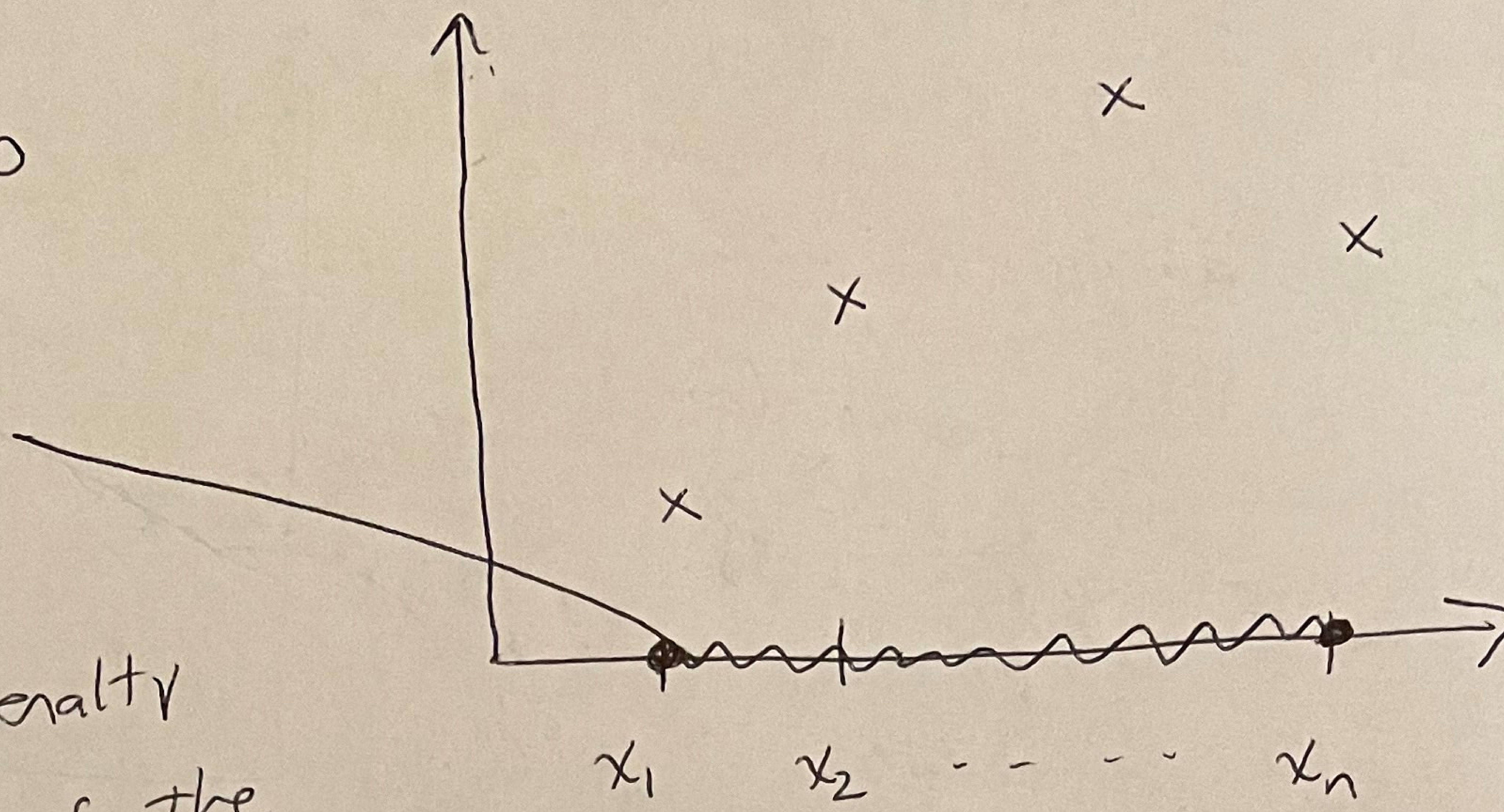
2.)

(a) $\lambda = \infty$; $m=0$

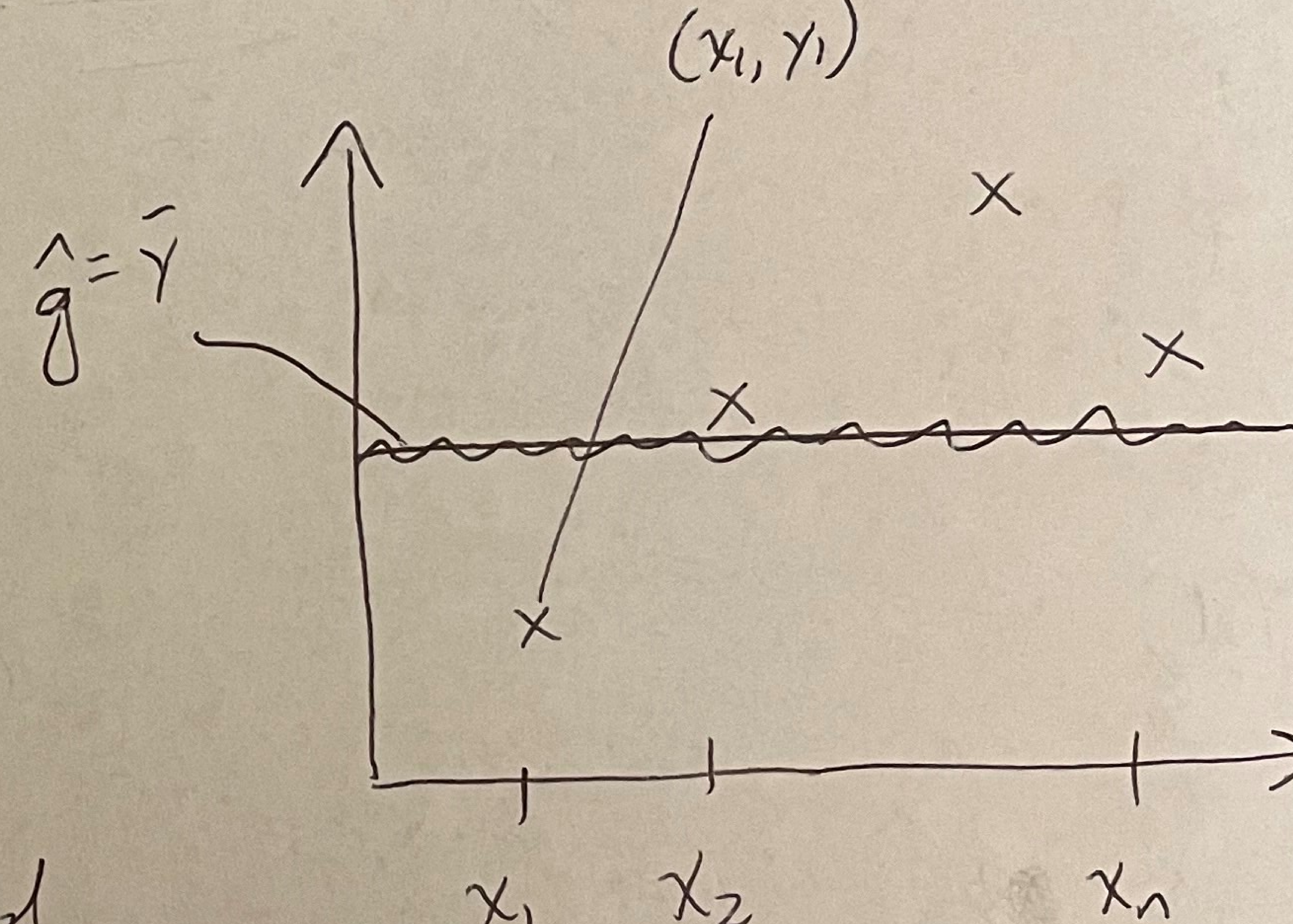
<u>Soln:</u> $\hat{g} = 0$.



<u>Reason:</u> when $\lambda \to \infty$, the second term = penalty dominates, regardless of the non-zero value of the integral.

when $g=0 \Rightarrow g^2 = 0 \Rightarrow \int g^2 = 0$, the minimum value of the argument is achieved.

(b) $\lambda = \infty$; $m=1$.



<u>Soln:</u>

$$\hat{g} = \bar{Y} = \left(\frac{1}{n} \sum_{i=1}^{n} Y_i\right)$$

<u>Reason:</u> Again, when $\lambda \to \infty$, the second term dominates. we can set the 2nd term to zero if

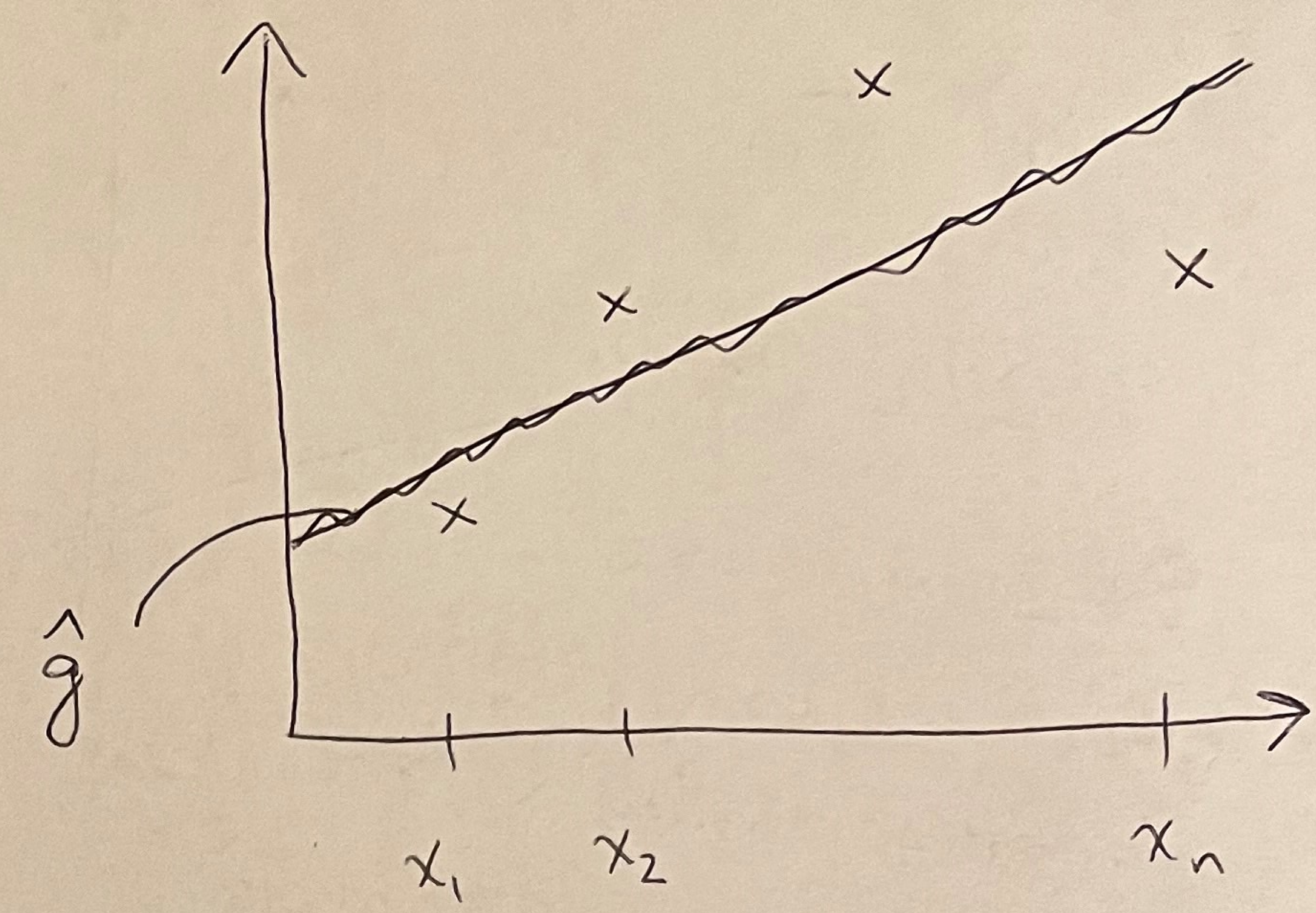
$g' = 0 \Rightarrow (g')^2 = 0 \Rightarrow \int (g')^2 = 0$.

Thus a constant function will do this.

All that is left to do is minimize the first term: $\sum_{i=1}^{n} (Y_i - g(x_i))^2$.

Assuming unwtd obs, this will be accomplished by setting $\hat{g}$ equal to the unwtd avg of $\{Y_i\}$, namely $\hat{g} = \bar{Y}$.

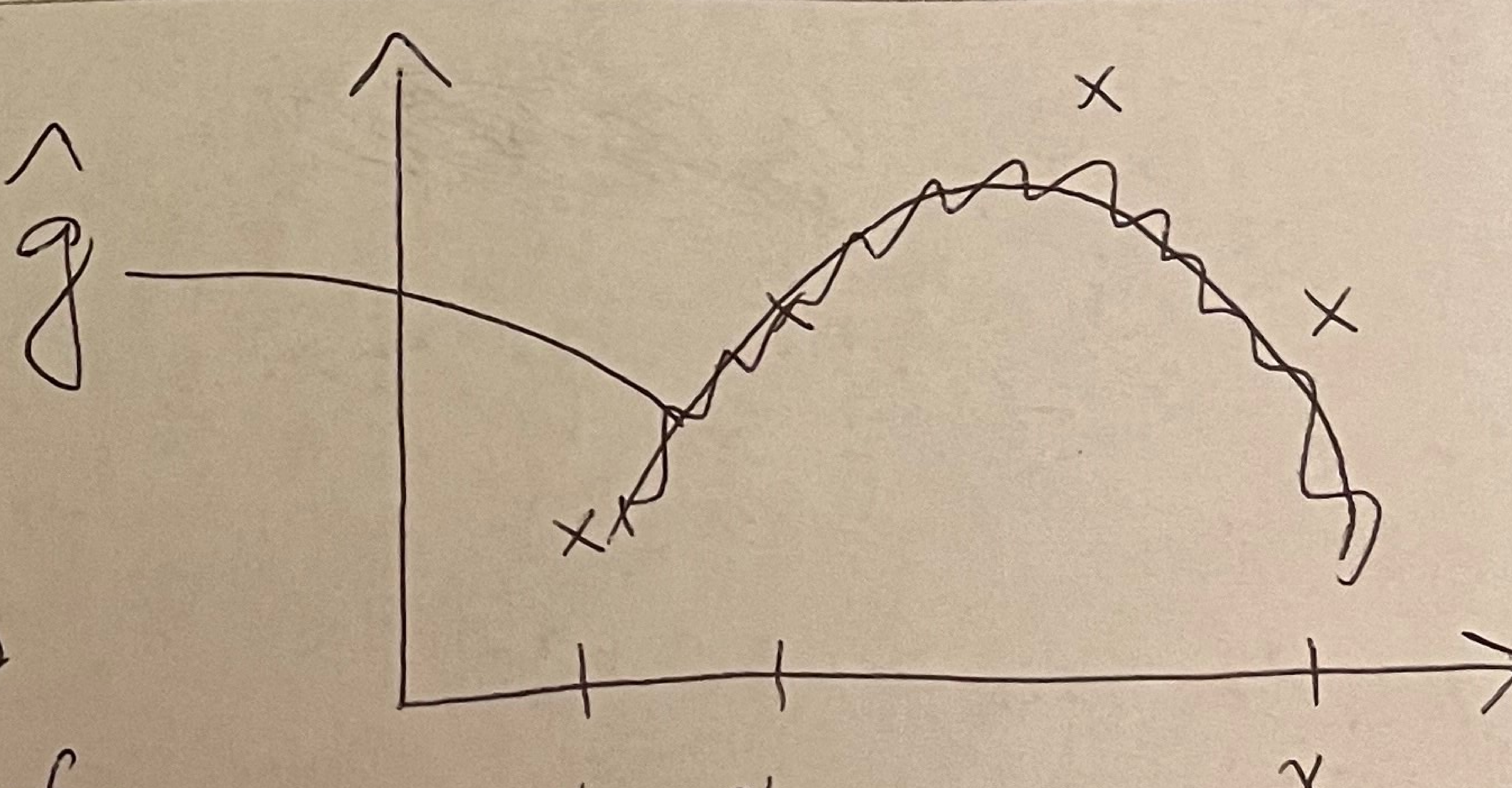
(c.) $\lambda = \infty$; $m = 2$



Soln: $\hat{g}_i = \hat{\beta}_0 + \hat{\beta}_1 \cdot x_i$, where $(\hat{\beta}_0, \hat{\beta}_1)$ are OLS parms from regression of $\{y_i\}$ on $\{x_i\}$.

Reason: Again we can set the second term to 0 if we set $g'' = 0$ globally. Any straight line (polynomial of order 0 or 1) will do this. Thus, all that is left to do is find the 0 or 1 order polynomial which minimizes $\sum_i (y_i - g(x_i))^2$, which is exactly the ordinary least squares regression line of $\{y_i\}$ on $\{x_i\}$.

(d) $\lambda = \infty$; $m = 3$.

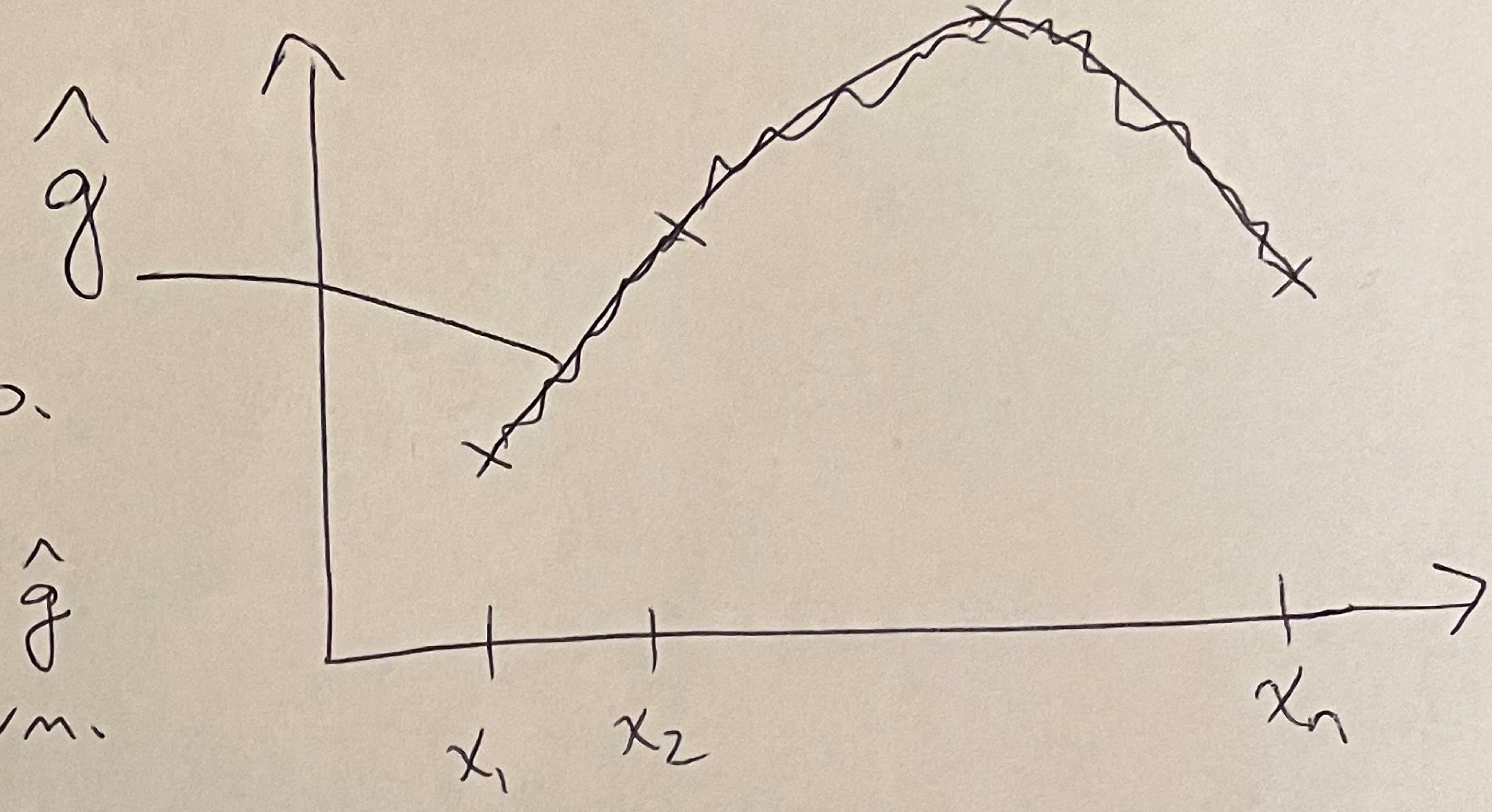


Soln: $\hat{g}(x_i) = \hat{\beta}_0 + \hat{\beta}_1 \cdot x_i + \hat{\beta}_2 \cdot x_i^2$, where $(\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2)$ are the parms from the polynomial regression of y on $(1, x, x^2)$.

Reason: Again, set 2nd term to 0 if set $g''' = 0$ globally. Any polynomial of degree 0, 1, or 2 will have a 3rd derivtive which is 0 globally, making 2nd term $= 0$. Thus, minimizing the first term will be accomplished by the polynomial regression of $\{y_i\}$ on $\{1, x_i, x_i^2\}$.

(2) continued.

(e.) $\lambda=0$; $m=3$.



As $\lambda=0$, the second term $=0$.

All that remains is to find $\hat{g}$

that minimizes the first term.

Obviously, this generally is a poor choice in modelling, but b/c there is no penalty/reason not to do, $\hat{g}$ will be the polynomial (of degree at most $(n-1)$) that perfectly interpolates the n points, thus setting the first term as well (and thus the whole expression) $=0$.

It does not matter the value of m, as $\lambda=0 \Rightarrow 2^{nd}$ term is 0; all we are trying to do here is minimize the train set SSE.