Exercises

6.7.1 Change the mean arrival rate to 5 and the mean service rate to 6. Calculate the theoretical expected wait time, W_q, and verify this number with the simulation.

6.7.2 Suppose the mean arrival rate is 1 and the service time is uniformly distributed between 0 and 1 minute. Calculate the theoretical expected wait time, W_q, and modify the formulas in your simulation to verify this number. **Hint**: See Example 6.5.1 to calculate the mean and standard deviation of the service time. How many customers will the server be able to serve each minute? Find a formula to model the service time.

6.7.3 The *Queue Length* is the number of customers standing in line waiting to be serviced when a customer arrives. This does not include any customers being serviced at the time, nor does it include the arriving customer. Add a column to the worksheet **Queue** to calculate the Queue Length at the moment each customer arrives. Calculate the overall average queue length and compare it to the theoretical mean $L_q = 4/3$ (use exponential distributions with a mean arrival rate of 2 and mean service rate of 3). (**Hint**: Stated another way, the queue length is the number of customers who have arrived but not yet started being serviced. Consider the scenario shown in Figure 6.50. When customer 81 arrives, customers 78, 79, and 80 have not yet started being serviced and are waiting in line, so the queue length is 3. Use the **COUNTIF** function to count the number waiting in line.)

Customer Number	Arrival Time	Start Time	Completion Time	Queue Length
76	30.58	30.72	31.20	0
77	30.86	31.20	31.86	0
78	31.16	31.86	32.19	1
79	31.43	32.19	32.40	1
80	31.56	32.40	32.68	2
81	31.73	32.68	32.71	3

Figure 6.50

6.8 A Coffee Shop Queuing Model

Consider this scenario:

> RV Smith, the manager of RV's 66 gas station, has 100 regular customers who stop in for coffee between the hours of 6:00 and 7:30 AM. Currently he has only self-serve coffee with optional cream and sugar, but he is interested in opening an optional full-service gourmet coffee shop in the station.
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> Talking with his customers, RV learns that about 80% of them would be interested in using the full-service shop. However, they say they won't wait more