Summer training Report

By

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MBA (Hospital and Health Management)

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Part 1:

Report on Summer Training

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Dr. Anuja Satpathy

MBA HM-24

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Comparative analysis of mental health of Millennials before and after lockdown amid COVID-19 – A Netnographic study

Dr. Anuja Satpathy, Ms. Shweta Aggarwal

Abstract-

COVID- 19 have an impaired impact on human mental health due to the crisis and the restrictive measures enforced on people in different countries. A strict lockdown leading to social distancing, isolation, and closer to the different organizations is challenging people's mental health leading to Anxiety, Stress, and Depression. In order to understand the impact of COVID 19 on the mental health of people, a mixed-method approach was performed to find the comparative analysis of millennials mentally before and after the lockdown. A Quantitative data of Anxiety, Stress, and Depression, before and after COVID 19 prevalence has been compared. For Qualitative analysis Netnographic study was done which shows anxiety, stress, and depression is a major problem for millennials and it occurs at different phases throughout the lockdown. Different strategies are used by people to deal with this issue include multiple forms of telecommunications, social media interaction, and professional evaluation. Results show Anxiety, Stress, and Depression was highest in the baby boomers and Gen X before COVID 19 prevalence whereas Anxiety, Stress, and Depression are highest in the Millennials after COVID 19 prevalence.

Keywords- COVID 19, Corona Virus, Mental Health, Psychological Impact

Introduction-

Coronavirus disease (COVID-19) is a communicable disease caused by the newly discovered coronavirus. Most people infected with the COVID-19 virus are experiencing mild to moderate respiratory illness and recover without requiring special treatment. Older individuals with underlying medical issues like cardiac disease, diabetes, chronic disease, and cancer are more likely to develop serious illness (WHO).

COVID 19(Novel-Corona Virus) is from a family of coronaviruses. It has an appearance of the crown which suggests "corona" in Latin. The other form of coronaviruses is SARS-Cov initially known in 2003 in China and MERS-Cov knew in 2012 in Saudi Arabia. COVID 19 was initially known in December 2019 in China in a very cluster of individuals with a symptom of fever, cough, and dyspnoea resulting in respiratory disorder and more cause kidney disease leading to death. COVID 19 spreads through salivary droplets or infected person's discharge from the nose once they cough or sneezes. At this moment there is no vaccine or treatment, but there are many clinical trials in process.

A sudden spread of the virus, all over the world is a challenging situation for everyone. Around 35.5 lakhs individuals and 215 countries and territories are infected by COVID 19. On 31 Dec,19 China alerted the WHO of many flu-like cases in the city than on 5 January,20 WHO suggested travel restriction than on 7 January,20 viruses known as Novel-Corona virus. On 11 Jan,20 initial coronavirus death case reportable, on 3 Feb,20 WHO strategic preparedness and response plan (SPRP) discharged, On 11 Feb,20 the name COVID 19 was given. (By WHO)

The government's sudden lockdown to the unprepared population created a panic, anxious, and stressed environment. There is a mass exodus of migrant staff working within the informal economy. Lacking jobs and money, and with public transportation shut down, thousands of migrants were underneath disagreeable conditions due to their family needs. This is causing a lot of stress leading to inappropriate decisions taken by everyone.

According to WHO, fear, worry, and stress are normal responses to perceived or real threats. So, it's normal and understandable that people are experiencing fear among the context of the COVID-19 pandemic. Adding to the fear of catching the virus throughout a pandemic like COVID-19, there are numerous changes to our daily lives like a restriction to movement to support the efforts containing and hampering the spread of the virus. Facing the new realities of working from home, temporary state, home-schooling of youngsters,

and lack of physical contact with different family relations, friends, and colleagues, we must glance once on our mental health.

One threat to the COVID-19 response in India is the spread of misinformation driven by fear, stigma, and blame. There are rising levels of violence and stigmatization of people towards health-care employees and those suspected to COVID-19. Anti-Muslim sentiment and violence were going on caused due to the news on the group of Tablighi Jamaat group known for being answerable for several cases. WHO have voluntarily formed Indian Scientists' Respond to COVID-19 to fight myths and misinformation regarding the disease. We hear several news relating to COVID 19 from all over the world, through television, social media, newspaper, family and friends, and different sources. The biggest issues for people's mental wellbeing are typically the shortage of testing and lack of diagnosis of the disease. 70 % of individuals would rather opt to be vaccinated, or have their children vaccinated against the coronavirus if one is developed. Everyone is following the recommendation provided by the government to prevent the virus's spread. Besides the clinical pressure that medical professionals face daily at work, they are also considered to be a high-risk group. Additionally, the college closures caused a negative influence on student's psychological state too with no insight towards the lockdown outcome.

Therefore, this study is done to understand the psychological state of the millennials under the lockdown amid COVID 19 circumstances in India. This study aims to find the prevalence of anxiety, Stress, and Depression within the millennials. This study can facilitate the government officials and aid professionals responsible for COVID 19 to decision making, to figure on and to understand the psychological status of the millennials of our country by implementing some fortification in techniques to create them working and activate them throughout this lockdown amid COVID19.

Methodology-

A two-step procedure is carried out for the study i.e. quantitative and qualitative study. A quantitative study is done to get an approximate percentage of the people suffering from anxiety stress and depression during the lockdown and a qualitative study is done to observe and understand the status of mental health during the lockdown.

AS PER QUANTITATIVE ANALYSIS-

Data before lockdown from the Nation Mental Health Survey of India 2016 using Depression Anxiety and Stress Scale (DASS- 21) in the year 2016 and an Online survey on 1000 people to assess Depression, Anxiety, and Stress after lockdown implemented in the year 2020 is taken, compared and evaluated.

AND AS PER QUALITATIVE ANALYSIS-

To better perceive the mental state of individuals and to answer the research question, we adopt a qualitative analysis approach to improve our understanding of the study i.e. Netnography as a research technique. Netnographic analysis relies on the gathering of people's reviews containing careful data regarding their experiences printed on the web, new social settings, virtual and increased reality, telepresence, and present computing (2nd Edition on Netnography Redefined, Henry M. Robert V Kozinets). Compared to alternative qualitative analysis techniques, the distinctive price of netnography is that it excels at telling the story, understanding complicated social phenomena, and assists the research worker in developing themes from the interviewee's points of reading (Kozinets, 2002; Rageh, Melewar, & Woodside, 2013). The standard methodologies to analyze experiences, like observation, interviews, and focus teams, have a variety of drawbacks, like respondent taciturnity (Rageh et al., 2013). With these traditional strategies, the researchers' presence affects and interrupts the natural, traditional practices of daily life. Therefore, netnography is faster, simpler, and economical than ancient ethnography. These are a lot of representational and unassertive than focus teams or interviews (Kozinets, 2002; Shanghai dialect & Pearce, 2014). Additionally, the active use of the latest technologies and social media by individuals opens new views to review the mental state (Xiang & Gretzel, 2010). Individual reception progressively uses social networks either to specific read to the public or through blogs or to share their expertise with others by telecommunication throughout lockdown (Thanh, T. V., & Kirova, V. (2018)).

Data collection

This paper adapts Kozinets' (2002) Netnographic procedure to access the mental state context. The paper picked telecommunications, online blogs, and online news feeds. Postings associated with “depression, anxiety, stress, tension, effects on personal and career” are selected. In line with the previous definition, ten reviews associated with mental state condition and effects area unit announce from March 2020 to June month 2020 were

selected. To boost the dependableness of the information collected, we tend to accept posts and reviews of operating people individuals regardless of their language, geographic region, faith, and caste. Additionally, telecommunication interviews were taken and transcribed.

Data analysis

This study was subjected to the thematic analysis technique reported by Braun and Clarke (2006). The codes were formed categorically to arrange them in different themes for better understanding. The themes emerged were: **Stress or tension regarding this pandemic condition, Sleeping or eating issue, Reaction of the family towards their child's mental health, Internet, or media impact, Effect on studies, Stress related to Career, Previous experience which helped in coping in this situation, Effect personally or professionally, Smoke or drink issue, Health professional's feeling on stress or tension or difficulty**.

Result-

We did a two-part study i.e. a quantitative and qualitative study as discussed in the earlier section.

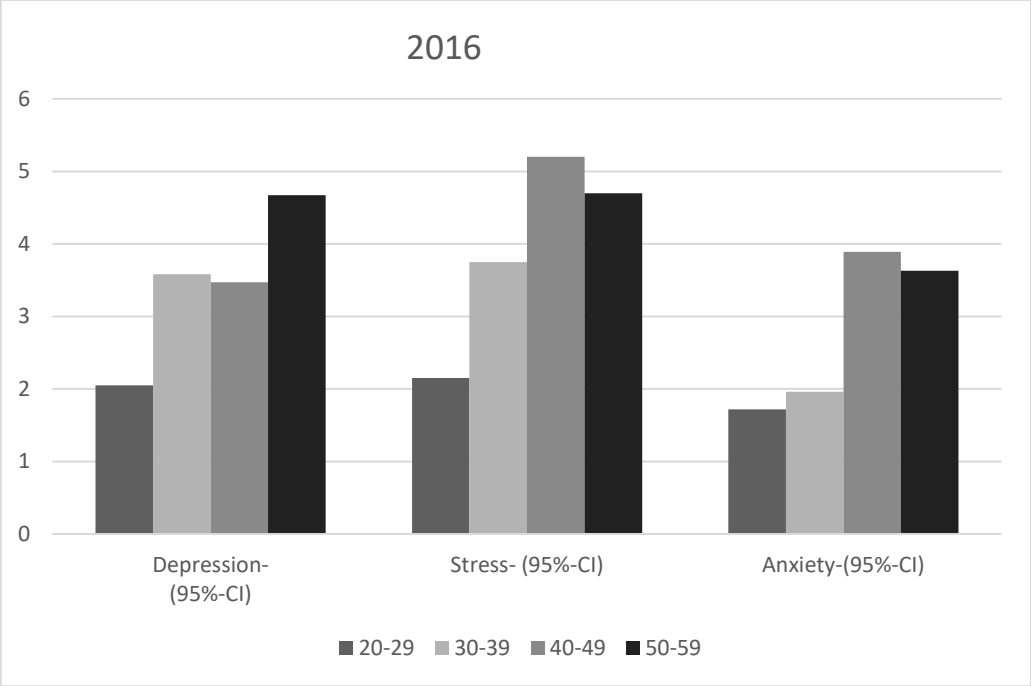
The result from a quantitative approach the data shows.

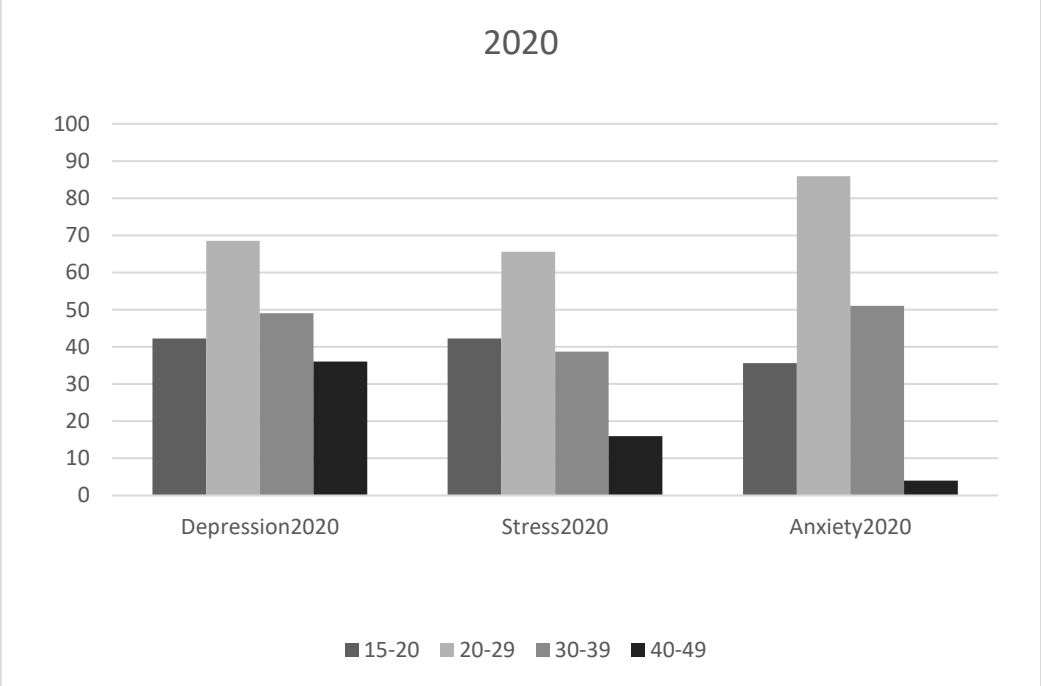
Age-

National Mental Health Survey of India 2016, Depression, Stress, and Anxiety was highest in the individuals belonging to the age range 40-49 years whereas it is highest in the individual belonging to age 20-29years after COVID 19 lockdown.

Age	**Depression-(95%-CI)**	**Stress-(95%-CI)**	**Anxiety-(95%-CI)**
20-29	2.05	2.15	1.72
30-39	3.58	3.75	1.96
40-49	3.47	5.2	3.89
50-59	4.67	4.7	3.63

Age	Depression 2020	Stress 2020	Anxiety 2020
15-20	42.2	42.2	35.6
20-29	68.5	65.6	85.9
30-39	49.0	38.7	51.0
40-49	36.0	16.0	4.0



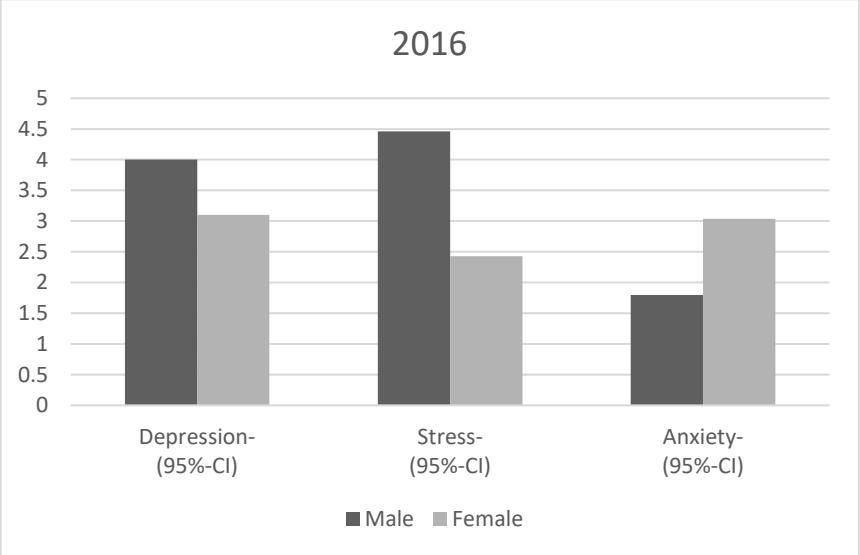


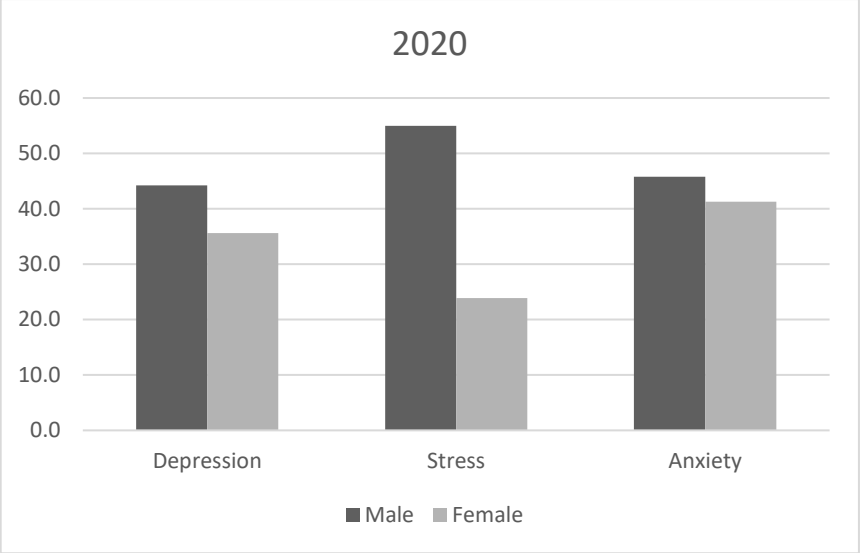
Gender-

The study of the National Mental Health Survey of India 2016 suggested that Anxiety is higher in females whereas males are depressed and stressed as compared to females. Anxiety increased in males after COVID 19 lockdown.

Gender	**Depression-(95%-CI)**	**Stress-(95%-CI)**	**Anxiety-(95%-CI)**
Male	4	4.46	1.8
Female	3.1	2.43	3.04

Gender	**Depression 2020**	**Stress 2020**	**Anxiety 2020**
Male	44.2	55.0	45.8
Female	35.6	23.9	41.3





The result from the qualitative approach of Netnographic study based on semi-structured and WHO interviews And online websites and blogs.

The study revealed that COVID 19 is creating psychological distress among the individual as there are restrictions due to lockdown. Individuals are going through a crisis and feeling a lack of control over their lives due to lockdown restrictions imposed upon them. Millennials and youngsters are facing uncertainty for career and profession. Clearly, millennials were expressing their feelings and looking for support from other's experiences via online modes. Mental health is expressed in varied ways, like from general feelings of boredom and loneliness to more alarming signs of depression. Most of the issues relating to anxiety and loneliness occurred in the first few months of the lockdown (cf., Ingleton and Cadman 2002).

Although it is believed that the data set from this particular forum is data-rich, still the limitation of this study was difficult to find mental health conditions of the millennials in a different profession. Nevertheless, the findings yielded several themes that contribute to existing knowledge on the experiences of millennials and highlight emerging themes that may be explored in future research. The outcome based on the themes created are-

1. Stress or tension regarding this pandemic condition

IN1) ".....I have a fear that after this lockdown ends how I will face the world, how I will interact with people and the greatest fear is about the job, as because of the pandemic every sector got a bad influence so after this lockdown, the organization will announce whether they have any job vacancy or not or any cut off in the salary negotiation…."

IN5) "…. Yah I have to stay at home there is no routine life. It's very stressful as there is a sudden cut off from people…."

2. Sleeping or eating issue

IN1) "…. There is a difference in sleeping patterns. I used to follow a healthy and scheduled life like I use to sleep at 10 pm and wake up at 5 or 6 am but it drastically changed to 2 am or 3 am to afternoon 11 am or 12 pm…."

IN4) "……. Yah, previously I use to work 10-12hrs a day and now it reduced to 4-5 hrs which have an impact in my physical work…."

IN5) ".....I guess I am not taking care of my health as its being to be initially, I use to sleep late and wake up late as it proceeded, I changed my habit I am following a routine life. But eating habit is the same I am not maintaining my diet…."

3. The reaction of the family towards their child's mental health

IN1) "…… yah they are paying attention to my mental and physical health and consolidation me by saying that everything is achieved as the time permits so don't worry about the job just study hard and try. If you get a job it's great, if you don't, then don't lose hope you will get someday, we are here….."

4. Internet or media impact

IN1) "…… it's scrying me 60% and helps me 40% personally like if I get any news regarding COVID cases that these many people died and all... So this aware me but scare me more…."

IN3) "..... After this COVID came into the picture I browse more about COVID before I use to browse about other stuff I am interested in but now I am browsing more about health and health-related issue like some disease Spanish loo or during the world war, there were many viruses attacked a wide population or whether COVID is a bioweapon or not and how its effecting human body, etc….."

IN5) "…… starting I use to browse a lot about corona but as the lockdown extended, I reduced the usage…."

IN7) "…… Minimizing watching, reading, or listening to news about COVID-19 that caused us to feel anxious or distressed; seeking information only from trusted sources and

mainly so that people can take practical steps to prepare for plans and protect themselves and loved ones. Seeking information updates at specific times during the day, once or twice. The sudden and near-constant stream of news reports. An outbreak can cause anyone to feel worried. Get the facts; not rumours and misinformation. Gather information at regular intervals from the WHO website and local health authority platforms in order to help you distinguish facts from rumours. Facts can help to minimize fears……"

5. Effect on studies

IN1) "……I suffer from lack of concentration. I am trying to do online studies and courses, but it's not working much for me as am not able to connect to it much……"

6. Stress-related to Career

IN2) "…… if I say no, I get support from my mates and seniors, we use to have conferences and meetings……"

IN5) "…… yah I am a student I had plans, and now due to this lockdown I have stress about the recruitment process and every other thing……"

7. Previous experience which helped in coping in this situation

IN2) "…… yes, I was bedridden for 1-2 months due to an accident few months ago. But everything went normal because I use to manage it by mobile by following up by teammates……"

IN5) "…… yah after my 12th boards I got a similar type of feeling but that time it resolved because my family was there with me but this time as my mom, my brother is not that I lack that.……."

8. Effect personally or professionally

IN3) "…… physically no but personally yah, I have a constant thought that when this corona will end, I want things to be normal I always have a thought whether it will ever go or not, will I be able to meet people whether I will be able to go to tourist places freely……."

"…… it's been 7 months I have met my family, I had many plans to go to my home-town which is not fulfilled due to corona so I had some psychological impact like constant fear because my parents are older, how it will affect my parent's health……."

IN4) "……I love it personally but as the time is rolling I have the stress of my professional life as I have my financial duty to overcome, I have to go to the hospital and also have to start my clinic in full terms……."

9. Smoke or drink issue

IN3) "…… yah I use to do it occasionally but after this lockdown, my frequency of smoking has increased maybe because of stress or maybe the impact of my friends' group……."

10. Health professional's feeling on stress or tension or difficulty

IN4) "…… 1st few days were hectic because of wearing PPE kit and maintaining all precautionary protocol, now I get habituated……."

IN7) "…… Feeling under pressure is a likely experience for you and many of your colleagues. It is quite normal to be feeling this way in the current situation. Stress and the feelings associated with it are by no means a reflection that you cannot do your job or that you are weak. Managing your mental health and psychosocial well-being during this time is as important as managing your physical health……."

IN7) "…… Take care of yourself at this time. Try and use helpful coping strategies such as ensuring sufficient rest and respite during work or between shifts, eat sufficient and healthy food, engage in physical activity, and stay in contact with family and friends. Avoid using unhelpful coping strategies such as the use of tobacco, alcohol, or other drugs. In the long term, these can worsen your mental and physical well-being. The COVID-19 outbreak is a unique and unprecedented scenario for many workers, particularly if they have not been involved in similar responses. Even so, using strategies that have worked for you in the past to manage times of stress can benefit you now. You are the person most likely to know how you can de-stress and you should not be hesitant in keeping yourself psychologically well. This is not a sprint; it's a marathon……."

IN7) "…… Some healthcare workers may, unfortunately, experience avoidance by their family or community owing to stigma or fear. This makes a challenging situation, more difficult. If possible, staying connected with your loved ones, including through digital

methods, is one way to maintain contact. Turn to your colleagues, your manager, or other trusted persons for social support – your colleagues may be having similar experiences to you……"

Followed by the thematic analysis which gave a gist about the reason for the mental illness of people during the lockdown, there were also some online reviews that lead to the conclusion of this study.

The Indian Express

By: Express News Service | Mumbai | Updated: June 16, 2020, 6:53:27 am

"A day when Sushant Singh Rajput was found dead at his Bandra home in Mumbai, the police aforementioned the actor had shown symptoms of depressive disorder and was consulting a specialist. The investigators said they learned this when recording the statement of six persons about Rajput's case"

India.com

Updated: June 26, 2020 11:17 PM IST

By IANS

"The mental depression is proving to additional dangerous than coronavirus in Jharkhand recently. If data of suicides are taken into consideration throughout the lockdown and Unlock 1.0, the average of individuals committing suicide each day is 5.5.

According to data of the state government, 449 folks have committed suicide in March, April, and up to June 25. In June itself 134 people have committed suicide. One person is committing suicide every 4.50 hours.

Psychiatrists say that the depression due to lockdown has created a deep impact on the minds of the people"

Updated: June 28, 2020 3:43 PM IST

By India.com News Desk

"Ludhiana Police on Sunday revealed that the number of suicide and domestic violence cases in the city have risen during the lockdown, with a total of 100 cases of suicide and

1,500 complaints of domestic violence being registered by the police in this duration, up dramatically from 60 and 850 respectively before the lockdown.
The police further attributed the surge in cases of suicide and domestic violence to depression, unemployment, and financial issues"

BBC News

25 June 2020

"Coronavirus: Young people 'more anxious during lockdown'
The study found the number of 27-29-year olds experiencing anxiety rose from 13% to 24% and they were more anxious than their parents.
Underlying conditions and financial worries may be behind the increase"

INSTAGRAM

Indiatimesinsta (https://www.instagram.com/tv/CCIDM8zCYiI/?Igshid=amv2yuinahhc)
Verified
The Lockdown Has Triggered A Rise In Violence Against Women
Domestic violence has been at a 10-year high in this lockdown period, according to the National Commission for Women. While the coronavirus pandemic has impacted everyone, it's been a double whammy for women. Not only are they reeling under increased household work, with their children and husbands now at home 24x7. They are now also subjected to more violence and abuse at home. Cases of rape, molestation, domestic violence, dowry abuse, physical and sexual violence have risen quite sharply. NCW says this is just the tip of the iceberg, the actual number of cases is much higher. @pragyaherself in this episode talks about why the cases are rising. What victims of domestic violence can do? And what all of us can do. She's Thinking Aloud. What about you?
.
.
.
#domesticviolence #sexualabuse #lockdown #covid19 #coronavirus #rape #suicide #helpline #help #equality #genderdiscrimation #stopabuse #lockdown #Unlock #violence

Discussion-

Studies suggest that this lockdown will cause psychological effects on Millennials, which is expressed as Anxiety, Stress, and Depression (Mei et al., 2011). The goal of the study was to assess the mental state of Millennials throughout the pandemic and survey the factors affecting their psychological state. The study revealed that Covid-19 is creating psychological distress among the individuals, as there are restrictions due to lockdown people which forced people to stay home. Individuals are feeling a lack of control over their lives due to lockdown and restrictions imposed upon them. Millennials are facing uncertainty concerning their career and professional life (jobs are at stake). Fear of infection is creating a panic situation among them. The results indicate that millennials' anxiety regarding the pandemic was associated with their area of living and source of earning. The condition of family earning is additionally a notable consideration in students experiencing anxiety throughout the COVID-19 crisis, which explains exaggerated psychological and economic pressure (Liu, 2013). Living with parents was another commending factor against feeling anxious. Moreover, unreasonable and sensational news headlines and inaccurate news reports have also added to anxiety and fear (Ayittey et al., 2020).

Travel warnings and bans, and increasing holidays to regulate the outbreak, are some actions taken by the government which inevitably disrupted routine life and resulted in anxiety, stress, and depression (Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., & Zheng, J. (2020)). The negative psychological effects caused by perceived immobility, unemployment, or extra-work are the beginning effect on people and it is becoming serious over time. If we expect people to keep following the recommendations of the government's further extension (as may be necessary to curb the spread of COVID-19) and remain inside, it is necessary to find ways to reduce the negative effects of lockdown. Possibilities on social interaction activities, safe ways for people to get fresh air outside, online collective work, classes will cause some differences in people's mental health. The novel ways of bridging social capital between young and old, or even giving out inexpensive tablets or laptops or any handsets to ensure the whole population has connectivity virtually. Communications from the government should be such that it explain to the citizens the ill effect and consequences of the disease. Interventions that make people staying at home by online social reading activities, virtual social interactions, exercise routines, classes, etc. — all planned to decrease the worries of long-term social isolation. If activities and

interventions are implemented, it will make the situation easier for those affected by it, the population may be able to better tolerate the treatment for as long as it takes to beat this public health crisis. (Barari, S., Caria, S., Davola, A., Falco, P., Fetzer, T., Fiorin, S., ... & Kraft-Todd, G. (2020)) Evaluating, preventing, and controlling mental health and helping in psychosocial rehabilitation of the affected individuals would lower the mental health crisis.

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Part 2:

Report on Online Course

Table of content

COURSE REPORT

Name Of The Course-

Data Analytics for Lean Six Sigma

Course Description-

This course thought data analytics techniques that will help in Lean Six Sigma improvement projects. Analysing and interpreting data under such a project will be learned. A statistical data tool i.e. Minitab is also added for further use. A brief outcome is also explained. Many different examples are used to illustrate from lean six sigma projects. The technique that can be used in a broader setting is used through data analytic tools.

Objectives of The Course-

Lean Six Sigma improves to analyze, interpret, and to use data for solving the problem.
The question that can be analysed are-
What is the important issue an organization should focus on?
How can a phenomenon have quantified?
Which department shows the best performance?
How to decrease no. of defects?
Is there a difference in quality before and after my project?

Course Contents-

Introduction to Data Analytics for Lean Six Sigma

Introduction to Lean Six Sigma
Data and DMAIC
Selecting CTQs
Units and Operational definition
Sampling
Organizing Data
What is Minitab
Introduction, installation, and loading data into Minitab.

Understanding and Visualizing data

Numerical and categorical data

Descriptive statistics

Visualizing categorical data

Pareto analysis

Visualizing two variables

Using Probability distribution

Population versus sampling

Estimation and confidence interval

Normal, Lognormal and Weibull

Probability plot

Empirical CDF

Properties of the normal distribution

Introduction to testing

Introduction to data analysis

Hypothesis testing

Causality

Testing: numerical Y and categorical X

Introduction to ANOVA

ANOVA analysis

ANOVA residual analysis

Kruskal-Wallis test

Two sample t-test

Test for equality of variance

Testing: numerical Y and numerical Y

Correlation

Introduction to regression

Regression analysis

Regression residual analysis

Regression prediction interval

Quadratic regression

Learning Methodology Used in The Course (Lectures/Ppt/Video/Cases/Webinar/ Assignments/Reading Material)

Video lecture, Reading Material, and Quiz

Key Learnings from The Course writing

Introduction to Lean Six sigma-A popular method to improve a process like withstand competition, Higher customer expectation adaption, innovating technology.

5 phases- DMAIC:

D. Define- select project and establish objective

M. Measure- Measurable and quantifying the problem

A. Analyze- Current situation analyzing and diagnosing

I. Improve- Improvement actions to be developed and implemented.

C. Control- Improved process performance controlling and project closing

CTQ-Critical To Quality-also known as

Y- Variable

Dependent Variable

Outcome Variable

Unit- People, Objects, Phenomena

(Experimental unit, Observational unit, Unit of analysis, Case, Subject)

Measurement Unit-Unit of Measurement

Sampling- Always use the computer for sampling

Organized Data- Unit (People, Objects, Phenomena) and Variable (Properties that are measured)

Organizing Database- Units in **rows** and Variables in **columns.**

Minitab17 software -Apply statistical tools to the data

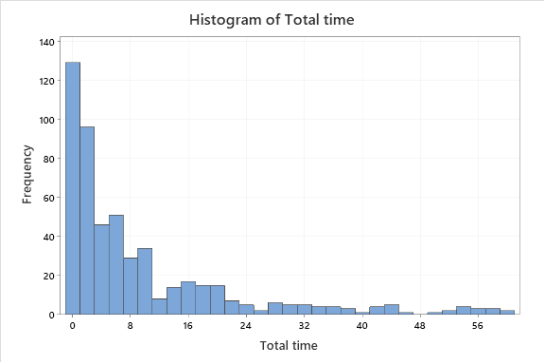
Numerical Data and Categorical Data

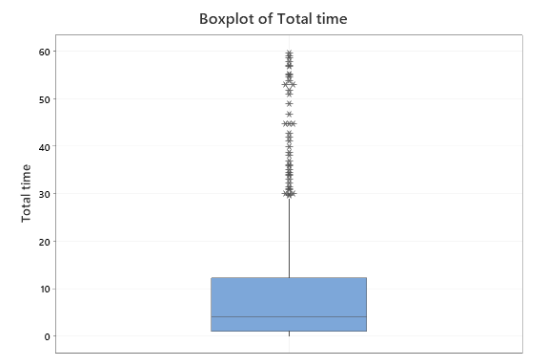
	Numerical	**Categorical**
About	Discrete and Continuous	Ordinal, Nominal and Binary
Type	Quantitative	Qualitative
Sample Size	N=30	N=300
CTQ	Histogram, Boxplot	Pie Chart, Bar Chart, Pareto Chart

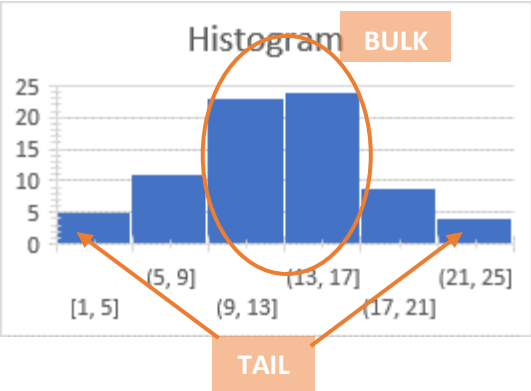
Descriptive statistics on Minitab- No. of values, Mean, Variance, Standard Deviation, Minimum and Maximum from the data, Median, Quartile, and Interquartile range (IQR).

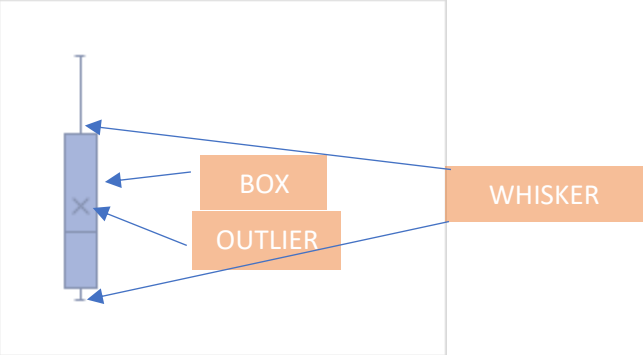
Graph-Histogram and Boxplot for a numerical variable

Types: Symmetrical distribution, Skewed or Mixture of distribution

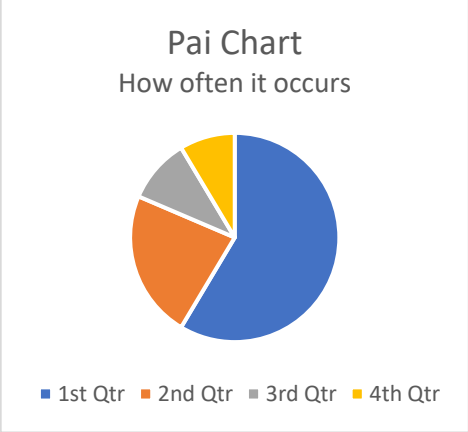


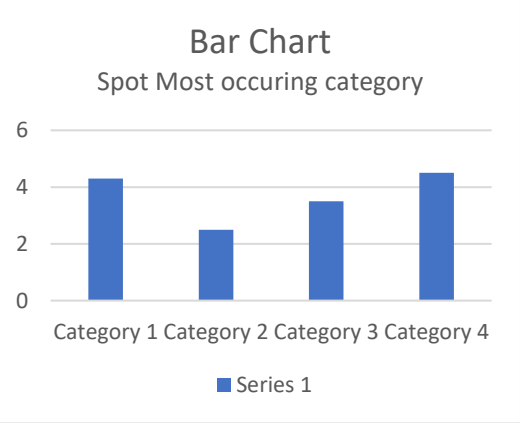






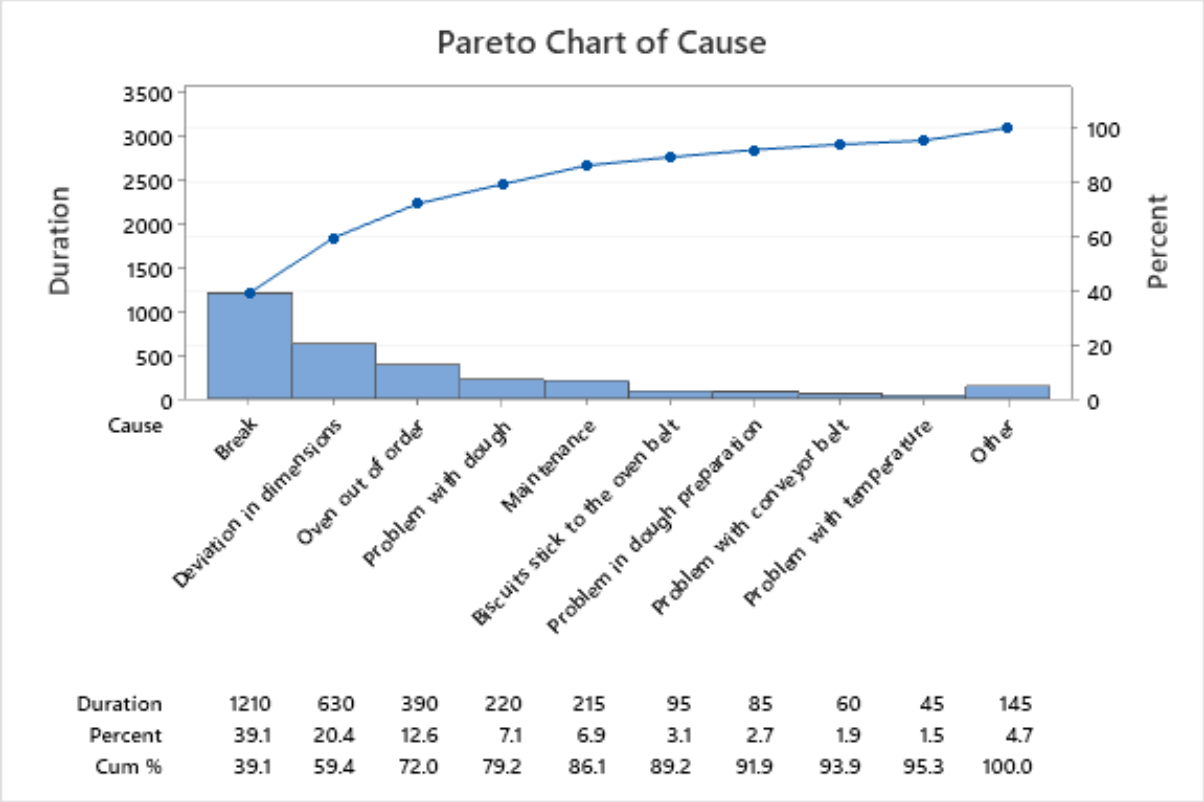
Pie Chart and Bar Chart for categorical variable





Tally Table
Show exact numbers

Pareto Chart- Single out the few Vital issues from the trivial many



Boxplot can be used to visualize the variable when there is numerical X and categorical Y.

Sample and population

Population- the collection of all unit of interest (μ, σ)

μ-population location:

- Mean -precise
- Median- take the out liars

σ- population spread:

- Standard Deviation(S)
- Interquartile range(Q_3-Q_1)
- Range (Max-Min)

Sample-a subset of the population (mean, S)

Estimation-Generalise the sample distribution to population distribution.

Confidence Interval -Gives boundaries, where the population mean, will be in between with a certain level of confidence.

Probability Distribution-

- **Normal**-symmetrical and bell-shaped

  68%-between σ

  95%- between 2σ

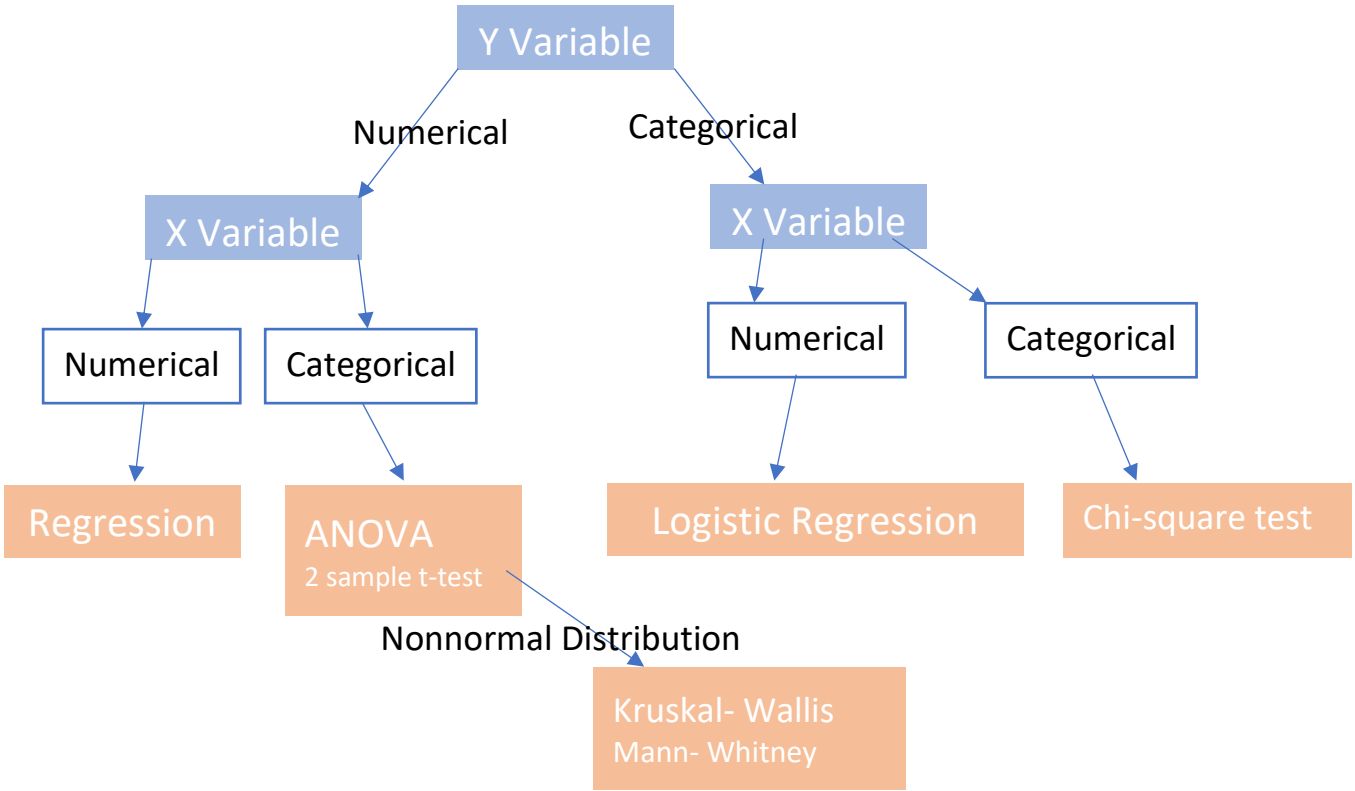
  99%-between 2.5σ

  99.7%-between 3σ
- **Weibull**-skewed
- **Lognormal**-skewed

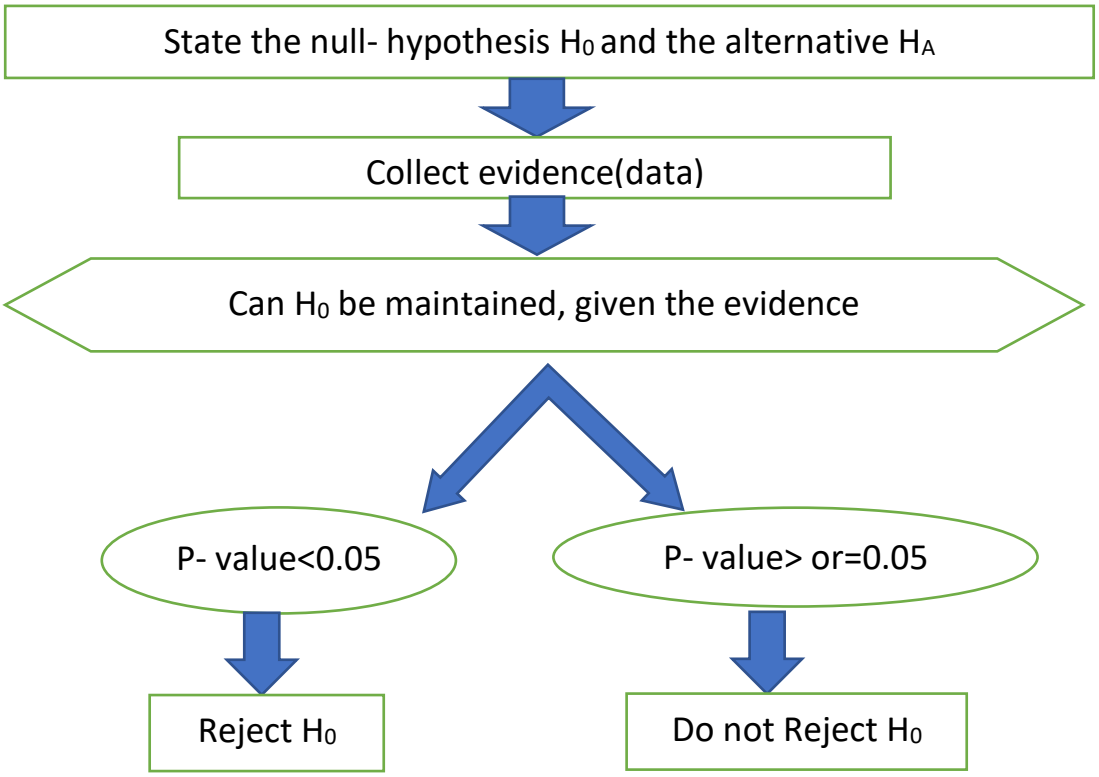
The probability plot is the visual tool to fit a distribution to the data and can be used data anomalies.

Empirical CDF-Use crosshairs or percentile lines to find percentages.
It is used to analyze the phase in Lean Six Sigma.

Data Base Testing- Improve phase of DMAIC



Hypothesis Testing-



Correlation and Causation-

- Correlation- two things move in the same direction
- Causation-one thing causes the other to change

ANOVA-Analysis of Variance analysis – Used to study the relation between numerical Y and categorical X variables

It is performed in three steps:

1. Organize data- Y and X variables are in separate columns.

2.ANOVA- Group means identical for each of the levels of the X variable.

3. Residuals-Random scatters, outliers, and irregularities.

ANOVA -Hypothesis Test

Analysis procedure often results in a p-value

Null hypothesis H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$

Alternative Hypothesis H_a: $\mu_i \neq \mu_j$ for some i and j

p- values determine the significance

- Below 0.5: X has a significant effect
- 0.05 or higher: X is not significant

R^2 is the percentage of the variation in the measurement that is explained by the model. It measures the impact of the influence factor.

- R^2 large: strong, X is a 'big fish'
- R^2 small: weak, vital Xs are missing

Residual-Calculated by subtracting the mean of the relevant machine from each observation.

(Residual = measurement – group mean)

Kruskal-Wallis Test-Non-parametric test does not make assumptions

It is an alternative to the ANOVA if assumptions are not met.

To interpret the output, you must look at:

- Median for each group
- P-value to determine if the results are significant

Two sample t test-It is a simple test comparing the means of two different groups.

p- values can be used to calculate whether the difference between two means is coincidental or truly significant.

Test for equal variance- it compares variance across groups with the test for equal variance. It is also used in ANOVA analysis to determine if the 'assume equal variance' mode be used (p-value will be more precise).

Correlation-it is an index that expresses how strong a relationship between two numerical variables is.

- The index is between -1 to +1
- 0 mean no relation

Rule of thumb-

- 0 to 0.4: No or weak positive correlation
- 0.4 to 0.8: Moderate positive correlation
- 0.8 to 1: Strong positive correlation

- 0 to -0.4: No or weak negative correlation
- -0.4 to -0.8: Moderate negative correlation
- -0.8 to -1: Strong negative correlation

Regression Analysis- it is a statistical method to test if two numerical variables are related to each other.

Steps: Study the relation between numerical Y and numerical X variable

1. Fitted line plot:
    - Fit a line $Y = a + bX$ that describe the relationship

2. Regression:
    - Is the evidence for the relationship significant?
    - Is the relationship strong?

Hypothesis test-

Null Hypothesis H_0: there is no significant relationship($b=0$)

Alternative Hypothesis H_A: there is a significant relationship($b \neq 0$)

$p < 0.05$: found significant relation, H_A can be supported

$p > 0.05$: found no significant relation, H_0 cannot be rejected

R^2 is large, X is a strong predictor of Y

R^2 is small, Variation in Y remains unexplained

3. Residuals:
    - Are the residuals normal?
    - Are there outliers or irregularities?

   Residual = observed value(data) – fitted value (estimated regression line)
    - Outliers: Remove outliers
    - Non-linearity: Quadratic regression
    - Other problems: Many possible solutions

4. Prediction interval:
    - Bounds for 95% of data points

   The prediction interval can be used to determine the level of the influence factor, which ensures a certain CTQ performance.

   A crosshair or the formula can be used to determine the required value of the influence factor.

Quadratic Regression- $Y = a + bX + cX^2$

If the assumptions of regression analysis are not met, an alternative technique is performed i.e. Quadratic regression

It fits a Curved Line

After the main analysis, residual analysis is performed.

Chi-square analysis-It is a suitable method if categorical Y and categorical X are present.

1. Cross Tabulation:
    - Copy cross-tabulation data into the worksheet

2. Chi-square analysis and p-value:
    - Chi-square analysis gives a p-value
    - The p-value shows whether the evidence for the relationship between X and Y is significant.

H_0: there is no relation between X and Y

H_A: there is a relation between X and Y

Logistic Regression-

Steps: Study the relation between categorical Y and numerical X variables

1. Enter data in trial/ event format
    - Convert the database

2. Make Fitted line plot
    - Evaluate the quality of the fit

3. P-value
    - Is the evidence for the relationship significant?