Data Science Project Lifecycle - A Case Study

Step 1: Busines Understanding

Problem Statement: Prediction of Yahoo Stock Market

Data Set: Yahoo Stock Price

ہمیں مسئلہ یہ درپیش ہے کہ یاہو کے اثاثوں کی مستقبل قریب میں کیا قیمت ہو گی؟ اس مرحلے میں کچھ اضافی سوالوں پر بھی نظر ثانی کرنی پڑتی ہے تاکہ ایک بہتر اور مفید ڈیٹا سیٹ حاصل کیا جا سکے۔ مثلاً، وہ کون سے عناصر ہیں جو اثاثوں کی قیمتوں پر نظرانداز ہو سکتے ہیں؟ کیا قیمتوں کا انحصار مدِ مقابل کمپنیوں کی قدر گرنے سے تو نہیں؟ کیا خارجی پالیسی اثاثوں کی قدر پر اثر انداز ہوتی ہیں؟ کیا اثاثوں کی قیمت کے برھان کا سبب مہنگائی تو نہیں۔ وغیرہ وغیرہ

ان سوالوں کی بنیاد پر ہم درپیش مسئلے کو مختلف زاویوں سے دیکھتے ہیں اور تجزیہ کرنے کے لئے متعلقہ ڈیٹا سیٹس کو اکٹھا کرتے ہیں۔

ڈیٹا سائنس لائف سائیکل کے پورے پروسس کو سمجھنے کے لئے ہم اس کیس اسٹڈی کا مطالعہ و تجزیہ کر رہے ہیں۔

Step 2: Data Exploration

Import Libraries

In [1]:

```
import pandas as pd
from datetime import datetime
import numpy as np
from sklearn.linear_model import LinearRegression
import matplotlib.pyplot as plt
```

Read Dataset

In [2]:

```python
SPY_data = pd.read_csv("C:/Users/sana.rasheed/Downloads/SPY_2015.csv")

# Change the Date column from object to datetime object
SPY_data["Date"] = pd.to_datetime(SPY_data["Date"])

# Preview the data
SPY_data.head(10)
```

Out[2]:

	Date	Open	High	Low	Close	Adj Close	Volume
0	2015-12-07	2090.419922	2090.419922	2066.780029	2077.070068	2077.070068	4043820000
1	2015-12-04	2051.239990	2093.840088	2051.239990	2091.689941	2091.689941	4214910000
2	2015-12-03	2080.709961	2085.000000	2042.349976	2049.620117	2049.620117	4306490000
3	2015-12-02	2101.709961	2104.270020	2077.110107	2079.510010	2079.510010	3950640000
4	2015-12-01	2082.929932	2103.370117	2082.929932	2102.629883	2102.629883	3712120000
5	2015-11-30	2090.949951	2093.810059	2080.409912	2080.409912	2080.409912	4245030000
6	2015-11-27	2088.820068	2093.290039	2084.129883	2090.110107	2090.110107	1466840000
7	2015-11-25	2089.300049	2093.000000	2086.300049	2088.870117	2088.870117	2852940000
8	2015-11-24	2084.419922	2094.120117	2070.290039	2089.139893	2089.139893	3884930000
9	2015-11-23	2089.409912	2095.610107	2081.389893	2086.590088	2086.590088	3587980000

Step 3: Data Cleansing and Transformation

Indexing and Sorting

In [3]:

```
# Set Date as index
SPY_data.set_index('Date',inplace=True)

# Reverse the order of the dataframe in order to have oldest values at top
SPY_data.sort_values('Date',ascending=True)
```

Out[3]:

	Open	High	Low	Close	Adj Close	Volume
Date						
2010-01-04	1116.560059	1133.869995	1116.560059	1132.989990	1132.989990	3991400000
2010-01-05	1132.660034	1136.630005	1129.660034	1136.520020	1136.520020	2491020000
2010-01-06	1135.709961	1139.189941	1133.949951	1137.140015	1137.140015	4972660000
2010-01-07	1136.270020	1142.459961	1131.319946	1141.689941	1141.689941	5270680000
2010-01-08	1140.520020	1145.390015	1136.219971	1144.979980	1144.979980	4389590000
...	...	...	...	...	...	...
2015-12-01	2082.929932	2103.370117	2082.929932	2102.629883	2102.629883	3712120000
2015-12-02	2101.709961	2104.270020	2077.110107	2079.510010	2079.510010	3950640000
2015-12-03	2080.709961	2085.000000	2042.349976	2049.620117	2049.620117	4306490000
2015-12-04	2051.239990	2093.840088	2051.239990	2091.689941	2091.689941	4214910000
2015-12-07	2090.419922	2090.419922	2066.780029	2077.070068	2077.070068	4043820000

1493 rows × 6 columns

Check Null Values

In [4]:

```
# Take the name of the columns of the SPY_data to see if null values exists
variables = SPY_data.columns
SPY_data.isnull().sum().loc[variables]
```

Out[4]:

```
Open         0
High         0
Low          0
Close        0
Adj Close    0
Volume       0
dtype: int64
```

Step 4: Exploratory Data Analysis

In [5]:

```
jet= plt.get_cmap('jet')
colors = iter(jet(np.linspace(0,1,10)))

def correlation(df,variables, n_rows, n_cols):
    fig = plt.figure(figsize=(8,6))
    #fig = plt.figure(figsize=(14,9))
    for i, var in enumerate(variables):
        ax = fig.add_subplot(n_rows,n_cols,i+1)
        asset = df.loc[:,var]
        ax.scatter(df["Adj Close"], asset, c = next(colors))
        ax.set_xlabel("Adj Close")
        ax.set_ylabel("{}".format(var))
        ax.set_title(var +" vs price")
    fig.tight_layout()
    plt.show()
```

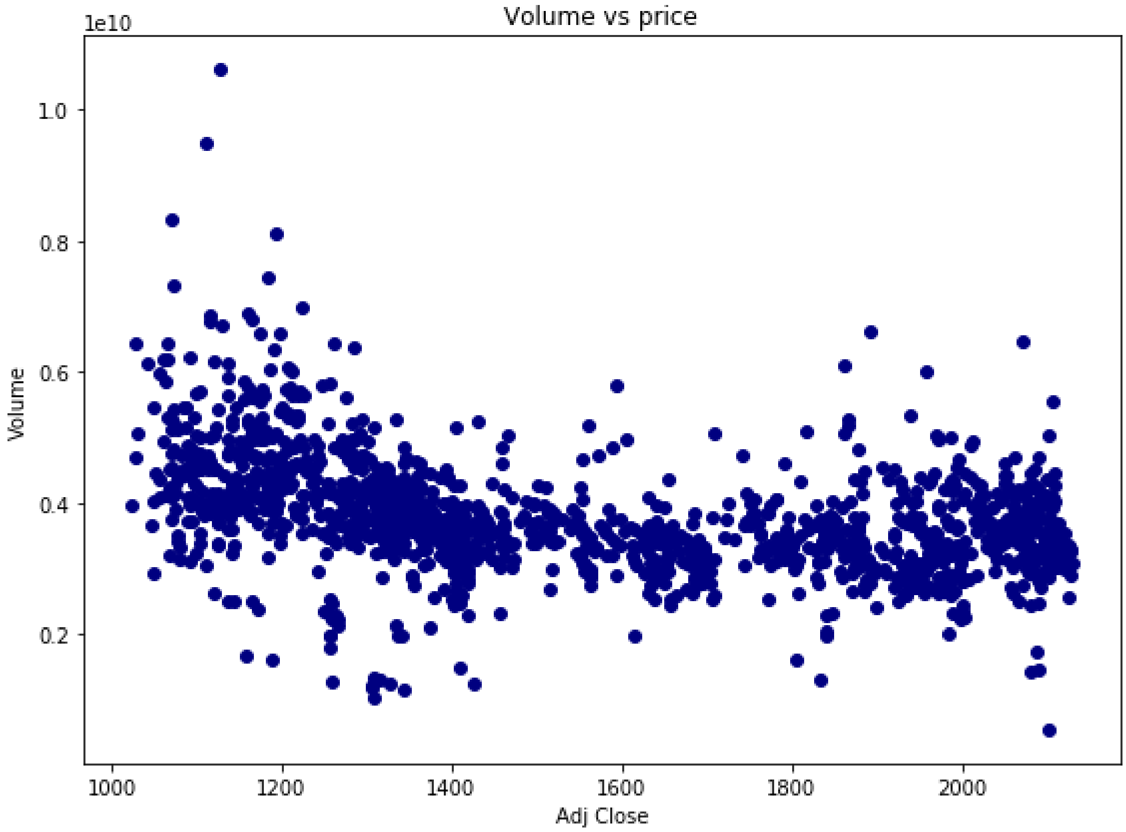
Correlation

Is there any correlation between Volume and Adj Close price?

In [6]:

```
# Is there any correlation between Volume and Adj Close price?
variables =SPY_data.columns[-1:] # read last column name
correlation(SPY_data,variables,1,1)
```

```
'c' argument looks like a single numeric RGB or RGBA sequence, which shoul
d be avoided as value-mapping will have precedence in case its length matc
hes with 'x' & 'y'.  Please use a 2-D array with a single row if you reall
y want to specify the same RGB or RGBA value for all points.
```



Is there any correlation between Adj Close price vs. Open, High, Low, Close ?

In [7]:

```
# Is there any correlation between Adj Close price vs. Open, High, Low, Close?
variables =SPY_data.columns#[0:6]
correlation(SPY_data,variables,3,3)
```

```
'c' argument looks like a single numeric RGB or RGBA sequence, which shoul
d be avoided as value-mapping will have precedence in case its length matc
hes with 'x' & 'y'.  Please use a 2-D array with a single row if you reall
y want to specify the same RGB or RGBA value for all points.
'c' argument looks like a single numeric RGB or RGBA sequence, which shoul
d be avoided as value-mapping will have precedence in case its length matc
hes with 'x' & 'y'.  Please use a 2-D array with a single row if you reall
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hes with 'x' & 'y'.  Please use a 2-D array with a single row if you reall
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hes with 'x' & 'y'.  Please use a 2-D array with a single row if you reall
y want to specify the same RGB or RGBA value for all points.
'c' argument looks like a single numeric RGB or RGBA sequence, which shoul
d be avoided as value-mapping will have precedence in case its length matc
hes with 'x' & 'y'.  Please use a 2-D array with a single row if you reall
y want to specify the same RGB or RGBA value for all points.
'c' argument looks like a single numeric RGB or RGBA sequence, which shoul
d be avoided as value-mapping will have precedence in case its length matc
hes with 'x' & 'y'.  Please use a 2-D array with a single row if you reall
y want to specify the same RGB or RGBA value for all points.
```
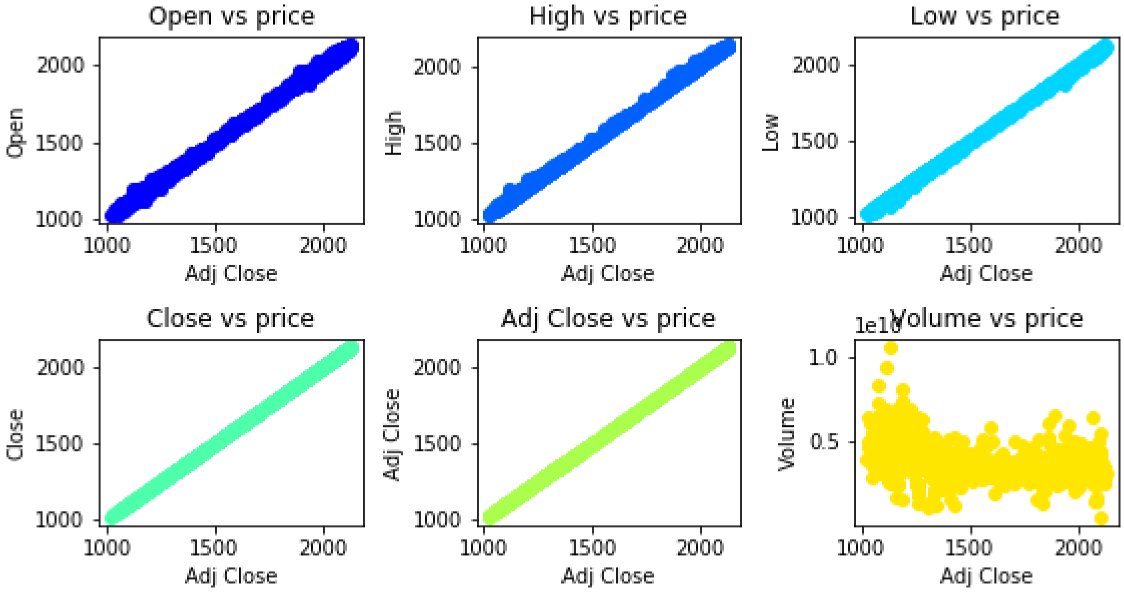



In [8]:

```
SPY_data.corr()['Adj Close'].loc[variables]
```

Out[8]:

```
Open          0.999187
High          0.999637
Low           0.999702
Close         1.000000
Adj Close     1.000000
Volume       -0.408814
Name: Adj Close, dtype: float64
```

Step 5: Featuer Engineering

In [9]:

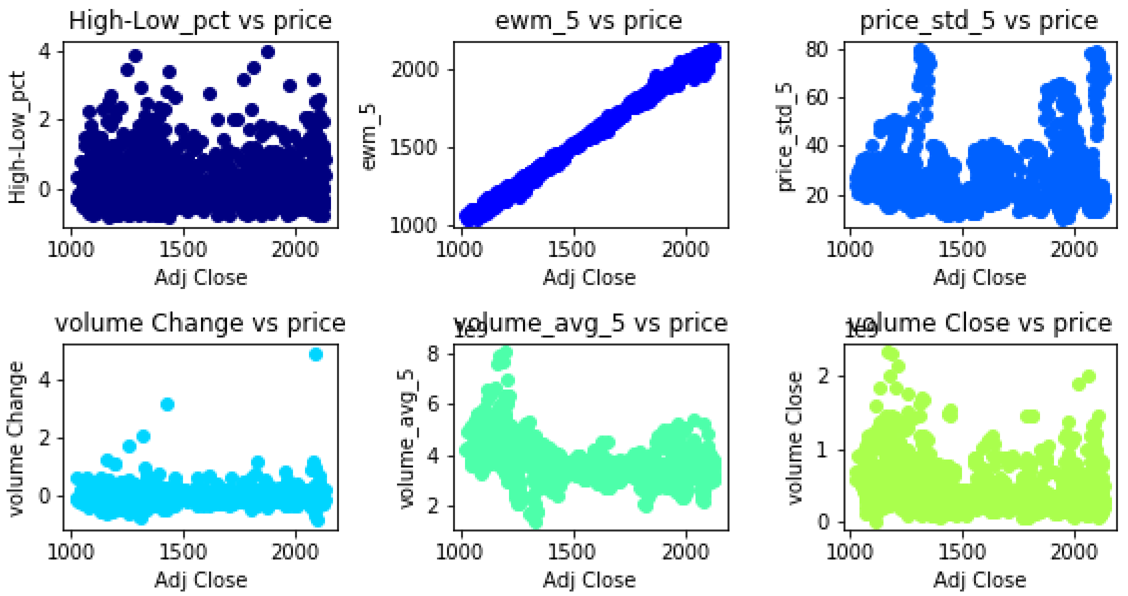
```
SPY_data['High-Low_pct'] = (SPY_data['High'] - SPY_data['Low']).pct_change()
SPY_data['ewm_5'] = SPY_data["Close"].ewm(span=5).mean().shift(periods=1)
SPY_data['price_std_5'] = SPY_data["Close"].rolling(center=False,window= 30).std().shif
t(periods=1)

SPY_data['volume Change'] = SPY_data['Volume'].pct_change()
SPY_data['volume_avg_5'] = SPY_data["Volume"].rolling(center=False,window=5).mean().shi
ft(periods=1)
SPY_data['volume Close'] = SPY_data["Volume"].rolling(center=False,window=5).std().shif
t(periods=1)
```

Correlation with New features

In [10]:

```
jet= plt.get_cmap('jet')
colors = iter(jet(np.linspace(0,1,10)))

# Take the name of the last 6 columns of the SPY_data which are the model features
variables = SPY_data.columns[-6:]

correlation(SPY_data,variables,3,3)
```

```
'c' argument looks like a single numeric RGB or RGBA sequence, which shoul
d be avoided as value-mapping will have precedence in case its length matc
hes with 'x' & 'y'.  Please use a 2-D array with a single row if you reall
y want to specify the same RGB or RGBA value for all points.
'c' argument looks like a single numeric RGB or RGBA sequence, which shoul
d be avoided as value-mapping will have precedence in case its length matc
hes with 'x' & 'y'.  Please use a 2-D array with a single row if you reall
y want to specify the same RGB or RGBA value for all points.
'c' argument looks like a single numeric RGB or RGBA sequence, which shoul
d be avoided as value-mapping will have precedence in case its length matc
hes with 'x' & 'y'.  Please use a 2-D array with a single row if you reall
y want to specify the same RGB or RGBA value for all points.
'c' argument looks like a single numeric RGB or RGBA sequence, which shoul
d be avoided as value-mapping will have precedence in case its length matc
hes with 'x' & 'y'.  Please use a 2-D array with a single row if you reall
y want to specify the same RGB or RGBA value for all points.
'c' argument looks like a single numeric RGB or RGBA sequence, which shoul
d be avoided as value-mapping will have precedence in case its length matc
hes with 'x' & 'y'.  Please use a 2-D array with a single row if you reall
y want to specify the same RGB or RGBA value for all points.
'c' argument looks like a single numeric RGB or RGBA sequence, which shoul
d be avoided as value-mapping will have precedence in case its length matc
hes with 'x' & 'y'.  Please use a 2-D array with a single row if you reall
y want to specify the same RGB or RGBA value for all points.
```



In [11]:

```
SPY_data.corr()['Adj Close'].loc[variables]
```

Out[11]:

```
High-Low_pct    -0.010328
ewm_5            0.998513
price_std_5      0.100524
volume Change   -0.005446
volume_avg_5    -0.485734
volume Close    -0.241898
Name: Adj Close, dtype: float64
```

Step 6: Build Predictive Model

Check Null values

In [12]:

```
SPY_data.head(5)
```

Out[12]:

	Open	High	Low	Close	Adj Close	Volume	High-Low_
Date							
2015-12-07	2090.419922	2090.419922	2066.780029	2077.070068	2077.070068	4043820000	N
2015-12-04	2051.239990	2093.840088	2051.239990	2091.689941	2091.689941	4214910000	0.802
2015-12-03	2080.709961	2085.000000	2042.349976	2049.620117	2049.620117	4306490000	0.001
2015-12-02	2101.709961	2104.270020	2077.110107	2079.510010	2079.510010	3950640000	-0.363
2015-12-01	2082.929932	2103.370117	2082.929932	2102.629883	2102.629883	3712120000	-0.247

In [13]:

```
SPY_data.isnull().sum().loc[variables]
```

Out[13]:

```
High-Low_pct      1
ewm_5             1
price_std_5      30
volume Change     1
volume_avg_5      5
volume Close      5
dtype: int64
```

Drop/Remove NA records

In [14]:

```
# To train a model, it is necessary to drop missing values.
SPY_data = SPY_data.dropna(axis=0)
```

Train & Test Dataset Distribution

In [15]:

```
# Generate the train and test sets
train = SPY_data[SPY_data.index < datetime(year=2015, month=1, day=1)]

test = SPY_data[SPY_data.index >= datetime(year=2015, month=1, day=1)]
dates = test.index
```

Building Regression Model

In [16]:

```
lr = LinearRegression()
X_train = train[["High-Low_pct","ewm_5","price_std_5","volume_avg_5","volume Change","v
olume Close"]]

Y_train = train["Adj Close"]

lr.fit(X_train,Y_train)
```

Out[16]:

```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None, normalize=F
alse)
```

Test Dataset

In [17]:

```
# Create the test features dataset (X_test) which will be used to make the predictions.
X_test = test[["High-Low_pct","ewm_5","price_std_5","volume_avg_5","volume Change","vol
ume Close"]].values

# The labels of the model
Y_test = test["Adj Close"].values # will be used for comparison
```

Prediction

In [18]:

```
close_predictions = lr.predict(X_test)
```

Model Evaluation

Mean Absolute Error (MAE):

In statistics, mean absolute error (MAE) is a measure of errors between paired observations expressing the same phenomenon. Examples of Y versus X include comparisons of predicted versus observed, subsequent time versus initial time, and one technique of measurement versus an alternative technique of measurement. MAE is calculated as:

$$\mathrm{MAE} = \frac{\sum_{i=1}^{n} |y_i - x_i|}{n} = \frac{\sum_{i=1}^{n} |e_i|}{n}$$

The mean absolute error is a common measure of forecast error in time series analysis.

In [19]:

```
mae = sum(abs(close_predictions - test["Adj Close"].values)) / test.shape[0]
print(mae)
```

```
18.09037765362944
```

The MAE value is approx. 18.

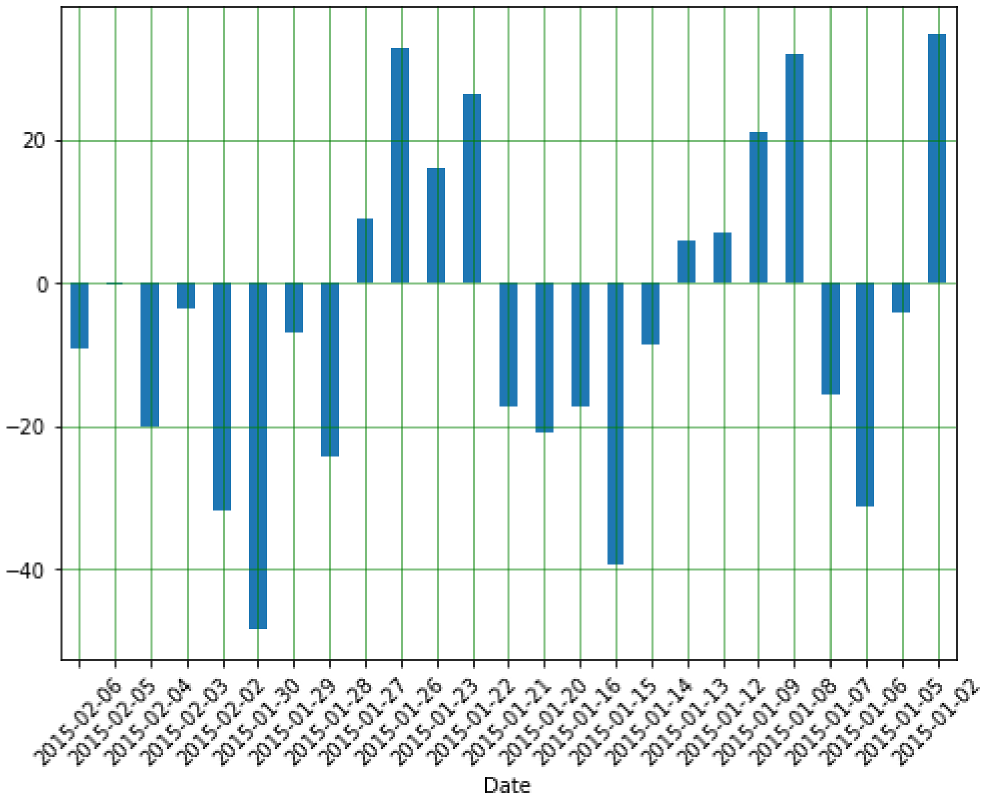
Error Graph for last 25 days

Simple error (Actual - Predicted) computered and ploted for last 25 days.

In [20]:

```
# Create a dataframe that output the Date, the Actual and the predicted values
df = pd.DataFrame({'Date':dates,'Actual': Y_test, 'Predicted': close_predictions})
df1 = df.tail(25)

# set the date with string format for plotting
df1['Date'] = df1['Date'].dt.strftime('%Y-%m-%d')

df1.set_index('Date',inplace=True)

error = df1['Actual'] - df1['Predicted']

# Plot the error term between the actual and predicted values for the last 25 days

error.plot(kind='bar',figsize=(8,6))
plt.grid(which='major', linestyle='-', linewidth='0.5', color='green')
plt.grid(which='minor', linestyle=':', linewidth='0.5', color='black')
plt.xticks(rotation=45)
plt.show()
```

```
C:\Users\sana.rasheed\Anaconda3\lib\site-packages\ipykernel_launcher.py:6:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-doc
s/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
```



In [ ]: