Bruce Hao

DATA604

Assignment 4

**Problem 2.9: Analytical solution to M/D/1 queue**

* Constant service time:
  + Lambda = 1 unit/minute 🡪 interarrival-time = 1 minute between units
  + Mu = 1/0.9 unit/minute 🡪 E(S) = 0.9 minute between units
  + Sigma = 0; since no variation
  + Wq = lambda \* (sigma^2 + 1/mu^2) / (2 \* (1 – lambda/mu)) = 0.81 / 0.2 = 4.05 minutes
  + W = Wq + E(S) = 4.95 minutes
  + L = lambda \* W = 4.95 units
  + Lq = lambda \* Wq = 4.05 units
  + Rho = lambda / (c \* mu) = 0.9
* Non-constant service time (e.g. M/M/1):
  + Rho = 0.9; unchanged
  + L = 9 units; much higher than 4.95 units in M/D/1 scenario
  + W = 9 minutes; much higher than 4.95 minutes in M/D/1 scenario
  + Wq = 8.1 minutes; much higher than 4.05 minutes in M/D/1 scenario
  + Lq = 8.1 units; much higher than 4.05 units in M/D/1 scenario
* Takeaway – removing variation in service/processing time dramatically reduces overall units and time in system and in queue

**Problem 4.15: Simio-based simulation of M/D/1 queue**

* Experiment: 30 hour total runtime; 20 hour warm-up time; 500 replications
* As illustrated below, the 95% confidence intervals for all metrics include the analytically calculated values
* A screenshot of the model is also included, with the constant 0.9 minute processing time highlighted



