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# **ECSA Graduate Attributes Project**

Industrial Engineering  
Quality Assurance 344

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Theuns Dirkse van Schalkwyk  
2025

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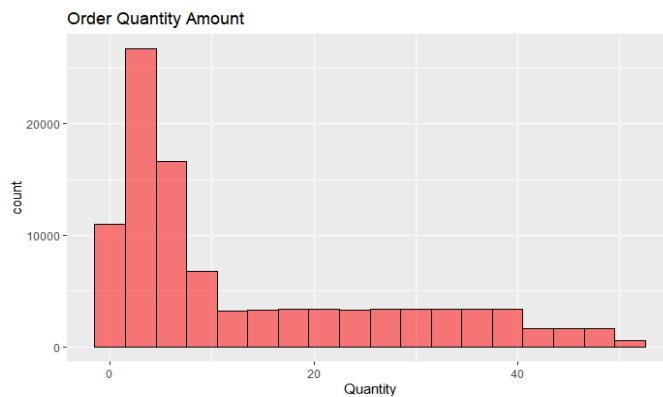
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# **1 Introduction**

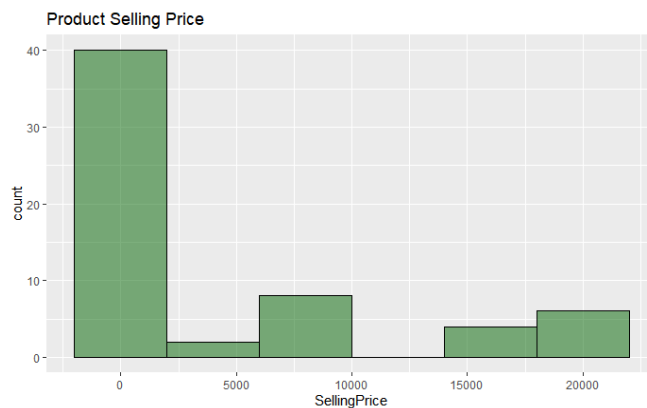
The following report is constructed to give recommendations to management and feedback based on different scenarios and problems in a business. Firstly, we will look at the data and wrangle it to determine what data is useable and what is unnecessary. Thereafter we will take the usable data and perform descriptive statistics to visualise the data and perform data analysis on the visualization.

## 2 Descriptive Statistics



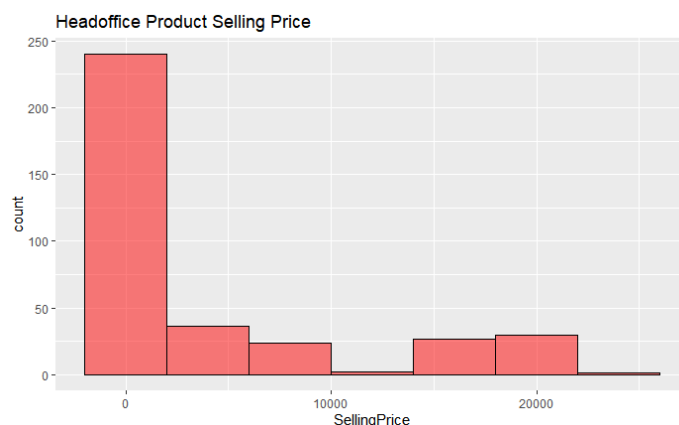
**Figure 1: Order Quantity Amount**

From the graph above we can see that most people buy smaller amounts of products. Meaning there is little to non-commercial buyers.



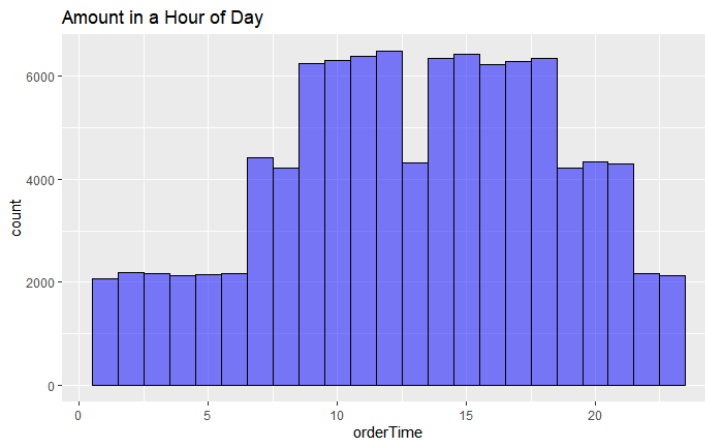
**Figure 2: Product Selling Price**

From this graph we can assume that most revenue comes from products that is less than 5000.



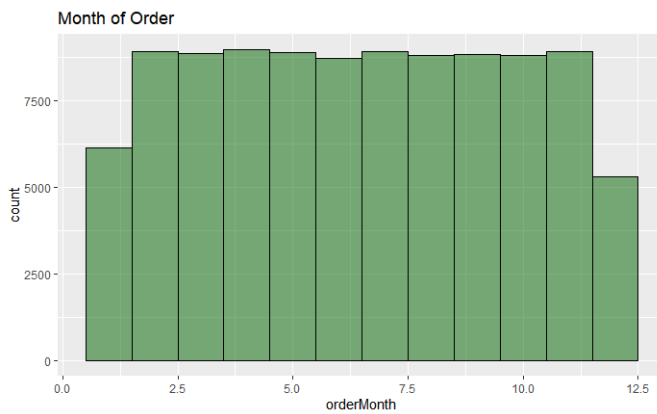
**Figure 3: Head office Product Selling Price**

The graph previously mentioned reflects the distribution of the products that is being sold from the Head office which indicates that the sales are good.



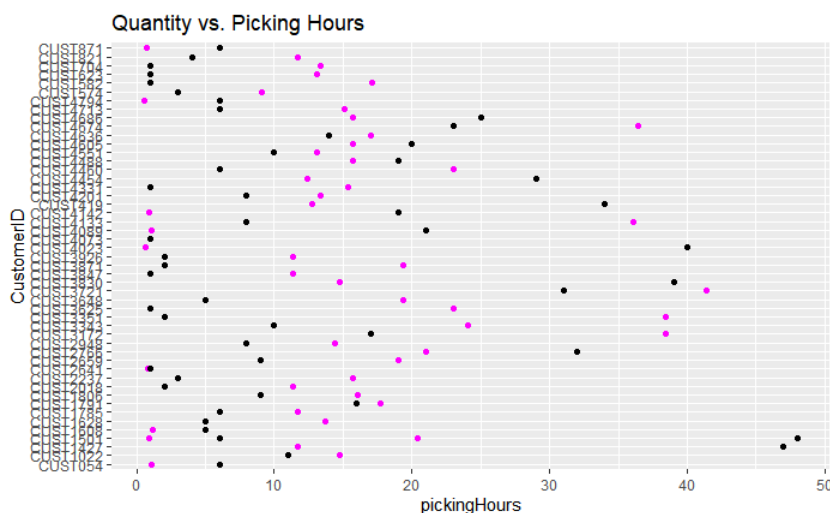
**Figure 4: Amount in an Hour of Day**

From this visualization we can clearly see that most of the purchases happens within the early morning hours and in the evening around 15h00 until closing time which looks to be around 17h00 to 18h00.

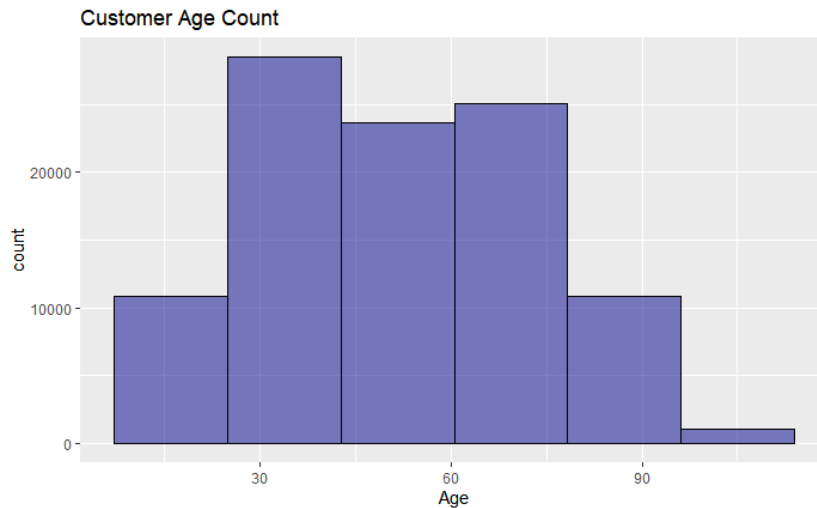


**Figure 5: Month of Order**

From the graph above we can conclude that the products sell good through the year with drops in numbers sold in January and in December due to holidays.

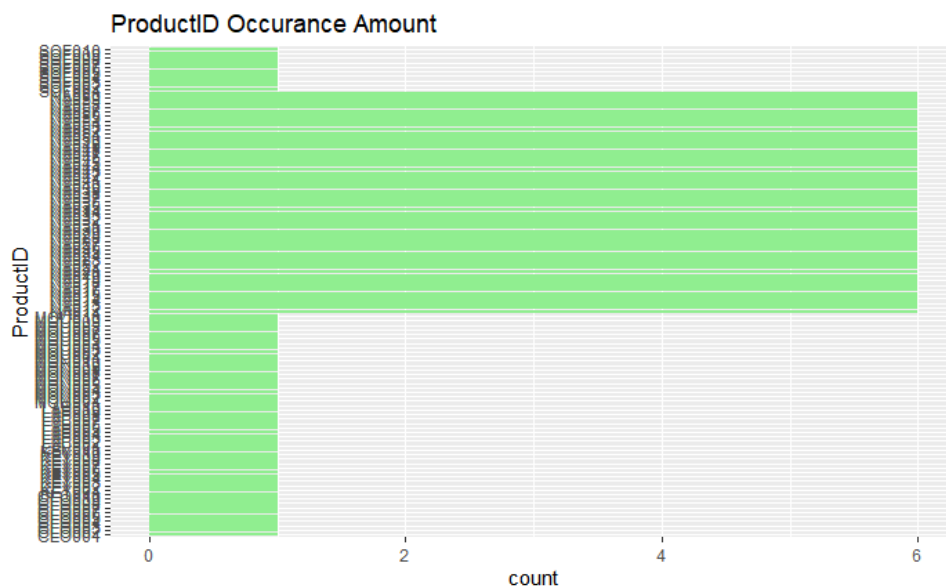


**Figure 6: Quantity vs. Picking Hours**



**Figure 8: Customer Age Count**

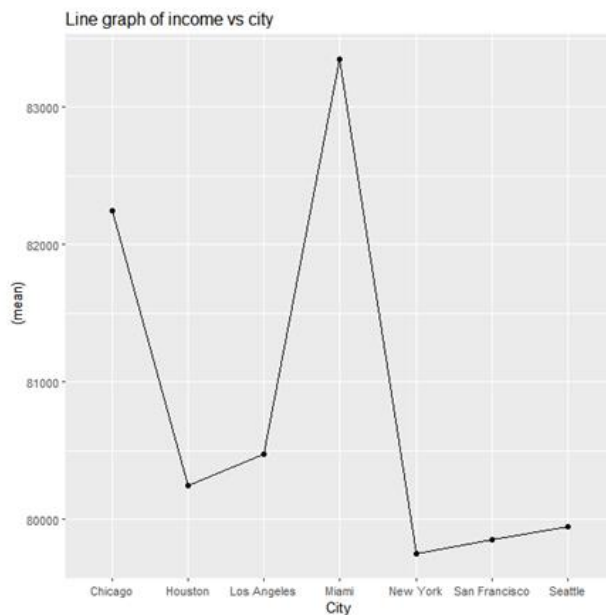
From the above graph we can see that most of the electronic devices is being sold to younger people of the age around 30. This is due to the fact that they have their own salary and can buy it themselves. The products that are being bought by older or elderly people are more than likely parents who buy the products for kids to be able to work or as gifts.



**Figure 7: ProductID Occurance Amount**

From this graph we can see that there are a clear productID that occurs the most and that is NA which is wrong.

(Note)The graphs below are generated in Radiant and therefore there is no code for these graphs.



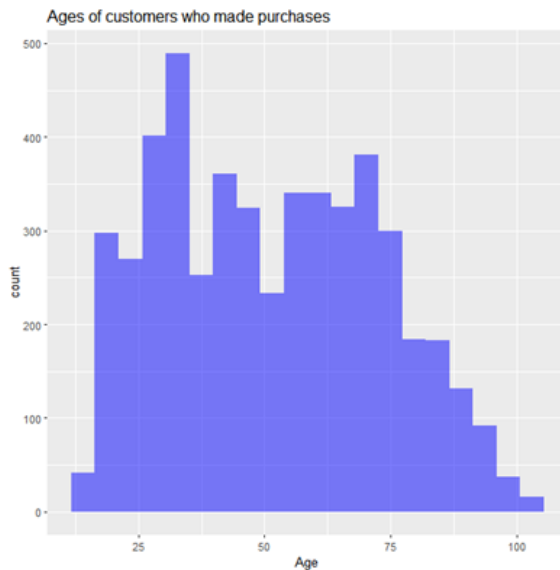
**Figure 9:Income vs City**

As we can see from the graph above, we can conclude that the most income is earned from the city of Miami and not San Francisco which is one of the cities with the least amount of income and which has the most sales. From this we can conclude that the income does not influence the number of sales in a specific city.



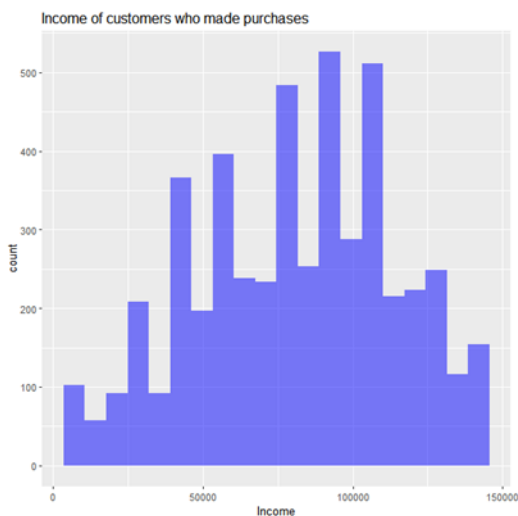
**Figure 10:City of Customers**

We can also see that the most people buy from our products from the regions of San Francisco. But we can also conclude that the products sell good all over the cities that is targeted with Miami being the least.



**Figure 12: Ages of Customers**

From the graph above we can conclude that more younger customers buy our businesses products with the highest number of products sold to people at around 30. And the elderly people buying the electronic products is more likely since they are buying presents for there children or it could be parents that need it for work. Or for their children to be able to work and study.



**Figure 11: Income of Customers**

As we can assume from the graph above, we can see that the most of our products gets bought by people with an income around 100000 with the biggest number of products bought by people earning just under 100000 a month.

## 3 Statistical Process Control

### 3.1 Control Charts

Based on the first 30 samples recorded, control chart limits were constructed using the methodology:

For x-bar chart  $\rightarrow UCL = \bar{x} + A_3(\bar{s})$

$$LCL = \bar{x} - A_3(\bar{s})$$

For s-bar chart  $\rightarrow UCL = B_4(\bar{s})$

$$LCL = B_3(\bar{s})$$

#### 3.1.1 Keyboard

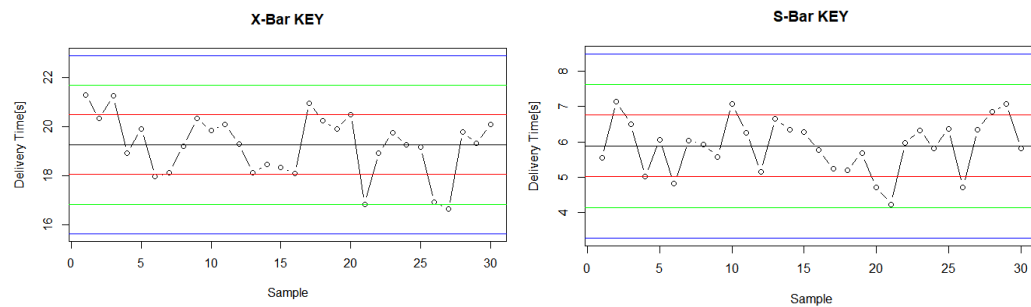


Figure 13: Keyboard X and S Bar

#### 3.1.2 Software

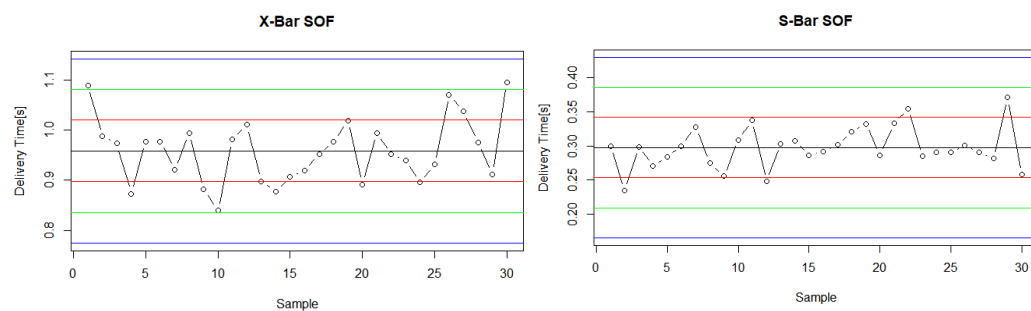


Figure 14: Software X and S Bar

### 3.1.3 Cloud

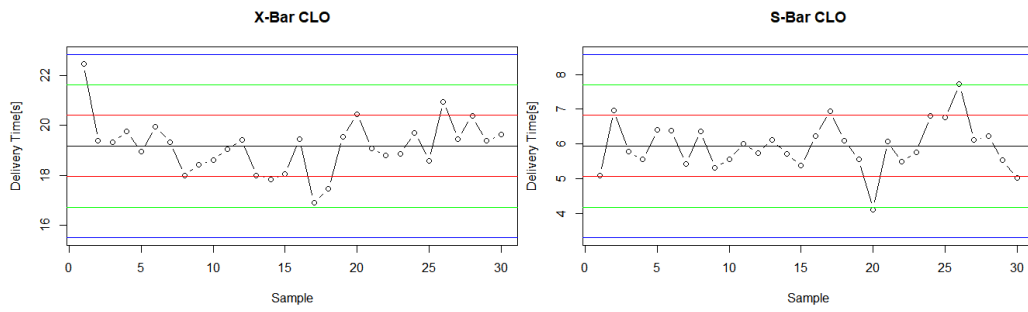


Figure 15: Cloud X and S Bar

### 3.1.4 Monitor

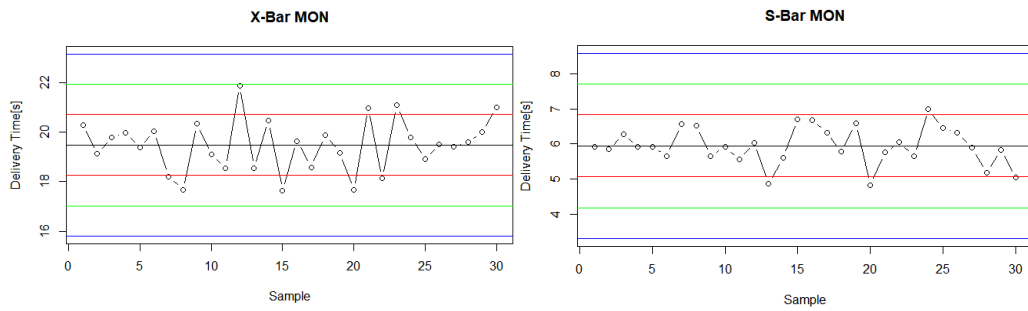


Figure 16: Monitor X and S Bar

### 3.1.5 Laptop

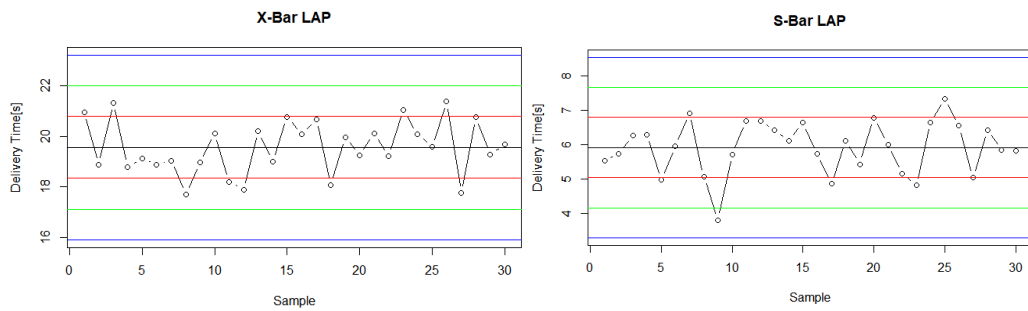


Figure 17: Laptop X and S Bar

### 3.1.6 Mouse

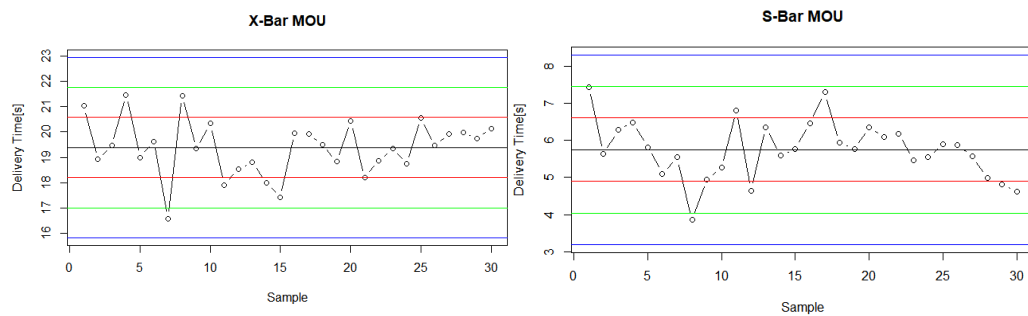


Figure 18: Mouse X and S Bar

## 3.2 Delivery Process Times

### 3.2.1 Keyboard

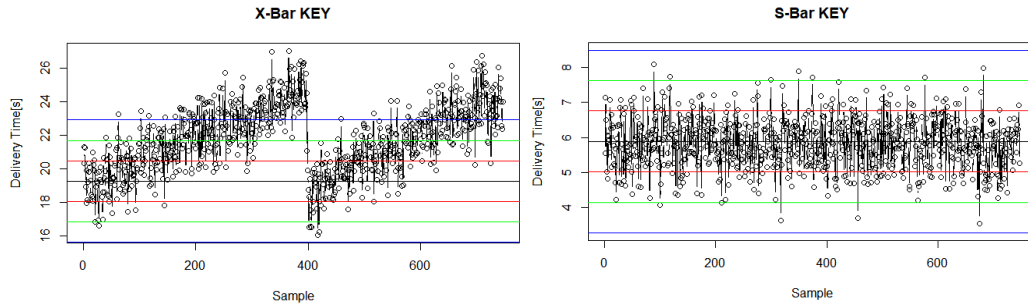


Figure 19: Keyboard Time X and S Bar

### 3.2.2 Mouse

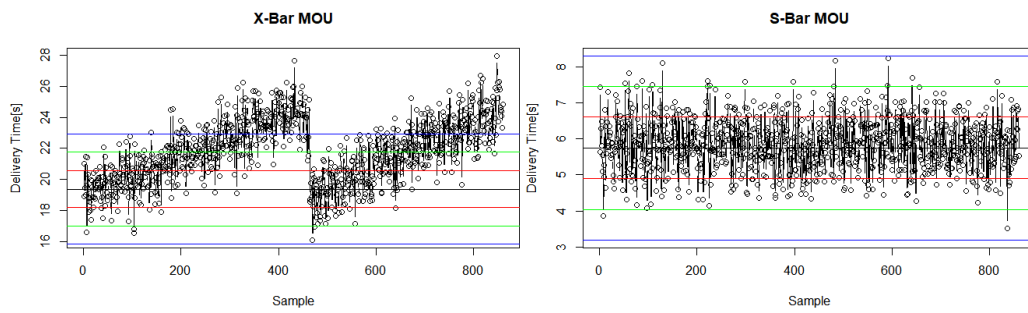


Figure 20: Mouse Time X and S Bar

### 3.2.3 Laptop

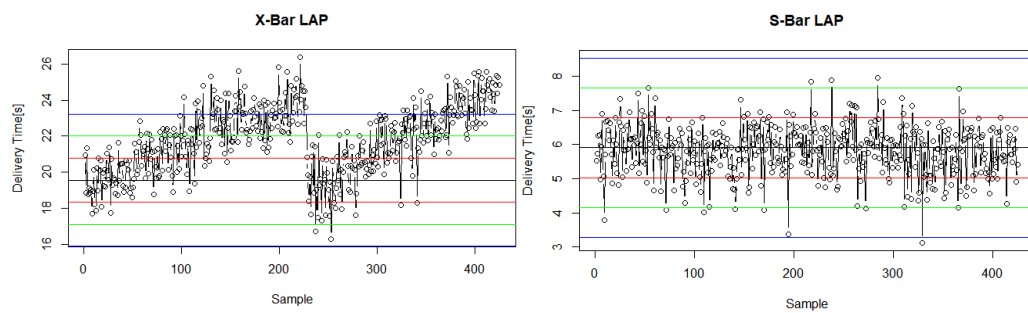


Figure 21: Laptop Time X and S Bar

### 3.2.4 Monitor

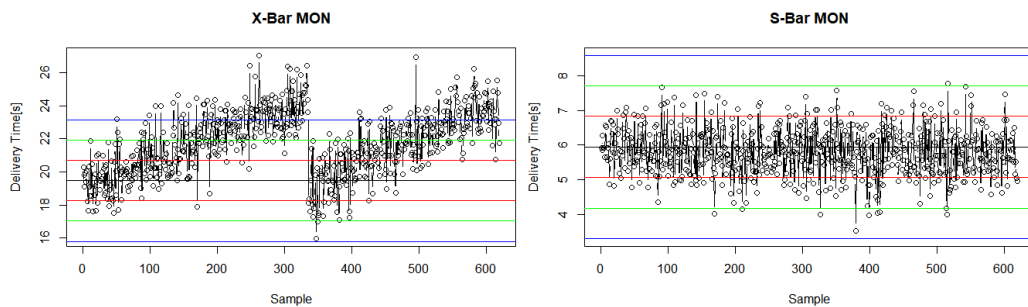


Figure 22: Monitor Time X and S Bar

### 3.2.5 Software

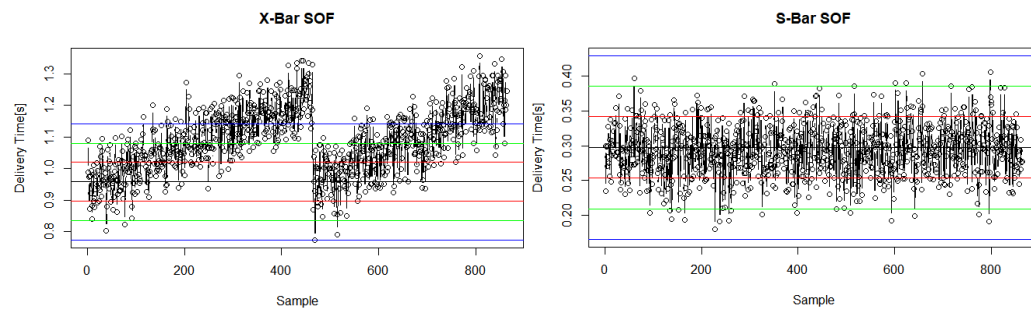


Figure 23: Software Time X and S Bar

### 3.2.6 Cloud

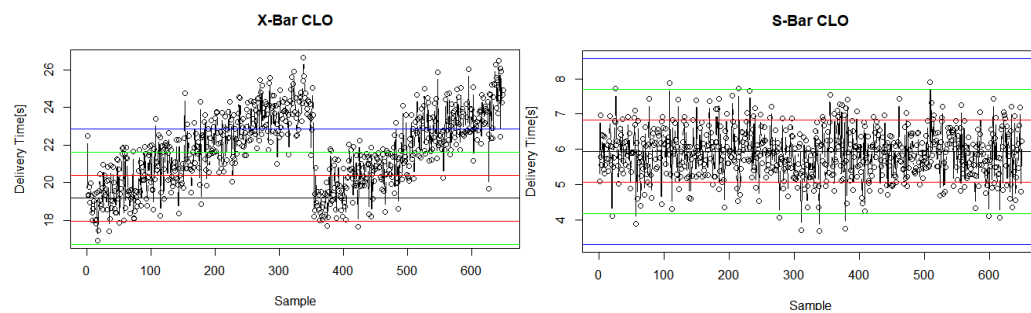


Figure 24: Cloud Time X and S Bar

It would be best if all the product managers adjust or check their process control at every 400 samples that gets sold. Except for the laptops process control which it is recommended to check it every 200 samples that gets sold.

### 3.2.7 Sample out of Specification

#### 3.2.7.1 Keyboard

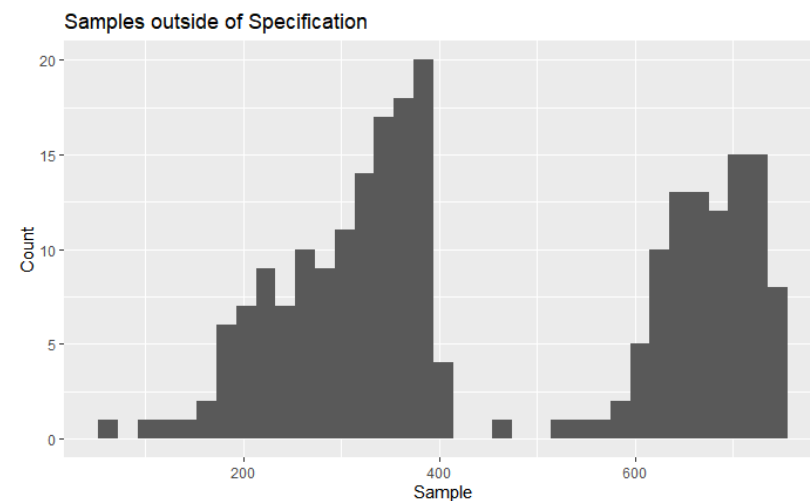


Figure 25: Keyboard Out of Spec

### 3.2.7.2 Mouse

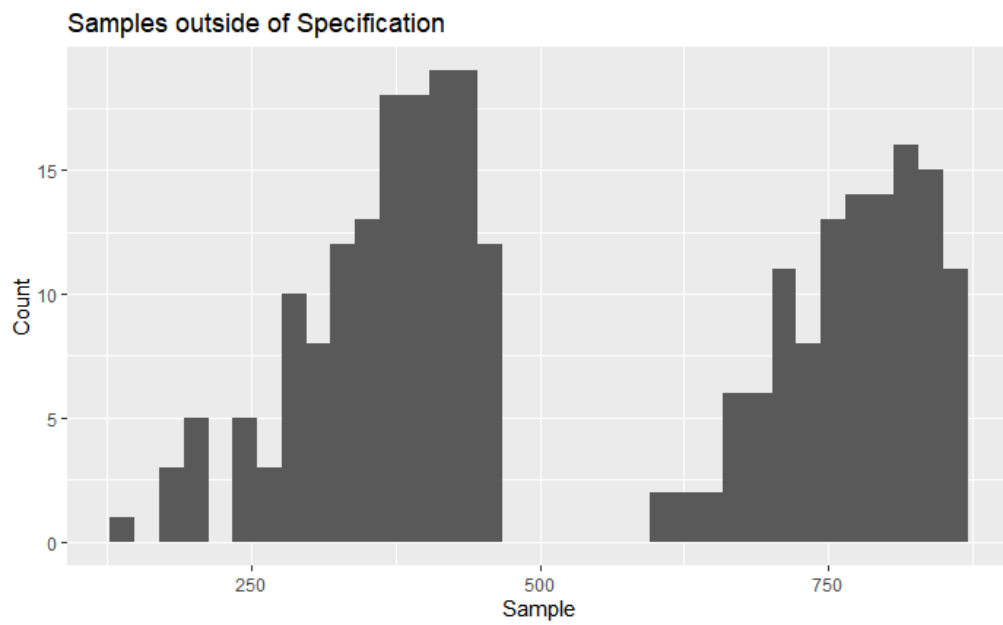


Figure 26: Mouse Out of Spec

### 3.2.7.3 Laptop

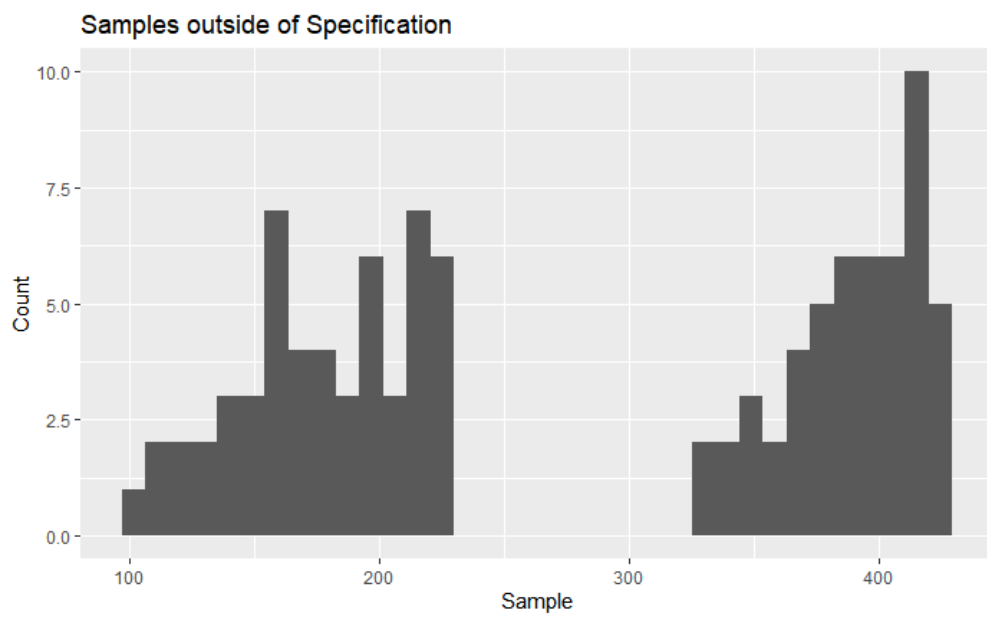


Figure 27: Laptop Out of Spec

### 3.2.7.4 Software

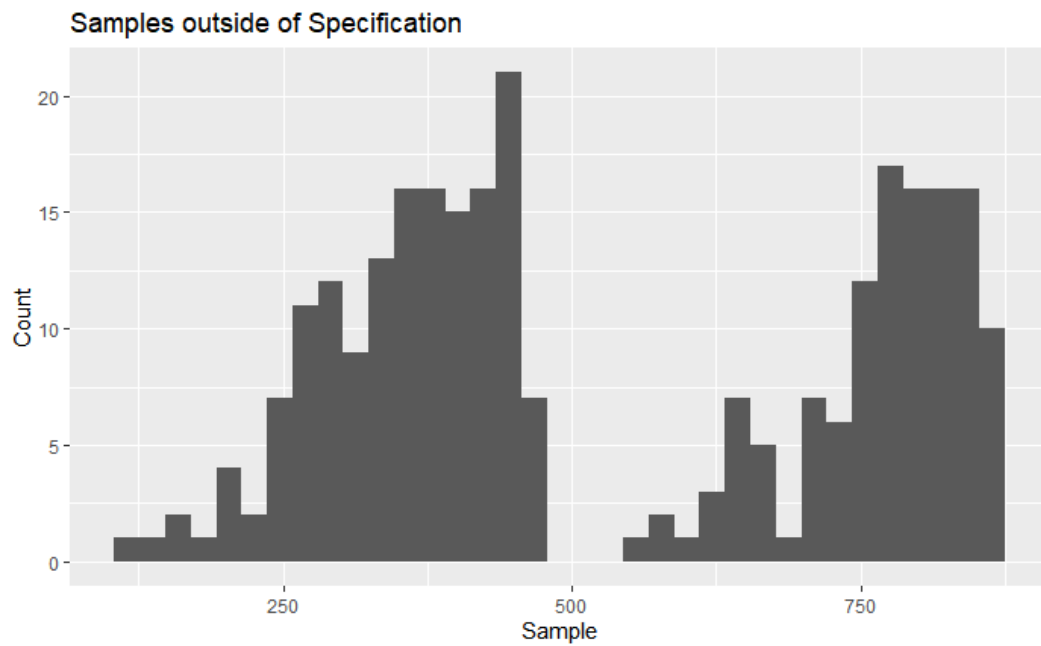


Figure 28: Software Out of Spec

### 3.2.7.5 Cloud

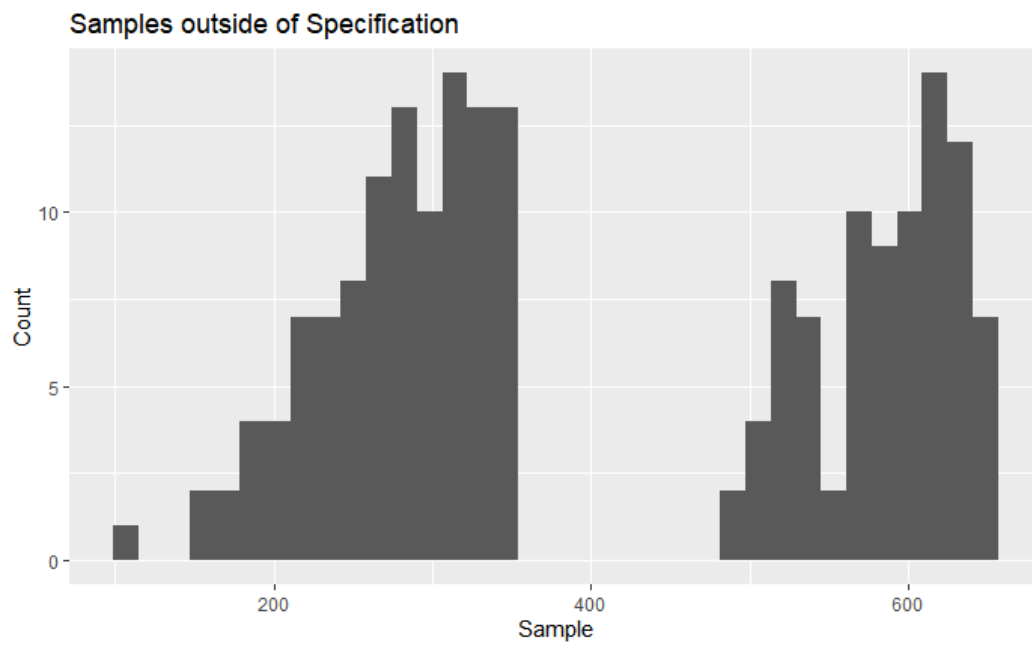


Figure 29: Cloud Out of Spec

### 3.2.7.6 Monitor

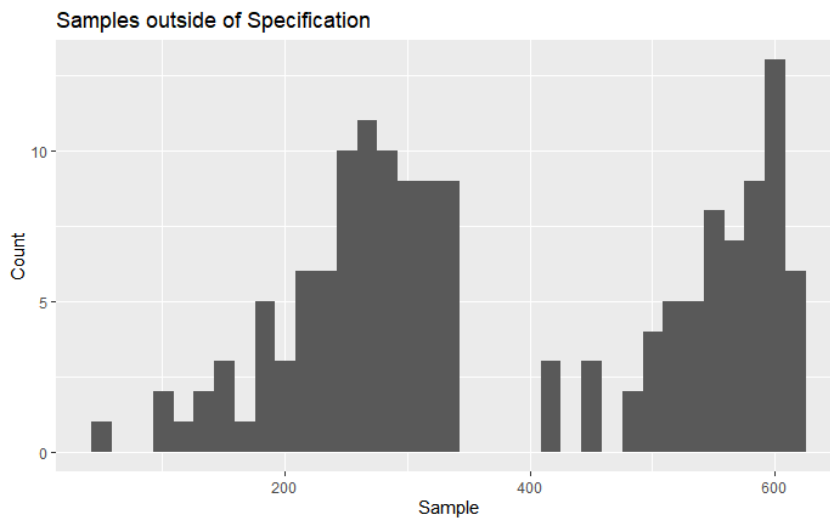


Figure 30: Monitor Out of Spec

## 3.3 Process Capability Indices

Table 1: Keyboard

Cp	Cpl	Cpu	Cpk
0.9171375	1.104921	0.7293536	0.7293536

Table 2: Mouse

Cp	Cpl	Cpu	Cpk
0.9151848	1.103799	0.726571	0.726571

Table 3: Laptop

Cp	Cpl	Cpu	Cpk
0.8987816	1.101345	0.6962187	0.6962187

Table 4: Software

Cp	Cpl	Cpu	Cpk
18.16573	1.084182	35.24728	1.084182

Table 5: Cloud

Cp	Cpl	Cpu	Cpk
0.8977458	1.078754	0.7167378	0.7167378

Table 6: Monitor

Cp	Cpl	Cpu	Cpk
0.889049	1.078528	0.6995705	0.6995705

From the tables above we can see that the all will meet the voice of the customer except for software which is very high and has a very wide spread.

## **3.4 Sample Observations**

### **3.4.1 Samples Outside of the Upper Control Limit**

From the data we can see that there are no instances where the standard deviation of a sample goes above the specified limit (UCL). The samples recorded is consistent with the first 30 samples. This indicates that the data has little variance meaning that the delivery times are consistent and short. This does not mean that the data does not have trends over time. This measurement does not conclude whether or not the data have trends over time.

## 4 Probability Calculations

### 4.1 Type I Errors

Type 1 error: **A** Probability: 0.0013498980316301

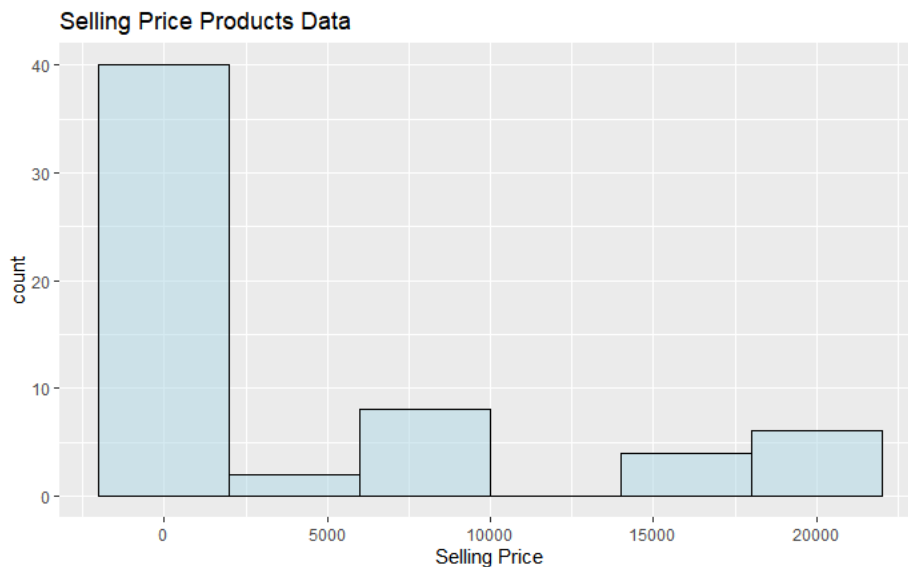
**B** Probability: 0.682689492137086

**C** Probability: 2.678771559804e-07

### 4.2 Type II Errors

Type 2 error probability: 0.841178284182247

### 4.3 Differences Product Data and Head-Office Data



**Figure 31: Selling Price Products Data**

The sum of 2023 sales: **KEY** = 5378598.87

**MOU** = 3773413.87

**LAP** = 86027413.33

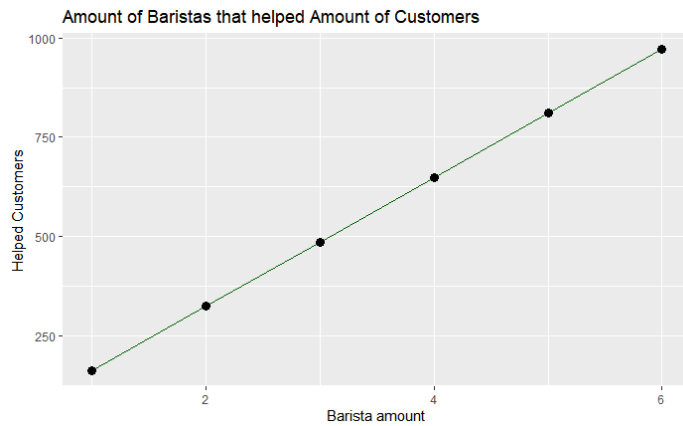
**MON** = 43126707.90

**CLO** = 7261887.10

**SOF** = 4867780.65

# 5 Optimisation of Profit

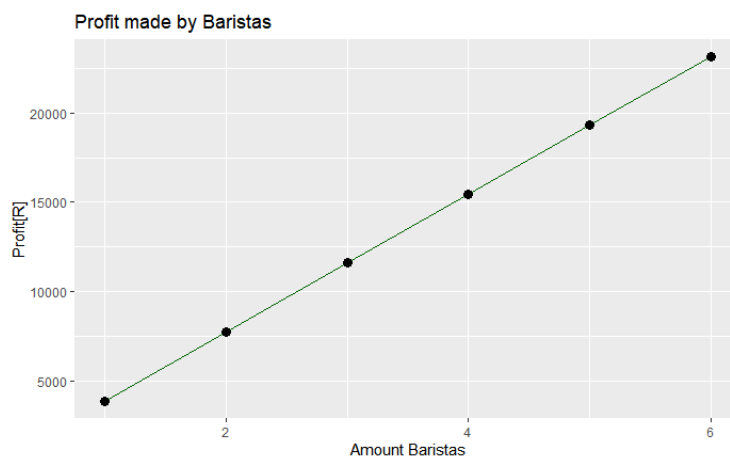
## 5.1 Time To Serve



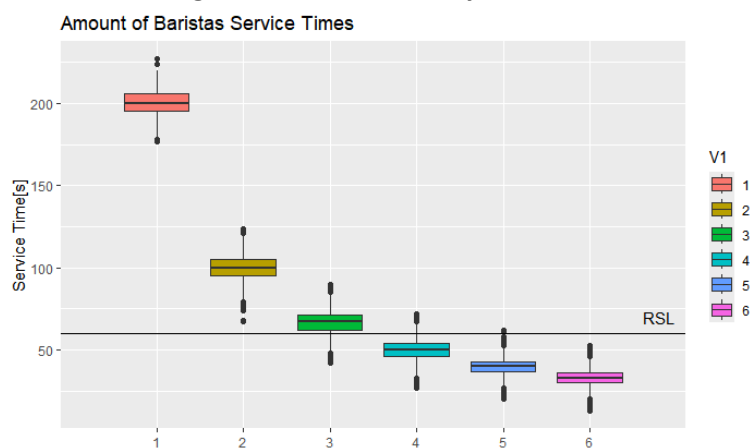
**Figure 32: Baristas that Helped number of customers**

Sum of profits:

3856.215[1], 7703.409[2], 11592.02[3], 15447.63[4], 19323.21[5], 23140.49[6]

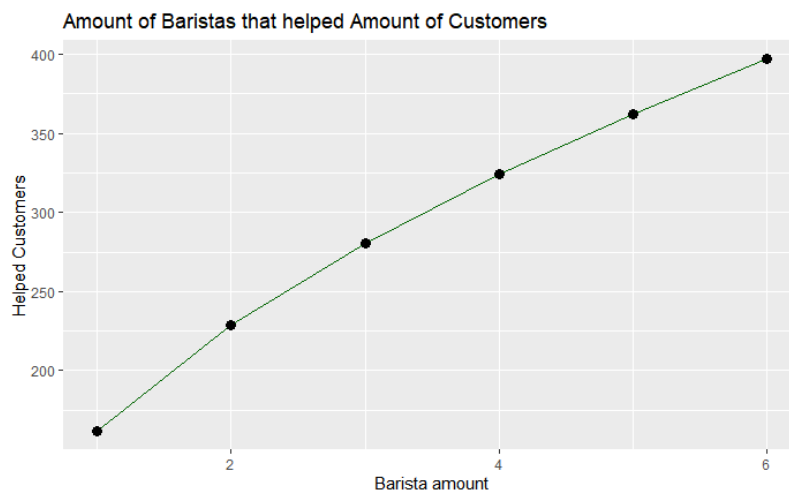


**Figure 34: Profit made by Baristas**



**Figure 33: Baristas Serving Times**

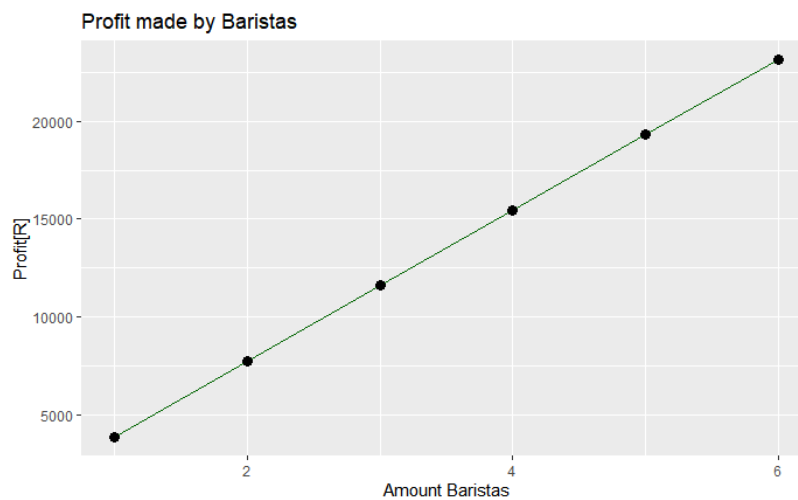
## 5.2 Time To Serve 2



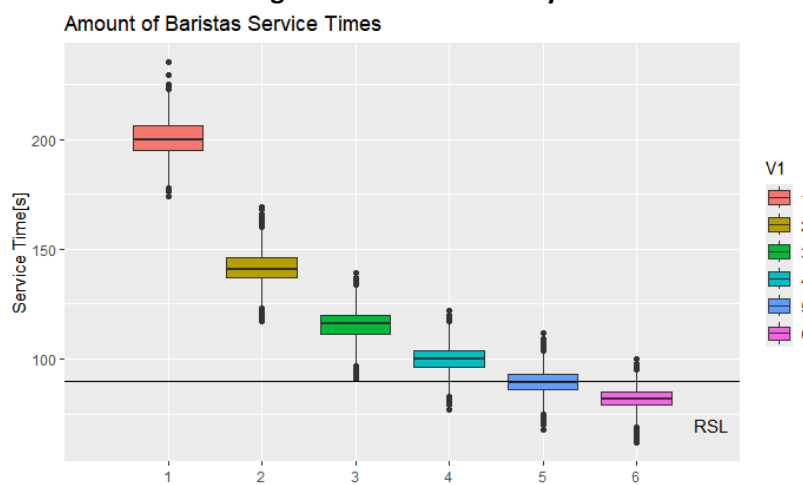
**Figure 35: Baristas that Helped number of Customers**

Sum of Profits:

3855.898[1], 4868.548[2], 5419.892[3], 5718.516[4], 5868.111[5], 5905.532[6]



**Figure 37: Profit Made by Baristas**



**Figure 36: Baristas Serving Times**

From the comparison between Time to Serving and Time to Serving2 we can clearly see an improvement with the profit made by the number clients served by the Baristas, this we see in the increase in servings. The profit made by Baristas did not particularly went up, but rather the amount of servings.

## 6 ANOVA

Table 7: Anova

		<i>Df</i>	<i>Sum Sq</i>	<i>Mean Sq</i>	<i>F - Value</i>	<i>Pr(&gt;F)</i>
<i>Keyboard</i>	<b>Order Year</b>	1	302	302.42	8.088	0.00446
	<b>Residuals</b>	17918	669951	37.39		
<i>Mouse</i>	<b>Order Year</b>	1	20	20.13	0.53	0.467
	<b>Residuals</b>	20660	784450	37.97		
<i>Laptop</i>	<b>Order Year</b>	1	19	18.92	0.513	0.474
	<b>Residuals</b>	10205	376427	36.89		
<i>Monitor</i>	<b>Order Year</b>	1	17	17.38	0.472	0.492
	<b>Residuals</b>	14862	547395	36.83		
<i>Software</i>	<b>Order Year</b>	1	0	0.01695	0.179	0.672
	<b>Residuals</b>	20747	1966	0.09475		
<i>Cloud</i>	<b>Order Year</b>	1	2	1.85	0.049	0.825
	<b>Residuals</b>	15596	588231	37.72		

## 7 Reliability of service

### 7.1 Reliable Service Days Left

#### 7.1.1 Time To Serve

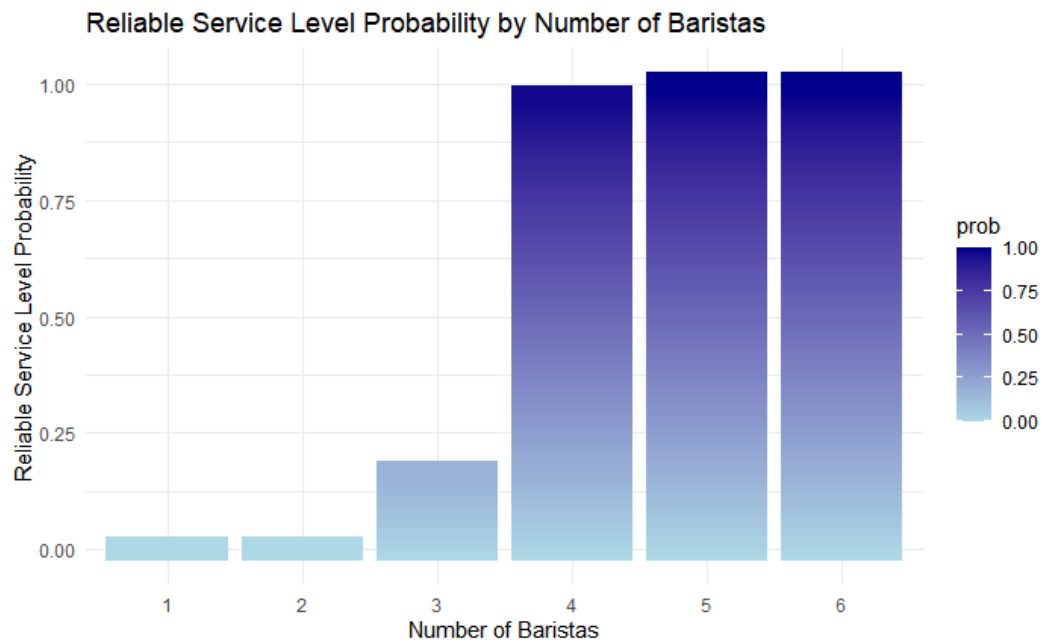


Figure 38: Reliable Service Level 1

#### 7.1.2 Time To Serve 2

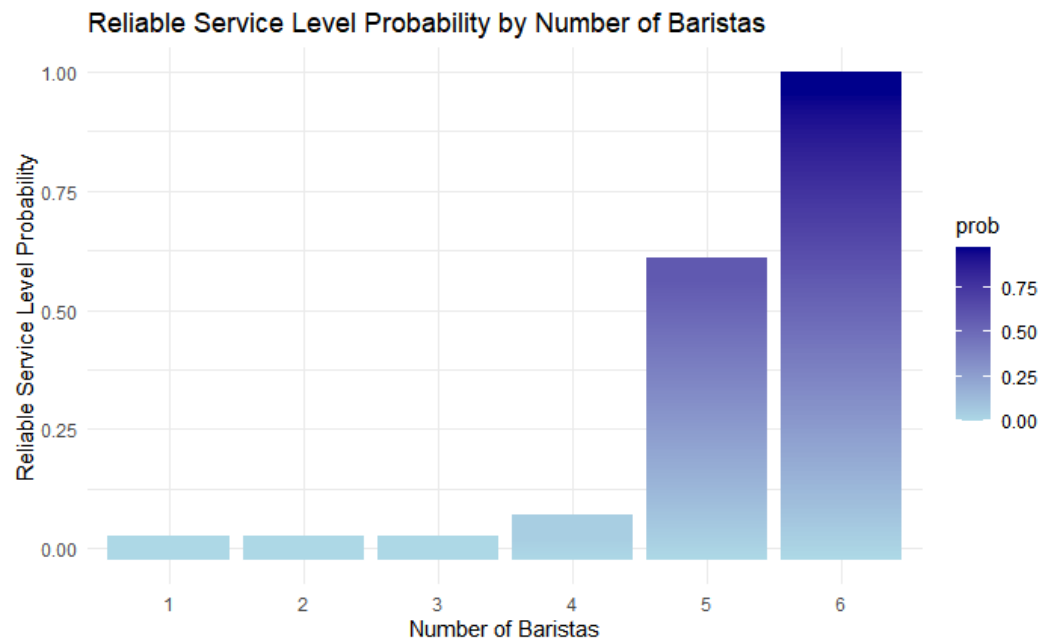
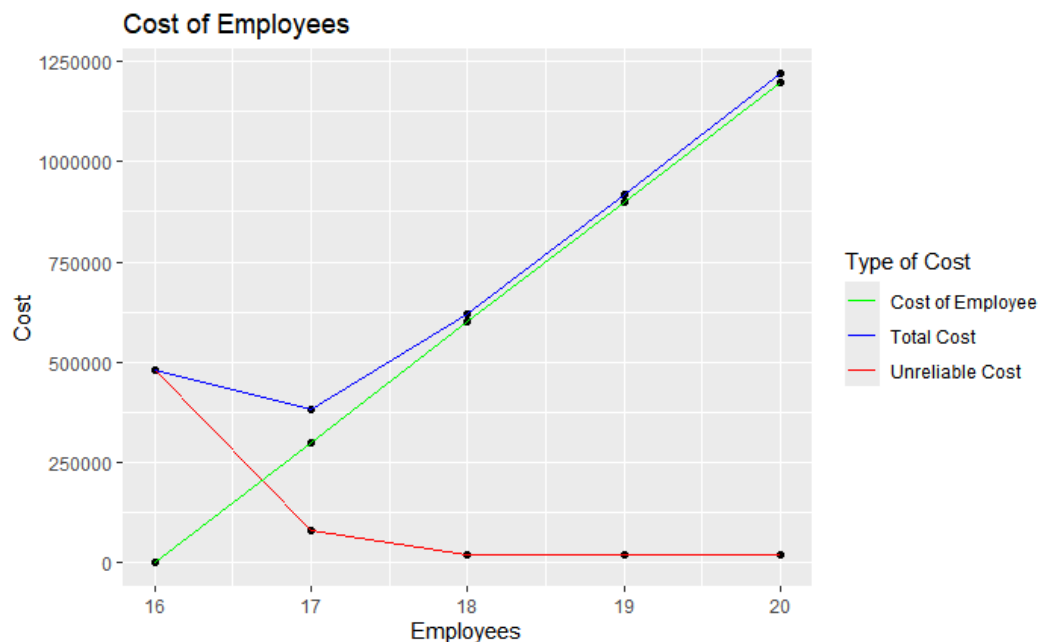


Figure 39: Reliable Service Level 2

In graph 1 (TimeToServe) we see that it shows us that there is more efficient staffing scenario. The graph indicates that reliability is reached to a 100% within 4 baristas. Whereas in graph 2 (TimeToServe2) it indicates that a less efficient or more demanding service strategy is followed. Which requires at least 6 baristas to meet the same reliability level as the first graph. This all is due to the increase in the servings and customer demand.

## 7.2 Optimisation of Company to Improve Profit



**Figure 40: Cost of Employees**

In the visualisation above we can conclude that the graph shows us the trade-off between Employee Cost and Reliability. In other words, increasing the employees will reduce the total cost by improving the reliability of the services. But after 18 employees there is no point in increasing the number of employees or hiring additional employees since it will have no effect on improving the reliability. From this we can finally conclude that the most cost-effective employee numbers will lie between 17 to 18 employees, whilst still maintaining a high reliability of serves.

## 8 References

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