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Modeling tumor growth in the presence of a therapy with an effect on rate growth and variability by means of a modified Gompertz diffusion process

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Abstract

In experimental studies on tumor growth, whenever the time evolution of the relative volume of a tumor in an untreated (control) group can be fitted by a Gompertz diffusion process there is a possibility that an antiproliferative therapy, which modifies the growth rate of the process that fits the treated group, may also affect its variability. The present paper proposes several procedures for the estimation of the time function included in the infinitesimal variance of the new process, as well as the time function affecting the growth rate (which is included in the infinitesimal mean). Also, a hypothesis testing is designed to confirm or refute the need for including such time-dependent function in the infinitesimal variance. In order to validate and compare the proposed procedures a simulation study has been carried out. In addition, a proposal is made for a strategy aimed at finding the optimal combination of procedures for each case. A real data application concerning the effects of cisplatin on a patient-derived xenograft (PDX) tumor model showcases the advantages of this model over others that have been used in the past.

Keywords: Gompertz diffusion process; Antiproliferative therapy; Tumor growth; PDX tumor model.

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