THE COALESCENCE PROBLEM IN BRANCHING PROCESSES AND ITS APPLICATIONS

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Abstract: A branching process is a Markov process which has been commonly used to describe the evolution of a population in various research fields such as genealogy, physics, ecology, epidemiology, finance, etc. One way to investigate the population is to look forward to its future. But, when a population grows so old, it is always interesting to know what happened to it in the past. The coalescence problem provides a way to understand the structure of the population and the ancestry of the individuals in it.

Here, we will consider branching processes with different settings and, in each process, We pick two individuals from those who are alive at the current time by simple random sampling without replacement and trace their lines of descent backward in time till they meet for the first time. We call the common ancestor of these chosen individuals at the coalescent time their *most recent common ancestor*. The coalescence problem is to investigate the limit behaviors of some characteristics of this most recent common ancestor such as its death time and its generation number. Moreover, we will also apply the results from the coalescence problem to branching random walks.

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