ARKANSAS STATE UNIVERSITY

STATISTICS SYMPOSIUM

PROGRAM AND ABSTRACTS

includes Mathematics Contributed Session

Welcoming Remarks: Friday, April 2, 2004, 8:45 am, CSM 217
Dr. Hector Flores, Dean of College of Sciences and Mathematics

Statistics Symposium Invited Session I: Friday a.m., CSM 217

Session Chair: Dr. Debra Ingram, Arkansas State University

9:00 – 10:00 a.m.

STATISTICAL RESEARCH AND GRADUATE EDUCATION IN THE 21ST CENTURY: INTERDISCIPLINARY RESEARCH

Dr. Jack D. Tubbs, Professor of Mathematics and Statistics, Director of the Institute of Statistics, Baylor University

This talk will focus on the ever expanding role that statistics and statisticians play at non Tier I research universities. As smaller universities seek to improve their ranking among research institutions, resources demand that these institutions improve their emphasis upon inter/intra disciplinary research opportunities. This emphasis not only affects the ways in which we evaluate our faculty but also the ways that we train our students. I will present the preliminary results of one such project which is motivated by the growing widespread problem of water pollution with pharmaceuticals. The work involves an analytical continuation of recent published studies that indicated that the pharmaceutical fluoxetine (Prozac), a selective serotonin reuptake inhibitor, is discharged in municipal wastewater treatment plant effluents to surface waters. The study attempts to answer some of the questions that are not presently understood. They are: (1) the magnitude, duration and frequency of fluoxetine exposure in aquatic systems, (2) mechanistic toxicity of fluoxetine in non-target biota, including behavioral responses, and (3) an assessment of environmentally relevant fluoxetine concentrations is needed to characterize ecological community responses.

Break 10:00 - 10:15 a.m.

10:15 – 10:45 a.m.

PROCESS IMPROVEMENT USING THE DMAIC METHOD

Dr. Mike Jackson, Continuous Improvement Consultant, Wal-Mart Stores, Inc.

The DMAIC methodology is a disciplined, data driven approach that focuses on a process and, more specifically, the variation within a process. Many companies have used this methodology to improve their business by eliminating defects and reducing process variation. Although the methodology has been used successfully in manufacturing for years, service organizations have recently started implementing the philosophy. The five phases of this improvement strategy are Define, Measure, Analyze, Improve, and Control. Members of the Wal-Mart Continuous Improvement team are responsible for the DMAIC training, project consulting, and statistical analysis.

10:50 – 11:20 a.m.

MODELING THE INCIDENCE RATES OF POSITIVE DRUG TESTS IN THE AIR FORCE 1996-1999

Dr. Chuck McGhee, Biostatistician, Tarrant County Public Health Department, Fort Worth, TX

The Air Force noticed an increase in positive drug tests in 1999. They had previously changed the criteria for random drug testing. This study looked at the random drug tests from October 1996 to September 1999. The goal was to predict positive drug tests and determine the trend of positive drug tests. Logistic regression was used to determine risk factors for positive drug tests. Cumulative incidence rates were tested for linear trend. Several variables were significant (status, age, rank, transfer & turn around time, and ethnicity) in the multivariate model. The cumulative incidence rate for the 36-month time period increased by 0.05 and was significant. The conclusions drawn from this were to continue monitoring the transport of samples for testing and to target the younger enlisted personnel in all service groups (active, reserve, and national guard) with more interventions.

Statistics Symposium Invited Session II: Friday p.m., CSM 217

Session Chair: Dr. J. Edward Bennett, Emeritus Professor of Chemistry, Arkansas State University

1:30 – 2:30 p.m.

MODELING, INFERENCE AND FORECASTING IN THE AGE OF FAST COMPUTERS

Dr. Katherine B. Ensor, Professor and Chair of Statistics, Rice University, Fellow of the American Statistical Association

Advances in statistical methodologies are inherently coupled to advances in computing technology. Examples of such paradigm shifts in statistical modeling and inference include the bootstrap, nonparametric function estimation, as well as the age of the MCMC solutions to Bayesian models. Just as significantly, the ability to easily simulate complicated stochastic processes provides us with a means of utilizing stochastic models increasingly in our scientific investigations. In this talk I will focus on the development of methodologies for dependent processes including computer intensive advances in inference and forecasting as well as highlight new work in the area of spatio-temporal modeling.

Break 2:30 - 2:45 p.m.

2:45 – 3:15 p.m.

FUNCTIONAL COEFFICIENT AUTOREGRESSIVE MODELING OF MULTIVARIATE TEMPORAL DATA

Dr. Jane Harvill, Assistant Professor of Statistics, Mississippi State University

Univariate nonlinear time series models have been used extensively over the past 15 to 20 years to model complex dynamic systems that cannot be adequately represented using linear models. A very general type of nonlinear time series model is the univariate functional coefficient autoregressive (FCAR) model, where the autoregressive coefficients are allowed to change as a function of one or more variables, which may be lagged values of the series or exogeneous predictors, including, for example, time. We extend the univariate FCAR model to the vector time series framework. A bootstrap test for vector time series nonlinearity is presented. FCAR methods are applied to a number of different datasets to illustrate utility. Extensions to spatial-temporal modeling are mentioned, but remain an open problem.

3:20 – 3:50 p.m.

SOME SELECTION PROCEDURES FOR THE BIRNBAUM-SAUNDERS DISTRIBUTION

Dr. Jeanne Hill, Visiting Assistant Professor of Statistics, Baylor University

In 1969, Z. W. Birnbaum and S. C. Saunders introduced a new fatigue life distribution which bears their names. This distribution was derived from considerations of the physical behavior of material subjected to cyclically repeated stress patterns. The distribution models the number of cycles needed to force the length of the fatigue crack to grow past a critical length. This talk will review some general results about the distribution and introduce new procedures for comparing two or more Birnbaum-Saunders populations. For two ore more independent Birnbaum-Saunders populations with unknown scale parameters, a better population is defined to be the one having a larger scale parameter. The problem of selecting *t* best of such populations is considered.

3:55 – 4:25 p.m.

BAYESIAN STATISTICS: AN IDEA WHOSE TIME HAS COME

Dr. Brian J. Smith, Assistant Professor of Biostatistics, University of Iowa

Today, the Bayesian approach to statistical modeling enjoys widespread acceptance in the statistical community. Not only an academic endeavor, the approach is being applied to solve many real-world problems. Bayesian methods are encouraged by the FDA for use in the development of medical devices and are being used to build more effective spam filters for e-mail. The rise in popularity of these methods is surprising considering that their use was one of the most debated and controversial statistical topics no more than a decade ago. We will look back at several advances that were key to the rise in popularity of Bayesian modeling. Our talk will begin with the origin of Bayes Theorem and then move on to the development of the Metropolis-Hastings algorithm, the impact of high-speed computing, and the arrival of custom software for performing Bayesian analyses.

Statistics Symposium Invited Session III: Saturday a.m., CSM 217

Session Chair: Dr. Roger Abernathy, Arkansas State University

9:30 – 10:00 a.m.

CONSTRUCTION OF OPTIMAL SCREENING DESIGNS FROM HADAMARD MATRICES

Dr. Debra Ingram, Assistant Professor of Statistics, Arkansas State University

Fractional factorial designs are used in a wide variety of industrial and scientific investigations, where time and resources are always limited, and, as a result, run size economy and run size flexibility are important issues. *Regular* fractional factorial designs are among the most widely used statistical experimental strategies for studying the effects of several variables simultaneously and are readily available in the literature. However, they are limited in that the number of experimental runs must be a power of two, leaving large gaps in the available run sizes. *Nonregular* fractional factorial designs taken from Hadamard matrices can be constructed for every run size that is a multiple of four, providing a distinct advantage over the regular designs. This talk focuses on the use of computationally efficient search algorithms applied to Hadamard matrices for the construction of optimal nonregular designs. The new designs compare favorably with the competing regular designs and make it possible for engineers and scientists to plan experiments for many different combinations of run size and number of variables to be studied.

10:05 – 10:35 a.m.

THE LOG F: A DISTRIBUTION FOR ALL SEASONS

Dr. Marty Spears, Associate Professor of Mathematics, Harding University

A family of statistical models based on the logarithm of an F variate was introduced over 20 years ago. This family of distributions is extremely versatile, but is little appreciated by the statistical community. The log F family of distributions belongs in the tool box of applied statisticians and should be used in data exploration. Examples of the log F model will be presented that cover a variety of statistical functions and several application areas. Details will be provided for where to obtain free computer code to fit the models to data.

Break 10:35 - 10:50 a.m.

10:50 – 11:50 a.m.

STATISTICS AS AN ENABLING DISCIPLINE

Dr. William B. Smith, Executive Director of the American Statistical Association (ASA), Fellow of the American Statistical Association, Professor Emeritus, Department of Statistics, Texas A&M University

Real-world examples and experiences will be presented in which effective use of statistical approaches provided insight. These situations include the Firestone/Ford tire failure analysis, an oil well pipe corrosion challenge, the recent controversy over FBI chemical analysis of ammunition identification, a long term investigation of a bone strengthening dietary supplement for race horses, and advances in veterinary ophthalmology. Open research opportunities and ASA's involvement in advancing the discipline will be shared.

Mathematics Contributed Session: Friday p.m., CSM 217

Session Chair: Dr. J. Edward Bennett, Emeritus Professor of Chemistry, Arkansas State University

4:35 – 4:50 p.m.

KNOTS, BRAIDS, AND DNA - canceled

Dr. Grant Lathrom
Department of Mathematics and Statistics, Arkansas State University, PO Box 70, State University, AR 72467

Knot theory has applications in many areas of physical science as well as being a fascinating area of mathematical research on its own. We will give a brief overview of knot theory and describe some techniques for determination of polynomial invariants for knots. We will conclude with a discussion of the application of knot theory to DNA replication.

4:55 – 5:10 pm

DISTINCT PATTERNS OF HEMI-SPATIAL NEGLECT: A MULTI-LESIONED MATHEMATICAL MODEL

Tony Sloan, M.D.
Department of Family Medicine, University of Alabama, Box 870377, Tuscaloosa, AL 35487

Left hemi-spatial neglect typically occurs after a right hemispheric stroke. Patients with hemi-spatial neglect exhibit a range of bizarre but consistent behaviors on classic clinical tests. Patients to some degree fail to attend to left hemi-space or to left sides of objects. A multi-lesioned mathematical model, the Gestalt grouping-combined hemi-attentional-affine representational model, is used to show the existence of several distinct patterns of hemi-neglect behavior that exist empirically in the neuroscience literature. Moreover, we establish the existence of several more distinct patterns of hemi-neglect behavior that have yet to appear in the empirical literature. The space of external visuo-spatial stimuli is realized as the space, $H([a,b] \times P)$, of compact subsets of a strip, $[a,b] \times P$, in the plane P^2. A Gestalt grouping procedure decomposes a finite collection of stimuli into disjoint perceptual objects. An internal representation of visuo-spatial stimuli is determined by the action of a group of isometries on $H([a,b] \times P)$. A combined hemi-attentional system, given by a linear combination of a pair of normal distributions, is applied to the internal representation. A lesion can be a representational error (related to the isometries), an attentional error (related to the combined hemi-attentional system), or a Gestalt grouping error.