*University of British Columbia Okanagan*

*COSC 421 / DATA 421 /521 Network Science*

*Homework Assignment 6*

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Maximum Marks = 20

[5 marks] Question 1. All the three networks ties are directed. How often were the advice, cowork and friendship reciprocated? Reciprocity of a directed network can be computed as

A2 <- advice %\*% advice

C2 <- cowork %\*% cowork

F2 <- friend %\*% friend

ma <- sum(advice)

mc <- sum(cowork)

mf <- sum(friend)

trA <- sum(diag(A2))

trC <- sum(diag(C2))

trF <- sum(diag(F2))

ra <- trA / ma

rc <- trC / mc

rf <- trF / mf

|  |  |
| --- | --- |
| **Network** | **Reciprocity** |
| Advice | 0.392 |
| Cowork | 0.685 |
| Friendship | 0.612 |

Which of the three relations has the lowest reciprocity? Why would you expect such a low value for this relation?

Advice has the lowest reciprocity. This is expected as just because person A gives advice to person B. It doesn’t mean that B will give advice to A. Advice can only be one way sometimes.

[15 marks] Question 2. ***Assortative Mixing***How are relationship ties formed by lawyers’ categories such as status and practice? We will look at the three relationship ties but first, convert each of the directed network to an undirected one by

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1. How strong are the advice, cowork and friendship ties among the lawyers across the status groups? Show the results in the following table. Which relation tie has most assortativity?

**## Calculating Q for Status**

n=71

adj\_advice <- get.adjacency(graph\_advice\_un)

twoM <- sum(adj\_advice)

k\_advice <- degree(graph\_advice\_un)

k2 <- k\_advice %\*% t(k\_advice)

temp <- k2/twoM

temp2 <- adj\_advice - temp

del.status <- matrix(0,ncol=71,nrow=71)

for (i in 1:n) {

for (j in 1:n) {

if (nodes$Status[i] == nodes$Status[j]) del.status[i,j] = 1

}}

sum(temp2 \* del.status)/twoM

modularity(graph\_advice\_un,nodes$Status)

adj\_cowork <- get.adjacency(graph\_cowork\_un)

twoM\_c <- sum(adj\_cowork)

k\_cowork <- degree(graph\_cowork\_un)

k2\_c <- k\_cowork %\*% t(k\_cowork)

temp3 <- k2\_c/twoM\_c

temp4 <- adj\_cowork - temp3

sum(temp4 \* del.status)/twoM\_c

modularity(graph\_cowork\_un,nodes$Status)

adj\_friend <- get.adjacency(graph\_friend\_un)

twoM\_f <- sum(adj\_friend)

k\_friend <- degree(graph\_friend\_un)

k2\_f <- k\_friend %\*% t(k\_friend)

temp5 <- k2\_f/twoM\_f

temp6 <- adj\_friend - temp5

sum(temp6 \* del.status)/twoM\_f

modularity(graph\_friend\_un,nodes$Status)

**## Calculating Q Max for status**

Qmax\_a = (twoM - sum(temp\*del.status))/twoM

Qmax\_a

Qmax\_C = (twoM\_c - sum(temp3\*del.status))/twoM\_c

Qmax\_C

Qmax\_f = (twoM\_f-sum(temp5\*del.status))/twoM\_f

Qmax\_f

|  |  |  |  |
| --- | --- | --- | --- |
| **Network** | **Q** | **Qmax** | **Q / Qmax** |
| **Advice** | 0.108 | 0.484 | 0.223 |
| **Cowork** | -0.0148 | 0.485 | -0.0305 |
| **Friendship** | 0.255 | 0.486 | 0.525 |

Friendship has the highest assortativity 0.525 which shows a moderately strong assortative pattern when it comes to friendship between the same status individuals. Advice shows some assortative patter and Cowork seems to show weak to no assortative pattern as the value is quite close to 0. Friendship has the strongest ties amongst lawyers in the same status.

1. How strong are the advice, cowork and friendship ties among the lawyers across the “law school attended” groups? Show the results in the following table. Which relation tie has most assortativity?

**## Calculating Q Law School**

del.laws <- matrix(0,ncol=71,nrow=71)

for (i in 1:n) {

for (j in 1:n) {

if (nodes$LawSchool[i] == nodes$LawSchool[j]) del.laws[i,j] = 1

}}

adj\_advice <- get.adjacency(graph\_advice\_un)

twoM <- sum(adj\_advice)

k\_advice <- degree(graph\_advice\_un)

k2 <- k\_advice %\*% t(k\_advice)

temp <- k2/twoM

temp2 <- adj\_advice - temp

sum(temp2 \* del.laws)/twoM

modularity(graph\_advice\_un,nodes$LawSchool)

adj\_cowork <- get.adjacency(graph\_cowork\_un)

twoM\_c <- sum(adj\_cowork)

k\_cowork <- degree(graph\_cowork\_un)

k2\_c <- k\_cowork %\*% t(k\_cowork)

temp3 <- k2\_c/twoM\_c

temp4 <- adj\_cowork - temp3

sum(temp4 \* del.laws)/twoM\_c

modularity(graph\_cowork\_un,nodes$LawSchool)

adj\_friend <- get.adjacency(graph\_friend\_un)

twoM\_f <- sum(adj\_friend)

k\_friend <- degree(graph\_friend\_un)

k2\_f <- k\_friend %\*% t(k\_friend)

temp5 <- k2\_f/twoM\_f

temp6 <- adj\_friend - temp5

sum(temp6 \* del.laws)/twoM\_f

modularity(graph\_friend\_un,nodes$LawSchool)

**## Calculating Q Max for Law School**

Qmax\_a = (twoM - sum(temp\*del.laws))/twoM

Qmax\_a

Qmax\_C = (twoM\_c - sum(temp3\*del.laws))/twoM\_c

Qmax\_C

Qmax\_f = (twoM\_f-sum(temp5\*del.laws))/twoM\_f

Qmax\_f

|  |  |  |  |
| --- | --- | --- | --- |
| **Network** | **Q** | **Qmax** | **Q / Qmax** |
| **Advice** | 0.0126 | 0.651 | 0.0194 |
| **Cowork** | -0.00669 | 0.646 | -0.0104 |
| **Friendship** | 0.0248 | 0.639 | 0.0388 |

Friendship has the highest assortativity with 0.0388. We can see the values are close to 0 which shows that the networks are mostly non-assortative. Friendship has the strongest ties amongst lawyers who went to the same law school.