Exercise 6 – Exam Questions

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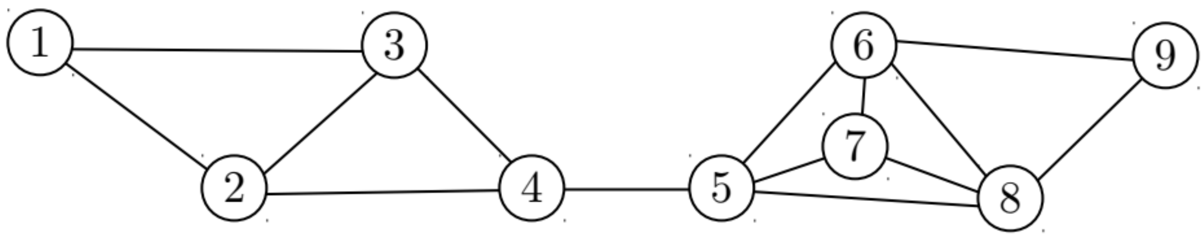
1 True or False (3 Points)

In a Dutch auction, prices go up.	FALSE
In random graphs, the average clustering is normally higher than in social networks	FALSE
A pure power law distribution $p(x) = c \cdot x^{-\alpha}, (\alpha > 1)$ shows as a straight line in a log-log plot	TRUE

2 Graph Theory (7 Points)



Write down the adjacency matrix of the graph G.

0 1 1 0 0 0 0 0 0
1 0 1 1 0 0 0 0 0
1 1 0 1 0 0 0 0 0
0 1 1 0 1 0 0 0 0
0 0 0 1 0 1 1 1 0
0 0 0 0 1 0 1 1 1
0 0 0 0 1 1 0 1 0
0 0 0 0 1 1 1 0 1
0 0 0 0 0 1 0 1 0

Give the local clustering coefficient of node 1 and node 5.

$$C_i = \frac{2|\{e_{jk} : v_j, v_k \in N_i, e_{jk} \in E\}|}{k_i(k_i - 1)}.$$

For node 1:
k = 2, e = 1
Ci = 2*1/(2*(2-1)) = 2/2 = 1

For node 5:
k = 4, e = 3
Ci = 2*3/(4*(4-1))=6/12 = 1/2

Give the total number of wedges s in the graph.

1-2-3 and 2-3-4 is a triangle so they have 6 wedges.
2-4-5 and 3-4-5.
5-6-7 and 5-7-8 and 6-7-8 and 6-8-9 and 5-6-8 are also triangles, so 15 more wedges.
4-5-6, 4-5-7, 4-5-8, 5-6-9, 5-8-9, 7-6-9, 7-8-9.

So total 6+2+15+7 = 30 wedges.

One variant of the global clustering coefficient is defined as the probability that two incident edges are completed by a third edge to form a triangle. Give it for the given graph.

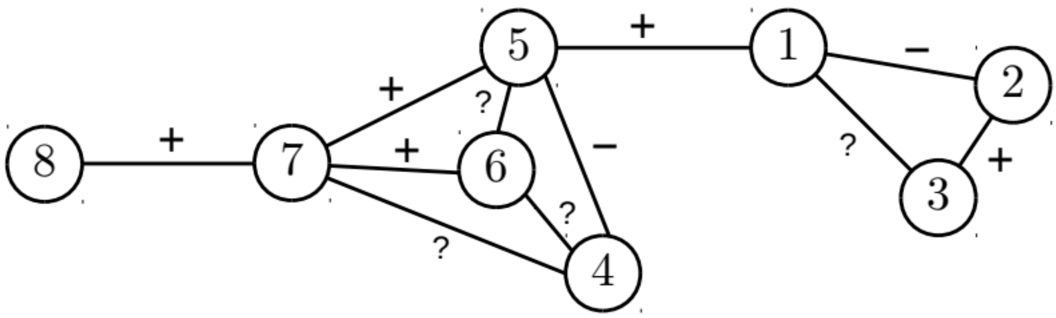
$$C = \frac{3 \times \text{number of triangles}}{\text{number of connected triplets of vertices}} = \frac{\text{number of closed triplets}}{\text{number of connected triplets of vertices}}.$$

NumOfTri = 7
Wedges = 30

C = 7*3/30 = 7/10 = 0.7

3 Signed Networks (Extra 3 Points)

A signed complete network is **weakly balanced**, if no three nodes have exactly two positive edges between them (and one negative edge).



7-4	-
6-4	-
6-5	+
1-3	-