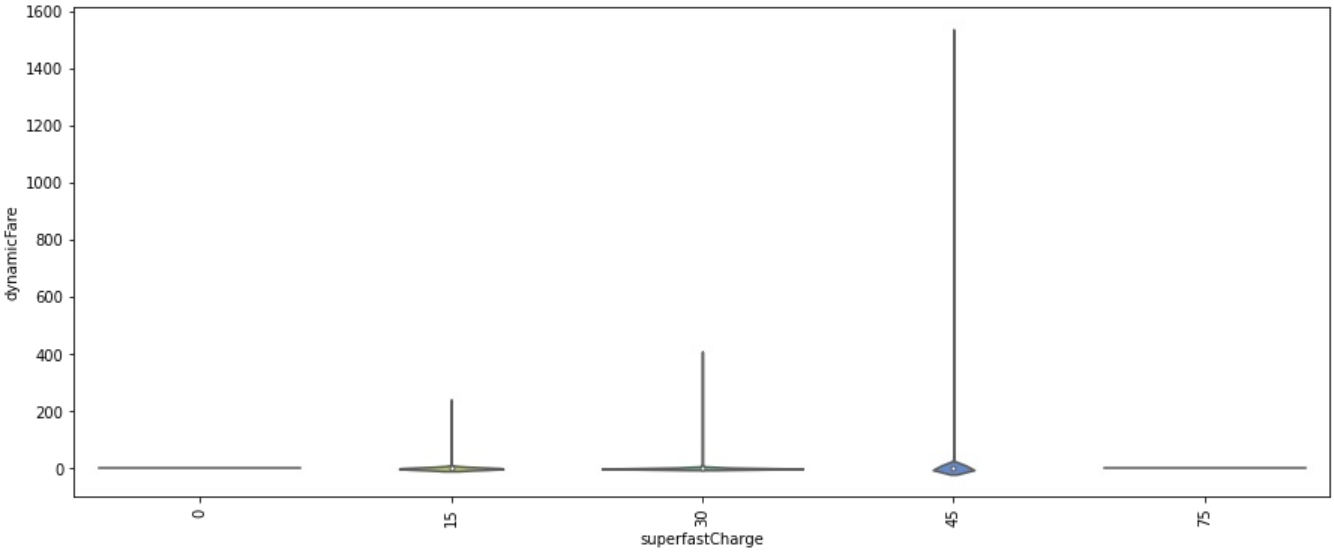
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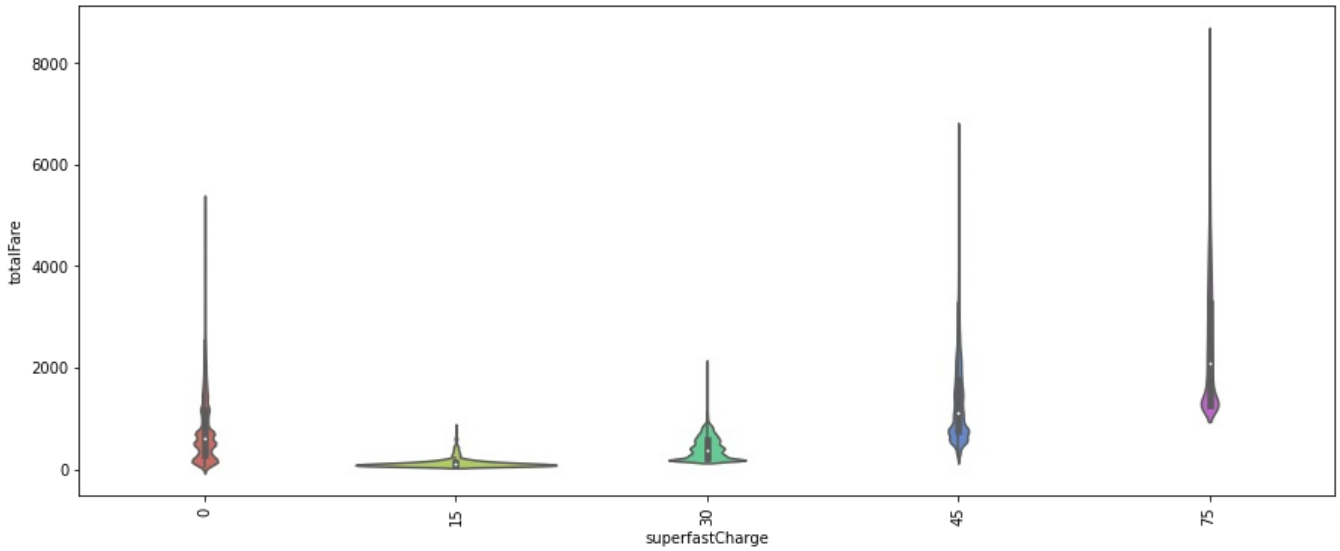
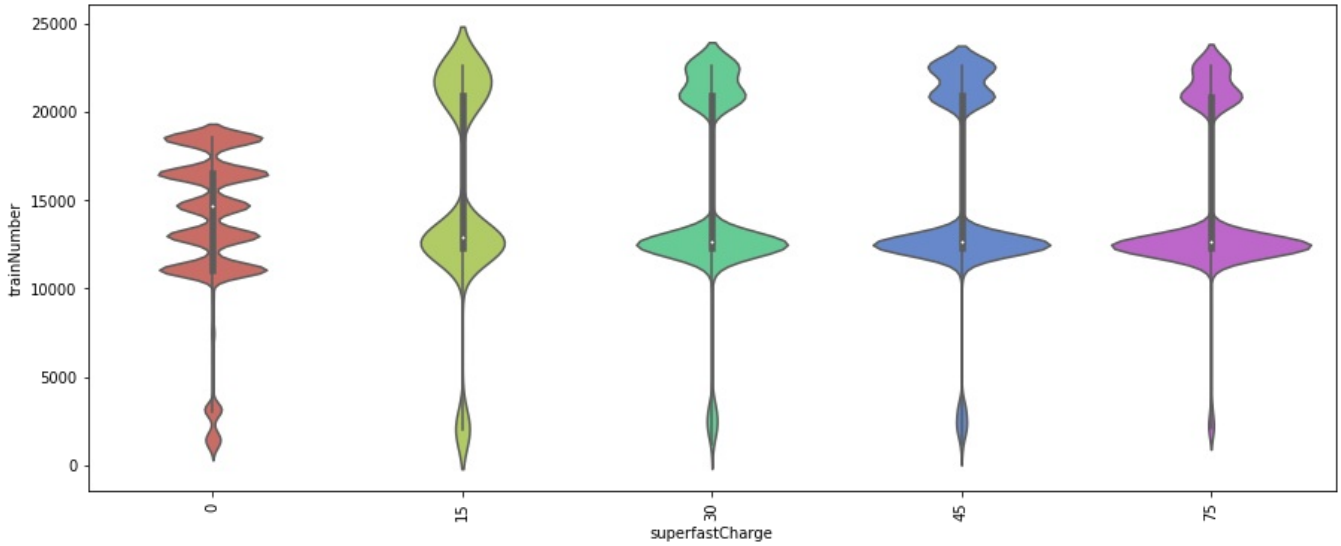
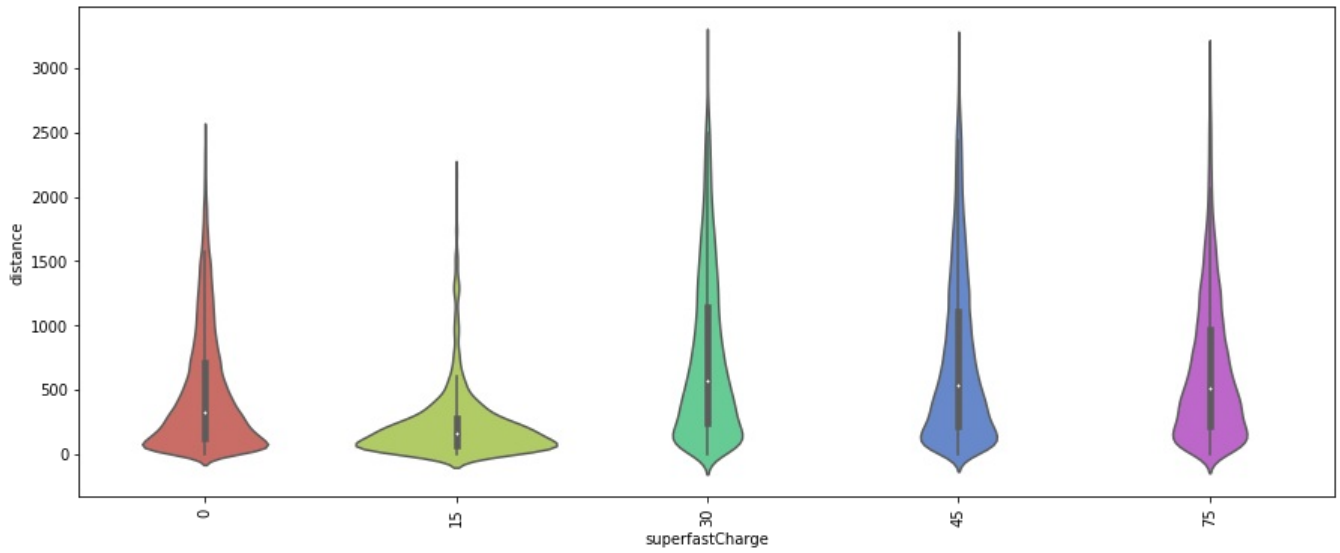
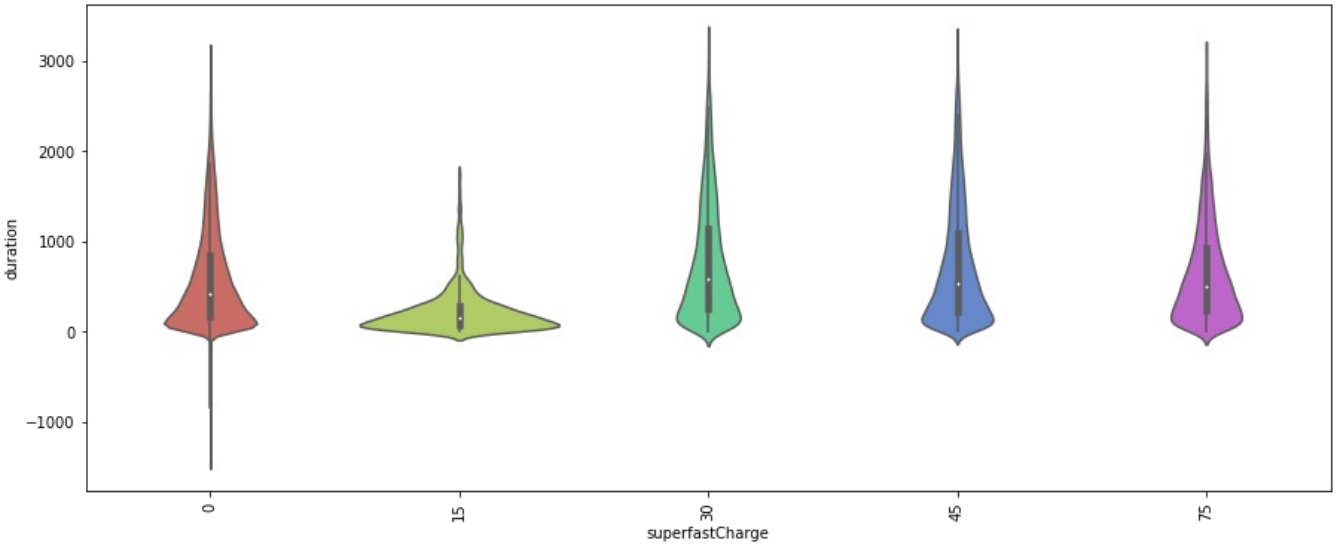
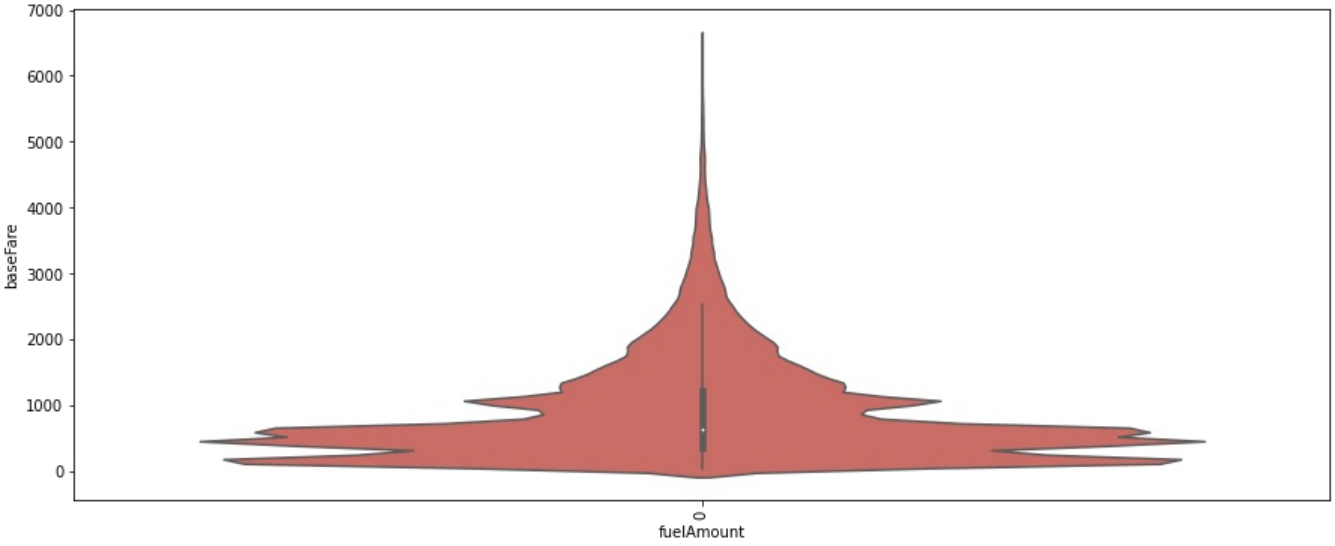
75
superfastCharge

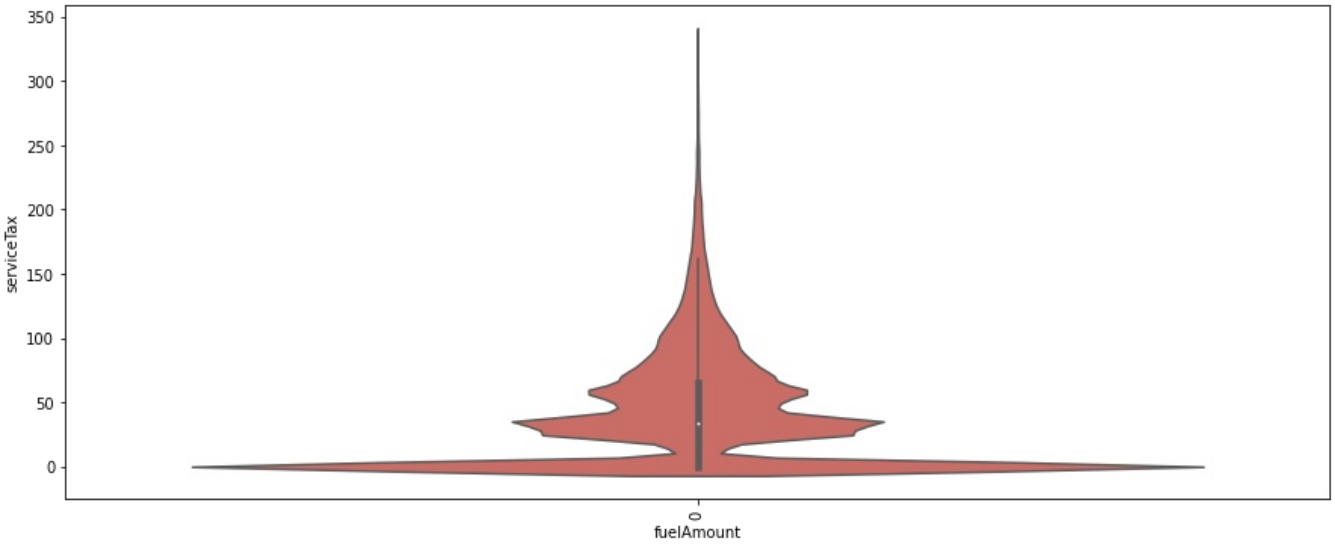

8000
6000
4000
2000
0
totalFare
0
15
30
45
75
superfastCharge

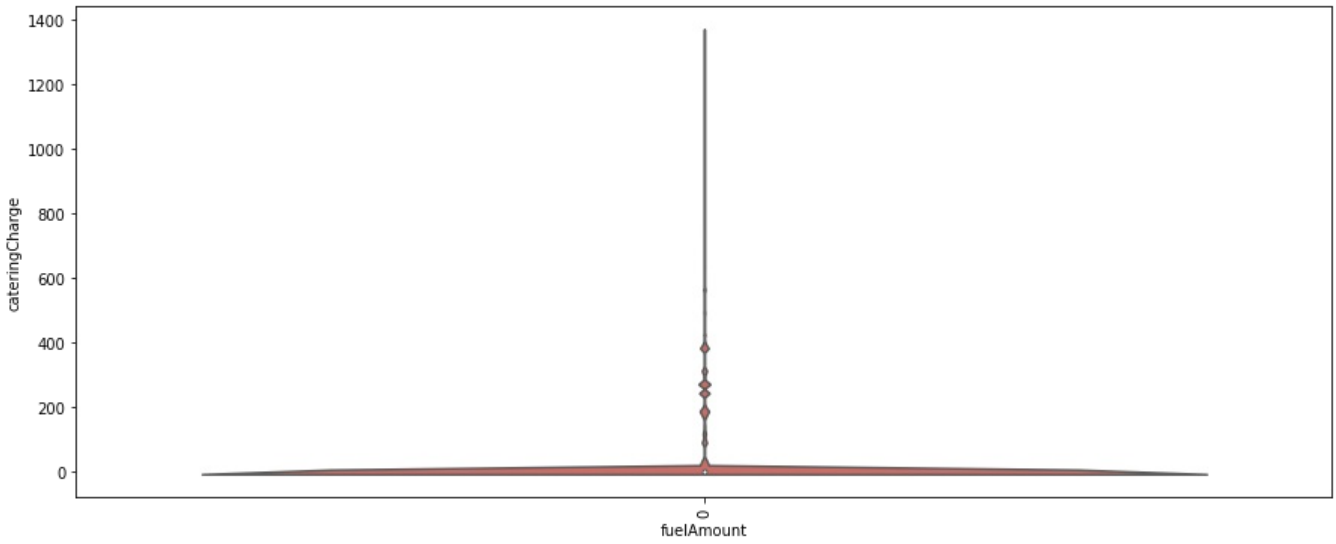

25000
20000
15000
10000
5000
0
trainNumber
0
15
30
45
75
superfastCharge

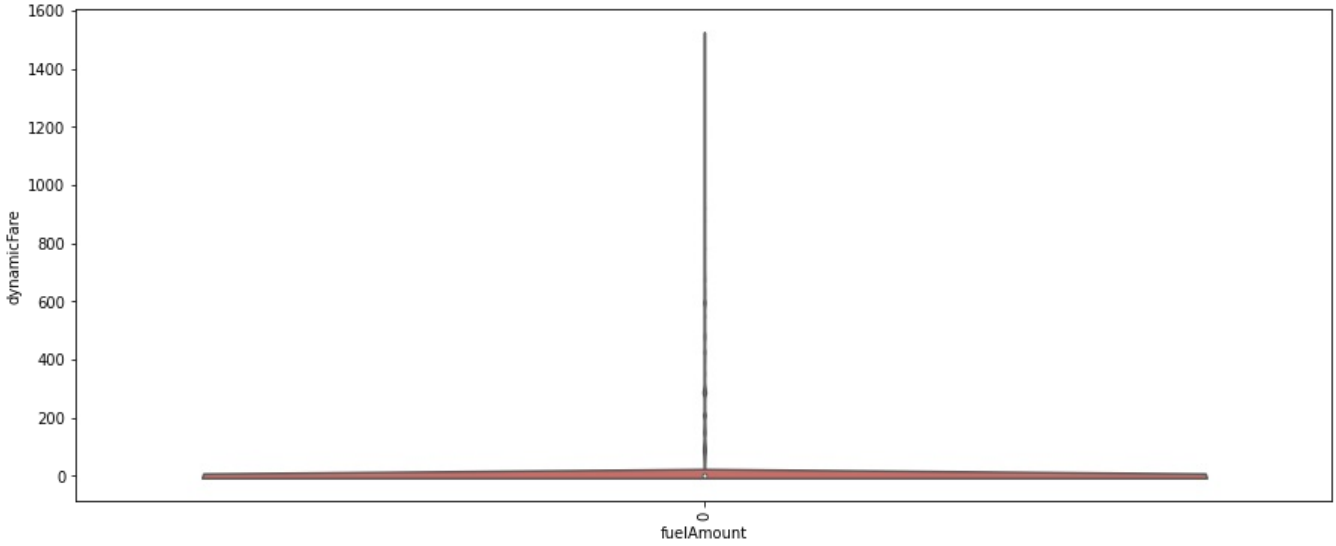

3000
2500
2000
1500
1000
500
0
distance
0
15
30
45
75
superfastCharge

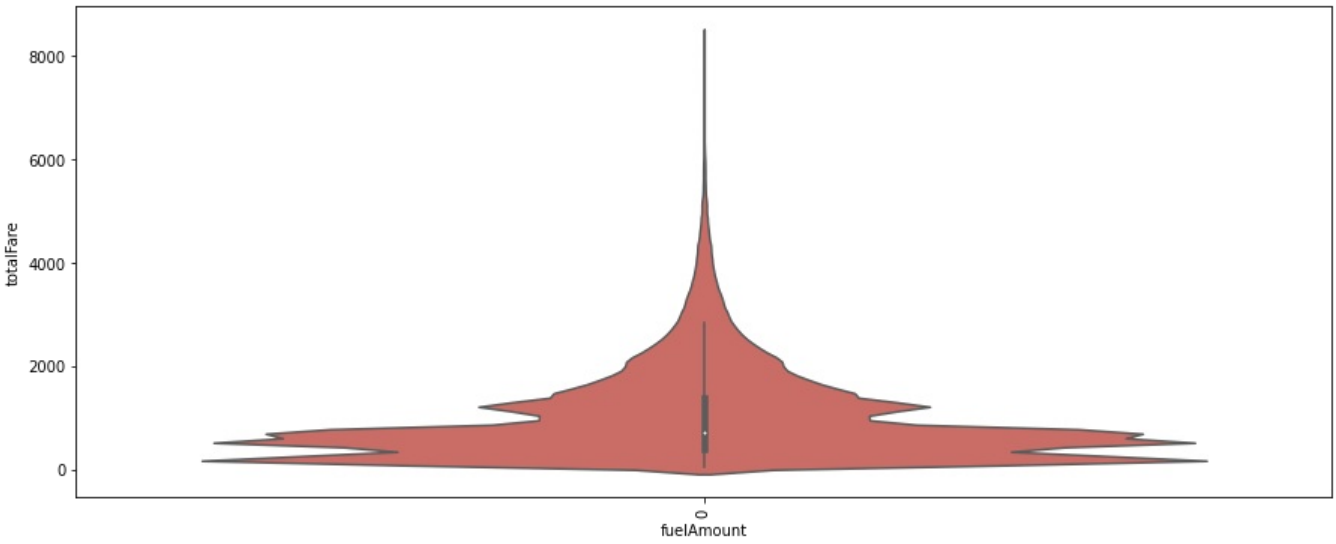

duration
3000
2000
1000
0
−1000
0
15
30
45
75
superfastCharge

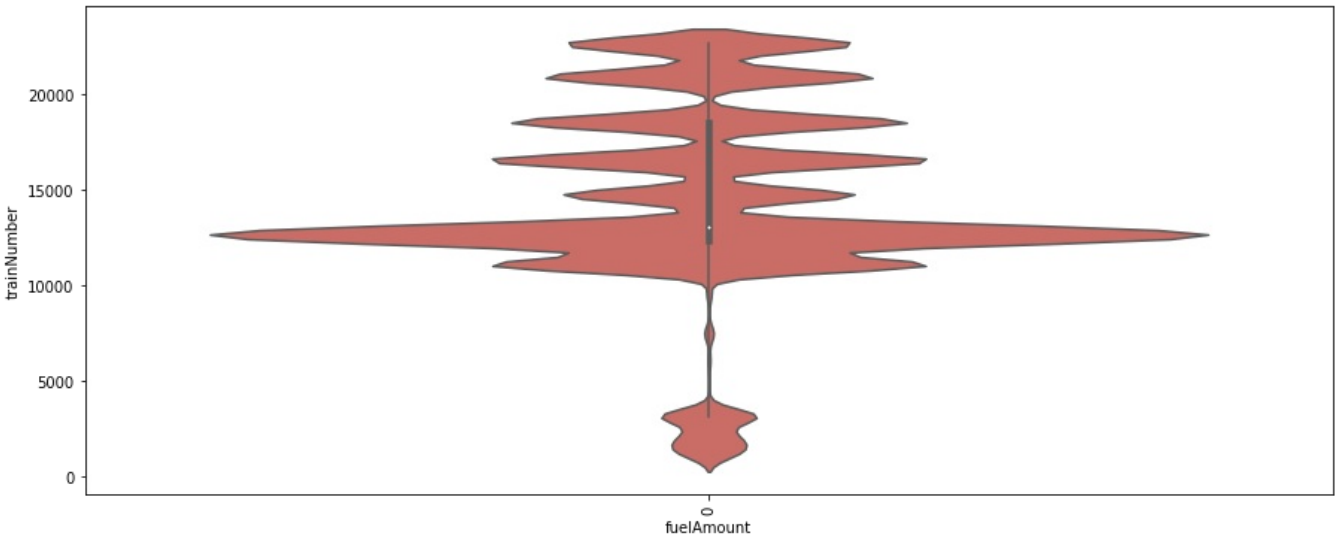

baseFare
7000
6000
5000
4000
3000
2000
1000
0
0
fuelAmount

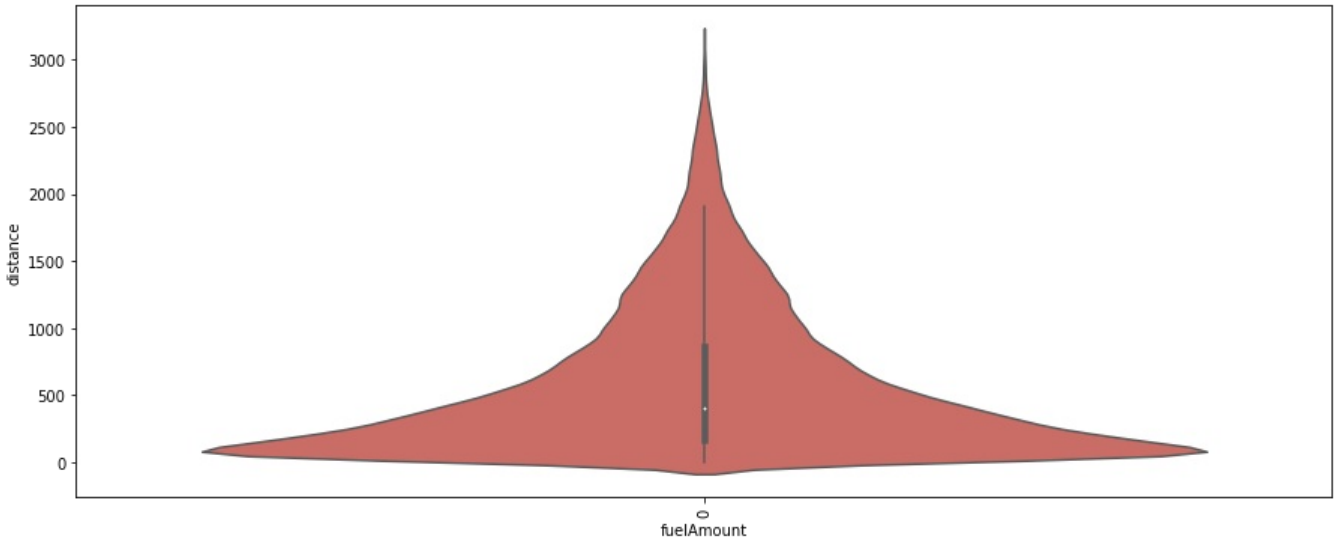

serviceTax
350
300
250
200
150
100
50
0
0
fuelAmount

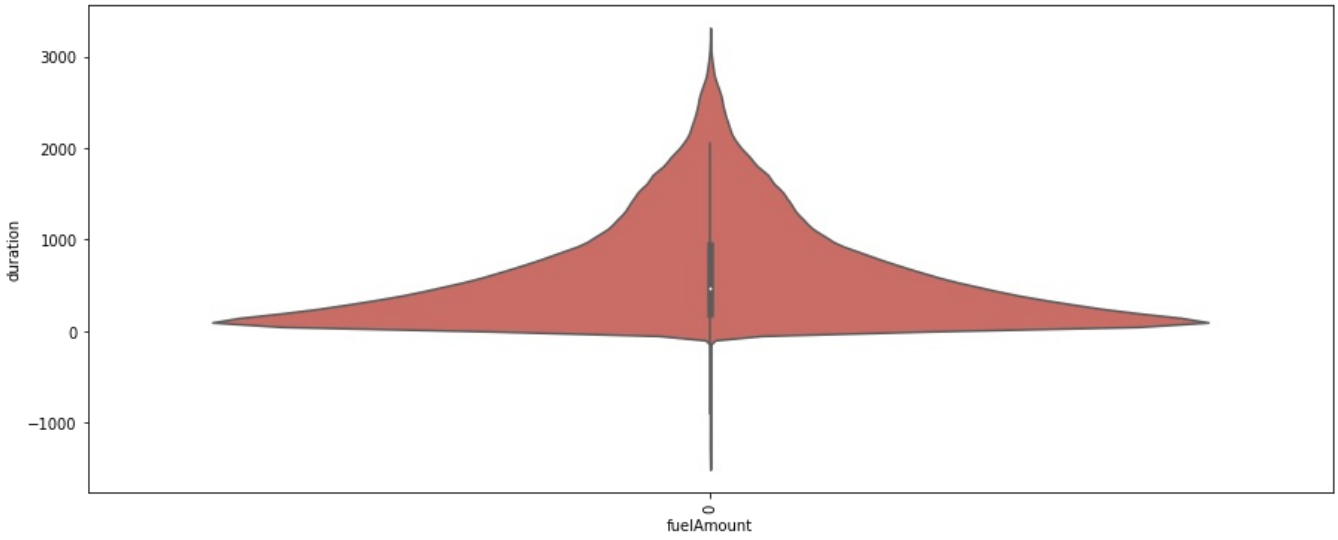

1400
1200
1000
800
600
400
200
0
cateringCharge
0
fuelAmount

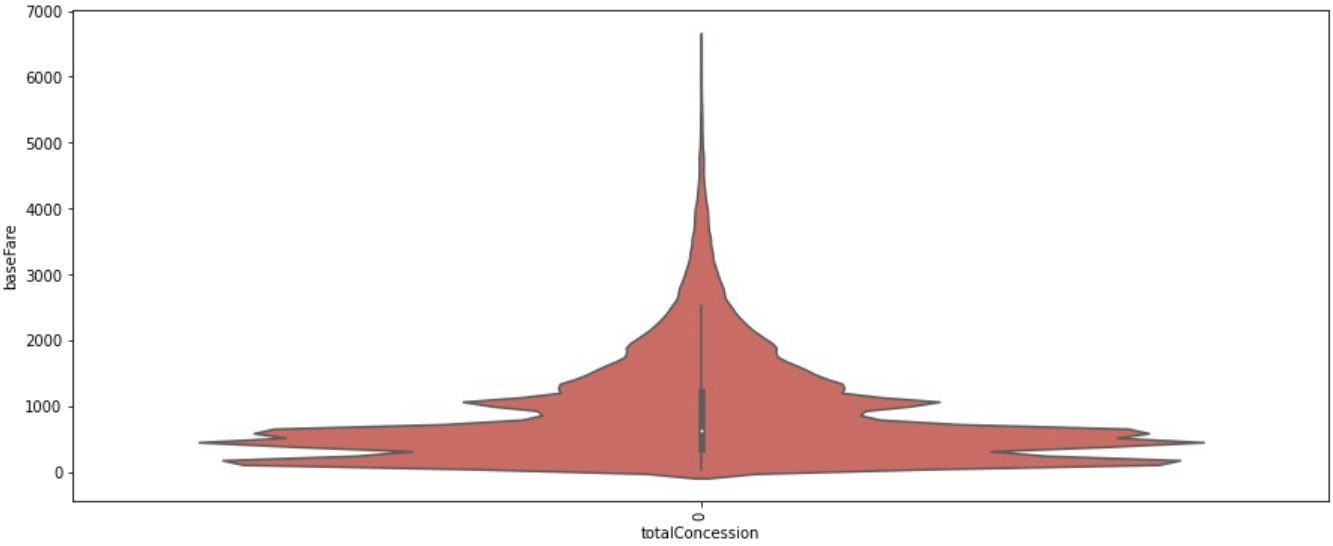

1600
1400
1200
1000
800
600
400
200
0
dynamicFare
0
fuelAmount

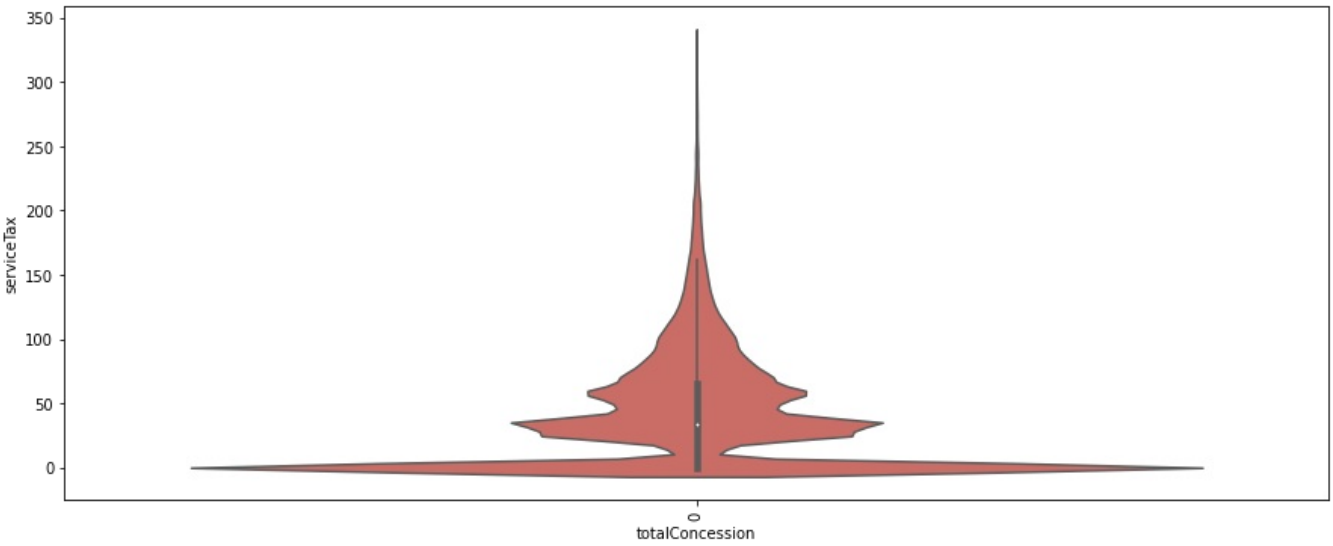

8000
6000
4000
2000
0
totalFare
0
fuelAmount

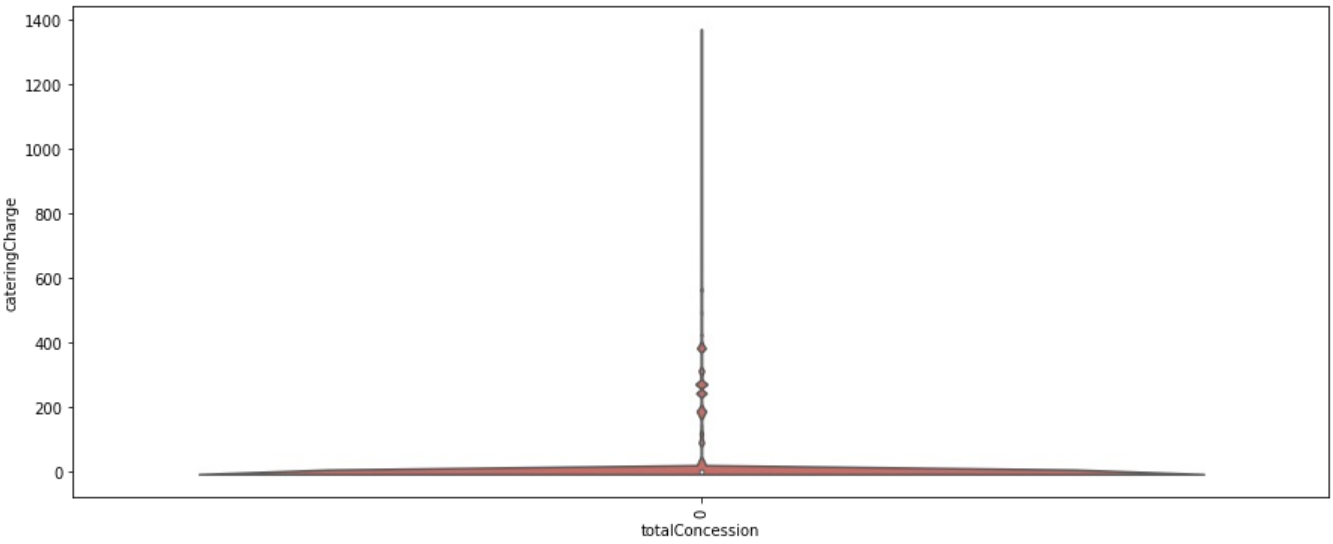

trainNumber
20000
15000
10000
5000
0
0
fuelAmount

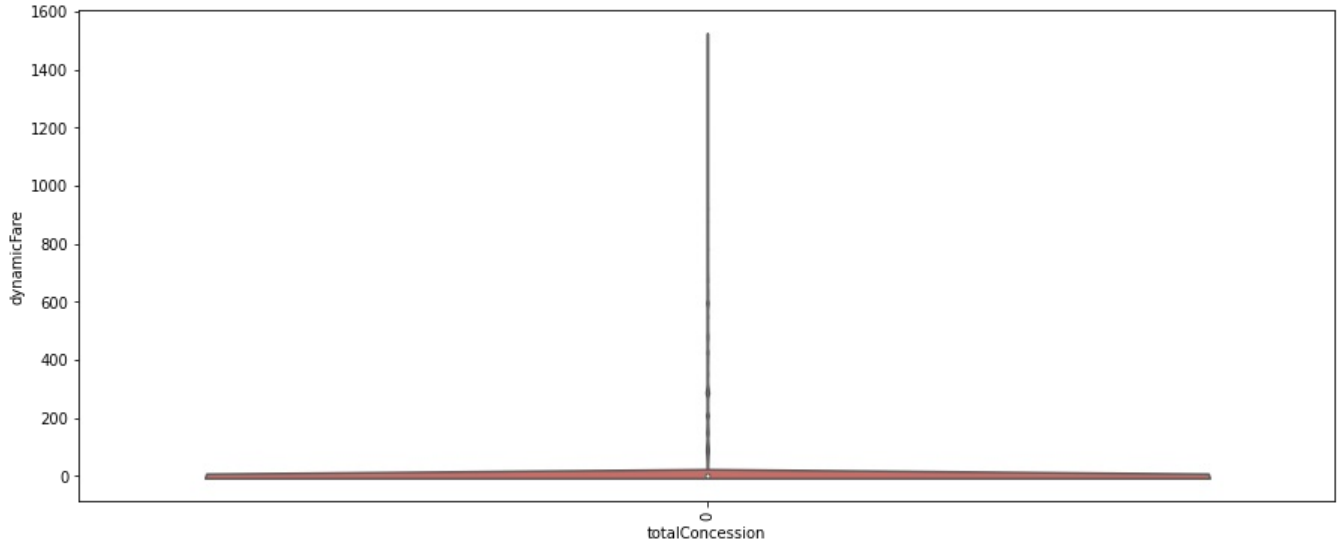

distance
3000
2500
2000
1500
1000
500
0
0
fuelAmount

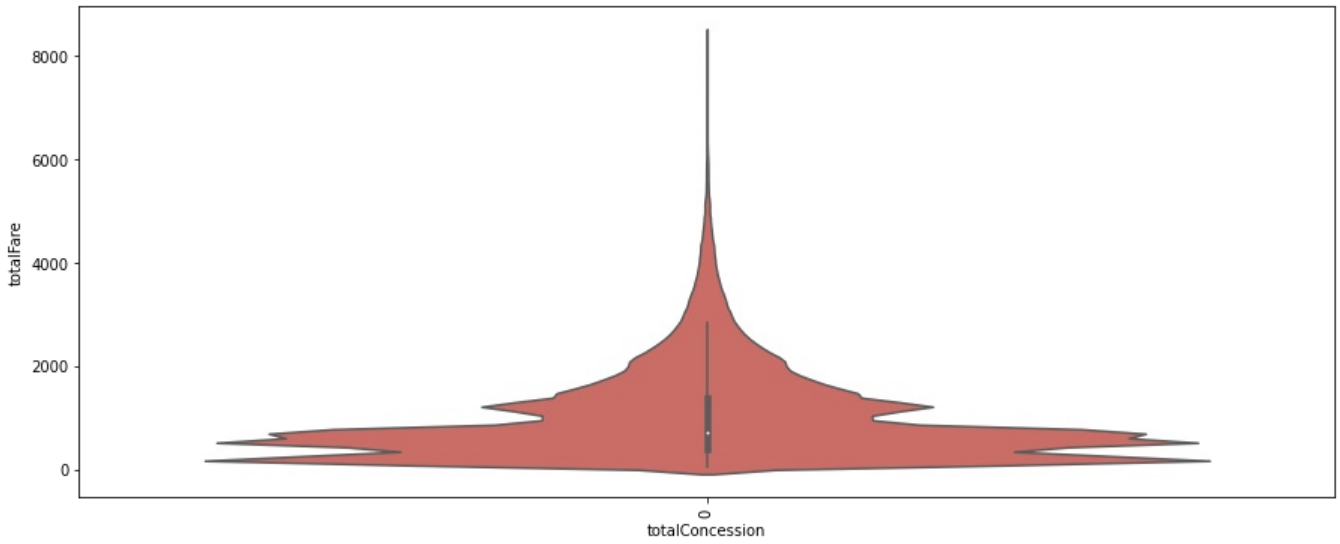

duration
3000
2000
1000
0
−1000
0
fuelAmount

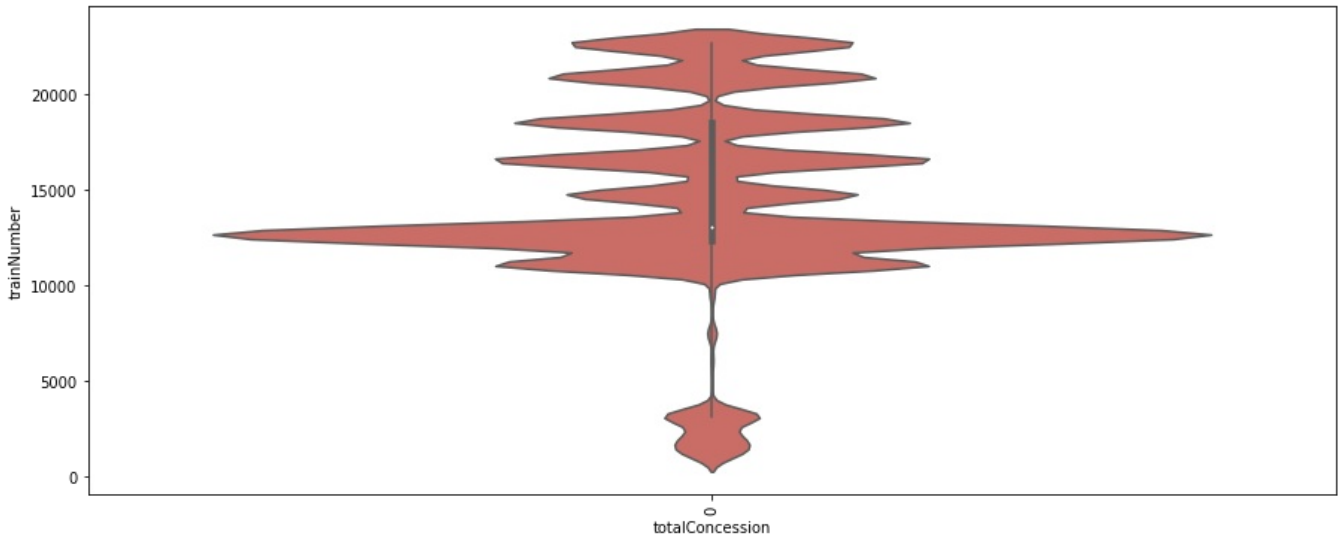

baseFare
7000
6000
5000
4000
3000
2000
1000
0
0
totalConcession

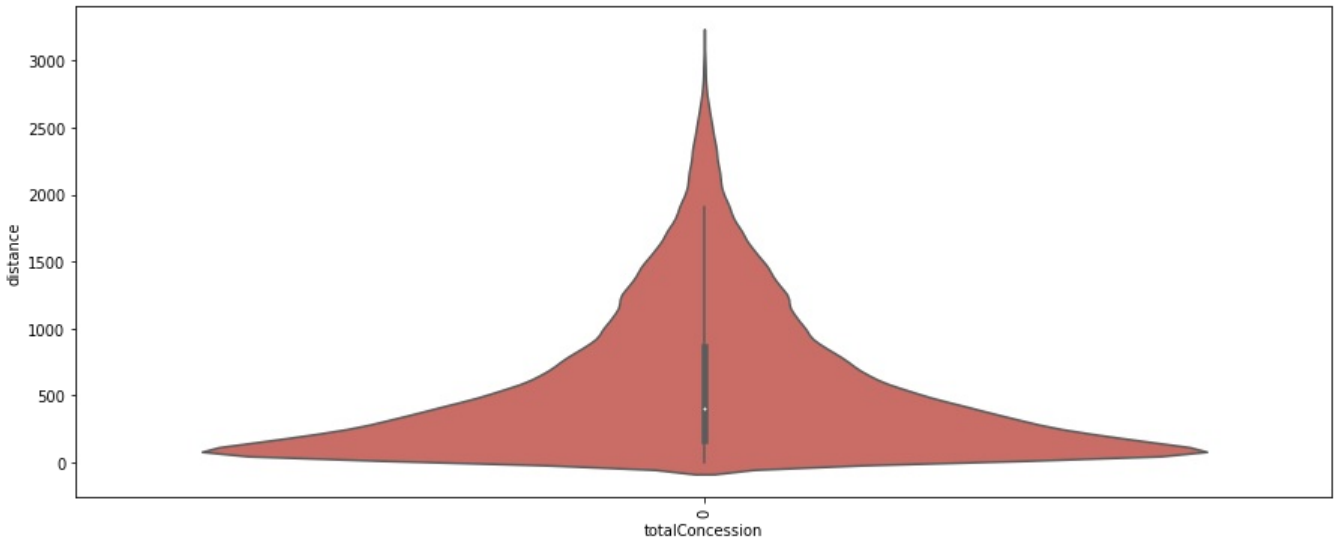

serviceTax
350
300
250
200
150
100
50
0
0
totalConcession

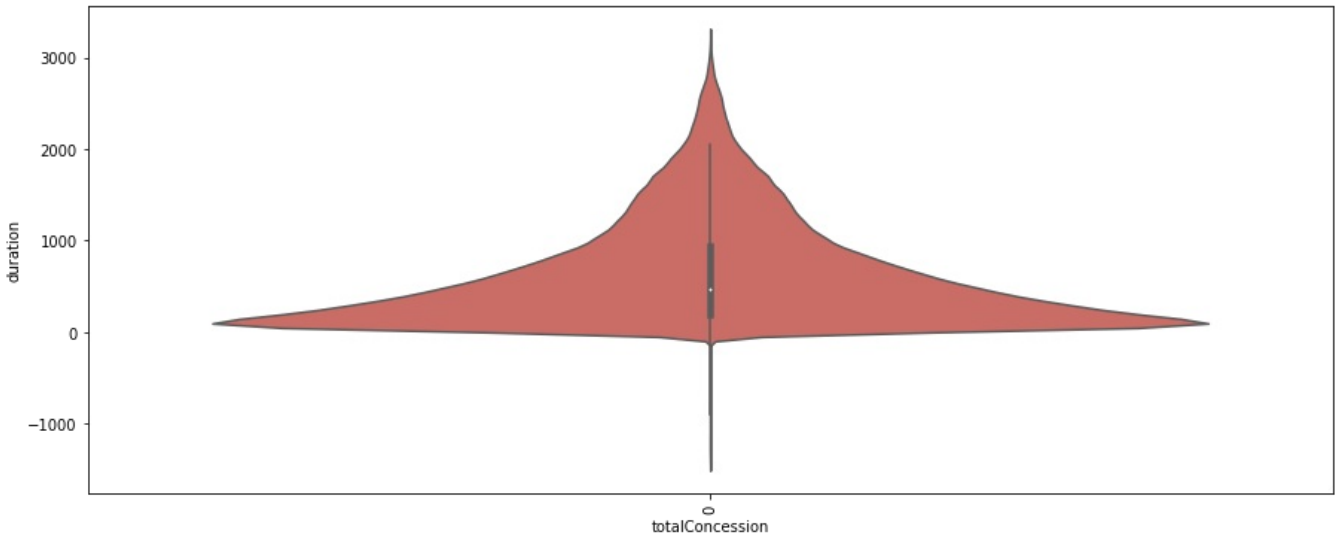

cateringCharge
1400
1200
1000
800
600
400
200
0
0
totalConcession

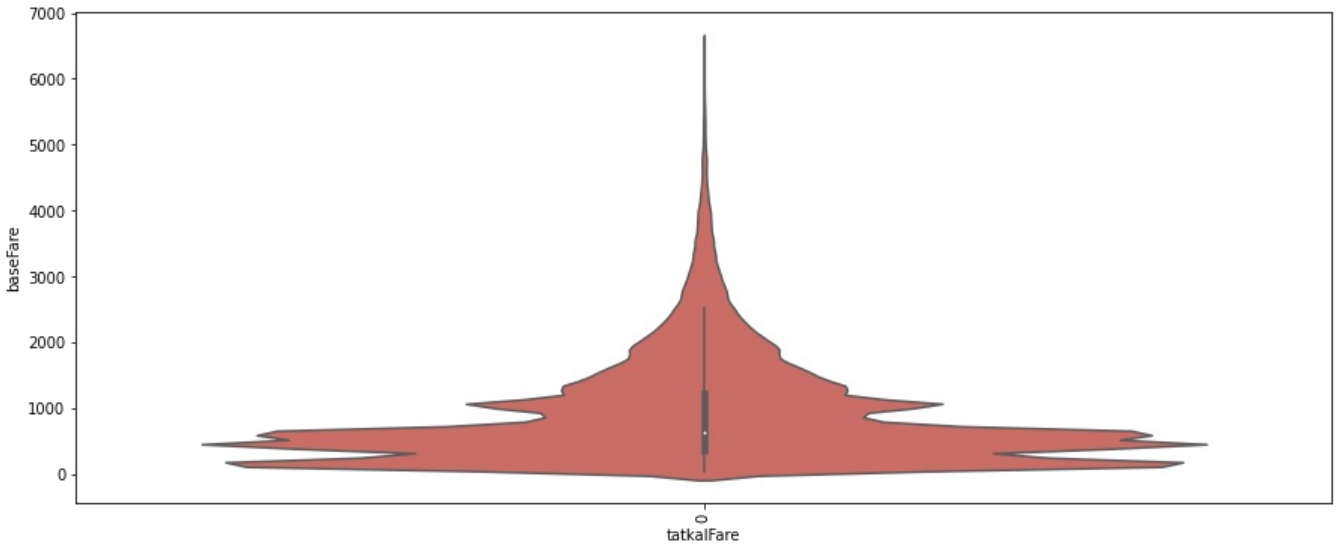

1600
1400
1200
1000
800
600
400
200
0
dynamicFare
0
totalConcession

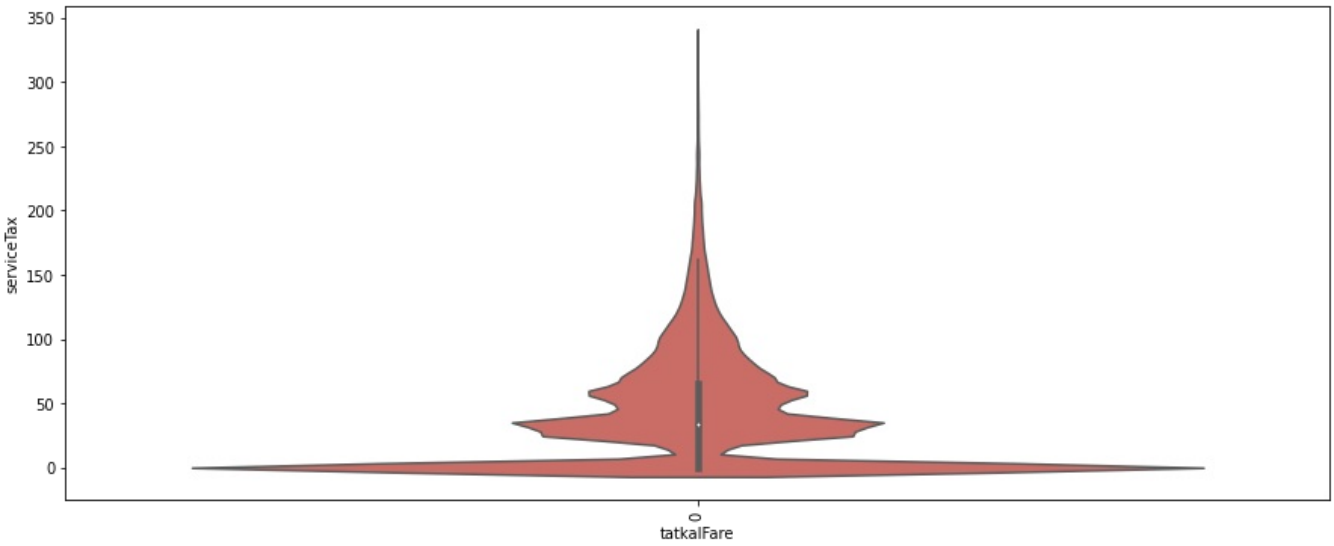

8000
6000
4000
2000
0
totalFare
0
totalConcession

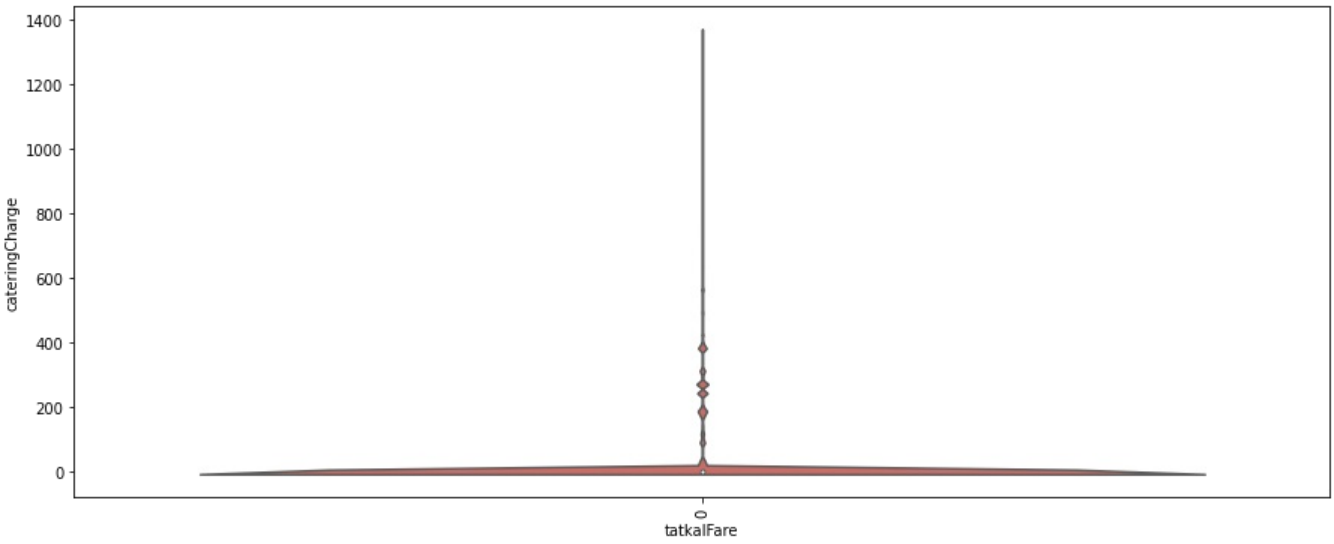

20000
15000
10000
5000
0
trainNumber
0
totalConcession

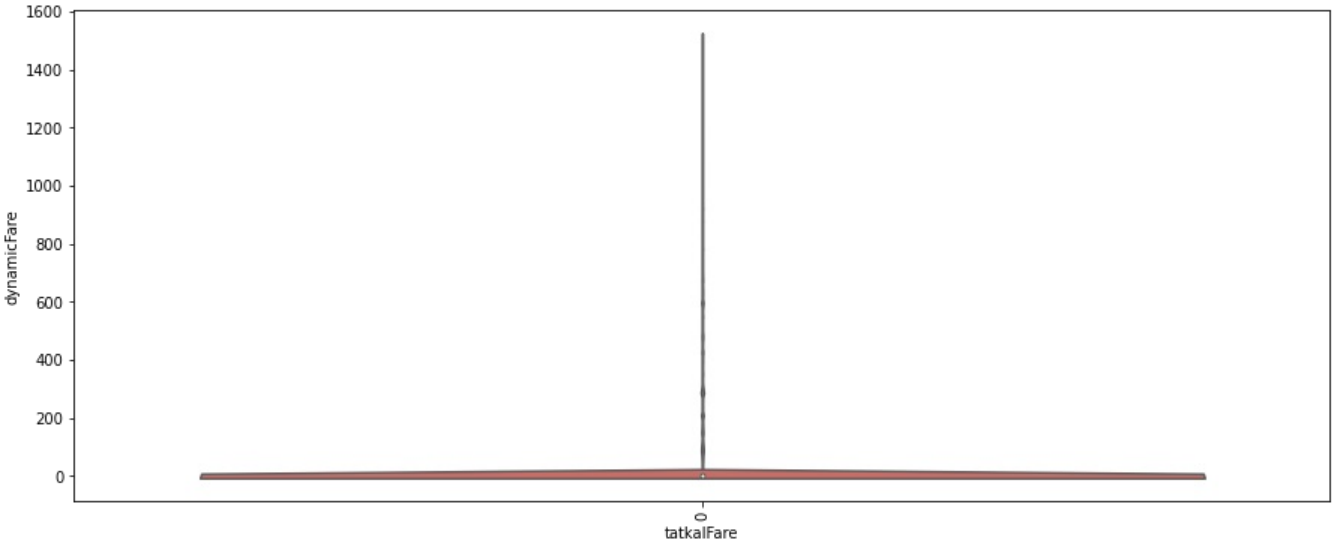

distance
3000
2500
2000
1500
1000
500
0
0
totalConcession

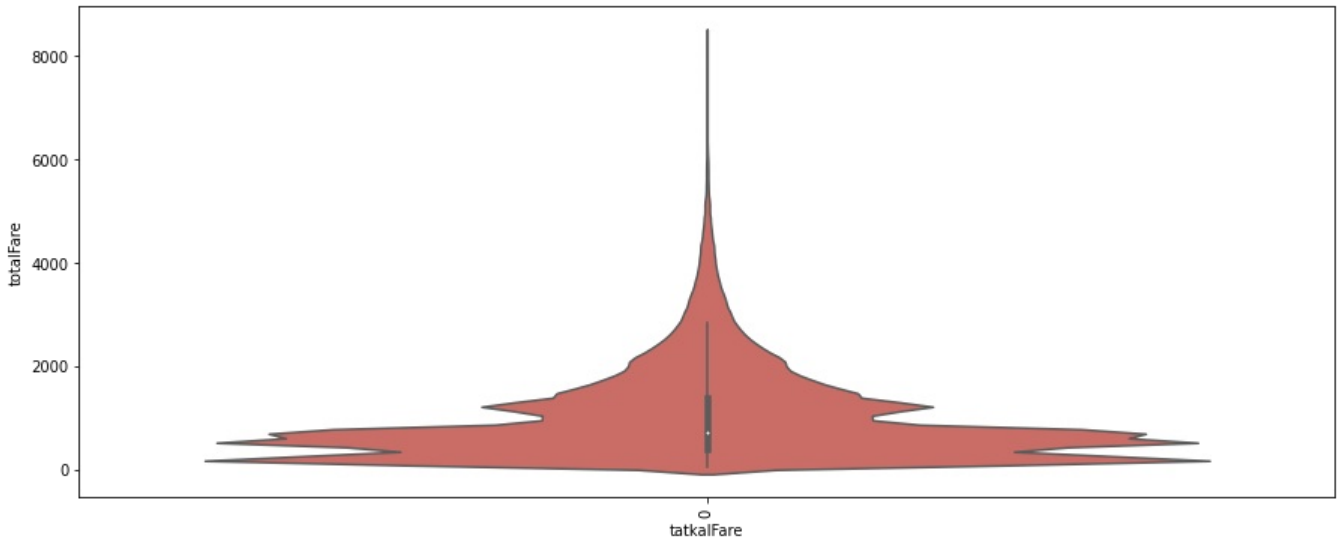

duration
3000
2000
1000
0
−1000
0
totalConcession

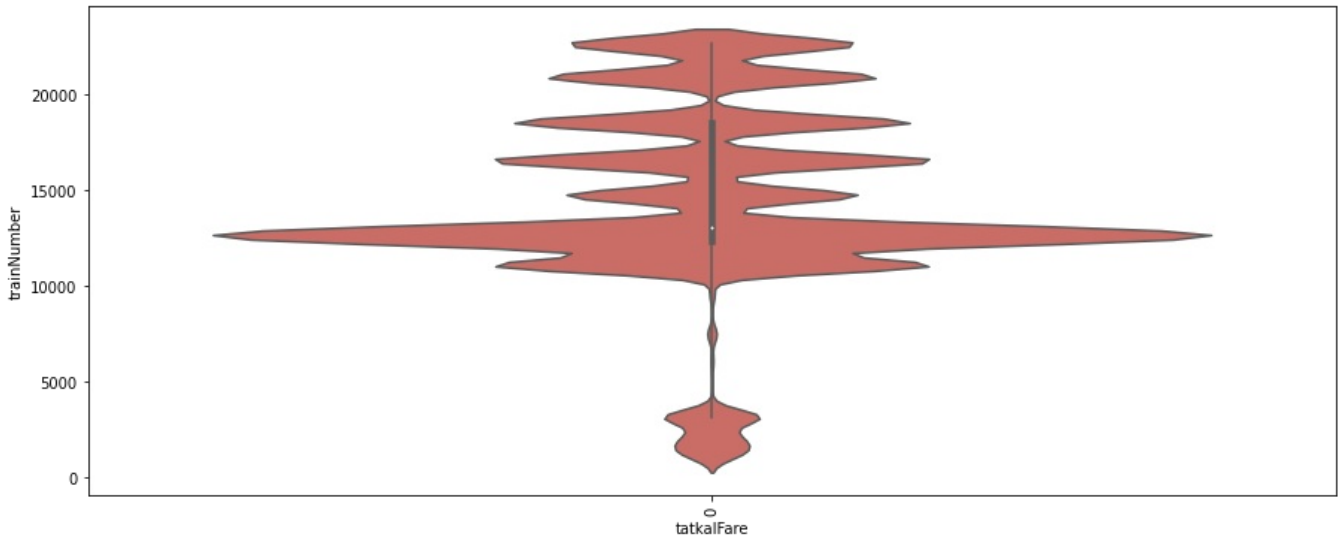

baseFare
7000
6000
5000
4000
3000
2000
1000
0
0
tatkalFare

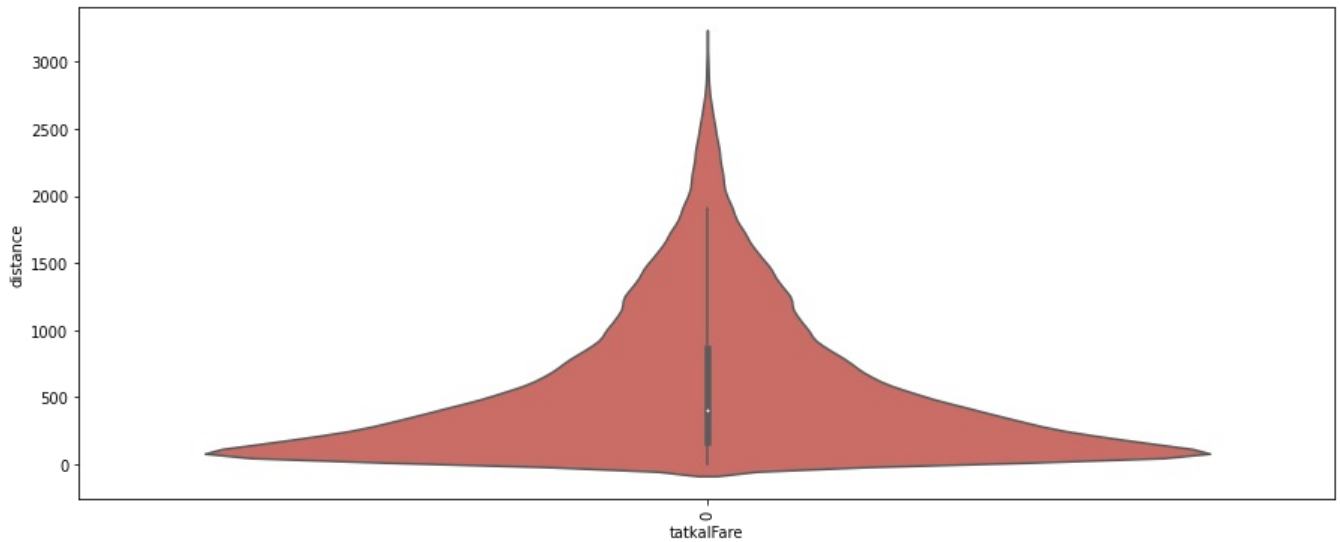

serviceTax
350
300
250
200
150
100
50
0
0
tatkalFare

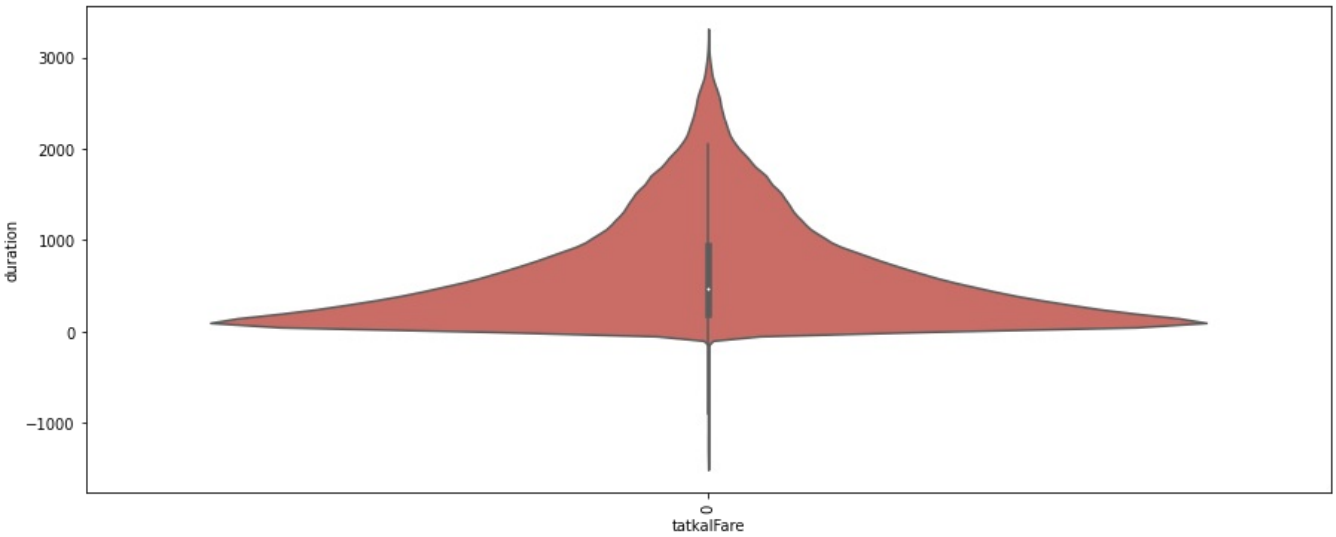

cateringCharge
1400
1200
1000
800
600
400
200
0
0
tatkalFare

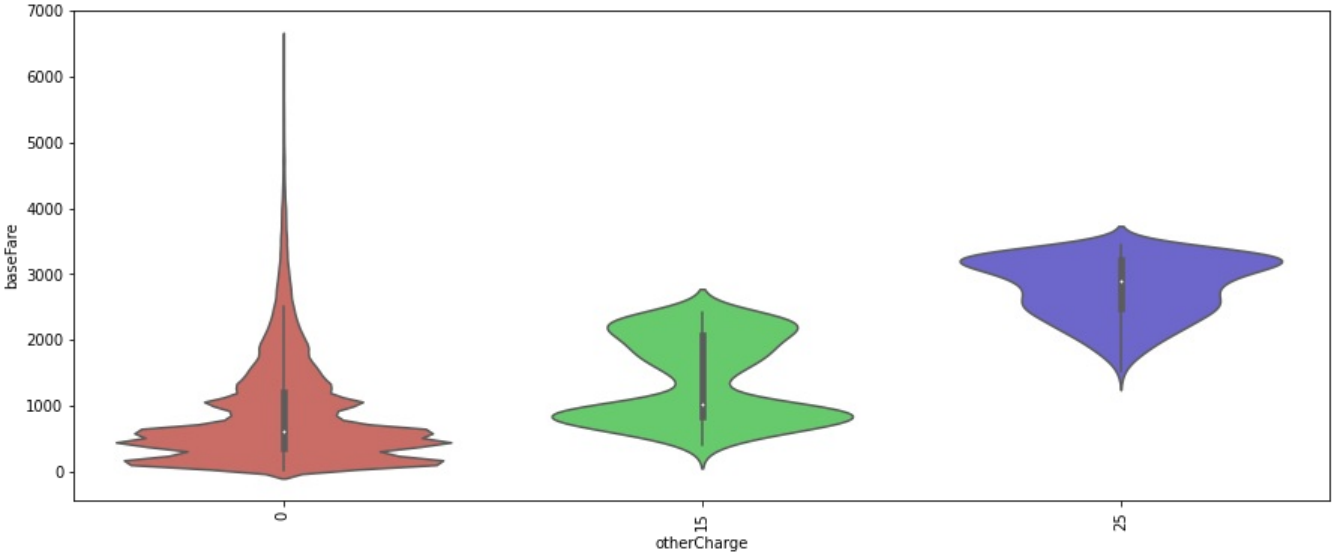

dynamicFare
1600
1400
1200
1000
800
600
400
200
0
0
tatkalFare

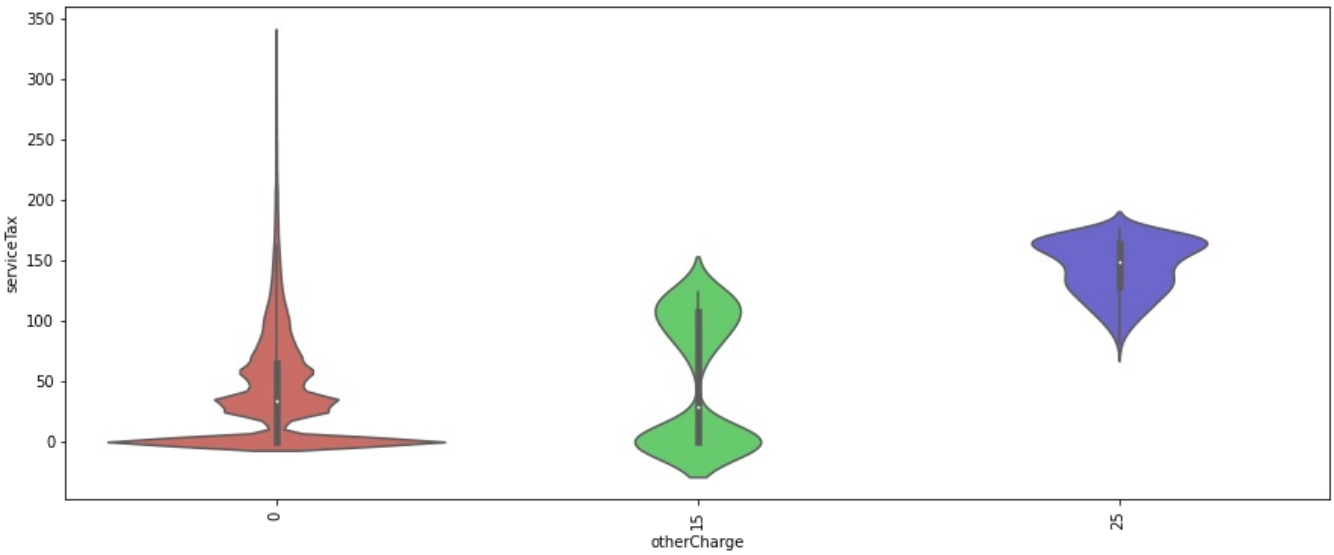

8000
6000
4000
2000
0
totalFare
0
tatkalFare

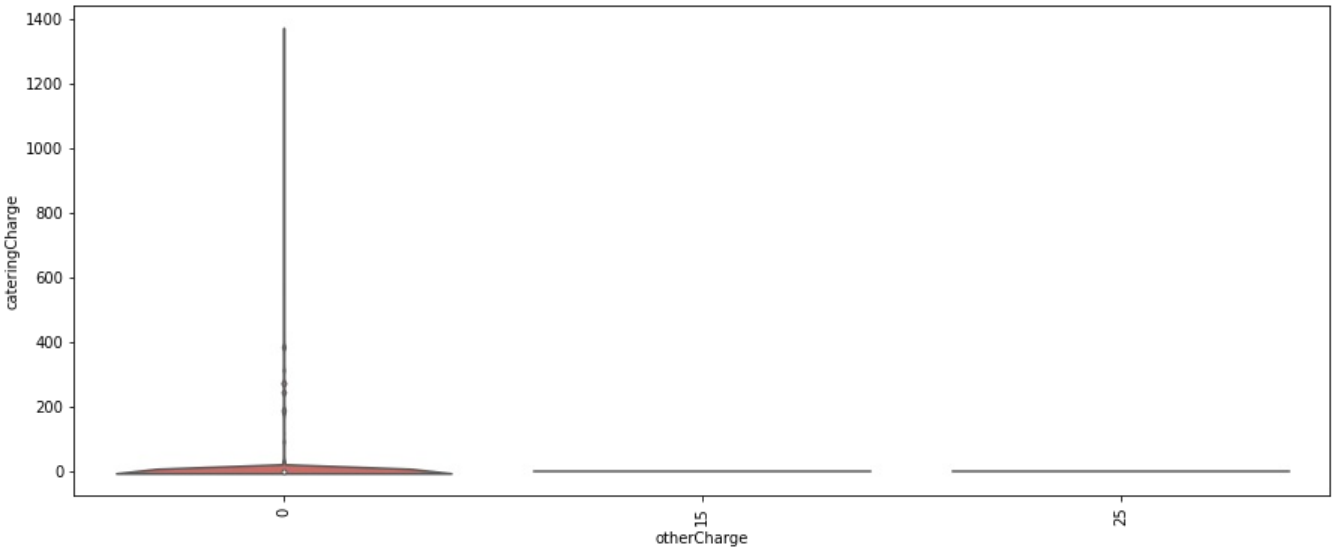

20000
15000
10000
5000
0
trainNumber
0
tatkalFare

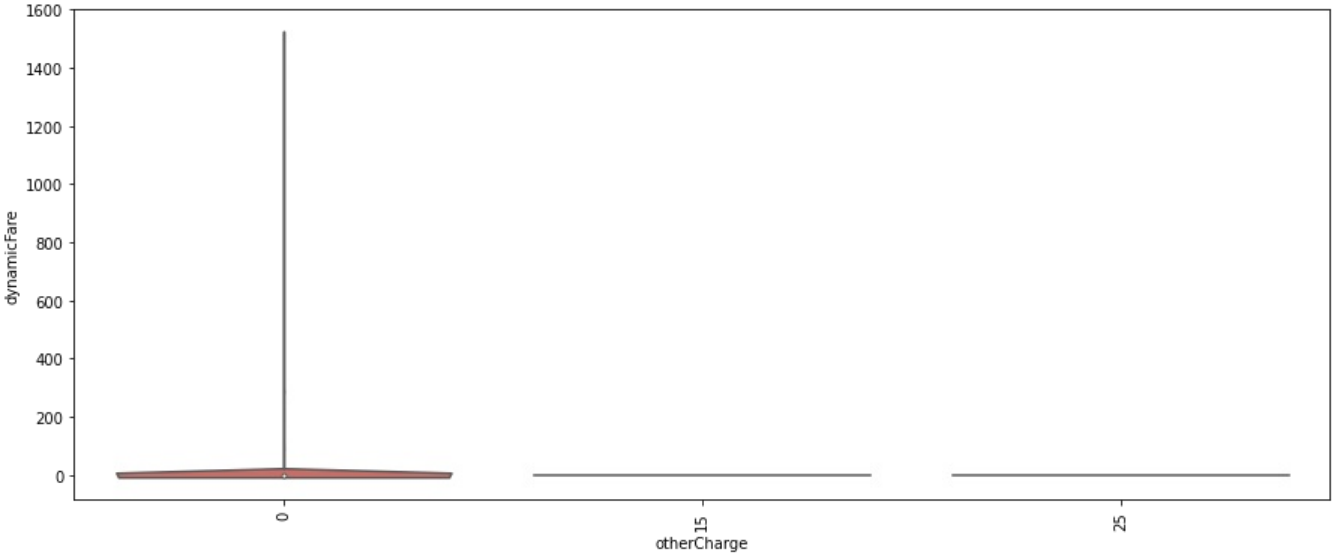

3000
2500
2000
1500
1000
500
0
distance
0
tatkalFare

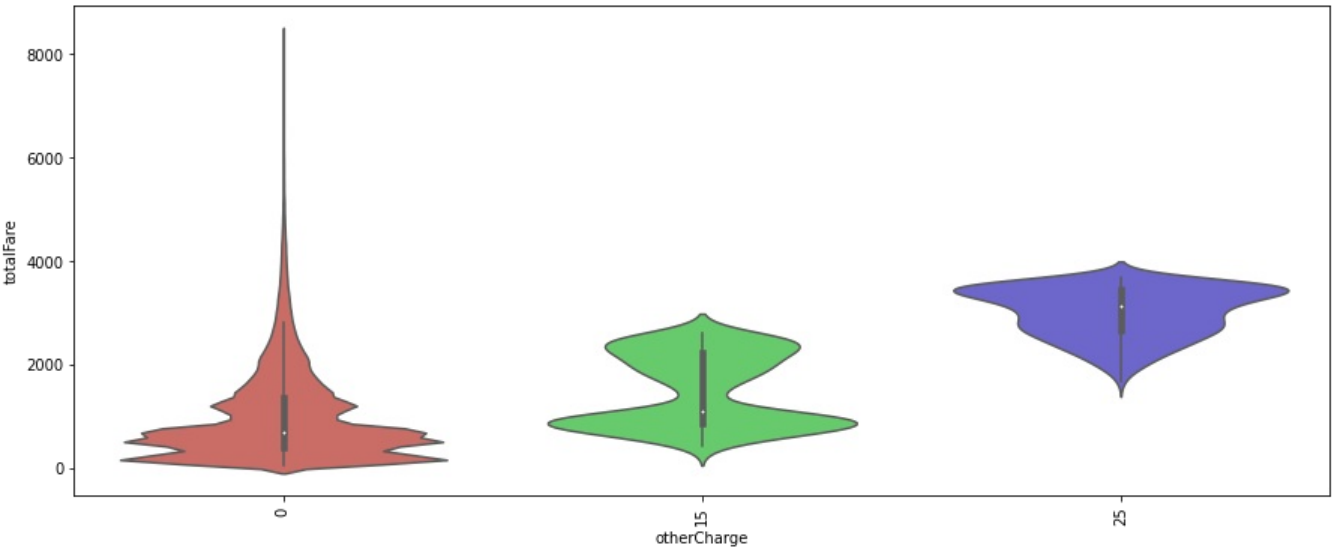

duration
3000
2000
1000
0
−1000
0
tatkalFare

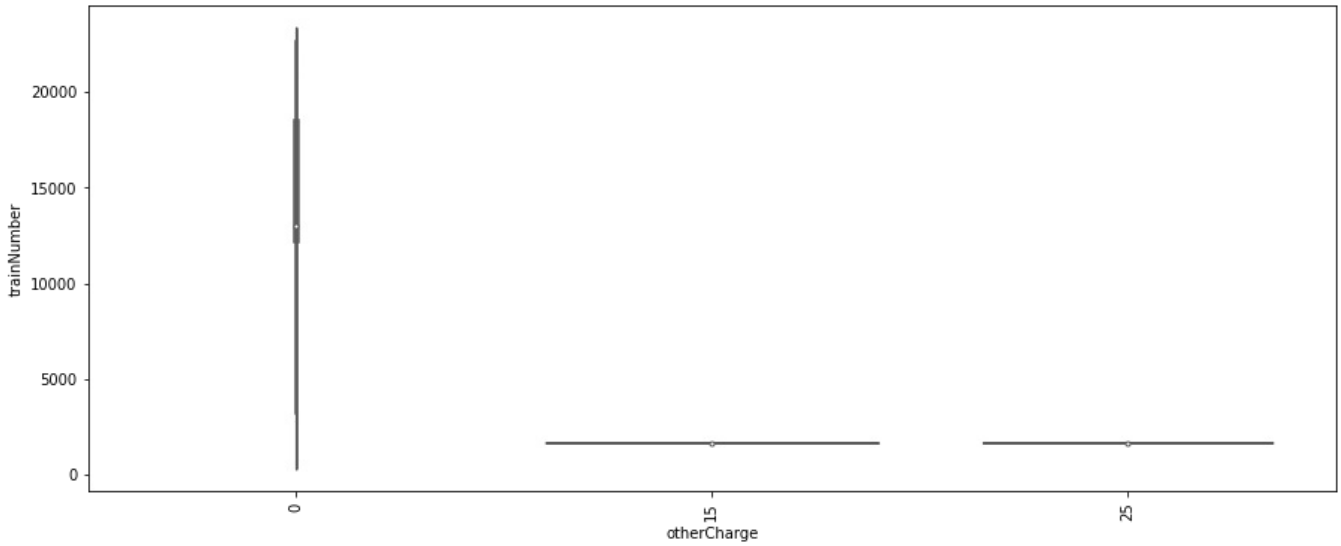

baseFare
7000
6000
5000
4000
3000
2000
1000
0
0
15
25
otherCharge

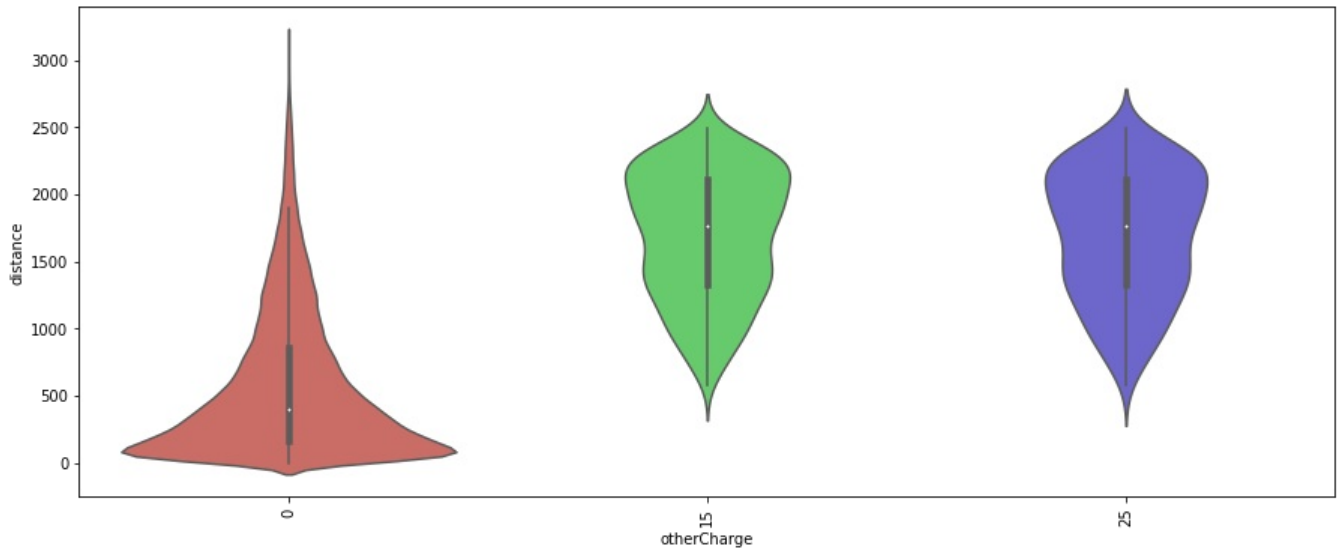

serviceTax
350
300
250
200
150
100
50
0
0
15
25
otherCharge

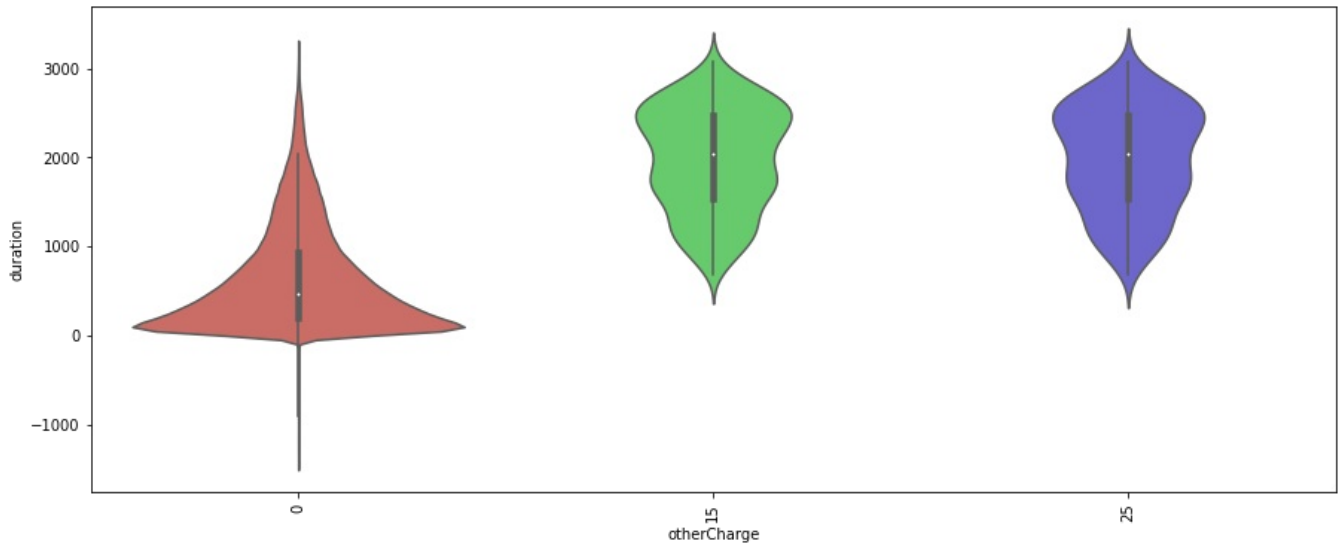

cateringCharge
1400
1200
1000
800
600
400
200
0
0
15
25
otherCharge


dynamicFare
1600
1400
1200
1000
800
600
400
200
0
0
15
25
otherCharge


totalFare
8000
6000
4000
2000
0
0
15
25
otherCharge







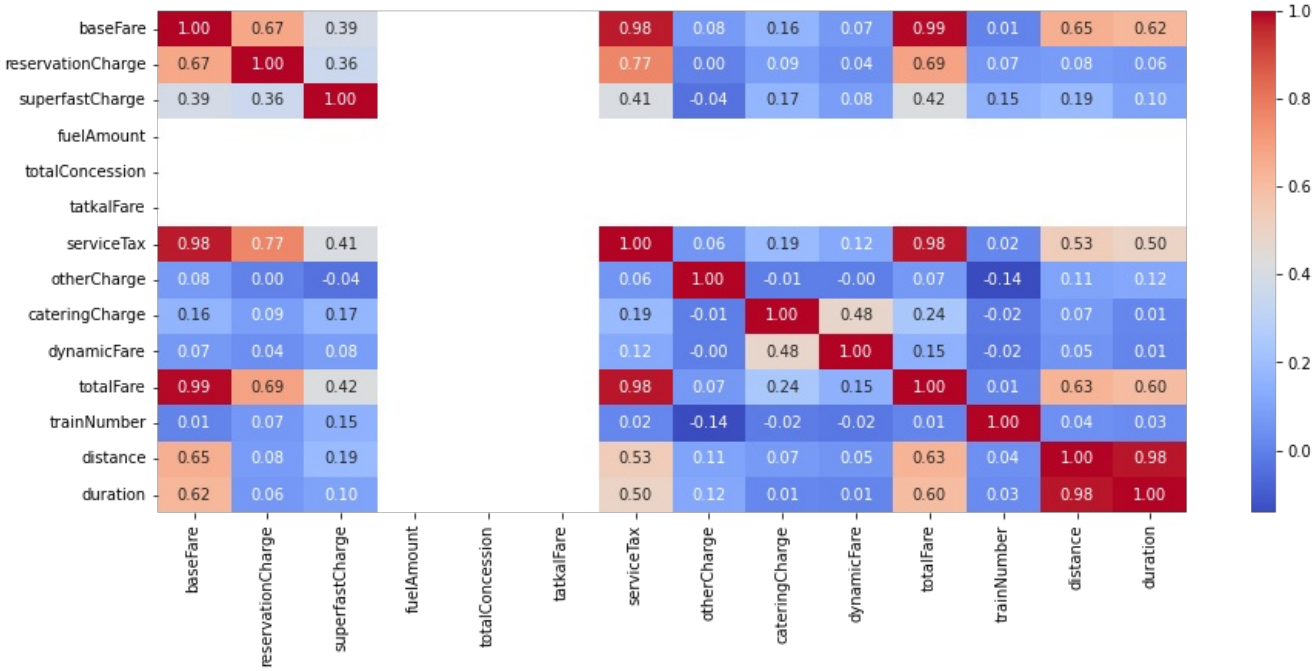
In [37]:
```
correlation_matrix = df.corr()
```

In [38]:
```
correlation_matrix
```

Out[38]:

	baseFare	reservationCharge	superfastCharge	fuelAmount	totalConcession	tatkalFare	serviceTax	otherCharge	cateringC
baseFare	1.000000	0.673303	0.390930	NaN	NaN	NaN	0.977310	0.075733	0.1
reservationCharge	0.673303	1.000000	0.356367	NaN	NaN	NaN	0.766696	0.003403	0.0
superfastCharge	0.390930	0.356367	1.000000	NaN	NaN	NaN	0.411748	-0.042521	0.1
fuelAmount	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
totalConcession	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
tatkalFare	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
serviceTax	0.977310	0.766696	0.411748	NaN	NaN	NaN	1.000000	0.058940	0.1
otherCharge	0.075733	0.003403	-0.042521	NaN	NaN	NaN	0.058940	1.000000	-0.0
cateringCharge	0.164796	0.085607	0.167257	NaN	NaN	NaN	0.186007	-0.006123	1.0
dynamicFare	0.067645	0.036815	0.083361	NaN	NaN	NaN	0.122862	-0.004500	0.4
totalFare	0.994863	0.685292	0.424102	NaN	NaN	NaN	0.981640	0.071453	0.2
trainNumber	0.005852	0.065096	0.150937	NaN	NaN	NaN	0.017397	-0.142707	-0.0
distance	0.650017	0.077533	0.186578	NaN	NaN	NaN	0.526907	0.105292	0.0
duration	0.624673	0.064718	0.098778	NaN	NaN	NaN	0.499302	0.119933	0.0

In [39]:
```
plt.figure(figsize=(15, 6))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt=".2f")
plt.show()
```



In [40]:
```
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.preprocessing import StandardScaler, OneHotEncoder
from sklearn.compose import ColumnTransformer
from sklearn.pipeline import Pipeline
from sklearn.metrics import mean_squared_error, r2_score
```

In [41]:
```
X = df[['classCode', 'availability', 'timeStamp', 'fromStnCode', 'toStnCode',
        'reservationCharge', 'superfastCharge', 'fuelAmount', 'totalConcession',
        'tatkalFare', 'otherCharge', 'baseFare', 'serviceTax', 'cateringCharge',
        'dynamicFare', 'trainNumber', 'distance', 'duration']]
```

In [42]:
```
y = df['totalFare']
```

In [43]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

In [44]:
```
numeric_features = ['reservationCharge', 'superfastCharge', 'fuelAmount', 'totalConcession',
                    'tatkalFare', 'otherCharge', 'baseFare', 'serviceTax', 'cateringCharge',
                    'dynamicFare', 'trainNumber', 'distance', 'duration']

categorical_features = ['classCode', 'availability', 'fromStnCode', 'toStnCode']
```

In [45]:
```
numeric_transformer = Pipeline(steps=[
    ('scaler', StandardScaler())
])

categorical_transformer = Pipeline(steps=[
```

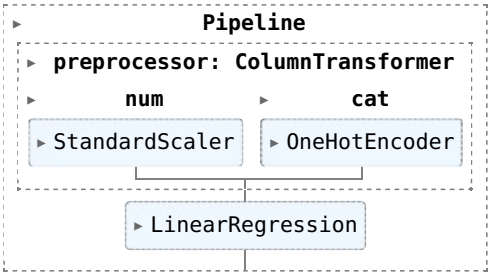
```
    ('onehot', OneHotEncoder(handle_unknown='ignore'))
])
```

In [46]:
```
preprocessor = ColumnTransformer(
    transformers=[
        ('num', numeric_transformer, numeric_features),
        ('cat', categorical_transformer, categorical_features)
    ])
```

In [47]:
```
model_lr = Pipeline(steps=[
    ('preprocessor', preprocessor),
    ('regressor', LinearRegression())
])
```

In [48]:
```
model_lr.fit(X_train, y_train)
```

Out[48]:

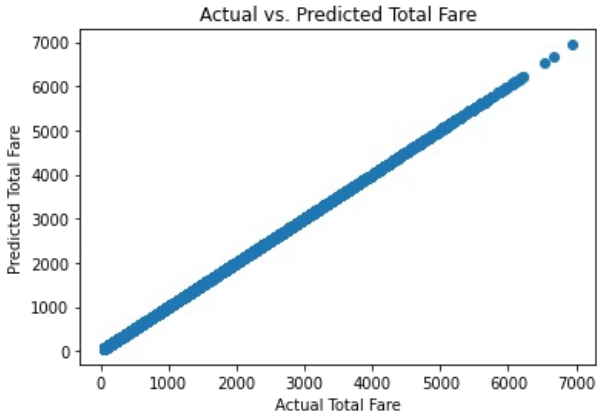


In [49]:
```
y_pred = model_lr.predict(X_test)
```

In [50]:
```
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)

print(f'Mean Squared Error: {mse}')
print(f'R-squared: {r2}')
```

```
Mean Squared Error: 0.0636917967886374
R-squared: 0.9999999160165995
```

In [51]:
```
plt.scatter(y_test, y_pred)
plt.xlabel('Actual Total Fare')
plt.ylabel('Predicted Total Fare')
plt.title('Actual vs. Predicted Total Fare')
plt.show()
```



In [52]:
```
correlation_matrix = X.corr().abs()
```

In [53]:
```
upper_triangle = correlation_matrix.where(np.triu(np.ones(correlation_matrix.shape), k=1).astype(np.bool))
```

In [54]:
```
correlated_features = [column for column in upper_triangle.columns if any(upper_triangle[column] > 0.75)]
```

In [55]:
```
X_filtered = X.drop(correlated_features, axis=1)
```

In [56]:
```
X_train, X_test, y_train, y_test = train_test_split(X_filtered, y, test_size=0.2, random_state=42)
```

In [57]:
```
numeric_features = list(X_filtered.select_dtypes(include=['float64', 'int64']).columns)
categorical_features = list(X_filtered.select_dtypes(include=['object']).columns)
```

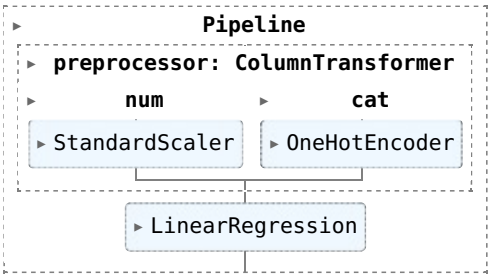
In [58]:
```
numeric_transformer = Pipeline(steps=[
    ('scaler', StandardScaler())
])

categorical_transformer = Pipeline(steps=[
    ('onehot', OneHotEncoder(handle_unknown='ignore'))
])
```

In [59]:
```
preprocessor = ColumnTransformer(
    transformers=[
        ('num', numeric_transformer, numeric_features),
        ('cat', categorical_transformer, categorical_features)
    ])
```

In [60]:
```
model_lr_ = Pipeline(steps=[
    ('preprocessor', preprocessor),
    ('regressor', LinearRegression())
])
```

In [61]:
```
model_lr_.fit(X_train, y_train)
```

Out[61]:

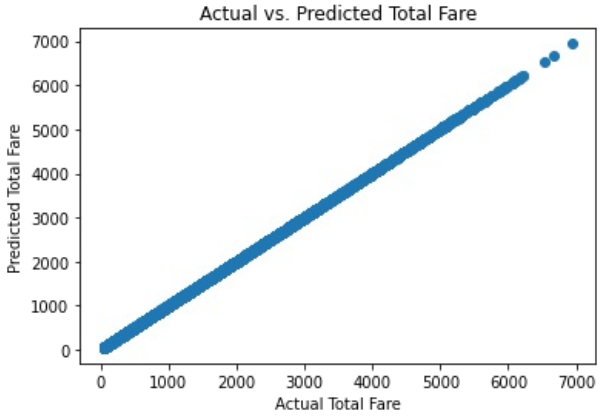


In [62]:
```
y_pred = model_lr_.predict(X_test)
```

In [63]:
```
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)

print(f'Mean Squared Error: {mse}')
print(f'R-squared: {r2}')
```

```
Mean Squared Error: 3.7379905707774577
R-squared: 0.9999950711210074
```

In [64]:
```
plt.scatter(y_test, y_pred)
plt.xlabel('Actual Total Fare')
plt.ylabel('Predicted Total Fare')
plt.title('Actual vs. Predicted Total Fare')
plt.show()
```



In [65]:
```
df_new = df.copy()
```

In [68]:
```
import ast
```

In [69]:
```
df_new['availability'] = df_new['availability'].apply(ast.literal_eval)
```

In [70]:
```
df_new['availability_date'] = df_new['availability'].apply(lambda x: [entry['date'] for entry in x])
```

In [71]:
```
df_new['availability_date']
```

Out[71]:
```
0         [2-12-2023, 3-12-2023, 5-12-2023, 6-12-2023, 7...
1         [2-12-2023, 3-12-2023, 5-12-2023, 6-12-2023, 7...
2         [2-12-2023, 3-12-2023, 5-12-2023, 6-12-2023, 7...
3         [2-12-2023, 3-12-2023, 5-12-2023, 6-12-2023, 7...
4         [2-12-2023, 3-12-2023, 5-12-2023, 6-12-2023, 7...
                                ...
326638    [26-11-2023, 28-11-2023, 30-11-2023, 2-12-2023...
326639    [7-12-2023, 9-12-2023, 10-12-2023, 12-12-2023,...
326640    [17-12-2023, 19-12-2023, 21-12-2023, 23-12-202...
326641    [28-12-2023, 30-12-2023, 31-12-2023, 2-1-2024,...
326642    [7-1-2024, 9-1-2024, 11-1-2024, 13-1-2024, 14-...
Name: availability_date, Length: 326643, dtype: object
```

In [72]:
```
df_new['availability_status'] = df_new['availability'].apply(lambda x: [entry['status'] for entry in x])
```

In [73]:
```
df_new['availability_status']
```

In [73]:
```
df_new['availability_status']
```

Out[73]:
```
0         [AVAILABLE-0008, AVAILABLE-0014, AVAILABLE-001...
1         [AVAILABLE-0020, AVAILABLE-0026, AVAILABLE-002...
2         [AVAILABLE-0136, AVAILABLE-0192, AVAILABLE-018...
3         [AVAILABLE-0090, AVAILABLE-0101, AVAILABLE-010...
4         [AVAILABLE-0008, AVAILABLE-0014, AVAILABLE-001...
                                ...
326638    [RLWL9/WL9, AVAILABLE-0005, RLWL2/WL2, RLWL3/W...
326639    [RLWL3/WL3, AVAILABLE-0006, AVAILABLE-0003, AV...
326640    [AVAILABLE-0006, AVAILABLE-0006, AVAILABLE-000...
326641    [AVAILABLE-0006, AVAILABLE-0005, AVAILABLE-000...
326642    [AVAILABLE-0006, AVAILABLE-0006, AVAILABLE-000...
Name: availability_status, Length: 326643, dtype: object
```

In [74]:
```
df_new['is_overnight'] = df_new['duration'] > 23
```

In [76]:
```
import re
```

In [77]:
```
waiting_pattern = re.compile(r'RLWL(\d+)/WL(\d+)')
```

In [78]:
```
df_new['has_waiting_ticket'] = df_new['availability_status'].apply(lambda x: any(waiting_pattern.match(status)
```

In [79]:
```
df_new['has_waiting_ticket']
```

Out[79]:
```
0         False
1         False
2         False
3         False
4         False
          ...
326638     True
326639     True
326640    False
326641    False
326642    False
Name: has_waiting_ticket, Length: 326643, dtype: bool
```

In [80]:
```
df_new['priority'] = (df_new['is_overnight'] & df_new['has_waiting_ticket']).astype(int)
```

In [81]:
```
df_new['priority']
```

Out[81]:
```
0         0
1         0
2         0
3         0
4         0
         ..
326638    1
326639    1
326640    0
326641    0
326642    0
Name: priority, Length: 326643, dtype: int32
```

In [82]:
```
df_priority = df_new[['availability', 'availability_date', 'availability_status', 'duration', 'is_overnight', '
```

In [83]:
```
df_priority
```

Out[83]:

	availability	availability_date	availability_status	duration	is_overnight	has_waiting_ticket	priority
0	[{'date': '2-12-2023', 'status': 'AVAILABLE-00...	[2-12-2023, 3-12-2023, 5-12-2023, 6-12-2023, 7...	[AVAILABLE-0008, AVAILABLE-0014, AVAILABLE-001...	33	True	False	0
1	[{'date': '2-12-2023', 'status': 'AVAILABLE-00...	[2-12-2023, 3-12-2023, 5-12-2023, 6-12-2023, 7...	[AVAILABLE-0020, AVAILABLE-0026, AVAILABLE-002...	33	True	False	0
2	[{'date': '2-12-2023', 'status': 'AVAILABLE-01...	[2-12-2023, 3-12-2023, 5-12-2023, 6-12-2023, 7...	[AVAILABLE-0136, AVAILABLE-0192, AVAILABLE-018...	33	True	False	0
3	[{'date': '2-12-2023', 'status': 'AVAILABLE-00...	[2-12-2023, 3-12-2023, 5-12-2023, 6-12-2023, 7...	[AVAILABLE-0090, AVAILABLE-0101, AVAILABLE-010...	33	True	False	0
4	[{'date': '2-12-2023', 'status': 'AVAILABLE-00...	[2-12-2023, 3-12-2023, 5-12-2023, 6-12-2023, 7...	[AVAILABLE-0008, AVAILABLE-0014, AVAILABLE-001...	49	True	False	0
...	...	...	...	...	...	...	...
326638	[{'date': '26-11-2023', 'status': 'RLWL9/WL9'}...	[26-11-2023, 28-11-2023, 30-11-2023, 2-12-2023...	[RLWL9/WL9, AVAILABLE-0005, RLWL2/WL2, RLWL3/W...	570	True	True	1
326639	[{'date': '7-12-2023', 'status': 'RLWL3/WL3'},...	[7-12-2023, 9-12-2023, 10-12-2023, 12-12-2023,...	[RLWL3/WL3, AVAILABLE-0006, AVAILABLE-0003, AV...	570	True	True	1
326640	[{'date': '17-12-2023', 'status': 'AVAILABLE-0...	[17-12-2023, 19-12-2023, 21-12-2023, 23-12-202...	[AVAILABLE-0006, AVAILABLE-0006, AVAILABLE-000...	570	True	False	0
326641	[{'date': '28-12-2023', 'status': 'AVAILABLE-0...	[28-12-2023, 30-12-2023, 31-12-2023, 2-1-2024,...	[AVAILABLE-0006, AVAILABLE-0005, AVAILABLE-000...	570	True	False	0
326642	[{'date': '7-1-2024', 'status': 'AVAILABLE-000...	[7-1-2024, 9-1-2024, 11-1-2024, 13-1-2024, 14-...	[AVAILABLE-0006, AVAILABLE-0006, AVAILABLE-000...	570	True	False	0

326643 rows × 7 columns

Thanks !!!