No 1

```
import numpy as np
import pandas as pd
import io
from pandas_datareader import data as wb
import matplotlib.pyplot as plt
from scipy.stats import norm
%matplotlib inline
```

```
print("Dipilih nilai dari: ")
S0 = 915
print("S0 = ", S0)
Miu = 0.045
print("Miu = ", Miu)
Sigma = 0.15
print("Sigma (Tidak boleh diatas 50%) = ", Sigma)
print("Dipilih T = 4 tahun dengan tiap tahun dibagi menjadi 250 unit waktu")
T_1 = 4
n_1 = 250*T_1
delta_T_1 = T_1/n_1
print("delta_T = ", delta_T_1)
```

```
Dipilih nilai dari:
S0 =  915
Miu =  0.045
Sigma (Tidak boleh diatas 50%) =  0.15
Dipilih T = 4 tahun dengan tiap tahun dibagi menjadi 250 unit waktu
delta_T =  0.004
```

```
data1 = pd.read_csv("No1.csv")
data1 = data1[["Hrg shm pd wkt (masa mendatang)","Hrg"]]
No1 = data1.set_index('Hrg shm pd wkt (masa mendatang)')
No1.head()
```

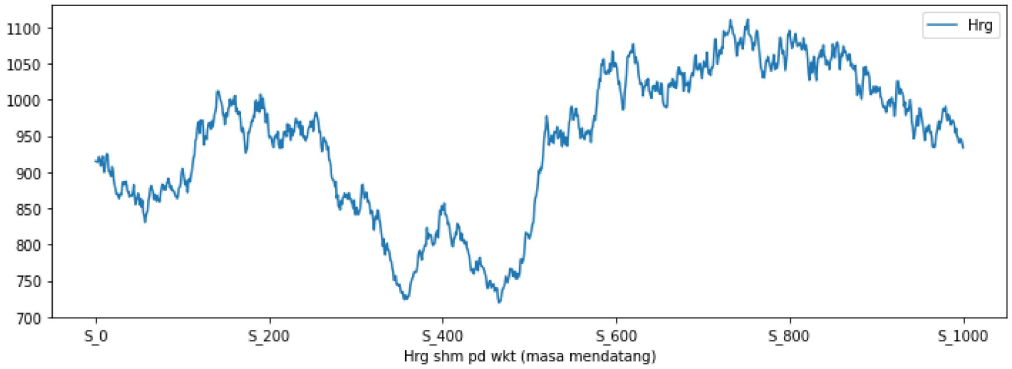
	Hrg
Hrg shm pd wkt (masa mendatang)	
S_0	915.000000
S_1	914.908343
S_2	913.598966
S_3	914.293321
S_4	921.129416

```
No1.tail()
```

	Hrg
Hrg shm pd wkt (masa mendatang)	
S_996	940.486050
S 997	945.621401

1b

```
No1.plot(figsize = (12,4))
hrg_shm_thdp_wkt_1 = plt.show()
```



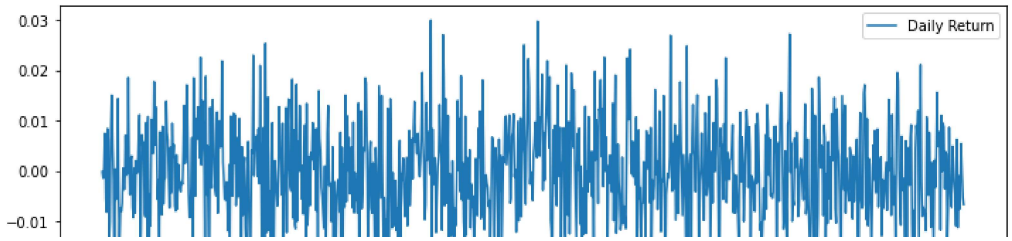
1c

Daily Return

```
return_daily_1 = No1.pct_change().dropna()
return_daily_1 = return_daily_1.rename({'Hrg':'Daily Return'}, axis=1)
return_daily_1.head()
```

	Daily Return
Hrg shm pd wkt (masa mendatang)	
S_1	-0.000100
S_2	-0.001431
S_3	0.000760
S_4	0.007477
S 5	-0.005523

```
return_daily_1.plot(figsize = (12,4))
plt.show()
```



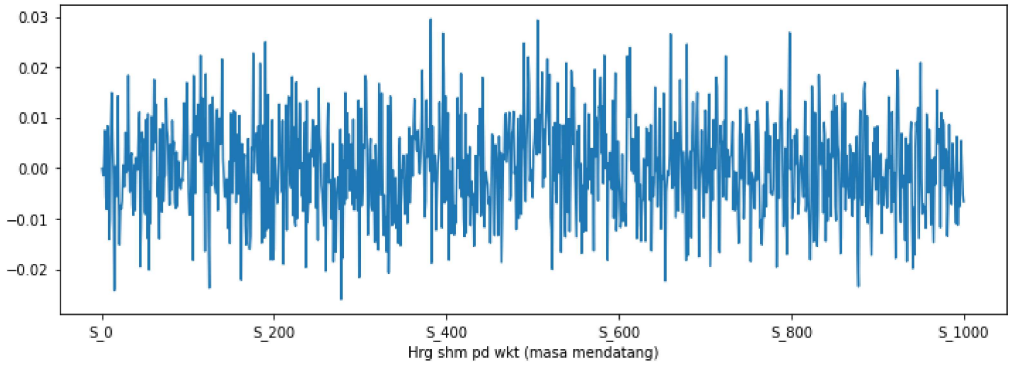
Daily Log Return

Hrg shm pd wkt (masa mendatang)

```
No1['Log Return'] = np.log(No1['Hrg']).diff()
No1
```

Hrg shm pd wkt (masa mendatang)	Hrg	Log Return
S_0	915.000000	NaN
S_1	914.908343	-0.000100
S_2	913.598966	-0.001432
S_3	914.293321	0.000760
S_4	921.129416	0.007449
...	...	...
S_996	940.486050	-0.001023
S_997	945.621401	0.005445
S_998	945.078063	-0.000575
S_999	940.149297	-0.005229
S_1000	933.935975	-0.006631

```
No1['Log Return'].plot(figsize = (12,4))
daily_log_return_1 = plt.show()
```



1e

```
mean_teoritis_1 = (Miu-(((Sigma*Sigma)/2)))*T_1
```

```
print("Mean Teoritis:", mean_teoritis_1)
```

```
Mean Teoritis: 0.135
```

```
u_1 = return_daily_1.mean()
print("Mean Empirik (daily return):", u_1)
```

```
Mean Empirik (daily return): Daily Return    0.000066
dtype: float64
```

```
u_log1 = No1['Log Return'].mean()
print("Mean Empirik (daily log return):", u_log1)
```

```
Mean Empirik (daily log return): 2.0483821353178833e-05
```

```
var_teoritis_1 = (Sigma*Sigma)*T_1
print("Var Teoritis:", var_teoritis_1)
```

```
Var Teoritis: 0.09
```

```
var_1 = return_daily_1.var()
print("Var Empirik (daily return):", var_1)
```

```
Var Empirik (daily return): Daily Return    0.000091
dtype: float64
```

```
var_log1 = No1['Log Return'].var()
print("Var Empirik (daily log return):", var_log1)
```

```
Var Empirik (daily log return): 9.115749319135314e-05
```

```
drift_1 = u_1 - (0.5 * var_1)
drift_1
```

```
Daily Return    0.00002
dtype: float64
```

```
drift_log1 = u_log1 - (0.5 * var_log1)
drift_log1
```

```
-2.5094925242497734e-05
```

```
stdev_1 = return_daily_1.std()
stdev_1
```

```
Daily Return    0.009554
dtype: float64
```

```
stdev_log1 = No1['Log Return'].std()
stdev_log1
```

```
0.009547643331804615
```

1a

```
iteration_1 = 1


return_daily_1a = np.exp(drift_1.values + stdev_1.values * norm.ppf(np.random.rand(n_1,iteration_1)))
return_daily_1a = np.array(return_daily_1a)
return_daily_1a
```

```
array([[1.0144662 ],
       [1.00793097],
       [1.00335578],
       [1.01550761],
       [0.99937971],
       [1.01177773],
       [0.99516328],
       [1.02071835],
       [0.99031199],
       [0.98810568],
       [0.99457781],
       [1.00828818],
       [1.01169055],
       [0.97900341],
       [1.00633771],
       [0.99619944],
       [0.99611773],
       [1.02108901],
       [1.00514918],
       [0.99119937],
       [1.00096063],
       [1.00431525],
       [1.00853466],
       [1.00431131],
       [0.98394894],
       [0.98828873],
       [0.99194936],
       [0.99697091],
       [0.99366616],
       [0.98498229],
       [1.00145241],
       [0.99838612],
       [0.99772242],
       [0.98416426],
       [0.99545151],
       [1.00640031],
       [0.98162069],
       [0.98875733],
       [1.00819149],
       [1.01160643],
       [1.01195942],
       [0.97740556],
       [0.98770866],
       [0.97934195],
       [1.00406926],
       [0.9929527 ],
       [0.99338312],
       [0.995207  ],
       [1.00516566],
       [0.99718534],
       [0.99927362],
       [1.00866629],
       [0.99675579],
       [1.00634885],
       [1.00133726],
       [0.99849289],
       [1.0087096 ],
       [1.00994963],
```

```
S_1 = data1.iloc[-1:,-1]
S_1
```

```
1000    933.935975
Name: Hrg, dtype: float64
```

```
price_list_1 = np.zeros_like(return_daily_1a)
price_list_1 = np.array(price_list_1)
price_list_1
```

```
array([[0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
       [0.],
```

```
       [0.],
       [0.],
       [0.],
       [0.],
```

```
price_list_1[0] = S_1
price_list_1
```

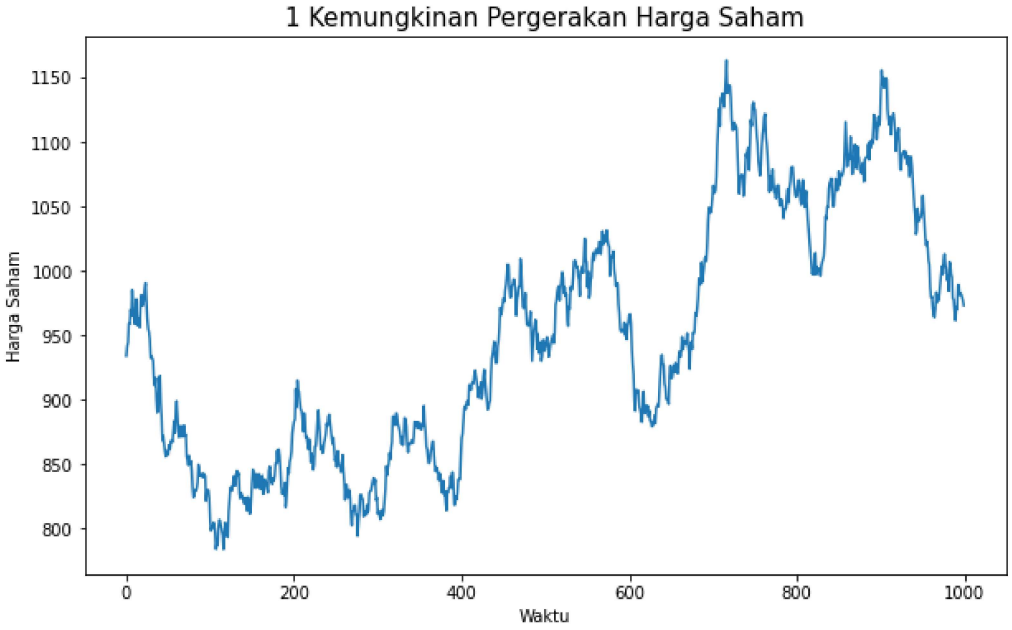
```
array([[933.935975],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
       [  0.      ],
```

```
for t_1 in range(1, n_1):
    price_list_1[t_1] = price_list_1[t_1 - 1] * return_daily_1a[t_1]


price_list_1
```

```
array([[ 933.935975  ],
       [ 941.3429974 ],
       [ 944.5019381 ],
       [ 959.14890175],
       [ 958.55395347],
       [ 969.84353877],
       [ 965.15268107],
       [ 985.14905618],
       [ 975.6049245 ],
       [ 964.00076886],
       [ 958.77377025],
       [ 966.72026297],
       [ 978.0217538 ],
       [ 957.48663628],
       [ 963.55491226],
       [ 959.89286523],
       [ 956.16630391],
       [ 976.33090097],
       [ 981.35820686],
       [ 972.72163941],
       [ 973.65606981],
       [ 977.85764162],
       [ 986.20332673],
       [ 990.45515592],
       [ 974.55730559],
       [ 963.1439996 ],
       [ 955.3900778 ],
       [ 952.49611621],
       [ 946.46315611],
       [ 932.24944728],
       [ 933.6034597 ],
       [ 932.09673732],
       [ 929.97380785],
       [ 915.24698011],
       [ 911.08398435],
       [ 916.91520875],
       [ 900.06294437],
       [ 889.94383105],
       [ 897.23380132],
       [ 907.64747935],
       [ 918.50241259],
       [ 897.74936948],
       [ 886.71482564],
       [ 868.39702429],
       [ 871.93075988],
       [ 865.7859995 ],
       [ 860.05719503],
       [ 855.93494301],
       [ 860.35640919],
       [ 857.93479574],
       [ 857.31161208],
       [ 864.74132549],
       [ 861.93592503],
       [ 867.40823061],
       [ 868.56818373],
       [ 867.25915184],
       [ 874.81263501],
       [ 883.51669872],
```

```
plt.figure(figsize=(10,6))
plt.plot(price_list_1)
plt.title("1 Kemungkinan Pergerakan Harga Saham", fontsize = 15)
plt.ylabel("Harga Saham", fontsize = 10)
plt.xlabel("Waktu", fontsize = 10)
plt.show()
```

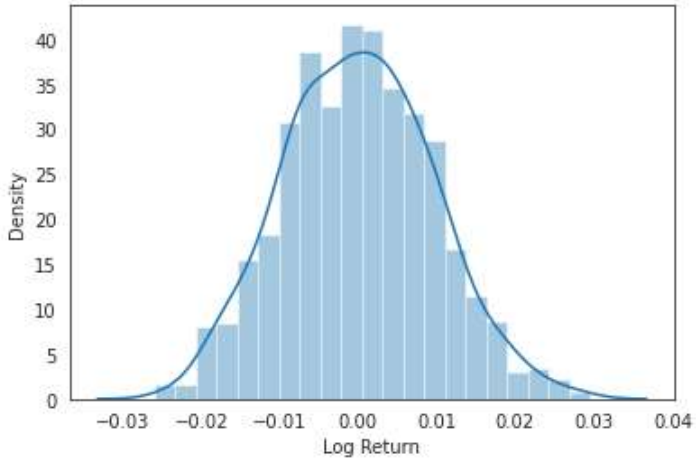


1d

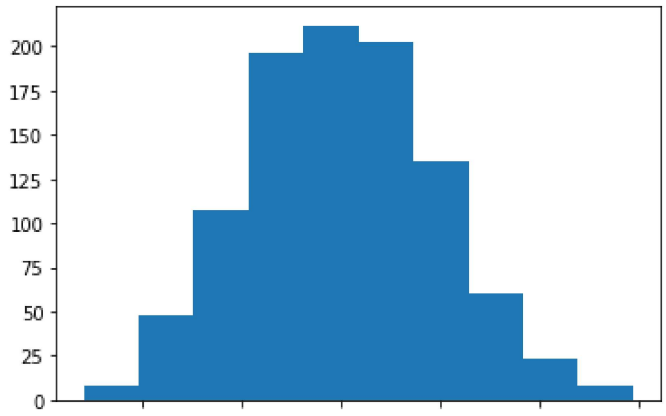
```
import seaborn as sns
import pandas as pd
import numpy as np
```

```
sns.distplot(No1['Log Return'])
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: Futu
  warnings.warn(msg, FutureWarning)
<matplotlib.axes._subplots.AxesSubplot at 0x7f14a54cbe50>
```




```
hist_1 = plt.hist(No1['Log Return'])
```



No 2

```
import numpy as np
import pandas as pd
import io
from pandas_datareader import data as wb
import matplotlib.pyplot as plt
from scipy.stats import norm
%matplotlib inline
```

```
print("Dipilih nilai dari: ")
S0 = 915
print("S0 = ", S0)
Miu = 0.045
print("Miu = ", Miu)
Sigma = 0.15
print("Sigma (Tidak boleh diatas 50%) = ", Sigma)
print("Dipilih T = 4 tahun dengan tiap tahun dibagi menjadi 250 unit waktu")
T_2 = 1
n_2 = 250*T_2
delta_T_2 = T_2/n_2
print("delta_T = ", delta_T_2)
```

```
Dipilih nilai dari:
S0 =  915
Miu =  0.045
Sigma (Tidak boleh diatas 50%) =  0.15
Dipilih T = 4 tahun dengan tiap tahun dibagi menjadi 250 unit waktu
delta_T =  0.004
```

```
data2 = pd.read_csv("No2.csv")
data2 = data2[["Hrg shm pd wkt (masa mendatang)","Hrg"]]
No2 = data2.set_index('Hrg shm pd wkt (masa mendatang)')
No2.head()
```

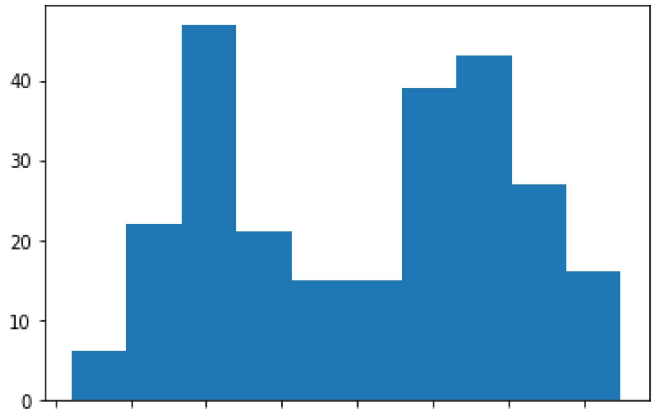
	Hrg
Hrg shm pd wkt (masa mendatang)	
S 0	915.000000

```
No2.tail()
```

	Hrg
Hrg shm pd wkt (masa mendatang)	
S_246	961.763856
S_247	962.088431
S_248	970.051644
S_249	962.424545
S 250	970.500400

2b

```
hist_2 = plt.hist(No2['Hrg'])
```



2c

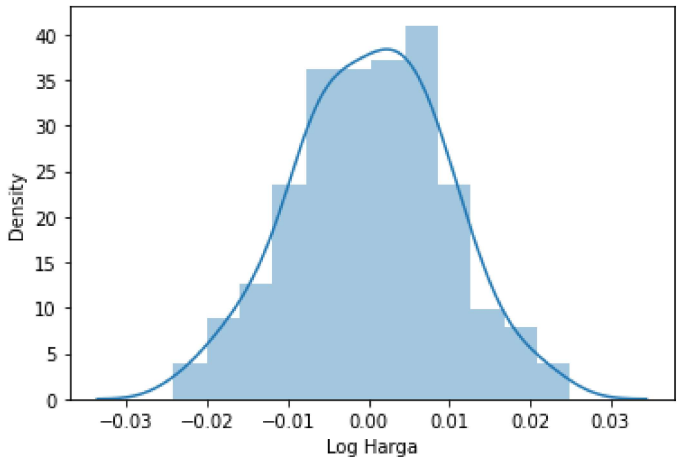
```
No2['Log Harga'] = np.log(No2['Hrg']).diff()
No2
```

Hrg shm pd wkt (masa mendatang)	Hrg	Log Harga
S_0	915.000000	NaN
S_1	914.908343	-0.000100
S_2	913.598966	-0.001432
S_3	914.293321	0.000760
S_4	921.129416	0.007449

```
import seaborn as sns
import pandas as pd
import numpy as np
```

```
sns.distplot(No2['Log Harga'])
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: Futu
  warnings.warn(msg, FutureWarning)
<matplotlib.axes._subplots.AxesSubplot at 0x7fb8c3a9ecd0>
```



Daily Return

```
return_daily_2 = No2.pct_change().dropna()
return_daily_2 = return_daily_2.rename({'Hrg':'Daily Return'}, axis=1)
return_daily_2 = return_daily_2[["Daily Return"]]
return_daily_2.head()
```

Hrg shm pd wkt (masa mendatang)	Daily Return
S_2	-0.001431
S_3	0.000760
S_4	0.007477
S_5	-0.005523
S_6	-0.008146

```
mean_teoritis_2 = (Miu-(((Sigma*Sigma)/2)))*T_2
print("Mean Teoritis:", mean_teoritis_2)
```

```
Mean Teoritis: 0.03375
```

```
u_log2 = No2['Log Harga'].mean()
print("Mean Empirik (log harga saham):", u_log2)
```

```
Mean Empirik (log harga saham): 0.00023555099879287768
```

```
var_teoritis_2 = (Sigma*Sigma)*T_2
print("Var Teoritis:", var_teoritis_2)
```

```
Var Teoritis: 0.0225
```

```
var_log2 = No2['Log Harga'].var()
print("Var Empirik (log harga saham):", var_log2)
```

```
Var Empirik (log harga saham): 9.002734657591212e-05
```

```
drift_2 = u_log2 - (0.5 * var_teoritis_2)
drift_2
```

```
-0.011014449001207122
```

```
stdev_2 = return_daily_2.std()
stdev_2
```

```
Daily Return    0.009508
dtype: float64
```

```
stdev_log2 = No2['Log Harga'].std()
stdev_log2
```

```
0.009488274162138871
```

2a

```
iteration_2 = 10000
```

```
return_daily_2a = np.exp(-0.011014449001207122 + 0.009508 * norm.ppf(np.random.rand(n_2,iteration_2)))
return_daily_2a = np.array(return_daily_2a)
return_daily_2a
```

```
array([[0.97239933, 0.98643967, 0.98172735, ..., 0.96006609, 0.98983474,
        0.9807196 ],
       [0.9947269 , 0.96816886, 1.0017258 , ..., 0.98163225, 0.9877441 ,
        1.00185351],
       [0.9849446 , 0.99116693, 0.98230672, ..., 0.99507363, 0.99420507,
        0.97849497],
       ...,
       [0.99130345, 1.00097899, 0.99852766, ..., 0.99297903, 0.99323667,
        0.99956989],
       [0.98887081, 1.00770948, 0.9947671 , ..., 0.98539343, 0.96703045,
        0.98934805],
       [0.99373931, 0.97752293, 0.99278446, ..., 0.99392165, 0.98279464,
        0.98491736]])
```

```
S2 = data2.iloc[-1]
S2
```

```
Hrg shm pd wkt (masa mendatang)    S_250
Hrg                                970.5
Name: 250, dtype: object
```

```
price_list_2 = np.zeros_like(return_daily_2a)
price_list_2 = np.array(price_list_2)
price_list_2
```

```
array([[0., 0., 0., ..., 0., 0., 0.],
       [0., 0., 0., ..., 0., 0., 0.],
       [0., 0., 0., ..., 0., 0., 0.],
       ...,
       [0., 0., 0., ..., 0., 0., 0.],
       [0., 0., 0., ..., 0., 0., 0.],
       [0., 0., 0., ..., 0., 0., 0.]])
```

```
price_list_2[0] = S_2
price_list_2
```

```
array([[970.5004002, 970.5004002, 970.5004002, ..., 970.5004002,
        970.5004002, 970.5004002],
       [  0.       ,   0.       ,   0.       , ...,   0.       ,
          0.       ,   0.       ],
       [  0.       ,   0.       ,   0.       , ...,   0.       ,
          0.       ,   0.       ],
       ...,
       [  0.       ,   0.       ,   0.       , ...,   0.       ,
          0.       ,   0.       ],
       [  0.       ,   0.       ,   0.       , ...,   0.       ,
          0.       ,   0.       ],
       [  0.       ,   0.       ,   0.       , ...,   0.       ,
          0.       ,   0.       ]])
```

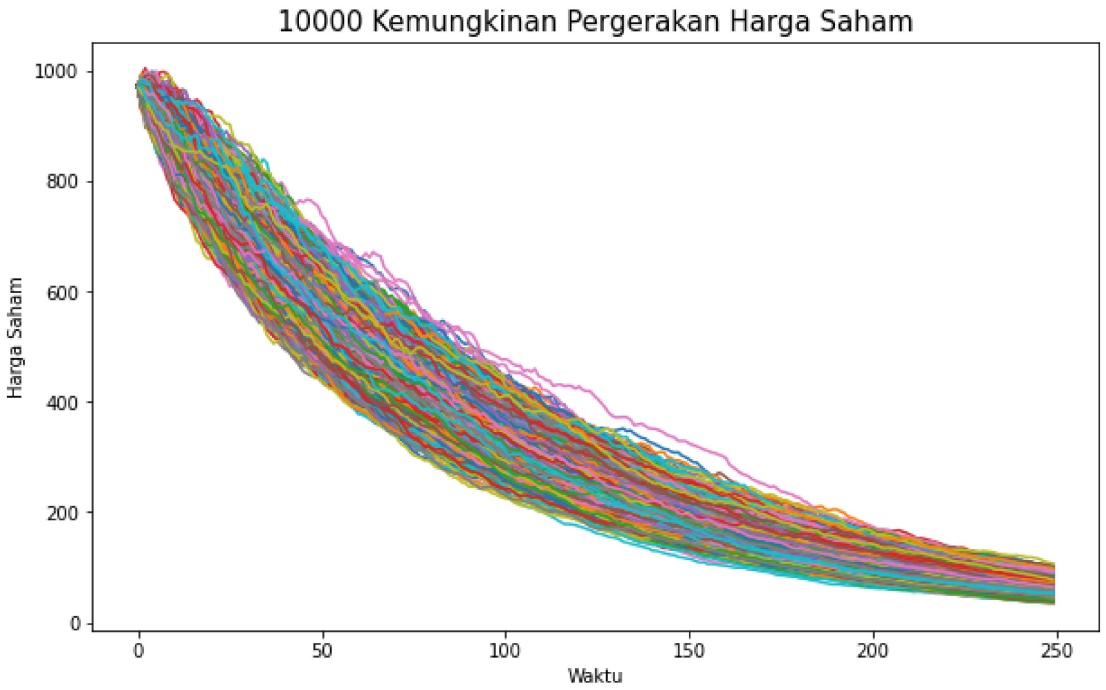
```
for t_2 in range(1, n_2):
    price_list_2[t_2] = price_list_2[t_2 - 1] * return_daily_2a[t_2]
```

```
price_list_2
```

```
array([[970.5004002 , 970.5004002 , 970.5004002 , ..., 970.5004002 ,
        970.5004002 , 970.5004002 ],
       [965.38285075, 939.60826693, 972.17528684, ..., 952.67449527,
        958.60604354, 972.2992354 ],
       [950.84862163, 931.30864149, 954.97431603, ..., 947.98126448,
        953.05098492, 951.3899085 ],
       ...,
       [ 86.4299455 ,  66.0546957 ,  67.14259427, ...,  59.50300912,
         81.08013636,  53.76131605],
       [ 85.46804986,  66.56394279,  66.79124389, ...,  58.63387403,
         78.40696082,  53.18865326],
       [ 84.93296066,  65.06778024,  66.30930919, ...,  58.27747695,
         77.05794062,  52.38642813]])
```

```
plt.figure(figsize=(10,6))
plt.plot(price_list_2)
plt.title("10000 Kemungkinan Pergerakan Harga Saham", fontsize = 15)
plt.ylabel("Harga Saham", fontsize = 10)
plt.xlabel("Waktu", fontsize = 10)
```

```
plt.show()
```



No 3

```
import numpy as np
import pandas as pd
from pandas_datareader import data as wb
import matplotlib.pyplot as plt
from scipy.stats import norm
%matplotlib inline


data = pd.read_csv("SIDO.JK.csv")
data = data[["Date","Adj Close"]]
SIDO = data.set_index('Date')
SIDO.head()
```

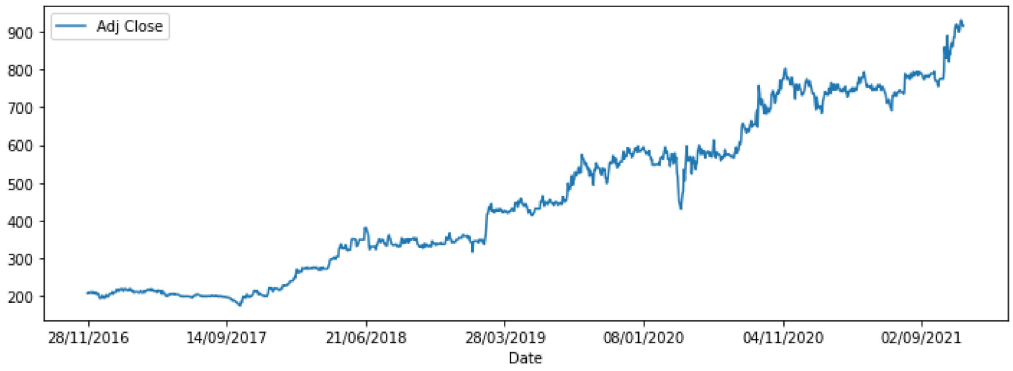
Date	Adj Close
28/11/2016	207.139099
29/11/2016	209.039490
30/11/2016	207.139099
01/12/2016	209.039490
02/12/2016	209.039490

```
SIDO.tail()
```

Date	Adj Close
22/11/2021	930.0
23/11/2021	930.0
24/11/2021	925.0

3a

```
SIDO.plot(figsize = (12,4))
hrg_shm_thdp_wkt = plt.show()
```



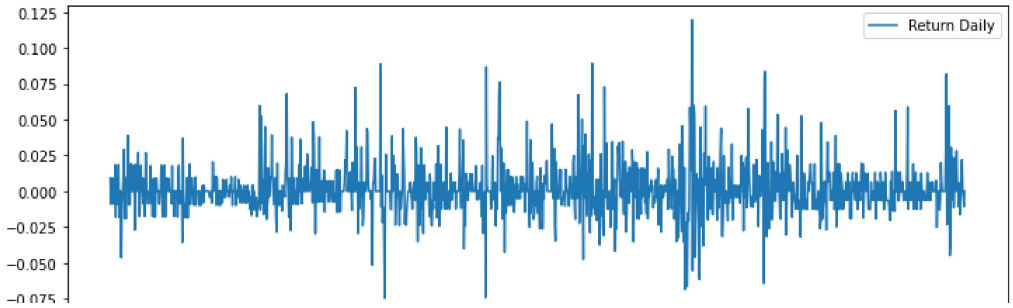
3b

Daily Return

```
return_daily = SIDO.pct_change().dropna()
return_daily = return_daily.rename({'Adj Close':'Return Daily'}, axis=1)
return_daily.head()
```

Date	Return Daily
29/11/2016	0.009174
30/11/2016	-0.009091
01/12/2016	0.009174
02/12/2016	0.000000
05/12/2016	0.009091

```
return_daily.plot(figsize = (12,4))
plt.show()
```

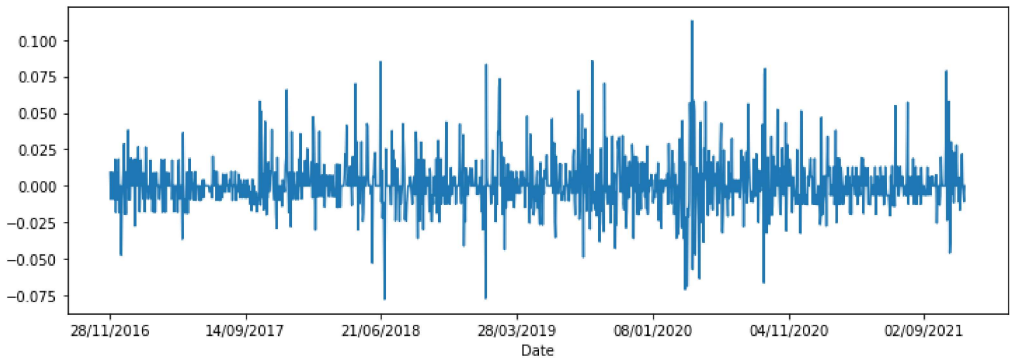


Daily Log Return

```
SIDO['Log Return'] = np.log(SIDO['Adj Close']).diff()
SIDO
```

Date	Adj Close	Log Return
28/11/2016	207.139099	NaN
29/11/2016	209.039490	0.009133
30/11/2016	207.139099	-0.009133
01/12/2016	209.039490	0.009133
02/12/2016	209.039490	0.000000
...	...	...
22/11/2021	930.000000	0.021740
23/11/2021	930.000000	0.000000
24/11/2021	925.000000	-0.005391
25/11/2021	915.000000	-0.010870
26/11/2021	915.000000	0.000000

```
SIDO['Log Return'].plot(figsize = (12,4))
hrg_shm_thdp_wkt_graph = plt.show()
```



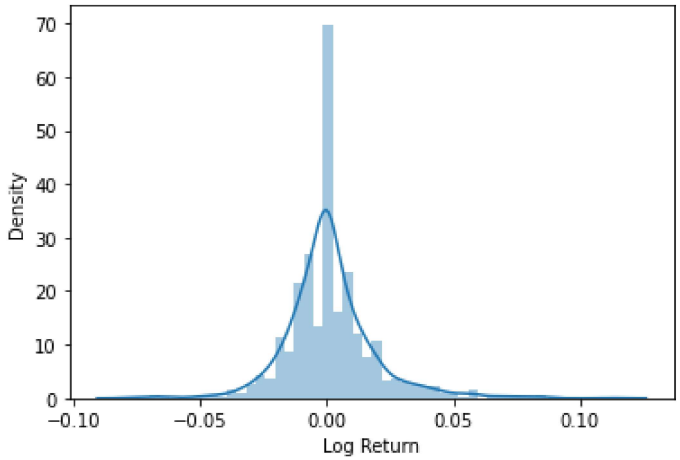
3c

Gambar Histogram Daily Log Return

```
import seaborn as sns
import pandas as pd
import numpy as np
```

```
sns.distplot(SIDO['Log Return'])
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/distributions.py:2619: Futu
  warnings.warn(msg, FutureWarning)
<matplotlib.axes._subplots.AxesSubplot at 0x7fb8c37c0490>
```




```
hrg_shm_thdp_wkt_hist = plt.hist(SIDO['Log Return'])
```