counting process

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A stochastic process $\{X(t) \mid t \in \mathbb{R}^+ \cup \{0\}\}$ is called a *counting process* if, for each outcome ω in the sample space Ω,

1. $X(t) \in \mathbb{Z}^+ \cup \{0\}$ for all t,
2. $X(t)(\omega)$ is piecewise constant,
3. $X(t)(\omega)$ is non-decreasing,
4. $X(t)(\omega)$ is right continuous (continuous from the right), and
5. for any t, there is an $s \in \mathbb{R}$ such that $t < s$ and $X(t)(\omega) + 1 = X(s)(\omega)$.

Remark. For any t, the random variable $X(t)$ is usually called the number of occurrences of some event by time t. Then, for $s < t$, $X(t) - X(s)$ is the number of occurrences in the half-open interval $(s, t]$.