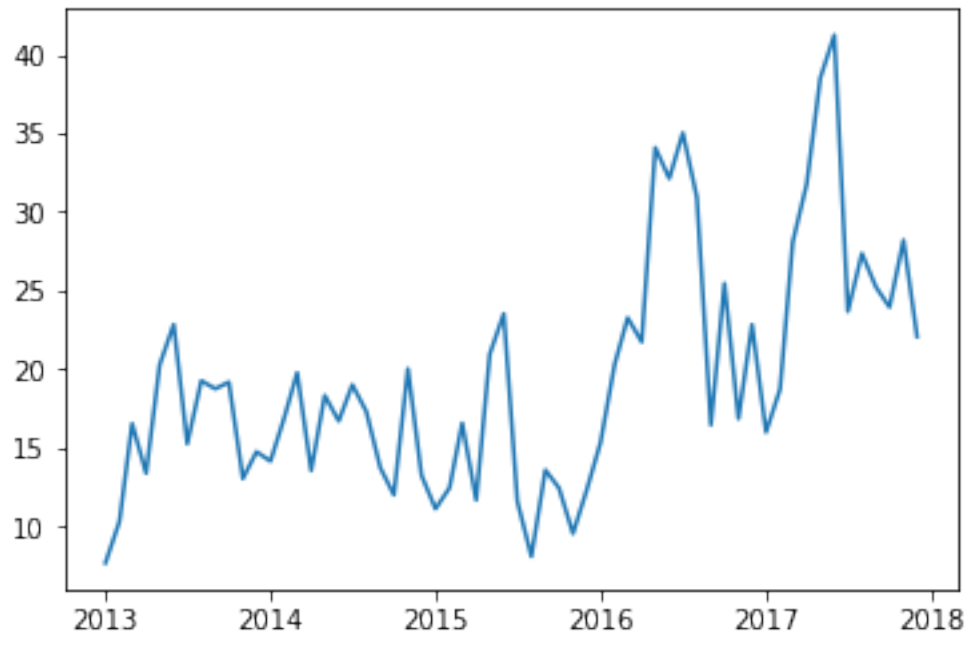
Time Series Analysis it's analysis of data which collected on certain time interval, it's very common form of data for example stock market data, daily sales data, home energy usage etc.here i am trying to do analysis of time series data This analysis have 4 phases: Load data check stationarity Make series stationary Buid model #1. Load data

In [11]:

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

data = pd.read_csv('~/Downloads/Retail.csv')

data['YearMonth'] = pd.to_datetime(data['YearMonth'],format="%Y%m")
data = data.sort_values(by = 'YearMonth')
data = data.set_index('YearMonth')
ts = data['Volume']

plt.plot(ts)
plt.show()
```

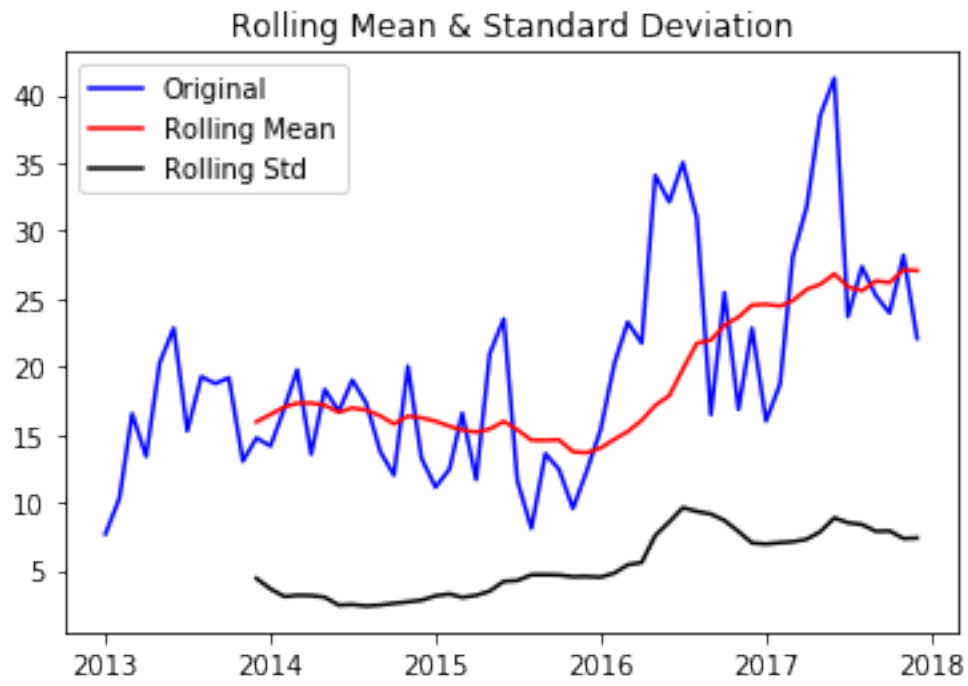


2. check stationarity

In [5]:

```
from statsmodels.tsa.stattools import adfuller

def st_check(timeseries):
    rolmean = pd.rolling_mean(timeseries, window=12) ## as month is year divide
by 12
    rolstd = pd.rolling_std(timeseries, window=12)

    #Plot rolling statistics:
    orig = plt.plot(timeseries, color='blue',label='Original')
    mean = plt.plot(rolmean, color='red', label='Rolling Mean')
    std  = plt.plot(rolstd, color='black', label = 'Rolling Std')
    plt.legend(loc='best')
    plt.title('Rolling Mean & Standard Deviation')
    plt.show()

    print ('Results of Dickey-Fuller Test:')
    dftest = adfuller(timeseries, autolag='AIC')
    dfoutput = pd.Series(dftest[0:4], index=['Test Statistic','p-value','#Lags U
sed','Number of Observations Used'])
    print (dfoutput)

print(st_check(ts))
```

```
/anaconda3/lib/python3.6/site-packages/statsmodels/compat/pandas.py:
56: FutureWarning: The pandas.core.datetools module is deprecated an
d will be removed in a future version. Please use the pandas.tseries
module instead.
  from pandas.core import datetools
/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:4: Futu
reWarning: pd.rolling_mean is deprecated for Series and will be remo
ved in a future version, replace with
        Series.rolling(window=12,center=False).mean()
  after removing the cwd from sys.path.
/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:5: Futu
reWarning: pd.rolling_std is deprecated for Series and will be remov
ed in a future version, replace with
        Series.rolling(window=12,center=False).std()
  """
```



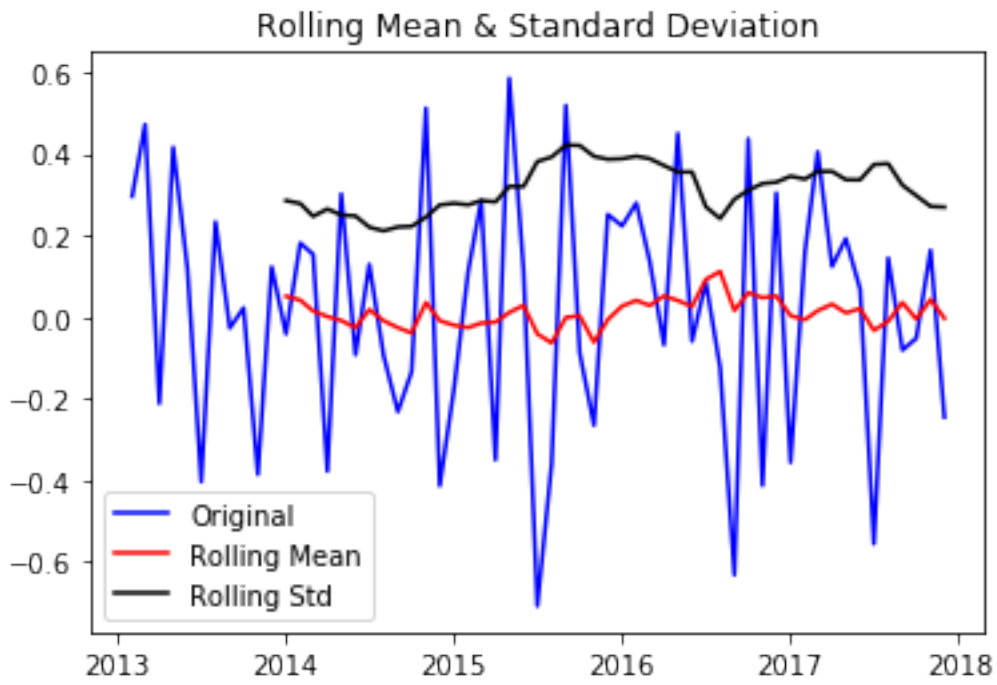

```
Results of Dickey-Fuller Test:
Test Statistic                  -3.422202
p-value                          0.010225
#Lags Used                       0.000000
Number of Observations Used     59.000000
dtype: float64
None
```

3. Make series stationary

In [6]:

```
ts_log=np.log(ts)
ts_log_dif = ts_log - ts_log.shift()
ts_log_dif.dropna(inplace=True)
print(st_check(ts_log_dif))
```

```
/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:4: Futu
reWarning: pd.rolling_mean is deprecated for Series and will be remo
ved in a future version, replace with
        Series.rolling(window=12,center=False).mean()
  after removing the cwd from sys.path.
/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:5: Futu
reWarning: pd.rolling_std is deprecated for Series and will be remov
ed in a future version, replace with
        Series.rolling(window=12,center=False).std()
  """
```

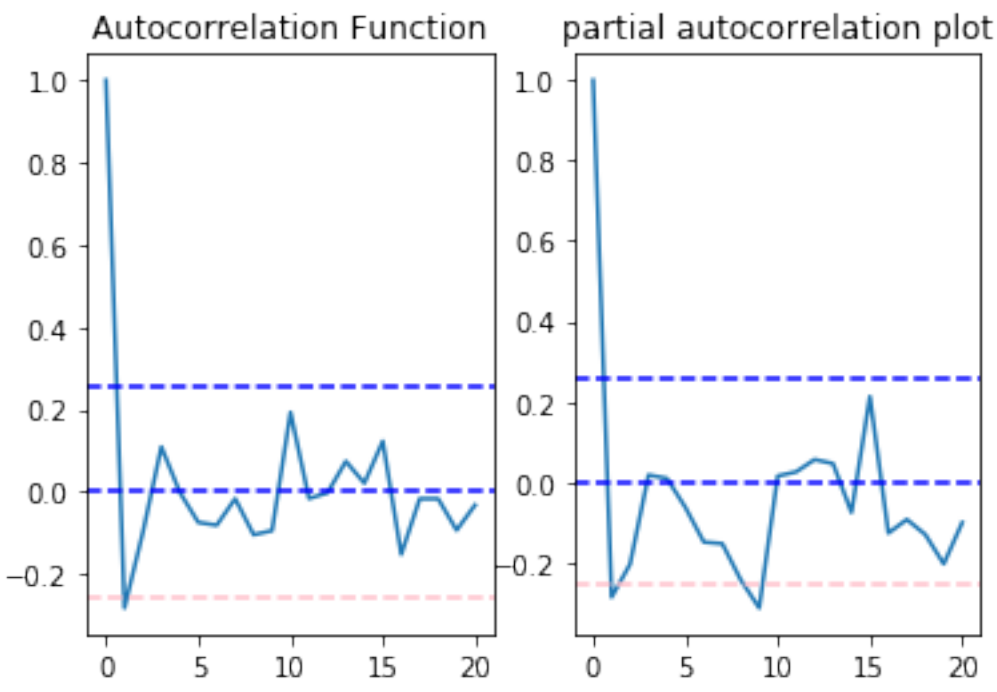



```
Results of Dickey-Fuller Test:
Test Statistic                -7.619334e+00
p-value                        2.149246e-11
#Lags Used                     1.000000e+00
Number of Observations Used    5.700000e+01
dtype: float64
None
```

4. Buid model and forecast

In [7]:

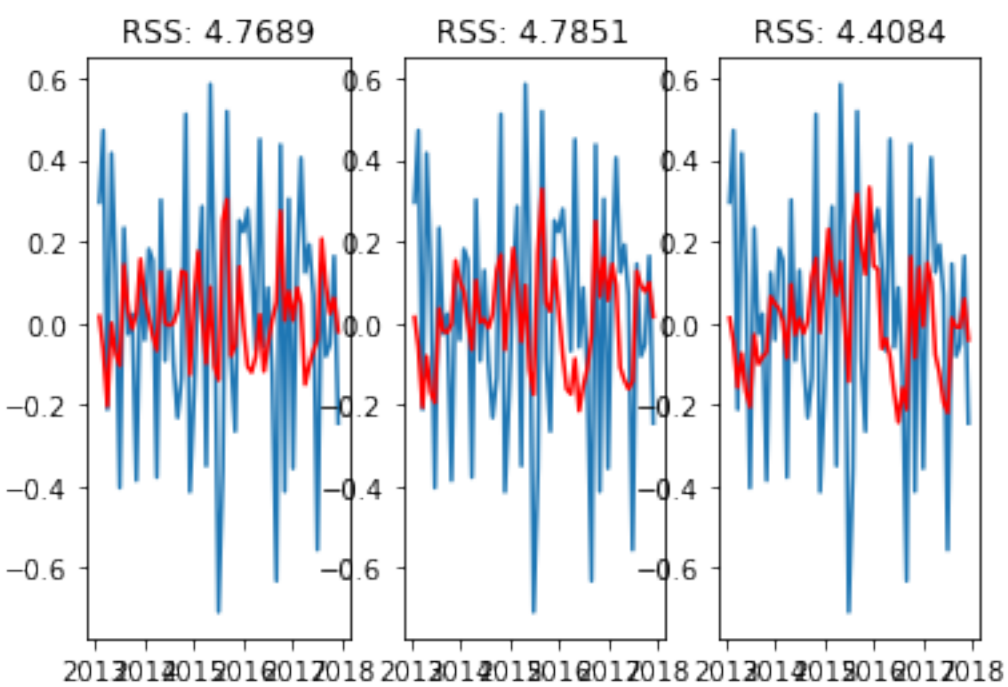
```
from statsmodels.tsa.stattools import acf,pacf

lag_acf = acf(ts_log_dif,nlags=20)
lag_pacf = pacf(ts_log_dif,nlags=20,method='ols')

########################## ACF #########################################

plt.subplot(121)
plt.plot(lag_acf)
plt.axhline(y=0,linestyle='--',color='blue')
plt.axhline(y=-1.96/np.sqrt(len(ts_log_dif)),linestyle='--',color='pink')
plt.axhline(y=1.96/np.sqrt(len(ts_log_dif)),linestyle='--',color='blue')
plt.title('Autocorrelation Function')


########################## PACF #########################################

plt.subplot(122)
plt.plot(lag_pacf)
plt.axhline(y=0,linestyle='--',color='blue')
plt.axhline(y=-1.96/np.sqrt(len(ts_log_dif)),linestyle='--',color='pink')
plt.axhline(y=1.96/np.sqrt(len(ts_log_dif)),linestyle='--',color='blue')
plt.title('partial autocorrelation plot')
plt.show()
```



In [8]:

```
from statsmodels.tsa.arima_model import ARIMA

## AR
plt.subplot(131)
model = ARIMA(ts_log,order=(2,1,0))
result_AR = model.fit(disp=-1)
plt.plot(ts_log_dif)
plt.plot(result_AR.fittedvalues, color='red')
plt.title('RSS: %.4f'% sum((result_AR.fittedvalues-ts_log_dif)**2))

## MA
plt.subplot(132)
model = ARIMA(ts_log,order=(0,1,2))
result_MA = model.fit(disp=-1)
plt.plot(ts_log_dif)
plt.plot(result_MA.fittedvalues,color='red')
plt.title('RSS: %.4f'% sum((result_MA.fittedvalues-ts_log_dif)**2))

## ARIMA
plt.subplot(133)
model = ARIMA(ts_log,order=(2,1,2))
result_MA = model.fit(disp=-1)
plt.plot(ts_log_dif)
plt.plot(result_MA.fittedvalues,color='red')
plt.title('RSS: %.4f'% sum((result_MA.fittedvalues-ts_log_dif)**2))
plt.show()
```

```
/anaconda3/lib/python3.6/site-packages/statsmodels/base/model.py:473
: HessianInversionWarning: Inverting hessian failed, no bse or cov_p
arams available
  'available', HessianInversionWarning)
/anaconda3/lib/python3.6/site-packages/statsmodels/base/model.py:496
: ConvergenceWarning: Maximum Likelihood optimization failed to conv
erge. Check mle_retvals
  "Check mle_retvals", ConvergenceWarning)
```



Taking the prediction to original scale

In [9]:

```
pred_arima_dif = pd.Series(result_MA.fittedvalues,copy=True)
arima_dif_cumsum = pred_arima_dif.cumsum()

pred_arima_log = pd.Series(ts_log.ix[0], index=ts_log.index)
pred_arima_log = pred_arima_log.add(arima_dif_cumsum,fill_value=0)
print(pred_arima_log.head())

pred = np.exp(pred_arima_log)
```

```
YearMonth
2013-01-01    2.037056
2013-02-01    2.049627
2013-03-01    2.005404
2013-04-01    1.848090
2013-05-01    1.773872
dtype: float64

/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:4: Depr
ecationWarning:
.ix is deprecated. Please use
.loc for label based indexing or
.iloc for positional indexing

See the documentation here:
http://pandas.pydata.org/pandas-docs/stable/indexing.html#ix-indexer
-is-deprecated
  after removing the cwd from sys.path.
```

Actual vs predicted plot

In [10]:

```
plt.plot(ts)
plt.plot(pred)
plt.show()
```