

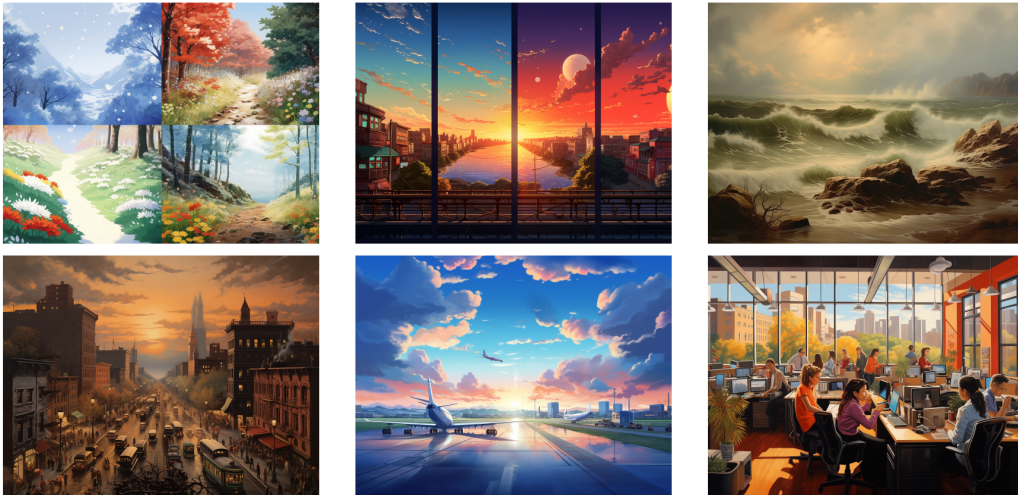
# An eigenfunction/eigenvalue-like approach to time-varying queues with periodic transition rates

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Many random phenomena exhibit periodic behavior. These include any processes influenced by the time of day or season of the year; natural phenomena like the tides; automobile and air traffic; call centers, and many other random processes.

In this talk we study a variety of ergodic queueing processes with periodic transition rates. Such processes will settle into a periodic distribution as  $t \rightarrow \infty$ . We describe a method to find this asymptotic periodic distribution for a variety of queueing processes including:

- the single-server queue,
- the multi-server queue,
- the multi-server queue with catastrophes and repair,
- level independent Quasi-Birth-Death process (QBD),
- level independent Quasi-Birth-Death process (QBD) with catastrophes and repair,
- fluid queues in a random environment.



A birth-death process is a stochastic process which permits one step transitions to adjacent states. A quasi-birth-death (QBD) process is a generalization of a birth-death process that uses a two-dimensional state space described by a level and a phase. Transitions are permitted only to adjacent levels. Phase transitions within a level are permitted to any phase based on the transition rates specific to the model. QBD processes are used to model a variety of applications including health care systems, queueing models, communication networks and reliability modeling.