Dependence I: Correlation and Copulas

Chair: Bruno Rémillard (HEC Montréal)

AYI AJAVON, Université de Montréal
Copulas Extensions for Non Continuous Random Variables

The copula of a non continuous random vector \((Y_1, \cdots, Y_d)\) is uniquely determined only on the range \(R_1 \times \cdots \times R_d\), where \(R_i\) is the range of \(F_i(Y_i)\), \(F_i\) is the distribution function of \(Y_i\), \(i = 1, \cdots, d\). It admits extensions on \([0,1]^d\). The most used are the “starred copula” and the “standard extension copula” of Schweizer. It is shown that they are equivalent in dimension \(d = 2\) but not yet in dimension \(d > 2\). We prove that these copulas are the same in dimension \(d \geq 2\). In addition, we provide the minimal and maximal extensions copulas in dimension \(d > 2\).

NIROSHAN WITHANAGE, University of Calgary
Joint Modeling of Hierarchically Clustered Non-Gaussian Continuous Outcomes via the Gaussian Copula

In many biomedical studies, researchers simultaneously record multiple outcomes. With non-Gaussian continuous responses with disparate distributions, joint analysis is rendered complicated by the lack of multivariate analogue to the multivariate normal distribution. We propose a copula-based approach to joint modeling of non-Gaussian clustered continuous outcomes. We use Gaussian copula to glue multiple outcomes and adopt GLMMs for the marginal models of the outcomes. The approach does not assume conditional independence of outcomes unlike in conventional GLMMs. It is thus able to capture all relevant associations in the data. The proposed methodology is illustrated using data from a comet assay.

YANLING CAI, University of British Columbia
Breaking the Same Board Twice: the Magic of Statistics!

Stresses affect strength properties of a lumber specimen simultaneously. A strong stochastic dependence between these properties would diminish a wooden structure’s reliability. Assessing strength relationships is a seemingly insurmountable challenge as every one of these strengths needs a destructive testing to measure. Here is where statistics comes to the rescue. This paper describes a large-scale experiment designed and conducted by statistics graduate students in a commercial testing lab. It proposes the new theory to infer the stochastic dependence, which applies proof load technique with a penalizing likelihood approach motivated by a Bayesian conjugate prior. The result: asymptotically consistent, more efficient.

ZIHANG LU, University of Toronto
The Bias for Sub-Hazard Ratio when the Event Times are Correlated

In the analysis of competing risk data, the effect of a covariate is modeled using the Fine and Gray approach, yielding a sub-distribution hazard ratio. The sub-hazard ratio provided by the Cox model cannot be interpreted as the degree of correlation between the two types of events is unknown. Our study investigates to what degree the sub-hazard ratio approximates the marginal hazard ratio for varying degrees of correlation. Using simulation, it was found that the bias was large for high correlations \((\geq 0.5)\), depends on the direction of correlation and can overestimate as well as underestimate the marginal hazard ratio.

CHAFIK BOUHADDIOUI, UAE University
Statistical Inference in Infinite-Order Cointegrated Vector Autoregressive Processes under Uncorrelated but Dependent Errors

The concept of co-integration processes is one of the most used concepts in economics and finance. Mainly, researchers are interested in the behavior of the estimators of the model parameters. In this paper, we will investigate the asymptotic behavior...
of the estimators of an infinite-order co-integrated vector autoregressive series under nonindependent errors by showing its asymptotic distribution. Using this result, we will construct a Likelihood Ratio (LR) test of the co-integration rank. One can also develop a method under unrestricative assumptions to select the autoregressive order. Monte Carlo experiments illustrate the finite sample performance of the LR test.