

Solutions to HW 4 problems

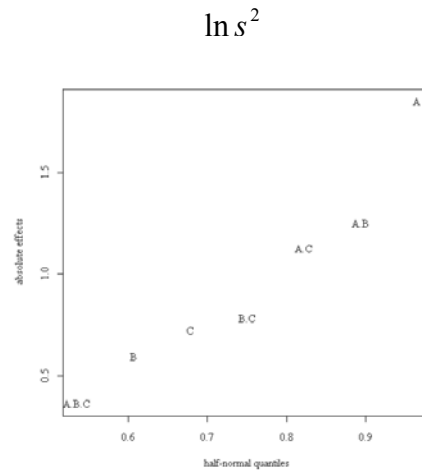
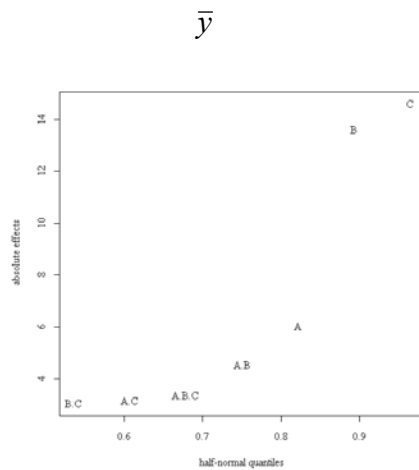
1. Substitute (3.6) in (3.13) and arrange the terms to get (3.14).
2. If it is assumed that any non-zero estimated effect is significant, it is clear from the 8 runs that the optimal setting corresponds to run 6 with % of non-cracked springs, $Y=90$. In the one-factor-at-a-time approach, suppose we start at run 1, for which Y is 67. Now change only oil temperature to 120, keeping other two factors unchanged. From run 5 we find $Y=59$, so the best level of oil temperature is 70. Now keeping oil temperature at 70 and steel temperature at 1450, change % Carbon. From run no. 3, we see that $Y=61$, so the best level of % Carbon is 0.50. Now keeping oil temperature at 70 and % Carbon at 0.50, change the steel temperature. From run 2, $Y=79$. So the best level of steel temperature is 1600. Thus the best setting from the one-factor-at-a-time approach is run 2 with $Y=79$. Thus we miss the optimal setting.

If, however, we conduct a full factorial analysis, we find from the half-normal plot that C (and maybe B and AC) is significant. Since our task is to maximize the response, we find $C=1600$ as the best setting. If in addition, B and AC are considered, then $A=120$, $B=0.50$ and $C=1600$ becomes the best.

3.(a)

\bar{y} : 74.96 80.04 50.44 68.28 57.92 75.96 49.16 66.60

$\ln s^2$: 7.213 4.221 4.226 3.523 2.628 2.609 2.865 3.686



The t_{PSE} values are given below. None of the effects are significant for $\ln s^2$. The main effects B and C for \bar{y} are significant at 10% IER.

	A	B	C	A.B	A.C	B.C	A.B.C
\bar{y}	-0.88	-2.00	2.14	0.67	0.46	0.45	-0.49
$\ln s^2$	-1.57	-0.50	-0.62	1.06	0.96	0.67	-0.31

(b) The fitted model for \bar{y} is $\bar{y} = 65.42 - 6.8B + 7.3C$. To get \bar{y} at 75, let $B = -1$ (800 rpm) then $C = 0.38$ (70.7 mm/min). There may actually be multiple solutions, generally the most economic one is selected.

4. $B_1B_2 = 1234 * 2345 = 15$. So the interaction **15** is confounded with the block effect B_1B_2 and the ability to estimate **15** is sacrificed. The main effect **5** will not be affected.