

### Evaluating model performance

#### The "Training Set-Validation Set-Test Set" Approach

##### The "Training Set-Validation Set-Test Set" Approach:

Useful for selecting one of several models and obtaining an estimate of the resulting performance (model assessment):

- Split the available data into a **training set**, a **validation set** and a **test set**:
  - depending on the **amount of available data** and the **number of models** to be compared, 50:25:25 or 60:20:20.
- Fit each model separately on the **training set**.
- Evaluate each model separately on the **validation set**.
- Choose the model that performs **best** on the **validation set**.
- Estimate the performance of that model on the **test set**.

At the end, train the selected model again using **all data!!!**

### Performance measures for regression

#### Performance Measures for Regression Problems

Let  $i$ -th **validation error** be  $e_i = Y_i - \hat{f}(X_{i1}, \dots, X_{ip})$ ,  $i = 1, \dots, n$ :

- mean absolute error:**  $\frac{1}{n} \sum_i |e_i|$
- average error:**  $\frac{1}{n} \sum_i e_i$
- mean absolute percentage error:**  $100\% \cdot \frac{1}{n} \sum_i \left| \frac{e_i}{y_i} \right|$
- root-mean-squared error:**  $\sqrt{\frac{1}{n} \sum_i e_i^2}$
- total sum of squared errors:**  $\sum_i e_i^2$

**Benchmark:** The "average predictor"  $\hat{f}(X_{i1}, \dots, X_{ip}) = \bar{y}$ , where  $\bar{y}$  is the **average output over the training set**.

### Performance measures for classification

#### Performance Measures for Classification Problems

Consider the following **confusion matrix**:

		Predicted Class	
		"yes"	"no"
Actual Class	"yes"	$n_{11}$	$n_{12}$
	"no"	$n_{21}$	$n_{22}$

- estimation misclassification rate (= total error rate):**  $\frac{n_{12} + n_{21}}{n_{11} + n_{12} + n_{21} + n_{22}}$
  - accuracy:** 1 - estimation misclassification rate
  - sensitivity:**  $\frac{n_{11}}{n_{11} + n_{12}}$
  - specificity:**  $\frac{n_{22}}{n_{21} + n_{22}}$
- if "yes" is the important class

**Benchmark:** The "majority predictor" (majority class in training data)

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