**Cluster Quality Metrics paper:**

https://www.researchgate.net/publication/220699248\_Is\_There\_a\_Best\_Quality\_Metric\_for\_Graph\_Clusters

Modularity states that a good cluster should have a bigger than expected number of internal edges and a smaller than expected number of inter-cluster edges when compared to a random graph with similar characteristics**.** The modularity index Q often presents values between 0 and 1, with 1 representing a clustering with very strong community characteristics. However, some limit cases may even present negative values. One example of such cases is in the presence of clusters with only one vertex. In this case, those clusters have 0 internal edges and, therefore, contribute nothing to the trace. Suﬃciently large numbers singleton clusters in a given clustering might cause its trace value to be so low as to overshadow other, possibly better formed, of its clusters and lead to very low modularity values regardless.

The coverage of a clustering C (where C = C1,C2,...,Ck) is given as the fraction of the weight of all intra-cluster edges with respect to the total weight of all edges in the whole graph.Coverage values usually range from 0 to 1. Higher values of coverage mean that there are more edges inside the clusters than edges linking diﬀerent clusters,which translates to a better clustering. From its formulation, we can observe that the main clustering characteristic needed for a high value of coverage is inter-cluster sparsity. Internal cluster density is in no way taken into account by this metric, and it probably causes a strong bias toward clusterings with less clusters. This can be seen in the example on Figure 1, where the clustering with two clusters would receive a better score than the clearly better clustering with three clusters.

Performance counts the number of internal edges in a cluster along with the edges that don’t exist between the cluster’s nodes and other nodes in the graph. Values range from 0 to 1, and higher values indicate that a cluster is both internally dense and externally sparse and, therefore, a better cluster. However, if we consider that complex networks tend to be sparse in nature, when performance is applied to larger graphs, there is a great possibility that g(C) becomes so high that it will dominate all other factors in its formula, awarding high scores indiscriminately.

**ZJ NETWORK**

**MODULARITY**

L1=0.45778182629387265

L2=0.6742824211778704

L3=0.4473341760856633

**PERFORMANCE**

L1=0.9729855612482534

L2=0.8708275112560161

L3=0.48920975003881384

**COVERAGE**

L1=0.49390243902439024

L2=0.8292682926829268

L3=0.9817073170731707

**BLA NETWORK (Length Clusters)**

**MODULARITY**

L1=0.5191836734693877

L2=0.4391836734693877

**PERFORMANCE**

L1=0.9182795698924732

L2=0.5698924731182796

**COVERAGE**

L1=0.6571428571428571

L2=0.9428571428571428

**BLA NETWORK (Capacity Clusters)**

**MODULARITY**

L1=0.5273469387755101

L2=0.393469387755102

**PERFORMANCE**

L1=0.9225806451612903

L2=0.5397849462365591

**COVERAGE**

L1=0.6571428571428571

L2=0.9428571428571428

**Lean Graphs**

**ZJ**

**Threshold 0.8**

**Threshold 0.5**