Industrial experiments have factors whose levels may be classified as hard-to-change (h-t-c) and easy-to-change (e-t-c). Due to the difficulty in changing the levels of the h-t-c factor, its levels are not independently reset if the same setting is required for successive runs. For example, if successive runs of an experiment require the same mold temperature, it is unusual to let the mold cool down before reheating it to the same temperature. When such an experiment is run in random order, the analysis proceeds under the incorrect assumption of independently distributed error terms and yields incorrect estimates of the error variance. The restriction in randomization causes the design to be inherently split-plotted, the h-t-c factor being confounded with the whole plots.

We investigate, over all randomizations, the statistical significance of the whole plot variance due to the restrictions in randomization. We quantify the average amount by which the error variance is overestimated in the unwittingly split-plotted design. Thus, tests on the h-t-c factor are incorrect. The chance to retrieve information from such designs is based on an existing method and a proposed modification of this method. The information that may be retrieved is low for moderate-sized designs. The experimenter is therefore urged to design experiments keeping in mind the complexities involved in changing factor levels, and by noting that the standard diagnostics on residuals are not sensitive to the correlated error structure. Designers of experiments should work closely with experimenters and recognize how the experiment is run in order to design experiments with the proper block structure. Experiments designed following this approach will yield correct tests for estimates in addition to providing a much smaller mean square error for most factors.