George Washington University
6289,2018 fall

Report of Homework 1

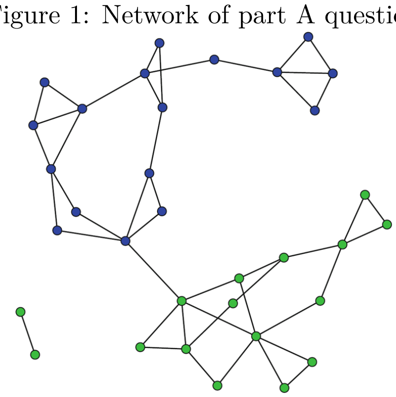
Jiaying Liu

September 14, 2018

1 Part A

The part A problem is going to manually verify the diameter and transitivity.

Figure 1: Network of part A question



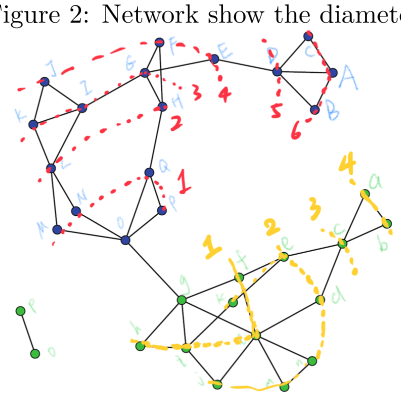
1.1 Introduction of the Theory

Diameter: The diameter for an entire network is the longest of the shortest paths across all pairs of nodes.
Transitivity is also call clustering coefficient. It is a ratio which is defined as the proportion of closed triangles to the total number of open and closed triangles. Note that when calculate the number of closed triangles, it should calculate the triads rather then the number of triangles.

1.2 Result

From the above original network graph, we can see the network is divided to three part one big blue part, one big green part and two small green nodes. To find the diameter, as the definition of diameter, we should find the longest of the shortest paths of all two nodes.
My method to find the longest path of the shortest path is that first begin with the two part. Find the edge of two part which are point big O and point small g. The longest path must goes through this two point. Then calculate the path of two part. From the figure 2, we can see that in the blue part, the longest of short path is 6. Similarly, the longest of shortest path in green part is 4. And the distinct of O and g is 1. In conclusion, the diameter is 6+4+1=11.

Figure 2: Network show the diameter



The following figure 3 show the result of closed triangle and open triangle. From the figure 3, we can see that there are 10 closed triangle and 75 open triangles. The method to calculate the number of open triangles is use C_n^2 where n represent the edges of a node. And it should delete the number of open triangle. So we get 75 open triangles.

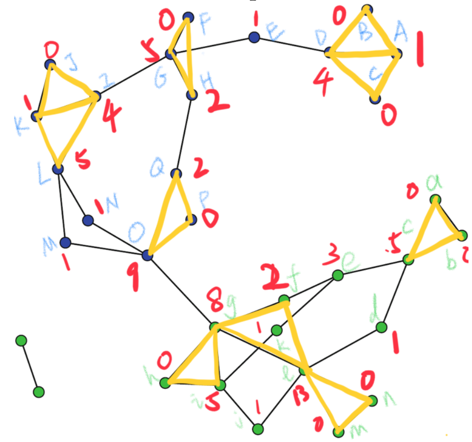
Table 1: P value of Filing and Prevailing Compensation

Point	Open Triads	Triads	Point	Open Triads	Triads
A	BAC	1	c	ace acd bce bcd dcb	5
D	EDB EDC EDA BDC	4	d	cdl	1
E	FED	1	e	fec kec fek	1
G	IGF IGE IGH FGE EGH	5	f	gfe lfe	2
H	FHQ GHQ	2	g	hgf hgl igl igf	4
I	JIL IJG KIG LIG	4	g	Ogh Ogi Ogl Ogf	4
K	JKL	1	i	hij hik gij gik kij	5
L	KLM KLN ILM ILN MLN	5	j	ijl	1
M	LMO	1	k	ike	1
N	LNO	1	l	jlm jln jlg jlf jld	5
O	MOg MON MOQ MOP NOQ	5	l	gld gln glm	3
O	NOP NOg QOg POg	4	l	fln flm	2
Q	OQH PQH	2	l	fld dln dlm	3

When calculate the transitivity, note that the number of open triangle should multiple three. so

$$transitivity = 10 * 3/(75 + 10 * 3) = 0.286$$

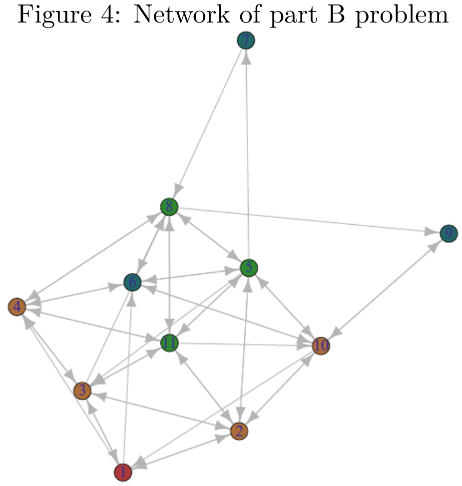
Figure 3: Network with open and closed triangles



2 Part B

Construct the network object for the network and plot the network object with a similar 4-color. Calculate the following statistical summaries for network object Size (or order), Density, Components, Diameter, transitivity.

Figure 4: Network of part B problem



2.1 Introduction of Theory

From the above, we can see that the network is a digraph which mean it have the direction. The graph contain graph and digraph. And we can also find out that there are different colors which mean the network contain different group.
Size:The size is simply the number of members, usually called nodes, vertices or actors
Density:Density is the proportion of observed ties (also called edges, arcs, or relations) in a network to the maximum number of possible ties
Components:A network is sometimes split into several subgroups. A component is a subgroup in which all actors are connected, directly or indirectly
Diameter:The diameter for an entire network is the longest of the shortest paths across all pairs of nodes.
transitivity:Transitivity is also call clustering coefficient. It is a ratio which is defined as the proportion of closed triangles to the total number of open and closed triangles.

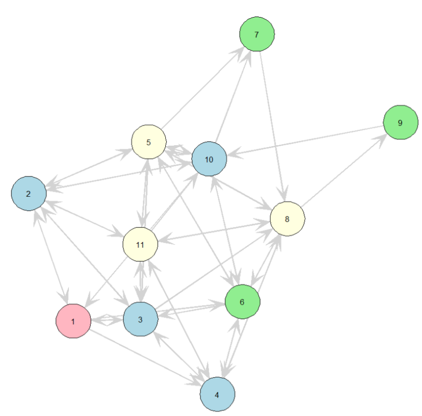
2.2 Result

The adjacency matrix of this network is

$$\begin{pmatrix}
0 & 1 & 1 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 1 \\
1 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 1 \\
0 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 1 \\
0 & 1 & 1 & 0 & 0 & 1 & 1 & 1 & 0 & 1 & 1 \\
0 & 0 & 1 & 1 & 1 & 0 & 0 & 1 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 1 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
1 & 1 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \\
0 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 0 & 1 & 0
\end{pmatrix}$$

From the following figure, I create my own network and plot it. The size of network is 11. The density of network is 0.4363. The Component of network is 1. The diameter is 4 The transitivity of network is 0.4924

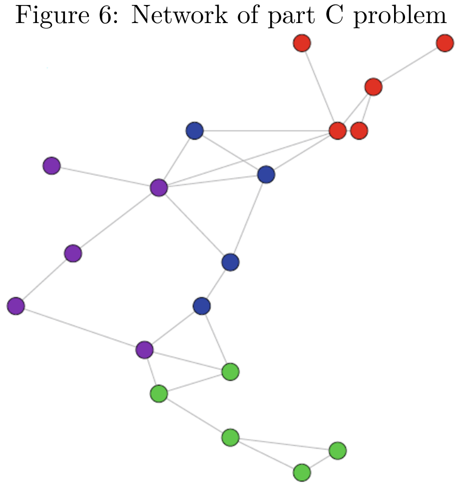
Figure 5: Network created by myself



3 Part C

From this question, we can see that the network is a graph which mean it do not have the direction.And we can also find out that there are different colors which mean the network contain different group.

Figure 6: Network of part C problem



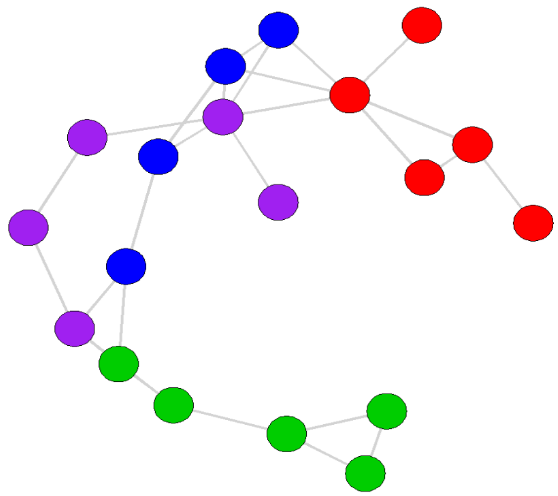
3.1 Result

The link list of the undirect network is

$\{1\} \rightarrow \{3\}$
$\{2\} \rightarrow \{4\}$
$\{3\} \rightarrow \{1 \quad 4 \quad 5\}$
$\{4\} \rightarrow \{2 \quad 3 \quad 5 \quad 6 \quad 7 \quad 8\}$
$\{5\} \rightarrow \{3 \quad 4\}$
$\{6\} \rightarrow \{4 \quad 7 \quad 8\}$
$\{7\} \rightarrow \{4 \quad 6 \quad 8 \quad 9\}$
$\{8\} \rightarrow \{4 \quad 6 \quad 7 \quad 9 \quad 10 \quad 11\}$
$\{9\} \rightarrow \{7 \quad 8 \quad 14\}$
$\{10\} \rightarrow \{8\}$
$\{11\} \rightarrow \{8 \quad 12\}$
$\{12\} \rightarrow \{11 \quad 13\}$
$\{13\} \rightarrow \{12 \quad 14 \quad 15 \quad 16\}$
$\{14\} \rightarrow \{9 \quad 13 \quad 15\}$
$\{15\} \rightarrow \{13 \quad 14 \quad 16\}$
$\{16\} \rightarrow \{13 \quad 15 \quad 17\}$
$\{17\} \rightarrow \{16 \quad 18 \quad 19\}$
$\{18\} \rightarrow \{17 \quad 19\}$
$\{19\} \rightarrow \{17 \quad 18\}$

From the following figure, I create my own network and plot it. The size of network is 19. The density of network is 0.1579. The Component of network is 1. The diameter is 9 The transitivity of network is 0.3971

Figure 7: Network created by myself



4 Appendix

4.1 Part B Code

```
library(network)
library(statnet)
netmat <- rbind(
c(0,1,1,1,0,1,0,0,0,0,0),
c(1,0,1,0,1,0,0,0,0,1,1),
c(1,1,0,1,0,0,0,1,0,0,1),
c(0,0,1,0,0,1,0,1,0,0,1),
c(0,1,1,0,0,1,1,1,0,1,1),
c(0,0,1,1,1,0,0,1,0,1,0),
c(0,0,0,0,0,0,0,1,0,0,0),
c(0,0,0,1,1,1,0,0,1,0,1),
c(0,0,0,0,0,0,0,0,0,1,0),
c(1,1,0,0,1,1,1,0,0,0,0),
c(0,1,1,1,1,0,0,1,0,1,0)
)
rownames(netmat) <- c("1","2","3","4","5","6","7","8","9","10","11")
colnames(netmat) <- c("1","2","3","4","5","6","7","8","9","10","11")
net <- network(netmat,matrix.type="adjacency")
set.vertex.attribute(net, "group", c("lightpink","lightblue","lightblue","lightblue"
class(net)
```

```
summary(net)
group= net %v% 'group'
gplot(net, displaylabels = T, gmode = 'digraph', vertex.col =group, vertex.cex=2, label.c
network.size(net)
gden(net)
components(net)
a=component.largest(net, result='graph')
b=geodist(a)
max(b$gdist)
gtrans(net)
```

4.2 Part C Code

```
library(statnet)
netmat2 <- rbind(
c(1,3),
c(2,4),
c(3,4),
c(3,5),
c(4,5),
c(4,6),
c(4,7),
c(4,8),
c(6,7),
c(6,8),
c(7,8),
c(7,9),
c(8,9),
c(8,10),
c(8,11),
c(9,14),
c(11,12),
c(12,13),
c(13,14),
c(13,15),
c(13,16),
c(14,15),
c(15,16),
c(16,17),
c(17,18),
c(17,19),
c(18,19)
)
net2=network(netmat2, matrix.type='edgelist', direct=F)
network.vertex.names(net2)=c("a","b","c","d","e","f","g","h","i","j","k","l","m","n"
summary(net2)
#net3=as.matrix(net2, matrix.type="adjacency")
#net3
```

```
#net4=network(net3,matrix.type="adjacency")
#class(net4)
#summary(net4)
#net3 <- symmetrize(net3,rule="weak")
#net4=network(net3,matrix.type="adjacency",directed = FALSE)
#summary(net4)
set.vertex.attribute(net2, "group",c(2,2,2,2,2,"blue","blue","purple","blue","purple
group= net2%v% 'group'
group
gplot(net2,displaylabels = F,gmode='graph',vertex.col =group,vertex.cex=2, label.cex
network.size(ne2t)
gden(net2)
components(net2)
a2=component.largest(net2,result='graph')
b2=geodist(a2)
max(b2$gdist)
gtrans(net2)
```