



Tze Leung Lai

📄 Curriculum Vitae available Online

CONTACT INFORMATION

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Bio

BIO

Tze Lai was the Ray Lyman Wilbur Professor of Statistics and, by courtesy, of Biomedical Data Science and of the Institute of Computational and Mathematical Engineering (ICME) at Stanford University. He served as Co-director of the Center for Innovative Study Design (CISD) at the Stanford School of Medicine. Professor Lai supervised more than 73 Ph.D. students and published over 300 papers in topics covering clinical trial design and analysis, population pharmacokinetics and pharmacodynamics, survival analysis, longitudinal data analysis, multiple endpoints, biomarkers, adaptive methods, sequential analysis and time series.

ACADEMIC APPOINTMENTS

- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Core Member, Center for Precision Mental Health and Wellness, Stanford University, (2018- present)
- Faculty Fellow, Center for Innovations in Global Health, Stanford University, (2018- present)
- Ray Lyman Wilbur Professor, Stanford University, (2017- present)
- Professor, by courtesy, of Biomedical Data Science (formerly Health Research and Policy), Stanford School of Medicine, (2015- present)
- Co-chair, Program in Mathematical and Computational Finance, Stanford University, (2014- present)
- Director, Financial and Risk Modeling Institute., Stanford University, (2012- present)
- International Advisory Committee Member, Mathematical Sciences Center, Tsinghua University, (2012- present)
- Advisory Committee Member, Institute of Mathematical Research, University of Hong Kong, (2011- present)
- Chair, Pao-Lu Hsu Distinguished Lecture Series in Statistics and Probability, Center for Mathematical Sciences, Tsinghua University, (2011- present)
- International Advisory Committee Member, Center for Statistical Sciences, Peking University, (2010- present)
- Co-director, Center for Innovative Study Design, Stanford School of Medicine, (2009- present)
- Professor, by courtesy, of the Institute of Computational and Mathematical Engineering, Stanford School of Engineering, (2009- present)
- Professor, by courtesy, of Health Research and Policy, Stanford School of Medicine, (2007-2015)

- Steering Committee, Methods of Analysis Program in the Social Sciences, Stanford University, (2005- present)
- Co-director, Biostatistics Core, Stanford Cancer Center, (2005-2016)
- Director, Interdisciplinary Program in Financial Mathematics, Stanford University, (2005-2014)
- Chair, School of Statistics, Chinese Academy of Sciences, (2003- present)

PROFESSIONAL EDUCATION

- B.A. with First Class Honors, University of Hong Kong , Mathematics (1967)
- M.A., Columbia University , Mathematical Statistics (1970)
- Ph.D., Columbia University , Mathematical Statistics (1971)

LINKS

- Statistics Department Faculty Page: <https://statistics.stanford.edu/people/tze-leung-lai>
- Financial and Risk Modeling Institute: <https://sites.stanford.edu/farm/>

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Tze Lai was widely recognized as a prolific leader in the field of sequential statistical analysis. Among his principal achievements was the development of a comprehensive theory of sequential tests of composite hypotheses, unifying previous approaches and providing far-reaching extensions to cope with the practical complexities that arise in the applications to group sequential clinical trials. In particular, this theory paved the way for his ground-breaking work with Shih on flexible and nearly-optimal group sequential tests that can "self-tune" to the unknown parameters during the course of the trial, under pre-specified constraints on the maximum sample size and significance level.

Other major breakthroughs include (a) accurate confidence intervals following sequential tests by using an innovative resampling approach, (b) a definitive solution to the long-standing "multi-armed bandit problem", and (c) the development of statistically and computationally efficient sequential change-point detection procedures in multivariate time series and stochastic systems, for applications to industrial quality control, fault detection in engineering systems and segmentation in computational biology.

Besides sequential analysis, Lai also made ground-breaking contributions to (i) stochastic approximation and recursive estimation, (ii) adaptive control of linear stochastic systems and Markov decision processes, (iii) saddlepoint approximations and boundary-crossing probabilities in Markov random walks and random fields, and (iv) survival analysis, in particular, rand- and M-estimators in regression models when the response variable is subject to censoring and truncation, and interim analysis of clinical trials with failure-time endpoints.

Publications

PUBLICATIONS

- **Power of an Adaptive Trial Design for Endovascular Stroke Studies Simulations Using IMS (Interventional Management of Stroke) III Data** *STROKE*
Lansberg, M. G., Bhat, N. S., Yeatts, S. D., Palesch, Y. Y., Broderick, J. P., Albers, G. W., Lai, T. L., Lavori, P. W.
2016; 47 (12): 2931-2937
- **MULTIVARIATE STOCHASTIC REGRESSION IN TIME SERIES MODELING** *STATISTICA SINICA*
Lai, T. L., Tsang, K. W.
2016; 26 (4): 1411-1426
- **Discussion on "Sequential detection/isolation of abrupt changes" by Igor V. Nikiforov** *SEQUENTIAL ANALYSIS-DESIGN METHODS AND APPLICATIONS*

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- Lai, T. L., Tsang, K. W.
2016; 35 (3): 305-310
- **Innovative designs of point-of-care comparative effectiveness trials** *CONTEMPORARY CLINICAL TRIALS*
Shih, M., Turakhia, M., Lai, T. L.
2015; 45: 61-68
 - **Adaptive design of confirmatory trials: Advances and challenges** *CONTEMPORARY CLINICAL TRIALS*
Lai, T. L., Lavori, P. W., Tsang, K. W.
2015; 45: 93-102
 - **ABO Mismatch Is Associated with Increased Nonrelapse Mortality after Allogeneic Hematopoietic Cell Transplantation** *BIOLOGY OF BLOOD AND MARROW TRANSPLANTATION*
Logan, A. C., Wang, Z., Alimoghaddam, K., Wong, R. M., Lai, T., Negrin, R. S., Grumet, C., Logan, B. R., Zhang, M., Spellman, S. R., Lee, S. J., Miklos, D. B.
2015; 21 (4): 746-754
 - **ASYMPTOTICALLY EFFICIENT PARAMETER ESTIMATION IN HIDDEN MARKOV SPATIO-TEMPORAL RANDOM FIELDS** *STATISTICA SINICA*
Lai, T. L., Lim, J.
2015; 25 (1): 403-421
 - **DYNAMIC EMPIRICAL BAYES MODELS AND THEIR APPLICATIONS TO LONGITUDINAL DATA ANALYSIS AND PREDICTION** *STATISTICA SINICA*
Lai, T. L., Su, Y., Sun, K. H.
2014; 24 (4): 1505-1528
 - **Discussion on "Sequential Estimation for Time Series Models" by T. N. Sriram and Ross Iaci** *SEQUENTIAL ANALYSIS-DESIGN METHODS AND APPLICATIONS*
Lai, T. L.
2014; 33 (2): 169-173
 - **A GENERAL THEORY OF PARTICLE FILTERS IN HIDDEN MARKOV MODELS AND SOME APPLICATIONS** *ANNALS OF STATISTICS*
Chan, H. P., Lai, T. L.
2013; 41 (6): 2877-2904
 - **Group sequential designs for developing and testing biomarker-guided personalized therapies in comparative effectiveness research.** *Contemporary clinical trials*
Lai, T. L., Liao, O. Y., Kim, D. W.
2013; 36 (2): 651-663
 - **Group sequential designs for developing and testing biomarker-guided personalized therapies in comparative effectiveness research.** *Contemporary clinical trials*
Lai, T. L., Liao, O. Y., Kim, D. W.
2013; 36 (2): 651-663
 - **STOCHASTIC CHANGE-POINT ARX-GARCH MODELS AND THEIR APPLICATIONS TO ECONOMETRIC TIME SERIES** *STATISTICA SINICA*
Lai, T. L., Xing, H.
2013; 23 (4): 1573-1594
 - **RARE-EVENT SIMULATION OF HEAVY-TAILED RANDOM WALKS BY SEQUENTIAL IMPORTANCE SAMPLING AND RESAMPLING** *ADVANCES IN APPLIED PROBABILITY*
Chan, H. P., Deng, S., Lai, T.
2012; 44 (4): 1173-1196
 - **Sequential design of phase II-III cancer trials** *STATISTICS IN MEDICINE*
Lai, T. L., Lavori, P. W., Shih, M.
2012; 31 (18): 1944-1960
 - **Clinical trial designs for testing biomarker-based personalized therapies** *CLINICAL TRIALS*
Lai, T. L., Lavori, P. W., Shih, M. I., Sikic, B. I.
2012; 9 (2): 141-154

- **Adaptive Trial Designs** *ANNUAL REVIEW OF PHARMACOLOGY AND TOXICOLOGY, VOL 52*
Lai, T. L., Lavori, P. W., Shih, M.
2012; 52: 101-110
- **Adaptation in clinical development plans and adaptive clinical trial designs** *STATISTICS AND ITS INTERFACE*
Lai, T. L., Liao, O. Y., Zhu, R. G.
2012; 5 (4): 431-442
- **Sequential Importance Sampling and Resampling for Dynamic Portfolio Credit Risk** *OPERATIONS RESEARCH*
Deng, S., Giesecke, K., Lai, T. L.
2012; 60 (1): 78-91
- **Futility stopping in clinical trials** *STATISTICS AND ITS INTERFACE*
He, P., Lai, T. L., Liao, O. Y.
2012; 5 (4): 415-423
- **Efficient Adaptive Randomization and Stopping Rules in Multi-arm Clinical Trials for Testing a New Treatment** *3rd International Workshop on Sequential Methodologies (IWSM)*
Lai, T. L., Liao, O. Y.
TAYLOR & FRANCIS INC.2012: 441-57
- **A SEQUENTIAL MONTE CARLO APPROACH TO COMPUTING TAIL PROBABILITIES IN STOCHASTIC MODELS** *ANNALS OF APPLIED PROBABILITY*
Chan, H. P., Lai, T. L.
2011; 21 (6): 2315-2342
- **EVALUATING PROBABILITY FORECASTS** *ANNALS OF STATISTICS*
Lai, T. L., Gross, S. T., Shen, D. B.
2011; 39 (5): 2356-2382
- **A STEPWISE REGRESSION METHOD AND CONSISTENT MODEL SELECTION FOR HIGH-DIMENSIONAL SPARSE LINEAR MODELS** *STATISTICA SINICA*
Ing, C., Lai, T. L.
2011; 21 (4): 1473-1513
- **MEAN-VARIANCE PORTFOLIO OPTIMIZATION WHEN MEANS AND COVARIANCES ARE UNKNOWN** *ANNALS OF APPLIED STATISTICS*
Lai, T. L., Xing, H., Chen, Z.
2011; 5 (2A): 798-823
- **Incorporating Individual and Collective Ethics into Phase I Cancer Trial Designs** *BIOMETRICS*
Bartroff, J., Lai, T. L.
2011; 67 (2): 596-603
- **A SIMPLE BAYESIAN APPROACH TO MULTIPLE CHANGE-POINTS** *STATISTICA SINICA*
Lai, T. L., Xing, H.
2011; 21 (2): 539-569
- **CRAMER TYPE MODERATE DEVIATIONS FOR STUDENTIZED U-STATISTICS** *ESAIM-PROBABILITY AND STATISTICS*
Lai, T. L., Shao, Q., Wang, Q.
2011; 15: 168-179
- **Discussion on "Two-Stage Procedures for High-Dimensional Data" by Makoto Aoshima and Kazuyoshi Yata** *SEQUENTIAL ANALYSIS-DESIGN METHODS AND APPLICATIONS*
Ing, C., Lai, T. L.
2011; 30 (4): 404-411
- **Sequential generalized likelihood ratio tests for vaccine safety evaluation** *STATISTICS IN MEDICINE*
Shih, M., Lai, T. L., Heyse, J. F., Chen, J.
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- **Approximate Dynamic Programming and Its Applications to the Design of Phase I Cancer Trials** *STATISTICAL SCIENCE*
Bartroff, J., Lai, T. L.
2010; 25 (2): 245-257
- **Multistage Tests of Multiple Hypotheses** *COMMUNICATIONS IN STATISTICS-THEORY AND METHODS*
Bartroff, J., Lai, T. L.
2010; 39 (8-9): 1597-1607
- **Theory and applications of multivariate self-normalized processes** *STOCHASTIC PROCESSES AND THEIR APPLICATIONS*
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- **Option hedging theory under transaction costs** *JOURNAL OF ECONOMIC DYNAMICS & CONTROL*
Lai, T. L., Lim, T. W.
2009; 33 (12): 1945-1961
- **Tests and confidence intervals for secondary endpoints in sequential clinical trials** *BIOMETRIKA*
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2009; 96 (4): 903-915
- **A Bayesian Approach to Sequential Surveillance in Exponential Families** *COMMUNICATIONS IN STATISTICS-THEORY AND METHODS*
Lai, T. L., Liu, T., Xing, H.
2009; 38 (16-17): 2958-2968
- **Modern sequential analysis and its applications to computerized adaptive testing** *PSYCHOMETRIKA*
Bartroff, J., Finkelman, M., Lai, T. L.
2008; 73 (3): 473-486
- **Statistical inference in dynamic panel data models** *JOURNAL OF STATISTICAL PLANNING AND INFERENCE*
Lai, T. L., Small, D. S., Liu, J.
2008; 138 (9): 2763-2776
- **Stochastic segmentation models for array-based comparative genomic hybridization data analysis** *BIOSTATISTICS*
Lai, T. L., Xing, H., Zhang, N.
2008; 9 (2): 290-307
- **A Hidden Markov Filtering Approach to Multiple Change-point Models** *47th IEEE Conference on Decision and Control*
Lai, T. L., Xing, H.
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- **Statistical models for the Basel II internal ratings-based approach to measuring credit risk of retail products** *STATISTICS AND ITS INTERFACE*
Lai, T. L., Wong, S. P.
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- **Corrected random walk approximations to free boundary problems in optimal stopping** *ADVANCES IN APPLIED PROBABILITY*
Lai, T. L., Yao, Y., Aitsahlia, F.
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- **Efficient importance sampling for Monte Carlo evaluation of exceedance probabilities** *ANNALS OF APPLIED PROBABILITY*
Chan, H. P., Lai, T. L.
2007; 17 (2): 440-473
- **A combined superiority and non-inferiority approach to multiple endpoints in clinical trials** *STATISTICS IN MEDICINE*
Bloch, D. A., Lai, T. L., Su, Z., Tubert-Bitter, P.
2007; 26 (6): 1193-1207
- **Nonparametric functionals of spectral distributions and their applications to time series analysis** *JOURNAL OF STATISTICAL PLANNING AND INFERENCE*
Lai, T. L., Xing, H.

2007; 137 (3): 1066-1075

- **Identification and adaptive control of change-point ARX models via Rao-Blackwellized particle filters** *IEEE TRANSACTIONS ON AUTOMATIC CONTROL*
Chen, Y., Lai, T. L.
2007; 52 (1): 67-72
- **Marginal regression analysis of longitudinal data with time-dependent covariates: a generalized method-of-moments approach** *JOURNAL OF THE ROYAL STATISTICAL SOCIETY SERIES B-STATISTICAL METHODOLOGY*
Lai, T. L., Small, D.
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- **Confidence intervals for survival quantiles in the Cox regression model** *LIFETIME DATA ANALYSIS*
Lai, T. L., Su, Z.
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- **Confidence intervals in group sequential trials with random group sizes and applications to survival analysis** *BIOMETRIKA*
Lai, T. L., Li, W.
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- **Efficient recursive estimation and adaptive control in stochastic regression and ARMAX models** *STATISTICA SINICA*
Lai, T. L., Ying, Z.
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- **Modified Haybittle-Peto group sequential designs for testing superiority and non-inferiority hypotheses in clinical trials** *STATISTICS IN MEDICINE*
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2006; 25 (7): 1149-1167
- **Flexible modeling via a hybrid estimation scheme in generalized mixed models for longitudinal data** *BIOMETRICS*
Lai, T. L., Shih, M. C., Wong, S. P.
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- **A new approach to modeling covariate effects and individualization in population pharmacokinetics-pharmacodynamics** *JOURNAL OF PHARMACOKINETICS AND PHARMACODYNAMICS*
Lai, T. L., Shih, M. C., Wong, S. P.
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- **Maxima of asymptotically Gaussian random fields and moderate deviation approximations to boundary crossing probabilities of sums of random variables with multidimensional indices** *ANNALS OF PROBABILITY*
Chan, H. P., Lai, T. L.
2006; 34 (1): 80-121
- **The optimal stopping problem for S-n/n and its ramifications** *Festschrift in Honor of Yuan Shih Chow on Random Walk, Sequential Analysis and Related Topics*
Lai, T. L., Yao, Y.
WORLD SCIENTIFIC PUBL CO PTE LTD.2006: 131-149
- **Autoregressive models with piecewise constant volatility and regression parameters** *NBER/NSF Time Series Conference*
Lai, T. L., Liu, H. Y., Xing, H. P.
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- **Optimal stopping for Brownian motion with applications to sequential analysis and option pricing** *JOURNAL OF STATISTICAL PLANNING AND INFERENCE*
Lai, T. L., Lim, T. W.
2005; 130 (1-2): 21-47
- **Power, sample size and adaptation considerations in the design of group sequential clinical trials** *BIOMETRIKA*
Lai, T. L., Shih, M. C.
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- **Self-normalized processes: Exponential inequalities, moment bounds and iterated logarithm laws** *ANNALS OF PROBABILITY*
De La Pena, V. H., Klass, M. J., Lai, T. L.
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- **Exercise regions and efficient valuation of American lookback options** *5th ICSA International Statistical Conference*
Lai, T. L., Lim, T. W.
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- **Valuation of American options via basis functions** *IEEE TRANSACTIONS ON AUTOMATIC CONTROL*
Lai, T. L., Wong, S. P.
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- **Limit theorems for moving averages** *Workshop on Probability with Applications to Finance and Insurance*
Lai, T. L.
WORLD SCIENTIFIC PUBL CO PTE LTD.2004: 1–14
- **A hybrid estimator in nonlinear and generalised linear mixed effects models** *BIOMETRIKA*
Lai, T. L., Shih, M. C.
2003; 90 (4): 859-879
- **Saddlepoint approximations and nonlinear boundary crossing probabilities of Markov random walks** *ANNALS OF APPLIED PROBABILITY*
Chan, H. P., Lai, T. L.
2003; 13 (2): 395-429
- **Nonparametric estimation in nonlinear mixed effects models** *BIOMETRIKA*
Lai, T. L., Shih, M. C.
2003; 90 (1): 1-13
- **Optimal learning and experimentation in bandit problems** *JOURNAL OF ECONOMIC DYNAMICS & CONTROL*
Brezzi, M., Lai, T. L.
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- **Detection and estimation in stochastic systems with time-varying parameters** *Workshop on Stochastic Theory and Control*
Lai, T. L.
SPRINGER-VERLAG BERLIN.2002: 251–265
- **One-sided tests in clinical trials with multiple endpoints** *BIOMETRICS*
Bloch, D. A., Lai, T. L., Tubert-Bitter, P.
2001; 57 (4): 1039-1047
- **Asymptotic expansions in multidimensional Markov renewal theory and first passage times for Markov random walks** *ADVANCES IN APPLIED PROBABILITY*
Fuh, C. D., Lai, T. L.
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- **Stochastic neural networks with applications to nonlinear time series** *JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION*
Lai, T. L., Wong, S. P.
2001; 96 (455): 968-981
- **Sequential analysis: Some classical problems and new challenges** *STATISTICA SINICA*
Lai, T. L.
2001; 11 (2): 303-351
- **Asymptotic approximations for error probabilities of sequential or fixed sample size tests in exponential families** *ANNALS OF STATISTICS*
Chan, H. P., Lai, T. L.
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Brezzi, M., Lai, T. L.
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- **Efficient score estimation and adaptive M-estimators in censored and truncated regression models** *STATISTICA SINICA*
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- **Sequential multiple hypothesis testing and efficient fault detection-isolation in stochastic systems** *IEEE TRANSACTIONS ON INFORMATION THEORY*
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- **Hybrid resampling methods for confidence intervals** *STATISTICA SINICA*
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- **Determination of power and sample size in the design of clinical trials with failure-time endpoints and interim analyses** *CONTROLLED CLINICAL TRIALS*
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- **Efficient recursive algorithms for detection of abrupt changes in signals and control systems** *IEEE TRANSACTIONS ON AUTOMATIC CONTROL*
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- **Regression smoothers and additive models for censored and truncated data** *COMMUNICATIONS IN STATISTICS-THEORY AND METHODS*
Kim, C. K., Lai, T. L.
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- **Information bounds and quick detection of parameter changes in stochastic systems** *IEEE TRANSACTIONS ON INFORMATION THEORY*
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- **Wald's equations, first passage times and moments of ladder variables in Markov random walks** *JOURNAL OF APPLIED PROBABILITY*
Fuh, C. D., Lai, T. L.
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- **Resampling methods for confidence intervals in group sequential trials** *BIOMETRIKA*
Chuang, C. S., Lai, T. L.
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- **Repeated significance testing with censored rank statistics in interim analysis of clinical trials** *STATISTICA SINICA*
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- **Stochastic adaptive control of linear time-varying systems using auxiliary variables** *37th IEEE Conference on Decision and Control*
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- **Moments of randomly stopped U-STATISTICS** *ANNALS OF PROBABILITY*
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- **Information and prediction criteria for model selection in stochastic regression and ARMA models** *STATISTICA SINICA*
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- DELAPENA, V. H., Lai, T. L.
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- **On optimal stopping problems in sequential hypothesis testing** *STATISTICA SINICA*
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 - **SEQUENTIAL CHANGEPOINT DETECTION IN QUALITY-CONTROL AND DYNAMICAL-SYSTEMS** *JOURNAL OF THE ROYAL STATISTICAL SOCIETY SERIES B-METHODOLOGICAL*
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 - **A MISSING INFORMATION PRINCIPLE AND M-ESTIMATORS IN REGRESSION-ANALYSIS WITH CENSORED AND TRUNCATED DATA** *ANNALS OF STATISTICS*
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 - **EDGEWORTH EXPANSIONS FOR SYMMETRICAL STATISTICS WITH APPLICATIONS TO BOOTSTRAP METHODS** *STATISTICA SINICA*
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- **CERTAINTY EQUIVALENCE WITH UNCERTAINTY ADJUSTMENTS IN STOCHASTIC ADAPTIVE-CONTROL** *WORKSHOP ON STOCHASTIC THEORY AND ADAPTIVE CONTROL*
Lai, T. L.
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- **RECURSIVE-IDENTIFICATION AND ADAPTIVE PREDICTION IN LINEAR STOCHASTIC-SYSTEMS** *SIAM JOURNAL ON CONTROL AND OPTIMIZATION*
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