BACHELOR THESIS

# IMPROVING THE PHONE TRIAGE PROCESS OF REGIONAL GENERAL PRACTITIONER EMERGENCY CENTERS

JAWAD ABDELLAOUI

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Improving the phone triage process of regional General Practitioner emergency centers

AUTHOR(S)
Jawad Abdellaoui

FIRST SUPERVISOR
Dr. Daniela Guericke

SECOND SUPERVISOR
Dr. Amin Asadi

COMPANY SUPERVISOR
Ir. Geert Jan Kommer

# MANAGEMENT SUMMARY

The RijksInstituut voor Volksgezondheid en Milieu (RIVM), wants to explore the feasibility of creating a universal capacity planning model for Huisartsen Posten (HAPs), General Practitioner Posts. This initiative seeks to optimize the patient journey, from the initial contact via telephone to the completion of treatment, and for any resources used for this journey to be used efficiently. For this goal we will look at the basics of the processes in a HAP and the first process the patient goes through: the triage. That is why we will try to answer the following research question with our research: *"Can we improve the scheduling of triage nurses of regional HAPs by combining the incoming calls of several HAPs?".*
To answer the research question we conducted a study which included the following: visiting a HAP to map the process of the triage and identify the key stakeholders, a data analysis of the incoming calls and a simulation of an optimized schedule for the triage process.

To model the triage process and develop an optimized schedule, we analysed the data of incoming calls from region A, which includes calls from three HAPs. Our data analysis identified arrival rates and service times, which were subsequently incorporated into our simulations.

We started with our first experiment by modeling HAP 1 and 2, and HAP 3, and determining how many triage nurses are required per planning period. We combined the number of triage nurses from both HAP 1 and 2 and HAP 3 and compared that to the number of triage nurses required when we combined the arrivals of all three HAPs.

In the second experiment aimed at developing an optimized schedule, we used shifts provided to us by Region A, we combined all incoming calls, and we limited the maximum service time to 30 minutes. Based on this experiment, we found that on average, we could save (762.5 – 571 =) 192.5 scheduled triage hours a week (762.5 - 553).

| | Nightshift | | Morning Afternoon | | Afternoon Evening | | Total | |
|---|---|---|---|---|---|---|---|---|
| Weekdays | 180 | 99 | - | - | 205 | 176 | 385 | 275 |
| Saturday | 36 | 27 | 96.75 | 79 | 56 | 45 | 188.75 | 151 |
| Sunday | 36 | 18 | 96.75 | 86 | 56 | 41 | 188.75 | 145 |
| Total | 252 | 144 | 193.5 | 165 | 317 | 262 | 762.5 | 571 |

*Table 1 Hours scheduled in old schedule (red), compared with new optimized schedule (green)*

Our experiments indicate that it is feasible to optimize the schedule of the triage by combining the arrivals of the triage process part from multiple regions. However this is limited to arrivals by phone and does not include walk-ins. To decrease the waiting time even more triagists can schedule in call backs with patient, at times when it is busier. We determined this by maximizing the duration of the calls. However we did n0ot implement the call backs, thus this should be tested in future research.

A key limitation of our research was the inability to incorporate scheduled callbacks and walk-in patients and the lack of emergency patients.
Despite these constraints, our findings suggest that implementing these strategies could enable HAPs to save a significant number of hours per week.

# ACKNOWLEDGMENT

Dear reader,

In front of you, you find my Bachelor's thesis, in which I conducted a study for the RIVM to optimize the triage process for regional HAPs.

In the past few months, I have had the privilege to apply the theory, I have learned for my Bachelor's Industrial Engineering and Management in practice with the RIVM. They have given me the opportunity to learn about the processes in a HAP and how to analyse a large batch off data to create a schedule using queueing theory and simulations.

I want to thank my family for their support during my long journey, they have always been there when I needed them even if I did not know it myself.

Next, I want to thank my UT supervisor Dr. Daniela Guericke and RIVM supervisor Ir. Geert Jan Kommer. Thank you for the guidance in knowledge during this time, I could not have done it without it!

Finally, I want to thank Dr Amin Asadi, for taking the time to be my second supervisor. And also the employees at the different HAPs for giving the much needed insight.

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# 1. INTRODUCTION

For this research we want to look into the possibility of improving the processes that happen inside a General Practitioner Post or Huisartsen Post (HAP) in Dutch, putting the focus on the triage process.

## 1.1 RIVM AND "HAP"

The RIVM, short for "RijksInstituut voor Volksgezondheid en Milieu", is a Dutch government institute committed to a healthy Dutch population and a sustainable, safe, and healthy living environment. This is done through research by their different department, which are also in turn divided into smaller departments (RIVM, sd). The department VZM, short for "Volksgezondheid, Zorg en Maatschappij", is one of those departments. And they research topics of public health and healthcare. The goal of the RIVM is to improve, optimize, or innovate healthcare. Recently they have studied a capacity model for a control room for ambulance care (RIVM, 2022). The RIVM is now also looking at improving emergency care for regional general practitioner posts. The goal is similar to ambulance care, to create a standardized capacity model for regional general practitioners emergency posts or Huisartsenpost (HAP) in Dutch. The HAPs currently use their own model and do their own scheduling, but the RIVM wants to look at all the options for optimizing and/ or making HAPs more efficient. For example, by creating a standardized capacity model to minimize scheduling problems, or to combine triages of different regions. For our research, we will look at the processes in a HAP and the arrivals and processing of the arrivals by the triage. We will analyse phone calls coming in at different HAPs in Region A and look into the possibility of combining them. The results from our research can in turn be used for further research on a complete capacity planning model.

## 1.2 IDENTIFICATION OF THE ACTION PROBLEM

### 1.2.1 Action Problem

"Anything or any situation that is not how you want it to be, is an action problem. It is where reality deviates from your norm." (Heerkens & Winden, 2017, p. 21). For this research, the action problem is inefficient planning that causes long waiting times for patients or unnecessary costs for the GPs.

### 1.2.2 Core Problem

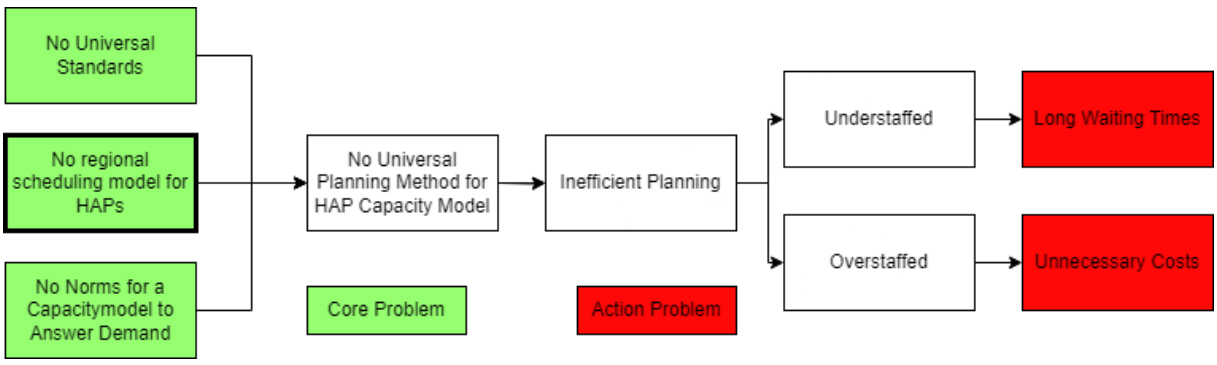



*Figure 1 Problem Cluster*

The problem cluster in Figure 1 visualizes the identified problems the RIVM perceives for wanting to create a capacity planning model for regional HAPs in the Netherlands. Discussions with the RIVM revealed that the RIVM perceives a lack of control over scheduling, resulting in limited influence over the planning process. The implementation of a capacity planning model could help address this issue by providing a structured framework for resource allocation. However, additional inputs are required to develop a comprehensive and effective capacity model.

To address the action problem,  it is essential to start by identifying and resolving its root cause, which is the core problem. The problem cluster in Figure 1 highlights three underlying causes. Given the scope of this research and the time available, the focus will be on analysing data on incoming calls made to regional HAPs and developing an optimized schedule to reduce staff hours. This core problem was selected based on its usefulness for later research. The data analysis tackles an important aspect of a capacity planning model, which is the demand. As a result, the findings can serve as input for the development of a capacity planning model in the future.

### 1.2.3 Norm and Reality

The discrepancy between norm and reality in the chosen core problems are in case of the overview of the processes, the RIVM wants to set norms and standards for a capacity planning model, which they do not have yet.
For the arrival rates the RIVM does not have a clear overview of the relations between arrival rate and different characteristics of patients.

## 1.3 PROBLEM SOLVING APPROACH

To answer our research question, we will adopt the Managerial-Problem-Solving Method(MPSM) (Heerkens & Winden, 2017)This method consists of seven phases see Figure 2 (Heerkens & Winden, 2017).

The MPSM starts with identifying the problem through a problem cluster, selecting the core problem and to express the problem in variables (Heerkens & Winden, 2017, p. 36) as we have done before in this chapter.
The second phase is the formation of the problem solving approach, which we will be done next in this chapter. This plan will be used to plan for the problem solution process (Heerkens & Winden, 2017, p. 36).
In the third phase we will be analysing the problem and solve the knowledge problems we have chosen to help us solve the core problem (Heerkens & Winden, 2017, p. 36)
For phase four we will use the previous analysis to generate different solutions, in our case it would be to present our analysis on what effects different characteristics of patients in a region can have on the arrival rate.
After we have generated our solutions, we will evaluate their feasibility in the fifth phase.
Then comes phase six, solution implementation, where we will try to implement our solution. And in the evaluation, we will compare it to the real-life situation to see whether our solution is valid.

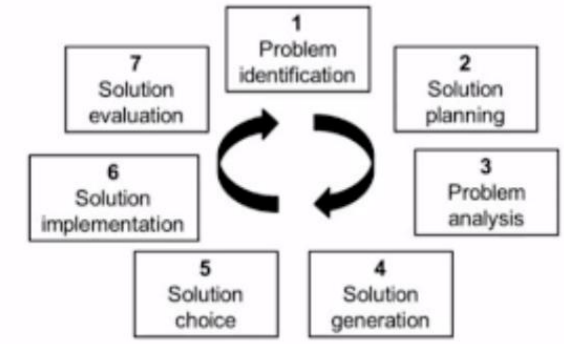



*Figure 2 Phases of the MPSM (Heerkens & Winden, 2017)*

The creation of a capacity planning model looks at the aspects of supply and demand that are present. And in the case of creating a model for a HAP supply is the available triage nurses, general practitioners, nurses and beds and/ or rooms.

Demand comes from the population that is connected to the GP post by their zip code and can be influenced by different characteristics. This research will look at the processes in a HAP and we will analyse the data of calls to the triages and based on the analysis create an optimized schedule. Thus, for this research we will be analysing the data of past demand of a regional HAP, but also the processes in a regional HAP. This gives us the following research question: *"Can we improve the scheduling of triage nurses of regional HAPs by combining the incoming calls?".*

### 1.3.1 Approach

The following sub questions will help us answer the research question.

1. What are the processes in a HAP?

To accurately map the processes within a HAP we will conduct one or multiple interviews. This information will be helpful to gain an understanding of what the expectations are for a capacity planning model. This will be a descriptive and qualitative study, as our goal is to describe the characteristics of the HAP.

2. *Who are the stakeholders involved in a HAP?*

To answer this sub- question, we will conduct a descriptive and qualitative study. Through interviews we want to find identify the key stakeholders involved in a regional HAP.

3. *What are the hourly arrival rates on a weekday and in the weekend?*

To answer this sub-question, we will conduct a quantitative and explanatory study. By analysing the data, we aim to gain insights into the distribution of incoming calls throughout the day. The data we will analyse are the call logs from Region A under which we have three different HAPs; HAP 1, HAP 2 and HAP 3. The incoming calls from HAP 1 and 2 have already been combined.

4. *How can we create a model of our situation?*

To address this sub-question, we will conduct a quantitative and explanatory study. By analysing the incoming call data, we aim to gain insights into the distribution of incoming calls throughout the day. The data we will analyse are the call logs from Region A under which we have three different HAPs; HAP 1, HAP 2 and HAP 3. The incoming calls from HAP 1 and 2 have already been combined.

5. *Can we improve the schedule?*

We will develop a schedule for the triage nurses to efficiently manage all incoming calls. This optimized schedule will aim to improve workforce allocation while maintaining service quality.

*Deliverables*

For this research, we aim to present an overview of all processes within a HAP, including a stakeholder analysis that identifies all involved parties. Additionally, we will conduct a data analysis of the incoming calls to gain insights into call patterns and demand.
To develop an optimal schedule, we will use information gathered from the processes and combining the incoming calls. Using the results from our data-analysis which consists of real-world data and comparing our improved schedule with the existing schedule we will validate our results. Furthermore, the improved schedule must adhere to an average waiting time ranging between 120 and 270 seconds.

# 2. INSIDE A HAP

In this chapter we will give an analysis on the processes and stakeholders within HAPs. For this part we visited Het Gelderse Vallei in Ede. Before we start it is important to notice that not all HAPs work the same. In this chapter we want to answer sub-question 1 and 2.

## 2.1 PROCESSES IN A HAP

From the interviews at "Het Gelderse Vallei" we found the processes depicted in Figure 3. They are an estimation of what the processes look like in an average HAP. The HAP in Ede is located in a hospital, the positioning inside a hospital does not hold for all HAPs throughout the country.

The processes in a HAP start with either a phone call or a walk-in from a patient. An estimation was made that about 1 in 10 patients coming in are walk-in. When the patient walks in they get a quick assessment at the service desk after which they get directed to the triage room. This is a room medically equipped to get a first diagnosis of the patient. The triage will decide whether the situation of the patient is urgent and needs a GP to take over. This is similar to when a patient calls instead of walks in. The triage nurse will ask a few questions, and the triage process consists of three phases. Since we do not have the walk-in data, our only focus will be on the calls that come in.

The first phase is to assess the current situation using ABCD [1]questions and to find out what the patient's whereabouts are, for example where they were or what they were doing.
Phase two is finding the compliant that can potentially cause the most problems and assessing the urgency. And for the final phase, the triage nurse decides on the follow-up action in agreement with the patient. The follow-up from phase three could be for the patient to wait and go to their own GP, come for a visit or for the GP to visit the patient.
The last two are processes for the GP. During the call it might be possible that the triage nurse is unsure of what to do, it is then possible for the directing GP of the shift to answer some questions or to take over the call. If this happens during an assessment in the triage room the patient will just be directed to a GP.
It is possible that patients are waiting but all triage nurses are already in a call, the coordinating triage (CoDi) will signal to the others to request them to keep calls short where possible and to call the patients back later. This is only allowed for the triage to decide in the third phase after they have concluded from their assessment that the urgency for the patient is low.

The directing GP is also a GP on duty and could stay in their own room or could be a GP that is scheduled as the visiting GP. Besides the directing GP, we have the other GPs or AIOS (a Dutch abbreviation that stands for Doctor in Training for Specialization), they have their own rooms for consultations. In the case of Het Gelderse Vallei, they also have a room for a specialized nurse, a nurse with a master's degree. They only focus on patients with single issues, for example, a twisted ankle or a wound that needs stitching. The specialized nurse also has their own room.

Currently at Het Gelderse Vallei, the GPs take about 15 minutes per patient, this duration is something the GPs do not want to decrease to be able to treat more patients. This is because they want to make sure they treat the patients properly. During the consultation, the GP will try to treat the patient and consult on further treatment for when the patient gets home, for example, medicine. But it is also possible that the GP will direct the patient to the emergency post of the hospital for a specialist or for example a CT scan.

[1] Airway, Breathing, Circulation and Disability

The GP that goes on visits does not drive by themselves; they always have a chauffeur. The number of cars in use at the GP depends on the size of the region. After every visit, the GP calls back to the GP to inform the coordinating triage nurse about their availability. It is then possible for the GP to immediately visit another patient if needed and thus not return to the HAP first.

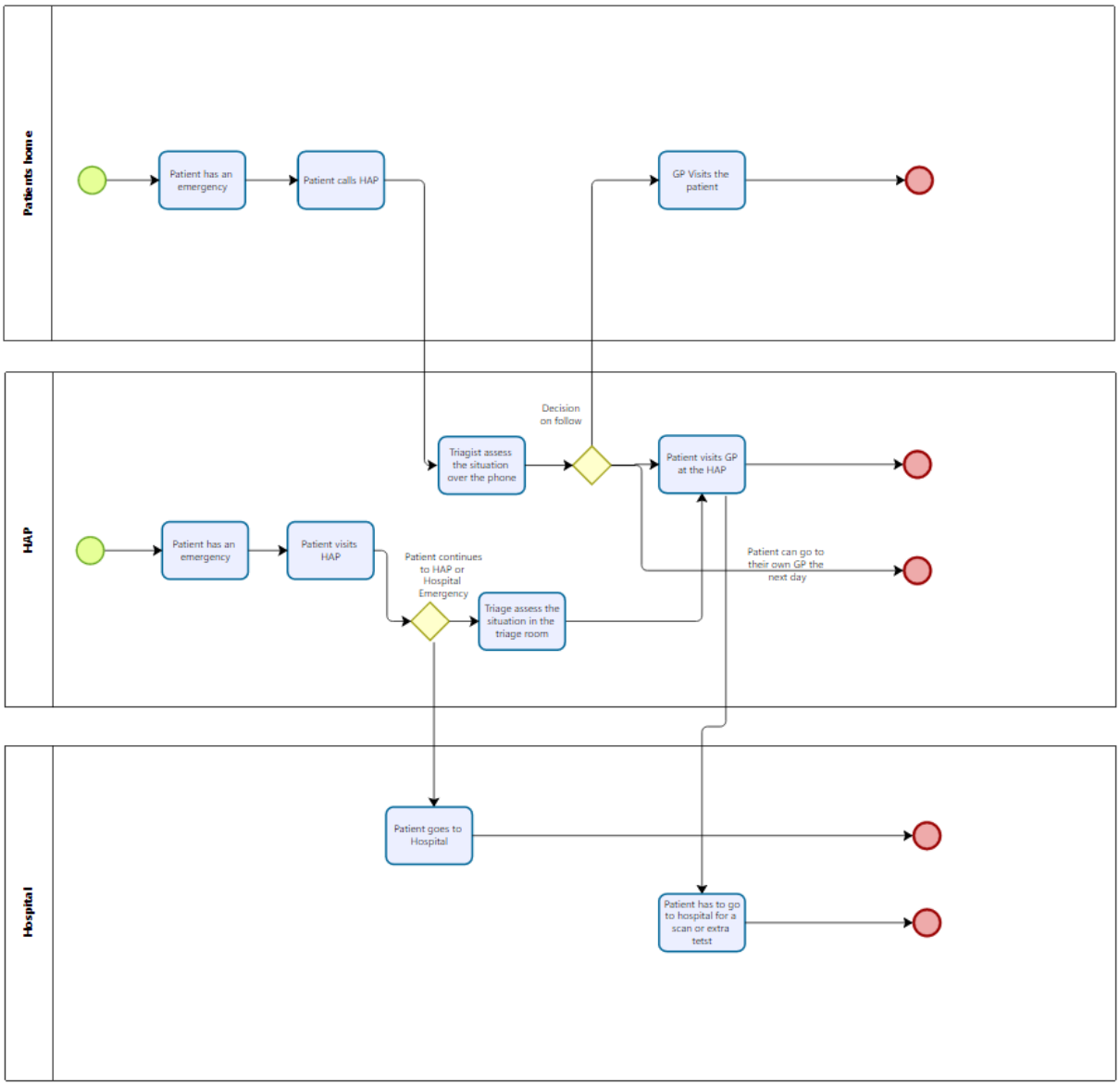



*Figure 3 Processes that take place inside a HAP*

## 2.2 STAKEHOLDERS-ANALYSIS

From our visit to the HAP Het Gelderse Vallei, we have also found the stakeholders that exist in a HAP. We will place these stakeholders in a stakeholder matrix to show their importance when creating a capacity planning model.

### 2.2.1 Stakeholders

Through discussions with staff from Het Gelderse Vallei, including triage nurses and the GPs, we identified several different stakeholders within the HAP. We have the triage nurses and GPs, both are led by the coordinating triage and the directing GP respectively. The GPs also go on house visits, where they do not drive to themselves, thus they need medically skilled drivers. The last stakeholders from the HAP side are the service desk workers. And not to forget the patients who require and deserve high-quality care.

We can place these stakeholders in a stakeholder matrix (Freeman, 1984), to show their importance in developing a capacity planning model. The matrix has two axes; “Relative Threatening Potential” and “Relative Cooperative Potential”.  In Figure 4 we can find the positions of the stakeholders. From our interview with the GP, we found that when a new capacity planning model comes, they do not like the idea of having less time per patient. They explained that this negatively affects the care they provide to their patients.
The triage nurses also need time to correctly assess the help the patient requires. What we gathered from talking to the triage nurses at Het Gelderse Vallei was that they do think they get enough time to do so. They do think that patients should not wait too long in line before they get to speak to a triage nurse. That is also why they agree to call patients back if the patient does not require immediate care and it is busy at that moment.

As mentioned earlier patients should not have waiting times that are too long, or even at all. But they are not able to influence the capacity planning model.
Based on this we created the following stakeholders matrix in Figure 4. The GPs and the triage nurses are put in the defensive group because they are hesitant about change that would decrease the quality of care they would provide. We will use this stakeholders matrix in the next part of our research, by making sure the triage nurses are able to provide the proper care for the patients.

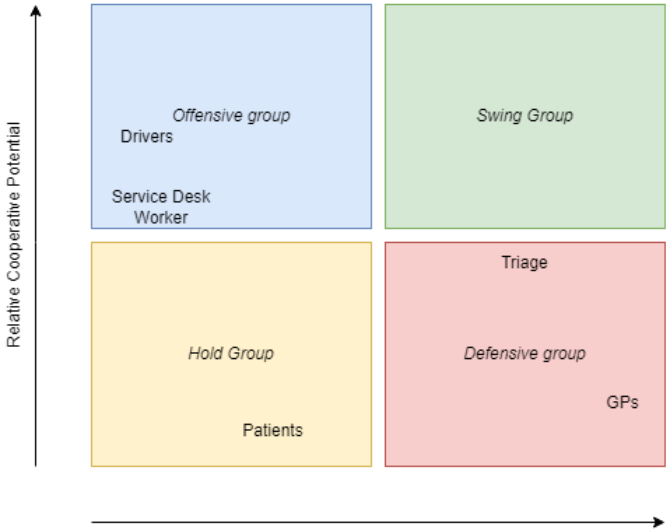



*Figure 4 Stakeholders Matrix*

## 2.3 CONCLUSION

When creating a universal planning model, we should pay attention to several actors. Most notable the GPs and the triage nurses, but the quality of care should not be forgotten. Patients can arrive in the system via various ways (calling or walking in).

When a queue is full it is possible that a triage nurse from a different HAP can help emptying the queue, or it is possible that triagists can schedule in callbacks and try to shorten the service when possible.

For the creation of a universal capacity planning model, the needs of the triage nurses and the GPs should be paid attention to most. As the defensive group they are the most difficult stakeholders to deal with.

# 3. MODELLING OF THE TRIAGE

In this chapter, we will look at what tool we can use to model our situation to answer our research question. As we are analysing what is essentially a call centre we will look at the survey research "Queueing Models of Call Centres An Introduction" (Koole & Mandelbaum, 2001). In the paper they conducted a survey of some academic research on call centres, since the triage is essentially a call centre with higher stakes.

## 3.1 QUEUEING MODEL OF CALL CENTRES

Koole and Mandelbaum say that arrivals for a call centre are typically random. The calls can come at any given minute, and the calls arrive independent of each other. Thanks to these circumstances, the arrival process for a call centre fits the Poisson process (Koole & Mandelbaum, 2001, p. 13).

They mention that for a call centre, a model like the M/M/s queue can be used, also known as Erlang C. Although they do mention that the model is an oversimplification. Factors like customer impatience and service processes are not taken into account. The examples they mention are more related to commercial call centres which a HAP is not comparable with. The service at the call centre of a HAP is done by triage nurses who all provide the same "service" for the caller, the patient. The call centre at the HAP also only has one queue, with multiple stations that are parallel to each other and not in series. When the triage nurse is done with the patient the call and thus the service ends (the patient could then visit the HAP but that is outside the scope of this research) (Koole & Mandelbaum, 2001, p. 8).

### 3.1.1 Modelling the Arrivals

A queueing system can be described by its arrivals, service process and its queue discipline (Winston, 2004, pp. 1052-1053). To model the arrivals for our queueing system we need to find the arrival rate λ. Using Equation (1), where λ stands for the arrival rate and t stands for time, we can recognize an exponential distribution see Appendix A for two examples, therefore we choose for our arrivals an exponential distribution.

$$a(t) = \lambda e^{-\lambda t} \quad (1)$$

Because the arrival of one call does not depend on the arrival on the previous arrivals we can assume the no memory property for our arrivals (Winston, 2004, pp. 1053-1055). We can now confirm from Winston that the arrivals follow a Poisson distribution. The theorem says: "Interarrival times are exponential with parameter t if and only if the number of arrivals to occur in an interval of length t follows a Poisson distribution with parameter λt." (Winston, 2004, p. 1055).

### 3.1.2 Modelling the Service Processes

To model the call centre as a queuing system we will also need to find the service time $\mu$. According to the research by Koole and Mandelbaum, queueing theory assumes service time to be exponentially distributed. This comes from the lack of empirical evidence (Koole & Mandelbaum, 2001, p. 15).

## 3.2 THE MODEL

To find how we can model our system we can use conceptual modelling from Robinson (Robinson S. , 2004). First, we need to understand the problem situation. The second is to find the modelling objectives. The third is to design the conceptual model and the last step is to collect and analyse the data that is needed to develop the model.

The problem situation as described before is, that we want to study options to optimize the scheduling by limiting the service time based on Chapter 2 and combining the incoming calls. Our objective when altering our model to optimize the schedule is to make sure that the average waiting time stays within 120 to 270 seconds.

### *Conceptual model*

Bouzada (2009) suggests from that for a call centre, using simulation would be a better tool than Queueing Theory. He used the following arguments; *"with simulation, the model will be closer to reality; the service levels calculated using Erlang formulas are usually underestimated; minimum and maximum values of important performance indicators can be obtained; we gain a better understanding of the system; communication can become easier via the use of graphic animations"* (Bouzada, 2009). Chassioti (2012) also mentions that simulation can be used for real and complex queuing problems, including call centres (Chassioti, 2012).

The Stationary Independent Period by Period (SIPP) approach is an approach that uses queueing models to set staffing requirements (Green, Kolesar, & Soares, 2001). Part of the approach is to divide the workday or workweek into so-called "planning periods" (Green, Kolesar, & Soares, 2001).

*Model*

Our simulation will run for five weeks, and starts with an empty queue on Monday at 17:00, therefore, we do not need a warmup period (Robinson S. , 2007). And our simulation ends on Monday at 08:00. We will collect our data in five batches that are each a week long corresponding to the five weeks this is the batch means method.

For our simulation, we will use the programme Plant Simulation for our discrete-event simulation. The inputs for our simulation will be the incoming calls, the service time and the number of triage nurses. In Figures 5 and 6 the design of the simulation and model is shown. The output we want from our simulation is the average waiting time per day.

The planning periods we will use will come from the next step of conceptual modelling, which will be done in chapter 4. The planning periods can be used by finding hours of the day where the arrival rate per hour is similar and combining those hours and consider that as a shift. During a shift that could take up multiple hours, the triage nurses also need breaks, therefore we will run two types of simulations for experiment 1. The two simulations will have six or seven minute breaks every hour, this comes down to about half an hour break for six hours of work and a bathroom break. In plant simulation, we can use the shift calendar to schedule breaks and shifts. In Figure 7 we show how the arrival rate and service time is used as input.
For experiment 2 we will use shifts from Region A to create an improved schedule.

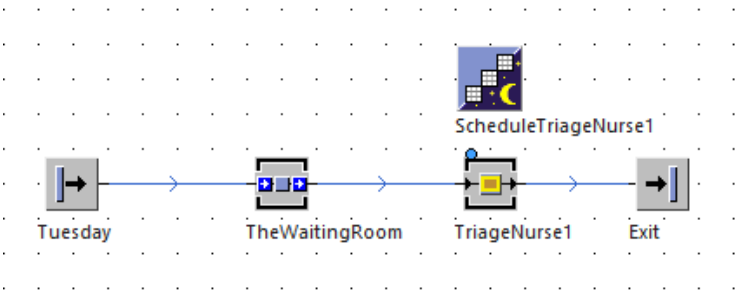



*Figure 5 Simplified design of the simulation in Plant Simulation*

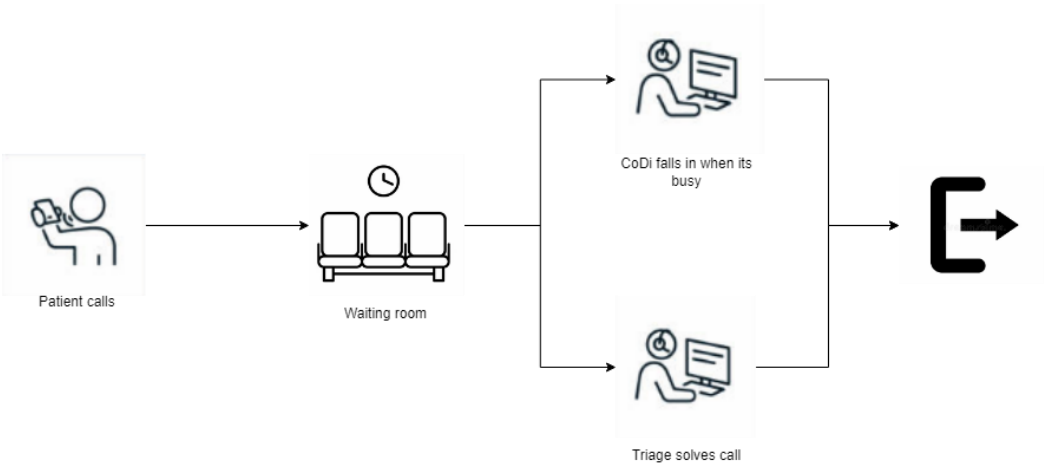



*Figure 6 Simplified design of the model (CoDi stands for the coordinating triage nurse)*

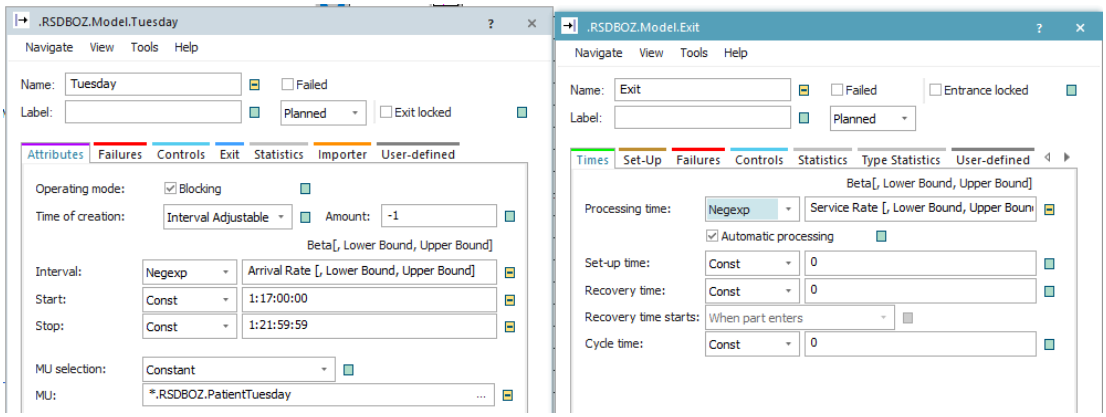



*Figure 7 Input for arrival rate and service rate in Plant Simulation*

Because of the planning periods, a day could have multiple shifts, for example the night shift, a shift from 17:00 to 22:00 and a shift from 22:00 to 00:00. For every planning period we will allocate a number of triage nurses. If after the simulation we find that the waiting time on a certain day is too high or too low, we will look at the density of the waiting time to add or subtract a triage nurse, from the planning period that overlaps with that density.
We have found two options that can be used to reduce the staffing hours of triage nurses, limiting the service time we got from the interviews and combining incoming calls from different HAPs. From region A, we received the data of incoming calls from HAP 1 and 2 and HAP 3. We will simulate the incoming calls over a five week period to find the optimal number of triage nurse which still maintains the service level of average waiting time between 120 and 270 seconds. We want to find the optimal number of triage nurses for HAP 1 and 2 and HAP 3, afterwards, we combine the total number of triage nurses with the total number of nurses we get when we combine the incoming calls from all three HAPs. A practical example is that a weekday starts at midnight till 23:59, with a break between 8 AM and 5 PM. We could divide this weekday in three different planning periods, in which the arrival rate per hour is similar within that planning period. We will then take the average arrival rate of that time range, for the arrivals of that time range. And we will create a shift for that time range in which a certain number of triage nurses will be active. For the average waiting times we will look at the whole day and depending on which planning period is too busy or perhaps the opposite we will add or subtract a triage nurse for that planning period.

So far we have then only looked at if we can reduce the number of triage nurses, but that is not necessarily compatible with optimizing the schedule. Thus, to improve the existing schedule we will combine all incoming calls and not use planning periods of several hours, but actual shifts. These shifts will be based on shifts from the existing schedules that we got from region A. The schedules are optimized if the hours from the triage nurses are reduced compared to the original situation. The last step of our conceptual modelling will be done in the next chapter.

## 3.3 CONCLUSION

To conclude this chapter, the triage process is essentially a call centre. Call centres can be modelled as an M/M/s queueing system. However, because of the complexity of modelling a call centre with queueing theory, we will use simulation. In the first experiment the schedule is optimized by combining the incoming calls and in the second experiment the schedule is optimized by combining the incoming calls and maximizing the service time. This should be done while keeping the average waiting time per day between 120 and 270 seconds.

# 4. DATA ANALYSIS

In this chapter we will follow the last step of conceptual modelling, we will analyse the data we received and use that as input for the simulation. Based on the arrival rates we will group the days and the hours of the day that have a similar arrival rate for our planning period and calculate their inter-arrival times. We will also calculate the duration of the calls to find how long it takes to process a call.

## 4.1 DATA ANALYSIS ARRIVALS

The data we have received from the RIVM, are calls made to three different HAPs. The data of the incoming calls from the first two HAPs were combined. The data set contains every incoming and outgoing call made from the period beginning on January first 2024 up until May 31st 2024. The total population the HAPs belong to are as follows: HAP 3 with 287,105 people, and HAP 1 and 2 combined with 295,255 people. The holidays on which the HAP was opened were January first, May 9th and 20th and April first. In the period of the data, we had 19 Mondays, 22 Tuesdays, 22 Wednesdays, 21 Thursdays, 22 Fridays, 21 Saturdays and Sundays and 4 holidays. This gives us the averages in Table 1 based on the total number of calls on each day from Figure 8.

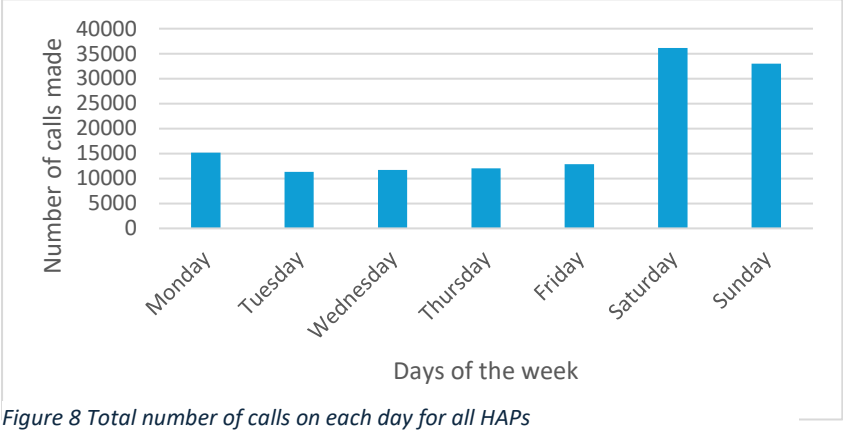



*Figure 8 Total number of calls on each day for all HAPs*

| Day of the week | Average number of calls |
|---|---|
| Monday | 149.79 |
| Tuesday | 144.45 |
| Wednesday | 152.18 |
| Thursday | 142.14 |
| Friday | 160.54 |
| Saturday | 480.95 |
| Sunday | 448.67 |
| Holidays | 452 |

*Table 2 Average number of calls on each day of the week*

During the period of the collected data, a total of 46,559 calls were made to and from HAPs 1 and 2 (Figure 9) and a total of 37,219 calls were made to and from HAP 3 (Figure 10). The spikes from both figure are caused by the office hours, during work days the HAPs are unavailable from 08:00 to 17:00 and during weekends and holidays (01-01, 01-04, 09-05 and 20-05) they are available all 24 hours.

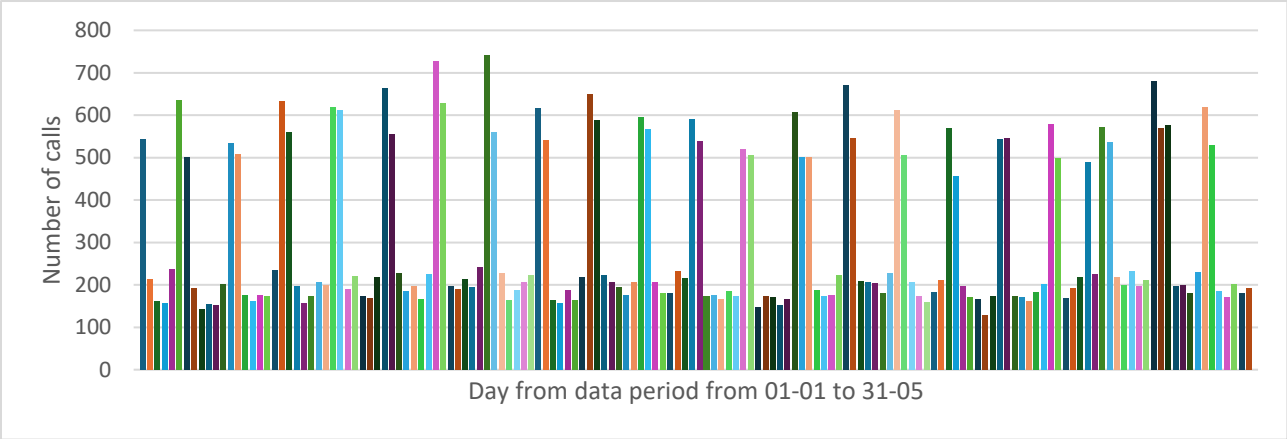



*Figure 9 Total number of calls made each day HAP 1 and 2 from 01-01 to 31-05*

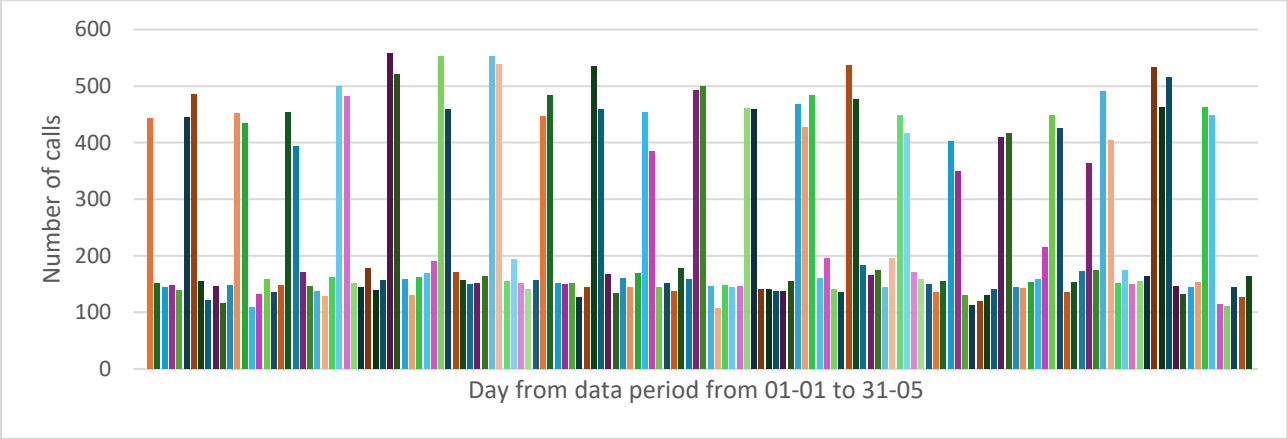



*Figure 10 Total number of calls made each day HAP 3 from 01-01 to 31-05*

Because of the difference in opening times when analysing the days we first make a distinction between weekdays, weekends and holidays. Because we want to compare two different sets of cities with each other, we start by looking at the population density of both cities. Combined HAP 1 and 2 have 295,255 citizens and HAP 3 has 287,105 citizens. This number is based on the work area of the HAPs. Because we do not have any data on the distribution of age or gender from the calls we will not make any conclusions on whether age or gender influences the numbers of calls.

When we look at the average calls made each day in Figures 11 and 12 we can see in both data groups that Saturdays are the busiest and out of the weekdays Fridays are slightly busier than the other weekdays. This can be explained because it is the start of the weekend.

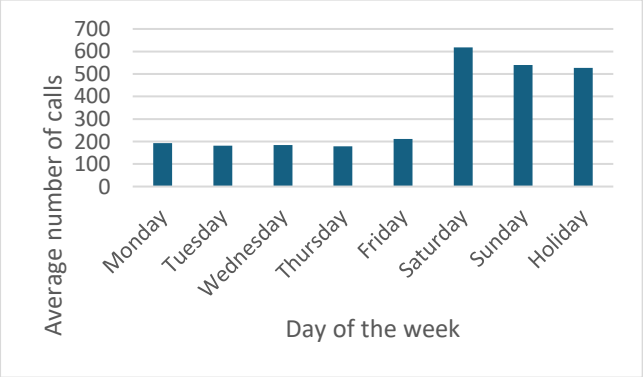



*Figure 11 Average calls each day of the week for HAP 1 and 2*

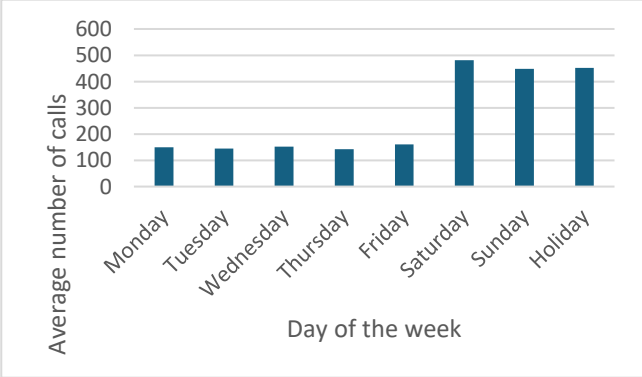



*Figure 12 Average calls each day of the week for HAP 3*

For each day we aggregated the arrivals for every 30 minutes, the average arrival for each day of the week can be found in the graphs in Appendix B. We excluded the holidays because the sample size, n= 4. In the graphs in we can see that for every day of the week, the arrivals of calls follow the same patterns. Saturday and Sunday are full 24 hours we took out the office hours. We calculated the mean for every 30 minutes and it's standard deviation see Appendix C. Based on the standard deviation for every 30 minutes we concluded that we could consider that the weekdays follow the same pattern of arrivals.

When looking at the pattern of the arrivals from Figure 13 and Figure 14 we find a similar pattern. Based on the pattern we will group the arrivals in the time ranges and calculate the corresponding interarrival times see Table 3.

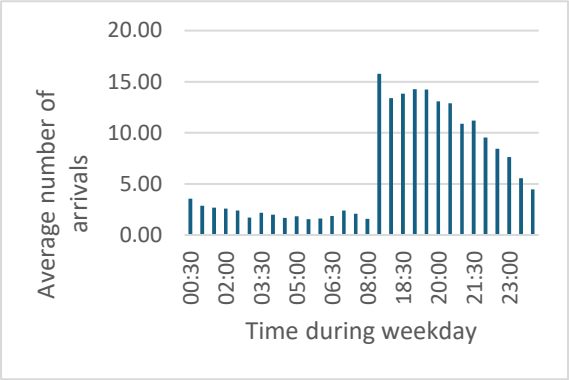



*Figure 13 Average arrivals per 30 minutes, weekdays, HAPs 1 and 2*

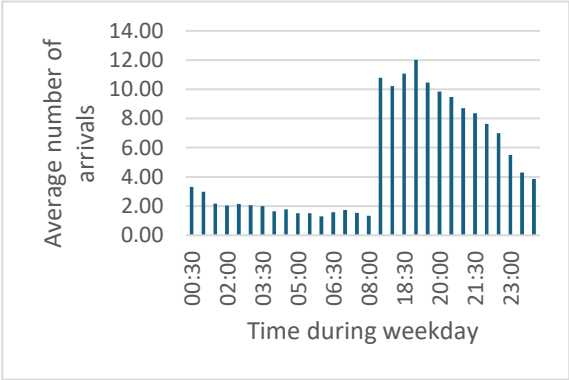



*Figure 14 Average arrivals per 30 minutes, weekdays, HAP 3*

| Time Ranges | Average arrival rate $\lambda t$ HAP 1 and 2 | Average interarrival times $\lambda$ HAP 1 and 2 | Average Arrival Rate $\lambda t$ HAP 3 | Average interarrival times $\lambda$ HAP 3 |
|---|---|---|---|---|
| 17:00 – 22:00 | 129.10 | 2:19 | 98.54 | 3:03 |
| 22:00 – 00:00 | 37.86 | 3:10 | 20.64 | 5:49 |
| 00:00 – 08:00 | 34.57 | 13:53 | 30.66 | 15:39 |

*Table 3 Average arrival rate and interarrival times weekdays*

We will create time ranges and find the corresponding arrivals and interarrival times also for Saturdays and Sundays based on the pattern of the arrivals. We have separated them because the standard deviation of the average arrivals was too larges for both HAPs for those days . At some points the standard deviation was higher than two and most of the 30 minute ranges it was also higher than one see Figure 19. Looking at the patterns of the arrivals for both HAPs figures 15 to 18 we have found the arrival rate and interarrival times in Tables 4 and 5.

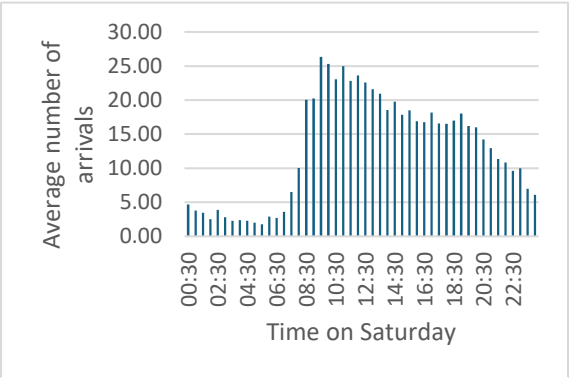



*Figure 15 Average arrivals per 30 minutes, Saturday, HAP 1 and 2*

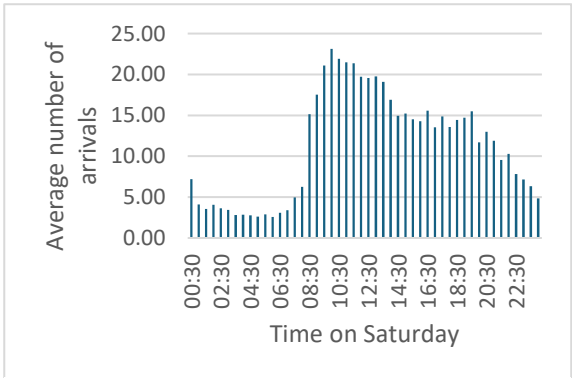



*Figure 16 Average arrivals per 30 minutes, Saturday, HAP 3*

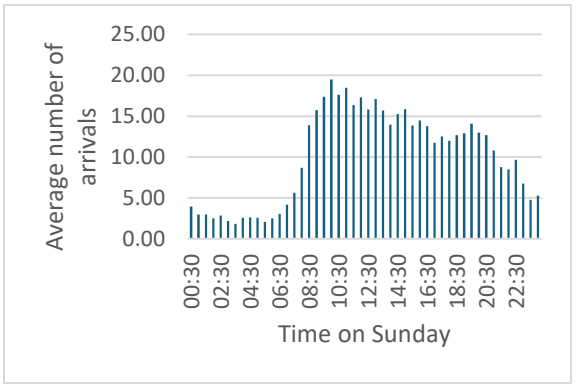



*Figure 18 Average arrivals per 30 minutes, Sunday, HAP 1 and 2*

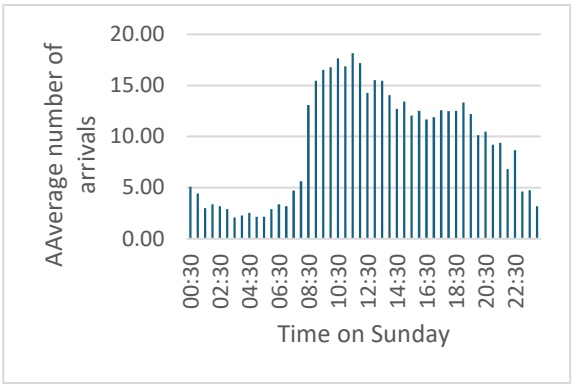



*Figure 17 Average arrivals per 30 minutes, Sunday, HAP 3*

| Time Ranges | Average arrival rate $\lambda t$ HAP 1 and 2 | Average interarrival times $\lambda$ HAP 1 and 2 | Average Arrival Rate $\lambda t$ HAP 3 | Average interarrival times $\lambda$ HAP 3 |
|---|---|---|---|---|
| 00:00 – 08:00 | 57.71 | 8:19 | 53.00 | 9:03 |
| 08:00 – 15:30 | 326.19 | 1:23 | 243.67 | 1:51 |
| 15:30 – 21:00 | 179.38 | 1:50 | 140.57 | 2:21 |
| 21:00 – 00:00 | 54.95 | 3:17 | 43.71 | 4:07 |

*Table 4 Average arrival rate and interarrival times Saturday*

| Time Ranges | Average arrival rate $\lambda t$ HAP 1 and 2 | Average interarrival times $\lambda$ HAP 1 and 2 | Average Arrival Rate $\lambda t$ HAP 3 | Average interarrival times $\lambda$ HAP 3 |
|---|---|---|---|---|
| 00:00 – 08:00 | 60.14 | 7:59 | 53.00 | 9:03 |
| 08:00 – 19:30 | 397.86 | 1:44 | 328.43 | 2:06 |
| 19:30 – 22:00 | 56.43 | 2:39 | 46.00 | 3:15 |
| 22:00 – 00:00 | 26.14 | 4:36 | 21.24 | 5:39 |

*Table 5 Average arrival rate and interarrival times Sunday*

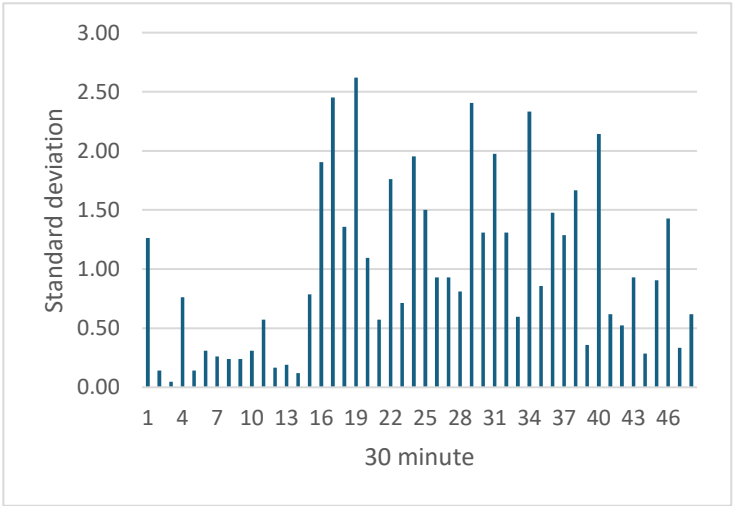



*Figure 19 Standard deviations per 30 minutes, HAP 1 and 2 and HAP 3 combining Saturday and Sunday*

## 4.2 DATA ANALYSIS SERVICE TIME

The service times we found were 5:08 for HAP 1 and 2 and 6:06 for HAP 3. And for all HAP combined we found it was 5:33. We found this by calculating the average duration of all calls made separated and combined.
Because triage nurses do not immediately go back in line to assist patients we will add 30 seconds to the found service times.
For the second experiment, we will only run the experiment with a service time of 6:03 seconds, which gives the triage nurse again 30 seconds of downtime between calls.

The minimum and maximum duration of the phone calls we found for HAP 1 and 2 and for HAP 3 were 0:01 and 33:19 and for all HAP combined we used 0:01 and 30:00. This will be our lower limit and upper limit for the service duration. This will be done for experiments 1 and 2, but for experiment 2 we will also run different experiments where we limit the max duration of the service time. This will be used to show the difference it makes when promoting the triage nurse to plan callbacks with patients, instead of staying on the phone for longer periods. So for experiment 2, we will use a lower limit of 0:01 and an upper limit of 30:00 for the first experiment and then decrease the upper limit to 27:30 and 25:00.

The phone calls that were short for example thirty seconds or less, were not excluded from this research, because they do take up time for the triage nurses.

## 4.3 CONCLUSION

We have completed the final step of conceptual modelling by analysing the data of the incoming calls. For experiment 1 we created the same planning period during the weekdays, but different planning periods on Saturday and Sunday. For experiment 2 we will use the hourly arrivals.
We have also found the service time for our simulations.

# 5. THE EXPERIMENTS

In this chapter, we will analyse the results of our simulations, our simulations will run for 5 weeks and we will group our output for each week. In experiment 1 we will compare the number of triage nurses we get from HAP 1 and 2 and HAP 3 with the number of triage nurses from all incoming calls combined. And in the second experiment, we will create a new schedule, that should have a reduced number of triage nurse hours planned compared to the schedule we received from Region A.

| Experiment 1 | Experiment 2 |
|---|---|
| Simulations with 6 and 7 minute breaks | Combine the arrivals and create an improved schedule |
| Combine the arrivals from all HAPs | - |

## 5.1 EXPERIMENT 1, COMBINING THE ARRIVALS

### 5.1.1 HAP 1 and 2 and HAP 3

The number of triages required for our first simulation, which was six-minute breaks every hour, service time plus thirty seconds, and -0% arrival rate, we have found are shown in Table 5. The waiting times for each HAP and more including the graphs can be found in Tables 6, 7 and 8. More detailed results can be found in Appendix G for the number of triages needed and Appendix H for the results of our runs. The numbers in Table 6 tell us that we have found that combining the triages results in less number of triages needed. We use fewer triagists but the average waiting times still stay in acceptable ranges. We have found a net benefit of 116 triage hours.

| | | HAP 1 and 2 | HAP 3 | All HAP combined |
|---|---|---|---|---|
| Weekday | 17:00 – 22:00 | 3 | 3 | 6 |
| Weekday | 22:00 – 00:00 | 2 | 2 | 3 |
| Weekday | 00:00 – 08:00 | 2 | 2 | 2 |
| Saturday | 00:00 – 08:00 | 2 | 2 | 3 |
| Saturday | 08:00 – 15:30 | 5 | 4 | 8 |
| Saturday | 15:30 – 21:00 | 4 | 4 | 7 |
| Saturday | 21:00 – 00:00 | 2 | 2 | 4 |
| Sunday | 00:00 – 08:00 | 2 | 2 | 3 |
| Sunday | 08:00 – 19:30 | 4 | 4 | 8 |
| Sunday | 19:30 – 22:00 | 3 | 3 | 4 |
| Sunday | 22:00 – 00:00 | 2 | 2 | 3 |
| | Total hours | 320 | 312.5 | 506.5 |

*Table 6 The minimum number of triage nurse required per planning period*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 310.45 | 1602.31 | 91 | 682.32 |
| Tuesday | 84.81 | 790.43 | 67 | 246.82 |
| Wednesday | 121.62 | 1621.02 | 51 | 467.42 |
| Thursday | 42.64 | 872.19 | 51 | 160.53 |
| Friday | 53.30 | 805.58 | 39 | 276.08 |
| Saturday | 156.78 | 1830.13 | 175 | 520.33 |
| Sunday | 112.22 | 1347.62 | 226 | 284.53 |

*Table 7 Waiting times HAP 1 and 2*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 133.03 | 1024.51 | 57 | 338.42 |
| Tuesday | 237.92 | 1655.26 | 62 | 544.91 |
| Wednesday | 61.56 | 911.54 | 37 | 227.93 |
| Thursday | 306.15 | 1902.10 | 63 | 690.05 |
| Friday | 49.22 | 907.95 | 20 | 347.03 |
| Saturday | 70.68 | 1156.29 | 119 | 291.05 |
| Sunday | 129.33 | 1989.05 | 142 | 431.70 |

*Table 8 Waiting times HAP 3*

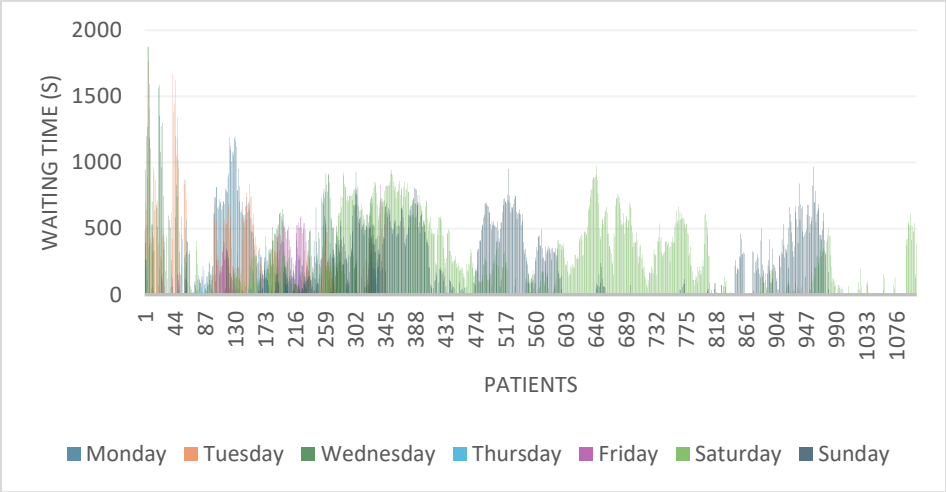



*Figure 20 Waiting times for each patient, incoming calls combined, 6 minute breaks, -0% interarrival time*

## 5.2 EXPERIMENT 2, IMPROVING THE SCHEDULE

For our second experiment we will compare the schedule given to us (see Appendix I) to the schedule that we create from our simulations. The schedule given to us by Region A can be found in Appendix I. We divided the scheduled hours into three different categories; night shifts, shifts that start in the morning into the afternoon and shifts that start in the afternoon into the evening. The total hours allocated by Region A per category are shown in table 9 these numbers show the total number of hours on weekdays and do not include the "CoDi" hours. The CoDi hours are from the directing triagists. The CoDi does call but not continuously as they are also involved in other activities. We therefore have not added the CoDi in the sum of the hours however, they can be added in the simulations. These totals will be compared to the hours we find from our simulations.

| | Nightshift | Morning Afternoon | Afternoon Evening | Total |
|---|---|---|---|---|
| Weekdays | 180 | - | 205 | 385 |
| Saturday | 36 | 96.75 | 56 | 188.75 |
| Sunday | 36 | 97.75 | 56 | 188.75 |
| Total | 252 | 193.5 | 317 | 762.5 |

*Table 9 Hours scheduled per shift over the days*

We will run three different simulations, where we only change the max duration of the phone calls, because this can help minimize the average waiting time in busy periods and is used by the HAP at the Gelders Vallei. This strategy can minimize the waiting times because patients that are waiting, will start their service earlier and thus have a shorter waiting time. And according to the triage nurses

at the Gelders Vallei, they found that planning in call backs resulted in patients feeling better already when they get called back.
The maximum duration we used for the three HAP was 33:19. And we used a maximum of 30 minutes for the combined incoming calls. Although Region A does not apply this in their processes, it is something they could add to reduce waiting times. For this reason we will run the simulation with three different maximum service times. The first runs we will have a duration of 30 minutes, the second run 27 minutes and thirty seconds and the third run will have a max duration of 25 minutes. The minimum duration of the phone calls will be the same as the previous experiment 0:01 and we will use the average service time we found for the combined incoming calls.
Contrary to the previous simulations, we will not use the same time planning periods. This is because we want to find an optimal schedule, thus we will in this case use the hourly arrivals. The hourly arrivals we have found and used are in appendix H.
In appendix I you can find back the combined schedule that is currently in use. Based on that schedule we have chosen some time slots that are used more frequently and used them for our optimized schedules.

### *30:00 maximum service time*

The results from our simulations to get to the required triage nurses to still maintain the service level can be found in Table 10. The schedule with the least hours used is from our third run which can be found in Table 10. Although Region A uses the same four or five triages on the weekdays we found that when using one less on the first four days is more efficient. Just like the schedule we were provided with, we had one triage nurse working from 17:00 to 22:00. But turning one triage form working 17:00 to 23:00 to working 17:00 to 22:00 saved us at least 8 hours a week. That is what we did and at the same time we added the CoDi to the line, who also accepts calls during two periods of 30 minutes between 19:24 and 21:04. The CoDi working the afternoon/ evening shift on the weekend did the same but only accepted calls for one period of thirty minutes between 18:45 and 19:15. This change helped us save 4 hours on average on Sunday.

| Day | Times | **1** | **2** | **3** |
|---|---|---|---|---|
| Monday - Thursday | 23:00 – 08:00 | 2 | 2 | 2 |
| Monday - Friday | 16:45 – 23:15 (CoDi) | 1 | 1 | 1 |
| Monday - Thursday | 17:00 – 23:00 | 4 | 4 | 4 |
| Friday | 17:00 – 23:00 | 5 | 5 | 5 |
| Monday – Thursday | 17:00 – 22:00 | 2 | 1 | 2 |
| Friday | 17:00 – 22:00 | 1 | 2 | 2 |
| Friday | 23:00 - 08:00 | 3 | 3 | 3 |
| Saturday | 23:00 – 08:00 | 3 | 3 | 3 |
| Saturday | 07:45 – 15:45 (CoDi) | - | - | - |
| Saturday | 09:00 – 17:00 | 4 | 4 | 4 |
| Saturday | 09:00 – 16:00 | 0 | 0 | 0 |
| Saturday | 07:30 – 15:30 | 2 | 2 | 2 |
| Saturday | 07:45 – 15:30 | 4 | 4 | 4 |
| Saturday | 15:30 – 23:15 (CoDi) | 1 | 1 | 1 |
| Saturday | 15:30 – 23:00 | 7 | 6 | 6 |
| Saturday | 15:30 – 21:00 | 0 | 0 | 0 |
| Sunday | 23:00 – 08:00 | 2 | 2 | 2 |
| Sunday | 07:45 – 15:45 (CoDi) | - | - | - |
| Sunday | 09:00 – 17:00 | 3 | 3 | 3 |
| Sunday | 09:00 – 16:00 | 1 | 1 | 1 |
| Sunday | 07:30 – 15:30 | 2 | 3 | 3 |
| Sunday | 07:45 – 15:30 | 4 | 4 | 4 |
| Sunday | 15:30 – 23:15 (CoDi) | 1 | 1 | 1 |
| Sunday | 15:30 – 23:00 | 4 | 4 | 4 |
| Sunday | 15:30 – 21:00 | 2 | 2 | 2 |

*Table 10 Optimized schedule with maximum service time of 30 minutes*

| | Nightshift | Morning Afternoon | Afternoon Evening | Total |
|---|---|---|---|---|
| Weekdays | 99 | - | 176 | 275 |
| Saturday | 27 | 79 | 45 | 151 |
| Sunday | 18 | 86 | 41 | 145 |
| Total | 144 | 165 | 262 | 571 |

*Table 11 Hours scheduled per category maximum service time 30 minutes*

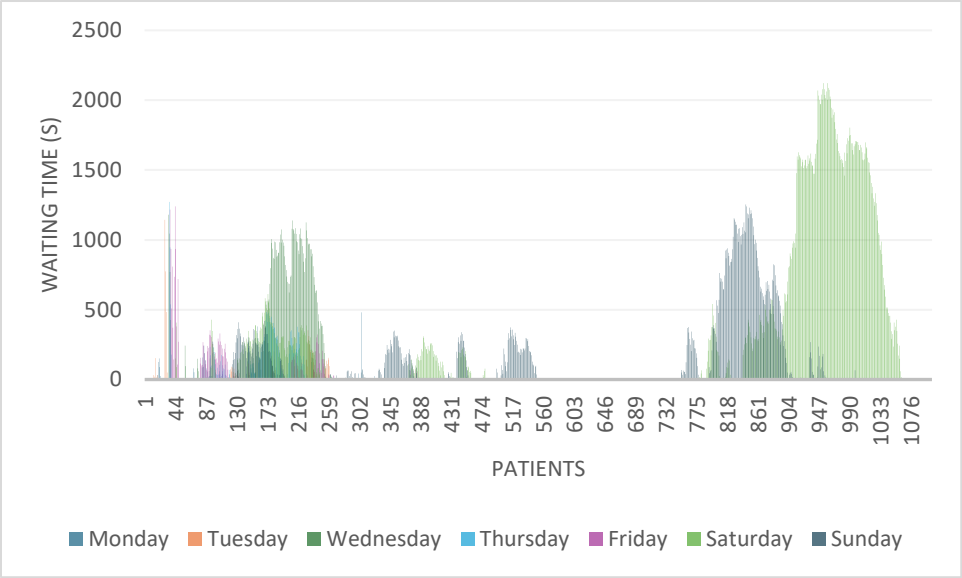



*Figure 21 Waiting times for each patient, experiment 2, run 3, 30:00 service time, week 1, other weeks are in Appendix K*

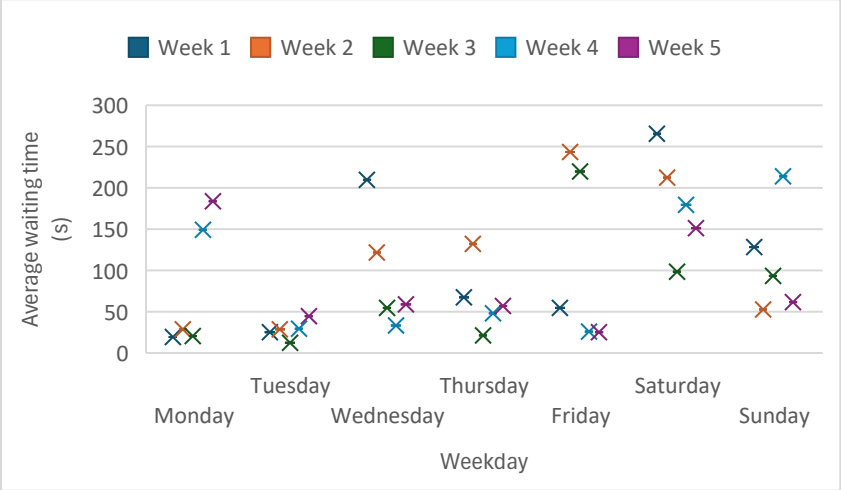



*Figure 22 Arrivals for each day for all five weeks in run 3, other runs can be found in Appendix L*

Table 10 shows the number of triagists we tested out during each run. In table 11 you can find the total hours scheduled which comes down to 571 over a whole week. This is a difference of 192.5 hours saved on average. Figure 21 shows the waiting times for each patient and Figure 22 plots the average waiting time for each day for all five weeks. The variance in the results from Figure 22 validates our results.

*27:30 maximum service time*

Following the same step as our previous simulation, we have optimized the schedule when limiting the duration of the service time to 27 minutes and thirty seconds in our third run, which can be found in Table 12. In Table 13 we can find the total hours scheduled, 552, which comes down to 210.5 hours saved.

| Day | Times | **1** | **2** | **3** |
|---|---|---|---|---|
| Monday - Thursday | 23:00 – 08:00 | 2 | 2 | 2 |
| Friday | 23:00 – 08:00 | 3 | 3 | 3 |
| Monday - Friday | 16:45 – 23:15 (CoDi) | - | | |
| Monday - Thursday | 17:00 – 23:00 | 4 | 3 | 2 |
| Friday | 17:00 – 23:00 | 4 | 4 | 4 |
| Monday - Thursday | 17:00 – 22:00 | 2 | 3 | 4 |
| Friday | 17:00 – 22:00 | 2 | 3 | 3 |
| Saturday | 23:00 – 08:00 | 3 | 3 | 3 |
| Saturday | 07:45 – 15:45 (CoDi) | 1 | 1 | 1 |
| Saturday | 09:00 – 17:00 | 4 | 4 | 4 |
| Saturday | 09:00 – 16:00 | 0 | 0 | 0 |
| Saturday | 07:30 – 15:30 | 2 | 2 | 2 |
| Saturday | 07:45 – 15:30 | 4 | 4 | 4 |
| Saturday | 15:30 – 23:15 (CoDi) | 1 | 1 | 1 |
| Saturday | 15:30 – 23:00 | 5 | 5 | 5 |
| Saturday | 15:30 – 21:00 | 1 | 1 | 1 |
| Sunday | 23:00 – 08:00 | 2 | 2 | 2 |
| Sunday | 07:45 – 15:45 (CoDi) | 1 | 1 | 1 |
| Sunday | 09:00 – 17:00 | 3 | 3 | 3 |
| Sunday | 09:00 – 16:00 | 1 | 1 | 1 |
| Sunday | 07:30 – 15:30 | 2 | 2 | 2 |
| Sunday | 07:45 – 15:30 | 4 | 4 | 4 |
| Sunday | 15:30 – 23:15 (CoDi) | 1 | 1 | 1 |
| Sunday | 15:30 – 23:00 | 4 | 4 | 4 |
| Sunday | 15:30 – 21:00 | 2 | 2 | 2 |

*Table 12 Optimized schedule service time 27:30*

| | Nightshift | Morning Afternoon | Afternoon Evening | Total |
|---|---|---|---|---|
| Weekdays | 99 | - | 167 | 266 |
| Saturday | 27 | 79 | 43 | 149 |
| Sunday | 18 | 78 | 41 | 137 |
| Total | 144 | 157 | 251 | 552 |

*Table 13 Hours scheduled per category service time 27:30*

Figure 23 shows the waiting times for each patient and Figure 24 plots the average waiting time for each day for all five weeks

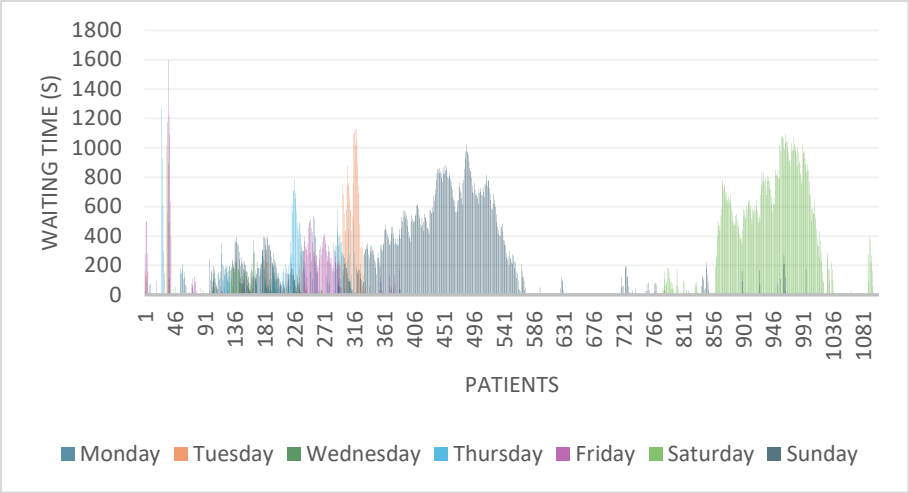



*Figure 23 Waiting times for each patient, experiment 2, run 3, 27:30 service time, week 5, other weeks are in Appendix K*

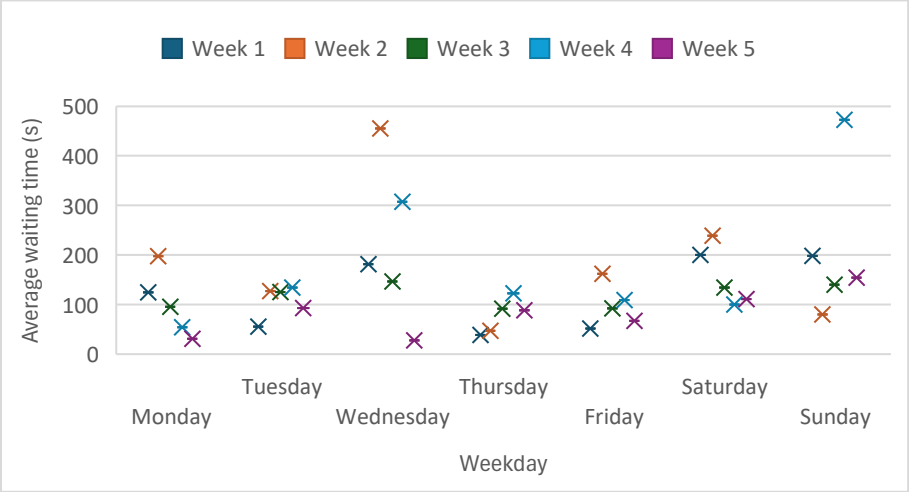



*Figure 24 Arrivals for each day for all five weeks in run 3, other runs can be found in Appendix L*

### *25:00 maximum service time*

For the last simulation we will limit the service time to 25 minutes. The optimized schedule can be found in Table 14 and the hours saved, which was 544, in Table 15.

| Day | Times | **1** |
|---|---|---|
| Monday - Thursday | 23:00 – 08:00 | 2 |
| Friday | 23:00 – 08:00 | 3 |
| Monday - Friday | 16:45 – 23:15 (CoDi) | |
| Monday - Thursday | 17:00 – 23:00 | 2 |
| Friday | 17:00 – 23:00 | 4 |
| Monday - Thursday | 17:00 – 22:00 | 4 |
| Friday | 17:00 – 22:00 | 2 |
| Saturday | 23:00 – 08:00 | 3 |
| Saturday | 07:45 – 15:45 (CoDi) | 1 |
| Saturday | 09:00 – 17:00 | 4 |
| Saturday | 09:00 – 16:00 | 0 |
| Saturday | 07:30 – 15:30 | 2 |
| Saturday | 07:45 – 15:30 | 4 |
| Saturday | 15:30 – 23:15 (CoDi) | 1 |
| Saturday | 15:30 – 23:00 | 4 |
| Saturday | 15:30 – 21:00 | 2 |
| Sunday | 23:00 – 08:00 | 2 |
| Sunday | 07:45 – 15:45 (CoDi) | 1 |
| Sunday | 09:00 – 17:00 | 2 |
| Sunday | 09:00 – 16:00 | 2 |
| Sunday | 07:30 – 15:30 | 2 |
| Sunday | 07:45 – 15:30 | 4 |
| Sunday | 15:30 – 23:15 (CoDi) | 1 |
| Sunday | 15:30 – 23:00 | 4 |
| Sunday | 15:30 – 21:00 | 2 |

*Table 14 Optimized schedule service time 25:00*

| | Nightshift | Morning Afternoon | Afternoon Evening | Total |
|---|---|---|---|---|
| Weekdays | 99 | - | 162 | 261 |
| Saturday | 27 | 79 | 41 | 147 |
| Sunday | 18 | 77 | 41 | 136 |
| Total | 144 | 156 | 244 | 544 |

*Table 15 Hours scheduled per category service time 25:00*

Figure 25 shows the waiting times for each patient and Figure 26 plots the average waiting time for each day for all five weeks

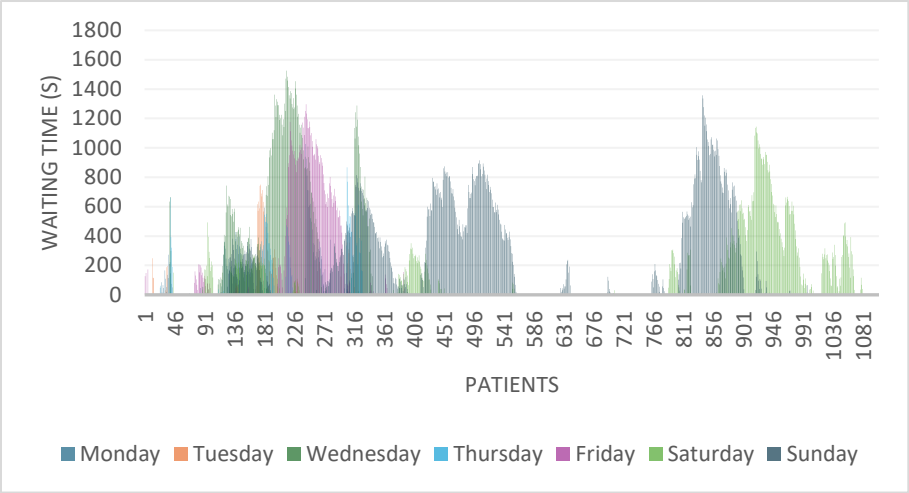



*Figure 25 Waiting times for each patient, experiment 2, run 1, 25:00 service time, week 1, other weeks are in Appendix K*

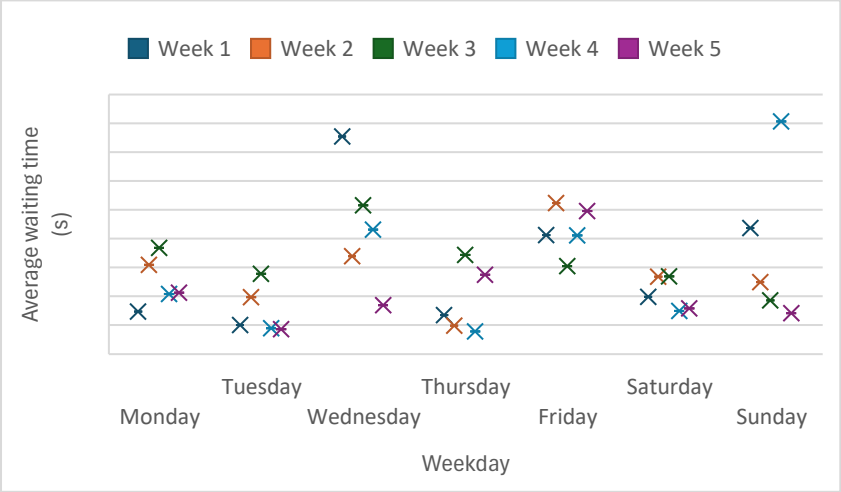



*Figure 26 Arrivals for each day for all five weeks in run 1*

## 5.3 CONCLUSION

Based on the results from our experiments we have found that it is a viable strategy, for the HAPs to combine the triage process over the phone of multiple HAPs and/ or for the RIVM to implement a callback process. By maximizing the service time we found that it reduces the average waiting times and thus the required triage nurses.

# 6. CONCLUSION, LIMITATIONS &RECOMMENDATIONS

In this final chapter we will answer our research question: *"Can we improve the scheduling of triage nurses of regional HAPs by combining the incoming calls?".* To answer this we went and visited a HAP and asked what would be important in a HAP and we analysed data of arriving calls and combined those in an experiment to create an optimized schedule. Based on our findings we will give our recommendation to the RIVM with the limitations of our research.

## 6.1 CONCLUSION

### 6.1.1 Processes inside the HAP

During the first part of our research we looked at the internal processes of a HAP, to map out what goes on inside a HAP. For this we visited a HAP and talked to the employees. What we have gathered is that not every HAP will have the same "lay out" or even the same type of employees. Some HAPs are connected to a hospital and can easier refer a patient to the hospital. Some HAPs also have multiple employees with different skillsets.

We also learned that in the triage process, HAP het Gelders Vallei plans callbacks when it gets busy, which decreases waiting times. This is not done in Region A and could be tested in our experiment.

### 6.1.2 Optimizing the schedule for multiple HAPs

For the second part of our research, we looked into optimising the schedule. As we have only gotten incoming call data for the triage process, we can look at our casus of the triage process as a call centre. Koole and Mandelbaum say that we can model a call centre as a M/M/s queue (Koole & Mandelbaum, 2001). Because of the complexity of call centres, we can use simulation as a tool (Chassioti, 2012).
To be able to simulate our model, we need the average interarrival times and the service times. That is what we got from our data analysis. The data we received were from three different HAPs from Region A. We analysed the data from HAP 1 and 2 combined and HAP 3 separately, we started the data analysis by separating the incoming calls into days of the week the calls came in and for every hour of the day. We used planning periods of multiple hours for the first experiment. And for the second experiment, we used hourly arrivals.
In the first experiment, we wanted to find out if combining the incoming calls would benefit the HAPs and result in fewer triage nurse hours. For the second experiment, we wanted to find out if combining the incoming calls and limiting the service time would also result in fewer triage nurse hours, by creating an optimized schedule.
Our experiments found that on average we could save at least 192.5 hours a week.

## 6.2 LIMITATIONS

The key limitation is the exclusion of emergency patients who would receive priority in the queue. The addition of emergency patients would bring the simulation closer to reality. They could impact the waiting times for other patients.

Our model also did not account for scheduling in callbacks, or walk-in visits. The lack of these inputs leads to a simplified representation of our system.

Future research should consider including emergency patients, scheduled call-backs, and walk-in visits.

## 6.3 RECOMMENDATIONS

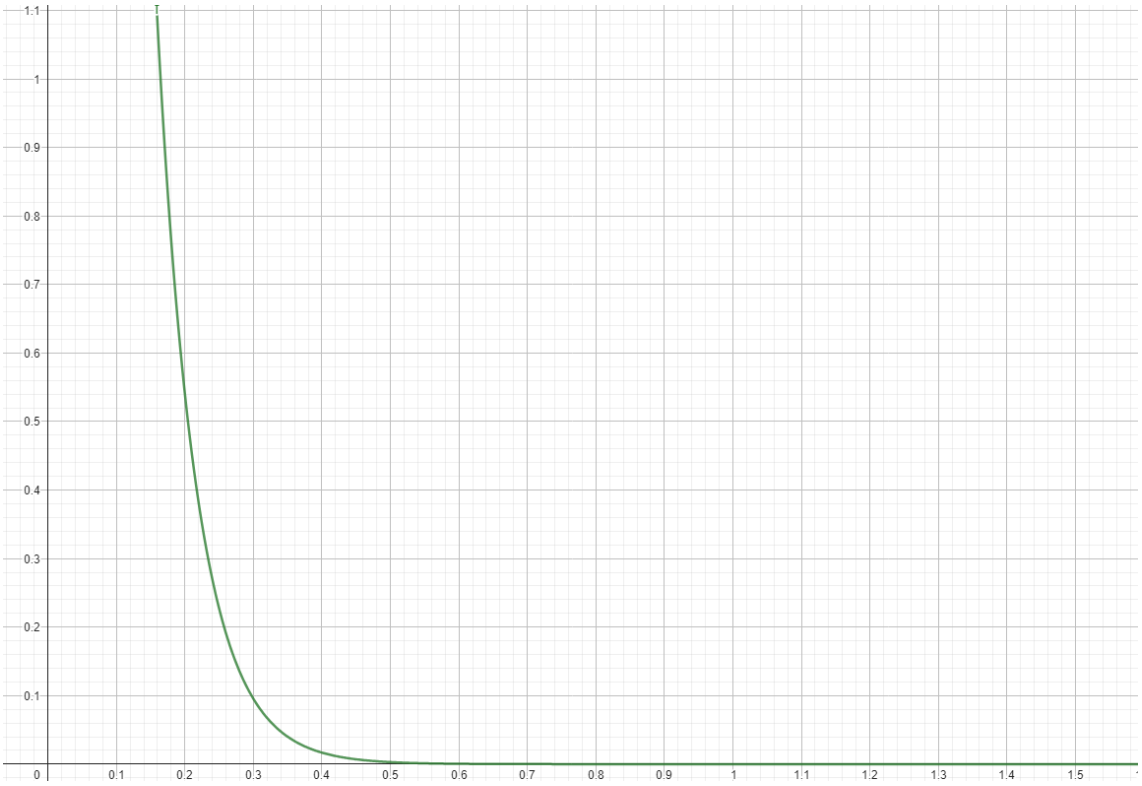
Based on the findings of our research, we recommend that the RIVM optimize the triage process by combining the triage of other HAPs within the same region. This is a first step in optimizing the triage process. The second step is incorporating call-backs in the process at times when it is buys. Our study indicates that such approaches can lead to a significant reduction in triage nurse hours required, an average of 192.5 hours a week. Maximizing the service time led to less triage nurse hours needed, but for further research we need to find out, if implementing callbacks will also reduce waiting times.

# 7. APPENDIX

## 7.1 APPENDIX A: DENSITY FUNCTION

Density function for average arrival rate HAP 1 and 2 during 17:00 - 19:30 on a weekday.

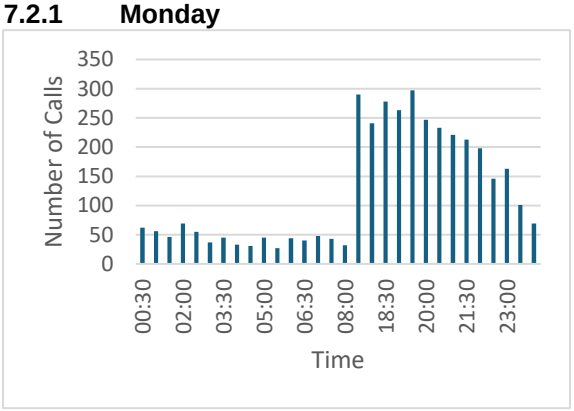

Density function for average arrival rate

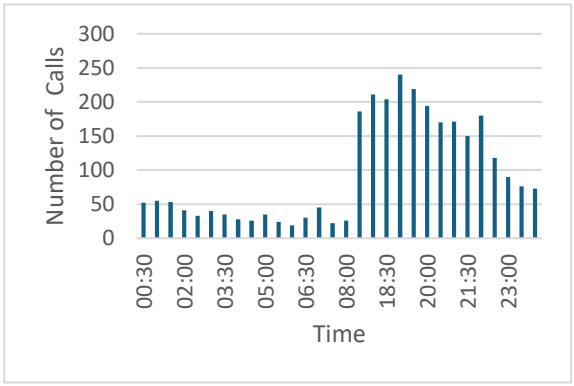


## 7.2 APPENDIX B: NUMBER OF INCOMING CALLS EXPERIMENT 1

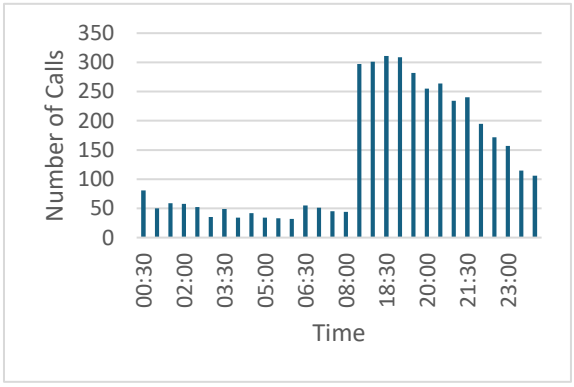
The graphs depict the total number of incoming calls per 30-minute interval. The left graph represents call volumes for HAP 1 and HAP 2, and the right graph displays data for HAP 3. The x-axis indicates time, and the y-axis represents the total number of calls received.

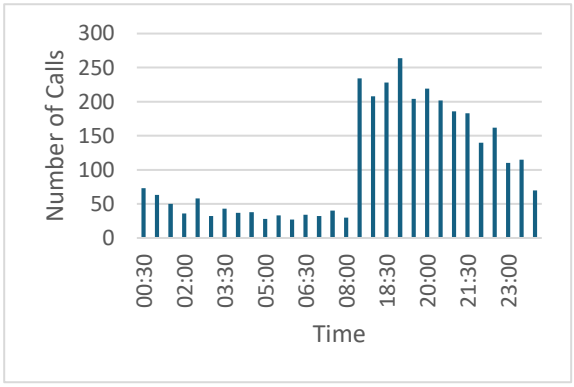
### 7.2.1 Monday



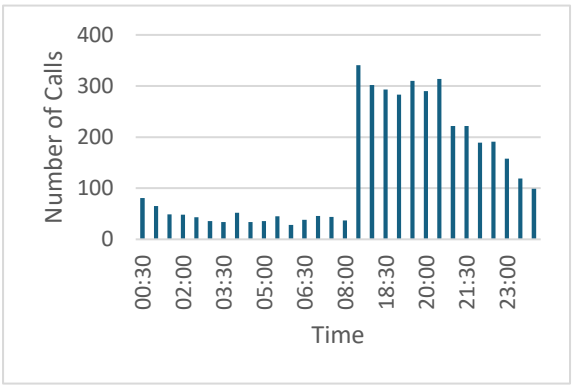



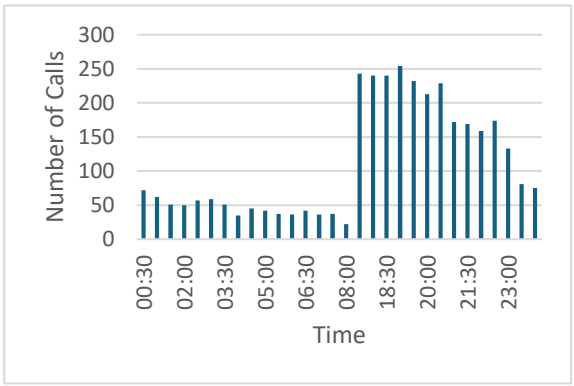

### 7.2.2 Tuesday



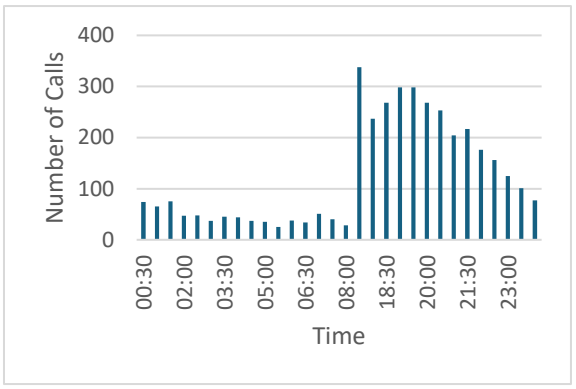



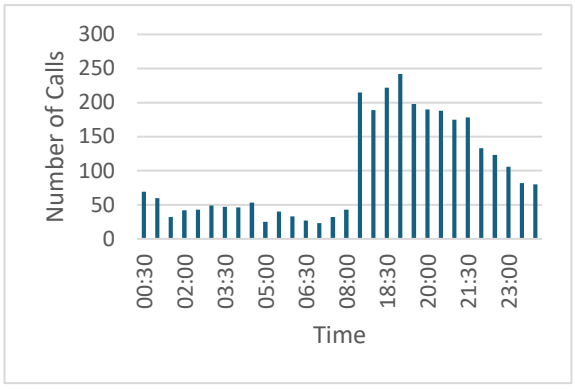

### 7.2.3 Wednesday



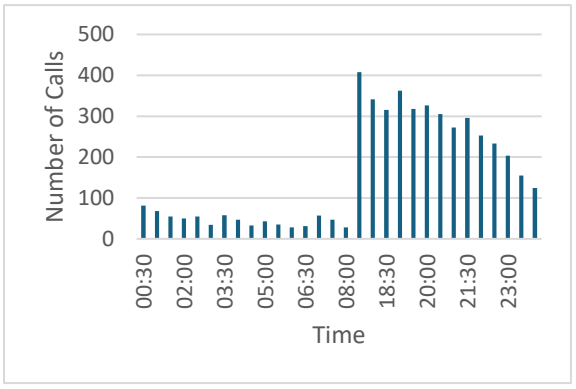



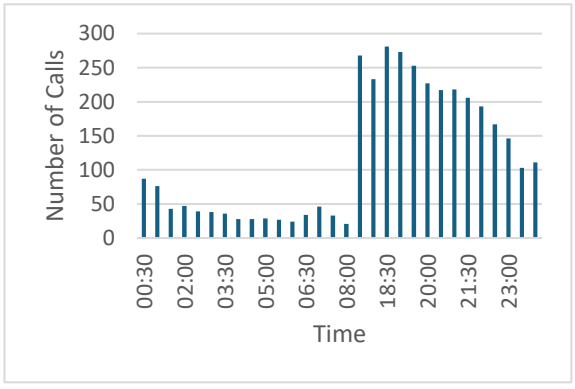
### 7.2.4 Thursday



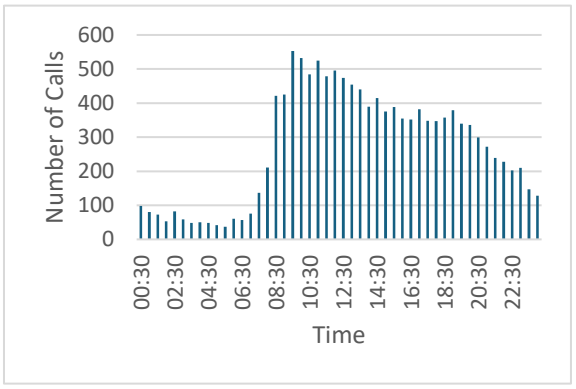



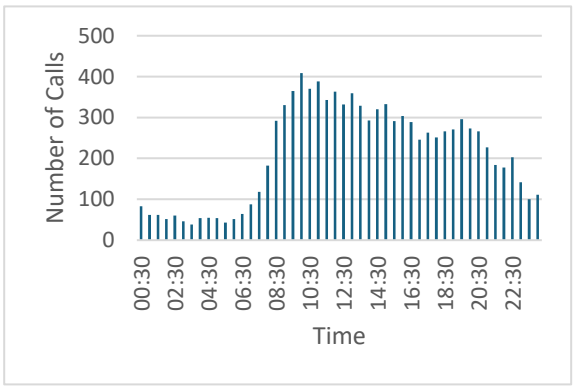

### 7.2.5 Friday



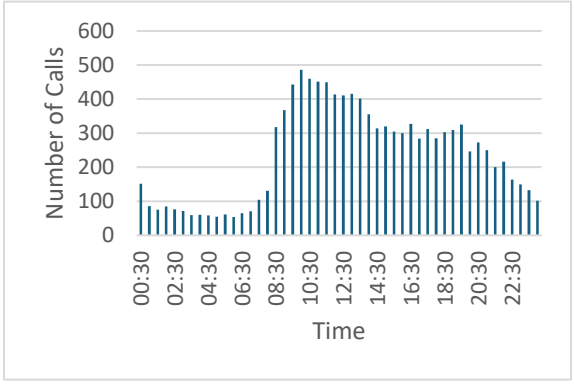



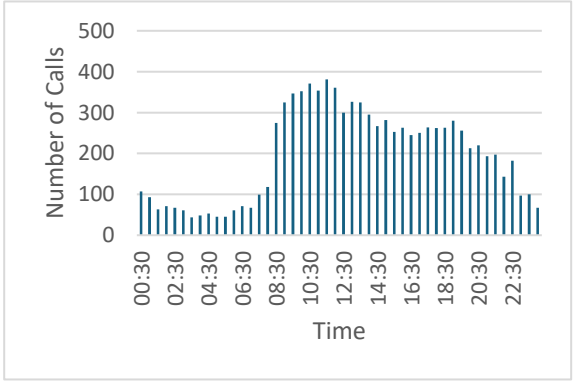

### 7.2.6 Saturday




### 7.2.7 Sunday



## 7.3 APPENDIX C: AVERAGE ARRIVALS WEEKDAYS EXPERIMENT 1

Average arrivals of incoming calls at HAP 1 and 2 every 30 minutes on weekdays:

| Time Ranges | Monday | Tuesday | Wednesday | Thursday | Friday | Average | Standard Deviation |
|---|---|---|---|---|---|---|---|
| 00:30 | 3.26 | 3.68 | 3.68 | 3.52 | 3.68 | 3.57 | 0.16 |
| 01:00 | 2.95 | 2.27 | 2.95 | 3.10 | 3.09 | 2.87 | 0.31 |
| 01:30 | 2.42 | 2.68 | 2.23 | 3.57 | 2.50 | 2.68 | 0.47 |
| 02:00 | 3.63 | 2.64 | 2.18 | 2.24 | 2.27 | 2.59 | 0.54 |
| 02:30 | 2.89 | 2.36 | 1.95 | 2.29 | 2.50 | 2.40 | 0.31 |
| 03:00 | 1.95 | 1.59 | 1.64 | 1.76 | 1.55 | 1.70 | 0.14 |
| 03:30 | 2.37 | 2.23 | 1.55 | 2.14 | 2.64 | 2.18 | 0.36 |
| 04:00 | 1.74 | 1.55 | 2.36 | 2.10 | 2.14 | 1.98 | 0.29 |
| 04:30 | 1.63 | 1.91 | 1.55 | 1.76 | 1.50 | 1.67 | 0.15 |
| 05:00 | 2.37 | 1.55 | 1.64 | 1.67 | 1.95 | 1.83 | 0.30 |
| 05:30 | 1.42 | 1.50 | 2.05 | 1.19 | 1.59 | 1.55 | 0.28 |
| 06:00 | 2.32 | 1.45 | 1.27 | 1.81 | 1.27 | 1.63 | 0.40 |
| 06:30 | 2.11 | 2.50 | 1.73 | 1.62 | 1.41 | 1.87 | 0.39 |
| 07:00 | 2.53 | 2.32 | 2.09 | 2.43 | 2.59 | 2.39 | 0.18 |
| 07:30 | 2.26 | 2.05 | 2.00 | 1.90 | 2.14 | 2.07 | 0.12 |
| 08:00 | 1.68 | 2.00 | 1.68 | 1.33 | 1.27 | 1.59 | 0.27 |
| 17:30 | 15.26 | 13.50 | 15.50 | 16.10 | 18.55 | 15.78 | 1.63 |
| 18:00 | 12.68 | 13.68 | 13.73 | 11.29 | 15.50 | 13.38 | 1.38 |
| 18:30 | 14.63 | 14.14 | 13.32 | 12.76 | 14.32 | 13.83 | 0.69 |
| 19:00 | 13.84 | 14.05 | 12.86 | 14.19 | 16.45 | 14.28 | 1.18 |
| 19:30 | 15.63 | 12.82 | 14.09 | 14.19 | 14.45 | 14.24 | 0.90 |
| 20:00 | 13.00 | 11.59 | 13.18 | 12.76 | 14.82 | 13.07 | 1.04 |
| 20:30 | 12.26 | 12.00 | 14.27 | 12.05 | 13.86 | 12.89 | 0.98 |
| 21:00 | 11.63 | 10.64 | 10.09 | 9.71 | 12.36 | 10.89 | 0.98 |
| 21:30 | 11.21 | 10.91 | 10.09 | 10.33 | 13.45 | 11.20 | 1.20 |
| 22:00 | 10.42 | 8.86 | 8.59 | 8.38 | 11.50 | 9.55 | 1.21 |
| 22:30 | 7.68 | 7.82 | 8.68 | 7.43 | 10.59 | 8.44 | 1.15 |
| 23:00 | 8.58 | 7.14 | 7.18 | 5.95 | 9.23 | 7.62 | 1.16 |
| 23:30 | 5.32 | 5.23 | 5.41 | 4.81 | 7.05 | 5.56 | 0.77 |
| 00:00 | 3.63 | 4.82 | 4.50 | 3.67 | 5.64 | 4.45 | 0.75 |

Average arrivals of incoming calls at HAP 3 every 30 minutes on weekdays:

| Time Ranges | Monday | Tuesday | Wednesday | Thursday | Friday | Averages | Standard Deviation |
|---|---|---|---|---|---|---|---|
| 00:30 | 2.74 | 3.32 | 3.27 | 3.29 | 3.95 | 3.31 | 0.43 |
| 01:00 | 2.89 | 2.86 | 2.82 | 2.86 | 3.45 | 2.98 | 0.27 |
| 01:30 | 2.79 | 2.27 | 2.32 | 1.52 | 1.95 | 2.17 | 0.47 |
| 02:00 | 2.16 | 1.64 | 2.27 | 2.00 | 2.14 | 2.04 | 0.25 |
| 02:30 | 1.74 | 2.64 | 2.59 | 2.05 | 1.77 | 2.16 | 0.43 |
| 03:00 | 2.11 | 1.45 | 2.68 | 2.33 | 1.73 | 2.06 | 0.48 |
| 03:30 | 1.84 | 1.95 | 2.32 | 2.24 | 1.64 | 2.00 | 0.28 |
| 04:00 | 1.47 | 1.68 | 1.59 | 2.19 | 1.27 | 1.64 | 0.34 |
| 04:30 | 1.37 | 1.73 | 2.05 | 2.52 | 1.27 | 1.79 | 0.51 |
| 05:00 | 1.84 | 1.27 | 1.91 | 1.19 | 1.32 | 1.51 | 0.34 |
| 05:30 | 1.26 | 1.50 | 1.68 | 1.90 | 1.23 | 1.52 | 0.29 |
| 06:00 | 1.00 | 1.23 | 1.64 | 1.57 | 1.09 | 1.31 | 0.29 |
| 06:30 | 1.58 | 1.55 | 1.91 | 1.29 | 1.55 | 1.57 | 0.22 |
| 07:00 | 2.37 | 1.45 | 1.64 | 1.10 | 2.09 | 1.73 | 0.51 |
| 07:30 | 1.16 | 1.82 | 1.68 | 1.52 | 1.50 | 1.54 | 0.25 |
| 08:00 | 1.37 | 1.36 | 1.00 | 2.05 | 0.95 | 1.35 | 0.44 |
| 17:30 | 9.79 | 10.64 | 11.05 | 10.24 | 12.18 | 10.78 | 0.91 |
| 18:00 | 11.11 | 9.45 | 10.91 | 9.00 | 10.59 | 10.21 | 0.93 |
| 18:30 | 10.74 | 10.36 | 10.91 | 10.57 | 12.77 | 11.07 | 0.97 |
| 19:00 | 12.63 | 12.00 | 11.55 | 11.52 | 12.41 | 12.02 | 0.50 |
| 19:30 | 11.53 | 9.27 | 10.55 | 9.43 | 11.50 | 10.45 | 1.08 |
| 20:00 | 10.21 | 9.95 | 9.68 | 9.05 | 10.32 | 9.84 | 0.51 |
| 20:30 | 8.95 | 9.18 | 10.41 | 8.95 | 9.86 | 9.47 | 0.64 |
| 21:00 | 9.00 | 8.45 | 7.82 | 8.33 | 9.91 | 8.70 | 0.79 |
| 21:30 | 7.89 | 8.32 | 7.68 | 8.48 | 9.36 | 8.35 | 0.65 |
| 22:00 | 9.47 | 6.36 | 7.23 | 6.33 | 8.77 | 7.63 | 1.43 |
| 22:30 | 6.21 | 7.36 | 7.91 | 5.86 | 7.59 | 6.99 | 0.90 |
| 23:00 | 4.74 | 5.00 | 6.05 | 5.05 | 6.64 | 5.49 | 0.81 |
| 23:30 | 4.00 | 5.23 | 3.68 | 3.90 | 4.68 | 4.30 | 0.64 |
| 00:00 | 3.84 | 3.18 | 3.41 | 3.81 | 5.05 | 3.86 | 0.72 |

## 7.4 APPENDIX D: AVERAGE ARRIVALS EXPERIMENT 1

Average arrivals HAP 1 and 2

| Time ranges | Monday | Tuesday | Wednesday | Thursday | Friday | Average |
|---|---|---|---|---|---|---|
| 17:00 - 19:30 | 72.05 | 68.18 | 69.50 | 68.52 | 79.27 | 71.51 |
| 19:30 - 21:30 | 48.11 | 45.14 | 47.64 | 44.86 | 54.50 | 48.05 |
| 21:30 - 23:00 | 26.68 | 23.82 | 24.45 | 21.76 | 31.32 | 25.61 |
| 23:00 - 00:30 | 12.21 | 13.73 | 13.59 | 12.00 | 16.36 | 13.58 |
| 00:30 - 08:00 | 34.26 | 30.59 | 28.86 | 30.90 | 30.41 | 31.01 |

| Time ranges | Monday | Tuesday | Wednesday | Thursday | Friday | Average |
|---|---|---|---|---|---|---|
| 17:00 - 22:00 | 130.58 | 122.18 | 125.73 | 121.76 | 145.27 | 129.10 |
| 22:00 - 00:00 | 46.84 | 33.86 | 34.36 | 30.24 | 44.00 | 37.86 |
| 00:00 - 08:00 | 37.53 | 34.27 | 32.55 | 34.43 | 34.09 | 34.57 |

Average arrivals HAP 3

| Time ranges | Monday | Tuesday | Wednesday | Thursday | Friday | Average |
|---|---|---|---|---|---|---|
| 17:00 - 19:30 | 55.79 | 51.73 | 54.95 | 50.76 | 59.45 | 54.54 |
| 19:30 - 21:30 | 36.05 | 35.91 | 35.59 | 34.81 | 39.45 | 36.36 |
| 21:30 - 23:00 | 20.42 | 18.73 | 21.18 | 17.24 | 23.00 | 20.11 |
| 23:00 - 00:30 | 10.58 | 11.73 | 10.36 | 11.00 | 13.68 | 11.47 |
| 00:30 - 08:00 | 26.95 | 26.41 | 30.09 | 28.33 | 24.95 | 27.35 |

| Time ranges | Monday | Tuesday | Wednesday | Thursday | Friday | Average |
|---|---|---|---|---|---|---|
| 17:00 - 22:00 | 101.32 | 94.00 | 97.77 | 91.90 | 107.68 | 98.54 |
| 22:00 - 00:00 | 18.79 | 20.77 | 21.05 | 18.62 | 23.95 | 20.64 |
| 00:00 - 08:00 | 29.68 | 29.73 | 33.36 | 31.62 | 28.91 | 30.66 |

## 7.5 APPENDIX E: ARRIVALS EXPERIMENT 1

Data on the arrivals on Saturday and Sunday for HAP 1 and 2 (black and white) and HAP 3 (Blue).

| Time ranges | Saturday | Sunday | Saturday average | Sunday Average | Average | Standard Deviation |
|---|---|---|---|---|---|---|
| 00:30 | 98 | 151 | 4.67 | 7.19 | 5.93 | 1.26 |
| 01:00 | 80 | 86 | 3.81 | 4.10 | 3.95 | 0.14 |
| 01:30 | 73 | 75 | 3.48 | 3.57 | 3.52 | 0.05 |
| 02:00 | 53 | 85 | 2.52 | 4.05 | 3.29 | 0.76 |
| 02:30 | 82 | 76 | 3.90 | 3.62 | 3.76 | 0.14 |
| 03:00 | 59 | 72 | 2.81 | 3.43 | 3.12 | 0.31 |
| 03:30 | 48 | 59 | 2.29 | 2.81 | 2.55 | 0.26 |
| 04:00 | 50 | 60 | 2.38 | 2.86 | 2.62 | 0.24 |
| 04:30 | 48 | 58 | 2.29 | 2.76 | 2.52 | 0.24 |
| 05:00 | 42 | 55 | 2.00 | 2.62 | 2.31 | 0.31 |
| 05:30 | 37 | 61 | 1.76 | 2.90 | 2.33 | 0.57 |
| 06:00 | 61 | 54 | 2.90 | 2.57 | 2.74 | 0.17 |
| 06:30 | 57 | 65 | 2.71 | 3.10 | 2.90 | 0.19 |
| 07:00 | 76 | 71 | 3.62 | 3.38 | 3.50 | 0.12 |
| 07:30 | 137 | 104 | 6.52 | 4.95 | 5.74 | 0.79 |
| 08:00 | 211 | 131 | 10.05 | 6.24 | 8.14 | 1.90 |
| 08:30 | 421 | 318 | 20.05 | 15.14 | 17.60 | 2.45 |
| 09:00 | 425 | 368 | 20.24 | 17.52 | 18.88 | 1.36 |
| 09:30 | 553 | 443 | 26.33 | 21.10 | 23.71 | 2.62 |
| 10:00 | 532 | 486 | 25.33 | 23.14 | 24.24 | 1.10 |
| 10:30 | 484 | 460 | 23.05 | 21.90 | 22.48 | 0.57 |
| 11:00 | 525 | 451 | 25.00 | 21.48 | 23.24 | 1.76 |
| 11:30 | 479 | 449 | 22.81 | 21.38 | 22.10 | 0.71 |
| 12:00 | 496 | 414 | 23.62 | 19.71 | 21.67 | 1.95 |
| 12:30 | 474 | 411 | 22.57 | 19.57 | 21.07 | 1.50 |
| 13:00 | 454 | 415 | 21.62 | 19.76 | 20.69 | 0.93 |
| 13:30 | 440 | 401 | 20.95 | 19.10 | 20.02 | 0.93 |
| 14:00 | 389 | 355 | 18.52 | 16.90 | 17.71 | 0.81 |
| 14:30 | 415 | 314 | 19.76 | 14.95 | 17.36 | 2.40 |
| 15:00 | 375 | 320 | 17.86 | 15.24 | 16.55 | 1.31 |
| 15:30 | 388 | 305 | 18.48 | 14.52 | 16.50 | 1.98 |
| 16:00 | 355 | 300 | 16.90 | 14.29 | 15.60 | 1.31 |
| 16:30 | 352 | 327 | 16.76 | 15.57 | 16.17 | 0.60 |
| 17:00 | 382 | 284 | 18.19 | 13.52 | 15.86 | 2.33 |
| 17:30 | 348 | 312 | 16.57 | 14.86 | 15.71 | 0.86 |
| 18:00 | 347 | 285 | 16.52 | 13.57 | 15.05 | 1.48 |
| 18:30 | 357 | 303 | 17.00 | 14.43 | 15.71 | 1.29 |
| 19:00 | 379 | 309 | 18.05 | 14.71 | 16.38 | 1.67 |
| 19:30 | 340 | 325 | 16.19 | 15.48 | 15.83 | 0.36 |
| 20:00 | 336 | 246 | 16.00 | 11.71 | 13.86 | 2.14 |
| 20:30 | 299 | 273 | 14.24 | 13.00 | 13.62 | 0.62 |
| 21:00 | 272 | 250 | 12.95 | 11.90 | 12.43 | 0.52 |
| 21:30 | 239 | 200 | 11.38 | 9.52 | 10.45 | 0.93 |
| 22:00 | 228 | 216 | 10.86 | 10.29 | 10.57 | 0.29 |
| 22:30 | 202 | 164 | 9.62 | 7.81 | 8.71 | 0.90 |
| 23:00 | 210 | 150 | 10.00 | 7.14 | 8.57 | 1.43 |
| 23:30 | 147 | 133 | 7.00 | 6.33 | 6.67 | 0.33 |
| 00:00 | 128 | 102 | 6.10 | 4.86 | 5.48 | 0.62 |

| Time ranges | Saturday | Sunday | Saturday Average | Sunday Averag | Average | Standard Deviation |
|---|---|---|---|---|---|---|
| 00:30 | 83 | 107 | 3.95 | 5.10 | 4.52 | 0.57 |
| 01:00 | 62 | 93 | 2.95 | 4.43 | 3.69 | 0.74 |
| 01:30 | 62 | 63 | 2.95 | 3.00 | 2.98 | 0.02 |
| 02:00 | 52 | 71 | 2.48 | 3.38 | 2.93 | 0.45 |
| 02:30 | 60 | 67 | 2.86 | 3.19 | 3.02 | 0.17 |
| 03:00 | 46 | 61 | 2.19 | 2.90 | 2.55 | 0.36 |
| 03:30 | 38 | 44 | 1.81 | 2.10 | 1.95 | 0.14 |
| 04:00 | 54 | 48 | 2.57 | 2.29 | 2.43 | 0.14 |
| 04:30 | 55 | 53 | 2.62 | 2.52 | 2.57 | 0.05 |
| 05:00 | 54 | 45 | 2.57 | 2.14 | 2.36 | 0.21 |
| 05:30 | 43 | 45 | 2.05 | 2.14 | 2.10 | 0.05 |
| 06:00 | 52 | 61 | 2.48 | 2.90 | 2.69 | 0.21 |
| 06:30 | 64 | 71 | 3.05 | 3.38 | 3.21 | 0.17 |
| 07:00 | 88 | 67 | 4.19 | 3.19 | 3.69 | 0.50 |
| 07:30 | 118 | 99 | 5.62 | 4.71 | 5.17 | 0.45 |
| 08:00 | 182 | 118 | 8.67 | 5.62 | 7.14 | 1.52 |
| 08:30 | 292 | 275 | 13.90 | 13.10 | 13.50 | 0.40 |
| 09:00 | 330 | 325 | 15.71 | 15.48 | 15.60 | 0.12 |
| 09:30 | 365 | 347 | 17.38 | 16.52 | 16.95 | 0.43 |
| 10:00 | 409 | 352 | 19.48 | 16.76 | 18.12 | 1.36 |
| 10:30 | 370 | 371 | 17.62 | 17.67 | 17.64 | 0.02 |
| 11:00 | 388 | 354 | 18.48 | 16.86 | 17.67 | 0.81 |
| 11:30 | 343 | 381 | 16.33 | 18.14 | 17.24 | 0.90 |
| 12:00 | 363 | 361 | 17.29 | 17.19 | 17.24 | 0.05 |
| 12:30 | 332 | 300 | 15.81 | 14.29 | 15.05 | 0.76 |
| 13:00 | 359 | 326 | 17.10 | 15.52 | 16.31 | 0.79 |
| 13:30 | 329 | 325 | 15.67 | 15.48 | 15.57 | 0.10 |
| 14:00 | 293 | 295 | 13.95 | 14.05 | 14.00 | 0.05 |
| 14:30 | 320 | 267 | 15.24 | 12.71 | 13.98 | 1.26 |
| 15:00 | 333 | 282 | 15.86 | 13.43 | 14.64 | 1.21 |
| 15:30 | 291 | 253 | 13.86 | 12.05 | 12.95 | 0.90 |
| 16:00 | 304 | 263 | 14.48 | 12.52 | 13.50 | 0.98 |
| 16:30 | 289 | 245 | 13.76 | 11.67 | 12.71 | 1.05 |
| 17:00 | 246 | 250 | 11.71 | 11.90 | 11.81 | 0.10 |
| 17:30 | 263 | 264 | 12.52 | 12.57 | 12.55 | 0.02 |
| 18:00 | 251 | 262 | 11.95 | 12.48 | 12.21 | 0.26 |
| 18:30 | 266 | 263 | 12.67 | 12.52 | 12.60 | 0.07 |
| 19:00 | 271 | 280 | 12.90 | 13.33 | 13.12 | 0.21 |
| 19:30 | 296 | 256 | 14.10 | 12.19 | 13.14 | 0.95 |
| 20:00 | 273 | 213 | 13.00 | 10.14 | 11.57 | 1.43 |
| 20:30 | 266 | 220 | 12.67 | 10.48 | 11.57 | 1.10 |
| 21:00 | 227 | 193 | 10.81 | 9.19 | 10.00 | 0.81 |
| 21:30 | 184 | 197 | 8.76 | 9.38 | 9.07 | 0.31 |
| 22:00 | 178 | 143 | 8.48 | 6.81 | 7.64 | 0.83 |
| 22:30 | 203 | 182 | 9.67 | 8.67 | 9.17 | 0.50 |
| 23:00 | 142 | 97 | 6.76 | 4.62 | 5.69 | 1.07 |
| 23:30 | 100 | 100 | 4.76 | 4.76 | 4.76 | 0.00 |
| 00:00 | 111 | 67 | 5.29 | 3.19 | 4.24 | 1.05 |

## 7.6 APPENDIX F: TRIAGE NURSES

Number of triage nurses required during Experiment 1

### 7.6.1 Simulation 1

6 min 0%

| | Run 1 | Run 2 | Run 3 | Run 1 | Run 1 | Run 2 |
|---|---|---|---|---|---|---|
| 17:00 – 22:00 | 3 | 4 | 4 | 4 | 4 | 4 |
| 22:00 – 00:00 | 2 | 2 | 3 | 3 | 3 | 3 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 | 2 |
| 08:00 – 15:30 | 5 | 5 | 5 | 5 | 5 | 5 |
| 15:30 – 21:00 | 4 | 4 | 4 | 4 | 4 | 4 |
| 21:00 – 00:00 | 2 | 2 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 | 2 |
| 08:00 – 19:30 | 4 | 4 | 4 | 4 | 4 | 4 |
| 19:30 – 22:00 | 3 | 3 | 3 | 3 | 3 | 4 |
| 22:00 – 00:00 | 2 | 2 | 2 | 2 | 2 | 2 |

7 min 0%

| | Run 1 | Run 1 | Run 1 | Run 2 |
|---|---|---|---|---|
| 17:00 – 22:00 | 4 | 4 | 4 | 4 |
| 22:00 – 00:00 | 3 | 3 | 3 | 3 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 |
| 08:00 – 15:30 | 5 | 5 | 5 | 5 |
| 15:30 – 21:00 | 4 | 4 | 4 | 4 |
| 21:00 – 00:00 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 |
| 08:00 – 19:30 | 4 | 4 | 4 | 4 |
| 19:30 – 22:00 | 3 | 3 | 3 | 4 |
| 22:00 – 00:00 | 2 | 2 | 2 | 2 |

6 min 5%

| | Run 1 | Run 1 | Run 1 | Run 2 |
|---|---|---|---|---|
| 17:00 – 22:00 | 4 | 4 | 4 | 5 |
| 22:00 – 00:00 | 3 | 3 | 3 | 3 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 |
| 08:00 – 15:30 | 5 | 5 | 5 | 5 |
| 15:30 – 21:00 | 4 | 4 | 4 | 4 |
| 21:00 – 00:00 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 |
| 08:00 – 19:30 | 4 | 4 | 4 | 4 |
| 19:30 – 22:00 | 4 | 4 | 4 | 4 |
| 22:00 – 00:00 | 2 | 2 | 2 | 2 |

7 min 5%

| | Run 1 | Run 1 | Run 2 | Run 1 | Run 2 |
|---|---|---|---|---|---|
| 17:00 – 22:00 | 4 | 4 | 5 | 5 | 5 |
| 22:00 – 00:00 | 3 | 3 | 3 | 3 | 3 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 |
| 08:00 – 15:30 | 5 | 5 | 5 | 5 | 5 |
| 15:30 – 21:00 | 4 | 4 | 4 | 4 | 4 |
| 21:00 – 00:00 | 2 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 |
| 08:00 – 19:30 | 4 | 4 | 4 | 4 | 5 |
| 19:30 – 22:00 | 4 | 4 | 4 | 4 | 4 |
| 22:00 – 00:00 | 2 | 2 | 2 | 2 | 2 |

6 min 10%

| | Run 1 | Run 1 | Run 1 | Run 2 |
|---|---|---|---|---|
| 17:00 – 22:00 | 5 | 5 | 5 | 5 |
| 22:00 – 00:00 | 3 | 3 | 3 | 3 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 |
| 08:00 – 15:30 | 5 | 5 | 5 | 5 |
| 15:30 – 21:00 | 4 | 4 | 4 | 5 |
| 21:00 – 00:00 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 |
| 08:00 – 19:30 | 4 | 4 | 4 | 4 |
| 19:30 – 22:00 | 4 | 4 | 4 | 4 |
| 22:00 – 00:00 | 2 | 2 | 2 | 2 |

7 min 10%

| | Run 1 | Run 1 | Run 2 | Run 1 |
|---|---|---|---|---|
| 17:00 – 22:00 | 5 | 5 | 5 | 5 |
| 22:00 – 00:00 | 3 | 3 | 3 | 3 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 |
| 08:00 – 15:30 | 5 | 5 | 5 | 5 |
| 15:30 – 21:00 | 4 | 4 | 5 | 5 |
| 21:00 – 00:00 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 |
| 08:00 – 19:30 | 5 | 5 | 5 | 5 |
| 19:30 – 22:00 | 4 | 4 | 4 | 4 |
| 22:00 – 00:00 | 2 | 2 | 2 | 2 |

### 7.6.2 Simulation 2

6 min 0%

| | Run 1 | Run 2 | Run 3 | Run 4 | Run 5 | Run 1 | Run1 | Run 2 |
|---|---|---|---|---|---|---|---|---|
| 17:00 – 22:00 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 4 |
| 22:00 – 00:00 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 08:00 – 15:30 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 |
| 15:30 – 21:00 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 |
| 21:00 – 00:00 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 08:00 – 19:30 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 19:30 – 22:00 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| 22:00 – 00:00 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

7 min 0%

| | Run 1 | Run 2 | Run 1 | Run 2 | Run 3 | Run 1 |
|---|---|---|---|---|---|---|
| 17:00 – 22:00 | 3 | 3 | 3 | 4 | 4 | 4 |
| 22:00 – 00:00 | 2 | 2 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 | 2 |
| 08:00 – 15:30 | 4 | 4 | 4 | 4 | 4 | 4 |
| 15:30 – 21:00 | 4 | 4 | 4 | 4 | 5 | 5 |
| 21:00 – 00:00 | 2 | 2 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 | 2 |
| 08:00 – 19:30 | 4 | 5 | 5 | 5 | 5 | 5 |
| 19:30 – 22:00 | 3 | 3 | 3 | 3 | 3 | 3 |
| 22:00 – 00:00 | 2 | 2 | 2 | 2 | 2 | 2 |

6 min 5%

| | Run 1 | Run 1 | Run 2 | Run 1 |
|---|---|---|---|---|
| 17:00 – 22:00 | 4 | 4 | 4 | 4 |
| 22:00 – 00:00 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 |
| 08:00 – 15:30 | 4 | 4 | 4 | 4 |
| 15:30 – 21:00 | 4 | 4 | 5 | 5 |
| 21:00 – 00:00 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 |
| 08:00 – 19:30 | 4 | 4 | 4 | 4 |
| 19:30 – 22:00 | 3 | 3 | 3 | 3 |
| 22:00 – 00:00 | 2 | 2 | 2 | 2 |

7 min 5%

| | Run 1 | Run 1 | Run 1 |
|---|---|---|---|
| 17:00 – 22:00 | 4 | 4 | 4 |
| 22:00 – 00:00 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 |
| 08:00 – 15:30 | 4 | 4 | 4 |
| 15:30 – 21:00 | 5 | 5 | 5 |
| 21:00 – 00:00 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 |
| 08:00 – 19:30 | 5 | 5 | 5 |
| 19:30 – 22:00 | 3 | 3 | 3 |
| 22:00 – 00:00 | 2 | 2 | 2 |

6 min 10%

| | Run 1 | Run 1 | Run 1 |
|---|---|---|---|
| 17:00 – 22:00 | 4 | 4 | 4 |
| 22:00 – 00:00 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 |
| 08:00 – 15:30 | 4 | 4 | 4 |
| 15:30 – 21:00 | 5 | 5 | 5 |
| 21:00 – 00:00 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 |
| 08:00 – 19:30 | 4 | 4 | 4 |
| 19:30 – 22:00 | 3 | 3 | 3 |
| 22:00 – 00:00 | 2 | 2 | 2 |

7 min 10%

| | Run 1 | Run 1 | Run 1 |
|---|---|---|---|
| 17:00 – 22:00 | 4 | 4 | 4 |
| 22:00 – 00:00 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 |
| 08:00 – 15:30 | 4 | 4 | 4 |
| 15:30 – 21:00 | 5 | 5 | 5 |
| 21:00 – 00:00 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 |
| 08:00 – 19:30 | 5 | 5 | 5 |
| 19:30 – 22:00 | 3 | 3 | 3 |
| 22:00 – 00:00 | 2 | 2 | 2 |

### 7.6.3 Simulation 3

6 min 0%

| | Run 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Run 1 | 2 | 3 | Run 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17:00 – 22:00 | 4 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 7 | 7 | 7 |
| 22:00 – 00:00 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 08:00 – 15:30 | 5 | 6 | 6 | 7 | 8 | 7 | 7 | 7 | 7 | 7 | 8 | 8 | 9 | 9 |
| 15:30 – 21:00 | 4 | 4 | 5 | 5 | 5 | 6 | 7 | 7 | 7 | 7 | 7 | 8 | 8 | 8 |
| 21:00 – 00:00 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 08:00 – 19:30 | 5 | 6 | 6 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 9 | 9 | 9 |
| 19:30 – 22:00 | 4 | 4 | 5 | 5 | 5 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 |
| 22:00 – 00:00 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

7 min 0%

| | Run 1 | Run 2 | Run 1 | Run 2 | Run 1 |
|---|---|---|---|---|---|
| 17:00 – 22:00 | 6 | 6 | 6 | 7 | 7 |
| 22:00 – 00:00 | 3 | 3 | 3 | 3 | 3 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 |
| 08:00 – 15:30 | 8 | 9 | 9 | 9 | 9 |
| 15:30 – 21:00 | 7 | 7 | 7 | 7 | 7 |
| 21:00 – 00:00 | 4 | 4 | 4 | 4 | 4 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 |
| 08:00 – 19:30 | 8 | 8 | 8 | 9 | 9 |
| 19:30 – 22:00 | 5 | 5 | 5 | 5 | 5 |
| 22:00 – 00:00 | 3 | 3 | 3 | 3 | 3 |

6 min 5%

| | Run 1 | Run 1 | Run 2 | Run 1 | Run 2 |
|---|---|---|---|---|---|
| 17:00 – 22:00 | 7 | 7 | 7 | 7 | 7 |
| 22:00 – 00:00 | 3 | 3 | 3 | 3 | 3 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 |
| 08:00 – 15:30 | 9 | 9 | 9 | 9 | 9 |
| 15:30 – 21:00 | 8 | 8 | 9 | 9 | 9 |
| 21:00 – 00:00 | 4 | 4 | 4 | 4 | 5 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 |
| 08:00 – 19:30 | 9 | 9 | 9 | 9 | 9 |
| 19:30 – 22:00 | 5 | 5 | 5 | 5 | 5 |
| 22:00 – 00:00 | 3 | 3 | 3 | 3 | 3 |

7 min 5%

| | Run 1 | Run 2 | Run 3 | Run 4 | Run 1 | Run 1 | Run 2 | Run 3 |
|---|---|---|---|---|---|---|---|---|
| 17:00 – 22:00 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| 22:00 – 00:00 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 00:00 – 08:00 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| 08:00 – 15:30 | 9 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 15:30 – 21:00 | 7 | 7 | 7 | 8 | 8 | 8 | 8 | 8 |
| 21:00 – 00:00 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 |
| 00:00 – 08:00 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 08:00 – 19:30 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| 19:30 – 22:00 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 22:00 – 00:00 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 |

## 7.7 APPENDIX G: RESULTS EXPERIMENT 1

Results of the simulations, in the graph the x-axis represents the patients, and the y-axis indicates the waiting time in seconds of those patients.

### 7.7.1 Simulation 1 HAP 1 and 2

Service time 6:08  6 minute break

Run 1 five weeks

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | | | | |
| Tuesday | | | | |
| Wednesday | | | | |
| Thursday | | | | |
| Friday | | | | |
| Saturday | | | | |
| Sunday | | | | |

Monday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | 200 | |
| Week 2 | | | 177 | |
| Week 3 | | | 237 | |
| Week 4 | | | 227 | |
| Week 5 | | | 170 | |

Tuesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Wednesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Thursday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Friday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |

| | | | | |
|---|---|---|---|---|
| Week 4 | | | | |
| Week 5 | | | | |

Saturday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Sunday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Run 2 five weeks

| | Average Waiting Time (s) | Max Waiting Time (s) | Average Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | | | | |
| Tuesday | | | | |
| Wednesday | | | | |
| Thursday | | | | |
| Friday | | | | |
| Saturday | | | | |
| Sunday | | | | |

Monday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Tuesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Wednesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |

| | | | | |
|---|---|---|---|---|
| Week 5 | | | | |

Thursday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Friday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Saturday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Sunday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Run 3 five weeks

| | Average Waiting Time (s) | Max Waiting Time (s) | Average Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | | | | |
| Tuesday | | | | |
| Wednesday | | | | |
| Thursday | | | | |
| Friday | | | | |
| Saturday | | | | |
| Sunday | | | | |

Monday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |

| | | | | |
|---|---|---|---|---|
| Week 4 | | | | |
| Week 5 | | | | |

Tuesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Wednesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Thursday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Friday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Saturday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Sunday

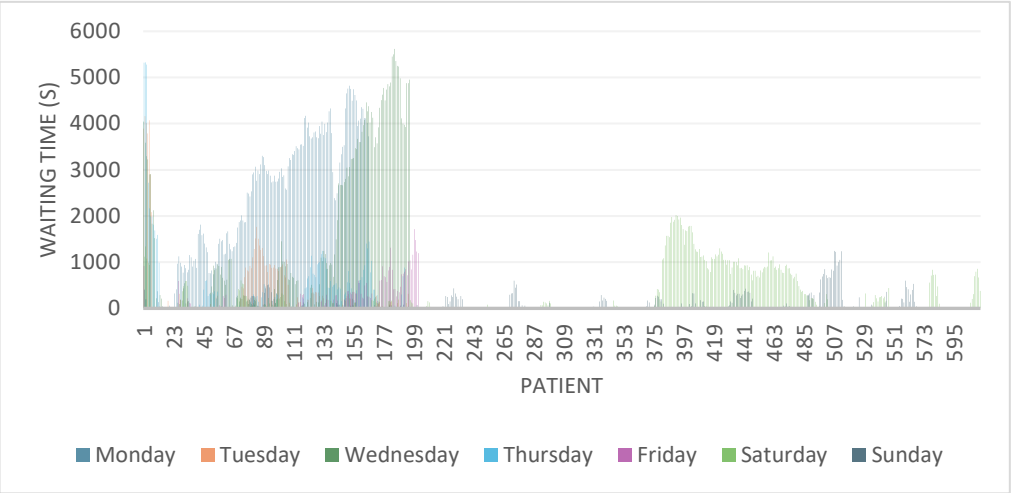
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | | | | |
| Week 2 | | | | |
| Week 3 | | | | |
| Week 4 | | | | |
| Week 5 | | | | |

Simulation -0% average interarrival rate

Service time 6:08  6 minute break

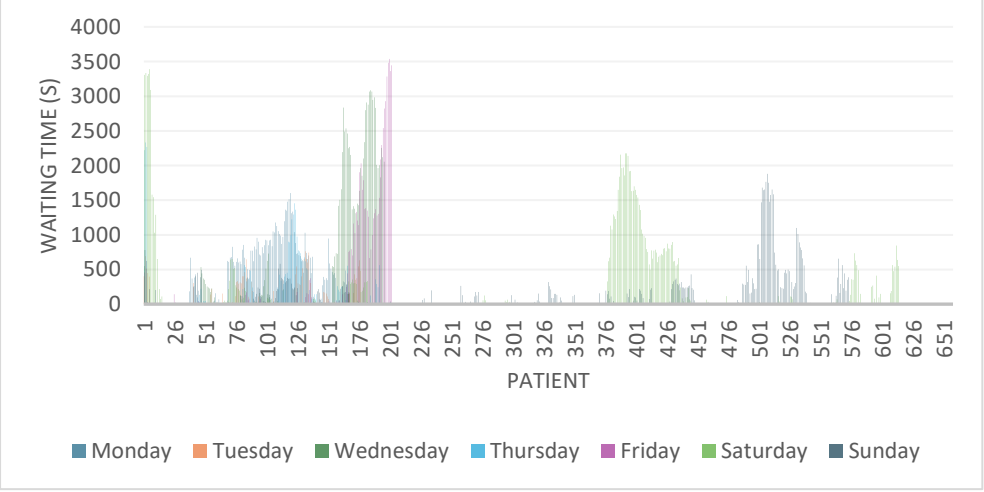
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 1897.66 | 4816.34 | 147 | 2581.84 |
| Tuesday | 350.60 | 4161.02 | 98 | 697.63 |
| Wednesday | 1473.93 | 5618.65 | 154 | 1875.91 |
| Thursday | 408.08 | 5328.06 | 101 | 775.76 |
| Friday | 183.99 | 1713.95 | 81 | 458.83 |
| Saturday | 242.66 | 2021.33 | 254 | 586.58 |
| Sunday | 74.93 | 1244.06 | 177 | 242.56 |



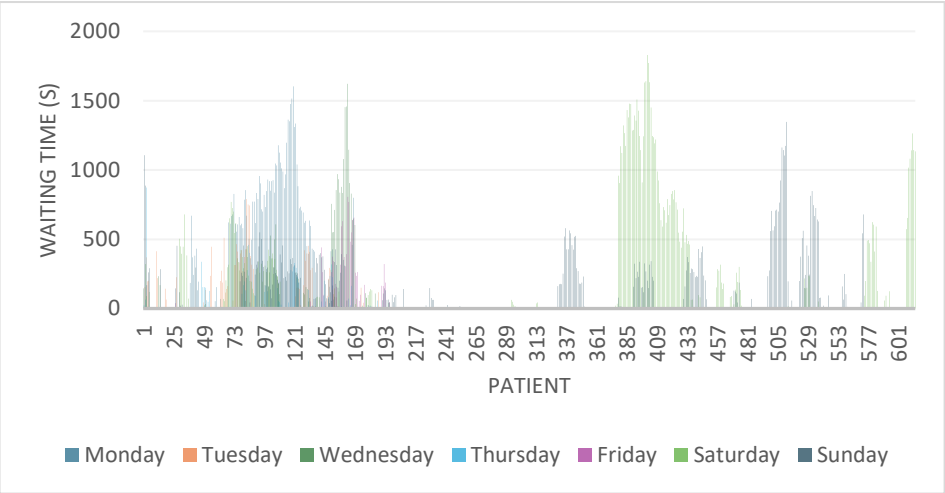

*Run 2*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 345.09 | 1602.31 | 105 | 657.32 |
| Tuesday | 97.05 | 763.43 | 60 | 315.40 |
| Wednesday | 476.31 | 3085.94 | 75 | 1244.75 |
| Thursday | 172.06 | 2334.36 | 71 | 465.30 |
| Friday | 324.93 | 3539.80 | 67 | 979.65 |
| Saturday | 184.32 | 3389.66 | 184 | 615.07 |
| Sunday | 116.01 | 1879.71 | 216 | 307.74 |



Run 3

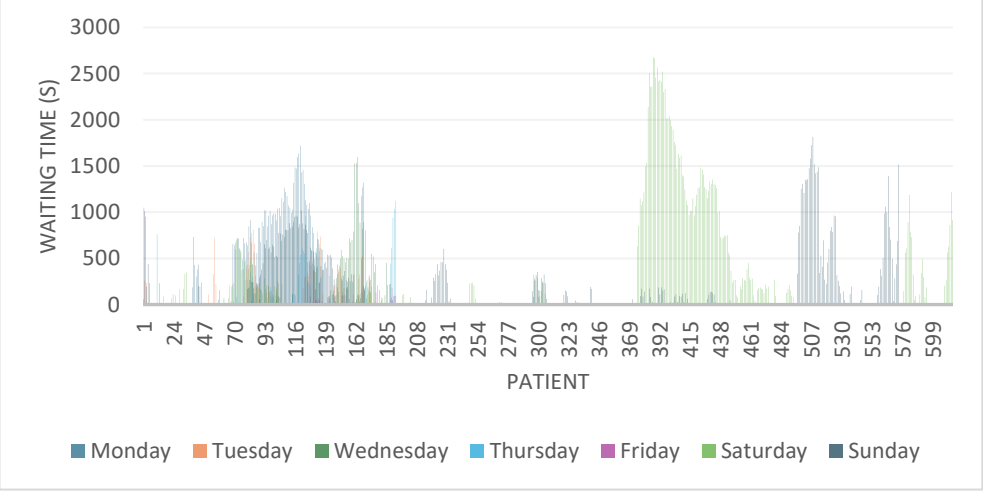
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 310.45 | 1602.31 | 91 | 682.32 |
| Tuesday | 84.81 | 790.43 | 67 | 246.82 |
| Wednesday | 121.62 | 1621.02 | 51 | 467.42 |
| Thursday | 42.64 | 872.19 | 51 | 160.53 |
| Friday | 53.30 | 805.58 | 39 | 276.08 |
| Saturday | 156.78 | 1830.13 | 175 | 520.33 |
| Sunday | 112.22 | 1347.62 | 226 | 284.53 |




Service time 6:08  7 minute break

*Run 1*

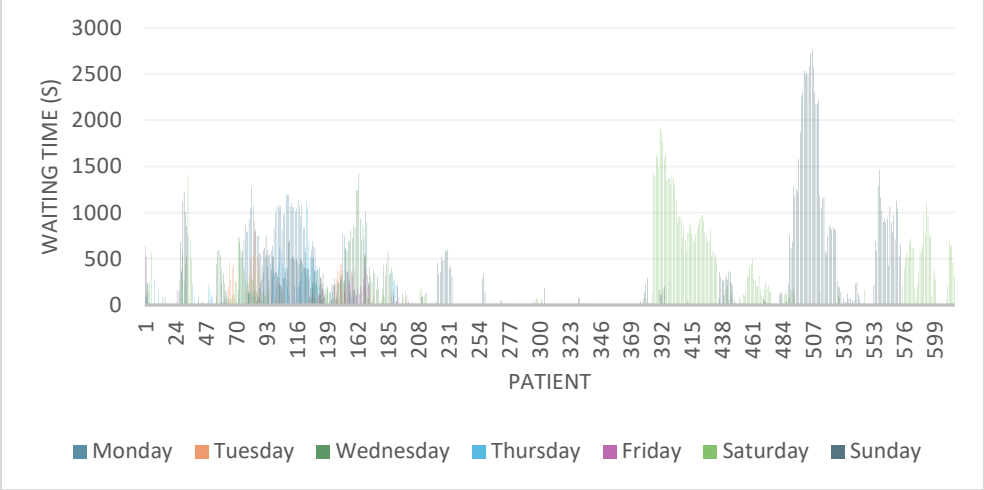
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 362.16 | 1722.31 | 98 | 739.09 |
| Tuesday | 108.14 | 810.92 | 71 | 297.02 |
| Wednesday | 126.89 | 1595.05 | 60 | 414.50 |
| Thursday | 90.08 | 1118.55 | 48 | 360.31 |
| Friday | 13.64 | 1049.29 | 24 | 114.77 |
| Saturday | 232.09 | 2679.08 | 218 | 653.97 |
| Sunday | 170.47 | 1815.62 | 235 | 415.65 |



Service time 6:23 6  minute break

*Run 1*

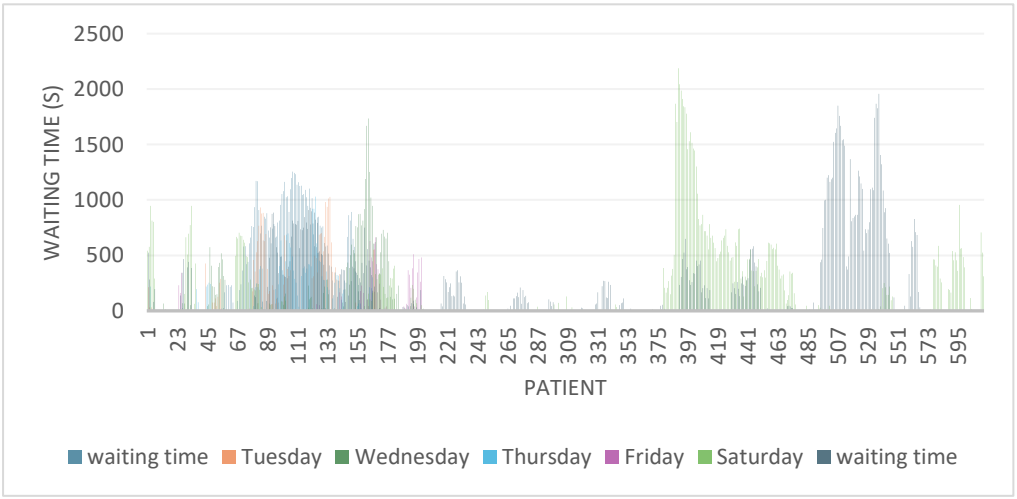
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 274.50 | 1278.87 | 85 | 645.89 |
| Tuesday | 73.70 | 910.81 | 61 | 235.60 |
| Wednesday | 147.39 | 1426.73 | 80 | 361.10 |
| Thursday | 95.84 | 1131.19 | 66 | 278.82 |
| Friday | 37.29 | 644.19 | 41 | 183.70 |
| Saturday | 149.69 | 1921.55 | 218 | 421.60 |
| Sunday | 202.17 | 2768.64 | 222 | 521.83 |




Service time 6:23  7 minute break

*Run 1*

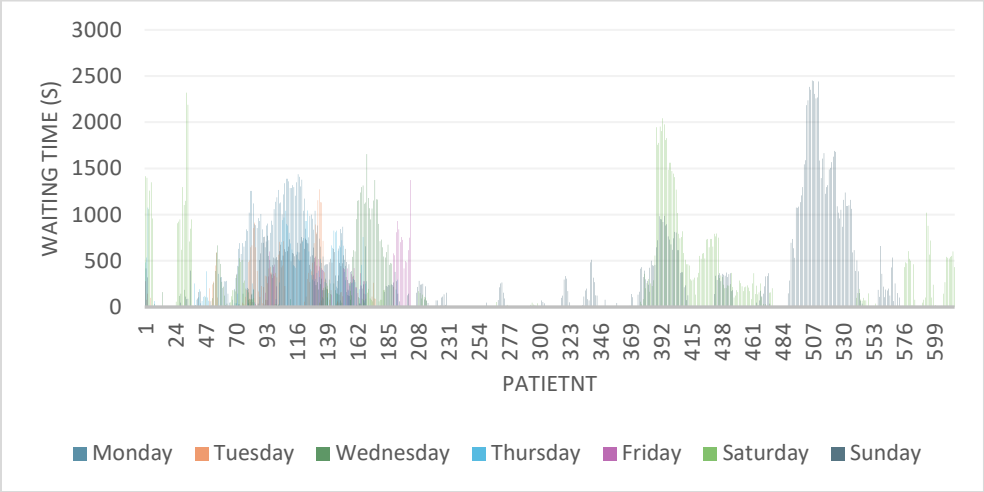
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 316.83 | 1256.77 | 91 | 696.33 |
| Tuesday | 131.50 | 1028.69 | 65 | 394.49 |
| Wednesday | 160.72 | 1735.35 | 81 | 388.91 |
| Thursday | 118.22 | 1029.52 | 70 | 324.25 |
| Friday | 47.31 | 664.73 | 40 | 238.90 |
| Saturday | 164.30 | 2188.51 | 227 | 444.40 |
| Sunday | 216.25 | 1955.95 | 275 | 450.58 |



Service time 6:38  6 minute break

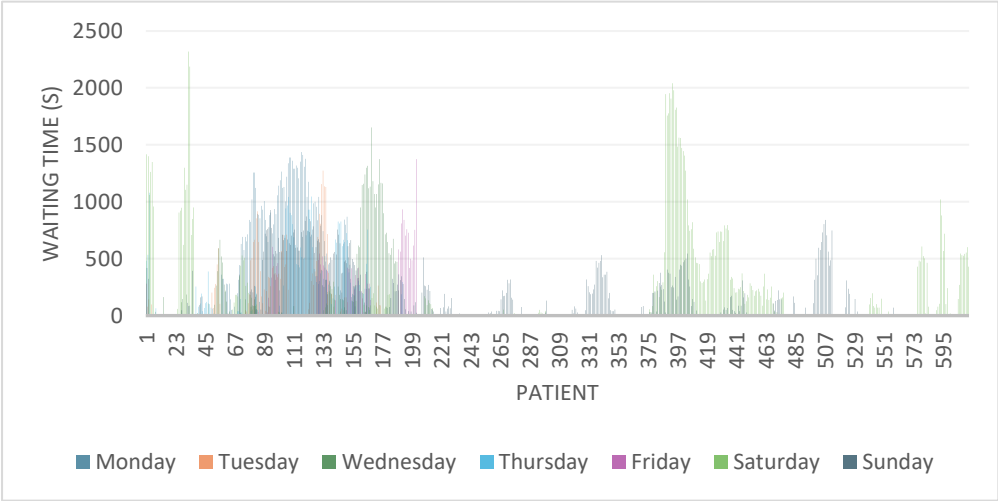
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 373.09 | 1435.08 | 96 | 777.27 |
| Tuesday | 139.44 | 1273.74 | 74 | 367.43 |
| Wednesday | 183.59 | 1653.48 | 74 | 468.27 |
| Thursday | 196.23 | 1077.86 | 96 | 392.47 |
| Friday | 112.07 | 1374.3 | 57 | 397.14 |
| Saturday | 162.38 | 2320.29 | 229 | 435.37 |
| Sunday | 272.01 | 2452.82 | 310 | 503.53 |




*Run 2*

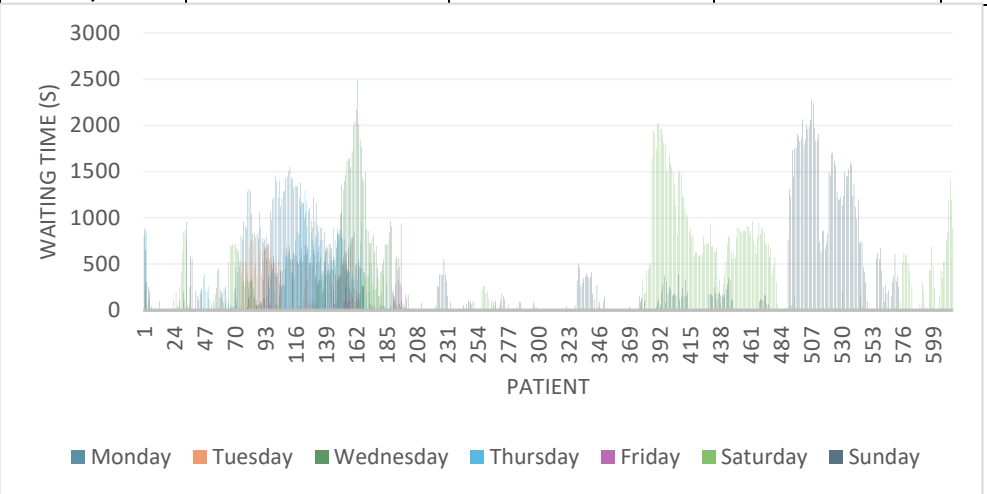
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 367.69 | 1435.08 | 93 | 790.74 |
| Tuesday | 139.44 | 1273.74 | 74 | 367.43 |
| Wednesday | 183.59 | 1653.48 | 74 | 468.27 |
| Thursday | 196.23 | 1077.86 | 96 | 392.47 |
| Friday | 112.07 | 1374.3 | 57 | 397.14 |
| Saturday | 162.38 | 2320.29 | 229 | 435.37 |
| Sunday | 148.48 | 926.02 | 282 | 301.70 |



Service time 6:38  7 minute break

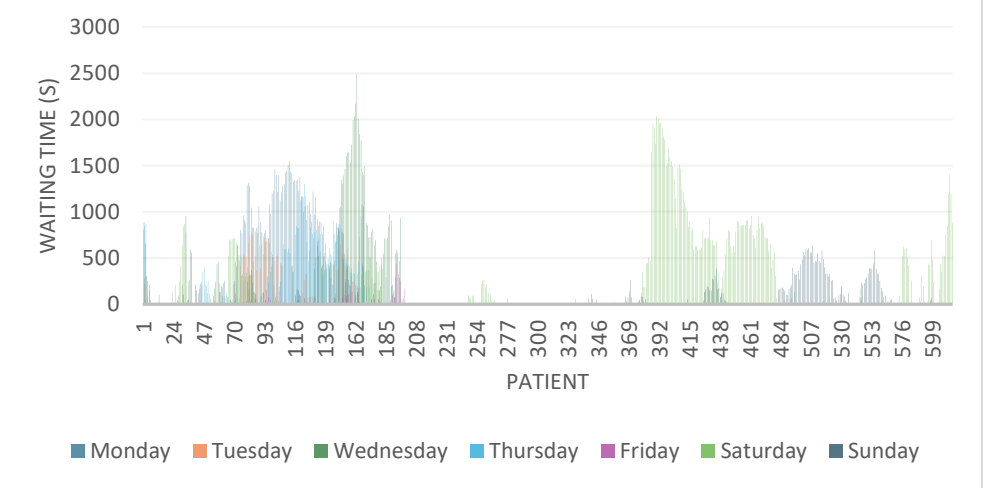
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 405.53 | 1549.74 | 96 | 844.85 |
| Tuesday | 132.96 | 843.07 | 72 | 360.10 |
| Wednesday | 324.51 | 2491.09 | 90 | 706.71 |
| Thursday | 246.23 | 1298.09 | 95 | 497.64 |
| Friday | 32.82 | 549.81 | 41 | 161.72 |
| Saturday | 214.69 | 2027.03 | 245 | 538.05 |
| Sunday | 272.51 | 2277.68 | 307 | 508.63 |




Run 2

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 404.98 | 1549.74 | 96 | 843.70 |
| Tuesday | 132.96 | 843.07 | 72 | 360.10 |
| Wednesday | 324.51 | 2491.09 | 90 | 706.71 |
| Thursday | 246.23 | 1298.09 | 95 | 497.64 |
| Friday | 32.82 | 549.81 | 41 | 161.72 |
| Saturday | 214.69 | 2027.03 | 245 | 538.05 |
| Sunday | 147.85 | 1252.55 | 256 | 330.93 |

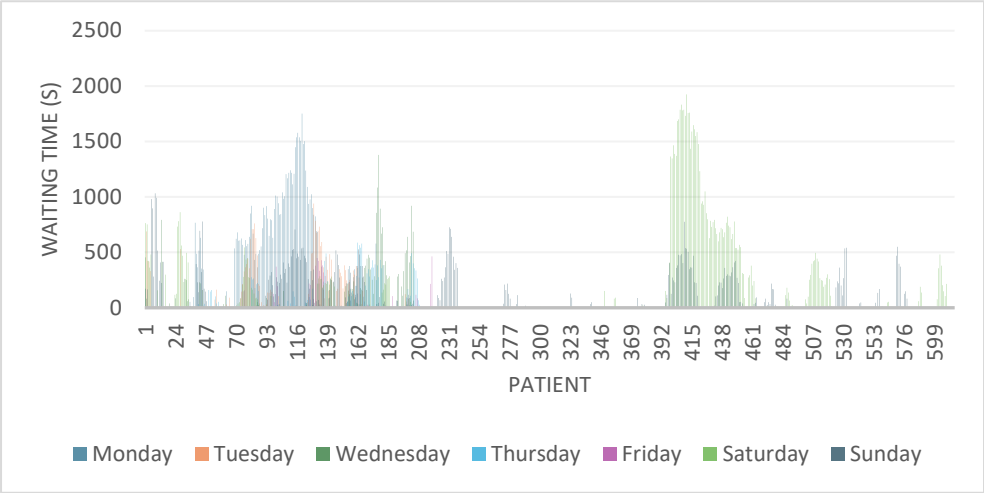


Simulation -5% average interarrival rate

Service time 6:08  6 minute break

*Run 1*

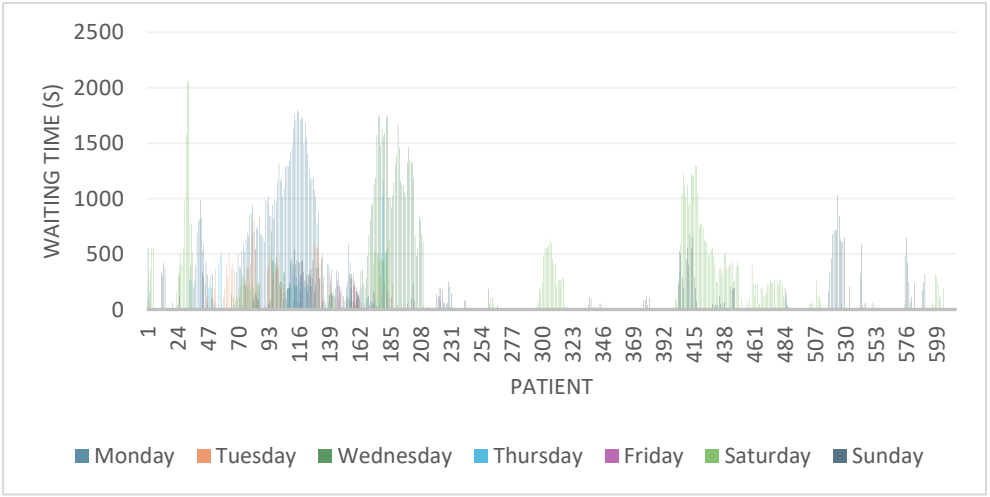
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 309.93 | 1750.27 | 90 | 726.62 |
| Tuesday | 117.76 | 941.10 | 79 | 302.61 |
| Wednesday | 100.00 | 1378.07 | 70 | 301.42 |
| Thursday | 74.34 | 586.13 | 77 | 201.79 |
| Friday | 26.15 | 462.07 | 27 | 211.16 |
| Saturday | 144.20 | 1924.36 | 170 | 469.19 |
| Sunday | 96.17 | 1031.39 | 222 | 258.19 |




Service time 6:08  7minute break

*Run 1*

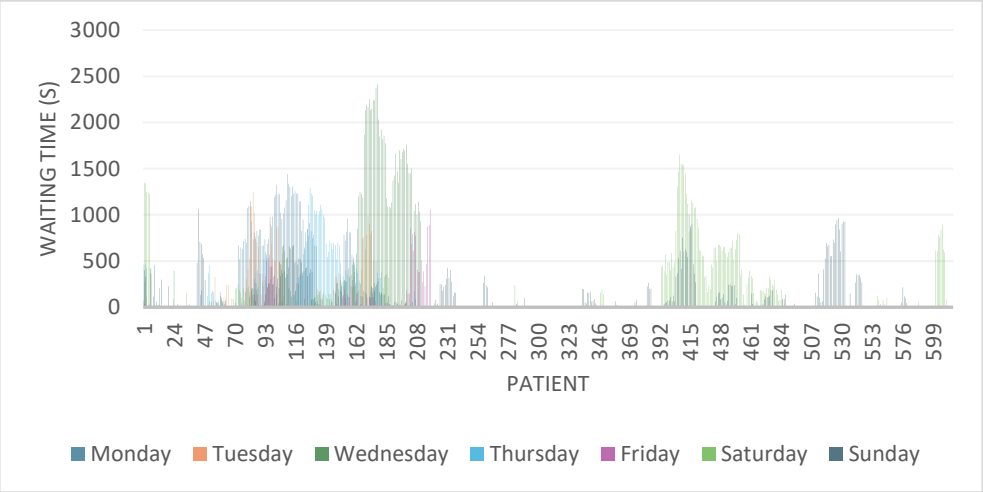
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 371.66 | 1804.44 | 95 | 813.75 |
| Tuesday | 110.34 | 821.14 | 79 | 280.73 |
| Wednesday | 287.88 | 1749.65 | 91 | 664.33 |
| Thursday | 59.41 | 1156.17 | 55 | 224.69 |
| Friday | 21.23 | 442.87 | 33 | 144.12 |
| Saturday | 127.59 | 2065.70 | 224 | 363.97 |
| Sunday | 67.20 | 1031.41 | 173 | 230.73 |



Service time 6:23  6 minute break

*Run 1*

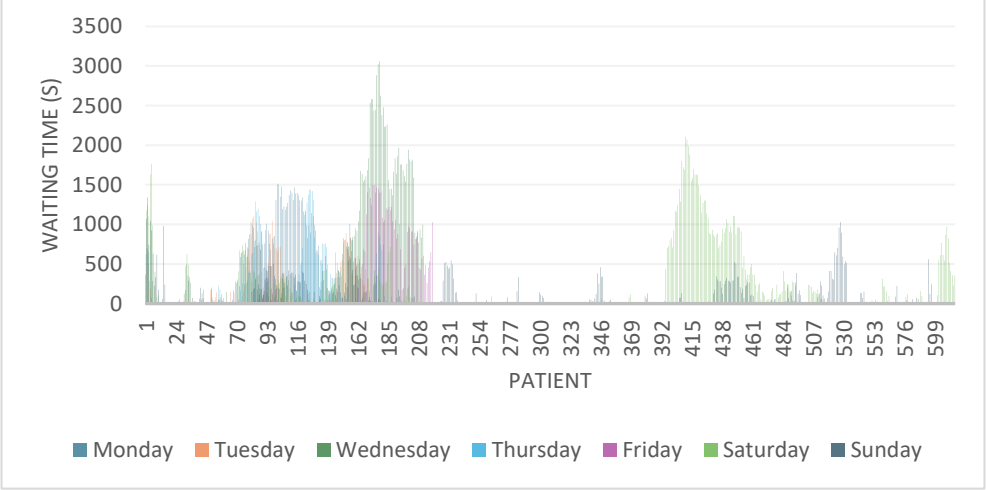
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 309.43 | 1442.12 | 95 | 687.25 |
| Tuesday | 145.14 | 1248.72 | 65 | 392.86 |
| Wednesday | 425.59 | 2413.44 | 99 | 907.06 |
| Thursday | 187.86 | 1296.08 | 81 | 484.73 |
| Friday | 78.40 | 1060.49 | 61 | 280.19 |
| Saturday | 123.34 | 1654.07 | 208 | 380.11 |
| Sunday | 103.30 | 1062.72 | 234 | 263.10 |




Service time 6:23 7 minute break

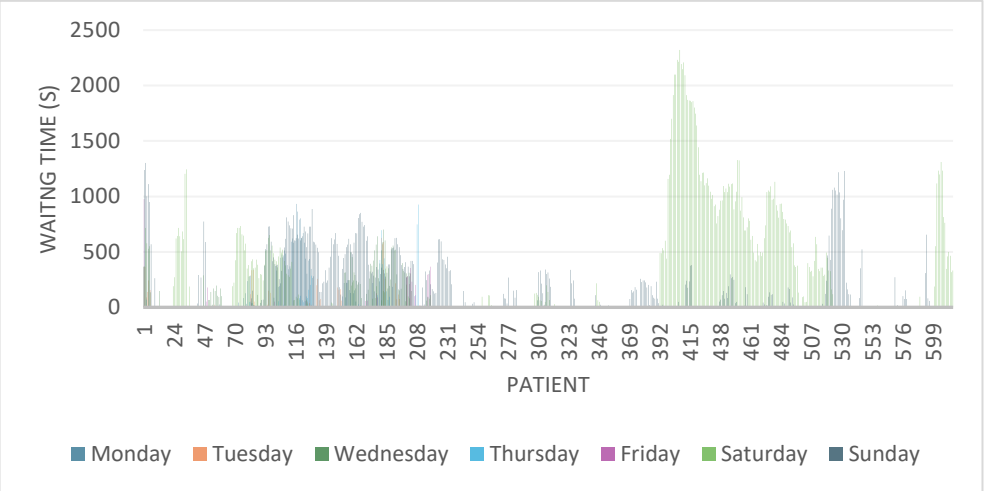
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 338.96 | 1512.78 | 96 | 745.01 |
| Tuesday | 183.93 | 1285.85 | 85 | 439.27 |
| Wednesday | 516.26 | 3062.67 | 108 | 1008.61 |
| Thursday | 213.96 | 1439.17 | 78 | 573.30 |
| Friday | 243.43 | 1496.01 | 77 | 689.18 |
| Saturday | 206.27 | 2109.86 | 271 | 487.90 |
| Sunday | 99.95 | 1341.88 | 258 | 230.89 |



*Run 2*

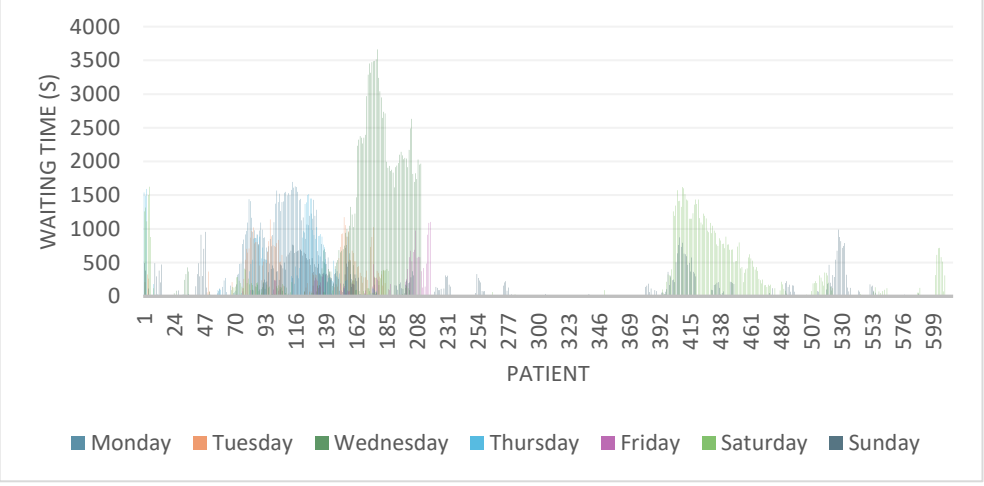
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 85.33 | 932.02 | 54 | 333.42 |
| Tuesday | 29.56 | 626.24 | 33 | 181.85 |
| Wednesday | 86.68 | 700.26 | 66 | 277.11 |
| Thursday | 27.18 | 926.89 | 32 | 177.53 |
| Friday | 19.44 | 975.97 | 21 | 201.82 |
| Saturday | 278.82 | 2322.67 | 287 | 62.74 |
| Sunday | 171.68 | 1303.38 | 291 | 351.61 |




Service time 6:38  6 minute break

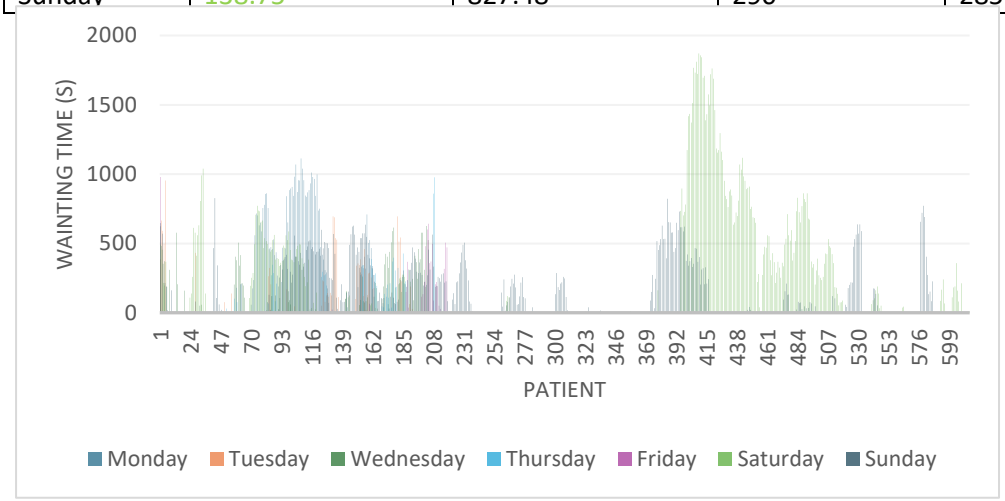
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 387.02 | 1697.17 | 98 | 833.27 |
| Tuesday | 217.98 | 1173.50 | 96 | 460.94 |
| Wednesday | 666.15 | 3662.94 | 97 | 1449.04 |
| Thursday | 199.55 | 1592.33 | 76 | 548.75 |
| Friday | 82.19 | 1100.83 | 66 | 271.46 |
| Saturday | 160.39 | 1627.00 | 244 | 421.35 |
| Sunday | 115.72 | 991.48 | 243 | 283.81 |



*Run 2*

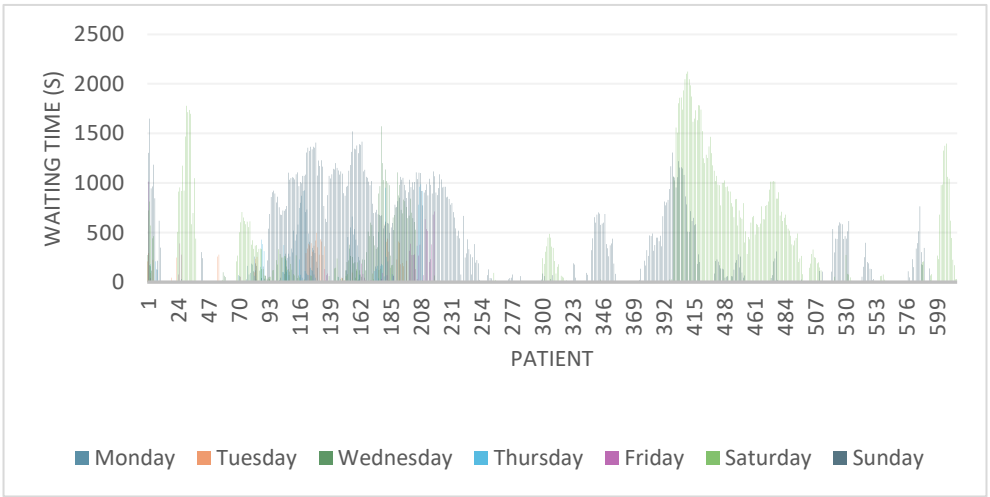
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 212.25 | 1114.13 | 83 | 539.57 |
| Tuesday | 71.69 | 953.82 | 52 | 279.88 |
| Wednesday | 82.87 | 626.91 | 62 | 282.01 |
| Thursday | 50.36 | 976.91 | 44 | 239.23 |
| Friday | 32.66 | 979.76 | 25 | 284.82 |
| Saturday | 212.04 | 1871.26 | 257 | 528.86 |
| Sunday | 138.75 | 827.48 | 290 | 285.15 |




Service time 6:38  7 minute break

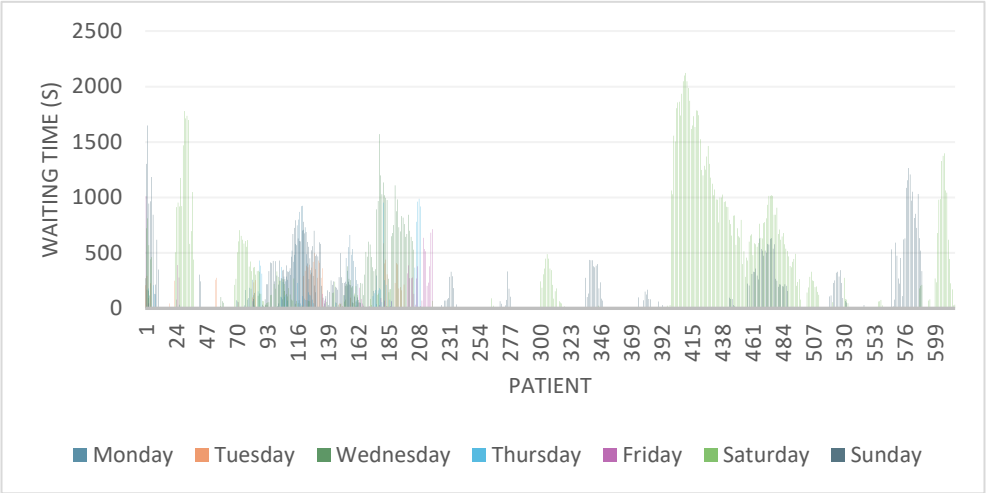
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 87.64 | 924.76 | 55 | 336.23 |
| Tuesday | 56.64 | 587.57 | 47 | 244.65 |
| Wednesday | 150.66 | 1571.68 | 65 | 489.08 |
| Thursday | 51.95 | 988.28 | 49 | 221.60 |
| Friday | 41.66 | 1015.63 | 37 | 245.48 |
| Saturday | 253.74 | 2123.73 | 279 | 582.96 |
| Sunday | 349.50 | 1649.77 | 335 | 621.80 |



*Run 2*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 86.64 | 924.76 | 55 | 332.41 |
| Tuesday | 56.64 | 587.57 | 47 | 244.65 |
| Wednesday | 150.66 | 1571.68 | 65 | 489.08 |
| Thursday | 51.95 | 988.28 | 49 | 221.60 |
| Friday | 41.66 | 1015.63 | 37 | 245.48 |
| Saturday | 253.74 | 2123.73 | 279 | 582.96 |
| Sunday | 119.28 | 1649.77 | 210 | 338.53 |

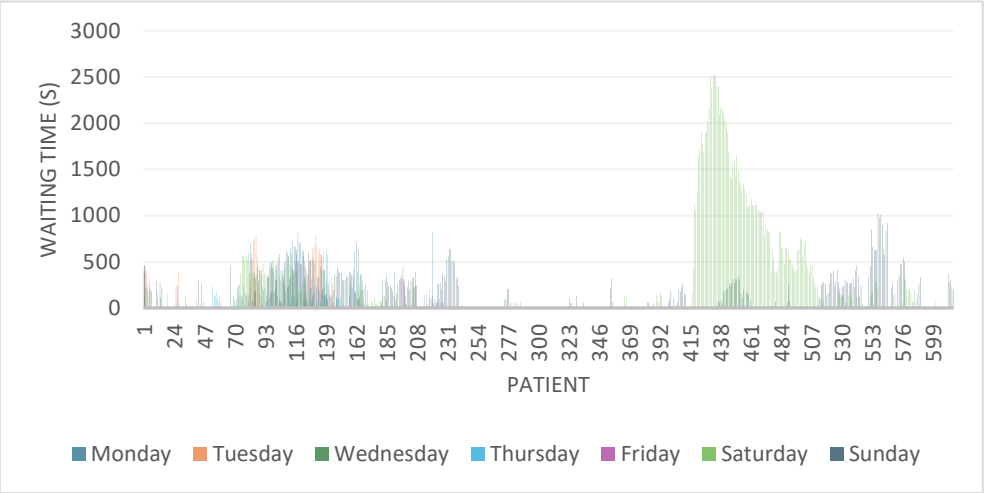


Simulation -10% average interarrival rate

Service time 6:08  6 minute break

*Run 1*

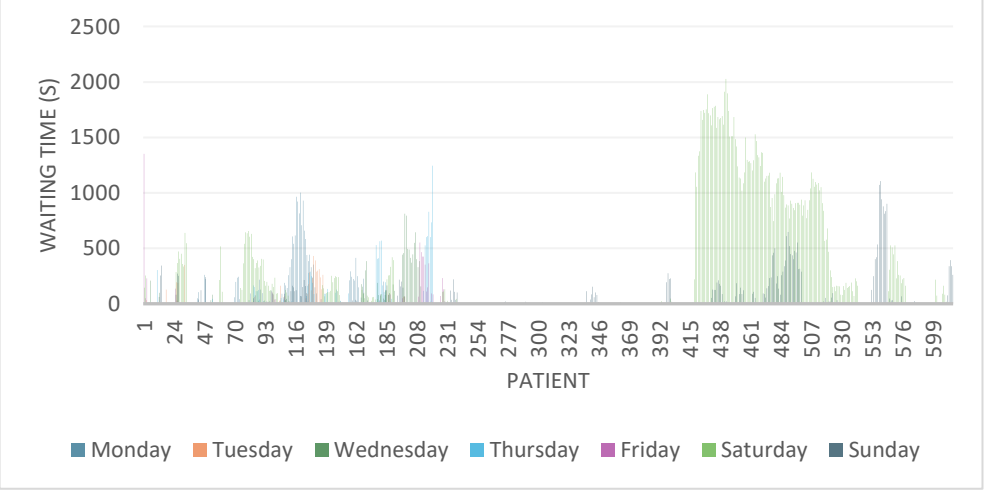
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 126.17 | 823.46 | 83 | 334.44 |
| Tuesday | 74.96 | 796.63 | 41 | 378.44 |
| Wednesday | 23.77 | 418.22 | 25 | 207.28 |
| Thursday | 31.49 | 624.75 | 45 | 151.87 |
| Friday | 13.67 | 453.46 | 17 | 183.29 |
| Saturday | 229.36 | 2531.52 | 279 | 559.00 |
| Sunday | 115.82 | 1019.84 | 265 | 276.21 |




Service time 6:08  7 minute break

*Run 1*

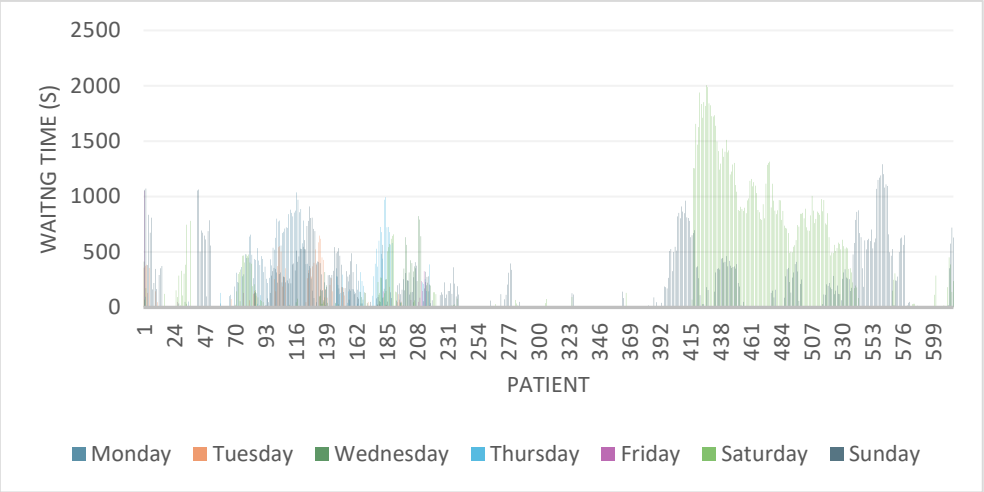
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 76.25 | 1003.80 | 56 | 302.29 |
| Tuesday | 22.88 | 431.35 | 29 | 164.14 |
| Wednesday | 44.58 | 811.41 | 38 | 256.91 |
| Thursday | 51.86 | 1245.65 | 47 | 242.74 |
| Friday | 25.13 | 1352.50 | 29 | 198.42 |
| Saturday | 245.61 | 2028.04 | 281 | 594.37 |
| Sunday | 50.48 | 1107.78 | 169 | 188.76 |



Service time 6:23  6 minute break

*Run 1*

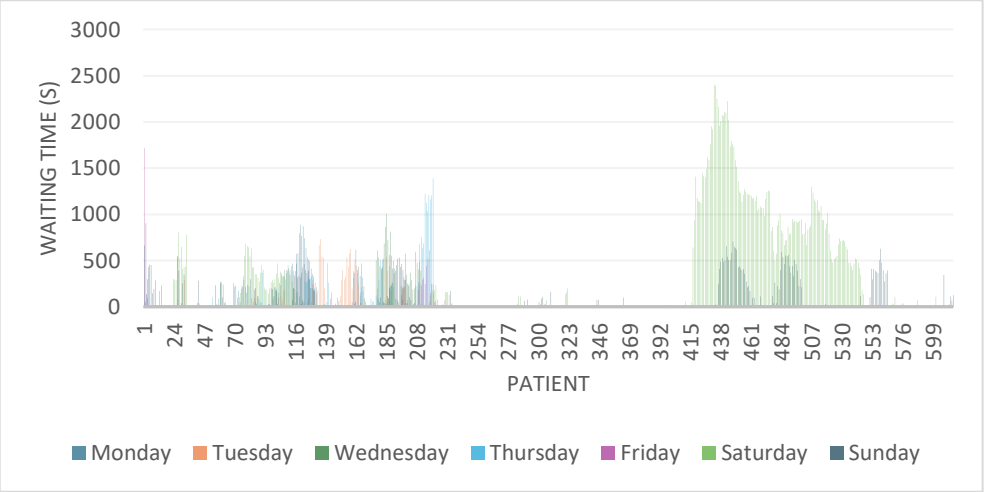
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 161.15 | 1036.55 | 84 | 423.98 |
| Tuesday | 64.30 | 646.93 | 59 | 225.59 |
| Wednesday | 47.56 | 824.71 | 45 | 230.41 |
| Thursday | 61.37 | 995.30 | 45 | 295.96 |
| Friday | 11.42 | 1052.77 | 15 | 173.56 |
| Saturday | 238.39 | 2004.90 | 279 | 581.02 |
| Sunday | 198.62 | 1292.66 | 377 | 381.55 |




Service time 6:23  7 minute break

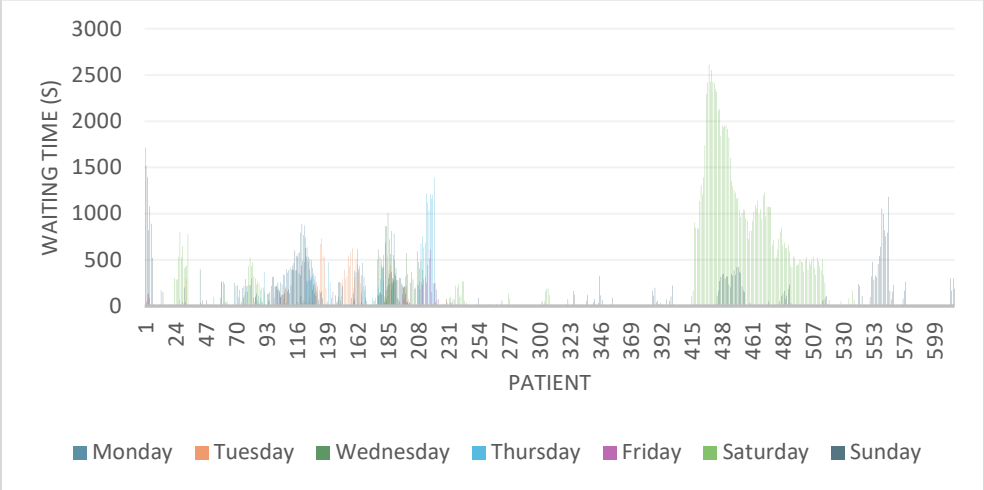
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 101.86 | 888.93 | 67 | 337.50 |
| Tuesday | 65.09 | 731.38 | 53 | 255.44 |
| Wednesday | 73.40 | 1004.44 | 49 | 328.04 |
| Thursday | 30.63 | 1715.12 | 54 | 348.05 |
| Friday | 30.63 | 17115.12 | 36 | 194.84 |
| Saturday | 286.09 | 2404.32 | 283 | 687.42 |
| Sunday | 95.70 | 1238.11 | 203 | 297.94 |



*Run 2*

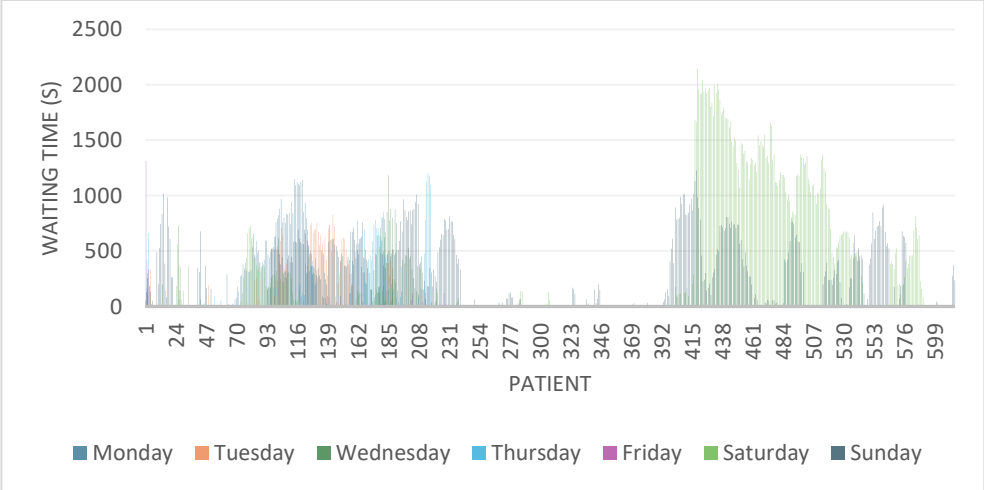
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 110.80 | 888.93 | 73 | 336.96 |
| Tuesday | 65.09 | 731.38 | 53 | 255.44 |
| Wednesday | 73.40 | 1004.44 | 49 | 328.04 |
| Thursday | 30.63 | 1715.12 | 54 | 348.05 |
| Friday | 30.63 | 17115.12 | 36 | 194.84 |
| Saturday | 211.03 | 2611.87 | 175 | 643.50 |
| Sunday | 82.50 | 1518.44 | 265 | 240.27 |




Service time 6:38  6 minute break

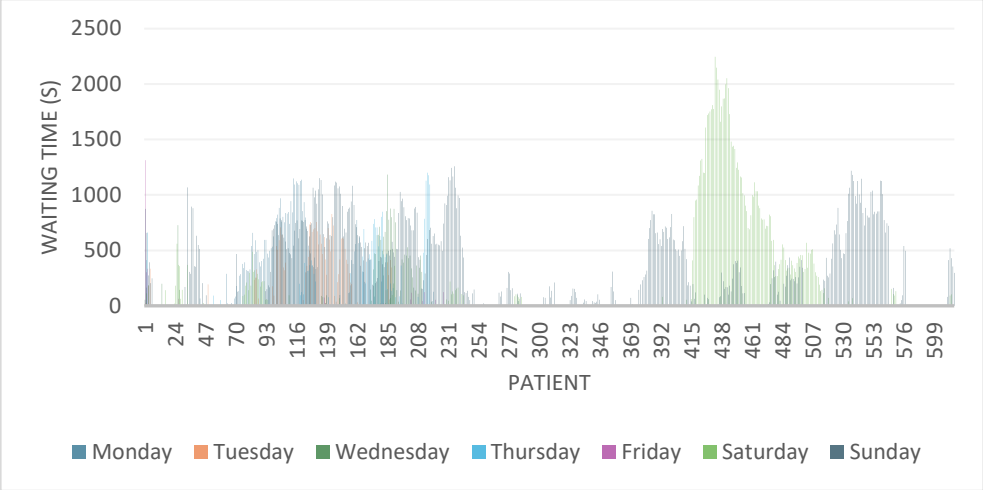
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 208.31 | 1148.91 | 87 | 529.15 |
| Tuesday | 122.77 | 828.35 | 63 | 403.38 |
| Wednesday | 92.74 | 1182.90 | 53 | 381.47 |
| Thursday | 106.57 | 1200.59 | 57 | 405.70 |
| Friday | 11.93 | 1312.61 | 19 | 143.12 |
| Saturday | 310.84 | 2143.45 | 314 | 673.15 |
| Sunday | 248.70 | 1227.00 | 405 | 436.60 |



*Run 2*

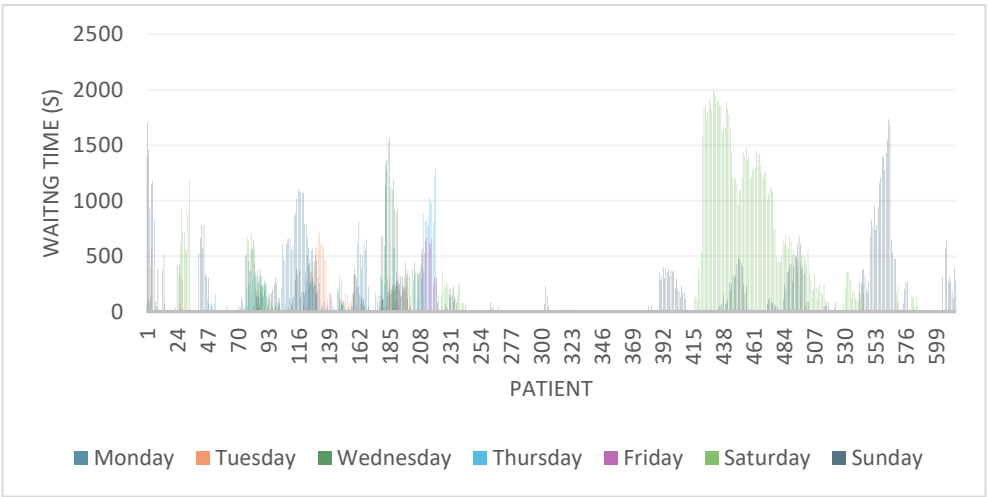
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 203.89 | 1148.91 | 88 | 512.05 |
| Tuesday | 122.77 | 828.35 | 63 | 403.38 |
| Wednesday | 92.74 | 1182.90 | 53 | 381.47 |
| Thursday | 106.57 | 1200.59 | 57 | 405.70 |
| Friday | 11.93 | 1312.61 | 19 | 143.12 |
| Saturday | 186.94 | 2245.53 | 225 | 564.96 |
| Sunday | 324.38 | 1579.83 | 398 | 515.10 |




Service time 6:38 7 minute break

*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 164.88 | 1273.94 | 84 | 435.76 |
| Tuesday | 61.35 | 720.78 | 48 | 265.86 |
| Wednesday | 111.37 | 1568.33 | 61 | 399.83 |
| Thursday | 95.87 | 1294.09 | 77 | 273.92 |
| Friday | 45.33 | 1400.90 | 35 | 296.61 |
| Saturday | 244.09 | 2002.08 | 246 | 674.72 |
| Sunday | 132.96 | 1734.90 | 262 | 320.74 |



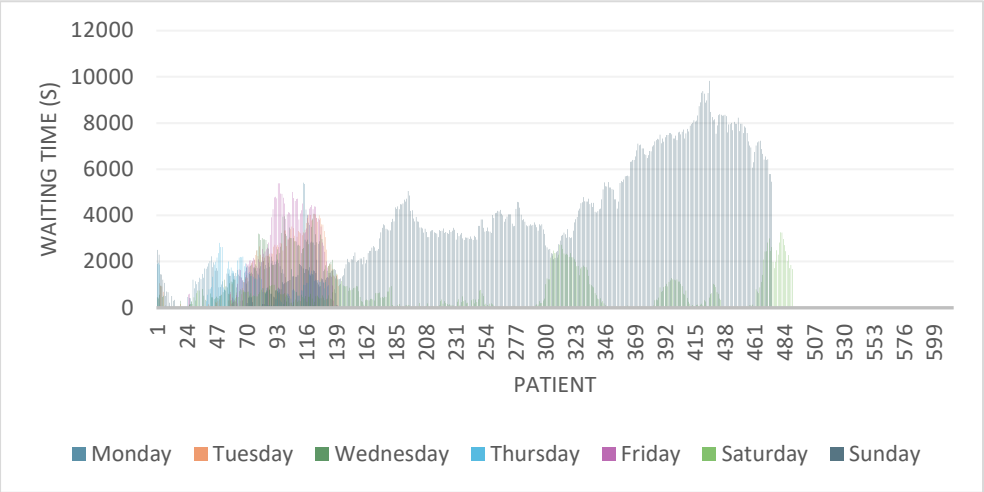
### 7.7.2 Simulation 2

Simulation -0% average interarrival rate

Service time 6:36 6 minute break

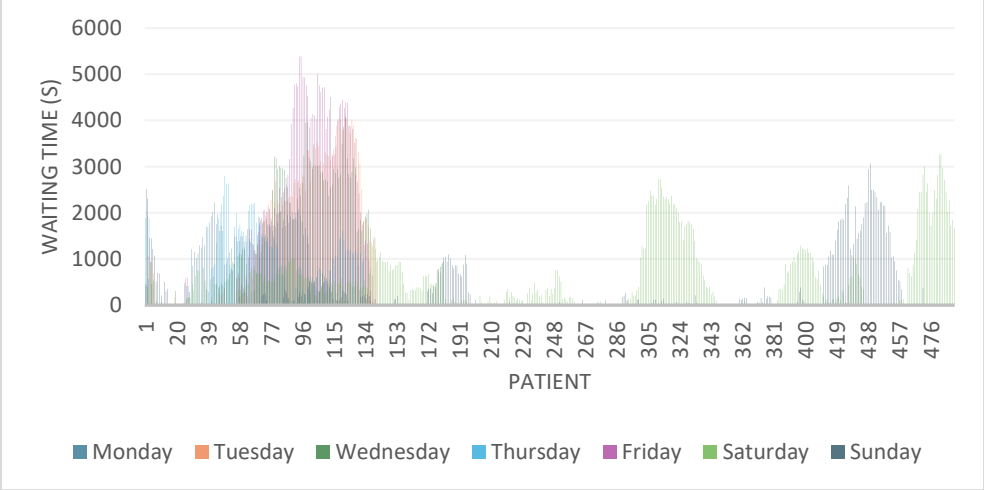
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 1074.42 | 5410.91 | 94 | 1657.35 |
| Tuesday | 1483.93 | 4063.99 | 96 | 2194.98 |
| Wednesday | 1455.06 | 4077.60 | 108 | 1845.78 |
| Thursday | 796.79 | 2803.22 | 97 | 1166.44 |
| Friday | 1712.63 | 5389.29 | 88 | 2744.09 |
| Saturday | 530.08 | 3263.47 | 344 | 755.06 |
| Sunday | 3603.81 | 9827.54 | 416 | 4106.26 |



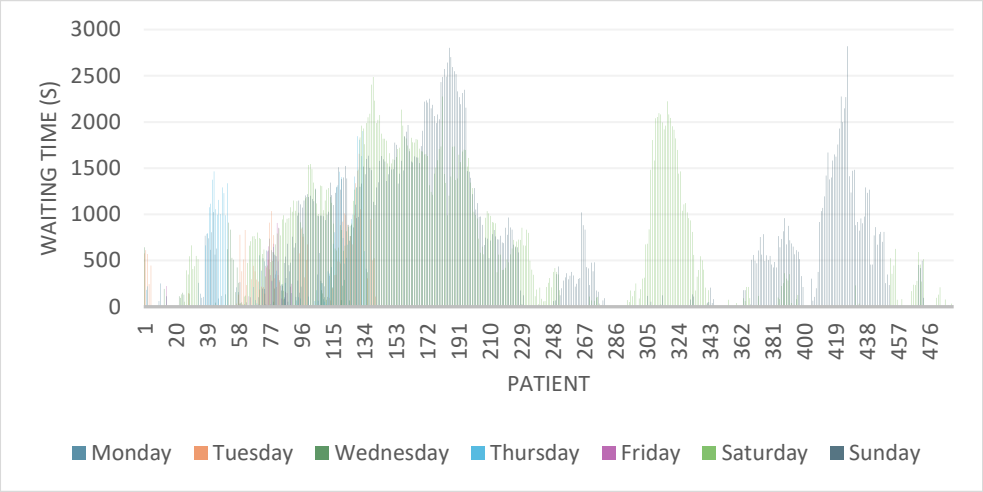

Run 2

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 786.73 | 2225.82 | 81 | 1408.35 |
| Tuesday | 1483.93 | 4063.99 | 96 | 2194.98 |
| Wednesday | 1455.06 | 4077.60 | 108 | 1845.78 |
| Thursday | 796.79 | 2803.22 | 97 | 1166.44 |
| Friday | 1712.63 | 5389.29 | 88 | 2744.09 |
| Saturday | 530.08 | 3263.47 | 344 | 755.06 |
| Sunday | 276.31 | 3069.74 | 187 | 700.37 |



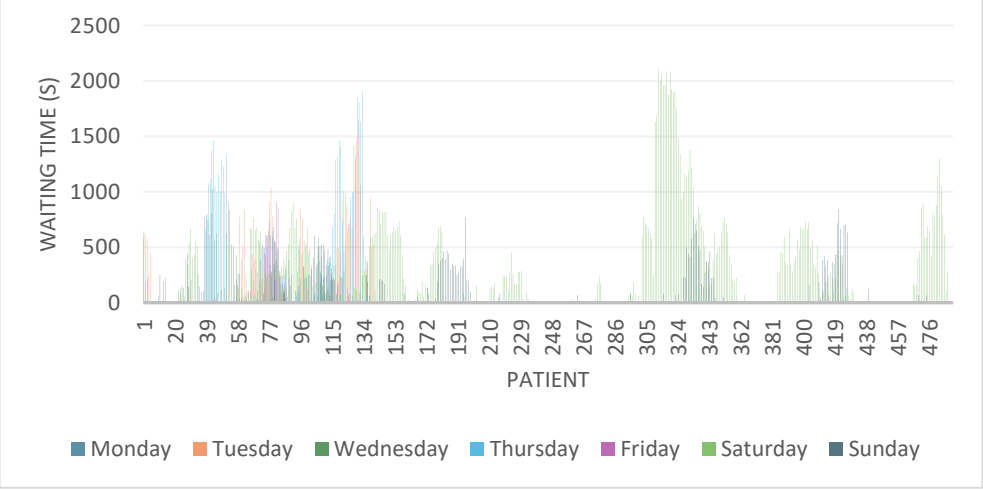
Run 3

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 133.03 | 1024.51 | 57 | 338.42 |
| Tuesday | 237.92 | 1655.26 | 62 | 544.91 |
| Wednesday | 61.56 | 911.54 | 37 | 227.93 |
| Thursday | 306.15 | 1902.10 | 63 | 690.05 |
| Friday | 49.22 | 907.95 | 20 | 347.03 |
| Saturday | 558.74 | 2487.99 | 308 | 888.91 |
| Sunday | 597.48 | 2819.75 | 283 | 1000.73 |



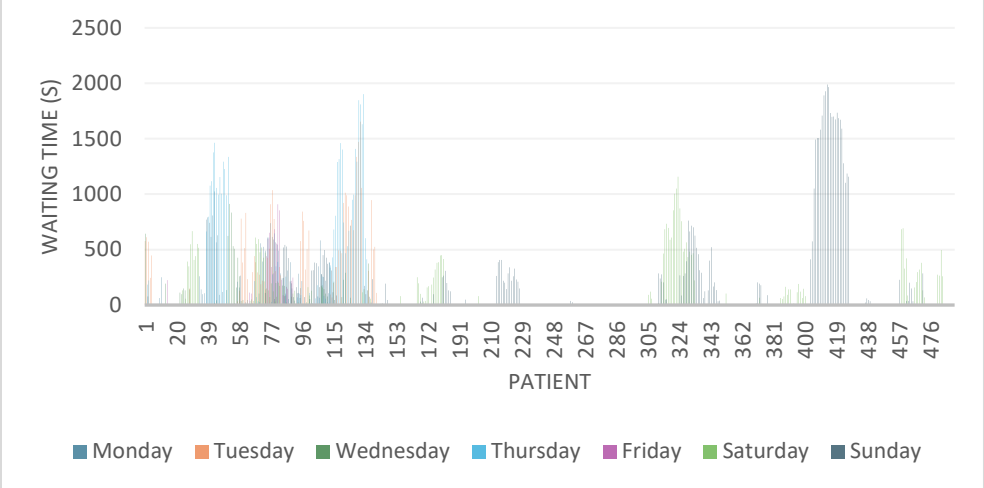

*Run 4*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 136.22 | 1024.51 | 59 | 334.77 |
| Tuesday | 237.92 | 1655.26 | 62 | 544.91 |
| Wednesday | 61.56 | 911.54 | 37 | 227.93 |
| Thursday | 306.15 | 1902.10 | 63 | 690.05 |
| Friday | 49.22 | 907.95 | 20 | 347.03 |
| Saturday | 286.39 | 2104.54 | 283 | 495.87 |
| Sunday | 71.58 | 846.53 | 121 | 281.47 |



*Run 5*

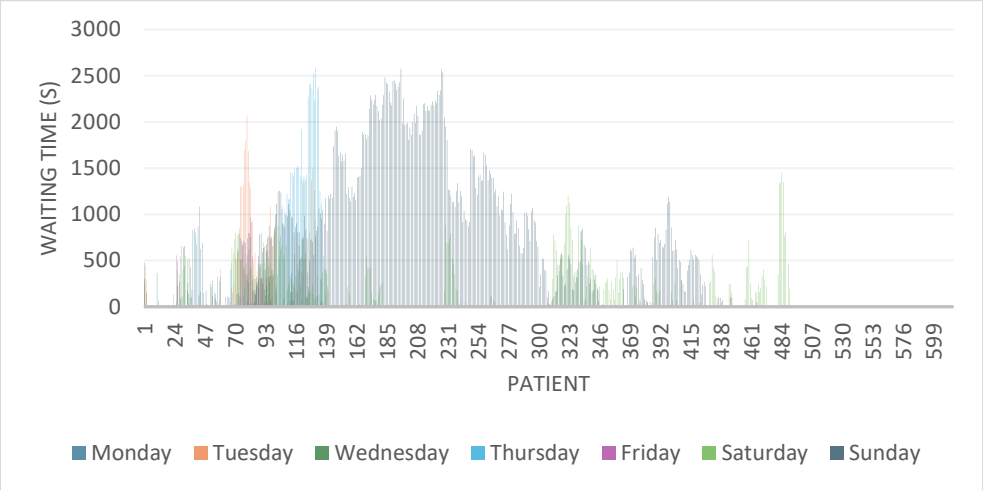
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 133.03 | 1024.51 | 57 | 338.42 |
| Tuesday | 237.92 | 1655.26 | 62 | 544.91 |
| Wednesday | 61.56 | 911.54 | 37 | 227.93 |
| Thursday | 306.15 | 1902.10 | 63 | 690.05 |
| Friday | 49.22 | 907.95 | 20 | 347.03 |
| Saturday | 70.68 | 1156.29 | 119 | 291.05 |
| Sunday | 129.33 | 1989.05 | 142 | 431.70 |



Service time 6:36 7 minute break

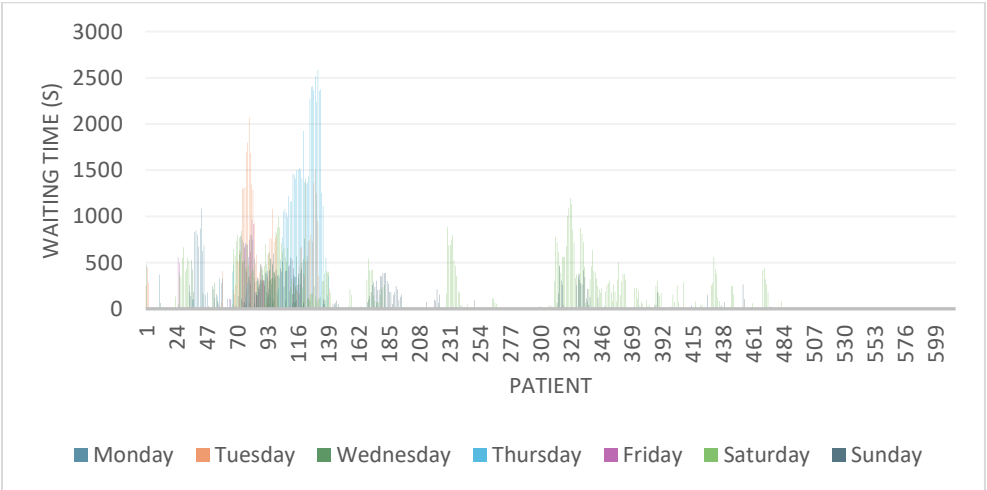
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 153.60 | 1084.51 | 55 | 404.95 |
| Tuesday | 294.21 | 2072.17 | 63 | 663.14 |
| Wednesday | 82.30 | 1406.14 | 40 | 281.87 |
| Thursday | 398.11 | 2585.40 | 53 | 1066.63 |
| Friday | 62.46 | 967.95 | 23 | 382.92 |
| Saturday | 174.03 | 1449.80 | 240 | 355.30 |
| Sunday | 733.52 | 2578.09 | 344 | 1010.72 |




*Run 2*

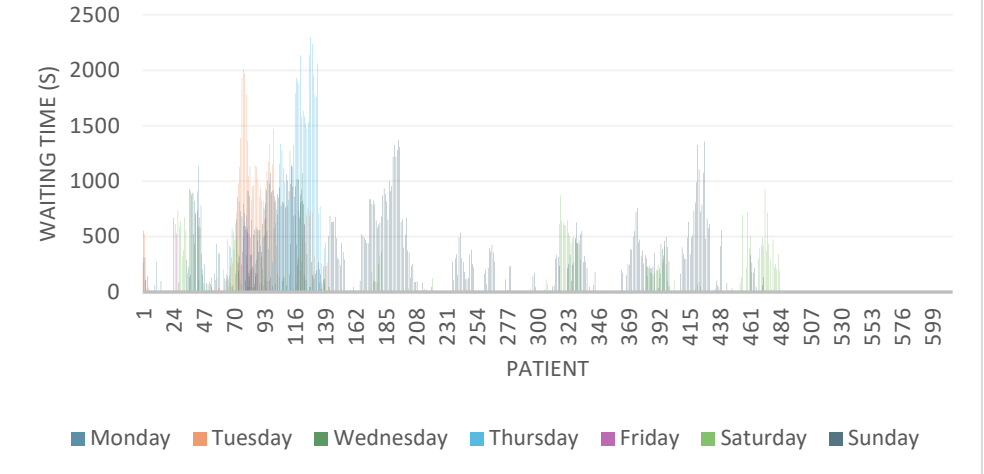
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 154.24 | 1084.51 | 56 | 399.37 |
| Tuesday | 294.21 | 2072.17 | 63 | 663.14 |
| Wednesday | 82.30 | 1406.14 | 40 | 281.87 |
| Thursday | 398.11 | 2585.40 | 53 | 1066.63 |
| Friday | 62.46 | 967.95 | 23 | 382.92 |
| Saturday | 152.44 | 1200.70 | 221 | 337.99 |
| Sunday | 56.01 | 596.92 | 117 | 226.89 |



Service time 6:51 6 minute break

*Run 1*

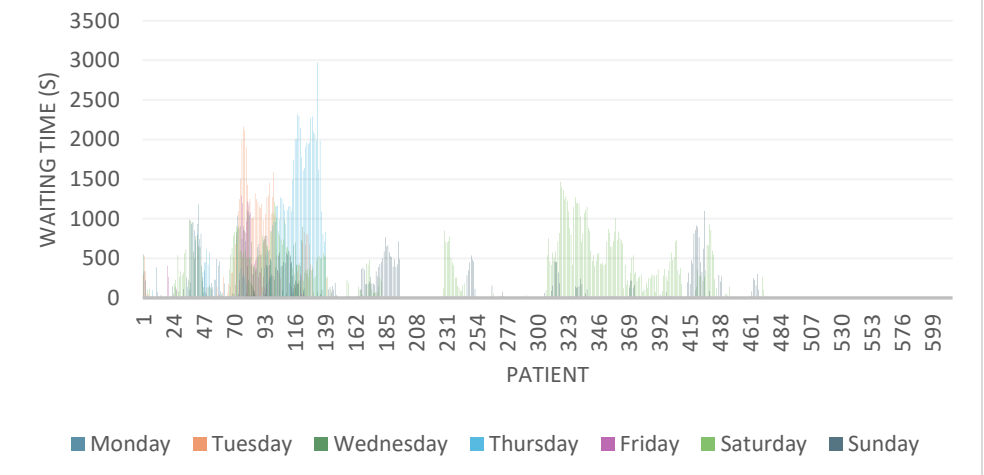
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 178.00 | 1134.07 | 61 | 423.12 |
| Tuesday | 320.80 | 2014.64 | 66 | 690.22 |
| Wednesday | 116.63 | 1070.55 | 43 | 371.57 |
| Thursday | 392.83 | 2302.49 | 37 | 978.63 |
| Friday | 50.82 | 690.37 | 20 | 358.29 |
| Saturday | 68.58 | 926.44 | 125 | 268.84 |
| Sunday | 246.73 | 1372.72 | 259 | 451.54 |




Service time 6:51 7 minute break

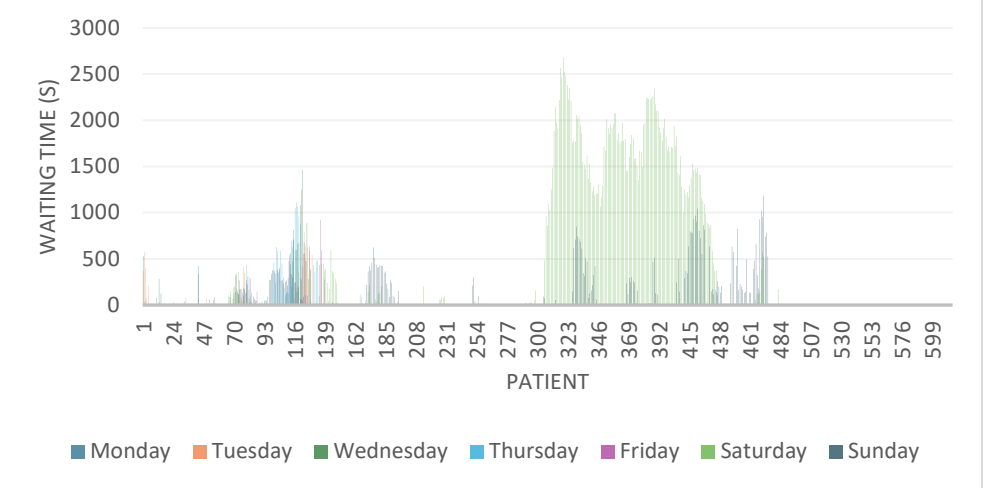
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 216.01 | 1184.28 | 66 | 474.57 |
| Tuesday | 362.72 | 2164.57 | 68 | 757.45 |
| Wednesday | 113.81 | 990.74 | 47 | 331.74 |
| Thursday | 503.51 | 2972.24 | 65 | 1099.99 |
| Friday | 98.97 | 1291.26 | 28 | 498.37 |
| Saturday | 250.50 | 1467.41 | 254 | 483.24 |
| Sunday | 88.27 | 1098.86 | 143 | 292.60 |



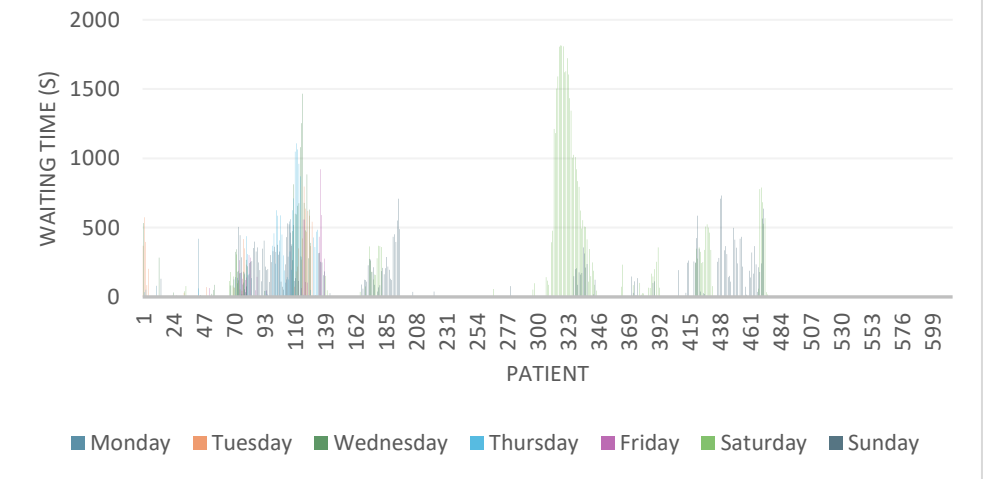
*Run 2*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 30.01 | 706.81 | 16 | 271.98 |
| Tuesday | 61.14 | 796.32 | 26 | 333.89 |
| Wednesday | 100.89 | 1466.36 | 33 | 418.87 |
| Thursday | 104.91 | 1107.26 | 38 | 392.02 |
| Friday | 38.05 | 922.25 | 22 | 243.89 |
| Saturday | 458.76 | 2676.38 | 201 | 1118.37 |
| Sunday | 116.63 | 1179.52 | 167 | 331.04 |




*Run 3*

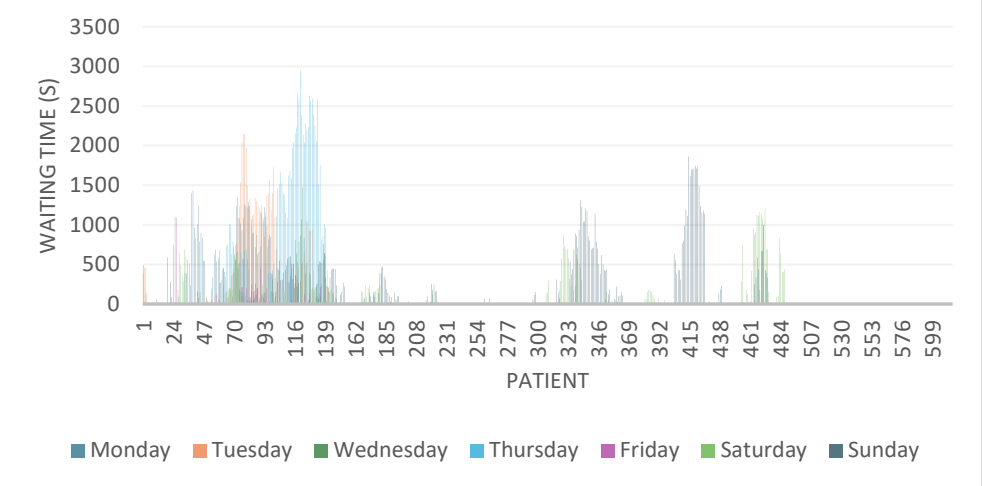
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 26.52 | 559.91 | 16 | 240.35 |
| Tuesday | 61.14 | 796.32 | 26 | 333.89 |
| Wednesday | 100.89 | 1466.36 | 33 | 418.87 |
| Thursday | 104.91 | 1107.26 | 38 | 392.02 |
| Friday | 38.05 | 922.25 | 22 | 243.89 |
| Saturday | 97.69 | 1815.63 | 109 | 439.14 |
| Sunday | 75.27 | 732.34 | 155 | 230.18 |



Service time 7:06 6 minute break

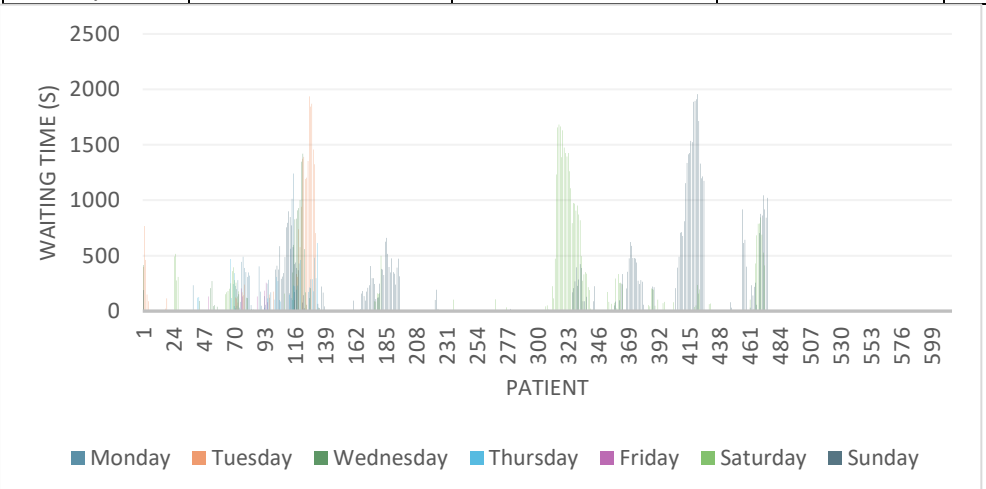
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 338.27 | 1436.50 | 72 | 681.24 |
| Tuesday | 397.31 | 2153.53 | 69 | 817.66 |
| Wednesday | 77.24 | 1473.96 | 28 | 377.94 |
| Thursday | 623.44 | 2953.64 | 76 | 1164.86 |
| Friday | 48.65 | 1101.80 | 28 | 245.00 |
| Saturday | 88.85 | 1211.05 | 143 | 304.46 |
| Sunday | 166.05 | 1859.57 | 171 | 460.28 |




*Run 2*

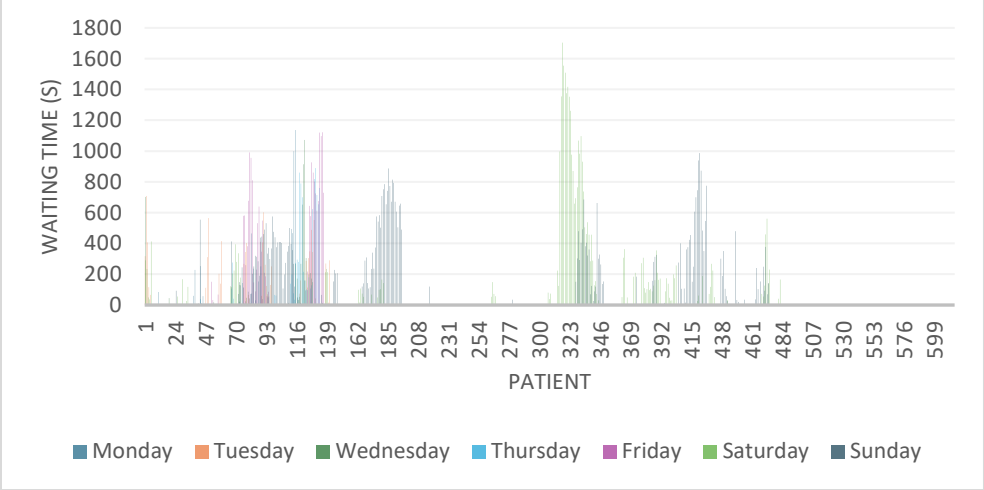
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 59.52 | 1241.73 | 32 | 269.68 |
| Tuesday | 153.81 | 1938.06 | 33 | 661.87 |
| Wednesday | 78.35 | 1420.38 | 25 | 429.36 |
| Thursday | 50.50 | 614.41 | 32 | 224.09 |
| Friday | 7.95 | 257.61 | 7 | 160.04 |
| Saturday | 84.56 | 1628.32 | 96 | 431.63 |
| Sunday | 139.79 | 1955.78 | 140 | 473.30 |



Service time 7:06 7 minute break

*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 37.97 | 1137.38 | 24 | 229.42 |
| Tuesday | 68.47 | 707.56 | 41 | 255.85 |
| Wednesday | 39.45 | 1071.51 | 20 | 270.26 |
| Thursday | 68.54 | 889.18 | 30 | 324.43 |
| Friday | 135.33 | 1122.24 | 36 | 530.04 |
| Saturday | 78.09 | 1704.32 | 121 | 316.22 |
| Sunday | 108.20 | 986.18 | 157 | 326.65 |

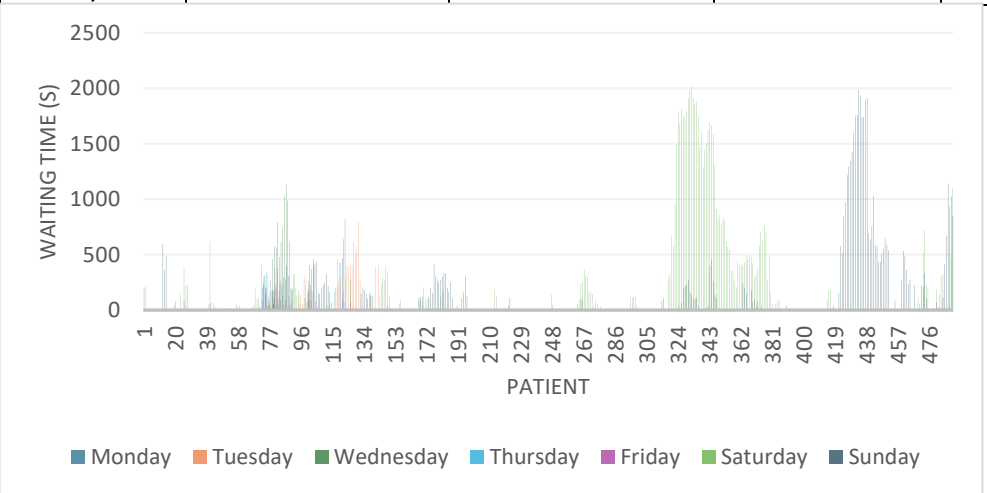


Simulation -5% average interarrival rate

Service time 6:36 6 minute break

*Run 1*

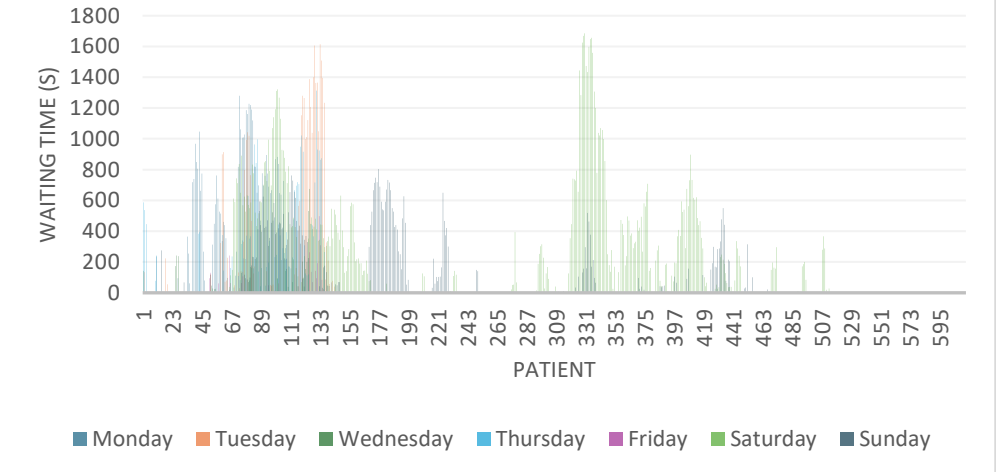
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 33.45 | 822.79 | 29 | 176.47 |
| Tuesday | 66.61 | 795.00 | 36 | 273.84 |
| Wednesday | 64.53 | 1132.25 | 17 | 535.21 |
| Thursday | 2755 | 470.94 | 19 | 211.68 |
| Friday | 9.87 | 803.89 | 16 | 93.11 |
| Saturday | 184.42 | 2017.74 | 188 | 506.16 |
| Sunday | 123.65 | 1989.81 | 162 | 374.02 |




Service time 6:36 7 minute break

*Run 1*

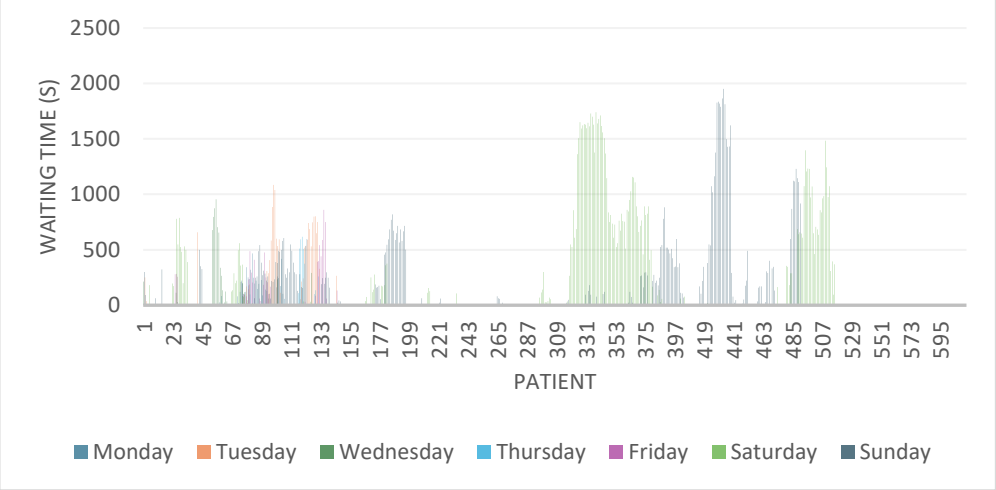
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 285.55 | 1278.82 | 70 | 624.12 |
| Tuesday | 235.77 | 1615.17 | 59 | 591.41 |
| Wednesday | 28.46 | 675.17 | 26 | 153.27 |
| Thursday | 193.90 | 1313.40 | 70 | 401.66 |
| Friday | 18.24 | 497.67 | 20 | 134.95 |
| Saturday | 222.47 | 1684.07 | 256 | 448.41 |
| Sunday | 95.61 | 803.91 | 158 | 296.53 |



Service time 6:51 6 minute break

*Run 1*

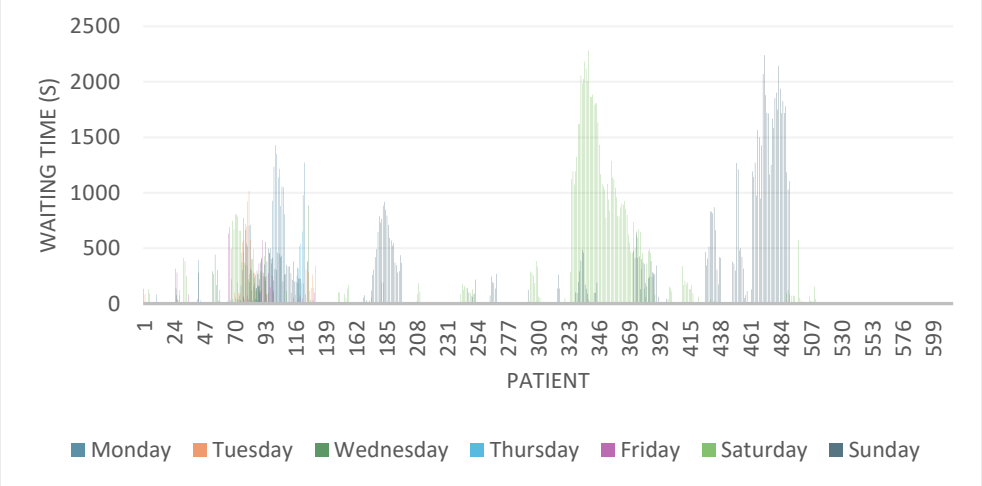
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 44.39 | 596.94 | 34 | 199.77 |
| Tuesday | 110.55 | 1085.82 | 36 | 454.47 |
| Wednesday | 47.23 | 955.70 | 18 | 350.53 |
| Thursday | 23.94 | 616.43 | 11 | 291.22 |
| Friday | 56.33 | 859.33 | 29 | 265.79 |
| Saturday | 200.75 | 1740.36 | 160 | 647.41 |
| Sunday | 157.13 | 1952.41 | 184 | 418.44 |




Service time 6:51 7 minute break

*Run 1*

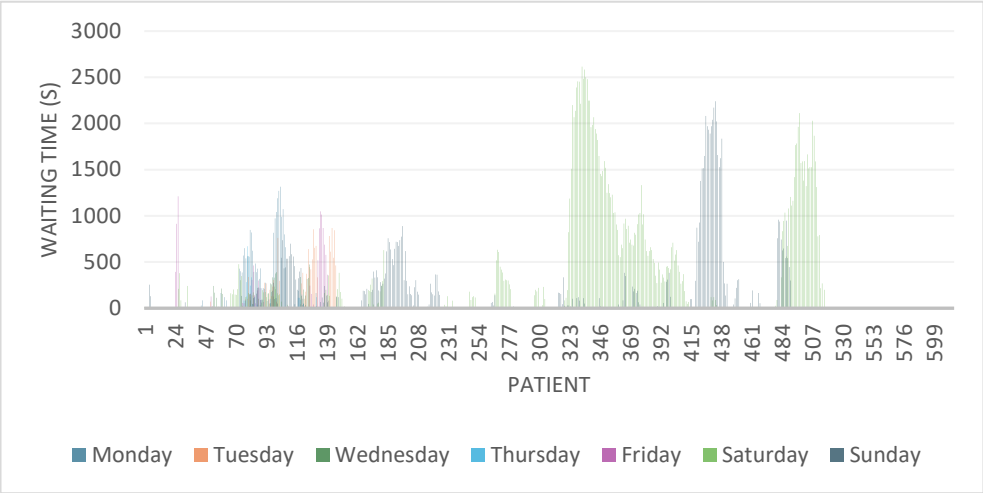
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 136.98 | 1428.08 | 40 | 523.95 |
| Tuesday | 69.00 | 1015.62 | 37 | 275.99 |
| Wednesday | 37.64 | 886.55 | 24 | 212.31 |
| Thursday | 18.96 | 650.22 | 14 | 184.50 |
| Friday | 40.63 | 690.33 | 26 | 211.53 |
| Saturday | 171.33 | 2365.20 | 174 | 508.09 |
| Sunday | 191.71 | 2241.54 | 173 | 543.00 |



Service time 7:06 6 minute break

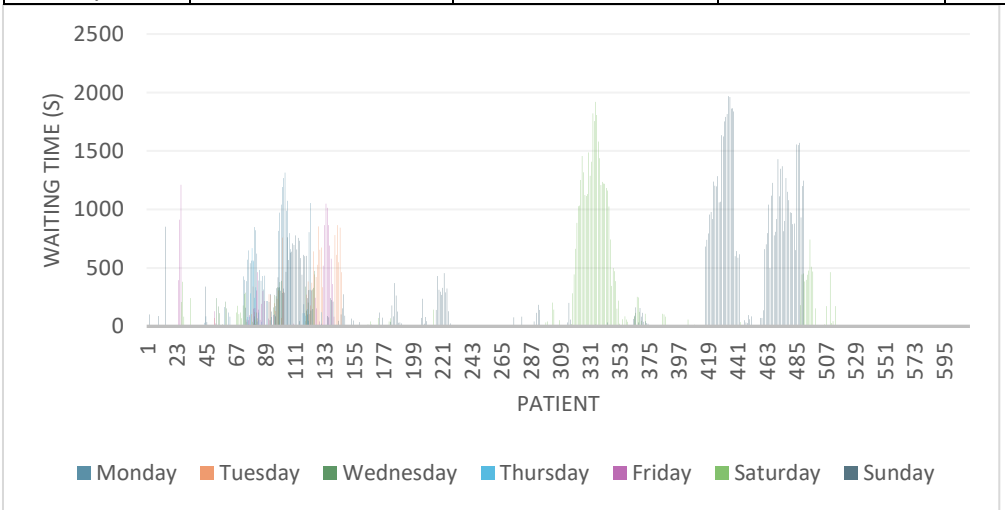
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 138.37 | 1314.58 | 44 | 481.16 |
| Tuesday | 89.18 | 867.08 | 34 | 388.22 |
| Wednesday | 36.16 | 473.12 | 27 | 188.84 |
| Thursday | 21.90 | 669.09 | 20 | 159.88 |
| Friday | 76.49 | 1210.26 | 35 | 330.02 |
| Saturday | 306.71 | 2614.40 | 235 | 673.46 |
| Sunday | 160.12 | 2240.69 | 192 | 408.65 |




*Run 2*

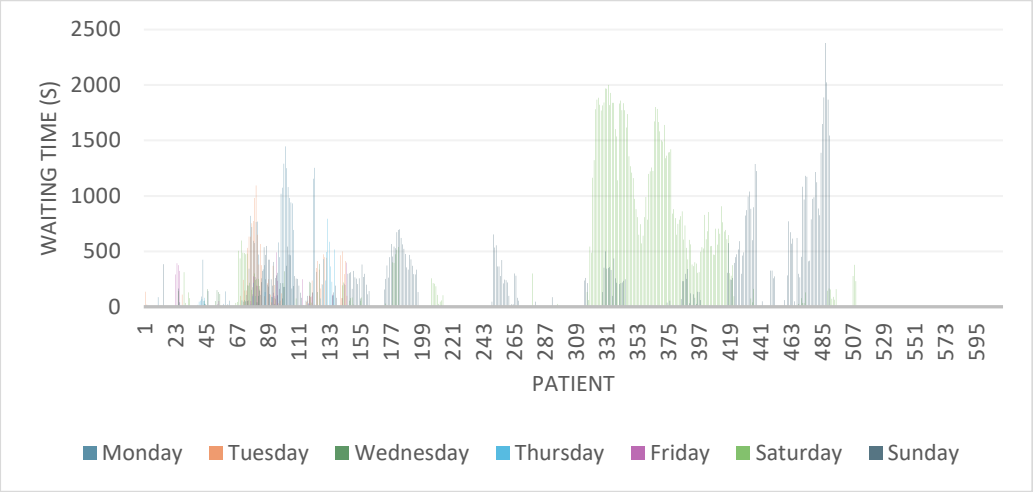
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 149.11 | 1314.58 | 43 | 530.57 |
| Tuesday | 89.18 | 867.08 | 34 | 388.22 |
| Wednesday | 36.16 | 473.12 | 27 | 188.84 |
| Thursday | 21.90 | 669.09 | 20 | 159.88 |
| Friday | 76.49 | 1210.26 | 35 | 330.02 |
| Saturday | 93.00 | 1919.66 | 104 | 461.41 |
| Sunday | 181.18 | 1968.48 | 174 | 510.21 |



Service time 7:06 7 minute break

*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 149.66 | 1446.44 | 48 | 477.04 |
| Tuesday | 102.38 | 1093.79 | 50 | 303.04 |
| Wednesday | 16.45 | 386.96 | 18 | 128.86 |
| Thursday | 34.74 | 792.88 | 29 | 174.89 |
| Friday | 33.91 | 491.95 | 31 | 165.16 |
| Saturday | 241.23 | 2001.43 | 180 | 691.52 |
| Sunday | 168.26 | 2378.99 | 206 | 400.24 |

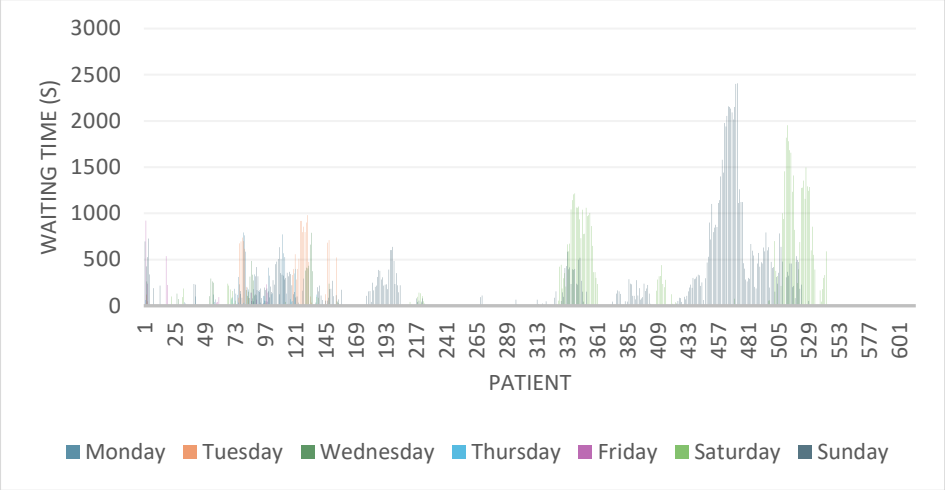


Simulation -10% average interarrival rate

Service time 6:36 6 minute break

*Run 1*

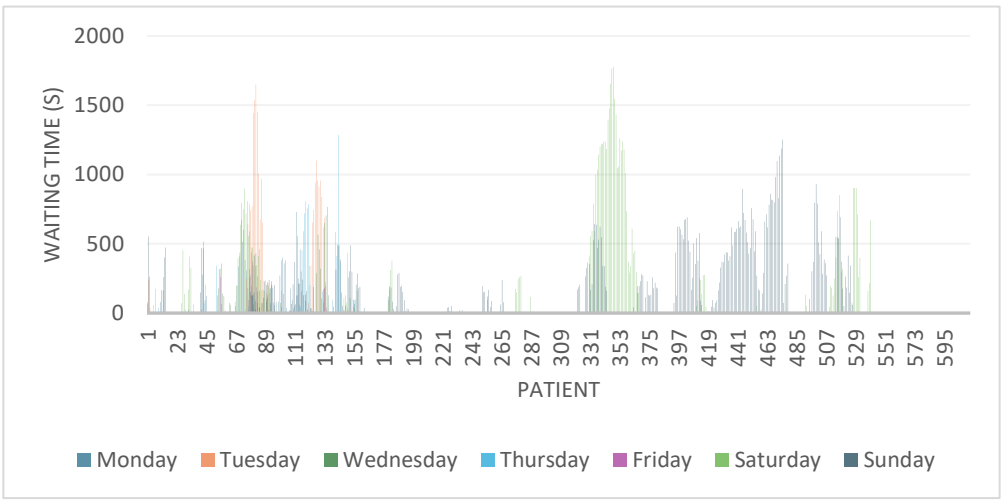
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 61.16 | 792.57 | 46 | 216.72 |
| Tuesday | 99.50 | 979.56 | 32 | 478.85 |
| Wednesday | 46.47 | 788.20 | 25 | 282.54 |
| Thursday | 9.51 | 398.20 | 17 | 86.67 |
| Friday | 17.12 | 921.29 | 11 | 242.86 |
| Saturday | 112.85 | 1955.55 | 115 | 532.83 |
| Sunday | 185.18 | 2408.98 | 262 | 373.90 |




Service time 6:36 7 minute break

*Run 1*

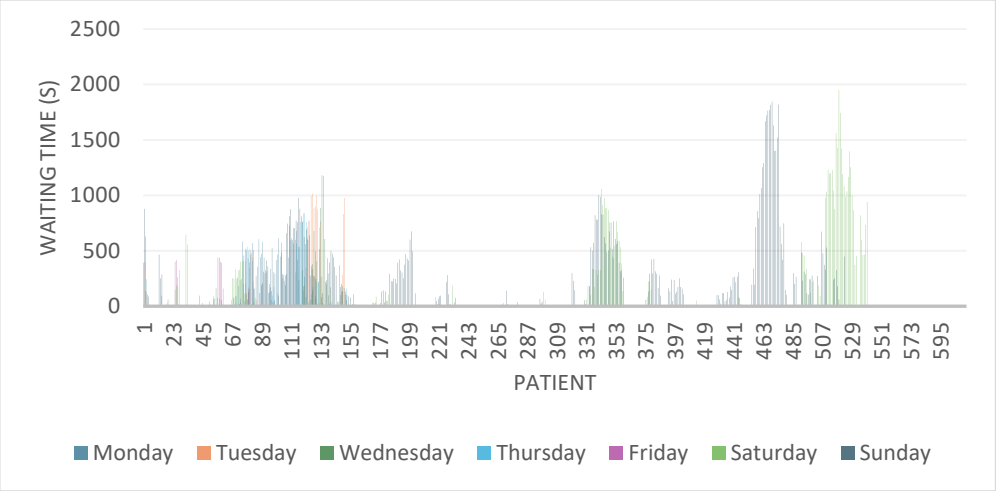
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 75.13 | 728.00 | 51 | 244.53 |
| Tuesday | 156.21 | 1649.48 | 40 | 597.52 |
| Wednesday | 41.78 | 765.62 | 25 | 254.02 |
| Thursday | 61.26 | 1284.76 | 33 | 287.75 |
| Friday | 18.82. | 434.63 | 20 | 145.82 |
| Saturday | 116.60 | 1777.97 | 133 | 473.42 |
| Sunday | 143.97 | 1250.12 | 245 | 310.28 |



### Service time 6:51 6 minute break

*Run 1*

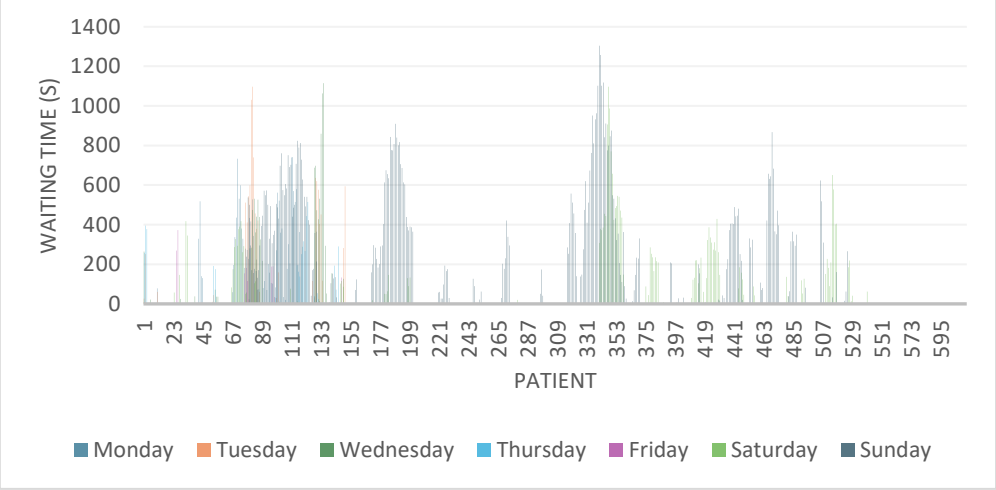
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 119.17 | 724.08 | 53 | 373.24 |
| Tuesday | 99.67 | 1016.34 | 42 | 476.54 |
| Wednesday | 67.97 | 1180.84 | 37 | 279.23 |
| Thursday | 78.22 | 841.37 | 42 | 290.53 |
| Friday | 22.64 | 439.02 | 17 | 206.45 |
| Saturday | 103.42 | 1951.43 | 136 | 443.21 |
| Sunday | 178.98 | 1844.28 | 245 | 385.73 |




### Service time 6:51 7 minute break

*Run 1*

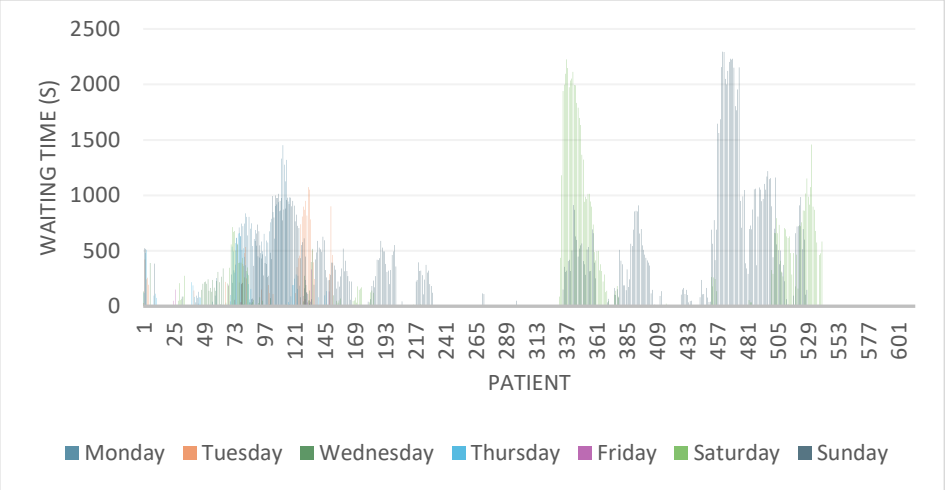
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 94.52 | 740.82 | 54 | 290.57 |
| Tuesday | 69.71 | 1096.58 | 30 | 355.53 |
| Wednesday | 71.46 | 1115.53 | 30 | 362.04 |
| Thursday | 30.16 | 514.55 | 25 | 188.17 |
| Friday | 10.74 | 373.24 | 10 | 166.41 |
| Saturday | 48.95 | 1096.46 | 110 | 240.30 |
| Sunday | 163.51 | 1304.11 | 225 | 383.70 |



Service time 7:06 6 minute break

*Run 1*

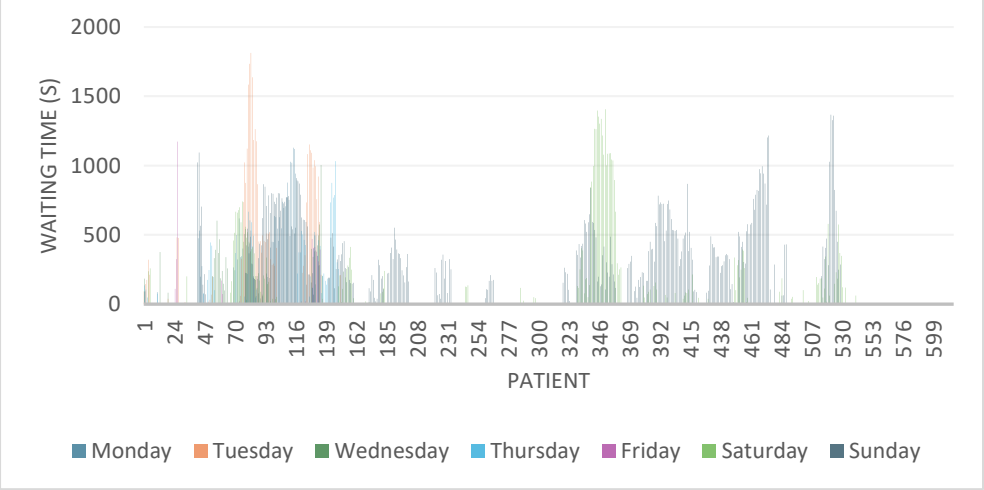
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 217.42 | 1451.98 | 63 | 572.87 |
| Tuesday | 106.71 | 1073.22 | 37 | 441.27 |
| Wednesday | 38.90 | 518.45 | 30 | 197.10 |
| Thursday | 68.87 | 662.00 | 42 | 255.80 |
| Friday | 6.79 | 331.74 | 10 | 117.02 |
| Saturday | 153.18 | 2227.16 | 150 | 551.44 |
| Sunday | 295.48 | 2294.82 | 285 | 547.42 |




Service time 7:06 7 minute break

*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 157.20 | 1129.74 | 59 | 442.30 |
| Tuesday | 230.51 | 1813.25 | 59 | 597.76 |
| Wednesday | 57.42 | 1003.46 | 25 | 349.13 |
| Thursday | 112.22 | 1032.03 | 55 | 318.30 |
| Friday | 29.82 | 1173.22 | 16 | 308.12 |
| Saturday | 91.93 | 1407.11 | 163 | 304.55 |
| Sunday | 223.40 | 1367.10 | 288 | 409.56 |



### 7.7.3 Simulation 3

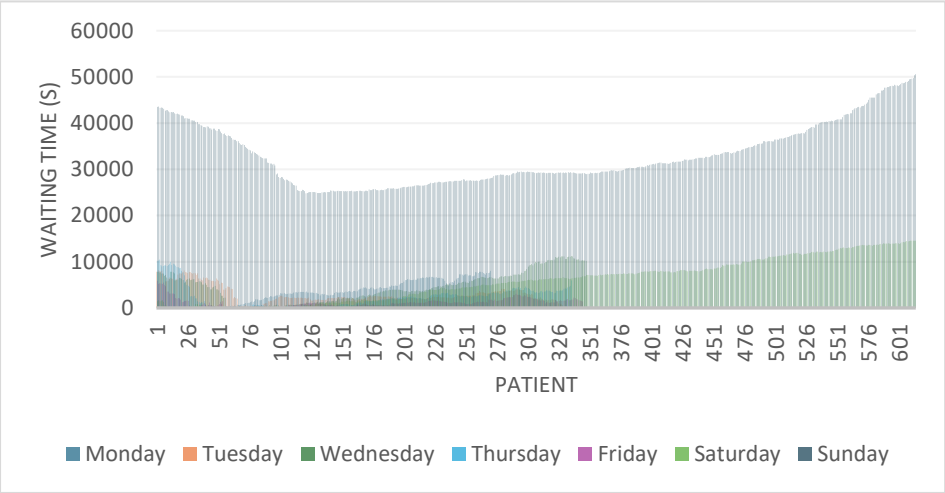
| Time Ranges | Average interarrival times $\lambda$ Weekdays | Average interarrival times $\lambda$ Saturday | Average interarrival times $\lambda$ Sunday |
|---|---|---|---|
| 00:00 – 08:00 | 7:17 | 4:20 | 4:15 |
| 08:00 – 15:30 | - | 0:47 | 0:57 |
| 15:30 – 21:00 | - | 1:02 | 1:28 |
| 21:00 – 00:00 | - | 1:49 | 2:32 |
| 17:00 – 22:00 | 1:18 | - | - |
| 22:00 – 24:00 | 2:23 | - | - |

Simulation -0% average interarrival rate

Service time 6:03  6 minute break

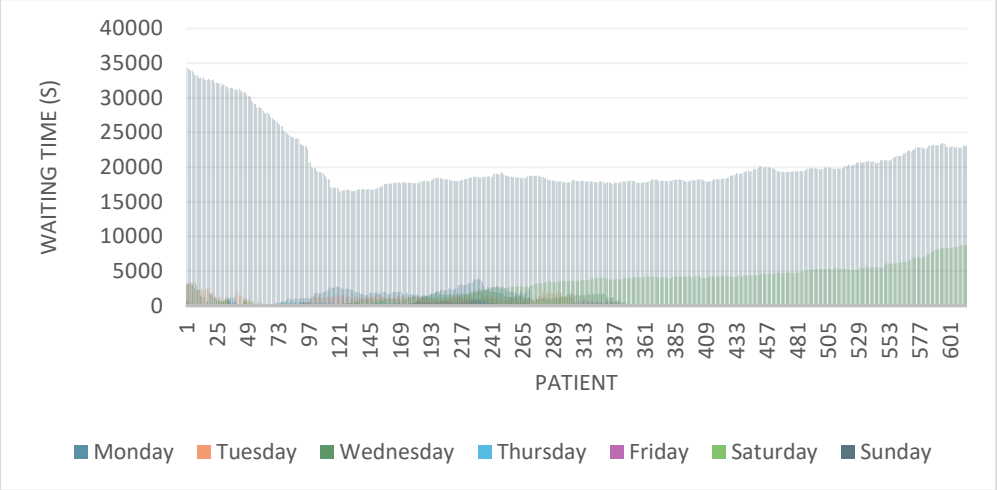
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 3348.33 | 8056.65 | 303 | 3812.59 |
| Tuesday | 3010.23 | 8143.76 | 328 | 3019.41 |
| Wednesday | 4547.20 | 11213.32 | 338 | 4681.74 |
| Thursday | 2331.07 | 10473.75 | 296 | 2646.08 |
| Friday | 1141.25 | 5916.27 | 303 | 1299.45 |
| Saturday | 17537.40 | 44050.06 | 1024 | 18924.63 |
| Sunday | 34533.22 | 54980.87 | 668 (983) | 34533.22 |



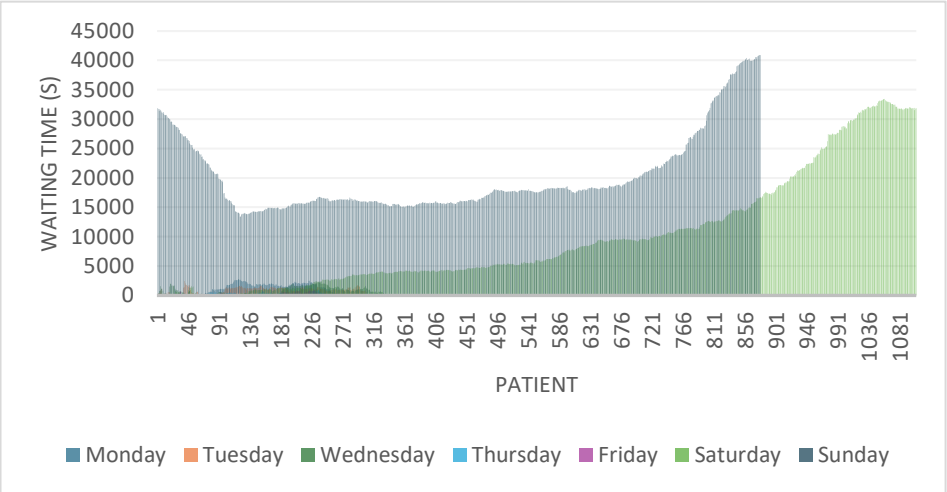
*Run 2*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 1495.21 | 3899.89 | 215 | 1884.67 |
| Tuesday | 1043.67 | 3373.41 | 280 | 1226.313 |
| Wednesday | 919.16 | 3390.85 | 280 | 1142.39 |
| Thursday | 190.91 | 1206.43 | 191 | 352.45 |
| Friday | 201.02 | 978.20 | 183 | 378.97 |
| Saturday | 11763.00 | 37588.13 | 1020 | 12743.25 |
| Sunday | 23829.32 | 45780.33 | 813 (983) | 23829.32 |



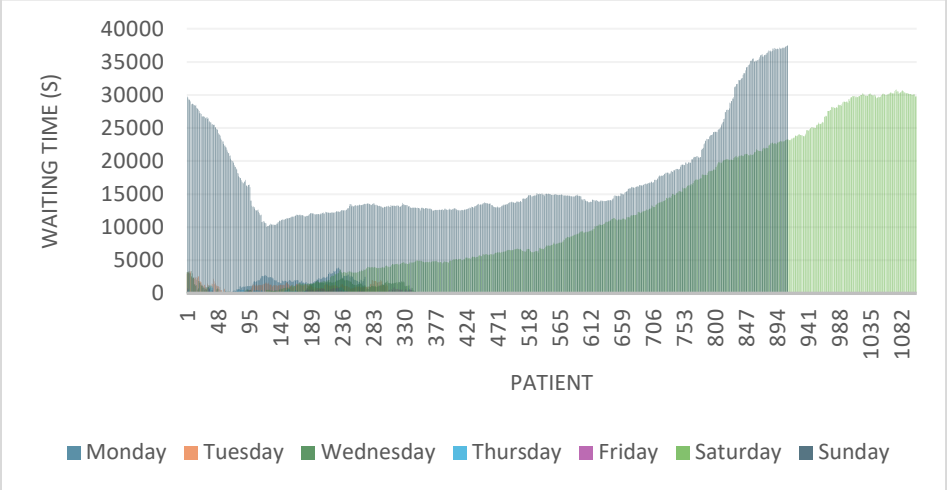

*Run 3*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 1173.02 | 2778.55 | 210 | 1513.75 |
| Tuesday | 823.54 | 2441.14 | 263 | 1030.21 |
| Wednesday | 706.66 | 2262.54 | 258 | 953.17 |
| Thursday | 149.52 | 990.96 | 152 | 330.52 |
| Friday | 140.56 | 931.87 | 144 | 336.76 |
| Saturday | 9846.24 | 33426.76 | 1022 | 10645.89 |
| Sunday | 20242.95 | 40917.99 | 878 | 20242.95 |



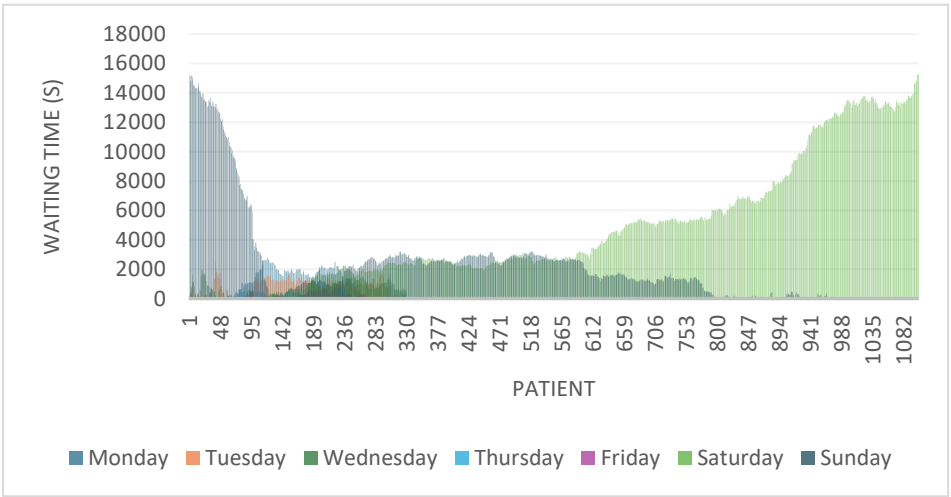
*Run 4*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 1495.21 | 3899.89 | 280 | 18884.66 |
| Tuesday | 1043.67 | 3373.41 | 280 | 1226.31 |
| Wednesday | 919.16 | 3390.85 | 280 | 1142.39 |
| Thursday | 190.91 | 1206.43 | 191 | 352.45 |
| Friday | 201.02 | 978.20 | 183 | 378.97 |
| Saturday | 11498.82 | 26586.93 | 1001 | 12693.5 |
| Sunday | 17507.92 | 37503.80 | 910 | 17507.92 |



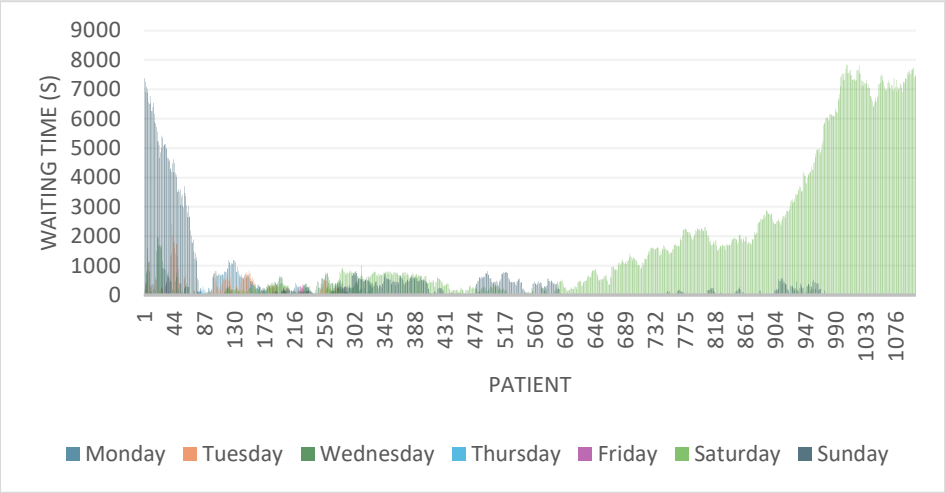

Run 5

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 955.80 | 2778.55 | 223 | 1440.13 |
| Tuesday | 823.54 | 2441.14 | 163 | 1030.21 |
| Wednesday | 706.66 | 2262.54 | 158 | 953.17 |
| Thursday | 149.52 | 990.96 | 152 | 330.52 |
| Friday | 140.56 | 931.87 | 144 | 336.76 |
| Saturday | 4669.82 | 15275.06 | 999 | 5165.31 |
| Sunday | 2533.22 | 15200.26 | 898 | 2773.00 |



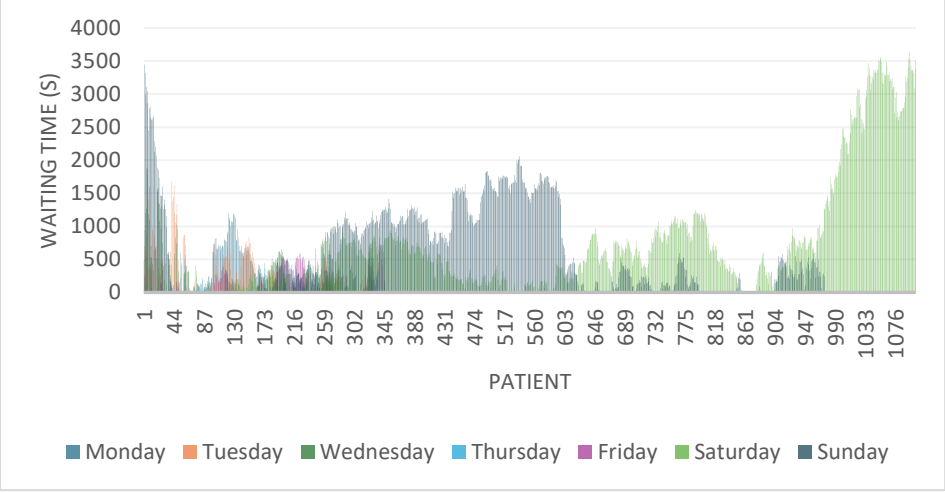
*Run 6*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 199.25 | 1197.92 | 166 | 403.30 |
| Tuesday | 234.47 | 2441.14 | 98 | 389.60 |
| Wednesday | 214.10 | 1979.63 | 101 | 370.68 |
| Thursday | 30.88 | 407.82 | 65 | 152.59 |
| Friday | 36.53 | 661.71 | 80 | 157.56 |
| Saturday | 1615.05 | 7857.67 | 936 | 1906.65 |
| Sunday | 495.21 | 738.98 | | |



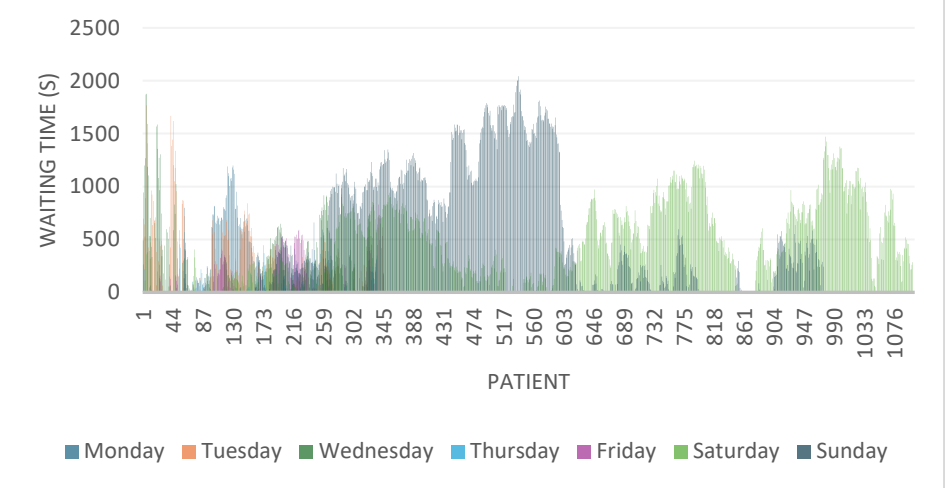

*Run 7*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 199.25 | 1197.92 | 166 | 403.30 |
| Tuesday | 250.80 | 1766.19 | 219 | 376.78 |
| Wednesday | 214.10 | 1979.63 | 221 | 380.41 |
| Thursday | 32.88 | 588.60 | 81 | 136.40 |
| Friday | 110.49 | 830.66 | 134 | 284.46 |
| Saturday | 662.04 | 3629.51 | 918 | 796.89 |
| Sunday | 596.42 | 3448.56 | 707 | 829.25 |



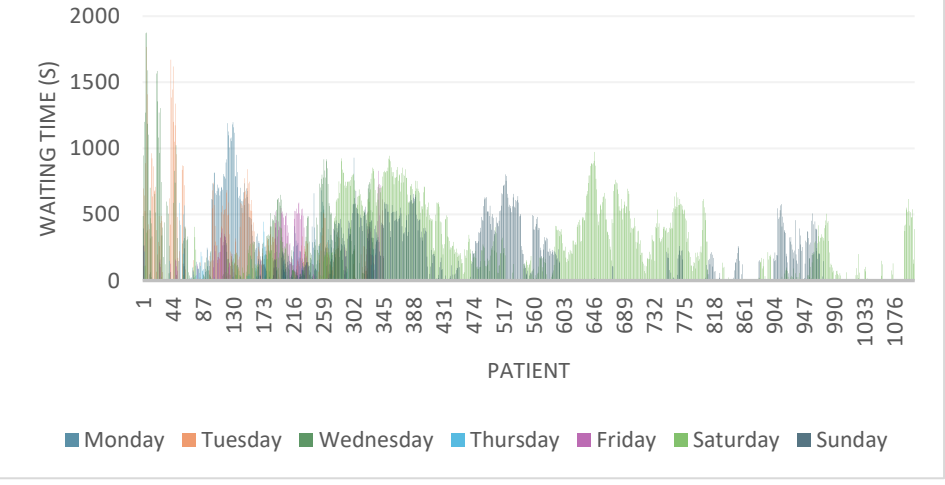
*Run 8*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 199.25 | 1197.92 | 166 | 403.30 |
| Tuesday | 250.80 | 1766.19 | 219 | 376.78 |
| Wednesday | 214.10 | 1979.63 | 221 | 380.41 |
| Thursday | 32.88 | 588.60 | 81 | 136.40 |
| Friday | 110.49 | 830.66 | 134 | 284.46 |
| Saturday | 426.53 | 1470.55 | 915 | 515.10 |
| Sunday | 511.70 | 2042.66 | 676 | 754.12 |



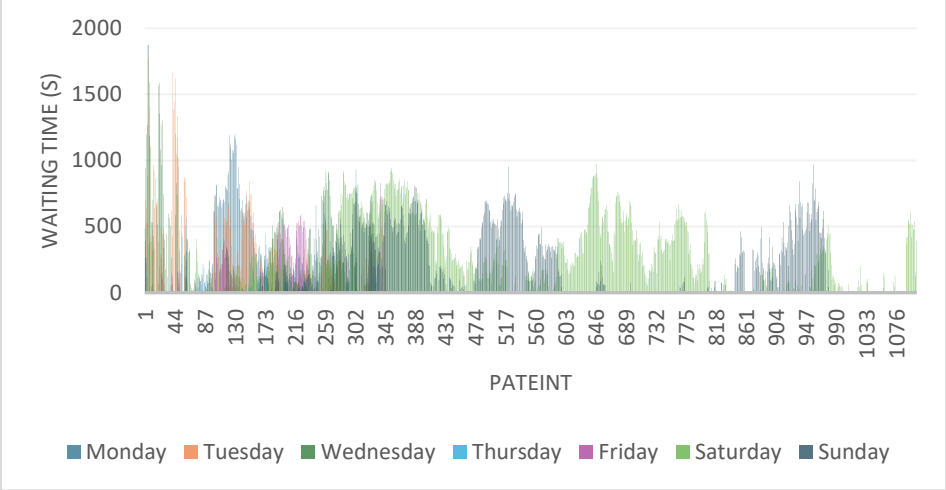

Run 9

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 199.25 | 1197.92 | 166 | 403.30 |
| Tuesday | 250.80 | 1766.19 | 219 | 376.78 |
| Wednesday | 214.10 | 1979.63 | 221 | 380.41 |
| Thursday | 32.88 | 588.60 | 81 | 136.40 |
| Friday | 110.49 | 830.66 | 134 | 284.46 |
| Saturday | 234.16 | 972.47 | 768 | 336.91 |
| Sunday | 164.64 | 803.30 | 500 | 288.30 |



Run 10

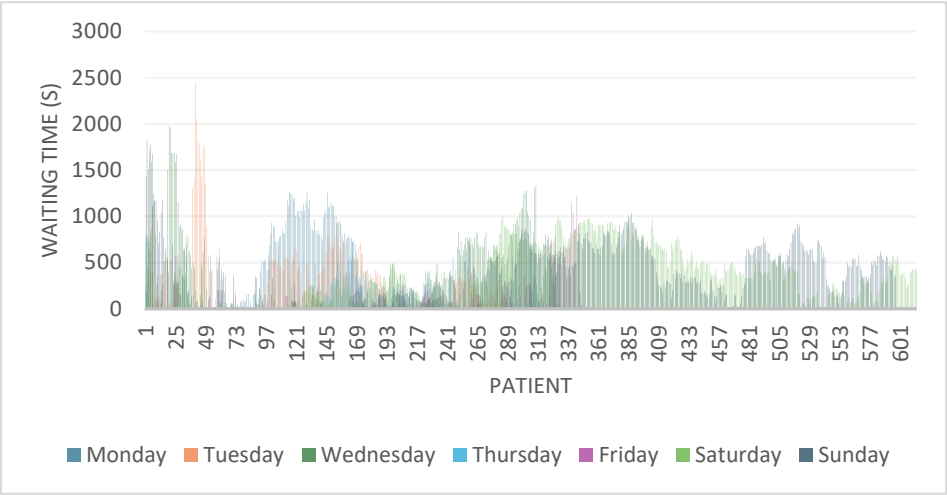
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 199.25 | 1197.92 | 166 | 403.30 |
| Tuesday | 250.80 | 1766.19 | 219 | 376.78 |
| Wednesday | 214.10 | 1979.63 | 221 | 380.41 |
| Thursday | 32.88 | 588.60 | 81 | 136.40 |
| Friday | 110.49 | 830.66 | 134 | 284.46 |
| Saturday | 234.16 | 972.47 | 768 | 336.91 |
| Sunday | 185.82 | 967.36 | 544 | 335.78 |



Service time 6:08  7 minute break

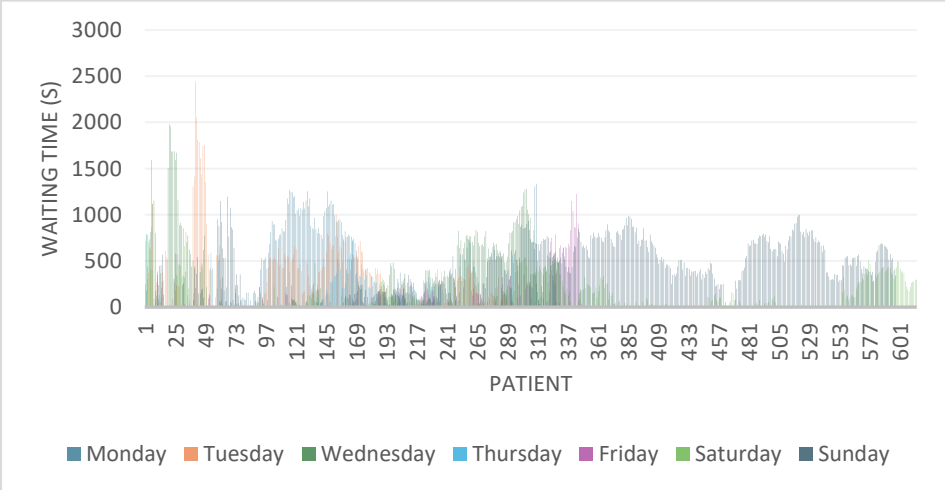
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 279.17 | 1336.35 | 191 | 491.11 |
| Tuesday | 272.41 | 2441.14 | 224 | 400.10 |
| Wednesday | 300.31 | 1979.63 | 219 | 477.21 |
| Thursday | 77.10 | 794.20 | 102 | 253.97 |
| Friday | 87.59 | 1223.04 | 116 | 260.50 |
| Saturday | 351.08 | 1328.24 | 874 | 443.88 |
| Sunday | 237.62 | 1825.31 | 587 | 397.92 |




Run 2

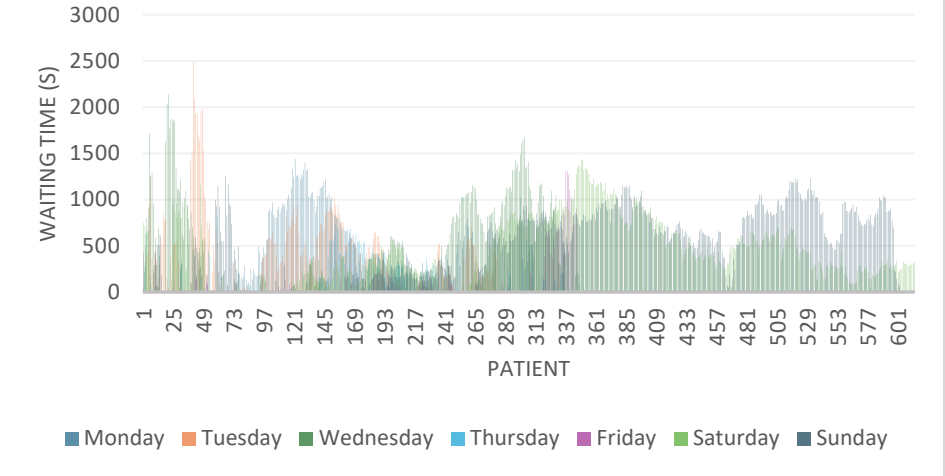
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 279.17 | 1336.35 | 191 | 491.11 |
| Tuesday | 272.41 | 2441.14 | 224 | 400.10 |
| Wednesday | 300.31 | 1979.63 | 219 | 477.21 |
| Thursday | 77.10 | 794.20 | 102 | 253.97 |
| Friday | 87.59 | 1223.04 | 116 | 260.50 |
| Saturday | 126.52 | 811.61 | 641 | 218.62 |
| Sunday | 239.87 | 1192.53 | 568 | 422.56 |



Service time 6:18 6  minute break

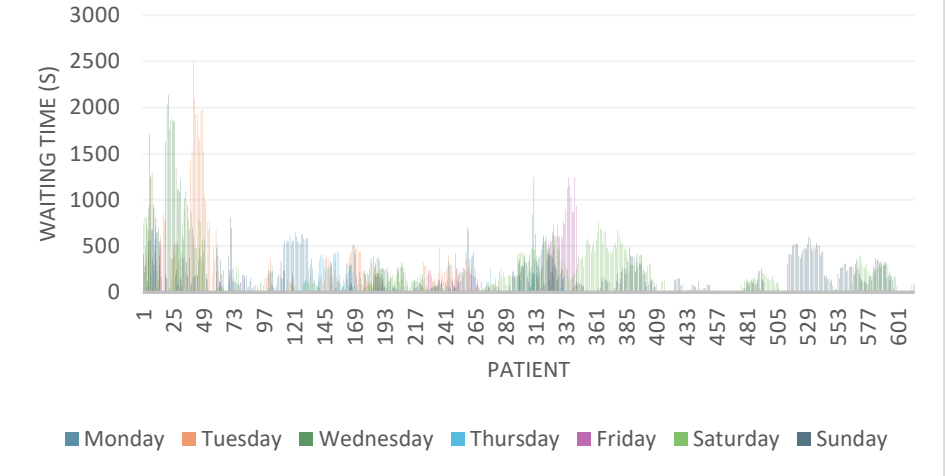
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 296.28 | 1441.05 | 185 | 538.11 |
| Tuesday | 335.42 | 2491.77 | 226 | 488.30 |
| Wednesday | 450.61 | 2138.11 | 243 | 645.32 |
| Thursday | 104.85 | 810.87 | 118 | 298.54 |
| Friday | 82.84 | 1318.96 | 106 | 269.62 |
| Saturday | 523.62 | 1709.52 | 922 | 627.55 |
| Sunday | 329.96 | 1254.34 | 617 | 525.69 |



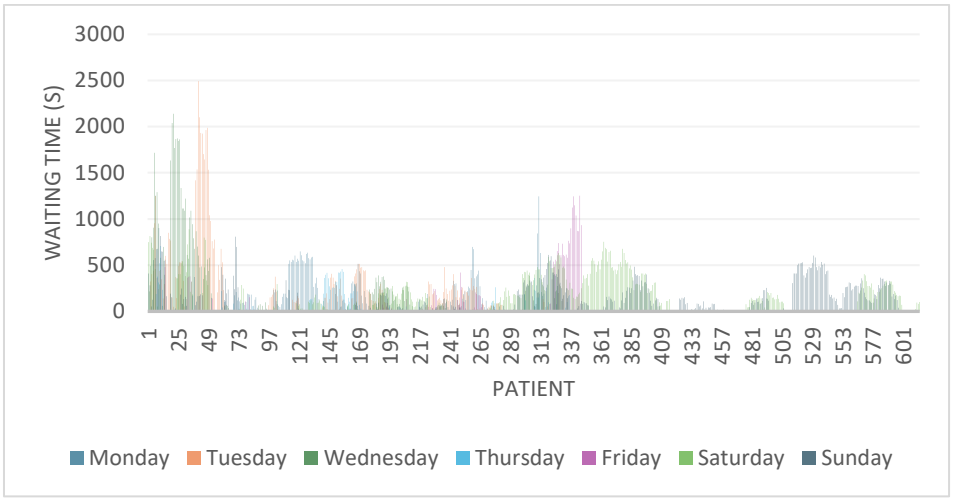

Run 2

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 101.66 | 1246.58 | 135 | 253.02 |
| Tuesday | 191.07 | 2491.77 | 175 | 359.20 |
| Wednesday | 154.48 | 2138.11 | 117 | 459.48 |
| Thursday | 42.15 | 706.27 | 79 | 179.26 |
| Friday | 71.72 | 1251.56 | 76 | 325.55 |
| Saturday | 411.18 | 1453.53 | 828 | 548.74 |
| Sunday | 134.36 | 1907.09 | 364 | 290.92 |



Run 3

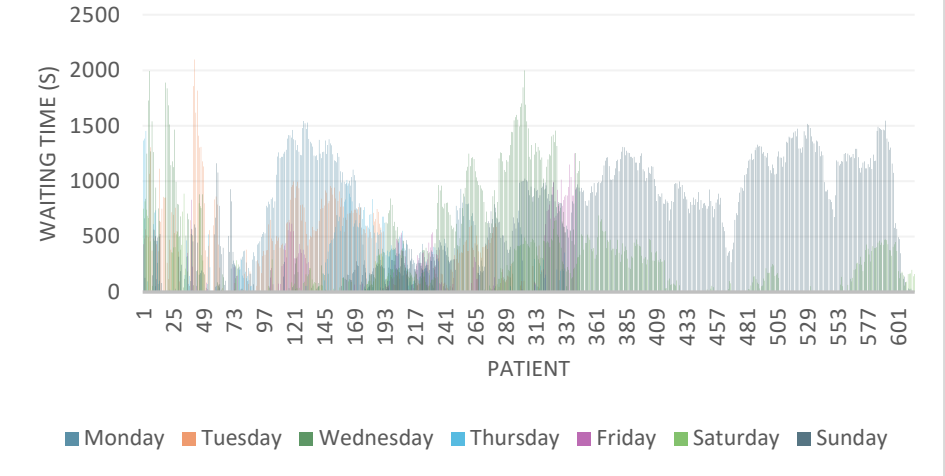
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 101.66 | 1246.58 | 135 | 253.02 |
| Tuesday | 191.07 | 2491.77 | 175 | 359.20 |
| Wednesday | 154.48 | 2138.11 | 117 | 459.48 |
| Thursday | 42.15 | 706.27 | 79 | 179.26 |
| Friday | 71.72 | 1251.56 | 76 | 325.55 |
| Saturday | 121.70 | 887.98 | 560 | 240.14 |
| Sunday | 104.63 | 903.06 | 443 | 232.17 |



Service time 6:18  7 minute break

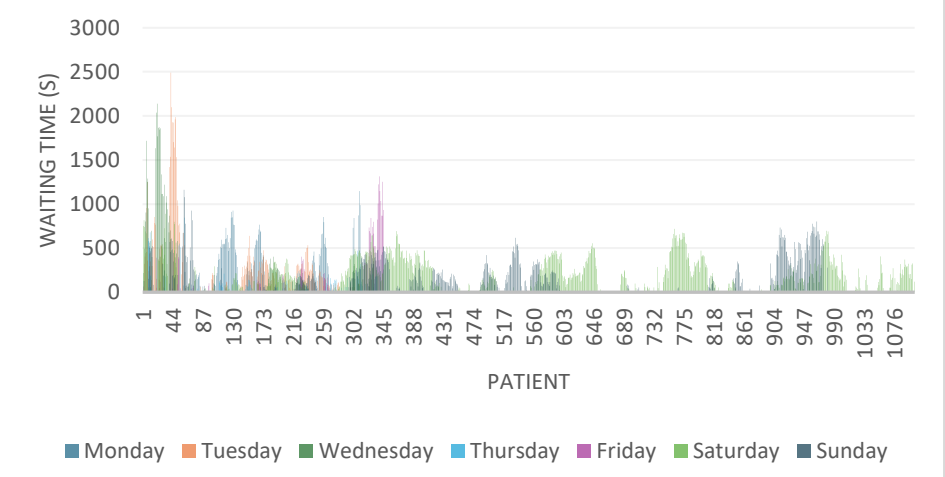
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 380.81 | 1541.84 | 192 | 633.43 |
| Tuesday | 383.59 | 2095.83 | 257 | 491.06 |
| Wednesday | 498.97 | 1998.75 | 215 | 728.67 |
| Thursday | 165.59 | 1452.21 | 142 | 391.82 |
| Friday | 137.54 | 1251.56 | 133 | 356.77 |
| Saturday | 153.87 | 887.98 | 682 | 249.31 |
| Sunday | 417.46 | 1545.86 | 537 | 644.21 |




*Run 2*

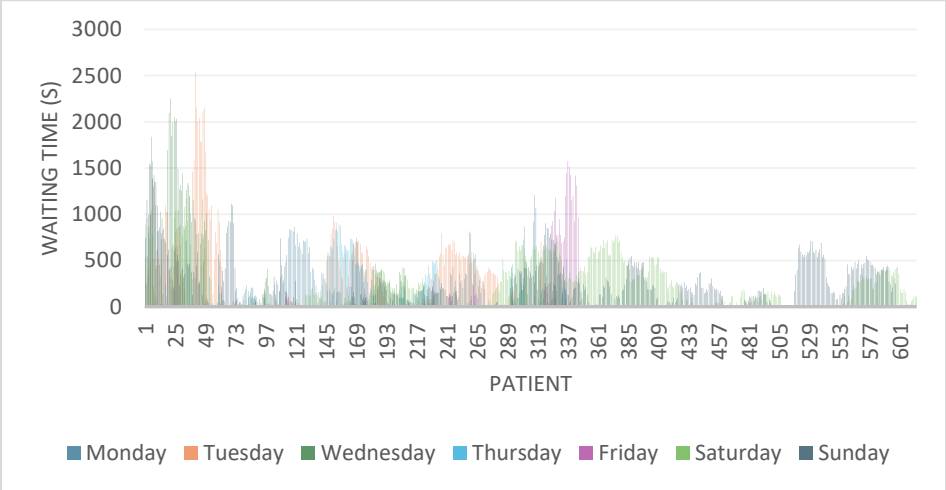
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 137.53 | 1146.08 | 125 | 369.67 |
| Tuesday | 200.00 | 2491.77 | 186 | 353.77 |
| Wednesday | 150.81 | 2138.11 | 115 | 456.37 |
| Thursday | 41.19 | 844.19 | 98 | 141.23 |
| Friday | 79.13 | 1313.01 | 83 | 328.93 |
| Saturday | 153.87 | 887.98 | 682 | 249.31 |
| Sunday | 113.03 | 1160.19 | 444 | 250.25 |



Service time 6:33  6 minute break

*Run 1*

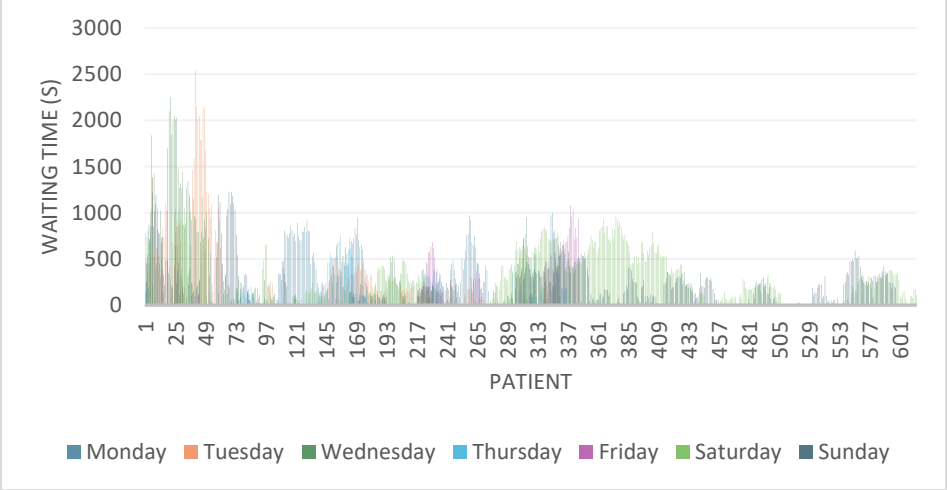
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 134.92 | 1204.52 | 142 | 319.24 |
| Tuesday | 323.74 | 2542.41 | 200 | 532.56 |
| Wednesday | 198.65 | 2253.55 | 146 | 473.49 |
| Thursday | 106.13 | 895.11 | 111 | 321.26 |
| Friday | 88.07 | 1577.54 | 72 | 421.98 |
| Saturday | 168.40 | 1318.06 | 643 | 289.40 |
| Sunday | 184.41 | 1571.47 | 541 | 335.08 |




Service time 6:33  7 minute break

*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 183.07 | 997.99 | 150 | 410.07 |
| Tuesday | 231.29 | 2542.41 | 92 | 396.32 |
| Wednesday | 206.67 | 2253.55 | 142 | 506.48 |
| Thursday | 81.32 | 811.71 | 114 | 239.67 |
| Friday | 90.46 | 1081.98 | 78 | 400.12 |
| Saturday | 243.40 | 1159.30 | 788 | 341.32 |
| Sunday | 188.24 | 1749.91 | 494 | 374.60 |



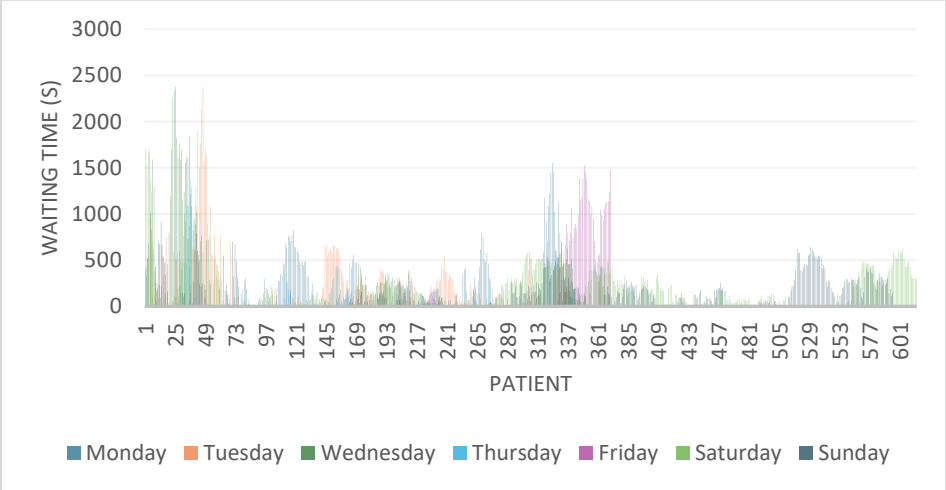
Simulation -5% average interarrival rate

| Time Ranges | Average interarrival times $\lambda$ Weekdays | Average interarrival times $\lambda$ Saturday | Average interarrival times $\lambda$ Sunday |
|---|---|---|---|
| 00:00 – 08:00 | 6:55 | 4:07 | 4:02 |
| 08:00 – 15:30 | - | 0:45 | 0:54 |
| 15:30 – 21:00 | - | 0:59 | 1:24 |
| 21:00 – 00:00 | - | 1:44 | 2:24 |
| 17:00 – 22:00 | 1:14 | - | - |
| 22:00 – 24:00 | 2:16 | - | - |

Service time 6:03  6 minute break

*Run 1*

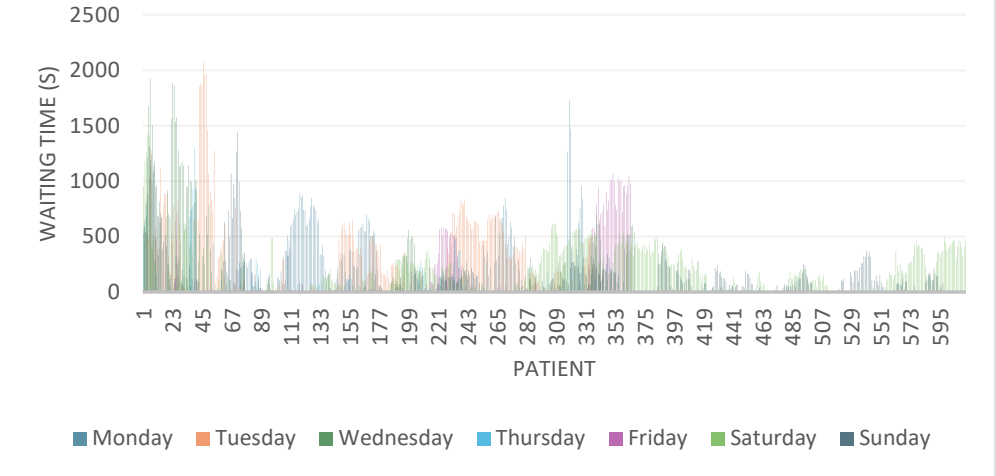
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 126.55 | 1556.23 | 113 | 397.56 |
| Tuesday | 190.95 | 2373.28 | 209 | 319.78 |
| Wednesday | 178.37 | 2382.21 | 136 | 480.03 |
| Thursday | 54.32 | 1382.02 | 88 | 212.96 |
| Friday | 119.94 | 1522.05 | 97 | 458.73 |
| Saturday | 189.04 | 1703.00 | 811 | 276.21 |
| Sunday | 88.09 | 911.94 | 438 | 205.95 |



Service time 6:03  7minute break

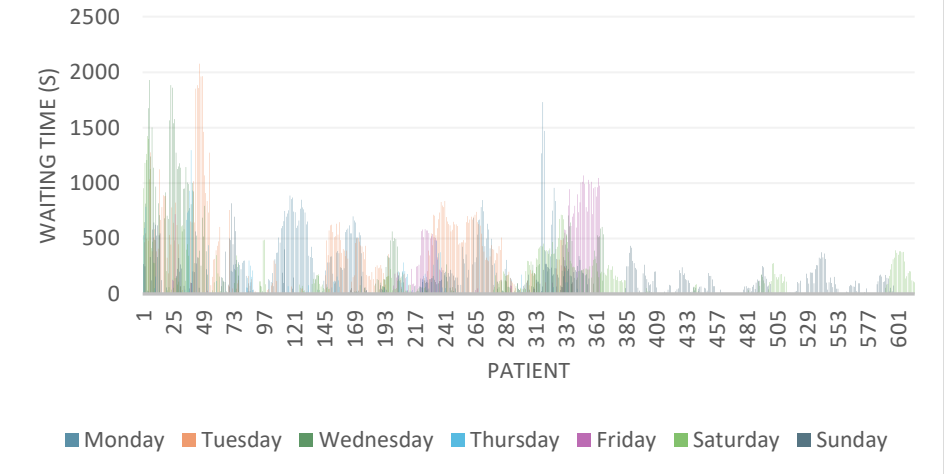
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 164.37 | 1729.21 | 156 | 377.21 |
| Tuesday | 283.47 | 2076.66 | 200 | 448.18 |
| Wednesday | 169.72 | 1929.10 | 115 | 464.83 |
| Thursday | 47.17 | 1296.11 | 77 | 204.58 |
| Friday | 104.12 | 1070.30 | 86 | 440.68 |
| Saturday | 434.27 | 1832.36 | 932 | 551.23 |
| Sunday | 91.65 | 1440.11 | 407 | 209.21 |



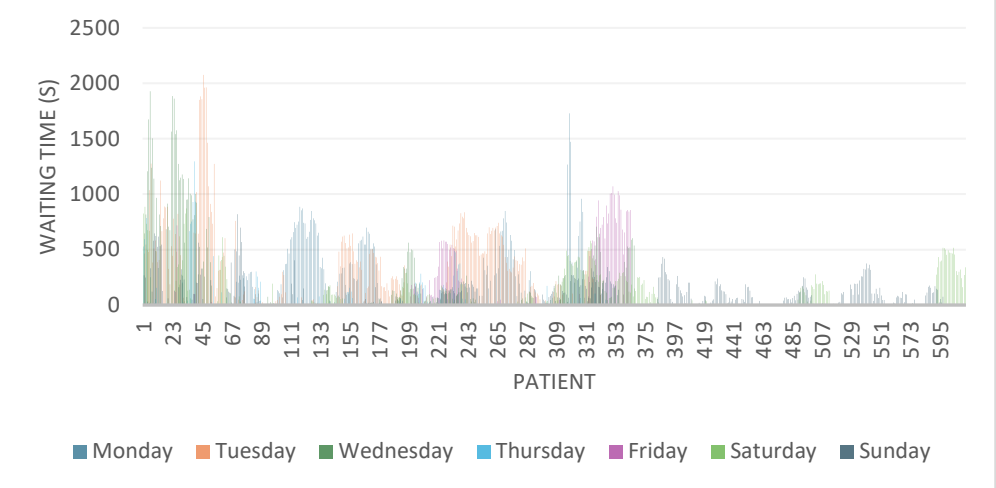

*Run 2*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 164.37 | 1729.21 | 156 | 377.21 |
| Tuesday | 283.47 | 2076.66 | 200 | 448.18 |
| Wednesday | 169.72 | 1929.10 | 115 | 464.83 |
| Thursday | 47.17 | 1296.11 | 77 | 204.58 |
| Friday | 104.12 | 1070.30 | 86 | 440.68 |
| Saturday | 325.16 | 1422.62 | 801 | 480.23 |
| Sunday | 75.87 | 818.36 | 432 | 180.01 |



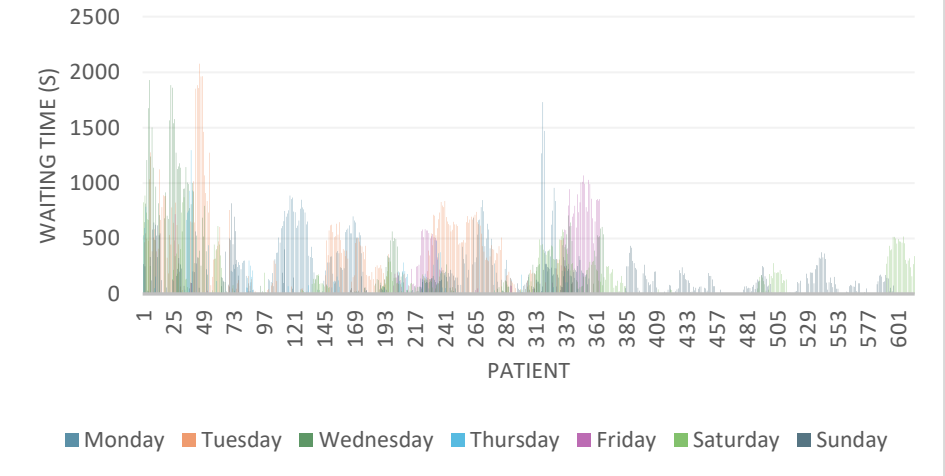
*Run 3*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 164.37 | 1729.21 | 156 | 377.21 |
| Tuesday | 283.47 | 2076.66 | 200 | 448.18 |
| Wednesday | 169.72 | 1929.10 | 115 | 464.83 |
| Thursday | 47.17 | 1296.11 | 77 | 204.58 |
| Friday | 100.10 | 1070.30 | 86 | 423.67 |
| Saturday | 315.17 | 1350.50 | 769 | 484.85 |
| Sunday | 75.87 | 818.36 | 432 | 180.01 |




*Run 4*

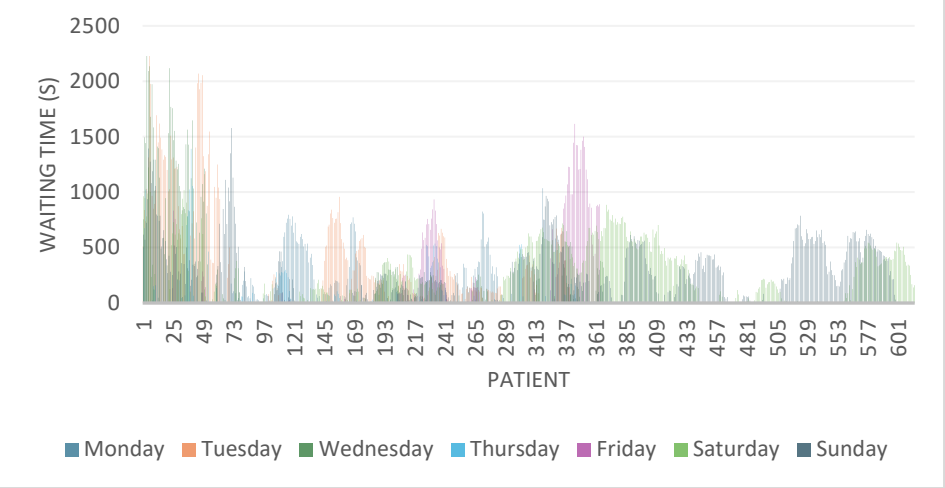
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 164.37 | 1729.21 | 156 | 377.21 |
| Tuesday | 283.47 | 2076.66 | 200 | 448.18 |
| Wednesday | 169.72 | 1929.10 | 115 | 464.83 |
| Thursday | 47.17 | 1296.11 | 77 | 204.58 |
| Friday | 100.10 | 1070.30 | 86 | 423.67 |
| Saturday | 150.02 | 886.54 | 654 | 271.36 |
| Sunday | 75.87 | 818.36 | 432 | 180.01 |



Service time 6:18  6 minute break

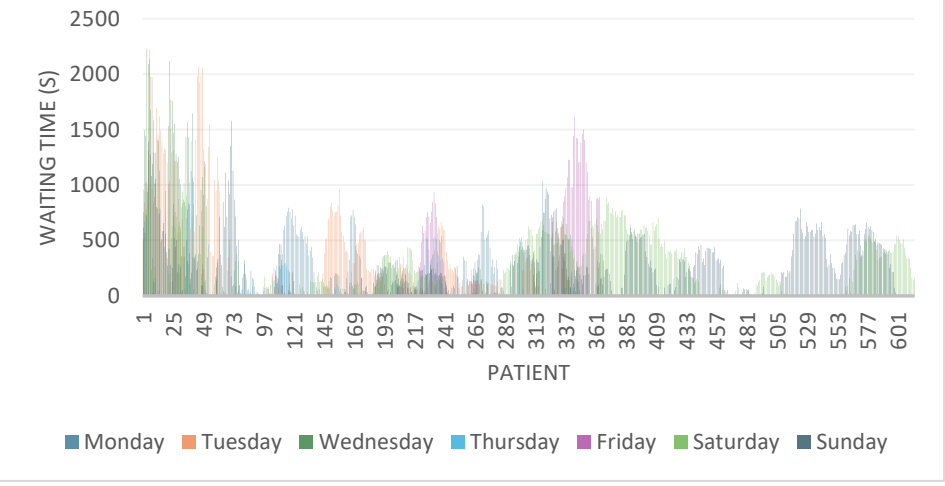
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 113.20 | 1036.30 | 142 | 285.38 |
| Tuesday | 325.65 | 2228.00 | 230 | 496.98 |
| Wednesday | 205.08 | 2229.44 | 126 | 597.32 |
| Thursday | 63.20 | 1391.47 | 89 | 246.41 |
| Friday | 151.00 | 1617.17 | 104 | 528.51 |
| Saturday | 317.03 | 1290.60 | 838 | 447.54 |
| Sunday | 183.72 | 1578.95 | 559 | 336.87 |




Run 2

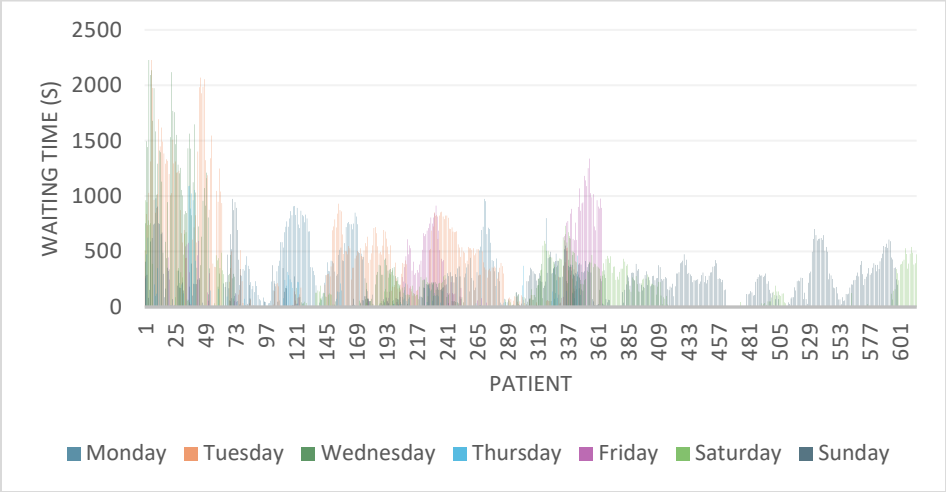
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 113.20 | 1036.30 | 142 | 285.38 |
| Tuesday | 325.65 | 2228.00 | 230 | 496.98 |
| Wednesday | 205.08 | 2229.44 | 126 | 597.32 |
| Thursday | 63.20 | 1391.47 | 89 | 246.41 |
| Friday | 151.00 | 1617.17 | 104 | 528.51 |
| Saturday | 232.83 | 1222.24 | 773 | 356.32 |
| Sunday | 183.72 | 1578.95 | 559 | 336.87 |



Service time 6:18 7 minute break

*Run 1*

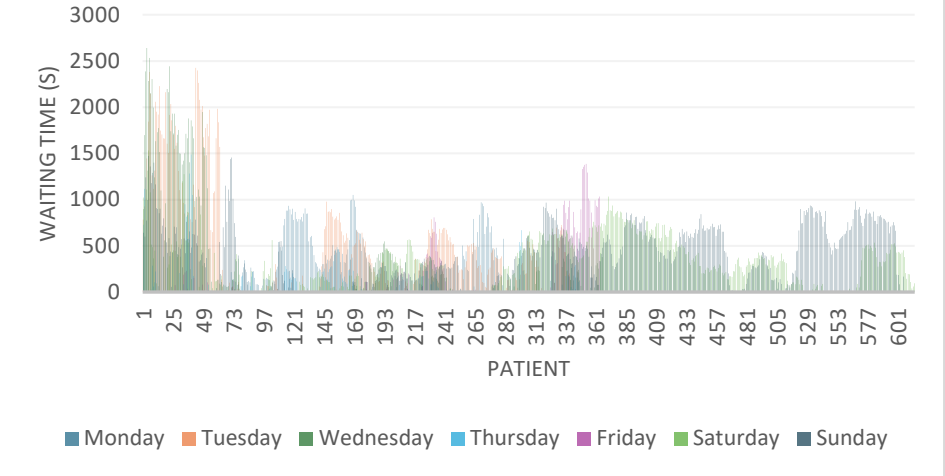
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 172.37 | 974.84 | 166 | 371.73 |
| Tuesday | 402.49 | 2228.00 | 254 | 556.19 |
| Wednesday | 211.61 | 2229.44 | 149 | 521.21 |
| Thursday | 51.46 | 1092.86 | 113 | 215.15 |
| Friday | 147.16 | 1337.94 | 117 | 457.83 |
| Saturday | 209.90 | 963.66 | 759 | 327.15 |
| Sunday | 137.46 | 979.35 | 535 | 263.36 |



Service time 6:33  6 minute break

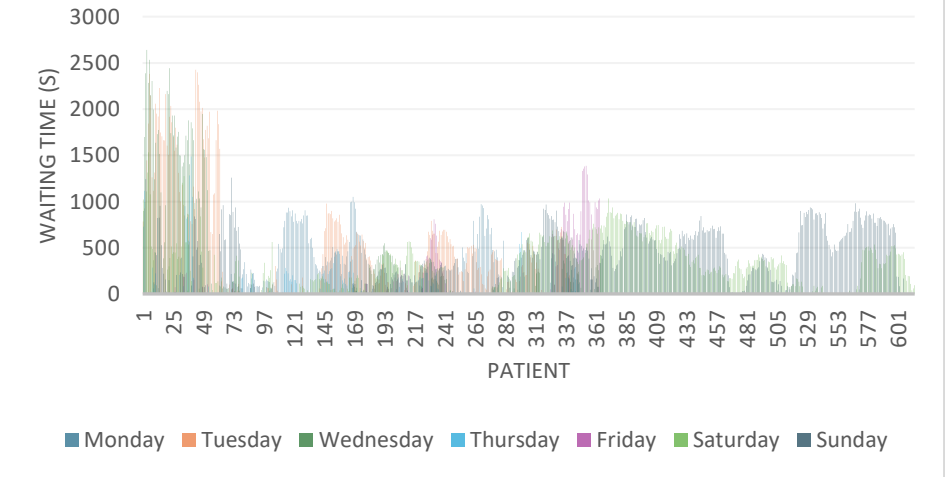
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 188.55 | 1050.34 | 167 | 404.19 |
| Tuesday | 462.78 | 2427.61 | 254 | 639.51 |
| Wednesday | 282.60 | 2641.54 | 148 | 700.77 |
| Thursday | 82.79 | 1486.83 | 116 | 247.64 |
| Friday | 119.37 | 1386.57 | 97 | 447.96 |
| Saturday | 292.17 | 1532.79 | 863 | 400.50 |
| Sunday | 276.31 | 1474.43 | 633 | 447.42 |




*Run 2*

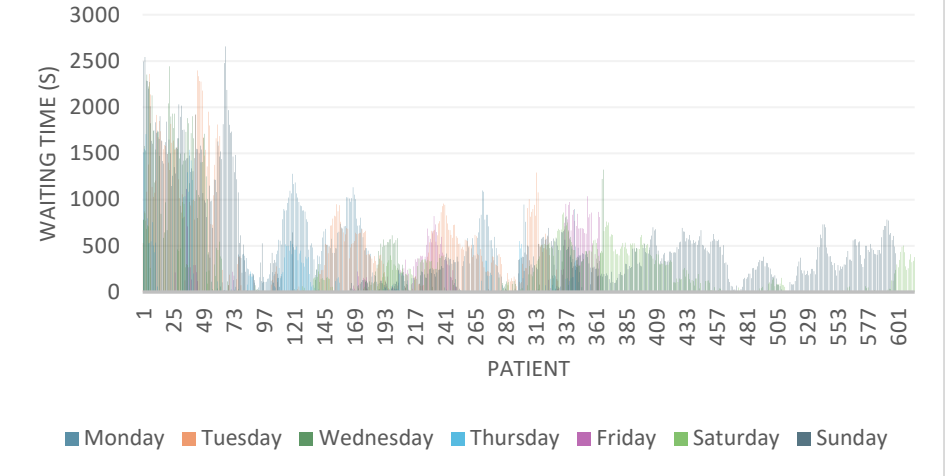
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 188.55 | 1050.34 | 167 | 404.19 |
| Tuesday | 462.78 | 2427.61 | 254 | 639.51 |
| Wednesday | 282.60 | 2641.54 | 148 | 700.77 |
| Thursday | 82.79 | 1486.83 | 116 | 247.64 |
| Friday | 119.37 | 1386.57 | 97 | 447.96 |
| Saturday | 272.16 | 1532.79 | 816 | 394.57 |
| Sunday | 250.96 | 1257.13 | 599 | 429.43 |



Service time 6:33  7 minute break

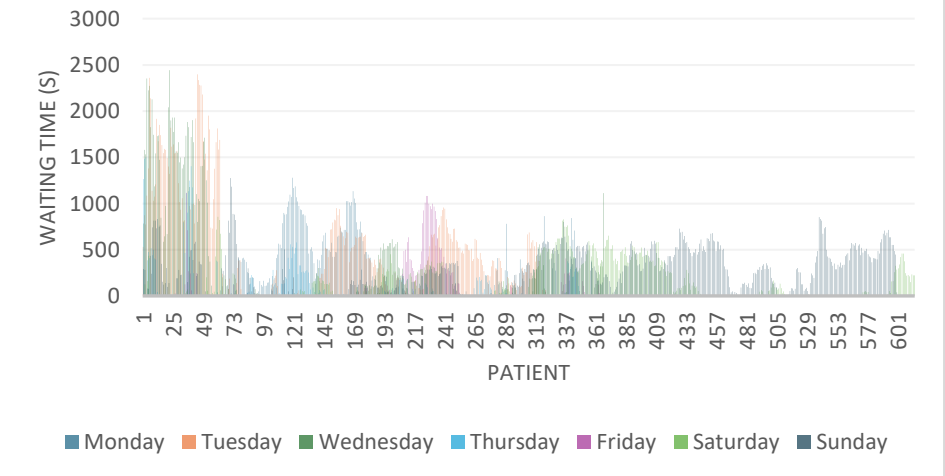
*Run 1*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 240.71 | 1277.68 | 191 | 452.28 |
| Tuesday | 470.33 | 2399.58 | 245 | 673.81 |
| Wednesday | 281.47 | 2443.08 | 149 | 693.27 |
| Thursday | 114.37 | 1709.00 | 121 | 327.99 |
| Friday | 122.03 | 1117.32 | 118 | 376.45 |
| Saturday | 319.00 | 2383.07 | 832 | 453.58 |
| Sunday | 284.05 | 2656.95 | 609 | 478.09 |



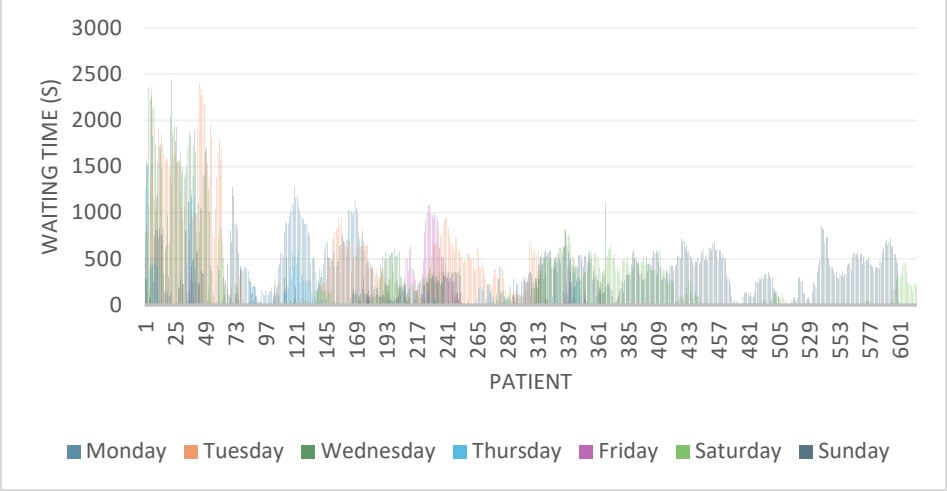

Run 2

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 200.10 | 1277.68 | 170 | 421.38 |
| Tuesday | 446.18 | 2399.58 | 235 | 666.43 |
| Wednesday | 266.97 | 2443.08 | 145 | 675.72 |
| Thursday | 95.29 | 1502.03 | 135 | 244.94 |
| Friday | 82.02 | 1117.32 | 92 | 324.50 |
| Saturday | 233.67 | 1125.23 | 758 | 364.68 |
| Sunday | 368.59 | 1432.26 | 605 | 217.56 |



*Run 3*

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 184.40 | 1277.68 | 162 | 407.51 |
| Tuesday | 446.18 | 2399.58 | 235 | 666.43 |
| Wednesday | 266.97 | 2443.08 | 145 | 675.72 |
| Thursday | 95.29 | 1502.03 | 135 | 244.94 |
| Friday | 82.02 | 1117.32 | 92 | 324.50 |
| Saturday | 233.67 | 1125.23 | 758 | 364.68 |
| Sunday | 181.58 | 1276.79 | 580 | 320.90 |



## 7.8 APPENDIX H: AVERAGE INTERARRIVAL TIME PER HOUR

Average interarrival time per hour for experiment 2 on most right column, with upper and lower limit based on the two half hours of that hour.

Monday

| Time Ranges | Monday Both | Monday BRD | Monday RSD BOZ | Column1 | Column2 | Column3 | Average IAT |
|---|---|---|---|---|---|---|---|
| 00:30 | 6.00 | 52 | 62 | 11.84 | 304 | 300 | 304, 300, 308 |
| 01:00 | 5.84 | 55 | 56 | 11.05 | | 308.1081081 | |
| 01:30 | 5.21 | 53 | 46 | 11.00 | 327.2727273 | 345.4545455 | 327, 311, 345 |
| 02:00 | 5.79 | 41 | 69 | 10.42 | | 310.9090909 | |
| 02:30 | 4.63 | 33 | 55 | 8.68 | 414.5454545 | 388.6363636 | 415, 389, 444 |
| 03:00 | 4.05 | 40 | 37 | 8.26 | | 444.1558442 | |
| 03:30 | 4.21 | 35 | 45 | 7.42 | 485.106383 | 427.5 | 485, 428, 561 |
| 04:00 | 3.21 | 28 | 33 | 6.21 | | 560.6557377 | |
| 04:30 | 3.00 | 26 | 31 | 7.21 | 499.270073 | 600 | 499, 428, 600 |
| 05:00 | 4.21 | 35 | 45 | 6.89 | | 427.5 | |
| 05:30 | 2.68 | 24 | 27 | 6.00 | 600 | 670.5882353 | 600, 543, 671 |
| 06:00 | 3.32 | 19 | 44 | 7.00 | | 542.8571429 | |
| 06:30 | 3.68 | 30 | 40 | 8.58 | 419.6319018 | 488.5714286 | 419, 368, 489 |
| 07:00 | 4.89 | 45 | 48 | 8.32 | | 367.7419355 | |
| 07:30 | 3.42 | 22 | 43 | 6.47 | 556.097561 | 526.1538462 | 556, 526, 590 |
| 08:00 | 3.05 | 26 | 32 | 28.11 | | 589.6551724 | |
| 17:30 | 25.05 | 186 | 290 | 48.84 | 73.70689655 | 71.8487395 | 74, 72, 76 |
| 18:00 | 23.79 | 211 | 241 | 49.16 | | 75.66371681 | |
| 18:30 | 25.37 | 204 | 278 | 51.84 | 69.44162437 | 70.95435685 | 69, 68, 71 |
| 19:00 | 26.47 | 240 | 263 | 53.63 | | 67.99204771 | |
| 19:30 | 27.16 | 219 | 297 | 50.37 | 71.47335423 | 66.27906977 | 71, 66, 78 |
| 20:00 | 23.21 | 194 | 247 | 44.42 | | 77.55102041 | |
| 20:30 | 21.21 | 170 | 233 | 41.84 | 86.03773585 | 84.86352357 | 86, 85, 87 |
| 21:00 | 20.63 | 171 | 221 | 39.74 | | 87.24489796 | |
| 21:30 | 19.11 | 150 | 213 | 39.00 | 92.30769231 | 94.21487603 | 92, 90, 94 |
| 22:00 | 19.89 | 180 | 198 | 33.79 | | 90.47619048 | |
| 22:30 | 13.89 | 118 | 146 | 27.21 | 132.3017408 | 129.5454545 | 132, 130, 135 |
| 23:00 | 13.32 | 90 | 163 | 22.63 | | 135.1778656 | |
| 23:30 | 9.32 | 76 | 101 | 16.79 | 214.4200627 | 193.220339 | 214, 193, 241 |
| 00:00 | 7.47 | 73 | 69 | 7.47 | | 240.8450704 | |

Tuesday

| Time Ranges | Tuesday Both | Tuesday BRD | Tuesday RSD BOZ | Column1 | Column2 | Column3 | Average IAT |
|---|---|---|---|---|---|---|---|
| 00:30 | 7.00 | 73 | 81 | 12.14 | 296.6292135 | 257.1428571 | 297, 257, 350 |
| 01:00 | 5.14 | 63 | 50 | 10.09 | | 350.4424779 | |
| 01:30 | 4.95 | 50 | 59 | 9.23 | 390.1477833 | 363.3027523 | 390, 363, 421 |
| 02:00 | 4.27 | 36 | 58 | 9.27 | | 421.2765957 | |
| 02:30 | 5.00 | 58 | 52 | 8.05 | 447.4576271 | 360 | 447, 360, 591 |
| 03:00 | 3.05 | 32 | 35 | 7.23 | | 591.0447761 | |
| 03:30 | 4.18 | 43 | 49 | 7.41 | 485.8895706 | 430.4347826 | 486, 430, 558 |
| 04:00 | 3.23 | 37 | 34 | 6.86 | | 557.7464789 | |
| 04:30 | 3.64 | 38 | 42 | 6.45 | 557.7464789 | 495 | 558, 495, 639 |
| 05:00 | 2.82 | 28 | 34 | 5.82 | | 638.7096774 | |
| 05:30 | 3.00 | 33 | 33 | 5.68 | 633.6 | 600 | 634, 600, 671 |
| 06:00 | 2.68 | 27 | 32 | 6.73 | | 671.1864407 | |
| 06:30 | 4.05 | 34 | 55 | 7.82 | 460.4651163 | 444.9438202 | 460, 445, 477 |
| 07:00 | 3.77 | 32 | 51 | 7.64 | | 477.1084337 | |
| 07:30 | 3.86 | 40 | 45 | 7.23 | 498.1132075 | 465.8823529 | 498, 466, 535 |
| 08:00 | 3.36 | 30 | 44 | 27.50 | | 535.1351351 | |
| 17:30 | 24.14 | 234 | 297 | 47.27 | 76.15384615 | 74.57627119 | 76, 75, 78 |
| 18:00 | 23.14 | 208 | 301 | 47.64 | | 77.79960707 | |
| 18:30 | 24.50 | 228 | 311 | 50.55 | 71.22302158 | 73.46938776 | 71, 69, 73 |
| 19:00 | 26.05 | 264 | 309 | 48.14 | | 69.10994764 | |
| 19:30 | 22.09 | 204 | 282 | 43.64 | 82.5 | 81.48148148 | 83, 81, 84 |
| 20:00 | 21.55 | 219 | 255 | 42.73 | | 83.5443038 | |
| 20:30 | 21.18 | 202 | 264 | 40.27 | 89.39051919 | 84.97854077 | 89, 85, 94 |
| 21:00 | 19.09 | 186 | 234 | 38.32 | | 94.28571429 | |
| 21:30 | 19.23 | 183 | 240 | 34.45 | 104.4854881 | 93.61702128 | 104, 94, 118 |
| 22:00 | 15.23 | 140 | 195 | 30.41 | | 118.2089552 | |
| 22:30 | 15.18 | 162 | 172 | 27.32 | 131.7803661 | 118.5628743 | 132, 119, 148 |
| 23:00 | 12.14 | 110 | 157 | 22.59 | | 148.3146067 | |
| 23:30 | 10.45 | 115 | 115 | 18.45 | 195.0738916 | 172.173913 | 195, 172, 225 |
| 00:00 | 8.00 | 70 | 106 | 8.00 | | 225 | |

Wednesday

| Time Ranges | Wednesday Both | Monday BRD | Wednesday | Column1 | Column2 | Column3 | Average IAT |
|---|---|---|---|---|---|---|---|
| 00:30 | 6.95 | 72 | 81 | 12.73 | 282.8571429 | 258.8235294 | 283, 259, 312 |
| 01:00 | 5.77 | 62 | 65 | 10.32 | | 311.8110236 | |
| 01:30 | 4.55 | 51 | 49 | 9.00 | 400 | 396 | 400, 396, 404 |
| 02:00 | 4.45 | 50 | 48 | 9.00 | | 404.0816327 | |
| 02:30 | 4.55 | 57 | 43 | 8.86 | 406.1538462 | 396 | 406, 396, 417 |
| 03:00 | 4.32 | 59 | 36 | 8.18 | | 416.8421053 | |
| 03:30 | 3.86 | 51 | 34 | 7.82 | 460.4651163 | 465.8823529 | 460, 455, 466 |
| 04:00 | 3.95 | 35 | 52 | 7.55 | | 455.1724138 | |
| 04:30 | 3.59 | 45 | 34 | 7.14 | 504.4585987 | 501.2658228 | 504, 501, 508 |
| 05:00 | 3.55 | 42 | 36 | 7.27 | | 507.6923077 | |
| 05:30 | 3.73 | 37 | 45 | 6.64 | 542.4657534 | 482.9268293 | 542, 483, 619 |
| 06:00 | 2.91 | 36 | 28 | 6.55 | | 618.75 | |
| 06:30 | 3.64 | 42 | 38 | 7.36 | 488.8888889 | 495 | 489, 483, 495 |
| 07:00 | 3.73 | 36 | 46 | 7.41 | | 482.9268293 | |
| 07:30 | 3.68 | 37 | 44 | 6.36 | 565.7142857 | 488.8888889 | 566, 489, 671 |
| 08:00 | 2.68 | 22 | 37 | 29.23 | | 671.1864407 | |
| 17:30 | 26.55 | 243 | 341 | 51.18 | 70.3374778 | 67.80821918 | 70, 68, 73 |
| 18:00 | 24.64 | 240 | 302 | 48.86 | | 73.06273063 | |
| 18:30 | 24.23 | 240 | 293 | 48.64 | 74.01869159 | 74.29643527 | 74 |
| 19:00 | 24.41 | 254 | 283 | 49.05 | | 73.74301676 | |
| 19:30 | 24.64 | 232 | 310 | 47.50 | 75.78947368 | 73.06273063 | 76, 73, 79 |
| 20:00 | 22.86 | 213 | 290 | 47.55 | | 78.72763419 | |
| 20:30 | 24.68 | 229 | 314 | 42.59 | 84.52508004 | 72.9281768 | 85, 73, 101 |
| 21:00 | 17.91 | 172 | 222 | 35.68 | | 100.5076142 | |
| 21:30 | 17.77 | 169 | 222 | 33.59 | 107.1718539 | 101.2787724 | 107, 101, 114 |
| 22:00 | 15.82 | 159 | 189 | 32.41 | | 113.7931034 | |
| 22:30 | 16.59 | 174 | 191 | 29.82 | 120.7317073 | 108.4931507 | 121, 108, 137 |
| 23:00 | 13.23 | 133 | 158 | 22.32 | | 136.0824742 | |
| 23:30 | 9.09 | 81 | 119 | 17.00 | 211.7647059 | 198 | 212, 198, 228 |
| 00:00 | 7.91 | 75 | 99 | 7.91 | | 227.5862069 | |

Thursday

| Time Ranges | Thursday Both | Thursday BRD | Thursday RSD BOZ | Column1 | Column2 | Column3 | Average IAT |
|---|---|---|---|---|---|---|---|
| 00:30 | 6.81 | 69 | 74 | 12.76 | 282.0895522 | 264.3356643 | 282, 264, 302 |
| 01:00 | 5.95 | 60 | 65 | 11.05 | | 302.4 | |
| 01:30 | 5.10 | 32 | 75 | 9.33 | 385.7142857 | 353.271028 | 386, 353, 425 |
| 02:00 | 4.24 | 42 | 47 | 8.57 | | 424.7191011 | |
| 02:30 | 4.33 | 43 | 48 | 8.43 | 427.1186441 | 415.3846154 | 427, 415, 440 |
| 03:00 | 4.10 | 49 | 37 | 8.48 | | 439.5348837 | |
| 03:30 | 4.38 | 47 | 45 | 8.67 | 415.3846154 | 410.8695652 | 415, 411, 420 |
| 04:00 | 4.29 | 46 | 44 | 8.57 | | 420 | |
| 04:30 | 4.29 | 53 | 37 | 7.14 | 504 | 420 | 504, 420, 630 |
| 05:00 | 2.86 | 25 | 35 | 5.95 | | 630 | |
| 05:30 | 3.10 | 40 | 25 | 6.48 | 555.8823529 | 581.5384615 | 556, 582, 532 |
| 06:00 | 3.38 | 33 | 38 | 6.29 | | 532.3943662 | |
| 06:30 | 2.90 | 27 | 34 | 6.43 | 560 | 619.6721311 | 560, 620, 511 |
| 07:00 | 3.52 | 23 | 51 | 6.95 | | 510.8108108 | |
| 07:30 | 3.43 | 32 | 40 | 6.81 | 528.6713287 | 525 | 529, 525, 533 |
| 08:00 | 3.38 | 43 | 28 | 29.71 | | 532.3943662 | |
| 17:30 | 26.33 | 215 | 338 | 46.62 | 77.22165475 | 68.35443038 | 77, 68, 89 |
| 18:00 | 20.29 | 189 | 237 | 43.62 | | 88.73239437 | |
| 18:30 | 23.33 | 222 | 268 | 49.05 | 73.39805825 | 77.14285714 | 73, 70, 77 |
| 19:00 | 25.71 | 242 | 298 | 49.33 | | 70 | |
| 19:30 | 23.62 | 198 | 298 | 45.43 | 79.24528302 | 76.20967742 | 79, 76, 82 |
| 20:00 | 21.81 | 190 | 268 | 42.81 | | 82.53275109 | |
| 20:30 | 21.00 | 188 | 253 | 39.05 | 92.19512195 | 85.71428571 | 92, 86, 100 |
| 21:00 | 18.05 | 175 | 204 | 36.86 | | 99.73614776 | |
| 21:30 | 18.81 | 178 | 217 | 33.52 | 107.3863636 | 95.69620253 | 107, 96, 122 |
| 22:00 | 14.71 | 133 | 176 | 28.00 | | 122.3300971 | |
| 22:30 | 13.29 | 123 | 156 | 24.29 | 148.2352941 | 135.483871 | 148, 135, 164 |
| 23:00 | 11.00 | 106 | 125 | 19.71 | | 163.6363636 | |
| 23:30 | 8.71 | 82 | 101 | 16.19 | 222.3529412 | 206.557377 | 222, 207, 241 |
| 00:00 | 7.48 | 80 | 77 | 7.48 | | 240.7643312 | |

Friday

| Time Ranges | Friday Both | Friday BRD | Friday RSD | Column1 | Column2 | Column3 | Average IAT |
|---|---|---|---|---|---|---|---|
| 00:30 | 8.00 | 87 | 81 | 14.86 | 242.3076923 | 225 | 242, 225, 263 |
| 01:00 | 6.86 | 76 | 68 | 11.52 | | 262.5 | |
| 01:30 | 4.67 | 43 | 55 | 9.29 | 387.6923077 | 385.7142857 | 388, 386, 390 |
| 02:00 | 4.62 | 47 | 50 | 9.10 | | 389.6907216 | |
| 02:30 | 4.48 | 39 | 55 | 7.90 | 455.4216867 | 402.1276596 | 455, 402, 525 |
| 03:00 | 3.43 | 38 | 34 | 7.90 | | 525 | |
| 03:30 | 4.48 | 36 | 58 | 8.05 | 447.3372781 | 402.1276596 | 447, 402, 504 |
| 04:00 | 3.57 | 28 | 47 | 6.48 | | 504 | |
| 04:30 | 2.90 | 28 | 33 | 6.33 | 568.4210526 | 619.6721311 | 568, 525, 620 |
| 05:00 | 3.43 | 29 | 43 | 6.38 | | 525 | |
| 05:30 | 2.95 | 27 | 35 | 5.43 | 663.1578947 | 609.6774194 | 663, 610, 727 |
| 06:00 | 2.48 | 24 | 28 | 5.57 | | 726.9230769 | |
| 06:30 | 3.10 | 34 | 31 | 8.00 | 450 | 581.5384615 | 450, 367, 582 |
| 07:00 | 4.90 | 46 | 57 | 8.71 | | 366.9902913 | |
| 07:30 | 3.81 | 33 | 47 | 6.14 | 586.0465116 | 472.5 | 586, 473, 771 |
| 08:00 | 2.33 | 21 | 28 | 34.52 | | 771.4285714 | |
| 17:30 | 32.19 | 268 | 408 | 59.52 | 60.48 | 55.91715976 | 60, 56, 66 |
| 18:00 | 27.33 | 233 | 341 | 55.71 | | 65.85365854 | |
| 18:30 | 28.38 | 281 | 315 | 58.62 | 61.41348497 | 63.42281879 | 61, 60, 63 |
| 19:00 | 30.24 | 273 | 362 | 57.43 | | 59.52755906 | |
| 19:30 | 27.19 | 253 | 318 | 53.52 | 67.25978648 | 66.19964974 | 67, 66, 68 |
| 20:00 | 26.33 | 227 | 326 | 51.19 | | 68.35443038 | |
| 20:30 | 24.86 | 217 | 305 | 48.19 | 74.70355731 | 72.4137931 | 75, 72, 77 |
| 21:00 | 23.33 | 218 | 272 | 47.24 | | 77.14285714 | |
| 21:30 | 23.90 | 206 | 296 | 45.14 | 79.74683544 | 75.29880478 | 80, 75, 85 |
| 22:00 | 21.24 | 193 | 253 | 40.29 | | 84.75336323 | |
| 22:30 | 19.05 | 167 | 233 | 35.67 | 100.9345794 | 94.5 | 101, 95, 108 |
| 23:00 | 16.62 | 146 | 203 | 28.90 | | 108.3094556 | |
| 23:30 | 12.29 | 103 | 155 | 23.48 | 153.346856 | 146.5116279 | 153, 147, 161 |
| 00:00 | 11.19 | 111 | 124 | 11.19 | | 160.8510638 | |

Saturday

| Time ranges | Both Saturday | BRD | RSD BOZ | Column1 | Column2 | Column3 | Average IAT |
|---|---|---|---|---|---|---|---|
| 00:30 | 8.62 | 83 | 98 | 15.38 | 234.06 | 208.84 | 234, 209, 266 |
| 01:00 | 6.76 | 62 | 80 | 13.19 | | 266.20 | |
| 01:30 | 6.43 | 62 | 73 | 11.43 | 315.00 | 280.00 | 315, 280, 360 |
| 02:00 | 5.00 | 52 | 53 | 11.76 | | 360.00 | |
| 02:30 | 6.76 | 60 | 82 | 11.76 | 306.07 | 266.20 | 306, 266, 360 |
| 03:00 | 5.00 | 46 | 59 | 9.10 | | 360.00 | |
| 03:30 | 4.10 | 38 | 48 | 9.05 | 397.89 | 439.53 | 398, 363, 440 |
| 04:00 | 4.95 | 54 | 50 | 9.86 | | 363.46 | |
| 04:30 | 4.90 | 55 | 48 | 9.48 | 379.90 | 366.99 | 380, 367, 394 |
| 05:00 | 4.57 | 54 | 42 | 8.38 | | 393.75 | |
| 05:30 | 3.81 | 43 | 37 | 9.19 | 391.71 | 472.50 | 392, 335, 473 |
| 06:00 | 5.38 | 52 | 61 | 11.14 | | 334.51 | |
| 06:30 | 5.76 | 64 | 57 | 13.57 | 265.26 | 312.40 | 265, 230, 312 |
| 07:00 | 7.81 | 88 | 76 | 19.95 | | 230.49 | |
| 07:30 | 12.14 | 118 | 137 | 30.86 | 116.67 | 148.24 | 117, 96, 148 |
| 08:00 | 18.71 | 182 | 211 | 52.67 | | 96.18 | |
| 08:30 | 33.95 | 292 | 421 | 69.90 | 51.50 | 53.02 | 52, 50, 53 |
| 09:00 | 35.95 | 330 | 425 | 79.67 | | 50.07 | |
| 09:30 | 43.71 | 365 | 553 | 88.52 | 40.67 | 41.18 | 41.00 |
| 10:00 | 44.81 | 409 | 532 | 85.48 | | 40.17 | |
| 10:30 | 40.67 | 370 | 484 | 84.14 | 42.78 | 44.26 | 43, 41, 44 |
| 11:00 | 43.48 | 388 | 525 | 82.62 | | 41.40 | |
| 11:30 | 39.14 | 343 | 479 | 80.05 | 44.97 | 45.99 | 45, 44, 46 |
| 12:00 | 40.90 | 363 | 496 | 79.29 | | 44.00 | |
| 12:30 | 38.38 | 332 | 474 | 77.10 | 46.70 | 46.90 | 47.00 |
| 13:00 | 38.71 | 359 | 454 | 75.33 | | 46.49 | |
| 13:30 | 36.62 | 329 | 440 | 69.10 | 52.10 | 49.15 | 52, 49, 55 |
| 14:00 | 32.48 | 293 | 389 | 67.48 | | 55.43 | |
| 14:30 | 35.00 | 320 | 415 | 68.71 | 52.39 | 51.43 | 52, 51, 53 |
| 15:00 | 33.71 | 333 | 375 | 66.05 | | 53.39 | |
| 15:30 | 32.33 | 291 | 388 | 63.71 | 56.50 | 55.67 | 56.00 |
| 16:00 | 31.38 | 304 | 355 | 61.90 | | 57.36 | |
| 16:30 | 30.52 | 289 | 352 | 60.43 | 59.57 | 58.97 | 60.00 |
| 17:00 | 29.90 | 246 | 382 | 59.00 | | 60.19 | |
| 17:30 | 29.10 | 263 | 348 | 57.57 | 62.53 | 61.87 | 63.00 |
| 18:00 | 28.48 | 251 | 347 | 58.14 | | 63.21 | |
| 18:30 | 29.67 | 266 | 357 | 60.62 | 59.39 | 60.67 | 59, 58, 61 |
| 19:00 | 30.95 | 271 | 379 | 61.24 | | 58.15 | |
| 19:30 | 30.29 | 296 | 340 | 59.29 | 60.72 | 59.43 | 61, 59, 62 |
| 20:00 | 29.00 | 273 | 336 | 55.90 | | 62.07 | |
| 20:30 | 26.90 | 266 | 299 | 50.67 | 71.05 | 66.90 | 71, 67, 76 |
| 21:00 | 23.76 | 227 | 272 | 43.90 | | 75.75 | |
| 21:30 | 20.14 | 184 | 239 | 39.48 | 91.19 | 89.36 | 91, 89, 93 |
| 22:00 | 19.33 | 178 | 228 | 38.62 | | 93.10 | |
| 22:30 | 19.29 | 203 | 202 | 36.05 | 99.87 | 93.33 | 100, 93, 107 |
| 23:00 | 16.76 | 142 | 210 | 28.52 | | 107.39 | |
| 23:30 | 11.76 | 100 | 147 | 23.14 | 155.56 | 153.04 | 156, 153, 158 |
| 00:00 | 11.38 | 111 | 128 | 11.38 | | 158.16 | |

Sunday

| Time ranges | Both Sunday | BRD | RSD BOZ | Column1 | Column2 | Hourly arrivals | Average IAT |
|---|---|---|---|---|---|---|---|
| 00:30 | 12.29 | 107 | 151 | 20.81 | 172.9977117 | 146.5116279 | |
| 01:00 | 8.52 | 93 | 86 | | | 211.1731844 | 173, 146, 211 |
| 01:30 | 6.57 | 63 | 75 | 14.00 | 257.1428571 | 273.9130435 | |
| 02:00 | 7.43 | 71 | 85 | | | 242.3076923 | 257, 242, 274 |
| 02:30 | 6.81 | 67 | 76 | 13.14 | 273.9130435 | 264.3356643 | |
| 03:00 | 6.33 | 61 | 72 | | | 284.2105263 | 274, 264, 284 |
| 03:30 | 4.90 | 44 | 59 | 10.05 | 358.2938389 | 366.9902913 | |
| 04:00 | 5.14 | 48 | 60 | | | 350 | 358, 350, 367 |
| 04:30 | 5.29 | 53 | 58 | 10.05 | 358.2938389 | 340.5405405 | |
| 05:00 | 4.76 | 45 | 55 | | | 378 | 358, 340, 378 |
| 05:30 | 5.05 | 45 | 61 | 10.52 | 342.081448 | 356.6037736 | |
| 06:00 | 5.48 | 61 | 54 | | | 328.6956522 | 342, 329, 357 |
| 06:30 | 6.48 | 71 | 65 | 13.05 | 275.9124088 | 277.9411765 | |
| 07:00 | 6.57 | 67 | 71 | | | 273.9130435 | 276, 274, 277 |
| 07:30 | 9.67 | 99 | 104 | 21.52 | 167.2566372 | 186.2068966 | |
| 08:00 | 11.86 | 118 | 131 | 40.10 | | 151.8072289 | 167, 151, 186 |
| 08:30 | 28.24 | 275 | 318 | 61.24 | 58.78693624 | 63.74367622 | |
| 09:00 | 33.00 | 325 | 368 | | | 54.54545455 | 59, 55, 64 |
| 09:30 | 37.62 | 347 | 443 | 77.52 | 46.43734644 | 47.84810127 | |
| 10:00 | 39.90 | 352 | 486 | | | 45.10739857 | 46, 45, 48 |
| 10:30 | 39.57 | 371 | 460 | 77.90 | 46.21026895 | 45.48736462 | |
| 11:00 | 38.33 | 354 | 451 | | | 46.95652174 | 46.2, 45.49, 46.96 |
| 11:30 | 39.52 | 381 | 449 | 76.43 | 47.10280374 | 45.54216867 | |
| 12:00 | 36.90 | 361 | 414 | | | 48.77419355 | 47, 45.5, 48.8 |
| 12:30 | 33.86 | 300 | 411 | 69.14 | 52.0661157 | 53.16455696 | |
| 13:00 | 35.29 | 326 | 415 | | | 51.01214575 | 52, 51, 53 |
| 13:30 | 34.57 | 325 | 401 | 65.52 | 54.94186047 | 52.0661157 | |
| 14:00 | 30.95 | 295 | 355 | | | 58.15384615 | 55, 52, 58 |
| 14:30 | 27.67 | 267 | 314 | 56.33 | 63.90532544 | 65.06024096 | |
| 15:00 | 28.67 | 282 | 320 | | | 62.79069767 | 64, 63, 65 |
| 15:30 | 26.57 | 253 | 305 | 53.38 | 67.43978591 | 67.74193548 | |
| 16:00 | 26.81 | 263 | 300 | | | 67.14031972 | 67 |
| 16:30 | 27.24 | 245 | 327 | 52.67 | 68.35443038 | 66.08391608 | |
| 17:00 | 25.43 | 250 | 284 | | | 70.78651685 | 68, 66, 71 |
| 17:30 | 27.43 | 264 | 312 | 53.48 | 67.31967943 | 65.625 | |
| 18:00 | 26.05 | 262 | 285 | | | 69.10420475 | 67, 65, 69 |
| 18:30 | 26.95 | 263 | 303 | 55.00 | 65.45454545 | 66.7844523 | |
| 19:00 | 28.05 | 280 | 309 | | | 64.17657046 | 65, 64, 67 |
| 19:30 | 27.67 | 256 | 325 | 49.52 | 72.69230769 | 65.06024096 | |
| 20:00 | 21.86 | 213 | 246 | | | 82.35294118 | 73, 65, 81 |
| 20:30 | 23.48 | 220 | 273 | 44.57 | 80.76923077 | 76.67342799 | |
| 21:00 | 21.10 | 193 | 250 | | | 85.32731377 | 81, 77, 85 |
| 21:30 | 18.90 | 197 | 200 | 36.00 | 100 | 95.21410579 | |
| 22:00 | 17.10 | 143 | 216 | | | 105.2924791 | 100, 95, 105 |
| 22:30 | 16.48 | 182 | 164 | 28.24 | 127.4873524 | 109.2485549 | |
| 23:00 | 11.76 | 97 | 150 | | | 153.0364372 | 127, 109, 153 |
| 23:30 | 11.10 | 100 | 133 | 19.14 | 188.0597015 | 162.2317597 | |
| 00:00 | 8.05 | 67 | 102 | | | 223.6686391 | 188, 162, 224 |

## 7.9 APPENDIX I: SCHEDULES PROVIDED BY REGION A

| Day | Times | Hours | HAP 1 and 2 | HAP 3 | Total | Total hours |
|---|---|---|---|---|---|---|
| Monday - Friday | 23:00 – 08:00 | 9 | 2 | 2 | 4 | 36 |
| Monday - Friday | 16:45 – 23:15 (CoDi) | 6.5 | 1 | 1 | 2 | 13 |
| Monday - Friday | 17:00 – 23:00 | 6 | 4 | 2 | 6 | 36 |
| Monday - Friday | 17:00 – 22:00 | 5 | | 1 | 1 | 5 |
| Saturday | 23:00 – 08:00 | 9 | 2 | 2 | 4 | 36 |
| Saturday | 07:45 – 15:45 (CoDi) | 8 | 1 | 1 | 2 | 16 |
| Saturday | 09:00 – 17:00 | 8 | 2 | | 2 | 16 |
| Saturday | 09:00 – 16:00 | 7 | 1 | 2 | 3 | 21 |
| Saturday | 07:30 – 15:30 | 8 | 1 | | 1 | 8 |
| Saturday | 07:45 – 15:30 | 7.75 | 3 | | 3 | 23.25 |
| Saturday | 15:30 – 23:15 (CoDi) | 7.75 | 1 | 1 | 2 | 15.5 |
| Saturday | 15:30 – 23:00 | 7.5 | 4 | | 4 | 30 |
| Saturday | 08:00 – 15:00 | 7 | | 2 | 2 | 14 |
| Saturday | 08:00 – 16:00 | 8 | | 1 | 1 | 8 |
| Saturday | 07:00 – 13:30 | 6.5 | | 1 | 1 | 6,5 |
| Saturday | 16:00 – 22:00 | 6 | | 1 | 1 | 6 |
| Saturday | 16:00 – 23:00 | 7 | | 2 | 2 | 14 |
| Saturday | 15:00 – 21:00 | 6 | | 1 | 1 | 6 |
| Sunday | 23:00 – 08:00 | 9 | 2 | 2 | 4 | 36 |
| Sunday | 07:45 – 15:45 (CoDi) | 8 | 1 | 1 | 2 | 16 |
| Sunday | 09:00 – 17:00 | 8 | 2 | | 2 | 16 |
| Sunday | 09:00 – 16:00 | 7 | 1 | 2 | 3 | 21 |
| Sunday | 07:30 – 15:30 | 8 | 1 | | 1 | 8 |
| Sunday | 07:45 – 15:30 | 7.75 | 3 | | 3 | 23.25 |
| Sunday | 15:30 – 23:15 (CoDi) | 7.75 | 1 | 1 | 2 | 15.5 |
| Sunday | 15:30 – 23:00 | 7.5 | 4 | | 4 | 30 |
| Sunday | 08:00 – 16:00 | 8 | | 2 | 2 | 16 |
| Sunday | 16:00 – 22:00 | 6 | | 1 | 1 | 6 |
| Sunday | 15:00 – 21:00 | 6 | | 1 | 1 | 6 |
| Sunday | 16:00 – 23:00 | 7 | | 2 | 2 | 14 |
| Sunday | 08:00 – 15:00 | 7 | | 1 | 1 | 7 |
| Sunday | 07:00 – 13:30 | 6.5 | | 1 | 1 | 6.5 |
| Total hours | | 233.5 | | | | 531.5 |

# 7.10 APPENDIX J: RESULTS EXPERIMENT 2

### 7.10.1 Service time 6:03, 30:00

Run 1 five weeks

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 67.59 | 1013.25 | 101.8 | 228.67 |
| Tuesday | 29.82 | 1139.25 | 56.4 | 178.15 |
| Wednesday | 134.23 | 1255.83 | 108.4 | 337.22 |
| Thursday | 84.16 | 1273.69 | 86.2 | 245.90 |
| Friday | 367.82 | 2630.27 | 249.8 | 725.8 |
| Saturday | 52.73 | 1187.72 | 270.8 | 206.49 |
| Sunday | 363.93 | 2675.29 | 560.8 | 592.70 |

Monday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 17.80 | 379.78 | 68 | 91.86 |
| Week 2 | 77.02 | 747.02 | 123 | 217.90 |
| Week 3 | 37.75 | 839.55 | 176 | 197.22 |
| Week 4 | 110.28 | 1013.25 | 100 | 384.89 |
| Week 5 | 95.12 | 707.12 | 132 | 251.48 |

Tuesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 17.80 | 379.78 | 69 | 119.83 |
| Week 2 | 56.42 | 1139.25 | 61 | 308.90 |
| Week 3 | 12.46 | 1185.71 | 29 | 142.69 |
| Week 4 | 45.72 | 1131.32 | 75 | 203.01 |
| Week 5 | 16.72 | 1015.54 | 48 | 116.32 |

Wednesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 209.75 | 1180.05 | 103 | 708.66 |
| Week 2 | 47.51 | 1180.42 | 91 | 185.35 |
| Week 3 | 44.72 | 1183.56 | 101 | 151.43 |
| Week 4 | 267.80 | 1255.83 | 175 | 534.07 |
| Week 5 | 22.18 | 1177.26 | 72 | 106.57 |

Thursday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 67.19 | 1271.22 | 103 | 213.97 |
| Week 2 | 142.80 | 1271.21 | 118 | 387.25 |
| Week 3 | 41.64 | 1267.13 | 49 | 273.61 |
| Week 4 | 31.51 | 1273.69 | 72 | 147.03 |
| Week 5 | 58.48 | 1271.13 | 89 | 207.65 |

Friday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 408.62 | 1283.88 | 256 | 633.68 |
| Week 2 | 1000.70 | 2630.27 | 290 | 1357.12 |
| Week 3 | 585.52 | 1995.84 | 272 | 856.76 |
| Week 4 | 164.85 | 1157.37 | 205 | 318.44 |
| Week 5 | 264.91 | 1230.57 | 226 | 463.00 |

Saturday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 90.05 | 1187.72 | 314 | 319.48 |
| Week 2 | 45.04 | 574.82 | 264 | 192.28 |
| Week 3 | 22.11 | 415.83 | 205 | 119.74 |
| Week 4 | 74.97 | 912.04 | 350 | 244.61 |
| Week 5 | 31.46 | 588.84 | 221 | 156.33 |

Sunday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 312.10 | 1344.34 | 611 | 509.79 |
| Week 2 | 134.96 | 879.93 | 478 | 282.05 |
| Week 3 | 205.64 | 1456.89 | 487 | 314.03 |
| Week 4 | 763.20 | 2675.29 | 665 | 1141.93 |
| Week 5 | 403.73 | 1651.88 | 563 | 715.68 |

Run 2 five weeks

| | Average Waiting Time (s) | Max Waiting Time (s) | Average Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 443.49 | 2170.42 | 206.8 | 771.06 |
| Tuesday | 321.73 | 2095.17 | 171.8 | 617.72 |
| Wednesday | 1019.55 | 5458.03 | 247.6 | 1405.73 |
| Thursday | 401.44 | 4414.12 | 153.2 | 748.16 |
| Friday | 71.80 | 1661.43 | 102.4 | 260.01 |
| Saturday | 184.87 | 2246.07 | 378 | 542.81 |
| Sunday | 107.14 | 1520.11 | 352 | 280.51 |

Monday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 509.59 | 1913.73 | 203 | 881.11 |
| Week 2 | 653.88 | 2170.42 | 220 | 1034.33 |
| Week 3 | 509.59 | 1913.73 | 184 | 708.56 |
| Week 4 | 416.89 | 1625.99 | 219 | 664.35 |
| Week 5 | 337.90 | 1493.78 | 208 | 566.96 |

Tuesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 240.18 | 1489.18 | 163 | 478.88 |
| Week 2 | 307.75 | 1465.18 | 200 | 513.94 |
| Week 3 | 257.52 | 1392.47 | 165 | 518.17 |
| Week 4 | 527.88 | 2095.17 | 195 | 901.45 |
| Week 5 | 275.33 | 1334.90 | 136 | 676.17 |

Wednesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 727.49 | 2370.89 | 258 | 981.27 |
| Week 2 | 2025.51 | 5458.03 | 282 | 2549.84 |
| Week 3 | 626.54 | 2022.00 | 239 | 896.56 |
| Week 4 | 833.64 | 2621.75 | 228 | 1276.06 |
| Week 5 | 884.56 | 2521.68 | 231 | 1324.92 |

Thursday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 254.80 | 1662.10 | 132 | 633.13 |
| Week 2 | 814.64 | 4414.12 | 233 | 1118.82 |
| Week 3 | 335.72 | 2059.59 | 138 | 783.34 |
| Week 4 | 549.59 | 1626.50 | 187 | 987.49 |
| Week 5 | 52.44 | 1271.13 | 76 | 218.04 |

Friday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 48.04 | 1661.43 | 90 | 211.90 |
| Week 2 | 21.24 | 1543.03 | 34 | 247.34 |
| Week 3 | 118.55 | 1241.63 | 145 | 325.41 |
| Week 4 | 40.15 | 1343.28 | 82 | 193.89 |
| Week 5 | 131.04 | 1230.57 | 161 | 321.50 |

Saturday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 229.39 | 1992.60 | 452 | 565.35 |
| Week 2 | 190.76 | 2246.07 | 397 | 541.53 |
| Week 3 | 107.91 | 1711.14 | 282 | 424.75 |
| Week 4 | 216.08 | 1943.07 | 442 | 558.30 |
| Week 5 | 180.19 | 1761.29 | 317 | 624.14 |

Sunday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 128.31 | 1252.72 | 386 | 331.74 |
| Week 2 | 52.51 | 706.91 | 265 | 197.96 |
| Week 3 | 93.68 | 990.02 | 406 | 233.74 |
| Week 4 | 221.46 | 1520.11 | 470 | 468.83 |
| Week 5 | 39.75 | 488.21 | 233 | 170.26 |

Run 3 five weeks

| | Average Waiting Time (s) | Max Waiting Time (s) | Average Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 80.11 | 1213.63 | 91.2 | 370.800 |
| Tuesday | 27.85 | 1185.71 | 58.4 | 747,7 |
| Wednesday | 95.54 | 1183.56 | 105.2 | 308.72 |
| Thursday | 65.02 | 1273.69 | 81.6 | 246.78 |
| Friday | 113.6 | 1299.54 | 121 | 300.33 |
| Saturday | 181.18 | 2493.14 | 371 | 534.2 |
| Sunday | 109.89 | 1480.91 | 358.4 | 289.07 |

Monday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 19.24 | 480.34 | 68 | 99.32 |
| Week 2 | 28.41 | 1145.10 | 91 | 641.95 |
| Week 3 | 20.38 | 839.55 | 60 | 118.89 |
| Week 4 | 149.08 | 929.27 | 128 | 406.46 |
| Week 5 | 183.45 | 1213.63 | 109 | 587.37 |

Tuesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 25.07 | 1144.20 | 68 | 119.83 |
| Week 2 | 28.41 | 1145.10 | 65 | 145.96 |
| Week 3 | 12.11 | 1185.71 | 31 | 129.74 |
| Week 4 | 29.24 | 1131.32 | 61 | 157.03 |
| Week 5 | 44.40 | 1015.54 | 67 | 195.14 |

Wednesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 209.75 | 1180.05 | 103 | 708.66 |
| Week 2 | 121.72 | 1180.42 | 147 | 293.94 |
| Week 3 | 54.40 | 1183.56 | 97 | 191.80 |
| Week 4 | 33.05 | 117.63 | 78 | 147.88 |
| Week 5 | 58.76 | 1177.26 | 101 | 201.30 |

Thursday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 67.19 | 1271.22 | 103 | 213.97 |
| Week 2 | 131.98 | 1271.21 | 104 | 406.11 |
| Week 3 | 21.14 | 1267.13 | 33 | 206.23 |
| Week 4 | 47.79 | 1273.69 | 88 | 182.47 |
| Week 5 | 56.99 | 1271.13 | 80 | 225.10 |

Friday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 54.41 | 1239.91 | 107 | 201.88 |
| Week 2 | 243.26 | 1299.54 | 168 | 573.41 |
| Week 3 | 219.82 | 1241.63 | 207 | 422.65 |
| Week 4 | 25.80 | 1157.37 | 72 | 141.92 |
| Week 5 | 24.99 | 1230.57 | 51 | 161.81 |

Saturday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 265.28 | 2122.96 | 463 | 638.27 |
| Week 2 | 212.14 | 2493.14 | 400 | 597.72 |
| Week 3 | 98.38 | 1597.54 | 280 | 390.00 |
| Week 4 | 179.28 | 1963.89 | 405 | 505.54 |
| Week 5 | 150.83 | 1500.63 | 307 | 539.47 |

Sunday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 128.31 | 1252.72 | 386 | 331.74 |
| Week 2 | 52.56 | 706.91 | 266 | 197.38 |
| Week 3 | 93.14 | 990.02 | 402 | 234.71 |
| Week 4 | 213.85 | 1480.91 | 480 | 443.29 |
| Week 5 | 61.59 | 641.69 | 258 | 238.24 |

### 7.10.2 Service time 6:03, 27:30

Run 1 five weeks

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 59.20 | 1514.70 | 76.8 | 237.38 |
| Tuesday | 36.13 | 1267.11 | 65.6 | 181.76 |
| Wednesday | 104.16 | 1208.11 | 127 | 262.27 |
| Thursday | 47.51 | 1273.69 | 65.88 | 225.61 |
| Friday | 316.26 | 1867.22 | 236.2 | 522.25 |
| Saturday | 174.89 | 2003.19 | 391.6 | 495.55 |
| Sunday | 208.82 | 1793.59 | 480.8 | 408.57 |

Monday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 17.62 | 480.34 | 61 | 101.39 |
| Week 2 | 62.77 | 761.38 | 73 | 299.25 |
| Week 3 | 11.22 | 487.44 | 28 | 140.23 |
| Week 4 | 85.42 | 630.61 | 114 | 261.50 |
| Week 5 | 118.99 | 1514.70 | 108 | 384.53 |

Tuesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 39.00 | 1267.11 | 102 | 124.28 |
| Week 2 | 32.30 | 1139.25 | 62 | 174.02 |
| Week 3 | 12.11 | 1185.71 | 26 | 154.60 |
| Week 4 | 66.11 | 1131.32 | 86 | 255.97 |
| Week 5 | 31.12 | 1015.54 | 52 | 199.91 |

Wednesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 42.23 | 1208.11 | 89 | 165.14 |
| Week 2 | 185.58 | 1203.46 | 182 | 361.98 |
| Week 3 | 39.21 | 1183.56 | 78 | 171.94 |
| Week 4 | 149.47 | 1177.63 | 153 | 340.94 |
| Week 5 | 104.30 | 1177.26 | 133 | 271.33 |

Thursday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 56.86 | 1271.22 | 93 | 200.55 |
| Week 2 | 75.17 | 1271.21 | 86 | 279.72 |
| Week 3 | 18.67 | 1267.13 | 33 | 187.84 |
| Week 4 | 30.25 | 1273.69 | 52 | 184.77 |
| Week 5 | 56.60 | 1271.13 | 65 | 275.18 |

Friday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 240.21 | 1407.44 | 218 | 437.45 |
| Week 2 | 653.39 | 1867.22 | 271 | 954.77 |
| Week 3 | 143.63 | 1241.63 | 256 | 223.31 |
| Week 4 | 294.88 | 1621.20 | 205 | 569.63 |
| Week 5 | 249.17 | 1230.57 | 231 | 426.07 |

Saturday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 208.92 | 1281.77 | 416 | 559.46 |
| Week 2 | 244.45 | 2003.19 | 437 | 630.42 |
| Week 3 | 117.56 | 1210.61 | 304 | 429.24 |
| Week 4 | 165.39 | 1107.95 | 467 | 404.44 |
| Week 5 | 138.15 | 1370.14 | 334 | 454.17 |

Sunday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 198.15 | 1281.77 | 515 | 383.99 |
| Week 2 | 82.58 | 719.31 | 386 | 213.72 |
| Week 3 | 115.51 | 1081.62 | 440 | 265.94 |
| Week 4 | 436.08 | 1793.59 | 602 | 720.76 |
| Week 5 | 211.77 | 1214.76 | 461 | 458.44 |

Run 2 five weeks

| | Average Waiting Time (s) | Max Waiting Time (s) | Average Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 45.11 | 1104.21 | 70.2 | 226.54 |
| Tuesday | 31.67 | 1185.71 | 57.4 | 183.64 |
| Wednesday | 125.18 | 1183.56 | 113.6 | 286.36 |
| Thursday | 33.58 | 1371.02 | 54 | 198.96 |
| Friday | 103.47 | 1563.12 | 127 | 300.97 |
| Saturday | 176.72 | 1929.68 | 389.2 | 503.41 |
| Sunday | 208.82 | 1793.59 | 480.8 | 408.57 |

Monday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 30.94 | 480.34 | 82 | 132.44 |
| Week 2 | 63.16 | 1104.21 | 90 | 244.23 |
| Week 3 | 44.59 | 851.64 | 51 | 306.01 |
| Week 4 | 24.18 | 438.89 | 52 | 162.27 |
| Week 5 | 62.67 | 725.61 | 76 | 287.77 |

Tuesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 72.97 | 1140.20 | 132 | 179.66 |
| Week 2 | 34.23 | 1139.25 | 43 | 265.88 |
| Week 3 | 17.05 | 1185.71 | 48 | 117.93 |
| Week 4 | 24.55 | 1131.32 | 46 | 177.75 |
| Week 5 | 9.54 | 1015.54 | 18 | 176.97 |

Wednesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 40.86 | 1180.05 | 90 | 157.99 |
| Week 2 | 167.32 | 1180.42 | 67 | 355.67 |
| Week 3 | 73.48 | 1183.56 | 111 | 226.39 |
| Week 4 | 291.06 | 1177.63 | 220 | 461.73 |
| Week 5 | 53.18 | 1177.26 | 80 | 230.02 |

Thursday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 41.72 | 1271.22 | 69 | 198.30 |
| Week 2 | 24.40 | 1371.02 | 38 | 205.48 |
| Week 3 | 22.28 | 1267.13 | 51 | 140.70 |
| Week 4 | 44.05 | 1273.69 | 57 | 246.66 |
| Week 5 | 35.45 | 1271.13 | 55 | 203.66 |

Friday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 45.94 | 1563.12 | 93 | 196.10 |
| Week 2 | 83.25 | 1286.25 | 130 | 253.58 |
| Week 3 | 201.34 | 1241.63 | 161 | 497.73 |
| Week 4 | 50.44 | 1157.37 | 102 | 195.83 |
| Week 5 | 136.40 | 1230.57 | 149 | 361.59 |

Saturday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 198.47 | 1677.94 | 413 | 535.34 |
| Week 2 | 259.75 | 1929.68 | 470 | 622.84 |
| Week 3 | 105.97 | 1185.22 | 312 | 377.01 |
| Week 4 | 174.49 | 1173.45 | 462 | 431.31 |
| Week 5 | 144.91 | 1431.61 | 289 | 550.57 |

Sunday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 198.15 | 1281.77 | 515 | 383.99 |
| Week 2 | 82.58 | 719.31 | 386 | 213.72 |
| Week 3 | 115.51 | 1081.62 | 440 | 265.94 |
| Week 4 | 436.08 | 1793.59 | 602 | 720.76 |
| Week 5 | 211.77 | 1214.76 | 461 | 458.44 |

Run 3 five weeks

| | Average Waiting Time (s) | Max Waiting Time (s) | Average Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 100.41 | 1572.57 | 112.2 | 288.98 |
| Tuesday | 106.85 | 1658.75 | 87.2 | 406.51 |
| Wednesday | 223.50 | 1841.38 | 137 | 433.30 |
| Thursday | 77.58 | 1612.52 | 84 | 303.07 |
| Friday | 96.29 | 1599.31 | 129.2 | 292.69 |
| Saturday | 156.83 | 1914.77 | 360.4 | 481.78 |
| Sunday | 208.88 | 1998.53 | 498 | 394.32 |

Monday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 124.44 | 1572.57 | 115 | 379.83 |
| Week 2 | 197.43 | 996.12 | 151 | 455.00 |
| Week 3 | 95.59 | 840.90 | 120 | 278.80 |
| Week 4 | 53.73 | 583.80 | 98 | 191.33 |
| Week 5 | 30.88 | 539.48 | 77 | 139.95 |

Tuesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 55.55 | 1658.75 | 66 | 273.53 |
| Week 2 | 126.72 | 1269.10 | 88 | 480.94 |
| Week 3 | 124.76 | 1535.26 | 75 | 552.27 |
| Week 4 | 134.41 | 1131.32 | 113 | 396.08 |
| Week 5 | 92.80 | 1131.55 | 94 | 329.75 |

Wednesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 181.33 | 1180.05 | 77 | 356.51 |
| Week 2 | 455.31 | 1841.38 | 202 | 800.17 |
| Week 3 | 146.40 | 1183.56 | 125 | 400.56 |
| Week 4 | 307.14 | 1177.63 | 212 | 472.21 |
| Week 5 | 27.33 | 1177.26 | 69 | 137.04 |

Thursday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 38.73 | 1500.60 | 63 | 201.64 |
| Week 2 | 46.94 | 1314.39 | 61 | 246.26 |
| Week 3 | 91.78 | 1612.52 | 60 | 492.53 |
| Week 4 | 122.43 | 1273.69 | 119 | 337.18 |
| Week 5 | 88.03 | 1271.13 | 117 | 237.76 |

Friday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 51.13 | 1216.29 | 131 | 154.95 |
| Week 2 | 161.90 | 1331.73 | 132 | 485.71 |
| Week 3 | 92.16 | 1241.63 | 148 | 247.84 |
| Week 4 | 109.06 | 1157.37 | 110 | 362.63 |
| Week 5 | 67.19 | 1599.31 | 125 | 212.33 |

Saturday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 200.29 | 1665.61 | 402 | 555.04 |
| Week 2 | 238.75 | 1914.77 | 411 | 654.67 |
| Week 3 | 134.29 | 1281.77 | 322 | 462.93 |
| Week 4 | 100.16 | 825.28 | 395 | 289.56 |
| Week 5 | 110.65 | 1099.70 | 272 | 446.69 |

Sunday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 198.15 | 1281.77 | 515 | 383.99 |
| Week 2 | 79.71 | 590.24 | 399 | 199.59 |
| Week 3 | 139.98 | 1307.87 | 507 | 279.69 |
| Week 4 | 472.71 | 1998.53 | 605 | 777.43 |
| Week 5 | 153.86 | 1025.36 | 464 | 330.92 |

### 7.10.3 Service time 6:03, 25:00

Run 1 five weeks

| | Average Waiting Time (s) | Max Waiting Time (s) | Average Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Monday | 124.47 | 2315.38 | 117.8 | 369.41 |
| Tuesday | 75.10 | 1082.78 | 74.6 | 330.05 |
| Wednesday | 220.96 | 1824.70 | 139.2 | 460.48 |
| Thursday | 92.94 | 1812.32 | 71.2 | 393.16 |
| Friday | 214.65 | 1523.19 | 169.6 | 460.32 |
| Saturday | 104.23 | 1372.88 | 330.2 | 336.70 |
| Sunday | 181.98 | 2000.76 | 459 | 367.82 |

Monday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 73.63 | 1027.35 | 113 | 228.72 |
| Week 2 | 154.75 | 906.76 | 149 | 361.42 |
| Week 3 | 183.87 | 2315.38 | 115 | 559.60 |
| Week 4 | 104.00 | 1252.00 | 96 | 378.10 |
| Week 5 | 106.09 | 729.31 | 116 | 319.20 |

Tuesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 50.33 | 750.71 | 63 | 259.63 |
| Week 2 | 98.32 | 1082.78 | 64 | 513.12 |
| Week 3 | 139.19 | 1058.41 | 123 | 375.70 |
| Week 4 | 44.44 | 862.17 | 76 | 194.70 |
| Week 5 | 43.22 | 781.18 | 47 | 307.11 |

Wednesday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 377.42 | 1524.61 | 200 | 656.72 |
| Week 2 | 169.43 | 1083.27 | 149 | 403.68 |
| Week 3 | 257.68 | 1824.70 | 172 | 512.36 |
| Week 4 | 215.48 | 1342.41 | 55 | 485.18 |
| Week 5 | 84.79 | 723.68 | 120 | 244.47 |

Thursday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 67.34 | 867.06 | 64 | 334.64 |
| Week 2 | 49.13 | 920.86 | 57 | 275.83 |
| Week 3 | 171.60 | 1562.44 | 100 | 552.56 |
| Week 4 | 39.14 | 905.52 | 61 | 215.61 |
| Week 5 | 137.50 | 1812.32 | 74 | 587.16 |

Friday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 206.43 | 1296.77 | 159 | 515.43 |
| Week 2 | 261.48 | 1312.70 | 185 | 559.70 |
| Week 3 | 152.22 | 1196.55 | 131 | 262.27 |
| Week 4 | 205.46 | 1219.88 | 164 | 496.11 |
| Week 5 | 247.67 | 1523.19 | 209 | 468.09 |

Saturday

| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 98.94 | 1144.66 | 384 | 287.02 |
| Week 2 | 134.32 | 993.41 | 409 | 370.11 |
| Week 3 | 134.47 | 1372.88 | 294 | 507.70 |
| Week 4 | 74.57 | 832.42 | 348 | 244.71 |
| Week 5 | 78.85 | 742.76 | 216 | 273.98 |

Sunday

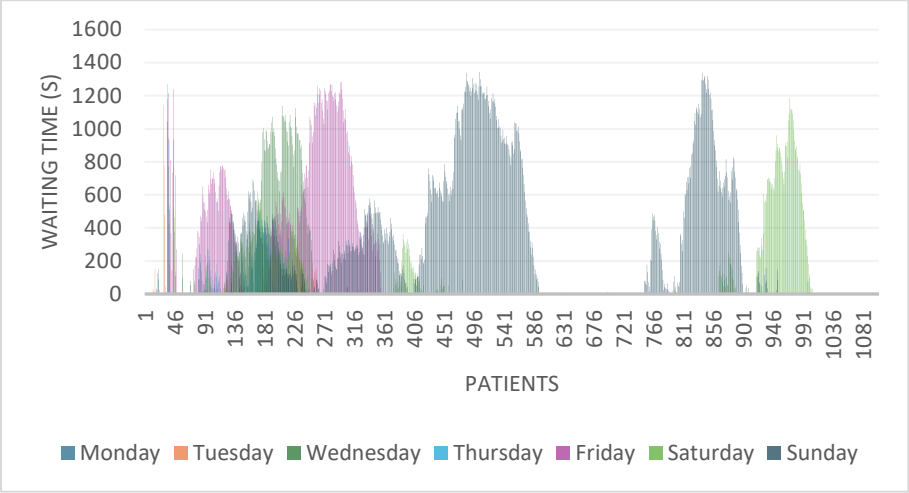
| | Average Waiting Time (s) | Max Waiting Time (s) | Total Patients Waiting | Average Waiting Time of Waiting Patients (s) |
|---|---|---|---|---|
| Week 1 | 218.26 | 1356.912 | 497 | 440.93 |
| Week 2 | 124.49 | 856.18 | 394 | 315.66 |
| Week 3 | 92.99 | 955.02 | 419 | 224.81 |
| Week 4 | 403.43 | 2000.76 | 592 | 678.06 |
| Week 5 | 70.74 | 804.58 | 393 | 179.64 |

## 7.11 APPENDIX K: RESULTS EXPERIMENT 2 IN GRAPHS

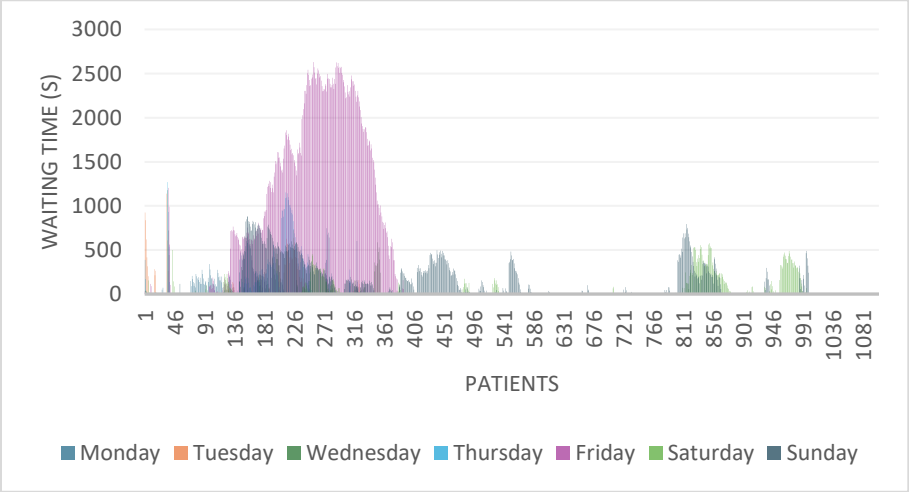
### 7.11.1 Service time 6:03, 30:00

*Run 1*

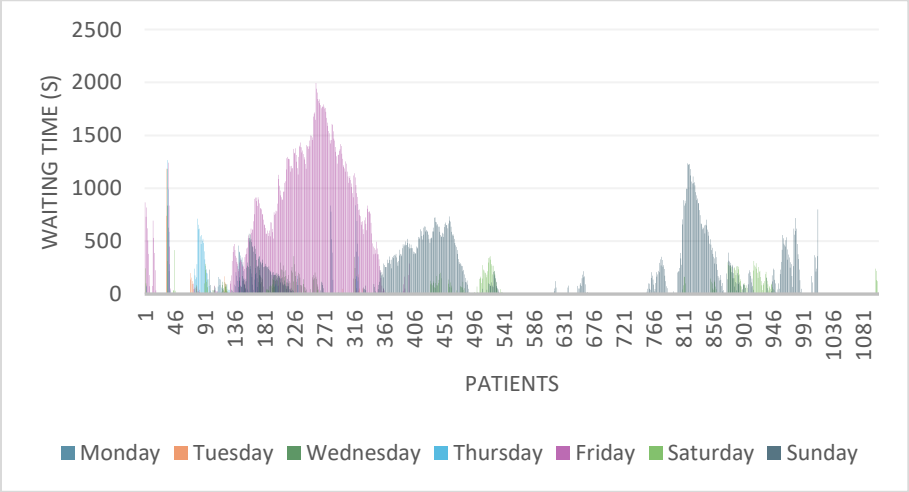
Week 1



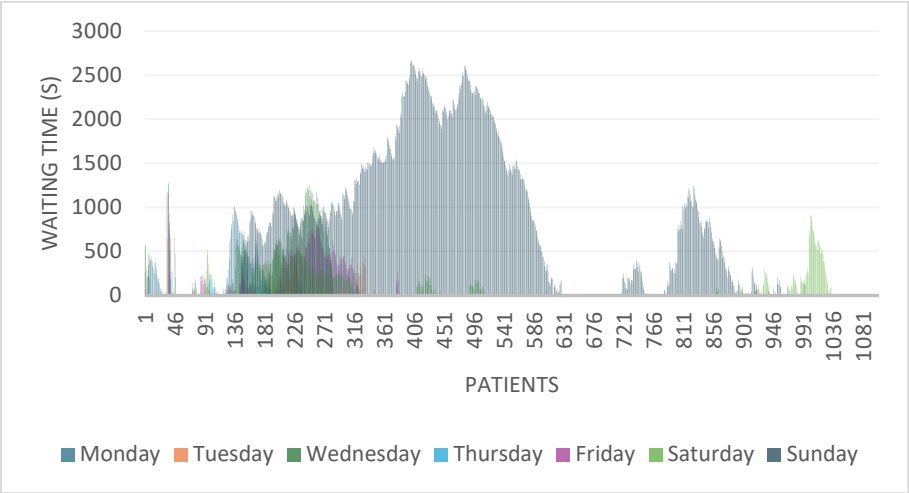

Week 2



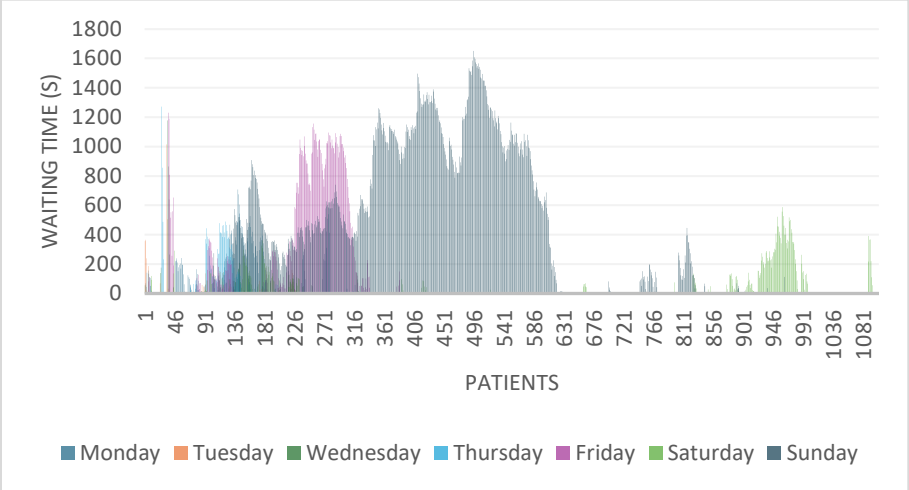

Week 3



Week 4

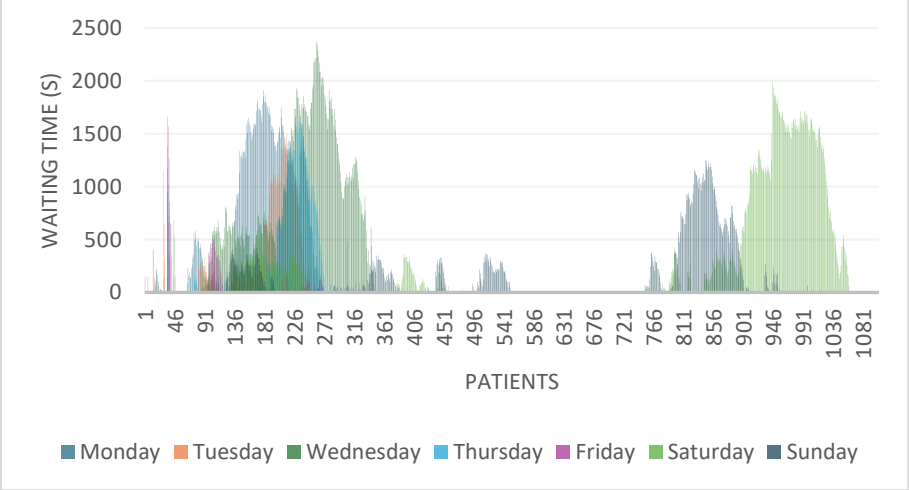



Week 5

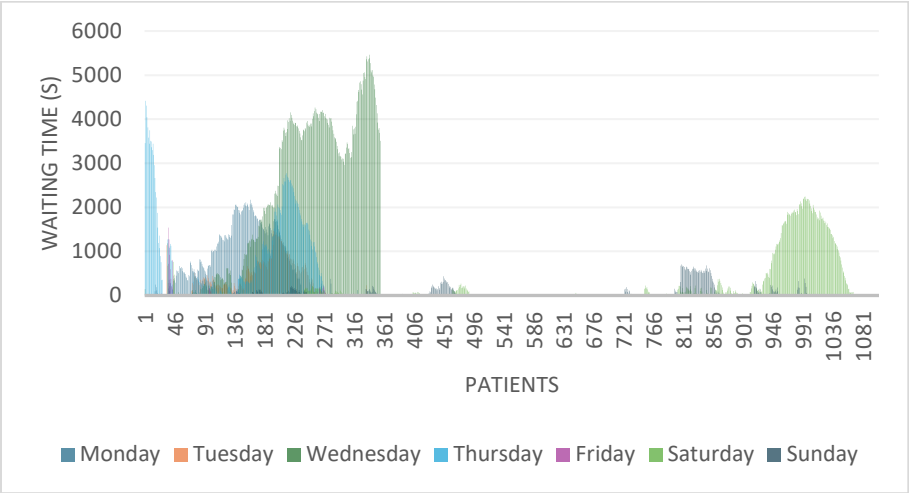



## *Run 2*

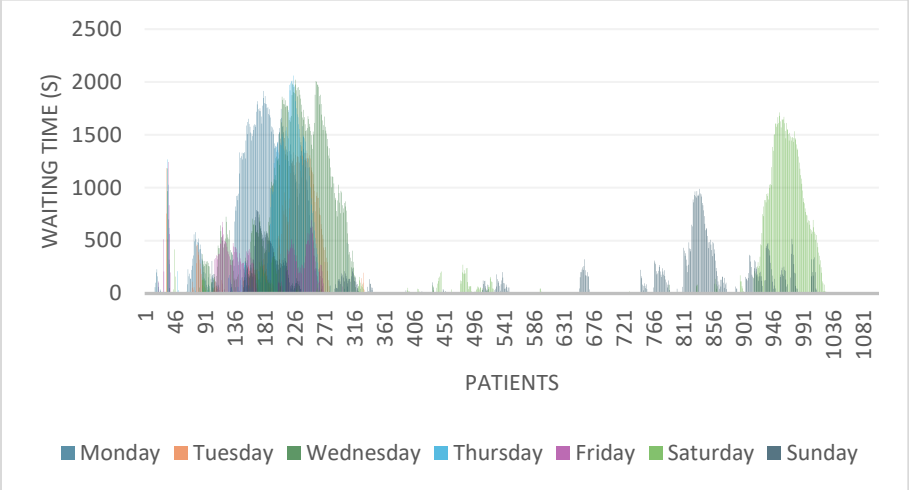
Week 1



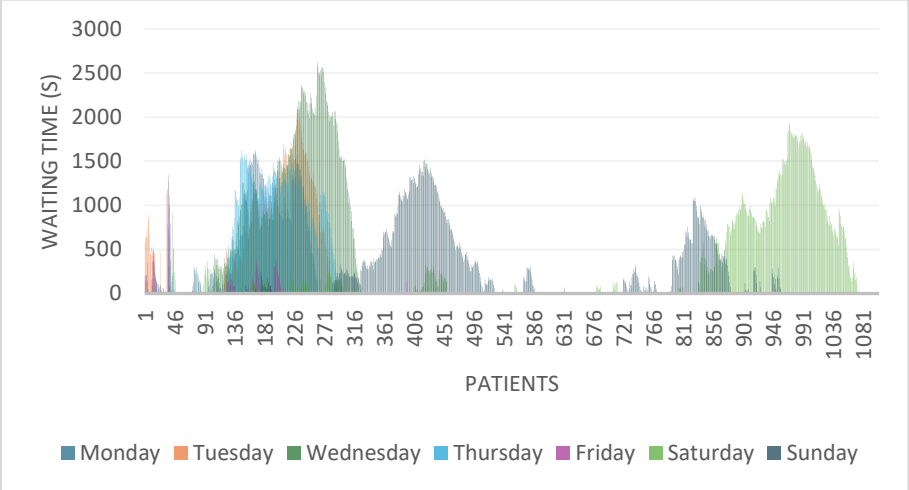
Week 2



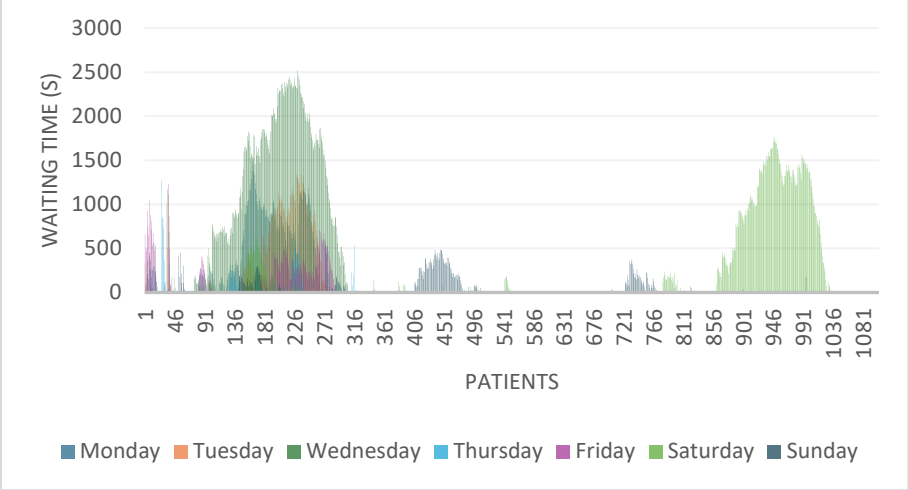

Week 3




Week 4

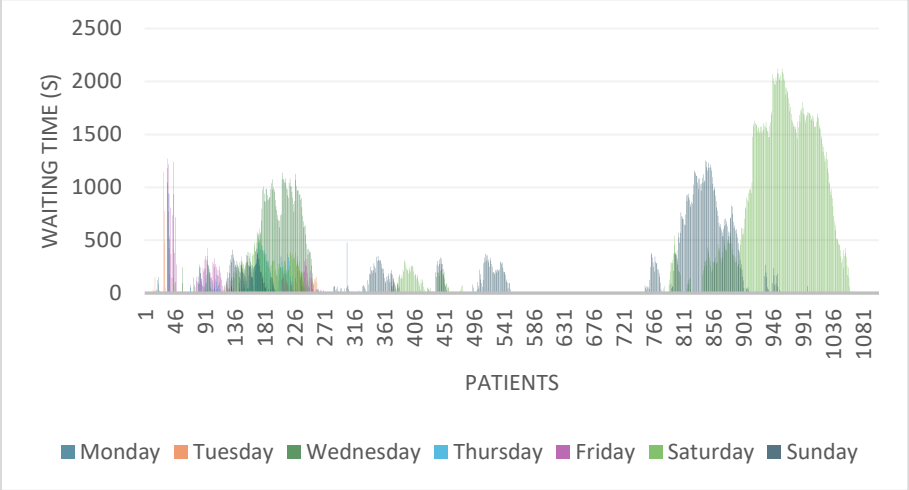


Week 5

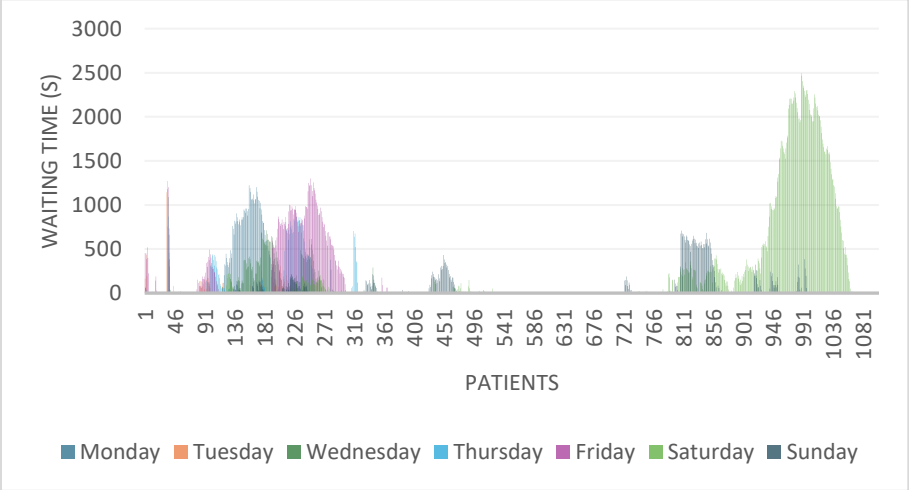



## *Run 3*

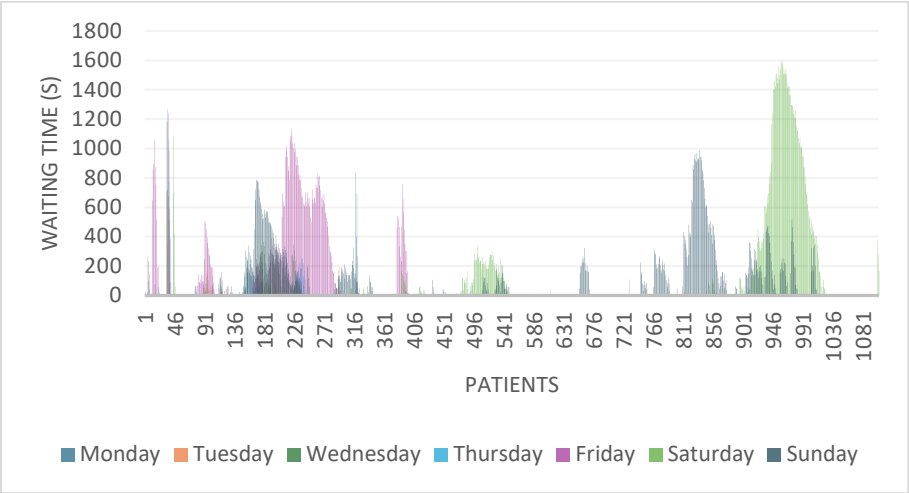
Week 1



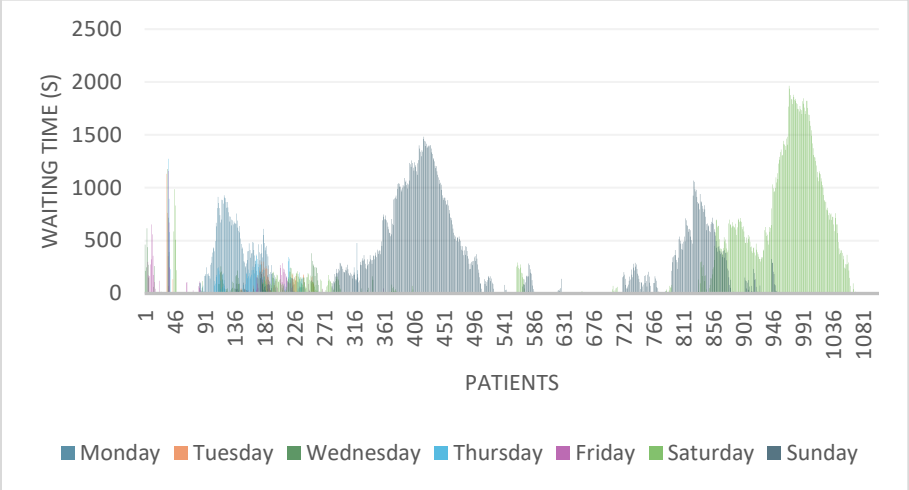

Week 2



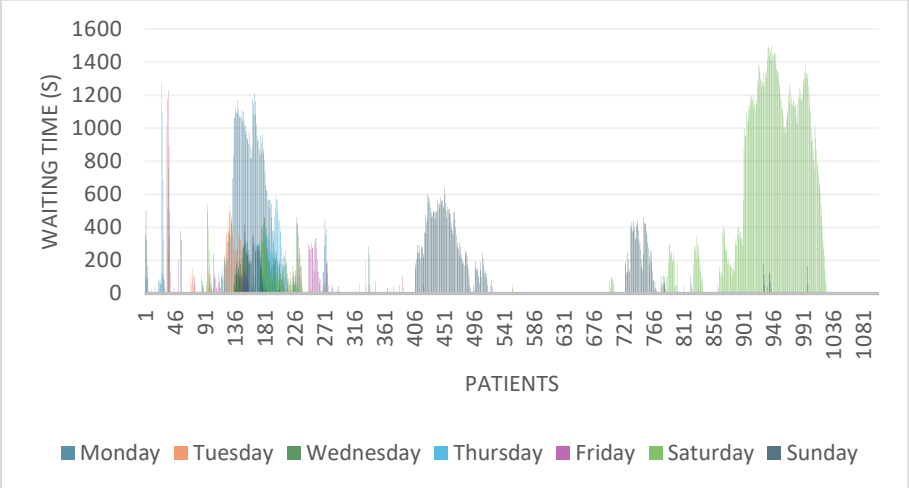
Week 3




Week 4



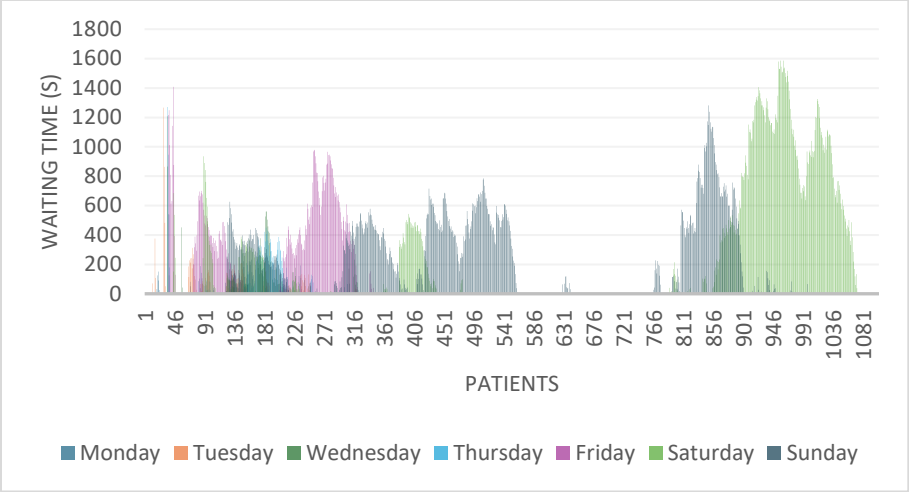

Week 5



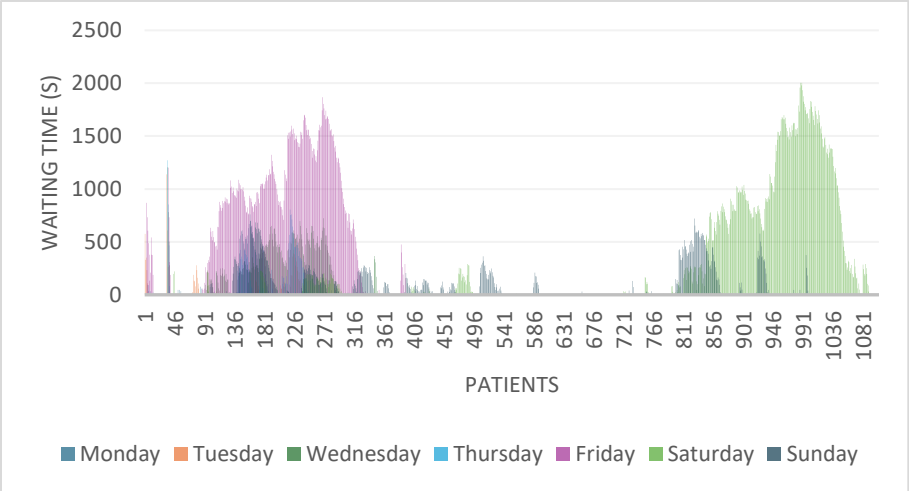
### 7.11.2 Service time 6:03, 27:30

*Run 1*

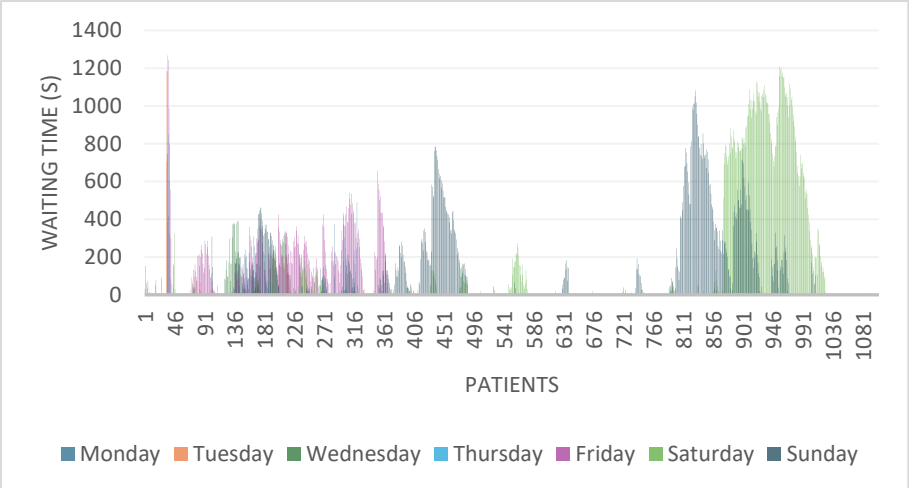
Week 1



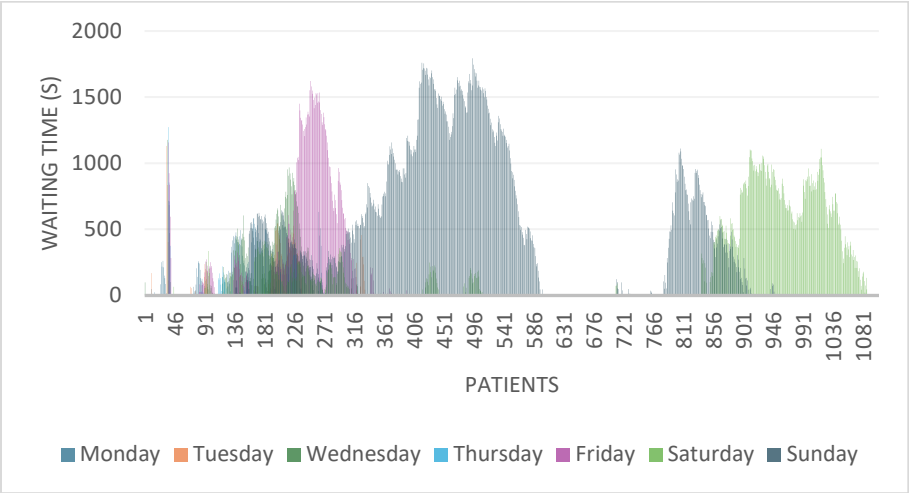

Week 2



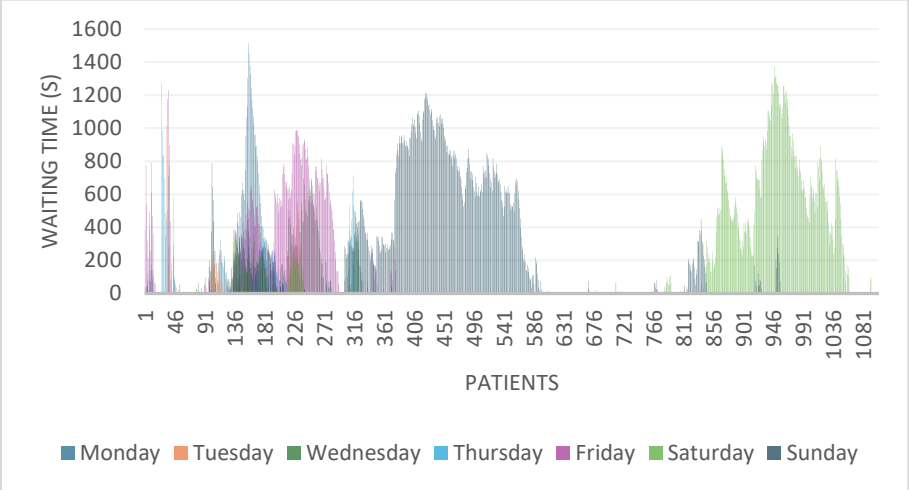

Week 3



Week 4

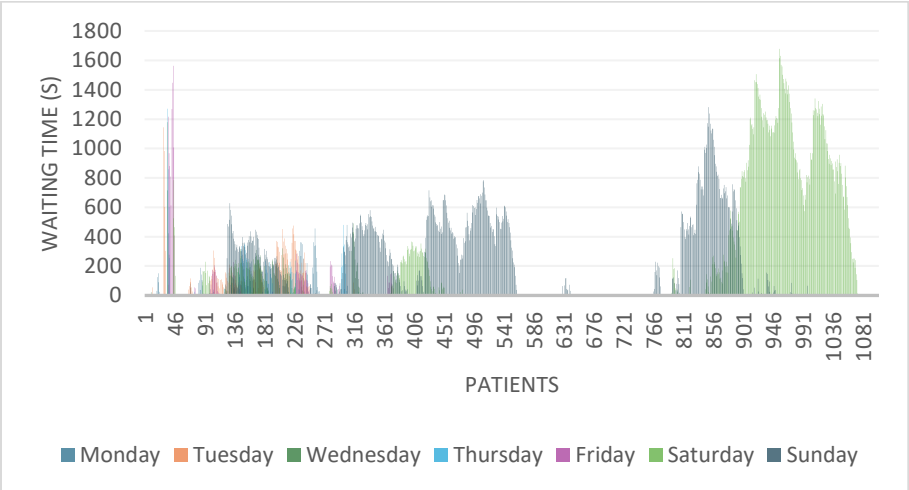



Week 5

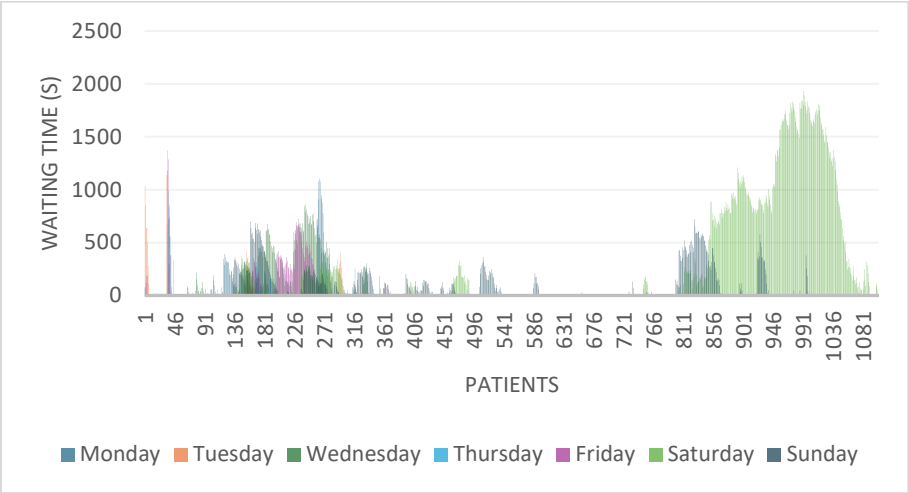



## *Run 2*

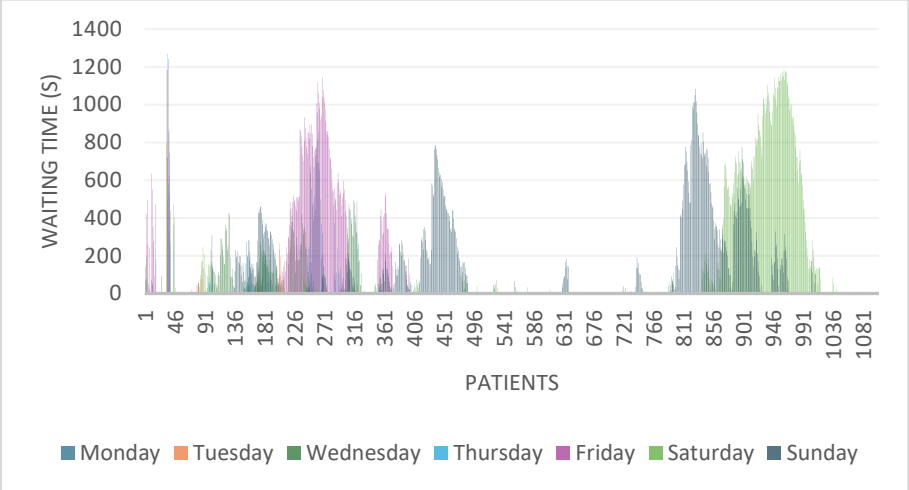
Week 1



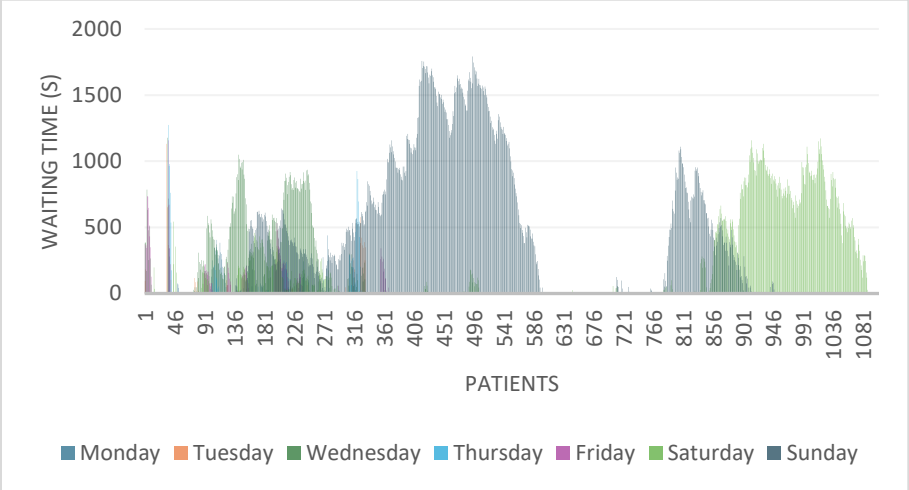
Week 2



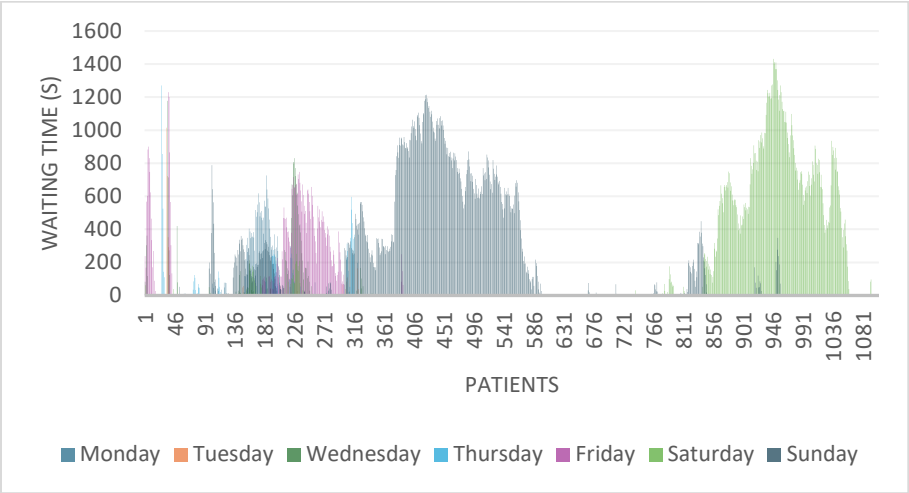

Week 3




Week 4

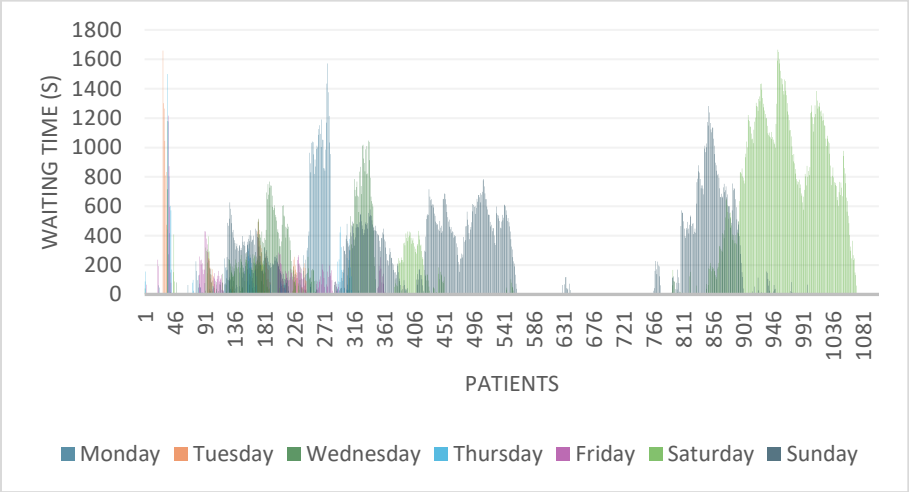


Week 5

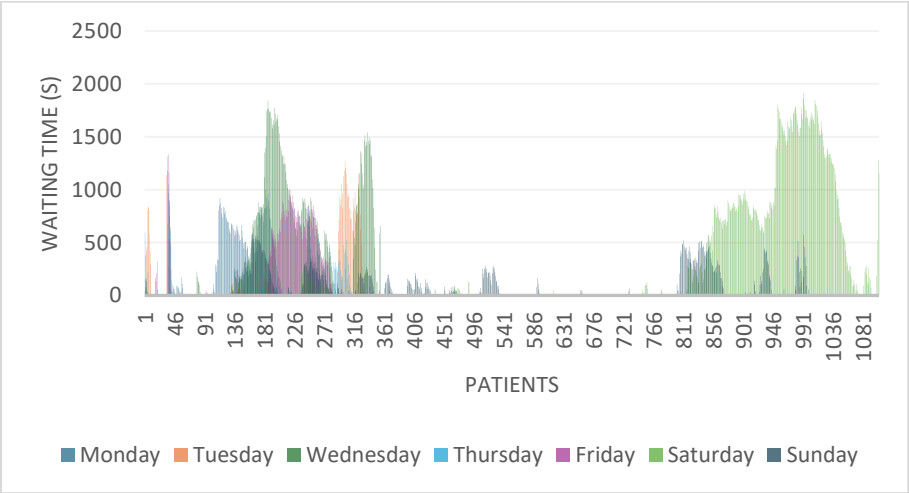



## *Run 3*

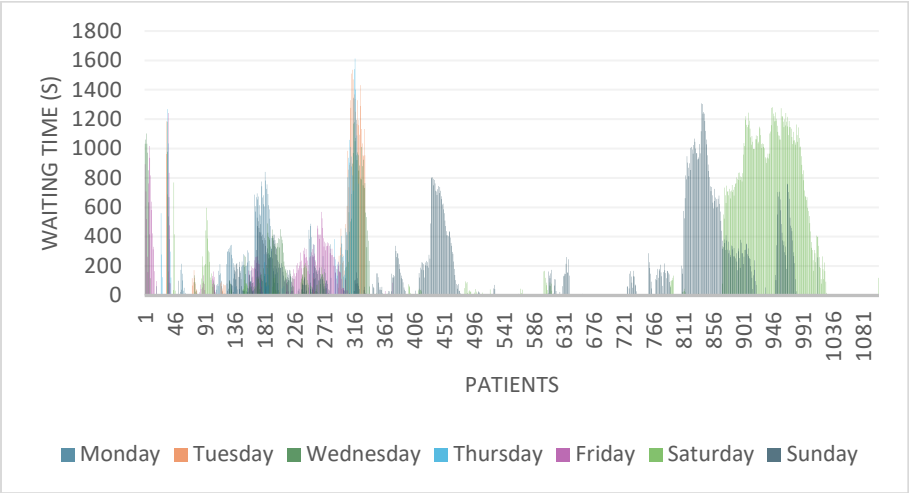
Week 1



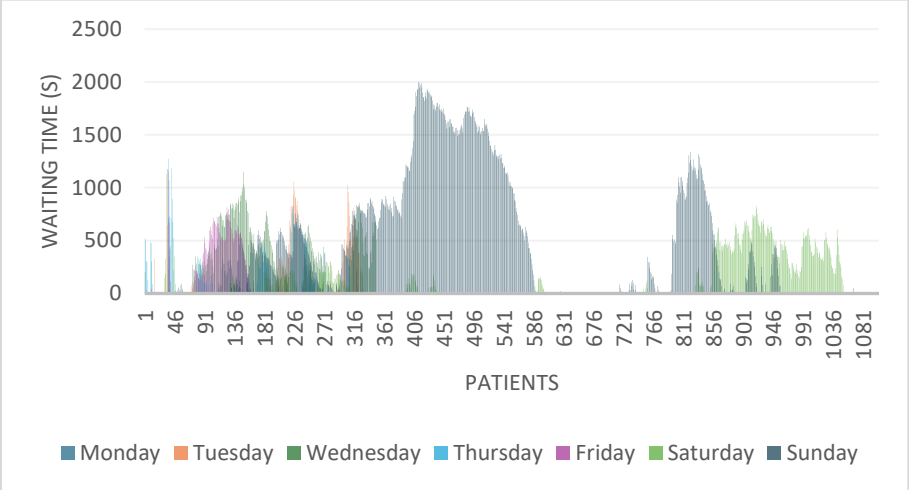

Week 2



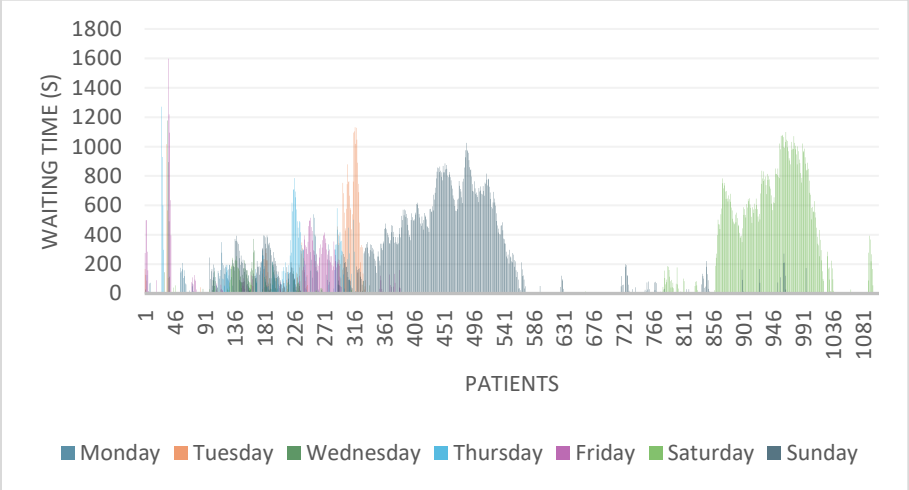
Week 3




Week 4



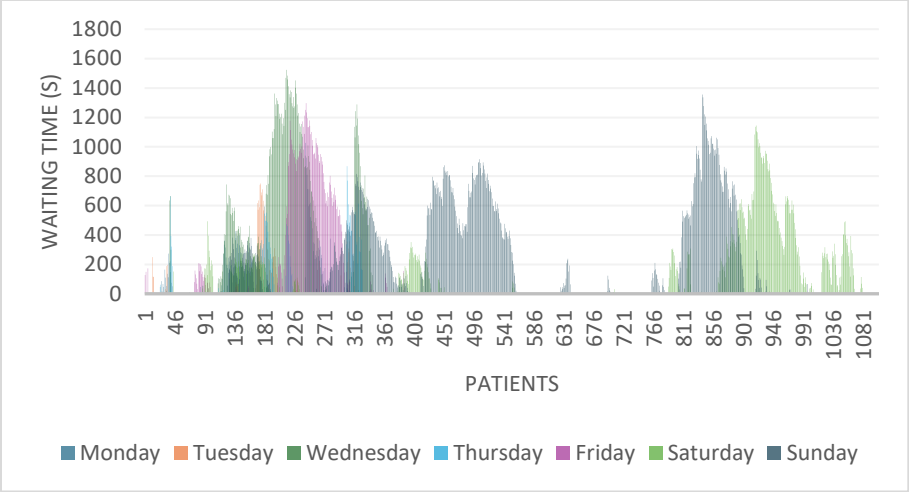

Week 5



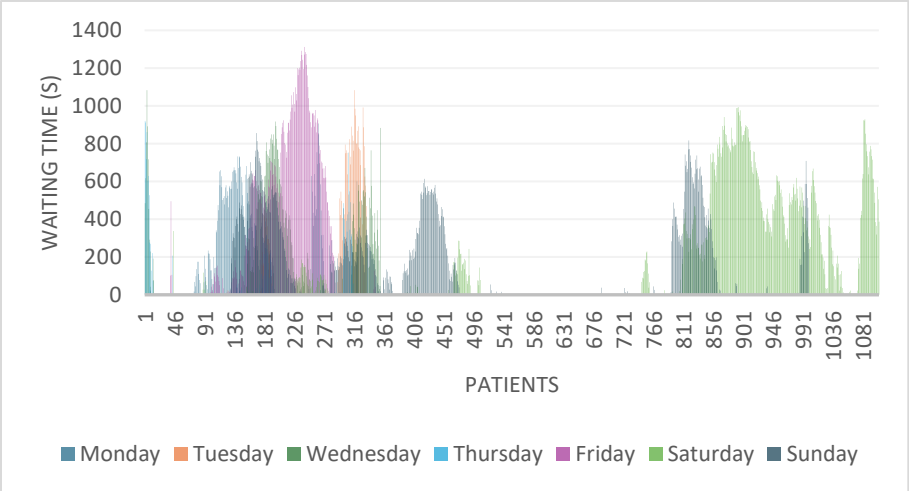
### 7.11.3 Service time 6:03, 25:00

*Run 1*

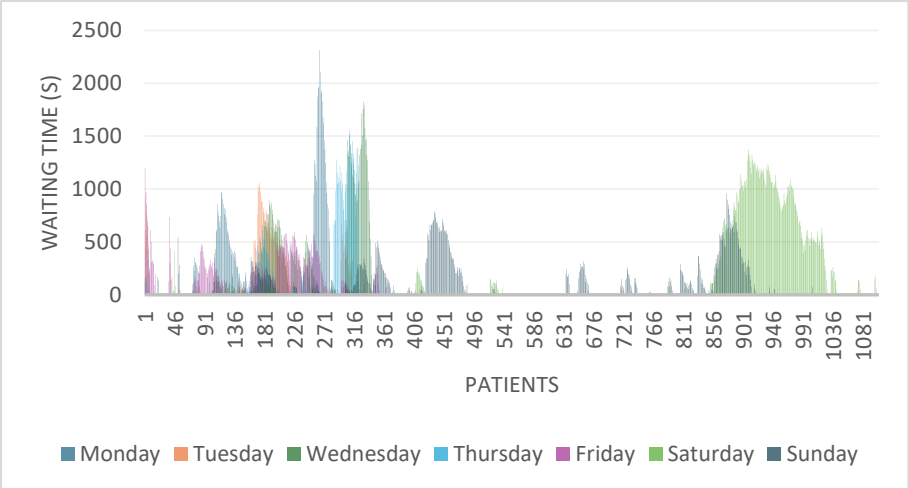
Week 1



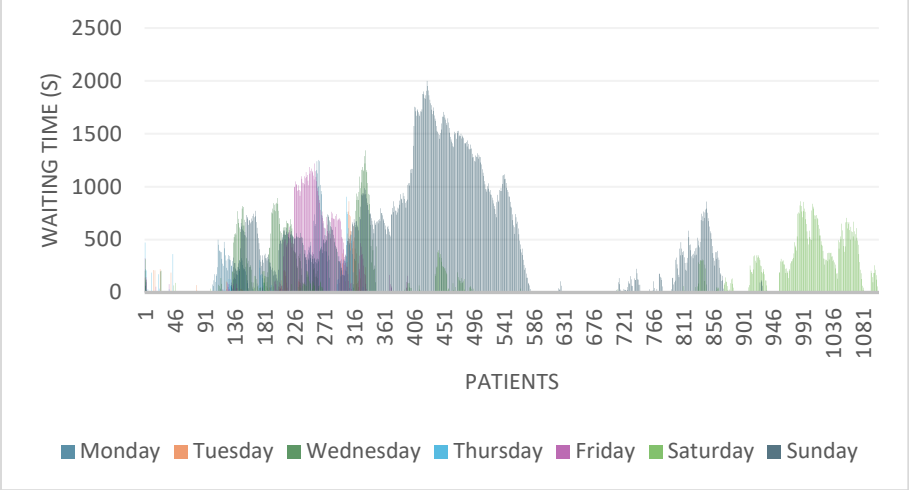

Week 2



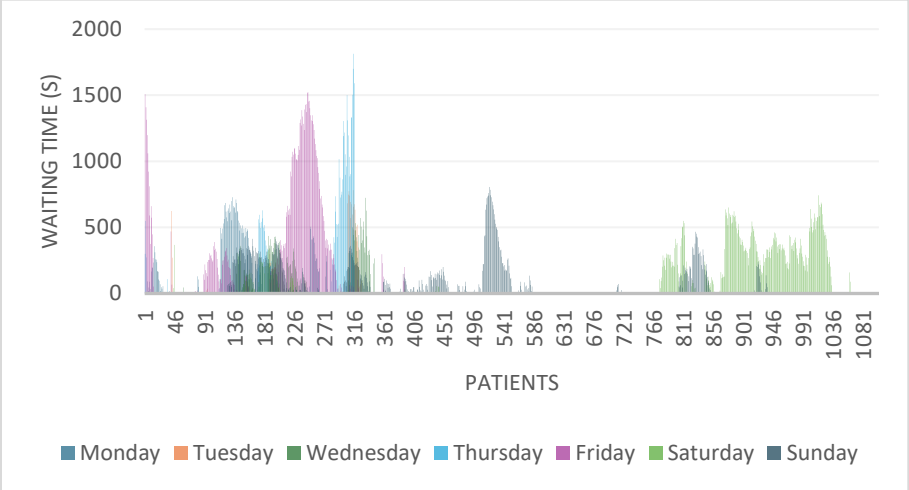

Week 3



Week 4


2500
2000
1500
1000
500
0
WAITING TIME (S)
1
46
91
136
181
226
271
316
361
406
451
496
541
586
631
676
721
766
811
856
901
946
991
1036
1081
PATIENTS
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday

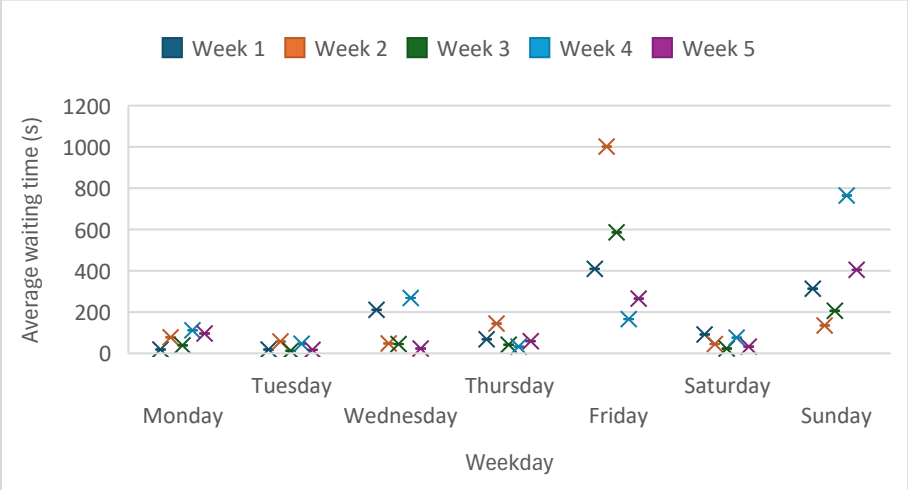
Week 5


2000
1500
1000
500
0
WAITING TIME (S)
1
46
91
136
181
226
271
316
361
406
451
496
541
586
631
676
721
766
811
856
901
946
991
1036
1081
PATIENTS
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday

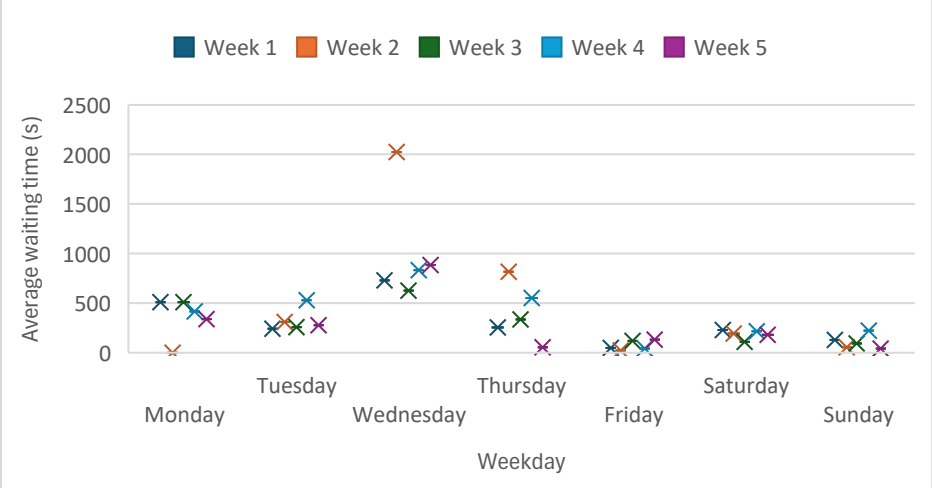
## 7.12 APPENDIX L: AVERAGE WAITING TIMES FOR EVERY RUN

### 7.12.1 Service time 6:03, 30:00

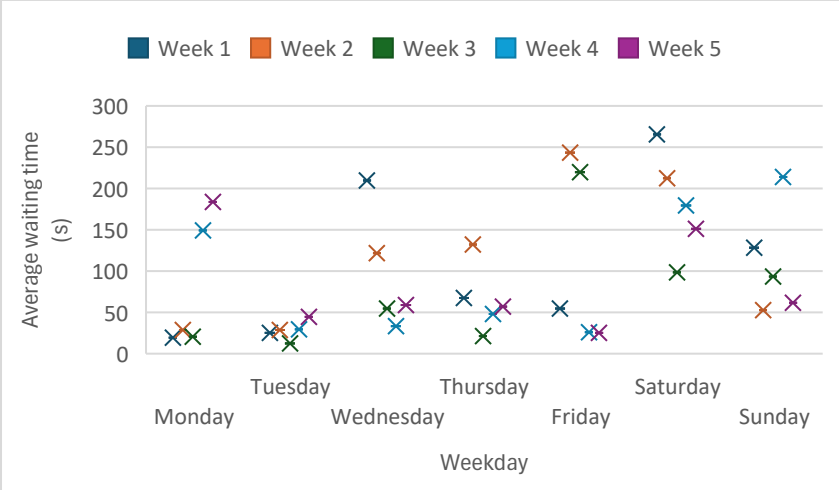
*Run 1*




*Run 2*

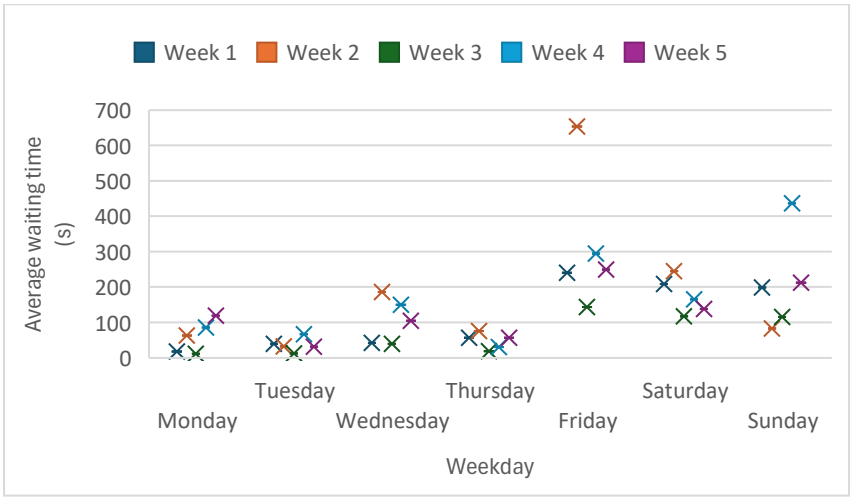



*Run 3*

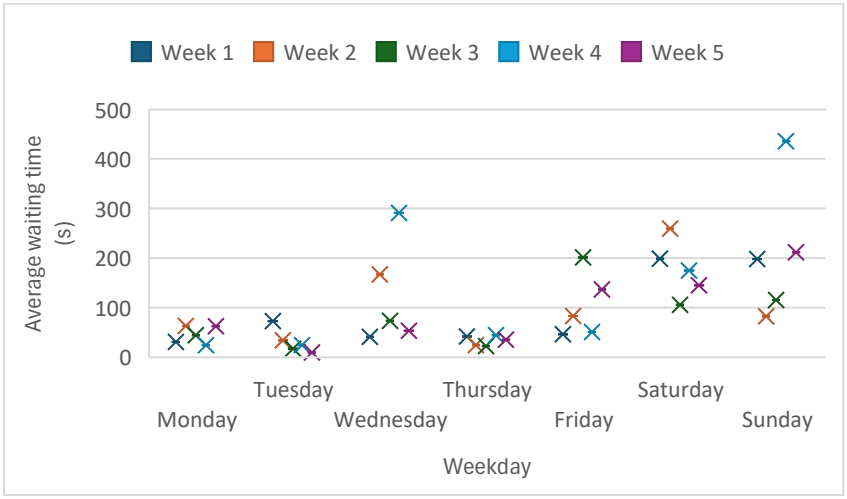


### 7.12.2 Service time 6:03, 27:30

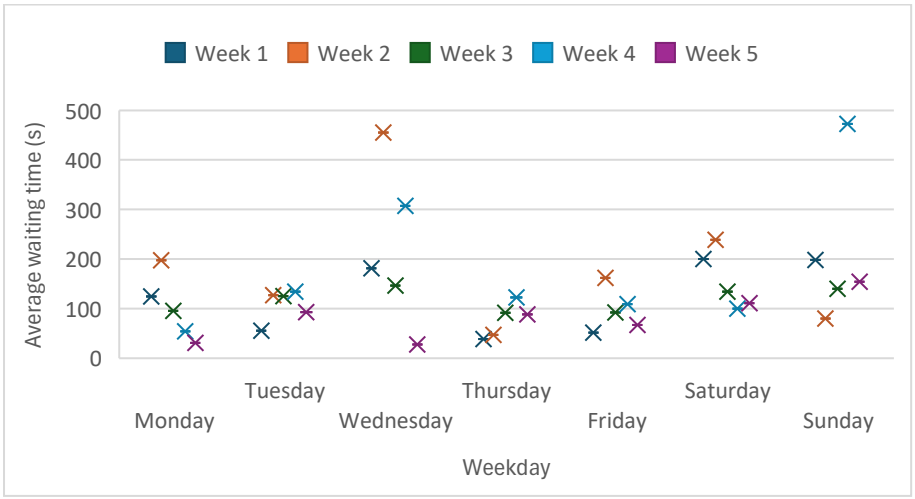
*Run 1*




*Run 2*

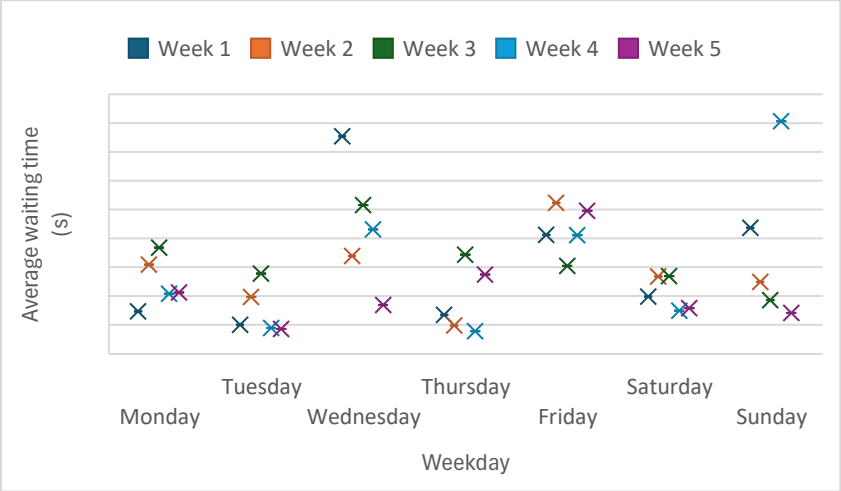



*Run 3*



### 7.12.3 Service time 6:03, 25:00

*Run 1*



# 8. BIBLIOGRAPHY

Bouzada, M. (2009). Dimensioning a Call Center: Simulation or Queue Theory? *The FlagshIp Research Journal of InternatIonal Conterene of The productIon and OperatIons Management Society*, 34-46.

Chassioti, E. (2012). *Queueing models for call centres.* Lancaster University.

Green, L. V., Kolesar, P. J., & Soares, J. (2001). Improving the SIPP Approach for Staffing ServiCe Systems that Have Cyclic Demands. *Operations Research Informs*, 549-564.

Heerkens, H., & Winden, A. v. (2017). *Solving Managerial Problems Systematically.* Groningen/ Houten: Nordhoff UItgevers bv.

Koole, G., & Mandelbaum, A. (2001). Queueing Models of Call Centers An Introduction. 1-36.

RIVM. (2022). *Capacity model for ambulance dispatch centres 2022.* RIVM.

RIVM. (n.d.). *Over RIVM*. Retrieved from rivm.nl: https://www.rivm.nl/over-het-rivm

Robinson, S. (2004). *Simulation The Practice of Model Development and Use.* John Wiley & Sons Ltd.

Robinson, S. (2007). A statistical process control approach to selecting a warm-up period for a discrete-event simulation. *European Journal of Operational Research*, 332 - 346.

Winston, W. L. (2004). *Operations Research Applications and Algorithms 4th edition.* Canada: Thomson Brooks/ Cole.

AI Tools were used to gain a better understanding of academic text and to improve my writing.

UNIVERSITY OF TWENTE
Drienerlolaan 5
7522 NB Enschede

P.O.Box 217
7500 AE Enschede

P +31 (0)53 489 9111

info@utwente.nl
www.utwente.nl