Yu-xian LIU, Ronald ROUSSEAU, 2020. Dynamic aspects of domination networks. *Frontiers of Information Technology & Electronic Engineering*, 21(4):635-648. https://doi.org/10.1631/FITEE.1800553

Dynamic aspects of domination networks

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Key words: Domination; Power structure; Digraphs; Network dynamics

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Motivation

The universe is often viewed through the dualities of high and low, left and right, yin and yang, or dominance and subordination. We explore how such dualities can—in some cases—be expressed in mathematical terms using zero-sum arrays (see further).

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Network theory

Network theory is an essential part of contemporary science. Biological networks, such as protein-protein networks, computer networks for resource sharing or providing connectivity, social networks, business networks, and scientific collaboration networks, are among the best known networks. Our point of focus is the study of dominance. Because science is a formal as well as an informal structure, it also includes dominance structures.

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Power structures in networks

In this investigation we discuss dynamic aspects of dominance structures by adding nodes and links to a network. Studying dynamic aspects of networks is essential for potential applications across various fields. In business management, for instance, employees get promoted or receive new responsibilities, possibly leading to a changed power structure in the organization. This happens on a much larger scale when two companies merge, where tensions may also emerge as new boundaries are formed.

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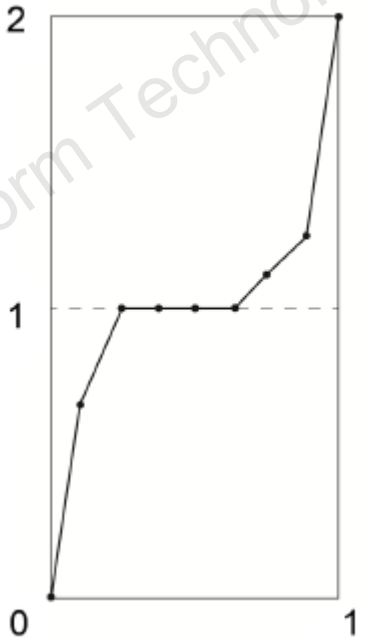
Main tools: zero-sum arrays and D-curves

Zero-sum arrays are finite arrays whose components sum to zero.

The D-curve of the array (4, 2, 0, 0, 0, −1, −1, −4) looks like this:



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Some simple observations

If *N* (the length of the array) increases, then the maximum D-curve also becomes larger. Similarly, the minimum D-curves become smaller.

Each directed network gives rise to two different zero-sum arrays and corresponding D-curves. One of these arrays is called the local case and uses only links arriving in or leaving a specific node. The other one is called the global case and is calculated based on the lengths of chains starting or ending in a node.

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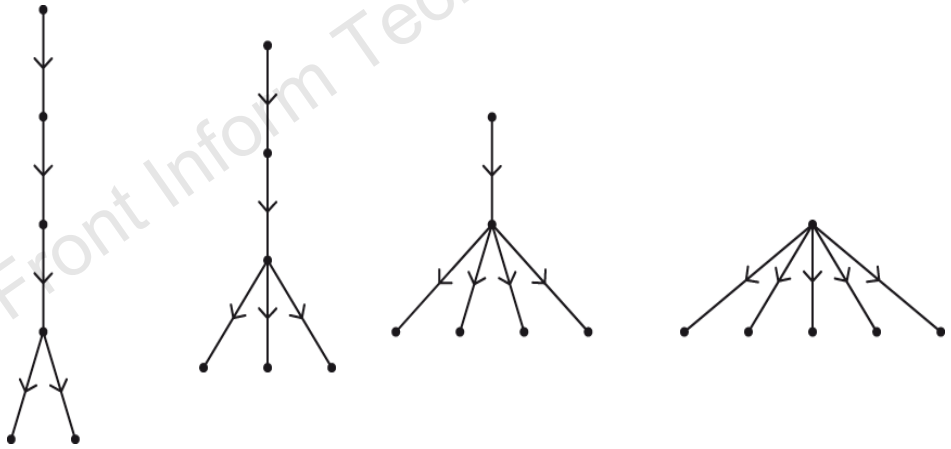
An example

The following figure presents an example of the type of dynamics studied in this article. The dominance structure increases from left to right.



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Some conclusions

In this article we continued our work on the dominance structure in a directed, acyclic network. We demonstrated an interesting change in the dominance structure when a dominance interaction happens from dominating individuals to subordinate individuals. The results show that when the system is monopolistic (i.e., just one individual has power), the dominance interaction decreases the dominance structure. Under other conditions, the dominance interaction leads to intersecting dominance curves, showing that the corresponding dominance structures are intrinsically incomparable.

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Earlier work

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