Prediction of the price of flats

Кому инетересно и есть время сделать итоговый проект по прогнозированию: Надо спрогнозировать ТО по месяцам за 2019. В исходнике - все данные по продажам с 2013 года - orders_all (orders_all https://drive.google.com/drive/u/0/folders/1C3HqlJcABblKM2tz8vPGiXTFT7MisrML (https://drive.google.com/drive/u/0/folders/1C3HqlJcABblKM2tz8vPGiXTFT7MisrML)). Нужно учесть пробои данных, некорректность. Т.е. в некоторых месяцах проставить поправочные коэффициенты. Ваша задача - глубоко проанализировать, как развивался магазин, как менялись ср чеки, повторность продаж, тренд и сделать скорректированный план на 2019 год по месяцам. В качестве вывода: строите график ТО по месяцам за 2019 год и детально описываете, что учитывали для прогноза в pdf.

- ТО по месяцам.
- Всего месяцев
- ТО в каждом месяце.
- Отсортировать данные

1. Analyse of dataset

1.1 General part

In [1]:

```
# We imported all needed library
import numpy as np
import pandas as pd
import calendar
from pylab import *

import matplotlib
import matplotlib.pyplot as plt
import matplotlib.dates as mdates

%matplotlib inline
#pd.options.display.max_rows = 72
```

In [17]:

```
# Path to train  datasets
TRAIN_DATASET_PATH='orders_all.csv'
#TEST_DATASET_PATH='test.csv'
```

In [18]:

```
# make a Pandas dataframe from train dataset and see first 15 rows
parse_dates=['o_date']
df=pd.read_csv(TRAIN_DATASET_PATH, delimiter=';', parse_dates=parse_dates)
df.head(15)
```

Out[18]:

	id_order	id_user	price	o_date
0	129	1	1337	26.04.2013
1	130	155	182	26.04.2013
2	131	1	602	26.04.2013
3	132	1	863	26.04.2013
4	133	1	2261	29.04.2013
5	134	44	966	16.05.2013
6	135	1	7070	16.05.2013
7	137	160	1260	16.05.2013
8	138	1	15645	17.05.2013
9	141	176	749	22.05.2013
10	142	179	462	23.05.2013
11	143	180	686	23.05.2013
12	144	181	1456	26.05.2013
13	145	1	20601	28.05.2013
14	146	1	5740	28.05.2013

In [221]:

```
df.describe()
```

Out[221]:

	id_order	id_user	price
count	4.309695e+06	4.309695e+06	4.309695e+06
mean	5.113688e+06	3.319879e+06	2.241497e+03
std	3.511252e+06	3.030066e+06	3.156176e+03
min	1.290000e+02	0.000000e+00	8.000000e+00
25%	1.780340e+06	5.694695e+05	7.550000e+02
50%	4.960172e+06	2.264086e+06	1.400000e+03
75%	8.376386e+06	5.468586e+06	2.518000e+03
max	1.098539e+07	9.900289e+06	9.992500e+04

In [6]:

```
#Check dataframe dimensionality
df.shape
```

Out[6]:

```
(4365731, 4)
```

In [29]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4365731 entries, 0 to 4365730
Data columns (total 4 columns):
id_order    int64
id_user     int64
price       int64
o_date      object
dtypes: int64(3), object(1)
memory usage: 133.2+ MB
```

1.2. Work with data types

In [30]:

```
#see on typical value of date (we have 55492 item with 00.00.0000 value)
df.o_date.describe()
```

Out[30]:

```
count        4365731
unique          2028
top       00.00.0000
freq           55492
Name: o_date, dtype: object
```

In [7]:

```
# check percent of zero date. Accept that value is important if it more than 10%
and need to analise.
df.o_date.describe().freq/df.shape[0]
```

Out[7]:

```
0.012710815210556949
```

In [32]:

```
# zero date and zero price
df[(df.o_date == '00.00.0000')&(df.price == 0)]
```

Out[32]:

	id_order	id_user	price	o_date
2136569	4900219	3764611	0	00.00.0000
2139866	4909909	3764611	0	00.00.0000
2139909	4910065	3764611	0	00.00.0000
2141378	4914559	3764611	0	00.00.0000
2141974	4916425	3764611	0	00.00.0000
...	...	...	...	...
4365726	16836178	4285099	0	00.00.0000
4365727	16839826	4285099	0	00.00.0000
4365728	16885534	4285099	0	00.00.0000
4365729	16955236	3764611	0	00.00.0000
4365730	16970584	3764611	0	00.00.0000

55492 rows × 4 columns

In [33]:

```
# conclusion: all zero data rows have a zero price. Try to analyse without zero
data
```

In [8]:

```
# new datafame without zero data
df = df[(df.o_date != '00.00.0000')]
df
```

Out[8]:

	id_order	id_user	price	o_date
0	129	1	1337	26.04.2013
1	130	155	182	26.04.2013
2	131	1	602	26.04.2013
3	132	1	863	26.04.2013
4	133	1	2261	29.04.2013
...	...	...	...	...
4363042	10985377	8946388	432	27.12.2018
4363043	10985380	9900283	1008	27.12.2018
4363044	10985383	7974196	279	27.12.2018
4363045	10985386	9589165	1116	27.12.2018
4363046	10985389	1196649	1608	27.12.2018

4310239 rows × 4 columns

In [9]:

```
#clean all rows with price < 7 rub
df = df[(df.price > 7 )]
```

In [10]:

```
df.o_date.describe()
```

Out[10]:

```
count         4309865
unique           2027
top        12.12.2017
freq            11163
Name: o_date, dtype: object
```

In [11]:

```
#Analyse price column
df.price.describe().apply("{0:.0f}".format)
```

Out[11]:

```
count               4309865
mean             1624183052
std           3371834163744
min                       8
25%                     755
50%                    1400
75%                    2518
max        7000000000000000
Name: price, dtype: object
```

In [12]:

```
# see on unikum user with owerprice
df[(df.price == 7000000000000000)]
```

Out[12]:

	id_order	id_user	price	o_date
637	777	7265	7000000000000000	15.08.2013

In [13]:

```
df[(df.id_user == 7265)]
```

Out[13]:

	id_order	id_user	price	o_date
637	777	7265	7000000000000000	15.08.2013

In [15]:
```
#show price over 100 000
df[(df.price > 100000)]
```

Out[15]:

	id_order	id_user	price	o_date
637	777	7265	7000000000000000	15.08.2013
96521	96708	134751	344746	22.06.2014
96534	96721	134751	111665	22.06.2014
110971	111161	149209	105798	21.07.2014
129868	130065	167982	115498	22.08.2014
...	...	...	...	...
4142001	10548937	9460948	277570	30.11.2018
4158520	10582695	39506	218346	03.12.2018
4163246	10592249	9503759	144804	03.12.2018
4200320	10663642	9573142	1679500	08.12.2018
4200589	10664233	9573142	293971	08.12.2018

170 rows × 4 columns

In [16]:
```
#we have a few rows with value over 100 000 rub and can drop it
df = df[(df.price < 100000)]
df
```

Out[16]:

	id_order	id_user	price	o_date
0	129	1	1337	26.04.2013
1	130	155	182	26.04.2013
2	131	1	602	26.04.2013
3	132	1	863	26.04.2013
4	133	1	2261	29.04.2013
...	...	...	...	...
4363042	10985377	8946388	432	27.12.2018
4363043	10985380	9900283	1008	27.12.2018
4363044	10985383	7974196	279	27.12.2018
4363045	10985386	9589165	1116	27.12.2018
4363046	10985389	1196649	1608	27.12.2018

4309695 rows × 4 columns

In [17]:
```
df.price.describe().apply("{0:.0f}".format)
```

Out[17]:
```
count    4309695
mean        2241
std         3156
min            8
25%          755
50%         1400
75%         2518
max        99925
Name: price, dtype: object
```

In [25]:
```
# save us result to new file
df.to_csv('orders_all_clear.csv')
```

Reread data with correct data format

In [2]:

```
parse_dates=['o_date']
df = pd.read_csv('orders_all_clear.csv', delimiter=',', parse_dates=parse_date
s).drop(['Unnamed: 0'],axis=1)
df
```

Out[2]:

	id_order	id_user	price	o_date
0	129	1	1337	2013-04-26
1	130	155	182	2013-04-26
2	131	1	602	2013-04-26
3	132	1	863	2013-04-26
4	133	1	2261	2013-04-29
...	...	...	...	...
4309690	10985377	8946388	432	2018-12-27
4309691	10985380	9900283	1008	2018-12-27
4309692	10985383	7974196	279	2018-12-27
4309693	10985386	9589165	1116	2018-12-27
4309694	10985389	1196649	1608	2018-12-27

4309695 rows × 4 columns

Now we have price values above mean and std values

1.3. Analyse of year/month commodity circulation

In [3]:

```
# Count of price group by year
c_p_y = df.groupby(pd.Grouper(key="o_date", freq="Y"))['id_order'].count()
c_p_y.describe().apply("{0:.0f}".format)
```

Out[3]:

```
count          6
mean      718282
std       549825
min        33791
25%       314081
50%       710570
75%      1071312
max      1481288
Name: id_order, dtype: object
```

In [4]:

```
# Count of price group by month
c_p_m = df.groupby(pd.Grouper(key="o_date", freq="M"))['id_order'].count()
c_p_m.describe().apply("{0:.0f}".format)
```

Out[4]:

```
count        72
mean      59857
std       45093
min         681
25%       17325
50%       61490
75%       89984
max      176208
Name: id_order, dtype: object
```

In [5]:
```
# Count of price group by month
c_p_w = df.groupby(pd.Grouper(key="o_date", freq="W"))['id_order'].count()
c_p_w.describe().apply("{0:.0f}".format)
```

Out[5]:
```
count      312
mean     13813
std      11080
min          0
25%       4218
50%      12375
75%      21675
max      62885
Name: id_order, dtype: object
```

In [6]:
```
# Count of price group by day
c_p_d = df.groupby(pd.Grouper(key="o_date", freq="d"))['id_order'].count()
c_p_d.describe().apply("{0:.0f}".format)
```

Out[6]:
```
count     2180
mean      1977
std       1775
min          0
25%        552
50%       1605
75%       3024
max      11163
Name: id_order, dtype: object
```

We will see how many days and weeks lost

In [7]:
```
# how many days
c_p_d[c_p_d==0]
```

Out[7]:
```
o_date
2013-01-13    0
2013-01-14    0
2013-01-15    0
2013-01-16    0
2013-01-17    0
             ..
2013-12-02    0
2013-12-03    0
2013-12-04    0
2013-12-05    0
2013-12-07    0
Name: id_order, Length: 153, dtype: int64
```

In [8]:
```
# how many weeks
c_p_w[c_p_w==0]
```

Out[8]:
```
o_date
2013-01-20    0
2013-01-27    0
2013-02-03    0
2013-02-24    0
2013-03-03    0
2013-03-24    0
2013-03-31    0
2013-04-21    0
Name: id_order, dtype: int64
```

we can drop 'zero' days

In [9]:

```
c_p_d = c_p_d[c_p_d!=0]
c_p_d.describe()
```

Out[9]:

```
count     2027.000000
mean      2126.144549
std       1752.907598
min          1.000000
25%        711.000000
50%       1797.000000
75%       3141.000000
max      11163.000000
Name: id_order, dtype: float64
```

In [10]:

```
# Sum of price group by month
s_p_y = df.groupby(pd.Grouper(key="o_date", freq="Y"))['price'].sum()
s_p_y
```

Out[10]:

```
o_date
2013-12-31      74276412
2014-12-31     530112700
2015-12-31    1128262822
2016-12-31    1800643620
2017-12-31    2731652633
2018-12-31    3395221336
Freq: A-DEC, Name: price, dtype: int64
```

In [11]:

```
# Sum of price group by month
s_p_m = df.groupby(pd.Grouper(key="o_date", freq="M"))['price'].sum()
s_p_m.describe().apply("{0:.0f}".format)
```

Out[11]:

```
count           72
mean     134169021
std      103254394
min        1437280
25%       40636484
50%      123978698
75%      217890430
max      362733218
Name: price, dtype: object
```

In [12]:

```
# Sum of price group by week
s_p_w = df.groupby(pd.Grouper(key="o_date", freq="W"))['price'].sum()
s_p_w.describe().apply("{0:.0f}".format)
```

Out[12]:

```
count          312
mean      30962082
std       24957737
min              0
25%        9336700
50%       25227588
75%       50919998
max      117155043
Name: price, dtype: object
```

In [69]:

```
s_p_w[s_p_w==0]
```

Out[69]:

```
o_date
2013-01-20    0
2013-01-27    0
2013-02-03    0
2013-02-24    0
2013-03-03    0
2013-03-24    0
2013-03-31    0
2013-04-21    0
Name: price, dtype: int64
```

so we can drop first 4 month

```
In [13]: # Sum of price group by day
         s_p_d = df.groupby(pd.Grouper(key="o_date", freq="d"))['price'].sum()
         s_p_d.describe().apply("{0:.0f}".format)
```

```
Out[13]: count        2180
         mean      4431270
         std       3893411
         min             0
         25%       1269306
         50%       3408358
         75%       7214560
         max      23015855
         Name: price, dtype: object
```

```
In [71]: # we can see total count of "zero" date. Equal to zero count value.
         s_p_d[s_p_d==0]
```

```
Out[71]: o_date
         2013-01-13    0
         2013-01-14    0
         2013-01-15    0
         2013-01-16    0
         2013-01-17    0
                      ..
         2013-12-02    0
         2013-12-03    0
         2013-12-04    0
         2013-12-05    0
         2013-12-07    0
         Name: price, Length: 153, dtype: int64
```

```
In [14]: # drop zero values
         s_p_d = s_p_d[s_p_d!=0]
         s_p_d.describe().apply("{0:.0f}".format)
```

```
Out[14]: count        2027
         mean      4765747
         std       3835177
         min            84
         25%       1642949
         50%       3752354
         75%       7444022
         max      23015855
         Name: price, dtype: object
```

```
In [15]: s_p = s_p_d.groupby(pd.Grouper(freq="m")).sum()
         s_p
```

```
Out[15]: o_date
         2013-01-31      1437280
         2013-02-28      1815527
         2013-03-31      2022531
         2013-04-30      1985335
         2013-05-31      2335177
                          ...
         2018-08-31    282198891
         2018-09-30    280213565
         2018-10-31    295590218
         2018-11-30    362733218
         2018-12-31    347389451
         Freq: M, Name: price, Length: 72, dtype: int64
```

In [273]:

```
# Will make month dataframe by year for analyse years separately
y_df = pd.DataFrame()
for y in sort(list(set(s_p.index.year))):
    y_df[y] = s_p.loc[s_p.index.year == y].values
y_df['Month'] = s_p_m.index[:12].month
#y_df.set_index([list(set(s_p_m.index.month))], inplace=True)
y_df.set_index('Month', inplace=True)
y_df
```

Out[273]:

	2013	2014	2015	2016	2017	2018
Month						
1	1437280	23636757	70488722	112063230	195538549	261594638
2	1815527	25428835	61024583	100504101	170926414	233403301
3	2022531	32157571	78444150	125437246	206764503	265213255
4	1985335	34199177	78490655	135249662	194012878	259738853
5	2335177	39833982	85943171	130088485	228859284	294771201
6	2673751	37384825	77039730	122520151	206271991	255992517
7	2614992	40903984	85622836	126523476	210168089	256382228
8	3975254	43892568	85979805	152045152	215314914	282198891
9	7410730	45249280	93415473	156199640	216576792	280213565
10	12545399	53292821	127209925	195211539	260504024	295590218
11	14064733	62544414	147665603	221831342	304286176	362733218
12	21395703	91588486	136938169	222969596	322429019	347389451

In [75]:

```
y_df.describe()
```

Out[75]:

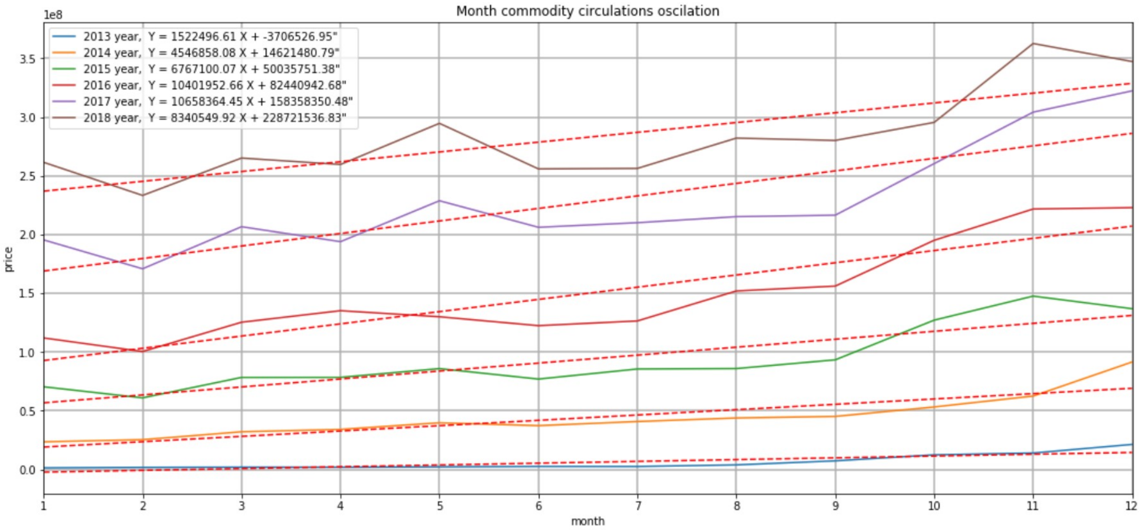
	2013	2014	2015	2016	2017	2018
count	1.200000e+01	1.200000e+01	1.200000e+01	1.200000e+01	1.200000e+01	1.200000e+01
mean	6.189701e+06	4.417606e+07	9.402190e+07	1.500536e+08	2.276377e+08	2.829351e+08
std	6.444074e+06	1.849488e+07	2.769421e+07	4.154261e+07	4.551802e+07	3.816495e+07
min	1.437280e+06	2.363676e+07	6.102458e+07	1.005041e+08	1.709264e+08	2.334033e+08
25%	2.013232e+06	3.368878e+07	7.809304e+07	1.247080e+08	2.035886e+08	2.588997e+08
50%	2.644372e+06	4.036898e+07	8.578300e+07	1.326691e+08	2.127415e+08	2.727134e+08
75%	8.694397e+06	4.726017e+07	1.018641e+08	1.659526e+08	2.367705e+08	2.949760e+08
max	2.139570e+07	9.158849e+07	1.476656e+08	2.229696e+08	3.224290e+08	3.627332e+08

Will accept what we have linear relation for every year and try to check it through diagram

In [326]:

```
coef_df=pd.DataFrame() #empty dataframe for coefficients of trend lines
```

In [327]:
```
# We will draw month diagram in year and compare all year
plt.figure(figsize=(18,8))
xticks(range(1, 13))
xlim(1, 12)

grid(linewidth = 1.5)
#minorticks_on()
#grid(which='major',
#        color = 'k',
#        linewidth = 1)
#grid(which='minor',
#        color = 'k',
#        linestyle = ':')

for i in y_df.columns:
    a = y_df.index
    b = y_df[i].values

    z = np.polyfit(a, b, 1)
    p = np.poly1d(z)
    coef_df[i]=[z[0],z[1]]

    plt.title('Month commodity circulations oscilation')
    plt.xlabel('month')
    plt.ylabel('price')

    plt.plot(a, b, label='%s year,  Y = %.2f X + %.2f"'%(i, z[0],z[1]))
    plt.legend()
    plt.plot(a,p(a),"r--")
```



As we see every year (exception 2018) is accompanied by an increase in sales growth rate.

In [328]:
```
coef_df.style.format("{:.2f}")
```

Out[328]:

	2013	2014	2015	2016	2017	2018
0	1522496.61	4546858.08	6767100.07	10401952.66	10658364.45	8340549.92
1	-3706526.95	14621480.79	50035751.38	82440942.68	158358350.48	228721536.83

In [317]:

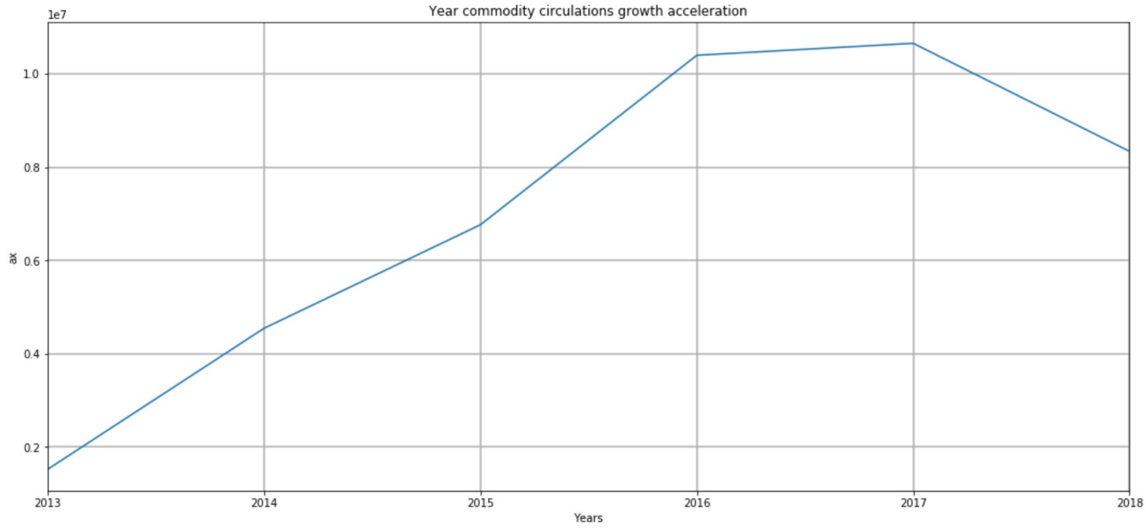
Out[317]:
```
1522496.608391608
```

```
In [329]: growth_coeff= [] #Check relation between every neighbor year
          for i in range(len(coef_df.columns)-1):
              x = coef_df[coef_df.columns[i]][0]/coef_df[coef_df.columns[i+1]][0]
              growth_coeff.append(x)
          growth_coeff
```

```
Out[329]: [0.3348458606564479,
           0.671906435094741,
           0.6505605522636034,
           0.9759426703889776,
           1.277897087044468]
```

```
In [339]: plt.figure(figsize=(18,8))
          grid(linewidth = 1.5)
          xlim(2013, 2018)
          plt.title('Year commodity circulations growth acceleration')
          plt.xlabel('Years')
          plt.ylabel('ax')

          plt.plot(coef_df.columns, coef_df.loc[0])
```

```
Out[339]: [<matplotlib.lines.Line2D at 0x24203e582c8>]
```



We can see growth axeleration for 2013-2016 period and slowdown in growth for 2016-2018 year

For diagram in one sheet we`ll make interim dataframe with serial indexes

In [276]:

```
m_df = pd.DataFrame()
m_df['Date'] = s_p_m.index
m_df['Sum price'] = s_p_m.values
m_df
```

Out[276]:

	Date	Sum price
0	2013-01-31	1437280
1	2013-02-28	1815527
2	2013-03-31	2022531
3	2013-04-30	1985335
4	2013-05-31	2335177
...	...	...
67	2018-08-31	282198891
68	2018-09-30	280213565
69	2018-10-31	295590218
70	2018-11-30	362733218
71	2018-12-31	347389451

72 rows × 2 columns

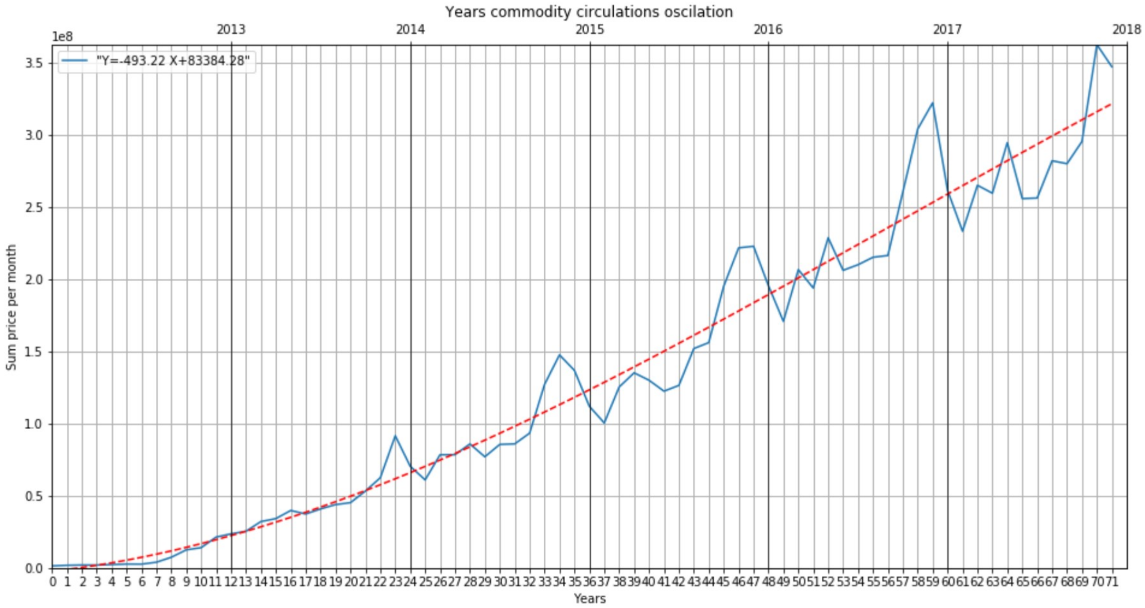
In [277]:

```
# Try to make trend line 3th order for all years
fig = plt.figure(figsize=(16,8))
ax1 = fig.add_subplot(111)
ax2 = ax1.twiny()

ax1.grid(linewidth = 1)
ax2.grid(linewidth = 0.75, color = 'black')

a = m_df.index
b = m_df['Sum price'].values
z = np.polyfit(a, b, 3)
p = np.poly1d(z)
print(z)
coef_df[i]=[z[0],z[1]]

ax1.set_title('Years commodity circulations oscilation')
ax1.set_xlabel('Years')
ax1.set_ylabel('Sum price per month')
ax1.set_xticks(range(72))
ax1.set_xlim(0, 72)
ax1.set_ylim(0, m_df['Sum price'].values[70])
ax2.set_xlim(2012, 2018)
ax2.set_xticks([2013, 2014, 2015, 2016, 2017, 2018])

ax1.plot(a, b, label='"Y=%.2f X+%.2f"'%(z[0],z[1]))
ax1.legend()
ax1.plot(a,p(a),"r--")
```

```
[-4.93218051e+02  8.33842830e+04  1.12972958e+06 -2.28286358e+06]
```

Out[277]:

```
[<matplotlib.lines.Line2D at 0x24202086888>]
```



Conclusion: We can see periodic month oscilation and linear growth of price sum. So, we will calculate month coefficient and normalise data.

In [362]:

```
fig = plt.figure(figsize=(16,8))

ax1 = fig.add_subplot(111)
ax1.grid(linewidth = 1)

ax1.plot(s_p_d.resample('W', how='mean'))
```

```
C:\Users\User\Anaconda3\lib\site-packages\ipykernel_launcher.py:5: FutureWarni
ng: how in .resample() is deprecated
the new syntax is .resample(...).mean()
  """
```

Out[362]:

```
[<matplotlib.lines.Line2D at 0x24211d080c8>]
```

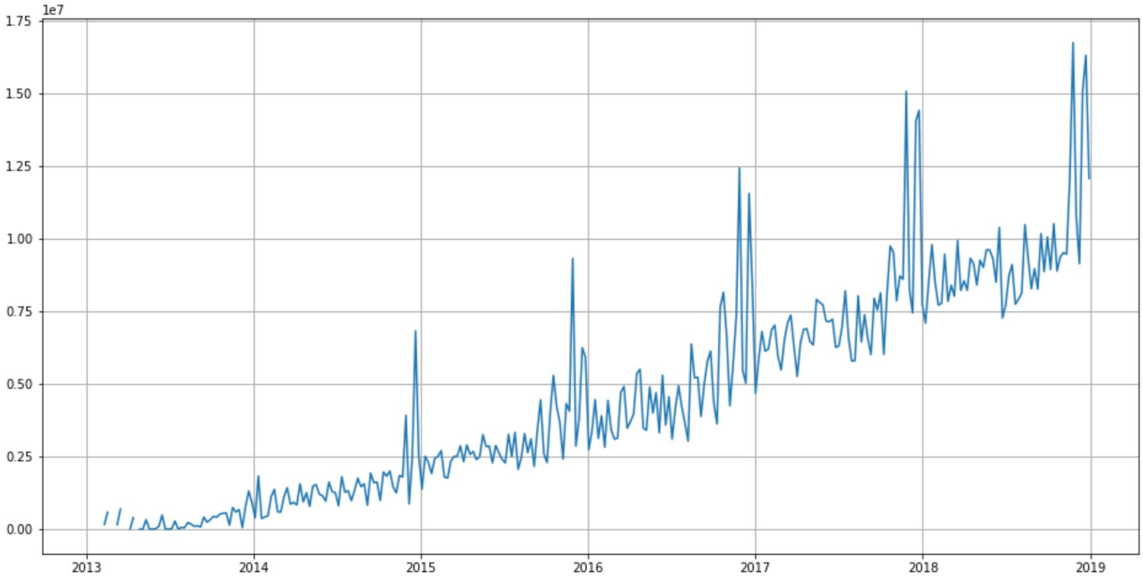


Diagram hawe expressed month splash in end of years and some trouble in start of 2013 year (lost data)

1.4 Analyse average check

In [19]:

```
a_c = pd.DataFrame()
a_c['Price'] = s_p_d
a_c['Count'] = c_p_d
a_c['AVG_CHECK'] = a_c['Price']/a_c['Count']
a_c
```

Out[19]:

	Price	Count	AVG_CHECK
o_date			
2013-01-08	25690	11	2335.454545
2013-01-09	109319	55	1987.618182
2013-01-10	339510	181	1875.745856
2013-01-11	421742	198	2130.010101
2013-01-12	541019	236	2292.453390
...	...	...	...
2018-12-23	14272726	8181	1744.618751
2018-12-24	16291480	9769	1667.671205
2018-12-25	16525971	9524	1735.192251
2018-12-26	15424882	8494	1815.973864
2018-12-27	12406	12	1033.833333

2027 rows × 3 columns

In [282]:

```
# Find values avg check more than max average check of 2014-2018 years
a_c[a_c['AVG_CHECK']> a_c[a_c.index.year>2013]['AVG_CHECK'].max()]
```

Out[282]:

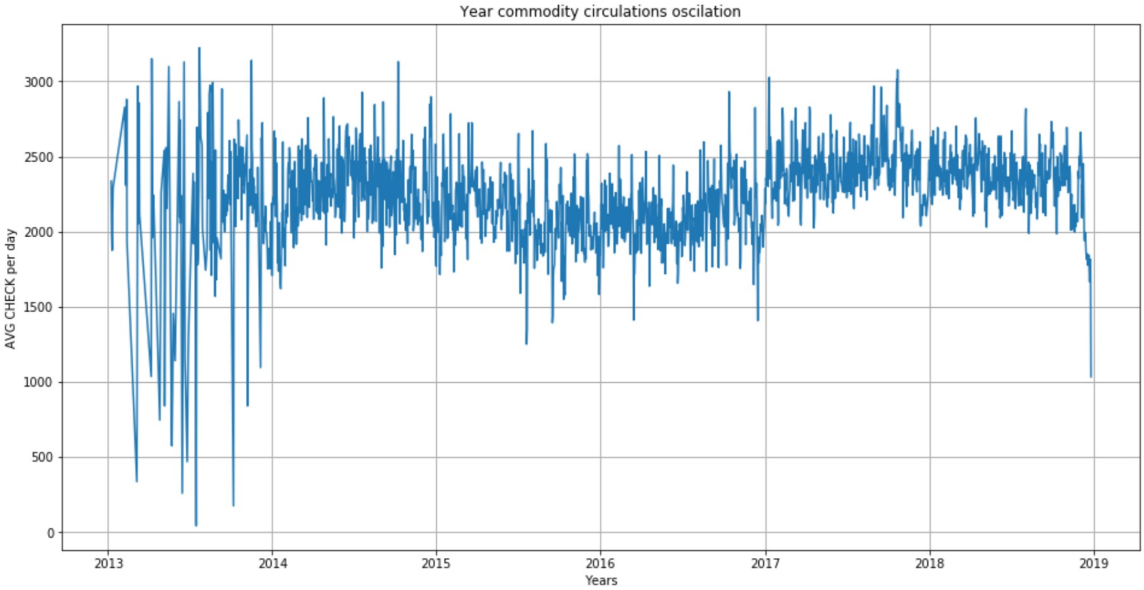
	Price	Count	AVG_CHECK
o_date			
2013-02-08	61271	15	4084.733333
2013-04-06	9604	2	4802.000000
2013-05-08	103264	29	3560.827586
2013-05-17	15645	1	15645.000000
2013-05-28	26341	2	13170.500000
2013-06-14	5922	1	5922.000000
2013-06-23	8778	2	4389.000000
2013-06-24	13958	2	6979.000000
2013-06-30	4732	1	4732.000000
2013-07-06	14427	3	4809.000000
2013-07-07	18760	2	9380.000000
2013-07-08	130501	35	3728.600000
2013-07-13	8792	1	8792.000000
2013-07-15	8092	2	4046.000000
2013-07-24	57288	16	3580.500000
2013-07-25	92932	25	3717.280000
2013-07-27	73773	22	3353.318182
2013-07-28	112595	18	6255.277778
2013-07-31	66605	16	4162.812500
2013-08-07	19859	4	4964.750000
2013-08-08	117159	30	3905.300000
2013-08-15	77889	23	3386.478261
2013-09-08	77385	21	3685.000000
2013-11-08	96663	25	3866.520000

In [283]:

```
#clear values above
a_c = a_c[a_c['AVG_CHECK']< a_c[a_c.index.year>2013]['AVG_CHECK'].max()]
```

```
In [284]: # make diagram for everage check
          fig = plt.figure(figsize=(16,8))
          ax1 = fig.add_subplot(111)
          ax1.grid(linewidth = 1)

          ax1.set_title('Year commodity circulations oscilation')
          ax1.set_xlabel('Years')
          ax1.set_ylabel('AVG CHECK per day')

          ax1.plot(a_c['AVG_CHECK'])
```

```
Out[284]: [<matplotlib.lines.Line2D at 0x24203fd8e48>]
```



How we can see 2013 year hawe too many trouble in any indexes. For more detail analyse of EC drop 2013y data

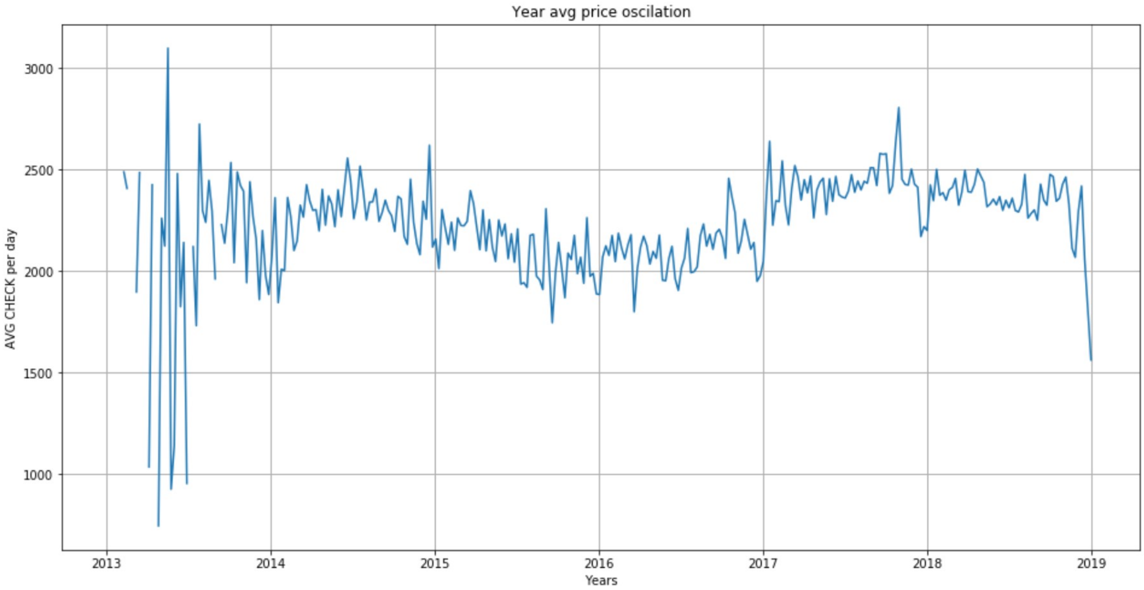
In [360]:

```
# make diagram for everage check with resampling by week
fig = plt.figure(figsize=(16,8))
ax1 = fig.add_subplot(111)

ax1.grid(linewidth = 1)

ax1.set_title('Year avg price oscilation')
ax1.set_xlabel('Years')
ax1.set_ylabel('AVG CHECK per day')

ax1.plot(a_c['AVG_CHECK'].resample('W', how='mean'))
```

```
C:\Users\User\Anaconda3\lib\site-packages\ipykernel_launcher.py:12: FutureWarn
ing: how in .resample() is deprecated
the new syntax is .resample(...).mean()
  if sys.path[0] == '':
```

Out[360]:

```
[<matplotlib.lines.Line2D at 0x24203ec9788>]
```



I want to see every year

In [286]:

```
a_c_clear = a_c[a_c.index.year>2013]#drop dirty 2013 year
a_c_clear.resample('y', how='mean')
```

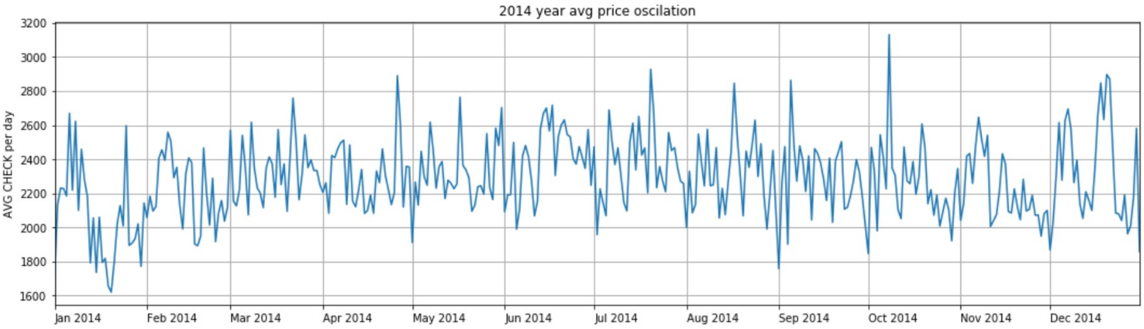
```
C:\Users\User\Anaconda3\lib\site-packages\ipykernel_launcher.py:2: FutureWarni
ng: how in .resample() is deprecated
the new syntax is .resample(...).mean()
```

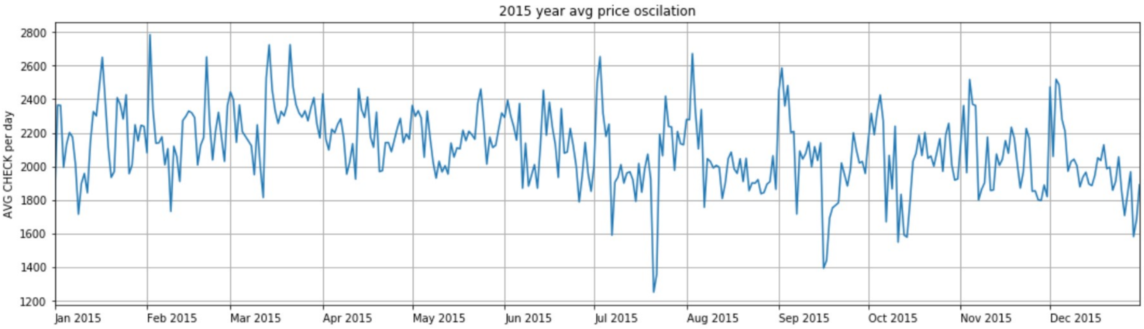
Out[286]:

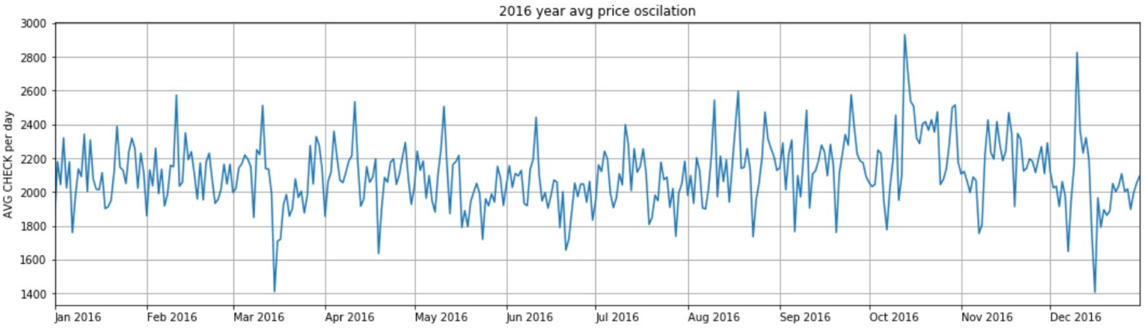
	Price	Count	AVG_CHECK
o_date			
2014-12-31	1.452364e+06	635.917808	2284.380268
2015-12-31	3.091131e+06	1534.230137	2104.847546
2016-12-31	4.919791e+06	2352.855191	2104.382004
2017-12-31	7.480817e+06	3128.291209	2420.628576
2018-12-31	9.405045e+06	4103.290859	2339.044070

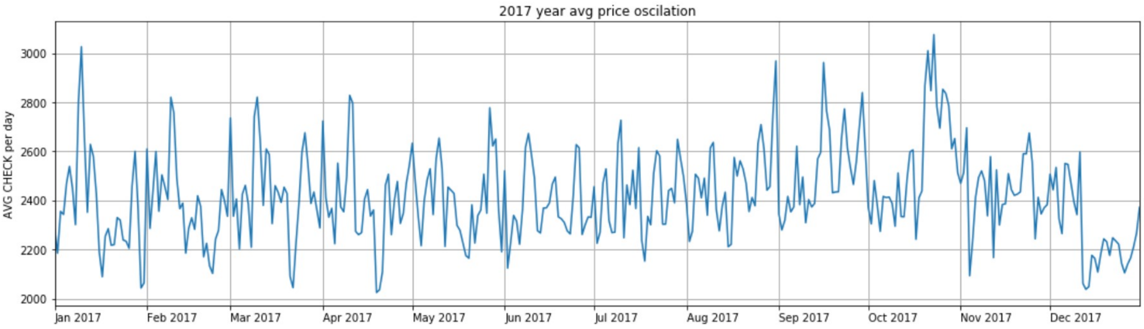
In [287]:

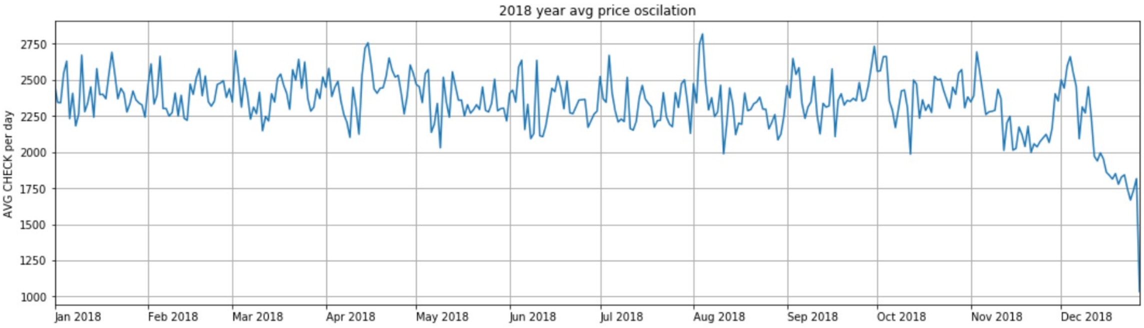
```
# We will draw avg price diagram in year and compare all years

fig, axes = plt.subplots(nrows = len(set(a_c_clear.index.year)), ncols =1, figs
ize=(18,28) )

for i in range(len(set(a_c_clear.index.year))):
    y = sort(list(set(a_c_clear.index.year)))[i]
    order_date = a_c_clear.loc[a_c_clear.index.year == y].index
    check_val = a_c_clear['AVG_CHECK'].loc[a_c_clear.index.year == y].values

    axes[i].set(title='%s year avg price oscilation'%y)
    axes[i].grid(linewidth = 1)
    axes[i].set_ylabel('AVG CHECK per day')
    axes[i].set_xlim(order_date[0],order_date[-1])
    axes[i].get_xaxis().set_major_locator(mdates.MonthLocator(interval=1))
    axes[i].get_xaxis().set_major_formatter(mdates.DateFormatter("%b %Y"))
    plt.setp(axes[i].get_xticklabels(),  ha="left")
    axes[i].plot(order_date, check_val, label=' year')
```


2014 year avg price oscilation
AVG CHECK per day
3200
3000
2800
2600
2400
2200
2000
1800
1600
Jan 2014
Feb 2014
Mar 2014
Apr 2014
May 2014
Jun 2014
Jul 2014
Aug 2014
Sep 2014
Oct 2014
Nov 2014
Dec 2014


2015 year avg price oscilation
AVG CHECK per day
2800
2600
2400
2200
2000
1800
1600
1400
1200
Jan 2015
Feb 2015
Mar 2015
Apr 2015
May 2015
Jun 2015
Jul 2015
Aug 2015
Sep 2015
Oct 2015
Nov 2015
Dec 2015


2016 year avg price oscilation
AVG CHECK per day
3000
2800
2600
2400
2200
2000
1800
1600
1400
Jan 2016
Feb 2016
Mar 2016
Apr 2016
May 2016
Jun 2016
Jul 2016
Aug 2016
Sep 2016
Oct 2016
Nov 2016
Dec 2016

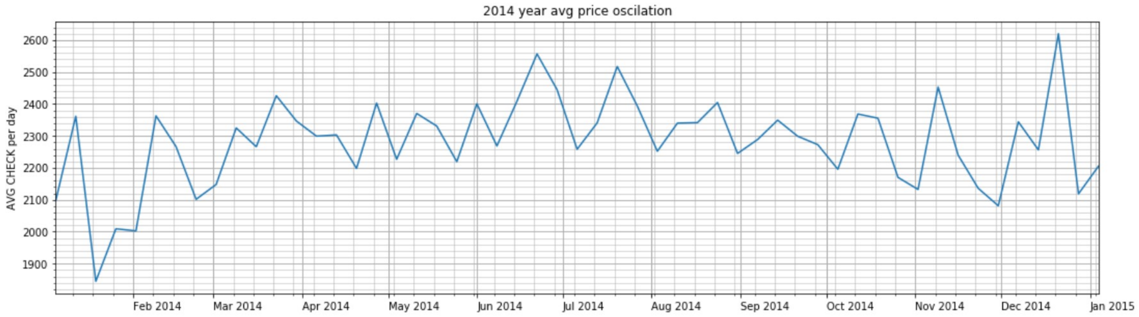

2017 year avg price oscilation
AVG CHECK per day
3000
2800
2600
2400
2200
2000
Jan 2017
Feb 2017
Mar 2017
Apr 2017
May 2017
Jun 2017
Jul 2017
Aug 2017
Sep 2017
Oct 2017
Nov 2017
Dec 2017

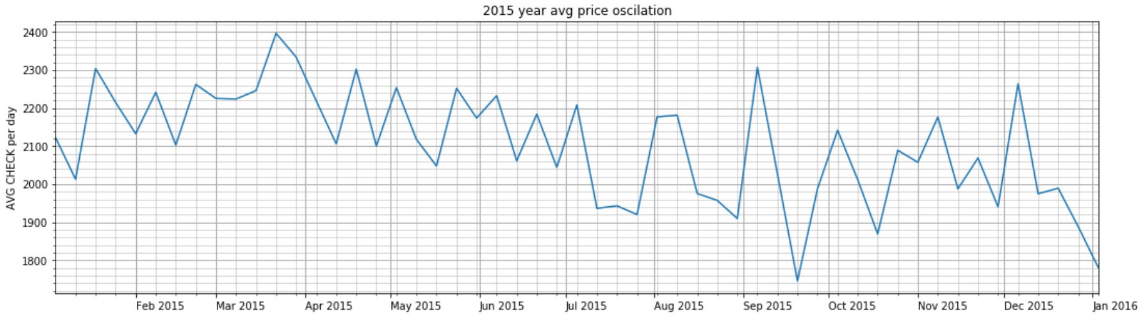

2018 year avg price oscilation
AVG CHECK per day
2750
2500
2250
2000
1750
1500
1250
1000
Jan 2018
Feb 2018
Mar 2018
Apr 2018
May 2018
Jun 2018
Jul 2018
Aug 2018
Sep 2018
Oct 2018
Nov 2018
Dec 2018

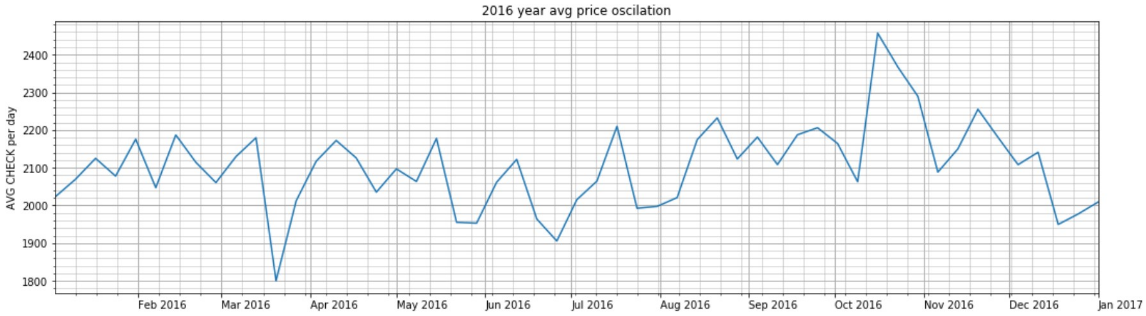
In [88]:

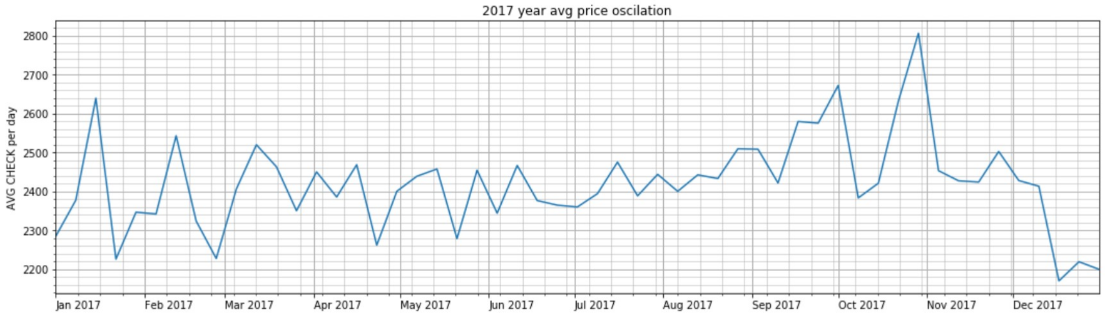
```
# We will draw week diagram in year and compare all year

fig, axes = plt.subplots(nrows = len(set(a_c_clear.index.year)), ncols =1, figsize=(18,28) )

for i in range(len(set(a_c_clear.index.year))):
    y = sort(list(set(a_c_clear.index.year)))[i]
    order_date = a_c_clear.loc[a_c_clear.index.year == y].resample('W', how='mean').index
    check_val = a_c_clear['AVG_CHECK'].loc[a_c_clear.index.year == y].resample('W', how='mean').values
    axes[i].minorticks_on()
    axes[i].grid(which='minor',
        linewidth = 0.5)
    axes[i].set(title='%s year avg price oscilation'%y)
    axes[i].grid(linewidth = 1)
    axes[i].set_ylabel('AVG CHECK per day')
    axes[i].set_xlim(order_date[0],order_date[-1])
    axes[i].get_xaxis().set_major_locator(mdates.MonthLocator(interval=1))
    axes[i].get_xaxis().set_major_formatter(mdates.DateFormatter("%b %Y"))
    plt.setp(axes[i].get_xticklabels(),  ha="left")
    axes[i].plot(order_date, check_val, label=' year')
```

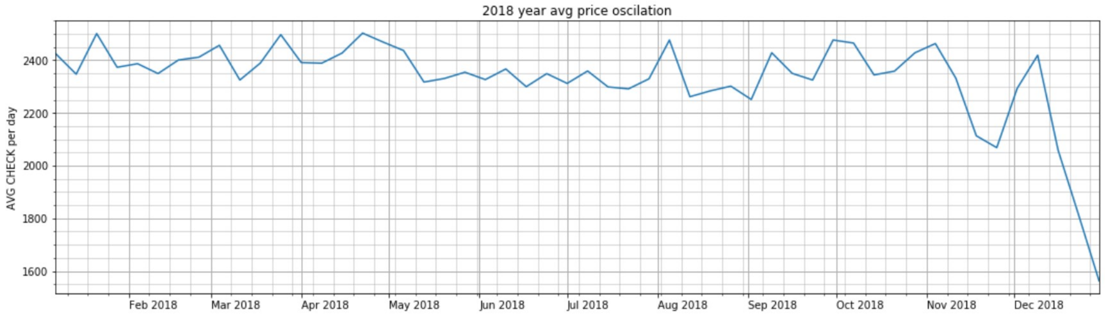
```
C:\Users\User\Anaconda3\lib\site-packages\ipykernel_launcher.py:7: FutureWarni
ng: how in .resample() is deprecated
the new syntax is .resample(...).mean()
  import sys
C:\Users\User\Anaconda3\lib\site-packages\ipykernel_launcher.py:8: FutureWarni
ng: how in .resample() is deprecated
the new syntax is .resample(...).mean()
```











We can see stable level of everage check, exept 2018 year.Most likely it`s related to inflation.

1.5. Repeated sales

In [24]:

```
#Create df with count of order per user by month
df1 = (df.groupby(['id_user',pd.Grouper(freq='M', key='o_date')])
        .size()
        .unstack(fill_value=0)
        .sort_index(axis=1))

df1.columns = df1.columns.date
df1.head(1)
```

Out[24]:

	2013-01-31	2013-02-28	2013-03-31	2013-04-30	2013-05-31	2013-06-30	2013-07-31	2013-08-31	201
id_user									
0	0	0	0	0	0	0	0	0	

1 rows × 72 columns

In [26]:

```
df1.cumsum(axis=1).to_csv('orders_count.csv')# Create .csv from df with cumulati
ve summary per month
```

In [38]:

```
c_df = pd.read_csv('orders_count.csv') #reread data for next time
c_df
```

Out[38]:

	id_user	2013-01-31	2013-02-28	2013-03-31	2013-04-30	2013-05-31	2013-06-30	2013-07-31	2013
0	0	0	0	0	0	0	0	0	
1	1	0	0	0	5	9	9	9	
2	19	0	0	0	0	0	0	0	
3	39	0	0	0	0	0	0	0	
4	44	0	0	0	0	1	1	1	
...	...	...	...	...	...	...	...	...	
2146519	9900265	0	0	0	0	0	0	0	
2146520	9900275	0	0	0	0	0	0	0	
2146521	9900283	0	0	0	0	0	0	0	
2146522	9900286	0	0	0	0	0	0	0	
2146523	9900289	0	0	0	0	0	0	0	

2146524 rows × 73 columns

In [39]:
```
c_df.set_index('id_user', inplace=True) #change index to id_user
c_df
```

Out[39]:

	2013-01-31	2013-02-28	2013-03-31	2013-04-30	2013-05-31	2013-06-30	2013-07-31	2013-08-31	20
id_user									
0	0	0	0	0	0	0	0	0	
1	0	0	0	5	9	9	9	11	
19	0	0	0	0	0	0	0	0	
39	0	0	0	0	0	0	0	0	
44	0	0	0	0	1	1	1	1	
...	...	...	...	...	...	...	...	...	
9900265	0	0	0	0	0	0	0	0	
9900275	0	0	0	0	0	0	0	0	
9900283	0	0	0	0	0	0	0	0	
9900286	0	0	0	0	0	0	0	0	
9900289	0	0	0	0	0	0	0	0	

2146524 rows × 72 columns

In [81]:
```
# Cteate df with grouped by count of orders users group (1 order, 2 ordes, more
than 3 orders)
distr_group = pd.DataFrame(index=[1,2,3])

for i in c_df.columns:
    g_counts = c_df.groupby(pd.Grouper(key=i))[i].count()
    count_1 = g_counts[g_counts.index == 1].sum()
    count_2 = g_counts[g_counts.index == 2].sum()
    count_3 = g_counts[g_counts.index > 3].sum()
    distr_group[i] = [count_1, count_2, count_3]

distr_group
```

Out[81]:

	2013-01-31	2013-02-28	2013-03-31	2013-04-30	2013-05-31	2013-06-30	2013-07-31	2013-08-31	2013-09-3
1	570	1223	1898	2564	3276	4082	4853	6097	835
2	26	55	87	131	190	273	342	436	66
3	6	16	20	27	33	42	52	64	10

3 rows × 72 columns

In [138]:
```
distr_group.columns = pd.to_datetime(distr_group.columns, format = '%Y/%m/%d')
#change name to date
distr_group
```

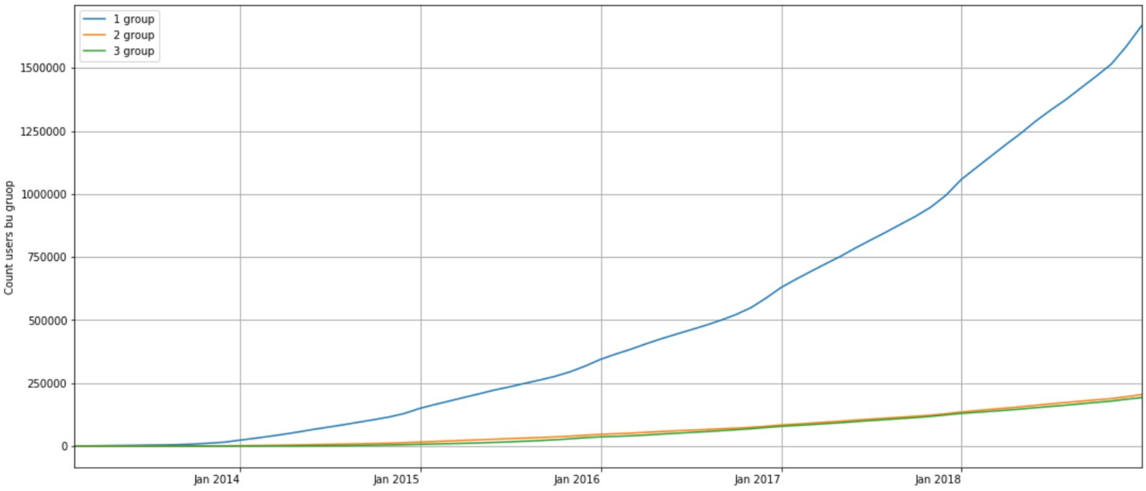
Out[138]:

	2013-01-31	2013-02-28	2013-03-31	2013-04-30	2013-05-31	2013-06-30	2013-07-31	2013-08-31	2013-09-3
1	570	1223	1898	2564	3276	4082	4853	6097	835
2	26	55	87	131	190	273	342	436	66
3	6	16	20	27	33	42	52	64	10

3 rows × 72 columns

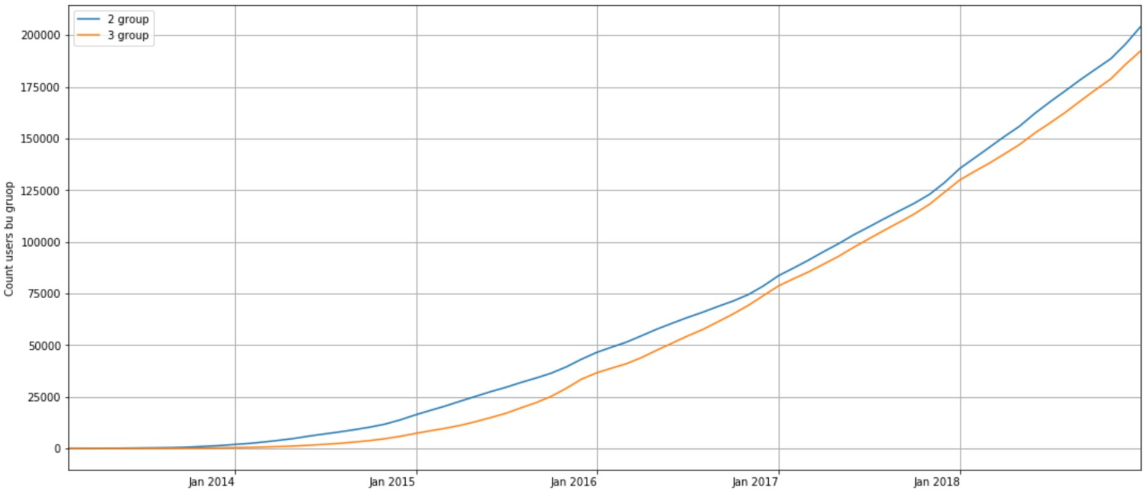
In [214]:

```
# Create  diagram for every group
fig, axes = plt.subplots(nrows = 1, ncols =1, figsize=(18,8) )
axes.grid(linewidth = 1)
axes.set_xlim(distr_group.columns[0],distr_group.columns[-1])
axes.get_xaxis().set_major_locator(mdates.YearLocator())
axes.get_xaxis().set_major_formatter(mdates.DateFormatter("%b %Y"))
axes.set_ylabel('Count users bu gruop')
plt.setp(axes.get_xticklabels(),  ha="right")

for i in distr_group.index:
    a = distr_group.columns
    b = distr_group[distr_group.index==i].values[0]
    axes.plot(a, b, label='%s group'%i)
    plt.legend()
```



How we can see repeated groupes don`t growth well. But one order group have considerable growth

In [218]:
```
# Create  diagram for 2 and 3 group
fig, axes = plt.subplots(nrows = 1, ncols =1, figsize=(18,8) )
axes.grid(linewidth = 1)
axes.set_xlim(distr_group.columns[0],distr_group.columns[-1])
axes.get_xaxis().set_major_locator(mdates.YearLocator())
axes.get_xaxis().set_major_formatter(mdates.DateFormatter("%b %Y"))
axes.set_ylabel('Count users bu gruop')
plt.setp(axes.get_xticklabels(),  ha="right")

for i in [2, 3]:
    a = distr_group.columns
    b = distr_group[distr_group.index==i].values[0]
    axes.plot(a, b, label='%s group'%i)
    plt.legend()
```



In [202]:
```
# create relative index
u_f_r=df.groupby(pd.Grouper(key='id_user'))['o_date'].min() #date of user first
registration
u_f_r
```

Out[202]:
```
id_user
1         2013-04-10
155       2013-04-26
44        2013-05-16
160       2013-05-16
176       2013-05-22
             ...
9899912   2018-12-26
9900275   2018-12-27
9900289   2018-12-27
9900286   2018-12-27
9900283   2018-12-27
Name: o_date, Length: 2146524, dtype: datetime64[ns]
```

In [204]:

```
u_r_d = pd.DataFrame(index = u_f_r)# users  registration data
u_r_d['id_user']=u_f_r.index
u_r_d
```

Out[204]:

	id_user
o_date	
2013-04-10	1
2013-04-26	155
2013-05-16	44
2013-05-16	160
2013-05-22	176
...	...
2018-12-26	9899912
2018-12-27	9900275
2018-12-27	9900289
2018-12-27	9900286
2018-12-27	9900283

2146524 rows × 1 columns

In [206]:

```
c_u_d = u_r_d.groupby(pd.Grouper(freq = 'M'))['id_user'].count()  #count of user
s per day
c_u_d
```

Out[206]:

```
o_date
2013-01-31       605
2013-02-28       692
2013-03-31       723
2013-04-30       725
2013-05-31       789
                ...
2018-08-31     60240
2018-09-30     57606
2018-10-31     61441
2018-11-30     86225
2018-12-31    100484
Freq: M, Name: id_user, Length: 72, dtype: int64
```

In [207]:

```
rel_orders = pd.DataFrame(index=[1,2,3]) # relative orders to users count
for i in distr_group.columns:

    rel_orders[i] = [distr_group[i].values[0]/c_u_d[i],
                     distr_group[i].values[1]/c_u_d[i],
                     distr_group[i].values[2]/c_u_d[i]]

rel_orders
```

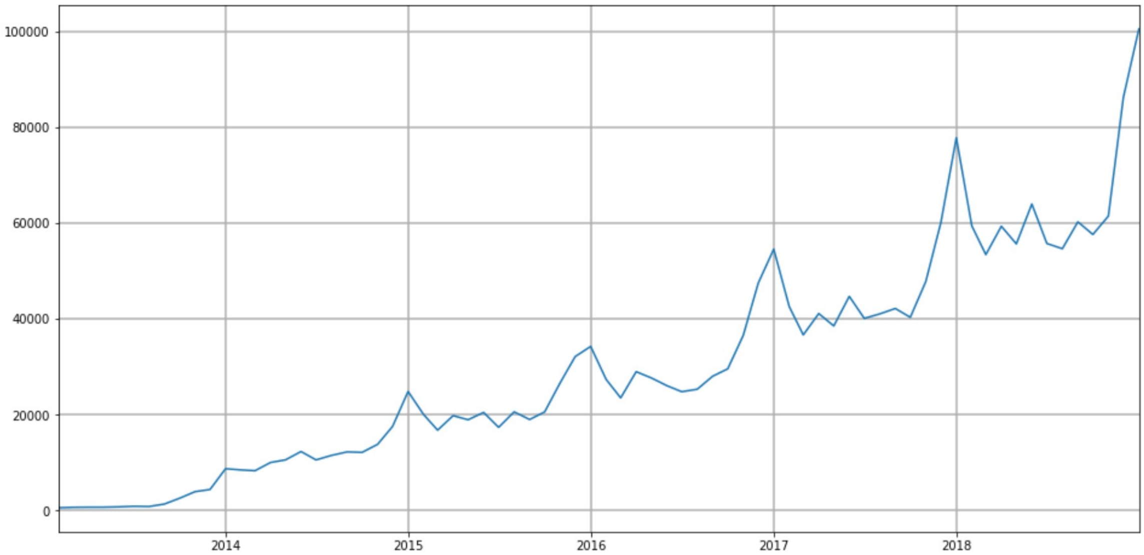
Out[207]:

	2013-01-31	2013-02-28	2013-03-31	2013-04-30	2013-05-31	2013-06-30	2013-07-31	2013-08-31	2013-09-3
1	0.942149	1.767341	2.625173	3.536552	4.152091	4.470975	5.597463	4.424528	3.2407
2	0.042975	0.079480	0.120332	0.180690	0.240811	0.299014	0.394464	0.316401	0.2566
3	0.009917	0.023121	0.027663	0.037241	0.041825	0.046002	0.059977	0.046444	0.0411

3 rows × 72 columns

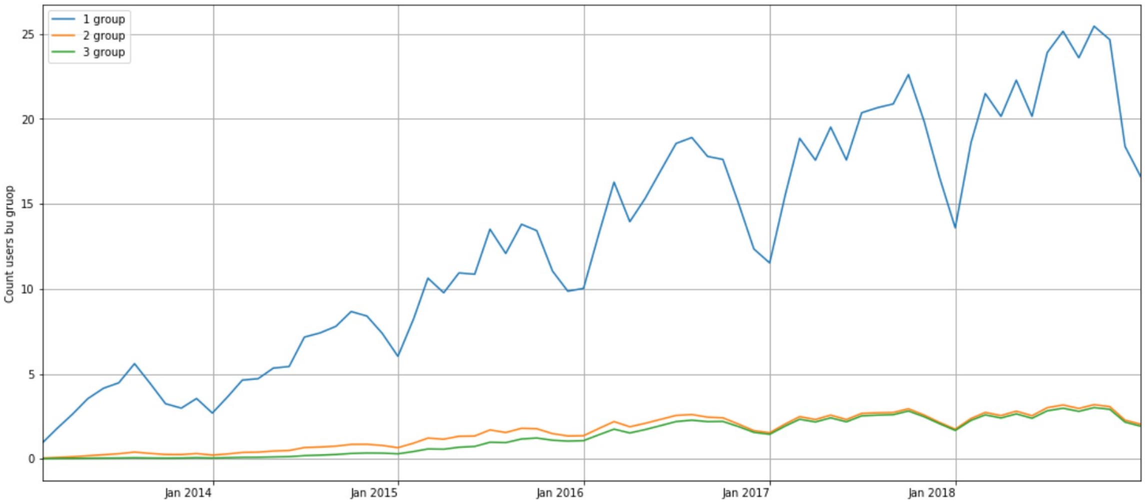
In [351]:

```
fig = plt.figure(figsize=(16,8)) # growth of users count per year
plt.plot(c_u_d)
xlim('2013-01-31', '2018-12-31')
grid(linewidth = 1.5)
plt.show()
```



In [209]:

```
# Create  diagram for 2 and 3 group
fig, axes = plt.subplots(nrows = 1, ncols =1, figsize=(18,8) )
axes.grid(linewidth = 1)
axes.set_xlim(rel_orders.columns[0],rel_orders.columns[-1])
axes.get_xaxis().set_major_locator(mdates.YearLocator())
axes.get_xaxis().set_major_formatter(mdates.DateFormatter("%b %Y"))
axes.set_ylabel('Count users bu gruop')
plt.setp(axes.get_xticklabels(),  ha="right")

for i in [1, 2, 3]:
    a = rel_orders.columns
    b = rel_orders[rel_orders.index==i].values[0]
    axes.plot(a, b, label='%s group'%i)
    plt.legend()
```



We can see more slowly growth 2 and 3 groups in comparison with 1st group, even in terms of the number of users

1.6. Sales predicting

1.7. 2019 year price

In [331]:

```
predicted = [301996977.213351,
266194655.672971,
314348302.5364,
305931101.919763,
326408665.940211,
286228540.210168,
290799820.761137,
303168475.318105,
301834969.538573,
353795864.975599,
402140890.213715,
418051865.604447,
]
```

In [335]:

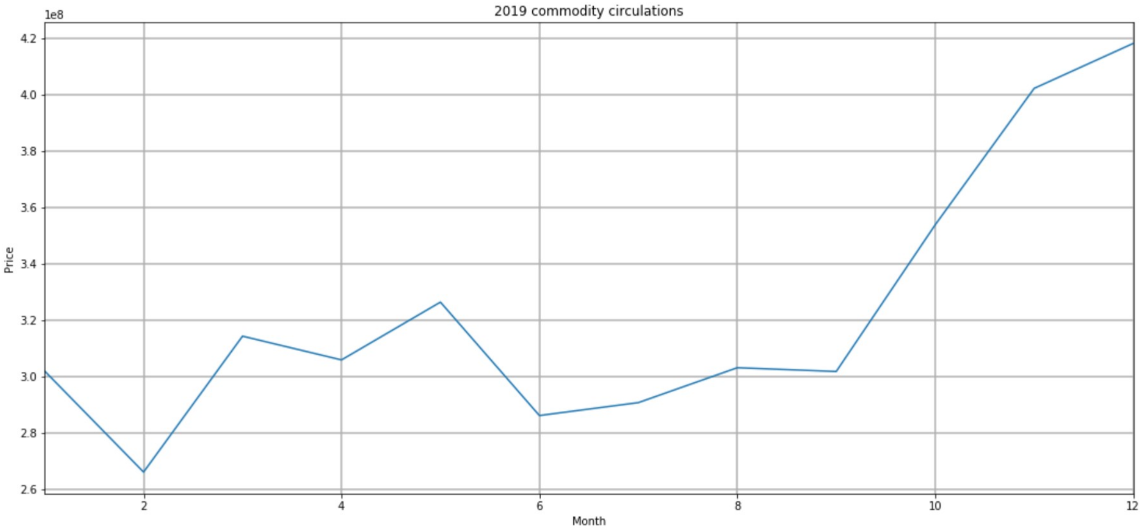
```
m_month = range(1,13)
```

In [348]:

```
plt.figure(figsize=(18,8))
grid(linewidth = 1.5)
xlim(1, 12)
plt.title('2019 commodity circulations')
plt.xlabel('Month')
plt.ylabel('Price')

plt.plot(m_month, predicted)
```

Out[348]:

```
[<matplotlib.lines.Line2D at 0x24203ff65c8>]
```



The End!