

**Title:** Crossing balanced and stair nested designs

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**Abstract:** Balanced nesting is the most usual form of nesting and originates, when used singly or with crossing of such sub-models, orthogonal models. In balanced nesting we are forced to divide repeatedly the plots and we have few degrees of freedom for the first levels. If we apply stair nesting we will have plots all of the same size rendering the designs easier to apply. The stair nested designs are a valid alternative for the balanced nested designs because we can work with fewer observations, the amount of information for the different factors is more evenly distributed and we obtain good results. The inference for models with balanced nesting is already well studied. For models with stair nesting it is easy to carry out inference because it is very similar to that for balanced nesting. Furthermore stair nested designs being unbalanced have an orthogonal structure. Other alternative to the balanced nesting is the staggered nesting that is the most popular unbalanced nested design which also has the advantage of requiring fewer observations. However staggered nested designs are not orthogonal, unlike the stair nested designs. In this work we start with the algebraic structure of the balanced, the stair and the staggered nested designs and we finish with the structure of the cross between balanced and stair nested designs.

**Author Keywords:** Balanced nesting; Stair nesting; Staggered nesting; Crossing; Variance components; Inference

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