Lecture 14 Outline:

1. Statistical Learning Process:
   (a) What is my goal?
   (b) Which model do I use?
   (c) Which tuning parameter do I use?
   (d) Model Fitting.
   (e) How good is my model / How do I expect it to perform?

2. Model Selection vs. Model Assessment.
   • Model Selection: Tuning parameters.
   • Model Assessment: How good is my model?
   • What criteria should we use for model selection or model assessment?

3. Prediction Error.
   • Example with squared error loss: bias-variance decomposition.
   • General sources of prediction error.

4. Training Error.
   • Why can’t we use this?
   • Training error decreases as model complexity increases.
   • Optimism of the training error.

5. Classical Model Selection Techniques:
   • AIC & BIC.
   • Effective degrees of freedom.
   • Are these useful for machine learning?

6. Ideal Scenario: Infinite data.
   • Chunk 1: Model Fitting.
   • Chunk 2: Model Selection.
   • Chunk 3: Model Assessment.

7. Cross-Validation: Finite data.
   • K-fold CV.
     – Pseudo-code.
   • One standard error rule.
   • Leave-one-out CV (LOOCV).
   • CV predominately used for model selection.
   • Can CV be used for model assessment?
– Affected by sample size (function of $K$).
– Shape of CV error curve often similar to shape of prediction error curve.

• Strengths and weaknesses of CV.
  – Does CV work for discrete losses?
  – Bias vs. Variance vs. Data Shake-up for LOOCV vs. K-fold.
  – Can CV be used to assess feature selection?

8. Important Points:

  (a) Test set remains hidden (no peeking . . . ever!).
  (b) Training (model fitting), model selection, and model assessment should be done separately.