Case Study: Out Patient Clinic

Purpose: To determine the most effective use of funds to decrease average patient time and increase the number of patients serviced.

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Experimental Information:

Title: Case Study: Out Patient Clinic

Objective: To determine the most effective use of funds to decrease average patient time and increase
the number of patients serviced.

Simulation upon termination:

Problem description:

Simulation runs for 30 days.

“Patients arrive to a 24-hour, 7-days-a-week outpatient clinic with interarrival time being distribute as exponential distribution with a mean of 5.95 (all times are in minutes); first patient arrivals at time zero. The clinic has five different stations (like nodes in a network), where patients might be directed for service before leaving. All patients first sign in with a single receptionist; sign-in times have a triangular distribution with parameters 1, 4 and 8. From there, they might go to the nurses’ station (probability 0.9888) or to one of the three exam rooms (probability 0.0112). The table below gives the five stations, service time and transition probabilities out of each station into the next station for a patient (including out of the sign-in station, just described):
All patients eventually go through the check-out station and go home. Note that it is possible that, after a visit to an exam room, a patient is directed to an exam room again (but may have to queue for it). After the patient checks in but is queuing for either the nurse's station or an exam room, regard the patient as being in the waiting room.

There are three identical exam rooms, but only one resource unit at each of the other four stations. Queue for each station are first-in, first-out, and we assume that the movement time is negligible.”

Results:

(1)
Average total time in system: 117.88 minutes
Average number of patients in clinic: 19.5187 patients
30 day throughput: 7,151 patients

(2)
Adding an additional examiner reduces the average patient's total time from 140.1 minutes to 101.1 minutes. For reducing wait times, it is the best solution and the only scenario that is statistically significantly better. No scenario statistically significantly increases the number of patients serviced.

OptQuest Results Average Patient Total Time:
OptQuest suggests the optimal solution is to hire 1 Checkout Administrator, 1 Examiner, 1 Nurse, and 1 Receptionist, which will reduce the average patient total time from 140.1 minutes in the base scenario to 43.8 minutes. The cost of these improvements is $370,000. The next best solution has a time of 47.9 minutes.

OptQuest Results Total Patients Serviced:

OptQuest suggests the optimal solution is to hire 1 Examiner, 2 Nurses, and 1 Receptionist, which will increase the total number of patients serviced from 7228.7 in the base scenario to 7362.0. The cost of these improvements is $400,000. The next best solution has a value of 7353.3 patients.

(4) If real-world data are available, one could compare simulation results to real-world data with a paired t-test to check for a statistically significant difference. Is there is no difference, the simulation is valid. For example, one could collect indicators (patient time, patient output) month-by-month for both the actual clinic and simulated results, find the difference for each month, and proceed with the paired t-test.

Conclusions:

The clinic will have to decide if they prefer to prioritize decreasing patient time or increasing patient throughput because each requires a different solution. However, the solution for decreasing patient time will likely be most optimal because patient times increase quickly as less efficient solutions are implemented whereas patients serviced decreases more slowly.

However, the most effective way to decrease costs and/or increase efficiency would probably be to schedule employees relative to need (time of day) because less are needed during off-times and more are needed during peak-times. Having the same level of staffing throughout the day is likely wasteful.