1  

\[ X(t) \leq X(t - 1) + q_i \leq X(t - 1) + q_i + 1 \]

\[ q_i = \sum_{j=0}^{q_i} (0 \leq k < n, \ k, n \in \mathbb{Z}) \]

\[ Z = \{0, 1, 2, \ldots\} \]

\[ F^{(1)}_{i,j} = 1, \quad F^{(j)}_{i,j} = \frac{1}{q_{i,j} + 1} \sum_{k=0}^{q_{i,j}} F^{(k)}_{i,j}, \quad 0 \leq i < n. \]

\[ q_{i,j} = \frac{q_{i,j} \cdot F^{(b)}_{i,j}}{F^{(b+1)}_{i,j}}, \quad i \geq 1; \]

\[ k = q_{i,j} + 1, \quad i \geq 0. \]
\[ m^{(n)} = \sum_{j=0}^{n-1} (F_j^{(n)} - d^{(n)}) \]
\[ i \geq 1, n > 1. \]

\[ a^i = \sum_{j=0}^{i-1} q_i = q_i^{(i-1)}, \quad i \geq 1; \]
\[ b^i = q_{i, i+1}, \quad i \geq 0. \]

\[ Q^i(0), \quad Q^i(1), \quad Q^i(2), \quad Q^i(3), \quad Q^i(4), \quad Q^i(5), \quad Q^i(6), \quad Q^i(7), \quad Q^i(8), \quad Q^i(9). \]

\[ \sup_{i > 0} \left( \sum_{j=0}^{i-1} \sum_{k=1}^{\infty} \frac{1}{M_{bk}} \right) = M. \]
\[ m_{00} \] = \[ n!(q_i^{n} + \sum_{k=1}^{n} (k!q_i^{n-k})^{-1} \cdot m_{1k}^{(n)}) \], \( n \geq 1. \)
\( \sum_{n=1}^{\infty} m_{\partial}^{(n)} < \infty, \quad m_{\partial}^{(n)} > 0, \quad 0 < Y < \infty. \)

\[ (11) \]

\[ m_{\partial}^{(n)} = n \sum_{j=1}^{n} \frac{1}{k=0} \sum_{m_{\partial}^{(n-1)}}< \infty, \quad m_{\partial}^{(n)} > 0, \quad 0 < Y < \infty. \]

\[ E_1 e^{\beta_0} = \sum_{n=0}^{\infty} \frac{X}{X} m_{\partial}^{(n)} = 1 + \sum_{n=0}^{\infty} \frac{X}{X} \left( \frac{1}{1 - \lambda} \right)^{\beta_0}. \]

\[ (16) \]

\[ (17) \]

\[ \lim_{n \to \infty} \left( \frac{d^{\beta_0}}{1 - \lambda} \right)^{\beta_0} = 0 < 1. \]

\[ \gamma = 1/\lambda \]

\[ \text{Stirling's approximation for large } n. \]

4.


A NOTE ON EXPONENTIAL ERGODICITY AND
$\not\exists$-ERGODICITY OF SINGLE BIRTH PROCESSES

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Abstract In the paper, an explicit and sufficient condition on exponential ergodicity of single birth processes is proven again by the comparison of moments of hitting time, which is different from the method reported in a previous work. Meanwhile, an explicit criterion on $\not\exists$-ergodicity for single birth processes is obtained.

Key words single birth processes; birth-death processes; exponentially ergodic; strongly ergodic; $\not\exists$-ergodic