Hacktiv8 PTP Introduction to Data Science Projects 1 // Pu
Plot

Title: Hacktiv8 PTP Introduction to Data Science Projects 1: Publication-Grade Plc
Last Updated: September 20, 2020
Author: Raka Ardhi

Publication-grade Plot Introduction

The aim of this projects is to introduce you to data visualization with Python as cor
possible. Using what you've learned; download the London Crime Dataset from Ka
of crime in major metropolitan areas, such as London, occurs in distinct patterns.
criminal reports by month, LSOA borough, and major/minor category from Jan 20(

This dataset contains:

- `lsoa_code` : this represents a policing area
- `borough` : the london borough for which the statistic is related
- `major_category` : the major crime category
- `minor_category` : the minor crime category
- `value` : the count of the crime for that particular borough, in that particular mo
- `year` : the year of the summary statistic
- `month` : the month of the summary statistic

Formulate a question and derive a statistical hypothesis test to answer the questic
that you're able to make decisions using data in a scientific manner. And the impo
Examples of questions can be:

- What is the change in the number of crime incidents from 2011 to 2016?
- What were the top 3 crimes per borough in 2016?

Please make sure that you have completed the session for this course, namely Ac
part of this Program.

Note: You can take a look at Project Rubric below:

Criteria	Meet Expectations

Criteria	Meet Expectations
Area Plot	Mengimplementasikan Area Plot Menggunakan `Matplotlib` Dengan Kegunaan Plot/Grafik
Histogram	Mengimplementasikan Histogram Menggunakan `Matplotlib` Dengan Kegunaan Plot/Grafik.
Bar Chart	Mengimplementasikan Bar Chart Menggunakan `Matplotlib` Dengan Kegunaan Plot/Grafik.
Pie Chart	Mengimplementasikan Pie Chart Menggunakan `Matplotlib` Dengan Kegunaan Plot/Grafik.
Box Plot	Mengimplementasikan Box Plot Menggunakan `Matplotlib` Dengan D Kegunaan Plot/Grafik.
Scatter Plot	Mengimplementasikan Scatter Plot Menggunakan `Matplotlib` Denga Kegunaan Plot/Grafik.
Word Clouds	Mengimplementasikan Word Clouds Menggunakan `Wordclouds` Librar Dengan Kegunaan Plot/Grafik.
Folium Maps	Mengimplementasikan London Maps Menggunakan `Folium` .
Preprocessing	Student Melakukan Preproses Dataset Sebelum Menerapkan Visualisasi.
Apakah Kode Berjalan Tanpa Ada Eror?	Seluruh Kode Berfungsi Dan Dibuat Dengan Benar.
Area Plot	Menarik Informasi/Kesimpulan Berdasarkan Area Plot Yang Telah Student
Histogram	Menarik Informasi/Kesimpulan Berdasarkan Histogram Yang Telah Student
Bar Chart	Menarik Informasi/Kesimpulan Berdasarkan Bar Chart Yang Telah Student
Pie Chart	Menarik Informasi/Kesimpulan Berdasarkan Pie Chart Yang Telah Student
Box Plot	Menarik Informasi/Kesimpulan Berdasarkan Box Plot Yang Telah Student B
Scatter Plot	Menarik Informasi/Kesimpulan Berdasarkan Scatter Plot Yang Telah Studer
Overall Analysis	Menarik Informasi/Kesimpulan Dari Keseluruhan Plot Yang Dapat Menjawa

Exploring Datasets with *pandas*

pandas is an essential data analysis toolkit for Python. From their website (http://p

> *pandas* is a Python package providing fast, flexible, and expressive data s
> make working with “relational” or “labeled” data both easy and intuitive. It a
> fundamental high-level building block for doing practical, **real world** data a

The course heavily relies on *pandas* for data wrangling, analysis, and visualizatio some time and familizare yourself with the *pandas* API Reference: http://pandas.p /api.html (http://pandas.pydata.org/pandas-docs/stable/api.html).

The first thing we'll do is import two key data analysis modules: *pandas* and **Nump**

In [1]:

```python
import numpy as np
import pandas as pd
```

In [2]:

```python
df = pd.read_csv('london_crime_by_lsoa.csv')

print ('Data read into a pandas dataframe!')
```

```
Data read into a pandas dataframe!
```

In [3]:

```python
# Let's view the top 5 rows of the dataset using the head() function
df.head()
```

	lsoa_code	borough	major_category	minor_category	value	year	month
0	E01001116	Croydon	Burglary	Burglary in Other Buildings	0	2016	11
1	E01001646	Greenwich	Violence Against the Person	Other violence	0	2016	11
2	E01000677	Bromley	Violence Against the Person	Other violence	0	2015	5
3	E01003774	Redbridge	Burglary	Burglary in Other Buildings	0	2016	3
4	E01004563	Wandsworth	Robbery	Personal Property	0	2008	6

In [4]:

```python
# We can also veiw the bottom 5 rows of the dataset using the tail()
df.tail()
```

	lsoa_code	borough	major_category	minor_category	value	year
13490599	E01000504	Brent	Criminal Damage	Criminal Damage To Dwelling	0	2015
13490600	E01002504	Hillingdon	Robbery	Personal Property	1	2015
13490601	E01004165	Sutton	Burglary	Burglary in a Dwelling	0	2011
13490602	E01001134	Croydon	Robbery	Business Property	0	2011
13490603	E01003413	Merton	Violence Against the Person	Wounding/GBH	0	2015

When analyzing a dataset, it's always a good idea to start by getting basic informa
can do this by using the `info()` method.

In [5]:

```python
print(df.info())
print(df.describe())
print('minor_category ',df.minor_category.unique())
print('major_category ',df.major_category.unique())
print('borough ',df.borough.unique())

print("To check if any colun has null values")
print(df.isnull().any())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 13490604 entries, 0 to 13490603
Data columns (total 7 columns):
 #   Column          Dtype 
---  ------          ----- 
 0   lsoa_code       object
 1   borough         object
 2   major_category  object
 3   minor_category  object
 4   value           int64 
 5   year            int64 
 6   month           int64 
dtypes: int64(3), object(4)
memory usage: 720.5+ MB
None
              value          year         month
count  1.349060e+07  1.349060e+07  1.349060e+07
mean   4.779444e-01  2.012000e+03  6.500000e+00
std    1.771513e+00  2.581989e+00  3.452053e+00
min    0.000000e+00  2.008000e+03  1.000000e+00
25%    0.000000e+00  2.010000e+03  3.750000e+00
50%    0.000000e+00  2.012000e+03  6.500000e+00
75%    1.000000e+00  2.014000e+03  9.250000e+00
max    3.090000e+02  2.016000e+03  1.200000e+01
minor_category  ['Burglary in Other Buildings' 'Other violence' 'Personal Property'
 'Other Theft' 'Offensive Weapon' 'Criminal Damage To Other Building'
 'Theft/Taking of Pedal Cycle' 'Motor Vehicle Interference & Tampering'
 'Theft/Taking Of Motor Vehicle' 'Wounding/GBH' 'Other Theft Person'
 'Common Assault' 'Theft From Shops' 'Possession Of Drugs' 'Harassment'
 'Handling Stolen Goods' 'Criminal Damage To Dwelling'
 'Burglary in a Dwelling' 'Criminal Damage To Motor Vehicle'
 'Other Criminal Damage' 'Counted per Victim' 'Going Equipped'
 'Other Fraud & Forgery' 'Assault with Injury' 'Drug Trafficking'
 'Other Drugs' 'Business Property' 'Other Notifiable' 'Other Sexual'
 'Theft From Motor Vehicle' 'Rape' 'Murder']
major_category  ['Burglary' 'Violence Against the Person' 'Robbery' 'Theft and Handling'
 'Criminal Damage' 'Drugs' 'Fraud or Forgery' 'Other Notifiable Offences'
 'Sexual Offences']
borough  ['Croydon' 'Greenwich' 'Bromley' 'Redbridge' 'Wandsworth' 'Ealing'
 'Hounslow' 'Newham' 'Sutton' 'Haringey' 'Lambeth' 'Richmond upon Thames'
 'Hillingdon' 'Havering' 'Barking and Dagenham' 'Kingston upon Thames'
 'Westminster' 'Hackney' 'Enfield' 'Harrow' 'Lewisham' 'Brent' 'Southwark'
 'Barnet' 'Waltham Forest' 'Camden' 'Bexley' 'Kensington and Chelsea'
 'Islington' 'Tower Hamlets' 'Hammersmith and Fulham' 'Merton'
 'City of London']
To check if any colun has null values
lsoa_code         False
borough           False
major_category    False
minor_category    False
value             False
```

```
year                 False
month                False
dtype: bool
```

To get the list of column headers we can call upon the dataframe's `.columns` para

In [6]:

```
df.columns.values
```

```
array(['lsoa_code', 'borough', 'major_category', 'minor_category',
       'value', 'year', 'month'], dtype=object)
```

Similarly, to get the list of indicies we use the `.index` parameter.

In [7]:

```
df.index.values
```

```
array([       0,        1,        2, ..., 13490601, 13490602, 13490603])
```

Rename column

In [8]:

```
df.rename(columns={'borough':'District'}, inplace=True)
df.head()
```

	lsoa_code	District	major_category	minor_category	value	year	month
0	E01001116	Croydon	Burglary	Burglary in Other Buildings	0	2016	11
1	E01001646	Greenwich	Violence Against the Person	Other violence	0	2016	11
2	E01000677	Bromley	Violence Against the Person	Other violence	0	2015	5
3	E01003774	Redbridge	Burglary	Burglary in Other Buildings	0	2016	3
4	E01004563	Wandsworth	Robbery	Personal Property	0	2008	6

To view the dimensions of the dataframe, we use the `.shape` parameter.

In [9]:

```
print(df.shape)
```

```
(13490604, 7)
```

Let's make one dataset that contains value 1 in value features.

In [10]:

```
criminal = df[df['value'] == 1]
```

In [11]:

```
df1 = df.copy()
```

```
df1.drop(['lsoa_code','minor_category'], axis=1, inplace=True)
df1
```

	District	major_category	value	year	month
0	Croydon	Burglary	0	2016	11
1	Greenwich	Violence Against the Person	0	2016	11
2	Bromley	Violence Against the Person	0	2015	5
3	Redbridge	Burglary	0	2016	3
4	Wandsworth	Robbery	0	2008	6
...	...	...	...	...	...
13490599	Brent	Criminal Damage	0	2015	2
13490600	Hillingdon	Robbery	1	2015	6
13490601	Sutton	Burglary	0	2011	2
13490602	Croydon	Robbery	0	2011	5
13490603	Merton	Violence Against the Person	0	2015	6

13490604 rows × 5 columns

In [12]:

```
drugs = df1[(df1['major_category'] == 'Drugs') & (df1['year'] == 201
print(drugs.value.sum())
```

```
38914
```

In [13]:

```
df_sum = df1.groupby(['year','District']).size().reset_index(name='c
print(df_sum)
print(df_sum.columns)
```

```
     year              District  count_per_year
0    2008  Barking and Dagenham           34560
1    2008                Barnet           63648
2    2008                Bexley           42852
3    2008                 Brent           54516
4    2008               Bromley           58212
..    ...                   ...             ...
292  2016                Sutton           35832
293  2016         Tower Hamlets           45792
294  2016        Waltham Forest           45144
295  2016            Wandsworth           55404
296  2016           Westminster           40740

[297 rows x 3 columns]
Index(['year', 'District', 'count_per_year'], dtype='object')
```

In [14]:

```
table = df1.pivot_table(values='value', index=['year'],columns=['maj
table
```

major_category	Burglary	Criminal Damage	Drugs	Fraud or Forgery	Other Notifiable Offences	Robbery	Sex Offen
year							
2008	88092	91872	68804	5325	10112	29627	1273
2009	90619	85565	60549	0	10644	29568	0
2010	86826	77897	58674	0	10768	32341	0
2011	93315	70914	57550	0	10264	36679	0
2012	93392	62158	51776	0	10675	35260	0
2013	87222	56206	50278	0	10811	29337	0
2014	76053	59279	44435	0	13037	22150	0
2015	70489	62976	39785	0	14229	21383	0
2016	68285	64071	38914	0	15809	22528	0

Visualizing Data using Matplotlib

Matplotlib: Standard Python Visualization Library

The primary plotting library we will explore in the course is Matplotlib (http://matplc
website:

> Matplotlib is a Python 2D plotting library which produces publication quality
> hardcopy formats and interactive environments across platforms. Matplotli
> scripts, the Python and IPython shell, the jupyter notebook, web applicatio
> graphical user interface toolkits.

If you are aspiring to create impactful visualization with python, Matplotlib is an es
disposal.

Matplotlib.Pyplot

One of the core aspects of Matplotlib is `matplotlib.pyplot` .

Let's start by importing `Matplotlib` and `Matplotlib.pyplot` as follows:

In [15]:

```
# we are using the inline backend
%matplotlib inline

import matplotlib as mpl
import matplotlib.pyplot as plt
```

In [16]:

```
mpl.style.use(['ggplot']) # optional: for ggplot-like style
```

Area Pots (Series/Dataframe)

What is a line plot and why use it?

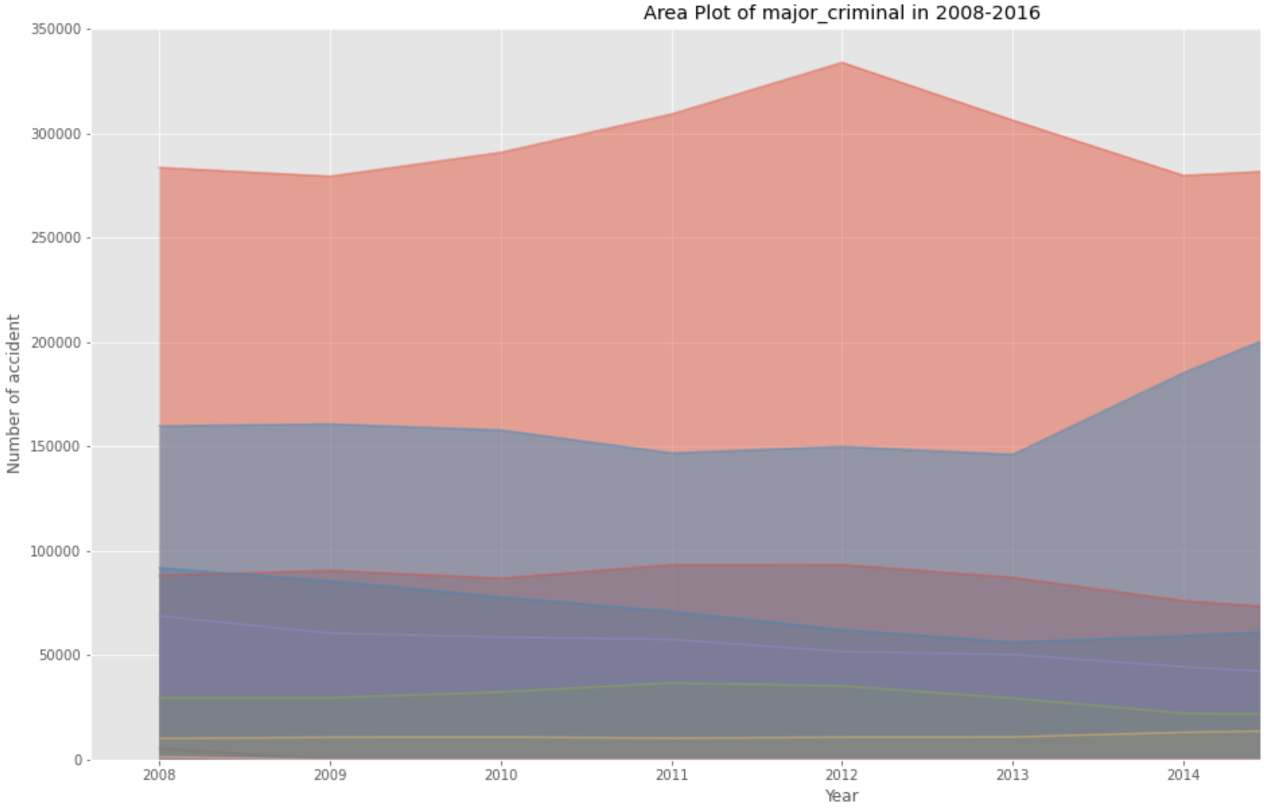
An Area chart or area plot is a type of plot which displays information as a series o
connected by straight line segments. It is a basic type of chart common in many fi
have a continuous data set. These are best suited for trend-based visualizations o

Questions:

1. what most major_criminal in 2008-2016?

In [17]:

```python
# Write your function below
table.plot(kind='area',
           alpha=0.45,
             stacked=False,
             figsize=(20, 10), # pass a tuple (x, y) size
             )
# Graded-Funtion Begin (~1 Lines)

# Graded-Funtion End

plt.title('Area Plot of major_criminal in 2008-2016') # add a title
plt.ylabel('Number of accident') # add y-label
plt.xlabel('Year') # add x-label

plt.show()
```



Insight:

Based on graph, Thef and Handling is most major criminal happend during 2008-2

Histogram

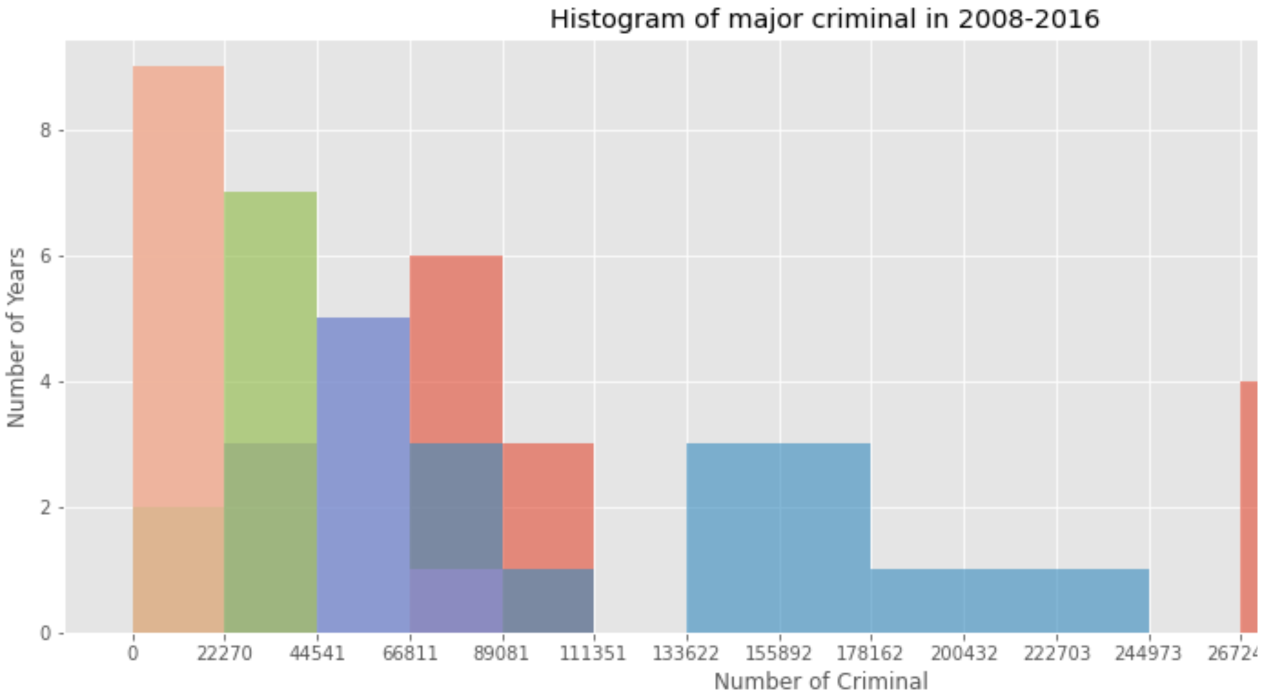
A histogram is a way of representing the frequency distribution of numeric dataset
the x-axis into bins, assigns each data point in our dataset to a bin, and then coun
that have been assigned to each bin. So the y-axis is the frequency or the numbe
that we can change the bin size and usually one needs to tweak it so that the distr

Question:

1. Frequency major case criminal in London (Make your own questions)

In [18]:

```
# Write your function below
count, bin_edges = np.histogram(table, 15)
table.plot(kind ='hist',
          figsize=(15, 6),
          bins=15,
          alpha=0.6,
          xticks=bin_edges,
         )
# Graded-Funtion Begin (~2 Lines)

# Graded-Funtion End

plt.title('Histogram of major criminal in 2008-2016') # add a title
plt.ylabel('Number of Years') # add y-label
plt.xlabel('Number of Criminal ') # add x-label

plt.show()
```



Insight: Most frequency cases in london between 2008-2016 is Thef and Handlin

Bar Charts (Dataframe)

A bar plot is a way of representing data where the *length* of the bars represents th
feature/variable. Bar graphs usually represent numerical and categorical variables

To create a bar plot, we can pass one of two arguments via `kind` parameter in `pl`

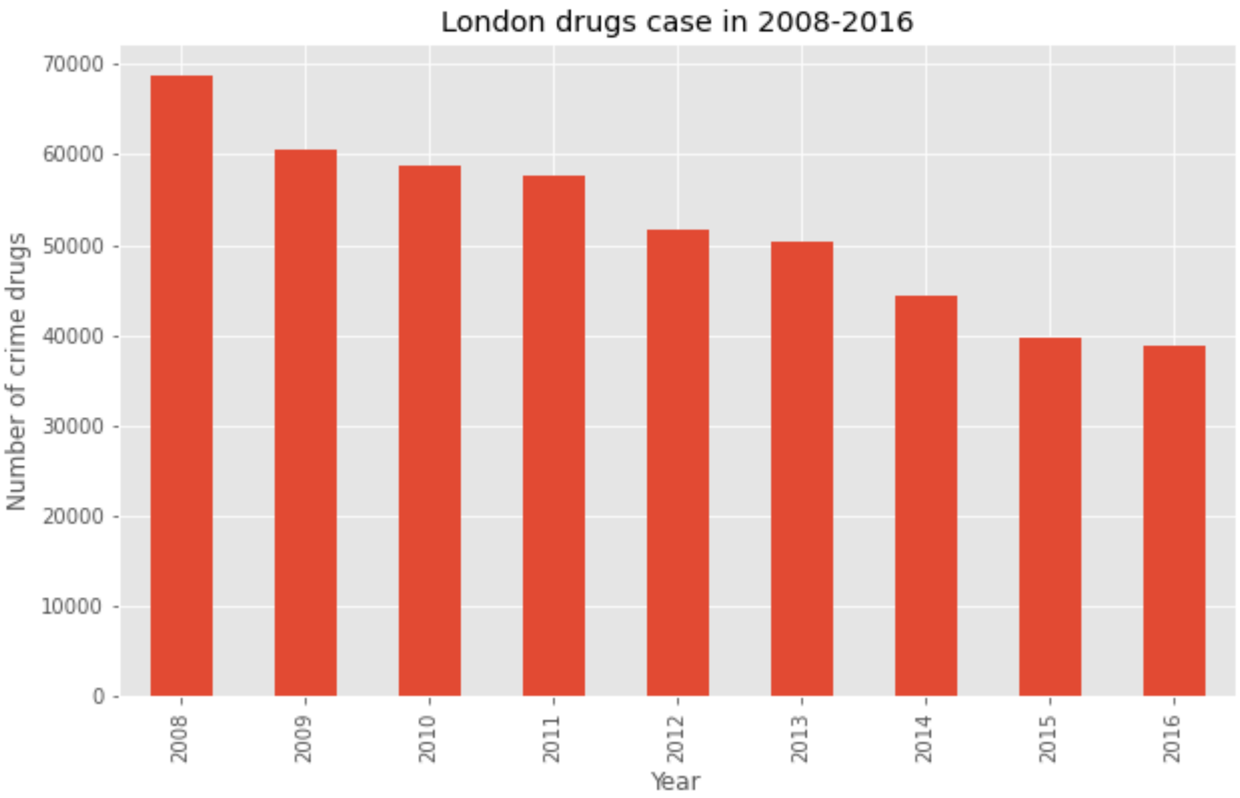
- `kind=bar` creates a *vertical* bar plot
- `kind=barh` creates a *horizontal* bar plot

Question:

1. Yearly drug case in London from 2008-2016?

In [19]:

```python
# Write your function below
table_bar = table['Drugs']
table_bar.plot(kind='bar', figsize=(10, 6))
# Graded-Funtion Begin (~1 Lines)

# Graded-Funtion End

plt.xlabel('Year') # add to x-label to the plot
plt.ylabel('Number of crime drugs') # add y-label to the plot
plt.title('London drugs case in 2008-2016') # add title to the plot

plt.show()
```



Insight:

Drug case in London is decrasing in 2008-2016

Pie Charts

A `pie chart` is a circualr graphic that displays numeric proportions by dividing a c
slices. You are most likely already familiar with pie charts as it is widely used in bu

create pie charts in Matplotlib by passing in the `kind=pie` keyword.

Question:

(Make your own questions)

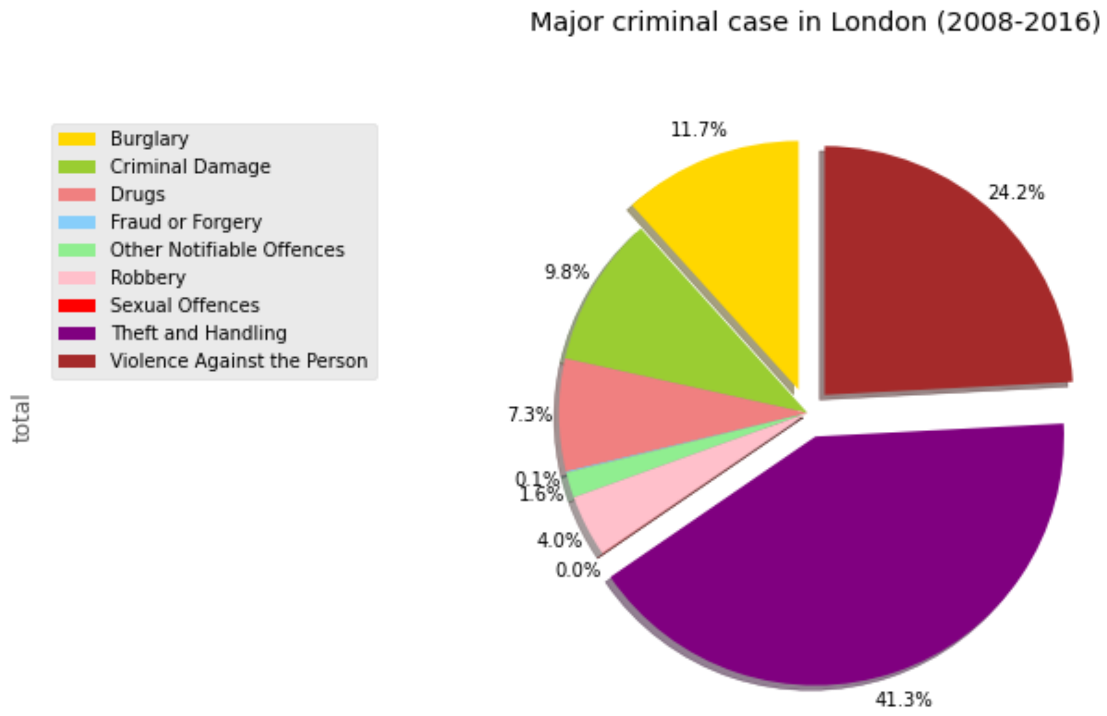
In [20]:

```
table_pie = table.transpose()
table_pie['total'] = table.sum()
table_pie

```

year	2008	2009	2010	2011	2012	2013	2014	2015	201
major_category									
Burglary	88092	90619	86826	93315	93392	87222	76053	70489	68285
Criminal Damage	91872	85565	77897	70914	62158	56206	59279	62976	64071
Drugs	68804	60549	58674	57550	51776	50278	44435	39785	38914
Fraud or Forgery	5325	0	0	0	0	0	0	0	0
Other Notifiable Offences	10112	10644	10768	10264	10675	10811	13037	14229	15809
Robbery	29627	29568	32341	36679	35260	29337	22150	21383	22528
Sexual Offences	1273	0	0	0	0	0	0	0	0
Theft and Handling	283692	279492	290924	309292	334054	306372	279880	284022	29413
Violence Against the Person	159844	160777	157894	146901	150014	146181	185349	218740	23238

In [23]:

```
# Write your function below

# ratio for each continent with which to offset each wedge.
colors_list = ['gold', 'yellowgreen', 'lightcoral', 'lightskyblue',
explode_list = [0.1, 0, 0, 0, 0, 0, 0, 0.1, 0.1]

# Graded-Funtion Begin (~8 Lines)
table_pie['total'].plot(kind='pie',
                      figsize=(15, 6),
                      autopct='%1.1f%%',
                      startangle=90,
                      shadow=True,
                      labels=None,         # turn off labels on pie
                      colors=colors_list,  # add custom colors
                      # the ratio between the center of each pie sli
                      pctdistance=1.12,
                      explode=explode_list  # 'explode'
                      )
# Graded-Funtion End

# scale the title up by 12% to match pctdistance
plt.title('Major criminal case in London (2008-2016)', y=1.12)

plt.axis('equal')

# add legend
plt.legend(labels=table_pie.index, loc='upper left')

plt.show()
```



Insight:

Theft and Handling is most major criminal case in London during 2008-2016, with

Box Plots

A `box plot` is a way of statistically representing the *distribution* of the data throug

- **Minimun:** Smallest number in the dataset.
- **First quartile:** Middle number between the `minimum` and the `median` .

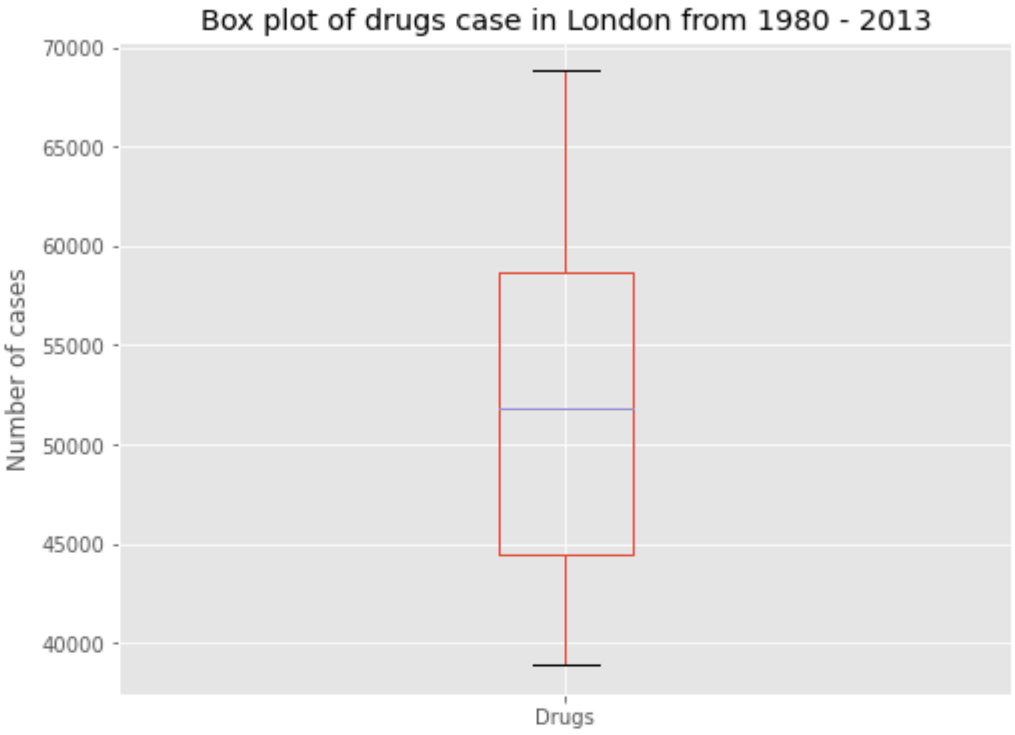
- **Second quartile (Median):** Middle number of the (sorted) dataset.
- **Third quartile:** Middle number between `median` and `maximum`.
- **Maximum:** Highest number in the dataset.

Question:

1. Describe drug case in London from 2008-2016? (Make your own questions)

In [24]:

```
# Write your function below
table_bar.plot(kind='box', figsize=(8, 6))
# Graded-Funtion Begin (~1 Lines)

# Graded-Funtion End

plt.title('Box plot of drugs case in London from 1980 - 2013')
plt.ylabel('Number of cases')

plt.show()
```



Insight: Drugs max cases is around 70000 cases (Make your own Insight)

Scatter Plots

A `scatter plot` (2D) is a useful method of comparing variables against each oth

`line plots` in that they both map independent and dependent variables on a 2D
connected together by a line in a line plot, they are not connected in a scatter plot
considered to express a trend. With further analysis using tools like regression, we
this relationship and use it to predict trends outside the dataset.

Question:

1. lets compare Drugs and Robbery

(Make your own questions)

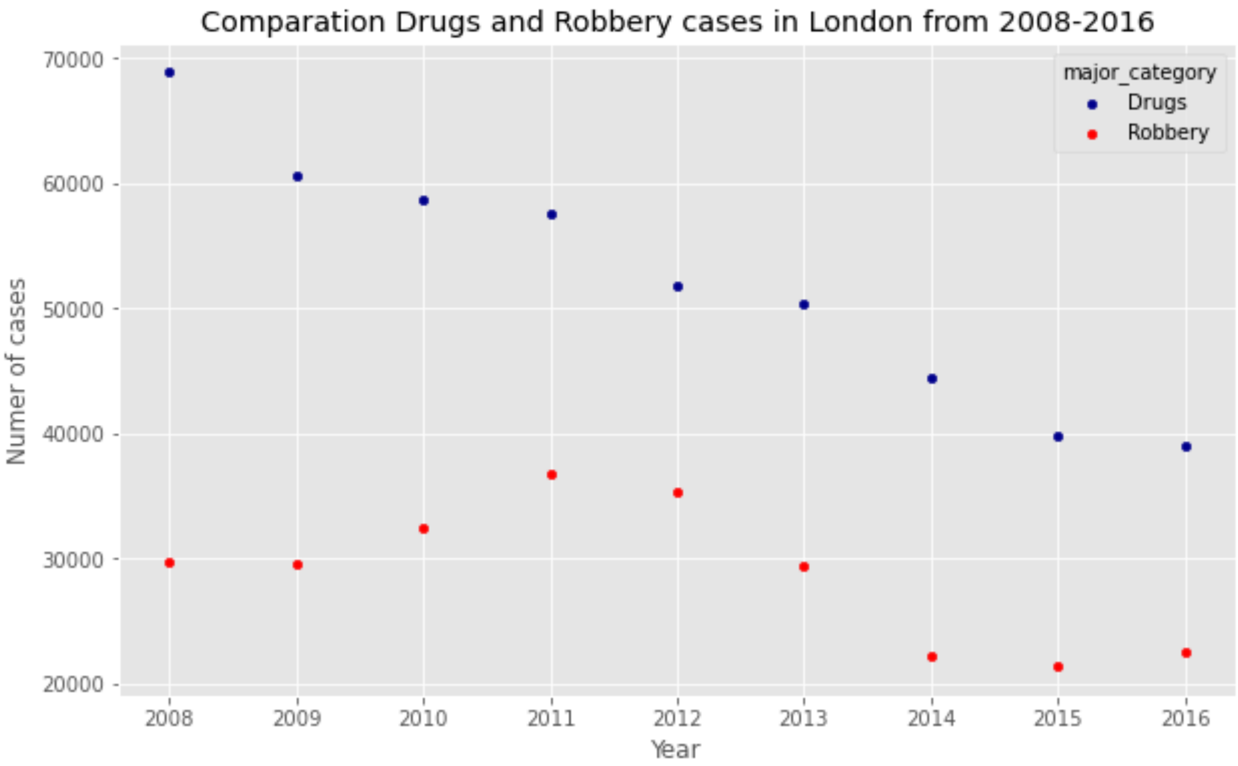
In [68]:

```
table_scatter = table[['Drugs','Robbery']]
table_scatter = table_scatter.reset_index()
table_scatter
```

major_category	year	Drugs	Robbery
0	2008	68804	29627
1	2009	60549	29568
2	2010	58674	32341
3	2011	57550	36679
4	2012	51776	35260
5	2013	50278	29337
6	2014	44435	22150
7	2015	39785	21383
8	2016	38914	22528

In [84]:

```
# Write your function below

# Graded-Funtion Begin (~1 Lines)
ax1 = table_scatter.plot(kind='scatter', x='year', y='Drugs', figsiz
ax2 = table_scatter.plot(kind='scatter', x='year', y='Robbery', figs

# Graded-Funtion End

plt.title('Comparation Drugs and Robbery cases in London from 2008-2
plt.xlabel('Year')
plt.ylabel('Numer of cases')
plt.show()
```



Word Clouds

`Word` clouds (also known as text clouds or tag clouds) work in a simple way: the r
a source of textual data (such as a speech, blog post, or database), the bigger an
cloud.

In [27]:

```
# install wordcloud
# !conda install -c conda-forge wordcloud --yes

# !pip install wordcloud

# import package and its set of stopwords
from wordcloud import WordCloud, STOPWORDS

print ('Wordcloud is installed and imported!')
```

```
Wordcloud is installed and imported!
```

In [28]:

```
stopwords = set(STOPWORDS)
```

In [29]:

```
# table_minor = df[['minor_category']]
source_dataset = ' '.join(df.major_category)
```

In [30]:

```
# instantiate a word cloud object
your_wordcloud = WordCloud(
    background_color='white',
    max_words=2000,
    stopwords=stopwords
)

# generate the word cloud
your_wordcloud.generate(source_dataset)
```

```
<wordcloud.wordcloud.WordCloud at 0x7fc1e4e41850>
```

In [31]:

```python
# Write your function below

# Graded-Funtion Begin (~1 Lines)
plt.imshow(your_wordcloud, interpolation='bilinear')
# Graded-Funtion End

plt.axis('off')
plt.show()
```

Folium

Folium is a powerful Python library that helps you create several types of Leaflet r
results are interactive makes this library very useful for dashboard building.

From the official Folium documentation page:

> Folium builds on the data wrangling strengths of the Python ecosystem an
> of the Leaflet.js library. Manipulate your data in Python, then visualize it in
> Folium.

> Folium makes it easy to visualize data that's been manipulated in Python c
> map. It enables both the binding of data to a map for choropleth visualizati
> Vincent/Vega visualizations as markers on the map.

> The library has a number of built-in tilesets from OpenStreetMap, Mapbox,
> supports custom tilesets with Mapbox or Cloudmade API keys. Folium sup
> and TopoJSON overlays, as well as the binding of data to those overlays t
> with color-brewer color schemes.

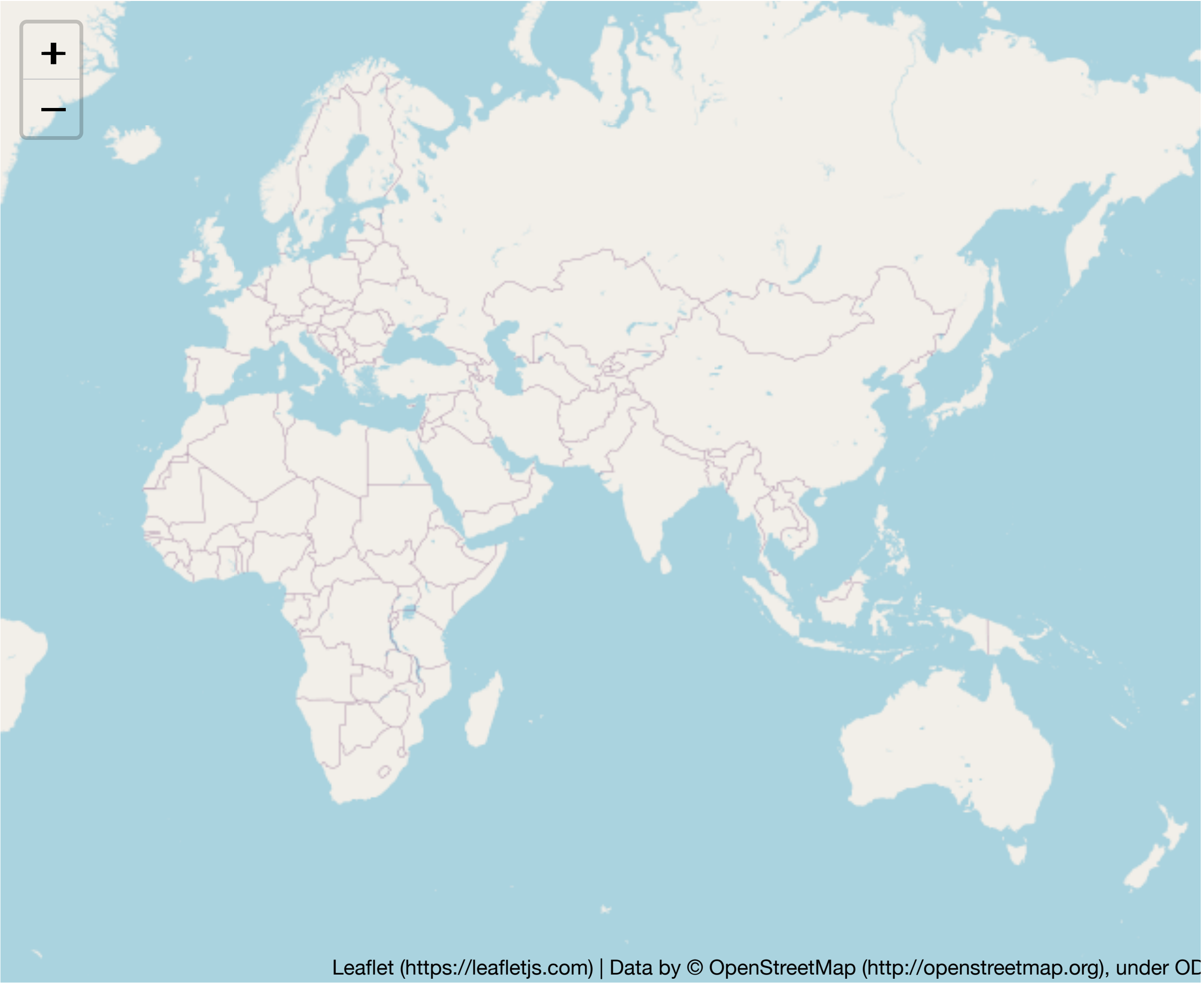
In [32]:

```
#!conda install -c conda-forge folium=0.5.0 --yes
import folium

print('Folium installed and imported!')
```

```
Folium installed and imported!
```

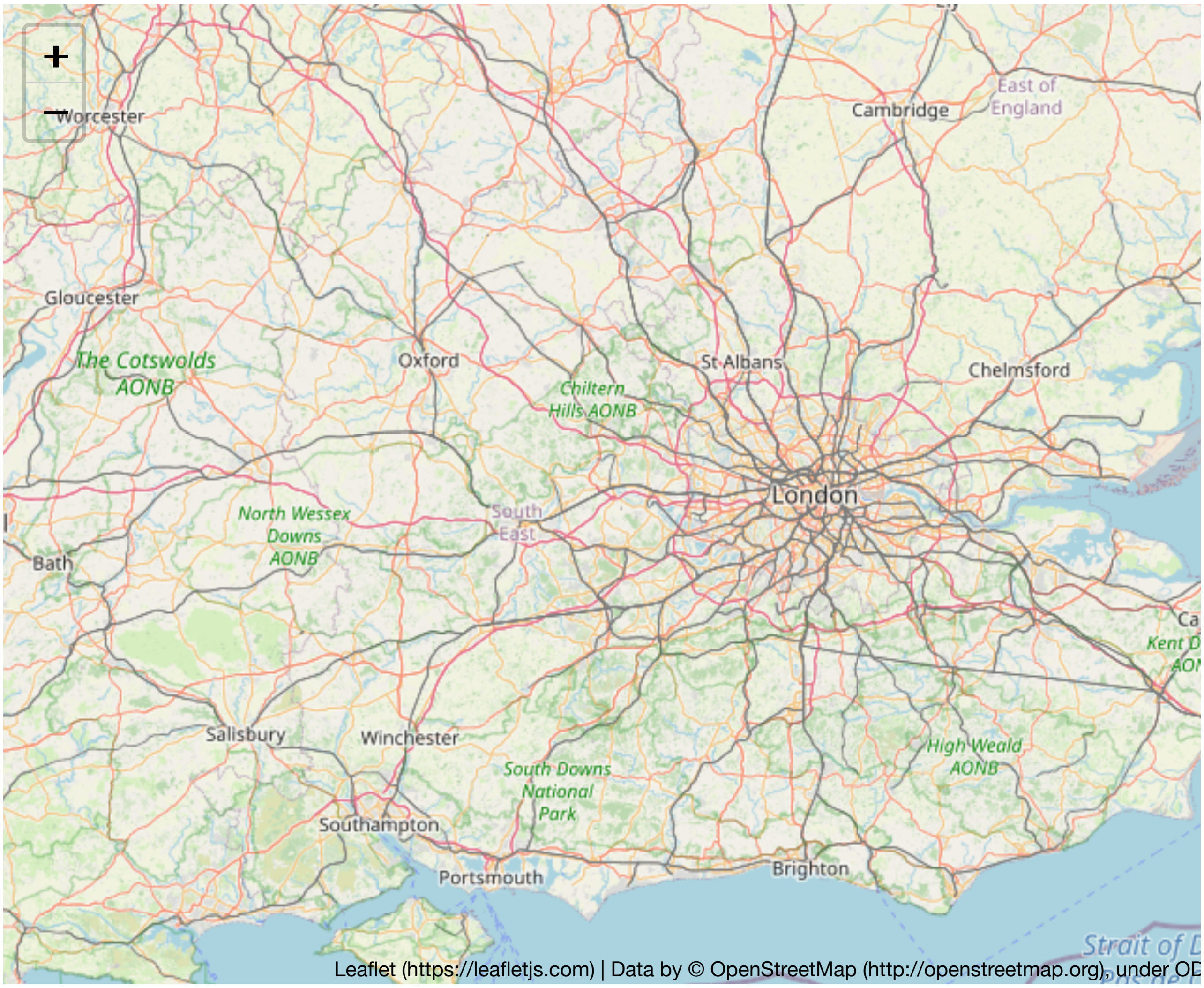
In [33]:

```
# define the world map
world_map = folium.Map()

# display world map
world_map
```


+
−
Leaflet (https://leafletjs.com) | Data by © OpenStreetMap (http://openstreetmap.org), under OD

In [35]:

```
# define the world map centered around London with a low zoom level
world_map = folium.Map(location=[51.509865, -0.118092], zoom_start=8
# Write your function below

# Graded-Funtion Begin (~1 Lines)

# Graded-Funtion End

# display world map
world_map
```



Leaflet (https://leafletjs.com) | Data by © OpenStreetMap (http://openstreetmap.org), under OD

Thanks For Completing This Labs!