Hands-on Activity 9.1 Data Visualization using Pandas and Matplotlib

Instructions:

Create a Python notebook to answer all shown procedures, exercises and analysis in this section. Resources:

Download the following datasets: earthquakes-1.csv Download earthquakes-1.csv, fb_stock_prices_2018.csv Download fb_stock_prices_2018.csv

Procedures:

9.1 Introduction to Matplotlib

9.2 Plotting with Pandas

9.3 Pandas Plotting Subpackage

Data Analysis:

Provide comments on output from the procedures above. Supplementary Activity:

Using the CSV files provided and what we have learned so far in this module complete the following exercises:

Plot the rolling 20-day minimum of the Facebook closing price with the pandas plot() method.

Create a histogram and KDE of the change from open to close in the price of Facebook stock.

Using the earthquake data, create box plots for the magnitudes of each magType used in Indonesia.

Make a line plot of the difference between the weekly maximum high price and the weekly minimum low price for Facebook. This should be a single line.

Using matplotlib and pandas, create two subplots side-by-side showing the effect that after-hours trading has had on Facebook's stock price:

The first subplot will contain a line plot of the daily difference between that day's opening price and the prior day's closing price (be sure to review the Time series section of Aggregating Pandas DataFrames for an easy way to do this).

The second subplot will be a bar plot showing the net effect this had monthly, using resample().

Bonus #1: Color the bars according to whether they are gains in the stock price (green) or drops in the stock price (red).

Bonus #2: Modify the x-axis of the bar plot to show the threeletter abbreviation for the month.

Summary/Conclusion:

Provide a summary of your learnings and the conclusion for this activity.

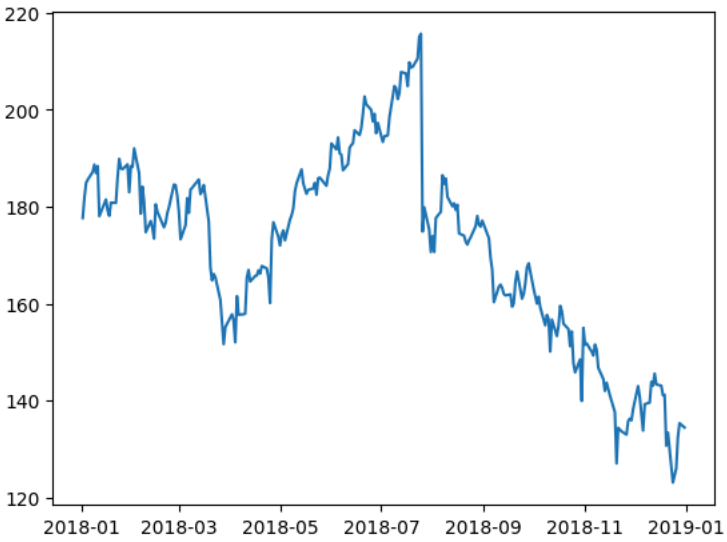
Start of HOA 9.1

```
import matplotlib.pyplot as plt
import pandas as pd

#Import libraries


fb = pd.read_csv(
    '/content/fb_stock_prices_2018.csv', index_col='date', parse_dates = True
)

plt.plot(fb.index, fb.open)
plt.show

#load csv file and use time series plot to show index as X and open as Y values
```

```
matplotlib.pyplot.show
def show(*args, **kwargs) -> None
```

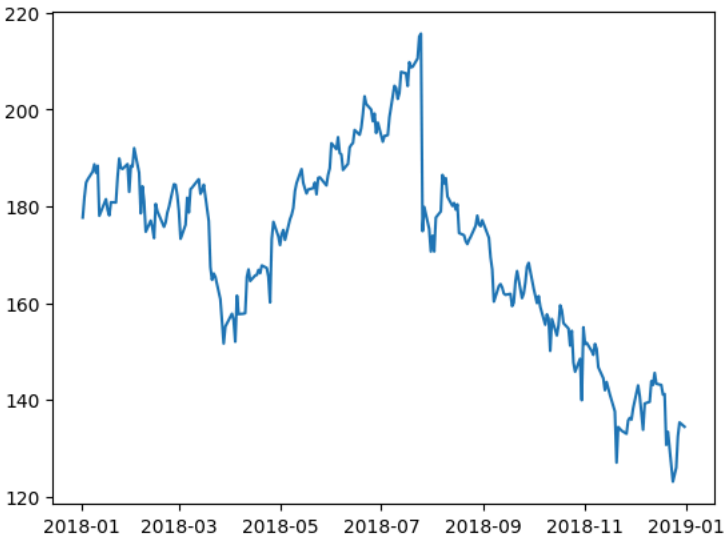
```
Display all open figures.

Paramet
----------
block : bool, optional
    Whether to wait for all figures to be closed before returning.
```

Insert code cell below (Ctrl+M B)



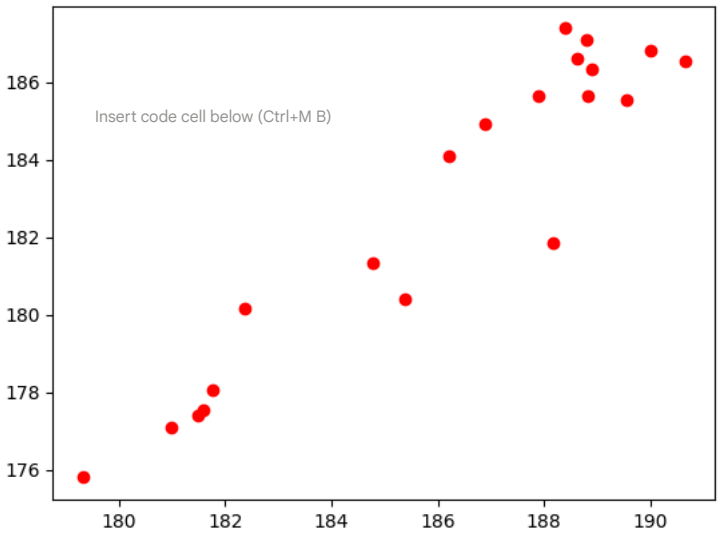

```
import matplotlib.pyplot as plt
import pandas as pd
%matplotlib inline

fb = pd.read_csv(
 '/content/fb_stock_prices_2018.csv', index_col='date', parse_dates=True
 )

plt.plot(fb.index, fb.open)

# Used time series plot for index as X and Open as Y values
```

```
[<matplotlib.lines.Line2D at 0x7b488b068b50>]
```



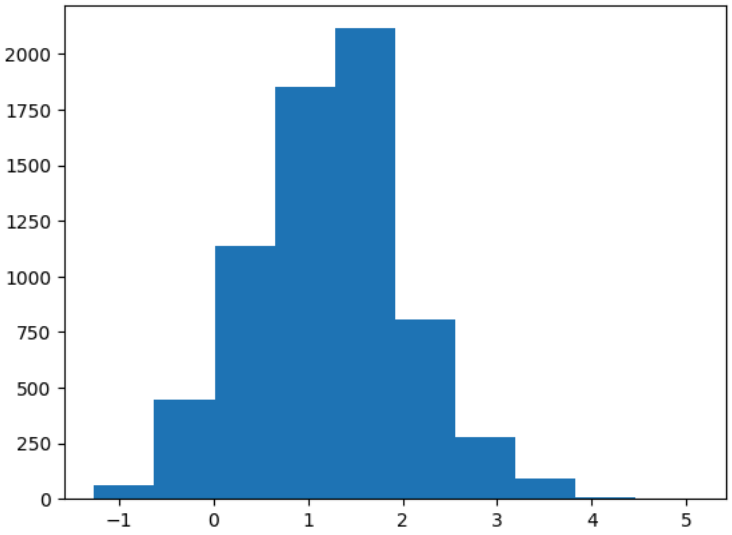

```
plt.plot('high','low','ro', data = fb.head(20))

#Scatter plot for data
```

```
[<matplotlib.lines.Line2D at 0x7b488b085890>]
```

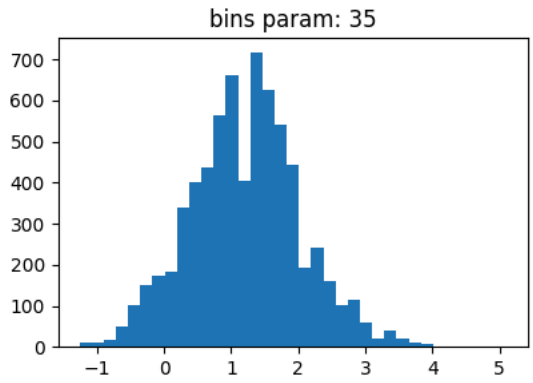



```
quakes = pd.read_csv('/content/earthquakes-1.csv')
plt.hist(quakes.query('magType == "ml"').mag)

#histogram of magtypes
```

```
(array([6.400e+01, 4.450e+02, 1.137e+03, 1.853e+03, 2.114e+03, 8.070e+02,
        2.800e+02, 9.200e+01, 9.000e+00, 2.000e+00]),
 array([-1.26 , -0.624,  0.012,  0.648,  1.284,  1.92 ,  2.556,  3.192,
         3.828,  4.464,  5.1  ]),
 <BarContainer object of 10 artists>)
```



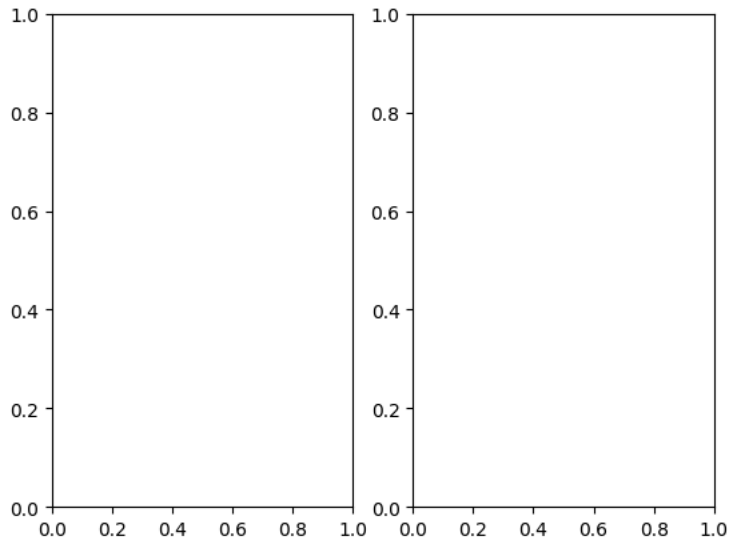

```
x = quakes.query('magType == "ml"').mag
fig, axes = plt.subplots(1, 2, figsize=(10, 3))
for ax, bins in zip(axes, [7, 35]):
  ax.hist(x, bins=bins)
  ax.set_title(f'bins param: {bins}')

  #histogram of magtypes sorted in bin sizes
```



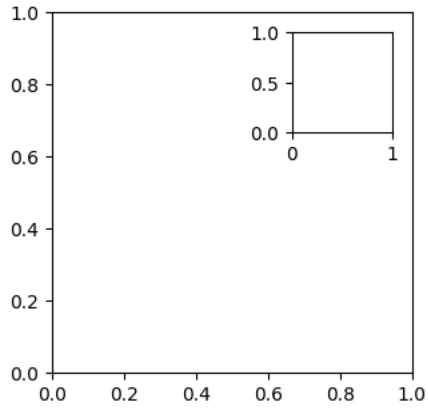

```
fig = plt.figure()
```

```
<Figure size 640x480 with 0 Axes>
```

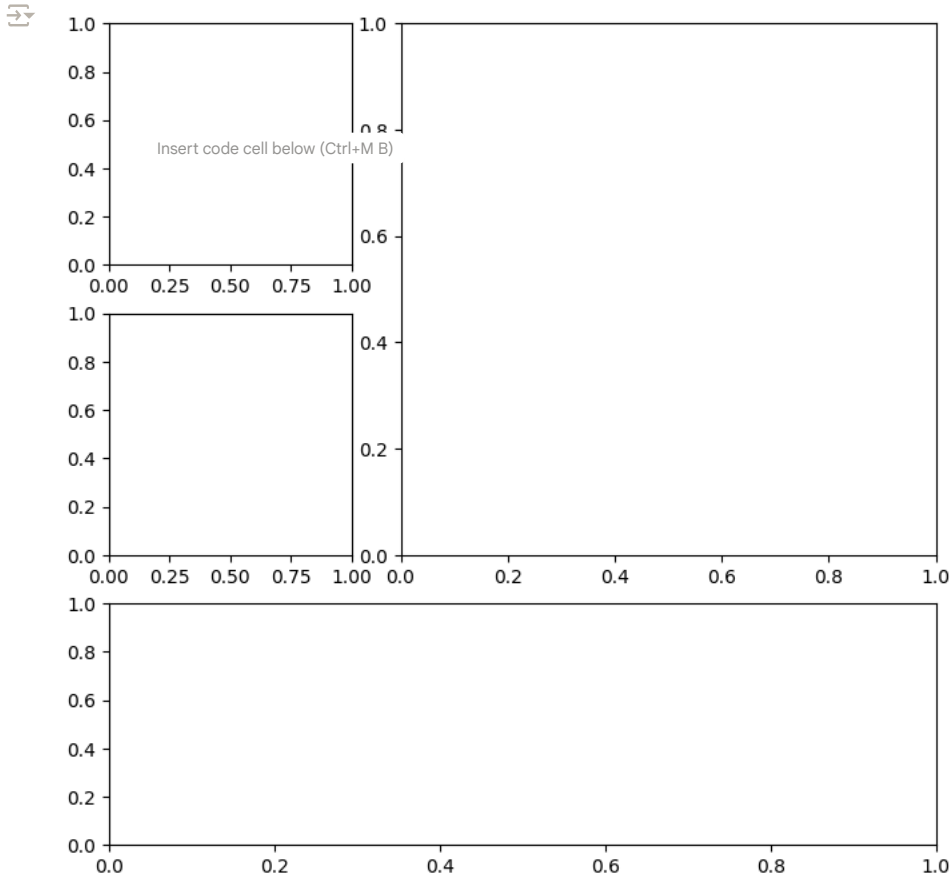
```
fig, axes = plt.subplots(1,2)
```



```
fig = plt.figure(figsize=(3, 3))
outside = fig.add_axes([0.1, 0.1, 0.9, 0.9])
inside = fig.add_axes([0.7, 0.7, 0.25, 0.25])
```



```
fig = plt.figure(figsize=(8, 8))
gs = fig.add_gridspec(3, 3)
top_left = fig.add_subplot(gs[0, 0])
mid_left = fig.add_subplot(gs[1, 0])
top_right = fig.add_subplot(gs[:2, 1:])
bottom = fig.add_subplot(gs[2,:])
```



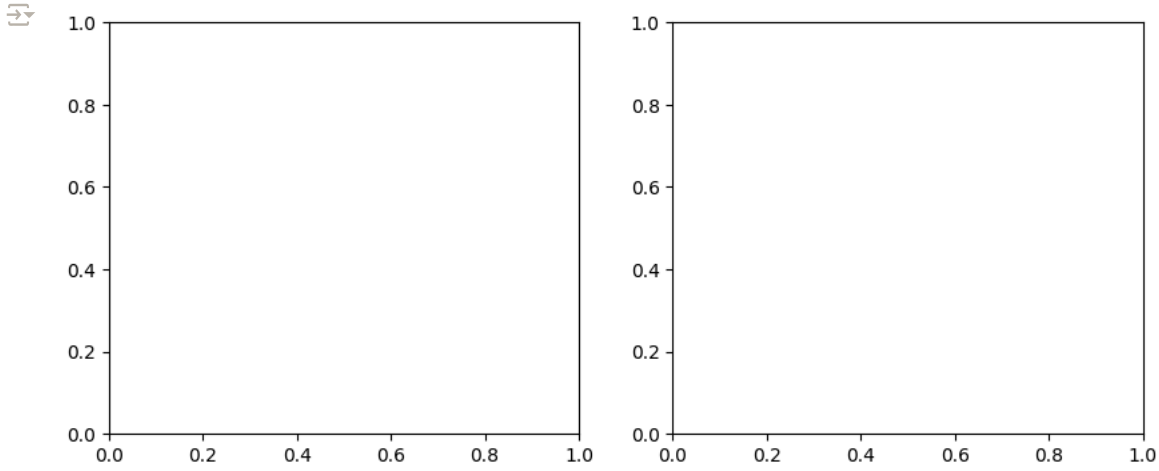

```
fig.savefig('empty.png')
```

```
plt.close('all')
```

```
fig = plt.figure(figsize=(10,4))
```

```
<Figure size 1000x400 with 0 Axes>
```

```
fig, axes = plt.subplots(1, 2, figsize=(10, 4))
```



```
import random
import matplotlib as mpl

rcparams_list = list(mpl.rcParams.keys())
random.seed(20) # make this repeatable
random.shuffle(rcparams_list)
sorted(rcparams_list[:20])
```

```
['axes.edgecolor',
 'axes.titleweight',
 'boxplot.whiskerprops.linestyle',
 'date.autoformatter.day',
 'figure.constrained_layout.hspace',
 'figure.titlesize'
 'image.i  Insert code cell below (Ctrl+M B)
 'keymap.copy',
 'legend.framealpha',
 'legend.handleheight',
 'lines.dash_joinstyle',
 'lines.markerfacecolor',
 'mathtext.default',
 'mathtext.fallback',
 'pdf.compression',
 'svg.fonttype',
 'text.usetex',
 'yaxis.labellocation',
 'ytick.major.size',
 'ytick.minor.visible']
```

```
mpl.rcParams['figure.figsize']
```

```
[6.4, 4.8]
```

```
mpl.rcParams['figure.figsize'] = (300, 10)
mpl.rcParams['figure.figsize']
```

```
[300.0, 10.0]
```

```
mpl.rcdefaults()
mpl.rcParams['figure.figsize']
```

```
[6.4, 4.8]
```

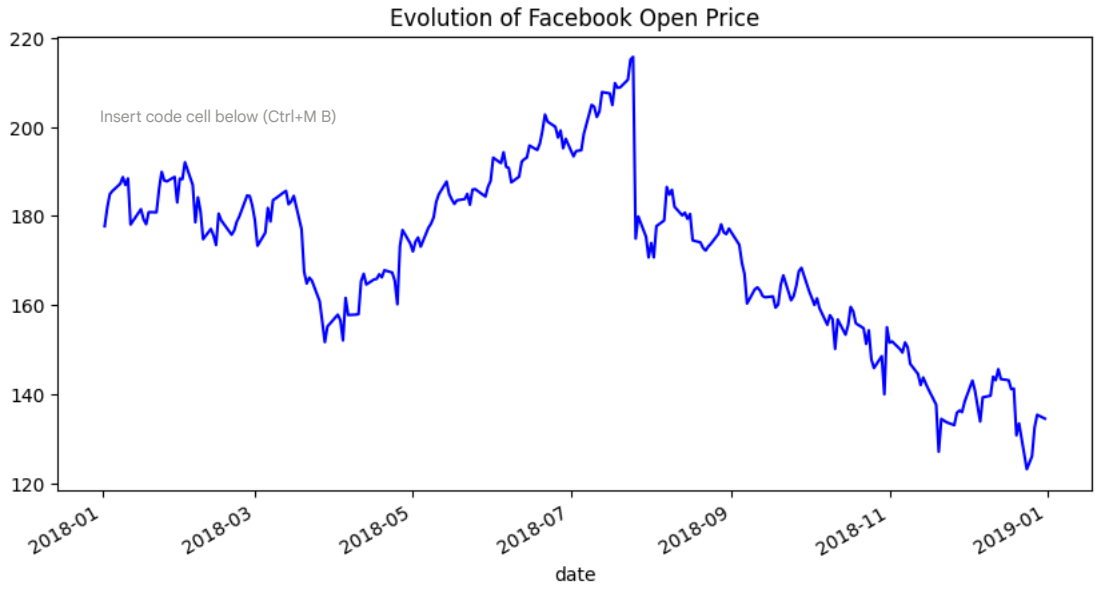
```
plt.rc('figure', figsize=(20, 20))
plt.rcdefaults()
```

Start of HOA 9.2

```
%matplotlib inline
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
fb = pd.read_csv(
   'fb_stock_prices_2018.csv', index_col='date', parse_dates=True
)
quakes = pd.read_csv('earthquakes-1.csv')
```

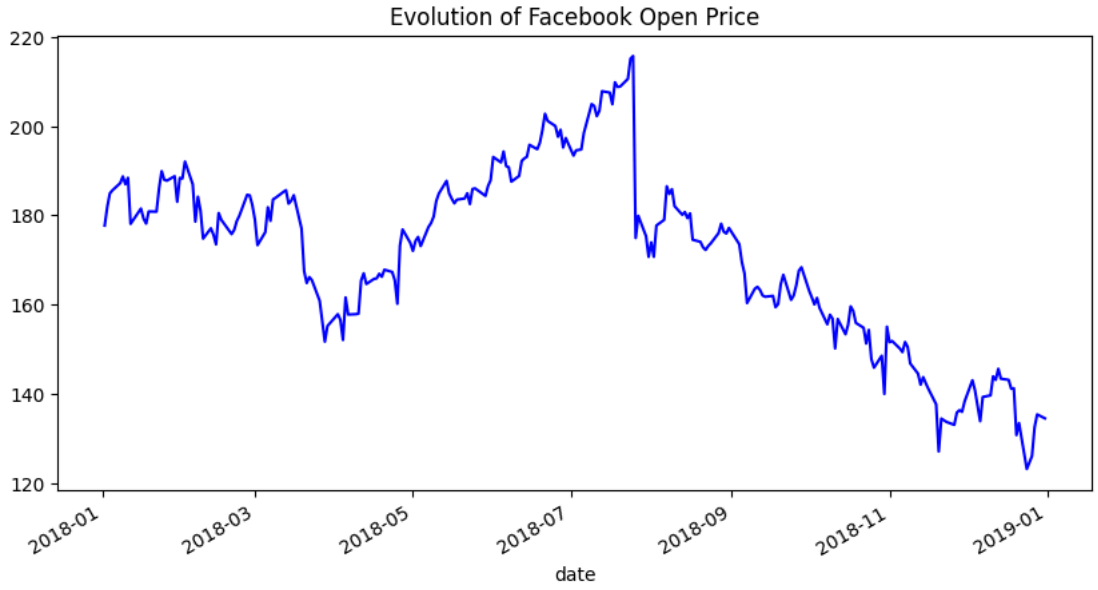
```
fb.plot(
    kind='line',
    y='open',
    figsize=(10, 5),
    style='b-',
    legend=False,
    title='Evolution of Facebook Open Price'
 )

#Time series plot of FB open price
```

```
<Axes: title={'center': 'Evolution of Facebook Open Price'}, xlabel='date'>
```



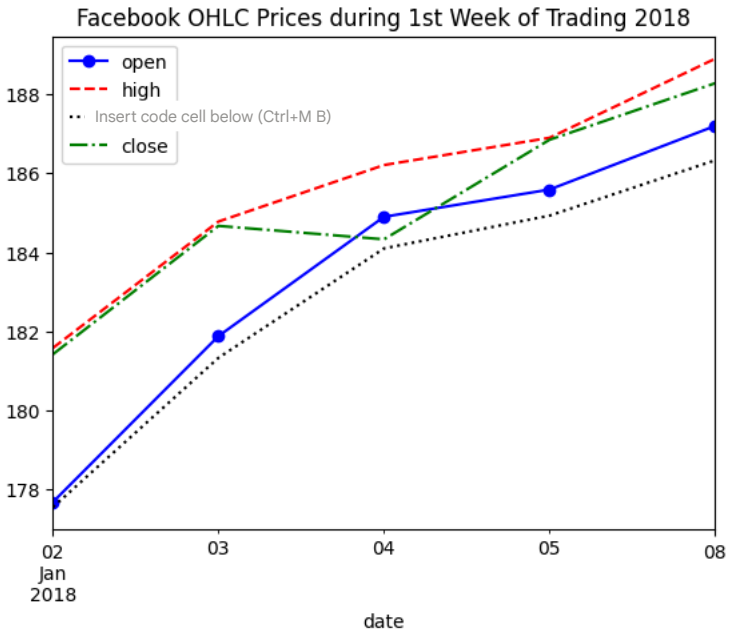

```
fb.plot(
    kind='line',
    y='open',
    figsize=(10, 5),
    color='blue',
    linestyle='solid',
    legend=False,
    title='Evolution of Facebook Open Price'
 )

#same as last ?
```

```
<Axes: title={'center': 'Evolution of Facebook Open Price'}, xlabel='date'>
```



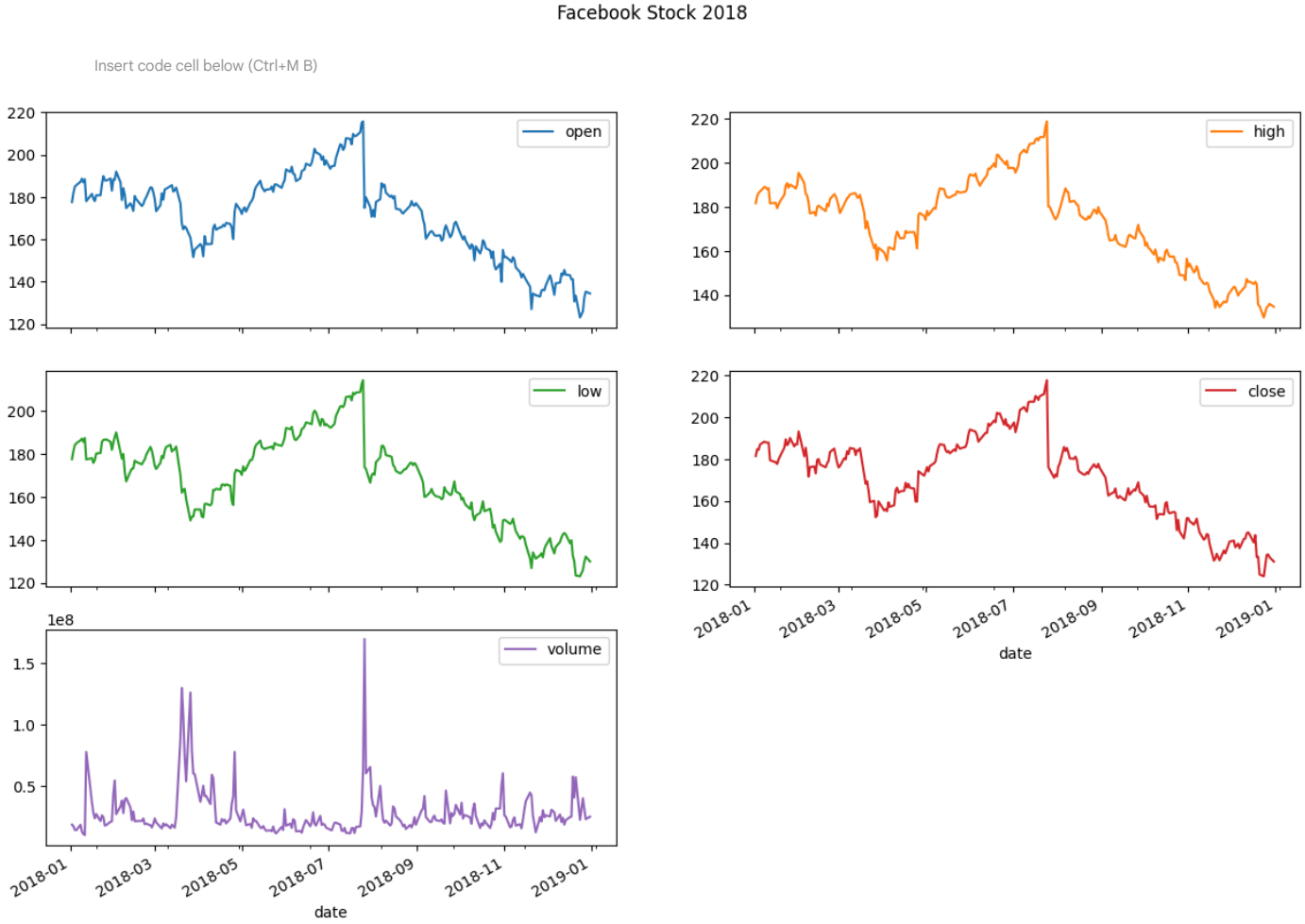

```
fb.iloc[:5,].plot(
 y=['open', 'high', 'low', 'close'],
 style=['bo-', 'r--', 'k:', 'g-.'],
 title='Facebook OHLC Prices during 1st Week of Trading 2018'
 )

#Step up plot
```

```
<Axes: title={'center': 'Facebook OHLC Prices during 1st Week of Trading 2018'}, xlabel='date'>
```




```
fb.plot(
 kind='line',
 subplots=True,
 layout=(3,2),
 figsize=(15,10),
 title='Facebook Stock 2018'
 )

#time series plot shows stock prices
```

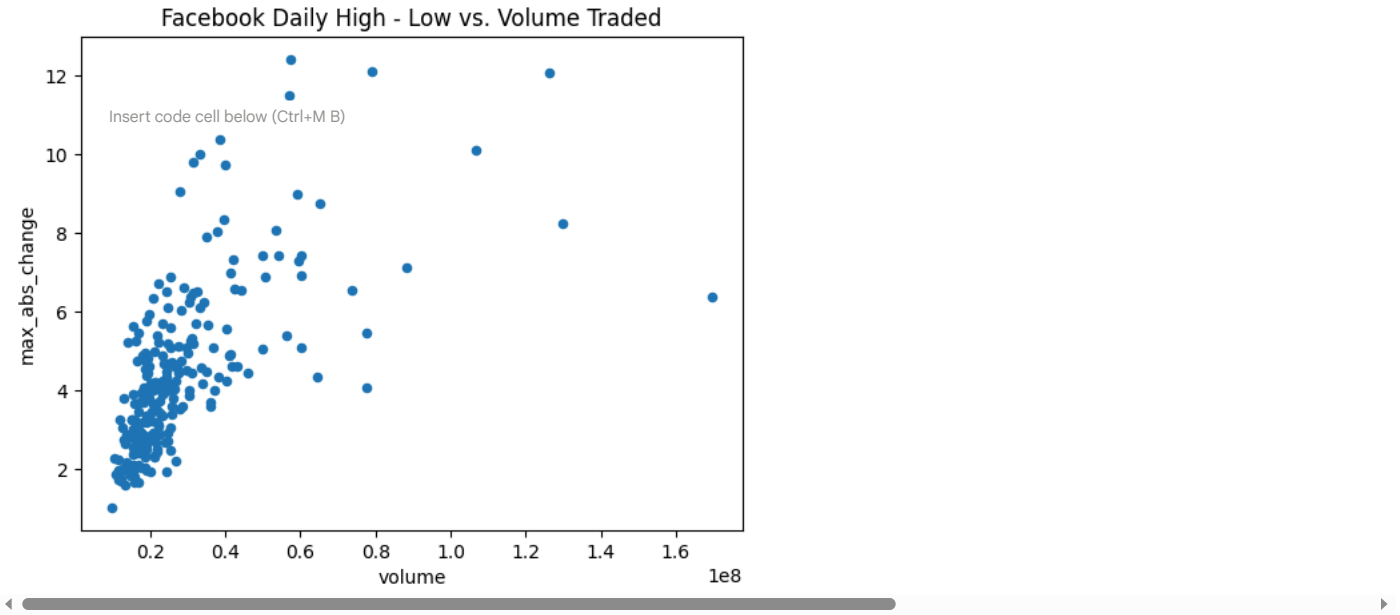
```
array([[<Axes: xlabel='date'>, <Axes: xlabel='date'>],
       [<Axes: xlabel='date'>, <Axes: xlabel='date'>],
       [<Axes: xlabel='date'>, <Axes: xlabel='date'>]], dtype=object)
```



Insert code cell below (Ctrl+M B)

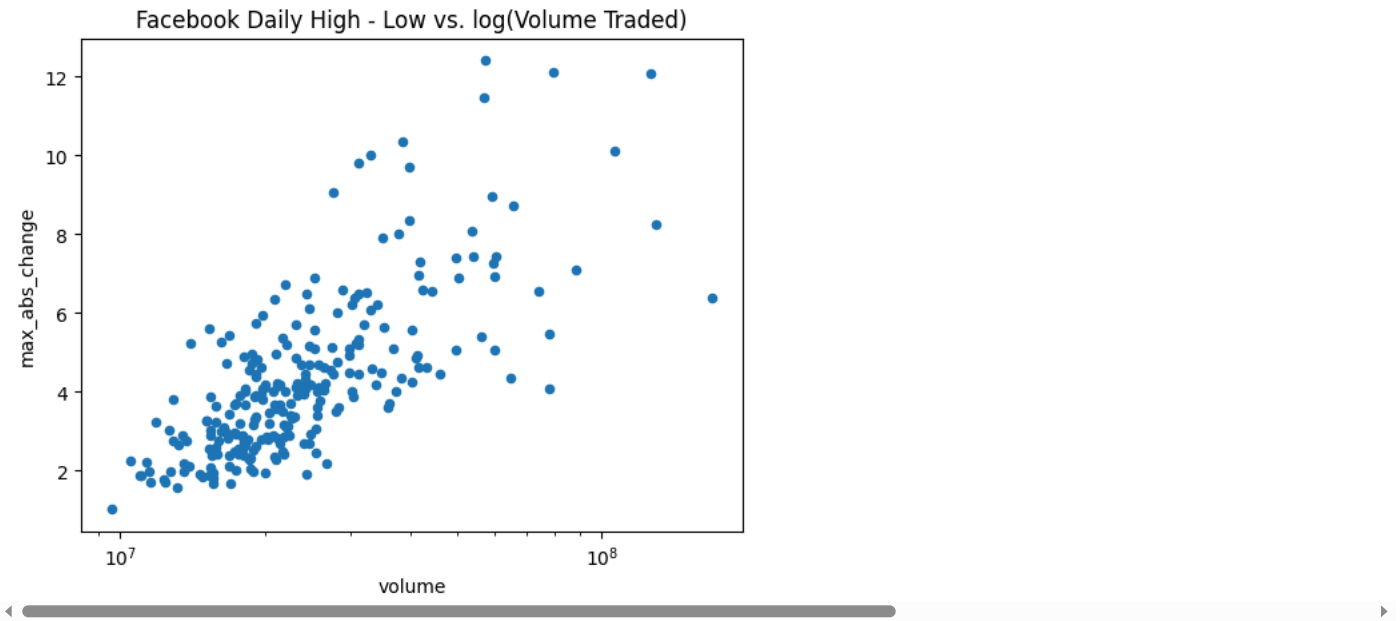
```
fb.assign(
 max_abs_change=fb.high - fb.low
 ).plot(
 kind='scatter', x='volume', y='max_abs_change',
 title='Facebook Daily High - Low vs. Volume Traded'
 )

 #scatter plot for fb vol trade
```

```
<Axes: title={'center': 'Facebook Daily High - Low vs. Volume Traded'}, xlabel='volume', ylabel='max_abs_change'>
```



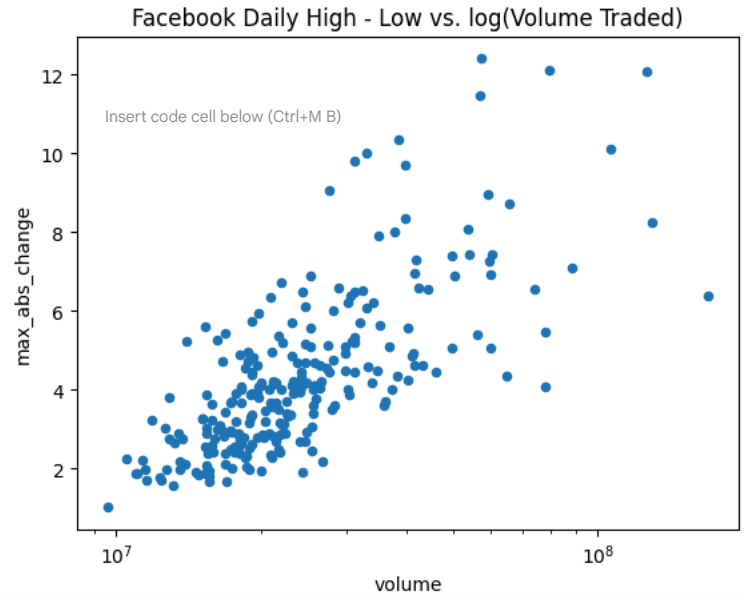

```
fb.assign(
max_abs_change=fb.high - fb.low
).plot(
kind='scatter', x='volume', y='max_abs_change',
title='Facebook Daily High - Low vs. log(Volume Traded)',
logx=True
)

#scatter plot for volume of fb trades
```

```
<Axes: title={'center': 'Facebook Daily High - Low vs. log(Volume Traded)'}, xlabel='volume', ylabel='max_abs_change'>
```



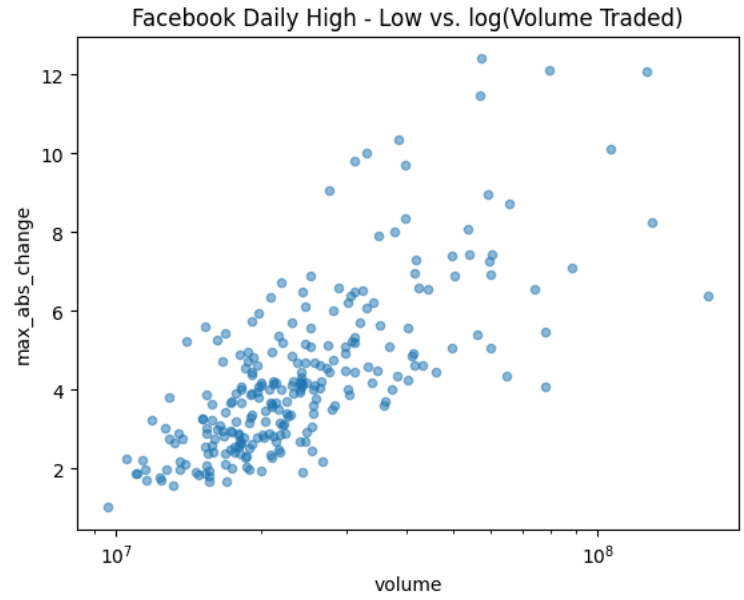

```
fb.assign(
max_abs_change=fb.high - fb.low
).plot(
kind='scatter', x='volume', y='max_abs_change',
title='Facebook Daily High - Low vs. log(Volume Traded)',
logx=True
)

#same as last
```

```
<Axes: title={'center': 'Facebook Daily High - Low vs. log(Volume Traded)'}, xlabel='volume', ylabel='max_abs_change'>
```




```
fb.assign(
 max_abs_change=fb.high - fb.low
 ).plot(
 kind='scatter', x='volume', y='max_abs_change',
 title='Facebook Daily High - Low vs. log(Volume Traded)',
 logx=True, alpha=0.50
 )

 #same as last but semi transparent ?
```

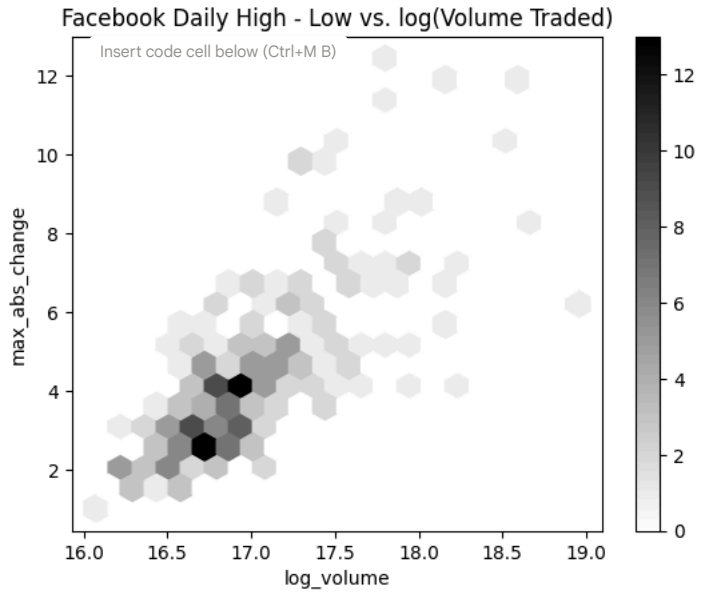
```
<Axes: title={'center': 'Facebook Daily High - Low vs. log(Volume Traded)'}, xlabel='volume', ylabel='max_abs_change'>
```




```
fb.assign(
 log_volume=np.log(fb.volume),
 max_abs_change=fb.high - fb.low
 ).plot(
 kind='hexbin',
 x='log_volume',
 y='max_abs_change',
 title='Facebook Daily High - Low vs. log(Volume Traded)',
 colormap='gray_r',
 gridsize=20,
sharex=False
 )
```

```
#hexplot ? cool design idk how to describe this well
```

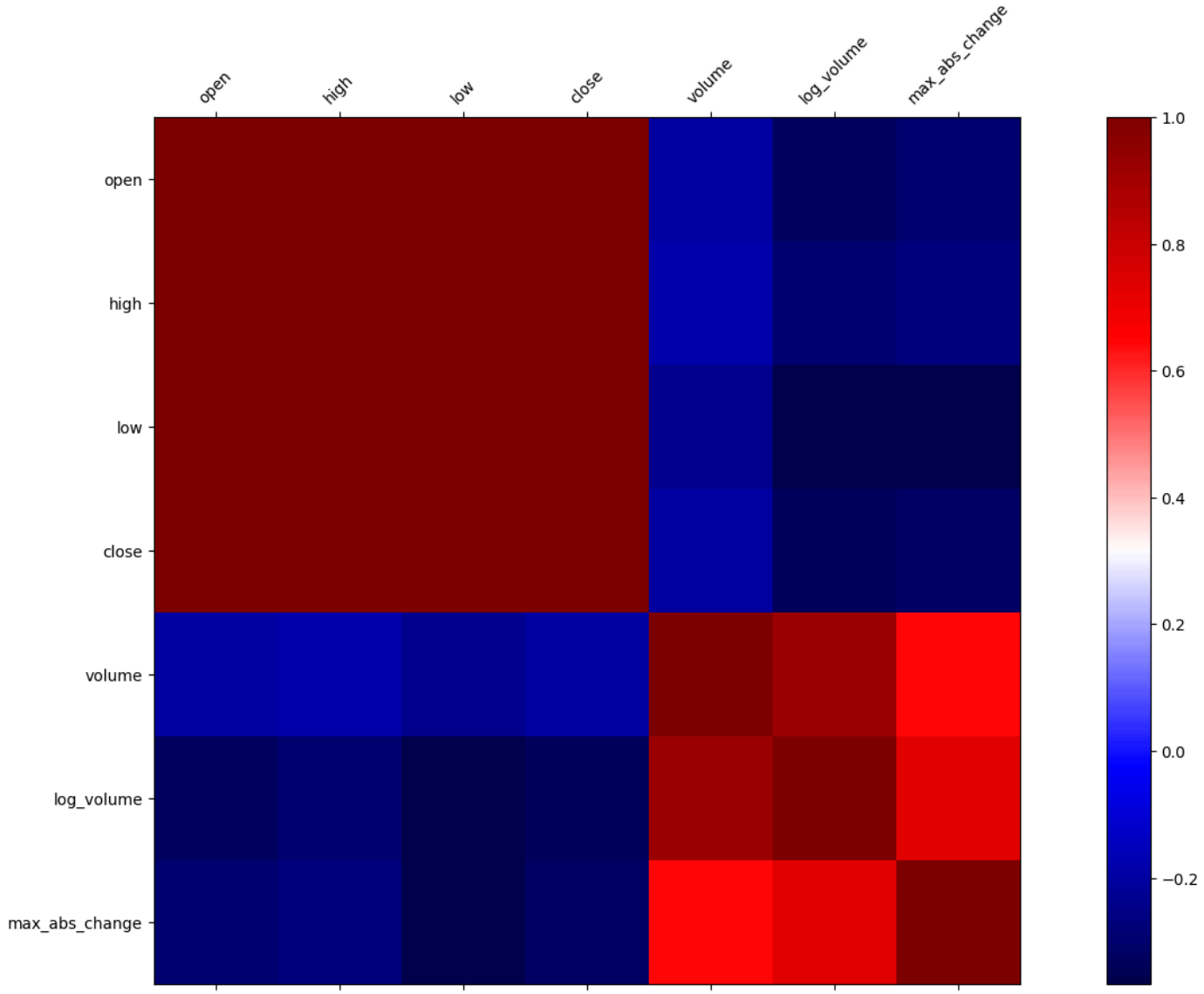
```
<Axes: title={'center': 'Facebook Daily High - Low vs. log(Volume Traded)'}, xlabel='log_volume', ylabel='max_abs_change'>
```




```
fig, ax = plt.subplots(figsize=(20, 10))

fb_corr = fb.assign(
log_volume=np.log(fb.volume),
max_abs_change=fb.high - fb.low
).corr()

im = ax.matshow(fb_corr, cmap='seismic')
fig.colorbar(im)

labels = [col.lower() for col in fb_corr.columns]
ax.set_xticklabels([''] + labels, rotation=45)
ax.set_yticklabels([''] + labels)
```

```
<ipython-input-35-7391fec8acfd>:12: UserWarning: set_ticklabels() should only be used with a fixed number of ticks, i.e. after set_ticks
  ax.set_xticklabels([''] + labels, rotation=45)
<ipython-input-35-7391fec8acfd>:13: UserWarning: set_ticklabels() should only be used with a fixed number of ticks, i.e. after set_ticks
  ax.set_yticklabels([''] + labels)
[Text(0, -1.0, ''),
 Text(0, 0.0, 'open'),
 Text(0,
 Text(0, 2.0, 'low'),
 Text(0, 3.0, 'close'),
 Text(0, 4.0, 'volume'),
 Text(0, 5.0, 'log_volume'),
 Text(0, 6.0, 'max_abs_change'),
 Text(0, 7.0, '')]
```

Insert code cell below (Ctrl+M B)




```
fb_corr.loc['max_abs_change', ['volume', 'log_volume']]
```

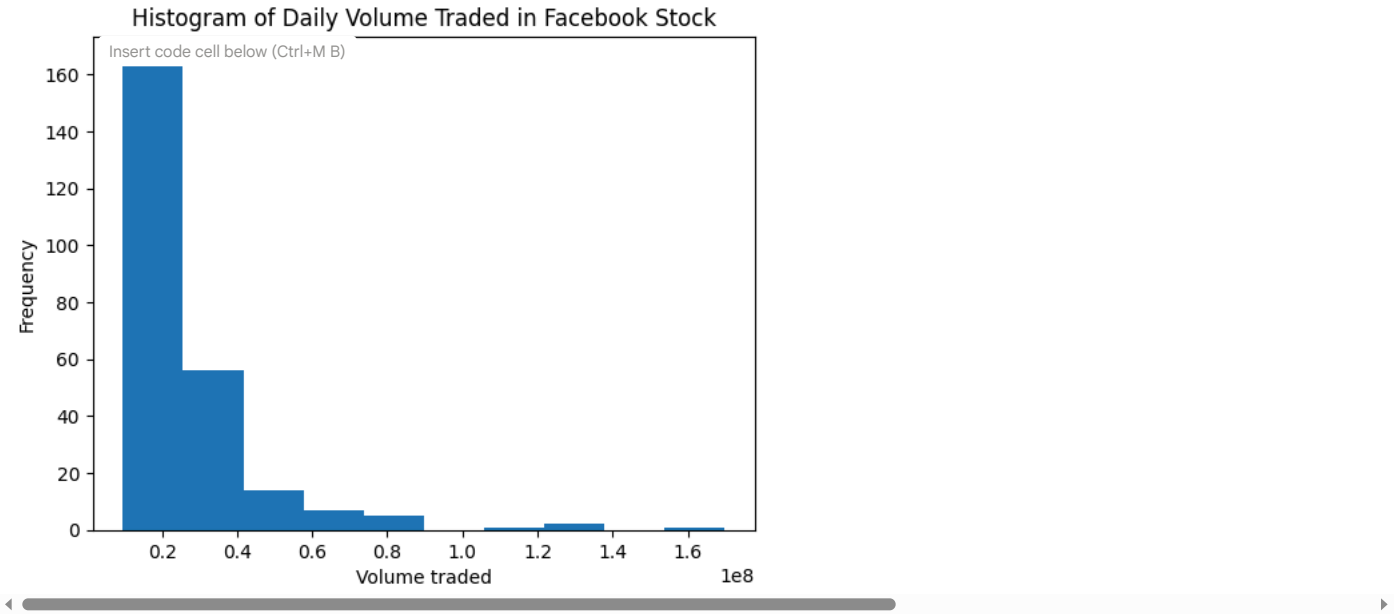
	max_abs_change
volume	0.642027
log_volume	0.731542

dtype: float64

```
fb.volume.plot(
 kind='hist',
title='Histogram of Daily Volume Traded in Facebook Stock'
 )
plt.xlabel('Volume traded') # label the x-axis (discussed in chapter 6)
```

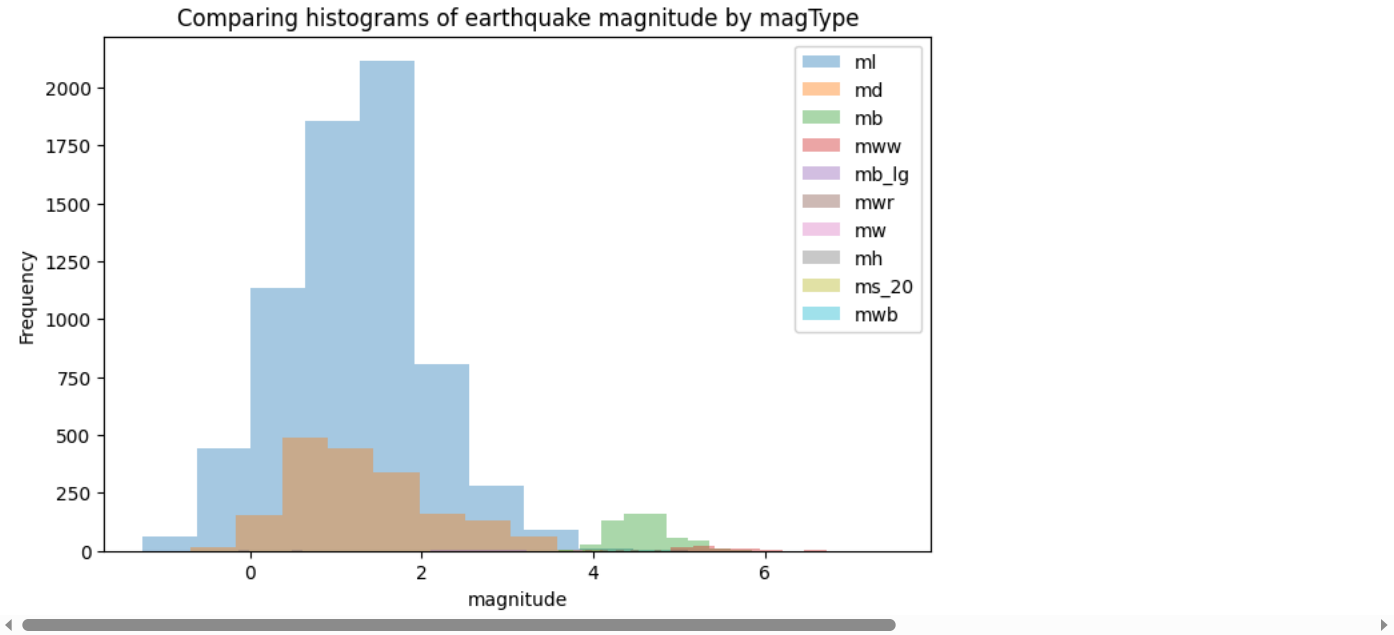
```
#histogram to display volume traded by frequency
```

```
Text(0.5, 0, 'Volume traded')
```



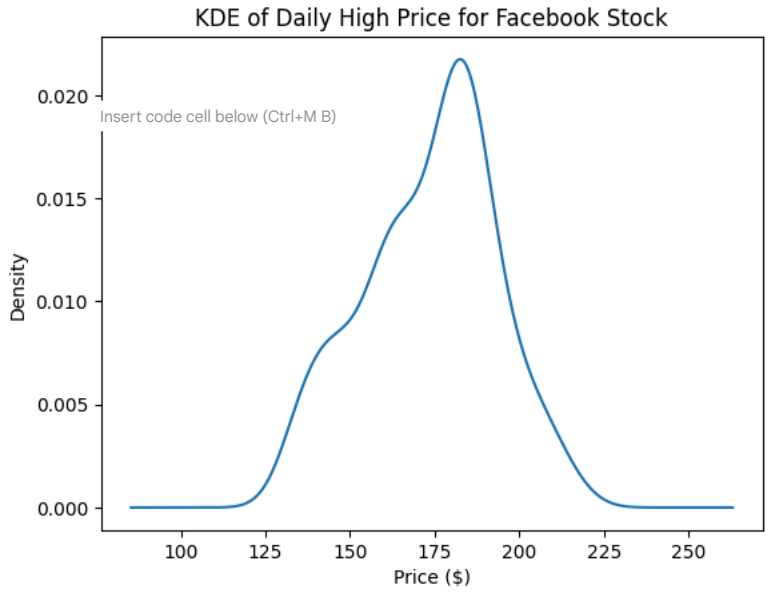

```
fig, axes = plt.subplots(figsize=(8, 5))
for magtype in quakes.magType.unique():
  data = quakes.query(f'magType == "{magtype}"').mag
  if not data.empty:
    data.plot(
      kind='hist', ax=axes, alpha=0.4,label=magtype, legend=True,
 title='Comparing histograms of earthquake magnitude by magType'
 )
plt.xlabel('magnitude') # label the x-axis (discussed in chapter 6)

#Multiple histograms in 1 so we can compare magnitutes by magtypes, but it would be better if the height would show more since we cannot see
```

```
Text(0.5, 0, 'magnitude')
```



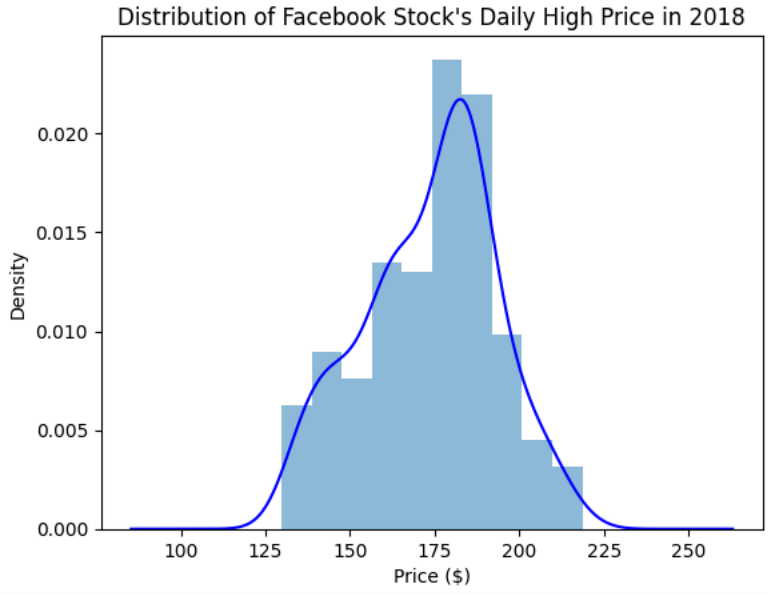

```
fb.high.plot(
 kind='kde',
title='KDE of Daily High Price for Facebook Stock'
 )
plt.xlabel('Price ($)') # label the x-axis (discussed in chapter 6)
```

```
Text(0.5, 0, 'Price ($)')
```



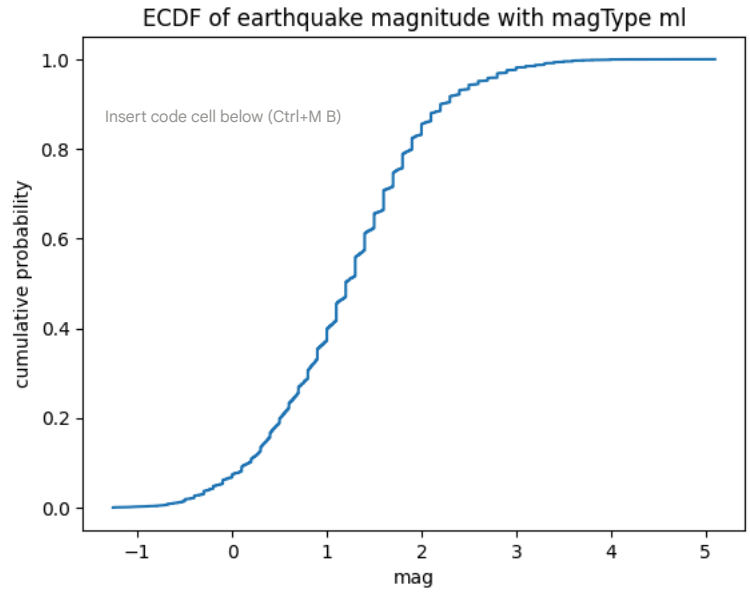

```
ax = fb.high.plot(kind='hist', density=True, alpha=0.5)
fb.high.plot(
ax=ax, kind='kde', color='blue',
title='Distribution of Facebook Stock\'s Daily High Price in 2018'
 )
plt.xlabel('Price ($)') # label the x-axis (discussed in chapter 6)
```

```
Text(0.5, 0, 'Price ($)')
```



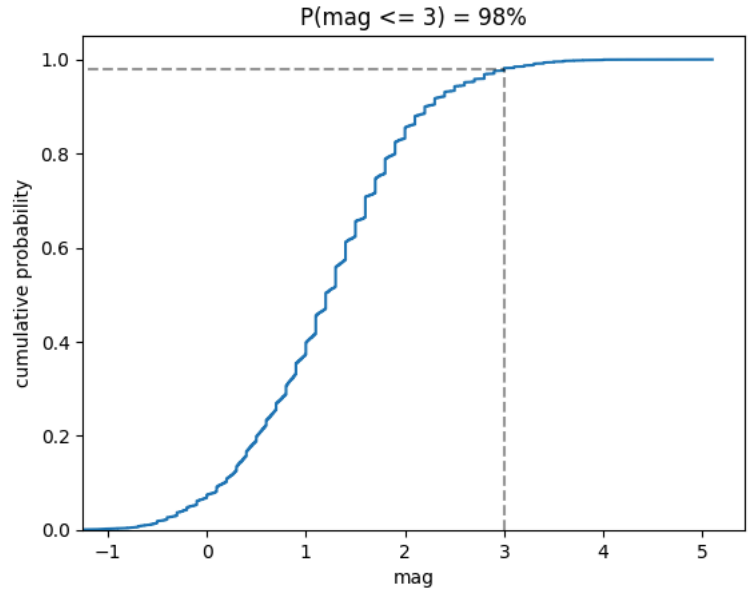

```
from statsmodels.distributions.empirical_distribution import ECDF

ecdf = ECDF(quakes.query('magType == "ml"').mag)
plt.plot(ecdf.x, ecdf.y)
# axis labels (we will cover this in chapter 6)
plt.xlabel('mag') # add x-axis label
plt.ylabel('cumulative probability') # add y-axis label
# add title (we will cover this in chapter 6)
plt.title('ECDF of earthquake magnitude with magType ml')

#step plot on the rise of probability of earthquake with magtype
```

```
Text(0.5, 1.0, 'ECDF of earthquake magnitude with magType ml')
```




```
from statsmodels.distributions.empirical_distribution import ECDF

ecdf = ECDF(quakes.query('magType == "ml"').mag)
plt.plot(ecdf.x, ecdf.y)
 # formatting below will all be covered in chapter 6
 # axis labels
plt.xlabel('mag') # add x-axis label
plt.ylabel('cumulative probability') # add y-axis label
 # add reference lines for interpreting the ECDF for mag <= 3
plt.plot(
    [3, 3], [0, .98], 'k--',
    [-1.5, 3], [0.98, 0.98], 'k--', alpha=0.4
)
 # set axis ranges
plt.ylim(0, None)
plt.xlim(-1.25, None)
 # add a title
plt.title('P(mag <= 3) = 98%')

#same as last?
```

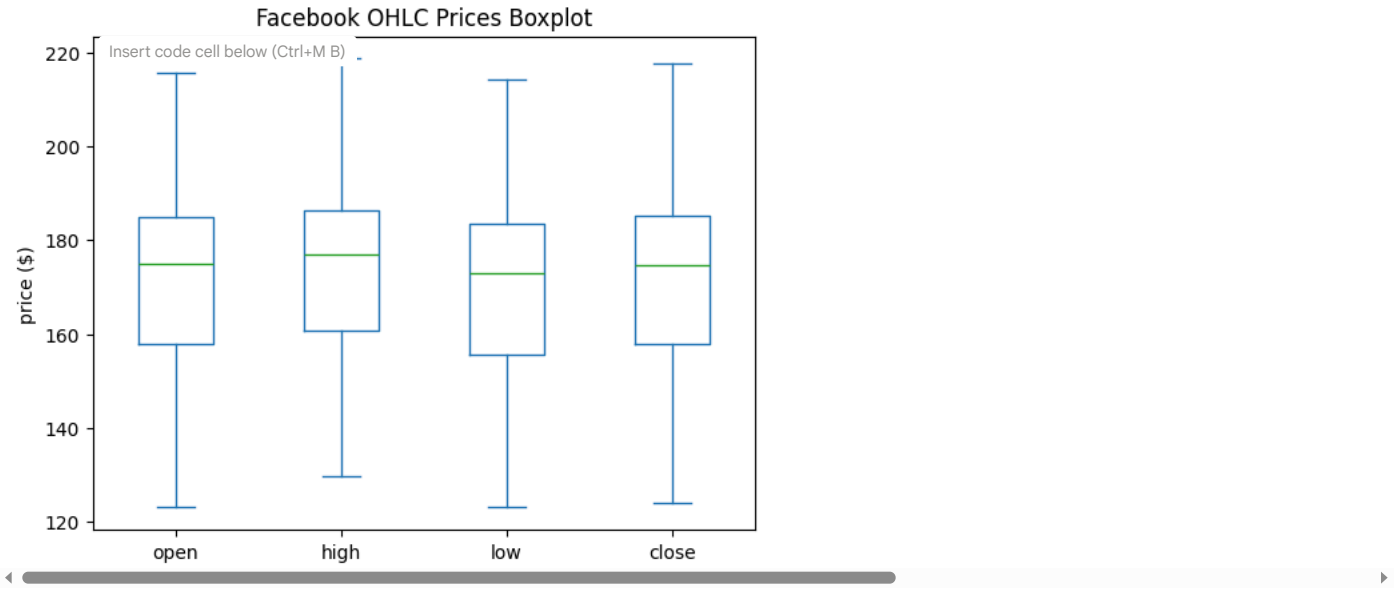
```
Text(0.5, 1.0, 'P(mag <= 3) = 98%')
```




```
fb.iloc[:,:4].plot(kind='box', title='Facebook OHLC Prices Boxplot')
plt.ylabel('price ($)') # label the x-axis (discussed in chapter 6)
```

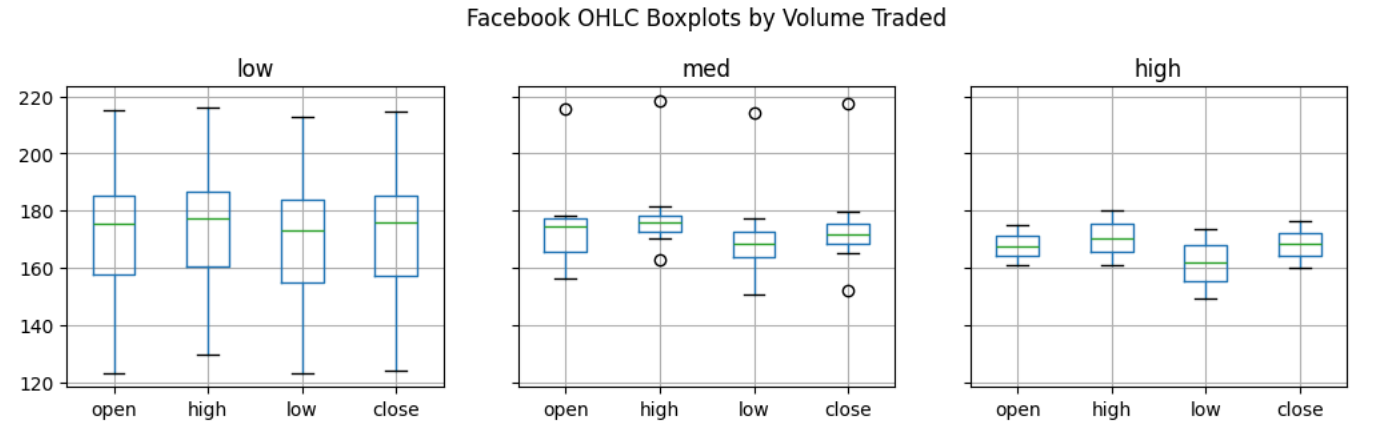
```
#box plot for stock prices, to obsere better
```

```
Text(0, 0.5, 'price ($)')
```



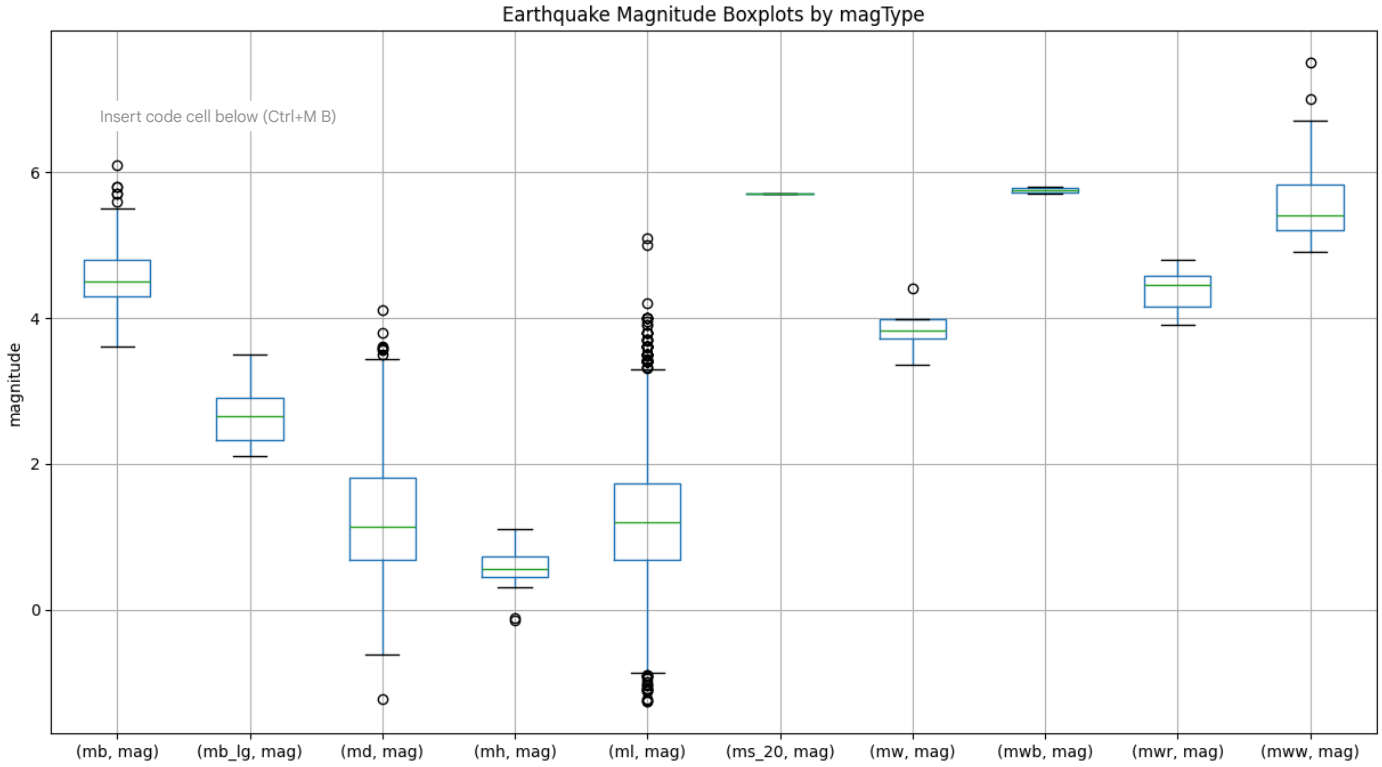

```
fb.assign(
 volume_bin=pd.cut(fb.volume, 3, labels=['low', 'med', 'high'])
 ).groupby('volume_bin').boxplot(
 column=['open', 'high', 'low', 'close'],
 layout=(1, 3), figsize=(12, 3)
 )
plt.suptitle('Facebook OHLC Boxplots by Volume Traded', y=1.1)
```

```
<ipython-input-45-a812919977da>:3: FutureWarning: The default of observed=False is deprecated and will be changed to True in a future ve
  ).groupby('volume_bin').boxplot(
Text(0.5, 1.1, 'Facebook OHLC Boxplots by Volume Traded')
```



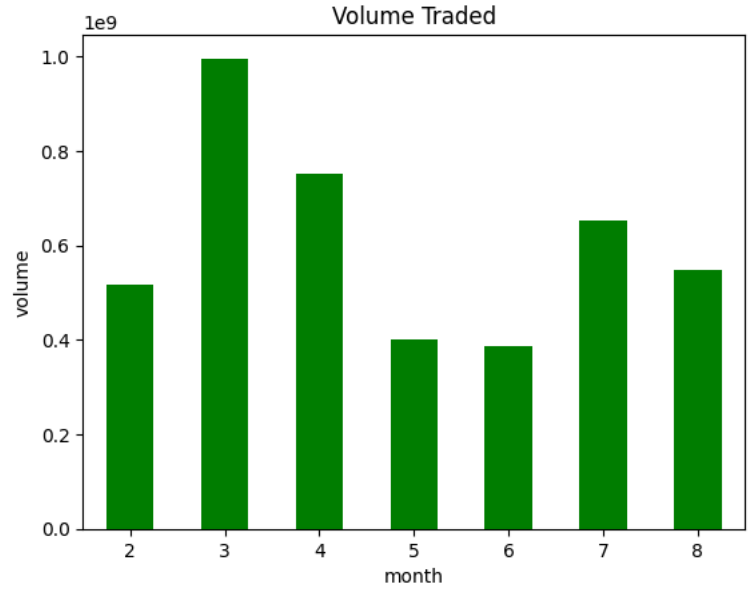

```
quakes[['mag', 'magType']].groupby('magType').boxplot(
 figsize=(15, 8), subplots=False
 )
plt.title('Earthquake Magnitude Boxplots by magType')
plt.ylabel('magnitude') # label the y-axis (discussed in chapter 6)
```

```
Text(0, 0.5, 'magnitude')
```




```
fb['2018-02':'2018-08'].assign(
 month=lambda x: x.index.month
 ).groupby('month').sum().volume.plot.bar(
 color='green', rot=0, title='Volume Traded'
 )
plt.ylabel('volume')

#display how much fb stocks were traded during this month
```

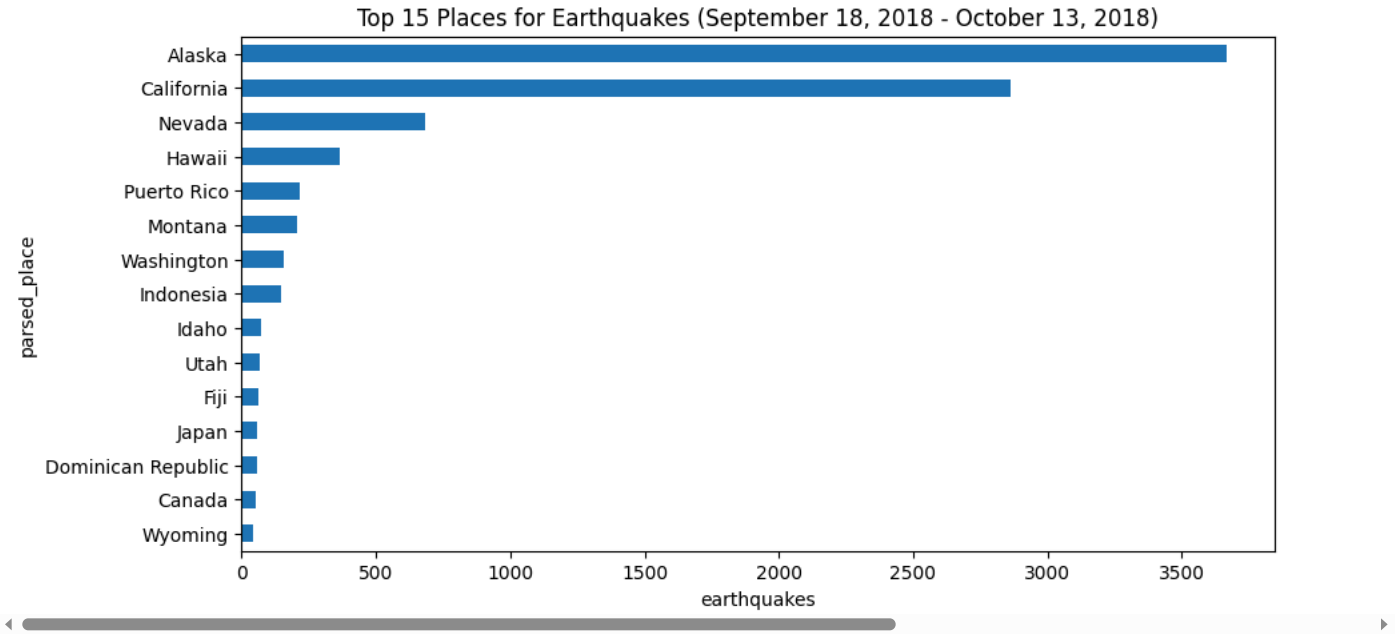
```
Text(0, 0.5, 'volume')
```




```
quakes.parsed_place.value_counts().iloc[14::-1,].plot(
 kind='barh', figsize=(10, 5),
 title='Top 15 Places for Earthquakes '\
```

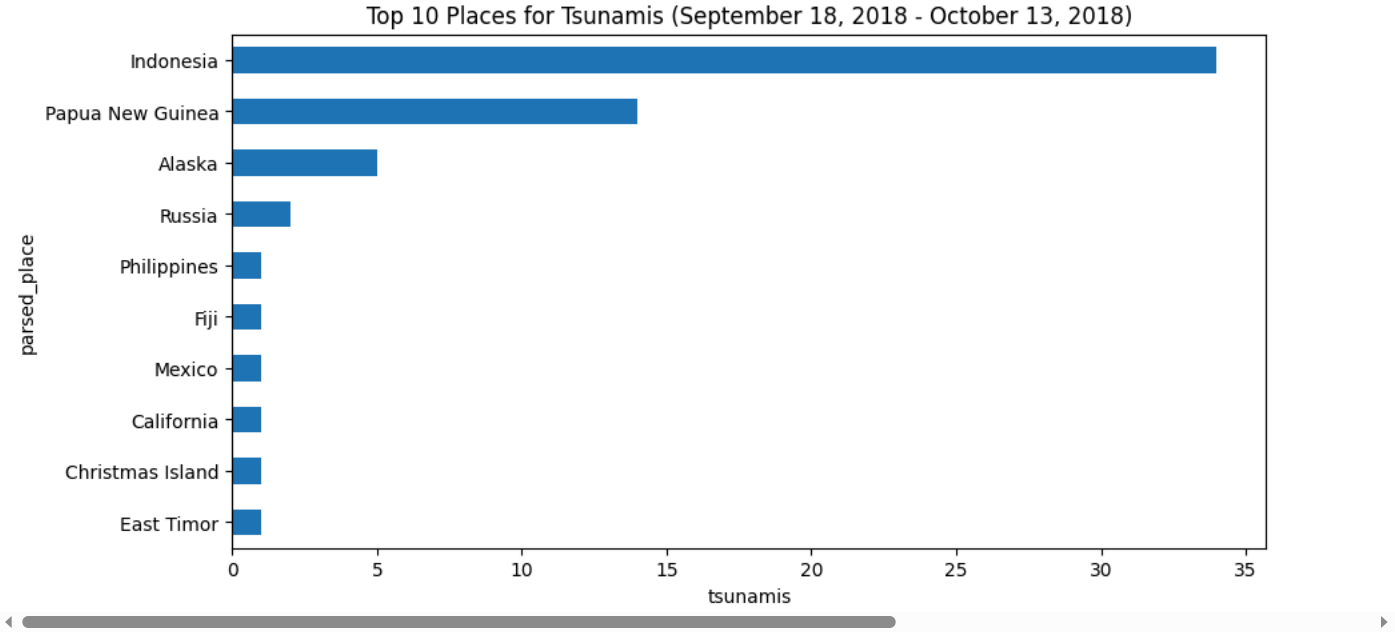
```
 '(September 18, 2018 - October 13, 2018)'
 )
plt.xlabel('earthquakes') # label the x-axis (discussed in chapter 6)

#Bar graph to show where most earthquakes occur
```

```
Text(0.5, 
```


```
quakes.groupby('parsed_place').tsunami.sum().sort_values().iloc[-10::,].plot(
 kind='barh', figsize=(10, 5),
title='Top 10 Places for Tsunamis '\
 '(September 18, 2018 - October 13, 2018)'
 )
plt.xlabel('tsunamis') # label the x-axis (discussed in chapter 6)

#bar plot for most places to have most tsunamies
```

```
Text(0.5, 0, 'tsunamis')
```

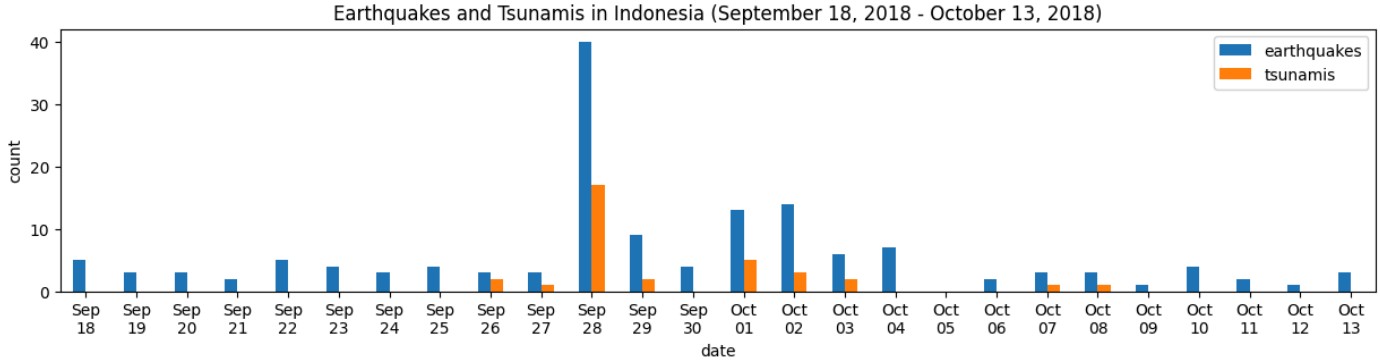



```
indonesia_quakes = quakes.query('parsed_place == "Indonesia"').assign(
    time=lambda x: pd.to_datetime(x.time, unit='ms'),
    earthquake=1
 ).set_index('time').resample('1D').sum()
indonesia_quakes.index = indonesia_quakes.index.strftime('%b\n%d')
indonesia_quakes.plot(
    y=['earthquake', 'tsunami'], kind='bar', figsize=(15, 3), rot=0,
```

```
    label=['earthquakes', 'tsunamis'],
    title='Earthquakes and Tsunamis in Indonesia '\
        '(September 18, 2018 - October 13, 2018)'
)
# label the axes (discussed in chapter 6)
plt.xlabel('da...')
plt.ylabel('co...')
```

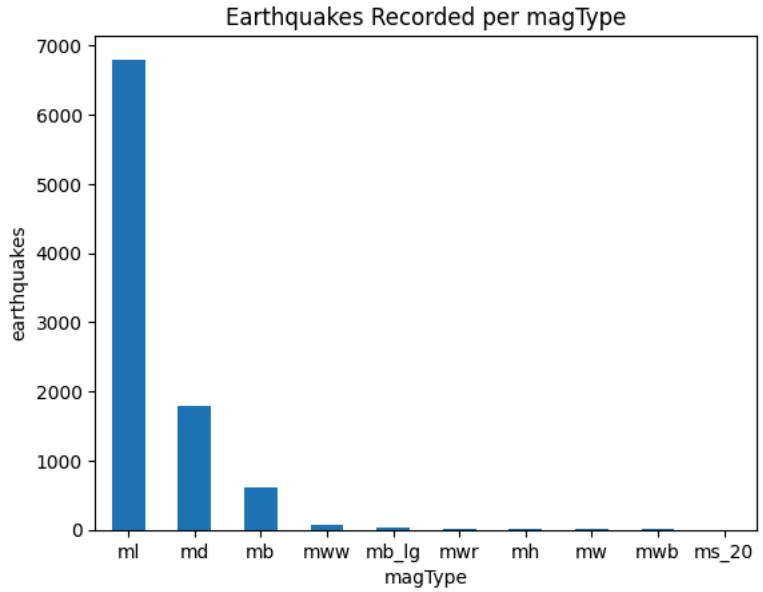
Insert code cell below (Ctrl+M B)

```
Text(0, 0.5, 'count')
```



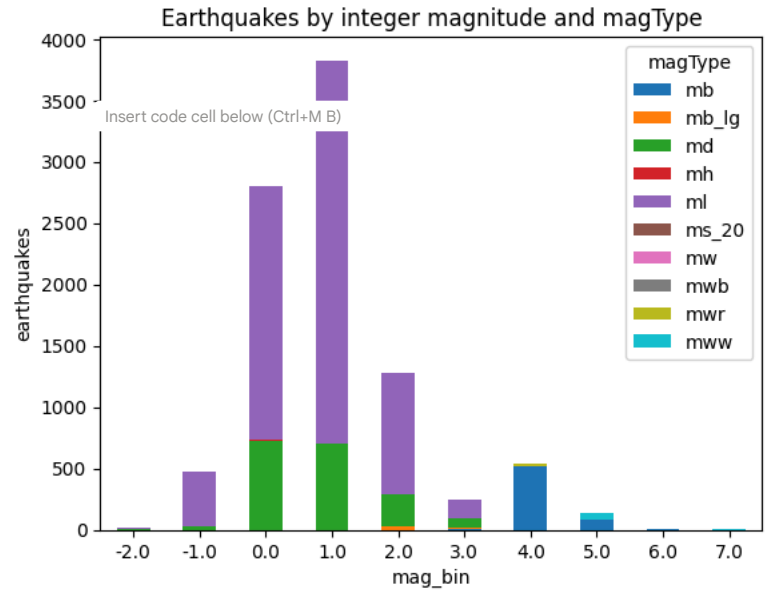

```
quakes.magType.value_counts().plot(
kind='bar', title='Earthquakes Recorded per magType', rot=0
)
# label the axes (discussed in chapter 6)
plt.xlabel('magType')
plt.ylabel('earthquakes')
```

```
Text(0, 0.5, 'earthquakes')
```



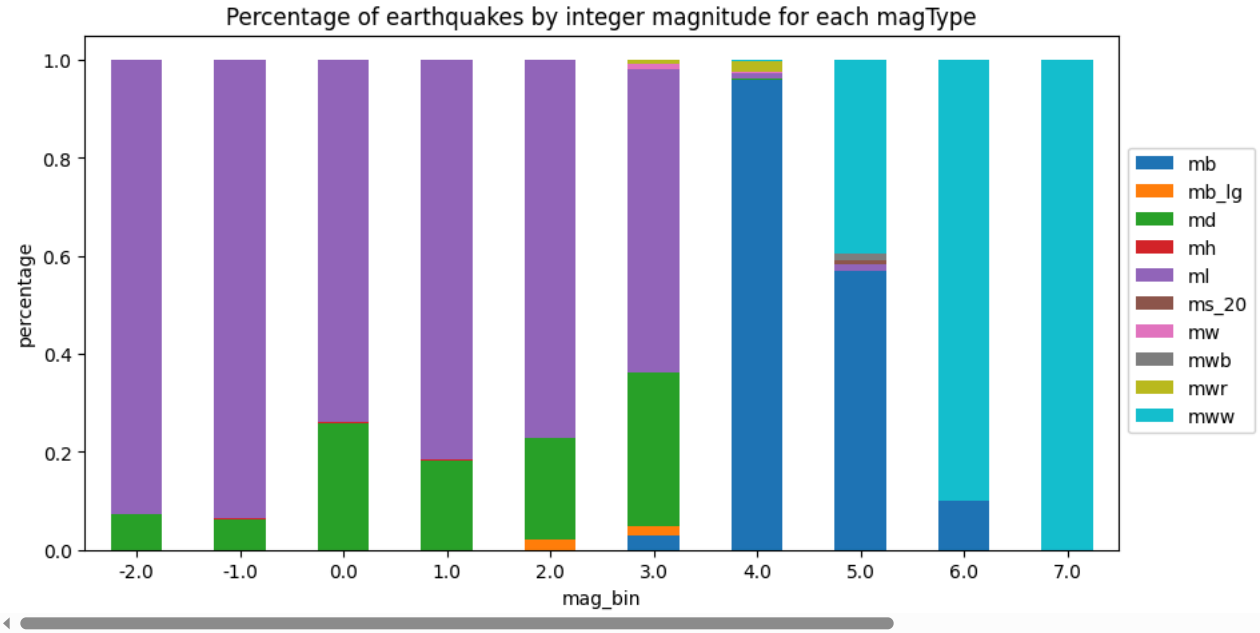

```
pivot = quakes.assign(
    mag_bin=lambda x: np.floor(x.mag)
).pivot_table(
    index='mag_bin', columns='magType', values='mag', aggfunc='count'
)
pivot.plot.bar(
    stacked=True, rot=0,
    title='Earthquakes by integer magnitude and magType'
)
plt.ylabel('earthquakes') # label the axes (discussed in chapter 6)
```

```
Text(0, 0.5, 'earthquakes')
```




```
normalized_pivot = pivot.fillna(0).apply(lambda x: x/x.sum(), axis=1)
ax = normalized_pivot.plot.bar(
    stacked=True, rot=0, figsize=(10, 5),
    title='Percentage of earthquakes by integer magnitude for each magType'
 )
ax.legend(bbox_to_anchor=(1, 0.8)) # move legend to the right of the plot
plt.ylabel('percentage') # label the axes (discussed in chapter 6)
```

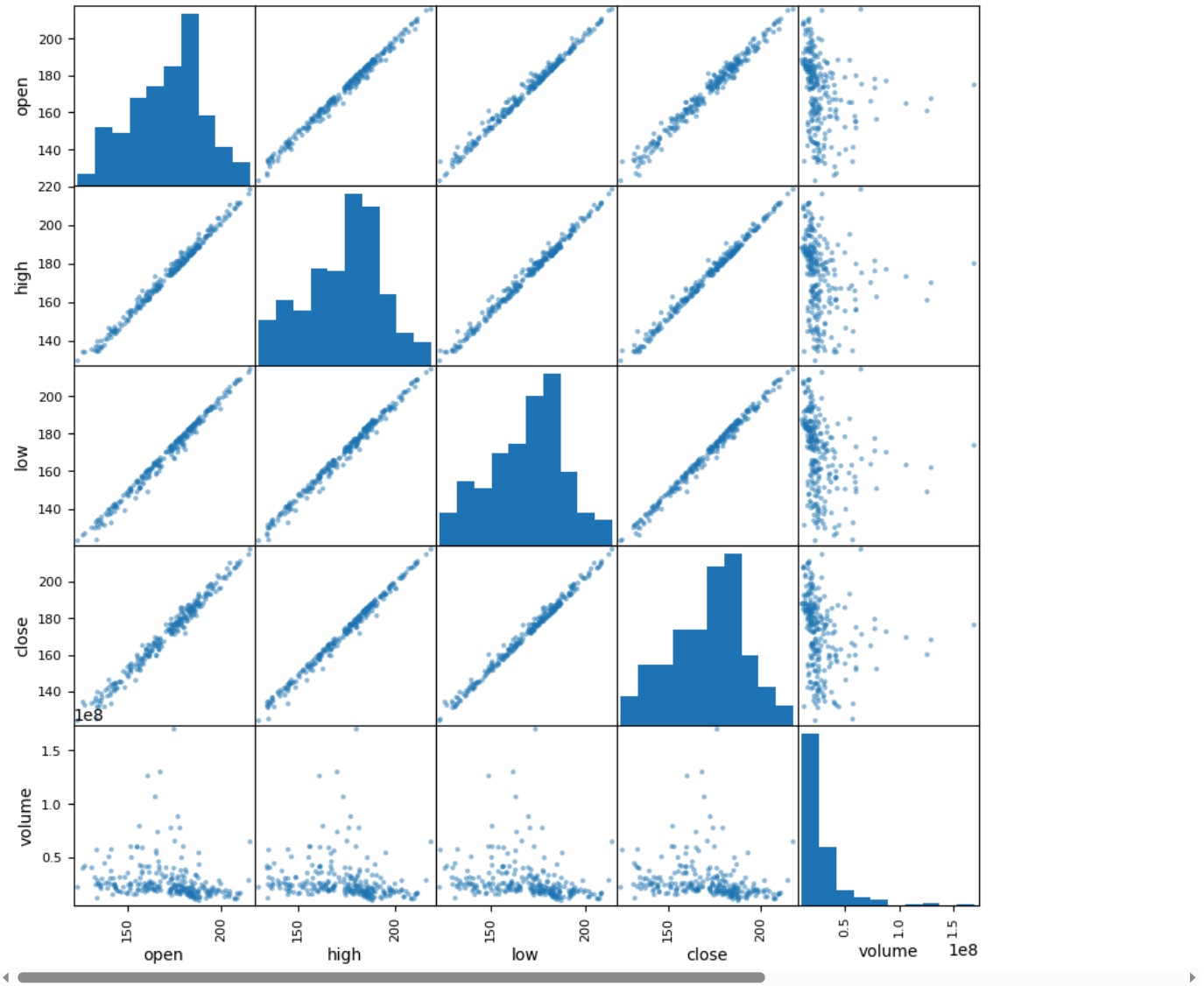
```
Text(0, 0.5, 'percentage')
```



HOA 9.3

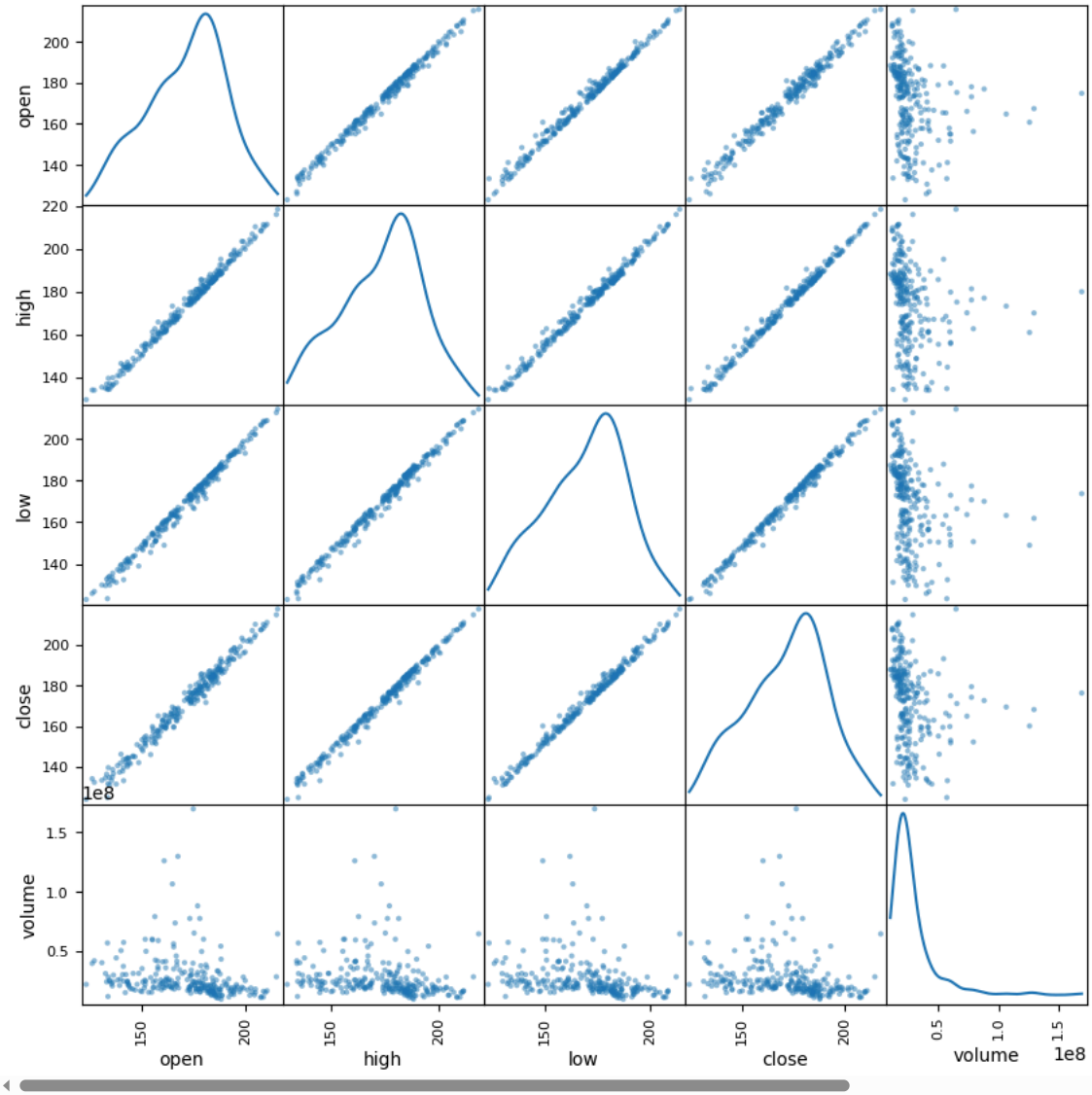
```
%matplotlib inline
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
fb = pd.read_csv(
'fb_stock_prices_2018.csv', index_col='date', parse_dates=True
)


from pandas.plotting import scatter_matrix
scatter_matrix(fb, figsize=(10, 10))
```

```
array([[<Axes: xlabel='open', ylabel='open'>,
        <Axes: xlabel='high', ylabel='open'>,
        <Axes: xlabel='low', ylabel='open'>,
        <Axes: xlabel='close', ylabel='open'>,
        <Axes: xlabel='volume', ylabel='open'>],
       [<Axes: xlabel='open', ylabel='high'>,
        <Axes: xlabel='high', ylabel='high'>,
        <Axes: xlabel='low', ylabel='high'>,
        <Axes: xlabel='close', ylabel='high'>,
        <Axes: xlabel='volume', ylabel='high'>],
       [<Axes: xlabel='open', ylabel='low'>,
        <Axes: xlabel='high', ylabel='low'>,
        <Axes: xlabel='low', ylabel='low'>,
        <Axes: xlabel='close', ylabel='low'>,
        <Axes: xlabel='volume', ylabel='low'>],
       [<Axes: xlabel='open', ylabel='close'>,
        <Axes: xlabel='high', ylabel='close'>,
        <Axes: xlabel='low', ylabel='close'>,
        <Axes: xlabel='close', ylabel='close'>,
        <Axes: xlabel='volume', ylabel='close'>],
       [<Axes: xlabel='open', ylabel='volume'>,
        <Axes: xlabel='high', ylabel='volume'>,
        <Axes: xlabel='low', ylabel='volume'>,
        <Axes: xlabel='close', ylabel='volume'>,
        <Axes: xlabel='volume', ylabel='volume'>]], dtype=object)
```



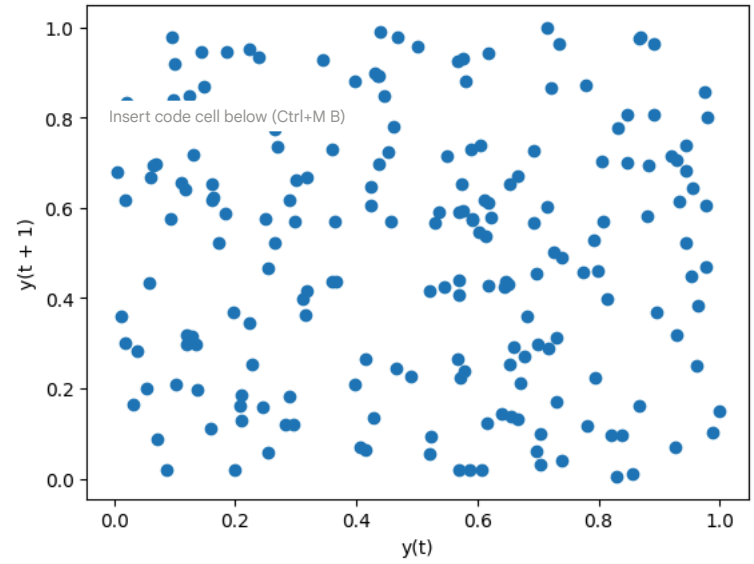

```
scatter_matrix(fb, figsize=(10, 10), diagonal='kde')
```

```
array([[<Axes: xlabel='open', ylabel='open'>,
        <Axes: xlabel='high', ylabel='open'>,
        <Axes: xlabel='low', ylabel='open'>,
        <Axes: xlabel='close', ylabel='open'>,
        <Axes: xlabel='volume', ylabel='open'>],
       [<Axes: xlabel='open', ylabel='high'>,
        <Axes: xlabel='high', ylabel='high'>,
        <Axes: xlabel='low', ylabel='high'>,
        <Axes: xlabel='close', ylabel='high'>,
        <Axes: xlabel='volume', ylabel='high'>],
       [<Axes: xlabel='open', ylabel='low'>,
        <Axes: xlabel='high', ylabel='low'>,
        <Axes: xlabel='low', ylabel='low'>,
        <Axes: xlabel='close', ylabel='low'>,
        <Axes: xlabel='volume', ylabel='low'>],
       [<Axes: xlabel='open', ylabel='close'>,
        <Axes: xlabel='high', ylabel='close'>,
        <Axes: xlabel='low', ylabel='close'>,
        <Axes: xlabel='close', ylabel='close'>,
        <Axes: xlabel='volume', ylabel='close'>],
       [<Axes: xlabel='open', ylabel='volume'>,
        <Axes: xlabel='high', ylabel='volume'>,
        <Axes: xlabel='low', ylabel='volume'>,
        <Axes: xlabel='close', ylabel='volume'>,
        <Axes: xlabel='volume', ylabel='volume'>]], dtype=object)
```



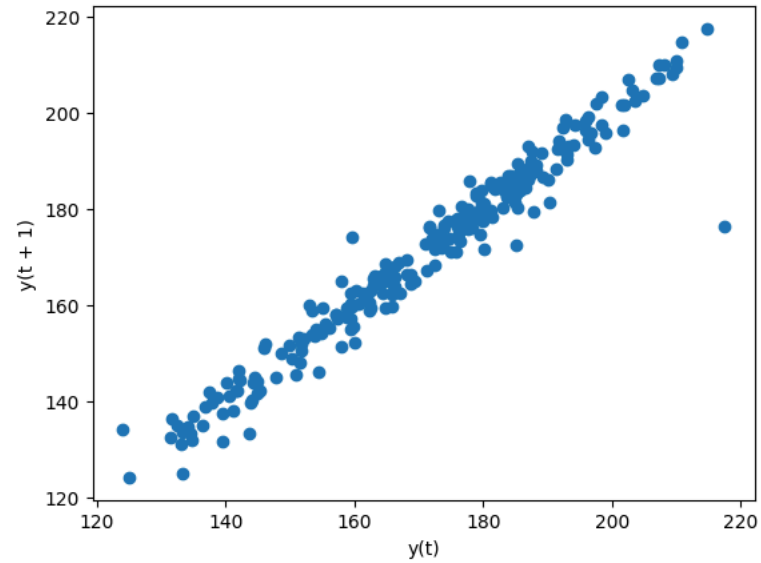

```
from pandas.plotting import lag_plot
np.random.seed(0) # make this repeatable
lag_plot(pd.Series(np.random.random(size=200)))
```

```
<Axes: xlabel='y(t)', ylabel='y(t + 1)'>
```



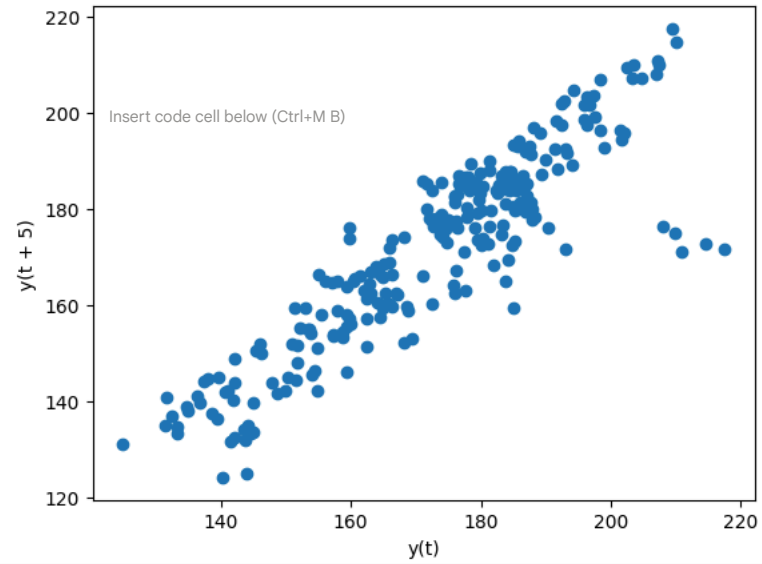

```
lag_plot(fb.close)
```

```
<Axes: xlabel='y(t)', ylabel='y(t + 1)'>
```



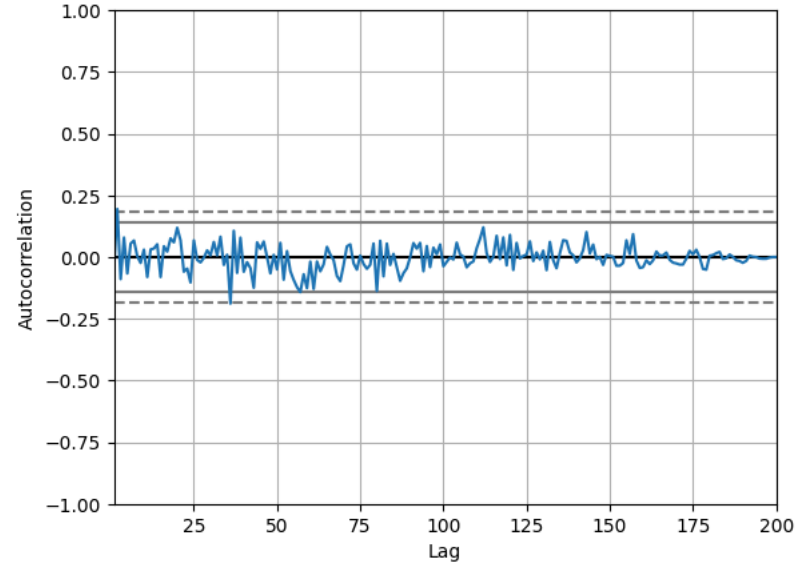

```
lag_plot(fb.close, lag=5)
```

```
<Axes: xlabel='y(t)', ylabel='y(t + 5)'>
```



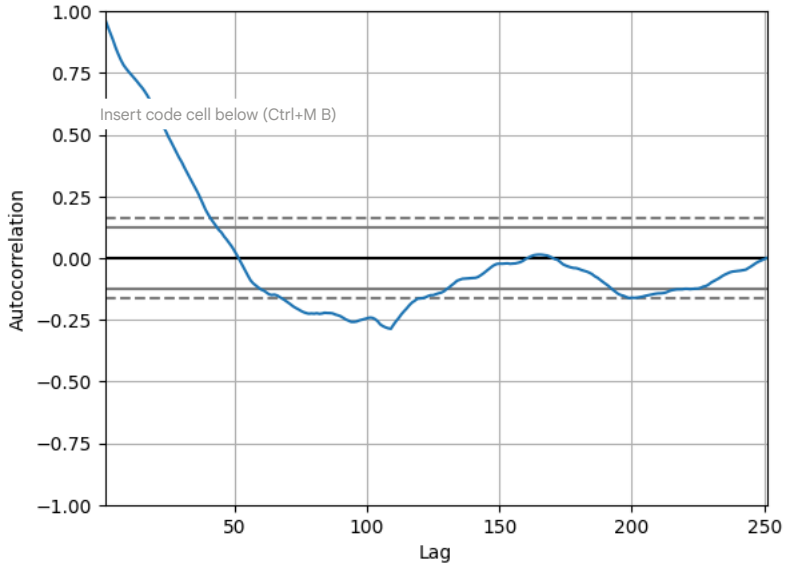

```
from pandas.plotting import autocorrelation_plot
np.random.seed(0) # make this repeatable
autocorrelation_plot(pd.Series(np.random.random(size=200)))
```

```
<Axes: xlabel='Lag', ylabel='Autocorrelation'>
```

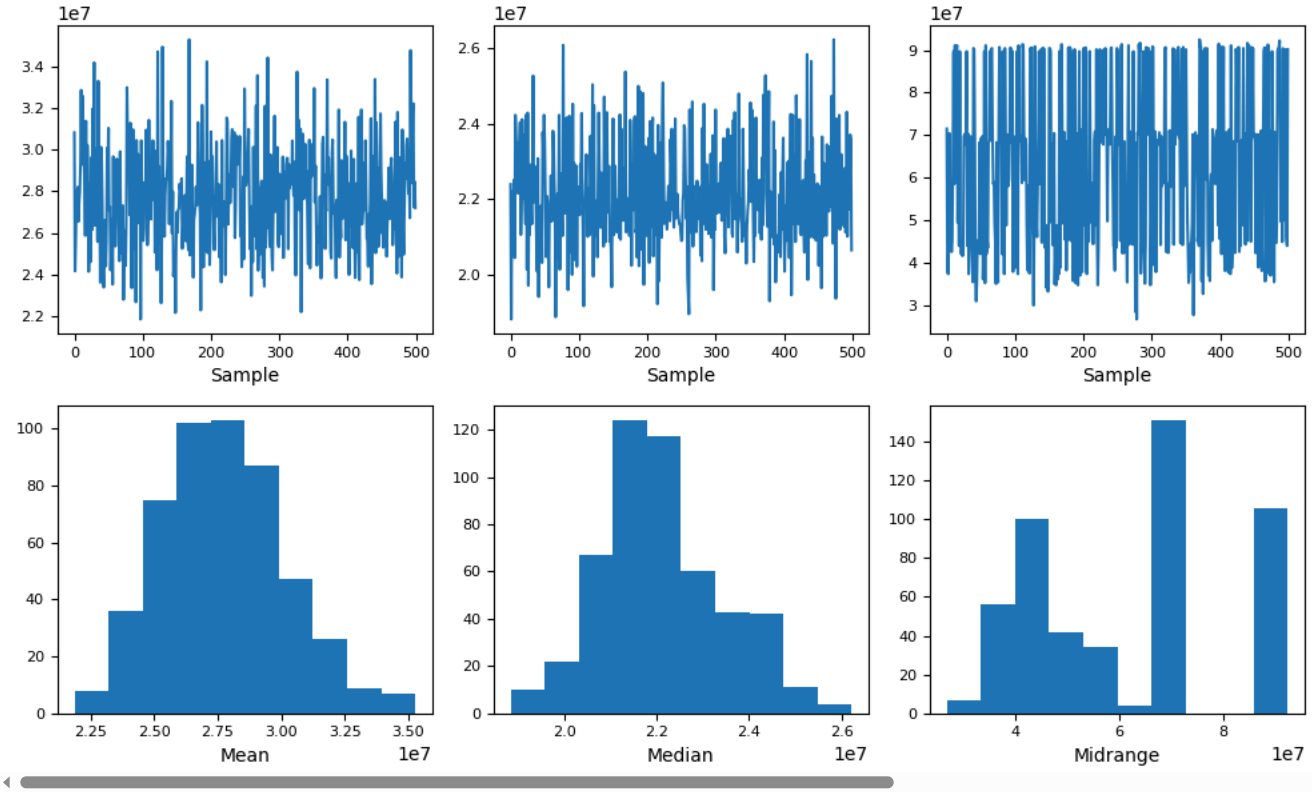



```
autocorrelation_plot(fb.close)
```

```
<Axes: xlabel='Lag', ylabel='Autocorrelation'>
```




```
from pandas.plotting import bootstrap_plot
fig = bootstrap_plot(fb.volume, fig=plt.figure(figsize=(10, 6)))
```



Supplementary Activity

```
fbnew = pd.read_csv('/content/fb_stock_prices_2018.csv')

fbnew['Rolling_20Min_Close'] = fbnew['close'].rolling(window=20).min()

# Plot the rolling minimum
fbnew[['close', 'Rolling_20Min_Close']].plot(figsize=(12, 6), title="Rolling 20-day Minimum of Closing Price")
plt.xlabel("Days")
plt.ylabel("Price")
plt.show()
```