

Preface

The impetus for this book came from the ‘perfect’ storm of events. As I was preparing for my recent sabbatical, I was involved in several biometrics projects that confirmed for me the need for some basic statistical methods for testing and evaluation of biometric devices. During my sabbatical, in the spring of 2007, I was asked by our host, Fabio Roli of L’Università di Cagliari in Sardinia, to teach a graduate-level short course on my research. In preparing for that course, I was struck by how little quality research had been done for the practicing biometric researcher, tester or engineer in the way of basic statistical methods for measuring the performance of biometric authentication systems or for comparing the performance of two or more such systems. Most of the work that does exist is focused on methods for a single false match rate or a single false non-match rate. But those two metrics are only part of the story for a bioauthentication system and there is a need for methods that appropriately compare two or more methods. This book is a direct result of that short course. For inviting us to visit, for hosting us and for asking me to teach that short course, I am indebted to Fabio Roli and this research group. *Grazie mille di cuore. Ora siamo sardi.*

The goal of this book is to provide *basic* statistical methodology for practitioners and testers of bioauthentication devices. (I will use both the term biometrics and the bioauthentication to describe the devices that take physiological measurements and make decisions about access from those measurements.) The book also covers general classification performance since the data collection for most classification systems is similar to approaches used in biometric authentication. I do *not* aim to present a complete and thorough set of methodology for all possible applications and all possible tests. Instead, the aim is on a basic framework of methods that cover a variety of circumstances but that can be extended and generalized as needed.

The research that led to the publication of this book was generously funded by the Center for Identification Technology Research (CITeR) and the National Science Foundation (NSF). Funding for this work comes from NSF grants CNS-0325640 and CNS-0520990. CNS-0325640 is cooperatively funded by the National Science Foundation and the United States Department of Homeland Security (DHS). *Any opinions, findings, and conclusions or recommendations expressed in this book are*

those of the author(s) and do not necessarily reflect the views of the National Science Foundation. I have been fortunate enough to obtain several grants from CITeR over the years. The support and the interaction that CITeR has provided have been pivotal to my research and my career. Special thanks to LaRue Williams at WVU for keeping CITeR running smoothly.

A book like this is never completely the effort of one individual. I have been blessed to have many giving mentors and teachers over the years who inspired as well as gave much of themselves and their time including: Joe Walker of Cumberland Valley High School, Robert Hultquist of Penn State, Brenda Gunderson at the University of Michigan, Sallee Anderson at Kellogg Company, Diane Sly Tielbur at Kellogg Company, Dean Isaacson of Iowa State University, Hal Stern, now at UC Irvine, Steve Vardeman of Iowa State University, Larry Hornak of West Virginia University, Patti Lock of St. Lawrence University and Robin Lock of St. Lawrence University.

I am very fortunate that the Department of Mathematics, Computer Science and Statistics at St. Lawrence University is an energetic and vibrant one. Patti Lock, the current chair, has been extremely flexible and encouraging throughout this process. My colleague, Robin Lock, is still willing to dispense his sage advice to his statistical junior. Jessica Chapman and Ivan Ramler have brought fresh energy to statistics at St. Lawrence. Collen Knickerbocker helped me down this path and I have not forgotten his wit and his wisdom. Jim DeFranza read the proposal for this book and offered helpful suggestions for improvements.

Many of my *undergraduate* students at St. Lawrence worked on this as part of a summer research grant fellowship or as part of their senior or honors projects. They are: Travis Atkinson, Hilary Hartson, Anne Hawley, Katie Livingstone, Dennis Lock, Nikki Lopez, Yordan Minev, Nona Mramba, Matt Norton, Amanda Pendergrass, and Emily Sheldon. (I am particularly indebted to Yordan for his assistance developing the R code for the ROC/EER chapter.) Marcus Tuttle assisted greatly in the creation of the tables and with the last minute minutia of book completion on some snowy days in December 2009. Ben von Reyn gave up part of his Thanksgiving and semester breaks to proofread and provide detailed feedback and comments on a draft of this book. Thanks to all.

Simon Rees and Wayne Wheeler at Springer have been tremendously supportive and patient with me as a first-time author. Thank you both for your time and efforts on behalf of this monograph.

I received many helpful comments and suggestions from colleagues and collaborators along the way. Rick Lazarick of CSC and Chris Miles at DHS have been encouraging throughout this process. Larry Hornak of West Virginia University and Bojan Cukic of West Virginia University have been tremendous mentors and wonderful friends. Andy Adler of Carleton University, Jessica Chapman of St. Lawrence University, Zach Dietz of Hamilton College, Eric Kukula of Purdue University, Gian Luca Marcialis dell'Università di Cagliari, Shimon Modi of Purdue University, Norman Poh of University of Surrey, George W. Quinn at the National Institute of Standards and Technology, and Stephanie Schuckers of Clarkson University each read a chapter and provided detailed feedback. Daqing Hou, my collaborator on the software that will accompany this book, has asked many questions that the target reader

would, and so, has made this text better. Their contributions improved all facets of this book and I appreciate all of their useful comments. Thank you all. The errors that remain are solely mine.

Eric Kukula and Shimon Modi of Purdue University generously allowed me to use their failure to enrol and failure to acquire data, respectively. I must also thank Norman Poh for providing the bioauthentication research community with the BANCA match score database and the XM2VTS match score database. Thanks to National Institute for Standards and Technology and Patrick Grother, in particular, for making the Biometrics Score Set Release 1 available. All of these are valuable tools for benchmarking and testing.

To my family, Stephanie, Daniel, Christopher and Gabriella, thank you so much for your love and support. I can never repay your patience amid the writing of this book but I will try. My parents gave up chunks of their retirement to be with their grandchildren and to allow me extra time in my office. Over the years they have also been incredibly generous and enthusiastic. I am very fortunate to have had that support. Thank you, Mom and Dad. My sisters, Lisa and Carly, as always, provided cheer, humor and encouragement during this process.

Finally, to Stephanie, for being such an extraordinary person and wife, for giving your support to this endeavor and for giving me so many *halcyon* days; I adore you and I am so lucky.

Canton, NY, USA

Michael E. Schuckers

Computational Methods in Biometric Authentication

Statistical Methods for Performance Evaluation

Schuckers, M.E.

2010, XXV, 317 p., Hardcover

ISBN: 978-1-84996-201-8