1. Under the setting of simple linear regression model, write down f explicitly and solve β through risk minimization of

$$EPE(f) = E(Y - f(X))^2 = \int (y - f(x))^2 dP_{Y,X}(y,x) \tag{1}$$
$$= E_X E_{Y|X} \left([Y - f(X)]^2 | X \right).$$

   Compare the β with usual LSE of β and comment of their differences.
   Do you think the question is ill-posed? Do you need extra assumptions/conditions to answer the question?

2. Follow §2.5 in HTF and use `R`, reproduce Fig 2.7 and Fig 2.9. You may need to install contributed R packages such as `kknn`.

3. Exercise 2.1,Exercise 2.6 and Exercise 2.7 in HTF (Print 10 version).

4. Write down the algorithm for Succession Orthogonalization and iterative residual fitting respectively. Prove (or disprove) that the obtained $\hat{\beta}$ also solves the normal equation.

5. Let λ be a positive number. The ridge estimate, $\hat{\beta}_{ridge}$, minimizes a regularized risk.

$$\hat{\beta}_{ridge} = argmin_{\beta} \left\{ (Y - X\beta)^t (Y - X\beta) + \lambda \beta^t \beta \right\}$$

   Show that
$$\hat{\beta}_{ridge} = (X^t X + \lambda I)^{-1} X^t Y.$$

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