

Team Control Number

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Problem Chosen

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2014 Mathematical Contest in Modeling (MCM) Summary Sheet

Hereby we construct 3 sets of influence measurement to evaluate 4 models to evaluate 3 types of networks. We develop a network-split method to fasten the implementation of PageRank and HITS algorithms. Combined with time series modeling, we provide a compass for research.

In the 1st model, we build an author network connected by collaborations. The analysis presents us a high clustering network with a power law degree distribution indicating scale free. Most authors are connected through limited "connectable" people. For connection influence measure, our PageRank centrality overcomes shortcomings of the non-weighting Katz Centrality and simple centralities. We found Harary is the most important and "connectable" author.

In the 2nd model, we analyze the paper citation network. The directional nature of the paper citation inspired us to introduce a new influence measure, authority and connectivity (hub), through the HITS algorithm. To improve the accuracy, we considered the out-of-circle citation and transformed it into an initial value for the equation set. The citations among same authors and journals are also lessened. Our high hub papers accurately equal to review paper.

For the semi-bipartite paper-author combined model, we develop the third and fourth models and lastly take the time element into consideration. In two models, the paper citation network is separated from the entire network to form the source citation influence. The third model considers paper-to-author one directional effect, thus creating a tree diagram. Authors and other academic entities collect citation influence from the source. It could be computation-efficiently used level-by-level to evaluate departments, universities and nations due to network similarity. For the fourth model, we put the paper and author two-way connected to retrieve the author-author connection effect and to reveal the paper and author influence from a cognitive sense. The time series analysis shows the network science emerging in 2000s.

Then we implement our method into the film-actor network of 007 film series, though the network is one-dimensional, the results showed buried popularity of Quantum of Solace and Judi Dench. With the time series analysis, the influence measure package offers flexible but effective choices in finding collaborator, innovator and discover a new filed. The sensitivity analysis indicates parameter is strong below maximum value, and we choose the optimal value within convergent range to give a high resolution of network influence.