SPECIAL SESSION: LATENT VARIABLE MODELING

VI WORKSHOP ON PROBABILISTIC AND STATISTICAL METHODS

This session will be held on Wednesday, February 7, at the Auditório 2, Biblioteca Comunitária - UFSCar

14:30 - 15:15

Time series and multilevel modeling for longitudinal item response theory data

Caio Lucidius N. Azevedo - UNICAMP

Longitudinal Item Response Theory (IRT) data occurs when experimental units are submitted to measurement instruments (e.g., cognitive test, psychiatric questionaires, biological essays among others) along different assessment conditions, as different time points. Very often, in this kind of study, we are interested in the so-called latent variables (or latent traits) and their behavior along these conditions, including the modeling of their inter-dependency structure. In this work we use some stationay and nonstationary time series and multilevel models to represent longitudinal IRT data. More specifically, we consider first order auto-regressive (AR(1)), first order moving average (MA(1), first order auto-regressive- moving average (ARMA(1,1)) time series models as well as the Uniform and Hankel dependency structures, induced by appropriate multilevel models. These structures are studied under a time-homocedastic and time-heteroscedastic fashions. We developed a Bayesian inference framework, which includes parameter estimation, model fit assessment and model comparison, through MCMC algorithms. Simulation studies are conducted in order to measure the parameter recovery and model comparison tools. A real data analysis, concerning a longitudinal cognitive study for Mathmatics achievement, conducted by the Federal Brazilian government, is performed. All computational implementations are made through the WinBUGS program, using the R2WinBUGS package, from R program. Joint work with Dalton F. Andrade.

15:15 - 16:00

Dynamic sparsity on dynamic regression models

Hedibert Freitas Lopes - Insper

We consider variable selection and shrinkage for Gaussian Dynamic Linear Models (DLM) within a Bayesian framework. In particular, we propose a novel method that accommodates time-varying sparsity, based on an extension of spike-and-slab priors for dynamic models. This is done by assigning appropriate priors for the time-varying coefficients? variances, extending the previous work of Ishwaran and Rao (2005). Our approach is similar to the Normal Gamma Autoregressive (NGAR) process of Kalli and Griffin (2014), nevertheless, we assume a Markov switching structure for the process variances instead of a Gamma Autoregressive (GAR) process. Furthermore, we investigate different priors, including the common Inverted gamma prior for the process variances, and other mixture prior distributions such as Gamma priors for both the spike and the slab, which leads to a mixture of Normal-Gammas priors (Brown and Griffin, 2010) for the coefficients and also different distributions for the spike and the slab. In this sense, our prior can be view as a dynamic variable selection prior which induces either smoothness (through the slab) or shrinkage towards zero (through the spike) at each time point. The MCMC method used for posterior computation uses Markov latent variables that can assume binary regimes at each time point to generate the coefficients? variances. In that way, our model is a dynamic mixture model, thus, we could use the algorithm of Gerlach et al. (2000) to generate the latent processes without conditioning on the states. Finally, our approach is exemplified through simulated examples and a real data application. This is joint work with Paloma Uribe.

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16:00 - 16:45

Estimating the DINA Model Parameters Using the No-U-Turn Sampler

Jorge Bazán - USP

The deterministic inputs, noisy ``and'' gate (DINA) model is a popular Cognitive Diagnosis Model (CDM) in psychology and psychometrics used to identify test takers' profiles with respect to a set of latent attributes or skills. In this work we propose an estimation method for the DINA model with the No-U-Turn Sampler (NUTS) algorithm, an extension to Hamiltonian Monte Carlo (HMC) method. We conduct a simulation study in order to evaluate the parameter recovery and efficiency of this new Markov chain Monte Carlo method and to compare it with two other Bayesian methods, the Metropolis Hastings and Gibbs sampling algorithms, and with a frequentist method, using the Expectation-Maximization algorithm. The results indicated that NUTS algorithm employed in the DINA model properly recovers all parameters and is more accurate than the other known methods used in the comparison. We apply this methodology in the mental health area in order to develop a new method of classification for respondents to the Beck Depression Inventory. The implementation of this method for the DINA model applied to other psychological tests has the potential to improve the medical diagnostic process.

Conjoint work with Marcelo Andrade da Silva, Eduardo Schneider Bueno de Oliveira and Alina A. von Davier.