BrunoFBessa_5881890_P7_results

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0.1 SFI5904 - Complex Networks

Project 7: Relationship between topolody and dynamics in complex netwoks First Semester of 2021

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A: Obtain scatterplots and respective Pearson correation coefficients between the degree and the activation rate for each node of at least 300 nodes with average degree between 5 and 7. Use one network for each one of the models ER, BA, WS (with 3 probabilities of reconnection) as well as the three geometric models seen during the course.

B: Make the networks used in (A) more and more directed, removing individual connections from them and check the effect on the correlations.

0.2 Results (A)

For this experiment the following synthetic networks were used (all with N=300 nodes and tuned so that their average degree lied between 5 and 7):

ER = Erdos-Renyi (prob=0.02)

BA = Barabási-Albert (m=4, plot=False)

VO = Voronoi

RA = Spatial with Radius (radius=0.079)

WX = Waxman (alpha=0.048

WS_1 = Watts-Strogatz (prob=0.1)

WS_2 = Watts-Strogatz (prob=0.2)

WS_3 = Watts-Strogatz (prob=1.0)

We performes random walks to calculate the activation rate of the undirected networks.

[2]:
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display.Image("images/results_a.png")
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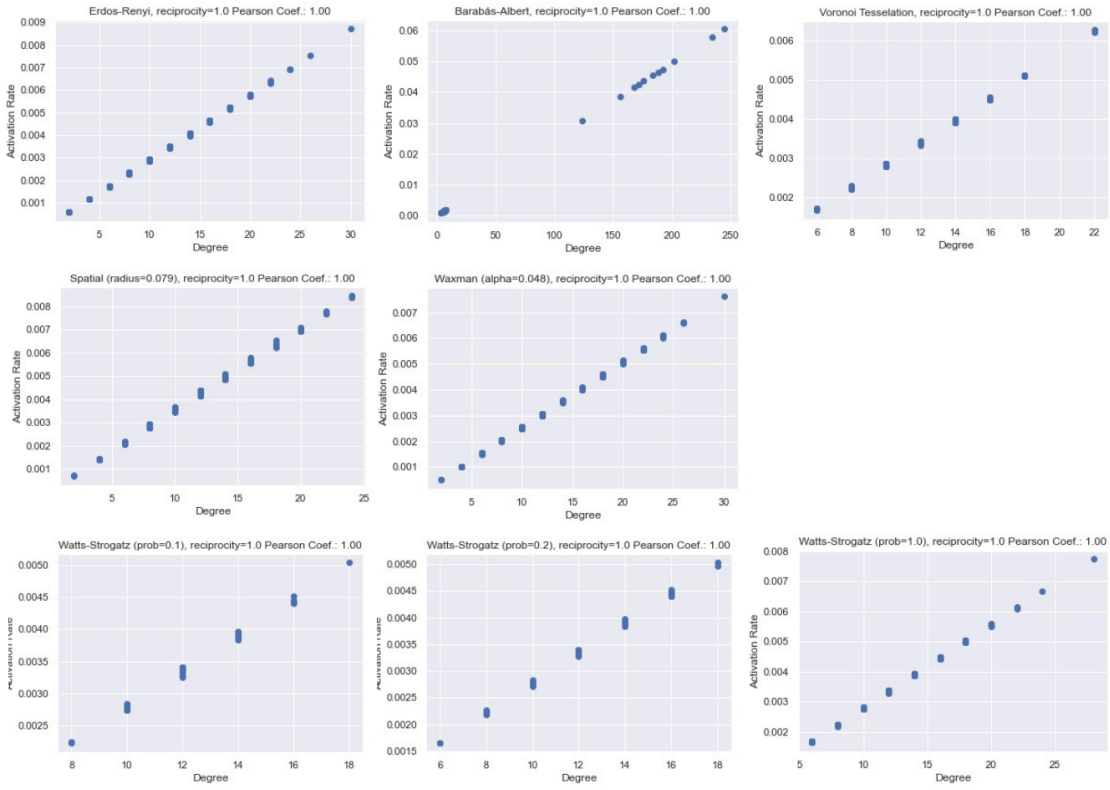
[2]:



0.3 Results (B)

In order to reproduce the effect of the steering coefficient as function of the topology, we created a function that loops over the edges of an undirected graph and reconnects it with direction following a probability.

[3]:
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display.Image("images/reconnect_directed.png")
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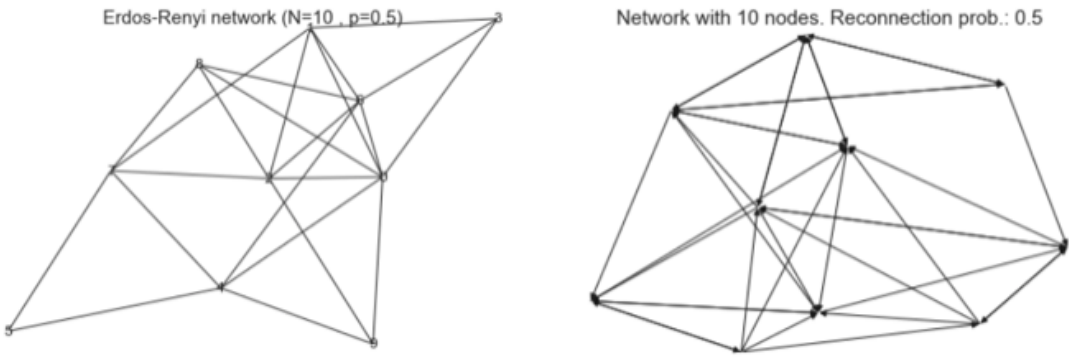
[3]:



The results are listed in the figures below:

[6]:
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display.Image("images/er_evolution.png")
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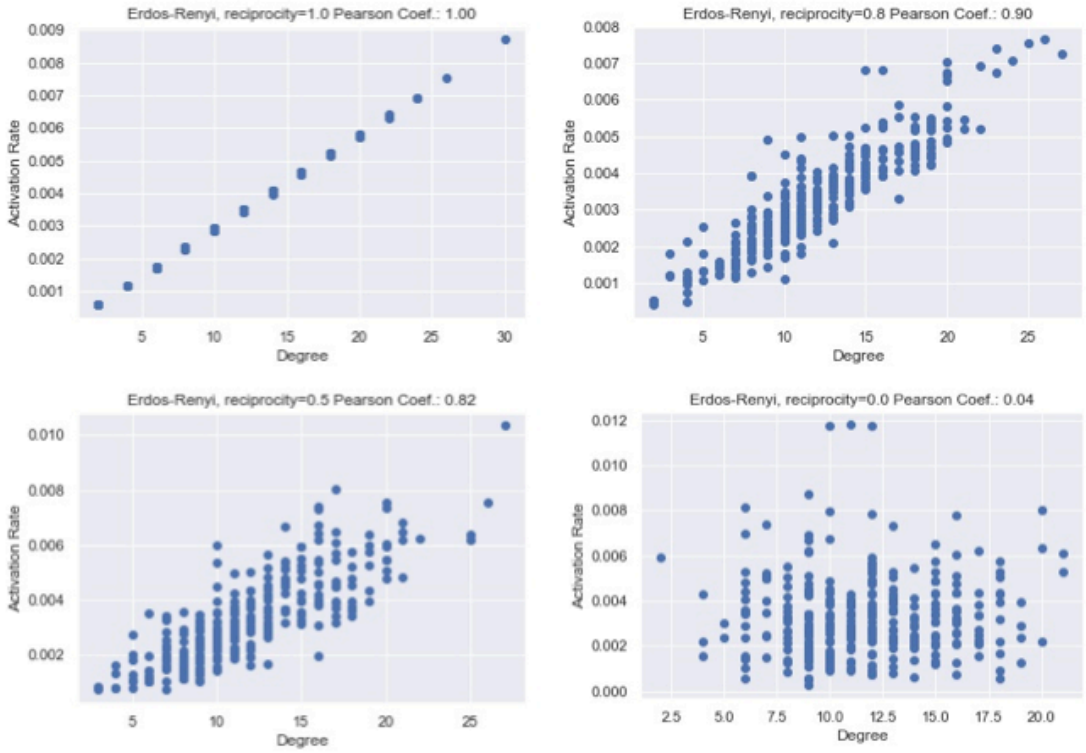
[6]:



[7]:
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display.Image("images/ba_evolution.png")
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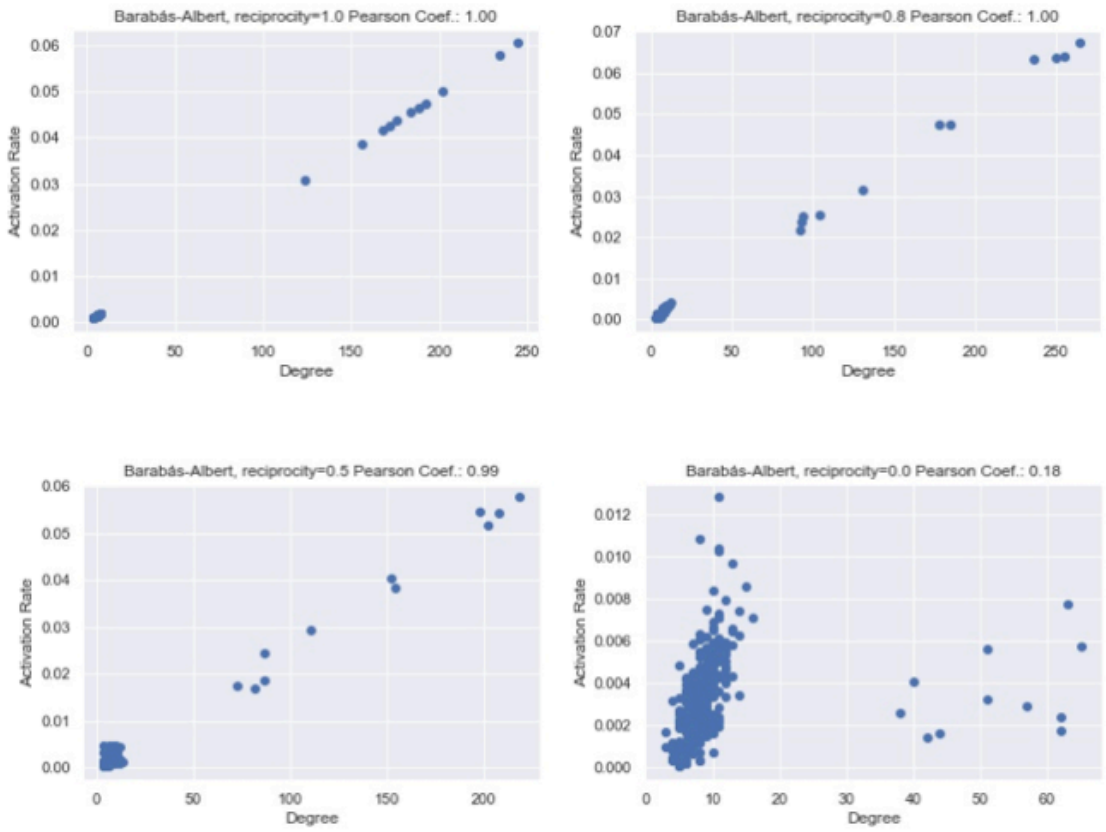
[7]:



[8]:
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display.Image("images/vo_evolution.png")
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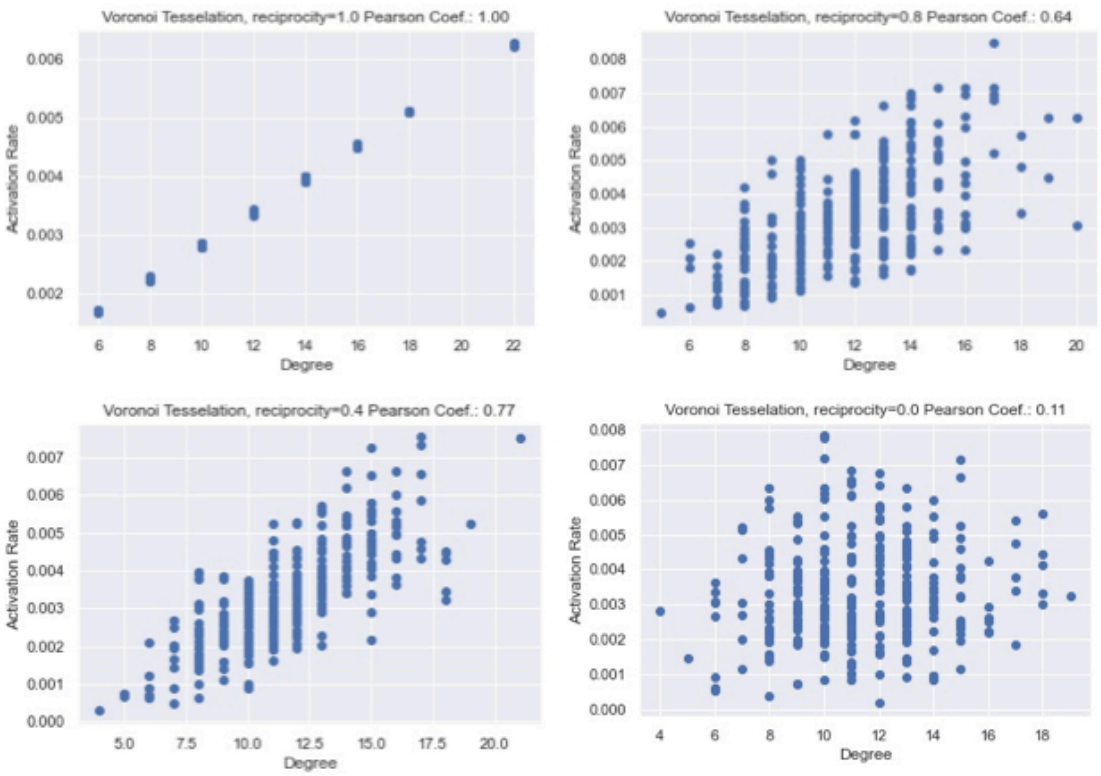
[8]:



[9]:
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display.Image("images/ra_evolution.png")
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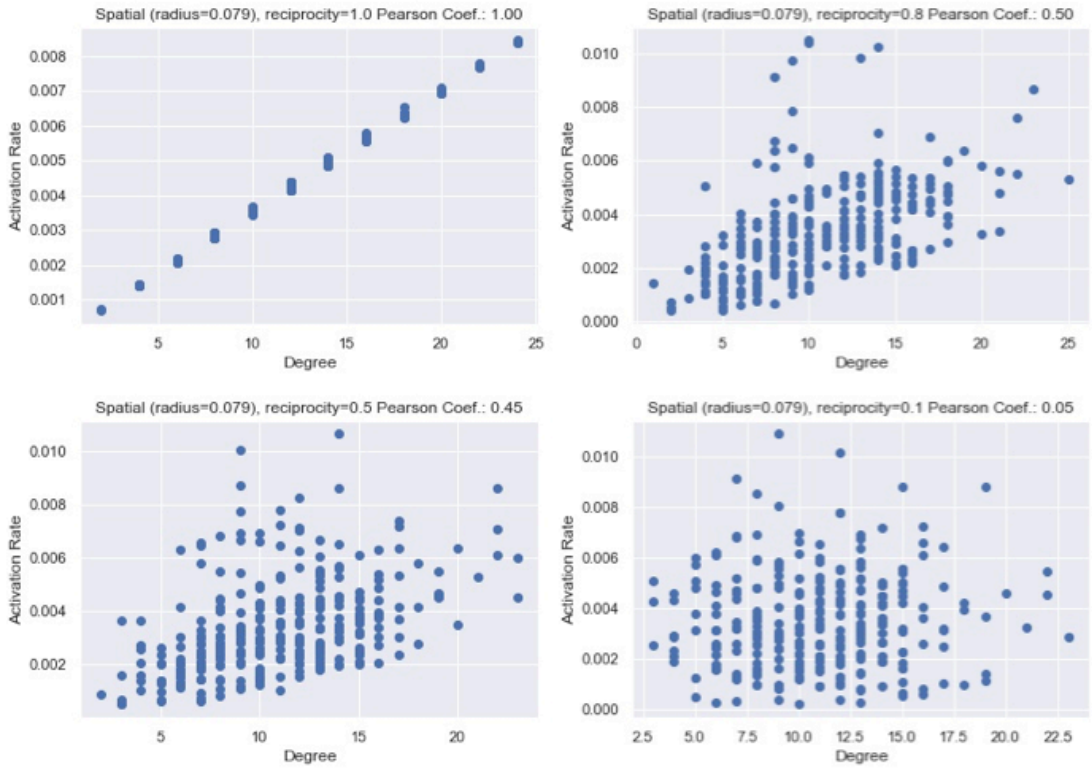
[9]:



[10]:
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display.Image("images/wx_evolution.png")
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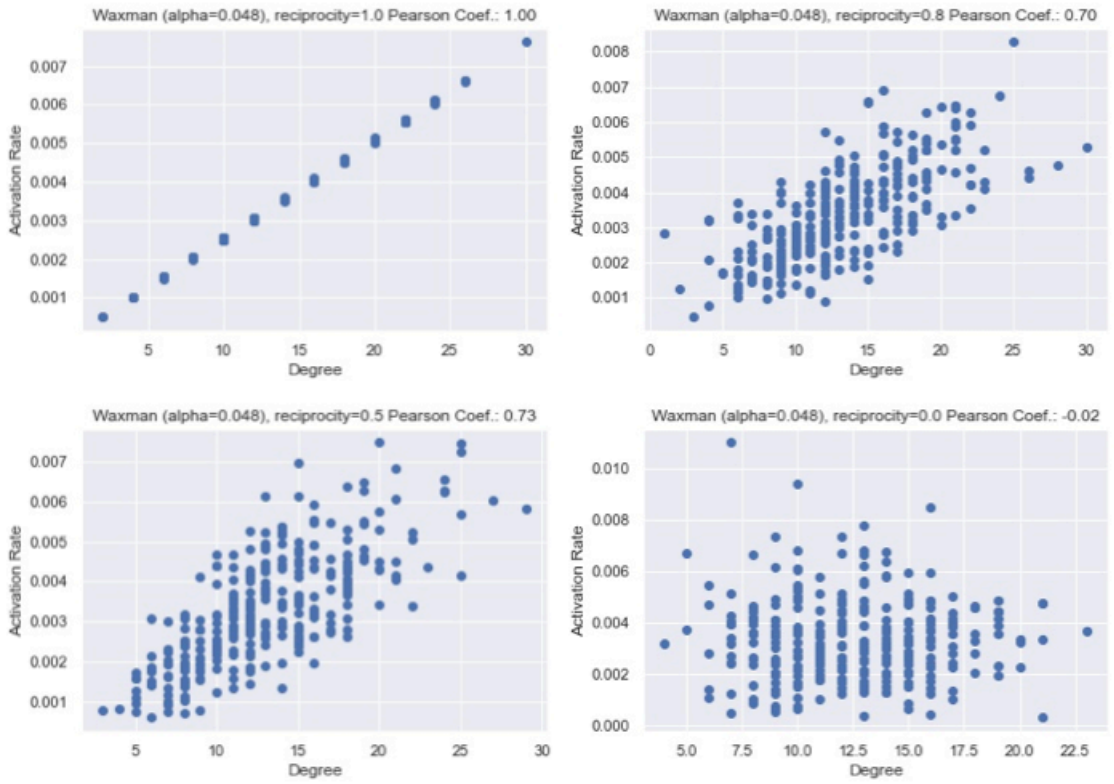
[10]:



[11]:
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display.Image("images/ws_1_evolution.png")
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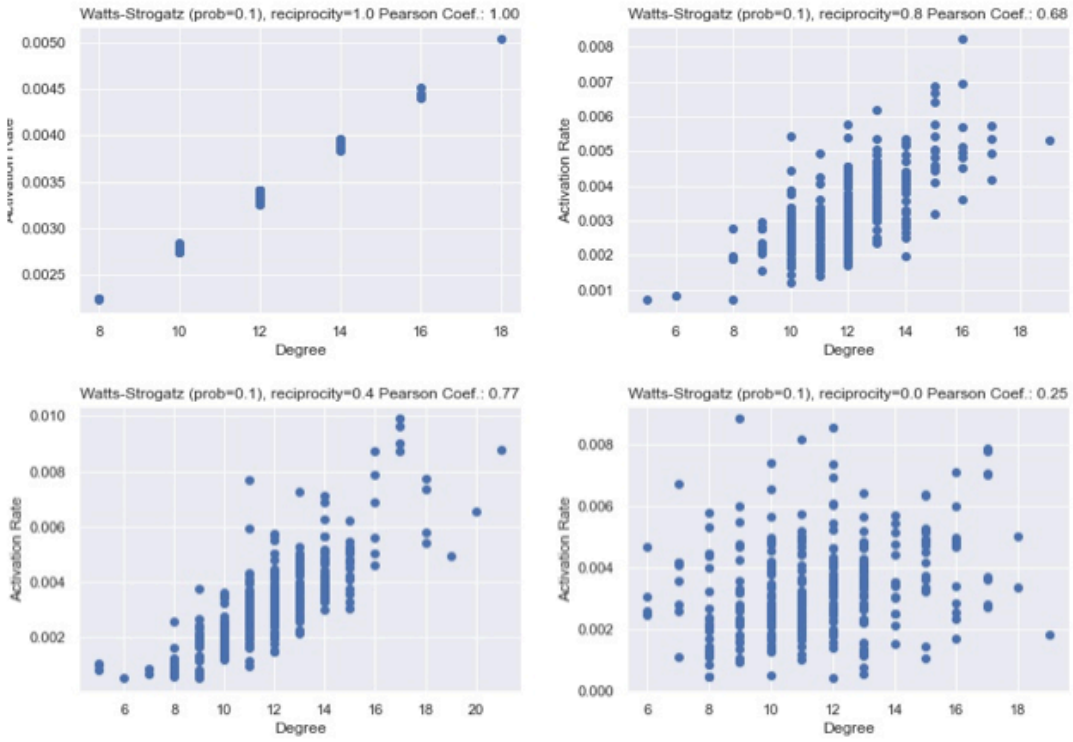
[11]:



[12]:
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display.Image("images/ws_2_evolution.png")
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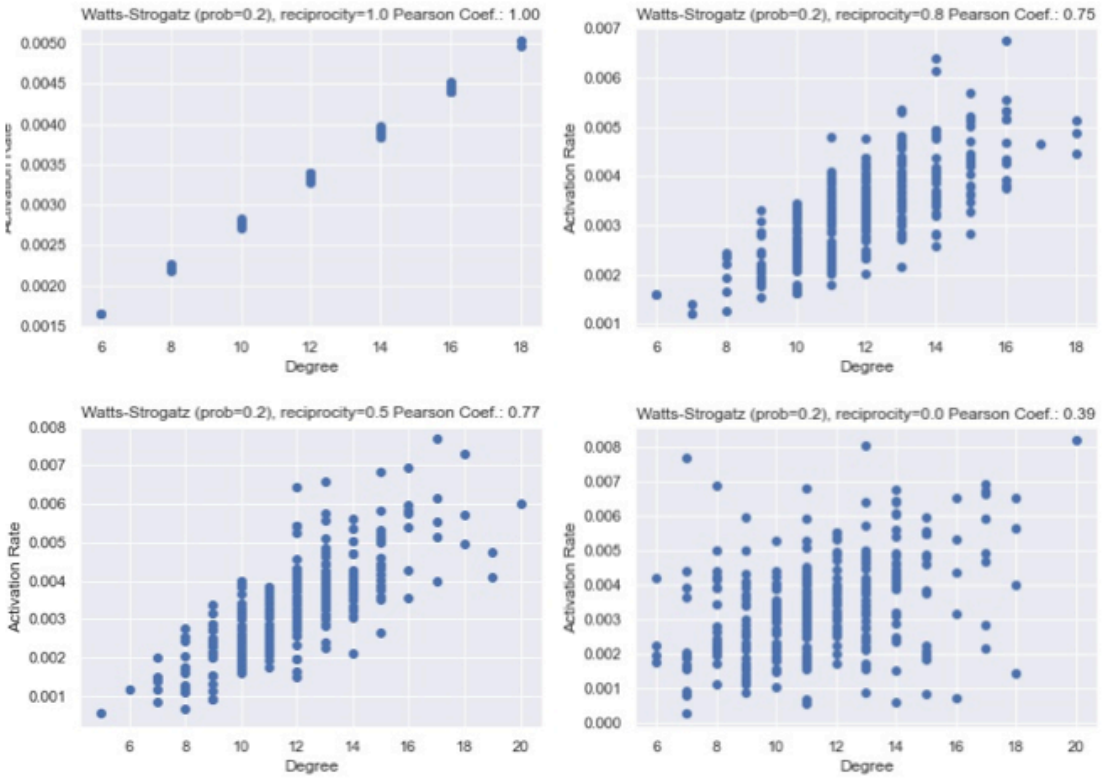
[12]:



[13]:
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display.Image("images/ws_3_evolution.png")
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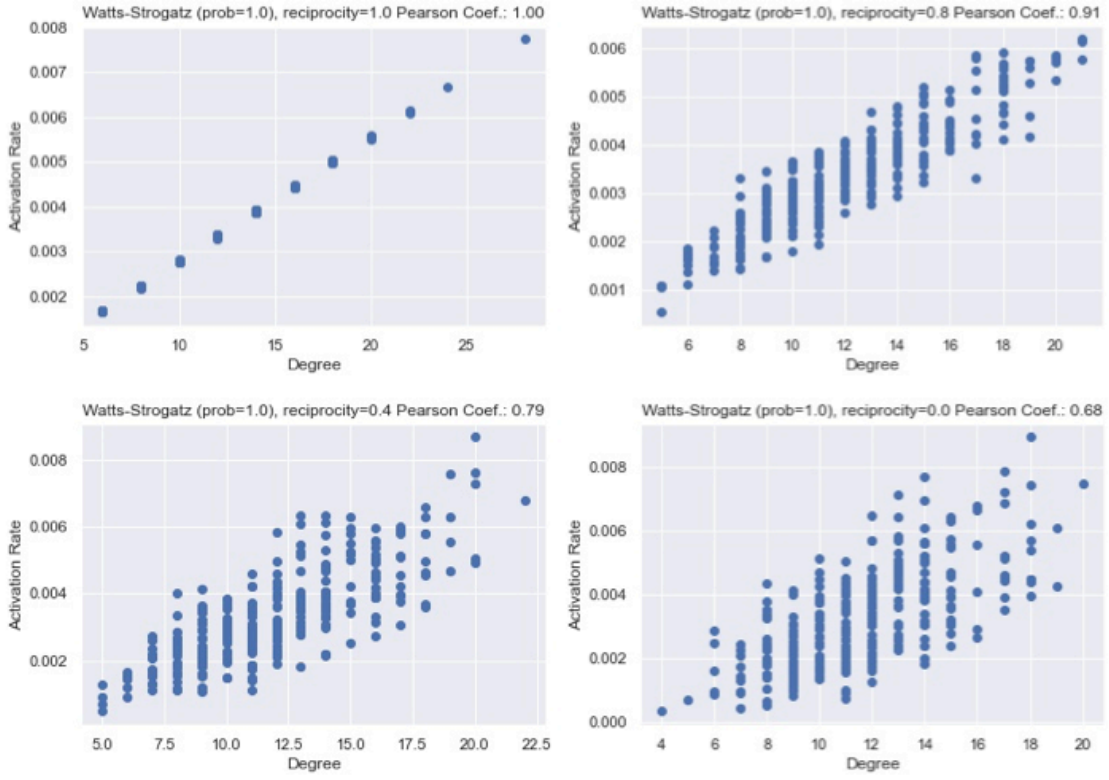
[13]:



0.4 Conclusion

It is clear that the activation rate is higly correlated with the degree of a network for undirected graphs.

As the reciprocity of the network decreases the correlation becomes weaker.

0.5 References

[1] Sousa, J. P., Comin, C. H., Costa, L. F., Topology and Dynamics in Complex Networks: The Role of Edge Reciprocity, arXiv:1711.08838, Nov. 2017.