Mathematical Statistics
Stockholm University
Research Report **2017:3**,
http://www.math.su.se

A Multi-type Preferential Attachment Model

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April 2017

Abstract

A multi-type preferential attachment model is introduced, and studied using general multi-type branching processes. For the p-type case we derive a framework for studying the model where a type i vertex generates new type j vertices with rate $w_{ij}(n_1, n_2, \ldots, n_p)$ where n_k is the number of type k vertices previously generated by the type i vertex, and w_{ij} is a function from $\mathbb{N}^p$ to $\mathbb{R}$. The framework is then used to derive results for models with more specific attachment rates.

In the case with linear preferential attachment—where type i vertices generate new type j vertices with rate $w_{ij}(n_1, n_2, \ldots, n_p) = \gamma_{ij}(n_1 + n_2 + \cdots + n_p) + \beta_{ij}$, where γ_{ij} and β_{ij} are positive constants—we show that under mild regularity conditions on the parameters $\{\gamma_{ij}\}, \{\beta_{ij}\}$ the asymptotic degree distribution of a vertex is a power law distribution. The asymptotic composition of the vertex population is also studied.

Keywords: Multi-type preferential attachment; multi-type general branching process; power law degree distribution; asymptotic composition.