1. Kịch bản

2 Ảnh trainning

```
df=pd.read_csv("GiaSMPvaSMPcap2021_GiathitruongSMP.csv", encoding='ISO-8859-1',sep =';')
df.head()
```

```
new_df= pd.concat([df['Ngày'],df['12']],axis=1)
new_df.head(10)
```

```
[4]  feats = ['12']
```

```
[5]  from sklearn.preprocessing import PowerTransformer
     X = df['12'].values.reshape(-1,1)

     transform = PowerTransformer()
     X_transformed = transform.fit_transform(X)
```

```
     BGM = BayesianGaussianMixture(n_components=7,covariance_type='full',random_state=1,n_init=15)
     # mô hình phù hợp và dự đoán cụm
     preds = BGM.fit_predict(X)

     # them tinh nang cum vao khung du lieu goc
     df["Clusters"]= preds
```

```
[7]  pp=BGM.predict_proba(X)
     # Calcualting the probabilities of each prediction
     df_new=pd.DataFrame(X,columns=feats)
     df_new[[f'predict_proba_{i}' for i in range(7)]]=pp # creating new dataframe columns of probabilites
     df_new['preds']=preds
     df_new['predict_proba']=np.max(pp,axis=1)
     df_new['predict']=np.argmax(pp,axis=1)

     train_index=np.array([])
     for n in range(7):
         n_inx=df_new[(df_new.preds==n) & (df_new.predict_proba > 0.68)].index
         train_index = np.concatenate((train_index, n_inx))
```

```
[9]  lgb_preds=0
     for model in model_list:
         lgb_preds+=model.predict(df_new[feats])
```

```
[10] labels=np.argmax(lgb_preds,axis=1)
```

```
[11] import numpy as np
     # Tính chuỗi return
     r_t = np.log(new_df['12'] / new_df['12'].shift(1)).values
```

```
[12] mean = np.nanmean(r_t)
     r_t[0]=mean
     r_t[:5]
```

```
     array([ 0.00016098,  0.0557576 , -0.03117627,  0.0224099 ,  0.04894091])
```

```
[13] from statsmodels.tsa.stattools import adfuller
     result = adfuller(r_t)
     print('ADF Statistic: %f' % result[0])
     print('p-value: %f' % result[1])
     print('Critical Values:')
     for key, value in result[4].items():
       print('\t%s: %.3f' % (key, value))
```

```
[8]  from sklearn.model_selection import StratifiedKFold
     X_new=df_new.loc[train_index][feats]
     y=df_new.loc[train_index]['preds']
     S
     params_lgb = {'learning_rate': 0.06,'objective': 'multiclass','boosting': 'gbdt','n_jobs': -1,'verbosity': -1, 'num_classes':7}

     model_list=[]

     gkf = StratifiedKFold(12)
     for fold, (train_idx, valid_idx) in enumerate(gkf.split(X_new,y)):

         tr_dataset = lgb.Dataset(X_new.iloc[train_idx],y.iloc[train_idx],feature_name = feats)
         vl_dataset = lgb.Dataset(X_new.iloc[valid_idx],y.iloc[valid_idx],feature_name = feats)

         model = lgb.train(params = params_lgb,
                    train_set = tr_dataset,
                    valid_sets =  vl_dataset,
                    num_boost_round = 5000,
                    callbacks=[ lgb.early_stopping(stopping_rounds=300, verbose=False), lgb.log_evaluation(period=200)])

         model_list.append(model)
```

```
[14] from statsmodels.graphics.tsaplots import plot_acf, plot_pacf
     import matplotlib.pyplot as plt
     plt.figure(figsize = (8, 6))
     ax1 = plot_acf(r_t,color='orange')
```

```
[15] from statsmodels.graphics.tsaplots import plot_acf, plot_pacf
     import matplotlib.pyplot as plt
     plt.figure(figsize = (8, 6))
     ax2 = plot_pacf(r_t)
```

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

# Khởi tạo và phù hợp với mô hình ARIMA
model_arima = ARIMA(r_t, order=(2, 0, 2))
model_fit = model_arima.fit()

# In ra tóm tắt của mô hình
print(model_fit.summary())
```

```
df['Ngày'] = pd.to_datetime(df['Ngày'], format='%d/%m/%Y')
df.sort_values(by='Ngày', ascending=True, inplace=True)
df.reset_index(drop=True, inplace=True)
```

```
test_size = df[df['Ngày'].dt.month==12].shape[0]
test_size
```

```
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```
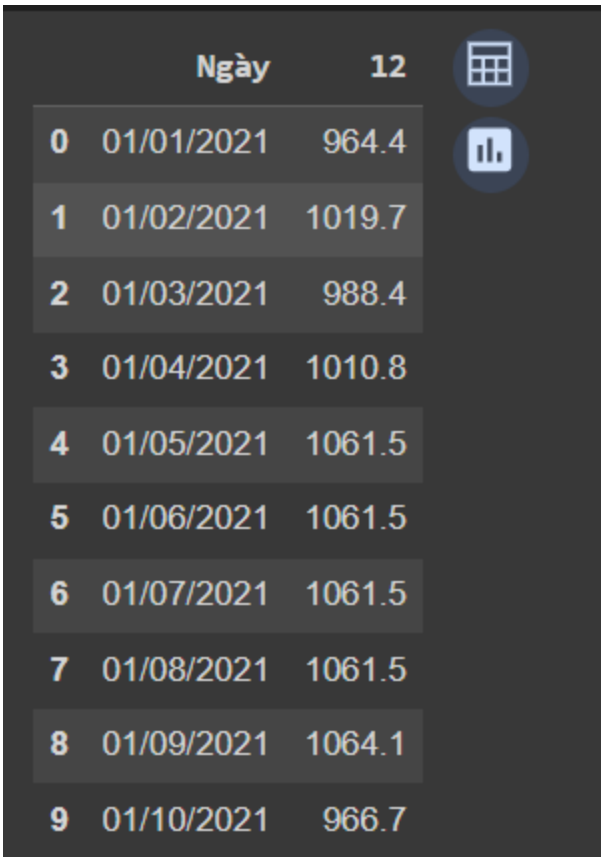
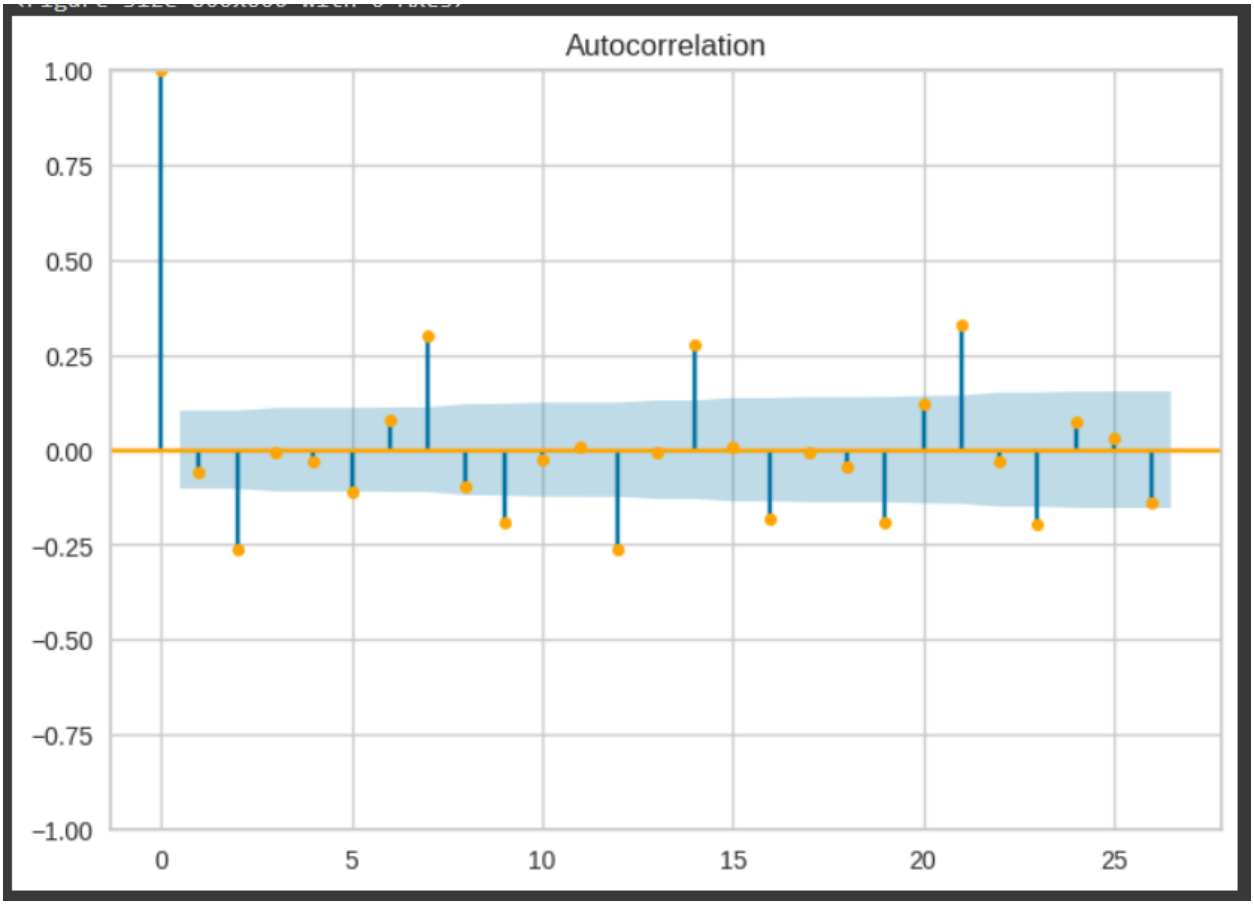
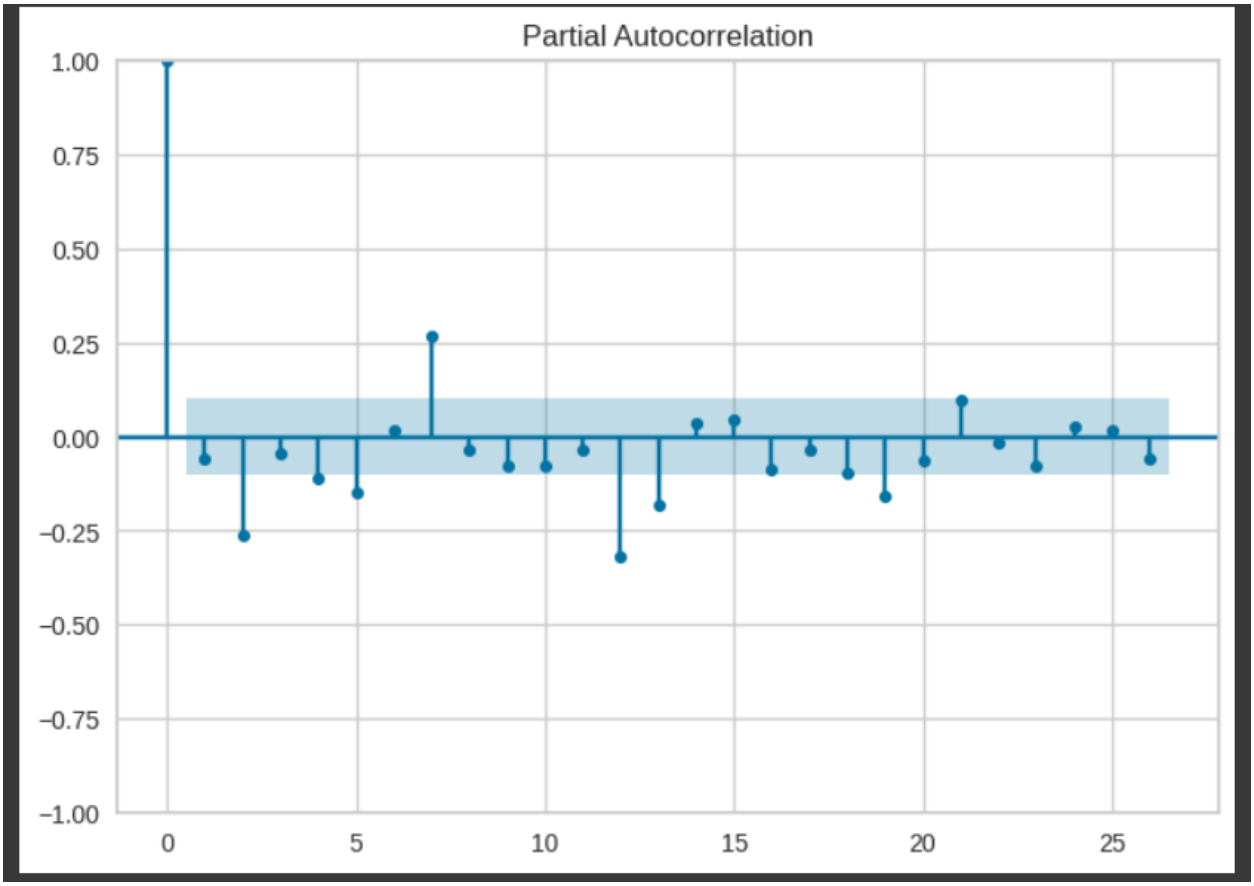

```
plt.figure(figsize=(15, 6), dpi=150)
plt.rcParams['axes.facecolor'] = 'gray'
plt.rc('axes',edgecolor='white')
plt.plot(df['Ngày'][:-test_size], df['10'][:-test_size], color='red', lw=2)
plt.plot(df['Ngày'][-test_size:], df['10'][-test_size:], color='pink', lw=2)
plt.title('10', fontsize=15)
plt.xlabel('Date', fontsize=12)
plt.ylabel('10', fontsize=12)
plt.legend(['Training set', 'Test set'], loc='upper left', prop={'size': 15})
plt.grid(color='white')
plt.show()
```

3. Ảnh kết quả

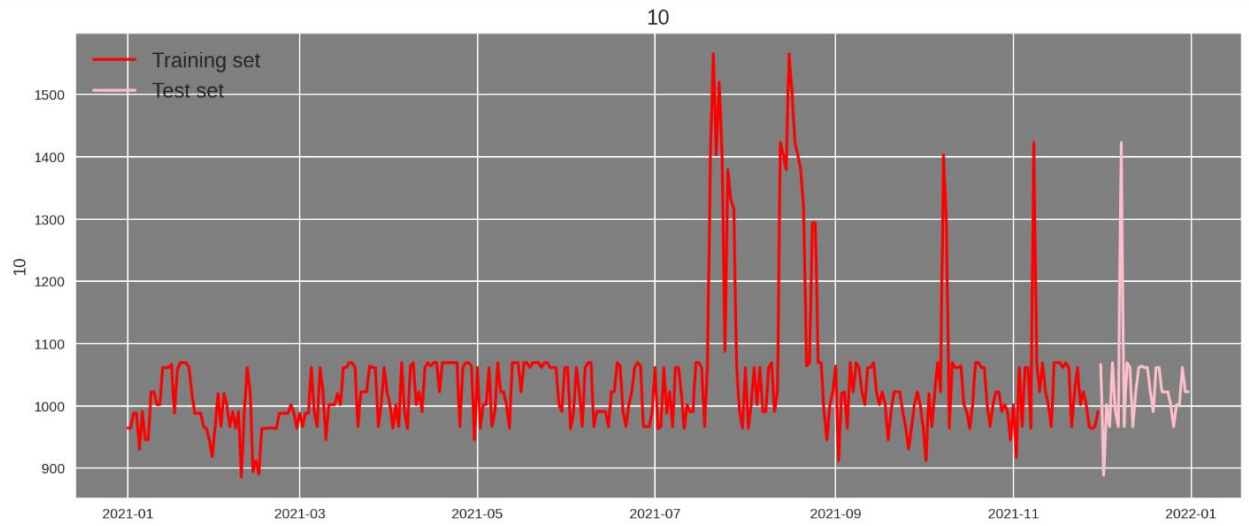


	Ngày	12
0	01/01/2021	964.4
1	01/02/2021	1019.7
2	01/03/2021	988.4
3	01/04/2021	1010.8
4	01/05/2021	1061.5
5	01/06/2021	1061.5
6	01/07/2021	1061.5
7	01/08/2021	1061.5
8	01/09/2021	1064.1
9	01/10/2021	966.7


Autocorrelation
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
5
10
15
20
25




```
  warnings.warn("Maximum Likelihood optimization failed to "
                              SARIMAX Results
==============================================================================
Dep. Variable:                      y   No. Observations:                  365
Model:                 ARIMA(2, 0, 2)   Log Likelihood                 563.223
Date:                Tue, 07 May 2024   AIC                          -1114.446
Time:                        04:44:20   BIC                          -1091.047
Sample:                             0   HQIC                         -1105.147
                                  - 365
Covariance Type:                  opg
==============================================================================
                 coef    std err          z      P>|z|      [0.025      0.975]
------------------------------------------------------------------------------
const      -4.829e-06      0.001     -0.006      0.995      -0.002       0.002
ar.L1         -0.1328      0.059     -2.233      0.026      -0.249      -0.016
ar.L2          0.5723      0.054     10.593      0.000       0.466       0.678
ma.L1         -0.0099      0.040     -0.249      0.804      -0.087       0.068
ma.L2         -0.8488      0.043    -19.543      0.000      -0.934      -0.764
sigma2         0.0027      0.000     25.500      0.000       0.002       0.003
===================================================================================
Ljung-Box (L1) (Q):                   0.26   Jarque-Bera (JB):               665.01
Prob(Q):                              0.61   Prob(JB):                         0.00
Heteroskedasticity (H):               1.72   Skew:                             0.50
Prob(H) (two-sided):                  0.00   Kurtosis:                         9.54
===================================================================================
```



4. link git

https://github.com/joyhh29/Thuchanh1_TS