Stochastic Dynamical Models - Cheatsheet

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1 About Exponential Distribution

1.1 Basic information:

Let $X \sim Exp(\lambda), \lambda > 0$,

- PDF : $f_X(x) = \lambda e^{-\lambda x} 1_{[0,+\infty[}(x)$;
- CDF : $F_X(x) = P(X \leq x) = (1 - e^{-\lambda x}) 1_{[0,+\infty[}(x)$;
- $E[X] = 1/\lambda$ and $Var(X) = 1/\lambda^2$;

1.2 Minimum of independent-exponentially-distributed random variables:

Let $X_1, ..., X_n$ **independent** random variables such that : $\forall i \in \{1, ..., n\}, X_i \sim Exp(\lambda_i)$. Then :

$$min(X_1, ..., X_n) \sim Exp(\lambda_1 + ... + \lambda_n)$$

1.3 Sum of i.i.d-exponentially-distributed random variables:

Let $X_1, ..., X_n$ **i.i.d** $\sim Exp(\lambda), \lambda > 0$. Then :

$$X_1 + ... + X_n \sim \Gamma(n, \lambda).$$

Where $X \sim \Gamma(n, \lambda), n, \lambda > 0$ means :

$$\text{PDF : } f_X(x) = \frac{\lambda}{\Gamma(n)} e^{-\lambda x} (\lambda x)^{n-1} 1_{]0,+\infty[}(x).$$

Where $\forall n \geq 1, \Gamma(n) = (n-1)!$.