UGBA 141 Production and Operations Management **Spring 2022**

Cheatsheet 5: Queue

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1. Coefficients of variation
   - Coefficients of variation for the arrival process CV_a= Std of interarrival time / average interarrival time
   - Coefficients of variation for the processing CV_p= Std of processing time / average processing time
2. Implied utilization = Demand / Capacity = $p/(a \times m)$. Utilization = Flow rate/ Capacity. When Implied utilization < 1, Demand = Flow rate, then utilization = implied utilization.
3. Time in queue / Waiting time

$$\text{Time in queue} = \left(\frac{p}{m}\right) \times \left(\frac{\text{Utilization}^{\sqrt{2m+2}-1}}{\text{1-Utilization}}\right) \times \left(\frac{CV_a^2 + CV_p^2}{2}\right)$$

   where a is average interarrival time. p is the average processing time, and m is the number of servers.

   Time in system = time in queue + processing time (p)
4. Number of customers = Time in system * flow rate ($\frac{1}{a}$)

References

[TC2006] C. Terwiesch and G. Cachon, Matching supply with demand: An introduction to operations management (Chapter 9), McGraw-Hill 2006