Good Research Practices and Research Ethics (GRP)

Instructors: Mauro Cherubini - mauro.cherubini@unil.ch - HEC
                       Leonardo Restivo - leonardo.restivo@unil.ch - FBM
Teaching assistants: Tabea Schoeler - tabea.schoeler@unil.ch - FBM
                       Pooja Rao - pooja.rao@unil.ch - HEC

Course given in: **English**
ECTS Credits: **3 credits**, 24h
Max number of students: 20
Schedule: **Spring 2022**, 3.0h. course (weekly average)
Link to the schedule
Link to moodle course website
Related programme: Doctoral school in Information Systems
                    Lemanic Neuroscience Doctoral School (LNDS)
Related courses: Philosophy of Social Science (G. Palazzo)
                       Experiments: Lab, Natural, Field and Quasi (C. Peukert and E. de Bellis)

Introduction

The goal of the course is to provide PhD students with an understanding of the **main perils that researchers can face during their careers**. Specifically, the course will support students in developing a critical mind necessary to spot issues affecting reproducibility and research integrity in the context of (preclinical and fundamental) research with both humans and animals.

The course will tackle **three main areas** of the contemporary debate on research excellence: **research ethics, scientific integrity, and reproducibility**. One of the aims of the instructors is to show how these topics are tightly interlinked. Another objective of this course is to provide students with **practical tools and strategies** to prevent experimental design mistakes, improve their scientific rigor, and conduct reproducible research.

The course will be taught using **contrasting case studies**: each core topic of the course will be presented through two case studies that reveal different facets of the same topic. Students will be asked to study the case studies, and prepare summaries highlighting the major ethical issues identified that will be presented and discussed in class.

Learning outcomes

At the end of the course students should be able to:
   A. Recognize design flaws of scientific studies that might lead to irreproducible research
   B. Refer to and integrate experimental designs that will lead to valid research results
   C. Provide necessary elements in their scientific reporting that will allow their research to be reproducible and replicable.

D. <u>Use</u> commonly accepted Open Research repositories and software.

Course structure

This course is a studio/seminar. The course is organized in a **reversed classroom** format: each week students will have to watch a few videos detailing the theoretical content. Class time will be devoted to discussing theory, answering students' questions, practical activities, etc. The last class of the course is a **workshop**: students will be invited to bring their own experimental designs and discuss how their experiments could be improved by including and considering reproducibility and ethical elements in their setups.

Students will be asked **to review readings before each class** and present a critique of the articles in class. The students will have to demonstrate knowledge of topics, and design and research methodologies presented during the course.

Grading of the knowledge acquisition of the course will be based on two elements:
1. The project presented during the workshop;
2. A **final written exam** consisting of open-ended questions.

COVID-19: Due to the coronavirus situation, this year the course will be taught in modality hi-flex: students will be able to choose between attending in person, attending remotely via Zoom, and following the course asynchronously. The theoretical content comes via short video recordings. Class time will be devoted to presentations, Q&A, exercises, and group activities. Classes can be attended physically or via Zoom. Because of the health evolution related to COVID-19, the study plans may be adapted during the semester.

Resources

All the content is available on the web site of the class (Moodle) and on the Ubicast channel of the course (rec.unil.ch).

The class will loosely follow the following books:
- Lazic, S. E. (2016). Experimental design for laboratory biologists: Maximising information and improving reproducibility. Cambridge University Press.
- American Psychological Association. (2020). Publication manual of the American Psychological Association (7th ed.). https://doi.org/10.1037/0000165-000

During the course, we will use different software for training and animate the classwork. Students will need to **bring their laptop** to class.

Pre-requisites

- Students need to have basic knowledge of Statistics (cf. Bachelor course "Statistics").
- We will try to adapt the technical prerequisite of the course to the audience. We will measure fluency with the following languages at signup: R, SPSS, coding/programming.

Maximum and minimum attendance

The course will be given with a minimum attendance of 6 students. Given the design of the course and the close-level coaching of the pedagogical activities, we have set a maximum attendance of 20 students.

Interested students will be required to sign up for the course using this form. Confirmation of official enrollment in the course will be sent to the students 2 weeks before the first class.

Evaluation

First attempt
Exam: Written 1h00 hours
Documentation: Not allowed
Calculator: Not allowed

Evaluation:
The evaluation has two elements:
- Assessment of the **workshop individual project** (20%)
- **Written exam**: open-ended questions (80%)

Active participation in classroom/Zoom activities will entitle the student to a 0.5 point bonus on the final grade. Active participation means making concrete contributions to classroom work (e.g, present result of group activity, provide detailed answers to a question).

Specific regulations:
- **A minimum grade of 3.0 in the written exam is required for other activities to count towards the final grade.** If the grade achieved in the written exam is less than this, other elements (i.e., active participation bonus, or workshop individual project) will not be part of final grade consideration.
- The written exam is a "closed book" examination. Only dictionaries are allowed.

Retake
Students will be given the option to go for an oral exam instead of a written exam. If one of the students in the retake session prefers the written exam, then all students in the retake session will have to take the written exam, like for the first exam session.

Exam: Oral 0h20 minutes exam plus 0h20 minutes preparation

Documentation: Not allowed
Calculator: Not allowed

Evaluation:
- The grade of the oral examination will replace the grade obtained during the final written exam. The other gradings (workshop individual project, active participation bonus) will remain unchanged and are part of the computing for the final grade.

Detailed schedule

Classes are held in the room indicated in the [schedule spreadsheet](#) from **2pm to 5pm**.

Class	Content
1 [3h]	**Scientific Integrity** ● What is scientific integrity? ● Why do we do what we do? a personal take on scientific integrity ● Why does scientific integrity get degraded? **Training activity** ● case studies: students will be challenged with scenarios that touch upon choices considered daily routine in a laboratory setting **Reading material** ● *Nature* Journals' competing interests declaration: https://www.nature.com/nature/editorial-policies/competing-interests ● Daniele Fanelli. How Many Scientists Fabricate and Falsify Research? A Systematic Review and Meta-Analysis of Survey Data. *PLOS*, (2009). https://doi.org/10.1371/journal.pone.0005738 ● Nicholas H. Steneck. Fostering integrity in research: Definitions, current knowledge, and future directions. *Science and Engineering Ethics*, (2006). https://doi.org/10.1007/PL00022268 ● David B. Resnik & Adil E. Shamoo. The Singapore Statement on Research Integrity. *Accountability in Research*, (2010). https://www.tandfonline.com/doi/full/10.1080/08989621.2011.557296
2 [3h]	**Reproducibility and Replicability** ● What is reproducible research? ● What are the main causes of irreproducible research? Biases (e.g., selection, confounding, confirmation, anchoring, social desirability). Low statistical power. P-hacking. Herding effect, Academic 'abandonware'. ● Endogeneity ● HARKing **Training activity**

	● Case studies: several readings will be proposed and reviewed in class. The goal will be to identify reproducibility flaws. **Reading material** ● Intro reproducibility: Open Science Collaboration. "Estimating the reproducibility of psychological science." *Science* 349, no. 6251 (2015). https://doi.org/10.1126/science.aac4716 ● Gilbert, Daniel T., Gary King, Stephen Pettigrew, and Timothy D. Wilson. "Comment on "Estimating the reproducibility of psychological science"." *Science* 351, no. 6277 (2016): 1037-1037. https://doi.org/10.1126/science.aad7243 ● Overview paper: Munafò, Marcus R., Brian A. Nosek, Dorothy VM Bishop, Katherine S. Button, Christopher D. Chambers, Nathalie Percie Du Sert, Uri Simonsohn, Eric-Jan Wagenmakers, Jennifer J. Ware, and John PA Ioannidis. "A manifesto for reproducible science." *Nature Human Behaviour* 1, no. 1 (2017): 1-9. http://dx.doi.org/10.1038/s41562-016-0021 ● For discussion: Halsey, Lewis G., Douglas Curran-Everett, Sarah L. Vowler, and Gordon B. Drummond. "The fickle P value generates irreproducible results." *Nature Methods* 12, no. 3 (2015): 179-185. https://doi.org/10.1038/nmeth.3288
3 [3h]	**Strategies to Design Reproducible Research** ● Detection of reporting inconsistencies and errors ● Experimental design (e.g., triangulation, blinding; systematic random sampling; inclusion of controls; pseudo-random number generator) ● Bayesian statistics ● Power analysis (inc. simulations) ● P-curves ● Exploratory vs confirmatory hypothesis testing ● Methods of quality control for reliability and reproducibility. ● Registered reports and study preregistration ● Restructuring incentives **Training activity** ● Power analyses: several experimental designs will be provided to the class. Students will be asked to compute a power analysis and identify the number of study participants required or verify whether the collected data had enough statistical power to detect effects. **Reading material** ● Simmons, J. P., Nelson, L. D., Simonsohn, U. (2011). False-positive psychology: Undisclosed flexibility in data collection and analysis allows presenting anything as significant. *Psychological Science*, 22, 1359-1366 https://doi.org/10.1177/0956797611417632 ● Simonsohn, U., Nelson, L. D., & Simmons, J. P. (2014). P-curve: A key to the file-drawer. *Journal of Experimental Psychology*: General, 143, 534-547 https://doi.org/10.1037/a0033242 ● Simonsohn, U., Nelson, L. D., & Simmons, J. P. (2014). p-curve and effect size: Correcting for publication bias using only significant results.

	Perspectives on Psychological Science, 9, 666-681. https://doi.org/10.1177/1745691614553988 ● Brown, Andrew W., Kathryn A. Kaiser, and David B. Allison. "Issues with data and analyses: Errors, underlying themes, and potential solutions." *Proceedings of the National Academy of Sciences* 115, no. 11 (2018): 2563-2570. https://doi.org/10.1073/pnas.1708279115 ● Bishop, Dorothy VM. "Fallibility in science: Responding to errors in the work of oneself and others." *Advances in Methods and Practices in Psychological Science* 1, no. 3 (2018): 432-438. https://doi.org/10.1177/2515245918776632 ● Exploratory vs confirmatory: Wagenmakers, Eric-Jan, Ruud Wetzels, Denny Borsboom, Han LJ van der Maas, and Rogier A. Kievit. "An agenda for purely confirmatory research." *Perspectives on Psychological Science* 7, no. 6 (2012): 632-638. https://doi.org/10.1177/1745691612463078 ● Power: Lakens, Daniel. 2021. "Sample Size Justification." PsyArXiv. January 4. https://doi.org/10.31234/osf.io/9d3yf ● Triangulation: Munafò, Marcus R., and George Davey Smith. "Robust research needs many lines of evidence." (2018): 399-401. https://doi.org/10.1038/d41586-018-01023-3 ● Restructuring incentives: Nosek, Brian A., Jeffrey R. Spies, and Matt Motyl. "Scientific utopia: II. Restructuring incentives and practices to promote truth over publishability." *Perspectives on Psychological Science* 7, no. 6 (2012): 615-631. https://doi.org/10.1177/1745691612459058
4 [3h]	**How to Tell the Truth with Numbers** ● Reporting guidelines ● Statistical analysis plans ● JASP: open-source statistical software ● Computational notebooks in R (guest speaker) ● Avoiding statistical pitfalls ● Practise on simulations **Training activity** ● Computational notebooks: students will be asked to prepare a computational notebook to share the statistical analysis of their study with reviewers or with the readers. We will discuss style and conventions to produce these artifacts. **Reading material** ● Wilson, Greg, Dhavide A. Aruliah, C. Titus Brown, Neil P. Chue Hong, Matt Davis, Richard T. Guy, Steven HD Haddock et al. "Best practices for scientific computing." *PLoS biology* 12, no. 1 (2014): e1001745. https://doi.org/10.1371/journal.pbio.1001745
5 [3h]	**Open Research** ● Data acquisition and ownership ● Why are data not shared? ● Manage and share your research ● Study protocols, questionnaire definitions, consent forms ● Registered reports and study preregistration

	● Open datasets, anonymization, and licensing ● Threats of Open Data (e.g., training-set leakage) ● Examples and discussion **Training activities** ● Anonymise example dataset: a demo of a software for anonymising a dataset will be provided. ● Create repository with OSF: students will be asked to create a test repository with OSF. In addition we will look for published projects (e.g. github/OSF) as an example of how this could help students with their own projects. **Reading material** ● Chambers, C. D. and L. Tzavella (2021). "The past, present and future of Registered Reports." Nature Human Behaviour. http://dx.doi.org/10.1038/s41562-021-01193-7 ● Preregistration: First analysis of 'pre-registered' studies shows sharp rise in null findings.*doi:* https://doi.org/10.1038/d41586-018-07118-1 ● tbd
6 [3h]	**Human Participation in Research** ● Compliance and ethics terms ● Interpersonal responsibility ● Vulnerable populations ● Conflict of interest ● Examples and discussion **Training activity** ● Prepare informed consent: students will be asked to prepare an informed consent for a study with particular focus on compliance with the ethics terms of UNIL. In addition students will be asked to detail their data management plan. **Reading material** ● John Rooksby, Parvin Asadzadeh, Alistair Morrison, Claire McCallum, Cindy Gray, and Matthew Chalmers. 2016. Implementing ethics for a mobile app deployment. In *Proceedings of the 28th Australian Conference on Computer-Human Interaction* (OzCHI '16). Association for Computing Machinery, New York, NY, USA, 406–415. https://doi.org/10.1145/3010915.3010919
7 [3h]	**Animal Participation in Research** ● 3Rs (Replacement, Reduction and Refinement) ● The EQIPD quality system for preclinical data ● Experimental Design Assistant (EDA, NC3Rs UK) ● Studying cognition in animals: pitfalls & opportunities **Training activity** ● Interactive exercise: develop a therapy (from bench to bedside) for

	Alzheimer's disease **Reading material** ● Bespalov et al, **Introduction to the EQIPD Quality System**. eLife 2021. 10:e63294 https://doi.org/10.7554/eLife.63294 ● Nathalie Percie du Sert et al, **The ARRIVE guidelines 2.0: Updated guidelines for reporting animal research**. PLOS Biology, 2020. https://doi.org/10.1371/journal.pbio.3000410 ● Adrian J Smith, R Eddie Clutton, Elliot Lilley, Kristine E Aa Hansen, Trond Brattelid. **PREPARE: guidelines for planning animal research and testing**. Laboratory Animals, 2017. https://doi.org/10.1177/0023677217724823
8 [3h]	**Workshop** Students will present research data (either their own data, experimental design, or peer-reviewed articles) using the point of view of a 'reproducibility scientist'. The goal is to probe the student's ability to apply the concepts and tools acquired during the course. This will be an open-discussion session where student-to-student discussions are encouraged) using the point of view of a 'reproducibility scientist'.

#	Date	Room	Author	Objective		Title of Class	Content	Training activities	Guest speaker	Support
				Course hi-level objective	Class objective					
C01	22/2	Amphipôle 338	L. Restivo	A - Develop a critical point of view on day-to-day behavior in scientific practice	A.1 - Introduction and definition of scientific integrity A.2 - causes and consequences of lack of integrity	Scientific Integrity	- What is scientific integrity? - Why we do what we do: a personal take on scientific integrity - Why does scientific integrity get degraded?	case studies: students will be challenged with scenarios that touch upon choices considered daily routine in a laboratory setting		
C02	8/3	Amphipôle 338	M. Cherubini	A - Recognize design flaws of scientific studies that might lead to irreproducible research	A.3 - introduction and definitions of reproducibility and replicability A.4 - causes and consequences of lack of reproducibility	Reproducibility and Replicability	- What is reproducible research? - What are the main causes of irreproducible research? - Biases (e.g., selection, confounding, confirmation, anchoring, social desirability). - Low statistical power. P-hacking. Herding effect, Academic 'abandonware'. - Endogeneity - HARKing	Case studies: several readings will be proposed and reviewed in class. The goal will be to identify reproducibility flaws.		
C03	22/3	Anthropole 3128	T. Shoeler	B - Refer to and integrate experimental designs that will lead to valid research results	B.1 - Strategies to design reproducible research B.2 - Statistical techniques for reproducible research	Strategies to Design Reproducible Research	- Detection of reporting inconsistencies and errors - Experimental design (e.g., triangulation, blinding; systematic random sampling; inclusion of controls; pseudo-random number generator) - Bayesian statistics - Power analysis (inc. simulations) - P-curves - Exploratory vs confirmatory hypothesis testing - Methods of quality control for reliability and reproducibility. - Registered reports and study preregistration - Restructuring incentives	- Power analyses: several experimental designs will be provided to the class. Students will be asked to compute a power analysis and identify the number of study participants required or verify whether the collected data had enough statistical power to detect effects. - Create a registered report		
C04	5/4	Anthropole 3128	L. Restivo	C - Provide necessary elements in their scientific reporting that will allow their research to be reproducible and replicable	C.1 - Reporting strategies for reproducible research C.2 - Computational notebooks for transparent data analysis	How to Tell the Truth with Numbers	- Reporting guidelines - Statistical analysis plans - JASP: open-source statistical software - Computational notebooks in R (guest speaker) - Avoiding statistical pitfalls - Practise on simulations	Computational notebooks: students will be asked to prepare a computational notebook to share the statistical analysis of their study with reviewers or with the readers. We will discuss style and conventions to produce these artifacts.	Dr. Marc-Olivier Boldi	
C05	26/4	Amphipôle 338	M. Cherubini	D - Use commonly accepted Open Research repositories and software	D.1 - Open science techniques	Open Research	- Data acquisition and ownership - Why are data not shared? - Manage and share your research - Study protocols, questionnaire definitions, consent forms - Open datasets, anonymization, and licensing - Threats of Open Data (e.g., training-set leakage)	- Anonymise example dataset: a demo of a software for anonymising a dataset will be provided. - Create repository with OSF: students will be asked to create a test repository with OSF. In addition we will look for published projects (e.g. github/OSF) as an example of how this could help students with their own projects.	Prof. Kévin Huguenin (tbc)	
C06	10/5	Anthropole 3128	M. Cherubini	C - Provide necessary elements in their scientific reporting that will allow their research to be reproducible and replicable	C.3 - Standard practices for research involving human subjects	Human Participation in Research	- Compliance and ethics terms - Interpersonal responsibility - Vulnerable populations - Conflict of interest	Prepare informed consent: students will be asked to prepare an informed consent for a study with particular focus on compliance with the ethics terms of UNIL. In addition students will be asked to detail their data management plan.	Ms. Anina Eggenberger (tbc)	
C07	24/5	Anthropole 3128	L. Restivo	C - Understand how best practices in research and animal welfare together lead to reproducible data	C.4 - Standard practices for research involving animals	Animal Participation in Research	- 3Rs (Replacement, Reduction and Refinement) - The EQIPD quality system for preclinical data - Experimental Design Assistant (EDA, NC3Rs UK) - Studying cognition in animals: pitfalls & opportunities	Interactive exercise: develop a therapy (from bench to bedside) for Alzheimer's disease		
C08	31/5	Anthropole 3128	All	B - Refer to and integrate experimental designs that will lead to valid research results	B.3 - Apply leaned concepts to own research	Workshop	- Presentations about articles or personal research with specific focus on how to integrate elements of integrity and reproducibility	Individual presentations		