Biostatistical Analysis of the Risks of Spatial Spread during the COVID-19 Pandemic

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Abstract

Introduction: With the unfold of the brand-new coronavirus across the world, governments of diverse nations have all started to apply the mathematical modeling technique to assemble a few virus transmission fashions assessing the dangers of spatial unfold of the brand-new coronavirus COVID-19, at the same time as wearing out epidemic prevention paintings, after which calculate the inflection factor for higher prevention and manage of epidemic transmission. This painting analyzes the unfold of the brand-new coronavirus in China, Italy, Germany, Spain and France and explores the quantitative dating among the increase price of the range of recent coronavirus infections and time.

Background: In December 2019, the primary Chinese sufferers with pneumonia of unknown cause is China admitted to sanatorium in Wuhan, Hubei Jinyintan, due to the fact then, COVID-19 withinside the fast enlargement of China Wuhan, Hubei, in some months' time, COVID-19 is Soon it unfold to a complete of 34 provincial-degree administrative areas in China and neighboring countries, and Hubei Province right away have become the toughest hit via way of means of the brand new coronavirus. In an emergency situation, we attempt to set up a correct infectious disorder retardation boom version to are expecting the improvement and propagation of COVID-19, and in this basis, make a few short-time period powerful predictions. The production of this version has Relevant departments are beneficial for the prevention and tracking of the brand-new coronavirus, and additionally try for greater time for the scientific trials of Chinese researchers and the studies on vaccines in opposition to the virus to dispose of the brand new corona virus as quickly as possible.

Methods: Collect and evaluate and combine the unfold of COVID-19 in China, Italy, France, Spain and Germany, report the virus transmission fashion amongst human beings in every us of a and the protest measures of applicable authorities departments. According to the unique statistics alternate law, Establish a Logistic increase model.

Findings: Based at the evaluation effects of the Logistic version version, the Logistic version has a very good becoming impact at the real cumulative wide variety of showed cases, that can convey a higher impact to the prediction of the epidemic scenario and the prevention and manage of the epidemic scenario.

Interpretation: In the early degree of the epidemic, because of insufficient anti-epidemic measures in diverse international locations, the epidemic scenario in diverse international locations unfold rapidly. However, with the sluggish knowledge of COVI D -19, the epidemic scenario started out to be step by step controlled, thereby retarding growth.

Keywords: New Coronavirus; Logistic Growth Model; Infection Prediction and Prevention

Introduction

After the outbreak of COVID-19 in China, COVID-19 has additionally erupted in different nations withinside the world. Among the nations in which new pneumonia outbreaks, Spain, Italy, France and Germany are greater serious [1]. As of April 27, Spain, Italy, France and Germany have every accrued identified 229842 cases, 199414 cases, 165,842 cases, 158758 cases, the brand-new crown pneumonia spread, and numerous measures of normal lifestyles and people's social regular operation had now no longer Estimated impact [2].

In fact, there are a few pressing issues to be solved concerning the unfold of COVID -19. Can present interventions efficaciously manipulate COVID-19? Can you problematic at the adjustments and improvement traits of every epidemic situation? Can you integrate the conclusions discovered withinside the contrast of the city/region, real countrywide population, clinical level, site visitors' conditions, geographic location, customs and culture, and anti-epidemic measures? What mathematical version are we able to construct to resolve the problem?

COVID-19 is a brand new coronavirus determined in December 2019. The epidemic statistics isn't always sufficient, and medical strategies inclusive of medical trials are nonetheless withinside the exploration stage. So far, the epidemic state of affairs statistics is hard to use at once to the prevailing mathematical model. The troubles to be solved are how powerful the prevailing emergency reaction is and the way to make investments scientific sources greater scientifically withinside the future. On this basis, this newsletter pursuits to look at the shortcomings of this part [3-5].

Methods

Data

We acquired epidemiological facts from the Aminer website, the People's Republic of China from January 22 to April 3 and Spain, Italy, France, Germany from February 15 to April 27. This consists of facts such as cumulative showed instances, cumulative deaths, newly recognized instances according to day, cumulative variety of cured instances and present showed instances. The relevant input is shown in the figure 1-5.
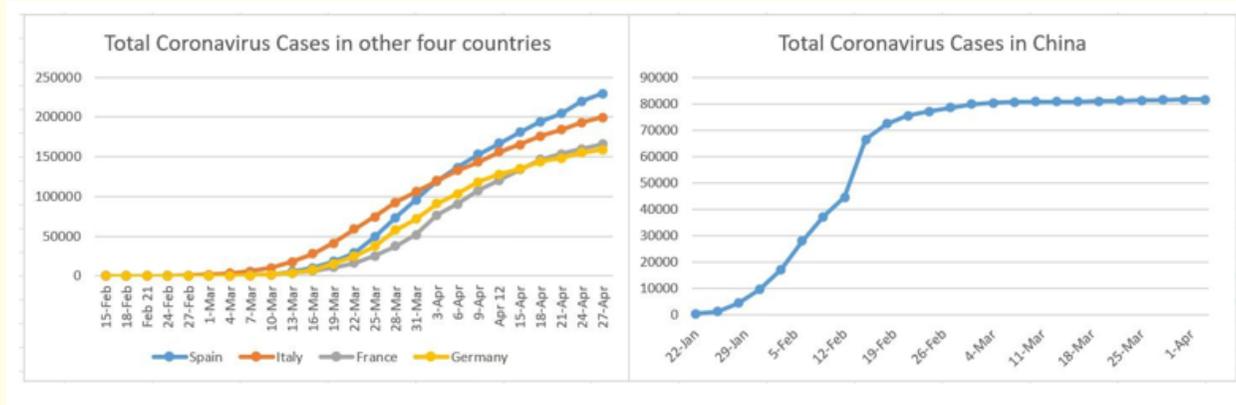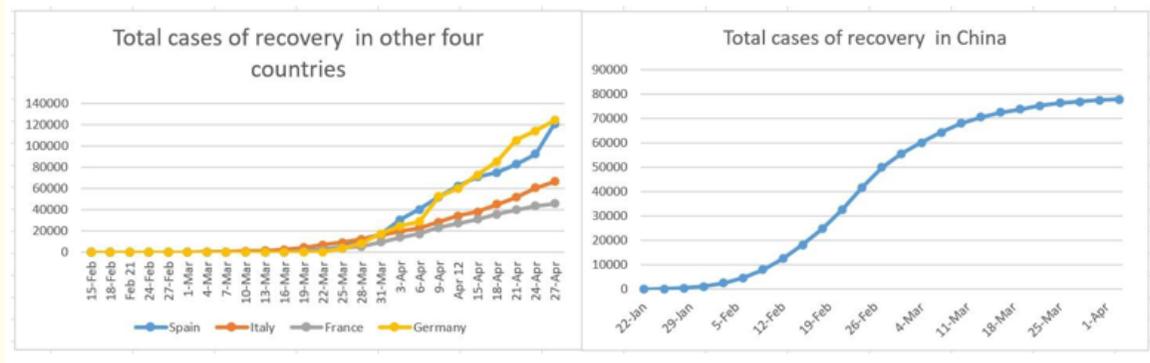

Figure 1: *Cumulatively confirmed cases.*

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***Figure 2:** Cumulatively cured cases.*
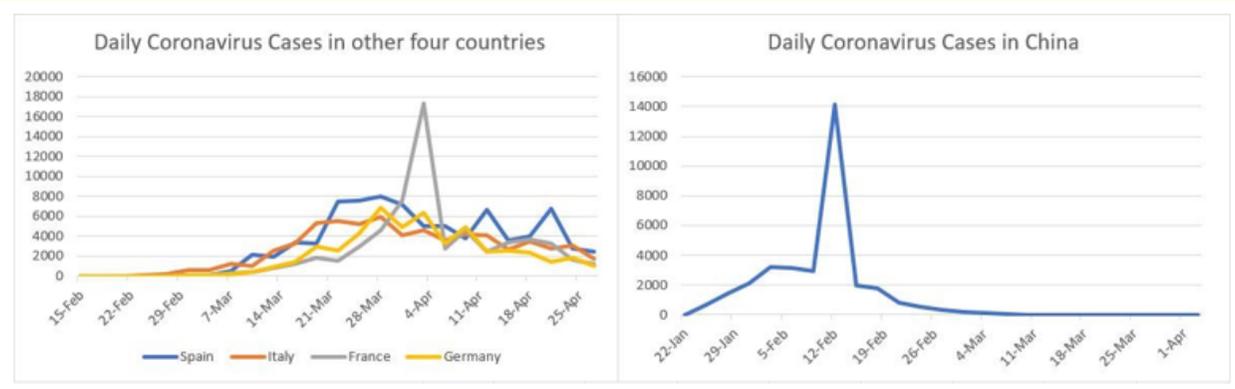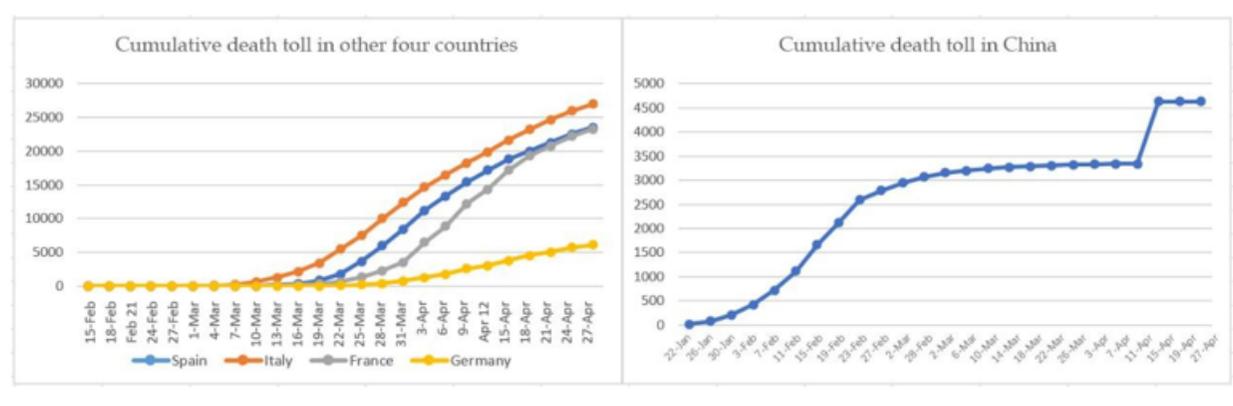

***Figure 3:** Daily new cases.*

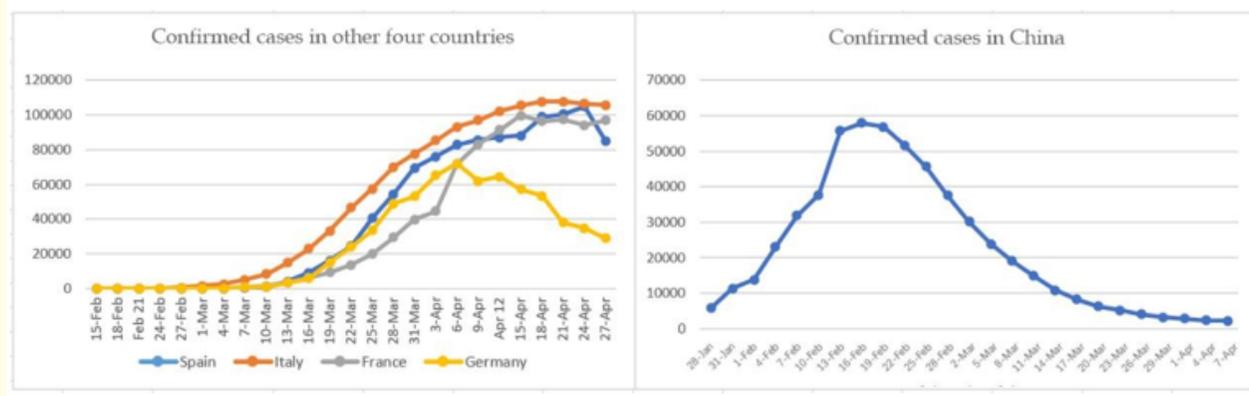***Figure 4:** Cumulative deaths.*

Figure 5: *Existing confirmed cases.*

The model

On the basis of the epidemic data collected, we tried to determine the law of spread of COVID-19 and suggested effective prevention and control methods.

In general, there are three ways to systematically study the spread of infectious diseases: one is to create a dynamic model of infectious diseases; the second is statistical modeling using statistical methods such as random processes and time series analysis; the third is the use of data mining technology. Gaining insight into the data and discovering the law on infectious diseases. Using data from different countries, this article mainly uses the third method.

In this paper, the increase version of COVID-19 transmission is established and the prediction impact of the mathematical version at the unfold of COVID-19 epidemic is compared.

Based on logistic estimated square law

The conventional SEIR version can't describe the one-of-a-kind tendencies of the epidemic well. After reading the real scenario and the prevailing information, we've mounted a greater powerful infectious sickness transmission version. According to the real scenario of the epidemic, we are able to examine the applicable information signs of the 5 countries (cumulatively recognized instances, cumulative deaths, newly recognized instances according to day, cumulative variety of cured instances, current showed instances) to evolve to the modern-day scenario of the brand new coronary pneumonia epidemic withinside the global propagation.

Symbol	Meaning	Unit
a,b	Parameter	None
x	The time since the outbreak began to count	Day
t	Time	Day
y	Cumulative confirmed cases	People
x0	e^(-t)	None
y0	1/y	None
e	Constants	None

Table 1: *The significance of each parameter under the construction of logistic model.*

As may be visible from the information graph, the alternate in cumulative demise toll in Italy over the years is a non-linear process. Considering the form of the scatter plot and the version usually regarding the Logistic curve version, right here we use the Logistic curve version for fitting. The fundamental shape of the logistic curve version is:

y = 1 / (a + be ^ (-t))

Therefore, we need to transform this nonlinear process into a linear model after data processing. Take x0 = e ^ (-t), y0 = 1/y; Then the original model is converted to a linear model y0 = a + bx0.

Simulation

Since COVID-19 has been growing in Italy for an extended length of time, and the cumulative quantity of showed instances is surprisingly large, the information is extra convincing, so right here we take the cumulative quantity of showed instances in Italy from February fifteenth to May third The nonlinear version will become a linear version, and matlab is used for becoming linear regression analysis. Matlab source code is as follows [6-9]:

x = [1: 1: 27].

Y= [3,3,21,229,655,1701,3089,5883,10149,17660,27980,41035,59138,74386,92472,105792,119827,132547,1436

26,156363,165155,175925,183957,192994,199414,205436, 210717].

plot (x, y, 'r *'); xlabel ('time')

ylabel ('population') x0 = exp (-x).

y0 = 1. / y.

f = polyfit (x0, y0,1).

y_fit = 1. / (f (1). * exp (-0.338. * x) + f (2)); plot (x, y_fit * 1000).

hold on

plot (x, y, 'r *'); xlabel ('time') ylabel ('population')

Results

Logistic model estimates

On the premise of the cumulative quantity of showed instances in Italy from February fifteenth to May 3rd, we used Matlab to set up a Logistic version and done linear regression analysis. Using the above processing, we can get the predicted cumulative number of confirmed cases in Italy as shown in figure 6.

As proven in figure 6, we are able to finish that the Logistic version has an amazing becoming impact at the real cumulative wide variety of showed cases, hence presenting reference fee for departments and hospitals in any respect ranges to successfully interfere and save you the unfold of recent coronavirus withinside the following few days.

Discussion

The unfold of COVID-19 is laid low with many complicated factors. In the early degree of the transmission of COVID-19, it's miles hard to set up a Logistic version and parameter estimation and reap a reasonably correct simulation result, however the preliminary expected parameters inclusive of the increase price of the showed instances and the viable cumulative most showed instances may be acquired via current data. It is useful to remedy essential parameters inclusive of contamination price and recuperation price, on the way to assist us to comprehend the transmission fashion of COVID-19 extra accurately.

Limitations of the Study

1. Promotion of the version: The SEIR version primarily based totally on 2019-nCoV may be established. The SEIR version is advanced to the logistic version in fashion prediction, however because of the numerous parameters to be considered, the calculation mistakes is more than the logistic model [10-19].

2. A dynamic increase price version primarily based totally on 2019-nCoV may be established. The dynamic increase price version has a very good becoming impact however has a positive error.

3. You also can optimize at the cost of r. The strategies of optimizing rare: 1. Perform grid optimization; 2. Perform bipartite optimization; You can optimize at the cost of K and replace in actual time.

4. After the turning factor of the epidemic situation, that is, the suitable impact of the reducer and the saturation length is poor, or even a huge blunders occurs [20-23].

Conflict of Interest

We have no conflict of interests to disclose, and the manuscript has been read and approved by all named authors.

Acknowledgement

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4. https://mp.weixin.qq.com/s?biz=MzU0MjY4NzU5Nw==&mid=2247485726&idx=5&sn=3cd57623b6775666b53f6b98497208e1&chksm=fb17a11ccc60280a14b139c45408d6af48184ea94aa942bbd711380b271ba382c6e4197a3b13&mpshare=1&scene=23&srcid=0423m9tmCjW9lEgP9Wtbju6G&sharer_sharetime=1587641 792708&sharer_shareid=b8fc3d4ec515cc6c342bf7bec53c2d7d#rd

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