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Functional Data Analysis (2nd Edition)
J.O. Ramsay and B.W. Silverman
Springer Series in Statistics
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Functional data analysis occupies an important position in current methodological and theoretical research in statistics. A significant part of recent applied research in statistics involves functional data in some form or the other. Both the authors of this book are leading experts in functional data analysis, and they have provided a comprehensive discussion on various statistical techniques for the analysis of functional data along with an impressive collection of illustrative examples involving data originating from real scientific studies.

The introductory chapter of the book gives an excellent exposition of "what are functional data", followed by some very elementary yet very useful discussion on the basics of functional data analysis. The discussion is presented in the form of a quick exposure to data representation, data registration and data display, which is followed by brief introductions of functional versions of descriptive statistics, principal components analysis, canonical correlations, linear models and the use of derivatives in functional data analysis. The second chapter of the book contains some basic mathematical and statistical tools required in functional data analysis. Chapters 3–6 of the book present a very elaborate discussion on several standard smoothing techniques that are widely used in functional data analysis. Various technical details on the optimization problems, which arise when functions are fitted to observed data, are extensively discussed along with many interesting examples.

Functional versions of principal components analysis are discussed in detail in Chapters 8–10. Chapter 11 discusses canonical correlations and discriminant analysis for functional data. As pointed out by the authors in the "Preface to the Second Edition", they felt that their treatment of principal components and canonical correlations in the First Edition of the book was quite adequate, and it has been retained in the Second Edition essentially unaltered. However, the authors have rightly noticed that their treatment

of functional linear models in the First Edition was only preliminary, and they have done a complete overhaul of the presentation of materials on functional linear models in the Second Edition. In the Second Edition, functional linear models have been discussed in Chapters 12–17. These chapters contain thorough discussion on different types of functional linear models with various types of response and covariates, namely functional response, scalar response, multivariate covariates and functional covariates.

The use of derivatives and differential equations for the modelling and the analysis of functional data has been discussed in Chapters 17–19. In particular, Chapter 19 contains a discussion on principal differential analysis together with a comparison of it with principal components analysis. Chapter 20 contains a discussion on Green's function and reproducing kernels, which are well-known mathematical tools used in functional data analysis. Chapter 21 takes the reader back to a discussion on roughness penalties used in function fitting that has been discussed earlier in Chapter 5 and also in Chapter 9. In Chapter 21, more general roughness penalties and related technical details are discussed. Chapter 22 brings back principal components analysis and provides some interesting perspectives of this useful data analytic tool. A very useful component of the book is the appendix containing some important algebraic concepts and results.

The book contains an impressive collection of examples chosen from diverse scientific fields, and those make the the book really enjoyable to read. Statistical technology presented in the book is largely based on the authors' own research in this field. The presentation is quite rigourous and very lucid, making the book very useful for students and young researchers. I expect the book to be widely read and referenced within the statistical community as well as scientists from different disciplines.

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