Preface

In multivariate statistical analysis, elliptical distributions have recently provided an alternative to the normal model. Most of the work, however, is spread out in journals throughout the world and is not easily accessible to the investigators. Fang, Kotz, and Ng presented a systematic study of multivariate elliptical distributions; however, they did not discuss the matrix variate case. Fang and Zhang have summarized the results of generalized multivariate analysis which include vector as well as the matrix variate distributions. On the other hand, Fang and Anderson collected research papers on matrix variate elliptical distributions, many of them published for the first time in English. They published very rich material on the topic, but the results are given in paper form which does not provide a unified treatment of the theory. Therefore, it seemed appropriate to collect the most important results on the theory of matrix variate elliptically contoured distributions available in the literature and organize them in a unified manner that can serve as an introduction to the subject.

The book will be useful for researchers, teachers, and graduate students in statistics and related fields whose interests involve multivariate statistical analysis and its application into portfolio theory. Parts of this book were presented by Arjun K. Gupta as a one semester course at Bowling Green State University. Knowledge of matrix algebra and statistics at the level of Anderson is assumed. However, Chap. 1 summarizes some results of matrix algebra. This chapter also contains a brief review of the literature and a list of mathematical symbols used in the book.

Chapter 2 gives the basic properties of the matrix variate elliptically contoured distributions, such as the probability density function and expected values. It also presents one of the most important tools of the theory of elliptical distributions, the stochastic representation.

The probability density function and expected values are investigated in detail in Chap. 3.

Chapter 4 focuses on elliptically contoured distributions that can be represented as mixtures of normal distributions.

The distributions of functions of random matrices with elliptically contoured distributions are discussed in Chap. 5. Special attention is given to quadratic forms.

Characterization results are given in Chap. 6.

The next three chapters are devoted to statistical inference. Chapter 7 focuses on estimation results, whereas Chap. 8 is concerned with hypothesis testing problems. Inference for linear models is studied in Chap. 9.

Chapter 10 deals with the application of the elliptically contoured distributions for modeling financial data. We present distributional properties of the estimated main characteristics of optimal portfolios, like variance and expected return assuming that the asset returns are elliptically contoured distributed. The joint distributions of the estimated parameters of the efficient frontier are derived as well as we provide exact inference procedures for the corresponding population values. We also study the distributional properties of the estimated weights of the global minimum variance portfolio in detail.

In Chap. 11, we consider a further extension of matrix variate elliptically contoured distributions that allows us to model the asymmetry in data. Here, first the multivariate skew normal distribution is presented and its matrix generalization is discussed. We also study the main properties of this distribution, like moments, the density function, and the moment-generating function. Next, the skew t-distribution is introduced as well as the general class of matrix variate skew elliptically contoured distributions. Moreover, we present the distributional properties of quadratic forms in skew elliptical distributions and discuss the inference procedures. An application into portfolio theory is discussed as well. Finally, an up-to-date bibliography has been provided, along with author and subject indexes. The materials in the first nine chapters are from the book Elliptically Contoured Models in Statistics by the first two authors. The material in Chaps. 10 and 11 is taken from the papers of the authors. Permission of their publishers Kluwer Academic Publishers (http://www.wkap.com), Japan Statistical Society (http://www.jss.gr.jp), Springer (http://www.springer.com), and Taylor and Francis (http://www.tandfonline.com/) is gratefully acknowledged.

We would like to thank the Department of Mathematics and Statistics, Bowling Green State University, and the Department of Mathematics, Humboldt University of Berlin, for supporting our endeavor and for providing the necessary facilities to accomplish the task. The first author is thankful to the Biostatistics Department, University of Michigan, for providing him the opportunity to organize the material in its final form. Thanks are also due to Professors D. K. Nagar, M. Siotani, J. Tang, and N. Nguyen for many helpful discussions. He would also like to acknowledge his wife, Meera, and his children, Alka, Mita, and Nisha, for their support throughout the writing of the book. The second author is thankful to his mother Edit for her support in the early stages of the work on this book. The third author acknowledges the support of the Department of Statistics, European University Viadrina and the German Research Foundation (DFG) via the Research Unit 1735 “Structural Inference in Statistics: Adaptation and Efficiency”. Thanks are also due to Professors W. Schmid and Y. Yelejko. He is also greatly thankful to his wife Olha and to his children Bohdan and Anna-Yaroslava for providing considerable help during the preparation of the book.

Finally our sincere thanks to Marc Strauss, Springer, for his help at every stage of the completion of this book.

Bowling Green, USA — Arjun K. Gupta
Budapest, Hungary — Tamas Varga
Berlin, Germany — Taras Bodnar

http://www.springer.com/978-1-4614-8153-9

Elliptically Contoured Models in Statistics and Portfolio Theory

Gupta, A.K.; Varga, T.; Bodnar, T.

2013, XX, 321 p. 7 illus., Hardcover
ISBN: 978-1-4614-8153-9