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

```
df=pd.read_csv("Delhi-Metro-Network.csv")
```

```
df.head(5)
```

	Station ID	Station Name	Distance from Start (km)	Line	Opening Date	Station Layout	Latitude	Longitude
0	1	Jhil Mil	10.3	Red line	2008-04-06	Elevated	28.675790	77.312390
1	2	Welcome [Conn: Red]	46.8	Pink line	2018-10-31	Elevated	28.671800	77.277560

```
#preprocessing data
```

```
missin_val=df.isnull().sum()
```

```
missin_val
```

```
Station ID                 0
Station Name               0
Distance from Start (km)   0
Line                       0
Opening Date               0
Station Layout             0
Latitude                   0
Longitude                  0
dtype: int64
```

```
df.describe()
```

	Station ID	Distance from Start (km)	Latitude	Longitude
count	285.000000	285.000000	285.000000	285.000000
mean	143.000000	19.218947	28.595428	77.029315
std	82.416625	14.002862	0.091316	2.875400
min	1.000000	0.000000	27.920862	28.698807
25%	72.000000	7.300000	28.545828	77.107130
50%	143.000000	17.400000	28.613453	77.207220
75%	214.000000	28.800000	28.666360	77.281165
max	285.000000	52.700000	28.878965	77.554479

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 285 entries, 0 to 284
Data columns (total 8 columns):
 #   Column                   Non-Null Count  Dtype
---  ------                   --------------  -----
 0   Station ID               285 non-null    int64
 1   Station Name             285 non-null    object
 2   Distance from Start (km) 285 non-null    float64
 3   Line                     285 non-null    object
 4   Opening Date             285 non-null    object
 5   Station Layout           285 non-null    object
 6   Latitude                 285 non-null    float64
 7   Longitude                285 non-null    float64
dtypes: float64(3), int64(1), object(4)
memory usage: 17.9+ KB
```

```
df['Opening Date'] = pd.to_datetime(df['Opening Date'])
```

```
df['Opening Date'].sample(5)
```

```
199   2018-03-14
32    2010-03-10
74    2019-09-03
276   2017-12-25
46    2018-03-14
Name: Opening Date, dtype: datetime64[ns]
```

```
df['Line'].value_counts()
```

```
Blue line            49
Pink line            38
Yellow line          37
Voilet line          34
Red line             29
Magenta line         25
Aqua line            21
Green line           21
Rapid Metro          11
Blue line branch      8
Orange line           6
Gray line             3
Green line branch     3
Name: Line, dtype: int64
```

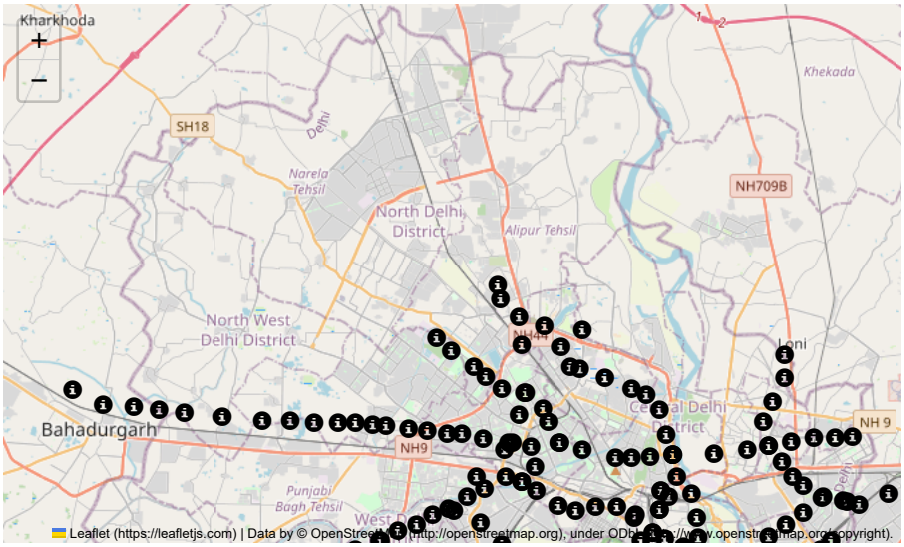
```
#Defining color schemas to represent my 13 metro lines
line_colors = {
    'Red line': 'red',
    'Blue line': 'blue',
    'Yellow line': 'magenta',
    'Green line': 'green',
    'Voilet line': 'purple',
    'Pink line': 'pink',
    'Magenta line': 'teal',
    'Orange line': 'peach',
    'Rapid Metro': 'violet',
    'Aqua line': 'black',
    'Green line branch': 'lightgreen',
    'Blue line branch': 'lavender',
    'Gray line': 'cyan'
}
```

```
Dmap = fo.Map(location=[28, 77.1025], zoom_start=11)
```

```
for index, row in df.iterrows():
    line = row['Line']
    color = line_colors.get(line, 'black')
    fo.Marker(
        location=[row['Latitude'], row['Longitude']],
        popup=f"{row['Station Name']}",
        tooltip=f"{row['Station Name']}, {line}",
        icon=fo.Icon(color=color)
    ).add_to(Dmap)
```

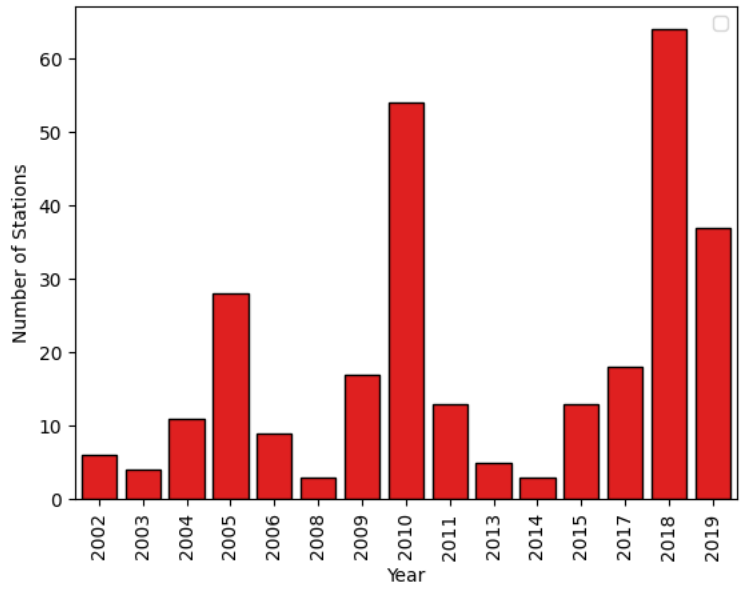
```
<ipython-input-62-e16be9d23289>:8: UserWarning: color argument of Icon should be one of: {'lightgray', 'white', 'orange', 'blue', 'light
  icon=fo.Icon(color=color)
```

```
Dmap
```




```
# Temporal Analysis of growth of stations over years

import matplotlib.colors as colors

df['Opening Year'] = df['Opening Date'].dt.year
stations = df['Opening Year'].value_counts().sort_index()

stationsdf=stations.reset_index()
stationsdf.columns = ['Year', 'Number of Stations']


sns.barplot(data=stationsdf,x='Year',y='Number of Stations',edgecolor='black',color='red')
plt.xticks(rotation=90)
plt.gca().margins(x=0.01)
plt.legend()
```

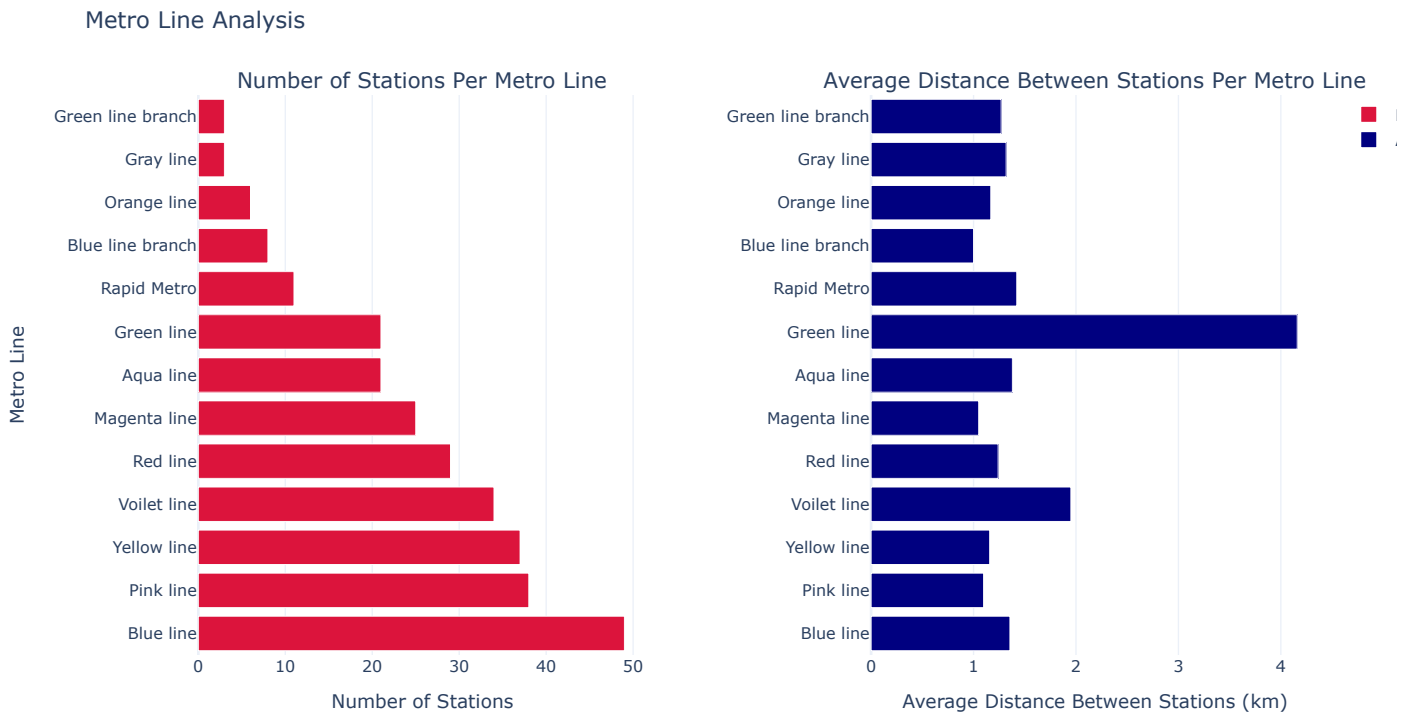
```
WARNING:matplotlib.legend:No artists with labels found to put in legend.  Note that arti
<matplotlib.legend.Legend at 0x7b404e51fa30>
```




```
st = df['Line'].value_counts()

total_dist_per_line = df.groupby('Line')['Distance from Start (km)'].max()

avg_dist_per_line = total_dist_per_line / (st - 1)

line_analysis = pd.DataFrame({
    'Line': st.index,
    'Number of Stations': st.values,
    'Average Distance Between Stations (km)': avg_dist_per_line
})

# sorting the DataFrame by the number of stations
line_analysis = line_analysis.sort_values(by='Number of Stations', ascending=False)

line_analysis.reset_index(drop=True, inplace=True)
print(line_analysis)
```

```
                 Line  Number of Stations  \
0          Blue line                  49
1          Pink line                  38
2        Yellow line                  37
3        Voilet line                  34
4           Red line                  29
5       Magenta line                  25
6          Aqua line                  21
7         Green line                  21
8        Rapid Metro                  11
9    Blue line branch                   8
10       Orange line                   6
11         Gray line                   3
12  Green line branch                   3

    Average Distance Between Stations (km)
0                                1.355000
1                                1.097917
2                                1.157143
3                                1.950000
4                                1.240000
5                                1.050000
6                                1.379167
7                                4.160000
8                                1.421622
9                                1.000000
10                               1.167857
11                               1.318182
12                               1.269444
```

```
import pandas as pd
import folium
import plotly.express as px
import plotly.graph_objects as go
from plotly.subplots import make_subplots
import plotly.io as pio


fig = make_subplots(rows=1, cols=2, subplot_titles=('Number of Stations Per Metro Line',
                                                    'Average Distance Between Stations Per Metro Line'),
                    horizontal_spacing=0.2)

fig.add_trace(
    go.Bar(y=line_analysis['Line'], x=line_analysis['Number of Stations'],
           orientation='h', name='Number of Stations', marker_color='crimson'),
    row=1, col=1
)

# plot for Average Distance Between Stations
fig.add_trace(
    go.Bar(y=line_analysis['Line'], x=line_analysis['Average Distance Between Stations (km)'],
           orientation='h', name='Average Distance (km)', marker_color='navy'),
    row=1, col=2
)

# update xaxis properties
fig.update_xaxes(title_text="Number of Stations", row=1, col=1)
fig.update_xaxes(title_text="Average Distance Between Stations (km)", row=1, col=2)

# update yaxis properties
fig.update_yaxes(title_text="Metro Line", row=1, col=1)
fig.update_yaxes(title_text="", row=1, col=2)

# update layout
fig.update_layout(height=600, width=1200, title_text="Metro Line Analysis", template="plotly_white")

fig.show()
```




```
layout_counts = df['Station Layout'].value_counts()
```

```
# creating the bar plot using Plotly
fig = px.bar(x=layout_counts.index, y=layout_counts.values,
             labels={'x': 'Station Layout', 'y': 'Number of Stations'},
             title='Distribution of Delhi Metro Station Layouts',
             color=layout_counts.index,
             color_continuous_scale='rainbow')

# updating layout for better presentation
fig.update_layout(xaxis_title="Station Layout",
                  yaxis_title="Number of Stations",
                  coloraxis_showscale=True,
                  template="plotly_white")

fig.show()
```