Exercise 8)

Exercise 13 from book

a)

We take r subsets with replacement of the data length n, and calculate the emperical mean r times. Then, for each subset, we subtract the mean of all the means from the mean of each subset, and count how many of theese numbers are within the interval [a,b]

b)

In [ ]:

```python
import numpy as np
x = np.array([56, 101, 78, 67, 93, 87, 64, 72, 80, 69])

r = 100000

X = [np.random.choice(x, len(x)) for _ in range(r)]
X = np.stack(X)
emp_mean = X.mean(axis=1)
mean = emp_mean.mean()
p = emp_mean - mean
p = np.count_nonzero(abs(p) < 5) / r
```

In [ ]:

```python
p
```

Out[ ]:

```
0.76581
```

Exercise 15 from book

In [ ]:

```python
n, r = 15, 10000
x = [5, 4, 9, 6, 21, 17, 11, 20, 7, 10, 21, 15, 13, 16, 8]
X = [np.random.choice(x, n) for _ in range(r)]
X = np.stack(X)
s2 = X.var(axis=1)

len(s2)

s2.var()
```

Out[ ]:

```
51.433067181649385
```

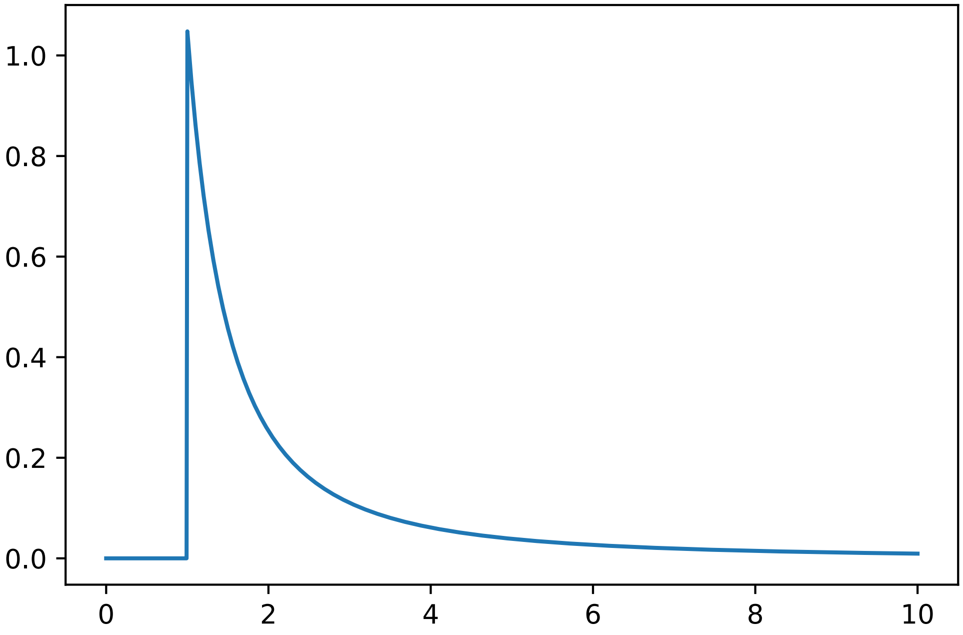
Exercise 8.3

In [ ]:

```
from scipy.stats import pareto as sci_pareto
import seaborn as sns
import pandas as pd

def pareto(beta, k):
    return sci_pareto(b=k, scale=beta)

def bootstrap(data, stat_func=lambda x: np.median, size = 1000):
    X = [np.random.choice(data, len(data)) for _ in range(size)]
    stat = stat_func(X, axis=1)
    return stat.var()

x = np.linspace(0,10,1000)
sns.lineplot(x=x, y=pareto(1, 1.05).pdf(x))
```

Out[ ]:

```
<AxesSubplot:>
```



In [ ]:

```
sample = pareto(1, 1.05).rvs(size=200)
```

In [ ]:

```
mean, median = sample.mean(), np.median(sample)
var_mean = bootstrap(sample, np.mean)
var_median = bootstrap(sample, np.median)
```

In [ ]:

```
df = pd.DataFrame({'stat': [mean, median], 'var':[var_mean, var_median]}, inde
```

In [ ]:

```
df
```

Out[ ]:

	stat	var
mean	4.141244	0.229267
median	1.749461	0.013682

The Precision of the median is much better