PhD student project:

Stochastic control and optimal stopping for game theory

Main supervisor: Kristoffer Lindensjö[1]

Applicants are expected to have a strong background within stochastic processes or probability. Knowledge of game theory, mathematical finance, economics or insurance can be a minor advantage but is in no way a requirement.

Suppose we can decide when to stop a stochastic process and that we want to do so according to an optimality criterion. We then face an optimal stopping problem. Suppose instead that we can control, to some extent, the evolution of a stochastic process and that we want to do this according to an optimality criterion. We then face a stochastic control problem. Stochastic control and optimal stopping theory has proven to be extremely useful for modelling decision making over time in random environments with applications in e.g., biology, engineering and mathematical economics/finance/insurance.

In the classical setting, stochastic control and optimal stopping theory considers one decision-maker. In many important real-world situations there are, however, two or more decision-makers with non-aligned objectives, and realistic modelling then requires game theory formulations.

Indeed, the recent years have seen a large and increasing interest in **stochastic dynamic games**—i.e., game theory regarding the control and stopping of stochastic processes dynamically over time.

Classical game theory relies largely on so called *randomized strategies* and *fixed-point techniques*. However, although there are strong indications that a general stochastic dynamic game theory also requires randomized strategies and fixed-point techniques, it holds that the role of these for stochastic dynamic game theory is to a large extent unexplored.

The general area of this project is stochastic control and stopping theory for game formulations in continuous time. A large variety of topics and problems can be studied within the project; both theoretical and more applied, based on the successful applicant's background and interests. Suggestions for specific research problems will be provided by the supervisor, based on discussions with the successful applicant. Examples of possible research areas in the project include:

- **Stopping games, stochastic control games and/or singular stochastic control games** with a focus on e.g., (i) developing general theory based on randomized strategies and/or fixed-point techniques, and/or (ii) studying specific applications withing e.g., mathematical economics/finance/insurance.
- **Games with combined features**; e.g., controller-stopper games.
- **Auction theory.** Recently, the Nobel Memorial Prize in Economic Sciences was awarded to two economists for their contributions to the theory of auctions. An exciting possibility is to develop a theory for dynamic auctions within a stochastic control/stopping setting.

If you have any questions please do not hesitate to contact me at kristoffer.lindensjo [at] math.su.se. If you want to know more about the mathematical methods that I rely on in my research then you may have a look at my recent papers (or contact me); see https://www.su.se/english/profiles/krli3389.

[1] Information about the supervisor can be found at https://www.su.se/english/profiles/krli3389.