ABSTRACT:
The prediction of time to default for personal loans using mixture cure models: including macro-economic factors.

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Since the Basel accords and the resulting higher need for more accurate credit risk calculations, survival analysis gained more importance in credit risk modelling due to being able to estimate time to default, as well as the probability of default (PD) during the loan term. The survival function $S(t) = P(T > t) = 1 - F(t)$ is the probability that an event has not occurred by a stated time $t$. As $S(t)$ goes to zero when time advances, the underlying assumption is that every subject will experience the event eventually. This property does not seem valid in the credit risk context, as a substantial part of the population will never experience default. The mixture cure model, a survival model that uses logistic regression to model a so-called “cured” or “unsusceptible” fraction was introduced for the first time in the credit risk context by Tong et al. (2012). Dirick et al. (2015) developed a model selection criterion for variable selection in these models, and applied this to credit risk data. With an unconditional survival function as follows:

$$S(t | x, z) = P(Y = 1 | z)S(t | Y = 1, x) + 1 - P(Y = 1 | z),$$

$Y$ is the susceptibility indicator ($Y = 1$ if an account is susceptible, and $Y = 0$ if not). Covariates $x$ and $z$ allowed in these models are typically (i) linked to a certain loan applicant (ii) considered not to change over time. However, macro-economic factors that change over time (e.g. interest rate) impact loan default. We extended the mixture cure model such that time-varying covariates are allowed, and macro-economic factors can be included. The simulation results show that time-varying covariates can indeed successfully be included in a mixture cure model. We conclude the research with a real-life credit data example.

References