5-1-2015

Reliability Polynomials of Chorded Cycle Graphs

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Abstract:

We denote by $C_{c_{1},c_{2}}^{c}$ the graphs comprised of a cycle on $c$ nodes having a single chord, with $c_{1}$ and $c_{2}$ cycle nodes on either side of the chord. When a graph is used to model a network, the All-Terminal Reliability (Rel) is the probability of network communication among all stations when the stations are perfectly reliable and the links fail with equal but independent probability. Thus, $Rel(G, p) = \sum_{i=0}^{\left|E(G)\right|} N_{i} p^{i} (1 - p)^{\left|E(G)\right|-i}$, where $E(G)$ is the total number of edges, $p$ is the probability of edge operation, and $N_{i}$ is the number of spanning connected subgraphs of size $i$. We present formulas for the Rel for all chorded cycle graphs having finite $c$, and prove that the uniformly most reliable such graph is the one in which $c_{1} = c_{2}$ when $c$ is even, and in which $c_{1}$ and $c_{2}$ differ by one when $c$ is odd.