ISTANBUL TECHNICAL UNIVERSITY
BLG 517E - MODELLING AND PERFORMANCE ANALYSIS OF NETWORKS
INSTRUCTOR: SEMA FATMA OKTUĞ

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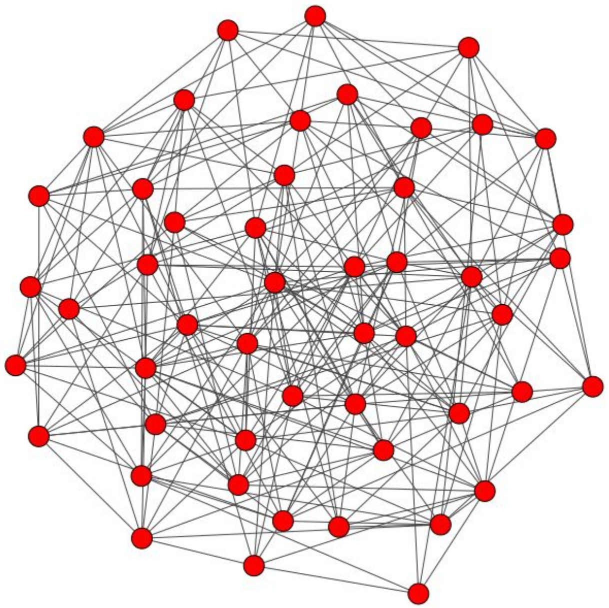
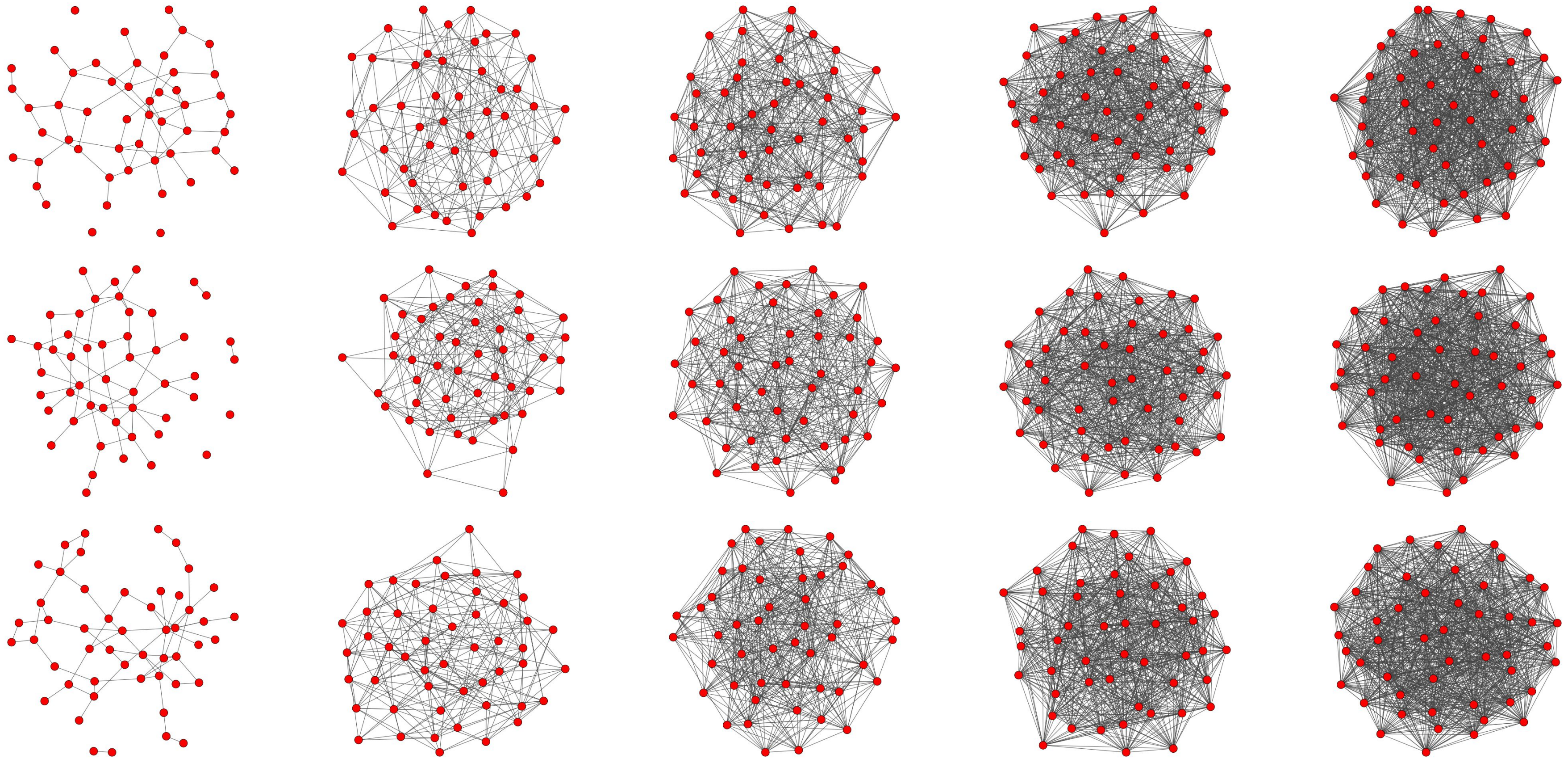
RANDOM GRAPHS PROJECT PRESENTATION

MAY 26, 2017

Random Graphs

- 5 random graphs are generated with;
  - p (possible edge probability) values 0.05, 0.20, 0.40, 0.60, 0.80
  - 50 nodes
- Following graph parameters are studied;
  - Edge distribution,
  - Degree distribution,
  - Size of giant component,
  - Diameter,
- These parameters are drawn into figures with samples from 5 random graph by %95 confidence interval.





1.

2.

3.

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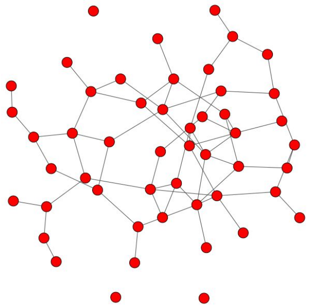
p=0.05 p=0.2 p=0.4 p=0.6 p=0.8

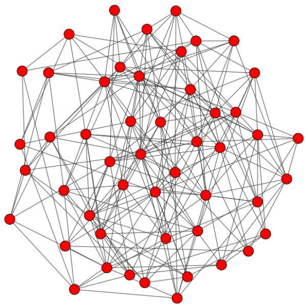
n=50

Sample Set



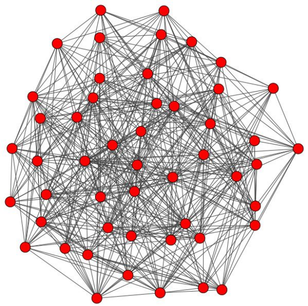
p=0.05
n=50

Edge=65
Giant component=47
Diameter=10
Average degree=2.6



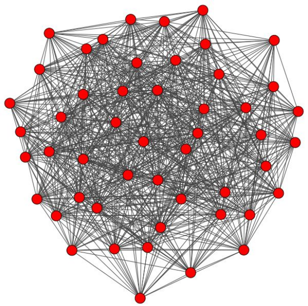
p=0.2
n=50

Edge=225
Giant component= 50
Diameter=3
Average degree=9.0



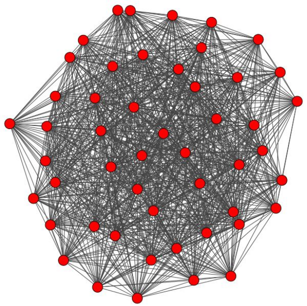
p=0.4
n=50

Edge=475
Giant component=50
Diameter=2
Average degree=19.0



p=0.6
n=50

Edge=751
Giant component=50
Diameter=2
Average degree=30.04



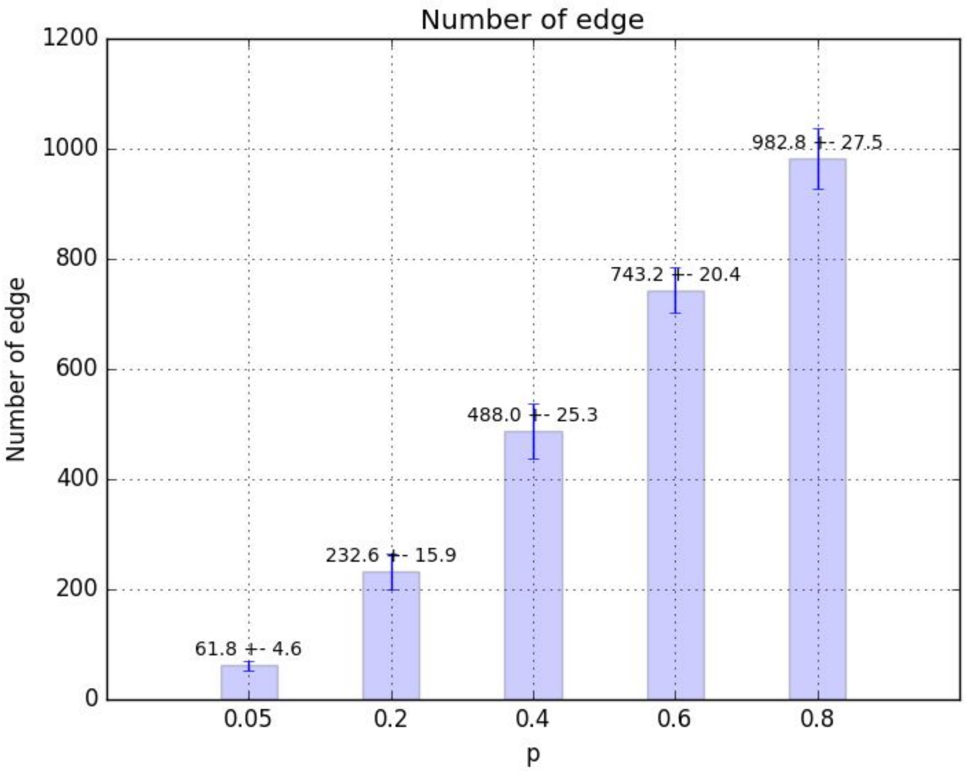
p=0.8
n=50

Edge=989
Giant component=50
Diameter=2
Average degree=39.56

Number of Edges

Expected number of edges <m>= $\binom{n}{2}p$

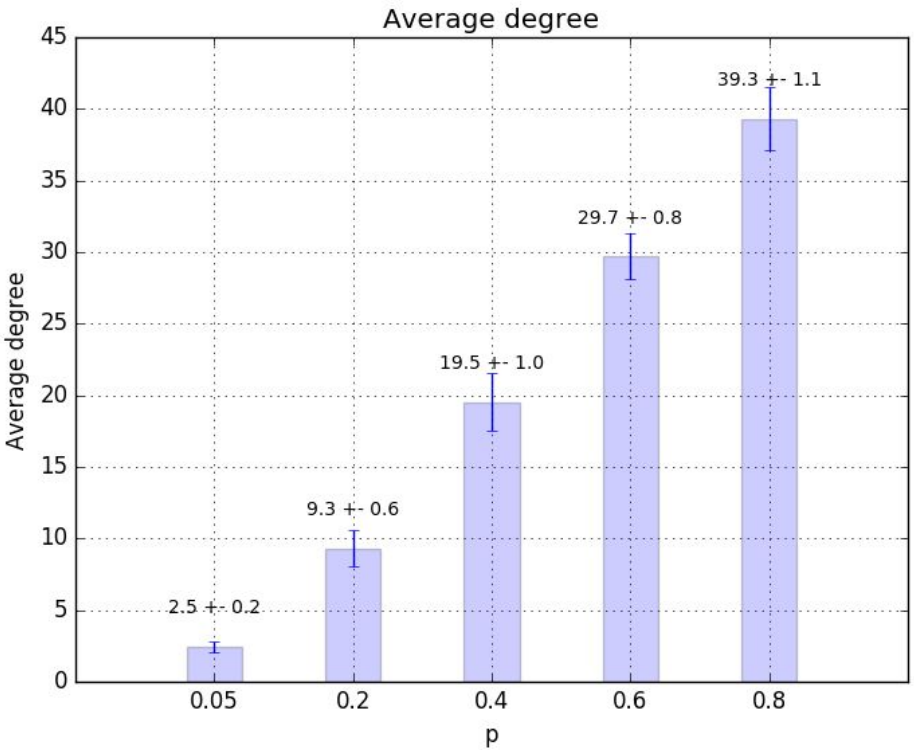
- With n=50, expected m for;
  - p=0.05 is **61.25**
  - p=0.20 is **245**
  - p=0.40 is **490**
  - p=0.60 is **735**
  - p=0.80 is **980**



Average Degree

Expected number of average degree <k>=(n-1)p

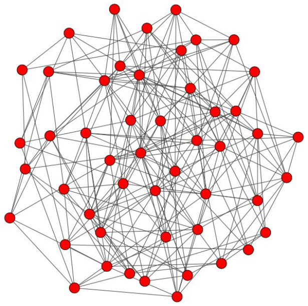
- With n=50, expected k for;
  - p=0.05 is **2.45**
  - p=0.20 is **9.8**
  - p=0.40 is **16.9**
  - p=0.60 is **29.4**
  - p=0.80 is **39.2**

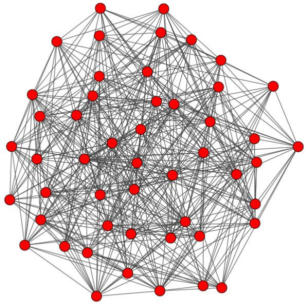


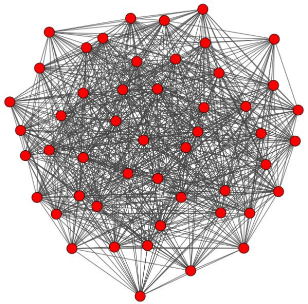
Degree Distribution

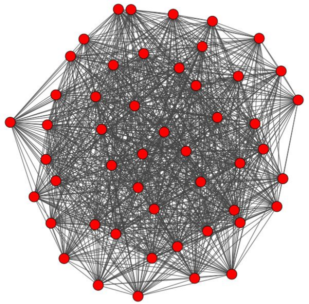
$$P(k) = \binom{n-1}{k} p^k (1-p)^{n-1-k}$$

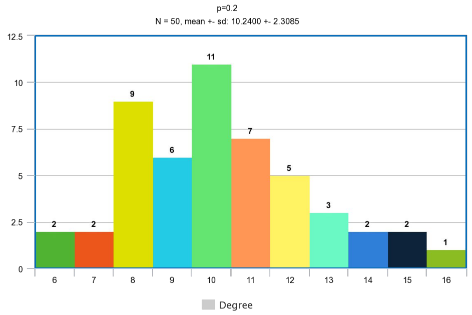
- Degree histograms for single random graph sample set with different p values.



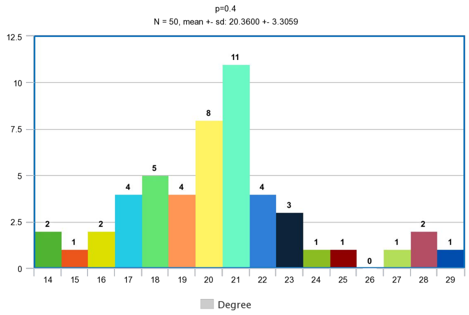




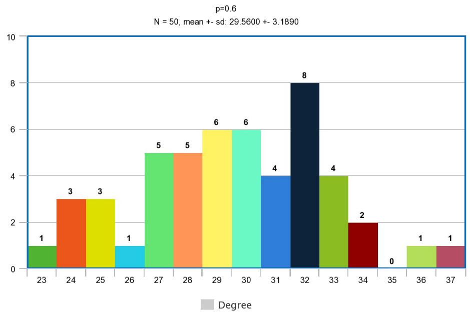




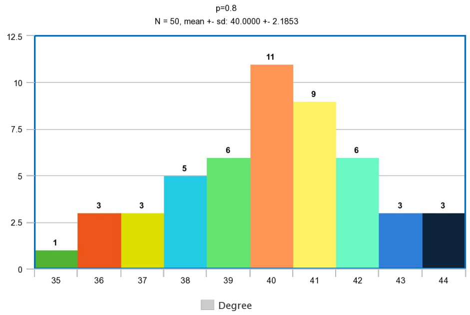
p=0.2
10.24 ± 2.30



p=0.4
20.36 ± 3.30



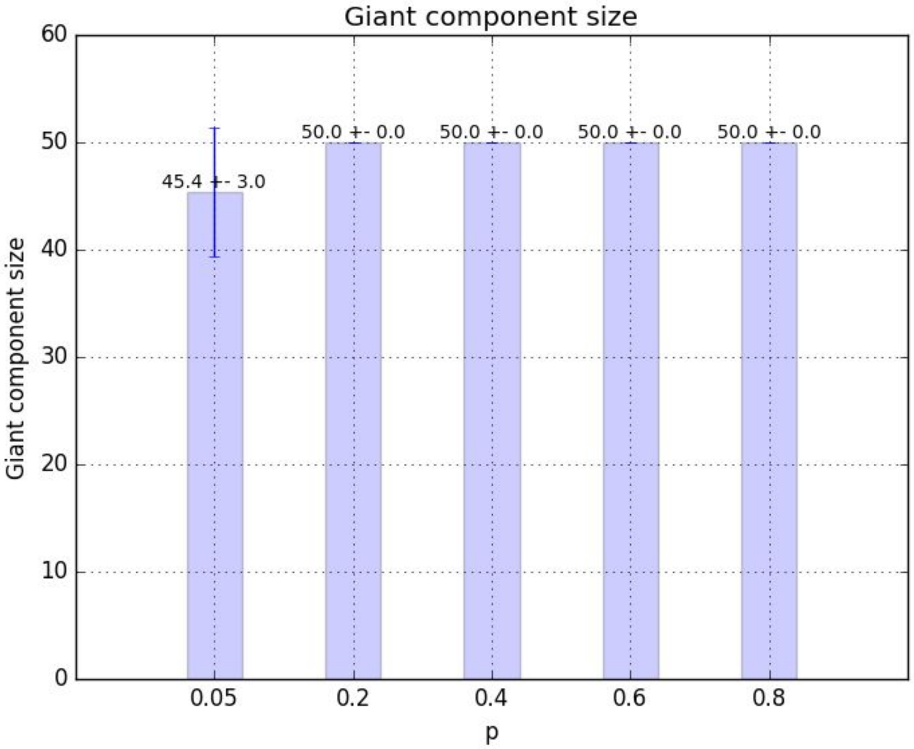
p=0.6
29.56 ± 3.18



p=0.8
40.00 ± 2.19

Giant Component Size

- Increasing p makes giant component size to converge to node count.
- When p=0 the size of the largest component is 1, whereas when p = 1 the size of the largest component is n.
- The fraction that belongs to the giant component is $S = 1 - e^{-cS}$

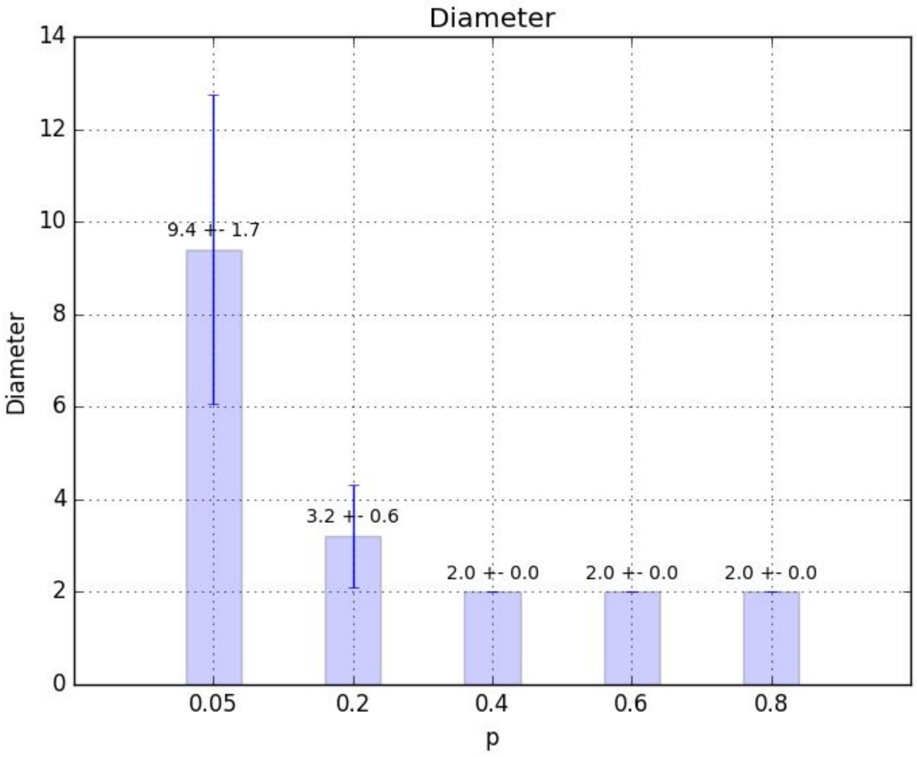


Diameter

- The diameter of a graph is the maximum length of the shortest path between a pair of nodes.
- Increasing p makes diameter to converge to 1.
    - With p=1, diameter will be 1.
- The diameter of a random graph and the average path length of the graph have been demonstrated to be;

$$\frac{ln\ n}{ln\ c}, \text{where } c = p(n-1)$$

- With n=50, expected l for;
    - p=0.05 is **4.36**
    - p=0.20 is **1.71**
    - p=0.40 is **1.31**
    - p=0.60 is **1.15**
    - p=0.80 is **1.06**



Thank you for listening!