Модели стохастических объектов (методы анализа данных)

Практическая работа №2

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Вариант 14.

Признаки `cat6_brandOfSoaps` , `cat2_hairColor` , `num1_15` , `num2_15` , `num3_15` .

In [296…

```
from collections import Counter
from scipy.stats import sigmaclip
from sklearn import preprocessing
from sklearn.impute import KNNImputer
from sklearn.preprocessing import OneHotEncoder, MinMaxScaler
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import seaborn as sns
```

In [297…

```
all_data = pd.read_excel('practice_dataframe.xlsx')

data = pd.DataFrame({
    'cat6_brandOfSoaps': all_data['cat6_brandOfSoaps'],
    'cat2_hairColor': all_data['cat2_hairColor'],
    'num1_15': all_data['num1_15'],
    'num2_15': all_data['num2_15'],
    'num3_15': all_data['num3_15']
})
data
```

Out[297…

	cat6_brandOfSoaps	cat2_hairColor	num1_15	num2_15	num3_15
0	lux	black	282.228024	NaN	807.976365
1	NaN	Red	1039.089956	268.388947	444.529442
2	Lux	black	500.696085	174.992127	428.723966
3	lux	Red	1346.429995	108.647900	520.238037
4	Dove	black	230.576445	150.113065	896.476167
...	...	...	...	...	...
995	Dove	Red	422.732662	170.810692	586.254084
996	lux	Brown	783.565442	237.086397	826.693312
997	Dove	Red	410.595523	196.686858	600.377791
998	Lux	black	-237.136035	179.262913	371.380055
999	Lux	black	22.006500	230.004737	326.04169

1000 rows × 5 columns

In [298…

```
data.info()
```

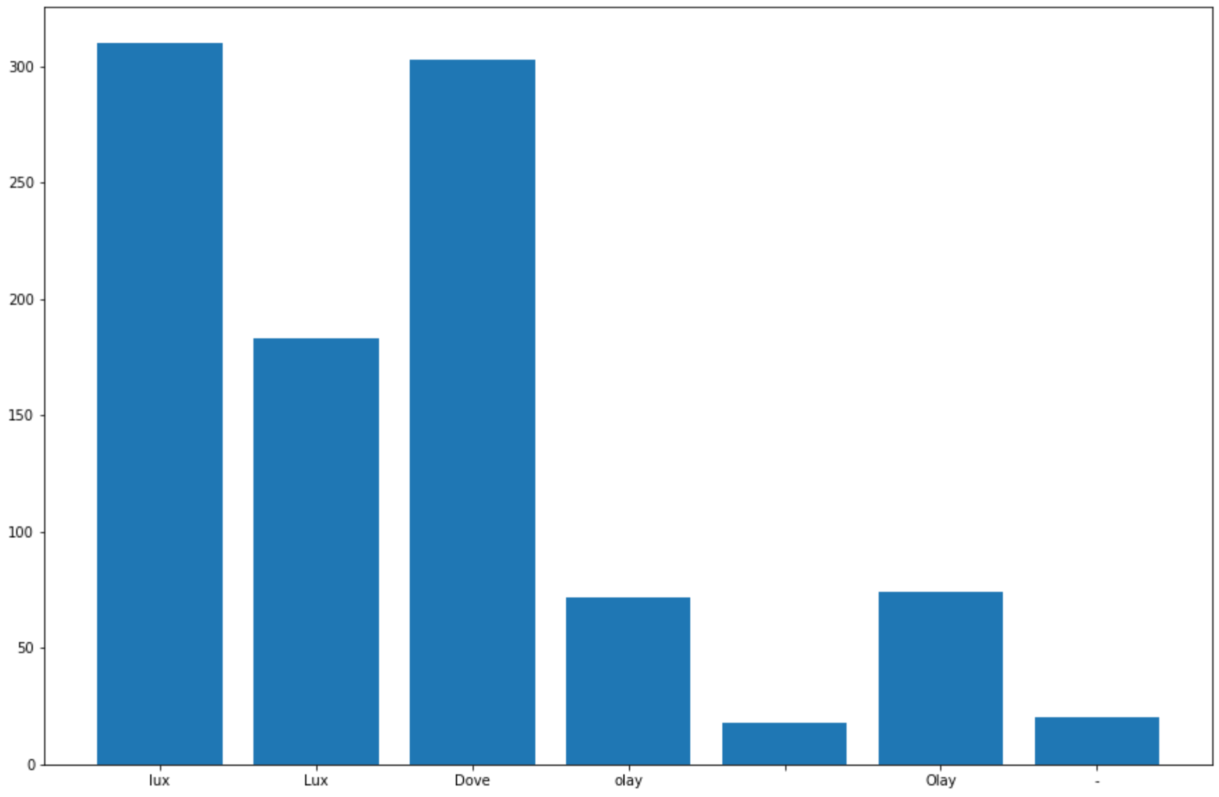
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 5 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   cat6_brandOfSoaps  980 non-null    object
 1   cat2_hairColor     980 non-null    object
 2   num1_15            1000 non-null   float64
 3   num2_15            950 non-null    float64
 4   num3_15            971 non-null    object
dtypes: float64(2), object(3)
memory usage: 39.2+ KB
```

1. Визуальный анализ данных

Столбчатые для категориальных до форматирования

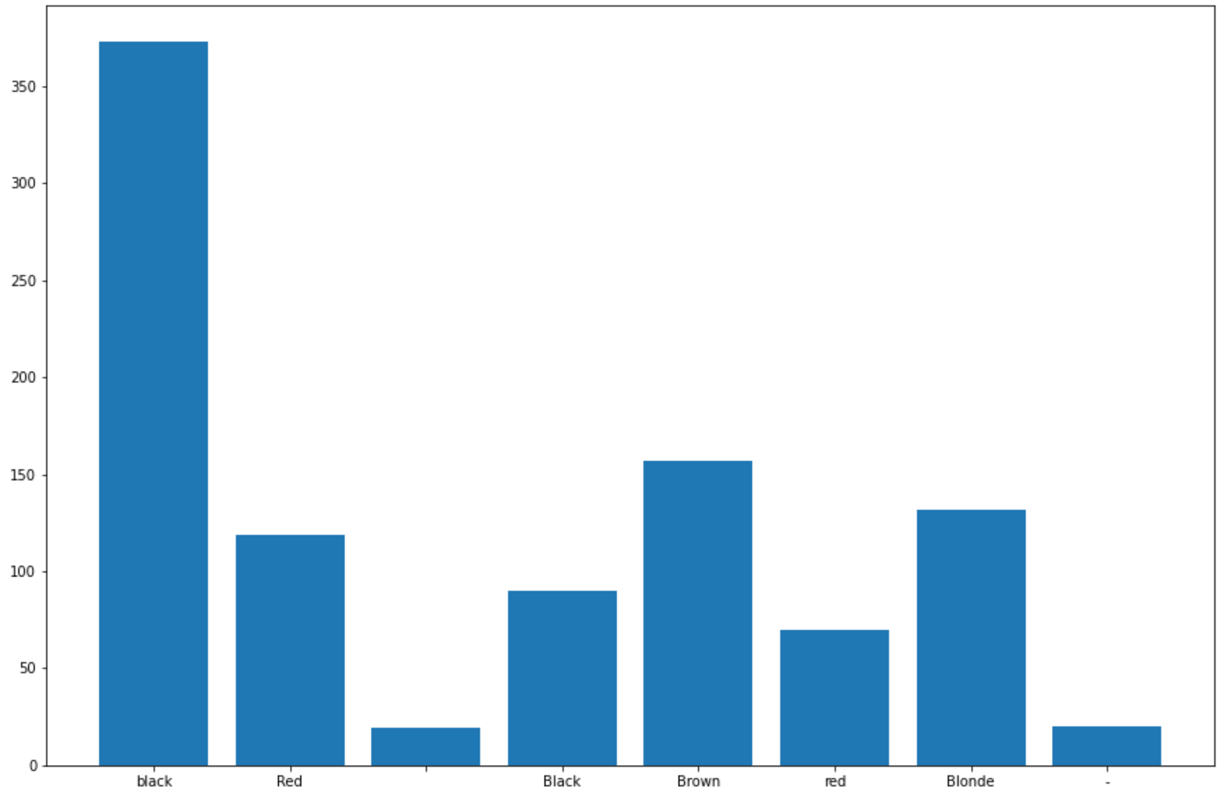
In [299…

```
# cat6_brandOfSoaps
counts = Counter(data['cat6_brandOfSoaps'].dropna())
plt.figure(figsize=(15, 10))
plt.bar(counts.keys(), counts.values())
plt.show()
```



In [300…

```
# cat2_hairColor
counts = Counter(data['cat2_hairColor'].dropna())
plt.figure(figsize=(15, 10))
plt.bar(counts.keys(), counts.values())
plt.show()
```



In [301…

```
def base_format(data_frame: pd.DataFrame):
    return data_frame.replace({-9999: np.nan}).replace(r'^[\s-]*$', np.nan, r

def format_str(data_frame: pd.DataFrame):
    return base_format(data_frame).str.capitalize().str.rstrip()

data['cat6_brandOfSoaps'] = format_str(data['cat6_brandOfSoaps'])
data['cat2_hairColor'] = format_str(data['cat2_hairColor'])
data["num1_15"] = base_format(data['num1_15'])
data["num2_15"] = base_format(data['num2_15'])
data["num3_15"] = base_format(data['num3_15'])

data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 5 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   cat6_brandOfSoaps  942 non-null    object
 1   cat2_hairColor     941 non-null    object
 2   num1_15            951 non-null    float64
 3   num2_15            950 non-null    float64
 4   num3_15            913 non-null    float64
dtypes: float64(3), object(2)
memory usage: 39.2+ KB
```

In [302…

```
data.describe()
```

Out[302…

	num1_15	num2_15	num3_15
count	951.000000	950.000000	913.000000
mean	843.822989	148.963833	555.429557
std	716.182943	106.847552	221.358521
min	-1467.940219	-184.922189	-168.839273

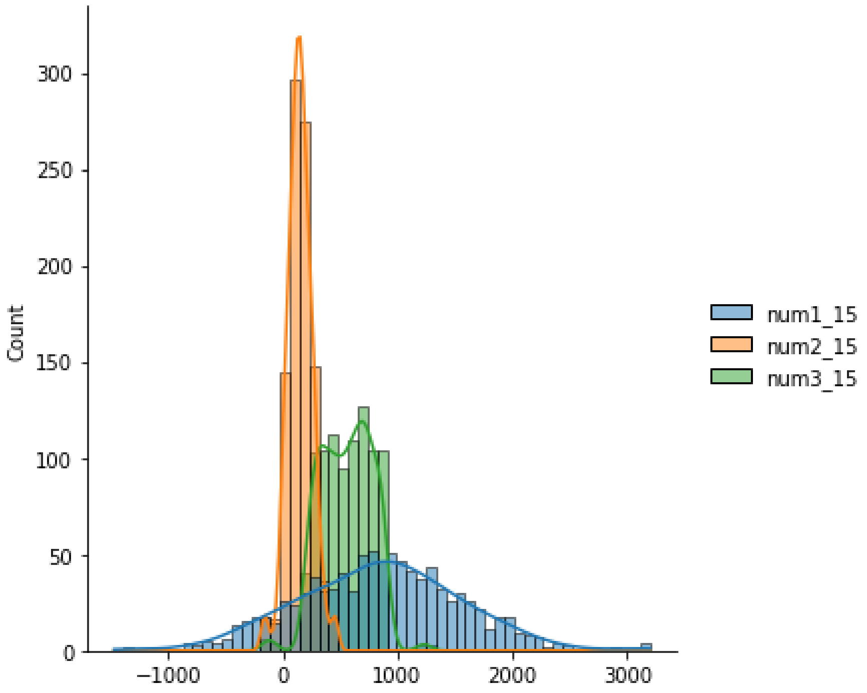
	num1_15	num2_15	num3_15
25%	377.718319	82.347973	373.272578
50%	859.934249	145.220453	562.668399
75%	1301.342806	215.636532	731.795739
max	3201.191252	479.162302	1265.142875

In [303…

```
sns.displot(data=data, kde=True)
```

Out[303…

```
<seaborn.axisgrid.FacetGrid at 0x7f6b40d82310>
```



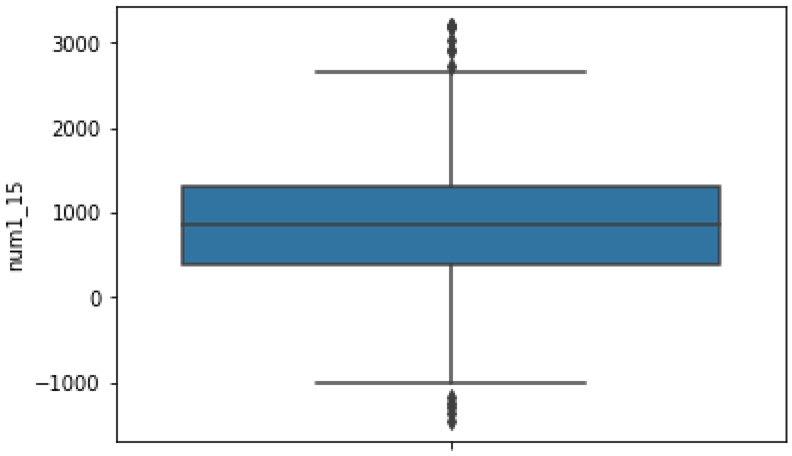
Ящик с усами для числовых

In [304…

```
# num1_15
sns.boxplot(y=data['num1_15'])
```

Out[304…

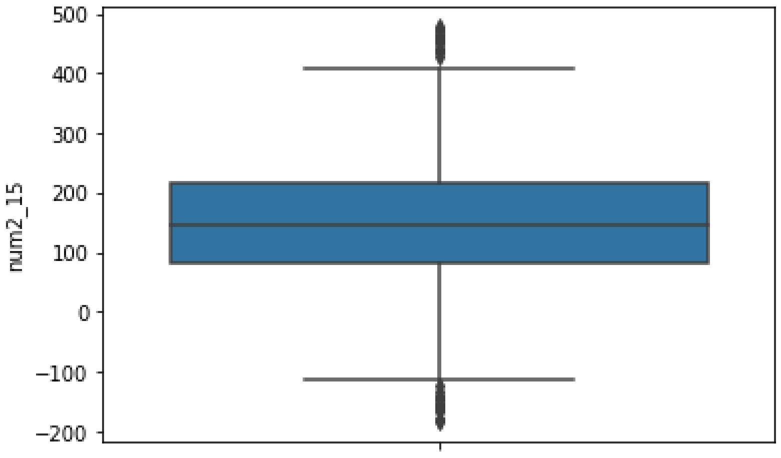
```
<AxesSubplot:ylabel='num1_15'>
```



In [305…

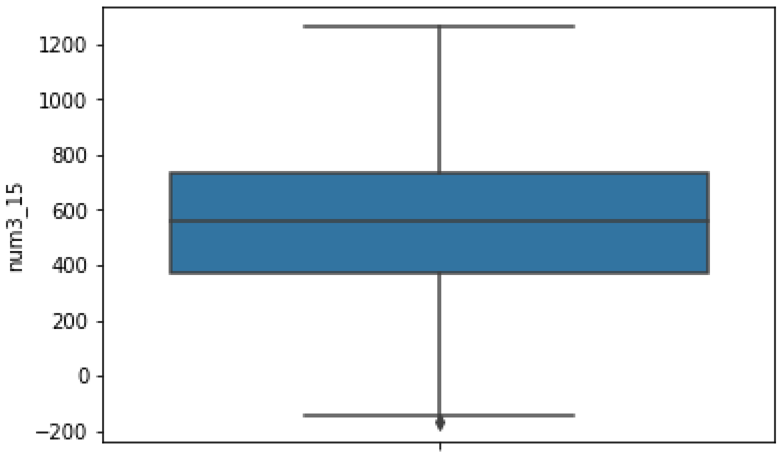
```
# num2_15
sns.boxplot(y=data['num2_15'])
```

```
Out[305…  <AxesSubplot:ylabel='num2_15'>
```



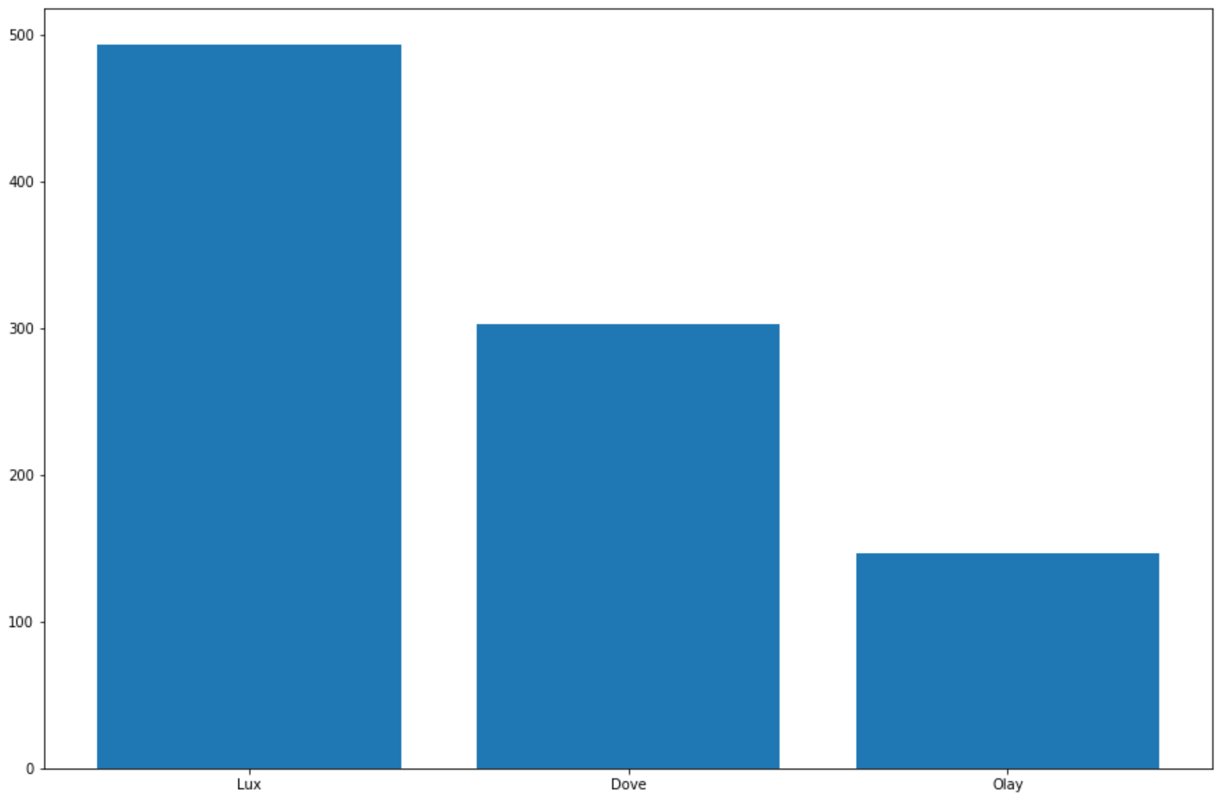
```
In [306…
# num3_15
sns.boxplot(y=data['num3_15'])
```

```
Out[306…  <AxesSubplot:ylabel='num3_15'>
```



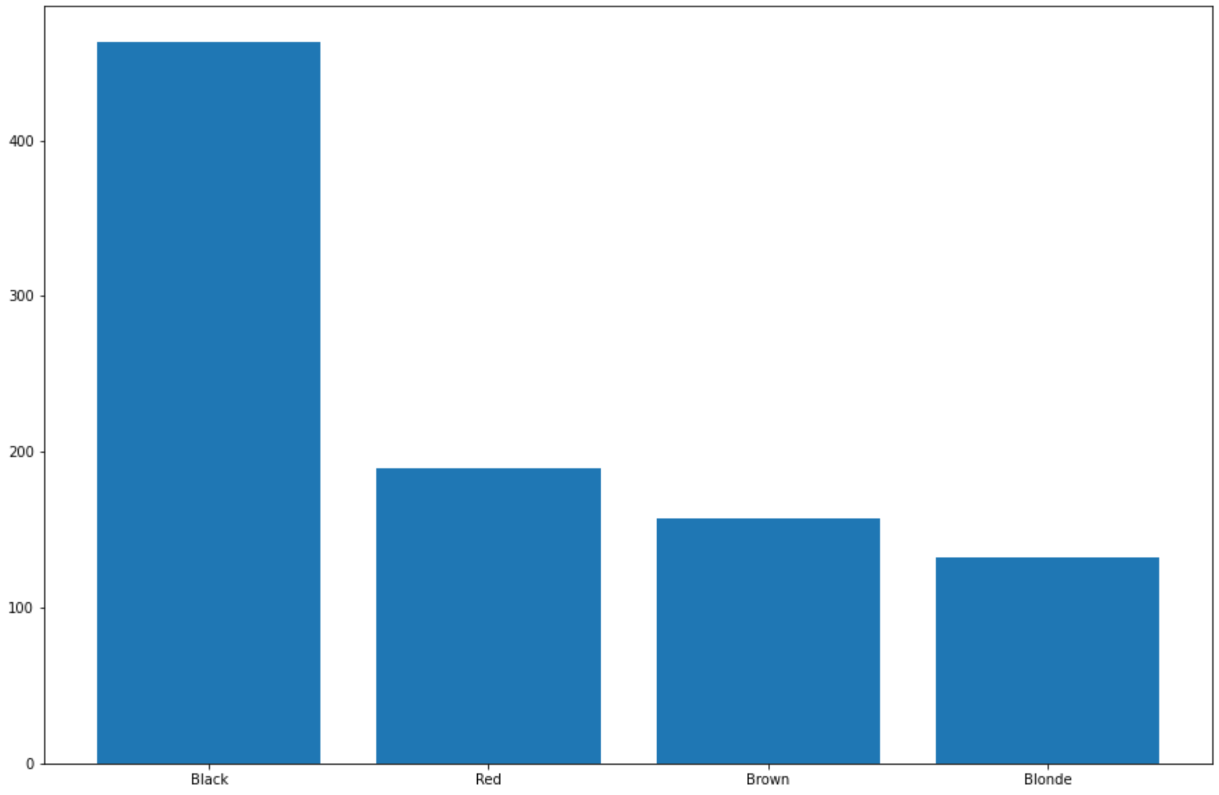
Столбчатые для категориальных

```
In [307…
# cat6_brandOfSoaps
counts = Counter(data['cat6_brandOfSoaps'].dropna())
plt.figure(figsize=(15, 10))
plt.bar(counts.keys(), counts.values())
plt.show()
```



In [308…

```
# cat2_hairColor
counts = Counter(data['cat2_hairColor'].dropna())
plt.figure(figsize=(15, 10))
plt.bar(counts.keys(), counts.values())
plt.show()
```



2. Провести проверку правдоподобности исходных данных

In [309…

```
data
```

Out[309…

	cat6_brandOfSoaps	cat2_hairColor	num1_15	num2_15	num3_15
0	Lux	Black	282.228024	NaN	807.976365
1	NaN	Red	1039.089956	268.388947	444.529442
2	Lux	Black	500.696085	174.992127	428.723966
3	Lux	Red	1346.429995	108.647900	520.238037
4	Dove	Black	230.576445	150.113065	896.476167
...	...	...	...	...	...
995	Dove	Red	422.732662	170.810692	586.254084
996	Lux	Brown	783.565442	237.086397	826.693312
997	Dove	Red	410.595523	196.686858	600.377791
998	Lux	Black	-237.136035	179.262913	371.380055
999	Lux	Black	22.006500	230.004737	326.041690

1000 rows × 5 columns

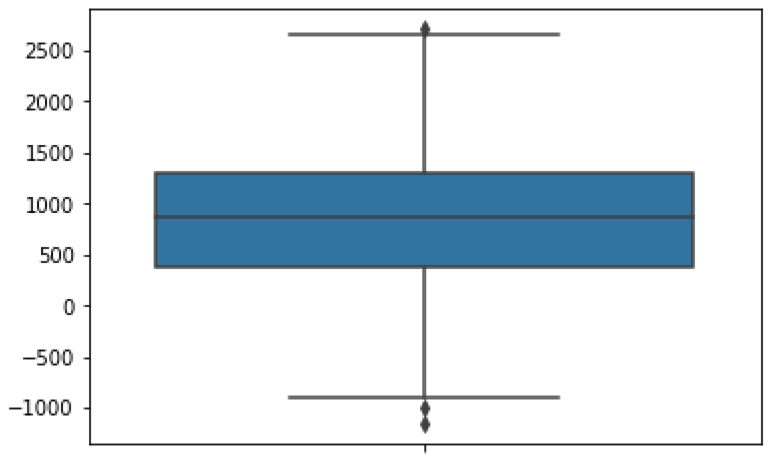
3. Поиск аномальных значений

In [310…

```
c, low, up = sigmaclip(data['num1_15'].dropna(), 3, 3)
sns.boxplot(y=c)
```

Out[310…

```
<AxesSubplot:>
```

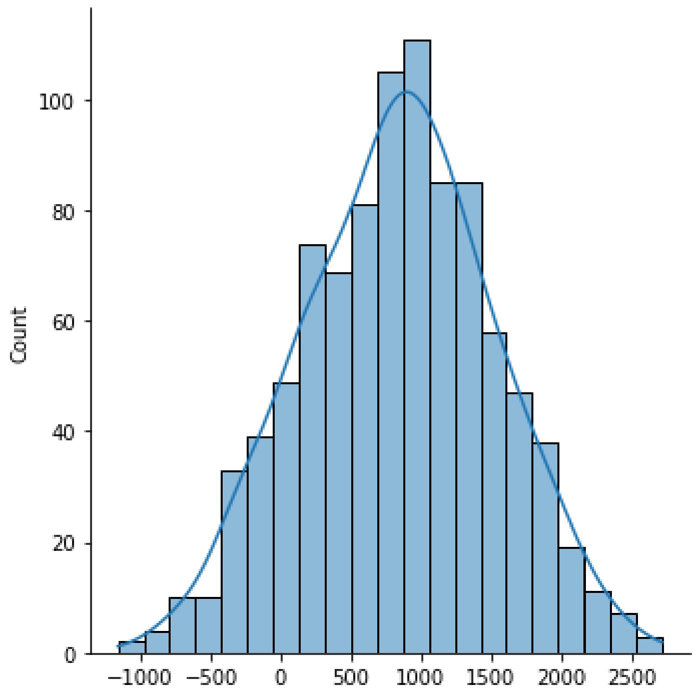


In [311…

```
sns.displot(c, kde=True)
```

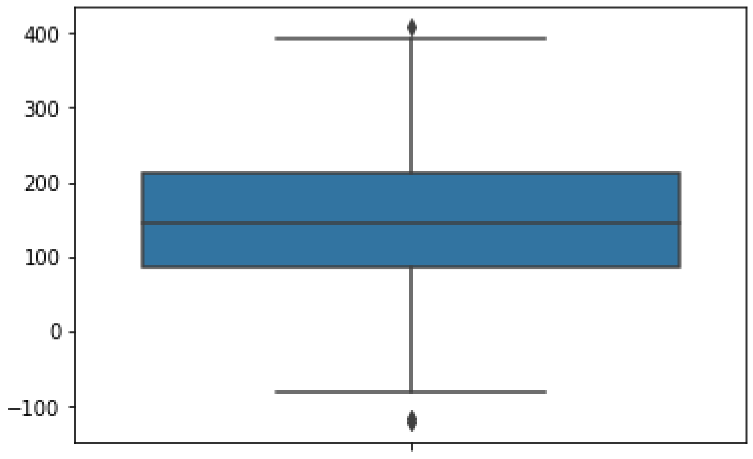
Out[311…

```
<seaborn.axisgrid.FacetGrid at 0x7f6b3ebf30a0>
```



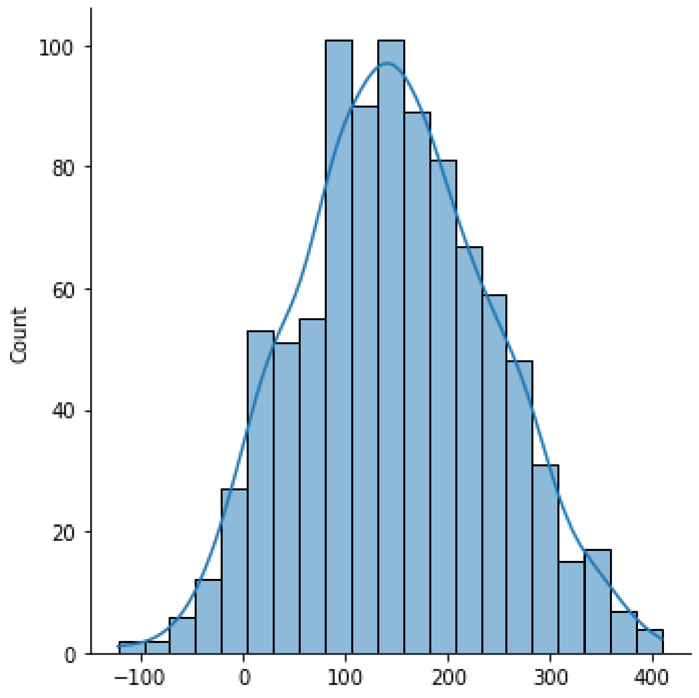
```
In [312…
c, low, up = sigmaclip(data['num2_15'].dropna(), 3, 3)
sns.boxplot(y=c)
```

```
Out[312… <AxesSubplot:>
```



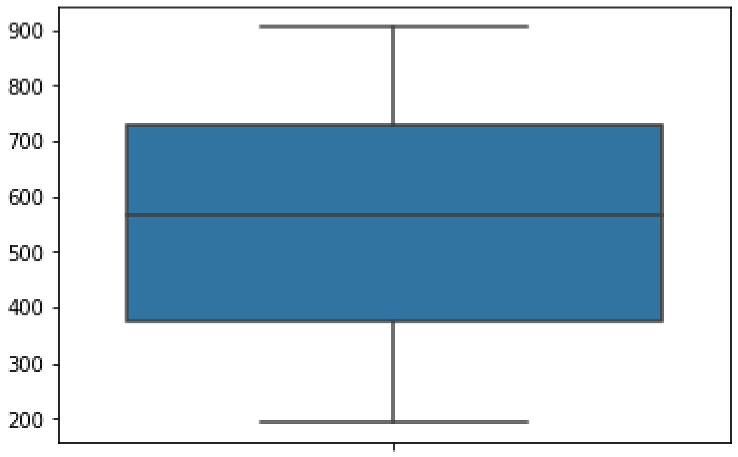
```
In [313…
sns.displot(c, kde=True)
```

```
Out[313… <seaborn.axisgrid.FacetGrid at 0x7f6b3ec029a0>
```



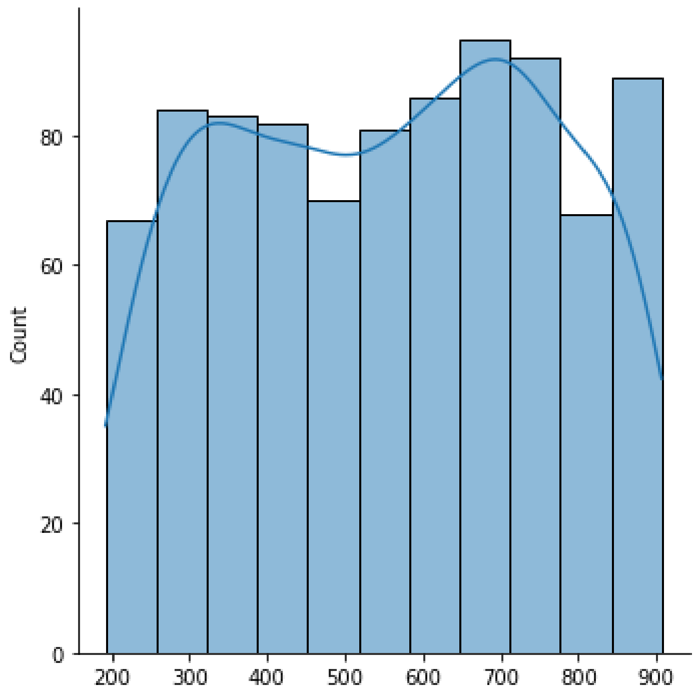
```
In [314…   c, low, up = sigmaclip(data['num3_15'].dropna(), 3, 3)
           sns.boxplot(y=c)

Out[314…  <AxesSubplot:>
```



```
In [315…   sns.displot(c, kde=True)

Out[315…  <seaborn.axisgrid.FacetGrid at 0x7f6b3eac6820>
```



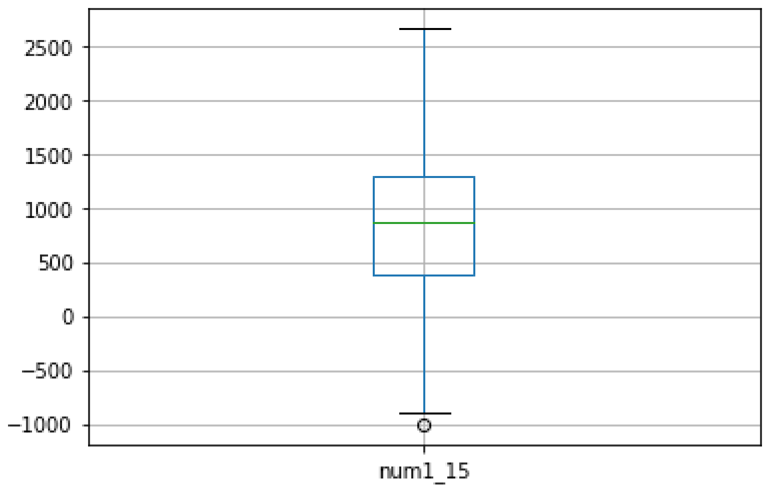
In [316…

```
# Метод квантилей

q1 = np.nanquantile(data['num1_15'], 0.25)
q3 = np.nanquantile(data['num1_15'], 0.75)
iqr = q3 - q1
data.query("@q1 - 1.5*@iqr < num1_15 < @q3 + 1.5*@iqr").boxplot(column='num1_
```

Out[316…

```
<AxesSubplot:>
```



In [316…

```

```

4. Поиск и восстановление пропущенных значений

In [317…

```
knn_imputer = KNNImputer()
enc = OneHotEncoder()
le = preprocessing.LabelEncoder()
```

Метод ближайших соседей для `cat6_brandOfSoaps`

In [318…

```
def formate_inputed_array(array):
    m = max(array)
    for i in range(len(array)):
        if array[i] == m:
            array[i] = 1
        else:
            array[i] = 0

    array = np.append(array, 0)

    return array

enc_dataset = pd.DataFrame(enc.fit_transform(data[['cat6_brandOfSoaps']]).toa
idx = enc_dataset.groupby([np.nan]).indices[1]
enc_dataset['Lux'] = pd.DataFrame(np.where(enc_dataset['Lux'].index.isin(idx)
enc_dataset['Dove'] = pd.DataFrame(np.where(enc_dataset['Dove'].index.isin(id
enc_dataset['Olay'] = pd.DataFrame(np.where(enc_dataset['Olay'].index.isin(id
enc_dataset = enc_dataset.drop(columns=[np.nan])
imputed_dataset = knn_imputer.fit_transform(enc_dataset)

imputed_dataset = np.apply_along_axis(formate_inputed_array, 1, imputed_datas

restored_data = enc.inverse_transform(imputed_dataset)
data['cat6_brandOfSoaps'] = restored_data
data['cat6_brandOfSoaps']
```

Out[318…
```
0      Dove
1      Olay
2      Dove
3      Dove
4      Dove
       ...
995    Dove
996    Dove
997    Dove
998    Dove
999    Dove
Name: cat6_brandOfSoaps, Length: 1000, dtype: object
```

Самым популярным значением для `cat2_hairColor`

In [319…
```
data1 = Counter(data['cat2_hairColor'].dropna())
mode = data1.most_common(1)[0][0]
data['cat2_hairColor'].fillna(mode, inplace=True)
data['cat2_hairColor']
```

Out[319…
```
0      Black
1        Red
2      Black
3        Red
4      Black
       ...
995      Red
996    Brown
997      Red
998    Black
999    Black
Name: cat2_hairColor, Length: 1000, dtype: object
```

Среднее для `num1_15`

In [320…
```
data['num1_15'].fillna(np.mean(data['num1_15'].dropna()), inplace=True)
data['num1_15']
```

Out[320…
```
0       282.228024
```

```
1       1039.089956
2        500.696085
3       1346.429995
4        230.576445
           ...
995      422.732662
996      783.565442
997      410.595523
998     -237.136035
999       22.006500
Name: num1_15, Length: 1000, dtype: float64
```

Медиана для num2_15

```
In [321…
data['num2_15'].fillna(np.median(data['num2_15'].dropna()), inplace=True)
data['num2_15']
```

```
Out[321…
0       145.220453
1       268.388947
2       174.992127
3       108.647900
4       150.113065
           ...
995     170.810692
996     237.086397
997     196.686858
998     179.262913
999     230.004737
Name: num2_15, Length: 1000, dtype: float64
```

Метод ближайших соседей для num3_15

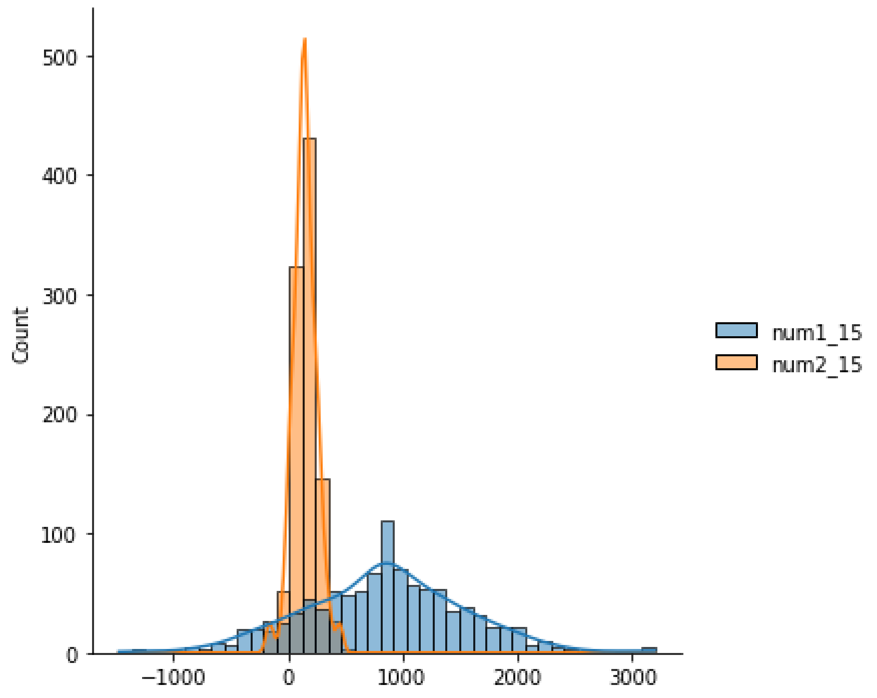
```
In [322…
scaler = MinMaxScaler()
scaled_values = scaler.fit_transform(data[['num3_15']])
data[['num3_15']] = scaled_values

dataset_copy = data.copy()
inputed_df = knn_imputer.fit_transform(dataset_copy[['num3_15']])
data['num3_15'] = inputed_df[:, 0]
data['num3_15']
```

```
Out[322…
0       0.681191
1       0.427738
2       0.416716
3       0.480534
4       0.742907
          ...
995     0.526571
996     0.694243
997     0.536420
998     0.376727
999     0.345110
Name: num3_15, Length: 1000, dtype: float64
```

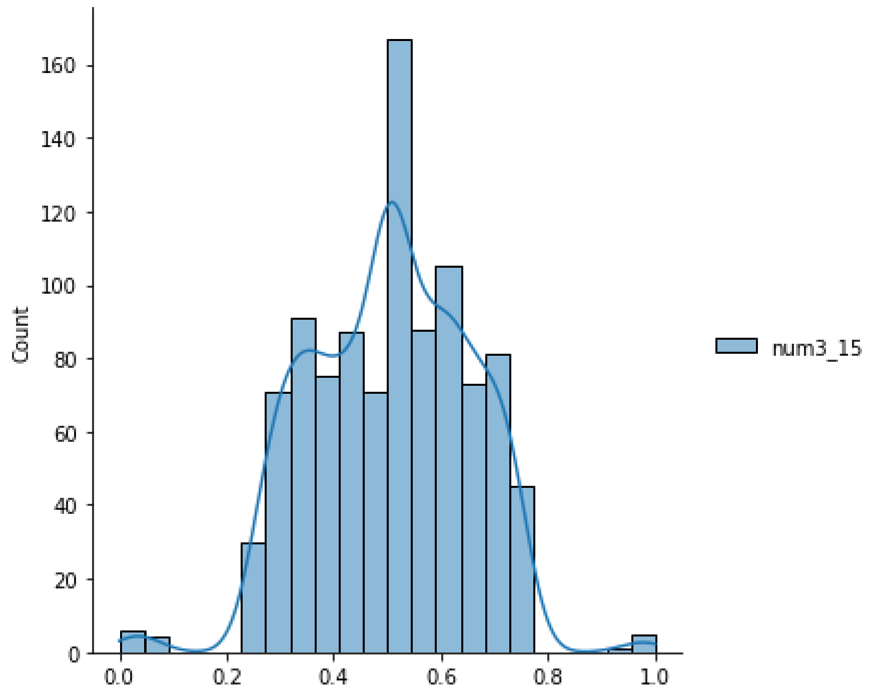
```
In [323…
sns.displot(data=[data['num1_15'], data['num2_15']], kde=True)
```

```
Out[323…
<seaborn.axisgrid.FacetGrid at 0x7f6b3ea34e80>
```



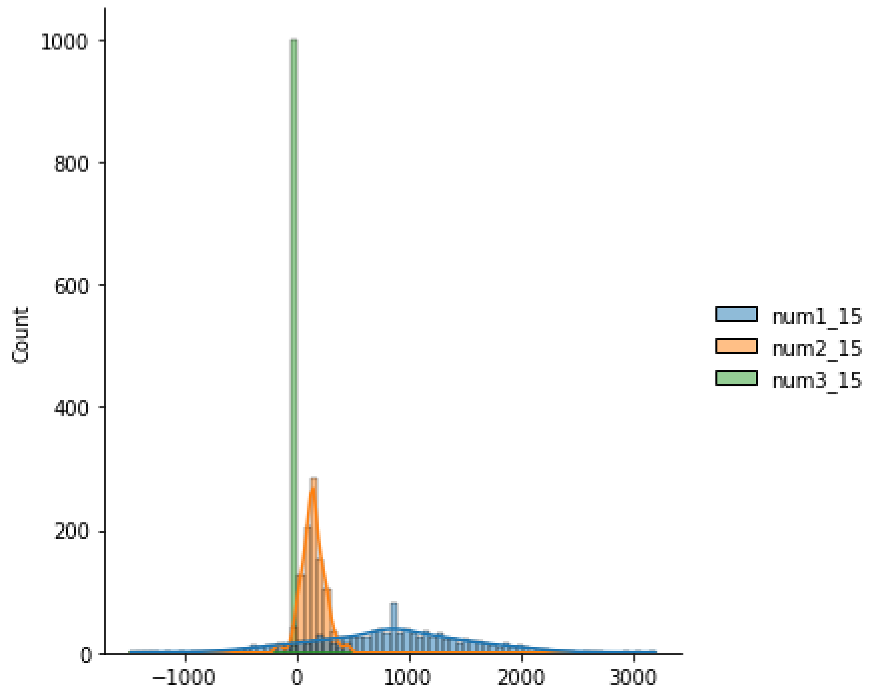
```
In [324…  sns.displot(data=[data['num3_15']], kde=True)

Out[324…  <seaborn.axisgrid.FacetGrid at 0x7f6b3e8a22e0>
```



```
In [325…  sns.displot(data=data, kde=True)

Out[325…  <seaborn.axisgrid.FacetGrid at 0x7f6b3ebf3940>
```



In [326…

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 5 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   cat6_brandOfSoaps  1000 non-null   object 
 1   cat2_hairColor     1000 non-null   object 
 2   num1_15            1000 non-null   float64
 3   num2_15            1000 non-null   float64
 4   num3_15            1000 non-null   float64
dtypes: float64(3), object(2)
memory usage: 39.2+ KB
```

In [327…

```
data.describe()
```

Out[327…

	num1_15	num2_15	num3_15
count	1000.000000	1000.000000	1000.000000
mean	843.822989	148.776664	0.505075
std	698.398072	104.142567	0.147492
min	-1467.940219	-184.922189	0.000000
25%	394.078433	86.660775	0.390650
50%	843.822989	145.220453	0.505075
75%	1284.983740	210.869817	0.617954
max	3201.191252	479.162302	1.000000

5. Преобразование данных

In [328…

```
# One-hot encoding для cat6_brandOfSoaps
one = enc.fit_transform(data[['cat6_brandOfSoaps']]).toarray()
one
```

```
array([[1., 0., 0.],
```

Out[328…
```
        [0., 0., 1.],
        [1., 0., 0.],
        ...,
        [1., 0., 0.],
        [1., 0., 0.],
        [1., 0., 0.]])
```

In [329…
```python
# Label encoding для cat2_hairColor

le.fit_transform(data['cat2_hairColor'])
```

Out[329…
```
array([0, 3, 0, 3, 0, 3, 0, 0, 0, 0, 0, 2, 3, 1, 0, 2, 0, 1, 0, 0, 0, 3,
       0, 0, 2, 3, 2, 0, 2, 0, 2, 2, 0, 0, 3, 0, 0, 0, 0, 2, 0, 2, 1, 0,
       0, 0, 2, 0, 0, 3, 0, 3, 0, 0, 0, 3, 0, 0, 0, 2, 2, 0, 0, 0, 0, 0,
       3, 0, 0, 3, 3, 2, 0, 0, 0, 0, 3, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1,
       0, 1, 0, 3, 0, 0, 0, 1, 0, 3, 3, 1, 0, 0, 0, 0, 0, 3, 2, 0, 2, 1,
       0, 0, 1, 3, 3, 2, 0, 2, 0, 0, 0, 0, 2, 0, 0, 0, 0, 3, 0, 0, 0, 0,
       0, 3, 0, 1, 1, 2, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 3, 2, 0, 0,
       1, 0, 0, 3, 1, 0, 0, 2, 0, 1, 0, 0, 2, 0, 0, 2, 1, 3, 0, 1, 2, 0,
       1, 3, 3, 0, 2, 3, 3, 0, 1, 3, 2, 1, 0, 0, 2, 2, 0, 3, 0, 3, 2, 0,
       3, 0, 1, 1, 1, 0, 2, 0, 0, 0, 2, 0, 0, 3, 2, 2, 3, 0, 2, 1, 0, 0,
       3, 3, 3, 2, 0, 0, 0, 2, 1, 0, 2, 3, 0, 1, 0, 0, 0, 3, 0, 0, 2, 0,
       3, 0, 0, 2, 2, 0, 3, 3, 0, 2, 0, 3, 3, 0, 0, 0, 1, 2, 0, 1, 3, 1,
       0, 3, 1, 3, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 3, 2, 2, 0, 2, 0, 2, 2,
       0, 0, 0, 3, 3, 0, 2, 1, 0, 2, 0, 2, 0, 2, 2, 1, 3, 0, 0, 0, 0, 0,
       0, 2, 0, 0, 3, 2, 1, 0, 2, 1, 3, 2, 3, 2, 2, 2, 0, 0, 1, 1, 1, 3,
       3, 1, 0, 0, 3, 0, 0, 0, 1, 1, 3, 2, 1, 0, 0, 3, 0, 0, 0, 1, 2, 0,
       0, 3, 0, 0, 0, 0, 2, 2, 0, 3, 3, 3, 3, 3, 0, 0, 2, 2, 0, 2, 0, 0,
       0, 0, 0, 0, 0, 1, 0, 3, 0, 0, 0, 0, 0, 0, 3, 0, 2, 0, 0, 3, 0, 3,
       0, 1, 1, 0, 2, 0, 1, 0, 0, 0, 1, 0, 1, 3, 0, 0, 1, 3, 1, 0, 0, 3,
       3, 1, 3, 3, 0, 0, 1, 0, 0, 1, 3, 0, 3, 0, 0, 0, 0, 0, 0, 3, 2, 3,
       2, 2, 1, 2, 0, 0, 3, 2, 1, 2, 2, 2, 0, 3, 0, 0, 3, 0, 0, 2, 2, 1,
       0, 2, 2, 0, 2, 1, 2, 1, 2, 0, 3, 1, 1, 2, 3, 0, 3, 0, 2, 3, 1, 0,
       0, 2, 0, 0, 2, 1, 3, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 3, 3, 0,
       0, 0, 0, 0, 2, 0, 3, 2, 1, 0, 0, 0, 2, 1, 1, 3, 0, 1, 3, 3, 0, 0,
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       1, 0, 3, 1, 0, 0, 3, 0, 0, 0, 0, 0, 2, 0, 1, 0, 1, 0, 0, 2, 3, 1,
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       2, 3, 0, 0, 2, 1, 0, 0, 0, 0, 3, 0, 0, 0, 0, 3, 0, 1, 0, 3, 3, 0,
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       2, 0, 2, 0, 0, 3, 2, 3, 0, 0])
```
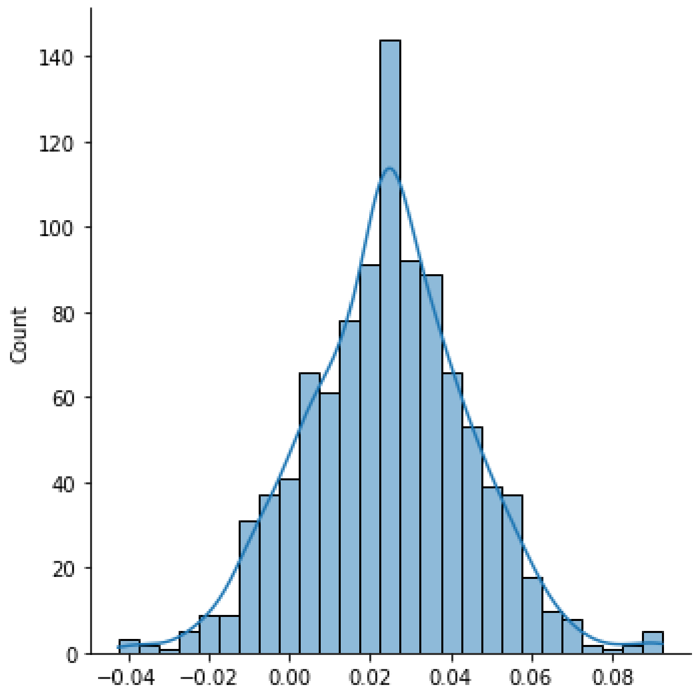

In [330…
```python
# Нормализация для num1_15

n = preprocessing.normalize([data['num1_15']])
sns.displot(n[0], kde=True)
```

Out[330…
```
<seaborn.axisgrid.FacetGrid at 0x7f6b3e7d3a00>
```

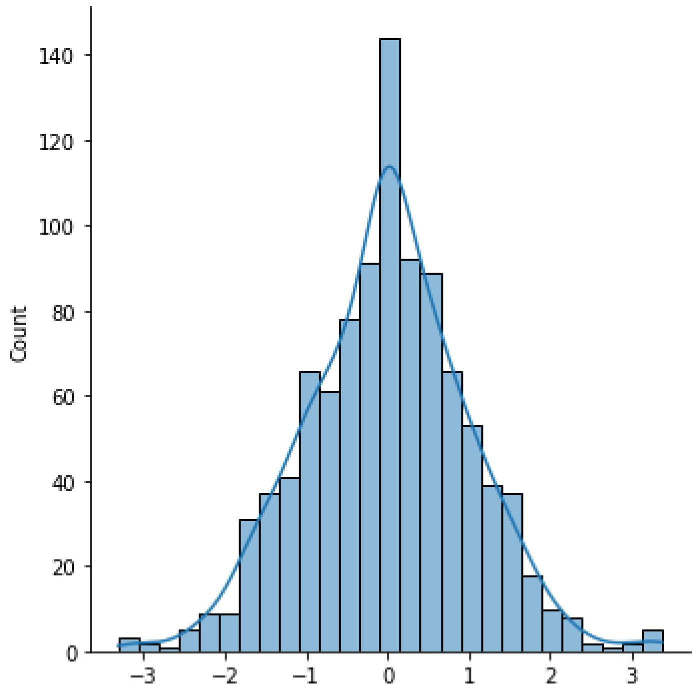


In [331…

```
# Стандартизация для num1_15

st = preprocessing.scale(data['num1_15'])
sns.displot(data=st, kde=True)
```

Out[331…

```
<seaborn.axisgrid.FacetGrid at 0x7f6b3e78e0d0>
```

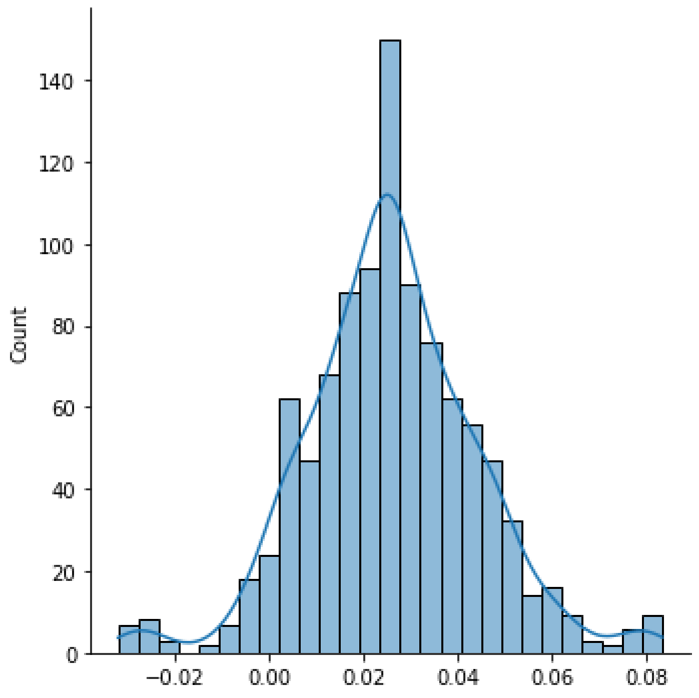


In [332…

```
# Нормализация для num2_15

n = preprocessing.normalize([data['num2_15']])
sns.displot(n[0], kde=True)
```

Out[332…

```
<seaborn.axisgrid.FacetGrid at 0x7f6b3e40e250>
```

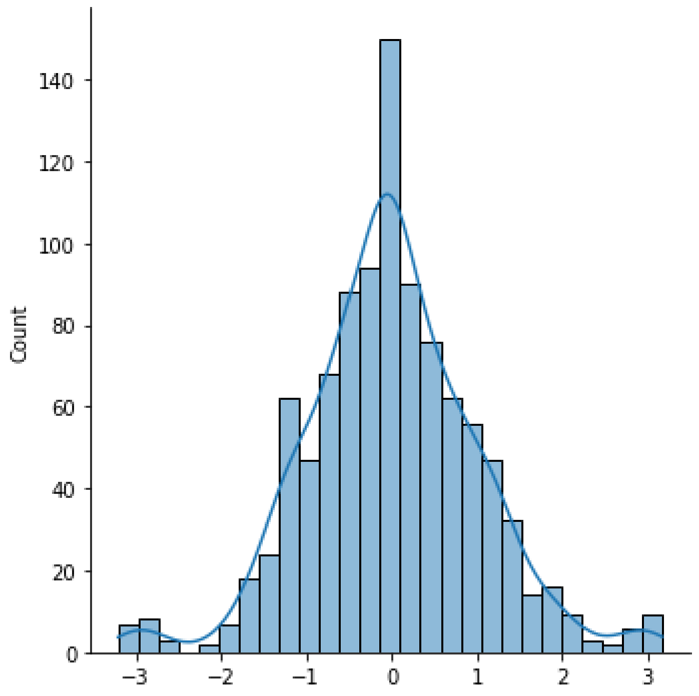


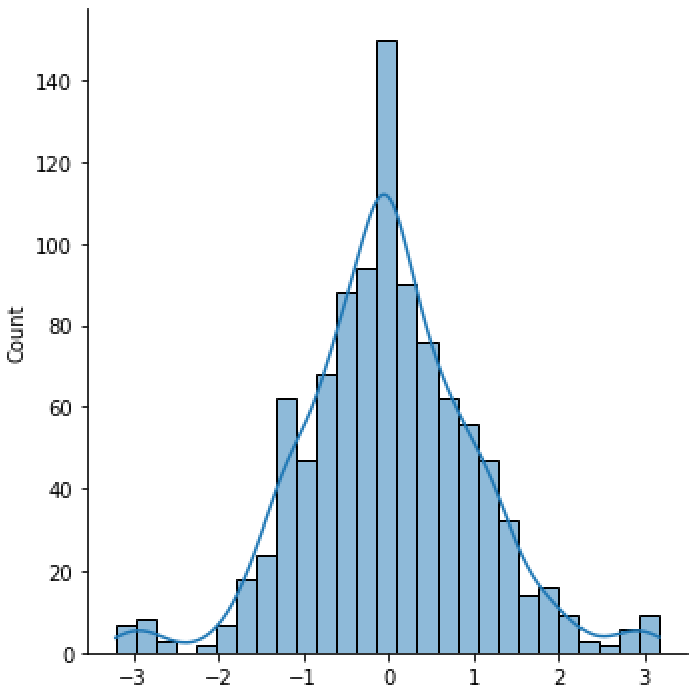
In [333…

```
# Стандартизация для num2_15

st = preprocessing.scale(data['num2_15'])
sns.displot(data=st, kde=True)
sns.displot(data=st, kde=True)
```

Out[333…

```
<seaborn.axisgrid.FacetGrid at 0x7f6b3e330220>
```



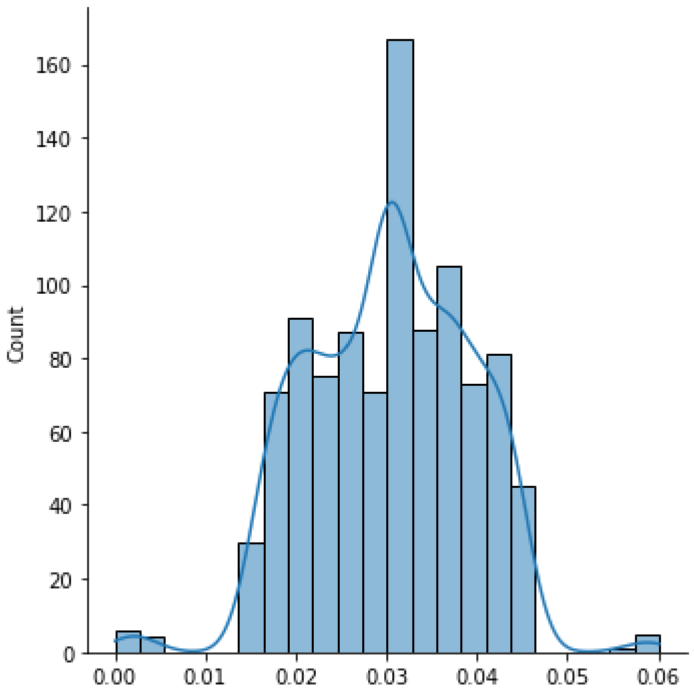


In [334…

```
# Нормализация для num3_15

n = preprocessing.normalize([data['num3_15']])
sns.displot(n[0], kde=True)
```

Out[334…

```
<seaborn.axisgrid.FacetGrid at 0x7f6b3e1ac1f0>
```

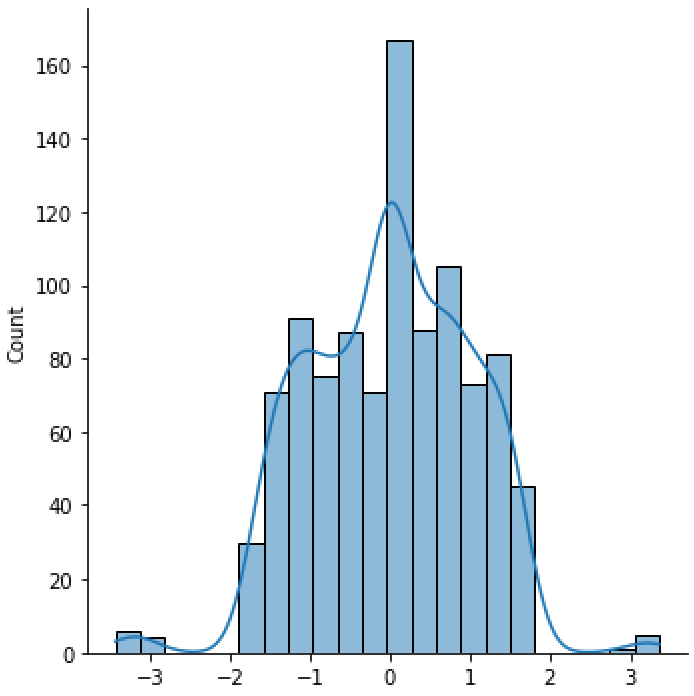


In [335…

```
# Стандартизация для num3_15

st = preprocessing.scale(data['num3_15'])
sns.displot(data=st, kde=True)
```

Out[335…

```
<seaborn.axisgrid.FacetGrid at 0x7f6b3e3db820>
```



Count
0
20
40
60
80
100
120
140
160
−3
−2
−1
0
1
2
3