

REPORT

PART-I

Impact of covid-19 lockdown on food wastage behavior of people in India



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Introduction

The virus SARS-CoV-2 that causes COVID-19 seems to be spreading mainly from person to person, easily and sustainably, leading to the respiratory illness, and deaths of older adults and people of any age who have serious underlying medical conditions (CDC 2020). Because of the absence of specific vaccines or treatments for COVID-19, many countries like India have chosen a lockdown strategy to stop the spread and to protect their populations. During lockdown, people are urged to stay at home and to go out only to meet the most urgent needs like buying food and other essential commodities. Therefore, COVID-19 caused a drop in household consumption and a shift in their life and spending habits.

Food wastage is an alarming issue in India. In terms of overall food waste agricultural produce, poultry and milk , India ranks seventh, with the Russian Federation at the top of the list.

According to the United Nations Development Program (UNDP), up to 40% of the food in India is wasted. About 21 million tons of wheat is wasted in India and 50% of all food across the world meets the same fate and never reaches the needy. Several factors in households can influence food waste such as in-store behavior (over-shopping) and household management practices (poor planning / food management, storage problems), as well as psycho-social factors (personal choice and lifestyle, food habits, lack of cooking skills).

This study aims to determine the impact of covid-19 lockdown on food wastage behaviour of people in India.



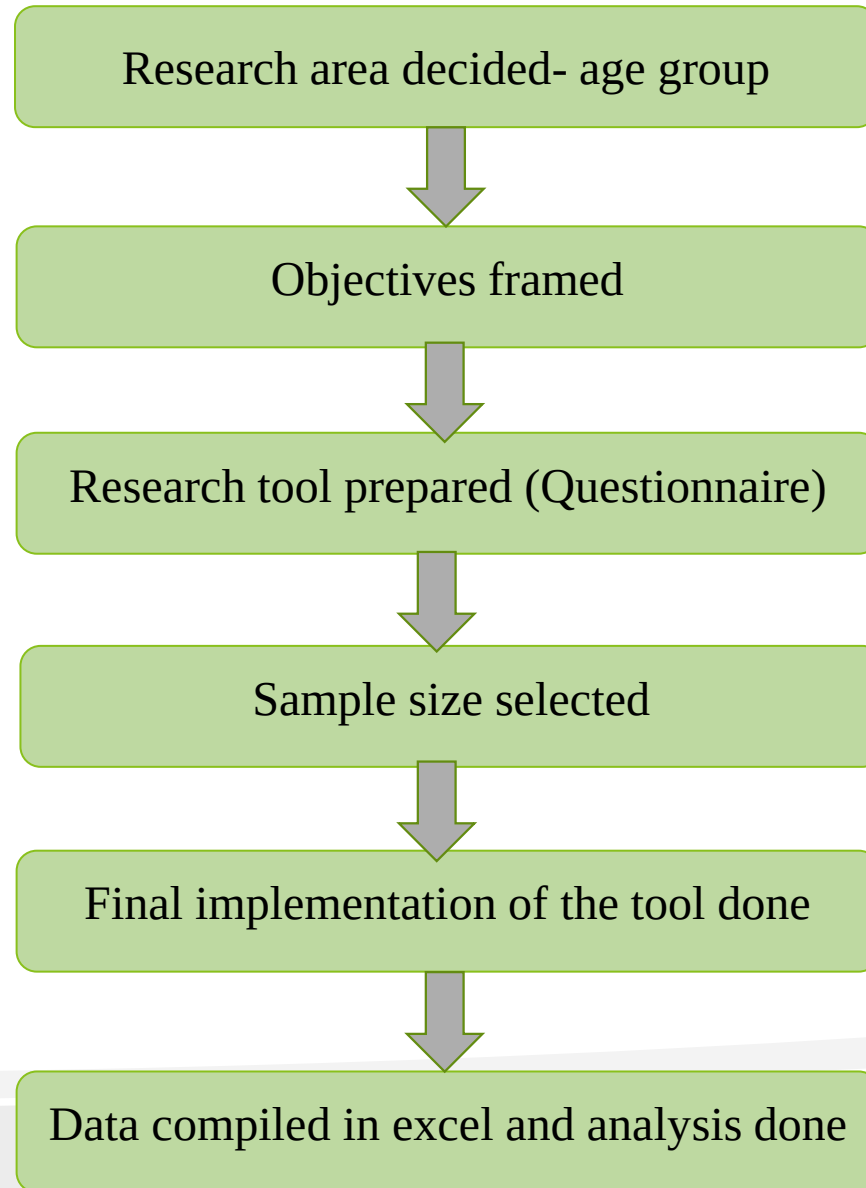
RESEARCH QUESTION

What is the impact of covid-19 lockdown on food wastage behavior of people of India and changes in behavior and attitudes regarding food wastage ?

OBJECTIVES

- To find the awareness of food wastage among people in India.
 - To find behavior of people towards food wastage, food purchase and expenditure.
 - To find the impact of lockdown on food wastage behavior of people of India.
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METHODOLOGY





DATA COLLECTION

- Study tool : Questionnaire
- Study Design : Cross-Sectional Observational Study
- Sampling Method : Convenience Sampling
- Study Area : India (urban area)
- Study Population : People between 15-59 years of age
- Duration of the Study : 2 months
- Sample Size : 385

A semi-structured questionnaire was administered using online google forms (<https://forms.gle/jx5iaaArt5oKdtx68>).



Sampling

Sample size is of 385 respondents. These people will belong to age group of 15-59 years because they economically active population. This age group is further decided because people of this age generally active for purchasing food and uses smart phones so they can respond to online google form. According to census 2011, population of India is 1,210,854,977 out of which 771556791 is economically active population living in urban area. Sample size is calculated by taking 95% confidence interval at 5% margin error. However, we got total of 216 responses (56.1%) who got agreed to participate and completed the survey.

Data collection

The questionnaire consisted of 22 multiple choice questions structured in 5 sections, namely socio-demographic characteristics of the respondents (6 questions), awareness and attitude towards food wastage in lockdown (4 questions), food purchase and preparation behavior (8 questions), quantity and extent of food wasted (2 questions) and at last, willingness and information needs to reduce household food waste (2 questions). The link for the survey was distributed among the participants via email, LinkedIn and social media.

Analysis done using Microsoft excel.

RESULTS

1.) Socio-Demographic characteristics of the respondents (n=216)

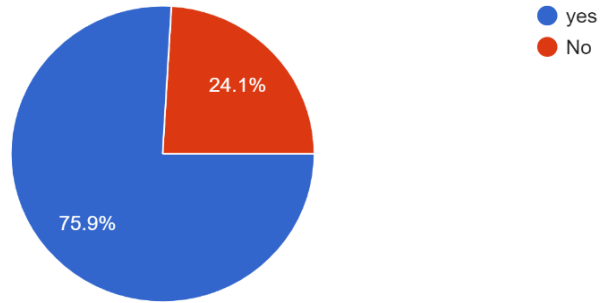
VARIABLES	CATEGORY	n(%)
Gender	Female	113 (52.3%)
	male	103 (47.7%)
	transgender	0
Age	15-24 years	106 (49.1%)
	25-34 years	84 (38.9%)
	35-44 years	12 (5.6%)
	45-59 years	14 (6.5%)
No. of member in house	Less than 4	62 (28.7%)
	4	80 (37%)
	5	42 (19.4%)
	More than 5	32 (14.8%)
Occupation	Government sector	6 (2.8%)
	Private sector	51 (23.6%)
	Business/ self employed	16 (7.4%)
	Doctor	17 (7.9%)
	Teacher	6 (2.8%)
	Student	102 (47.2%)
	House-maker	11 (5.1%)
	Unemployed	7 (3.2%)
Education level	Post-graduate	81 (37.5%)
	Graduate	124 (57.4%)
	Primary & high school	11 (5.1%)

- Demographics research shows that 52.3% of the respondents are women, and 47.7% are male respondents. This shows that women are more active in maintaining food wastage and household shopping.
- Majority of the respondents lie in age group of 15-24 years whereas the least participation was from age group of 35-44 years which is only 5.6% of total respondents.
- 14.8% live in households with more than 5 members whereas 37% live in household with 4 members.
- Graph also shows that 57.4% of respondents are graduate whereas 37.5% are highly educated with post graduate degree.

2.)Awareness among people and their attitude towards food wastage during covid-19 lockdown

Are you aware about the amount of food wastage in India ?

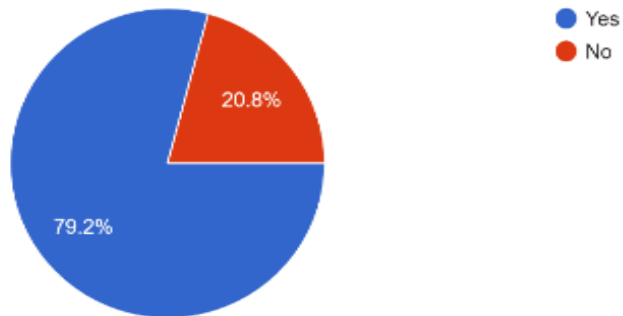
216 responses



Our results shows that a large majority (75.9%) of respondents are aware about the amount of food wastage in India.

Do you eat food left the next day ?

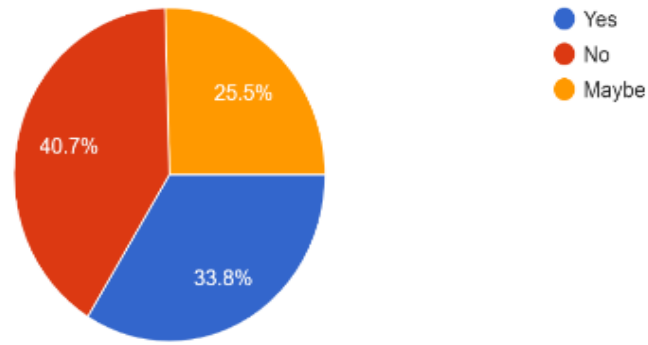
216 responses



To the question whether they eat the food left next day 79.2% said yes. This shows increased levels of awareness and changes in attitudes, toward food waste during times of crisis. This high level of awareness about the food waste constitutes an important condition for a future behavior change.

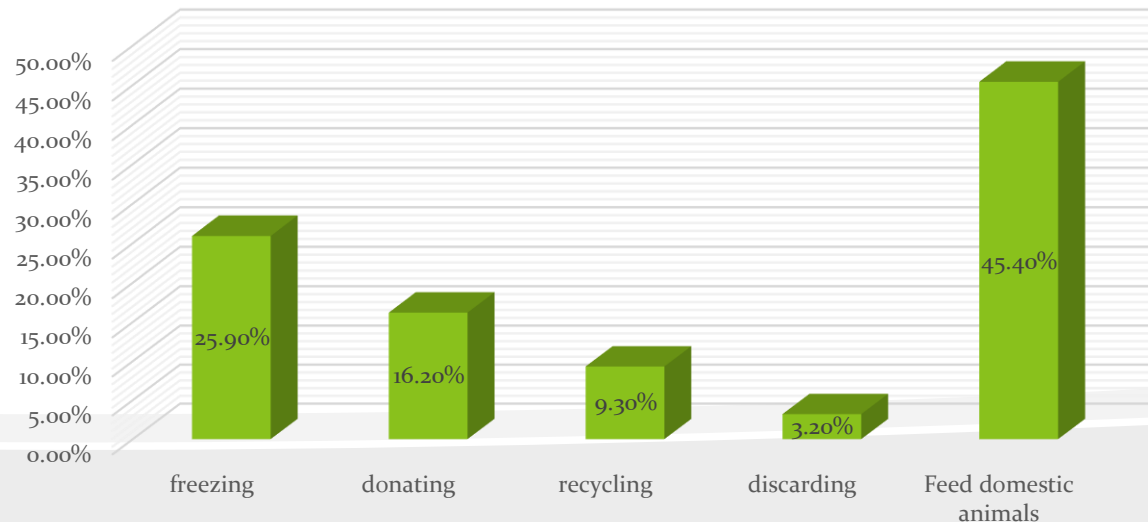
Did covid-19 lockdown impacted your level of food wastage ?

216 responses



To the question that whether lockdown has impacted their level of food waste- 41% of respondents said yes. . Age and education increased significantly reported efforts to control food wastage during COVID-19 lockdown. Moreover, this situation increased awareness, probably, due food availability.

practices to control food wastage



Respondents were also made to ask qualitative questions about their level of awareness. To the question that what efforts they put most to control food wastage. It was found that 45.4% of people feed domestic animals to control food wastage whereas only 3.2% of people discard the leftover food.

3.) Food purchase behaviors and attitude of people towards COVID-19 lockdown



FOOD PURCHASE BEHAVIOUR	n (%)
Purchases food material for the house	159 (73.6%)
Order food online during lockdown	22 (10.2%)
Buy discounted food products	162 (75%)
Do a shopping list	152 (70.4%)
Covid-19 lockdown changed their shopping habits	182 (84.3%)

According to our survey, 70.4% of respondents declared to use a shopping list. Making food shopping list is considered as an efficient food waste prevention tool at the household level, by preventing the purchase of surplus foods (van Geffen et al. [2020](#)).

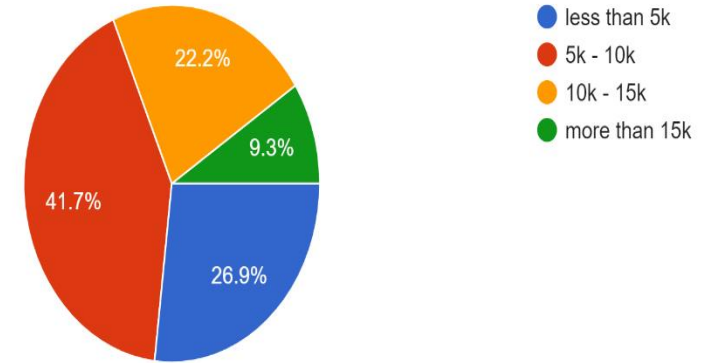
When asked about do they buy discounted food products, 75% of people always buy these products. Recent findings have pointed out that people who are price oriented or have an attraction to special offers tend to waste less (Jörissen et al. [2015](#); van Geffen et al. [2020](#)).

To the question “Has COVID-19 lockdown changed your shopping habits?,” 84.3% of respondents have answered positively.

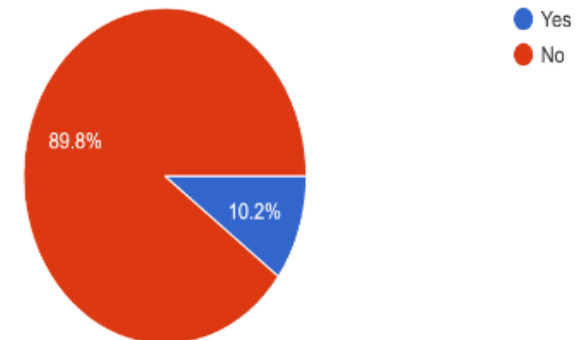
Regarding their household food expenditure, 41.7% of the respondents affirmed to spend monthly between Rs 5000 and 10000, 26.9% spend less than 5000 per month on food, 22.2% spend somewhere near Rs 10000-15000 and only 9.3% of the respondent's monthly food expenditure is more than Rs 15000. It would be expected in this context that the way money was spent during COVID-19 lockdown might be different. individuals would be more strategic about how they spend their money under stress. In other words, stressed consumers increase spending on necessities and spend less on discretionary items.

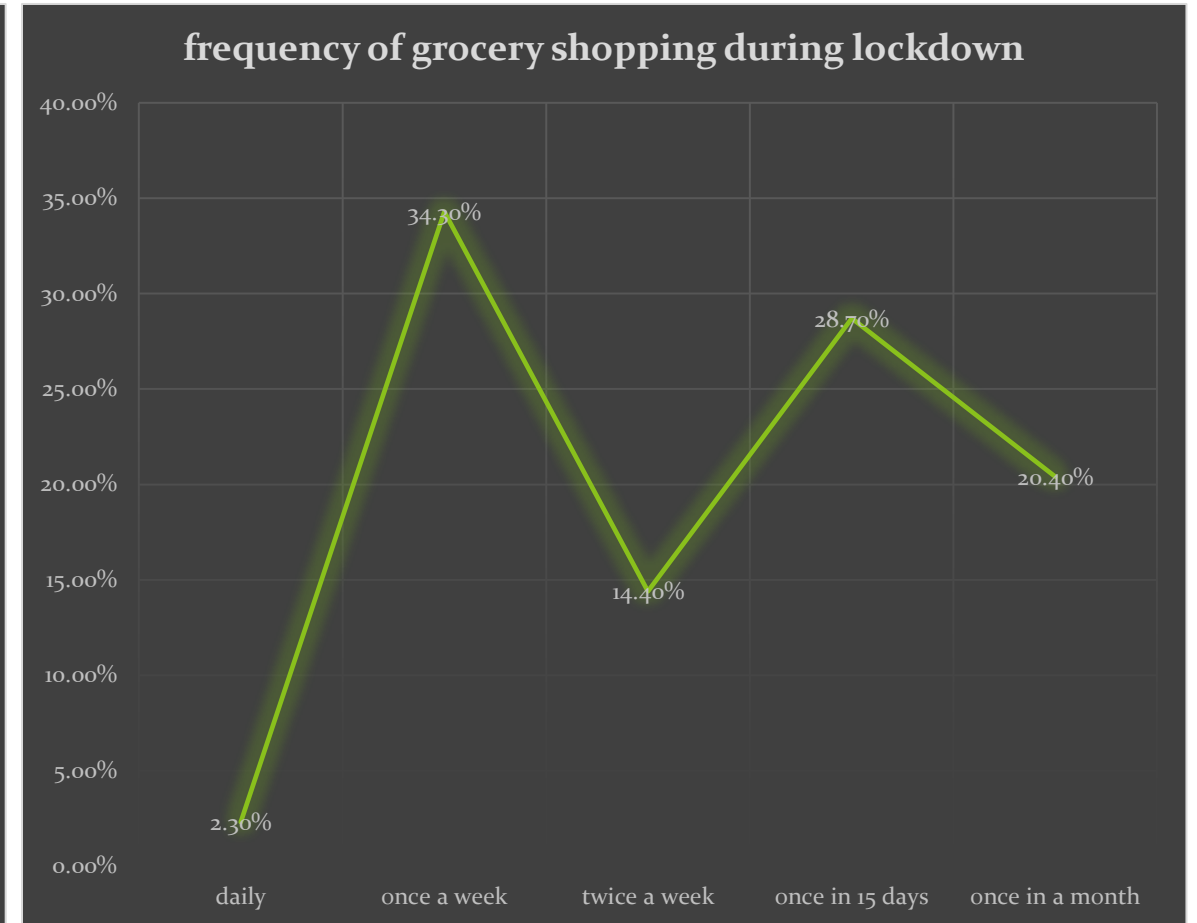
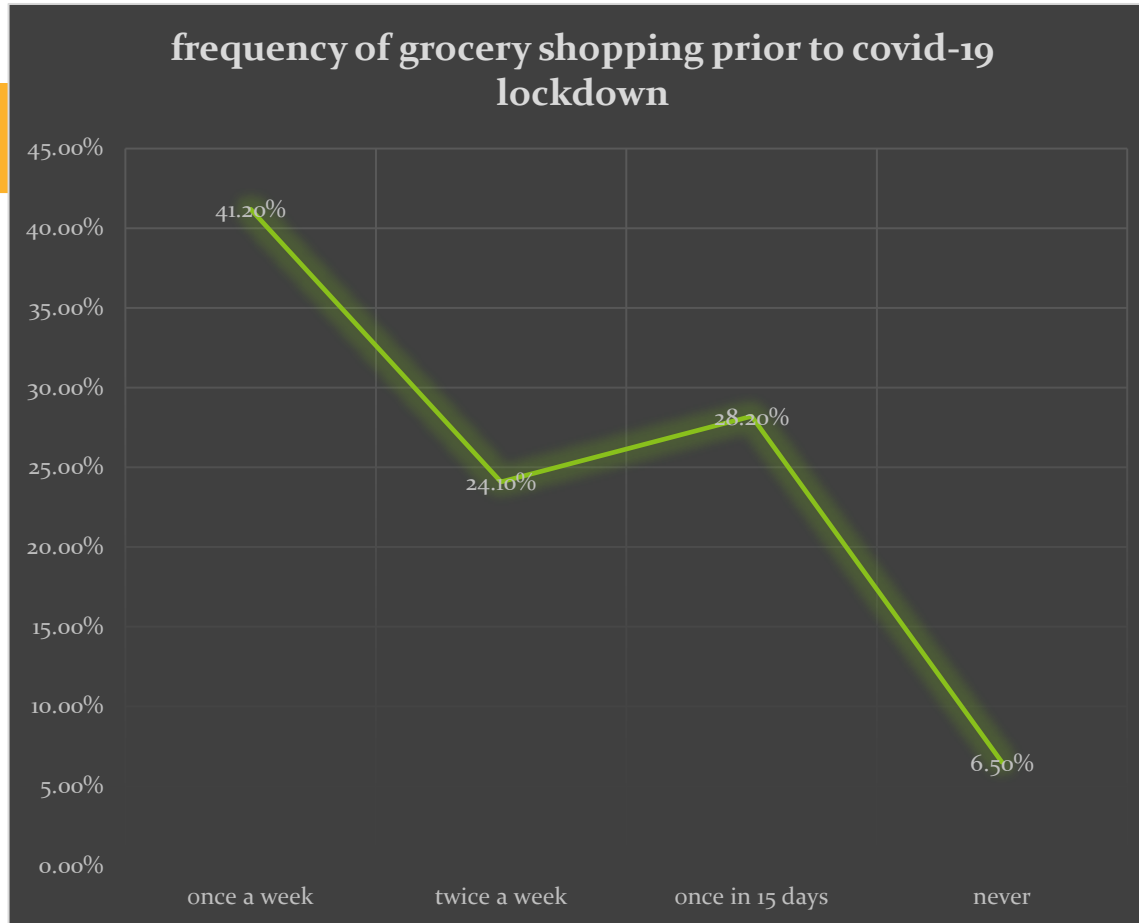
A large proportion of Indian consumers, nearly 90% do not give preference to order food online during covid-19 lockdown. Thus, our results showed an impact of COVID-19 pandemic on online food ordering. This can be explained by the concern of safety.

Household monthly food expenditure -
216 responses



Do you order food online during lockdown ?
216 responses

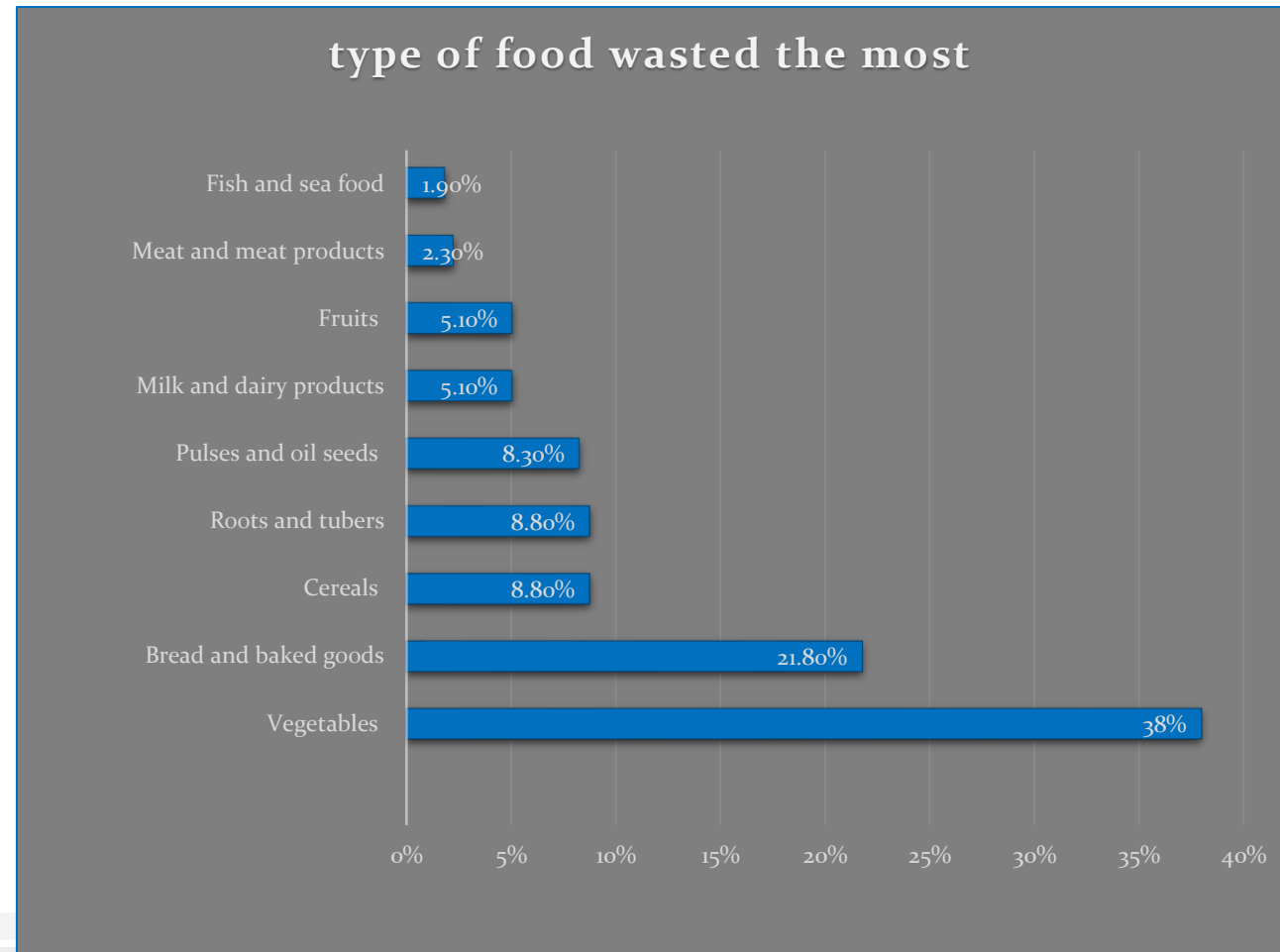




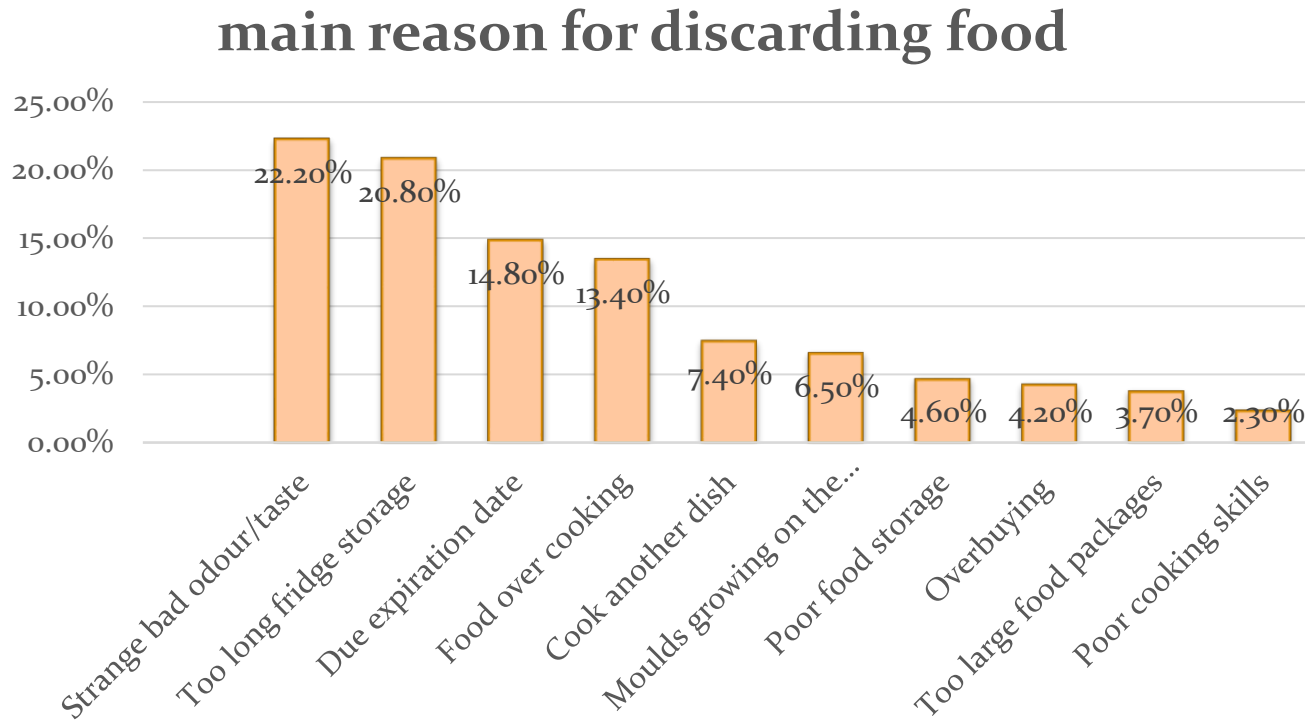
Prior to lockdown 41.2% of people used to purchase food material once in a week. However, this percentage got decreased to 34.3% during the time of covid-19 lockdown. There were only 2.3% of people who go for grocery shopping daily during the covid-19 lockdown. This shows a positive impact of lockdown on people's purchase behavior. These results show that people avoided going out unnecessarily during this pandemic. During COVID-19 pandemic, there was a tremendous concern about safety.

4.) Quantity and extent of household food waste during COVID-19 lockdown

According to our survey, the food which is wasted the most are vegetables (38%), followed by bread and baked goods (21.8%) and to a lesser extent cereals, roots and tubers (8.8%). In contrast, fish and seafood group, meat and meats products are the least wasted food, mostly estimated as less than 3% of purchased foods.



MAIN REASON FOR DISCARDING FOOD



Responses uncover the most referred to reasons were strange bad odour and taste (22.2%) and a too long storage in the fridge (20.8%).

4.2 percent of respondents have asserted over buying as a fundamental explanation of food wastage.

14.8% accepted that due expiration date and 13.4% food overcooking are fundamental purpose behind disposing of food.

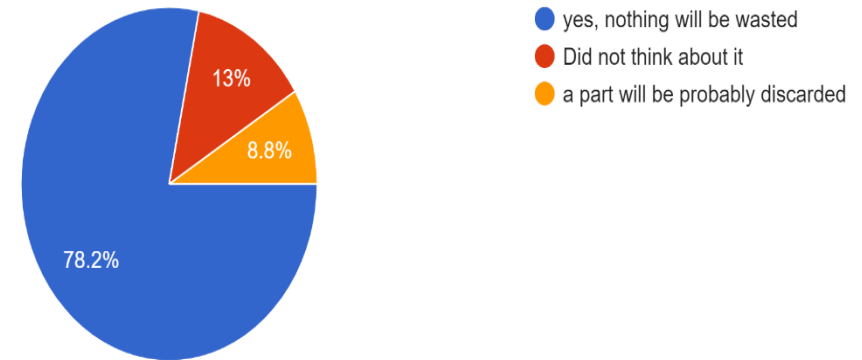
5.) Willingness and future intentions to reduce household food waste

To the question “Will you consume all the food items that you have bought, during COVID-19 crisis,” 78.2% have said yes that nothing will be wasted, whereas 13% did not think about this issue and 8.8% declared a part will be probably discarded. This result confirmed the increased awareness in food waste issue, during COVID-19 crisis.

This pie chart shows respondent's future intentions to cut down food wastage. More than half of respondents (56.5%) claimed to be ready to modify their behavior toward food waste. Around 13.4% of respondents said that they will probably change their behavior. These behavioral intentions can constitute a basis for implementing food wastage prevention and reduction measures. In contrast, 26.4% of people believes that they already do what they can do. In addition, 3.7% said that they will not do anything: they might probably externalize the responsibility of food wastage, suggesting a lack of problem awareness and a denial of the food waste issue.

Will you consume all the food items that you have bought during covid-19 crises?

216 responses



REPORTED FUTURE INTENTIONS TO AVOID FOOD WASTAGE		n (%)
-	Ready to modify their behavior towards food wastage	122 (56.5%)
-	Probably change their behavior	57 (26.4%)
-	Already do what they can do	29 (13.4%)
-	Will not do anything	8 (3.7%)

DISCUSSION

- The survey collected information on demographic data, awareness and attitudes toward food waste, food purchase behavior and household food expenditure estimation; extent of household food waste; willingness and information needs to reduce food waste.
- About 75.9% of respondents claimed to be aware of food waste, and the COVID-19 lockdown would impact for 33.8% of respondents, their waste levels, and for 84.3% their grocery shopping habits has changed. Interestingly, the COVID-19 lockdown improved food shopping performances and pushed toward a positive behavioral change regarding food wastage: 78.2% respondents declared nothing of what they bought would be discarded.
- The most referred to reasons given for discarding of food were strange bad odour/taste (22.2%) and too long fridge storage (20.8%).



CONCLUSION



- Our study has established that COVID-19 outbreak lockdown has caused respondents to strive toward reducing food waste. Respondents have developed positive attitudes toward food waste prevention; during the first two weeks of COVID-19 lockdown, they have adapted their habits that have been found to be close to the good practices.
- In conclusion, our study contributes to a better understanding how a crisis situation affects consumer behavior and raises awareness regarding food waste.
- Taken together, our study has shown the positive influence of COVID-19 lockdown on consumer's behavior toward food waste prevention. Our findings have pointed out the need to implement Government incentive mechanisms including information campaigns, to help consumers to improve home cooks efficiency in terms of suitable quantities, and food storage as well as to better assess food safety, and to recycle leftovers.

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NAME OF THE COURSE :-

Data Analytics for Lean Six Sigma

COURSE DESCRIPTION :-

- The course is available on Coursera and is offered by University of Amsterdam.
- This course introduces data analytics techniques that are typically useful within Lean Six Sigma improvement projects. It is a 5 weeks course and requires 16 hours to complete.
- This course will help to learn data analytics techniques that are typically useful within Lean Six Sigma improvement projects. Through this course we will be able to analyze and interpret the data gathered within such a project.

OBJECTIVES OF THE COURSE :-

- To analyze, process and interpret data.
- To make a problem measurable.
- To select appropriate tool for data-based testing.
- To emphasize on use of data analytics tools and interpretation of the outcome.
- To learn techniques that can be used in a broader setting apart from improvement projects.
- To illustrate all the tools by using many different examples from actual lean six sigma project.

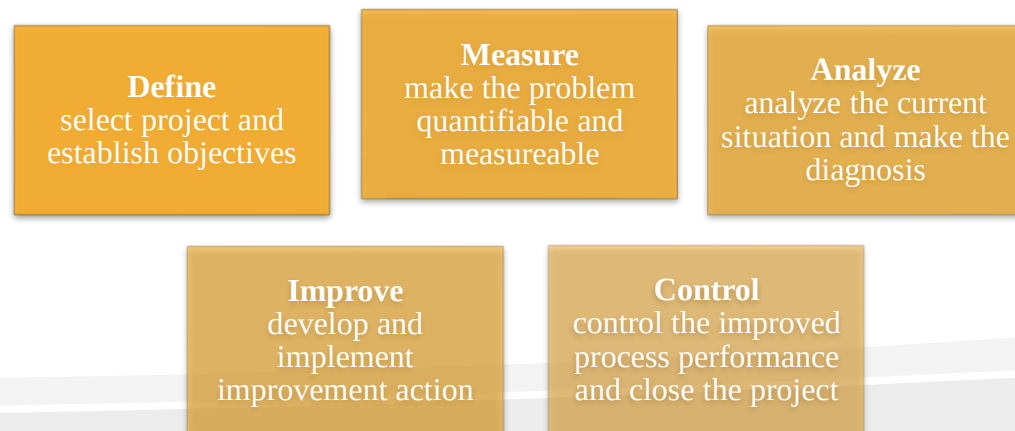


COURSE CONTENT

1. Data and Lean Six Sigma

a) **Introduction to data analytics for lean six sigma-** Process improvement is important to organizations and Lean Six Sigma is a popular method to do this. Processes are a series of actions or steps taken to make a product or deliver a service. So main features of Lean Six Sigma are it's evidence based and that it makes use of process data. Data is important when you want to improve your processes. Data can help you to find the biggest problems. Diagnose the current processes or to investigate the effects of your improvement actions.

b) **Data and DMAIC**



c) **CTQ (Critical to Quality)**-What we want to change determines our CTQ. In statistics, this variable is called your Y-variable or the dependent variable.

d) **Units** - are people, objects or phenomena you collect data on. These are sometimes referred as units of analysis, as cases, or as subjects. It can be experimental units, observational units and measurement unit which is sometimes referred to as the unit of measurement.

e) **Sampling**- It tells us that sample should always be representative of the population.

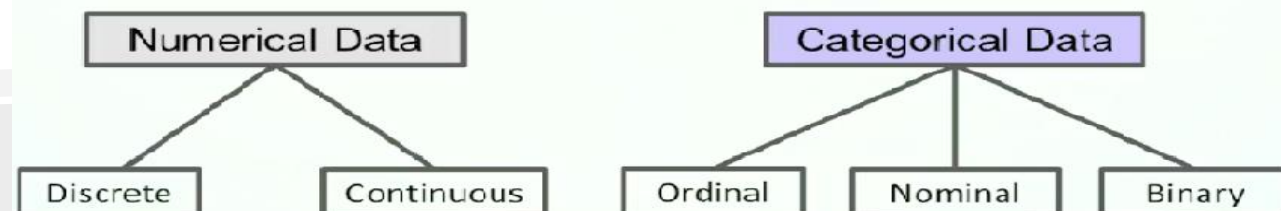
f) **Organizing the data**- The dataset consists of units and variables. The rows represent the units and columns represent variables.

2. Understanding and visualizing data

There are two types of data:

- Qualitative data (Categorical)
- Quantitative data (Numerical)

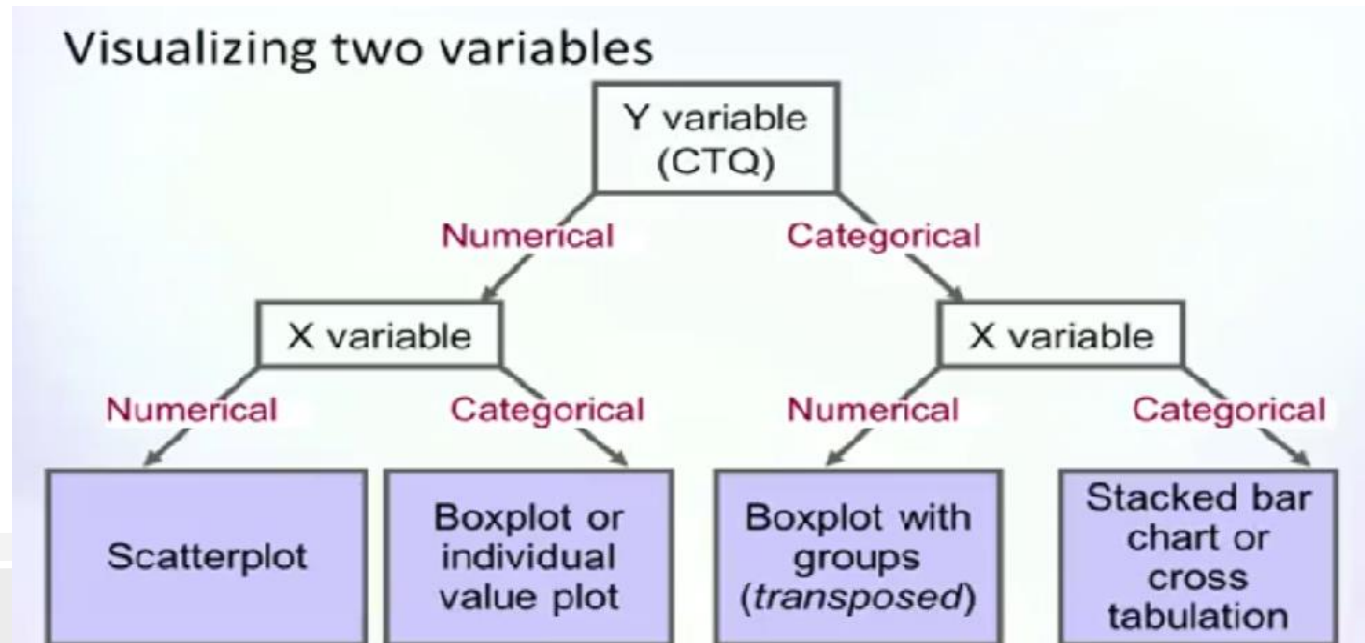
Numerical and categorical data



Descriptive Studies- are based on mathematical operations like addition and multiplication. However, there is always a certain degree of variation or dispersion in the data. Descriptive Studies-are based on mathematical operations like addition and multiplication. However, there is always a certain degree of variation or dispersion in the data. In some cases, the **range** is used to indicate dispersion.

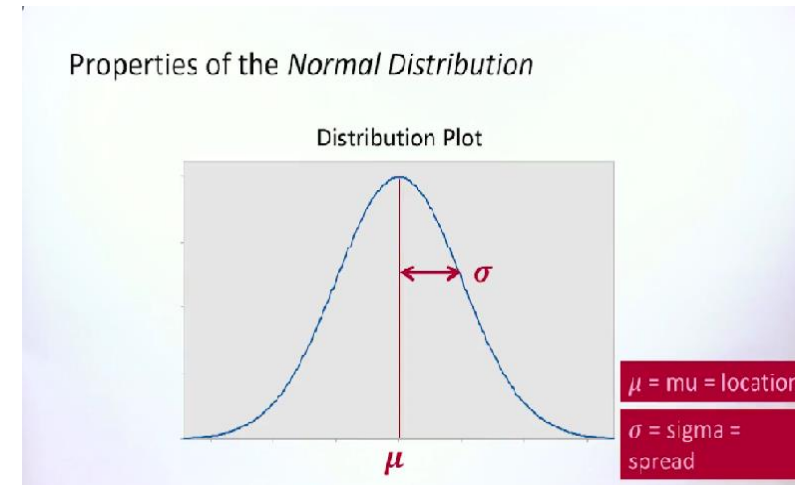
Pareto analysis- It is a 80/20 principle. Only a few issues cause the majority of the problems. However, it will never be exactly 80 and 20%. Pareto chart can help to distinguish the vital few causes from the trivial many. We can do this, either by counting the number of occurrences, or by weighing them with the relevant characteristic.

Visualizing two variables- it basically tells that what kind of graph we can plot for our data.



3. Using probability distributions

- a) **Probability plot-** A probability plot can be used to find a theoretical distribution that fits best to your data.
- b) **Empirical CDF-** We can use the Empirical CDF to calculate percentages. The Empirical CDF is a useful tool in the analyze phase of Lean Six Sigma project.
- c) **Properties of Normal Distribution-** A Normal Distribution has two parameters that determine the shape of its distribution. The first parameter is the location parameter which determines the midpoint. This is denoted by μ , which is the location or mean. The second parameter describes the shape of the distribution and is known as the dispersion parameter, denoted by σ and it determines the spread of the distribution.



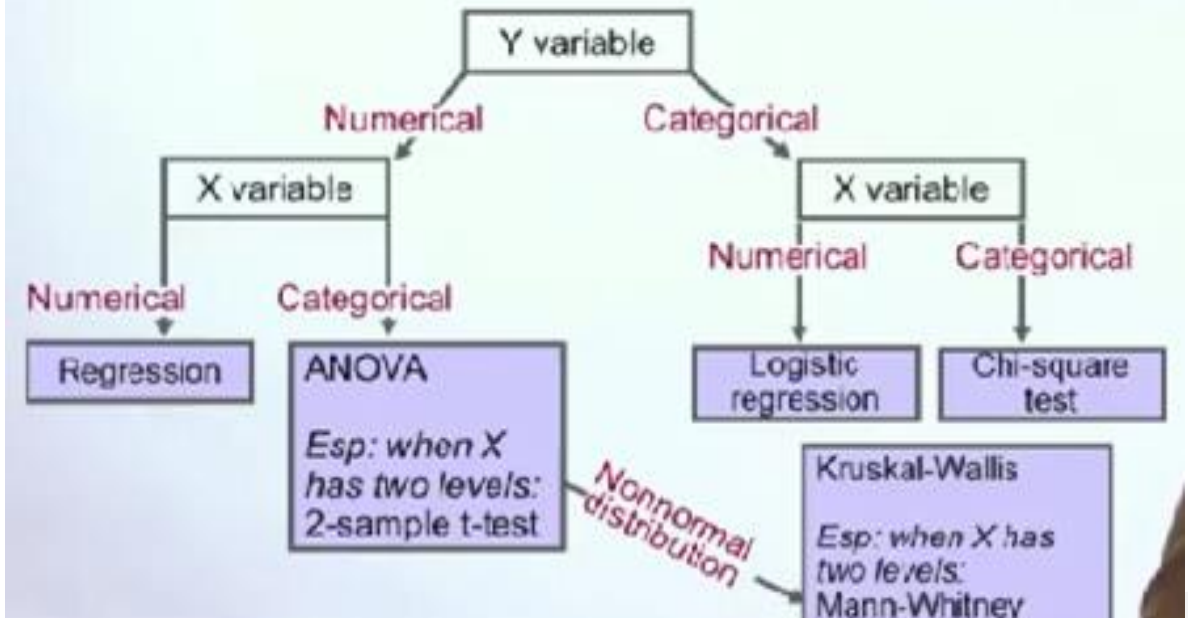
4 . (i) Introduction to testing

Introduction to Data Analysis- To analyze if two variables are related, you have to determine which variable is your influence factor, or your X variable, and which variable is your CTQ, or your Y. Next, you have to determine whether your variables are categorical or numerical. And these are the methods that you can use for that data-based testing of ideas and improvements in your Lean Six Sigma project.

Hypothesis Testing- We start with constructing the hypothesis, then collecting the data and finally, drawing the conclusion

Causality- causation means that the one thing causes the other to change. It's about cause and effect relationships. This means when you change your X variable and nothing else your Y variable will change as a result.

Introduction to data analysis – *Summary*



- **(ii) Testing: numerical Y and categorical X**

This module focuses on applied mathematics testing and the way to determine relationship between a numerical Y variable (the CTQ) and categorical influence factors (the X variables).

- ANOVA Analysis ANOVA stands for Analysis of Variance and ANOVA is the appropriate statistical technique when the Y variable is numerical and the X variable is categorical. It is a suitable statistical method if you are comparing means across various groups. The analysis consists of three steps, organizing your data, performing the ANOVA, and performing residual analysis just to check if the assumptions are met. ANOVA consists of three steps:
 - Organize the data
 - ANOVA
 - Residuals

5. a.) Testing: numerical Y and categorical X

- 
- **Correlation**-is an index that expresses how strong a relationship between two numerical variables is. This index is always between minus 1 and plus 1. A correlation of 0 means that there is no linear relationship. A positive correlation means that higher values of one of the variables will generally correspond to higher values of the other variables. Whereas a negative correlation means that the variables are correlated in the opposite direction.
 - **Regression analysis**-is a statistical method to test if two numerical variables are related by calculating the best fitting line.
 - **Quadratic Regression**- Quadratic regression makes it possible to study a curved line. This technique fits a curved line to your data instead of a straight line.

b) Testing: Categorical Y

Chi-Square Analysis- It shows you whether or not the effect you found is significant

Logistic regression- It consists of three steps:

- In the first step, you may need to convert your data to the correct format.
- In the second step, you make a fitted line plot and evaluate the quality of the fit.
- In the final step, you analyze the p-value and see if you have found a significant relationship.



LEARNING METHODOLOGY USED IN THE COURSE :-

- Learning methodologies used in this course are mainly videos, reading materials, quizzes.
- It is an online based learning course of 16 hours with flexible deadlines to refresh the statistical knowledge with the help of video lectures along with the reading material so that we won't miss out anything if we wish to review it again.
- There are weekly practice quiz and graded quiz to test our learning objectives and self assessment. There are weekly forums where course related problem-solving take place.
- In this module, it also introduced a software package called Minitab which is used throughout the videos for data analytics. Many day to day process improvement examples are also use for a better understanding of the concept. There are some video exercises also which gives us hands on practice for solving the problems.



KEY LEARNINGS FROM THE COURSE :-

- **WEEK 1:** In this week we came to learn about the lean six sigma, Data and DMAIC framework, how to select CTQs, how to perform sampling, organizing the data, the units and operational definition along with installation of Minitab.
- **WEEK 2:** In this week we learn to visualize numerical and categorical data, descriptive statistics, Pareto analysis, visualizing two variables along with video exercises on investigation time and coffee batch.
- **WEEK 3:** In this week we got to know the difference between population and sampling, we learn about estimation, empirical CDF and confidence intervals, normal, lognormal and weibull distribution curves, probability plot and a video exercise on the length of stay.
- **WEEK 4:** In this week we got to learn about data analysis, hypothesis testing, causality, ANOVA analysis, ANOVA residual analysis, Kruskal-Wallis test, Two sample t-test, test for equality of variances and video exercises on productivity and department.
- **WEEK 5:** In this week we learnt way to determine relationship between a numerical Y variable (the CTQ) and categorical influence factors (the X variables), about correlation, regression analysis, regression residual analysis, regression prediction interval, quadratic regression, chi-square analysis, logistic regression and video exercises on picking, printers and students.



THANK YOU

