7.2. a) $T = \{(-2,4),(2,4),(1,1),(-1,1),(0,0),(3,9)\}$

$T_1 = \{(-2,4),(2,4)\}$ $T_2 = \{(1,1),(-1,1)\}$ $T_3 = \{(0,0),(3,9)\}$

i) $T_{train} = T_1 \cup T_2$ $T_{val} = T_3$

$f_{KNN}(0) = \frac{1}{2}(1+1) = 1$; $f_{KNN}(3) = \frac{1}{2}(1+4) = \frac{5}{2}$

$ERR_1 = \frac{1}{2}\left((0-1)^2 + (9-\frac{5}{2})^2\right) = 21.625$

ii) $T_{train} = T_1 \cup T_3$ $T_{val} = T_2$

$f_{KNN}(1) = \frac{1}{2}(0+4) = 2$; $f_{KNN}(-1) = \frac{1}{2}(0+4) = 2$

$ERR_2 = \frac{1}{2}\left((1-2)^2 + (1-2)^2\right) = 1$

iii) $T_{train} = T_2 \cup T_3$ $T_{val} = T_1$

$f_{KNN}(-2) = \frac{1}{2}(1+0) = \frac{1}{2}$; $f_{KNN}(2) = \frac{1}{2}(1+9) = 5$

$ERR_3 = \frac{1}{2}\left((4-\frac{1}{2})^2 + (4-5)^2\right) = \frac{1}{2}\left(\frac{49}{4}+1\right) = 6,625$

$EGE(f_{KNN}) = \frac{1}{3}\sum_{i=1}^{3} ERR_i = \frac{1}{3}(21,625 + 1 + 6,625) = 9,75$

b) T is given as before, $T = T_1 \cup \dots \cup T_6$

i) $T_{val} = T_1$; $T_{train} = T \setminus T_{val}$; $\hat{\beta} = (1, 2)$

$f(-2) = -3$, $ERR_1 = (4 - (-3))^2 = 49$

ii) $T_{val} = T_2$; $\hat{\beta} = (1.08, 2.78)$; $f(2) = 4.95$; $ERR_2 = 0.895$

iii) $T_{val} = T_3$; $\hat{\beta} = (3.16, 1.09)$; $f(1) = 4.26$; $ERR_3 = 16.6$

iv) $T_{val} = T_4$; $\hat{\beta} = (2.86, 0.92)$; $f(-1) = 1.95$; $ERR_4 = 0.895$

v) $T_{val} = T_5$; $\hat{\beta} = (3.26, 0.9)$; $f(0) = 3.26$; $ERR_5 = 16.6$

vi) $T_{val} = T_6$; $\hat{\beta} = (2, 0)$; $f(3) = 2$; $ERR_6 = 49$

$$EGE(f) = \frac{1}{6} \sum_{i=1}^{6} ERR_i = 20.165$$