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Admissible statistics from a latent variable perspective

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Appendix C

Types of Interactions According to Group Mean Ordering

When no two group means are equal in a two-by-two interaction design, the group means can be ranked 1,2, 3 and 4. All possible effects, corresponding to all possible permutations of this ranking, are provided in Figure C.1. The first column consists of effects that show two main effects and no interaction, which we will name an order-independent effect (for reasons that will become apparent later). The second column consists of crossing interactions, where the ordering of the groups on one factor reverses for the levels of the other factor and vice versa. The third column consists of partial interactions where the ordering of the groups on one factor reverses for the levels of the other factor but *not* vice versa.

When group means are allowed to be equal there are several possibilities. If all group means are equal there are obviously no effects whatsoever. This situation is represented in the top left subplot in Figure C.2. The remaining four plots in the first column represent the possible permutations of the group means when three group means are equal. These effects all consist of a minimal interaction, the interaction is caused by a minimal difference caused by one group mean. The possible permutations when two pairs of interactions are equal, are shown in the second column of Figure C.2. These effects consist of either exactly one main effect or a perfectly crossing interaction that cancels out the main effects.

When two means are equal but the remaining other two are not, several types of effects can occur, as shown in Figure C.3. First of all, an effect that is very similar to the minimal interaction can occur. The ordering of the groups on one factor shows a difference on the first level of the other fac-

tor but no difference on the second level. For the minimal interaction the same holds when we reverse the factors. This is not the case for this type of interaction, which we shall term a near-minimal interaction. This type of interaction, shown in the first column in Figure C.3, is less vulnerable to distortion due to sampling error than the true minimal interaction. In the second column types of effects are shown that we have already seen, namely the order-independent effect and the crossing interaction. In the third column the last type of effect is displayed. This type of effect is similar to the partial interaction. For one factor the ordering of the group means reverses between the levels of the other factor. For the other factor the group means do not reverse between the levels of the other factor, because for one level the group means are equal. We will call this type of effect a near-partial interaction.

In summary we can distinguish only eight basic types of effects: the order-independent effect, crossing interaction, partial interaction, no effects whatsoever, minimal interaction, one main effect only, near-minimal interaction and near-partial interaction. For all these types of effects, except the order-independent type, the type changes as soon as the rank order of one of these means relative to the others is changed. Only for the order-independent effect can the order of the means, specifically the non-extreme means, be changed without changing the effect type. This is the reason for the name order-independent. For all other types a monotonically increasing transformation of the ranks will not result in a change in substantive interpretation of the effect. For example, in a minimal interaction, the type of effect remains the same, no matter whether the one group that deviates does so to a small or to a very large degree. Order-independent effects however, can be transformed so that an existing interaction is eliminated or reversely, an interaction can be introduced where there previously was none.

Figure C.1: All possible interactions when group means are unequal. Factor levels are designated by control (C) and experimental (E) and a dashed (D) and solid (S) line. Group mean ordering for groups DC, SC, DE, SE is provided above each subplot

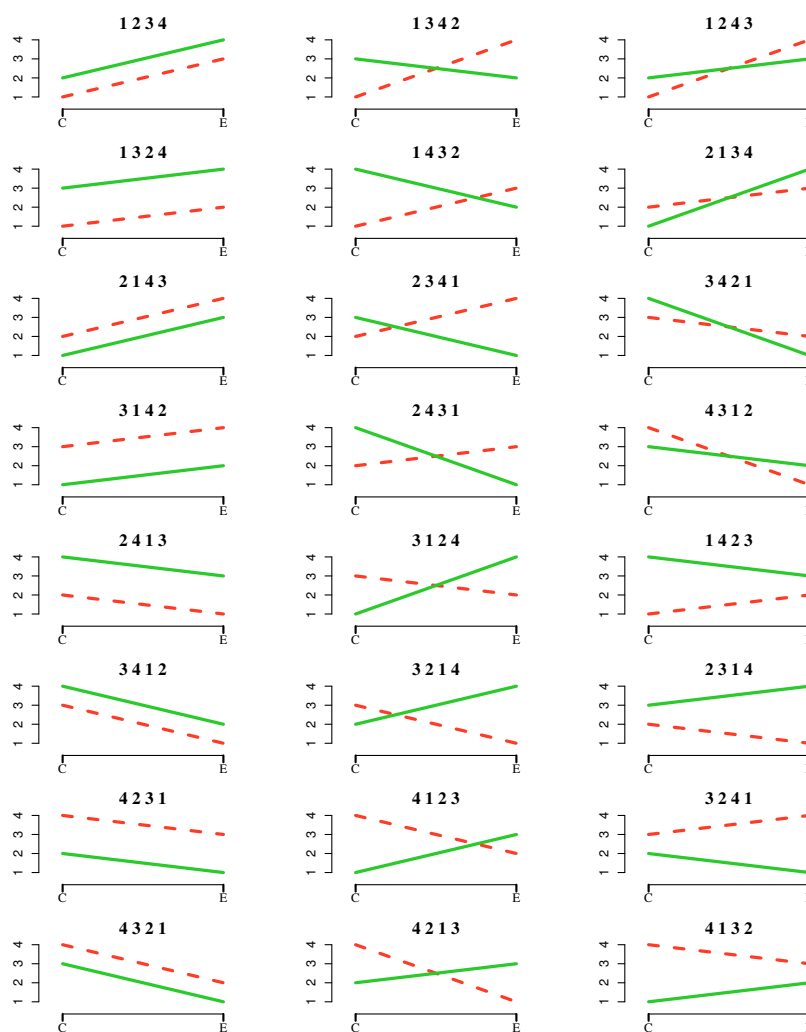


Figure C.2: All possible interactions when all, three or two pairs of group means are equal. Factor levels are designated by control (C) and experimental (E) and a dashed (D) and solid (S) line. Group mean ordering for groups DC, SC, DE, SE is provided above each subplot

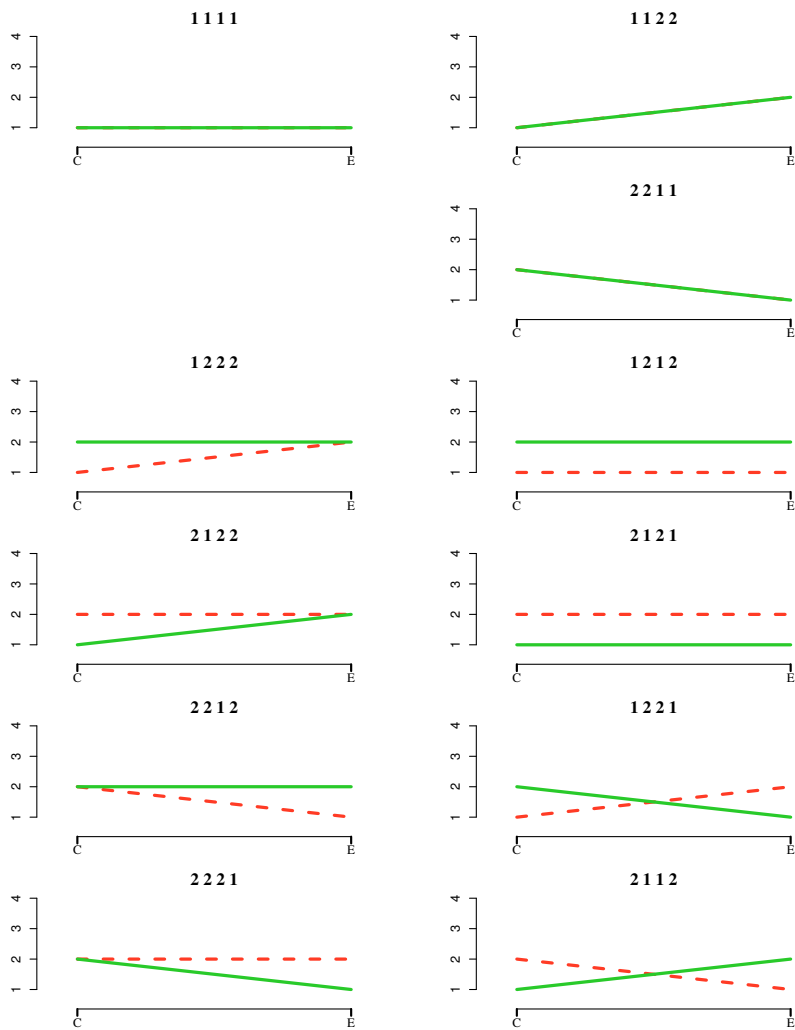


Figure C.3: All possible interactions when two group means are equal and the remaining two unequal. Factor levels are designated by control (C) and experimental (E) and a dashed (D) and solid (S) line. Group mean ordering for groups DC, SC, DE, SE is provided above each subplot

