Due: Friday, December 1st (9:30 a.m. PT.)

Reading

For Friday, November 10th, Sections 5.2.3 and 5.2.4 of *Probability Models*.

For Friday, November 17th, Sections 5.3.1 and 5.3.2 of *Probability Models*, see also Section 2.9 of *Simulation*.

For Monday, November 20th, Section 5.3.3 and 5.3.4 of *Probability Models*.

For Wednesday, November 22nd, Section 5.4.1 of *Probability Models* and Section 5.4 of *Simulation*.

For Friday, November 24th, the introduction to Chapter 2, and Section 2.2 of The Big Book of Simulation.

For Monday, November 27th, Sections 6.1 and 6.2 of *Network Performance Analysis* by Bonald and Feuillet, see also Sections 7.1 and 7.2 of *Simulation*.

For Wednesday, November 29th, Sections 6.3, 6.4 and 6.5 of *Network Performance Analysis* by Bonald and Feuillet.

For Friday, December 1st, Sections 6.1 and 6.2 of *Probability Models*.

For Monday, December 4th, Section 6.3 of *Probability Models*.

Assignment exercises to hand in

Some of the questions in this assignment require the use of the simulation software `AnyLogic`. You should download and install the Personal Learning Edition (PLE):

`https://www.anylogic.com/s/download-free-simulation-software-for-education/`.

1. In class we considered a model soccer game where one team scores at a rate of once per 40 minutes, and another at a rate of once per 50 minutes. Reproduce this model in `AnyLogic`. Starting with your SFU id as the random seed, and increasing by one after each trial, run ten 90 minute games under these conditions, extending by 30 minutes should the game be tied after 90 minutes. For each game, write the final score, along with the times that each team scored.

2. Build a simulation of an $M/M/1$ queue using `AnyLogic`. The arrival rate is 1 customer per hour, and the mean service time is 50 minutes. Provide a printed screen shot of your `AnyLogic` model, or submit the model file on-line via `Canvas`.

3. Starting with your SFU id as the random seed, run the simulation for 100 hours. When did the third customer arrive and leave?

4. For how much of the first hundred hours was the queue empty?

5. Now run 10 independent runs of your simulation model, stopping after 10,000 hours. The first one should use your student id as a random seed, and then add one to the seed for each subsequent trial. Record the queue length every 100 hours.

6. Use the results of the experiments in the previous part to estimate the mean number of customers in the queue at a steady-state. Compare your result to the formula for the expected number of customers in an $M/M/1$ queue.

7. Estimate the mean queue length at 50 hours. Note that at that time, the queue will not yet be in a steady state.

8. Estimate the time required for the expected queue length to reach 80% of its steady-state value. Explain your reasoning or computation method.

9. *Simulation*, Chapter 2, Exercise 31

10. *Probability Models*, Chapter 5, Exercise 2

11. *Probability Models*, Chapter 5, Exercise 3

12. *Probability Models*, Chapter 5, Exercise 21

13. *Probability Models*, Chapter 5, Exercise 32

14. *Probability Models*, Chapter 5, Exercise 49

Final Exam

The final exam schedule has now been released. Our exam is on Thursday, December 14th from 8:30-11:30 a.m. in WMC 2202.