**Statistical Experimental Design**

Good experimental design generates information-rich data with a clear message. In both scientific research and industry, experimental design plays a critical role in obtaining reliable and meaningful results. Specifically, biomedical scientists can better understand their work when they carry out well-conceived, well-executed experiments and then extract, communicate, and act on information generated in those experiments. This course will prepare biomedical scientists in research and industry to design rigorous experiments that generate high-value data and to extract and communicate its messages. By applying statistical concepts in designing experiments, understanding variability, and drawing meaningful inferences, the course equips students with the knowledge and skills for data-driven decision-making.

The course begins with statistical experimental design and data analysis fundamentals to equip participants with the background they need to plan, execute, and analyze experiments effectively. Data visualization approaches will aid to interpret and communicate findings. Case studies using standard experimental designs will illuminate concepts and place these designs in a real-world context. At the end of the course, participants will be able to:

* Describe the benefits of good experimental design
* Explain how blinding and randomization reduce experimental bias and confounding
* Explain how blocking controls natural variation in experiments
* Calculate statistical power and perform power simulations
* Perform statistical significance tests and interpret their results
* Plot experimental results in histograms, boxplots and other visualizations
* Describe the perils of p-values and common misinterpretations of confidence intervals
* Sketch out randomized, block, factorial and repeated measures designs

**Syllabus**

Why design experiments?

Essential Features of a Comparative Experiment

Experimental Design Principles

Statistics in Data Analysis

Completely Randomized Designs

Completely Randomized Design with More than One Treatment Factor

Randomized Complete Block Designs

Repeated Measures Designs

**Who:** Experimentalists in biomedical research and industry who would like to develop rigorous experimental design practices and communicate experimental results effectively.

**Duration:** Two full days, 9am-5pm

**Prerequisites:** Basic knowledge of the R statistical programming language is needed for success in this course.