



**MathsNET**

A joined up approach to  
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mathematics

# The poisson process

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- Draw the transition graph for the poisson process. How many states does this markov chain have.
- Write out the jump rate matrix for the poisson process.
- Explain the three assumptions that we make when we model a counting process using a poisson process.
- Use the kolmogorov equation to derive a differential equation involving  $\frac{dp_{03}(t)}{dt}$  for the Poisson process.



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- Show in your notes why the fact that  $\frac{dP_{00}(t)}{dt} = -\lambda t$  together with the fact that  $P_{00}(t) = 0$  implies that  $P_{00}(t) = e^{-\lambda t}$ .
- Show that  $\frac{d[e^{\lambda t} P_{01}(t)]}{dt} = e^{\lambda t} \frac{dP_{01}(t)}{dt} + \lambda e^{\lambda t} P_{01}(t)$  using the product rule and explain how this fact is used when we solve a differential equation using an integrating factor.
- Use the method of integrating factors to derive an expression for  $P_{03}(t)$  starting from the differential equation that you wrote down in the third of these questions.
- Give the expression for  $P_{0n}(t)$  that is derived in the video for the poisson process.



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- Given the expression that we derived for  $P_{0n}(t)$  what is the expectation value for  $\mathbb{E}[N(t)]$  if  $N(t)$  is a counting process that can be modelled using a Poisson random variable.