In [1]:
```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
#Importing data
df = pd.read_excel(r'F:\Prthon Programming\Time Series Modelling\Sample - Supe
rstore.xls')
#Printing head
df.head()
```

Out[1]:

	Row ID	Order ID	Order Date	Ship Date	Ship Mode	Customer ID	Customer Name	Segment	Country	City
0	1	CA-2016-152156	2016-11-08	2016-11-11	Second Class	CG-12520	Claire Gute	Consumer	United States	Henderson
1	2	CA-2016-152156	2016-11-08	2016-11-11	Second Class	CG-12520	Claire Gute	Consumer	United States	Henderson
2	3	CA-2016-138688	2016-06-12	2016-06-16	Second Class	DV-13045	Darrin Van Huff	Corporate	United States	Los Angeles
3	4	US-2015-108966	2015-10-11	2015-10-18	Standard Class	SO-20335	Sean O'Donnell	Consumer	United States	Fort Lauderdale
4	5	US-2015-108966	2015-10-11	2015-10-18	Standard Class	SO-20335	Sean O'Donnell	Consumer	United States	Fort Lauderdale

5 rows × 21 columns
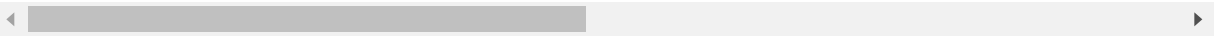
In [2]:
```python
df.shape
```

Out[2]: (9994, 21)

In [3]:
```python
df.Category.value_counts()
```

Out[3]:
```
Office Supplies    6026
Furniture          2121
Technology         1847
Name: Category, dtype: int64
```

In [4]:
```python
furniture = df.loc[df['Category'] == 'Furniture']
furniture.shape
```

Out[4]: (2121, 21)

In [6]:
```python
furniture=furniture[["Order Date","Sales"]]
furniture = furniture.sort_values('Order Date')
```

In [7]:
```python
furniture['Order Date'].min(), furniture['Order Date'].max()
```

Out[7]: `(Timestamp('2014-01-06 00:00:00'), Timestamp('2017-12-30 00:00:00'))`

```
In [8]: furniture
```

Out[8]:

	Order Date	Sales
7474	2014-01-06	2573.8200
7660	2014-01-07	76.7280
866	2014-01-10	51.9400
716	2014-01-11	9.9400
2978	2014-01-13	545.9400
4938	2014-01-13	333.9990
6474	2014-01-14	61.9600
970	2014-01-16	127.1040
5465	2014-01-19	181.4700
6327	2014-01-20	272.9400
6332	2014-01-20	14.7300
1123	2014-01-20	38.6000
5737	2014-01-20	19.3000
1126	2014-01-20	1067.9400
9989	2014-01-21	25.2480
2578	2014-01-26	62.8200
2583	2014-01-26	12.4200
8150	2014-01-26	141.9600
3795	2014-01-27	333.0000
3365	2014-01-31	290.6660
9266	2014-02-08	14.5600
9254	2014-02-11	60.8900
5631	2014-02-11	1256.2200
9257	2014-02-11	332.9400
456	2014-02-12	129.5680
6081	2014-02-18	25.1600
4521	2014-02-20	20.3200
8310	2014-03-01	376.5090
157	2014-03-01	457.5680
6547	2014-03-01	634.1160
...	...	...
2058	2017-12-22	411.8000
8949	2017-12-22	934.9560
8577	2017-12-22	607.5200
7151	2017-12-22	182.5500

	Order Date	Sales
6222	2017-12-23	72.7040
8391	2017-12-23	27.4600
2294	2017-12-23	181.9500
3314	2017-12-24	271.7640
5147	2017-12-24	8.5440
5148	2017-12-24	842.3760
4030	2017-12-24	232.8800
3700	2017-12-24	37.9300
8956	2017-12-25	21.0000
688	2017-12-25	191.9840
110	2017-12-25	41.9600
2425	2017-12-25	273.0600
2003	2017-12-25	304.4500
6149	2017-12-28	340.7040
6821	2017-12-28	2.9600
954	2017-12-28	78.8528
6819	2017-12-28	7.9680
6820	2017-12-28	113.3720
2431	2017-12-28	7.4000
5131	2017-12-29	101.1200
7632	2017-12-29	1207.8400
7635	2017-12-29	300.9800
5457	2017-12-29	68.4600
1877	2017-12-29	393.5680
7636	2017-12-29	258.7500
906	2017-12-30	323.1360

2121 rows × 2 columns

```
In [9]:  furniture = furniture.groupby('Order Date')['Sales'].sum().reset_index()
         furniture.shape
```

```
Out[9]:  (889, 2)
```

```
In [10]:  furniture = furniture.set_index('Order Date')
```

In [11]: `furniture.head()`

Out[11]:

	Sales
Order Date	
2014-01-06	2573.820
2014-01-07	76.728
2014-01-10	51.940
2014-01-11	9.940
2014-01-13	879.939

In [12]: `y = furniture['Sales'].resample('MS').sum()`

In [13]: `y.head()`

Out[13]:
```
Order Date
2014-01-01     6242.525
2014-02-01     1839.658
2014-03-01    14573.956
2014-04-01     7944.837
2014-05-01     6912.787
Freq: MS, Name: Sales, dtype: float64
```

In [14]: `y.shape`

Out[14]: `(48,)`

In [15]:
```python
y.plot(figsize=(10, 6))
plt.show()
```
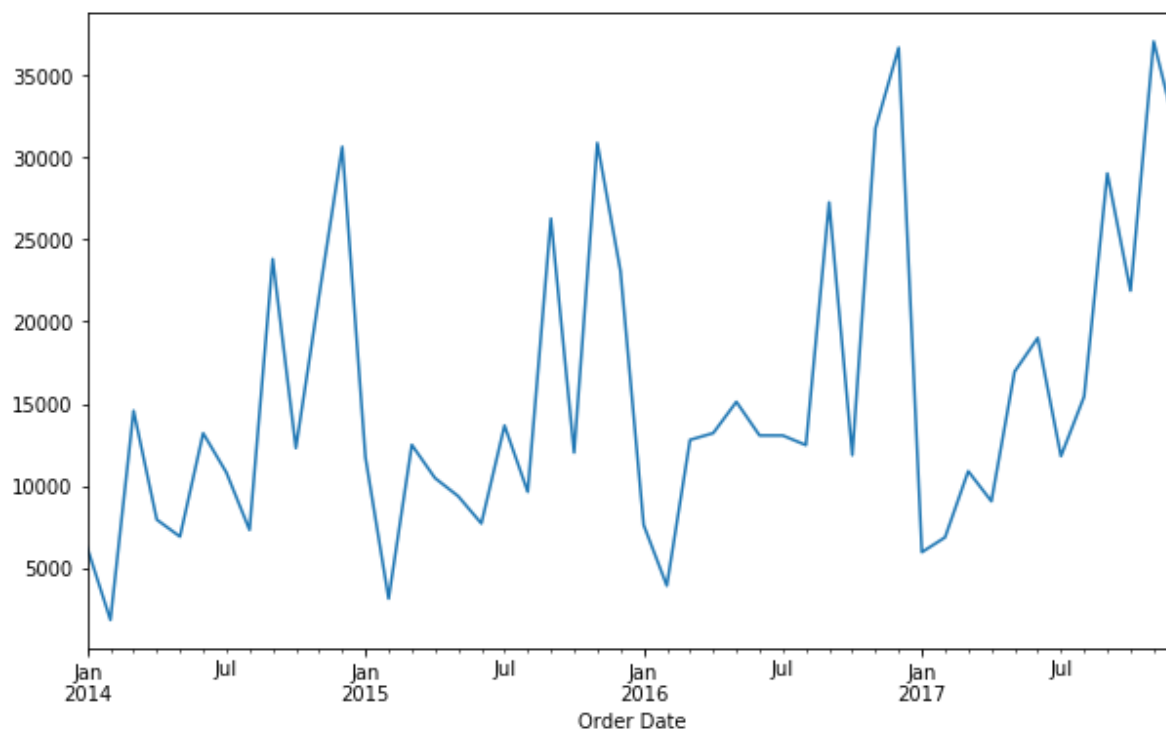

In [16]:
```python
#checking stationarity
from statsmodels.tsa.stattools import adfuller

result = adfuller(y)
print('ADF Statistic:',result[0])
print('p-value: %f' %result[1])
```
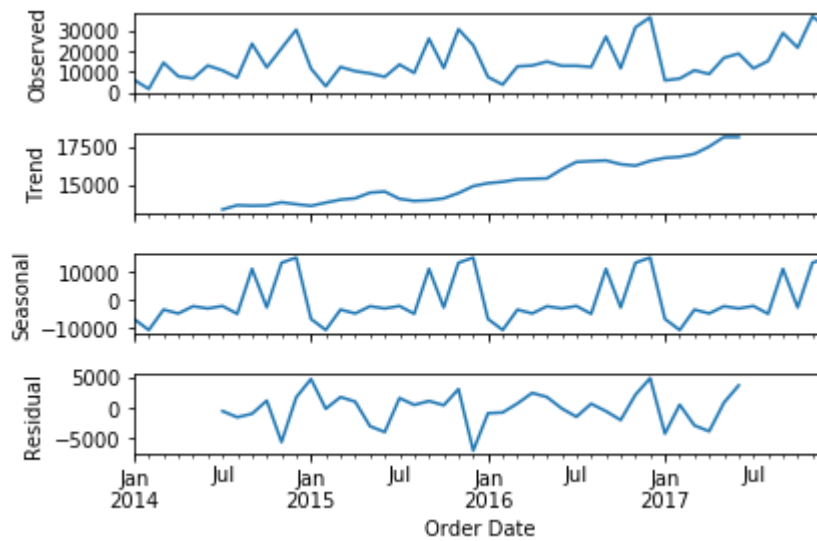
```
ADF Statistic: -4.699026242828904
p-value: 0.000085
```

In [ ]:

In [17]:
```python
"""f=y.diff( periods= 1)
f.plot(figsize=(10, 6))
plt.show()
"""
```

Out[17]: `'f=y.diff( periods= 1)\nf.plot(figsize=(10, 6))\nplt.show()\n'`

In [18]:
```python
import statsmodels.api as sm
decomposition = sm.tsa.seasonal_decompose(y).plot()
plt.show()
```


In [19]:
```python
import itertools
p = d = q = range(0, 3)
pdq = list(itertools.product(p, d, q))
seasonal_pdq = [(x[0], x[1], x[2], 12) for x in list(itertools.product(p, d, q
))]

print('SARIMAX:',pdq[1],'x', seasonal_pdq[0])
```

SARIMAX: (0, 0, 1) x (0, 0, 0, 12)

In [20]: pdq

Out[20]: [(0, 0, 0),
 (0, 0, 1),
 (0, 0, 2),
 (0, 1, 0),
 (0, 1, 1),
 (0, 1, 2),
 (0, 2, 0),
 (0, 2, 1),
 (0, 2, 2),
 (1, 0, 0),
 (1, 0, 1),
 (1, 0, 2),
 (1, 1, 0),
 (1, 1, 1),
 (1, 1, 2),
 (1, 2, 0),
 (1, 2, 1),
 (1, 2, 2),
 (2, 0, 0),
 (2, 0, 1),
 (2, 0, 2),
 (2, 1, 0),
 (2, 1, 1),
 (2, 1, 2),
 (2, 2, 0),
 (2, 2, 1),
 (2, 2, 2)]

In [21]:
```python
#from pylab import rcParams
for param in pdq:
    for param_seasonal in seasonal_pdq:
        try:

            mod = sm.tsa.statespace.SARIMAX(y, order=param,
            seasonal_order=param_seasonal)
            results = mod.fit()
            print('ARIMA',param,'x',param_seasonal,' - AIC:',results.aic)
        except:
            continue

for param in pdq:
```

```
C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\tsa\statespace\represe
ntation.py:375: FutureWarning: Using a non-tuple sequence for multidimensiona
l indexing is deprecated; use `arr[tuple(seq)]` instead of `arr[seq]`. In the
future this will be interpreted as an array index, `arr[np.array(seq)]`, whic
h will result either in an error or a different result.
  return matrix[[slice(None)]*(matrix.ndim-1) + [0]]
```

```
ARIMA (0, 0, 0) x (0, 0, 0, 12)  - AIC: 1078.25888197625
ARIMA (0, 0, 0) x (0, 1, 0, 12)  - AIC: 711.5292873229321
ARIMA (0, 0, 0) x (0, 2, 0, 12)  - AIC: 497.8250498333558
ARIMA (0, 0, 0) x (1, 1, 0, 12)  - AIC: 713.4200494282587
ARIMA (0, 0, 0) x (1, 2, 0, 12)  - AIC: 490.1871497788159
ARIMA (0, 0, 0) x (2, 1, 0, 12)  - AIC: 708.7100068262416
ARIMA (0, 0, 1) x (0, 0, 0, 12)  - AIC: 1059.3672749377372
ARIMA (0, 0, 1) x (0, 1, 0, 12)  - AIC: 712.7790106247764
ARIMA (0, 0, 1) x (0, 2, 0, 12)  - AIC: 499.43007675371155
ARIMA (0, 0, 1) x (1, 1, 0, 12)  - AIC: 714.3827137353888
ARIMA (0, 0, 1) x (1, 2, 0, 12)  - AIC: 488.44042095057733
ARIMA (0, 0, 1) x (2, 1, 0, 12)  - AIC: 711.4497716825224
ARIMA (0, 0, 2) x (0, 0, 0, 12)  - AIC: 1058.9383831637708
ARIMA (0, 0, 2) x (0, 1, 0, 12)  - AIC: 714.9183736731646
ARIMA (0, 0, 2) x (0, 2, 0, 12)  - AIC: 501.3441254046397
ARIMA (0, 0, 2) x (1, 1, 0, 12)  - AIC: 716.4370665861805
ARIMA (0, 0, 2) x (1, 2, 0, 12)  - AIC: 493.93736561637286
ARIMA (0, 0, 2) x (2, 1, 0, 12)  - AIC: 713.9025584287729
ARIMA (0, 1, 0) x (0, 0, 0, 12)  - AIC: 1005.373641264173
ARIMA (0, 1, 0) x (0, 1, 0, 12)  - AIC: 714.9974499615421
ARIMA (0, 1, 0) x (0, 2, 0, 12)  - AIC: 492.4441040872967
ARIMA (0, 1, 0) x (1, 0, 0, 12)  - AIC: 979.0640123348828
ARIMA (0, 1, 0) x (1, 0, 1, 12)  - AIC: 980.1027910110653
ARIMA (0, 1, 0) x (1, 1, 0, 12)  - AIC: 713.4941299842149
ARIMA (0, 1, 0) x (1, 2, 0, 12)  - AIC: 479.188161731529
ARIMA (0, 1, 0) x (2, 0, 0, 12)  - AIC: 981.8451811921093
```

```
C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\base\model.py:508: Con
vergenceWarning: Maximum Likelihood optimization failed to converge. Check ml
e_retvals
  "Check mle_retvals", ConvergenceWarning)
```

```
ARIMA (0, 1, 0) x (2, 0, 1, 12)  - AIC: 978.2990713685822
ARIMA (0, 1, 0) x (2, 1, 0, 12)  - AIC: 713.7596081782846
ARIMA (0, 1, 1) x (0, 0, 0, 12)  - AIC: 994.2446376692089
ARIMA (0, 1, 1) x (0, 1, 0, 12)  - AIC: 711.3983144343784
ARIMA (0, 1, 1) x (0, 2, 0, 12)  - AIC: 483.73048878609376
ARIMA (0, 1, 1) x (1, 0, 0, 12)  - AIC: 968.1204696377122
ARIMA (0, 1, 1) x (1, 0, 1, 12)  - AIC: 967.6697035962119
ARIMA (0, 1, 1) x (1, 1, 0, 12)  - AIC: 709.3634613045627
ARIMA (0, 1, 1) x (1, 2, 0, 12)  - AIC: 468.73771275188085
ARIMA (0, 1, 1) x (2, 0, 0, 12)  - AIC: 964.6630550623803
ARIMA (0, 1, 1) x (2, 0, 1, 12)  - AIC: 984.1714525596075
ARIMA (0, 1, 1) x (2, 1, 0, 12)  - AIC: 709.1624931868283
ARIMA (0, 1, 2) x (0, 0, 0, 12)  - AIC: 994.8502225261554
ARIMA (0, 1, 2) x (0, 1, 0, 12)  - AIC: 712.2228795169501
ARIMA (0, 1, 2) x (0, 2, 0, 12)  - AIC: 484.6128970481769
ARIMA (0, 1, 2) x (1, 0, 0, 12)  - AIC: 982.3324890615988
ARIMA (0, 1, 2) x (1, 0, 1, 12)  - AIC: 968.9617194121556
ARIMA (0, 1, 2) x (1, 1, 0, 12)  - AIC: 709.4008540021892
ARIMA (0, 1, 2) x (1, 2, 0, 12)  - AIC: 480.1291111839206
ARIMA (0, 1, 2) x (2, 0, 0, 12)  - AIC: 966.2441674284768
ARIMA (0, 1, 2) x (2, 0, 1, 12)  - AIC: 968.3934922848431
ARIMA (0, 1, 2) x (2, 1, 0, 12)  - AIC: 709.9370469103158
ARIMA (0, 2, 0) x (0, 0, 0, 12)  - AIC: 1032.1247708705991
ARIMA (0, 2, 0) x (0, 1, 0, 12)  - AIC: 730.6784162481124
ARIMA (0, 2, 0) x (0, 2, 0, 12)  - AIC: 491.9347976016204
ARIMA (0, 2, 0) x (1, 0, 0, 12)  - AIC: 1005.614140272284
ARIMA (0, 2, 0) x (1, 1, 0, 12)  - AIC: 730.2416363743312
ARIMA (0, 2, 0) x (1, 2, 0, 12)  - AIC: 493.03453860582493
ARIMA (0, 2, 0) x (2, 0, 0, 12)  - AIC: 1004.75748134836
ARIMA (0, 2, 0) x (2, 1, 0, 12)  - AIC: 736.800479563943
ARIMA (0, 2, 2) x (0, 0, 0, 12)  - AIC: 983.9203676816951
ARIMA (0, 2, 2) x (0, 1, 0, 12)  - AIC: 692.5276503503761
ARIMA (0, 2, 2) x (0, 2, 0, 12)  - AIC: 476.2412610696081
ARIMA (0, 2, 2) x (1, 0, 0, 12)  - AIC: 976.269909808377
ARIMA (0, 2, 2) x (1, 1, 0, 12)  - AIC: 690.3352934312088
ARIMA (0, 2, 2) x (1, 2, 0, 12)  - AIC: 456.4105128136662
```

C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\base\model.py:508: Con
vergenceWarning: Maximum Likelihood optimization failed to converge. Check ml
e_retvals
  "Check mle_retvals", ConvergenceWarning)

```
ARIMA (0, 2, 2) x (2, 0, 0, 12)  - AIC: 954.8065689573727
ARIMA (0, 2, 2) x (2, 1, 0, 12)  - AIC: 690.8239786199736
ARIMA (1, 0, 0) x (0, 0, 0, 12)  - AIC: 1026.1291342527693
ARIMA (1, 0, 0) x (0, 1, 0, 12)  - AIC: 712.5992604202137
ARIMA (1, 0, 0) x (0, 2, 0, 12)  - AIC: 499.3653811453298
ARIMA (1, 0, 0) x (1, 1, 0, 12)  - AIC: 714.0923601681997
ARIMA (1, 0, 0) x (1, 2, 0, 12)  - AIC: 491.0268894632976
ARIMA (1, 0, 0) x (2, 1, 0, 12)  - AIC: 710.8560188488758
ARIMA (1, 0, 2) x (0, 0, 0, 12)  - AIC: 1019.1717695861923
ARIMA (1, 0, 2) x (0, 1, 0, 12)  - AIC: 716.8489022859978
ARIMA (1, 0, 2) x (1, 1, 0, 12)  - AIC: 718.388446170616
ARIMA (1, 0, 2) x (2, 1, 0, 12)  - AIC: 715.3465921012211
ARIMA (1, 1, 0) x (0, 0, 0, 12)  - AIC: 999.1166037056389
ARIMA (1, 1, 0) x (0, 1, 0, 12)  - AIC: 713.180780609953
ARIMA (1, 1, 0) x (0, 2, 0, 12)  - AIC: 492.94482781840037
ARIMA (1, 1, 0) x (1, 0, 0, 12)  - AIC: 974.7378628151226
ARIMA (1, 1, 0) x (1, 0, 1, 12)  - AIC: 986.0083910557215
ARIMA (1, 1, 0) x (1, 1, 0, 12)  - AIC: 711.1441203937896
ARIMA (1, 1, 0) x (1, 2, 0, 12)  - AIC: 480.76797102866595
ARIMA (1, 1, 0) x (2, 0, 0, 12)  - AIC: 974.016698946044
ARIMA (1, 1, 0) x (2, 0, 1, 12)  - AIC: 987.3370862731582
ARIMA (1, 1, 0) x (2, 1, 0, 12)  - AIC: 711.2665291418245
ARIMA (1, 1, 1) x (0, 0, 0, 12)  - AIC: 994.7447798905675
ARIMA (1, 1, 1) x (0, 1, 0, 12)  - AIC: 710.7930830536706
ARIMA (1, 1, 1) x (0, 2, 0, 12)  - AIC: 484.60173696478853
ARIMA (1, 1, 1) x (1, 0, 0, 12)  - AIC: 971.0228633394825
ARIMA (1, 1, 1) x (1, 0, 1, 12)  - AIC: 984.0314199895295
ARIMA (1, 1, 1) x (1, 1, 0, 12)  - AIC: 708.4278175033152
ARIMA (1, 1, 1) x (1, 2, 0, 12)  - AIC: 478.8080756224909
ARIMA (1, 1, 1) x (2, 0, 0, 12)  - AIC: 983.7594109904682
```

C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\base\model.py:508: Con
vergenceWarning: Maximum Likelihood optimization failed to converge. Check ml
e_retvals
  "Check mle_retvals", ConvergenceWarning)

```
ARIMA (1, 1, 1) x (2, 0, 1, 12)  - AIC: 972.8171697461755
ARIMA (1, 1, 1) x (2, 1, 0, 12)  - AIC: 708.9846472774391
ARIMA (1, 1, 2) x (0, 0, 0, 12)  - AIC: 996.508469235134
ARIMA (1, 1, 2) x (1, 0, 0, 12)  - AIC: 971.9013759410728
ARIMA (1, 1, 2) x (2, 0, 0, 12)  - AIC: 974.7529267129316
```

C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\base\model.py:508: Con
vergenceWarning: Maximum Likelihood optimization failed to converge. Check ml
e_retvals
  "Check mle_retvals", ConvergenceWarning)

```
ARIMA (1, 1, 2) x (2, 0, 1, 12)  - AIC: 980.0366752893024
ARIMA (1, 2, 0) x (0, 0, 0, 12)  - AIC: 1012.9597085181141
ARIMA (1, 2, 0) x (0, 1, 0, 12)  - AIC: 716.8567528573021
ARIMA (1, 2, 0) x (0, 2, 0, 12)  - AIC: 483.5407673371978
ARIMA (1, 2, 0) x (1, 0, 0, 12)  - AIC: 996.8249898608191
ARIMA (1, 2, 0) x (1, 1, 0, 12)  - AIC: 715.6089894970385
ARIMA (1, 2, 0) x (1, 2, 0, 12)  - AIC: 472.987208264965
ARIMA (1, 2, 0) x (2, 0, 0, 12)  - AIC: 982.9303384038968
ARIMA (1, 2, 0) x (2, 1, 0, 12)  - AIC: 716.4975643377264
ARIMA (1, 2, 1) x (0, 0, 0, 12)  - AIC: 983.4961032602013
ARIMA (1, 2, 1) x (0, 2, 0, 12)  - AIC: 473.555445044065
ARIMA (1, 2, 1) x (1, 0, 0, 12)  - AIC: 957.5158692394735
ARIMA (1, 2, 1) x (1, 2, 0, 12)  - AIC: 467.0759719585721
ARIMA (1, 2, 1) x (2, 0, 0, 12)  - AIC: 957.3971653372782
ARIMA (1, 2, 2) x (0, 2, 0, 12)  - AIC: 476.75780896747415
```

```
C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\base\model.py:508: Con
vergenceWarning: Maximum Likelihood optimization failed to converge. Check ml
e_retvals
  "Check mle_retvals", ConvergenceWarning)
```

```
ARIMA (1, 2, 2) x (1, 2, 0, 12)  - AIC: 460.70261769898116
ARIMA (2, 0, 0) x (0, 0, 0, 12)  - AIC: 1022.6194463277427
ARIMA (2, 0, 0) x (0, 1, 0, 12)  - AIC: 714.5665834215898
ARIMA (2, 0, 0) x (0, 2, 0, 12)  - AIC: 501.23776659221903
ARIMA (2, 0, 0) x (1, 1, 0, 12)  - AIC: 715.9756024118651
ARIMA (2, 0, 0) x (1, 2, 0, 12)  - AIC: 493.0799800195158
ARIMA (2, 0, 0) x (2, 1, 0, 12)  - AIC: 712.9258249332372
ARIMA (2, 0, 1) x (0, 2, 0, 12)  - AIC: 502.6138722362498
ARIMA (2, 0, 1) x (1, 2, 0, 12)  - AIC: 495.13000119605476
ARIMA (2, 0, 2) x (0, 1, 0, 12)  - AIC: 718.8453743001758
```

```
C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\base\model.py:508: Con
vergenceWarning: Maximum Likelihood optimization failed to converge. Check ml
e_retvals
  "Check mle_retvals", ConvergenceWarning)
```

```
ARIMA (2, 0, 2) x (1, 1, 0, 12)  - AIC: 715.0085603499401
ARIMA (2, 0, 2) x (2, 1, 0, 12)  - AIC: 717.3187936713397
ARIMA (2, 1, 0) x (0, 0, 0, 12)  - AIC: 996.3001515631211
ARIMA (2, 1, 0) x (0, 1, 0, 12)  - AIC: 715.3780616351931
ARIMA (2, 1, 0) x (0, 2, 0, 12)  - AIC: 494.20694466093016
ARIMA (2, 1, 0) x (1, 0, 0, 12)  - AIC: 972.968657719973
ARIMA (2, 1, 0) x (1, 0, 1, 12)  - AIC: 983.0714575970293
ARIMA (2, 1, 0) x (1, 1, 0, 12)  - AIC: 712.398353969588
ARIMA (2, 1, 0) x (1, 2, 0, 12)  - AIC: 480.8787512301341
ARIMA (2, 1, 0) x (2, 0, 0, 12)  - AIC: 982.7111557114589
ARIMA (2, 1, 0) x (2, 0, 1, 12)  - AIC: 984.1053144096237
ARIMA (2, 1, 0) x (2, 1, 0, 12)  - AIC: 712.4270757509883
ARIMA (2, 1, 1) x (0, 0, 0, 12)  - AIC: 998.3130305829334
ARIMA (2, 1, 1) x (0, 1, 0, 12)  - AIC: 712.5526169602472
ARIMA (2, 1, 1) x (0, 2, 0, 12)  - AIC: 486.5847082718699
ARIMA (2, 1, 1) x (1, 0, 0, 12)  - AIC: 982.8793329125845
ARIMA (2, 1, 1) x (1, 0, 1, 12)  - AIC: 984.4150503643885
ARIMA (2, 1, 1) x (1, 1, 0, 12)  - AIC: 710.3345211237325
ARIMA (2, 1, 1) x (1, 2, 0, 12)  - AIC: 480.79429517043553
ARIMA (2, 1, 1) x (2, 0, 0, 12)  - AIC: 984.1102509828837
```

```
C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\base\model.py:508: Con
vergenceWarning: Maximum Likelihood optimization failed to converge. Check ml
e_retvals
  "Check mle_retvals", ConvergenceWarning)

ARIMA (2, 1, 1) x (2, 0, 1, 12)  - AIC: 974.8355273113718
ARIMA (2, 1, 1) x (2, 1, 0, 12)  - AIC: 710.6940536852787
ARIMA (2, 1, 2) x (0, 0, 0, 12)  - AIC: 997.2772232911359
ARIMA (2, 1, 2) x (1, 0, 0, 12)  - AIC: 981.7604314544373

C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\base\model.py:508: Con
vergenceWarning: Maximum Likelihood optimization failed to converge. Check ml
e_retvals
  "Check mle_retvals", ConvergenceWarning)

ARIMA (2, 1, 2) x (1, 0, 1, 12)  - AIC: 974.380629088097

C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\base\model.py:508: Con
vergenceWarning: Maximum Likelihood optimization failed to converge. Check ml
e_retvals
  "Check mle_retvals", ConvergenceWarning)

ARIMA (2, 1, 2) x (2, 0, 0, 12)  - AIC: 970.4142943055391

C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\base\model.py:508: Con
vergenceWarning: Maximum Likelihood optimization failed to converge. Check ml
e_retvals
  "Check mle_retvals", ConvergenceWarning)

ARIMA (2, 1, 2) x (2, 0, 1, 12)  - AIC: 977.6919099578511
ARIMA (2, 2, 0) x (0, 0, 0, 12)  - AIC: 995.9410841743105
ARIMA (2, 2, 0) x (0, 1, 0, 12)  - AIC: 711.8024299912222
ARIMA (2, 2, 0) x (0, 2, 0, 12)  - AIC: 481.69866985628136
ARIMA (2, 2, 0) x (1, 0, 0, 12)  - AIC: 981.0483035271783
ARIMA (2, 2, 0) x (1, 1, 0, 12)  - AIC: 710.0466742717314
ARIMA (2, 2, 0) x (1, 2, 0, 12)  - AIC: 471.32853471831663
ARIMA (2, 2, 0) x (2, 0, 0, 12)  - AIC: 982.3000631733253
ARIMA (2, 2, 0) x (2, 1, 0, 12)  - AIC: 711.1880634546504
ARIMA (2, 2, 1) x (0, 0, 0, 12)  - AIC: 983.9651557316288
ARIMA (2, 2, 1) x (0, 1, 0, 12)  - AIC: 695.9758736108664
ARIMA (2, 2, 1) x (1, 0, 0, 12)  - AIC: 956.3395260445423
ARIMA (2, 2, 1) x (1, 1, 0, 12)  - AIC: 694.8621053831948
ARIMA (2, 2, 1) x (2, 0, 0, 12)  - AIC: 956.5981041489323
ARIMA (2, 2, 1) x (2, 1, 0, 12)  - AIC: 695.6670902417981
ARIMA (2, 2, 2) x (0, 0, 0, 12)  - AIC: 984.8312848392773

C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\base\model.py:508: Con
vergenceWarning: Maximum Likelihood optimization failed to converge. Check ml
e_retvals
  "Check mle_retvals", ConvergenceWarning)

ARIMA (2, 2, 2) x (0, 1, 0, 12)  - AIC: 697.5732405175189
ARIMA (2, 2, 2) x (0, 2, 0, 12)  - AIC: 478.1593087289474
ARIMA (2, 2, 2) x (1, 0, 0, 12)  - AIC: 974.7846634688374
ARIMA (2, 2, 2) x (1, 1, 0, 12)  - AIC: 696.1063786268087
ARIMA (2, 2, 2) x (1, 2, 0, 12)  - AIC: 468.09258204542715
ARIMA (2, 2, 2) x (2, 0, 0, 12)  - AIC: 976.4879259535405
ARIMA (2, 2, 2) x (2, 1, 0, 12)  - AIC: 695.3721300997123
```

```
C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\base\model.py:508: Con
vergenceWarning: Maximum Likelihood optimization failed to converge. Check ml
e_retvals
  "Check mle_retvals", ConvergenceWarning)
```

In [22]:
```python
mod = sm.tsa.statespace.SARIMAX(y,
                                order=(0,2,2),
                                seasonal_order=(1, 2, 0, 12))
results = mod.fit()
results.aic
```

Out[22]: 456.4105128136662

In [23]:
```python
pred = results.get_prediction(start=pd.to_datetime('2017-01-01'))
plt.figure(figsize=(10,6))
ax = y['2014':].plot(label='observed')
pred.predicted_mean.plot(ax=ax, label='One-step ahead Forecast')
ax.set_xlabel('Date')
ax.set_ylabel('Furniture Sales')
plt.legend()
plt.show()
```
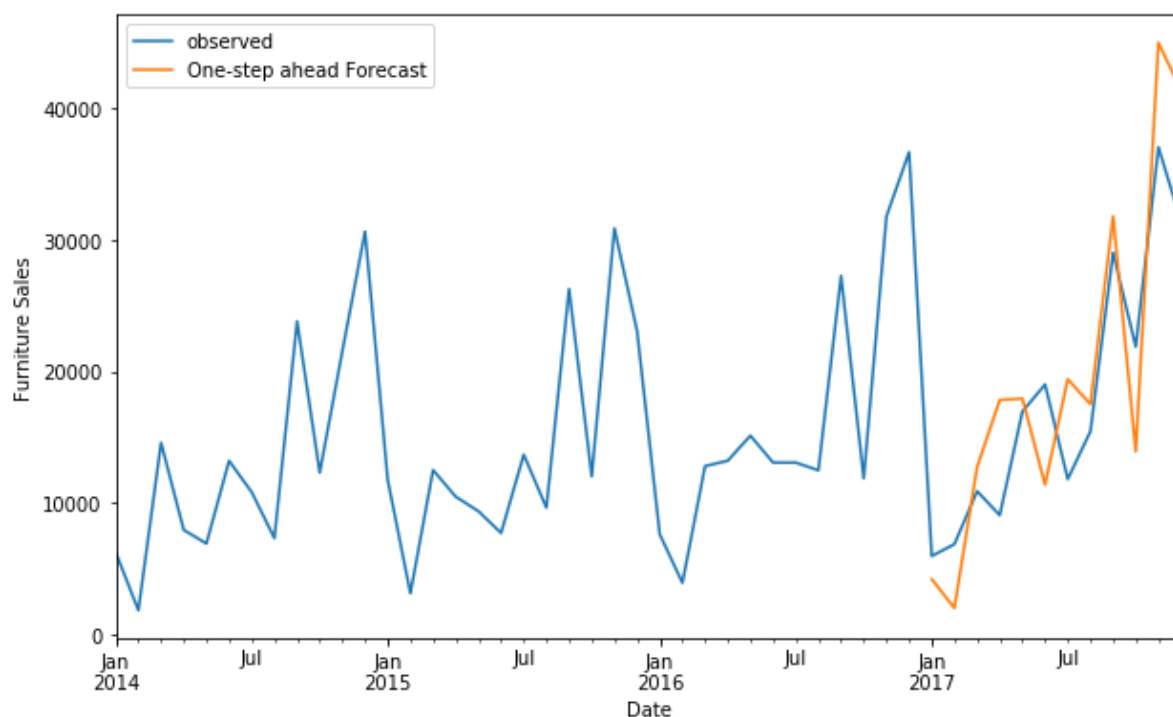

In [24]:
```python
Y_pred = pred.predicted_mean
Y_test = y['2017-01-01':]

from sklearn.metrics import mean_squared_error
from math import sqrt
rms = sqrt(mean_squared_error(Y_test,Y_pred))
print(rms)
```

6203.457594066279

In [25]:
```python
pred_uc = results.get_forecast(steps=24)
plt.figure(figsize=(10,6))
ax = y['2014':].plot(label='observed')
pred_uc.predicted_mean.plot(ax=ax, label='One-step ahead Forecast')
ax.set_xlabel('Date')
ax.set_ylabel('Furniture Sales')
plt.legend()
plt.show()
```
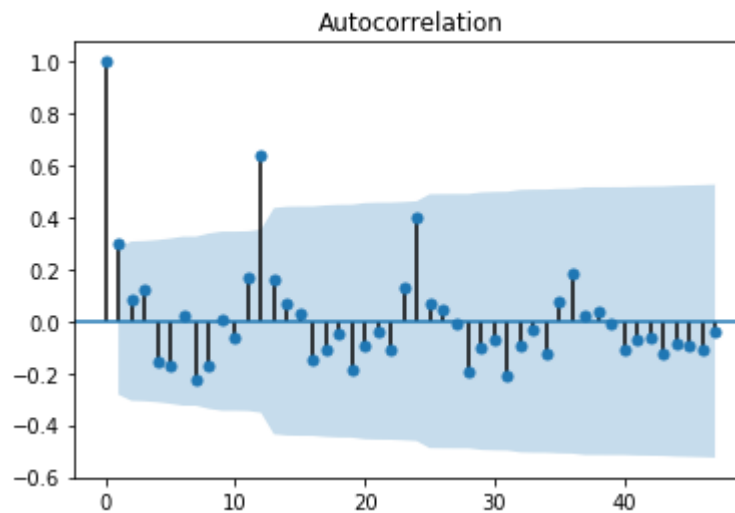
C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\tsa\base\tsa_model.py:
320: FutureWarning: Creating a DatetimeIndex by passing range endpoints is de
precated. Use `pandas.date_range` instead.
  freq=base_index.freq)
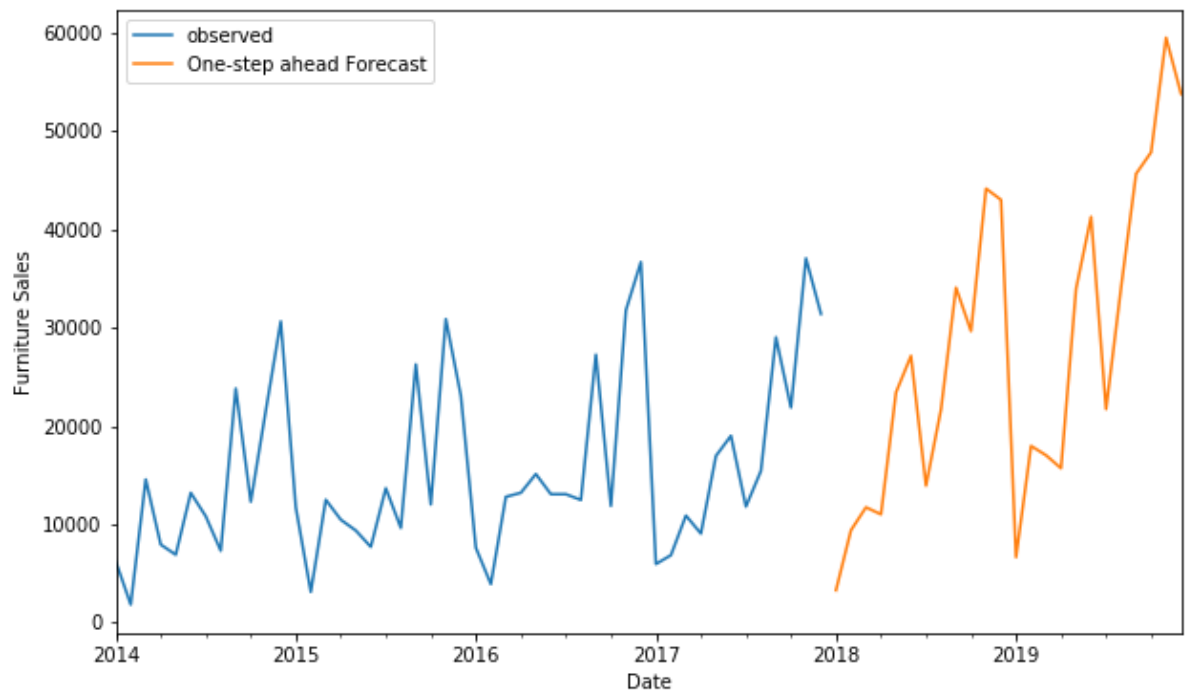
In [26]: `pred_uc.predicted_mean`
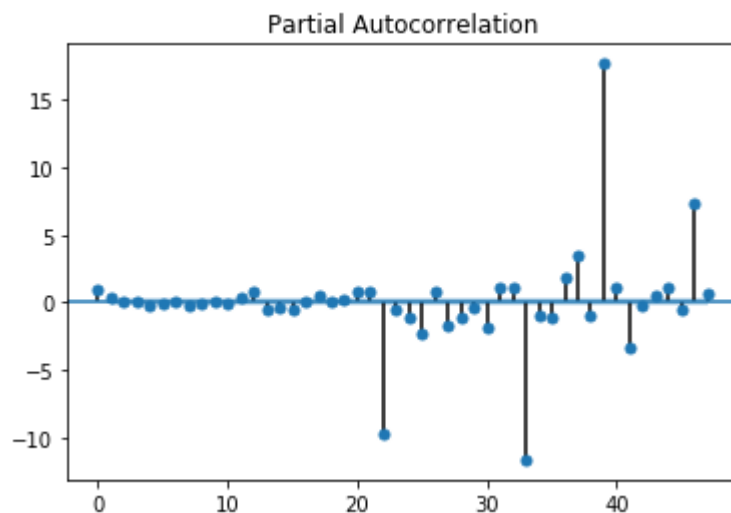
Out[26]:
```
2018-01-01      3304.001742
2018-02-01      9403.179979
2018-03-01     11733.329562
2018-04-01     11017.502538
2018-05-01     23418.993226
2018-06-01     27141.848166
2018-07-01     13931.858186
2018-08-01     21695.823765
2018-09-01     34074.227752
2018-10-01     29656.594347
2018-11-01     44148.414092
2018-12-01     43011.142638
2019-01-01      6655.546167
2019-02-01     17977.406899
2019-03-01     17025.560885
2019-04-01     15711.057314
2019-05-01     33954.623177
2019-06-01     41283.483801
2019-07-01     21717.998468
2019-08-01     34069.486855
2019-09-01     45651.746927
2019-10-01     47844.386264
2019-11-01     59498.870928
2019-12-01     53780.269005
Freq: MS, dtype: float64
```

In [27]:
```python
import statsmodels
a=statsmodels.graphics.tsaplots.plot_acf(y)
```

In [28]: `b=statsmodels.graphics.tsaplots.plot_pacf( y)`

```
C:\Users\admin\Anaconda3\lib\site-packages\statsmodels\regression\linear_mode
l.py:1283: RuntimeWarning: invalid value encountered in sqrt
  return rho, np.sqrt(sigmasq)
```

Partial Autocorrelation

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]: