

### Questions

Suppose that  $y_i$  is a binary dependent variable and that  $y_i$  can only take the values 0 and 1 for  $i = 1, \dots, n$ . Consider the linear regression model

$$y_i = \beta_1 + \beta_2 x_i + \varepsilon_i,$$

where  $x_i$  is an explanatory variable and  $\beta_1$  and  $\beta_2$  are parameters. Assume that  $E[\varepsilon_i] = 0$ .

- (a) What is the expected value of  $y_i$  expressed in terms of the parameters and  $x_i$ ?
- (b) Show that the expected value of  $y_i$  equals the probability that  $y_i$  equals 1.
- (c) What is the probability that  $y_i$  equals 0 expressed in terms of  $x_i$  and the  $\beta$  parameters?
- (d) Since  $y_i$  can only take two values, there are two possible values for the error term given the value of  $x_i$  and the parameters  $\beta$ . Give these two values and also provide the probability that these two values occur.
- (e) What is the variance of  $\varepsilon_i$  expressed in terms of  $x_i$  and the  $\beta$  parameters? Are the errors homoscedastic?