Tuesday 23 July 2024

11:00-12:30 Invited Session 5 (Main Room)

Machine Learning Algorithms for Survival Analysis

(Chairs: Michal Abrahamowicz, Dimitris Rizopoulos)

Hypothesis Testing for the Deep Cox Model

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Deep learning has become enormously popular in the analysis of complex data, including event time measurements with censoring. To date, deep survival methods have mainly focused on prediction. Such methods are scarcely used in matters of statistical inference such as hypothesis testing. Due to their black-box nature, deep-learned outcomes lack interpretability which limits their use for decision-making in biomedical applications. This paper provides estimation and inference methods for the nonparametric Cox model – a flexible family of models with a nonparametric link function to avoid model misspecification. Here we assume the nonparametric link function is modeled via a deep neural network. To perform statistical inference, We utilize sample splitting and cross-fitting procedures to get neural network estimators and construct test statistic. These procedures enable us to propose a new significance test to examine the association of certain covariates with event times. We establish convergence rates of the neural network estimators, and show that deep learning can overcome the curse of dimensionality in nonparametric regression by learning to exploit low-dimensional structures underlying the data. In addition, we show that our test statistic converges to a normal distribution under the null hypothesis and establish its consistency, in terms of the Type II error, under the alternative hypothesis. Numerical simulations and a real data application demonstrate the usefulness of the proposed test.