ISLR 6.8.5 (d)

$(y_1-\hat{\beta}_1x_{11}-\hat{\beta}_2x_{12})^2+(y_2-\hat{\beta}_1x_{12}-\hat{\beta}_2x_{22})^2+\lambda(|\hat{\beta}_1|+|\hat{\beta}_2|)$

assuming $x_{11}=x_{12}=-x_{21}=-x_{22}=a$,

$y_1+y_2=0 \Rightarrow y_1=-y_2=b$.

$\Rightarrow (b-\hat{\beta}_1a-\hat{\beta}_2a)^2+(-b+\hat{\beta}_1a+\hat{\beta}_2a)^2+\lambda(|\hat{\beta}_1|+|\hat{\beta}_2|)$

$\frac{\partial}{\partial\beta_1}=0 \Rightarrow 2(b-\beta_1a-\beta_2a)\cdot(-a)+2(-b+\beta_1a+\beta_2a)\cdot(a)+(\pm\lambda)=0$ ...①

$\frac{\partial}{\partial\beta_2}=0 \Rightarrow 2(b-\beta_1a-\beta_2a)\cdot(-a)+2(-b+\beta_1a+\beta_2a)\cdot(a)+(\pm\lambda)=0$ ...②

① $2a(-b+\beta_1a+\beta_2a-b+\beta_1a+\beta_2a)=\pm\lambda$.

② $2a(-b+\beta_1a+\beta_2a-b+\beta_1a+\beta_2a)=\pm\lambda$.

$\Rightarrow 4a[b-a(\beta_1+\beta_2)]=\pm\lambda$

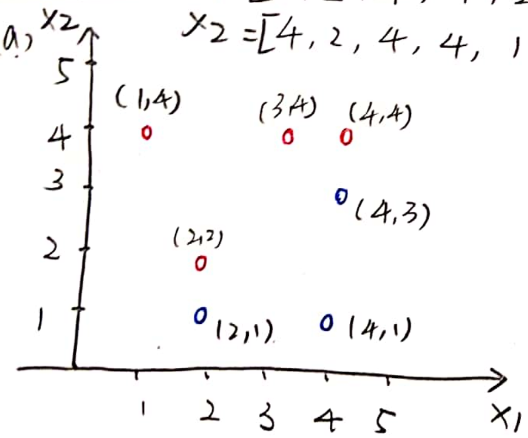
-According to the above, (the boundary of the Lasso constraint),
In this case, the Lasso coefficients $\hat{\beta}_1$ and $\hat{\beta}_2$ are not unique.

ISLR 9.7.3.

$x_1=[3,2,4,1,2,4,4]$ (r, r, r, r, B, B, B)

$x_2=[4,2,4,4,1,3,1]$

(a)



(b) from above figure:

use: (2,2)(4,4)

(2,1)(4,3)

$\Rightarrow (\frac{2+2}{2},\frac{2+1}{2}),(\frac{4+4}{2},\frac{4+3}{2})$

$\Rightarrow \underset{\text{point1}}{(2,1.5)},\underset{\text{point2}}{(4,3.5)}$

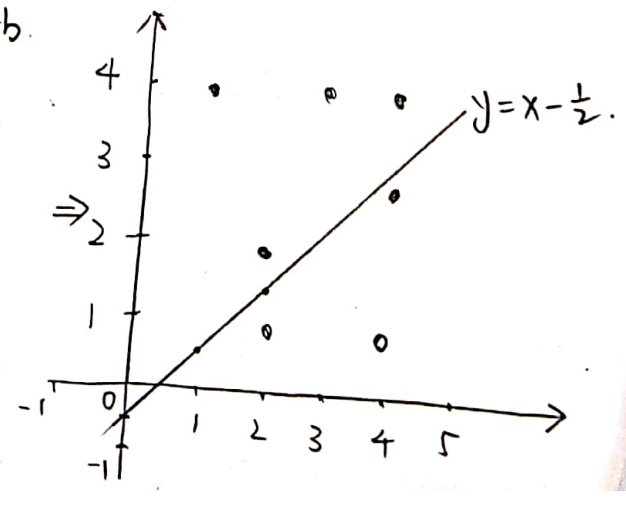
assume $y=ax_1+b$.

$\Rightarrow \begin{cases}1.5=2a+b\\3.5=4a+b\end{cases}$

$\Rightarrow \begin{cases}a=1\\b=-0.5\end{cases}$

$\Rightarrow y=x-\frac{1}{2}$

$\Rightarrow$



(c) ~~$\beta_0+\beta_1X_1+\beta_2X_2>0$~~

Red $x_1-x_2-0.5<0$

Blue $x_1-x_2-0.5>0$

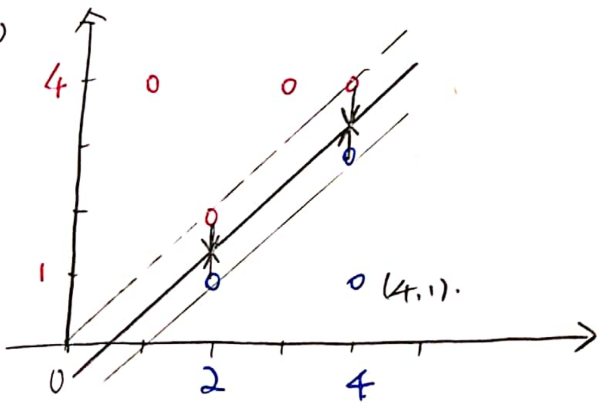
(d) I check $\underline{\overset{(4,3)}{(4,4)}}$. $X_1-X_2-0.5=0$

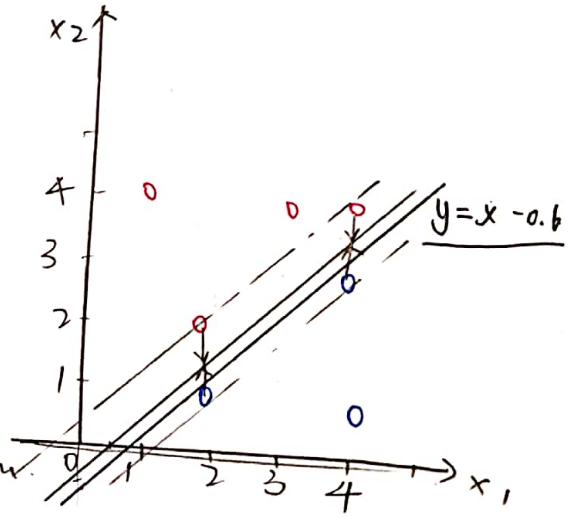
$$\frac{|4-4-0.5|}{\sqrt{1+1}}=\frac{0.5}{\sqrt{2}}=0.3536$$

$$\frac{|4-3-0.5|}{\sqrt{2}}=\frac{0.5}{\sqrt{2}}=0.3536.$$

$\Rightarrow$ the maximal margin hyperplane $=0.3536$.

(e)





f) A slight movement of observation ~~#7~~ (4,1). blue would not have an effect on the maximum margin hyperplane. Since its movement would be outside of margin.

(g) assume. $y=ax+b$, between $\begin{cases} y=x-\frac{1}{2} \\ y=x-1 \end{cases}$ $\Leftarrow$ $(4,3)\ (2,1) \Rightarrow \begin{cases} 3=4a+b \\ 1=2a+b. \end{cases}$ $\Rightarrow \begin{cases} a=1. \\ b=-1 \end{cases}$

$\Rightarrow$ $y=x-0.6$

(h) In the case. set a red observation ~~in to~~ into $x_1-x_2-0.5>0$.