

## 9th exercises for SIM'2021

### Ex. 1

Use inversion method from 8.1.1 and derive a formula for drawing random numbers from exponential distribution  $f(y) = \lambda \exp(-\lambda y)$ . Create 1,000 numbers from  $\text{Exp}(3)$  and draw histogram or box-and-whiskers plot.

### Ex. 2

a) Create two random data from normal distribution. Use Eq. (8.2) and the fact that if  $X \sim \mathcal{N}(0, 1)$  then  $Y = \sigma X + \mu \sim \mathcal{N}(\mu, \sigma^2)$ . Both data should have  $n = 1,000$ , but  $\mathbf{y}_1$  with  $\mu = 2, \sigma^2 = 2$  and  $\mathbf{y}_2$  with  $\mu = 4, \sigma^2 = 4$ .

b) Compute the difference between medians,  $m = \text{median}(\mathbf{y}_2) - \text{median}(\mathbf{y}_1)$ . Use bootstrap to resample from both datasets and compute the (bootstrap) 95 % confidence interval for  $m$ .

### Ex. 3

Let's invent our own "order test". We have array of integers  $\mathbf{y} = (1, 2, 3, 16, 5, 12, 13, 11, 9, 10, 8, 6, 7, 14, 15, 4, 17, 18, 19, 20)$ . It seems like it has some kind of order, but can it be purely by accident? We could compute e.g. a measure of order as

$$t = \sum_i^{n-1} I(y_i, y_{i+1}), \text{ where } I(a, b) = \begin{cases} 1, & \text{if } a < b \\ -1, & \text{if } a > b \end{cases}$$

Test using permutation test and the statistics  $t$  if the array has order or is randomly ordered.