FIT3158 Business Decision Modelling

Tutorial 5

Network Modelling

Quote: "Mathematical models of networks give us algorithms so computationally efficient that we can employ them to evaluate problems so big to be solved any other way." (Lapin & Whisler, Quantitative Decision Making)

***Network flow problems** share a common characteristic – they can be described or displayed in a graphical form known as a network.*

Topics covered:

- **The Shortest Route Problem**
- **Minimal Spanning Tree Problem**
- **Maximal Flow Problem**

Note: Transhipment & Transportation/Assignment Problems will be covered next week.

Exercise 1: Security Alarm Company (*Adapted from: Lapin & Whisler, Chapter 13*)

Security Alarm Company is installing a motion detection system in a building. Altogether, the plan requires 10 sensor sites, shown as nodes in the network diagram (*Figure 1*) below. The arcs connecting these sites are feasible linkages that might be included in the final design, with the arc lengths representing the distance (metres) between the respective pair of nodes. The sensor sites will be joined by a series of optical fibre cable connections over which intruder alarms can be relayed, via any open route through connected sensors, to a central processor (CPU) located at one of the sites

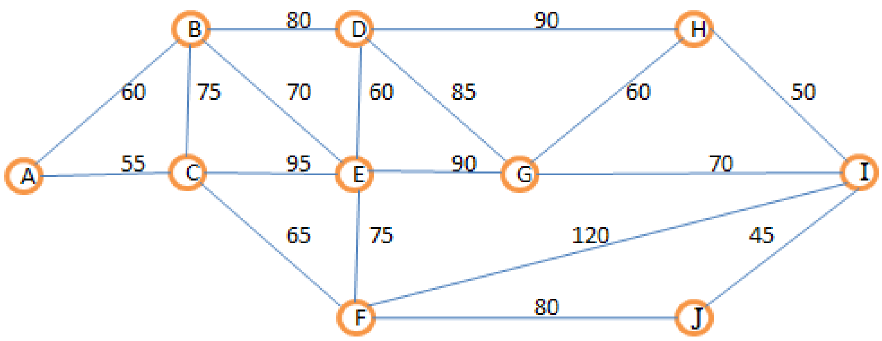

Figure 1:
Security Alarm Company Network

The Shortest Route Problem:

Referring to the Security Alarm Company network in Figure 1, find the shortest route from site A to site I:

a) Manually;

b) Build a spreadsheet model to confirm your solution to (a). You may use either one of the spreadsheet model discussed in the lecture.

Minimal Spanning Tree Problem:

Security Alarm Company wants to determine the plan which minimises the total cable distance. The manager is seeking your help in this.

Using the Minimal Spanning algorithm, you are to advise the manager accordingly.

Exercise 2: Lilliput Telephone Company – The Maximum Flow Problem
(*Adapted from: Lapin & Whisler, Chapter 13*)

A telecommunications network connects various trunk terminals to relay telephone calls. Equipment automatically routes a particular call over the first clear path found between the trunks connected to the respective telephones. The physical configuration of the system for determining how many calls can be made between any two connected trunks must be set in advance. How well a particular telephone system works can be quantified in terms of the maximum number of calls it can accommodate.

Figure 2 below shows the trunk network for the Lilliput Telephone Company. Each node is a switching trunk. The arcs represent linkage between trunks. The arcs are directed, proceeding from a beginning node (originating trunk) to an ending node (destination trunk), as indicated with the arrowheads. Each arc value indicates the ***arc capacity***, i.e. the maximum number of calls that may be connected from the originating trunk to the destination.

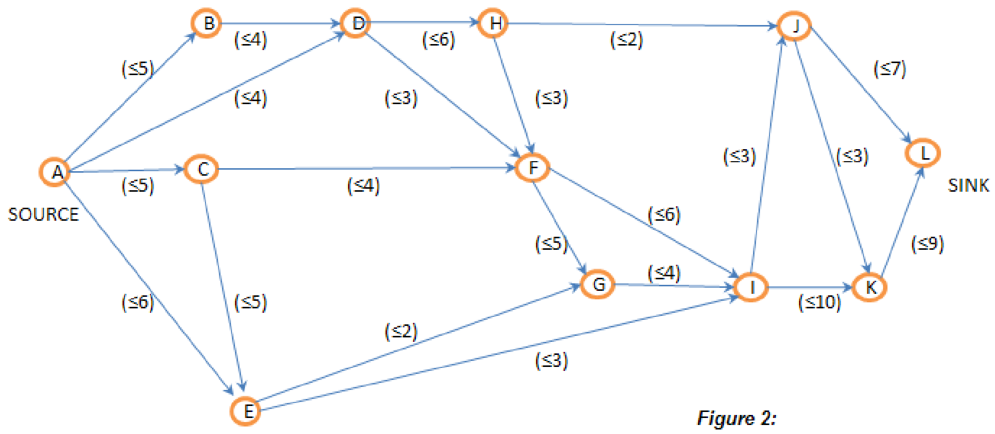

Figure 2:
Lilliput Telephone Company Trunk Network

Lilliput will measure performance in terms of how many calls might be routed from trunk A through the network to trunk L. Lilliput arbitrarily designates trunk A as the ***source node*** and trunk L, the ***sink node***. Lilliput wants to determine a routing scheme that will maximise the number of calls originating at the source and terminating at the sink.

Model the problem in a spreadsheet and advise the manager of Lilliput Company accordingly.

<u>Extra Exercise</u>: Those who like some challenges can attempt Ragsdale Chapter 5 Q30
(A Minimum Cost Maximum Flow Problem)