Лабораторная работа №3

Подготовка обучающей и тестовой выборки, кросс-валидация и подбор гиперпараметров на примере метода ближайших соседей

Загрузим все необходимые библиотеки

In [1]:
```
import pandas as pd
from sklearn.model_selection import train_test_split
import numpy as np
import matplotlib.pyplot as plt
from sklearn.metrics import mean_squared_error, r2_score
import seaborn as sns
from sklearn.neighbors import KNeighborsRegressor
from sklearn.model_selection import GridSearchCV
from sklearn.model_selection import KFold, RepeatedKFold
```

В качестве датасета выберем набор данных сна за месяц

In [2]:
```
df = pd.read_csv("Sleep_data.csv")
df = df.dropna()
```

In [3]:
```
df = df.dropna()
df.head()
```

Out[3]:

	DECEMBER	DATE	SLEEP SCORE	HOURS OF SLEEP	REM SLEEP	DEEP SLEEP	HEART RATE BELOW RESTING	SLEEP TIME
1	Wednesday	12/01/2021	91.0	7:33:00	23.00%	19.00%	98.00%	10:56pm - 7:20am
2	Thursday	12/02/2021	81.0	7:17:00	16.00%	13.00%	94.00%	10:45pm - 6:58am
3	Friday	12/03/2021	80.0	7:17:00	15.00%	17.00%	78.00%	10:51pm - 7:02am
4	Saturday	12/04/2021	85.0	8:23:00	20.00%	15.00%	58.00%	9:53pm - 7:17am
5	Sunday	12/05/2021	82.0	7:19:00	20.00%	12.00%	79.00%	11:54pm - 8:16am

In [4]:
```
df.shape
```

Out[4]:
```
(31, 8)
```

Обучающая и тестовая выборка

- В качестве обучающей выборки будем использовать время в часах и минутах
- В качестве целевого признака будет выступать оценка качества сна
- Алгоритм KNN будет решать задачу регрессии

In [5]:
```
df["HOURS OF SLEEP"]
```

Out[5]:
```
1     7:33:00
2     7:17:00
3     7:17:00
4     8:23:00
5     7:19:00
6     7:18:00
7     8:02:00
8     6:47:00
9     7:32:00
10    7:45:00
11    7:57:00
12    6:47:00
13    8:33:00
14    7:33:00
15    7:08:00
16    6:34:00
17    7:18:00
18    8:14:00
19    7:08:00
20    7:06:00
21    8:26:00
22    7:29:00
23    8:37:00
24    9:03:00
25    6:39:00
26    7:51:00
27    7:06:00
28    6:57:00
29    7:23:00
30    7:48:00
31    8:09:00
Name: HOURS OF SLEEP, dtype: object
```

In [6]:
```
hours = []
minutes = []
for item in df["HOURS OF SLEEP"]:
    hours.append(int(item[0]))
    minutes.append(int(item[2:4]))
myData = pd.DataFrame({"h": hours, "m": minutes, "score": df["SLEEP SCOR
myData
```

Out[6]:

	h	m	score
1	7	33	91.0
2	7	17	81.0
3	7	17	80.0
4	8	23	85.0
5	7	19	82.0
6	7	18	80.0
7	8	2	89.0

8	6	47	85.0
9	7	32	85.0
10	7	45	87.0
11	7	57	78.0
12	6	47	85.0
13	8	33	87.0
14	7	33	83.0
15	7	8	79.0
16	6	34	74.0
17	7	18	84.0
18	8	14	87.0
19	7	8	83.0
20	7	6	85.0
21	8	26	91.0
22	7	29	88.0
23	8	37	89.0
24	9	3	78.0
25	6	39	75.0
26	7	51	91.0
27	7	6	83.0
28	6	57	85.0
29	7	23	91.0
30	7	48	87.0
31	8	9	89.0

In [7]:
```
#С помощью метода train_test_split разделим выборку на обучающую и тесто

data= np.array([[myData["h"].iloc[i], myData["m"].iloc[i]] for i in rang
target= np.array(myData["score"])
trainX, testX, trainY, testY = train_test_split(data, target, train_size
```

In [8]:
```
testX
```

Out[8]:
```
array([[ 6, 57],
       [ 8, 23],
       [ 7,  6],
       [ 9,  3]], dtype=int64)
```

In [9]:
```
from sklearn.neighbors import KNeighborsRegressor
neigh = KNeighborsRegressor(n_neighbors=3)
neigh.fit(trainX, trainY)
pred3_1 = neigh.predict(testX)
pred3_2 = neigh.predict(trainX)
pred3_1 = [i for  i in pred3_1]
pred3_2 = [i for  i in pred3_2]
```

In [10]:
```
neigh = KNeighborsRegressor(n_neighbors=10)
neigh.fit(trainX, trainY)
pred10_1 = neigh.predict(testX)
pred10_2 = neigh.predict(trainX)
pred10_1 = [i for  i in pred10_1]
pred10_2 = [i for  i in pred10_2]
```

In [11]:
```
print("Истинные значения:")
for i in testY:
    print(i)
```

```
Истинные значения:
85.0
85.0
85.0
78.0
```

In [12]:
```
print("Предсказания с гиперпараметром 3:")
for i in pred3_1:
    print(i)
```

```
Предсказания с гиперпараметром 3:
85.33333333333333
88.0
81.66666666666667
85.0
```

In [13]:
```
print("Предсказания с гиперпараметром 10:")
for i in pred10_1:
    print(i)
```

```
Предсказания с гиперпараметром 10:
83.4
84.9
83.5
83.5
```

Проверим качество модели с помощью метрик регрессии

Метрика Root mean squared error (RMSE)

In [14]:
```
myrmse3_1 = mean_squared_error(testY, pred3_1, squared=False)
myrmse3_2 = mean_squared_error(trainY, pred3_2, squared=False)
print("Для К=3:\t {}\t{}".format(myrmse3_2, myrmse3_1))
```

```
Для К=3:	 3.8522079607466035	 4.1599946581162275
```

In [15]:
```
myrmse10_1 = mean_squared_error(testY, pred10_1, squared=False)
myrmse10_2 = mean_squared_error(trainY, pred10_2, squared=False)
print("Для К=3:\t {}\t{}".format(myrmse10_2, myrmse10_1))
```

```
Для К=3:	 4.696925708493918	 2.960996453898585
```

In [16]:
```
rmse = []
```

```
rmse.append(myrmse10_2)
rmse.append(myrmse10_1)
```

Коэффициент детерминации

In [17]:
```
r2_1 = r2_score(testY,pred3_1)
r2_2 = r2_score(trainY,pred3_2)
print("Для К=3:\t {}\t{}".format(r2_1, r2_2))
```

```
Для К=3:         -0.8835978835978826    0.3393991206643868
```

In [18]:
```
r2_1 = r2_score(testY,pred10_1)
r2_2 = r2_score(trainY,pred10_2)
print("Для К=10:\t {}\t{}".format(r2_1, r2_2))
```

```
Для К=10:        0.04571428571428626    0.017919516365413557
```

Подбор гиперпараметра с помощью кросс-валидации

Найдём наилучший гиперпараметр используя текущую перестановку

KFold()

In [19]:
```
kf = KFold(n_splits=10)
r = np.array(range(1,24))
params = [{"n_neighbors": r}]
gs= GridSearchCV(KNeighborsRegressor(), params, cv=kf, scoring="neg_root_
gs.fit(trainX, trainY)
```

Out[19]:
```
GridSearchCV(cv=KFold(n_splits=10, random_state=None, shuffle=False),
             estimator=KNeighborsRegressor(),
             param_grid=[{'n_neighbors': array([ 1,  2,  3,  4,  5,  6,
7,  8,  9, 10, 11, 12, 13, 14, 15, 16, 17,
       18, 19, 20, 21, 22, 23])}],
             scoring='neg_root_mean_squared_error')
```

In [20]:
```
plt.plot(r, gs.cv_results_['mean_test_score'])
plt.title("Гиперпараметр при KFold()")
```

Out[20]:
```
Text(0.5, 1.0, 'Гиперпараметр при KFold()')
```

In [21]:
```
gs.best_estimator_.fit(trainX, trainY)
predGs1 = gs.best_estimator_.predict(testX)
predGs2 = gs.best_estimator_.predict(trainX)
```

In [22]:
```
rmse.append(mean_squared_error(testY, predGs1, squared=False))
rmse.append(mean_squared_error(trainY, predGs2, squared=False))
(mean_squared_error(testY, predGs1, squared=False), mean_squared_error(t
```

Out[22]:
```
(4.1599946581162275, 3.8522079607466035)
```

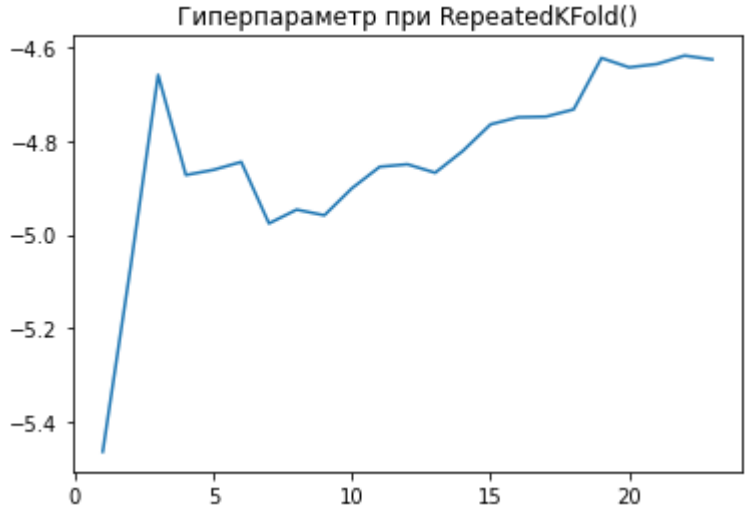
RepeatedKFold()

In [23]:
```
kf = RepeatedKFold(n_splits=10, n_repeats = 3)
r = np.array(range(1,24))
params = [{"n_neighbors": r}]
gs2= GridSearchCV(KNeighborsRegressor(), params, cv=kf, scoring="neg_roo
gs2.fit(trainX, trainY)
```

Out[23]:
```
GridSearchCV(cv=RepeatedKFold(n_repeats=3, n_splits=10, random_state=Non
e),
             estimator=KNeighborsRegressor(),
             param_grid=[{'n_neighbors': array([ 1,  2,  3,  4,  5,  6,
7,  8,  9, 10, 11, 12, 13, 14, 15, 16, 17,
       18, 19, 20, 21, 22, 23])}],
             scoring='neg_root_mean_squared_error')
```

In [24]:
```
plt.plot(r, gs2.cv_results_['mean_test_score'])
plt.title("Гиперпараметр при RepeatedKFold()")
```

Out[24]:
```
Text(0.5, 1.0, 'Гиперпараметр при RepeatedKFold()')
```



In [25]:
```
gs2.best_estimator_.fit(trainX, trainY)
predGs1 = gs2.best_estimator_.predict(testX)
predGs2 = gs2.best_estimator_.predict(trainX)
```

In [26]:
```
rmse.append(mean_squared_error(testY, predGs1, squared=False))
rmse.append(mean_squared_error(trainY, predGs2, squared=False))
(mean_squared_error(testY, predGs1, squared=False), mean_squared_error(t
```

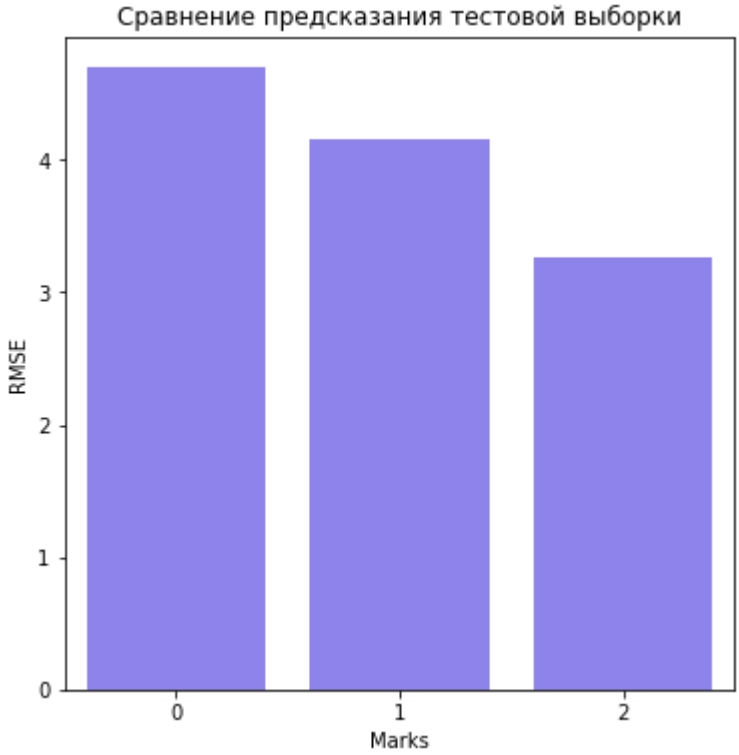
Out[26]:
```
(3.256668302076842, 4.741391438833892)
```

Сравним метрики качества исходной и оптимальных моделей

In [27]:
```
X = [i for i in range(len(rmse)//2)]
testRMSE = []
trainRMSE = []
for i in range(len(rmse)):
   if i%2==0:
        trainRMSE.append(rmse[i])
   else:
        testRMSE.append(rmse[i])
```

In [28]:
```
dataframe = pd.DataFrame({"Marks": X, "RMSE": trainRMSE})
fig, ax = plt.subplots(figsize=(6,6))
ax.title.set_text("Сравнение предсказания тестовой выборки")
sns.barplot(data=dataframe, y="RMSE", x="Marks", color="#8172fb")
```

Out[28]:
```
<AxesSubplot:title={'center':'Сравнение предсказания тестовой выборки'},
xlabel='Marks', ylabel='RMSE'>
```

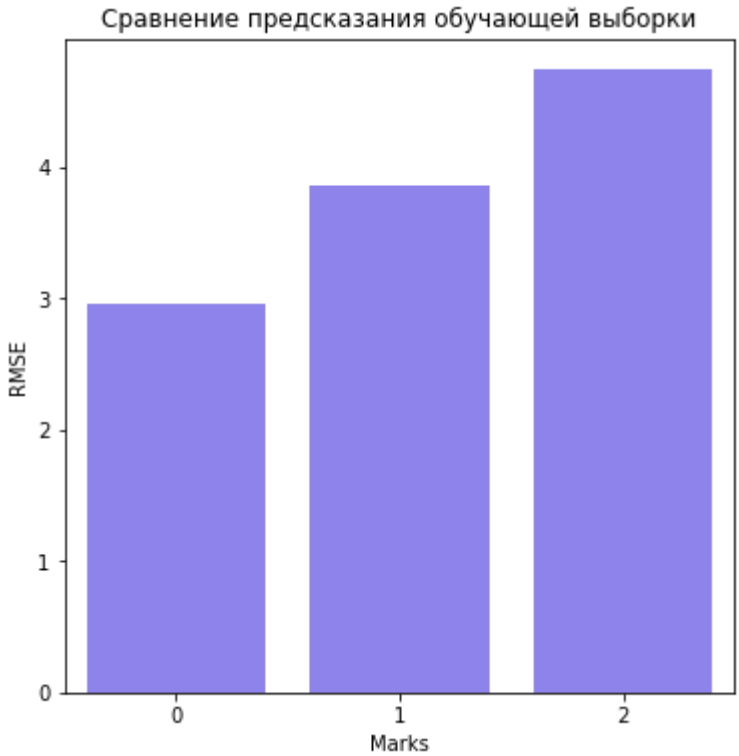


In [29]:

```
dataframe = pd.DataFrame({"Marks": X, "RMSE": testRMSE})
fig, ax = plt.subplots(figsize=(6,6))
ax.title.set_text("Сравнение предсказания обучающей выборки")
sns.barplot(data=dataframe, y="RMSE", x="Marks", color="#8172fb")
```

Out[29]:

```
<AxesSubplot:title={'center':'Сравнение предсказания обучающей выборки'},
xlabel='Marks', ylabel='RMSE'>
```



In [ ]:

In [ ]: