Poster session I (Thursday)

Burden Of Disease, Health Status And Clinical Trials. A Statistical Overview

Grace Maria Antony, Clinical research

Abstract: Statistics play a major role in compiling the information on mapping of disease prevalence and health status of various regions of the globe. Various international agencies and the government departments are gathering the data based on national level studies. Many a times the relevant information for different time points may not be available for comparison purpose. The clinical trials are conducted all over the world on different drugs. The bases of conducting these trials in different geographical regions are depending on various factors. World health organization has produced number of reports on the burden of mortality and morbidity of various regions and countries. It is interesting to study the scenario globally about the burden of disease and the conduct of clinical trials for improving the health status of the population.

The data available on the burden of diseases from various reports are studied in detail. The clinical trials scenario is also studied as per the number of trials registered on specific therapeutic areas. We will discuss how the statistical knowledge can be utilized to for planning and conducting clinical trials by the industry. Challenges and issues are identified and will be discussed. The association of disease prevalence and the health situation globally in relation to clinical trials will be presented. The importance of outcome research of clinical trials also will be discussed.

Row-column designs good for many purposes

R. A. Bailey, Queen Mary, University of London

Abstract: Large agricultural trials often take place in rectangular layouts. There is usually expected to be some spatial variation, but it is not known in advance whether this is chiefly variation between rows, between columns, or some autoregressive process, or a combination of all three. I have developed some row column designs that are good for this situation. A bonus is that they are also good for several other purposes.

Optimal supersaturated designs

Ashish Das, Indian Institute of Technology Bombay, Mumbai, India

Abstract: A popular measure to assess 2-level supersaturated designs is the $E(s^2)$ criterion. We consider 2-level supersaturated designs with even as well as odd number of runs which have minimum $E(s^2)$. Improved or more explicit lower bounds on $E(s^2)$ are used to show optimality properties of supersaturated designs. Conditions for supersaturated designs which attain the lower bounds are given. Hadamard matrices and finite fields are used for constructing $E(s^2)$-optimal supersaturated designs. The lower bound is improved when the number of factors is large, and designs attaining the improved bounds are constructed by using the complements of designs with small number of factors. We give a method to

construct $E(s^2)$–optimal supersaturated designs with odd number of runs from $E(s^2)$ –optimal supersaturated designs with even number of runs by deleting a run. We also discuss optimal supersaturated designs for s^m experiments with number of runs not a multiple of s.

Bayesian Data Analysis for Ordinal Data

Fanglong Dong, University of Missouri-Kansas City

Abstract: Bayesian statistics is an important part of statistics and it provide another angle of statistics. Ordinal data are every common in daily life such as the student's grade. We can easily fit a logistic regression model on this type of data, however, we are not sure how to define residual from a frequentist's perspective thus we are unable to detect outlier. Recent research try to solve this problem but not perfectly solved because the dimension of the estimated probabilities falling in every category form a vector. We try to look at this question from a Bayesian perspective by using the idea of latent variable. With the help of latent variable, we can successfully detect outlier. I will talk briefly about the idea of Bayesian thinking and how can we apply Bayesian statistics to ordinal data analysis.

Evolutionary Markov Chain Monte Carlo Algorithms for Expected Utility Maximization

Ramiro Ruiz[1], **Marco A. R. Ferreira[2]** and Alexandra M. Schmidt[3]

1 Universidade Federal de Minas Gerais, Brazil

2University of Missouri - Columbia, USA

3Universidade Federal do Rio de Janeiro, Brazil

Abstract: We propose an evolutionary Markov chain Monte Carlo (EMCMC) framework for expected utility maximization. This is particularly useful when the optimal decision cannot be obtained analytically, as in problems of Bayesian estimation and optimal design with non-standard utility functions. In those situations, two main tasks have to be performed numerically: calculation of the expected utility and maximization over the decision space. Muller and coauthors have developed a clever simulation based framework for Bayesian optimal design blending MCMC with simulated annealing. Nevertheless, their approach has difficulties with the exploration of highly multimodal decision spaces. Building upon their work, we develop an algorithm that simulates a population of Markov chains, each having its own temperature. The different temperatures allow hotter chains to easily cross valleys and colder chains to rapidly climb hills. The population evolves according to genetic operators such as mutation and crossover, allowing the chains to explore the decision space both locally and globally through information exchange among chains. As a result, our framework explores the decision space very effectively. To illustrate our methodology, we perform optimal design of a network of monitoring stations for ground-level ozone.

Distribution of Cotton Fiber Lengths

Linxiong Li and Rachid Belmasrour, University of New Orleans

Abstract: Fiber length is one of the most important properties of cotton in marketing and yarn processing. In the past decades, cotton industry and researchers have been trying to develop efficient methods to measure the length of cotton. However, nearly all efforts were focused on the distribution of the projecting fiber length. Studies on the distribution of actual fiber lengths, due to, we believe, technical difficulties, have not been done successfully. Since knowing the distribution of the actual fiber length is of great practical interest, we in this study are trying to develop a method that estimates the distribution of the actual fiber length based on the observed projecting length. In particular, we have obtained two results: (1) We found the distribution of fiber lengths which is a mixture of two Weibull distributions, and (2) we used partial least squares regression to estimate the distribution of the actual fiber length based on that of the projecting fiber length. Calculations show that the method works well.

Optimal supersaturated designs under measures of multi-collinearity

C.J. Marley, D.C. Woods and S.M. Lewis, University of Southampton

Abstract: When performing industrial experiments there is often pressure to keep the number of runs to a minimum in order to reduce costs. To achieve this goal in screening a large number of factors, an experimenter may wish to use a supersaturated design, having more factors than runs, to determine those factors that have a substantial effect on the response of interest. Most existing criteria for generating or assessing supersaturated designs focus only on dependencies between pairs of factors. We propose a new class of criteria for supersaturated designs based on measures of multi-collinearity among subsets of the factors. The criteria are applied to the problem of assigning factors to columns of a given design for experiments where some prior information on factor effects is available. We also use the new criteria to generate designs for experiments where the factor levels cannot be set independently.

D-optimum designs for a dynamic model

Kieran Martin, Stefanie Biedermann, Sue Lewis and Dave Woods, University of Southampton

Abstract: Models derived from differential equations occur frequently in the pharmaceutical industry. Optimal designs for these models are required to efficiently gather information for model fitting. Finding such designs can be problematic: the models will usually be non-linear, making the performance of the designs parameter-dependent, and the differential equations may not have an analytical solution. An example is investigated, and an equivalence theorem is used to show that the designs obtained are D-optimal. Pseudo-Bayesian designs are found, under the constraint that consecutive observations must be at least a specified time apart. A D-optimal design is found for the case where the differential equations are not analytically solvable.

Sparse Sampling Designs in Quadratic Regression With Random Effects

Tobias Mielke, Otto-von-Guericke-University Magdeburg

Abstract: In mixed effect models the variability of the regression parameters has substantial influence on the choice of optimal designs. If less observations per individual are possible than parameters are to be estimated, the individual information matrices will be singular and with this reliable estimates of the individual parameters in general cannot be found. Nevertheless estimation of the population location parameters may still be possible taking the structure of the random coefficients into account. In this poster we will show and discuss some results on designs minimizing the maximal variance of the population parameter estimates for the case of quadratic regression with random effects.

Efficient modelling of microbial growth

Farinaz Monadjemi, Campden BRI, United Kingdom

Abstract: The growth of microorganisms in foods causes both spoilage and food poisoning. The growth

has been mathematically modelled to inform product and process development, and risk assessment and control. Models are usually divided into two kinds (Whiting and Buchanan,1993):

- 'Primary' models of growth vs. time under constant conditions; *y = Prim(time;pars).* Primary models are usually non-linear and sigmoidal (e.g. Gompertz)
- 'Secondary' models introduce dependence on conditions (e.g. temperature) by making primary model parameters functions of conditions; **pars = Sec(conds;coeffs).** Secondary models are usually quite simple, and often linear (e.g. quadratic response surface)
- Primary and secondary models are normally expressed and fitted separately in a 2-stage approach:
- *{y, time}* data is fitted to the primary model for several different sets of constant conditions, to give corresponding parameter values.
- The resulting **{pars, conds}** data set is fitted to the secondary models to give the coefficients.

Although relatively simple practically this approach has inefficiencies and problems. We illustrate these problems through real examples, and present an alternative 1-stage approach. The real objective is a 'compound' model of growth as a function of time and conditions, *y = Comp(time,**conds,coeffs**)* which can be directly fitted to a data set *{y, time, **conds**}* to deduce coefficients directly. The approach is illustrated on a single data set (organism and set of conditions) with a single choice of primary and secondary models. However, the implementation (in 'R') is not so limited, providing a wide range of primary and secondary models which can be combined arbitrarily. The approach has been applied to many different data sets, resulting in a wide range of predictive models.

Min-Max Robust Parameter Design

Siuli Mukhopadhyay and Debraj Chakraborty**,** Indian Institute of Technology Bombay, India

Abstract: Conventionally the robust parameter design approach aims at finding the control settings that limits/minimizes product variability due to uncontrollable noise factors. It is argued in this article, that in many safety and quality critical processes, control settings should instead be chosen to maximally improve the worst product quality that could possibly result due to presence of noise and disturbances. Such a choice of the control variable guarantees that the quality of each and every product is better than some guaranteed worst quality. Moreover, any other choice of the control variable results in a worse guaranteed quality. Using the single response surface approach of Myers, Khuri and Vining (1992), this objective is realized when the maximum possible deviation (caused by noise) of the estimated process response from the specified target value is minimized with respect to the control variables. Algorithms for computing the minimizing control settings are discussed and comparisons of this design paradigm with the methodology proposed in Myers, Khuri and Vining (1992) are illustrated using numerical examples.

Optimal and Efficient Crossover Designs Under Subject Dropout

Ozgu Issever Ozan, University of Georgia

Abstract: Optimal design choices for crossover experiments have been discussed widely in the literature. As in many types of experiments, there is a chance of subjects dropping out from a crossover trial before the completion of the study. This situation may lead to loss of considerable amount of information, especially if dropouts occur in early periods, and may make an optimal design choice inefficient. The studies in optimal design literature on this subject examine the effect of dropout in the final period on designs that are known to be optimal under one linear model that involve carryover effects when all observations are available (Low, Lewis, and Prescott, 1999; Majumdar, Dean, and Lewis, 2008). However, for a specified dropout probability, a non-optimal design may outperform an optimal design in the presence of dropouts. In this study, by incorporating the possibility of subjects dropping out in earlier periods, we propose an algorithm that searches for optimal or efficient crossover designs under subject dropout for various models adjusting for the carryover effects.

Row-Wise Complementary Designs

Chien-Yu Peng and Shao-Wei Cheng, Academia Sinica and National Tsing-Hua University, Taiwan

Abstract: The technique of (columnwise) complementary designs, proposed independently by Chen and Hedayat (1996) and Tang and Wu (1996), is powerful for characterizing designs with a large number of factors. In this work, we extend the idea and propose rowwise complementary designs which are particularly useful in handling designs with large run sizes. A pair of designs is mutually rowwise complementary of order r if they are row partition of a full factorial design with r replicates. Based on a polynomial representation approach for factorial designs called indicator function, we establish a series of relationships between a design and its rowwise complementary design, which includes isomorphism, orthogonality, generalized word length pattern, minimum aberration, moment aberration, and uniformity. In addition, we apply the technique of rowwise complementary design to identify minimum aberration

two-level designs with larger run sizes. The method can be generalized and applied to higher-level, mixed-level, blocked factorial designs, or columnwise complementary designs.

Very fast enumeration of orthogonal arrays

Eric D. Schoen and Pieter T. Eendebak**,** TNO Science & Industry and U. of Antwerp

Abstract: We specify an algorithm to enumerate a minimum complete set of combinatorially non-isomorphic orthogonal arrays of given strength t, run-size N, and level-numbers of the factors. We implemented the algorithm in a C program. For t = 2, we obtained all mixed-level series with N≤28, and all pure-level series with N≤27. In addition, we obtained all OA(28; 2^a; 2) for a≤ 7. For t = 3, we obtained all series with N≤64, excepting the pure two-level series with N = 56 and N = 64, and OA(64; $4^1 2^a$). For t = 4 we enumerated all series with N≤162. We discuss the cases for which the algorithm is expected to return complete sets in a reasonable amount of time.

Methods of estimation of sensitivity indices --a review and comparison

Josh Svenson, The Ohio State University

Abstract: Sensitivity indices are used for measuring the effects of input variables on the output response of a deterministic computer model. The first-order sensitivity index of an input variable is the variance of the expected value of the response over the range of the input variable. Higher order sensitivity indices can also be calculated. Since the response is unknown over the input space, these indices need to be estimated. Methods for estimation are reviewed and compared, including (i) averages of responses obtained according to a prescribed sampling scheme, and (ii) numerical integration of predicted responses over the space, where the predictions arise from a Bayesian or non-Bayesian stochastic process model.

On de la Garza Phenomenon

Min Yang, University of Missouri

Abstract: Deriving optimal designs for nonlinear models is a challenging task. The crucial step is to determine number of support points needed. The celebrated de la Garza Phenomenon states that under a (p-1)th-degree degrees polynomial regression model, any optimal design can be based on at most p design points, the number of parameters in the model. This makes it relatively easy to derive a specific optimal design, analytically or numerically. Does this phenomenon also exist for other nonlinear models? A novel approach is developed to address this. With this new approach, it can be easily shown that such phenomenon exists for many commonly studied nonlinear models, such as Emax model, exponential model, three and four parameters log-linear models, Emax-PK1 model, as well as many classical polynomial regression models. This approach unifies and extends many well-known results in optimal design literature. It has three advantages: (i) it can be applied on any design region; (ii) it can be applied for multiple-stage optimal design; and (iii) conditions are mild and can be easily checked.

Optimal Crossover Designs for Comparing Test Treatments to a Control Treatment When Subject Effects are Random

Wei Zheng, University of Illinois at Chicago

Abstract: The statistical optimality and efficiency of crossover designs for the purpose of comparing several test treatments with a control treatment when the subject effects are random depend heavily on the unknown ratio □ of the variance of subject effects and the error variance. However, it is proved that if the class of competing designs contains a totally balanced test control incomplete crossover designs (TBTCI), as defined by Hedayat and Yang (2005), then this TBTCI design is simultaneously A- and MV-optimal for all values of □ This result is essentially a generalization of a result in Hedayat and Yang (2005) since their statistical model is based on fixed subject effects, where the Fisher information matrix would be identical to that of random subject effect model when □ goes to infinity. Partial works on the construction of the designs are carried out.

Poster session II (Friday)

Optimal and Sequential Design for Bridge Regression

S.B. Carnaby and D.C. Woods**,** University of Southampton

Abstract: Bridge regression is a family of coefficient shrinkage methods, including ridge regression and the lasso as special cases that perform continuous subset selection. They can provide lower prediction error than ordinary least squares through trading variance for bias and can alleviate problems of multicollinearity. Bridge regression minimises the residual sum of squares subject to the constraint $\sum |\beta_j|^{\gamma} \le t$, where β_j are the regression coefficients (j = 1, . . . , p), with $\gamma \ge 1$. This constraint allows more predictors than runs to be considered. Using the correspondence between the Bridge penalty and the prior density in Bayesian regression, D-optimal designs for these models are developed and investigated. A particular focus is lasso regression. The improvement of these designs through sequential experimentation is explored, with subsequent selection of design points that exhibit the highest prediction variance or mean squared error, where these quantities are approximated using the bootstrap. The methods are applied to an example from organic chemistry where the melting point temperature of a compound, fundamental in the design and development of chemicals with desired thermophysical behaviour, may depend on any of a number of variables related to molecular and crystal structure.

Bayesian Adaptive Design for State-space Models with Covariates

A.N. Dolia, S.M. Lewis, S.K. Sahu, D.C. Woods, University of Southampton

Abstract: Modelling data that change over space and time is important in many areas, such as environmental monitoring of air and noise pollution using a sensor network over a long period of time. Often such data are collected dynamically together with a variety of related variables. Due to resource limitations, an optimal choice (or design) for the locations of the sensors is essential for achieving accurate predictions. This choice depends on the adopted model, that is, the spatial and temporal processes, and the dependence of the responses on relevant covariates. We investigate adaptive designs for state-space models where the selection of locations at time point tn+1 draws on information gained from observations made at the locations sampled at preceding time points t1; :::; tn. A Bayesian design selection criterion is developed and its performance evaluated using several examples.

Comparison of Screening Methods in the Presence of Interactions

Danel Dragulji□[(1)], joint work with Dave Woods[(2)], Sue Lewis[(2)], and Angela Dean[(1)]

[(1)] *The Ohio State University*

[(2)] *University of Southampton, UK*

Abstract: When designing an experiment which involves a large number of factors, conventional fractional factorial designs may be economically infeasible due to the number of runs required for estimation of all the effects of interest. One way of handling such an experiment is to perform a "screening experiment" followed later by a conventional experiment on a subset of the factors. The goal of a screening experiment is to sift through all effects of interest and to identify the few effects that influence the response in a substantial way. An effective tool in a screening experiment is a supersaturated design; that is, a design which contains fewer runs than number of effects to be estimated. The design and analysis of supersaturated designs is an area which has received an extensive amount of research. This discussion will briefly describe cyclic methods of construction of supersaturated designs and present and compare the associated analysis methods proposed in the literature. In addition, a two-stage group screening method will be included in the comparison. The comparison is carried out through an extensive test of the ability of different methods to identify correctly the significant effects under a range of scenarios.

Weighted space-filling designs for dependent variables with application to deterministic computer codes

M. Feddag, D. Woods and V. Bowmany, University of Southampton, UK

Abstract: In order to explore and understand computationally expensive computer models, experiments are often performed where the treatments are combinations of values of the input variables and the responses are deterministic outputs from the computer code. The designs used are often chosen to cover, or space-fill, the design region of possible input values. Many of these space-filling designs, such as computer-generated coverage designs based on Euclidean distance; do not take into account

dependencies between variables which often exist in applications. Further, these dependencies may result in substantial areas of the design region which are of little relevance to the application, for example, where it is known that no response can occur. Standard space-filling techniques can therefore result in highly inefficient designs, in terms of the numbers of points in interesting regions of the design space.

This work is motivated by dispersion models, which typically have the following features:

- the input variables are usually of two types (meteorological and source), and can be quantitative or qualitative
- there is substantial prior information about the distribution of the input variables from, for example, empirical observations (meteorological) or expert prior knowledge (source)
- these distributions are not usually independent, either within type (for example, wind direction and speed is defined via a wind rose) or between type (wind direction and source location)
- the distributions define a joint probability density (or weight function) on the design region, which is likely to have substantial areas of low weight.

Methods of incorporating known dependencies between variables into design selection are investigated. Adaptations of computer-generated coverage designs are considered, accounting for dependencies between variables through redefining distance between two points, x1 and x2 ($\in$Rk), to include a weight function, or probability measure, w(x1; x2). The weight function is based upon a specified joint distribution for the k input variables, chosen to reflect application specific dependencies, and can also be used to define the Mahalanobis distance between x1 and x2. The methods can include quantitative and qualitative (ordered and unordered categorical) variables, and different types of prior information. We compare this approach with the use of Latin Hypercube designs, where the design points are chosen so that the values of each input variable will approximate the marginal distribution of that variable. The different approaches are demonstrated through interrogation of a computer model for atmospheric dispersion. Both the weighted space-filling and Latin Hypercube designs are critically compared with computationally expensive Monte Carlo techniques.

Springback behavior Prediction and Compensation of Aluminum Alloy Sheets in Bending, especially V-Bending operation

Vahid Ghomi, University Malaya

Abstract: In sheet metal stamping industry, bending has significant importance and the major problem is getting the sheet metal to conform exactly to the shape of the die. Bending is a method of forming shapes by stressing metal beyond its yield strength but below the ultimate strength. The springback, being one of the main defects associated with sheet metal bending operation should be taken into consideration in order to produce bent sheet metal parts within acceptable tolerance limits. The springback is influenced by various input process variables such as sheet thickness, bend radius, punch speed, dwell time, grain size, and the rolling direction of sheet metal. In the present study, the spring back behavior of aluminum sheet metals of different thickness in V-bending operation in rolling direction has been investigated for 600 and 900 bend. The most important input variables influencing springbck will be identified and some preventive measures will be suggested in order to reduce the springback. It is

expected that the study will reduce the process variability due to spring back after bending operation and reduce the product cost through minimization of the reworks which can be created by spring back.

DESIGNS FOR ESTIMATING THE EC_{50}

Seung Won Hyun, Nancy Flournoy and Min Yang, University of Missouri

Abstract: The EC50 is interesting feature to study when mean responses have a downturn at high doses. To estimate the EC50, researchers select doses in a design space that is restricted to be between a minimum dose and a estimated peak dose. If researchers are unaware of the downturn, the restriction is taken to be high in what is believed to be the plateau of a monotone response function. For a biologically motivated model that incorporates a downturn in the response function, we find the c-optimal design for the EC50. We also find c-optimal designs restricting upper limit of the design space to successively smaller percentages of peak dose distribution. The efficiencies of these restricted designs are displayed.

Equivalence of factorial designs with both qualitative and quantitative factors.

Tena Katsaounis, Ohio State University at Mansfield

Abstract: The problem of equivalence of factorial experiments with both qualitative and quantitative factors is considered. Two fractional factorial designs with qualitative and quantitative factors are said to be equivalent if one can be obtained from the other by reordering the runs, relabeling the factors of the same type, relabeling the levels of the qualitative factors and reversing the levels of the quantitative factors. A necessary and sufficient criterion for detecting equivalence or nonequivalence of such factorial designs is given. Some screening criteria of nonequivalence are suggested.

Optimal designs for multi-objective dose-ranging studies

S. Krishna Padmanabhan, Wyeth Research

Abstract: A dose-ranging study is a critical part of the drug development process before going on to large scale clinical trials. The design problem is to allocate subjects efficiently to the candidate doses, in order to maximize learning about the dose-response. We introduce new optimal designs for dose-ranging with a continuous efficacy endpoint. Our design incorporates aspects of both $D-$ and $c-$ optimality. This design is studied under the context of a flexible (Sigmoid $E_{\max}$) model for the mean of the efficacy response. We derive the Fisher Information Matrix and the optimality criteria. This design can be used when the goals of the study are characterization of dose response (akin to proof of concept), followed by identification of the ”correct” dose. We derive various optimal designs for a combination of these criteria for a variety of scenarios. We consider locally optimal designs for one criterion ($D-$ or $c-$), optimal compound design for both criteria and sequentially optimal (augmented) designs for the two criteria. The designs are compared on metrics such as D-efficiency, variance of the estimator of target dose etc. We show that, for the goals under consideration, the sequentially augmented design (Augmented $Dc-$optimal design) performs well. Simulations are shown with results comparing this design (run in an

adaptive fashion) to the parallel group approach.

Nested Latin hypercube designs

Peter Z. G. Qian, Department of Statistics, University of Wisconsin-Madison

Abstract: We propose an approach to constructing nested Latin hypercube designs. Such designs are useful for conducting multiple computer experiments with different levels of accuracy. A nested Latin hypercube design with two layers is defined to be a special Latin hyper-cube design that contains a smaller Latin hypercube design as a subset. Our method is easy to implement and can accommodate any number of factors. We also extend this method to construct nested Latin hypercube designs with more than two layers. Illustrative examples are given. Some statistical properties of the constructed designs are derived.

Fast Calibration of Complex Computer Models

Matthew Pratola, Simon Fraser University

Abstract: Computer models enable scientists to investigate real-world phenomena in a virtual laboratory using computer experiments. Recently, statistical calibration enabled scientists to incorporate field data. However, the practical application is hardly straightforward. For instance, large and non-stationary computer model output is not well addressed. We present a computationally efficient approach using a criterion that measures discrepancy between the computer model and field data. One can then construct empirical distributions for the parameters and perform sequential design. The strength of this approach is its simple computation using existing algorithms. Our method also provides good parameter estimates for large and non-stationary data.

Search Design in Tree Structure

Angshuman Sarkar, Visva-Bharati University, India.

Abstract: Practitioners in industrial experiments, involving a large number of factors, generally interested in identifying and estimating the effects among which most are negligible but some of them may be non-negligible besides estimating the effects about which it is certain that they are non-negligible. In this regard, considering the hierarchy of factorial effects Srivastava and Hveberg (1992) has observed a tree structure in the factorial effects when analyzing data arises from behavioral sciences. That is the non-negligibility of interactions F1F2 and F3F4 may implies the non-negligibility of $F_1F_2F_3$ or $F_1F_2F_4$ or $F_1F_3F_4$ or $F_2F_3F_4$ for a four factor experiment involving factors F_1, F_2, F_3 and F_4. Recently Chatterjee and Fang (2001) has constructed a plan capable of identifying and estimating one possible present two-factor and one three-factor interaction under tree structure, beside estimating all the main effects and general mean. In this work we at first propose a necessary and sufficient condition (under noiseless situation) for a plan which is capable of searching two non-negligible two-factor interactions and one three-factor interaction where the three factor interaction is derived from the possible present two-factor interactions. Then, we propose a search design to solve the above search and estimation problem. As the noiseless

case is not achievable in practice so we study the performance of the proposed plans in the presence of noise by calculating its probability of correct searching through simulation.

D-optimal Designs for a Probit Model of Efficacy and Toxicity

Xie Sun and Nancy Flournoy, University of Missouri

Abstract: We find D-optimal designs using a probit model of efficacy and toxicity. The model is derived from one used by Dragalin, Fedorov and Wu (2007). We examine the effects of adjusting the scale and location parameters of the model on the optimal design using grid searches. The optimality of each design is verified using General Equivalence Theorem and sensitivity functions are shown to validate the correctness of D-optimality designs.

Efficiencies of Reinforced BIB and Augmented Block Designs in Test Families vs Control Experiments

P. M. Wachira[1], F. Onyango[2] and E. Onginjo[1]

[1]Kenya Sugar Research Foundation, Kenya

[2]Maseno University, Kisumu Kenya

Abstract: The problem of comparing a set of more than one control to a set of test treatments in block design has received relatively little attention. This problem is more urgent in sugarcane breeding programmes where breeders have shifted from mass selection to family selection. This shift has created a need for efficient experimental designs to evaluate hybridized sugarcane families. In this study we hypothesize that reinforced balanced incomplete block design (RBIB) and augmented block design (ABD) are more efficient than randomized complete block designs (RCBD) in comparison of test families against a set of controls. ABD and RBIB designs have been proposed for test versus control experiments though their efficiencies in test families versus control experiments are not known.

To compare the efficiencies of ABD and RBIB we use five families and two controls with known, normally distributed yields. The required variables are presented by pseudo-random numbers generated through Monte-Carlo simulation framework. ABD and RBID designs are constructed and data fitted by inclusion of block effects and random errors. The fitted data is then subjected to analysis of variance for two way non-orthogonal data and duncan's multiple range procedure to test for test families versus control difference. The resultant difference is then compared to that generated by corresponding randomized complete block (RCBD) design using a two sample paired t-test. Finally, the design efficiencies are calculated using Fisher's approach.

The result shows that the expected relative efficiency for RIBD against RCBD is 3.58 while the expected relative efficiency for ABD against RCBD ranges from 1.50 to 12.00 depending on the error variance. In conclusion we note that the RBIB will be more efficiency when large intra-block variations are expected whereas ABD will be more efficient when materials for test families are scarce.

Optimal Blocked Semifoldover Designs

William Li[1] and **Po Yang[2],**

1.University of Minnesota

2.DePaul University

Abstract: Foldover designs have been in the literatures for many years, the new added runs are used to de-alias confounded effects. Semifoldover designs are partial foldover designs obtained by adding half of the new runs. It is known that, in many cases, a semifoldover design can de-alias as many main factors or two-factor interactions as the corresponding foldover design. Since, usually, the new runs are performed in a different time, we are interested in considering these designs when a block factor is included. In this article, we consider blocked semifoldover designs. We study when the block factor does not affect the results obtained when a block factor is not involved and when the block factor affect the results. The optimal blocked semifoldover designs are also tabulated. Moreover, given an original design, there are many semifoldover design, we classify the equivalent semifoldover designs and, also, provide a way to obtain the equivalent semifoldover designs. (with William Li)

Optimal allocation with multiple treatments for Weibull Models

Dibyen Majumdar and **Cuilan Zhang,** University of Illinois at Chicago

Abstract: Rosenberger and Hu (2003) considered the problem of response-adaptive randomization procedures for clinical trials. They reviewed and proposed criteria for allocating participants to different treatments and give explicit formulae for the allocation proportions for Binomial and Normal responses. In this work we consider the Weibull distribution with a common shape parameter. Weibull models for lifetime are used in engineering (Stone, G.C. and Lawless J.F. (1979), Lawless, J.F. (1982)) and medicine (Mudholkar, G.S., Srivastava D.K. and Kollia G.D. (1996), Kevin, J. and Carroll, M.Sc (2003)). We will present results for the case of k=2 populations. Extensions to the case of k=3 populations along the lines of the recent work by Zhu and Hu (2009) will be indicated.

Information in adaptive optimal designs

Ping Yao, University of Northern Illinois

Abstract: This paper addresses an important outstanding question concerning information as derived from sequentially implementing estimated optimal designs. Optimal designs are optimization problems. Classically the optimality criterion is a function of the information matrix. When the response function under consideration is nonlinear, the optimal design is a function of the unknown parameters. Sequential experiments, each based on the optimal design estimated from the data obtained in all prior stages have been proposed. In the literature, in the place of the joint information for responses and design points, the sum of the Fisher information for each stage conditional on the design is commonly used. This paper establishes that this sum indeed is the joint information so long as the design for each new stage is

completely determined by a function of the maximum likelihood estimates of the parameters. Examples are given to indicate it.