МОСКОВСКИЙ ГОСУДАРСТВЕННЫЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ
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Факультет «Информатика и системы управления»
Кафедра «Систем обработки информации и управления»

ОТЧЕТ

Рубежный контроль №__1__
по дисциплине «Методы машинного обучения»

Тема: «Методы обработки данных»

ИСПОЛНИТЕЛЬ: ___Алексеев_А_С__
ФИО

группа ИУ5-25 ___________________
подпись

"__"_________2024 г.

ПРЕПОДАВАТЕЛЬ: ___Гапанюк_Ю_Е__
ФИО

____
подпись

"__"_________2024 г.

Москва - 2024

Варианты заданий

Номер варианта - 1
Номер задачи - №1:

Для набора данных проведите кодирование одного (произвольного) категориального признака с использованием метода "count (frequency) encoding".

Номер задачи - №21:

Для набора данных проведите масштабирование данных для одного (произвольного) числового признака с использованием масштабирования по медиане.

Дополнительные требования по группам:

Для студентов группы ИУ5-25М - для произвольной колонки данных построить парные диаграммы (pairplot).

Импорт библиотек

```
In [1]:import numpy as np
       import pandas as pd
       import seaborn as sns
       import matplotlib.pyplot as plt
       from sklearn.preprocessing import RobustScaler
       from sklearn.model_selection import train_test_split
       from sklearn.impute import SimpleImputer
       from sklearn.impute import MissingIndicator
       from sklearn.impute import KNNImputer
       from sklearn.preprocessing import StandardScaler
       from sklearn.linear_model import Lasso
       from sklearn.pipeline import Pipeline
       from sklearn.model_selection import GridSearchCV
       from sklearn.ensemble import RandomForestRegressor
       from sklearn.experimental import enable_iterative_imputer
       from sklearn.impute import IterativeImputer
       from sklearn.preprocessing import LabelEncoder
       from IPython.display import Image
       import scipy.stats as stats
       %matplotlib inline
       sns.set(style="ticks")
```

Загрузка датасета

```
In [2]:hdata_loaded  = pd.read_csv("googleplaystore.csv")
       print(hdata_loaded)
       Unnamed: 0                                               App  \
0               0     Photo Editor & Candy Camera & Grid & ScrapBook
1               1                               Coloring book moana
2               2  U Launcher Lite – FREE Live Cool Themes, Hide ...
3               3                             Sketch - Draw & Paint
4               4              Pixel Draw - Number Art Coloring Book
...           ...                                               ...
10836       10836                                  Sya9a Maroc - FR
10837       10837                  Fr. Mike Schmitz Audio Teachings
10838       10838                            Parkinson Exercices FR
10839       10839                     The SCP Foundation DB fr nn5n
10840       10840     iHoroscope - 2018 Daily Horoscope & Astrology

                  Category  Rating Reviews                Size     Installs  \
0           ART_AND_DESIGN     4.1     159                 19M      10,000+
1           ART_AND_DESIGN     3.9     967                 14M     500,000+
2           ART_AND_DESIGN     4.7   87510                8.7M   5,000,000+
3           ART_AND_DESIGN     4.5  215644                 25M  50,000,000+
4           ART_AND_DESIGN     4.3     967                2.8M     100,000+
...                    ...     ...     ...                 ...          ...
10836               FAMILY     4.5      38                 53M       5,000+
10837               FAMILY     5.0       4                3.6M         100+
10838              MEDICAL     NaN       3                9.5M       1,000+
10839  BOOKS_AND_REFERENCE     4.5     114  Varies with device       1,000+
10840            LIFESTYLE     4.5  398307                 19M  10,000,000+

       Type Price Content Rating                     Genres Last Updated  \
0      Free     0       Everyone               Art & Design     7-Jan-18
1      Free     0       Everyone  Art & Design;Pretend Play    15-Jan-18
2      Free     0       Everyone               Art & Design     1-Aug-18
3      Free     0           Teen               Art & Design     8-Jun-18
4      Free     0       Everyone    Art & Design;Creativity    20-Jun-18
...     ...   ...            ...                        ...          ...
10836  Free     0       Everyone                  Education    25-Jul-17
10837  Free     0       Everyone                  Education     6-Jul-18
10838  Free     0       Everyone                    Medical    20-Jan-17
10839  Free     0     Mature 17+          Books & Reference    19-Jan-15
10840  Free     0       Everyone                  Lifestyle    25-Jul-18

              Current Ver         Android Ver
0                   1.0.0        4.0.3 and up
1                   2.0.0        4.0.3 and up
2                   1.2.4        4.0.3 and up
3      Varies with device          4.2 and up
4                     1.1          4.4 and up
...                   ...                 ...
10836                1.48          4.1 and up
10837                   1          4.1 and up
10838                   1          2.2 and up
10839  Varies with device  Varies with device
10840  Varies with device  Varies with device

[10841 rows x 14 columns]
```

Устранение пропусков в данных

```
In [3]:hdata = hdata_loaded
       list(zip(hdata.columns, [i for i in hdata.dtypes]))
```

```
Out[3]:[('Unnamed: 0', dtype('int64')),
        ('App', dtype('O')),
        ('Category', dtype('O')),
        ('Rating', dtype('float64')),
        ('Reviews', dtype('O')),
        ('Size', dtype('O')),
        ('Installs', dtype('O')),
        ('Type', dtype('O')),
        ('Price', dtype('O')),
        ('Content Rating', dtype('O')),
        ('Genres', dtype('O')),
        ('Last Updated', dtype('O')),
        ('Current Ver', dtype('O')),
        ('Android Ver', dtype('O'))]
```

```
In [4]:# Колонки с пропусками
       hcols_with_na = [c for c in hdata.columns if hdata[c].isnull().sum() > 0]
       hcols_with_na
```

```
Out[4]:['Rating', 'Type', 'Content Rating', 'Current Ver', 'Android Ver']
```

```
In [5]:# Количество пропусков
       [(c, hdata[c].isnull().sum()) for c in hcols_with_na]
```

```
Out[5]:[('Rating', 1474),
        ('Type', 1),
        ('Content Rating', 1),
        ('Current Ver', 8),
        ('Android Ver', 3)]
```

```
In [6]:# Доля (процен т) пропусков
       [(c, hdata[c].isnull().mean()) for c in hcols_with_na]
```

```
Out[6]:[('Rating', 0.13596531685268887),
        ('Type', 9.224241306152569e-05),
        ('Content Rating', 9.224241306152569e-05),
        ('Current Ver', 0.0007379393044922055),
        ('Android Ver', 0.0002767272391845771)]
```

Заполнение показателями центра распределения и константой

```
In [7]:def impute_column(dataset, column, strategy_param, fill_value_param=None):
           """
           Заполнение пропусков в одном признаке
           """
           temp_data = dataset[[column]].values
           size = temp_data.shape[0]

           indicator = MissingIndicator()
           mask_missing_values_only = indicator.fit_transform(temp_data)

           imputer = SimpleImputer(strategy=strategy_param,
                                   fill_value=fill_value_param)
           all_data = imputer.fit_transform(temp_data)

           missed_data = temp_data[mask_missing_values_only]
           filled_data = all_data[mask_missing_values_only]

           return all_data.reshape((size,)), filled_data, missed_data
```

```
In [8]:all_data, filled_data, missed_data = impute_column(hdata, 'Rating', 'mean')
       all_data
```

```
Out[8]:array([4.1       , 3.9       , 4.7       , ..., 4.19333832, 4.5       ,
              4.5       ])
```

```
In [9]:filled_data
```

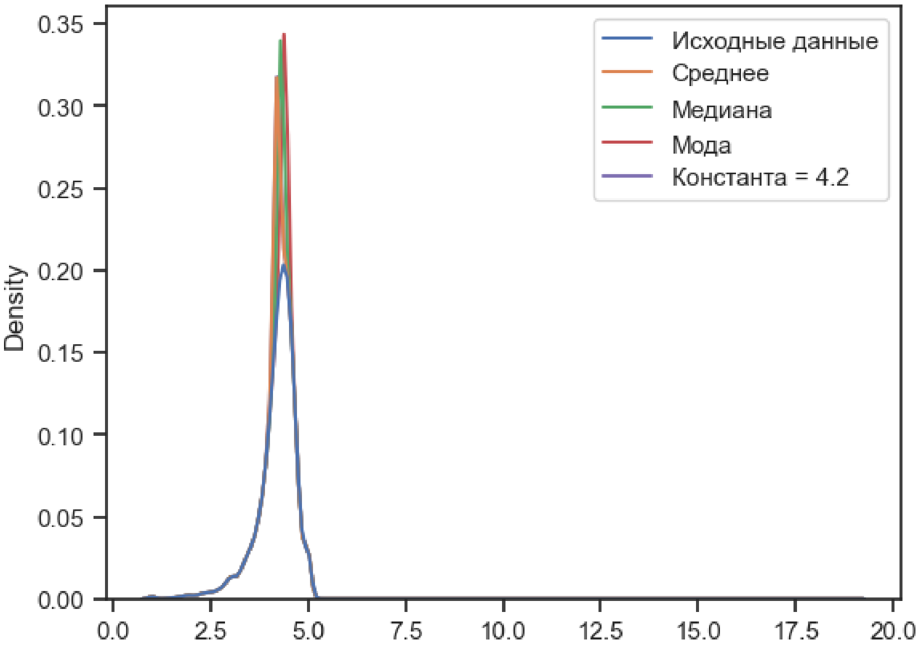
```
Out[9]:array([4.19333832, 4.19333832, 4.19333832, ..., 4.19333832, 4.19333832,
              4.19333832])
```

```
In [10]:missed_data
```

```
Out[10]:array([nan, nan, nan, ..., nan, nan, nan])
```

```
In [11]:def research_impute_numeric_column(dataset, num_column, const_value=None):
            strategy_params = ['mean', 'median', 'most_frequent', 'constant']
            strategy_params_names = ['Среднее', 'Медиана', 'Мода']
            strategy_params_names.append('Константа = ' + str(const_value))

            original_temp_data = dataset[[num_column]].values
            size = original_temp_data.shape[0]
            original_data = original_temp_data.reshape((size,))

            new_df = pd.DataFrame({'Исходные данные':original_data})

            for i in range(len(strategy_params)):
                strategy = strategy_params[i]
                col_name = strategy_params_names[i]
                if (strategy!='constant') or (strategy == 'constant' and const_value!=None):
                    if strategy == 'constant':
                        temp_data, _, _ = impute_column(dataset, num_column, strategy, fill_value_param=const_value)
                    else:
                        temp_data, _, _ = impute_column(dataset, num_column, strategy)
                    new_df[col_name] = temp_data

            sns.kdeplot(data=new_df)
```

```
In [12]:research_impute_numeric_column(hdata, 'Rating', 4.2)
```



In [13]:
```
knnimpute_cols = ['Unnamed: 0','Rating']
knnimpute_hdata = hdata[knnimpute_cols].copy()
knnimputer = KNNImputer(
    n_neighbors=5,
    weights='distance',
    metric='nan_euclidean',
    add_indicator=False,
)
knnimpute_hdata_imputed_temp = knnimputer.fit_transform(knnimpute_hdata)
knnimpute_hdata_imputed = pd.DataFrame(knnimpute_hdata_imputed_temp, columns=knnimpute_hdata.columns)
knnimpute_hdata_imputed.head()
```

Out[13]:

	Unnamed: 0	Rating
0	0.0	4.1
1	1.0	3.9
2	2.0	4.7
3	3.0	4.5
4	4.0	4.3

In [14]:
```
# Пропуски заполнены
knnimpute_hdata_imputed.isnull().sum()
```

Out[14]:
```
Unnamed: 0    0
Rating        0
dtype: int64
```

In [15]:
```
LotFrontage_df = pd.DataFrame({'original': knnimpute_hdata['Rating'].values})
LotFrontage_df['KNN_5'] = knnimpute_hdata_imputed['Rating']
```

In [16]:
```
hdata_loaded['Rating'] = LotFrontage_df['KNN_5']
hcols_with_na = [c for c in hdata_loaded.columns if hdata_loaded[c].isnull().sum() > 0]
[(c, hdata_loaded[c].isnull().sum()) for c in hcols_with_na]
```

Out[16]:
```
[('Type', 1), ('Content Rating', 1), ('Current Ver', 8), ('Android Ver', 3)]
```

In [17]:
```
hdata_loaded
```

Out[17]:

	Unnamed: 0	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	
0	0	Photo Editor & Candy Camera & Grid & ScrapBook	ART_AND_DESIGN	4.100000	159	19M	10,000+	Free	0	Everyone	Art
1	1	Coloring book moana	ART_AND_DESIGN	3.900000	967	14M	500,000+	Free	0	Everyone	Desig
2	2	U Launcher Lite – FREE Live Cool Themes, Hide ...	ART_AND_DESIGN	4.700000	87510	8.7M	5,000,000+	Free	0	Everyone	Art
3	3	Sketch - Draw & Paint	ART_AND_DESIGN	4.500000	215644	25M	50,000,000+	Free	0	Teen	Art
4	4	Pixel Draw - Number Art Coloring Book	ART_AND_DESIGN	4.300000	967	2.8M	100,000+	Free	0	Everyone	Design;
...	...	...	...	...	...	...	...	...	...	...	
10836	10836	Sya9a Maroc - FR	FAMILY	4.500000	38	53M	5,000+	Free	0	Everyone	E
10837	10837	Fr. Mike Schmitz Audio Teachings	FAMILY	5.000000	4	3.6M	100+	Free	0	Everyone	E
10838	10838	Parkinson Exercices FR	MEDICAL	4.615385	3	9.5M	1,000+	Free	0	Everyone	
10839	10839	The SCP Foundation DB fr nn5n	BOOKS_AND_REFERENCE	4.500000	114	Varies with device	1,000+	Free	0	Mature 17+	F
10840	10840	iHoroscope - 2018 Daily Horoscope & Astrology	LIFESTYLE	4.500000	398307	19M	10,000,000+	Free	0	Everyone	

10841 rows × 14 columns

```
In [18]:hcols_with_na = [c for c in hdata_loaded.columns if hdata_loaded[c].isnull().sum() > 0]
         [(c, hdata_loaded[c].isnull().sum()) for c in hcols_with_na]
```

```
Out[18]:[('Type', 1), ('Content Rating', 1), ('Current Ver', 8), ('Android Ver', 3)]
```

```
In [19]:res = hdata_loaded.dropna(axis=0, how='any')
In [20]:hcols_with_na = [c for c in res.columns if res[c].isnull().sum() > 0]
         [(c, res[c].isnull().sum()) for c in hcols_with_na]
```

```
Out[20]:[]
```

```
In [21]:Categlist = res['Category'].unique().tolist()
         for i in res['Category']:
             for j in Categlist:
                 if i == j:
                     k = res[res['Category']==i].index[0]
                     res['Category'][k] = Categlist.index(j)
```

```
c:\users\aleka\appdata\local\programs\python\python37\lib\site-packages\ipykernel_launcher.py:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
```

```
In [22]:Typelist = res['Type'].unique().tolist()
         for i in res['Type']:
             for j in Typelist:
                 if i == j:
```

```
            k = res[res['Type']==i].index[0]
            res['Type'][k] = Typelist.index(j)
```

```
c:\users\aleka\appdata\local\programs\python\python37\lib\site-packages\ipykernel_launcher.py:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
```

In [23]:
```
ContentRatinglist = res['Content Rating'].unique().tolist()
for i in res['Content Rating']:
    for j in ContentRatinglist:
        if i == j:
            k = res[res['Content Rating']==i].index[0]
            res['Content Rating'][k] = ContentRatinglist.index(j)
```

```
c:\users\aleka\appdata\local\programs\python\python37\lib\site-packages\ipykernel_launcher.py:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
```

Кодирование категориального признака Category с использованием метода "count (frequency) encoding"

In [24]:
```
res = res.drop('Unnamed: 0', axis = 1)
res
```

Out[24]:

	App	Category	Rating	Reviews	Size	Installs	Type	Price	Content Rating	Genres	Last Updated	Current Ver
0	Photo Editor & Candy Camera & Grid & ScrapBook	0	4.100000	159	19M	10,000+	0	0	0	Art & Design	7-Jan-18	1.0.0
1	Coloring book moana	0	3.900000	967	14M	500,000+	0	0	0	Art & Design;Pretend Play	15-Jan-18	2.0.0
2	U Launcher Lite – FREE Live Cool Themes, Hide ...	0	4.700000	87510	8.7M	5,000,000+	0	0	0	Art & Design	1-Aug-18	1.2.4
3	Sketch - Draw & Paint	0	4.500000	215644	25M	50,000,000+	0	0	1	Art & Design	8-Jun-18	Varies with device
4	Pixel Draw - Number Art Coloring Book	0	4.300000	967	2.8M	100,000+	0	0	0	Art & Design;Creativity	20-Jun-18	1.1
...	...	...	...	...	...	...	...	...	...	...	...	...
10836	Sya9a Maroc - FR	18	4.500000	38	53M	5,000+	0	0	0	Education	25-Jul-17	1.48
10837	Fr. Mike Schmitz Audio Teachings	18	5.000000	4	3.6M	100+	0	0	0	Education	6-Jul-18	1
10838	Parkinson Exercices FR	19	4.615385	3	9.5M	1,000+	0	0	0	Medical	20-Jan-17	1
10839	The SCP Foundation DB fr nn5n	3	4.500000	114	Varies with device	1,000+	0	0	3	Books & Reference	19-Jan-15	Varies with device
10840	iHoroscope - 2018 Daily Horoscope & Astrology	16	4.500000	398307	19M	10,000,000+	0	0	0	Lifestyle	25-Jul-18	Varies with device

10829 rows × 13 columns

In [25]:
```
from category_encoders.count import CountEncoder as ce_CountEncoder
```

```
In [26]:ce_CountEncoder1 = ce_CountEncoder()
        data_COUNT_ENC = ce_CountEncoder1.fit_transform(res[res.columns.difference(['Survived'])])
In [27]:data_COUNT_ENC
```

Out[27]:

	Android Ver	App	Category	Content Rating	Current Ver	Genres	Installs	Last Updated	Price	Rating	Reviews	Size	Type
0	1501	1	64	8704	136	57	1052	6	10032	4.100000	9	154	10032
1	1501	2	64	8704	51	2	538	10	10032	3.900000	4	193	10032
2	1501	1	64	8704	10	57	752	285	10032	4.700000	1	38	10032
3	393	1	64	1208	1458	57	289	38	10032	4.500000	1	143	10032
4	980	1	64	8704	275	7	1169	44	10032	4.300000	4	65	10032
...	...	...	...	...	...	...	...	...	...	...	...	...	...
10836	2451	1	1968	8704	3	548	476	6	10032	4.500000	29	43	10032
10837	2451	1	1968	8704	842	548	718	63	10032	5.000000	137	57	10032
10838	244	1	463	8704	842	463	905	2	10032	4.615385	175	28	10032
10839	1361	1	230	499	1458	230	905	2	10032	4.500000	13	1694	10032
10840	1361	1	382	8704	1458	381	1252	164	10032	4.500000	1	154	10032

10829 rows × 13 columns

```
In [28]:res['Category'].unique()
Out[28]:array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18,
               19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32],
              dtype=object)
In [29]:data_COUNT_ENC['Category'].unique()
Out[29]:array([  64,   85,   53,  230,  460,   60,  387,  234,  156,  149,  366,
                127,  341,   88,   84,  382, 1144, 1968,  463,  295,  260,  335,
                384,  258,  841,  390,  424,   82,  175,  283,  137], dtype=int64)
In [30]:ce_CountEncoder2 = ce_CountEncoder(normalize=True)
        data_FREQ_ENC = ce_CountEncoder2.fit_transform(res[res.columns.difference(['Survived'])])
In [31]:data_FREQ_ENC
```

Out[31]:

	Android Ver	App	Category	Content Rating	Current Ver	Genres	Installs	Last Updated	Price	Rating	Reviews	Size
0	0.138609	0.000092	0.005910	0.803768	0.012559	0.005264	0.097147	0.000554	0.926401	4.100000	0.000831	0.014221
1	0.138609	0.000185	0.005910	0.803768	0.004710	0.000185	0.049681	0.000923	0.926401	3.900000	0.000369	0.017823
2	0.138609	0.000092	0.005910	0.803768	0.000923	0.005264	0.069443	0.026318	0.926401	4.700000	0.000092	0.003509
3	0.036291	0.000092	0.005910	0.111552	0.134638	0.005264	0.026688	0.003509	0.926401	4.500000	0.000092	0.013205
4	0.090498	0.000092	0.005910	0.803768	0.025395	0.000646	0.107951	0.004063	0.926401	4.300000	0.000369	0.006002
...	...	...	...	...	...	...	...	...	...	...	...	...
10836	0.226337	0.000092	0.181734	0.803768	0.000277	0.050605	0.043956	0.000554	0.926401	4.500000	0.002678	0.003971
10837	0.226337	0.000092	0.181734	0.803768	0.077754	0.050605	0.066303	0.005818	0.926401	5.000000	0.012651	0.005264
10838	0.022532	0.000092	0.042756	0.803768	0.077754	0.042756	0.083572	0.000185	0.926401	4.615385	0.016160	0.002586
10839	0.125681	0.000092	0.021239	0.046080	0.134638	0.021239	0.083572	0.000185	0.926401	4.500000	0.001200	0.156432
10840	0.125681	0.000092	0.035276	0.803768	0.134638	0.035183	0.115615	0.015145	0.926401	4.500000	0.000092	0.014221

10829 rows × 13 columns

```
In [32]:data_FREQ_ENC['Category'].unique()
Out[32]:array([0.00591006, 0.00784929, 0.00489427, 0.02123926, 0.04247853,
               0.00554068, 0.03573737, 0.02160864, 0.01440576, 0.01375935,
               0.03379813, 0.01172777, 0.03148952, 0.00812633, 0.00775695,
               0.03527565, 0.10564226, 0.18173423, 0.04275556, 0.02724167,
               0.0240096 , 0.03093545, 0.03546034, 0.02382491, 0.07766183,
               0.03601441, 0.03915412, 0.00757226, 0.01616031, 0.02613353,
               0.01265121])
```

Масштабирование данных для числового признака quality с использованием масштабирования по медиане

```
In [33]:df = pd.read_csv("winequalityN.csv")
        Typelist = df['type'].unique().tolist()
        for i in df['type']:
            for j in Typelist:
```

```
        if i == j:
            k = df[df['type']==i].index[0]
            df['type'][k] = Typelist.index(j)
df
```

```
c:\users\aleka\appdata\local\programs\python\python37\lib\site-packages\ipykernel_launcher.py:7: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  import sys
```

Out[33]:

	type	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density	pH	sulphates	alcohol	quality
0	0	7.0	0.270	0.36	20.7	0.045	45.0	170.0	1.00100	3.00	0.45	8.8	6
1	0	6.3	0.300	0.34	1.6	0.049	14.0	132.0	0.99400	3.30	0.49	9.5	6
2	0	8.1	0.280	0.40	6.9	0.050	30.0	97.0	0.99510	3.26	0.44	10.1	6
3	0	7.2	0.230	0.32	8.5	0.058	47.0	186.0	0.99560	3.19	0.40	9.9	6
4	0	7.2	0.230	0.32	8.5	0.058	47.0	186.0	0.99560	3.19	0.40	9.9	6
...	...	...	...	...	...	...	...	...	...	...	...	...	...
6492	1	6.2	0.600	0.08	2.0	0.090	32.0	44.0	0.99490	3.45	0.58	10.5	5
6493	1	5.9	0.550	0.10	2.2	0.062	39.0	51.0	0.99512	3.52	NaN	11.2	6
6494	1	6.3	0.510	0.13	2.3	0.076	29.0	40.0	0.99574	3.42	0.75	11.0	6
6495	1	5.9	0.645	0.12	2.0	0.075	32.0	44.0	0.99547	3.57	0.71	10.2	5
6496	1	6.0	0.310	0.47	3.6	0.067	18.0	42.0	0.99549	3.39	0.66	11.0	6

6497 rows × 13 columns

In [34]:
```
X_ALL = df.drop('quality', axis=1)
# Функция для восстановления датафрейма
# на основе масштабированных данных
def arr_to_df(arr_scaled):
    res = pd.DataFrame(arr_scaled, columns=X_ALL.columns)
    return res
# Разделим выборку на обучающую и тестовую
X_train, X_test, y_train, y_test = train_test_split(X_ALL, df['quality'],
                                                    test_size=0.2,
                                                    random_state=1)
# Преобразуем массивы в DataFrame
X_train_df = arr_to_df(X_train)
X_test_df = arr_to_df(X_test)

X_train_df.shape, X_test_df.shape
```

Out[34]:
```
((5197, 12), (1300, 12))
```

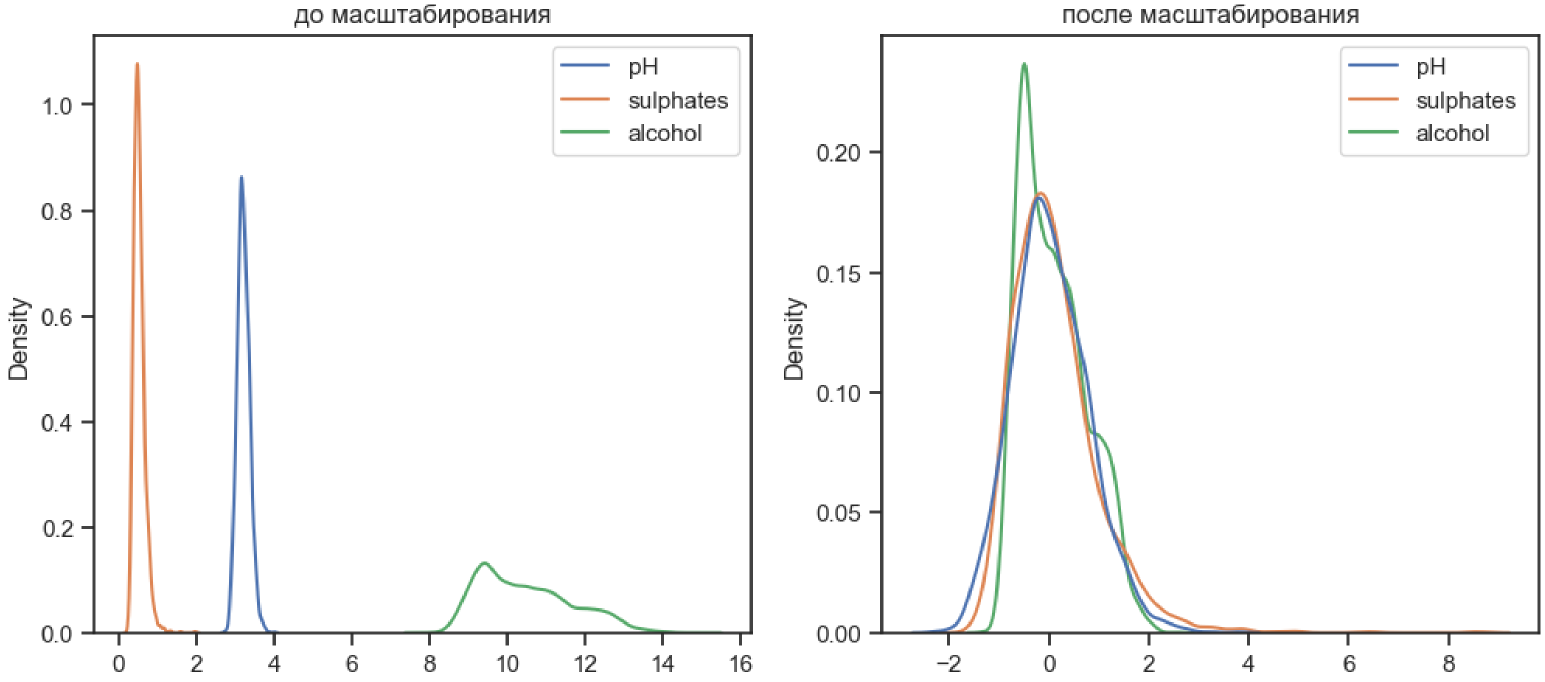
In [35]:
```
from sklearn.preprocessing import RobustScaler
cs41 = RobustScaler()
data_cs41_scaled_temp = cs41.fit_transform(X_ALL)
# формируем DataFrame на основе массива
data_cs41_scaled = arr_to_df(data_cs41_scaled_temp)
data_cs41_scaled.describe()
```

Out[35]:

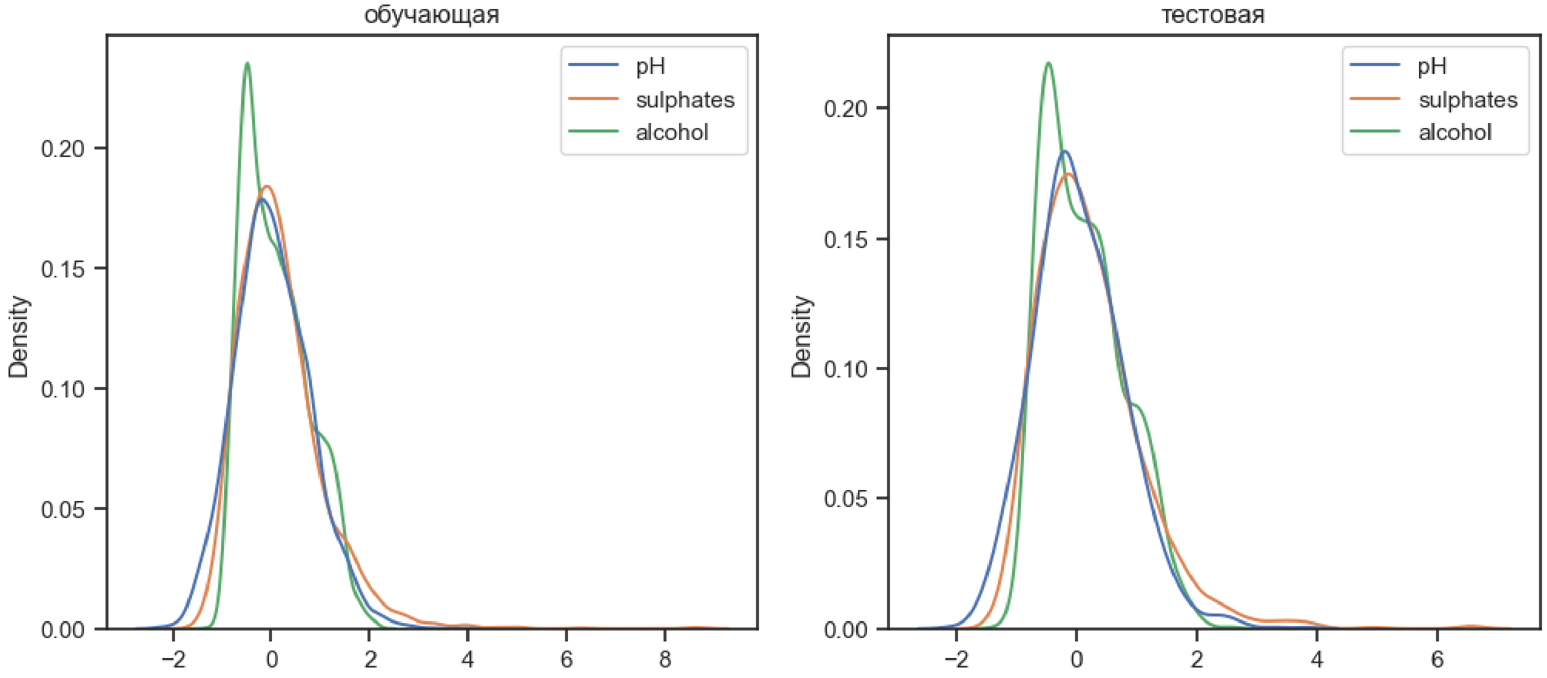
	type	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide	total sulfur dioxide	density
count	6497.000000	6487.000000	6489.000000	6494.000000	6495.000000	6495.000000	6497.000000	6497.000000	6497.000000
mean	0.246114	0.166599	0.292300	0.062299	0.387988	0.334873	0.063555	-0.028550	-0.041584
std	0.430779	0.997500	0.968524	1.037606	0.755258	1.297631	0.739558	0.715467	0.644876
min	0.000000	-2.461538	-1.235294	-2.214286	-0.380952	-1.407407	-1.166667	-1.417722	-1.673118
25%	0.000000	-0.461538	-0.352941	-0.428571	-0.190476	-0.333333	-0.500000	-0.518987	-0.548387
50%	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
75%	0.000000	0.538462	0.647059	0.571429	0.809524	0.666667	0.500000	0.481013	0.451613
max	1.000000	6.846154	7.588235	9.642857	9.968254	20.888889	10.833333	4.075949	9.481720

In [36]:
```
cs42 = RobustScaler()
cs42.fit(X_train)
```

```
         data_cs42_scaled_train_temp = cs42.transform(X_train)
         data_cs42_scaled_test_temp = cs42.transform(X_test)
         # формируем DataFrame на основе массива
         data_cs42_scaled_train = arr_to_df(data_cs42_scaled_train_temp)
         data_cs42_scaled_test = arr_to_df(data_cs42_scaled_test_temp)
In [37]:# Построение плотности распределения
         def draw_kde(col_list, df1, df2, label1, label2):
             fig, (ax1, ax2) = plt.subplots(
                 ncols=2, figsize=(12, 5))
             # первый график
             ax1.set_title(label1)
             sns.kdeplot(data=df1[col_list], ax=ax1)
             # второй график
             ax2.set_title(label2)
             sns.kdeplot(data=df2[col_list], ax=ax2)
             plt.show()
In [38]:x_col_list = ['pH','sulphates','alcohol']
         draw_kde(x_col_list, df, data_cs41_scaled, 'до масштабирования', 'после масштабирования')
```

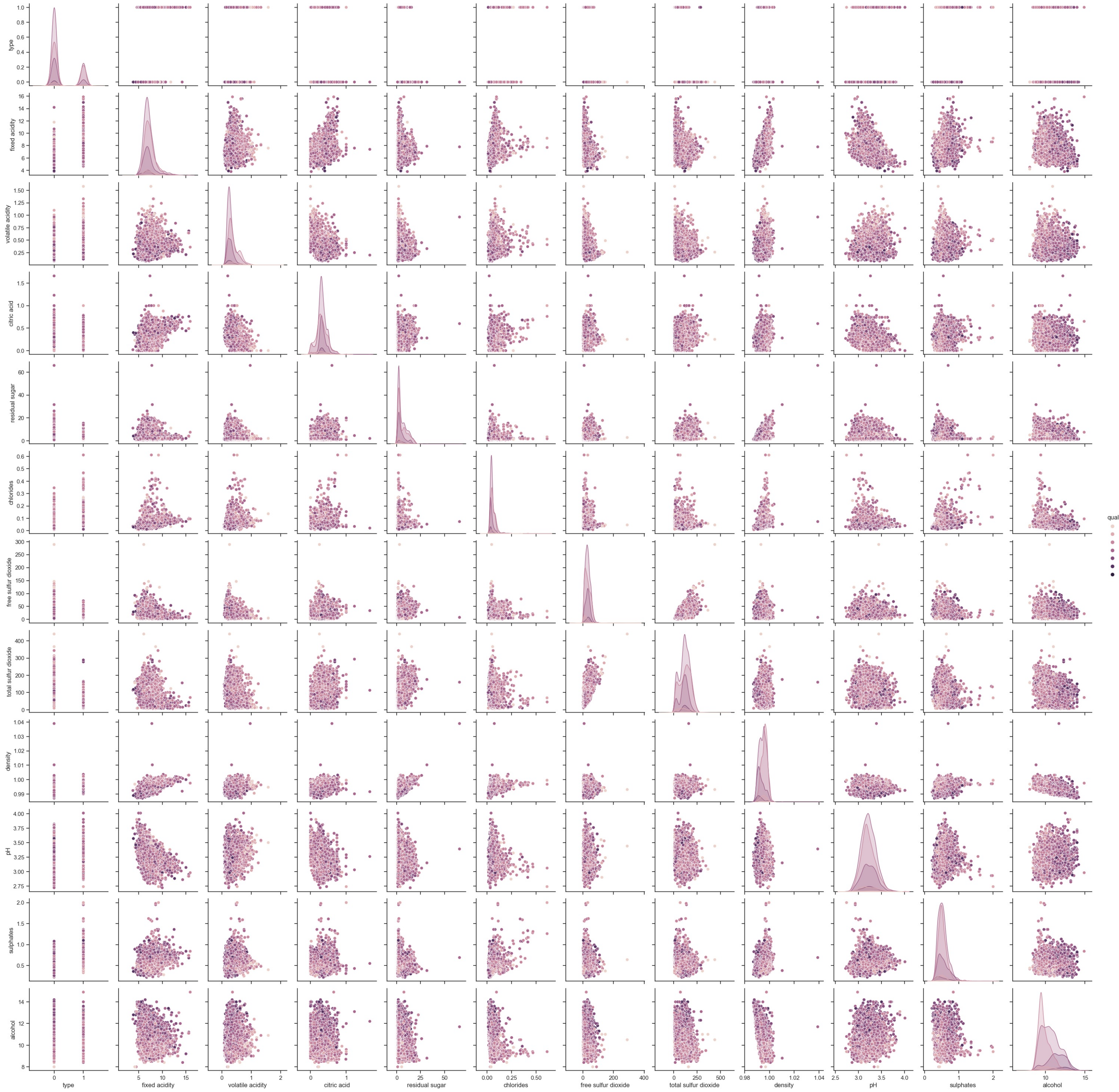


```
In [39]:draw_kde(x_col_list, data_cs42_scaled_train, data_cs42_scaled_test, 'обучающая', 'тестовая')
```



Парные диаграммы (pairplot)

```
In [40]:# pairplot with hue quality
         sns.pairplot(df, hue ='quality')
         # to show
         plt.show()
```


type
fixed acidity
volatile acidity
citric acid
residual sugar
chlorides
free sulfur dioxide
total sulfur dioxide
density
pH
sulphates
alcohol
quality
3
4
5
6
7
8
9
0
1
5
10
15
0
1
2
0
1
0
25
50
0.00
0.25
0.50
0
200
400
0
250
500
0.98
1.00
1.02
1.04
2.5
3.0
3.5
4.0
0
1
2
10
15

In [ ]: