

**STAT 3008**  
**Exercise 10**

1. Let  $Y = (1, 2, 4, 5, 7)$ ,  $X = (2, 7, 7, 9, 12)$ . For the regression  $Y = \beta_0 + \beta_1 X + e$ , find
  - i)  $\hat{e}$ , and verify that  $\hat{e} \cdot 1 = 0$ .
  - ii)  $Var(e)$  (write in terms of  $\sigma$ ).
  - iii)  $Var(\hat{e})$  (write in terms of  $\sigma$ ).
  - iv)  $Var(\hat{e})$ .
  - v)  $Var(e)$ .
  
2. For the regression model  $Y = X\beta + e$ ,  $e \sim N(0, \sigma^2 I)$ , find
  - i)  $Cov(e, Y)$ .
  - ii)  $Cov(e, \hat{Y})$ .
  - iii)  $Cov(\hat{e}, \hat{Y})$ .
  - iv)  $E(\sum_{i=1}^n (\hat{Y}_i - \bar{Y})^2)$ .