Received: 4 December 2018 | Accepted: 14 December 2018

DOI: 10.1111/1365-2656.12964

Journal of Animal Ecology | BRITISH ECOLOGICAL SOCIETY

FORUM

Beware *z*-scores

Chuliang Song[1] | Rudolf P. Rohr[2] | Serguei Saavedra[1]

[1]Department of Civil and Environmental Engineering, MIT, Cambridge, Massachusetts

[2]Department of Biology – Ecology and Evolution, University of Fribourg, Fribourg, Switzerland

Correspondence
Chuliang Song
Email: clsong@mit.edu

Handling Editor: Anna Eklöf

It is known that optimization is a hard mathematical and computational task (Boyd & Vandenberghe, 2004), and Simmons et al. (2019) have come up with a better solution to the problem of finding the maximum level of nestedness that can be reached in a network with a given set of constraints. Specifically, Simmons et al. (2019) have used simulated annealing initialized with a greedy algorithm to find the maximum level of nestedness that a network can achieve given a fixed number of species and interactions. Simmons et al. (2019) have shown that this combination of algorithms can reach higher levels of nestedness than the greedy algorithm alone provided in Song et al. (2017). In fact, Figure 1 shows that on average, simulated annealing alone (with an unstructured initialization) cannot outperform either the combination of algorithms proposed by Simmons et al. (2019).

In light of these new results, we repeated all the analyses in Song et al. (2017) that depend on the level of maximum nestedness using the algorithm proposed by Simmons et al. (2019). We found that all results have been strengthened with the algorithm proposed by Simmons et al. (2019). Specifically, Figure 2a (figure 1c in Song et al., 2017) confirms the result that raw nestedness (NODF) is strongly correlated (Pearson correlation of 0.52) with maximum nestedness (maximum NODF). Additionally, by normalizing the level of nestedness as proposed in Song et al. (2017), Figure 2b (figure 5c in Song et al., 2017) confirms that the level of nestedness in a network strongly covaries with temperature seasonality.

Because *z*-score values (related to *p*-values in statistics) cannot be compared across networks (samples) of different sizes, and *z*-scores do not take into account all the constraints imposed by the network (e.g. maximum value of nestedness), the results above serve again as a reminder that *z*-scores must not be used for comparison purposes or for drawing conclusions from an ensemble of networks with different dimensions and properties (Song et al., 2017).

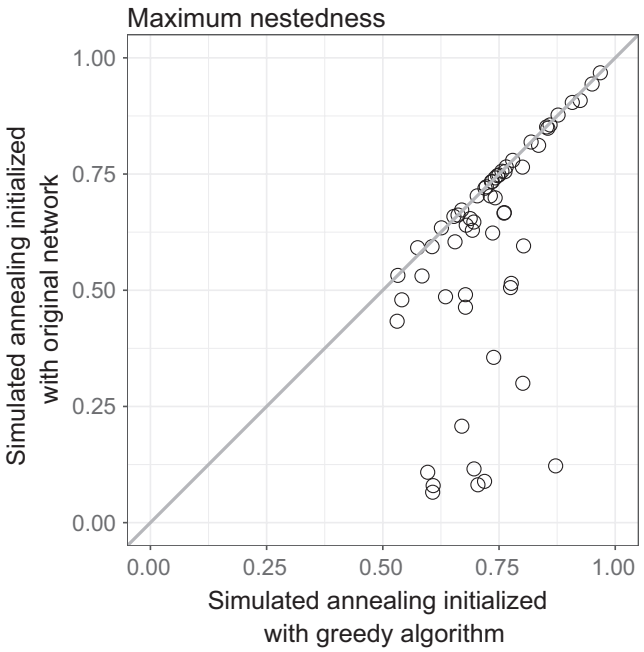

FIGURE 1 The "Dynamic Duo". The figure shows that on average, the duo of simulated annealing and greedy algorithm can reach higher values of maximum nestedness than simulated annealing alone (using the original plant-pollinator network as the initializing seed). Simmons et al. (2019) have already shown that the duo can outperform the greedy algorithm alone

AUTHORS' CONTRIBUTION

All authors contributed equally to the manuscript.

DATA ACCESSIBILITY

See Song et al. (2017).

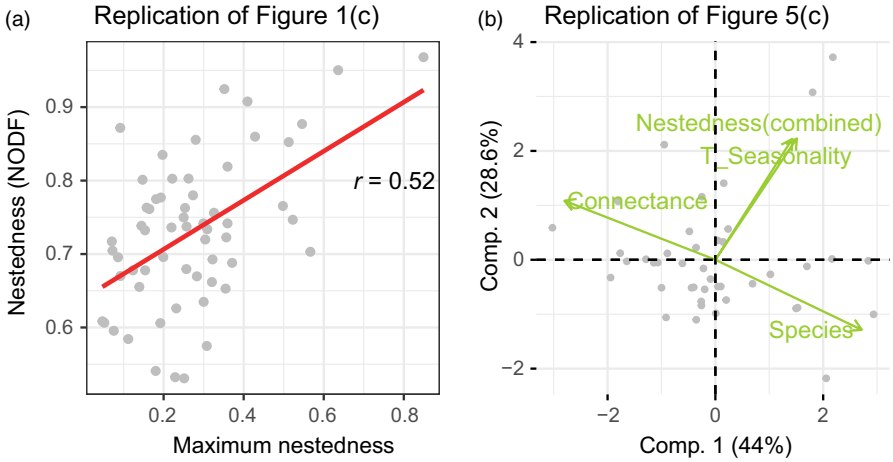

FIGURE 2 Confirming results from Song et al. (2017). Using the combination of simulated annealing and greedy algorithm proposed by Simmons et al. (2019), the figure confirms that all results in Song et al. (2017) that depend on the level of maximum nestedness hold. Panel (a) replicates figure 1(c) in Song et al. (2017), showing a strong correlation between raw nestedness (NODF) and maximum nestedness. Panel (b) replicates figure 5(c) in Song et al. (2017), showing that the level of nestedness (normalized as proposed in Song et al., 2017) strongly covaries with temperature seasonality

ORCID

Chuliang Song https://orcid.org/0000-0001-7490-8626
Rudolf P. Rohr https://orcid.org/0000-0002-3757-6746
Serguei Saavedra https://orcid.org/0000-0003-1768-363X

REFERENCES

Boyd, S., & Vandenberghe, L. (2004). *Convex optimization*. Cambridge, UK: Cambridge University Press.

Simmons, B. I., Hoeppke, C., & Sutherland, W. J. (2019). Beware greedy algorithms. *Journal of Animal Ecology*.

Song, C., Rohr, R. P., & Saavedra, S. (2017). Why are some plant-pollinator networks more nested than others? *Journal of Animal Ecology*, *86*, 1417–1424.

How to cite this article: Song C, Rohr RP, Saavedra S. Beware *z*-scores. *J Anim Ecol*. 2019;00:1–2. https://doi.org/10.1111/1365-2656.12964