R for Ocean Science Data Analysis

Course Overview

Analytical programming languages have become a critical part of research in many fields, including ocean science. As technology has given us a window into the ocean environment through various instruments, our tools to analyze and make sense of those data have also had to become increasingly complex. Several programming languages are typically used in ocean sciences, including MATLAB and Python in addition to R to analyze data. R has the benefit of being free, open source, and includes ample packages to do almost any desired analysis. For more computationally intensive analyses R is also compatible with extensions in Fortran and C. In addition, R is user friendly and relatively straight-forward to set up and learn.

BioSci and Ocean Science Analytics collaborate to bring you an online, asynchronous course entitled "R for Ocean Science Data Analysis." This introductory course is intended for individuals that are interested in learning how set-up, program and analyze their ocean science data in R. Participants will practice using R and its various tools to read, organize, summarize, and analyze example data sets which represent typical ocean science data. Advanced and/or specialized programming topics will be covered in additional course(s). This course is intended to cover a wide range of topics that are applicable to all ocean science studies and give the student tools to comfortably use R in their research.

Each module of the course consists of a topic and its related subsections. Within each module is an informational video regarding the topic along with more detailed, guided videos outlining the steps required for accomplishing a specific task. Also included is an activity for participants to complete. At the conclusion of the course, participants will receive a certificate of completion, that indicates if they have completed all modules or the completed modules. Feedback regarding activities will be provided in two forms – provision of a correct example of an activity after submission, as well as individual feedback regarding the submission via email, intended to clarify any mistakes in the submission and provide input for correcting those mistakes. Participants have access to the course for one month after the start of the training and are able to retain/download R materials.

Course Topics

MODULE 1: Introduction to Data Analysis in Ocean Sciences

- 1.1: Review of ocean data collection, management, uses, and tools
- 1.2: Data analysis methods for conservation and resource management
- 1.3: Brief introduction to R programming language and reproducible research
- 1.4: Introduction to Course Interface

MODULE 2: Creating & Accessing Data

- 2.1: Data creation and importing from a file
- 2.2: Accessing data from a database
- 2.3: Accessing data from the web
- 2.4: Using an Application Programming Interface (API)

MODULE 3: Objects & Data Structure

- 3.1: Object modes and classes
- 3.2: Switching object classes
- 3.3: Special values (e.g., NULL, NA, NaN, etc.)

MODULE 4: Indexing, Subsetting, and Controlling Workflow

- 4.1: Indexing
- 4.2: Subsetting
- 4.3: String editing
- 4.4 Conditional statements (if/else/then)

MODULE 5: Data Wrangling

- 5.1: Vertical and horizontal data formats
- 5.2: Changing data formats

MODULE 6: Functions

- 6.1: Custom functions
- 6.2: CRAN repository

MODULE 7: Data Visualization

- 7.1: Base plot function
- 7.2: Histogram and Q-Q plots
- 7.3: Bar and scatter plots
- 7.4: Box plots
- 7.5: ggplot2 package

MODULE 8: Mapping

- 8.1: Map creation
- 8.2: Overlaying data on maps
- 8.3: Spatial Data Analysis

MODULE 9: Descriptive Statistics & Hypothesis Testing

- 9.1: Descriptive Statistics: summarizing your data
- 9.2: Inferential Statistics: parametric & nonparametric t-test & ANOVA
- 9.3: Additional useful statistics

MODULE 10: Introduction to Modular Coding

- 10.1 Loops
- 10.2 Lists
- 10.3 Vectorization

Certificate of Completion: This course is recognized as a continuing professional development (CPD) course as assessed by the Institute of Marine Engineering, Science and Technology (IMarEST). This independent internationally recognized organization attests to the high standards and quality of this marine scientific focused training. Upon completion of this course, you will receive a certificate indicating the course topics completed.