Formally…

Let X be the total number of flips needed, Y be the flips after the second.

$\mathbb{P}(Y = k | X \geq 3) =?$

…

Which is $p_X(k)$.

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Poisson Distribution

$X \sim \text{Poi}(\lambda)$

Let λ be the average number of incidents in a time interval.

X is the number of incidents seen in a particular interval.

Support $\mathbb{N}$

$p_X(k) = \frac{\lambda^k e^{-\lambda}}{k!}$ (for $k \in \mathbb{N}$)

$F_X(k) = e^{-\lambda} \sum_{i=0}^{\lfloor k \rfloor} \frac{\lambda^i}{i!}$

$\mathbb{E}[X] = \lambda$

$\text{Var}(X) = \lambda$

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Try it

More generally, run independent trials with probability p. How many trials do you need for r successes?

What's the pmf?

What's the expectation and variance (hint: linearity)

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Zoo!

$X \sim \mathbf{Unif}(a,b)$	$X \sim \mathbf{Ber}(p)$	$X \sim \mathbf{Bin}(n,p)$	$X \sim \mathbf{Geo}(p)$
$p_X(k) = \frac{1}{b-a+1}$ $\mathbb{E}[X] = \frac{a+b}{2}$ $\mathbf{Var}(X) = \frac{(b-a)(b-a+2)}{12}$	$p_X(0) = 1-p;$ $p_X(1) = p$ $\mathbb{E}[X] = p$ $\mathbf{Var}(X) = p(1-p)$	$p_X(k) = \binom{n}{k} p^k (1-p)^{n-k}$ $\mathbb{E}[X] = np$ $\mathbf{Var}(X) = np(1-p)$	$p_X(k) = (1-p)^{k-1} p$ $\mathbb{E}[X] = \frac{1}{p}$ $\mathbf{Var}(X) = \frac{1-p}{p^2}$

$X \sim \mathbf{NegBin}(r,p)$	$X \sim \mathbf{HypGeo}(N,K,n)$	$X \sim \mathbf{Poi}(\lambda)$
$p_X(k) = \binom{k-1}{r-1} p^r (1-p)^{k-r}$ $\mathbb{E}[X] = \frac{r}{p}$ $\mathbf{Var}(X) = \frac{r(1-p)}{p^2}$	$p_X(k) = \frac{\binom{K}{k}\binom{N-K}{n-k}}{\binom{N}{n}}$ $\mathbb{E}[X] = n\frac{K}{N}$ $\mathbf{Var}(X) = \frac{K(N-K)(N-n)}{N^2(N-1)}$	$p_X(k) = \frac{\lambda^k e^{-\lambda}}{k!}$ $\mathbb{E}[X] = \lambda$ $\mathbf{Var}(X) = \lambda$

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