

Environmental Analysis and Modelling | TAA2 Task Notes

An assessment on the use of environmental modelling to predict and manage invasive species

This document takes you through the main steps to complete your practical report for TAA2 of Environmental Analysis and Modelling. You will need to generate code for the modelling exercises, analyse the code, and write an accompanying 2000 word report. Note that the report builds on tasks that you have encountered during Part 2 of this unit, and so it is **important to have worked through the Offline Activities**.

The purpose of the assessment is to evaluate your practical modelling skills, your ability to evaluate the efficacy of modelling techniques for decision making and to be able to communicate results clearly and professionally.

Note that the models you are developing are simple, but powerful tools, in invasive species management. Your write up should interpret them and also contrast them with more detailed and species-specific models from the literature. The models we develop in this practical are not applied to specific cases of invasive species, but you should critically analyse how they could, and have been applied, in practice.

You should develop your model using the **R programming language** (www.r-project.org) and the environment for developing R programs, **RStudio** (www.rstudio.com). Although it is compulsory to use R, you are permitted to use other environments to develop your code, though RStudio is recommended. You may also re-use and adapt code that has been provided throughout the module.

Before you begin, ensure you have downloaded and installed R and RStudio. Please see the document “Reader: Primer in R Programming File.pdf” from topic 4 for more information.

- To download R: <https://cran.r-project.org/mirrors.html>
- To download RStudio: <https://www.rstudio.com/products/RStudio/>

Part 1

Logistic growth models

Throughout part 2 of the module we have explored the use of population growth curves and their importance for modelling invasive species. An important class of population growth curves are logistic models.

- 1.1. The first task is to generate a deterministic version of the logistic growth curve in R. *Hint: you can modify the code that was presented for the exponential growth model in “Growth curves in R”. The equation of logistic model is described in the narrated PowerPoint on “Population growth curves”.*
- 1.2. Using graphs to communicate your results, describe how the dynamics of the population change for different values of the model parameters. *Hint: choose default values for your parameters and then for each select at least one higher value and lower value than the default.*

- 1.3. Describe the main assumptions of the model, and provide a critical analysis of the use of the logistic model to inform invasive species management, drawing on your own examples from the literature. *Hint: consider what the limitations of the model are, and how the logistic model has been used in other studies.*

Part 2

Spatial spread models

- 2.1. Develop an individual-based stochastic spread model for an invasive species that can be run over multiple simulations. *Hint: You can modify the code from topic 6 on “An individual based model in R” from a single run to multiple runs.*
- 2.2. Explore the model by producing maps of the probability that each patch becomes occupied by the end of the simulated time (this time is arbitrary but should be chosen not too early or late in the invasion so there is some variability, and all probabilities are not zero or 1). *Hint: this probability can be determined from the proportion of simulations in which the patch became occupied. You will have to ensure you store this value in a vector as the simulations progress.*
- 2.3. Describe the main assumptions of the model, and provide a critical analysis of how individual based models can be used to design targeted surveillance and control programs for invasive species. *Hint: the model presented here is simplistic, what are its limitations and what additions could be made to the model to enable its use in practice? Draw on examples from the literature where this has been done.*

Suggested structure of the report

1. General introduction

Part 1

2. Description of **part 1 model** (how you developed the model in words, with the code as an appendix)
3. Description of the results from your model
4. Critical discussion of the limits of the model and its use in the management of invasive species.

Part 2

5. Description of **part 2 model** (how you developed the model in words, with the code as an appendix)
6. Description of the results from your model
7. Critical discussion of the limits of the model and its use in the management of invasive species.
8. Short conclusion