OLGA VALLS

COMPLEX NETWORKS

LAB01: Structural descriptors of complex networks

a) Numerical Descriptors

For this part of the Laboratory, the NetworkX Python library has been used, as it's quite easy to compute the main structural descriptors.
The software Gephi has been also used to visually see the shape of some of the networks and check some of the results computed via NetworkX.

In the following tables, the descriptors for the Networks are shown:

TOY CATEGORY

Descriptors	**circle9**	**star**	**graph3+1+3**	**grid-p-6x6**
Number of nodes	9	9	7	36
Number of edges	9	8	8	72
Minimum degree	2	1	2	4
Maximum degree	2	8	3	4
Average degree	2.0	1.7777	2.2857142857142856	4.0
Average clustering coefficient	0,0	0.0	0.6666666666666667	0.0
Assortativity	nan	-1.0	-0.6	nan
Average path length	2.5	1.7777	2.1904761904761907	3.085714285714286
Diameter	4	2	4	6

MODEL CATEGORY

Descriptors	homorand_N1000_K4_0	ER1000k8	SF_1000_g2.7	ws1000
Number of nodes	1000	1000	1000	1000
Number of edges	2000	3956	1668	3000
Minimum degree	4	1	3	3
Maximum degree	4	17	24	13
Average degree	4.0	7.912	3.336	6.0
Average clustering coefficient	0.002	0.00804211017740429	0.0066504543070635405	0.004364840714840713
Assortativity	nan	-0.016833267357878608	-0.0019608989554759882	-0.09992885591125493
Average path length	5.64	3.569777777777778	5.4688268268268265	4.091303303303303
Diameter	9	6	12	6

REAL CATEGORY

Descriptors	zachary_unwh	airports_UW
Number of nodes	34	3618
Number of edges	78	14142
Minimum degree	1	1
Maximum degree	17	250
Average degree	4.588235294117647	7.817578772802653
Average clustering coefficient	0.5706384782076823	0.4957489312349583
Assortativity	-0.47561309768461457	0.04622413053190781
Average path length	2.408199643493761	4.439594641910406
Diameter	5	17

b) <u>Plot the degree distributions (PDF, probability distribution function) and the complementary cumulative degree distributions (CCDF, complementary cumulative distribution function) for the following networks:</u>

For this part of the Laboratory, the matplotlib.pyplot Python library has been used to create the plots.

The **log-scale plots** are presented in the cases where the linear-scale presents a power-law tail, which are the cases for *SF_1000_g2.7* and *airports_UW* networks.

- For the **PDF** plot, on the left, in the x axis, the widths of the bins are constant on a logarithmic scale, where the bins of the range of logs for the different k degrees of the network are shown. The y axis shows the estimation of vertices having degree k, in log scale.
- For the **CCDF** plot, on the right, the x axis shows the bins of the range of logs for the different k degrees of the network, as the y axis shows the accumulation of the estimations for the probabilities for each log-scale bin.

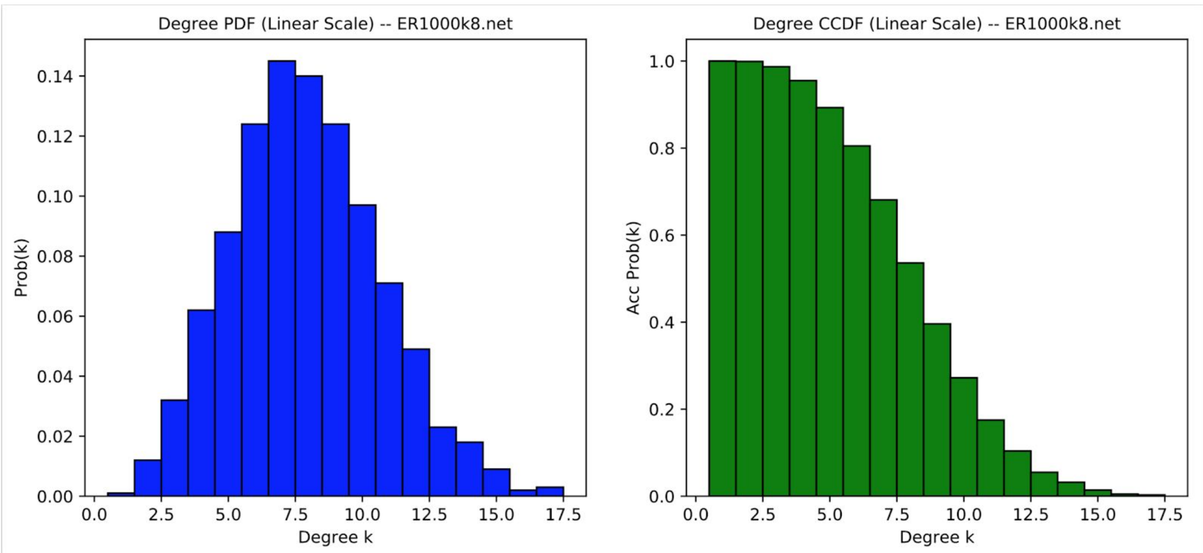
For the other two cases, *ER1000k8* and *ws1000*, the **linear-scale plots** are presented.

- For the **PDF** plot, on the left, the x axis shows the different k degrees of the network, as the y axis shows the estimation of vertices having degree k.
- For the **CCDF** plot, on the right, the x axis shows the different k degrees of the network, as the y axis shows the accumulation of the estimation of vertices having degree k.

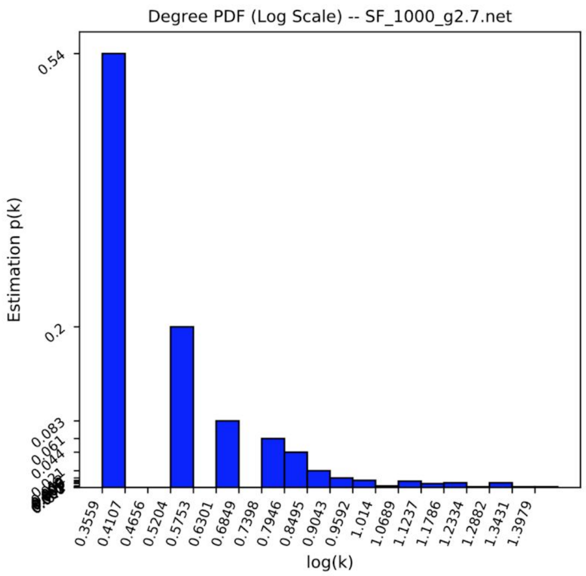
Below, the **PDF** and **CCDF** plots are shown, where the number of bins for the log-scale is 20 as it showed most defined plots than for 10 bins.

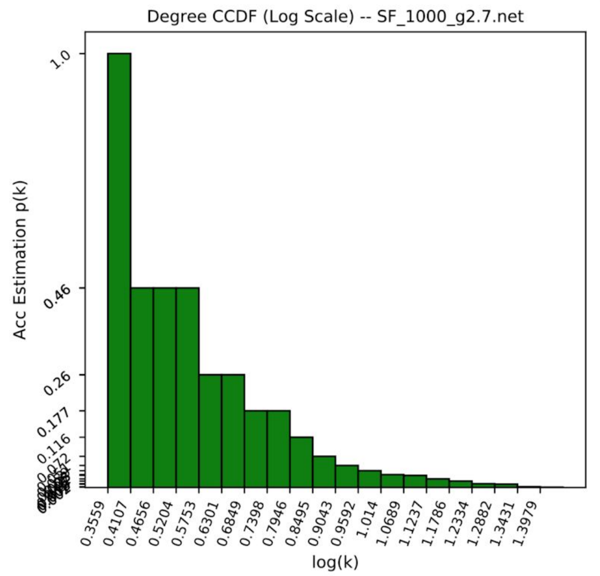
MODEL CATEGORY

ER1000k8 network → Linear-scale

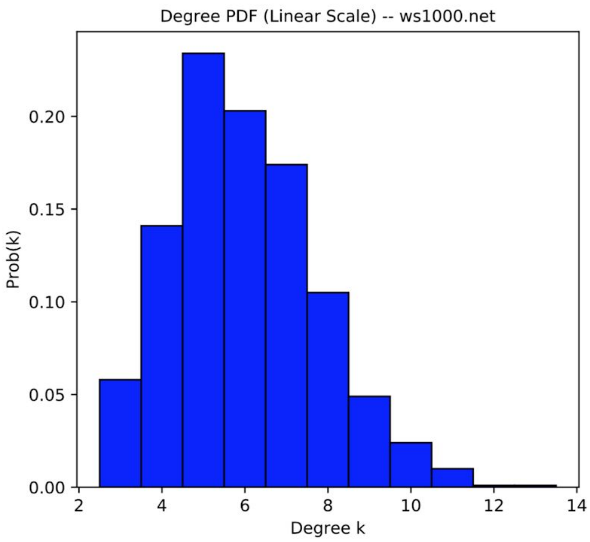


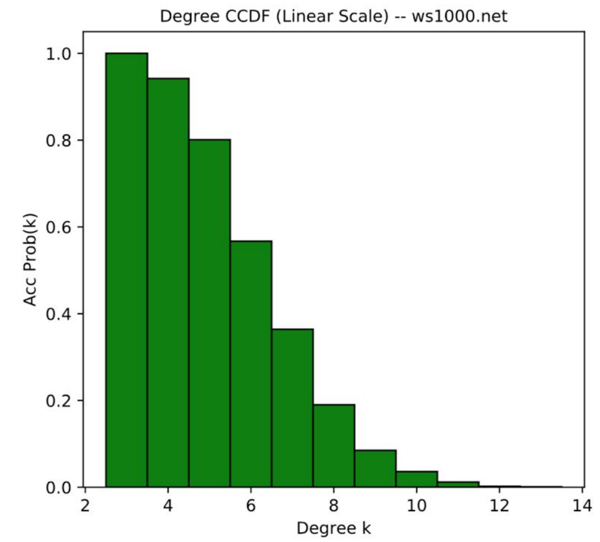
SF_1000_g2.7 network → Log-scale





ws1000 network → Linear-scale





REAL CATEGORY: airports_UW network → Log-scale