BIVARIATE MARKOV CHAINS CONTAINING A FAILURE PROCESS

BY NANCY FLOURNOY

The American University

This paper is directed toward the challenge to model dependencies among discrete-state processes. In an earlier motivating application, we used proportional hazards regression models with time-dependent covariates to examine the relationship between relapse following treatment for leukemia, internal biological processes fighting the leukemia, and interventions intended to fix defects in these processes or to stimulate them to behave more aggressively. Complexities in this application led to the introduction of new dependency measures derived from extending Kolmogorov's differential equations. In this paper these dependency measures are interpreted for a bivariate Markov chain where one process is a failure process and another evolves concurrently. Likelihood construction using these dependency measures and others currently used in the context of a failure process are discussed.

1. Introduction. Our interest in measures of association that evolve in time has its genesis in an application involving multiple parallel, non-independent, discrete-state random processes evolving in time. A motivating application involving certain random events and the relationship between these events is described briefly in Section 2 to provide a context for the theoretical development. The principal issue is how to define and model the dependency of a failure process on discrete-state continuous-time random covariates. In Flournoy (1990) we develop measures of dependency among multivariate discrete state stochastic processes by extending the concept of intensity functions using multivariate extensions of Kolmogorov's differential equations. Now these dependency measures are made explicit and interpreted for the situation where one process is a failure process and another (possibly vector-valued) process evolves concurrently. Also we describe

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