Network Science

Lab #1
Scale free properties

Timetable

- Lab 1 – Fri Oct 12
  - Scale free properties
- Lab 2 – Fri Oct 19
  - Albert-Baràbasi model
- Lab 3 – Fri Oct 26
  - Assortativity
- Lab 4 – Fri Nov 16
  - Ranking
- Lab 5 – Fri Nov 23
  - Community detection – Spectral
- Lab 6 – Fri Nov 30
  - Community detection – PageRank-Nibble
- Lab 7 – Fri Dec 7
  - Gephi

MATLAB Licence

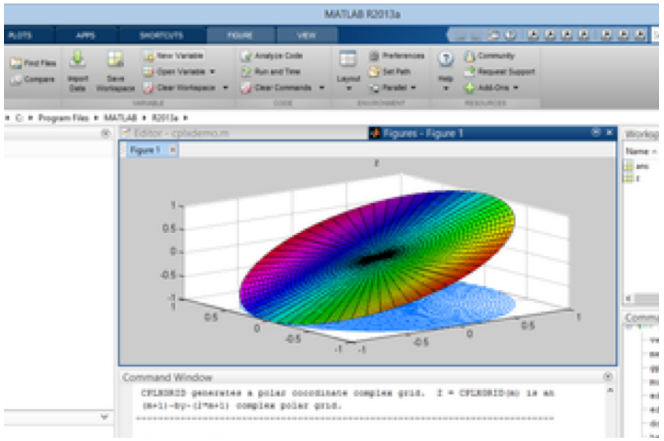
MATLAB = MATrix LABoratory by MathWorks

MATLAB *"is a numerical computer environment which allows matrix manipulations, plotting of functions and data, implementation of algorithms"* [wiki]

Total Academic Headcount
Campus & Student

You can freely install MATLAB in your laptop.

https://www.csia.unipd.it/servizi/servizi-utenti-istituzionali/contratti-software-e-licenze/matlab



Lab 1 – Assignment 1

Wikipedia voting dataset
(you can find it in the elearning website)

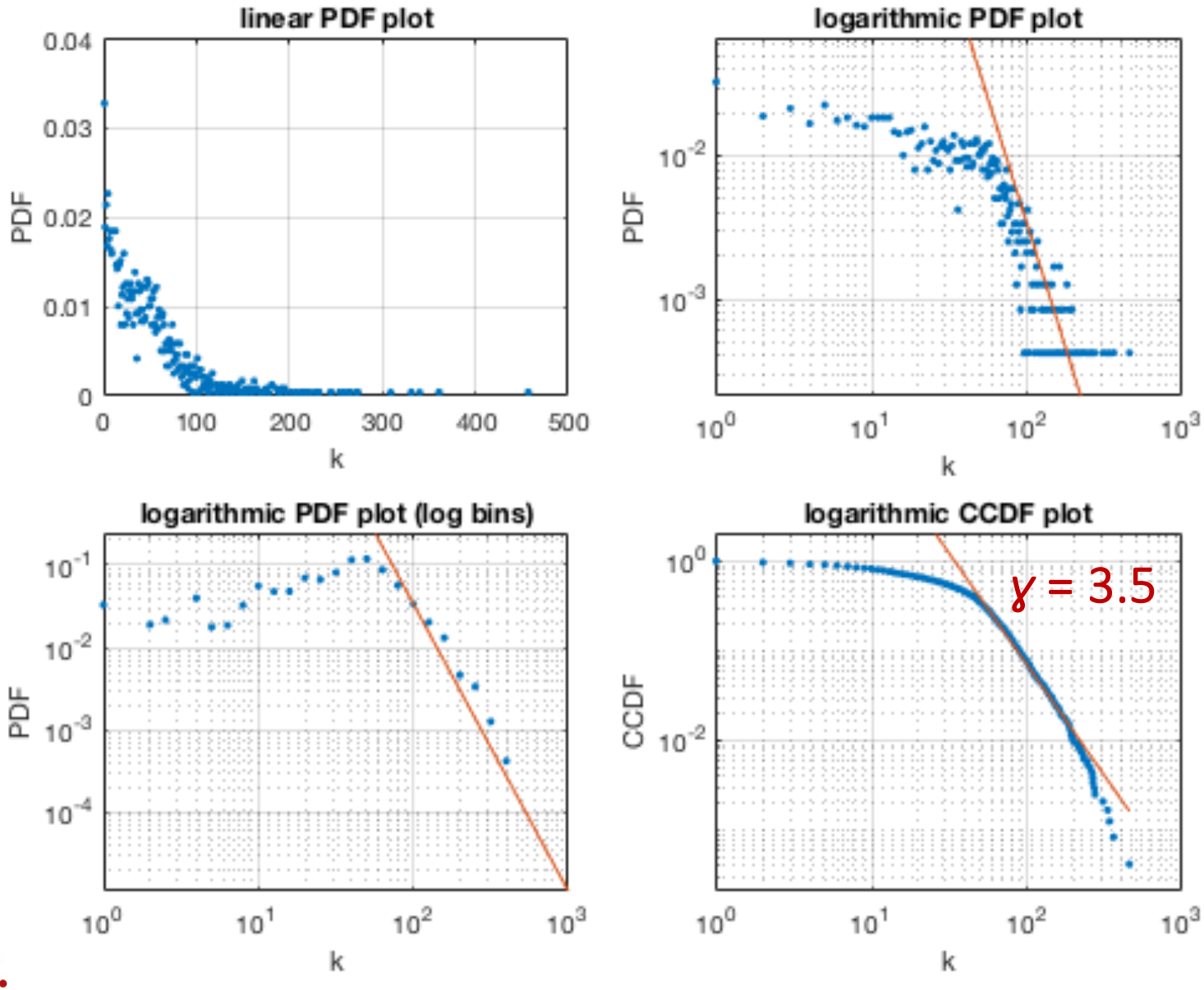
https://snap.stanford.edu/data/wiki-Vote.html

1. Perform network pre-processing
2. Show PDF and CCDF plots
3. ML estimate the exponent

$$\gamma = 1 + \sum_i 1 / \sum_i \ln(k_i / k_{min})$$

4. Graphically check consistency

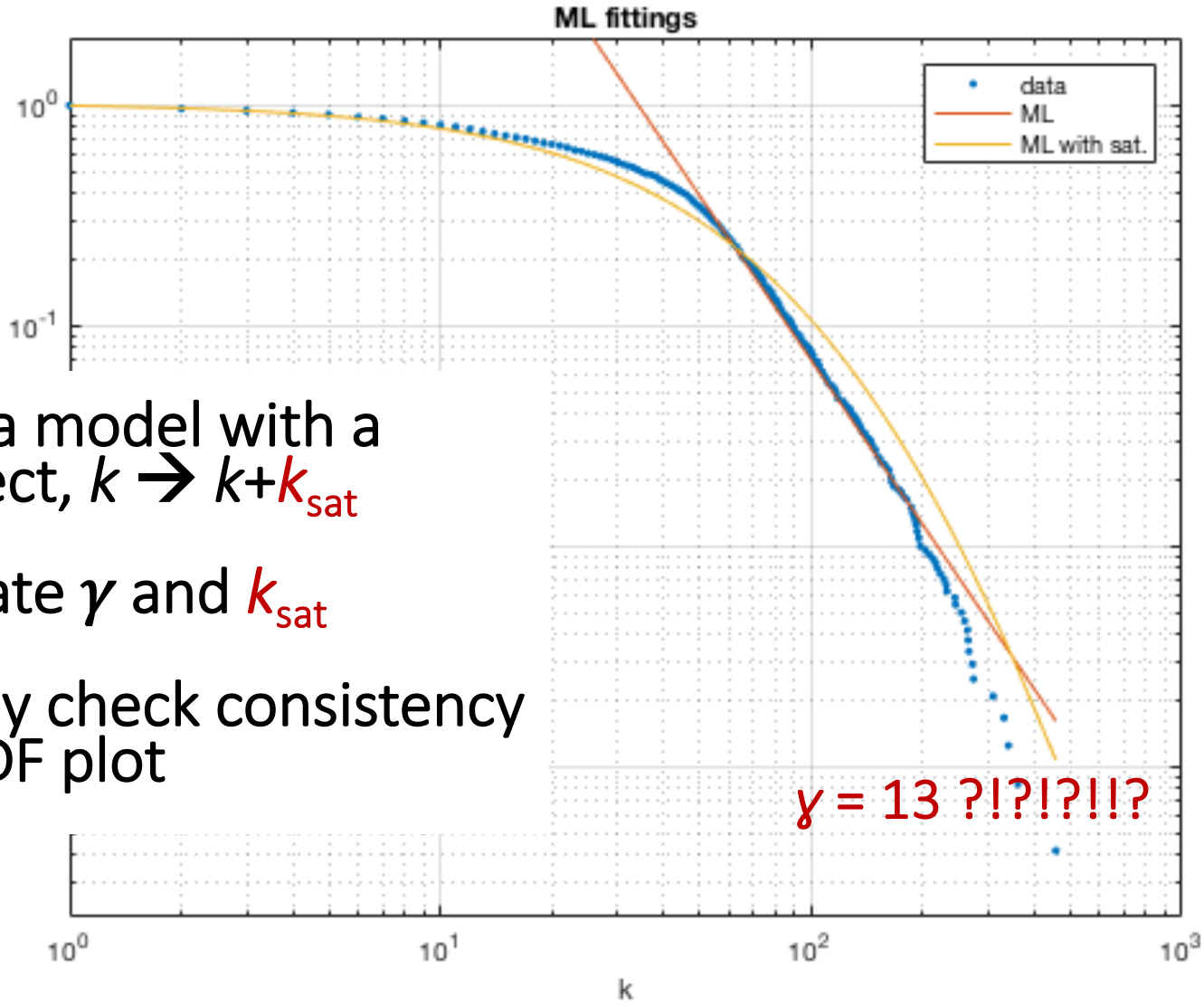
Lab 1 – Sketch of the result



Lab 1 – MatLab hints

1. Sum: sums a (sparse) matrix by columns or rows
2. Unique: finds the unique elements of a vector
   unique([1 2 3 2 1]) = [1 2 3]
3. Cumsum: cumulative sum
   cumsum([1 2 3 2 1]) = [1 3 6 8 9]
4. Mean: computes the average
5. Histc: counts occurrences in a vector
   histc([0.5,0.9,1.3],[0 1 2]) = [2 1 0]
   histc([-1,0,1,2,3],[0 1 2]) = [1 1 1]
6. Loglog: logarithmic plot

Lab 1 – Assignment 2



This time use a model with a saturation effect, $k \rightarrow k+k_{sat}$

1. ML estimate γ and k_{sat}
2. Graphically check consistency in the CCDF plot

Lab 1 – ML estimate

- PDF model

$$p(k \mid \gamma, k_{sat}) = (\gamma\text{-}1) \cdot (k+k_{sat})^{-\gamma} / (k_{min}+k_{sat})^{1-\gamma}$$

- CCDF model

$$P(k \mid \gamma, k_{sat}) = ((k+k_{sat})/(k_{min}+k_{sat}))^{1-\gamma}$$

- ML target function (to be maximized)

$$f(\gamma, k_{sat}) = \sum p(k_i \mid \gamma, k_{sat})$$

- ML estimate of the exponent (for a given k_{sat})

$$\gamma(k_{sat}) = 1 + 1/\text{mean}\{ \log[(k+k_{sat})/(k_{min}+k_{sat})]\}$$