<6장 의문점>

1. MSE

$\mathrm{bias}(\widehat{\theta}_n) = \mathbb{E}_\theta(\widehat{\theta}_n) - \theta.$

&

$\mathrm{se} = \mathrm{se}(\widehat{\theta}_n) = \sqrt{\mathbb{V}(\widehat{\theta}_n)}.$ 일때

$\mathrm{MSE} = \mathbb{E}_\theta(\widehat{\theta}_n - \theta)^2.$

> **6.9 Theorem.** *The* MSE *can be written as*
>
> $$\mathrm{MSE} = \mathrm{bias}^2(\widehat{\theta}_n) + \mathbb{V}_\theta(\widehat{\theta}_n). \tag{6.7}$$

인가?

$E(\hat{\theta}_n) = \bar{\theta}_n$

$$
\begin{aligned}
MSE &= E_\theta(\hat{\theta}_n - \theta)^2 \\
&= E_\theta(\underbrace{\hat{\theta}_n - \bar{\theta}_n}_{a} + \underbrace{\bar{\theta}_n - \theta}_{b})^2 \\
&= E_\theta(a+b)^2 \\
&= E_\theta(a^2 + 2ab + b^2) \\
&= E_\theta(\hat{\theta}_n - \bar{\theta}_n)^2 + 2(\bar{\theta}_n - \theta)\underbrace{E(\hat{\theta}_n - \bar{\theta}_n)}_{=0} + E_\theta(\bar{\theta}_n - \theta)^2 \\
&= \underbrace{(\bar{\theta}_n - \theta)^2}_{\text{bias}^2} + \underbrace{E_\theta(\hat{\theta} - \bar{\theta}_n)^2}_{\text{Variance}}
\end{aligned}
$$