Final clusters:

Cluster 1: Low Income, Moderate Spending Customers

A(15,39)

C(25,55)

E(30,60)

Centroid: (23.33, 51.33)

Cluster 2: High Income, High-Spending Customers

B(45,81)

D(60,95)

Centroid: (52.5, 88)

SPARSITY AND CONNECTEDNESS OF UNDIRECTED GRAPH:

Graphs can be used to model various types of relationships, such as between assets, companies or individuals.

Understanding connectedness and sparsity of these graphs is crucial for analyzing network in finance, such as portfolio diversification, credit networks, market interactions and fraud detection.

Financial Asset Network (Portfolio Diversification)

In portfolio diversification, we can model the relationship between different financial assets (eg. stocks, bonds, commodities) using a graph where:

* Vertices (nodes) represent different financial assets
* Edges represent relationships between assets, often based

on correlations or co-movements in price changes over time.

Sparsity in a Financial Asset Network:

In a sparse asset network, there may be only a few assets with strong correlations or co-movements (i.e. the edges between most of the assets are weak or nonexistent.)

Connectedness in a Financial Asset Network:

Connectedness in this context would mean that there is a way to reach every asset through a path of correlated assets.

* Fully Connected Graph
* Disconnected Graph.

Example:

Imagine a portfolio consisting of 10 assets, and the edge weights between these assets represent how correlated their prices are (with strong correlation meaning a heavier edge). After calculating the correlations.

* Assets 1, 2 and 3 are strongly correlated and form a connected subgraph.
* Assets 4, 5 and 6 are loosely correlated and form another disconnected subgraph.
* Assets 7, 8, 9 and 10 are highly correlated with each other and other assets, meaning they are isolated.

In this case:

* The portfolio's overall connectedness would be low (indicating strong diversification)

* The graph is sparse, because not every asset is strongly correlated with others.

CREDIT NETWORKS (RISK AND DEFAULT PROPAGATION)

In a credit network, the nodes represent financial institutions (banks, companies etc). and the edges represent credit relationships or loans between these institutions. The network can be used to analyze the spread of financial risks, defaults or contagion in the financial system.

Sparsity in a Credit Network:

A sparse credit network could occur when banks or companies only have limited credit relationships with others.

Connectedness in a Credit Network:

Connectedness in a credit network indicates the spread of risk and the propagation of defaults. If the network is connected, the failure of a single institution could cause default contagion, meaning it could lead to the failure of other connected institutions due to their interdependencies.

* Highly Connected Graph.
* Disconnected Graph.

Semester: VIII Subject: AIEB Academic Year: 2024-25

Example:-

Suppose you have a credit network with 8 financial institutions, and the edges represent direct credit relationships (loans or guarantees between them).

If institutions 1, 2 and 3 are connected, but institutions 4, 5, 6, 7 and 8 are only loosely connected, the network is disconnected. This suggests that if one of the connected institutions defaults (say, institution1), it may not affect institutions 4-8 because they are not strongly linked.

However, if institutions 1, 2, 3, 4, 5, 6, 7 and 8 are all interconnected, the network is connected, meaning that the failure of any institution could quickly lead to a cascading failure, as they have links to each other.