NBE-E4530 Special Course in Human Neuroscience: Human brain connectivity (Spring 2017)

Pre-assignment 3, exercise 3
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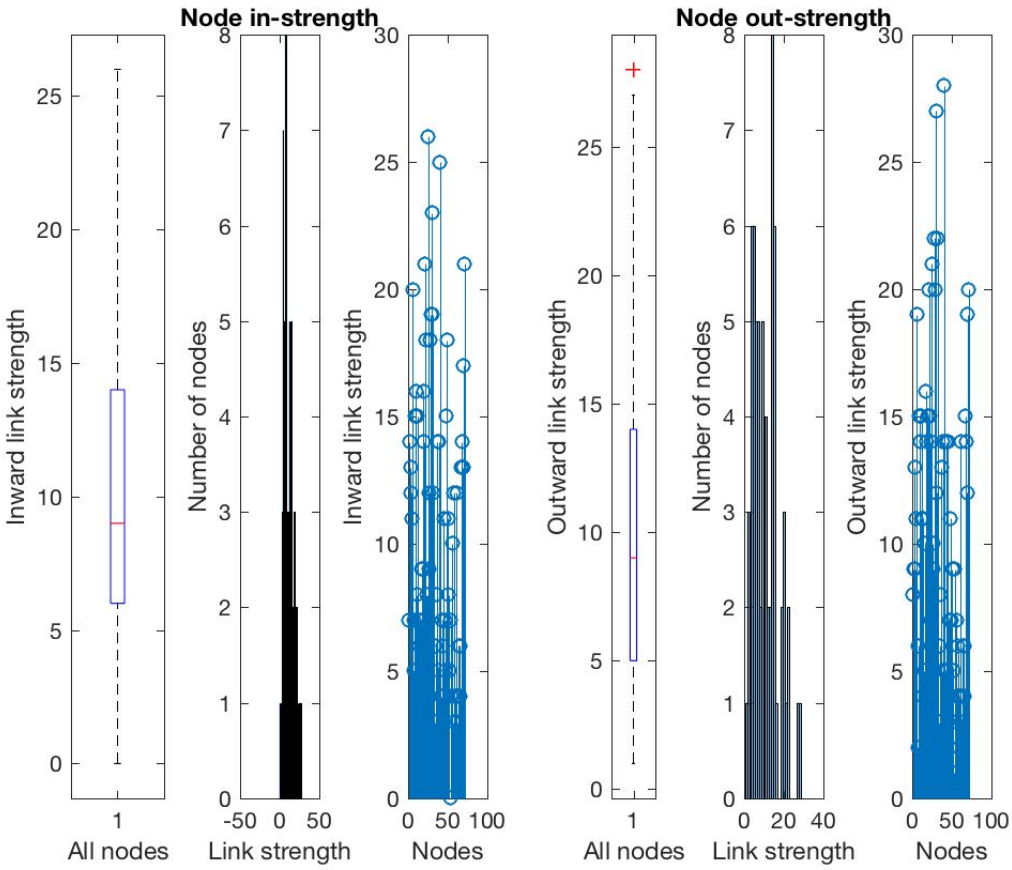
We used the Macaque cortical connectivity data set, which is a binary directed network.

Degree and similarity

Degree

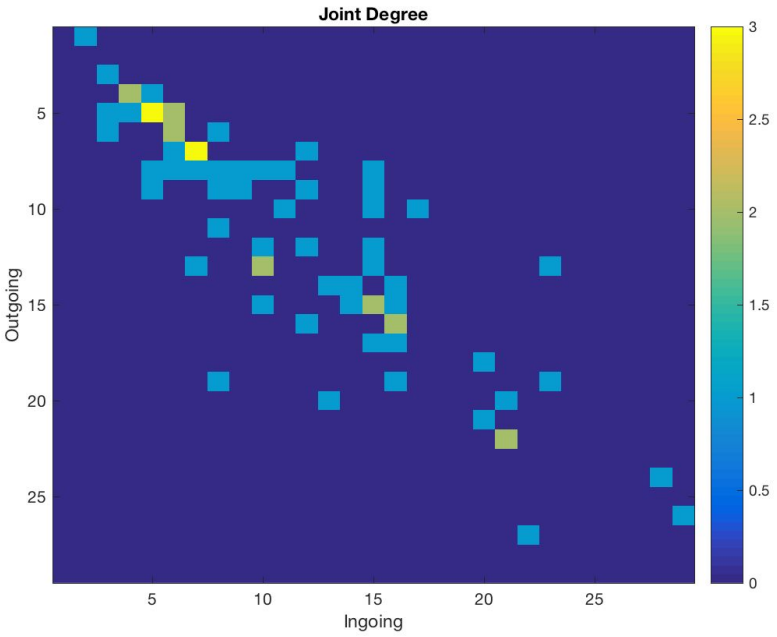
The fraction of present connections to possible connections, **density**, in our data is 0.1501. The number of vertices is 71 and number of edges 746.

Strength



Node strength computed as the sum of weights of links connected to the node separately for inward and outward links.

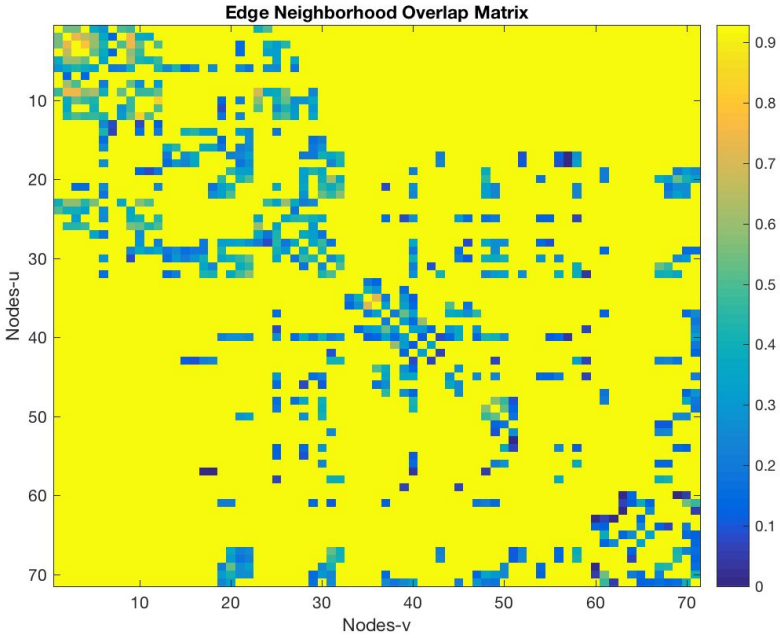
Joint Degree



Joint degree distribution matrix in which each element corresponds to the number of nodes that have u outgoing connections and v incoming connections.

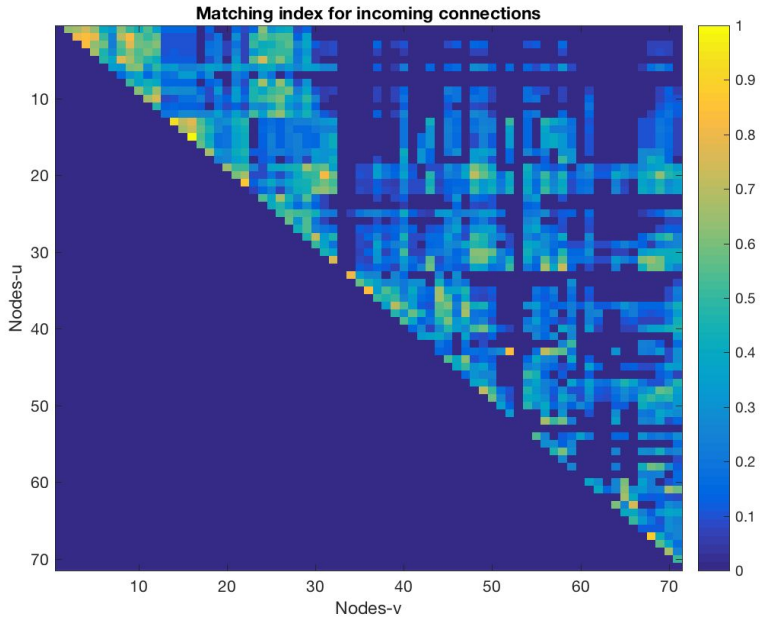
Number of vertices with od>id = 25, number of vertices with id>od = 27, number of vertices with id=od = 19

Neighborhood overlap



The neighbors of two nodes that are linked by an edge, and their overlap.

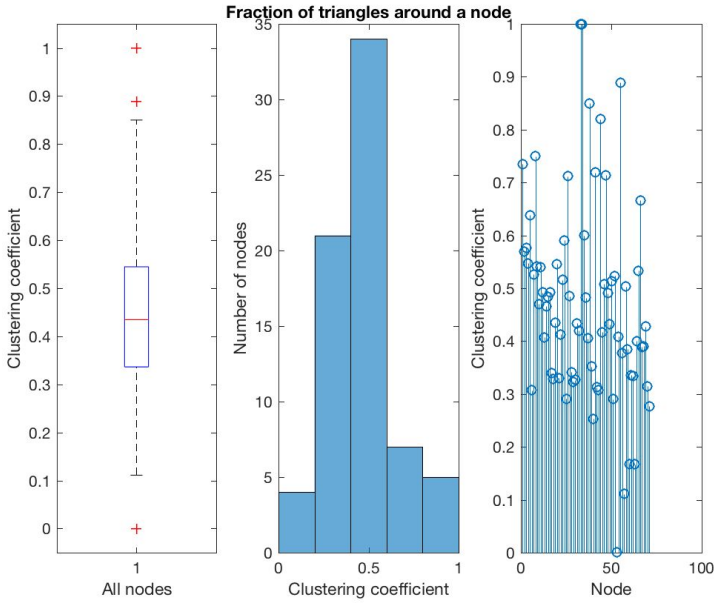
Matching Index



The matching index computed as the amount of overlap in the connection patterns of node u and node v.

Clustering and Community Structure

Clustering Coefficient

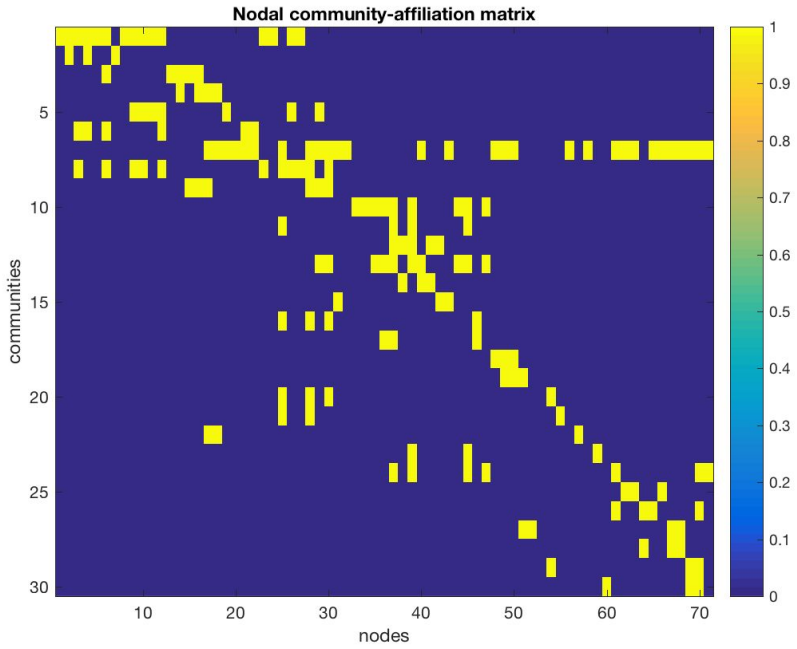


The clustering coefficient computed as the fraction of triangles around a node.

Transitivity

The ratio of 'triangles to triplets' in the network, **transitivity**, in our data is 0.3980.

Community Structure Modularity (link communities)



Nodal community-affiliation matrix in which the nodes belonging to a community is depicted in yellow (1). The network is subdivided into groups of nodes which have a high number of within-group connections and a low number of between group connections.

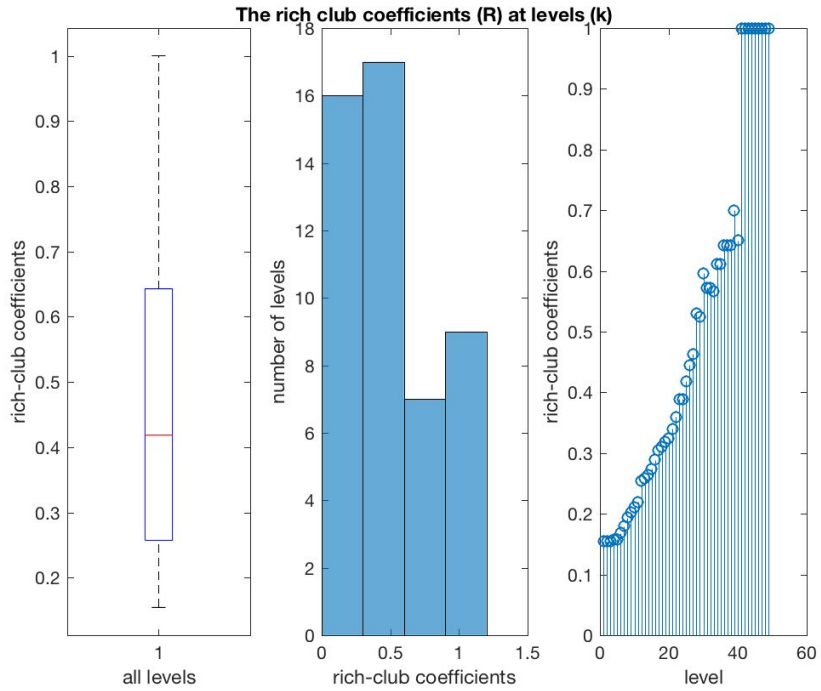
Modularity Degeneracy and Consensus Partitioning (Agreement)

We tried to use the function D = agreement(ci), but we did not know what the ci (set of (possibly) degenerate partitions) should be.

Assortativity

The correlation coefficient between the degrees of all nodes on two opposite ends of a link, assortativity coefficient, was -0.0066, suggesting the nodes don't link to other nodes with same or similar degree.

Rich Club Coefficient



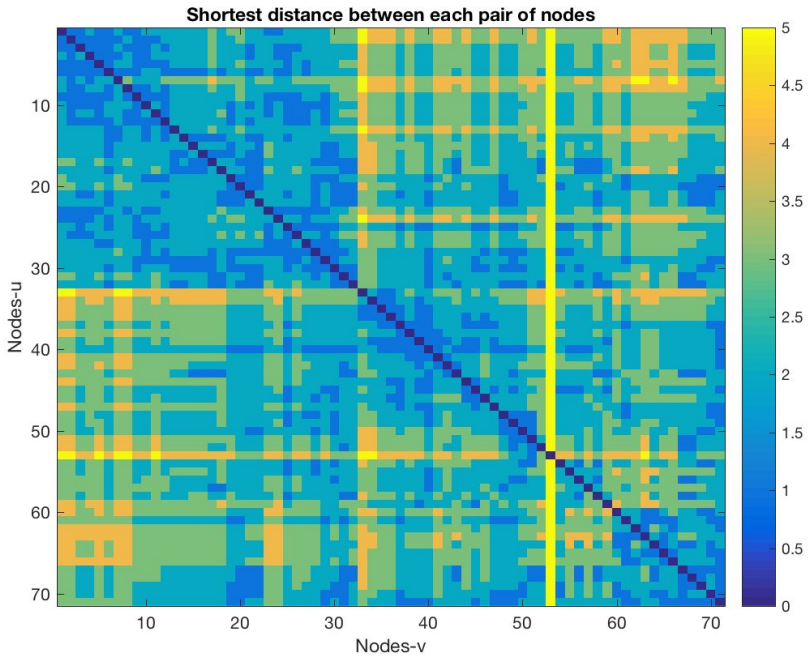
The rich club coefficient at different levels. The graph on the left depicts the distribution of rich-club coefficients computed at all levels. The histogram in the middle shows the number of levels associated with different coefficient. The graph on right shows the coefficients at each level k. The rich club coefficients were computed as the fraction of edges that connect nodes of degree k out of the maximum number of edges that such nodes might share.

K-Core

We tried using the function kcore_bd(CIJ,k), but we did not know what the K-core value should be.

Paths and Distances

Distance



Distance matrix depicts the shortest distance between each pair of nodes, shortest distance is depicted in blue (0) and longest distance in yellow (5).

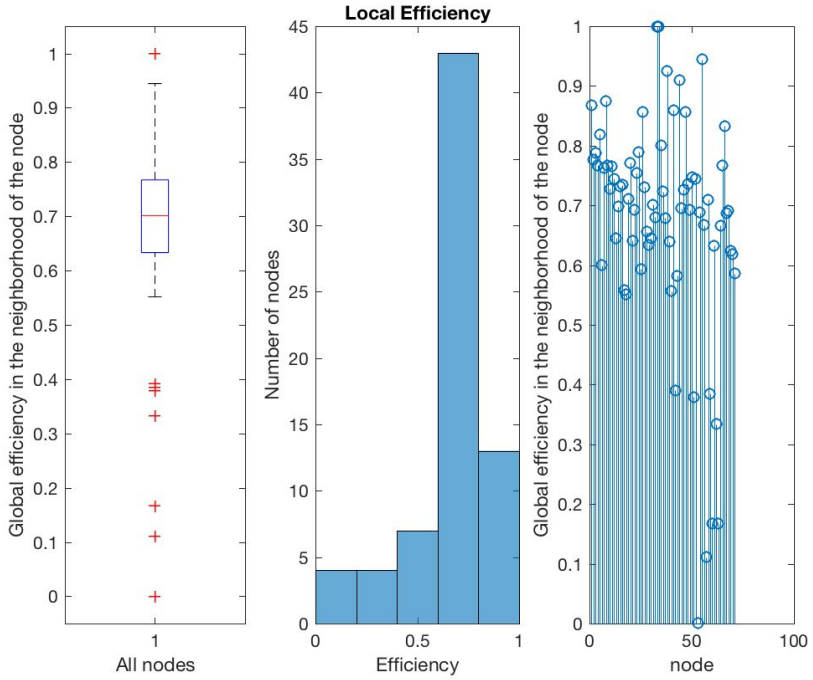
Characteristic Path Length

Characteristic path length, i.e., the average shortest path length between all pairs of nodes in the network, was 0.1501.

Efficiency and Diffusion

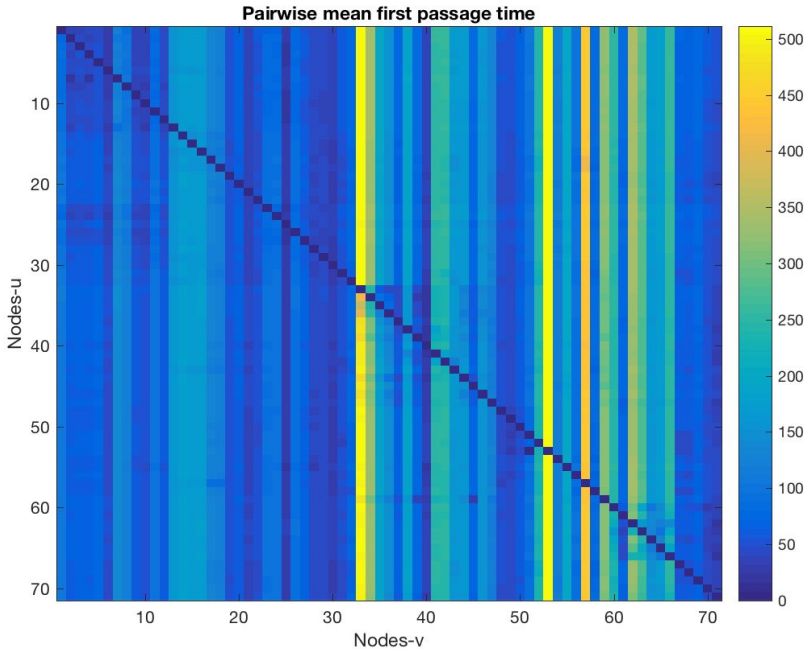
Efficiency

The global efficiency is the average of inverse shortest path length between each pair of nodes. Global efficiency in our data is 0.4961.



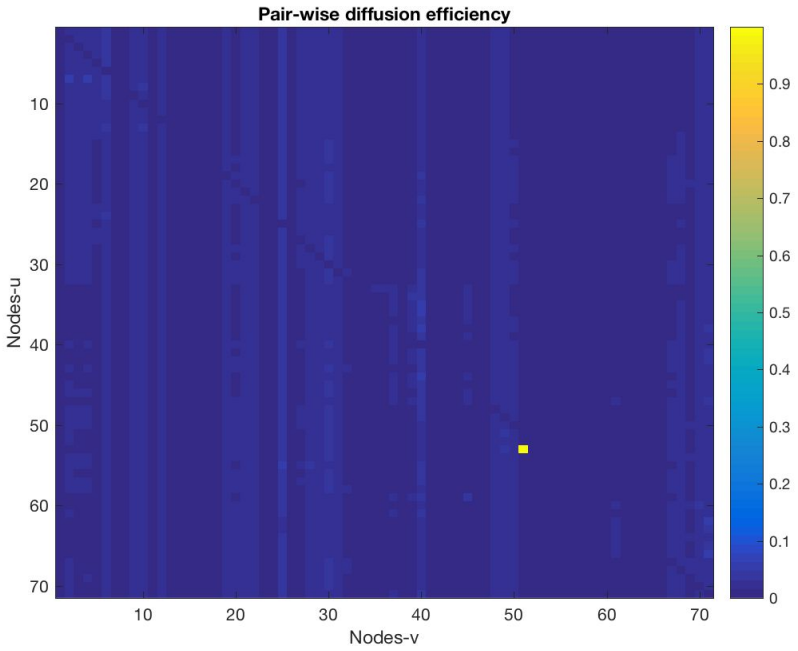
Local efficiency computed as the global efficiency in the neighborhood of each node.

Mean first Passage Time



The expected number of steps for a random walker from one node to another. Greater distances are shown in yellow and shorter in blue.

Diffusion Efficiency

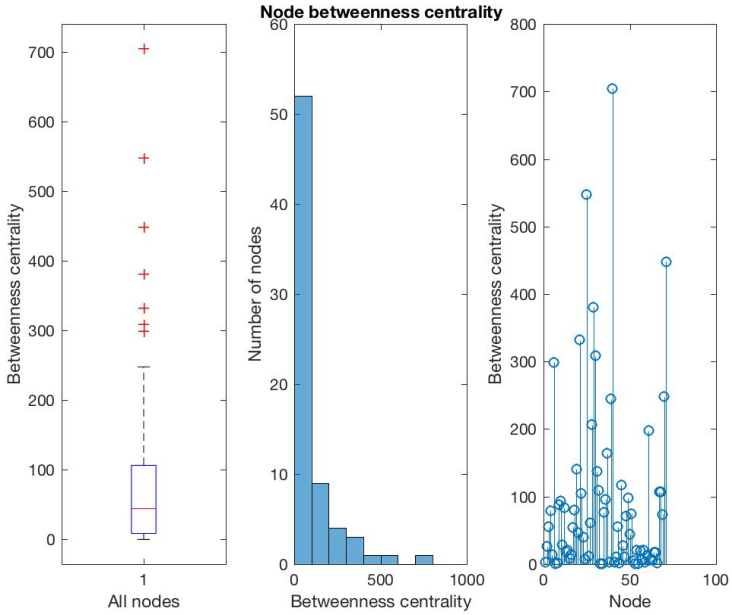


Diffusion efficiency computed as the inverse of the mean first passage time from node u to node v.

Global diffusion efficiency, GEdiff, was 0.0128.

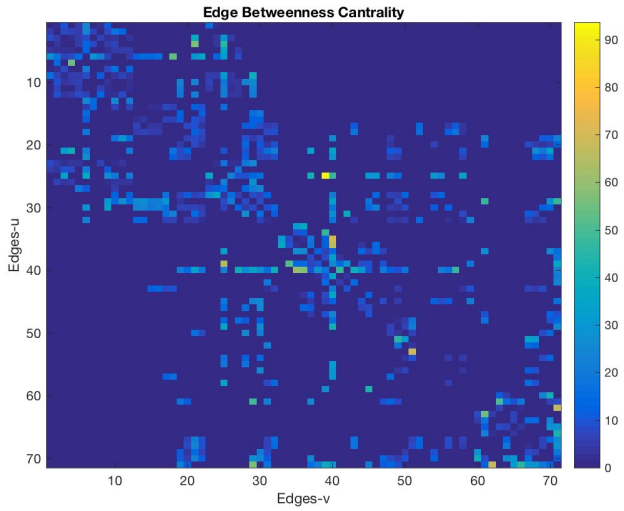
Centrality

Betweenness Centrality



Node betweenness centrality computed as the fraction of all shortest paths in the network containing a certain node. High value of betweenness centrality indicates that the node is a part of a large number of shortest paths. The first graph depicts the distribution of centrality values, the graph in the middle shows the number of nodes associated with certain betweenness centrality values, and the last graph shows the centrality values for each node.

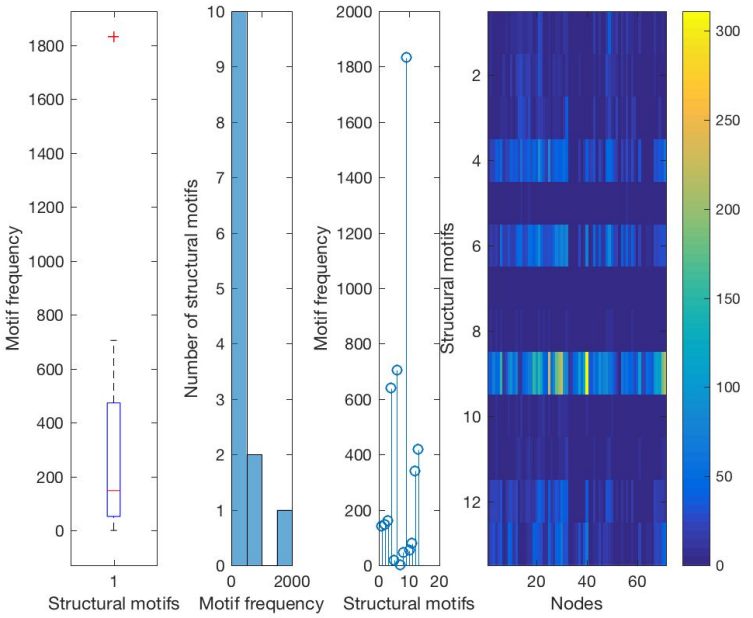
Edge Betweenness Centrality



Edge betweenness centrality computed as the fraction of all shortest paths in the network that contain a given edge. Edges with high values participate in a large number of shortest paths.

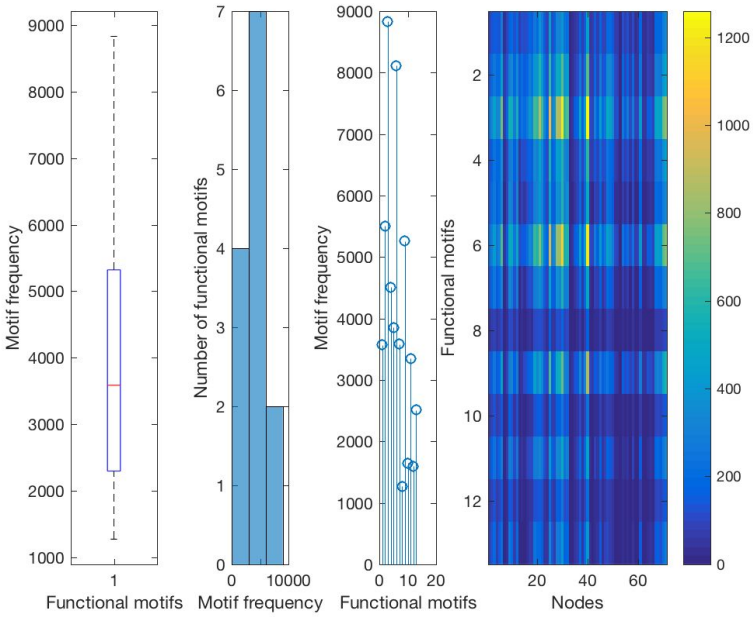
Motifs

Structural Motifs



Patterns of local connectivity in complex networks.

Functional Motifs



Possible subsets of patterns of local connectivity embedded within structural motifs.