```
#necessary imports
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from statsmodels.graphics.tsaplots import plot_acf,plot_pacf
```

```
df=pd.read_csv('/content/SBI3Y.csv',index_col='Date',parse_dates=True)#reading data to a pandas dataframe
```

Start coding or generate with AI.

```
df.head()
```

Date	Open	High	Low	Close	Adj Close	Volume
2021-03-24	368.500000	369.049988	358.649994	359.850006	344.386780	42318999
2021-03-25	360.000000	360.850006	345.200012	355.200012	339.936615	57495003
2021-03-26	360.000000	362.000000	354.549988	357.200012	341.850647	40718848
2021-03-30	360.100006	364.299988	356.299988	360.799988	345.295959	39405124
2021-03-31	360.299988	367.850006	357.950012	364.299988	348.645538	38651025

Next steps: Generate code with df | View recommended plots

```
# performing the necessary statistics
df.describe()
```

	Open	High	Low	Close	Adj Close	Volume
count	742.000000	742.000000	742.000000	742.000000	742.000000	7.420000e+02
mean	530.184502	535.709098	524.120619	529.903370	520.149722	1.989648e+07
std	85.002279	85.370810	84.655232	84.969595	89.607174	1.481146e+07
min	326.000000	332.049988	321.299988	328.850006	314.718903	3.692065e+06
25%	469.012512	475.512497	463.275009	468.399994	455.863212	1.187084e+07
50%	530.475006	535.649994	524.200012	530.100006	518.057831	1.578465e+07
75%	586.937500	590.250015	580.662506	585.287476	581.326172	2.245517e+07
max	790.000000	793.400024	783.000000	788.049988	788.049988	1.928108e+08

Start coding or generate with AI.

Data Preprocessing and Exploratory data analysis

Performance of a stock is anlysed base on the daily returns% i.e, valve-prev/prev % . calculating the daily returns for the closed data

```
df['daily_returns']=df['Close'].pct_change()
```

```
df.head()
```

Date	Open	High	Low	Close	Adj Close	Volume	daily_retu
2021-03-24	368.500000	369.049988	358.649994	359.850006	344.386780	42318999	N
2021-03-25	360.000000	360.850006	345.200012	355.200012	339.936615	57495003	-0.012
2021-03-26	360.000000	362.000000	354.549988	357.200012	341.850647	40718848	0.005

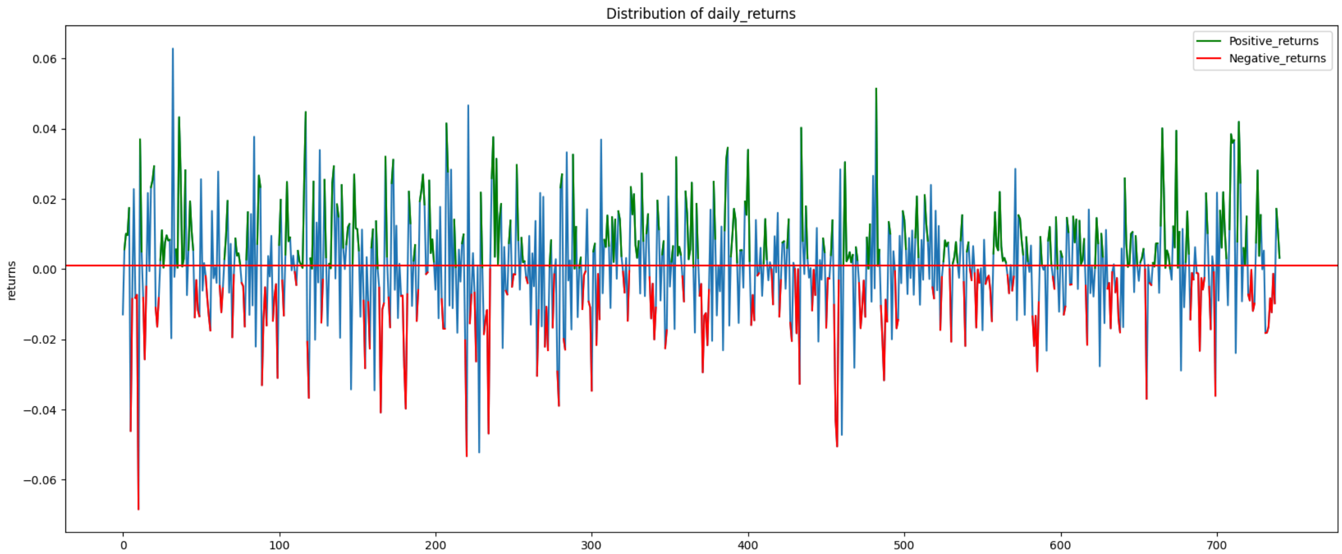
Next steps: Generate code with df | View recommended plots

```
df=df.dropna()
df.head()
```

	Open	High	Low	Close	Adj Close	Volume	daily_returns
Date							
2021-03-25	360.000000	360.850006	345.200012	355.200012	339.936615	57495003	-0.012922
2021-03-26	360.000000	362.000000	354.549988	357.200012	341.850647	40718848	0.005631
2021-03-30	360.100006	364.299988	356.299988	360.799988	345.295959	39405124	0.010078
2021-03-31	360.299988	367.850006	357.950012	364.299988	348.645538	38651025	0.009701
2021-04-01	367.700012	371.899994	363.100006	370.649994	354.722687	31883453	0.017431

Next steps: Generate code with df View recommended plots

```
# in the above plot the values with positve returns above 0 are shown in green and values with negative returns are shown in red color
fig, ax = plt.subplots(figsize=(20,8))
plt.plot(df['daily_returns'].values)
plt.plot(np.where(df['daily_returns']>0,df['daily_returns'], None), color="green", label="Positive_returns")
plt.plot(np.where(df['daily_returns'] <= 0,df['daily_returns'], None), color="red", label="Negative_returns")
plt.axhline(df['daily_returns'].mean(), color='red')
plt.legend()
plt.ylabel('returns')
plt.title('Distribution of daily_returns')
plt.show()
```



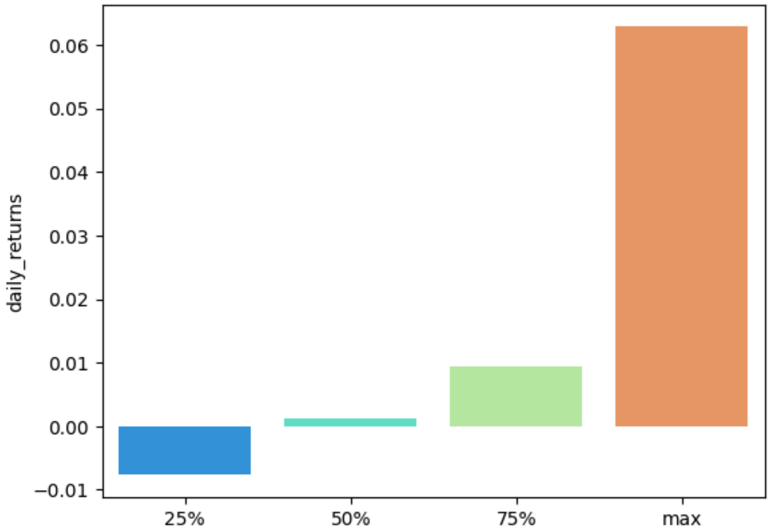

```
df['daily_returns'].describe()
```

```
count    741.000000
mean       0.001112
std        0.015902
min       -0.068414
25%       -0.007700
50%        0.001243
75%        0.009498
max        0.062838
Name: daily_returns, dtype: float64
```

```
returns_quantiles= df['daily_returns'].describe()[['25%','50%','75%','max']]
```

```
sns.barplot(returns_quantiles,palette='rainbow') # plotting the returns quatilels
```

```
<ipython-input-11-1843fd361d7d>:1: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `le

  sns.barplot(returns_quantiles,palette='rainbow') # plotting the returns quatilels
<Axes: ylabel='daily_returns'>
```




```
#calculating outliers
Q1= -0.009777
Q3= 0.011454
IQR= Q3-Q1
upper_bound=Q3+1.5*IQR
lower_bound=Q1-1.5*IQR
outliers =df[(df['daily_returns']>upper_bound) | (df['daily_returns']<lower_bound)]
```

```
outliers
```

Date	Open	High	Low	Close	Adj Close	Volume	daily_returns
2021-04-05	367.500000	369.200012	349.049988	353.549988	338.357483	51743981	-0.046135
2021-04-12	344.000000	344.000000	322.549988	328.850006	314.718903	75501713	-0.068414
2021-05-17	364.399994	385.200012	363.649994	383.100006	366.637695	106555796	0.062838
2021-09-16	444.850006	466.100006	442.750000	463.700012	447.871368	42637448	0.044722
2022-02-14	515.000000	515.599976	499.700012	501.399994	484.284454	26153332	-0.053248
2022-02-15	502.000000	526.849976	497.100006	524.799988	506.885651	23842951	0.046669
2022-02-24	480.000000	487.950012	468.000000	472.649994	456.515869	32356037	-0.052236
2022-03-07	447.500000	453.950012	433.450012	440.299988	425.270142	33720472	-0.046867
2023-01-25	595.849976	595.849976	567.400024	568.700012	557.859375	25686294	-0.043156
2023-01-27	568.000000	568.549988	532.250000	539.950012	529.657410	40163464	-0.050554
2023-02-01	561.400024	565.000000	499.350006	527.349976	517.297546	38218810	-0.047245
2023-03-03	542.000000	564.299988	541.750000	561.200012	550.502380	27656538	0.051429

Next steps: Generate code with `outliers` View recommended plots

```
outliers=outliers.sort_values('daily_returns',ascending=False)
```

```
outliers
```

Date	Open	High	Low	Close	Adj Close	Volume	daily_returns
2021-05-17	364.399994	385.200012	363.649994	383.100006	366.637695	106555796	0.062838
2023-03-03	542.000000	564.299988	541.750000	561.200012	550.502380	27656538	0.051429
2022-02-15	502.000000	526.849976	497.100006	524.799988	506.885651	23842951	0.046669
2021-09-16	444.850006	466.100006	442.750000	463.700012	447.871368	42637448	0.044722
2023-01-25	595.849976	595.849976	567.400024	568.700012	557.859375	25686294	-0.043156
2021-04-05	367.500000	369.200012	349.049988	353.549988	338.357483	51743981	-0.046135
2022-03-07	447.500000	453.950012	433.450012	440.299988	425.270142	33720472	-0.046867
2023-02-01	561.400024	565.000000	499.350006	527.349976	517.297546	38218810	-0.047245
2023-01-27	568.000000	568.549988	532.250000	539.950012	529.657410	40163464	-0.050554
2022-02-24	480.000000	487.950012	468.000000	472.649994	456.515869	32356037	-0.052236
2022-02-14	515.000000	515.599976	499.700012	501.399994	484.284454	26153332	-0.053248
2021-04-12	344.000000	344.000000	322.549988	328.850006	314.718903	75501713	-0.068414

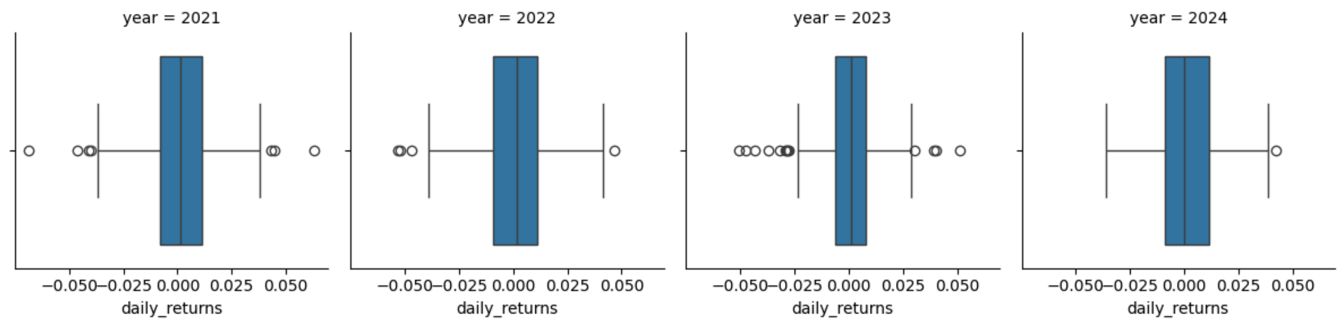
Next steps: Generate code with outliers | View recommended plots

Here further see the reason for particular outliers. For example on May5 2021 stok market has rose due to psu etc

```
df['year'] = pd.DatetimeIndex(df.index).year
```

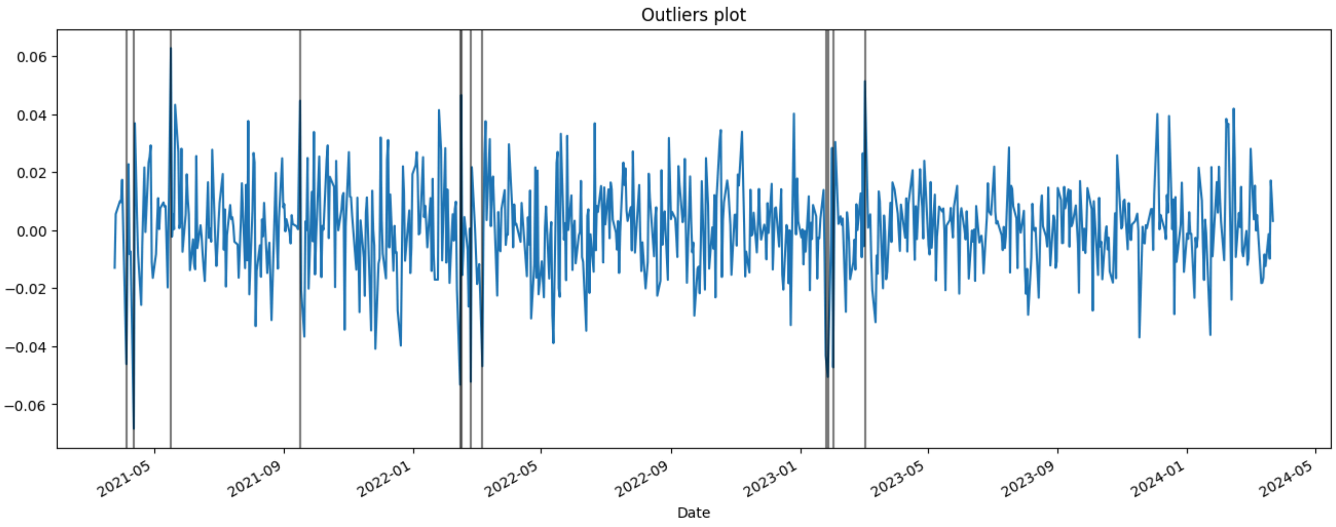
```
# outliers identified based on year
g = sns.FacetGrid(df, col="year")
g.map(sns.boxplot, "daily_returns")
```

```
/usr/local/lib/python3.10/dist-packages/seaborn/axisgrid.py:718: UserWarning: Using the boxplot function without specifying `order`
  warnings.warn(warning)
<seaborn.axisgrid.FacetGrid at 0x7bd6ef3fd480>
```




```
Start coding or generate with AI.
```

```
ax=df['daily_returns'].plot(figsize=(16,6),title='Outliers plot')
for i in outliers.index:
  ax.axvline(i,color='black',alpha=0.5)
```



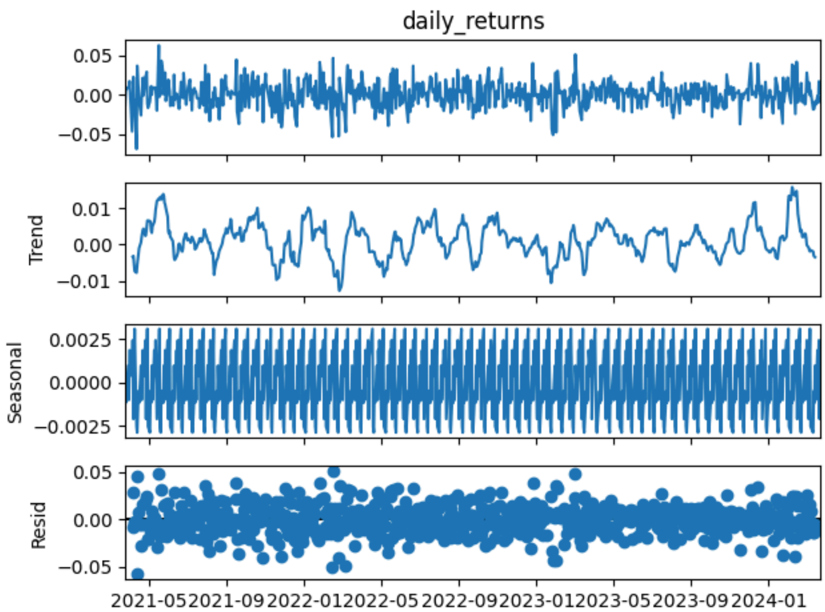
Start coding or generate with AI.

Understanding the ETS(error, trend and seasonality of the stock by using ETS decomposition method of statsmodels library)

```
from statsmodels.tsa.seasonal import seasonal_decompose
```

```
result=seasonal_decompose(df['daily_returns'],model='additive',period=12) # there are two modes for trend analysis either additive or multiplicati
```

```
result.plot();
```



from the above we can make following inference

- Residuals are very high which shows uncertainity of data
- Data follows a cyclic pattern which have to be obtained by using forecasting models and find the seasonal components

We have taken 1d , 3d and 5d simple moving averages in order to analyze the trend or seasonality

```
df['sma1d']=df['daily_returns'].rolling(window=1).mean()
```

```
df['sma3d']=df['daily_returns'].rolling(window=3).mean()
```

```
df['sma5d']=df['daily_returns'].rolling(window=5).mean()
```

```
df=df.dropna()
```

```
df.head()
```

Date	Open	High	Low	Close	Adj Close	Volume	daily_returns	year	sma1d	sma3d	sma5d
2021-04-01	367.700012	371.899994	363.100006	370.649994	354.722687	31883453	0.017431	2021	0.017431	0.012403	0.005984
2021-04-05	367.500000	369.200012	349.049988	353.549988	338.357483	51743981	-0.046135	2021	-0.046135	-0.006335	-0.000659
2021-04-06	355.700012	357.000000	349.299988	350.549988	335.486420	44147709	-0.008485	2021	-0.008485	-0.012397	-0.003482
2021-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

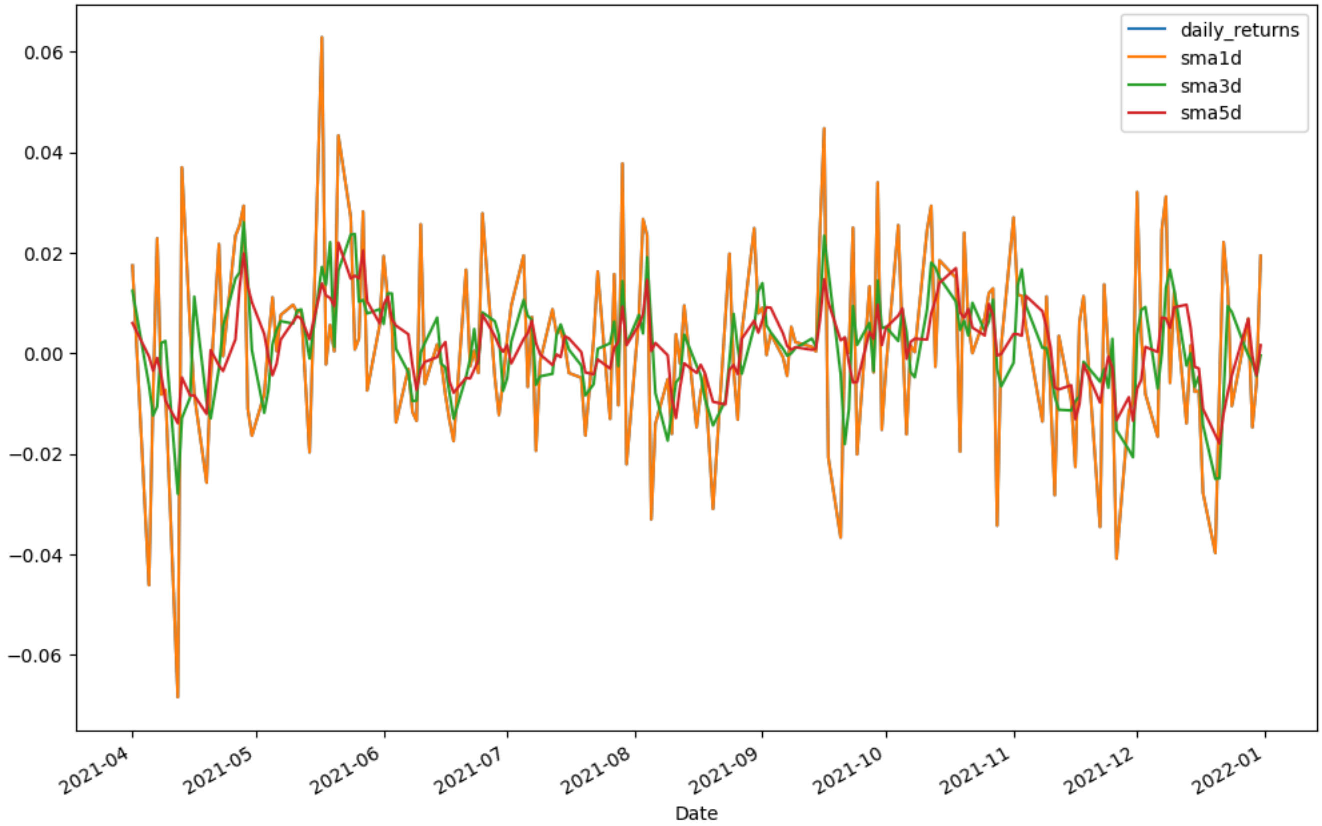
Next steps: Generate code with df View recommended plots

```
df[['daily_returns','sma1d','sma3d','sma5d']].plot(figsize=(12,8))
```

<Axes: xlabel='Date'>

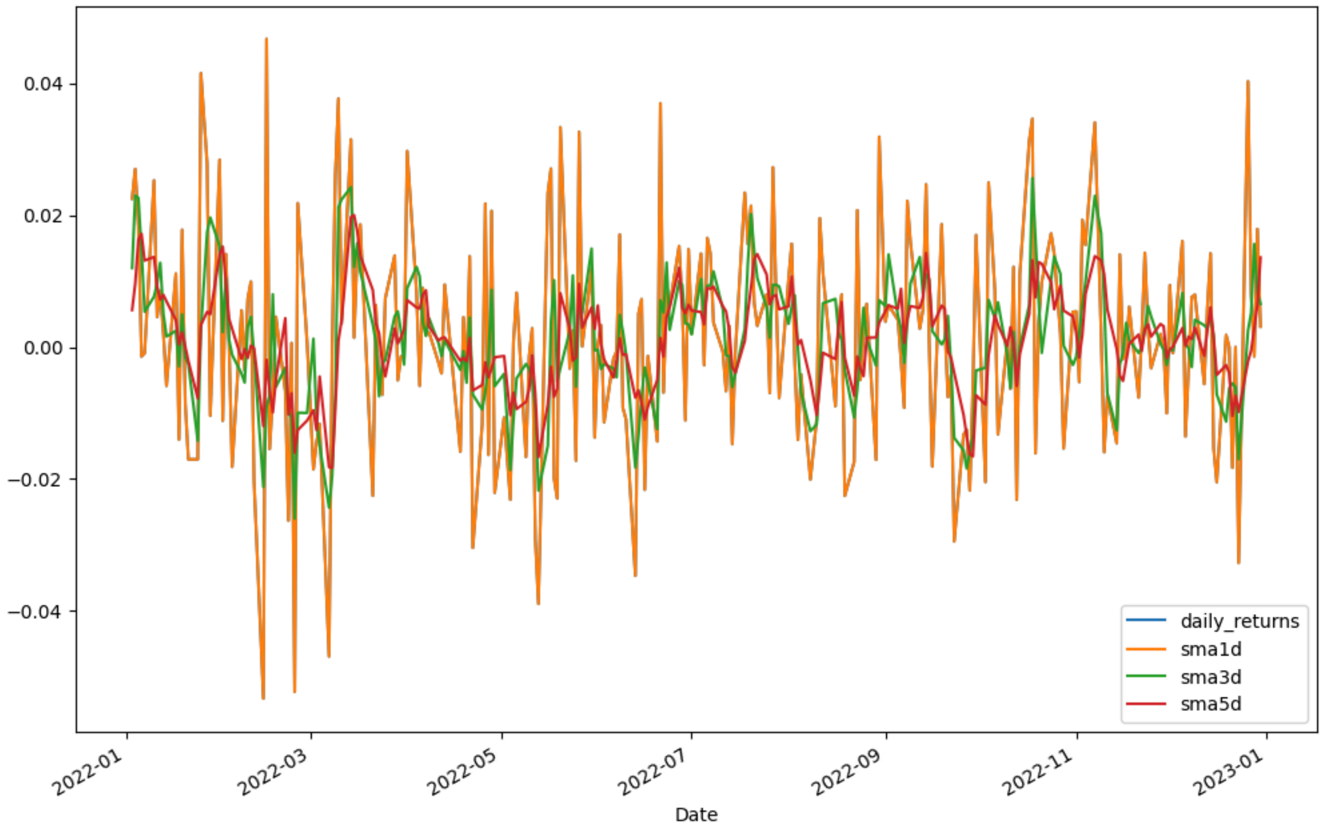

```
#Distribution for 2021
df[:'2021-12-31'][['daily_returns','sma1d','sma3d','sma5d']].plot(figsize=(12,8))
```

```
<Axes: xlabel='Date'>
```



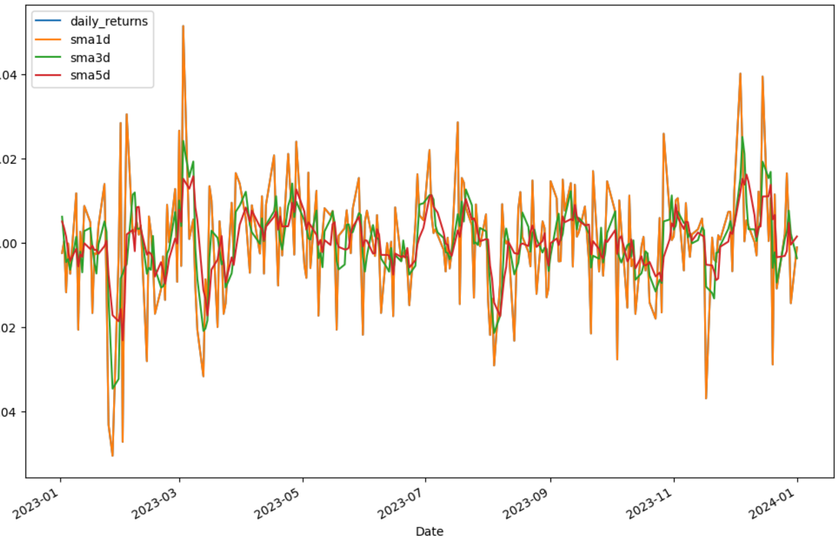

```
#Distribution for 2022
df['2022-01-01':'2023-01-01'][['daily_returns','sma1d','sma3d','sma5d']].plot(figsize=(12,8))
```

```
<Axes: xlabel='Date'>
```



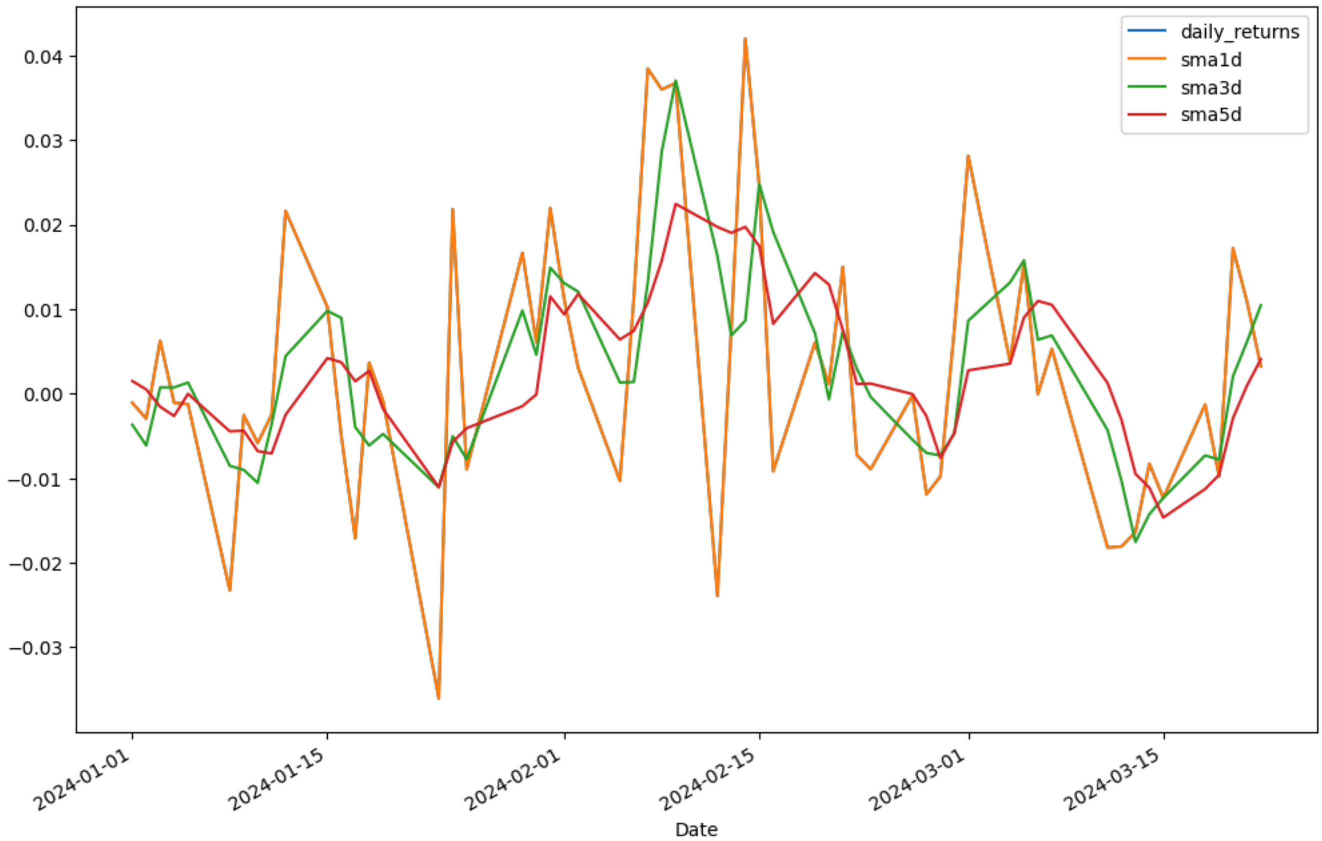

```
#distribution for 2023
df['2023-01-01':'2024-01-01'][['daily_returns','sma1d','sma3d','sma5d']].plot(figsize=(12,8))
```

<Axes: xlabel='Date'>




```
#distribution for 2024
df['2024-01-01':][['daily_returns','sma1d','sma3d','sma5d']].plot(figsize=(12,8))
```

<Axes: xlabel='Date'>



Start coding or generate with AI.

Checking if the returs distribution is stationery by using Augumented Dickey fuller test

```
# Using Augumented dickey fuller test
from statsmodels.tsa.stattools import adfuller
def adf_test(series,title=''):
   print('Augmented Dicky fuller test :{title}')
   result=adfuller(series.dropna(),autolag='AIC')
   labels=['ADF test_statistic','p-value','#lags_used','#observations']
   out=pd.Series(result[0:4],index=labels)
   for key,val in result[4].items():
    out[f'Critical value ({key})']=val
   print(out.to_string())
   if result[1]<0.05:
    print('reject null hypothesis')
    print('Data has no unit root and is stationary')
   else:
    print('no evidence to reject null hypothesis')
    print('Data has unit root and is non-stationary')
```

```
adf_test(df['daily_returns']) #here we can see that as p-value is less that 0.05 it falls in the region of rejection of null hypothesis and the da
```

```
Augmented Dicky fuller test :{title}
ADF test_statistic     -1.224990e+01
p-value                 9.593358e-23
#lags_used              3.000000e+00
#observations           7.330000e+02
Critical value (1%)    -3.439303e+00
Critical value (5%)    -2.865491e+00
Critical value (10%)   -2.568874e+00
reject null hypothesis
Data has no unit root and is stationary
```

#here we can see that as p-value is less that 0.05 it falls in the region of rejection of null hypothesis and the data is stationery which was observed that data is around the mean

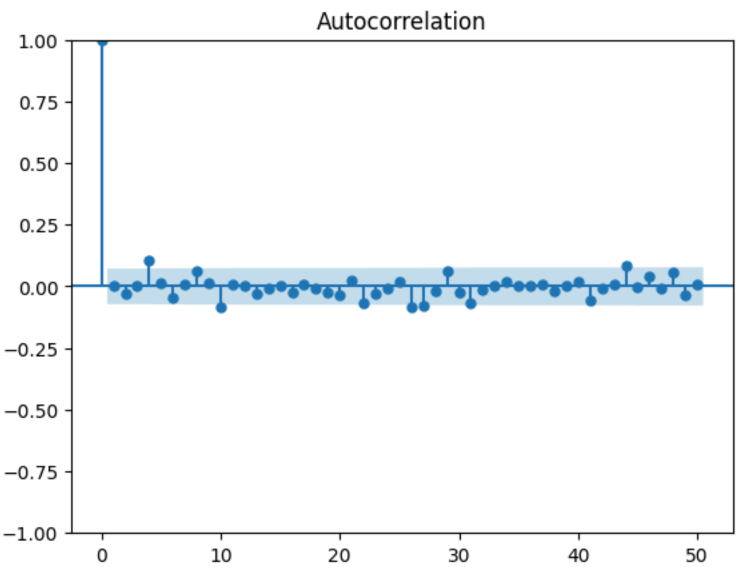
```
df.tail()
```

	Open	High	Low	Close	Adj Close	Volume	daily_returns	year	sma1d	sma3d	sma5d
Date											
2024-03-18	727.099976	737.900024	722.099976	730.950012	730.950012	18145126	-0.001298	2024	-0.001298	-0.007314	-0.011285
2024-03-19	730.000000	734.349976	721.150024	723.799988	723.799988	15205043	-0.009782	2024	-0.009782	-0.007809	-0.009622
2024-03-20	725.150024	738.950012	719.799988	736.250000	736.250000	25405455	0.017201	2024	0.017201	0.002040	-0.002905
2024-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

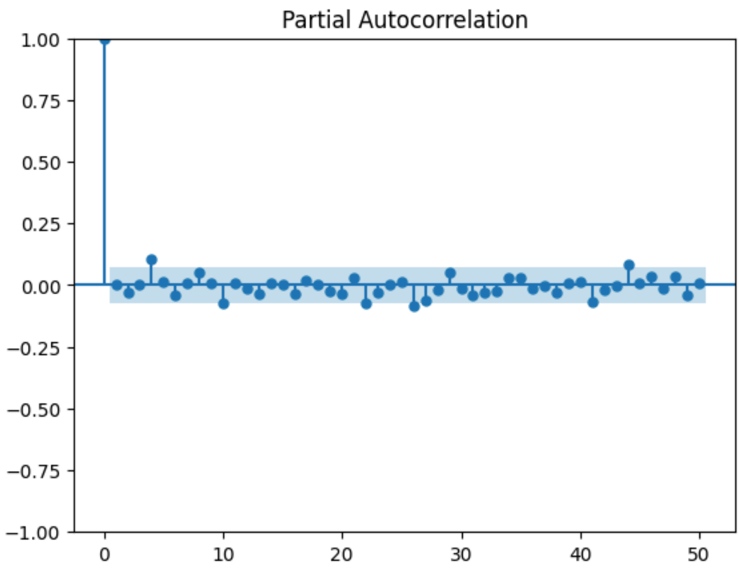
Choosing the appropriate model

```
from statsmodels.graphics.tsaplots import plot_acf, plot_pacf
```

```
acf_plot = plot_acf(df['daily_returns'], lags = 50)
```



```
pacf_plot = plot_pacf(df['daily_returns'], lags = 50)
```



From pacf plot we can infer that values for p are 1,5,44 whch are outside shaded region

```
Start coding or generate with AI.
```

Splitting data set in to training and testing

```
len(df)
```

```
737
```

```
train=df[:-30]
test=df[-30:]
```

ARIMA model

```
from statsmodels.tsa.arima.model import ARIMA
```

```
Start coding or generate with AI.
```

```
model = ARIMA(train['daily_returns'],order=(1,0,5))
result=model.fit()
result.summary()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning: A date index has been provided, but it
  self._init_dates(dates, freq)
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning: A date index has been provided, but it
  self._init_dates(dates, freq)
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning: A date index has been provided, but it
  self._init_dates(dates, freq)
```

SARIMAX Results

Dep. Variable:	daily_returns	**No. Observations:**	707
Model:	ARIMA(1, 0, 5)	**Log Likelihood**	1927.811
Date:	Mon, 25 Mar 2024	**AIC**	-3839.622
Time:	02:03:55	**BIC**	-3803.134
Sample:	0 - 707	**HQIC**	-3825.524
Covariance Type:	opg		

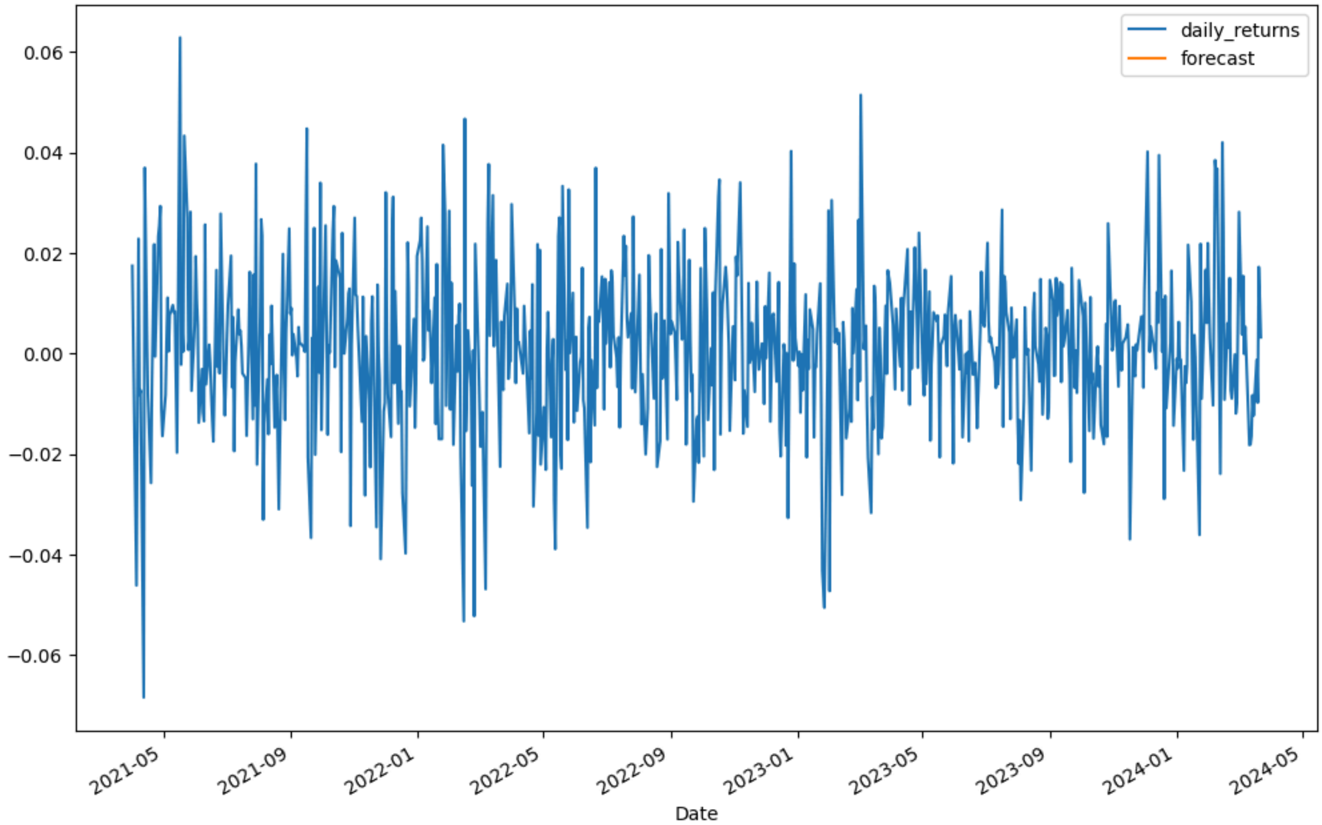
	coef	std err	z	P>|z|	[0.025	0.975]
const	0.0010	0.001	1.628	0.104	-0.000	0.002
ar.L1	0.0536	8.474	0.006	0.995	-16.555	16.662
ma.L1	-0.0641	8.479	-0.008	0.994	-16.682	16.554
ma.L2	-0.0304	0.101	-0.302	0.763	-0.228	0.167
ma.L3	0.0008	0.262	0.003	0.998	-0.513	0.514
ma.L4	0.0909	0.039	2.323	0.020	0.014	0.168
ma.L5	-0.0008	0.770	-0.001	0.999	-1.511	1.509
sigma2	0.0003	1.09e-05	23.015	0.000	0.000	0.000

Ljung-Box (L1) (Q):	0.00	**Jarque-Bera (JB):**	47.82
Prob(Q):	0.99	**Prob(JB):**	0.00
Heteroskedasticity (H):	0.49	**Skew:**	-0.14
Prob(H) (two-sided):	0.00	**Kurtosis:**	4.24

Warnings:
[1] Covariance matrix calculated using the outer product of gradients (complex-step).

```
start=len(train)
end=len(train)+len(test)-1

df['forecast']=result.predict(start = start, end = end)
df[['daily_returns','forecast']].plot(figsize=(12,8))
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Predic
  return get_prediction_index(
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In th
  return get_prediction_index(
<ipython-input-51-dda93fc59791>:4: 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-docs/stable/user_guide/indexing.html#returning-a-view-versus
  df['forecast']=result.predict(start = start, end = end)
<Axes: xlabel='Date'>
```



SARIMAMODEL

Generate | randomly select 5 items from a list | Close

Generate is available for a limited time for unsubscribed users. Upgrade to Colab Pro

```
from statsmodels.tsa.statespace.sarimax import SARIMAX
model_S = SARIMAX(df['daily_returns'],order=(2, 0, 0),seasonal_order=(1,0,1,44))
result_S = model_S.fit()
result_S.summary()
```

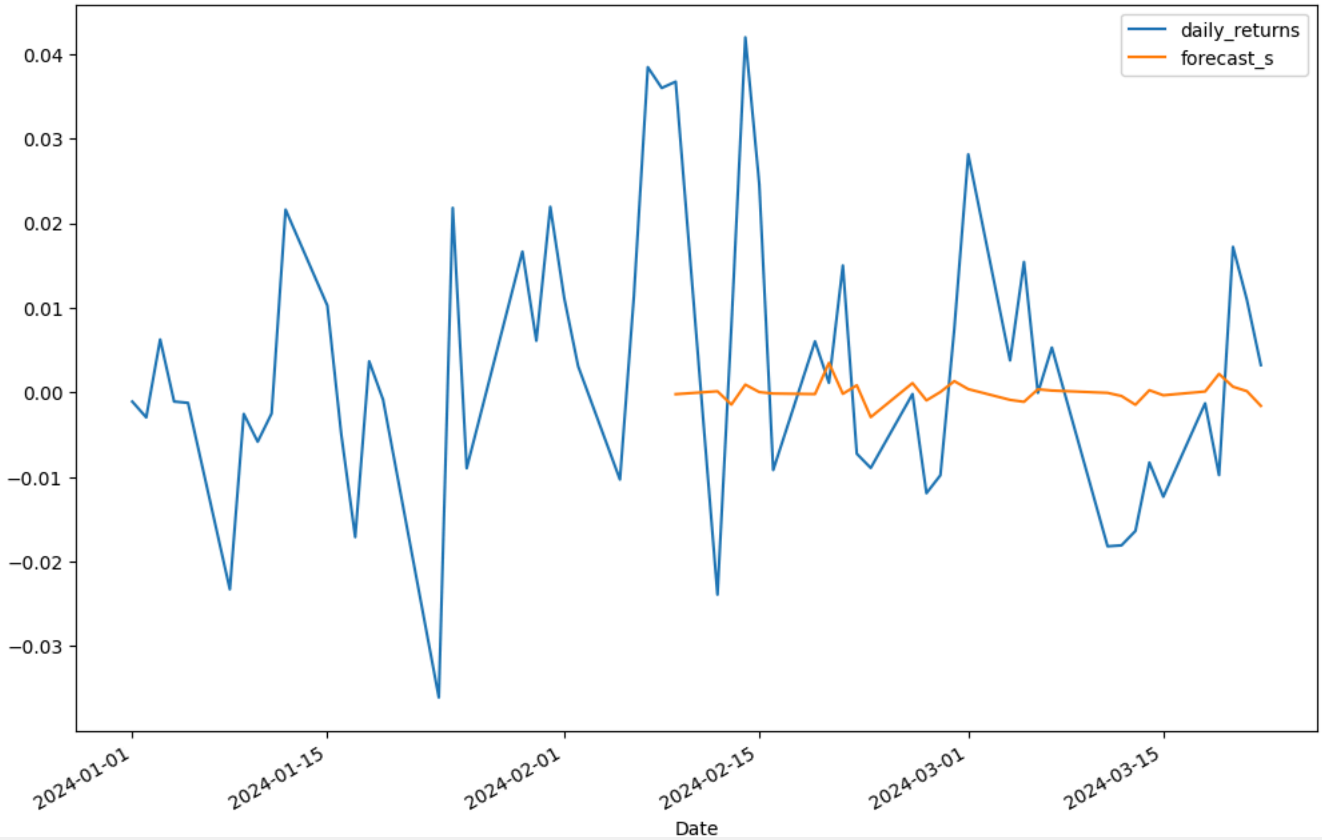
```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning: A date index has been provided, but it
  self._init_dates(dates, freq)
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning: A date index has been provided, but it
  self._init_dates(dates, freq)
```

SARIMAX Results

Dep. Variable:	daily_returns	**No. Observations:**	737
Model:	SARIMAX(2, 0, 0)x(1, 0, [1], 44)	**Log Likelihood**	2007.067

```
df['forecast_s']=result_S.predict(start= start, end =end)
df['2024-01-01':][['daily_returns','forecast_s']].plot(figsize=(12,8))
```

```
<ipython-input-58-ca9f0ce5183b>:1: 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-docs/stable/user_guide/indexing.html#returning-a-view-versus
  df['forecast_s']=result_S.predict(start= start, end =end)
<Axes: xlabel='Date'>
```



performing similar analysis for simple moving averages

```
adf_test(df['sma1d'])
```

```
Augmented Dicky fuller test :{title}
ADF test_statistic     -1.224990e+01
p-value                 9.593358e-23
#lags_used              3.000000e+00
#observations           7.330000e+02
Critical value (1%)    -3.439303e+00
Critical value (5%)    -2.865491e+00
Critical value (10%)   -2.568874e+00
reject null hypothesis
Data has no unit root and is stationary
```

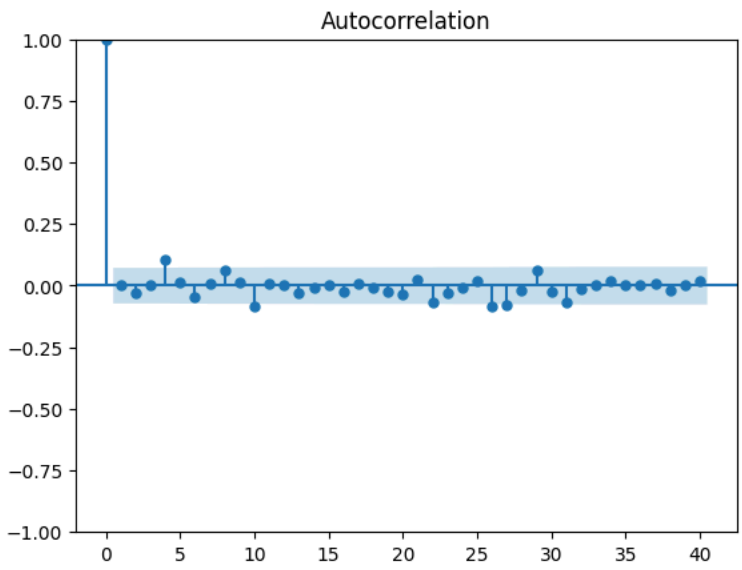
```
adf_test(df['sma3d'])
```

```
Augmented Dicky fuller test :{title}
ADF test_statistic     -6.653637e+00
p-value                 5.047662e-09
#lags_used              2.000000e+01
#observations           7.160000e+02
Critical value (1%)    -3.439516e+00
Critical value (5%)    -2.865585e+00
Critical value (10%)   -2.568924e+00
reject null hypothesis
Data has no unit root and is stationary
```

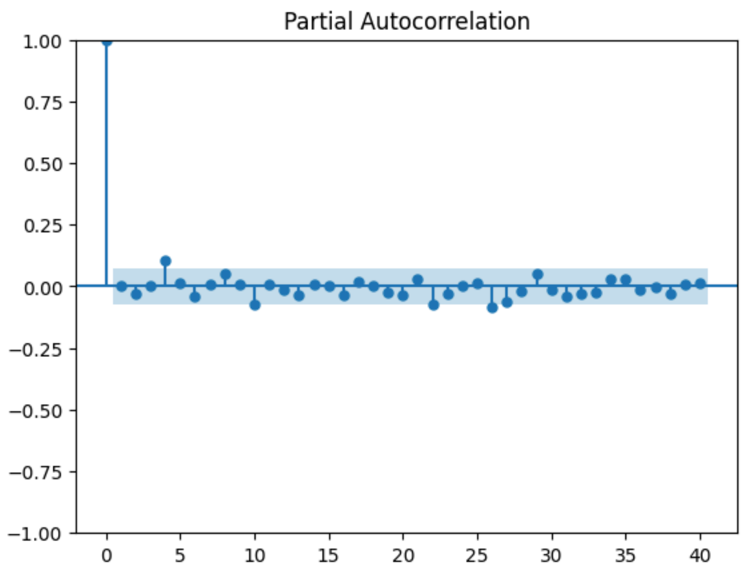
```
adf_test(df['sma5d'])
```

```
Augmented Dicky fuller test :{title}
ADF test_statistic       -5.623599
p-value                   0.000001
#lags_used               20.000000
#observations           716.000000
Critical value (1%)      -3.439516
Critical value (5%)      -2.865585
Critical value (10%)     -2.568924
reject null hypothesis
Data has no unit root and is stationary
```

```
plot_acf(df['sma1d'],lags=40);
```



```
plot_pacf(df['sma1d'],lags=40);
```



wecan see that 1,5 are values for p

```
from statsmodels.tsa.statespace.sarimax import SARIMAX
model_1d = SARIMAX(df['sma1d'],order=(2, 0, 0),seasonal_order=(1,0,1,44))
result_1d = model_1d.fit()
result_1d.summary()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueW
  self._init_dates(dates, freq)
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueW
  self._init_dates(dates, freq)
```

SARIMAX Results

Dep. Variable:	sma1d	**No. Observations:**	737
Model:	SARIMAX(2, 0, 0)x(1, 0, [1], 44)	**Log Likelihood**	2007.067
Date:	Mon, 25 Mar 2024	**AIC**	-4004.135
Time:	02:42:31	**BIC**	-3981.122
Sample:	0	**HQIC**	-3995.260
	- 737		
Covariance Type:	opg		

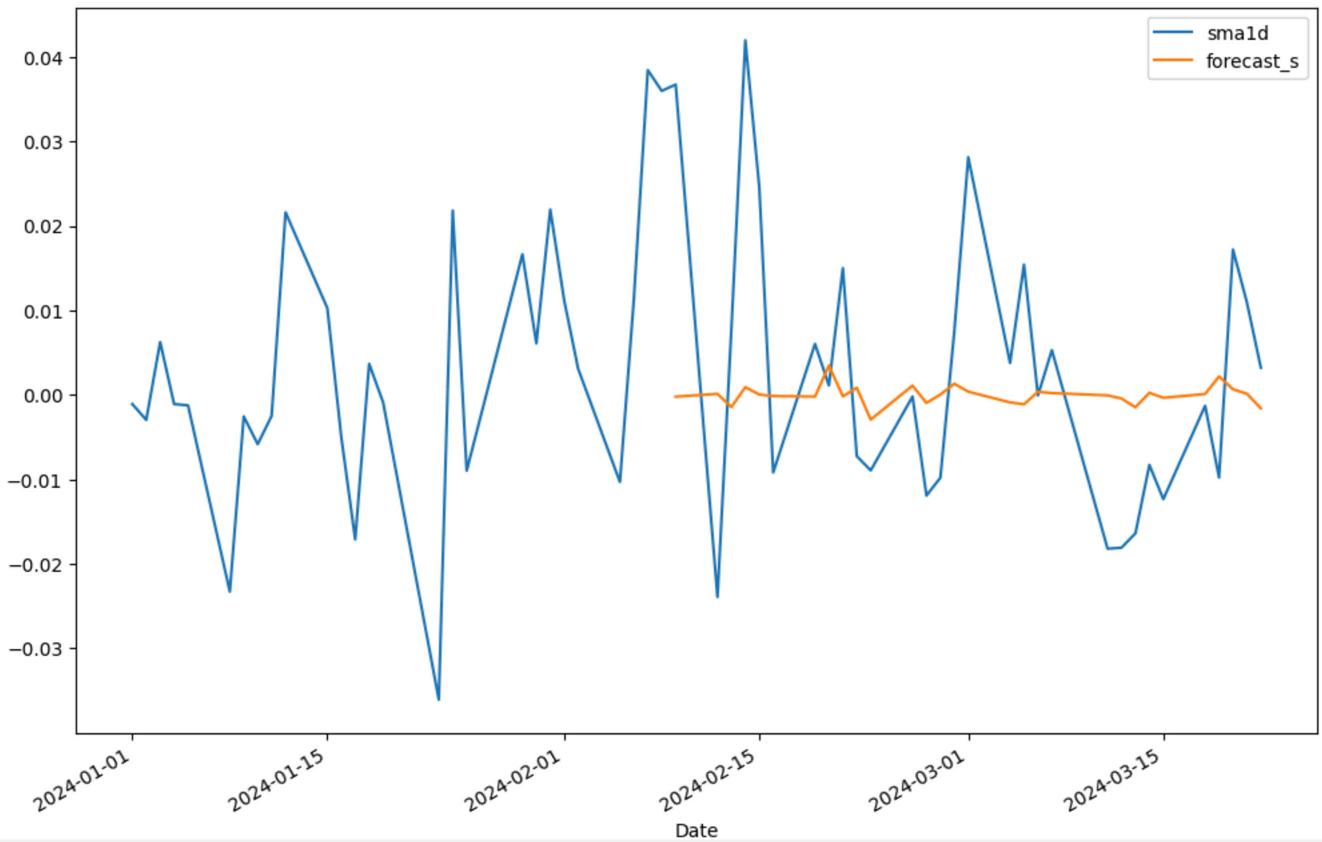
	coef	std err	z	P>|z|	[0.025	0.975]
ar.L1	0.0131	0.031	0.417	0.677	-0.048	0.075
ar.L2	-0.0273	0.037	-0.740	0.459	-0.100	0.045
ar.S.L44	0.3035	0.444	0.683	0.495	-0.567	1.174
ma.S.L44	-0.2204	0.452	-0.488	0.625	-1.105	0.665
sigma2	0.0003	1.04e-05	24.320	0.000	0.000	0.000

Ljung-Box (L1) (Q):	0.05	**Jarque-Bera (JB):**	53.97
Prob(Q):	0.82	**Prob(JB):**	0.00
Heteroskedasticity (H):	0.48	**Skew:**	-0.12
Prob(H) (two-sided):	0.00	**Kurtosis:**	4.31

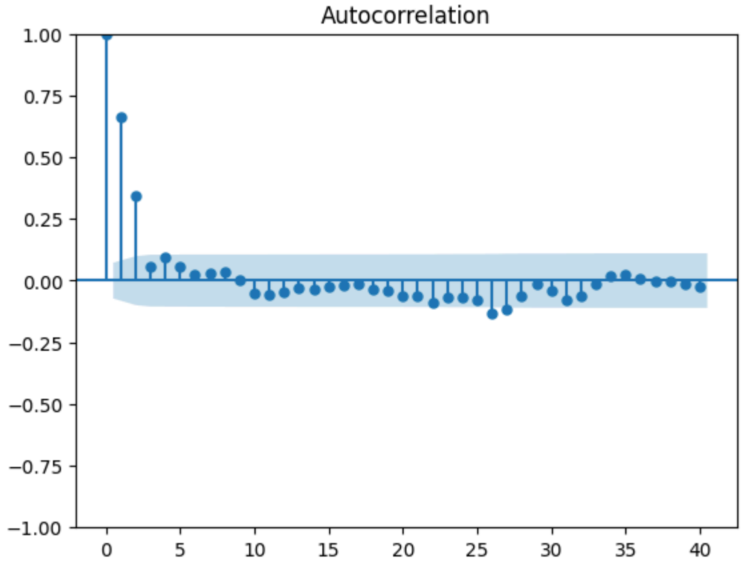
Warnings:
[1] Covariance matrix calculated using the outer product of gradients (complex-step).

```
df['forecast_1d']=result_1d.predict(start= start, end =end)
df['2024-01-01':][['sma1d','forecast_s']].plot(figsize=(12,8))
```

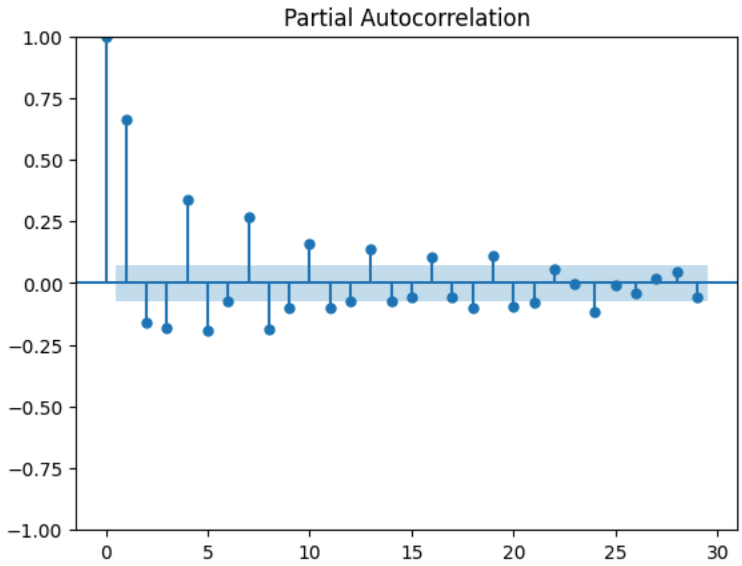
```
<ipython-input-78-a8f6a960f2ee>:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus
  df['forecast_1d']=result_1d.predict(start= start, end =end)
<Axes: xlabel='Date'>
```




```
# for sma3d
acf_plot=plot_acf(df['sma3d'],lags=40)
```




```
pacf_plot=plot_pacf(df['sma3d'])
```



from pacf we can use 1,2,5,8,11,14,17,20,23 for autoreggression

```
from statsmodels.tsa.statespace.sarimax import SARIMAX
model_3d = SARIMAX(df['sma3d'],order=(2, 0,2),seasonal_order=(1,0,1,20))
result_3d = model_3d.fit()
result_3d.summary()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueW
  self._init_dates(dates, freq)
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueW
  self._init_dates(dates, freq)
/usr/local/lib/python3.10/dist-packages/statsmodels/base/model.py:607: ConvergenceWar
  warnings.warn("Maximum Likelihood optimization failed to "
```

SARIMAX Results

Dep. Variable:	sma3d	**No. Observations:**	737
Model:	SARIMAX(2, 0, 2)x(1, 0, [1], 20)	**Log Likelihood**	2800.868
Date:	Mon, 25 Mar 2024	**AIC**	-5587.737
Time:	02:42:59	**BIC**	-5555.519
Sample:	0 - 737	**HQIC**	-5575.312
Covariance Type:	opg		

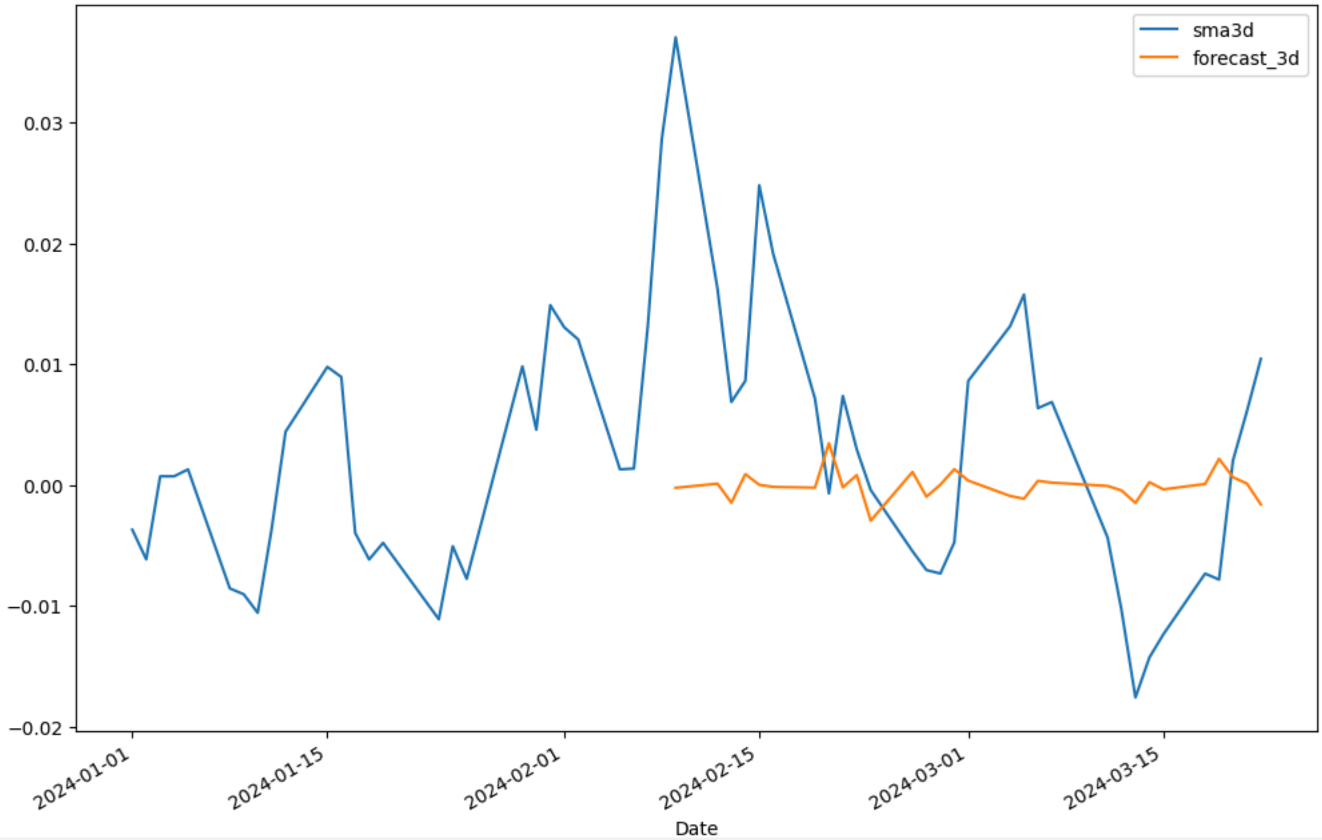
	coef	std err	z	P>|z|	[0.025	0.975]
ar.L1	0.0726	0.031	2.340	0.019	0.012	0.133
ar.L2	-0.0373	0.038	-0.976	0.329	-0.112	0.038
ma.L1	0.9737	0.013	76.324	0.000	0.949	0.999
ma.L2	0.9732	0.013	72.185	0.000	0.947	1.000
ar.S.L20	-0.1239	0.292	-0.425	0.671	-0.696	0.448
ma.S.L20	-0.0148	0.291	-0.051	0.960	-0.586	0.556
sigma2	2.889e-05	1.18e-06	24.544	0.000	2.66e-05	3.12e-05

Ljung-Box (L1) (Q):	1.92	**Jarque-Bera (JB):**	62.33
Prob(Q):	0.17	**Prob(JB):**	0.00
Heteroskedasticity (H):	0.48	**Skew:**	-0.08
Prob(H) (two-sided):	0.00	**Kurtosis:**	4.41

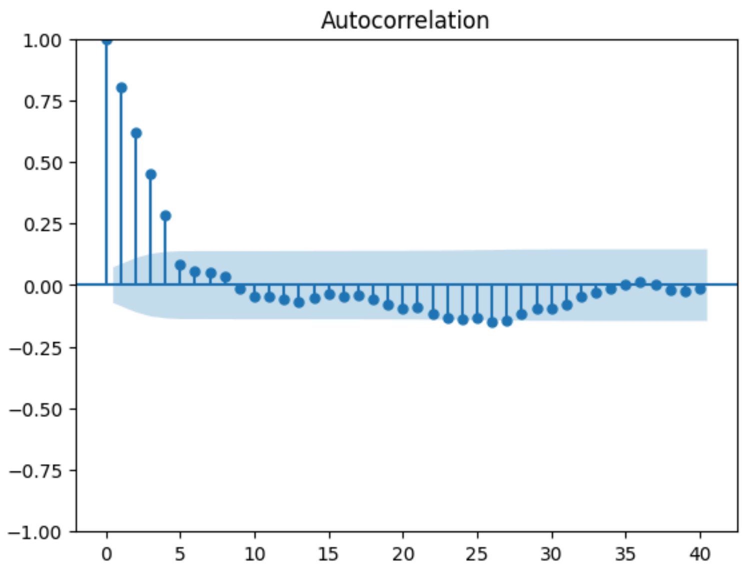
Warnings:
[1] Covariance matrix calculated using the outer product of gradients (complex-step).

```
df['forecast_3d']=result_1d.predict(start= start, end =end)
df['2024-01-01':][['sma3d','forecast_3d']].plot(figsize=(12,8))
```

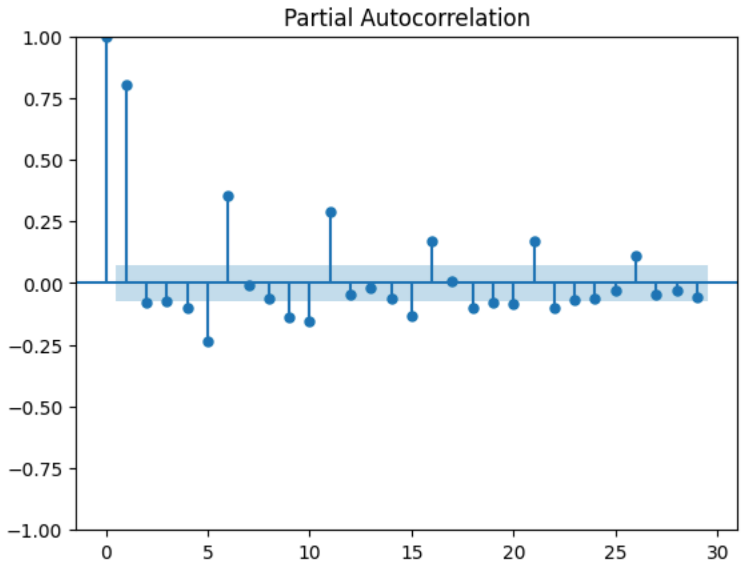
```
<ipython-input-82-84960f4f556d>:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus
  df['forecast_3d']=result_1d.predict(start= start, end =end)
<Axes: xlabel='Date'>
```




```
# for 5day
acf_plot=plot_acf(df['sma5d'],lags=40)
```




```
pacf=plot_pacf(df['sma5d'])
```



p value can be 1,6,11,16,21,26

```
from statsmodels.tsa.statespace.sarimax import SARIMAX
model_5d = SARIMAX(df['sma3d'],order=(1, 0,5),seasonal_order=(1,0,5,20))
result_5d = model_3d.fit()
result_5d.summary()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning: A date index has been provided, but it
  self._init_dates(dates, freq)
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning: A date index has been provided, but it
  self._init_dates(dates, freq)
/usr/local/lib/python3.10/dist-packages/statsmodels/base/model.py:607: ConvergenceWarning: Maximum Likelihood optimization failed to
  warnings.warn("Maximum Likelihood optimization failed to "
```

SARIMAX Results

Dep. Variable:	sma3d	**No. Observations:**	737
Model:	SARIMAX(2, 0, 2)x(1, 0, [1], 20)	**Log Likelihood**	2800.868
Date:	Mon, 25 Mar 2024	**AIC**	-5587.737

```
df['forecast_5d']=result_1d.predict(start= start, end =end)
df['2024-01-01':][['sma5d','forecast_5d']].plot(figsize=(12,8))
```

```
<ipython-input-86-7286b4942a1a>:1: 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-docs/stable/user_guide/indexing.html#returning-a-view-versus
  df['forecast_5d']=result_1d.predict(start= start, end =end)
<Axes: xlabel='Date'>
```