1. Do Exercise 1.4.2 (a), (b), (c), (f), (g) in Christensen.

2. Do Exercise 1.4.4 in Christensen.

3. Do Exercise 1.4.7 in Christensen.

4. Let $X = (x_1, \ldots, x_r)$ be an $n \times r$ matrix whose columns are a linearly independent set.
   
   (a) Show that $X^T X$ is nonsingular.
   
   (b) Let $H = X (X^T X)^{-1} X^T$. Show that $Hu = u$ if $u \in C(X)$ and $Hu = 0$ if $u \in C(X)^\perp$.
   
   (c) Show that for any $u \in \mathbb{R}^n$, $Hu$ is the projection of $u$ onto $C(X)$, i.e., that $Hu$ is the element of $C(X)$ closest to $u$ using the usual norm, $||y||^2 = y^T y$. 