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Stochastic models of tumor latency and their biostatistical applications. (English)

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This monograph is concerned with mathematical modeling and statistical inference of tumor latency and time to occurrence or recurrence after treatment of a tumor with a focus on parametrically specified models that are capable of eliciting biologically meaningful information and interpretation. The introductory Chapter 1 provides a short overview on survival analysis tools and methods. The next three chapters 2.–4., on the Mathematical Description of Tumor Latency, on the Regression Analysis of Tumor Recurrence Data, and on Threshold Models of Tumor Latency, present a stochastic model of tumor recurrence developed within the first author's work on random minima: $U = \min(X_i,\ 0 \leq i \leq \nu)$, where X_i are nonnegative i.i.d. (e.g., gamma or $\alpha/2$ stable distributed) and where $\nu \sim$ Poisson distributed.

A simulation model of tumor recurrence is developed for validating latent time and recurrence time distribution models. There is a differentiation between true recurrence and spontaneous carcinogenesis. Survival models allowing for cure rate are exhibited and a parametric regression model is established with applications to breast cancer and cancer of cervix uteri, with an option to derive a method for choosing best cancer treatments based on covariate information. A threshold model of tumor latency is based on a linear birth and death process with absorbing barrier (corresponding to extinction and cure) and the tumor size at detection (recurrence) is derived. Limit theorems are given.

The three chapters 5.–7. of the second part of the book are on the Statistical Analysis of Discrete Cancer Surveillance, on the Minimum Delay Time Approach, and on the Minimal Cost Approach. This comprises a detailed outline of the statistical estimation problems in cancer screening and the estimation in presence of incomplete (e.g. doubly censored or grouped) data. Cost-utility approaches are provided for determining the optimal number of examinations and their schedule, with the expected proportion of detected and undetected cancers and the expected residual lifetime considered. Minimization of the mean delay time with a fixed number of inspections is investigated for optimal allocation of resources.

Applications are given for breast cancer, lung cancer and radiation-induced thyropathy. A comprehensive list of 330 references and an index round up the book which addresses a mathematical readership as well as physicians with some background in probability and statistics.

Reviewer: Lutz Edler (Heidelberg)

MSC:

92C50	Medical applications (general)
92-02	Research exposition (monographs, survey articles) pertaining to biology
62P10	Applications of statistics to biology and medical sciences; meta analysis

Keywords:

tumor latency; regression analysis; minimum delay time approach; minimal cost approach; tumor recurrence; carcinogenesis; regression model; cancer screening; breast cancer; lung cancer; radiation-induced thyropathy