Preface

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Almost half of the papers in this Third Special Issue of *Linear Algebra and Its Applications* on Linear Algebra and Statistics were presented at the International Workshop on Linear Models, Experimental Designs, and Related Matrix Theory held in Tampere, Finland, 6–8 August 1990. Several other papers presented at this Workshop, but which involve less linear algebra and/or are more statistical in nature, will be published in a forthcoming Special Issue of the *Journal of Statistical Planning and Inference*. Many thanks go to Erkki Liski and Simo Puntanen, both of the Department of Mathematical Sciences/Statistics, University of Tampere, for their excellent organization of this Workshop.

Two years have passed since the publication of the Second Special Issue on Linear Algebra and Statistics (Vol. 127, January 1990; Michael D. Perlman, Friedrich Pukelsheim, and George P. H. Styan, Eds.), and about six years since the First Special Issue (Vol. 67, June 1985; Vol. 70, October 1985; and Vol. 82, October 1986, pp. 143–279; Ingram Olkin, C. Radhakrishna Rao, and George P.H. Styan, Eds.).

As was noted in the Preface to the First Special Issue of *Linear Algebra and Its Applications* on Linear Algebra and Statistics,

> . . . 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.

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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 17 research papers in this Third Special Issue involve the following topics in linear algebra and matrix theory and their applications to statistics and probability: diagonally range-dominant matrices, eigenvalues of matrix sums, generalized inverses (Banachiewicz-Schur form, inner, outer, symmetric reflexive), Hermite polynomials, idempotent matrices, inequalities, infinite products of matrices, iterative maximization, Laguerre polynomials, matrix commutativity, matrix derivatives, matrix norms and antinorms, matrix partial orderings (Löwner, minus, sharp, star), numerical methods, periodicity, polynomial matrix equations, rank additivity and subtractivity of matrices, Schur complements, stochastic and V-matrices, supermultiplicativity factors, and zonal polynomials.

In addition these papers cover certain aspects of the linear-algebraic and matrix-theoretic methods associated with the following topics in statistics and probability: admissible estimators, asymptotics, canonical correlations, Cochran's theorem, constrained least-squares estimators, correspondence analysis, covariance and correlation structures, Edgeworth expansions, efficiency and optimality of ordinary least squares, Gauss–Markov models, generalized ridge estimators, linear models, linear regression, linear unbiased estimators, Markov chains, maximum-likelihood estimators, minimax estimators, multicollinearity, multiple regression, multivariate statistical analysis, nonhomogeneous Markov systems, orthogonal designs, and the Wishart distribution.