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# Markov Chains in Continuous time

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- BEFORE WATCHING THE VIDEO: Write out the definition of the derivative as a limit
- BEFORE WATCHING THE VIDEO: Write out the McLaurin expansion for the exponential function
- Explain in your own words how continuous time Markov chains differ from the Markov chains that we have been studying thus far in this course.
- How do we take a limit of a matrix of functions and how then do we differentiate a matrix of functions



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- Explain why the following matrix of limits cannot be calculated using the method you have just described  $\lim_{\delta t \rightarrow 0} \frac{P(t+\delta t) - P(t)}{\delta t}$
- How is the Jump rate matrix for a continuous time Markov chain,  $\mathbf{Q}$ , defined?
- Explain how the exponential of a matrix is calculated. Hint: You do not take the exponential of each of the elements in turn.
- Show by substitution that  $\mathbf{P}(t) = \exp(\mathbf{Q}t)$  is a solution of the Kolmogorov equation.



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- How do you determine whether or not a continuous time Markov chain has a limiting stationary distribution and how do you determine the elements of this distribution