UNIVERSITÀ DI PISA

DIPARTIMENTO DI INGEGNERIA DELL'INFORMAZIONE

Dottorato di Ricerca in Ingegneria dell'Informazione

Doctoral Course

"Applied statistics for research in Engineering"

Ing. Vincenzo Catrambone, PhD

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Short Abstract: This course will focus on the complexity of data collected in engineering experimental research. Therefore, the course will focus on topics like experiment design, sample size estimation, and multi-factorial methods. First, basic designs of experimental studies will be discussed, then a review of some well-known and widely used parametric and non-parametric methods will be provided. After that, the course will describe the concept of statistical power and its practical application in the choices to be made in experimental research. The last part of the course will focus on the differences between statistical analysis and Machine Learning approaches, to make PhD students aware of the most appropriate tool to be used in their own research.

The aim of the course is to make PhD students able to write a full statistical analysis plan, analyze at least part of their data and write a preliminary result section for documentation of any statistical procedures they have used.

Course Contents in brief:

- Experimental design: observational, case-control, retrospective, prospective.
- Brief recap on descriptive and inferential statistics.
- The ability to understand the assumptions and perform the following statistical tests: Multifactorial ANOVA, Repeated measures ANOVA, Multiple and non-linear regression, Survival Analysis.
- Understand power and sample-size calculation (sample-size considerations) and perform them in the specific context of own studies.
- Increase statistical power through surrogate data analysis.
- When to choose between statistical analysis and Machine Learning approaches.

Total # of hours of lecture: 20

References:

[1] Montgomery, Douglas C., and George C. Runger. Applied statistics and probability for engineers. John wiley & sons, 2020.

[2] Vidakovic, Brani. Statistics for bioengineering sciences: with MATLAB and WinBUGS support. Springer Science & Business Media, 2011.

CV of the Teacher

Vincenzo Catrambone, Ph.D., is an Assistant Professor at the Neuro-Cardiovascular Intelligence Lab of the Bioengineering and Robotics Research Centre "E. Piaggio" and Information Engineering Department of University of Pisa. His research work spans statistical and nonlinear biomedical signal and image processing, cardiovascular and neural modelling, physiologically interpretable artificial intelligence systems. Applications of his research include the assessment of brain-heart interactions in physiological and pathological conditions, brain-computer interfaces, affective computing, assessment of mood and mental/neurological disorders, and neurorehabilitation. He received the Bachelor's and Master's Degree in Biomedical Engineering from University of Pisa, Italy, in 2013 and 2016, respectively. In 2020, he received the Ph.D. in Information Engineering cum laude, and his Ph.D. Thesis was specifically focused on the estimation of functional brain-heart interplay. He is an author of several international scientific contributions in these fields published in peer-reviewed international journals, and conference proceedings. He is involved in several international research projects, and in the past few years, he has been visiting researcher at the École Normale Supérieure de Lyon, France, and at the Brain Imaging Centre of the Maastricht University, Netherlands.

Final Exam: Oral presentation of the practical application, where the focus is on applying the methods to relevant and realistic data sets collected in PhD student's own research.

Room and Schedule

Room: *Aula Riunioni del Dipartimento di Ingegneria dell'Informazione, Via G. Caruso 16, Pisa – Ground Floor*

Schedule:

Day1 –11/12/2023: 14:00 - 18:00, Aula Riunioni del Piano Terra - via Caruso

Day2 – 12/12/2023: 14:00 - 18:00, Aula Riunioni del Piano Terra - via Caruso

Day3 – 13/12/2023: 14:00 - 18:00, Aula Riunioni del Piano Terra - via Caruso

Day4 – 15/12/2023: 14:00 - 18:00, Aula Riunioni del Piano 6 - Largo Lucio Lazzarino

Day5 – 18/12/2023: 14:00 - 18:00, Aula Riunioni del Piano Terra - via Caruso