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## DK Summer School 2018

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### Direct and inverse problems in population dynamics

The aim of this course is an introduction to structured population models, to their mathematical analysis and the inverse problem consisting in estimating the division rate and selecting the most convenient "structuring" variable.

We shall first give a general overview of the models and their application domains, detailing the correspondence between the population view and the "microscopic" individual based models (modelled by stochastic branching processes).

We shall then focus on the inverse problem consisting in the estimation of the division rate. This is a key step in the calibration and selection of the models, and also a bridge between the (deterministic) population and the (stochastic) individual viewpoints.

This lead us to the question of model selection - which can be formulated as: how to be certain of what is the real "structuring" variable? This a very natural question since structured population models are often purely empirical, so that assessing their validity on the basis of quantitative results represents an important challenge of mathematical biology. Finally, we investigate how to model variability among cells, and its possible influence on the fitness of the overall population, in order to know whether variability may be seen as a benefit or a drawback.