



# Experimental Design for Laboratory Biologists: Maximising Information and Improving Reproducibility

By Stanley E. Lazic

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Specifically intended for lab-based biomedical researchers, this practical guide shows how to design experiments that are reproducible, with low bias, high precision, and widely applicable results. With specific examples from research using both cell cultures and model organisms, it explores key ideas in experimental design, assesses common designs, and shows how to plan a successful experiment. It demonstrates how to control biological and technical factors that can introduce bias or add noise, and covers rarely discussed topics such as graphical data exploration, choosing outcome variables, data quality control checks, and data pre-processing. It also shows how to use R for analysis, and is designed for those with no prior experience. An accompanying website ([www.cambridge.org/9781107424883](http://www.cambridge.org/9781107424883)) includes all R code, data sets, and the labstats R package. This is an ideal guide for anyone conducting lab-based biological research, from students to principle investigators working in either academia or industry.

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### Editorial Review

#### Review

'This is a wonderfully lucid introduction to experimental design, written by an author who is clearly aware of the pitfalls that exist for the unwary experimenter. The focus is on how to design experiments to ensure reproducible research, with many examples illustrating general principles that need to be understood to avoid error and bias. The coverage of statistical analysis follows on naturally from the design issues, and is amply illustrated with exercises in R. Highly recommended.' Dorothy Bishop, University of Oxford

'Worldwide there is a salient discussion about deficiencies in the validity and predictiveness of research in the life sciences. Indeed, a fullblown 'reproducibility crisis' has been proclaimed. Against this backdrop this important textbook is a timely and highly useful contribution in the pressing quest to improve the robustness, rigor, and reproducibility of current biological and preclinical research. Proper experimental design is the bedrock for obtaining reliable evidence. By providing the necessary conceptual know-how and practical knowledge, [this book] enables investigators in all stages of their careers to minimize bias and improve statistical power through proper design and analysis of their experiments. This volume is unique ... [as] it is immensely readable and accessible even for those with little previous knowledge, in combining all relevant aspects in a practical, concise and comprehensive manner, and in its clear focus on factors that help to improve the quality of research.' Ulrich Dirnagl, Charité University Hospital, Germany

'There is an increasing need to better design experiments not only to reduce the number of any animals being used in any such work, but also to ensure that the data so produced is meaningful. As part of that process knowing how to power studies and then properly analyse the data so generated is vital, and of late there have been concerns that this is not been done to same vigour as that seen in the clinical arena. However, most scientists struggle with this aspect of their work, and thus it is really refreshing to come across a book that explicitly deals with experimental design and analysis. This new book clearly lays out what can and should be done and is written by an acknowledged expert and I have no doubt that this book will become a recommended read for all those contemplating undertaking work of this type.' Roger Barker, University of Cambridge

#### About the Author

Stanley E. Lazic holds a PhD in Neuroscience and a Masters degree in Computational Biology from the University of Cambridge and has conducted research at the University of Oxford, the University of Cambridge, and Harvard University, Massachusetts. He has written several papers on reproducible research and the design and analysis of biological experiments, and has published in Science and Nature. He is currently a Team Leader in Quantitative Biology (Statistics) at AstraZeneca.

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