BB512 - Instructor Resources

Owen R. Jones (Course Coordinator)

2024-09-14

This website and other course materials

This website contains resources for instructors in BB512.

We may not do ALL of these exercises, but you are welcome to do ones we miss in your own time.

Software

We will use Excel and R/RStudio during this course.

Excel

I expect you will already have Excel installed, so there is not much to say here.

Be aware that Excel differs depending on the language it is localised in. For example, Danish vs. English. This means that some of the commands might differ between version. See here for examples.

R and RStudio

R and RStudio are two separate pieces of software. RStudio is a user-friendly interface to talk to R, it cannot work if you have not got R installed. So, when you install these two programs, install R first, then RStudio.

Already have them installed? I strongly recommend to update to the latest versions of R, which you can download here and RStudio Desktop, which you can find here.

(PART) Evolution by Natural Selection

The Blind Watchmaker

Coming soon…

Bug hunt camouflage (Netlogo)

Coming soon. . .

(PART) Population Growth Models

Geometric growth

Coming soon…

Estimating Population Growth Rate

This exercise explores the geometric growth model in discrete time steps, focusing on how different values of λ affect population dynamics. It aims to develop students' understanding of growth models, the effects of log transformations, and the limitations of simple models.

Key Concepts:

- Geometric growth assumes constant λ, leading to exponential growth or decline.
- Plotting log-transformed population sizes allows easier visualisation of trends.
- Limitations of the model include the assumption of infinite resources and lack of environmental constraints.

Model Answers

1. How does the population size change with time for different values of λ?

- For $\lambda > 1$, the population size increases exponentially.
- For $\lambda = 1$, the population size remains constant.
- For $\lambda < 1$, the population size decreases exponentially.

Explanation: The growth rate λ drives the population's exponential increase or decrease. $\lambda = 1$ represents equilibrium.

2. Why is it useful to plot log-transformed population size?

- Log-transformation converts exponential growth into a straight line, simplifying the interpretation of growth rates.

Explanation: Log-transformations linearise exponential relationships, allowing for easier interpretation of the growth rate, as the slope corresponds to $\log(\lambda)$.

3. What are the limitations of the geometric growth model?

- The model assumes infinite resources, no competition, or environmental constraints, making it unrealistic for real-world populations.

Explanation: Real-world populations face density-dependent factors and environmental stochasticity, which the geometric model does not account for.

4. What would happen if we introduced a carrying capacity to this model?

- The population would follow a logistic growth model, where growth slows as the population nears the carrying capacity.

Explanation: A carrying capacity introduces limits to population size, stabilising it after an initial period of exponential growth.

Teaching Tips:

1. **Excel Guidance**: Ensure students understand how to perform log transformations and add trendlines.
2. **Conceptual Understanding**: Clarify the assumptions of the model (no immigration, emigration, or environmental changes).
3. **Real-World Application**: Use examples like invasive species or epidemics to explain how geometric growth can be observed in certain scenarios.
4. **Class Discussion**: Engage students in discussions about how the model could be adapted to account for real-world variables like environmental factors or density dependence.

Additional Resources

- **Excel Tutorial**: If students are unfamiliar with Excel's log transformation and trendline features, provide a walkthrough.

Stochastic population growth

Coming soon. . .

Basic logistic population growth

Coming soon…

Deeper into logistic growth

Coming soon…

Life tables and survivorship types

Coming soon…

Matrix population modelling

Coming soon...

Pre- and Post-reproduction census

Coming soon…

Life Table Response Experiments

Coming soon…

How many eggs should a bird lay?

Coming soon...

Trade-offs and the declining force of selection

Coming soon…

(PART) Population Genetics and Evolution

Hardy-Weinberg equilibrium

Coming soon. . .

The Gene Pool Model

Coming soon. . .

Neutral or Adaptive Evolution in Humans: What Drives Evolution of Our Traits?

Coming soon…

Heritability from a linear regression

Coming soon…

(PART) Interactions Between Species and Community Structure

Lotka-Volterra competition

Coming soon…

Lotka-Volterra predator-prey dynamics

Coming soon. . .

(PART) Animal behaviour, altruism and sexual selection

Game theory: Hawks and doves

Coming soon…

(PART) Appendix - extras

Exponential growth in detail

Coming soon…

The legend of Ambalapuzha

Coming soon…

From population biology to fitness

Coming soon…