11th Workshop on Quality Improvement Methods
at the HN hotel in Dortmund

Königswall 1. D-44137 Dortmund
tel.: (0231) 90550 fax.: (0 231) 9055900

ABSTRACTS

Monitoring the Coefficient of Variation using EWMA Charts

Philippe Castagliola, Université de Nantes

The coefficient of variation CV is a quality characteristic that has several applications in applied statistics and is receiving increasing at- tention in quality control. A few papers have proposed control charts that monitor this normalized measure of dispersion. This presentation suggests a new method to monitor the CV by means of two one-sided EWMA charts of the coe?cient of variation squared γ^2. Tables are provided for the statistical properties of the EWMA- γ^2 when the shift size is deterministic or unknown. An example illustrates the use of these charts on real data gathered from a manufacturing process.

Statistical analysis of damage evolution

Christine Müller, Technische Universität Dortmund

The surface damage evolution under stress is often analysed by images of long-distance microscopes. Usually hundreds of images are obtained during the fatigue process. To analyse this huge amount of images automatically, a new image tool implemented in R was developed. This new image tool allows the automatic detection of micro cracks and corresponding statistical analysis of crack quantities. It uses a shortest path algorithm to detect micro cracks in situations where the cracks are surrounded by plastic deformations and where a discrimination between cracks and plastic deformations is difficult. In a first step, crack clusters are detected as connected components of pixels with values below a given threshold value. Then the crack paths are determined by Dijkstra's algorithm as longest shortest paths through the darkest parts of the crack clusters. Linear parts of kinked paths can be identified with this. The new method was applied to over 2000 images. In particular several specific damage parameters can be calculated during the fatigue process. Some of these specific damage parameters are compared statistically with simple damage parameters using images of two specimens under different stress levels at different time points of the fatigue process. It is shown that the specific damage parameters discriminate between the two different damage evolutions in an earlier stage than the simple parameters. They are also less influenced by different brightness and scales of the images and show other desirable properties of a damage parameter.

Gunkel, C., Stepper, A., Müller, A.C., and Müller, Ch.H. (2012). Micro crack detection with Dijkstra's shortest path algorithm. Machine Vision and Applications 23, 589-601.

Müller, Ch.H., Gunkel, C., and Denecke, L. (2011). Statistical analysis of damage evolution with a new image tool. Fatigue & Fracture of Engineering Materials & Structures 34, 510-520.

Müller, Ch.H. (2011). Data depth for simple orthogonal regression with application to crack orientation. Metrika 74, 135-165.

Future job description for statisticians in industry

Ursula Garczarek, Unilever, Vlaardingen, The Netherlands

You analyse business problems and identify those where statistics will make the difference. You develop statistical solutions and strategies for those problems and sell them to the management of your company. You do provide your colleagues with easy-to-use tools and training to plan, process, and analyse experiments, or implement statistical process control. For complex questions and in cases of problems you provide your colleagues with statistical support.

Statisticians in industry have and will always be under pressure to justify their existence. Pressure varies in strength, depending on the ups and downs of the economy, and also dependent on waves of fashion around outsourcing or in-sourcing. I assume in the following that those factors are predominantly uncontrollable for the statistical community of practice, forming the background on which statisticians do their work.

I want to discuss with you the factors that statisticians can influence to improve their true and perceived added value in industry: their own skills and capabilities. Which ones are most important and which ones can and should be addressed (better) in a statisticians' training at university?

A preliminary list is given below:

- Communication skills with management
- Business planning skills (budget, project, resources)
- Capability to identify and acquire high impact projects
- Data management skills
- Capabilities in business and problem understanding
- Software design and software development skills
- Programming skills
- Statistical consultancy skills
- Skills in didactic of statistics
- Statistical knowledge

Towards Timbre-controlled Reconstruction of Music Signals in the CQT Domain

Anil Nagatil (Ruhr-Universität Bochum)

Titel

Oliver Melsheimer

Improved Split-Plot and Multi-Stratum Designs

Steven Gilmour, University of Southampton

Many industrial experiments involve some factors whose levels are harder to set than others. The best way to deal with these is to plan the experiment carefully as a split-plot, or more generally a multi-stratum, design. Several different approaches for constructing split-plot type response surface designs have been proposed in the literature in the last 10 years or so, which has allowed experimenters to make better use of their resources by using more efficient designs than the classical balanced ones. One of these approaches, the stratum-by-stratum strategy, has been shown to produce designs that are less efficient than locally D-optimal designs. An improved stratum-by-stratum algorithm is given, which, though more computationally intensive than the old one, makes most use of the advantages of this approach, i.e. it can be used for any structure and does not depend on prior estimates of the variance components. This is shown to be almost as good as the locally optimal designs in terms of their own criteria and more robust across a range of criteria.

Ranking criteria for mixed level orthogonal arrays

Ulrike Grömping, Beuth University of Applied Sciences, Berlin

Mixed level (or asymmetric) orthogonal arrays are more difficult to handle than fixed level (or symmetric) ones, as there is no obvious fair way to treat factors with different numbers of levels in a comparable way. Xu and Wu (2001) introduced Generalized Minimum Aberration (GMA), which is a natural extension of minimum aberration (MA). The latter - together with resolution - is a concept well-known even to the community of experimentation practitioners for regular 2-level fractional factorial designs. GMA has been refined into absolute (Xu and Wu 2004) or relative (Grömping 2011) projection aberration, which breaks down overall indication of confounding into contributions by various projections, e.g. the overall number of length 3 words into contributions from all triples of experimental factors. Neither approach takes care of the request by Wu and Zhang (1993) to differentiate different types of words in mixed level designs. While it has been argued that such differentiation is not needed (e.g. Ankenman 1999), there is nevertheless a notable difference in the worst possible confounding for a 2-level factor in a triple of 2-level factors and a 4-level factor that comes in a triple with two 2-level factors. Wu and Zhang's (1993) approach to resolving this issue, while voicing an understandable concern, leads to substantial complications and does not easily generalize to situations for factors at numbers of levels other than 2 and 4. This talk explores the pros and cons of different views and looks for the workshop's feedback on appropriate ways to measure suitability of a design for screening. It makes ample use of visualizing design projections with mosaic plots (Hartigan and Kleiner 1981, 1984), which the author believes to be a very useful tool for visualizing orthogonal array projections.

Ankenman, B. E. (1999). Design of Experiments with Two-Level and Four-Level Factors, Journal of Quality Technology 31, 368-375.

Grömping, U. (2011). Relative projection frequency tables for orthogonal arrays. Report 1/2011, Reports in Mathematics, Physics and Chemistry, Department II, Beuth University of Applied Sciences Berlin.

Hartigan, J. A., and Kleiner, B. (1981). Mosaics for contingency tables. In W. F. Eddy (Ed.), Computer Science and Statistics: Proceedings of the 13th Symposium on the Interface. New York: Springer-Verlag. Hartigan, J.A., and Kleiner, B. (1984). A mosaic of television ratings. The American Statistician 38, 32-35.

Xu, H. and Wu, C. F. J. (2001). Generalized minimum aberration for asymmetrical fractional factorial designs. Annals of Statistics, 29, 1066-1077.

Wu C.F.J. and Zhang R.C. (1993). Minimum aberration designs with two-level and four-level factors. Biometrika 80, 203-209.

Optimal designs for clinical trials with active control

Christine Kiss, Ruhr-Universität Bochum

Dose finding studies often compare several doses of a new compound with a marketed standard treatment as an active control. In the past, however, research has focused mostly on experimental designs for placebo-controlled dose finding studies. To the best of our knowledge, optimal designs for dose finding studies with an active control have not been considered so far. As the statistical analysis for an active controlled dose finding study can be formulated in terms of a mixture of two regression models, the related design problem is different to what has been investigated before in the literature. We present a rigorous approach to the problem of determining optimal designs for estimating the smallest dose achieving the same treatment effect as the active control. We determine explicitly the locally optimal designs for a broad class of models employed in such studies. We also discuss robust design strategies and determine related Bayesian and standardized minimax optimal designs. We illustrate the results by investigating alternative designs for a special clinical trial.

A clustering algorithm for functional data spatially connected

Elvira Romano, Università degli Studi di Napoli 'Federico II', Italy

A Clustering method for functional data when they are spatially connected is presented. The method is based on a dynamic clustering algorithm which both optimizes a criterion of representation and allocation taking into account the spatial connectivity between curves. The syntheses of each cluster are expressed by variogram functions for functional data, while clusters are groups of curves spatially correlated. The approach can be applied to any type of study where data are many curves spatially connected. Different simulations studies are discussed according to four main spatial functional variability structures. An application on a real datasets is illustrated.

Benchmarking Continuous Optimizers

Dimo Brockhoff, INRIA Lille - Nord Europe

Numerical optimization problems of the form minimize "minimize $f : \mathbb{R}^d \to \mathbb{R}^k$" with $d, k \geq 1$ occur frequently in practice. If the objective function f is non-differentiable, non-convex, multi-modal, noisy, or too complex to be mathematically tractable, the optimization problem can be approached with so-called black box algorithms that interpret the problem as a black box with the function values of some query points as the only available information. Due to the importance of such black box problems, nowadays many optimization algorithms are available and the main difficulty when facing a new optimization problem in practice is to choose which algorithm to apply. Benchmarking optimization algorithms is a possible way to assist in this decision of which algorithm to use in which context if the suite of benchmark problems is well-chosen with respect to the various difficulties one faces in practical applications. The main aspect of benchmarking should thereby be, from my-point-of-view, to improve our *understanding* of the algorithms and their concepts rather than choosing an overall *winner*.

In this talk, I am going to present an overview of the state-of-the-art in benchmarking continuous black box optimization algorithms, with a particular focus on the COmparing Continuous Optimizers platform (COCO), its fundamental research concepts, and some interesting research outcomes about numerical single-objective ($k = 1$) black box optimizers. In the end of the talk, I will mention future plans to extend COCO towards constrained, expensive, large-scale, and in particular multiobjective ($k \geq 2$) optimization and present the most challenging research questions for the latter in more detail.