ON THE PROBABILITY OF DEATH FROM SPECIFIC CAUSES IN THE PRESENCE OF COMPETING RISKS

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1. Introduction

The characteristic of a mortality study is that the basic event, the death of an individual, is not repetitive. Suppose we wish to assess the congenital malformation as a cause of infant death; how shall we count the malformed child who dies of tuberculosis in his first year of life? The risk of death due to the congenital malformation no longer exists, but neither can he survive the condition until his first birthday. It is clear that the evaluation of congenital malformation as a cause of death must allow for the effect of all causes operating in the human population. To take a second example, perhaps the problem is to estimate the length of time between diagnosis and death due to coronary heart disease. A study group of diagnosed cases is formed, but a number of them will die from other diseases before the observation period is ended. How can we correct our estimate for the competing risks? In another study, we may be interested in the susceptibility of individuals with a certain chronic condition to other diseases. Is a diagnosed case of arteriosclerotic heart disease more likely to die from cancer than a person without the heart condition? How can we take into account the competition between arteriosclerotic heart disease and cancer for the life of the heart patient?

To answer these and similar questions, the investigator may explore three general types of probabilities of death with respect to a specific risk: (1) the crude probability, (2) the net probability, and (3) the partial crude probability. Symbolically, they are defined as follows. To describe death from a specific risk, say R_k, we have the crude probability

$Q_{xk} = P\{$an individual alive at time x will die in the interval $(x, x+1)$ from risk R_k in the presence of all other risks in the population$\}$;

the net probabilities

$q_{xk} = P\{$an individual alive at x will die in the interval $(x, x+1)$ if R_k is the only risk of death acting in the population$\}$,

$q_{x.k} = P\{$an individual alive at x will die in the interval $(x, x+1)$ if R_k is eliminated as a risk of death from the population$\}$;

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