ANALYSIS OF MULTI-UNIT VARIANCE COMPONENTS MODELS WITH STATE SPACE PROFILES

JOHN V. TSIMIKAS[1] AND JOHANNES LEDOLTER[2]

[1] *Department of Health Care Policy, Harvard Medical School, 25 Shattuck Str, Boston MA 02115, U.S.A.*
[2] *Department of Statistics and Actuarial Science, University of Iowa, Iowa City, IA 52242, U.S.A.*

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Abstract. We apply the Kalman Filter to the analysis of multi-unit variance components models where each unit's response profile follows a state space model. We use mixed model results to obtain estimates of unit-specific random effects, state disturbance terms and residual noise terms. We use the signal extraction approach to smooth individual profiles. We show how to utilize the Kalman Filter to efficiently compute the restricted loglikelihood of the model. For the important special case where each unit's response profile follows a continuous structural time series model with known transition matrix we derive an EM algorithm for the restricted maximum likelihood (REML) estimation of the variance components. We present details for the case where individual profiles are modeled as local polynomial trends or polynomial smoothing splines.

Key words and phrases: Continuous-time stochastic models, EM algorithm, Kalman Filter, mixed model prediction, restricted maximum likelihood, smoothing splines, unequally spaced observations, variance components.