

September 17th, 2021 – Part II

A.Y. 2020/21

Carefully read the following scenario and answer the questions listed below.

A study is conducted with the aim to **understand the brain organization** in a **neurological pathological condition** mostly affecting **elderly patients**.

The subjects enrolled in the study undergo an **EEG screening** during the **resting state**. They are seated in a comfortable position in a quiet, dim room and they are just asked to relax for the duration of the recordings.

Six cortical regions (3 for each hemisphere, 2 in the frontal lobe and 1 in the parietal lobe) are selected for a connectivity study of **causality in the statistical sense**. The goal is to describe the network properties in terms of **integration** and **segregation** between different modules.

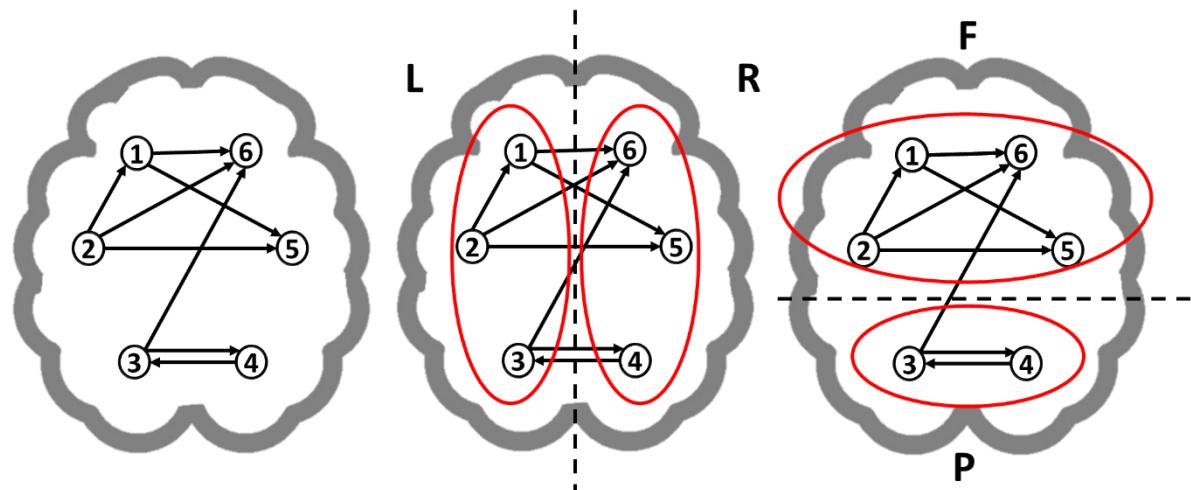


Fig. 1-A

Fig. 1-B

Fig. 1-C

Questions

Q1 – Indicate which connectivity estimator you would use to perform the network analysis.

Motivate your choice. NB: the answer and the motivation are independent from the networks depicted in Fig.1. (3 points)

(write the answers in the exam.net editor)

Q2 – Assuming that the network analysis returns the functional network reported in **Fig. 1-A**:

Q2.1: Extract the corresponding **adjacency matrix** (*1 point*)

Q2.2: Compute the **Indegree** and the **Outdegree** for each node (*1 point*)

Q2.3: Compute the **Divisibility D** and the **Modularity Q** of the network, considering the two hemispheres as classes, like in **Fig. 1-B**: $C=[1,1,1,2,2,2]$ (*2 points*)

Q2.4: Compute the **Divisibility D** and the **Modularity Q** of the network, considering the frontal lobe and the parietal lobe as classes, like in **Fig. 1-C**: $C=[1,1,2,2,1,1]$ (*2 points*)

(*write the answers on paper*)

Q3 – Given the results obtained at Q2, indicate which of the two divisions in classes (left-right or fronto-parietal) corresponds to a more segregated (=divided in two modules) network. **Motivate your answer.** (*2 points*)

(*write the answers in the exam.net editor*)