

Alternative General Formula to Estimate and Test Influences of Early Diagnosis on Cancer Survival

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Abstract : Background and purpose: Cancer diagnosis is part of a complex stochastic process, in which patients' personal and social characteristics influence the choice of diagnosing methods, diagnosing methods, in turn, influence the initial assessment of cancer stage, the initial assessment, in turn, influences the choice of treating methods, and treating methods in turn influence cancer outcomes such as cancer survival. To evaluate diagnosing methods, one needs to estimate and test the causal effect of a regime of cancer diagnosis and treatments. Recently, Wang and Yin (Annals of statistics, 2020) derived a new general formula, which expresses these causal effects in terms of the point effects of treatments in single-point causal inference. As a result, it is possible to estimate and test these causal effects via point effects. The purpose of the work is to estimate and test causal effects under various regimes of cancer diagnosis and treatments via point effects. Challenges and solutions: The cancer stage has influences from earlier diagnosis as well as on subsequent treatments. As a consequence, it is highly difficult to estimate and test the causal effects via standard parameters, that is, the conditional survival given all stationary covariates, diagnosing methods, cancer stage and prognosis factors, treating methods. Instead of standard parameters, we use the point effects of cancer diagnosis and treatments to estimate and test causal effects under various regimes of cancer diagnosis and treatments. We are able to use familiar methods in the framework of single-point causal inference to accomplish the task. Achievements: we have applied this method to stomach cancer survival from a clinical study in Sweden. We have studied causal effects under various regimes, including the optimal regime of diagnosis and treatments and the effect moderation of the causal effect by age and gender.

Keywords : cancer diagnosis, causal effect, point effect, G-formula, sequential causal effect

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