```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
sns.set(style="ticks")
data_url = "http://lib.stat.cmu.edu/datasets/boston"
raw_df = pd.read_csv(data_url, sep="\s+", skiprows=22, header=None)
data = np.hstack([raw_df.values[::2, :], raw_df.values[1::2, :2]])
target = raw_df.values[1::2, 2]
```

```
raw_df.rename(columns={0: 'CRIM'}, inplace=True)
raw_df.rename(columns={1: 'ZN'}, inplace=True)
raw_df.rename(columns={2: 'INDUS'}, inplace=True)
raw_df.rename(columns={3: 'CHAS'}, inplace=True)
raw_df.rename(columns={4: 'NOX'}, inplace=True)
raw_df.rename(columns={5: 'RM'}, inplace=True)
raw_df.rename(columns={6: 'AGE'}, inplace=True)
raw_df.rename(columns={7: 'DIS'}, inplace=True)
raw_df.rename(columns={8: 'RAD'}, inplace=True)
raw_df.rename(columns={9: 'TAX'}, inplace=True)
raw_df.rename(columns={10: 'PTRATIO'}, inplace=True)
# Первые 5 строк датасета
raw_df.head()
```

```
        CRIM     ZN  INDUS  CHAS    NOX     RM   AGE     DIS  RAD  
TAX  \
0    0.00632  18.00   2.31   0.0  0.538  6.575  65.2  4.0900  1.0  
296.0   
1  396.90000   4.98  24.00   NaN    NaN    NaN   NaN     NaN  NaN  
NaN   
2    0.02731   0.00   7.07   0.0  0.469  6.421  78.9  4.9671  2.0  
242.0   
3  396.90000   9.14  21.60   NaN    NaN    NaN   NaN     NaN  NaN  
NaN   
4    0.02729   0.00   7.07   0.0  0.469  7.185  61.1  4.9671  2.0  
242.0   

   PTRATIO  
0     15.3  
1      NaN  
2     17.8  
3      NaN  
4     17.8  
```

```
# Размер датасета - 1012 строк, 11 колонок
raw_df.shape
```

```
(1012, 11)
```

```
total_count = raw_df.shape[0]
print('Всего строк: {}'.format(total_count))
```

```
Всего строк: 1012
```

```
# Список колонок
raw_df.columns
```

```
Index(['CRIM', 'ZN', 'INDUS', 'CHAS', 'NOX', 'RM', 'AGE', 'DIS', 
'RAD', 'TAX',
       'PTRATIO'],
      dtype='object')
```

```
# Проверим наличие пустых значений
# Цикл по колонкам датасета
for col in raw_df.columns:
    # Количество пустых значений - все значения заполнены
    temp_null_count = raw_df[raw_df[col].isnull()].shape[0]
    print('{} - {}'.format(col, temp_null_count))
```

```
CRIM - 0
ZN - 0
INDUS - 0
CHAS - 506
NOX - 506
RM - 506
AGE - 506
DIS - 506
RAD - 506
TAX - 506
PTRATIO - 506
```

```
# Список колонок с типами данных
raw_df.dtypes
```

```
CRIM       float64
ZN         float64
INDUS      float64
CHAS       float64
NOX        float64
RM         float64
AGE        float64
DIS        float64
RAD        float64
TAX        float64
PTRATIO    float64
dtype: object
```

```
raw_df.describe()
```

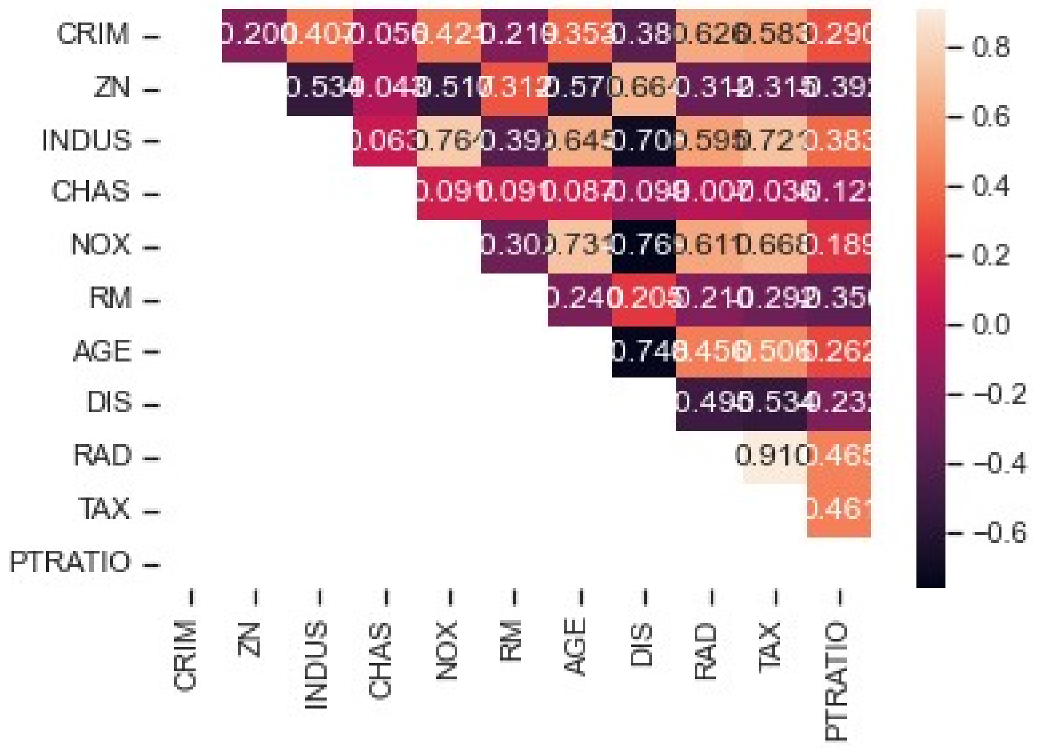
```
              CRIM           ZN        INDUS        CHAS        
NOX  \
count  1012.000000  1012.000000  1012.000000  506.000000  506.000000

mean    180.143778    12.008350    16.834792    0.069170    0.554695

std     188.132839    17.250728     9.912616    0.253994    0.115878

min       0.006320     0.000000     0.460000    0.000000    0.385000

25%       0.257830     0.000000     8.375000    0.000000    0.449000

50%      24.021000     7.240000    18.100000    0.000000    0.538000

75%     391.435000    16.780000    21.890000    0.000000    0.624000

max     396.900000   100.000000    50.000000    1.000000    0.871000
```

```
               RM         AGE         DIS         RAD         TAX  
PTRATIO
count  506.000000  506.000000  506.000000  506.000000  506.000000  
506.000000
mean     6.284634   68.574901    3.795043    9.549407  408.237154  
18.455534
std      0.702617   28.148861    2.105710    8.707259  168.537116  
2.164946
min      3.561000    2.900000    1.129600    1.000000  187.000000  
12.600000
25%      5.885500   45.025000    2.100175    4.000000  279.000000  
17.400000
50%      6.208500   77.500000    3.207450    5.000000  330.000000  
19.050000
75%      6.623500   94.075000    5.188425   24.000000  666.000000  
20.200000
max      8.780000  100.000000   12.126500   24.000000  711.000000  
22.000000
```

```
# Определим уникальные значения для целевого признака
raw_df['TAX'].unique()
```

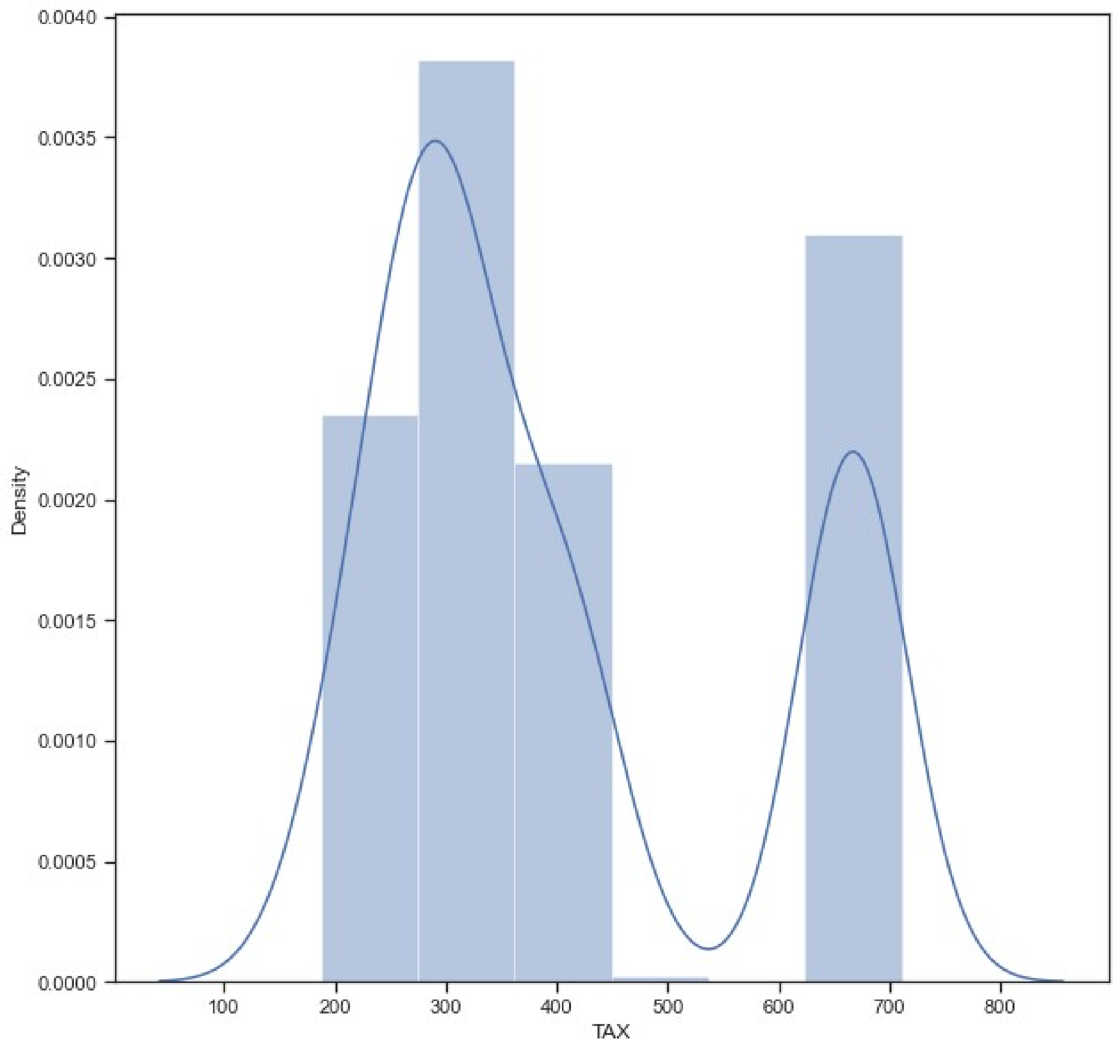
```
array([296.,  nan, 242., 222., 311., 307., 279., 252., 233., 243., 
469.,
       226., 313., 256., 284., 216., 337., 345., 305., 398., 281., 
247.,
       270., 276., 384., 432., 188., 437., 403., 193., 265., 255., 
329.,
       402., 348., 224., 277., 300., 330., 315., 244., 264., 223., 
254.,
       198., 285., 241., 293., 245., 289., 358., 304., 287., 430., 
422.,
       370., 352., 351., 280., 335., 411., 187., 334., 666., 711.,
391.,
       273.])

# Удаление строк, содержащих пустые значения
raw_df_2 = raw_df.dropna(axis=0, how='any')
(raw_df.shape, raw_df_2.shape)

((1012, 11), (506, 11))

raw_df_2.head()

      CRIM    ZN  INDUS  CHAS    NOX     RM   AGE     DIS  RAD    TAX  
PTRATIO
0  0.00632  18.0   2.31   0.0  0.538  6.575  65.2  4.0900  1.0  296.0  
15.3
2  0.02731   0.0   7.07   0.0  0.469  6.421  78.9  4.9671  2.0  242.0  
17.8
4  0.02729   0.0   7.07   0.0  0.469  7.185  61.1  4.9671  2.0  242.0  
17.8
6  0.03237   0.0   2.18   0.0  0.458  6.998  45.8  6.0622  3.0  222.0  
18.7
8  0.06905   0.0   2.18   0.0  0.458  7.147  54.2  6.0622  3.0  222.0  
18.7

# Проверим наличие пустых значений
# Цикл по колонкам датасета
for col in raw_df_2.columns:
    # Количество пустых значений - все значения заполнены
    temp_null_count = raw_df_2[raw_df_2[col].isnull()].shape[0]
    print('{} - {}'.format(col, temp_null_count))

CRIM - 0
ZN - 0
INDUS - 0
CHAS - 0
NOX - 0
RM - 0
AGE - 0
DIS - 0
RAD - 0
TAX - 0
PTRATIO - 0

# Вывод значений в ячейках
mask = np.zeros_like(raw_df_2.corr(), dtype=np.bool)
mask[np.tril_indices_from(mask)] = True
sns.heatmap(raw_df_2.corr(), mask=mask, annot=True, fmt='.3f')
# Как мы можем видеть RAD и TAX имеют почти прямую зависимость, 
поэтому можно сделать вывод, чем выше индекс доступности
# к радиальным магистралям, тем выше полная стоимость недвижимости.
```

```
C:\Users\7272~1\AppData\Local\Temp/ipykernel_18912/3416543911.py:2:
DeprecationWarning: `np.bool` is a deprecated alias for the builtin
`bool`. To silence this warning, use `bool` by itself. Doing this will
not modify any behavior and is safe. If you specifically wanted the
numpy scalar type, use `np.bool_` here.
Deprecated in NumPy 1.20; for more details and guidance:
https://numpy.org/devdocs/release/1.20.0-notes.html#deprecations
  mask = np.zeros_like(raw_df_2.corr(), dtype=np.bool)

<AxesSubplot:>
```



```
# Гистограмма
fig, ax = plt.subplots(figsize=(10,10))
sns.distplot(raw_df['TAX'])
```

```
C:\Users\Админ\AppData\Local\Programs\Python\Python39\lib\site-
packages\seaborn\distributions.py:2619: FutureWarning: `distplot` is a
deprecated function and will be removed in a future version. Please
adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for
histograms).
  warnings.warn(msg, FutureWarning)

<AxesSubplot:xlabel='TAX', ylabel='Density'>
```


0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Density
100
200
300
400
500
600
700
800
TAX