Lesson 9

Ex. 2.4.3 **a) Block 1: (1), ab, ac, bc, ad, bd, cd, abcd; Block 2: a, b, c, abc, d, abd, acd, bcd.**
b) Block effect overlaid with interaction ABCD; $\widehat{(\tau\beta\gamma\delta)}_{1111} = 0.0625$**, and this effect appears to be negligible.**
c) $Y_{ijkl} = m_{ij} + \gamma_k + \delta_l + \epsilon_{ijkl}$**. Model is motivated by significance of AB, C and D.**
d) $I_{m_{-1,1}-m_{-1,-1}} = (-1.13, -0.02)$**; choose machine B=-1 for A=-1.**
$I_{m_{1,1}-m_{1,-1}} = (0.52, 1.63)$**; choose machine B=1 for A=1.**
$I_{\gamma_1-\gamma_{-1}} = (0.26, 1.04)$**; choose C=1.**
$I_{\delta_1-\delta_{-1}} = (0.11, 0.89)$**; choose D=1.**

Ex. 2.4.4 **a) No. 3: B+ACDE, No. 5: C+ABDE and No. 7: BC+ADE according to normal probability plot. Effect no. 16 is E+ABCD. Estimated value is -0.475.**
b) $Y_{ijk} = \mu_{ij} + \epsilon_{ijk}$ **for B-level** i **and C-level** j. $I_{\mu_{ij}-\mu_{uv}} = (\bar{y}_{ij\cdot} - \bar{y}_{uv\cdot} \pm 2.94)$**. High level for both B and C is better than the other combinations.**
c) D-factor has the biggest impact among those effects that we neglected.

Ex. 2.4.5 **a) The most important effects are A+ABCDE, AD+ABCE and AB+ACDE, that we interpret as A, AD and AB. Main effect of E is included in the parameter estimate together with parameter estimate for interaction BCD, i.e. no. 15: -0.128, which seems quite negligible.**
b) A complete three factor model with A, B and D. A should be on low level according to result in a). $I_{\mu_{-1jk}-m_{-1pq}} = (\bar{y}_{-1jk} - \bar{y}_{-1pq} \pm 4.24)$**, where we use** $t = 2.31$**, that gives simultaneous confidence level at least 70%.**
$I_{\mu_{-1,1,1}-m_{-1,1,-1}} = (\bar{y}_{-1,1,1} - \bar{y}_{-1,1,-1} \pm 4.24) = (-2.38, 6.10)$**. Choice of B- and D- levels is not clear.**

Ex. 2.4.6 **a) Observations are e a b abe c ace bce abc d ade bde abd cde acd bcd abcde.**
b) The most important effects are no. 2, i.e. effect A+BCDE, and no. 3, i.e. B+ACDE, which we interpret as the main effects of A and B. $\hat{e}$ **is included in no. 16 and estimated with 10.625.**
c) Model: $Y_{ijkl(v)} = \mu + \tau_i + \beta_j + \gamma_k + \delta_l + e_v + \epsilon_{ijkl(v)}$ **where** $\epsilon_{ijkl(v)} \sim N(0, \sigma)$ **independent + usual constains. The worst result i.e. The worst result that most cracks one gets when A, B, C, D and E are on high level, that gives estimated value** $\hat{\theta} = \hat{\mu} + \hat{\tau}_1 + \hat{\beta}_1 + \hat{\gamma}_1 + \hat{\delta}_1 + \hat{e}_1 = 1133.00$**. By using the fact that r.v.** $\hat{\mu}, \ldots, \hat{e}$ **are independent and normally distributed with variance** $\sigma^2/16$ **we obtain t-interval:** $I_\theta = (1133.0 \pm 29.40) = (1103.6, 1162.4)$**, where t(10)-distributed help variable was used.**