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1. a) $\hat{y} = Xw = \begin{bmatrix} b+c+2 \\ 2b-2c \\ 6-3b-3c \end{bmatrix}$

b) If $y = \begin{bmatrix} y \\ c \\ 0 \end{bmatrix}$, $\begin{cases} b+c+2=4 \\ 2b=2c \\ 3b+3c=6 \end{cases}$

$\rightarrow \begin{cases} b=1 \\ c=1 \end{cases}$

c) Similar as b), $\begin{cases} b+c+2=-2 \\ 2b-2c=0 \\ 6-3b-3c=12 \end{cases}$

$\begin{cases} b=-1 \\ c=-1 \end{cases}$

2. a) $Z = \frac{4x_3}{9x_1+4x_2+4x_3} < \frac{1}{4}$.

So, $9x_1+4x_2-12x_3>0$

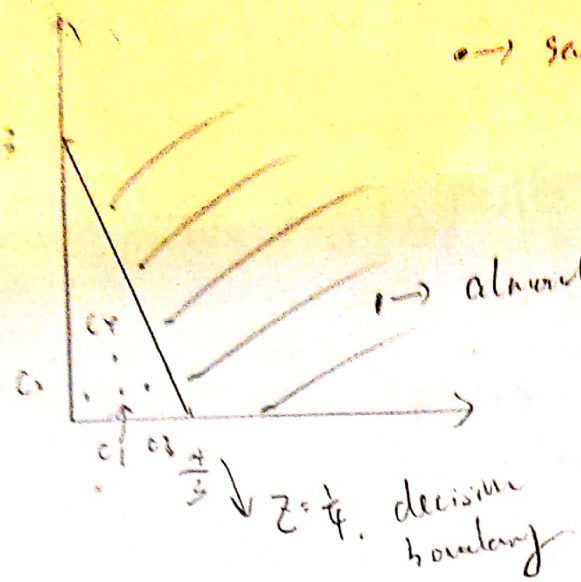
To satisfy this eqn., we set $\begin{cases} \tilde{w}_1 = 9 \\ \tilde{w}_2 = 4 \\ \tilde{w}_3 = -12 \end{cases}$.

b). We need to use f & r_p to re-express Z

So, $Z = \frac{4x_3}{9x_1+4x_2+4x_3} < \frac{1}{4}$

$9r_f + 4r_p - 12 > 0$

c)



d) Calculating r_f & r_p for c_1, c_2, c_3, c_4,

carry to get.: for c_1 to c_4, $9r_f + 4r_p - 12 < 0$.

Thus, none classified as low carb.

e) for almond butter, $r_f = 3$, $r_p = \frac{3.4}{3}$.

$9r_f + 4r_p - 12 = 27 > 0$, → low carb

f) Similar as e), $r_f = 19$, $r_p = 2$,

$9r_f + 4r_p - 12 = 9 \times 19 + 4 \times 2 - 12 > 0$ → low carb.

3. a) We need to calculate the misclassifications for each of the 6 vectors and to get the lowest misclassifications.

for, $w_1 = \begin{bmatrix} 0 \\ -1 \end{bmatrix}$, $w_2 = \begin{bmatrix} 2 \\ -3 \end{bmatrix}$, $w_3 = \begin{bmatrix} 3 \\ -2 \end{bmatrix}$, $w_4 = \begin{bmatrix} 1 \\ 4 \end{bmatrix}$, $w_5 = \begin{bmatrix} 3 \\ 2 \end{bmatrix}$,

$w_6 = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$, we find that, for $w_2 = \begin{bmatrix} 2 \\ -3 \end{bmatrix}$, $w_4 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$,

we get the lowest misclassifications, i.e, 2.

b). Similar as a), but this time, we need to find the misclassifications, After calculation, easy to get that $w = \begin{bmatrix} 2 \\ -1 \end{bmatrix}, \begin{bmatrix} 2 \\ -3 \end{bmatrix}, \begin{bmatrix} 3 \\ 2 \end{bmatrix}$ are fair.

c).

$w = \begin{bmatrix} 2 \\ -3 \end{bmatrix}$

No. since $\begin{bmatrix} 1 \\ 0 \end{bmatrix}$ is not fair.