12th Workshop on Quality Improvement Methods
at the NH hotel in Dortmund

Königswall 1. D-44137 Dortmund
tel.: +49.231.90550 fax.: +49.231.9055900

ABSTRACTS

Design of Progressively Censored Experiments

Marco Burkschat, Otto-von-Guericke-University Magdeburg

In a progressively Type-II censored life-testing experiment, after every failure of a unit a fixed number of active units can be withdrawn from the test. Such progressive censoring may be applied for the purpose of planning a life test in the sense of experimental design. The flexibility gained by considering different censoring schemes may be exploited in order to improve the outcome of the experiment with respect to a given optimality criterion. In the talk, some recent results for several criteria are given.

Significance tests in parameter designs

Ying Chen, Shanghai University of Finance and Economics

In parameter designs, experimental factors that affect the variance as well as those that affect the mean are studied by statistical experimental designs. The original analysis methods proposed by Taguchi are powerless in discovering the significance of the effects in parameter designs. In fact, we need meaningful ways of detecting signals in noise such as significance tests to catalyze the creativity of engineers and scientists. In this paper, we will apply some test methods to the significance tests in parameter designs. Some examples will be given for the illustration.

Optimal designs for the prediction of individual effects in random coefficient regression models

Maryna Prus, Otto-von-Guericke-University Magdeburg

Random coefficient regression models attract an increasing popularity in many fields of application, especially in biosciences. Besides the estimation of population parameters describing the mean behavior across all individuals a prediction of the individual responses or the individual deviations from the population means may be of interest, the latter for example in selection studies in animal breeding.
The problem of optimal designs for the estimation of the mean population parameters in these models has been extensively considered and many analytical and practical results are available in the literature. For the prediction of the individual responses the theory developed by Gladitz and Pilz (1982) is commonly used, requires however the prior knowledge of the population parameters.
Here we develop the theory and solutions for prediction of individual responses and individual deviations for the practical relevant situation of unknown population parameters. The optimal designs for the individual responses differ from the Bayesian designs proposed in the literature, but the Bayesian designs remain optimal if only the individual deviations are of interest (see Prus and Schwabe, 2011). If the dispersion matrix of the random effects is singular, the optimal designs in the reduced model, where the fixed individual effects are absent, are found to be optimal for the prediction of the individual deviations. However, it has to be emphasized that the latter statement does not hold for the prediction of the individual responses themselves. We illustrate the theoretical results obtained by a simple example.

Exponential Smoothing with Covariates with Application on Electricity Load Forecasting

Kristina Lurz, University of Würzburg

For long, exponential smoothing (ES) was considered rather a heuristic forecast- ing technique without a precise model foundation which guarantees optimality. In 1997, Ord et al. provided the basis for a solid model framework by formulating the single source of error (SSOE) state space scheme, which allowed to demonstrate the optimality of the classical ES predictors. By introducing an additive term de- pending linearly on exogeneous variables into the observation equation of the SSOE model, Wang (2006) developed the method of exponential smoothing with covari- ates (ESCov). The present study considers extensions and variants of ESCov in the following respects: i) the way of including covariates, ii) multiple seasonalities, iii) prediction intervals. The models are applied to Italian electricity load data with the objective of forecasting the load under the use of covariates, in particular meteorological information.

Voice and Affect Dimensions: A Multimodal Approach to Predictive Modeling

Pauline Mouawad, Université Bordeaux

The understanding that music expresses emotions is widely accepted and numerous studies investigate the role of musical dimensions with the perceived emotion of a musical piece. Various computational models are developed to predict music's emotional expressivity from the musical dimensions in a monomodal approach, while other models integrate the multimodal approach to music emotion recognition (MER). The latter is preferred over the former in that it contributes positively to the emotion prediction accuracy and improves the general performance of a MER system. The multimodal approach incorporates the study of music genre, lyrics, or voice in addition to the structural musical dimensions such as rhythm, tempo or melody. Research on the perception of emotion from voice has been addressed, however it mainly focused on speech and research on the singing voice is still in its early stages. From a multimodal perspective, this research investigates first, the role of the singing voice features in the perception of emotion as well as the degree of predictability of those emotions, and second it examines the combined effect of the vocal features with rhythmic features on the perception of emotion from singing. This issue grounded on the interdisciplinary field of affective computing that spans computer sciences, psychology and cognitive sciences, motivates this research. To address the first part, an experiment is made where participants are asked to annotate short audio clips of a singing voice without music or lyrics, according to four emotional dimensions. Details of the experiment and preliminary results are discussed and debated during the presentation. Applications to this research are wide and include improvisational affective music therapy, automatic affective classification of a singer's voice, and affective singing synthesis.

Pedestrian Dynamics: Experiments, Measurements and Modeling

Mohcine Chraibi, Research Centre Jülich

Pedestrian dynamics can be defined as the study of properties and characteristics emerging from the collective motion of pedestrians. In everyday life a pedestrian moves in space freely without any restrictions from his environment. However, up the time where a pedestrian enters a building or an area where in the same time other pedestrians reside, this "freedom" of movement becomes manifestly restricted. In such cases security concerns rise and necessitate thoroughly understanding of the dynamics. In the past several aspects of pedestrian dynamics were investigated e.g., analysis of design issues of facilities in urban areas, evacuation planning, computer animation and computer vision [1]. Independently of the investigated issue the central concern is how accurate and realistic the modeling of pedestrian dynamics is. The first part of the presentation gives a brief overview of different experiments performed under laboratory conditions and measurement methods providing results on an individual scale. In the second part the goodness of force-based models of pedestrian dynamics is discussed. Having the quantitative validation of mathematical models in focus principle questions will be addressed throughout the presentation: Is it manageable to describe pedestrian dynamics solely with the equations of motion derived from the Newtonian dynamics? Another important issue is the geometrical representation of modeled pedestrians. Does the geometrical shape of a two dimensional projection of the human body matter when modeling pedestrian movement? If yes which form is most suitable? This point is investigated in the third part while introducing the Generalized Centrifugal Force Model (GCFM) [2]. Moreover, we highlight a frequently underestimated aspect in force-based modeling which is to what extent the steering of pedestrians influences their dynamics? Finally, validation and verification of the GCFM is demonstrated by means of several simulations in different geometrical scenarios.

References

[1] Andreas Schadschneider and Armin Seyfried. Modeling pedestrian dynamics - from experiment to theory and back. In *Traffic and Granular Flow '09*, 2009.

[2] Mohcine Chraibi, Armin Seyfried, and Andreas Schadschneider. The generalized centrifugal force model for pedestrian dynamics. *Phys. Rev. E*, 82:046111, 2010.

The Double Sampling S^2 Chart with Estimated Process Variance

Philippe Castagliola, Université de Nantes

This presentation introduces the DS (Double Sampling) S^2 chart and investigates the properties of the DS S^2 chart with *estimated* process variance, in terms of the ARL (Average Run Length), the $SDRL$ (Standard-Deviation of the Run Length) and the ASS (Average Sample Size), providing a numerical comparison with the *known* process variance case. It also provides constraints on the chart parameters in order to systematically design the DS S^2 chart both with *known* and *estimated* process variance. Two optimal design procedures with estimated process variance are presented, for (a) minimizing the out-of-control ARL and (b) minimizing the out-of-control ASS. An extensive numerical comparison is provided in order to a) show how different are the ARL, $SDRL$ and ASS in the *known* v.s. *estimated* process variance case, for both the in-control and out-of-control situations, b) warn the reader about the actual number of Phase I samples required, c) propose alternative chart parameters taking the practical number of Phase I samples into account.

Adaptive control chart with Time Varying control limits based on online classification methods for data streams

Dhouha Mejri, University of Tunis

In recent years, advances in hardware technology have witnessed new ways of collecting data continuously. In most of statistical process control applications, such as traffic monitoring, data are growing overtime which is referred to us data streams. In this context, many data mining methods such as classification, clustering, pattern mining are considered to be more sophisticated. Classification methods designed to monitor incremental data with concept drift are among these topics. In this paper, we propose the integration of Dynamic Weighted Majority-Winnow (DWM-WIN) of [1], an online classification ensemble method for changing environment, to asses a time varying control limit for an adaptive control chart. This method integrates an improved version of DWM of [2] by considering expert's age in the ensemble as well as the contribution of good experts in the learning process into the new control chart. Experiments are based on a normal process with known standard deviation where the aim is mean shift identification. Control limits are adjusted each time a new concept drift is detected. We show that a quick detection of initial out-of-control condition can be achieved by using time adjusting control limit and that the integration of DWM-WIN improves the control chart effectiveness in terms of Average Run Length.

References:

[1] Mejri, D., Khanchel, R., Limam, M. : "An ensemble method for concept drift in nonstationary environment", Journal of Statistical Computation and Simulation, vol. 82, 2012, p. 1-14.

[2] Kolter, Z., J. and Maloof, M., A., (2007) "Dynamic weighted majority : An ensemble Method for Drifting Concepts", Journal of Machine Learning Research, vol.8,(13), p. 2755-2790.

Process Monitoring with Multivariate Cross- and Autocorrelated Data

Murat Kulahci, Technical University of Denmark

As sensor and computer technology continues to improve, it is not unusual that data collected from a system/process involve multiple variables. As in many areas of industrial statistics, this brings forth various challenges in statistical process control and monitoring. In many continuous processes such as chemical and pharmaceutical processes, the high dimensional data often exhibit not only cross-correlation among the variables of interest but also serial dependence as a consequence of high sampling frequency and system dynamics. In practice, the most common method of monitoring multivariate data is the so-called the Hotelling's T2 control chart. Also for high dimensional data with excessive amount of cross correlation, practitioners are often recommended to use latent structures methods such as Principal Component Analysis and monitor the handful of important principal components rather than the original variables. In this paper, we discuss the effect of autocorrelation (when it is ignored) on multivariate control charts based on these methods and provide some practical suggestions to overcome this problem.

The ideal profile analysis: from the formulation to the optimization of skin creams

Sébastien Lê, Agrocampus Ouest

The Ideal Profile Method (IPM) is a descriptive analysis in which consumers are asked to rate products on both their perceived and ideal intensities on a list of attributes. In addition, overall liking is asked. At the end of the test, each consumer provides a sensory profile of the products, hedonic ratings and the ideal profile. From a theoretical point of view this information is of utmost importance as it is used to formulate an ideal product. Still lots of things are asked to the consumers and the information is fragile. Does such methodology work in practice? Eight skin creams were created varying in four main factors: the quantity of coemulsifier MF and VE, and the quantity and nature of the vegetal oil used. Seventy two women tested them according to the IPM, and rated the products on 13 attributes. After performing the Ideal Profile Analysis (IPA) consisting in checking for the consistency of the ideal data and guide on improvement, two "ideal products" were estimated and created. These two newly developed creams were tested with six of the eight original products using the same methodology. This second test showed that the optimization procedure worked well since the two newly developed products were rated higher on liking than the original products.

Some new (open source) sensometrics analysis tools

Per Brockhoff, Technical University of Denmark

Sensory analysis is used as a tool for quality control as well as for product development in both food and non-food industries. In this talk some of the sensometrics methodological development carried out in our group will be presented by presenting some of the open source software tools that we recently have made available. This will include the R-packages sensR, ordinal and lmerTest and the stand alone tools PanelCheck (www.panelcheck.com) and ConsumerCheck (available from 2014). PanelCheck, ConsumerCheck and the R-package sensR are specifically designed to deal with sensory and consumer data, whereas the R-packages ordinal and lmerTest are for generel purpose statistical use. Especially the benefits of combining "statistical" and "Thurstonian" modelling provided by the R-packages sensR and ordinal will be illustrated.

References:

Brockhoff, P.B. and Christensen, R.H.B. (2010). Thurstonian models for sensory discrimination tests as generalized linear models. Food Quality and Preference 21(3), 330-338.

Christensen, R. H. B. (2012). ordinal—Regression Models for Ordinal Data R package version 2012.01-19 http://www.cran.r-project.org/package=ordinal/.

Christensen, R.H.B. and P.B.Brockhoff (2011). sensR—An R-package for sensory discrimination package version 1.2.10 http://www.cran.r-project.org/package=sensR/.

Christensen, R.H.B. Cleaver, G. and Brockhoff, P.B. (2011). Statistical and Thurstonian models for the A-not A protocol with and without sureness, Food Quality and Preference, 22(6), 542-54.

Christensen, R. H. B., H.-S. Lee and P. B. Brockhoff (2012). Estimation of the Thurstonian model for the 2-AC protocol. Food Quality and Preference. 24(1), 119-128

Alexandra Kuznetsova, Per Bruun Brockhoff and Rune Haubo Bojesen Christensen (2012). lmerTest: Tests for random and fixed effects for linear mixed effect models (lmer objects of lme4 package). R package version 1.0-2. http://www.cran.r-project.org/package=lmerTest/.

T. Næs, P.B. Brockhoff and O. Tomic, (2010). Statistics for Sensory and Consumer Science, John Wiley & Sons

PanelCheck, Open source software for sensory profile data, www.panelcheck.com