# PhD research topic proposal

**BME, Doctoral School of Mathematics and Computer Science**

**Name and degree of supervisor :**

Tóbiás, András József, PhD

**Are you willing to supervise Stipendium Hungaricum applicants?**

No.

**Title of the topic:**

Population-genetic models with clonal interference: The case of moderate selection

**Short description:**

In population genetics, an intermediate regime between rare and frequent mutations was introduced by Gerrish & Lenski (1998), where the frequency of mutations per generation is inversely proportional to the logarithm of the population size. Here, most of the time there is a single resident population, most mutants are born from the current resident, and clonal interference, i.e., the interaction between multiple beneficial mutants plays a crucial role. In an ongoing research project, González Casanova, Hermann, Soares dos Santos, Tóbiás and Wakolbinger study a population-genetic mode in this regime. After a suitable rescaling of time, the logarithmic frequencies of sub-populations converge to a limiting process. This process is piecewise linear and a deterministic function of the random birth times and selective advantages of the successful mutants, which form a Poisson point process. A major question is the speed of increase of resident fitness in this process.
In this project, only the case of strong selection (whose strength does not vanish as the population size diverges) was studied. The doctoral candidate working on this topic shall investigate the case of moderate selection, i.e., when the selective advantages of mutants decay as a negative power of the population size. We expect that here, the limiting process still contains piecewise linear parts, but it also has jumps, related to extreme initial growth of mutants conditional on survival. Recently, Boenkost, González Casanova, Pokalyuk and Wakolbinger studied the survival probability of mutants in this selection regime, and their results may as well be useful for the PhD project.

**Requirements:**

Stochastic processes; Markov processes and martingales. Especially: Continuous-time Markov chains and their stationary distributions, Poisson process, martingale convergence theorems, branching processes, generators of continuous-space Markov processes. Preliminary knowledge in mathematical population genetics is not required, but it may help the candidate achieve the publication goal faster. There are no prerequisites in pure biology.

**Contact:**

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**Place of work:**

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