The economics of queueing (M S Turner)

Non equilibrium statistical mechanics has given rise to formalisms for treating discrete entities (queuing individuals) on a one dimensional lattice ("the queue"). Many models [1,2] are built around the assumption that a forward move is only permitted into a vacant site, which gives rise to jamming [3] (much like in traffic).

More recently these models have been modified to incorporate a number of different kinds of walker. These walkers can be classified as "first class", "second class" etc. The dynamics are then restricted so that walkers of the n^{th} class can overtake workers of class $m < n$. The velocity of these walkers is then a known functional of the densities of all walkers $v_n\{\rho_i\}$.

In this project it is proposed to construct a simple economic model of this process in an environment in which each walker generates financial resources by moving quickly (productively) through the queue. Wealthy walkers have an incentive to pay poorer walkers to relegate themselves to a lower class of overtaking priority and poorer (or slower) walkers have an incentive to take this reward.

The purpose of this mini-project is to investigate the dynamics of the financial exchange between walkers. Is a steady state wealth (velocity) distribution ever reached and how does this depend on the details of the financial constraints? The student may first assume quasi-statically slow adaptation in which analytic results for the mean velocity and diffusion constant of walkers can be used, together with a "negotiation" phase, in which different strategies compete to remain economically viable. This project has the advantages that it realises an economically well defined game, with potential real world applicability, for which numerous analytic results are already available. Because of this there is no need to carry out time consuming simulations of the dynamics. Instead analytic results for the dynamics can be utilised, allowing the student to focus directly on the competition between different economic strategies.

The idea of using an analytically tractable dynamic model to construct a well-defined "bottom up" model of an economic system is appealing, primarily because of the rigour of the results so obtained. Science has taught us that it is often useful to utilise exactly solvable models, even if these are over-simplified, in order to advance our understanding of complex systems. There is extensive scope to extend this study in a variety of directions in order to develop a PhD proposal.

References

[1] http://xxx.soton.ac.uk/abs/cond-mat/0110630
[2] http://xxx.soton.ac.uk/abs/cond-mat/9910242
[3] http://xxx.soton.ac.uk/abs/cond-mat/9712112
[4] http://www.sbfisica.org.br/bjp/files/v30_42.pdf