

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

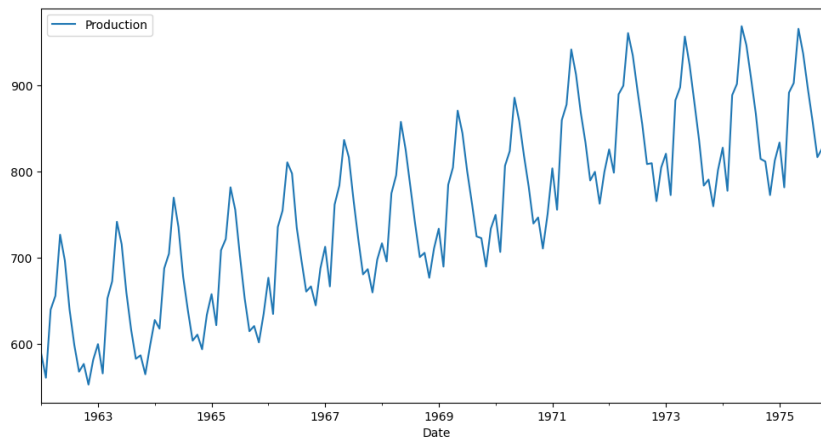
```
df = pd.read_csv('/content/monthly_milk_production.csv', index_col='Date', parse_dates=True)
df.index.freq='MS'
```

```
df.head()
```

	Production
Date	
1962-01-01	589
1962-02-01	561
1962-03-01	640
1962-04-01	656
1962-05-01	727

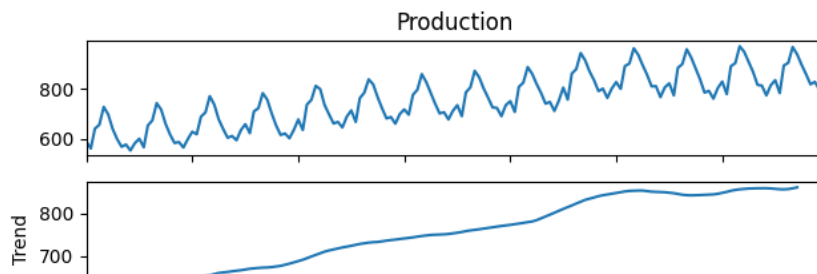
```
df.plot(figsize=(12,6))
```

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



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

```
results = seasonal_decompose(df['Production'])
results.plot();
```



```
len(df)
```

```
168
```

```
sc = df[['Production']]
```

```
train = df.iloc[:156]
```

```
test = df.iloc[156:]
```

```
sc = df[['Production']]
```

```
from sklearn.preprocessing import MinMaxScaler
```

```
scaler = MinMaxScaler()
```

```
sc = df[['Production']]
```

```
df.head(),df.tail()
```

```
(
  Date      Production
1962-01-01    589
1962-02-01    561
1962-03-01    640
1962-04-01    656
1962-05-01    727,
  Date      Production
1975-08-01    858
1975-09-01    817
1975-10-01    827
1975-11-01    797
1975-12-01    843)
```

```
scaler.fit(train)
```

```
scaled_train = scaler.transform(train)
```

```
scaled_test = scaler.transform(test)
```

```
scaled_train[:10]
```

```
array([[0.08653846],
       [0.01923077],
       [0.20913462],
       [0.24759615],
       [0.41826923],
       [0.34615385],
       [0.20913462],
       [0.11057692],
       [0.03605769],
       [0.05769231]])
```

```
from keras.preprocessing.sequence import TimeseriesGenerator
```

```
# define generator
```

```
n_input = 3
```

```
n_features = 1
```

```
generator = TimeseriesGenerator(scaled_train, scaled_train, length=n_input, batch_size=1)
```

```
X,y = generator[0]
```

```
print(f'Given the Array: \n{X.flatten()}')
```

```
print(f'Predict this y: \n {y}')
```

```
Given the Array:
[0.08653846 0.01923077 0.20913462]
Predict this y:
[[0.24759615]]
```

```
X.shape
```

(1, 3, 1)

```
# We do the same thing, but now instead for 12 months
n_input = 12
generator = TimeseriesGenerator(scaled_train, scaled_train, length=n_input, batch_size=1)
```

```
from keras.models import Sequential
from keras.layers import Dense
from keras.layers import LSTM
```

```
# define model
model = Sequential()
model.add(LSTM(100, activation='relu', input_shape=(n_input, n_features)))
model.add(Dense(1))
model.compile(optimizer='adam', loss='mse')
```

```
model.summary()
```

Model: "sequential"

Layer (type)	Output Shape	Param #
=====		
lstm (LSTM)	(None, 100)	40800
dense (Dense)	(None, 1)	101
=====		
Total params: 40901 (159.77 KB)		
Trainable params: 40901 (159.77 KB)		
Non-trainable params: 0 (0.00 Byte)		

```
# fit model
model.fit(generator, epochs=50)
```

```

epoch 44/50
144/144 [=====] - 1s 6ms/step - loss: 0.0021
Epoch 45/50
144/144 [=====] - 1s 6ms/step - loss: 0.0021
Epoch 46/50
144/144 [=====] - 1s 6ms/step - loss: 0.0020
Epoch 47/50
144/144 [=====] - 1s 6ms/step - loss: 0.0027
Epoch 48/50
144/144 [=====] - 2s 13ms/step - loss: 0.0021
Epoch 49/50
144/144 [=====] - 1s 8ms/step - loss: 0.0019
Epoch 50/50
144/144 [=====] - 1s 7ms/step - loss: 0.0021
<keras.src.callbacks.History at 0x7940c04d8d30>

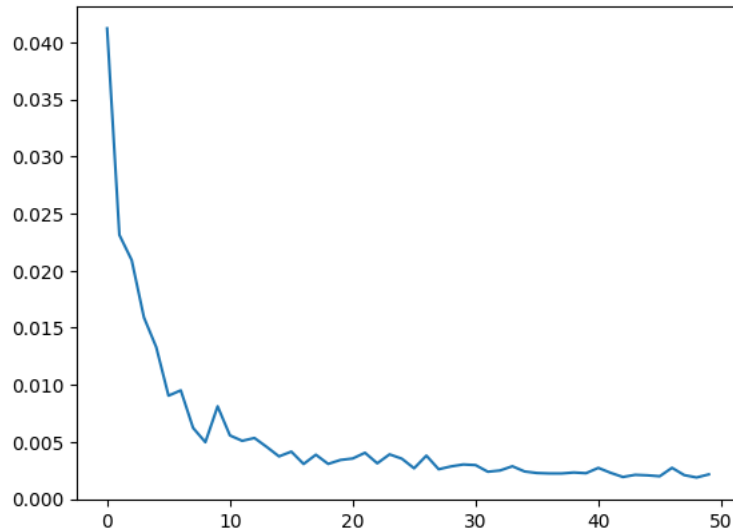
```

```

loss_per_epoch = model.history.history['loss']
plt.plot(range(len(loss_per_epoch)), loss_per_epoch)

```

```
[<matplotlib.lines.Line2D at 0x7940b2ec7100>]
```



```

last_train_batch = scaled_train[-12:]

last_train_batch = last_train_batch.reshape((1, n_input, n_features))

model.predict(last_train_batch)

1/1 [=====] - 0s 206ms/step
array([[0.6740278]], dtype=float32)

scaled_test[0]

array([0.67548077])

test_predictions = []

first_eval_batch = scaled_train[-n_input:]
current_batch = first_eval_batch.reshape((1, n_input, n_features))

for i in range(len(test)):

    # get the prediction value for the first batch
    current_pred = model.predict(current_batch)[0]

    # append the prediction into the array
    test_predictions.append(current_pred)

    # use the prediction to update the batch and remove the first value
    current_batch = np.append(current_batch[:,1:,:], [[current_pred]], axis=1)

1/1 [=====] - 0s 26ms/step
1/1 [=====] - 0s 22ms/step
1/1 [=====] - 0s 22ms/step
1/1 [=====] - 0s 22ms/step

```

```

1/1 [=====] - 0s 24ms/step
1/1 [=====] - 0s 25ms/step
1/1 [=====] - 0s 22ms/step
1/1 [=====] - 0s 21ms/step
1/1 [=====] - 0s 21ms/step
1/1 [=====] - 0s 26ms/step
1/1 [=====] - 0s 27ms/step
1/1 [=====] - 0s 22ms/step

```

```
test_predictions
```

```

[array([0.6740278], dtype=float32),
 array([0.6351541], dtype=float32),
 array([0.81465983], dtype=float32),
 array([0.8758115], dtype=float32),
 array([0.9919943], dtype=float32),
 array([0.9742231], dtype=float32),
 array([0.9031107], dtype=float32),
 array([0.8039626], dtype=float32),
 array([0.69187504], dtype=float32),
 array([0.66172874], dtype=float32),
 array([0.60486245], dtype=float32),
 array([0.65057373], dtype=float32)]

```

```
true_predictions = scaler.inverse_transform(test_predictions)
```

```

from sklearn.metrics import mean_squared_error
from math import sqrt
rmse=sqrt(mean_squared_error(test['Production'],test['Predictions']))
print(rmse)

```

```
20.078180854790947
```