

## Mathematical Properties of the $G_{N,E}$ Model

### Expected Degree

The expected degree  $\langle k \rangle$  of a vertex in the  $G_{N,E}$  model is given by:

$$\langle k \rangle = \frac{2E}{N}$$

### Degree Distribution

The degree distribution of the vertices can be approximated by a binomial distribution. For large graphs, this can be approximated by a Poisson distribution when  $E$  scales properly with  $N$ . The Poisson distribution for vertex degrees is:

$$P(k) \approx \frac{e^{-\langle k \rangle} \langle k \rangle^k}{k!}$$

where  $\langle k \rangle$  is the average degree  $\frac{2E}{N}$ .

### Variance

The variance of the degree distribution, assuming a Poisson approximation, is:

$$\text{Var}(K) = \langle k \rangle$$