

Annual Progress Review

Thomas William Boughen



Newcastle University

School of Mathematics, Statistics and Physics

Research Progress

This research has been focused on networks and modelling how they grow. The main focus has so far been the degree distribution of both real world networks as well as networks simulated from various models.

Degree Distribution of Real Networks

The research began by looking at the degree distributions of real networks, with the aim of gaining some insight to how they may have grown and will continue to. Looking at Figure 1 it is clear that the degree distribution of networks can have various different shapes. Some look almost linear, but others look more concave.

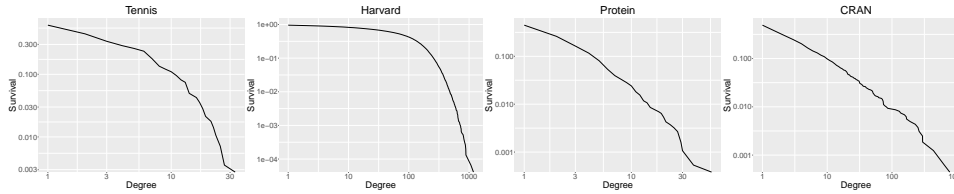


Figure 1: Survival function of the degrees.

Network generation is a complex subject and so finding a fairly simple way of modelling how real networks might have grown is very attractive and the one of the reasons for the popularity of the Barabási-Albert model.

Barabási-Albert Model

First introduced by Barabási and Albert (1999), this is a simple network growth model whereby, when a vertex is added to the network it connects to those already in the network with probability proportional to their degree. More formally, starting with m_0 nodes, the edges between them chosen arbitrarily such that each node has at least one link. The network then develops using two steps:

1. Growth

At each time step, add a node to the network that will connect to $m \leq m_0$ nodes (already in the network) with m edges.

2. Preferential Attachment

The probability that an edge from the new node connects to node i is proportional to its current degree k_i i.e $k_i / \sum_j k_j$.

References

Barabási, Albert-László, and Réka Albert. 1999. “Emergence of Scaling in Random Networks.” *Science* 286 (5439): 509–12. <https://doi.org/10.1126/science.286.5439.509>.