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# Comparative Analysis of Microwave Users in Golden-hours and Other Days

**Huda Feroz Ahmed (ha04081)**

*Habib University, Karachi, Pakistan*

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## 1 Introduction

The aim of this observational study is to perform a comparative analysis of microwave usage in golden-hours and on other days. The Tapal Cafeteria has one microwave for the use of student-body and is occasionally also used by some faculty and staff members. There has been a growing demand by the university's student-body for an additional microwave for the cafe. The purpose of this study is to analyse if there is a difference in this demand on different weekdays.

## 2 Methods

Population of interest is the students of Habib who have lunch in the Tapal Cafeteria between 2:30 and 3:30. Sample was selected using non-probabilistic method. We used convenience sampling method as the sample was drawn from that part of the population that is close to hand i.e. who will eat lunch between 2:30 and 3:30.

The data recorded was the size of queue that was noted each time a person put food in microwave, timer they set on microwave and which day of the week it was. Cafe's microwave only allows for 30 seconds intervals (0.5 minutes) so timer readings are intervals of 0.5 only. Data was collected manually throughout the week from 2:30 pm to 3:30 pm. The size of the queue was noted to assess demand of microwave and timer's time was noted for developing a hypothesis later. A total of 68 observations of 3 variables were collected.

Sampling protocol was devised as such that bias is minimized. An account of co-founding variable bias was taken as there may have been an effect of day on the use of microwave more people can bring food from home on specific day(s). Therefore, to account for it sampling was carried on 2 golden hours i.e. on Tuesday and Thursday. Moreover, an account of observer bias was taken as I bring my food from home almost daily, have my lunch in Tapal cafe, and warm my food using the microwave. On a few days, I have to stand in a long queue to get my turn to microwave food. Therefore, I may have had subjective bias about the studied. This was combated through constant self-reflection. [1]

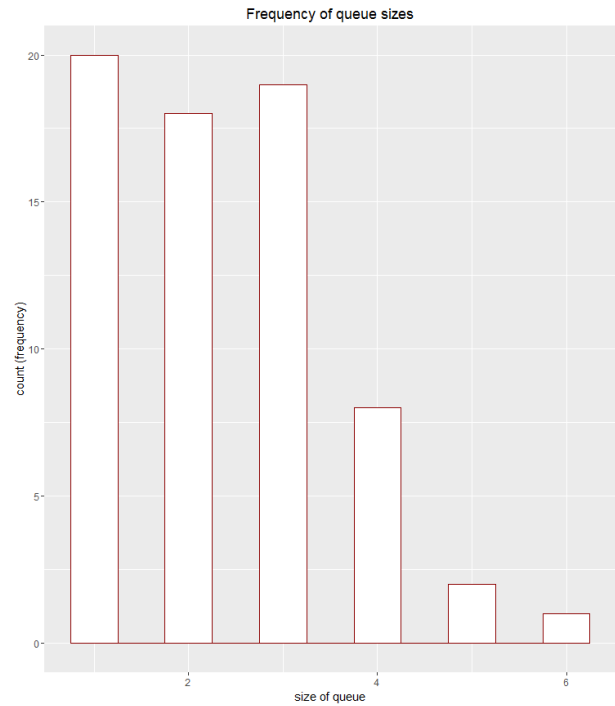
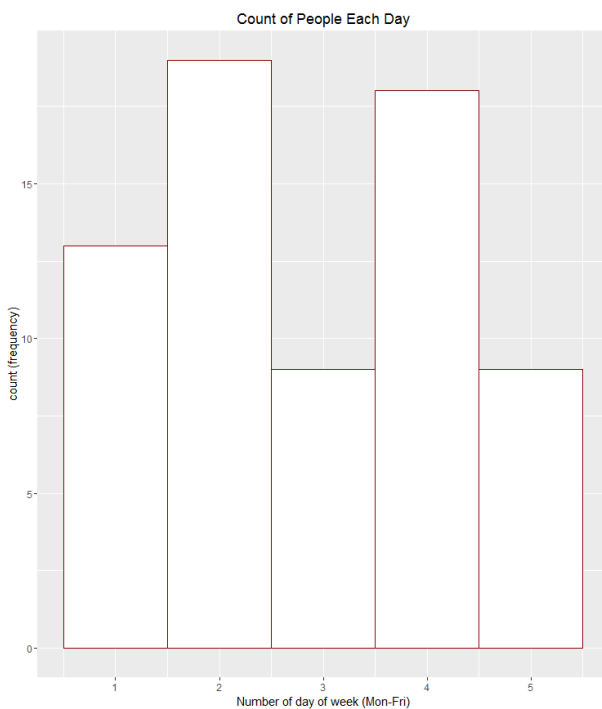
## 3 Results

Varying number of people used microwave during different days. Table 1 summaries the count of data on different days. Figure 1 shows that the shape of number of people on each days is bi-modal and non-symmetric, and a greater number of people used the facility on Tuesday and Thursday (golden-hours).

The minimum size recorded of a queue for using microwave was 1 and maximum was 6. Figure 2 shows frequency of queue sizes throughout the week and we can see that the queue size mostly remained between 1 and 3. The shape of the data is skewed right. Figure 3 shows frequency of a queue size on different days and it can be seen that maximum queue size was observed on Thursday and queues of size greater than 4 were only seen during golden hours. Figure 4 depicts different

**Table 1:** Microwave users on a day

Day	Count
Monday	13
Tuesday	19
Wednesday	9
Thursday	18
Friday	9

**Figure 2:** Frequency of each queue size**Figure 1:** Varying number of people on different week days

days of week as groups and shows mean values for each day and variability outside the upper and lower quarterlies for queue sizes for using microwave. It is obvious that from figure 4 that upper variability range i.e. queue size in golden hours (Tuesday and Thursday) were much higher comparatively.

The minimum timer time used was 0.5 minutes and maximum was 2.5 minutes. Figure 5 shows frequency of the times microwave's timer was set to a certain point. It can be seen that most people used the microwave for 1.5 minutes and shape of data is bi-modal and non-symmetric. Figure 6 depicts different days of week as groups and shows mean values for each day and variability outside the upper and lower quarterlies for the time which was set on microwave to warm food. The figure shows that sample size of Tuesday and Thursdays is larger comparatively, and throughout all days (except for Fridays) data spread is the same. There are also 2 outliers, one on Friday and one of Tuesday, as these people warmed their food for 2.5 minutes, while expected data range was between 1 and 2.

## 4 Discussion

### 4.1 Measures of Center

- Queue sizes: Figure 2 shows that mode representation for central tendency is important as it shows most data points lie between size of 1 to 3. Mean is not a perfect measure of central tendency

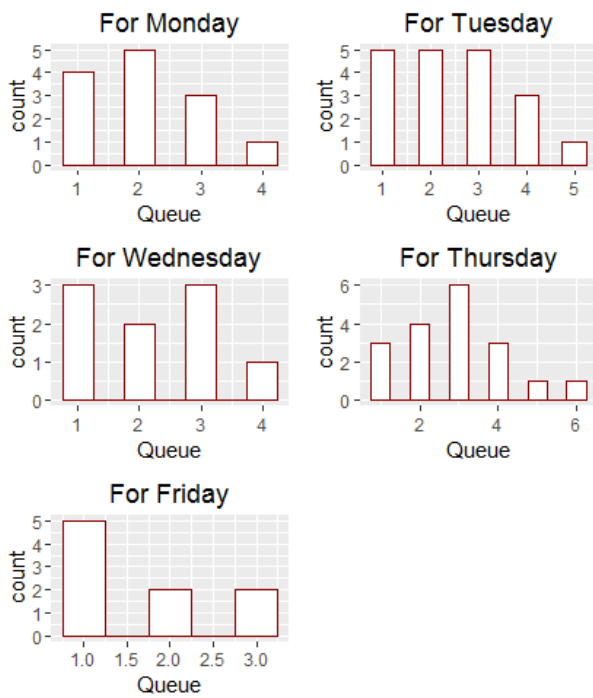


Figure 3: Frequency of each queue size for each day

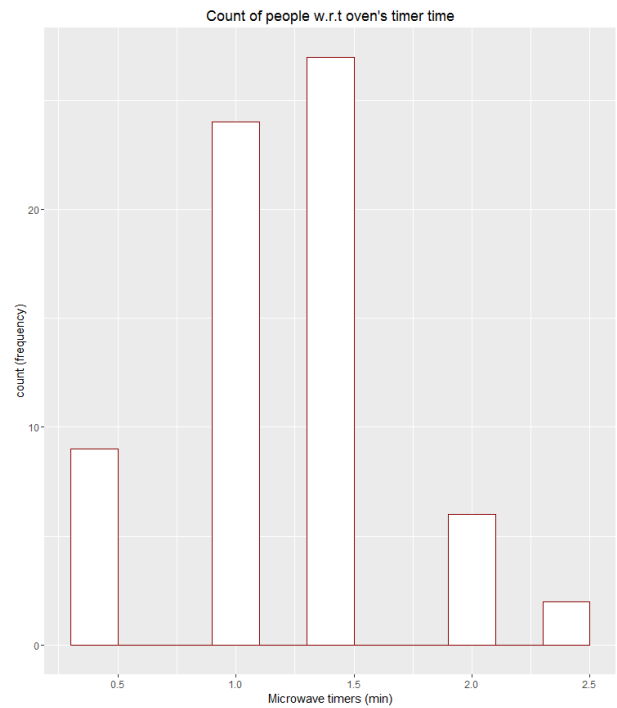


Figure 5: Frequency of microwave's timer time set by people

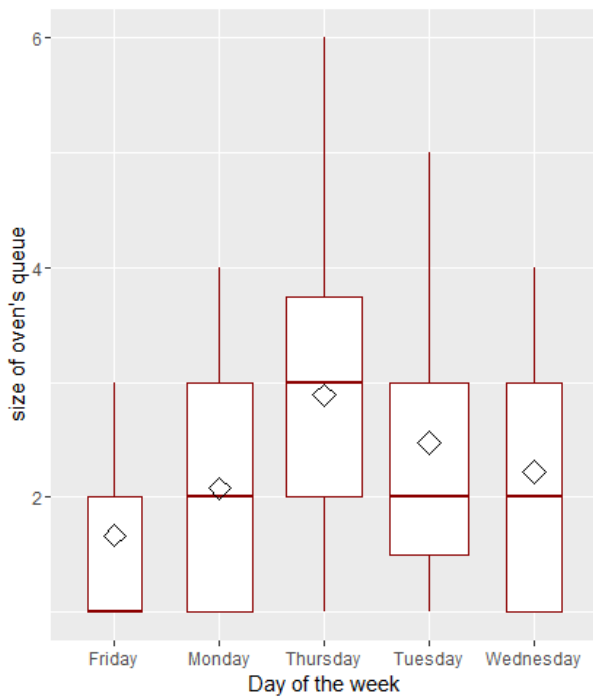


Figure 4: Summary (boxplot) of each queue size for each day

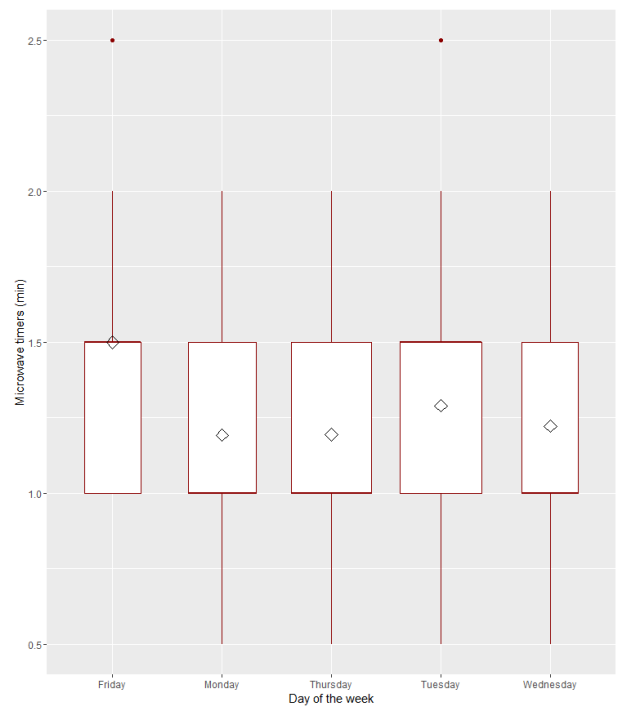


Figure 6: Summary (boxplot) of Microwave timer per Day

here as most data lies towards the left.

- Microwave timer for each user: Figure 5 shows that mean is not a perfect measure of central tendency here as most data points lie towards the left. Mode captures the central tendency better as knowing that for how long is the microwave mostly kept occupied more relevant in the perspective of application of results.

## 4.2 Applications and Biases

Although, the sampling protocol was devised in a way that effect of biases is minimized, the sampling study still includes several biases which were not accounted for or were difficult to account for and they may have affected the results.

1. **Sample size was very small** so there is possibility of large observational error.  
Due to logistical limitations and limitations of available time, could not account for this.
2. **Sampling bias:** since the sample was selected at convenience and was non-probabilistic so some members of the intended population had a lower sampling probability than others.  
Due to logistical limitations and limitations of available time had to use convenience sampling method.
3. **Selection bias of individuals:** in this sampling study, selection of individuals was in a way that proper randomization was not achieved, thereby the sample obtained was not representative of the entire population.  
Logistical and time limitations did not allow to follow a probabilistic model.
4. **Observer bias:** although sampling protocol was devised as such to take it into account; however, self-reflection may not have eliminated the bias completely.
5. **Co-founding variable bias:** although sampling protocol was devised as such to take it into account; however, there may have been an affect of week, which have not been accounted for. It could be improved by carrying out data collection for multiple weeks.

We can observe that throughout the week, it is during the golden hours that there is a greater influx of people in cafeteria and greater microwave's users. Moreover, the size of queue during the golden hours is larger than other days. However, on other days the queue size did reach up to 4, and the frequency of queue size being 3 in also to be considered. For some people, a queue of size 3 may also mean wastage of time in waiting. Therefore, this study does not

conclude with that is demand of microwave justified, or is it only effect of day which gives rise to this demand. However, we can say that during golden hours, the demand of microwave facility is much higher.

The results can further be used to analyse that how many students in cafeteria bring food from home. Record of if microwave user is student or other (staff and faculty) can be added to analyse that is one microwave enough if only students use it. Further collection of data of the same sample about what food they are warming in microwave can be applied to analyse the variety and limitations of food students bring to campus.

The results can be generalized to the entire Habib population that more people use microwave facility during the golden hours. The same generalization can be used to analyze how many students students bring food from home.

## References

- [1] <https://www.catalyst.org/research/infographic-how-to-combat-unconscious-bias-as-an-individual/>Catalyst, How to Combat Unconscious Bias as an Individual (February 11, 2015).
- [2] <https://www.umsl.edu/~lindquists/sample.html>Umsl.edu. (2020). POPULATIONS AND SAMPLING. [online]
- [3] <https://data36.com/statistical-bias-types-explained/>Mester, T. (2020). Statistical Bias Types explained (with examples) - part1. [online] Data36.