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Using a Cox's Proportional Hazard Approach for modeling seed quality decay over time

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Survival analysis, popularly used for clinical trials in medical sciences, provides new opportunities to evaluate the changes in seed quality during storage or other processes that occur over time.   These types of data are difficult to model using traditional analysis of variance (ANOVA) because of time-dependent nature of data, unequal variations of the response over time, nonlinear effect of time, and non-normality. We used a proportional hazard approach to model loss of soybean seed vigor during summer warehouse storage. The analysis began with developing a Kaplan-Meier curve that charted the number of seed lots that remained above a threshold level at each sampling time. A proportional hazard model, called a Cox regression, took these curves and related the effects of temperature and relative humidity on loss of seed vigor. The Cox regression is useful to address such questions as 1) common effect of temperature or relative humidity on seed damage at all time points, 2) hazard ratio (relative risk) of control vs. treatment group, 3) expected survival time given some predictors, and 4) probability of survival of soybeans at a particular time point. Usually, a Cox model is appropriate for a longitudinal cohort study (where the same group of individuals is studied over time) in which ANOVA assumptions easily fail because a time variable is involved. With the Cox regression, we related starting level of the seed vigor measurement, warehouse, cultivar, and the confounded effects of temperature and relative humidity to declines in seed vigor. Those results are present in the adjacent poster. Our results demonstrate the usefulness of proportional hazard modeling in agricultural systems.