

CN - Activity 3

Implementation of models of complex networks

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1 Project description

Implement generators of complex networks for, at least, two of the following models of complex networks (sorted by increasing difficulty), which must include at least one of the two last ones (BA or CM): Erdős-Rényi (ER) networks, either $G(N,K)$ or $G(N,p)$ [score: 3] Watts-Strogatz (WS) small-world model [score: 5] Barabási Albert (BA) preferential attachment model [score: 3] Configuration Model (CM) [score: 5]

The correction, the number and the difficulty of the implemented models will be taken into account. It is not allowed to use already implemented network generators such as the ones in NetworkX or Pajek. You may use libraries implementing “network” or “graph” data types, to avoid unnecessary work, but not the algorithms for the generation of networks for these models.

2 Project decisions

As for prior projects, I decided working using Python, mainly because it is a language I really like and I am trying to learn more, and also because there is a lot of libraries and documentation useful for this kind of projects.

Additionally, I decide working with the first three generators in the list, which are: Erdős-Rényi (ER), Watts-Strogatz (WS) and Barabási Albert (BA).

3 Erdős-Rényi (ER)

erdos_renyi_[n=100,p=0.01]

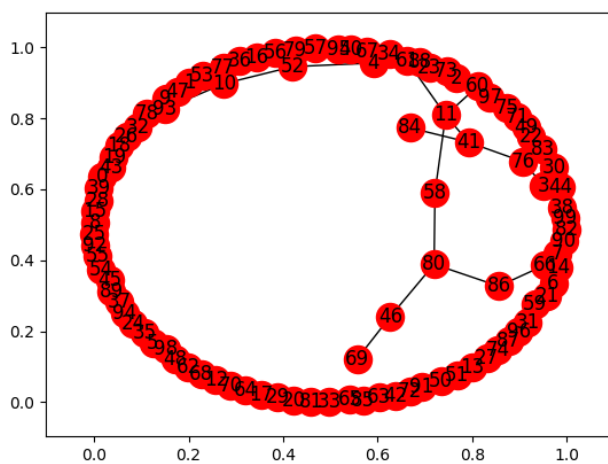


Figure 1: erdos_renyi_[n=100,p=0.01]

Degree distribution

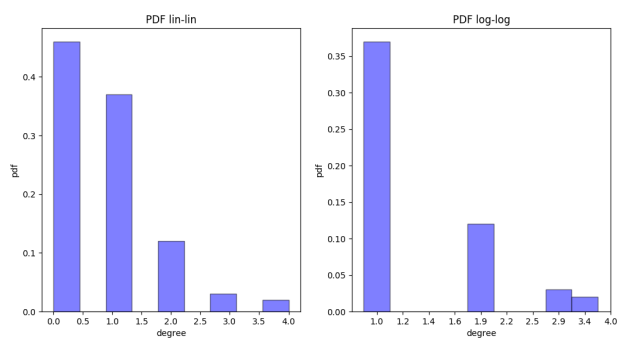


Figure 2: Degree distribution

erdos_renyi_[n=100,p=0.02]

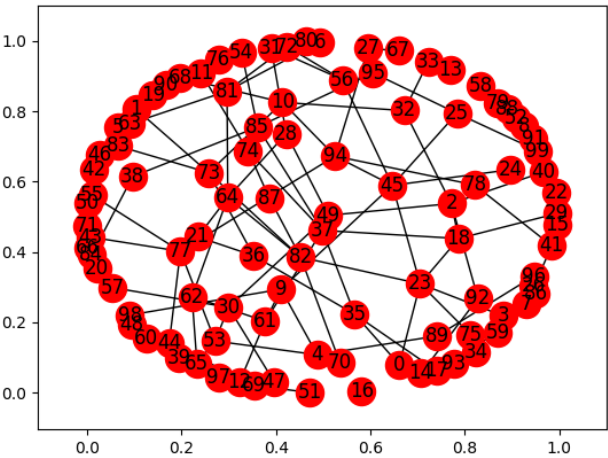


Figure 3: erdos_renyi_[n=100,p=0.02]

Degree distribution

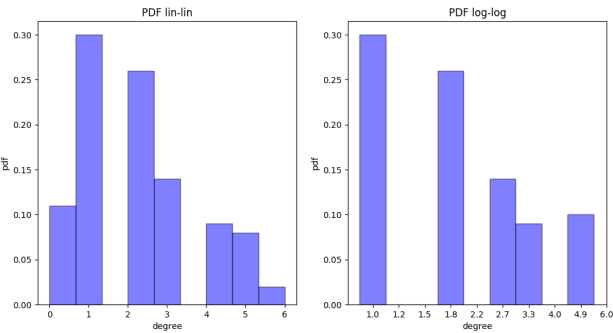


Figure 4: Degree distribution

erdos_renyi_[n=100,p=0.03]

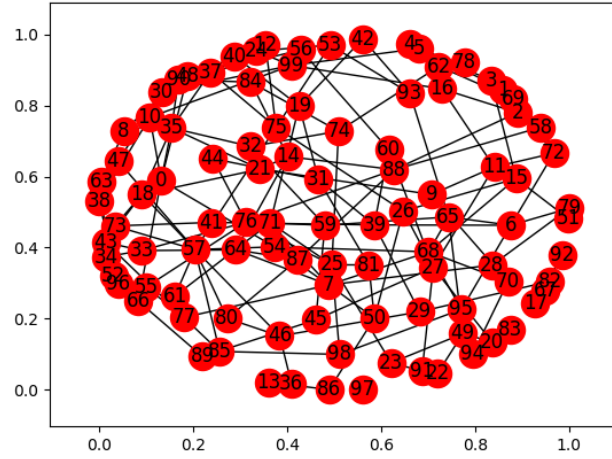


Figure 5: erdos_renyi_[n=100,p=0.03]

Degree distribution

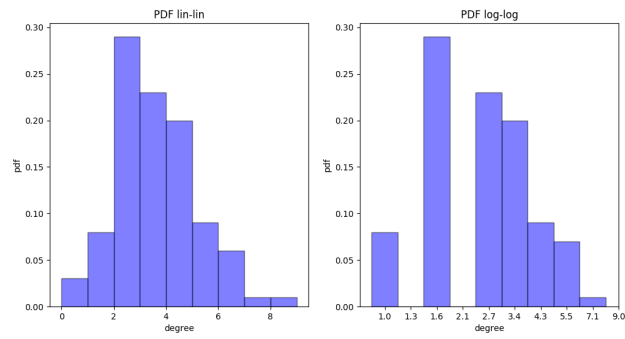


Figure 6: Degree distribution

erdos_renyi_[n=100,p=0.05]

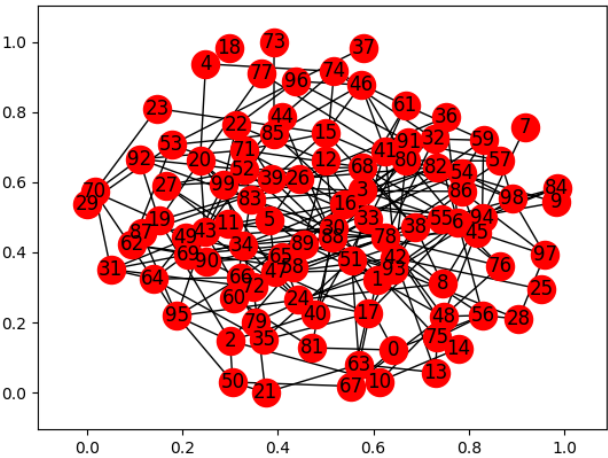


Figure 7: erdos_renyi_[n=100,p=0.05]

Degree distribution

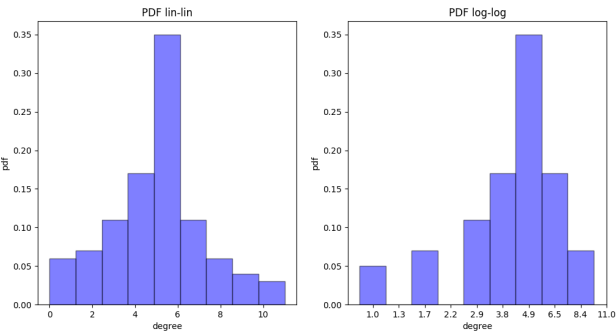


Figure 8: Degree distribution

erdos_renyi_[n=100,p=0.0]

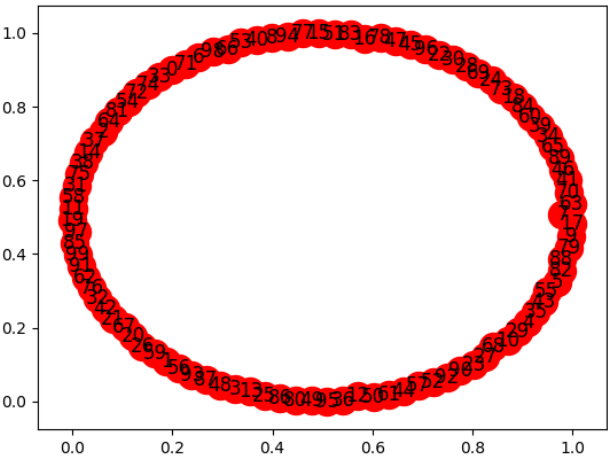


Figure 9: erdos_renyi_[n=100,p=0.0]

Degree distribution

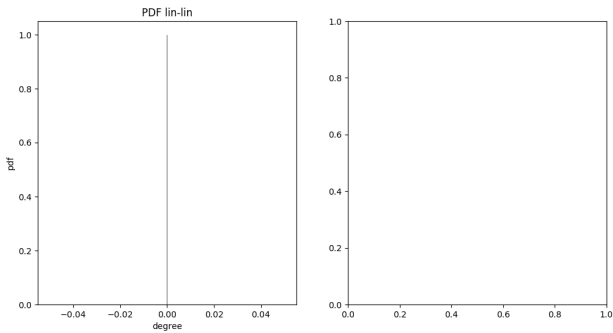


Figure 10: Degree distribution

erdos_renyi_[n=100,p=0.1]

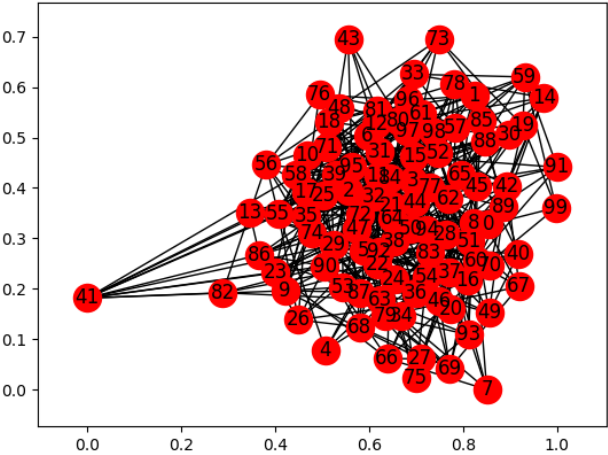


Figure 11: erdos_renyi_[n=100,p=0.1]

Degree distribution

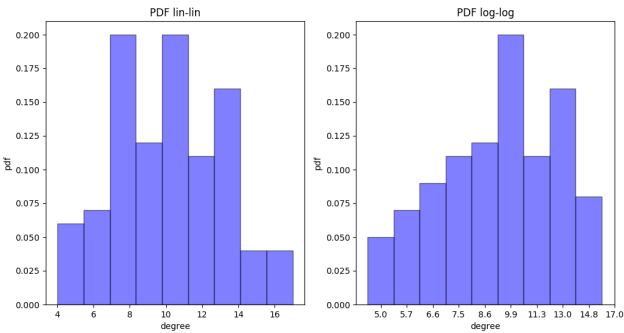


Figure 12: Degree distribution

erdos_renyi_[n=20,p=0.01]

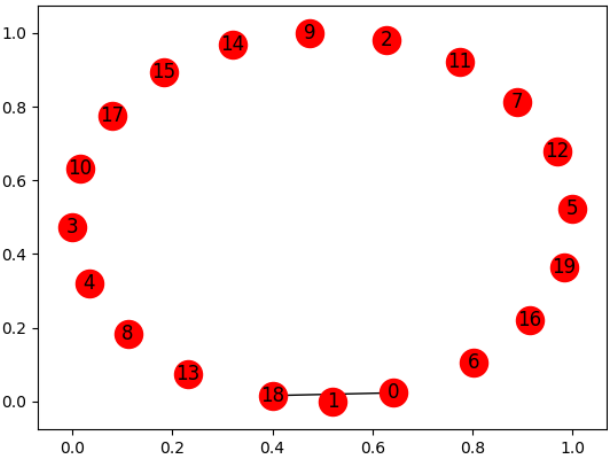


Figure 13: erdos_renyi_[n=20,p=0.01]

Degree distribution

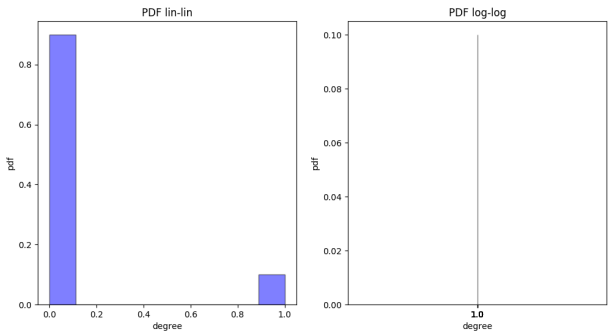


Figure 14: Degree distribution

erdos_renyi_[n=20,p=0.02]

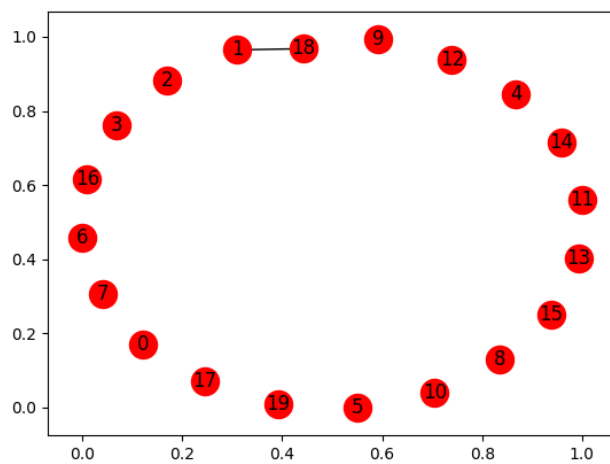


Figure 15: erdos_renyi_[n=20,p=0.02]

Degree distribution

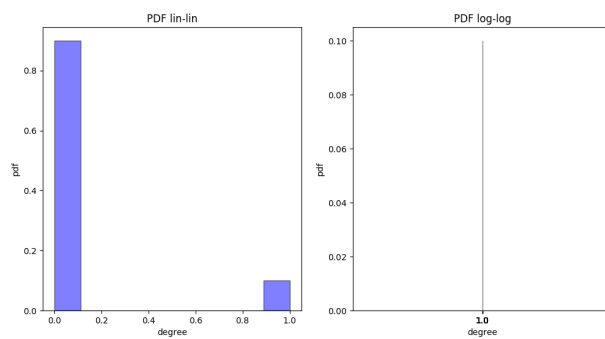


Figure 16: Degree distribution

erdos_renyi_[n=20,p=0.03]

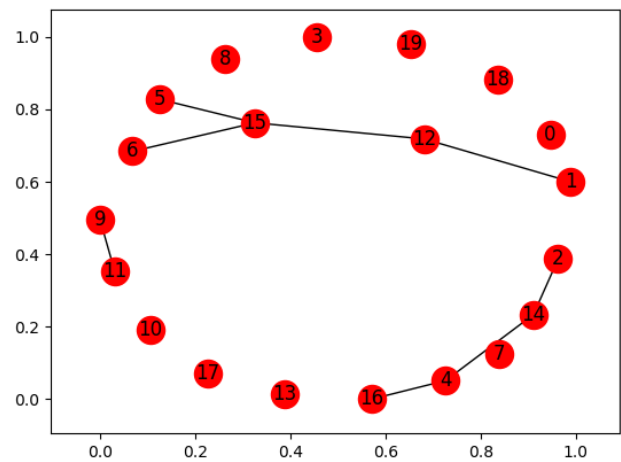


Figure 17: erdos_renyi_[n=20,p=0.03]

Degree distribution

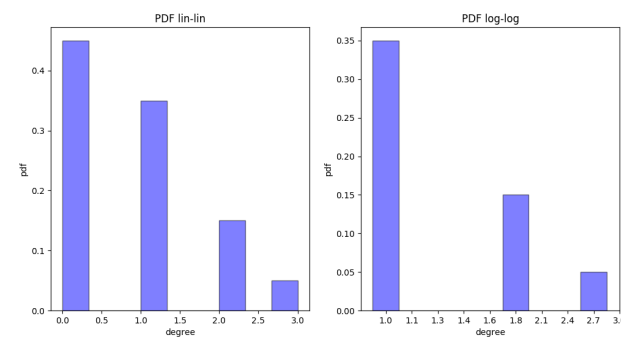


Figure 18: Degree distribution

erdos_renyi_[n=20,p=0.05]

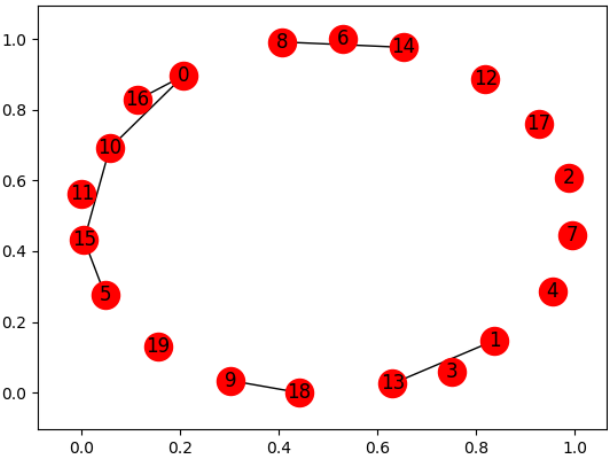


Figure 19: erdos_renyi_[n=20,p=0.05]

Degree distribution

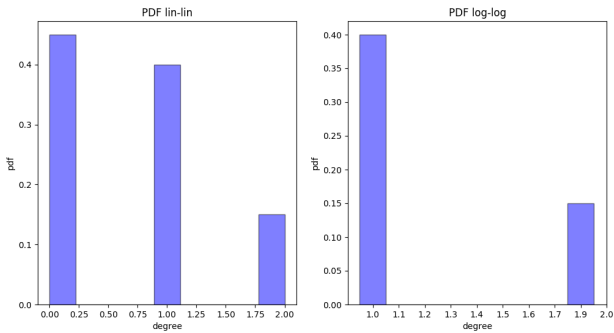


Figure 20: Degree distribution

erdos_renyi_[n=20,p=0.0]

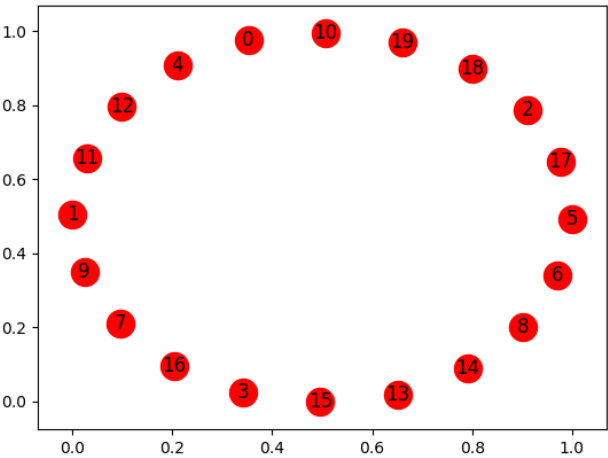


Figure 21: erdos_renyi_[n=20,p=0.0]

Degree distribution

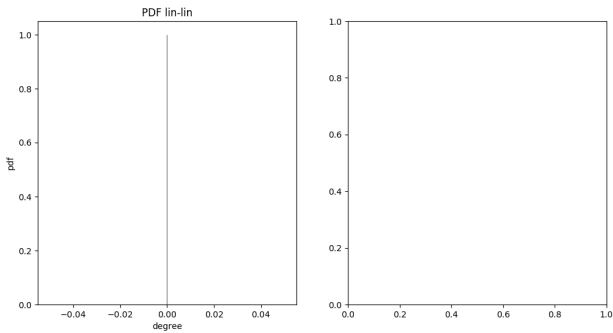


Figure 22: Degree distribution

erdos_renyi_[n=20,p=0.1]

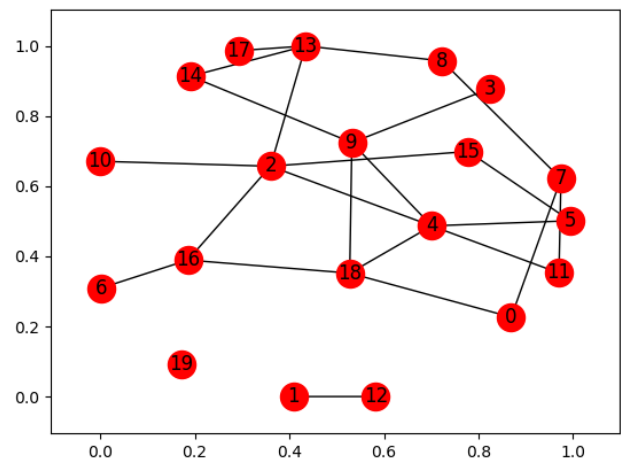


Figure 23: erdos_renyi_[n=20,p=0.1]

Degree distribution

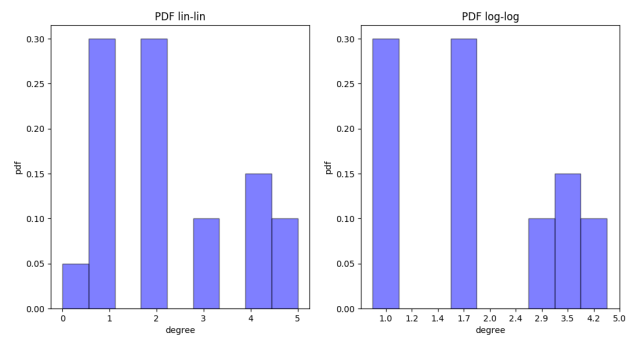


Figure 24: Degree distribution

erdos_renyi_[n=50,p=0.01]

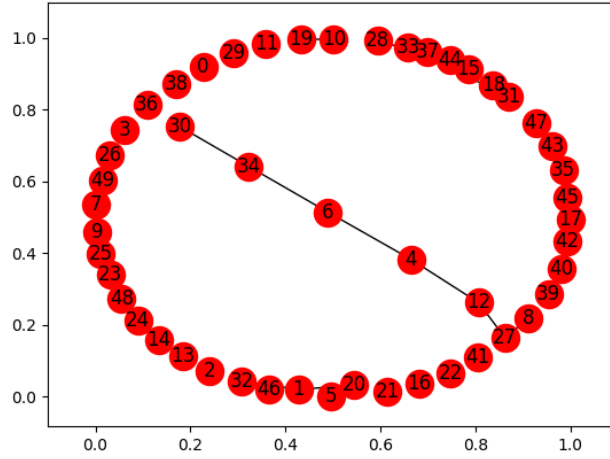


Figure 25: erdos_renyi_[n=50,p=0.01]

Degree distribution

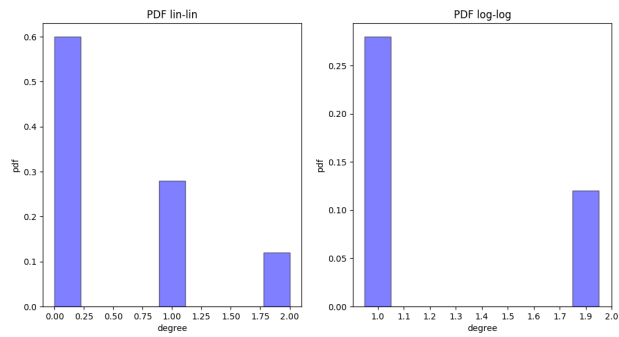


Figure 26: Degree distribution

erdos_renyi_[n=50,p=0.02]

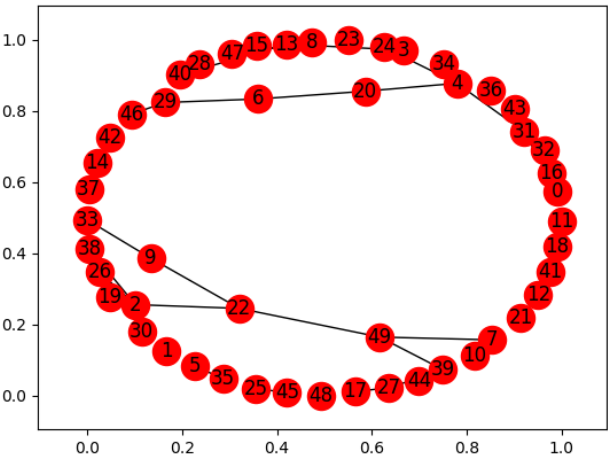


Figure 27: erdos_renyi_[n=50,p=0.02]

Degree distribution

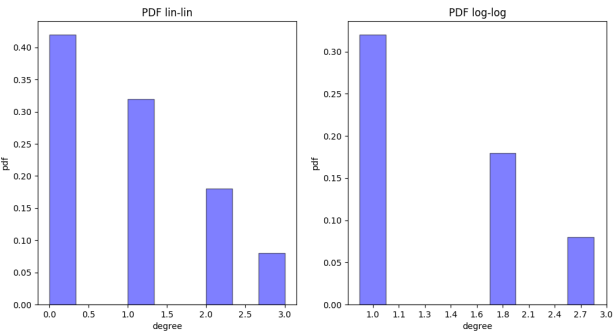


Figure 28: Degree distribution

erdos_renyi_[n=50,p=0.03]

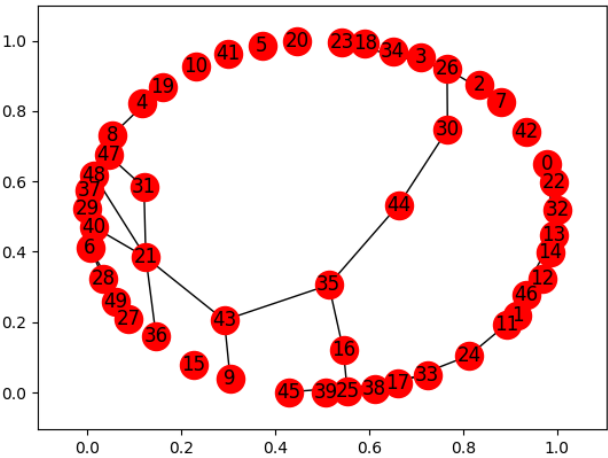


Figure 29: erdos_renyi_[n=50,p=0.03]

Degree distribution

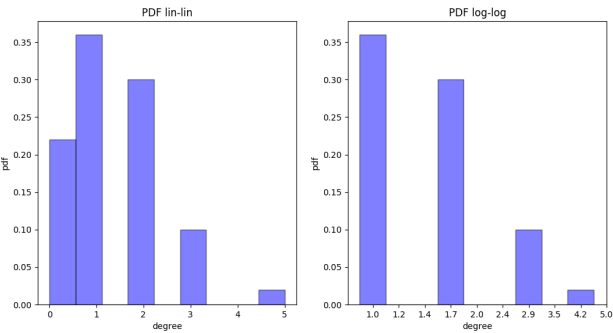


Figure 30: Degree distribution

erdos_renyi_[n=50,p=0.05]

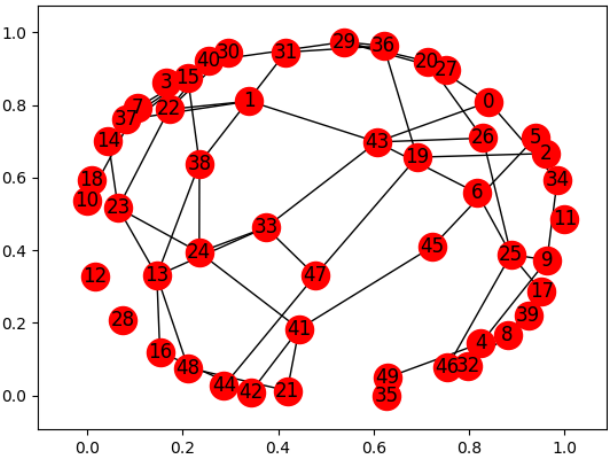


Figure 31: erdos_renyi_[n=50,p=0.05]

Degree distribution

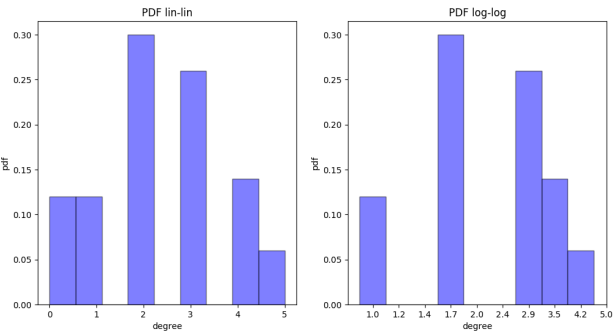


Figure 32: Degree distribution

erdos_renyi_[n=50,p=0.0]

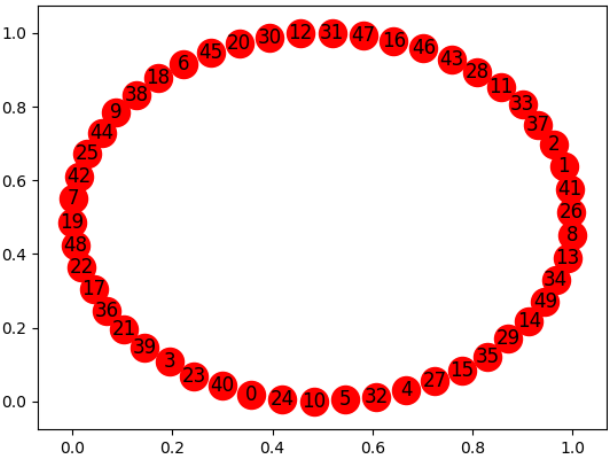


Figure 33: erdos_renyi_[n=50,p=0.0]

Degree distribution

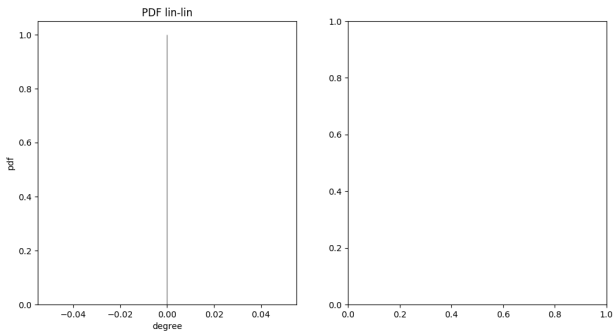


Figure 34: Degree distribution

erdos_renyi_[n=50,p=0.1]

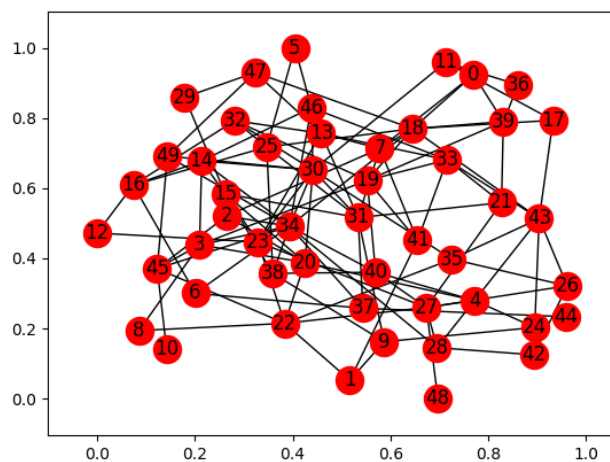


Figure 35: erdos_renyi_[n=50,p=0.1]

Degree distribution

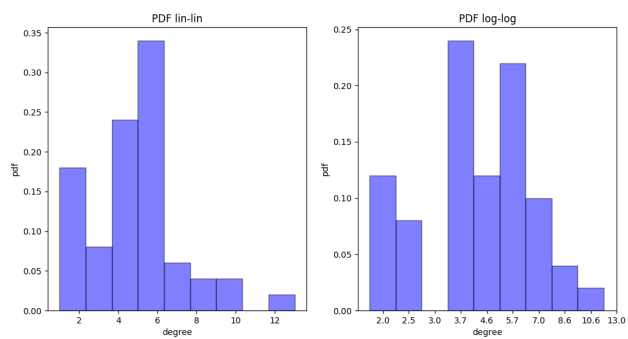


Figure 36: Degree distribution

4 Watts-Strogatz (WS)

watts_strogatz_[n=100,k=4,p=0.0]

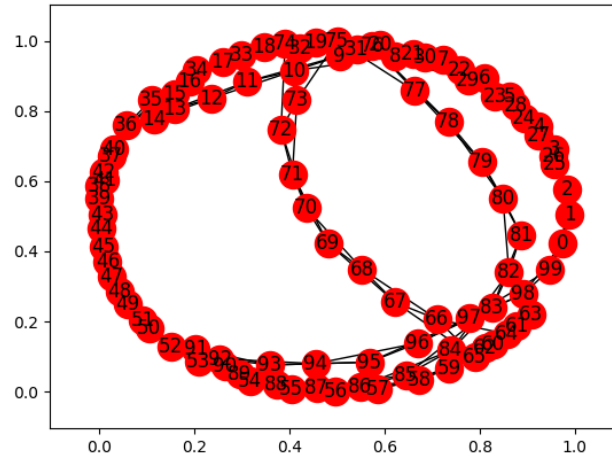


Figure 37: watts_strogatz_[n=100,k=4,p=0.0]

Degree distribution

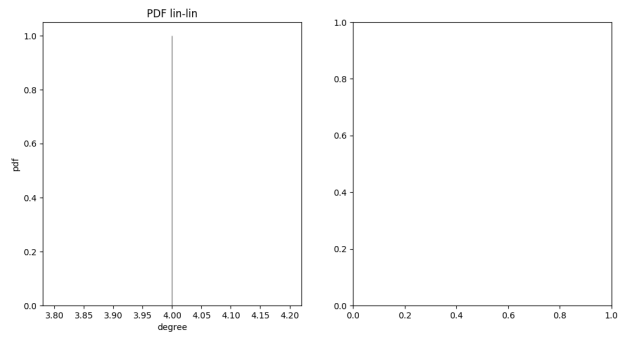


Figure 38: Degree distribution

watts_strogatz_[n=100,k=4,p=0.1]

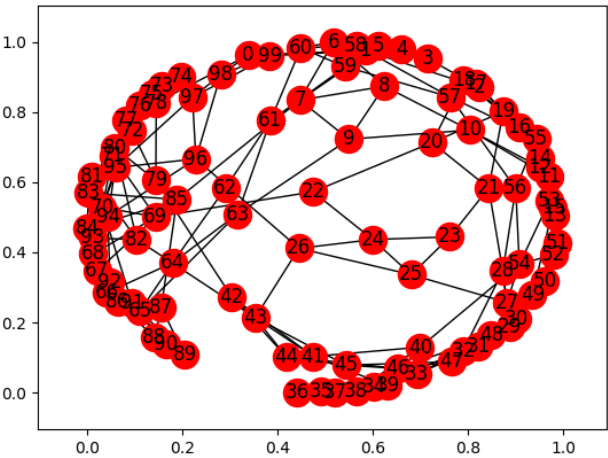


Figure 39: watts_strogatz_[n=100,k=4,p=0.1]

Degree distribution

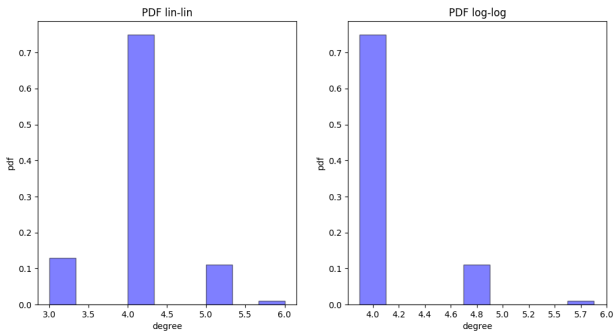


Figure 40: Degree distribution

watts_strogatz_[n=100,k=4,p=0.2]

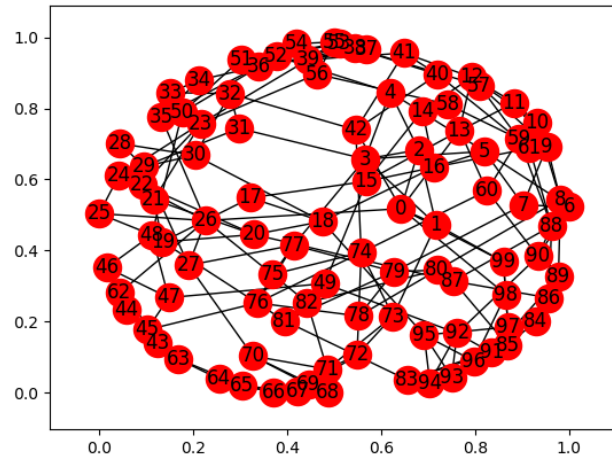


Figure 41: watts_strogatz_[n=100,k=4,p=0.2]

Degree distribution

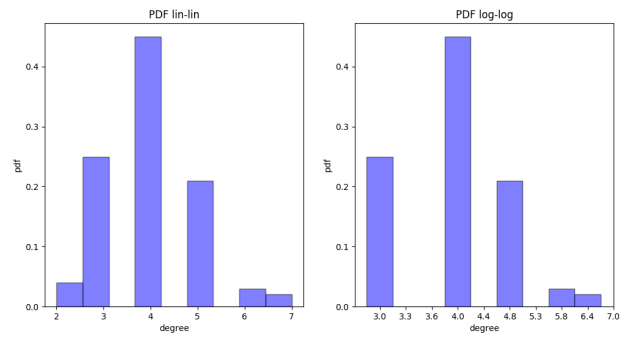


Figure 42: Degree distribution

watts_strogatz_[n=100,k=4,p=0.5]

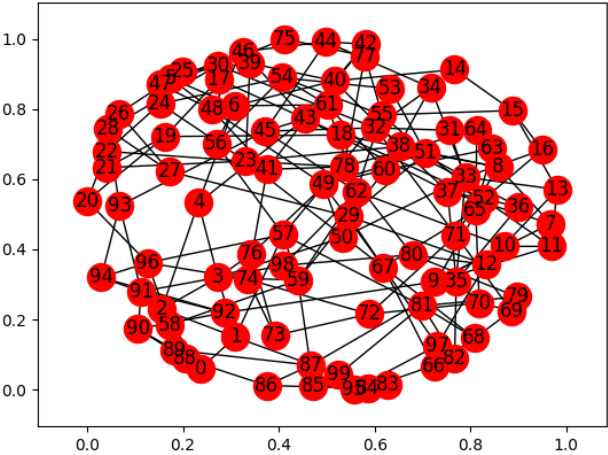


Figure 43: watts_strogatz_[n=100,k=4,p=0.5]

Degree distribution

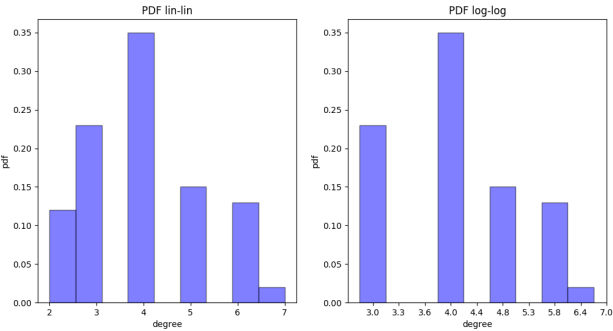


Figure 44: Degree distribution

watts_strogatz_[n=100,k=4,p=0.9]

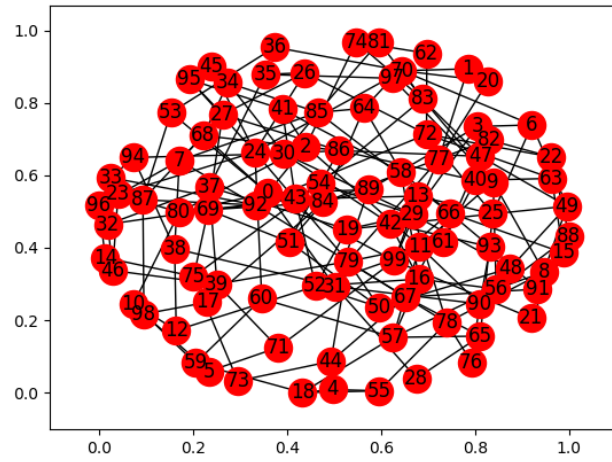


Figure 45: watts_strogatz_[n=100,k=4,p=0.9]

Degree distribution

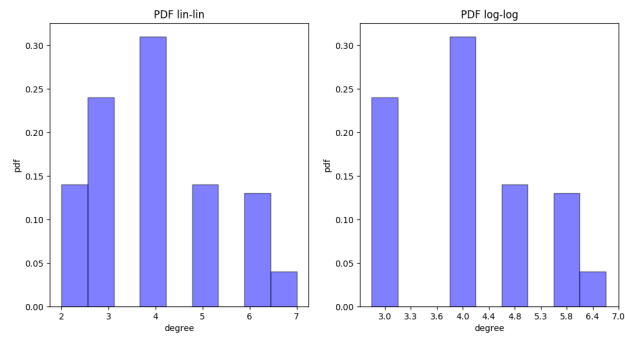


Figure 46: Degree distribution

watts_strogatz_[n=100,k=4,p=1.0]

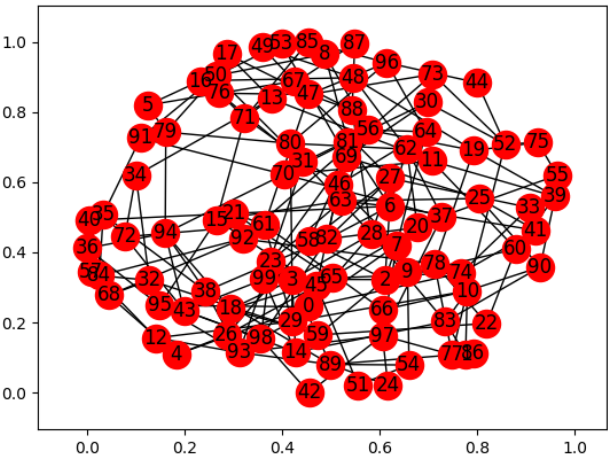


Figure 47: watts_strogatz_[n=100,k=4,p=1.0]

Degree distribution

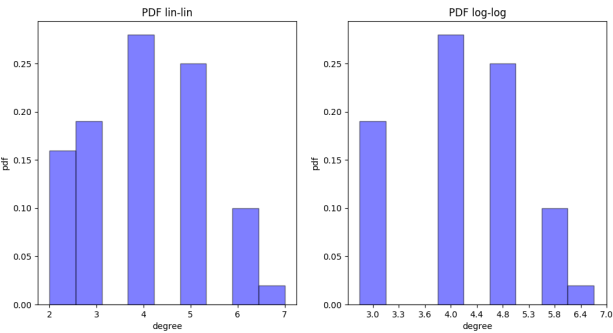


Figure 48: Degree distribution

watts_strogatz_[n=20,k=4,p=0.0]

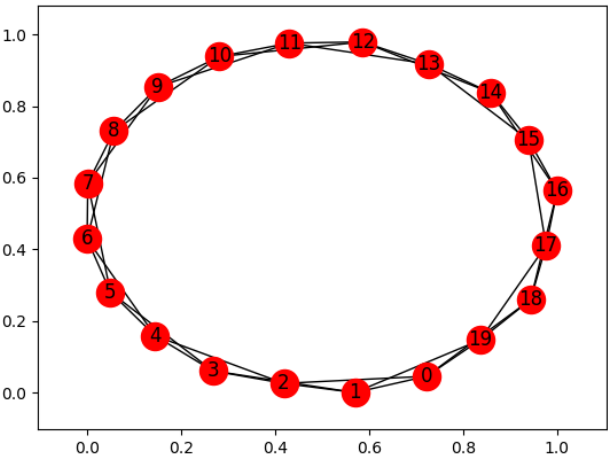


Figure 49: watts_strogatz_[n=20,k=4,p=0.0]

Degree distribution

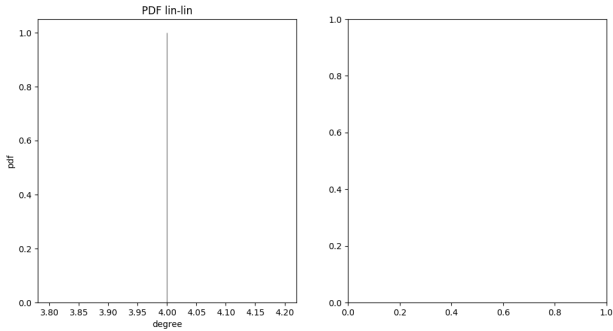


Figure 50: Degree distribution

watts_strogatz_[n=20,k=4,p=0.1]

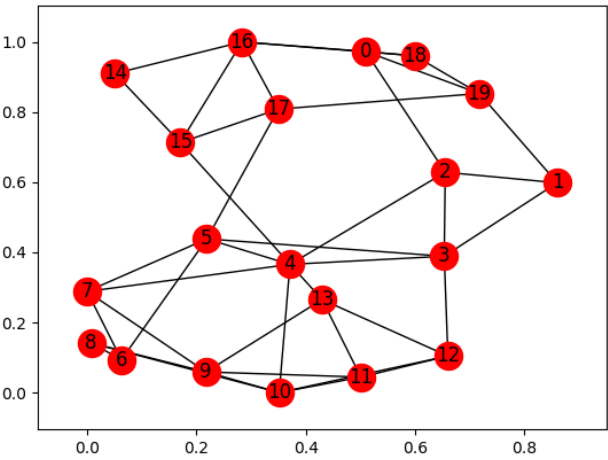


Figure 51: watts_strogatz_[n=20,k=4,p=0.1]

Degree distribution

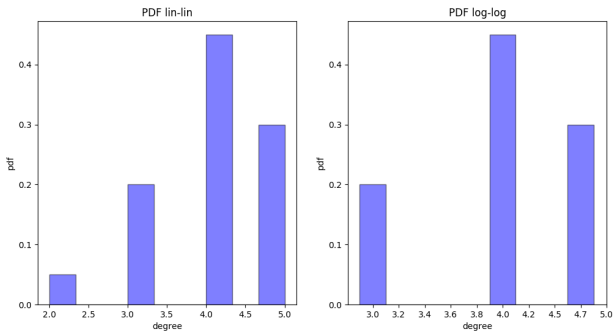


Figure 52: Degree distribution

watts_strogatz_[n=20,k=4,p=0.2]

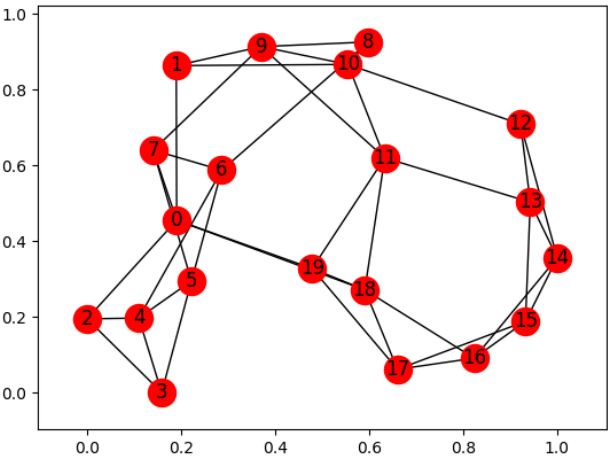


Figure 53: watts_strogatz_[n=20,k=4,p=0.2]

Degree distribution

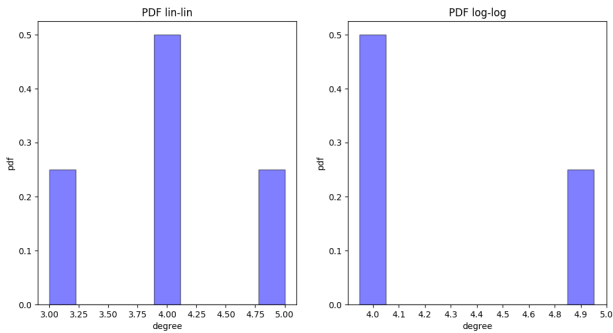


Figure 54: Degree distribution

watts_strogatz_[n=20,k=4,p=0.5]

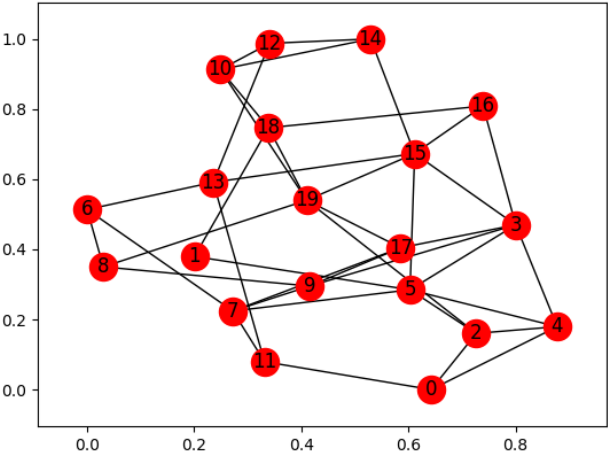


Figure 55: watts_strogatz_[n=20,k=4,p=0.5]

Degree distribution

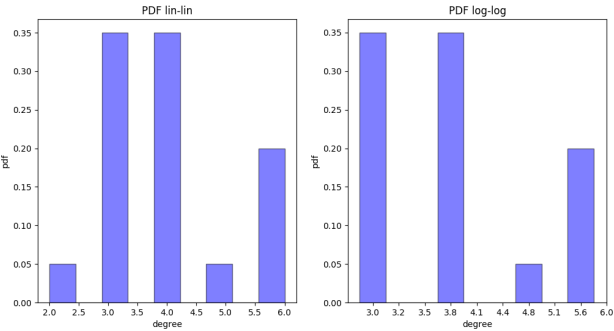


Figure 56: Degree distribution

watts_strogatz_[n=20,k=4,p=0.9]

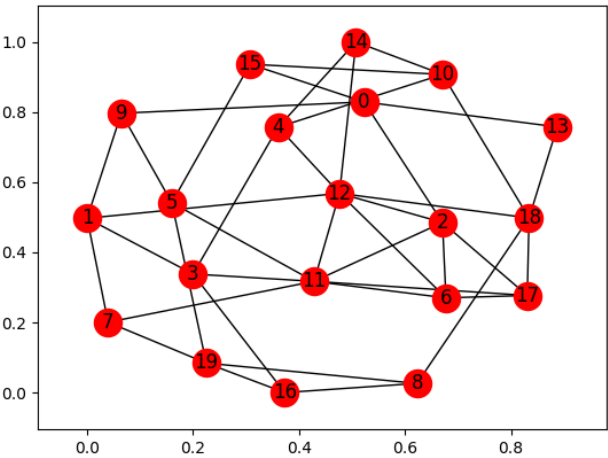


Figure 57: watts_strogatz_[n=20,k=4,p=0.9]

Degree distribution

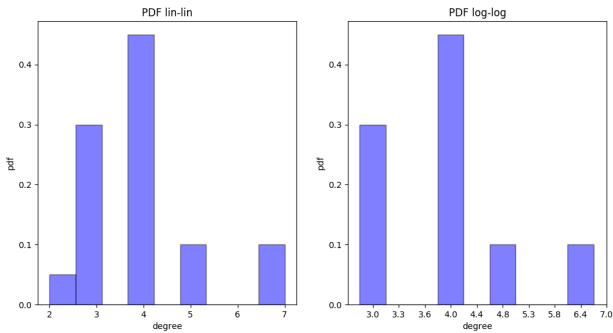


Figure 58: Degree distribution

watts_strogatz_[n=20,k=4,p=1.0]

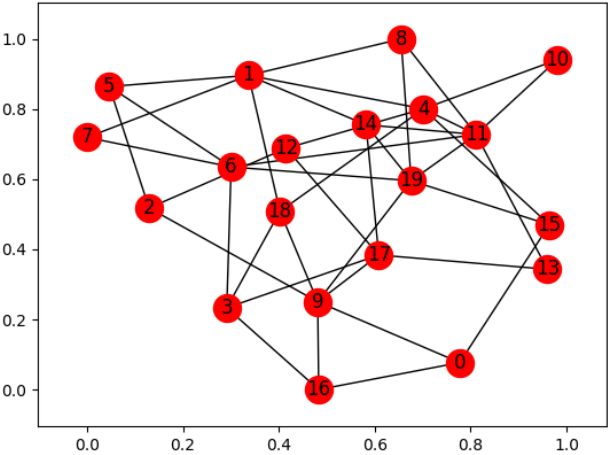


Figure 59: watts_strogatz_[n=20,k=4,p=1.0]

Degree distribution

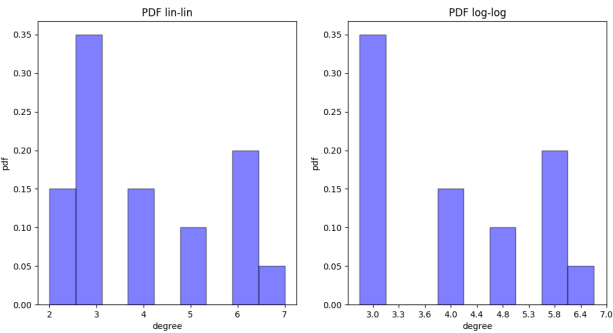


Figure 60: Degree distribution

watts_strogatz_[n=50,k=4,p=0.0]

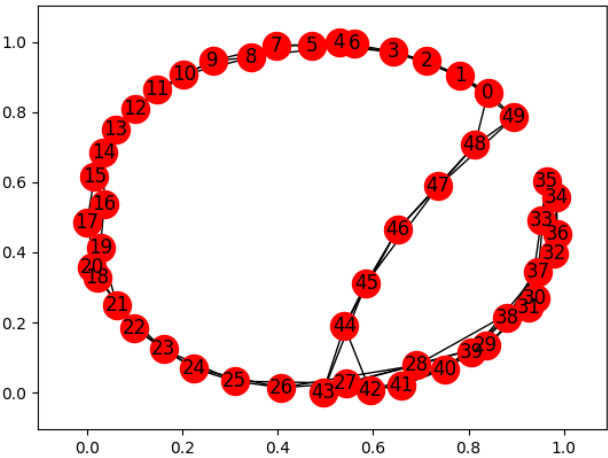


Figure 61: watts_strogatz_[n=50,k=4,p=0.0]

Degree distribution

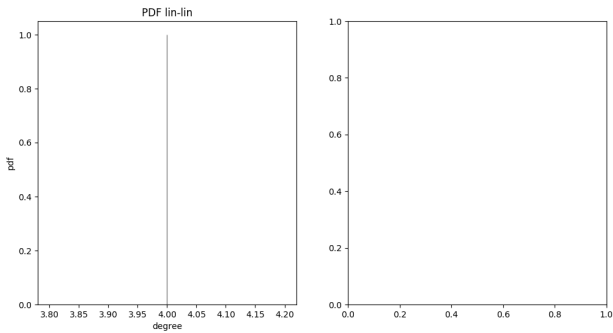


Figure 62: Degree distribution

watts_strogatz_[n=50,k=4,p=0.1]

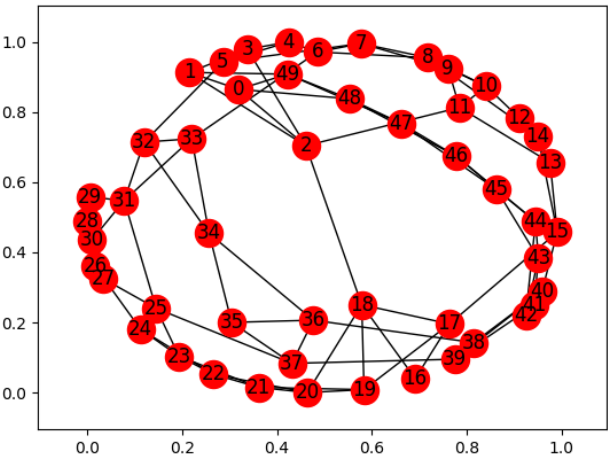


Figure 63: watts_strogatz_[n=50,k=4,p=0.1]

Degree distribution

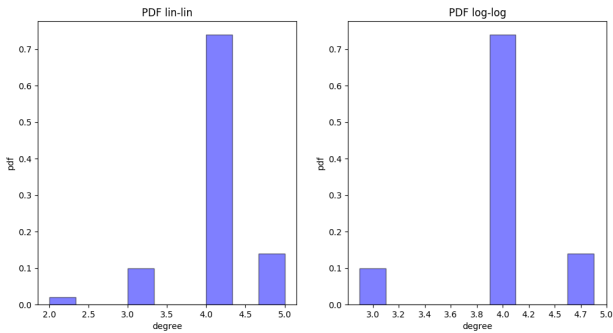


Figure 64: Degree distribution

watts_strogatz_[n=50,k=4,p=0.2]

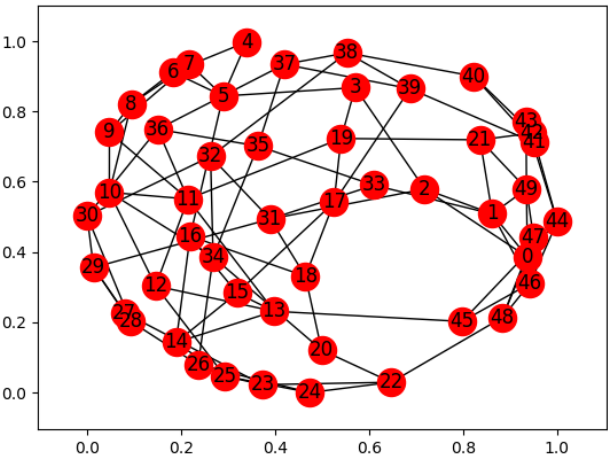


Figure 65: watts_strogatz_[n=50,k=4,p=0.2]

Degree distribution

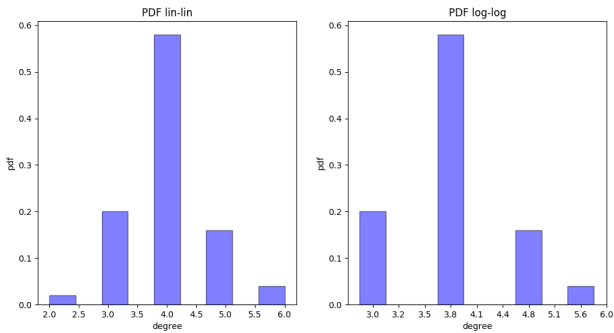


Figure 66: Degree distribution

watts_strogatz_[n=50,k=4,p=0.5]

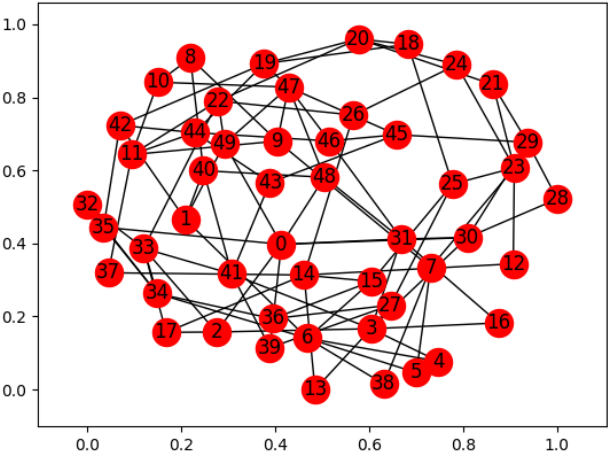


Figure 67: watts_strogatz_[n=50,k=4,p=0.5]

Degree distribution

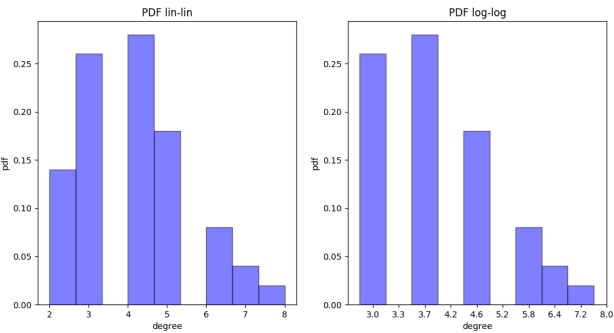


Figure 68: Degree distribution

watts_strogatz_[n=50,k=4,p=0.9]

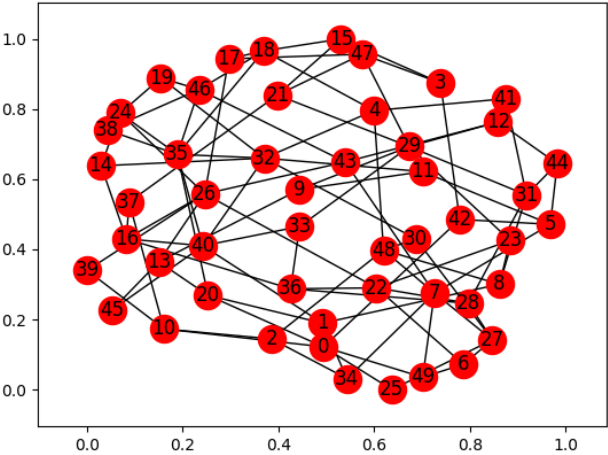


Figure 69: watts_strogatz_[n=50,k=4,p=0.9]

Degree distribution

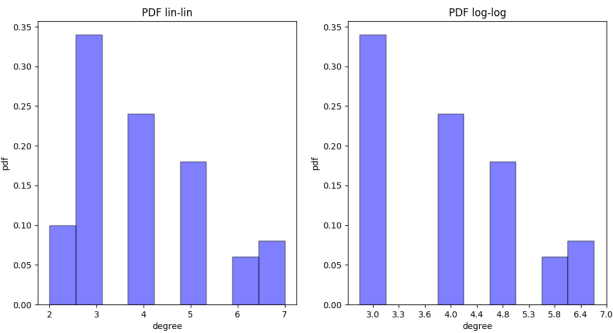


Figure 70: Degree distribution

watts_strogatz_[n=50,k=4,p=1.0]

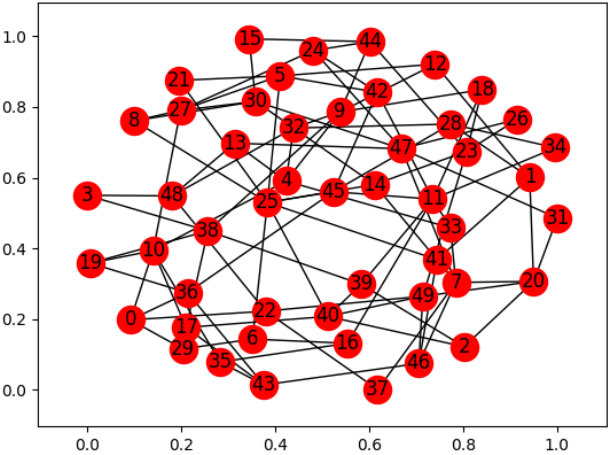


Figure 71: watts_strogatz_[n=50,k=4,p=1.0]

Degree distribution

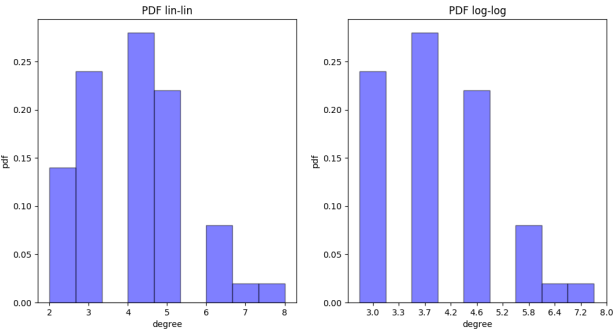


Figure 72: Degree distribution

5 Barabási Albert (BA)

barabasi_albert_[n=100,m=10]

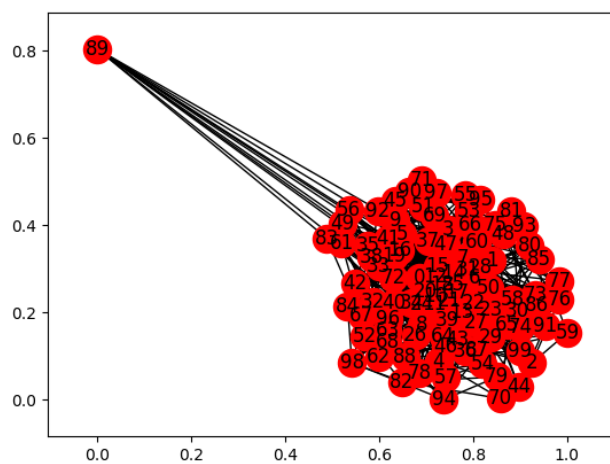


Figure 73: barabasi_albert_[n=100,m=10]

Degree distribution

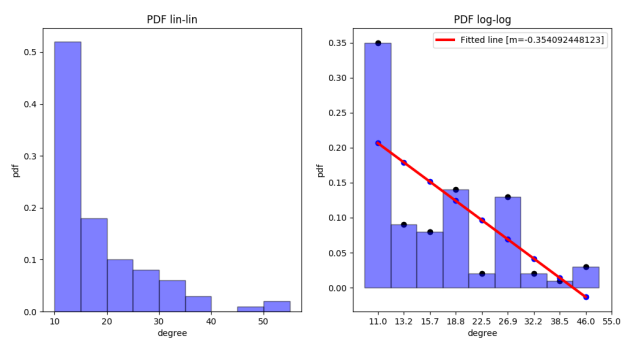


Figure 74: Degree distribution

barabasi_albert_[n=100,m=1]

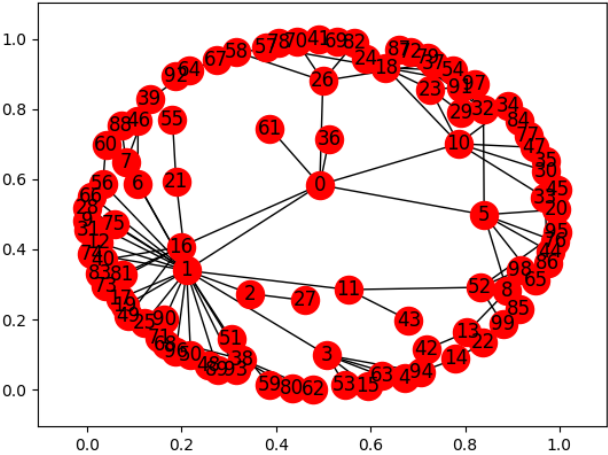


Figure 75: barabasi_albert_[n=100,m=1]

Degree distribution

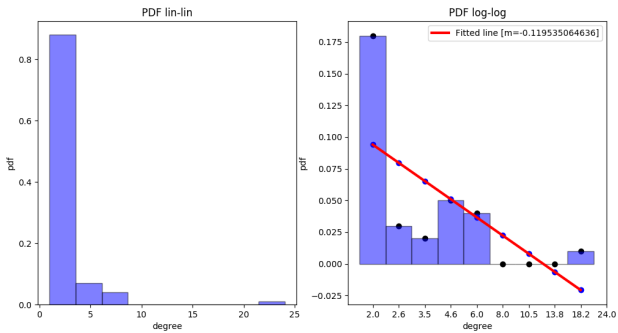


Figure 76: Degree distribution

barabasi_albert_[n=100,m=2]

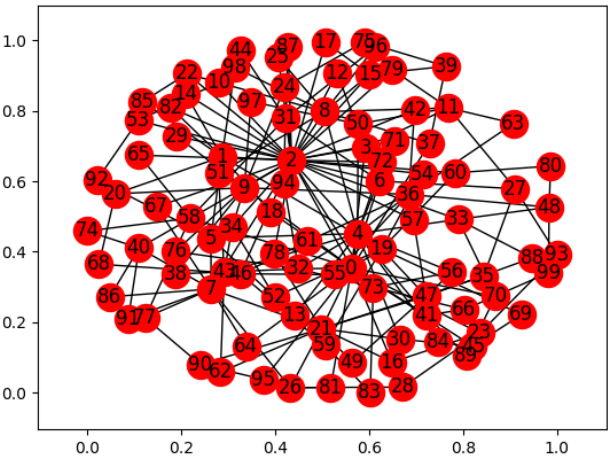


Figure 77: barabasi_albert_[n=100,m=2]

Degree distribution

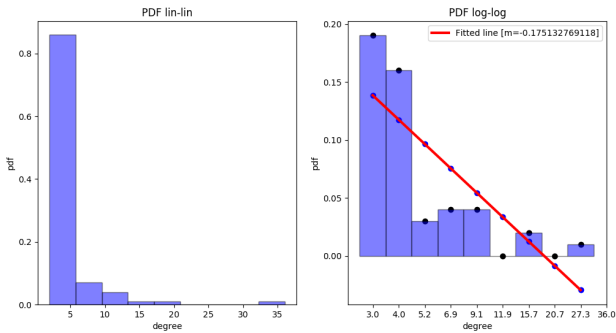


Figure 78: Degree distribution

barabasi_albert_[n=100,m=4]

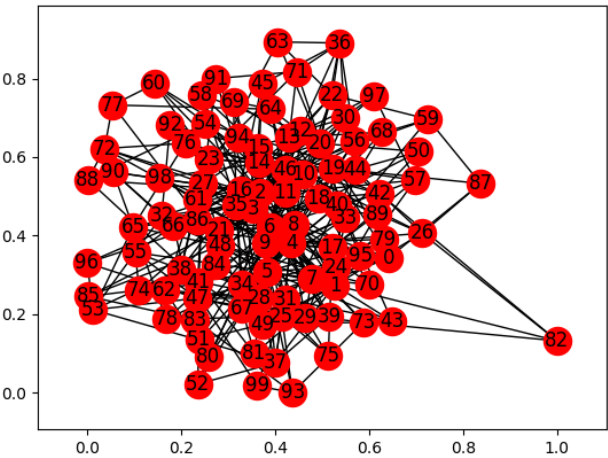


Figure 79: barabasi_albert_[n=100,m=4]

Degree distribution

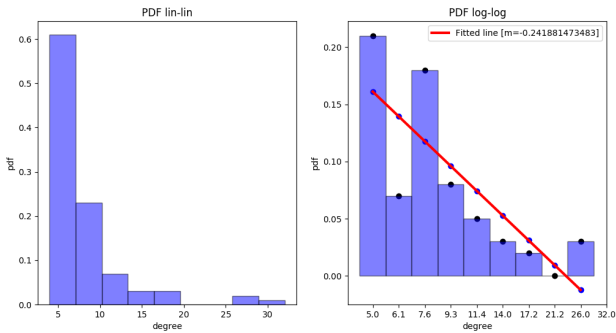


Figure 80: Degree distribution

barabasi_albert_[n=1000,m=10]

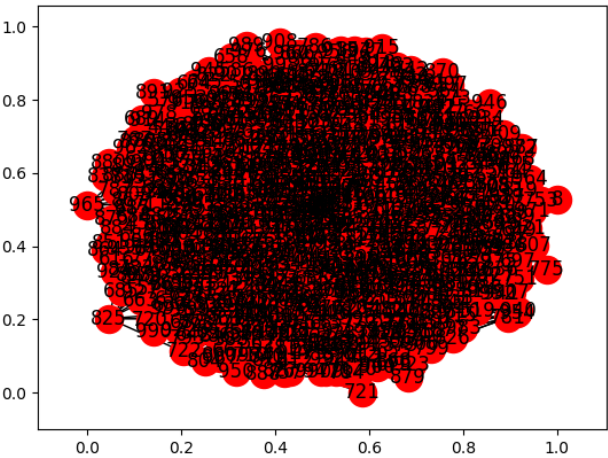


Figure 81: barabasi_albert_[n=1000,m=10]

Degree distribution

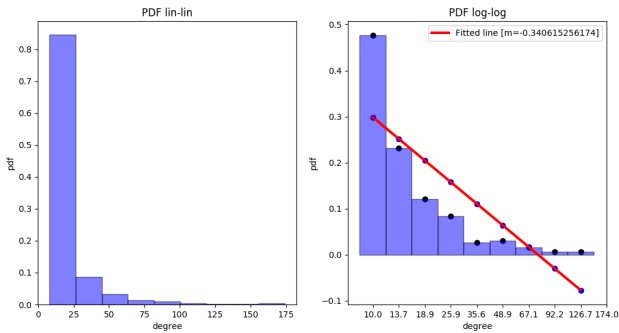


Figure 82: Degree distribution

barabasi_albert_[n=1000,m=1]

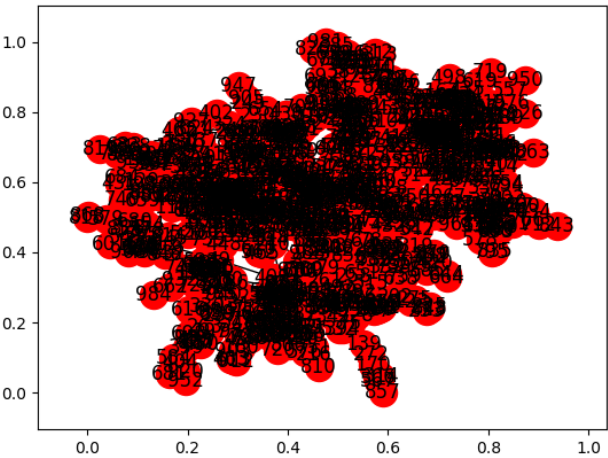


Figure 83: barabasi_albert_[n=1000,m=1]

Degree distribution

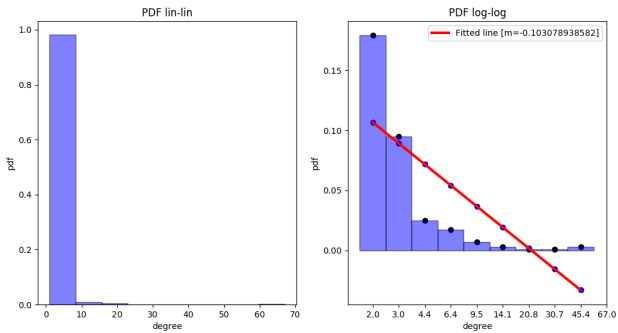


Figure 84: Degree distribution

barabasi_albert_[n=1000,m=2]

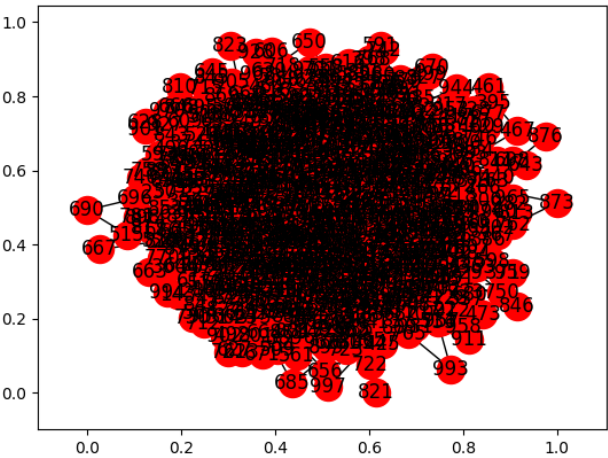


Figure 85: barabasi_albert_[n=1000,m=2]

Degree distribution

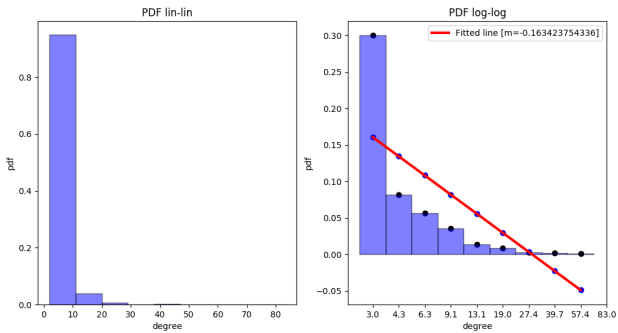


Figure 86: Degree distribution

barabasi_albert_[n=1000,m=4]

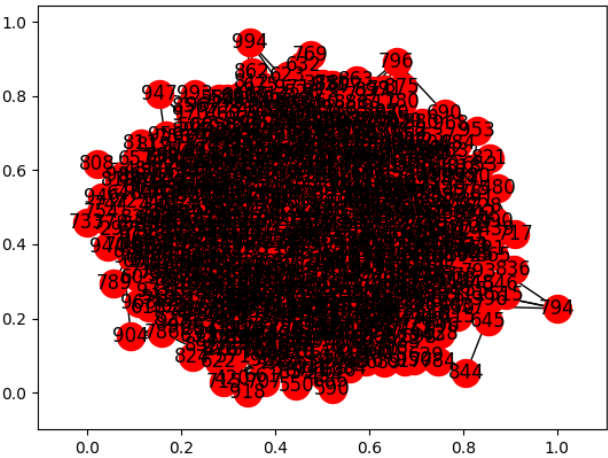


Figure 87: barabasi_albert_[n=1000,m=4]

Degree distribution

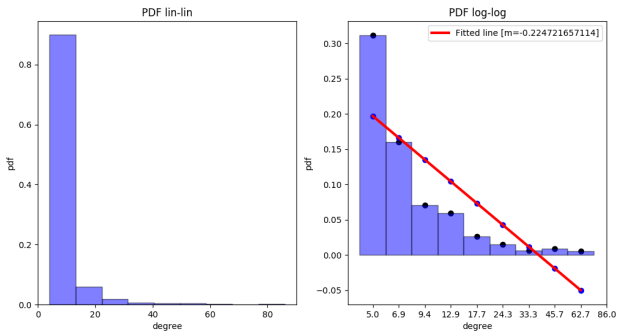


Figure 88: Degree distribution

barabasi_albert_[n=50,m=10]

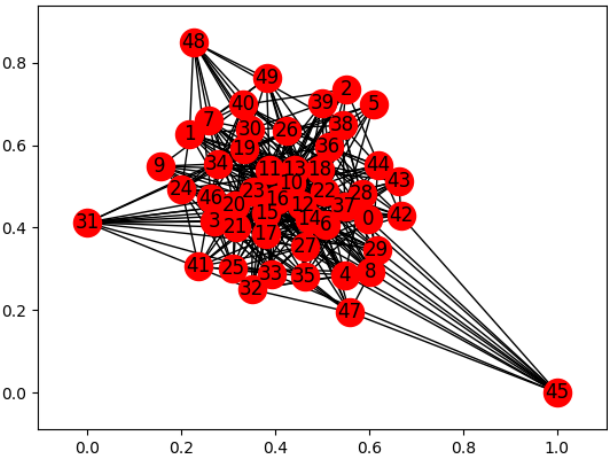


Figure 89: barabasi_albert_[n=50,m=10]

Degree distribution

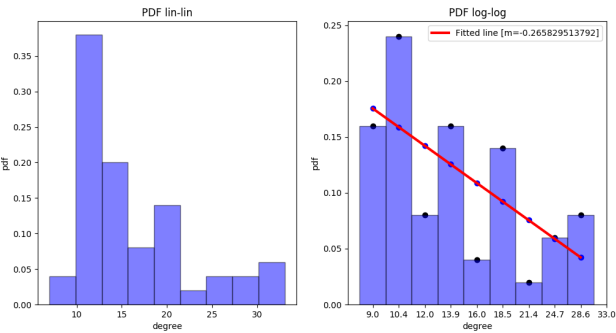


Figure 90: Degree distribution

barabasi_albert_[n=50,m=1]

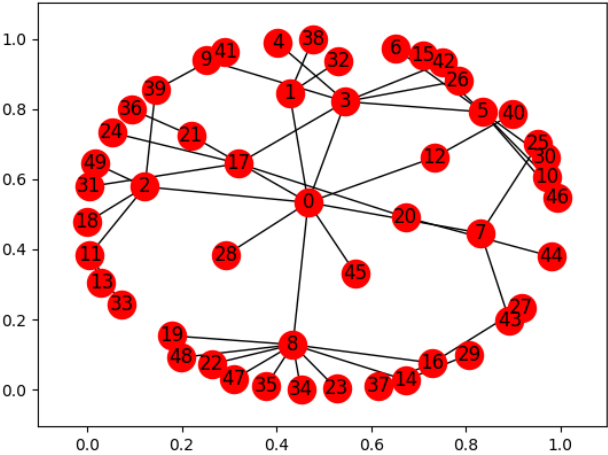


Figure 91: barabasi_albert_[n=50,m=1]

Degree distribution

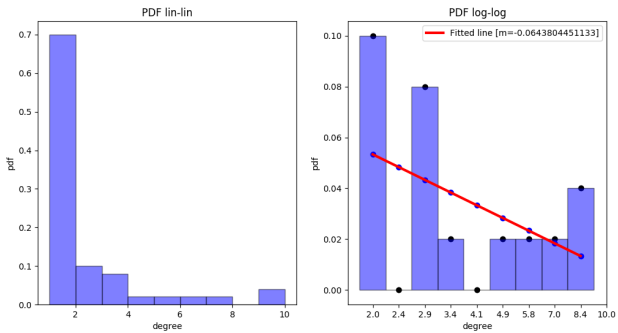


Figure 92: Degree distribution

barabasi_albert_[n=50,m=2]

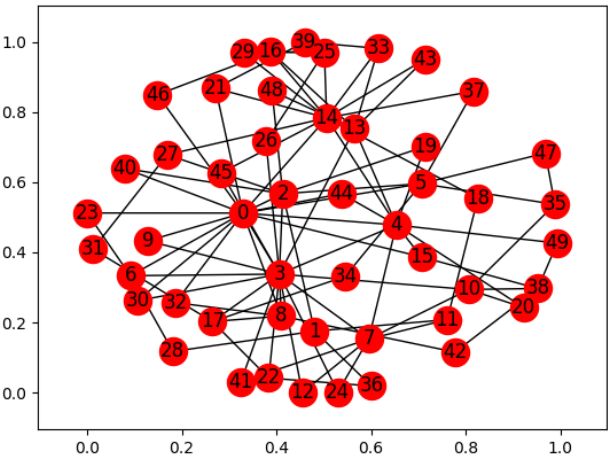


Figure 93: barabasi_albert_[n=50,m=2]

Degree distribution

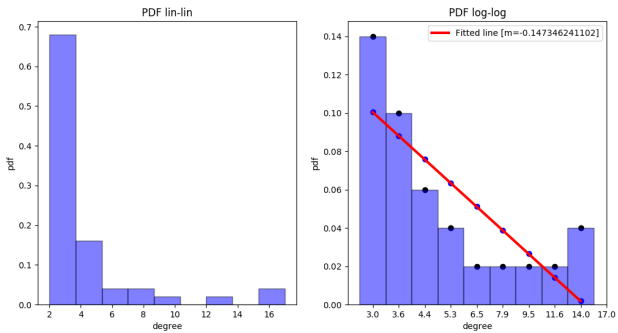


Figure 94: Degree distribution

barabasi_albert_[n=50,m=4]

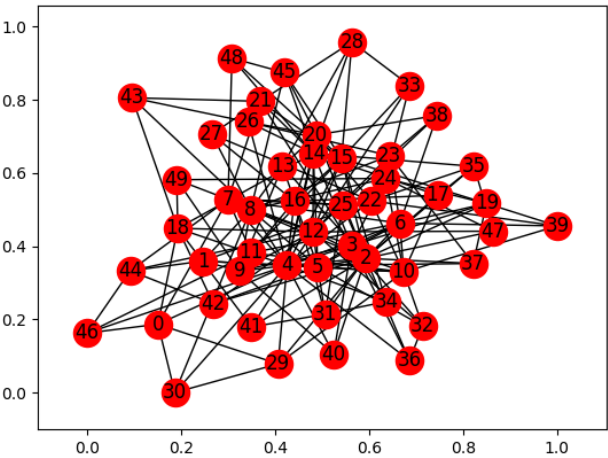


Figure 95: barabasi_albert_[n=50,m=4]

Degree distribution

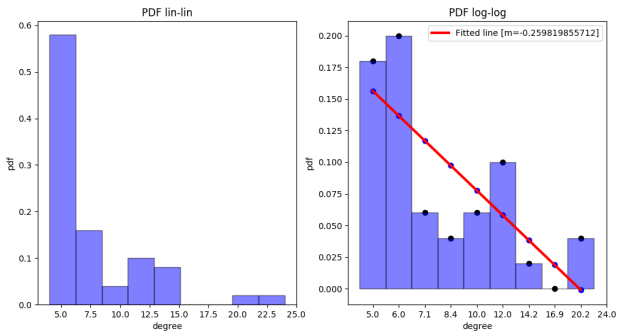


Figure 96: Degree distribution