|  |  |  |
| --- | --- | --- |
| Защищено:  Гапанюк Ю.Е.    "\_\_"\_\_\_\_\_\_\_\_\_\_\_\_\_2022 г. |  | Демонстрация:  Гапанюк Ю.Е.  "\_\_"\_\_\_\_\_\_\_\_\_\_\_\_\_2022 г. |

**Отчет по лабораторной работе № 6 по курсу**

**Технологии машинного обучения**

**ГУИМЦ**

#### Тема работы: " Разработайте макет веб-приложения, предназначенного для анализа данных."

9

(количество листов)

Вариант № **3**

|  |  |
| --- | --- |
| ИСПОЛНИТЕЛЬ: |  |
| студент группы ИУ5Ц-84Б | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
|  | (подпись) |
| Семенова А.А. | "\_\_"\_\_\_\_\_\_\_\_\_\_\_\_\_2022 г. |

Москва, МГТУ - 2022

In[1]

**import** streamlit **as** st

**import** numpy **as** np

**import** pandas **as** pd

**import** seaborn **as** sns

**import** matplotlib.pyplot **as** plt

**from** sklearn.model\_selection **import** train\_test\_split, learning\_curve

**from** sklearn.metrics **import** plot\_confusion\_matrix, accuracy\_score, roc\_curve, roc\_auc\_score, f1\_score

**from** sklearn.preprocessing **import** MinMaxScaler

**from** catboost **import** Pool, CatBoostClassifier

*# Запуск приложения streamlit run /Users/liza/Desktop/LR6/Lol.py [ARGUMENTS]*

**def** load():

col\_list **=** ['Pelvic\_incidence',

'Pelvic\_tilt',

'Lumbar\_lordosis\_angle',

'Sacral\_slope',

'Pelvic\_radius',

'Degree\_spondylolisthesis',

'Pelvic\_slope',

'Direct\_tilt',

'Thoracic\_slope',

'Cervical\_tilt',

'Sacrum\_angle',

'Scoliosis\_slope',

'Class\_att',

'To\_drop']

data **=** pd**.**read\_csv('/Users/liza/Desktop/LR6/Dataset\_spine.csv', names**=**col\_list, header**=**1, sep**=**",")

data**.**drop('To\_drop', axis**=**1, inplace**=True**)

**return** data

*# Готовим данные к ML*

**def** preprocess\_data(data):

scale\_cols **=** ['Pelvic\_incidence',

'Pelvic\_tilt',

'Lumbar\_lordosis\_angle',

'Sacral\_slope',

'Pelvic\_radius',

'Degree\_spondylolisthesis',

'Pelvic\_slope',

'Direct\_tilt',

'Thoracic\_slope',

'Cervical\_tilt',

'Sacrum\_angle',

'Scoliosis\_slope']

sc1 **=** MinMaxScaler()

sc1\_data **=** sc1**.**fit\_transform(data[scale\_cols])

**for** i **in** range(len(scale\_cols)):

data[scale\_cols[i]] **=** sc1\_data[:, i]

data['Class\_att'] **=** data['Class\_att']**.**map({'Abnormal': 1, 'Normal': 0})

*# Разделим данные на целевой столбец и признаки*

X **=** data**.**drop("Class\_att", axis**=**1)

Y **=** data["Class\_att"]

*# С использованием метода train\_test\_split разделим выборку на обучающую и тестовую*

X\_train, X\_test, Y\_train, Y\_test **=** train\_test\_split(X, Y, test\_size**=**0.25, random\_state**=**1)

**return** X\_train, X\_test, Y\_train, Y\_test

*# Отрисовка графика ROC\_CURVE*

**def** draw\_roc\_curve(y\_true, y\_score, ax, pos\_label**=**1, average**=**'micro'):

fpr, tpr, thresholds **=** roc\_curve(y\_true, y\_score,

pos\_label**=**pos\_label)

roc\_auc\_value **=** roc\_auc\_score(y\_true, y\_score, average**=**average)

*# plt.figure()*

lw **=** 2

ax**.**plot(fpr, tpr, color**=**'darkorange',

lw**=**lw, label**=**'ROC curve (area = %0.2f)' **%** roc\_auc\_value)

ax**.**plot([0, 1], [0, 1], color**=**'navy', lw**=**lw, linestyle**=**'--')

ax**.**set\_xlim([0.0, 1.0])

ax**.**set\_xlim([0.0, 1.05])

ax**.**set\_xlabel('False Positive Rate')

ax**.**set\_ylabel('True Positive Rate')

ax**.**set\_title('Receiver operating characteristic')

ax**.**legend(loc**=**"lower right")

*# Вывод метрик ML*

**def** print\_metrics(X\_train, Y\_train, X\_test, Y\_test, clf):

clf**.**fit(X\_train, Y\_train)

target **=** clf**.**predict(X\_test)

test\_score **=** accuracy\_score(Y\_test, target)

roc\_res **=** clf**.**predict\_proba(X\_test)

roc\_auc **=** roc\_auc\_score(Y\_test, roc\_res[:, 1])

f1\_test\_score **=** f1\_score(Y\_test, target)

st**.**write(f"accuracy (точность): {test\_score}")

st**.**write(f"f1 метрика: {f1\_test\_score}")

st**.**write(f"ROC AUC: {roc\_auc}")

fig1, ax1 **=** plt**.**subplots()

draw\_roc\_curve(Y\_test, roc\_res[:, 1], ax1)

st**.**pyplot(fig1)

fig2, ax2 **=** plt**.**subplots(figsize**=**(10, 5))

plot\_confusion\_matrix(clf, X\_test, Y\_test, ax**=**ax2, display\_labels**=**['1', '0'], cmap **=** 'Purples', normalize**=**'true')

ax2**.**set(title**=**"Confusion matrix")

st**.**pyplot(fig2)

**return** test\_score

*# Вывод кривой обучения*

**def** plot\_learning\_curve(data\_X, data\_y, clf, name**=**'accuracy', scoring**=**'accuracy'):

train\_sizes, train\_scores, test\_scores **=** learning\_curve(estimator**=**clf, scoring**=**scoring, X**=**data\_X, y**=**data\_y, train\_sizes**=**np**.**linspace(0.1, 1.0, 10), cv**=**5)

train\_mean **=** np**.**mean(train\_scores, axis**=**1)

train\_std **=** np**.**std(train\_scores, axis**=**1)

test\_mean **=** np**.**mean(test\_scores, axis**=**1)

test\_std **=** np**.**std(test\_scores, axis**=**1)

fig **=** plt**.**figure(figsize**=**(7, 5))

plt**.**plot(train\_sizes, train\_mean, color**=**'blue', marker**=**'o', markersize**=**5, label**=**f'тренировочная {name}-мера')

plt**.**fill\_between(train\_sizes, train\_mean **+** train\_std, train\_mean **-** train\_std, alpha**=**0.15, color**=**'blue')

plt**.**plot(train\_sizes, test\_mean, color**=**'green', linestyle**=**'--', marker**=**'s', markersize**=**5,

label**=**f'проверочная {name}-мера')

plt**.**fill\_between(train\_sizes, test\_mean **+** test\_std, test\_mean **-** test\_std, alpha**=**0.15, color**=**'green')

plt**.**grid()

plt**.**legend(loc**=**'lower right')

plt**.**xlabel('Число тренировочных образцов')

plt**.**ylabel(f'{name}-мера')

st**.**pyplot(fig)

**if** \_\_name\_\_ **==** '\_\_main\_\_':

st**.**title('Метод градиентного бустинга')

data **=** load()

data\_X\_train, data\_X\_test, data\_y\_train, data\_y\_test **=** preprocess\_data(data)

*# Будем показывать матрицу только по запросу, чттобы не тормозить процесс*

**if** st**.**checkbox('Показать корреляционную матрицу'):

fig\_corr, ax **=** plt**.**subplots(figsize**=**(20, 20))

sns**.**heatmap(data**.**corr(), annot**=True**, cmap **=** 'Purples', fmt**=**'.3f')

st**.**pyplot(fig\_corr)

*# Выбор гиперпараметров в сайдбаре*

st**.**sidebar**.**subheader('Гиперпараметры :')

estimators **=** st**.**sidebar**.**slider('Количество деревьев: ', min\_value**=**1, max\_value**=**100, value**=**5, step**=**1)

max\_depth **=** st**.**sidebar**.**slider('Максимальная глубина', min\_value**=**1, max\_value**=**10, value**=**4, step**=**1)

eval\_metric **=** st**.**sidebar**.**selectbox('Оптимизируемая метрика:', ('Accuracy', 'F1', 'AUC'))

*# Вывод результатов*

translation\_dict **=** {'Accuracy': 'accuracy', 'F1': 'f1', 'AUC': 'roc\_auc'}

gd **=** CatBoostClassifier(n\_estimators**=**estimators, max\_depth**=**max\_depth, eval\_metric**=**eval\_metric, random\_state**=**1)

result **=** print\_metrics(data\_X\_train, data\_y\_train, data\_X\_test, data\_y\_test, gd)

data\_X **=** pd**.**concat([data\_X\_train, data\_X\_test])

data\_y **=** pd**.**concat([data\_y\_train, data\_y\_test])

plot\_learning\_curve(data\_X, data\_y, gd, name**=**translation\_dict**.**get(eval\_metric), scoring**=**translation\_dict**.**get(eval\_metric))

*# Показать данные*

**if** st**.**checkbox('Показать первые 10 строк датасета "Dataset\_spine"'):

st**.**write(data**.**head(10))

out[1]

Learning rate set to 0.5

0: learn: 0.8311688 total: 1.08ms remaining: 4.32ms

1: learn: 0.8441558 total: 1.82ms remaining: 2.73ms

2: learn: 0.8571429 total: 2.58ms remaining: 1.72ms

3: learn: 0.8744589 total: 3.27ms remaining: 818us

4: learn: 0.8614719 total: 4.03ms remaining: 0us

Learning rate set to 0.269978

0: learn: 1.0000000 total: 501us remaining: 2.01ms

1: learn: 0.9583333 total: 1.01ms remaining: 1.51ms

2: learn: 1.0000000 total: 1.54ms remaining: 1.03ms

3: learn: 1.0000000 total: 2.06ms remaining: 516us

4: learn: 1.0000000 total: 2.54ms remaining: 0us

Learning rate set to 0.366178

0: learn: 0.7959184 total: 430us remaining: 1.72ms

1: learn: 0.8775510 total: 899us remaining: 1.35ms

2: learn: 0.8979592 total: 1.36ms remaining: 909us

3: learn: 0.9387755 total: 1.74ms remaining: 434us

4: learn: 0.9387755 total: 2.29ms remaining: 0us

Learning rate set to 0.436657

0: learn: 0.9054054 total: 467us remaining: 1.87ms

1: learn: 0.8783784 total: 982us remaining: 1.47ms

2: learn: 0.8918919 total: 1.49ms remaining: 991us

3: learn: 0.9189189 total: 1.95ms remaining: 486us

4: learn: 0.9054054 total: 2.45ms remaining: 0us

Learning rate set to 0.492303

0: learn: 0.8877551 total: 484us remaining: 1.94ms

1: learn: 0.8775510 total: 1.06ms remaining: 1.59ms

2: learn: 0.8673469 total: 1.6ms remaining: 1.07ms

3: learn: 0.8877551 total: 2.15ms remaining: 537us

4: learn: 0.8979592 total: 2.7ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8943089 total: 632us remaining: 2.53ms

1: learn: 0.8943089 total: 1.16ms remaining: 1.74ms

2: learn: 0.8943089 total: 1.67ms remaining: 1.12ms

3: learn: 0.8861789 total: 2.37ms remaining: 593us

4: learn: 0.9024390 total: 2.96ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8175676 total: 515us remaining: 2.06ms

1: learn: 0.8310811 total: 1.19ms remaining: 1.78ms

2: learn: 0.8716216 total: 1.75ms remaining: 1.17ms

3: learn: 0.8851351 total: 2.29ms remaining: 572us

4: learn: 0.8986486 total: 2.84ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8197674 total: 561us remaining: 2.24ms

1: learn: 0.8720930 total: 1.23ms remaining: 1.85ms

2: learn: 0.8837209 total: 2.05ms remaining: 1.36ms

3: learn: 0.8837209 total: 2.98ms remaining: 745us

4: learn: 0.8953488 total: 3.64ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8375635 total: 648us remaining: 2.59ms

1: learn: 0.8426396 total: 1.25ms remaining: 1.88ms

2: learn: 0.8730964 total: 2.03ms remaining: 1.35ms

3: learn: 0.8934010 total: 2.76ms remaining: 689us

4: learn: 0.9187817 total: 3.59ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8783784 total: 604us remaining: 2.42ms

1: learn: 0.8828829 total: 1.32ms remaining: 1.98ms

2: learn: 0.8918919 total: 1.98ms remaining: 1.32ms

3: learn: 0.9009009 total: 2.74ms remaining: 685us

4: learn: 0.9144144 total: 3.63ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8704453 total: 661us remaining: 2.64ms

1: learn: 0.8825911 total: 1.37ms remaining: 2.05ms

2: learn: 0.8906883 total: 2.01ms remaining: 1.34ms

3: learn: 0.9028340 total: 2.73ms remaining: 682us

4: learn: 0.9068826 total: 3.42ms remaining: 0us

Learning rate set to 0.269978

0: learn: 0.9583333 total: 390us remaining: 1.56ms

1: learn: 0.9583333 total: 794us remaining: 1.19ms

2: learn: 0.9583333 total: 1.21ms remaining: 807us

3: learn: 0.9583333 total: 1.6ms remaining: 401us

4: learn: 0.9166667 total: 2.04ms remaining: 0us

Learning rate set to 0.366178

0: learn: 0.8571429 total: 375us remaining: 1.5ms

1: learn: 0.9183673 total: 1.12ms remaining: 1.68ms

2: learn: 0.9795918 total: 1.6ms remaining: 1.07ms

3: learn: 0.9387755 total: 2.12ms remaining: 530us

4: learn: 0.9795918 total: 2.71ms remaining: 0us

Learning rate set to 0.436657

0: learn: 0.8108108 total: 391us remaining: 1.56ms

1: learn: 0.8108108 total: 1.17ms remaining: 1.75ms

2: learn: 0.8783784 total: 1.72ms remaining: 1.15ms

3: learn: 0.9054054 total: 2.15ms remaining: 536us

4: learn: 0.9189189 total: 2.63ms remaining: 0us

Learning rate set to 0.492303

0: learn: 0.7653061 total: 414us remaining: 1.66ms

1: learn: 0.8571429 total: 970us remaining: 1.46ms

2: learn: 0.8469388 total: 1.47ms remaining: 981us

3: learn: 0.8673469 total: 2.23ms remaining: 557us

4: learn: 0.8877551 total: 2.82ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8130081 total: 681us remaining: 2.72ms

1: learn: 0.8130081 total: 1.4ms remaining: 2.11ms

2: learn: 0.8130081 total: 1.94ms remaining: 1.29ms

3: learn: 0.8617886 total: 2.56ms remaining: 641us

4: learn: 0.8617886 total: 3.2ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.7972973 total: 500us remaining: 2ms

1: learn: 0.7905405 total: 1.34ms remaining: 2.01ms

2: learn: 0.8378378 total: 1.98ms remaining: 1.32ms

3: learn: 0.8310811 total: 2.61ms remaining: 652us

4: learn: 0.8716216 total: 3.33ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8023256 total: 521us remaining: 2.09ms

1: learn: 0.8139535 total: 1.1ms remaining: 1.66ms

2: learn: 0.8430233 total: 1.63ms remaining: 1.09ms

3: learn: 0.8313953 total: 2.29ms remaining: 571us

4: learn: 0.8720930 total: 2.81ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8172589 total: 544us remaining: 2.18ms

1: learn: 0.8071066 total: 1.21ms remaining: 1.82ms

2: learn: 0.8324873 total: 1.77ms remaining: 1.18ms

3: learn: 0.8629442 total: 2.42ms remaining: 606us

4: learn: 0.8629442 total: 3.03ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8288288 total: 578us remaining: 2.31ms

1: learn: 0.8198198 total: 1.24ms remaining: 1.86ms

2: learn: 0.8558559 total: 1.82ms remaining: 1.22ms

3: learn: 0.8693694 total: 2.46ms remaining: 615us

4: learn: 0.8693694 total: 3.16ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8421053 total: 556us remaining: 2.23ms

1: learn: 0.8542510 total: 1.4ms remaining: 2.1ms

2: learn: 0.8461538 total: 2.08ms remaining: 1.39ms

3: learn: 0.8866397 total: 2.76ms remaining: 691us

4: learn: 0.8906883 total: 3.39ms remaining: 0us

Learning rate set to 0.269978

0: learn: 0.9583333 total: 275us remaining: 1.1ms

1: learn: 0.9583333 total: 685us remaining: 1.03ms

2: learn: 0.9583333 total: 1.06ms remaining: 704us

3: learn: 0.9583333 total: 1.45ms remaining: 361us

4: learn: 0.9166667 total: 1.79ms remaining: 0us

Learning rate set to 0.366178

0: learn: 0.8571429 total: 446us remaining: 1.78ms

1: learn: 0.9183673 total: 917us remaining: 1.38ms

2: learn: 0.9795918 total: 1.32ms remaining: 879us

3: learn: 0.9387755 total: 1.73ms remaining: 431us

4: learn: 0.9795918 total: 2.22ms remaining: 0us

Learning rate set to 0.436657

0: learn: 0.8243243 total: 362us remaining: 1.45ms

1: learn: 0.8108108 total: 833us remaining: 1.25ms

2: learn: 0.8378378 total: 1.31ms remaining: 877us

3: learn: 0.8513514 total: 1.81ms remaining: 453us

4: learn: 0.8648649 total: 2.38ms remaining: 0us

Learning rate set to 0.492303

0: learn: 0.8061224 total: 469us remaining: 1.88ms

1: learn: 0.8367347 total: 1.02ms remaining: 1.54ms

2: learn: 0.8571429 total: 1.51ms remaining: 1ms

3: learn: 0.8775510 total: 2.06ms remaining: 515us

4: learn: 0.8673469 total: 2.51ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8699187 total: 464us remaining: 1.86ms

1: learn: 0.8617886 total: 1.09ms remaining: 1.63ms

2: learn: 0.8780488 total: 1.58ms remaining: 1.05ms

3: learn: 0.8780488 total: 2.29ms remaining: 572us

4: learn: 0.9105691 total: 2.95ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8175676 total: 469us remaining: 1.88ms

1: learn: 0.8378378 total: 1.03ms remaining: 1.54ms

2: learn: 0.8310811 total: 1.55ms remaining: 1.03ms

3: learn: 0.8783784 total: 2.1ms remaining: 525us

4: learn: 0.8648649 total: 2.64ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8488372 total: 825us remaining: 3.3ms

1: learn: 0.8546512 total: 1.56ms remaining: 2.34ms

2: learn: 0.8662791 total: 2.09ms remaining: 1.39ms

3: learn: 0.8837209 total: 2.63ms remaining: 658us

4: learn: 0.8662791 total: 3.16ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8375635 total: 542us remaining: 2.17ms

1: learn: 0.8680203 total: 1.57ms remaining: 2.35ms

2: learn: 0.8781726 total: 2.38ms remaining: 1.59ms

3: learn: 0.8984772 total: 2.95ms remaining: 738us

4: learn: 0.9086294 total: 3.55ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8423423 total: 539us remaining: 2.16ms

1: learn: 0.8513514 total: 1.22ms remaining: 1.83ms

2: learn: 0.8513514 total: 1.84ms remaining: 1.23ms

3: learn: 0.8603604 total: 2.73ms remaining: 681us

4: learn: 0.8693694 total: 3.53ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8502024 total: 553us remaining: 2.21ms

1: learn: 0.8623482 total: 1.43ms remaining: 2.14ms

2: learn: 0.8704453 total: 2.12ms remaining: 1.41ms

3: learn: 0.8947368 total: 2.88ms remaining: 720us

4: learn: 0.8825911 total: 3.91ms remaining: 0us

Learning rate set to 0.269978

0: learn: 0.9583333 total: 305us remaining: 1.22ms

1: learn: 0.9583333 total: 799us remaining: 1.2ms

2: learn: 0.9583333 total: 1.29ms remaining: 857us

3: learn: 0.9583333 total: 1.81ms remaining: 453us

4: learn: 0.9166667 total: 2.17ms remaining: 0us

Learning rate set to 0.366178

0: learn: 0.8571429 total: 429us remaining: 1.72ms

1: learn: 0.9183673 total: 1.01ms remaining: 1.51ms

2: learn: 0.9795918 total: 1.78ms remaining: 1.19ms

3: learn: 0.9387755 total: 2.27ms remaining: 567us

4: learn: 0.9795918 total: 2.8ms remaining: 0us

Learning rate set to 0.436657

0: learn: 0.8243243 total: 360us remaining: 1.44ms

1: learn: 0.8108108 total: 982us remaining: 1.47ms

2: learn: 0.8378378 total: 1.54ms remaining: 1.03ms

3: learn: 0.8513514 total: 2.07ms remaining: 517us

4: learn: 0.8648649 total: 2.53ms remaining: 0us

Learning rate set to 0.492303

0: learn: 0.8061224 total: 462us remaining: 1.85ms

1: learn: 0.8367347 total: 985us remaining: 1.48ms

2: learn: 0.8571429 total: 1.52ms remaining: 1.01ms

3: learn: 0.8775510 total: 2.21ms remaining: 552us

4: learn: 0.8673469 total: 2.88ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8699187 total: 464us remaining: 1.86ms

1: learn: 0.8617886 total: 1.01ms remaining: 1.51ms

2: learn: 0.8780488 total: 1.54ms remaining: 1.03ms

3: learn: 0.8780488 total: 2.19ms remaining: 548us

4: learn: 0.9105691 total: 2.77ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8445946 total: 681us remaining: 2.73ms

1: learn: 0.8986486 total: 1.33ms remaining: 1.99ms

2: learn: 0.8378378 total: 1.92ms remaining: 1.28ms

3: learn: 0.8445946 total: 2.54ms remaining: 634us

4: learn: 0.8716216 total: 3.17ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8139535 total: 732us remaining: 2.93ms

1: learn: 0.7965116 total: 1.47ms remaining: 2.2ms

2: learn: 0.8546512 total: 2.18ms remaining: 1.45ms

3: learn: 0.8779070 total: 2.86ms remaining: 714us

4: learn: 0.8895349 total: 3.59ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8426396 total: 758us remaining: 3.03ms

1: learn: 0.8426396 total: 1.5ms remaining: 2.25ms

2: learn: 0.8477157 total: 2.27ms remaining: 1.51ms

3: learn: 0.8578680 total: 3.05ms remaining: 762us

4: learn: 0.8527919 total: 3.73ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8603604 total: 699us remaining: 2.8ms

1: learn: 0.8558559 total: 1.71ms remaining: 2.57ms

2: learn: 0.8873874 total: 2.64ms remaining: 1.76ms

3: learn: 0.8918919 total: 3.49ms remaining: 872us

4: learn: 0.8963964 total: 4.27ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8663968 total: 595us remaining: 2.38ms

1: learn: 0.8582996 total: 1.76ms remaining: 2.65ms

2: learn: 0.8785425 total: 2.79ms remaining: 1.86ms

3: learn: 0.8825911 total: 3.9ms remaining: 974us

4: learn: 0.8866397 total: 4.74ms remaining: 0us

Learning rate set to 0.269978

0: learn: 0.9583333 total: 308us remaining: 1.23ms

1: learn: 0.9583333 total: 865us remaining: 1.3ms

2: learn: 0.9583333 total: 1.27ms remaining: 844us

3: learn: 0.9583333 total: 1.75ms remaining: 436us

4: learn: 0.9166667 total: 2.07ms remaining: 0us

Learning rate set to 0.366178

0: learn: 0.8571429 total: 348us remaining: 1.39ms

1: learn: 0.9183673 total: 1.04ms remaining: 1.56ms

2: learn: 0.9795918 total: 1.61ms remaining: 1.07ms

3: learn: 0.9387755 total: 2.27ms remaining: 567us

4: learn: 0.9795918 total: 2.79ms remaining: 0us

Learning rate set to 0.436657

0: learn: 0.8243243 total: 622us remaining: 2.49ms

1: learn: 0.8108108 total: 1.33ms remaining: 1.99ms

2: learn: 0.8378378 total: 2.01ms remaining: 1.34ms

3: learn: 0.8513514 total: 2.59ms remaining: 648us

4: learn: 0.8648649 total: 3.16ms remaining: 0us

Learning rate set to 0.492303

0: learn: 0.8061224 total: 430us remaining: 1.72ms

1: learn: 0.8367347 total: 1.06ms remaining: 1.59ms

2: learn: 0.8571429 total: 1.8ms remaining: 1.2ms

3: learn: 0.8775510 total: 2.38ms remaining: 595us

4: learn: 0.8673469 total: 2.95ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8699187 total: 540us remaining: 2.16ms

1: learn: 0.8617886 total: 1.21ms remaining: 1.81ms

2: learn: 0.8780488 total: 1.88ms remaining: 1.25ms

3: learn: 0.8780488 total: 2.41ms remaining: 603us

4: learn: 0.9105691 total: 3.07ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8445946 total: 465us remaining: 1.86ms

1: learn: 0.8986486 total: 1.11ms remaining: 1.66ms

2: learn: 0.8378378 total: 1.77ms remaining: 1.18ms

3: learn: 0.8445946 total: 2.61ms remaining: 653us

4: learn: 0.8716216 total: 3.5ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8139535 total: 453us remaining: 1.81ms

1: learn: 0.7965116 total: 1.06ms remaining: 1.59ms

2: learn: 0.8546512 total: 1.72ms remaining: 1.15ms

3: learn: 0.8779070 total: 2.48ms remaining: 620us

4: learn: 0.8895349 total: 3.32ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8071066 total: 539us remaining: 2.16ms

1: learn: 0.8121827 total: 1.22ms remaining: 1.82ms

2: learn: 0.8324873 total: 1.78ms remaining: 1.18ms

3: learn: 0.8375635 total: 2.41ms remaining: 602us

4: learn: 0.8680203 total: 3.31ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8108108 total: 524us remaining: 2.1ms

1: learn: 0.8108108 total: 1.46ms remaining: 2.2ms

2: learn: 0.8378378 total: 2.11ms remaining: 1.41ms

3: learn: 0.8558559 total: 2.76ms remaining: 689us

4: learn: 0.8468468 total: 3.41ms remaining: 0us

Learning rate set to 0.5

0: learn: 0.8137652 total: 558us remaining: 2.23ms

1: learn: 0.8056680 total: 1.31ms remaining: 1.97ms

2: learn: 0.8178138 total: 1.92ms remaining: 1.28ms

3: learn: 0.8947368 total: 2.52ms remaining: 629us

4: learn: 0.8785425 total: 3.18ms remaining: 0us





