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In this work, we present closed form expressions for powers and exponentials of tridiagonal Toeplitz matrices. We present examples illustrating the use of these closed form expressions when solving the following problems: 1. Find the probability of going from state i to state j in n -steps where i and j are in $[0, H]$ and n is any natural number and H is some fixed natural number. We assume transitions follow a birth-death chains having constant probabilities p, r, q restricted to a strip of integer states in $[0, H]$. 2. Find the probability of going from state i to state j for any time t where i and j are in $[0, E]$. where E is a constant, even natural number. We assume that transitions are governed by a birth-death process having constant birth and death rates on the integer states within $[0, E]$. 3. Find the probability that in a two-candidate election that the winner was never behind the opponent throughout the counting of the votes. Voting is modeled here according to the birth-death chain described in problem 1. (Received September 17, 2019)