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Statistical Methods for the Evaluation of Educational Services and Quality of Products

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Preface

The book presents statistical methods and models that can usefully support the evaluation of educational services and quality of products. The contributions collected in this book summarize the work of several researchers from the universities of Bologna, Firenze, Napoli and Padova. The contributions are written with a consistent notation and a unified view, and concern methodological advances developed mostly with reference to specific problems of evaluation using real data sets.

The evaluation of educational services, as well as the analysis of judgements and preferences, poses severe methodological challenges because of the presence of one or more of the following aspects: the observational (non experimental) nature of the context, which is associated with the well-known problems of selection bias and presence of nuisance factors; the hierarchical structure of the data, that entails correlated observations and consideration of effects at different levels of the hierarchy and their interactions (multilevel analysis); the multivariate and qualitative nature of the dependent variable, that requires the use of ad hoc statistical methodologies; the presence of non observable factors, e.g. the satisfaction, calling for the use of latent variables models; the simultaneous presence of components of pleasure and components of uncertainty in the explication of the judgments, that asks for the specification and estimation of mixture models.

The first part of the book deals with latent variable models. In many fields of application most of the variables under investigation are not directly observable, and hence not measurable. In this context latent variable models assume a prominent role. Traditionally, latent variable models were used in psychometrics and have been concerned with measurement error, and latent variable constructs measured with multiple indicators (factor analysis). Nowadays, latent variables are used to represent different phenomena, such as true variables measured with error, hierarchical and longitudinal data, unobserved heterogeneity and missing data. Chapters 2, 3 and 4 illustrate latent variable models with educational behaviour applications. Since the variables under investigation are abilities, initial status, or rate of change in temporal achievement, the models rely on continuous latent variables, but different types of observations can be considered. Latent variable models for hierarchical data, i.e. multilevel models, are considered in Chaps. 5 and 6. In particular,

Chapter 5 reviews the use of multilevel models for value-added analysis in education. Chapter 6 describes the specification and estimation of a multilevel mixture factor model with continuous and categorical latent variables.

From a different point of view, Chap. 7 proposes an approach mainly based on individual perceptions about the discrete choices. In this framework, the latent process guiding the preferences and the judgements is represented by a mixture model. Extensions dealing with multi-attribute methods, such as conjoint analysis and choice modelling, are provided in Chap. 8, carrying out a brief and critical review in order to clarify the distinctions between the models as well as to point out their common issues.

A frequently encountered problem in fitting statistical models is the presence of outliers. Chapter 9 deals with a robust diagnostic approach known as Forward Search that detects the presence of outliers and assesses their influence on the estimates of the model parameters. In particular, the use of this approach is investigated in generalized liner models applied in studies on university performance evaluation.

The last chapters are devoted to nonparametric hypotheses testing via permutation methods for complex observational studies and to nonparametric construction of composite indicators. Chapter 10 presents a novel global performance score for the construction of a global performance index when the focus is at evaluating the product performances in connection with more than one aspect (dimension) and/or under several conditions (strata). Chapter 11 considers permutation methods for multivariate testing on ordered categorical variables within the framework of multivariate randomised complete block designs with application to a case study related to food sensorial evaluation. Chapter 12 is devoted to permutation tests for stochastic ordering problems where the main goal is to find out where the treatment peak is located (so called "umbrella alternative"). Chapter 13 deals with a novel method for constructing preference rankings based on the nonparametric combination procedure with application to the evaluation of professional profiles of municipal directors.

The Editors would like to thank all the people who, by their intensive research and aptitude of integration, have contributed to the realization of this book.

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