Case Studies in Neural Data Analysis: A Guide for the Practicing Neuroscientist (Computational Neuroscience Series)

By Mark A. Kramer, Uri T. Eden

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As neural data becomes increasingly complex, neuroscientists now require skills in computer programming, statistics, and data analysis. This book teaches practical neural data analysis techniques by presenting example datasets and developing techniques and tools for analyzing them. Each chapter begins with a specific example of neural data, which motivates mathematical and statistical analysis methods that are then applied to the data. This practical, hands-on approach is unique among data analysis textbooks and guides, and equips the reader with the tools necessary for real-world neural data analysis.

The book begins with an introduction to MATLAB, the most common programming platform in neuroscience, which is used in the book. (Readers familiar with MATLAB can skip this chapter and might decide to focus on data type or method type.) The book goes on to cover neural field data and spike train data, spectral analysis, generalized linear models, coherence, and cross-frequency coupling. Each chapter offers a stand-alone case study that can be used separately as part of a targeted investigation. The book includes some mathematical discussion but does not focus on mathematical or statistical theory, emphasizing the practical instead. References are included for readers who want to explore the theoretical more deeply. The data and accompanying MATLAB code are freely available on the authors' website. The book can be used for upper-level undergraduate or graduate courses or as a professional reference.

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Editorial Review

Review

The advancement of large-scale recording techniques have created a deluge of data that needs to be appropriately analyzed and interpreted. This volume comes at the right time and will certainly be a desk-companion for many neurophysiologists trying to make sense of complex data.

(György Buzsáki, Biggs Professor of Neuroscience, NYU; author of *Rhythms of the Brain*)

No one knows what the future of neuroscience will bring, but it seems certain that ever increasing amounts of complex data will be one of its hallmarks. Kramer and Eden address an important need by offering an accessible, systematic hands-on approach to data analysis. This unique and invaluable book will be greatly appreciated by everyone who faces the tough analytic challenges of modern neuroscience.

(Olaf Sporns, Distinguished Professor, Indiana University; author of *Networks of the Brain* and *Discovering the Human Connectome*)

Case Studies in Neural Data Analysis by Mark Kramer and Uri Eden is a significant contribution to the neuroscience and statistics literatures. By combining actual data analysis problems with the essential statistics and mathematics, Kramer and Eden take the experimental neuroscientist from having no MATLAB programming experience to being able to apply in a principled manner the most commonly used neuroscience data analysis methods. The book's clear pedagogical format makes it readily accessible to undergraduates, graduate students, postdoctoral fellows, and principal investigators. *Case Studies in Neural Data Analysis* is a must-read for experimental neuroscientists as well as for anyone outside of neuroscience (statisticians, physicists, computer scientists, and engineers) wishing to learn about neuroscience data analysis problems and methods.

(Emery N. Brown, Edward Hood Taplin Professor of Medical Engineering, Institute for Medical Engineering and Science, MIT; Professor of Computational Neuroscience, Picower Institute for Learning and Memory, MIT; Department of Brain and Cognitive Sciences, MIT)

About the Author

Mark A. Kramer and Uri T. Eden are Associate Professors in the Department of Mathematics and Statistics at Boston University.

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