

ASSIGNMENT 2 – RANDOM GRAPHS

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Erdős–Renyi Terminology

In the lecture, we have considered the Erdős–Renyi model. Answer the following questions:

- What are the key assumptions of this model?
- What is an isolated node?
- What is a hub node?
- What is phase transition? Which parameters does it depend on?

Erdős–Renyi Degree Variance [hard]

Prove that in the Erdős–Renyi model with parameters n, p , the variance of the node degree equals

$$\text{Var}[\deg(u)] = p(1 - p)(n - 1).$$

You might find help in the proof of the expected node degree and by using the expression

$$k \binom{n}{k} = n \binom{n-1}{k-1}.$$

Erdős–Renyi Implementation

Implement a random graph generator using the Erdős–Renyi model. That is, your program should take as input the values of n and $p \in [0, 1]$ and output a `networkx` graph object.

- Try playing around with different numbers of n and p and analyze the node degree distribution of the resulting network.
- Count the number of isolated nodes in the resulting network and analyze how this value changes with varying n and p .