Quiz 3

02 Bias-Variance Decomposition

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Treat this as an exam situation. You will be given 5 minutes to complete this quiz.

1 Just Bias and Variance

Let us consider a probabilistic perspective, where the data is now “random”. We believe that our data is sampled from a true distribution, and our goal is to uncover that underlying distribution. Take your data to be i.i.d. $\{\vec{x_i}\}_{i=1}^n$ where $\vec{x_i} \sim \mathcal{N}(\mu, \sigma^2 I), \vec{x_i} \in \mathbb{R}^d$.

1. Say you have only one point (e.g., $n = 1$). Compute the maximum likelihood estimate $\hat{\mu}$ for $E[X]$. What is $\hat{\mu}$?
2. Compute the mean-squared error (MSE), $E\|\hat{\mu} - \mu\|_2^2$. Express it terms of μ, σ, d.
3. Instead of MLE, say we develop an affine model to estimate μ, $\hat{\mu}_2 = \alpha x + \beta$. What is $E[\hat{\mu}_2]$?
4. For simplicity, say $\beta = 0$. Compute the MSE for $\hat{\mu}_2$.