HW2

December 22, 2021

1 HW2

```
[1]: import requests
     import pandas as pd
     import numpy as np
     import matplotlib.pyplot as plt
     from functools import reduce

     %matplotlib inline
```

Get the time series for ETH, SOL, AVAX, USDT and FLOW from cryptowat.ch starting from 2021-11-22, hourly data

```
[2]: def get_data(token):
         res = requests.get(
             f'https://api.cryptowat.ch/markets/coinbase-pro/{token}usd/ohlc',
             params={
                 'periods': '3600',
                 'after': str(int(pd.Timestamp('2021-11-22').timestamp()))
             }
         )

         df = pd.DataFrame(
             res.json()['result']['3600'],
             columns=['ts', 'open', 'high', 'low', 'close', 'volume', 'volumeUSD']
         )
         df['ts'] = pd.to_datetime(df.ts, unit='s')
         df['token'] = token

         return df
```

```
[3]: def get_data_FLOW(token):
         res = requests.get(
             f'https://api.cryptowat.ch/markets/kraken/{token}usd/ohlc',
             params={
                 'periods': '3600',
                 'after': str(int(pd.Timestamp('2021-11-22').timestamp()))
             }
```

```
    )

    df = pd.DataFrame(
        res.json()['result']['3600'],
        columns=['ts', 'open', 'high', 'low', 'close', 'volume', 'volumeUSD']
    )
    df['ts'] = pd.to_datetime(df.ts, unit='s')
    df['token'] = token

    return df
```

```
[4]: tokens = ['ETH', 'SOL', 'USDT', 'AVAX']
```

```
[5]: df = pd.concat(get_data(token) for token in tokens)
     df = pd.concat([df, get_data_FLOW('FLOW')])

     df['chain'] = np.where(df.token.isin(['ETH', 'AAVE', 'COMP']), np.full(df.
      ↪shape[0], 'ETH'), df.token)
     df.set_index('ts', inplace=True)
```

```
[6]: df
```

```
[6]:                          open      high       low     close        volume  \
     ts
     2021-11-22 00:00:00  4317.980  4342.240  4246.070  4262.990   7262.562789
     2021-11-22 01:00:00  4263.040  4270.340  4212.450  4234.370   8437.946084
     2021-11-22 02:00:00  4234.870  4246.720  4171.170  4217.890   9259.725370
     2021-11-22 03:00:00  4217.880  4223.480  4163.580  4193.470   9259.899519
     2021-11-22 04:00:00  4192.950  4213.590  4147.000  4168.350   7934.546906
     …                         …         …        …         …             …
     2021-12-23 03:00:00     8.762     8.838     8.762     8.787   9049.150374
     2021-12-23 04:00:00     8.741     8.749     8.693     8.741   4147.529975
     2021-12-23 05:00:00     8.743     8.762     8.724     8.738  10187.858482
     2021-12-23 06:00:00     8.754     8.754     8.741     8.741   1901.119825
     2021-12-23 07:00:00     8.725     8.759     8.725     8.749   2447.971162

                             volumeUSD token chain
     ts
     2021-11-22 00:00:00  3.123077e+07   ETH   ETH
     2021-11-22 01:00:00  3.574586e+07   ETH   ETH
     2021-11-22 02:00:00  3.895639e+07   ETH   ETH
     2021-11-22 03:00:00  3.882032e+07   ETH   ETH
     2021-11-22 04:00:00  3.315476e+07   ETH   ETH
     …                             …     …     …
     2021-12-23 03:00:00  7.974868e+04  FLOW  FLOW
     2021-12-23 04:00:00  3.615037e+04  FLOW  FLOW
     2021-12-23 05:00:00  8.910109e+04  FLOW  FLOW
```

```
2021-12-23 06:00:00  1.662739e+04  FLOW  FLOW
2021-12-23 07:00:00  2.136340e+04  FLOW  FLOW

[3760 rows x 8 columns]
```

Get the total USD volume traded for each token in a dataframe, sorted from highest volume to lowest volume

```
[7]: df.groupby('token')['volumeUSD'].sum().to_frame().sort_values('volumeUSD',␣
      ↪ascending=False)
```

```
[7]:           volumeUSD
     token
     ETH    2.692272e+10
     SOL    8.930835e+09
     AVAX   5.037573e+09
     USDT   2.471907e+09
     FLOW   1.023934e+08
```

Add a column that calculates the close price ratio between ETH and SOL for each house

```
[8]: df['ratio'] = df.loc[df['token'] == 'ETH', 'close'] / df.loc[df['token'] ==␣
      ↪'SOL', 'close']
```

```
[9]: df
```

```
[9]:                          open      high       low     close         volume  \
     ts
     2021-11-22 00:00:00  4317.980  4342.240  4246.070  4262.990    7262.562789
     2021-11-22 01:00:00  4263.040  4270.340  4212.450  4234.370    8437.946084
     2021-11-22 02:00:00  4234.870  4246.720  4171.170  4217.890    9259.725370
     2021-11-22 03:00:00  4217.880  4223.480  4163.580  4193.470    9259.899519
     2021-11-22 04:00:00  4192.950  4213.590  4147.000  4168.350    7934.546906
     …                          …         …         …         …              …
     2021-12-23 03:00:00     8.762     8.838     8.762     8.787    9049.150374
     2021-12-23 04:00:00     8.741     8.749     8.693     8.741    4147.529975
     2021-12-23 05:00:00     8.743     8.762     8.724     8.738   10187.858482
     2021-12-23 06:00:00     8.754     8.754     8.741     8.741    1901.119825
     2021-12-23 07:00:00     8.725     8.759     8.725     8.749    2447.971162

                             volumeUSD token chain      ratio
     ts
     2021-11-22 00:00:00  3.123077e+07   ETH   ETH  18.471694
     2021-11-22 01:00:00  3.574586e+07   ETH   ETH  18.736150
     2021-11-22 02:00:00  3.895639e+07   ETH   ETH  18.577985
     2021-11-22 03:00:00  3.882032e+07   ETH   ETH  18.794937
     2021-11-22 04:00:00  3.315476e+07   ETH   ETH  18.891059
     …                             …   …   …          …
```

```
2021-12-23 03:00:00  7.974868e+04  FLOW  FLOW  22.038169
2021-12-23 04:00:00  3.615037e+04  FLOW  FLOW  21.885512
2021-12-23 05:00:00  8.910109e+04  FLOW  FLOW  22.003510
2021-12-23 06:00:00  1.662739e+04  FLOW  FLOW  22.007583
2021-12-23 07:00:00  2.136340e+04  FLOW  FLOW  22.020801

[3760 rows x 9 columns]
```

Change the name of the volume and volumeUSD columns to volumeBase and volumeTerm

```
[10]: df = df.rename(
          columns={
              'volume':'volumeBase',
              'volumeUSD':'volumeTerm'
          }
      )
```

```
[11]: df
```

```
[11]:                           open      high       low     close    volumeBase  \
      ts
      2021-11-22 00:00:00  4317.980  4342.240  4246.070  4262.990   7262.562789
      2021-11-22 01:00:00  4263.040  4270.340  4212.450  4234.370   8437.946084
      2021-11-22 02:00:00  4234.870  4246.720  4171.170  4217.890   9259.725370
      2021-11-22 03:00:00  4217.880  4223.480  4163.580  4193.470   9259.899519
      2021-11-22 04:00:00  4192.950  4213.590  4147.000  4168.350   7934.546906
      …                         …         …         …         …             …
      2021-12-23 03:00:00     8.762     8.838     8.762     8.787   9049.150374
      2021-12-23 04:00:00     8.741     8.749     8.693     8.741   4147.529975
      2021-12-23 05:00:00     8.743     8.762     8.724     8.738  10187.858482
      2021-12-23 06:00:00     8.754     8.754     8.741     8.741   1901.119825
      2021-12-23 07:00:00     8.725     8.759     8.725     8.749   2447.971162

                             volumeTerm token chain      ratio
      ts
      2021-11-22 00:00:00  3.123077e+07   ETH   ETH  18.471694
      2021-11-22 01:00:00  3.574586e+07   ETH   ETH  18.736150
      2021-11-22 02:00:00  3.895639e+07   ETH   ETH  18.577985
      2021-11-22 03:00:00  3.882032e+07   ETH   ETH  18.794937
      2021-11-22 04:00:00  3.315476e+07   ETH   ETH  18.891059
      …                             …   …   …          …
      2021-12-23 03:00:00  7.974868e+04  FLOW  FLOW  22.038169
      2021-12-23 04:00:00  3.615037e+04  FLOW  FLOW  21.885512
      2021-12-23 05:00:00  8.910109e+04  FLOW  FLOW  22.003510
      2021-12-23 06:00:00  1.662739e+04  FLOW  FLOW  22.007583
      2021-12-23 07:00:00  2.136340e+04  FLOW  FLOW  22.020801
```

```
[3760 rows x 9 columns]
```

Create a fat table indexed by the timestamp, and each column is the close price of each token

```
[12]: df_fat = df.loc[df['token'] == 'FLOW', 'close'].rename('FLOW').to_frame()

      for token in tokens:
          df_fat = df_fat.join(df.loc[df['token'] == token, 'close'].rename(token).
       ↪to_frame())
```

```
[13]: df_fat
```

```
[13]:                        FLOW      ETH      SOL    USDT    AVAX
      ts
      2021-11-22 00:00:00  14.150  4262.99  230.785  1.0012  128.67
      2021-11-22 01:00:00  13.621  4234.37  226.000  1.0013  134.85
      2021-11-22 02:00:00  13.753  4217.89  227.037  1.0012  132.54
      2021-11-22 03:00:00  13.652  4193.47  223.117  1.0011  133.38
      2021-11-22 04:00:00  13.581  4168.35  220.652  1.0009  136.29
      …                       …        …     …      …       …
      2021-12-23 03:00:00   8.787  3966.65  179.990  1.0002  122.28
      2021-12-23 04:00:00   8.741  3960.84  180.980  1.0002  122.87
      2021-12-23 05:00:00   8.738  3949.85  179.510  1.0004  120.39
      2021-12-23 06:00:00   8.741  3947.06  179.350  1.0004  120.10
      2021-12-23 07:00:00   8.749  3948.77  179.320  1.0003  119.76

      [752 rows x 5 columns]
```

Calculate the hour by hour log return of the close price of each token

```
[14]: df_fat['FLOW'] = np.log(df_fat['FLOW'].shift(-1) / df_fat['FLOW'])

      for token in tokens:
          df_fat[token] = np.log(df_fat[token].shift(-1) / df_fat[token])
```

```
[15]: df_fat = df_fat[:-1]
```

```
[16]: df_fat
```

```
[16]:                          FLOW       ETH       SOL    USDT      AVAX
      ts
      2021-11-22 00:00:00 -0.038102 -0.006736 -0.020952  0.0001  0.046912
      2021-11-22 01:00:00  0.009644 -0.003900  0.004578 -0.0001 -0.017279
      2021-11-22 02:00:00 -0.007371 -0.005806 -0.017417 -0.0001  0.006318
      2021-11-22 03:00:00 -0.005214 -0.006008 -0.011109 -0.0002  0.021583
      2021-11-22 04:00:00 -0.014014 -0.002472 -0.015161 -0.0001 -0.031832
      …                         …        …        …       …        …
      2021-12-23 02:00:00  0.001025  0.002587 -0.001388 -0.0002  0.002948
```

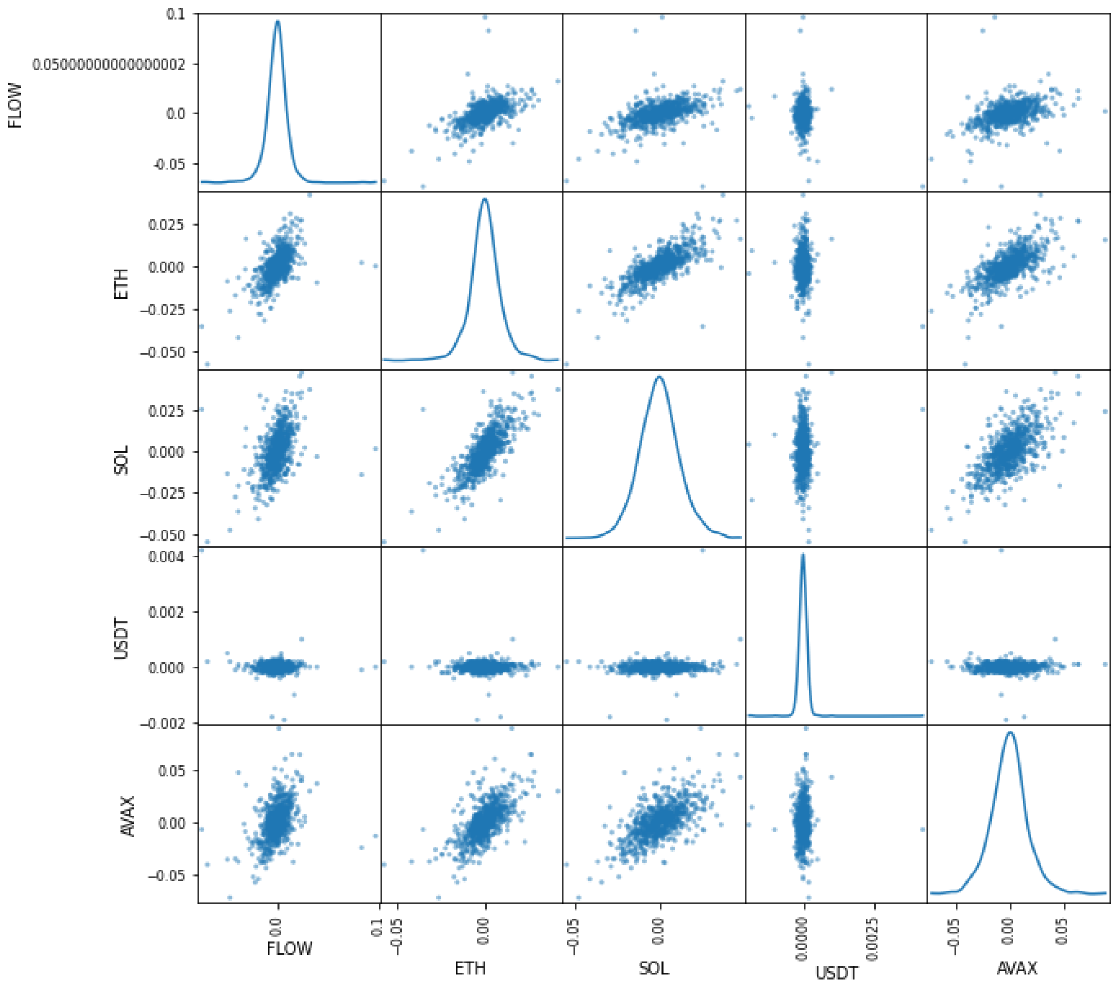
```
2021-12-23 03:00:00 -0.005249 -0.001466  0.005485  0.0000  0.004813
2021-12-23 04:00:00 -0.000343 -0.002779 -0.008156  0.0002 -0.020390
2021-12-23 05:00:00  0.000343 -0.000707 -0.000892  0.0000 -0.002412
2021-12-23 06:00:00  0.000915  0.000433 -0.000167 -0.0001 -0.002835

[751 rows x 5 columns]
```

Calculate the correlation of the tokens using the table above

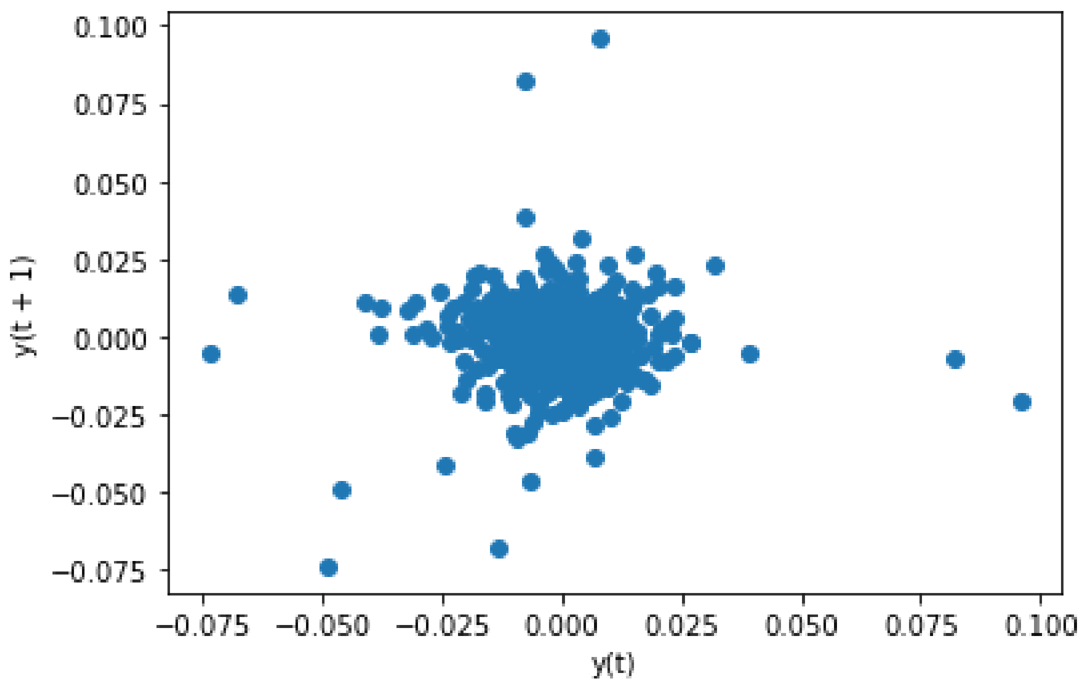
[17]:
```
from pandas.plotting import scatter_matrix, lag_plot, autocorrelation_plot
```

[18]:
```
r = scatter_matrix(df_fat, figsize = (10,10), diagonal='kde')
```



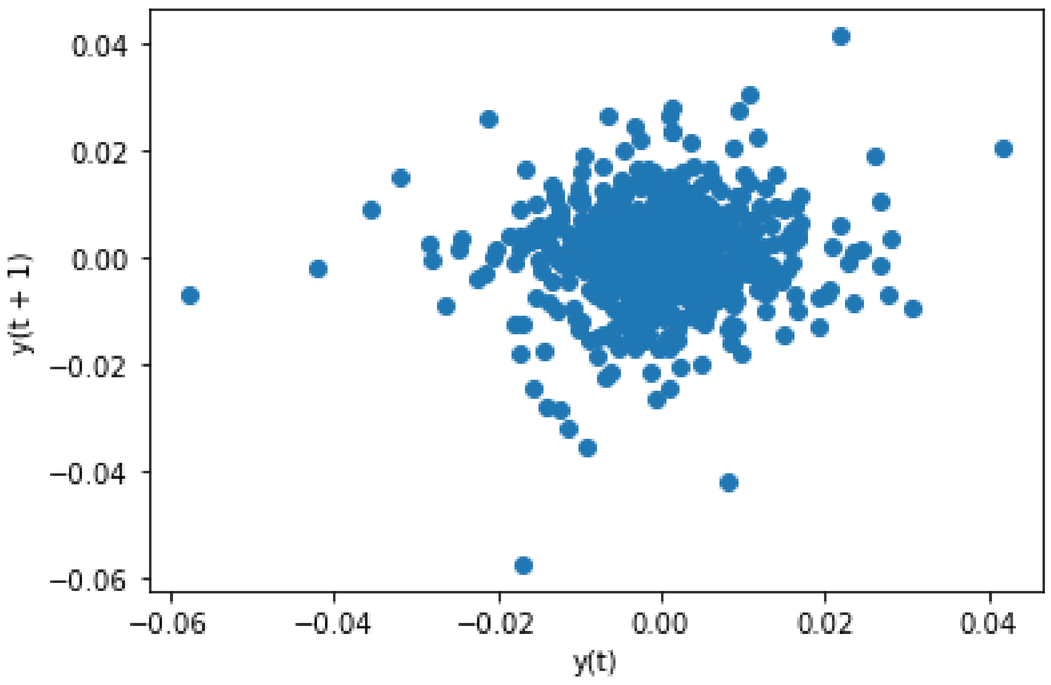
[19]:
```
lag_plot(df_fat.FLOW)
```

[19]:
```
<AxesSubplot:xlabel='y(t)', ylabel='y(t + 1)'>
```



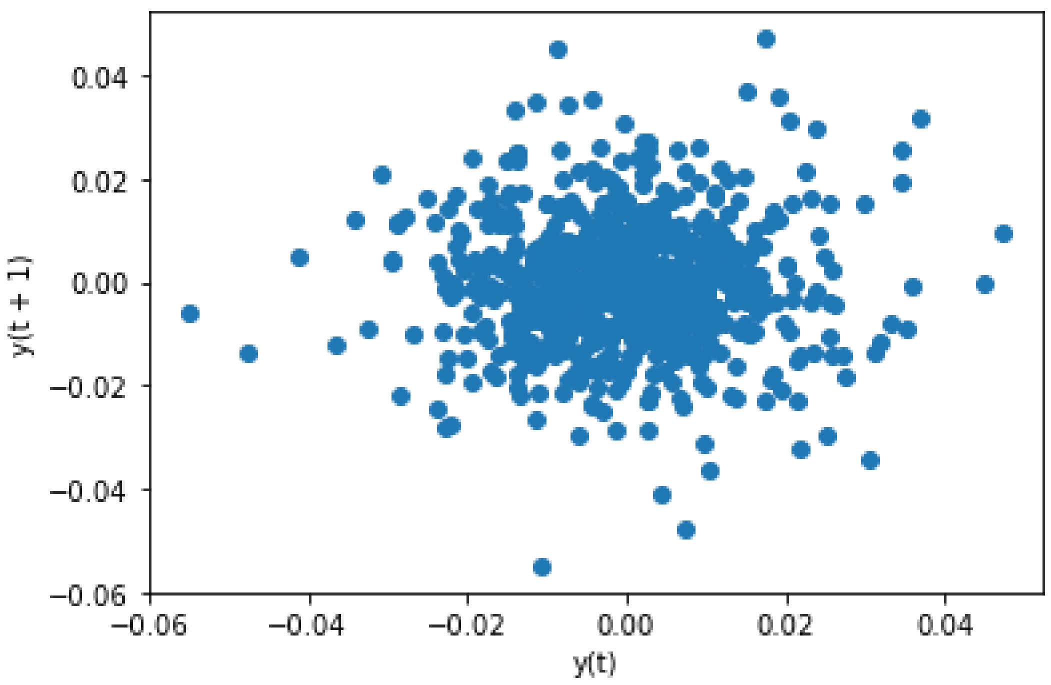
```
[20]: lag_plot(df_fat.ETH)
```

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



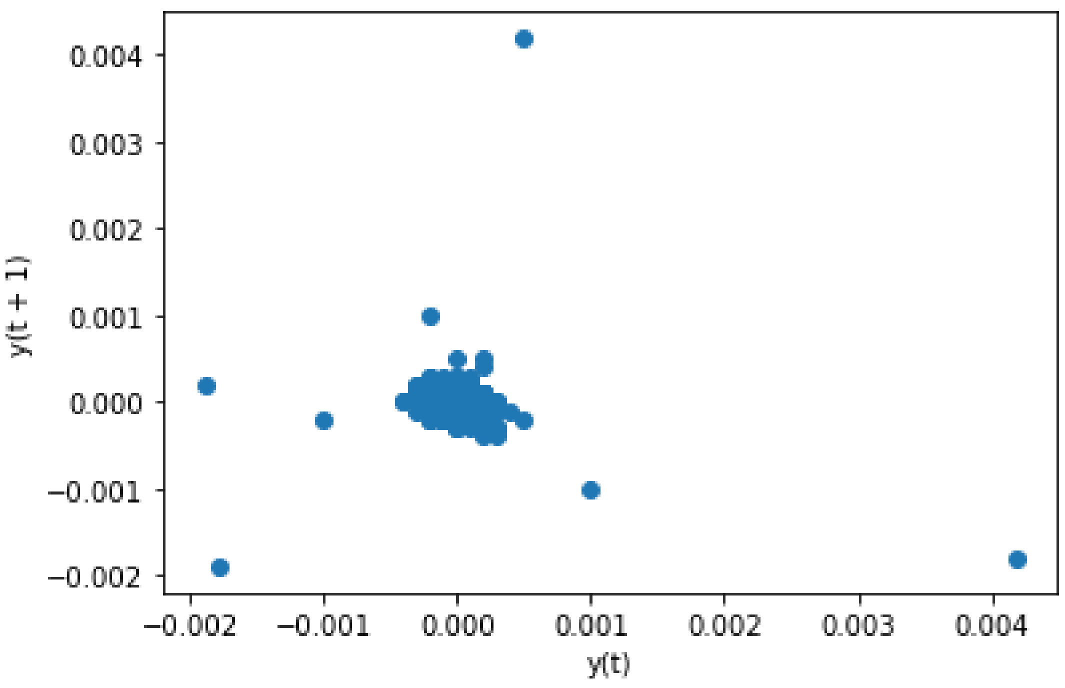
[21]:
```
lag_plot(df_fat.SOL)
```

[21]:
```
<AxesSubplot:xlabel='y(t)', ylabel='y(t + 1)'>
```



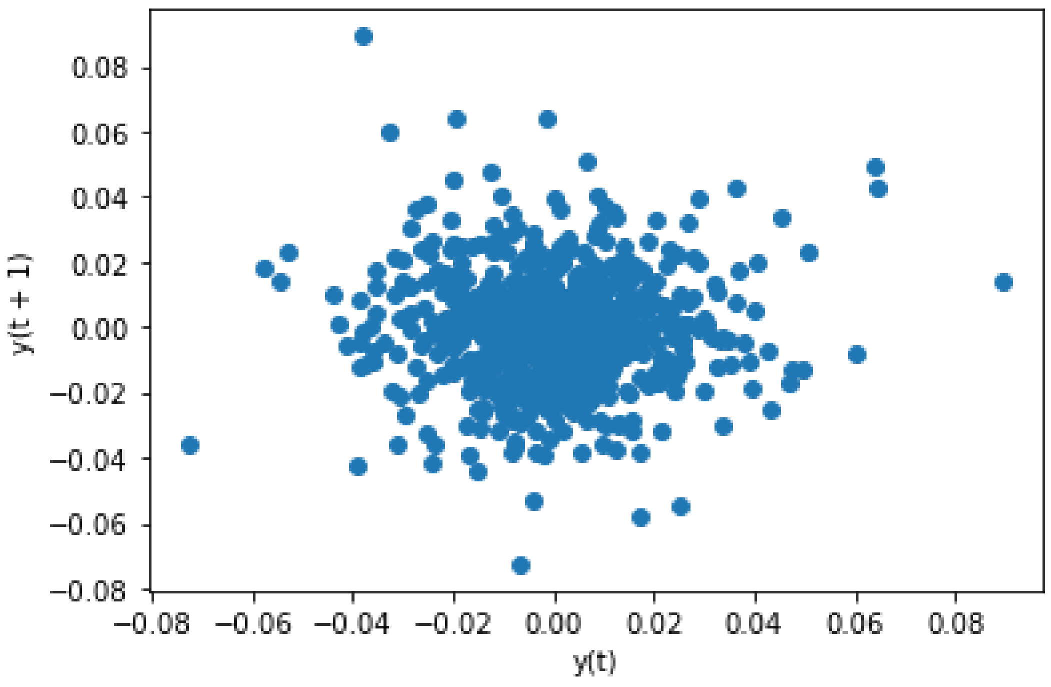
[22]:
```
lag_plot(df_fat.USDT)
```

[22]:
```
<AxesSubplot:xlabel='y(t)', ylabel='y(t + 1)'>
```



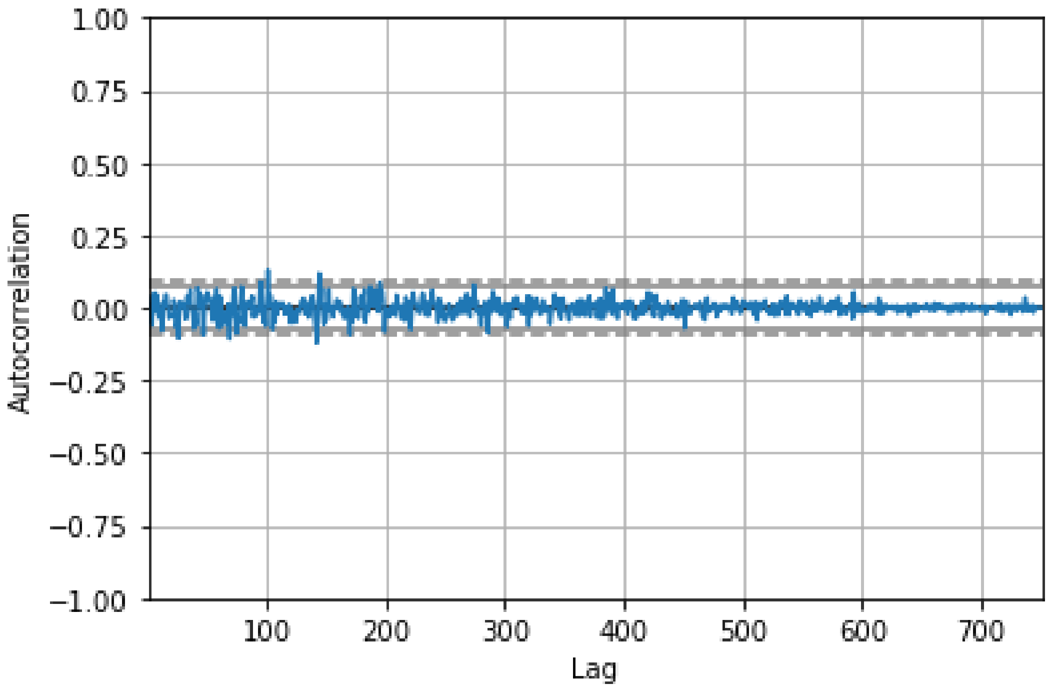
```
[23]: lag_plot(df_fat.AVAX)
```

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



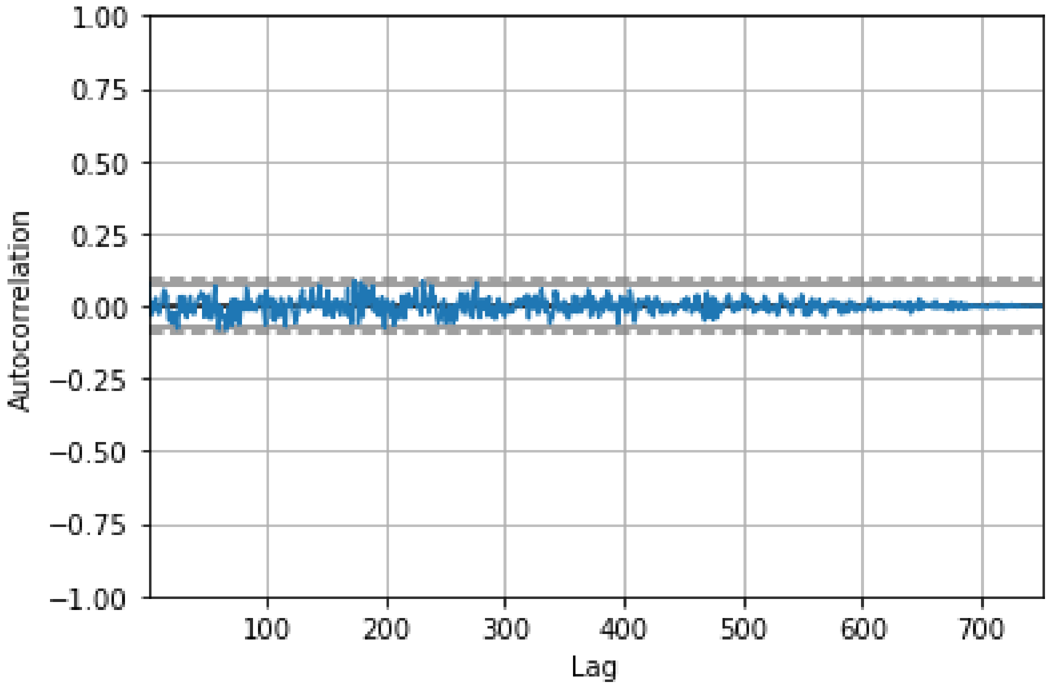
[24]:
```
autocorrelation_plot(df_fat.FLOW)
```

[24]:
```
<AxesSubplot:xlabel='Lag', ylabel='Autocorrelation'>
```



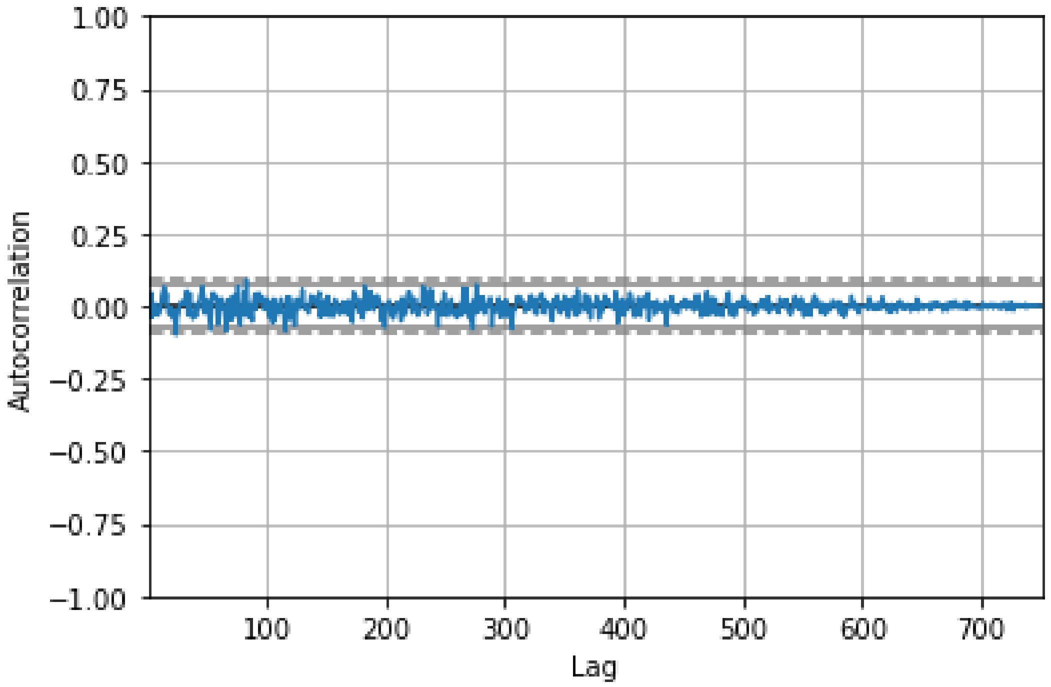
[25]:
```
autocorrelation_plot(df_fat.ETH)
```

[25]:
```
<AxesSubplot:xlabel='Lag', ylabel='Autocorrelation'>
```



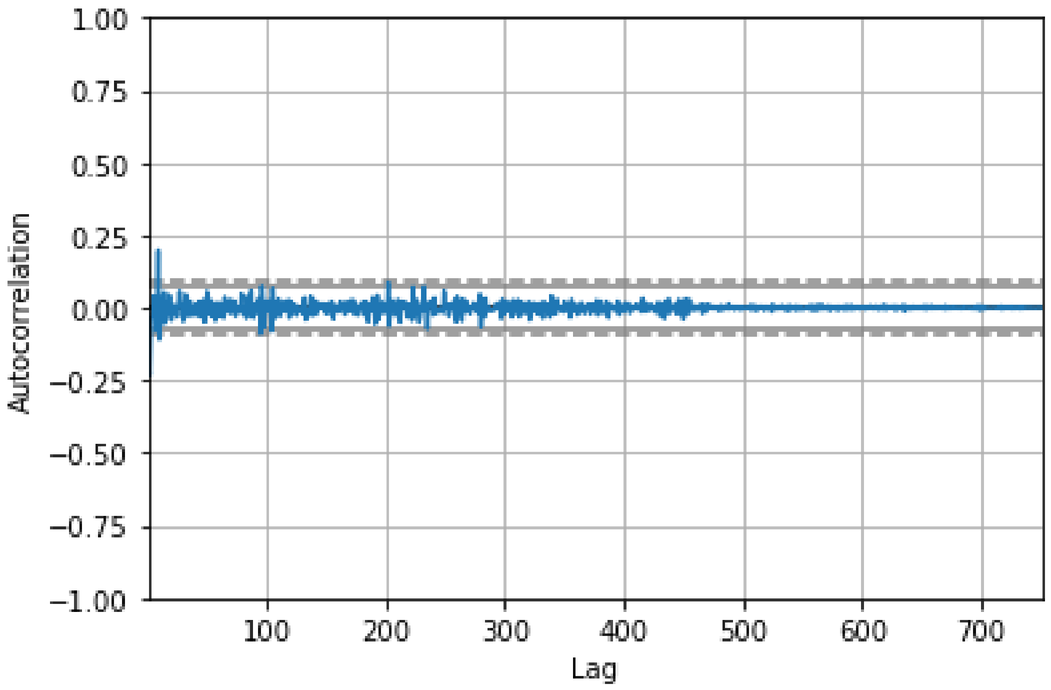
[26]:
```
autocorrelation_plot(df_fat.SOL)
```

[26]:
```
<AxesSubplot:xlabel='Lag', ylabel='Autocorrelation'>
```



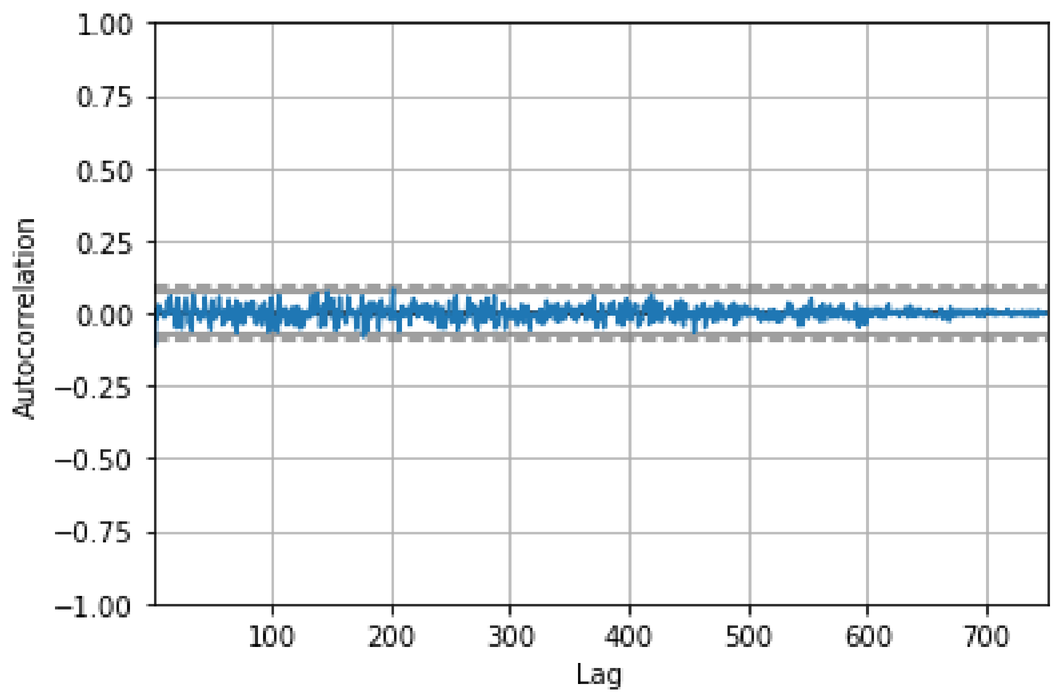
[27]:
```
autocorrelation_plot(df_fat.USDT)
```

[27]:
```
<AxesSubplot:xlabel='Lag', ylabel='Autocorrelation'>
```



[28]:
```
autocorrelation_plot(df_fat.AVAX)
```

[28]:
```
<AxesSubplot:xlabel='Lag', ylabel='Autocorrelation'>
```



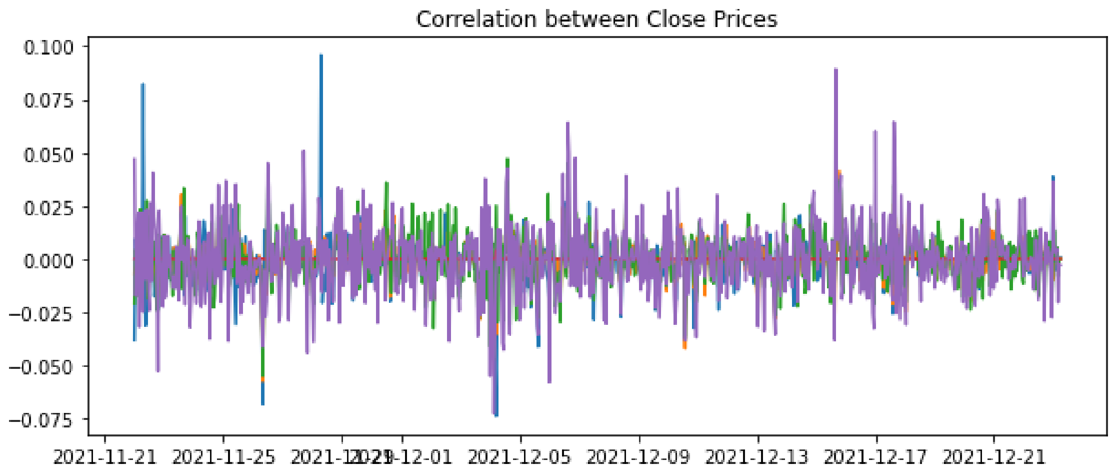
Visualize the correlation in a matplpotlib plot

[29]:
```
plt.figure(figsize=(10, 4))

plt.plot(df_fat.reset_index().ts, df_fat.FLOW)
plt.plot(df_fat.reset_index().ts, df_fat.ETH)
plt.plot(df_fat.reset_index().ts, df_fat.SOL)
plt.plot(df_fat.reset_index().ts, df_fat.USDT)
plt.plot(df_fat.reset_index().ts, df_fat.AVAX)

plt.title('Correlation between Close Prices')
```

[29]:
```
Text(0.5, 1.0, 'Correlation between Close Prices')
```


Correlation between Close Prices
0.100
0.075
0.050
0.025
0.000
−0.025
−0.050
−0.075
2021-11-21
2021-11-25
2021-11-29
2021-12-01
2021-12-05
2021-12-09
2021-12-13
2021-12-17
2021-12-21

```
[ ]:
```