regression

April 14, 2022

1 Linear Regression

1.0.1 Importing libraries

[1]:
```
import pandas as pd
import numpy as np
from datetime import datetime
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score, median_absolute_error
```

1.0.2 Uploading data

[2]:
```
url = "https://raw.githubusercontent.com/Agablue-red/Machine-Learning/master/
↪data/Dataset.csv"
data = pd.read_csv(url)
```

[3]:
```
data.head()
```

[3]:

	Date	symbol	sector	score	close	return_rate
0	2004-02-11	SU	Energy Minerals	0.953727	12.830000	NaN
1	2004-02-11	GGG	Producer Manufacturing	0.952753	9.322222	NaN
2	2004-02-11	CWT	Utilities	0.934181	14.245000	NaN
3	2004-02-11	BLL	Process Industries	0.922862	8.012500	NaN
4	2004-02-11	APA	Energy Minerals	0.912117	39.509998	NaN

[4]:
```
nan_rows = data[data['return_rate'].isnull()]
if nan_rows.symbol.nunique() == len(nan_rows):
    print("NaN for first period")
```

```
NaN for first period
```

Replacing NaNs with 0 value:

[5]:
```
data['return_rate'] = data['return_rate'].fillna(0)
```

Looking at the tail of the data, meaning the newest observations:

[6]:
```
data.tail()
```

[6]:
```
             Date symbol                 sector     score       close  \
30546  2022-02-09    PEP  Consumer Non-Durables  0.701507  171.940002
30547  2022-02-09   SSNC    Technology Services  0.701123   82.419998
30548  2022-02-09    GEF     Process Industries  0.697954   56.930000
30549  2022-02-09    DPZ      Consumer Services  0.697741  444.760010
30550  2022-02-09  LIFZF    Non-Energy Minerals  0.695644   34.410000

       return_rate
30546    -0.003189
30547     0.025890
30548    -0.001753
30549     0.015272
30550     0.069630
```

1.0.3 Information about dataset

Data types:

[7]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 30551 entries, 0 to 30550
Data columns (total 6 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   Date         30551 non-null  object
 1   symbol       30551 non-null  object
 2   sector       30551 non-null  object
 3   score        30551 non-null  float64
 4   close        30551 non-null  float64
 5   return_rate  30551 non-null  float64
dtypes: float64(3), object(3)
memory usage: 1.4+ MB
```

Checking if there is any lack of data:

[8]:
```
data.isnull().sum()
```

[8]:
```
Date           0
symbol         0
sector         0
score          0
close          0
return_rate    0
dtype: int64
```

Changing the type of 'date' variable:

[9]:
```
data['Date'] = pd.to_datetime(data['Date'], format = '%Y-%m-%d')
data = data.set_index('Date')
```

Fundamental statistics on numeric variables

[10]:
```
data.describe()
```

[10]:

	score	close	return_rate
count	30551.000000	30551.000000	30551.000000
mean	0.731206	101.353658	0.003849
std	0.117692	2627.016498	0.044643
min	0.413554	0.020000	-0.951550
25%	0.653428	26.072500	-0.016298
50%	0.741474	44.770000	0.002865
75%	0.813471	73.910004	0.023672
max	0.987225	453000.000000	0.632911

There are in total 30 551 observations. The mean score for this dataset is 0,73, mean closing price is 101,3 and mean return rate is 0,004.

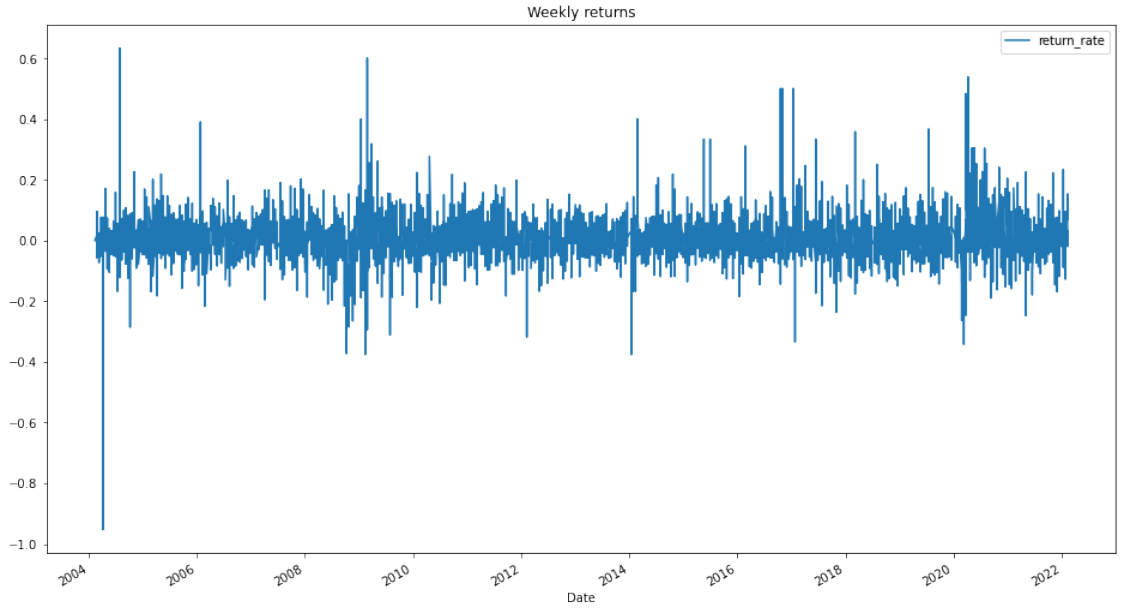
[11]:
```
data.symbol.value_counts()
```

[11]:
```
SHW      170
GEF      140
ORLY     138
GPC      122
INGR     122
        …
ATSG       1
LMAT       1
NOVT       1
HRNNF      1
POST       1
Name: symbol, Length: 1338, dtype: int64
```

There are 1338 companies in total, some of them occur only once in the time series and some even over 100 times.

1.0.4 Visualization of return rate for 2004 - 2022

[12]:
```
fig, ax=plt.subplots(figsize=(16, 9))
data['return_rate'].plot(ax=ax, label='return_rate', title='Weekly returns')
ax.legend();
```



The figure shows return rates since 2004 to 2022. It has a lot of deviations, seasonality is not observed. The highest deviance was observed in 2004. In years from 2008 and 2010 the biggest fluctuations on return rates were noted.

1.0.5 Splitting the data into training and testing sets

Training set involves data from 2010 to 2020 and testing set includes the year 2021.

[13]:
```
X_train = data['2010':'2020'].drop(['symbol','sector','return_rate', 'close'],␣
 ↪axis = 1)
y_train = data.loc['2010':'2020', 'return_rate']

X_test = data['2021'].drop(['symbol','sector','return_rate', 'close'], axis = 1)
y_test = data.loc['2021', 'return_rate']
```

```
<ipython-input-13-e0a87765a94e>:4: FutureWarning: Indexing a DataFrame with a
datetimelike index using a single string to slice the rows, like
`frame[string]`, is deprecated and will be removed in a future version. Use
`frame.loc[string]` instead.
  X_test = data['2021'].drop(['symbol','sector','return_rate', 'close'], axis =
1)
```

[14]:
```
X_train.head()
```

[14]:

	score
Date	
2010-01-13	0.895419
2010-01-13	0.839992

```
2010-01-13  0.829445
2010-01-13  0.809663
2010-01-13  0.774477
```

[15]:
```
y_train.shape
```

[15]:
```
(19797,)
```

[16]:
```
y_test.shape
```

[16]:
```
(2021,)
```

[17]:
```
X_train.shape
```

[17]:
```
(19797, 1)
```

[18]:
```
X_test.shape
```

[18]:
```
(2021, 1)
```

Testing sets have 2021 observations and training sets consist of 19797 obserations.

1.0.6 Dummy regression

[19]:
```
from sklearn.dummy import DummyRegressor
```

[20]:
```
reg_dummy = DummyRegressor(strategy = 'mean').fit(X_train, y_train)

y_pred_dum = reg_dummy.predict(X_test)

reg_dummy.score(X_train, y_train)
```

[20]:
```
0.0
```

[21]:
```
print("Mean squared error (linear model): {:.3f}".
 ↪format(mean_squared_error(y_test, y_pred_dum)))
print("Median absolute error (linear model): {:.3f}".
 ↪format(median_absolute_error(y_test, y_pred_dum)))
```

```
Mean squared error (linear model): 0.002
Median absolute error (linear model): 0.023
```

1.0.7 Linear regression

[22]:
```
lm = LinearRegression().fit(X_train, y_train)
y_pred = lm.predict(X_test)
```

```
lm.score(X_train, y_train)
```

[22]: 0.005437296983874185

[23]:
```
print("Mean squared error (linear model): {:.3f}".
 ↪format(mean_squared_error(y_test, y_pred)))
print("Median absolute error (linear model): {:.3f}".
 ↪format(median_absolute_error(y_test, y_pred)))
```

```
Mean squared error (linear model): 0.002
Median absolute error (linear model): 0.023
```

1.0.8 Comparison between dummy regression and linear regression in combination with observations from testing sets

[24]:
```
plt.scatter(X_test, y_test,  color='black')
plt.plot(X_test, y_pred, color='red', linewidth=3)
plt.plot(X_test, y_pred_dum, color='blue', linestyle = 'dashed',
        linewidth=2, label = 'dummy')
```

[24]: [<matplotlib.lines.Line2D at 0x173e8e91ee0>]