HW07 DUE 12/13/2022

1) Main effect A(Temperature) $= \frac{7.6+13.0+14.0+\ldots+12.8+18.6}{8} - \frac{15.3+11.2+10.8+\ldots+15.0+13.0}{8}$

$= \frac{105.3}{8} - \frac{103.1}{8} = 13.163 - 12.888 = \boxed{0.275}$

Main effect B(Oil) $= \frac{11.2+13.0+17.8+\ldots+13.0+18.6}{8} - \frac{15.3+7.6+10.8+\ldots+15.0+12.8}{8} = \frac{106.6}{8} - \frac{101.8}{8}$

$= 13.325 - 12.725 = \boxed{0.6}$

Main effect C(Mixing) $= \frac{10.8+14.0+17.8+\ldots+13.0+18.6}{8} - \frac{15.3+7.6+11.2+\ldots+11.0+8.8}{8} = \frac{115.2}{8} - \frac{93.2}{8}$

$= 14.4 - 11.65 = \boxed{2.75}$

Main effect D(Sugar) $= \frac{9.0+17.3+11.0+\ldots+13.0+18.6}{8} - \frac{15.3+7.6+11.2+\ldots+17.8+13.2}{8} = \frac{105.5}{8} - \frac{102.9}{8}$

$= 13.188 - 12.863 = \boxed{0.325}$

Interaction AB $= \frac{103.7}{8} - \frac{104.7}{8} = 12.963 - 13.086 = \boxed{-0.123}$

Interaction AC $= \frac{105.1}{8} - \frac{103.3}{8} = 13.138 - 12.913 = \boxed{0.225}$

Interaction AD $= \frac{112.6}{8} - \frac{95.8}{8} = 14.075 - 11.975 = \boxed{2.1}$

Interaction BC $= \frac{111.8}{8} - \frac{96.6}{8} = 13.975 - 12.075 = \boxed{1.9}$

Interaction BD $= \frac{99.1}{8} - \frac{109.3}{8} = 12.388 - 13.663 = \boxed{-1.275}$

Interaction CD $= \frac{106.5}{8} - \frac{101.9}{8} = 13.313 - 12.738 = \boxed{0.575}$

Interaction ABC $= \frac{104.7}{8} - \frac{103.2}{8} = \boxed{0.125}$

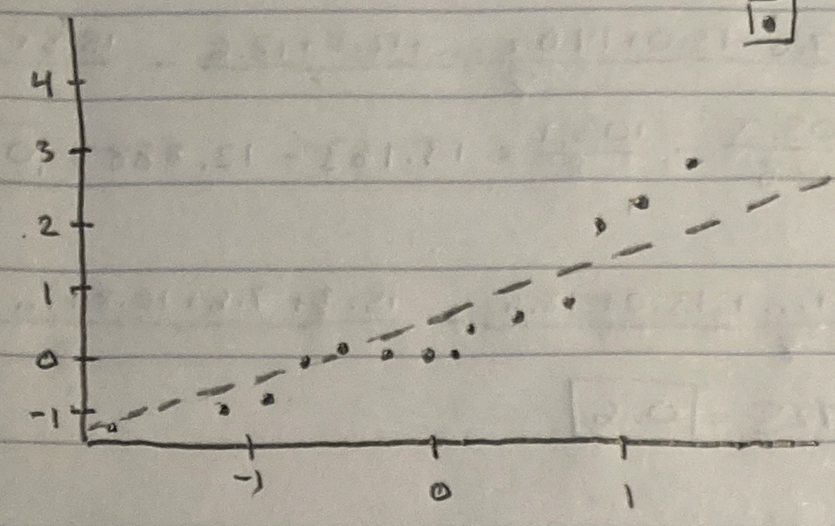
Interaction ABD $= \frac{102}{8} - \frac{106.4}{8} = \boxed{-0.55}$

Interaction ACD $= \frac{100.6}{8} - \frac{107.8}{8} = \boxed{-0.9}$

Interaction BCD $= \frac{106.9}{8} - \frac{101.5}{8} = \boxed{0.675}$

Interaction ABCD $= \frac{122}{8} - \frac{86.4}{8} = \boxed{4.45}$

2) Daniel's method



We see the ABCD term is an outlier on the normal qqplot, meaning it is a significant effect according to Daniel's method

Lenth's method

median of effects = 0.6 → $s_0 = 1.5(0.6) = 0.9$

↳ All effects other than |C| and |ABCD| are less than $2.5(s_0) = 2.25$

↳ median of effects other than |C| and |ABCD| = 0.575

$PSE = 1.5(0.575) = 0.863$, $v = \frac{9}{3} = \frac{15}{3} = 5$

at $\alpha = 0.1$, $\gamma = 0.5(1-(1-\alpha)^{1/9}) = 0.0035$

↳ $t_{v,\gamma} \cdot PSE = 4.404 \cdot 0.863 = \boxed{3.8}$ → ABCD effect is significant, as $4.45 > 3.8$

Dong's Method

As calculated above, $2.5(s_0) = 2.25$, and $m_1 = 13$ (All effects - C and ABCD)

$s_1^2 = (0.275^2 + 0.6^2 + 0.325^2 + \ldots + 0.9^2 + 0.675^2)/13 = 0.936$

$s_1 = 0.936$ → $2.5 \cdot 0.936 = 2.4$ → all other effects other than C and ABCD are less than $2.5 \cdot s_1$

$m_2 = 13$, $s_2 = s_1 = 0.936$

↳ $t_{m_2,\gamma} \cdot s_2 = t_{13,0.0035} \cdot s_2 = 3.1981 \cdot 0.936 = \boxed{2.99}$ → ABCD effect is significant

3) 2fi and 3fi are assumed negligible

↳ Var (effect) = $(AB^2 + AC^2 + \ldots + BCD^2)/10 = 11.626/10 = 1.163$

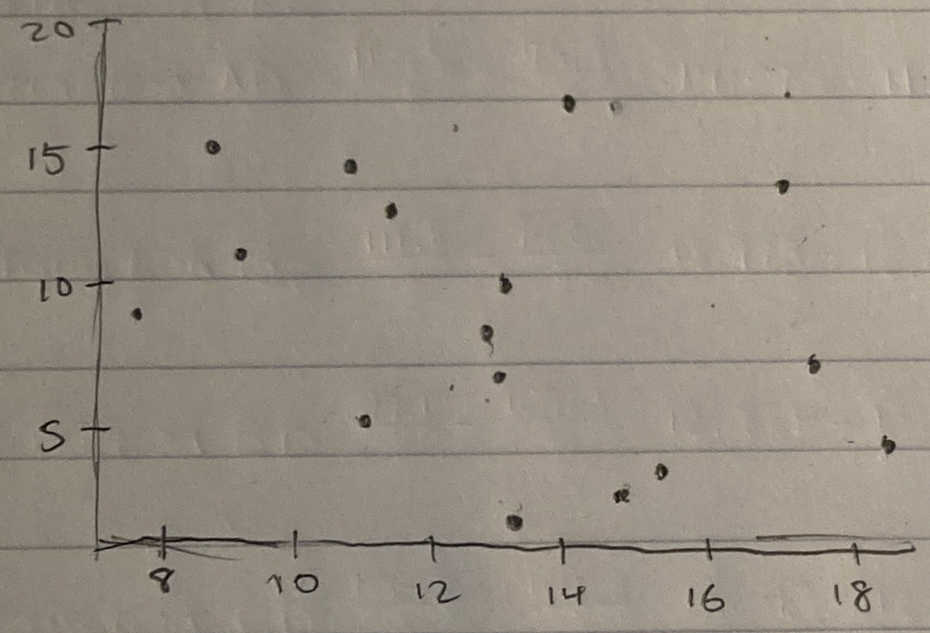
↳ sd (effect) = 1.078 with 10 df

90% Bonferroni → Effect $\pm$ 2.9606 * 1.078 => **Effect $\neq$ 3.19**

↳ ABCD significant at 0.1

4)

5)



6) Any run that contains a high level of C (mixing) shows high average scores, which explains the large C main effect value, and as such, makes sense that ABCD is significant, as all other effects are high level as well