Jon Wakefield: Bayesian and Frequentist Regression Methods

Taeryon CHOI

Regression analysis is a methodology for studying the relationship between two sets of variables. It includes many statistical techniques for modeling and analyzing different types of observed data to explain the relationship between a dependent variable and a set of independent variables. Recently, there has been a dramatic increase in the development of research, textbooks, and software for regression analysis in theory and methods as well as real applications in practice. Roughly speaking, two main philosophical approaches to quantifying uncertainty exist in the field of statistics: the Bayesian and frequentist approaches. In brief, Bayesian statistics is characterized by updating the prior opinion of the parameter based on the observed data, whereas frequentist statistics is characterized by investigating the behavior of parameter estimates in repeated sampling from the population. These two philosophical approaches to statistics thus provide different inferential paradigms and interpretations in all branches of statistics, including regression analysis.

Jon Wakefield's book *Bayesian and Frequentist Regression Methods* is an incomparable regression text in that it provides the most comprehensive combination of Bayesian and frequentist methods that exists. The central topic of the book is an exposition of Bayesian and frequentist methods in regression analysis with a detailed illustration of these methods based on real data analysis. The book also discusses a comparison of Bayesian and frequentist approaches in basic inferential procedures, hypothesis testing, variable selection, and general regression modeling. There are a few other books in statistics that unify or compare two different statistical paradigms (see, e.g., Geisser 2006; Samaniego 2010, and Held and Sabanés Bové 2014), but no book expounds the subject in the manner of this book, which provides an extensive and thorough discussion of the regression analysis to reflect recent advances in the field from the two statistical perspectives in terms of methods, implementation, and practical applications. The

Taeryon Choi (✉) is Associate Professor (E-mail: *trchoi@gmail.com*), Department of Statistics, Korea University, Seoul, Republic of Korea

book concerns many different types of regression problems, describing the Bayesian and frequentist approaches for the specific regression models and illustrating these approaches with empirical analysis based on real data applications and the computer programs used to implement them. Each of the methods for the specific regression model are demonstrated with in-depth discussion, and the author provides a supplementary website (*http://faculty.washington.edu/jonno/regression-methods.html*) that includes datasets and R and WinBUGS computer codes. The book covers many different kinds of parametric regression models, including, for example, linear regression, binary data, GLM, and mixed models in detail with real data examples for the Bayesian and frequentist methods. Nonparametric regression and classification models are also discussed in detail based on the spline and kernel methods. From my perspective, the exposition on regression methods in the book leaves nothing to be desired except for one thing: More attention could have been devoted to Bayesian nonparametric regression models. These are discussed in Section 11 via linear mixed model spline representation for Bayesian inference, but other approaches found in the literature, such as basis expansion models, P-spline models using `BayesX`, and Gaussian process models, could have been included. (see, e.g., Denison et al. 2002; Congdon 2006, Chapter 10; Fahrmeir et al. 2013; Gelman et al. 2013, Chapter 21, and references therein).

In summary, this book provides an excellent exposition of regression methods from both Bayesian and frequentist perspectives. I greatly enjoyed reading *Bayesian and Frequentist Regression Methods*. The book will serve very well as a textbook for graduate students in regression analysis, and it can also be used as a helpful reference book for researchers and practitioners in related areas. I highly recommend *Bayesian and Frequentist Regression Methods* as a must-have book for both the Bayesian and the frequentist.

REFERENCES

Congdon, P. (2006), *Bayesian Statistical Modelling*, *Wiley Series in Probability and Statistics* (2nd ed.) Chichester: John Wiley & Sons

Denison, D. G. T., Holmes, C. C., Mallick, B. K., and Smith, A. F. M. (2002), *Bayesian Methods for Nonlinear Classification and Regression*, *Wiley Series in Probability and Statistics*, Chichester: John Wiley & Sons

Fahrmeir, L., Kneib, T., Lang, S., and Marx, B. (2013), *Regression: Models, Methods and Applications*, Heidelberg: Springer.

Geisser, S. (2006), *Modes of Parametric Statistical Inference*, *Wiley Series in Probability and Statistics*, Hoboken, NJ: Wiley-Interscience.

Gelman, A., Carlin, J. B., Stern, H. S., Dunson, D. B., Vehtari, A., and Rubin, D. B. (2013), *Bayesian Data Analysis*, *Texts in Statistical Science Series* (3rd ed.) Boca Raton, FL: Chapman & Hall/CRC.

Held, L., and Sabanés Bové, D. (2014), *Applied Statistical Inference*, *Springer Series in Statistics*, New York: Springer.

Samaniego, F. J. (2010), *A Comparison of the Bayesian and Frequentist Approaches to Estimation*, *Springer Series in Statistics*, New York: Springer.