

THE GINI CONCENTRATION INDEX IN SURVIVAL ANALYSIS

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The Gini index is one of the most common statistical indices employed in social sciences for measuring concentration in the distribution of a given random variable; it is mainly used in economics as a measure of income or wealth inequality among individuals or households. Recently, the Gini coefficient has been applied to describe concentration in levels of mortality, or in length of life, among different socio-economic groups, or inequality in health and in life expectancy.

We apply the (sample) Gini index to the measurement of concentration in survival times within a group of patients, and in particular as a way to compare the distribution of survival times across groups of patients in clinical studies. In particular, we propose a nonparametric estimator of a restricted version of the index from right censored data. We derive the asymptotic distribution of the resulting Gini statistic, and construct a consistent estimator for its asymptotic variance. We use these results to propose a novel test for differences in survival distributions from the point of view of the concentration of the two distributions.

We also explore the operating characteristics of the proposed test via a simulation study. We focus in particular on traditional cure rate models and on generalized cure rate models, i.e. mixture models with a distribution of the lifetimes of the cured patients that is not degenerate at infinity. We compare the Gini-based test to traditional nonparametric tests for the equality of survival distributions (log-rank, Wilcoxon, and Gray-Tstatis) in terms of power via simulations.

Results suggest that the Gini index may be useful in some situations, and that it should be considered together with existing tests. Rejection of the null hypothesis of equality in concentration between the survival distributions of two patient groups might suggest that subgroups of patients exist for whom treatment has a strong positive (or detrimental) effect, thus providing justification for further subgroups analyses.

Use of the test is illustrated on the classic data arising from the Eastern Cooperative Oncology Group melanoma clinical trial E1690.