

A comprehensive estimation and analysis of the basic reproduction number (R_0) of novel corona virus in India: A comparative study with different lockdown phase of COVID-19



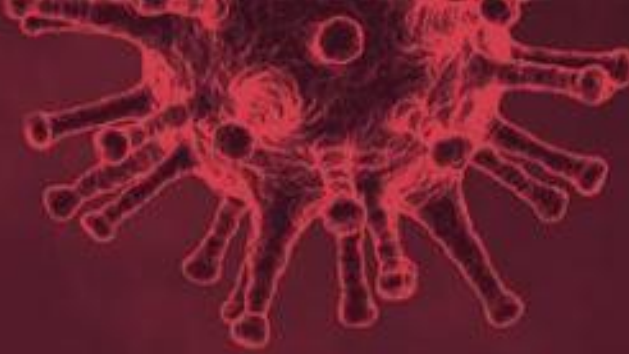
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MBA-Hospital & Healthcare Administration
1st Year
ROLL NO - 0931

INTRODUCTION

Corona virus disease COVID-19 seems to be more infectious than the previously identified SARS viruses and is caused by a member of the viral SARS family, named the Corona virus CoV 2 virus. World Health organization declared Covid-19 as an outbreak. The cases of corona in India has been raised exponentially and it will cause more loss for India. The cases are growing rapidly and the Indian administration department must implement combative preventive measures like lockdown, wearing of masks, and using face shields contained social distancing should be taken to control the spread of infection by the community. Governments around the world made more severe and perhaps onerous lockdown steps as a policy measure of containment. The lockdown had a lot impact on corona. During the lockdown, the growth might control and not have been have gone into the exponential zone. The data of official Indian sources shown that how the cases varies in lockdown and without lockdown. Also a term reproduction number (R_0), demonstrate a overview of average number of individuals who are susceptible to infection and help in a disease transmission analysis. The effect partial lifting of the lockdown (unlock) is also seen in the results, in terms of increment in R_0 values. Hence, a study will essential for provides a platform for policy makers and government authorities for implementing the strategies to prevent the spread of infection.

Key Terms:

COVID-19,
India,
Lockdown,
Outbreak,
Prediction,
R packages,
R0 estimation



SARS-CoV-2

N95

COVID-19

Coronavirus

Quarantine

Pandemic

Social Distancing

A blue surgical mask is positioned over a view of the Earth from space. The mask's mesh and pleated sections are visible, and it appears to be protecting the planet. The word "OBJECTIVES" is written in large, bold, pink capital letters across the center of the mask.

OBJECTIVES

Exhaustive analysis of the reproductive number in India with major intervention for COVID-19 outbreaks and analysed the lockdown effects on the Covid-19 viral disease spread.

Various facets are addressed, including the spread of diseases in various lockdown in India, predicted reproductive numbers for the next several days, the effect of this forecasting on prolonged lockdown, the influence of social distances on the residents in India, and the analysis of Indian lock-up methodologies. It has also studied the potential justification for such defections.

About

The basic reproduction R_0 is the number of secondary infections by a disease's primary infection, and it is a basic epidemiological metric that assesses the first-rate of infection transmission throughout a disease outbreak, along with other aspects.

R_0 predictions are based upon the assumption that perhaps the values at the beginning of the outbreak represent the population's assets and thus predict a plausible rate of infectious disease if an outbreak is back on the rise.

The infection occurs to start growing in a community whenever $R_0 > 1$, and not after $R_0 < 1$. The bigger the significance of R_0 , the more difficult the outbreak is to manage and the more likely an epidemic is to occur.

The global pandemic reproduction number (R_0) can be defined in various ways, for example with the Stochastic SIR (DCM) model, the Poissonian probability-based (ML) model, and the Exponential Growth Rate (EGR) model.

The background image shows a city street scene, possibly during a lockdown. A large, red, distressed-style text 'LOCKDOWN' is superimposed across the upper half of the image. Below it, the text 'In INDIA' is visible in a lighter, semi-transparent font. The scene includes a road, a fence, and some buildings in the distance.

LOCKDOWN

In INDIA

The nationwide lockdown on 22nd March 2020 announced by the central government of India



COVID-19 CRISIS

FIRST DAY OF LOCKDOWN IN INDIA

The Indian government has taken this initiative strictly and announced the 25 March 2020 lockdown, which had lasted 21 days until 14 April 2020. The residents were only permitted to leave in emergencies with prior authorization from the local authorities.



Home quarantine is applicable to all such contacts of a suspect or confirmed case of COVID-19.



Health experts and governments across the world have been advising people to practice social distancing to halt the spread of the deadly coronavirus. In India too, constantly being told to avoid physical contact and maintain a distance of at least one meter from others.



From dairy, fruits, vegetables to groceries, there are plenty of products delivered at our doorsteps which aren't exactly sterile. WHO has advised to clean the surface with simple disinfectant and wash your hands thoroughly with soap and water for at least 20 seconds or clean them with an alcohol-based hand sanitizer.

**Government
announced that face
should be cover using
mask or any shield
thing**

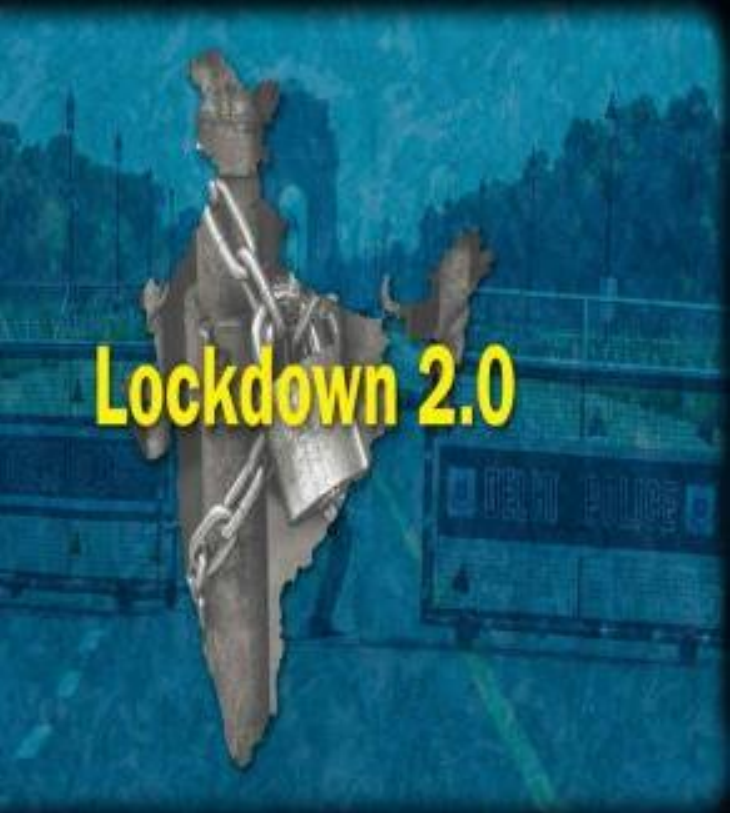


**After started Lockdown, the police
and administration in action. The
government provided to Indian
polices legal permission to charge
against any Individuals who are not
worry about corona and breaks the
rules.**



**Starting of lockdown the
policy measures action such
as Thermal Skinning should
be compulsory for each
individuals who migrate in
India from one place to other
and also who reached india
from other country.**





Lockdown 2.0

Effectiveness of lockdown 1 gives a decision to healthcare authorities and central government to implement lockdown 2 to further reduce the spread of infection. Lockdown 2 was implemented for 18 day from 15th April until 3rd May with similar restricted movement as in lockdown 1.

Both lockdown 1 and lockdown 2 last for almost 39 days with restricted movement, this causes an uncertainty and lack of household resources, tends public and authorities to generate an alternative options. During lockdown 3 the state government allow a flow of movement in orange and green zone areas for a restricted time and with complete precaution measures like social distancing, wearing mask etc. Lockdown 3 was implemented for 14 day from 4th May until 17th May in whole India.



Lockdown 4.0

The Final lockdown had been implemented during 18th May until 18th May with a opened allow guideline to with low strict actions and rules.

Certain mathematical equations and parameters for the number reproduction (R_0) have been implemented in the current analysis.

SIR model based method used (S- Susceptible, I- Infected, R- Recovered

Reproduction rate is $R(t) = \beta E(t) = \frac{\beta}{\gamma}$, where β , the infection rate that manage the transition between S and I and γ the

The mathematical essence of the model can captured by a set of coupled first order linear homogenous differential equations

Implemented some mathematical algorithm and method (LBFGS) with packages of R programming language code

Demonstrate the optimal values of β and γ parameters for daily basis cases

The ode() function that defined ordinary differential equation, from r packages deSolve creates equation easy for the system

Estimates values of parameters for calculation of R_0 for the current study, simply used the optim() function



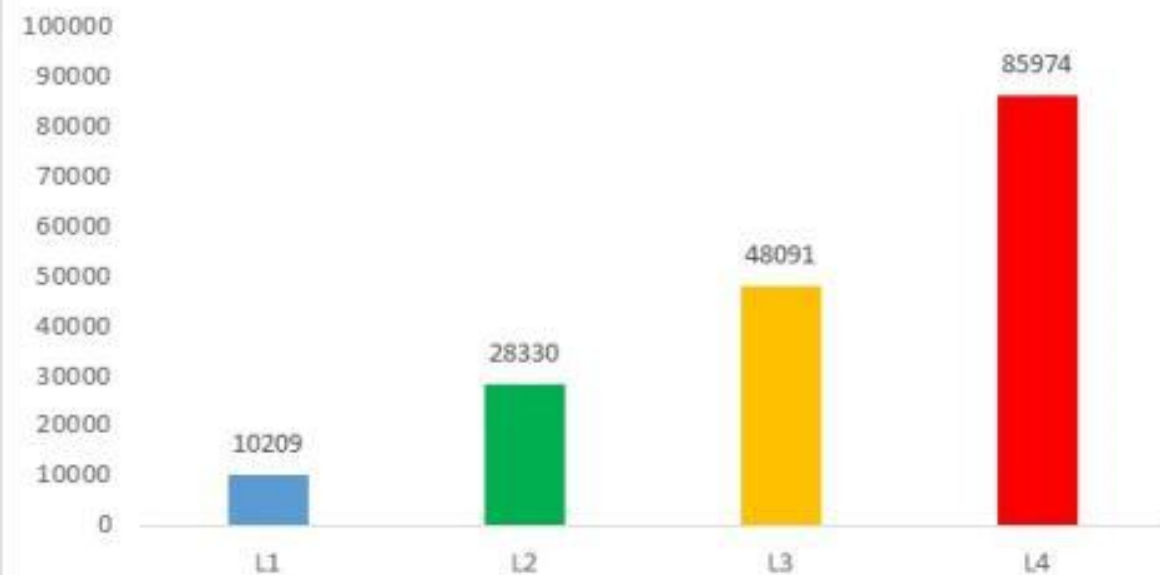
RESULT

**Lockdown
Analysis**

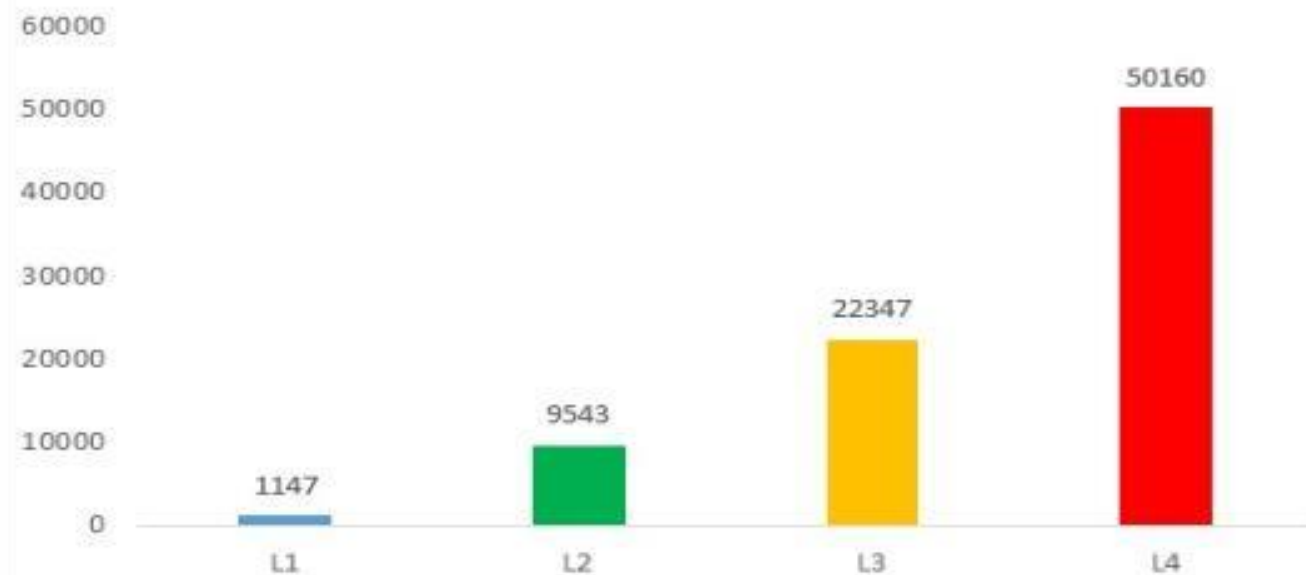
**R0
Analysis**

**STAY HOME
BE SAFE**

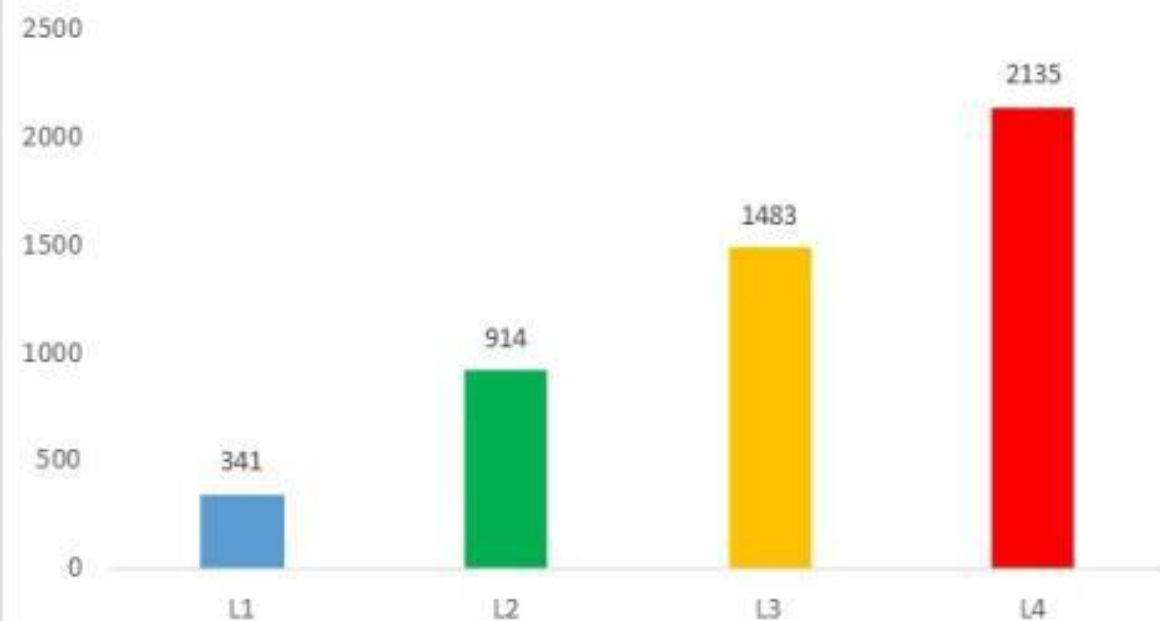
Total Confirmed Cases in Different Lockdowns



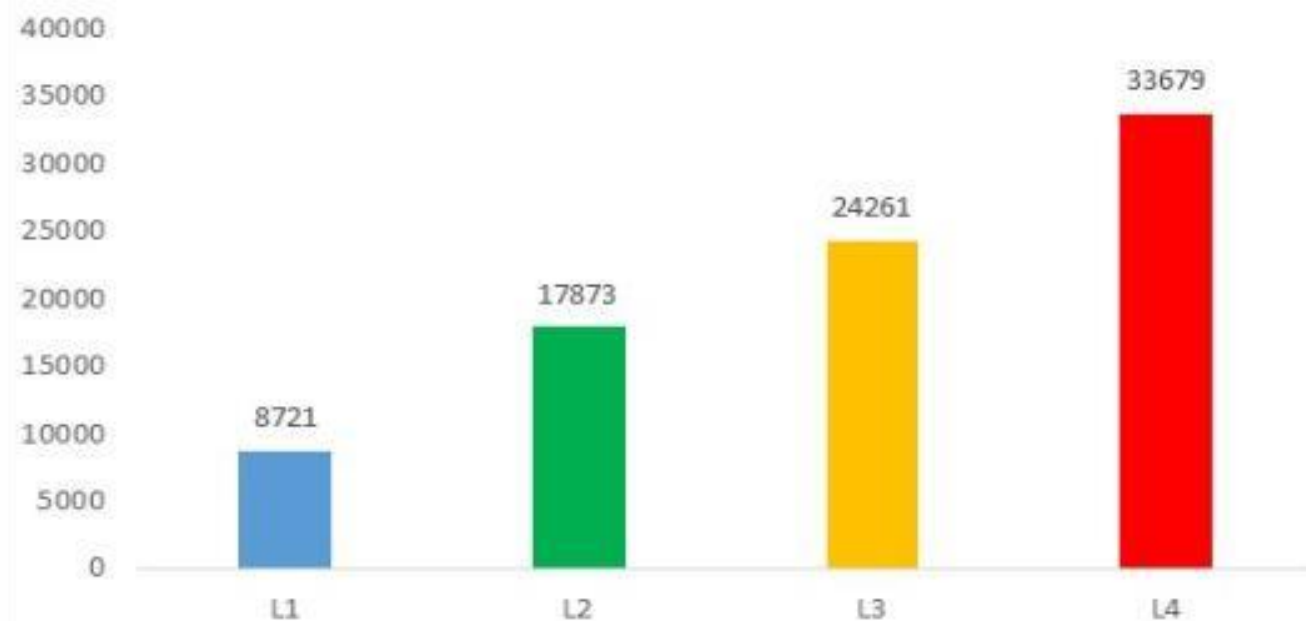
Total Recovered Cases in Different Lockdowns



Total Death Cases in Different Lockdowns



Active Cases in Different Lockdowns

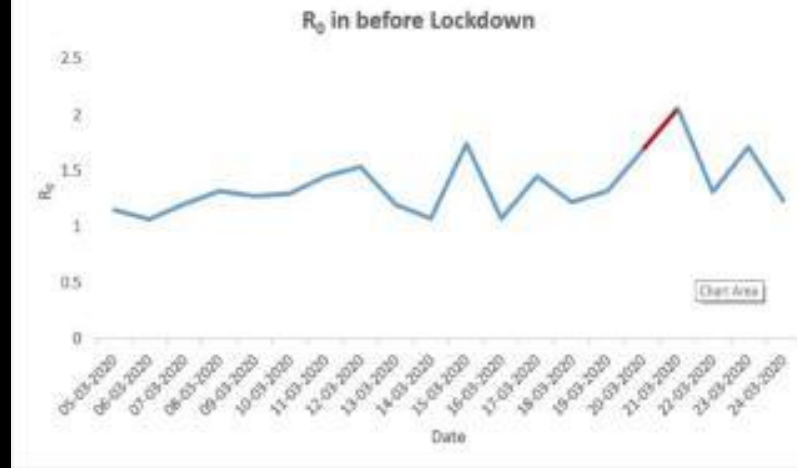


A spike was noted on 21 March 2020 in India. Thereafter, the nationwide lockdown on 22nd March 2020 announced by the central government of India, proves to be an effective measure in reducing the value of reproduction number (R_0)

Merely after this effective measure, a lockdown for 21 days was announced

Initially at the beginning of lockdown i.e. on 25 March, the R_0 value is around 1.37, thus merely started declining within 2 days of lockdown

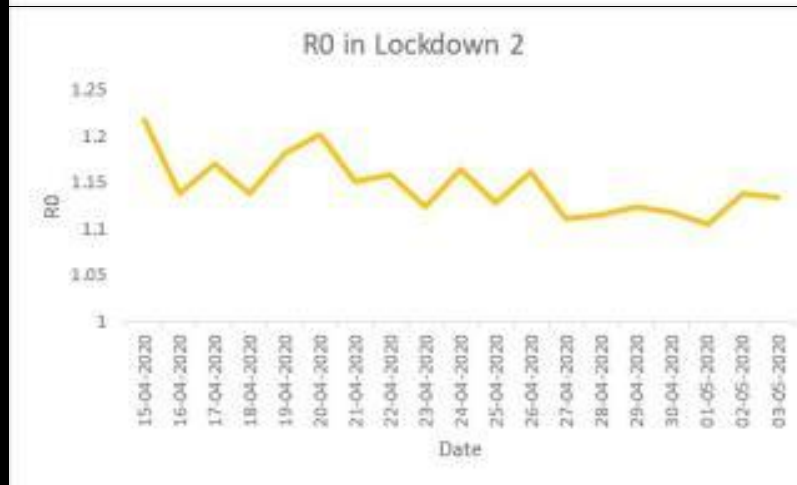
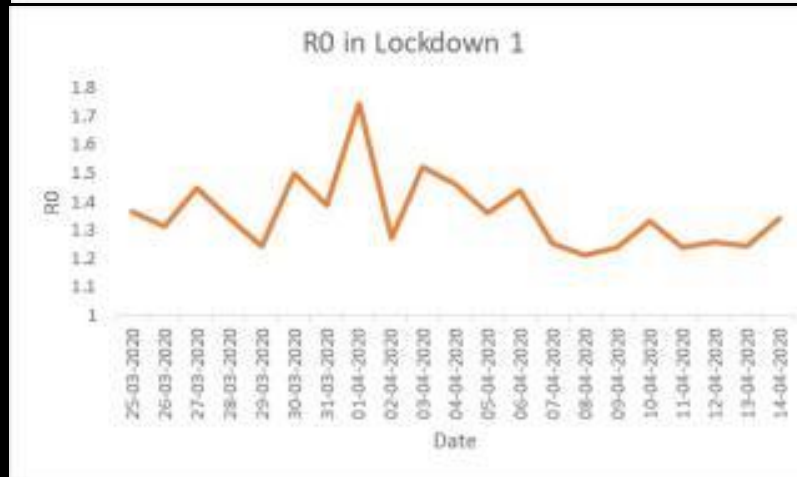
Henceforth lockdown 1 can be considered as significantly effective as it not only control the spread of infection but also reduces the reproduction number from 1.37 to 1.23



During first week of April around two sharp peaks were obtained indicating the increase in number of infected cases

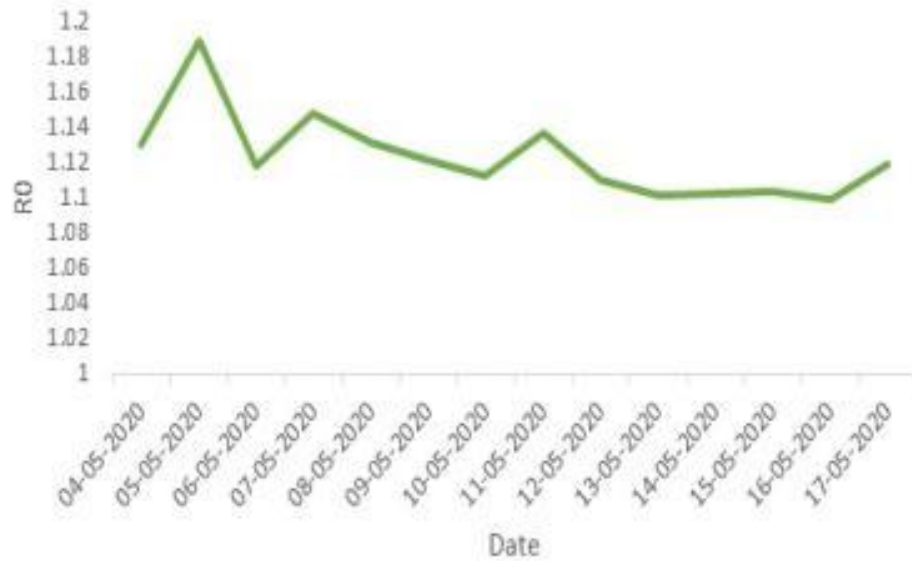
Afterward the value of R_0 peak declined continuously to 1.21, hence reducing the spread

Around 18 April a peak was observed where R_0 value increases due to the fall off effect of tablighi jamaat



Afterwards the R_0 peak continuously declined from 1.21 to 1.13, hence this can be considered as an effective lockdown in contrast to preventing the spread of infection

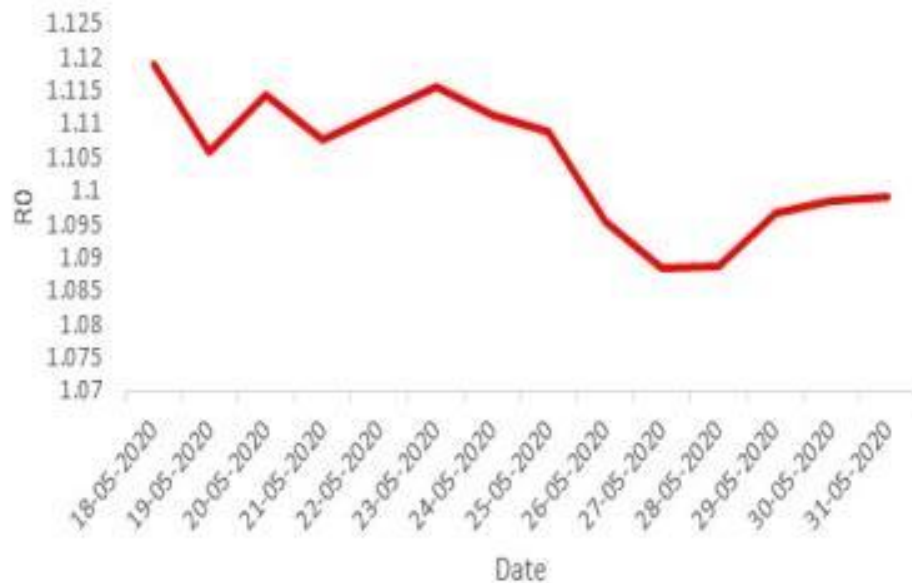
R0 in Lockdown 3



During lockdown 3 the state government allow a flow of movement in orange and green zone areas for a restricted time and with complete precaution measures like social distancing, wearing mask etc. Moreover the transportation restrictions are somehow lifted with shramik train facilities and pass facility for personal vehicle; this leads to a sudden rise in peak around 5th May, which drastically goes down as the precautionary measures are taken carefully.

Lockdown 3 doesn't prove as an effective because the restricted policies are lifted and a slight change in spread rate is observed i.e. from 1.13 to 1.12 value of R0

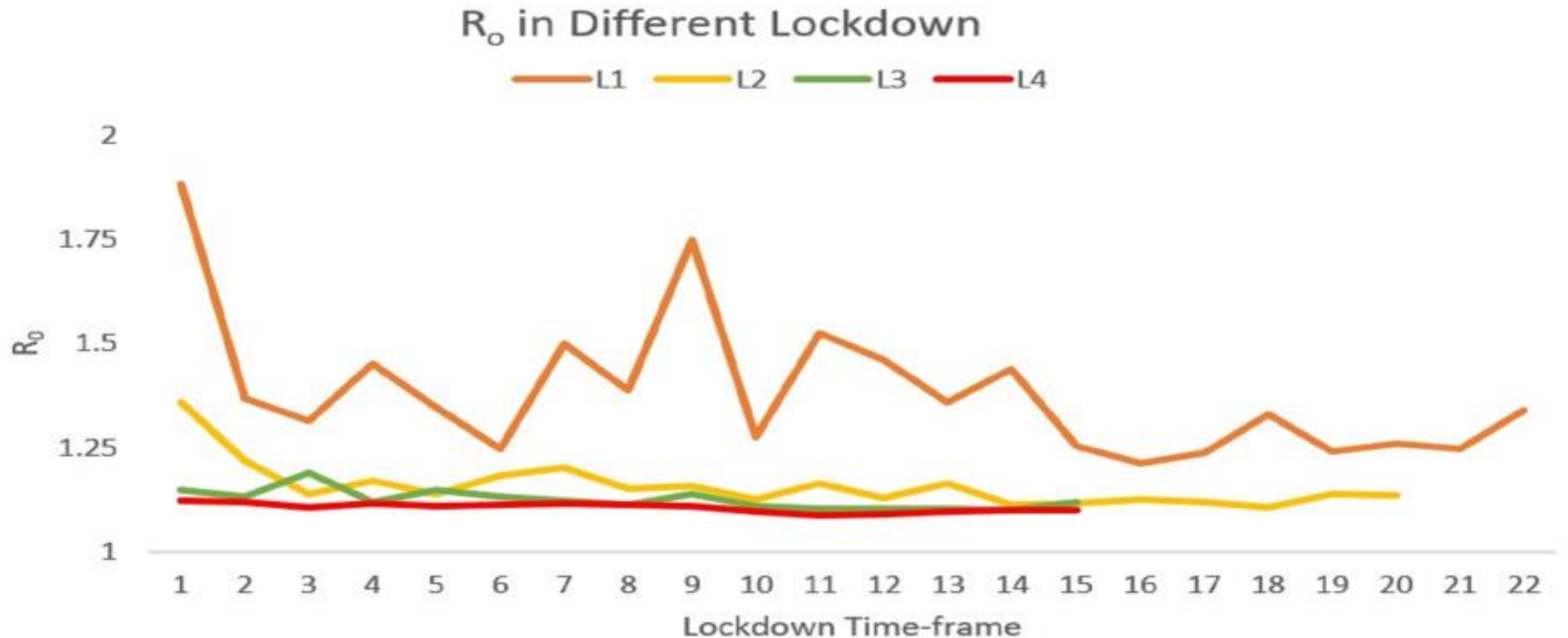
R0 in Lockdown 4



Unlike lockdown 3, a considerably change in spread of infection was observed further during lockdown 4 i.e. from 18 May till 30th May, the R0 value decreased down from 1.12 to 1.08 (Fig 2). This is due to health belief of people due covid-19 like wearing mask, good hygiene practice, social distancing and other factors

Taking lockdown into account, it gives a continuously decline in R0 value from 1.73 to 1.08 from lockdown 1 to lockdown 4

A comprehensive analysis chart define the transmission of COVID-19 reproduction rate (R_0) in varies lockdown time frame in India



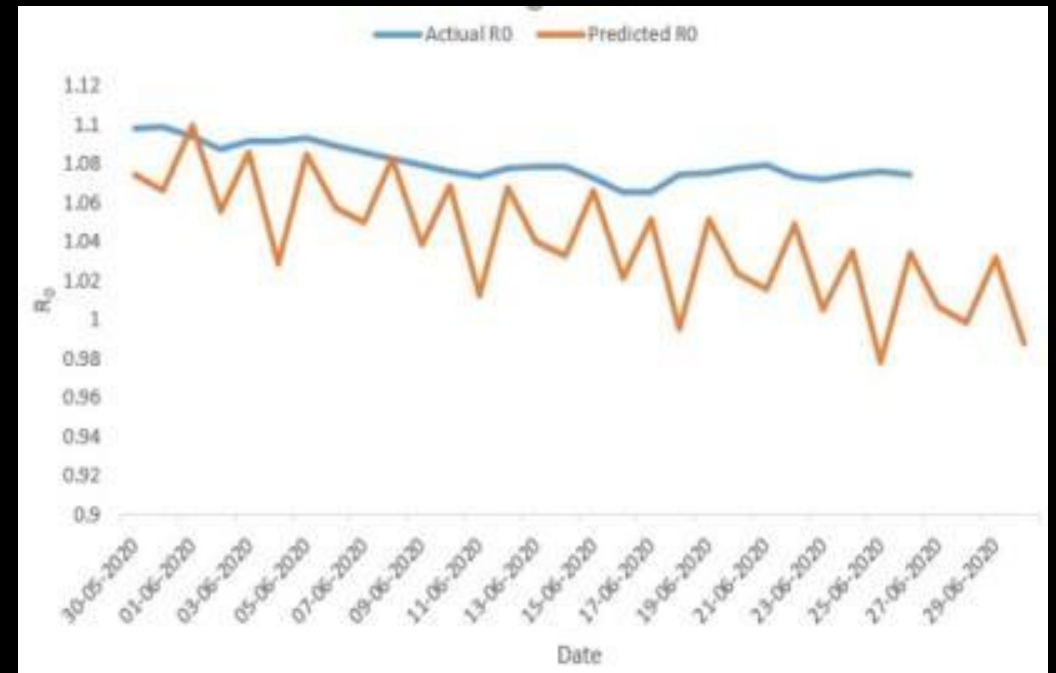


During first week of April around two sharp peaks were obtained indicating the increase in number of infected cases, this is due to “*Tablighi jamaat*” congregation that took place in Delhi during March 2020. More than 9,000 people have attended the congregation, from various states of India, and with more than 4,000 confirmed infected cases and around 27 deaths linked to this event were reported. By 3 April, over 950 confirmed cases were detected across 14 states and union territories in the country, including 97 percent of the total confirmed cases in the country (647 out of 664 cases).

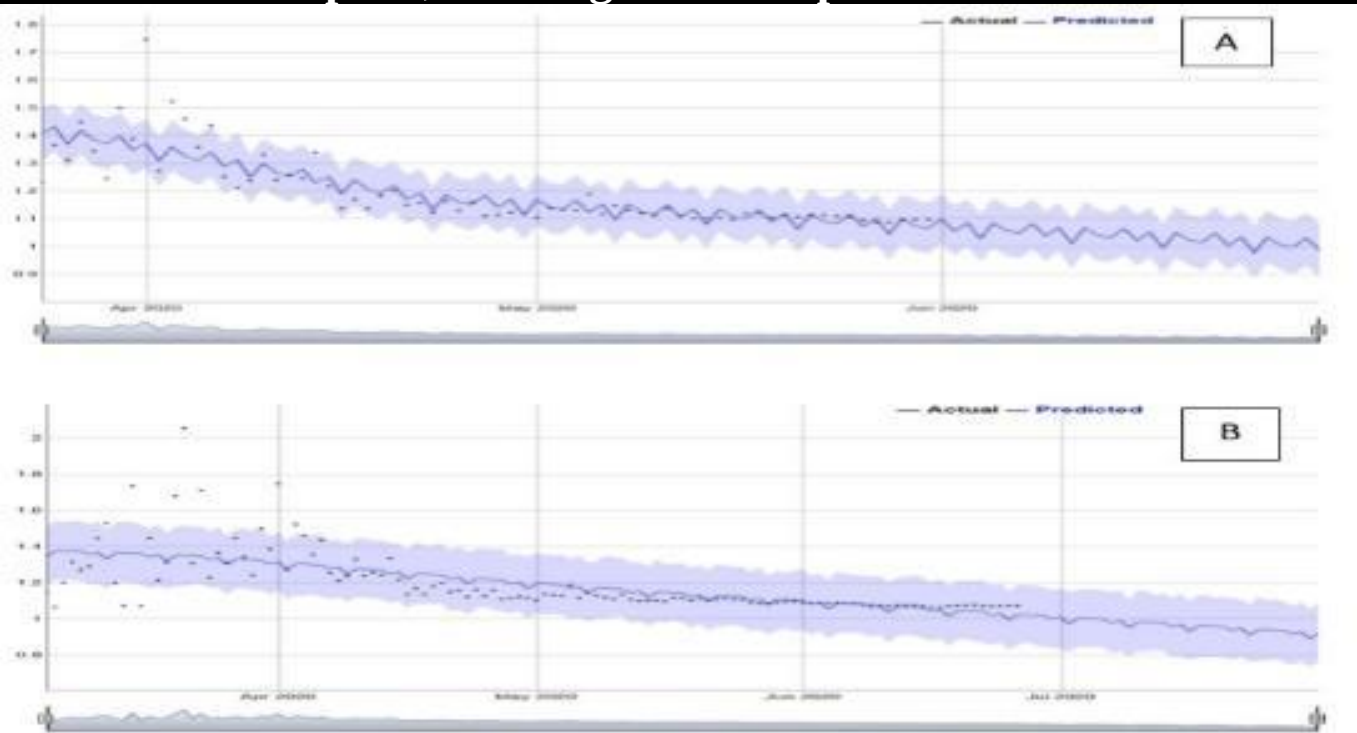
Tamil Nadu was the worst affected state, as 364 of the 411 people who tested positive had attended the event, 259 of the 386 cases in Delhi and 140 of the 161 cases in Andhra Pradesh were linked to the event. According to health authorities, until 2 April, among 2000 positive cases in India nearly 400 cases can be epidemiologically traced to the “*Tablighi Jamaat*” cluster. As of 4 April, 1,023 cases with links to this cluster were reported which is about 30% of total cases in the country. Around 18 April a peak was observed where R_0 value increases due to the fall off effect of tablighi jamaat, Union Health Ministry said 4,291 out of 14,378 confirmed cases in 23 Indian states and union territories have been linked to this event, around a third of all cases.



Using a predictive analytics, a prediction by regression modelling can give us a brief idea about the decline in spread rate (R_0) in next consecutive lockdown in month of June i.e. lockdown 5. It was observed a sudden decline in R_0 value to less than 1 in the end of June if lockdown 5 was implemented (Fig 4). The R_0 value less than 1 simplifies the spread rate is optimal and the infection curve will flattened, with low spread rate. This prediction analysis suggested that lockdown in June month could defiantly decline the number of cases and leads to fall the peak, forming a bell shaped curve.



The predicted R_0 values based on calculated R_0 values by daily cumulative cases A) Prediction of R_0 values for month of June (if lockdown sustain) based on calculated R_0 values from 24 March till 31 May and B) Prediction of R_0 values for month of July (if lockdown sustain) based on calculated R_0 values from 5 March 2020 till 26 June.





DISCUSSION

With regard to cases in India, it is indeed obvious that a spike was noted on 21 March 2020 in India. Thereafter, on 22 March 2020, the government formally declared a freeze, planning the situation in the manner of the government, and in Lockdown, people were going to be managed. It clearly demonstrates that Indian government were responsive enough even to estimate the spread rate in the India and to take the required measures to maintain social distance by declaring a restrictive locking phase.

From 25 March 2020, the date when lockdown started in India. Within few days of the commencement, in the instant reproductive number, India has already shown a major steady decline.

Although the number had been in single digits in the early stages, the growth rate was very high. Neglecting this duration, the growth rate has fluctuated about 20 percent with a trend line projections of up to about 28 percent, taking into account the second stage of the phase from 5 March to 22 March 2020, precisely well before lockdown.

The growth rate, meanwhile, marginally increased for the duration after lockdown, i.e. from 22 March 2020, but still about the same 20 percent level. And the trend line also expected a moderate growth of 28 percent per day . Furthermore, the next lockdowns shows only slight changes in terms of declining R_0 value.

Recent results have been consistent with previous COVID-19 outbreak predictions in India of R_0 . The only tactic to maintain the epidemic effectively is the non-pharmaceutical strategies.

In India, the COVID-19 epidemic has been monitored with the government actions on demographic control, isolation of verified infectious persons, quarantine of suspected infected persons based on touch monitoring, hospital and health care, social separation initiatives, community socio-economic structure, lock-down, and policies, might well predict the establishment of new cases, recoveries and death, etc.

India is currently minimized lockdown restrictions and choosing partial lockdowns as a tactic for phasing out the lockdowns. In certain cases, largely due to ignorance or misunderstanding, the infected persons & belongings remain ignored and are found by the Government after a surveillance campaign. Unanticipated labour immigration from cities to rural ancestral lands can be shifting the area of infection in most scenarios. Anyone of these activities tends to affect the differential population distribution of infected and dead cases.

India has already shown a major steady decline. The growth rate has fluctuated about 20 percent with trend line projections in various lockdown. A comparative analysis gives an idea of decline in value of R_0 from 1.73 to 1.08

CONCLUSION

- The whole study provided an overview of the COVID-19 lockdown measure in India. The increase in the number of cases of COVID-19 could be contained under national lockdown.
- The development could not have been controlled in India without the need for lockdown and may have been too rapidly explosive.
- This helps both state-level and regional managers and health professionals to brace themselves for the growing number of cases.
- We have shown that in India the lockdown has been very effective without Tablighi jamaat, migration, or enhanced transmission in some areas, etc.
- Moreover predictive analysis for further implementation of lockdown was also shown with R_0 values for month of July.
- The effect partial lifting of the lockdown (unlock) is also seen in the results, in terms of increment in R_0 values.
- Hence this study provides a platform for policy makers and government authorities for implementing the strategies to clog the transmission of infection.



THANK YOU





THE DATA SCIENCE COURSE 2020: COMPLETE DATA SCIENCE BOOTCAMP

WHY THIS COURSE....?

- Data scientist is one of the best suited professions to thrive this century. It is digital, programming-oriented, and analytical.
- Therefore, it comes as no surprise that the demand for data scientists has been surging in the job marketplace.
- However, supply has been very limited. It is difficult to acquire the skills necessary to be hired as a data scientist



LEARNING METHODOLOGY

The instructors were Martin and Ylia from 365 careers team on Udemy platform.

- 29 hours on-demand video lectures
- With 90 articles and 154 downloadable resources
- Multiple real-life business cases (Case Study)
- An unsolved assignment and quiz

COURSE OBJECTIVES

- To analyze data driven decisions require well organized and relevant data stored in a digital format.
- To use data how to create reports and dashboards to gain business insights.
- To assess potential future scenarios by using advanced statistical methods.
- To understand various business driven processes like basic customer data financial, trading data, price Optimization, inventory management, User experience, sales forecasting, fraud detection and client retention
- To utilize artificial intelligence to predict behavior in unprecedented ways.
- To learn data preprocessing and data analysis various statistical tools like regression and clustering analysis.
- To understand basic of python, machine learning, artificial intelligence and statistical methods.

COURSE MODULE

This course was divided into 8 sections namely

The field of data science - Introducing various data science disciplines, career in data science

Probability - Bayesian interface, permutation combination, probability distributions and probability in Healthcare

Statistics - Descriptive statistics practical examples, inferential statistics and hypothesis testing`

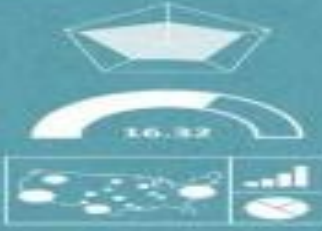
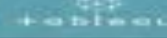
Python - Basic syntax, functions, iterations, advanced statistics method in Python, linear equation, multiple regression, Logistic regression and clustering analysis.

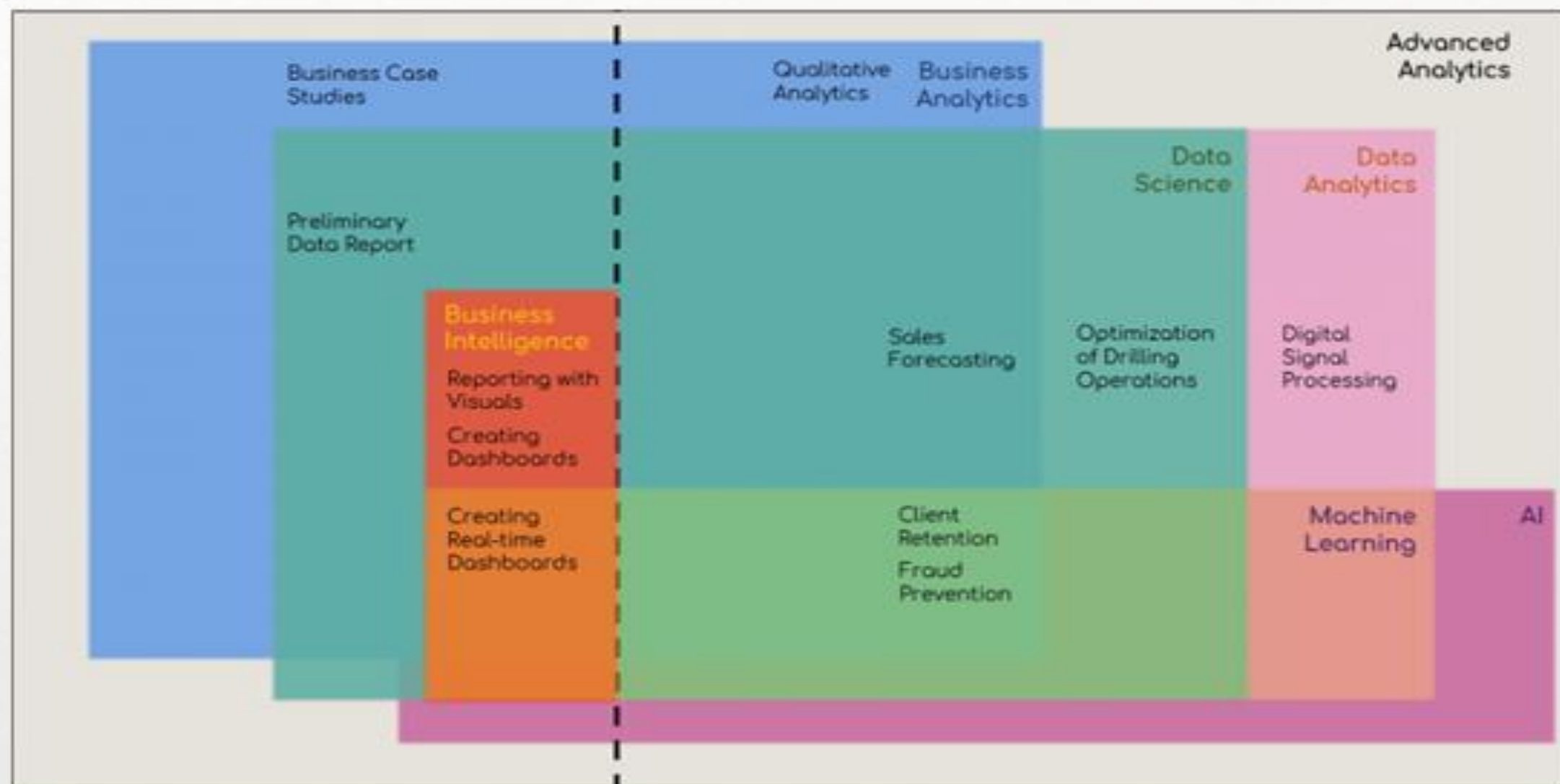
Deep learning - Neural networking, TensorFlow, overfitting & underfitting and MNIST data set

Business case analysis by deep learning TensorFlow

Case study

Analyzing the Predicted Outputs in Tableau

	Data		Data Science		
	TRADITIONAL	BIG	BUSINESS INTELLIGENCE	TRADITIONAL METHODS	MACHINE LEARNING
WHEN it is applied	At the beginning of your analysis		After the data has been gathered & organized	After BI reports have been created and discussed	
			PAST	NOW	FUTURE
WHY you need it	data-driven decisions require well-organized and relevant raw data stored in a digital format		use data to create reports and dashboards to gain business insights	Predictive Analytics	
WHAT techniques are involved	DATA COLLECTION PREPROCESSING - class labeling (categorical vs numerical) - data cleansing - dealing with missing values CASE SPECIFIC - e.g. balancing & shuffling datasets		ANALYZE THE DATA EXTRACT INFO AND PRESENT IT IN THE FORM OF: - metrics - KPIs - reports - dashboards	REGRESSION  LOGISTIC REGRESSION  CLUSTERING  FACTOR ANALYSIS  TIME SERIES 	SUPERVISED LEARNING - SVMs - NNs - deep learning - random forests - boosted networks UNSUPERVISED LEARNING - k-means - deep learning REINFORCEMENT LEARNING similar to supervised learning, but instead of minimizing the loss, one maximizes reward
					
WHERE	BASIC CUSTOMER DATA HISTORICAL STOCK PRICE DATA	SOCIAL MEDIA FINANCIAL TRADING DATA	PRICE OPTIMIZATION INVENTORY MANAGEMENT	USER EXPERIENCE (UX) SALES FORECASTING	FRAUD DETECTION CLIENT RETENTION
HOW using what tools	PROGRAMMING LANGUAGES     SOFTWARE  	PROGRAMMING LANGUAGES     SOFTWARE 	PROGRAMMING LANGUAGES     SOFTWARE     	PROGRAMMING LANGUAGES    SOFTWARE    	PROGRAMMING LANGUAGES       SOFTWARE   SOFTWARE  
WHO	DATA ARCHITECT DATA ENGINEER DATABASE ADMINISTRATOR	BIG DATA ARCHITECT BIG DATA ENGINEER	BI ANALYST BI CONSULTANT BI DEVELOPER	DATA SCIENTIST DATA ANALYST	DATA SCIENTIST MACHINE LEARNING ENGINEER
ARE YOU AWARE	200,000 lines of data is not necessarily big data. It is not just volume that defines a data set, its variety, verbiage, velocity, veracity , and other characteristics are determinative as well.		Qualitative analyses such as SWOT are not used for quantitative analysis. Hence, they are not part of business intelligence.	Software like Excel, SPSS, and Stata can be successfully used by data science teams in many companies.	



KEY LEARNINGS

The course provides the entire toolbox that need to become a data scientist.

Developed the data science skills: Statistical analysis, Python programming with NumPy, pandas, matplotlib, and Seaborn, Advanced statistical analysis, Tableau, Machine Learning with stats models and scikit-learn, Deep learning with TensorFlow

Learn how to pre-process data

Understand the mathematics behind Machine Learning

Start coding in Python and learn how to use it for statistical analysis

Perform linear and logistic regressions in Python

Carry out cluster and factor analysis

Be able to create Machine Learning algorithms in Python, using NumPy, stats models and scikit-learn

Applying skills to real-life business cases

Use state-of-the-art Deep Learning frameworks such as Google's TensorFlow develop a business intuition while coding and solving tasks with big data

Unfold the power of deep neural networks

Improve Machine Learning algorithms by studying underfitting, overfitting, training, validation, n-fold cross validation, testing, and how hyperparameters could improve performance.

ACHEIVE

