In [29]:
```
#Examine the Stanford Open Policing Project dataset and analyze the impact of ge
```

In [1]:
```
# Import the pandas library as pd
import pandas as pd
```

In [7]:
```
# Read 'police.csv' into a DataFrame named ri
ri = pd.read_csv('RI-clean.csv', nrows=50000, low_memory=False)
```

In [8]:
```
# Examine the head of the DataFrame
ri.head()
```

Out[8]:

	id	state	stop_date	stop_time	location_raw	county_name	county_fips	fine_grained_location
0	RI-2005-00001	RI	2005-01-02	01:55	Zone K1	NaN	NaN	NaN
1	RI-2005-00002	RI	2005-01-02	20:30	Zone X4	NaN	NaN	NaN
2	RI-2005-00003	RI	2005-01-04	11:30	Zone X1	NaN	NaN	NaN
3	RI-2005-00004	RI	2005-01-04	12:55	Zone X4	NaN	NaN	NaN
4	RI-2005-00005	RI	2005-01-06	01:30	Zone X4	NaN	NaN	NaN

5 rows × 26 columns

In [9]:
```
# Count the number of missing values in each column
print(ri.isnull().sum())
```

```
id                          0
state                       0
stop_date                   0
stop_time                   0
location_raw                0
county_name             50000
county_fips             50000
fine_grained_location   50000
police_department           0
driver_gender            1990
driver_age_raw           1971
driver_age               2208
driver_race_raw          1988
driver_race              1988
violation_raw            1988
violation                1988
```

```
search_type_raw          47988
search_type              47988
contraband_found             0
stop_outcome              1988
is_arrested               1988
stop_duration             1988
out_of_state              2203
drugs_related_stop           0
district                     0
dtype: int64
```

In [10]:
```
# Examine the shape of the DataFrame
print(ri.shape)
```

```
(50000, 26)
```

In [ ]:
```
# Dropping the unnecessary columns
```

In [11]:
```
# Drop the 'county_name' and 'state' columns
ri.drop(['county_name', 'state'], axis='columns', inplace=True)
```

In [12]:
```
# Examine the shape of the DataFrame (again)
print(ri.shape)
```

```
(50000, 24)
```

In [13]:
```
# Dropping rows
```

In [14]:
```
# Drop all rows that are missing 'driver_gender'
ri.dropna(subset=['driver_gender'], inplace=True)
```

In [15]:
```
# Count the number of missing values in each column (again)
print(ri.isnull().sum())
```

```
id                          0
stop_date                   0
stop_time                   0
location_raw                0
county_fips             48010
fine_grained_location   48010
police_department           0
driver_gender               0
driver_age_raw              0
driver_age                232
driver_race_raw             0
driver_race                 0
violation_raw               0
violation                   0
search_conducted            0
search_type_raw         45998
search_type             45998
contraband_found            0
stop_outcome                0
```

```
out_of_state              215
drugs_related_stop          0
district                    0
dtype: int64
```

In [16]:
```
# Examine the shape of the DataFrame
print(ri.shape)
```

```
(48010, 24)
```

In [17]:
```
# Fixing a data type
```

In [18]:
```
# Examine the head of the 'is_arrested' column
print(ri.is_arrested.head())
```

```
0    False
1    False
3    False
4    False
5    False
Name: is_arrested, dtype: object
```

In [19]:
```
# Check the data type of 'is_arrested'
print(ri.is_arrested.dtype)
```

```
object
```

In [20]:
```
# Change the data type of 'is_arrested' to 'bool'
ri['is_arrested'] = ri.is_arrested.astype('bool')
```

In [21]:
```
# Check the data type of 'is_arrested' (again)
print(ri.is_arrested.dtype)
```

```
bool
```

In [22]:
```
# Combining object columns
```

In [23]:
```
# Concatenate 'stop_date' and 'stop_time' (separated by a space)
combined = ri.stop_date.str.cat(ri.stop_time, sep=' ')
```

In [24]:
```
# Convert 'combined' to datetime format
ri['stop_datetime'] = pd.to_datetime(combined)
```

In [25]:
```
# Examine the data types of the DataFrame
print(ri.dtypes)
```

```
id                                object
stop_date                         object
stop_time                         object
location_raw                      object
                                  loat64
fine_grained_location            float64
```

```
police_department                 object
driver_gender                     object
driver_age_raw                   float64
driver_age                       float64
driver_race_raw                   object
driver_race                       object
violation_raw                     object
violation                         object
search_conducted                    bool
search_type_raw                   object
search_type                       object
contraband_found                    bool
stop_outcome                      object
is_arrested                         bool
stop_duration                     object
out_of_state                      object
drugs_related_stop                  bool
district                          object
stop_datetime           datetime64[ns]
dtype: object
```

In [26]:
```
# Set 'stop_datetime' as the index
ri.set_index('stop_datetime', inplace=True)
```

In [27]:
```
# Examine the index
print(ri.index)
```

```
DatetimeIndex(['2005-01-02 01:55:00', '2005-01-02 20:30:00',
               '2005-01-04 12:55:00', '2005-01-06 01:30:00',
               '2005-01-12 08:05:00', '2005-01-18 08:15:00',
               '2005-01-18 17:13:00', '2005-01-23 23:15:00',
               '2005-01-24 20:32:00', '2005-02-09 03:05:00',
               ...
               '2006-08-08 22:22:00', '2006-08-08 22:25:00',
               '2006-08-08 22:30:00', '2006-08-08 22:30:00',
               '2006-08-08 22:45:00', '2006-08-08 22:45:00',
               '2006-08-08 22:45:00', '2006-08-08 22:53:00',
               '2006-08-08 23:00:00', '2006-08-08 23:00:00'],
              dtype='datetime64[ns]', name='stop_datetime', length=48010, freq=N
one)
```

In [28]:
```
# Examine the columns
print(ri.columns)
```

```
Index(['id', 'stop_date', 'stop_time', 'location_raw', 'county_fips',
       'fine_grained_location', 'police_department', 'driver_gender',
       'driver_age_raw', 'driver_age', 'driver_race_raw', 'driver_race',
       'violation_raw', 'violation', 'search_conducted', 'search_type_raw',
       'search_type', 'contraband_found', 'stop_outcome', 'is_arrested',
       'stop_duration', 'out_of_state', 'drugs_related_stop', 'district'],
      dtype='object')
```

In [30]:
```
"""
Does the gender of a driver have an impact on police behavior during a traffic s
In this chapter, we will explore that question while practicing filtering, group
Boolean math, string methods, and more!
"""
```



```
ve an impact on police behavior during a traffi
c stop? \nIn this chapter, you will explore that question while practicing filte
```

```
ring, grouping, method chaining, \nBoolean math, string methods, and more!\n'
```

In [31]:
```
ri = pd.read_csv('RI-clean.csv', nrows=50000, low_memory=False)

ri.drop(['county_name', 'state'], axis='columns', inplace=True)
ri.dropna(subset=['driver_gender'], inplace=True)

ri['is_arrested'] = ri.is_arrested.astype('bool')

combined = ri.stop_date.str.cat(ri.stop_time, sep=' ')
ri['stop_datetime'] = pd.to_datetime(combined)

ri.set_index('stop_datetime', inplace=True)
```

In [32]:
```
# Count the unique values in 'violation'
print(ri.violation.value_counts())
```

```
Speeding               36111
Moving violation        6522
Equipment               3022
Registration/plates     1463
Other                    892
Name: violation, dtype: int64
```

In [33]:
```
# Express the counts as proportions
print(ri.violation.value_counts(normalize=True))
```

```
Speeding               0.752156
Moving violation       0.135847
Equipment              0.062945
Registration/plates    0.030473
Other                  0.018579
Name: violation, dtype: float64
```

In [34]:
```
# Comparing violations by gender
```

In [35]:
```
# Create a DataFrame of female drivers
female = ri[ri.driver_gender=='F']

# Create a DataFrame of male drivers
male = ri[ri.driver_gender=='M']
```

In [36]:
```
# Compute the violations by female drivers (as proportions)
print(female.violation.value_counts(normalize=True))
```

```
Speeding               0.811180
Moving violation       0.099031
Equipment              0.045608
Registration/plates    0.027575
Other                  0.016605
Name: violation, dtype: float64
```

In [37]:
```
# Compute the violations by male drivers (as proportions)
print(male.violation.value_counts(normalize=True))
```

```
Speeding               0.729518
Moving violation       0.149967
Equipment              0.069595
Registration/plates    0.031584
Other                  0.019337
Name: violation, dtype: float64
```

In [38]:
```
# Comparing speeding outcomes by gender
```

In [39]:
```
# Create a DataFrame of female drivers stopped for speeding
female_and_speeding = ri[(ri.driver_gender=='F') & (ri.violation=='Speeding')]

# Create a DataFrame of male drivers stopped for speeding
male_and_speeding = ri[(ri.driver_gender=='M') & (ri.violation=='Speeding')]
```

In [40]:
```
# Compute the stop outcomes for female drivers (as proportions)
print(female_and_speeding.stop_outcome.value_counts(normalize=True))

# Compute the stop outcomes for male drivers (as proportions)
print(male_and_speeding.stop_outcome.value_counts(normalize=True))
```

```
Citation            0.973416
Warning             0.012968
Arrest Driver       0.007410
N/D                 0.003612
Arrest Passenger    0.002316
No Action           0.000278
Name: stop_outcome, dtype: float64
Citation            0.957298
Arrest Driver       0.026230
Warning             0.010666
N/D                 0.003397
Arrest Passenger    0.002015
No Action           0.000395
Name: stop_outcome, dtype: float64
```

In [41]:
```
# Calculating the search rate
```

In [42]:
```
# Check the data type of 'search_conducted'
print(ri.search_conducted.dtype)
```

```
bool
```

In [43]:
```
# Calculate the search rate by counting the values
print(ri.search_conducted.value_counts(normalize=True))
```

```
False    0.958092
True     0.041908
Name: search_conducted, dtype: float64
```

In [44]:
```
# Calculate the search rate by taking the mean
print(ri.search_conducted.mean())
```

```
0.0419079358466986
```

In [45]:
```
# Comparing search rates by gender
```

In [46]:
```
# Calculate the search rate for female drivers
print(ri[ri.driver_gender=='F'].search_conducted.mean())
```

```
0.017807498685100308
```

In [47]:
```
# Calculate the search rate for male drivers
print(ri[ri.driver_gender=='M'].search_conducted.mean())
```

```
0.05115126365234431
```

In [48]:
```
# Calculate the search rate for both groups simultaneously
print(ri.groupby('driver_gender').search_conducted.mean())
```

```
driver_gender
F    0.017807
M    0.051151
Name: search_conducted, dtype: float64
```

In [49]:
```
# Adding a second factor to the analysis
```

In [50]:
```
# Calculate the search rate for each combination of gender and violation
print(ri.groupby(['driver_gender', 'violation']).search_conducted.mean())
```

```
driver_gender  violation
F              Equipment              0.079077
               Moving violation       0.047800
               Other                  0.045249
               Registration/plates    0.114441
               Speeding               0.006854
M              Equipment              0.123395
               Moving violation       0.088778
               Other                  0.154993
               Registration/plates    0.171533
               Speeding               0.028560
Name: search_conducted, dtype: float64
```

In [51]:
```
# Reverse the ordering to group by violation before gender
print(ri.groupby(['violation', 'driver_gender']).search_conducted.mean())
```

```
violation            driver_gender
Equipment            F                0.079077
                     M                0.123395
Moving violation     F                0.047800
                     M                0.088778
Other                F                0.045249
                     M                0.154993
Registration/plates  F                0.114441
                     M                0.171533
Speeding             F                0.006854
                     M                0.028560
Name: search_conducted, dtype: float64
```

In [52]:
```
# Counting protective frisks
```

```
print(ri.search_type.value_counts())
```

```
Incident to Arrest                                    958
Probable Cause                                        244
Protective Frisk                                      204
Inventory                                             117
Incident to Arrest,Inventory                          116
Incident to Arrest,Probable Cause                      76
Incident to Arrest,Protective Frisk                    63
Reasonable Suspicion                                   43
Probable Cause,Protective Frisk                        36
Incident to Arrest,Inventory,Protective Frisk          33
Inventory,Protective Frisk                             23
Incident to Arrest,Probable Cause,Protective Frisk     20
Incident to Arrest,Inventory,Probable Cause            19
Protective Frisk,Reasonable Suspicion                  16
Inventory,Probable Cause                               16
Probable Cause,Reasonable Suspicion                    12
Incident to Arrest,Reasonable Suspicion                 5
Probable Cause,Protective Frisk,Reasonable Suspicion    5
Inventory,Probable Cause,Protective Frisk               2
Incident to Arrest,Inventory,Reasonable Suspicion       1
Inventory,Reasonable Suspicion                          1
Incident to Arrest,Probable Cause,Reasonable Suspicion  1
Incident to Arrest,Protective Frisk,Reasonable Suspicion 1
Name: search_type, dtype: int64
```

In [53]:
```
# Check if 'search_type' contains the string 'Protective Frisk'
ri['frisk'] = ri.search_type.str.contains('Protective Frisk', na=False)
```

In [54]:
```
# Check the data type of 'frisk'
print(ri.frisk.dtype)
```

```
bool
```

In [56]:
```
# Take the sum of 'frisk'
print(ri.frisk.sum())
```

```
403
```

In [57]:
```
# Comparing frisk rates by gender
```

In [58]:
```
# Comparing frisk rates by gender
```

In [59]:
```
# Create a DataFrame of stops in which a search was conducted
searched = ri[ri.search_conducted]
```

In [60]:
```
# Calculate the overall frisk rate by taking the mean of 'frisk'
print(searched.frisk.mean())
```

```
0.20029821073558648
```

In [61]:
```
# Calculate the frisk rate for each gender
print(searched.groupby('driver_gender').frisk.mean())
```

```
driver_gender
F    0.164557
M    0.205070
Name: frisk, dtype: float64
```

In [62]:
```
###
```

In [63]:
```
# Visual exploratory data analysis
```

In [64]:
```
ri = pd.read_csv('RI-clean.csv', nrows=50000, low_memory=False)

ri.drop(['county_name', 'state'], axis='columns', inplace=True)
ri.dropna(subset=['driver_gender'], inplace=True)

ri['is_arrested'] = ri.is_arrested.astype('bool')

combined = ri.stop_date.str.cat(ri.stop_time, sep=' ')
ri['stop_datetime'] = pd.to_datetime(combined)

ri.set_index('stop_datetime', inplace=True)
```

In [65]:
```
# Calculate the overall arrest rate
print(ri.is_arrested.mean())
```

```
0.05182253697146428
```

In [66]:
```
# Calculate the hourly arrest rate
print(ri.groupby(ri.index.hour).is_arrested.mean())
```

```
stop_datetime
0     0.091657
1     0.113384
2     0.113103
3     0.084877
4     0.065217
5     0.037975
6     0.020573
7     0.022004
8     0.023802
9     0.031267
10    0.033094
11    0.026150
12    0.046575
13    0.035284
14    0.034194
15    0.046850
16    0.044487
17    0.054431
18    0.049796
19    0.059952
20    0.060850
21    0.115991
22    0.073970
23    0.066730
Name: is_arrested, dtype: float64
```


In [67]:

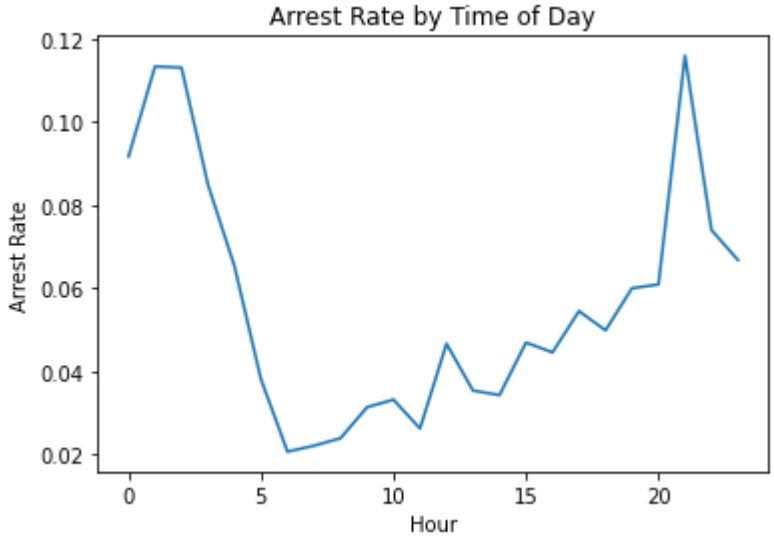
```
# Save the hourly arrest rate
hourly_arrest_rate = ri.groupby(ri.index.hour).is_arrested.mean()
```

In [70]:
```
# Plotting the hourly arrest rate
import matplotlib.pyplot as plt
```

In [71]:
```
# Create a line plot of 'hourly_arrest_rate'
hourly_arrest_rate.plot()

# Add the xlabel, ylabel, and title
plt.xlabel('Hour')
plt.ylabel('Arrest Rate')
plt.title('Arrest Rate by Time of Day')

# Display the plot
plt.show()
```



In [72]:
```
# Plotting drug-related stops
```

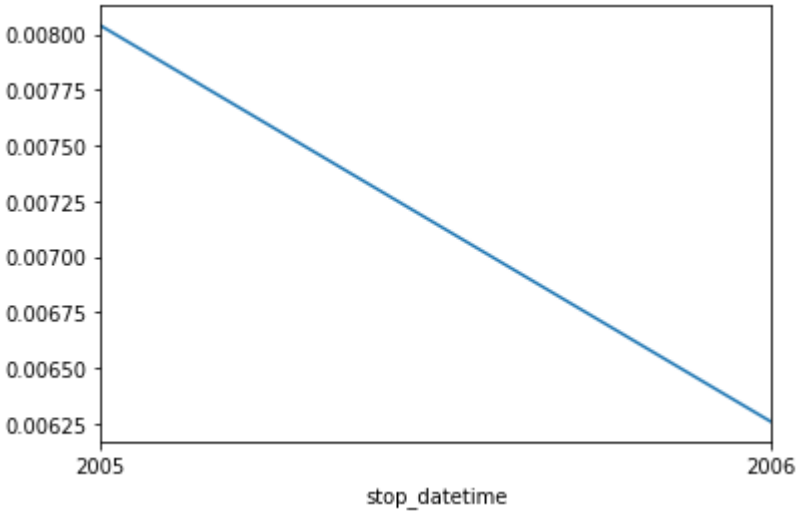
In [73]:
```
# Calculate the annual rate of drug-related stops
print(ri.drugs_related_stop.resample('A').mean())
```

```
stop_datetime
2005-12-31    0.008038
2006-12-31    0.006257
Freq: A-DEC, Name: drugs_related_stop, dtype: float64
```

In [74]:
```
# Save the annual rate of drug-related stops
annual_drug_rate = ri.drugs_related_stop.resample('A').mean()
```

In [75]:
```
# Create a line plot of 'annual_drug_rate'
annual_drug_rate.plot()

# Display the plot
```



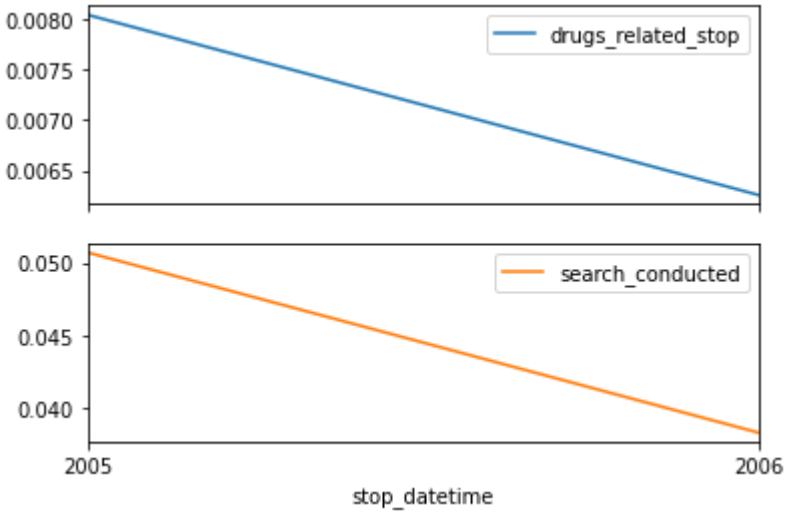
In [76]:
```
# Comparing drug and search rates
```

In [77]:
```
# Calculate and save the annual search rate
#annual_search_rate = ri.search_conducted.resample('A').mean()
annual_search_rate = ri.search_conducted.dropna().astype('int').resample('A').me
```

In [78]:
```
# Concatenate 'annual_drug_rate' and 'annual_search_rate'
annual = pd.concat([annual_drug_rate, annual_search_rate], axis='columns')
```

In [79]:
```
# Create subplots from 'annual'
annual.plot(subplots=True)

# Display the subplots
plt.show()
```



In [80]:
```
# Tallying violations by district
```

In [81]:
```
stricts and violations
print(pd.crosstab(ri.district, ri.violation))
```

violation	Equipment	Moving violation	Other	Registration/plates	Speeding
district					
Zone K1	276	517	69	52	5895
Zone K2	422	1220	156	256	7653
Zone K3	1083	1181	247	435	10608
Zone X1	93	643	44	9	1128
Zone X3	342	741	127	102	4148
Zone X4	806	2220	249	609	6679

In [82]:
```
# Save the frequency table as 'all_zones'
all_zones = pd.crosstab(ri.district, ri.violation)
```

In [83]:
```
# Select rows 'Zone K1' through 'Zone K3'
print(all_zones.loc['Zone K1':'Zone K3'])
```

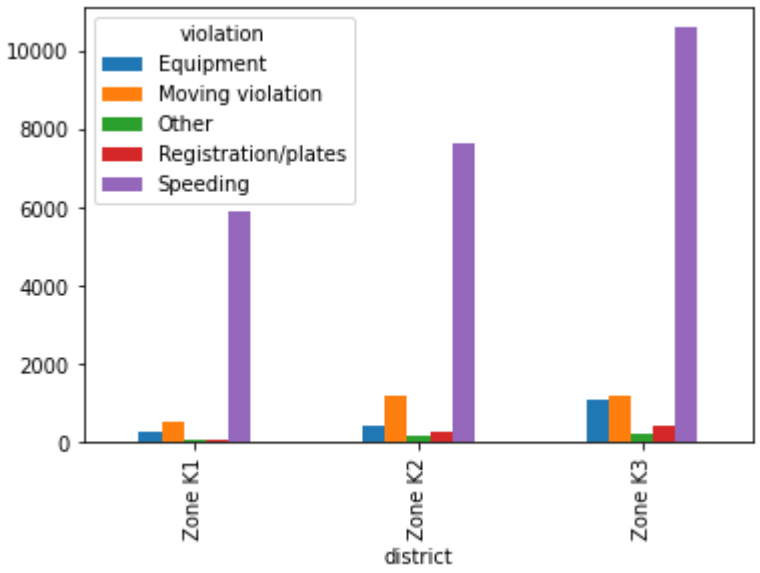
violation	Equipment	Moving violation	Other	Registration/plates	Speeding
district					
Zone K1	276	517	69	52	5895
Zone K2	422	1220	156	256	7653
Zone K3	1083	1181	247	435	10608

In [84]:
```
# Save the smaller table as 'k_zones'
k_zones = all_zones.loc['Zone K1':'Zone K3']
```

In [85]:
```
# Plotting violations by district
```

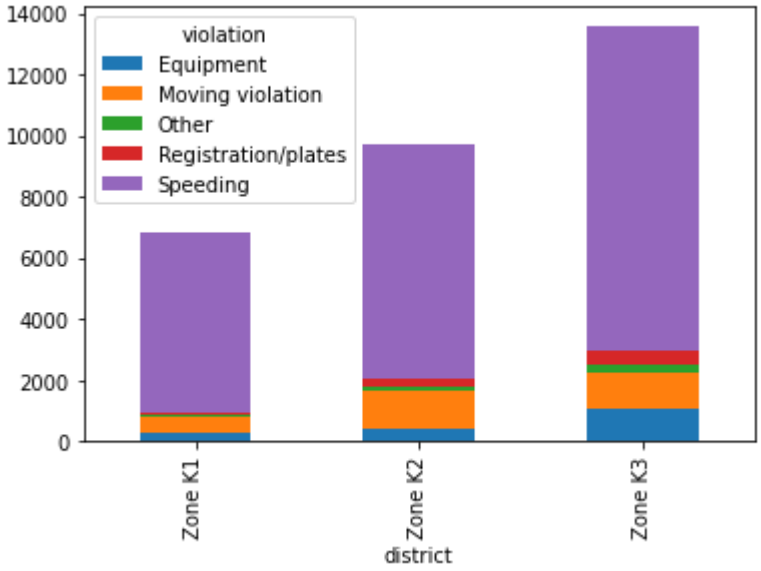
In [86]:
```
# Create a bar plot of 'k_zones'
k_zones.plot(kind='bar')

# Display the plot
plt.show()
```



In [87]:
```
# Create a stacked bar plot of 'k_zones'
                                    =True)
```

```
# Display the plot
plt.show()
```



In [ ]: