데이터사이언스세미나I 5주차 과제

2020380613 강정민

1. R tnet 라이브러리의 Freemans.EIES.net.1.n48 자료는 48명 연구자 간 '친밀도' 관계를 1차 조사한 사회네트워크 자료이다. 이 네트워크에서 연결선은 친밀도 s로서 4, 3, 2, 1, 0의 값을 갖는데, "4"는 매우 친밀한 관계임을, "3"은 보통 친구임을, "2"는 만난 적이 있는 관계임을, "1"은 들어본 적이 있는 사람임을, "0"은 전혀 모르는 사람임을 나타낸다. 노드 간 거리 d를 $\frac{1}{2^s}$로 정의하여 사회 네트워크의 중심성을 분석하여라.

```
library(tnet)
library(ergm)
library(sna)
force(Freemans.EIES.net.1.n48)
```

```
      i  j w
1     1  2 4
2     1  3 2
3     1  6 2
4     1  8 2
5     1 10 2
6     1 11 2
7     1 13 2
8     1 14 2
9     1 18 2
10    1 19 2
11    1 20 2
12    1 21 2
13    1 22 2
14    1 23 2
15    1 24 2
16    1 25 2
17    1 26 3
18    1 27 2
19    1 31 2
20    1 32 2
21    1 33 2
22    1 35 2
23    1 36 2
24    1 37 2
25    1 38 2
26    1 39 3
```

27 1 40 2
28 1 41 2
29 1 42 2
30 1 43 2
31 1 44 4
32 1 45 2
33 1 46 2
34 2 1 4
35 2 3 2
36 2 8 1
37 2 11 3
38 2 13 3
39 2 14 4
40 2 18 1
41 2 19 3
42 2 21 2
43 2 22 2
44 2 23 2
45 2 24 3
46 2 25 2
47 2 27 1
48 2 32 2
49 2 33 3
50 2 35 2
51 2 37 2
52 2 40 2
53 2 41 1
54 2 42 2
55 2 43 3
56 2 44 4
57 2 45 4
58 2 46 2
59 3 1 3
60 3 2 1
61 3 6 4
62 3 8 1
63 3 13 2
64 3 18 2
65 3 19 4
66 3 20 4
67 3 22 4

68 3 23 1
69 3 24 2
70 3 25 2
71 3 26 2
72 3 27 1
73 3 31 1
74 3 32 2
75 3 33 2
76 3 35 2
77 3 36 4
78 3 37 2
79 3 39 2
80 3 41 1
81 3 42 1
82 3 43 1
83 6 1 2
84 6 3 2
85 6 8 2
86 6 13 2
87 6 14 2
88 6 18 2
89 6 19 2
90 6 20 2
91 6 21 2
92 6 22 2
93 6 23 2
94 6 24 1
95 6 27 4
96 6 31 1
97 6 32 2
98 6 33 2
99 6 35 2
100 6 36 2
101 6 37 2
102 6 38 2
103 6 40 2
104 6 41 2
105 6 42 2
106 6 44 2
107 8 1 3
108 8 6 2

109 8 13 2
110 8 14 3
111 8 18 2
112 8 19 2
113 8 20 1
114 8 22 2
115 8 23 1
116 8 24 2
117 8 25 2
118 8 27 1
119 8 32 2
120 8 33 2
121 8 35 2
122 8 37 2
123 8 38 1
124 8 40 1
125 8 41 2
126 8 42 2
127 8 44 2
128 8 45 2
129 10 1 3
130 10 13 2
131 10 22 2
132 10 24 1
133 10 27 2
134 10 33 1
135 10 40 2
136 10 42 2
137 10 44 2
138 11 1 3
139 11 2 2
140 11 3 1
141 11 13 2
142 11 14 2
143 11 19 1
144 11 21 3
145 11 41 2
146 13 1 2
147 13 2 2
148 13 3 2
149 13 6 2

150 13 8 2
151 13 14 1
152 13 19 2
153 13 21 2
154 13 22 2
155 13 23 2
156 13 24 2
157 13 25 2
158 13 27 1
159 13 32 2
160 13 33 2
161 13 35 1
162 13 36 1
163 13 37 2
164 13 38 2
165 13 40 2
166 13 42 2
167 13 43 2
168 14 1 3
169 14 2 4
170 14 8 2
171 14 13 2
172 14 19 1
173 14 21 2
174 14 22 1
175 14 33 1
176 14 35 3
177 14 40 3
178 14 45 4
179 18 1 2
180 18 2 1
181 18 3 3
182 18 6 3
183 18 8 2
184 18 11 1
185 18 13 2
186 18 14 2
187 18 19 2
188 18 20 3
189 18 22 1
190 18 23 2

191 18 24 2
192 18 25 2
193 18 27 2
194 18 31 2
195 18 32 3
196 18 33 2
197 18 35 2
198 18 36 4
199 18 37 2
200 18 38 2
201 18 41 2
202 18 42 2
203 18 43 2
204 19 1 1
205 19 2 3
206 19 3 2
207 19 6 1
208 19 8 1
209 19 13 3
210 19 14 1
211 19 18 1
212 19 22 2
213 19 23 1
214 19 24 2
215 19 25 2
216 19 27 1
217 19 31 2
218 19 32 2
219 19 33 2
220 19 35 2
221 19 36 1
222 19 37 2
223 19 38 2
224 19 40 2
225 19 41 1
226 19 42 1
227 19 44 1
228 20 1 1
229 20 3 1
230 20 6 2
231 20 13 1

232 20 18 3
233 20 22 2
234 20 24 1
235 20 27 2
236 20 32 2
237 20 33 2
238 20 35 2
239 20 38 2
240 20 42 2
241 20 43 2
242 21 1 3
243 21 2 3
244 21 3 1
245 21 6 2
246 21 8 1
247 21 11 3
248 21 13 3
249 21 14 2
250 21 18 1
251 21 19 1
252 21 22 1
253 21 23 1
254 21 24 1
255 21 27 2
256 21 31 1
257 21 32 1
258 21 33 1
259 21 35 1
260 21 36 1
261 21 39 2
262 21 40 4
263 21 41 2
264 21 42 2
265 21 43 2
266 21 44 3
267 21 45 3
268 22 1 3
269 22 2 2
270 22 3 4
271 22 6 2
272 22 8 3

273 22 13 3
274 22 14 2
275 22 18 1
276 22 19 2
277 22 20 3
278 22 21 1
279 22 23 3
280 22 24 4
281 22 25 3
282 22 26 2
283 22 27 3
284 22 31 2
285 22 32 3
286 22 33 3
287 22 35 4
288 22 36 3
289 22 37 3
290 22 38 3
291 22 39 2
292 22 40 1
293 22 41 2
294 22 42 4
295 22 43 3
296 22 44 2
297 22 46 1
298 23 1 3
299 23 2 2
300 23 3 2
301 23 6 3
302 23 8 1
303 23 11 1
304 23 13 2
305 23 14 2
306 23 18 2
307 23 19 2
308 23 20 1
309 23 22 3
310 23 24 2
311 23 25 2
312 23 27 2
313 23 31 4

```
314 23 32 1
315 23 33 2
316 23 35 1
317 23 36 2
318 23 37 2
319 23 38 2
320 23 42 3
321 23 44 2
322 23 46 1
323 24  1 2
324 24  2 2
325 24  3 2
326 24  6 1
327 24  8 3
328 24 13 3
329 24 14 1
330 24 19 2
331 24 22 3
332 24 23 2
333 24 25 3
```

```
summary(Freemans.EIES.net.1.n48)
```

```
       i                j                w
 Min.   : 1.00   Min.   : 1.00   Min.   :1.000
 1st Qu.:14.00   1st Qu.:14.00   1st Qu.:2.000
 Median :25.00   Median :24.00   Median :2.000
 Mean   :25.05   Mean   :24.47   Mean   :2.069
 3rd Qu.:37.00   3rd Qu.:36.00   3rd Qu.:2.000
 Max.   :46.00   Max.   :46.00   Max.   :4.000
```

```
class(Freemans.EIES.net.1.n48)
```

```
[1] "data.frame"
```

```
frm <- as.sociomatrix(as.network(Freemans.EIES.net.1.n48))
```

```
frm
```

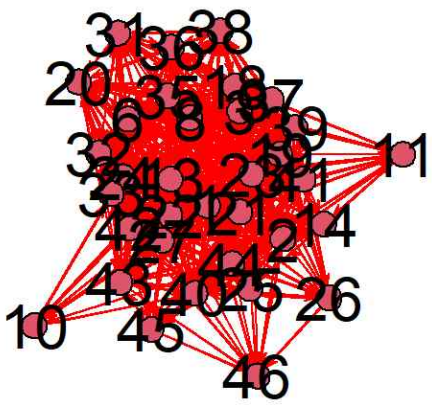
```
   1 2 3 6 8 10 11 13 14 18 19 20 21 22 23 24 25 26 27 31 32 33 35 36 37 38
1  0 1 1 1 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
2  1 0 1 0 1  0  1  1  1  1  1  0  1  1  1  1  1  0  1  0  1  1  1  0  1  0
3  1 1 0 1 1  0  0  1  0  1  1  1  0  1  1  1  1  1  1  1  1  1  1  1  1  0
6  1 0 1 0 1  0  0  1  1  1  1  1  1  1  1  1  1  0  0  1  1  1  1  1  1  1
8  1 0 0 1 0  0  0  1  1  1  1  1  0  1  1  1  1  0  1  0  1  1  1  0  1  1
10 1 0 0 0 0  0  0  1  0  0  0  0  0  1  0  1  0  0  1  0  0  1  0  0  0  0
11 1 1 1 0 0  0  0  1  1  0  1  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0
13 1 1 1 1 1  0  0  0  1  0  1  0  1  1  1  1  1  0  1  0  1  1  1  1  1  1
```

14	1	1	0	0	1	0	0	1	0	0	1	0	1	1	0	0	0	0	0	0	0	1	1	0	0	0
18	1	1	1	1	1	0	1	1	1	0	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1
19	1	1	1	1	1	0	0	1	1	1	0	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1
20	1	0	1	1	0	0	0	1	0	1	0	0	0	1	0	1	0	0	1	0	1	1	1	0	0	1
21	1	1	1	1	1	0	1	1	1	1	1	0	0	1	1	1	0	0	1	1	1	1	1	1	0	0
22	1	1	1	1	1	0	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
23	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0	1	1	0	1	1	1	1	1	1	1	1
24	1	1	1	1	1	0	0	1	1	0	1	0	0	1	1	0	1	0	1	1	1	1	1	0	1	1
25	1	1	1	0	1	0	0	1	1	1	1	0	0	1	1	1	0	0	1	0	1	1	1	0	1	0
26	1	1	1	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	0	0	0	1	0
27	1	0	1	1	1	0	0	1	0	1	0	1	0	1	1	1	0	0	0	0	1	1	1	1	1	1
31	1	0	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	0	0	0	1	0	1	1	1	1
32	1	1	1	1	1	0	0	1	0	1	1	1	0	1	1	1	1	0	1	1	0	1	1	1	1	1
33	1	1	1	1	1	0	0	1	1	1	1	1	0	1	1	1	1	0	1	1	1	0	1	1	1	1
35	1	1	1	1	0	0	0	1	1	1	1	0	0	1	0	1	1	0	1	0	1	1	0	0	1	1
36	1	0	1	1	0	0	0	0	0	1	0	1	0	1	1	1	0	0	1	1	1	1	1	0	1	1
37	1	1	1	1	1	0	0	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	0	1
38	1	1	1	1	1	0	0	1	0	1	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	0
39	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1
40	1	1	1	1	1	0	0	1	1	1	1	0	1	1	1	1	1	0	1	0	1	1	0	0	0	0
41	1	1	0	1	0	0	0	0	0	1	1	0	1	1	1	1	0	0	1	0	1	1	1	0	1	1

	39	40	41	42	43	44	45	46
1	1	1	1	1	1	1	1	1
2	0	1	1	1	1	1	1	1
3	1	0	1	1	1	0	0	0
6	0	1	1	1	0	1	0	0
8	0	1	1	1	0	1	1	0
10	0	1	0	1	0	1	0	0
11	0	0	1	0	0	0	0	0
13	0	1	0	1	1	0	0	0
14	0	1	0	0	0	0	1	0
18	0	0	1	1	1	0	0	0
19	0	1	1	1	0	1	0	0
20	0	0	0	1	1	0	0	0
21	1	1	1	1	1	1	1	0
22	1	1	1	1	1	1	0	1
23	0	0	0	1	0	1	0	1
24	0	0	0	1	0	0	0	0
25	0	0	1	1	0	1	0	1
26	1	1	1	1	1	1	0	1
27	1	0	1	1	1	1	0	1

```
31  0  0  0  1  0  0  0  0
32  0  0  1  1  1  0  0  0
33  0  1  1  1  1  0  1  0
35  0  0  1  1  0  0  0  0
36  0  0  1  1  0  0  0  0
37  0  1  1  1  0  0  0  0
38  0  0  1  0  0  0  0  0
39  0  0  1  1  0  1  0  1
40  0  0  0  0  1  0  0  0
41  1  1  0  1  0  1  0  0
 [ reached getOption("max.print") -- omitted 5 rows ]
```

```
gplot(frm, displaylabels=T, vertex.cex=2, label.cex = 2, edge.col="red",
      label.pos = 5, boxed.labels=F, arrowhead.cex=1)
```



```
(F.w <- 1/frm)
     1   2   3   6   8  10  11  13  14  18  19  20  21  22  23  24  25  26
1  Inf   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
2    1 Inf   1 Inf   1 Inf   1   1   1   1   1 Inf   1   1   1   1   1 Inf
3    1   1 Inf   1   1 Inf Inf   1 Inf   1   1   1 Inf   1   1   1   1   1
6    1 Inf   1 Inf   1 Inf Inf   1   1   1   1   1   1   1   1   1 Inf Inf
8    1 Inf Inf   1 Inf Inf Inf   1   1   1   1   1 Inf   1   1   1   1 Inf
10   1 Inf Inf Inf Inf Inf Inf   1 Inf Inf Inf Inf Inf   1 Inf   1 Inf Inf
11   1   1   1 Inf Inf Inf Inf   1   1 Inf   1 Inf   1 Inf Inf Inf Inf Inf
13   1   1   1   1   1 Inf Inf Inf   1 Inf   1 Inf   1   1   1   1   1 Inf
14   1   1 Inf Inf   1 Inf Inf   1 Inf Inf   1 Inf   1   1 Inf Inf Inf Inf
18   1   1   1   1   1 Inf   1   1   1 Inf   1   1 Inf   1   1   1   1 Inf
19   1   1   1   1   1 Inf Inf   1   1   1 Inf Inf Inf   1   1   1   1 Inf
20   1 Inf   1   1 Inf Inf Inf   1 Inf   1 Inf Inf Inf   1 Inf   1 Inf Inf
21   1   1   1   1   1 Inf   1   1   1   1   1 Inf Inf   1   1   1 Inf Inf
22   1   1   1   1   1 Inf Inf   1   1   1   1   1   1 Inf   1   1   1   1
```

23	1	1	1	1	1	Inf	1	1	1	1	1	1	Inf	1	Inf	1	1	Inf
24	1	1	1	1	1	Inf	Inf	1	1	Inf	1	Inf	Inf	1	1	Inf	1	Inf
25	1	1	1	Inf	1	Inf	Inf	1	1	1	1	Inf	Inf	1	1	1	Inf	Inf
26	1	1	1	Inf	Inf	Inf	Inf	Inf	Inf	Inf	1	Inf	Inf	1	1	Inf	Inf	Inf
27	1	Inf	1	1	1	Inf	Inf	1	Inf	1	Inf	1	Inf	1	1	1	Inf	Inf
31	1	Inf	1	1	1	Inf	Inf	Inf	Inf	1	1	1	Inf	1	1	1	Inf	Inf
32	1	1	1	1	1	Inf	Inf	1	Inf	1	1	1	Inf	1	1	1	1	Inf
33	1	1	1	1	1	Inf	Inf	1	1	1	1	1	Inf	1	1	1	1	Inf
35	1	1	1	1	Inf	Inf	Inf	1	1	1	1	Inf	Inf	1	Inf	1	1	Inf
36	1	Inf	1	1	Inf	Inf	Inf	Inf	Inf	1	Inf	1	Inf	1	1	1	Inf	Inf
37	1	1	1	1	1	Inf	Inf	1	1	1	1	1	Inf	1	1	1	1	Inf
38	1	1	1	1	1	Inf	Inf	1	Inf	1	1	1	Inf	1	1	1	Inf	Inf
39	1	1	1	1	1	Inf	1	1	Inf	1	1	1	1	1	1	1	Inf	1
40	1	1	1	1	1	Inf	Inf	1	1	1	1	Inf	1	1	1	1	1	Inf
41	1	1	Inf	1	Inf	Inf	Inf	Inf	Inf	1	1	Inf	1	1	1	1	Inf	Inf

	27	31	32	33	35	36	37	38	39	40	41	42	43	44	45	46
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	Inf	1	1	1	Inf	1	Inf	Inf	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	Inf	1	Inf	1	1	1	Inf	Inf	Inf
6	1	1	1	1	1	1	1	1	Inf	1	1	1	Inf	1	Inf	Inf
8	1	Inf	1	1	1	Inf	1	1	Inf	1	1	1	Inf	1	1	Inf
10	1	Inf	Inf	1	Inf	Inf	Inf	Inf	Inf	1	Inf	1	Inf	1	Inf	Inf
11	Inf	Inf	Inf	Inf	Inf	Inf	Inf	Inf	Inf	Inf	1	Inf	Inf	Inf	Inf	Inf
13	1	Inf	1	1	1	1	1	1	Inf	1	Inf	1	1	Inf	Inf	Inf
14	Inf	Inf	Inf	1	1	Inf	Inf	Inf	Inf	1	Inf	Inf	Inf	Inf	1	Inf
18	1	1	1	1	1	1	1	1	Inf	Inf	1	1	1	Inf	Inf	Inf
19	1	1	1	1	1	1	1	1	Inf	1	1	1	Inf	1	Inf	Inf
20	1	Inf	1	1	1	Inf	Inf	1	Inf	Inf	Inf	1	1	Inf	Inf	Inf
21	1	1	1	1	1	1	Inf	Inf	1	1	1	1	1	1	1	Inf
22	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Inf	1
23	1	1	1	1	1	1	1	1	Inf	Inf	Inf	1	Inf	1	Inf	1
24	1	1	1	1	1	Inf	1	1	Inf	Inf	Inf	1	Inf	Inf	Inf	Inf
25	1	Inf	1	1	1	Inf	1	Inf	Inf	Inf	1	1	Inf	1	Inf	1
26	1	Inf	Inf	Inf	Inf	Inf	1	Inf	1	1	1	1	1	1	Inf	1
27	Inf	Inf	1	1	1	1	1	1	1	Inf	1	1	1	1	Inf	1
31	Inf	Inf	1	Inf	1	1	1	1	Inf	Inf	Inf	1	Inf	Inf	Inf	Inf
32	1	1	Inf	1	1	1	1	1	Inf	Inf	1	1	1	Inf	Inf	Inf
33	1	1	1	Inf	1	1	1	1	Inf	1	1	1	1	Inf	1	Inf
35	1	Inf	1	1	Inf	Inf	1	1	Inf	Inf	1	1	Inf	Inf	Inf	Inf
36	1	1	1	1	1	Inf	1	1	Inf	Inf	1	1	Inf	Inf	Inf	Inf
37	1	1	1	1	1	1	Inf	1	Inf	1	1	1	Inf	Inf	Inf	Inf

```
38    1    1    1    1    1    1    1 Inf Inf Inf    1 Inf Inf Inf Inf Inf
39    1 Inf    1    1    1    1    1    1 Inf Inf    1    1 Inf    1 Inf    1
40    1 Inf    1    1 Inf Inf Inf Inf Inf Inf Inf Inf    1 Inf Inf Inf
41    1 Inf    1    1    1 Inf    1    1    1    1 Inf    1 Inf    1 Inf Inf
 [ reached getOption("max.print") -- omitted 5 rows ]
```

geodist(F.w,ignore.eval=F)

$counts

	[,1]	[,2]	[,3]	[,4]	[,5]	[,6]	[,7]	[,8]	[,9]	[,10]	[,11]	[,12]	[,13]
[1,]	1	1	1	1	1	1	1	1	1	1	1	1	1
[2,]	1	1	1	20	1	2	1	1	1	1	1	11	1
[3,]	1	1	1	1	1	1	5	1	14	1	1	1	8
[4,]	1	19	1	1	1	2	5	1	1	1	1	1	1
[5,]	1	19	19	1	1	2	4	1	1	1	1	1	9
[6,]	1	8	9	9	9	1	2	1	7	6	7	5	5
[7,]	1	1	1	6	7	1	1	1	1	6	1	2	1
[8,]	1	1	1	1	1	1	4	1	1	20	1	13	1
[9,]	1	1	9	10	1	1	3	1	1	9	1	4	1
[10,]	1	1	1	1	1	1	1	1	1	1	1	1	9
[11,]	1	1	1	1	1	2	5	1	1	1	1	15	9
[12,]	1	12	1	1	12	1	2	1	8	1	11	1	5
[13,]	1	1	1	1	1	2	1	1	1	1	1	14	1
[14,]	1	1	1	1	1	2	7	1	1	1	1	1	1
[15,]	1	1	1	1	1	2	1	1	1	1	1	1	8
[16,]	1	1	1	1	1	1	3	1	1	17	1	13	6
[17,]	1	1	1	17	1	2	5	1	1	1	1	11	7
[18,]	1	1	1	12	12	2	5	13	8	13	1	8	8
[19,]	1	18	1	1	1	2	5	1	12	1	17	1	8
[20,]	1	12	1	1	1	1	3	15	10	1	1	1	3
[21,]	1	1	1	1	1	1	4	1	14	1	1	1	7
[22,]	1	1	1	1	1	1	4	1	1	1	1	1	10
[23,]	1	1	1	1	17	1	3	1	1	1	1	11	7
[24,]	1	13	1	1	14	1	3	15	9	1	14	1	4
[25,]	1	1	1	1	1	1	4	1	1	1	1	1	8
[26,]	1	1	1	1	1	1	4	1	13	1	1	1	6
[27,]	1	1	1	1	1	2	1	1	16	1	1	1	1
[28,]	1	1	1	1	1	1	5	1	1	1	1	10	1
[29,]	1	1	19	1	18	2	7	19	14	1	1	12	1

	[,14]	[,15]	[,16]	[,17]	[,18]	[,19]	[,20]	[,21]	[,22]	[,23]	[,24]	[,25]
[1,]	1	1	1	1	1	1	1	1	1	1	1	1
[2,]	1	1	1	1	6	1	11	1	1	1	14	1
[3,]	1	1	1	1	1	1	1	1	1	1	1	1

[4,]	1	1	1	15	5	1	1	1	1	1	1	1
[5,]	1	1	1	1	4	1	11	1	1	1	14	1
[6,]	1	9	1	7	4	1	4	8	1	8	7	8
[7,]	8	7	7	5	2	7	4	7	8	8	5	6
[8,]	1	1	1	1	5	1	13	1	1	1	1	1
[9,]	1	9	11	9	2	11	5	11	1	1	6	8
[10,]	1	1	1	1	5	1	1	1	1	1	1	1
[11,]	1	1	1	1	5	1	1	1	1	1	1	1
[12,]	1	12	1	10	5	1	9	1	1	1	11	13
[13,]	1	1	1	16	7	1	1	1	1	1	1	21
[14,]	1	1	1	1	1	1	1	1	1	1	1	1
[15,]	1	1	1	1	5	1	1	1	1	1	1	1
[16,]	1	1	1	1	4	1	1	1	1	1	14	1
[17,]	1	1	1	1	5	1	10	1	1	1	13	1
[18,]	1	1	14	10	1	1	6	13	14	13	10	1
[19,]	1	1	1	14	7	1	12	1	1	1	1	1
[20,]	1	1	1	11	4	16	1	1	16	1	1	1
[21,]	1	1	1	1	5	1	1	1	1	1	1	1
[22,]	1	1	1	1	5	1	1	1	1	1	1	1
[23,]	1	17	1	1	4	1	11	1	1	1	13	1
[24,]	1	1	1	10	4	1	1	1	1	1	1	1
[25,]	1	1	1	1	4	1	1	1	1	1	1	1
[26,]	1	1	1	14	3	1	1	1	1	1	1	1
[27,]	1	1	1	15	1	1	14	1	1	1	1	1
[28,]	1	1	1	1	4	1	11	1	1	18	12	15
[29,]	1	1	1	13	5	1	12	1	1	1	15	1

	[,26]	[,27]	[,28]	[,29]	[,30]	[,31]	[,32]	[,33]	[,34]
[1,]	1	1	1	1	1	1	1	1	1
[2,]	14	8	1	1	1	1	1	1	1
[3,]	19	1	13	1	1	1	13	5	10
[4,]	1	8	1	1	1	13	1	5	6
[5,]	1	6	1	1	1	12	1	1	8
[6,]	6	5	1	6	1	8	1	2	5
[7,]	4	4	7	1	7	5	5	4	2
[8,]	1	6	1	18	1	1	11	7	8
[9,]	7	3	1	8	9	8	7	1	4
[10,]	1	6	13	1	1	1	11	6	8
[11,]	1	7	1	1	1	12	1	5	8
[12,]	1	5	7	12	1	1	5	3	5
[13,]	17	1	1	1	1	1	1	1	10
[14,]	1	1	1	1	1	1	1	7	1

[15,]	1	6	12	19	1	12	1	5	1
[16,]	1	5	11	15	1	9	10	5	7
[17,]	14	7	12	1	1	11	1	5	1
[18,]	8	1	1	1	1	1	1	3	1
[19,]	1	1	11	1	1	1	1	4	1
[20,]	1	4	7	13	1	7	7	2	4
[21,]	1	6	12	1	1	1	11	5	8
[22,]	1	6	1	1	1	1	12	1	9
[23,]	1	6	11	1	1	10	9	4	6
[24,]	1	6	7	1	1	9	7	2	5
[25,]	1	6	1	1	1	12	11	5	7
[26,]	1	5	10	1	20	10	9	4	5
[27,]	1	1	14	1	1	14	1	5	1
[28,]	12	5	1	14	17	1	10	7	7
[29,]	1	1	1	1	1	11	1	4	8

[reached getOption("max.print") -- omitted 5 rows]

$gdist

	[,1]	[,2]	[,3]	[,4]	[,5]	[,6]	[,7]	[,8]	[,9]	[,10]	[,11]	[,12]	[,13]
[1,]	0	1	1	1	1	1	1	1	1	1	1	1	1
[2,]	1	0	1	2	1	2	1	1	1	1	1	2	1
[3,]	1	1	0	1	1	2	2	1	2	1	1	1	2
[4,]	1	2	1	0	1	2	2	1	1	1	1	1	1
[5,]	1	2	2	1	0	2	2	1	1	1	1	1	2
[6,]	1	2	2	2	2	0	2	1	2	2	2	2	2
[7,]	1	1	1	2	2	2	0	1	1	2	1	2	1
[8,]	1	1	1	1	1	2	2	0	1	2	1	2	1
[9,]	1	1	2	2	1	2	2	1	0	2	1	2	1
[10,]	1	1	1	1	1	2	1	1	1	0	1	1	2
[11,]	1	1	1	1	1	2	2	1	1	1	0	2	2
[12,]	1	2	1	1	2	2	2	1	2	1	2	0	2
[13,]	1	1	1	1	1	2	1	1	1	1	1	2	0
[14,]	1	1	1	1	1	2	2	1	1	1	1	1	1
[15,]	1	1	1	1	1	2	1	1	1	1	1	1	2
[16,]	1	1	1	1	1	2	2	1	1	2	1	2	2
[17,]	1	1	1	2	1	2	2	1	1	1	1	2	2
[18,]	1	1	1	2	2	2	2	2	2	2	1	2	2
[19,]	1	2	1	1	1	2	2	1	2	1	2	1	2
[20,]	1	2	1	1	1	2	2	2	2	1	1	1	2
[21,]	1	1	1	1	1	2	2	1	2	1	1	1	2
[22,]	1	1	1	1	1	2	2	1	1	1	1	1	2

[23,]	1	1	1	1	2	2	2	1	1	1	1	2	2
[24,]	1	2	1	1	2	2	2	2	2	1	2	1	2
[25,]	1	1	1	1	1	2	2	1	1	1	1	1	2
[26,]	1	1	1	1	1	2	2	1	2	1	1	1	2
[27,]	1	1	1	1	1	2	1	1	2	1	1	1	1
[28,]	1	1	1	1	1	2	2	1	1	1	1	2	1
[29,]	1	1	2	1	2	2	2	2	2	1	1	2	1

	[,14]	[,15]	[,16]	[,17]	[,18]	[,19]	[,20]	[,21]	[,22]	[,23]	[,24]	[,25]
[1,]	1	1	1	1	1	1	1	1	1	1	1	1
[2,]	1	1	1	1	2	1	2	1	1	1	2	1
[3,]	1	1	1	1	1	1	1	1	1	1	1	1
[4,]	1	1	1	2	2	1	1	1	1	1	1	1
[5,]	1	1	1	1	2	1	2	1	1	1	2	1
[6,]	1	2	1	2	2	1	2	2	1	2	2	2
[7,]	2	2	2	2	2	2	2	2	2	2	2	2
[8,]	1	1	1	1	2	1	2	1	1	1	1	1
[9,]	1	2	2	2	2	2	2	2	1	1	2	2
[10,]	1	1	1	1	2	1	1	1	1	1	1	1
[11,]	1	1	1	1	2	1	1	1	1	1	1	1
[12,]	1	2	1	2	2	1	2	1	1	1	2	2
[13,]	1	1	1	2	2	1	1	1	1	1	1	2
[14,]	0	1	1	1	1	1	1	1	1	1	1	1
[15,]	1	0	1	1	2	1	1	1	1	1	1	1
[16,]	1	1	0	1	2	1	1	1	1	1	2	1
[17,]	1	1	1	0	2	1	2	1	1	1	2	1
[18,]	1	1	2	2	0	1	2	2	2	2	2	1
[19,]	1	1	1	2	2	0	2	1	1	1	1	1
[20,]	1	1	1	2	2	2	0	1	2	1	1	1
[21,]	1	1	1	1	2	1	1	0	1	1	1	1
[22,]	1	1	1	1	2	1	1	1	0	1	1	1
[23,]	1	2	1	1	2	1	2	1	1	0	2	1
[24,]	1	1	1	2	2	1	1	1	1	1	0	1
[25,]	1	1	1	1	2	1	1	1	1	1	1	0
[26,]	1	1	1	2	2	1	1	1	1	1	1	1
[27,]	1	1	1	2	1	1	2	1	1	1	1	1
[28,]	1	1	1	1	2	1	2	1	1	2	2	2
[29,]	1	1	1	2	2	1	2	1	1	1	2	1

	[,26]	[,27]	[,28]	[,29]	[,30]	[,31]	[,32]	[,33]	[,34]
[1,]	1	1	1	1	1	1	1	1	1
[2,]	2	2	1	1	1	1	1	1	1
[3,]	2	1	2	1	1	1	2	2	2

```
 [4,]    1    2    1    1    1    2    1    2    2
 [5,]    1    2    1    1    1    2    1    1    2
 [6,]    2    2    1    2    1    2    1    2    2
 [7,]    2    2    2    1    2    2    2    2    2
 [8,]    1    2    1    2    1    1    2    2    2
 [9,]    2    2    1    2    2    2    2    1    2
[10,]    1    2    2    1    1    1    2    2    2
[11,]    1    2    1    1    1    2    1    2    2
[12,]    1    2    2    2    1    1    2    2    2
[13,]    2    1    1    1    1    1    1    1    2
[14,]    1    1    1    1    1    1    1    2    1
[15,]    1    2    2    2    1    2    1    2    1
[16,]    1    2    2    2    1    2    2    2    2
[17,]    2    2    2    1    1    2    1    2    1
[18,]    2    1    1    1    1    1    1    2    1
[19,]    1    1    2    1    1    1    1    2    1
[20,]    1    2    2    2    1    2    2    2    2
[21,]    1    2    2    1    1    1    2    2    2
[22,]    1    2    1    1    1    1    2    1    2
[23,]    1    2    2    1    1    2    2    2    2
[24,]    1    2    2    1    1    2    2    2    2
[25,]    1    2    1    1    1    2    2    2    2
[26,]    0    2    2    1    2    2    2    2    2
[27,]    1    0    2    1    1    2    1    2    1
[28,]    2    2    0    2    2    1    2    2    2
[29,]    1    1    1    0    1    2    1    2    2
 [ reached getOption("max.print") -- omitted 5 rows ]
```

```
round(closeness(F.w,ignore.eval=F),3)
```

```
 [1] 1.000 0.805 0.786 0.786 0.750 0.579 0.569 0.750 0.600 0.805 0.786 0.635
[13] 0.825 0.917 0.805 0.702 0.717 0.647 0.750 0.660 0.767 0.825 0.688 0.673
[25] 0.786 0.717 0.825 0.688 0.702 0.786 0.702 0.846 0.673 0.524
```

```
betweenness(F.w,ignore.eval=F)
```

```
 [1] 89.2362671 30.3802097 18.9233900 11.2782965 11.3672087  0.0000000
 [7]  0.3512427 14.4256316  4.9462406 12.9282344 13.1868023  1.2247399
[13] 12.2466647 34.8041242 14.6802076  8.2547903  3.7053933  0.8660015
[19] 16.2071695  0.6972017  9.0696739 20.5070879  5.4997857  1.5019839
[25]  7.8836480  3.3540112  4.3948446  6.0416386 10.1542166 27.5395437
[31]  8.6468050 20.4884505  2.0862716  0.1222222
```

```
degree(frm,ignore.eval=F)
```

```
 [1] 66 51 51 49 46 11 15 50 30 49 50 30 39 61 50 48 37 22 51 30 50 55 45
35
```

```
[25] 48 39 35 36 42 52 35 43 24 15
```

```
round(evcent(frm,ignore.eval=F),2)
```

```
 [1] 0.25 0.19 0.20 0.19 0.18 0.08 0.07 0.18 0.10 0.20 0.20 0.12 0.21 0.23
[15] 0.19 0.16 0.16 0.12 0.18 0.13 0.19 0.21 0.15 0.14 0.19 0.17 0.21 0.15
[29] 0.17 0.19 0.15 0.20 0.14 0.03
```

2. R tnet 라이브러리의 Freemans.EIES.net.2.n48 자료는 앞과 동일한 연구자 간 '친밀도' 관계를 2차 조사한 사회네트워크 자료이고 친밀도도 같은 방식으로 코딩되었다. 2차 네트워크의 중심성을 분석하고 1차 네트워크의 중심성과 어떤 차이가 있는가를 살펴보라.

```
> force(Freemans.EIES.net.2.n48)
```

	i	j	w
1	1	2	4
2	1	3	2
3	1	6	2
4	1	8	2
5	1	10	2
6	1	11	2
7	1	13	3
8	1	14	3
9	1	18	2
10	1	19	3
11	1	20	2
12	1	21	3
13	1	22	2
14	1	23	2
15	1	24	2
16	1	25	2
17	1	26	3
18	1	27	2
19	1	31	2
20	1	32	2
21	1	33	2
22	1	35	2
23	1	36	2
24	1	37	2
25	1	38	2
26	1	39	3
27	1	40	2
28	1	41	2
29	1	42	3
30	1	43	2

31 1 44 4
32 1 45 3
33 1 46 3
34 2 1 4
35 2 3 2
36 2 6 2
37 2 8 1
38 2 10 2
39 2 11 2
40 2 13 3
41 2 14 4
42 2 18 2
43 2 19 3
44 2 21 2
45 2 22 2
46 2 23 2
47 2 24 2
48 2 25 2
49 2 26 2
50 2 27 2
51 2 32 2
52 2 33 2
53 2 35 2
54 2 36 2
55 2 37 2
56 2 38 2
57 2 39 2
58 2 40 2
59 2 41 2
60 2 42 2
61 2 43 3
62 2 44 4
63 2 45 4
64 2 46 2
65 3 1 3
66 3 2 1
67 3 6 4
68 3 8 1
69 3 13 2
70 3 18 2
71 3 19 4

72 3 20 4
73 3 22 4
74 3 23 1
75 3 24 2
76 3 25 2
77 3 26 2
78 3 27 1
79 3 31 1
80 3 32 2
81 3 33 2
82 3 35 2
83 3 36 4
84 3 37 2
85 3 39 2
86 3 41 1
87 3 42 1
88 3 43 1
89 6 1 2
90 6 2 2
91 6 3 2
92 6 8 2
93 6 10 2
94 6 13 2
95 6 14 2
96 6 18 3
97 6 19 2
98 6 20 2
99 6 21 1
100 6 22 2
101 6 23 2
102 6 24 2
103 6 26 2
104 6 27 4
105 6 31 1
106 6 32 2
107 6 33 2
108 6 35 2
109 6 36 2
110 6 37 2
111 6 38 2
112 6 39 2

113 6 40 2
114 6 41 2
115 6 42 2
116 6 43 2
117 6 44 2
118 6 46 2
119 8 1 3
120 8 6 2
121 8 13 2
122 8 14 3
123 8 18 2
124 8 19 2
125 8 20 1
126 8 22 2
127 8 23 1
128 8 24 2
129 8 25 2
130 8 27 1
131 8 32 2
132 8 33 2
133 8 35 2
134 8 37 2
135 8 38 1
136 8 40 1
137 8 41 2
138 8 42 2
139 8 44 2
140 8 45 2
141 10 1 4
142 10 2 2
143 10 13 3
144 10 18 2
145 10 19 2
146 10 22 2
147 10 23 2
148 10 24 2
149 10 27 2
150 10 31 2
151 10 33 2
152 10 37 3
153 10 39 2

154 10 40 2
155 10 41 2
156 10 42 3
157 10 44 4
158 10 45 2
159 10 46 3
160 11 1 3
161 11 2 2
162 11 3 1
163 11 13 2
164 11 14 2
165 11 19 1
166 11 21 3
167 11 41 2
168 13 1 3
169 13 2 2
170 13 3 2
171 13 6 2
172 13 8 2
173 13 10 2
174 13 11 1
175 13 14 1
176 13 18 2
177 13 19 4
178 13 20 1
179 13 21 2
180 13 22 2
181 13 23 2
182 13 24 2
183 13 25 2
184 13 26 2
185 13 27 2
186 13 32 2
187 13 33 2
188 13 35 2
189 13 36 2
190 13 37 2
191 13 38 2
192 13 40 2
193 13 41 1
194 13 42 2

195 13 43 2
196 13 44 2
197 13 45 4
198 13 46 2
199 14 1 3
200 14 2 4
201 14 8 2
202 14 13 2
203 14 19 2
204 14 21 2
205 14 22 1
206 14 24 1
207 14 25 2
208 14 33 2
209 14 35 2
210 14 40 3
211 14 42 1
212 14 44 2
213 14 45 4
214 14 46 2
215 18 1 3
216 18 3 2
217 18 6 3
218 18 8 2
219 18 11 1
220 18 13 2
221 18 14 1
222 18 19 2
223 18 20 3
224 18 21 2
225 18 22 1
226 18 23 2
227 18 24 2
228 18 25 2
229 18 26 2
230 18 27 2
231 18 31 2
232 18 32 4
233 18 33 2
234 18 35 2
235 18 36 4

236 18 37 2
237 18 38 2
238 18 40 2
239 18 41 2
240 18 42 3
241 18 43 2
242 18 44 2
243 18 45 1
244 19 1 3
245 19 2 2
246 19 3 2
247 19 6 2
248 19 8 2
249 19 10 2
250 19 13 4
251 19 14 2
252 19 18 2
253 19 21 2
254 19 22 2
255 19 23 2
256 19 24 2
257 19 25 2
258 19 26 2
259 19 27 2
260 19 31 2
261 19 32 2
262 19 33 2
263 19 35 2
264 19 36 1
265 19 37 2
266 19 38 2
267 19 40 2
268 19 41 2
269 19 42 2
270 19 44 3
271 19 45 3
272 19 46 2
273 20 1 2
274 20 3 1
275 20 6 2
276 20 11 1

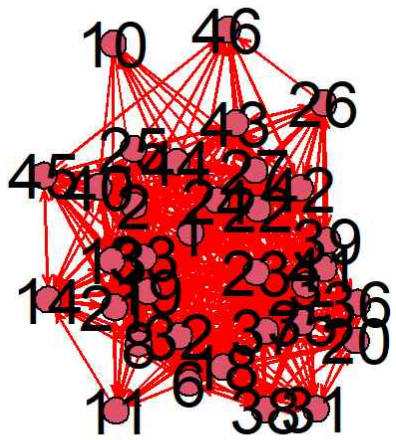
277 20 13 1
278 20 18 3
279 20 22 2
280 20 23 1
281 20 24 1
282 20 27 2
283 20 31 2
284 20 32 3
285 20 33 2
286 20 35 1
287 20 36 1
288 20 37 1
289 20 38 2
290 20 41 1
291 20 43 1
292 20 44 2
293 20 45 2
294 20 46 2
295 21 1 3
296 21 2 3
297 21 3 1
298 21 6 2
299 21 8 1
300 21 11 3
301 21 13 3
302 21 14 2
303 21 18 1
304 21 19 2
305 21 22 1
306 21 23 1
307 21 24 2
308 21 26 2
309 21 27 2
310 21 31 1
311 21 32 1
312 21 33 2
313 21 35 2
314 21 36 1
315 21 39 2
316 21 40 4
317 21 41 2

```
318 21 42 2
319 21 43 2
320 21 44 3
321 21 45 3
322 22  1 3
323 22  2 2
324 22  3 4
325 22  6 3
326 22  8 3
327 22 13 3
328 22 18 2
329 22 19 2
330 22 20 3
331 22 21 2
332 22 23 3
333 22 24 4
 [ reached 'max' / getOption("max.print") -- omitted 497 rows ]
> summary(Freemans.EIES.net.2.n48)
       i                j                w
 Min.   : 1.00   Min.   : 1.00   Min.   :1.000
 1st Qu.:14.00   1st Qu.:14.00   1st Qu.:2.000
 Median :25.00   Median :25.00   Median :2.000
 Mean   :25.55   Mean   :25.49   Mean   :2.184
 3rd Qu.:38.00   3rd Qu.:38.00   3rd Qu.:3.000
 Max.   :46.00   Max.   :46.00   Max.   :4.000
> class(Freemans.EIES.net.2.n48)
[1] "data.frame"
> frm1 <- as.sociomatrix(as.network(Freemans.EIES.net.2.n48))
> frm1
   1 2 3 6 8 10 11 13 14 18 19 20 21 22 23 24 25 26 27 31 32 33 35 36 37 38
1  0 1 1 1 1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
2  1 0 1 1 1  1  1  1  1  1  1  0  1  1  1  1  1  1  1  0  1  1  1  1  1  1
3  1 1 0 1 1  0  0  1  0  1  1  1  0  1  1  1  1  1  1  1  1  1  1  1  1  0
6  1 1 1 0 1  1  0  1  1  1  1  1  1  1  1  1  1  0  1  1  1  1  1  1  1  1
8  1 0 0 1 0  0  0  1  1  1  1  1  0  1  1  1  1  0  1  0  1  1  1  0  1  1
10 1 1 0 0 0  0  0  1  0  1  1  0  0  1  1  1  0  0  1  1  0  1  0  0  1  0
11 1 1 1 0 0  0  0  1  1  0  1  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0
13 1 1 1 1 1  1  1  0  1  1  1  1  1  1  1  1  1  1  1  0  1  1  1  1  1  1
14 1 1 0 0 1  0  0  1  0  0  1  0  1  1  0  1  1  0  0  0  0  1  1  0  0  0
18 1 0 1 1 1  0  1  1  1  0  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
19 1 1 1 1 1  1  0  1  1  1  0  0  1  1  1  1  1  1  1  1  1  1  1  1  1  1
```

20	1	0	1	1	0	0	1	1	0	1	0	0	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1
21	1	1	1	1	1	0	1	1	1	1	1	0	0	1	1	1	0	1	1	1	1	1	1	1	0	0	
22	1	1	1	1	1	0	0	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	
23	1	1	1	1	1	0	0	1	1	1	1	1	0	1	0	1	1	0	1	1	1	1	1	1	1	1	
24	1	1	1	1	1	1	0	1	1	1	1	0	0	1	1	0	1	0	1	1	1	1	1	0	1	1	
25	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	1	0	1	0
26	1	1	1	0	0	0	1	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
27	1	0	1	1	1	0	0	1	0	1	0	1	0	1	1	1	0	0	0	0	1	1	1	1	1	1	
31	1	0	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	0	0	0	1	0	1	1	1	1	
32	1	1	1	1	1	0	0	1	0	1	1	1	0	1	1	1	1	0	1	1	0	1	1	1	1	1	
33	1	1	1	1	1	0	0	1	1	1	1	1	0	1	1	1	1	0	1	1	1	0	1	1	1	1	
35	1	1	1	1	0	0	0	1	1	1	1	0	0	1	1	1	1	0	1	0	1	1	0	0	1	1	
36	1	1	1	1	0	0	0	1	0	1	0	1	0	1	1	1	0	0	1	1	1	1	1	0	1	1	
37	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	
38	1	1	1	1	1	0	0	1	0	1	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	0	
39	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	
40	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	0	
41	1	1	0	1	0	0	0	1	0	1	1	0	1	1	1	1	0	0	1	0	1	1	1	0	1	1	

	39	40	41	42	43	44	45	46
1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1
3	1	0	1	1	1	0	0	0
6	1	1	1	1	1	1	0	1
8	0	1	1	1	0	1	1	0
10	1	1	1	1	0	1	1	1
11	0	0	1	0	0	0	0	0
13	0	1	1	1	1	1	1	1
14	0	1	0	1	0	1	1	1
18	0	1	1	1	1	1	1	0
19	0	1	1	1	0	1	1	1
20	0	0	1	0	1	1	1	1
21	1	1	1	1	1	1	1	0
22	1	1	1	1	1	1	1	1
23	0	1	0	1	0	1	1	0
24	1	1	1	1	0	1	1	1
25	1	1	1	1	1	1	1	1
26	1	1	0	1	1	1	1	1
27	1	0	1	1	1	1	0	1
31	0	0	0	1	0	0	0	0
32	0	0	1	1	1	0	0	0
33	0	1	1	1	1	0	1	0

```
35  0  0  1  1  0  0  1  0
36  0  0  1  1  1  1  0  1
37  0  1  1  1  1  1  1  1
38  0  0  1  1  0  0  0  0
39  0  0  1  1  0  1  0  1
40  0  0  0  1  1  1  1  1
41  1  1  0  1  0  1  1  1
 [ reached getOption("max.print") -- omitted 5 rows ]
> gplot(frm, displaylabels=T, vertex.cex=2, label.cex = 2, edge.col="red",
+         label.pos = 5, boxed.labels=F, arrowhead.cex=1)
```



```
> (F.w1 <- 1/frm1)
     1   2   3   6   8  10  11  13  14  18  19  20  21  22  23  24  25  26
1  Inf   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1   1
2    1 Inf   1   1   1   1   1   1   1   1   1 Inf   1   1   1   1   1   1
3    1   1 Inf   1   1 Inf Inf   1 Inf   1   1   1 Inf   1   1   1   1   1
6    1   1   1 Inf   1   1 Inf   1   1   1   1   1   1   1   1   1 Inf   1
8    1 Inf Inf   1 Inf Inf Inf   1   1   1   1   1 Inf   1   1   1   1 Inf
10   1   1 Inf Inf Inf Inf Inf   1 Inf   1   1 Inf Inf   1   1   1 Inf Inf
11   1   1   1 Inf Inf Inf Inf   1   1 Inf   1 Inf   1 Inf Inf Inf Inf Inf
13   1   1   1   1   1   1   1 Inf   1   1   1   1   1   1   1   1   1   1
14   1   1 Inf Inf   1 Inf Inf   1 Inf Inf   1 Inf   1   1 Inf   1   1 Inf
18   1 Inf   1   1   1 Inf   1   1   1 Inf   1   1   1   1   1   1   1   1
19   1   1   1   1   1   1 Inf   1   1   1 Inf Inf   1   1   1   1   1   1
20   1 Inf   1   1 Inf Inf   1   1 Inf   1 Inf Inf Inf   1   1   1 Inf Inf
21   1   1   1   1   1 Inf   1   1   1   1   1 Inf Inf   1   1   1 Inf   1
22   1   1   1   1   1 Inf Inf   1 Inf   1   1   1   1 Inf   1   1   1   1
23   1   1   1   1   1 Inf Inf   1   1   1   1   1 Inf   1 Inf   1   1 Inf
24   1   1   1   1   1   1 Inf   1   1   1   1 Inf Inf   1   1 Inf   1 Inf
```

25	1	1	1	1	1	Inf	Inf	1	1	1	1	1	1	1	1	Inf	1
26	1	1	1	Inf	Inf	Inf	1	1	Inf	Inf	1	Inf	1	1	Inf	Inf	Inf	Inf
27	1	Inf	1	1	1	Inf	Inf	1	Inf	1	Inf	1	Inf	1	1	1	Inf	Inf
31	1	Inf	1	1	1	Inf	Inf	Inf	Inf	1	1	1	Inf	1	1	1	Inf	Inf
32	1	1	1	1	1	Inf	Inf	1	Inf	1	1	1	Inf	1	1	1	1	Inf
33	1	1	1	1	1	Inf	Inf	1	1	1	1	1	Inf	1	1	1	1	Inf
35	1	1	1	1	Inf	Inf	Inf	1	1	1	1	Inf	Inf	1	1	1	1	Inf
36	1	1	1	1	Inf	Inf	Inf	1	Inf	1	Inf	1	Inf	1	1	1	Inf	Inf
37	1	1	1	1	1	1	Inf	1	1	1	1	1	1	1	1	1	1	1
38	1	1	1	1	1	Inf	Inf	1	Inf	1	1	1	Inf	1	1	1	Inf	Inf
39	1	1	1	1	1	Inf	1	1	Inf	1	1	1	1	1	1	1	Inf	1
40	1	1	1	1	1	1	Inf	1	1	1	1	Inf	1	1	1	1	1	1
41	1	1	Inf	1	Inf	Inf	Inf	1	Inf	1	1	Inf	1	1	1	1	Inf	Inf

	27	31	32	33	35	36	37	38	39	40	41	42	43	44	45	46
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	Inf	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	Inf	1	Inf	1	1	1	Inf	Inf	Inf
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Inf	1
8	1	Inf	1	1	1	Inf	1	1	Inf	1	1	1	Inf	1	1	Inf
10	1	1	Inf	1	Inf	Inf	1	Inf	1	1	1	1	Inf	1	1	1
11	Inf	Inf	Inf	Inf	Inf	Inf	Inf	Inf	Inf	Inf	1	Inf	Inf	Inf	Inf	Inf
13	1	Inf	1	1	1	1	1	1	Inf	1	1	1	1	1	1	1
14	Inf	Inf	Inf	1	1	Inf	Inf	Inf	Inf	1	Inf	1	Inf	1	1	1
18	1	1	1	1	1	1	1	1	Inf	1	1	1	1	1	1	Inf
19	1	1	1	1	1	1	1	1	Inf	1	1	1	Inf	1	1	1
20	1	1	1	1	1	1	1	1	Inf	Inf	1	Inf	1	1	1	1
21	1	1	1	1	1	1	Inf	Inf	1	1	1	1	1	1	1	Inf
22	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
23	1	1	1	1	1	1	1	1	Inf	1	Inf	1	Inf	1	1	Inf
24	1	1	1	1	1	Inf	1	1	1	1	1	1	Inf	1	1	1
25	1	Inf	1	1	1	Inf	1	Inf	1	1	1	1	1	1	1	1
26	Inf	Inf	Inf	Inf	Inf	Inf	Inf	Inf	1	1	Inf	1	1	1	1	1
27	Inf	Inf	1	1	1	1	1	1	1	Inf	1	1	1	1	Inf	1
31	Inf	Inf	1	Inf	1	1	1	1	Inf	Inf	Inf	1	Inf	Inf	Inf	Inf
32	1	1	Inf	1	1	1	1	1	Inf	Inf	1	1	1	Inf	Inf	Inf
33	1	1	1	Inf	1	1	1	1	Inf	1	1	1	1	Inf	1	Inf
35	1	Inf	1	1	Inf	Inf	1	1	Inf	Inf	1	1	Inf	Inf	1	Inf
36	1	1	1	1	1	Inf	1	1	Inf	Inf	1	1	1	1	Inf	1
37	1	1	1	1	1	1	Inf	1	Inf	1	1	1	1	1	1	1
38	1	1	1	1	1	1	1	Inf	Inf	Inf	1	1	Inf	Inf	Inf	Inf
39	1	Inf	1	1	1	1	1	1	Inf	Inf	1	1	Inf	1	Inf	1

```
40    1 Inf    1    1    1    1    1 Inf Inf Inf Inf    1    1    1    1    1
41    1 Inf    1    1    1 Inf    1    1    1    1 Inf    1 Inf    1    1    1
 [ reached getOption("max.print") -- omitted 5 rows ]
> geodist(F.w1,ignore.eval=F)
$counts
      [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10] [,11] [,12] [,13]
 [1,]    1    1    1    1    1    1    1    1    1     1     1     1     1
 [2,]    1    1    1    1    1    1    1    1    1     1     1    18     1
 [3,]    1    1    1    1    1    9    7    1   13     1     1     1    14
 [4,]    1    1    1    1    1    1    9    1    1     1     1     1     1
 [5,]    1   19   19    1    1   10    5    1    1     1     1     1    14
 [6,]    1    1   16   19   18    1    6    1   13     1     1    12    13
 [7,]    1    1    1    7    7    4    1    1    1     7     1     3     1
 [8,]    1    1    1    1    1    1    1    1    1     1     1     1     1
 [9,]    1    1   13   16    1   10    5    1    1    16     1     8     1
[10,]    1   25    1    1    1   11    1    1    1     1     1     1     1
[11,]    1    1    1    1    1    1    7    1    1     1     1    18     1
[12,]    1   19    1    1   17    9    1    1   13     1    20     1    11
[13,]    1    1    1    1    1   11    1    1    1     1     1    16     1
[14,]    1    1    1    1    1   13    9    1   18     1     1     1     1
[15,]    1    1    1    1    1   11    6    1    1     1     1     1    14
[16,]    1    1    1    1    1    1    6    1    1     1     1    18    16
[17,]    1    1    1    1    1   13    9    1    1     1     1     1     1
[18,]    1    1    1   14   13   10    1    1   10    14     1     7     1
[19,]    1   19    1    1    1    9    6    1   12     1    20     1    11
[20,]    1   13    1    1    1    6    3   16    9     1     1     1     7
[21,]    1    1    1    1    1    9    5    1   13     1     1     1    12
[22,]    1    1    1    1    1   11    5    1    1     1     1     1    15
[23,]    1    1    1    1   19    9    4    1    1     1     1    14    13
[24,]    1    1    1    1   18   10    6    1   12     1    20     1    11
[25,]    1    1    1    1    1    1    8    1    1     1     1     1     1
[26,]    1    1    1    1    1    8    5    1   12     1     1     1    10
[27,]    1    1    1    1    1   10    1    1   16     1     1     1     1
[28,]    1    1    1    1    1    1    7    1    1     1     1    16     1
[29,]    1    1   20    1   21   12    7    1   16     1     1    14     1
      [,14] [,15] [,16] [,17] [,18] [,19] [,20] [,21] [,22] [,23] [,24] [,25]
 [1,]     1     1     1     1     1     1     1     1     1     1     1     1
 [2,]     1     1     1     1     1     1    16     1     1     1     1     1
 [3,]     1     1     1     1     1     1     1     1     1     1     1     1
 [4,]     1     1     1    20     1     1     1     1     1     1     1     1
 [5,]     1     1     1     1    11     1    13     1     1     1    17     1
```

[6,]	1	1	1	15	11	1	1	18	1	18	16	1
[7,]	8	7	8	6	6	7	4	7	8	8	6	6
[8,]	1	1	1	1	1	1	17	1	1	1	1	1
[9,]	1	14	1	1	10	15	7	15	1	1	11	15
[10,]	1	1	1	1	1	1	1	1	1	1	1	1
[11,]	1	1	1	1	1	1	1	1	1	1	1	1
[12,]	1	1	1	15	9	1	1	1	1	1	1	1
[13,]	1	1	1	19	1	1	1	1	1	1	1	24
[14,]	1	1	1	1	1	1	1	1	1	1	1	1
[15,]	1	1	1	1	13	1	1	1	1	1	1	1
[16,]	1	1	1	1	14	1	1	1	1	1	20	1
[17,]	1	1	1	1	1	1	14	1	1	1	20	1
[18,]	1	11	14	12	1	13	6	13	13	13	12	13
[19,]	1	1	1	16	11	1	14	1	1	1	1	1
[20,]	1	1	1	12	8	16	1	1	16	1	1	1
[21,]	1	1	1	1	12	1	1	1	1	1	1	1
[22,]	1	1	1	1	13	1	1	1	1	1	1	1
[23,]	1	1	1	1	11	1	12	1	1	1	16	1
[24,]	1	1	1	16	11	1	1	1	1	1	1	1
[25,]	1	1	1	1	1	1	1	1	1	1	1	1
[26,]	1	1	1	15	10	1	1	1	1	1	1	1
[27,]	1	1	1	17	1	1	16	1	1	1	1	1
[28,]	1	1	1	1	1	1	15	1	1	1	1	1
[29,]	1	1	1	17	13	1	13	1	1	1	19	1

	[,26]	[,27]	[,28]	[,29]	[,30]	[,31]	[,32]	[,33]	[,34]
[1,]	1	1	1	1	1	1	1	1	1
[2,]	1	1	1	1	1	1	1	1	1
[3,]	21	1	17	1	1	1	20	18	17
[4,]	1	1	1	1	1	1	1	23	1
[5,]	1	10	1	1	1	15	1	1	16
[6,]	15	1	1	1	1	12	1	1	1
[7,]	5	5	7	1	8	5	7	7	6
[8,]	1	15	1	1	1	1	1	1	1
[9,]	10	9	1	14	1	11	1	1	1
[10,]	1	13	1	1	1	1	1	1	19
[11,]	1	15	1	1	1	19	1	1	1
[12,]	1	9	13	1	21	1	1	1	1
[13,]	20	1	1	1	1	1	1	1	18
[14,]	1	1	1	1	1	1	1	1	1
[15,]	1	11	1	22	1	18	1	1	17
[16,]	1	1	1	1	1	16	1	1	1

```
[17,]    20     1     1     1     1     1     1     1     1
[18,]     8     1     1    13     1     1     1     1     1
[19,]     1     1    14     1     1     1     1    16     1
[20,]     1     6    10    15     1    10    12    11     9
[21,]     1    10    16     1     1     1    18    17    15
[22,]     1    11     1     1     1     1    21     1    18
[23,]     1    11    16     1     1    14    16     1    14
[24,]     1    10    14     1     1     1     1    16     1
[25,]     1    15     1     1     1     1     1     1     1
[26,]     1     9    14     1     1    14    16    15    13
[27,]     1     1    17     1     1    17     1    19     1
[28,]    18    14     1    23     1     1     1     1     1
[29,]     1     1     1     1     1    15     1     1     1
 [ reached getOption("max.print") -- omitted 5 rows ]

$gdist
      [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10] [,11] [,12] [,13]
 [1,]    0    1    1    1    1    1    1    1    1     1     1     1     1
 [2,]    1    0    1    1    1    1    1    1    1     1     1     2     1
 [3,]    1    1    0    1    1    2    2    1    2     1     1     1     2
 [4,]    1    1    1    0    1    1    2    1    1     1     1     1     1
 [5,]    1    2    2    1    0    2    2    1    1     1     1     1     2
 [6,]    1    1    2    2    2    0    2    1    2     1     1     2     2
 [7,]    1    1    1    2    2    2    0    1    1     2     1     2     1
 [8,]    1    1    1    1    1    1    1    0    1     1     1     1     1
 [9,]    1    1    2    2    1    2    2    1    0     2     1     2     1
[10,]    1    2    1    1    1    2    1    1    1     0     1     1     1
[11,]    1    1    1    1    1    1    2    1    1     1     0     2     1
[12,]    1    2    1    1    2    2    1    1    2     1     2     0     2
[13,]    1    1    1    1    1    2    1    1    1     1     1     2     0
[14,]    1    1    1    1    1    2    2    1    2     1     1     1     1
[15,]    1    1    1    1    1    2    2    1    1     1     1     1     2
[16,]    1    1    1    1    1    1    2    1    1     1     1     2     2
[17,]    1    1    1    1    1    2    2    1    1     1     1     1     1
[18,]    1    1    1    2    2    2    1    1    2     2     1     2     1
[19,]    1    2    1    1    1    2    2    1    2     1     2     1     2
[20,]    1    2    1    1    1    2    2    2    2     1     1     1     2
[21,]    1    1    1    1    1    2    2    1    2     1     1     1     2
[22,]    1    1    1    1    1    2    2    1    1     1     1     1     2
[23,]    1    1    1    1    2    2    2    1    1     1     1     2     2
[24,]    1    1    1    1    2    2    2    1    2     1     2     1     2
```

[25,]	1	1	1	1	1	1	2	1	1	1	1	1	1
[26,]	1	1	1	1	1	2	2	1	2	1	1	1	2
[27,]	1	1	1	1	1	2	1	1	2	1	1	1	1
[28,]	1	1	1	1	1	1	2	1	1	1	1	2	1
[29,]	1	1	2	1	2	2	2	1	2	1	1	2	1

	[,14]	[,15]	[,16]	[,17]	[,18]	[,19]	[,20]	[,21]	[,22]	[,23]	[,24]	[,25]
[1,]	1	1	1	1	1	1	1	1	1	1	1	1
[2,]	1	1	1	1	1	1	2	1	1	1	1	1
[3,]	1	1	1	1	1	1	1	1	1	1	1	1
[4,]	1	1	1	2	1	1	1	1	1	1	1	1
[5,]	1	1	1	1	2	1	2	1	1	1	2	1
[6,]	1	1	1	2	2	1	1	2	1	2	2	1
[7,]	2	2	2	2	2	2	2	2	2	2	2	2
[8,]	1	1	1	1	1	1	2	1	1	1	1	1
[9,]	1	2	1	1	2	2	2	2	1	1	2	2
[10,]	1	1	1	1	1	1	1	1	1	1	1	1
[11,]	1	1	1	1	1	1	1	1	1	1	1	1
[12,]	1	1	1	2	2	1	1	1	1	1	1	1
[13,]	1	1	1	2	1	1	1	1	1	1	1	2
[14,]	0	1	1	1	1	1	1	1	1	1	1	1
[15,]	1	0	1	1	2	1	1	1	1	1	1	1
[16,]	1	1	0	1	2	1	1	1	1	1	2	1
[17,]	1	1	1	0	1	1	2	1	1	1	2	1
[18,]	1	2	2	2	0	2	2	2	2	2	2	2
[19,]	1	1	1	2	2	0	2	1	1	1	1	1
[20,]	1	1	1	2	2	2	0	1	2	1	1	1
[21,]	1	1	1	1	2	1	1	0	1	1	1	1
[22,]	1	1	1	1	2	1	1	1	0	1	1	1
[23,]	1	1	1	1	2	1	2	1	1	0	2	1
[24,]	1	1	1	2	2	1	1	1	1	1	0	1
[25,]	1	1	1	1	1	1	1	1	1	1	1	0
[26,]	1	1	1	2	2	1	1	1	1	1	1	1
[27,]	1	1	1	2	1	1	2	1	1	1	1	1
[28,]	1	1	1	1	1	1	2	1	1	1	1	1
[29,]	1	1	1	2	2	1	2	1	1	1	2	1

	[,26]	[,27]	[,28]	[,29]	[,30]	[,31]	[,32]	[,33]	[,34]
[1,]	1	1	1	1	1	1	1	1	1
[2,]	1	1	1	1	1	1	1	1	1
[3,]	2	1	2	1	1	1	2	2	2
[4,]	1	1	1	1	1	1	1	2	1
[5,]	1	2	1	1	1	2	1	1	2

```
 [6,]    2    1    1    1    1    2    1    1    1
 [7,]    2    2    2    1    2    2    2    2    2
 [8,]    1    2    1    1    1    1    1    1    1
 [9,]    2    2    1    2    1    2    1    1    1
[10,]    1    2    1    1    1    1    1    1    2
[11,]    1    2    1    1    1    2    1    1    1
[12,]    1    2    2    1    2    1    1    1    1
[13,]    2    1    1    1    1    1    1    1    2
[14,]    1    1    1    1    1    1    1    1    1
[15,]    1    2    1    2    1    2    1    1    2
[16,]    1    1    1    1    1    2    1    1    1
[17,]    2    1    1    1    1    1    1    1    1
[18,]    2    1    1    2    1    1    1    1    1
[19,]    1    1    2    1    1    1    1    2    1
[20,]    1    2    2    2    1    2    2    2    2
[21,]    1    2    2    1    1    1    2    2    2
[22,]    1    2    1    1    1    1    2    1    2
[23,]    1    2    2    1    1    2    2    1    2
[24,]    1    2    2    1    1    1    1    2    1
[25,]    1    2    1    1    1    1    1    1    1
[26,]    0    2    2    1    1    2    2    2    2
[27,]    1    0    2    1    1    2    1    2    1
[28,]    2    2    0    2    1    1    1    1    1
[29,]    1    1    1    0    1    2    1    1    1
 [ reached getOption("max.print") -- omitted 5 rows ]
> round(closeness(F.w1,ignore.eval=F),3)
 [1] 1.000 0.943 0.786 0.917 0.750 0.702 0.569 0.943 0.660 0.892 0.892 0.750
[13] 0.846 0.917 0.805 0.846 0.868 0.647 0.750 0.660 0.767 0.825 0.717 0.750
[25] 0.943 0.733 0.825 0.846 0.750 0.892 0.805 1.000 0.805 0.660
> round(closeness(F.w1,cmode="suminvundir",ignore.eval=F),3)
 [1] 1.000 0.924 0.909 0.939 0.848 0.682 0.652 0.985 0.758 0.955 0.939 0.788
[13] 0.818 0.939 0.894 0.939 0.864 0.712 0.848 0.742 0.909 0.924 0.879 0.833
[25] 0.985 0.848 0.894 0.909 0.833 0.939 0.864 1.000 0.879 0.742
> betweenness(F.w1,ignore.eval=F)
 [1] 26.4641279 18.8190358  9.9494045 13.2490161  4.6747221  1.5112313
 [7]  0.5498868 21.3717352  3.0408623 14.8668240 16.0437657  5.0431351
[13]  8.8778581 13.8957893  6.1874174 11.6458464  6.4828016  2.2650981
[19]  5.7624444  1.1191932  4.6269248  7.6435704  4.0390412  2.9904611
[25] 13.3631822  2.4067162  5.0240692  6.0197410  7.1959810 14.4343449
[31]  5.1558934 15.8487038  7.7564847  3.6746907
> degree(frm1,ignore.eval=F)
```

```
 [1] 66 59 51 59 47 32 17 63 35 59 59 41 46 61 52 58 49 31 50 33 51 55 49
44
[25] 60 43 41 49 49 60 45 59 49 38
> round(evcent(frm1,ignore.eval=F),2)
 [1] 0.22 0.21 0.17 0.20 0.16 0.14 0.06 0.21 0.12 0.19 0.20 0.15 0.18 0.20
[15] 0.17 0.19 0.19 0.11 0.15 0.11 0.16 0.18 0.14 0.15 0.21 0.15 0.17 0.19
[29] 0.16 0.20 0.18 0.22 0.18 0.12
```

* 주의 : tnet 라이브러리가 불러질 때 igraph 라이브러리가 같이 들어오게 되는데 이 라이브러리의 몇 개 함수가 sna 라이브러리의 몇 개 함수와 충돌을 일으키는 문제가 생긴다. 따라서 두 라이브러리가 공존하지 않게 조치할 필요가 있다. 다음이 한 방법이다.

```
library(tnet)
data(Freemans.EIES)
detach(package:igraph)
library(sna)
```