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PROOF: Let $0 \leq s < t$ be given. Because $N(t) - N(s)$ is independent of $\mathcal{F}(s)$ and has expected value $\lambda(t - s)$, we have

$$\begin{aligned} \mathbb{E}[M(t)|\mathcal{F}(s)] &= \mathbb{E}[M(t) - M(s)|\mathcal{F}(s)] + \mathbb{E}[M(s)|\mathcal{F}(s)] \\ &= \mathbb{E}[N(t) - N(s) - \lambda(t - s)|\mathcal{F}(s)] + M(s) \\ &= \mathbb{E}[N(t) - N(s)] - \lambda(t - s) + M(s) \\ &= M(s). \end{aligned}$$

□


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D 11.2.4 Mean and Variance of Poisson Increments Let $0 < s < t$ be given. According to **Theorem 11.2.3**, the Poisson increment $N(t) - N(s)$ has distribution ...

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4- 4- Let $X(t) = M(t) = N(t) - \lambda t$, where $N(t)$ is a Poisson process with intensity λ so that $M(t)$ is the compensated Poisson process of **Theorem 11.2.4**. ...

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