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Randomizing versus not randomizing split-plot experiments

Monday, 13 September 2021 15:45 (30 minutes)

Randomization is a fundamental principle underlying the statistical planning of experiments. In this talk, we illustrate the impact when the experimenter either cannot or chooses not to randomize the application of the experimental factors to their appropriate experimental units for split-plot experiments (Berni et al., 2020). The specific context is an experiment to improve the production process of an ultrasound transducer for medical imaging. Due to the constraints presented by the company requirements, some of the design factors cannot be randomized. Through a simulation study based on the experiment for the transducer, we illustrate visually the impact of a linear trend over time for both the randomized and nonrandomized situations, at the whole-plot and at the sub-plot levels. We assess the effect of randomizing versus not randomizing by considering the estimated model coefficients, and the whole-plot and sub-plot residuals. We also illustrate how to detect and to estimate the linear trend if the design is properly randomized, by also analyzing the impact of different slopes for the trend. We show that the nonrandomized design cannot detect the presence of the linear trend through residual plots because the impact of the trend is to bias the estimated coefficients. The simulation study provides an excellent way to explain to engineers and practitioners the fundamental role of randomization in the design and analysis of experiments.
REFERENCES:
Rossella Berni, Francesco Bertocci, Nedka D. Nikiforova & G. Geoffrey Vining (2020) A tutorial on randomizing versus not randomizing Split-Plot experiments, Quality Engineering, 32:1, 25-45, DOI: 10.1080/08982112.2019.1617422.

Keywords

randomization, linear trend, ultrasound probe

Special/invited session

Invited Talk for the SIS (Italian Statistical Society) Session, organized by Prof. Grazia Vicario

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