Important Discrete Random Variables

Name	Description	Assumptions	Distribution	Mean	Variance
Binomial	The number of successes in n Bernoulli trial.	1. Each trial is either a success or a failure. 2. The probability of a success p is constant for each trial. 3. All n trials are independent.	$P(X=k)=\binom{n}{k}p^k q^{n-k}$ $k=0,1,2,\ldots,n$ $q=1-p$	np	npq
Poisson	The number of times an event occurs in a given unit of time or space. It can be used to approximate a Binomial when n is large and $\lambda=np$ is small.	1. The average rate of occurrences ($\lambda>0$) is known. 2. Events occur independently.	$P(X=k)=\frac{e^{-\lambda}\lambda^k}{k!}$ $k=0,1,2,\ldots$	λ	λ
Geometric	The number of failures prior to the first success in a sequence of Bernoulli trials.	1. Each trial is either a success or a failure. 2. The probability of a success p is constant for each trial. 3. All trials are independent. 4. The sequence of trials ends after the first success.	$P(X=k)=pq^k$ $k=0,1,2,\ldots$ $q=1-p$	$\frac{q}{p}$	$\frac{q}{p^2}$
Negative Binomial	The number of failures prior to the rth success in a sequence of Bernoulli trials.	1. Each trial is either a success or a failure. 2. The probability of a success p is constant for each trial. 3. All trials are independent. 4. The sequence of trials ends after the rth success.	$P(X=k)=\binom{k+r-1}{k}p^r q^k$ $k=0,1,2,\ldots$ $q=1-p$	$\frac{rq}{p}$	$\frac{rq}{p^2}$
Hypergeometric	The number of successes in a sample of size n.	Sampling is done without replacement from a finite set of size N containing M successes and $N-M$ failures. We let $p=M/N$ and $q=1-p$.	$P(X=k)=\frac{\binom{M}{k}\binom{N-M}{n-k}}{\binom{N}{n}}$ $\max(0,n+M-N)\leq k$ $k\leq\min(n,M)$	np	$npq\left(\frac{N-n}{N-1}\right)$

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