Logistic Regression w/ K categories in the Response.

The labels of the categories: $C = \{1, 2, \ldots, K\}$

In the book:

$$P[Y = K \mid X = x] = \frac{1}{1 + \sum_{k=1}^{K-1} e^{\beta_{0k} + \beta_{1k} x_1 + \cdots + \beta_{pk} x_p}}$$

For all the other categories $l = \{1, 2, \ldots, K-1\}$

$$P[Y = l \mid X = x] = \frac{e^{\beta_{0l} + \beta_{1l} x_1 + \cdots + \beta_{pl} x_p}}{1 + \sum_{k=1}^{K-1} e^{\beta_{0k} + \beta_{1k} x_1 + \cdots + \beta_{pk} x_p}}$$