Analyse data daily-sea-ice-extent National Snow & Ice Data Center with RNN LSTM one-time step univariate time series

In [1]:

```python
# setup absolute path to location of package Starts and config-file
from inspect import getsourcefile
import os.path as path, sys
current_dir = path.dirname(path.abspath(getsourcefile(lambda:0)))
sys.path.insert(0, current_dir[:current_dir.rfind(path.sep)])

from Starts.startml import *
from Starts.startvis import *
from Starts.startmodtf import *
%matplotlib inline
```

local_kwargs {'data_path': './data/daily-sea-ice-extent-data/seaice.csv, ./data/nsidc_ice_extent.csv, ./data/north_ice_extent.csv, ./data/south_ice _extent.csv, ./data/glacier-inventory/database.csv', 'drop_obj_col': Fals e, 'nan_drop_col': False, 'nan_drop_row': False, 'nan_zero': False, 'nan_m ean': True, 'nan_mean_neighbors': False}

Using TensorFlow backend.

In [2]:

```python
ice = idata[1]
north = idata[2]
south = idata[3]
```

In [3]:

```python
north.head()
```

Out[3]:

	Time	Extent
0	1978-10-26	10.231
1	1978-10-28	10.420
2	1978-10-30	10.557
3	1978-11-01	10.670
4	1978-11-03	10.777

In [4]:

```
south.head()
```

Out[4]:

	Time	Extent
0	1978-10-26	17.624
1	1978-10-28	17.803
2	1978-10-30	17.670
3	1978-11-01	17.527
4	1978-11-03	17.486

In [5]:

```
north.set_index('Time', inplace=True)
north.head()
```

Out[5]:

	Extent
Time	
1978-10-26	10.231
1978-10-28	10.420
1978-10-30	10.557
1978-11-01	10.670
1978-11-03	10.777

In [6]:

```
# StartML.convert_time_series(south, time_column='Time').head()
south.set_index('Time', inplace=True)
south.head()
```

Out[6]:

	Extent
Time	
1978-10-26	17.624
1978-10-28	17.803
1978-10-30	17.670
1978-11-01	17.527
1978-11-03	17.486

In [7]:

```python
stf = StartModTFRNN(n_classes=None, dependent_label='Extent')
stf.info_parameters()
```

Input_units: 1

Hidden_units: [10, 10]

Output_units: 1

Optimizer: Adagrad

Activation_function: relu

Learning_Rate: 0.001

Training_Steps: 1000

Batch_Size: 10

Number_of_epochs: 1

Feature_Scaling: False

Loss_function: mean_squared_error

Drop_out: 0.2

Recurrent_drop_out: 0.2

Bias_Initializer: random_uniform

Depth_wise_Initializer: random_uniform

Seed: 10

Kernel_size: 1

Filter_size: [3, 3]

n_filters: 1

n_padding: 1

n_strides: 1

momentum: 0.2

In [12]:

```python
# Update parameters
new_param={'input_units': 1000, 'hidden_units': [1,1], 'output_units': 1, 'optimizer':
'Adam',
          'activation_fn': 'sigmoid', 'learning_rate': 0.001,
          'steps': 5000, 'batch_size': 1, 'num_epochs': 5, 'feature_scl': True,
          'loss_fn': 'mean_squared_error', 'drop_out': 0.5, 'rec_drop_out': 0.6,
          'bias_initializer': 'random_uniform', 'depth_wise_initializer': 'random_unif
orm', 'seed': 10,
          'kernel_size': 1, 'filter_size': 1, 'momentum': 0.2, 'n_filters': 32, 'n_pad
ding': 1, 'n_strides': 1}
stf.update_parameters=new_param
stf.info_parameters()
```

Input_units: 1000

Hidden_units: [1, 1]

Output_units: 1

Optimizer: Adam

Activation_function: sigmoid

Learning_Rate: 0.001

Training_Steps: 5000

Batch_Size: 1

Number_of_epochs: 5

Feature_Scaling: True

Loss_function: mean_squared_error

Drop_out: 0.5

Recurrent_drop_out: 0.6

Bias_Initializer: random_uniform

Depth_wise_Initializer: random_uniform

Seed: 10

Kernel_size: 1

Filter_size: 1

n_filters: 32

n_padding: 1

n_strides: 1

momentum: 0.2

In [13]:

```
lstm_model, y_truth, y_pred = stf.keras_rnn_lstm_onestep_univ(data=north, repeats=2)
```

```
At time point=1, Predicted=13.191129, Expected=13.236000
At time point=2, Predicted=13.192548, Expected=13.398000
At time point=3, Predicted=13.316690, Expected=13.475000
At time point=4, Predicted=13.416486, Expected=13.520000
At time point=5, Predicted=13.460177, Expected=13.456000
At time point=6, Predicted=13.418672, Expected=13.514000
At time point=7, Predicted=13.492661, Expected=13.574000
At time point=8, Predicted=13.615141, Expected=13.631000
At time point=9, Predicted=13.695504, Expected=13.715000
At time point=10, Predicted=13.755773, Expected=13.727000
At time point=11, Predicted=13.704213, Expected=13.778000
At time point=12, Predicted=13.698567, Expected=13.848000
At time point=13, Predicted=13.913072, Expected=13.855000
At time point=14, Predicted=13.880517, Expected=13.987000
At time point=15, Predicted=13.994483, Expected=13.997000
At time point=16, Predicted=14.003572, Expected=14.029000
At time point=17, Predicted=13.984396, Expected=14.131000
At time point=18, Predicted=14.104981, Expected=14.209000
At time point=19, Predicted=14.260167, Expected=14.218000
At time point=20, Predicted=14.246802, Expected=14.162000
At time point=21, Predicted=14.143195, Expected=14.139000
At time point=22, Predicted=14.095734, Expected=14.132000
At time point=23, Predicted=14.089215, Expected=14.198000
At time point=24, Predicted=14.119644, Expected=14.241000
At time point=25, Predicted=14.186357, Expected=14.341000
At time point=26, Predicted=14.290535, Expected=14.293000
At time point=27, Predicted=14.214153, Expected=14.291000
At time point=28, Predicted=14.256950, Expected=14.363000
At time point=29, Predicted=14.320460, Expected=14.286000
At time point=30, Predicted=14.248418, Expected=14.315000
At time point=31, Predicted=14.279665, Expected=14.254000
At time point=32, Predicted=14.304493, Expected=14.363000
At time point=33, Predicted=14.319270, Expected=14.307000
At time point=34, Predicted=14.320751, Expected=14.174000
At time point=35, Predicted=14.145603, Expected=14.218000
At time point=36, Predicted=14.173454, Expected=14.284000
At time point=37, Predicted=14.230103, Expected=14.365000
At time point=38, Predicted=14.299282, Expected=14.396000
At time point=39, Predicted=14.374641, Expected=14.451000
At time point=40, Predicted=14.409680, Expected=14.446000
At time point=41, Predicted=14.402671, Expected=14.381000
At time point=42, Predicted=14.376327, Expected=14.500000
At time point=43, Predicted=14.444726, Expected=14.560000
At time point=44, Predicted=14.505760, Expected=14.594000
At time point=45, Predicted=14.542014, Expected=14.602000
At time point=46, Predicted=14.552492, Expected=14.562000
At time point=47, Predicted=14.628025, Expected=14.573000
At time point=48, Predicted=14.592995, Expected=14.566000
At time point=49, Predicted=14.626127, Expected=14.656000
At time point=50, Predicted=14.635940, Expected=14.651000
At time point=51, Predicted=14.614922, Expected=14.659000
At time point=52, Predicted=14.624540, Expected=14.629000
At time point=53, Predicted=14.694889, Expected=14.658000
At time point=54, Predicted=14.655783, Expected=14.688000
At time point=55, Predicted=14.685957, Expected=14.720000
At time point=56, Predicted=14.726462, Expected=14.811000
At time point=57, Predicted=14.876059, Expected=14.804000
At time point=58, Predicted=14.842497, Expected=14.773000
At time point=59, Predicted=14.775443, Expected=14.559000
At time point=60, Predicted=14.583759, Expected=14.616000
At time point=61, Predicted=14.601204, Expected=14.617000
```

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At time point=62, Predicted=14.605003, Expected=14.711000
At time point=63, Predicted=14.705902, Expected=14.816000
At time point=64, Predicted=14.811966, Expected=14.929000
At time point=65, Predicted=14.994371, Expected=14.889000
At time point=66, Predicted=14.902542, Expected=14.923000
At time point=67, Predicted=14.965447, Expected=14.937000
At time point=68, Predicted=14.925293, Expected=14.957000
At time point=69, Predicted=14.978455, Expected=14.973000
At time point=70, Predicted=14.976320, Expected=14.936000
At time point=71, Predicted=14.999994, Expected=15.007000
At time point=72, Predicted=15.019714, Expected=14.949000
At time point=73, Predicted=14.926563, Expected=14.785000
At time point=74, Predicted=14.849504, Expected=14.754000
At time point=75, Predicted=14.733137, Expected=14.700000
At time point=76, Predicted=14.730629, Expected=14.716000
At time point=77, Predicted=14.659181, Expected=14.715000
At time point=78, Predicted=14.760074, Expected=14.653000
At time point=79, Predicted=14.626205, Expected=14.638000
At time point=80, Predicted=14.672633, Expected=14.497000
At time point=81, Predicted=14.481568, Expected=14.538000
At time point=82, Predicted=14.460976, Expected=14.585000
At time point=83, Predicted=14.553026, Expected=14.541000
At time point=84, Predicted=14.519488, Expected=14.541000
At time point=85, Predicted=14.592711, Expected=14.475000
At time point=86, Predicted=14.474019, Expected=14.573000
At time point=87, Predicted=14.528047, Expected=14.610000
At time point=88, Predicted=14.666531, Expected=14.547000
At time point=89, Predicted=14.501056, Expected=14.479000
At time point=90, Predicted=14.405069, Expected=14.470000
At time point=91, Predicted=14.532540, Expected=14.464000
At time point=92, Predicted=14.478679, Expected=14.348000
At time point=93, Predicted=14.402576, Expected=14.358000
At time point=94, Predicted=14.355730, Expected=14.171000
At time point=95, Predicted=14.125350, Expected=14.174000
At time point=96, Predicted=14.141831, Expected=14.202000
At time point=97, Predicted=14.165269, Expected=14.147000
At time point=98, Predicted=14.124973, Expected=14.039000
At time point=99, Predicted=14.018693, Expected=13.945000
At time point=100, Predicted=13.902224, Expected=13.837000
At time point=101, Predicted=13.829359, Expected=13.797000
At time point=102, Predicted=13.843048, Expected=13.814000
At time point=103, Predicted=13.797777, Expected=13.802000
At time point=104, Predicted=13.763168, Expected=13.762000
At time point=105, Predicted=13.705385, Expected=13.797000
At time point=106, Predicted=13.820051, Expected=13.804000
At time point=107, Predicted=13.788299, Expected=13.711000
At time point=108, Predicted=13.715514, Expected=13.738000
At time point=109, Predicted=13.649978, Expected=13.671000
At time point=110, Predicted=13.632122, Expected=13.624000
At time point=111, Predicted=13.602723, Expected=13.637000
At time point=112, Predicted=13.581519, Expected=13.558000
At time point=113, Predicted=13.600895, Expected=13.350000
At time point=114, Predicted=13.276096, Expected=13.262000
At time point=115, Predicted=13.314174, Expected=13.200000
At time point=116, Predicted=13.205539, Expected=13.180000
At time point=117, Predicted=13.183666, Expected=13.125000
At time point=118, Predicted=13.083228, Expected=13.046000
At time point=119, Predicted=13.006069, Expected=13.054000
At time point=120, Predicted=13.084506, Expected=12.978000
At time point=121, Predicted=13.026978, Expected=12.938000
At time point=122, Predicted=12.952149, Expected=12.906000
```

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At time point=123, Predicted=12.906172, Expected=12.877000
At time point=124, Predicted=12.942507, Expected=12.778000
At time point=125, Predicted=12.823284, Expected=12.716000
At time point=126, Predicted=12.781381, Expected=12.701000
At time point=127, Predicted=12.715985, Expected=12.676000
At time point=128, Predicted=12.728702, Expected=12.672000
At time point=129, Predicted=12.671150, Expected=12.678000
At time point=130, Predicted=12.738779, Expected=12.647000
At time point=131, Predicted=12.625870, Expected=12.595000
At time point=132, Predicted=12.660525, Expected=12.568000
At time point=133, Predicted=12.612433, Expected=12.531000
At time point=134, Predicted=12.487907, Expected=12.524000
At time point=135, Predicted=12.497534, Expected=12.504000
At time point=136, Predicted=12.520272, Expected=12.442000
At time point=137, Predicted=12.408065, Expected=12.354000
At time point=138, Predicted=12.399434, Expected=12.323000
At time point=139, Predicted=12.277028, Expected=12.278000
At time point=140, Predicted=12.251408, Expected=12.222000
At time point=141, Predicted=12.287646, Expected=12.195000
At time point=142, Predicted=12.230814, Expected=12.238000
At time point=143, Predicted=12.187461, Expected=12.164000
At time point=144, Predicted=12.130192, Expected=12.052000
At time point=145, Predicted=12.006890, Expected=12.005000
At time point=146, Predicted=11.969286, Expected=11.913000
At time point=147, Predicted=11.931836, Expected=11.850000
At time point=148, Predicted=11.809853, Expected=11.724000
At time point=149, Predicted=11.752749, Expected=11.714000
At time point=150, Predicted=11.657327, Expected=11.751000
At time point=151, Predicted=11.770098, Expected=11.709000
At time point=152, Predicted=11.736341, Expected=11.665000
At time point=153, Predicted=11.632710, Expected=11.531000
At time point=154, Predicted=11.504934, Expected=11.492000
At time point=155, Predicted=11.455082, Expected=11.401000
At time point=156, Predicted=11.342824, Expected=11.323000
At time point=157, Predicted=11.301821, Expected=11.295000
At time point=158, Predicted=11.256358, Expected=11.085000
At time point=159, Predicted=11.057181, Expected=11.139000
At time point=160, Predicted=11.189438, Expected=11.141000
At time point=161, Predicted=11.134668, Expected=10.997000
At time point=162, Predicted=10.968920, Expected=10.863000
At time point=163, Predicted=10.872560, Expected=10.787000
At time point=164, Predicted=10.776849, Expected=10.676000
At time point=165, Predicted=10.619465, Expected=10.562000
At time point=166, Predicted=10.605301, Expected=10.395000
At time point=167, Predicted=10.369939, Expected=10.301000
At time point=168, Predicted=10.249564, Expected=10.296000
At time point=169, Predicted=10.264937, Expected=10.236000
At time point=170, Predicted=10.172281, Expected=10.063000
At time point=171, Predicted=10.049730, Expected=9.835000
At time point=172, Predicted=9.805783, Expected=9.560000
At time point=173, Predicted=9.548844, Expected=9.617000
At time point=174, Predicted=9.603870, Expected=9.324000
At time point=175, Predicted=9.275581, Expected=9.234000
At time point=176, Predicted=9.186107, Expected=9.125000
At time point=177, Predicted=9.037804, Expected=9.067000
At time point=178, Predicted=9.012923, Expected=8.964000
At time point=179, Predicted=8.927607, Expected=8.907000
At time point=180, Predicted=8.835415, Expected=8.879000
At time point=181, Predicted=8.847233, Expected=8.708000
At time point=182, Predicted=8.669913, Expected=8.653000
At time point=183, Predicted=8.610159, Expected=8.534000
```

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At time point=184, Predicted=8.482981, Expected=8.392000
At time point=185, Predicted=8.337496, Expected=8.378000
At time point=186, Predicted=8.359485, Expected=8.293000
At time point=187, Predicted=8.236642, Expected=8.180000
At time point=188, Predicted=8.172713, Expected=8.074000
At time point=189, Predicted=8.078440, Expected=7.999000
At time point=190, Predicted=7.987235, Expected=7.898000
At time point=191, Predicted=7.890233, Expected=7.864000
At time point=192, Predicted=7.824221, Expected=7.839000
At time point=193, Predicted=7.904994, Expected=7.778000
At time point=194, Predicted=7.760020, Expected=7.680000
At time point=195, Predicted=7.634520, Expected=7.631000
At time point=196, Predicted=7.694207, Expected=7.649000
At time point=197, Predicted=7.703456, Expected=7.530000
At time point=198, Predicted=7.555637, Expected=7.510000
At time point=199, Predicted=7.511293, Expected=7.392000
At time point=200, Predicted=7.325018, Expected=7.350000
At time point=201, Predicted=7.371164, Expected=7.312000
At time point=202, Predicted=7.276961, Expected=7.128000
At time point=203, Predicted=7.093318, Expected=7.055000
At time point=204, Predicted=7.064897, Expected=7.035000
At time point=205, Predicted=6.987538, Expected=6.984000
At time point=206, Predicted=6.952762, Expected=6.859000
At time point=207, Predicted=6.911717, Expected=6.803000
At time point=208, Predicted=6.804384, Expected=6.751000
At time point=209, Predicted=6.690425, Expected=6.739000
At time point=210, Predicted=6.691303, Expected=6.660000
At time point=211, Predicted=6.705411, Expected=6.599000
At time point=212, Predicted=6.663133, Expected=6.629000
At time point=213, Predicted=6.685073, Expected=6.553000
At time point=214, Predicted=6.611261, Expected=6.457000
At time point=215, Predicted=6.511014, Expected=6.363000
At time point=216, Predicted=6.330175, Expected=6.251000
At time point=217, Predicted=6.205083, Expected=6.184000
At time point=218, Predicted=6.145045, Expected=6.173000
At time point=219, Predicted=6.100669, Expected=6.082000
At time point=220, Predicted=6.054646, Expected=6.022000
At time point=221, Predicted=5.965947, Expected=5.940000
At time point=222, Predicted=6.003592, Expected=5.825000
At time point=223, Predicted=5.813458, Expected=5.795000
At time point=224, Predicted=5.787810, Expected=5.758000
At time point=225, Predicted=5.792747, Expected=5.705000
At time point=226, Predicted=5.719109, Expected=5.665000
At time point=227, Predicted=5.729504, Expected=5.657000
At time point=228, Predicted=5.659876, Expected=5.552000
At time point=229, Predicted=5.566949, Expected=5.539000
At time point=230, Predicted=5.496682, Expected=5.548000
At time point=231, Predicted=5.525817, Expected=5.500000
At time point=232, Predicted=5.448833, Expected=5.429000
At time point=233, Predicted=5.375884, Expected=5.494000
At time point=234, Predicted=5.476027, Expected=5.452000
At time point=235, Predicted=5.429710, Expected=5.446000
At time point=236, Predicted=5.412366, Expected=5.380000
At time point=237, Predicted=5.353710, Expected=5.371000
At time point=238, Predicted=5.424594, Expected=5.370000
At time point=239, Predicted=5.353910, Expected=5.320000
At time point=240, Predicted=5.372586, Expected=5.255000
At time point=241, Predicted=5.319504, Expected=5.246000
At time point=242, Predicted=5.240511, Expected=5.204000
At time point=243, Predicted=5.159449, Expected=5.182000
At time point=244, Predicted=5.184786, Expected=5.178000
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At time point=245, Predicted=5.118690, Expected=5.122000
At time point=246, Predicted=5.099376, Expected=5.124000
At time point=247, Predicted=5.084293, Expected=5.100000
At time point=248, Predicted=5.049866, Expected=5.049000
At time point=249, Predicted=5.086394, Expected=5.044000
At time point=250, Predicted=5.024199, Expected=5.032000
At time point=251, Predicted=5.005020, Expected=4.988000
At time point=252, Predicted=4.894497, Expected=5.029000
At time point=253, Predicted=5.093504, Expected=5.088000
At time point=254, Predicted=5.089463, Expected=5.116000
At time point=255, Predicted=5.180415, Expected=5.163000
At time point=256, Predicted=5.196120, Expected=5.199000
At time point=257, Predicted=5.202195, Expected=5.160000
At time point=258, Predicted=5.189508, Expected=5.168000
At time point=259, Predicted=5.232504, Expected=5.253000
At time point=260, Predicted=5.232640, Expected=5.298000
At time point=261, Predicted=5.363676, Expected=5.368000
At time point=262, Predicted=5.417440, Expected=5.344000
At time point=263, Predicted=5.408150, Expected=5.422000
At time point=264, Predicted=5.414596, Expected=5.483000
At time point=265, Predicted=5.487817, Expected=5.542000
At time point=266, Predicted=5.600070, Expected=5.683000
At time point=267, Predicted=5.657821, Expected=5.760000
At time point=268, Predicted=5.721427, Expected=5.787000
At time point=269, Predicted=5.850489, Expected=5.831000
At time point=270, Predicted=5.845990, Expected=5.952000
At time point=271, Predicted=6.017237, Expected=6.018000
At time point=272, Predicted=6.051785, Expected=6.081000
At time point=273, Predicted=6.056031, Expected=6.130000
At time point=274, Predicted=6.190350, Expected=6.244000
At time point=275, Predicted=6.213090, Expected=6.336000
At time point=276, Predicted=6.348250, Expected=6.500000
At time point=277, Predicted=6.516766, Expected=6.646000
At time point=278, Predicted=6.637517, Expected=6.838000
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At time point=280, Predicted=6.880212, Expected=6.926000
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At time point=957, Predicted=5.021396, Expected=5.101000
At time point=958, Predicted=5.056063, Expected=4.982000
At time point=959, Predicted=4.925277, Expected=4.939000
At time point=960, Predicted=4.906763, Expected=4.850000
At time point=961, Predicted=4.909893, Expected=4.710000
At time point=962, Predicted=4.675960, Expected=4.537000
At time point=963, Predicted=4.586979, Expected=4.707000
At time point=964, Predicted=4.771504, Expected=4.547000
At time point=965, Predicted=4.536668, Expected=4.469000
At time point=966, Predicted=4.533504, Expected=4.388000
At time point=967, Predicted=4.400467, Expected=4.278000
At time point=968, Predicted=4.319802, Expected=4.211000
At time point=969, Predicted=4.188704, Expected=4.263000
At time point=970, Predicted=4.212778, Expected=4.258000
At time point=971, Predicted=4.220550, Expected=4.201000
At time point=972, Predicted=4.166129, Expected=4.203000
At time point=973, Predicted=4.151843, Expected=4.083000
At time point=974, Predicted=4.055434, Expected=4.104000
At time point=975, Predicted=4.057932, Expected=4.137000
At time point=976, Predicted=4.200228, Expected=4.160000
```

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At time point=977, Predicted=4.138682, Expected=4.209000
At time point=978, Predicted=4.274373, Expected=4.236000
At time point=979, Predicted=4.240816, Expected=4.341000
At time point=980, Predicted=4.305057, Expected=4.357000
At time point=981, Predicted=4.422951, Expected=4.378000
At time point=982, Predicted=4.442504, Expected=4.363000
At time point=983, Predicted=4.309136, Expected=4.309000
At time point=984, Predicted=4.373504, Expected=4.434000
At time point=985, Predicted=4.457776, Expected=4.495000
At time point=986, Predicted=4.542235, Expected=4.533000
At time point=987, Predicted=4.585033, Expected=4.593000
At time point=988, Predicted=4.657842, Expected=4.627000
At time point=989, Predicted=4.674841, Expected=4.814000
At time point=990, Predicted=4.771901, Expected=4.899000
At time point=991, Predicted=4.889075, Expected=4.916000
At time point=992, Predicted=4.940716, Expected=5.071000
At time point=993, Predicted=5.074836, Expected=5.143000
At time point=994, Predicted=5.079730, Expected=5.174000
At time point=995, Predicted=5.236302, Expected=5.175000
At time point=996, Predicted=5.158462, Expected=5.187000
At time point=997, Predicted=5.218595, Expected=5.281000
At time point=998, Predicted=5.290423, Expected=5.285000
At time point=999, Predicted=5.273341, Expected=5.269000
At time point=1000, Predicted=5.236143, Expected=5.269000
At time point=1001, Predicted=5.243998, Expected=5.327000
At time point=1002, Predicted=5.392302, Expected=5.387000
At time point=1003, Predicted=5.391295, Expected=5.363000
At time point=1004, Predicted=5.355032, Expected=5.405000
At time point=1005, Predicted=5.419150, Expected=5.386000
At time point=1006, Predicted=5.363950, Expected=5.425000
At time point=1007, Predicted=5.385294, Expected=5.446000
At time point=1008, Predicted=5.380740, Expected=5.515000
At time point=1009, Predicted=5.465173, Expected=5.554000
At time point=1010, Predicted=5.510465, Expected=5.598000
At time point=1011, Predicted=5.539798, Expected=5.736000
At time point=1012, Predicted=5.780684, Expected=5.857000
At time point=1013, Predicted=5.912068, Expected=5.880000
At time point=1014, Predicted=5.871419, Expected=5.931000
At time point=1015, Predicted=5.995504, Expected=6.105000
At time point=1016, Predicted=6.144373, Expected=6.310000
At time point=1017, Predicted=6.292926, Expected=6.466000
At time point=1018, Predicted=6.376794, Expected=6.583000
At time point=1019, Predicted=6.514336, Expected=6.705000
At time point=1020, Predicted=6.669916, Expected=6.794000
At time point=1021, Predicted=6.826038, Expected=6.956000
At time point=1022, Predicted=6.969664, Expected=6.965000
At time point=1023, Predicted=6.940067, Expected=7.006000
At time point=1024, Predicted=6.983315, Expected=7.103000
At time point=1025, Predicted=7.055367, Expected=7.111000
At time point=1026, Predicted=7.113532, Expected=7.048000
At time point=1027, Predicted=7.022419, Expected=7.080000
At time point=1028, Predicted=6.997997, Expected=7.172000
At time point=1029, Predicted=7.148537, Expected=7.342000
At time point=1030, Predicted=7.315766, Expected=7.551000
At time point=1031, Predicted=7.495955, Expected=7.634000
At time point=1032, Predicted=7.611706, Expected=7.858000
At time point=1033, Predicted=7.830498, Expected=8.042000
At time point=1034, Predicted=8.094885, Expected=8.184000
At time point=1035, Predicted=8.200241, Expected=8.238000
At time point=1036, Predicted=8.206273, Expected=8.386000
At time point=1037, Predicted=8.314123, Expected=8.403000
```

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At time point=1038, Predicted=8.354284, Expected=8.520000
At time point=1039, Predicted=8.480053, Expected=8.615000
At time point=1040, Predicted=8.677611, Expected=8.613000
At time point=1041, Predicted=8.644826, Expected=8.676000
At time point=1042, Predicted=8.684252, Expected=8.714000
At time point=1043, Predicted=8.741100, Expected=8.753000
At time point=1044, Predicted=8.817504, Expected=8.606000
At time point=1045, Predicted=8.582391, Expected=8.534000
At time point=1046, Predicted=8.591027, Expected=8.560000
At time point=1047, Predicted=8.549145, Expected=8.671000
At time point=1048, Predicted=8.622208, Expected=8.905000
At time point=1049, Predicted=8.888051, Expected=8.983000
At time point=1050, Predicted=8.943487, Expected=9.040000
At time point=1051, Predicted=9.094393, Expected=9.173000
At time point=1052, Predicted=9.160176, Expected=9.269000
At time point=1053, Predicted=9.267448, Expected=9.530000
At time point=1054, Predicted=9.490603, Expected=9.652000
At time point=1055, Predicted=9.593249, Expected=9.712000
At time point=1056, Predicted=9.705145, Expected=9.789000
At time point=1057, Predicted=9.764057, Expected=9.902000
At time point=1058, Predicted=9.874908, Expected=10.215000
At time point=1059, Predicted=10.239037, Expected=10.380000
At time point=1060, Predicted=10.434775, Expected=10.362000
At time point=1061, Predicted=10.386130, Expected=10.362000
At time point=1062, Predicted=10.340399, Expected=10.426000
At time point=1063, Predicted=10.415659, Expected=10.508000
At time point=1064, Predicted=10.459090, Expected=10.653000
At time point=1065, Predicted=10.610749, Expected=10.719000
At time point=1066, Predicted=10.664340, Expected=10.809000
At time point=1067, Predicted=10.765452, Expected=11.046000
At time point=1068, Predicted=11.076121, Expected=11.231000
At time point=1069, Predicted=11.258686, Expected=11.264000
At time point=1070, Predicted=11.244840, Expected=11.348000
At time point=1071, Predicted=11.382060, Expected=11.521000
At time point=1072, Predicted=11.493209, Expected=11.553000
At time point=1073, Predicted=11.602140, Expected=11.725000
At time point=1074, Predicted=11.702229, Expected=11.762000
At time point=1075, Predicted=11.743165, Expected=11.785000
At time point=1076, Predicted=11.692360, Expected=11.853000
At time point=1077, Predicted=11.810836, Expected=11.983000
At time point=1078, Predicted=12.035188, Expected=11.836000
At time point=1079, Predicted=11.794321, Expected=11.919000
At time point=1080, Predicted=11.944962, Expected=11.745000
At time point=1081, Predicted=11.795484, Expected=11.848000
At time point=1082, Predicted=11.834733, Expected=12.028000
At time point=1083, Predicted=12.088070, Expected=12.097000
At time point=1084, Predicted=12.056685, Expected=12.279000
At time point=1085, Predicted=12.233465, Expected=12.439000
At time point=1086, Predicted=12.403038, Expected=12.533000
At time point=1087, Predicted=12.505682, Expected=12.669000
At time point=1088, Predicted=12.733334, Expected=12.608000
At time point=1089, Predicted=12.639145, Expected=12.608000
At time point=1090, Predicted=12.581303, Expected=12.614000
At time point=1091, Predicted=12.602697, Expected=12.705000
At time point=1092, Predicted=12.705926, Expected=12.956000
At time point=1093, Predicted=13.020429, Expected=12.932000
At time point=1094, Predicted=12.908555, Expected=12.843000
At time point=1095, Predicted=12.811797, Expected=12.852000
At time point=1096, Predicted=12.824929, Expected=12.879000
At time point=1097, Predicted=12.927652, Expected=12.847000
At time point=1098, Predicted=12.890841, Expected=12.884000
```

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At time point=1099, Predicted=12.851870, Expected=13.054000
At time point=1100, Predicted=13.070573, Expected=12.869000
At time point=1101, Predicted=12.901352, Expected=12.869000
At time point=1102, Predicted=12.864107, Expected=12.855000
At time point=1103, Predicted=12.917654, Expected=12.887000
At time point=1104, Predicted=12.934964, Expected=13.000000
At time point=1105, Predicted=13.008800, Expected=12.978000
At time point=1106, Predicted=13.027433, Expected=13.080000
At time point=1107, Predicted=13.091551, Expected=13.188000
At time point=1108, Predicted=13.158797, Expected=13.313000
At time point=1109, Predicted=13.377504, Expected=13.373000
At time point=1110, Predicted=13.406138, Expected=13.490000
At time point=1111, Predicted=13.509571, Expected=13.635000
At time point=1112, Predicted=13.631649, Expected=13.710000
At time point=1113, Predicted=13.742890, Expected=13.763000
At time point=1114, Predicted=13.798121, Expected=13.739000
At time point=1115, Predicted=13.697733, Expected=13.701000
At time point=1116, Predicted=13.641249, Expected=13.654000
At time point=1117, Predicted=13.649197, Expected=13.623000
At time point=1118, Predicted=13.614145, Expected=13.721000
At time point=1119, Predicted=13.728837, Expected=13.774000
At time point=1120, Predicted=13.828233, Expected=13.821000
At time point=1121, Predicted=13.798998, Expected=13.826000
At time point=1122, Predicted=13.760022, Expected=13.886000
At time point=1123, Predicted=13.942711, Expected=13.834000
At time point=1124, Predicted=13.821002, Expected=13.863000
At time point=1125, Predicted=13.927666, Expected=13.956000
At time point=1126, Predicted=13.943454, Expected=13.873000
At time point=1127, Predicted=13.832168, Expected=13.901000
At time point=1128, Predicted=13.866829, Expected=13.912000
At time point=1129, Predicted=13.847988, Expected=13.926000
At time point=1130, Predicted=13.893940, Expected=13.865000
At time point=1131, Predicted=13.869158, Expected=13.898000
At time point=1132, Predicted=13.866704, Expected=14.034000
At time point=1133, Predicted=14.047661, Expected=14.161000
At time point=1134, Predicted=14.115702, Expected=14.151000
At time point=1135, Predicted=14.215515, Expected=14.301000
At time point=1136, Predicted=14.281412, Expected=14.275000
At time point=1137, Predicted=14.234090, Expected=14.304000
At time point=1138, Predicted=14.325574, Expected=14.327000
At time point=1139, Predicted=14.321584, Expected=14.300000
At time point=1140, Predicted=14.250117, Expected=14.287000
At time point=1141, Predicted=14.205311, Expected=14.418000
At time point=1142, Predicted=14.478143, Expected=14.378000
At time point=1143, Predicted=14.421043, Expected=14.357000
At time point=1144, Predicted=14.364224, Expected=14.362000
At time point=1145, Predicted=14.426504, Expected=14.324000
At time point=1146, Predicted=14.306928, Expected=14.284000
At time point=1147, Predicted=14.253572, Expected=14.305000
At time point=1148, Predicted=14.352976, Expected=14.358000
At time point=1149, Predicted=14.328202, Expected=14.379000
At time point=1150, Predicted=14.347310, Expected=14.406000
At time point=1151, Predicted=14.312311, Expected=14.431000
At time point=1152, Predicted=14.407345, Expected=14.447000
At time point=1153, Predicted=14.408599, Expected=14.424000
At time point=1154, Predicted=14.358862, Expected=14.391000
At time point=1155, Predicted=14.333323, Expected=14.356000
At time point=1156, Predicted=14.414247, Expected=14.318000
At time point=1157, Predicted=14.340782, Expected=14.284000
At time point=1158, Predicted=14.236840, Expected=14.421000
At time point=1159, Predicted=14.485504, Expected=14.403000
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At time point=1160, Predicted=14.452099, Expected=14.370000
At time point=1161, Predicted=14.424492, Expected=14.424000
At time point=1162, Predicted=14.396621, Expected=14.407000
At time point=1163, Predicted=14.455672, Expected=14.273000
At time point=1164, Predicted=14.279632, Expected=14.242000
At time point=1165, Predicted=14.207174, Expected=14.178000
At time point=1166, Predicted=14.235638, Expected=14.195000
At time point=1167, Predicted=14.232979, Expected=14.217000
At time point=1168, Predicted=14.196638, Expected=14.196000
At time point=1169, Predicted=14.172950, Expected=14.136000
At time point=1170, Predicted=14.118753, Expected=14.076000
At time point=1171, Predicted=14.128258, Expected=14.073000
At time point=1172, Predicted=14.102452, Expected=14.073000
At time point=1173, Predicted=14.070921, Expected=14.107000
At time point=1174, Predicted=14.057723, Expected=14.169000
At time point=1175, Predicted=14.153759, Expected=14.178000
At time point=1176, Predicted=14.143715, Expected=14.178000
At time point=1177, Predicted=14.102286, Expected=14.181000
At time point=1178, Predicted=14.158030, Expected=14.172000
At time point=1179, Predicted=14.122192, Expected=14.126000
At time point=1180, Predicted=14.071572, Expected=14.143000
At time point=1181, Predicted=14.199382, Expected=14.227000
At time point=1182, Predicted=14.211648, Expected=14.209000
At time point=1183, Predicted=14.178387, Expected=14.114000
At time point=1184, Predicted=14.157747, Expected=14.040000
At time point=1185, Predicted=14.015238, Expected=14.094000
At time point=1186, Predicted=14.058371, Expected=13.993000
At time point=1187, Predicted=13.964144, Expected=13.875000
At time point=1188, Predicted=13.940867, Expected=13.899000
At time point=1189, Predicted=13.912216, Expected=13.935000
At time point=1190, Predicted=13.919583, Expected=13.911000
At time point=1191, Predicted=13.832942, Expected=13.785000
At time point=1192, Predicted=13.695477, Expected=13.717000
At time point=1193, Predicted=13.661074, Expected=13.740000
At time point=1194, Predicted=13.747675, Expected=13.704000
At time point=1195, Predicted=13.686423, Expected=13.738000
At time point=1196, Predicted=13.679307, Expected=13.667000
At time point=1197, Predicted=13.652270, Expected=13.624000
At time point=1198, Predicted=13.688485, Expected=13.591000
At time point=1199, Predicted=13.578289, Expected=13.562000
At time point=1200, Predicted=13.556794, Expected=13.492000
At time point=1201, Predicted=13.534711, Expected=13.498000
At time point=1202, Predicted=13.547101, Expected=13.496000
At time point=1203, Predicted=13.495547, Expected=13.459000
At time point=1204, Predicted=13.454942, Expected=13.464000
At time point=1205, Predicted=13.529431, Expected=13.451000
At time point=1206, Predicted=13.427321, Expected=13.436000
At time point=1207, Predicted=13.397484, Expected=13.425000
At time point=1208, Predicted=13.401468, Expected=13.393000
At time point=1209, Predicted=13.371827, Expected=13.134000
At time point=1210, Predicted=13.137990, Expected=13.096000
At time point=1211, Predicted=13.140917, Expected=13.114000
At time point=1212, Predicted=13.113198, Expected=13.026000
At time point=1213, Predicted=13.036333, Expected=13.035000
At time point=1214, Predicted=13.091853, Expected=13.079000
At time point=1215, Predicted=13.142735, Expected=12.985000
At time point=1216, Predicted=12.959488, Expected=12.985000
At time point=1217, Predicted=13.031282, Expected=12.934000
At time point=1218, Predicted=12.992139, Expected=12.899000
At time point=1219, Predicted=12.914666, Expected=12.830000
At time point=1220, Predicted=12.745057, Expected=12.753000
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At time point=1221, Predicted=12.714922, Expected=12.687000
At time point=1222, Predicted=12.708514, Expected=12.665000
At time point=1223, Predicted=12.642426, Expected=12.673000
At time point=1224, Predicted=12.645817, Expected=12.605000
At time point=1225, Predicted=12.635279, Expected=12.600000
At time point=1226, Predicted=12.555495, Expected=12.500000
At time point=1227, Predicted=12.521344, Expected=12.495000
At time point=1228, Predicted=12.455122, Expected=12.514000
At time point=1229, Predicted=12.579974, Expected=12.434000
At time point=1230, Predicted=12.411400, Expected=12.353000
At time point=1231, Predicted=12.375814, Expected=12.345000
At time point=1232, Predicted=12.305872, Expected=12.302000
At time point=1233, Predicted=12.267999, Expected=12.255000
At time point=1234, Predicted=12.231032, Expected=12.274000
At time point=1235, Predicted=12.216578, Expected=12.214000
At time point=1236, Predicted=12.199933, Expected=12.156000
At time point=1237, Predicted=12.126055, Expected=12.107000
At time point=1238, Predicted=12.146730, Expected=12.065000
At time point=1239, Predicted=12.036635, Expected=11.997000
At time point=1240, Predicted=11.963202, Expected=11.780000
At time point=1241, Predicted=11.784754, Expected=11.765000
At time point=1242, Predicted=11.741716, Expected=11.681000
At time point=1243, Predicted=11.639837, Expected=11.601000
At time point=1244, Predicted=11.605598, Expected=11.545000
At time point=1245, Predicted=11.502366, Expected=11.510000
At time point=1246, Predicted=11.494661, Expected=11.455000
1) Test RMSE: 0.093

At time point=1, Predicted=13.209626, Expected=13.236000
At time point=2, Predicted=13.185450, Expected=13.398000
At time point=3, Predicted=13.342553, Expected=13.475000
At time point=4, Predicted=13.425174, Expected=13.520000
At time point=5, Predicted=13.469037, Expected=13.456000
At time point=6, Predicted=13.432810, Expected=13.514000
At time point=7, Predicted=13.522084, Expected=13.574000
At time point=8, Predicted=13.621482, Expected=13.631000
At time point=9, Predicted=13.732848, Expected=13.715000
At time point=10, Predicted=13.769755, Expected=13.727000
At time point=11, Predicted=13.718484, Expected=13.778000
At time point=12, Predicted=13.722760, Expected=13.848000
At time point=13, Predicted=13.894699, Expected=13.855000
At time point=14, Predicted=13.887277, Expected=13.987000
At time point=15, Predicted=14.016331, Expected=13.997000
At time point=16, Predicted=14.029207, Expected=14.029000
At time point=17, Predicted=13.983181, Expected=14.131000
At time point=18, Predicted=14.121322, Expected=14.209000
At time point=19, Predicted=14.259429, Expected=14.218000
At time point=20, Predicted=14.262507, Expected=14.162000
At time point=21, Predicted=14.164231, Expected=14.139000
At time point=22, Predicted=14.101967, Expected=14.132000
At time point=23, Predicted=14.099982, Expected=14.198000
At time point=24, Predicted=14.142075, Expected=14.241000
At time point=25, Predicted=14.194836, Expected=14.341000
At time point=26, Predicted=14.298837, Expected=14.293000
At time point=27, Predicted=14.237058, Expected=14.291000
At time point=28, Predicted=14.270272, Expected=14.363000
At time point=29, Predicted=14.332682, Expected=14.286000
At time point=30, Predicted=14.264992, Expected=14.315000
At time point=31, Predicted=14.299045, Expected=14.254000
At time point=32, Predicted=14.302381, Expected=14.363000
At time point=33, Predicted=14.307700, Expected=14.307000
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```
At time point=34, Predicted=14.319358, Expected=14.174000
At time point=35, Predicted=14.155311, Expected=14.218000
At time point=36, Predicted=14.180981, Expected=14.284000
At time point=37, Predicted=14.237235, Expected=14.365000
At time point=38, Predicted=14.310703, Expected=14.396000
At time point=39, Predicted=14.394404, Expected=14.451000
At time point=40, Predicted=14.421711, Expected=14.446000
At time point=41, Predicted=14.414144, Expected=14.381000
At time point=42, Predicted=14.402486, Expected=14.500000
At time point=43, Predicted=14.448223, Expected=14.560000
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At time point=1059, Predicted=10.254273, Expected=10.380000
At time point=1060, Predicted=10.443980, Expected=10.362000
At time point=1061, Predicted=10.405723, Expected=10.362000
At time point=1062, Predicted=10.363734, Expected=10.426000
At time point=1063, Predicted=10.442917, Expected=10.508000
At time point=1064, Predicted=10.461390, Expected=10.653000
At time point=1065, Predicted=10.621522, Expected=10.719000
At time point=1066, Predicted=10.671389, Expected=10.809000
At time point=1067, Predicted=10.776530, Expected=11.046000
At time point=1068, Predicted=11.080419, Expected=11.231000
At time point=1069, Predicted=11.274039, Expected=11.264000
At time point=1070, Predicted=11.264544, Expected=11.348000
```
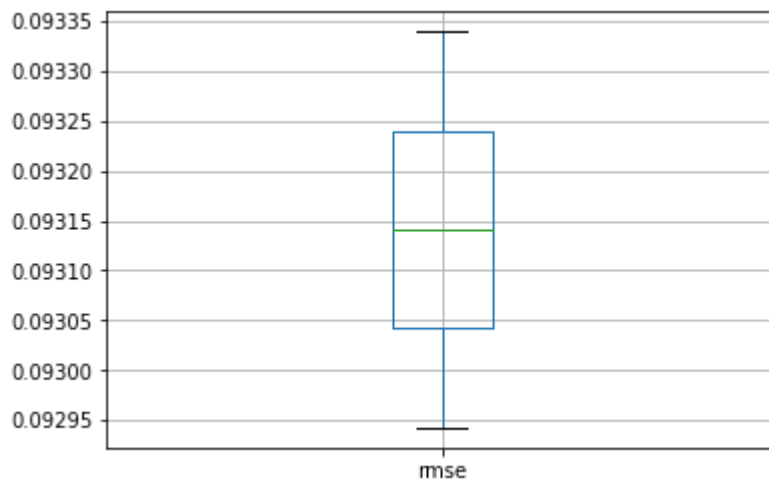
```
At time point=1071, Predicted=11.392473, Expected=11.521000
At time point=1072, Predicted=11.496474, Expected=11.553000
At time point=1073, Predicted=11.598508, Expected=11.725000
At time point=1074, Predicted=11.697880, Expected=11.762000
At time point=1075, Predicted=11.760515, Expected=11.785000
At time point=1076, Predicted=11.732641, Expected=11.853000
At time point=1077, Predicted=11.821469, Expected=11.983000
At time point=1078, Predicted=12.027394, Expected=11.836000
At time point=1079, Predicted=11.781061, Expected=11.919000
At time point=1080, Predicted=11.936189, Expected=11.745000
At time point=1081, Predicted=11.800560, Expected=11.848000
At time point=1082, Predicted=11.846653, Expected=12.028000
At time point=1083, Predicted=12.092075, Expected=12.097000
At time point=1084, Predicted=12.041129, Expected=12.279000
At time point=1085, Predicted=12.238197, Expected=12.439000
At time point=1086, Predicted=12.416910, Expected=12.533000
At time point=1087, Predicted=12.528511, Expected=12.669000
At time point=1088, Predicted=12.737532, Expected=12.608000
At time point=1089, Predicted=12.653317, Expected=12.608000
At time point=1090, Predicted=12.590584, Expected=12.614000
At time point=1091, Predicted=12.624936, Expected=12.705000
At time point=1092, Predicted=12.731257, Expected=12.956000
At time point=1093, Predicted=13.032092, Expected=12.932000
At time point=1094, Predicted=12.882077, Expected=12.843000
At time point=1095, Predicted=12.818969, Expected=12.852000
At time point=1096, Predicted=12.844092, Expected=12.879000
At time point=1097, Predicted=12.927903, Expected=12.847000
At time point=1098, Predicted=12.902745, Expected=12.884000
At time point=1099, Predicted=12.839542, Expected=13.054000
At time point=1100, Predicted=13.075531, Expected=12.869000
At time point=1101, Predicted=12.913759, Expected=12.869000
At time point=1102, Predicted=12.887710, Expected=12.855000
At time point=1103, Predicted=12.926712, Expected=12.887000
At time point=1104, Predicted=12.947698, Expected=13.000000
At time point=1105, Predicted=13.034697, Expected=12.978000
At time point=1106, Predicted=13.037818, Expected=13.080000
At time point=1107, Predicted=13.116317, Expected=13.188000
At time point=1108, Predicted=13.177267, Expected=13.313000
At time point=1109, Predicted=13.416476, Expected=13.373000
At time point=1110, Predicted=13.419015, Expected=13.490000
At time point=1111, Predicted=13.531739, Expected=13.635000
At time point=1112, Predicted=13.661108, Expected=13.710000
At time point=1113, Predicted=13.758995, Expected=13.763000
At time point=1114, Predicted=13.814708, Expected=13.739000
At time point=1115, Predicted=13.688797, Expected=13.701000
At time point=1116, Predicted=13.648815, Expected=13.654000
At time point=1117, Predicted=13.663008, Expected=13.623000
At time point=1118, Predicted=13.638036, Expected=13.721000
At time point=1119, Predicted=13.752976, Expected=13.774000
At time point=1120, Predicted=13.836511, Expected=13.821000
At time point=1121, Predicted=13.792536, Expected=13.826000
At time point=1122, Predicted=13.770334, Expected=13.886000
At time point=1123, Predicted=13.914149, Expected=13.834000
At time point=1124, Predicted=13.819708, Expected=13.863000
At time point=1125, Predicted=13.931330, Expected=13.956000
At time point=1126, Predicted=13.931660, Expected=13.873000
At time point=1127, Predicted=13.836718, Expected=13.901000
At time point=1128, Predicted=13.881677, Expected=13.912000
At time point=1129, Predicted=13.857700, Expected=13.926000
At time point=1130, Predicted=13.909020, Expected=13.865000
At time point=1131, Predicted=13.893472, Expected=13.898000
```

```
At time point=1132, Predicted=13.881410, Expected=14.034000
At time point=1133, Predicted=14.065228, Expected=14.161000
At time point=1134, Predicted=14.113434, Expected=14.151000
At time point=1135, Predicted=14.217155, Expected=14.301000
At time point=1136, Predicted=14.255674, Expected=14.275000
At time point=1137, Predicted=14.238821, Expected=14.304000
At time point=1138, Predicted=14.332379, Expected=14.327000
At time point=1139, Predicted=14.342484, Expected=14.300000
At time point=1140, Predicted=14.251460, Expected=14.287000
At time point=1141, Predicted=14.231425, Expected=14.418000
At time point=1142, Predicted=14.444120, Expected=14.378000
At time point=1143, Predicted=14.427714, Expected=14.357000
At time point=1144, Predicted=14.385321, Expected=14.362000
At time point=1145, Predicted=14.458449, Expected=14.324000
At time point=1146, Predicted=14.281264, Expected=14.284000
At time point=1147, Predicted=14.262000, Expected=14.305000
At time point=1148, Predicted=14.349436, Expected=14.358000
At time point=1149, Predicted=14.314154, Expected=14.379000
At time point=1150, Predicted=14.357971, Expected=14.406000
At time point=1151, Predicted=14.353641, Expected=14.431000
At time point=1152, Predicted=14.422676, Expected=14.447000
At time point=1153, Predicted=14.422288, Expected=14.424000
At time point=1154, Predicted=14.369442, Expected=14.391000
At time point=1155, Predicted=14.341902, Expected=14.356000
At time point=1156, Predicted=14.395121, Expected=14.318000
At time point=1157, Predicted=14.352388, Expected=14.284000
At time point=1158, Predicted=14.232428, Expected=14.421000
At time point=1159, Predicted=14.496075, Expected=14.403000
At time point=1160, Predicted=14.459794, Expected=14.370000
At time point=1161, Predicted=14.435818, Expected=14.424000
At time point=1162, Predicted=14.378691, Expected=14.407000
At time point=1163, Predicted=14.442052, Expected=14.273000
At time point=1164, Predicted=14.293923, Expected=14.242000
At time point=1165, Predicted=14.214391, Expected=14.178000
At time point=1166, Predicted=14.230109, Expected=14.195000
At time point=1167, Predicted=14.245431, Expected=14.217000
At time point=1168, Predicted=14.210897, Expected=14.196000
At time point=1169, Predicted=14.194531, Expected=14.136000
At time point=1170, Predicted=14.145101, Expected=14.076000
At time point=1171, Predicted=14.132342, Expected=14.073000
At time point=1172, Predicted=14.119356, Expected=14.073000
At time point=1173, Predicted=14.098767, Expected=14.107000
At time point=1174, Predicted=14.058036, Expected=14.169000
At time point=1175, Predicted=14.170246, Expected=14.178000
At time point=1176, Predicted=14.158955, Expected=14.178000
At time point=1177, Predicted=14.121972, Expected=14.181000
At time point=1178, Predicted=14.172741, Expected=14.172000
At time point=1179, Predicted=14.127621, Expected=14.126000
At time point=1180, Predicted=14.079280, Expected=14.143000
At time point=1181, Predicted=14.182561, Expected=14.227000
At time point=1182, Predicted=14.208652, Expected=14.209000
At time point=1183, Predicted=14.190937, Expected=14.114000
At time point=1184, Predicted=14.156637, Expected=14.040000
At time point=1185, Predicted=14.013370, Expected=14.094000
At time point=1186, Predicted=14.069205, Expected=13.993000
At time point=1187, Predicted=13.984023, Expected=13.875000
At time point=1188, Predicted=13.949384, Expected=13.899000
At time point=1189, Predicted=13.925081, Expected=13.935000
At time point=1190, Predicted=13.942933, Expected=13.911000
At time point=1191, Predicted=13.855641, Expected=13.785000
At time point=1192, Predicted=13.730739, Expected=13.717000
```

```
At time point=1193, Predicted=13.669549, Expected=13.740000
At time point=1194, Predicted=13.761821, Expected=13.704000
At time point=1195, Predicted=13.707794, Expected=13.738000
At time point=1196, Predicted=13.684912, Expected=13.667000
At time point=1197, Predicted=13.668211, Expected=13.624000
At time point=1198, Predicted=13.693719, Expected=13.591000
At time point=1199, Predicted=13.567252, Expected=13.562000
At time point=1200, Predicted=13.573372, Expected=13.492000
At time point=1201, Predicted=13.541209, Expected=13.498000
At time point=1202, Predicted=13.558139, Expected=13.496000
At time point=1203, Predicted=13.520303, Expected=13.459000
At time point=1204, Predicted=13.484316, Expected=13.464000
At time point=1205, Predicted=13.544603, Expected=13.451000
At time point=1206, Predicted=13.399612, Expected=13.436000
At time point=1207, Predicted=13.402312, Expected=13.425000
At time point=1208, Predicted=13.420899, Expected=13.393000
At time point=1209, Predicted=13.397186, Expected=13.134000
At time point=1210, Predicted=13.163694, Expected=13.096000
At time point=1211, Predicted=13.149587, Expected=13.114000
At time point=1212, Predicted=13.136557, Expected=13.026000
At time point=1213, Predicted=13.061490, Expected=13.035000
At time point=1214, Predicted=13.101113, Expected=13.079000
At time point=1215, Predicted=13.159176, Expected=12.985000
At time point=1216, Predicted=12.933830, Expected=12.985000
At time point=1217, Predicted=13.014152, Expected=12.934000
At time point=1218, Predicted=12.999646, Expected=12.899000
At time point=1219, Predicted=12.933277, Expected=12.830000
At time point=1220, Predicted=12.777294, Expected=12.753000
At time point=1221, Predicted=12.723643, Expected=12.687000
At time point=1222, Predicted=12.718207, Expected=12.665000
At time point=1223, Predicted=12.657103, Expected=12.673000
At time point=1224, Predicted=12.666017, Expected=12.605000
At time point=1225, Predicted=12.645781, Expected=12.600000
At time point=1226, Predicted=12.548844, Expected=12.500000
At time point=1227, Predicted=12.519672, Expected=12.495000
At time point=1228, Predicted=12.451599, Expected=12.514000
At time point=1229, Predicted=12.575218, Expected=12.434000
At time point=1230, Predicted=12.383461, Expected=12.353000
At time point=1231, Predicted=12.373074, Expected=12.345000
At time point=1232, Predicted=12.302185, Expected=12.302000
At time point=1233, Predicted=12.280629, Expected=12.255000
At time point=1234, Predicted=12.254190, Expected=12.274000
At time point=1235, Predicted=12.222505, Expected=12.214000
At time point=1236, Predicted=12.218569, Expected=12.156000
At time point=1237, Predicted=12.145812, Expected=12.107000
At time point=1238, Predicted=12.150424, Expected=12.065000
At time point=1239, Predicted=12.033595, Expected=11.997000
At time point=1240, Predicted=11.975336, Expected=11.780000
At time point=1241, Predicted=11.805017, Expected=11.765000
At time point=1242, Predicted=11.762539, Expected=11.681000
At time point=1243, Predicted=11.649927, Expected=11.601000
At time point=1244, Predicted=11.624831, Expected=11.545000
At time point=1245, Predicted=11.503913, Expected=11.510000
At time point=1246, Predicted=11.513931, Expected=11.455000
2) Test RMSE: 0.093

          rmse
count  2.000000
mean   0.093141
std    0.000281
min    0.092942
```

```
25%     0.093042
50%     0.093141
75%     0.093240
max     0.093340
```
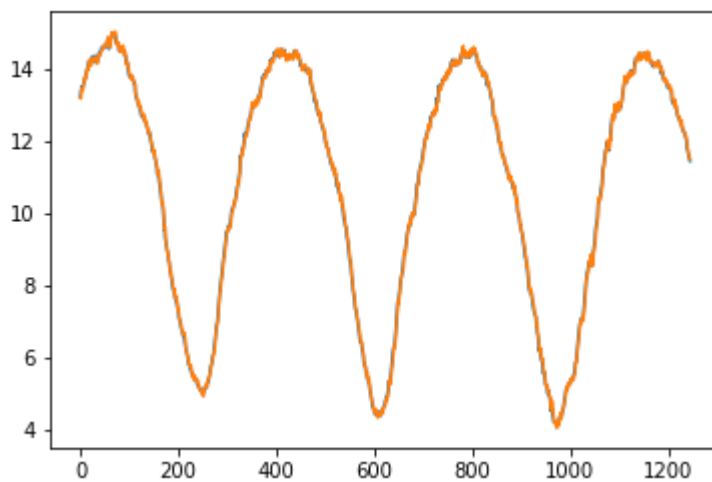

In [14]:

```
lstm_model
```

Out[14]:

```
<keras.models.Sequential at 0x7f4599f79ef0>
```

In [15]:

```python
# line plot of observed vs predicted on test_data
plt.plot(y_truth)
plt.plot(y_pred)
plt.show()
```


In [ ]: