

# A CONTINUOUS-STATE POLYNOMIAL BRANCHING PROCESS

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**Abstract:** A continuous-state polynomial branching process is constructed as the pathwise unique solution of a stochastic integral equation with absorbing boundary condition. The extinction and explosion probabilities and the mean extinction and explosion times are computed explicitly, which are also new in the classical branching case. We present necessary and sufficient conditions for the process to extinguish or explode in finite times. In the critical or subcritical case, we give a construction of the process coming down from infinity. Finally, it is shown that the continuous-state polynomial branching process arises naturally as the rescaled limit of a sequence of discrete-state processes.