In [1]:
```python
# First let's import the packages we will use in this project
import pandas as pd
import numpy as np
import seaborn as sns

import matplotlib.pyplot as plt
import matplotlib.mlab as mlab
import matplotlib
plt.style.use('ggplot')
from matplotlib.pyplot import figure

%matplotlib inline
matplotlib.rcParams['figure.figsize'] = (12,8)
```

In [84]:
```python
df1 = pd.read_csv("US_Accidents_Dec21_updated.csv")
df1
```

```
C:\ProgramData\Anaconda3\lib\site-packages\IPython\core\interactiveshell.py:3444: DtypeWarning: Columns (30,31,32,33,34,35,36,37,38,39,40,41,42) have mixed ty
pes.Specify dtype option on import or set low_memory=False.
  exec(code_obj, self.user_global_ns, self.user_ns)
```

Out[84]:

	ID	Severity	Start_Time	End_Time	Start_Lat	Start_Lng	End_Lat	End_Lng	Distance(mi)	Description	...	Roundabout	Station	Stop	Traffic_Calming	Traffic_Signal	Turning_Loop
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...	...	False	False	False	False	False	False
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.	...	False	False	False	False	False	False
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.	...	False	False	False	False	False	False
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.	...	False	False	False	False	False	False
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.	...	False	False	False	False	False	False
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
22916	A-22917	2	2016-10-06 23:51:28	2016-10-07 05:51:28	32.852590	-96.883690	32.858389	-96.889910	0.539	At Purple Heart Trl - Accident.	...	False	False	False	False	False	False
22917	A-22918	4	2016-10-07 01:11:32	2016-10-07 07:11:32	29.665780	-95.259957	29.677687	-95.269697	1.009	Closed between College Ave and Bellfort Ave/Ho...	...	False	False	False	False	False	False
22918	A-22919	2	2016-10-07 01:12:53	2016-10-07 07:12:53	41.695450	-92.789130	41.695410	-92.801580	0.642	At CR-T38/Exit 179 - Accident.	...	False	False	False	False	False	False
22919	A-22920	4	2016-10-07 02:59:07	2016-10-07 08:59:07	30.293073	-95.464451	30.280880	-95.458130	0.923	Closed at Gladstell St/Exit 85 - Road closed d...	...	False	False	False	False	True	False
22920	A-22921	2	2016-10-07 03:08:37	2016-10-07 09:08:37	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN

22921 rows × 47 columns

In [85]:
```python
df1.columns
```

Out[85]:
```
Index(['ID', 'Severity', 'Start_Time', 'End_Time', 'Start_Lat', 'Start_Lng',
       'End_Lat', 'End_Lng', 'Distance(mi)', 'Description', 'Number', 'Street',
       'Side', 'City', 'County', 'State', 'Zipcode', 'Country', 'Timezone',
       'Airport_Code', 'Weather_Timestamp', 'Temperature(F)', 'Wind_Chill(F)',
       'Humidity(%)', 'Pressure(in)', 'Visibility(mi)', 'Wind_Direction',
       'Wind_Speed(mph)', 'Precipitation(in)', 'Weather_Condition', 'Amenity',
       'Bump', 'Crossing', 'Give_Way', 'Junction', 'No_Exit', 'Railway',
       'Roundabout', 'Station', 'Stop', 'Traffic_Calming', 'Traffic_Signal',
       'Turning_Loop', 'Sunrise_Sunset', 'Civil_Twilight', 'Nautical_Twilight',
       'Astronomical_Twilight'],
      dtype='object')
```

In [ ]:

In [ ]:

In [86]:
```python
df1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 22921 entries, 0 to 22920
Data columns (total 47 columns):
 #   Column                 Non-Null Count  Dtype
---  ------                 --------------  -----
 0   ID                     22921 non-null  object
 1   Severity               22921 non-null  int64
 2   Start_Time             22921 non-null  object
 3   End_Time               22921 non-null  object
 4   Start_Lat              22920 non-null  float64
 5   Start_Lng              22920 non-null  float64
 6   End_Lat                22920 non-null  float64
 7   End_Lng                22920 non-null  float64
 8   Distance(mi)           22920 non-null  float64
 9   Description            22920 non-null  object
 10  Number                 3215 non-null   float64
 11  Street                 22920 non-null  object
 12  Side                   22920 non-null  object
 13  City                   22920 non-null  object
 14  County                 22920 non-null  object
 15  State                  22920 non-null  object
 16  Zipcode                22914 non-null  object
 17  Country                22920 non-null  object
 18  Timezone               22914 non-null  object
 19  Airport_Code           22913 non-null  object
 20  Weather_Timestamp      22666 non-null  object
 21  Temperature(F)         22275 non-null  float64
 22  Wind_Chill(F)          3961 non-null   float64
 23  Humidity(%)            22255 non-null  float64
 24  Pressure(in)           22307 non-null  float64
 25  Visibility(mi)         22241 non-null  float64
 26  Wind_Direction         22662 non-null  object
 27  Wind_Speed(mph)        19320 non-null  float64
 28  Precipitation(in)      1920 non-null   float64
 29  Weather_Condition      22268 non-null  object
 30  Amenity                22920 non-null  object
 31  Bump                   22920 non-null  object
 32  Crossing               22920 non-null  object
 33  Give_Way               22920 non-null  object
 34  Junction               22920 non-null  object
 35  No_Exit                22920 non-null  object
 36  Railway                22920 non-null  object
 37  Roundabout             22920 non-null  object
 38  Station                22920 non-null  object
 39  Stop                   22920 non-null  object
 40  Traffic_Calming        22920 non-null  object
 41  Traffic_Signal         22920 non-null  object
 42  Turning_Loop           22920 non-null  object
 43  Sunrise_Sunset         22920 non-null  object
 44  Civil_Twilight         22920 non-null  object
 45  Nautical_Twilight      22920 non-null  object
 46  Astronomical_Twilight  22920 non-null  object
dtypes: float64(13), int64(1), object(33)
memory usage: 8.2+ MB
```

In [9]:
```python
df1.describe()
```

Out[9]:

	Severity	Start_Lat	Start_Lng	End_Lat	End_Lng	Distance(mi)	Number	Temperature(F)	Wind_Chill(F)	Humidity(%)	Pressure(in)	Visibility(mi)	Wind_Speed(mph)
count	22921.000000	22920.000000	22920.000000	22920.000000	22920.000000	22920.000000	3215.000000	22275.000000	3961.000000	22255.000000	22307.000000	22241.000000	19320.000000
mean	2.321234	35.803312	-106.313440	35.803478	-106.313383	0.684327	8425.976983	59.150519	22.595228	63.308605	29.999129	9.271692	9.506693
std	0.585371	4.157034	12.863701	4.157162	12.863910	1.737037	10120.026381	18.167628	18.119386	21.415269	0.261188	3.043264	9.571508
min	2.000000	26.218240	-123.526160	26.209870	-123.526160	0.000000	1.000000	-18.000000	-34.700000	4.000000	20.670000	0.000000	0.000000
25%	2.000000	32.880480	-118.287120	32.883650	-118.286965	0.188000	1700.500000	51.800000	10.600000	48.000000	29.890000	10.000000	5.800000
50%	2.000000	34.139250	-98.501670	34.139920	-98.501879	0.417000	4882.000000	62.600000	24.200000	64.000000	29.990000	10.000000	8.100000
75%	3.000000	38.606267	-95.333918	38.605600	-95.334934	0.675250	11202.500000	70.000000	34.000000	80.000000	30.110000	10.000000	11.500000
max	4.000000	48.125360	-80.005270	48.122370	-79.958150	150.138000	88699.000000	127.400000	101.000000	100.000000	30.920000	70.000000	822.800000

In [12]:
```python
numerics = ['int16', 'int32', 'int64', 'float16', 'float32', 'float64']
numeric_df1 = df1.select_dtypes(include=numerics)
numeric_df1.head()
```

Out[12]:

	Severity	Start_Lat	Start_Lng	End_Lat	End_Lng	Distance(mi)	Number	Temperature(F)	Wind_Chill(F)	Humidity(%)	Pressure(in)	Visibility(mi)	Wind_Speed(mph)	Precipitation(in)
0	3	40.108910	-83.092860	40.112060	-83.031870	3.230	NaN	42.1	36.1	58.0	29.76	10.0	10.4	0.00
1	2	39.865420	-84.062800	39.865010	-84.048730	0.747	NaN	36.9	NaN	91.0	29.68	10.0	NaN	0.02
2	2	39.102660	-84.524680	39.102090	-84.523960	0.055	NaN	36.0	NaN	97.0	29.70	10.0	NaN	0.02
3	2	41.062130	-81.537840	41.062170	-81.535470	0.123	NaN	39.0	NaN	55.0	29.65	10.0	NaN	NaN
4	3	39.172393	-84.492792	39.170476	-84.501798	0.500	NaN	37.0	29.8	93.0	29.69	10.0	10.4	0.01

In [87]:
```python
#missing values
missing_perc=df1.isna().sum().sort_values(ascending=False)/len(df1)
missing_perc
```

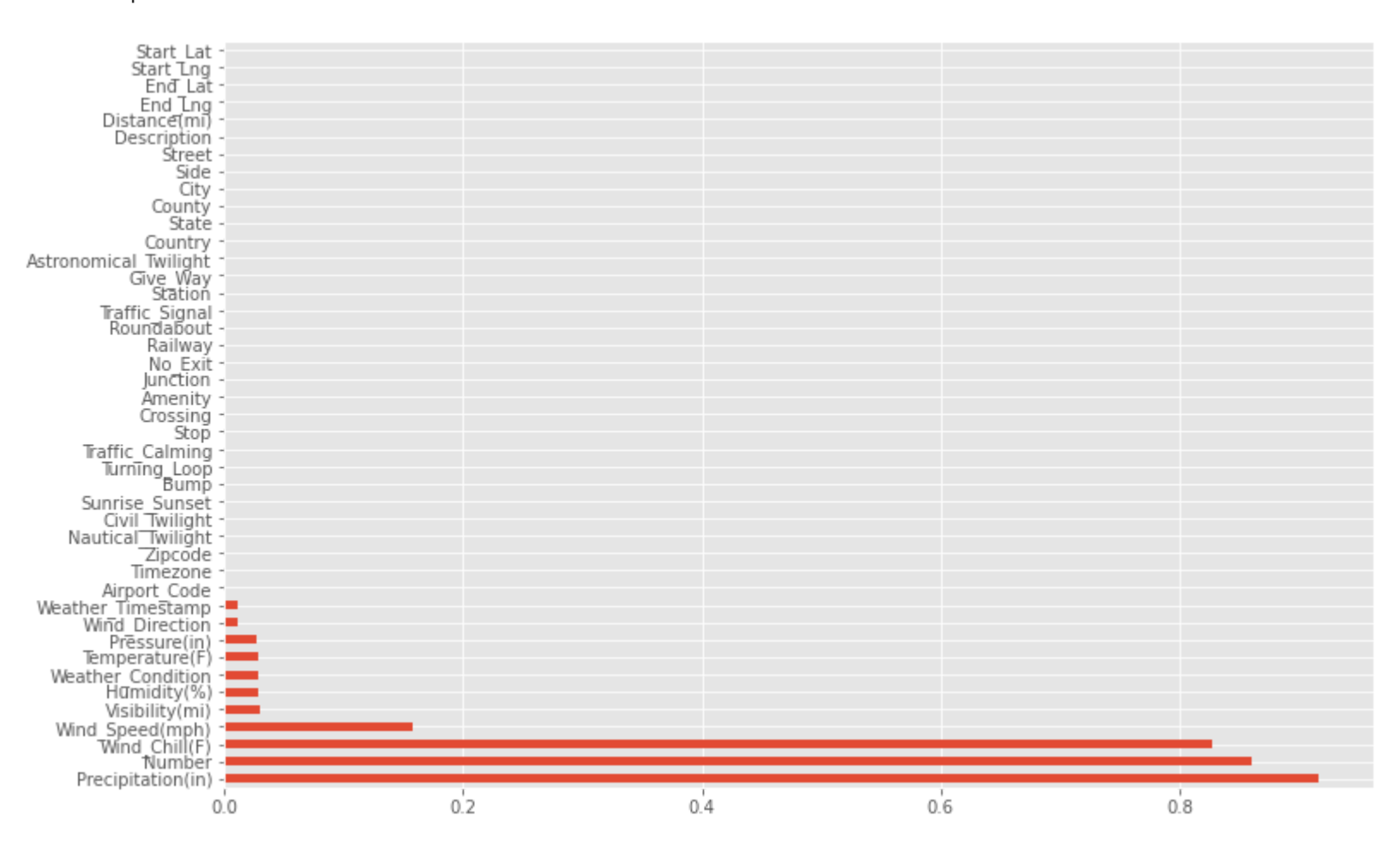
Out[87]:
```
Precipitation(in)        0.916234
Number                   0.859736
Wind_Chill(F)            0.827189
Wind_Speed(mph)          0.157105
Visibility(mi)           0.029667
Humidity(%)              0.029056
Weather_Condition        0.028489
Temperature(F)           0.028184
Pressure(in)             0.026788
Wind_Direction           0.011300
Weather_Timestamp        0.011125
Airport_Code             0.000349
Timezone                 0.000305
Zipcode                  0.000305
Nautical_Twilight        0.000044
Civil_Twilight           0.000044
Sunrise_Sunset           0.000044
Bump                     0.000044
Turning_Loop             0.000044
Traffic_Calming          0.000044
Stop                     0.000044
Crossing                 0.000044
Amenity                  0.000044
Junction                 0.000044
No_Exit                  0.000044
Railway                  0.000044
Roundabout               0.000044
Traffic_Signal           0.000044
Station                  0.000044
Give_Way                 0.000044
Astronomical_Twilight    0.000044
Country                  0.000044
State                    0.000044
County                   0.000044
City                     0.000044
Side                     0.000044
Street                   0.000044
Description              0.000044
Distance(mi)             0.000044
End_Lng                  0.000044
End_Lat                  0.000044
Start_Lng                0.000044
Start_Lat                0.000044
Severity                 0.000000
End_Time                 0.000000
Start_Time               0.000000
ID                       0.000000
dtype: float64
```

In [15]:
```python
#removing zeroes perc
missing_perc[missing_perc != 0]
```

Out[15]:
```
Precipitation(in)        0.916234
Number                   0.859736
Wind_Chill(F)            0.827189
Wind_Speed(mph)          0.157105
Visibility(mi)           0.029667
Humidity(%)              0.029056
Weather_Condition        0.028489
Temperature(F)           0.028184
Pressure(in)             0.026788
Wind_Direction           0.011300
Weather_Timestamp        0.011125
Airport_Code             0.000349
Timezone                 0.000305
Zipcode                  0.000305
Nautical_Twilight        0.000044
Civil_Twilight           0.000044
Sunrise_Sunset           0.000044
Bump                     0.000044
Turning_Loop             0.000044
Traffic_Calming          0.000044
Stop                     0.000044
Crossing                 0.000044
Amenity                  0.000044
Junction                 0.000044
No_Exit                  0.000044
Railway                  0.000044
Roundabout               0.000044
Traffic_Signal           0.000044
Station                  0.000044
Give_Way                 0.000044
Astronomical_Twilight    0.000044
Country                  0.000044
State                    0.000044
County                   0.000044
City                     0.000044
Side                     0.000044
Street                   0.000044
Description              0.000044
Distance(mi)             0.000044
End_Lng                  0.000044
End_Lat                  0.000044
Start_Lng                0.000044
Start_Lat                0.000044
dtype: float64
```

In [16]:
```python
missing_perc[missing_perc != 0].plot(kind = 'barh')
```

Out[16]: `<AxesSubplot:>`



Exploratory Analysis and Visualization

Columns we'll analyze:

City Start Time Start Lat, Start Lng Temperature Weather Condition

In [19]:
```python
df1.columns
```

Out[19]:
```
Index(['ID', 'Severity', 'Start_Time', 'End_Time', 'Start_Lat', 'Start_Lng',
       'End_Lat', 'End_Lng', 'Distance(mi)', 'Description', 'Number', 'Street',
       'Side', 'City', 'County', 'State', 'Zipcode', 'Country', 'Timezone',
       'Airport_Code', 'Weather_Timestamp', 'Temperature(F)', 'Wind_Chill(F)',
       'Humidity(%)', 'Pressure(in)', 'Visibility(mi)', 'Wind_Direction',
       'Wind_Speed(mph)', 'Precipitation(in)', 'Weather_Condition', 'Amenity',
       'Bump', 'Crossing', 'Give_Way', 'Junction', 'No_Exit', 'Railway',
       'Roundabout', 'Station', 'Stop', 'Traffic_Calming', 'Traffic_Signal',
       'Turning_Loop', 'Sunrise_Sunset', 'Civil_Twilight', 'Nautical_Twilight',
       'Astronomical_Twilight'],
      dtype='object')
```

In [21]:
```python
df1.City.unique()
```

Out[21]:
```
array(['Dublin', 'Dayton', 'Cincinnati', ..., 'Missouri City', 'Alvin',
       nan], dtype=object)
```

Ask & answer questions Are there more accidents in warmer or colder areas? Which 5 states have the highest number of accidents? Among the top 100 cities in number of accidents, which states do they belong to most frequently. What time of the day are accidents most frequent in? Which days of the week have the most accidents? Which months have the most accidents? What is the trend of accidents year over year (decreasing/increasing?)

In [88]:
```python
cities_by_accident = df1.City.value_counts()
cities_by_accident
```

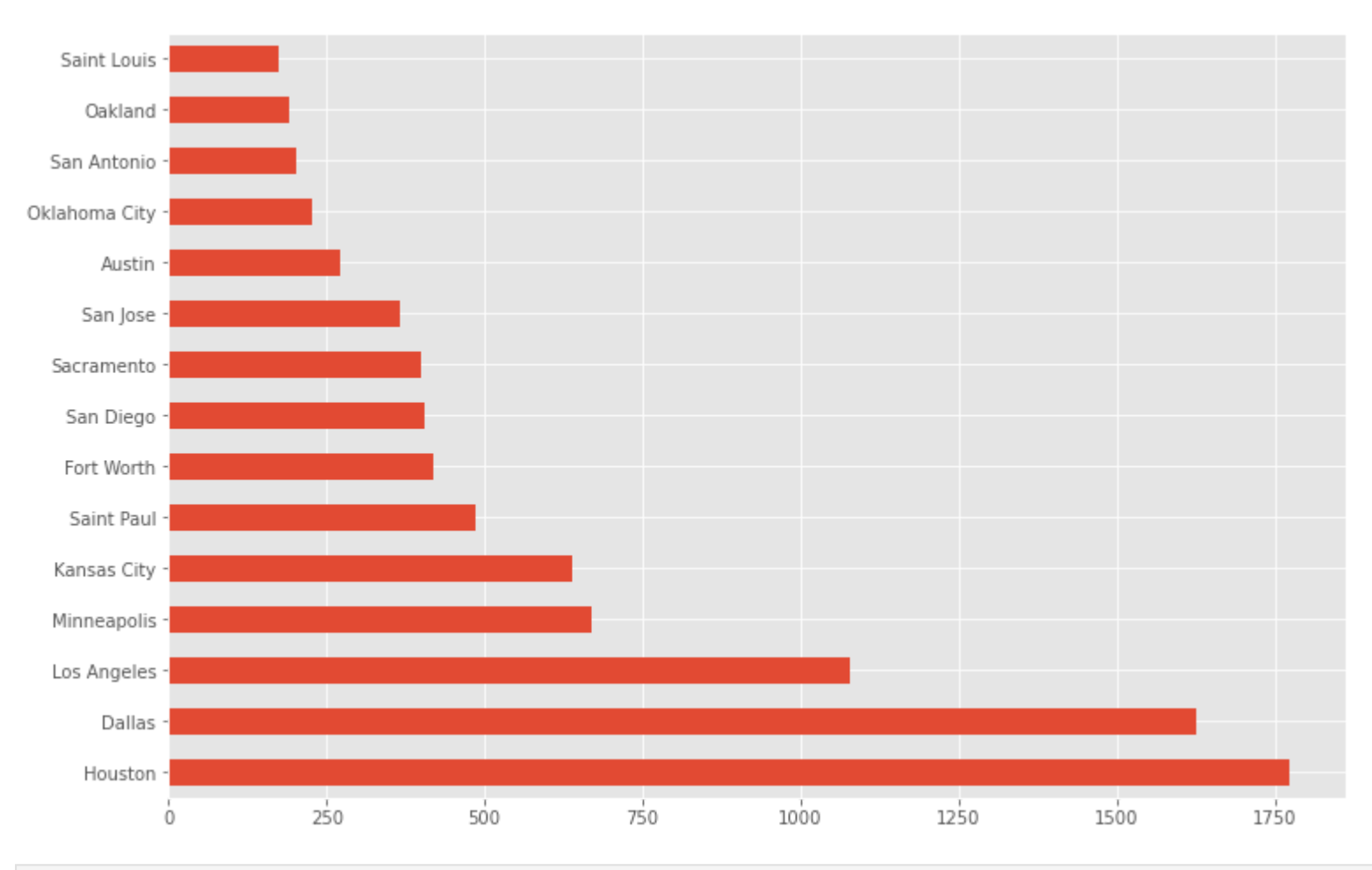
Out[88]:
```
Houston          1774
Dallas           1627
Los Angeles      1077
Minneapolis       669
Kansas City       638
                 ...
Zelienople          1
Holts Summit        1
Frankford           1
Phillipsburg        1
Portsmouth          1
Name: City, Length: 1530, dtype: int64
```

In [23]:
```python
cities_by_accident[:15]
```

Out[23]:
```
Houston          1774
Dallas           1627
Los Angeles      1077
Minneapolis       669
Kansas City       638
Saint Paul        485
Fort Worth        420
San Diego         406
Sacramento        398
San Jose          367
Austin            271
Oklahoma City     226
San Antonio       201
Oakland           191
Saint Louis       174
Name: City, dtype: int64
```

In [24]:
```python
cities_by_accident[:15].plot(kind='barh')
```

Out[24]: `<AxesSubplot:>`



In [25]:
```python
sns.set_style("darkgrid")
sns.histplot()
```

In [41]:
```python
high_accident_cities=cities_by_accident[cities_by_accident>=100]
low_accident_cities=cities_by_accident[cities_by_accident<100]
```

In [42]:
```python
len(high_accident_cities)
```

Out[42]: 30

In [43]:
```python
len(low_accident_cities)
```

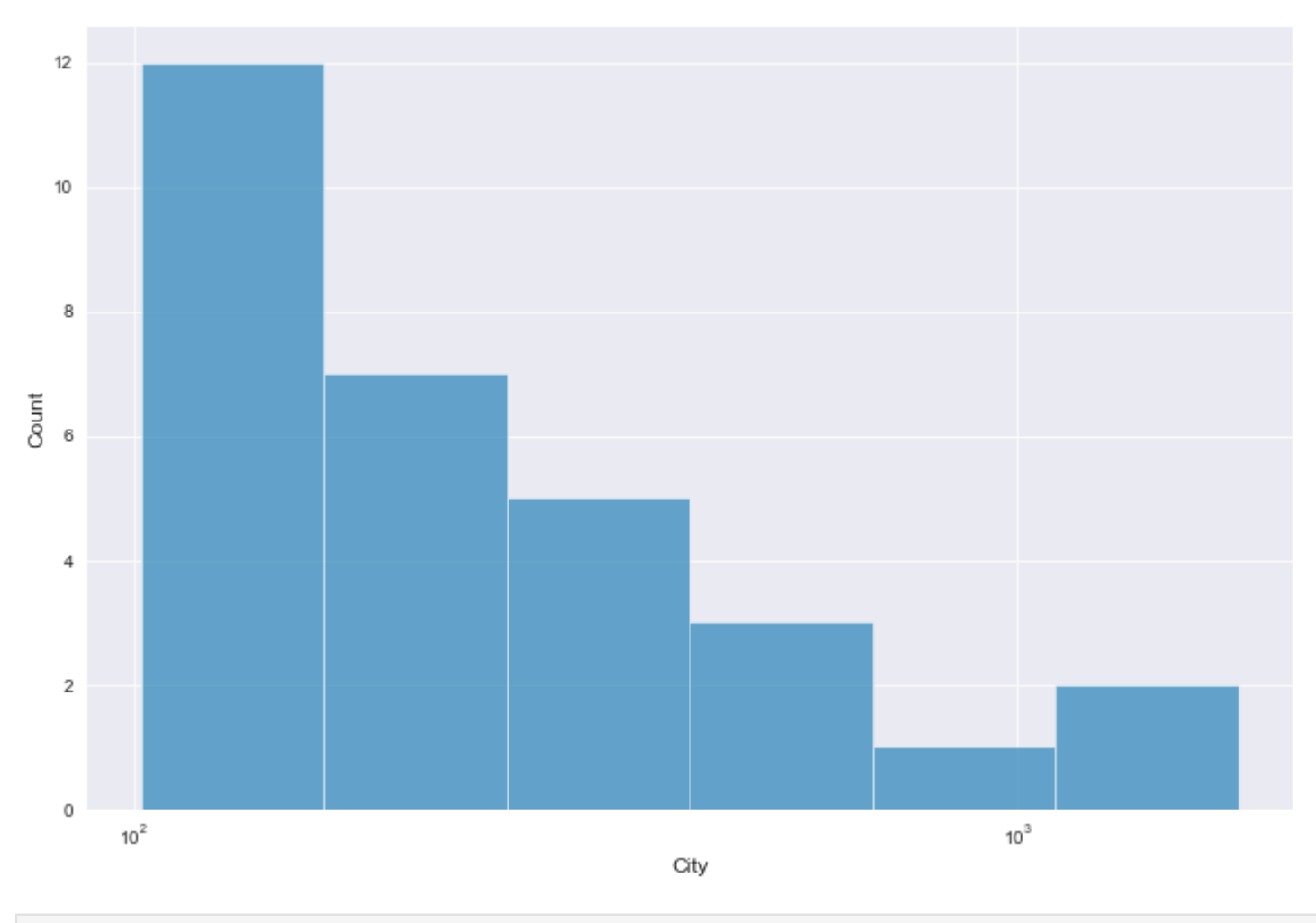
Out[43]: 1500

In [44]:
```python
len(high_accident_cities)/len(cities_by_accident)
```

Out[44]: 0.0196078431372549

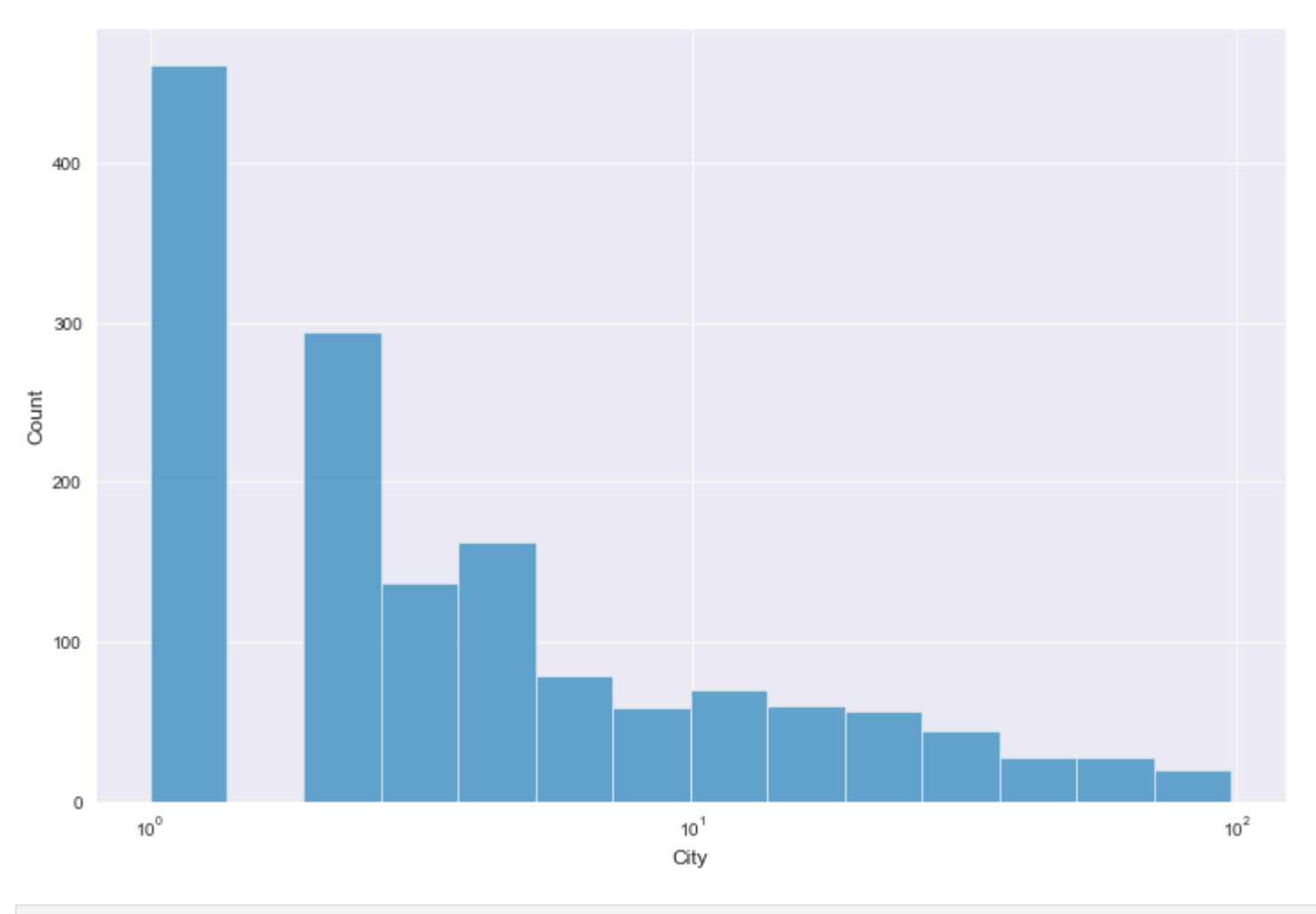
In [49]:
```python
sns.histplot(high_accident_cities,log_scale=True)
```

Out[49]: `<AxesSubplot:xlabel='City', ylabel='Count'>`



In [50]:
```python
sns.histplot(low_accident_cities,log_scale=True)
```

Out[50]: `<AxesSubplot:xlabel='City', ylabel='Count'>`



In [47]:
```python
cities_by_accident[cities_by_accident == 1]
```

Out[47]:
```
Lester Prairie    1
Carencro          1
La Vista          1
Malcom            1
Fulshear          1
                 ..
Zelienople        1
Holts Summit      1
Frankford         1
Phillipsburg      1
Portsmouth        1
Name: City, Length: 462, dtype: int64
```

In [48]:
```python
len(cities_by_accident[cities_by_accident == 1])
```

Out[48]: 462

In [ ]:

In [51]:
```python
df1.Start_Time
```

Out[51]:
```
0        2016-02-08 00:37:08
1        2016-02-08 05:56:20
2        2016-02-08 06:15:39
3        2016-02-08 06:51:45
4        2016-02-08 07:53:43
                ...
22916    2016-10-06 23:51:28
22917    2016-10-07 01:11:32
22918    2016-10-07 01:12:53
22919    2016-10-07 02:59:07
22920    2016-10-07 03:08:37
Name: Start_Time, Length: 22921, dtype: object
```

In [52]:
```python
df1.Start_Time=pd.to_datetime(df1.Start_Time)
```

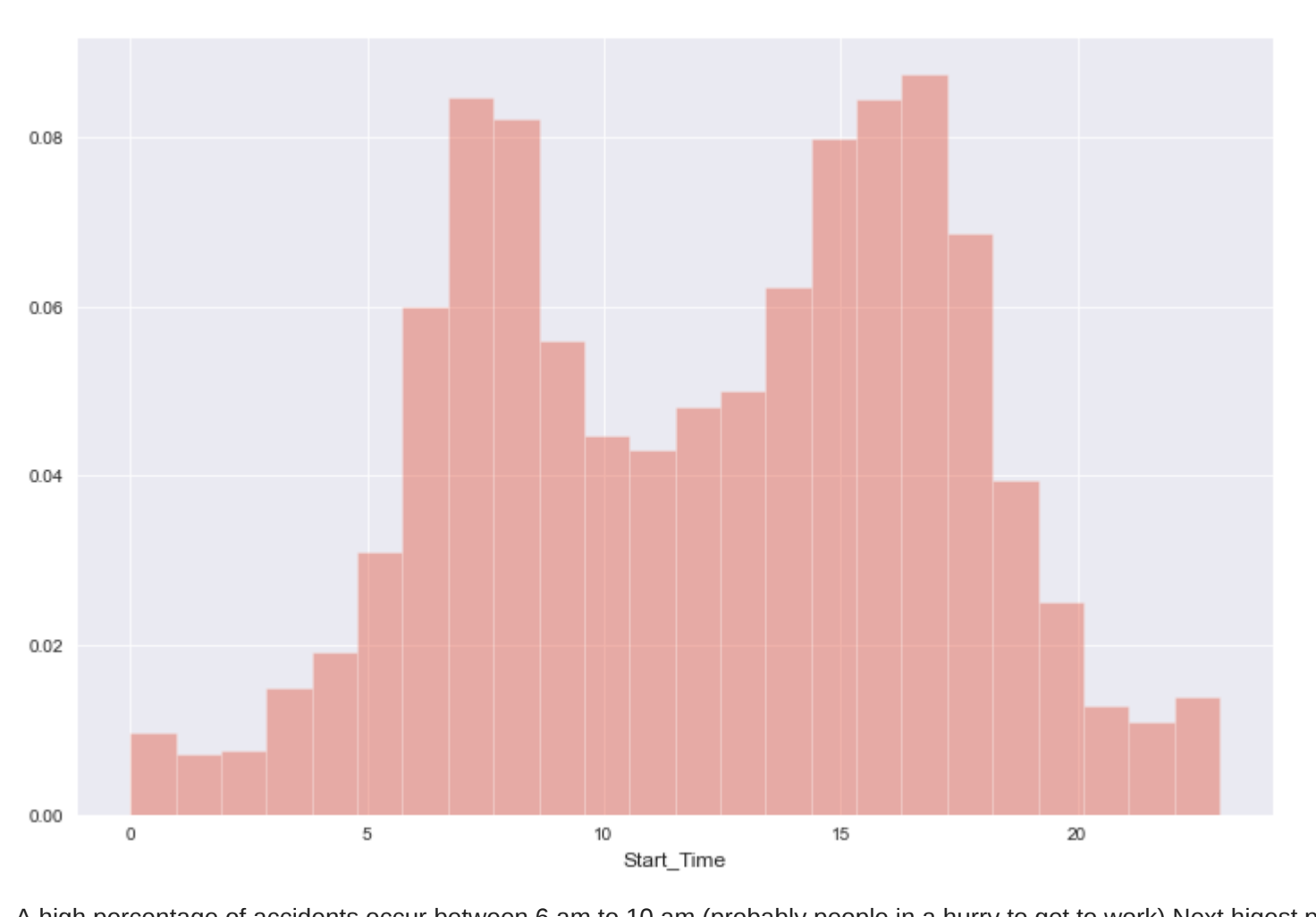
In [53]:
```python
df1.Start_Time[0]
```

Out[53]: Timestamp('2016-02-08 00:37:08')

In [56]:
```python
sns.distplot(df1.Start_Time.dt.hour,bins=24,kde=False,norm_hist=True)
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\distributions.py:2619: FutureWarning: `distplot` is a deprecated function and will be removed in a future v
ersion. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histogram
s).
  warnings.warn(msg, FutureWarning)
```

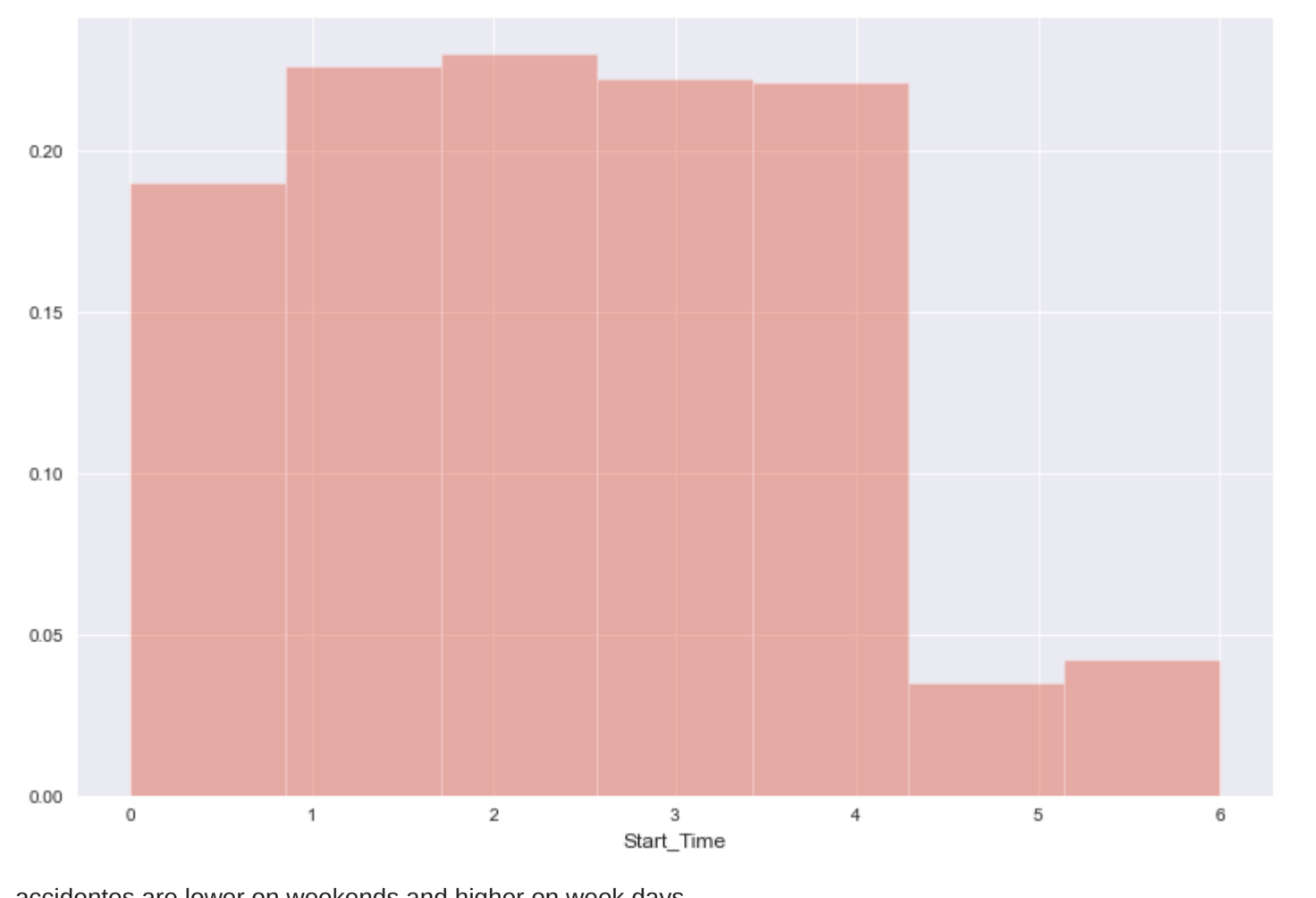
Out[56]: `<AxesSubplot:xlabel='Start_Time'>`



A high percentage of accidents occur between 6 am to 10 am (probably people in a hurry to get to work) Next higest percentage is 3 pm to 6 pm.

In [57]:
```python
sns.distplot(df1.Start_Time.dt.dayofweek,bins=7,kde=False,norm_hist=True)
```

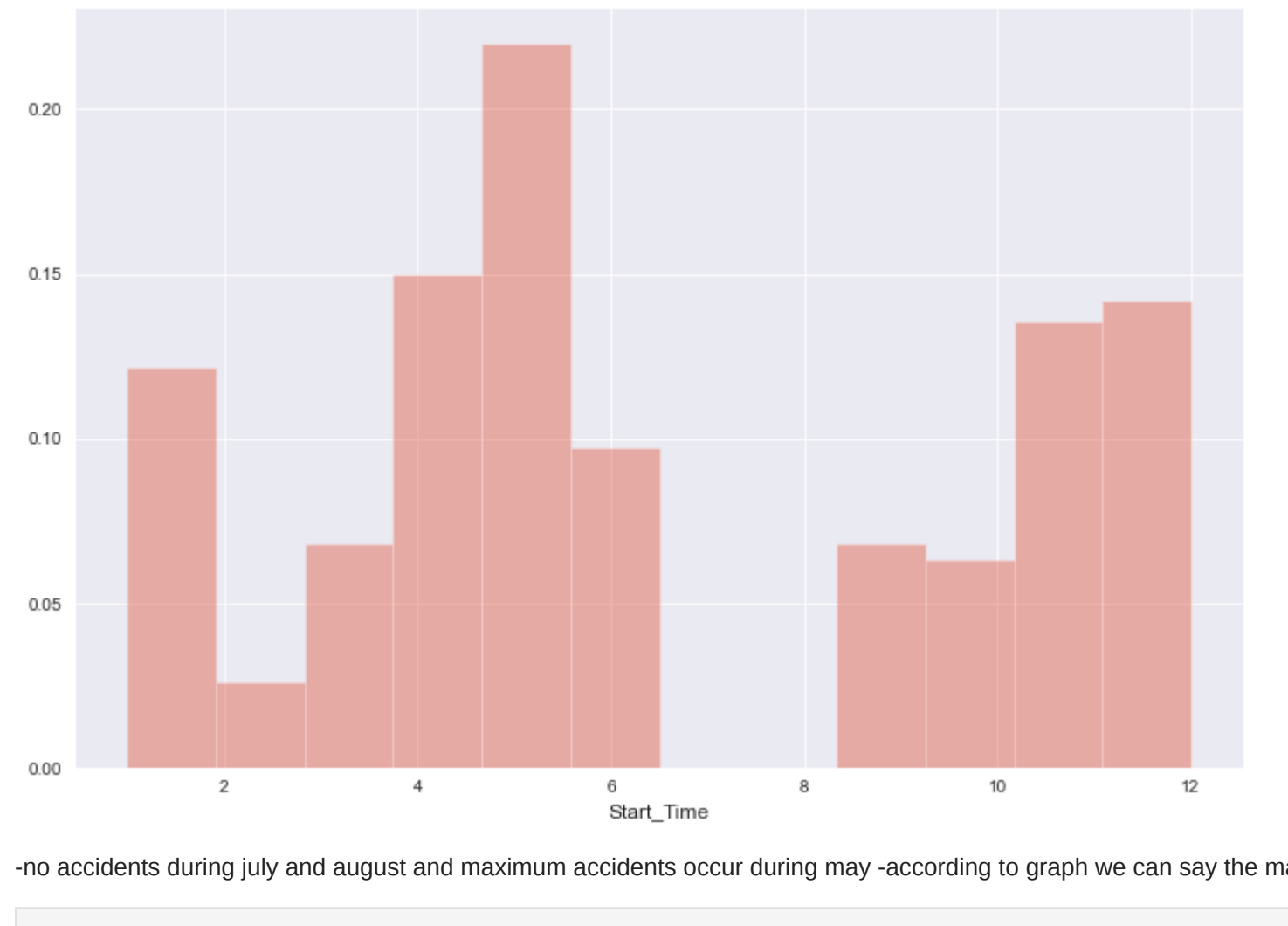
Out[57]: `<AxesSubplot:xlabel='Start_Time'>`



accidentes are lower on weekends and higher on week days

In [60]:
```python
sns.distplot(df1.Start_Time.dt.month,bins=12,kde=False,norm_hist=True)
```

Out[60]: `<AxesSubplot:xlabel='Start_Time'>`



-no accidents during july and august and maximum accidents occur during may -according to graph we can say the majority of accidents occur during winters(nov,dec,jan)

In [ ]:

Start Latitude & Longitude

In [93]:
```python
df1.Start_Lat
```

Out[93]:
```
0        40.108910
1        39.865420
2        39.102660
3        41.062130
4        39.172393
           ...
22916    32.852590
22917    29.665780
22918    41.695450
22919    30.293073
22920          NaN
Name: Start_Lat, Length: 22921, dtype: float64
```

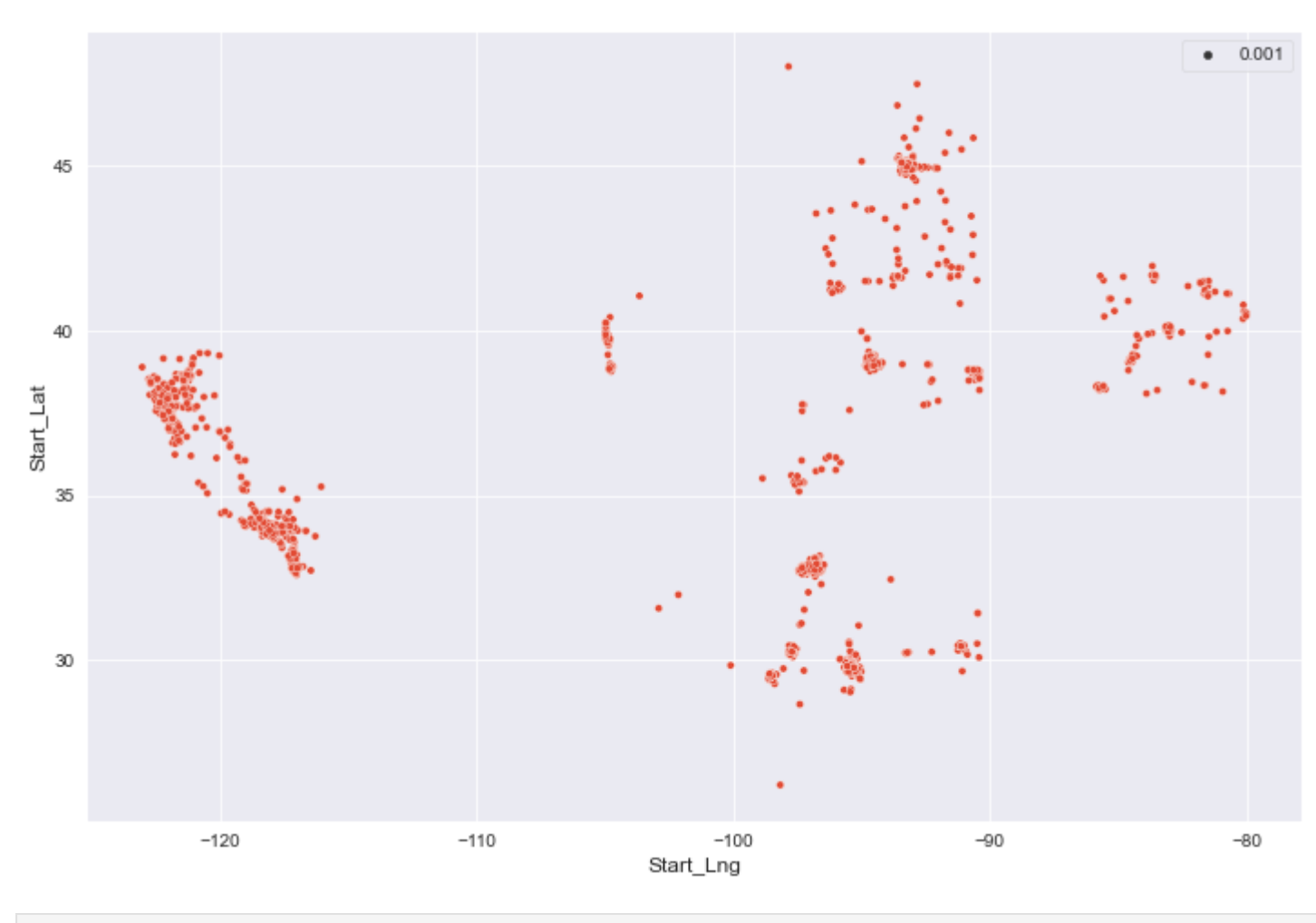
In [94]:
```python
df1.Start_Lng
```

Out[94]:
```
0       -83.092860
1       -84.062800
2       -84.524680
3       -81.537840
4       -84.492792
           ...
22916   -96.883690
22917   -95.259957
22918   -92.789130
22919   -95.464451
22920          NaN
Name: Start_Lng, Length: 22921, dtype: float64
```

In [95]:
```python
sample_df1=df1.sample(int(0.1 * len(df1)))
```

In [96]:
```python
sns.scatterplot(x=sample_df1.Start_Lng, y=sample_df1.Start_Lat, size=0.001)
```

Out[96]: `<AxesSubplot:xlabel='Start_Lng', ylabel='Start_Lat'>`



In [102...
```python
df1.State.value_counts()
```

Out[102...
```
CA    10792
TX     5828
MN     1739
MO     1269
OH      624
KS      503
CO      471
IA      416
OK      347
LA      280
NE      152
IN      124
KY      108
WI       76
PA       66
WV       52
MS       19
MI       14
WY       12
NM        8
AR        6
NV        4
SD        4
MT        3
IL        2
ND        1
Name: State, dtype: int64
```

In [ ]:
```python
df1.State()
```

california,texas,minnesota,missouri and ohio has the maximum accidents