Understanding Migration Networks: Insights into Global Mobility and Societal Dynamics

Abhishek Mandlik | Atharva Tiwari | Aman Singh

Undergraduate Research Showcase

Project completed as part of ES404 | Complex Networks and Systems

Supervised by **Prof. Udit Bhatia**

MOTIVATION

Migration networks are crucial for understanding the dynamics of human movement across borders, facilitating the exchange of people, ideas, cultures, and resources. These networks influence socio-economic, political, and cultural aspects of both origin and destination areas, providing insights into the causes, patterns, and effects of migration on multiple scales.

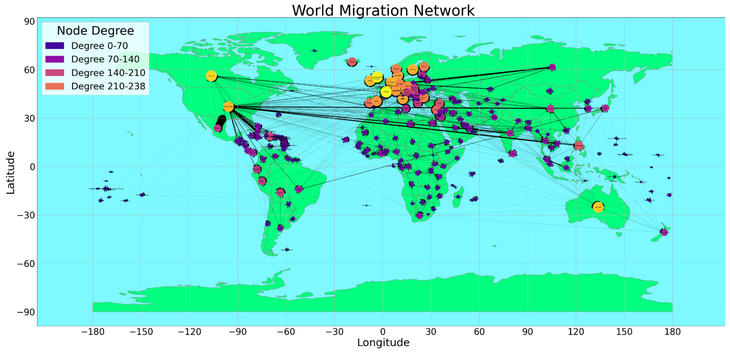


FIGURE 1 ***World Migration Network***

PROBLEM STATEMENT

Analyze the ***degree distribution*** and ***assortativity*** of the network.
Observe and understand ***impact of global events*** on the network and observe how ***migration communities*** have ***evolved*** over time.

EXPERIMENTS AND INFERENCES

MIGRATION FOLLOW A POWER-LAW!

We find that migration networks follow a ***power-law*** and are **scale-free** (power law exponent was around ***2.501***).

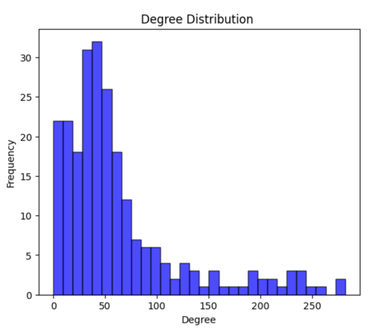


FIGURE 2 ***Degree Distribution of the Network***

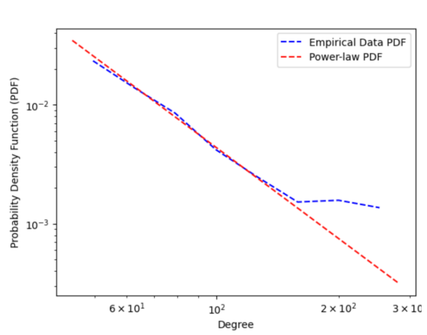


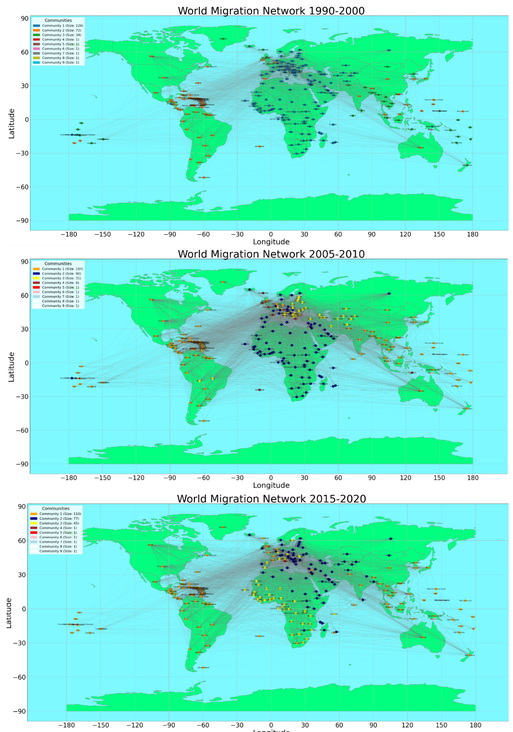
FIGURE 3 ***Comparisn of PDF of network with Power law***

MIGRATION NETWORKS ARE (WEAK) *DISASSORTATIVE* !

The ***assortativity*** of the International migration network comest out to be ***negative*** which implies that International Migration Networks are ***disassortative*** which implies that different type/different degree nodes are interacting with each other.

IMPACT OF GLOBAL EVENTS ON ASSORTATIVITY

- We expected the Migration network to be properly disassortative , but we observe it to be weakly disassortative. This happens becaues of ***global events*** like ***war, political crisis, econimic crisis*** in any country.
- Some of the Global Events that we observed were ***Economic Crisis in Venezuala*** due to which people from Venezuala started migrating to nearby countries especially Chile and Peru, Similar Events occured from Burundi to tanzania, Myanmar to Thailand to name a few.
- We observed that these type of events ***regularly*** kept happening over the 30 year span. In such conditions people move to a ***limited set of destinations*** perceived as safe or offering better economic opportunities and are ***geographically near*** those countries.
- Hence, ***interaction*** develops between ***low degree/similar type*** of nodes due to which network becomes ***weak disassortative***.
- We verified this through our network too. During a time period when ***we removed links*** which had increased migration flow due to such global events , the network became ***more*** disassortative.



Evolving Communities

For different time periods we observe that every time, ***9 different*** communities are formed.
Broadly 3 major communities are formed:

- ***Global Hubs*** and ***Economic Powerhouses*** like US,UK,Canada,Australia alongside ***major asian economies*** like Japan, China , India.
- Countries grouped by ***shared historical ties***, language, or ***geographical proximity***. include post-Soviet states, African coutries linked with specific European countries.
- The smallest communities observed are ***isolated*** or ***sparsely distributed.***

Evolving Connectivity and Efficiency

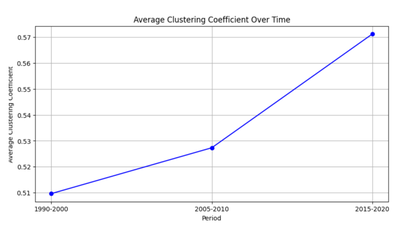


FIGURE 5 ***Comparison of average clustering coefficient over time***

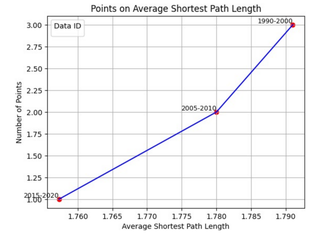


FIGURE 6 ***Comparison of ASPL over time***

As you can see ***average clustering coeffecient*** is ***increasing*** over time. Due to this we can see that ***Average shortest path length*** *also* ***decreases***
The possible reasons for increase in clustering are:

Increased Globalization and Connectivity: As ***globalization*** intensifies, countries become more interconnected not just economically but also socially through migration.

Formation of Migrant Networks: Over time, ***established migrant communities*** might facilitate further migrations through family ties and social networks.

CONCLUSION AND FUTURE WORKS

- The degree distribution of the migration network adheres to a ***power-law*** and are ***scale free***.
- The network displays a ***weak disassortative*** mixing pattern, suggesting that countries tend to establish migration links with a diverse set of partners rather than with similar ones, influenced by various global events.
- Over time, there has been an observable ***increase in clustering and connectivity*** within the network, pointing towards the formation of more ***defined migration communities*** due to factors like globalization and policies.
- Mitigation strategies should be devised to ***enhance the network's resilience*** against synchronized global events, paving the way for ***more effective governmental policies*** in response to economic downturns, conflicts, and crises.

DID YOU KNOW?

- In African Continent, during 2005-2010, Somalia was the country that had the highest emigration while from 2015 to 2020 it had largest immigration.
- Even if you remove top 5-10 high-degree nodes the network still follows power law and remains scale free (Power law exponent increases)