# STATISTICAL COMPUTATIONAL METHODS

## Seminar Nr. 3

## Computer Simulations of Random Variables and Monte Carlo Studies; Inverse Transform Method, Rejection Method, Special Methods

**1.**
**a)** Use the DITM to generate a $Geo(p), p \in (0,1)$, variable.

**b)** Then use that to generate a $NB(n,p), n \in \mathbb{N}, p \in (0,1)$, variable.

**2.**
**a)** Use the ITM to generate an $Exp(\lambda), \lambda > 0$, variable.

**b)** Then use that to generate a $Gam(\alpha, \lambda), \alpha \in \mathbb{N}, \lambda > 0$, variable (a Gamma $Gam(\alpha, \lambda)$ variable is the sum of $\alpha$ independent $Exp(1/\lambda)$ variables).

**3.** Use a special method to generate a $Poiss(\lambda), \lambda > 0$, variable.

**4** Use the rejection method to approximate $\pi$ (see Example 7.2, Lecture 4).

**5. Application: Forecasting for new software release**
An IT company is testing a new software to be released. Every day, software engineers find a random number of errors and correct them. On each day $t$, the number of errors found, $X_t$, has a Poisson($\lambda_t$) distribution, where the parameter $\lambda_t$ is the lowest number of errors found during the previous $k$ days,

$$\lambda_t = \min\{X_{t-1}, X_{t-2}, \ldots, X_{t-k}\}.$$

If some errors are still undetected after $tmax$ days (i.e. if not all errors are found in $tmax - 1$ days), the software is withdrawn and goes back to development. Generate a Monte Carlo study to estimate
a) the time it will take to find all errors;
b) the total number of errors found in this new release;
c) the probability that the software will be sent back to development.
(Try $k = 4, [X_{t-1}, X_{t-2}, X_{t-3}, X_{t-4}] = [10, 5, 7, 6], tmax = 10.$)