Name :- Susmita Dakua **Roll No. :- 538**

Practical No 1

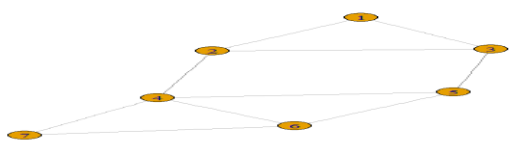
Aim:

Write a program to compute the following for a given a network: (i) number of edges, (ii) number of nodes; (iii) degree of node; (iv) node with lowest degree; (v) the adjacency list; (vi) matrix of the graph.

>library(igraph)

>g <- graph.formula(1-2, 1-3, 2-3, 2-4, 3-5, 4-5, 4-6,4-7, 5-6, 6-7)

>plot(g)



1)<u>number of edges</u>

> ecount(g)

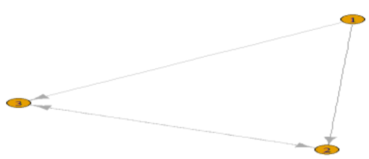
[1] 10

2)<u>no of nodes</u>

> vcount(g)

[1] 7

3)Degree Of nodes



> degree(g)

1 2 3 4 5 6 7

2 3 3 4 3 3 2

> dg <- graph.formula(1-+2, 1-+3, 2++3)

> plot(dg)

> degree(dg, mode="in")

1 2 3
0 2 2
> degree(dg, mode="out")
1 2 3

2 1 1

4) Node with lowest degree

```
>V(dg)$name[degree(dg)==min(degree(dg))]
[1] "1"
```

Node with highest degree

```
> V(dg)$name[degree(dg)==max(degree(dg))]
[1] "2" "3"
```

5) To find neighbours / adjacency list:

```
> neighbors(g,5)
[1] 3 4 6
> neighbors(g,2)
[1] 1 3 4
> get.adjlist(dg)
$`1`
[1] 2 3
$`2`
[1] 1 3 3
$`3`
[1] 1 2 2
```

6)Adjacency Matrix

```
>  get.adjacency(g)
7 x 7 sparse Matrix of class "dgCMatrix"
  1 2 3 4 5 6 7
  1 . 1 1 . . . .
  2 1 . 1 1 . . .
  3 1 1 . . 1 . .
  4 . 1 . . 1 1 1
  5 . . 1 1 . 1 .
  6 . . . 1 1 . 1
  7 . . . 1 . 1 .
```

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Practical No 2

Aim:

Perform following tasks: (i) View data collection forms and/or import onemode/two-mode datasets; (ii) Basic Networks matrices transformations

(i) View data collection forms and/or import one-mode/ two-mode datasets;

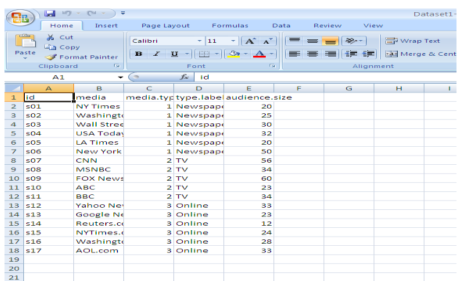
getwd()

[1] "C:/Users/admin/Documents"

> setwd("d:/SNA_pract")

<u>Reading data from a csv file</u>

>nodes <- read.csv("nodes.csv", header=T, , as.is=T)



	A	B	C	D	E
1	id	media	media.typ	type.label	audience.size
2	s01	NY Times	1	Newspape	20
3	s02	Washingt	1	Newspape	25
4	s03	Wall Stree	1	Newspape	30
5	s04	USA Toda	1	Newspape	32
6	s05	LA Times	1	Newspape	20
7	s06	New York	1	Newspape	50
8	s07	CNN	2	TV	56
9	s08	MSNBC	2	TV	34
10	s09	FOX News	2	TV	60
11	s10	ABC	2	TV	23
12	s11	BBC	2	TV	34
13	s12	Yahoo Ne	3	Online	33
14	s13	Google Ne	3	Online	23
15	s14	Reuters.c	3	Online	12
16	s15	NYTimes.	3	Online	24
17	s16	Washingt	3	Online	28
18	s17	AOL.com	3	Online	33

> head(nodes)

<u>Output:-</u>

```
   id              media media.type type.label audience.size
 1 s01          NY Times          1  Newspaper            20
 2 s02     Washington Post        1  Newspaper            25
 3 s03  Wall Street Journal       1  Newspaper            30
 4 s04          USA Today         1  Newspaper            32
 5 s05          LA Times          1  Newspaper            20
 6 s06       New York Post        1  Newspaper            50
```

> links <- read.csv(“edges.csv", header=T, as.is=T)

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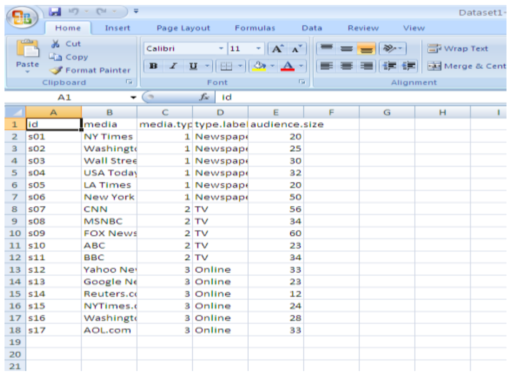


id	media	media.typ	type.label	audience.size
s01	NY Times	1	Newspape	20
s02	Washingt	1	Newspape	25
s03	Wall Stree	1	Newspape	30
s04	USA Today	1	Newspape	32
s05	LA Times	1	Newspape	20
s06	New York	1	Newspape	50
s07	CNN	2	TV	56
s08	MSNBC	2	TV	34
s09	FOX News	2	TV	60
s10	ABC	2	TV	23
s11	BBC	2	TV	34
s12	Yahoo Ne	3	Online	33
s13	Google Ne	3	Online	23
s14	Reuters.c	3	Online	12
s15	NYTimes.c	3	Online	24
s16	Washingt	3	Online	28
s17	AOL.com	3	Online	33

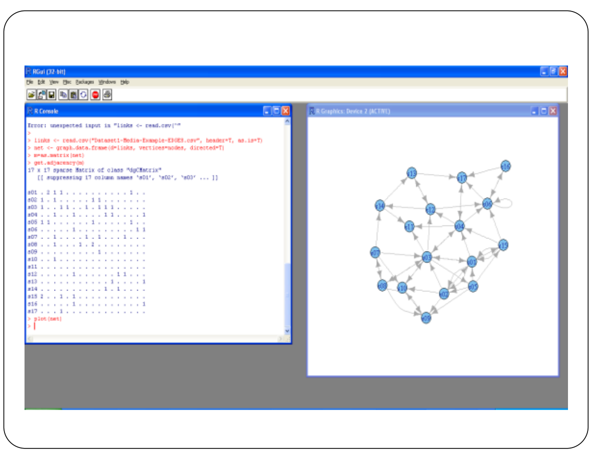
> head(links)

<u>Output:-</u>

```
  from  to weight      type
1  s01 s02     10 hyperlink
2  s01 s02     12 hyperlink
3  s01 s03     22 hyperlink
4  s01 s04     21 hyperlink
5  s04 s11     22   mention
6  s05 s15     21   mention
```

(ii) Basic Networks matrices transformations

```
> net <- graph.data.frame(d=links, vertices=nodes, directed=T)
> m=as.matrix(net)
>get.adjacency(m)
>plot(net)
```



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Practical N0 3

Aim:

Compute the following node level measures: (i) Density; (ii) Degree; (iii) Reciprocity; (iv) Transitivity; (v) Centralization; (vi) Clustering.

1)Density

>vcount(g)

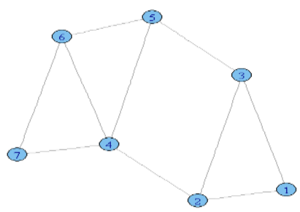
[1] 7

> ecount(g)

[1] 10

> ecount(g)/(vcount(g)*(vcount(g)-1)/2)

[1] 0.4719



2) Degree

> degree(net)

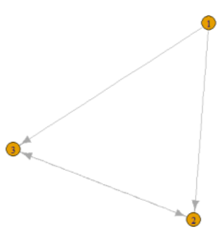
s01 s02 s03 s04 s05 s06 s07 s08 s09 s10 s11 s12

10 7 13 9 5 8 5 6 5 5 3 6

s13 s14 s15 s16 s17

4 4 6 3 5

3) **Reciprocity:**



>dg <- graph.formula(1-+2, 1-+3, 2++3)

>plot(dg)

> reciprocity(dg)

[1] 0.5

- **Formula**

> dyad.census(dg)

$mut

[1] 1

$asym

[1] 2

$null

[1] 0

> 2*dyad.census(dg)$mut/ecount(dg)

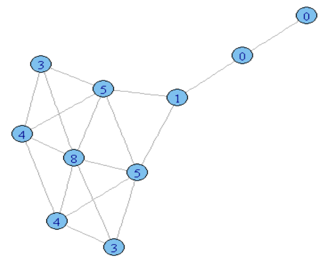
[1] 0.5

4)Transitivity

> kite <- graph.famous("Krackhardt_Kite")

> atri <- adjacent.triangles(kite)

> plot(kite, vertex.label=atri)



> transitivity(kite, type="local")

[1] 0.6666667 0.6666667 1.0000000 0.5333333 1.0000000 0.5000000

[7] 0.5000000 0.3333333 0.0000000   NaN

Formula

> adjacent.triangles(kite) / (degree(kite) * (degree(kite)-1)/2)

[1] 0.6666667 0.6666667 1.0000000 0.5333333 1.0000000 0.5000000

[7] 0.5000000 0.3333333 0.0000000   NaN

5)Centralization

- **Degree of centrality**

> centralization.degree(net, mode="in", normalized=T)

- **Closeness Centralization**

> closeness(net, mode="all", weights=NA)

> centralization.closeness(net, mode="all", normalized=T

- **Betweeness Centrality**

> betweenness(net, directed=T, weights=NA)

> edge.betweenness(net, directed=T, weights=NA)

> centralization.betweenness(net, directed=T, normalized=T)

- **Eigenvector centrality**

> centralization.evcent(net, directed=T, normalized=T)

6) **Clustering**

>library(igraph)

let's generate two networks and merge them into one graph.

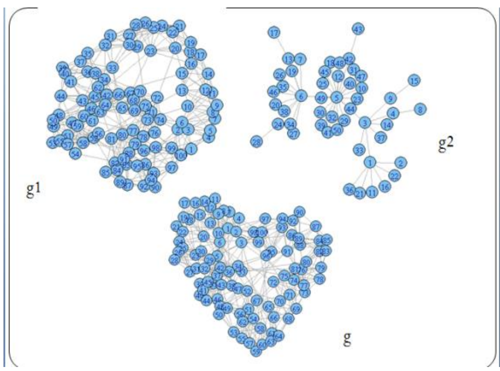
>g2 <- barabasi.game(50, p=2, directed=F)

>g1 <- watts.strogatz.game(1, size=100, nei=5, p=0.05)

>g <- graph.union(g1,g2)

#Let's remove multi-edges and loops

>g <- simplify(g)



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Practical No 4

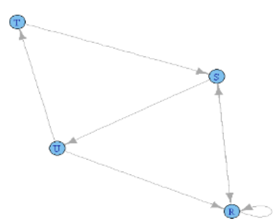
Aim:

For a given network find the following: (i) Length of the shortest path from a given node to another node; (ii) the density of the graph

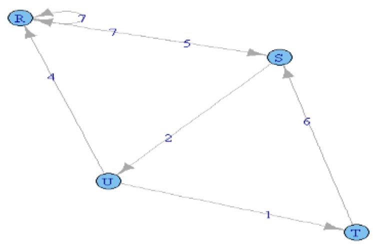
(i) Length of the shortest path from a given

node to another node;

```
> library(igraph)

> matt <- as.matrix(read.table(text=

 "node  R  S  T  U

      R  7  5  0  0

     S  7  0  0  2

    T  0  6  0  0

   U  4  0  1  0", header=T))

> nms <- matt[,1 ]

> matt <- matt[, -1]

> colnames(matt) <- rownames(matt) <- nms

>  matt[is.na(matt)] <- 0

> g <- graph.adjacency(matt, weighted=TRUE)

> plot(g)
```




```
> s.paths <- shortest.paths(g, algorithm = "dijkstra")

> print(s.paths)

  R S T U

R 0 5 5 4

S 5 0 3 2

T 5 3 0 1

U 4 2 1 0
```



> shortest.paths(g, v="R", to="S")

S

R 5

>plot(g, edge.label=E(g)$weight)

(ii) the density of the graph;

> library(igraph)

> dg <- graph.formula(1-+2, 1-+3, 2++3)

> plot(dg)

> graph.density(dg, loops=TRUE)

[1] 0.4444444

- Without considering loops

> graph.density(simplify(dg), loops=FALSE)

[1] 0.6666667

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Practical No 5

Aim:

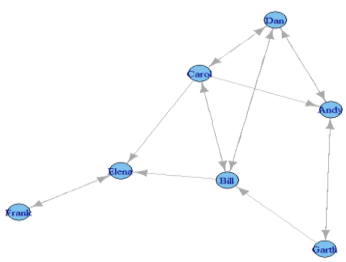
Write a program to distinguish between a network as a matrix, a network as an edge list, and a network as a sociogram (or “network graph”) using 3 distinct networks representatives of each.

1)a network as a sociogram (or “network graph”)

```
> library(igraph)
```

```
> ng<-graph.formula(Andy++Garth,Garth-+Bill,Bill-+Elena,Elena++Frank,Carol-+Andy,Carol-+Elena,Carol++Dan,Carol++Bill,Dan++Andy,Dan++Bill)
```

```
> plot(ng)
```



2) a network as a matrix,

```
> get.adjacency(ng)
```

7 x 7 sparse Matrix of class "dgCMatrix“

	Andy	Garth	Bill	Elena	Frank	Carol	Dan
Andy	.	1	.	.	.	.	1
Garth	1	.	1	.	.	.	.
Bill	.	.	.	1	.	1	1
Elena	.	.	.	.	1	.	.
Frank	.	.	.	1	.	.	.
Carol	1	.	1	1	.	.	1
Dan	1	.	1	.	.	1	.

iii) a network as an edge list.

```
> E(ng)
```

Edge sequence:

[1] Andy -> Garth

[2] Andy -> Dan

[3] Garth -> Andy

[4] Garth -> Bill

[5] Bill -> Elena

[6] Bill -> Carol

[7] Bill -> Dan

[8] Elena -> Frank

[9] Frank -> Elena

[10] Carol -> Andy

[11] Carol -> Bill

[12] Carol -> Elena

[13] Carol -> Dan

[14] Dan   -> Andy

[15] Dan   -> Bill

[16] Dan   -> Carol

---get.adjedgelist(ng,mode="in")

$Andy

[1] 3 10 14

$Garth

[1] 1

$Bill

[1] 4 11 15

$Elena

[1] 5 9 12

$Frank

[1] 8

$Carol

[1] 6 16

$Dan

[1] 2 7 13

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Practical No 6

Aim:

Write a program to exhibit structural equivalence, automorphic equivalence, and regular equivalence from a network.

i) structural equivalence

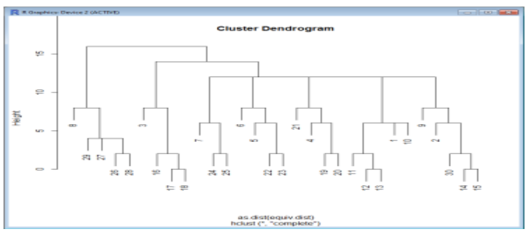
```
> library(sna)

> library(igraph)

> links2 <- read.csv("edges1.csv", header=T, row.names=1)

> eq<-equiv.clust(links2)

> plot(eq)
```

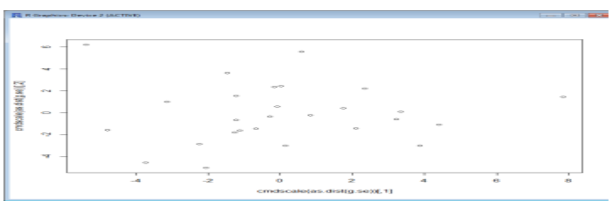


ii) automorphic equivalence,

```
>g.se<-sedist(links2)
```

<u>Plot a metric MDS of vertex positions in two dimensions</u>

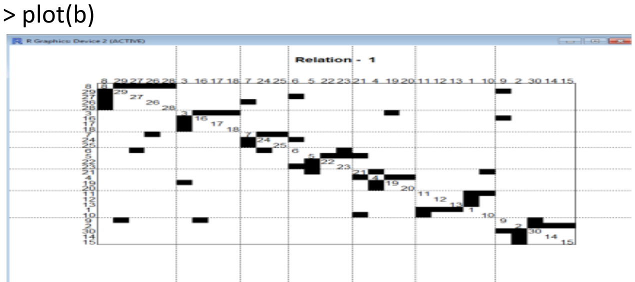
```
>plot(cmdscale(as.dist(g.se)))
```



3) regular equivalence from a network.

<u>Blockmodeling</u>

```
> b<-blockmodel(links2,eq,h=10)
> plot(b)
```



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Practical No 7

Aim:

Create sociograms for the persons-by-persons network and the committee-bycommittee network for a given relevant problem. Create one-mode network and two-node network for the same.

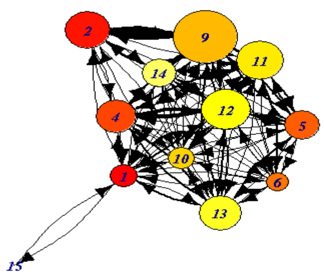
>library(Dominance)

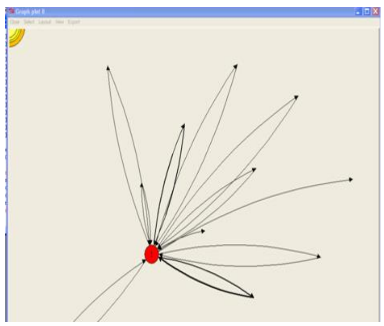
>data(data_Network_1)

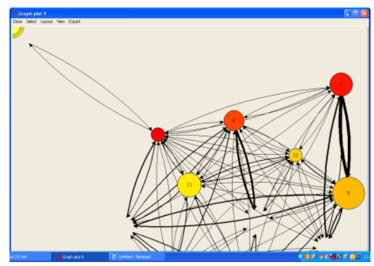
set 1 for action you want to show

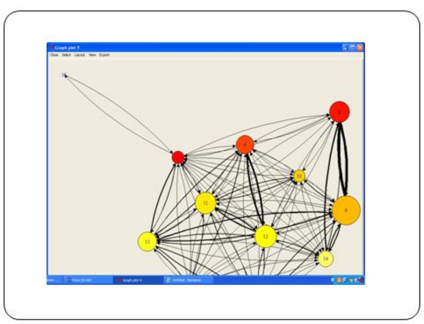
>bytes= "001111111111000000000"

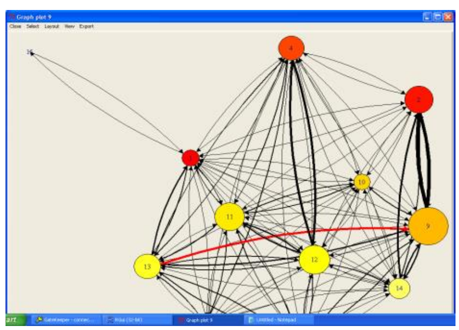
>Sociogram(data_Network_1,bytes)











```
> print(data_Network_1)
  Name Beschreibung item.number dominance.order age sex action.from.
1    1       Pferd1           1               1  NA   2            4
2    2       Pferd2           2               2  NA   1            9
3    3       Pferd3           3              NA  NA   1            4
4    4       Pferd4           4               5  NA   1           12
5    5       Pferd5           5              10  NA   1            5
6    6       Pferd6           6               3  NA   1            9
7    7       Pferd7           7               6  NA   1            5
8    8       Pferd8           8              NA  NA   1            9
```

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	action.to	kind.of.action	time	test.2.kind.of.action
1	9	11	<NA>	3
2	4	11	2009-06-07 03:30:00	3
3	12	11	<NA>	3
4	4	11	<NA>	3
5	9	11	<NA>	3
6	5	11	<NA>	3

	test.3.kind.of.acttion	name.of.action	action.number	classification
1	3	leading	1	1
2	3	following	2	2
3	3	approach	3	1
4	3	bite	4	1
5	3	threat to bite	5	1
6	3	kick	6	1

	weighting
1	1
2	-1
3	1
4	1
5	1
6	1

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Practical N0 8

Aim:

Perform SVD analysis of a network.

```
>library(igraph)
>a <- matrix(c(1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 0,
     0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1), 9, 4)
>print(a)
 [,1] [,2] [,3] [,4]
 [1,]    1    1    0    0
 [2,]    1    1    0    0
 [3,]    1    1    0    0
 [4,]    1    0    1    0
 [5,]    1    0    1    0
 [6,]    1    0    1    0
 [7,]    1    0    0    1
 [8,]    1    0    0    1
 [9,]    1    0    0    1
> svd(a)
d
[1] 3.464102e+00 1.732051e+00 1.732051e+00 9.687693e-17
 $u
           [,1]       [,2]        [,3]          [,4]
 [1,] -0.3333333  0.4687136  0.05029703  3.375152e-01
 [2,] -0.3333333  0.4687136  0.05029703 -8.126230e-01
 [3,] -0.3333333  0.4687136  0.05029703  4.751078e-01
 [4,] -0.3333333 -0.2779153  0.38076936  1.160461e-16
 [5,] -0.3333333 -0.2779153  0.38076936  1.160461e-16
 [6,] -0.3333333 -0.2779153  0.38076936  1.160461e-16
 [7,] -0.3333333 -0.1907983 -0.43106639 -7.755807e-17
```

```
 [8,] -0.3333333 -0.1907983 -0.43106639 -7.755807e-17
 [9,] -0.3333333 -0.1907983 -0.43106639 -7.755807e-17


$v
           [,1]          [,2]        [,3] [,4]
[1,] -0.8660254 -2.464364e-17  0.00000000  0.5
[2,] -0.2886751  8.118358e-01  0.08711702 -0.5
[3,] -0.2886751 -4.813634e-01  0.65951188 -0.5
[4,] -0.2886751 -3.304723e-01 -0.74662890 -0.5
```