```
import numpy as np
import collections
import scipy
import matplotlib.pyplot as plt
import seaborn as sns


def find_modes(sample):
  if (len(set(sample)) == len(sample)):
    return sample
  else:
    dict_sample = {}
    for i in sample:
      if i in dict_sample:
        dict_sample[i] += 1
      else:
        dict_sample[i] = 1
    mode = [(0, 0)]
    for i in dict_sample.keys():
      if dict_sample[i] == mode[0][1]:
        mode.append((i, dict_sample[i]))
      elif dict_sample[i] > mode[0][1]:
        mode = []
        mode.append((i, dict_sample[i]))
    return mode


def averages_density(x):
    return 1 / np.sqrt(2 * np.pi) * np.exp(-0.5 * ((x - 1) / 0.2) ** 2)


def median_density(x):
    return 67603900 * (1 - np.exp(-x)) ** 12 * (np.exp(-x)) ** 13
```

Генерация выборки

```
sample = np.random.exponential(size=25)
sorted_sample = sorted(sample)
```

Моды

```
modes = find_modes(sorted_sample)
```

Медиана

```
median = np.median(sorted_sample)
print(median)
```

```
0.7901726678969572
```

Размах

```
sample_range = sorted_sample[-1] - sorted_sample[0]
print(sample_range)
```

```
4.295858825449476
```

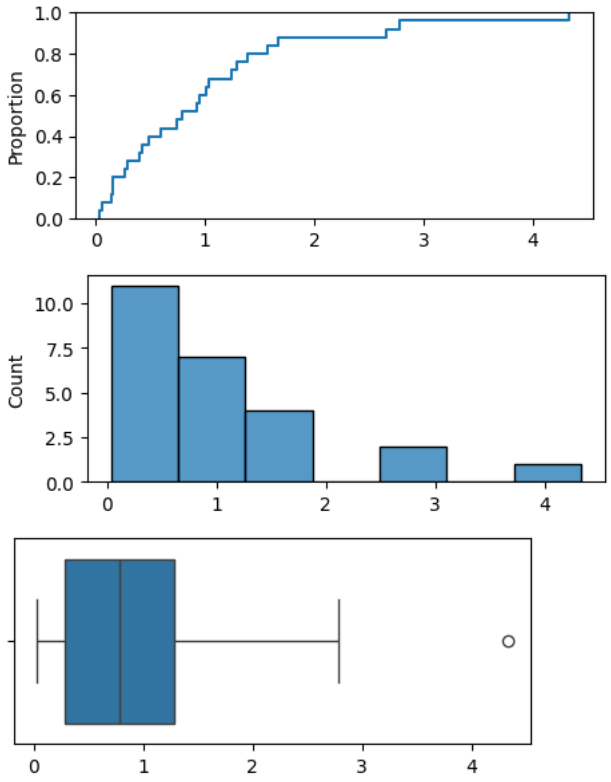
Коэффициент ассимметрии

```
asymmetry_coefficient = scipy.stats.skew(sample)
print(asymmetry_coefficient)
```

```
1.7309923314260969
```

```
fig, ax = plt.subplots(figsize=(5, 2))
sns.ecdfplot(x = sample, ax = ax)
fig1, ax = plt.subplots(figsize=(5, 2))
sns.histplot(x = sample)
fig2, ax = plt.subplots(figsize=(5, 2))
sns.boxplot(x = sample)
```

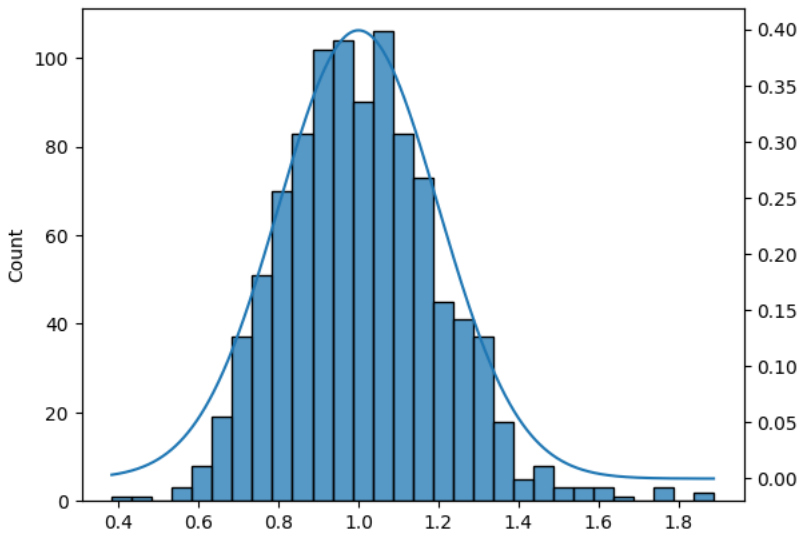
```
<Axes: >
```

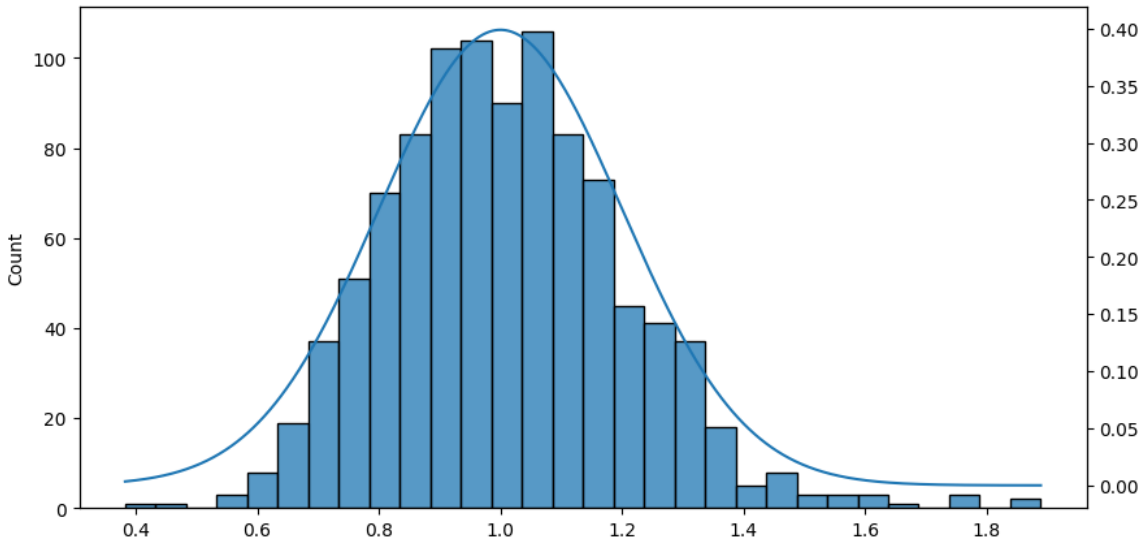


Магия с бутстрапом

Для n = 1000

```
bootstrap_samples = [np.random.choice(np.array(sample), 25) for i in range(1000)]
bootstrap_samples_averages = np.array([np.average(array) for array in bootstrap_samples])

fig = plt.figure()
ax1 = fig.add_subplot()
ax2 = ax1.twinx()

x = np.linspace(np.min(bootstrap_samples_averages), np.max(bootstrap_samples_averages), 1000)
y = averages_density(x)

sns.histplot(x=bootstrap_samples_averages, ax=ax1)
sns.lineplot(x=x, y=y, ax=ax2)

plt.show()
```



Чтобы изменить содержимое ячейки, дважды нажмите на нее (или выберите "Ввод")

```
bootstrap_samples_median = np.array([np.median(array) for array in bootstrap_samples])

fig_s = plt.figure(figsize=(10, 5))
ax1_s = fig_s.add_subplot(111)
ax2_s = ax1_s.twinx()

x_s = np.linspace(np.min(bootstrap_samples_median), np.max(bootstrap_samples_median), 1000)
y_s = median_density(x)

sns.histplot(x=bootstrap_samples_averages, ax=ax1_s)
sns.lineplot(x=x, y=y, ax=ax2_s)

plt.show()
```