Multivariate Linear Processes with Observations taken at Different Frequencies in each Component

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The class of linear processes is one of the most frequently used classes of processes in time series analysis. For many statistical quantities, among them sample autocovariances and autocorrelations, central limit theorems are available in the literature. For classical univariate linear processes it was recently shown that only one particular time scale possesses a linear structure. Thus, observing a linear process at a lower frequency leads to substantially different asymptotic results for standard statistical quantities. We review central limit results for the univariate setting and present a multivariate extension of this non-standard observation approach. Corresponding to the univariate case, the linear structure is destroyed as well once we observe the multivariate process at a lower frequency, and again we obtain different asymptotic results. Furthermore, the multivariate results are generalized in two reasonable ways. On the one hand the multivariate linear process is assumed to be observed on a different frequency in each component. Thus, we can only observe certain components at each specific time point but not necessarily the entire random vector. On the other hand the components of the multivariate process are each assumed to be univariate linear processes but not necessarily with the same underlying linear time scale for each component. Thus, there is no clear linear structure for the whole multivariate process although there is one for each component. As a conclusion, we give a central limit theorem for the sample autocovariance, the statistic of interest throughout our whole investigation. It is shown that the generalized model contains the well-known standard setting as a special case.

Key Words: Central limit theorem, autocovariance, linear structure, time scale.