Chapter 6
Graph Theory Approach to Epidemic Study

ABSTRACT

Graphs can be very helpful in understanding a complex situation by presenting it in a simple and meaningful manner. In graphs, there are only two entities we deal with, vertices/nodes and edges/links. The nodes represent the objects and links represent the relationships between them. The application of this theory can be found in diverse fields such as psychology to anthropology and linguistics to communication networks. This chapter contains an introduction to graphs and their applications to the real world. Graph theory is described briefly, followed by the introduction of epidemic studies and a discussion of different types of epidemiology studies. It is discussed how graph theory was used in the study with a few examples on how the theory was used in general. There are also descriptions of different ways of representing the networks in graphs.

INTRODUCTION TO GRAPHS

The concept of graph theory developed in a much similar way as the probability theory developed. The latter was motivated by the efforts to understand the chances in games while the former was motivated by the understanding of games and patterns.

DOI: 10.4018/978-1-7998-8343-2.ch006

Drawing a graph eases understanding a complicated situation in engineering. In graphs we deal with only two entities vertices/nodes and edges/links. Nodes represent the object while the links represent the relation between the objects. The application of this theory can be found in diverse fields such as psychology to anthropology and linguistics to communication networks.

The pictorial representation makes it easier for the person trying to understand the concept and to look into various other applications. The concept of graphs was introduced by Euler during the 18th century. In the initial stages a few papers were published in this field but now graph theory has applications in almost all fields. As such the study of graph theory has emerged as a worthwhile mathematical discipline in its own right. Like other branches of mathematics, say applied mathematics where the concepts are based on mathematical equations like ordinary and partial differential equations, graph theory does not have such an approach. Whatever equations appear are simple algebraic equations which are easy to understand but difficult to obtain. Among many interesting problems enumeration of graphs had drawn attention of many researchers. Lot of work has been done in graph enumeration but in the modern days researchers use computational power in the form of software's for enumeration. Graph theory mainly feeds on problems. It may be possible to write a graph with any number of characteristics as the person writing it may want but to obtain a general result on the properties of the graph or to characterize the graphs with the properties written is a very difficult problem.

On 26 August 1735, at the Academy of Sciences, St. Petersburg, Russia, Leonhard Euler delivered a lecture "The solution of a problem relating to the geometry of position" which proved that there is no such continuous walk across the seven bridges.

As a subject, graph theory took its birth through a paper "Solutio problematis ad geometriam Situs pertinantis" authored by Leonard Euler, a swiss mathematician in 1736. This paper was the solution of the famous Konigsberg bridge problem that ultimately led to the concept of Eulerian graphs and paths.

In 1809, Poinsot, worked on the Eulerian trial in a complete graph with odd vertices. In 1856, Thomas Kirkman, in this research paper found the different types of polyhedra which possess an Eulerian path. He also gave an example of "cell of a bee" polyhedral that has no such cycle. In 1847, G. R. Kirchhoff introduced the concept of trees and used it in electrical networks. Later in 1889 A. Cayley, explored the concept of trees to enumerate the isomersF of hydrocarbon C_nH_{2n+2}.