PSY9511: Seminar 4

Model selection, validation and testing

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Outline

1. Assignment 3
2. Loss functions and performance metrics
3. Strategies for model evaluation
    - Training and validation split
    - (Stratification)
    - (Leave-one-out cross-validation)
    - Cross-validation
    - Bootstrap
    - Model comparison
4. Strategies for model selection **and** evaluation
    - Train/validation/test split
    - Nested cross-validation

Assigment 3

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Assignment 3

Loss functions and performance metrics

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Loss functions and performance metrics

Commonalities

- Allows us to evaluate the performance of a model
- Typically on the form $f(y, \hat{y})$

Loss functions

- Tailored specifically for mathematical optimization of models

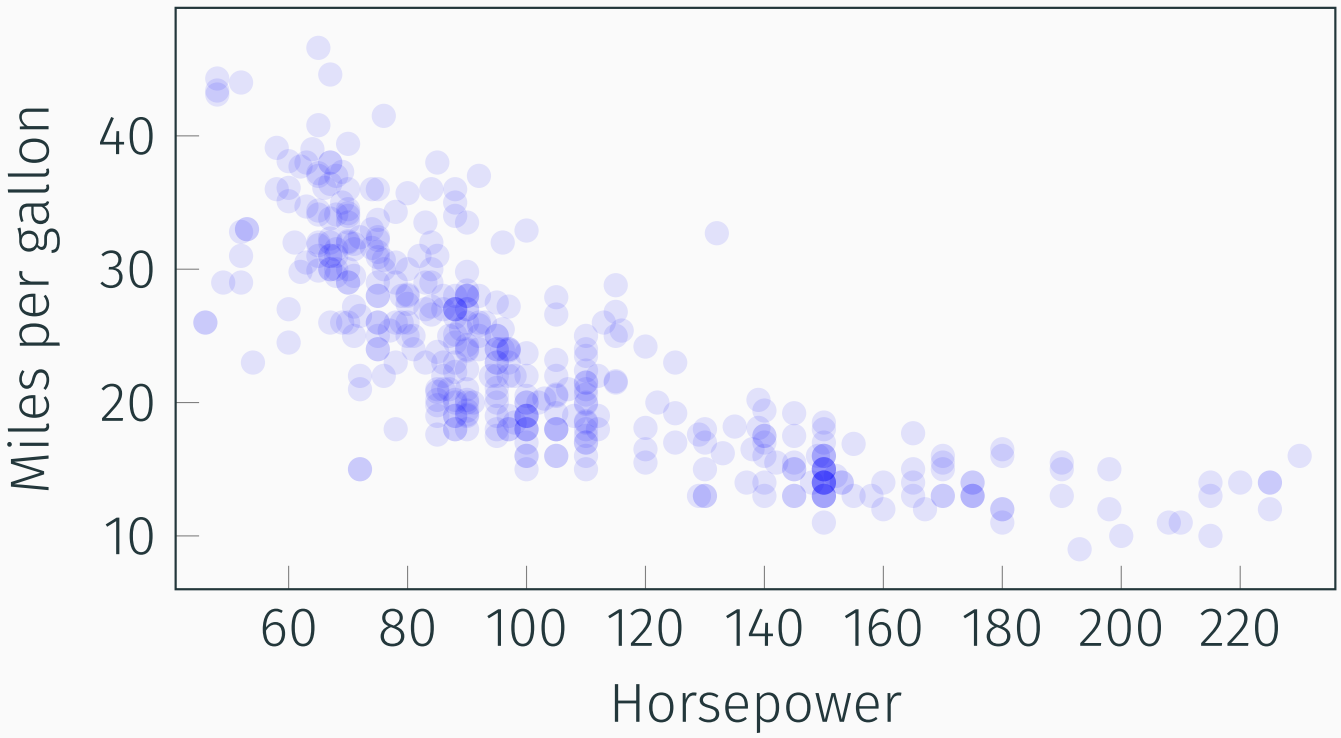
Performance metrics

- Tailored specifically for interpretation of model performance by humans

Loss functions and performance metrics

$$\text{mse}(y, \hat{y}) = \frac{1}{n} \sum_{i=0}^{n} (y_i - \hat{y}_i)^2$$

Loss functions and performance metrics



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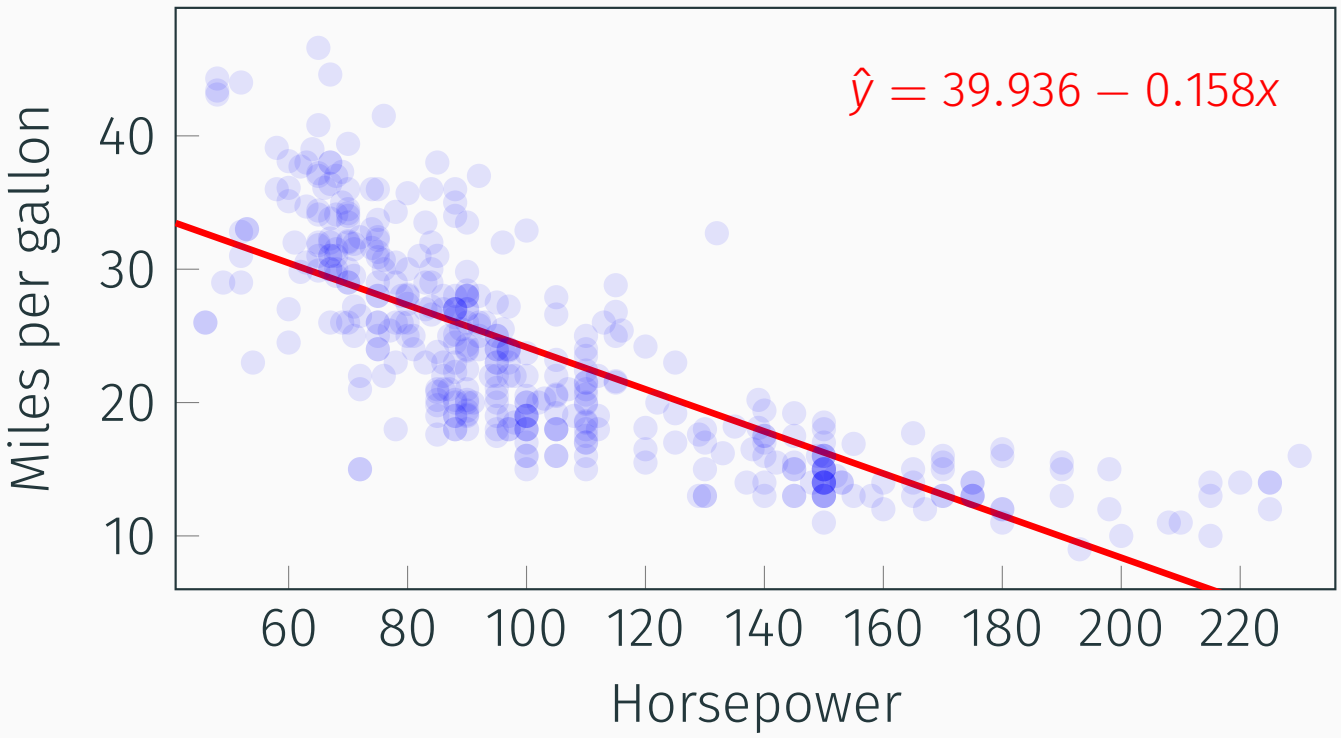
Loss functions and performance metrics



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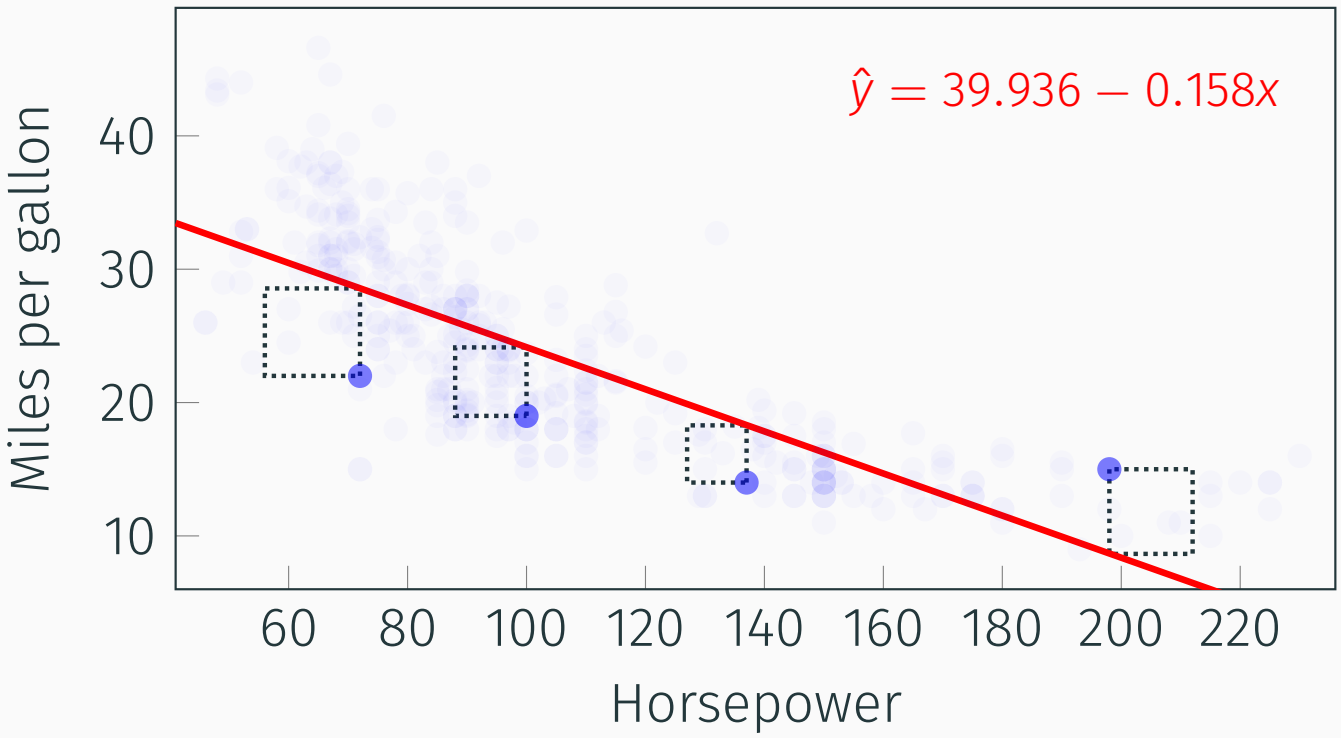
Loss functions and performance metrics



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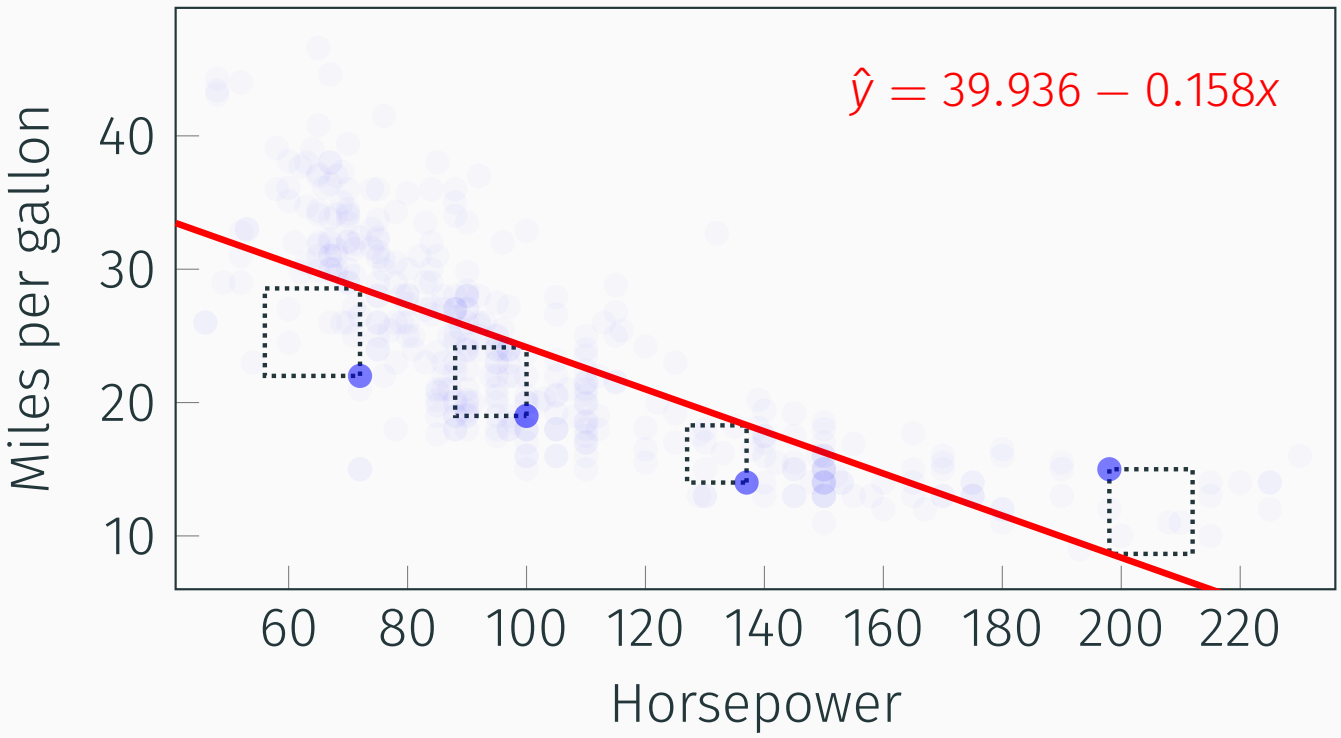
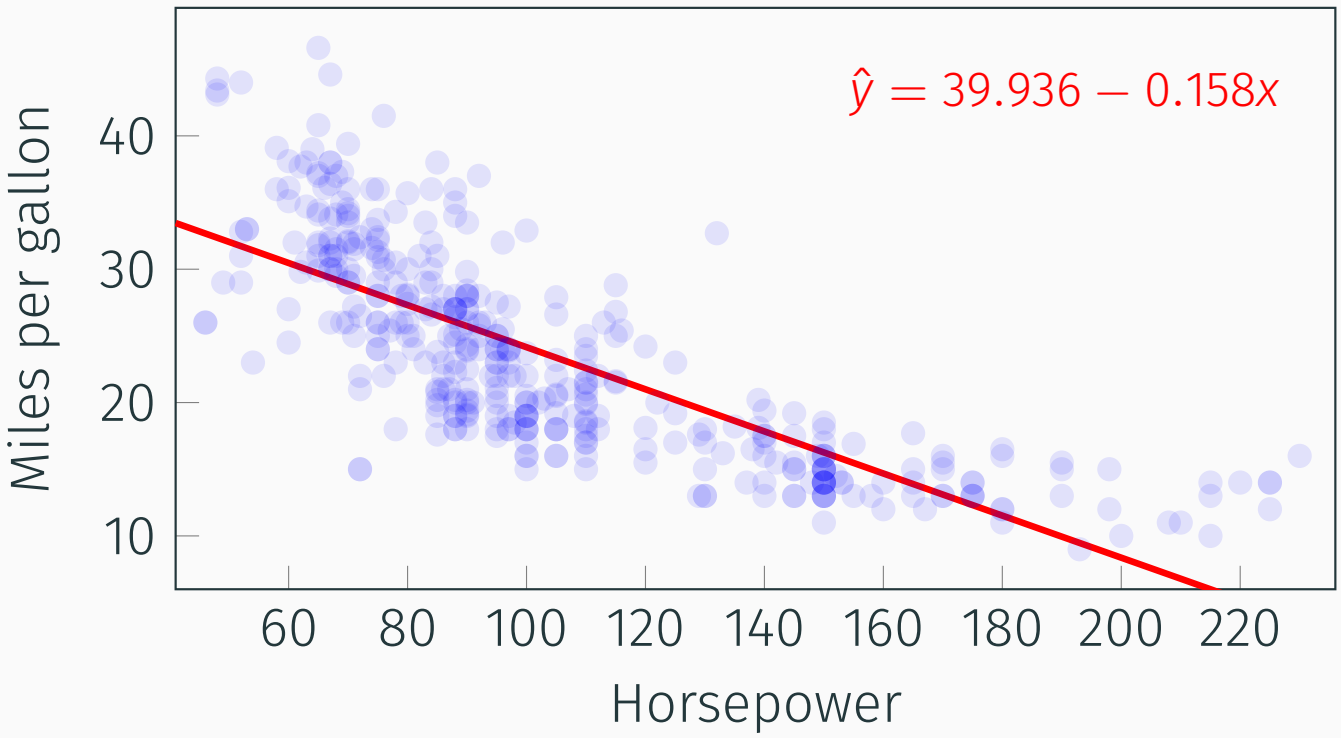
Loss functions and performance metrics



$$\text{mse}(y, \hat{y}) = \frac{1}{n} \sum_{i=0}^{n} (y_i - \hat{y}_i)^2$$

$$= 23.94$$

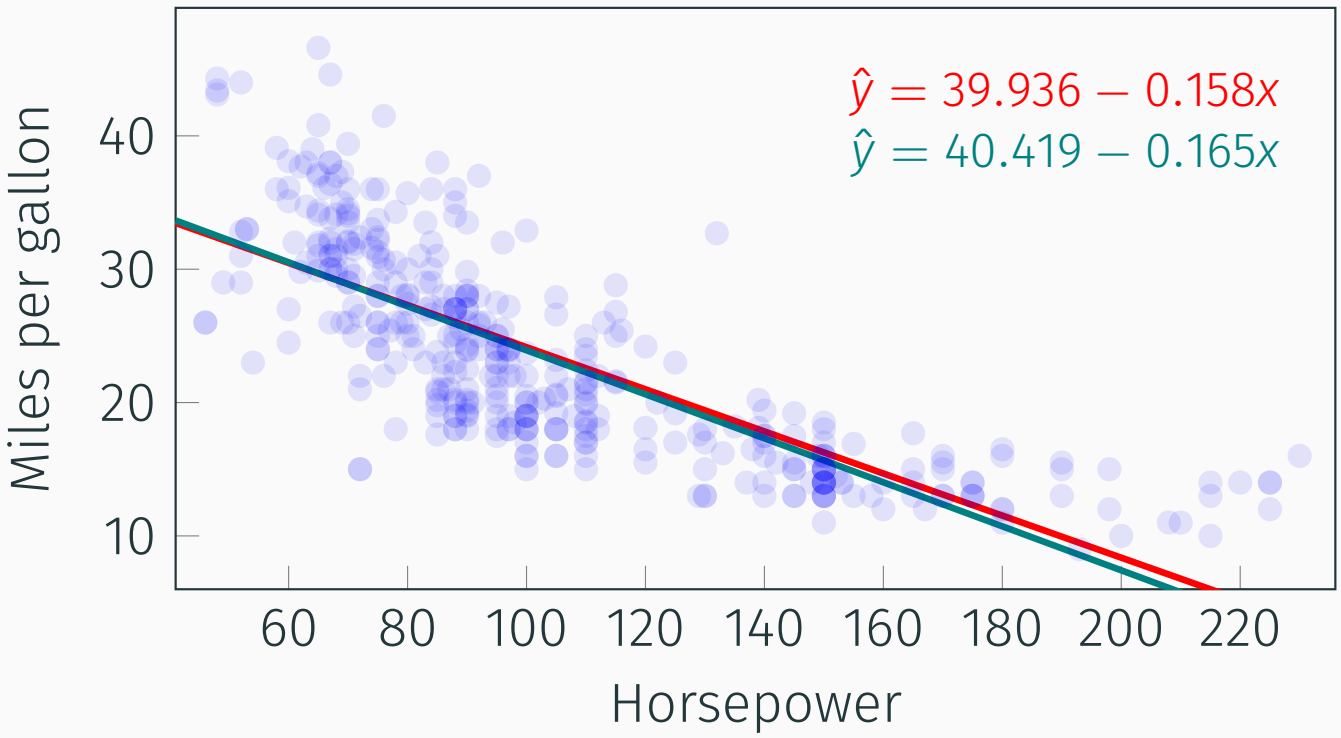
Loss functions and performance metrics



$$\text{mse}(y, \hat{y}) = \frac{1}{n} \sum_{i=0}^{n} (y_i - \hat{y}_i)^2$$

$$\text{mae}(y, \hat{y}) = \frac{1}{n} \sum_{i=0}^{n} |y_i - \hat{y}_i|$$

Loss functions and performance metrics



$$\text{mse}(y, \hat{y}) = \frac{1}{n} \sum_{i=0}^{n} (y_i - \hat{y}_i)^2$$

$$\text{mae}(y, \hat{y}) = \frac{1}{n} \sum_{i=0}^{n} |y_i - \hat{y}_i|$$

Loss functions and performance metrics

Loss functions

- Different loss functions measures different properties of the model fit
- Optimizing for them gives different parameter estimates
- Can also be performance metrics
- Must be differentiable to allow for mathematical optimization

Loss functions and performance metrics

Tolerance-based accuracy:

A prediction is considered corrected if it is within a predefined margin of error from the true value

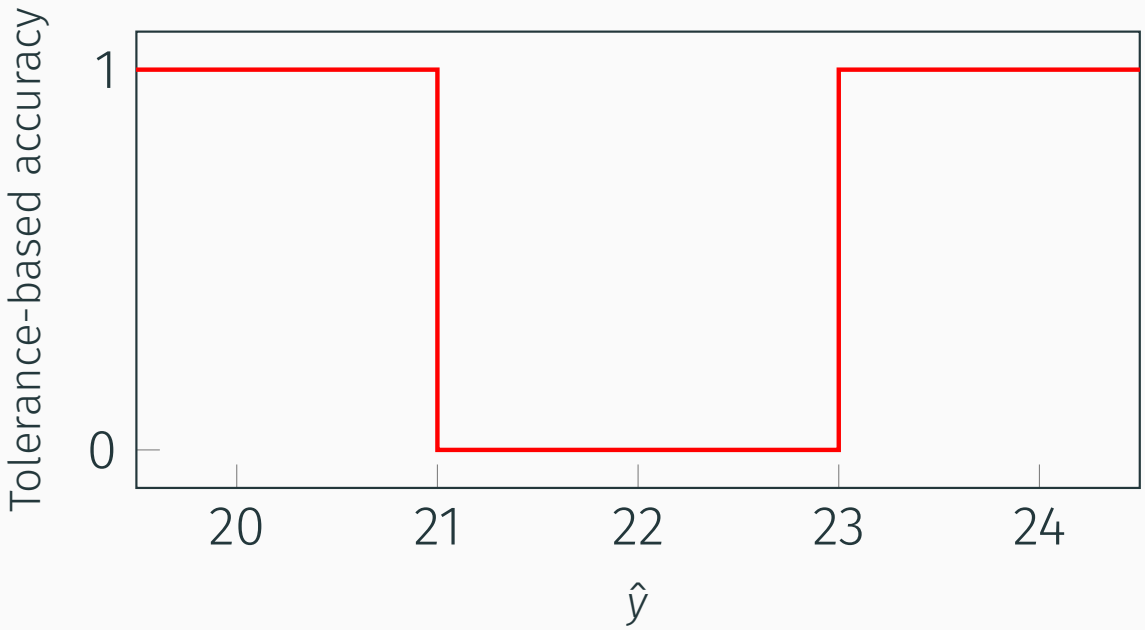
$$\text{accuracy*}(y, \hat{y}) = \begin{cases} 0 & \text{if } |y - \hat{y}| < \text{tolerance} \\ 1 & \textit{else} \end{cases}$$

Loss functions and performance metrics

mpg	horsepower
22	72

Loss functions and performance metrics

mpg	horsepower
22	72



Loss functions and performance metrics

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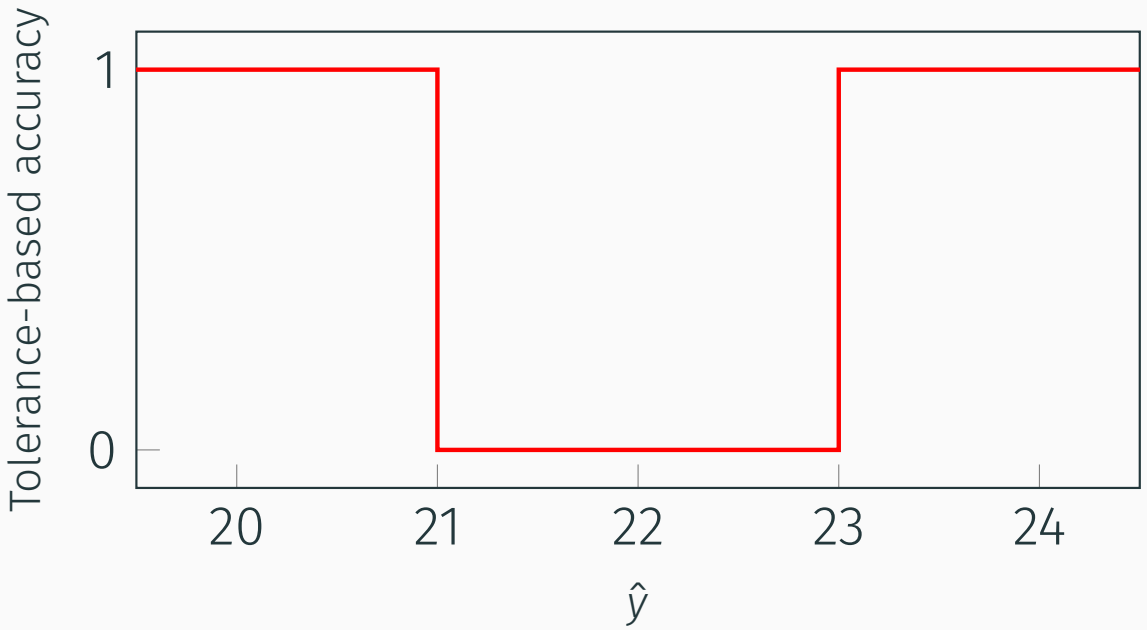

$$\hat{y} = \beta_0 + \beta_1 \times \text{horsepower}$$

Loss functions and performance metrics

mpg	horsepower
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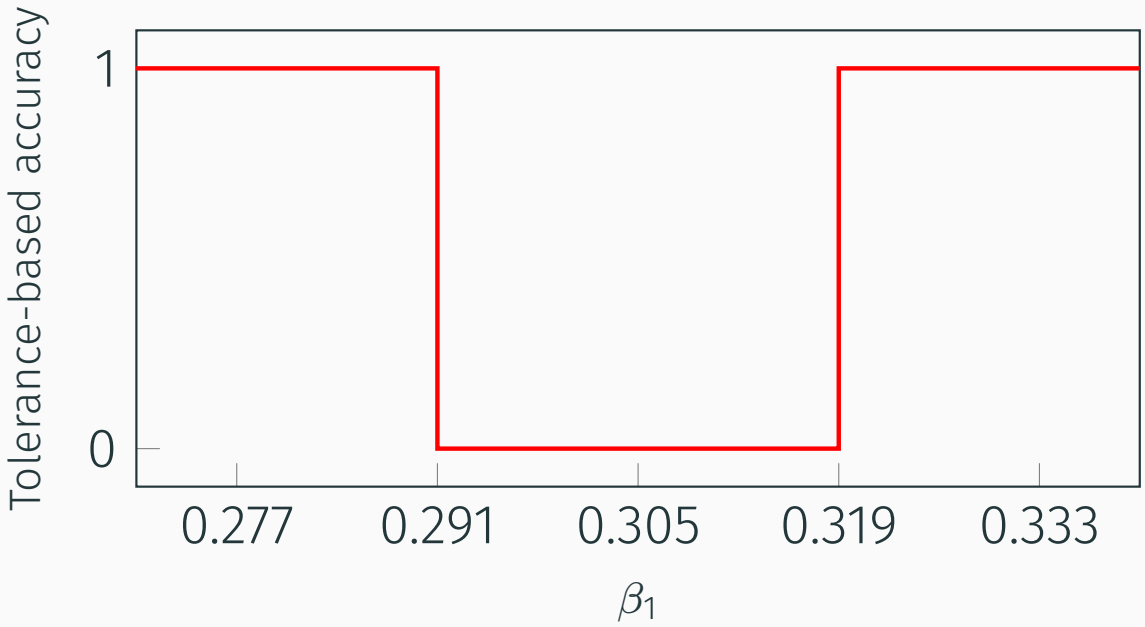

$$\hat{y} = \beta_0 + \beta_1 \times \text{horsepower}$$

Loss functions and performance metrics

$$\hat{y} = 0 + 1 \times \text{horsepower}$$

Loss functions and performance metrics