



# An approach to statistical analysis-using the average transmission model of Covid 19

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## Abstract

Since receiving mysterious pneumonia patients at each district Govt. Hospital in Tamil Nadu, India in April 04, 2020-April 13, 2020, the new corona virus (COVID-19) has quickly increase in Tamil Nadu and spread to the whole State of Tamil Nadu and some neighboring states. We found the dynamics model of transmittable diseases and time series model to forecast the tendency and short-term forecast of the spread of COVID-19, which will be conducive to the intrusion and avoidance of COVID-19 by departments at all levels in mainland India and buy more time for medical trials. Based on the communication machinery of COVID-19 in the population and the implemented deterrence and manage measures, we establish the active models of the three chambers, and establish the average transmission model based on different mathematical formulas using authentic original data. The results based on the increasing analysis of pneumonia of COVID-19 in mainland Tamil Nadu can reach 1,377 after ten days (4-4-2020 to 13-4-2020). The results of the compassion psychotherapy shows that the time it takes for an assumed population to be diagnosed as a long-established population can have a major impact on the peak size and duration of the increasing number of diagnoses. Increased humanity leads to additional cases of pneumonia, while augmented cure rates are not sensitive to the increasing number of confirmed cases. Indian governments at different levels have intervened in many ways to control the outbreak. According to the results of the model analysis, we suppose that the urgent situation intervention actions adopted in the early stage of the epidemic, such as overcrowding by using wearing the mask and regular hand sanitization, preventive outcome on the original spread of the epidemic. It is a very successful anticipation and handling method to continue to increase speculation in various medical resources to make sure that suspected patients can be diagnosed and treated in an appropriate method. Based on the results of the sensitivity analysis, we consider that better action of the bodies of departed patients can be helpful in ensuring that the bodies themselves and the procedure do not result in additional viral infections, and once the pneumonia patients with the COVID-19 are cured, the antibodies left in their bodies may put off them from re-infection COVID-19 for a longer era of time.

## Keywords

Mean, Average, pandemic.

## AMS Subject Classification

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## 1. Introduction

Since December 2019, many mysterious cases of pneumonia with cough, dyspnea, fatigue, and fever as the main symptoms have occurred in Wuhan, China in a short period of time [15,29]. China's health authorities and CDC swiftly recognized the pathogen of such cases as a new type of corona virus, which the World Health Organization (WHO) named COVID-19 on January 10, 2020 [37]. On January 22, 2020, the Information Office of the State Council of the People's Republic of China held a press conference introduced the significant condition of pneumonia hindrance and manage of new corona virus infection. On the same day, the People's Republic of China's CDC released a plan for the prevention and to manage of pneumonitis of new corona virus infection, including the COVID-19 epidemic Research, sample collection and testing, tracking and supervision of close contacts, and misinformation, education and threat communication to the public [24]. Wuhan, China is the origin of COVID-19 and one of the city's most precious by it. The spread of COVID-19 and a variety of interventions have had an immense negative impact on People's daily lives and the normal performance of society.

The COVID-19 is a novel corona virus that was only revealed in December 2019, so data on the outbreak is still inadequate, and medical resources such as clinical trials are still in a not easy investigative stage [29]. So far, epidemic data have been tricky to apply directly to accessible mathematical models, and questions need to be addressed as to how effective the obtainable emergency response has been and how to spend medical resources more scientifically in the prospect and so on. Based on this, this editorial aims to learn the gaps in this part.

## 2. Methods

### 2.1 Data

Recently, COVID-19 suddenly strike in certain district of Tamil Nadu, the increasing number of suspected cases, the increasing number of peoples was recovered, and the increasing number of deaths is considered for this model. At the same time, we together the epidemic data of various districts and Chennai city.

### 2.2 The Model

Based on the composed epidemic data, we tried to find the propagation rule of the COVID-19, forecast the epidemic situation, and then put forward successful control and prevention methods. There are normally three kinds of methods to study the law of infectious disease transmission. The first is to begin a dynamic model of infectious diseases; The second is statistical modeling based on random process, time series analysis and other statistical methods. The third is to use data mining technology to obtain the information in the data and find the pandemic law of infectious diseases [23]. Considering the lack of the collected public data in time span, the research

content of this paper is mainly based on the first two kinds of methods. The spread of the COVID-19 has exploded rapidly in various s of Tamil Nadu, and successful government involvement and prevention and control procedures in all sectors depend on the best possible outburst prediction [38]. Here we build a dynamic model of COVID-19 transmission and a statistical model based on time series analysis, and compares the calculation effects of these mathematical models on the spread of COVID-19 epidemic. Due to the epidemic of existing data is not comparatively large sample data, in the spread of COVID-19 at this stage, the dynamics model we built an additional suitable for containing parameters to be estimated to forecast the development trend of epidemic, climax size, etc., based on time series analysis of statistical modeling is more perfectly forecast the value of data in the short term.

### 2.3 The Method for Estimation

After the outburst of the COVID-19 epidemic, the Tamil Nadu government has taken many effective measures to battle the epidemic, such as inspection detention, isolation treatment, isolation of cities, and stopping traffic on nook and corner of each roads and streets and Villages. However, some of the traditional model cannot fully explain the contact of these measures on unusual populations. Based on the analysis of the concrete situation and accessible data, we alienated the population into special warehouses and recognized a more successful model for the dynamic spread of infectious diseases. According to the actual situation of the epidemic, we separated the population into merely 3 different categories to fulfill with the existing spread of COVID-19 in Tamil Nadu. See Table 1 for specific classification.

Since the incubation period of the COVID-19 is on condition that 2 to 14 days. Some people who have been infected (I) require to go through a convinced incubation period before so-called symptoms can be detected. Chest CT imaging was used to monitor whether there were glassy gloom in the lungs to conclude whether the diagnosis was confirmed (D). Another part of the population has been infected and has been sick, because not inaccessible, is very much infectious in the population. After a phase of quarantine treatment, these two groups of community will be discharged from hospital (R), or face death due to basic diseases, based on these, we categorize the population as shown in Table 1.

During December 2019, it was reported in Wuhan, China, a pneumonia category of illness outbreak. On 31 September 2019, that was traced and recognized as a novel corona virus. The World Health Organization (WHO) called it as 2019-nCoV. Later, the International Committee on Taxonomy of viruses called it as SARS-CoV-2. Since, April 04, 2020 – April 13, 2020, there have been found at least 334 confirmed deaths and more than 1377 confirmed cases in the corona virus pandemic over 34 districts in Tamil Nadu.



### 3. Preliminaries

Before taking place to some of the fundamentals essential for the study, we are now presenting the novelty, new assis-

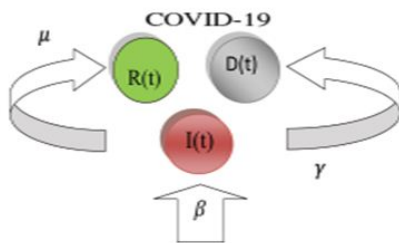
**Table 1.** Descriptions of the Input Variables.

Classes	Explanations
$I(t)$	Infected by the Corona Virus
$R(t)$	Recovered from the Corona Virus
$D(t)$	Death of a person due to Corona Virus

tance and new objectives, which will stimulate the readers and researchers.

This is in which the epidemic modeling without considering the susceptible population was framed. Many papers are up-and-coming daily to predict the daily cases but a new idea called maintaining the 14 day normal infectious, recovered and death populations under threshold populations is given to control the spread and human loss.

With these idea the following model is made



**Figure 1.** Model Formulation

#### 3.1 Transmission Model

Let  $\beta, \mu, \gamma$  and  $\zeta$  be the rate of infected  $I(t)$ , recovered  $R(t)$ , Death  $D(t)$  and the total cases  $T(t)$  respectively. We know that the rate of total case is always 100. i.e.,  $\zeta = 100$ .

#### 3.2 Numerical simulations

Since the model we considered is a stiff system of differential equations, as already discussed the exact solutions of  $\tilde{I}(t), \tilde{R}(t), \tilde{D}(t)$  are in the form  $e^{(-ve) \text{ value}}$ . Also those negative values are high requiring very precise small step size which will lead to more number of iterations. The following plots will be useful to check the average of 14 days pandemic transmission. The plots for April 4 to April 13 are not provided since seeing the table itself we can understand that all the cases like susceptible, infected and recovered are increasing like exponential growth. From the above table it was found that  $I(t), R(t)$  and  $D(t)$  increases rapidly and also it is clear that  $I(t) > R(t) > D(t)$  and obviously  $\beta > \mu > \gamma$ . But without considering from the table we shall calculate  $\beta, \mu$  and  $\gamma$  using separate formulae later. So the COVID-19 model is the exponentially growing model. Since the spread of this pandemic disease is not coming to an end or any proper medicine was not yet found it is not a right way to go for the logistic growth model. If so, what will be the carrying capacity, as

total population and susceptible population are not clearly known? Biologist and Doctors says the average life of this COVID-19 is 14 days. At least we can check whether its average population model is growing exponentially or not. If this is not growing exponentially then we can suggest doctors to maintain this average initial population as threshold numbers. Exceeding this may lead to loss the control of infections and deaths. Throughout the paper,  $\delta$  represents rate of change in population of Infected, Recovered and Dead cases with respect to time  $t$  and  $D$  represents death population.

$$\begin{aligned} \Delta I &= (\beta I(t) - \mu I(t)R(t) - \gamma(t)D(t)) \\ \Delta R(t) &= (\mu I(t)R(t) - \beta I(t)R(t) - \gamma R(t)D(t)) \\ \Delta D(t) &= (\gamma D(t) - \mu R(t)D(t)) \end{aligned} \tag{3.1}$$

#### 3.3 Description of the model

As already discussed,  $\beta, \mu$  and  $\gamma$  be the rate of healthy become infected ( $I(t)$ ), infected become recovered ( $R(t)$ ), infected become death ( $D(t)$ ) respectively. Mathematically death is similar to recovered because both are infection free. The average rate of infectious become death are given by  $\gamma I(t)D(t)$ . The average rate of infectious become recovered and recovered become infectious are given by  $\mu I(t)R(t)$  and  $\beta I(t)R(t)$ . The average rate of recovered become death are represented in two ways as  $\gamma R(t)D(t)$  to study death during infection or partial recovery and  $\mu R(t)D(t)$  to study death after being recovered, i.e., natural death. The exact solutions of (3.1) is found to be

$$\begin{aligned} I(t) &= ce^{\int_0^t (\beta - \mu R(t) - \gamma D(t)) dt} \\ R(t) &= ce^{\int_0^t (\mu I(t) - \beta I(t) - \gamma D(t)) dt} \\ D(t) &= ce^{\int_0^t (\gamma - \mu R(t)) dt} \end{aligned}$$

For any value  $t_0 \leq t \leq t_n, \beta - \mu R(t) - \gamma D(t) < 0, \mu I(t) - \beta I(t) - \gamma D(t) < 0, \gamma - \mu R(t) < 0$  which produces (-ve) values as the solutions of (3.1). Thus we call the model (3.1) as system of stiff deferential equations. We shall present the test later to conform it. Now fuzzy system of stiff deferential equation is given in (3.2)

$$\begin{aligned} \Delta \tilde{I}(t) &= (\beta \tilde{I}(t) - \mu \tilde{I}(t)\tilde{R}(t) - \gamma \tilde{I}(t)\tilde{D}(t)) \\ \Delta \tilde{R}(t) &= (\mu \tilde{I}(t)\tilde{R}(t) - \beta \tilde{I}(t)\tilde{R}(t) - \gamma \tilde{R}(t)\tilde{D}(t)) \\ \Delta \tilde{D}(t) &= (\gamma \tilde{D}(t) - \mu \tilde{R}(t)\tilde{D}(t)) \end{aligned} \tag{3.2}$$

Where,  $\tilde{f}(t) = (0.75 + 0.25r, 1.125 - 0.125r)f(t)$  is the fuzzy number with  $r \in [0, 1]$ . The initial conditions are the average populations, we presented in Table 3. Since the population cannot be a fractional number we take

$$\begin{aligned} I(t_0) &= I_0 = m_1 = 1357, t = t_0 \\ R(t_0) &= R_0 = m_2 = 671, t = t_0 \\ D(t_0) &= D_0 = m_3 = 334, t = t_0 \end{aligned}$$

The rate of infection, recovered and death are also found by average of ratios of 10 days. Instead of taking  $\beta, \mu$  and  $\gamma$  from the Table 2, we are calculating them using more appropriate



**Table 2.** COVID 19 PANDEMIC DISEASE-TAMIL NADU, INDIA (Affected during 4.4.2020 to 13.4.2020)

S.No.	Cities	4.4.20	5.4.20	6.4.20	7.4.20	8.4.20	9.4.20	10.4.20	11.4.20	12.4.20	13.4.20
1	ARIYALUR	0	0	0	0	0	0	1	1	1	1
2	CHENGALPATTU	15	15	18	20	20	24	36	40	42	44
3	CHENNAI	49	91	98	152	159	166	175	182	200	209
4	COIMBATORE	33	33	62	64	64	64	90	97	119	126
5	CUDDALORE	0	3	10	13	13	13	14	15	19	19
6	DINDIGUL	17	43	45	45	46	46	54	55	56	56
7	ERODE	27	27	27	27	27	53	55	60	64	64
8	KALLAKURICHI	0	2	2	2	2	3	3	3	3	3
9	KANCHEEPURAM	3	4	5	7	7	7	7	7	7	7
10	KANNIYAKUMARI	5	5	6	6	6	14	15	15	15	15
11	KARUR	17	22	22	22	22	22	22	22	25	40
12	MADURAI	15	17	19	24	24	25	25	25	25	39
13	NAGAPATTINAM	0	5	11	11	11	12	12	24	24	29
14	NAMAKKAL	18	24	25	28	33	41	41	41	45	45
15	PERAMBALUR	0	1	1	1	1	1	1	1	1	1
16	RAMANATHAPURAM	2	2	2	2	2	2	2	2	2	5
17	RANIPET	4	22	24	26	26	26	35	36	38	38
18	SALEM	6	9	12	12	13	14	14	14	18	18
19	SIVAGANGA	5	5	5	5	5	6	6	6	6	10
20	TENKASI	0	0	0	0	0	1	1	1	2	2
21	THANJAVUR	1	1	5	11	11	11	11	11	11	11
22	THE NILGIRIS	0	0	0	0	4	4	7	9	9	9
23	THENI	20	23	24	24	40	41	41	41	41	41
24	THIRUVALLUR	1	11	12	12	13	13	13	29	30	34
25	THIRUVARUR	7	12	12	12	12	13	13	13	13	16
26	THOOTHUKKUDI	5	9	11	17	17	22	24	24	24	26
27	TIRUCHIRAPPALLI	1	18	18	31	37	37	37	39	43	43
28	TIRUNELVELI	30	37	38	38	42	58	58	58	58	58
29	TIRUPATHUR	10	10	10	11	11	11	11	16	16	17
30	TIRUPPUR	1	3	3	20	22	26	26	26	61	79
31	TIRUVANNAMALAI	2	2	4	5	5	5	6	7	7	8
32	VELLORE	2	4	6	6	7	12	12	11	12	16
33	VILUPPURAM	3	14	19	20	24	24	27	27	27	27
34	VIRUDHUNAGAR	10	11	11	11	11	11	11	11	11	17
	TOTAL	294	456	567	685	737	828	906	969	1075	1173

formulae given below.  $\beta \rightarrow$  the rate of infection=Infected case  $\times \zeta /$  total case  $\mu \rightarrow$  the rate of recovery = Recovered case  $\times \zeta /$  total case  $\gamma \rightarrow$  the rate of death = death case  $\times \zeta /$  total case  $\zeta \rightarrow$  the rate of total case. The total case  $T(t) =$  Infected case  $I(t) +$  Recovered case  $R(t) +$  Death case  $D(t) = 185.2$  at  $t = t_0, T_0(t) = I_0(t) + R_0(t) + D_0(t)$ . Now we consider the average of those 14 days rate as the required rate. We found that  $\beta = 58, \mu = 28, \gamma = 14$  and  $\zeta = 100$ .

#### 4. Conclusion and future work

Novel Corona virus leftovers on human body for 14 days so it might be likely that during premature stages of infection there are no symptoms but if the patient have any checkup history or might travel to infected country or might come in contact with infected person the he or she have to do this assessment daily up to 14 days. This model can only help those who can identify their symptoms but if someone is ignorant about the virus and been exposed to other persons then

it is extremely believed that those persons might be infected by that person. As in Figure 3 we conclude that Chennai, Cadaloor, Erodu, Thirupathur occupy the first four places. About 100% population of which, the ratio of infection, recovered and death cases are 58:28:14. From all those cities from Tamilnadu, the most affected peoples are countered and constructed a model. The future work, we simulate our model in to an Artificial Neural Network, Machine Learning can be used to educate the model and give more exact results.

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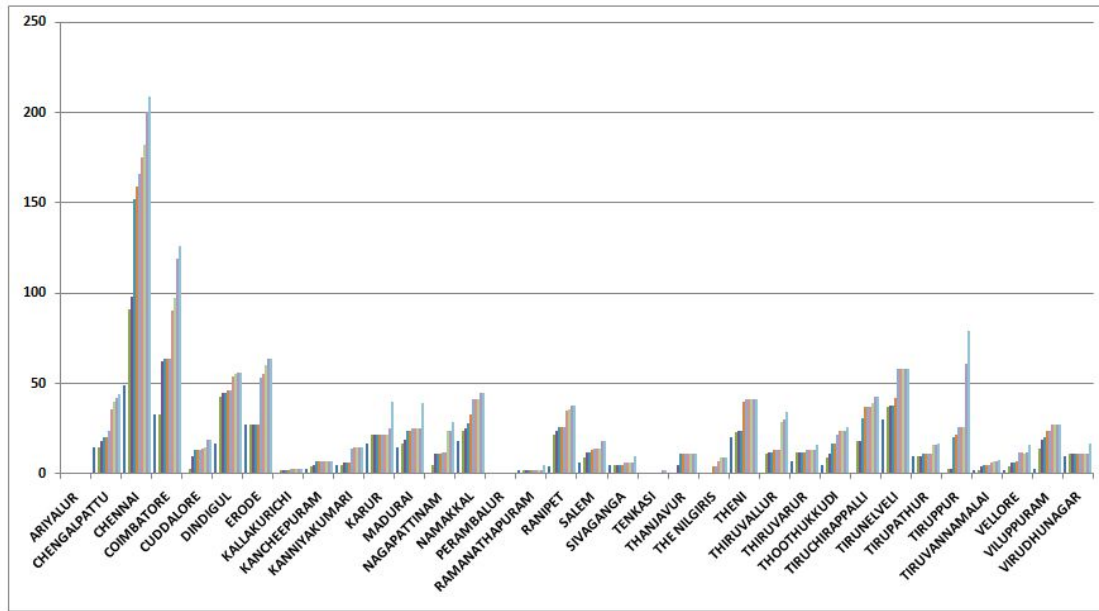


Figure 2. Bardigram of the Covid 19 affected persons in district of Tamilnad (From 04.04.2020 to 13.04.2020)

Table 3. List of Corona Virus affected, recovered and Death cases in Tamil Nadu.

Date(t)	$I(t)$	$\beta$	$R(t)$	$\mu$	$D(t)$	$\gamma$	$T(t)$
04.04 .2020	73	57.03	41	32.03	14	10.93	128
05.04 .2020	92	52.87	37	21.26	45	25.86	174
06.04 .2020	111	61.67	54	30.00	15	08.33	180
07.04 .2020	113	65.32	45	26.01	15	08.67	173
08.04 .2020	102	54.26	54	28.72	32	17.02	188
09.04 .2020	151	55.31	75	27.47	47	17.22	273
10.04 .2020	178	57.79	108	35.06	22	07.14	308
11.04 .2020	163	59.71	70	25.64	40	14.65	273
12.04 .2020	196	55.37	89	25.14	69	19.49	354
13.04 .2020	198	59.82	98	29.61	35	10.57	331
Sum	1377	579.15	671	280.94	334	139.88	2382
Average	137.7	57.92	67.1	28.09	33.4	13.99	238.2

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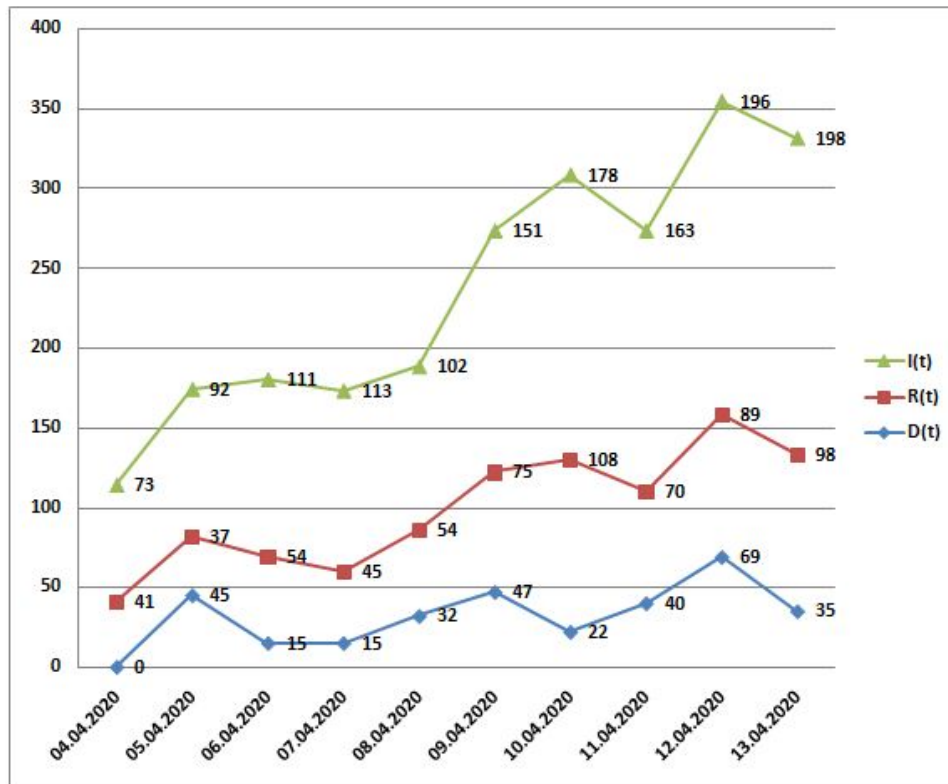


Figure 3. Covid19-Infected, Recovered and Death

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