Problem 2

Part c.

Find $\nabla l(\beta | X, \vec{y})$, $X_i \beta = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2}$

$$l(\beta | X, \vec{y}) = \sum_{i=1}^{n} y_i \cdot (\beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2}) - \sum_{i=1}^{n} \ln\left(1 + e^{\beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2}}\right)$$

$$\nabla l(\beta | X, \vec{y}) = \begin{bmatrix} \dfrac{\partial l}{\partial \beta_0} = \sum_{i=1}^{n} y_i - \sum_{i=1}^{n} \dfrac{e^{\beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2}}}{1 + e^{\beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2}}} \\ \dfrac{\partial l}{\partial \beta_1} = \sum_{i=1}^{n} y_i x_{i1} - \sum_{i=1}^{n} \dfrac{x_{i1} \cdot e^{\beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2}}}{1 + e^{\beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2}}} \\ \dfrac{\partial l}{\partial \beta_2} = \sum_{i=1}^{n} y_i x_{i2} - \sum_{i=1}^{n} \dfrac{x_{i2} \cdot e^{\beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2}}}{1 + e^{\beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2}}} \end{bmatrix}$$