Plotting with Pandas

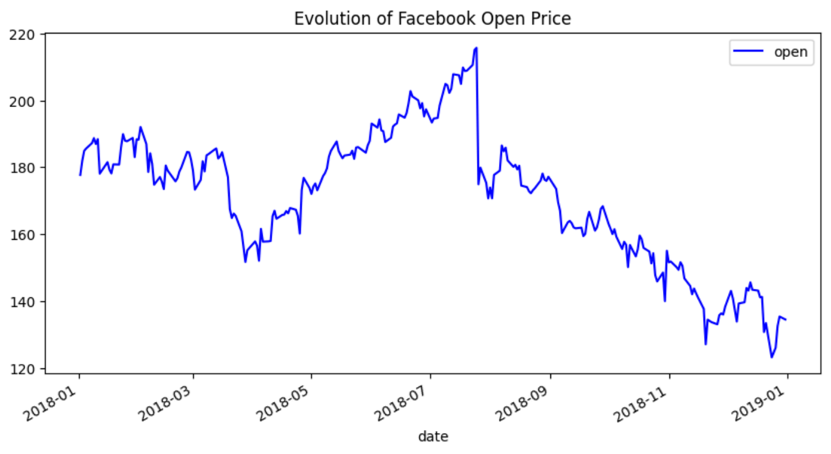
Setup

```
%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.csv')
```

Evolution over time

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

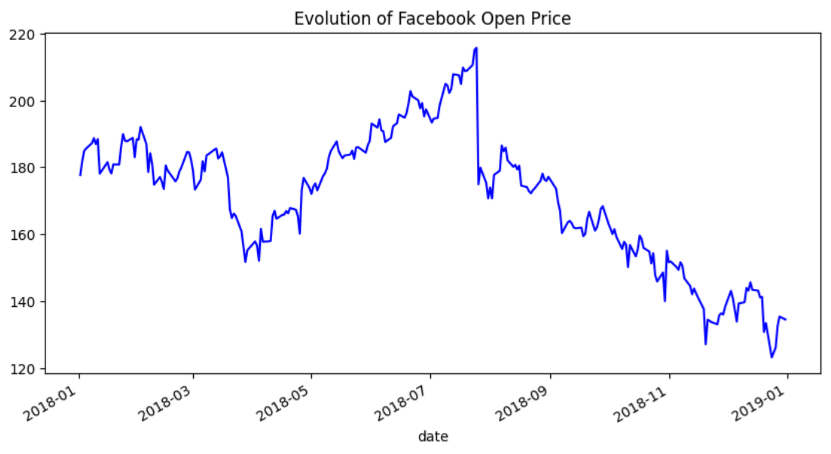
```
<Axes: title={'center': 'Evolution of Facebook Open Price'}, xlabel='date'>
```



We provided the style argument in the previous example; however, we can use the color and linestyle arguments to get the same result:

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

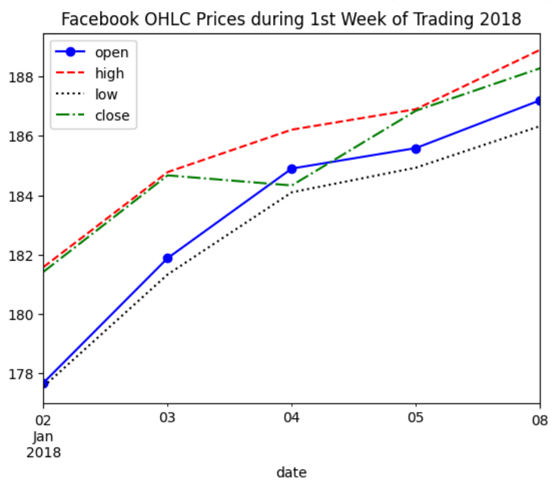
```
<Axes: title={'center': 'Evolution of Facebook Open Price'}, xlabel='date'>
```



We can also plot many lines at once by simply passing a list of the columns to plot:

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

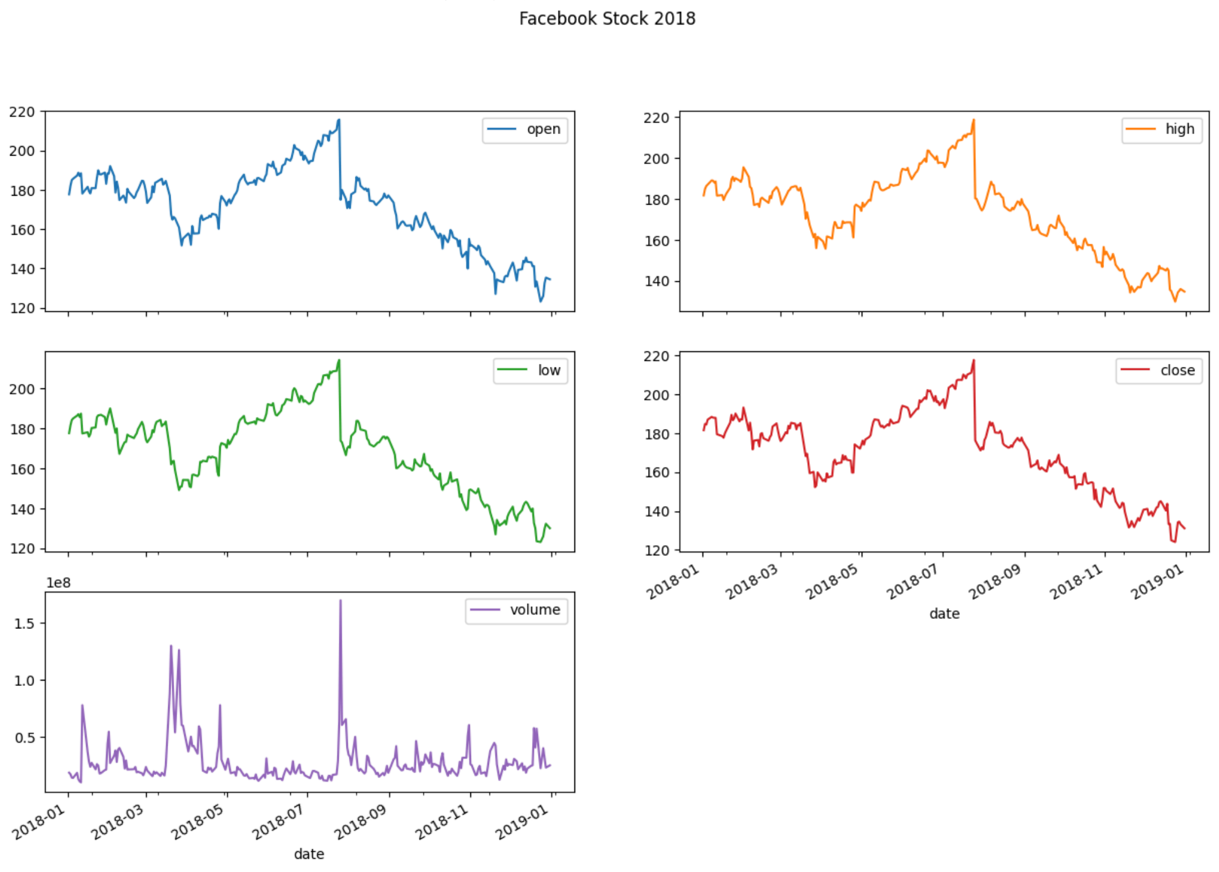
```
<Axes: title={'center': 'Facebook OHLC Prices during 1st Week of Trading 2018'}, xlabel='date'>
```



Creating subplots

```
fb.plot(
  kind='line',
  subplots=True, # simply pass it to plot
  layout=(3,2), # optional layout in a tuple of rows and columns
  figsize=(15,10),
  title='Facebook Stock 2018'
)
```

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

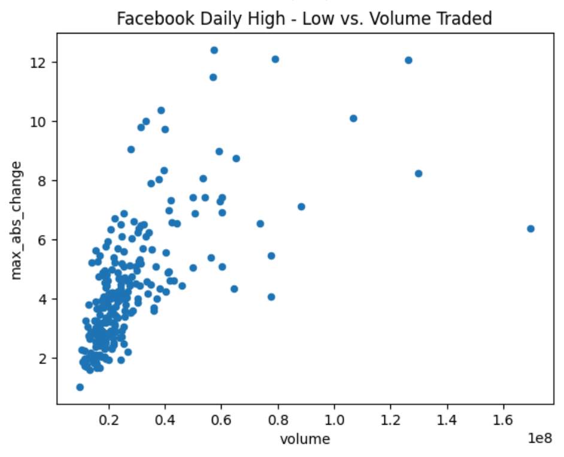


Visualizing relationships between variables

Scatter plots

```
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'
)
```

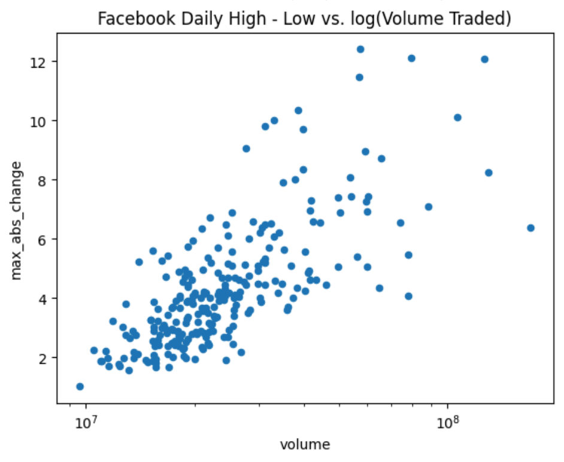
```
<Axes: title={'center': 'Facebook Daily High - Low vs. Volume Traded'}, xlabel='volume', ylabel='max_abs_change'>
```



The relationship doesn't seem to be linear, but we can try a log transform on the x-axis since the scales of the axes are very different. With pandas, we simply pass in logx=True :

```
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
)
```

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

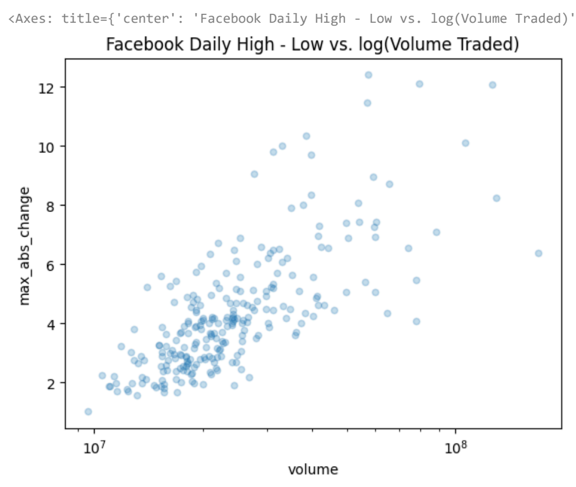


With matplotlib, we could use plt.xscale('log') to do the same thing.

Adding Transparency to Plots with alpha

```
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 = (0.25)
)
```

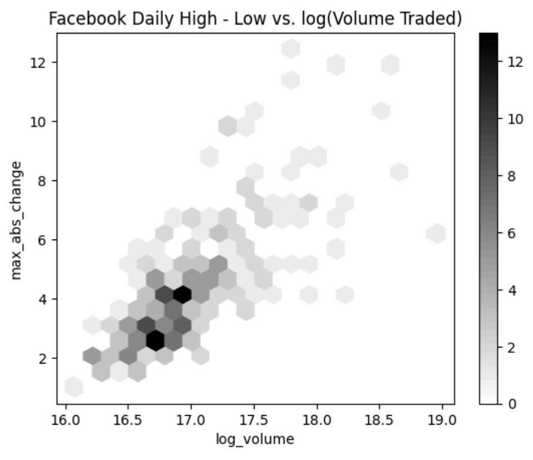
```
<Axes: title={'center': 'Facebook Daily High - Low vs. log(Volume Traded)'}, xlabel='volume', ylabel='max_abs_change'>
```



Hexbins

```
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
)
```

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



Visualizing Correlations with Heatmaps

pandas dont offer heatmaps so we get our data in a matrix and use matshow() from matplotlib as an alternative

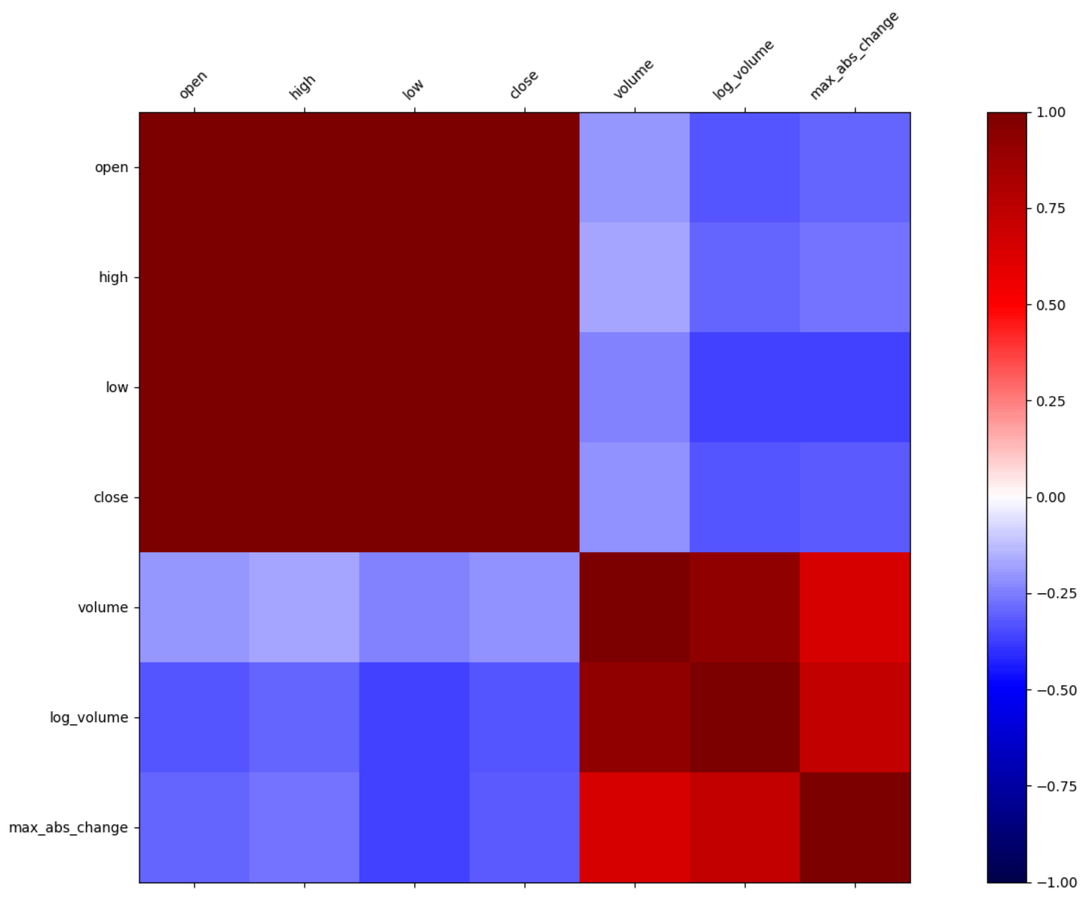
```
fig, ax = plt.subplots(figsize=(20, 10))
fb_corr = fb.assign(
  log_volume=np.log(fb.volume),
  max_abs_change=fb.high - fb.low
).corr() # corr() computes correlation

im = ax.matshow(fb_corr, cmap='seismic') #.matshow() for the plotting
fig.colorbar(im)

im.set_clim(-1, 1)

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

```
    <ipython-input-27-46113212040d>:13: UserWarning: FixedFormatter should only be used together with FixedLocator
      ax.set_xticklabels([''] + labels, rotation=45)
    <ipython-input-27-46113212040d>:14: UserWarning: FixedFormatter should only be used together with FixedLocator
      ax.set_yticklabels([''] + labels)
    [Text(0, -1.0, ''),
     Text(0, 0.0, 'open'),
     Text(0, 1.0, 'high'),
     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, '')]
```



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

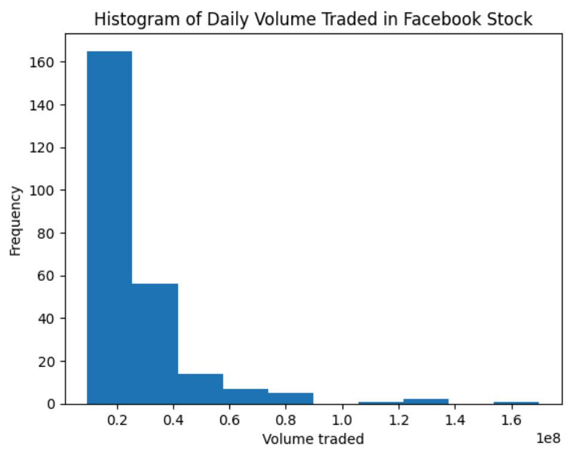
```
    volume        0.642027
    log_volume    0.731542
    Name: max_abs_change, dtype: float64
```

Visualizing distributions

Histograms With the pandas plot() method, making histograms is as easy as passing in kind='hist' :

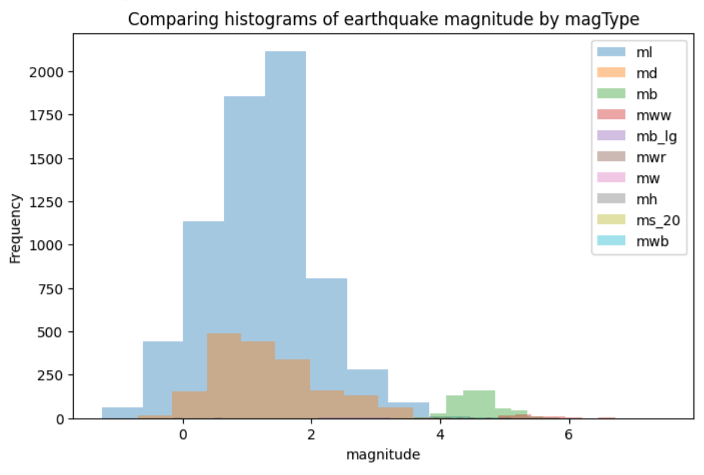
```
fb.volume.plot(
  kind='hist',
  title='Histogram of Daily Volume Traded in Facebook Stock'
)
plt.xlabel('Volume traded') # label the x-axis (discussed in chapter 6)
```

```
    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)
```

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

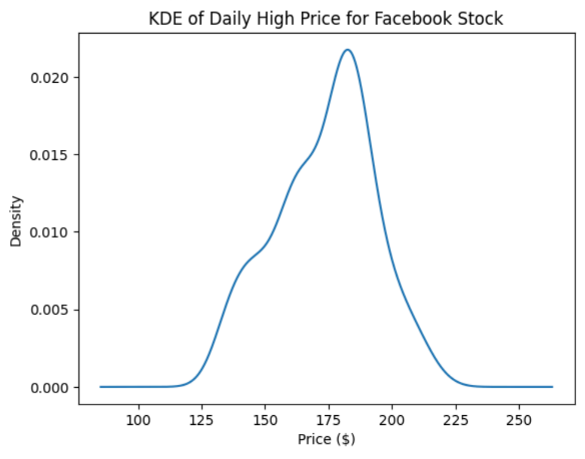


Kernel Density Estimation (KDE)

We can pass kind='kde' for a probability density function (PDF), which tells us the probability of getting a particular value

```
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)
```

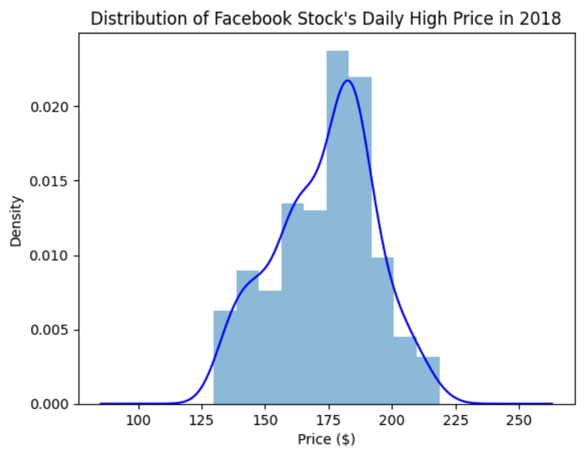
```
    Text(0.5, 0, 'Price ($)')
```



Adding to the result of plot()

```
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 ($)')
```



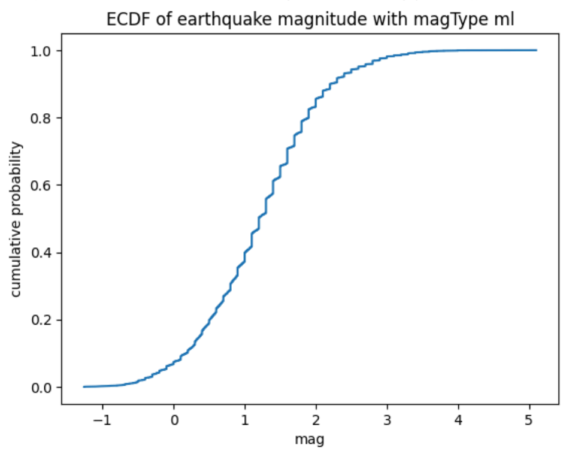
Plotting the ECDF

```
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')
```

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

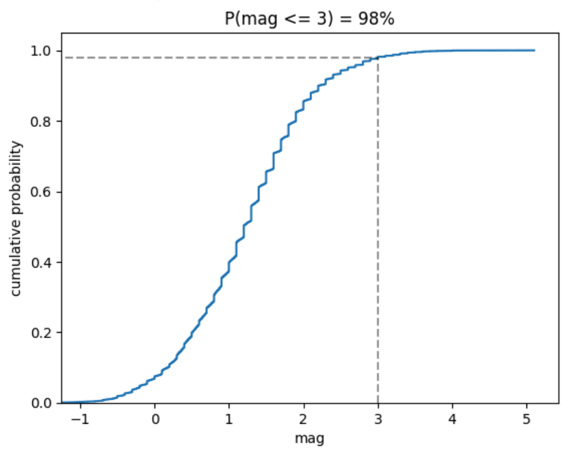


This ECDF tells us the probability of getting an earthquake with magnitude of 3 or less using the ml scale is 98%

```
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%')
```

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

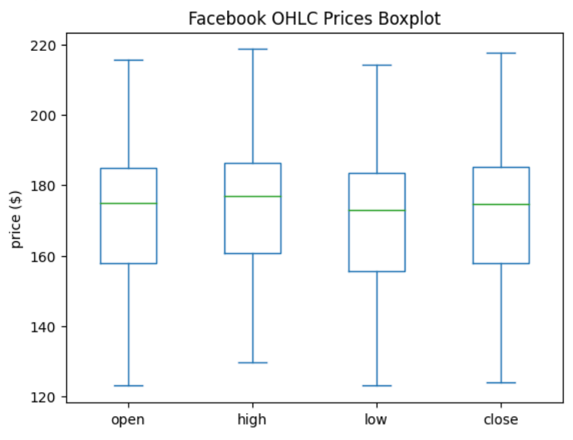


Box Plots

To make box plots with pandas, we pass kind='box' to the plot() method:

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

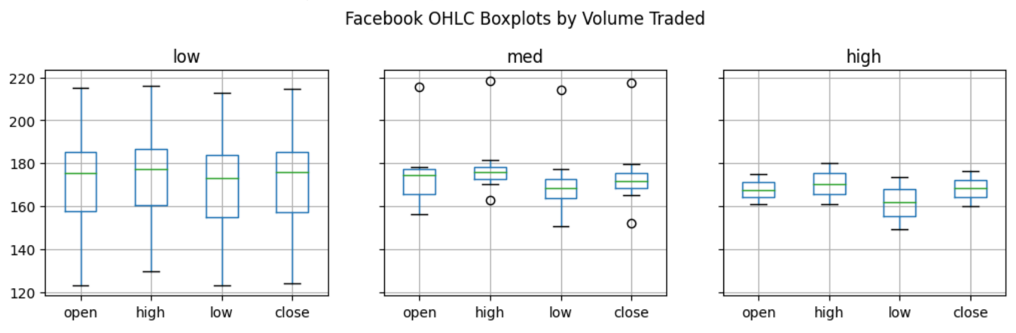
```
Text(0, 0.5, 'price ($)')
```



This can also be combined with a groupby() :

```
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)
```

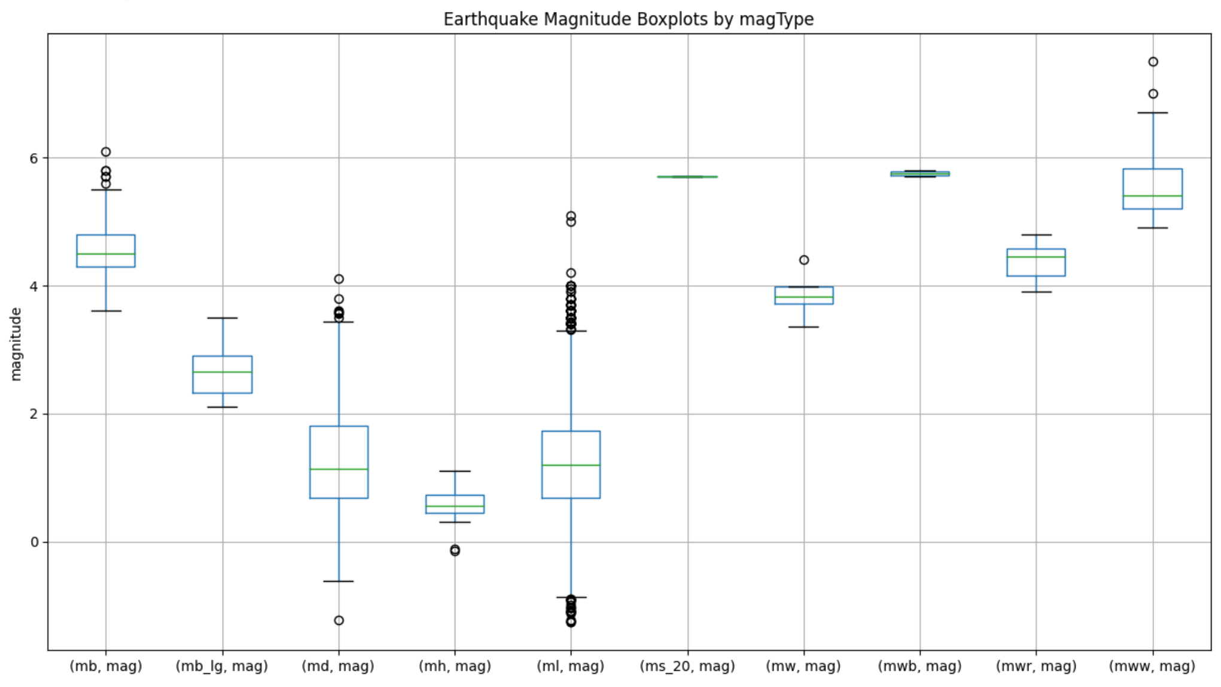
```
Text(0.5, 1.1, 'Facebook OHLC Boxplots by Volume Traded')
```



We can use this to see the distribution of magnitudes across the different measurement methods for earthquakes:

```
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')
```

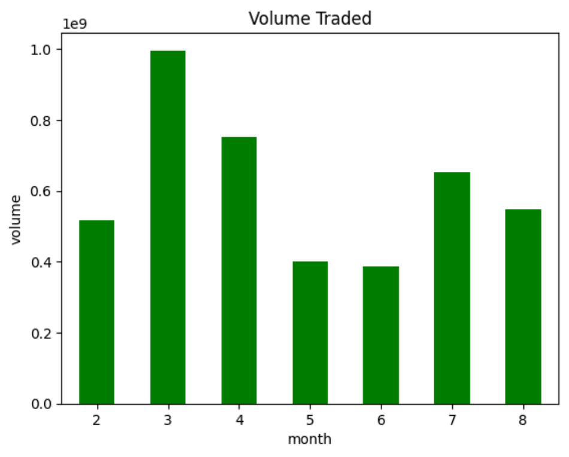


Counts and frequencies

Bar charts

```
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') # label the y-axis (discussed in chapter 6)
```

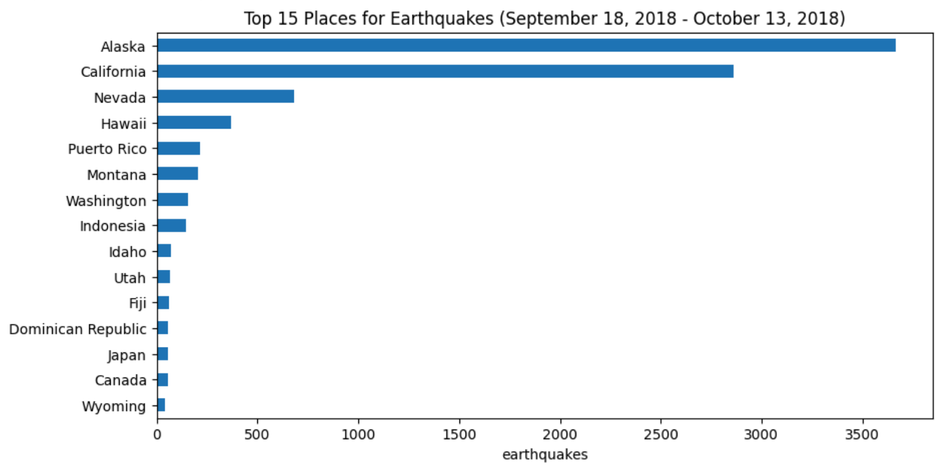
```
Text(0, 0.5, 'volume')
```



different approach using barh

```
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)
```

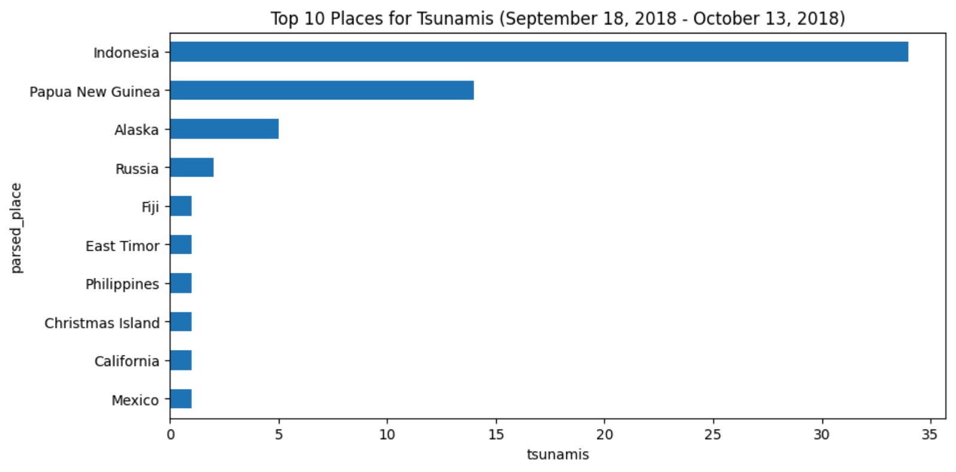
```
Text(0.5, 0, 'earthquakes')
```



We also have data on whether earthquakes were accompanied by tsunamis. Let's see what the top places for tsunamis are:

```
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)
```

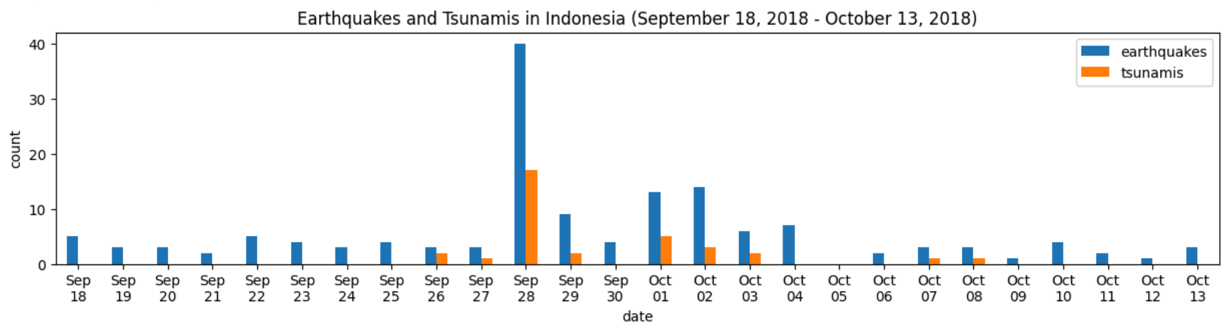
```
Text(0.5, 0, 'tsunamis')
```



Seeing that Indonesia is the top place for tsunamis during the time period we are looking at, we may want to look how many earthquakes and tsunamis Indonesia gets on a daily basis. We could show this as a line plot or with bars; since this section is about bars, we will use bars here

```
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('date')
plt.ylabel('count')
```

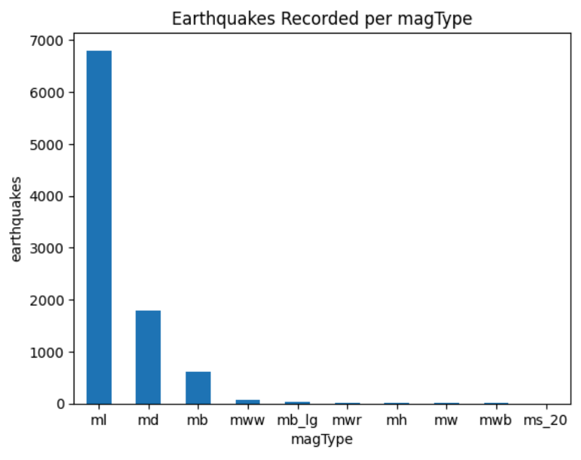
```
<ipython-input-53-a247e4f26079>:4: FutureWarning: The default value of numeric_only in DataFrameGroupBy.sum is deprecated. In a future version, numeric_only will default to False. Either specify numeric_only or select only columns which should be valid for the function.
  ).set_index('time').resample('1D').sum()
Text(0, 0.5, 'count')
```



Using the kind argument for vertical bars when the labels for each bar are shorter:

```
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')
```

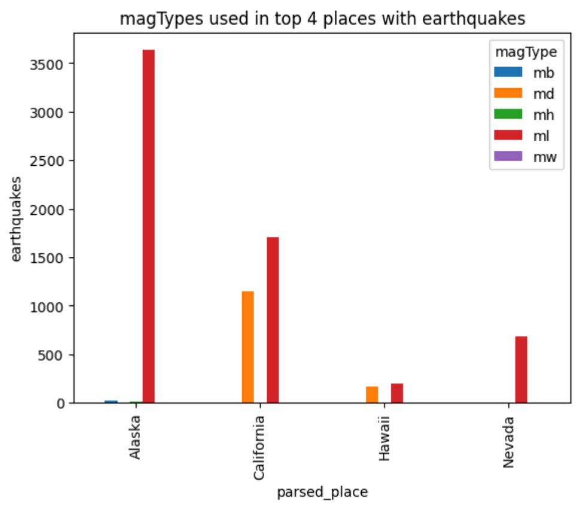
```
Text(0, 0.5, 'earthquakes')
```



Top 4 places with earthquakes:

```
quakes[
   quakes.parsed_place.isin(['California', 'Alaska', 'Nevada', 'Hawaii'])
].groupby(['parsed_place', 'magType']).mag.count().unstack().plot.bar(
   title='magTypes used in top 4 places with earthquakes'
)
plt.ylabel('earthquakes') # label the axes (discussed in chapter 6)
```

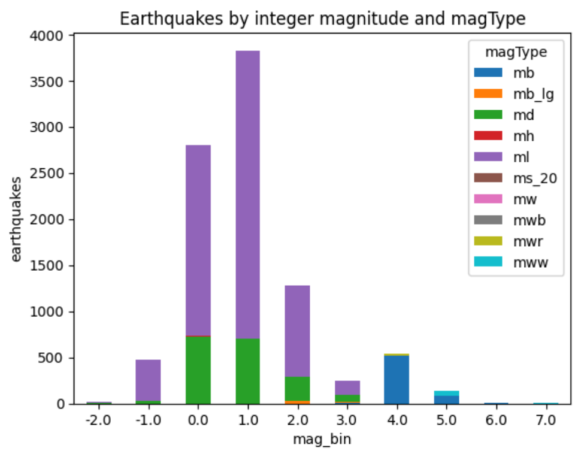
```
Text(0, 0.5, 'earthquakes')
```



Stacked bar chart

```
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')
```

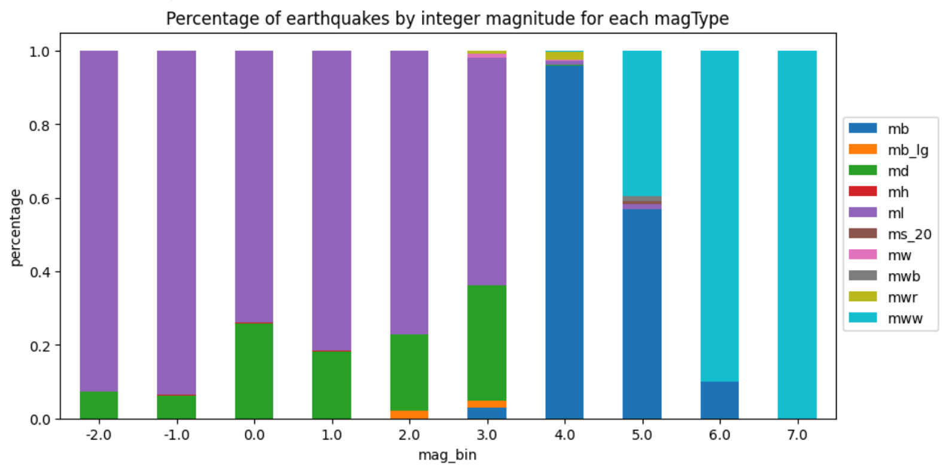


Normalized stacked bars

Plot the percentages to be better able to see the different magTypes

```
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')
```


Percentage of earthquakes by integer magnitude for each magType
percentage
mag_bin
mb
mb_lg
md
mh
ml
ms_20
mw
mwb
mwr
mww