

## Graph Centrality Projects

Once again you will present in groups of three an analysis of the graphs for a problem listed below. Your presentation should answer the following questions (you decide the organization):

- What problem were you given?
- What were the key features of your graph?
- What do the measures of centrality say about the situation you are confronted with?

### **Terrorist Network Project**

In his article “Uncloaking Terrorist Networks,” Valdis Krebs analyzed the contact information for the 9/11 Terrorists. Which terrorist do you think is Mohammed Atta – the purported mastermind of the network? If you were given this terrorist network information and asked to name the top three contacts to target in a raid, which would you name?

### **Chesapeake Food Web Project**

What are the crucial organisms that support the healthy life in the Chesapeake Bay? The file contains information on the food connections between 36 organisms. Are there organisms we need to support more to ensure the food web is working? Are there some that are not important?

### **Unionization Project**

The CEO of a small hi-tech computer firm, HiTech, Inc., which sells, installs, and maintains computer systems is trying to understand what will happen in the company when the question of unionization is brought forward to employees. The file contains the friendship ties among the employees, which were gathered by means of the question: Who do you consider to be a personal friend? Three employees (Fran, Quincy, and York) did not return the questionnaire. A friendship choice is only included in the list if both persons involved acknowledge it. In addition, we asked how each employee felt about joining a union, and most indicated that they had no opinion (or left the question blank). There were a few who indicated support and a few who indicated opposition. Whom should we work with to influence the decision to NOT unionize?

### **Compensation Package Project**

We want to understand what happened in a company when they proposed changes to the workers' compensation package, which the workers did not accept. They started a strike, which has led to a negotiation stalemate. We think that information about the proposed changes was not effectively communicated to all employees. The current union officers are Sam and Russ; we want to determine who else to pull into the conversation so that all groups can be informed about the benefits of the changes, and, if a compromise is needed, can be involved in determining what that compromise is. The file contains information from employees indicating the frequency with which they discussed the strike with each of their colleagues on a 5-point scale, ranging from 'almost never' (less than once per week) to 'very often' (several times per day). If at least one of two persons indicated that they discussed work with a frequency of three or more, then we included that pair in the communication list.

### **Trade Route Project**

Many historians have debated why Moscow grew into a center for trade and migration, dominating other towns in Russia in the 13th century. In 1965, Forrest Pitts produced a graph of the major medieval urban locations along Russian river transportation routes (people and goods traveled by boat in summer and by sleigh on the frozen rivers in winter) in an effort to see if a graphical analysis could shed light on the situation. He used a self-designed analysis of shortest paths to show that Kolomna (34 on the network) was in fact the best connected place with Moscow (35) ranking second. From a centrality point of view is this conclusion supported?

### **Doctor Communication Project – Friendship**

We recently received information about a new form of an antibacterial drug, and we want to see how best to share that information with our community of 31 physicians. We have data on the dissemination of another drug recently introduced to use as a test case. We know the first subscription of this other drug by physicians in our network, in the form of the number of months since the drug was introduced. In addition, we investigated ties of friendship and perceived levels of professional reputation between the physicians, asking them to name three doctors who they considered to be personal friends and to nominate three doctors who they feel are “experts” in diagnosis and treatment. Analyze the friendship connections. Who are the doctors we should work most closely with to get out the information on this new drug?

### **Doctor Communication Project – Expert Consultation**

We recently received information about a new form of an antibacterial drug, and we want to see how best to share that information with our community of 31 physicians. We have data on the dissemination of another drug recently introduced to use as a test case. We know the first subscription of this other drug by physicians in our network, in the form of the number of months since the drug was introduced. In addition, we investigated ties of friendship and perceived levels of professional reputation between the physicians, asking them to name three doctors who they considered to be personal friends and to nominate three doctors who they feel are “experts” in diagnosis and treatment. Analyze the “expert advice” connections. Who are the doctors we should work most closely with to get out the information on this new drug?

### **Student Government Project**

How does information flow between the main players in student government at a large university? The 11 member steering committee was asked to provide the names of other steering committee members they most often discussed government issues with in the last 6 months at least once a month. Is there a key person on the steering committee? Analyze the connections between members.

### **Inter-related terms from Graph Theory**

What are the key ideas from graphs and digraphs? An analysis of the definitions in a particular book led to the following date: An edge from term X to term Y exists if the term Y is used to describe the meaning of term X. Are there a few key ideas that are clearly fundamental to understanding the topic?