PhD in Biostatistics: Design and analysis for longitudinal animal studies with high-dimensional outcomes

Background

Sound experimental design, followed up by rigorous statistical analysis of the results, is of great importance in studies involving animals, where for ethical and economic reasons, we aim to reduce the number of animals used while making sure that the sample size is sufficient to gain the required knowledge. The potential for reducing the number of animals needed by employing efficient experimental designs is huge. When animals or litters are measured repeatedly over time, we can use longitudinal design and analysis methods to gain statistical power. However, existing methods assume that each sample at each time provides only one, or at most a few, measured outcomes (Diggle, Heagerty, Liang and Zeger, 2002).

Meanwhile, modern high-throughput biotechnologies deliver very high-dimensional outcome data from a single sample. While most research acknowledges the dependence amongst different dimensions of the data (e.g. linkage disequilibrium in the genome, spatial correlation in brain function imaging), there is a need for study design and analysis methods that bridge the gap between traditional longitudinal studies and the high-dimensional world of biomedicine.

Project Description

This project will be concerned with developing a statistical model for the design and analysis of high-dimensional longitudinal studies, based on generalized linear mixed models and Gaussian processes. The student will apply this method to existing mouse functional brain imaging data from the lab of our collaborator Dr Neil Dawson. The aim will be to gain new scientific insights into developmental changes in mouse brain function, and to demonstrate the effectiveness of the high-dimensional longitudinal method for increasing the statistical power and reducing the number of mice needed.

The project will be jointly supervised by Professor Peter Diggle, Dr Frank Dondelinger and Dr James Hensman. The student will be based in the Centre for Health Informatics, Computing and Statistics (CHICAS) in the Lancaster Medical School, Lancaster University. The candidate will also have opportunities to interact with researchers in the School of Mathematics and Statistics and the Lancaster Data Science Institute.

Qualifications

This project would suit a graduate with a 2:1 or 1st class Honours degree or Masters in statistics, machine learning or other numerical field, with an interest in applying statistical approaches to make a positive impact in animal research. The applicant should have some knowledge of either longitudinal data analysis or high-dimensional statistics, and good programming skills in R or Python. Experience in working with brain imaging and molecular data is a bonus, but is not required.

Student Training

As part of the PhD studentship, the student will receive training in statistical genomics and genetics, longitudinal data analysis, brain imaging technology and neuroimaging statistics, the MCID Imaging software used for mouse brain imaging.

Funding and Eligibility

The studentship is funded for three years by the NC3Rs (https://www.nc3rs.org.uk). Funding covers home fees and a competitive stipend of £18,000/year. It also includes a £22,940 research training and support grant to be used over the three years.

The studentship is open to candidates of any nationality, but NC3Rs will only fund tuition fees at the home level, and will only pay a stipend to UK nationals, or EU nationals who have been resident in the UK for three years prior to application (this can include residence while undertaking undergraduate study).

Applications

Students wishing to apply should in the first instance contact Dr Frank Dondelinger (f.dondelinger@lancaster.ac.uk) informally to discuss suitability. The closing date for applications is Tuesday 31st January 2017.