MATHEMATISCHES FORSCHUNGSINSTITUT OBERWOLFACH

Tagungsbericht 34/1991

7th European Young Statisticians Meeting

11.8. bis 17.8.1991

The conference was organized by Gerold Alsmeyer (Kiel); 46 persons from 16 countries attended, 43 from Europe, 1 person from the United States and 1 person from Mexico. The intention of the meeting was to provide young researchers in probability and statistics, perhaps just started in, or about to enter postdoctoral positions an introduction to the international scene and to introduce their own work. Topics were expected to cover a broad range from probability to statistics and this was achieved.

There were 43 talks which covered the following topics: Parametric and nonparametric inference (regression, bootstrapping, empirical likelihood, robustness), goodness of fit, experimental design, distribution theory, stochastic approximation, filtering, analysis of stochastic processes in a general or applied context (risk, queueing or branching models), simulated annealing, stochastic geometry and stochastic differential equations.

The intimate atmosphere of the conference led to many interesting discussions which helped not only to learn about other statistical and probablistic fields, but also, for instance, about different educational systems and problems arising from them. The major intention of providing a good "soil" for future contacts was fully accomplished.

All participants were extremely satisfied with the inspiring atmosphere at the conference centre and its perfect management. On behalf of all of them sincere thanks go to the staff of the centre and especially to its head, Professor Barner, for making this conference possible.

Abstracts

S. Aalto. *An approximative filtering algorithm for a doubly stochastic Poisson process.*

Consider a Poisson counting process (N_t) with stochastic intensity function (λ_t). In this case the counting process is called doubly stochastic. Our aim is to construct a recursive,

approximative algorithm for calculating the posterior distribution of intensity based on the observed jump times of (N_t). In our construction we apply results given by Snyder(1972).

Reference

D.L. Snyder (1972). Filtering and detection for doubly stochastic Poisson processes. *IEEE Trans. on Inf. Theory* **IT-18**, 91-102.

M. Alex. *Invariance principles in risk models under interest and inflation.*

A very general risk theory model including macroeconomical interest and inflation is considered. By using invariance principles for compound renewal processes an approximation with rates for the probability of ultimate ruin in finite time by the distribution of the first exit time of a Brownian motion through a one-sided curved boundary is presented.

G. Alsmeyer. *Renewal theory for a class of generalized random walks.*

Blackwell's renewal theorem is discussed for a class of generalized random walks whose increments need neither be independent nor stationary. Their intrinsic property is that the conditional increment distribution functions are bounded from below and above by integrable distribution functions. We introduce certain drift constants which then lead to bounds for the renewal measure of the considered random walk. Under further regularity assumptions, notably minorazation conditions inspired by similar ones arising in the theory of Harris chains and Markov random walks, Blackwell's renewal theorem can be extended. The main ideas of the proof which uses a coupling argument are also presented.

J.R. Artalejo. *On Markovian queues with returning customers and breakdowns of the servers.*

Markovian retrial queues subject to interruptions of service are investigated. Different models can be distinguished according to the behaviour of displaced customers. Sufficient conditions for ergodicity are eatblished. In the single-server case a complete analysis of the main operation characteristics and some asymptotic properties are provided.

J.H. Badsberg. *Exact conditional tests between any two decomposable models in multidimensional contingency tables by Monte Carlo methods.*

An introduction to the subclass graphical models of hierarchical log-linear models for multidimensional contingency tables is given as well as a discussion of exact tests between any two decomposable models. Exact tests by Monte Carlo methods are implemented in the program CoCo.

P. Bajorski. *Intermediate efficiency.*

Comparison of tests can be made locally by letting alternatives tend to the null hypothesis (Pitman efficiency), or non-locally where an alternative is kept fixed (Cochran-Bahadur efficiency). In the Pitman approach the significance level remains constant, whereas in the Bahadur approach it tends to 0. An intermediate approach was proposed by Kallenberg who lets the alternative tend to the null hypothesis and simultaneously the significance level to 0,

though more slowly than in the Cochran-Bahadur approach. In this talk a similar concept is introduced. However, our intermediate efficiency and deficiency depend on the way of tending towards the null hypothesis. This is justified by certain linear and max-type tests of goodness of fit.

M. Beibel. *A generalization of Varadhan's large deviation theorem to metrics stronger than uniform metric.*

We consider large deviations for $\varepsilon^{1/2}W$, as $\varepsilon \to 0$, where W is standard Brownian motion. Let q be a nondecreasing function on $[0,1]$ which is $EFKP$ upper class at the origin. We show that in the large deviation theorem due to Schilder and Varadhan the uniform topology can be replaced by the topology induced by the q-metric d_q. This modification is motivated by an application to boundary crossing probabilities.

A. Clerc-Bérod. *Robust inference of a regression parameter.*

We present bioptimal estimation of a regression parameter. Bioptimal estimators are convex combinations of Pitman estimators, and are optimally robust for a confrontation containing two shapes. Since they define the lower bound of the possible behaviours they are an essential ingredient for the comparison of existing robust methods. Simulation results are presented. The idea of compromising two shapes can also be used to construct bioptimal interval estimators.

M. Bojkova. *Asymptotic behaviour of non-critical Bellman-Harris branching processes with state-dependent immigration.*

Non-critical Bellman-Harris branching processes with state-dependent immigration are investigated. The asymptotic behaviour of the first two factorial moments is obtained and two types of limit theorems are also proved. In the subcritical case the existence of a stationary limit distribution is established. In the supercritical case we find a necessary and sufficient condition for convergence in distribution of the process to a non-degenerated random variable.

U. Boldt. *Elliptically contoured measures of k-dimensional orthants.*

Let $\mathcal{E}$ be the class of k-dimensional elliptically contoured distribtutions and $\mathcal{E}_0 \in \mathcal{E}$. We show that for a random variable Y with distribution $\mathcal{E}_0(0,\Sigma)$ one can calculate $\Phi(A,\mathcal{E}_0) = P(Y \in A)$ for several k-dimensional sets A like simplices or orthants and special correlation matrices Σ by using a representation formula for spherically distributed random variables.

R. Buckdahn. *Skorohod stochastic differential equations.*

We show existence and uniqueness of the linear stochastic differential equation with Skorohod integral, given by

$$X_t = G + \int_0^t a_s X_s \, dW_s + \int_0^t b_s X_s \, ds.$$

Here G is an integrable function of the whole path of the driving Brownian motion (W_t), $(a_s) \in L_2([0,1])$ and (b_s) are essentially bounded and anticipative. A review on more general results is also given.

A. Butov. *Consistent procedures for estimation of the parameters of multidimensional random environment by observation of random walk.*

Vector processes of birth and death in random environment of functional type are discussed. Along with the limit theorem for the normalized process the inverse problem is solved: to determine the consistent estimates of the parameters of the random environment by observation of the random walk.

A.J. Cabo. *On functionals of the convex hull of a uniform sample.*

In 1988, Groeneboom derived a central limit theorem for the number of vertices of the convex hull of a uniform sample from the interior of a convex polygon. This is done by approximating the process of vertices of the convex hull by the process of extreme points of a Poisson point process and by considering the latter process of extreme points as a Markov process (for a particular parametrization). We show that this method can also be used to derive limit theorems for the area and the boundary length of the convex hull. This extends results of Rényi and Sulanke(1963) and shows that the boundary length and the area have a strikingly different probabilistic behaviour. [This is joint work with P. Groeneboom, Delft University of Technology, Delft, The Netherlands.]

References

Groeneboom, P. (1988). Limit theorems for convex hulls. *Probab. Th. Rel. Fields* **79**, 327-368.

Rényi, A. and Sulanke, R. (1963). Über die konvexe Hülle von n zufällig gewählten Punkten. *Z. Wahrscheinlichkeitstheorie verw. Geb.* **2**, 75-84.

R. Cao-Abad. *A bootstrap bandwidth selector in nonparametric density estimation.*

A method for bootstrapping the mean integrated square error in nonparametric density estimation is presented. As a consequence, a smoothed bootstrap bandwidth selector is defined and a rate of convergence result as well as a limit distribution are derived for it.

M. Casalis. *The Wishart families on symmetric cones.*

The Wishart families on symmetric cones are introduced with the formalism of Jordan algebras which allow to study five canonical cases in a unified way. The families are the only ones (with their opposite) to be invariant under the group of automorphisms which preserve the cone and they are also characterized by a homogeneous quadratic variance function.

B. Fernandez. *Hydrdynamic and fluctuation limits of a branching particle system with changes of mass.*

Branching diffusions are models of particle systems which evolve in space by random migration and branching. We consider a "branching mass" model where each particle has its own mass. When a particle branches the mass of each of its offspring is proportional to the mass of its parent and further depends on the number of offspring produced. We present laws of large

numbers and fluctuation limits under different rescalings. The fluctuation limits are Markovian generalized Gaussian Orbstein-Uhlenbeck processes.

J. López-Fidalgo. *Simplex algorithm for optimal experimental design.*

An easy algorithm for the calculation of the optimal design for any given optimality criterion is presented. This algorithm should be used when the situation of optimal design is approximately known. In fact, it will then be obtained as a linear combination of several designs chosen beforehand.

J. van Horebeek. *Study of a parallel stochastic optimazation method.*

In this presentation a new parallel stochastic optimization is introduced. Compared to the Boltzman machine it possesses a higher level of parallelization. We derive a set of functions that can be maximized and present simulation results.

D. Jakimavicius. *Large deviations for sums of dependent random variables.*

Zones of large deviations for sums of dependent random variables ξ_i can be connected with a number γ by $|\mathrm{cum}_k(\sum_{i=1}^n \xi_i)| \leq (k!)^\gamma \Delta_n^k$. Cumulants are expressed in terms of centered moments. This is a new possibility and can be achieved by a symmetric group technique (instead of using partitions).

U. Kamps. *Identities for the difference of moments of successive order statistics and record values.*

A general identity for the difference of moments of successive order statistics is given which is valid in a class of probability distributions including Weibull, power function, Pareto, Burr XII, and logistic distributions. An analogous result is stated for moments of k-th record values.

J. Knif. *Parameter variability in time series regression.*

Both simple tests based on recursive residuals and tests against the alternative of random coefficients are presented. Comparisons are made on the basis of an application to the single factor market model using data from the Helsinki stock exchange.

B.P. Kovachev. *Almost linear regression models: Geometrical interpretation and asymptotic properties.*

A class of nonlinear regression models named "almost-linear" is introduced. Its characterization is the reduction of the sample space. In that sense its statistical properties correspond to those of curved exponential families. An accelerated double-step least squares estimator is proposed. Consistency, first, second and third order efficiency of the estimators are discussed from a geometrical point of view. Asymptotic information losses due to the nonlinearity of the model are calculated in correspondence with its geometrical structure.

E. Kreutzberger. *Bootstrapping polynomial regression.*

The aim is to estimate the unknown order Q of a polynomial. As the measure of an approximation, the Final Prediction Error, cannot be calculated exactly, a bootstrap equivalent is examined and shown to converge uniformly in the approximation order.

J. Krob. *The Shannon capacity of a statistical experiment and its asymptotic behaviour.*

Let $\mathcal{E}$ be an experiment with finite parameter θ. With the help of the Kullback-Leibler distance the average amount of information provided by the experiment can be defined. The Shannon capacity is the maximum average amount of information. The sequence of capacities of replicated experiments $\mathcal{E}^k$ converges at an exponential rate to $\log\theta$.

D.P. Kroese. *Point processes and stochastic integration in a cyclic server model.*

We consider a cyclic server queueing model in which we are interested in the positions of the waiting customers. The model is analyzed by means of point and regenerative processes combined with some stochastic integration theory.

I. Malá. *Stochastic approximation with delayed observations.*

The Robbins-Monro stochastic approximation procedure provides an estimate for the zero of a regression function which is observable at any argument x and any time point $n \in \mathbb{N}$ with an experimental error. The case of delayed observations is investigated where approximation is allocated to $k \geq 1$ parallel processes. Asymptotic properties for collaborating and non-collaborating systems are presented.

P. Marzec. *Testing the equality in dispersion of two distributions.*

We consider the problem of testing that two distributions are identical except for an unknown location parameter against the alternative that one is less dispersed than the other. Tests are proposed and shown to be asymptotically distribution free and consistent. The asymptotic relative efficiency with respect to several other tests for a number of specific alternatives as well as asymptotic results for some test statistics based upon spacings are also given.

L. Mattner. *Completeness of location families, translated moments, and uniqueness of charges.*

A sufficient condition for statistical completeness of location families generated by a probability density in Euclidean space is given. As an application, completeness of families generated by a symmetric stable law is proved. Our criterion, complementing a classical result of Wiener and recent work of Isenbeck and Rüschendorf, is in terms of regularity of the generating density and zerofreeness of its characteristic function. Its proof relies upon a local version of the convolution theorem for Fourier transforms of tempered distributions. A more general version of the criterion is applicable to apparently different problems as is illustrated by giving a simultaneous proof of a theorem of translated moments by P. Hall and a uniqueness result of M. Riesz in potential theory.

H. Monod. *Factorial neighbour-balanced designs.*

A method of construction of partially neighbour-balanced designs is presented when the treatments are the combinations of levels of two-level factors. These designs are shown to be universally optimal under the assumption of additive neighbour effects from each factor. The randomization properties are discussed.

W.G. Müller. *Optimal design for moving local regressions.*

The so-called *moving local regression* is described, a special nonparametric statistical tool. Its incorporation into the design framework is given including the derivation of the necessary formulae. Some geometrical examples illuminate the interrelations of the basic ingredients of the method. Additionally results from a practical study, the optimal design of an air-monitoring network, are presented.

M. Neumann. *A completely data-driven kernel estimator of the varaince.*

In a nonparametric regression model we construct a kernel estimator of the variance function which is based on a kernel estimator of the mean. We select the bandwidths by cross-validation and prove that the integrated mean square error of this estimator attains the optimum uniform convergence rate in Sobolev classes. Further, we show that cross-validation is efficient as a selection rule.

A.B. Owen. *Emprical likelihood for linear models.*

The method of empirical likelihood is introduced and then extended to cover the linear regression model. Versions are presented for both, fixed and random regressors. In both cases there is no need to assume a parametric error distribution or even constant error variance. The method is applied to model the mean and variance of some cancer incidence data as a function of population size.

M. Pecková. *Change point problem in a simple regression model.*

Let $X_1, ..., X_n$ be independent random variables observed at time points $t_1 < ... < t_n$, and let X_i have the continuous distribution function $F(x - c_i\theta_i)$, $i = 1, ..., n$, where $c_1, ..., c_n$ are known regression constants and $\theta_1, ..., \theta_n$ are unknown parameters. In this model we want to test $H_0 : \theta_1 = ... = \theta_n$ against $H_1 : theta_1 = ... = \theta_m \neq \theta_{m+1} = ... = \theta_n$. One of the approaches to this problem is a test based on maximum likelihood ratio. The test statistic obtained for the case of normal observations X_i can be extended to the general case, but it is necessary to use some robust procedure. The work is concentrated on procedures related to M-estimators. We provide some possibilities of how to find the critical regions. The procedures have been examined in a simulation study.

I. Pigeot-Kübler. *Asymptotically efficient relative risk estimators in the presence of confounding.*

In epidemiological studies it is of interest to estimate the common odds ratio. This can be interpreted as the relative risk of developing a certain disease when a person is exposed to

some risk factor. Here a new and simple principle of constructing noniterative odds ratio estimators is presented. The estimators are shown to be consistent, asymptotically normal and asymptotically efficient.

G.O. Roberts. *An asymptotic relation between information measures for stochastic processes.*

We derive an asymptotic relation between Shannon information and Fisher's information for obsercations of a possibly time-inhomogeneous diffusion process. In the statistical context of i.i.d. observations, a result of this type was proved by Ibragimov and H'asminski using the Le Cam-Ibragimov Z-process. Here we extend their result using similar techniques.

J. Romo. *Bootstrapping k-means.*

We present results showing that the bootstrap works in probability for the k-means algorithm in clustering analysis under the same conditions as in Pollard's(1982) central limit theorem for k-means.

Reference

Pollard, D. (1982). A central limit theorem for k-means clustering. *Ann. Statist.* **10**, 919-926.

H. Schmidli. *Insurance risk models in an economic environment: an application of martingale theory.*

Let X_t be the cash-flow process of an insurance company which is allowed to borrow money and gets interest for capital above a certain "liquid reserve" level. Under the assumption of Poissonian claim times and i.i.d. claim sizes independent of the claim times we construct martingales using the theory of piecewise deterministic Markov processes. Ruin probabilities and a Lundberg exponent are computed without assuming a net profit condition.

J. Schumacher. *Asymptotic properties of χ^s-divergence statistics.*

We investigate the class of χ^s-divergence statistics applied to the problem of multinomial goodness of fit. Considering higher order local alternatives we obtain asymptotic formulae for the error probabilities. The results lead to approximations of the critical values for the tests given an almost arbitrary rate of convergence to 0 of the error probabilities.

D. Wauters. *Simulataneous two-parameter tests for the gamma family.*

The two-parameter gamma family is considered as a statistical manifold, equiped with the Burbea-rao γ-entropy metric. The γ-entropy metric tensor $g^{(\gamma)}$ is obtained in terms of gamma, digamma and trigamma functions. For a simple null hypothesis (α_0, β_0) the $g^{(\gamma)}$-LMMPU-test, the LR-test and the score test are constructed. The acceptance region of the $g^{(\gamma)}$-LMMPU-test is an ellipse in the sufficient statistics $(S, P) = (\bar{X}, \ln(\prod_{i=1}^n X_i)^{1/n})$ and is investigated for dependence on γ. The information LMMPU-, the LR- and the score test which are asymptotically equivalent are numerically compared as to power for a small sample experiment.

M. Weber. *A class of infinitesimal generators and time reversal for the associated class of one-dimensional Markov processes.*

A class of infinitesimal generators of strongly continuous nonnegative contraction semigroups is introduced. They contain a diffusion and an integral term which govern possible jumps of the generated process. This process is constructed and time reversal considered. More general generators with a singularity in the integral term are approximated.

H.J. Witte. *Some optimality results for Poisson point process approximations.*

Let $\xi = \sum_{j=1}^{n} \xi_j$ be a Poisson-Bernoulli point process where $(\xi)_{1 \leq i \leq n}$ is a sequence of independent Bernoulli point processes. Sharp upper and lower bounds are derived for the approximation of ξ by a Poisson point process η w.r.t. total variation distance $d(\xi, \eta)$. Especially, we consider the question of optimal choice of the approximating point process η.

V. Zayats. *Estimation of the correlation function and its derivatives over the whole parametric set.*

The most natural approach to the estimation of functional characteristics of stationary processes and homogeneous fields consists in studying the properties of estimators of the said functions in certain spaces of functions defined on the whole parametric sets of these functions. This approach permits to obtain "global" approximations for the considered functions. The correlation function estimator over the whole parametric set will be our main subject of the talk. We shall concentrate on limit theorems for this estimator, both after one sample as well as in a series scheme after many samples. Also different problems arising upon these studies will be broached such as equivalent forms of the CLT for triangular arrays of Hilbert-space-valued random variables, comparison theorems and upper functions for Gaussian random processes, etc.

I. Žežula. *Covariance components estimation in the growth curve model.*

We give a short introduction into the growth curve (multivariate regression) model with "Kronecker-structured" covariance matrix. Several explicit formulae for the optimal estimators of unknown covariance components under different conditions are presented and their use for first order parameter estimators is discussed.

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