COVID ERA: A MATHEMATICAL APPROACH

Renjini Raveendran P
Assistant Professor
Department of Mathematics
All Saints' College,
University of Kerala,
Thiruvananthapuram

Abstract: The Corona Virus profoundly changed the world. Public health, money, the environment, climate, human behaviour, and other factors are all impacted by it. As of the now, it causes a crisis in 213 various countries around the world. Geopolitics explores how the physical characteristics of the planet, such as its population, topography, climate, and natural resources, influence politics and other aspects of world affairs. The comprehension of mathematics is helpful for both geopolitical and historical studies. The use of mathematical concepts converts historical ideas into predominantly pictorial forms. Use of graphs or maps helps even the average individual understand concepts in a straightforward manner.This study focuses on the use of mathematics in geopolitics during and after the COVID era, including mapping techniques, signed graphs, prediction, modelling, establishing COVID zones, route maps for infected individuals, networks, and more. It also covers a few mathematical tools that are frequently employed in historical research. For the world to be ready for either the second/third phase of COVID or the second outbreak of the virus infection, prediction and modelling approaches are crucial. Only with the aid of forecasting, which can be approximated using mathematical techniques and instruments, is it possible to improve medical facilities

.Introduction:

In the early 19th century, German mathematician Carl Friedrich Gauss called **Mathematics** the "**Queen of the Sciences**" because it was so successful at uncovering the nature of physical reality. Even in this COVID pandemic, it helps to predict, tabulate, plots, models the present as well as future situations.

Keywords: Graph, Planar Graph, Graph Coloring, Split Network

Some changes in the world in Post Covid Era

- The population of the world decreases.

- Due to fear, some people fled from the native places to new geographical areas.

- Income from foreign countries reduces.

- The death rate due to poverty is much more than that of COVID death.

- Personal hygiene increases.

- Use of mask and sanitizer help people from other communicable disease.

- Social Distancing has become a part of life.

- Highly developed countries became helpless in front of an invisible virus.

- Politics, Economy, Finance, Weapons etc has nothing to do with CORONA

    Radiation Increase in Nature

- Due to some of the above mentioned facts students from play school to professional courses depend purely on electronic devices for learning purposes. This cause increased level of radiation.

    Nature refreshed after Lockdown

- Due to complete lockdown in most places, the negative effects of human interference on nature decreases and the atmosphere, water bodies, living organisms get refreshed.

In these all Mathematics plays a key role. Let us consider one by one:

GEOPOLITICS AND MAPS

A map plays an important role in Geopolitics. So many mathematical ideas can be combined to get a map.

1) Scale Drawing

    The maps are not exactly the same size as that of the area it represents. The measurements are scaled down to make a graph using ratio concept.

The scale of drawing = Drawing length: Actual length

2) Map Colouring

It is the process of giving colours to maps. Graph theory is a branch of mathematics. A graph is said to be planar if it can be drawn in a plane so that no edge cross. **Four Colour Problem** gives an idea about colouring graphs which says "Every planar graph is four-colorable."

There are other mathematical concepts that can be used in mapping as follows:

| Mathematical Concepts	Uses in Mapping Technique
Co-ordinate geometry	Latitudes and longitudes
Plane Euclidean geometry	Surveying small areas
Spherical geometry and trigonometry	Map projections
Topology	Spatial analysis of networks
Differential equations	Dynamic processes

Signed Graphs for Inter-relations

These graphs can be used to show the mutual relationship between countries. Here A, B and C represent countries. The following signed graph can be read as:

The countries (A , B), and (A, C) are positive in their relation. But B and C are negatively related.
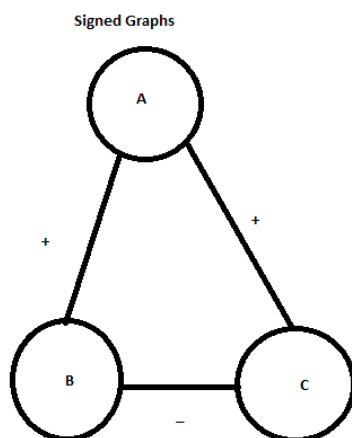

Prediction and Mathematical Modelling to reduce the risk of International Spread

a) <u>Prediction -Transmission of Virus in coming future.</u>
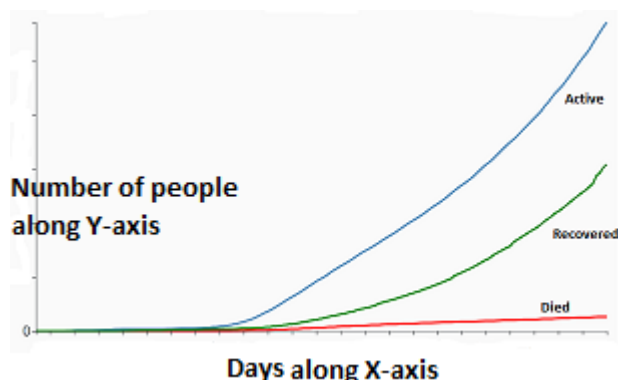
Consider the graph showing active, recovered and died population each day. This curve has approximate shape of exponential curve. With the help of exponential functions, we can predict the approximate number of patients in coming months. This way we are making predictions like "In the coming December there will be a higher number of infected people "and so on. (**exponential** functions **are** functions of the form: $y = \mathbf{b}\mathbf{a}^{x}$, where **b** stands for the initial amount, **a** is the growth factor , b $\neq$ 1)

b) Mathematical Modelling
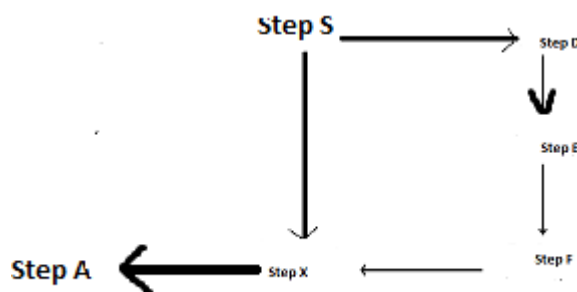
This type of figures can be used for studying a process or model before its implementation. By constructing these types of models, one can make decisions, point out defects, make changes etc

These types of models in medical treatment systems help a country to point out the drawbacks or lack of facilities in present situation and to do improvements in future.

For example: Can model present medical facilities and find out factors that help for the future treatments or to make sufficient facilities for a second outbreak of the pandemic.

Some of them are more ICUs , Ventilators , Beds, to appoint more Doctors , nurses and so on.

Split networks from sequences

Reduced median networks are mainly used in phylogeography and population studies which are important in Goepolitics. The COVID outbreak has forced organisms to move from place to place. This network helps to represent closely related organisms sampled across various parts of the world
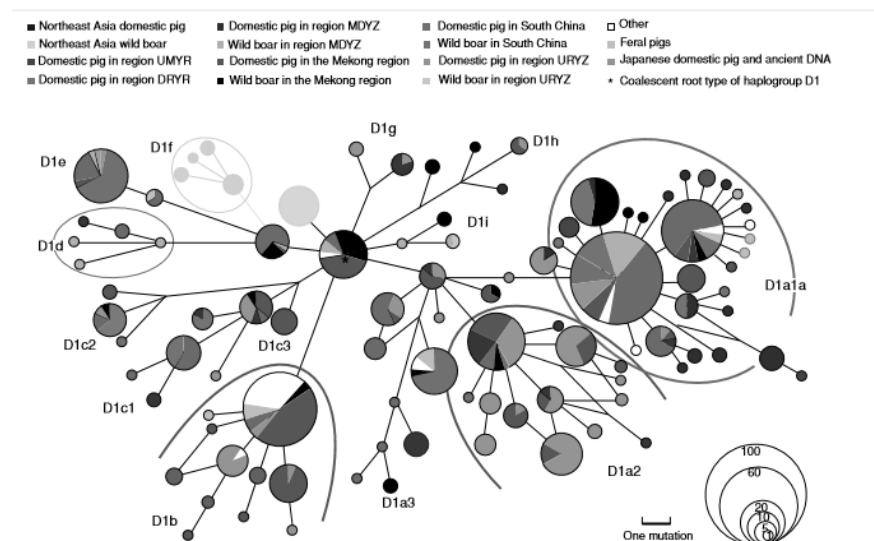

Figure   A reduced median network reported for a set of over 700 pigs, wild boar and other closely related animals sampled across China, South East Asia and India, based on mtDNA [245]. This network was constructed to investigate the question whether pigs were independently domesticated in multiple places. Reprinted from Genome Biology 8:R245 (2007) under the Creative Commons Attribution License.

Mathematics in forming COVID Zones

    i.   Mapping of cases and contacts

Graph Theory and Route Map of Corona infected person

The places a person visited can be considered as vertices and the route can be treated as edges. Calculations will be easier by considering the route map as a graph. This is useful for finding high risk contacts.

O PLACES ———— ROUTE
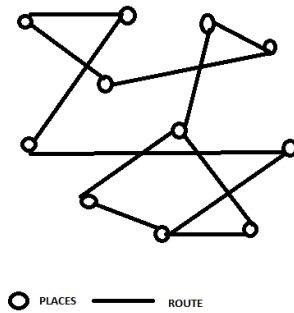
ii.   Geographical dispersion of COVID infected cases and their contacts

This measure shows the scattering of the infected cases and their contacts.

DISPERSION

Number of infected people - Y axis
Number of days - X axis
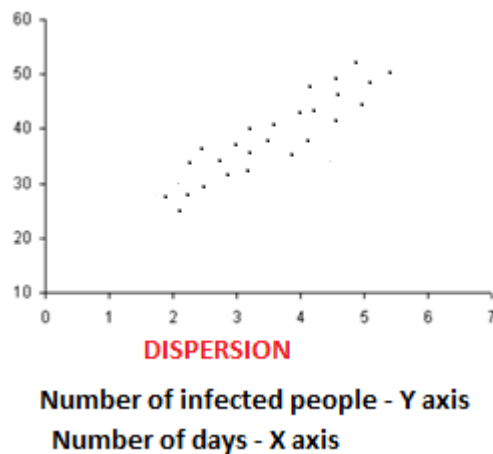
iii. Distinguish the infected area with well demarcated perimeter

 iv. Enforceability of perimeter control and denoting the zones by maps.

The perimeters of containment zones are decided based on the number of positive cases in the area, contact tracing history, and population density. The perimeters of containment zones can be calculated by identifying a patients' Route map – the place he visited before the identification of CORONA infection.

ZONES ON PERIMETER BASIS
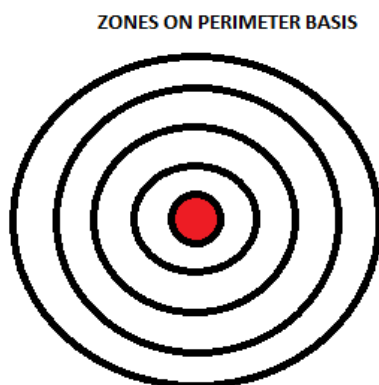
The red area denotes the point or place of infection.

Mathematical Networks Everywhere

The schools closed for long periods. All educational institutions Started online mode of education for all. No seminars, no get together, no crowded queues in offices, banks etc. Every one give preference to online mode for communication, financial transfers and so on. Uses of electronic gadgets get increased. These all give rise to Networks which are mathematical in nature.
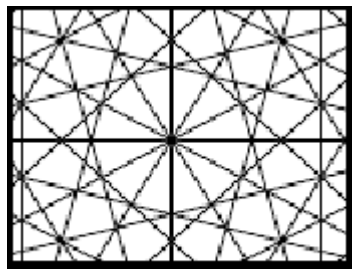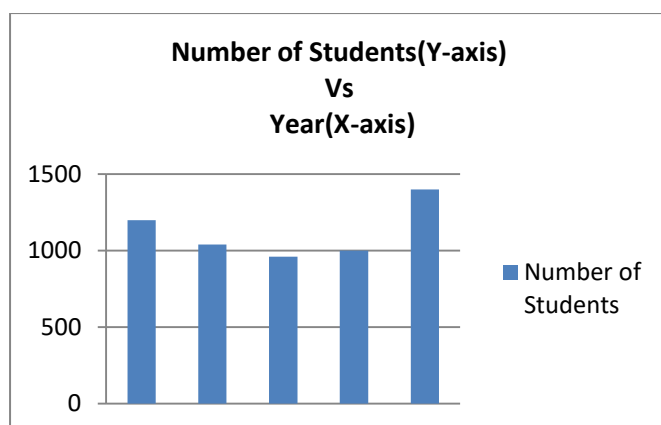

NETWORK PATTERN

Mathematical Network shows various connections and interconnections. The study of all these will depend on these network studies.

Mathematical tools used excessively during and after Covid

This is mainly used for comparison : To compare the active, recovered, etc due to COVID 19 during various time periods. Pictorial representations are more acceptable. These can be easily understandable even to common man.
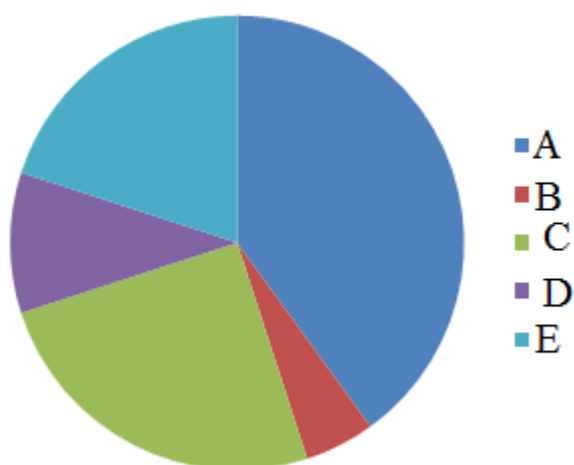
BAR GRAPH

An example for Bar Graph

**Number of Students(Y-axis)
Vs
Year(X-axis)**

(bar chart showing values approximately 1200, 1050, 960, 1000, 1400 with y-axis from 0 to 1500; legend: Number of Students)

PIE CHART

An example for Pie chart

(pie chart with segments A, B, C, D, E)

Conclusion

 Mathematics has its application in almost all branches of Science. Even in this present and post COVID pandemic times, Mathematics is an essential tool for all calculations, predictions, comparisons and can be a part of history in the coming future. Without mathematics never ever a history become complete and perfect.

References

1. Dr Suresh Singh, G.(2010). *Graph Theory.* New Delhi: PHI Private Limited.

2. Narsing Deo. *Graph Theory with Applications to Engineering and   Computer Science*: PHI Learning

3. Daniel Huson,H, Regula Rupp & Celine Scornavacca. *Phylogenetic Networks: Concepts, Algorithms and Applications*: Cambridge University Press.

4. Riley,K,F,Hobson,M.P & Bence,S.J. *Mathematical Methods for Physics and Engineering*: 3rd Edition, Cambridge University Press

5. Mary Boas,L. *Mathematics Methods in the Physical Sciences*, 3rd Edition, Wiley

6. Howard Anton, Irl Bivens & Stephen Davis. *Calculus* 10th Edition

.