Mechanical Versus Digital Lock Survey

Group - F

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INTRODUCTION

- In this study, we wanted to know the type of locks users mostly use, their use pattern, satisfaction with current type of locks they are using, inclination towards digital locks etc.
- Electronic locks have many advantages over traditional locks like convenient, more secured, maintenance free
- Their use is restricted mostly due to high cost, unawareness about the current technologies, power outage concerns etc.
- However, with the advent of IOT technology and digitization, smart electronic locks are finding their way from commercial complexes and hotels to the household doors.

OBJECTIVES

- Are the consumers ready for this massive shift from traditional mechanical locks to electronic locks?
- How much are they ready to pay for this change?
- Will the new system prove to be more safe & secured?
- What functionality would the consumers expect & value in a smart digital door locks?
- What technology would they prefer to use to unlock their front doors? Card or Fob, or PIN code or Smartphone or something else?
- What will be the potential treats with this change that needs to be taken care of?

METHODOLOGY

- Determined factors that influence use of different types of locks
- Formed a survey questionnaire
- Circulated the questionnaire amongst target population
- Encouraged people to take the survey (Reduce non-responsiveness by designing the questionnaire carefully)

- Recorded data from filled responses
- Data cleaning was done due to repeated or missing data
- Visualized data collected using some graphs & charts

- Analyzed the data using descriptive statistics tools & techniques
- Estimated & formed the hypothesis with required confidence interval

- Drew inferences based on results from hypothesis testing

SURVEY

205 people were surveyed and recorded data is as follows:

	A	B	C	D	E	F	G	H	I	
1	Timestamp	Name	Profession	E mail Id	Do you want this survey result ?	What kind of door lock do you use ?	How many times had you lost/forgot the key in 2018 ?	What is the cost of your door lock? (in Rs)	Have you ever used digital lock? (In office, malls, institutions, metros, etc)	We pay
2	8/28/2018 10:27:49	Inderjeet Singh	Student	isidhu302@gmail.com	Yes	Mechanical Locks (Metal key locks)	1 to 3 times	20 - 100	Yes	
3	8/30/2018 12:04:41	VINAY CHOURASIYA	Student	mail.vinaychourasiya@gmail.com	Yes	Mechanical Locks (Metal key locks)	1 to 3 times	20 - 100	Yes	
4	8/30/2018 12:10:51	Ashutosh Kushwaha	Student		Yes	Mechanical Locks (Metal key locks)	None	20 - 100	Yes	
5	8/30/2018 12:12:37	NMT	Student		No	Mechanical Locks (Metal key locks)	None	20 - 100	Yes	
6	8/30/2018 12:15:11	KUMAR BAJIYA RAKESH	Student	rakeshbajiya1310@gmail.com	Yes	Mechanical Locks (Metal key locks)	More than 3 times	20 - 100	Yes	
7	8/30/2018 12:20:31	Vishwas Patil	Student	vish.globle2787@gmail.com	Yes	Digital/electronic locks (eg. fingerprint, Card, Bluetooth, Wifi)				
8	8/30/2018 12:22:07	PRITISH SANJAYRAO PAWAR	Student	PRITISHPAWAR1445@GMAIL.COM	Yes	Mechanical Locks (Metal key locks)	1 to 3 times	20 - 100	No	500
9	8/30/2018 12:27:29	Santosh	Student	Kuresanthosh@gmail.com	Yes	Mechanical Locks (Metal key locks)	1 to 3 times	More than 500	No	1000
10	8/30/2018 12:27:38	Ashok vaid	Student	ashokvaid0052@gmail.com	Yes	Digital/electronic locks (eg. fingerprint, Card, Bluetooth, Wifi)				
11	8/30/2018 12:30:30	Mohan dhone	Student	mohandhone77@gmail.com	Yes	Mechanical Locks (Metal key locks)	1 to 3 times	20 - 100	No	Not
12	8/30/2018 12:31:57	SUMIT D DESHMUKH	Student	deshmukh2139@gmail.com	Yes	Mechanical Locks (Metal key locks)	1 to 3 times	20 - 100	No	Not
13	8/30/2018 12:32:42	Nilesh Mohite	Student	nkmohite358 @gmail.com	Yes	Digital/electronic locks (eg. fingerprint, Card, Bluetooth, Wifi)				
14	8/30/2018 12:32:48	Madhav	Student	guntemadhav82@gmail.com	Yes	Digital/electronic locks (eg. fingerprint, Card, Bluetooth, Wifi)				
15	8/30/2018 12:33:55	Amit tekam	Student	amit.tekam498@gmail.com	Yes	Mechanical Locks (Metal key locks)	1 to 3 times	20 - 100	No	500
16	8/30/2018 12:40:33	Jaideep Singh	Student	mailmeatid@gmail.com	Yes	Mechanical Locks (Metal key locks)	1 to 3 times	20 - 100	Yes	

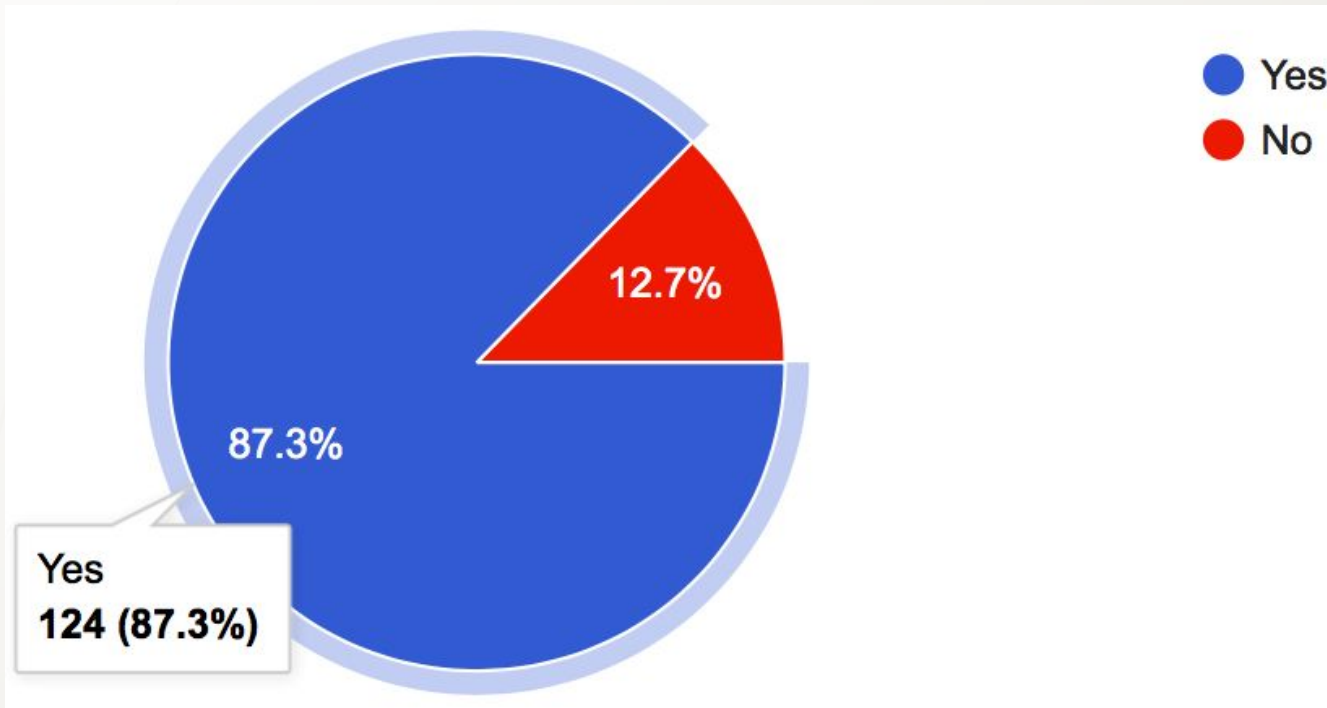Form responses 1

SURVEY (QUESTIONNAIRE)

What is the profession of the respondent?
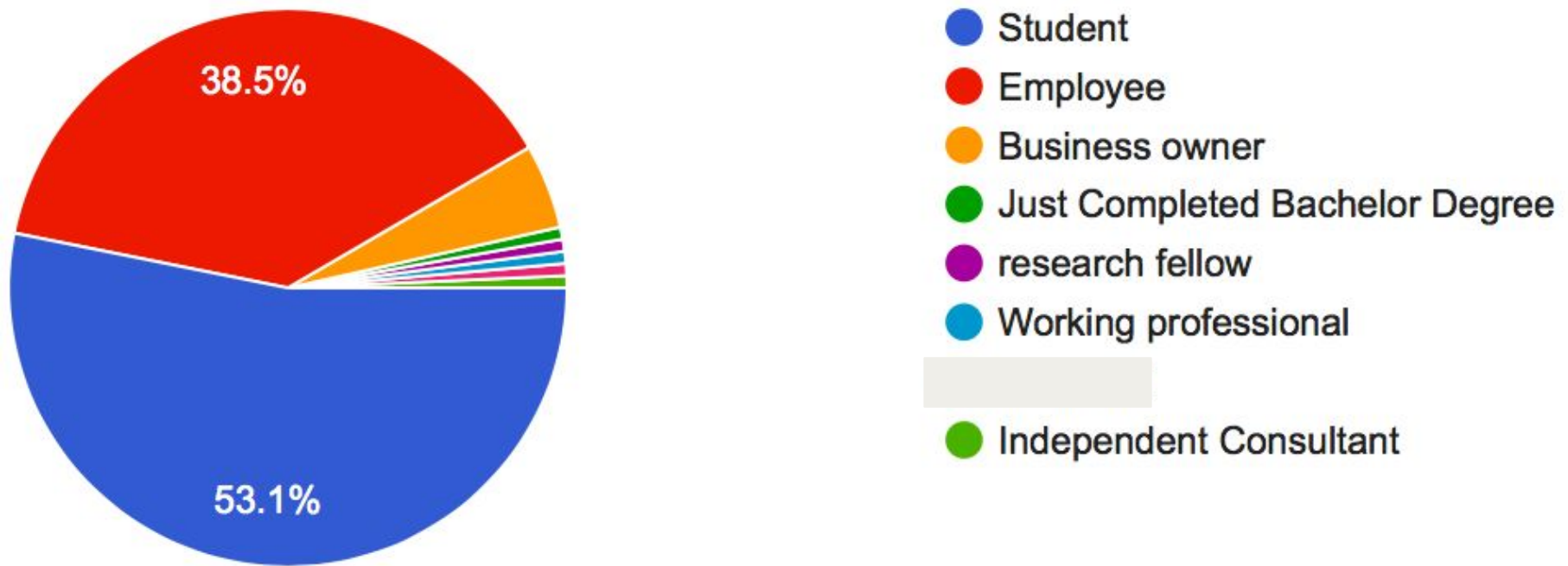
Since profession can decide what type of lock is used by the person.
Most of the respondents were students in this survey as can be seen.
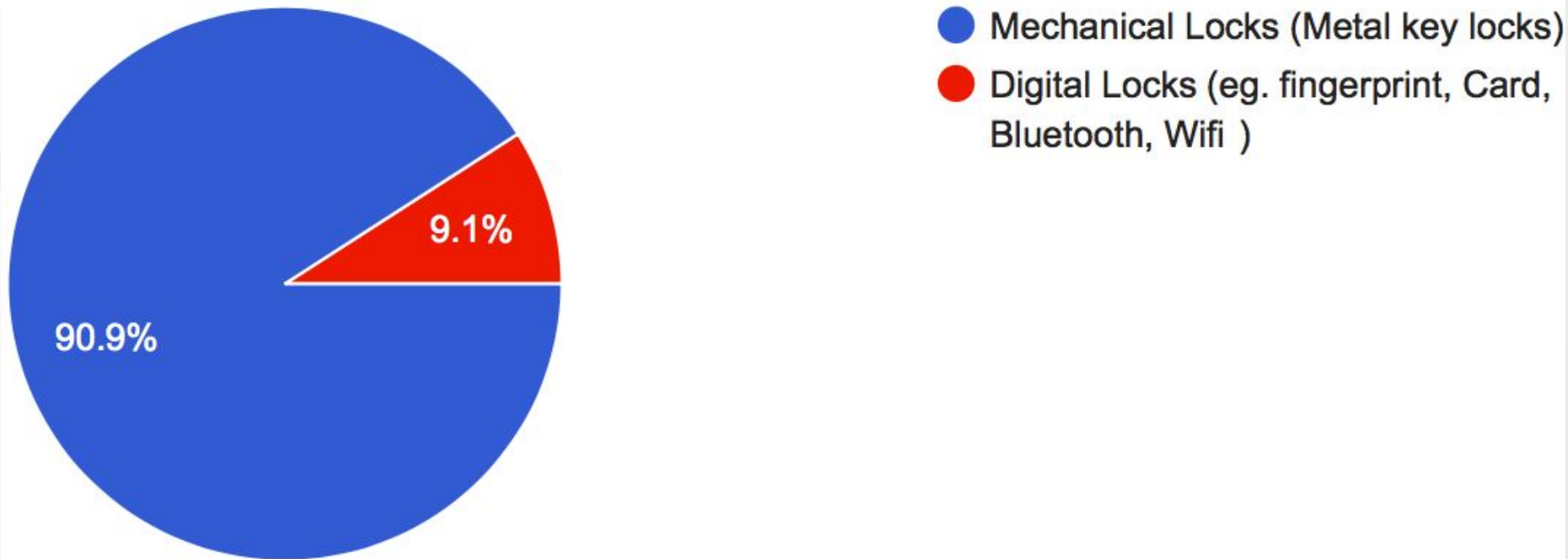
SURVEY (QUESTIONNAIRE)

Do you want this survey result ?

This showed the interest of the respondent towards filling the survey. Most of the respondents were interested in the survey.
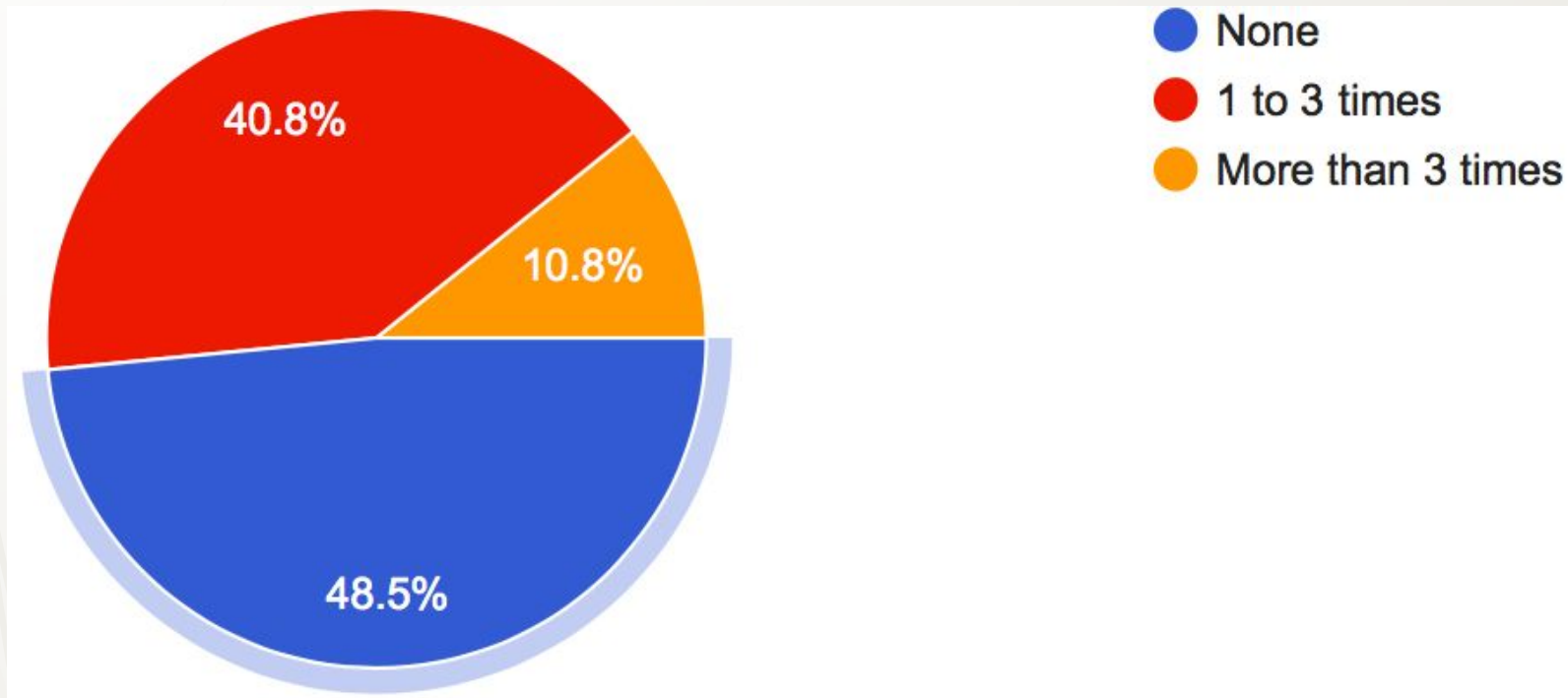
SURVEY (QUESTIONNAIRE)

What kind of door lock do you use?

● Mechanical Locks (Metal key locks)
● Digital Locks (eg. fingerprint, Card, Bluetooth, Wifi)

9.1%

90.9%

Most of the respondents (almost 90%)use mechanical lock for locking their doors.
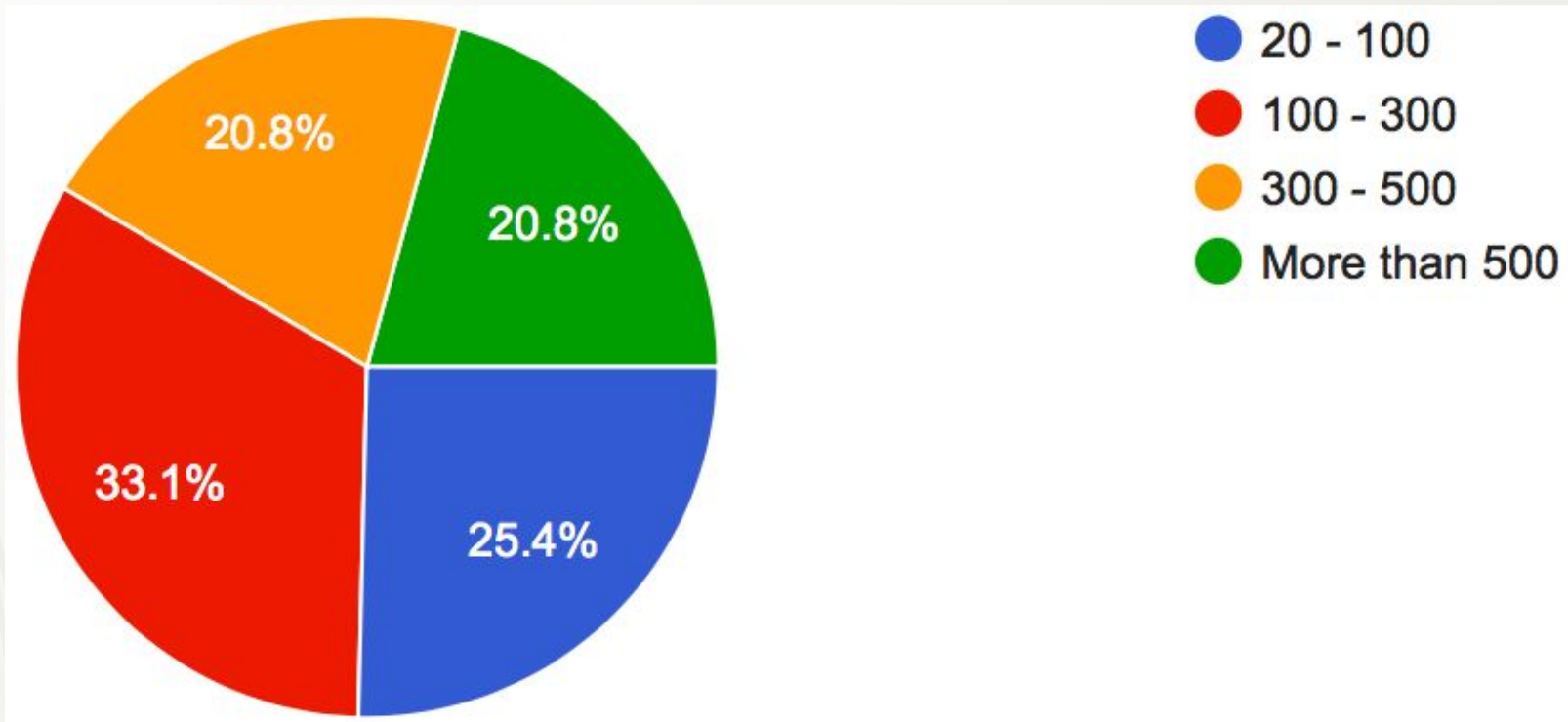
SURVEY (QUESTIONNAIRE)

How many times had you lost/forgot the key in 2018?

Almost 50% of the respondents did not lost their keys and 10% lost their keys more that 3 times.
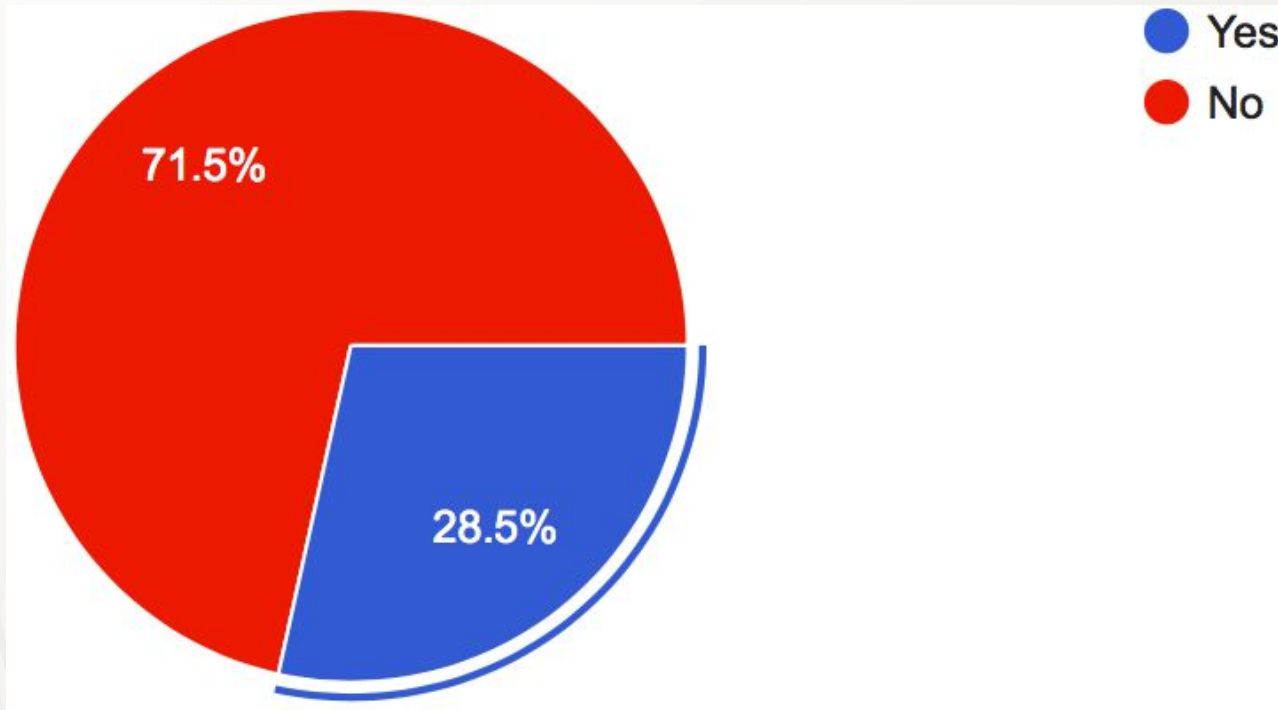
SURVEY (QUESTIONNAIRE)

What is the cost of your door lock?

The respondents bought locks nearly uniformly over the price range.
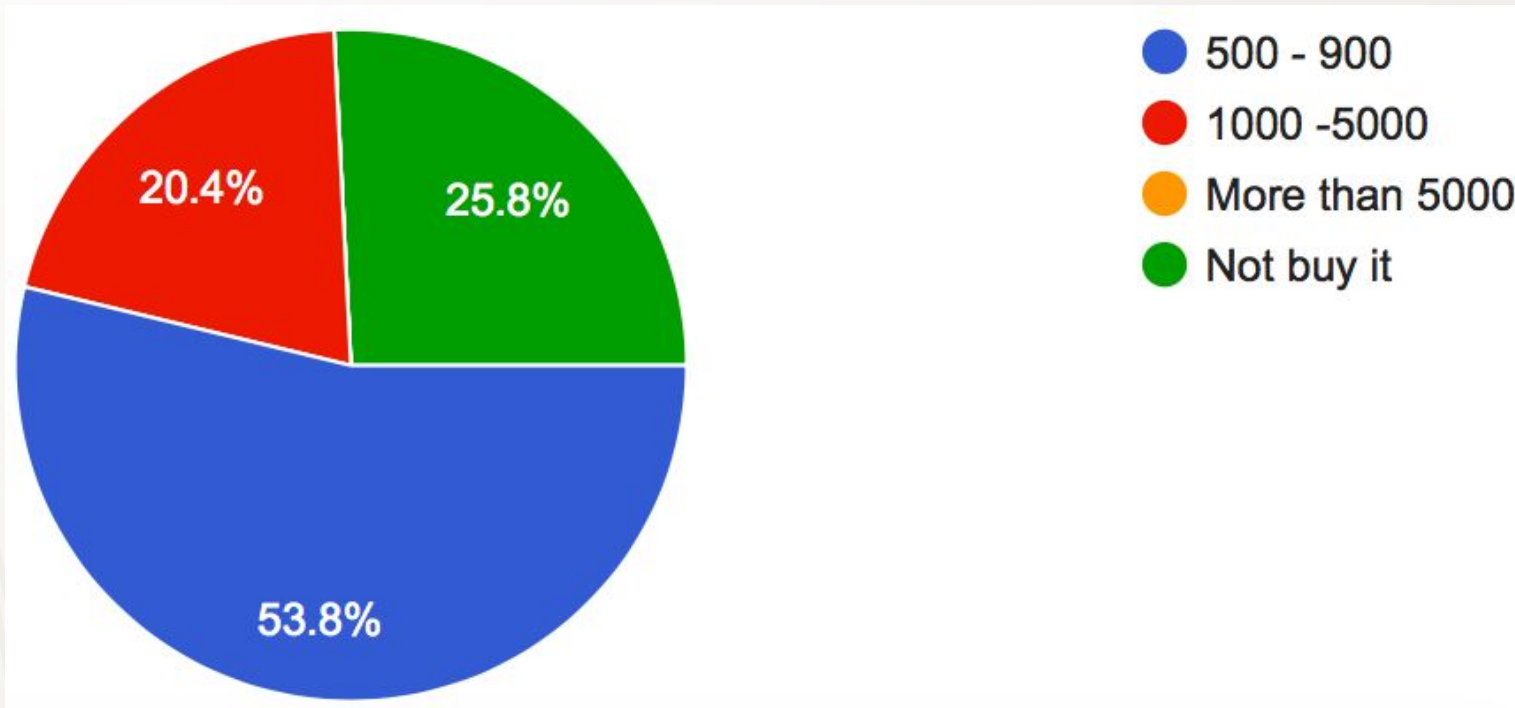
SURVEY (QUESTIONNAIRE)

Have you ever used digital lock?

Less number of people 30% have used an electronic lock.
Which might be the cost or unreliability towards digital lock.
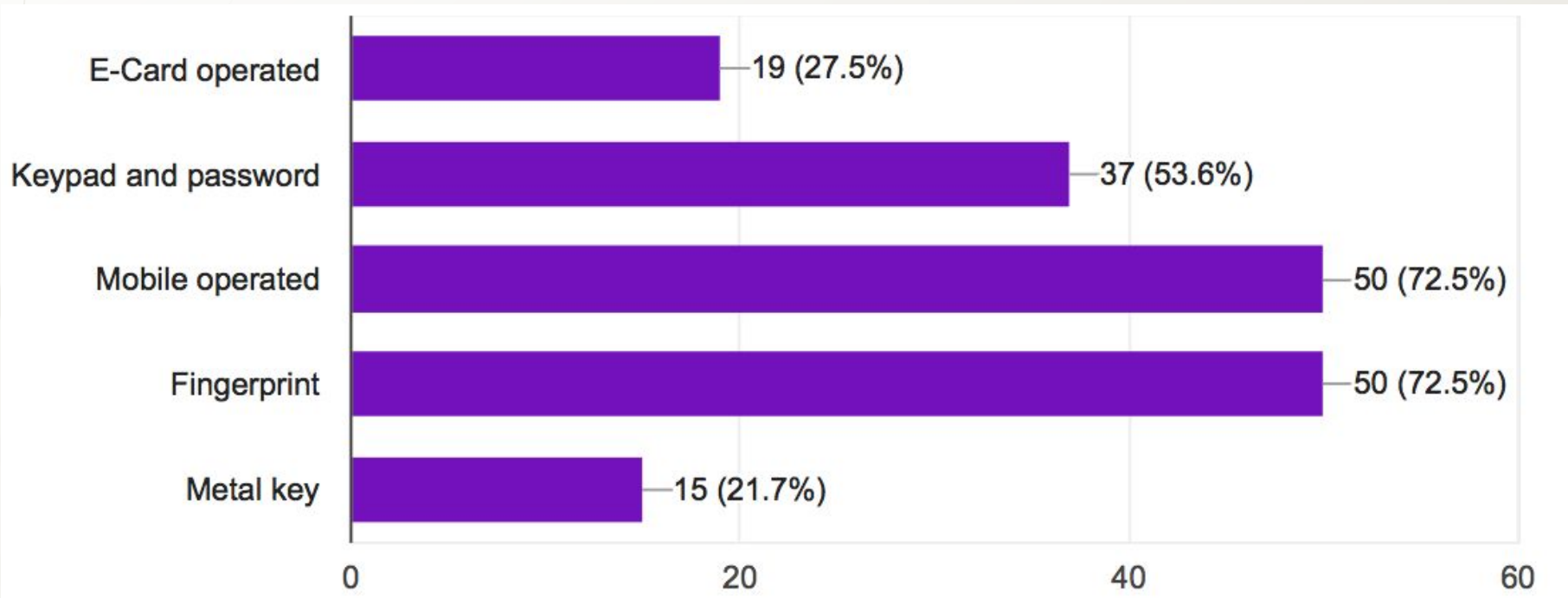
SURVEY (QUESTIONNAIRE)

We will give you smartphone based locks, how much will you pay?

Legend:
- 500 - 900
- 1000 -5000
- More than 5000
- Not buy it

Pie chart values: 20.4%, 25.8%, 53.8%

Most of the people wanted to get the electronic lock within Rs 900.
No one wanted to buy it if the cost was above Rs 5000. And 25% of the people did not wanted to get the smartphone based lock.
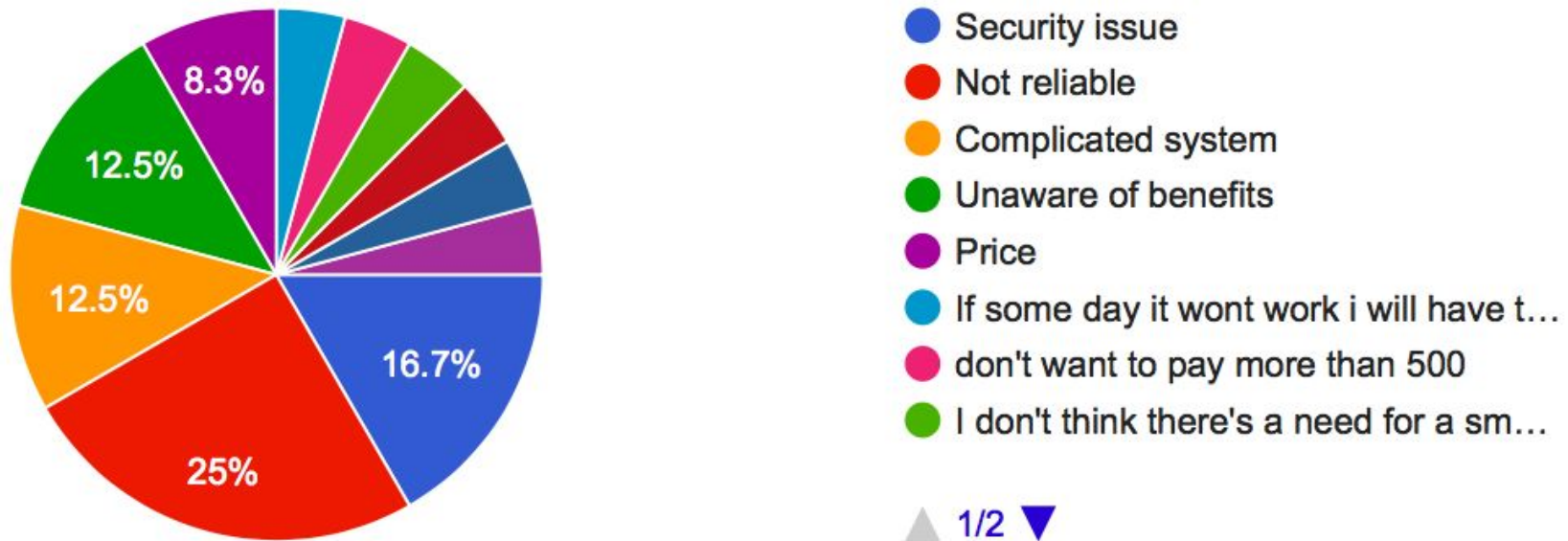
SURVEY (QUESTIONNAIRE)

What features do you want in it?

Most of the people wanted mobile operated or fingerprint operated door locks as these are the things which people have access all the time. And these are good measures of security.
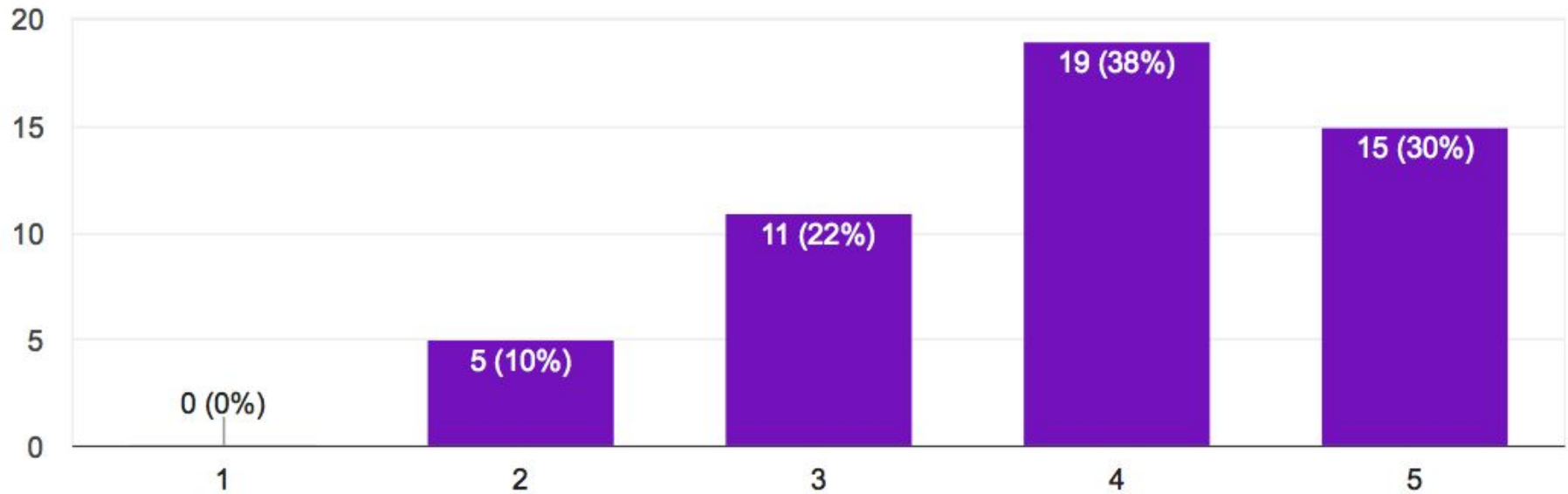
SURVEY (QUESTIONNAIRE)

If they do not want electric lock then why not?

Respondents gave a varied number of reasons for their reluctance towards electric lock.

SURVEY (QUESTIONNAIRE)

How do you rate the digital lock?

Depending upon customer satisfaction and reliability customer rated the digital locks. Most of them were quite satisfied with the digital lock.

ANALYSIS

- Statistical techniques such as hypothesis testing methods such as two sample t-test, ANOVA, Regression, Covariance analysis, Correlation coefficient calculation.

1. LOCK COST VS NUMBER OF TIMES KEY LOST:

    Single Factor One Way ANOVA Analysis is used to analysis the relationship between the lock cost and number of times key lost because there was only one factor which had four levels.

Method:
Null hypothesis: All means are equal
Alternative hypothesis : Not all means are equal
Significance level: = 0.05
Equal variances were assumed for the analysis.
Factor Information
Factor: What is the cost of your door
Levels: 4
Values: 100 - 300, 20 - 100, 300 - 500, More than 500

ANALYSIS

One-way ANOVA: How many times had you lost/for versus What is the cost of your door l

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Analysis of Variance
Source                            DF   Adj SS   Adj MS   F-Value   P-Value
What is the cost of your door l    3    10.31    3.437      1.55     0.202
Error                            178   393.56    2.211
Total                            181   403.87
```

- The above result that there is no significant effect of cost of locks on the loss of keys. Since this can also be understood intuitively that in our daily life we are mostly concerned about the inconvenience caused due to lost key rather than the loss of lock

- The result of difference in variance we can also conclude that there in no significant difference between the variances of all three levels of cost

- The level of cost considered was not too high (Range was relatively low) in our case, which can also be the reasons of current results

ANALYSIS

One-way ANOVA: How many times had you lost/for versus What is the cost of your door I

Grouping Information Using the Tukey Method and 95% Confidence

What is the cost of your door l	N	Mean	Grouping
More than 500	30	1.700	A
100 - 300	60	1.417	A
20 - 100	64	1.250	A
300 - 500	28	0.893	A

Means that do not share a letter are significantly different.

Figure 3.4: Tukey's Method

We can see that all the levels were grouped in a single group A. So there is no significant difference between them.

ANALYSIS
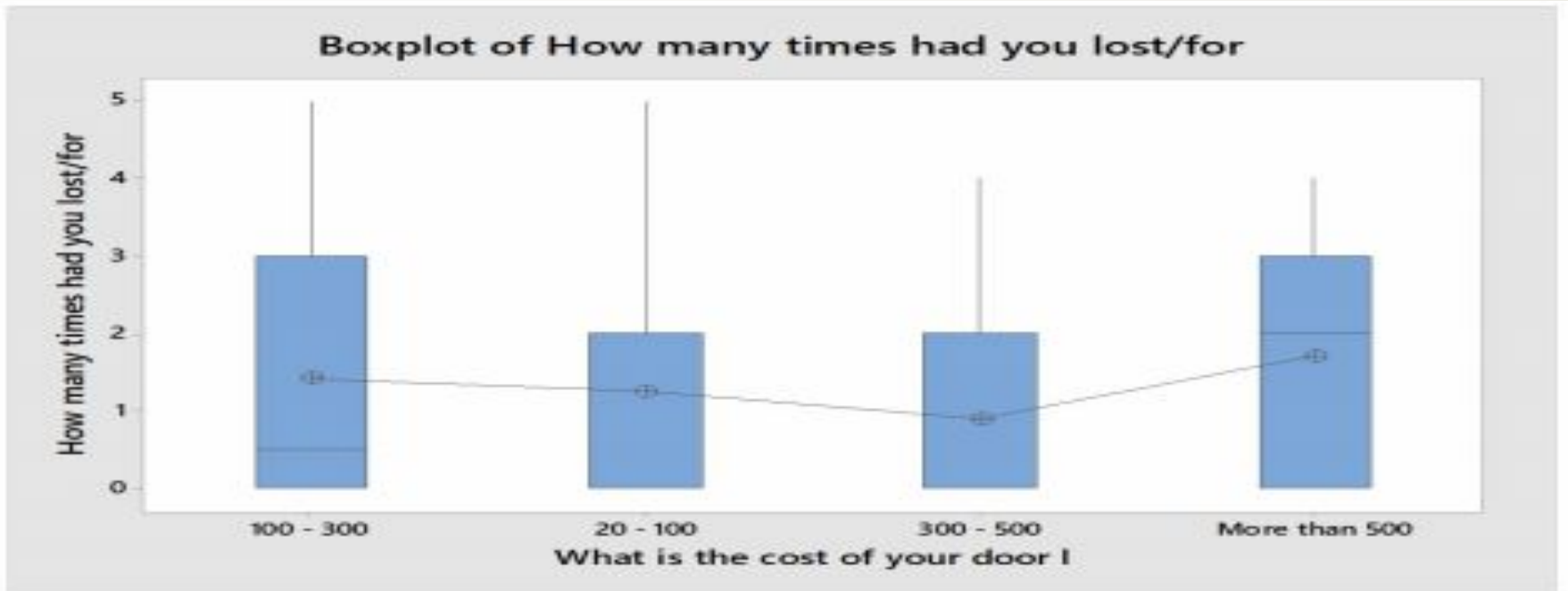
Boxplot of How many times had you lost/for

Figure 3.6: Residual Analysis

We can see that rate of loss of key was minimum for the user having a lock of cost 300-500, while it was observed highest for the most expensive loss category.
This observation seems counter-intuitive but there may be following reasons as,
- the users really don't care about the cost of lock,
- the sample is not truly representative
- the characteristics of the keys of expensive locks,
- may be the expensive locks were used by very busy professionals who were very careless about its handling
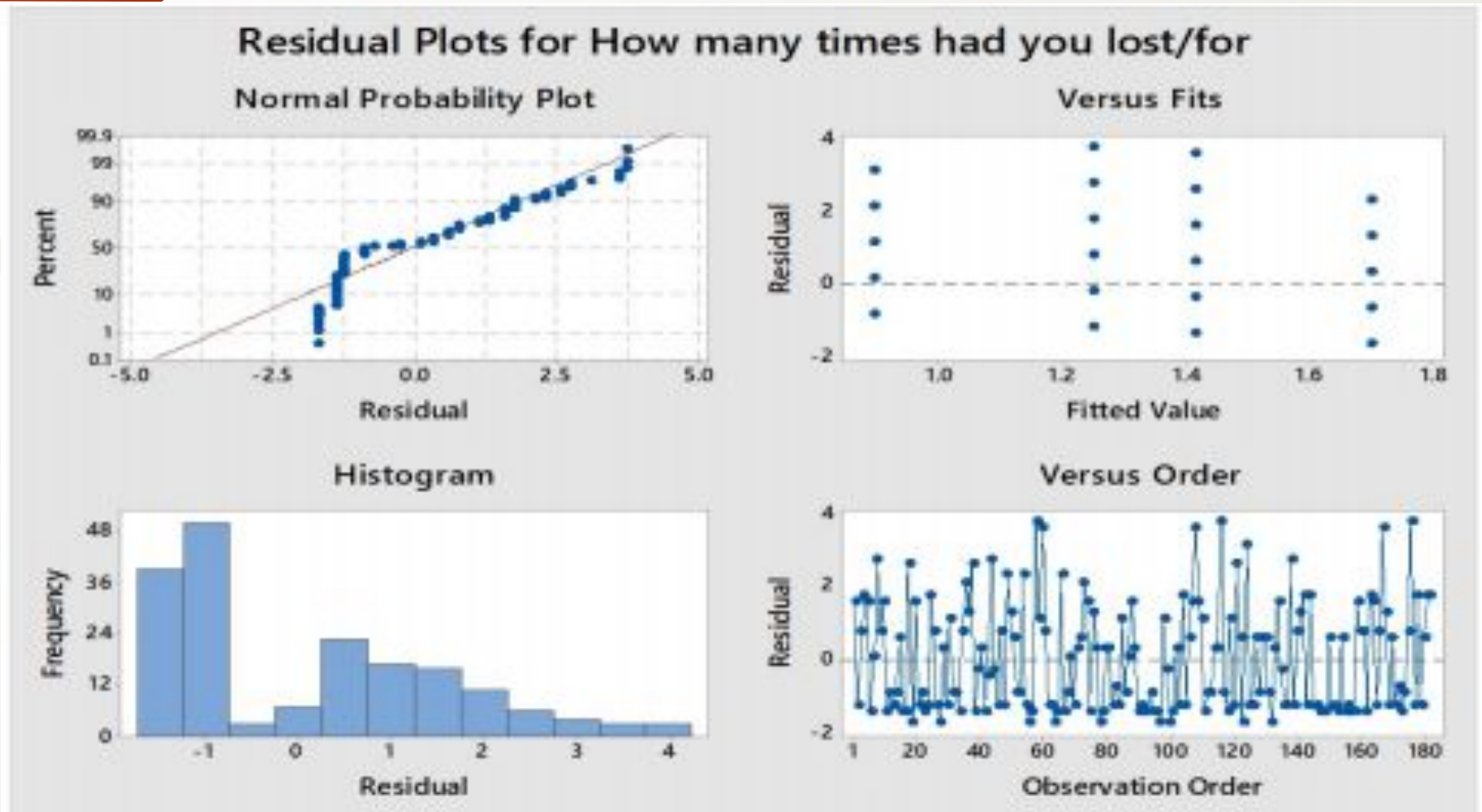
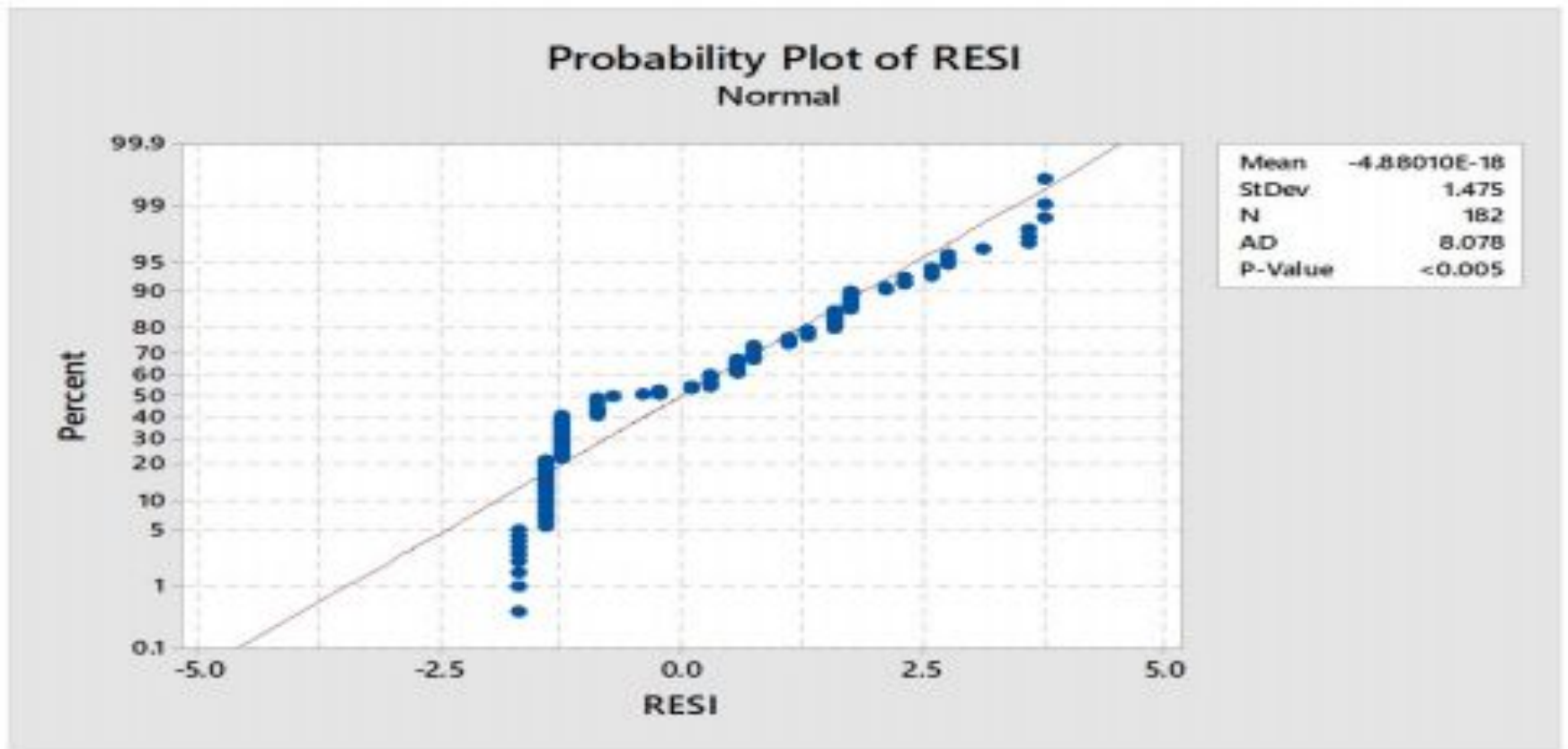# ANALYSIS

Figure 3.7: Residual Analysis

ANALYSIS

Figure 3.8: Probability Plot for Residuals

We can observe that the p-value was less then our significant level, Which means that there is a strong evidence to reject the null hypothesis of normality of residuals, which means that residuals are not normal.

ANALYSIS

2. NUMBER OF TIMES KEYS LOST/FORGOT:

The two sample t-test was did for the samples of number of times key lost. in 2018
The two samples were from mechanical lock where the user lost his keys and in electronic lock the user forgot his password.

Method:
Null hypothesis: All means are equal
Alternative hypothesis : Not all means are equal
Significance level: = 0.05
Equal variances were assumed for the analysis.

Factor Information
Factor: What is the cost of your door
Levels: 4
Values: 100 - 300, 20 - 100, 300 - 500, More than 500

ANALYSIS

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Method
μ₁: mean of digi
μ₂: mean of mech
Difference: μ₁ - μ₂
Equal variances are not assumed for this analysis.


Descriptive Statistics
Sample        N     Mean    StDev    SE Mean
digi         21    0.524    0.873       0.19
mech        183    1.36     1.49        0.11


Estimation for Difference
                   95% CI for
Difference         Difference
   -0.837     (-1.283, -0.390)
```

Figure 3.9: Two sample t-test

Our null hypothesis was that the sample mean of the two samples are equal.

ANALYSIS

Test
Null hypothesis $H_0: \mu_1 - \mu_2 = 0$
Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-3.81	35	0.001

Figure 3.10: Two sample t-test

We can observe that p-value was 0.001, which is less then the significance level, which means we have strong evidence to reject the null hypothesis
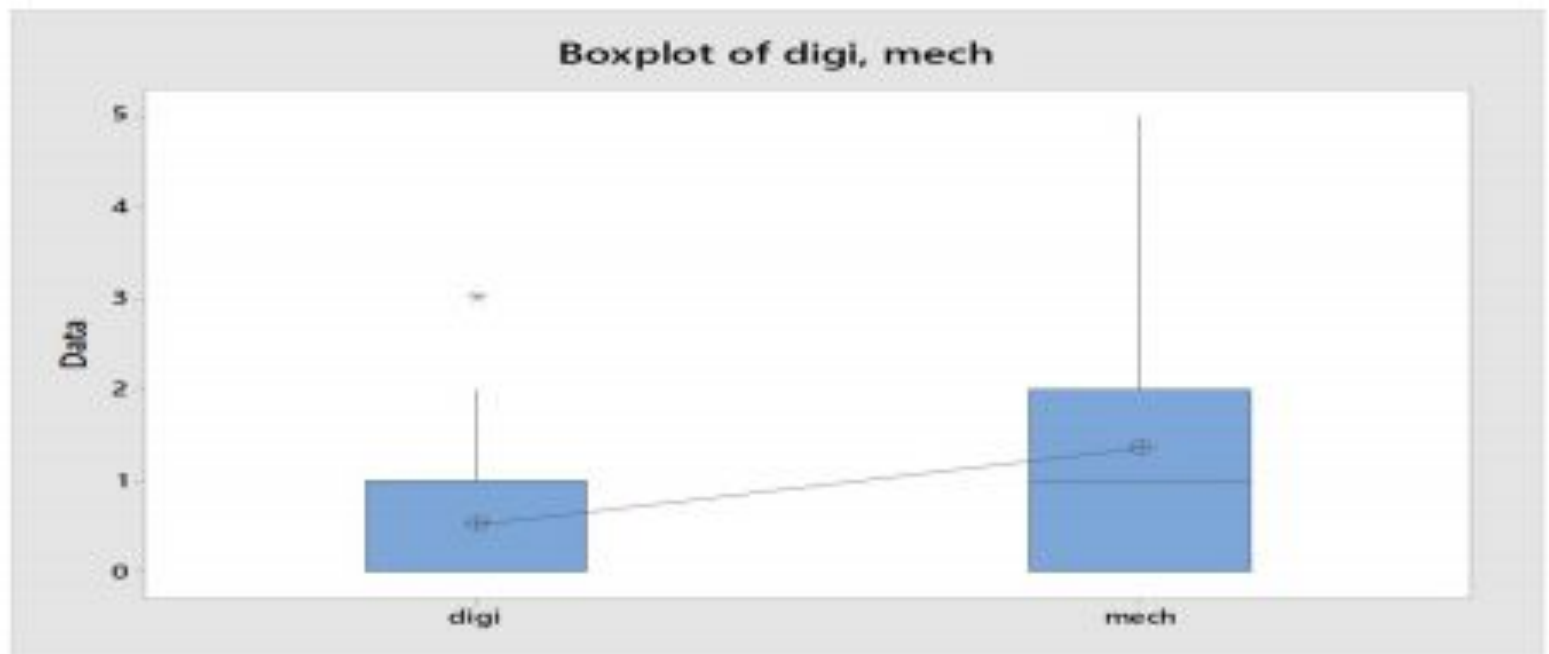
ANALYSIS

Figure 3.11: Box-plot of digital vs mechanical locks

Mean loss of keys was significantly higher in the case of mechanical locks as compared to digital locks

ANALYSIS

Test
Null hypothesis $H_0: \sigma_1 / \sigma_2 = 1$
Alternative hypothesis $H_1: \sigma_1 / \sigma_2 \neq 1$
Significance level $\alpha = 0.05$

	Test			
Method	Statistic	DF1	DF2	P-Value
Bonett	*			0.003
Levene	16.30	1	202	0.000

Figure 3.13: Variance test

We can conclude that there were significant variations in the variance of the distribution of loss of keys for both categories of locks.
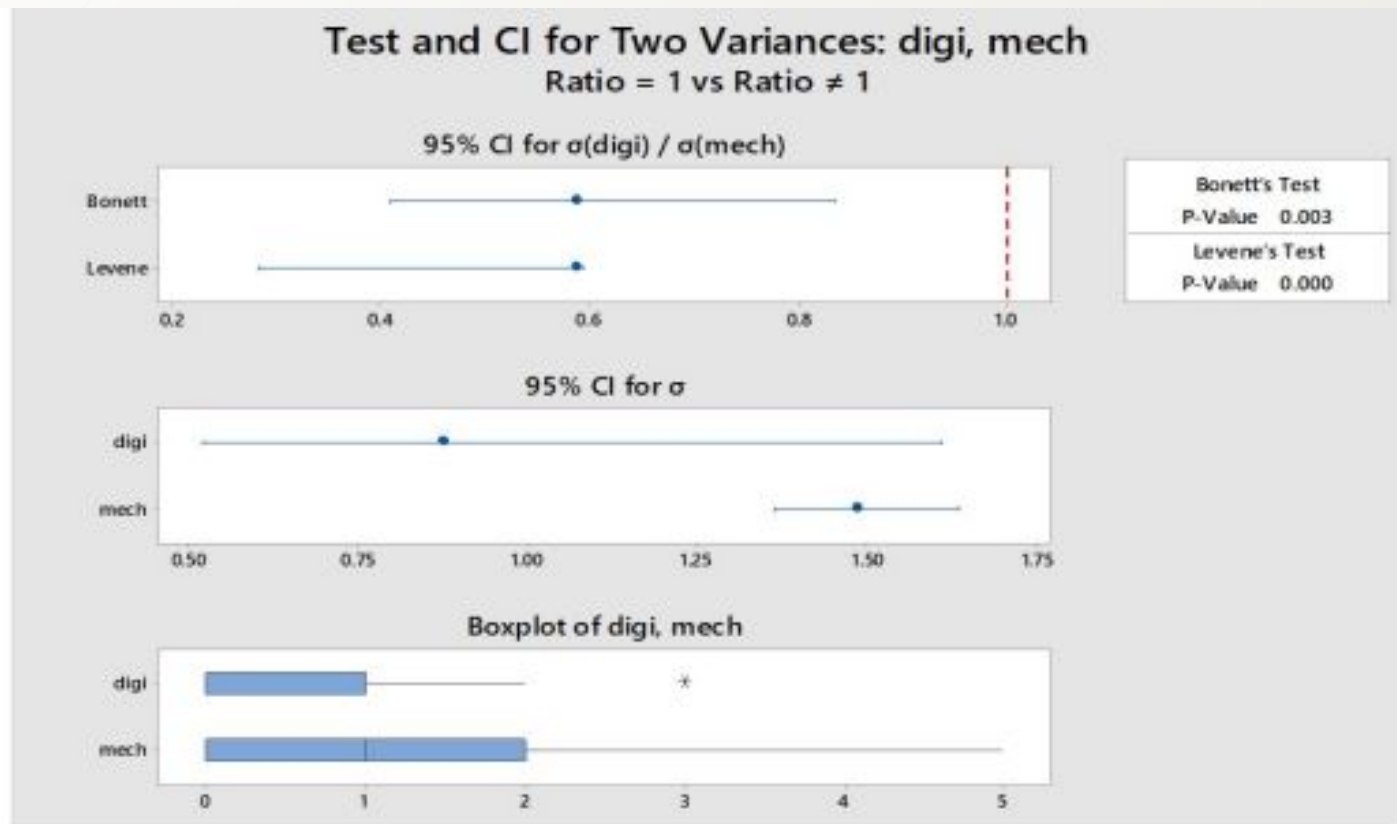
ANALYSIS

Figure 3.14: Mechanical vs digital lock

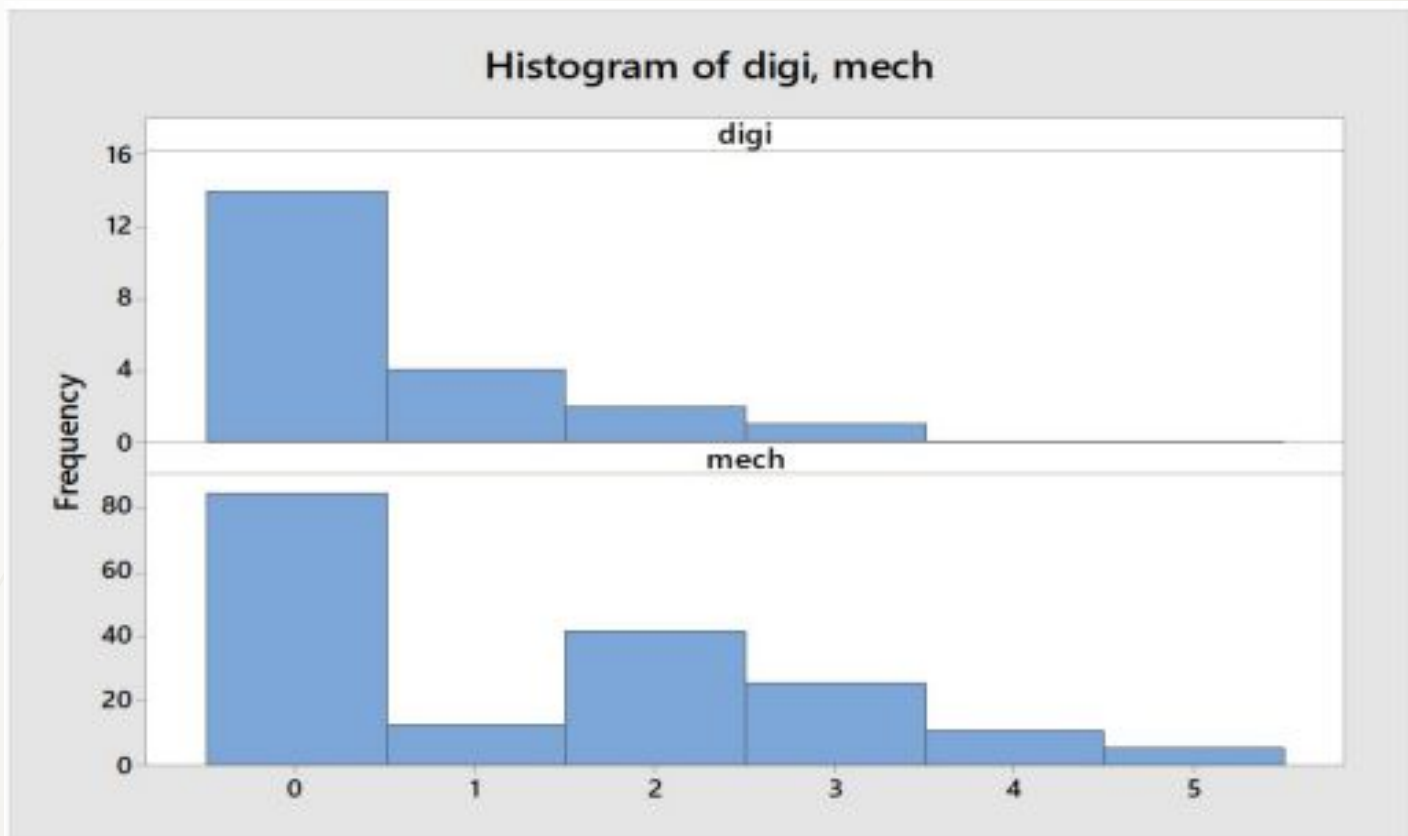Variation of loss of keys for each type of lock.

ANALYSIS

Figure 3.15: Mechanical vs digital lock

Frequency of loss of keys for each type of lock.

ANALYSIS

Descriptive Statistics: C1

```
Statistics
          Total
Variable  Count   N   N*  CumN  Percent   CumPct    Mean  SE Mean  TrMean   StDev  Variance
C1           92  80  12    80  86.9565  86.9565  1.2250   0.0470  1.1944  0.4202    0.1766
                              Sum of
Variable  CoefVar      Sum  Squares  Minimum      Q1  Median      Q3  Maximum    Range
C1          34.30  98.0000 134.0000   1.0000  1.0000  1.0000  1.0000   2.0000   1.0000
                            N for
Variable     IQR  Mode    Mode  Skewness  Kurtosis     MSSD
C1        0.0000     1      62      1.34     -0.20   0.2029
```

Figure 3.16: Descriptive data of tries to open the lock

Average number of times it takes to open an electronic lock is around 1.225 times.
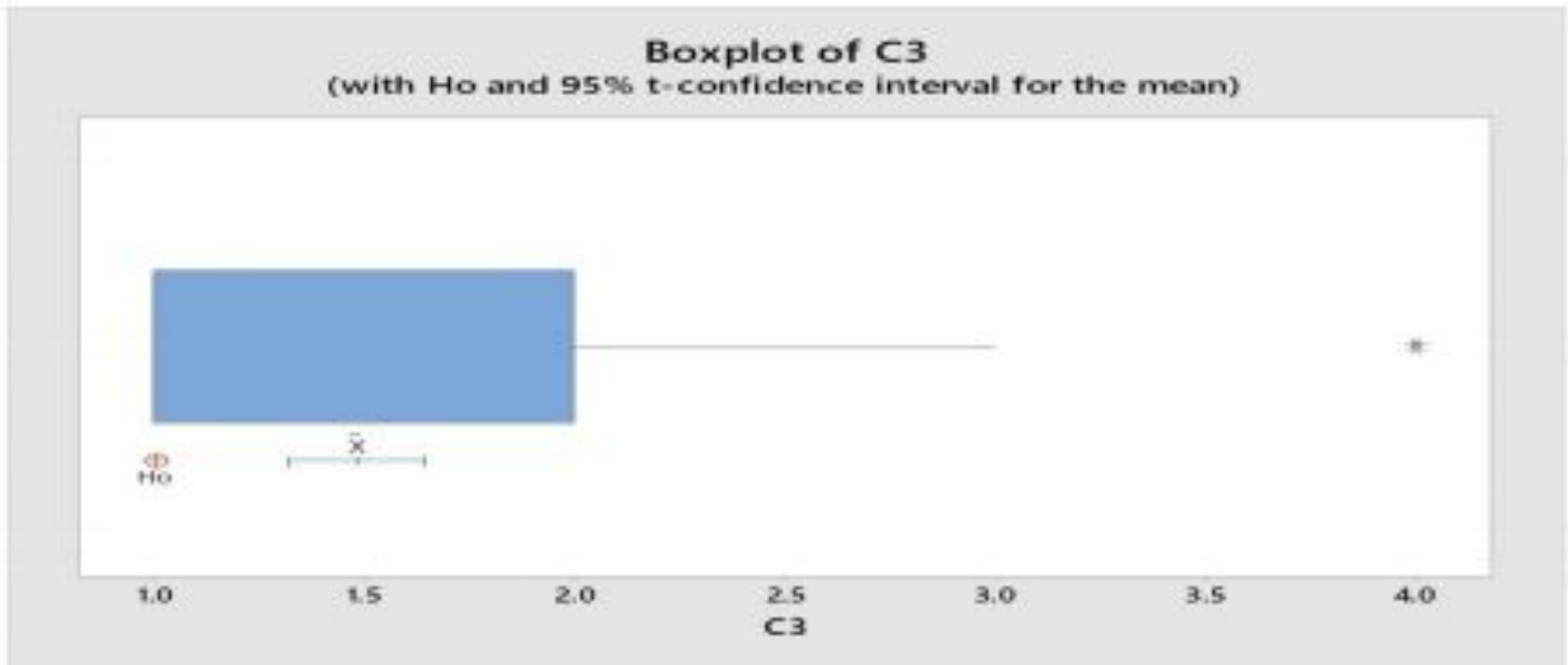
ANALYSIS

Figure 3.18: Boxplot of number of tries to open the electronic lock

From the box plot of the data we found two outlier in the data where it took four tries to open the lock. Then we assumed a null hypothesis that it takes one chance to open the lock and after hypothesis testing we found a p-value of zero where our confidence interval was 0.05. So we reject our null hypothesis that it takes one chance to open the lock.

ANALYSIS

- Tried to find the correlation between number of tries it takes to open an electronic lock vs rating given by the respondent.
- After correlation analysis we found a Spearman ratio of zero which shows that the rating given the respondent did not depend on the number of tries it takes to open the lock.

Descriptive Statistics: How do you rate the digital loc

```
Statistics
Variable                       N  N*     Mean  SE Mean    StDev  Minimum       Q1  Median       Q3
How do you rate the digi      92   0   4.0000   0.0901   0.8644   2.0000   3.0000  4.0000   5.0000
Variable                   Maximum
How do you rate the digi    5.0000
```

Figure 3.23: Statistics about Rating of the electronic lock

ANALYSIS

Spearman Rho: How many tries does it require, How do you rate the digital loc

```
Correlations
Spearman rho   0.002
P-value        0.982
```

Figure 3.21: Spearman Ratio between rating of electronic lock and number of trails to open the lock.
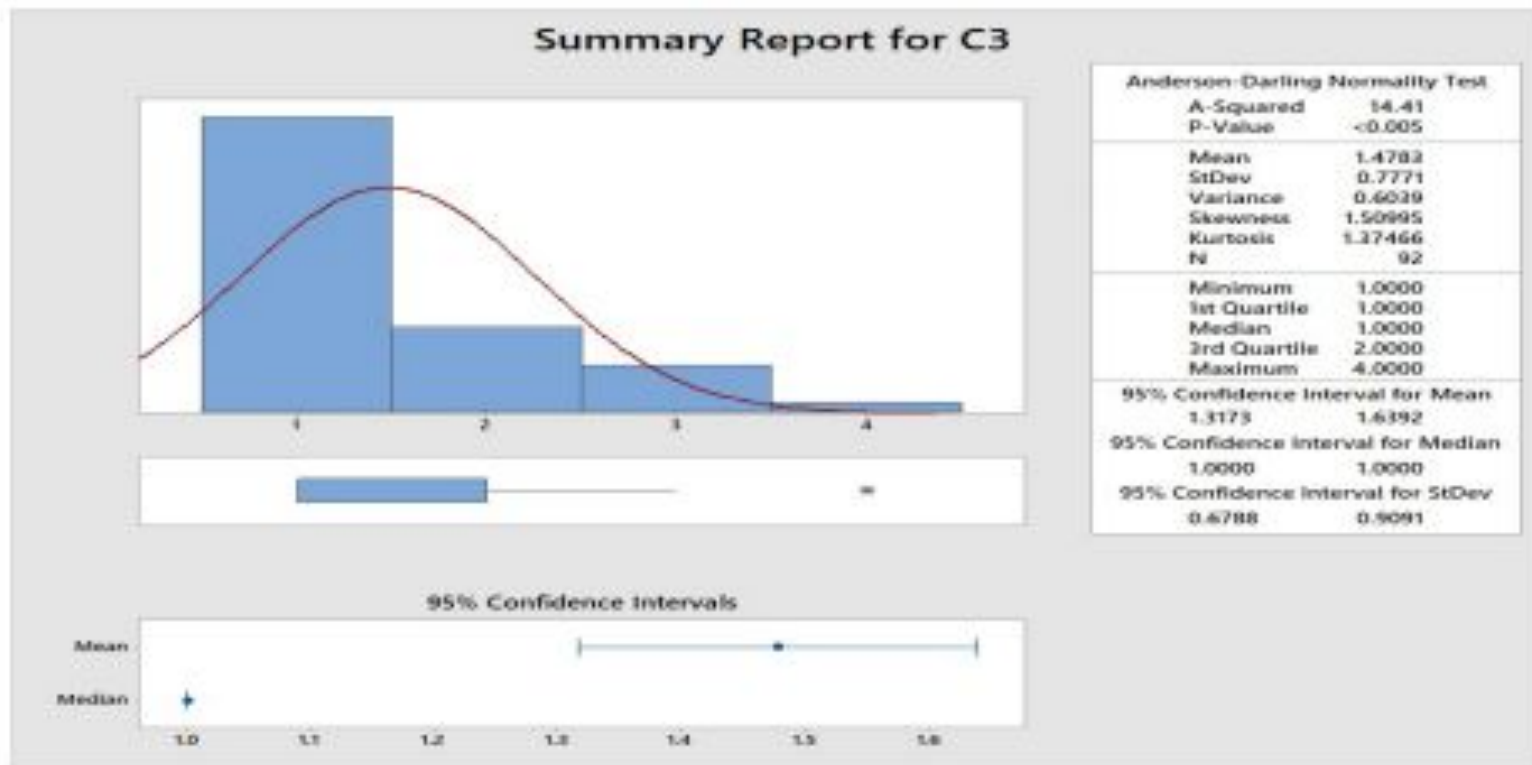
ANALYSIS

Figure 3.17: Rating of the digital lock

From the normality graph it was found to be skewed.

CONCLUSION

• Out of 200 (approx.) surveyed, nearly 95 % requested for the result for this survey, indicating they were quite interested in this survey.

• There is no difference in lost key instances found for the four different levels of mechanical lock factor. This means that cost of the type of mechanical lock really don't affect the lost key instance rate.

• Regression can not be used to predict the number of lost key instances on the basis of type of lock due to discrete nature of the dependent & independent variable.

• Residuals were not normal & transformation also didn't work due to non continuity of variables. So Single Factor One Way ANOVA failed in this case.

• The instance of key lost is dependent on the type of the lock i.e there were significant differences found in the means of lost key instance for each type of locks. Lost key cases for mechanical locks were significantly higher as compared to lost key cases in digital locks.

CONCLUSION

- Plot of number of trails to open an electronic lock was skew shaped and its mean was definitely not equal to one.
- There was no correlation between the rating given by the user to the electronic lock and the number of failed tries to open the lock which seems to be counter intuitive. The people who do not want to upgrade to digital locks are mainly concerned with security and high cost problem.

THANK YOU

☺