

Assignments \mathcal{N}^o 1

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Please, send the solutions (in .PDF and .R files) to `viviana.amati@uni-konstanz.de` and `juergen.lerner@uni-konstanz.de` by Monday 02.11.2015

Task 1: Uniform Random Graph Model

2 points

Assume we have drawn a random graph from the uniform random graph model on the set of all undirected, loopless graphs with n vertices. What is the probability that this graph has exactly m edges?

Task 2: Structural Balance

4 points

Let Δ the set of undirected triangle graphs, in which each edge is either labeled positive or labeled negative — that is, instead of being present or not, each of the three edges is either positive or negative. Define a random graph model on Δ , such that the three following conditions hold at the same time. (You have to proof that these conditions hold.)

- (1) All balanced graphs are more probable than unbalanced ones.
- (2) All dyads are pairwise independent.
- (3) Every dyad depends on the two others.

Task 3: $\mathcal{G}(n, p)$ characterization

4 points

Proof the following three properties of the $\mathcal{G}(n, p)$ model:

- (1) The edge probability of every dyad is equal to p .

- (2) The model is fully independent.
- (3) There is just one model satisfying properties (1) and (2).

Task 4: Preparing data for further analysis

5 points

- (a) Import (as R matrices) the adjacency matrices `klas12b-net-1`, `klas12b-net-2`, `klas12b-net-3`, `klas12b-net-4` in R.
 - (a.1) With respect to every matrix: delete the 21st row and the 21st column corresponding to a pupil who did not always fill the questionnaire.
 - (a.2) Replace the missing links in each wave (coded by 9) by values of the previous wave (e.g. missing links in second wave by values of the first wave).
 - (a.3) Export the four matrices in .csv (comma separated) files. Name the files `net-1.csv`, `net-2.csv`, `net-3.csv` and `net-4.csv`.

- (b) Import the file `klas12b-demographics.dat`.
 - (b.1) Delete the 21st row.
 - (b.2) Add a (first) column with an id for each pupil (i.e. numbers from 1 to 25).
 - (b.3) Name the columns `id`, `gender`, `age`, `ethnicity`, `religion`.
 - (b.4) Export the result in a .csv (comma separated) file named `demographics.csv`.

- (c) Import the file `klas12b-delinquency.dat`.
 - (c.1) Delete the 21st row.
 - (c.2) Add a (first) column with an id for each pupil (i.e. numbers from 1 to 25).
 - (c.3) Replace missing values (coded by 0) by value of previous wave (succeeding wave if no previous value is available).
 - (c.4) Name the columns `id`, `wave.1`, `wave.2`, `wave.3`, `wave.4`.
 - (c.5) Export the result in a .csv (comma separated) file named `delinquency.csv`.