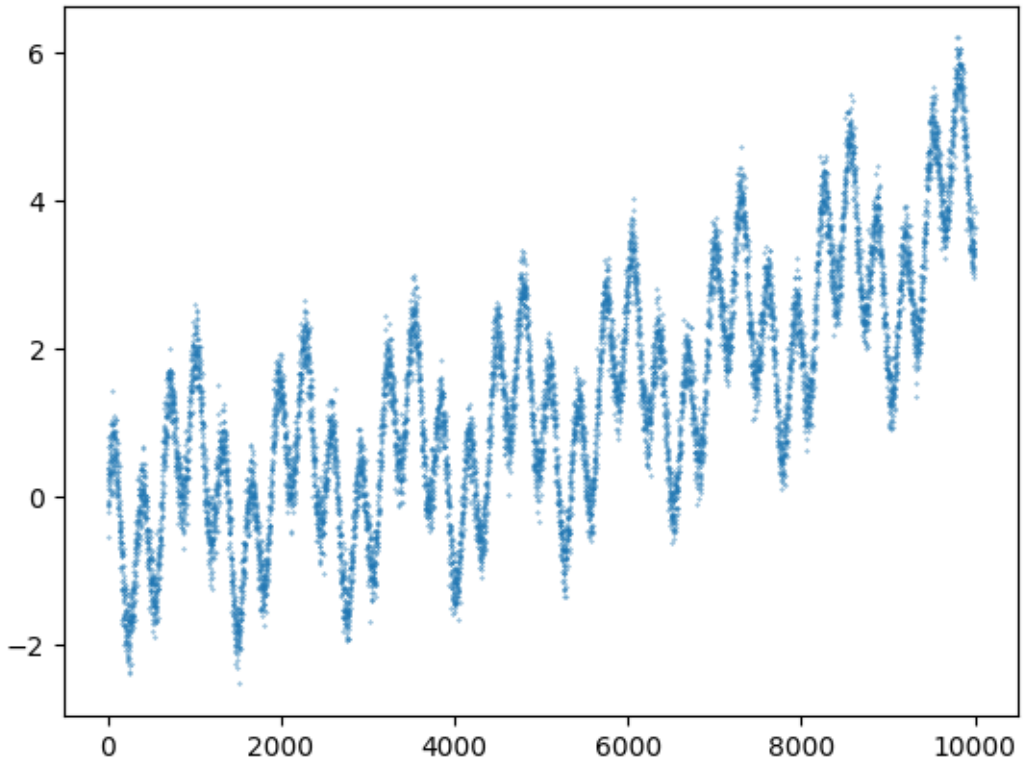
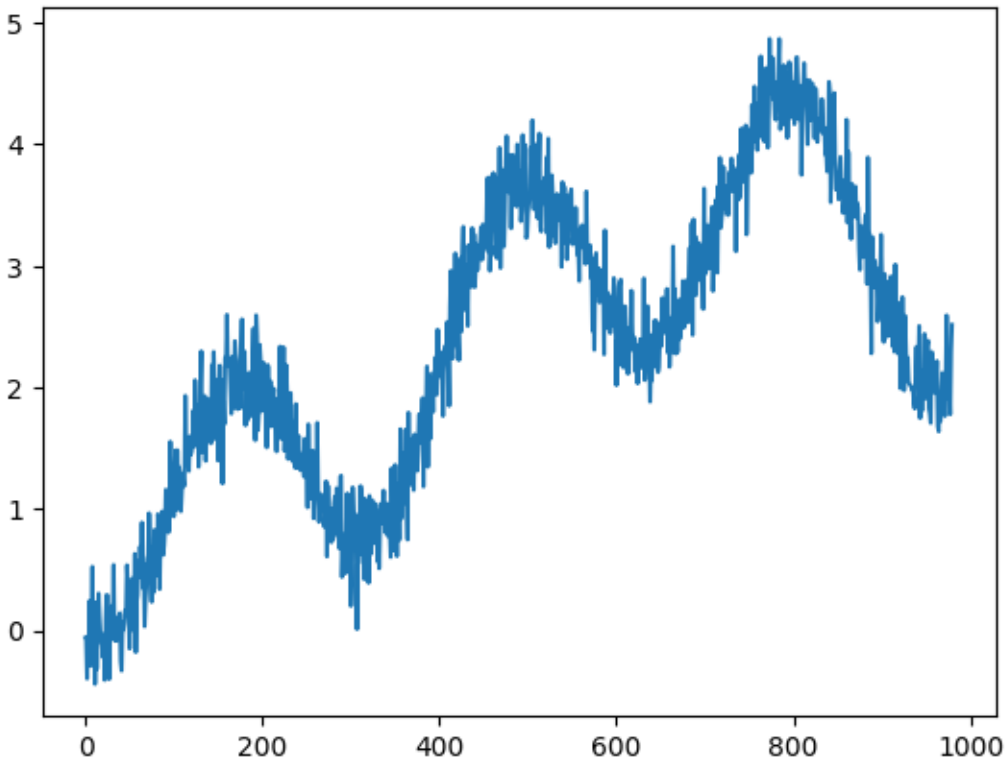
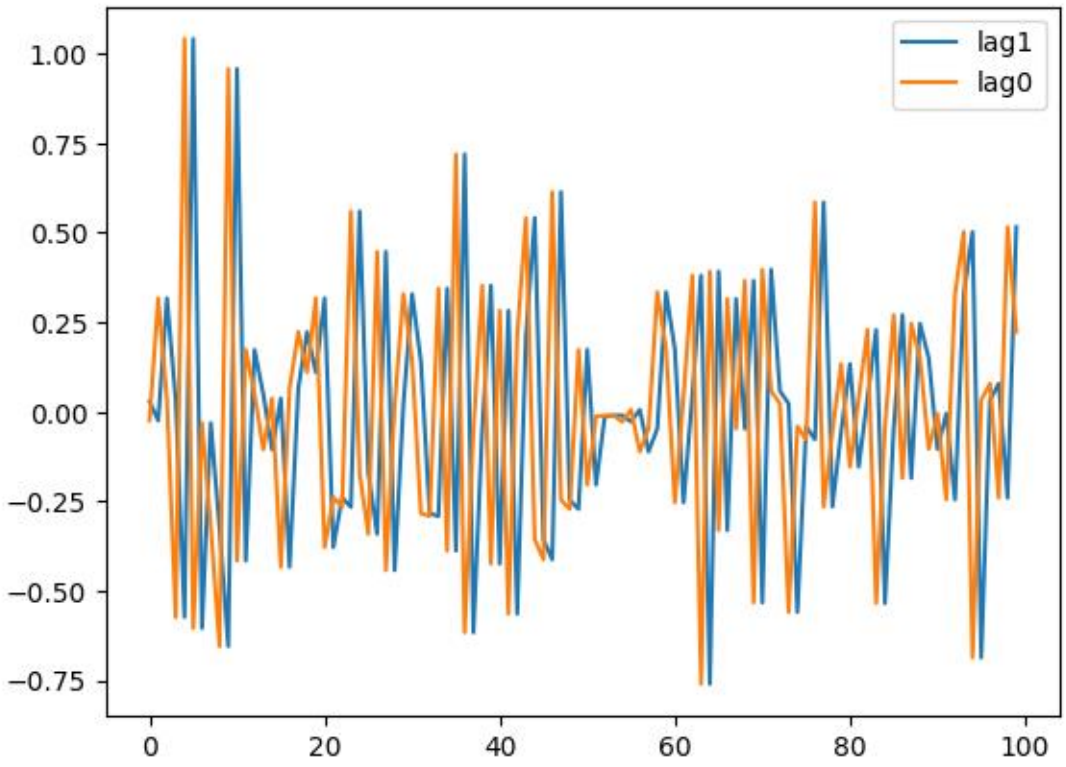
Лабораторная работа 5

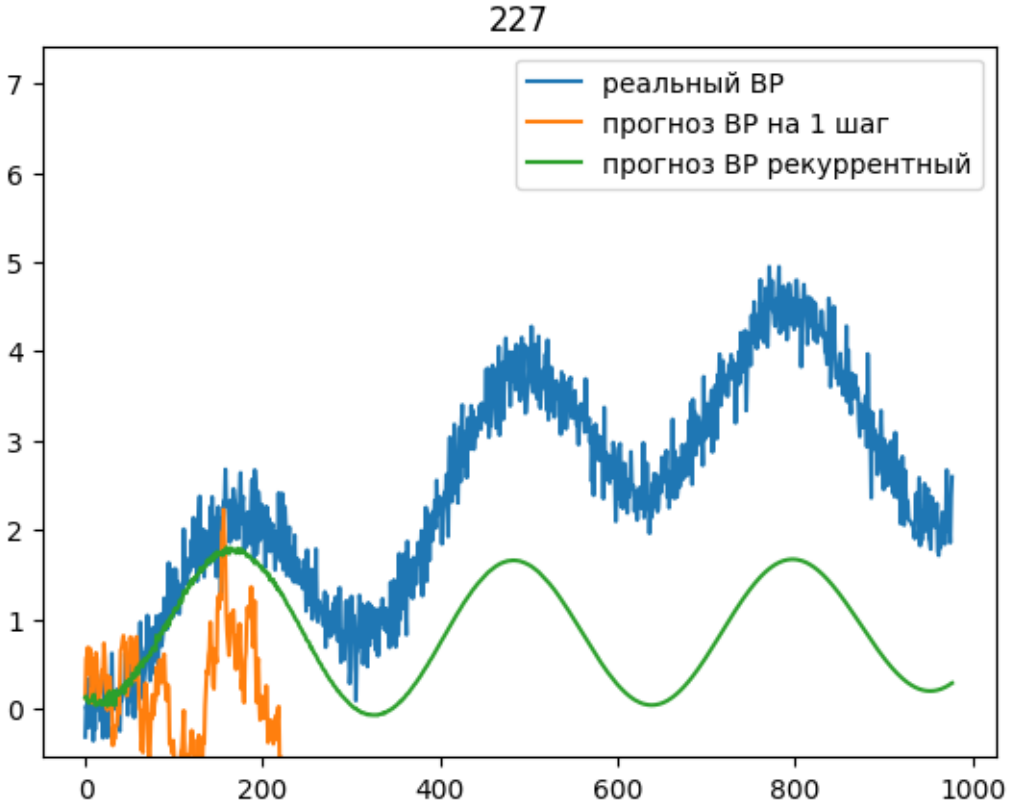
Генерация синтетических данных

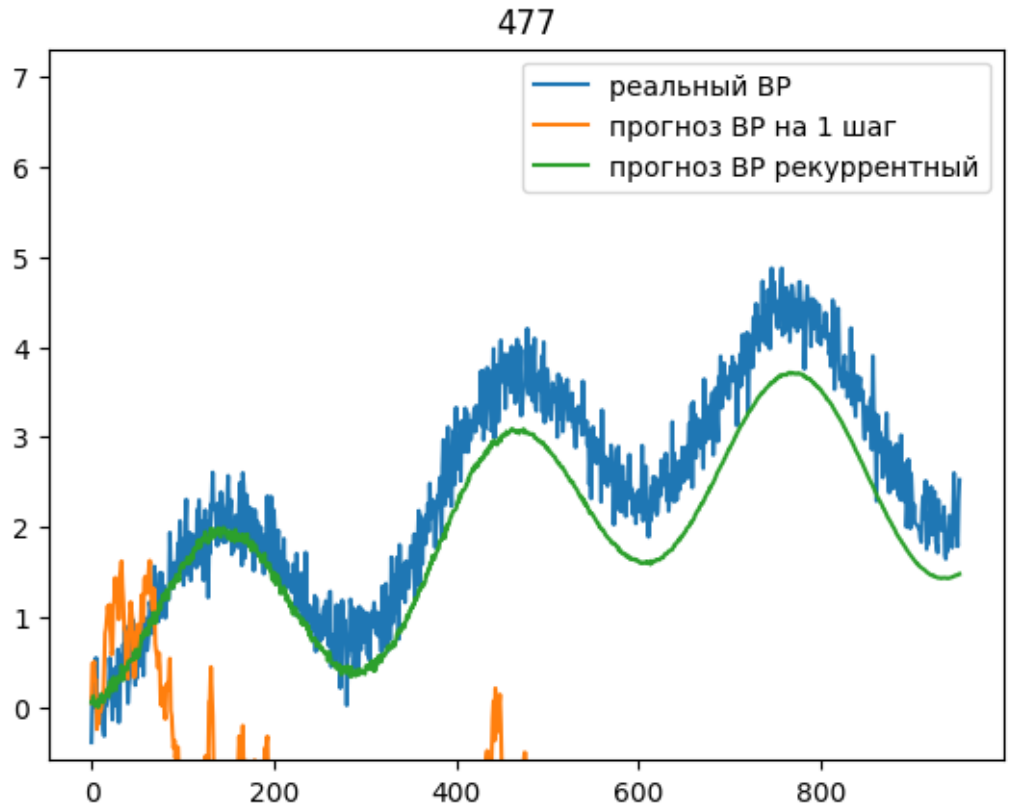


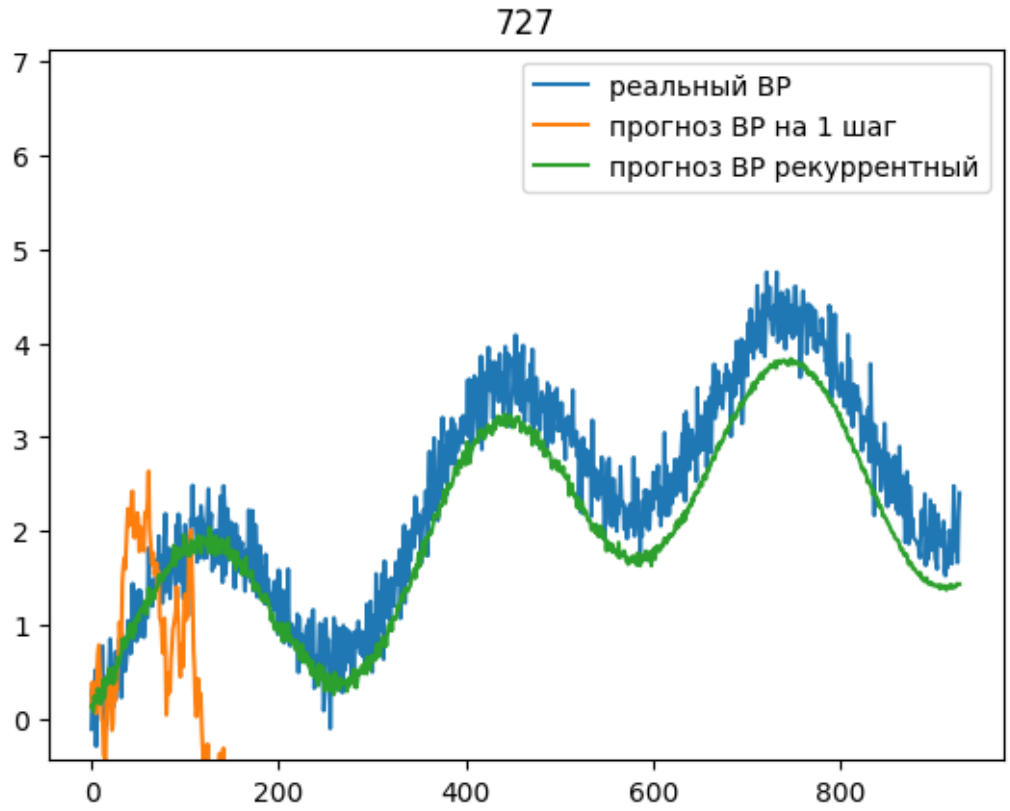


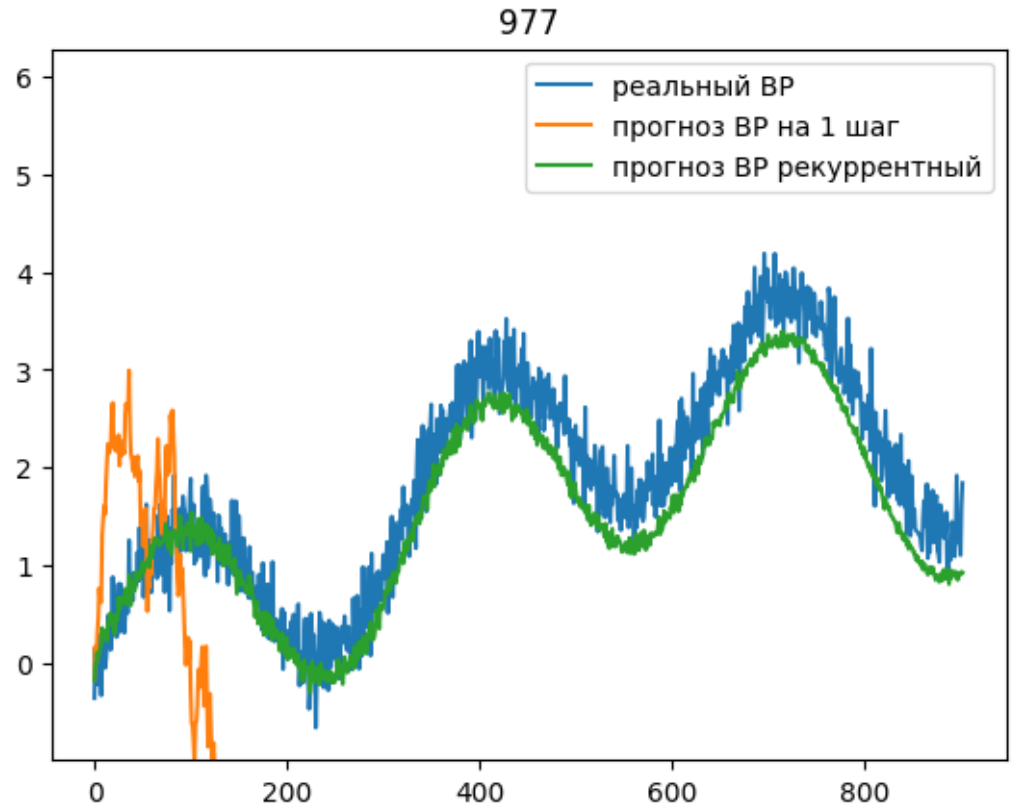


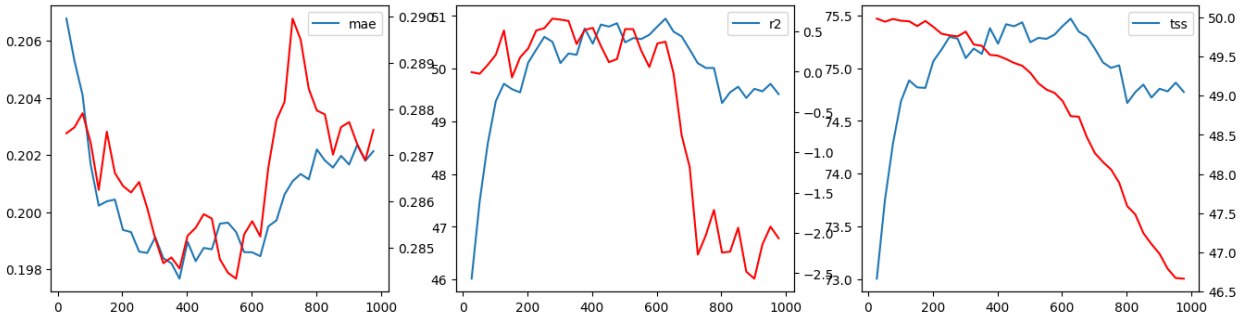
Модель авторегрессии

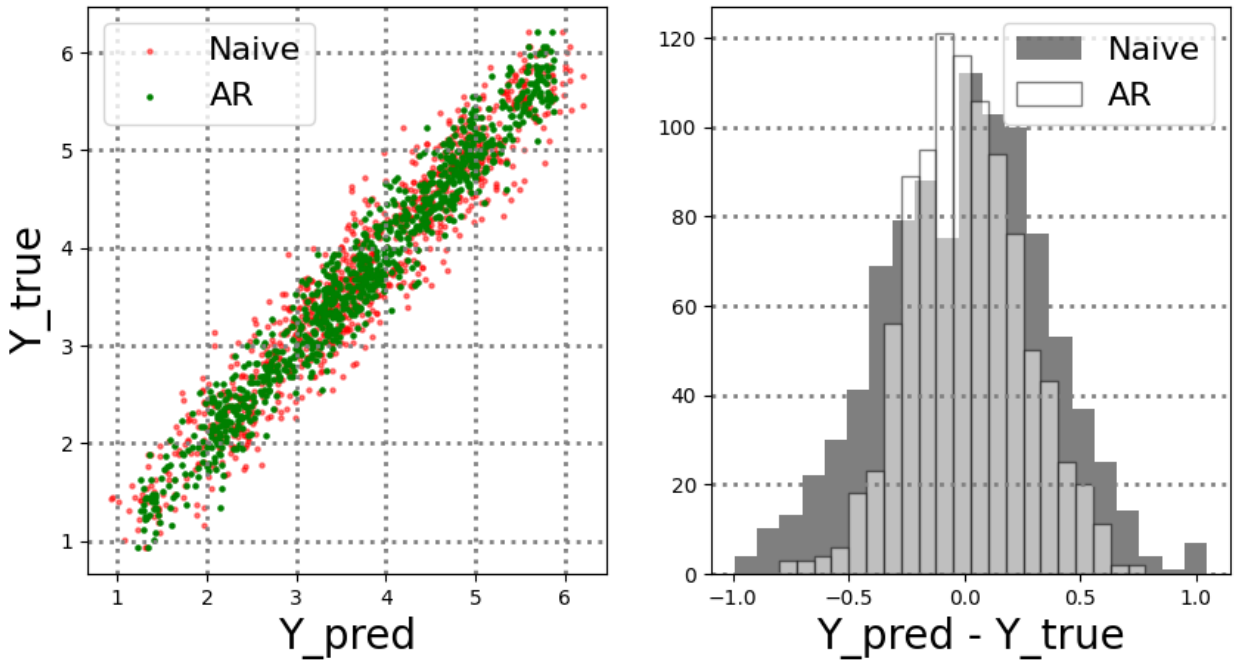



477
реальный ВР
прогноз ВР на 1 шаг
прогноз ВР рекуррентный
0
1
2
3
4
5
6
7
0
200
400
600
800

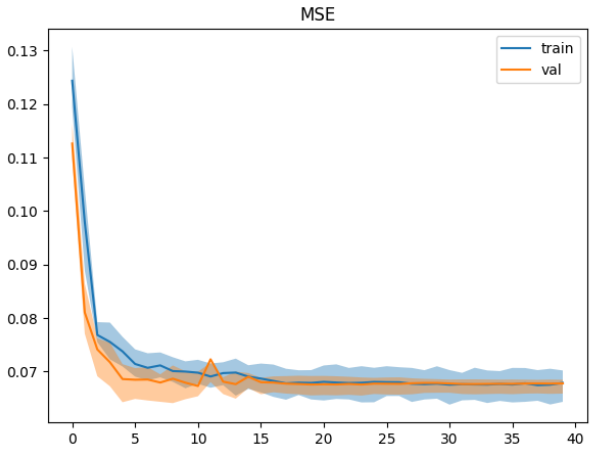

727
реальный ВР
прогноз ВР на 1 шаг
прогноз ВР рекуррентный
0
1
2
3
4
5
6
7
0
200
400
600
800

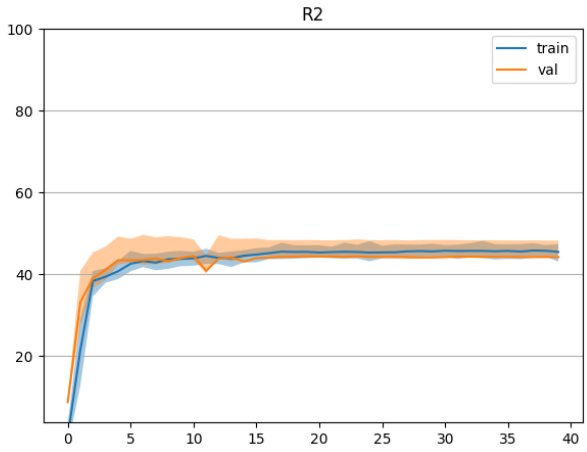

977
реальный BP
прогноз BP на 1 шаг
прогноз BP рекуррентный

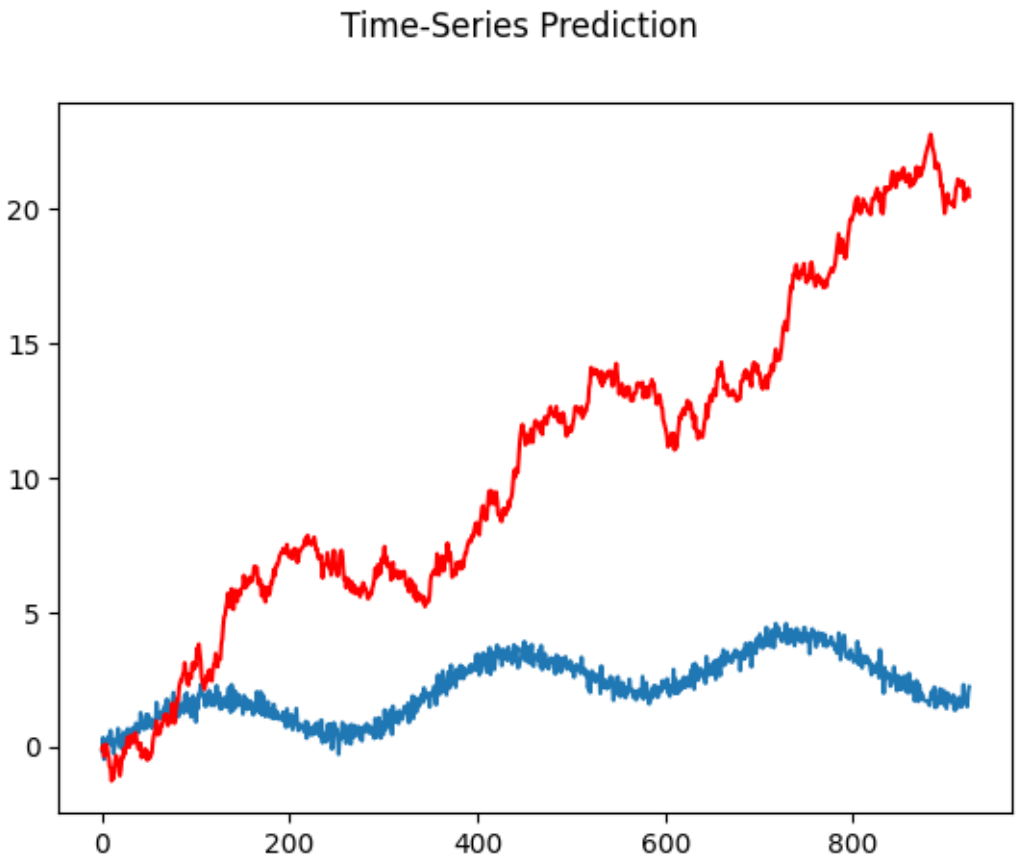

mae
r2
tss

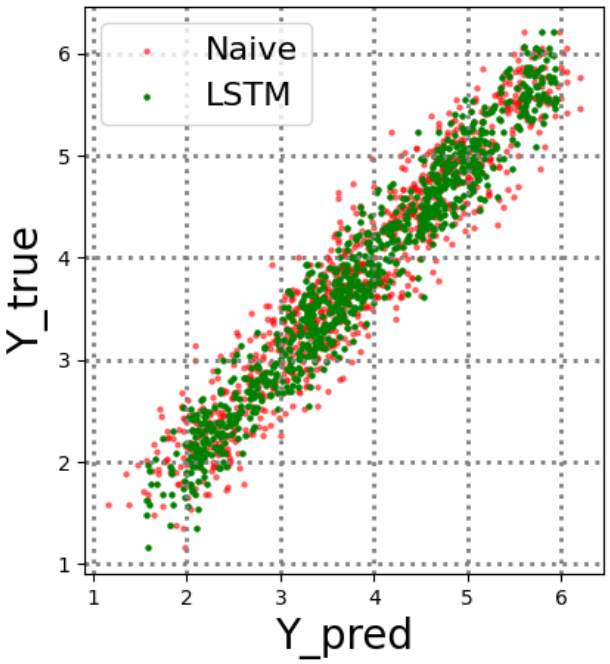

Naive
AR
Y_true
Y_pred
Naive
AR
Y_pred - Y_true

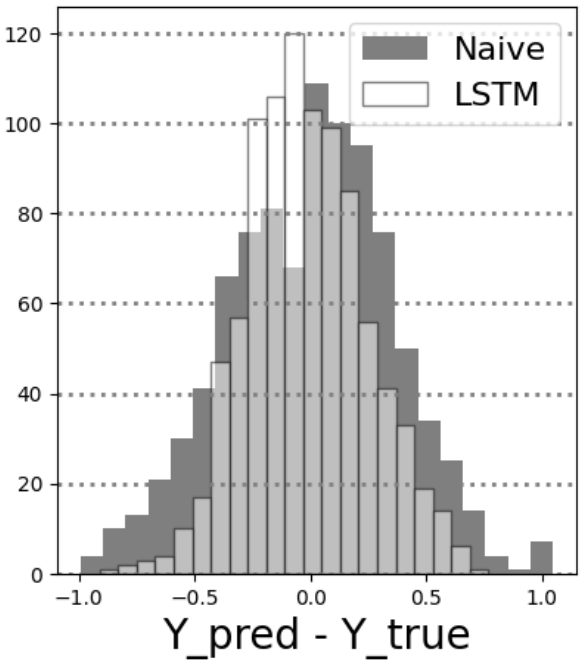
Модель LSTM

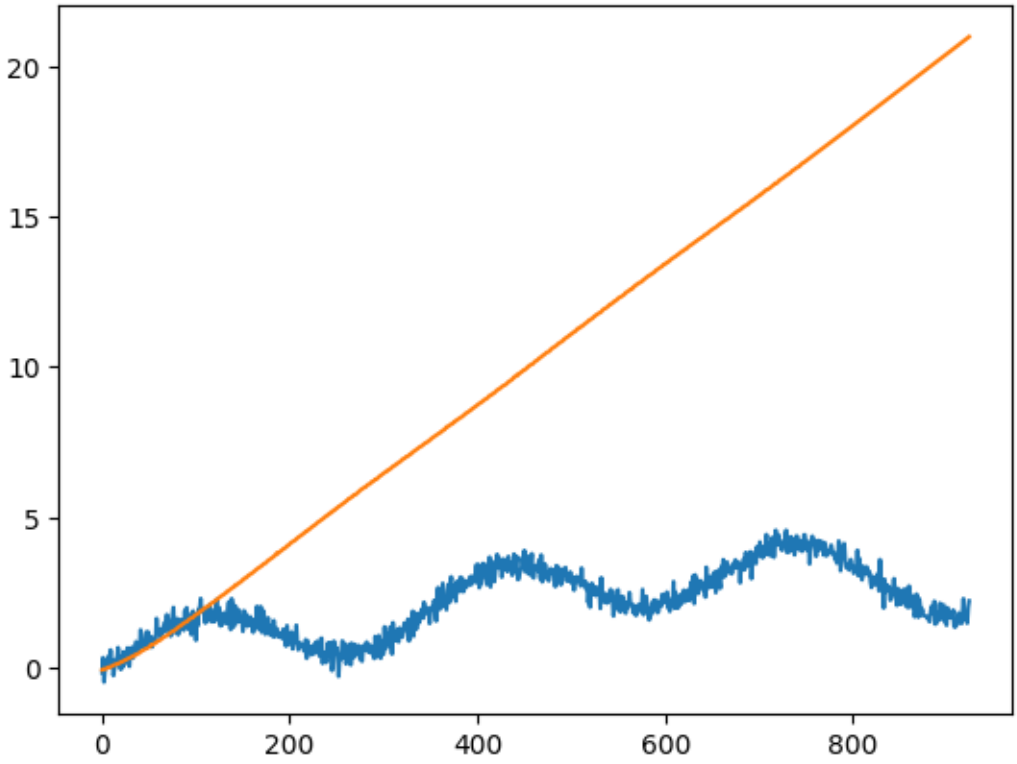

MSE
train
val
0.13
0.12
0.11
0.10
0.09
0.08
0.07
0
5
10
15
20
25
30
35
40


R2
train
val
100
80
60
40
20
0
5
10
15
20
25
30
35
40


Time-Series Prediction
20
15
10
5
0
0
200
400
600
800


Naive
LSTM
Y_true
Y_pred
1
2
3
4
5
6

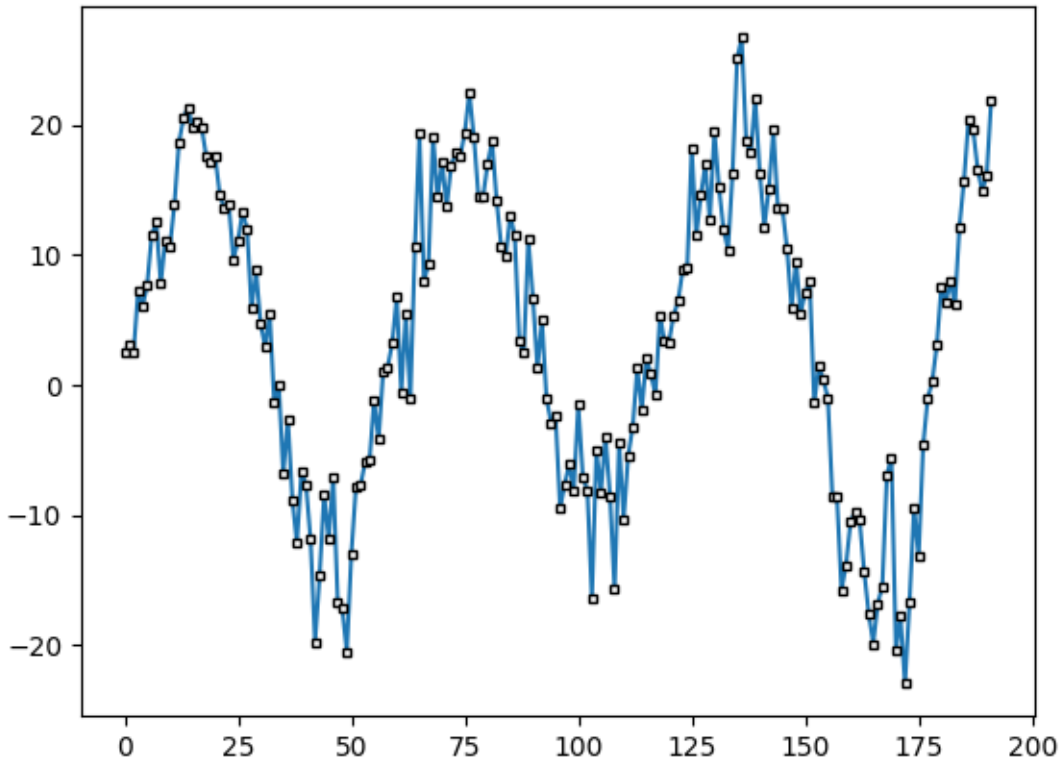

Naive
LSTM
Y_pred - Y_true
0
20
40
60
80
100
120
−1.0
−0.5
0.0
0.5
1.0


0
5
10
15
20
0
200
400
600
800

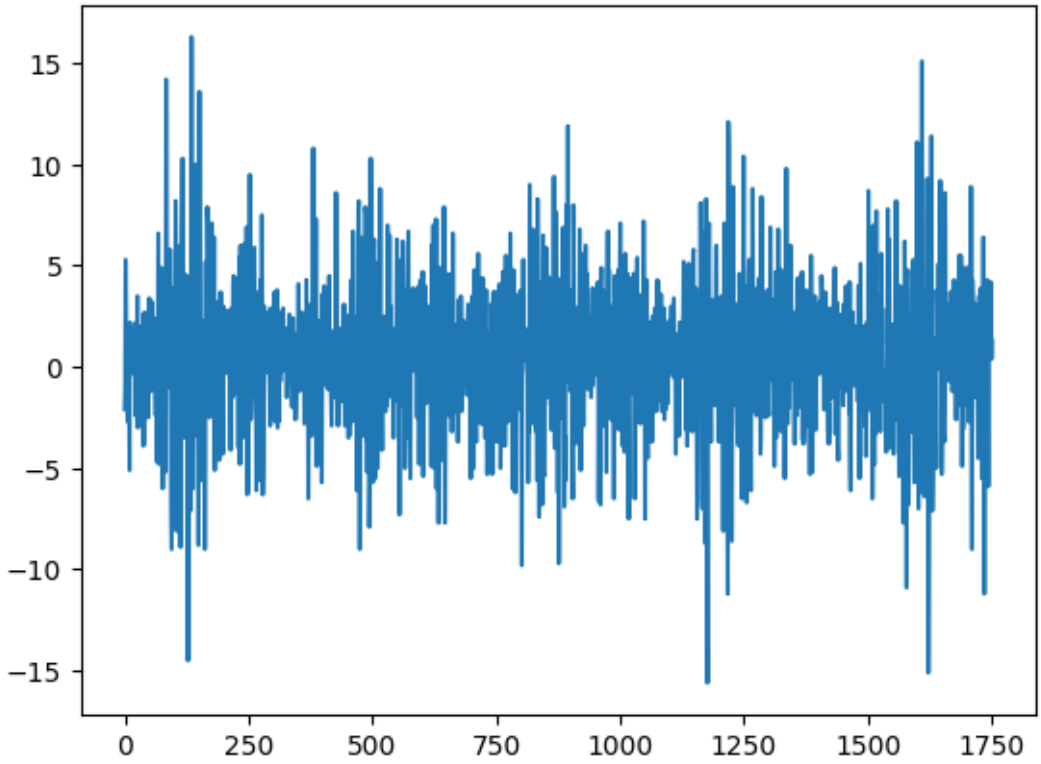
```
================================================
#       Тип     Кол-во точек    R2, %   TSS, %
#       one-step        2       26.36   33.95
#       one-step        3       60.64   66.37
#       one-step        5       69.31   70.32
#       one-step        10      41.92   46.64
#       one-step        50      46.90   52.78
#       one-step        -1      47.86   52.93
================================================
#       recursive       2       -4.69   -22.67
#       recursive       3       -2.34   8.05
#       recursive       5       6.60    2.68
#       recursive       10      4.06    5.59
#       recursive       50      0.97    10.77
#       recursive       -1      -0.28   9.35
================================================
```

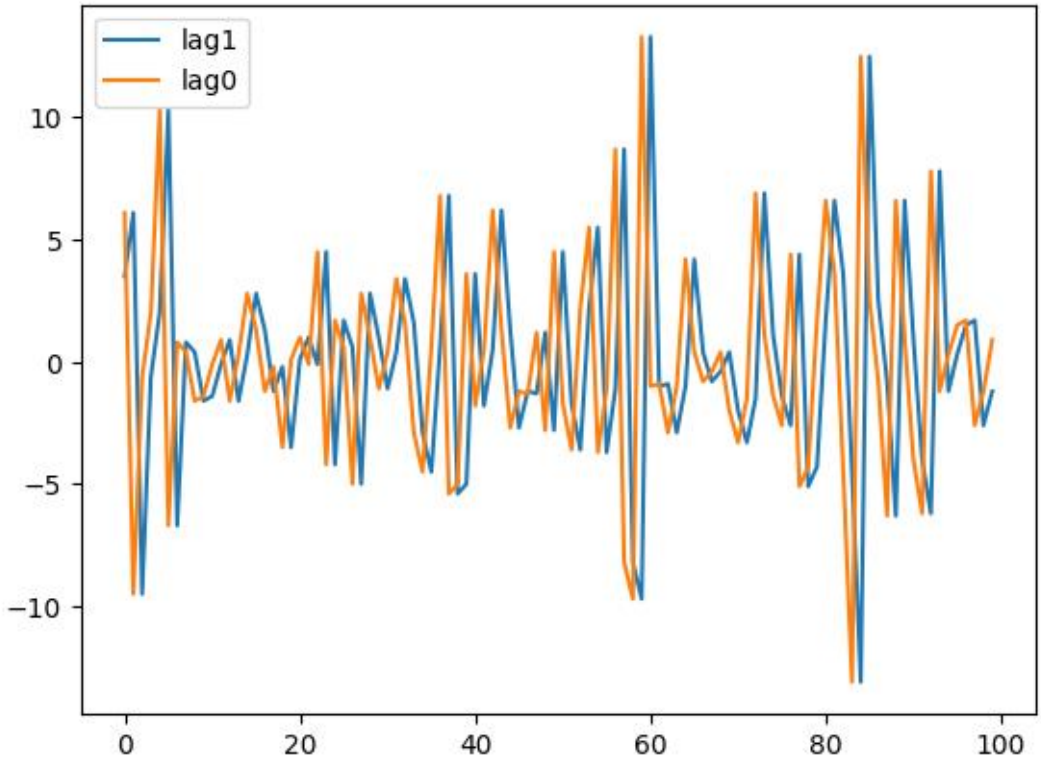
Обучение модели на реальных данных

Екатеринбург

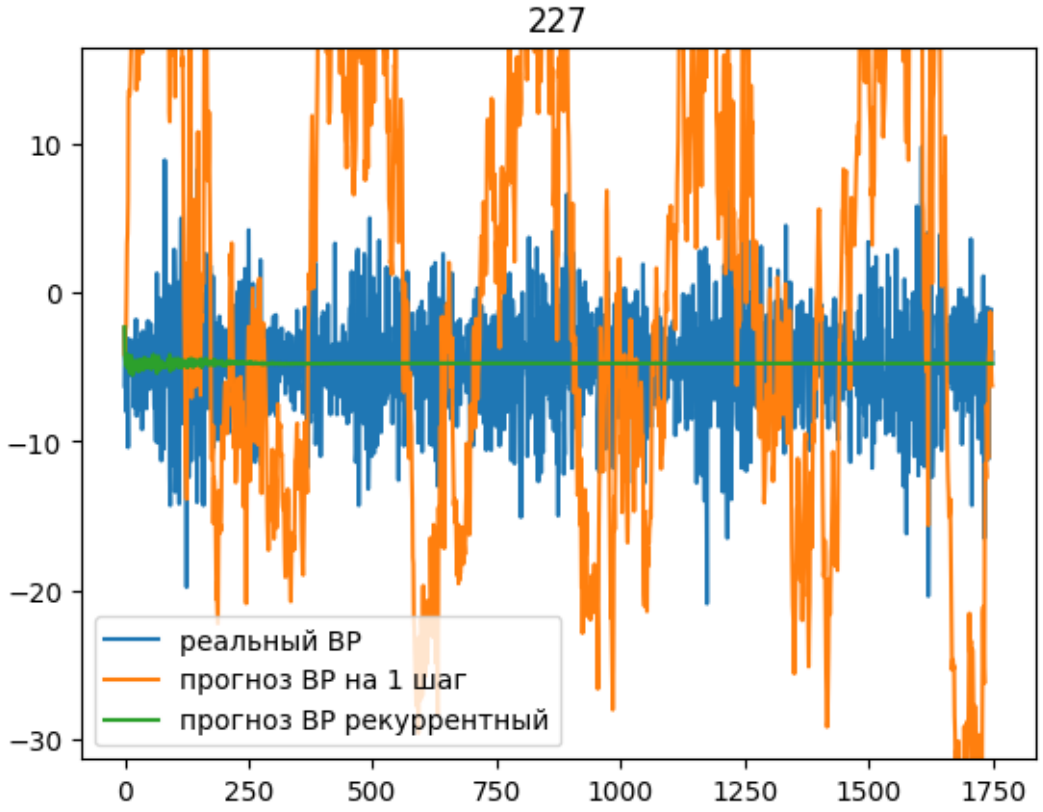


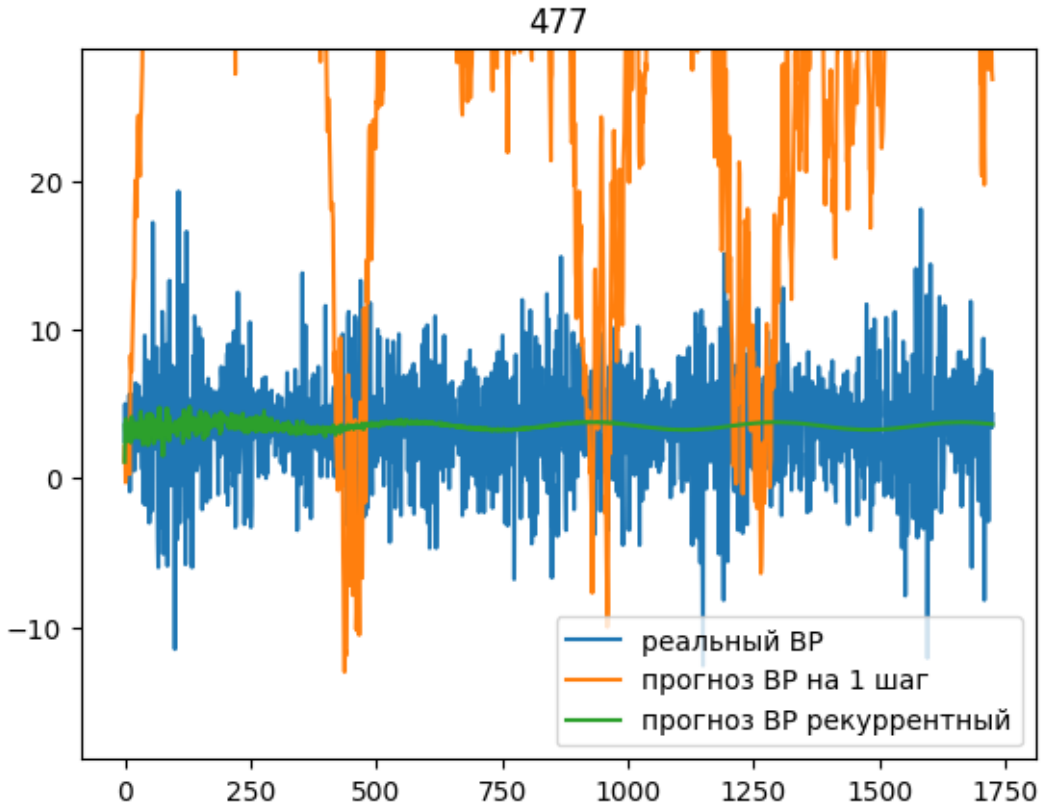
Данные

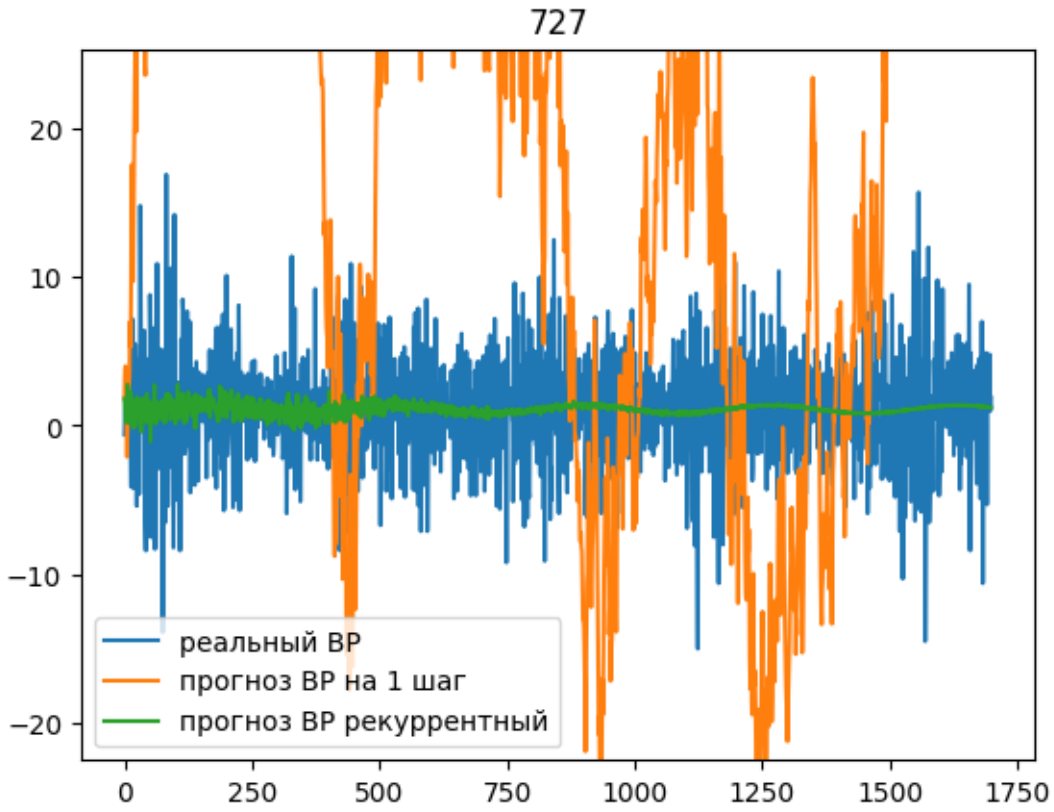

15
10
5
0
−5
−10
−15
0
250
500
750
1000
1250
1500
1750

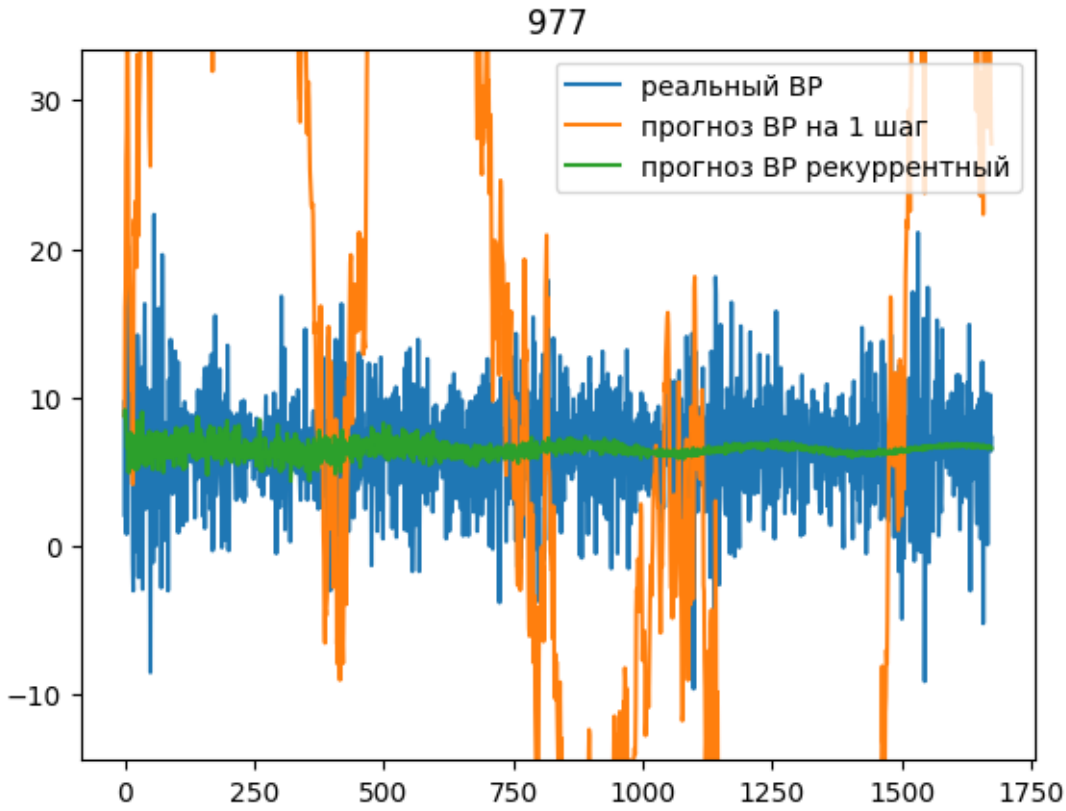

lag1
lag0
10
5
0
−5
−10
0
20
40
60
80
100

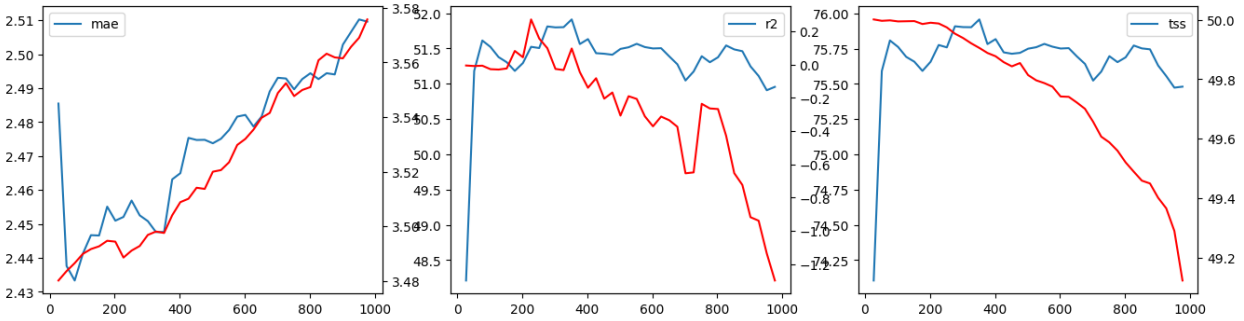
Авторегрессия

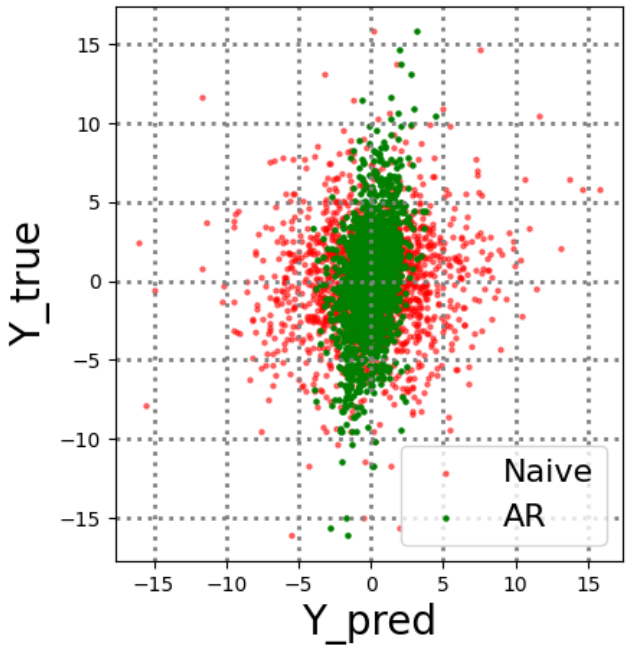


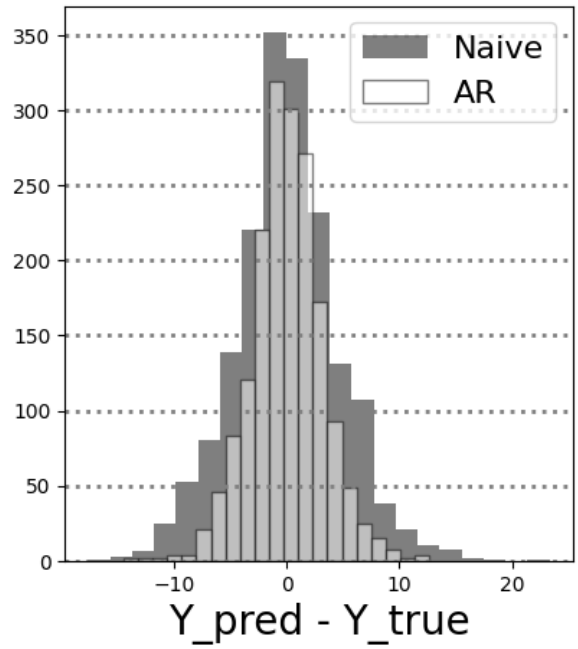



727
20
10
0
−10
−20
0
250
500
750
1000
1250
1500
1750
реальный ВР
прогноз ВР на 1 шаг
прогноз ВР рекуррентный

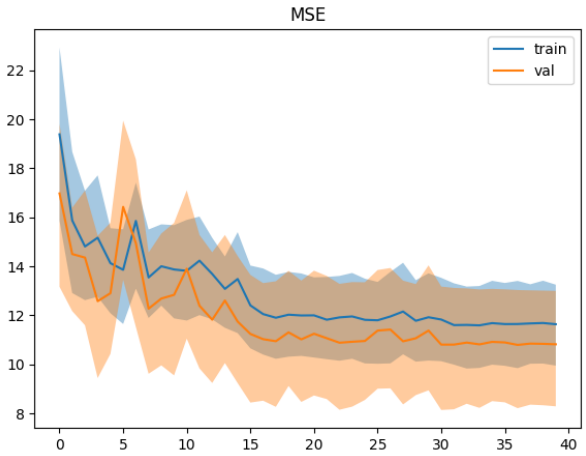

977
30
20
10
0
−10
0
250
500
750
1000
1250
1500
1750
реальный ВР
прогноз ВР на 1 шаг
прогноз ВР рекуррентный

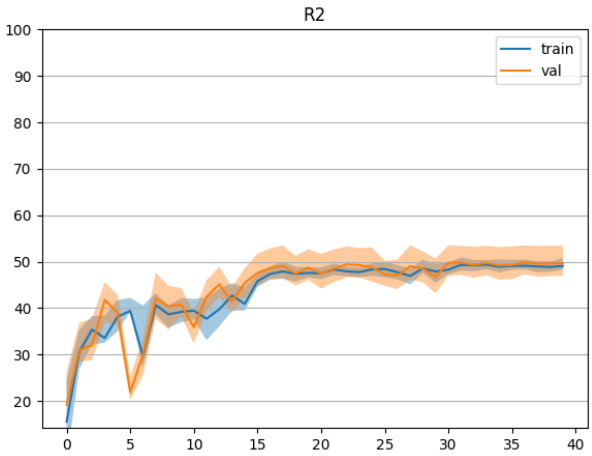

mae
r2
tss

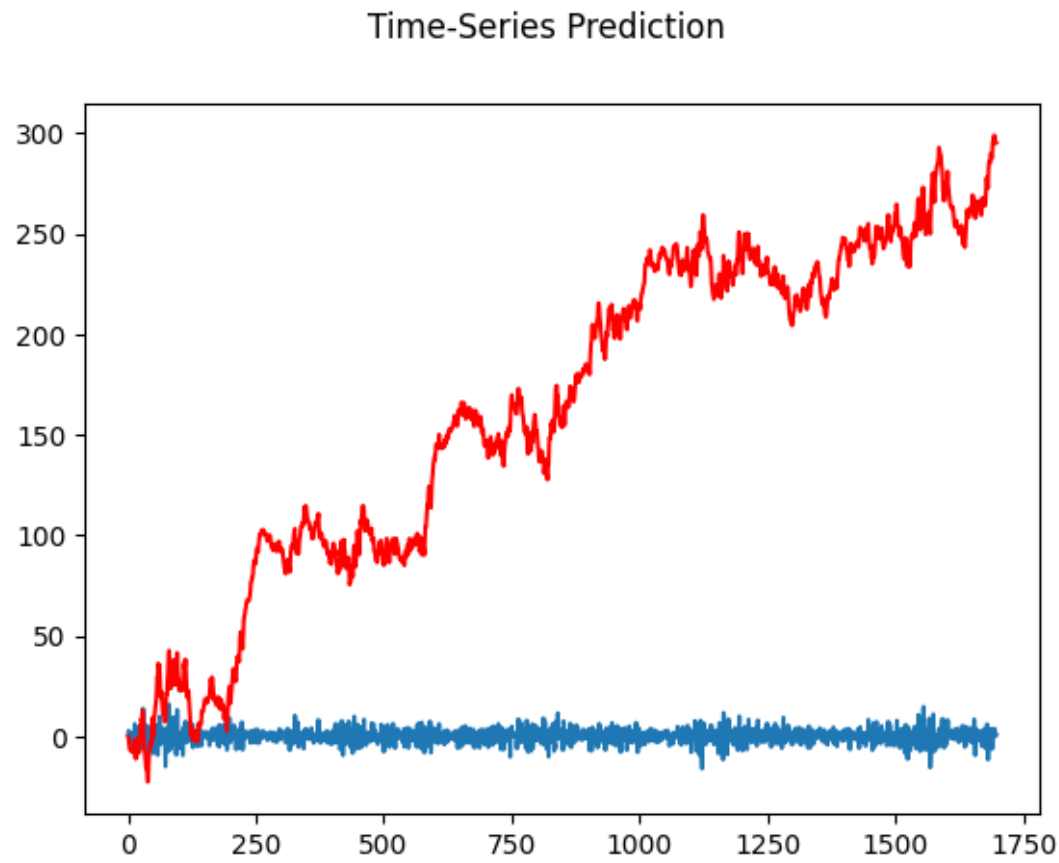

Y_true
Y_pred
Naive
AR

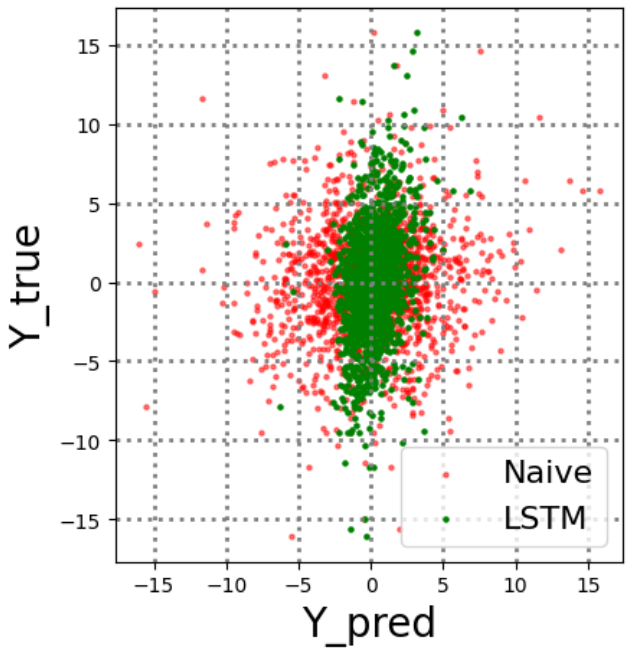

Naive
AR
Y_pred - Y_true

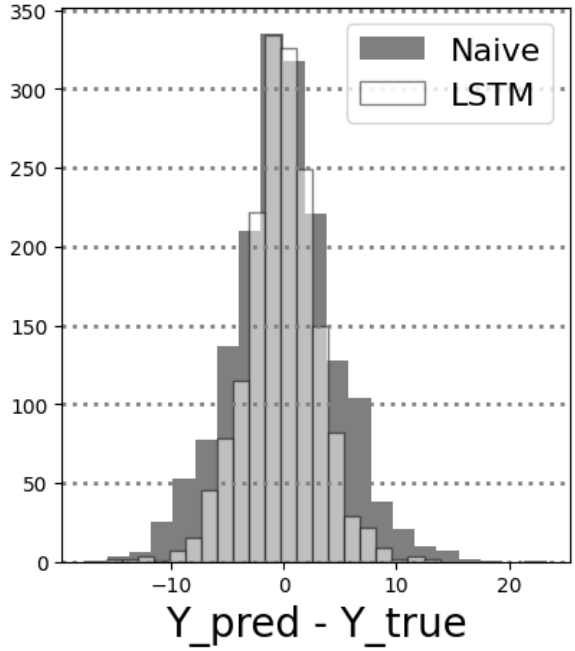
Модель LSTM

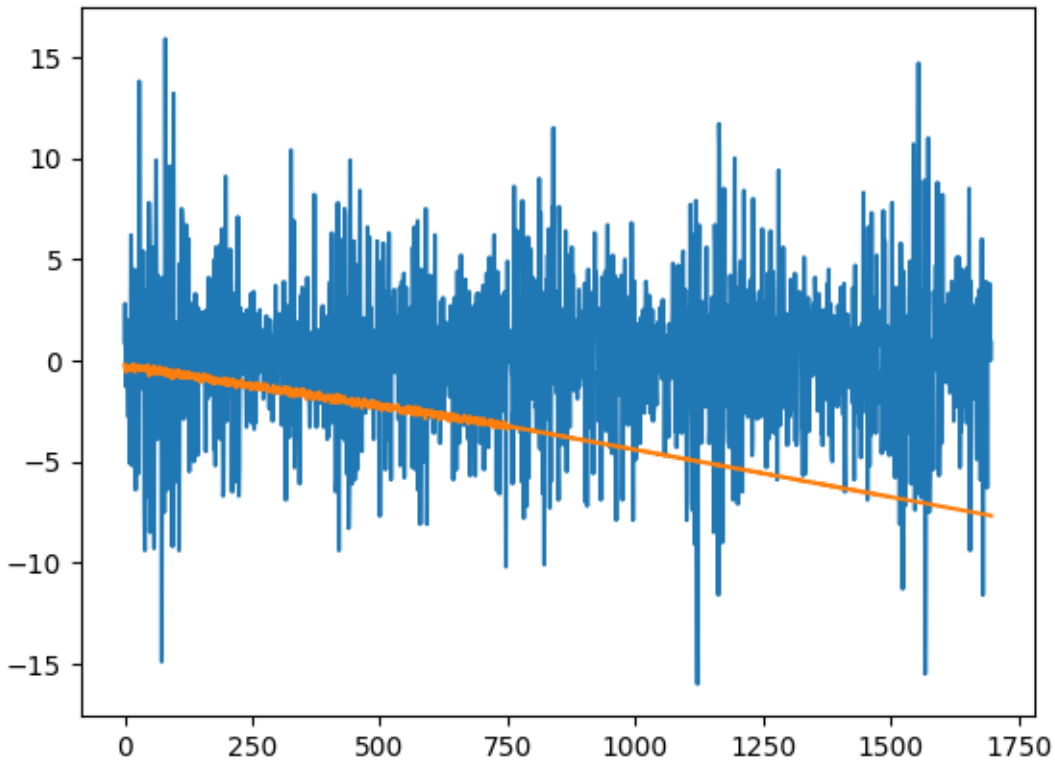

MSE
train
val


R2
train
val


Time-Series Prediction
300
250
200
150
100
50
0
0
250
500
750
1000
1250
1500
1750


Y_true
Y_pred
Naive
LSTM
15
10
5
0
−5
−10
−15
−15
−10
−5
0
5
10
15

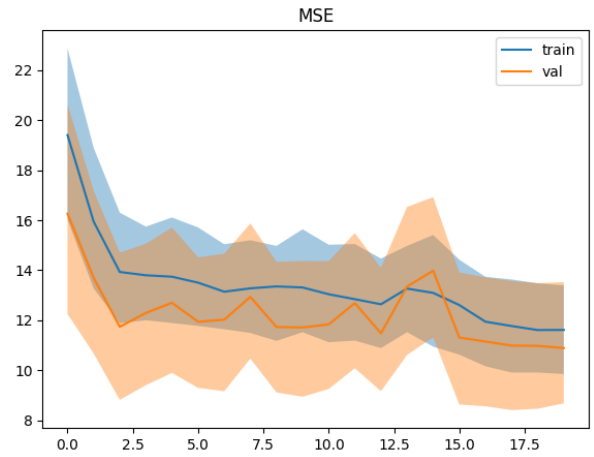

Naive
LSTM
Y_pred - Y_true
350
300
250
200
150
100
50
0
−10
0
10
20

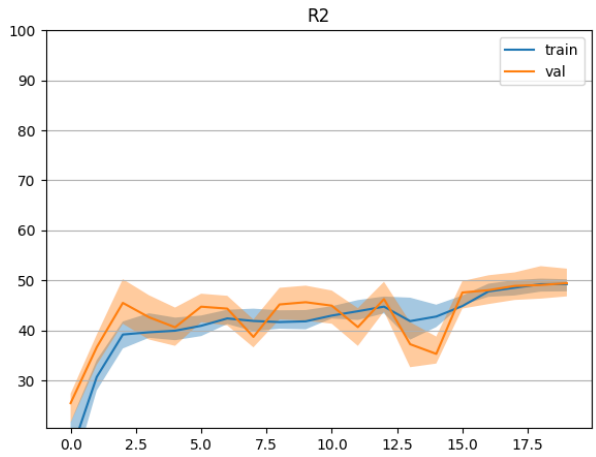


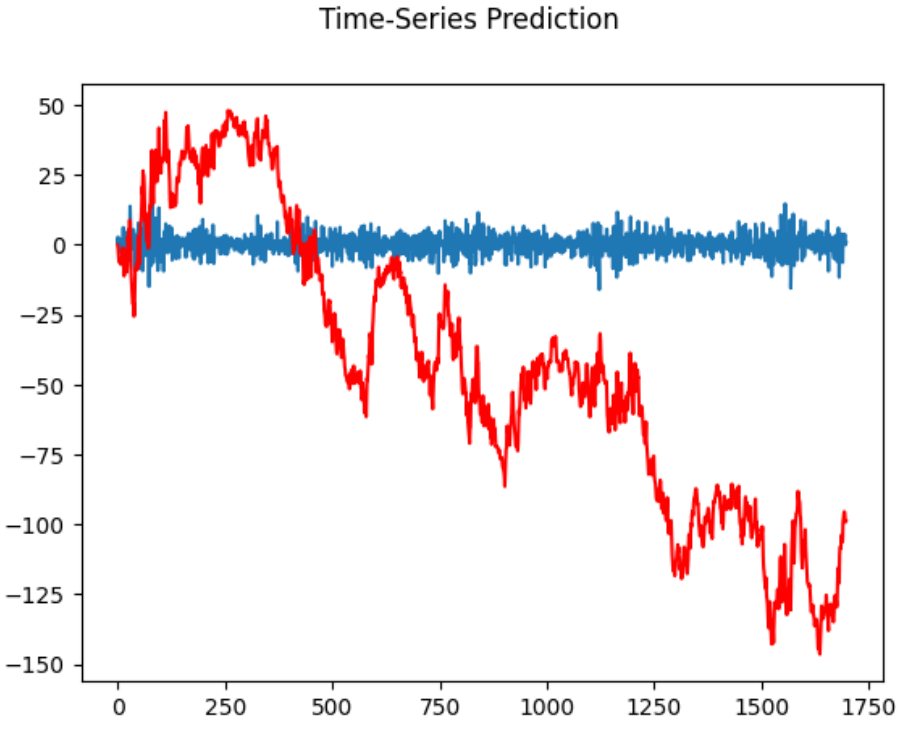

```
================================================
#       Тип     Кол-во точек    R2, %   TSS, %
#       one-step        2       -2083.26        -375.08
#       one-step        3       -46.41  -22.83
#       one-step        5       4.58    27.09
#       one-step        10      34.22   43.05
#       one-step        50      44.39   51.14
#       one-step        -1      49.84   56.08
================================================
#       recursive       2       -1043.88        -148.33
#       recursive       3       -21.50  10.97
#       recursive       5       -5.33   22.53
#       recursive       10      -2.74   11.54
#       recursive       50      -1.79   12.03
#       recursive       -1      -0.03   12.39
================================================
```

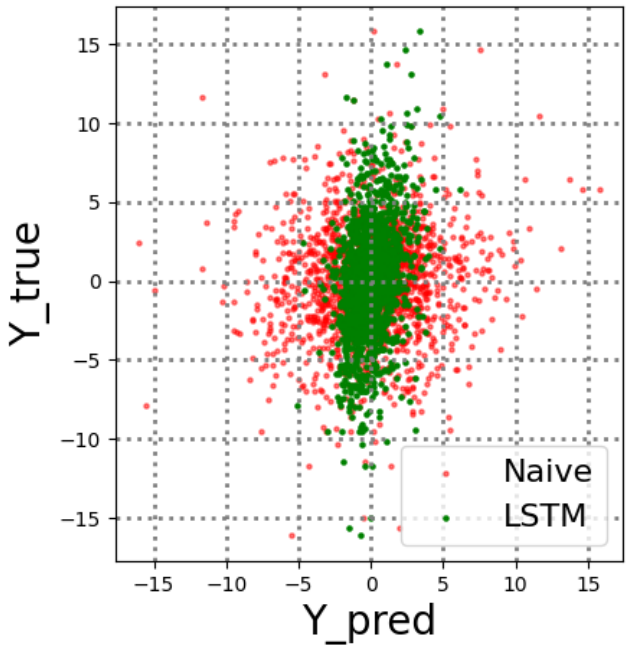
Изменим параметры (кол-во нейронов – 20, эпохи – 30)

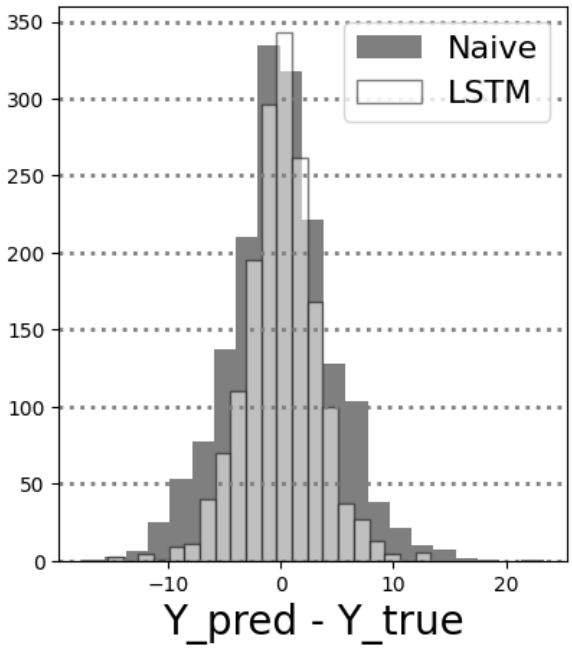
```python
learning_rate = 0.01

num_features = 1
input_size = 1
hidden_size = 20
num_layers = 2
bidirectional = True
dropout_rate = 0.2

model = LSTM(
    num_features,
    input_size,
    hidden_size,
    num_layers,
    bidirectional,
    dropout_rate
).to(device)

criterion = torch.nn.MSELoss()    # среднеквадратическое отклонение
optimizer = torch.optim.Adam(model.parameters(), lr=learning_rate)
# добавляем постепенное уменьшение шага обучения каждые 15 эпох
scheduler = optim.lr_scheduler.StepLR(optimizer, step_size=15, gamma=0.1)
```

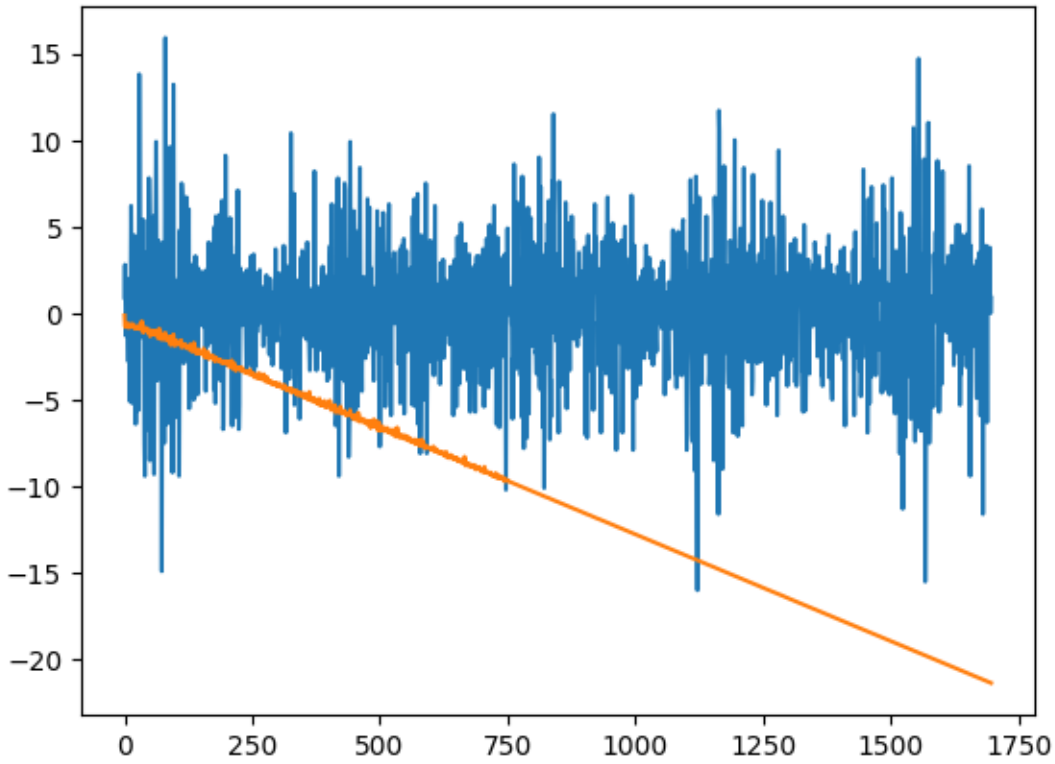












```
================================================
#       Тип     Кол-во точек    R2, %   TSS, %
#       one-step        2       -1956.00        -347.39
#       one-step        3       -35.54  -13.71
#       one-step        5       11.71   32.53
#       one-step        10      36.88   45.35
#       one-step        50      45.31   51.95
#       one-step        -1      49.86   56.10
================================================
#       recursive       2       -1395.57        -202.97
#       recursive       3       -37.71  5.23
#       recursive       5       -22.89  21.70
#       recursive       10      -8.57   10.79
#       recursive       50      -0.59   12.02
#       recursive       -1      0.15    12.40
================================================
```