```
pip install fredapi
```

```
Collecting fredapi
  Downloading fredapi-0.5.1-py3-none-any.whl (11 kB)
Requirement already satisfied: pandas in /usr/local/lib/python3.10/dist-packages (from fredapi) (1.5.3)
Requirement already satisfied: python-dateutil>=2.8.1 in /usr/local/lib/python3.10/dist-packages (from pandas->fredapi) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-packages (from pandas->fredapi) (2023.3.post1)
Requirement already satisfied: numpy>=1.21.0 in /usr/local/lib/python3.10/dist-packages (from pandas->fredapi) (1.23.5)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.10/dist-packages (from python-dateutil>=2.8.1->pandas->fredapi) (
Installing collected packages: fredapi
Successfully installed fredapi-0.5.1
```

```
import pandas as pd
import statsmodels.api as sm
import matplotlib.pyplot as plt
from statsmodels.tsa.stattools import adfuller, coint
from statsmodels.tsa.api import VAR
from pandas_datareader import data as pdr
import datetime
from fredapi import Fred
import numpy as np


api_key = '230970faf44ea208229d77dff9f995f3'
fred = Fred(api_key=api_key)

# Define the series IDs
# Define the series IDs
series_ids = {
    'NASDAQ': 'NASDAQCOM',                          # NASDAQ Composite Index
    '10YR_Treasury_Yield': 'GS10',                  # 10-Year Treasury Constant Maturity Rate
    'Real_GDP US': 'GDPC1',                         # Real Gross Domestic Product
    'Industrial_Production': 'INDPRO',              # Industrial Production Index
    'Consumer_Price_Index': 'CPIAUCSL',             # Consumer Price Index for All Urban Consumers
    'Personal_Consumption_Expenditures': 'PCE',     # Personal Consumption Expenditures
    'Unemployment_Rate': 'UNRATE',                  # Unemployment Rate
    'Nonfarm_Payrolls': 'PAYEMS',                   # Total Nonfarm Payrolls
    'Consumer_Sentiment': 'UMCSENT',                # University of Michigan: Consumer Sentiment
    'Housing_Starts': 'HOUST',                      # New Privately-Owned Housing Units Started
    'Crude_Oil_Prices_WTI': 'DCOILWTICO',           # Crude Oil Prices: West Texas Intermediate
    'US_Euro_Exchange_Rate': 'DEXUSEU',             # U.S. / Euro Foreign Exchange Rate
    'M2_Money_Stock': 'M2SL',                       # M2 Money Stock
    'Manufacturing_PMI': 'MANEMP',            # ISM Manufacturing PMI
    'Producer_Price_Index': 'PPIACO',               # Producer Price Index
    'Business_Inventories': 'BUSINV',               # Total Business Inventories
}



# Define the observation period
start_date = '2000-01-01'
end_date = '2023-10-31'

# Download the data
data = {}
for series_name, series_id in series_ids.items():
    data[series_name] = fred.get_series(series_id, start_date, end_date, frequency='q')

# Transform the series (log)
for series_name, series_data in data.items():
    data[series_name] = pd.Series(data[series_name])

# Create a DataFrame from the log-transformed data
df = pd.DataFrame(data)
df = np.log(df)


df
```

	NASDAQ	10YR_Treasury_Yield	Real_GDP US	Industrial_Production	Consumer_Pric
2000-01-01	8.395675	1.868721	9.538071	4.519083	5
2000-04-01	8.228769	1.821318	9.556120	4.531269	5
2000-07-01	8.277206	1.773256	9.557139	4.530477	5
2000-10-01	8.015133	1.717395	9.563091	4.527747	5
2001-01-01	7.764519	1.619388	9.559808	4.515371	5
...	...	...	...	...	
2022-10-01	9.293889	1.342865	9.998342	4.631380	5
2023-01-01	9.348487	1.294727	10.003891	4.630754	5
2023-04-01	9.447525	1.278152	10.008989	4.632714	5

```
FAMAFACTORS=pd.read_csv('F-F_Research_Data_5_Factors_2x3_daily.csv')
```

07-01	9.534504		1.423108	10.021553		4.637715	5

```
FAMAFACTORS.Date = pd.to_datetime(FAMAFACTORS.Date, format='%Y%m%d')
FAMAFACTORS
```

	Date	Mkt-RF	SMB	HML	RMW	CMA	RF
0	1963-07-01	-0.67	0.02	-0.35	0.03	0.13	0.012
1	1963-07-02	0.79	-0.28	0.28	-0.08	-0.21	0.012
2	1963-07-03	0.63	-0.18	-0.10	0.13	-0.25	0.012
3	1963-07-05	0.40	0.09	-0.28	0.07	-0.30	0.012
4	1963-07-08	-0.63	0.07	-0.20	-0.27	0.06	0.012
...	...	...	...	...	...	...	...
15183	2023-10-25	-1.58	-0.02	0.84	1.50	0.20	0.021
15184	2023-10-26	-1.15	1.19	1.66	-0.76	0.48	0.021
15185	2023-10-27	-0.53	-0.58	-0.57	0.42	-0.96	0.021
15186	2023-10-30	1.15	-0.34	0.28	-0.14	0.17	0.021
15187	2023-10-31	0.63	0.06	-0.08	-0.83	0.06	0.021

15188 rows × 7 columns

```
FAMAFACTORS=FAMAFACTORS.set_index('Date')
```

```
FAMAFACTORS=FAMAFACTORS.resample('Q').mean()
```

```
import pandas as pd

# Assuming FAMAFACTORS is a pandas DataFrame with a datetime index
FAMAFACTORS.index = FAMAFACTORS.index + pd.Timedelta(days=1)
```

```
FAMAFACTORS
```

Date	Mkt-RF	SMB	HML	RMW	CMA	RF
1963-10-01	0.047187	-0.024844	0.010781	0.003594	-0.017500	0.012281
1964-01-01	0.058387	-0.071129	0.028871	0.033548	0.000968	0.013919
1964-04-01	0.082903	0.025161	0.123226	-0.032581	0.082742	0.013984
1964-07-01	0.044375	-0.028594	0.028906	-0.030156	-0.012500	0.013344

```
df_merged=df.merge(FAMAFACTORS, left_index=True,right_index=True, how='left')
```

```
df.columns
```

```
Index(['NASDAQ', '10YR_Treasury_Yield', 'Real_GDP US', 'Industrial_Production',
       'Consumer_Price_Index', 'Personal_Consumption_Expenditures',
       'Unemployment_Rate', 'Nonfarm_Payrolls', 'Consumer_Sentiment',
       'Housing_Starts', 'Crude_Oil_Prices_WTI', 'US_Euro_Exchange_Rate',
       'M2_Money_Stock', 'Manufacturing_PMI', 'Producer_Price_Index',
       'Business_Inventories'],
      dtype='object')
```

```
df_merged['Returns']=df_merged['NASDAQ'].diff()
```

```
df_merged['Returns']=df_merged['Returns'].fillna(0)
```

```
df_merged['Excess_returns']=df_merged['Returns']-df_merged['RF']
```

```
df_merged
```

	NASDAQ	10YR_Treasury_Yield	Real_GDP US	Industrial_Production	Consumer_Price_Index	Personal_Consumption_Expenditures	Une
2000-01-01	8.395675	1.868721	9.538071	4.519083	5.136386	8.797579	
2000-04-01	8.228769	1.821318	9.556120	4.531269	5.144193	8.811637	
2000-07-01	8.277206	1.773256	9.557139	4.530477	5.153292	8.827615	
2000-10-01	8.015133	1.717395	9.563091	4.527747	5.160393	8.841969	
2001-01-01	7.764519	1.619388	9.559808	4.515371	5.169916	8.852994	
...	...	...	...	...	...	...	
2022-10-01	9.293889	1.342865	9.998342	4.631380	5.698854	9.793511	
2023-01-01	9.348487	1.294727	10.003891	4.630754	5.708209	9.812994	
2023-04-01	9.447525	1.278152	10.008989	4.632714	5.714891	9.821138	
2023-07-01	9.534504	1.423108	10.021553	4.637715	5.723693	9.836894	
2023-10-01	NaN	NaN	NaN	NaN	NaN	NaN	

96 rows × 24 columns

```
ind=[ '10YR_Treasury_Yield', 'Real_GDP US', 'Industrial_Production',
       'Consumer_Price_Index', 'Personal_Consumption_Expenditures',
       'Unemployment_Rate', 'Nonfarm_Payrolls', 'Consumer_Sentiment',
       'Housing_Starts', 'Crude_Oil_Prices_WTI', 'US_Euro_Exchange_Rate',
       'M2_Money_Stock', 'Manufacturing_PMI', 'Producer_Price_Index',
       'Business_Inventories']
```

```
df_merged[ind]= df_merged[ind].diff().fillna(0)
```

```
df_merged
```

:penditures	Unemployment_Rate	Nonfarm_Payrolls	Consumer_Sentiment	Housing_Starts	...	Producer_Price_Index	Business_Inventories
0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.000000
0.014059	-0.025318	0.005865	-0.011878	-0.044370	...	0.018345	0.016924
0.015977	0.025318	0.001922	-0.012020	-0.053717	...	0.013048	0.013162
0.014354	-0.025318	0.002039	-0.034062	0.026248	...	0.013116	0.011438
0.011025	0.074108	0.001538	-0.118385	0.038747	...	0.016349	-0.002023
...	...	...	...	...	...	...	...
0.013084	0.000000	0.006164	0.047006	-0.028764	...	-0.029584	0.007690
0.019483	-0.028171	0.006242	0.094073	-0.014337	...	-0.013002	0.002169
0.008144	0.028171	0.004281	-0.036253	0.045863	...	-0.014957	-0.001265
0.015756	0.027399	0.003898	0.110803	-0.058945	...	0.007729	0.003568
0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.000000

```
y=df_merged['Excess_returns']
X =df_merged.drop(['Excess_returns','NASDAQ','Returns','RF','10YR_Treasury_Yield','M2_Money_Stock'],axis=1)


import pandas as pd
import statsmodels.api as sm

# Assuming your DataFrame is named df
# First, calculate the excess returns by subtracting the RF from the portfolio returns


# Define your independent variables (Mkt-RF, SMB, HML)
X = sm.add_constant(X)  # Adds a constant term to the predictor

# Define your dependent variable (Excess_Returns)

# Create the model
model = sm.OLS(y, X, missing='drop').fit()  # 'missing=drop' handles any NaN values by dropping

# Print out the statistics
model_summary = model.summary()
print(model_summary)
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:         Excess_returns   R-squared:                       0.566
Model:                            OLS   Adj. R-squared:                  0.464
Method:                 Least Squares   F-statistic:                     5.571
Date:                Sun, 03 Dec 2023   Prob (F-statistic):           4.03e-08
Time:                        15:45:56   Log-Likelihood:                131.18
No. Observations:                  96   AIC:                            -224.4
Df Residuals:                      77   BIC:                            -175.6
Df Model:                          18
Covariance Type:            nonrobust
=================================================================================================
                                    coef    std err          t      P>|t|      [0.025      0.975]
-------------------------------------------------------------------------------------------------
const                             0.0190      0.020      0.967      0.336      -0.020       0.058
Real_GDP US                       2.7265      2.160      1.262      0.211      -1.574       7.027
Industrial_Production            -1.0324      0.983     -1.050      0.297      -2.990       0.926
Consumer_Price_Index             -1.0049      2.628     -0.382      0.703      -6.237       4.227
Personal_Consumption_Expenditures     1.2371      1.823      0.678      0.500      -2.394       4.868
Unemployment_Rate                -0.1373      0.258     -0.533      0.596      -0.650       0.376
Nonfarm_Payrolls                 -6.1097      2.993     -2.041      0.045     -12.069      -0.150
Consumer_Sentiment                0.4200      0.129      3.245      0.002       0.162       0.678
Housing_Starts                    0.0898      0.129      0.695      0.489      -0.168       0.347
Crude_Oil_Prices_WTI              0.0184      0.093      0.197      0.844      -0.167       0.204
US_Euro_Exchange_Rate             0.2676      0.222      1.207      0.231      -0.174       0.709
Manufacturing_PMI                 3.6759      1.698      2.165      0.034       0.295       7.057
Producer_Price_Index              1.0847      0.678      1.600      0.114      -0.265       2.434
```

```
Business_Inventories                -1.5589      0.992     -1.571      0.120      -3.534       0.417
Mkt-RF                               0.1171      0.084      1.394      0.167      -0.050       0.284
SMB                                 -0.2612      0.129     -2.024      0.046      -0.518      -0.004
HML                                 -0.0085      0.117     -0.073      0.942      -0.241       0.224
RMW                                 -0.1060      0.126     -0.842      0.402      -0.357       0.145
CMA                                 -0.2457      0.164     -1.497      0.138      -0.572       0.081
==============================================================================
Omnibus:                       22.189   Durbin-Watson:                   2.145
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               31.171
Skew:                          -1.078   Prob(JB):                     1.70e-07
Kurtosis:                       4.773   Cond. No.                         491.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

```
                            OLS Regression Results
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Df Residuals:                      77   BIC:                            -175.6
Df Model:                          18
Covariance Type:            nonrobust
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------------------------------------------------------------------------------
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Industrial_Production               -1.0324      0.983     -1.050      0.297      -2.990       0.926
Consumer_Price_Index                -1.0049      2.628     -0.382      0.703      -6.237       4.227
Personal_Consumption_Expenditures    1.2371      1.823      0.678      0.500      -2.394       4.868
Unemployment_Rate                   -0.1373      0.258     -0.533      0.596      -0.650       0.376
Nonfarm_Payrolls                    -6.1097      2.993     -2.041      0.045     -12.069      -0.150
Consumer_Sentiment                   0.4200      0.129      3.245      0.002       0.162       0.678
Housing_Starts                       0.0898      0.129      0.695      0.489      -0.168       0.347
Crude_Oil_Prices_WTI                 0.0184      0.093      0.197      0.844      -0.167       0.204
US_Euro_Exchange_Rate                0.2676      0.222      1.207      0.231      -0.174       0.709
Manufacturing_PMI                    3.6759      1.698      2.165      0.034       0.295       7.057
Producer_Price_Index                 1.0847      0.678      1.600      0.114      -0.265       2.434
Business_Inventories                -1.5589      0.992     -1.571      0.120      -3.534       0.417
Mkt-RF                               0.1171      0.084      1.394      0.167      -0.050       0.284
SMB                                 -0.2612      0.129     -2.024      0.046      -0.518      -0.004
HML                                 -0.0085      0.117     -0.073      0.942      -0.241       0.224
RMW                                 -0.1060      0.126     -0.842      0.402      -0.357       0.145
CMA                                 -0.2457      0.164     -1.497      0.138      -0.572       0.081
==============================================================================
Omnibus:                       22.189   Durbin-Watson:                   2.145
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               31.171
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```
Notes:
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```

OLS Regression Results

Dep. Variable: Excess_returns R-squared: 0.566 Model: OLS Adj. R-squared: 0.464 Method: Least Squares F-statistic: 5.571 Date: Sun, 03 Dec 2023 Prob (F-statistic): 4.03e-08 Time: 15:45:56 Log-Likelihood: 131.18 No. Observations: 96 AIC: -224.4 Df Residuals: 77 BIC: -175.6 Df Model: 18

Covariance Type: nonrobust

coef std err t P>|t| [0.025 0.975]

const 0.0190 0.020 0.967 0.336 -0.020 0.058 Real_GDP US 2.7265 2.160 1.262 0.211 -1.574 7.027 Industrial_Production -1.0324 0.983 -1.050 0.297 -2.990 0.926 Consumer_Price_Index -1.0049 2.628 -0.382 0.703 -6.237 4.227 Personal_Consumption_Expenditures 1.2371 1.823 0.678 0.500 -2.394 4.868 Unemployment_Rate -0.1373 0.258 -0.533 0.596 -0.650 0.376 Nonfarm_Payrolls -6.1097 2.993 -2.041 0.045 -12.069 -0.150 Consumer_Sentiment 0.4200 0.129 3.245 0.002 0.162 0.678 Housing_Starts 0.0898 0.129 0.695 0.489 -0.168 0.347 Crude_Oil_Prices_WTI 0.0184 0.093 0.197 0.844 -0.167 0.204 US_Euro_Exchange_Rate 0.2676 0.222 1.207 0.231 -0.174 0.709 Manufacturing_PMI 3.6759 1.698 2.165 0.034 0.295 7.057 Producer_Price_Index 1.0847 0.678 1.600 0.114 -0.265 2.434 Business_Inventories -1.5589 0.992 -1.571 0.120 -3.534 0.417 Mkt-RF 0.1171 0.084 1.394 0.167 -0.050 0.284 SMB -0.2612 0.129 -2.024 0.046 -0.518 -0.004 HML -0.0085 0.117 -0.073 0.942 -0.241 0.224 RMW -0.1060 0.126 -0.842 0.402 -0.357 0.145

CMA -0.2457 0.164 -1.497 0.138 -0.572 0.081

Omnibus: 22.189 Durbin-Watson: 2.145 Prob(Omnibus): 0.000 Jarque-Bera (JB): 31.171 Skew: -1.078 Prob(JB): 1.70e-07

Kurtosis: 4.773 Cond. No. 491.

Notes: [1] Standard Errors assume that the covariance matrix of the errors is correctly specified.