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Ввод [1]:

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

Ввод [2]:

```
ts_fb= pd.read_csv('https://www.dropbox.com/s/j04e6thkqmk02z1/LPL.csv?dl=1',
                   header=0,
                   index_col=0,
                   parse_dates=True,
                   squeeze=True)

ts_fb.head()
```

Out[2]:

	Open	High	Low	Close	Adj Close	Volume
Date						
2021-01-04	8.78	8.80	8.60	8.66	8.66	256300
2021-01-05	8.59	8.65	8.56	8.64	8.64	168200
2021-01-06	8.86	9.03	8.84	8.96	8.96	522200
2021-01-07	9.08	9.17	9.05	9.16	9.16	305200
2021-01-08	9.15	9.27	9.14	9.21	9.21	530800

Ввод [3]:

```
ts_fb.info()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 48 entries, 2021-01-04 to 2021-03-12
Data columns (total 6 columns):
 #   Column     Non-Null Count  Dtype  
---  ------     --------------  -----  
 0   Open       48 non-null     float64
 1   High       48 non-null     float64
 2   Low        48 non-null     float64
 3   Close      48 non-null     float64
 4   Adj Close  48 non-null     float64
 5   Volume     48 non-null     int64  
dtypes: float64(5), int64(1)
memory usage: 2.6 KB
```

Ввод [4]:

```
ts_fb['Open']['2021-01']
```

Out[4]:

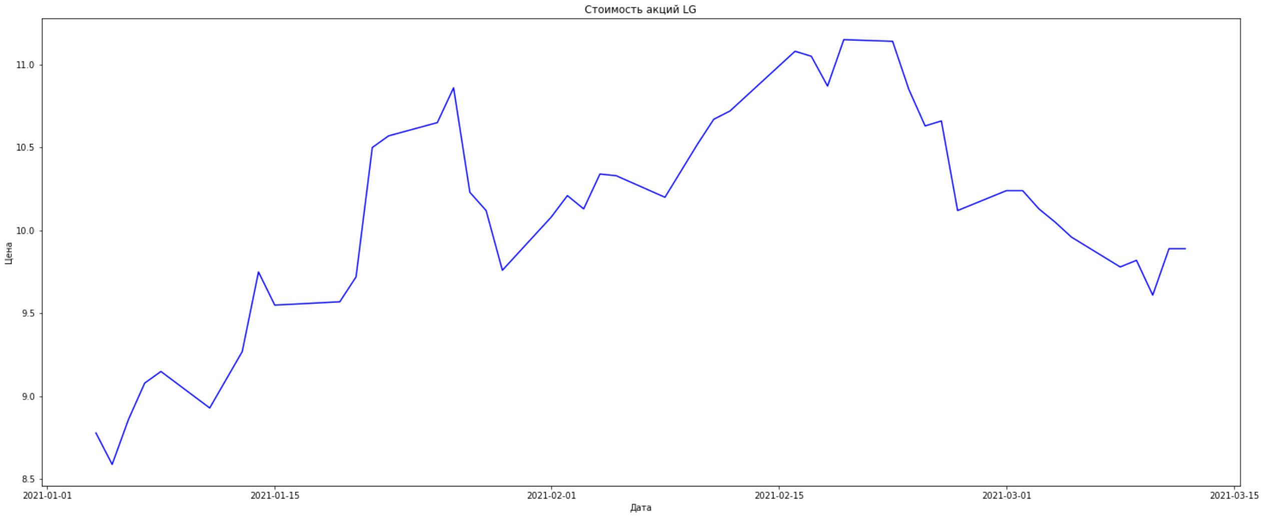
```
Date
2021-01-04     8.78
2021-01-05     8.59
2021-01-06     8.86
2021-01-07     9.08
2021-01-08     9.15
2021-01-11     8.93
2021-01-12     9.10
2021-01-13     9.27
2021-01-14     9.75
2021-01-15     9.55
2021-01-19     9.57
2021-01-20     9.72
2021-01-21    10.50
2021-01-22    10.57
2021-01-25    10.65
2021-01-26    10.86
2021-01-27    10.23
2021-01-28    10.12
2021-01-29     9.76
Name: Open, dtype: float64
```

Ввод [5]:

```
plt.figure(figsize = (25, 10))
plt.title('Стоимость акций LG')
plt.xlabel('Дата')
plt.ylabel('Цена')
plt.plot(ts_fb['Open'], 'blue', label = 'Тренировочные данные')
```

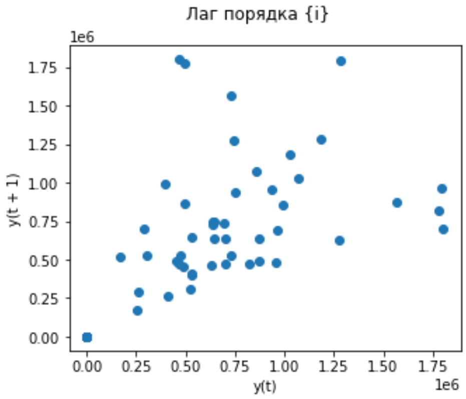
Out[5]:

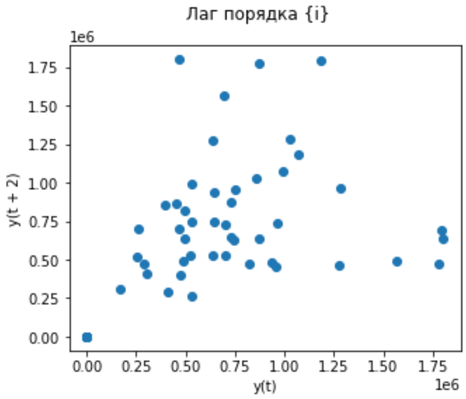
```
[<matplotlib.lines.Line2D at 0x7fa05b9cb220>]
```

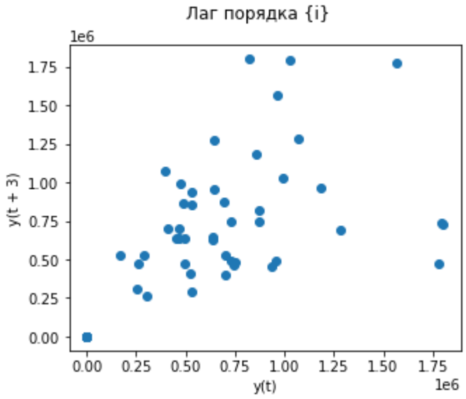


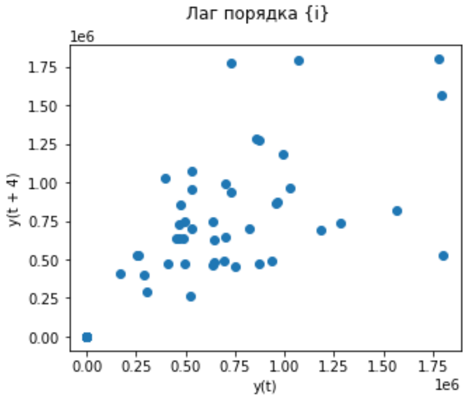
Ввод [6]:

```
for i in range(1, 5):
    fig, ax = pyplot.subplots(1, 1, sharex='col', sharey='row', figsize=(5,4))
    fig.suptitle('Лаг порядка {i}')
    pd.plotting.lag_plot(ts_fb, lag=i, ax=ax)
    pyplot.show()
```

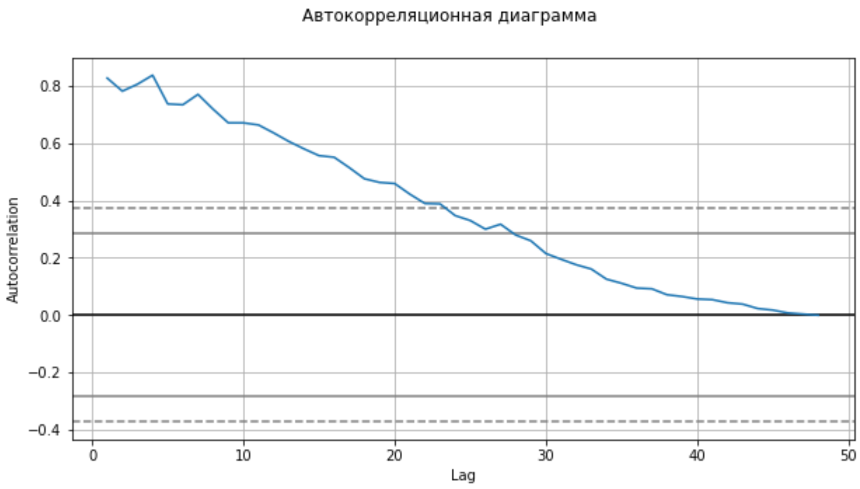








Ввод [7]:
```
fig, ax = pyplot.subplots(1, 1, sharex='col', sharey='row', figsize=(10,5))
fig.suptitle('Автокорреляционная диаграмма')
pd.plotting.autocorrelation_plot(ts_fb, ax=ax)
pyplot.show()
```



1 Прогнозирование временного ряда авторегрессионными методами

Ввод [8]:
```
from statsmodels.tsa.arima.model import ARIMA
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
```

Ввод [9]:
```
X = list(range(ts_fb.shape[0]))
y = ts_fb['Open'].values
```

Ввод [10]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, shuffle=False, train_size=0.8)
```

Ввод [11]:
```
history = [y for y in y_train]
predictions = list()
for t in range(len(y_test)):
    model = ARIMA(history, order = (5, 1, 0))
    model_fit = model.fit()
    yhat = model_fit.forecast()[0]
    predictions.append(yhat)
    history.append(y_test[t])
```

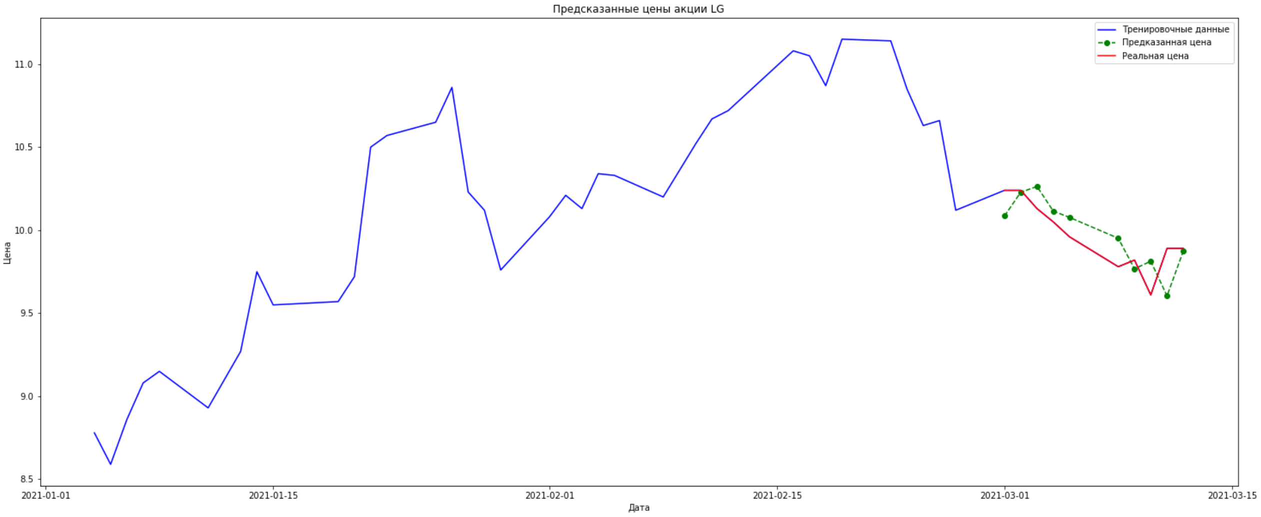
Ввод [12]:
```
ts_fb['ARIMA'] = (len(X_train) * [np.NAN]) + list(predictions)
ts_fb['test'] = (len(X_train) * [np.NAN]) + list(y_test)
ts_fb['train'] = list(y_train) + (len(X_test) * [np.NAN])
```

Ввод [13]:

```
plt.figure(figsize = (25, 10))
plt.plot(ts_fb['Open'], color = 'blue', label = 'Тренировочные данные')
plt.plot(ts_fb.index, ts_fb['ARIMA'], color = 'green', marker = 'o', linestyle = 'dashed', label = 'Предказанна
plt.plot(ts_fb.index, ts_fb['test'], color = 'red', label = 'Реальная цена')
plt.title('Предсказанные цены акции LG')
plt.xlabel('Дата')
plt.ylabel('Цена')
plt.legend()
```

Out[13]:

```
<matplotlib.legend.Legend at 0x7fa05eb75cd0>
```



2 Прогнозирование временного ряда методом символьной регресии

import sys !{sys.executable} -m pip install gplearn

Ввод [14]:

```
from gplearn.genetic import SymbolicRegressor
```

Ввод [15]:

```
function_set = ['add', 'sub', 'mul', 'div', 'sin', 'sqrt']
est_gp = SymbolicRegressor(population_size=100, metric='mse',
                           generations=60, stopping_criteria=0.01,
                           init_depth=(4, 10), verbose=1, function_set=function_set,
                           const_range=(-100, 100), random_state=0)
```

Ввод [16]:

```
est_gp.fit(np.array(X_train).reshape(-1, 1), y_train)
```

```
    |   Population Average    |             Best Individual              |
---- ------------------------- ------------------------------------------ ----------
 Gen   Length          Fitness   Length          Fitness      OOB Fitness  Time Left
   0   139.53      1.81723e+34       27          12.2766              N/A     10.66s
   1    68.47          4638.27       36         0.502071              N/A      4.71s
   2    32.11          9207.89       41         0.152806              N/A      3.54s
   3    34.51          270.283       41         0.152806              N/A      3.47s
   4    38.49          41.8878       41         0.141622              N/A      3.47s
   5    38.54          233.437       44         0.138505              N/A      3.66s
   6    39.90          282.588       41         0.138393              N/A      3.39s
   7    42.32          39.5408       44         0.138367              N/A      3.56s
   8    37.67          112.575       41         0.138393              N/A      3.34s
   9    35.86          677.953       52         0.130495              N/A      3.92s
  10    35.79          122.939       30         0.140228              N/A      4.81s
  11    32.56          440.868       30         0.140228              N/A      3.78s
  12    29.75          193.582       30         0.140228              N/A      3.06s
  13    29.98           461807       32         0.138276              N/A      2.88s
  14    29.28          311.369       30         0.140228              N/A      2.91s
  15    29.57          172.905       30         0.140228              N/A      2.67s
  16    29.21          573.909       30         0.138276              N/A      2.70s
```

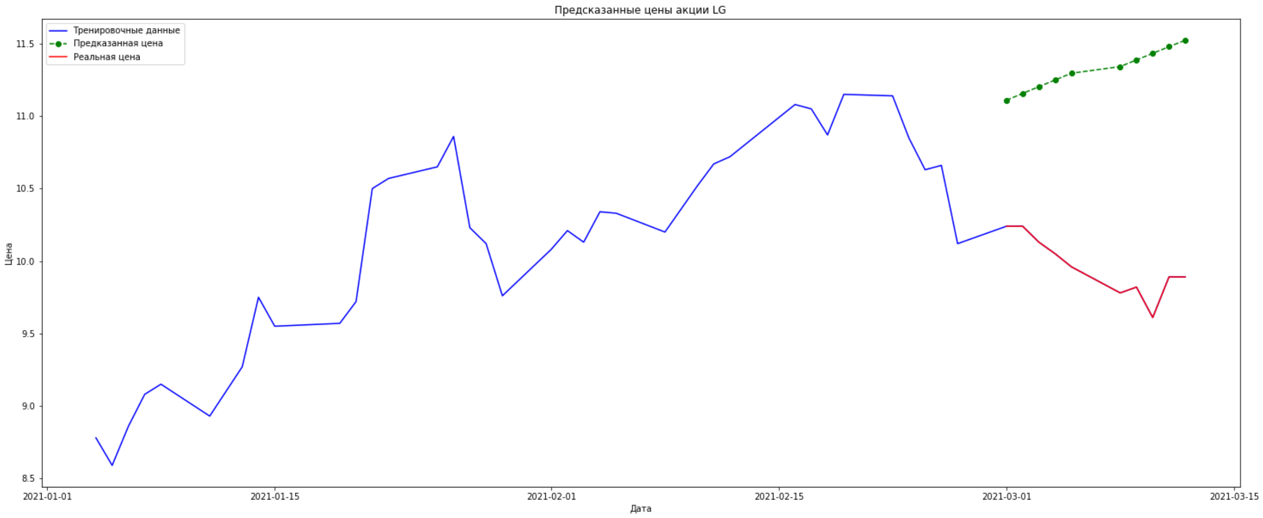
Ввод [17]:

```
y_gp = est_gp.predict(np.array(X_test).reshape(-1, 1))
ts_fb['GPLEARN'] = (len(X_train) * [np.NAN]) + list(y_gp)

plt.figure(figsize = (25, 10))
plt.plot(ts_fb['Open'], color = 'blue', label = 'Тренировочные данные')
plt.plot(ts_fb.index, ts_fb['GPLEARN'], color = 'green', marker = 'o', linestyle = 'dashed', label = 'Предказан
plt.plot(ts_fb.index, ts_fb['test'], color = 'red', label = 'Реальная цена')
plt.title('Предсказанные цены акции LG')
plt.xlabel('Дата')
plt.ylabel('Цена')
plt.legend()
```

Out[17]:

```
<matplotlib.legend.Legend at 0x7fa05f52f730>
```



3 Сравнение 2 методов

Ввод [18]:

```
mean_squared_error(y_test, predictions), mean_squared_error(y_test, y_gp)
```

Out[18]:

```
(0.021489463034870607, 1.9387660240167992)
```