

INDR 371 HOMEWORK-4

1. Consider a single-machine production system that produces aluminum sheets for car manufacturing. The monthly production target is 100 sheets. The minimum and maximum thickness of the aluminum sheets should be between 2.97 and 3.03 millimeters to meet the car manufacturing standards. The historical data shows that the thickness of the sheets produced by the current pressing machine has a normal distribution with a mean of 3.00 mm and a standard deviation of 0.02mm.
 - (a) (25 pts) Use the normal approximation to the binomial yield model to estimate the probability that the production requirements are met if the number of items that are manufactured is 100, 110, and 120.
 - (b) (25 pts) Repeat the same exercise if the required quantity is 1000 and 1000, 1100, and 1200 items are produced.
2. (50 pts) Consider a production cell with a single worker and several semiautonomous machines. Due to the issues with the raw material used, with a two percent probability, a product may get stuck in a machine after the processing, and a repair team is called to remove the product and recalibrate the machine if that happens. The maintenance takes 45 minutes to complete (including the traveling time of the team) and during the repair, there is a 40% chance that the product gets damaged. The maintenance teams do not end their shift before fixing a broken machine (they work overtime if needed). We know the following parameters for the production system.
 - There is a single shift in the factory that lasts 8 hours. The workers take a 20-minute break at the middle of the shift.
 - Machining time for a product is a random variable that is uniformly distributed between 5 and 7 minutes.
 - The loading time is normally distributed with a mean of 45 seconds and a standard deviation of 10 seconds. Similarly, the unloading time is also normally distributed with a mean of 30 seconds and a standard deviation of 5 seconds.
 - The quality check takes 1 minute for the worker (if the part is not stuck) and if a part is not stuck the probability that it passes the quality check is 98.5%.
 - It takes 40 seconds for a worker to move from one machine to the other one.

Use a simulation approach to answer the following questions.

- (a) What would be the expected production quantities if 2,3,4 or 5 machines are placed in the production cell?
- (b) Assume 3 machines are placed in the cell. How much the daily production quantity would increase if the stuck probability is reduced by 1 percent?
- (c) Assume 3 machines are placed in the cell. How much the daily production quantity would increase if the successful production probability for the unstuck parts is increased by 1 percent? Comment on the effectiveness of the system improvements in parts (b) and (c) by comparing the production increases.