Lab Nr. 4, Probability and Statistics

Random number generators; RND; Computer simulations of discrete random variables Numerical characteristics of 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	$U(m)$	[M,V] = unidstat(N)	
Binomial	$B(n,p)$	[M,V] = binostat(N,P)	
Hypergeometric	$H(N,n_1,n)$	[MN,V] = hygestat(M,K,N)	
Poisson	$P(\lambda)$	M = poisstat(lambda) [M,V] = poisstat(lambda)	
Pascal (Neg. Bin.)	$NB(n,p)$	[M,V] = nbinstat(R,P)	
Geometric	$G(p)$	[M, V] = geostat(P)	
Uniform	$U(a,b)$	[M,V] = unifstat(A,B)	
Normal	$N(\mu,\sigma)$	[M,V] = normstat(mu,sigma)	
Gamma	$Ga(a,b)$	[M,V] = gamstat(A,B)	
Exponential	$Exp(\lambda)$	[M,V] = expstat(mu)	
Beta	$\beta(a,b)$	[M,V] = betastat(A,B)	
Student	$T(n)$	[M,V] = tstat(nu)	
Chi squared	$\chi^2(n)$	[M,V] = chi2stat(NU)	
Fisher	$F(m,n)$	[M,V] = fstat(V1,V2)	