PREFACE

Linear Algebra and Statistics: Second Special Issue

About four years have passed since the publication of the first Special Issue of *Linear Algebra and Its Applications* on Statistics (vol. 67, June 1985; vol. 70, October 1985; and vol. 82, October 1986, pp. 143–279; I. Olkin, C. R. Rao and G. P. H. Styan, eds.). As was noted in its Preface the application of linear algebraic methods in statistics can be traced back to the work of Gauss on the optimality of the least squares estimator under a very general set-up which is now known as the Gauss-Markov model. The next major applications in recent times were in the study of Markov chains involving properties of stochastic matrices and limits of their powers, and in deriving the distribution of quadratic forms of normal variables using the concepts of idempotent matrices and rank additivity of symmetric nonnegative definite matrices. But the major impact of the methods of linear algebra in statistics can be found in multivariate analysis and inference from linear models which exhibit singularities. We see heavy use of linear algebra in papers on factor analysis, multidimensional scaling, and in the pioneering work of R. A. Fisher on the roots of determinantal equations.

Generalized inverses of matrices, separation theorems for singular values of matrices, generalizations of Chebychev type and Kantorovich inequalities, stochastic orderings, generalized projectors, limits of eigenvalues of random matrices, and Petrie matrices are some of the contributions to linear algebra, which are motivated by problems in statistics. The impact of linear algebra on statistics has been so substantial, in fact, that there are now available at least five books devoted entirely to linear and matrix algebra for statistics, and a number of other statistical books in which linear and matrix algebra play a major role.

The 36 research papers in this second Special Issue of *Linear Algebra and Its Applications* on Statistics include applications to statistics and probability of circulants, determinantal equations, generalized inverses, infinite products, invariant spaces, majorization, matrix partial orderings, orthogonal arrays, permanents, permutations, rank additivity, reflection groups, Schur concavity, and Toeplitz matrices. In addition these papers cover certain aspects of the linear-algebraic and matrix-theoretic methods associated with the following topics in statistics and probability: asymptotics, Cochran's theorem, covariance and correlation structures, cyclic designs, exchangeability, experi-

mental design, factor analysis, Gauss-Markov model, general balance, hypothesis testing, likelihood-ratio statistics, linear models, linear unbiased estimation, Markov chains, minimax designs, multiple regression, relative efficiency, robustness, and stationary processes, as well as generalized, restricted, unrestricted, weighted, and ordinary least squares.

Michael D. Perlman
Friedrich Pukelsheim
George P. H. Styan