Arnab Bhattacharjee
University of St Andrews

Bayesian Inference in Hazard Regression Models Under Order Restrictions on Covariate Dependence and Ageing

We propose Bayesian inference in hazard regression models where the baseline hazard is unknown, covariate effects are possibly age-varying (non-proportional), and there is multiplicative frailty with arbitrary distribution.

Our framework incorporates a wide variety of order restrictions on covariate dependence and duration dependence (ageing). We propose estimation and evaluation of age-varying covariate e¤ects when covariate dependence is monotone rather than proportional. In particular, we consider situations where the lifetime conditional on a higher value of the covariate ages faster or slower than that conditional on a lower value; this kind of situation is common in applications. In addition, there may be restrictions on the nature of ageing. For example, relevant theory may suggest that the baseline hazard function decreases with age.

The proposed framework enables evaluation of order restrictions in the nature of both covariate and duration dependence as well as estimation of hazard regression models under such restrictions. The usefulness of the proposed Bayesian model and inference methods are illustrated with an application to corporate bankruptcies in the UK.

Melanie Birke
Ruhr-Universität Bochum

Kernel based methods for nonparametric regression under monotonicity and convexity constraints

The problem of estimating a function under shape restrictions such as monotonicity or convexity has much been considered in the literature. One possibility for estimating an increasing function is the method of increasing rearrangements. To obtain an increasing estimate the method starts with an unconstrained estimator for which the increasing rearrangement is calculated in a second step. If this method is applied to the derivative of an unconstrained regression estimate, a convex estimate for the regression function can be constructed. It is also possible to include further restrictions like bounds on the first derivative in the estimation procedure. With this concept it is possible to construct completely kernel based constrained estimators.

Although the methods were originally developed for estimating the regression function in nonparametric regression under monotonicity or convexity constraints this concept provides a general method for estimating functions under those qualitative constraints and works with nearly any kind of unconstrained estimators, e.g. kernel, spline or series estimators.

Under certain assumptions on the smoothness of the unknown function it can be shown that those constrained estimators have the same asymptotic behaviour as the unconstrained estimators. That is, they are consistent or asymptotically normal if the unconstrained estimator is consistent or asmyptotically.

In finite samples the constrained estimators show a very similar behaviour as the unconstrained estimators with slight advantages for the constrained ones and yield comparable results to other constrained estimators, e.g. constrained maximum likelihood or least squares estimators.

Nicolai Bissantz
Ruhr-Universität Bochum

Multi-Scale Selection of the Stopping Criterion for MLEM Reconstructions in PET

We present a fully data-driven selection algorithm for the stopping criterion for MLEM reconstructions in PET.
The method can be generalized to various other reconstruction algorithms, and is based on a statistical analysis of the residuals between projected model and data.
To this end we test whether the residuals are consistent with the hypothesis of being solely due to Poisson noise.
Moreover, our method includes a multiresolution approach, i.e. we test whether the residuals are consistent with pure Poisson noise for all possible re-binning of the data into increasing bin sizes in the detector space, and at all positions.

Technically, our method is based on the almost sure limiting behaviour of partial sums of the residuals. We determine the rate function which appears in the corresponding almost sure limit theorem for Poisson noise, and which is different from the Gaussian noise case. We close with results from a Monte Carlo study which demonstrates the performance of the method.

Natalia Bochkina
University of Edinburgh

Effect of the choice of prior distribution on pointwise optimality of Bayes Factor wavelet function estimators

We consider errors of Bayes Factor wavelet estimator under pointwise lr risks, 1 6 r < 1, without the assumption of Gaussian noise or Gaussian tail of the prior distribution. The prior imposed on wavelet coe_cients is a mixture of an atom of probability at zero and either a power exponential or a heavy-tailed density, under either power exponential or t error dis-tribution. We state adaptive and nonadaptive minimax pointwise rates of convergence under rth power loss over the Besov spaces, and show for which choices of the prior distribution and its hyperparameters, the Bayes Factor

wavelet estimator is asymptotically minimax. We compare the results for the pointwise squared risk with those for the global mean squared error.
This is joint work with T.Sapatinas.

Paul Eilers
Leiden University

Shape-constrained smoothing with asymmetric penalties

Quantile regression has become rather popular in recent years. The idea is simple: minimize an asymmetrically weighted sum of absolute values of residuals in a regression model. With specialized linear programming algorithms one can compute solutions efficiently. It is less well known that the same idea can be applied in least squares: apply different weights to positive and negative residuals. One can avoid linear programming: iteratively re-weighted regression is enough for guaranteed convergence to the optimal solution.

Most roughness penalties have a quadratic character, so it is natural to apply asymmetry there too. Again iterative re-weighting leads to simple algorithms (although convergence is probably not guaranteed). This allows us to (locally) mix and match sign-constraints, monotone behaviour and convexity/concavity in an elegant and simple way.

Asymmetric penalties are a natural companion to P-splines, the combination of a rich B-spline basis with discrete roughness penalties. A number of examples will be presented, like sign-constrained and monotone smoothing in one and two dimensions, unimodal and log-concave smoothing.

Piotr Fryzlewicz
University of Bristol

BaSTA: consistent multiscale multiple change-point detection for piecewise-stationary ARCH processes

The piecewise-stationary ARCH time series model explains well the commonly observed features of logarithmic returns on financial instruments. We present a new multiscale technique for change-point detection in this framework, which relies on two ingredients: appropriate "normalisation" of the process, and binary segmentation. We discuss the choice of a suitable normalising function, demonstrate the consistency of the procedure and illustrate its practical performance.
joint work with Suhasini Subba Rao, Texas A&M

Kevin Hayes
University of Limerick

Bayesian wavelet regression of correlated near infrared spectra

This paper applies Bayesian wavelet shrinkage to correlated near-infrared spectra. The aim is to remove noise from the entire collection of spectra simultaneously, while exploiting correlation between spectra in order to preserve the subtle informative features that would be submerged if severe smoothing were applied to spectra individually. The prior used places low prior variance on high frequency wavelet coefficients, but also allows correlation between the wavelet coefficients of time adjacent spectra. Consequently, recurrent high frequency feature avoid the effects of over smoothing. The resulting Bayesian shrinkage estimate is used as a signal enhancement algorithm for the collection of near infrared spectra. An automatic procedure for averaging out the hyperparameters is also proposed.
Joint work with Don Barry, Norma Coffey and John Paul Breen

Alexander Meister
Universität Ulm

Deconvolution from non-standard error densities

Deconvolution problems occur in many fields of nonparametric statistics, e.g. estimation of densities or regression curves under measurement error and image deblurring. Research has mainly focused on two classes of error densities, namely ordinary smooth and supersmooth densities, where in both settings the corresponding Fourier transform is assumed to vanish nowhere and to decay about monotonously. On the other hand, there are important error densities which do not satisfy these conditions but their Fourier trans-forms rather have some zeros and show oscillatory behaviour. Therefore, in my talk, new estimation procedures are introduced to handle deconvolution from those rarely-studied error densities. The underlying minimax theory is derived in various of settings and applications are discussed.

Juhyun Park
University of Lancaster

Curve alignment and FPCA

When dealing with multiple curves as functional data, it is a common practice to apply functional PCA to summarise and characterise random variation in finite dimension. With proven usefulness in practice, its statistical properties are also well established. Often functional data however exhibits additional time variability that distorts the assumed common structure. This is recognized as the problem of curve registration and is routinely employed and considered as preprocessing step prior to any serious analysis. Consequently, the effect of alignments is mostly ignored

in subsequent analyses and is not well understood. We revisit the issue by particularly focusing on the effect of time variability on the FPCA and try to illustrate the phenomena from a borrowed perturbation viewpoint. This is very much working in progress and hopefully it will give us some insight into further analysis.

Poster Presentation

Katerina Aristodemou
Brunel University

Bayesian Quantile Regression for Errors in Variables Model

Carlo Pariset
University of New Castle

Inversion of Spectroscopic Measurements for Extracting Particle Size Distribution