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Mathematisches Kolloquium

The block containing 1 for exchangeable coalescent processes

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We consider exchangeable coalescent processes, which are Markovian processes $(\mathrm{II}_t)t\geq 0$. Their state space is the set of the partitions of $\mathbb{N}$ and all transitions are mergers of partition blocks. We focus on the behavior of the partition block $\mathrm{B}_1(t)$ at time *t* which contains 1 ∈ $\mathbb{N}$. Let f 1 = $(f_1(t))_{t\geq 0}$ be the asymptotic frequency process of 1 defined by f1(*t*) := $\lim_{n\to\infty} n^{-1}$ | B_1 (*t*) ∩ [*n*]|, where [*n*] := $\{1, \ldots, n\}$ and |A| denotes the cardinality of set *A*. For coalescent processes with dust, i.e. where *t* has a positive fraction of $i \in \mathbb{N}$ as singleton blocks $\{i\}$ with positive probability, f_1 is a jump-hold process which can be described via a stick-breaking procedure with uncorrelated stick lengths with common mean. We provide a closer look at the law of the first jump of f_1 for a subclass of coalescents with dust.

Consider the restriction of the coalescent process to [*n*] by intersecting all partition blocks with [*n*]. The restriction, the (Markovian) n-coalescent, can be interpreted as a random tree and used as a model for a gene genealogy of a sample of DNA sequences [*n*], whose mutations are modeled by a homogeneous Poisson point process with rate θ on the branches of this tree. We consider the size On of the partition block containing 1 in the *n*-coalescent at a random time Tn, given by the sum of the waiting time for the first merger of 1 and an independent exponential time with rate . On can be interpreted as the size of the smallest (non-trivial) family of sequence 1 which can be distinguished by the sampled sequences. We analyze the distribution of On for different *n*-coalescents and its asymptotics for *n* → ∞. We end with a discussion about the use of On as a test statistic to distinguish between differently distributed *n*-coalescents with mutation, modeling different evolutionary scenarios.