# Lab Nr. 4, Probability and Statistics

## Numerical characteristics of random variables;
## Random Number Generators; RND;
## Computer Simulations of Discrete Random Variables

**1.** Function **rnd** in Statistics Toolbox; special functions **rand** and **randn**.

**2.** Using a $\mathcal{U}(0,1)$ (standard uniform) random number generator, generate the common discrete probability distributions:

**a. Bernoulli Distribution** $Bern(p)$, with parameter $p \in (0,1)$: $X \begin{pmatrix} 0 & 1 \\ 1-p & p \end{pmatrix}$;

**b. Binomial Distribution** $Bino(p)$,with parameters $n \in \mathbb{N}, p \in (0,1)$: $X \begin{pmatrix} k \\ C_n^k p^k q^{n-k} \end{pmatrix}_{k=\overline{0,n}}$;

**Hint:** A binomial $Bino(n,p)$ variable is the sum of $n$ independent $Bern(p)$ variables;

**c. Geometric Distribution** $Geo(p)$, with parameter $p \in (0,1)$: $X \begin{pmatrix} k \\ pq^k \end{pmatrix}_{k \in \mathbb{N}}$;

**Hint:** A geometric $Geo(p)$ variable represents the number of failures (i.e. the number of Bernoulli trials that ended up being failures) needed to get the first success;

**d. Pascal Distribution** $NB(n,p)$ with parameters $n \in \mathbb{N}, p \in (0,1)$: $X \begin{pmatrix} k \\ C_{n+k-1}^k p^n q^k \end{pmatrix}_{k \in \mathbb{N}}$;

**Hint:** A Pascal $NB(n,p)$ variable is the sum of $n$ independent $Geo(p)$ variables;

**3.** Numerical Characteristics of Random Variables: in *Statistics Toolbox* **stat**

The means and variances of the following distributions (fill in the table):

| **Distribution** | **Notation** | **Mean** $E(X)$ | **Variance** $V(X)$ |
|---|---|---|---|
| discrete uniform | $U(m)$ | | |
| binomial | $B(n,p)$ | | |
| hypergeometric | $H(N,n_1,n)$ | | |
| Poisson | $P(\lambda)$ | | |
| Pascal (Neg. Bin.) | $NB(n,p)$ | | |
| geometric | $G(p)$ | | |
| uniform | $U(a,b)$ | | |
| normal | $N(\mu,\sigma)$ | | |
| gamma | $Ga(a,b)$ | | |
| exponential | $Exp(\lambda)$ | | |
| beta | $\beta(a,b)$ | | |
| Student | $T(n)$ | | |
| chi squared | $\chi^2(n)$ | | |
| Fisher | $F(m,n)$ | | |