

**Syllabus Module 215: Minor B “Minor B Introduction to R: computing, graphics for statistics and epidemiology”**

<b>N° : 215</b>	<b>Minor B “Introduction to R: computing and graphics for statistics and epidemiology”</b>
<b>Coordinator</b>	Nolwenn LE MEUR, Eng, PhD Professeur of Biostatistics, EHESP <a href="mailto:Nolwenn.LeMeur@ehesp.fr">Nolwenn.LeMeur@ehesp.fr</a>
<b>Dates</b>	Monday 18 <sup>th</sup> – Friday 22 <sup>nd</sup> November 2019
<b>ECTS</b>	3ECTS
<b>Duration</b>	30 hours (5 days of 6h)
<b>Location</b>	EHESP 20 Avenue George Sand 93210 LA PLAINE ST DENIS
<b>Description</b>	<p>The course will teach students to apply basic statistical analysis and analytical epidemiologic methods using the R statistical computing. R is not only a free statistical software but also a language and environment for statistical computing and graphics. R is highly extensible and runs on a wide variety of UNIX platforms, Windows and MacOS.</p> <p>During this module, the emphasis will be on learning by doing. Practice material and data will be grounded on actual research questions and are intended to illustrate the kinds of issues that often arise when practicing statistics and epidemiology. Students will be encouraged to apply the material to their own research interests and epidemiological analyses. Each session is a combination of didactic lecture and hands-on practice. Students will conduct epidemiological analyses on actual data sets, and learn the importance of data preparation and cleaning, descriptive analyses, as well as how to conduct basic statistical analyses including regression analyses.</p>
<b>Prerequisites</b>	Students are assumed to be familiar with elementary statistical methodology (such as descriptive analysis, hypothesis testing, etc)
<b>Course learning objectives</b>	<p>The course will familiarize students with the programming skills necessary to:</p> <ul style="list-style-type: none"> <li>• Use the R statistical computing environment to enter, read, clean, organize, index and manipulate data in R.</li> <li>• Analyze rate, ratio and risk data in R using matrices, arrays and data frames.</li> <li>• Apply R functions and packages for regression models to analyze epidemiologic data.</li> <li>• Apply base graphics and ggplot2 to explore, plot, and present analyses.</li> <li>• Understand the R transition from classic to grammar-oriented programming (with dplyr, tidyr, ggplot2 libraries)</li> <li>• Understand how R can be extended with function.</li> <li>• Save analysis for reproducible research</li> </ul>
<b>Structure</b> (details of sessions title/speaker/date/duration )	<p>Class meets Monday thru Friday from 9:00 am – 4:00 pm (30 hours total). Classes encompass lectures, practical, quiz and final project assignment. Dr Nolwenn Le Meur delivers all sessions, details of each session are provided below.</p> <ul style="list-style-type: none"> <li>• R environment - Day 1 – 9:00 am to 12 am <ul style="list-style-type: none"> <li>○ R packages, command, script</li> <li>○ Rmarkdown</li> </ul> </li> <li>• Data management – Day 1 – 1:00 pm to 4:00pm <ul style="list-style-type: none"> <li>○ Importing, exporting, data types and structure, recoding variables</li> </ul> </li> <li>• Descriptive statistics – Day 2 - 9:00 am – 4:00 pm <ul style="list-style-type: none"> <li>○ Summary, statistical test, intro to grammar-oriented programming</li> </ul> </li> <li>• Graphical procedure (lecture and practical) – Day 3 - 9:00 am – 4:00 pm <ul style="list-style-type: none"> <li>○ Basic plot and ggplot2</li> </ul> </li> <li>• Regression statistical models (lecture and practical) – Day 4 - 9:00 am – 4:00 pm <ul style="list-style-type: none"> <li>○ Linear, logistic, Poisson</li> </ul> </li> <li>• Project: Day 5. 9:00 am – 4:00 pm</li> </ul>
<b>Resources</b>	<p><b>The following texts are recommended:</b></p> <p>An Introduction to R. Free at <a href="http://cran.r-project.org/doc/manuals/R-intro.pdf">http://cran.r-project.org/doc/manuals/R-intro.pdf</a> (also comes with default installation)</p> <p>Aragon TJ, et al. Applied Epidemiology Using R. Free at <a href="https://bookdown.org/medepi/phds/">https://bookdown.org/medepi/phds/</a></p>
<b>Course requirement</b>	Students have to come to class with a computer with the software R and RStudio installed (Instructions for installation will be send one week before the course)

<p><b>Grading and assessment</b></p>	<p><b>In-class Exercises: 20%</b> Starting the second day, the morning sessions will begin with a quiz related to the previous day. The quiz will be proposed via the EHESP REAL platform.</p> <p><b>Final Project: 80%</b> At the beginning of the week the students will receive a dataset on a public health issue that they will have to analyze using R. They will be able to start working on the data at home and will have the last day of the week to finalize the analysis. The objective is to</p> <ul style="list-style-type: none"> <li>• Describe the data (present summary statistics and graphs)</li> <li>• Investigate the factors associated with public health issue</li> </ul> <p>Students are required to submit a final paper and the associated R code presenting their analysis. The assignment is intended to allow the student the opportunity to demonstrate his or her ability to conduct preliminary analyses of an epidemiologic problem using R. The final paper is limited to 5-pages.</p> <ul style="list-style-type: none"> <li>• Cover Page: Title, student's name, Affiliations (if any) and abstract or overview of the vignette including methods and results.</li> <li>• Introduction: What is known about the epidemiological topic, what is not known, why it is important.</li> <li>• Approach: Analytic design or method to be presented, including variables and their roles in the analysis (explanatory, confounding, interaction, etc...). The main R packages used with version.</li> <li>• Results: Narrative walkthrough of the analysis with graphics and table of results.</li> <li>• Discussion: Including limitations, conclusions, possible next steps.</li> <li>• References: Limited to 15 citations (not counted toward pagelimit).</li> </ul>
<p><b>Course policy</b></p>	<p><b>Attendance &amp; punctuality</b> <b>Regular and punctual class attendance is a prerequisite for receiving credit in a course.</b> Students are expected to attend each class. Attendance will be taken at each class. The obligations of attendance and punctuality cover every aspect of the course: - lectures, conferences, group projects, assessments, examinations, as described in EHESP Academic Regulations <a href="http://mph.ehesp.fr">http://mph.ehesp.fr</a> EHESP Academic Regulation Article. 3). If students are not able to make it to class, they are required to send an email to the instructor and to the MPH program coordinating team explaining their absence prior to the scheduled class date. All supporting documents are provided to the end-of-year panel. Students who miss class are responsible for content. Any student who misses a class has the responsibility for obtaining copies of notes, handouts and assignments. If additional assistance is still necessary, an appointment should be scheduled with the instructor. Class time is not to be used to go over material with students who have missed class.</p> <p><b>Lateness:</b> Students who are more than 10 minutes late may be denied access to a class. Repeated late arrivals may be counted as absences (See <a href="http://mph.ehesp.fr">http://mph.ehesp.fr</a> EHESP Academic Regulation Article. 3 Attendance &amp; Punctuality)</p> <p><b>Maximum absences authorized &amp; penalty otherwise</b> Above 20% of absences will be designated a fail for a given class. The students will be entitled to be reassessed in any failed component(s). If they undertake a reassessment or they retake a module this means that they cannot normally obtain more than the minimum pass mark (i.e. 10 out of 20)</p> <p><b>Exceptional circumstances</b> Absence from any examination or test, or late submission of assignments due to illness, psychological problems, or exceptional personal reasons must be justified; otherwise, students will be penalized, as above mentioned. Students must directly notify their professor or the MPH academic secretariat before the exam or before the assignment deadline. Before accepting the student's justification, the professor or the MPH academic secretariat has the right to request either a certificate from the attending physician or from a psychologist, or from any other relevant person (See <a href="http://mph.ehesp.fr">http://mph.ehesp.fr</a> EHESP Academic Regulation Article 4 Examinations).</p> <p><b>Courtesy:</b> <u>All cell phones/pages MUST be turned off during class time.</u> Students are required to conduct themselves according to professional standards, eating during class time is not permitted during class time, such as course or group work.</p>

<b>Valuing diversity</b>	Diversity enriches learning. It requires an atmosphere of inclusion and tolerance, which oftentimes challenges our own closely-held ideas, as well as our personal comfort zones. The results, however, create a sense of community and promote excellence in the learning environment. This class will follow principles of inclusion, respect, tolerance, and acceptance that support the values of diversity. Diversity includes consideration of: (1) life experiences, including type, variety, uniqueness, duration, personal values, political viewpoints, and intensity; and (2) factors related to "diversity of presence," including, among others, age, economic circumstances, ethnic identification, family educational attainment, disability, gender, geographic origin, maturity, race, religion, sexual orientation and social position.
<b>Course evaluation</b>	EHESP requests that you complete a course evaluation at the end of the school year. Your responses will be anonymous, with feedback provided in the aggregate. Open-ended comments will be shared with instructors, but not identified with individual students. Your participation in course evaluation is an expectation, since providing constructive feedback is a professional obligation. Feedback is critical, moreover, to improving the quality of our courses, as well as for instructor assessment.

<b>Session 1</b>	<b>"Introduction to R: computing and graphics for statistics and epidemiology"</b>
Session Title	R environment and Data management
Speaker	N. Le Meur
Session outline	Lecture and lab <ul style="list-style-type: none"> <li>• R environment: <i>RStudio</i>, command and script</li> <li>• Loading data in R</li> <li>• Verify data type and transform if necessary</li> <li>• Create new and dummy variable</li> <li>• Count missing data</li> <li>• Save data</li> </ul>
Learning Objectives	Prepare data for statistical analysis
Reading	<a href="https://bookdown.org/medepi/phds/">https://bookdown.org/medepi/phds/</a>
Duration	6h
Dates	18 November 2019
Training methods	Short lectures and lab
Validation	In-class Exercises and final project

<b>Session 2</b>	<b>"Introduction to R: computing and graphics for statistics and epidemiology"</b>
Session Title	Descriptive statistical analysis
Speaker	N. Le Meur
Session outline	Lecture and lab <ul style="list-style-type: none"> <li>• Compute descriptive statistical summaries</li> <li>• Assess data distribution</li> <li>• Compute statistical tests: Fisher Exact test, chi-square, t-test, Kruskal Wallis, Mann-Whitney</li> <li>• Compute and test for correlation</li> <li>• Apply function through the <i>data.table</i> library</li> </ul>
Learning Objectives	Perform statistical descriptive and bivariate analysis
Reading	<a href="https://bookdown.org/medepi/phds/">https://bookdown.org/medepi/phds/</a>
Duration	6h
Dates	19 November 2019
Training methods	Short lectures and lab
Validation	In-class Exercises and final project

<b>Session 3</b>	<b>“Introduction to R: computing and graphics for statistics and epidemiology”</b>
Session Title	Graphical display
Speaker	N. Le Meur
Session outline	Lecture and lab <ul style="list-style-type: none"> <li>• Create mining full graphics in coherence with data types</li> <li>• Create customizable graphics with the <i>ggplot2</i> library</li> </ul>
Learning Objectives	Render clear and meaningful information thru visual display of data
Reading	<a href="https://bookdown.org/medepi/phds/">https://bookdown.org/medepi/phds/</a>
Duration	6h
Dates	20 November 2019
Training methods	Short lectures and lab
Validation	In-class Exercises and final project

<b>Session 4</b>	<b>“Introduction to R: computing and graphics for statistics and epidemiology”</b>
Session Title	Multivariate analysis
Speaker	N. Le Meur
Session outline	Lecture and lab <ul style="list-style-type: none"> <li>• Perform a multivariate analysis step by step: linear, logistic or Poisson regression</li> <li>• Assess quality of a model (residual analysis, quality criteria)</li> </ul>
Learning Objectives	Analysis the effect of multiple covariates on an outcome
Reading	<a href="https://bookdown.org/medepi/phds/">https://bookdown.org/medepi/phds/</a>
Duration	6h
Dates	21 November 2019
Training methods	Short lectures and lab
Validation	In-class Exercises and final project