


Bradley Efron

Max H. Stein Professor and Professor of Statistics and of Biomedical Data Science

 NIH Biosketch available Online

 Curriculum Vitae available Online

CONTACT INFORMATION

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Bio

BIO

Brad is Max H. Stein Professor of Humanities and Sciences, Professor of Statistics, and Professor of Biostatistics with the Department of Biomedical Data Science in the School of Medicine; he serves as Co-director of the Mathematical and Computational Sciences Program. He has held visiting faculty appointments at Harvard, UC Berkeley, and Imperial College, London. A recipient of a 2005 National Medal of Science for his contributions to theoretical and applied statistics, especially the bootstrap sampling technique, in 2014 he was awarded the Guy Medal in Gold by the Royal Statistical Society. Together with David Cox of the University of Oxford, Efron was honored as a Laureate in the 2016 edition of the BBVA Foundation Frontiers of Knowledge Awards, “for revolutionizing statistics and making it into an indispensable tool for other sciences.”

ACADEMIC APPOINTMENTS

- Professor, Statistics
- Professor, Biomedical Data Science
- Member, Stanford Cancer Institute

ADMINISTRATIVE APPOINTMENTS

- Professor of Biomedical Data Science, Stanford School of Medicine Department of Biomedical Data Science, (2015- present)
- Chairman, Stanford University Department of Statistics, (1998-1999)
- Chairman, Stanford University Faculty Senate, (1998-1999)
- Chairman, Stanford University Advisory Board, (1996-1997)
- Chairman, Stanford University Department of Statistics, (1993-1994)
- Chairman, Stanford University Department of Statistics, (1991-1994)
- Max H. Stein Professor of Humanities and Sciences, Stanford University, (1988- present)
- Associate Dean, Stanford University School of Humanities and Sciences, (1987-1990)
- Co-director, Stanford University Mathematical and Computational Science Program, (1980- present)
- Professor, Stanford University Department of Statistics, (1972- present)

- Professor of Biostatistics, Stanford School of Medicine Department of Health Research and Policy, (1972-2015)
- Visiting Scholar, Imperial College London Department of Mathematics, (1971-1972)
- Associate Professor, Stanford University Department of Statistics, (1968-1972)
- Visiting Lecturer, Harvard University Department of Statistics, (1967-1968)
- Assistant Professor, Stanford University Department of Statistics, (1964-1967)

LINKS

- Statistics Department Faculty Page: <https://statistics.stanford.edu/people/bradley-efron>

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

My main project during the last two years has been "Computer Age Statistical Inference", a book written in collaboration with Trevor Hastie. Our goal is to review the development of statistical thinking since the introduction of electronic computation in the 1950s. Individual chapters concern progress in important topic areas, emphasizing the interplay between computational methods and inferential ideas. The survival analysis chapter, for example, traces the steps from life tables, the Kaplan-Meier estimator, and the Mantel Haenszel log rank test to the proportional hazards model.

The book proceeds in three parts: Part 1 reviews classical inference, Bayesian, frequentist, and Fisherian. Part 2 covers developments from 1955 through 1995, empirical Bayes, James-Stein estimation, ridge regression, generalized linear models, jackknife and bootstrap methods, objective Bayes and MCMC, plus several other topics. Part 3 concerns 21st century topics, false discovery rates, sparse modeling and the lasso, support vector machines, neural networks, random forests, and other modern data analytic algorithms. First drafts of Parts 1 and 2 are now complete. Part 3 is in progress, and we hope to complete work in 2016.

The broader impact of my other work over the previous few years has been to establish both within and outside the field the practical importance of computer-intensive statistical methods, such as the bootstrap, shrinkage estimation, and local false discovery rates. Besides gaining traction themselves, these methods have stimulated parallel developments in other areas, such as MCMC algorithms for Bayesian calculations.

Teaching

COURSES

2018-19

- Applied Statistics II: STATS 305B (Win)

2017-18

- Methods for Applied Statistics I: Exponential Families in Theory and Practice: STATS 305B (Win)

2015-16

- Methods for Applied Statistics: Empirical Bayes Methods: STATS 306B (Spr)

Publications

PUBLICATIONS

- **Proteomic analysis of monolayer-integrated proteins on lipid droplets identifies amphipathic interfacial alpha-helical membrane anchors.** *Proceedings of the National Academy of Sciences of the United States of America*
Pataki, C. I., Rodrigues, J., Zhang, L., Qian, J., Efron, B., Hastie, T., Elias, J. E., Levitt, M., Kopito, R. R.
2018
- **CURVATURE AND INFERENCE FOR MAXIMUM LIKELIHOOD ESTIMATES** *ANNALS OF STATISTICS*

- Efron, B.
2018; 46 (4): 1664-92
- **SPECIAL SECTION IN MEMORY OF STEPHEN E. FIENBERG (1942-2016) AOAS EDITOR-IN-CHIEF 2013-2015 ANNALS OF APPLIED STATISTICS**
Gneiting, T., Asher, J., Carriquiry, A., Davis, R., Dawid, A., Efron, B., Haberman, S., Kou, S., Newton, M., Paddock, S., Prewitt, K., Raftery, A., Stein, et al
2018; 12 (2): III-X
 - **Anti-HER2 scFv-directed extracellular vesicle-mediated mRNA-based gene delivery inhibits growth of HER2-positive human breast tumor xenografts by prodrug activation.** *Molecular cancer therapeutics*
Wang, J., Forterre, A. V., Zhao, J., Frimannsson, D. O., Delcayre, A., Antes, T. J., Efron, B., Jeffrey, S. S., Pegram, M. D., Matin, A. C.
2018
 - **Improvement in treatment abandonment in pediatric patients with cancer in Guatemala.** *Pediatric blood & cancer*
Alvarez, E., Seppa, M., Rivas, S., Fuentes, L., Valverde, P., Antillón-Klussmann, F., Castellanos, M., Sweet-Cordero, E. A., Messacar, K., Kurap, J., Bustamante, M., Howard, S. C., Efron, et al
2017
 - **Effect of Perioperative Gabapentin on Postoperative Pain Resolution and Opioid Cessation in a Mixed Surgical Cohort: A Randomized Clinical Trial.** *JAMA surgery*
Hah, J., Mackey, S. C., Schmidt, P., McCue, R., Humphreys, K., Trafton, J., Efron, B., Clay, D., Sharifzadeh, Y., Ruchelli, G., Goodman, S., Huddleston, J., Maloney, et al
2017
 - **Empirical Bayes deconvolution estimates** *BIOMETRIKA*
Efron, B.
2016; 103 (1): 1-20
 - **Exploring Value in Congenital Heart Disease: An Evaluation of Inpatient Admissions** *CONGENITAL HEART DISEASE*
Shin, A. Y., Hu, Z., Jin, B., Lal, S., Rosenthal, D. N., Efron, B., Sharek, P. J., Sutherland, S. M., Cohen, H. J., McElhinney, D. B., Roth, S. J., Ling, X. B.
2015; 10 (6): E278-E287
 - **Allogeneic hematopoietic cell transplantation after failed autologous transplant for lymphoma using TLI and anti-thymocyte globulin conditioning** *BONE MARROW TRANSPLANTATION*
Rezvani, A. R., Kanate, A. S., Efron, B., Chhabra, S., Kohrt, H. E., Shizuru, J. A., Laport, G. G., Miklos, D. B., Benjamin, J. E., JOHNSTON, L. J., Arai, S., Weng, W., Negrin, et al
2015; 50 (10): 1286-1292
 - **Frequentist accuracy of Bayesian estimates** *JOURNAL OF THE ROYAL STATISTICAL SOCIETY SERIES B-STATISTICAL METHODOLOGY*
Efron, B.
2015; 77 (3): 617-646
 - **Outcomes Following Cardiac Catheterization After Congenital Heart Surgery** *CATHETERIZATION AND CARDIOVASCULAR INTERVENTIONS*
Siehr, S. L., Martin, M. H., Axelrod, D., Efron, B., Peng, L., Roth, S. J., Perry, S., Shin, A. Y.
2014; 84 (4): 622-628
 - **Outcomes following cardiac catheterization after congenital heart surgery.** *Catheterization and cardiovascular interventions*
Siehr, S. L., Martin, M. H., Axelrod, D., Efron, B., Peng, L., Roth, S. J., Perry, S., Shin, A. Y.
2014; 84 (4): 622-628
 - **Estimation and Accuracy After Model Selection** *JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION*
Efron, B.
2014; 109 (507): 991-1007
 - **Two Modeling Strategies for Empirical Bayes Estimation** *STATISTICAL SCIENCE*
Efron, B.
2014; 29 (2): 285-301
 - **Confidence Intervals for Random Forests: The Jackknife and the Infinitesimal Jackknife** *JOURNAL OF MACHINE LEARNING RESEARCH*
Wager, S., Hastie, T., Efron, B.
2014; 15: 1625-1651

- **The Impact of Circadian Misalignment on Athletic Performance in Professional Football Players** *SLEEP*
Smith, R. S., Efron, B., Mah, C. D., Malhotra, A.
2013; 36 (12): 1999-2001
- **Mathematics. Bayes' theorem in the 21st century.** *Science*
Efron, B.
2013; 340 (6137): 1177-1178
- **Outcomes After Non-Myeloablative Allogeneic Hematopoietic Cell Transplantation with Total Lymphoid Irradiation and Anti-Thymocyte Globulin in Lymphoid Malignancies After Failed Autologous Transplantation** *BMT Tandem Meetings*
Kanate, A. S., Efron, B., Chhabra, S., Kohrt, H., Shizuru, J. A., Laport, G. G., Miklos, D. B., Benjamin, J., Johnston, L., Arai, S., Weng, W., Negrin, R., Strober, et al
ELSEVIER SCIENCE INC.2013: S154-S155
- **A 250-YEAR ARGUMENT: BELIEF, BEHAVIOR, AND THE BOOTSTRAP** *BULLETIN OF THE AMERICAN MATHEMATICAL SOCIETY*
Efron, B.
2013; 50 (1): 129-146
- **BAYESIAN INFERENCE AND THE PARAMETRIC BOOTSTRAP** *ANNALS OF APPLIED STATISTICS*
Efron, B.
2012; 6 (4): 1971-1997
- **Tweedie's Formula and Selection Bias** *JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION*
Efron, B.
2011; 106 (496): 1602-1614
- **False discovery rates and copy number variation** *BIOMETRIKA*
Efron, B., Zhang, N. R.
2011; 98 (2): 251-271
- **THE BOOTSTRAP AND MARKOV-CHAIN MONTE CARLO** *JOURNAL OF BIOPHARMACEUTICAL STATISTICS*
Efron, B.
2011; 21 (6): 1052-1062
- **Correlated z-Values and the Accuracy of Large-Scale Statistical Estimates** *JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION*
Efron, B.
2010; 105 (491): 1042-1055
- **The Future of Indirect Evidence** *STATISTICAL SCIENCE*
Efron, B., Greenland, S., Gelman, A., Kass, R. E.
2010; 25 (2): 145-171
- **Imprecision of Creatinine-Based GFR Estimates in Uninephric Kidney Donors** *CLINICAL JOURNAL OF THE AMERICAN SOCIETY OF NEPHROLOGY*
Tan, J. C., Ho, B., Busque, S., Blouch, K., Derby, G., Efron, B., Myers, B. D.
2010; 5 (3): 497-502
- **The Future of Indirect Evidence.** *Statistical science : a review journal of the Institute of Mathematical Statistics*
Efron, B.
2010; 25 (2): 145-57
- **ARE A SET OF MICROARRAYS INDEPENDENT OF EACH OTHER?** *ANNALS OF APPLIED STATISTICS*
Efron, B.
2009; 3 (3): 922-942
- **Empirical Bayes Estimates for Large-Scale Prediction Problems** *JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION*
Efron, B.
2009; 104 (487): 1015-1028
- **SIMULTANEOUS INFERENCE: WHEN SHOULD HYPOTHESIS TESTING PROBLEMS BE COMBINED?** *ANNALS OF APPLIED STATISTICS*
Efron, B.

2008; 2 (1): 197-223

- **Comment: Microarrays, empirical Bayes and the two-groups model** *STATISTICAL SCIENCE*
Benjamini, Y., Cai, T. T., Morris, C. N., Rice, K., Spiegelhalter, D., Efron, B.
2008; 23 (1): 23-47
- **Microarrays, empirical Bayes and the two-groups model** *STATISTICAL SCIENCE*
Efron, B.
2008; 23 (1): 1-22
- **Prediction of early progression in recently diagnosed IgA nephropathy** *NEPHROLOGY DIALYSIS TRANSPLANTATION*
Lemley, K. V., Lafayette, R. A., Derby, G., Blouch, K. L., Anderson, L., Efron, B., Myers, B. D.
2008; 23 (1): 213-222
- **Size, power and false discovery rates** *ANNALS OF STATISTICS*
Efron, B.
2007; 35 (4): 1351-1377
- **ON TESTING THE SIGNIFICANCE OF SETS OF GENES** *ANNALS OF APPLIED STATISTICS*
Efron, B., Tibshirani, R.
2007; 1 (1): 107-129
- **Correlation and large-scale simultaneous significance testing** *JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION*
Efron, B.
2007; 102 (477): 93-103
- **Minimum volume confidence regions for a multivariate normal mean vector** *JOURNAL OF THE ROYAL STATISTICAL SOCIETY SERIES B-STATISTICAL METHODOLOGY*
Efron, B.
2006; 68: 655-670
- **Signature patterns of gene expression in mouse atherosclerosis and their correlation to human coronary disease** *PHYSIOLOGICAL GENOMICS*
Tabibiazar, R., Wagner, R. A., Ashley, E. A., King, J. Y., Ferrara, R., Spin, J. M., Sanan, D. A., Narasimhan, B., Tibshirani, R., Tsao, P. S., Efron, B., Quertermous, T.
2005; 22 (2): 213-226
- **Impact of HIV-1 subtype and antiretroviral therapy on protease and reverse transcriptase genotype: Results of a global collaboration** *PLOS MEDICINE*
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- **Mouse strain-specific differences in vascular wall gene expression and their relationship to vascular disease** *ARTERIOSCLEROSIS THROMBOSIS AND VASCULAR BIOLOGY*
Tabibiazar, R., Wagner, R. A., Spin, J. M., Ashley, E. A., Narasimhan, B., Rubin, E. M., Efron, B., Tsao, P. S., Tibshirani, R., Quertermous, T.
2005; 25 (2): 302-308
- **The 'miss rate' for the analysis of gene expression data** *BIOSTATISTICS*
Taylor, J., Tibshirani, R., Efron, B.
2005; 6 (1): 111-117
- **The estimation of prediction error: Covariance penalties and cross-validation** *JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION*
Efron, B.
2004; 99 (467): 619-632
- **Least angle regression** *ANNALS OF STATISTICS*
Efron, B., Hastie, T., Johnstone, I., Tibshirani, R.
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- **Large-scale simultaneous hypothesis testing: The choice of a null hypothesis** *JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION*
Efron, B.
2004; 99 (465): 96-104

- **Transcriptional adaptation of Mycobacterium tuberculosis within macrophages: Insights into the phagosomal environment** *JOURNAL OF EXPERIMENTAL MEDICINE*
Schnappinger, D., Ehrt, S., Voskuil, M. I., Liu, Y., Mangan, J. A., Monahan, I. M., Dolganov, G., Efron, B., Butcher, P. D., Nathan, C., Schoolnik, G. K.
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- **Second thoughts on the bootstrap** *STATISTICAL SCIENCE*
Efron, B.
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- **Recent trends in National Institutes of Health funding of surgical research** *122nd Annual Meeting of the American-Surgical-Association*
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2002; 97 (459): 766-782
- **Empirical Bayes methods and false discovery rates for microarrays** *GENETIC EPIDEMIOLOGY*
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2002; 23 (1): 70-86
- **Pre-validation and inference in microarrays.** *Statistical applications in genetics and molecular biology*
Tibshirani, R. J., Efron, B.
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- **The two-way proportional hazards model** *JOURNAL OF THE ROYAL STATISTICAL SOCIETY SERIES B-STATISTICAL METHODOLOGY*
Efron, B.
2002; 64: 899-909
- **Empirical Bayes analysis of a microarray experiment** *160th Annual Meeting of the American-Statistical-Association*
Efron, B., Tibshirani, R., Storey, J. D., Tusher, V.
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- **Infectious complications among 620 consecutive heart transplant patients at Stanford University Medical Center** *10th International Symposium on Infections in the Immunocompromised*
Montoya, J. G., Giraldo, L. F., Efron, B., Stinson, E. B., Gamberg, P., Hung, S., Giannetti, N., Miller, J., Remington, J. S.
OXFORD UNIV PRESS INC.2001: 629-40
- **Infectious complications among 620 consecutive heart transplant patients at Stanford University Medical Center** *10th International Symposium on Infection in the Immunocompromised Host*
Montoya, J. G., Giraldo, L. F., Efron, B., Stinson, E. B., Gamberg, P., Hunt, S., Giannetti, N., Miller, J., Remington, J. S.
CELL PRESS.2001: 629-U6
- **A meta-analysis of peritoneal drainage versus laparotomy for perforated necrotizing enterocolitis** *31st Annual Meeting of the Section-on-Surgery of the American-Academy-of-Pediatrics*
Moss, R. L., Dimmitt, R. A., Henry, M. C., Geraghty, N., Efron, B.
W B SAUNDERS CO-ELSEVIER INC.2001: 1210-13
- **Statistical modeling: The two cultures - Comments and rejoinders** *STATISTICAL SCIENCE*
Cox, D. R., Efron, B., Hoadley, B., Parzen, E., Breiman, L.
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- **Selection criteria for scatterplot smoothers** *ANNALS OF STATISTICS*
Efron, B.
2001; 29 (2): 470-504
- **The bootstrap and modern statistics** *JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION*
Efron, B.
2000; 95 (452): 1293-1296

- **HIV-1 genotypic resistance patterns predict response to saquinavir-ritonavir therapy in patients in whom previous protease inhibitor therapy had failed** *ANNALS OF INTERNAL MEDICINE*
Zolopa, A. R., Shafer, R. W., Warford, A., Montoya, J. G., Hsu, P., KATZENSTEIN, D., Merigan, T. C., Efron, B.
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- **Nonparametric methods for doubly truncated data** *JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION*
Efron, B., Petrosian, V.
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- **Clinical resistance patterns and responses to two sequential protease inhibitor regimens in saquinavir and reverse transcriptase inhibitor-experienced persons** *5th Conference on Retroviruses and Opportunistic Infections*
Lawrence, J., Schapiro, J., Winters, M., Montoya, J., Zolopa, A., Pesano, R., Efron, B., Winslow, D., Merigan, T. C.
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- **Resistance mutations to zidovudine and saquinavir in patients receiving zidovudine plus saquinavir or zidovudine and zalcitabine plus saquinavir in AIDS Clinical Trials Group 229** *JOURNAL OF INFECTIOUS DISEASES*
Schapiro, J. M., Lawrence, J., Speck, R., Winters, M. A., Efron, B., COOMBS, R. W., Collier, A. C., Merigan, T. C.
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- **Risk for retinitis in patients with AIDS can be assessed by quantitation of threshold levels of cytomegalovirus DNA burden in blood** *JOURNAL OF INFECTIOUS DISEASES*
Rasmussen, L., Zipeto, D., Wolitz, R. A., Dowling, A., Efron, B., Merigan, T. C.
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- **A predictive morphometric model for the obstructive sleep apnea syndrome** *ANNALS OF INTERNAL MEDICINE*
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- **Effect of therapeutic immunization with recombinant gp160 HIV-1 vaccine on HIV-1 proviral DNA and plasma RNA: Relationship to cellular immune responses** *JOURNAL OF ACQUIRED IMMUNE DEFICIENCY SYNDROMES*
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- **The length heuristic for simultaneous hypothesis tests** *BIOMETRIKA*
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- **Circadian rhythms and enhanced athletic performance in the National Football League** *SLEEP*
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- **Bootstrap confidence intervals** *STATISTICAL SCIENCE*
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- **Bootstrap confidence levels for phylogenetic trees** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
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- **The effect of high-dose saquinavir on viral load and CD4(+) T-cell counts in HIV-infected patients** *ANNALS OF INTERNAL MEDICINE*
Schapiro, J. M., Winters, M. A., Stewart, F., Efron, B., Norris, J., Kozal, M. J., Merigan, T. C.
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- **Empirical Bayes methods for combining likelihoods** *JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION*
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Petrosian, V., Efron, B.
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- **MISSING DATA, IMPUTATION, AND THE BOOTSTRAP** *JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION*
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- **BAYES AND LIKELIHOOD CALCULATIONS FROM CONFIDENCE-INTERVALS** *BIOMETRIKA*
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