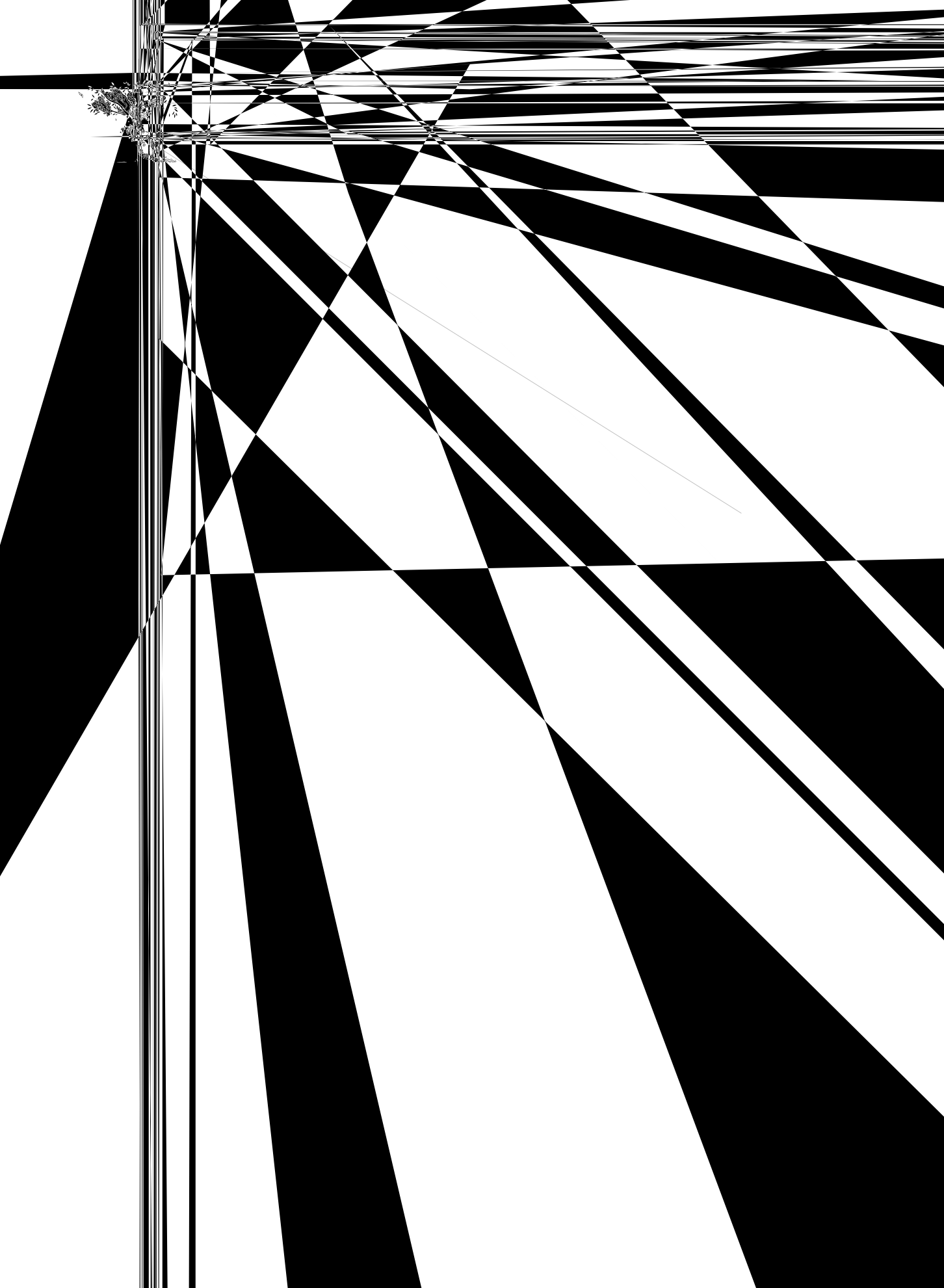

sociological problems and statistical theory, in which subject the most famous works is the Nash equilibrium proposed by John Nash in 1950 [3] and 1951 [4]. Generally, game theory provides a formal language for the representation and analysis of interactive situations, where several players take actions that affect each other.

Game theory mainly has two branches, namely cooperative and non-cooperative game theories. The former assumes that the players can communicate and sign binding agreements, while the latter assumes that the players are either unable to communicate or able to communicate but cannot sign binding contracts. Since Smith and Price [5] introduced game theory to evolutionary and behavioral studies in the 1970s, its application in this area has developed rapidly. In essence, this theory was first developed by RA Fisher in his attempt to explain the approximate equality of the sex ratio in mammals. Clearly, the game theory has proven itself to be a particular use in biological studies [6].

There is no doubt that the confluence between statistical genetics and game theory will open a new direction in the future for genetic research in mathematical biology. In the long term, this will not only advance and promote the general theory of genetic mapping into medical and agricultural genetics, but also increase the application spectrum of game theory. Pfeiffer et al. [7] introduced game theory to investigate how the cooperation and competition of molecules lead to the evolution of ATP-producing pathways. As we know, production of a specific phenotype is a consequence of the trade-off between competition and cooperation among the underlying components pervasively expressed at different levels of organization. Thus, Zhu et al. [8] integrated game theory with genetic mapping of complex traits, and this provides new opportunities to enhance the precision and resolution of quantitative trait locus mapping for complex traits.

2. Potential applications in plants

Potential factor in the application of epigenetic game theory in plants and humans. The cooperation and competition mechanisms in epigenetic game theory are conditional on vigorous sperms and oocytes. If sperms or oocytes have no vigor, it may be necessary to incorporate new parameters in the current epiGame framework. For example, Ma et al. [9] demonstrated a correlation between zika virus and testis infection/damage and suggest that zika virus infection, under certain circumstances, can eventually lead to male infertility. Actually, this situation is more complicated in plants because genes control plant fertility and sexual reproduction requires recognition between the male and female gametes. For example, peptides have been identified as female attractants, while between male as fertility

complicated, some genes cooperate and other genes compete. These relationships can be described by ODEs. This is similar to the epiGame framework.

3. Future issue

The epiGame framework is based on ODE. As described by Karlebach and Shamir [12], simple ODE systems can be formulated by an analytical solution, while large or complicated networks always require a numerical solution. When the number of ODEs is not too large, it is not difficult to estimate their parameters. In this situation, many algorithms, such as fourth-order Runge–Kutta algorithm, generalized profiling approach, Bayesian estimation, nonlinear mixed effects model method [1] and continuous optimization approach [13], are available. If the number of ODEs is too large, it is difficult to estimate their parameters. Therefore, this issue should be addressed in the future.

Acknowledgement

This work was supported by Huazhong Agricultural University Scientific & Technological Self-innovation Foundation (Program No. 2014RC020).

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