In [1]:

```
import pandas as pd
from statsmodels.tsa.arima.model import ARIMA
from statsmodels.tsa.stattools import adfuller
from pmdarima import auto_arima
import warnings
from sklearn.metrics import mean_squared_error
from math import sqrt

warnings.filterwarnings("ignore")
def ad_test(data):
    dftest = adfuller(data,autolag = 'AIC')
    print("1. ADf:",dftest[0])
    print("2. p-value:",dftest[1])
    print("3. Num of Lags:",dftest[2])
    print("4. Num of observations used:",dftest[3])
    print("5. Critical Values:",dftest[3])
    for key,val in dftest[4].items():
        print(key,":",val)


# Load the data
data = pd.read_csv("ForecastData.csv", index_col="Month", parse_dates=True)
print(data)
ad_test(data)
# Fit ARIMA model
#model = ARIMA(data, order=(p, d, q))
#model_fit = model.fit()

# Forecast temperatures for Jan-24 to Dec-24
#forecast = model_fit.forecast(steps=12)
#print(forecast)
stepwise_fit  = auto_arima(data['Temperature'],trace = True,supress_warnings
stepwise_fit.summary()

train = data.iloc[:-30]
test = data.iloc[-30:]
print(train.shape,test.shape)
```

```
        Temperature
Month
Jan-00           82
Feb-00           82
Mar-00           85
Apr-00           90
May-00           97
...             ...
Aug-23          110
Sep-23          110
Oct-23           96
Nov-23           86
Dec-23           80

[288 rows x 1 columns]
1. ADf: -4.167090021487841
2. p-value: 0.0007487107862045819
3. Num of Lags: 16
4. Num of observations used: 271
5. Critical Values: 271
1% : -3.4547128138328875
5% : -2.8722649771800155
10% : -2.5724850011573914
Performing stepwise search to minimize aic
 ARIMA(2,0,2)(0,0,0)[0] intercept   : AIC=1703.141, Time=0.87 sec
 ARIMA(0,0,0)(0,0,0)[0] intercept   : AIC=2140.786, Time=0.02 sec
 ARIMA(1,0,0)(0,0,0)[0] intercept   : AIC=1868.930, Time=0.08 sec
 ARIMA(0,0,1)(0,0,0)[0] intercept   : AIC=1950.257, Time=0.11 sec
 ARIMA(0,0,0)(0,0,0)[0]             : AIC=3421.092, Time=0.04 sec
 ARIMA(1,0,2)(0,0,0)[0] intercept   : AIC=1818.365, Time=0.44 sec
 ARIMA(2,0,1)(0,0,0)[0] intercept   : AIC=1757.996, Time=0.59 sec
 ARIMA(3,0,2)(0,0,0)[0] intercept   : AIC=1745.490, Time=0.80 sec
 ARIMA(2,0,3)(0,0,0)[0] intercept   : AIC=1641.765, Time=0.80 sec
 ARIMA(1,0,3)(0,0,0)[0] intercept   : AIC=1791.416, Time=0.67 sec
 ARIMA(3,0,3)(0,0,0)[0] intercept   : AIC=1673.786, Time=0.87 sec
 ARIMA(2,0,4)(0,0,0)[0] intercept   : AIC=1694.819, Time=1.00 sec
 ARIMA(1,0,4)(0,0,0)[0] intercept   : AIC=inf, Time=0.91 sec
 ARIMA(3,0,4)(0,0,0)[0] intercept   : AIC=1650.033, Time=1.09 sec
 ARIMA(2,0,3)(0,0,0)[0]             : AIC=1861.991, Time=0.40 sec

Best model:  ARIMA(2,0,3)(0,0,0)[0] intercept
Total fit time: 8.689 seconds
(258, 1) (30, 1)
```

In [2]:
```
train = data.iloc[:-30]
test = data.iloc[-30:]
print(train.shape,test.shape)

model = ARIMA(train['Temperature'],order = (2,0,3))
model = model.fit()
model.summary()
```

```
(258, 1) (30, 1)
```

Out[2]:

SARIMAX Results

Dep. Variable:	Temperature	**No. Observations:**	258
Model:	ARIMA(2, 0, 3)	**Log Likelihood**	-722.196
Date:	Wed, 01 May 2024	**AIC**	1458.392
Time:	15:19:53	**BIC**	1483.263
Sample:	0	**HQIC**	1468.393
	- 258		
Covariance Type:	opg		

	coef	std err	z	P>|z|	[0.025	0.975]
const	90.6981	0.342	265.081	0.000	90.028	91.369
ar.L1	1.7321	0.001	2079.580	0.000	1.730	1.734
ar.L2	-0.9998	0.000	-2740.549	0.000	-1.001	-0.999
ma.L1	-1.4233	0.256	-5.571	0.000	-1.924	-0.923
ma.L2	0.5008	0.233	2.151	0.031	0.044	0.957
ma.L3	0.2896	0.115	2.520	0.012	0.064	0.515
sigma2	15.0644	4.572	3.295	0.001	6.104	24.025

Ljung-Box (L1) (Q):	0.73	**Jarque-Bera (JB):**	2.43
Prob(Q):	0.39	**Prob(JB):**	0.30
Heteroskedasticity (H):	0.67	**Skew:**	-0.23
Prob(H) (two-sided):	0.07	**Kurtosis:**	3.15

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

In [7]:

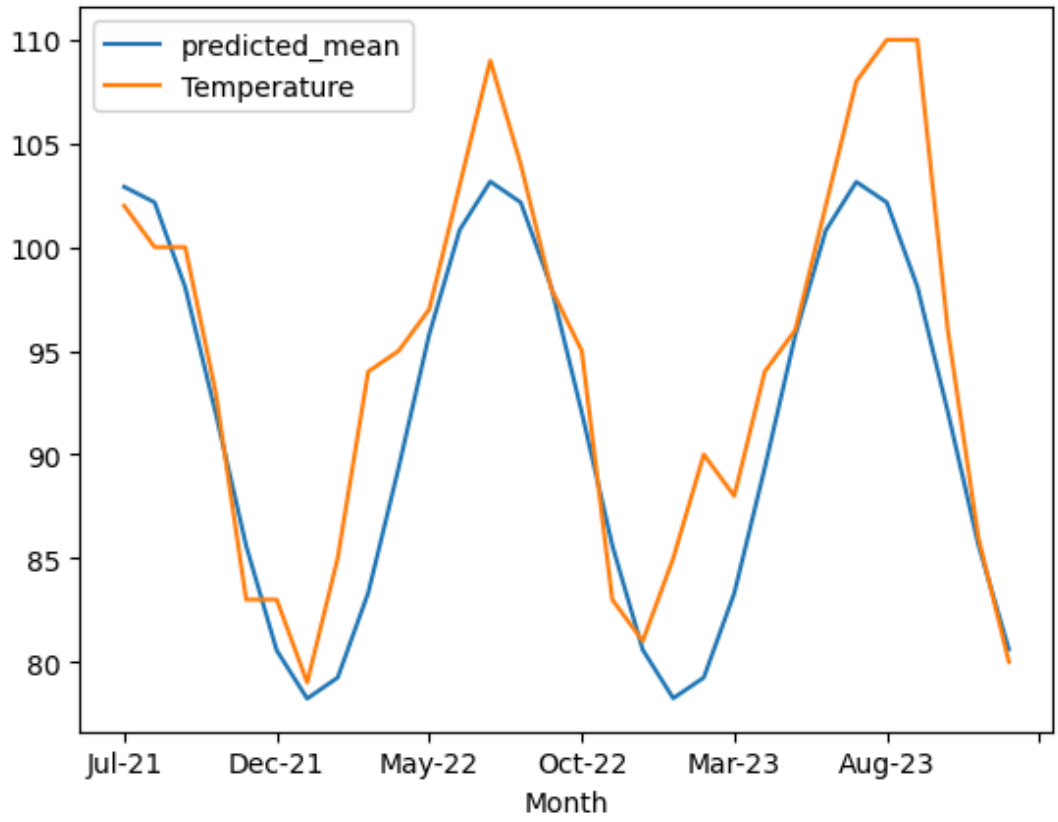
```
start = len(train)
end = len(train) +len(test) -1
pred = model.predict(start = start,end = end,type = 'levels')
pred = pd.DataFrame(pred,columns = ['predicted_mean'])
predicted_index = pd.date_range(start='2021-07-01', periods=len(pred), freq=
predicted_index_str = predicted_index.strftime('%b-%y')

pred['predicted_index'] = predicted_index_str
pred.set_index('predicted_index', inplace=True)

print(pred)

print(test['Temperature'])
pred.plot(legend=True,label='Temperature predicted by model')
test['Temperature'].plot(legend = True)
```

predicted_index	predicted_mean
Jul-21	102.910477
Aug-21	102.158062
Sep-21	98.068701
Oct-21	92.006616
Nov-21	85.595212
Dec-21	80.551146
Jan-22	78.224694
Feb-22	79.238285
Mar-22	83.319976
Apr-22	89.376412
May-22	95.785700
Jun-22	100.831748
Jul-22	103.163751
Aug-22	102.157791
Sep-22	98.083769
Oct-22	92.032986
Nov-22	85.625821
Dec-22	80.577799
Jan-23	78.240255
Feb-23	79.238590
Mar-23	83.304945
Apr-23	89.350072
May-23	95.755106
Jun-23	100.805092
Jul-23	103.148169
Aug-23	102.157453
Sep-23	98.098762
Oct-23	92.059294
Nov-23	85.656399
Dec-23	80.604458

Month	
Jul-21	102
Aug-21	100
Sep-21	100
Oct-21	93
Nov-21	83
Dec-21	83
Jan-22	79
Feb-22	85
Mar-22	94
Apr-22	95
May-22	97
Jun-22	103
Jul-22	109
Aug-22	104
Sep-22	98
Oct-22	95
Nov-22	83
Dec-22	81
Jan-23	85
Feb-23	90
Mar-23	88
Apr-23	94
May-23	96
Jun-23	102
Jul-23	108

```
Aug-23    110
Sep-23    110
Oct-23     96
Nov-23     86
Dec-23     80
Name: Temperature, dtype: int64
```

Out[7]: <Axes: xlabel='Month'>



In [4]:
```
print(test['Temperature'].mean())
rmse = sqrt(mean_squared_error(pred,test['Temperature']))
print(rmse)
```

```
94.3
4.869253682983691
```

In [5]:
```
index_future_months = pd.date_range(start='2024-01-01',end='2025-01-01', fre
index_future_months = index_future_months.strftime('%b-%y')
print(index_future_months)
pred2 = model.predict(start = len(data),end = len(data)+11,type = 'levels').
pred2.index = index_future_months
print(pred2)
```

```
Index(['Jan-24', 'Feb-24', 'Mar-24', 'Apr-24', 'May-24', 'Jun-24', 'Jul-2
4',
       'Aug-24', 'Sep-24', 'Oct-24', 'Nov-24', 'Dec-24'],
      dtype='object')
Jan-24     78.255859
Feb-24     79.238962
Mar-24     83.289989
Apr-24     89.323795
May-24     95.724544
Jun-24    100.778430
Jul-24    103.132543
Aug-24    102.157047
Sep-24     98.113681
Oct-24     92.085541
Nov-24     85.686945
Dec-24     80.631124
Name: ARIMA PRedictions, dtype: float64
```