

Experimental design and power analysis for *in-vivo* scientists

Course description: This intensive workshop run over two live online sessions is intended for Bioscience researchers at any stage of their research career who wish to be able to design a robust experiment when working with animal models. Participants will gain the theoretical and practical knowledge necessary to design *in vivo* experiments that are robust and reproducible. A freeware tool that can calculate the statistical power for many designs and a design proforma which can guide researchers through the design process will also be introduced.

This course is for beginners and assumes no prior knowledge of experimental design for *in vivo* experiments.

In summary:

Course title	Experiments design and power analysis for <i>in-vivo</i> scientists
Who for	Bioscience researchers at any stage of their research career who are actively designing <i>in-vivo</i> experiments
Length	2x 4.5-hour online sessions (Thursday & Friday 12:30-17:00) including a minimum 2x15 minute coffee breaks.
Format	Interactive mix of presentations, group discussions, demonstrations, and individual exercises.
Overall Purpose	To give participants the theoretical and practical knowledge necessary to design experiments that are robust such that causality can be assigned and have sufficient sensitivity for the effect of interest.
Key content	<ol style="list-style-type: none"> 1. Theory: <ol style="list-style-type: none"> a. Experimental design b. Statistical power 2. Activities: <ol style="list-style-type: none"> a. Debate: causes of replicability crisis b. identify potential confounders c. Debate: type one versus type two errors which is worse d. Identify experimental unit e. Calculate statistical power f. Review an experimental design proforma 3. Demonstrate: <ol style="list-style-type: none"> a. randomisation tools b. Russ Lenth power tool

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Learning outcomes	<p>By the end of this course participants will understand, appreciate or know:</p> <ul style="list-style-type: none"> • the goal of an experiment is to assign causality and the main risks to an experiment arise from five areas: low power, poor control of type one errors, poor randomisation, low internal validity, low external validity, and low construct validity. • the roles of various possible controls in experimental design. • the risk of extrapolation and that breadth of an experiment is a balance between clarity and resources available. • the difference between randomising and controlling and to appreciate that the experimenter will need to identify which factors are significant in affecting their experiment and decide whether to randomise or control these when planning the experiment. • why we use randomisation and awareness of tools that can help randomise samples or animals. • why experiments should be blind and gain an awareness of the strategies used to achieve this. • the role of statistical tests in data analysis and to know the different possible outcomes of a statistical tests (correct call/false positive/false negative). • all statistical tests have assumptions and when these assumptions are not met the tests will not perform as expected. • more complex experiment designs exist that can be more efficient when you are interested in the effect of multiple factors. • there are research reporting standards • the differences between a type 1 and type 2 error • statistical power is a measure of sensitivity and appreciate the factors that influence the statistical power of an experiment. • why low power inflates both type 1 and 2 error rate. • statistical power can be estimated for classic statistical tests and have practical skills in calculating power for a student's t-Test. • to adjust the sample size estimation to account for sample attrition • that there are alternative approaches, such as simulation, to estimate sample size when using non-standard analysis.
Pre-requisites/pre-work	None
Course provider	Responsible Research in Practice
Course Tutor	Natasha Karp or Benjamin Phillips
Max no. of attendees	20
Specifications	This workshop can be tailored to specific institutional requirements.