The Satterthwaite-Welch t-Test with Covariates

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Abstract

In many biological, ecological, psychological, or medical studies, the statistical comparison of two independent samples is of paramount importance. Hereby, other variables that are called covariates can obscure the factor effects, i.e. the weight gain may be associated with the original weight (baseline) of the animal in the comparison of different feeds. Analysis of Covariance (ANCOVA) can adjust the treatment effects for the impact of the covariates on the response variable. The classical ANCOVA model is regularly based on the assumptions of multivariate normality and equal variances. In many experiments, however, these assumptions are hard justify, e.g., when reaction times or count data are observed. Inference with violation of assumptions may lead to conservative or liberal test decisions. We modify the classical Satterthwaite-Welch t-Test for covariate adjustments. The new method neither assumes homogeneous variances across the treatment groups nor a normal distribution. Simulation studies show that the new test controls the type-1 error rate even for small sample sizes. A real data set illustrates the application of the new method.