Papers in Physics, vol. 1, art. 010003 (2009)

www.papersinphysics.org

Received: 2 October 2009, Accepted: 6 October 2009
Edited by: M. C. Barbosa

DOI: 10.4279/PIP.010003

ISSN 1852-4249

Commentary on "A note on the consensus time of mean-field majority-rule dynamics"

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In this Commentary, I review the article by D. H. Zanette on the consensus time of mean-field majority-rule dynamics [1]. The paper identifies two different regimes for the mean field (MF) version of the majority-rule (MR) opinion dynamics, characterized by different dependences on the population size N. In one of them, corresponding to gradual persuasion, the typical known logarithmic dependence is observed. The novelty appears in the alternative regime, associated with very drastic events, which is governed by a power law. In this Commentary, I point out a couple of minor points that, in my opinion, deserve further clarification. I also make some general remarks and briefly discuss some features which can be incorporated in order to use the model in more realistic contexts.

The author addresses the problem of the dependence of the consensus time with the population size in a mean field (MF) version of the majority-rule (MR) opinion dynamics. The size of the group of agents selected at each evolution step, G, is drawn from a probability distribution p_G, which for large G decays as a power law.

The main result is that, for MFMR, the consensus time S exhibits two distinct regimes, characterized by different dependences on the population size N. If the exponent of p_G is larger than 2, S has a dependence of the kind $N \log N$ which is already known from analytical results for constant G. On the other hand, if the exponent of the distribution of group sizes is less or equal than 2, the dependence of S on N is also given by a power law. It is interesting that the two regimes are related to two different mechanisms of consensus attainment: gradual persuasion versus drastic large-G events which involve the whole population at a single evolution step.

Some points that would need further clarification are:

a. The equivalence of the MFMR to a random walk under the action of a force field, mentioned at the end of page 1, is an interesting issue. For those who are not experts on this area I think that it deserves a more detailed explanation; indeed, the walk has variable step length since only the agents with the minority opinion flip, and the direction of the force seems to exhibit a sort of persistence.

b. What is the rationale for considering values of G larger than the population size? In fact, the maximum physically possible G is N. Perhaps it is for technical reasons or difficulties implementing the constraint that G cannot be greater than N?

Some considerations, a little beyond the scope of the majority-rule opinion model, on features concerning realistic situations which are not included in this model:

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1. *Individual heterogeneity.* There are always individuals who are not susceptible to the MR for their convictions, or by necessity, and resist the majority opinion. In addition, there are individuals who can change their mind not only by following *herd behaviour* but also through other mechanisms like learning from experience, etc.

2. *Space.* The spatial structure might have a relevant effect on the MR opinion dynamics. Has this been studied? In general, it turns out that spatial correlation may introduce important differences in agent based models.

3. *Chance.* The application of the MR is completely deterministic. The effects of introducing a stochastic component is something worth exploring. For example, in the form that some of the individuals in the minority of G do not flip or some in the majority suffer spontaneous flips.

4. *Population dynamics.* For long times it seems unavoidable to consider births and deaths, this turnover population seems to be a dynamic source for the opinion formation. Maybe this could be implemented by a noise term like the one mentioned above.

5. *Opinion Formation Factors.* Mass media signals, advertising and propaganda operating over the individuals play an important role in opinion formation and can have an important impact. It seems that this could be modeled by external fields.

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[1] D H Zanette, *A note on the consensus time of mean-field majority-rule dynamics*, Pap. Phys. **1**, 010002 (2009).