

What if $k \in (q, \infty)$? is the top pdf legal and the bottom pdf legal? yes

$$\int_0^{\infty} \frac{\lambda^k e^{-\lambda t} t^{k-1}}{\Gamma(k)} dt = 1 \quad \text{and} \quad \sum_{t=0}^{\infty} \frac{\Gamma(k+t)}{\Gamma(k) t!} (1-p)^t p^k = 1$$

Which means ... these are rx's

$$X \sim \text{Gamma}(\alpha, \beta) := \frac{\beta^\alpha}{\Gamma(\alpha)} t^{\alpha-1} e^{-\beta t} \quad t \geq 0$$

$$X \sim \text{Neg Bin}(k, p)$$

Transformation for discrete rx's

$$X \sim \text{Bern}(p), Y = X+3 \sim \begin{cases} 3 & \text{w.p. } 1-p \\ 4 & \text{w.p. } p \end{cases} \quad p^x (1-p)^{1-x} \quad x \in \{0, 1\}$$

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How do I express the transform if $Y = g(X) \sim P_Y(Y) = P_X(g^{-1}(Y))$ Pmf using the original pmf

$$= P_X(g^{-1}(Y)) \rightarrow g^{-1}(Y) = X$$

is this formula general? No, this is only the formula for g invertible. If g non-invertible.

$$X \sim U(1, 2, \dots, 10) = \frac{1}{10} \quad x \in \{1, 2, \dots, 10\}$$

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$X_1, X_2, \dots \sim \text{iid Exp}(\lambda)$

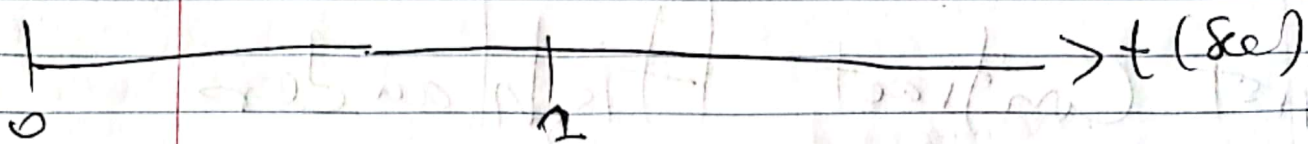
$T_k \sim \text{Erlang}(k, \lambda)$, $N \sim \text{poisson}(\lambda)$

$$P(T_k > 1)$$

$$= 1 - F_{T_k}(1) = Q(k, \lambda)$$

$$F_N(x) = Q(k+1, \lambda)$$

$\Rightarrow 1 - F_{T_k}(1) = F_N(k-1)$ "poisson process"



$$\{T_5 > 1\} = \{x_1 + x_2 + x_3 + x_4 < 1\} \cup \{x_1 + x_2 + x_3 < 1\} \cup \{x_1 + x_2 < 1\} \cup \{x_1 < 1\} \cup \{x_1 > 1\}$$

$$1 - F_{T_5}(1) \quad F_N(4)$$

$$= \{N=4\} \cup \{N=3\} \cup \{N=2\} \cup \{N=1\} \cup \{N=0\}$$

$$P(T_5 > 1) = P(N \leq 4)$$

$$T \sim \text{Erlang}(k, \lambda) \Rightarrow \frac{\lambda^k e^{-\lambda t} t^{k-1}}{(k-1)!} \quad t \geq 0$$

$$k \in \mathbb{N}, \lambda \in (0, \infty)$$

$$\Gamma(k)$$

$$T \sim \text{Neg Bin}(k, p) = \frac{\binom{k+t-1}{k-1} (1-p)^k p^t}{\Gamma(k) \Gamma(t)}$$

$$\frac{\Gamma(k+t)}{\Gamma(k) \Gamma(t)} (1-p)^k p^t \quad t \in \mathbb{N}_0$$

$$k \in \mathbb{N}, p \in (0, 1)$$