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Multivariate comparison of growth curves

Growth curves are essential tools in biology for tracking changes in population size or biomass over time. Biological growth usually follows a sigmoid pattern, characterized by an initial slow growth (lag phase), a rapid increase (exponential or log phase), and a leveling off as they approach mature values (stationary phase and plateau). Commonly used growth models include the logistic model, generalized logistic model (Richards model), Baranyi-Roberts model and Gompertz model. The goal is often to investigate how various extrinsic factors affect growth, necessitating statistical assessment of growth curves. Comparisons are typically made visually or by univariate analysis of model parameters like lag time or maximum growth rate.

This study aims to develop a method for statistically comparing growth curves from designed experiments, assessing how experimental factors affect the shapes of the curves, and providing results that are easy to interpret and communicate to biologists. We applied ANOVA-simultaneous component analysis (ASCA) to a case study involving human muscle cells grown and continuously measured in an Incucyte® Live-Cell Analysis System. The cells were exposed to different treatments according to an experimental design. Cell growth measured at multiple time points serves as the response variables, which is modeled in relation to design factors Treatment and Dose. We compare two approaches: one where ASCA is applied directly to the raw cell growth data, and the other where ASCA is applied to the parameters derived from growth models fitted to the data.

Special/ Invited session

Classification

Both methodology and application

Keywords

Growth curves, design of experiments, ASCA

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Track Classification: Design of Experiments