CSI 5340 Assignment 1

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Introduction

Regression analysis is a fundamental tool in machine learning and statistics, aiming to model the relationship between variables and make predictions based on observed data. In this experiment, we delve into the exploration of fitting and generalization in regression models through a simulation-based approach. The problem at hand involves understanding the relationship between a real-valued random variable X and its corresponding dependent variable Y, which is affected by both a cosine function of X and a zero-mean Gaussian random variable Z.

The objective is to design and analyze polynomial regression models without prior knowledge of the true underlying relationship between X and Y. Specifically, we seek to investigate the impact of model complexity, sample size, and noise variance on the model's fitting capabilities and generalization performance. We also extend our analysis to consider the effect of weight decay regularization in the context of this regression problem. Through careful experimentation and observation, we aim to draw insights that contribute to a deeper understanding of regression modeling and guide practical applications of these insights in real-world scenarios. The experiment is structured to evaluate the Mean Squared Error (MSE) as a metric for both in-sample (Ēin) and out-of-sample (Ēout) performance, shedding light on the trade-offs and optimizations necessary for constructing effective regression models.