Exercise G

The general likelihood equations (with constant weights) are

$$\sum_{i=1}^{m} \frac{y_i - \mu_i}{v(\mu_i)} \cdot \frac{x_{i2}}{g'(\mu_i)} = 0 \iff \sum_{i=1}^{m} \frac{x_{i2} y_i}{v(\mu_i) g'(\mu_i)} = \sum_{i=1}^{m} \frac{x_{i2} \mu_i}{v(\mu_i) g'(\mu_i)}.$$

In general, it is $\underline{\underline{\text{not}}}$ true that $\sum_{i=1}^{m} y_i = \sum_{i=1}^{m} \mu_i$, i.e. $\sum_{i=1}^{m}(y_i - \mu_i) = 0$. However, if the model has an $\underline{\text{intercept}}$, say $x_{i1} = 1$ and in the canonical link case, we get

$$(v(\mu_i) g'(\mu_i) = 1)$$

$$\sum_{i=1}^{m} y_i - \mu_i = 0 \iff \sum_{i=1}^{m} y_i = \sum_{i=1}^{m} \mu_i.$$

If the intercept were not present, we could not "omit" the x_{i2} term.