# A Geographical Exploration of Urban Risk and COVID-19:

*An Innovative and Systematic Approach*

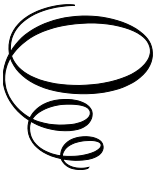
# A Geographical Exploration of Urban Risk and COVID-19:

## *An Innovative and Systematic Approach*

Edited by

Subhash Anand, B. Srinagesh
and R.B. Singh

**Cambridge Scholars**
Publishing



A Geographical Exploration of Urban Risk and COVID-19:
An Innovative and Systematic Approach

Edited by Subhash Anand, B. Srinagesh and R.B. Singh

This book first published 2023

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library



ISBN (10): 1-5275-2940-1
ISBN (13): 978-1-5275-2940-3

# CONTENTS

Preface ..... viii

Chapter 1 ..... 1
Geospatial Modelling for Covid-19 Cases in India: A Case Study of Interpolation Approach
*Prisilla Jayanthia and Muralikrishna Iyyanki*

Chapter 2 ..... 24
Global Covid-19 Outbreak and Melting Down the Human Hair Business: An Assessment of Local to Global Economic and Social Impacts on the Chandipur-Bhagwanpur Region of Purba Medinipur District, West Bengal, India
*R. Das and M. Mondal*

Chapter 3 ..... 80
The Water Stress Situation during Covid-19: A Macro-Level Study of Ajmer City, Rajasthan.
*B. Ratnu and A. Ratnu*

Chapter 4 ..... 104
Telemedicine Modelling for Assuring a Sustainable Public Healthcare System in the Context of the Covid-19 Pandemic in Kerala State, India
*S. K. Sheheersha and V. Saravanabavan*

Chapter 5 ..... 118
Assessing the Knowledge, Attitude and Impact of Covid-19 on the Health of Healthcare Workers in Gandhinagar, Gujarat
*P. Yadav and S. Anand*

Chapter 6 ..... 138
The Impact of Covid-19 on the Migrants of India: A Case Study of Bihar
*Sugandh*

Chapter 7 ..... 157
The Impact of Covid-19 on the Health of Women in Indian Society
*V. Chandna and S. Sahdev*

Chapter 8 ..... 168
Migration and Reverse Migration amid the Covid-19 Situation in India: Challenges and Issues
*H. Kumar, U. Rani*, *Anju Singh and Vaibhav Anand*

Chapter 9 ..... 186
Global Pandemic Covid-19 as a Health Hazard: Issues and Challenges
*S. Anand, V.R. Sharma and S. K. Sanu*

Chapter 10 ..... 215
The Impact of the Covid -19 Pandemic on Livelihood Systems: A Case Study of a Tribal Village in Odisha
*Subhasmita Parida and Sujata Mishra*

Chapter 11 ..... 232
When Education Goes Virtual: Gauhati University during the Covid-19 Pandemic
*Chandan Bhuyan, Syeda Fahima Shahnaz Sultana and Madhushree Das*

Chapter 12 ..... 245
Maternal, Infant and Child Mortality in India and its Major Determinants: A Spatial Analysis
*Annu and S.P. Kaushik*

Chapter 13 ..... 268
Human Capital and Basic Amenities: A Study of Slums in Faridabad City
*Rakesh Kumar*

Chapter 14 ..... 285
An Analytical Study of Agricultural Labourers' and Farmers' Suicide in Punjab
*Kiran Mann and Suman Chauhan*

Chapter 15 ..... 299
Habitat Fragmentation, "A Threat to Health and Life on Land": A Geographical Study of the Patna Urban Area
*Vinita Prasad*

Chapter 16 ..... 317
Health Conditions of Women with Disabilities in Multi-ethnic Societies of Rural India
*Somnath Mukherjee*

# PREFACE

Human health is a fundamental right which is closely linked to the functions and lifestyles of people in urban and peri-urban areas. Corona has been a vibrant and very commonly-used term all over the world since December 2019. The Coronavirus disease (Covid-19) is a very infectious disease caused by the SARS-CoV-2 virus. The majority of the people infected with the virus experience mild to moderate respiratory illness, and recover without requiring special treatment. However, some become seriously ill and require medical attention. The occurrence of Covid-19 is considered as the biggest disaster of this century. According to the World Health Organization, on 5 October 2021, there had been 235,175,106 confirmed cases of Covid-19 around the world, including 4,806,841 deaths, while exactly one year before, on 5 October 2020, the total number of confirmed cases was reported as 2,392,804, with 40,475 deaths. Hence, over a single year, there was an increase of 232,782,302 cases and 4,766,366 deaths of Covid-19. On 30 December 2021, the number of confirmed cases again increased to 285,014,531 with 5,441,298 deaths. Geographically, the maximum number of Covid-19 cases was reported in America, followed by Europe, South-east Asia, the Eastern Mediterranean, Western Pacific, and Africa.

Keeping in the mind the urgency of a book on Covid-19 and health issues, we planned to bring out a volume consisting of various case studies. Hence, the present book is the outcome of valuable contributions made by eminent scientists and research scholars, who have been trying to develop alternative strategies, and sustainable solutions for sustainable health and wellbeing.

We dedicate this book to our 'Guruji'. Professor R. B. Singh, Secretary General and Treasurer, International Geographical Union (IGU).

This edition consists of a total of sixteen chapters, based on research case studies related to Covid-19, and various health issues on different scales. The first chapter of the book is contributed by Jayanthi et al, and analyzes the role of geospatial modeling for Covid-19 cases in an Indian context, through a real interpolation approach to perform the analysis and distribution of the confirmed cases. The study results were found to be

accurate, based on RMSS and K-Bessel location value. The second chapter, written by Das and Mondal, assesses the global Covid-19 outbreak and the human hair business, with its local and global economic and social impacts on the Chandipur-Bhagwanpur region of the Purba Medinipur district of West Bengal state. The study reflects the huge human costs in terms of socio-economic shocks evolving from the global outbreak of the deadly Coronavirus indicating its black-and-white journey in terms of economic uncertainty and livelihood crisis. The next chapter is authored by Ratnu and Ratnu, and describes a macro-level study on the water stress situation during the Covid-19 pandemic in Ajmer city, in Rajasthan. The authors deal with the question of how demand for water has increased, and how sources of supply are challenged in this ongoing pandemic. The study found that the high income and middle income groups are susceptible to Corona, but not as much as the poor are, even during the lockdown period. The fourth chapter is contributed by Sheheersha and Saravanabavan, who applied telemedicine modelling for assuring a sustainable public healthcare system in the context of the Covid-19 pandemic in Kerala, and explored the remodeling of the public healthcare delivery system to ensure uninterrupted and efficient medical aid, and ensure medical service in each and every corner of the state. To a greater extent, this system can reduce present rural urban disparities in the healthcare delivery system. In the fifth chapter, Yadav and Anand assessed the knowledge, attitudes, and impact of Covid-19 on the health of healthcare workers in Gandhinagar, of Gujarat, evaluating the level of knowledge, attitudes and practices of healthcare workers. The lack in level of understanding of the disease among HCWs can result in delayed diagnosis and treatment resulting in faster spread of infection and putting patients' lives at risk. In this study, the authors found that HCWs have good level of knowledge and a positive attitude on the journey of the Covid-19 outbreak.

Sugandh, in Chapter six, analyzes the impact of the Covid-19 pandemic on internal migrants of Bihar state. It shows that there has been an unprecedented increase in Covid cases, due to mobile migrant workers. This is not merely a pandemic, but is also instrumental in the social, economic and demographic dimensions of the country. In the next chapter, Chandna and Sahdev highlight the impact of Covid-19 on women's health in Indian society. The chapter aims to explore the impact of Covid-19 on women's mental health, to assist policy makers to take actions on policies for good health and wellbeing. It was found that the women manage all the household activities (with or without) much help from the family members, and are physically and mentally exhausted, and anxious. At the same time, they are also nervous about the whole situation, as some of them are also facing

verbal abuse or domestic violence. Kumar at el., in Chapter Eight discuss in detail the major emerging issues and challenges of migration and reverse migration during the period of Covid-19, in an Indian context. The study mentions the main driving forces, and the effects of migration and migrant labor during Covid-19, together with suggesting long-term sustainable strategies for migrant labor in India. The ninth chapter is contributed by Anand et al., who extensively examine the nature, and dynamics of Covid-19 and its impacts on various sectors in India, describing how it has become a global disaster. Due to global epidemics such as Coronavirus, we have to reconsider human survival on planet Earth.

The tenth chapter of the book was written by Parida and Mishra, who have analysed the impact of Covid-19 which has resulted in an unexpected loss of human life worldwide, and affected public health, food systems and living conditions. There are huge economic and social disturbances which have resulted in disastrous changes to the lives of a number of people who are at risk of falling into extreme poverty. The study concluded from the analysis that 80% of households in the sample experienced a reduction in expenditure, and more than 60% did not have enough money for basic essentials. So, it’s urgent to take effective measures to support the tribal livelihood of this region who have limited opportunities for income. The next chapter, authored by Bhuyan et al., assesses the challenges faced, elucidates on and assesses the practices adopted, and acknowledges the underlying perceptions developed among students and teachers of Gauhati University, a higher education institute of North East India, in the process of switching to digital modes of learning. The outcome indicates the adoption of new practices and activities, and also coping strategies, by the students and teachers to counter the uncertainties in education. It also foregrounds the need to make learning more inclusive and responsive, by blending of conventional means with digital.

Annu and Kaushik, in their chapter, undertake spatial analysis of maternal, infant and child mortality, and discuss the major determinates, highlighting the disturbing patterns in India's maternal, infant, and child health. The study also points out that maternal, infant, and child death is high in nine high-focus states, compared to other Indian states. Chapter Thirteen of the book is authored by Kumar, and analyzes the human capital and basic amenities of slum areas in Faridabad city, in the state of Haryana. The study found that the provision of basic amenities and facilities such as water supply, sanitation, solid waste collection, electricity, drainage facility etc. are the key components in urban areas, as they improve the quality of life and people’s productivity, therefore helping human capital formation at

large. The next chapter of the book is contributed by Mann and Chauhan, who discuss the suicides of agricultural labourers and farmers in the state of Punjab. This study reports that Sangrur and Mansa, in Malwa region of Punjab are highly suicide-prone, and the spread of suicide victims is largely concentrated in the age group of below 35 years. The authors also debunked the prevailing myth that agrarian distress affects only males. They provide suggestions and recommendations to farmers and policymakers, realizing the need for a science-policy interface, so that suicide can be prevented.

The second-to-last chapter of the book is contributed by Prasad, who investigated habitat fragmentation: a threat to health and life on land, evaluating the extent and consequences of bio-diversity loss. Further, Prasad explores the ways and means to protect and preserve the dwindling bio-diversity in the urban Patna region in Bihar. In the last chapter of the book, Mukherjee explores the nutritional status of women with disabilities of both scheduled and non-scheduled castes, exploring the probable factors behind poor health particularly among women with disabilities in rural India. The study identifies some measures to improve their health and suggests that other research should address the gap in knowledge about different healthcare needs, such as the reproductive healthcare of the women with disabilities.

We are highly thankful to all the authors for their significant contributions. This book provides a very comprehensive critical understanding of various health issues, and it will be of immense use to academicians, research scholars, practitioners, policymakers, and people, concerned with health issues.

**The Editors**

# CHAPTER 1

# GEOSPATIAL MODELLING FOR COVID-19 CASES IN INDIA: A CASE STUDY OF INTERPOLATION APPROACH

PRISCILLA JAYANTHI*[1]
AND MURALIKRISHNA IYYANKI[2]

**Abstract**: Ever since Covid-19's initial attack, it is showing no sign of breaking its chain around the world. India reported its first Covid-19 case in the first week of March 2019, and gradually positive cases have nudged to a count of 380,532. In this study, the areal interpolation approach is used to analyze the spread of active cases. For this analysis, the dataset has been obtained from the Ministry of Health and Family Welfare Government of India. The papers aim to analyze the spatial spreading and prediction using the cases recorded on March 15, April 12, May 12, and June 19, 2020. The results of the models were obtained from active cases on March 15 (Model: 19.786 Spherical (30.018); April 12 (Model: 118170 Spherical (30.018), May 12 (Model: 1.475e7 Spherical (30.018)) and June 19, 2020 (Model: 2.4625e8 Spherical (30.018)). The highlight of this study is the state district-wise spatial distribution in four states, and graphs of their respective day-wise increase of confirmed cases.

**Keywords:** Covid-19, Real Interpolation, Spatial, Spread, District-wise and Day-wise increase.

[1] Associate Professor, Department of Computer Science and Engineering, Mahindra University, Hyderabad - 500043, India.
[2] Former Professor and Director (R &D), JNTU, Hyderabad, India. UC Berkeley.
* Corresponding author.

# I. Introduction

Areal interpolation is an approach to making estimates from a source set of polygons to an overlapping but dissimilar set of target polygons (Prener 2020). Spatial data are usually combined into spatial units. Spatial unit convergence is known as a real interpolation that addresses the problem of differences in spatial units (Murakami & Tsutsumi 2011). There are various types of spatial units of aggregation; these differences in aggregation units make handling data difficult. Therefore, moving spatial data from one zonal structure to another is beneficial. Such a process is called a real interpolation.

In a case study of population data Zhang & Qiu (2011) introduced a point-based intelligent approach to the interpolation problem by using zero-dimensional points as ancillary data that are associated locationally with the variable of interest. The study of interpolating population data in a suburban area proposed areal interpolation (ArIp) solutions based on the evaluation of its results with accuracy and efficiency. In their study, Comber & Zeng (2019) discuss the four areal interpolations using the New Haven census tracts (source zones) and the 500m polygon grid (target zones). The four interpolations are dissymmetric, street weighted, statistical, and point-based, which is demonstrated. The spatial and statistical distributions of the house estimates using data from the property website are also demonstrated, with numerous target zones with a house estimate of 0. In a case study on the areal interpolation of population, Murakami & Tsutsumi (2011) demonstrated improvements in predictive accuracy. The study suggests that the consideration of spatial autocorrelation is imperative for accurate real interpolation.

# II. Discussion and Results

Spatial analysis is the approach of examining locations, attributes, and relationships of features in spatial data to gain a better understanding. For instance, while looking at a map of the features and relationships with Covid-19, rainfall, or wildfire, one can draw certain conclusions based on the spatial data available. Spatial interpolation is the assumptions carried out using the spatially distributed objects that are spatially correlated; i.e. items that are close together tend to have similar characteristics. Spatial interpolation is of two categories, namely point, and areal interpolation. Figure 1 shows the types of spatial interpolation methods.

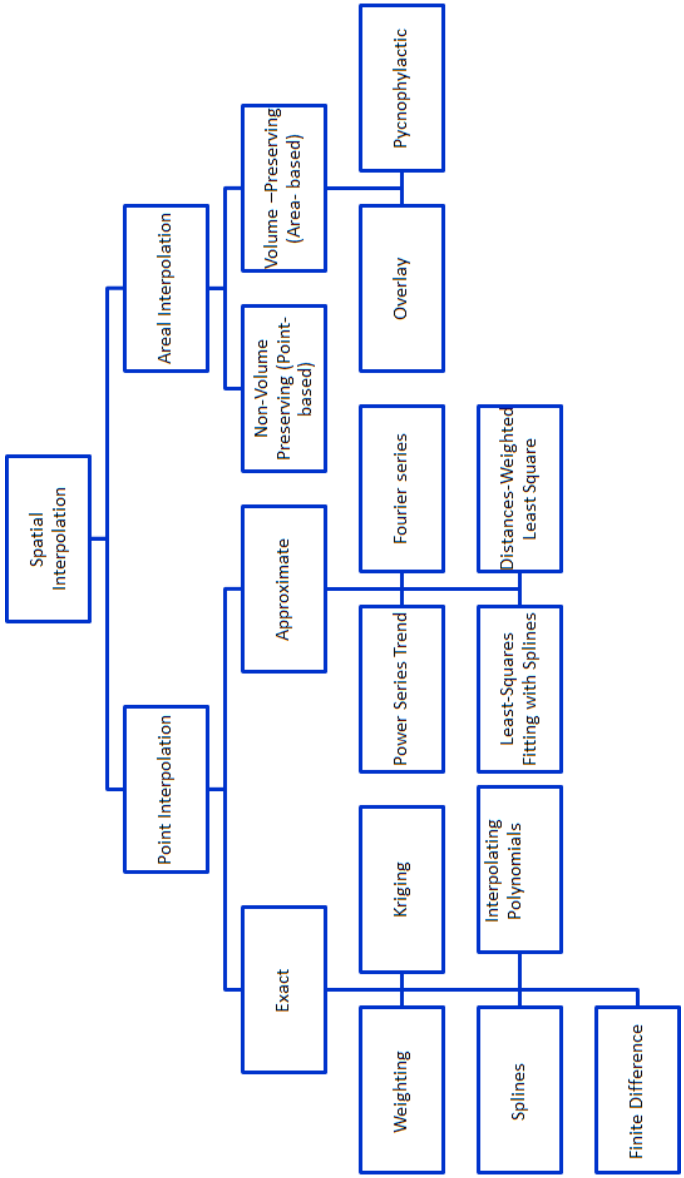
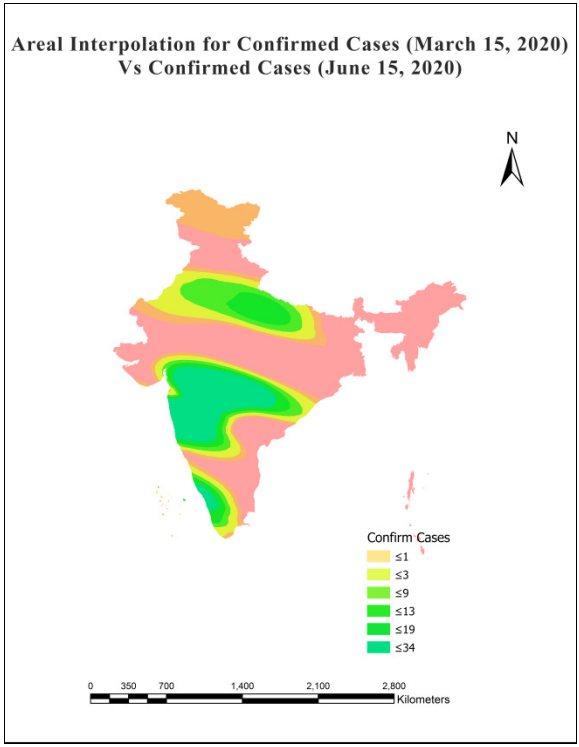
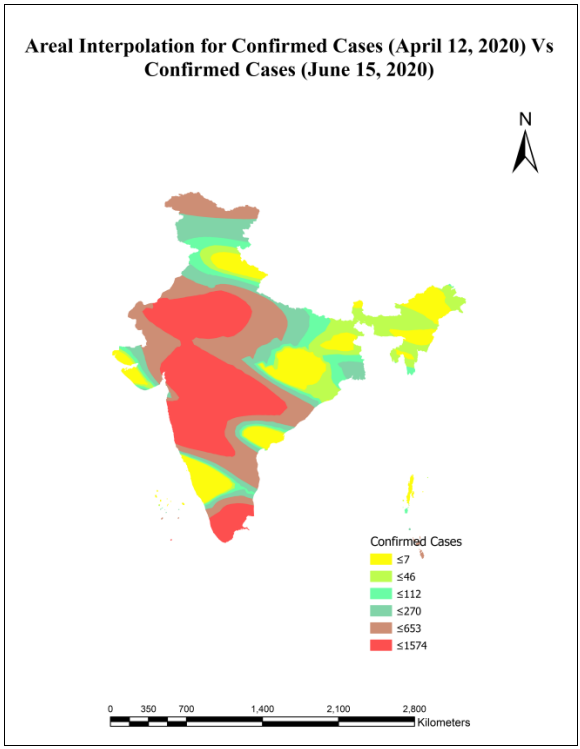
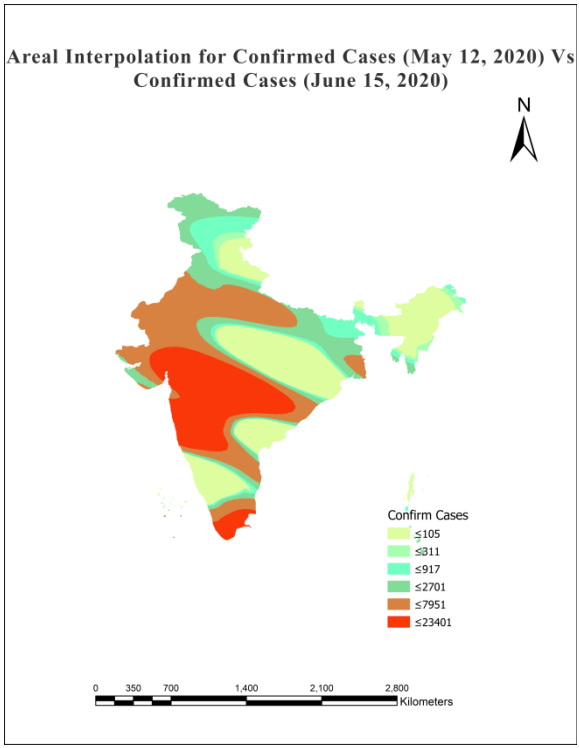



Figure 1: Various types of spatial interpolation

This study is carried out using areal interpolation on active cases of the Covid-19 dataset to analyze the spread of spatial data geographically. Areal interpolation is a kriging-based interpolation method designed to work with data collected in polygons. Data comes in three forms. First, Gaussian data is averaged over polygons. Secondly, binomial counts indicate the number of successes and trials per polygon. Thirdly, Poisson data counts the number of events in a polygon over a specified time. In this study, the dataset was obtained from https://www.mohfw.gov.in/ and analysis was carried out on ArcGIS. Figure 2 shows the interpolated prediction map for confirmed cases in the first, fourth, eighth, and twelfth week of Covid-19 in India.




Areal Interpolation for Confirmed Cases (April 12, 2020) Vs Confirmed Cases (June 15, 2020)
N
Confirmed Cases
≤7
≤46
≤112
≤270
≤653
≤1574
0 350 700 1,400 2,100 2,800
Kilometers


Areal Interpolation for Confirmed Cases (May 12, 2020) Vs Confirmed Cases (June 15, 2020)
N
Confirm Cases
≤105
≤311
≤917
≤2701
≤7951
≤23401
0 350 700 1,400 2,100 2,800
Kilometers

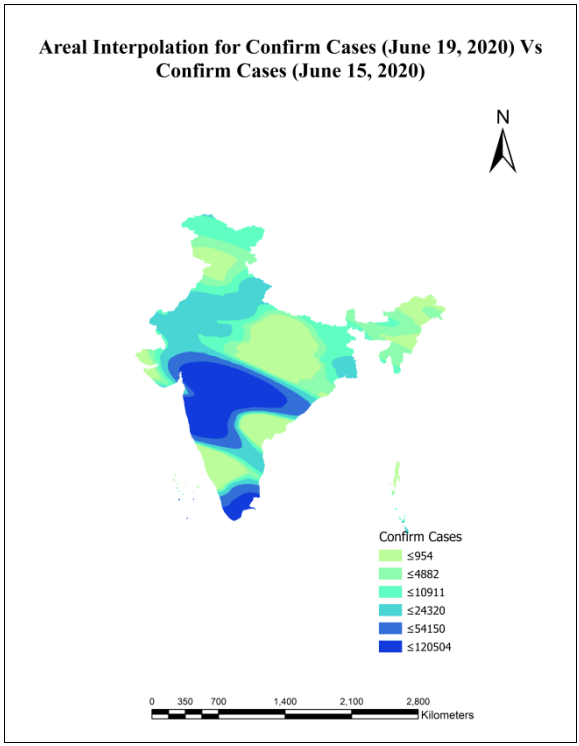



Figure 2: Areal interpolation of confirmed cases: a) March 15, b) April 12, c) May 12, d) June 19, 2020.

The summary of empirical co-variances of the Spherical model and K-Bessel model of the cases in different weeks is shown in Table 1 for a lag size (2.50149) and several lags (12).

**Table 1: Summary of Spherical and K-Bessel model for Covid-19 cases**

| Week | Date | Spherical Model | Location | K-Bessel Model | Location | Mean | Average standard error |
|---|---|---|---|---|---|---|---|
| First | March 15 | 19.786 | 30.018 | 58.428 | 8.2585 | 0.9660 | 4.1667 |
| Fourth | April 12 | 118170 | 30.018 | 228690 | 8.3104 | 76.1065 | 259.7061 |
| Eighth | May 12 | 1.475e7 | 30.018 | 2.9168e7 | 8.7924 | 738.0731 | 2830.35 |
| Twelfth | June 19 | 2.4625e8 | 30.018 | 6.3155e8 | 8.1047 | 4930.488 | 13864.6677 |

Anisotropy is a correlation between two points which depends on their orientation and their distance. When anisotropy is true, it allows for fitting the model in different semi-variogram or co-variances for different directions. Figures 3 and 4 are explained when anisotropy is true.

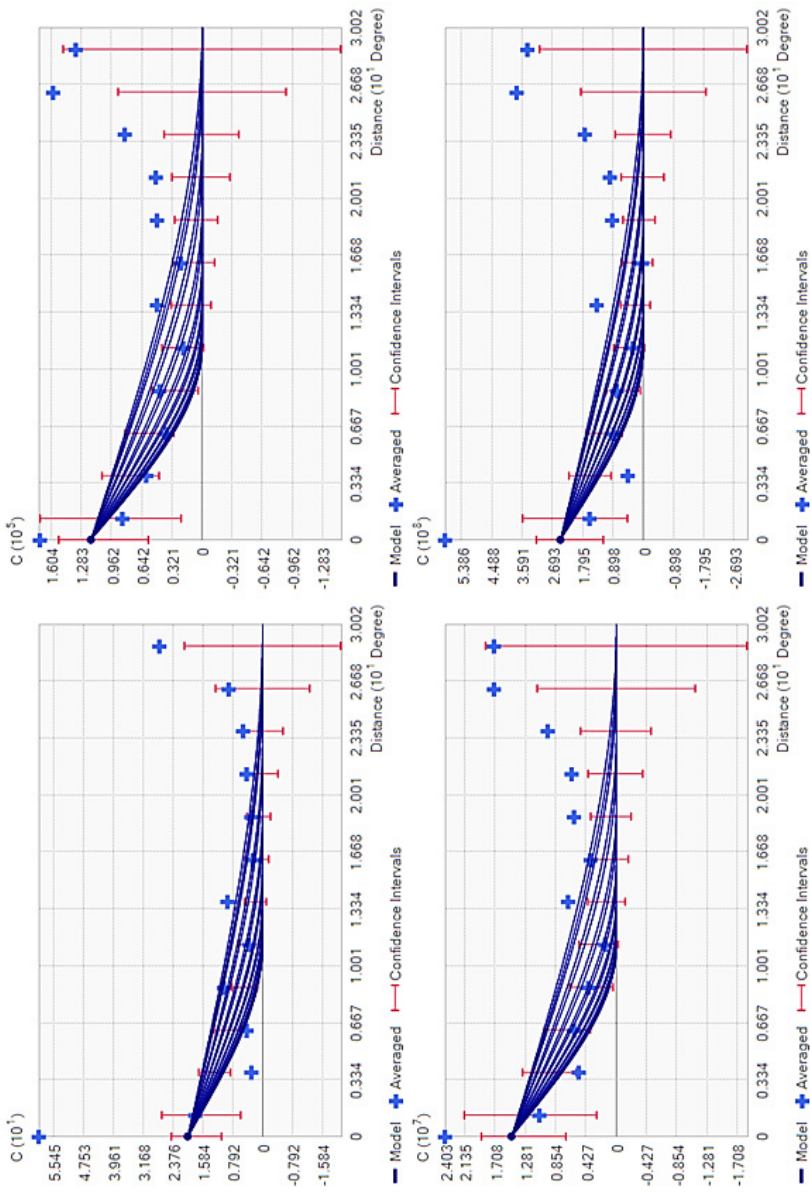



Figure 3: Spherical model of active cases: a) March 15, b) April 12, c) May 12, d) June 19, 2020.

The models of Spherical and K-Bessel are a better fit at the respective location given in Table 1. At this location, one can find the model is best with a covariance curve that appears better, and most of the empirical covariances fall within the confidential interval.

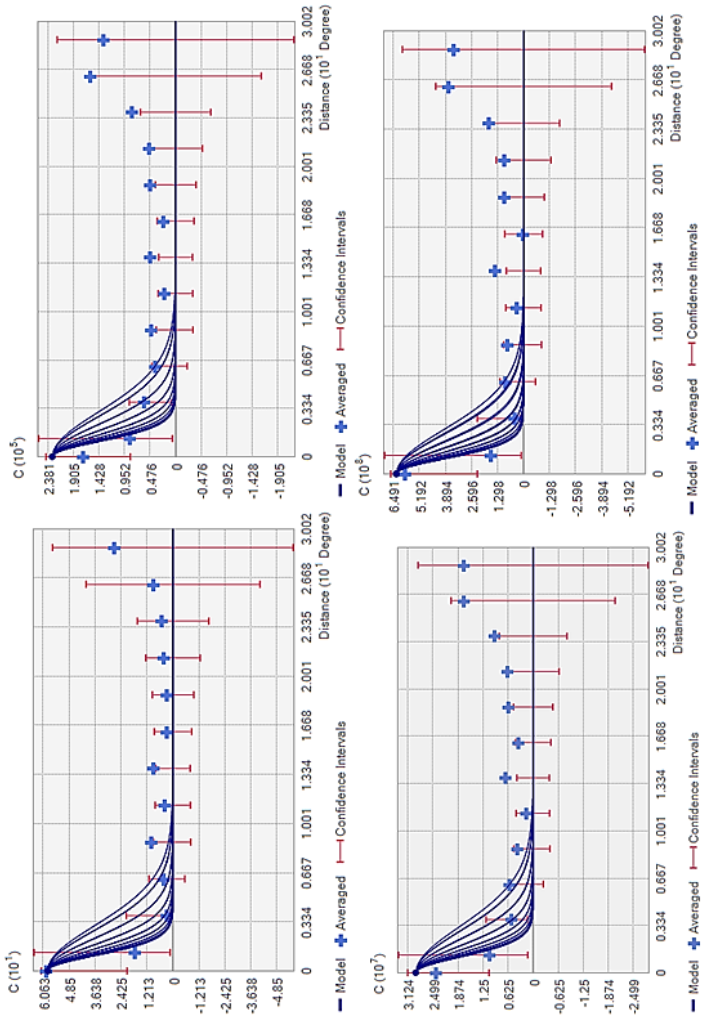



Figure 4 K-Bessel model of active cases: a) March 15, b) April 12, c) May 12, d) June 19, 2020.

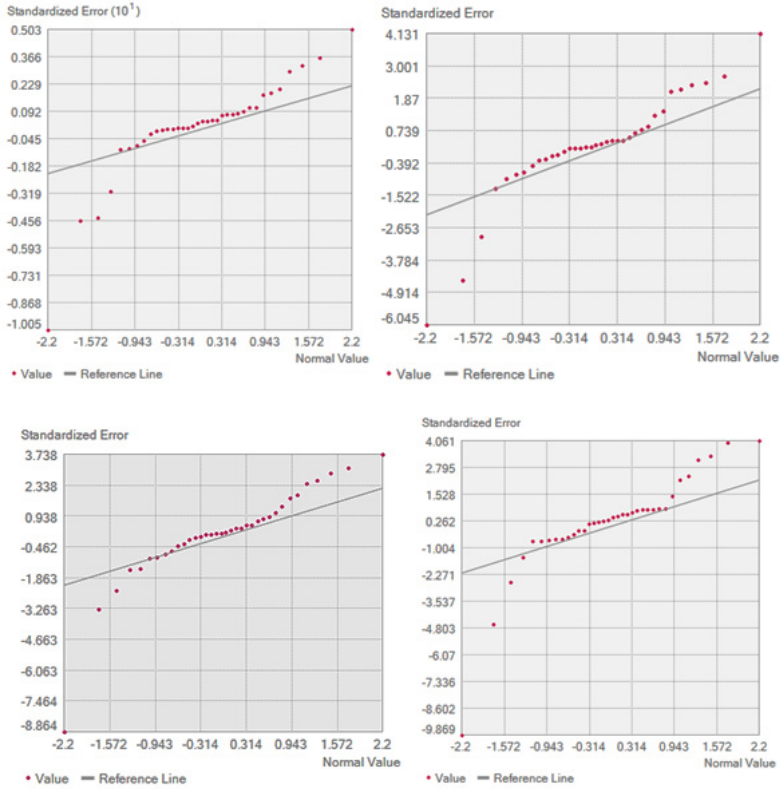



Figure 5: Normal QQ plot for active cases: a) March 15, b) April 12, c) May 12, d) June 19, 2020.

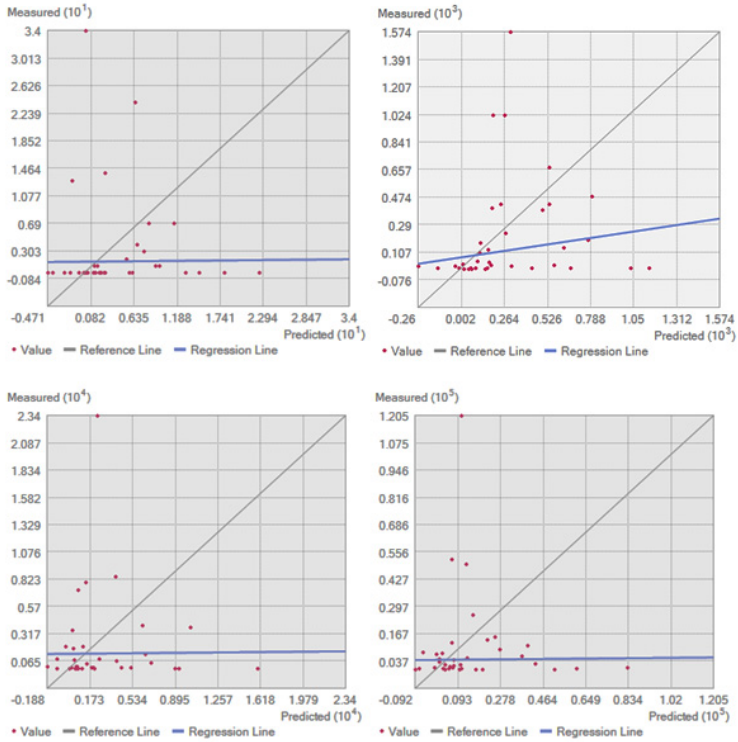



Figure 6: Predicted plots for active cases: a) March 15, b) April 12, c) May 12, d) June 19, 2020.

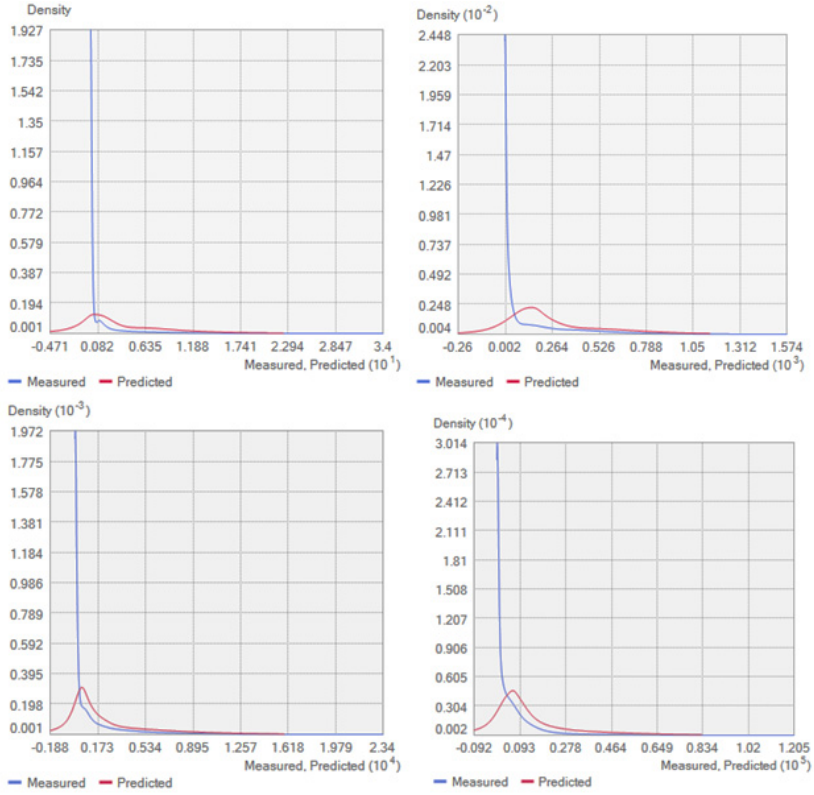



Figure 7: Measured–predicted plot for active cases: a) March 15, b) April 12, c) May 12, d) June 19, 2020.

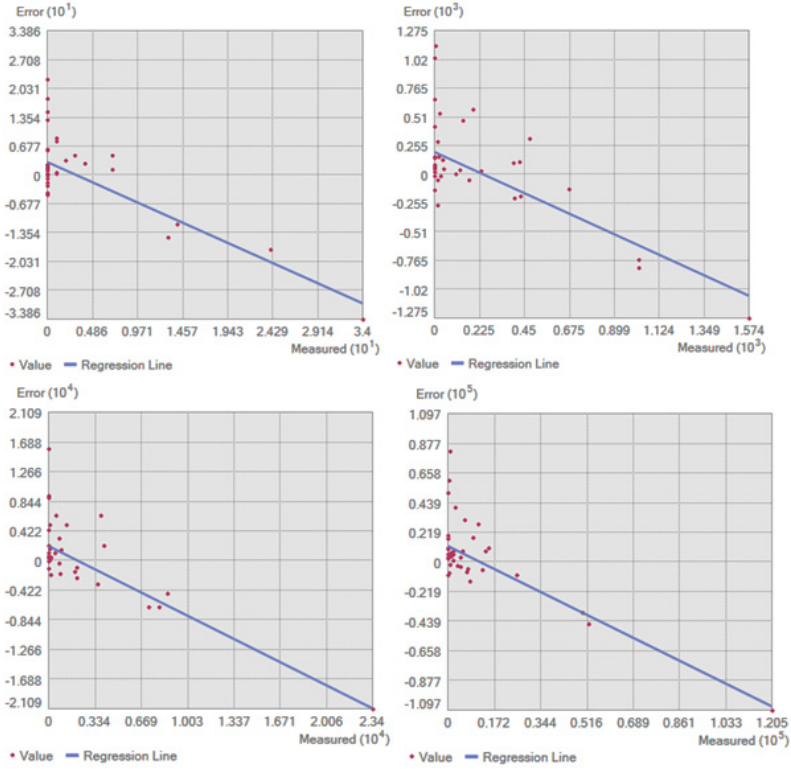



Figure 8: Errors plot for active cases: a) March 15, b) April 12, c) May 12, d) June 19, 2020.

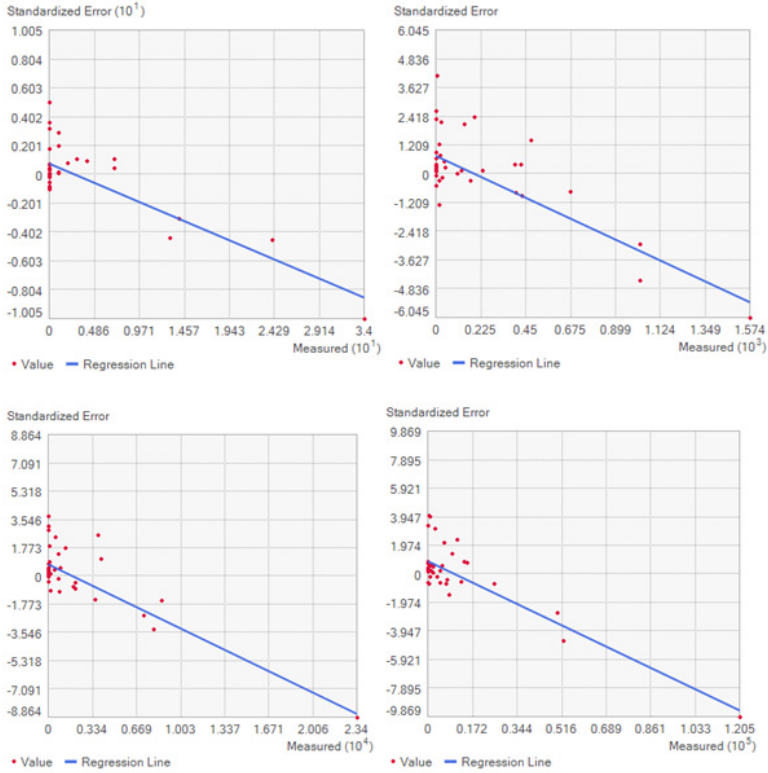



Figure 9: Standardized Errors plot for active cases: a) March 15, b) April 12, c) May 12, d) June 19, 2020.

From Figure 5, the Normal QQ plot shows that the model is perfect with Root-Mean-Square Standardized (RMSS) nearer to 1. RMSS scores for the active cases of March 15 (2.51), April 12 (1.82), May 12 (2.11), and June 19 (2.37) are obtained. Also Mean Standardized for March 15 (0.09), April 12 (0.15), May 12 (0.12) and June 19 (0.17) and the values lie in between 0.1 and 1. Figure 6 shows the prediction plot for the cases and the following equation is obtained for the respective models of the corresponding week.

1. y = 0.0101 * x + 1.54--------- eq (1)
2. y = 0.1638 * x + 73.49--------- eq (2)
3. y = 0.0099 * x + 1324.91---------- eq (3)
4. y = 0.0095 * x + 4339.36 ---------- eq (4)

Figure 7 represents the measured-predicted plot for each week respectively, and similarly, Figure 8 shows the error plot for each predicted plot of the model. Figure 9 shows the standardized error plots for the active cases and average standardized error values are mentioned in table 1.

## III. Temporal analysis of Covid-19

The day-wise increase in active cases is obtained using the same dataset with STATA software shown in figure 10. India's total active cases are 9,36,181 as of July 15, 2020. A few states like Sikkim (209), Meghalaya (318), Mizoram (238), Nagaland (896), and Chandigarh (600) show a minimum number of active cases. States such as Kerala (8930) showed inclination in cases in the month of March, but later the cases were found to be declining gradually.

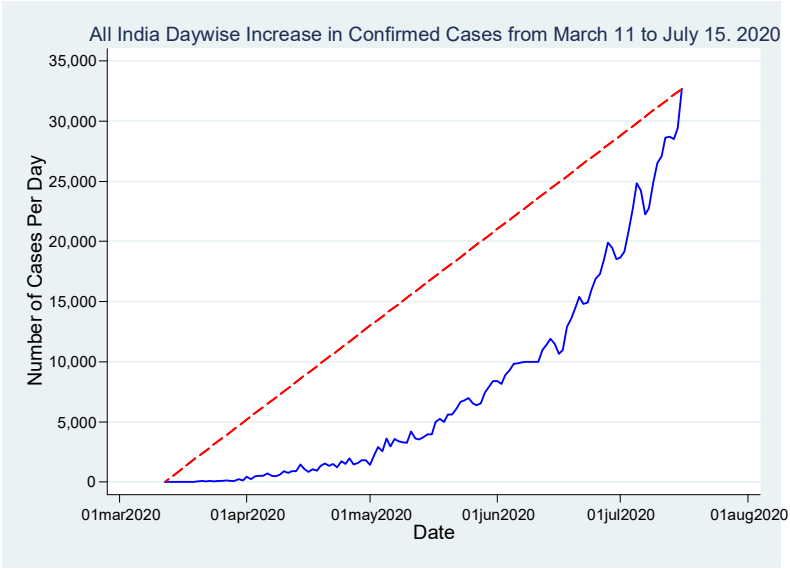
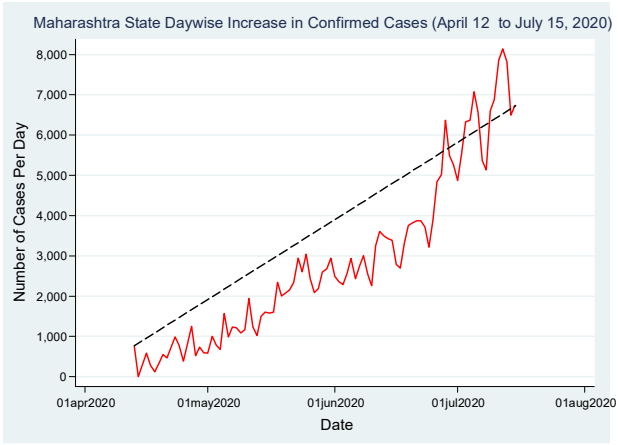
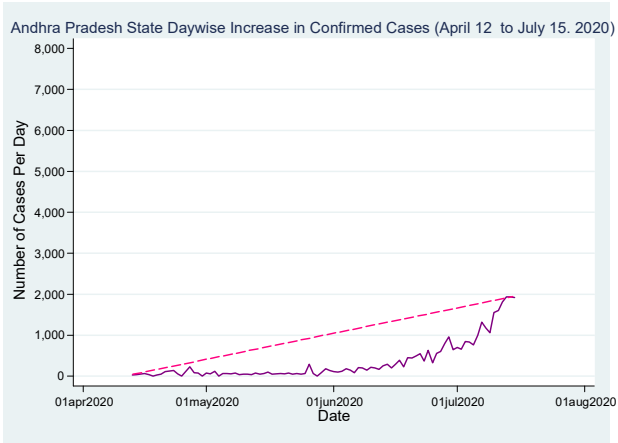



Figure 10: Daywise increase in active cases in India

The data for the graph (Figure 11) was obtained from www.mohfw.gov.in from April 12 2020 to July 15 2020, where Maharashtra is still at the peak with 267665 active cases. Total samples tested were 641,441, tests per million 5,251, and the positive rate was found to be 16.3%. Andhra Pradesh has 33,019 active cases, out of the total samples tested

(11,53,849). Tests per million were 21,364, and average growth rate 6.0%. In Telangana, the average growth rate was 8% with 37,745 active cases and 3,782 tests per million whereas Kerala had average growth rate of 5% out of 8,930 cases, and tests per million were 9,124. Kerala's curve was flat when compared to TS and AP. TS curve showed a rapid increase due to the lifting of lockdown (2.0).



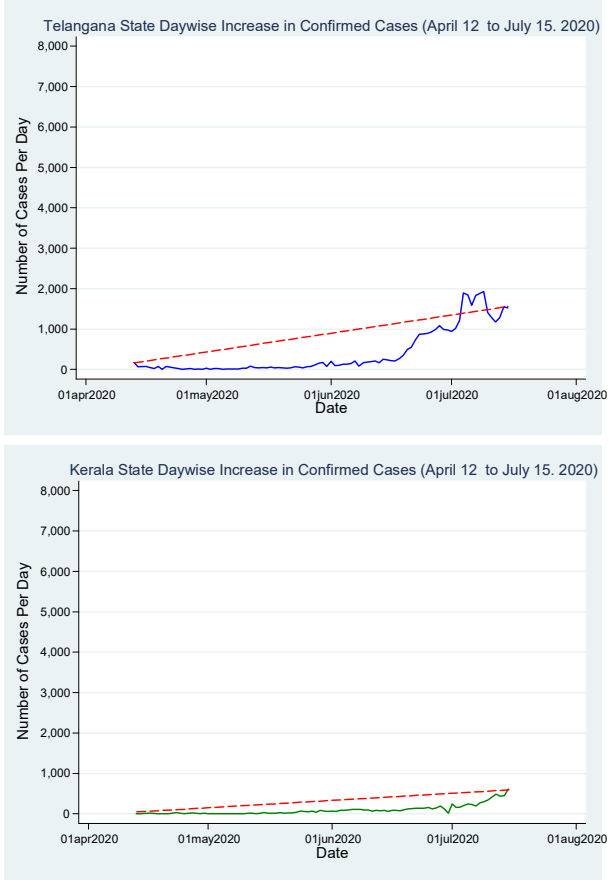



Fig 11. Daywise increase in cases in four states - Maharashtra, AP, TS, and Kerala

## IV. Distribution of Covid-19 in districts

In this study, four different states were considered for analyzing the cumulative cases, as of July 10 2020 (Figure 12) at the peak, average and median of cases. The district data was collected from https://www.covid19 india.org/. Maharashtra has thirty-four districts that were affected by the Covid-19 virus, with the highest number in Mumbai (5,205), followed by Thane (1,536). Similarly, the highest number of cases were found in Kurnool district (2,939), followed by Anantapur (2,850) and in Andhra Pradesh, Hyderabad (24,710) followed by Ranga Reddy district (2,112).