# STAT 3690 Lecture 32

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## Misclassification/error rate

- Population: $\Pr(Y \neq h(\mathbf{X}))$
  - $h(\cdot)$: the classifier to be evaluated
- Apparent estimation
  - Implementation
    1. Fit a classifier according to training data
    2. Apply the fitted classifier to training data as well
    3. Estimate the error rate by the misclassification proportion
  - Comments
    - Training and testing with identical data points
    - Severe underestimation likely
- Parametric estimation
  - Implementation
    1. Express $\Pr(Y \neq h(\mathbf{X}))$ in terms of unknown parameters
    2. Plug in estimates of unknown parameters
  - Comment
    - Able to derive the analytical form of $\Pr(Y \neq h(\mathbf{X}))$ in rare cases
    - Underestimation likely

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- Estimation via $M$-fold cross validation (CV)
  - Implementation
    1. The dataset is randomly partitioned into $M$ chunks.
    2. Train one classifier upon each combination of $M-1$ chunks.
    3. Apply each classifier to the corresponding remaining chunk and compute the empirical error rate.
    4. Estimate the population error rate by averaging these $M$ empirical error rates.
  - Comment
    - Leave-one-out CV $\Leftrightarrow$ $n$-fold CV
- Estimation via $M \times L$-fold CV
  - Implementation
    1. Repeat the four steps of $M$-fold CV $L$ times.
    2. Average all the $ML$ resulting empirical error rates.
  - Comment
    - $M \times 1$-fold CV $\Leftrightarrow$ $M$-fold CV

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