Matthew Slusser
CS-4830 Systems Simulation
Project 1 Report

Introduction

For this simulation we are created our two different drive-thru scenarios. The first one would have two stationary order stations that cars would pull up to order and if there was room pull ahead, while the second scenarios would have two order stations that would be able to move to the next vehicle in line if there was not space ahead for the first car to pull forward. Our goal with looking at these two scenarios was to find how small the arrival time could be between customers before the lines got too long and customers would be lost.

Methodology

For each scenarios I decided that I would run them both with an increasing mean in interarrival times, starting at 1.0 going up to 2.0. Each drive-thru would run with 1000 replicates and ran for 120-time units to simulate the lunch rush from 11:00am to 1:00pm.

Scenarios One Results

Mean Interarrival Time: 1.0
The average number of customers processed is 64.188 or 32.094 customers/hour
The average number of customers to bawk over 1000 runs is 55.269
The variance of customers lost is 152.021

Mean Interarrival Time: 1.1
The average number of customers processed is 63.949 or 31.974 customers/hour
The average number of customers to bawk over 1000 runs is 44.894
The variance of customers lost is 135.615

Mean Interarrival Time: 1.2
The average number of customers processed is 63.918 or 31.959 customers/hour
The average number of customers to bawk over 1000 runs is 36.043
The variance of customers lost is 119.781

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Mean Interarrival Time: 1.3
The average number of customers processed is 63.455 or 31.727 customers/hour
The average number of customers to bawk over 1000 runs is 29.226
The variance of customers lost is 118.519

Mean Interarrival Time: 1.4
The average number of customers processed is 63.106 or 31.553 customers/hour
The average number of customers to bawk over 1000 runs is 22.536
The variance of customers lost is 99.925

Mean Interarrival Time: 1.5
The average number of customers processed is 62.768 or 31.384 customers/hour
The average number of customers to bawk over 1000 runs is 17.107
The variance of customers lost is 88.260

Mean Interarrival Time: 1.6
The average number of customers processed is 62.042 or 31.021 customers/hour
The average number of customers to bawk over 1000 runs is 13.193
The variance of customers lost is 81.862

Mean Interarrival Time: 1.7
The average number of customers processed is 60.576 or 30.288 customers/hour
The average number of customers to bawk over 1000 runs is 10.290
The variance of customers lost is 67.422

Mean Interarrival Time: 1.8
The average number of customers processed is 59.607 or 29.803 customers/hour
The average number of customers to bawk over 1000 runs is 7.288
The variance of customers lost is 47.575

Mean Interarrival Time: 1.9
The average number of customers processed is 58.211 or 29.105 customers/hour
The average number of customers to bawk over 1000 runs is 4.840
The variance of customers lost is 35.568

Mean Interarrival Time: 2.0
The average number of customers processed is 56.331 or 28.166 customers/hour
The average number of customers to bawk over 1000 runs is 3.442
The variance of customers lost is 24.277

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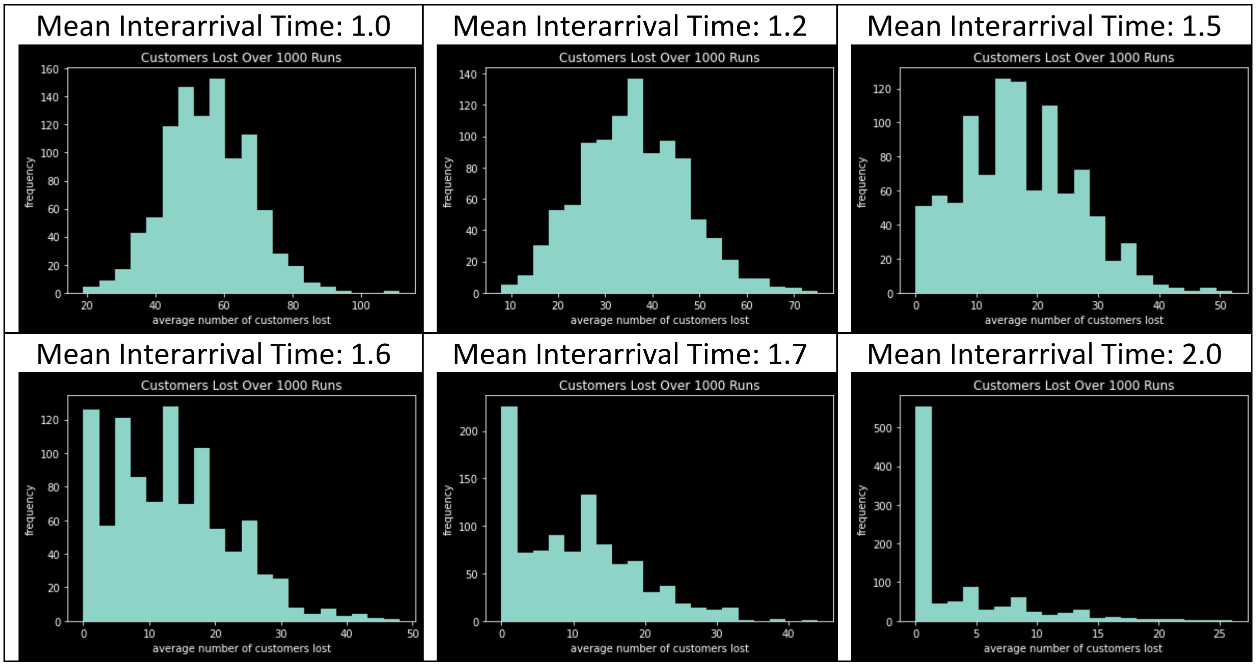
Graphs

I won't show all the graphs to save space but here are six that I feel show this movement of the how many customers were lost over 1000 replicates.



Scenarios Two Results

Mean Interarrival Time: 1.0
The average number of customers processed is 82.872 or 41.436 customers/hour
The average number of customers to bawk over 1000 runs is 36.618
The variance of customers lost is 160.662

Mean Interarrival Time: 1.1
The average number of customers processed is 82.042 or 41.021 customers/hour
The average number of customers to bawk over 1000 runs is 27.372
The variance of customers lost is 131.012

Mean Interarrival Time: 1.2
The average number of customers processed is 80.468 or 40.234 customers/hour
The average number of customers to bawk over 1000 runs is 19.801
The variance of customers lost is 121.689

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Mean Interarrival Time: 1.3
The average number of customers processed is 79.394 or 39.697 customers/hour
The average number of customers to bawk over 1000 runs is 13.142
The variance of customers lost is 95.076

Mean Interarrival Time: 1.4
The average number of customers processed is 76.818 or 38.409 customers/hour
The average number of customers to bawk over 1000 runs is 8.681
The variance of customers lost is 71.305

Mean Interarrival Time: 1.5
The average number of customers processed is 74.640 or 37.320 customers/hour
The average number of customers to bawk over 1000 runs is 5.200
The variance of customers lost is 41.296

Mean Interarrival Time: 1.6
The average number of customers processed is 72.043 or 36.022 customers/hour
The average number of customers to bawk over 1000 runs is 3.495
The variance of customers lost is 28.796

Mean Interarrival Time: 1.7
The average number of customers processed is 68.464 or 34.232 customers/hour
The average number of customers to bawk over 1000 runs is 2.077
The variance of customers lost is 16.251

Mean Interarrival Time: 1.8
The average number of customers processed is 65.383 or 32.691 customers/hour
The average number of customers to bawk over 1000 runs is 1.265
The variance of customers lost is 9.851

Mean Interarrival Time: 1.9
The average number of customers processed is 62.619 or 31.309 customers/hour
The average number of customers to bawk over 1000 runs is 0.712
The variance of customers lost is 5.105

Mean Interarrival Time: 2.0
The average number of customers processed is 59.993 or 29.997 customers/hour
The average number of customers to bawk over 1000 runs is 0.482
The variance of customers lost is 2.818

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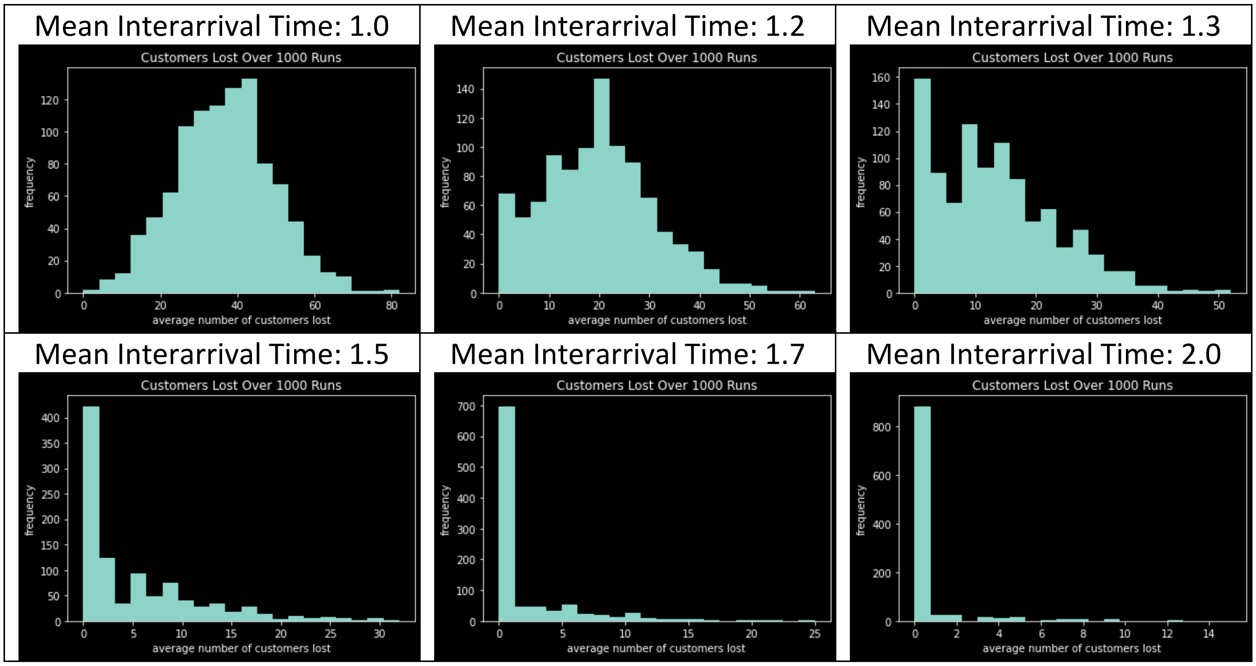

Analysis and Conclusions

Looking at the two scenarios we observe a similar shift in the drive-thru's ability to keep up with the flow of customers. For both as the interarrival time increases they are both losing fewer customers, but this shift happens steeply around an inter arrival time of 1.7 to 1.8 for scenarios one meanwhile for scenarios two, the same tipping point seems to be seen around 1.4 to 1.5. Scenarios two is clearly more efficient and does increase customer throughput in every run when compared to scenarios one, while at times increased throughput is upwards of 8 or more customers per hour with significantly fewer customers lost during this period. I would consider the true upper limit of scenarios two to be between 1.3 and 1.4.