

Mark clearly (A/B) whether you would like to have the course registered A) with the new code 38.3143 (5 ETCS pt) or B) old code 38.143 (3 cr).

1. Let $N(t)$, $t \geq 0$, be a Poisson process with rate λ . Let S_n denote the time of occurrence of the n th event. Find
 - a) $E[S_4]$
 - b) $E[S_4|N(1) = 2]$
 - c) $E[N(4) - N(2)|N(1) = 3]$
2. Customers arrive at a taxi station according to a Poisson process with intensity λ . There is room for K taxis in the station and practically unlimited number of customers. Taxis arrive at the station according to a Poisson process with intensity of μ . If the station is full, the taxi drives immediately away. If there is a customer waiting in the station, the taxi picks the customer, otherwise the taxi joins the queue of taxis. Determine the steady state distribution for both the customer and taxi queues. What are the distributions if $\lambda = 1/\text{min}$, $\mu = 2/\text{min}$ and $K = 5$? What is the probability that a customer must wait for a taxi? Hint: Customer and taxi queues cannot exist simultaneously. Start writing the state diagram from state 0, where there are neither customers nor taxis waiting at the station.
3. Customers arrive at an $M/G/1$ system according to a Poisson process with rate λ . The service of each customer comprises of k different steps (only after all these steps have been accomplished can the next customer be taken into service). Each of the steps takes independently an exponentially distributed time, $\text{Exp}(\mu)$. Find the mean waiting and sojourn times of a customer in the system?
4. Persons arrive at a copying machine according to a Poisson process with rate $2/\text{min}$. The number of copies to be made by each person is uniformly distributed between 1 and 5. Each copy requires 4 s. Find the average waiting time in queue when
 - a) Each person uses the machine on a first-come first-served basis.
 - b) Persons with just a single copy to make are given non-preemptive priority over other persons.
5. In the closed queueing network depicted in the figure there are two customers. What is the average customer stream through queue 4?

