NETWORK ANALYSIS IN R

Network Structure

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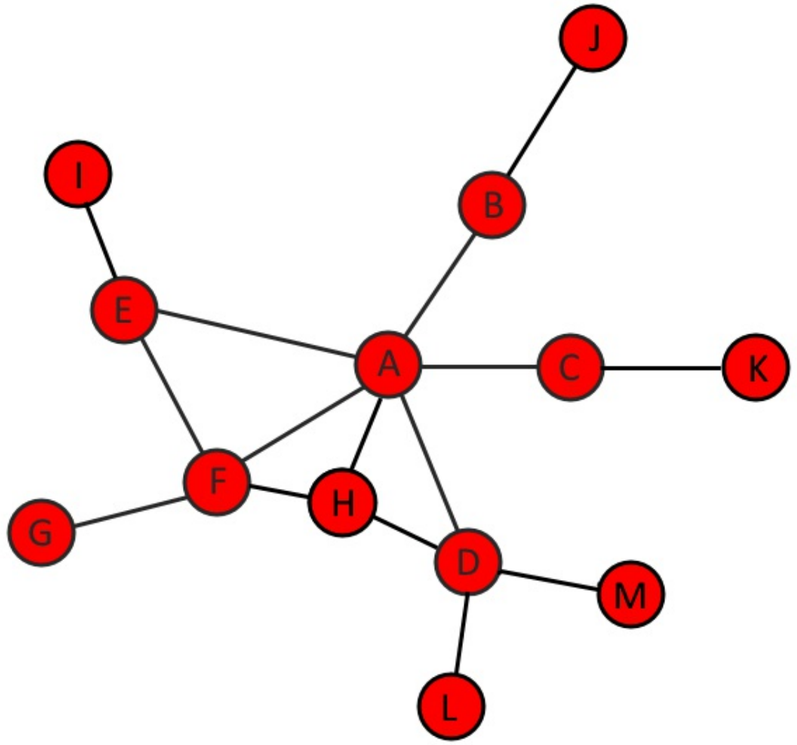
Eigenvector Centrality

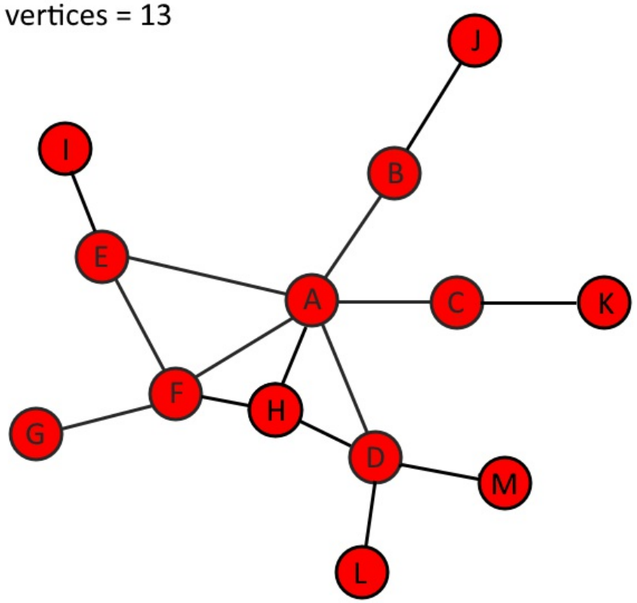



```
eigen_centrality(g)$vector
```

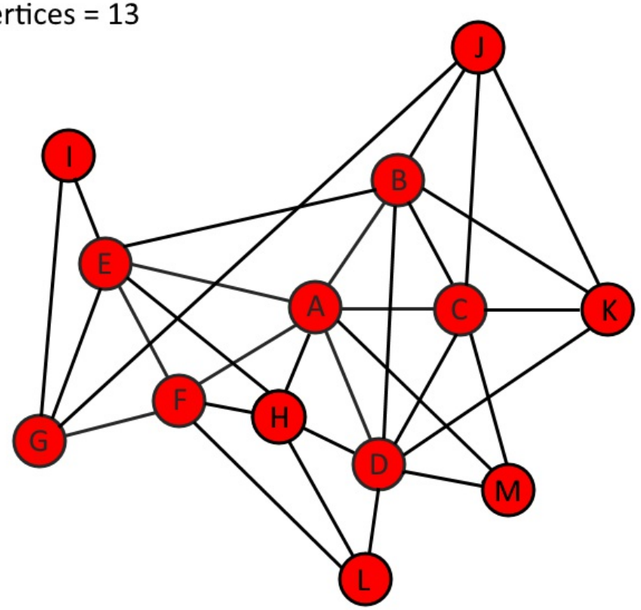
```
   A    B    C    D    E    F    G
1.00 0.33 0.33 0.63 0.58 0.76 0.23


   H    I    J    K    L    M
0.71 0.17 0.10 0.10 0.19 0.19
```

Density

density = 0.19
edges = 15
vertices = 13



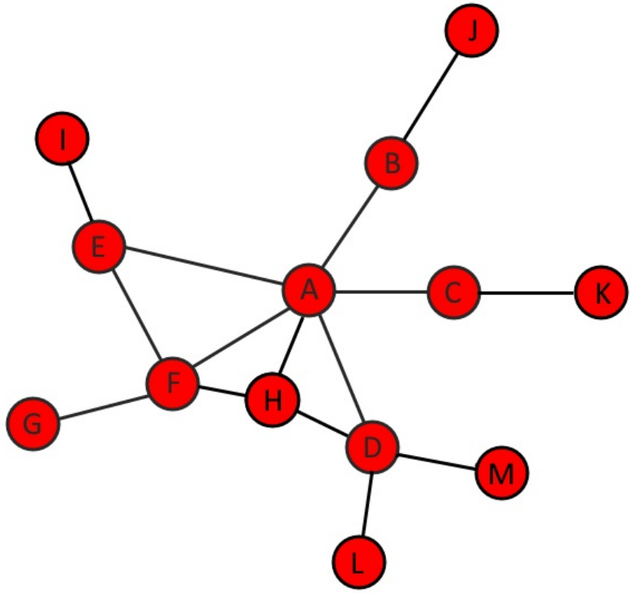
density = 0.38
edges = 30
vertices = 13



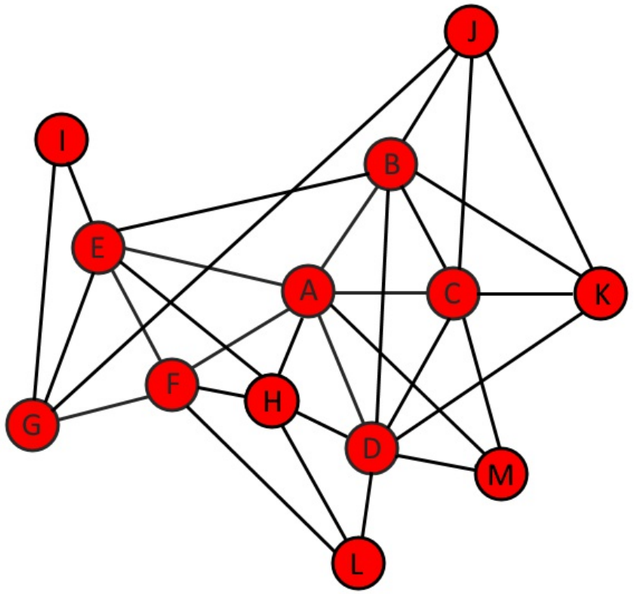

```
edge_density(g)
```

Average Path Length

average path length = 2.47



average path length = 1.81




```
mean_distance(g, directed = FALSE)
```

NETWORK ANALYSIS IN R

Let's practice!

NETWORK ANALYSIS IN R

Network Randomizations

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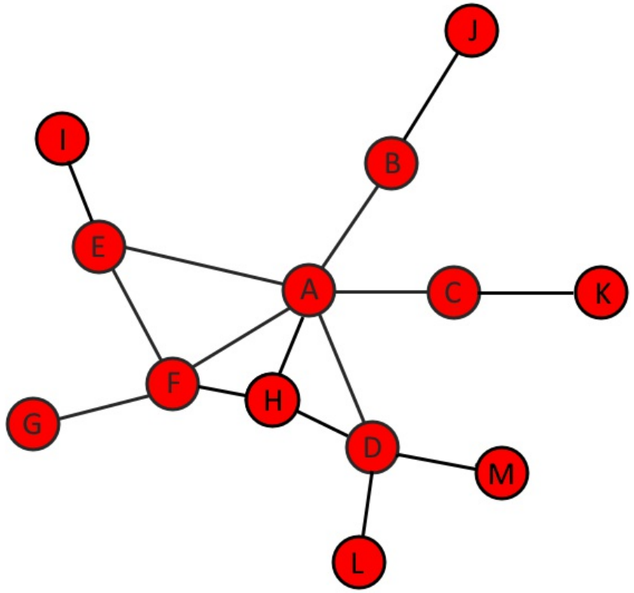
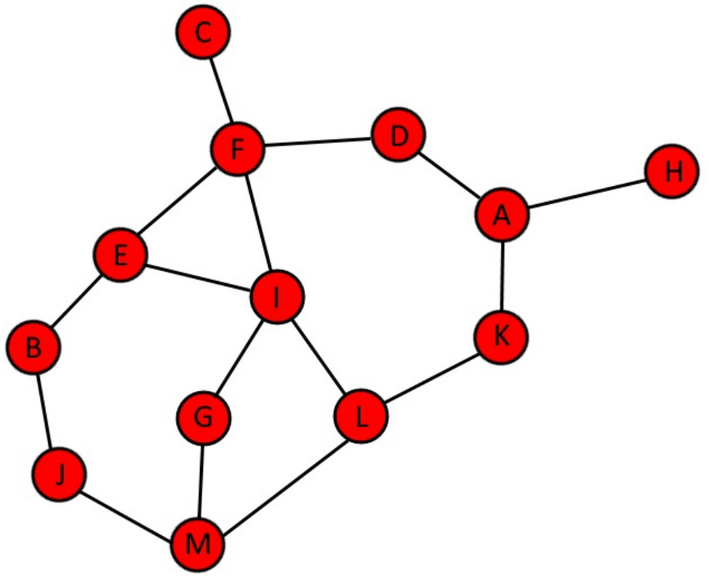
Random Graphs

density = 0.19
vertices = 13



density = 0.21
vertices = 13




```
erdos.renyi.game(n = gorder(g), p.or.m = edge_density(g), type = "gnp")
```

Random Graphs & Randomization Tests

1. Generate 1000 random graphs based on the original network - e.g. with the same number of vertices and approximate density.

2. Calculate the average path length of the original network.

3. Calculate the average path length of the 1000 random networks.

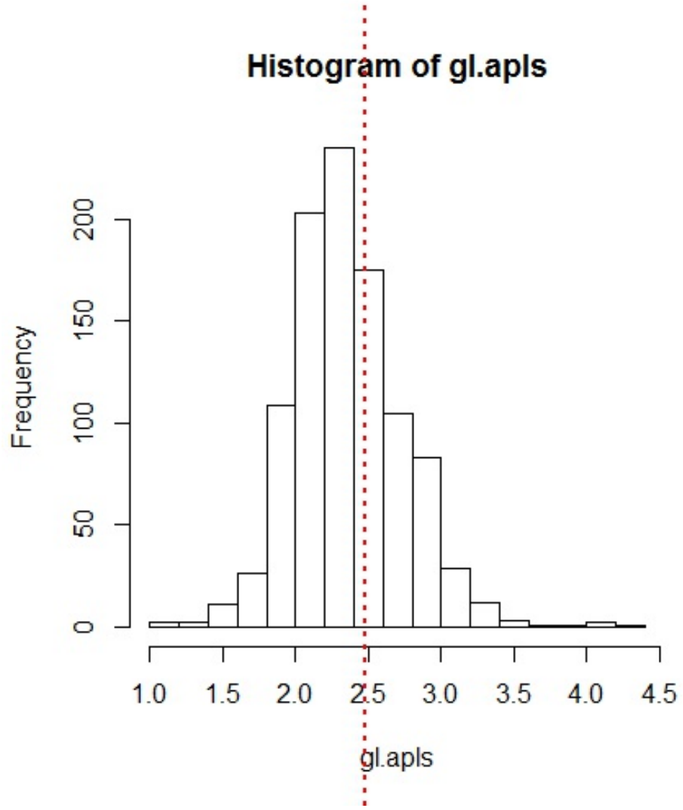
4. Determine how many random networks have an average path length greater or less than the original network's average path length.

Generating 1000 random graphs

```
# Generate 1000 random graphs

gl <- vector('list',1000)

for(i in 1:1000){

    gl[[i]] <- erdos.renyi.game(
                    n = gorder(g),
                    p.or.m = edge_density(g),
                    type = "gnp"
                     )
}
```

```
# Calculate average path length of 1000 random graphs

gl.apls <- unlist( lapply(gl, mean_distance, directed = FALSE) )
```

Comparing to the original network




```
hist(gl.apls, breaks = 20)

abline(v = mean_distance(g, directed=FALSE), col = "red", lty = 3, lwd=2)
```

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Network Substructures

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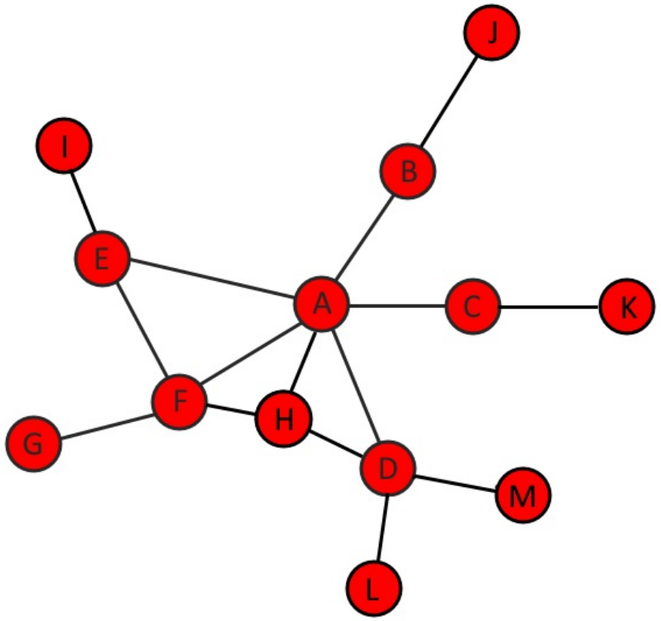
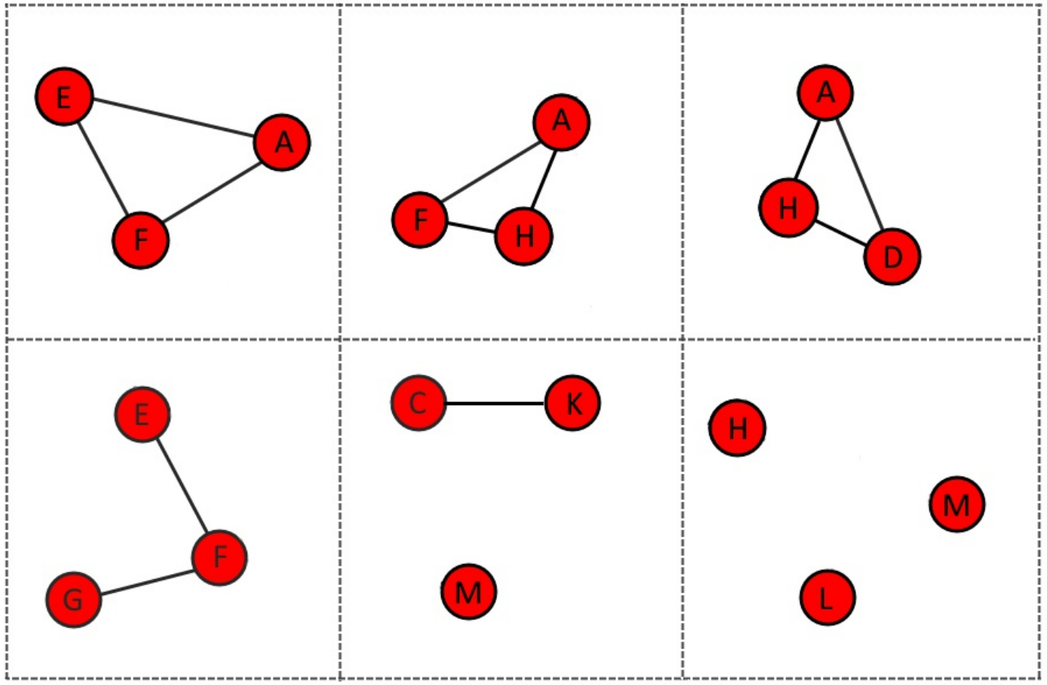
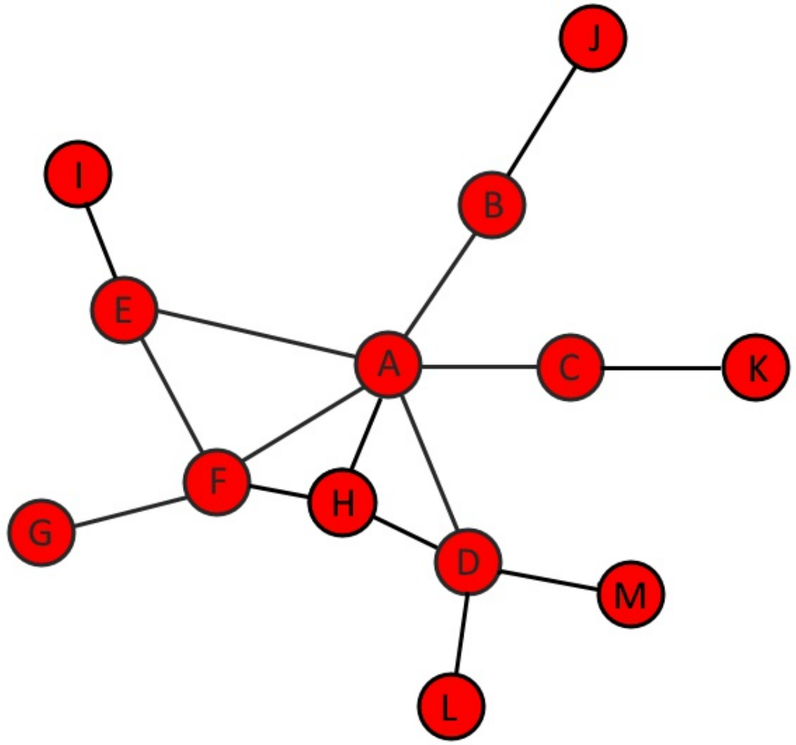
Transitivity






```
triangles(g)
```

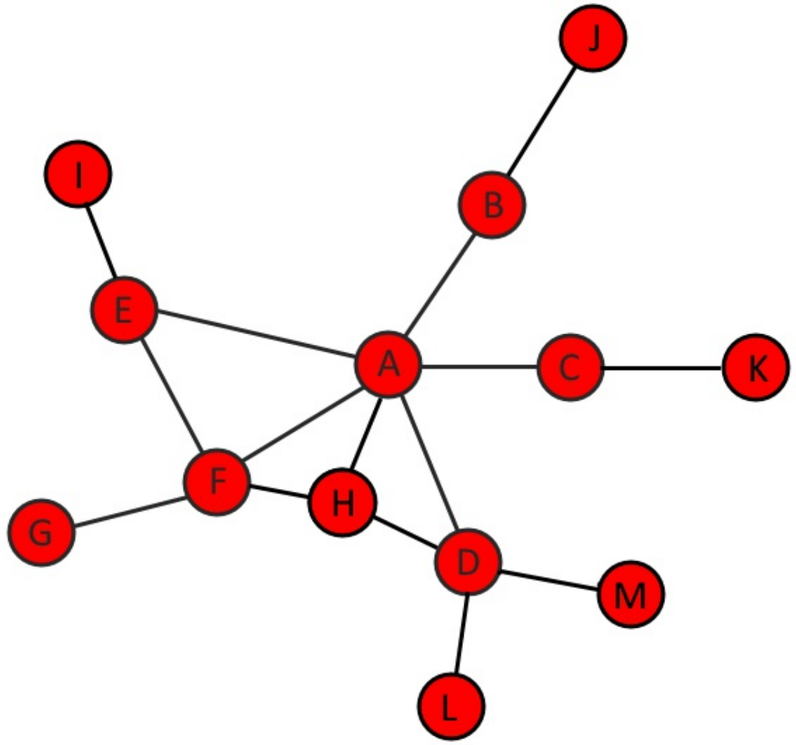
Global Transitivity




```
transitivity(g)
```

```
[1] 0.26
```

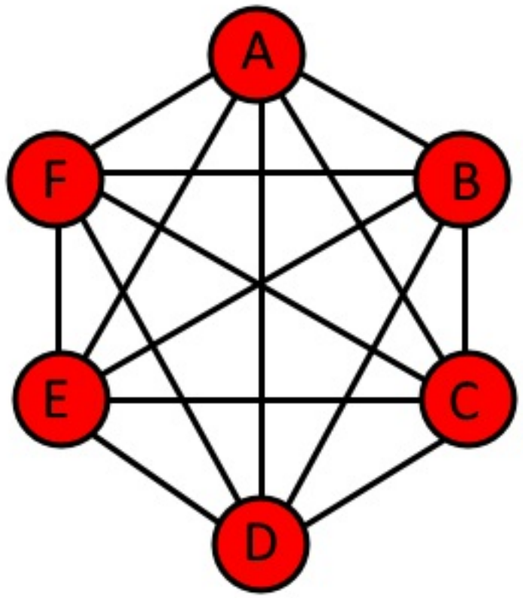
Local Transitivity

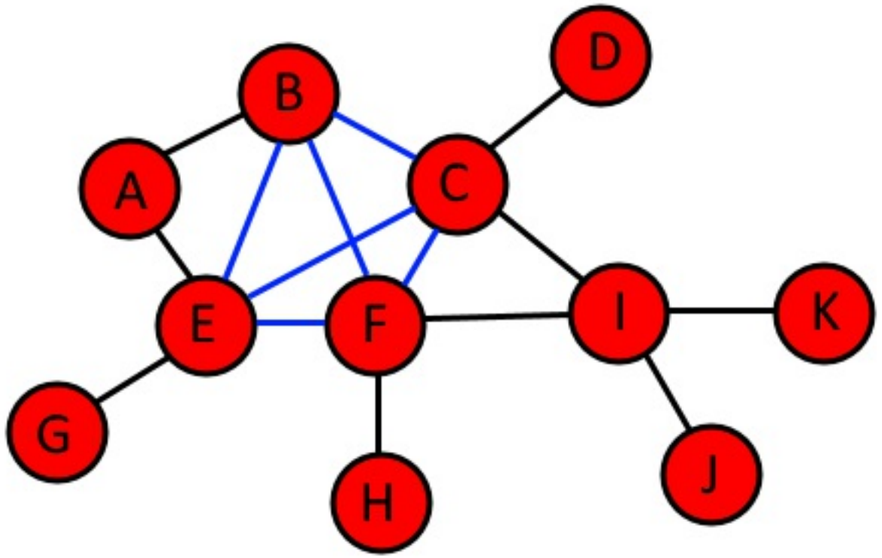



```
count_triangles(g, vids = 'A')

3

count_triangles(g, vids = 'F')

2
```

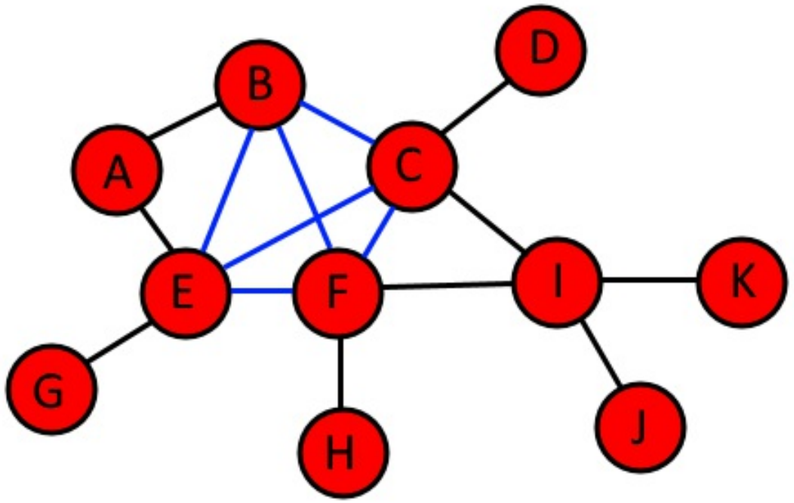
```
transitivity(g,
             vids = 'A',
             type = "local")

0.2

transitivity(g,
             vids = 'F',
             type = "local")

0.33
```

Cliques





Identifying Cliques




```
largest_cliques(g)

+ 4/11 vertices, named:
[1] C F B E
```

```
max_cliques(g)
.
.
.
[[6]]
 + 3/11 vertices, named:
 [1] A B E

[[7]]
 + 3/11 vertices, named:
 [1] I C F

[[8]]
 + 4/11 vertices, named:
 [1] E B F C
```

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