

Homework: Queueing Theory

Hayden Atchley

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A deterministic queueing theory is one in which constant behavior is assumed. For example, an arrival rate of 60 individuals per hour in a deterministic theory means that each minute exactly one individual will arrive. A stochastic theory, on the other hand, involves an element of randomness, i.e. there is a distribution which behavior follows. There will be e.g. an *average* arrival rate, but the exact arrival times are somewhat random.

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A freeway on-ramp has a toll booth which takes 20 seconds to service a vehicle, for a capacity rate of 180 vehicles per hour. The peak period flow on this on-ramp is 100 vehicles per hour.

Using the `queueing` R package gives the following values: The average number of vehicles in the system (including any vehicles being served) is 1.25 and the average wait time (before being served) is 0.0069 hours or 25 seconds. Additionally, the probability of a queue 3 vehicles long or longer $P(\geq 4)$ (note that the queue does not include any vehicles being serviced) is given by $1 - \sum_{n=0}^3 P(n)$. $P(0)$, $P(1)$, $P(2)$ and $P(3)$ are given by 0.44, 0.25, 0.14, and 0.08, respectively, and so the probability of there being three or more vehicles in the queue is 0.1.