

**The IMA Volumes
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and its Applications**

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Willard Miller, Jr.

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Seymour Geisser
Editor

Diagnosis and Prediction

With 17 Illustrations



Springer

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FOREWORD

This IMA Volume in Mathematics and its Applications

DIAGNOSIS AND PREDICTION

is one of the series based on the proceedings of a very successful 1997 IMA Summer Program on “Statistics in the Health Sciences.”

I would like to thank Seymour Geisser of University of Minnesota, School of Statistics for his excellent work as organizer of the meeting and for editing the proceedings. I am grateful to Donald A. Berry, Duke University (Statistics); Patricia Grambsch, University of Minnesota (Biostatistics); Joel Greenhouse, Carnegie Mellon University (Statistics); Nicholas Lange, Harvard Medical School (Brain Imaging Center, McLean Hospital); Barry Margolin, University of North Carolina-Chapel Hill (Biostatistics); Sandy Weisberg, University of Minnesota (Statistics); Scott Zeger, Johns Hopkins University (Biostatistics); and Marvin Zelen, Harvard School of Public Health (Biostatistics) for organizing the six weeks summer program.

I also take this opportunity to thank the National Science Foundation (NSF) and the Army Research Office (ARO), whose financial support made the workshop possible.

Willard Miller, Jr., Professor and Director

PREFACE

This volume contains refereed papers submitted by participants of the third week of a six week workshop on Statistics in the Health Sciences held by the Institute of Mathematics and its Applications in Minneapolis, Minnesota during July of 1997. This week was devoted to the closely related topics of Diagnosis and Prediction.

Theoretical and applied statisticians from Universities, Medical and Public Health Schools, government and private research institutions, and pharmaceutical companies involved in prediction problems in the life and social sciences and in diagnostic and screening tests were brought together to discuss and exchange new results and information on these important and related issues. Especially lively discussions ensued involving the critical issues and difficulties in using and interpreting diagnostic tests and implementing mass screening programs.

A diagnostic test for a condition or disease can be either a retrodiction (a "prediction" of an event that may have already occurred whose outcome was not overt) or a prediction, i.e. the test actually discerns whether a potential precursor of the condition exists that will, with appreciable probability, eventually lead to the condition. Most diagnostic tests are not of the gold standard variety that can predict whether or not the condition has or will occur with perfect accuracy.

Several papers are directed towards developing and explicating the theoretical and methodological aspects of various characteristics of diagnostic tests such as false positives, false negatives, the estimation of the probability of the condition given the test results and comparisons among tests. Applications are discussed in the paper by Le et al. with regard to a disease, and the one by Sinclair and Gastwirth with respect to social science phenomena. The paper by Wang and Geisser supplies the theory for the optimal administration of several mass screening tests whether given jointly or sequentially, when losses for errors and the costs of different tests can be assessed.

Other papers and talks develop prediction methods for future events such as survival, comparative survival and survival post intervention for diseases and other natural events. Utts and Niemeier develop and apply prediction methods to pollutants. Johnson, using a Dirichlet process prior, generates results for the prediction of survival using interval data. Papanonatos develops methodology for predictive interim analyses using Weibull regression complicated by frailty. Chen et al. devise an optimal procedure for controlling the prediction of a future event for certain time series that could be useful for chronic disease processes.

Zelterman and Yu model longevity for twin data and obtain distributions for the number of pairs both alive at various ages.

Papers in this volume exhibited both frequentist and Bayesian approaches in attacking the problems.

Seymour Geisser

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