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STOCHASTIC MATCHING MODELS

BEHROOZ NIKNAMI

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Stochastic matching models are buffer queues that track and match items which are submitted over time. Items are matched based on their compatibility with other items which are present in the buffer. In the presence of multiple suitable matches, the match is chosen based on some predetermined priority discipline. After finding a match, the item and its pair will depart the system.

Stochastic matching models are stochastic in the sense that the 'type' and 'arrival pattern' of items into the system over time is governed by some stochastic process. Whilst this process can be very general, throughout the work, we take it to be a marked Poisson process over some space of item types and compatibilities. We formalise what this space will be in the context of the different models we consider.

Depending on these settings, stochastic matching models can describe a diverse range of phenomena in business, healthcare or economics. Two examples are the double auctions underlying stock markets or organ donation registers.

In this work, we review some emerging results concerning first-come-first-served priority matching models and their equilibrium behaviour. We develop the notion of *benevolent arrivals* and extend the results for matching models to models which also contain these types of arrivals. Benevolent arrivals are items which match compatible items that are already in the buffer queue; however, they will otherwise depart unmatched and *not* join the buffer to wait for a later compatible arrival with which they can match.

In addition, we explore how a novel reversibility argument, first proposed in [1], can be used to find tractable performance measures for first-come-first-served priority systems. We then explain how these could be used to optimise performance by, for instance, minimising expected congestion.

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We also review results on double auctions which are stochastic matching models with an ordered priority discipline. We then study the behaviour of double auctions with the first-come-first-served priority discipline. This is done to shine some light on the similarities and differences which may arise by altering the priority discipline and using the better understood first-come-first-served priority.

Reference

[1] I. Adan, A. Bušić, J. Mairesse and G. Weiss, 'Reversibility and further properties of FCFS infinite bipartite matching', *Math. Oper. Res.* **43**(2) (2018), 598–621.

BEHROOZ NIKNAMI, Department of Mathematics and Statistics,
University of Melbourne, Parkville, Victoria 3010, Australia
e-mail: bniknami@student.unimelb.edu.au

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