Temporal data (Day 2)

Introduction

In ecology and evolution we may encounter data collected over time, such as population density time-series. Faced with this kind of data, we have fundamentally two options for analysis: First, a purely statistical approch with methods such as ARIMA. Second, we could use the large body of theory from population and community ecology that allows us to formulate relationships between densities and time from theoretically established principles.

Here, we will focus on the latter and an example of such an approach can be found, for example in Sibly et al. 2005 who study the shape of density-dendependence confronting a theta-logistic model with time-series data from the Global Population Density Database.

Building a population dynamics model

As we have seen in the first day, a population dynamics model fundamentally is a bookkeeping exercise that foamlizes inputs (e.g., births) and outputs (e.g., deaths). We will see this using the logistic model in its r-K-(Pianka) and in its r-alpha (Verhulst) formulation (see Mallet 2012). We will dive more deeply into the logistc by trying to derive it assuming either competition for food resources or for space.

Confronting model with data

After this exercise of model building, we will learn how to confront such models with data focusing on the statistical interface using a Bayesian approach (stan, rstan). Besides diving into code we will explore error types (observation error, process error) and data structure complexity.

The afternoon will be dedicated to a hands-on exercise for fitting time-series data to different dynamics models. Details can be found e.g. in Rosenbaum & Fronhofer (2023).

Two papers for student project on Friday

- Yoshida et al. 2003
- Gause 1934

References

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@Article{Rosenbaum2023, author = {Benjamin Rosenbaum and Emanuel A. Fronhofer}, journal = {Ecosphere}, title = {Confronting population models with experimental microcosm data: from trajectory matching to state-space models}, year = {2023}, number = {4}, pages = {e4503}, volume = {14}, data_doi = {https://doi.org/10.5281/zenodo.7702324}, doi = {10.1002/ecs2.4503}, }

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{303–306}, issn = {0028-0836}, doi = {10.1038/nature01767}, url = {http://dx.doi.org/10.1038/nature01767},
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