**An integrated choice and latent variable model for multiple discrete continuous choice kernels: Application exploring the association between day level moods and**

**discretionary activity engagement choices**

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In the recent years, multiple discrete continuous (MDC) models have emerged as a popular framework to simultaneously model the choice of multiple goods (that are imperfect substitutes to one another) and the associated consumption quantities. The paper presents a new integrated choice and latent variable (ICLV) model implementation called the Hybrid Multiple Discrete Continuous (HMDC) model that is capable of incorporating the influence of psychological factors (modeled as latent constructs) on MDC choice behaviors. Estimation of ICLV models (with single discrete choice kernels and MDC kernels) has been a challenge owing to the high dimensional integrals involved in the likelihood function. The typically used maximum simulated likelihood estimation (MSLE) approach becomes cumbersome when the dimensionality of integration increases. In this research, a composite marginal likelihood (CML) based estimation approach is proposed for parameter estimation of the HMDC framework. Unlike the ICLV model implementations with single discrete choice kernel, the dimension of the integral to be decomposed in the HMDC varies across observations. This necessitated the use of weights when decomposing the likelihood function using the CML approach. A simulation study was conducted using synthetic datasets to demonstrate the superiority of the weighted CML approach over its unweighted counterpart in the presence of MDC choice kernel. The applicability of the proposed model formulation and associated estimation routine was demonstrated using an empirical case study with data from the 2013 American Time Use Survey (ATUS). The empirical study identifies interesting association between day level moods and discretionary activity participation decisions.