1.12 if $m=n$, then $E[x_m x_n] = E[x^2] = \mu^2+\sigma^2$

if $m \neq n$, then x_m and x_n are independent. $E[x_m x_n] = E[x_m]\,E[x_n]$

$= \mu^2$

Next $E[\mu_{ML}] = E\left[\frac{1}{N}\sum x_n\right] = \frac{1}{N}\sum E[x_n] = \frac{1}{N}\cdot N\mu = \mu$.

Finally, $E[\sigma^2_{ML}] = E\left[\frac{1}{N}\sum_n (x_n-\mu_{ML})^2\right]$ using (1.56)

$$= E\left[\frac{1}{N}\sum_n \left(x_n - \frac{1}{N}\sum_m x_m\right)^2\right]$$

$$= E\left[\frac{1}{N}\left(\sum_n \left(x_n^2 - 2x_n\left(\frac{1}{N}\sum_m x_m\right) + \left(\frac{1}{N}\sum_m x_m\right)^2\right)\right)\right]$$

$$= \frac{1}{N} E\left[\sum_n x_n^2 - \sum_n 2x_n \frac{1}{N}\sum_m x_m + \sum_n \frac{1}{N^2}\left(\sum_m x_m\right)^2\right]$$

$$= \frac{1}{N}\sum_n E\left[x_n^2 - \frac{2x_n}{N}\sum_m x_m + \frac{1}{N^2}\sum_l\sum_k x_l x_k\right]$$

$$\boxed{\text{using } \left(\sum_m x_m\right)^2 = \sum_l \sum_k x_l x_k}$$

$$= \mu^2+\sigma^2 - 2\left(\mu^2 + \frac{1}{N}\sigma^2\right) + \mu^2 + \frac{1}{N}\sigma^2$$

$$= \frac{(N-1)}{N}\sigma^2$$