개별 연구

실험 결과 파일들

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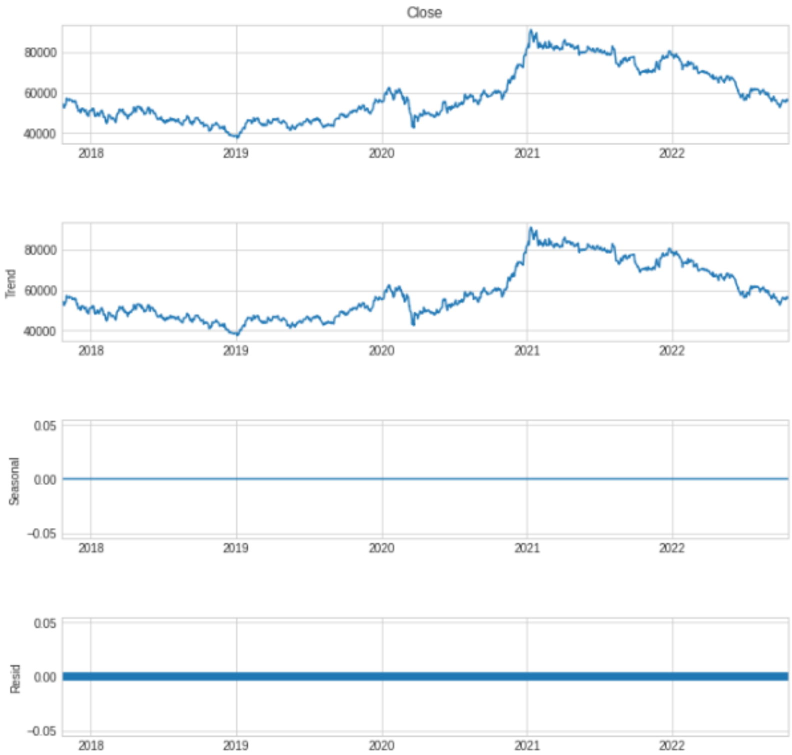
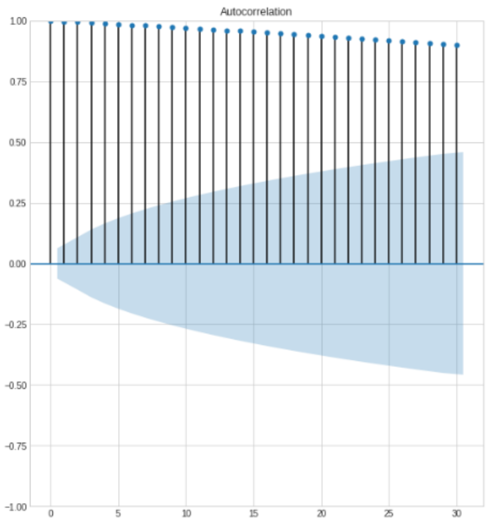
이　　름	김준하

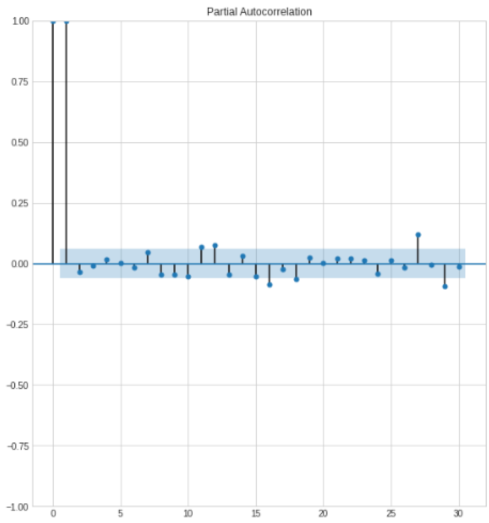
1. 그래프

- 원본 데이터의 시계열 분해 모습

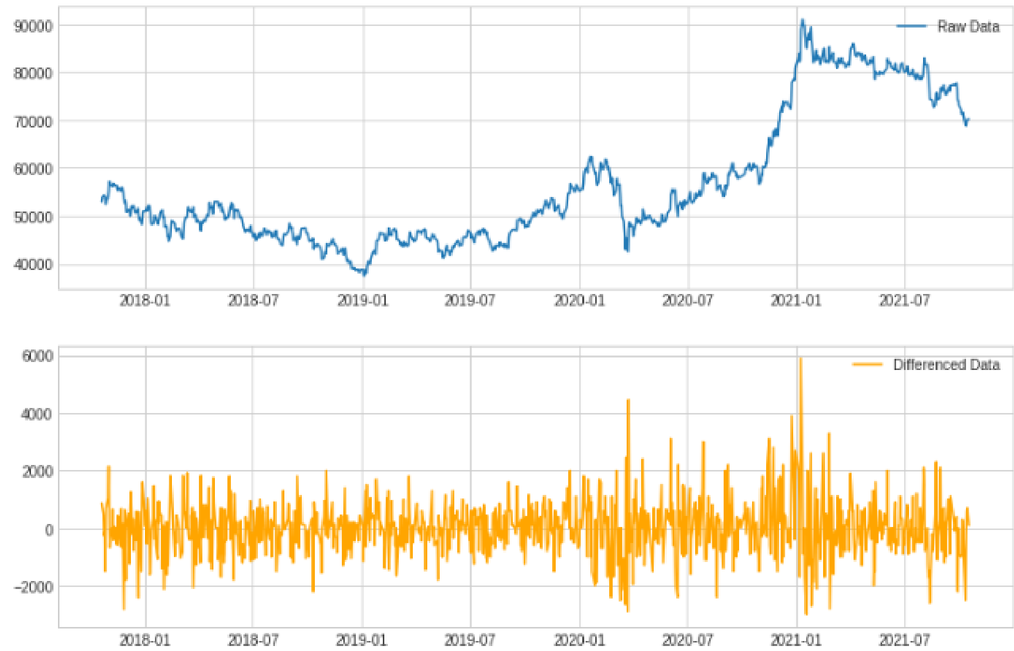


- 원본 데이터를 사용하여 그린 ACF, PACF plot

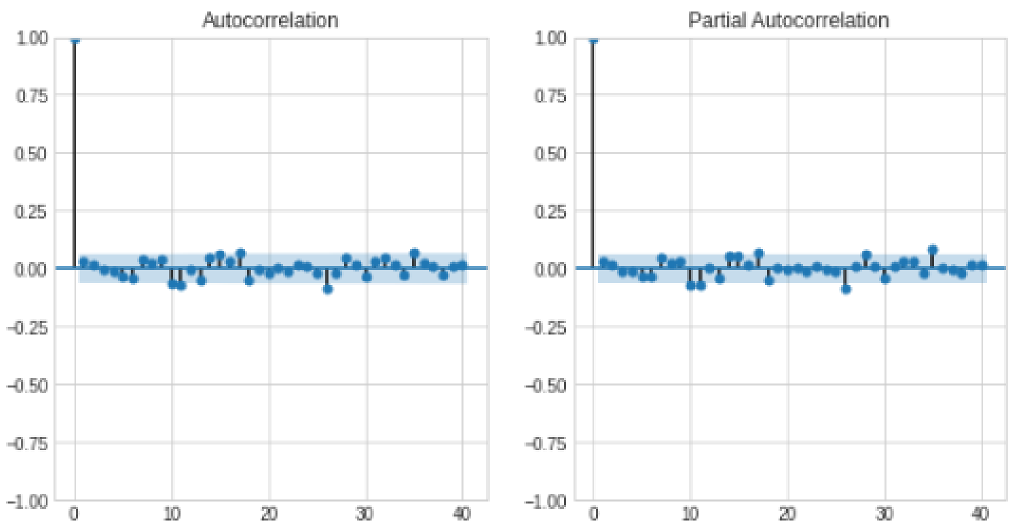




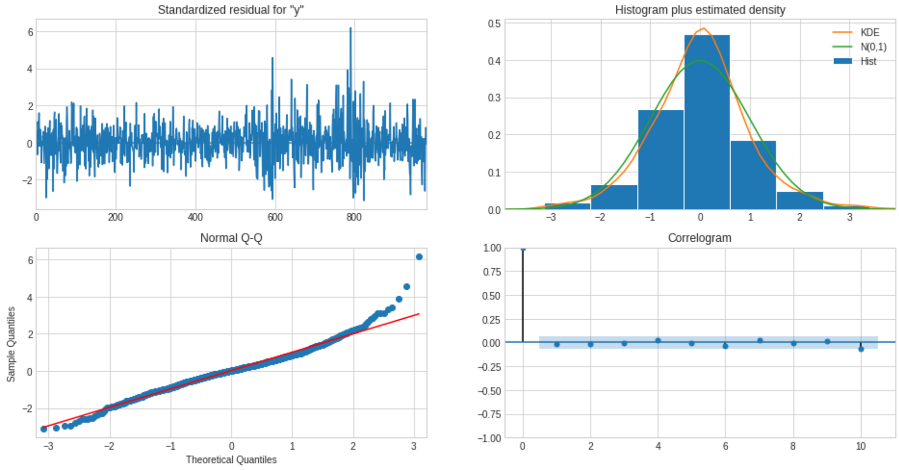
- 원본 데이터와 차분을 진행한 데이터의 정상성 확인



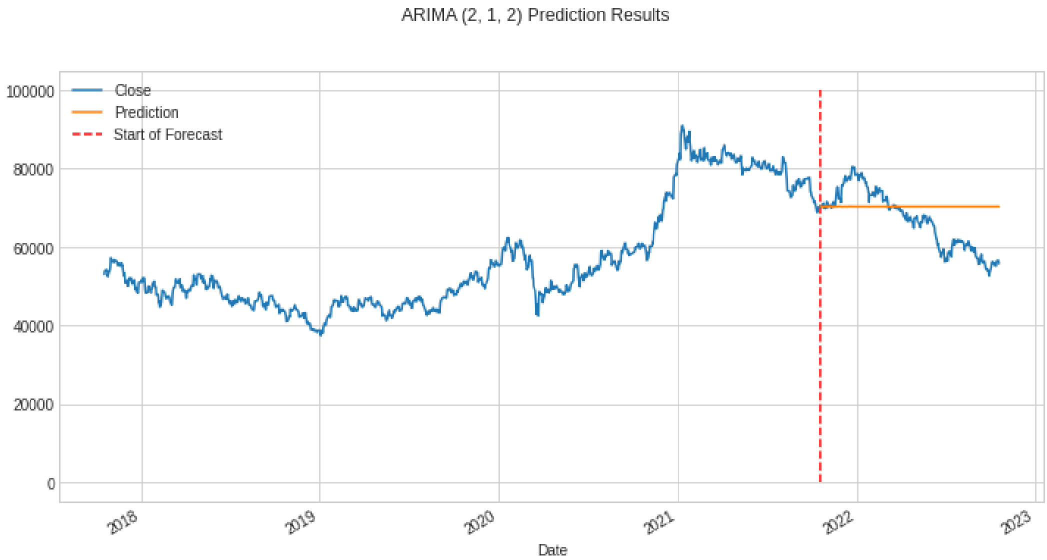
- 차분을 진행한 데이터의 ACF, PACF plot



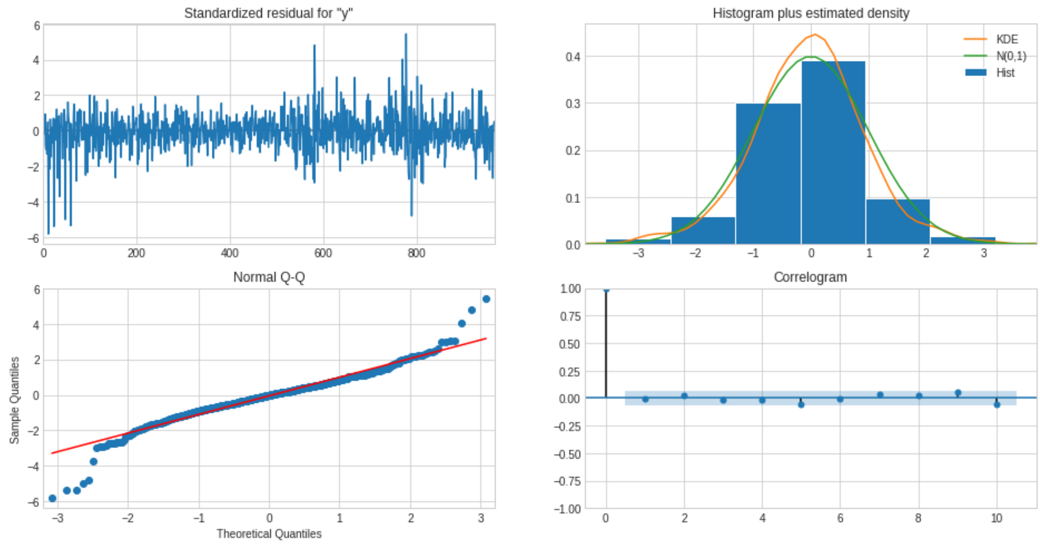
- ARIMA 모델1: ARIMA(2,1,2) 모델로 훈련을 진행한 결과



- ARIMA 모델1: ARIMA(2,1,2) 모델의 예측



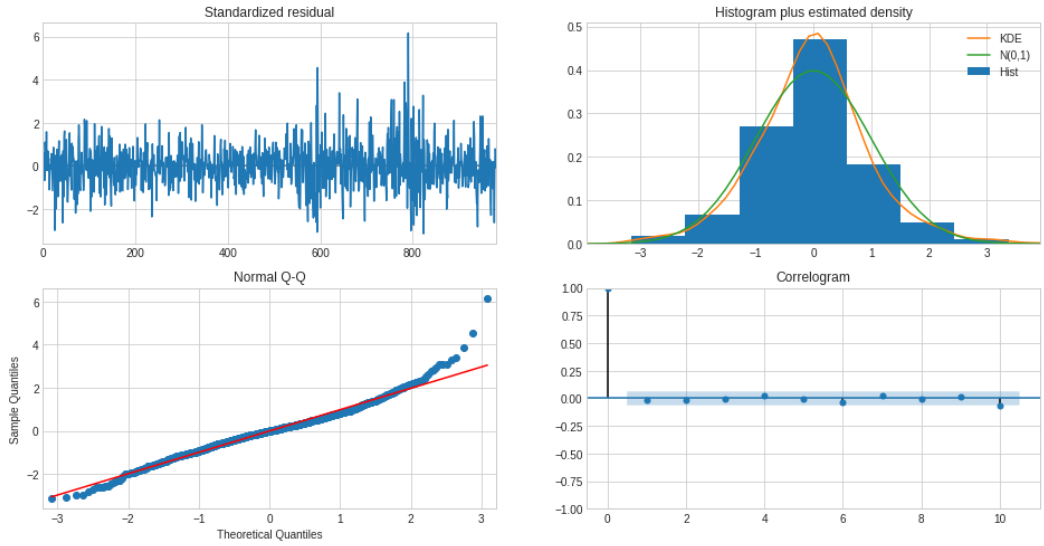
- SARIMA 모델1: SARIMA(1,1,0)(0,1,2,12) 모델로 훈련을 진행한 결과



- SARIMA 모델1: SARIMA(1,1,0)(0,1,2,12) 모델의 예측

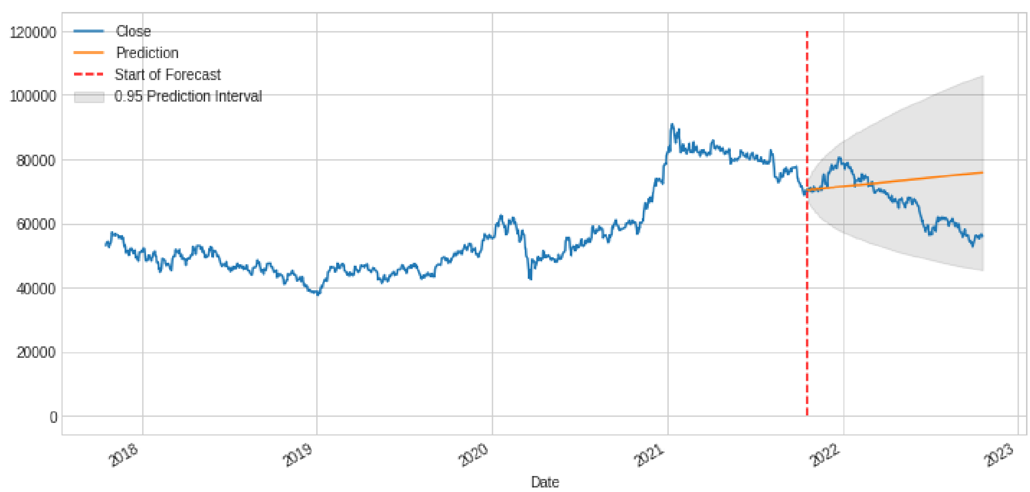
SARIMA (1, 1, 0), (0, 1, 2, 12)

- ARIMA 모델2: ARIMA(2,1,2) 모델로 훈련을 진행한 결과

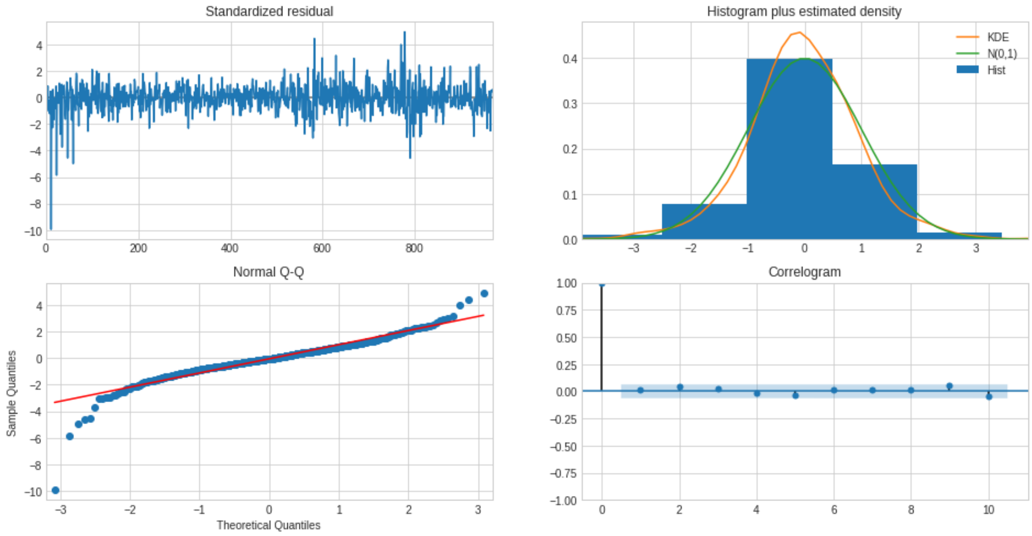


- ARIMA 모델2: ARIMA(2,1,2) 모델의 예측

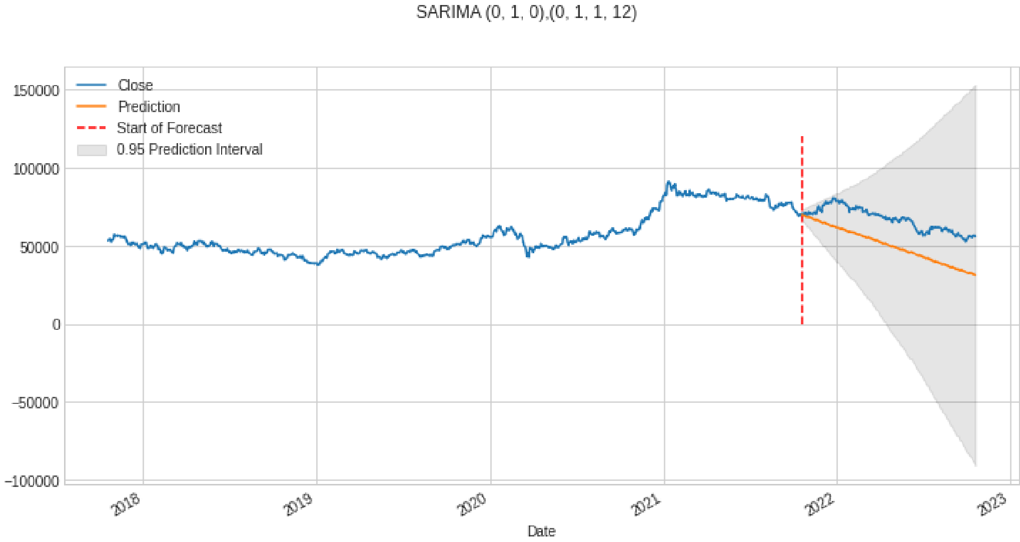
SARIMA (2, 1, 2),(0, 0, 0, 0)



- SARIMA 모델2: SARIMA(0,1,0)(0,1,1,12) 모델로 훈련을 진행한 결과



- SARIMA 모델2: SARIMA(0,1,0)(0,1,1,12) 모델로 훈련을 진행한 결과



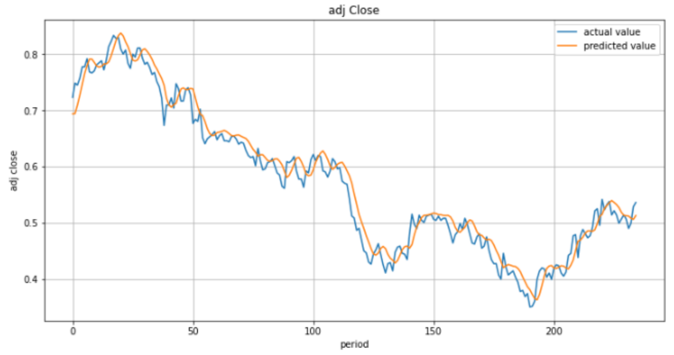
- LSTM 모델의 예측

```
pred = model.predict(x_test)

plt.figure(figsize=(12, 6))
plt.title('adj Close')
plt.ylabel('adj close')
plt.xlabel('period')
plt.plot(y_test, label='actual value')
plt.plot(pred, label='predicted value')
plt.grid()
plt.legend(loc='best')

plt.show()
```

```
8/8 [==============================] - 0s 17ms/step
```



2. 표

- ACF와 PACF 도표의 형태를 사용하여 모델을 결정하는 Graphical method

모델	ACF	Partial ACF
MA(q)	q시차 이후 0으로 급감	지수적으로 감소, 소멸하는 sine함수 형태
AR(p)	지수적으로 감소, 소멸하는 sine함수 형태	p시차 이후 0으로 급감
ARMA(p,q)	시차 (q-p)이후 급감	시차 (q-p)이후 급감

-

3. 실행 결과

- 원본 데이터에 차분을 진행한 결과

```
              Close
Date
2017-10-19   52980
2017-10-20   53840
2017-10-23   54300
2017-10-24   54040
2017-10-25   53900
...            ...
2021-10-12   69000
2021-10-13   68800
2021-10-14   69400
2021-10-15   70100
2021-10-18   70200

[982 rows x 1 columns]
Date
2017-10-20      860.0
2017-10-23      460.0
2017-10-24     -260.0
2017-10-25     -140.0
2017-10-26    -1500.0
                ...
2021-10-12    -2500.0
2021-10-13     -200.0
2021-10-14      600.0
2021-10-15      700.0
2021-10-18      100.0
Name: Close, Length: 981, dtype: float64
```

- ARIMA(1,1,2) 모델로 훈련을 진행한 결과

SARIMAX Results

Dep. Variable:	y	**No. Observations:**	982
Model:	ARIMA(1, 1, 2)	**Log Likelihood**	-8116.739
Date:	Thu, 27 Oct 2022	**AIC**	16241.478
Time:	02:32:56	**BIC**	16261.033
Sample:	0	**HQIC**	16248.917
	- 982		
Covariance Type:	opg		

	coef	std err	z	P>|z|	[0.025	0.975]
ar.L1	-0.5182	0.867	-0.598	0.550	-2.217	1.180
ma.L1	0.5501	0.868	0.634	0.526	-1.150	2.250
ma.L2	0.0356	0.032	1.116	0.264	-0.027	0.098
sigma2	9.024e+05	2.68e+04	33.622	0.000	8.5e+05	9.55e+05

Ljung-Box (L1) (Q):	0.00	**Jarque-Bera (JB):**	307.91
Prob(Q):	0.96	**Prob(JB):**	0.00
Heteroskedasticity (H):	1.80	**Skew:**	0.42
Prob(H) (two-sided):	0.00	**Kurtosis:**	5.61

- ARIMA 모델1: ARIMA(2,1,2) 모델로 훈련을 진행한 결과

SARIMAX Results

Dep. Variable:	y	**No. Observations:**	982
Model:	ARIMA(2, 1, 2)	**Log Likelihood**	-8109.215
Date:	Thu, 27 Oct 2022	**AIC**	16228.431
Time:	06:29:51	**BIC**	16252.874
Sample:	0	**HQIC**	16237.729
	- 982		
Covariance Type:	opg		

	coef	std err	z	P>|z|	[0.025	0.975]
ar.L1	1.1737	0.044	26.958	0.000	1.088	1.259
ar.L2	-0.9114	0.044	-20.483	0.000	-0.999	-0.824
ma.L1	-1.1379	0.045	-25.271	0.000	-1.226	-1.050
ma.L2	0.9063	0.047	19.208	0.000	0.814	0.999
sigma2	9.024e+05	2.8e+04	32.178	0.000	8.47e+05	9.57e+05

Ljung-Box (L1) (Q):	0.24	**Jarque-Bera (JB):**	304.31
Prob(Q):	0.62	**Prob(JB):**	0.00
Heteroskedasticity (H):	1.80	**Skew:**	0.43
Prob(H) (two-sided):	0.00	**Kurtosis:**	5.59

- SARIMA 모델1: SARIMA(1,1,0)(0,1,2,12) 모델로 훈련을 진행한 결과

SARIMAX Results

Dep. Variable:	y	**No. Observations:**	982
Model:	SARIMAX(1, 1, 0)x(0, 1, [1, 2], 12)	**Log Likelihood**	-8154.245
Date:	Thu, 27 Oct 2022	**AIC**	16316.490
Time:	06:39:47	**BIC**	16335.995
Sample:	0	**HQIC**	16323.915
	- 982		
Covariance Type:	opg		

	coef	std err	z	P>|z|	[0.025	0.975]
ar.L1	0.0440	0.025	1.753	0.080	-0.005	0.093
ma.S.L12	-0.6993	0.013	-55.632	0.000	-0.724	-0.675
ma.S.L24	-0.2021	0.008	-26.146	0.000	-0.217	-0.187
sigma2	1.059e+06	3.2e+04	33.110	0.000	9.96e+05	1.12e+06

Ljung-Box (L1) (Q):	0.04	**Jarque-Bera (JB):**	746.38
Prob(Q):	0.85	**Prob(JB):**	0.00
Heteroskedasticity (H):	1.13	**Skew:**	-0.37
Prob(H) (two-sided):	0.27	**Kurtosis:**	7.23

- ARIMA 모델2: ARIMA(2,1,2) 모델로 훈련을 진행한 결과

SARIMAX Results

Dep. Variable:	y	**No. Observations:**	982
Model:	SARIMAX(2, 1, 2)	**Log Likelihood**	-8109.090
Date:	Thu, 27 Oct 2022	**AIC**	16230.181
Time:	06:43:08	**BIC**	16259.512
Sample:	0	**HQIC**	16241.339
	- 982		
Covariance Type:	opg		

	coef	std err	z	P>|z|	[0.025	0.975]
intercept	16.6461	24.149	0.689	0.491	-30.684	63.976
ar.L1	1.1739	0.043	26.988	0.000	1.089	1.259
ar.L2	-0.9118	0.044	-20.497	0.000	-0.999	-0.825
ma.L1	-1.1382	0.045	-25.316	0.000	-1.226	-1.050
ma.L2	0.9066	0.047	19.235	0.000	0.814	0.999
sigma2	9.022e+05	2.87e+04	31.435	0.000	8.46e+05	9.58e+05

Ljung-Box (L1) (Q):	0.24	**Jarque-Bera (JB):**	304.35
Prob(Q):	0.63	**Prob(JB):**	0.00
Heteroskedasticity (H):	1.80	**Skew:**	0.43
Prob(H) (two-sided):	0.00	**Kurtosis:**	5.59

- SARIMA 모델2: SARIMA(0,1,0)(0,1,1,12) 모델로 훈련을 진행한 결과

SARIMAX Results

Dep. Variable:	y	**No. Observations:**	982
Model:	SARIMAX(0, 1, 0)x(0, 1, [1], 12)	**Log Likelihood**	-8179.188
Date:	Thu, 27 Oct 2022	**AIC**	16362.376
Time:	06:46:26	**BIC**	16372.129
Sample:	0	**HQIC**	16366.089
	- 982		
Covariance Type:	opg		

	coef	std err	z	P>|z|	[0.025	0.975]
ma.S.L12	-0.7448	0.009	-78.933	0.000	-0.763	-0.726
sigma2	1.085e+06	3.22e+04	33.714	0.000	1.02e+06	1.15e+06

Ljung-Box (L1) (Q):	0.38	**Jarque-Bera (JB):**	4232.31
Prob(Q):	0.54	**Prob(JB):**	0.00
Heteroskedasticity (H):	0.98	**Skew:**	-1.03
Prob(H) (two-sided):	0.86	**Kurtosis:**	13.03