HW4-ISE560 Fall 2022, Due on Dec 9th, 2022

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Please note that this is a group homework so each group need to submit only one copy. Make sure that you have your group member's names on submitted homework

Queueing Approximation

Use queueing theory (and QueueingTools.xls) to get rough-cut answers to the following problem. Leviathan Limited maintains a repair facility that reconditions certain expensive products when they fail. The repair facility consists of a repair station, an inspection station, and a combined repair-and-inspection station. The repair station makes the first attempt to repair the product. The product then moves to the inspection station to verify that repairs have been successful. Products that pass inspection are sent back to their owner. The small numbers of products that fail inspection are sent to the combined station where they are repeatedly repaired and inspected until they work properly. The original vision for this configuration was to exploit the efficiency of specialized repair and inspection stations for most products and have a general-purpose station for particularly difficult cases. However, management is currently searching for ways to make more efficient use of resources. An industrial engineer noticed that the combined station is not heavily utilized; she speculates that this station can be eliminated by sending products that fail inspection back to the primary repair station and then to inspection again. For this to be a viable option it must not lead to excessive delays. Your task is to predict the impact of this change on customers who send their products to be repaired. Products arrive for repair at a rate of 5 per day; repairs take 4 hours on average, while inspection takes 3 hours on average (treat a day as 24 hours working around the clock). Ten percent of products fail inspection, and work at the combined station takes 20 hours on average. Note: When we eliminate the combined station and return products that fail inspection to the repair station, some products will fail inspection multiple times. Approximate this by using a 10% chance of failing inspection independent of how many times a product has been repaired.
There are two hints below:
Hint 1: Start by sketching the current and proposed systems. Then figure out the arrival rates to each station using the network formula discussed in

class. Also compute the service rates. Finally, approximate each station as an M/M/something queue and use the relevant performance measures.
Hint 2: A product's total time at the facility consists of the sum of its waiting time and service time at each station it visits.

Assignment: Create a report in Word that contains 2 tables: One with the arrival rates, service rates and performance measures for each station in the current system, and a corresponding table for the proposed system. Then write a paragraph with your assessment of the impact.