

# Mean–Mean Multiple Comparison Displays for Families of Linear Contrasts

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We graphically convey the results of procedures for simultaneous inferences involving some or all members of a set of population means. Our *Mean–mean Multiple Comparison (MMC)* plot succinctly and compactly displays the results of traditional procedures for multiple comparisons of population means or of linear contrasts involving means. We introduced the MMC plot for balanced data in (Heiberger and Holland, 2004b). In this paper we extend the plot to include comparisons of means in multifactor unbalanced designs with covariates. The MMC plot is a generalization and refinement of a plot introduced and used by (Hsu and Peruggia, 1994) for the more restrictive problem of comparing all pairs of means.

Standard procedures for graphically presenting the results of such procedures suffer from an inability to show *all* of the relevant information in the same plot:

1. The sample means themselves, with correct relative distances,
2. The point and interval estimates of the  $\binom{k}{2}$  pairwise differences,
3. The point and interval estimates for arbitrary contrasts of the level means,
4. Declarations of significance,
5. Confidence interval widths that are correct when the sample sizes are unequal.

The MMC plot described in this paper displays **all** of these items in the same plot.

We introduced the MMC plot for balanced data in (Heiberger and Holland, 2004b) for three commonly encountered uses of multiple comparison procedures for comparing  $k$  means of main effects (in the absence of interaction) or simple effects (in the presence of interaction):

1. Comparisons among all  $\binom{k}{2}$  pairs arising from  $k$  population means,
2. Comparisons of one designated population mean with the means of  $k - 1$  related populations,
3. Comparisons among members of a set of linear contrasts involving the  $k$  means

We present and discuss a simple MMC plot and give details on the construction of MMC plots, emphasizing the implementations in R and S-PLUS (which differ as they build respectively on the capabilities of the `simint` function in the `multcomp` package in R and on the `multcomp` function in S-PLUS).

## REFERENCES

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- (Hsu and Peruggia, 1994) Hsu, J. and Peruggia, M. (1994). Graphical representations of Tukey’s multiple comparison method. *Journal of Computational and Graphical Statistics*, 3:143–161.

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