**Individual Assignment questions (Social Network)**

The questions below are related to the group assignment and lectures but are not suitable for group work. Please answer these questions individually in writing, and submit the result on Blackboard by the end of April 11th.

Read the research paper “Students under lockdown: Comparisons of students’ social networks and mental health before and during the COVID-19 crisis in Switzerland”, available from: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0236337

Answer following quetions within 600 words: 1) The five types of social relations the authors are taking into account to build the social network and how these networks might differ in function, intimacy and stability 2) What types of metrics do the authors use to measure the social network during and prior lockdown? And how do these metrics change? 3) How do the authors analyze the face-to-face interaction network and digitial interaction network during COVID-19 crisis? What are their conclusions? 4) What do the author mean by ‘survivied ties’? And which type of social ties survive better during COVID time? 5) What will be the policy implications that you will draw based upon their results? (Question 1, 8 points)

Rumors are the basis for viral marketing and, therefore, rumors diffusion is a topic widely studied. Zanette 2001 developed a rumor spreading model based on the epidemiological SIR model. Read the paper of Zanetee 2001 and answer 1) how did they reframe the popluations in epidemiology (i.e., S, I, R) into a rumor spreading process? Mazzoli et al. (2018) twisted the model into an agent-based model (ABM) to simulate rumor spreading. Read the paper of Mazzoli et al. (2018) and summarize 2) how did Mazzoli et al. set up an ABM to simulate the real-like diffusion of information and misinformation (e.g., what are the agents in their ABM, assumptions on the micro behaviours of agents, and key paramters)? And 3) how well did Mazzoli’s model reproduce the diffusion of information during the announcement of the discovery of the Higgs Boson on Twitter? (Provide your answer within 500 words, Question 2, 8 points)

Paper:

Dami´an H. Zanette, 2001. Critical behavior of propagation on small-world networks, avaliable from <https://arxiv.org/abs/cond-mat/0105596>.

Mattia Mazzoli, Tullio Re, Roberto Bertilone, et al, 2018. Agent Based Rumor Spreading in a scale-free network, available from: <https://arxiv.org/abs/1805.05999>.

Describe the principles of independent cascade, threshold models, and epidemiology models such as SIS and SEIR models. Can you intefer the assumptions that each of them make on the dismission of signal within the network? Under each model, provide one real-world example that might fit their assumptions and explian why. (Question 3, 8 points)

In Ex 3 of group assignment, the threshold model assumes a deterministic threshold, e.g., one will adopt only if the fraction of one’s neighbour exceed a certain amount (threshold *qi*):

F(xi)=1 | xi>=qi

F(xi)=0 | xi<qi

where F(xi) is the probability function of node i to adopt, subject to the xi, which is the fraction of adopters in node *i*’s neighbours; and qi is the threshold of node *i*.

Such a clear-cut adoption function, however, might violate the complexity in human being’s decision making process. Empricial adoption rates with k and k-1 neighbouring adopters ofter have similar magnitudes. Rather than positing determinism, analyses of discrete choice problems typically hypothesize that individuals are random utility maximizers leading to postive choice probabilities. Embracing such complexties in human decision-making, efforts are made to fine tune the probability function of threshold model.

One way is to allow a small proabality of below-threshold aodption.

F(xi)=1 | xi>=q1,i

F(xi)=pi | q2,i <xi<q1,i

F(xi)=0 | xi<q2,i

where F(xi) is the probability function of node i to adopt, subject to the xi, which is the fraction of adopters in node i’s neighbours; q1,i is slightly smaller to the original qi, and exceed which will lead to an adoption for sure; q2,i is somewhere between q1,i and 0, which will lead to a small chance of adoption (pi) if exceeds.

The other way is to change the deterministic adoption function to an ‘S-Shape’ logit function.

Where F(xi) is the probability function of node i to adopt, subject to the xi, which is the fraction of adopters in node *i*’s neighbours; and qi is the threshold of node *i*; b is a new parameter that is introduced to control the shape of the probability funciton.

For a given seed size, change the deterministic probability function to the above two more realistic assumptions (i.e., one allows below-threshold adoption, the other with S-shape logit function) and play around the parameters such as pi, q1,i, q2,i and b. Check how does such more realistic assumptions affect 1) final diffusion size, 2) the shape of diffusion curve, and 3) the target nodes of seeding. (Notes: to make results comparable, you should make sure the expected values of thresholds are the same cross different assumptions; you can work on the network and the threshold model for the vegetarian reciept in the group assignment or use your own data and threshold distribution; you should test the result for different seed sizes as it might change your conclusion) (Question 4, 14 points)

**BONUS QUESTION:**

After the introductions of more realistic assumptions of threshold, do we need more weak ties to accelerate diffusion, or the opposite (i.e., we need more strong ties to accelerate diffusion)? Can you test your conjecture by rewiring the network strucutre (e.g., adding long ties or triadic closure) and monitoring the change of diffusion scale and speed? (Question 5, 5 points).