CMPE 302 - Worksheet: Probability, Estimation, and Nonlinear Regression

Anıl Demirel

April 6, 2025

Problem 1: Conditional Probability (Simulation)

Description: A bag contains 6 red, 3 blue, and 1 green marble. Define:

- Event A: drawing a red marble
- Event B: drawing a marble that is not green

Estimate $P(A \mid B)$ using simulation.

Problem 2: Maximum Likelihood Estimation (Linear Regression)

Dataset: $X = [1, 2, 3, 4]$, $Y = [2.1, 2.9, 3.9, 5.2]$
Task: Compute MLE weights using the closed-form solution.

Problem 3: MAP Estimation with Gaussian Prior (Ridge Regression)

Assume: Prior precision $\beta = 1$, noise variance $\sigma^2 = 1$
Task: Estimate weights using the MAP formula.

Problem 4: Estimate Noise Variance σ^2

Task: Estimate variance using residuals from MLE.

Problem 5: Nonlinear Regression using RBF Kernels

Task: Use RBF basis functions with $\lambda = 0.1$ to perform regression.

Problem 6: RBF Prediction and Visualization

Task: Predict outputs for 100 new values using the RBF model.