In [ ]:

```
%matplotlib inline
import matplotlib.pyplot as plt
import numpy as np
import seaborn as sns
import pandas as pd
```

In [ ]:

```
fb = pd.read_csv('fb_stock_prices_2018.csv', index_col='date', parse_dates=True)
quakes = pd.read_csv('earthquakes.csv')
```

Categorical Data

In [ ]:

```
# A 7.5 magnitude earthquake on September 28, 2018 near Palu, Indonesia caused a devastating tsunami afterwards.
# Let's take a look at some visualizations to understand
# what magTypes are used in Indonesia,
# the range of magnitudes there,
# and how many of the earthquakes are accompanied by a tsunami.

quakes.assign(
    time=lambda x: pd.to_datetime(x.time, unit='ms')
).set_index('time').loc['2018-09-28'].query(
    "parsed_place == 'Indonesia' and tsunami == 1 and mag == 7.5"
)
```

Out[ ]:

	mag	magType	place	tsunami	parsed_place
time					
2018-09-28 10:02:43.480	7.5	mww	78km N of Palu, Indonesia	1	Indonesia

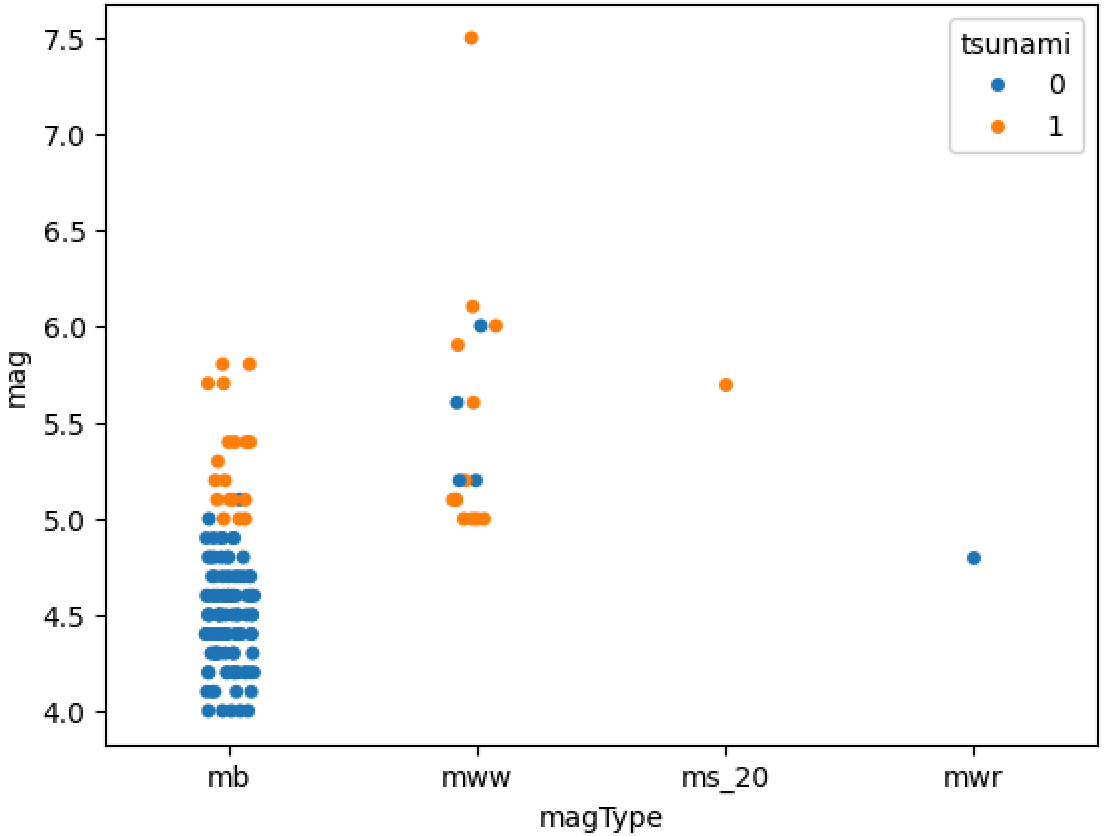
Strip Plot

In [ ]:

```
sns.stripplot(
    x='magType',
    y='mag',
    hue='tsunami',
```

```
    data=quakes.query('parsed_place == "Indonesia"')
)
```

Out[ ]: <Axes: xlabel='magType', ylabel='mag'>



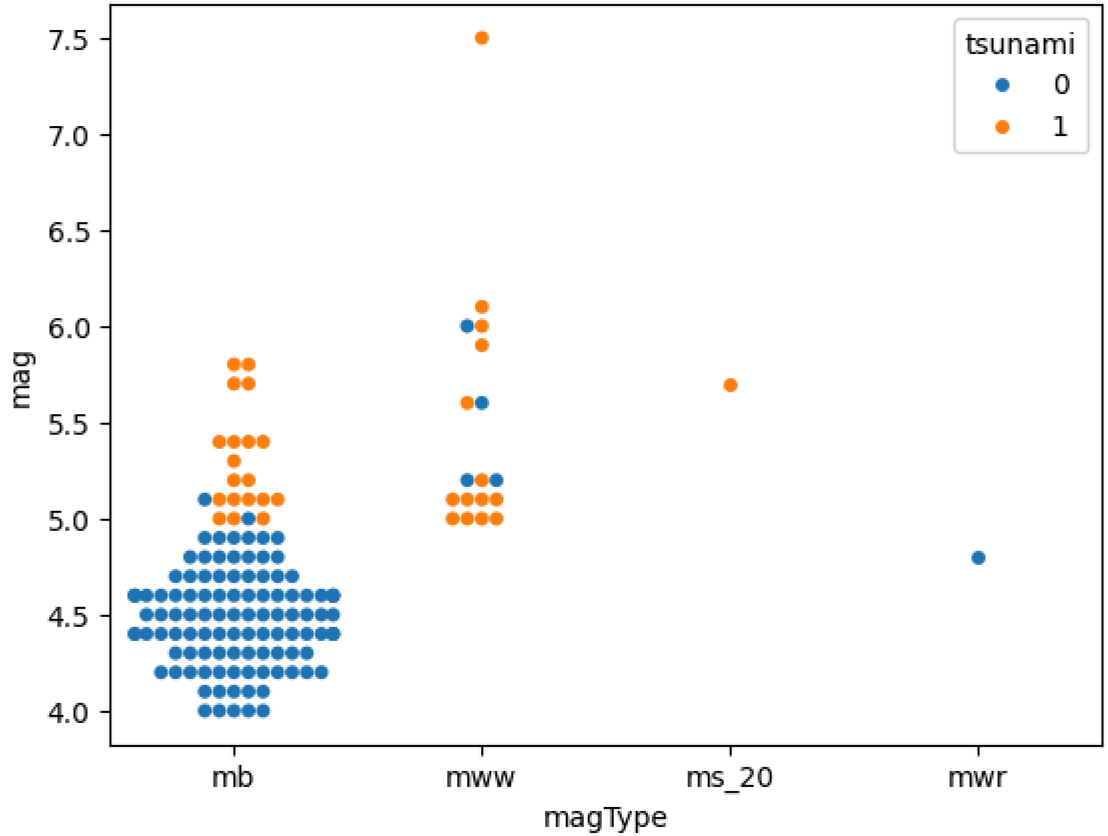
Swarm Plot

In [ ]:
```
# The bee swarm plot helps address this issue be keeping the points from overlapping.

sns.swarmplot(
 x='magType',
 y='mag',
 hue='tsunami',
```

```
data=quakes.query('parsed_place == "Indonesia"')
)
```

Out[ ]: `<Axes: xlabel='magType', ylabel='mag'>`

```
/usr/local/lib/python3.11/dist-packages/seaborn/categorical.py:3399: UserWarning: 10.2% of the points cannot be placed; you may want to decrease the size of the markers or use stripplot.
  warnings.warn(msg, UserWarning)
```



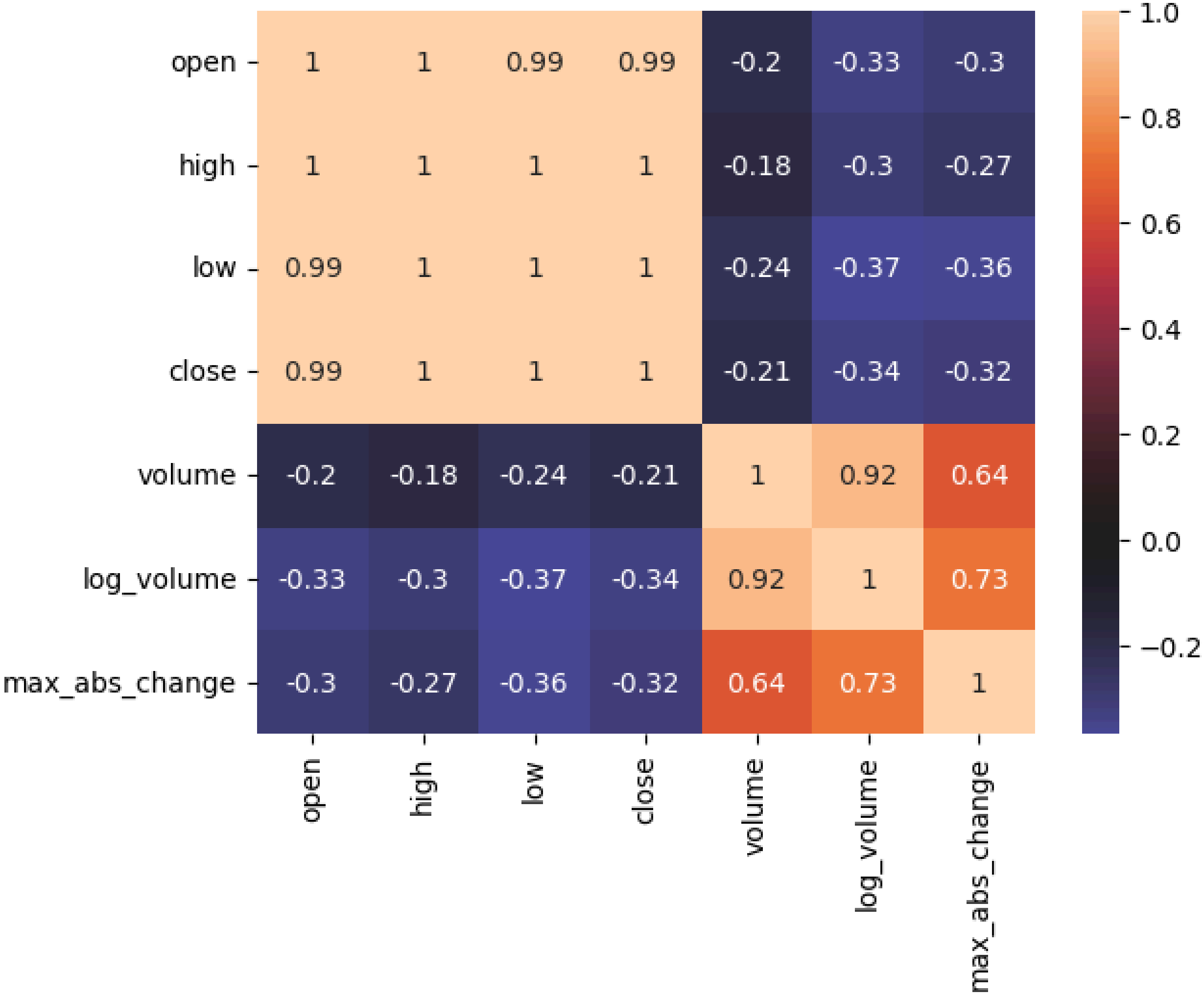
Correlations and Heatmaps

In [ ]:
```
# heatmap
```

In [ ]:
```
# An easier way to create correlation matrix is to use seaborn
```

```
sns.heatmap(
 fb.sort_index().assign(
 log_volume=np.log(fb.volume),
 max_abs_change=fb.high - fb.low
).corr(),annot=True, center=0)
```

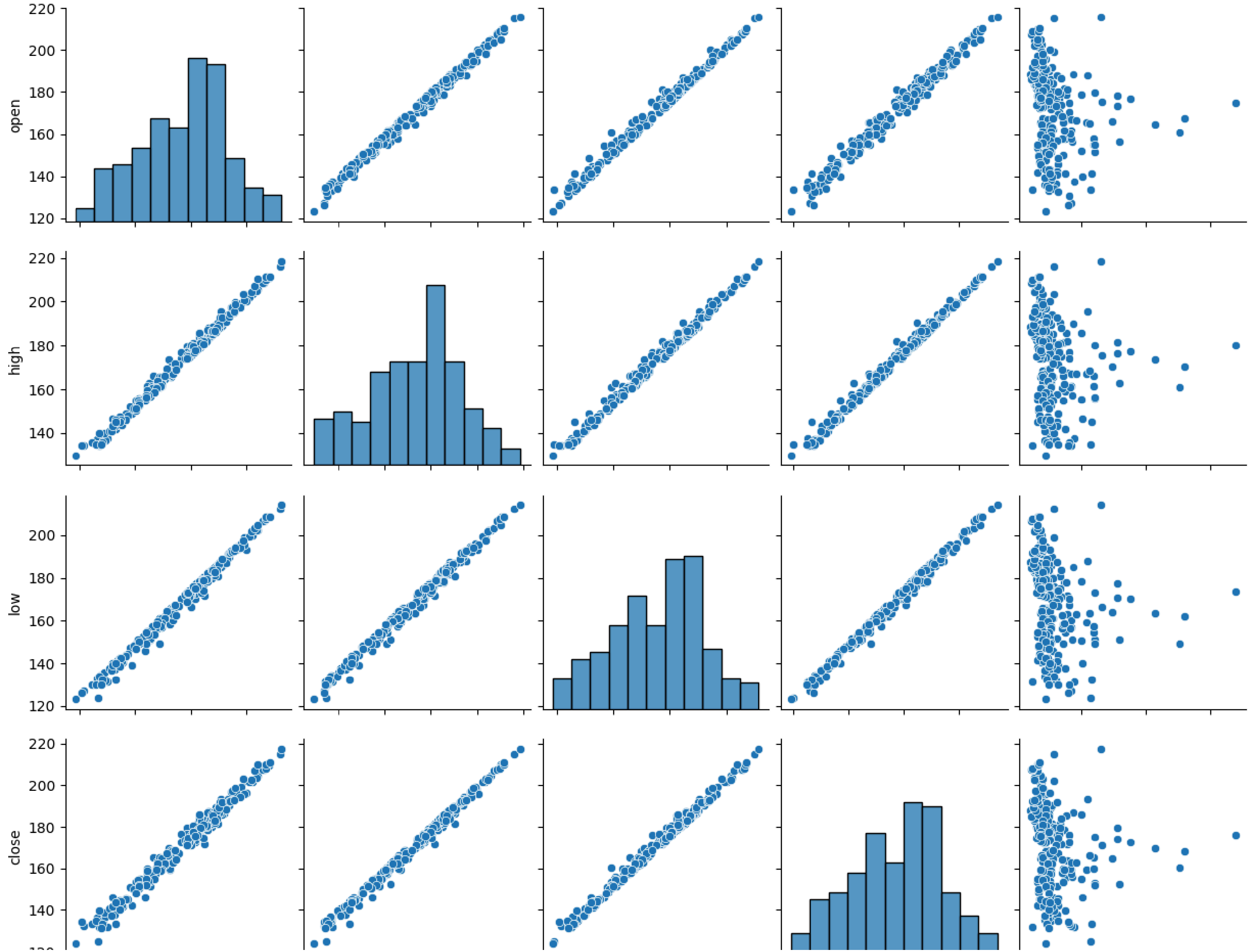
Out[ ]: <Axes: >

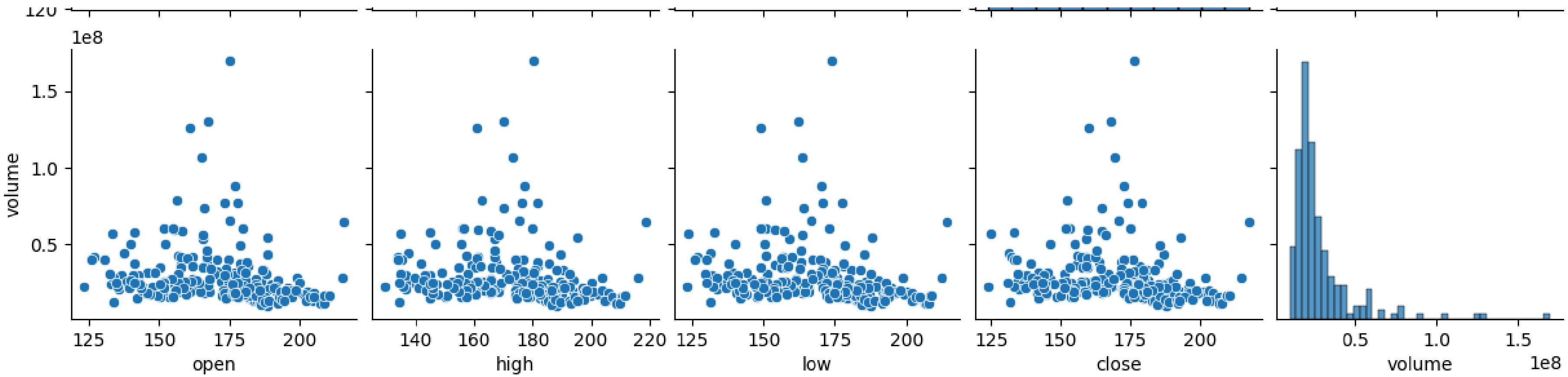


Pair Plots

In [ ]:
```
# Similar to pandas scatter matrix

sns.pairplot(fb)
```

Out[ ]:
```
<seaborn.axisgrid.PairGrid at 0x7fe5138e7b90>
```

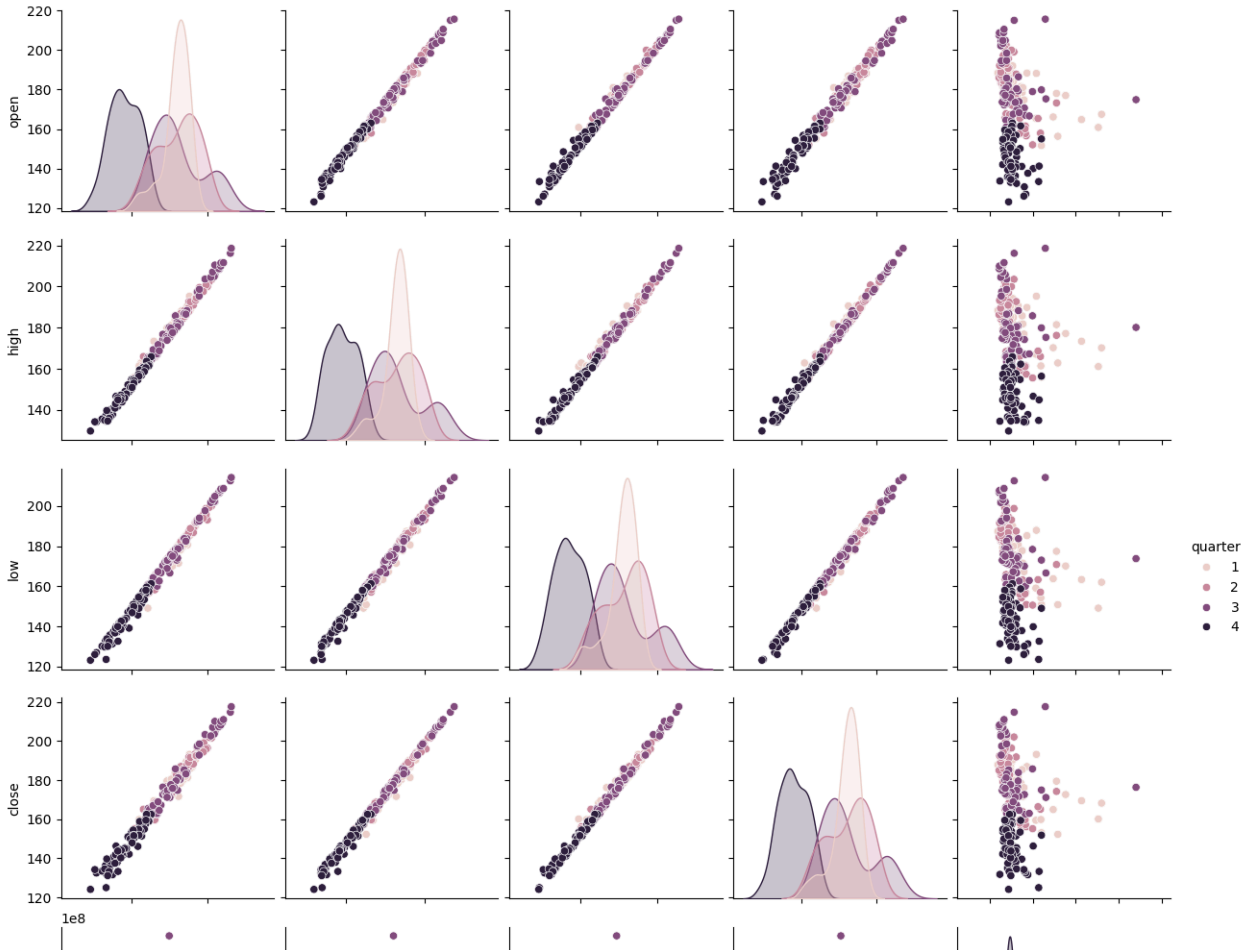

open
high
low
close
220
200
180
160
140
120



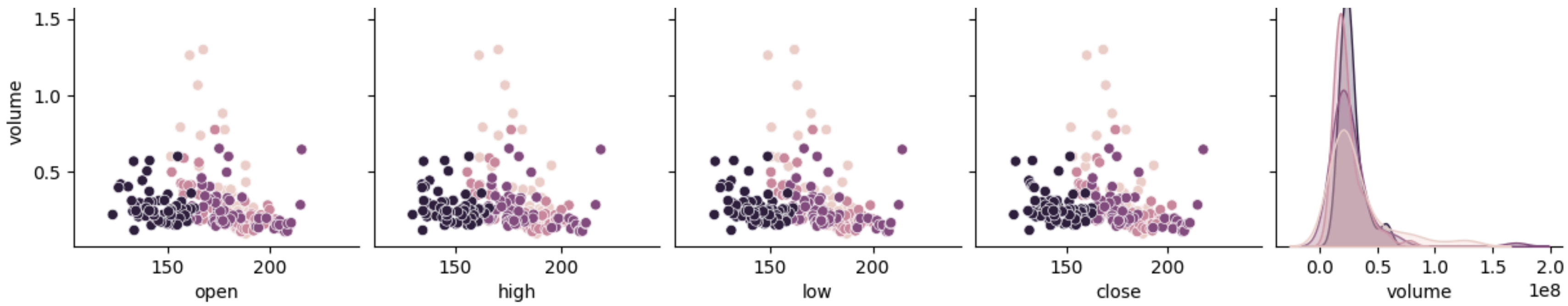
In [ ]:

```
# Seaborn also allows us to change color
# based on another column or data with similar shape

sns.pairplot(
 fb.assign(quarter=lambda x: x.index.quarter),
 diag_kind='kde',
 hue='quarter'
)
```

Out[ ]: <seaborn.axisgrid.PairGrid at 0x7fe513b7d890>



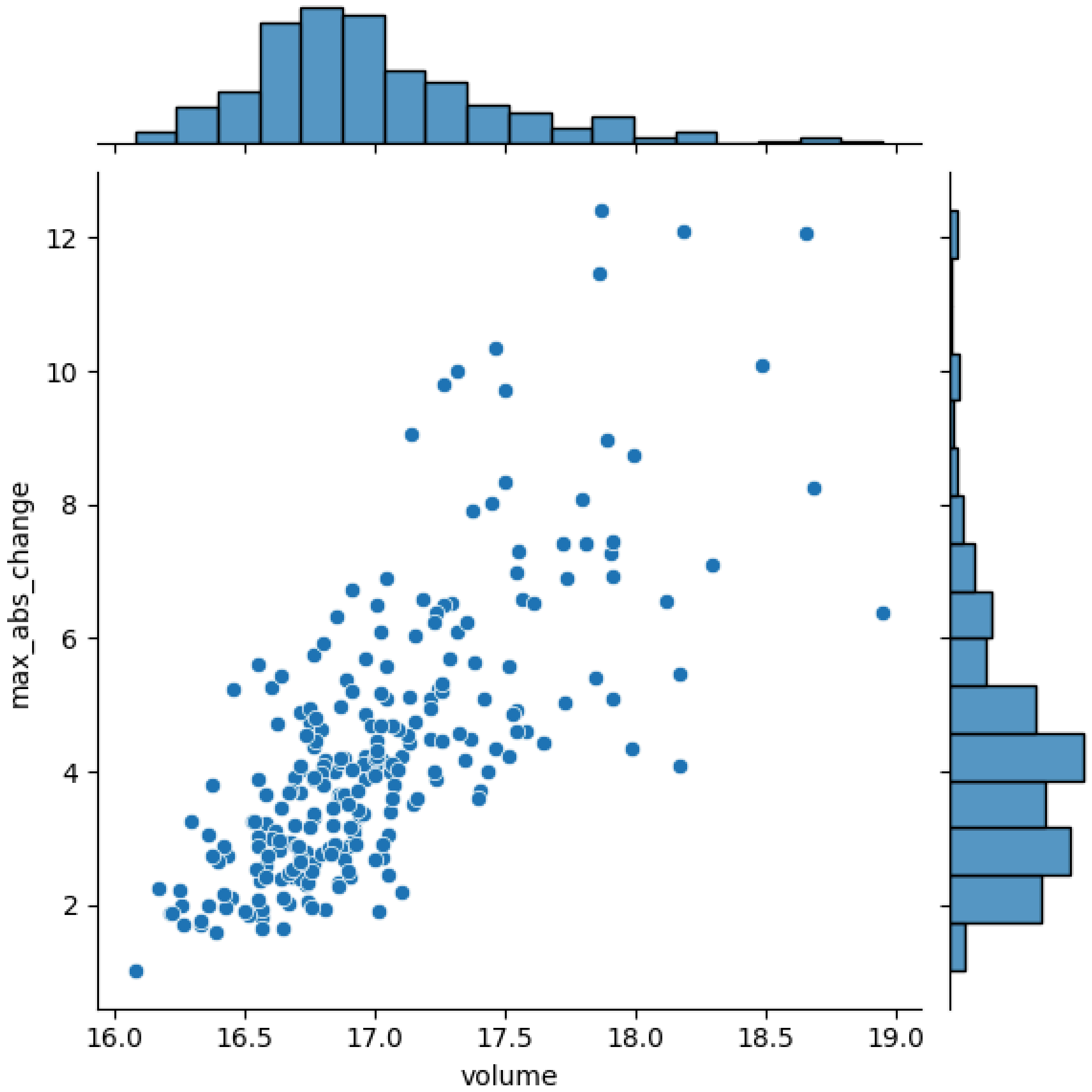
open
high
low
close
quarter
1
2
3
4
1e8
120
140
160
180
200
220



Joint Plot

In [ ]:
```
# The joint plot allows us to visualize the relationship between two variables, like a scatter plot.
# However, we get the added benefit of being able to visualize their distributions at the same time (as a histogram or KDE)

sns.jointplot(
 x='volume',
 y='max_abs_change',
 data=fb.assign(
 volume=np.log(fb.volume),
 max_abs_change=fb.high - fb.low)
)
```

Out[ ]:
```
<seaborn.axisgrid.JointGrid at 0x7fe512000710>
```

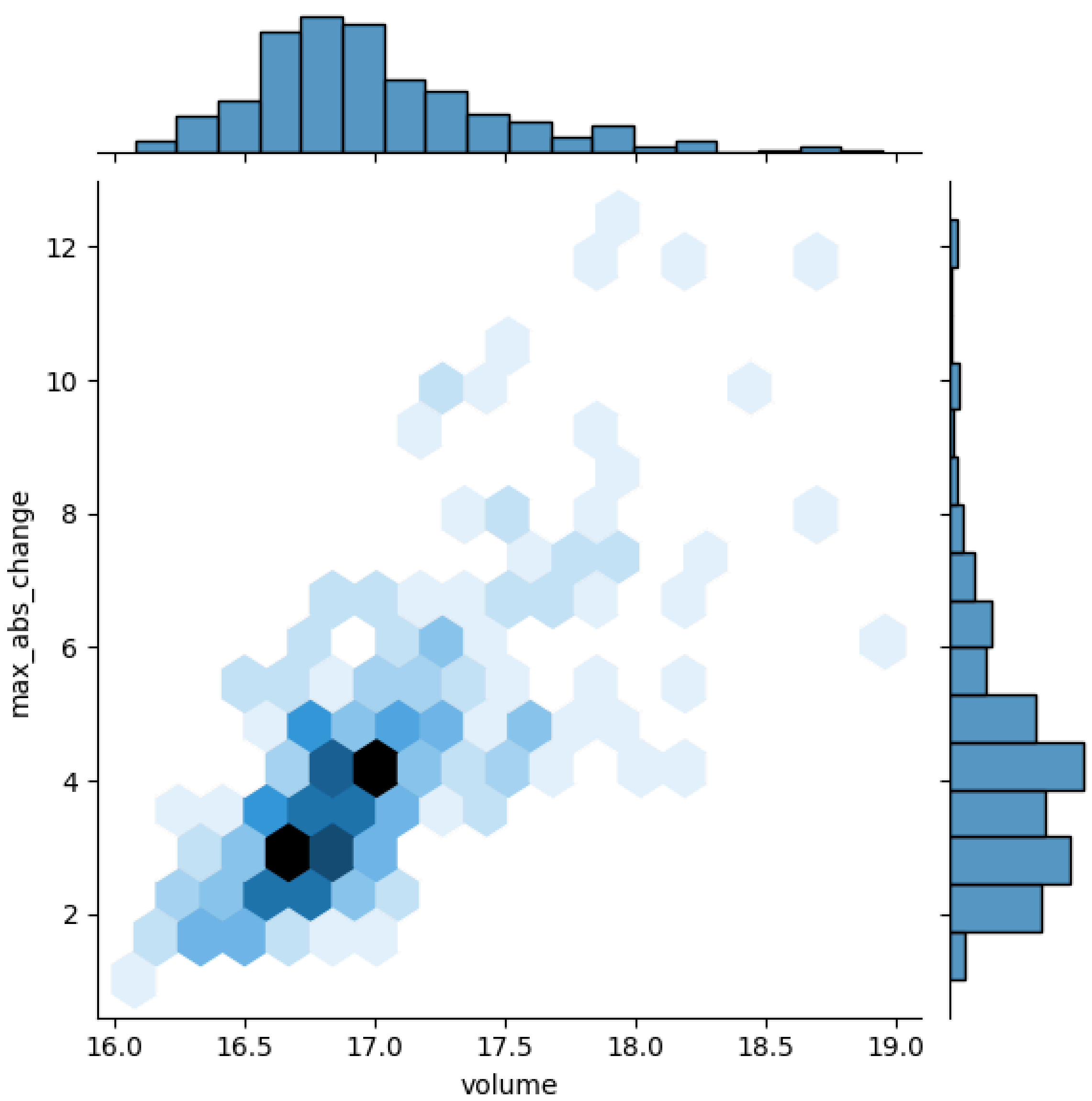


In [ ]:
```
# By changing the kind argument, we can change how the center of the plot is displayed.
```

In [ ]:
```
# kind ='hex'
```

```
sns.jointplot(
 x='volume',
 y='max_abs_change',
 kind='hex',
 data=fb.assign(
 volume=np.log(fb.volume),
 max_abs_change=fb.high - fb.low)
)
```

Out[ ]: <seaborn.axisgrid.JointGrid at 0x7fe512473050>

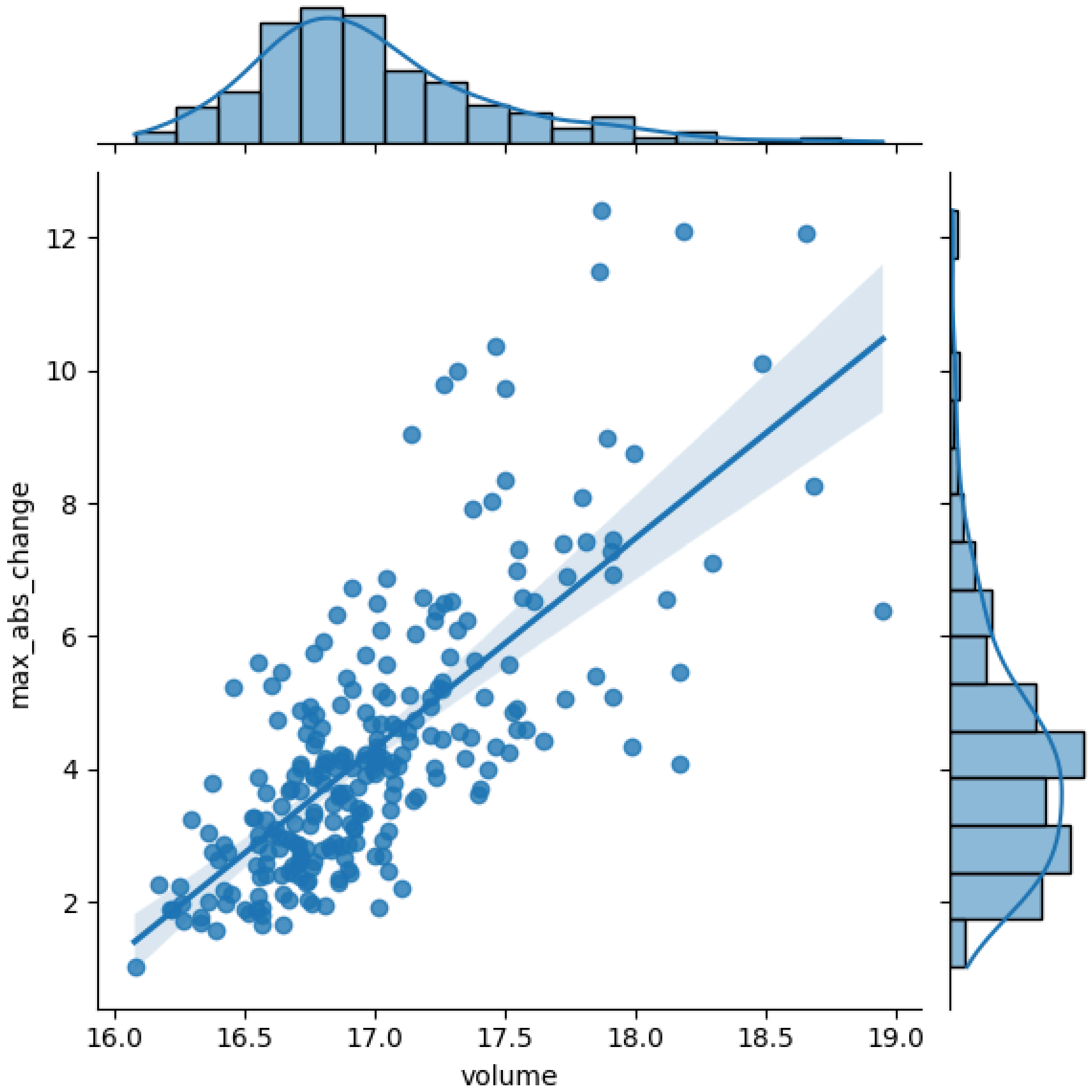


In [ ]:

```
# Kind = 'reg'

sns.jointplot(
 x='volume',
 y='max_abs_change',
```

```python
kind='reg',
data=fb.assign(
volume=np.log(fb.volume),
max_abs_change=fb.high - fb.low)
)
```

Out[ ]: <seaborn.axisgrid.JointGrid at 0x7fe511c7cd90>

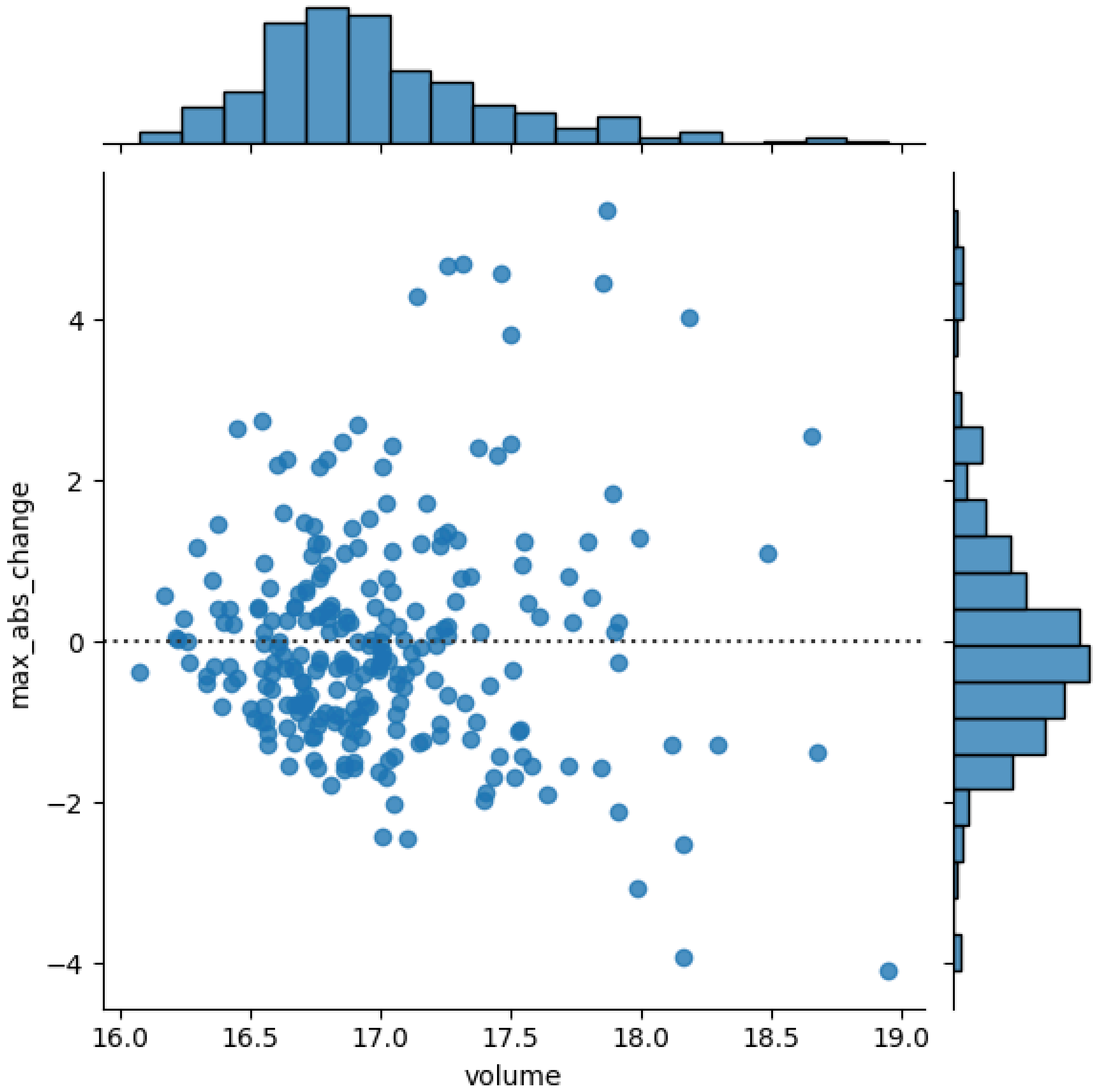


In [ ]:

```
# kind='resid'

sns.jointplot(
 x='volume',
 y='max_abs_change',
```

```
 kind='resid',
 data=fb.assign(
 volume=np.log(fb.volume),
 max_abs_change=fb.high - fb.low)
)
```

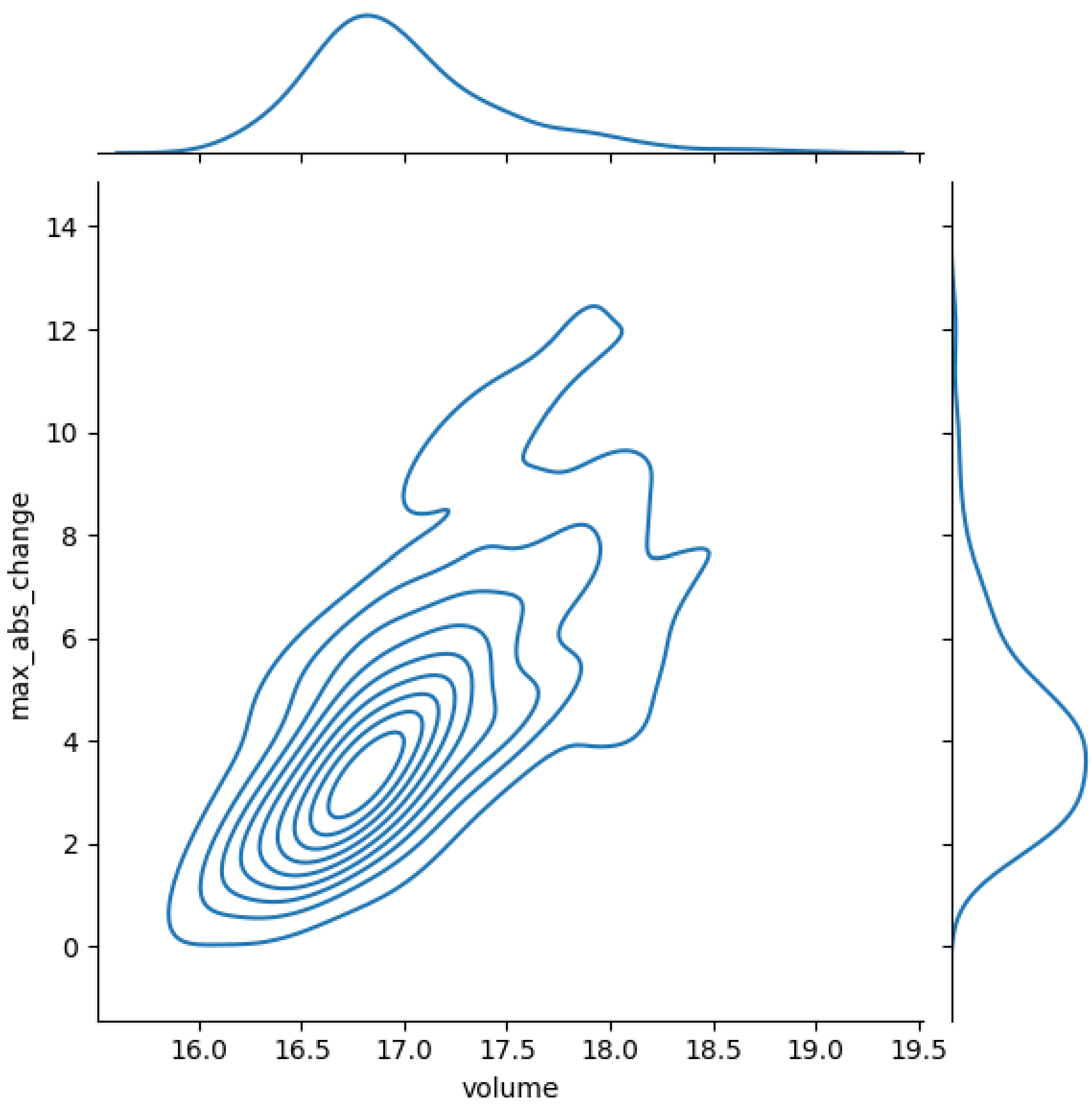
Out[ ]: <seaborn.axisgrid.JointGrid at 0x7fe511949d90>



In [ ]:
```
# kind = 'kde'

sns.jointplot(
 x='volume',
 y='max_abs_change',
```

```
kind='kde',
data=fb.assign(
volume=np.log(fb.volume),
max_abs_change=fb.high - fb.low)
)
```

Out[ ]: <seaborn.axisgrid.JointGrid at 0x7fe5115d8710>



Regression Plots

In [ ]:
```
# visualize a linear regression between
# the log of the volume traded in Facebook stock
```

```
# and the maximum absolute daily change (daily high stock price - daily low stock price).
```

In [ ]:
```
# We first need to isolate this data

fb_reg_data = fb.assign(
 volume=np.log(fb.volume),
 max_abs_change=fb.high - fb.low
).iloc[:,-2:]
```

In [ ]:
```
# Since we want to visualize each column as the regressor,
# we need to look at permutations of their order
# We can use itertools for calculating permutations and combination

import itertools
```

In [ ]:
```
# itertools gives us efficient iterators. Iterators are objects that we loop over, exhausting them.
# This is an iterator from itertools
# notice how the second loop doesn't do anything:

iterator = itertools.repeat("I'm an iterator", 1)
for i in iterator:
  print(f'-->{i}')
print('This printed once because the iterator has been exhausted')
for i in iterator:
  print(f'-->{i}')
```

```
-->I'm an iterator
This printed once because the iterator has been exhausted
```

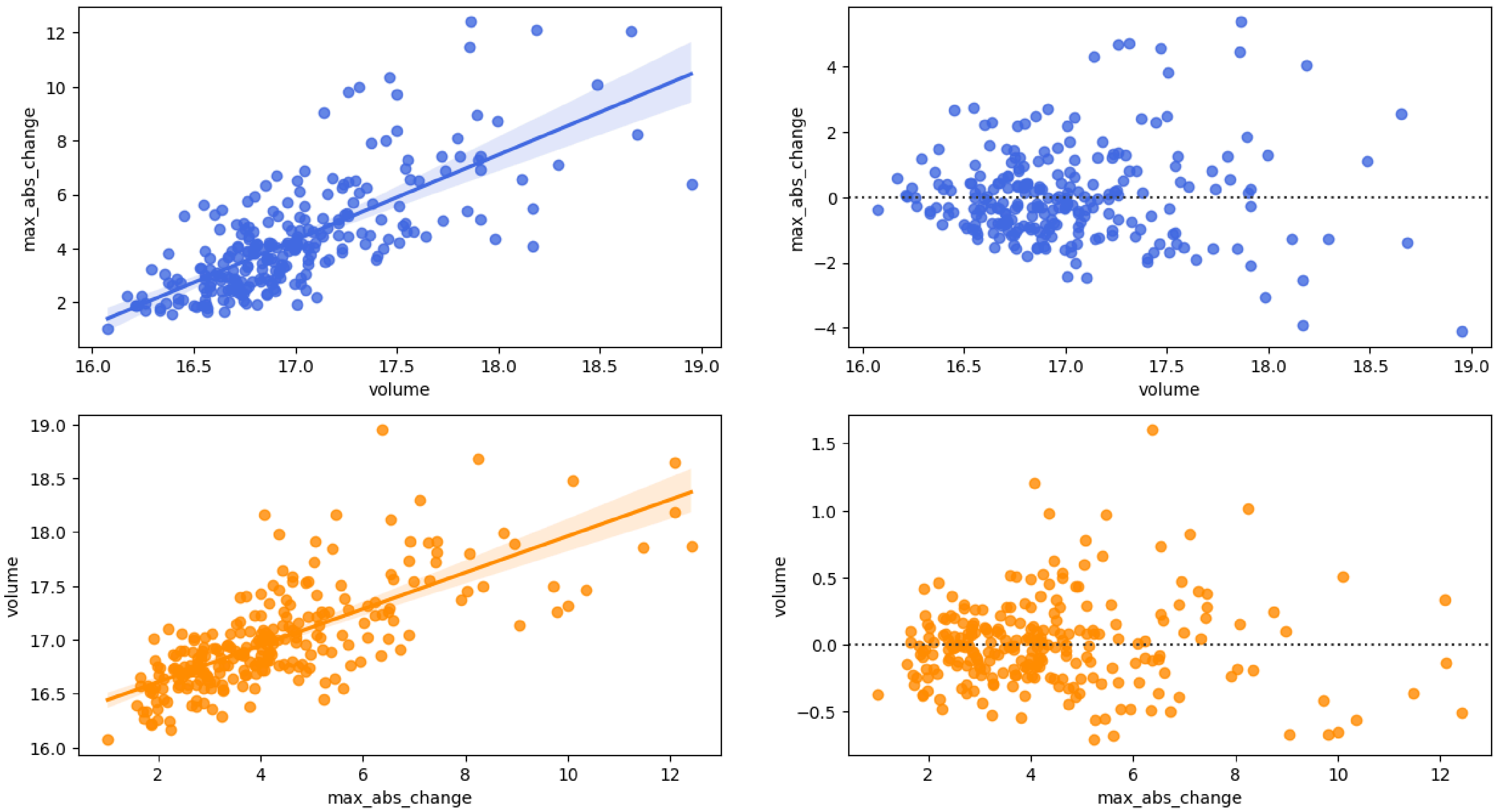
In [ ]:
```
# Iterables are objects that can be iterated over. When entering a loop, an iterator is made from the iterable to handle the i
# Iterators are iterables, but not all iterables are iterators. A list is an iterable.
# If we turn that iterator into an iterable (a list in this case), the second loop runs:

iterable = list(itertools.repeat("I'm an iterable", 1))

for i in iterable:
  print(f'-->{i}')
print('This prints again because it\'s an iterable:')
for i in iterable:
  print(f'-->{i}')
```

```
-->I'm an iterable
This prints again because it's an iterable:
-->I'm an iterable
```

In [ ]:

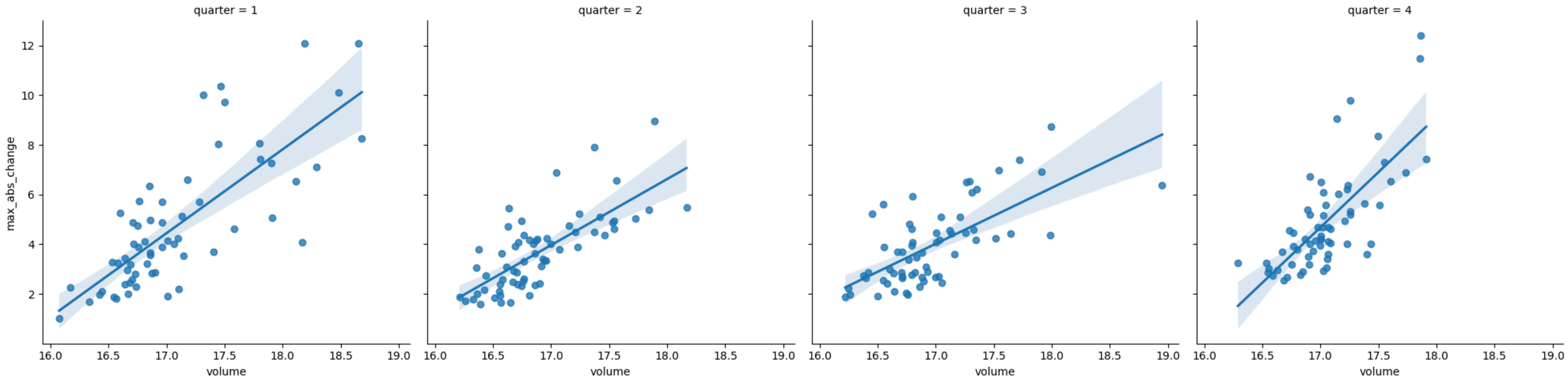
```python
# The reg_resid_plots() function from the reg_resid_plot.py module in this folder uses
# regplot() and residplot() from seaborn along with itertools to plot the regression and residuals side-by-side:

from reg_resid_plot import reg_resid_plots
reg_resid_plots(fb_reg_data)
```

Out[ ]:



In [ ]:
```python
# We can use lmplot() to split our regression across subsets of our data.
# For example, we can perform a regression per quarter on the Facebook stock data:

sns.lmplot(
 x='volume',
 y='max_abs_change',
 data=fb.assign(
 volume=np.log(fb.volume),
 max_abs_change=fb.high - fb.low,
 quarter=lambda x: x.index.quarter),
 col='quarter'
)
```

Out[ ]: <seaborn.axisgrid.FacetGrid at 0x7fe511564810>



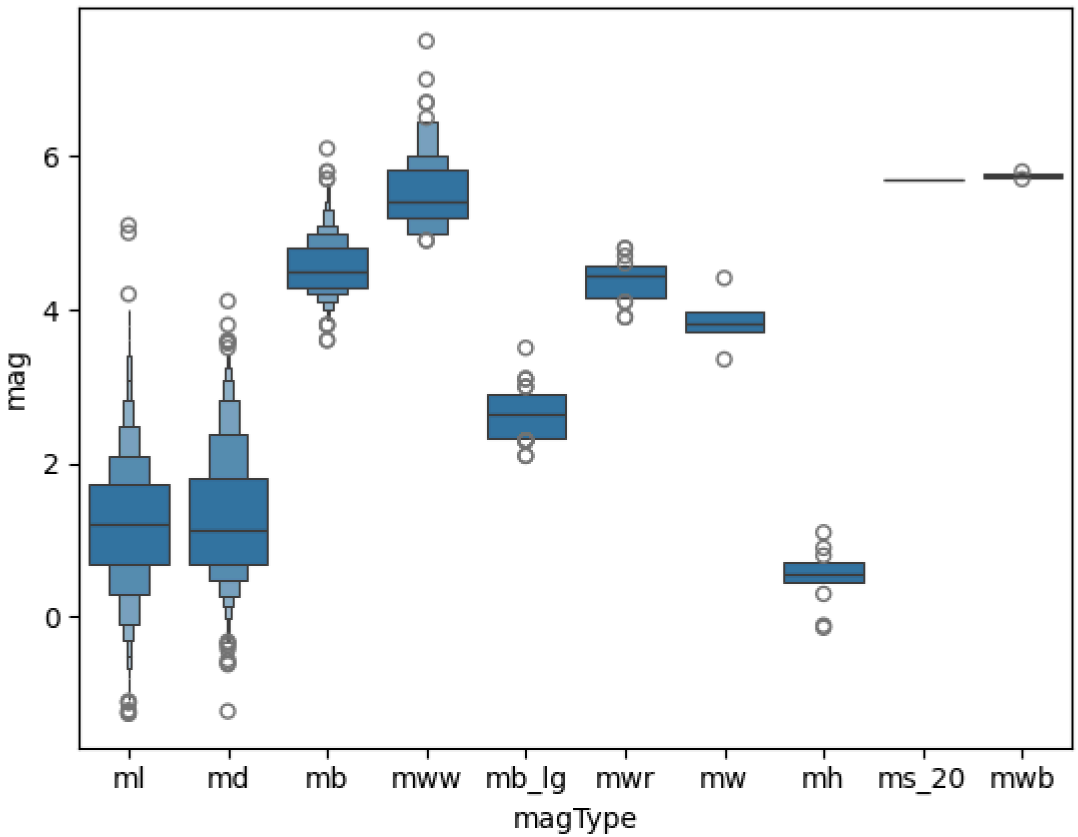
Distributions

In [ ]:
```python
# Boxenplot
```

In [ ]:
```python
# The boxenplot is a box plot that shows additional quantiles

sns.boxenplot(x='magType', y='mag', data=quakes[['magType', 'mag']])
plt.suptitle('Comparing earthquake magnitude by magType')
```

Out[ ]: Text(0.5, 0.98, 'Comparing earthquake magnitude by magType')

Comparing earthquake magnitude by magType

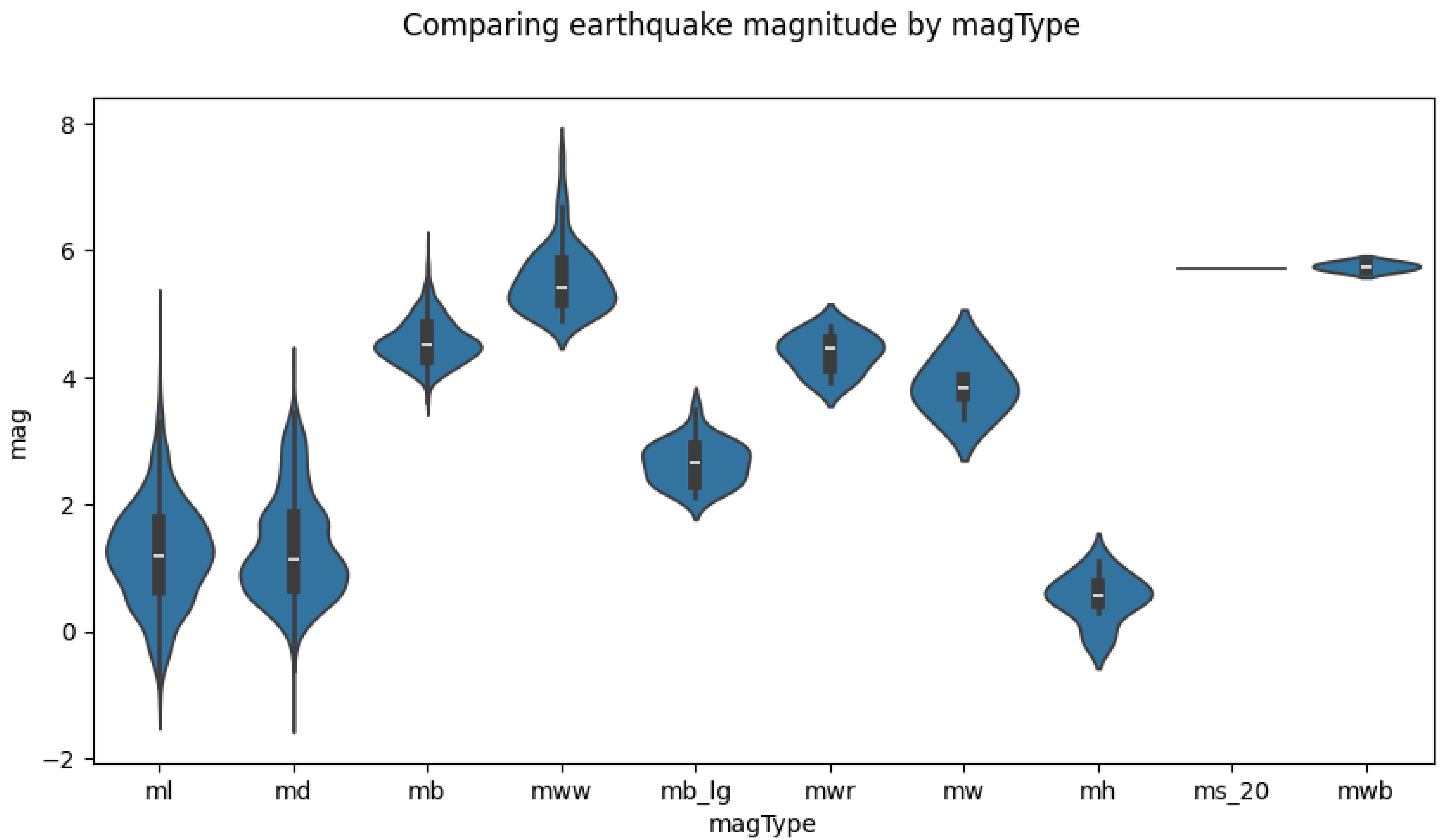



```
In [ ]: # Violinplot
```

```
In [ ]: # Box plots lose some information about the distribution, so we can use violin plots which combine box plots and KDEs

fig, axes = plt.subplots(figsize=(10, 5))
sns.violinplot(
  x='magType', y='mag', data=quakes[['magType', 'mag']],
  ax=axes, scale='width' # all violins have same width
)
plt.suptitle('Comparing earthquake magnitude by magType')
```

```
<ipython-input-62-3eed4115c982>:4: FutureWarning:

The `scale` parameter has been renamed and will be removed in v0.15.0. Pass `density_norm='width'` for the same effect.
  sns.violinplot(
```

Out[ ]:
```
Text(0.5, 0.98, 'Comparing earthquake magnitude by magType')
```



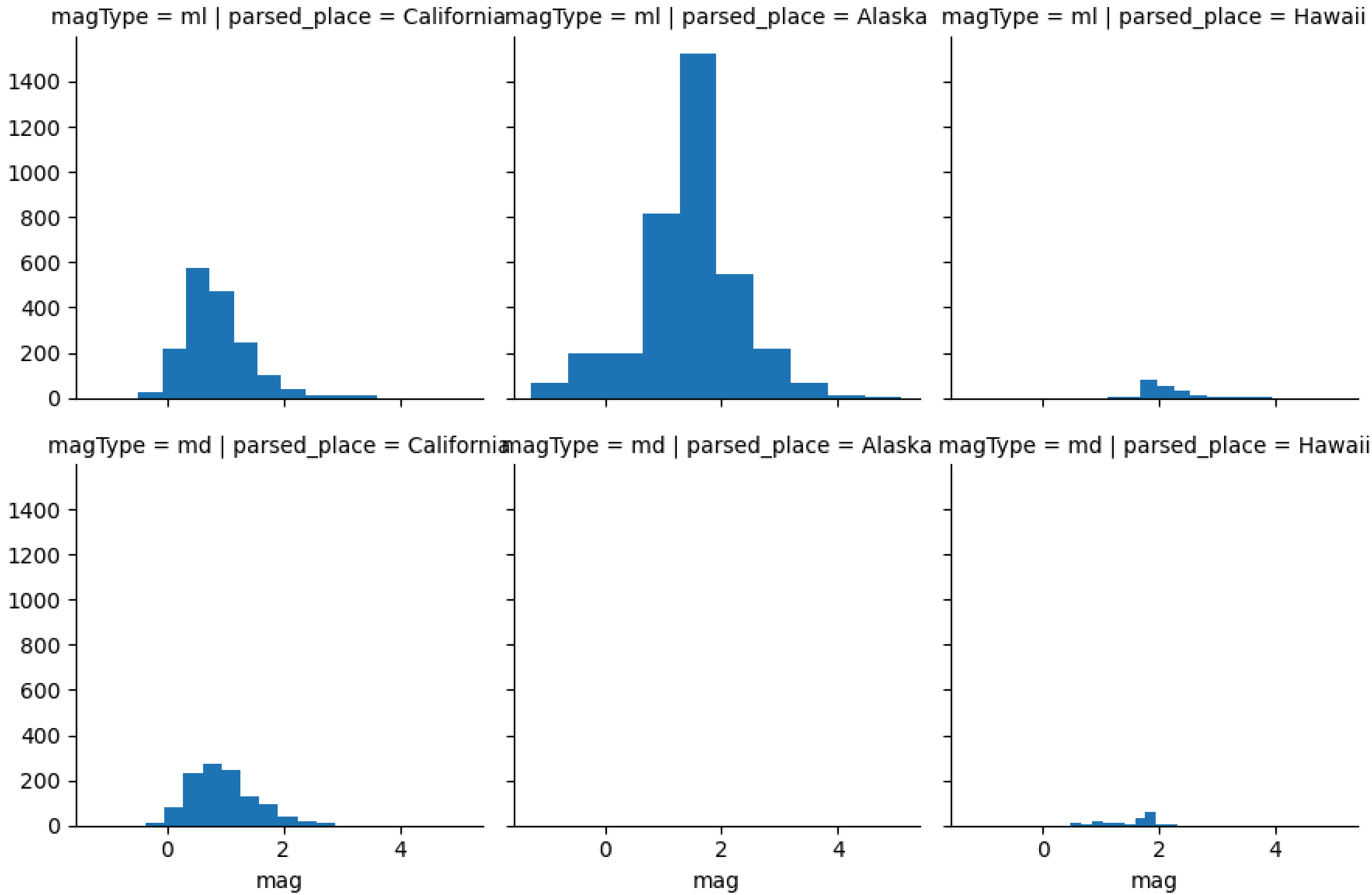
Faceting

In [ ]:
```
# We can create subplots across subsets of our data by faceting.
# First, we create a FacetGrid specifying how to layout the plots (which categorical column goes along therows and which one a
```

```
# Then, we call the map() method of the FacetGrid and pass in the plotting function we want to use (along with any additional
```

In [ ]:

```
# Let's make histograms showing the distribution of earthquake magnitude in California, Alaska, and Hawaii faceted by magType

g = sns.FacetGrid(
  quakes[
    (quakes.parsed_place.isin([
      'California', 'Alaska', 'Hawaii'
    ]))\
    & (quakes.magType.isin(['ml', 'md']))
  ],
  row='magType',
  col='parsed_place'
)
g = g.map(plt.hist, 'mag')
```



Formatting Plots

In [ ]:
```
%matplotlib inline
import matplotlib.pyplot as plt
```

```
import numpy as np
import pandas as pd
import seaborn as sns

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

Titles and Axis Labels

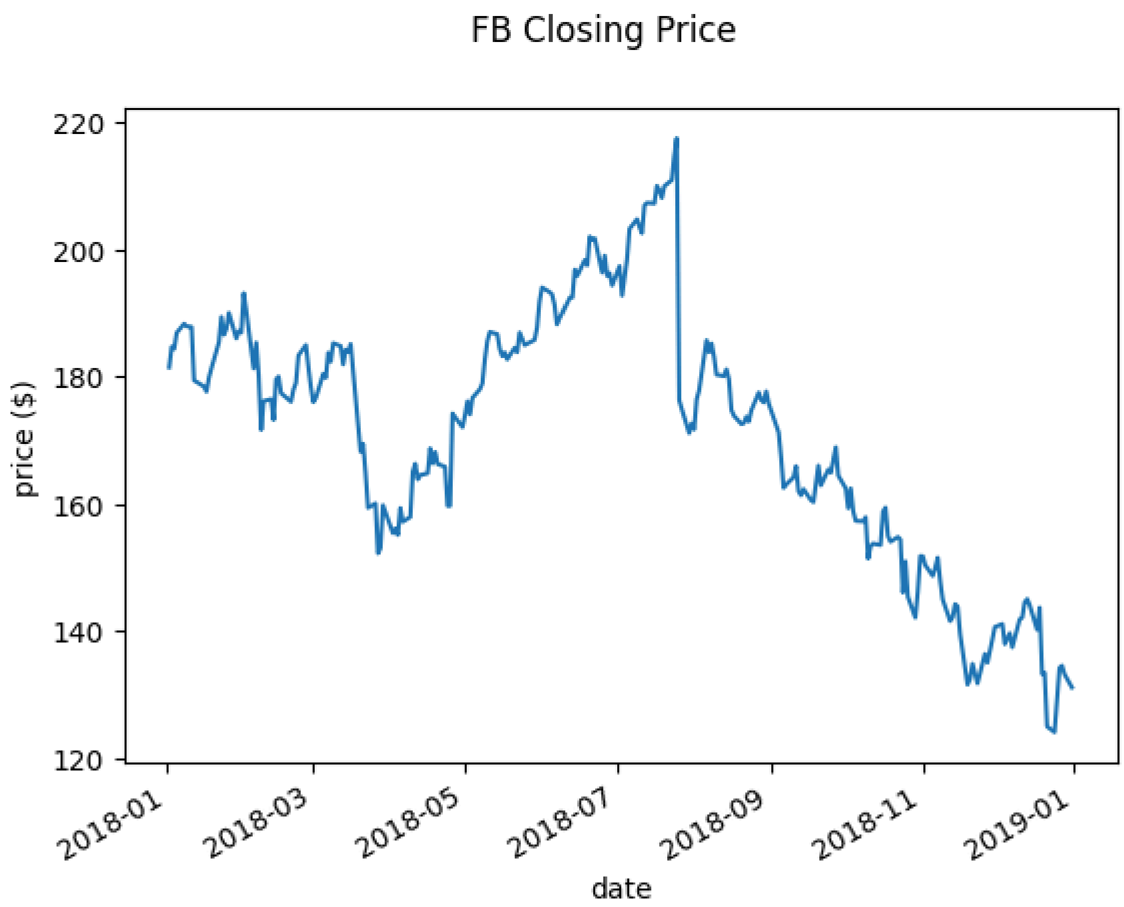
- plt.suptitle() adds a title to plots and subplots
- plt.title() adds a title to a single plot
- plt.xlabel() labels the x-axis
- plt.ylabel() labels the y-axis

In [ ]:

```
fb.close.plot()
plt.suptitle('FB Closing Price')
plt.xlabel('date')
plt.ylabel('price ($)')
```

Out[ ]:

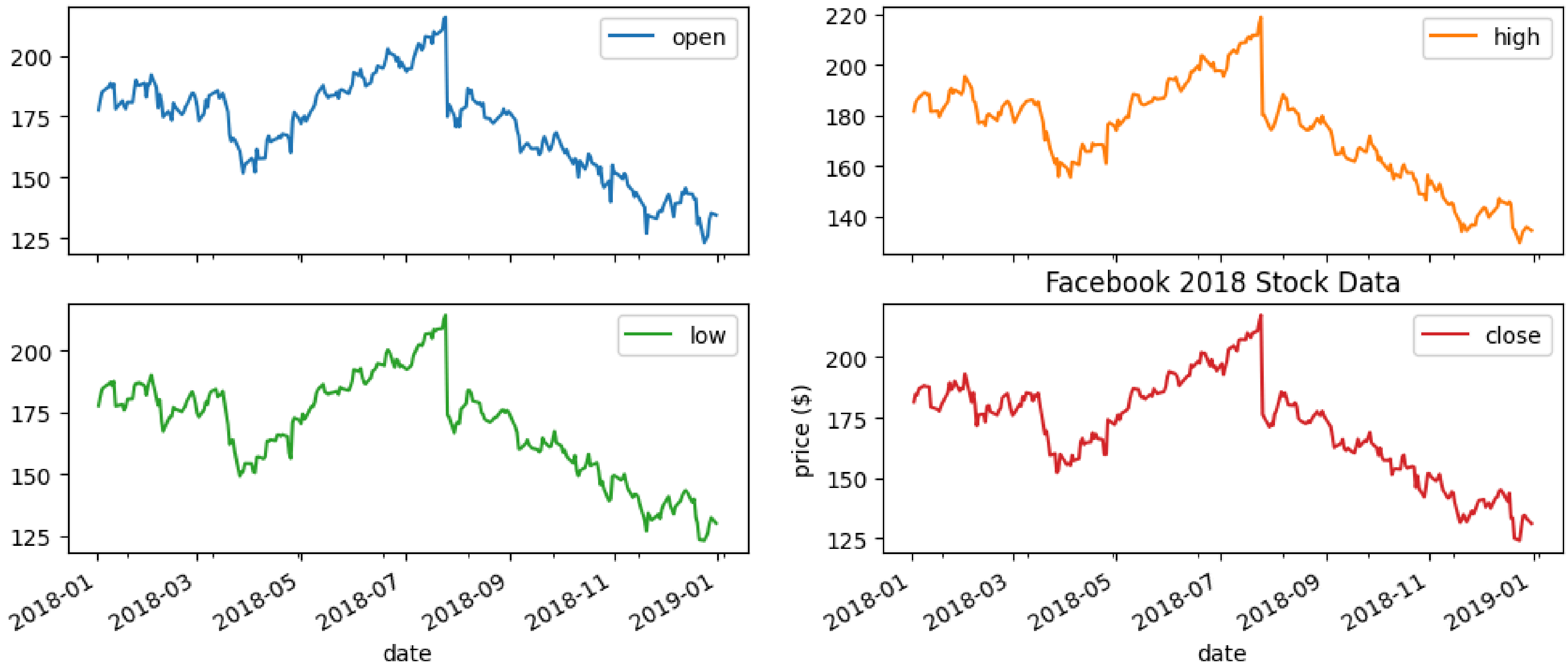
```
Text(0, 0.5, 'price ($)')
```



In [ ]:
```
# plt.suptitle() vs. plt.title()
```

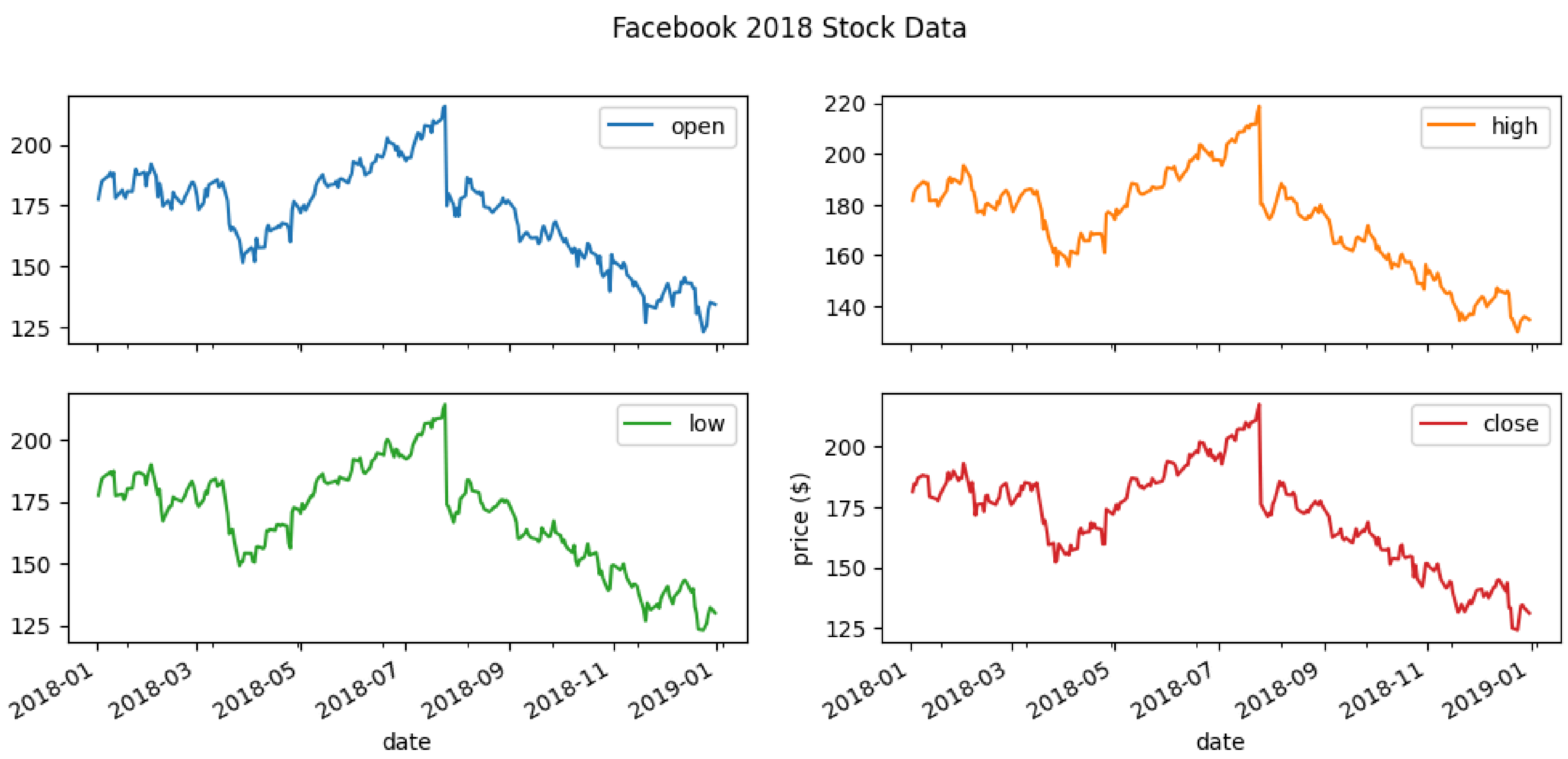
In [ ]:
```
# Check out what happens when we call plt.title() with subplots

fb.iloc[:,:4].plot(subplots=True, layout=(2, 2), figsize=(12, 5))
plt.title('Facebook 2018 Stock Data')
plt.xlabel('date')
plt.ylabel('price ($)')
```

Out[ ]:
```
Text(0, 0.5, 'price ($)')
```



In [ ]:
```
# It's better to get into the habit of just using suptitle instead

fb.iloc[:,:4].plot(subplots=True, layout=(2, 2), figsize=(12, 5))
plt.suptitle('Facebook 2018 Stock Data')
plt.xlabel('date')
plt.ylabel('price ($)')
```

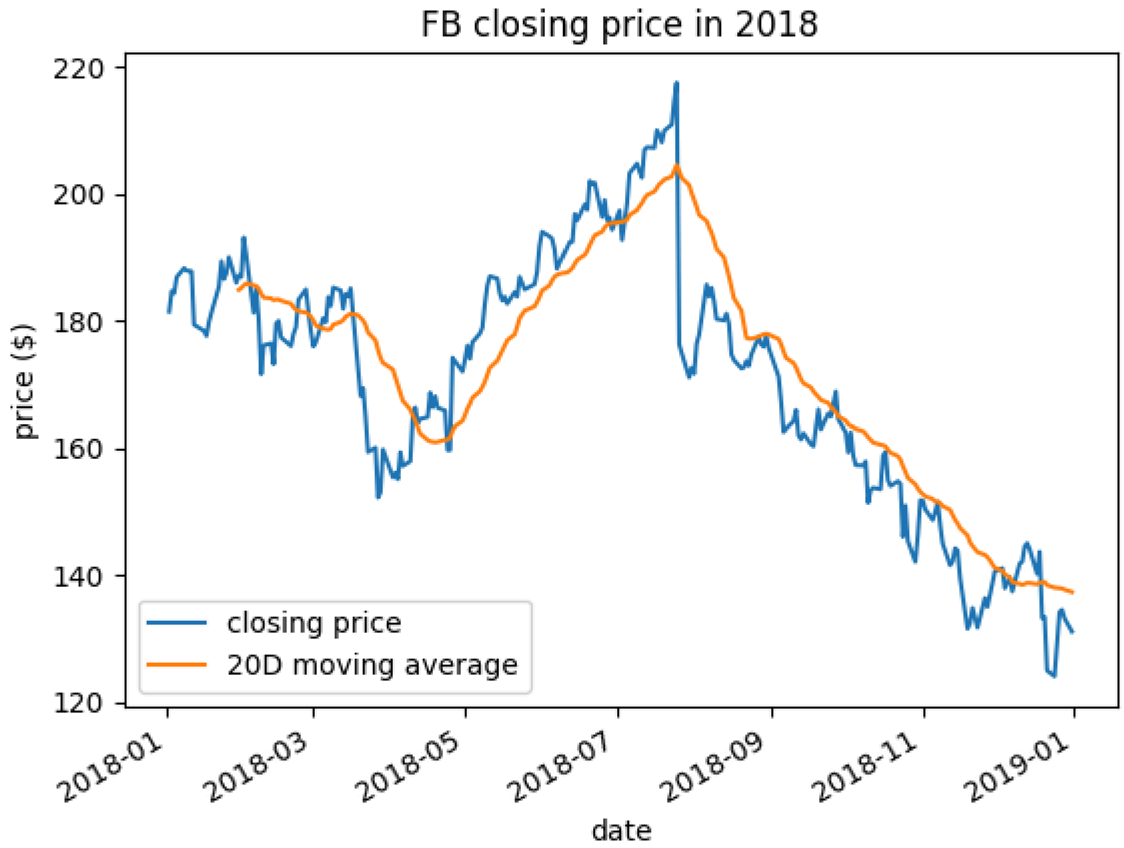
Out[ ]:
```
Text(0, 0.5, 'price ($)')
```



Legends

```
In [ ]: # plt.legend() adds a legend to the plot. We can specify where to place it with the loparameter

fb.assign(
  ma=lambda x: x.close.rolling(20).mean()
).plot(
  y=['close', 'ma'],
  title='FB closing price in 2018',
  label=['closing price', '20D moving average']
)
plt.legend(loc='lower left')
plt.ylabel('price ($)')
```

Out[ ]: Text(0, 0.5, 'price ($)')

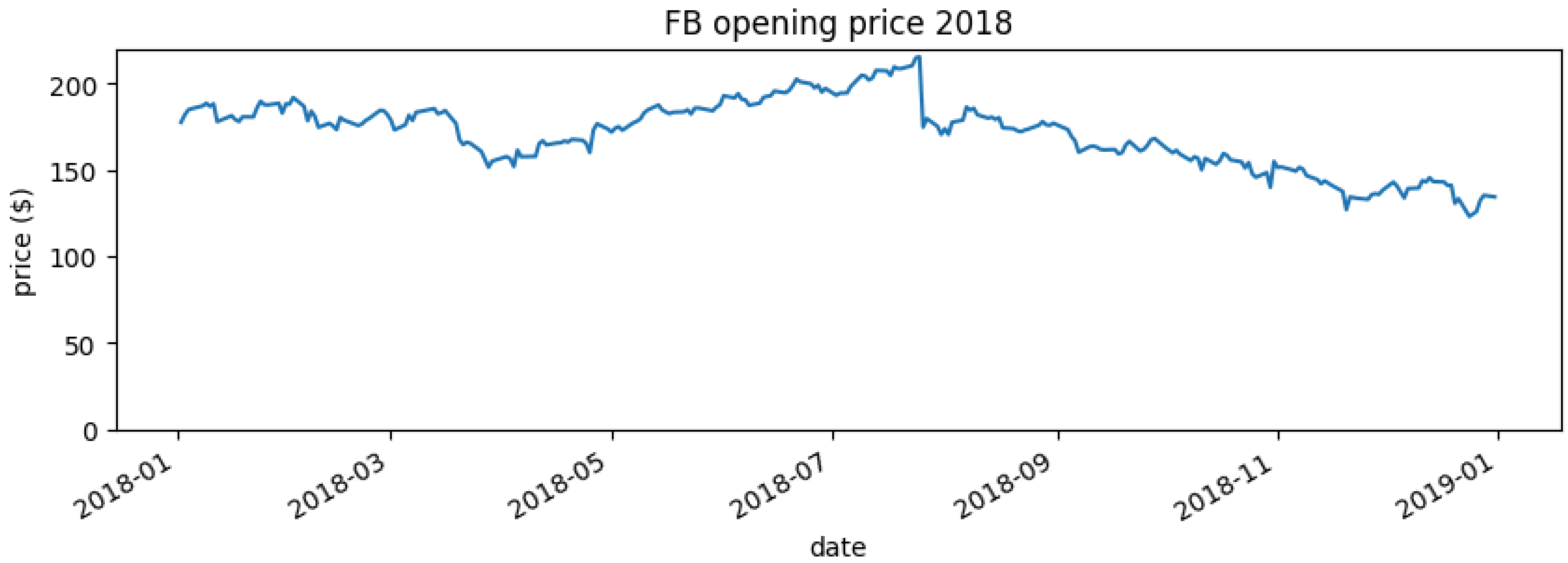


Formatting Axes

In [ ]:
```
# Specifying axis limits
```

In [ ]:
```
# plt.xlim() and plt.ylim() can be used to specify the minimum and maximum values for the axis. Passing None will have matplot

fb.open.plot(figsize=(10, 3), title='FB opening price 2018')
plt.ylim(0, None)
plt.ylabel('price ($)')
```

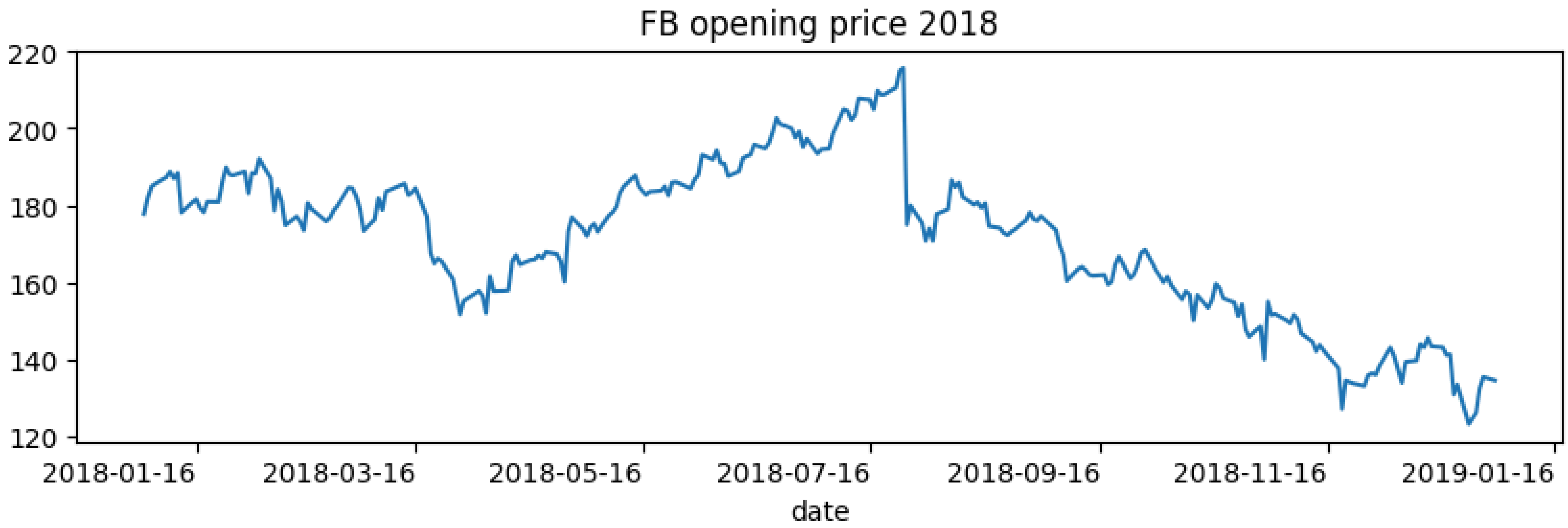
Out[ ]: Text(0, 0.5, 'price ($)')



In [ ]:
```
# Formatting the Axis Ticks
```

In [ ]:
```
# We can use plt.xticks() and plt.yticks() to provide tick labels and specify, which ticks to show. Here, we show every other

import calendar

fb.open.plot(figsize=(10, 3), rot=0, title='FB opening price 2018')
locs, labels = plt.xticks()
plt.xticks(locs + 15, calendar.month_name[1::2])
plt.ylabel('price ($)')
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
<ipython-input-20-c8885cb7af73> in <cell line: 0>()
      5 fb.open.plot(figsize=(10, 3), rot=0, title='FB opening price 2018')
      6 locs, labels = plt.xticks()
----> 7 plt.xticks(locs + 15, calendar.month_name[1::2])
      8 plt.ylabel('price ($)')

/usr/local/lib/python3.11/dist-packages/matplotlib/pyplot.py in xticks(ticks, labels, minor, **kwargs)
   2243             l._internal_update(kwargs)
   2244     else:
-> 2245         labels_out = ax.set_xticklabels(labels, minor=minor, **kwargs)
   2246 
   2247     return locs, labels_out

/usr/local/lib/python3.11/dist-packages/matplotlib/axes/_base.py in wrapper(self, *args, **kwargs)
     72 
     73         def wrapper(self, *args, **kwargs):
---> 74             return get_method(self)(*args, **kwargs)
     75 
     76         wrapper.__module__ = owner.__module__

/usr/local/lib/python3.11/dist-packages/matplotlib/axis.py in set_ticklabels(self, labels, minor, fontdict, **kwargs)
   2115             # remove all tick labels, so only error for > 0 labels
   2116             if len(locator.locs) != len(labels) and len(labels) != 0:
-> 2117                 raise ValueError(
   2118                     "The number of FixedLocator locations"
   2119                     f" ({len(locator.locs)}), usually from a call to"

ValueError: The number of FixedLocator locations (7), usually from a call to set_ticks, does not match the number of labels
(6).
```

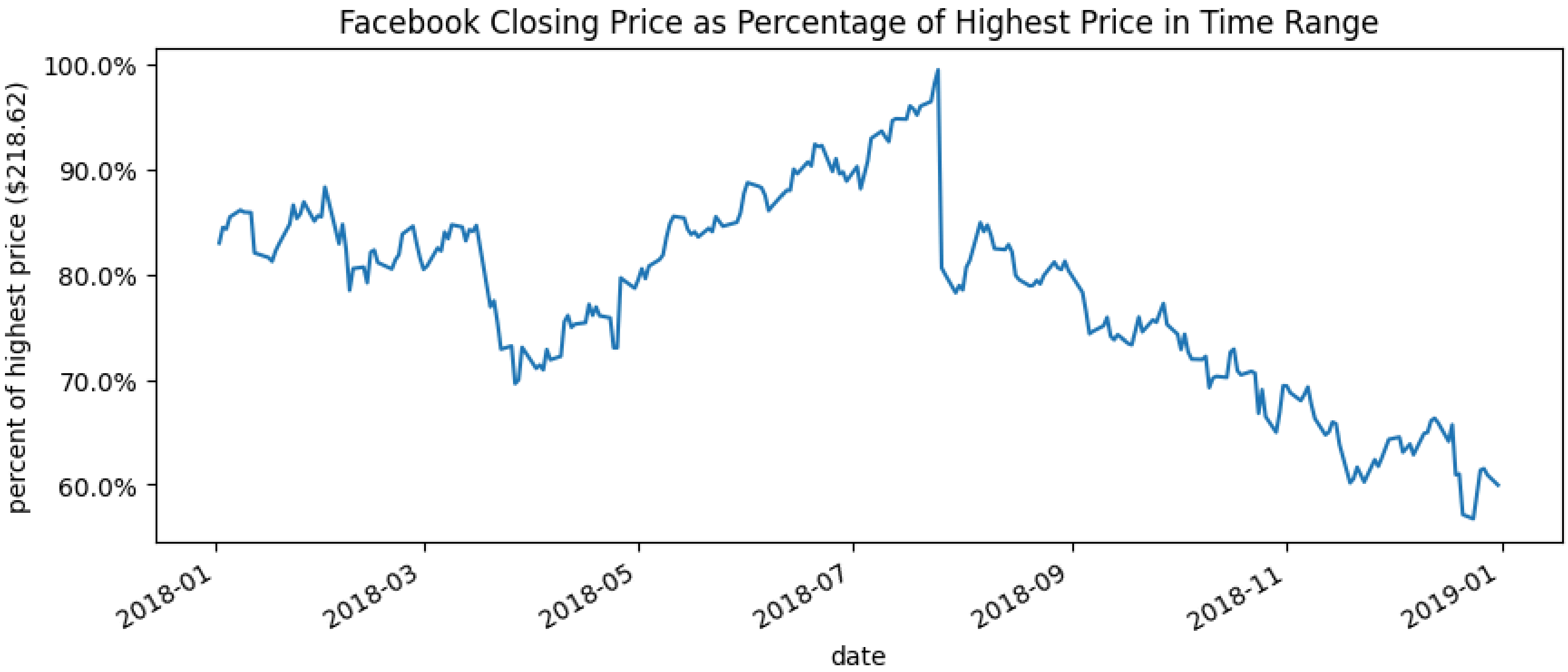


Using Ticker

In [ ]:
```
# PercentFormatter
```

In [ ]:
```
# We can use ticker.PercentFormatter and specify the denominator ( xmax ) to use when calculating the percentages.
# This gets passed to the set_major_formatter() method of the x-axis or y-axis on the Axes

import matplotlib.ticker as ticker
ax = fb.close.plot(
  figsize=(10, 4),
  title='Facebook Closing Price as Percentage of Highest Price in Time Range'
)
ax.yaxis.set_major_formatter(
  ticker.PercentFormatter(xmax=fb.high.max())
)
ax.set_yticks([
  fb.high.max()*pct for pct in np.linspace(0.6, 1, num=5)
]) # show round percentages only (60%, 80%, etc.)
ax.set_ylabel(f'percent of highest price (${fb.high.max()})')
```

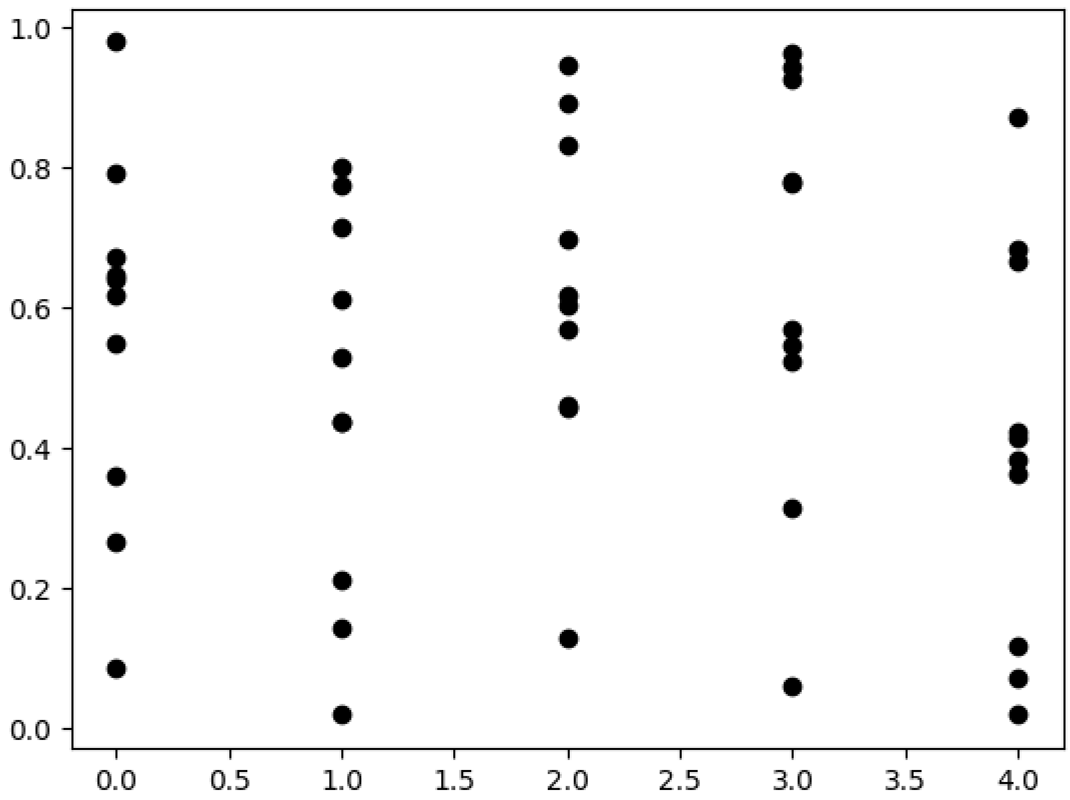
Out[ ]:
```
Text(0, 0.5, 'percent of highest price ($218.62)')
```



In [ ]:
```python
# MultipleLocator
```

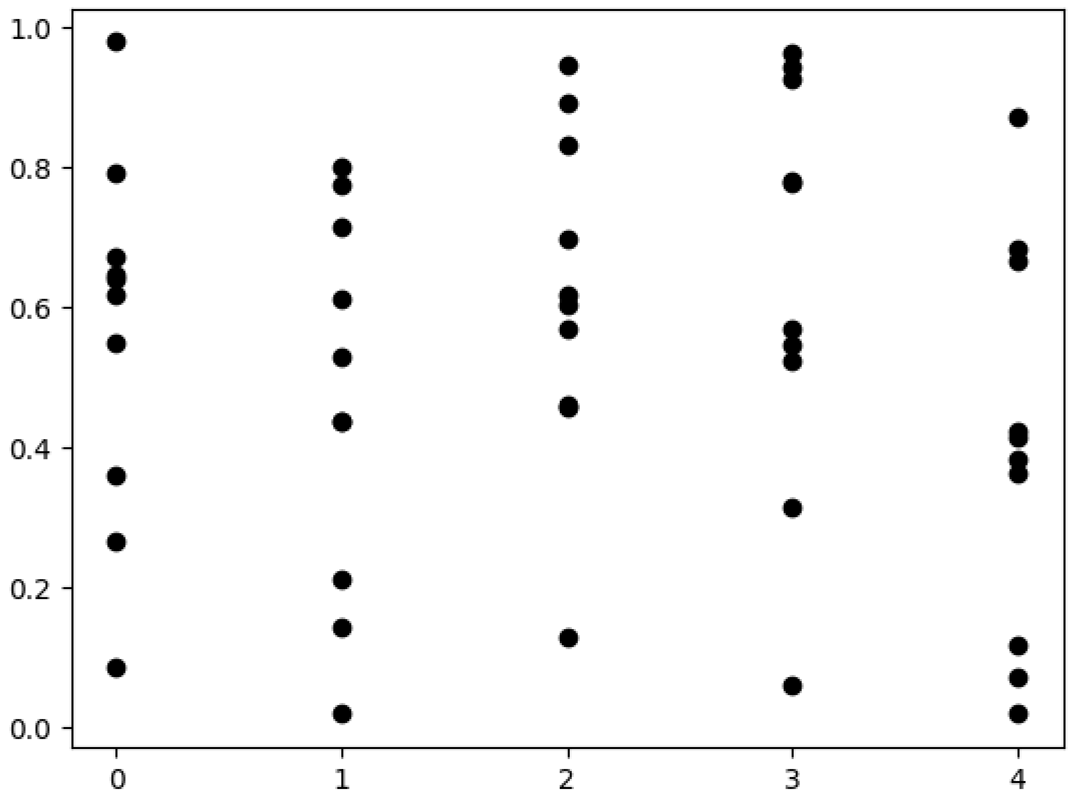
In [ ]:
```python
# Say we have the following data. The points only take on integer values for x

fig, ax = plt.subplots(1, 1)
np.random.seed(0)
ax.plot(np.tile(np.arange(0, 5), 10), np.random.rand(50), 'ko')
```

Out[ ]: `[<matplotlib.lines.Line2D at 0x7e18172d6410>]`



In [ ]:

```
# If we don't want to show decimal values on the x-axis, we can use the MultipleLocator.
# This will give ticks for all multiples of a number specified with the baseparameter.
# To get integer values, we use base=1

fig, ax = plt.subplots(1, 1)
np.random.seed(0)
ax.plot(np.tile(np.arange(0, 5), 10), np.random.rand(50), 'ko')
ax.get_xaxis().set_major_locator(
  ticker.MultipleLocator(base=1)
)
```

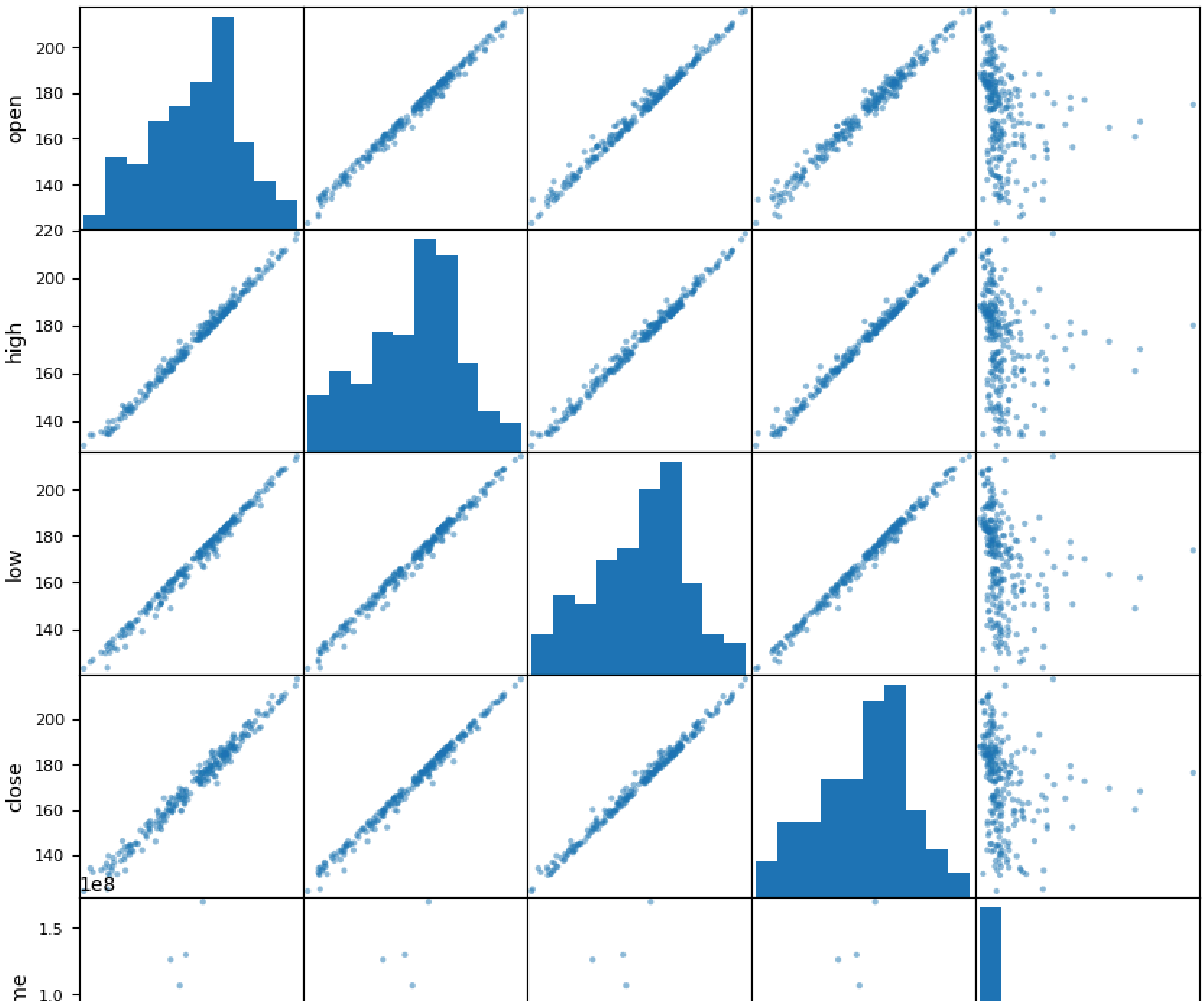


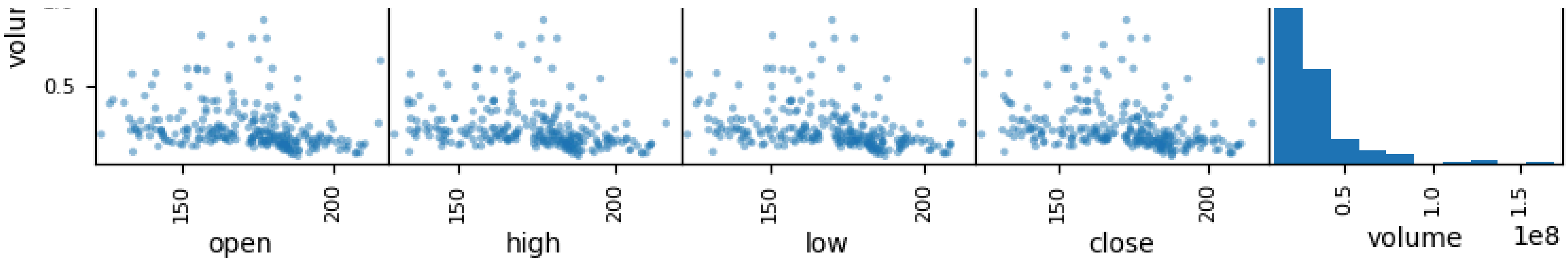
Customize Visualizations

In [ ]:
```
%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)
```

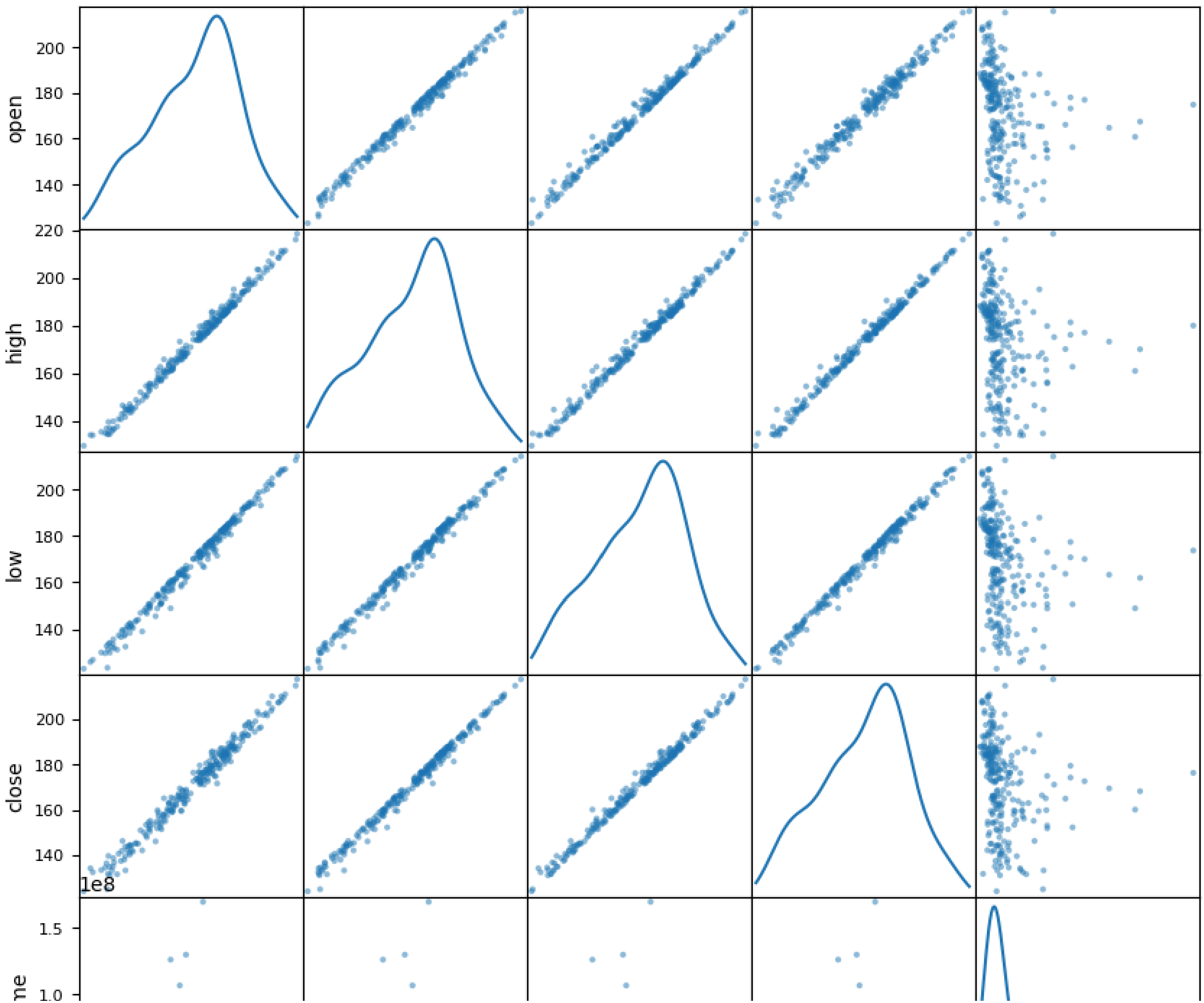
In [ ]:
```
# Scatter Matrix
```

In [ ]:
```
from pandas.plotting import scatter_matrix
scatter_matrix(fb, figsize=(10, 10));
```

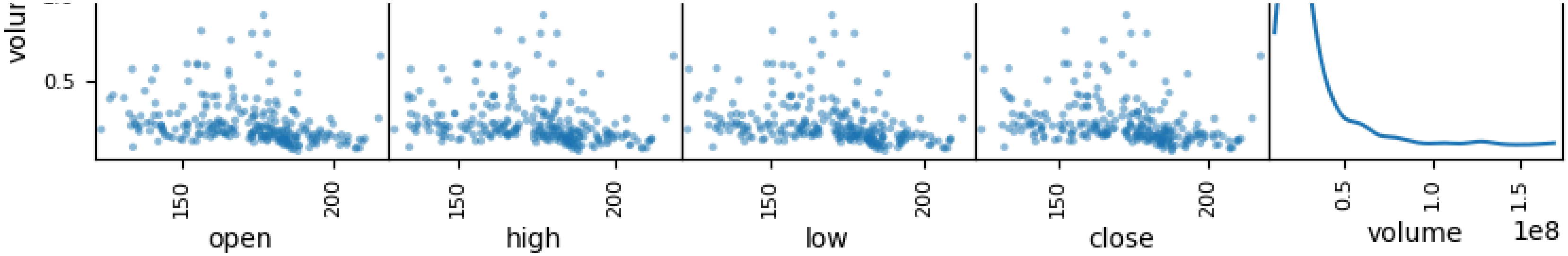

open
high
low
close
me
200
180
160
140
220
1e8
1.5
1.0



In [ ]:
```
# Changing the diagonal from histogram to KDE

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



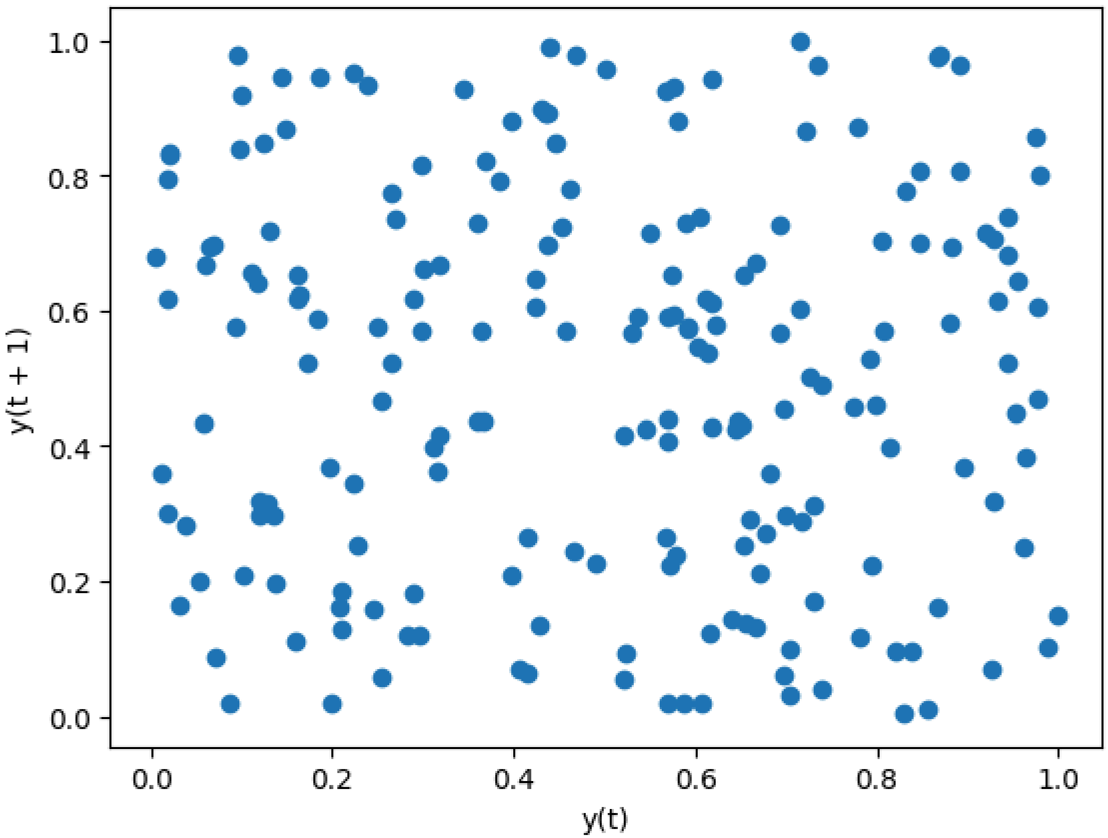
open
high
low
close
me
1e8
200
180
160
140
220
1.5
1.0




```
In [ ]: # Lag plots
```

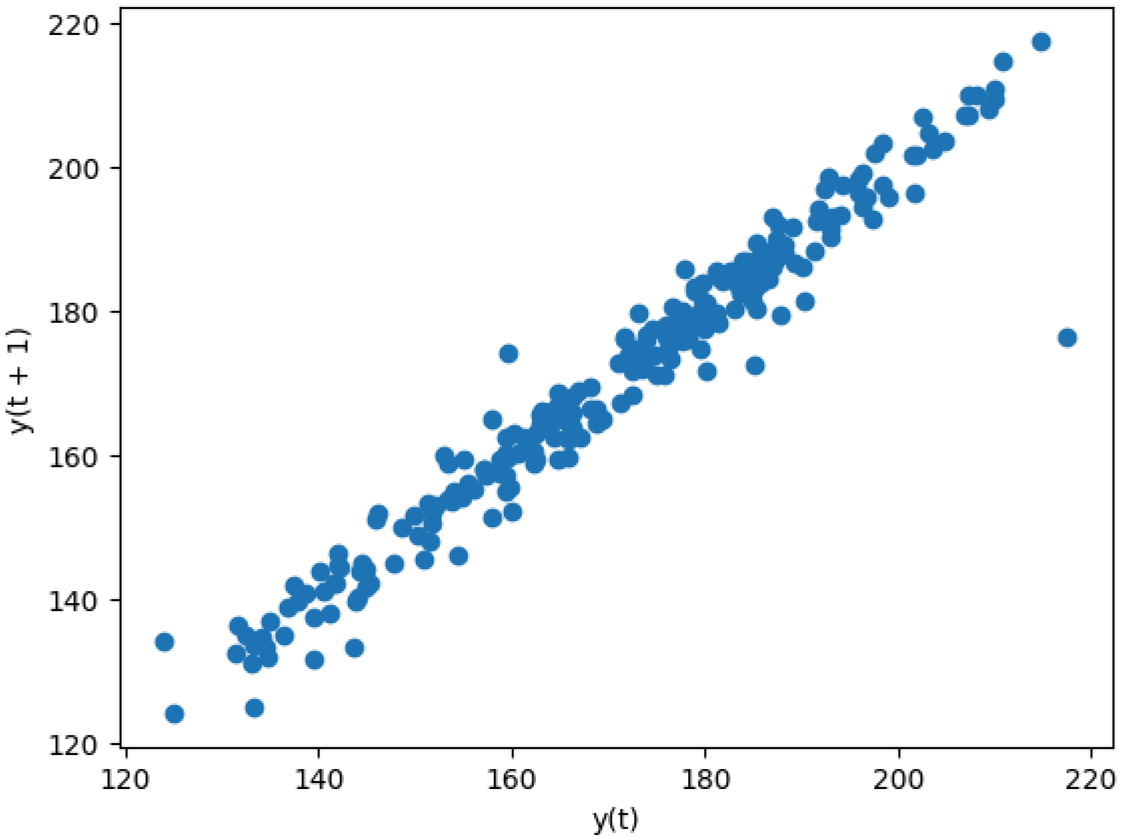
```
In [ ]: # Lag plots let us see how the variable correlations with past observations of itself. Random data has no pattern

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

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



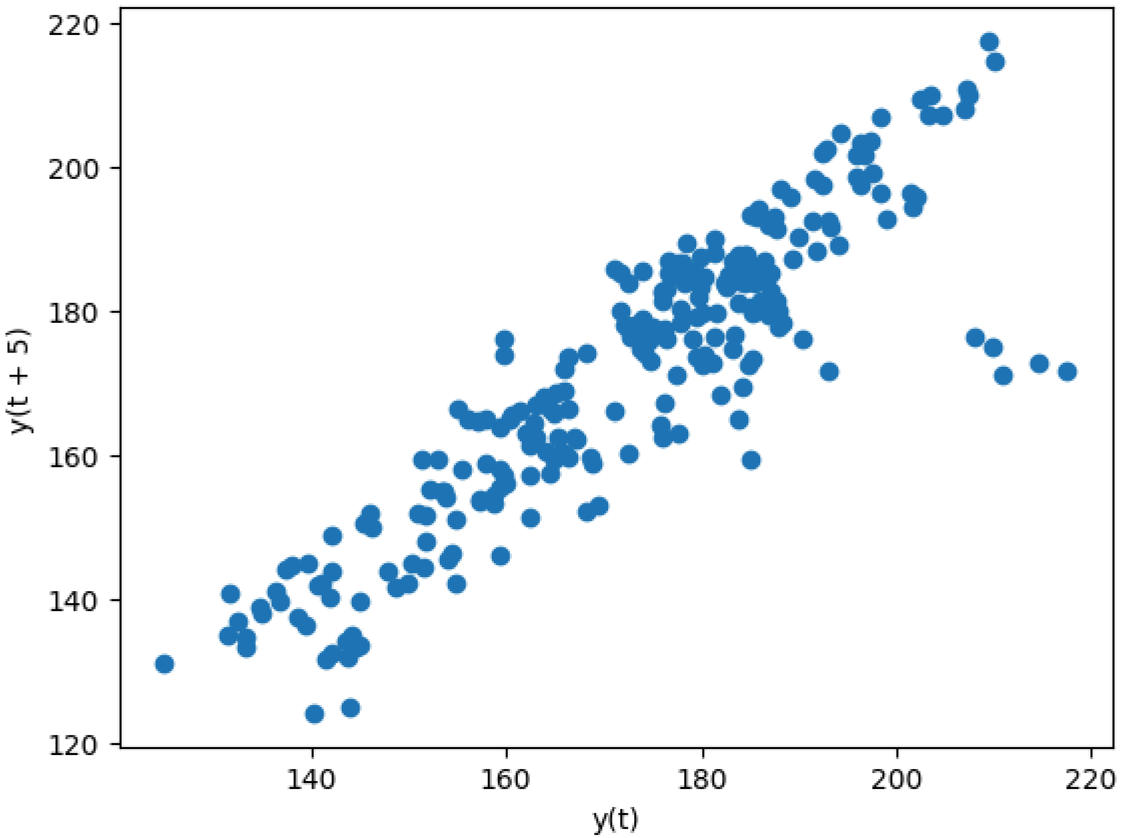
In [ ]:
```
# Data with some level of correlation to itself (autocorrelation) may have patterns. Stock prices are highly auto-correlated

lag_plot(fb.close)
```

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



In [ ]:
```
# The default lag is 1, but we can alter this with the lag parameter. Let's look at a 5 day lag

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

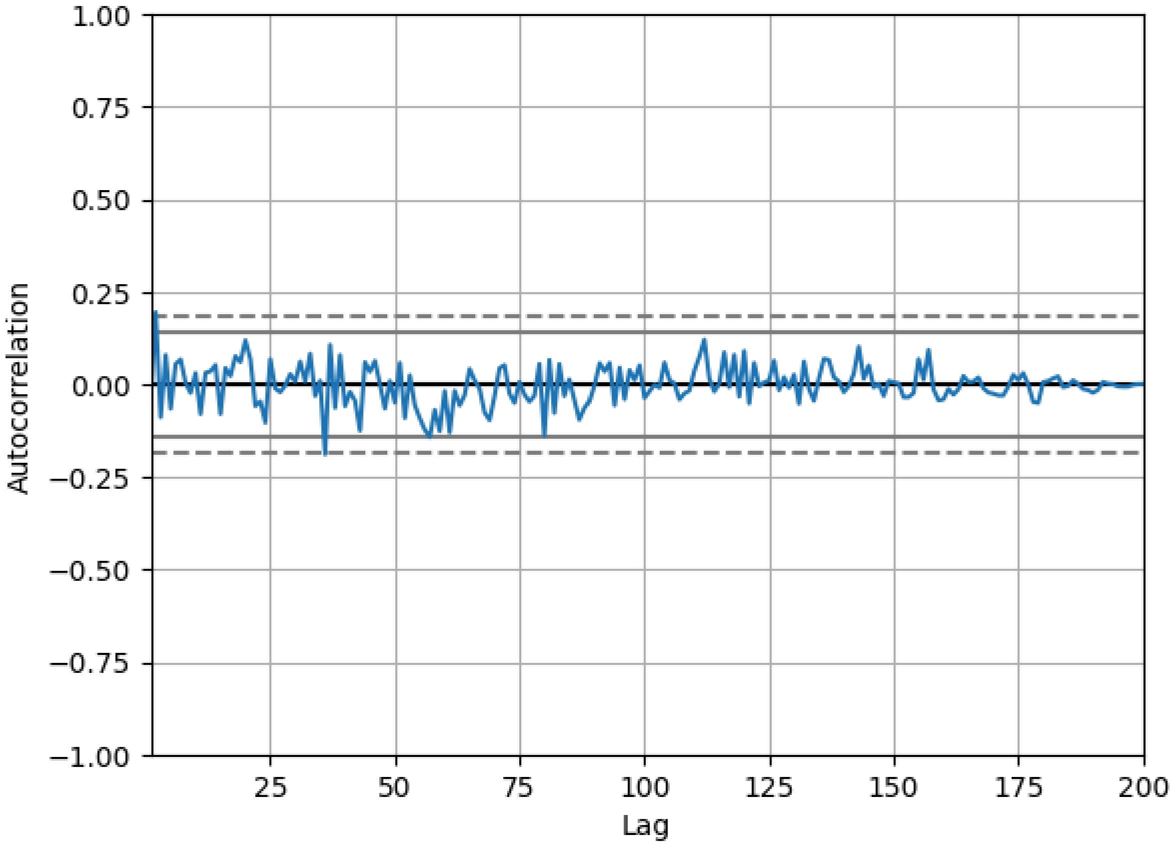
Out[ ]:
```
<Axes: xlabel='y(t)', ylabel='y(t + 5)'>
```



In [ ]:
```
# Autocorrelation Plots
```

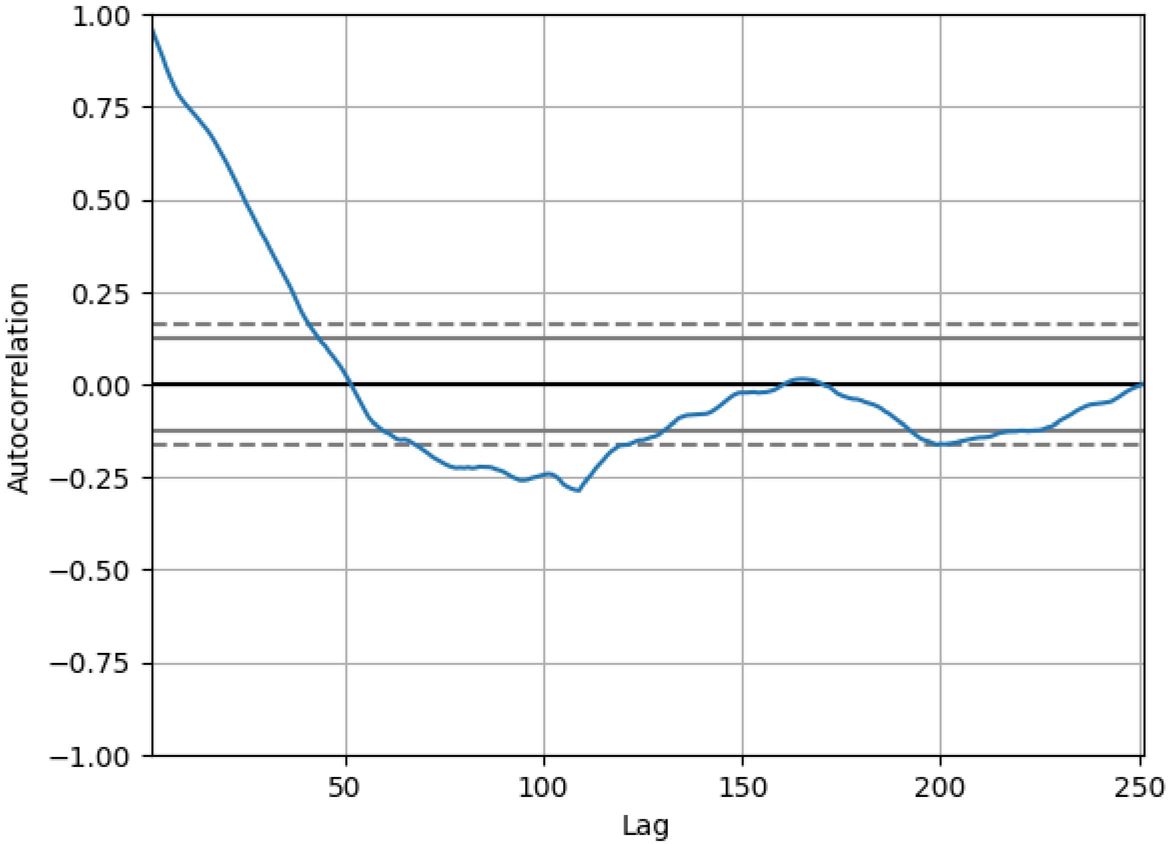
In [ ]:
```
# We can use the autocorrelation plot to see if this relationship may be meaningful or just noise.
# Random data will not have any significant autocorrelation

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

Out[ ]: <Axes: xlabel='Lag', ylabel='Autocorrelation'>



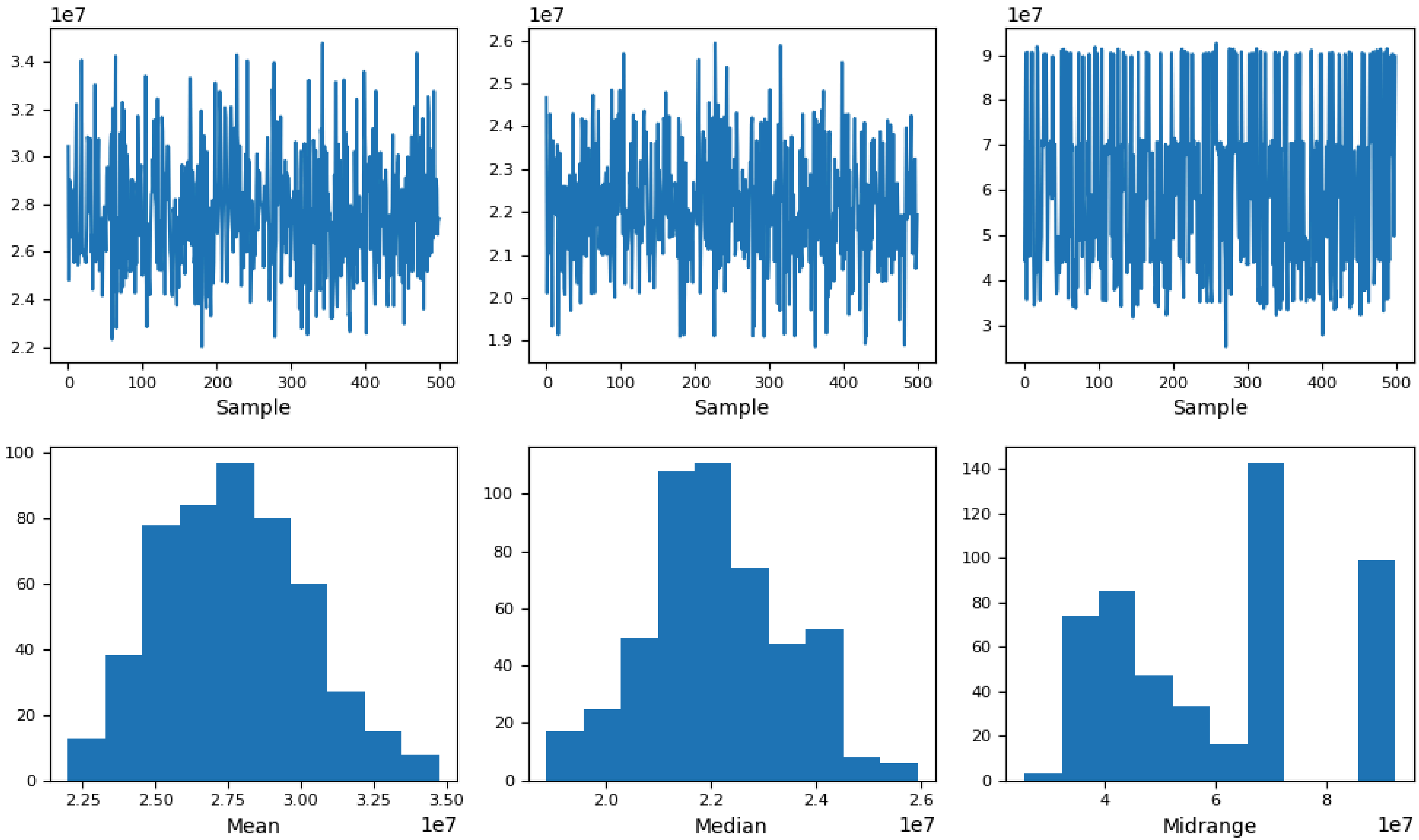
In [ ]:
```
# Stock data, on the other hand, does have significant autocorrelation

autocorrelation_plot(fb.close)
```

Out[ ]: <Axes: xlabel='Lag', ylabel='Autocorrelation'>



In [ ]:
```
# Bootstrap Plot
```

In [ ]:
```
# This plot helps us understand the uncertainty in our summary statistics

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



Supplementary

In [15]:

```
%matplotlib inline
import matplotlib.pyplot as plt
import numpy as np
```

```
import seaborn as sns
import pandas as pd
```

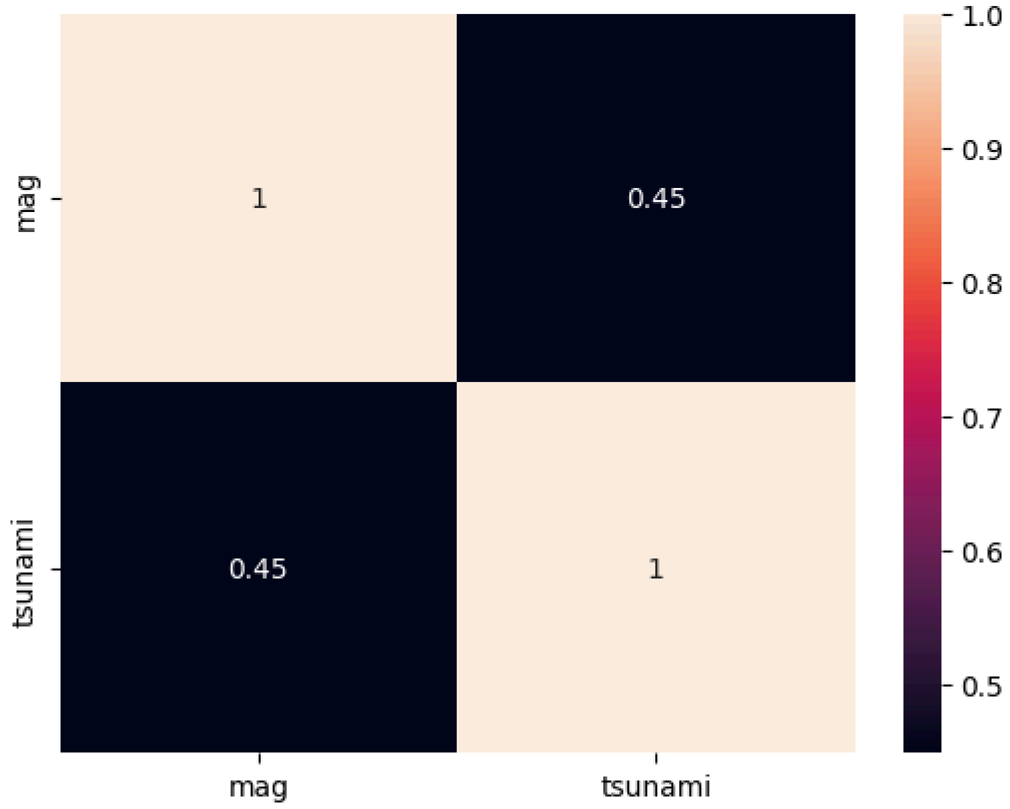
In [16]:
```
fb = pd.read_csv('fb_stock_prices_2018.csv', index_col='date', parse_dates=True)
quakes = pd.read_csv('earthquakes.csv')
```

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

1. Using seaborn, create a heatmap to visualize the correlation coefficients between earthquake magnitude and whether there was a tsunami with the magType of mb.

In [17]:
```
# I will make a query to filter the magType
# Then only extract the mag and tsunami column
# Then sort the index
# Proceed with the heatmap

sns.heatmap(
 quakes.query('magType == "mb"')[['mag','tsunami']].sort_index().corr(),annot=True)
```

Out[17]:
```
<Axes: >
```



2. Create a box plot of Facebook volume traded and closing prices, and draw reference lines for the bounds of a Tukey fence with a multiplier of 1.5. The bounds will be at Q1 - 1.5 * IQR and Q3 + 1.5 * IQR. Be sure to use the quantile() method on the data to make this easier. (Pick whichever orientation you prefer for the plot, but make sure to use subplots.)

In [19]:
```
fb.head()
```

Out[19]:

	open	high	low	close	volume
date					
2018-01-02	177.68	181.58	177.5500	181.42	18151903
2018-01-03	181.88	184.78	181.3300	184.67	16886563
2018-01-04	184.90	186.21	184.0996	184.33	13880896
2018-01-05	185.59	186.90	184.9300	186.85	13574535
2018-01-08	187.20	188.90	186.3300	188.28	17994726

In [48]:

```
lower_volume = fb.volume.quantile(0.25)- (1.5 * (fb.volume.quantile(0.75) - fb.volume.quantile(0.25)))
lower_volume
```

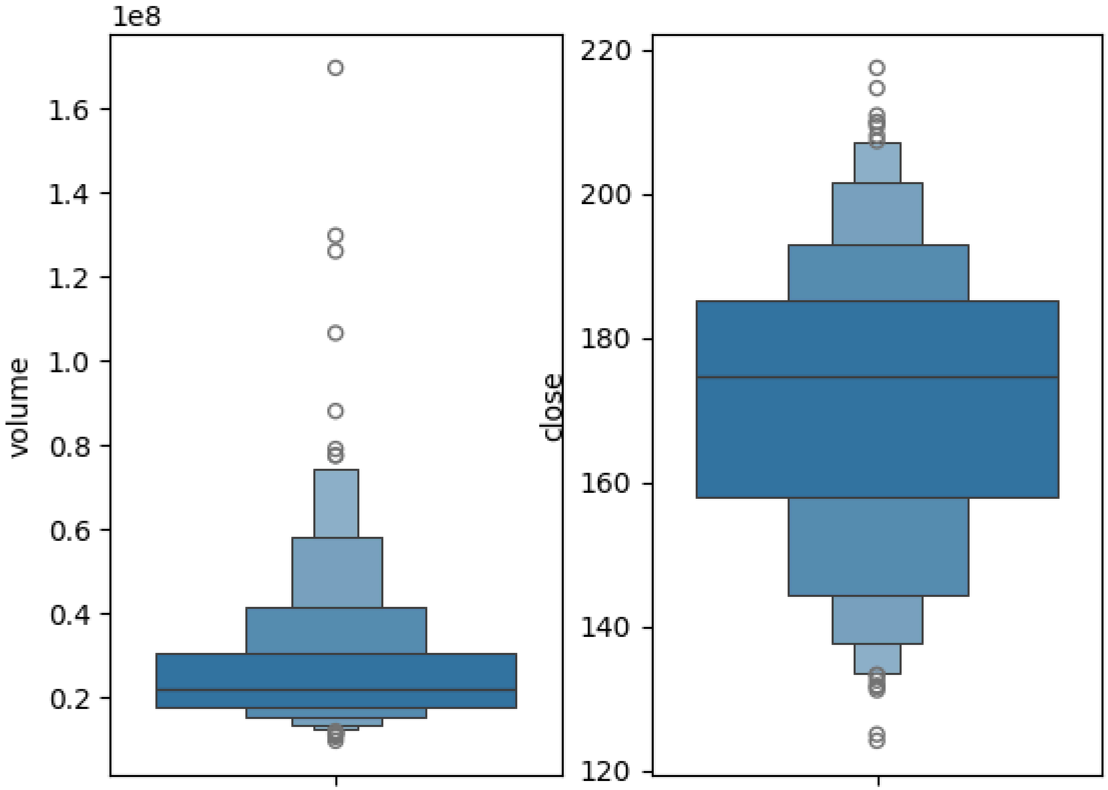
Out[48]:

```
np.float64(-899775.0)
```

In [50]:

```
f, subs = plt.subplots(1, 2)
sns.boxenplot(y = 'volume', data = fb[['volume', 'close']], orient = 'v', ax = subs[0])
sns.boxenplot(y = 'close', data = fb[['volume', 'close']], orient = 'v', ax = subs[1])

# Make bounds (Q1 - 1.5 * IQR and Q3 + 1.5 * IQR)
lower_volume = fb.volume.quantile(0.25)- (1.5 * (fb.volume.quantile(0.75) - fb.volume.quantile(0.25)))
higher_volume = fb.volume.quantile(0.75)+ (1.5 * (fb.volume.quantile(0.75) - fb.volume.quantile(0.25)))
lower_close = fb.close.quantile(0.25)- (1.5 * (fb.close.quantile(0.75) - fb.close.quantile(0.25)))
higher_close = fb.close.quantile(0.75)+ (1.5 * (fb.close.quantile(0.75) - fb.close.quantile(0.25)))

subs[0].hxlines(fb[['volume', 'close']], 1, 2) # Test
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
<ipython-input-50-4c1e3c4041ee> in <cell line: 0>()
      9 higher_close = fb.close.quantile(0.75)+ (1.5 * (fb.close.quantile(0.75) - fb.close.quantile(0.25)))
     10
---> 11 subs[0].hxlines(fb[['volume', 'close']], 1, 2) # Test

AttributeError: 'Axes' object has no attribute 'hxlines'
```



3. Fill in the area between the bounds in the plot from exercise #2.

In [ ]:

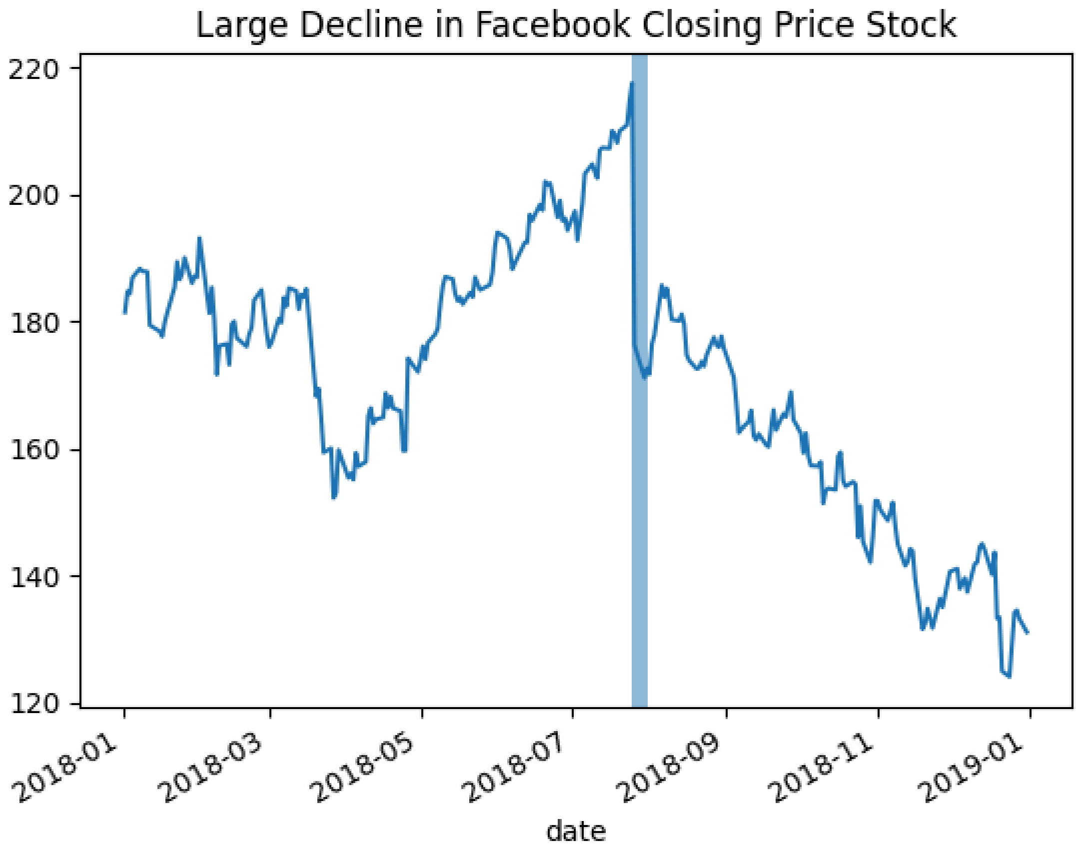
```

```

4. Use axvspan() to shade a rectangle from '2018-07-25' to '2018-07-31', which marks the large decline in Facebook price on a line plot of the closing price.

In [62]:

```
fb.close.plot(title = 'Large Decline in Facebook Closing Price Stock').axvspan('2018-07-25','2018-07-31', alpha = 0.5)
```

Out[62]: <matplotlib.patches.Rectangle at 0x7befa66b0350>



5. Using the Facebook stock price data, annotate the following three events on a line plot of the closing price:

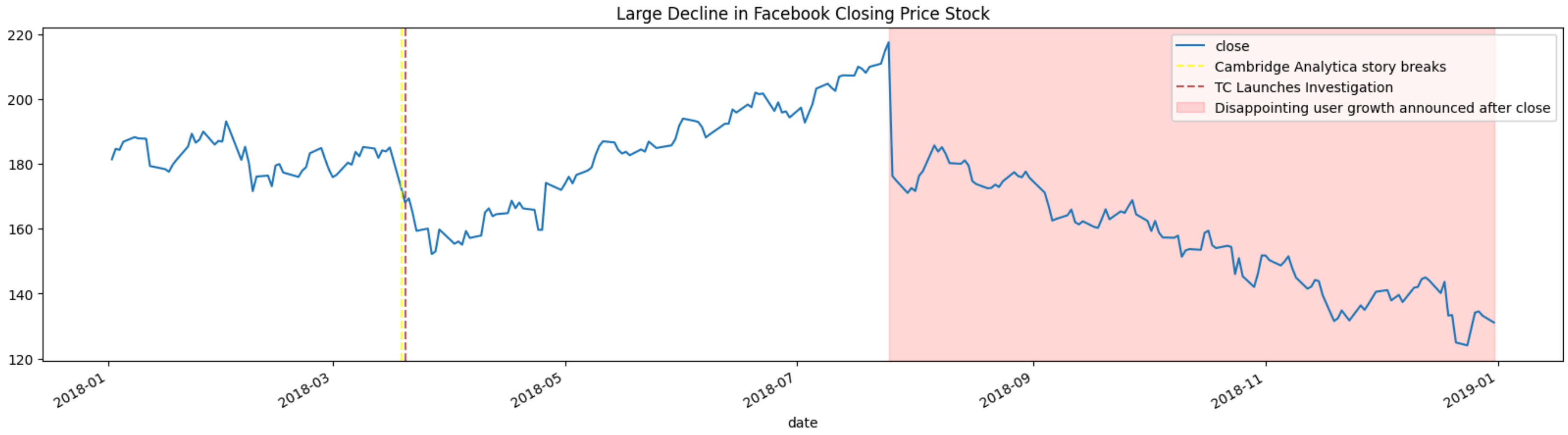
- Disappointing user growth announced after close on July 25, 2018
- Cambridge Analytica story breaks on March 19, 2018 (when it affected the market)
- FTC launches investigation on March 20, 2018

In [71]:

```
# Use axvline and axvspan for the highlights of the dates
fb.close.plot(title = 'Large Decline in Facebook Closing Price Stock', figsize = (20, 5)
).axvline('2018-03-19',alpha = 0.75, color = 'yellow', linestyle = '--', label = 'Cambridge Analytica story breaks')
plt.axvline('2018-03-20', alpha = 0.75, color = 'brown', linestyle = '--', label = 'TC Launches Investigation')
```

```
plt.axvspan('2018-07-25', fb.index.max(), alpha = 0.15, color = 'red', label = 'Disappointing user growth announced after clos
plt.legend(loc = 'upper right')
```

Out[71]: <matplotlib.legend.Legend at 0x7befa67f46d0>



6. Modify the reg_resid_plots() function to use a matplotlib colormap instead of cycling between two colors. Remember, for this use case, we should pick a qualitative colormap or make our own.

Conclusion

In this activity, I was able to learn some Seaborn syntaxes. I learned that some syntax also works the same as matplot, including passing of dataframe transformation into it. I want to learn more about this, considering I didn't finish the supplementary activity.