

# Jerome H. Friedman

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## Address:

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## Education:

University of California, Berkeley:  
A. B. Degree, Physics (1962)  
Ph. D. Degree, High Energy Particle Physics (1967)

## Experience:

Professor of Statistics: Stanford University (1982 - present)  
Staff Member: Stanford Linear Accelerator Center, Stanford University (2003 - 2007)  
Leader: Computation Research Group, Stanford Linear Accelerator Center, Stanford University (1972 - 2003)  
Visiting Scientist: CSIRO Mathematics and Information Sciences, Sydney, Australia (1998 -1999)  
Visiting Scientist: Division of Mathematics and Statistics, CSIRO, Sydney, Australia (1992)  
Chairman: Department of Statistics, Stanford University (1988 - 1991)  
Visiting Professor: Department of Statistics, University of California, Berkeley (1981 - 1984)  
Visiting Scientist: European Organization for Nuclear Research (CERN), Geneva (1976 -1977)  
Research Physicist: Lawrence Berkeley Laboratory (1968 - 1971)

## Consulting:

eBay, Inc. (2009 - 2010)  
Proventys, Inc. (2005 - present)  
Quantcast, Inc. (2006 - present)  
Turn, Inc. (2005 - present)  
Adchemy, Inc. (2005 - present)  
Yahoo, Sunnyvale, CA (2004 - present)

Alta Vista, Palo Alto, CA (2002 - 2004)  
Beyond Genomics, Boston, MA (2001 - present)  
Enkata Technologies, San Mateo, CA (2001 - 2003)  
BigResearch, Worthington, OH (2000 - present)  
Salford Systems, San Diego, CA (1995 - present)  
Broad Base, Menlo Park, CA (2000 - 2002)  
Panopticon, Palo Alto, CA (1999 - 2000)  
Hitachi Corporation, San Jose, CA (1997 - 1998)  
IBM Corporation, San Jose, CA (1997 - 1998)  
3M Corporation, St. Paul, MN (1994 - 1997)  
Teknekron, Palo Alto, CA (1989 - 1990)  
Impact Resources, Inc., Columbus, OH (1989 - 1991)  
U. S. West, Denver, CO (1988)  
Decision Services, Inc., Stamford, CT (1987 - 1989)  
ALCOA, Pittsburgh, PA (1987 - 1988)  
Ford Motor Company, Detroit, MI (1986)  
TRYPOS Systems, Inc., St. Louis, MO (1985 - 1986)  
O'Connor Research, Inc., Denver, CO (1984 - 1985)  
The Upjon Company, Kalamazoo, MI (1984)  
Enhansys Corporation, Sunnyvale, CA (1983 - 1984)  
Lockheed Missiles and Space Co., Inc., Sunnyvale, CA (1983 - 1984)  
Speech Systems, Inc., Encino, CA (1982 - 1986)  
Energy Information Agency, Washington, DC (1979 - 1981)  
ADP Network Services, Inc., Ann Arbor, MI (1978 - 1980)  
Technology Service Corporation, Santa Monica, CA (1974 - 1976)

**Professional Activities:**

Associate Editor: *Data Mining and Knowledge Discovery* (1997 - present)  
Associate Editor: *Machine Learning* (1997 - present)  
Advisory Council: Department of Statistics, Harvard University (1990 - 1995)  
Editorial Board: *Journal of Chemometrics*. (1986 - 1995)  
Editorial Board: *Chemometrics and Intelligent Laboratory Systems*. (1986 - 1990)  
Advisory Committee: Oak Ridge National Laboratory, Oak Ridge, TN (1986 - 1989)  
Advisory Committee: University of California, San Diego, Ischemic Heart Disease (SCOR) Project (1985 - 1988)  
Committee on Applied and Theoretical Statistics: National Academy of Sciences (1984 - 1987)  
Advisory Council: Department of Statistics, Princeton University (1983 - 1985)  
Panel: Future of Computing in Statistics, National Research Council (1982 - 1984)  
Panel: Discriminant Analysis and Clustering, National Research Council (1981 - 1985)

Advisory Committee: Computers in Education, Brown University, Providence, RI (1981 - 1983)  
 Advisory Committee: Training Statisticians for Industry, American Statistical Association (1981 - 1982)  
 Associate Editor: *SIAM Journal on Scientific and Statistical Computing* (1979 - 1985)  
 Advisory Committee: Battelle Pacific Northwest Laboratories, Richland, WA (1978 - 1983)  
 Advisory Committee: Lawrence Berkeley Laboratory, Berkeley, CA (1978 - 1982)  
 Associate Editor: *Journal of Computational Physics* (1972 - 1975)

### Honors:

Fellow of the American Statistical Association  
 Paper of the year: Journal of the American Statistical Association (1980)  
 Paper of the year: Journal of the American Statistical Association (1985)  
 Paper of the year: Technometrics (1988)  
 Paper of the year: Technometrics (1992)  
 Statistician of the year: American Statistical Association, Chicago Chapter (1999)  
 Reitz Lecture: Institute of Mathematical Statistics (1999)  
 ACM Data Mining Lifetime Innovation Award (2002)  
 Emanuel and Carol Parzen Award for Statistical Innovation (2004)  
 Fellow: The American Academy of Arts and Sciences (2005)  
 Wald Lectures: Institute of Mathematical Statistics (2009)  
 Noether Senior Lecturer: American Statistical Association (2010)  
 Member: National Academy of Sciences (2010)

### List of Publications (authored or coauthored):

#### Physics:

1. Low-energy  $k^-$  - meson interaction in hydrogen. *Phys. Rev.* **139**, B719 (1965)
2. Production and decay properties of the  $k^*(892)$  produced in the reaction  $k^-p \rightarrow pk^0\pi^-$  at 2.1, 2.45, and 2.64 GeV/c. *Phys. Rev. Letters* **16**, 845 (1966)
3. Evidence for the existence of two  $Y_1^*(1660)$  resonances. *Phys. Rev. Letters* **22**, 200 (1969)
4. Experimental tests of the quark model using the reactions  $k^-p \rightarrow k^*\Delta$  at 2.63 GeV/c. *Phys. Rev. Letters* **22**, 152 (1969)
5. Is the L a meson? *Phys. Rev. Letters* **22**, 1207 (1969)
6. Evidence against  $A_1$  production in  $k^+p$  interactions. *Phys. Letters* **24**, 925 (1970)
7.  $A_2$  mass spectrum in 7 - GeV/c  $\pi^+p$  interactions. *Phys. Letters* **33B**, 607 (1970)
8. Remarks on the existence of two  $\Sigma(1660)$  resonances. Proc. Durham Topical Conference. Hyperon Resonances - 70, Durham, NC (1970)
9. Branching ratios of the  $A_2^+$  meson observed in 7 - GeV/c  $\pi^+p$  interactions. *Phys. Letters* **34B**, 156 (1971)
10.  $f^0$  mass spectrum in 7 - GeV/c  $\pi^+p$  interactions. *Phys. Letters* **34B**, 551 (1971)
11. Comparison of an inclusive multiperipheral model to secondary spectra in  $pp$  collisions. *Phys. Rev. Letters* **27**, 353 (1971)
12. A simple test for the existence of multiperipheralism at high energy. Proc. Fourth Hawaii Topical Conference in Particle Physics (1971)

13. Observation of an anomaly in the  $\pi^+\pi^-$  system at 980 MeV. *Physics Letters* **36B**, 152 (1971)
14. Measurement of the  $T=3/2$   $k\pi$  elastic scattering cross section using the Duerr - Pilkuhn form factor. *Phys. Rev.* **D4**, 3254 (1971)
15. Long range correlations and the dynamics of multiparticle production. *Phys. Rev. Letters* **28**, 191 (1972)
16. Analysis of the observed anomaly in the  $\pi\pi$  s - wave scattering near  $k\bar{k}$  threshold. *Phys. Letters* **38B**, 232 (1972)
17. New data on the reaction  $k^+p \rightarrow \pi^+pk^0$  and a detailed comparison with Veneziano model. *Phys. Rev.* **D5**, 4 (1972)
18. Energy dependence of inclusive distributions in pion induced reactions. *Phys. Letters* **39B**, 402 (1972)
19. Comparison of the multiperipheral model with inclusive data in  $k^+p$  and  $\pi^-p$  reactions. *Phys. Rev.* **D5**, 402 (1972)
20. A multiregge model applied to high-energy quasi-inclusive photoproduction. *Nucl. Phys.* **B43**, 178 (1972)
21. Investigation of low-mass  $k\pi\pi$  systems in 12 GeV/c  $k^+p$  interactions. *Phys Rev.* **D5**, 2688 (1972)
22. Experimental spectra for 12 GeV/c  $k^+p \rightarrow pk^+\varphi$  and  $pk^+\omega$ . *Nucl. Phys.* **B44**, 344 (1972)
23. A  $\pi^+\pi^-$  phase shift analysis form reactions  $\pi^+p \rightarrow \pi^+\pi^-\Delta^{++}$  and  $\pi^+p \rightarrow k^+k^-\Delta^{++}$  at 7.1 GeV/c. *Phys. Rev.* **D7**, 1279 (1973)
24. Spin-parity analysis of the B-meson. *Phys. Letters* **47B**, 526 (1973)
25. A new  $k\pi$  partial wave analysis below 1 GeV/c  $k\pi$  mass. Proc. Tallahassee Conf. on  $\pi\pi$  Scattering and Associated Topics, Tallahassee, FL, March (1973)
26. Measurements of multivariate scaling and factorization in exclusive multiparticle production. *Phys. Rev.* **D9**, 3053 (1974)

### Computer Science:

1. Random event generation with preferred frequency distributions. *J. Comp. Phys.* **7**, 1 (1971)
2. An efficient Monte Carlo event generation method for multiperipheral models. *J. Comp. Phys.* **8**, 144 (1971)
3. An algorithm for finding nearest neighbors. *IEEE Trans. Computers* **C-24**, 1000 (1975)
4. An algorithm for finding best matches in logarithmic expected time. *ACM Trans. Math. Software* **3**, 209 (1977)
5. Fast algorithms for constructing minimal spanning trees in coordinate spaces. *IEEE Trans. Computers*, 97 (1978)
6. A survey of algorithms and data structures for range queries. *ACM Computing Surveys* **11**, 397 (1979)
7. A nested partitioning algorithm for numerical multiple integration. *ACM Trans. Math. Software* **7**, 76 (1981)
8. Multidimensional additive spline approximation. *SIAM J. Scientific and Statistical Computing* **4**, 291 (1983)

### Statistics:

1. A projection pursuit algorithm for exploratory data analysis. *IEEE Trans. Computers* **C-23**, 881 (1974)
2. PRIM-9: an interactive multidimensional data display and analysis system. Conf. Proc. ACM Pacific 75 (1975)

3. Searching for structure in multivariate data. Proc. 2nd Topical Conf. on Multidimensional Data Analysis, CERN, Geneva, Switzerland (1976)
4. A recursive partitioning decision rule for nonparametric classification. *IEEE Trans. Computers* **C-26**, 404 (1977)
5. Fast algorithms for multivariate lining and planing. Proc. 12th Annual Symp. on the Interface (1979)
6. Multivariate analogs of the Wald-Wolfowitz and Smirnov two-sample tests. *Annals of Statistics* **7**, 697 (1979)
7. Approaches to analysis of data that concentrate near intermediate dimensional manifolds. In: *Data Analysis and Informatics*, (Didday, et al. eds.) North Holland (1980)
8. Graphics for the multivariate two-sample problem. (with discussion) *J. Amer. Statist. Assoc.* **76**, 277 (1981)
9. Projection pursuit regression *J. Amer. Statist. Assoc.* **76**, 817 (1981)
10. Projection pursuit methods for data analysis. In: *Modern Data Analysis* (Laurner and Seigel, eds.) Academic Press (1981)
11. A tree-structured approach to nonparametric multiple regression. In: *Smoothing Techniques for Curve Estimation* (Gasser and Rosenblatt, eds.), Springer Verlag, 5 (1982)
12. An introduction to real time graphical techniques for analyzing multivariate data. Proc. Third Annual Conference of the National Computer Graphics Association, 421 (1982)
13. M and N plots. In: *Recent Advances in Statistics* (Rizvi, Rustagi, and Siegmund, eds.) Academic Press (1983)
14. Graph-theoretic measures of multivariate association and prediction. *Annals of Statistics* **11**, 377 (1983)
15. *Classification and Regression Trees*. Monograph, Wadsworth, Inc. (1983)
16. "Hardware for kinematic statistical graphics" Proc. 14th Symp. on the Interface, North Holland 163 (1983)
17. Discussion: "Developments in linear regression methodology" by R. R. Hocking, *Technometrics* **25** 219 (1983)
18. Projection pursuit density estimation. *J. Amer. Statist. Assoc.* **79**, 599 (1984)
19. The monotone smoothing of scatter plots. *Technometrics* **26**, 243 (1984)
20. Estimating optimal transformations for multiple regression and correlation (with discussion). *J. Amer. Statist. Assoc.* **80**, 580 (1985)
21. Discussion: "Projection pursuit" by P. Huber, *Annals of Statistics* **13**, 475 (1985)
22. Discussion: "What is projection pursuit" by M. C. Jones and R. Sibson, *J. Royal Statist. Soc. A* **150**, 26 (1987)
23. Exploratory projection pursuit. *J. Amer. Statist. Assoc.* **82**, 249 (1987)
24. Discussion: "Tree-structured classification via generalized discriminant analysis" by Loh and Vanichsetakul, *J. Amer. Statist. Assoc.* **83**, 725 (1988)
25. Fitting functions to noisy data in high dimensions. Proc. 20th Symposium on the Interface (Wegman, Gantz, and Miller, eds.) 13 (1988)
26. Flexible parsimonious smoothing and additive modeling (with discussion) *Technometrics* **31**, 3 (1989)
27. Regularized discriminant analysis. *J. Amer. Statist. Assoc.* **84**, 165 (1989)
28. Classification: oldtimers and newcomers. *J. of Chemometrics* **3**, 463 (1989)
29. Discussion: "Continuum regression: cross-validated sequentially-constructed prediction embracing ordinary least squares, partial least squares, and principal components regression" by Stone and Brooks, *J. Royal Statist. Soc. B* **52**, 237 (1990)

30. Multivariate adaptive regression splines (with discussion). *Annals of Statistics* **19**, 1 (1991)
31. Adaptive spline networks. In: *Neural Information Processing Systems II*. Morgan Kaufmann (1991)
32. Discussion: “The  $\pi$ -method for estimating multivariate functions form noisy data” by L. Breiman, *Technometrics* **33**, 145 (1991)
33. A statistical view of some chemometrics regression tools (with discussion). *Technometrics* **35**, 109 (1993)
34. Estimating functions of mixed ordinal and categorical variables using adaptive splines. In: *New Directions in Statistical Data Analysis and Robustness* (Morgenthaler, Ronchetti, and Stahel, eds.) Birkhauser (1993)
35. Fast MARS. Dept. of Statistics, Stanford University Tech. Report LCS110. *J. Comp. Graph. Stat.* (submitted).
36. An overview of computational learning and function approximation. In: *From Statistics to Neural Networks. Theory and Pattern Recognition Applications* (Cherkassky, Friedman, and Wechsler, eds.) Springer-Verlag 1 (1994)
37. An introduction to multivariate adaptive regression splines . *Statistical Methods in Medical Research* **4**, 197 (1995).
38. Predicting multivariate responses in multiple linear regression (with discussion). *J.Roy. Statist. Soc. B* **59**, 3 (1997).
39. On bias, variance, 0/1-loss, and the curse-of-dimensionality. *J. Data Mining and Knowledge Discovery* **1**, 55 (1997).
40. Local learning based on recursive covering. *Annals of Statist.* (to appear).
41. Another approach to polychotomous classification. *Machine learning* (to appear).
42. Bump hunting in high-dimensional data (with discussion). *Statistics and Computing* **9**, 123 (1999)
43. Data Mining and Statistics: What’s the connection? Proc. 29th Symposium on the Interface (D. Scott, ed.) (1998)
44. Additive logistic regression: a statistical view of boosting (with discussion). *Annals of Statist.* **28**, 337 (2000).
45. Greedy function approximation: a gradient boosting machine. *Annals of Statist.* **29**, 1180 (2001).
46. Stochastic gradient boosting. *Computational Statistics and Data analysis.* **38**, 367 (2002).
47. The role of Statistics in the data revolution. *Intl. Statist. Rev.* **69**, 5 (2001)
48. *Elements of Statistical Learning*. Springer (2001).
49. On bagging and nonlinear estimation. *J. Planning and inference*, **137**, 669.
50. Clustering objects on subsets of attributes. (with discussion). *J. Roy. Statist. Soc. B* **66**, 815 (2004).
51. Importance sampled learning ensembles. *Journal of Machine Learning Research* (submitted).
52. Gradient directed regularization for linear regression and classification. *Technometrics* (submitted).
53. Recent advances in predictive (machine) learning. *J. Classification* **23**, 75 (2006)
54. On multivariate goodness-of-fit and two-sample testing. Proceedings: *Conference on Statistics in Physics and Astrophysics*, Stanford, CA (2004).
55. Predictive learning via rule ensembles. *Annals of Applied Statistics* **2**, 515 (2008)
56. Fast Sparse Regression and Classification. (*Annals of Applied Statistics*, submitted)
57. Pathwise coordinate optimization. *Annals of Applied Statistics* **1**, 302 (2007)
58. Sparse inverse covariance estimation with the graphical lasso. *Biostatistics* **9**, 432.
59. Discussion of ”Evidence contrary to the statistical view of boosting (David Mease and Aaron Wyner)” *JMLR9* (2008) 59-64.

60. Regularized Paths for Generalized Linear Models via Coordinate Descent. *Journal of Statistical Software*, 33(1), 2010 The R package glmnet is available from CRAN
61. *Data Mining, Inference and Prediction (Second Edition)*. February, 2009. 745 pages in full color. Springer-Verlag, New York.
62. SparseNet: Coordinate Descent with Non-Convex Penalties. (2009, submitted)
63. A Note on the Group Lasso and a Sparse Group Lasso. (2010, submitted)
64. Applications of the lasso and grouped lasso to the estimation of sparse graphical models. (2010, submitted)
65. Strong rules for discarding predictors in lasso-type problems. (2010, submitted)

**Special keynote/plenary invited lectures:**

- Annual Meeting of American Statistical Association, Houston, TX (1980)
- Annual Meeting of Institute of Mathematical Statistics, Aspen, CO (1981)
- Wilks Memorial Lecture, Princeton University, Princeton, NJ (1984)
- Annual meeting of American Statistical Association, Las Vegas NV (1985)
- DATA' 86 Symposium, Sydney, Australia (1986)
- Eastern Regional Meeting, American Statistical Association, Newark, NJ (1986)
- Computer Science and Statistics: 20th Symposium on the Interface, Washington, DC (1988)
- Ninth Australian Statistical Conference, Canberra, Australia (1988)
- XXth European Symposium on Statistics, Grenoble, France (1988)
- Annual Meeting of the American Statistical Association, New Orleans, LA (1988)
- CBMS Distinguished Lecture Series, National Science Foundation, Washington, DC (1989)
- Fourth International Conference on Neural Information Processing Systems, Denver, CO (1992)
- Statistical Society of Australia, Sydney, Australia (1992)
- Annual Meeting of the American Statistical Association, Boston, MA (1992)
- Statistical Society of Canada, Presidential Invited Address, Wolfville, Nova Scotia (1993)
- IMS Spring Research Conference on Statistics in Industry and Technology, Chapel Hill, NC (1994)
- Institute of Mathematical Statistics, Orlando, FL (1995)
- Neural Networks for Computing, Snowbird, UT (1995)
- European Neural Network Society, Paris (1995)
- Computer Science and Statistics: 28th Symposium on the Interface, Sydney, Australia (1996)
- Computer Science and Statistics: 29th Symposium on the Interface, Houston, TX (1997)
- Annual Meeting of Institute of Mathematical Statistics (Riesz Lecture), Baltimore, MD (1999)
- Seventeenth International Conference on Machine Learning, Stanford (2000)
- Fifteenth Australian Statistical Conference, Adelaide, Australia (2000)
- Classification Society of Germany, Munich (2001)
- Classification Society of Italy, Palermo (2001)
- Netherlands Statistical Association, Utrecht (2001)
- Classification Society of The Netherlands, Leiden (2001)
- International Conference on Data Mining 2001, San Jose (2001)
- Stanford Computer Science Broad Area Colloquium, Stanford (2002)

Conference on Nonparametric Statistical Methods, Crete (2002)  
 Conference on Statistical Learning, Paris (2002)  
 Conference on Multiple Classifiers, London (2003)  
 Annual Meeting of the Psychometric Society, Sardinia (2003)  
 Conference on Statistics in Physics and Astrophysics, Stanford (2003)  
 Army Research Conference, Napa, CA (2003)  
 National Institute of Statistical Sciences Distinguished Lecture (2003)  
 Conference on Statistics in Physics and Astrophysics, Oxford (2005)  
 Computer Science and Statistics: 37th Symposium on the Interface, St. Louis, MO (2005)  
 Annual Meeting of Institute of Mathematical Statistics (Wald Lectures), Washington, DC (2009)  
 Annual Meeting of American Statistical Association (Noether Senior Lecture), Seattle, WA (2010)

**Technical reports (unpublished):**

1. A study of the reactions  $k^-p \rightarrow k^0\pi^+\pi^-$ ,  $k^-p \rightarrow p k^0\pi^0\pi^-$ , and  $k^-p \rightarrow n k^0\pi^+\pi^-$  2.1 to 2.7 GeV/c. Lawrence Berkeley Laboratory Report UCRL 18860 (1969)
2. A  $\pi\pi$  partial wave analysis form reactions  $\pi^+p \rightarrow \pi^+\pi^-\Delta^{++}$  and  $\pi^+p \rightarrow k^+k^-\Delta^{++}$  at 7.1 GeV/c. Lawrence Berkeley Laboratory Report LBL-970 (1972)
3. A study of  $k^+\pi^-$  scattering in the reaction  $k^+p \rightarrow k^+\pi^-\Delta^{++}$  at 12 GeV/c. Lawrence Berkeley Laboratory Report LBL-1537 (1973)
4. Data analysis techniques for high energy particle physics. Stanford Linear Accelerator Center Report SLAC-176 (1974)
5. NVERTEX: a general purpose Monte Carlo event generating and histogramming program. Fermi National Laboratory Report PM004 (1974)
6. Multidimensional associative searching. CERN, Geneva, Switzerland, Yellow Report CERN 76-24 (1976)
7. The in-out method for linear regression with censored data. Division of Biostatistics, Stanford University, Technical Report 65 (1979)
8. Smoothing of scatterplots. Department of Statistics, Stanford University, Technical Report ORION 003 (1982)
9. Projection pursuit categorical regression and classification. Department of Statistics, Stanford University, Technical Report ORION 004 (1983)
10. Project ORION - final report. Department of Statistics, Stanford University, Technical Report ORION 026 (1984)
11. SMART user's guide. Department of Statistics, Stanford University, Technical Report, LCS 01 (1984)
12. A variable span smoother. Department of Statistics, Stanford University, LCS 05 (1985)
13. Classification and multiple response regression through projection pursuit. Department of Statistics, Stanford University, Technical Report LCS 12 (1985)
14. DART/HYESS User's Guide. Department of Statistics, Stanford University, Technical Report (1996).