

Simultaneous CI Formulas for a CRD with k Treatments and n Replications per Treatment

Bonferroni

$$\underline{\ell}'\hat{\beta} \pm (t_{nk-k,1-\frac{\alpha}{2k}})\sqrt{\hat{\sigma}^2\underline{\ell}'(X'X)^{-1}\underline{\ell}}$$

vs.

Scheffe for all linear combinations

$$\underline{\ell}'\hat{\beta} \pm \sqrt{kF_{k,nk-k,1-\alpha}}\sqrt{\hat{\sigma}^2\underline{\ell}'(X'X)^{-1}\underline{\ell}}$$

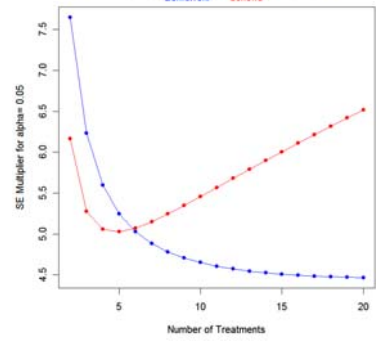
or

Scheffe for all contrasts

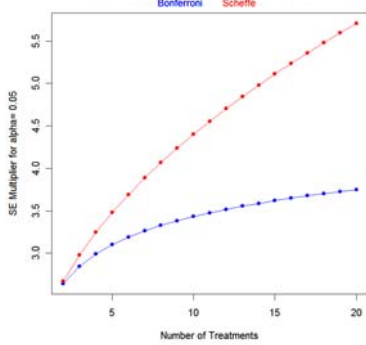
$$\underline{\ell}'\hat{\beta} \pm \sqrt{(k-1)F_{k-1,nk-k,1-\alpha}}\sqrt{\hat{\sigma}^2\underline{\ell}'(X'X)^{-1}\underline{\ell}}$$

The question of which simultaneous intervals are best (narrowest) does not depend on the data.

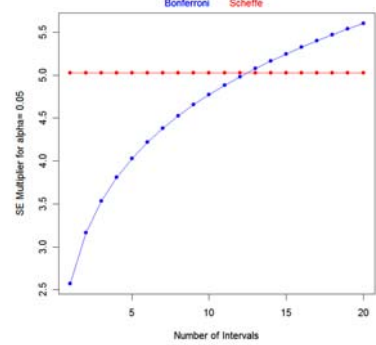
CRD with 2 reps per k treatments and k + k(k-1)/2 intervals



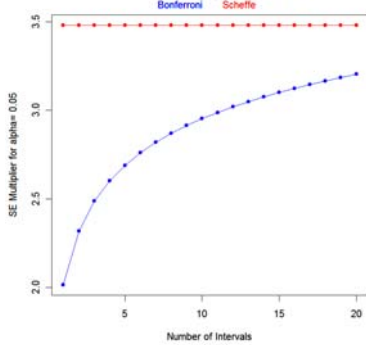
CRD with 10 reps per k treatments and k + k(k-1)/2 intervals



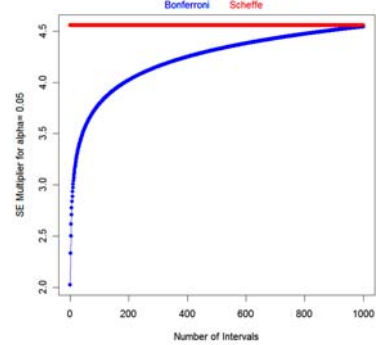
CRD with 2 reps per 5 treatments

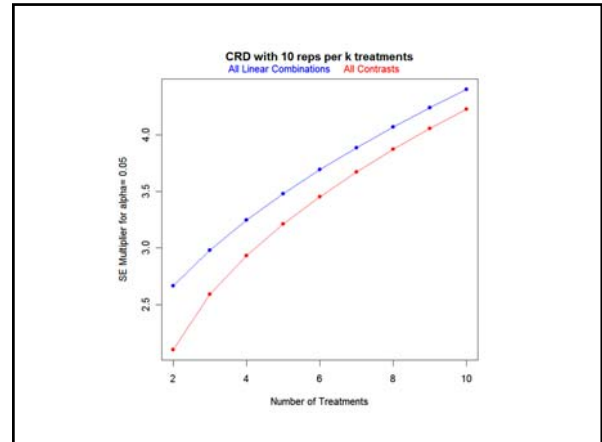
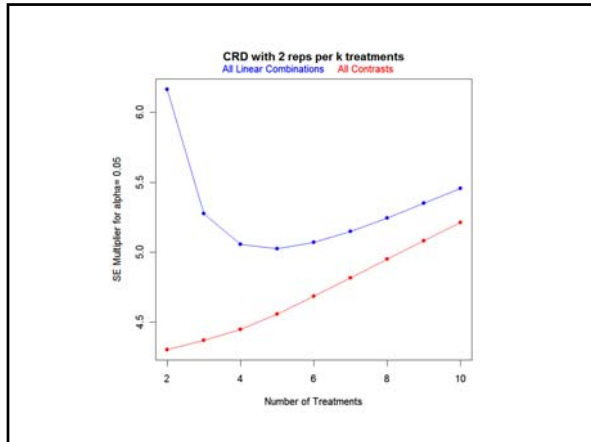


CRD with 10 reps per 5 treatments



CRD with 5 reps per 10 treatments





- ### Hybrid Methods
- Suppose we want simultaneous 95% CI's for all means and all pairwise differences among means.
 - We could construct simultaneous 97.5% CI's for all means using Bonferroni's method and simultaneous 97.5% CI's for all pairwise differences among means using Tukey's method.
 - The combined set of intervals gives simultaneous coverage at least 95% using Bonferroni's inequality.

R Commands for Distribution of the Studentized Range

ptukey(u, nmeans=k, df=n*k-k)
 gives $P\{U \leq u\}$.

qtukey(p, nmeans=k, df=n*k-k)
 gives value of u such that $P\{U \leq u\} = p$.