Вариант	Задача 1	Задача 2
5	5	25

Группа ИУ5-21М

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Задача 1

Для набора данных проведите кодирование одного (произвольного) категориального признака с использованием метода "one-hot encoding".

In [ ]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.impute import SimpleImputer
from sklearn.impute import MissingIndicator
import scipy.stats as stats
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing import MinMaxScaler
from sklearn.preprocessing import RobustScaler
from sklearn.linear_model import LogisticRegression
from sklearn.svm import LinearSVC
%matplotlib inline
sns.set(style="ticks")
```

In [ ]:
```
def repair_df(df : pd.DataFrame):
    df['Population (2020)'] = df['Population (2020)'].apply(lambda x: int(''.joi
    df[' (km2).2'] = df[' (km2).2'].apply(lambda x: float(''.join(x.split(','))
    df[' (km2).1'] = df[' (km2).1'].apply(lambda x: float(''.join(x.split(','))
    df[' (km2)'] = df[' (km2)'].apply(lambda x: int(''.join(x.split(','))))
    df['Water area (sq mi)'] = df['Water area (sq mi)'].apply(lambda x: float('
    df['Land area (sq mi)'] = df['Land area (sq mi)'].apply(lambda x: float(''.j
    df['Total area (sq mi)'] = df['Total area (sq mi)'].apply(lambda x: float('
    return df
```

In [ ]:
```
df = repair_df(pd.read_csv('dataset.csv'))
df.head()
df.rename(columns={
    'Rank': 'Rank',
    'City': 'City',
    'State': 'State',
    'Land area (sq mi)': 'Land area',
    ' (km2)': 'km2',
    'Water area (sq mi)': 'Water area',
    ' (km2).1': 'km2.1',
    'Total area (sq mi)': 'Total area',
    ' (km2).2': 'km2.2',
    'Population (2020)': 'Population'
}, inplace=True)
```

```
df.to_csv('new_dataset.csv', index=False)
df.columns
```

Out[ ]:
```
Index(['Rank ', 'City ', 'State ', 'Land area', 'km2', 'Water area', 'km2.1',
       'Total area', 'km2.2', 'Population'],
      dtype='object')
```

In [ ]:
```
df = pd.read_csv('new_dataset.csv')
print(df.columns)
print()
df.head()
```

```
Index(['Rank ', 'City ', 'State ', 'Land area', 'km2', 'Water area', 'km2.1',
       'Total area', 'km2.2', 'Population'],
      dtype='object')
```

Out[ ]:

	Rank	City	State	Land area	km2	Water area	km2.1	Total area	km2.2	Population
0	1	Sitka	Alaska	2870.1	7434	1945.1	5038.0	4815.1	12471.0	8458
1	2	Juneau	Alaska	2704.0	7003	550.7	1426.0	3254.7	8430.0	32255
2	3	Wrangell	Alaska	2556.0	6620	920.6	2384.0	3476.6	9004.0	2127
3	4	Anchorage	Alaska	1706.8	4421	239.9	621.0	1946.7	5042.0	291247
4	5	Tribune	Kansas	778.2	2016	0.0	0.0	778.2	2016.0	1182

In [ ]:
```
from sklearn.preprocessing import OneHotEncoder
ohe = OneHotEncoder()
cat_enc_ohe = ohe.fit_transform(df[['State ']])
cat_enc_ohe
```

Out[ ]:
```
<150x39 sparse matrix of type '<class 'numpy.float64'>'
        with 150 stored elements in Compressed Sparse Row format>
```

In [ ]:
```
cat_enc_ohe.todense()[0:10]
```

Out[ ]:
```
matrix([[0., 1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0.],
        [0., 1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0.],
        [0., 1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0.],
        [0., 1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0.],
        [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 1., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0.],
        [0., 0., 0., 0., 0., 0., 1., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0.],
        [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0.],
        [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 1., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0.],
        [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 1., 0., 0., 0., 0.],
        [0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 1., 0., 0., 0.,
         0., 0., 0., 0., 0., 0., 0.]])
```

In [ ]:
```python
# Добавление отдельной колонки, признака пустых значений
pd.get_dummies(df[['State ']], dummy_na=True).head()
```

Out[ ]:

	State _Alabama	State _Alaska	State _Arizona	State _Arkansas	State _California	State _Colorado	State _Florida	State _Georgia
0	False	True	False	False	False	False	False	False
1	False	True	False	False	False	False	False	False
2	False	True	False	False	False	False	False	False
3	False	True	False	False	False	False	False	False
4	False	False	False	False	False	False	False	False

5 rows × 40 columns

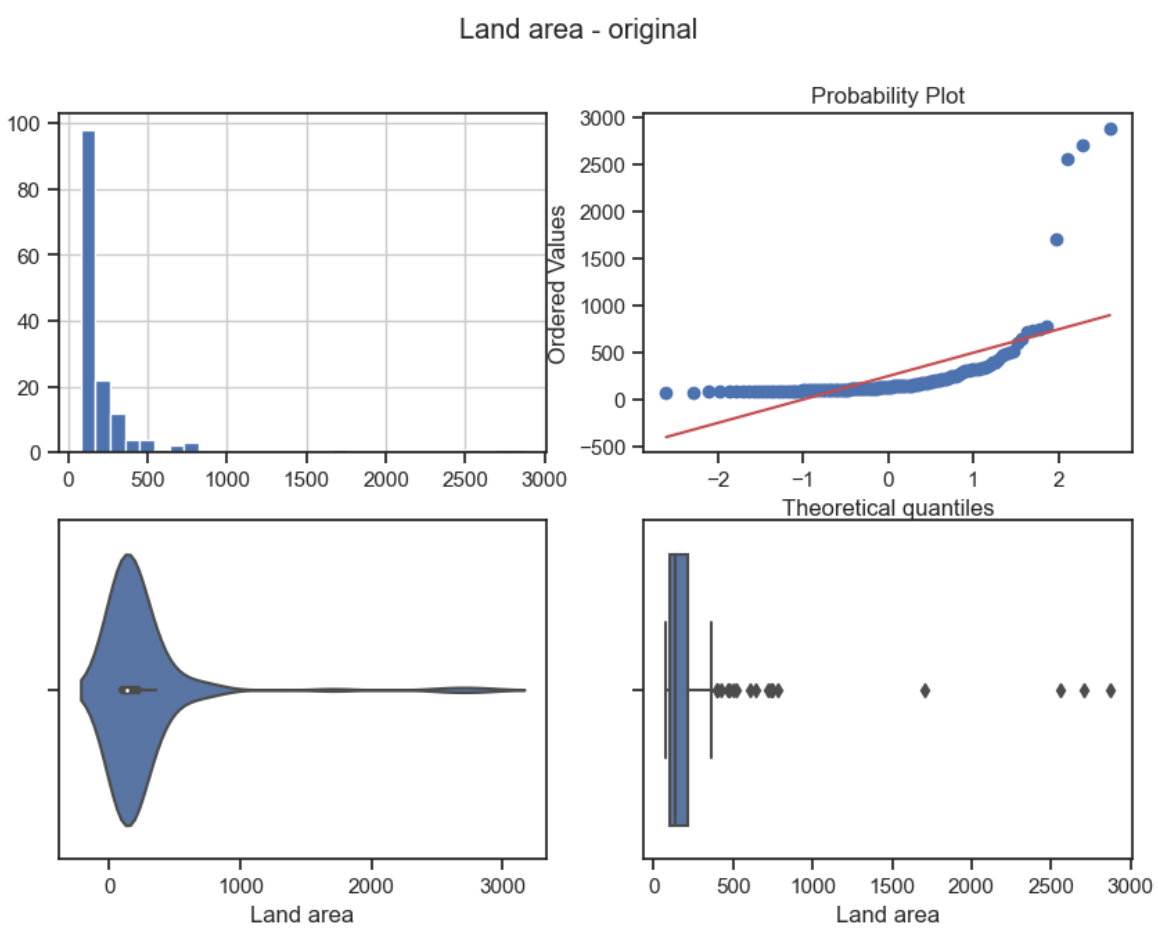
Задача 2

Для набора данных для одного (произвольного) числового признака проведите обнаружение и удаление выбросов на основе межквартильного размаха.

In [ ]:
```
def diagnostic_plots(df, variable, title):
    fig, ax = plt.subplots(figsize=(10,7))
    # гистограмма
    plt.subplot(2, 2, 1)
    df[variable].hist(bins=30)
    ## Q-Q plot
    plt.subplot(2, 2, 2)
    stats.probplot(df[variable], dist="norm", plot=plt)
    # ящик с усами
    plt.subplot(2, 2, 3)
    sns.violinplot(x=df[variable])
    # ящик с усами
    plt.subplot(2, 2, 4)
    sns.boxplot(x=df[variable])
    fig.suptitle(title)
    plt.show()
```

In [ ]:
```
diagnostic_plots(df, 'Land area', 'Land area - original')
# diagnostic_plots(df, 'km2', 'km2 - original')
# diagnostic_plots(df, 'Water area', 'Water area - original')
# diagnostic_plots(df, 'km2.1', 'km2.1 - original')
# diagnostic_plots(df, 'Total area', 'Total area - original')
# diagnostic_plots(df, 'km2.2', 'km2.2 - original')
# diagnostic_plots(df, 'Population', 'Population - original')
```

```
C:\Users\hae19\AppData\Local\Temp\ipykernel_26196\223523601.py:4: MatplotlibDepre
cationWarning: Auto-removal of overlapping axes is deprecated since 3.6 and will
be removed two minor releases later; explicitly call ax.remove() as needed.
  plt.subplot(2, 2, 1)
```



In [ ]:
```python
# Тип вычисления верхней и нижней границы выбросов
from enum import Enum
class OutlierBoundaryType(Enum):
    SIGMA = 1
    QUANTILE = 2
    IRQ = 3

# Функция вычисления верхней и нижней границы выбросов
def get_outlier_boundaries(df, col, outlier_boundary_type: OutlierBoundaryType):
    if outlier_boundary_type == OutlierBoundaryType.SIGMA:
        K1 = 3
        lower_boundary = df[col].mean() - (K1 * df[col].std())
        upper_boundary = df[col].mean() + (K1 * df[col].std())

    elif outlier_boundary_type == OutlierBoundaryType.QUANTILE:
        lower_boundary = df[col].quantile(0.05)
        upper_boundary = df[col].quantile(0.95)

    elif outlier_boundary_type == OutlierBoundaryType.IRQ:
        K2 = 1.5
        IQR = df[col].quantile(0.75) - df[col].quantile(0.25)
        lower_boundary = df[col].quantile(0.25) - (K2 * IQR)
        upper_boundary = df[col].quantile(0.75) + (K2 * IQR)

    else:
        raise NameError('Unknown Outlier Boundary Type')

    return lower_boundary, upper_boundary
```

In [ ]:
```python
lower_boundary, upper_boundary = get_outlier_boundaries(df, 'Land area', Outlier
# Флаги для удаления выбросов
```

```
outliers_temp = np.where(df['Land area'] > upper_boundary, True,
                         np.where(df['Land area'] < lower_boundary, True, Fal
# Удаление данных на основе флага
data_trimmed = df.loc[~(outliers_temp), ]
title = 'Поле-{}, метод-{}, строк-{}'.format('Land area', OutlierBoundaryType.IF
diagnostic_plots(df, 'Land area', 'Land area - original')
diagnostic_plots(data_trimmed, 'Land area', title)
```

```
C:\Users\hae19\AppData\Local\Temp\ipykernel_26196\223523601.py:4: MatplotlibDepre
cationWarning: Auto-removal of overlapping axes is deprecated since 3.6 and will
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  plt.subplot(2, 2, 1)
```

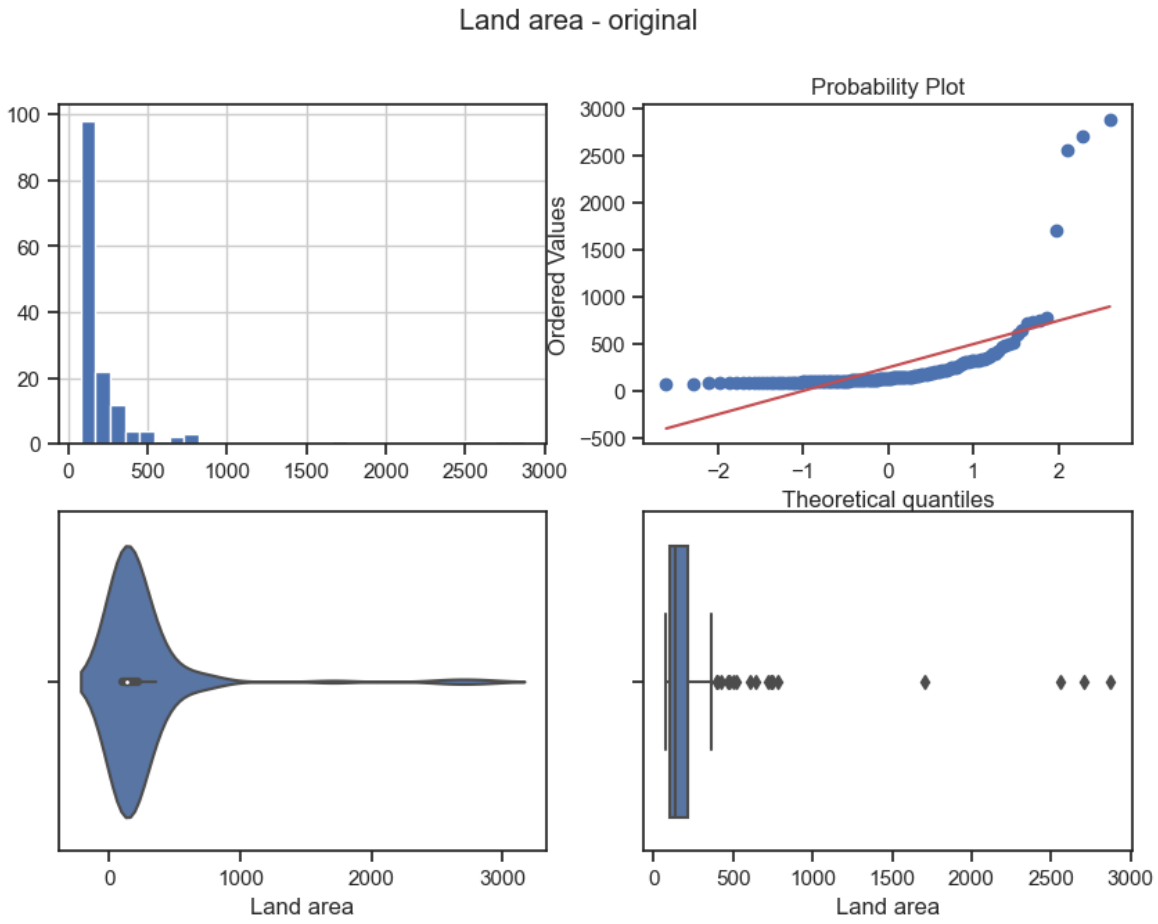


```
C:\Users\hae19\AppData\Local\Temp\ipykernel_26196\223523601.py:4: MatplotlibDepre
cationWarning: Auto-removal of overlapping axes is deprecated since 3.6 and will
be removed two minor releases later; explicitly call ax.remove() as needed.
  plt.subplot(2, 2, 1)
```

Поле-Land area, метод-OutlierBoundaryType.IRQ, строк-133