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2.1 Part1: How good is this current system?

Simulate the above scenario for an entire day starting at 8:00 am until store close at 1:00 am at a granularity of 1 minute. Customers arrive with the aforesaid probability to a single queue. Each customer arrival is a call to the enqueue function. The dequeue process is assumed to be a steady stream of order processing: the chefs move onto the next order as soon as they process the current one; i.e., at every minute, we check to see if a customer is done so we can call the dequeue function.

After the simulation, provide answers for the following:

1. Average customer *wait time*. This is the mean wait time until they can place an order, i.e., time spent standing in line to get to the person behind the counter.
2. Average customer *service time*. This is the mean time to get the order in hand from the second they enter the store, i.e., wait time + service time.
3. Average *queue length*. The mean number of people in line at any given time averaged over the entire day.
4. The *best case* and *worst case* for each of the above and *at what time* did that occur: (i) wait time, (ii) service time, and (iii) queue length.

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| WELCOME TO BURGER KING |
| here are today's stats |
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Total customer count: 116
Average wait time: 3.68966 minutes
Average service time: 7.34483 minutes
Average queue length: 4
Minimum wait time: 1 minutes at time 8 minutes
Maximum wait time: 6 minutes at time 36 minutes
Minimum service time: 2 minutes at 14 minutes
Maximum service time: 12 minutes at 85 minutes
Maximum queue length: 13 at 270 minutes
Minimum queue length: 1 at 15 minutes
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| WELCOME TO BURGER KING |
| here are today's stats |
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Total customer count: 115
Average wait time: 3.52174 minutes
Average service time: 7.34783 minutes
Average queue length: 2
Minimum wait time: 3 minutes at time 1018 minutes
Maximum wait time: 6 minutes at time 7 minutes
Minimum service time: 2 minutes at 59 minutes
Maximum service time: 12 minutes at 285 minutes
Maximum queue length: 9 at 334 minutes
Minimum queue length: 1 at 7 minutes
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| WELCOME TO BURGER KING |
| here are today's stats |
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Total customer count: 121
Average wait time: 3.57025 minutes
Average service time: 7.06612 minutes
Average queue length: 4
Minimum wait time: 1 minutes at time 47 minutes
Maximum wait time: 6 minutes at time 44 minutes
Minimum service time: 2 minutes at 251 minutes
Maximum service time: 12 minutes at 244 minutes
Maximum queue length: 17 at 330 minutes
Minimum queue length: 1 at 19 minutes
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| WELCOME TO BURGER KING |
| here are today's stats |
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Total customer count: 119
Average wait time: 3.36134 minutes
Average service time: 7.04202 minutes
Average queue length: 4
Minimum wait time: 1 minutes at time 2 minutes
Maximum wait time: 6 minutes at time 3 minutes
Minimum service time: 2 minutes at 17 minutes
Maximum service time: 12 minutes at 447 minutes
Maximum queue length: 16 at 323 minutes
Minimum queue length: 1 at 58 minutes
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=====
| WELCOME TO BURGER KING |
| here are today's stats |
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Total customer count: 116
Average wait time: 3.56897 minutes
Average service time: 6.97414 minutes
Average queue length: 2
Minimum wait time: 1 minutes at time 24 minutes
Maximum wait time: 6 minutes at time 22 minutes
Minimum service time: 2 minutes at 86 minutes
Maximum service time: 12 minutes at 503 minutes
Maximum queue length: 12 at 324 minutes
Minimum queue length: 1 at 61 minutes
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| WELCOME TO BURGER KING |
| here are today's stats |
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Total customer count: 121
Average wait time: 3.64463 minutes
Average service time: 6.96694 minutes
Average queue length: 3
Minimum wait time: 1 minutes at time 18 minutes
Maximum wait time: 6 minutes at time 31 minutes
Minimum service time: 2 minutes at 9 minutes
Maximum service time: 12 minutes at 117 minutes
Maximum queue length: 10 at 331 minutes
Minimum queue length: 1 at 16 minutes
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Based on multiple different tests, I have found that the average wait time for a customer in line is typically around 3.5 minutes. The average service time for a customer was calculated to be around 7 minutes at the time that an order is received. For both of these, there have been slight outliers, but typically the wait time and service time average at around these times.

The average queue (line) length is roughly 3 people, but evidently it tends to be within a range between 2 and 4, and can

be larger sometimes. This is definitely impacted by the probability of a customer arrival during different times of the day.

Typically the best case for wait time is always 1 minute, simply because wait times range between 1 and 6 minutes, and it is extremely rare to have a 17 hour day at this Burger King without at least one 1 minute wait time. Likewise, the maximum wait time for a customer is usually 6 minutes for the same reason that the minimum wait time is usually 1 minute. These minimum and maximum values happen at many different times throughout the day, but the time of the first recorded occurrence of these values is what is shown in the final stats.

The best case scenario for service time is almost always 2 minutes, but it is not quite as common as with minimum wait time, because the minimum service time is dependent on both wait time and order time. Thus, requiring both wait time and order time to be 1 minute, and as a result, its first occurrence is very random when recorded in the final stats. For example, in some runs, this is found at around 14 minutes and in others it is found at 251 minutes or more. All in all, the recorded time is quite inconsistent simply because of how random these occurrences are. This also applies to the worst case scenario, which is almost always 12 minutes at various different times.

Unlike with wait time and service time, the maximum and minimum queue length has a lot more consistency with its timing. The maximum queue length varies each time, but is typically within a range between 9 and 17 people. The time range for the maximum queue length is almost always between 270 and 340 minutes, which is during lunch time. This makes sense because the probability of a new customer arriving at the Burger King is highest during this time, and as a result, more people will be getting in line at this time than other times of day; however, there have been some runs where the maximum queue length occurred during dinner time, which has the second highest probability of having a new customer getting in line. With the minimum queue length, it is almost always 1 because the smallest amount of people that can be in line is 1 person. This typically first occurs early in the day, when the line doesn't get very large because it's early. The line most likely reaches 1 person multiple times throughout the day, perhaps more likely during times when less customers are probably getting in line.