FISH 552 Introduction to R Programming

Syllabus Autumn 2018

Instructor: Kristin Privitera-Johnson, kpjohns@uw.edu
Office hours: Wednesdays, 11:30 am – 12:30 pm; FISH 336B

Teaching Assistant: Lukas DeFilippo, ldefilip@uw.edu
Office hours: Tuesdays, 2:00 pm – 3:00 pm; FISH 358B

Course overview

Combined Class/Lab: Tuesdays and Thursdays 10:30 – 12:20 pm
Location: MGH 030

Important Note:
Ten combined lectures/labs from 27 September to 30 October.
Followed immediately by 10 lectures of FISH 553 Advanced R Programming.

Course objective

This course introduces the statistical computing language R for graduate students with no prior background in R or programming.

Required readings

Course handouts and lectures. No required textbooks.

Evaluation and grading

Credit/no credit, 2 credits. Credit awarded based on the completion of all assigned weekly homework exercises, which will average 4 hours per week.

Lectures/In-class exercises: The course will consist of two 1 hour and 50-minute combined lectures and laboratory work per week. Lectures will be primarily PowerPoint based and made available on Canvas before class for downloading and reviewing. Bringing your own computer is acceptable and encouraged. Alternatively, the computers in MGH 030 should be sufficient for viewing lectures. If using the lab computers, please note that is imperative to bring a storage device (e.g., a USB drive), use cloud-based storage (e.g., Google Drive), or alternate method of your choosing to save your notes and work! Files saved locally to these lab computers are periodically deleted throughout the quarter.

Assignments: There are four assignments in this course. All assignments, in the form of R scripts, will be uploaded to Canvas by 5pm. **The due dates are as follows: October 12, October 19, October 26, and November 2.**

Attendance: Attendance is expected for every lecture. Regular attendance and participation are essential for a good performance in this course.

Online tools: There is a Canvas website that will be used to disseminate resources for the class. To access materials on Canvas, you will need your UW NetID and password. A Canvas email list will be used for notifications. Please check your UW email regularly for course announcements.

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Disability Accommodations: It is crucial that all students in this class have access to the full range of learning experiences. At the University of Washington, it is the policy and practice to create inclusive and accessible learning environments consistent with federal and state law. Full participation in this course requires: 1) the ability to attend two 1 hour and 50-minute lectures per week with 40 other students; 2) participate in small group discussions on during in-class exercises, and 3) make short presentations that synthesize small group discussions and/or results of in-class exercises to the class orally.

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Course schedule

* Lecture topics are subject to change based upon the needs/interests of the enrolled students.

Date	Lecture
September 27, 2018	Lecture 1. Why use R? & The RStudio editor
October 2, 2018	Lecture 2. Working with Data I
October 4, 2018	Lecture 3. Working with Data II
October 9, 2018	Lecture 4. Introduction to plotting
October 11, 2018	Lecture 5. Data manipulation I
October 16, 2018	Lecture 6. Data manipulation II
October 18, 2018	Lecture 7. Data manipulation: An example
October 23, 2018	Lecture 8. More complex graphics
October 25, 2018	Lecture 9. Functions
October 30, 2018	Lecture 10. R as statistical platform

FISH 552 Learning Objectives

Over the course of FISH 552, we will cover the following skills-based learning objectives. There are six overarching themes and there are several objectives listed under each theme. The learning objectives have a corresponding ID for quick reference in assignments/Power Point slides.

Themes

R Basics
Working with Data
Plotting
Data manipulation
Statistics in R
Functions

R Basics	
RB1	I can define what R is.
RB2	I can define what Rstudio is.
RB3	I can create an R script.
RB4	I can find the help file(s) for a function or package.
RB5	I can set my working directory in Rstudio.
RB6	I can create a project in Rstudio.
RB7	I make use of #comments to annotate my R scripts.
RB8	I can define an object in R.
RB9	I can assign an object a value in R.
RB10	I can print an object value to the R Console.
RB11	I can define data types of R objects.
RB12	I can find the data type of an object.
RB13	I can define an element in R.
RB14	I can define a vector.
RB15	I can create a vector.

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Working with Data	
WID1	I can read in a data file into Rstudio.
WID2	I can subset a vector.
WID3	I can define Boolean operators.
WID4	I can use Boolean operators.
WID5	I can subset a vector using Boolean operators.
WID6	I can define a data frame.
WID7	I can create a data frame.
WID8	I can extract the column names of a data frame.
WID9	I can assign column names to a data frame.
WID10	I can extract columns of a data frame by name.
WID11	I can extract columns of a data frame by indices.
WID12	I can extract columns of a data frame using Boolean operators.
WID13	I can remove NA from objects (e.g., data frame, matrix, or list).
WID14	I can define a matrix.
WID15	I can create a matrix.
WID16	I can find the dimensions of a data frame or matrix.
WID17	I can define an array.
WID18	I can create an array.
WID19	I can define a list.
WID20	I can create a list.
WID21	I can extract elements from a list.
WID22	I can convert a data frame into a list.
WID23	I can replace elements in an object (e.g., data frame, matrix, or list).
WID24	I can define a factor.
WID25	I can create a factor.

FISH 552 Learning Objectives

Plotting Data	
Plot1	I can use the x and y arguments of plot() to create a plot.
Plot2	I can label the x- and y-axes and title of a plot.
Plot3	I can define the x- and y-limits of a plot.
Plot4	I can remove the space around zero on the x-and y-axes of a plot.
Plot5	I can change the color of points, lines, text, etc. on a plot.
Plot6	I can change the point characteristics (pch) or line type (lty) on a plot.
Plot7	I can change the character expansion (cex) or line width (lwd) of data on a plot.
Plot8	I can add an accurate legend to a plot.
Plot9	I can suppress the axes in the call to plot().
Plot10	I can create custom axes for a plot (e.g., axis(), xaxp and yaxp arguments).
Plot11	I can add text to the inside of a plot.
Plot12	I can change the type of plot (e.g., points, lines, etc.).
Plot13	I can add additional lines() or points() to a plot.
Plot14	I can use par(mfrow) or par(mfcol) to create a multi-panel plot.
Plot15	I can use par(mar) or par (oma) to manipulate the margins of a multi-panel plot.
Plot16	I can use mtext() to add text to the outside of a plot.
Plot17	I can use layout() to create a multi-panel plot.
Plot18	I can create a boxplot.
Plot19	I can create a barplot.
Plot20	I can save plots as a pdf().

Data manipulation	
DM1	I can find the unique elements in an object. → what kind of object?
DM2	I can find the duplicated elements in an object.
DM3	I recall how to look up the built-in constants in R.
DM4	I can use subset() to subset an object.
DM5	I can use apply() to use an arithmetic function on a matrix.
DM6	I can use tapply() to use an arithmetic function on a matrix using a categorical variable. → which (x==y)
DM7	I can identify the difference between sort() and order().
DM8	I can apply sort() and order() to objects.
DM9	I can use system.time() to calculate how long it takes to run a command.
DM10	I can combine two objects using merge().
DM11	I can assign an object a Date or POSIXtclass. -- ~~obct~~ ??
DM12	I can extract components of dates. -- Fun!!
DM13	I can apply arithmetic functions to objects of Date class.
DM14	I can install a package in Rstudio.
DM15	I can load a package in Rstudio.

FISH 552 Learning Objectives

Statistics in R	
STAT1	I can differentiate between the functions for finding the probability, density, quantile, or random numbers from a given probability distribution.
STAT2	I can locate the built-in probability distributions in R.
STAT3	I can define pseudorandom generation.
STAT4	I can use set.seed() to create reproducible random number generation.
STAT5	I can use sample() to randomly draw elements from an object.
STAT6	I can locate functions for data summarization: summary(), fivenum(), sd(), range().
STAT7	I can plot data using pairs(), hist(), boxplot(), or density().
STAT8	I can locate functions for basic statistical tests built into R.

Functions	
FUN1	I can describe the difference between local and global objects (i.e., scope).
FUN2	I can identify the different parts of a function.
FUN3	I can specify the arguments required for a function.
FUN4	I can return() an object local to a function for use in the global environment.
FUN5	I can use a list to return multiple objects local to a function for use in the global environment.
FUN6	I can write objects to a file (e.g., .csv).

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Combined Class/Lab: Tuesdays and Thursdays 10:30 – 12:20 pm
Location: MGH 030

Important Note:
Ten combined lectures/labs from 1 November to 6 December.

Course objective

This course teaches graduate students how to program in the statistical computing language R.

Required readings

Course handouts and lectures. No required textbooks.

Evaluation and grading

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**** Note: there is no class meeting on November 22, 2018 in observance of Thanksgiving.**

Date	Lecture
November 1, 2018	Lecture 1. Good programming principles
November 6, 2018	Lecture 2. Debugging code and big projects
November 8, 2018	Lecture 3. Loops, if-then-else, while statements
November 13, 2018	Lecture 4. Introduction to maximum likelihood estimation
November 15, 2018	Lecture 5. Minimizing non-linear functions use mle & optim
November 20, 2018	Lecture 6. Likelihood profiles and confidence intervals
November 27, 2018	Lecture 7. Bootstrapping, resampling, simulation-estimation
November 29, 2018	Lecture 8. Writing faster R code, editing existing R functions
December 4, 2018	Lecture 9. Large projections, pitfalls in R
December 6, 2018	Lecture 10. Data wizardry: tools for data summarization and manipulation