Roy E. Welsch

Eastman Kodak Leaders for Global Operations Professor of Management
Professor of Statistics and Data Science
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EDUCATION

Princeton University, 1961-1965

Degree:	Bachelor of Arts, 1965 (Magna Cum Laude, Phi Beta Kappa, Sigma Xi)
Major:	Mathematics
Thesis:	Conditional Monte Carlo and Measures of Significance for a New Multiple Range Test Supervisors: J. W. Tukey and J. A. Hartigan

Stanford University, 1965-1969

Degrees:	Master of Science (Mathematics), 1966 Doctor of Philosophy (Mathematics), 1969
Thesis:	Weak Convergence of Extreme Order Statistics from ϕ-mixing Processes Supervisor: Samuel Karlin

SCHOLARSHIPS AND FELLOWSHIPS

Andrew H. Brown Prize Scholarship in Mathematics, 1964
Woodrow Wilson Fellow (Honorary), 1965
National Science Foundation Graduate Fellowship, 1965-1969

EMPLOYMENT

17 March 2014- 28 March 2014	Professor, Singapore University of Technology and Design, Singapore
1 July 2009-	Eastman Kodak Leaders for Global Operations Professor of Management
1 July 2009- 1 Jan. 2018	Head of the Management Science Area, Sloan School of Management, MIT
1 Jan. 2007- 30 June 2011	Adjunct Professor, Nanyang Technological Univ. Singapore
1 July 2005 -	Professor of Engineering Systems, MIT
1 July 1988 - 30 June 1993	Leaders for Manufacturing Professor, MIT
1 July 1986 - 30 June 1989	Co-Director, MIT Statistics Center
1 July 1986 -	Director, MIT Center for Computational Research in Economics and Management Science
1 July 1984 - 30 June 1986	Director, MIT Statistics Center
1 July 1981 - 30 June 1984	Co-Director, MIT Statistics Center
1 July 1979 -	Professor of Statistics and Management Science, MIT
1 July 1979 - 30 June 1986	Associate Director, MIT Center for Computational Research in Economics and Management Science
1 July 1973 - 30 June 1979	Associate Professor of Statistics and Management Science, MIT
1 July 1973 - 31 January 1978	Senior Research Associate, Computer Research Center for Economics and Management Science, National Bureau of Economic Research
1 July 1969 - 30 June 1973	Assistant Professor of Management, Massachusetts Institute of Technology
Spring 1969	Assistant in Instruction, Mathematics Department, Stanford University
Fall 1968	Research Assistant, Mathematics Research Center, University of Wisconsin
Summer 1968	Research Assistant, Mathematics Department, Stanford University
Summer 1965	Research Assistant, Division of Mathematics and Physics, Midwest Research Institute, Kansas City, Missouri

Summer 1964	Research Assistant, Operations Research Dept., Hallmark Cards, Inc., Kansas City, Missouri

VISITING POSITIONS

Summer 1978	Department of Computer Science, Stanford University
Winter 1977	Bell Telephone Laboratories, Murray Hill, New Jersey

PROFESSIONAL SOCIETIES

American Statistical Association (Fellow)
Institute of Mathematical Statistics (Fellow)
International Association for Statistical Computing (ISI)
International Statistical Institute (Full Member)
American Association for the Advancement of Science (Fellow)

PUBLICATIONS

Articles

1971 A Weak Convergence Theorem for Order Statistics from Strong-Mixing Processes, *Annals of Mathematical Statistics*, *42*, pp. 1637-1646.

1972 Limit Laws for Extreme Order Statistics from Strong-Mixing Processes, *Annals of Mathematical Statistics, 43,* pp. 439-446.

1973 A Convergence Theorem for Extreme Values from Gaussian Sequences, *Annals of Probability, 1,* pp. 398-404. Translated into Russian.

1975 (with R. Becker) Robust Nonlinear Regression Using the DOGLEG Algorithm, *Proceedings of the Computer Science and Statistics Eighth Annual Symposium on the Interface.* Edited by J. W. Frane, Health Sciences Computing Facility, University of California at Los Angeles, pp. 272-279. (Invited paper.)

1975 Algorithms and Plots for Model Validation, *Proceedings of the NSF Vail Conference on Model Formulation, Validation, and Improvement.* Edited by E. P. Howrey. National Bureau of Economic Research, Cambridge, MA, pp. 84-92. (Invited paper.)

1976 Graphics for Data Analysis, *Computers and Graphics,* 2, No. 1, pp. 31-37.

1976 (with P. Velleman) Some Evaluation Criteria for Interactive Statistical Program Packages, *Communications in Statistics, B5(4)*, pp. 197-205.

1976 Confidence Regions for Robust Regression, *1975 Proceedings of the ASA Statistical Computing Section,* American Statistical Association, Washington, D. C., pp. 36-42. (Invited paper.)

1976 (with David Hoaglin and Steve Peters) MIT-SNAP: An Interactive Data Analysis System, *Proceedings of the Ninth Interface Symposium on Computer Science and Statistics,* edited by David C. Hoaglin and Roy E. Welsch; Prindle, Weber, and Schmidt, Boston: pp. 245-249.

1976 (with Edwin Kuh) The Variances of Regression Coefficient Estimates Using Aggregate Data, *Econometrica, 44,* pp. 353-363. Translated into French.

1977 Stepwise Multiple Comparison Procedures, *Journal of the American Statistical Association, 72,* pp. 566-575.

1977 Discussion of "Do Robust Estimators Work with Real Data?" by Stephen M. Stigler, *Annals of*

Statistics, 5, pp. 1095-1096.

1977 (with P. Holland) Robust Regression Using Iteratively Re-Weighted Least-Squares, *Communications in Statistics, Part A, 6(9)*, pp. 813-827.

1977 Nonlinear Statistical Data Analysis, *Proceedings of the Tenth Interface Symposium on Computer Science and Statistics,* edited by D. Hogben and D. Fife: National Bureau of Standards, Washington, D. C., pp. 77-86. (Invited paper.)

1978 Computing Regression Diagnostics, *Proceedings of the Stanford Conference on Numerical and Statistical Computing,* edited by Gene Golub and Virginia Klema. MIT Center for Computational Research in Economics and Management Science, Cambridge, MA (Microfiche, p. 6.)

1978 (with John Dennis) Techniques for Nonlinear Least-Squares and Robust Regression, *Communications in Statistics, B7,* pp. 345-359.

1978 (with David Hoaglin) The Hat Matrix in Regression and ANOVA, *The American Statistician, 32,* pp. 17-22 and *Corrigenda, 32*, p. 146.

1978 Discussion of "Statisticians Can Matter" by Harry V. Roberts, *The American Statistician, 32,* pp. 52-53.

1978 (with Steve Peters) Finding Influential Subsets of Data in Regression Models. *Proceedings of the Eleventh Interface Symposium on Computer Science and Statistics,* edited by A. R. Gallant and T. M. Gerig, Institute of Statistics, North Carolina State University, Raleigh, N. C., pp. 240-244.

1978 History of Bounded-Influence Estimation and Comments on Paper by Frank Hampel, David Hinkley, and R. Douglas Martin. *1978 Proceedings of the A. S. .. Statistical Computing Section,* American Statistical Association, Washington, D. C., pp. 65-67. (Invited paper.)

1979 Data Analysis, Communication, and Control, *Communications and Control in Society,* edited by Klaus Krippendorf, Gordon and Breech, Inc., London, pp. 99-114.

1979 Discussion of "Teaching Statistical Computing Using Computer Packages" by Ronald A. Thisted, T*he American Statistician, 33*, p. 34.

1979 Discussion of "Nonparametric Statistical Data Modeling" by Emanuel Parzen, *Journal of the American Statistical Association, 74*, pp. 123-124.

1979 Improving the Reliability of Econometric Models, *1979 Proceedings of the Social Statistics Section,* American Statistical Association, Washington, D. C. pp. 79-86. (Invited paper.)

1980 Robust and Bounded-Influence Regression, *Proceedings of the 42nd Session of the International Statistical Institute*, Voorburg, Netherlands. (Invited paper.)

1980 (with Edwin Kuh) Econometric Models and Their Assessment for Policy: Some New Diagnostics Applied to the Translog Energy Demand in Manufacturing. *Proceedings of the Workshop on Validation and Assessment Issues of Energy Models,* edited by S. Gass. National Bureau of Standards, Washington, D. C., pp. 445-475. (Invited paper.)

1980 Regression Sensitivity Analysis and Bounded-Influence Estimation, *Evaluation of Econometric Models*, edited by Jan Kmenta and James Ramsey: New York: Academic Press, pp. 153-167.

1980 Regression Diagnostics for Desktop Computers, *COMPSTAT 1980: Proceedings in Computational Statistics,* ed. by M. M. Barritt and D. Wishart, Physica-Verlag, pp. 283-289.

1981 (with Paul Velleman) Efficient Computing of Regression Diagnostics, *The American Statistician,*

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1981 (with John Dennis and David Gay) An Adaptive Nonlinear Least-Squares Algorithm. *Transactions on Mathematical Software, 7,* pp. 348-383.

1982 Influence Functions and Regression Diagnostics, *Modern Data Analysis,* edited by R. Launer and A. Siegel. Academic Press, Inc., pp. 149-169.

1982 (with William Krasker) Efficient Bounded-Influence Regression Estimation, *Journal of the American Statistical Association, 77,* pp. 596-604.

1982 Discussion of "Regression Diagnostics, Transformations, and Constructed Variables," by A. C. Atkinson, *J. R. Statist. Soc. B, 44,* 1982, pp. 1-36.

1982 (with A. Samarov) Computational Procedures for Bounded-Influence Regression, *COMPSTAT 1982: Proceedings in Computational Statistics,* edited by H. Caussinus, P. Ettinger, and R. Tomassone, Physica-Verlag Wein, pp. 412-418.

1982 Discussion of "Robust Methods in Econometrics," by Roger Koenker, *Econometric Reviews, 1*, pp. 279-284.

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1983 Diagnostics and Graphics for Influential Data, *American Society for Quality Control 37th Annual Quality Congress Transactions*, ASQC, Milwaukee, WI, pp. 7-9.

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1983 Discussion of "Developments in Linear Regression Methodology: 1959-1982," by R. R. Hocking, *Technometrics, 25,* pp. 245-246.

1983 (with W. S. Krasker and E. Kuh) Estimation for Dirty Data and Flawed Models, *Handbook of Econometrics, 1,* edited by Z. Griliches and M. D. Intrilligator, North-Holland, Amsterdam, pp. 651-698.

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1985 (with W. S. Krasker) Resistant Estimation for Simultaneous-Equations Models Using Weighted Instrument Variables, *Econometrica, 53,* pp. 1475-1488.

1986 (with Stephen Swartz) Applications of Bounded-Influence and Diagnostic Methods in Energy Modeling, *Model Reliability*, edited by D. A. Belsley and E. Kuh, MIT Press, Cambridge, MA, pp. 154-190.

1987 Discussion of "Influential Observations, High Leverage Points, and Outliers in Linear Regression" by S. Chatterjee and A. Hadi, *Statistical Science 1,* pp. 379-416.

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1988 (with D. A. Belsley and A. Venetoulias) Computer Guided Diagnostics, *COMPSTAT Proceedings in Computational Statistics,* edited by D. Edwards and N. E. Raun, Heidelberg: Physica-Verlag, pp. 99-106. (Invited paper.)

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1989 (with D. A. Belsley and A. Venetoulias) Hypercard as an Environment for Guided Computing in Statistics. *Proceedings of the Twentieth Symposium on the Interface*. Also, Technical Report TR-67, MIT Center for Computational Research in Economics and Management Science, Cambridge, MA.

1990 (with E. Newton and A. Venetoulias) Collinearity Diagnostics: VIF's Revisited. Technical Report TR-68, MIT Center for Computational Research in Economics and Management Science, Cambridge, MA.

1992 Invited discussion of "Statistical Consulting is Scholarship" by W. J. Wilson. *The American Statistician*, 46, 302-304.

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1998 (with A. Sylla and A. Samarov). Portfolio Optimization Using Non-Gaussian Return Distributions (Technical Report, Finance Research Center, Massachusetts Institute of Technology, Cambridge, MA.)

1998 (with V. Sharma, D. Boning, and S. Eppinger). A New Modeling Methodology Combining Engineering and Statistical Modeling Methods: A Semiconductor Manufacturing Application (Technical Report, Leaders for Manufacturing Program, Massachusetts Institute of Technology, Cambridge, MA.)

1998 (with H. Chen and D. Boning). Partial Least Squares (PLS) Models Using Kodak Roll-Coating Data Technical Report, Leaders for Manufacturing Program, Massachusetts Institute of Technology, Cambridge, MA.

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2001 (with J. Demain, K. Johnson, S. Prakashan, and A. Samarov) The Use of Machine Check Architecture (MCA) to Perform Reliability Studies on Servers. *Proceedings of the 2001 American Statistical Association Quality and Productivity Research Conference*, http://www.sematech.org/public/news/conferences/qp2001/index.htm.

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2003 (with G. Lauprete and A. Samarov) High Dimensional Portfolio Risk Estimation. *Bulletin of the International Statistical Institute*, Berlin, 54th Session, CPM-014-1.

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2006 (with R. Menjoge) Comparing Variable Selection Methods in Gene Selection and Classification of Microarray Data. *Interface 2006-Computing Science and Statistics*, Vol. 38.

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2007 (with R. Menjoge and T. Nguyen) Robust Estimation or Robust Optimization for Portfolio Selection: Which Should You Use? *Bulletin of the International Statistical Institute 56th Session*, CPM019, Lisboa. (Refereed)

2007 (with L. McCann) Robust Variable Selection Using Least Angle Regression and Elemental Set Sampling. *Computational Statistics and Data Analysis.* 52, 249-257. Available at http://dx.doi.org/10.1016/j.csda.2007.01.012.

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2008 A. Ng, V. Horodincu, J. Rajapakse, P. Madsudaira, R. Welsch, and J. Evans, Statistical Analysis of Drug Treated Cell Morphologies from HCS Image Data, *Proceedings of the Third IAPR Conference on Pattern Recognition in Bioinformatics*, Melbourne, 257-260.

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2008 A. Ng, J. C. Rajapakse, J. G. Evans and R. E. Welsch, "Statistical Analysis of Macrophage Cell Morphology after Microtuble Disruption," *Proceedings of the12th International Conference on Research in Computational Molecular Biology (RECOMB 2008)*, 248-249, Singapore, March 2008.

2008 M. Veronika, J. G. Evans, P. Matsudaira, R. Welsch, and J. C. Rajapakse, "Size-Specific and Brightness-Weighted Cell Tracking in 2D images," *Proceedings of the 12th International Conference on Research in Computational Molecular Biology (RECOMB 2008)*, 256-257, Singapore, March 2008.

2009. (with R. Menjoge) Comparing and Visualizing Gene Selection and Classification Methods for Microarray Data, Chapter 2 of *Machine Learning in Bioinformatics* edited by J. Rajapakse and Y. Zhang 2009, pp. 47-68.

2009 M. Veronika, J. Evans, P. Matsudaira, R. Welsch and J. Rajapakse, Sub-population analysis based on temporal features of high content images, *BMC Bioinformatics,* 10: Suppl. 15, art. no. S4, Dec. 2009.

2010. (with R. Menjoge) A Diagnostic Method for Simultaneous Feature Selection and Outlier Identification in Linear Regression, *Computational Statistics and Data Analysis*, 54, 3181-3193.

2010 (with Tri-Dung Nguyen) Robust Regression Using Semi-Definite Programming, *Computational Statistics and Data Analysis*, 54, 3212-3226

2010 (with Tri-Dung Nguyen) Outlier Detection and Robust Covariance Estimation Using Mathematical Programming, *Advances in Data Analysis and Classification*, 4(4), 301-334.

2010 (with R. Menjoge) Visualizing the Sampling Variability of Plots, *Proceedings of COMPSTAT 2010*, 1375-1382, Springer. (Refereed)

2010 A. Ng, J. C. Rajapakse, R. Welsch, P. Matsudaira, and J. Evans, A Cell Profiling Framework for Modeling Drug Responses from HCS Imaging, *Journal of Biomolecular Screening* 15(7), 858-868.

2010 Zhu, S., Matsudaira, P., Welsch, R., Rajapakse, J., Quantification of cytoskeletal protein co-localization from high content images" *Proceedings of 5th IAPR International Conference on Pattern Recognition in Bioinformatics* (PRIB 2010), Nijmegen, The Netherlands, *Lecture Notes in Bioinformatics,* LNBI 6282, pp. 289 - 300, Nov 2010. (Refereed)

2010 He, Y., Kang, C., Xu, S., Tuo, X., Trasti, S., Tai, D., Raja, A., Peng, Q., So, P., Rajapakse, J., Welsch, R., Yu, H., Towards Surface Quantification of Liver Fibrosis Progression, *Journal of Biomedical Optics* 15(5), 1-11.

2010 Naegle, K., Gymrek, M., Joughin, B., Wagner, J., Welsch, R., Yaffe, M., Lauffenburger, D., White, F.), PTMSCOUT: A Web Resource for Analysis of High-throughput Post-Translational Proteomic Studies, *Molecular and Cellular Proteomics*, 9(11), 2558-2570.

2011 Zheng, B., Tan, L., Mo, X., Yu, W., Wang, Y., Tucker-Kellogg, L., Welsch, R., So, P., Yu, H. Predicting *in vivo* Anti-Heptatofribrotic Drug Efficacy based on *in vitro* High-Content Analysis. *PLoS ONE* 6(11): e26230. http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0026230

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2011 M. Veronika, R. Welsch, P. Matsudaira, J. Rajapakse, Correlation of cell membrane dynamics and cell motility," *BMC Bioinformatics*, 12 (Suppl.13), S19, 2011.

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1972 A Multiple Comparison Procedure Based on Gaps, Sloan School of Management Working Paper 628-72.

1976 Comparing Relative and Total Cost Multiple Comparison Procedures Via James-Stein Estimators, Sloan School of Management Working Paper 892-76.

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1974 TROLL Experimental Programs. CLOUDS, STARS, FACES, M.I.T. Information Processing Center.

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1981 (with L. Roseman and D. Gay) NLS: Nonlinear Least-Squares Regression, TROLL Documentation Series, M.I.T. Information Processing Center.

PROFESSIONAL ACTIVITIES

Associate Editor, *Journal of Computational and Statistical Graphics*, 1992.

Associate Editor, *SIAM Review,* 1979-1981.

Associate Editor, *Journal of the American Statistical Association*, 1976-1979.

Associate Editor, *Communications in Statistics, Series B: Simulation and Computation,* 1977-1979.

Associate Editor, *Annals of Statistics*, 1974-1977.

Publications Liaison Officer, 1975, ASA Statistical Computing Section.

Secretary-Treasurer, 1978, ASA Statistical Computing Section.

IMS Committee on Special Papers, 1974-1976.

IMS Nominating Committee, 1982.

IMS Liaison to AAAS, Section T, 1982-1984.

Co-organizer of the Ninth Interface Symposium on Computer Science and Statistics (held at Harvard University, 1 and 2 April, 1976).

Co-Chairman of the Data Analysis Working Group of the Faculty Seminar on Human Experimentation in Health and Medicine, Harvard School of Public Health, 1974-1975.

Review panel for NSF Postdoctoral Fellowships, 1976-1979 (Chairman 1978).

Lecturer, 1982 Gordon Research Conference on Statistics in Chemistry and Chemical Engineering.

IMS Representative to AAAS.

AAAS, Section U, Electorate Nominating Committee, 1984-87.

Chairman, ASA Management Committee for the *Journal of Business and Economic Statistics,* 1988-89.

Member, Board of Directors of the ASA, 1990.

Vice-Chairman, Council of Sections, ASA, 1991.

Member, Board of Directors of the Quality and Productivity Research Conference, 1992

Chair-Elect, Chair, Past-Chair Section on Statistical Graphics, ASA, 1993-95

Statistical Graphics Section Representative to the ASA Council of Sections 1997-2000

Member of the Scientific Committee for ICORS (International Conference on Robust Statistics) 2005-

Associate Editor, *Computational Statistics and Data Analysis* 2008-2010

Member of the Executive Council for the International Association of Statistical Computing (IASC), 2009-2015

Member (Chair 2010-2012) of the Management Committee for the *Journal of Computational and Graphical Statistics* 2010-

Head, Management Science Area of the MIT Sloan School, 2010-2017

Chair of the ASA Journal of Computational and Graphical Statistics (JCGS) Management Committee 2020-

CONSULTING

Boston Statistical Consultants
Massachusetts Rate Setting Commission
Cambridge Project
Compugraphic Corporation
Harvard Medical School - PBBH
Management Decision Systems
Bell Telephone Laboratories
Baylor College of Medicine
Tufts New England Medical Center
Honeywell
Tektronix Corporation
PSTAT, Inc.
United States Army
Tech. Ops., Inc.
Food and Drug Administration
World Bank
Kodak
Schlumberger, Inc.
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Rath and Strong
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Freedom Capital
The Analysis Group
Manatt, Phelps, Phillips
Dyson, Inc.
Analog Devices
Bank of America
Goodwin Proctor
Williams and Connolly
Cornerstone
J.P. Morgan
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Apple Computer
IBM Yorktown Research Laboratory
Blue Cross of Massachusetts
Lee, Toomey and Kent
Decision Research Corporation
Gillette North America
Blue Cross of Maine
Stone and Webster
Beneficial Finance
Acrison, Inc.
Cabot Corporation
Cravath, Swaine and Moore
Massachusetts Financial Services
New York Stock Exchange
Instrumentation Laboratory, Inc.
Fidelity Investments
Citibank
Lotus Development
Shawmut Bank
Numeric Investors
Lucent Technologies
Heater Advertising
Integral, Inc.
Inventum, Inc.
Intuit
GMO
Fieldturf
Analysis Group
UNUM
Sullivan and Cromwell
Goldman Sachs
Barnes and Thornburg
IQOR