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Toward uncertainty of weighted networks: An entropy-based model

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Abstract

Measuring the uncertainty is of both theoretical value and practical interest in the network science. The previous studies focus on measuring the uncertainty of the entire networks. However, how to measure the uncertainty of individuals is still an open issue. To address this issue, the “asking for help” example is used to model the user behaviors and explain the mechanism of the proposed method. In this paper, we develop three heuristic rules to measure the utility of adjacent neighbors to each ego in the networks. Then, the fuzzy systems theory is used to convert the utility of each neighbor into the membership functions. Next, we derive the uncertainty of each node based on the Shannon entropy. Our result demonstrates the overall uncertainty of the networks, and also the uncertainty for the individual nodes. Moreover, our model also reflects the uncertainty of nodes for choosing to strengthen or weaken the existed links between their neighbors with the evolution of networks. Instead of forming new links but changing the existed relationship between nodes, we consider the proposed uncertainty measure may suggest a crucial property of the networks on the opposite side of link prediction.

Keywords: Uncertainty; Link prediction; Entropy; Weighted networks

1. Introduction

From ancient prophets to modern scientists, making predictions is always an attractive activity throughout the history [1]. However, the uncertainty is ubiquitous in any predictive models, and how to handle the uncertainty is still an open issue. Luckily, the human-beings are skilled in abstraction, and the scientists have developed many mathematical tools to model the predictive problems, such as time-series uncertainty models [2, 3], fuzzy systems methods [4, 5] and the network approaches [6, 7]. These models are similar to black boxes, and they act in a manner to change the key of prediction models from “how it works” to “what are the outputs”. Specifically, the time-series models focus on the change of different

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