Exam 1

Bright

3/6/2021

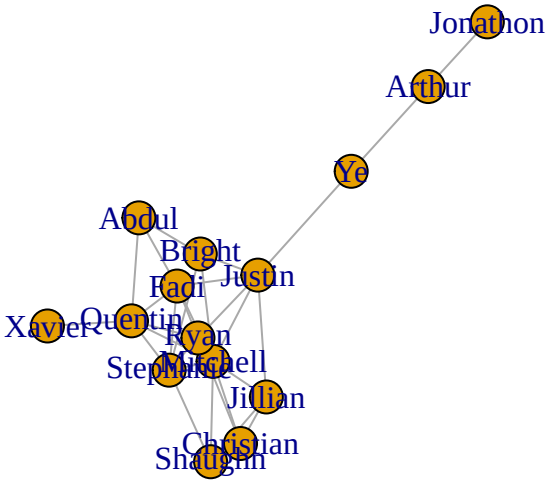
```
# Problem 2
#part a

#Clustering Coefficient

d=read.csv("C:\\Users\\corny\\Desktop\\network rcodes\\my_social_network_mat690.csv",row.names = 1)
d[is.na(d)]=0
library(igraph)
```

```
##
## Attaching package: 'igraph'
```

```
## The following objects are masked from 'package:stats':
##
##     decompose, spectrum
```

```
## The following object is masked from 'package:base':
##
##     union
```

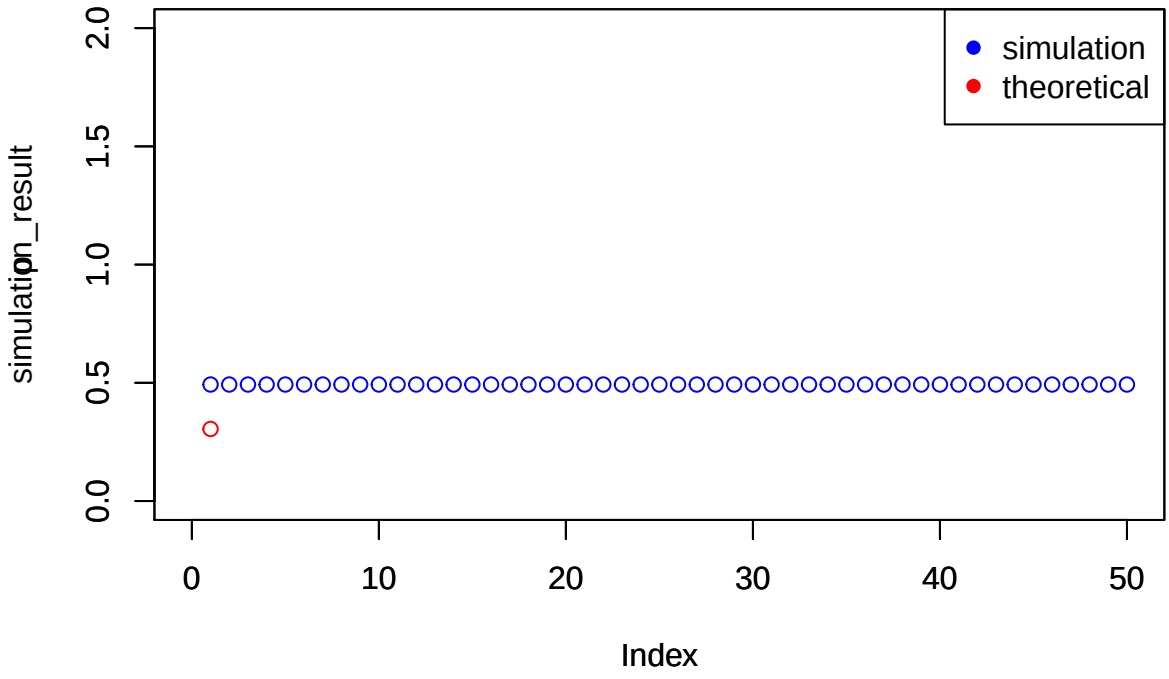
```
g_social=graph_from_adjacency_matrix(as.matrix(d), mode = "upper")
plot(g_social)
```




```
#The G(n,p) of our class social network

n=15 # Number of nodes
c=sum(degree(g_social))/n # Average degree
p = c/(n-1) #probability


simulation_number=50

  simulation_result=rep(0,simulation_number)

  for (i in 1:simulation_number){
  gnp_social <- erdos.renyi.game(n, p, type = "gnp") #generate a random graphs in G(n,p)

 simulation_result[i]=transitivity(g_social,type = "undirected", isolates = "zero")
  }
  simulation_result
```

```
##  [1] 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571
##  [8] 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571
## [15] 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571
## [22] 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571
## [29] 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571
## [36] 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571
## [43] 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571 0.4928571
## [50] 0.4928571
```

```r
plot(simulation_result,xlim=c(0,50),ylim=c(0,2),col="blue")
par(new=TRUE)

#Homework 5, the theorectical clustering coeffcient of the G(n,p) model is p this is C= c/(n-1).

plot(p,xlim=c(0,50),ylim=c(0,2),col="red")
legend("topright",legend=c("simulation","theoretical"),col = c("blue","red"),pch=16)
```



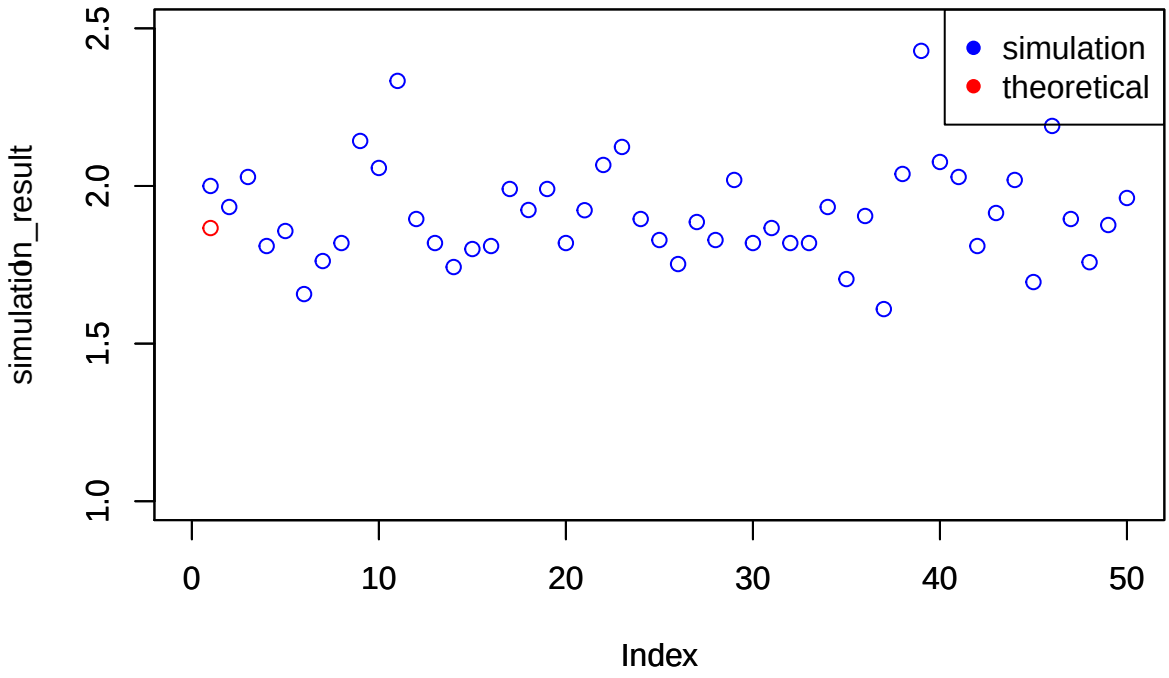

```r
# Our Social network can be generated by our the G(n,p) model
```

```r
#Problem 2 part (a)

#Average Path length

d=read.csv("C:\\Users\\corny\\Desktop\\network rcodes\\my_social_network_mat690.csv",row.names = 1)
d[is.na(d)]=0
library(igraph)
g_social=graph_from_adjacency_matrix(as.matrix(d), mode = "upper")

#The G(n,p) of our class social network

n=15 # Number of nodes
c=sum(degree(g_social))/n # Average degree
p = c/(n-1) #probability

simulation_number=50
```

```
 simulation_result=rep(0,simulation_number)
 for (i in 1:simulation_number){
   g_social <- erdos.renyi.game(n, p, type = "gnp")

simulation_result[i]=mean_distance(g_social, directed = F, unconnected = T)
 }
 simulation_result
```

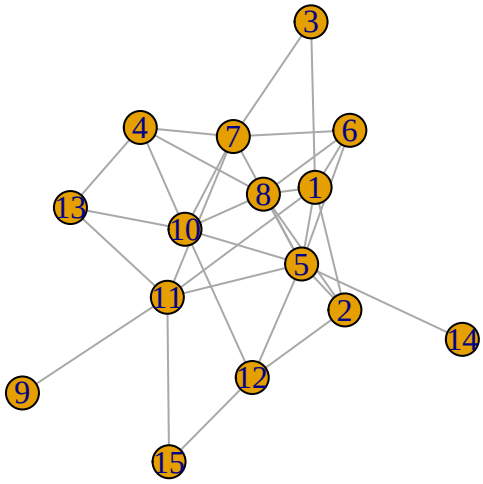
```
##  [1] 2.000000 1.933333 2.028571 1.809524 1.857143 1.657143 1.761905 1.819048
##  [9] 2.142857 2.057143 2.333333 1.895238 1.819048 1.742857 1.800000 1.809524
## [17] 1.990476 1.923810 1.990476 1.819048 1.923077 2.066667 2.123810 1.895238
## [25] 1.828571 1.752381 1.885714 1.828571 2.019048 1.819048 1.866667 1.819048
## [33] 1.819048 1.933333 1.704762 1.904762 1.609524 2.038095 2.428571 2.076190
## [41] 2.028571 1.809524 1.914286 2.019048 1.695238 2.190476 1.895238 1.758242
## [49] 1.876190 1.961905
```

```
 #thereoctical l

l=log(n)/log((n-1)*p)



plot(simulation_result,xlim=c(0,50),ylim=c(1,2.5),col="blue")
par(new=TRUE)

plot(l,xlim=c(0,50),ylim=c(1,2.5),col="red")
legend("topright",legend=c("simulation","theoretical"),col = c("blue","red"),pch=16)
```




```
# Our Social network can be generated by our the G(n,p) model
```

```
#THE CONFIGURATION MODEL

d=read.csv("C:\\Users\\corny\\Desktop\\network rcodes\\my_social_network_mat690.csv",row.names = 1)
d[is.na(d)]=0
library(igraph)
g_social=graph_from_adjacency_matrix(as.matrix(d), mode = "upper")

n=15 # Number of nodes
c=sum(degree(g_social))/n # Average degree
p = c/(n-1) #probability

deg=degree(g_social)
g2 <- sample_degseq(deg,  in.deg = NULL,method = "vl")

plot(g2)# Our social network using configuration model
```




```
an=knn(g2)
neig_deg=an$knn
Ex_avr_deg=1/n*(sum(neig_deg))

#Clustering Coefficient
C=1/n*((sum(degree(g2)^2))^2)/(sum(degree(g2)))^2

Act_C= transitivity(g2)
print(C)
```

```
## [1] 1.926042
```

```
print(Act_C)
```

```
## [1] 0.3642857
```

```
#Our class social network is not a configuration model.
```

```
# Problem 3
simulation_number=50

  simulation_result=rep(0,simulation_number)

  for (j in 1:simulation_number){
    g <- sample_degseq(rep(2,100))

    simulation_result[j]=transitivity(g,type ="undirected",isolates="zero")
  }
```

```
  clustering_coef=mean(simulation_result)

print(clustering_coef)
```

```
## [1] 0.001818306
```

```
# Theorectical Clustering coefficient of the confuguration model

  n=100
  k=1/n*(sum(degree(g)))
  k_squ=1/n*(sum(degree(g)^2))
  C_theorectical =1/n*(k_squ^2/k^3)

print(C_theorectical)
```

```
## [1] 0.02
```

```
# From the simulations, the theorectical clustering coefficient in Not equal to the actual clustering c
```