**Required Part:**

1. Exercise 4.5 (a) (b) on page 201.

2. Exercise 4.13 on pages $203-204$.

3. Suppose $Y_1, \ldots, Y_n$ is a random sample from $N_p(W\beta, \Sigma)$, where $W$ is a known $p \times k$ matrix of rank $k$, $\Sigma$ is a known $p \times p$ matrix of rank $p$, and $\beta$ is an unknown $k \times 1$ vector. Find the MLE of $\beta$.

**Optional Part (no need to hand in):**

4. If $Y \sim N_p(\mu, \Sigma)$, then derive the moment generating function of $(Y - \mu)'A(Y - \mu)$ for a symmetric matrix $A$.

5. Suppose $S \sim W_{n-1}(\cdot \mid \Sigma)$, $S^{-1} = (s^{ij})_{p \times p}$ , $\Sigma^{-1} = (\sigma^{ij})_{p \times p}$ . Show that

$$\frac{\sigma^{11}}{s^{11}} \sim \chi^2(n - p)$$