

Bias Variance Trade-Off

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November 30, 2016

Abstract

This document introduces the trade-off between bias and variance.

1 Introduction

1.1 Bias Variance trade-off

- The bias-variance trade-off is the point where we are adding just noise by adding model complexity (flexibility).
- The **training error** goes down as it has to, but the **test error** is starting to go up.
- The model after the bias trade-off begins to **overfit**.

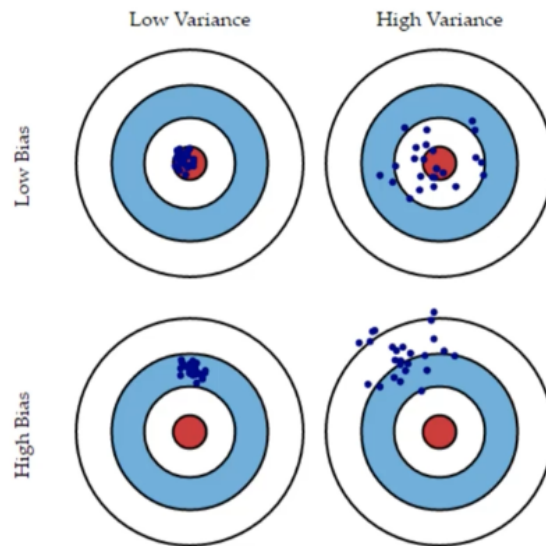


Figure 1: Bias variance trade-off. The center of the target is a model that perfectly predicts the correct values. As we move away from the bulls-eye, our predictions get worse and worse.

- A common temptation for beginners is to continually add complexity to a model until it fits the training set very well.

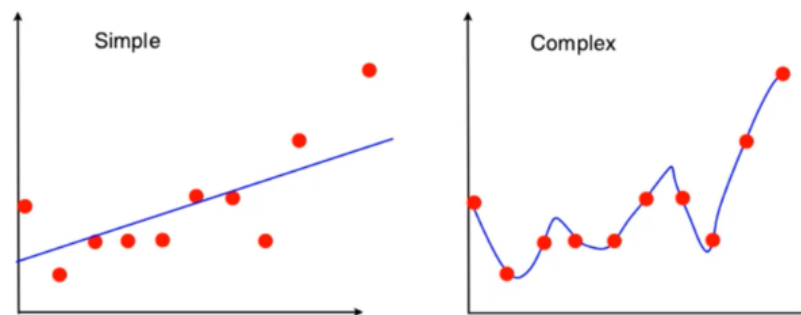


Figure 2: Use simple-complex model to fit training data. Complex model may overfit to training data and cause large errors on new data, such as the test set.

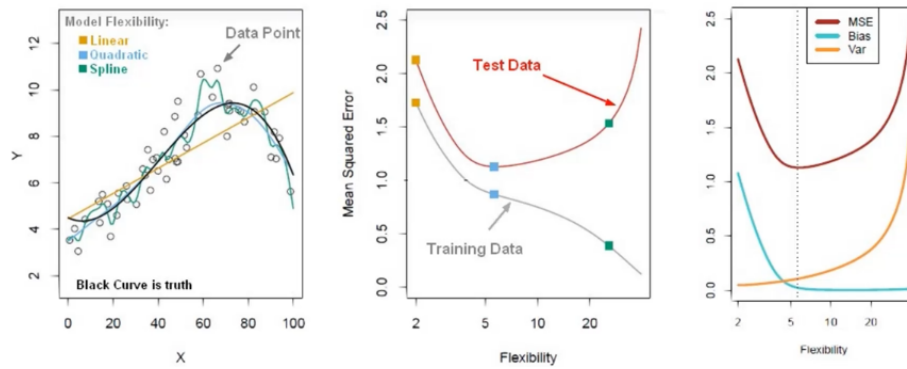


Figure 3: The relationship between Mean Squared Error (MSE) and the complexity (flexibility). A black curve with some “noise” points off it is used to represent the True shape the data follows.

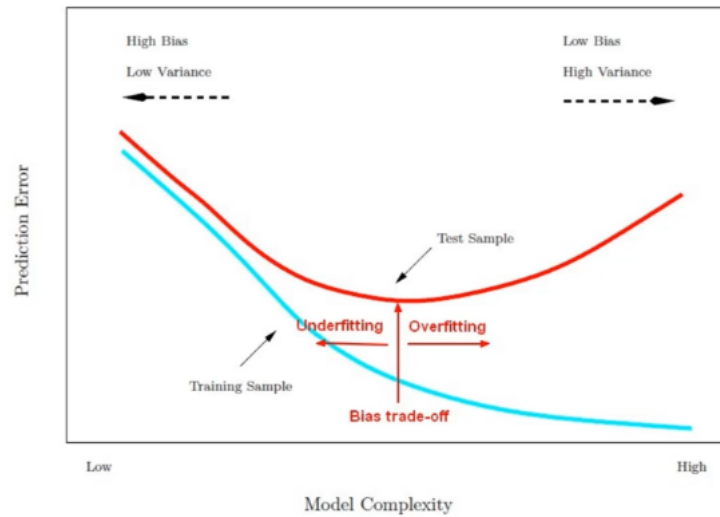


Figure 4: The relationship between Prediction Error and the complexity (flexibility).