

The effect of three factors are investigated on yield. The results are the following:

Temperature 0C	concentration %			
	20		40	
	Type of catalyst			
	A	B	A	B
160	60	52	54	45
180	72	83	68	80

- Recognize the type of the design. Estimate the effect of each factor!
- Make a main effect graph for the temperature!
- Make an interaction graph to study the possible interaction between the temperature and the concentration! What do you think, is there an interaction?
- Estimate the model parameters for each factor and two factor interaction parameters.
- What is the estimated yield with catalyst A, at 170 °C if the concentration is 20%?

Answers

- It is a 2^3 factorial design.

z1 (Temp)	z2 (Conc)	z3 (Catalyst)	x1	x2	x3	y (Yield)
160	20	A	-	-	-	60
160	20	B	-	-	+	52
160	40	A	-	+	-	54
160	40	B	-	+	+	45
180	20	A	+	-	-	72
180	20	B	+	-	+	83
180	40	A	+	+	-	68
180	40	B	+	+	+	80

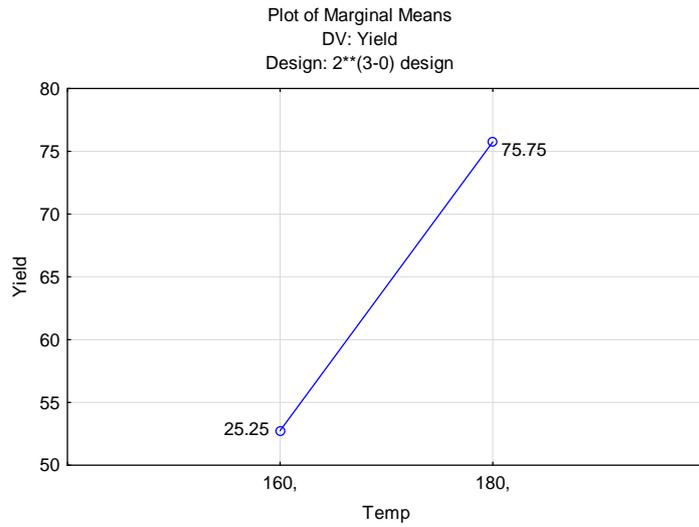
Effect of the temperature:

$$effect_1 = \bar{y}_{x1=+} - \bar{y}_{x1=-} = \frac{72 + 83 + 68 + 80}{4} - \frac{60 + 52 + 54 + 45}{4} = 75.75 - 52.75 = 23$$

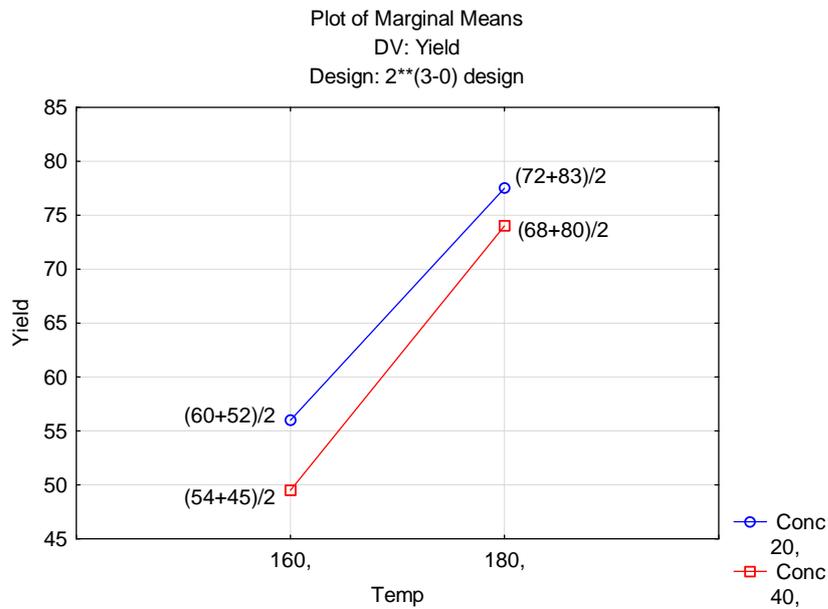
Concentration: $effect_2 = -5$

Catalyst: $effect_3 = 1.5$

b)



c) As the lines on the interaction graph are nearly parallel, there is no interaction between the two factors.



d)

Effect Estimates; Var.:Yield; R-sqr=1, (Spreadsheet28	
2**(3-0) design	
DV: Yield	
Factor	Coeff.
Mean/Interc.	64,25000
(1)Temp	11,50000
(2)Conc	-2,50000
(3)Catalyst	0,75000
1 by 2	0,75000
1 by 3	5,00000
2 by 3	0,00000

e) $z_1=170^{\circ}\text{C} \rightarrow x_1=0$; $z_2=20\% \rightarrow x_2=-1$; $z_3=\text{Catalyst A} \rightarrow x_3=-1$
 $\hat{Y} = 64.25 + 2.5 - 0.75 = 66$