Is the optimal intervention policy UC superior to the suboptimal policy MFPT over inferred probabilistic Boolean network models?

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ABSTRACT. A salient problem in translational genomics is the use of gene regulatory networks to determine therapeutic intervention strategies. Theoretically, in a complete network, the optimal policy performs better than the suboptimal policy. However, this theory may not hold if we intervene in a system based on a control policy derived from imprecise inferred networks, especially in the small-sample scenario. In this paper, we compare the performance of the unconstrained (UC) policy with that of the mean-first-passage-time (MFPT) policy in terms of the quality of the determined control gene and the effectiveness of the policy. Our simulation results reveal that the quality of the control gene determined by the robust MFPT policy is better in the small-sample scenario, whereas the sensitive UC policy performs better in the large-sample scenario. Furthermore, given the same control gene, the MFPT policy is more efficient than the UC policy for the small-sample

scenario. Owing to these two features, the MFPT policy performs better in the small-sample scenario and the UC policy performs better only in the large-sample scenario. Additionally, using a relatively complex model (gene number N is more than 1) is beneficial for the intervention process, especially for the sensitive UC policy.

Key words: Probabilistic Boolean networks; Intervention policy; UC; MFPT