

Utilization of Social-Graph Analysis for Investigating Social Structures through the use of Networks and Graph Theory

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Abstract

Social Network Analysis (SNA) is a digital process that helps to represent the collaboration between the individuals of society. Graphical representation of individual data has helped to understand social structure. Along with that, this research study has selected a secondary data collection method to understand the actual structure of the society. This graphical representation has included several nodes and edges of society to understand the interaction between the communities. In the present time, different organizations have faced difficulties due to a lack of communication. Along with that, graphical theory and network diagrams have helped to understand the weak ties and strong ties of society. According to that, society got the chance to improve the structure and build effective collaboration.

Keywords

Interpersonal relationship, nodes, edges, Social Network Analysis (SNA), ties.

INTRODUCTION

Social Network Analysis (SNA) helps to understand social structures through graph theory and networks. In the social structure, there are several terms of nodes such as people, individual actors, and other things. In this regard, the relationship and interaction between these social nodes have helped to create an effective social structure. Along with this, this research study has included social graph analysis through using network and graph theory to find social structure. Social graph analysis has represented consistency and relationship between people in the society that indicate social structure.

Rationale

Social graph analysis is a digital information process to make a network based on relationships and communication among the people of the society. Social network analysis is a mathematical and statistical process that represents the social interaction of people. This graph analysis depends on the personal data of individual people in society ([7] 2020). This technical social analysis has provided mathematical graph theory based on the relationship between different objectives of social structure ([1] 2017). In society, many nodes create difficulties to establish an effective structure. **Group formation** among the society is one of the most effective difficulties that create issues to develop the proper structure of society.

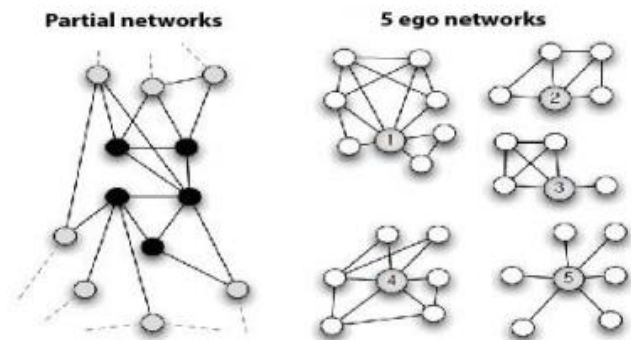


Fig 1: Partial and Ego network
(Sources: [7] 2020)

On the other hand, **partiality** is another most effective aspect that creates issues to establish proper communication between individual people of the society. Moreover, **ego** and **interpersonal relationship between people** of the society has created difficulties to make the effective structure of the society ([7] 2020). Along with that, mathematical and statistical analysis through using **algorithms**, **python code** has helped to represent the relationship and network graphs to understand the actual structure of the society. In the present time, **organization** and identification of **public health** have used this graphical representation of social networks to improve social structure.

Aim and objective

- To describe social networks through using network and graph theory.
- To analyze the importance of social structure through social graph analysis.
- To understand the application of social network analysis.

Research questions

- How do social graph analysis use network and graph theory?
- What is the importance of social structure through social graph analysis?
- How does the application of social network analysis work?

Concept of Social Network Analysis (SNA)

SNA is the mathematical process that helps to find social structure. This is the unique approach that combines *various nodes* and *edges* of the society to understand effective social structure. Along with that, various techniques such as *algorithms, python code* and *statistics*, and graph theory have helped to explain the dynamics, patterns of society. In the SNA most important components are *nodes* and *edges* that help to represent social structure. In the words of [8] (2021), nodes usually represent the self-proportion of the individual people such as *size, weight, position*, and *other attributes* that help to develop social networks. Moreover, network-based properties of the society are *neighbors, degree number*, and *other cluster-connected nodes* that help to establish the social network of the society. On the other hand, edges have helped to establish the connection between nodes ([9] 2020). In this regard, edges represent the strength of connection through weight representation of the people and *asymmetry relationship between people* of the society. Moreover, time application has helped to understand the actual structure of society. These aspects have helped to describe the basic phenomena of society. In this regard, *virtual routing networks, road networks, social connections, physical electricity networks, biology relations networks*, and many other relationships of people have helped to develop social networks.

Social graph theory analysis for investigating the social structure

Graph theory has represented a number of edges to understand the social structure. Calculation of social structure has to represent maximum and minimum degrees of vertices through graph theory. In degrees of sequences of vertices non-orientation graphs represent non-increasing sequences along with that, *isometric graphs* and *non-isometric graphs* have provided sequences of vertices of the society ([6] 2018). The main problem of degree sequence is to find a graph through natural numbers. In this graph representation, *zero degrees* have been ignored because this number has changed through removing isolated vertices. On the other hand, graphs represent graphical sequences of social structure. Along with that, mathematical calculation and formula have helped to represent sequence but in this mathematical calculation, odd sums such as 3,1 cannot provide the power of graph. Along with that, the sum of even numbers has provided a degree of a multigraph.

The graph is simple representation of social structure for this reason; the combination of vertices has added a sequence of social structure. From the empirical study, non-increasing

sequences (d1, d2, ..., dn) have helped to represent sequences of degrees through simple graphs. On the other hand, *intermediate centrality* has helped to measure times of node acts. In this regard, nodes act as a bridge between two aspects of social structure. In this mathematical calculation, the power centrality of Vertex v for a graph $G=(V, E)$ represents *V as a set of vertices* and *E represents a set of edges*.

$$C_D(v) = deg(v).$$

The calculation of degree centrality graph has represented "X:=(Y, Z), where |Y| is a connected graph which maximized the following number (with y* vertex, which is the most powerful of centrality at X)"

$$H = \sum_{j=1}^{|Y|} [C_D(y^*) - C_D(y_j)].$$

Moreover, the degree of centrality graph represent G equals to

$$G_D(G) = \frac{\sum_{j=1}^{|Y|} [C_D(v^*) - C_D(v_j)]}{H}.$$

In this calculation, the value of "H" is maximum and X contains unique central vertices that are connected with other vertices that help to understand social structure.

METHODOLOGY

In the research study, the methodology has helped to describe the design of SNA. Along with that, this research study has analyzed *previous research papers* to design a research study. In this regard, this research study has selected *five years of previous research paper* to find the actual result of SNA. The research paper "*MNEs from emerging markets: a review of the current literature through "bibliographic coupling" and social network analysis*" has described primary data analysis by algorithmic approaches. In this research, the paper edge has represented friendship, education, kinship, and profession that help to represent individual information in social structure. This research study has drawn the general network structure of society through cohesion based on the distribution of ties between different nodes of the society ([2] 2020). In a region, core periphery topology represents dense nodes that help to understand the connection between the societies. Along with that, the matrix of social structure has helped to understand the lower possible range and dense range in the region. Along with that matrix, social structure and connection between the people can improve through better solutions.

DATA ANALYSIS

Secondary data analysis

Thematic analysis

Theme 1: Role of Social graph analysis to find social structure

Social graph analysis was used to understand *the social and behavioral change* of community. In the present time, social and behavioral change of community has impacted on the social structure along with that, social graph analysis has

helped to represent relationships among individual people. Moreover, social graph analysis has helped to realize network perspective to represent *standard, behavior, economic, political, and social structure*. In recent times, graph theory is the mathematical and statistical approach that helps to provide graphs of individual information. In this regard, graph theory has provided step by step procedures through using algorithms that help to develop a network of social structure ([10] 2020). Graph theory consists of nodes and edges to create links between vertices of social aspects. Along with that statistical graph, people can identify the actual problems of society. In the social structure, relationship and connection between the community has helped to build the effective structure.

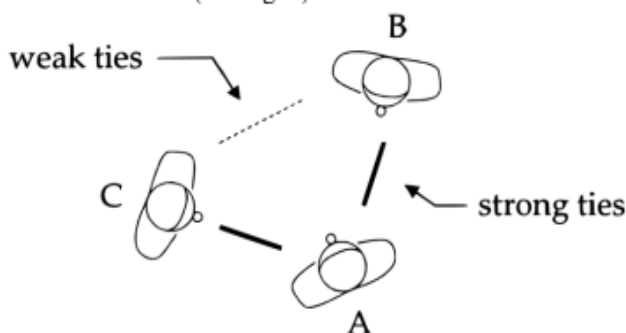


Fig 2: Connection ties
(Source: [10]. 2020)

Moreover, Social graph analysis has helped to find *weak and strong ties* of the society that help to build the effective structure of the society. This graphical representation has helped to predict the improvement of social structure in the weak ties. Strong ties have represented better communication and relationships between the communities of the society. On the other hand, weak ties have represented a lack of collaboration among the communities that create difficulties in the social structure ([4] 2018). Moreover, *medium ties* have represented equal communication and interaction between the communities that helps to understand relationships among the community. In this regard, this graphical representation has helped to improve social structure based on the social graph analysis.

Theme 2: Application of social graph analysis to improve the social structure

The mathematical graph representation has helped to determine coefficient values of necessary parameters that help to determine strong and weak collaboration between the communities. Social network diagrams play a key role in network dynamics that help to measure different centralities of society. In this regard, the most effective aspects of SNA are *degree, page rank, closeness, and betweenness*. In the words of [4] (2018), the degree has helped to represent the number of neighbor nodes in the society that help to establish social structure. Moreover, PageRank has helped to represent iterative circles of neighbors that help to understand relationships among the community in the society. On the

other hand, another most significant aspect of SNA is the closeness that represents the cohesion of the society and helps to build an effective social structure ([5] 2018). Moreover, betweenness is another important element of SNA that represents the short path of nodes.

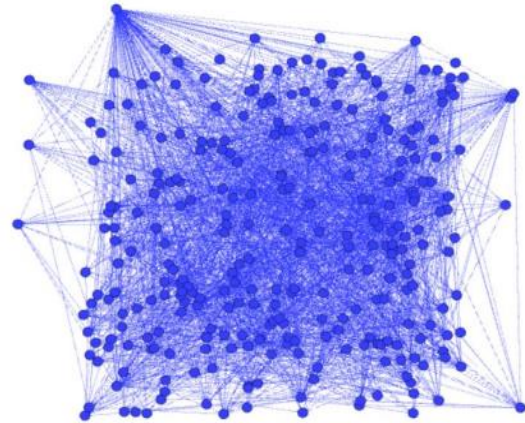


Fig 3: Visualization of the friend's graph
(Source: [5] 2018)

Along with that, the below-mentioned neutral network graph has included **8,717 vertices** and **31,525 edges** to understand social structure. In this regard, the below mentioned figure has built a network of mutual friends that helps to understand the relationship between the community. In this diagram **306 vertices** and **2,096 edges** have shown significant coefficients among the friends of society that help to improve the structure of the society. In this regard, as an example, SNA has helped to improve the structure of public health. Analysis of public health in the society there are several nodes and edges such as *sexual, transactional, and emotional issues*. Along with that, mathematical and statistical graph representation has helped to understand health compromise and the relationship between the people in the society. Along with that, graphical representation of nodes and edges has helped to understand infections, disease transmission, and parameters of disease to spread in society ([4] 2018). This graphical representation has helped to understand individual needs in society. This statistical and mathematical analysis has helped to improve social structure and interaction between proponents to improve public health.

CONCLUSION

After all these discussions it can be concluded that SNA is the modern and unique mathematical approach that helps to establish an effective social network. In society, effective communication among the people has helped to improve social structure. Along with that, graph theory and network have represented several social nodes and edges to represent relationships among the society. In the present time, the weak collaboration between people has created difficulties in the social structure. Along with that, this statistical and mathematical approach has represented weak and strong ties

of the society. Along with the graph, people can improve social structure with improved interaction.

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