US_Accidents_Exploratory_Data_Analysis

Steps to follow

- Select a large real_world (more then 2.5M Records) dataset from kaggle
- Perform data preparation & cleaning using Pandas & Numpy
- Perform exploratory analysis & visualization using Matplotlib & Seaborn
- Ask & answer questions about the data in a jupyter notebook
- Summarize your inferences & write a conclusion

Questions to ask from this dataset

- 1) Which 5 states have the highest number of accidents?
- 2) Top 100 cities in number of accidents
- 3) What time of the day are accidents most frequent in ?
- 4) Which days of the week have the most accidents ?
- 5) Which months have the most accidents?
- 6) What is the trend of accidents year over year (decreasing/increasing) ?

Data Preparation and Cleaning

- Load the file using Pandas
- Look at some information about the data & the columns
- Fix any missing or incorrect values

Import required libraries

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

In [4]:
```
df= pd.read_csv(r"G:\Udemy\DATA SCIENCE ineuron\EDA\US_Accidents_Dec21_updated.csv")
```

In [3]:
```
df.head()
```

In [3]:
```python
df.head()
```

Out[3]:

	ID	Severity	Start_Time	End_Time	Start_Lat	Start_Lng	End_Lat	End_Lng	Distance(mi)	Description	...	Roundabo
0	A-1	3	2016-02-08 00:37:08	2016-02-08 06:37:08	40.108910	-83.092860	40.112060	-83.031870	3.230	Between Sawmill Rd/Exit 20 and OH-315/Olentang...	...	Fal
1	A-2	2	2016-02-08 05:56:20	2016-02-08 11:56:20	39.865420	-84.062800	39.865010	-84.048730	0.747	At OH-4/OH-235/Exit 41 - Accident.	...	Fal
2	A-3	2	2016-02-08 06:15:39	2016-02-08 12:15:39	39.102660	-84.524680	39.102090	-84.523960	0.055	At I-71/US-50/Exit 1 - Accident.	...	Fal
3	A-4	2	2016-02-08 06:51:45	2016-02-08 12:51:45	41.062130	-81.537840	41.062170	-81.535470	0.123	At Dart Ave/Exit 21 - Accident.	...	Fal
4	A-5	3	2016-02-08 07:53:43	2016-02-08 13:53:43	39.172393	-84.492792	39.170476	-84.501798	0.500	At Mitchell Ave/Exit 6 - Accident.	...	Fal

5 rows × 47 columns

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

Out[6]: (2845342, 47)

In [4]:
```python
len(df.columns)
```

Out[4]: 47

In [7]:
```python
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2845342 entries, 0 to 2845341
Data columns (total 47 columns):
 #   Column                 Dtype  
---  ------                 -----  
 0   ID                     object 
 1   Severity               int64  
 2   Start_Time             object 
 3   End_Time               object 
 4   Start_Lat              float64
 5   Start_Lng              float64
 6   End_Lat                float64
 7   End_Lng                float64
```

In [7]:

```python
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2845342 entries, 0 to 2845341
Data columns (total 47 columns):
 #   Column                 Dtype
---  ------                 -----
 0   ID                     object
 1   Severity               int64
 2   Start_Time             object
 3   End_Time               object
 4   Start_Lat              float64
 5   Start_Lng              float64
 6   End_Lat                float64
 7   End_Lng                float64
 8   Distance(mi)           float64
 9   Description            object
 10  Number                 float64
 11  Street                 object
 12  Side                   object
 13  City                   object
 14  County                 object
 15  State                  object
 16  Zipcode                object
 17  Country                object
 18  Timezone               object
 19  Airport_Code           object
 20  Weather_Timestamp      object
 21  Temperature(F)         float64
 22  Wind_Chill(F)          float64
 23  Humidity(%)            float64
 24  Pressure(in)           float64
 25  Visibility(mi)         float64
 26  Wind_Direction         object
 27  Wind_Speed(mph)        float64
 28  Precipitation(in)      float64
 29  Weather_Condition      object
 30  Amenity                bool
 31  Bump                   bool
 32  Crossing               bool
 33  Give_Way               bool
 34  Junction               bool
 35  No_Exit                bool
 36  Railway                bool
 37  Roundabout             bool
 38  Station                bool
 39  Stop                   bool
 40  Traffic_Calming        bool
 41  Traffic_Signal         bool
```

In [8]:

```
df.describe().T
```

Out[8]:

	count	mean	std	min	25%	50%	75%	max
Severity	2845342.0	2.137572	0.478722	1.000000	2.000000	2.000000	2.000000	4.000000e+00
Start_Lat	2845342.0	36.245201	5.363797	24.566027	33.445174	36.098609	40.160243	4.900058e+01
Start_Lng	2845342.0	-97.114633	18.317819	-124.548074	-118.033113	-92.418076	-80.372431	-6.711317e+01
End_Lat	2845342.0	36.245321	5.363873	24.566013	33.446278	36.097987	40.161049	4.907500e+01
End_Lng	2845342.0	-97.114387	18.317632	-124.545748	-118.033331	-92.417718	-80.373383	-6.710924e+01
Distance(mi)	2845342.0	0.702678	1.560361	0.000000	0.052000	0.244000	0.764000	1.551860e+02
Number	1101431.0	8089.408114	18360.093995	0.000000	1270.000000	4007.000000	9567.000000	9.999997e+06
Temperature(F)	2776068.0	61.793556	18.622629	-89.000000	50.000000	64.000000	76.000000	1.960000e+02
Wind_Chill(F)	2375699.0	59.658231	21.160967	-89.000000	46.000000	63.000000	76.000000	1.960000e+02
Humidity(%)	2772250.0	64.365452	22.874568	1.000000	48.000000	67.000000	83.000000	1.000000e+02
Pressure(in)	2786142.0	29.472344	1.045286	0.000000	29.310000	29.820000	30.010000	5.890000e+01
Visibility(mi)	2774796.0	9.099391	2.717546	0.000000	10.000000	10.000000	10.000000	1.400000e+02
Wind_Speed(mph)	2687398.0	7.395044	5.527454	0.000000	3.500000	7.000000	10.000000	1.087000e+03
Precipitation(in)	2295884.0	0.007017	0.093488	0.000000	0.000000	0.000000	0.000000	2.400000e+01

In [5]:

```
# How many numeric columns in the dataset

numerics = ['int16', 'int32', 'int64', 'float16', 'float32', 'float64']

numeric_df = df.select_dtypes(include=numerics)
len(numeric_df.columns)

```

Out[5]: 14

Find the missing values

In [44]:

```
df.isna().sum().sort_values(ascending = False)[:10]
```

Out[44]:

```
Number               1743911
Precipitation(in)     549458
Wind_Chill(F)         469643
Wind_Speed(mph)       157944
Wind_Direction         73775
Humidity(%)            73092
```

Find the missing values

In [44]:
```
df.isna().sum().sort_values(ascending = False)[:10]
```

Out[44]:
```
Number                1743911
Precipitation(in)      549458
Wind_Chill(F)          469643
Wind_Speed(mph)        157944
Wind_Direction          73775
Humidity(%)             73092
Weather_Condition       70636
Visibility(mi)          70546
Temperature(F)          69274
Pressure(in)            59200
dtype: int64
```

Percentage of missing values per columns

In [45]:
```
missing_percentage = df.isna().sum().sort_values(ascending = False) / len(df)
missing_percentage[:10]
```

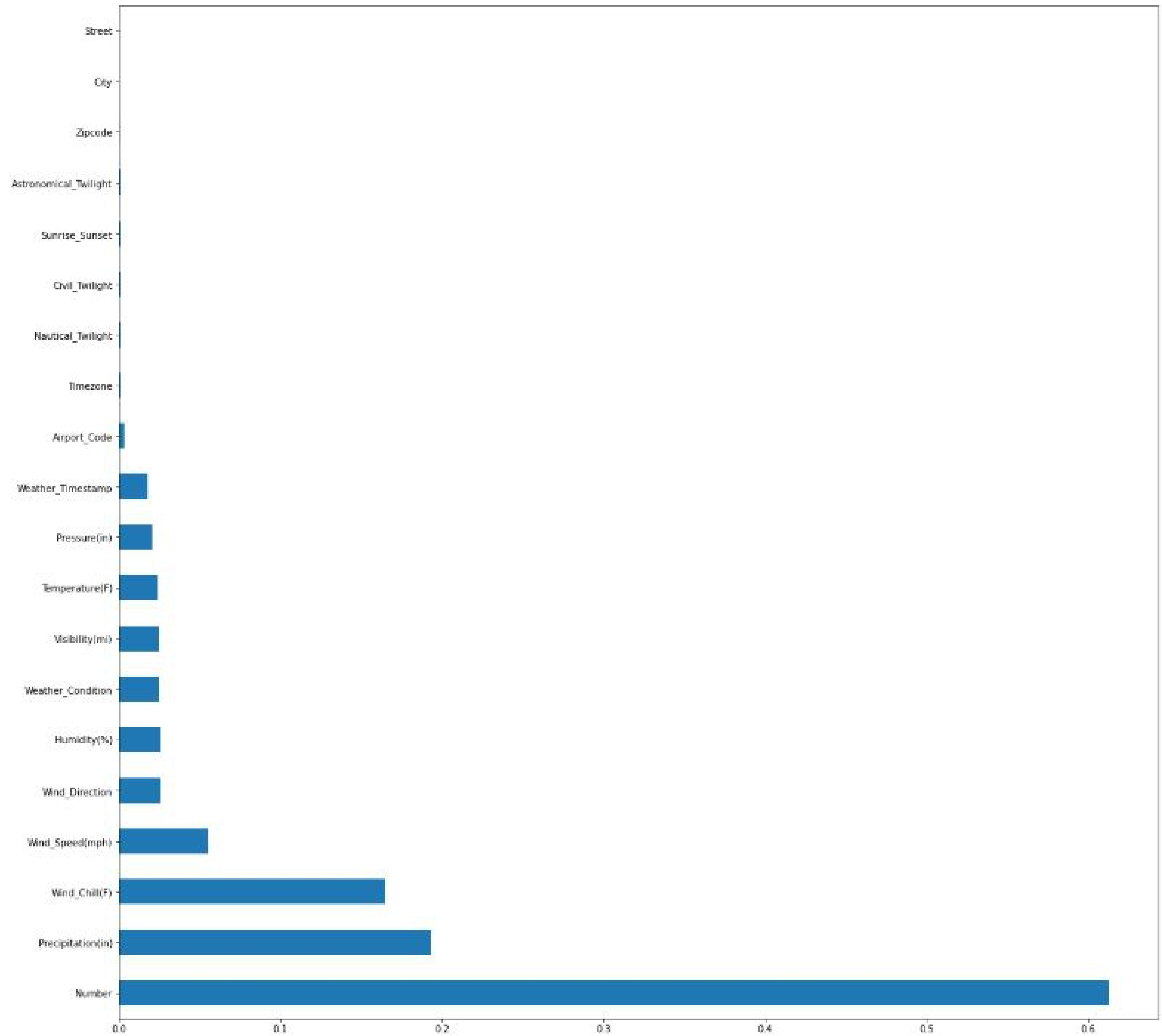
Out[45]:
```
Number               0.612900
Precipitation(in)    0.193108
Wind_Chill(F)        0.165057
Wind_Speed(mph)      0.055510
Wind_Direction       0.025928
Humidity(%)          0.025688
Weather_Condition    0.024825
Visibility(mi)       0.024794
Temperature(F)       0.024346
Pressure(in)         0.020806
dtype: float64
```

In [11]:
```
# Shows only those columns which has missing values

missing_percentage[missing_percentage !=0]
```

Out[11]:
```
Number                   6.129003e-01
Precipitation(in)        1.931079e-01
Wind_Chill(F)            1.650568e-01
Wind_Speed(mph)          5.550967e-02
Wind_Direction           2.592834e-02
Humidity(%)              2.568830e-02
Weather_Condition        2.482514e-02
Visibility(mi)           2.479350e-02
Temperature(F)           2.434646e-02
Pressure(in)             2.080593e-02
```

In [12]:
```
missing_percentage[missing_percentage !=0].plot(kind = 'barh', figsize =(20,20))
```
Out[12]: <AxesSubplot:>



Columns we will analyse

1. City
2. Start_Time
3. Start_Lat, Start_Lng
4. Temperature
5. Weather_Condition

In [12]:
```
cities = df.City.unique()
len(cities)
```

Out[12]:
```
11682
```

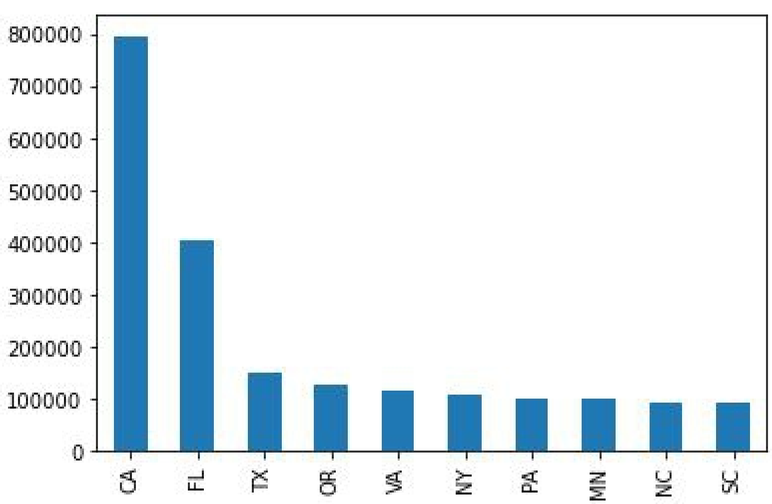
Answer of Questions

1) Which 5 states have the highest number of accidents?

In [6]:
```
states_by_accident = df['State'].value_counts()[:10]
```

In [7]:
```
states_by_accident.plot(kind = 'bar')
```

Out[7]:
```
<AxesSubplot:>
```



- Observation

5 States having the highest number of accidents are

5 States having the highest number of accidents are

In [8]:
```
df['State'].value_counts()[:5]
```

Out[8]:
```
CA    795868
FL    401388
TX    149037
OR    126341
VA    113535
Name: State, dtype: int64
```

2) Top 100 cities in number of accidents

In [37]:
```
cities_by_accident = df.City.value_counts()
cities_by_accident[:20]
```

Out[37]:
```
Miami          106966
Los Angeles     68956
Orlando         54691
Dallas          41979
Houston         39448
Charlotte       33152
Sacramento      32559
San Diego       26627
Raleigh         22840
Minneapolis     22768
Portland        20944
Nashville       20267
Austin          18301
Baton Rouge     18182
Phoenix         17143
Saint Paul      16869
New Orleans     16251
Atlanta         15622
Jacksonville    14967
Richmond        14349
Name: City, dtype: int64
```

3) What time of the day are accidents most frequent in ?

In [16]:
```
df.Start_Time[0]
```

Out[16]: '2016-02-08 00:37:08'

3) What time of the day are accidents most frequent in ?

In [16]:
```
df.Start_Time[0]
```

Out[16]:
```
'2016-02-08 00:37:08'
```

In [17]:
```
df.Start_Time = pd.to_datetime(df.Start_Time)
```

In [18]:
```
# convert Datetime to hour

pd.DatetimeIndex(df['Start_Time']).hour
```

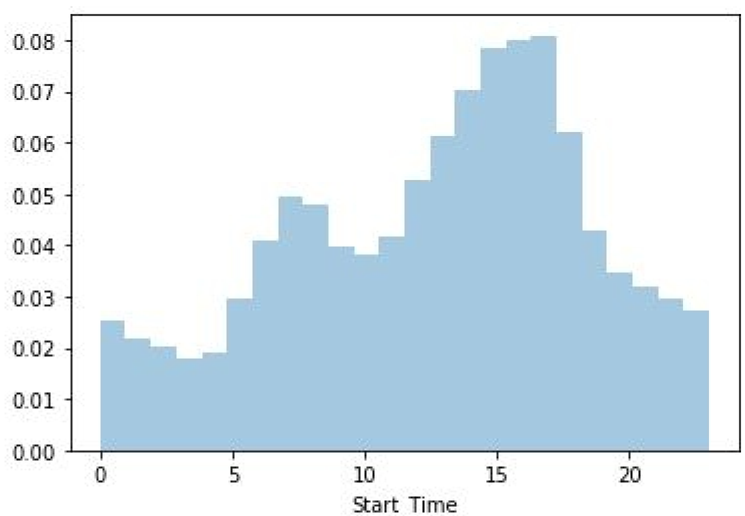
Out[18]:
```
Int64Index([ 0,  5,  6,  6,  7,  8,  8, 11, 14, 15,
            ...
            17, 17, 17, 17, 18, 18, 19, 19, 19, 18],
           dtype='int64', name='Start_Time', length=2845342)
```

In [12]:
```
# Plot Histogram

sns.distplot(pd.DatetimeIndex(df['Start_Time']).hour, bins = 24, kde = False, norm_hist= True)
```

```
C:\Users\SAHILJOSAN\anaconda3\lib\site-packages\seaborn\distributions.py:2619: FutureWarning: `distpl
ot` is a deprecated function and will be removed in a future version. Please adapt your code to use e
ither `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level funct
ion for histograms).
  warnings.warn(msg, FutureWarning)
```

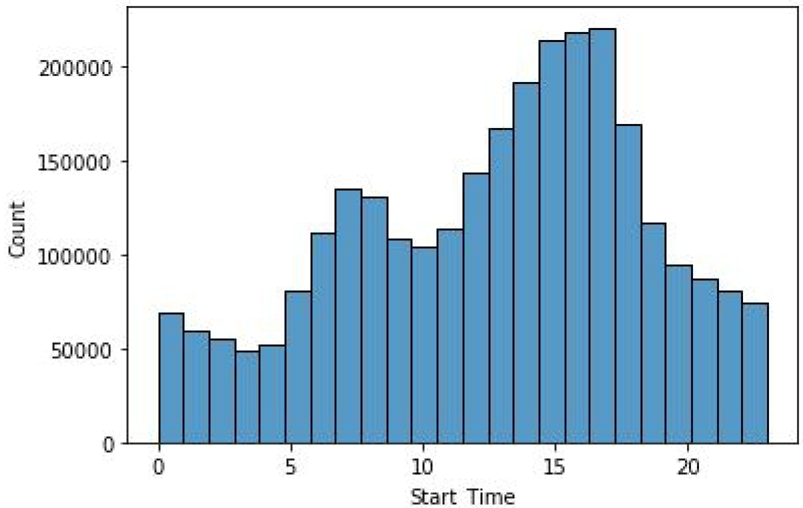
Out[12]:
```
<AxesSubplot:xlabel='Start_Time'>
```



At which time of the day highest accidents occur

In [94]:
```
1 sns.histplot(data = df, x = pd.DatetimeIndex(df['Start_Time']).hour, bins = 24)
```

Out[94]: <AxesSubplot:xlabel='Start_Time', ylabel='Count'>



- Observation

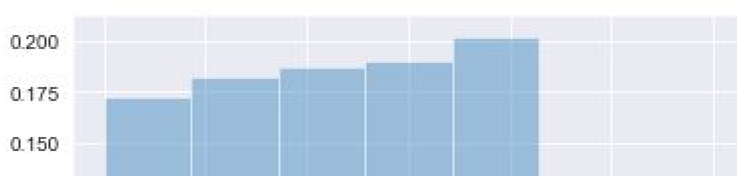
A high number of the accidents occur between 3 pm to 5 pm

Is the distribution of accidents by hour the same on weekends as on weekdays?

In [28]:
```
1 sns.distplot(df.Start_Time.dt.dayofweek, bins = 7, kde = False, norm_hist= True)
```

```
C:\Users\SAHILJOSAN\anaconda3\lib\site-packages\seaborn\distributions.py:2619: FutureWarning: `distpl
ot` is a deprecated function and will be removed in a future version. Please adapt your code to use e
ither `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level funct
ion for histograms).
  warnings.warn(msg, FutureWarning)
```

Out[28]: <AxesSubplot:xlabel='Start_Time'>



Is the distribution of accidents by hour the same on weekends as on weekdays?

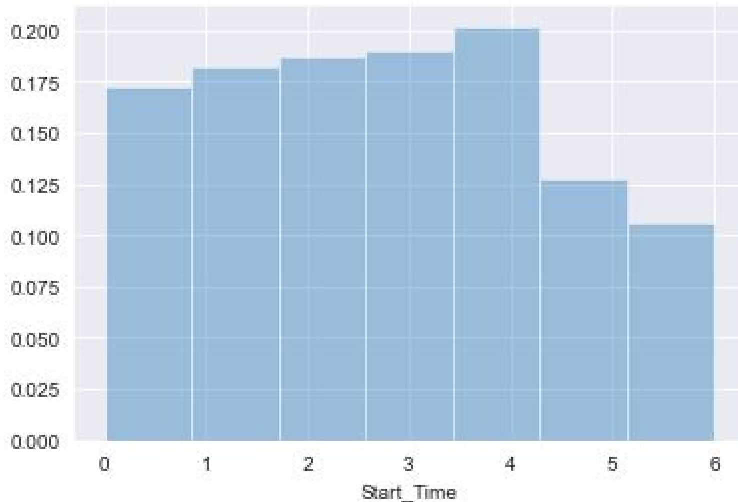
In [28]:

```
sns.distplot(df.Start_Time.dt.dayofweek, bins = 7, kde = False, norm_hist= True)
```

```
C:\Users\SAHILJOSAN\anaconda3\lib\site-packages\seaborn\distributions.py:2619: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

Out[28]:

```
<AxesSubplot:xlabel='Start_Time'>
```



- Observation

  ### From the graph it is seen that on weekdays more number of accidents occur compare to weekends

Over 1110 cities have reported just 1 accident (need to investigate)

In [29]:

```
cities_by_accident[cities_by_accident == 1]
```

Out[29]:

```
Carney                          1
Waverly Hall                    1
Center Sandwich                 1
Glen Flora                      1
Sulphur Springs                 1
                               ..
```

```
Sulphur Springs                1
                              ..
Ridgedale                      1
Sekiu                          1
Wooldridge                     1
Bullock                        1
American Fork-Pleasant Grove   1
Name: City, Length: 1110, dtype: int64
```

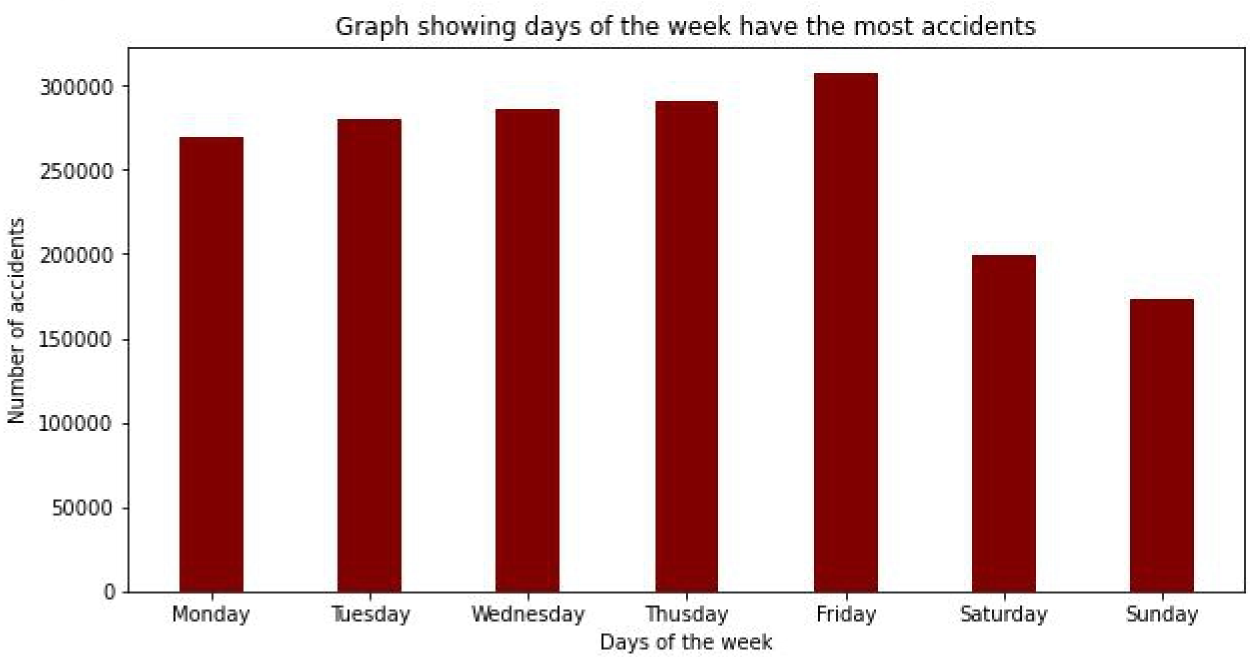
4) Which days of the week have the most accidents ?

In [34]:

```python
fig = plt.figure(figsize = (10, 5))

# creating the bar plot
plt.bar(days,list_days_of_the_week, color ='maroon',width = 0.4)

plt.xlabel("Days of the week")
plt.ylabel("Number of accidents")
plt.title("Graph showing days of the week have the most accidents")
plt.show()
```



- Observation

Maximum number of accidents occurs on Fridays

In [20]:

```python
list_days_of_the_week = []
for i in range(0,7):
    list_days_of_the_week.append(len(df.Start_Time[df.Start_Time.dt.dayofweek == (i)].unique()))
list_days_of_the_week
```

Out[20]:

```
[268929, 280241, 286551, 291495, 307609, 198976, 173510]
```

In [28]:

```python
days = ["Monday","Tuesday","Wednesday","Thusday","Friday","Saturday","Sunday"]
days
```

Out[28]:

```
['Monday', 'Tuesday', 'Wednesday', 'Thusday', 'Friday', 'Saturday', 'Sunday']
```

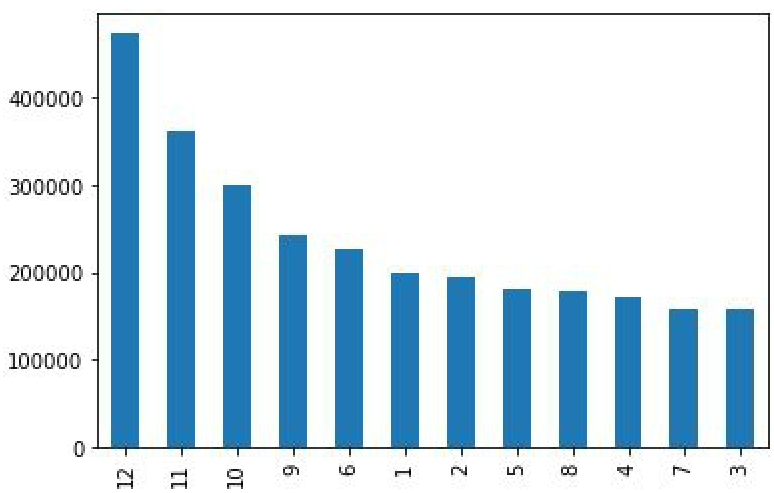
5) Which months have the most accidents?

In [44]:

```python
df.Start_Time.dt.month.value_counts().plot(kind = "bar")
```

Out[44]:

```
<AxesSubplot:>
```



6) What is the trend of accidents year over year (decreasing/increasing) ?

In [38]:

```python
trend_of_accident = df.Start_Time.dt.year.value_counts()
trend_of_accident.plot(kind= "bar")
```

Out[38]:

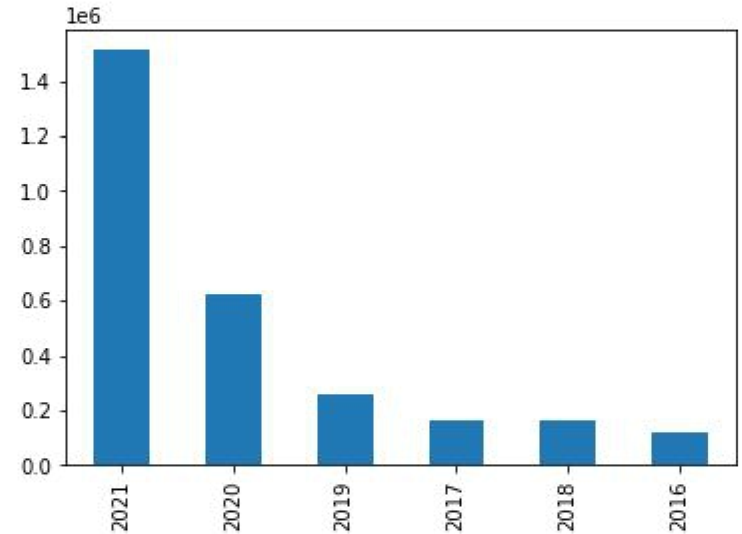
```
<AxesSubplot:>
```

6) What is the trend of accidents year over year (decreasing/increasing) ?

In [38]:

```
trend_of_accident = df.Start_Time.dt.year.value_counts()
trend_of_accident.plot(kind= "bar")
```

Out[38]: <AxesSubplot:>



In [86]:

```
df.Start_Time.dt.year.value_counts()
```

Out[86]:

```
2021    1511745
2020     625864
2019     258615
2017     163918
2018     163176
2016     122024
Name: Start_Time, dtype: int64
```

Accidents occur in the year 2019

In [78]:

```
# Data of 2019

df_2019 = df[df.Start_Time.dt.year == 2019]
sns.distplot(df_2019.Start_Time.dt.month, bins = 12, kde = False, norm_hist = True)
```

```
C:\Users\SAHILJOSAN\anaconda3\lib\site-packages\seaborn\distributions.py:2619: FutureWarning: `distpl
ot` is a deprecated function and will be removed in a future version. Please adapt your code to use e
ither `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level funct
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  warnings.warn(msg, FutureWarning)
```
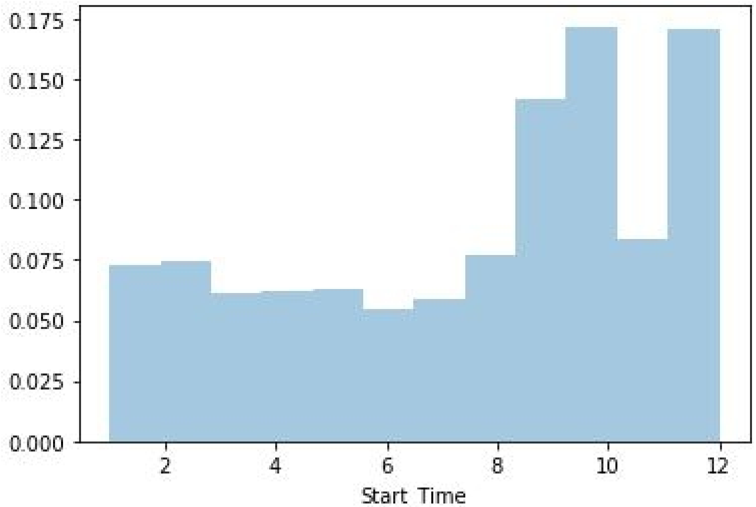



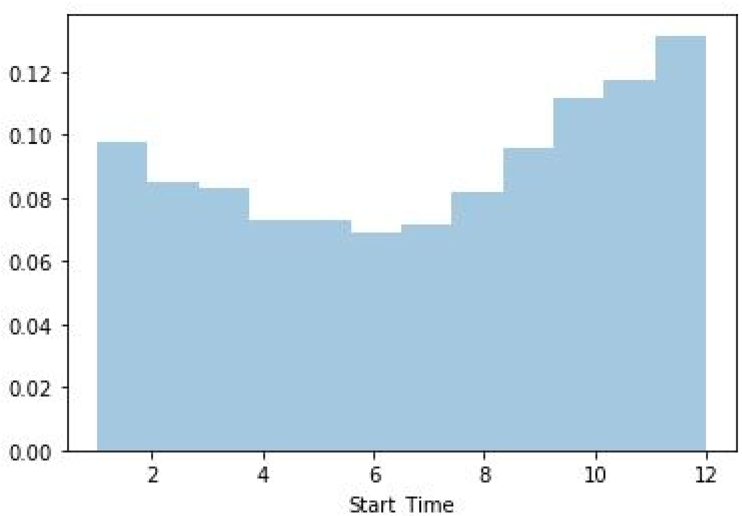
Accidents occur in the year 2018

In [79]:

```
# Data of 2018

df_2018 = df[df.Start_Time.dt.year == 2018]
sns.distplot(df_2018.Start_Time.dt.month, bins = 12, kde = False, norm_hist = True)
```

Out[79]:

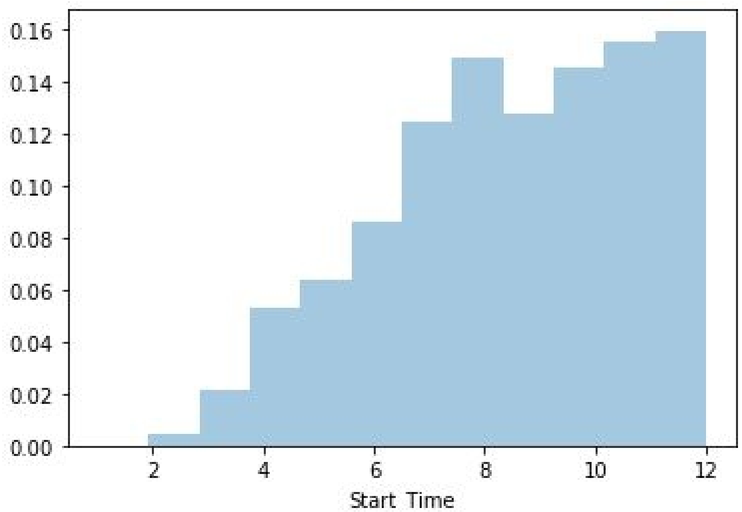
```
<AxesSubplot:xlabel='Start_Time'>
```



Accidents occur in the year 2016

In [80]:
```
# Data of 2016

df_2016 = df[df.Start_Time.dt.year == 2016]
sns.distplot(df_2016.Start_Time.dt.month, bins = 12, kde = False, norm_hist = True)
```

Out[80]:
```
<AxesSubplot:xlabel='Start_Time'>
```



- Observation

  Much Data is missing for 2016. Maybe even 2017

High Accident Cities and low accident cities

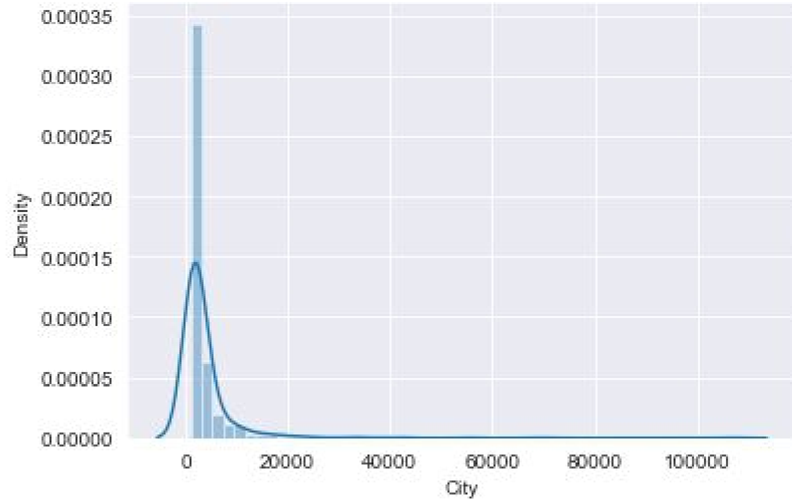
In [19]:
```
high_accident_cities = cities_by_accident[cities_by_accident >= 1000]
low_accident_cities = cities_by_accident[cities_by_accident < 1000]
```

In [20]:
```
len(high_accident_cities)
```

Out[20]:
```
496
```

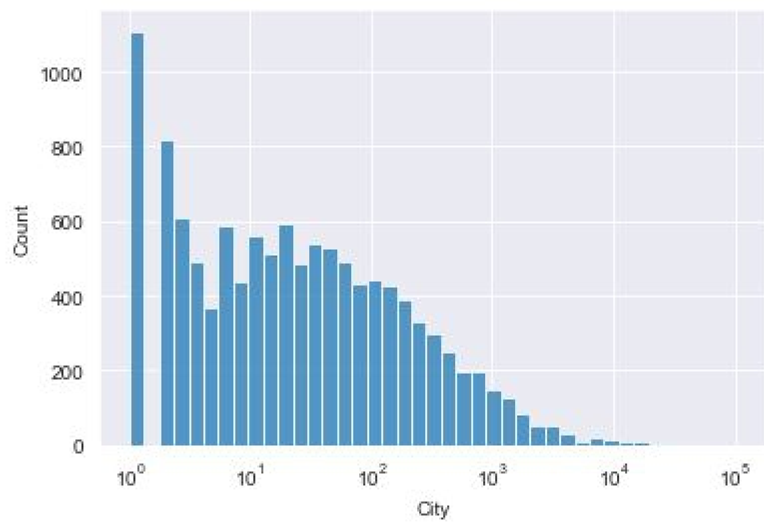
In [21]:
```
sns.distplot(high_accident_cities)
```

```
C:\Users\SAHILJOSAN\anaconda3\lib\site-packages\seaborn\distributions.py:2619: FutureWarning: `distpl
ot` is a deprecated function and will be removed in a future version. Please adapt your code to use e
ither `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level funct
```



In [22]:
```
sns.histplot(cities_by_accident, log_scale = True)
```

Out[22]: <AxesSubplot:xlabel='City', ylabel='Count'>



Analysis basis on Start Latitude & Longitude

In [28]:
```
df.Start_Lat[:5]
```

Out[28]:
```
0    40.108910
1    39.865420
2    39.102660
3    41.062130
4    39.172393
Name: Start_Lat, dtype: float64
```

Analysis basis on Start Latitude & Longitude

In [28]:
```
df.Start_Lat[:5]
```

Out[28]:
```
0    40.108910
1    39.865420
2    39.102660
3    41.062130
4    39.172393
Name: Start_Lat, dtype: float64
```

In [29]:
```
df.Start_Lng[:5]
```

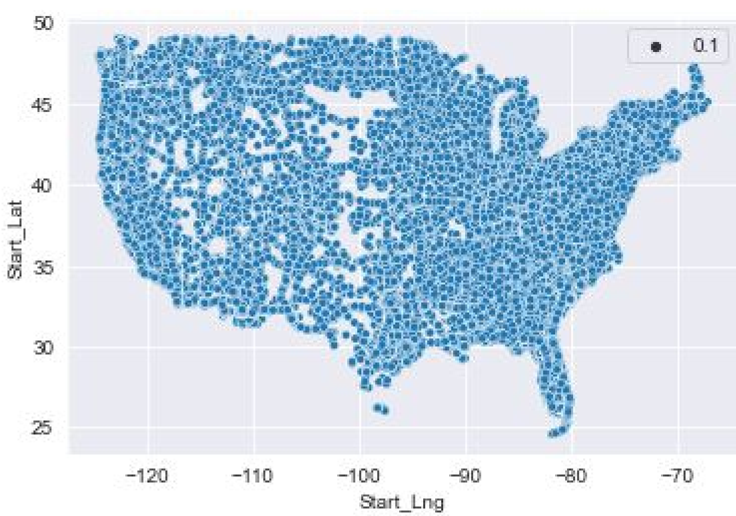
Out[29]:
```
0   -83.092860
1   -84.062800
2   -84.524680
3   -81.537840
4   -84.492792
Name: Start_Lng, dtype: float64
```

Scatterplot using Start_Lng and Start_Lat columns

- By using scatterplot we can see the area in the country where accident occurs

In [84]:
```
sns.scatterplot(x = df.Start_Lng, y=df.Start_Lat, size = 0.1)
```

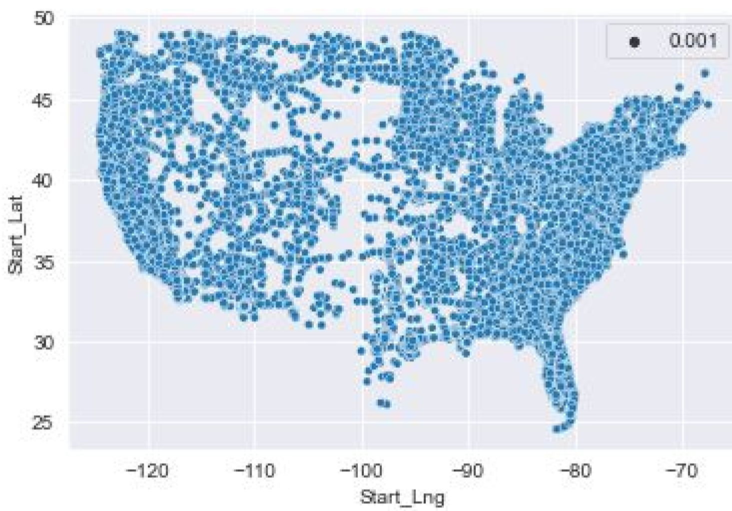
Out[84]:
```
<AxesSubplot:xlabel='Start_Lng', ylabel='Start_Lat'>
```



Data is very big so we have take 0.1% sample of whole dataset

In [86]:
```python
# Take sample of the dataset and plot it

sample_df = df.sample(int(0.1 * len(df)))

sns.scatterplot(x = sample_df.Start_Lng, y = sample_df.Start_Lat, size = 0.001)
```

Out[86]:
```
<AxesSubplot:xlabel='Start_Lng', ylabel='Start_Lat'>
```



Import Folium to plot the markers on google map

In [46]:
```python
import folium
```

In [47]:
```python
lat,lng = df.Start_Lat[0], df.Start_Lng[0]
lat,lng
```

Out[47]:
```
(40.10891, -83.09286)
```

Plot 1 marker on the map

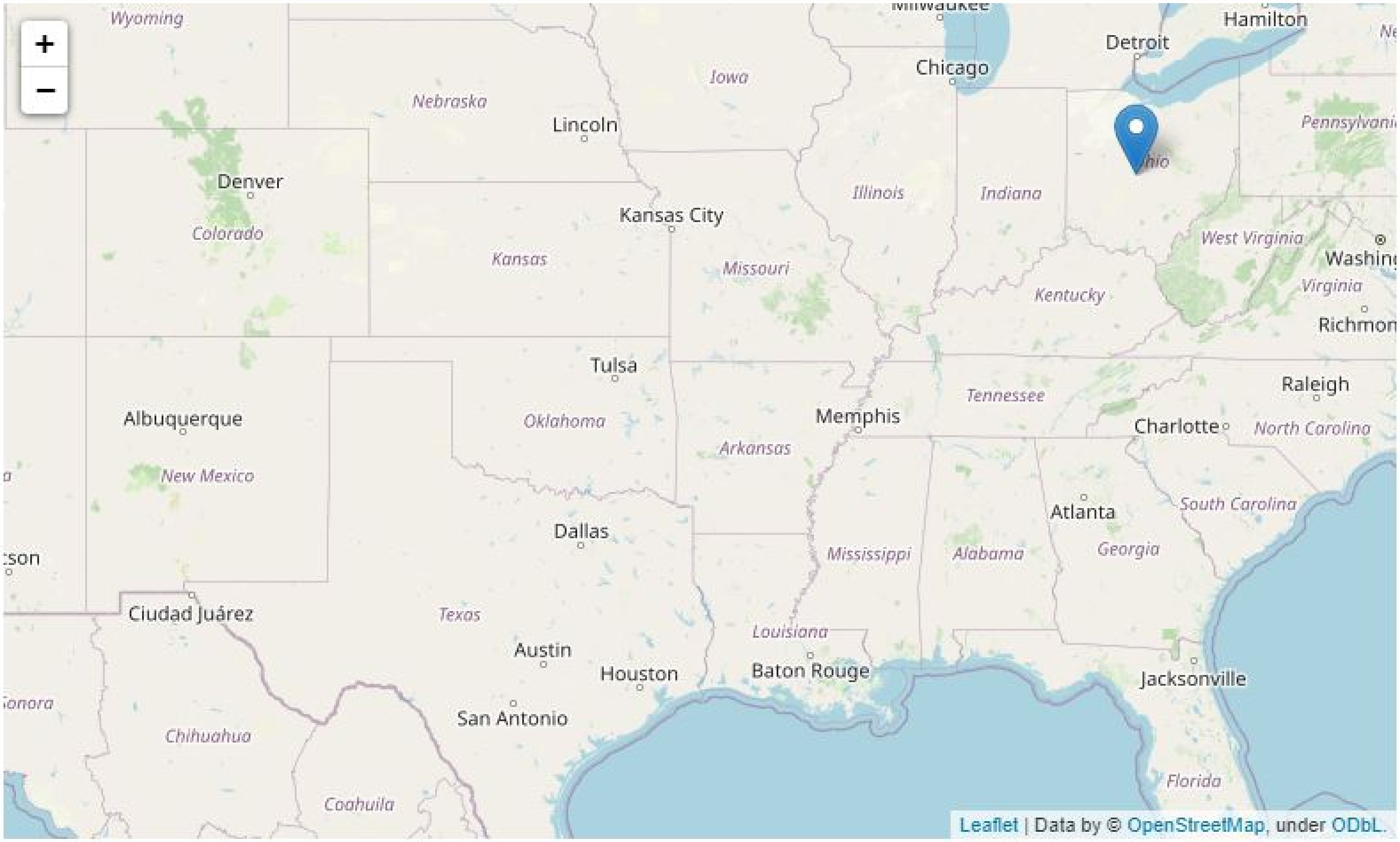
In [48]:
```python
# plot 1 marker on the map

map = folium.Map()
marker = folium.Marker((lat,lng))
marker.add_to(map)
map
```

Plot 1 marker on the map

In [48]:

```
# plot 1 marker on the map

map = folium.Map()
marker = folium.Marker((lat,lng))
marker.add_to(map)
map
```

Out[48]:



In [49]:

```
list(zip(list(df.Start_Lat), list(df.Start_Lng)))[:10]
```

Out[49]:

```
[(40.10891, -83.09286),
 (39.86542, -84.0628),
 (39.10266, -84.52468),
 (41.06213, -81.53784),
 (39.172393, -84.49279200000002),
 (39.06324, -84.03243),
 (39.77565, -84.18603),
 (41.37531, -81.82016999999998),
```

To plot multiple markers on the map

- We have to take 0.01% of sample of whole data

In [50]:

```
sample_df = df.sample(int(0.001 * len(df)))
```

In [51]:

```
locations = sample_df[['Start_Lat', 'Start_Lng']]
locationlist = locations.values.tolist()
len(locationlist)
locationlist[7]
```

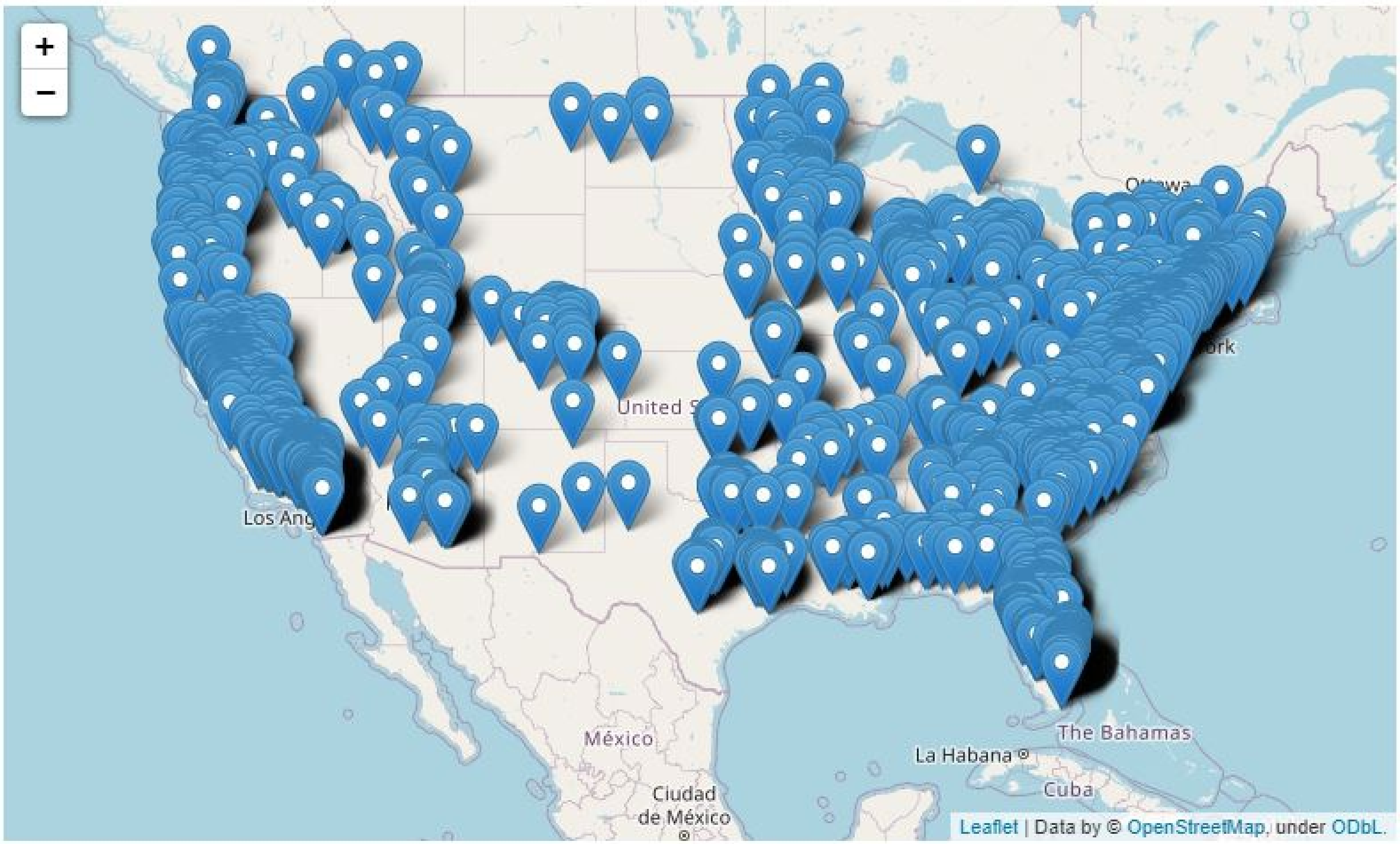
Out[51]:

```
[26.775749, -80.097928]
```

In [52]:

```
map = folium.Map()
for point in range(0, len(locationlist)):
    marker = folium.Marker((locationlist[point]))
    marker.add_to(map)
map
```

Out[52]:



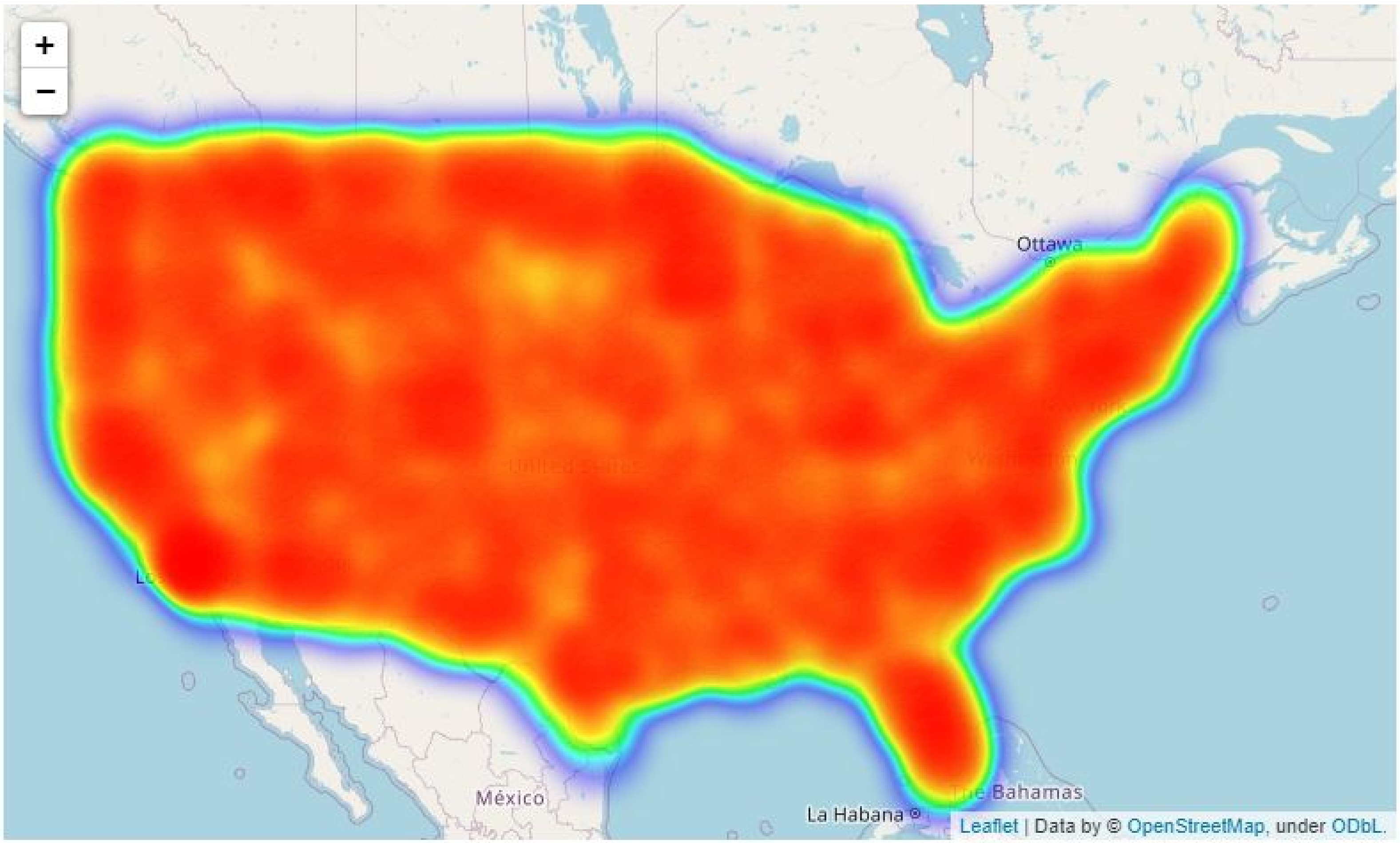
- Observation

The above maps mark's the states where accidents occured

Heatmap of area where accidents occured using Start_Lat,Start_Lng

In [53]:
```
from folium import plugins
from folium.plugins import HeatMap

map = folium.Map()
HeatMap(zip(list(df.Start_Lat), list(df.Start_Lng))).add_to(map)
map
```

Out[53]:



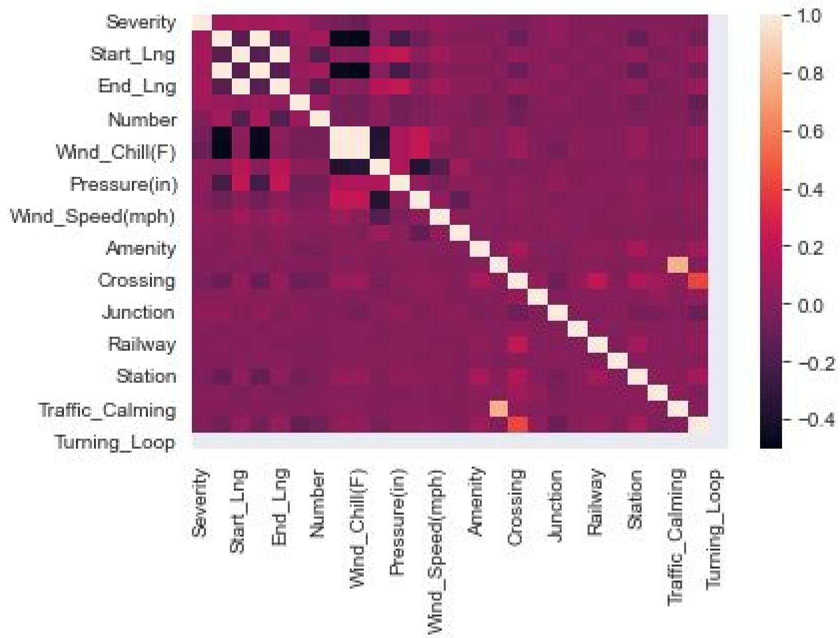
In [52]:
```
df.columns
```

Out[52]: `Index(['ID', 'Severity', 'Start_Time', 'End_Time', 'Start_Lat', 'Start_Lng',`

Heatmap of correlation

In [49]:
```
sns.heatmap(df.corr())
```

Out[49]: <AxesSubplot:>



Summary and Conclusion

Insights

- Less then 5% of cities have more than 1000 yearly accidents
- We have seen top 5 states having more number of accidents
- We have seen top 100 cities having more number of accidents
- High number of accidents occur between 3 pm to 5 pm
- Over 1110 cities have reported just 1 accident (need to investigate)
- Maximum number of accidents occurs on Fridays
- December month have reported the maximum number of accidents
- Much Data of 2016 and 2017 is missing, still from the graph we can say that the trend of accidents increases year by year
- We have used scatterplot using Start_longitude, Start_latitude
- We have used Folium to plot the markerss on google map
- We have seen the Heatmap of areas where accidents occured using Start_lat, Start_Lng